Panasonic®

AC Servo Motor Driver
MINAS AIII-series
Operating Manual

DV0P3450

[Be sure to give this instruction manual to the user.]

- Thank you very much for your buying Panasonic AC Servo Motor Driver, MINAS AIII-series.
- Before use, read through this manual to ensure proper use. Keep this manual at an easily accessible place so as to be referred anytime as necessary.

***This document is not enclosed in a carton of servo drive. Option Part # : DV0P3450**

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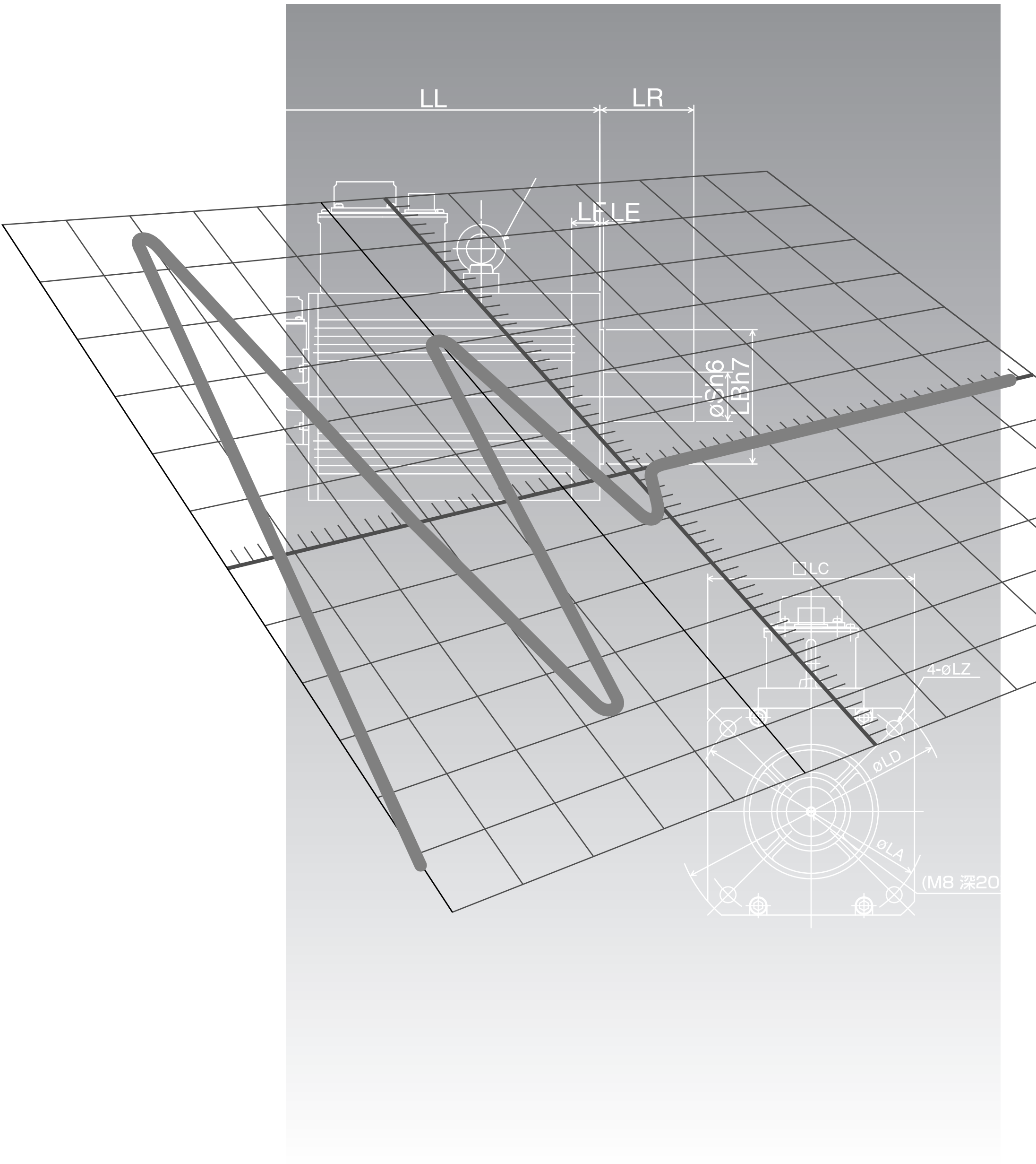
LL
LR
LF LE
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LBh7
□LC
4-øLZ
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(M8 深20

Safety Precautions (Important)

See the following precautions in order to avoid damages on machinery and injuries among the operators and other people during the operation.

- The following symbols are used to indicate the level of danger possibly occurred when you fail to observe the safety precautions.

⚠ **DANGER**	Indicates a potentially hazardous situation, which if not avoided, will result in death or serious injury.
⚠ **CAUTION**	Indicates a potentially hazardous situation, which if not avoided, will result in minor injury or physical damage.

- The following symbols indicate what you must do.

⊘	Indicates that the operation is prohibited to do.
❗	Indicates that the operation must be done.

◈ DANGER

Do not subject the product to water, corrosive or flammable gases, and combustibles.

⊘ **The failure could result in fire.**

Do not expose the cables to sharp objects, excessive pressing or pinching forces, and heavy loads.

⊘ **The failure could result in electric shocks, damages, or malfunction.**

An over-current protection, earth leakage breaker, over temparture protecter and emergency stop device must be installed.

❗ **The failure could result in electric shocks, injuries, or fire.**

Conduct the transportation, wiring and inspection at least 10 minutes after the power off. Only electronic expert is allowed to conduct wiring.

❗ **The failure could result in electric shocks.**

Ground the earth terminal of the servo motor and servo driver.

❗ **The failure could result in electric shocks.**

Install an external emergency stop device to shut down the main power source in any emergency.

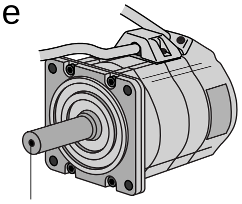
❗ **The failure could result in electric shocks, injuries, fire, damages,**

DANGER

Install the product properly to avoid personal accidents or fire in case of an earthquake.

The failure could result in electric shocks, injuries, or fire.

Do not touch the rotating part of the motor while operating.



The failure could result in injuries.

Do not put your hands in the servo driver.

The failure could result in burns, or electric shocks.

Make sure to secure the safety after the earthquake.

The failure could result in electric shocks, injuries, or fire.

Do not drive the motor from the outside.

The failure could result in fire.

Attach the motor, driver, regenerative discharge resistor to incombustible matter such as metal.

The failure could result in fire.

Do not place inflammable matter near the motor, driver, and regenerative discharge resistor.

The failure could result in fire.

Arrange the phase sequense of the motor and wiring of the encoder.

The failure could result in injuries, damages, or malfunction.

Do not touch the motor, driver, and external regenerative discharge of driver, since they become hot.

The failure could result in burns.

Safety Precautions (Important)

⚠ CAUTION

Do not hold the cables or motor shaft when transporting the motor.

🚫 **The failure could result in injuries.**

Use the motor and driver with the specified combination.

❗ **The failure could result in fire.**

Use the eye-bolt of the motor only when you carry the motor. Do not use it when you carry the machine.

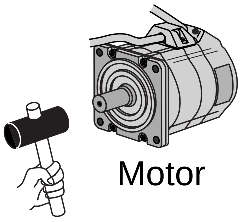
❗ **The failure could result in injuries, or damages.**

Install the driver and the motor in the specified direction.

❗ **The failure could result in damages.**

Do not give hard pressure to the shaft.

🚫 **The failure could result in damages.**



Do not shock the driver and the motor.

🚫 **The failure could result in damages.**

Do not block the heat dissipation hole.

🚫 **The failure could result in electric shocks, or fire.**

Make sure that the wirings are correctly connected.

❗ **The failure could result in electric shocks, or injuries.**

Never start and stop the motor by magnet contactor which is provide on the main line.

🚫 **The failure could result in damages.**

Do not climb or stand on the servo equipment .

🚫 **The failure could result in electric shocks, injuries, damages, or malfunction.**

Conduct proper installation according to product weight or rated output.

❗ **The failure could result in injuries, or damages.**

Ambient temperature of installed driver should be under permittable one.

❗ **The failure could result in damages.**

⚠ CAUTION

Use the specified voltage on the product.

❗ **The failure could result in electric shocks, injuries, or fire.**

Avoid excessive gain adjustments, changes, or unstable operation of the product.

🚫 **The failure could result in injuries.**

Do not use the motor internal brake for the purpose of controlling speed of load.

🚫 **The failure could result in injuries, or damages.**

Connect a relay that stops at emergency stop in series with the brake control relay.

❗ **The failure could result in injuries, or damages.**

Do not modify, dismantle or repair the product.

🚫 **The failure could result in electric shocks, injuries, or fire.**

This product should be treated as an industrial waste when it is disposed.

Do not turn on or off the power frequently.

🚫 **The failure could result in damages.**

Execute the trial-operations with the motor fixed and a load unconnected. Connect a load to the motor after the successful trial-operations.

❗ **The failure could result in injuries.**

Do not approach to the equipment after recovery from the power failure because they may restart suddenly. Execute the personal safety setting on the Equipment after the restart.

🚫 **The failure could result in injuries, or damages.**

If an error occurs, remove the causes of the error and secure the safety before restarting

❗ **The failure could result in injuries.**

When you dispose batteries, insulate them with tape or the like, and dispose them according to the local ordinances of your self-governing body.

Maintenance and Inspections

- **Routine maintenance and inspections are essential for proper and satisfactory operation of the driver and motor.**

Notes to Maintenance/Inspections Personnel

1) Power-on/off operations should be done by the operators themselves.
2) For a while after power off, the internal circuits is kept charged at higher voltage. Inspections should be done a while (about 10 minutes), after the power is turned off and the LED lamp on the panel is extinguished.
3) Do not take insulation resistance measures. Otherwise the driver will be damaged.

Inspection Items and Cycles

Normal (correct) operating conditions:

Ambient condition: 20 hours max. at 30ºC (annual average) and under 80% or less load ratio

Daily and periodical inspections should be done per the following instructions.

Type	Cycles	Inspection items
Daily inspection	Cycles	• Ambient temperature, humidity, dust, particles, foreign matters, etc. • Abnormal sound and vibration • Main circuit voltage • Odor • Lint or other foreign matters in the ventilation openings • Cleanliness of the operation board • Damaged circuits • Loosened connections and improper pin positions • Foreign matters caught in the machine (motor load)
Periodical inspection	Every year	• Loosened screws • Signs of overheat • Burned terminals

<Notes>

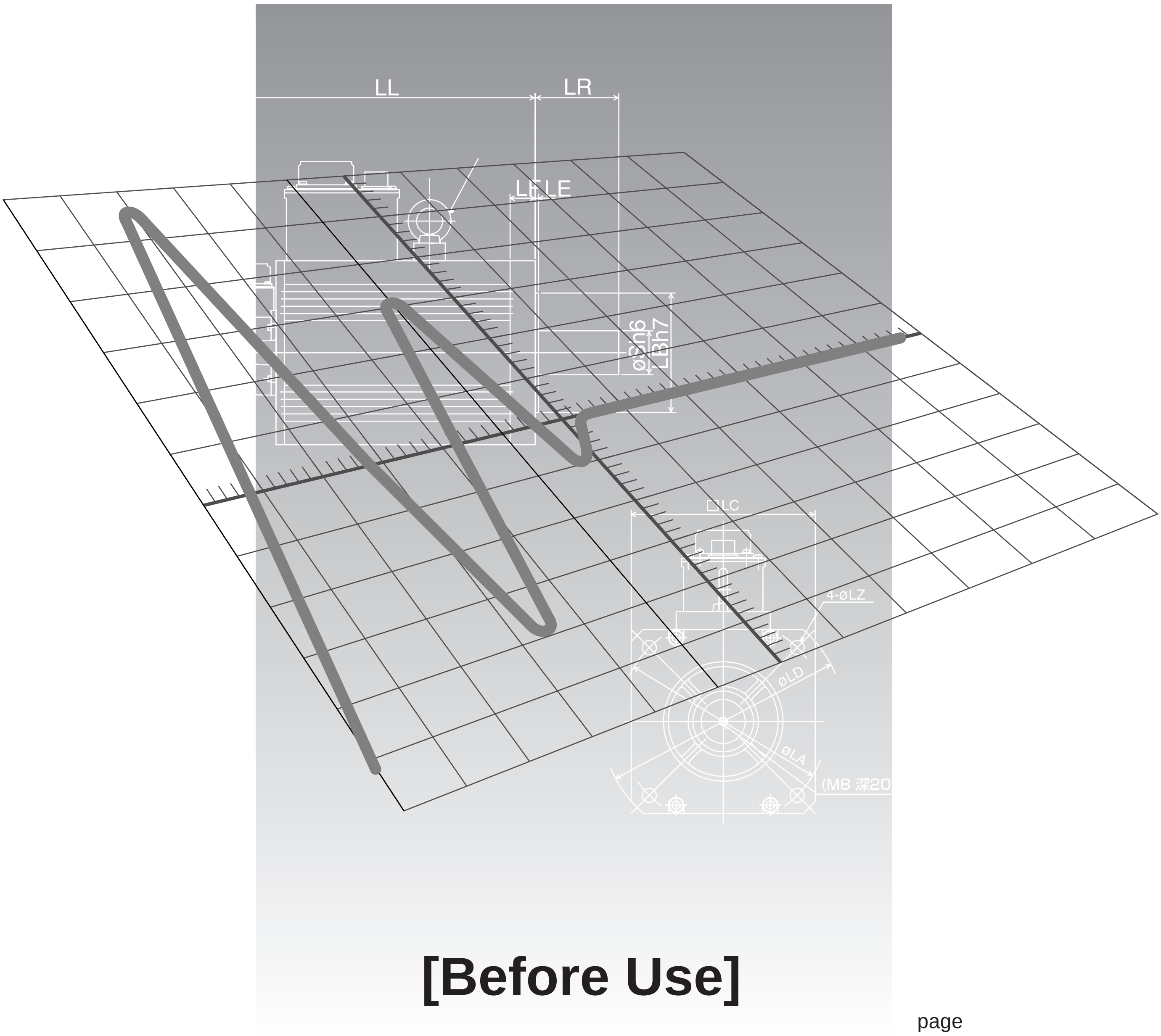
If the actual operating conditions differ from things mentioned above, the inspection cycles may change accordingly.

Replacement Guidance

Parts replacement cycles depend on the actual operating conditions and how the equipment has been used. Defective parts should be replaced or repaired immediately.

🚫 **Prohibited**	**Dismantling for inspections or repairs should be done by our company (or our sales agents).**

Equipment	Part	Standard replacement cycles (hour)	Remarks
Driver	Smoothing condenser	about 5 years	The replacement cycles shown here are just only for reference. If any part is found defective regardless of the standard replacement cycles, immediately replace it with a new one.
	Cooling fan	2 to 3 years (10 to 30 thousand hours)	
	Aluminum electrolytic capacitor on the print board	about 5 years	
	Inrush current preventing relay	Approx. 100 thousand times (Life expectancy depends on operating condition)	
Motor	Bearing	3 to 5 years (20 to 30 thousand hours)	
	Oil seal	5000 hours	
	Encoder	3 to 5 years (20 to 30 thousand hours)	
	Battery (Absolute encoder)	1 year from the first use	



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Introduction

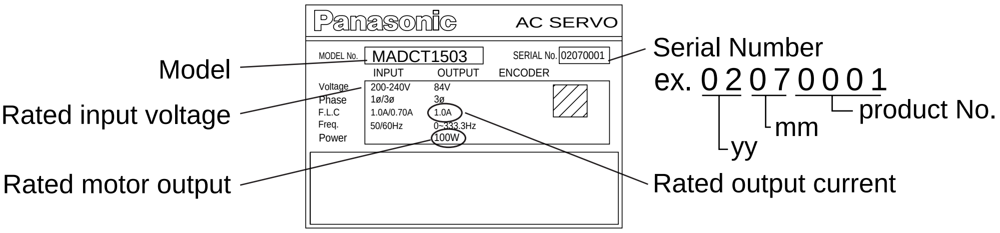
Outline

The high performance AC servo motor driver MINAS-AIII series which can drive a machine at a high speed through a small servomotor of 30 W or a large servomotor of 5.0 kW. By using a top performance CPU, it responses to a speed at frequency 1 kHz, enabling the driven machine to operate at a high speed and significantly reducing tact time.
It supports full closed loop control and has an auto-tuning function. The motor can support either 2,500 p/r incremental encoder specification or a high-resolution 17-bit absolute/incremental encoder.
It also has a damping control equipment that makes it possible to automate complicated gain tuning and enables a low rigid equipment to have stable stop performance. A variety of high speed motors are available for various applications.
This document is prepared for you to fully make use of excellent features and functions available on the MINAS-AIII series.

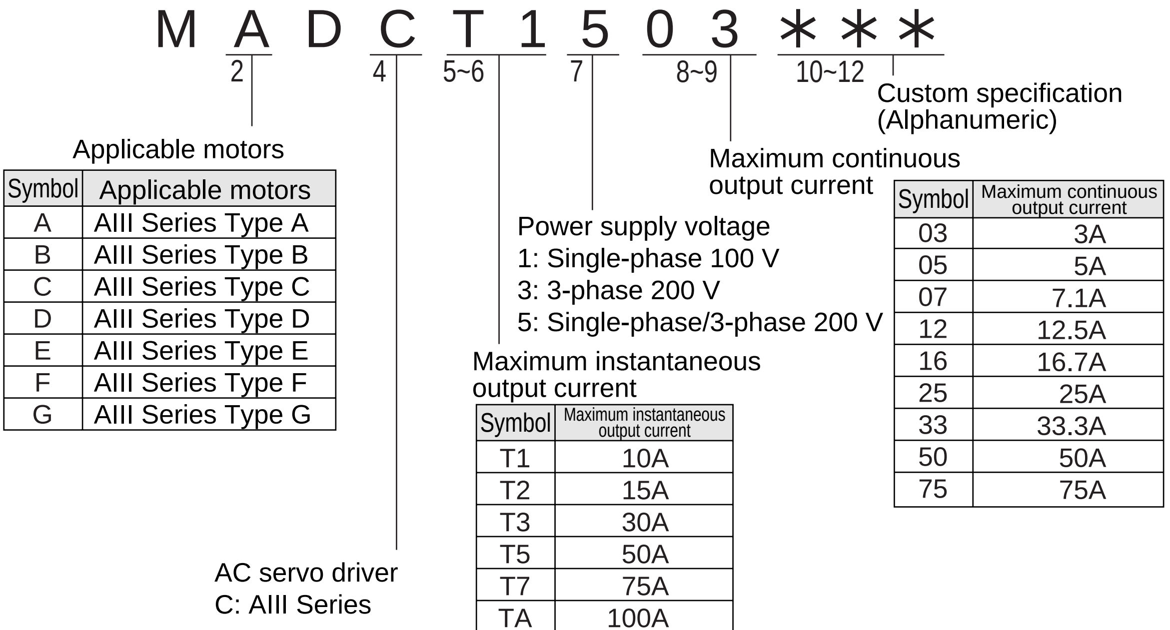
Precautions
(1) No part of this publication may be reproduced in any form by any means without prior permission.
(2) Contents of this publication are subject to change without notice.

Check the Model of Driver

Name plate



Model Designation



Applicable motors

Symbol	Applicable motors
A	AIII Series Type A
B	AIII Series Type B
C	AIII Series Type C
D	AIII Series Type D
E	AIII Series Type E
F	AIII Series Type F
G	AIII Series Type G

Maximum instantaneous output current

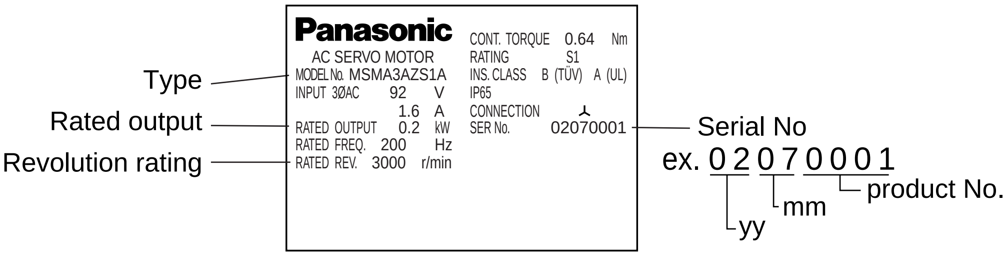
Symbol	Maximum instantaneous output current
T1	10A
T2	15A
T3	30A
T5	50A
T7	75A
TA	100A
TB	150A
TC	200A

Maximum continuous output current

Symbol	Maximum continuous output current
03	3A
05	5A
07	7.1A
12	12.5A
16	16.7A
25	25A
33	33.3A
50	50A
75	75A

Check the Model of Motor

Name plate



Panasonic
AC SERVO MOTOR
MODEL No. MSMA3AZS1A
INPUT 3ØAC 92 V
1.6 A
RATED OUTPUT 0.2 kW
RATED FREQ. 200 Hz
RATED REV. 3000 r/min

CONT. TORQUE 0.64 Nm
RATING S1
INS. CLASS B (TÜV) A (UL)
IP65
CONNECTION ⅄
SER No. 02070001

Model Designation

M S M A 3 A Z S 1 A ∗∗

- 1~4: Type (MSMA)
- 5~6: Rated output (Table 1-a Rated Motor Output)
- 7: Voltage
  1: 100V
  2: 200V
  Z: 100/200V
  (only 30/50W)
- 8: Specification for Position/Speed Detector (Table 1-b Rotary encoder)
- 9: Custom specification
  1: Standard
- 10: Motor structure (Table 1-c Motor Structure)
- 11~12: Custom specification

Symbol	Type
MSMA	Low inertia
MAMA	Ultra Low inertia
MDMA	Middle inertia
MHMA	High inertia
MFMA	Middle inertia
MGMA	Middle inertia

Table 1-a Rated Motor Output

Symbol	Rated output	Symbol	Rated output
3A	30W	10	1.0kW
5A	50W	12	1.2kW
01	100W	15	1.5kW
02	200W	20	2.0kW
03	300W	25	2.5kW
04	400W	30	3.0kW
05	500W	35	3.5kW
06	600W	40	4.0kW
08	750W	45	4.5kW
09	900W	50	5.0kW

Table 1-b Rotary encoder

Symbol	Specifications			
	Type	No. of pulses	Resolution	Lead wire
P	Incremental	2500P/r	10000	5-wire
S	Absolute/Incremental	17bit	131072	7-wire

Table 1-c Motor Structure

	Shaft		Holding Brake		Oil Seal	
	Straight	Key way	None	Yes	None	Yes
A	●		●		●	
B	●			●	●	
C	●		●			●
D	●			●		●
E		●	●		●	
F		●		●	●	
G		●	●			●
H		●		●		●

Introduction

Check the Combination of Driver and Motor

The Driver has been designed for use in combination with the specified motors only. Check the specifications (Series symbol, output rating, voltage rating and encoder type) of the motor you want to use.

With the incremental type encoder: 2500P/r

*** You must not use a combination other than those listed below:**

Driver power suply	Motor				Driver	
	Series symbol	Revolution rating	Motor type	Output rating	Driver	Driver type
Single-phase 200V	MAMA Ultra Low inertia	5000r/min	MAMA012P1*	100W	MADCT1505	Type A
					MBDCT1505	Type B
			MAMA022P1*	200W	MBDCT2507	Type B
			MAMA042P1*	400W	MCDCT3512	Type C
			MAMA082P1*	750W	MDDCT5516	Type D
Three-phase 200V			MAMA012P1*	100W	MADCT1505	Type A
					MBDCT1505	Type B
			MAMA022P1*	200W	MBDCT2507	Type B
			MAMA042P1*	400W	MCDCT3512	Type C
			MAMA082P1*	750W	MDDCT5516	Type D
Single-phase 100V	MSMA Low inertia	3000r/min	MSMA3AZP1*	30W	MADCT1103	Type A
					MBDCT1103	Type B
			MSMA5AZP1*	50W	MADCT1103	Type A
					MBDCT1103	Type B
			MSMA011P1*	100W	MADCT1105	Type A
					MBDCT1107	Type B
			MSMA021P1*	200W	MBDCT2107	Type B
			MSMA041P1*	400W	MCDCT3112	Type C
Single-phase 200V			MSMA3AZP1*	30W	MADCT1503	Type A
					MBDCT1503	Type B
			MSMA5AZP1*	50W	MADCT1503	Type A
					MBDCT1503	Type B
			MSMA012P1*	100W	MADCT1503	Type A
					MBDCT1503	Type B
			MSMA022P1*	200W	MADCT1505	Type A
					MBDCT1507	Type B
			MSMA042P1*	400W	MBDCT2507	Type B
			MSMA082P1*	750W	MDDCT5512	Type D
Three-phase 200V			MSMA3AZP1*	30W	MADCT1503	Type A
					MBDCT1503	Type B
			MSMA5AZP1*	50W	MADCT1503	Type A
					MBDCT1503	Type B
			MSMA012P1*	100W	MADCT1503	Type A
					MBDCT1503	Type B
			MSMA022P1*	200W	MADCT1505	Type A
					MBDCT1507	Type B
			MSMA042P1*	400W	MBDCT2507	Type B
			MSMA082P1*	750W	MCDCT3312	Type C
					MDDCT5512	Type D
			MSMA102P1*	1.0KW	MDDCT5316	Type D
					MEDCT5316	Type E
			MSMA152P1*	1.5KW	MDDCT5325	Type D
					MEDCT5325	Type E
			MSMA202P1*	2.0KW	MFDCT7333	Type F
			MSMA252P1*	2.5KW	MFDCT7333	Type F
			MSMA302P1*	3.0KW	MGDCTA350	Type G
			MSMA352P1*	3.5KW	MGDCTB375	Type G
			MSMA402P1*	4.0KW	MGDCTB375	Type G
			MSMA452P1*	4.5KW	MGDCTB375	Type G
			MSMA502P1*	5.0KW	MGDCTB375	Type G

Driver power suply	Motor				Driver	
	Series symbol	Revolution rating	Motor type	Output rating	Driver	Driver type
Single-phase 200V	MDMA Middle inertia	2000r/min	MDMA082P1*	750W	MDDCT5512	Type D
Three-phase 200V			MDMA082P1*	750W	MDDCT5512	Type D
					MEDCT5312	Type E
			MDMA102P1*	1.0KW	MEDCT5316	Type E
					MDDCT5316	Type D
			MDMA152P1*	1.5KW	MDDCT5325	Type D
					MEDCT5325	Type E
			MDMA202P1*	2.0KW	MFDCT7333	Type F
			MDMA252P1*	2.5KW	MFDCT7333	Type F
			MDMA302P1*	3.0KW	MGDCTA350	Type G
			MDMA352P1*	3.5KW	MGDCTB350	Type G
			MDMA402P1*	4.0KW	MGDCTB375	Type G
			MDMA452P1*	4.5KW	MGDCTB375	Type G
			MDMA502P1*	5.0KW	MGDCTB375	Type G
Single-phase 200V	MHMA High inertia	2000r/min	MHMA052P1*	500W	MDDCT5507	Type D
Three-phase 200V			MHMA052P1*	500W	MDDCT5507	Type D
					MEDCT5307	Type E
			MHMA102P1*	1.0KW	MDDCT5316	Type D
					MEDCT5316	Type E
			MHMA152P1*	1.5KW	MDDCT5325	Type D
					MEDCT5325	Type E
			MHMA202P1*	2.0KW	MFDCT7333	Type F
			MHMA302P1*	3.0KW	MGDCTA350	Type G
			MHMA402P1*	4.0KW	MGDCTB375	Type G
			MHMA502P1*	5.0KW	MGDCTB375	Type G
Single-phase 200V	MFMA Middle inertia	2000r/min	MFMA042P1*	400W	MDDCT5507	Type D
			MFMA082P1*	750W	MDDCT5512	Type D
Three-phase 200V			MFMA042P1*	400W	MCDCT3307	Type C
					MDDCT5507	Type D
			MFMA082P1*	750W	MDDCT5512	Type D
					MEDCT5312	Type E
			MFMA152P1*	1.5KW	MDDCT5325	Type D
					MEDCT5325	Type E
			MFMA252P1*	2.5KW	MFDCT7333	Type F
			MFMA352P1*	3.5KW	MGDCTB350	Type G
			MFMA452P1*	4.5KW	MGDCTB375	Type G
Single-phase 200V	MGMA Middle inertia	1000r/min	MGMA032P1*	300W	MDDCT5507	Type D
			MGMA062P1*	600W	MDDCT5512	Type D
Three-phase 200V			MGMA032P1*	300W	MCDCT3307	Type C
					MDDCT5507	Type D
			MGMA062P1*	600W	MDDCT5512	Type D
					MEDCT5312	Type E
			MGMA092P1*	900W	MDDCT5316	Type D
					MEDCT5316	Type E
			MGMA122P1*	1.2KW	MFDCT7325	Type F
			MGMA202P1*	2.0KW	MGDCTA350	Type G
			MGMA302P1*	3.0KW	MGDCTB375	Type G
			MGMA452P1*	4.5KW	MGDCTB375	Type G

Introduction

With the Absolute/Incremental type encoder: 17bit

*** You must not use a combination other than those listed below:**

Driver power suply	Motor				Driver	
	Series symbol	Revolution rating	Motor type	Output rating	Driver	Driver type
Single-phase 200V	MAMA Ultra Low inertia	5000r/min	MAMA012S1*	100W	MADCT1505	Type A
					MBDCT1505	Type B
			MAMA022S1*	200W	MBDCT2507	Type B
			MAMA042S1*	400W	MCDCT3512	Type C
			MAMA082S1*	750W	MDDCT5516	Type D
Three-phase 200V			MAMA012S1*	100W	MADCT1505	Type A
					MBDCT1505	Type B
			MAMA022S1*	200W	MBDCT2507	Type B
			MAMA042S1*	400W	MCDCT3512	Type C
			MAMA082S1*	750W	MDDCT5516	Type D
Single-phase 100V	MSMA Low inertia	3000r/min	MSMA3AZS1*	30W	MADCT1103	Type A
					MBDCT1103	Type B
			MSMA5AZS1*	50W	MADCT1103	Type A
					MBDCT1103	Type B
			MSMA011S1*	100W	MADCT1105	Type A
					MBDCT1107	Type B
			MSMA021S1*	200W	MBDCT2107	Type B
			MSMA041S1*	400W	MCDCT3112	Type C
Single-phase 200V			MSMA3AZS1*	30W	MADCT1503	Type A
					MBDCT1503	Type B
			MSMA5AZS1*	50W	MADCT1503	Type A
					MBDCT1503	Type B
			MSMA012S1*	100W	MADCT1503	Type A
					MBDCT1503	Type B
			MSMA022S1*	200W	MADCT1505	Type A
					MBDCT1507	Type B
			MSMA042S1*	400W	MBDCT2507	Type B
			MSMA082S1*	750W	MDDCT5512	Type D
Three-phase 200V			MSMA3AZS1*	30W	MADCT1503	Type A
					MBDCT1503	Type B
			MSMA5AZS1*	50W	MADCT1503	Type A
					MBDCT1503	Type B
			MSMA012S1*	100W	MADCT1503	Type A
					MBDCT1503	Type B
			MSMA022S1*	200W	MADCT1505	Type A
					MBDCT1507	Type B
			MSMA042S1*	400W	MBDCT2507	Type B
			MSMA082S1*	750W	MCDCT3312	Type C
					MDDCT5512	Type D
			MSMA102S1*	1.0KW	MDDCT5316	Type D
					MEDCT5316	Type E
			MSMA152S1*	1.5KW	MDDCT5325	Type D
					MEDCT5325	Type E
			MSMA202S1*	2.0KW	MFDCT7333	Type F
			MSMA252S1*	2.5KW	MFDCT7333	Type F
			MSMA302S1*	3.0KW	MGDCTA350	Type G
			MSMA352S1*	3.5KW	MGDCTB375	Type G
			MSMA402S1*	4.0KW	MGDCTB375	Type G
			MSMA452S1*	4.5KW	MGDCTB375	Type G
			MSMA502S1*	5.0KW	MGDCTB375	Type G

Driver power suply	Motor				Driver	
	Series symbol	Revolution rating	Motor type	Output rating	Driver	Driver type
Single-phase 200V	MDMA Middle inertia	2000r/min	MDMA082S1*	750W	MDDCT5512	Type D
Three-phase 200V			MDMA082S1*	750W	MDDCT5512	Type D
					MEDCT5312	Type E
			MDMA102S1*	1.0KW	MEDCT5316	Type E
					MDDCT5316	Type D
			MDMA152S1*	1.5KW	MDDCT5325	Type D
					MEDCT5325	Type E
			MDMA202S1*	2.0KW	MFDCT7333	Type F
			MDMA252S1*	2.5KW	MFDCT7333	Type F
			MDMA302S1*	3.0KW	MGDCTA350	Type G
			MDMA352S1*	3.5KW	MGDCTB350	Type G
			MDMA402S1*	4.0KW	MGDCTB375	Type G
			MDMA452S1*	4.5KW	MGDCTB375	Type G
			MDMA502S1*	5.0KW	MGDCTB375	Type G
Single-phase 200V	MHMA High inertia	2000r/min	MHMA052S1*	500W	MDDCT5507	Type D
Three-phase 200V			MHMA052S1*	500W	MDDCT5507	Type D
					MEDCT5307	Type E
			MHMA102S1*	1.0KW	MDDCT5316	Type D
					MEDCT5316	Type E
			MHMA152S1*	1.5KW	MDDCT5325	Type D
					MEDCT5325	Type E
			MHMA202S1*	2.0KW	MFDCT7333	Type F
			MHMA302S1*	3.0KW	MGDCTA350	Type G
			MHMA402S1*	4.0KW	MGDCTB375	Type G
			MHMA502S1*	5.0KW	MGDCTB375	Type G
Single-phase 200V	MFMA Middle inertia	2000r/min	MFMA042S1*	400W	MDDCT5507	Type D
			MFMA082S1*	750W	MDDCT5512	Type D
Three-phase 200V			MFMA042S1*	400W	MCDCT3307	Type C
					MDDCT5507	Type D
			MFMA082S1*	750W	MDDCT5512	Type D
					MEDCT5312	Type E
			MFMA152S1*	1.5KW	MDDCT5325	Type D
					MEDCT5325	Type E
			MFMA252S1*	2.5KW	MFDCT7333	Type F
			MFMA352S1*	3.5KW	MGDCTB350	Type G
			MFMA452S1*	4.5KW	MGDCTB375	Type G
Single-phase 200V	MGMA Middle inertia	1000r/min	MGMA032S1*	300W	MDDCT5507	Type D
			MGMA062S1*	600W	MDDCT5512	Type D
Three-phase 200V			MGMA032S1*	300W	MCDCT3307	Type C
					MDDCT5507	Type D
			MGMA062S1*	600W	MDDCT5512	Type D
					MEDCT5312	Type E
			MGMA092S1*	900W	MDDCT5316	Type D
					MEDCT5316	Type E
			MGMA122S1*	1.2KW	MFDCT7325	Type F
			MGMA202S1*	2.0KW	MGDCTA350	Type G
			MGMA302S1*	3.0KW	MGDCTB375	Type G
			MGMA452S1*	4.5KW	MGDCTB375	Type G

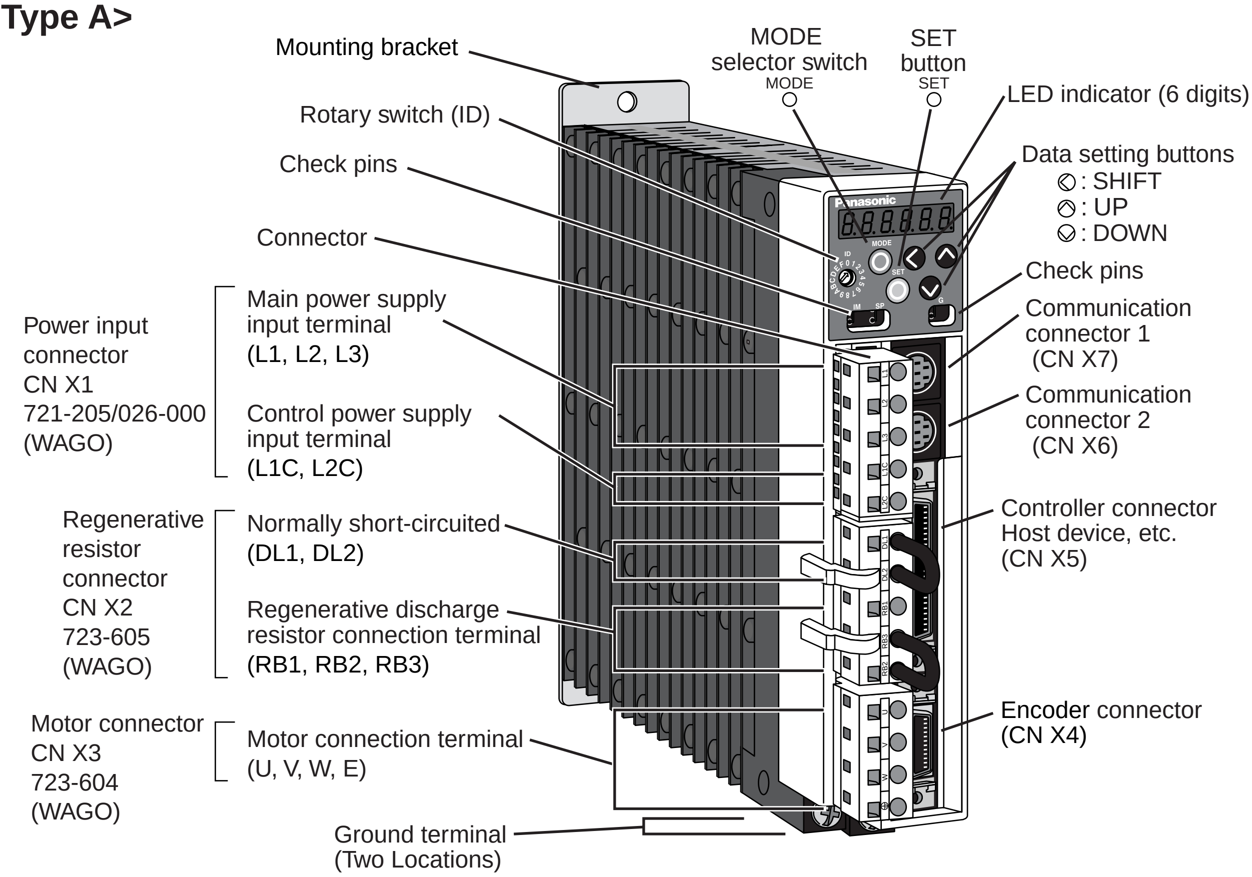
< Notes >

1. The default is for "incremental" spec.
   When you use the driver with the "absolute" spec, you need to;
   1) Install the battery (see page 278 "Optional Parts" in Appendix).
   2) Change the value of the parameter "Absolute encoder set-up (Pr0B)" from 1 (factory set default) to 0.
2. When the 17-bit 7-wire absolute encoder is used as an incremental encoder, the backup battery needs not to be connected.

Parts Description

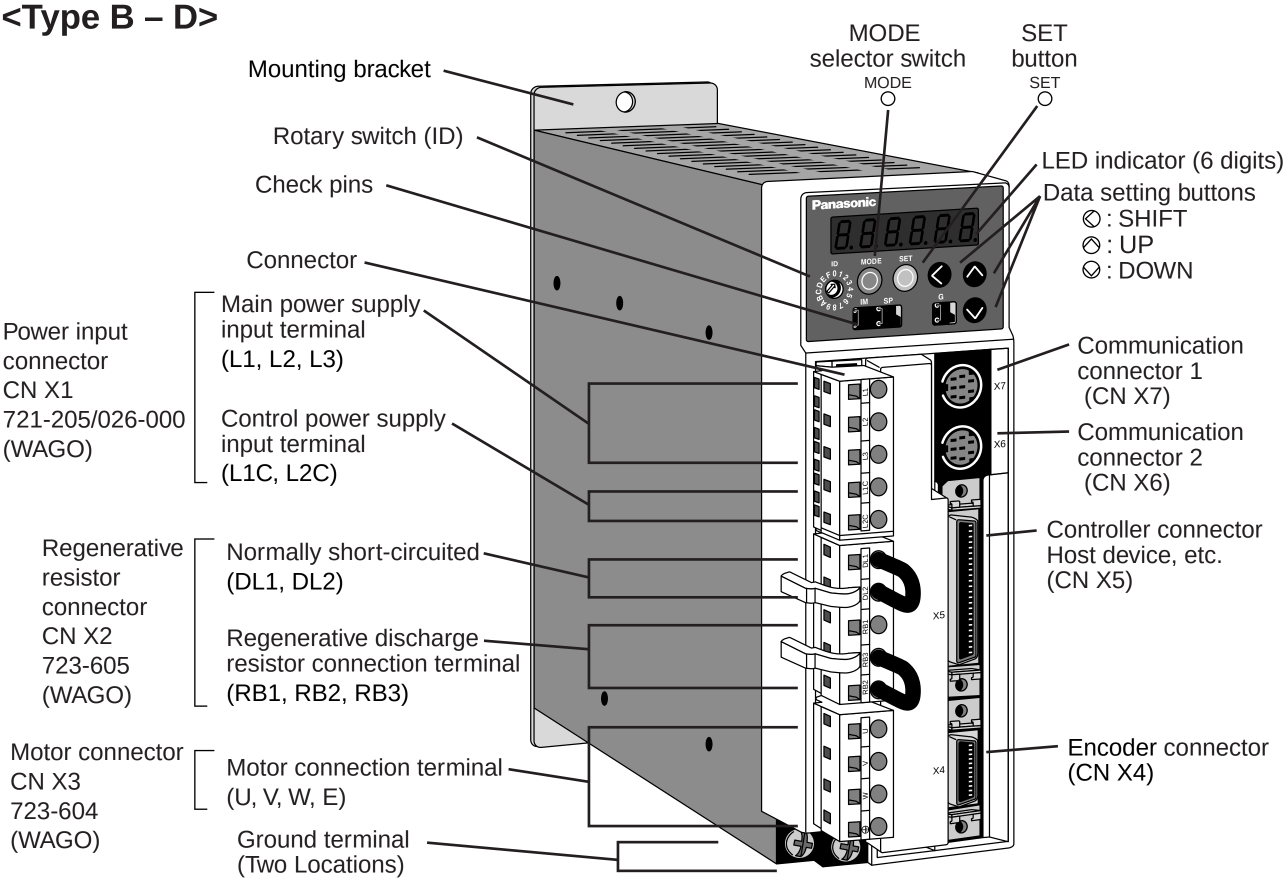
Driver

<Type A>



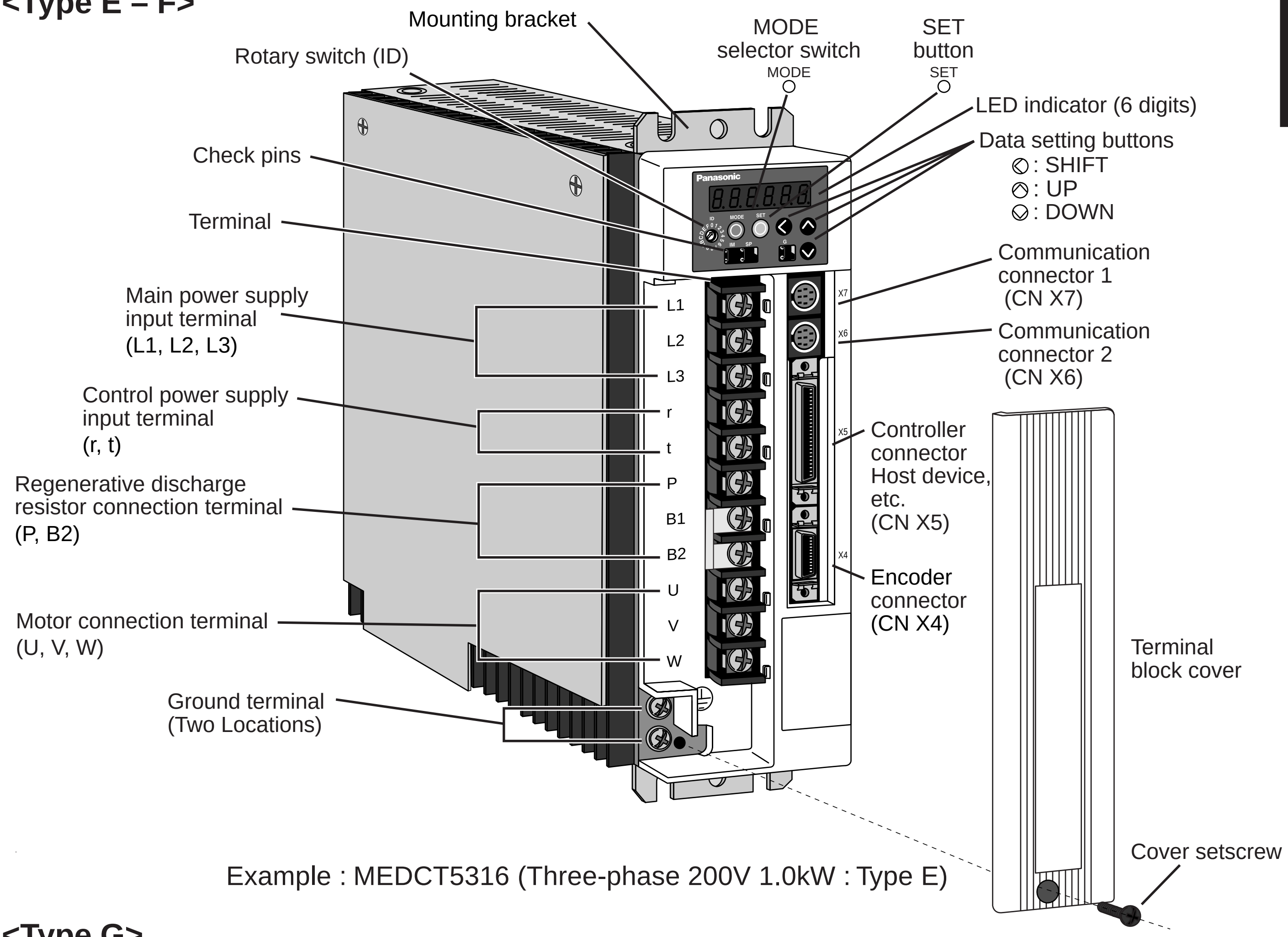
Example : MADCT1505 (Single-phase/Three-phase 200V 100W : Type A)

<Type B – D>



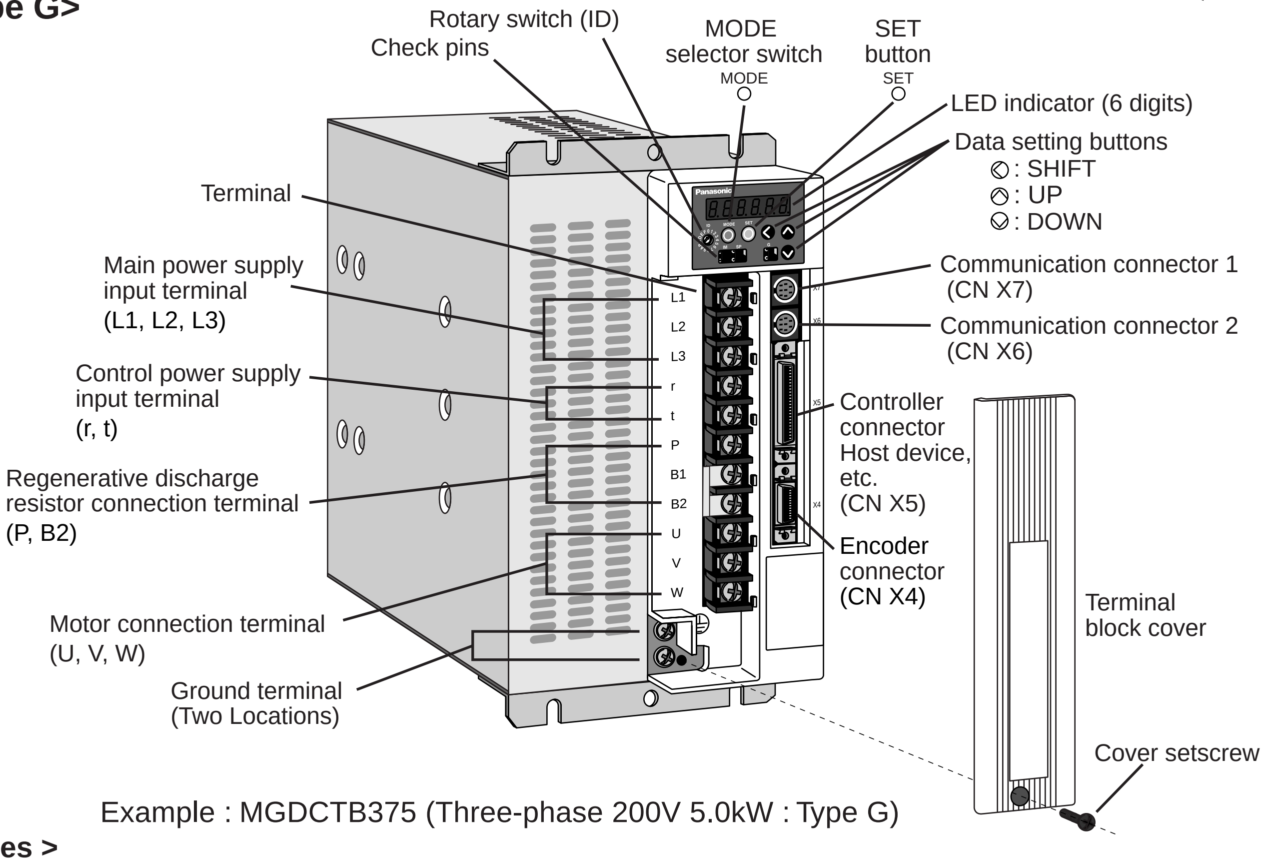
Example : MBDCT2507 (Single-phase/Three-phase 200V 400W : Type B)

<Type E – F>



Example : MEDCT5316 (Three-phase 200V 1.0kW : Type E)

<Type G>



Example : MGDCTB375 (Three-phase 200V 5.0kW : Type G)

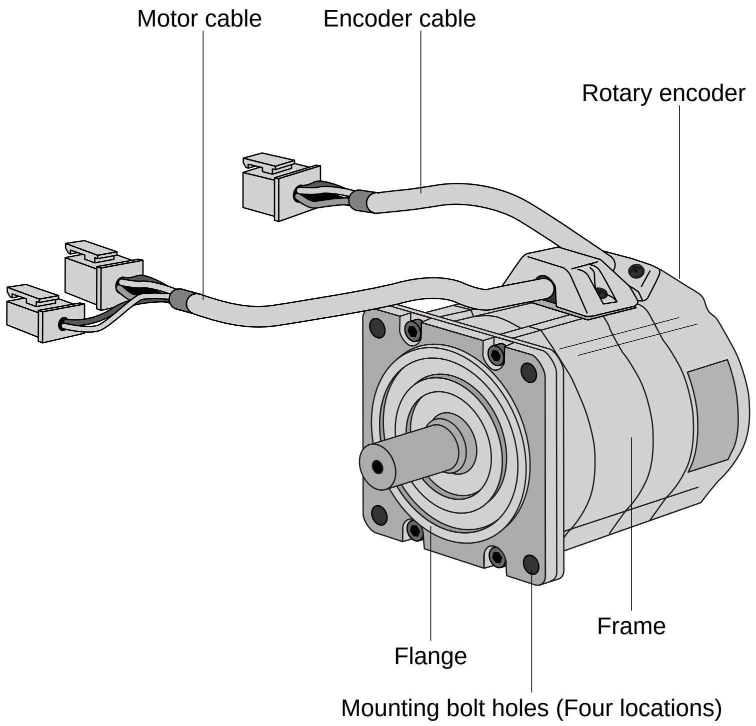
< Notes >

For detailed information for each of driver types, see page 292 ~ page 295 " Dimensions" in Appendix.
Connectors X1, X2 and X3 come with frames A to D.

Parts Description

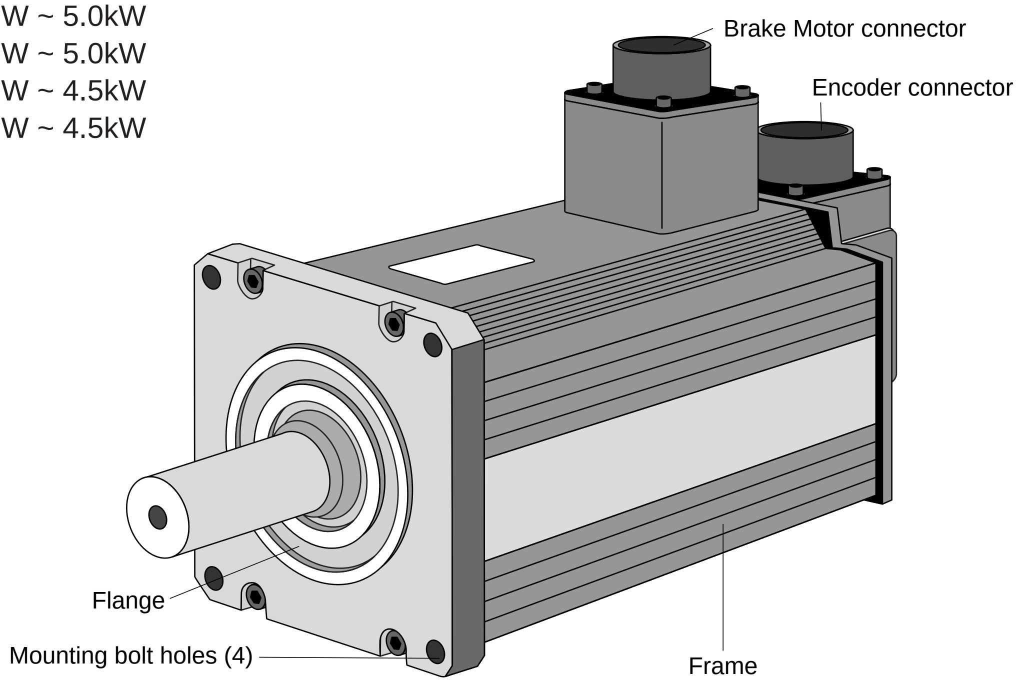
Motor

MAMA	100W ~ 200W
MSMA	30W ~ 750W



Example: Low-Inertia Motor (MSMA Series, 50W)

MSMA	1.0kW ~ 5.0kW
MDMA	750W ~ 5.0kW
MHMA	500W ~ 5.0kW
MFMA	400W ~ 4.5kW
MGMA	300W ~ 4.5kW



Example: Middle-Inertia Motor (MDMA Series, 1.0kW)

< Notes >

For detailed information for each of motor types, see page 284 ~ page 290 " Dimensions" in Appendix.

Installation

The motor and driver should be properly installed to avoid failures, mechanical damages and injuries.

Driver

Location

1) Indoors, where the driver is not subjected to rain water and direct sun beams. Note that the driver is not a waterproof structure.
2) A void the place where the driver is subjected to corrosive gases, flammable gases, grinding liquids, oil mists, iron powders and cutting particles.
3) Place in a well-ventilated, and humid- and dust-free space.
4) Place in a vibration-free space.

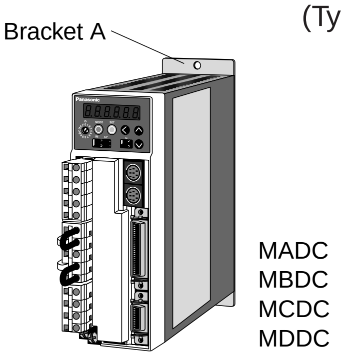
Environmental Conditions

Item	Conditions
Ambient temperature	0 to 55˚C (free from freezing)
Ambient humidity	Not greater than 90%RH (free from condensation)
Storage temperature	–20 to 80˚C (free from freezing)
Storage humidity	Not greater than 90%RH (free from condensation)
Vibration	Not greater than 5.9m/s^2 (0.6G) at 10 to 60 Hz
Altitude	Not greater than 1000 m

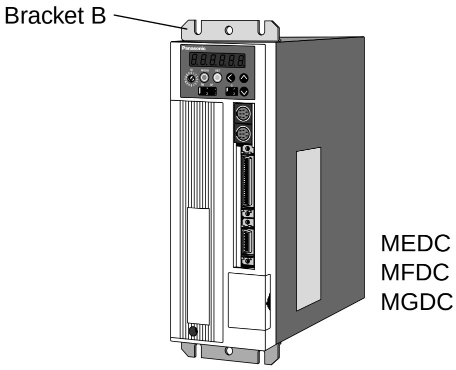
How to Install

1) This is a rack-mount type.
Place the driver vertically. Allow enough space surrounding for ventilation.
Type D and smaller : Back panel mount type (projected, use Bracket A)
Type E and larger : Front panel mount type (recessed, use Bracket B)

(Type A – D)



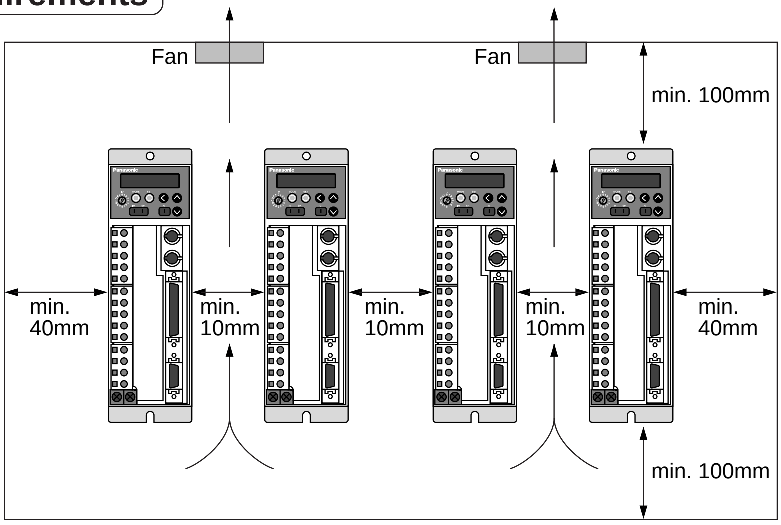
(Type E – G)



2) If you want to change the mounting configuration, use the optional bracket (see page 273 "Optional Parts" in Appendix).

Mounting Direction and Space Requirements

- Allow enough space to ensure enough cooling.
- Install fans to provide a uniform distribution of temperature in the control box.
- Observe the environmental requirements for the control box, mentioned in the previous page.



Installation

Motor

Location

1) Indoors, where the driver is not subjected to rain water and direct sun beams.
2) Avoid the place where the driver is subjected to corrosive gases, flammable gases, grinding liquids, oil mists, iron powders and cutting particles.
3) Place in a well-ventilated, and humid- and dust-free space.
4) Easy maintenance, inspections and cleaning is also important.

Environmental Conditions

Item		Conditions
Ambient temperature		0 to 40˚C (free from freezing)
Ambient humidity		Not greater than 85%RH (free from condensation)
Storage temperature		-20 to 80˚C (free from freezing)
Storage humidity		Not greater than 85%RH (free from condensation)
Vibration	Motor only	Not greater than 49m/s^2 (5G) in operation; not greater than 24.5m/s^2 (2.5G) at rest
Mechanical shock	Motor only	Not greater than 98m/s^2 (10G)

How to Install

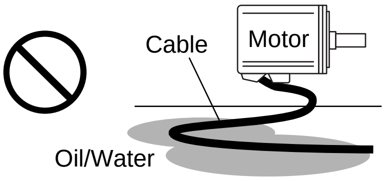
The motor can be installed either vertically or horizontally. Observe the following notes.

1) Horizontal mounting
- Place the motor with the cable outlet facing down to prevent the entry of oil and water.

2) Vertical mounting
- If the motor is coupled with a reduction gear, make sure that the oil in the reduction gear does not enter into the motor.

Oil and Water Protections

1) This motor can be used where it is subjected to water and/or oil drops, but is not water or oilproof. Therefore, the motors should not be placed or used in such environment.
2) If the motor is coupled with a reduction gear, use the motor should with oil seals to prevent the reduction gear oil from entering into the motor.
3) Don't use the motor with the cables being immersed in oil or water.



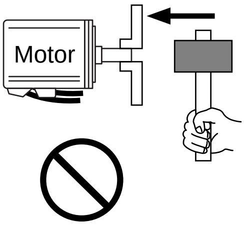
Cable: Stress Relieving

1) Make sure that the cables are not subjected to moments or vertical loads due to external bending forces or self-weight at the cable outlets or connections.
2) In case the motor is movable, secure the cable (proper one supplied together with the motor) to a stationery part (e.g. floor), and it should be extended with an additional cable which should be housed in a cable bearer so that
bending stresses can be minimized.
3) Make the bending radius of cables as large as possible. Minimum bend radius: 20 mm

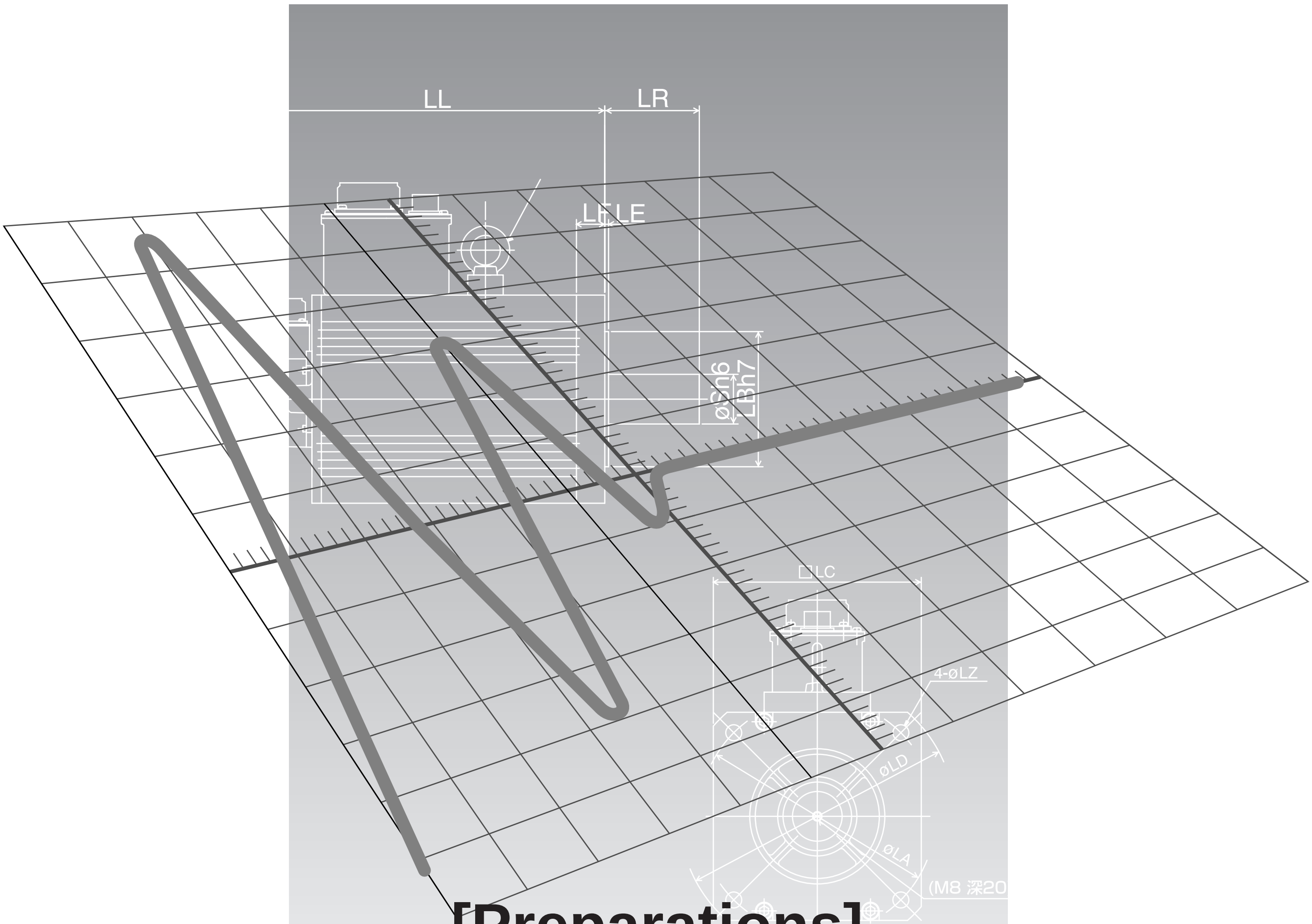
Permissible Shaft Load

1) Make sure that both of radial and thrust load to be applied to the motor shaft during installation and running, becomes within the specified value of each model.
2) Pay extra attention at installing a rigid coupling(especially an excess bending load which may cause the damages and/or wear of the shaft and bearings.
3) Flexible coupling is recommended in order to keep the radial load smaller than the permissible value, which is designed exclusively for servo motors with high mechanical stiffness.
4) For the permissible shaft load, see page 269 "Allowable Shaft Loads Listing" in Appendix.

Installation Notes



1) Don't hit the shaft with a hammer directly while attaching/detaching the coupling to the motor shaft.(otherwise the encoder at the opposite end of the shaft will be damaged).
2) Try perfect alignment between shafts (misalignment may cause vibration, and damages of the bearings).



[Preparations]

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System Configuration and Wiring

General Wiring Diagram (Example : Type B)

<Main Circuits>

Non-Fuse Breaker (NFB) (See P.30 and 31)
Used to protect the power lines: overcurrent will shutoff the circuit.

Noise Filter (NF) (See P.267)
Prevents the external noise from the power line, and reduces the effect of the noises generated by the servo motor.

Magnetic Contactor (MC) (See P.30 and 31)
Turns on/off the main power of the servo motor.
Used together with a surge absorber.

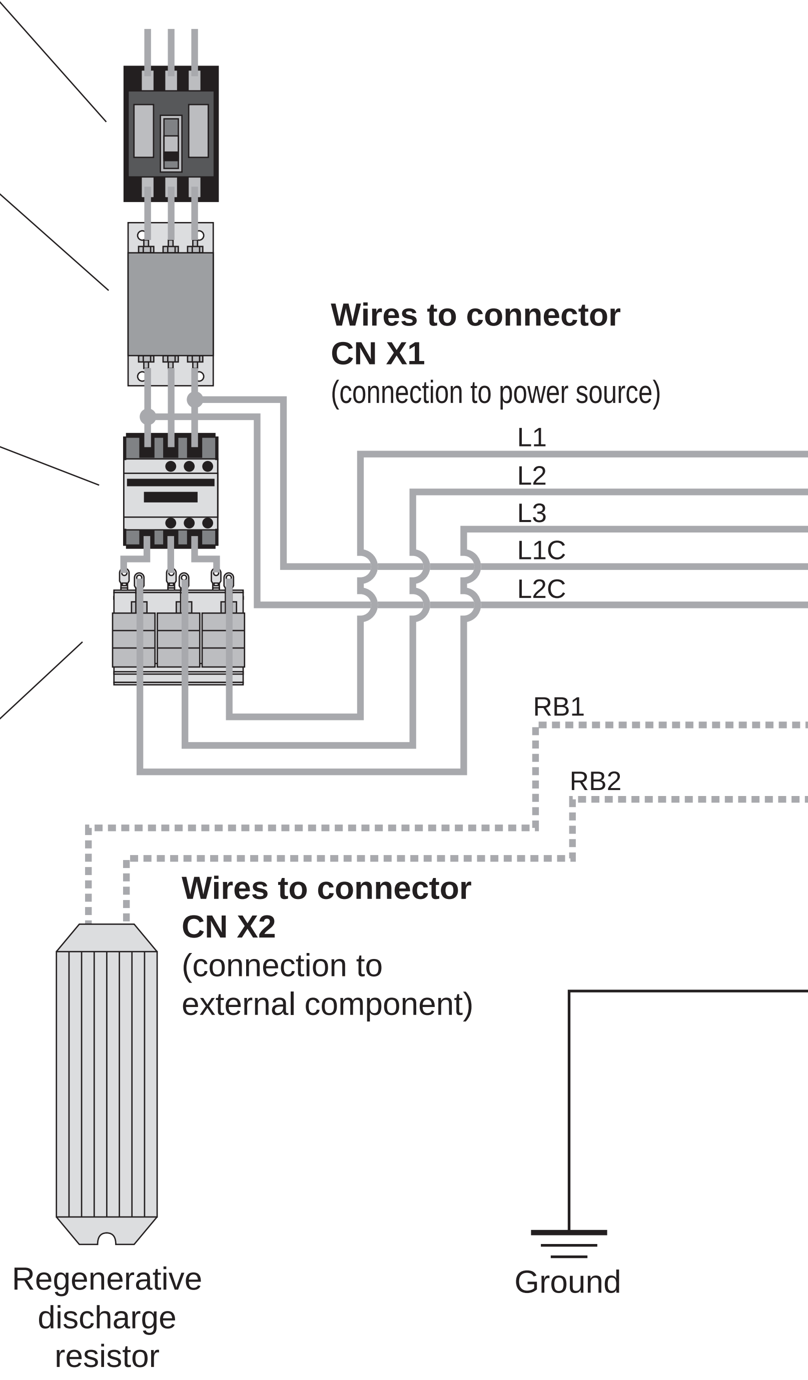
- **You must not absolutely run nor stop a motor with the magnetic contactor.**

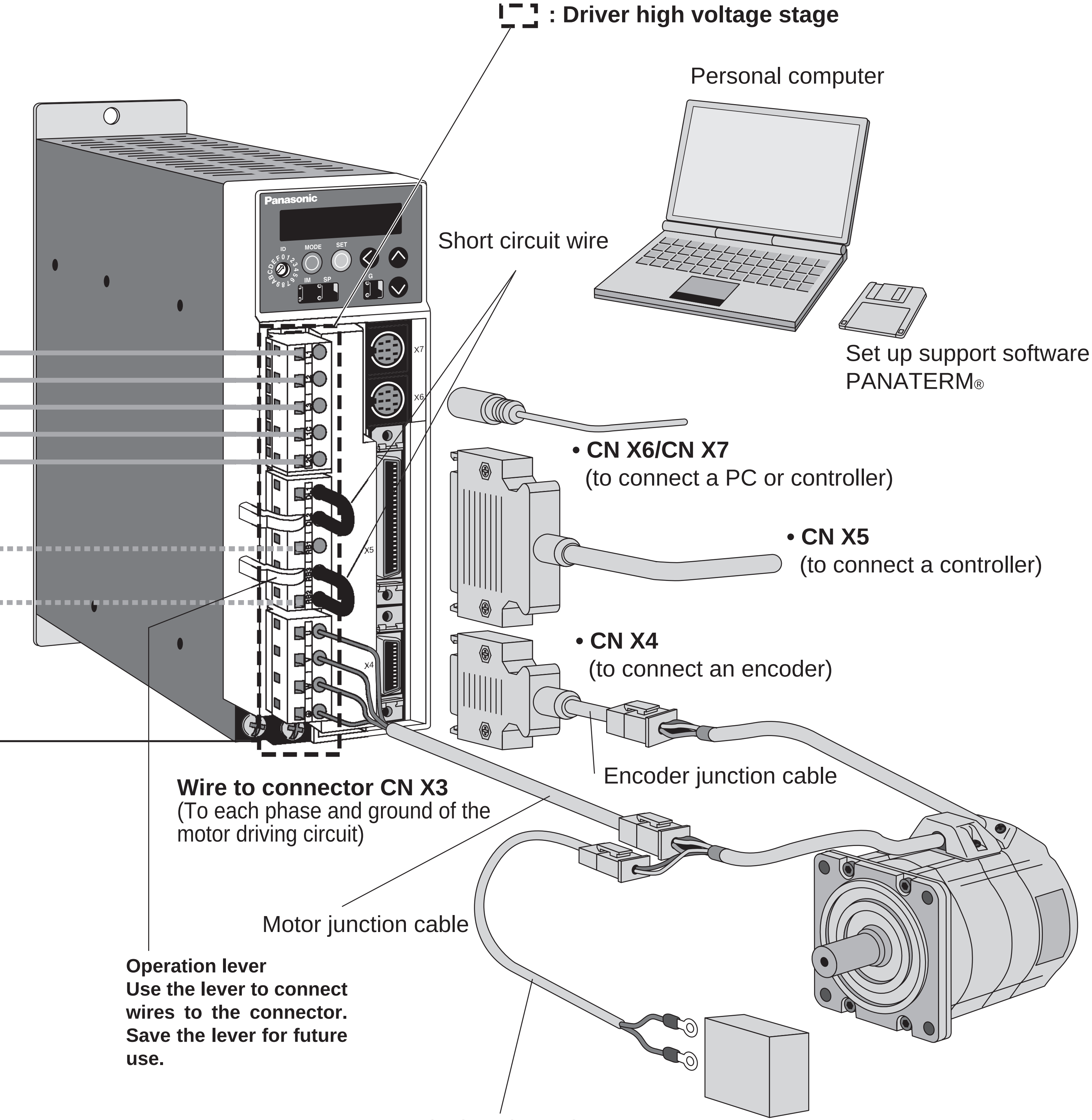
Reactor (L) (See P.281)
Reduces the harmonic in the main power.

Terminals RB1, RB2 and RB3

- Normally keep RB2 and RB3 shorted.
- **If the capacity of the internal regenerative discharge resistor is not enough, disconnect between RB2 and RB3**, and connect **an external regenerative discharge resistor** to RB1 and RB2 terminals.

(Type A does not include regenerative resistor. When installing the resistor, follow the procedure shown above.)





: Driver high voltage stage

Personal computer

Short circuit wire

Set up support software PANATERM®

• CN X6/CN X7
(to connect a PC or controller)

• CN X5
(to connect a controller)

• CN X4
(to connect an encoder)

Encoder junction cable

Wire to connector CN X3
(To each phase and ground of the motor driving circuit)

Motor junction cable

Operation lever
Use the lever to connect wires to the connector. Save the lever for future use.

Brake junction cable

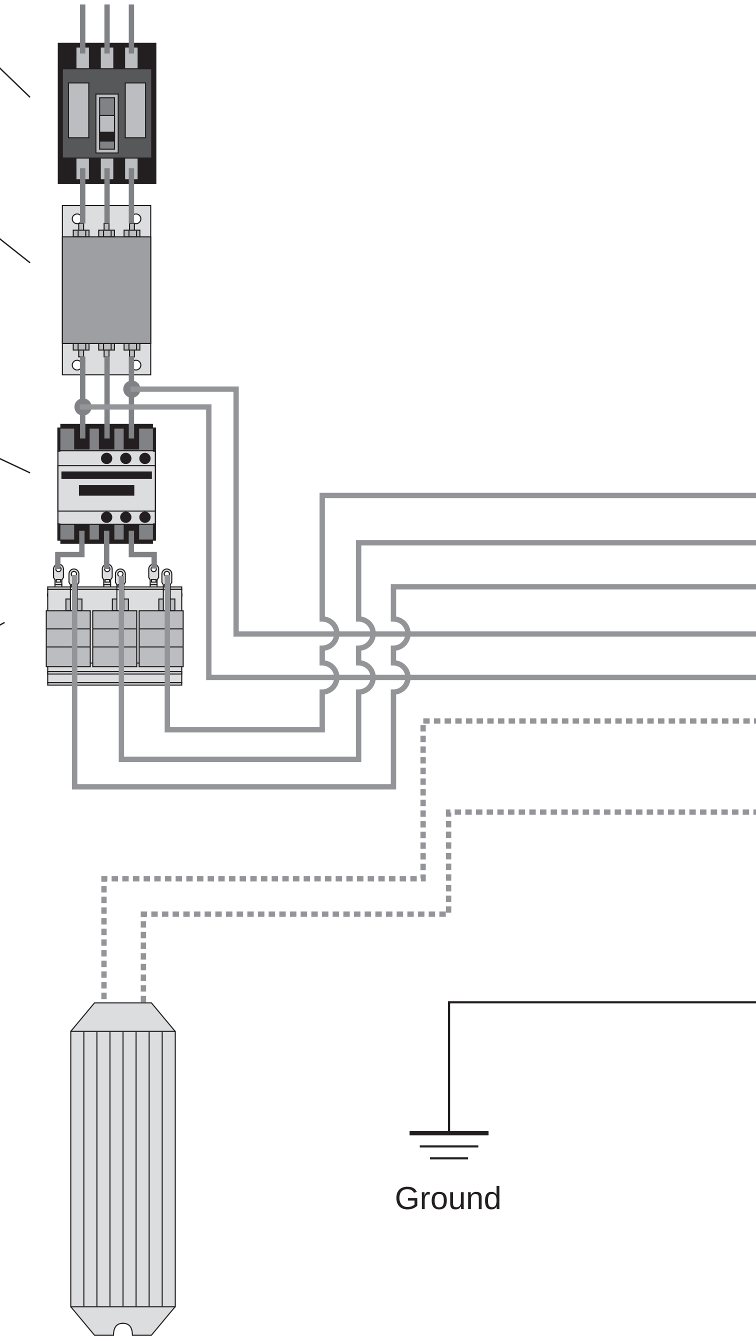
Brake power supply
(24VDC)

*For connection, see page 32 "Wiring Instructions".

System Configuration and Wiring

General Wiring Diagram (Example : Type G)

<Main Circuits>



Non-Fuse Breaker (NFB) (See P.30 and 31)
Used to protect the power lines: overcurrent will shutoff the circuit.

Noise Filter (NF) (See P.267)
Prevents the external noise from the power line, and reduces the effect of the noises generated by the servo motor.

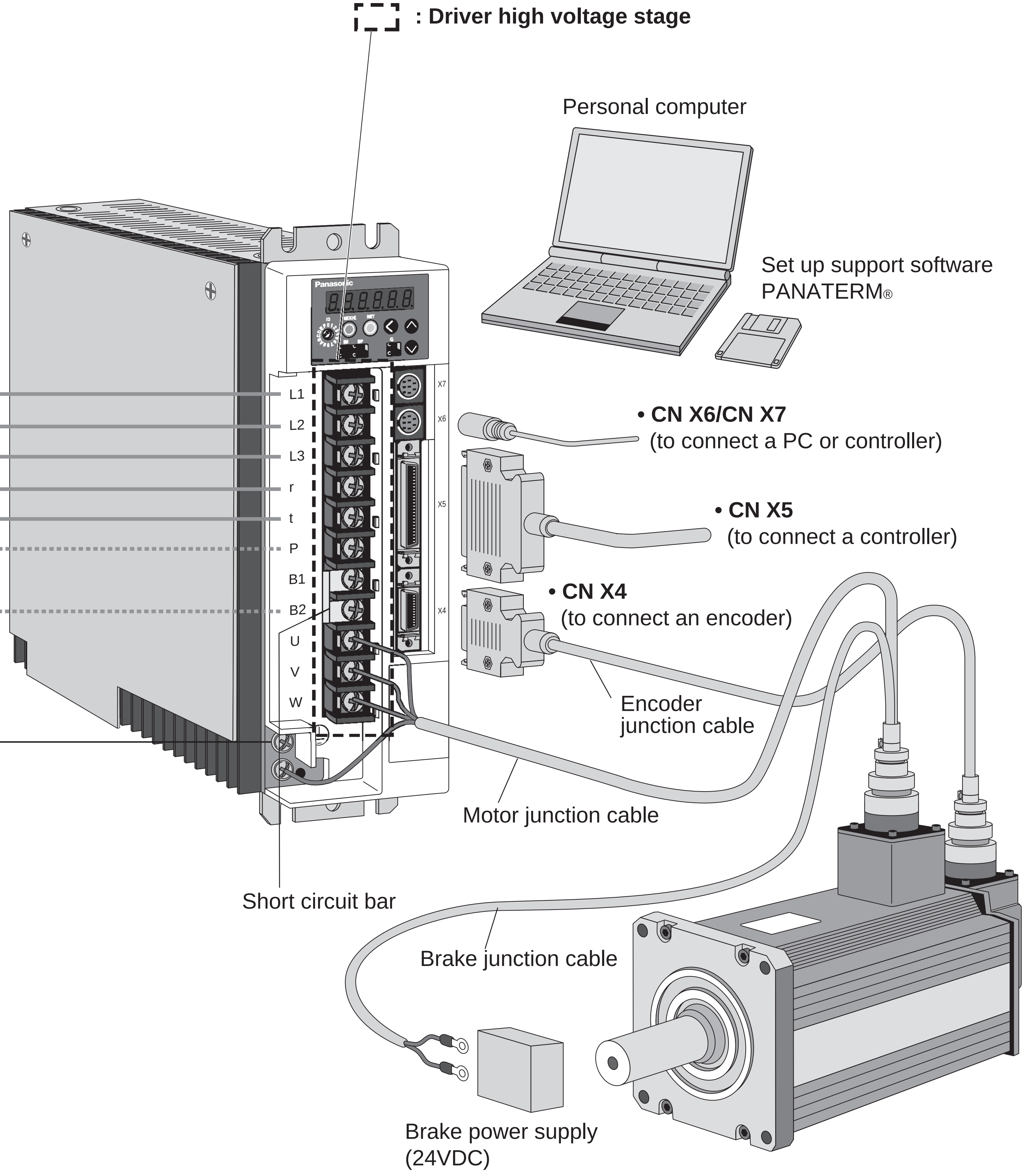
Magnetic Contactor (MC) (See P.30 and 31)
Turns on/off the main power of the servo motor.
Used together with a surge absorber.

- **You must not absolutely run nor stop a motor with the magnetic contactor.**

Reactor (L) (See P.281)
Reduces the harmonic in the main power.

Terminals P, B1 and B2

- Normally keep B1 and B2 shorted.
- **When the internal regenerative resistance does not have sufficient capacity, remove the short bar between B1 and B2,** and connect **an external regenerative resistance** to P to B2 terminals.



• CN X6/CN X7
(to connect a PC or controller)

• CN X5
(to connect a controller)

• CN X4
(to connect an encoder)

*For connection, see page 33 "Wiring Instructions".

System Configuration and Wiring

List of Drivers and Compatible Peripheral Equipment

Driver	Compatible motor	Voltage	Output	Required Power (at the rated load)	Circuit breaker (rated current)	Noise filter	Magnetic contactor (contacts)	Main circuit wire diameter	Control power wire diameter	Wiring on connector
MADC	MSMA	Single-phase 100V	30W ~ 50W	approx. 0.3kVA	BBC 2101N (10A)	DV0P3390	BMFT61041N (3P+1a)	0.75 ~ 2.0mm^2 AWG14 – 18	0.75mm^2 AWG18	Wiring to dedicated connector
			100W	approx. 0.4kVA						
		Single-phase 200V	30W ~ 100W	approx. 0.3kVA	BBC 3101N (10A)		BMFT61541N (3P+1a)			
			200W	approx. 0.5kVA						
	MAMA		100W	approx. 0.3kVA						
	MSMA	Three-phase 200V	30W ~ 100W	approx. 0.3kVA			BMFT61042N (3P+10a)			
			200W	approx. 0.5kVA						
	MAMA		100W	approx. 0.3kVA						
MBDC	MSMA	Single-phase 100V	30W ~ 50W	approx. 0.3kVA	BBC 2101N (10A)	DV0P1441	BMFT61041N (3P+1a)			
			100W	approx. 0.4kVA						
			200W	approx. 0.5kVA						
		Single-phase 200V	30W ~ 100W	approx. 0.3kVA	BBC 3101N (10A)		BMFT61541N (3P+1a)			
			200W	approx. 0.5kVA						
			400W	approx. 0.9kVA						
	MAMA		100W	approx. 0.3kVA						
			200W	approx. 0.5kVA						
	MSMA	Three-phase 200V	30W ~ 100W	approx. 0.3kVA			BMFT61042N (3P+10a)			
			200W	approx. 0.5kVA						
			400W	approx. 0.9kVA						
	MAMA		100W	approx. 0.3kVA						
			200W	approx. 0.5kVA						
MCDC	MSMA	Single-phase 100V	400W	approx. 0.9kVA	BBC 2101N(10A)		BMFT61541N (3P+1a)			
	MAMA	Single-phase 200V	400W	approx. 0.9kVA	BBC 3151N (15A)					
	MSMA	Three-phase 200V	750W	approx. 1.3kVA			BMFT61042N (3P+10a)			
	MFMA		400W	approx. 0.9kVA						
	MGMA		300W	approx. 0.7kVA						
	MAMA		400W	approx. 0.9kVA						
MDDC	MSMA	Single-phase 200V	750W	approx. 1.6kVA		DV0P3410	BMFT61541N (3P+1a)			
	MDMA		750W	approx. 1.6kVA						
	MFMA		400W	approx. 0.9kVA						
			750W	approx. 1.6kVA						
	MHMA		500W	approx. 1.1kVA						
	MGMA		300W	approx. 0.7kVA						
			600W	approx. 1.2kVA						
	MAMA		750W	approx. 1.6kVA						
	MSMA	Three-phase 200V	750W	approx. 1.3kVA			BMFT61042N (3P+10a)			
	MDMA		750W	approx. 1.3kVA						
	MFMA		400W	approx. 1.0kVA						
			750W	approx. 1.3kVA						
	MHMA		500W	approx. 1.0kVA						
	MGMA		300W	approx. 0.7kVA						
			600W	approx. 1.1kVA						
	MAMA		750W	approx. 1.3kVA						
	MGMA		900W	approx. 1.8kVA			BMFT61542N (3P+1a)	2.0mm^2 AWG14		
	MSMA		1kW	approx. 1.8kVA						
	MDMA		1kW	approx. 1.8kVA						
	MHMA		1kW	approx. 1.8kVA						
	MSMA		1.5kW	approx. 2.3kVA	BBC 3201N (20A)		BMFT61842N (3P+1a)			
	MDMA		1.5kW	approx. 2.3kVA						
	MFMA		1.5kW	approx. 2.3kVA						
	MHMA		1.5kW	approx. 2.3kVA						

Driver	Compatible motor	Voltage	Output	Required Power (at the rated load)	Circuit breaker (rated current)	Noise filter	Magnetic contactor (contacts)	Main circuit wire diameter	Control power wire diameter	Pressure terminal on terminal block
MEDC	MDMA	Three-phase 200V	750W	approx. 1.3kVA	BBC 3151N (15A)	DV0P1442	BMFT61042N (3P+10a)	0.75 ~ 2.0mm^2 AWG14 – 18	0.75mm^2 AWG18	M5
	MFMA		750W	approx. 1.3kVA						
	MHMA		500W	approx. 1.0kVA						
	MGMA		600W	approx. 1.1kVA						
			900W	approx. 1.8kVA			BMFT61542N (3P+1a)	2.0mm^2 AWG14		
	MSMA		1kW	approx. 1.8kVA						
	MDMA		1kW	approx. 1.8kVA						
	MHMA		1kW	approx. 1.8kVA						
	MSMA		1.5kW	approx. 2.3kVA	BBC 3201N (20A)		BMFT61842N (3P+1a)			
	MDMA		1.5kW	approx. 2.3kVA						
	MFMA		1.5kW	approx. 2.3kVA						
	MHMA		1.5kW	approx. 2.3kVA						
MFDC	MGMA		1.2kW	approx. 2.3kVA	BBC 3301N (30A)					
	MSMA		2kW	approx. 3.3kVA			BMF6252N (3P+2a2b)			
	MDMA		2kW	approx. 3.3kVA						
	MHMA		2kW	approx. 3.3kVA						
	MSMA		2.5kW	approx. 3.8kVA			BMF6352N (3P+2a2b)			
	MDMA		2.5kW	approx. 3.8kVA						
	MFMA		2.5kW	approx. 3.8kVA						
MGDC	MGMA		2kW	approx. 3.8kVA	BBC 3501N (50A)					
	MSMA		3kW	approx. 4.5kVA		DV0P1443		3.5mm^2 AWG11		
			3.5kW	approx. 5.3kVA						
	MDMA		3kW	approx. 4.5kVA						
			3.5kW	approx. 5.3kVA						
	MHMA		3kW	approx. 4.5kVA						
	MFMA		3.5kW	approx. 5.3kVA						
	MGMA		3kW	approx. 5.3kVA						
	MSMA		4kW	approx. 6.0kVA			BMF6502N (3P+2a2b)			
	MDMA		4kW	approx. 6.0kVA						
	MHMA		4kW	approx. 6.0kVA						
	MFMA		4.5kW	approx. 6.8kVA						
	MSMA		4.5kW	approx. 6.8kVA				5.3mm^2 AWG10		
	MDMA		4.5kW	approx. 6.8kVA						
	MSMA		5kW	approx. 7.5kVA			BMF6652N (3P+2a2b)			
	MDMA		5kW	approx. 7.5kVA						
	MHMA		5kW	approx. 7.5kVA						
	MGMA		4.5kW	approx. 7.5kVA						

*Select the single-phase/3-phase 200 V type according to the power supply used.

- Manufacturer of circuit breaker and electromagnetic contactor: Matsushita Electric Works, Ltd.
  When it is necessary to conform to the EC Directive, be sure to use a circuit breaker having IEC and Ⓤ marking between the power source and the noise filter.
  For models of 750W or greater, when the installation is protected by a circuit breaker maximum rating of which is 20A, energy fed to the circuit should be limited to 5000 Arms. Ensure that no load exceeding these values should be applied.
- For further information on the noise filter, see page 268 "Peripheral Devices Applicable to Drivers (EC Directires)" in Appendix.

<Please note>

- Select circuit breaker and noise filter rated at a capacity enough to accommodate the applicable power and load.
- Terminal block and ground terminal
  For wiring, use a copper conductor cable having 60*C or higher temperature rating.
  For protective earth terminals, use M4 for types A to D and M5 for types E to G.
  Mounting torque of screws in excess of the maximum value (M4: 1.2N·m and M5: 2.0N·m) might break down a terminal block.
- When output is 30W to 2.5kW, use earth cable whose wire diameter is 2.0 mm^2 (AWG14) or greater. When output ranges from 3kW to 5kW, use earth cable whose wire diameter is not less than 3.5mm^2 (AWG 11).
- For types A to D, you should use an ancillary dedicated connector. In this case, the length of bare cable must be 8 to 9 mm.

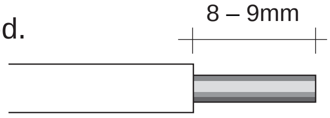
System Configuration and Wiring

Main Circuits (Type A – D)

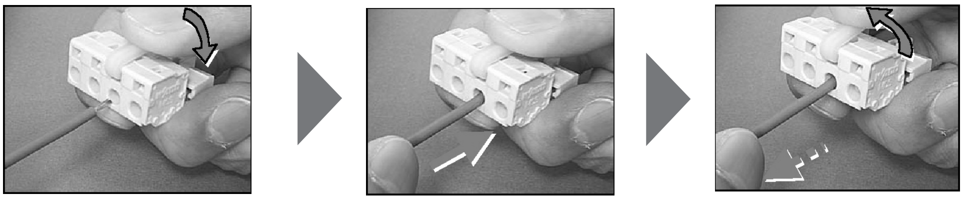
- Wiring work must be conducted by a qualified electrician.
- Don't turn on the main power until the wiring is completed, to avoid electric shocks.

Wiring Instructions

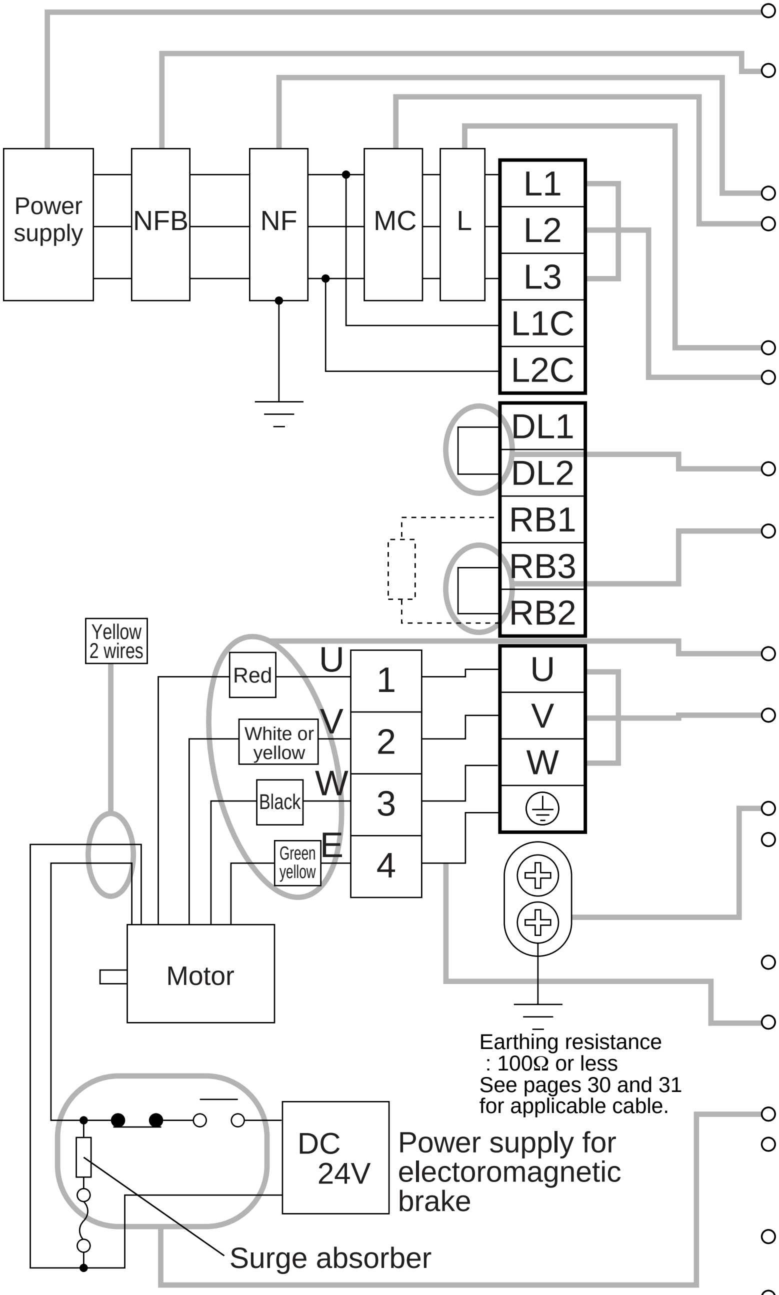
1. Unsheathe the cable to be used.



2. Insert the cable into the connector disconnected from the body. Release the lever and verify that the cable is positively held. For further information, see page 70 "Connecting cables to the terminal block".



3. Set the wired connector to the body.



○ See the nameplate of the driver to check the power specification.

○ Install a non-fuse breaker or leakage breaker. The latter should be a special one intended for inverters, i.e. with a countermeasure against higher harmonics.

○ Install a noise filter without fail.

○ Install a surge absorber to the magnetic contactor coil.
Never start or stop the motor by using the electromagnetic contactor.

○ Install an AC reactor.

○ For single-phase 100V, 200V connect between L1 and L1C, and between L3 and L2C. Do not use L2 terminal.

○ Don't remove the Short circuit wire connecting between DL1 and DL2.

○ Don't remove the Short circuit wire connecting between RB2 and RB3. Remove this only when an external regenerative discharge resistor is connected.

○ Ensure matching in color between the motor wires and terminals (U, V and W).

○ **Don' t short circuit or ground. Don' t connect to the main power.**

○ **Connect to the grounding system of the facility.**

○ Never fail to connect between the driver's protective earth terminal (⏚) and control board's protective earth terminal (PE) in order to avoid electric shocks.

○ No multiple connections to a single earth terminal permissible. There are two earth terminals (⏚)

○ Earth wires should in no case be connected or made contact to any of the terminals other than the earth terminals on the block.

○ The electromagnetic brake is not polar-sensitive.

○ The brake control circuit should have double circuit configuration so that it can be actuated even on receipt of an external emergency stop signal.

○ For power capacities and for use of the brake, see page 44 "Holding Brake".

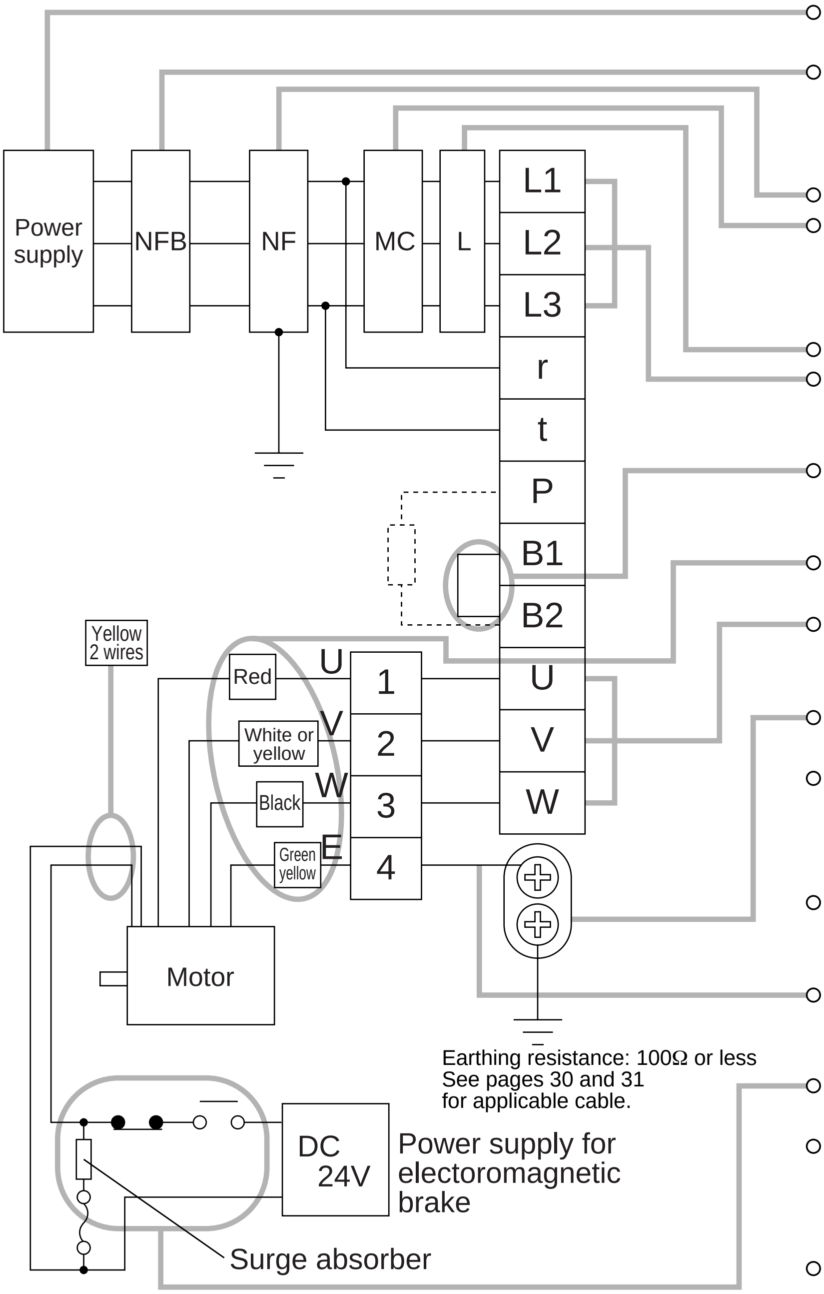
○ Provide a surge absorber.

Main Circuits (Type E – G)

- Wiring work must be conducted by a qualified electrician.
- Don't turn on the main power until the wiring is completed, to avoid electric shocks.

Wiring Instructions

1. Detach the terminal block by removing the cover securing screw.
2. Make necessary connections.
   Use clamp terminal connectors with an insulation cover. For wire diameter and connector sizes, see List of Available Components (page 30, 31).
3. Attach the terminal block cover and tighten the cover securing screw.



Earthing resistance: 100Ω or less
See pages 30 and 31
for applicable cable.

- ○ See the nameplate of the driver to check the power specification.
- ○ Install a non-fuse breaker or leakage breaker. The latter should be a special one intended for inverters, i.e. with a countermeasure against higher harmonics.
- ○ Install a noise filter without fail.
- ○ Install a surge absorber to the magnetic contactor coil.
  Never start or stop the motor by using the electromagnetic contactor.
- ○ Install an AC reactor.
- ○ For single-phase 200V connect between L1 and r, and between L3 and t. Do not use L2 terminal.
- ○ Don't remove the circuit bar connecting between B1 and B2. Remove this only when an external regenerative discharge resistor is connected.
- ○ Ensure matching in color between the motor wires and terminals (U, V and W).
- ○ **Don't short circuit or ground. Don't connect to the main power.**

- ○ **Connect to the grounding system of the facility.**
- ○ Never fail to connect between the driver's protective earth terminal (⏚) and control board's protective earth terminal (PE) in order to avoid electric shocks.
- ○ No multiple connections to a single earth terminal permissible. There are two earth terminals (⏚)
- ○ Earth wires should in no case be connected or made contact to any of the terminals other than the earth terminals on the block.
- ○ The electromagnetic brake is not polar-sensitive.
- ○ The brake control circuit should have double circuit configuration so that it can be actuated even on receipt of an external emergency stop signal.
- ○ For power capacities and for use of the brake, see page 44 "Holding Brake".
- ○ Provide a surge absorber.

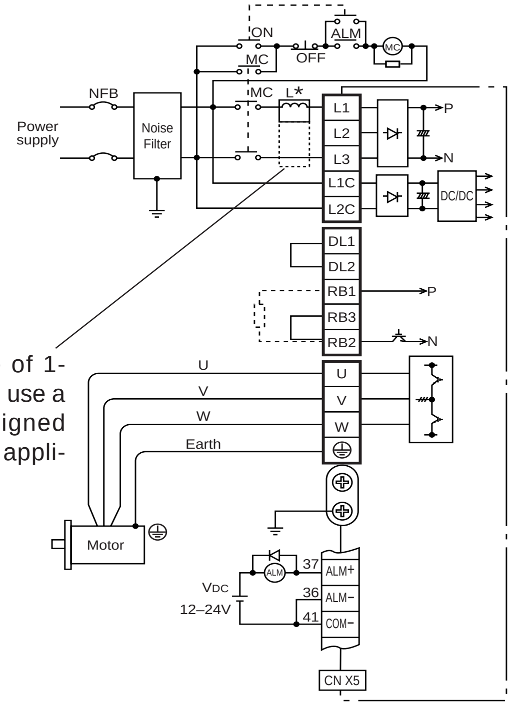
System Configuration and Wiring

Wiring Diagrams

Configure the circuit so that the power supply for the main circuit turns OFF at occurrence of an alarm.

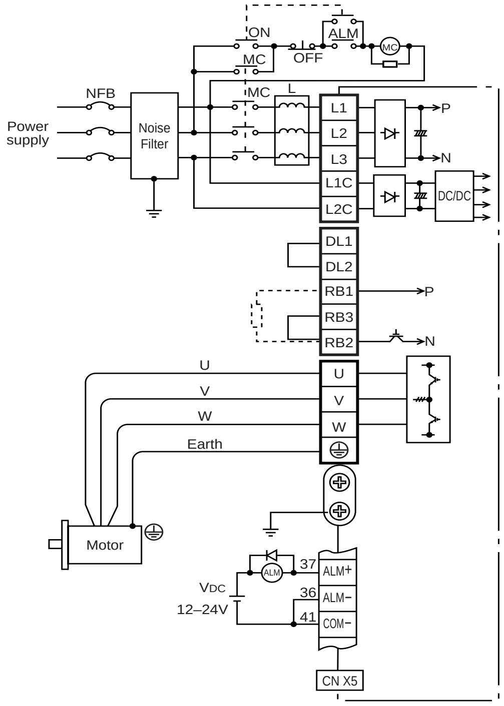
For 1-phase 100V/200V, 3-phase 200V(Type A)

For 1-phase 100V/200V*

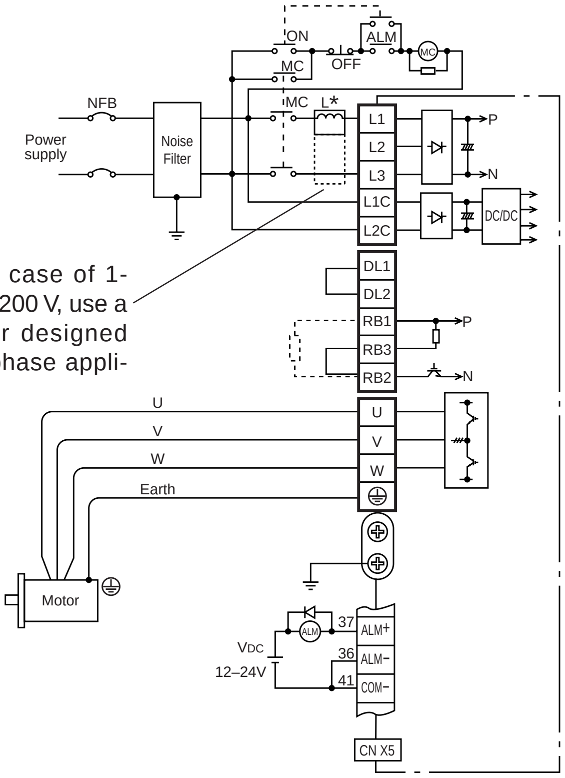


* In the case of 1-phase 200 V, use a reactor designed for 3-phase application.

For 3-phase 200V

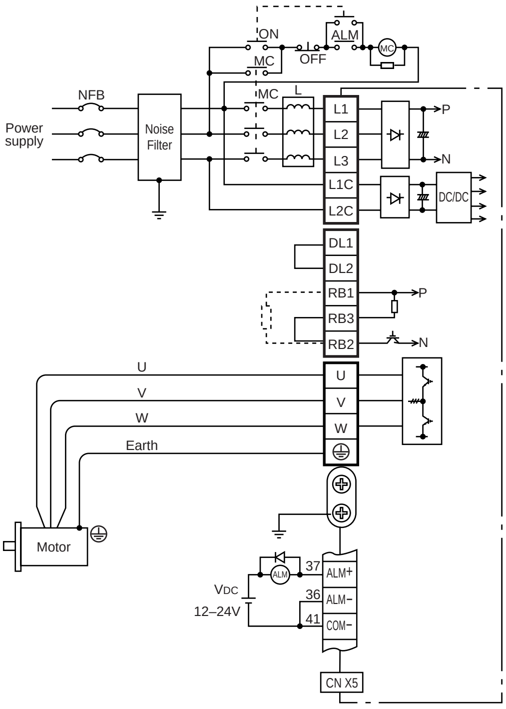


For 1-phase 100V/200V(Type B – D)*

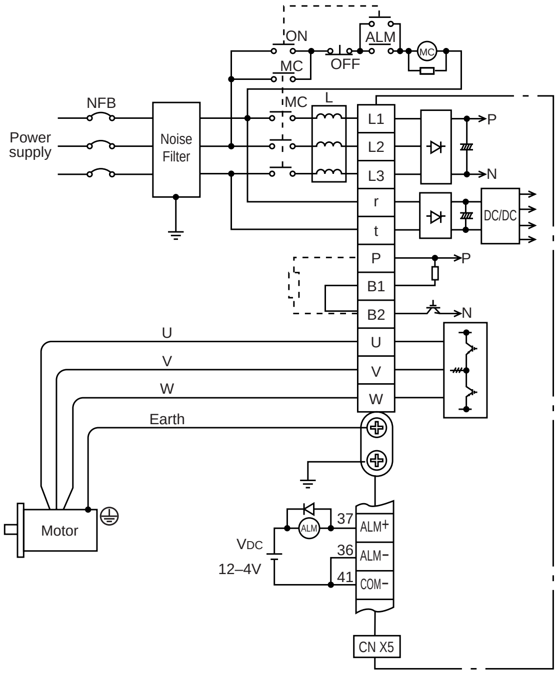


* In the case of 1-phase 200 V, use a reactor designed for 3-phase application.

For 3-phase 200V(Type B – D)



3-phase 200V(Type E – G)



- Cannon Plug Type Motor Connectors

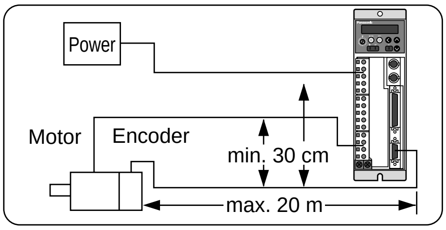
Motor			Cannon plug' s pin no.					
Brake	**Series symbol**	**Output rating**	**U**	**V**	**W**	**E**	**Brake 1**	**Brake 2**
Not fitted	MSMA	1 ~ 2.5kW	A	B	C	D	——	——
	MDMA	0.75 ~ 2.5kW						
	MGMA	0.3 ~ 0.9kW						
	MHMA	0.5 ~ 1.5kW						
	MSMA	3 ~ 5kW	A	B	C	D	——	——
	MDMA	3 ~ 5kW						
	MGMA	1.2 ~ 4.5kW						
	MHMA	2 ~ 5kW						
	MFMA	0.75 ~ 1.5kW	F	I	B	D, E	——	——
	MFMA	2.5 ~ 4.5kW	D	E	F	G, H	——	——
Fitted	MSMA	1 ~ 2.5kW	F	I	B	D E	G	H
	MDMA	0.75 ~ 2.5kW						
	MGMA	0.3 ~ 0.9kW						
	MHMA	0.5 ~ 1.5kW						
	MFMA	0.4 ~ 1.5kW						
	MSMA	3 ~ 5kW	D	E	F	G H	A	B
	MDMA	3 ~ 5kW						
	MGMA	1.2 ~ 4.5kW						
	MHMA	2 ~ 5kW						
	MFMA	2.5 ~ 4.5kW						

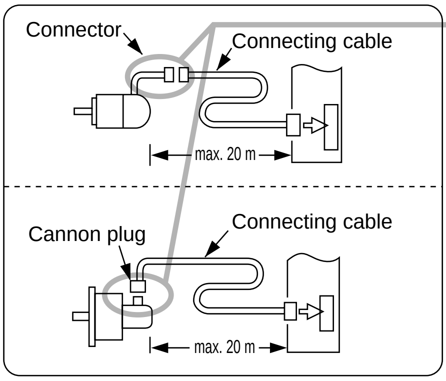
<Note> See page 270 "Optional Parts" (Specifications of connectors/plugs for motors) in Appendix.

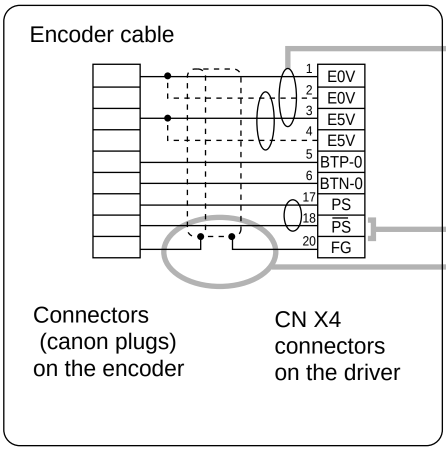
System Configuration and Wiring

CN X4 Connector (For Encoder)

Wiring Instructions





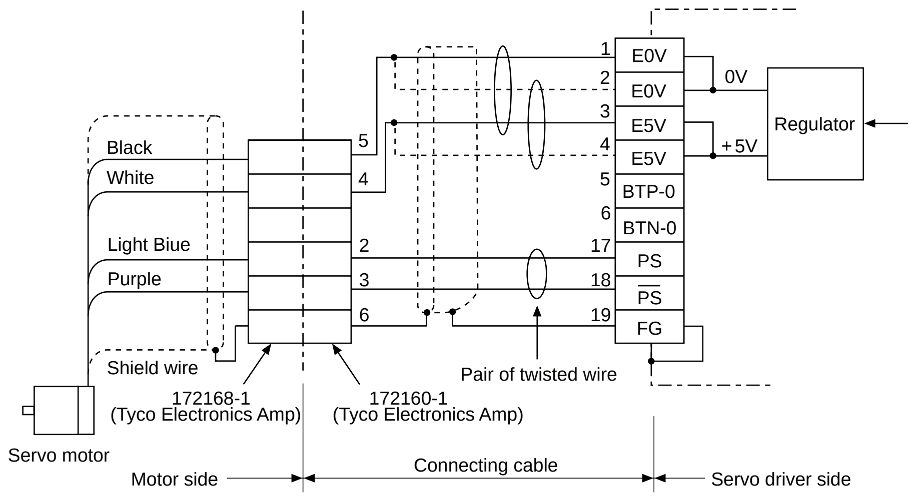


- ○ The cable length between the driver and motor should be max. 20 m. If you use a longer cable, contact the dealer or sales agent. (See the back cover.)
- ○ Separate these wiring min. 30 cm from the main circuit wires. Don't lay these wires in the same duct of the mains or bundle with them.
- ○ Two types of encoder wire exit: One is "Lead wire + connector" and other is Cannon plug type(depending on the motor model).
- ○ If you make junction cables to the encoder by yourself, observe the following (for connectors, refer to page 275 of Appendix, " Optional Parts (Connector Kit for Connection of Motor and Encoder)" :
  1) Refer to the wiring diagram.
  2) Wire material: 0.18 mm^2 (AWG24) or above, shielded twist-paired wire with an enough bending durability.
  3) Signal/power paired wires should be of a twist-paired type.
  4) Shield:
    - The shield at the driver side should be connected to Pin 20 (FG) of CN X4 Connector.
    - The shield at the motor side should be connected to:
      Pin 3 (for AMP connector of 9 pins type)
      Pin 6 (for AMP connector of 6 pins type)
      J -pin (for canon plug connector)
  5) If the cable is longer than 10 m, the encoder power line (+5V and 0V) should be dual per the figure shown left.
  6) Leave empty terminals of each connector and Canon plug unconnected.

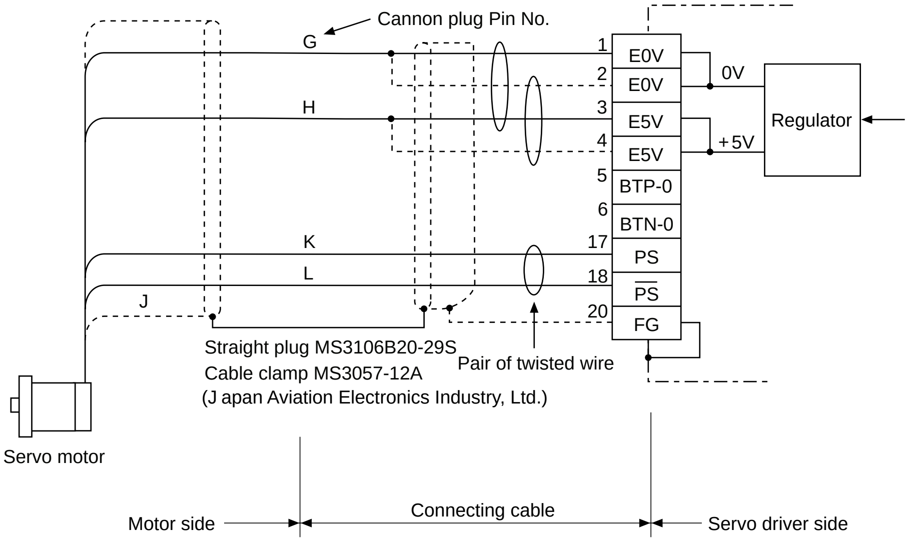
Wiring Diagrams

with a 2500P/r incremental type encoder ([P] *1)

• MSMA 750W or smaller, and MAMA



- MSMA 1kW or larger, MDMA, MFMA, MHMA, MGMA

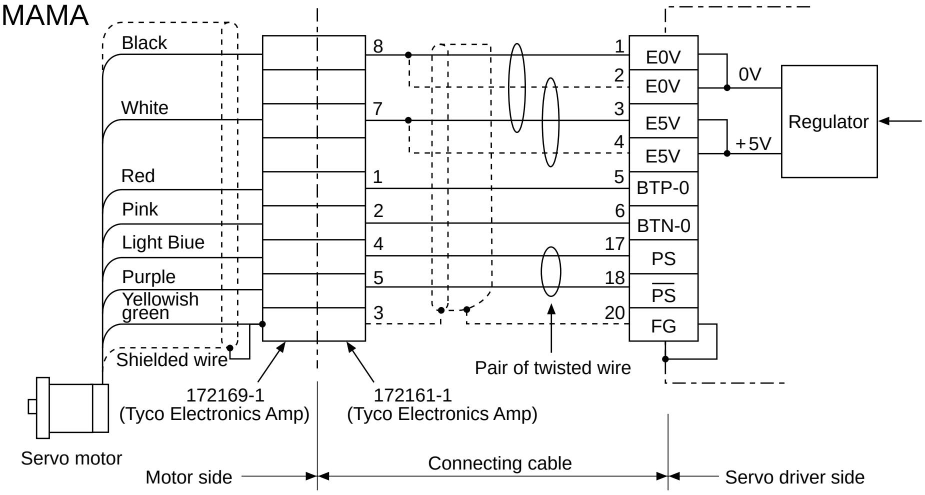


* 1 For encoder symbols, see Table 1-b in page 15. ⦵) shows a pair of twisted wires.

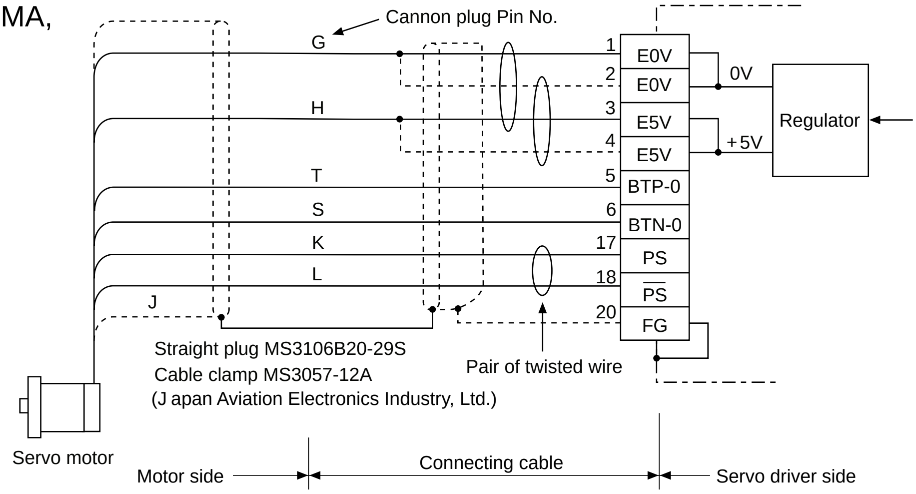
Wiring Diagrams

Driver with a 17 bits absolute/incremental encoder ([S] *2)

- MSMA 750W or smaller, MAMA



- MSMA 1kW or larger, MDMA, MFMA, MHMA, MGMA



*2 If you use an absolute/incremental encoder ([S]) as an incremental encoder, you don't need to connect the back-up battery.

⦵ shows a pair of twisted wires.

System Configuration and Wiring

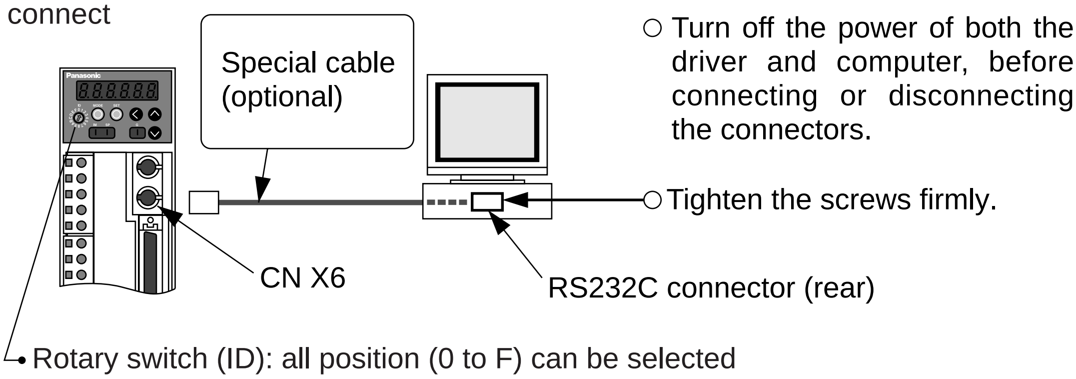
CN X6 and CN X7 Connector (For Personal Computer/Host Controller)

- These connectors can be used as either RS232C or RS485. There are three ways for using these connectors as shown below.

For RS232C communication only

Connect the personal computer and the driver 1:1 through RS-232C,The PANATERM® using for Set up support softwere. The PANATERM® using this function the monitor of the personal computer settings wave graphics.

How to connect

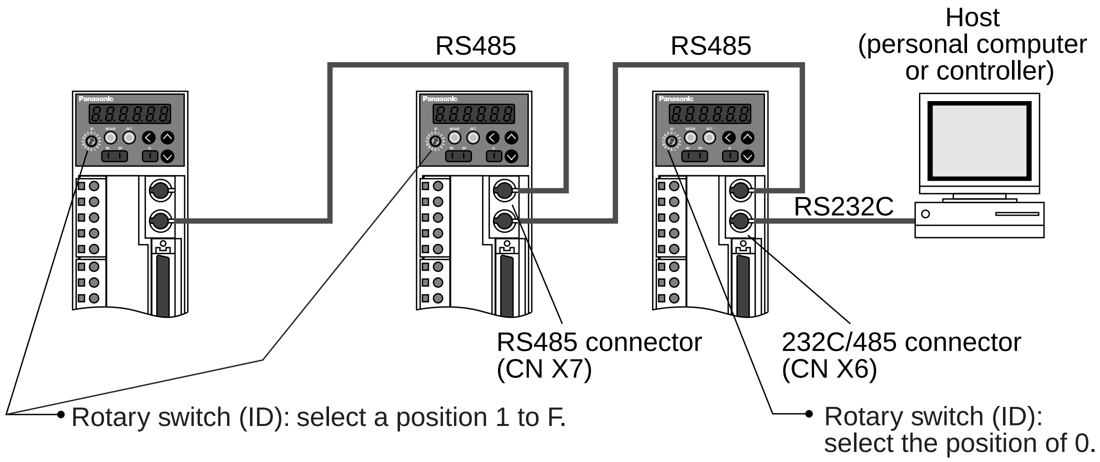


○ Turn off the power of both the driver and computer, before connecting or disconnecting the connectors.

○ Tighten the screws firmly.

For both RS232C and RS485 communication

Connect the personal computer/host controller and the driver with RS232. Then, use RS 485 to connect between drivers after the 1st axis.



For RS485 communication only

Connect all the driver and a host with RS485.

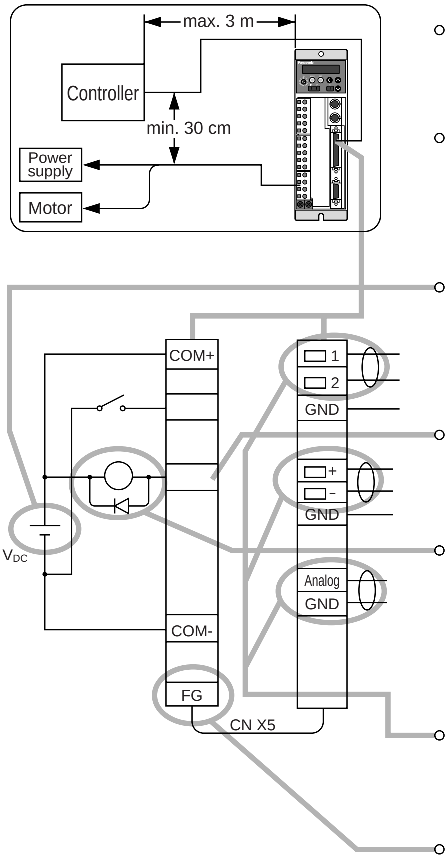
- Rotary switch (ID): select a position 1 to F.

< NOTE >

- Max. 15 driver can be connected to a host.
- For detailed information, see page 238 “ Communication” .

CN X5 Connector (For High order control equipment)

Wiring Instructions



- ○ Displace the peripheral devices such as the controller max. 3m away from the driver.
- ○ Separate these wiring min. 30 cm from the main circuit wires. Don't lay these wires in the same duct of the mains or bundle with them.
- ○ The control power (V_{DC}) between COM+ and COM- should be supplied by the customer (recommended voltage: +12VDC to +24VDC).
- ○ Control signal output terminals can accept max. 24V or 50mA: Don't apply larger voltage or current exceeding these limits.
- ○ If you directly activate a relay using the control signal, install a diode in parallel to the relay as shown in the left figure. Without a diode or with it but placed in the opposite direction, the driver will be damaged.
- ○ Use a shielded twist-paired type for the wiring of pulse input, encoder signal output or analog command input.
- ○ The Frame Ground (FG) is connected to an earth terminal in the driver.

- For details, refer to the following on connection in respective control modes:
  Position control mode on page 73
  Speed control mode on page 107
  Torque control mode on page 133
  Full-closed control mode on page 160

• CN X5 Connector Specifications

Receptacle on the driver side	Connector to controller side		Manufacturer
	Part description	Part No.	
529865071	Connector (with solder)	54306-5011	Molex J apan Co., Ltd.
	Connector cover	54331-0501	
	Connector (with solder)	10150-3000VE	Sumitomo 3M
	Connector cover	10350-52A0-008	

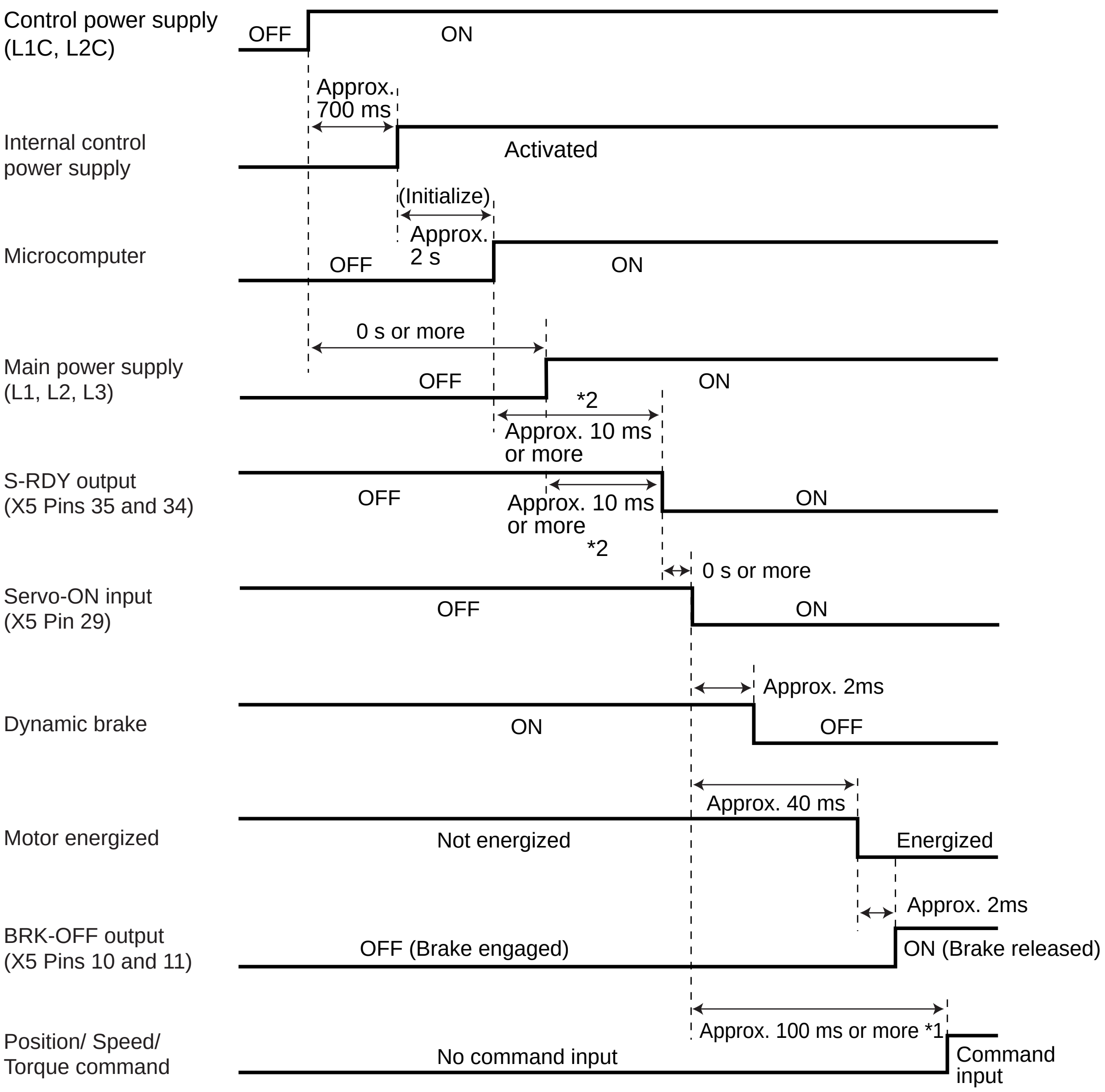
< NOTE >

- The CN X5 pins assignment is shown in page 278 "Optional Parts" in Appendix.

System Configuration and Wiring

Timing Chart

After Power ON (receiving Servo-ON signal)



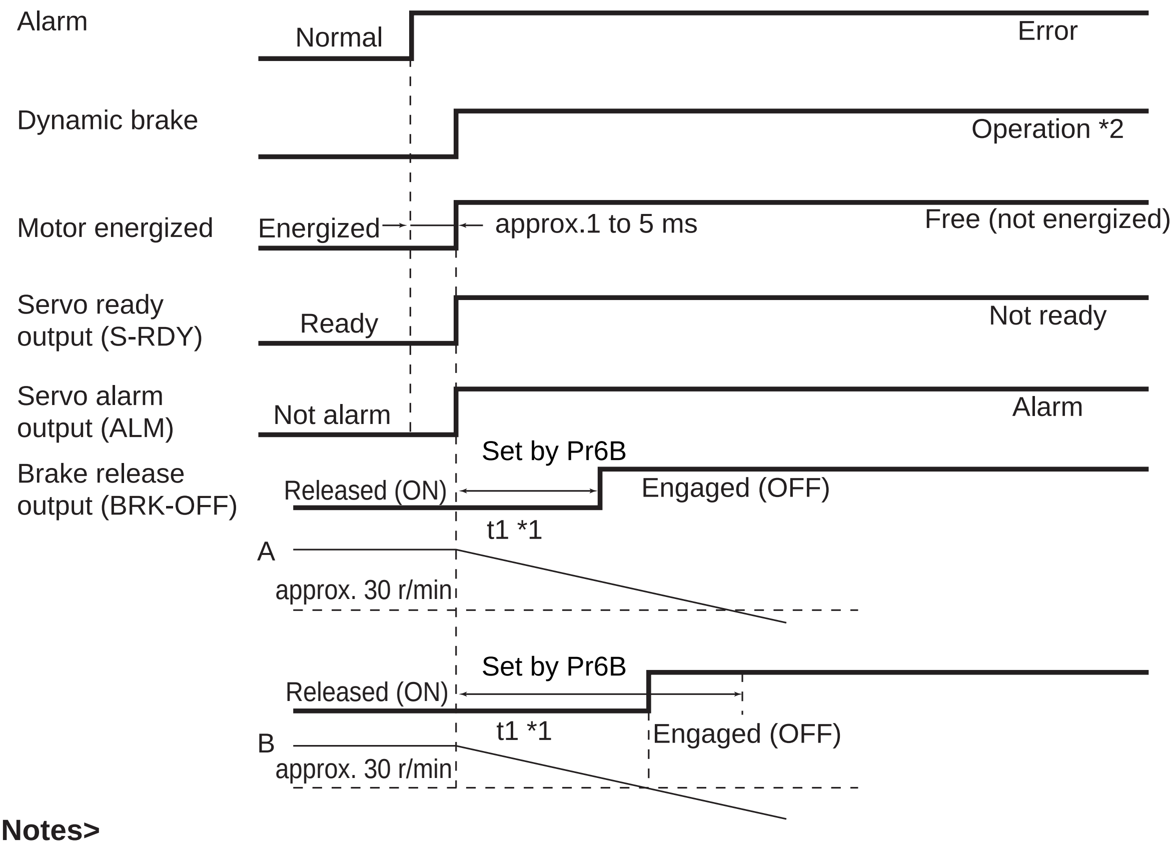
<Notes>

- The above chart shows the timing from AC power-ON to command input.
- Activate the Servo-ON signal and external command input according to the above timing chart.

*1. During this period, the SRV-ON signal is mechanically input, but not accepted actually.

*2. The S-RDY output turns ON when the microcomputer's initialization is completed, and the main power supply is activated.

After an Alarm event (during Servo-ON)

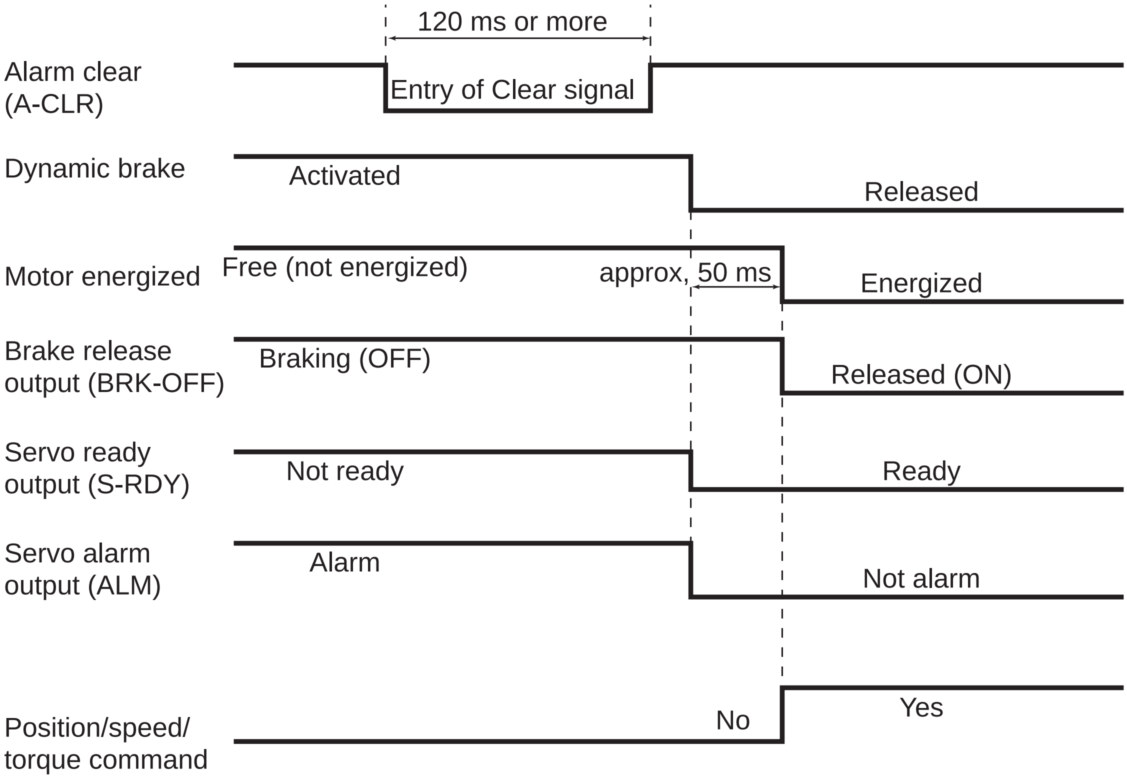


<Notes>

*1.The value of t1 is the value of Pr6B or the time needed for decreasing the motor speed to approx. 30 r/min, which is shorter.

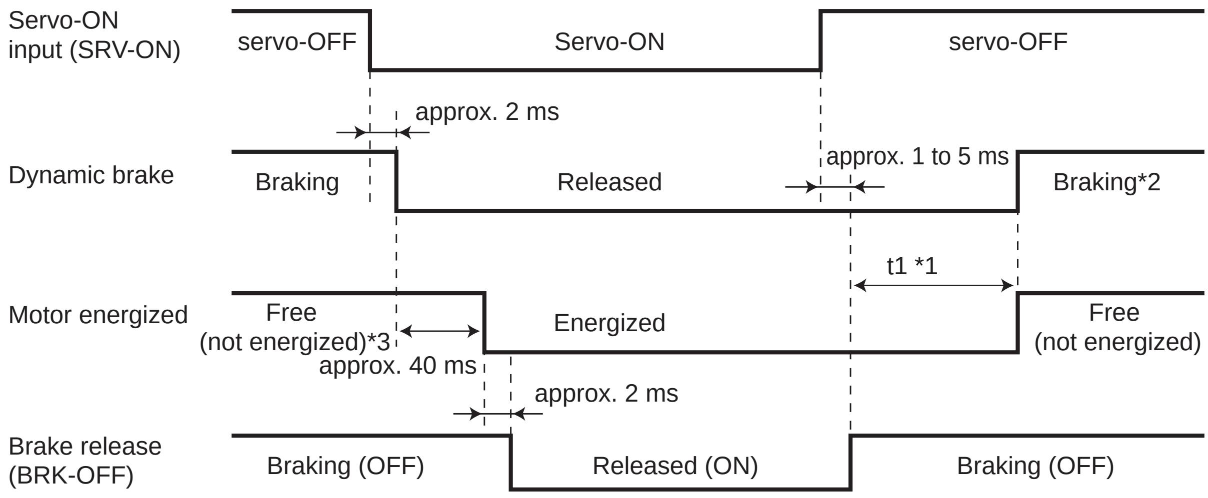
*2. For the operation of the dynamic brake following an alarm event, also see the description on Pr68 "Sequence upon alarm", "Parameter setting" (for individual control modes).

After an Alarm is cleared (during Servo-ON)



Servo-ON/OFF operation when the motor is stopped

(During normal operation, perform the Servo-ON/OFF operation after the motor stops.)



<Notes>

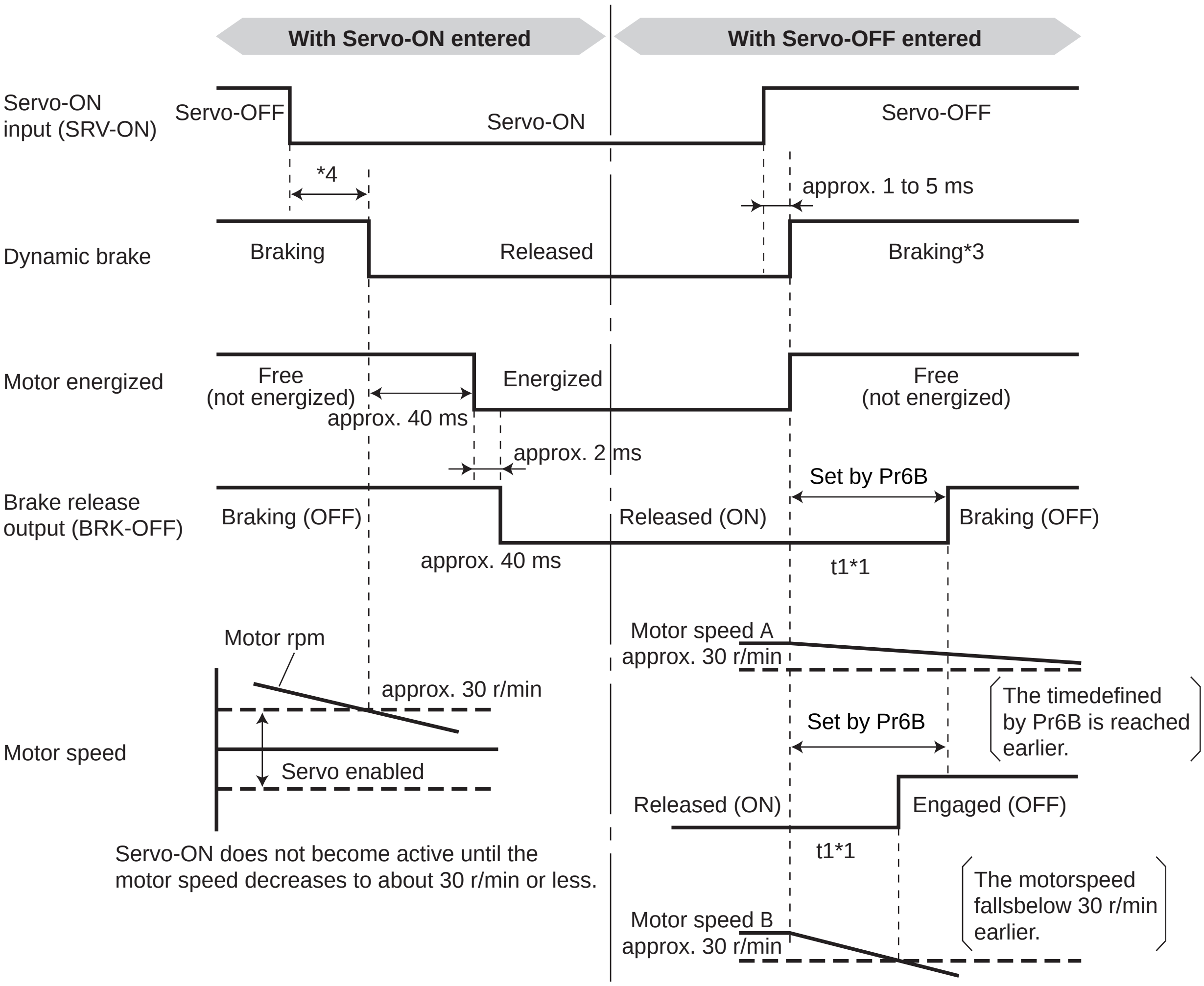
*1. "tl" depends on the setting of Pr6A.

*2. For the operation of the dynamic brake during servo-off status, also see the description on Pr69 "Sequence during servo-off", "Parameter settings" (for individual control modes).

*3. The Servo-ON input does not become active until the motor speed falls below approx. 30 r/min.

Servo-ON/OFF operation when the motor is in operation

(The following chart shows the timing in emergency stop or trip. The Servo-ON/OFF cannot be repeatedly used.)



<Notes>

*1. "t1" is the time defined by Pr6B or the time required to decrease the motor speed to approx. 30 r/min, whichever is earlier.

*2. Even if the SRV-ON signal turns ON again during motor deceleration, the SRV-ON input does not become active until the motor stops.

*3. For the operation of the dynamic brake during servo-off status, also see the description on Pr69 "Sequence during servo-off", "Parameter settings" (for individual control modes).

*4 The Servo-ON input does not become active until the motor speed falls below approx. 30 r/min.

Holding Brake

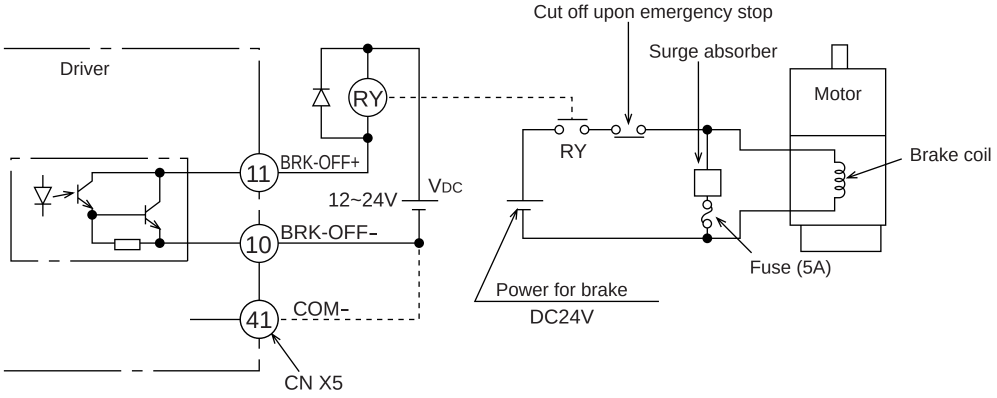
The brake is to hold the work (movable part coupled to a vertical motor axis) to prevent it from falling by gravity in case the servo power is lost.

<Caution>

The holding brake is to hold the work, not stop its motion. Never use the brake for decelerating and stopping the machine.

Wiring (Example)

This circuit shows a function of controlling the brake using the brake release signal (BRK-OFF) from the driver.



<Notes and Cautions>

1. The brake coil has no polarities.
2. The power supply for the brake should be supplied by the customer. Do not use the control power (V_{DC}) for driving the brake.
3. Install a surge absorber per the figure above in order to suppress the surge voltage due to the on/off operation of the relay (RY). If you use a diode for surge absorber, note that the start of the servo motor after releasing the brake is delayed.
4. Use the recommended surge absorber. See page 282 "Recommended Parts" in Appendix.
5. The recommended parts are those specified for measurement of brake release time. They may not ensure enough noise immunity.
   The reactance of the cable varies depending on the cable length, causing a sporadic voltage rise. Select a surge absorber so that the relay coil voltage (maximum rating: 30 V, 50 mA) and the voltage between the brake terminals do not exceed the rated value.

BRK-OFF Signal

- Refer to “ Timing Chart” on page 40 for timing to release the brake at power-on or timing to actuate the brake in case of servo-off/alarm while the motor is running.
- The timing (delay) of deactivating BRK-OFF signal (i.e. activating the brake) after the motor is freed into a non-excited status in case of Servo-OFF or alarm event can be adjusted by using Pr6B (brake output delay time set-up at motor in motion). For details, see "Parameter setting" (for individual control modes).

<Note>

1. The brake may produce a sound (rattling of brake liner). This is not a problem.
2. When energizing the brake coil (when the brake is off), magnetic flux may leak from the end of the axis. If a magnetic sensor or similar device is used near the motor, make sure that the device is not affected by the magnetic flux.

Holding Brake Specifications

Motor	Capacity	Static friction torque (N· m)	Inertia x 10^{-4} (kg· m^2)	Responding time (ms)	Releasing time (ms) * 1	Excitation current (DC current (A)) (during cooling)	Releasing voltage	Allowable thermal equivalent of work per braking (J)	Allowable overall thermal equivalent of work(x10^3 J)
MAMA	100W	0.29 or less	0.002	35 or less	10 or less	0.25	2VDC or more	39.2	4.9
	200W, 400W	1.27 or less	0.018	50 or less		0.30		137	44.1
	750W	2.45 or less	0.075	70 or less	20 or less	0.35		196	147
MSMA	30W – 100W	0.29 or more	0.003	25 or less	20 or less (30)	0.26	1VDC or more	39.2	4.9
	200W, 400W	1.27 or more	0.03	50 or less	15 or less (100)	0.36		137	44.1
	750W	2.45 or more	0.09	60 or less		0.43		196	147
MSMA	1kW	4.9 or more	0.25	50 or less		0.74	2VDC or more	392	196
	1.5kW – 2.5kW	7.8 or more	0.33			0.81			490
	3kW, 3.5kW	11.8 or more		80 or less					
	4kW – 5kW	16.1 or more	1.35	110 or less	50 or less (130)	0.90		1470	2156
MDMA	750W	7.8 or more	0.33	50 or less	15 or less (100)	0.81		392	490
	1kW	4.9 or more	1.35	80 or less	70 or less (200)	0.59		588	784
	1.5kW, 2kW	13.7 or more		100 or less	50 or less (130)	0.79		1176	1470
	2.5kW, 3kW	16.1 or more		110 or less		0.90		1470	2156
	3.5kW, 4kW	21.5 or more	4.25	90 or less	35 or less (150)	1.10		1078	2450
	4.5kW, 5kW	24.5 or more	4.7	80 or less	25 or less (200)	1.30		1372	2940
MHMA	500W, 1kW	4.9 or more	1.35		70 or less (200)	0.59		588	784
	1.5kW	13.7 or more		100 or less	50 or less (130)	0.79		1176	1470
	2kW – 5kW	24.5 or more	4.7	80 or less	25 or less (200)	1.30		1372	2940
MFMA	400W	4.9 or more	1.35		70 or less (200)	0.59		588	784
	750W, 1.5kW	7.8 or more	4.7		35 or less (150)	0.83		1372	2940
	2.5kW, 3.5kW	21.6 or more	8.75	150 or less	100 or less (450)	0.75		1470	1470
	4.5kW	31.4 or more							2156
MGMA	300W	4.9 or more	1.35	80 or less	70 or less (200)	0.59		588	784
	600W, 900W	13.7 or more		100 or less	50 or less (130)	0.79		1176	1470
	1.2kW, 2kW	24.5 or more	4.7	80 or less	25 or less (200)	1.3		1372	2940
	3kW, 4.5kW	58.8 or more		150 or less	50 or less (130)	1.4			

- Excitation voltage should be 24VDC ± 10%
  *1) Delay of DC cutoff in case a surge absorber is used.
  The values given in ( ) are the actual values measured with the diode (V03C manufactured by HITACHI Semiconductor and Devices Sales Co., Ltd.).
- The values in this table are representative (except the friction torque, releasing voltage and excitation voltage).
- The backlash of the brake is factory-set to within ±1 degree.
- Allowed angle acceleration : MAMA series is 30000 rad/s^2
  : MSMA, MDMA, MHMA, MFMA, MGMA series are 10000 rad/s^2
- The life of number of acceleration/deceleration according to allowed angular acceleration is not less than 10 million.

System Configuration and Wiring

Dynamic Brake (DB)

The driver has a dynamic brake for emergency use.
Observe the following precautions.

<Notes>
1. The dynamic brake should be used for emergency stop only.

Do not start or stop the motor by switching servo-on signal on or off. Otherwise, the dynamic brake circuit may be broken.

The motor, when driven by the external power, operates as a generator. Dynamic braking causes a short circuit current to flow which may lead to smoking and firing.

2. The dynamic brake should be on for just a short time for emergency. If the dynamic brake is activated during a high-speed operation, leave the motor stopped for at least three minutes.

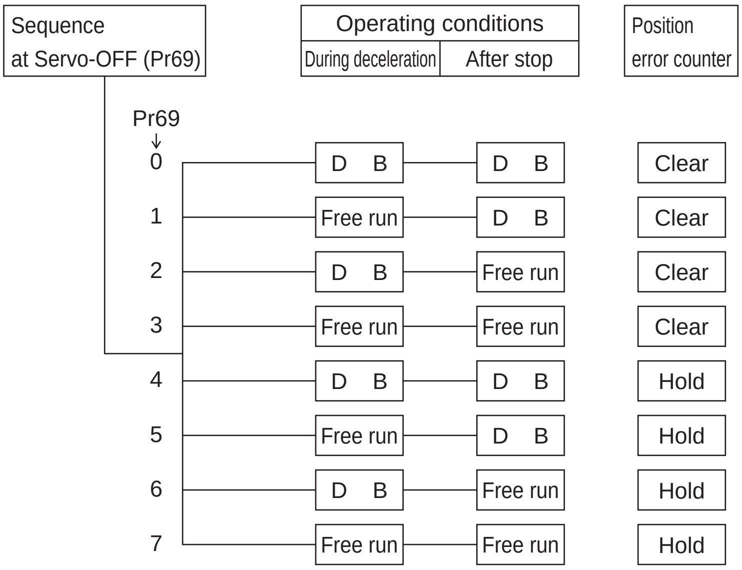
The dynamic brake can be used in the following cases.
1) Main power OFF.
2) Servo-OFF
3) One of the protective functions is activated.
4) Over-travel Inhibit (CWL or CCWL) is activated.

In any of four cases above, the dynamic brake can be activated either during deceleration or after stop, or can be made disabled (i.e. allowing the free running of the motor). These features can be set by using the relevant parameters. However, when control power is switched OFF, the dynamic brake is kept ON for types A to F, while type G will be free run.

1) Options of the operation through deceleration and stop by turning off the main power (Pr67)

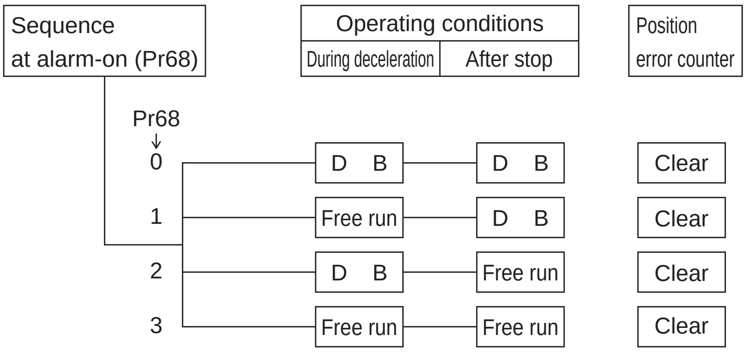
Sequence at main power-off (Pr67)	Operating conditions		Position error counter
	During deceleration	After stop	
Pr67 ↓ 0	D B	D B	Clear
1	Free run	D B	Clear
2	D B	Free run	Clear
3	Free run	Free run	Clear
4	D B	D B	Hold
5	Free run	D B	Hold
6	D B	Free run	Hold
7	Free run	Free run	Hold

2) Options of the operation through deceleration and stop by turning on Servo-OFF (Pr69)



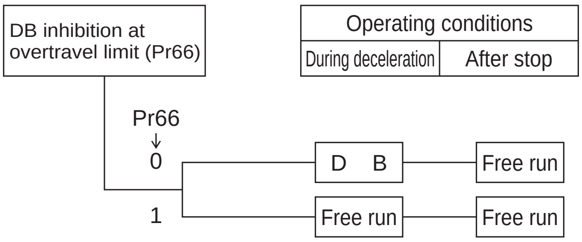
Sequence at Servo-OFF (Pr69) Pr69	Operating conditions During deceleration	Operating conditions After stop	Position error counter
0	D B	D B	Clear
1	Free run	D B	Clear
2	D B	Free run	Clear
3	Free run	Free run	Clear
4	D B	D B	Hold
5	Free run	D B	Hold
6	D B	Free run	Hold
7	Free run	Free run	Hold

3) Options of the operation through deceleration and stop by turning on a protective function (Pr68)



Sequence at alarm-on (Pr68) Pr68	Operating conditions During deceleration	Operating conditions After stop	Position error counter
0	D B	D B	Clear
1	Free run	D B	Clear
2	D B	Free run	Clear
3	Free run	Free run	Clear

4) Options of the operation through deceleration and stop by turning on Over-travel Inhibit (CWL or CCWL) (Pr66)



DB inhibition at overtravel limit (Pr66) Pr66	Operating conditions During deceleration	Operating conditions After stop
0	D B	Free run
1	Free run	Free run

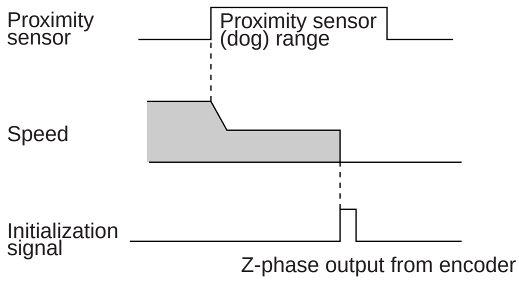
System Configuration and Wiring

Initializ ation (Precautions)

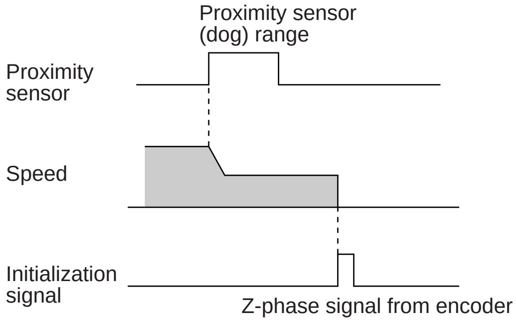
- In the operation of initialization (returning to the home position), if the initialization signal (Z-phase signal from the encoder) is entered before the motor is not substantially decelerated (after the proximity sensor is activated), the motor may not stop at the required position. To avoid this, determine the positions with the proximity sensor on and initialization signal on in consideration of the number of pulses required for successful deceleration. The parameters for setting the acceleration/deceleration time also affect the operation of initialization, so that these parameters should be determined in consideration of both the positioning and initializing operations.
  For details on the origin return operation, refer to the operation manual for the host controller.

Example of Origin Return Operation

Proximity dog ON .... The motor will start to decelerate with the proximity sensor ON, and stop with the first initialization signal (Z-phase).



Proximity dog OFF .... The motor will start to decelerate with the proximity sensor ON, and stop with the first initialization Z-phase signal after the proximity sensor OFF.



MEMO

Setting parameters and mode

Outline

This driver has various parameters that are used for adjusting or setting the features or functions of the driver.
This section describes the purpose and functions of these parameters. Understanding these parameters is essential for obtaining the best, application-specific operation of the driver.

You can view, set and adjust these parameters using either:
1) the front touch panel or
2) your personal computer with Set up support software PANATERM®.

Parameter Groups and Listing

Group	Parameter No. (Pr□□)	Brief explanation
Function selection	00 – 0F	To select control mode, allocate input/output signals, set baud rate, etc.
Adjustment	10 – 1F	To set servo gains (No.1 and No.2) such as position/speed/integration or time constants for various filters.
	20 – 2F	The parameters related to real-time auto gain tuning are used to select the mode, select machine stiffness, etc.
Position control	30 – 3F	To set parameters related to switching between the 1st and 2nd gains.
	40 – 4F	To set input format of command pulses, logic selection, dividing of encoder output pulse, multiply division ratio of command pulses.
Speed and torque control	50 – 5B	To set input gain, polarity inversion, and offset adjustment of speed command. To set internal speed (the 1st to 4th gear, JOG speed) acceleration/deceleration time, etc.
	5C – 5F	To set input gain, polarity inversion, offset adjustment, and torque limit of torque command.
Sequence	60 – 6F	To set not only output detection conditions of output signals such as completion of positioning, zero speed, etc., but also processing conditions when positional deviation is excessive. To set stop conditions when main power is off/when alarm is generated/when servo is turned off as well as conditions for clearing the deviation counter.
Full-close version	70 – 7F	The parameters related to “ full-closed” specifications

For details, see "Parameter setting" (for individual control modes).

<In this manual, the following symbols represent specific mode.>

Symbol	Control mode	Command form
P	Position control mode	Position
PS	Semi-closed control mode	
HP	Position control (for high stiffness)	
LP	Position control (for low stiffness)	
S	Speed control mode	Speed
LS	Speed control (for low stiffness)	

Symbol	Control mode	Command form
T	Torque control mode	Torque
PF	Full-closed control mode	Full closed loop
PH	Hybrid control mode	
PR	External encoder control mode	
UPF	2nd integrated full-closed control mode	

- You can select position control for high rigid and low rigid devices, speed control for low rigid devices, and the 2nd full-closed control can be made only when 17-bit encoder is used.
- For respective control modes, refer to connection and setting of each control mode, and a block diagram by adjustment and control mode.

Parameters for Selecting Function

Parameter No. (Pr□□)	Parameter description	Range	Default	Unit	Related control mode
* 0 0	Axis address	0 – 15	1	–	All
* 0 1	LED display at power up	0 – 15	1	–	All
* 0 2	Control mode	0 – 14	1	–	All
0 3	Analog torque limit input disabled	0 – 1	1	–	Other than T
0 4	Overtravel input inhibit	0 – 1	1	–	All
0 5	Internal / external speed switching	0 – 2	0	–	S, LS
* 0 6	ZEROSPD input selection	0 – 1	0	–	T, S, LS
0 7	Speed monitor (SP) selection	0 – 9	3	–	All
0 8	Torque monitor (IM) selection	0 – 12	0	–	All
0 9	TLC output selection	0 – 5	0	–	All
0 A	ZSP output selection	0 – 5	1	–	All
* 0 B	Absolute encoder set up	0 – 2	1	–	All
* 0 C	Baud rate of RS232C	0 – 2	2	–	All
* 0 D	Baud rate of RS485	0 – 2	2	–	All
0 E	(For manufacturer use)	–	–	–	
0 F	(For manufacturer use)	–	–	–	

- With the parameter number marked with * in the table, the set value becomes valid when the control power supply is turned OFF and then turned ON again after the set value is written into the EEPROM.

Parameters for Adjusting Time Constants of Gain Filters, etc.

Parameter No. (Pr□□)	Parameter description	Range	Default	Unit	Related control mode
1 0	1st position loop gain	0 – 32767	<63>	1/s	P, PS, PF, PH, UPF, HP, LP
1 1	1st velocity loop gain	1 – 3500	<35>	Hz	Other than PR
1 2	1st velocity loop integration time constant	1 – 1000	<16>	ms	Other than PR
1 3	1st speed detection filter	0 – 6	<0>	–	Other than PR
1 4	1st torque filter time constant	0 – 2500	<65>	0.01ms	Other than PR
1 5	Velocity feed forward	–2000 – 2000	<300>	0.1%	P, PS, PF, PH, PR, UPF, HP, LP
1 6	Feed forward filter time constant	0 – 6400	<50>	0.01ms	P, PS, PF, PH, PR, UPF, HP, LP
1 7	1st position integration gain	0 – 10000	<0>	$x10/s^2$	HP
1 8	2nd position loop gain	0 – 32767	<73>	1/s	P, PS, PF, PH, UPF, HP, LP, PR
1 9	2nd velocity loop gain	1 – 3500	<35>	Hz	All
1 A	2nd velocity loop integration time constant	1 – 1000	<1000>	ms	All
1 B	2nd speed detection filter	0 – 6	<0>	–	All
1 C	2nd torque filter time constant	0 – 2500	<65>	0.01ms	All
1 D	1st notch frequency	100 – 1500	1500	Hz	All
1 E	1st notch width selection	0 – 4	2	–	All
1 F	2nd position integration gain	0 – 10000	<0>	$x10/s^2$	HP
2 6	Disturbance torque compensation gain	0 – 200	0	%	HP, LP, LS, UPF
2 7	Disturbance torque observer filter selection	0 – 255	<0>	–	P, S, T, PS, HP, LP, LS, UPF
2 8	2nd notch frequency	100 – 1500	1500	Hz	All
2 9	2nd notch width selection	0 – 4	2	–	All
2 A	2nd notch depth selection	0 – 99	0	–	All
2 B	Vibration suppression frequency	0 – 500	0	Hz	P, PS, LP
2 C	Vibration suppression filter	–20 – 250	0	Hz	P, PS, LP

<Notes>

- Default setting of parameter in < > will be changed automatically as the real time auto gain tuning operates. To manually adjust the parameter, see page 196 "Disabling of auto tuning function".

Parameters for Defining the Real Time Auto Gain Tuning

Parameter No. (Pr□□)	Parameter description	Range	Default	Unit	Related control mode
2 0	Inertia ratio	0 – 10000	<100>	%	All
2 1	Real time auto tuning set up	0 – 7	1	–	P, S, T, PS
2 2	Machine stiffness at auto tuning	0 – 15	4	–	P, S, T, PS
2 3	Fit gain function set up	0 – 2	2	–	P,PS
2 4	Result of fit gain function	–32768 – 32767	0	–	P, PS
2 5	Normal auto tuning motion set up	0 – 7	0	–	P, S, T, PS
2 D	(For manufacturer use)	–	–	–	–
2 E	(For manufacturer use)	–	–	–	–
2 F	Adaptive filter frequency	0 – 64	<0>	–	P, S, T, PS

Parameters for Adjustments (for 2nd Gain)

Parameter No. (Pr□□)	Parameter description	Range	Default	Unit	Related control mode
3 0	2nd gain action set up	0 – 1	<1>	–	All
3 1	Position control switching mode	0 – 10	<10>	–	P, PS, PF, PH, PR, UPF, HP, LP
3 2	Position control switching delay time	0 – 10000	<30>	166µs	P, PS, PF, PH, PR, UPF, HP, LP
3 3	Position control switching level	0 – 20000	<50>	–	P, PS, PF, PH, PR, UPF, HP, LP
3 4	Position control switching hysteresis	0 – 20000	<33>	–	P, PS, PF, PH, PR, UPF, HP, LP
3 5	Position gain switching time	0 – 10000	<20>	1 + Set value x 166µs	P, PS, PF, PH, PR, UPF, HP, LP
3 6	Speed control switching mode	0 – 5	<0>	–	S, LS
3 7	Speed control switching delay time	0 – 10000	0	166µs	S, LS
3 8	Speed control switching level	0 – 20000	0	–	S, LS
3 9	Speed control switching hysteresis	0 – 20000	0	–	S, LS
3 A	Torque control switching mode	0 – 3	<0>	–	T
3 B	Torque control switching delay time	0 – 10000	0	166µs	T
3 C	Torque control switching level	0 – 20000	0	–	T
3 D	Torque control switching hysteresis	0 – 20000	0	–	T
3E–3F	(For manufacturer use)	–	–	–	–

<Notes>

- Default setting of parameter in < > will be changed automatically as the real time auto gain tuning operates. To manually adjust the parameter, see page 196 "Disabling of auto tuning function".

- **In this manual, the following symbols represent specific mode.**

P : Position control mode, S : Speed control mode, T : Torque control mode,
PS : Semi-closed control mode, PF : Full-closed control mode, PH : Hybrid control mode, PR : External encoder control mode,
HP : Position control (for high stiffness), LP : Position control (for low stiffness), LS : Speed control (for low stiffness),
UPF : 2nd integrated full-closed control mode

Parameters for Position Control

Parameter No. (Pr□□)	Parameter description	Range	Default	Unit	Related control mode
* 4 0	Command pulse multiplier set up	1 – 4	4	–	P, PS, PF, PH, PR, UPF ,HP, LP
* 4 1	Command pulse logic inversion	0 – 3	0	–	P, PS, PF, PH, PR, UPF ,HP, LP
* 4 2	Command pulse input mode	0 – 3	1	–	P, PS, PF, PH, PR, UPF ,HP, LP
4 3	Command pulse inhibit input invalidation	0 – 1	1	–	P,PS,HP,LP,UPF
* 4 4	Output pulses per single turn	1 – 16384	2500	P/r	All
* 4 5	Pulse output logic inversion	0 – 1	0	–	All
4 6	1st numerator of command pulse ratio	1 – 10000	10000	–	P, PS, PF, PH, PR, UPF ,HP, LP
4 7	2nd numerator of command pulse ratio	1 – 10000	10000	–	P, PS, PF, PH, PR
4 8	3rd numerator of command pulse ratio	1 – 10000	10000	–	PS, PF, PH, PR
4 9	4th numerator of command pulse ratio	1 – 10000	10000	–	PS, PF, PH, PR
4 A	Multiplier of numerator of command pulse ratio	0 – 17	0	2^n	P, PS, PF, PH, PR, UPF, HP, LP
4 B	Denominator of command pulse ratio	1 – 10000	10000	–	P, PS, PF, PH, PR, UPF, HP, LP
4 C	Smoothing filter	0 – 7	1	–	P, PS, PF, PH, PR, UPF, LP
4 D	Counter clear input	0 – 1	0	–	P, PS, PF, PH, PR, UPF, HP, LP
* 4 E	FIR filter 1 set up	0 – 31	0	Set value + 1	HP, LP
* 4 F	FIR filter 2 set up	0 – 31	0	Set value + 1	HP

- With the parameter number marked with * in the table, the set value becomes valid when the control power supply is turned OFF and then turned ON again after the set value is written into the EEPROM.

Parameters for Velocity and Torque Control

Parameter No. (Pr□□)	Parameter description	Range	Default	Unit	Related control mode
5 0	Velocity command input gain	10 – 2000	500	(r/min) /V	S, LS
5 1	Velocity command input logic inversion	0 – 1	1	–	S, LS
5 2	Velocity command offset	–2047 – 2047	0	0.3mV	S, T, LS
5 3	1st internal speed	–20000 – 20000	0	r/min	S, LS
5 4	2nd internal speed	–20000 – 20000	0	r/min	S, LS
5 5	3rd internal speed	–20000 – 20000	0	r/min	S, LS
5 6	4th internal speed	–20000 – 20000	0	r/min	S, T, LS
5 7	J OG speed set up	0 – 500	300	r/min	All
5 8	Acceleration time	0 – 5000	0	2ms/(1000r/min)	S, LS
5 9	Deceleration time	0 – 5000	0	2ms/(1000r/min)	S, LS
5 A	S-shaped acceleration/deceleration time	0 – 500	0	2ms	S, LS
* 5 B	Speed command FIR filter set up	0 – 31	0	Set value + 1	LS
5 C	Torque command input gain	10 – 100	30	0.1V/100%	T
5 D	Torque command input inversion	0 – 1	0	–	T
5 E*1	Torque limit	0 – 500	500 *1	%	All
5 F	(For manufacturer use)	–	–	–	–

*1 Normal default setting of Pr5E is based on the combination of driver and motor. Refer to page 55 "Pr5E Torque limit setting" shown below.

Setting parameters and mode

Parameters for Sequence

Parameter No. (Pr□□)	Parameter description	Range	Default	Unit	Related control mode
6 0	In-position range	0 – 32767	131	Pulse	P, PS, PF, PH, PR, UPF, HP, LP
6 1	Zero speed	0 – 20000	50	r/min	All
6 2	At-speed	0 – 20000	1000	r/min	S, T, LS
6 3	Position deviation error level	1 – 32767	25000	256Pulse	P, PS, PF, PH, PR, UPF, HP, LP
6 4	Position error invalidation	0 – 1	0	–	P, PS, PF, PH, PR, UPF, HP, LP
6 5	Undervoltage error response at main power-off	0 – 1	1	–	All
6 6	Dynamic breke inhibition at overtravel limit	0 – 1	0	–	P, S, T, HP, LP, LS, UPF
6 7	Error response at main power-off	0 – 7	0	–	All
6 8	Error response action	0 – 3	0	–	All
6 9	Sequence at Servo-OFF	0 – 7	0	–	All
6 A	Mechanical brake delay at motor standstill	0 – 100	0	2ms	All
6 B	Mechanical brake delay at motor in motion	0 – 100	0	2ms	All
* 6 C	External regenerative resister set up	0 – 3	0	–	All
* 6 D	Main power-off detection time	0 – 32767	35	2ms	All
6E–6F	(For manufacturer use)	–	–	–	–

- With the parameter number marked with * in the table, the set value becomes valid when the control power supply is turned OFF and then turned ON again after the set value is written into the EEPROM.

Parameters for " Full-Closed" driver

Parameter No. (Pr□□)	Parameter description	Range	Default	Unit	Related control mode
7 0	Hybrid switching speed	1 – 20000	10	r/min	PH
7 1	Hybrid shifting delay time	0 – 10000	0	2ms	PH
7 2	Hybrid control period	1 – 10000	10	2ms	PH
7 3	Hybrid error limit excess	1 – 10000	100	Resolution of external scale	PF, PH, PR, UPF
7 4	Numerator of external ratio	1 – 10000	1	–	PF, PH, PR, UPF
7 5	Multiplier of numerator of external scale ratio	0 – 17	17	2^n	PF, PH, PR, UPF
7 6	Denominator of external scale ratio	1 – 10000	10000	–	PF, PH, PR, UPF
* 7 7	Scale error cancel	0 – 3	1	–	PF, PH, PR, UPF
* 7 8	Pulse output selection	0 – 1	0	–	PF, PH, PR, UPF
* 7 9	Numerator of external scale pulse output ratio	1 – 10000	10000	–	PF, PH, PR, UPF
* 7 A	Denominator of external scale pulse output ratio	1 – 10000	10000	–	PF, PH, PR, UPF
7 B	Torsion correction gain	–2000 – 2000	<0>	1/s	UPF
7 C	Torsion/ Differential speed detection filter	0 – 255	<0>	3.7Hz	UPF
7 D	Torsion feedback gain	–2047 – 2047	<0>	–	UPF
7 E	Differential speed feedback gain	–2047 – 2047	<0>	–	UPF
7 F	(For manufacturer use)	–	–	–	–

- With the parameter number marked with * in the table, the set value becomes valid when the control power supply is turned OFF and then turned ON again after the set value is written into the EEPROM.

<Notes>

- Default setting of parameter in < > will be changed automatically as the real time auto gain tuning operates. To manually adjust the parameter, see page 196 "Disabling of auto tuning function".

- **In this manual, the following symbols represent specific mode.**

P : Position control mode, S : Speed control mode, T : Torque control mode,
PS : Semi-closed control mode, PF : Full-closed control mode, PH : Hybrid control mode, PR : External encoder control mode,
HP : Position control (for high stiffness), LP : Position control (for low stiffness), LS : Speed control (for low stiffness),
UPF : 2nd integrated full-closed control mode

Pr5E Torque limit setting

For driver-motor combinations other than those listed blew, the standard default setting of Pr5E is 300.

Type	Model	Compatible motor	Pr5E Range	Pr5E Max.
A	MADCT1505	MAMA012***	00 – 500	500
B	MBDCT1505	MAMA012***	00 – 500	500
	MBDCT2507	MAMA022***	00 – 500	500
C	MCDCT3307	MGMA032***	00 – 260	260
	MCDCT3512	MAMA042***	00 – 500	500
D	MDDCT5507	MGMA032***	00 – 260	260
	MDDCT5512	MHMA052***	00 – 255	255
		MGMA062***	00 – 260	260
D	MDDCT5316	MGMA092***	00 – 225	225
	MDDCT5516	MAMA082***	00 – 500	500
E	MEDCT5312	MGMA062***	00 – 260	260
	MEDCT5316	MGMA092***	00 – 225	225
F	MFDCT7325	MGMA122***	00 – 245	245
G	MGDCTA350	MGMA202***	00 – 230	230
	MGDCTB375	MGMA302***	00 – 235	235
		MGMA452***	00 – 255	255

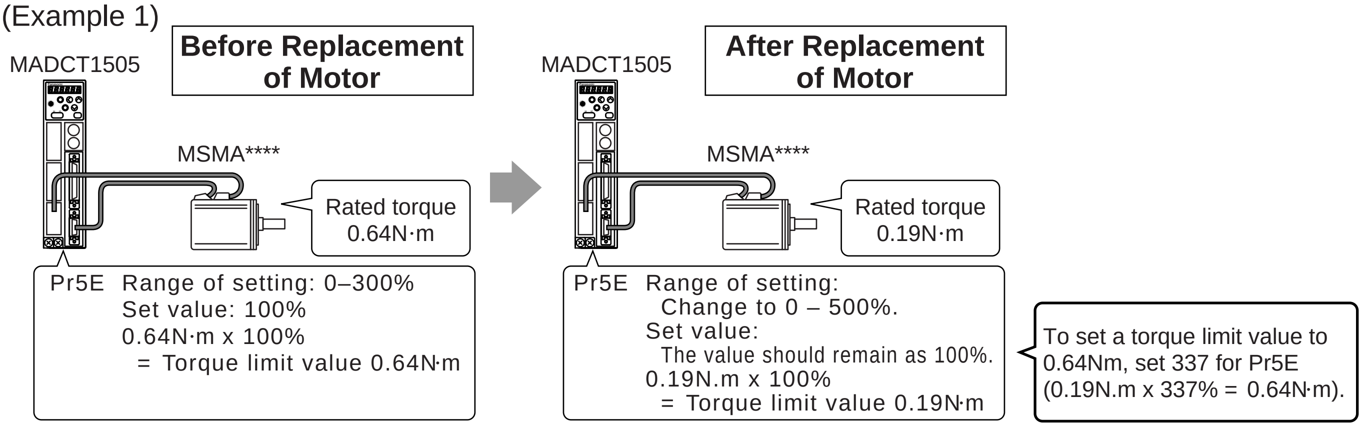
Precautions When You Replace Motor

When you connect a motor to an driver, an upper limit in the range of Pr5E torque limits will be automatically determined. Thus, reconfirm setting because, depending on a type of motor, setting of Pr5E may vary when you replace a motor.

1. When you replace a motor with one having a same model name:
   After replacement, a value programmed in the driver prior to replacement will be a new set value of Pr5E. A user does not need to make a change.

2. When you impose limit on torque of the motor:
   Setting of Pr5E torque limit is % value to rated torque. If you change your motor to a motor of different series or having different W number, reset Pr5E because a new motor will have a different rated torque value (Refer to Example 1).

(Example 1)



Before Replacement of Motor

Rated torque 0.64N·m

Pr5E Range of setting: 0–300%
Set value: 100%
0.64N·m x 100%
= Torque limit value 0.64N·m

After Replacement of Motor

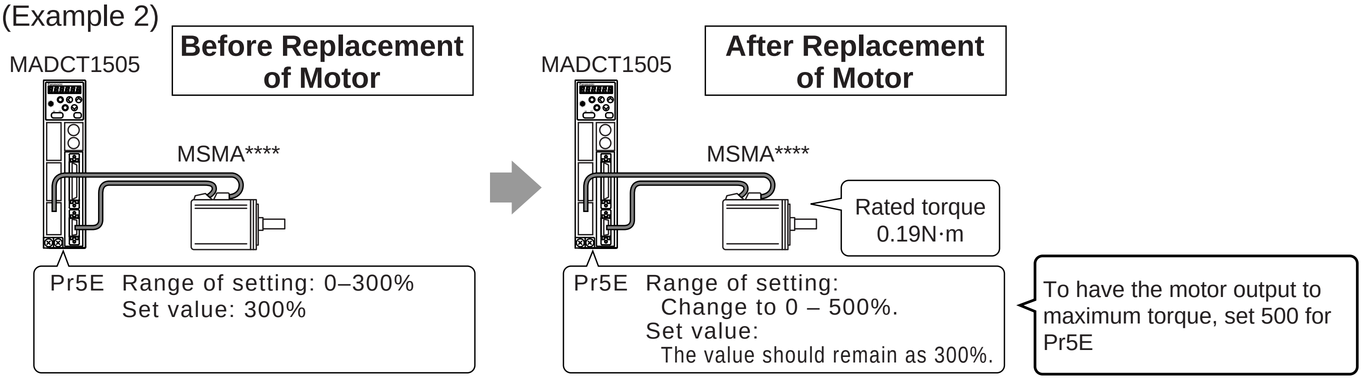
Rated torque 0.19N·m

Pr5E Range of setting:
Change to 0 – 500%.
Set value:
The value should remain as 100%.
0.19N.m x 100%
= Torque limit value 0.19N·m

To set a torque limit value to 0.64Nm, set 337 for Pr5E (0.19N.m x 337% = 0.64N·m).

3. When you have motor output to maximum torque:
   Reset Pr5E to an upper limit because before or after replacement, an upper limit in set range of Pr5E torque limit may vary (Refer to Example 2).

(Example 2)



Before Replacement of Motor

Pr5E Range of setting: 0–300%
Set value: 300%

After Replacement of Motor

Rated torque 0.19N·m

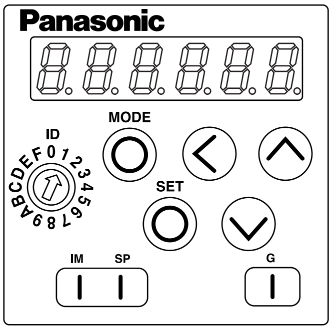
Pr5E Range of setting:
Change to 0 – 500%.
Set value:
The value should remain as 300%.

To have the motor output to maximum torque, set 500 for Pr5E

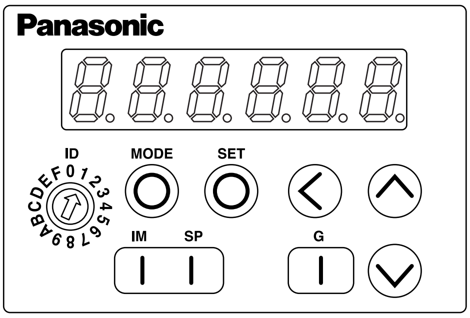
Setting parameters and mode

Front Panel Key Operations and Display

Configuration of the operation and display panel



Type A



Type B ~ G

Functions of the Key Switches

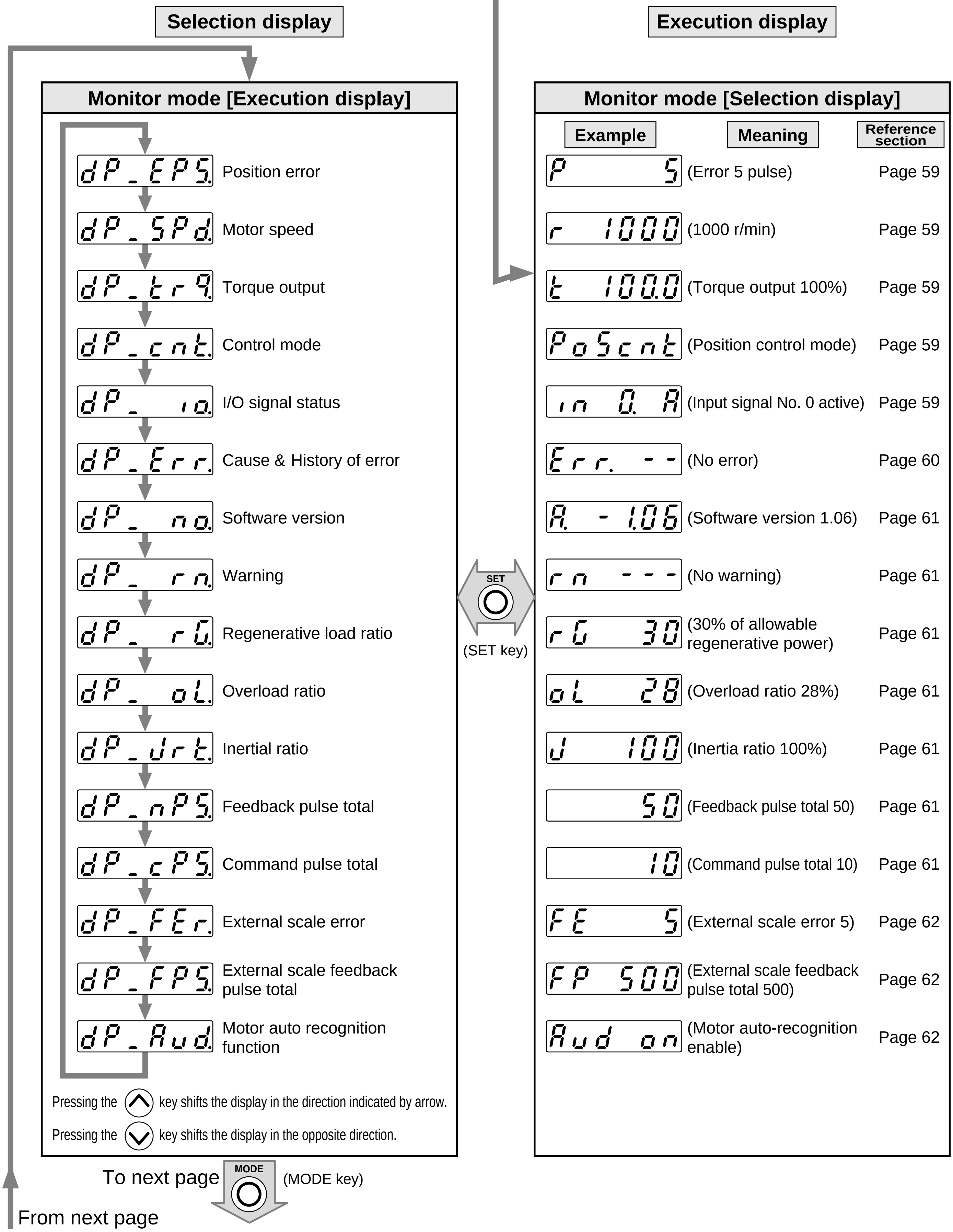
Switch	Active condition	Function
MODE ○ (MODE key)	Active on the selection display	Used to shift between the following five modes: 1) Monitor mode 2) Parameter setup mode 3) EEPROM write mode 4) Auto tuning mode 5) Auxiliary function mode
SET ○ (SET key)	Always active	**<NOTE>** Used to switch between the selection display and execution display.
∧ ∨	Active for the digit with a blinking decimal point	Used to change the display in each mode, change data, select parameters and execute operations.
<		Used to move the changeable digit to the higher-order digit.

<Notes>

The above five modes provide "selection display" and "execution display" individually.
For details on these displays, see to page 57 "operating procedure.

Operating procedure

When you turn on the power of this servo driver for the first time, r 0 is displayed (when the motor is stopped). If you wish to change display at power on, change setting of Pr01 LED initial state (For details, refer to parameter settings for each control mode).



Monitor mode [Execution display]		Monitor mode [Selection display] Example	Meaning	Reference section
dP_EPS.	Position error	P 5	(Error 5 pulse)	Page 59
dP_SPd.	Motor speed	r 1000	(1000 r/min)	Page 59
dP_trq.	Torque output	t 100.0	(Torque output 100%)	Page 59
dP_cnt.	Control mode	PoScnt	(Position control mode)	Page 59
dP_io.	I/O signal status	in 0. A	(Input signal No. 0 active)	Page 59
dP_Err.	Cause & History of error	Err. --	(No error)	Page 60
dP_no.	Software version	A. -1.06	(Software version 1.06)	Page 61
dP_rn.	Warning	rn ---	(No warning)	Page 61
dP_rG.	Regenerative load ratio	rG 30	(30% of allowable regenerative power)	Page 61
dP_oL.	Overload ratio	oL 28	(Overload ratio 28%)	Page 61
dP_Jrt.	Inertial ratio	J 100	(Inertia ratio 100%)	Page 61
dP_nPS.	Feedback pulse total	50	(Feedback pulse total 50)	Page 61
dP_cPS.	Command pulse total	10	(Command pulse total 10)	Page 61
dP_FEr.	External scale error	FE 5	(External scale error 5)	Page 62
dP_FPS.	External scale feedback pulse total	FP 500	(External scale feedback pulse total 500)	Page 62
dP_Aud.	Motor auto recognition function	Aud on	(Motor auto-recognition enable)	Page 62

Pressing the ∧ key shifts the display in the direction indicated by arrow.

Pressing the ∨ key shifts the display in the opposite direction.

Setting parameters and mode

To previous page

From previous page

Parameter setup mode [Selection display]

PA_ 00 Pr00

PA_ 7F Pr7F

Pressing the ⌃ key shifts the display in the direction indicated by arrow.

Pressing the ⌄ key shifts the display in the opposite direction.

NOTE A change of the parameter with the " r "mark displayed before the parameter No. becomes valid after the power supply is reset.

SET (SET key)

Parameter setup mode [Execution display]

Example	**Meaning**	**Reference section**
1000.	(Parameter value: 1000)	Page 63

Set up the parameter by using the ⌃ ⌄, or < key. The digit with a blinking decimal point can be set up or changed.

MODE (MODE key)

EEPROM write mode [Selection display]

EE_SEt

To write a parameter into the EEPROM, press the SET key to go to the execution display.

SET (SET key)

EEPROM write mode [Execution display]

Example	**Meaning**	**Reference section**
EEP	Writing parameter into EEPROM	Page 63
	Keep pressing the ⌃ key.	
StArt	Writing starts.	
FiniSh.	Writing is completed.	

MODE (MODE key)

Auto gain tuning mode [Selection display]

At_no0.	Mechanical stiffness No. 0 (low)
	:
At_noE.	Mechanical stiffness No. 14
At_noF.	Mechanical stiffness No. 15 (high)
At_F1t.	Fit gain window

Pressing the ⌃ key shifts the display in the direction indicated by arrow.

Pressing the ⌄ key shifts the display in the opposite direction.

After difining the mechanical stiffness, press the SET key to go to the execution display.

NOTE For " mechanical stiffness ", see page 139.

SET (SET key)

Normal Mode Auto Gain Tuning Mode [Execution Display]

Example	**Meaning**	**Reference section**
Atu	(Auto gain tuning)	Page 64
	Keep pressing the ⌃ key.	
StArt	Tuning starts.	
FiniSh.	Tuning is completed.	

Real-time Auto Gain Tuning [Execution Display]

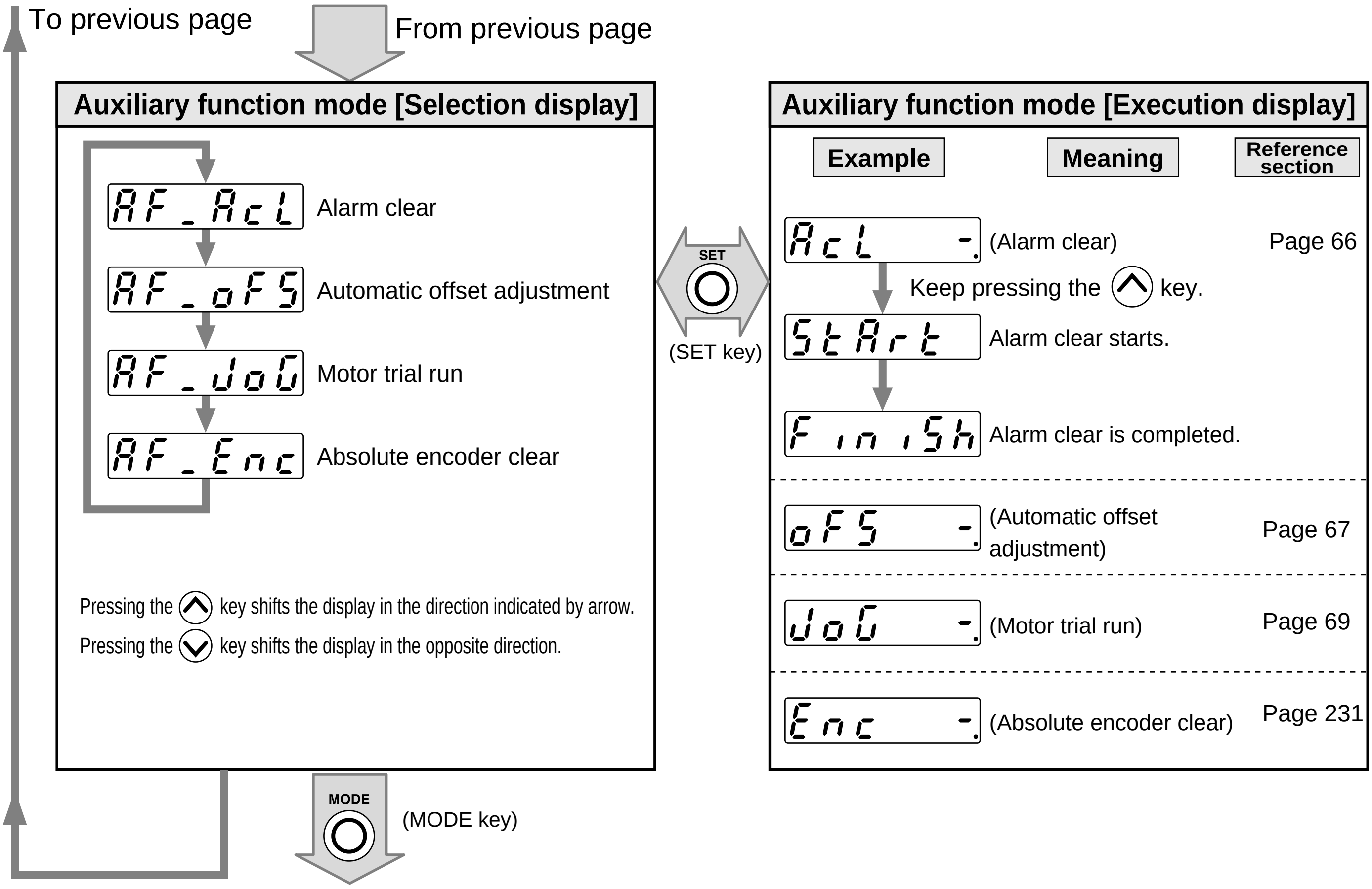
Example	**Meaning**	**Reference section**
F-1-14.	(Adaptive filter enabled)	Page 65

Real time auto tuning stiffness 4

To next page

MODE (MODE key)

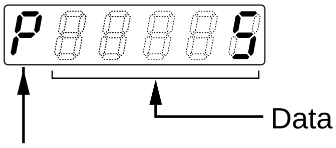
From next page


To previous page
From previous page
Auxiliary function mode [Selection display]
AF_AcL
Alarm clear
AF_oFS
Automatic offset adjustment
AF_JoG
Motor trial run
AF_Enc
Absolute encoder clear
Pressing the key shifts the display in the direction indicated by arrow.
Pressing the key shifts the display in the opposite direction.
SET
(SET key)
MODE
(MODE key)
Auxiliary function mode [Execution display]
Example
Meaning
Reference section
AcL -
(Alarm clear)
Page 66
Keep pressing the key.
StArt
Alarm clear starts.
FiniSh
Alarm clear is completed.
oFS -
(Automatic offset adjustment)
Page 67
JoG -
(Motor trial run)
Page 69
Enc -
(Absolute encoder clear)
Page 231

Setting parameters and mode

Details of the execution display in the monitor mode

Position error, motor speed and torque output display



P .... Position error (Pulse count accumulated in the error counter)
- Polarity (+): CCW torque (viewed from the axis end)
  (–): CW torque (viewed from the axis end)

r .... Motor speed (Unit: r/min)
- Polarity (+): CCW, (–): CW

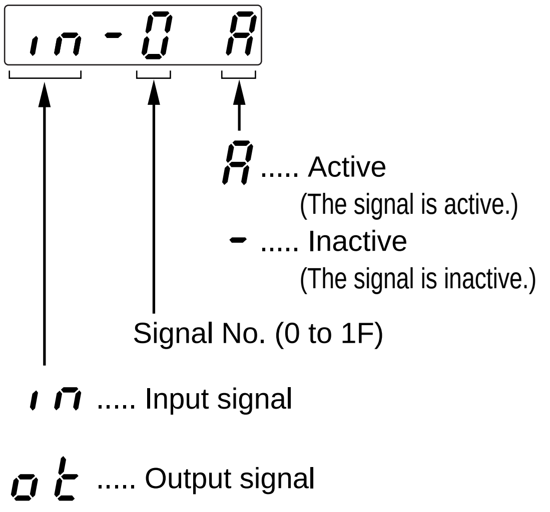
t .... Torque output
- Polarity (+): CCW, (–): CW

<Note>
LED does not display “ +” . It only displays “ –” .

Control mode display

PoScnt	..... Position control mode	EEncnt	..... External encoder control mode
SPdcnt	..... Speed control mode	HiPoSc	..... Position control (for high stiffness)
trqcnt	..... Torque control mode	LoPoSc	..... Position control (for low stiffness)
Sclcnt	..... Semi-closed control mode	LoSPdc	..... Speed control (for low stiffness)
hybcnt	..... Hybrid control mode	unFclc	..... Integrated full-closed control mode
Fclcnt	..... Full-closed control mode		

I/O signal status display



A ..... Active
(The signal is active.)
- ..... Inactive
(The signal is inactive.)

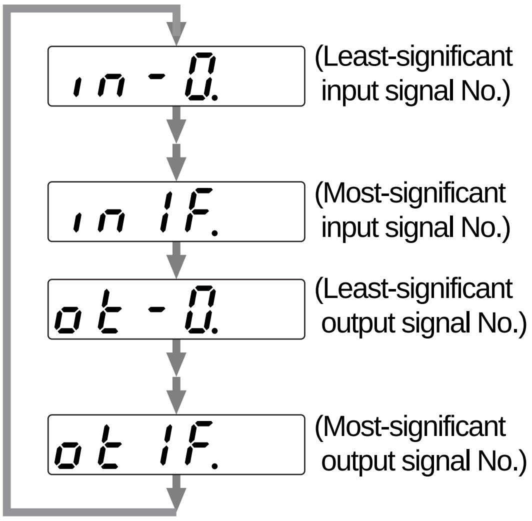
Signal No. (0 to 1F)

in ..... Input signal

ot ..... Output signal

- Press the ⌃ or ⌄ key to select the signal No. to be monitored.

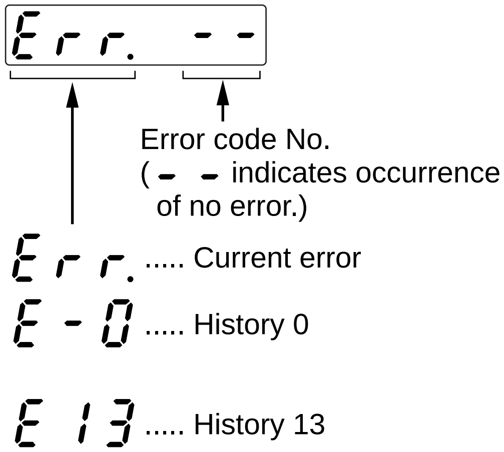
Pressing the ⌃ key shifts the display in this order.



- **Relation between signal No. and signal name**

Input signal				Output signal			
Signal No.	Signal name	Code	Pin No.	Signal No.	Signal name	Code	Pin No.
00	Servo ON	SRV-ON	29	0	Servo ready	S-RDY	35/34
01	Alarm clear	A-CLR	31	1	Servo alarm	ALM	37/36
02	CW overtravel input	CWL	8	2	In-position	COIN	39/38
03	CCW overtravel input	CCWL	9	3	External brake release	BRK-OFF	11/10
04	Control mode switching	C-MODE	32	4	Zero speed detection	ZSP	12
05	Speed zero clamp	ZEROSPD	26	5	Torque limit control	TLC	40
06	Command pulse scale switch 1	DIV	28	9	At-speed	COIN	39/38
07	Command pulse scale switch 2	DIV2	9	A	Full-closed in-position	EX-COIN	39/38
08	Command pulse input inhibit	INH	33				
09	Gain switching	GAIN	27				
0A	Error counter clear	CL	30				
0C	Internal command speed selection 1	INTSPD1	33				
0D	Internal command speed selection 2	INTSPD2	30				
0F	Scale error	SC-ERR	33				
12	Smoothing switching	SMOOTH	8				

Cause of error and history reference



- Causes of up to 14 errors in the past (including the current error) can be seen.
  Select the history No. to be seen by pressing the ∧ or ∨ key.

NOTE 1) The following errors are not stored in the history.
11: Control power supply undervoltage error
13: Undervoltage error
36: EEPROM parameter error
37: EEPROM check code error
38: Overtravel input error
95: Motor automatic recognition error
97: Control mode setting error

NOTE 2) During occurrence of an error to be stored in the history, the current error and History 0 indicate the same error code No.

- **Relation between error code No. and contents**

Error code No.	Contents	Error code No.	Contents
11	Control power supply undervoltage error	35	External scale wiring error
12	Overvoltage error	36	EEPROM parameter error
13	Undervoltage error	37	EEPROM check code error
14	Overcurrent error	38	Overtravel input error
15	Overheat error	40	Absolute system shutdown error
16	Overload error	41	Absolute counter overflow error
18	Regenerative overload error	42	Absolute encoder overspeed error
21	Encoder communication error	44	Absolute encoder single-revolution counter error
23	Encoder communication data error	45	Absolute encoder multi-revolution counter error
24	Position error limit excess error	47	Absolute status error
25	Excessive hybrid deviation error	48	Encoder Z-phase error
26	Overspeed error	49	Encoder CS signal error
27	Command pulse scale error	95	Motor automatic recognition error
28	External scale error	97	Control mode setting error
29	Error counter overflow error	Other	Other errors

Setting parameters and mode

Software version

A. - 1. 0 6 CPU1 software version

Every time the ⋀ or ⋁ key is pressed, the software version is switched between CPU1 and CPU2.

b. - 1. 0 1 CPU2 software version

Warning indication

r n - - -

- ..... No warning A ..... Occurrence of warning

Regenerative overload warning:
Indicates that the regenerative load ratio is 85% or less of the regenerative overload protection alarm level.
When Pr6C (External regenerative discharge resistor selection) is set to "1", regenerative discharge resistor's duty ratio 10% is defined as the alarm level.

Overload warning: Indicates that the load ratio is 85% or less of the overload protection alarm level.

Battery warning: Indicates that the voltage of the absolute encoder battery is the warning level (approx. 3.2 V) or lower.

Indication of regenerative load ratio

r G 3 0

Indicates the ratio (%) of the regenerative load to the regenerative overload protection alarm level.

Indication of overload ratio

o L 2 8

Indicates the ratio (%) of the actual load to the rated load.

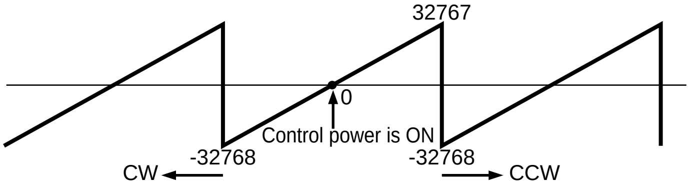
Indication of inertia ratio

J 1 0 0 Indicates the current setting of Pr20 (Inertia ratio).

Indication of feedback pulse total and command pulse total

5 0

Indicates the total pulse count after power-on of the control power supply. The pulse count overflows asshown below.



External scale error

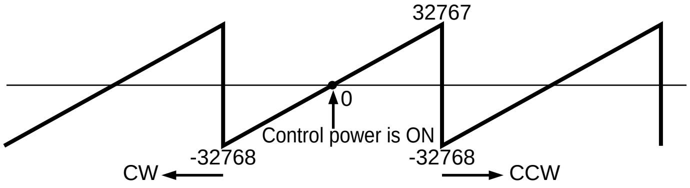
F E 5

- Polarity (+) : CCW, (–) : CW

External scale feedback pulse total

F P 5 0 0

Indicates the total pulse count after power-on of the control power supply. The pulse count overflows as shown below.



Motor automatic recognition function

Aud on Automatic recognition enabled (Always displayed this sign)

Details of the execution display in the parameter setup mode

Parameter setup

- Define the parameter value by pressing the ▲ or ▼ key (Pressing the ▲ key increases the set value, and pressing the ▼ key decreases it.)
- Every time the ◀ key is pressed, the blinking decimal point shifts to the higher-order digit. The digit with the blinking decimal point can be changed.

NOTE) As soon as you change a value of parameter, the change will be reflected in control. When you change a value of parameters (i.e., speed loop gain, position loop gain, etc., in particular) that will have great effect on behavior of the motor, you should change a value little by little, instead of changing it considerably at one time.

Details of the execution display in the EEPROM writing mode

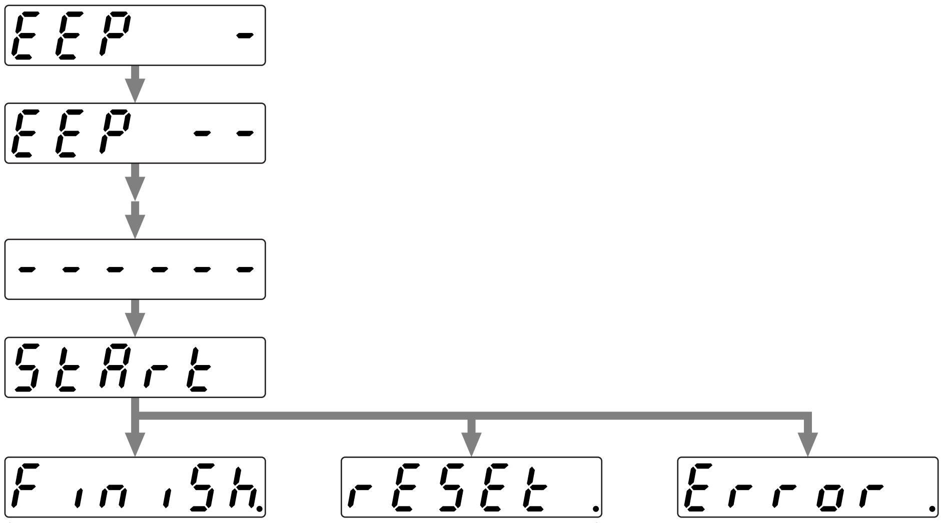
Writing parameter into EEPROM

- To execute the writing, keep pressing the ▲ key until the display is switched to "StArt".

Keep pressing the ▲ key for approx. 5 seconds.
" - " is added as shown on the right.

Writing starts.

Writing ends.



- If you change the setting of the parameter that will become valid after reset, "rESEt." will be displayed after completion of the writing. In this case, turn OFF the control power supply once, and reset it.

NOTE 1) When a writing error occurs, re-write the same data into the EEPROM. If the same writing error occurs repeatedly, the servo driver may be defective.

NOTE 2) Do not turn OFF the power supply while writing data into the EEPROM. Otherwise, incorrect data may be written into the EEPROM. If this trouble occurs, re-set up all parameters, and perform re-writing after checking the parameter settings thoroughly.

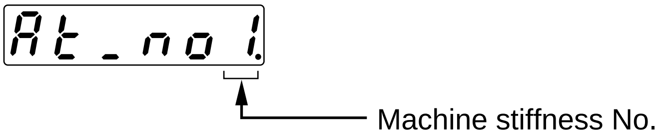
Details of the execution display in the auto gain tuning mode

Auto gain tuning

NOTE 1) For details of the auto gain tuning function, see page 185 "Adjustments. We would like to ask you to start using the auto gain tuning function after carefully reading the scope, precautions, etc. herein.

NOTE 2) In normal auto gain tuning mode, the driver automatically operates the motor in a predetermined pattern. You can change this operation pattern with Pr25 (setting of the normal mode auto tuning operation). However, execute the normal mode auto gain tuning only after moving load to a position where no trouble will be caused by this operation pattern.

[Selection display]

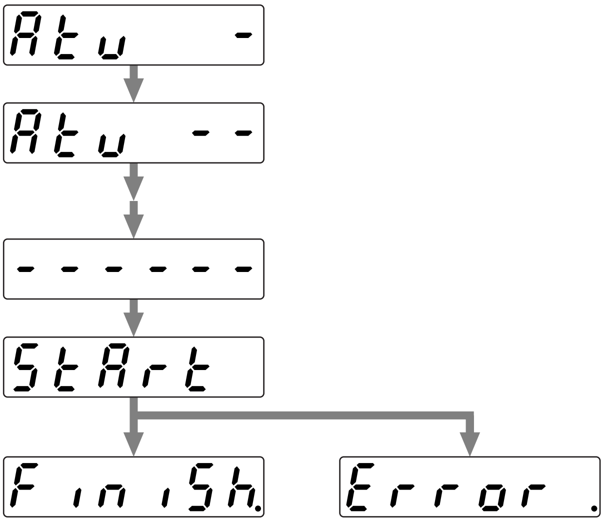


Select machine stiffness No. by pressing the (∧) or (∨) key.
(For machine stiffness No., see page 195.)

[Execution display]

Press the ◎ key to show the execution display At u -.
To execute the auto gain tuning function, inhibit a command input first, and then activate the SER-ON signal. Then, keep pressing the (∧) key until the display is switched to StArt.

Keep pressing the (∧) key for approx. 5 seconds.
" - " is added as shown on the right.



Motor starts.

End

Tuning is completed.

Error occurred.

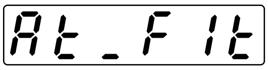
NOTE) If any of the following conditions occurs during execution of auto tuning, it is judged as a tuning error.

1) During auto tuning :
   - An error occurred.
   - Servo-OFF is activated.
   - The error counter is cleared.
2) When the output torque is saturated because the inertia or load is too large:
3) When the tuning cannot be normally completed due to oscillation, etc.

If a tuning error occurs, each gain will be reset to the value defined before executed of the auto tuning. The tuning error does not result in a trip, unless other error simultaneously occurs. Also, oscillation may occur without the tuning error indication Error depending on the load. During auto gain tuning, exercise through caution to ensure safety.

Real-time Auto Gain Tuning Screen

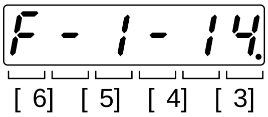
[Selection display]



Fit gain window

[Execution display]

- Press the SET ◎ to display the execution window.



- Position the decimal point to [1] , [2] , [4] or [6] using the ◁ key. The fit gain function can be started or real time auto gain tuning/adaptive filter can be altered or stored using the ∧ ∨ keys.
- Meaning of the display

[1] Setting of the real time auto gain tuning stiffness/fit gain starting up

Display	Meaning	Extension function
Can be changed with ∧∨ F. ⋮ 1. 0.	Stiffness 15 ⋮ Stiffness 1 Stiffness 0	Rigidity will change in the sequence of 0 to 9, A (10) to F (15) every time you press ∧. If you hold down ∨ about 3 seconds in this state, the fit gain function will start.

[2] Real time auto gain tuning operation setting

Display	Meaning	Extension function
Can be changed with ∧∨ 3. 2. 1. 0.	Enabled : Load inertia changes sharply Enabled : Load inertia changes slowly Enabled : Little change in load inertia Disabled :	Real time auto tuning disabled In a state of (0), press the ∨ for approx. 3 seconds. Gain auto setting corresponding to the stiffness is carried out. (See sect.11)

[3] Real time auto gain tuning operation status (display only)

(blank)	: Disabled
-	: Enabled
‾ or _	: Load inertia estimating

[4] Copying to the 1st notch filter of adaptive filter operation switching and adaptive filter setting

Display	Meaning	Extension function
Can be changed with ∧∨ 1. 0.	Enabled Disabled	In a state of adaptive filter enabled , press ∧ for approx. 3 seconds. Present adaptive filter setting is copied to the first notch frequency (Pr1D, Pr1E). In a state of adaptive filter disabled , press ∨ for approx. 3 seconds. The setting of the 1st. notch frequency (Pr1D, Pr1E) is cleared.

[5] Adaptive filter operation status (display only)

(blank)	: Disabled
-	: Enabled
‾ or _	: Operation tuning

[6] Fit gain result application status

Display	Meaning	Extension function
Can not be switched F. n.	Enabled Disabled	In the state of fit gain enabled, press ∧ for approx. 3 seconds. Result of fit gain function (Pr23 and Pr24) is cleared. Press ∨ for approx. 3 seconds , present setting is written in the EEPROM.

Details of the execution display in the auxiliary function mode

Alarm clear

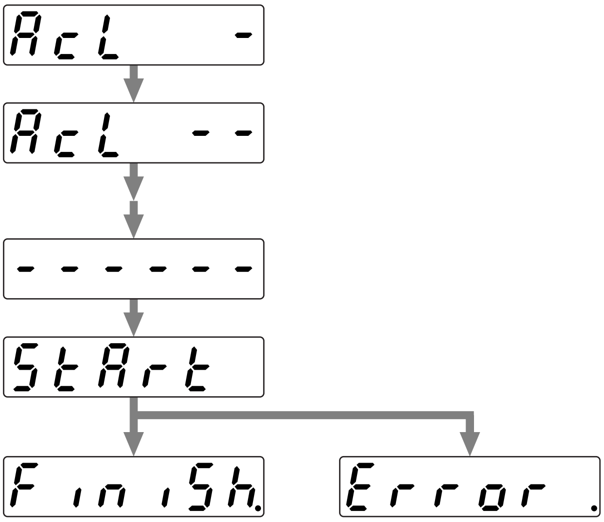
This function is used to cancel a trip condition.

[Selection display]

AF_AcL

[Execution display]

- Press the SET key to show the execution display AcL - .
  To execute the alarm clear function, keep pressing the ∧ key until the display is switched to StArt .



Keep pressing the ∧ key for approx. 5 seconds.
A bar is added as shown on the right.

Alarm clear starts.

End

Alarm clear is completed.

Alarm cannot be cleared.
Reset the power supply.

Automatic offset adjustment

This function is used to adjust the offset value (Pr52 Speed command offset) for the analog speed command input (SPR/TRQR) automatically.

[Selection display]

AF_oFS

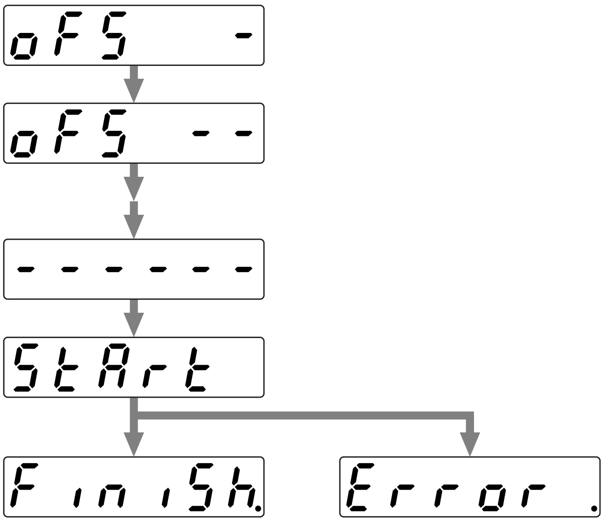
[Execution display]

- Press the SET key to show the execution display oFS -.
  To execute the automatic offset adjustment, set a command input to 0 V first, and then keep pressing the ⋀ key until the display is switched to StArt.

Keep pressing the ⋀ key for approx. 5 seconds.
A bar is added as shown on the right.

Automatic offset adjustment starts.

End



Automatic offset adjustment is completed.

Error occurred.

NOTE 1) This function is disabled in the position control mode.

NOTE 2) Even if the automatic offset adjustment is executed, the offset data are not written to the EEPROM.
To reflect the offset adjustment result on the control, write the offset data into the EEPROM.

Trial Run (JOG)

Inspections before Trial Run

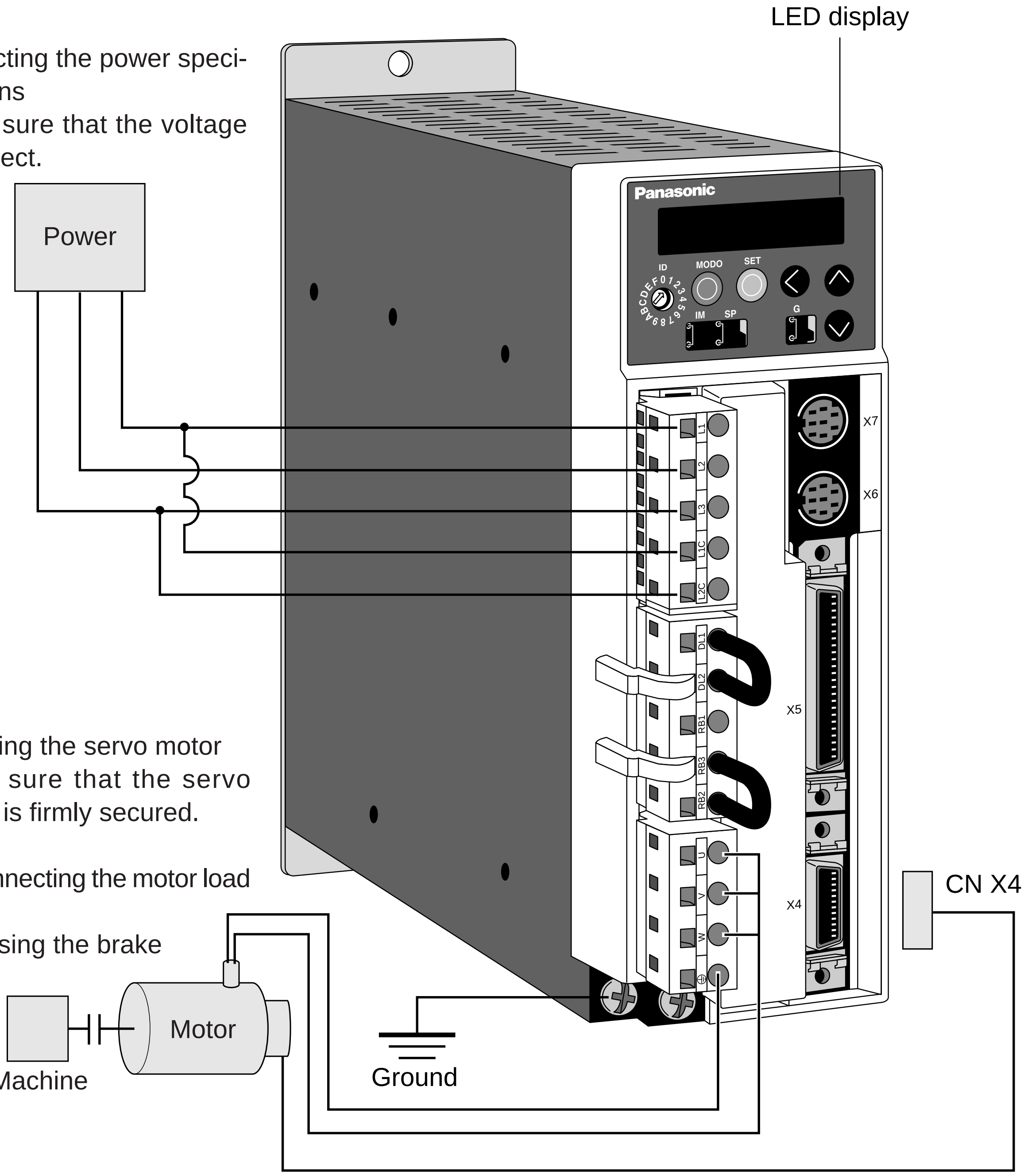
1) Inspecting the wiring
- Make sure that all wire connections (especially main power and motor output) are correct.
- Make sure that there are no improper grounding connections, and earth wires are properly connected.
- Make sure there is no loose connection.

2) Inspecting the power specifications
- Make sure that the voltage is correct.

3) Securing the servo motor
- Make sure that the servo motor is firmly secured.

4) Disconnecting the motor load

5) Releasing the brake



Motor trial run

The motor can be run on trial, without connection of the X5 connector.

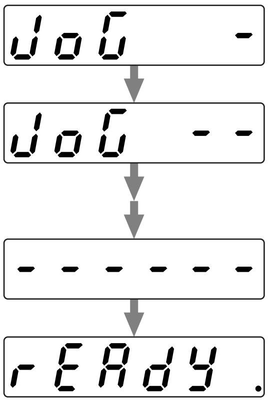
[Selection display]

AF_JoG

[Execution display]

- Press the SET ◎ key to show the execution display JoG -.
  To execute the motor trial run, keep pressing the ⌃ key until the display is switched to rEAdY..

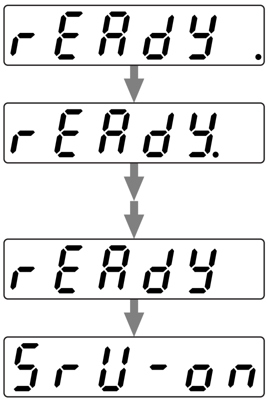
Keep pressing the ⌃ key for approx. 5 seconds.
A bar is added as shown on the right.



Preparatory step 1

- Then, keep pressing the < key until the display is switched to SrV_on.

Keep pressing the ⌃ key for approx. 5 seconds.
The dot (.) moves as shown on the right.



Preparatory step 2

(Servo-ON)

- After Servo-ON, pressing the ⌃ key runs the motor CCW, and pressing the ⌄ key runs the motor CW at a speed defined by Pr57 (J OG speed setup).

NOTE 1) Before starting a trial run, be sure to remove a load from the motor, and disconnect the CN X5 connector.

NOTE 2) To execute a trial run, reset Pr10 (1st position loop gain) and Pr11 (1st speed loop gain) to the initial values to avoid troubles such as oscillation.

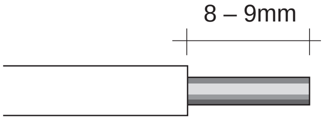
NOTE 3) Set Pr03 (Analog torque limit input disabled) and Pr04 (Overtravel input inhibit) to "1". If these parameters are set to "0", the motor will not run.

Connecting cables to the terminal block

Connect cables to the power connectors X1 , X2 and X3 according to the following the procedure.

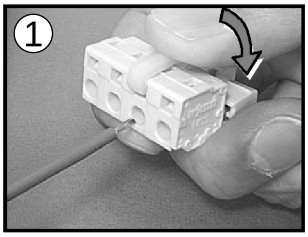
Wiring procedure

1. Unsheathe the cable to be used.

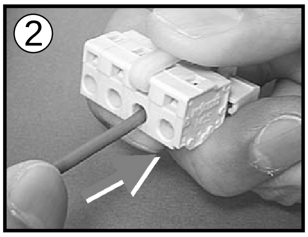


2. Plug the cable in the connector. To plug the cable, the following two methods are available:
   (a) Insert the cable by using the supplied operation lever.
   (b) Insert the cable by using either a flat head (lip width 3.0 to 3.5 mm) or any of 210-120J , 210-350/01,270-258J of WAGO Company of J apan, Ltd.

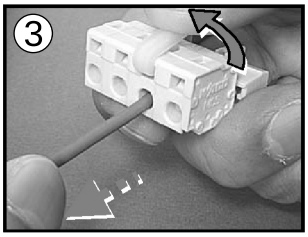
(a) When using the operation lever



Push the operation lever located in the upper opera-tion slot with your finger to lower the spring.

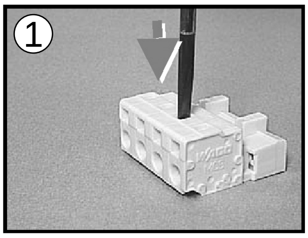


While pressing the operation lever, insert the cable into the cable insertion hole (round hole) until it reaches the innermost of the hole.

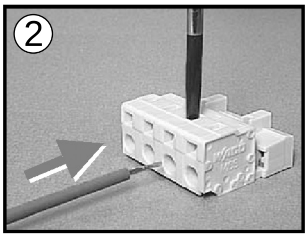


Releasing the lever completes the cable connection.

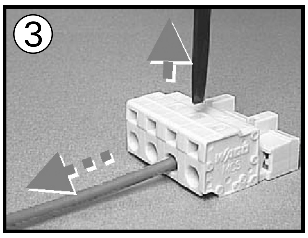
(b)-1 When using a screwdriver (I)



Put the dedicated screw-driver in the upper operation slot, and push it to lower the spring.



Insert the properly-unsheathed cable into the cable insertion hole (round hole) until it reaches the innermost of the hole.

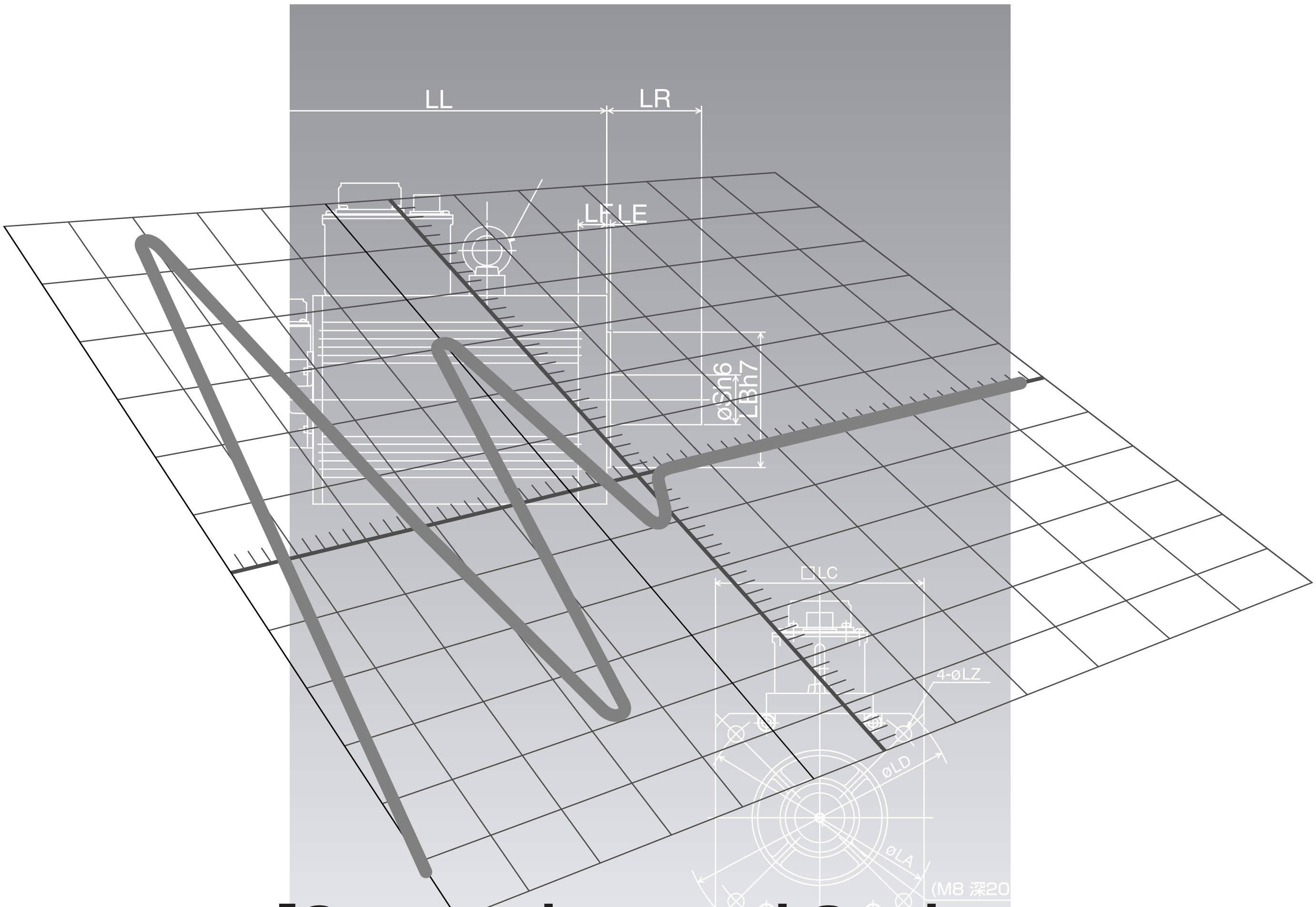


Releasing the lever completes the cable connection.

* The cable can be disconnected from the connector in the same manner as the above procedure.

CAUTION

- Unsheathe the cable exactly by the specified length. (8 – 9mm)
- Before connecting a cable into the connector, remove the connector from the servo driver.
- Only one cable can be inserted into one insertion hole of the connecter.
- Be careful not to be injured when using a screwdriver.



[Connections and Settings in Position Control Mode]

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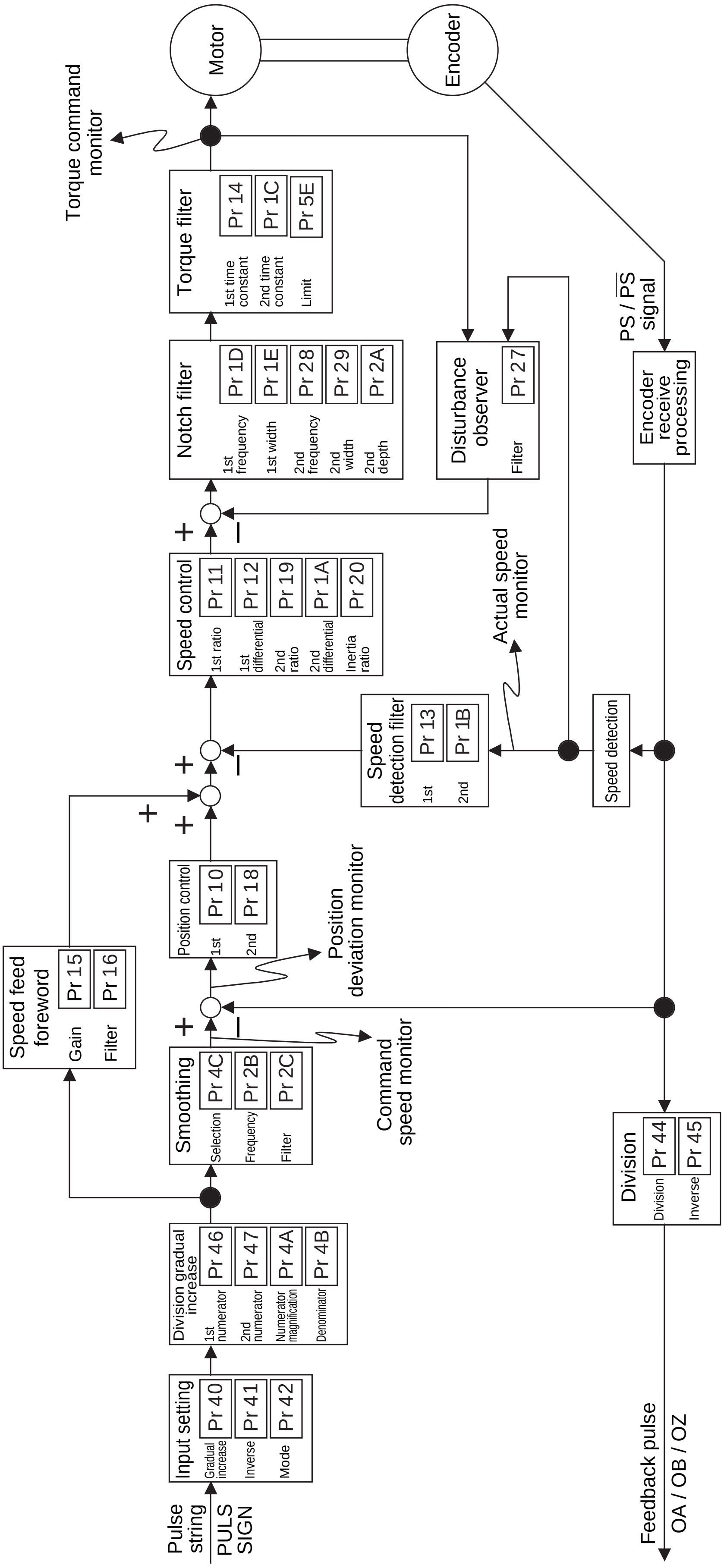
Position control block diagram

- **Control mode set-up: when Pr02 is [0]***

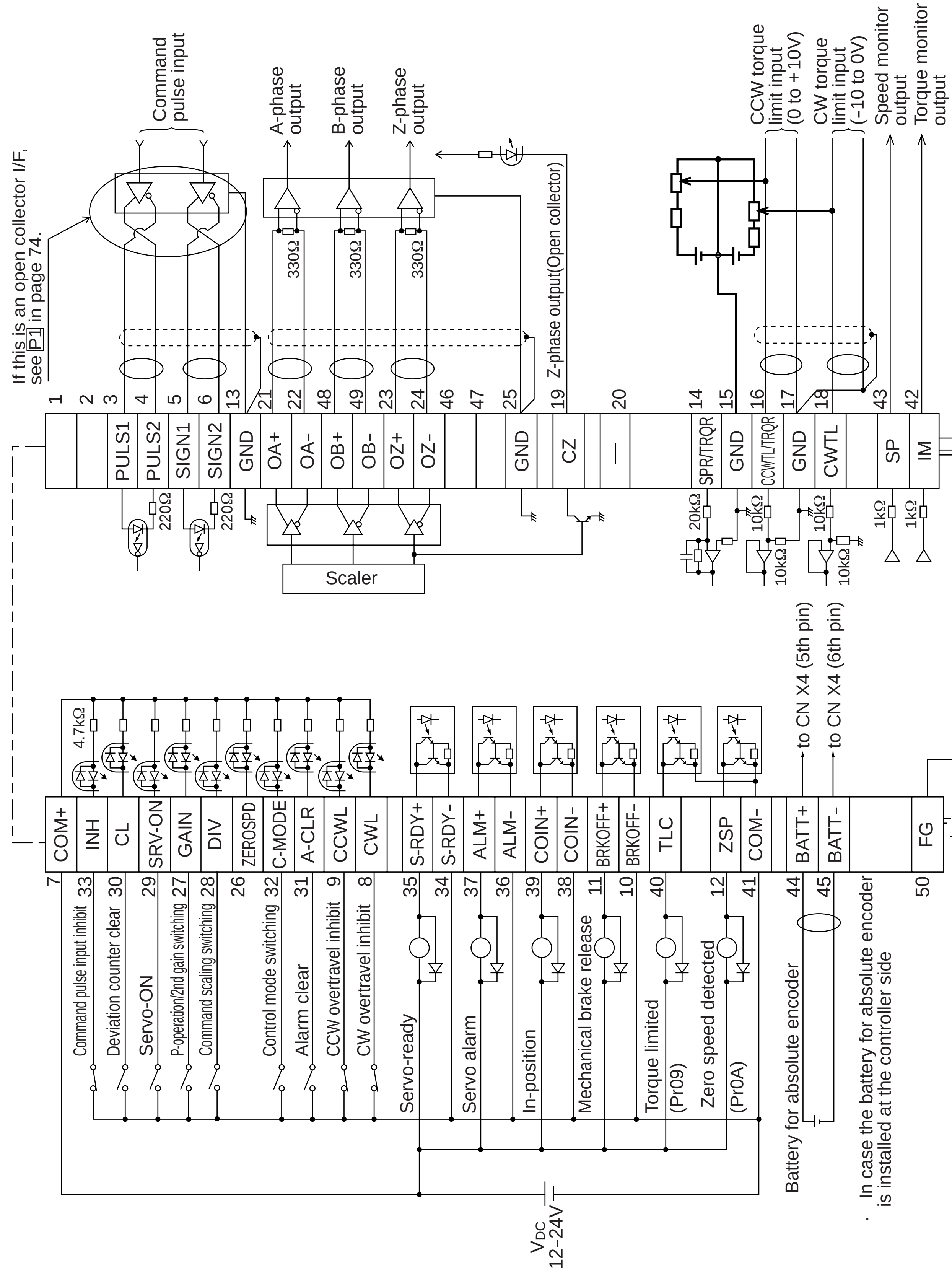


* For the block diagram showing "Control mode set-up parameter Pr02=[11] (position control for high-stiffness equipment) and Pr02 [12] (position control for low-stiffness equipment), see page 301"Appendix".

CN X5 Connector

CN X5 Connector

Circuits Available for Position control mode

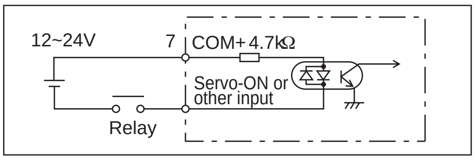


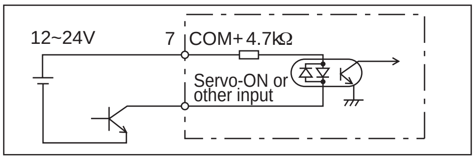
CN X5 Connector

Interface Circuit

Input Circuit

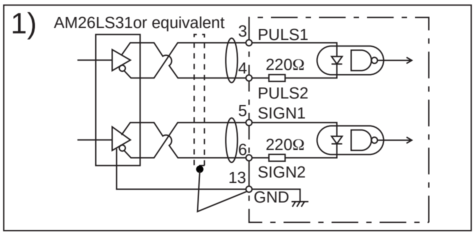
SI SI Connecting to sequence input signals

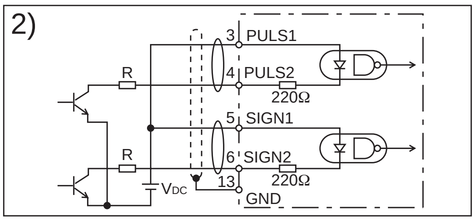




- Connect to a contact of switch and relay, or a transistor of an open collector output.
- Use a switch or relay for micro current so that insufficient contact can be avoided.
- Lower limit of the power supply (12 to 24V) should not be less than 11.4V in order to secure the appropriate level of primary current of the photo coupler.

PI PI Command pulse input circuit





Max. input voltage DC24V
Rated current 10mA

1) Line Driver I/F
- This is a good signal transmission method that is less sensitive to noises. We recommend you to use this to maintain the reliability of signals.

2) Open Collector I/F
- This uses an external control power supply(V_{DC}).
- This requires a current-limiting resistor (R) corresponding to the capacity of the V_{DC} value.
- Be sure to connect specified resistance (R).

V_{DC}	R value
12V	1kΩ 1/2W
24V	2kΩ 1/2W

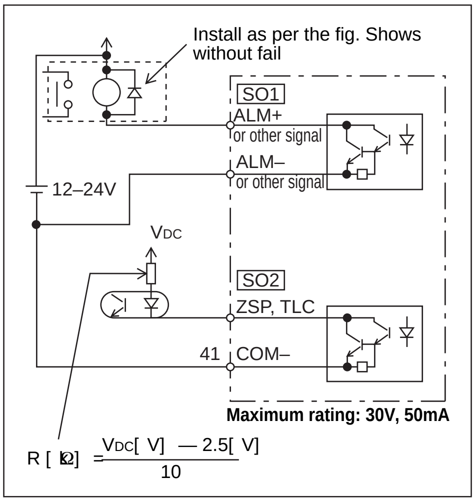
$$\frac{V_{DC} - 1.5}{R + 220} \fallingdotseq 10mA$$

⊖ shows a pair of twisted wires.

Output Circuit

SO1 SO2 Sequence output circuit

- This comprises a Darlington driver with an open collector. This is connected to a relay or photo coupler.
- There exists a collector-to-emitter voltage V_{CE}(SAT) of approx. 1V at transistor ON, because of Darlington connection of the out put transistor. Note that normal TTLIC can't be directly connected since this does not meet VIL requirement.
- This circuit has an independent emitter connection, or an emitter connection that is commonly used as the minus (–) terminal (COM–) of the control power.
- Calculate the value of R using the formula below so as the primary current of the photo coupler become approx. 10mA.

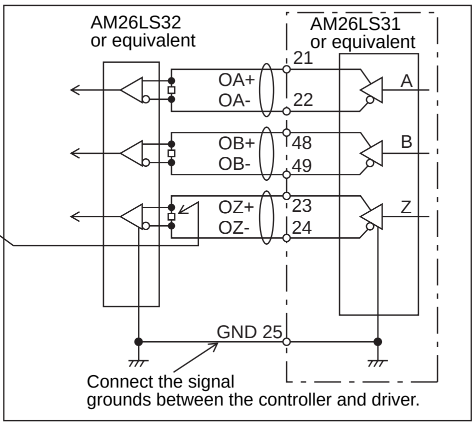


For the recommended primary current value, check the data sheet on the equipment and photo-coupler used.

PO1 Line Driver (Differential Output) Output

- Provides differential outputs of encoder signals (A, B and Z phases) that come from the scalar.
- Receive these signals with a line receivers. In this case, install a resistor of approx. 330Ω between the inputs.
- These outputs are non-insulated signals.

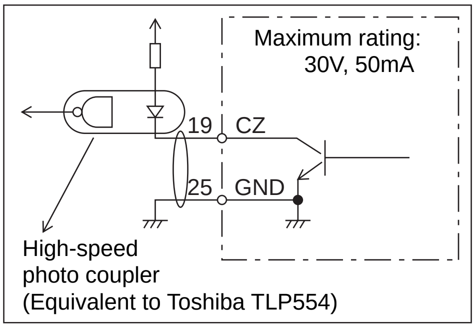
⊖ shows a pair of twisted wires.



PO2 Open Collector Output

- Outputs Z-phase signals among those from the encoder. The outputs are non-insulated.
- Receive these signal with high-speed photo coupler at controller side, since these Z-phase signal width is normally narrow.

⊖ shows a pair of twisted wires.



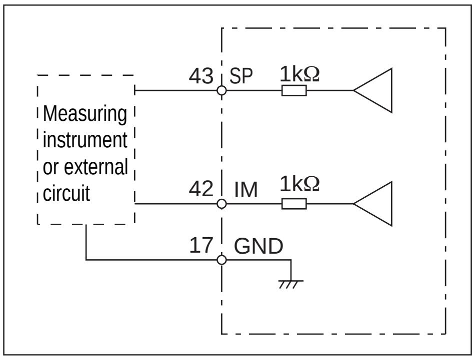
AO Analogue Monitor Output

- This output is the speed monitor signal (SP) or torque monitor signal (IM).
- The signal range is approx. 0 to ± 9V.
- The output impedance is 1kΩ. Pay attention to the input impedance of your measuring instruments and external circuits connected.

<Resolution>

1) Speed monitor signal (SP): 8r/min./LSB calculated from 6V/3000r/min (Pr07 = 3)

2) Torque monitor signal (IM): 0.4%/LSB calculated from 3V/rated value (100%)



CN X5 Connector

Input signal (common) assignment to CN X5 connector pins

Input Signals (Common) and their Functions

<table>
<tr><th>Signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Control signal power (+)</td><td>7</td><td>COM +</td><td>• Connect to (+) of an external power supply (12VDC to 24VDC).
• Use source voltage of 12V±10% – 24V±10%.</td><td rowspan="2">–</td></tr>
<tr><td>Control signal power (–)</td><td>41</td><td>COM –</td><td>• Connect to (–) of an external power supply (12VDC to 24VDC).
• The required capacity depends on the I/O circuit configuration. 0.5A or larger is recommended.</td></tr>
<tr><td rowspan="2">Servo-ON</td><td>29</td><td>SRV-ON</td><td>• When this signal is connected to COM–, the dynamic brake will be released and the driver is enabled. (Servo-ON).</td><td rowspan="2">SI
page 74</td></tr>
<tr><td colspan="3"><Notes>
1. This signal becomes effective about two seconds after power on (see the Timing Chart).
2. Don't use this Servo-ON or Servo-OFF signal to turn on or off the motor. See page 46 "Dynamic Brake" in Preparations.
• Allow at least 50ms delay after the driver is enabled before any command input is entered.
• By opening the connection to COM– , the driver will be disabled(Servo-OFF) and the current flow to the motor will be inhibited.
• Operation of the dynamic brake and clearing action of the position error counter can be selected using Pr69 (Sequence under Servo-OFF).</td></tr>
<tr><td rowspan="2">Control mode switching</td><td>32</td><td>C-MODE</td><td>• When Pr02 (Control Mode Selection) = 3, 4 or 5, the control mode is selected per the table below.</td><td rowspan="2">SI
page 74</td></tr>
<tr><td colspan="3">
<table>
<tr><th></th><th colspan="2">Connection with COM–</th></tr>
<tr><th>Pr02 value</th><th>open (1st)</th><th>closed (2nd)</th></tr>
<tr><td>3</td><td>Position control mode</td><td>Speed control mode</td></tr>
<tr><td>4</td><td>Position control mode</td><td>Torque control mode</td></tr>
<tr><td>5</td><td>Speed control mode</td><td>Torque control mode</td></tr>
</table>
</td></tr>
<tr><td>CW overtravel inhibit</td><td>8</td><td>CWL</td><td>• If COM– is opened when the movable part of the machine has moved to CW exceeding the limit, the motor does not generate torque.</td><td>SI
page 74</td></tr>
<tr><td>CCW overtravel inhibit</td><td>9</td><td>CCWL</td><td>• If COM– is opened when the movable part of the machine has moved CCW exceeding the limit, the motor does not generate torque.
• If you set 1 to Pr04 (Overtravel input inhibited invalid), CWL/CCWL input will be disabled. A factory setting is Disable (1).
• With Pr66 (DB deactivate when driving is inhibited), you can activate dynamic brake when CWL/CCWL input is enabled. According to a factory setting, dynamic brake operates (Pr66 is set to 0).</td><td>SI
page 74</td></tr>
<tr><td rowspan="2">Counter clear</td><td>30</td><td>CL</td><td>The function differs depending on the control mode.</td><td rowspan="2">SI
page 74</td></tr>
<tr><td colspan="3">
<table>
<tr><td>Position control</td><td>• Clears the position error counter.
Connect to COM– to clear the counter.
• Use Pr4D to select the clear mode.
<table>
<tr><th>Pr4D value</th><th>Meaning</th></tr>
<tr><td>0(Factory-setting)</td><td>LEVEL</td></tr>
<tr><td>1</td><td>EDGE</td></tr>
</table>
</td></tr>
<tr><td>Speed control</td><td>• With speed setting of the 2nd selection input, you can set 4 speeds in combination with INH.
• For details, see Pr05 (Speed Set-Up Switching) description.</td></tr>
<tr><td>Torque control</td><td>• Invalid</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Command pulse input inhibit</td><td>33</td><td>INH</td><td>The function differs depending on the control mode.
<table>
<tr><td>Position control</td><td>• Enter command pulse input inhibit.
• You can disable this input with Pr43 (disable command pulse input inhibit).
<table>
<tr><th>Pr43 value</th><th>Meaning</th></tr>
<tr><td>1(Factory-setting)</td><td>The INH signal (input) is disabled.</td></tr>
<tr><td>0</td><td>• With COM– closed, the pulse command signal (PULSE SIGN) is enabled.
• With COM– open, the pulse command signal (PULSE SIGN) is inhibited.</td></tr>
</table></td></tr>
<tr><td>Speed control</td><td>• With speed setting of the 1st selection input, you can set 4 speeds in combination with CL input.
• For details, see Pr05 (Speed Set-Up Switching) description.</td></tr>
<tr><td>Torque control</td><td>• Invalid</td></tr>
</table></td><td>SI
page 74</td></tr>
<tr><td>Speed zero clamp</td><td>26</td><td>ZEROSPD</td><td>• With COM– open, the speed command is considered zero.
• This input can be made disabled using Pr06.
• With factory setting, disconnecting this pin from COM– sets the speed to zero.
<table>
<tr><th>Pr06 value</th><th>Meaning</th></tr>
<tr><td>0 (Factory-setting)</td><td>ZEROSPD is disabled.</td></tr>
<tr><td>1</td><td>ZEROSPD is enabled.</td></tr>
</table></td><td>SI
page 74</td></tr>
<tr><td>Gain switching</td><td>27</td><td>GAIN</td><td>• This is setting of Pr30 (2nd gain setting) and has the following 2 types of functions:
<table>
<tr><th>Pr30 value</th><th>Connection to COM–</th><th>Function</th></tr>
<tr><td rowspan="2">0
(Factory-setting)</td><td>Open</td><td>Speed loop: PI (Proportional / Integral) action</td></tr>
<tr><td>Close</td><td>Speed loop: P (Proportional) action</td></tr>
<tr><td rowspan="3">1</td><td>Open</td><td>• 1st gain selected (Pr10, 11, 12, 13 and 14)</td></tr>
<tr><td>Close</td><td>• 2nd gain selected (Pr18, 19, 1A, 1B, 1C)</td></tr>
<tr><td colspan="2">To use the second gain, set Pr31 to “ 2” .</td></tr>
</table>
• No.2 Gain change Funcutions, see page 202 "Adjustments ".</td><td>SI
page 74</td></tr>
<tr><td>Alarm clear</td><td>31</td><td>A-CLR</td><td>• If the COM– connection is kept closed for more than 120 ms, the alarm status will be cleared.
• For details about not cleared alarm, see page 216 "Protective Functions".</td><td>SI
page 74</td></tr>
</table>

CN X5 Connector

Input signal assignment to CN X5 connector pins - designation(logic)

Input Signals (Position Control) and their Functions

Signal	Pin No.	Symbol	Function	I/F circuit
Command pulse	**3**	**PULS1**	• This is the input terminal for command pulses. The driver receives this signal by a high-speed photo coupler. **• Max input voltage 24VDC/Rated current 10mA.** • The input impedance of PULSE and SIGN signals is 220Ω. • Command pulses can be input in three different ways. Use Pr42 to select one of the following. 1) Quadrature (A and B) input 2) CW (PULSE)/CCW (SIGN) pulse input 3) Command pulse (PULS)/Sign (SIGN) input	PI page 74
	4	**PULS2**		
Command sign	**5**	**SIGN1**		
	6	**SIGN2**		
Command pulse scalar switch	**28**	**DIV**	• With COM– closed, the numerator of the command scalar is changed from the value stored in Pr46 (Numerator of 1st Command Scalar) to the value stored in Pr47 (Numerator of 2nd Command Scalar). **< Note >** Don't enter command pulses 10 ms after or before switching.	SI page 74
Battery +	**44**	**BATT +**	• Connect a backup battery for absolute encoder (pole-sensitive !). • If the battery is connected directly to the driver, it is not necessary to connect a battery to this terminal.	–
Battery –	**45**	**BATT –**		

Output signal assignment to CN X5 connector pins - designation(logic)

Output Signals (Common) and their Functions

Signal	Pin No.	Symbol	Function	I/F circuit
Servo alarm output	**37** **36**	**ALM +** **ALM –**	• This output(transistor) turns OFF, when the driver detects and error(trip).	SO1 page 75
Servo-ready output	**35** **34**	**S-RDY +** **S-RDY –**	• This output(transistor) turns ON, when the main power is on(for both the driver and the motor) and no alarm is active.	SO1 page 75
Mechanical brake release output	**11** **10**	**BRK-OFF +** **BRK-OFF –**	• This is used to release the electromagnetic brake of the motor. • Turn the output transistor ON when releasing brake. • Refer to “ Timing Chart” on page 40, on Preparations.	SO1 page 75
Zero speed detection	**12**	**ZSP**	• Signal which is selected at Pr0A (ZSP Output Selection) will be turned on.	SO2 page 75

Pr0A value	Function
0	Output(transistor) turns ON during the In-toque limiting.
1 (Factory-setting)	Output(transistor) turns ON when the motor speed becomes lower than that of the preset speed with Pr61(Zero speed).
2*	Output(transistor) turns ON when either one of over-regeneration, overload or battery warning is activated.
3*	Output(transistor) turns ON when the over-regeneration (more than 85% of permissible power of the internal regenerative discharge resistor) warning is activated.
4*	Output(transistor) turns ON when the overload (the effective torque is more than 85% of the overload trip level) warning is activated.
5*	Output(transistor) turns ON when the battery (the voltage of the backup battery becomes lower than approx. 3.2V at the encoder side) warning is activated.

* When the setting is a value between 2 and 5, the output transistor will be turned on for at least 1 second upon detecting an alarm condition.

Signal	Pin No.	Symbol	Function	I/F circuit
Torque in-limit	**40**	**TLC**	• Signal which is selected by Pr09 (TLC Output Selection) will be turned ON. Factory-setting: 0 • See the above ZSP signal for the set-up of Pr09 and functions.	SO2 page 75
In-position/ At-speed	**39** **38**	**COIN +** **COIN –**	• Function changes at control mode. < Caution> As positional deviation is always around 0 even during operation in control following commands, COIN (positioning complete signal) may remain ON. Position: • In-position output • Output(transistor) turns ON when the position error is below the preset value by Pr60 (In-Position Range). Speed and torque: • At-speed output • Output(transistor) turns ON when the motor speed reaches the preset value by Pr62 (At-Speed).	SO1 page 75
A-phase output	**21**	**OA +**	• Provides differential outputs of the encoder signals (A, B and Z phases) that come from the driver (equivalent to RS422 signals). • The logical relation between A and B phases can be selected by Pr45 (Output Pulse Logic Inversion). • Not insulated	PO1 page 75
	22	**OA –**		
B-phase output	**48**	**OB +**		
	49	**OB –**		
Z-phase output	**23**	**OZ +**		
	24	**OZ –**		
Z-phase output	**19**	**CZ**	• Z-phase signal output in an open collector (not insulated) • Not insulated	PO2 page 75
Speed monitor output	**43** **(17)**	**SP** **(GND)**	• Outputs the motor speed, or voltage in proportion to the commanded speed with polarity. + : CCW rotation – : CW rotation • Use Pr07 (Speed Monitor Selection) to switch between actual and commanded speed, and to define the relation between speed and output voltage.	AO page 75
Torque monitor output	**42** **(17)**	**IM** **(GND)**	• Outputs the output torque, or voltage in proportion to the position error with polarity. + : Fgenerating CCW-torque – : Fgenerating CW-torque • Use Pr08 (Torque Monitor Selection) to switch between torque and positional error, and to define the relation between torque/positional error and output voltage.	AO page 75

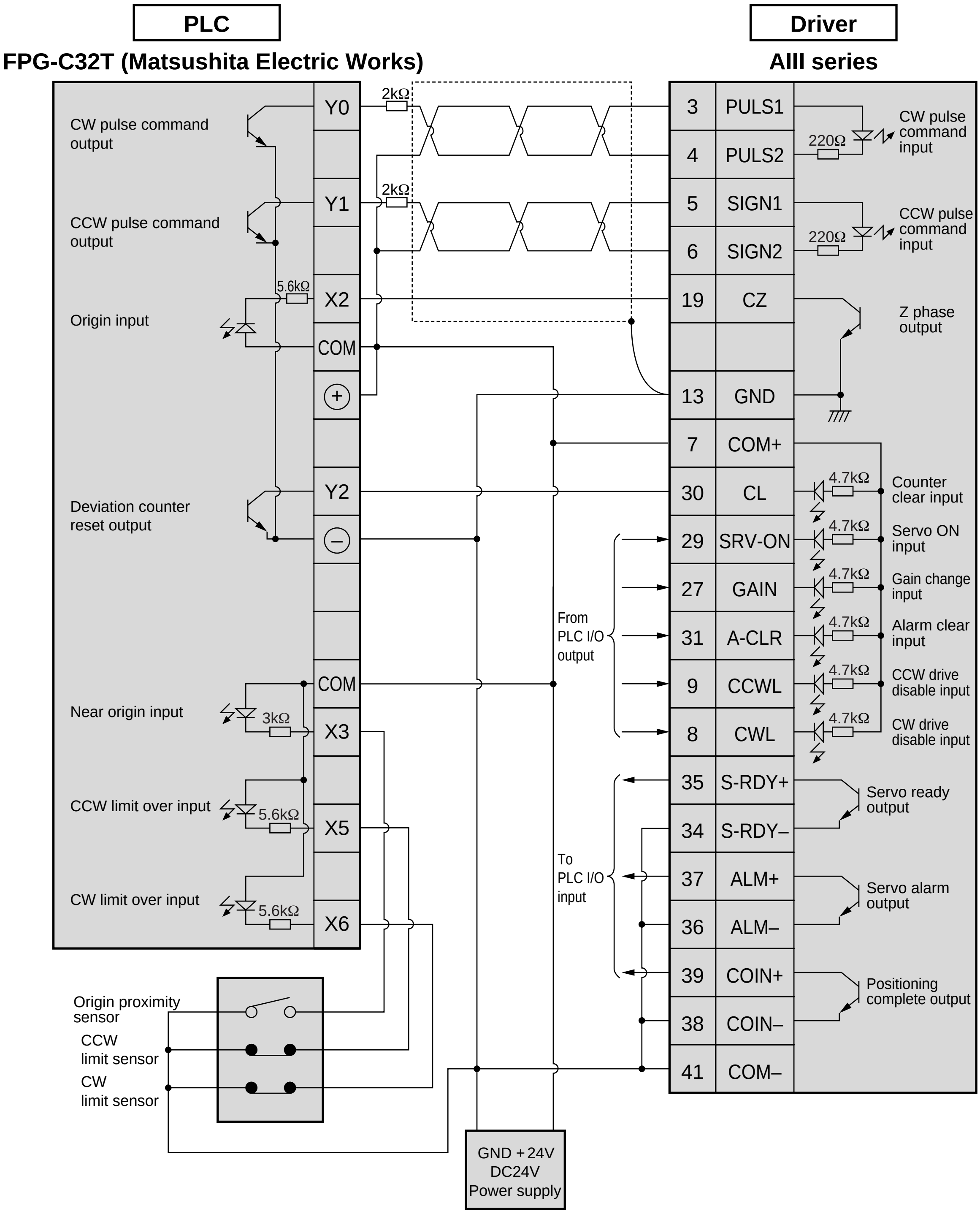
Output Signals (Others) and their Functions

Signal	Pin No.	Symbol	Function	I/F circuit
Signal ground	**13** **15** **17** **25**	**GND**	• Signal ground in the driver • Internally isolated from the control power (COM -).	–
Frame ground	**50**	**FG**	• Internally connected to the earth terminal.	–
(Not in use)	**1** **2** **20** **46** **47**	**–**	• No connections should be made.	–

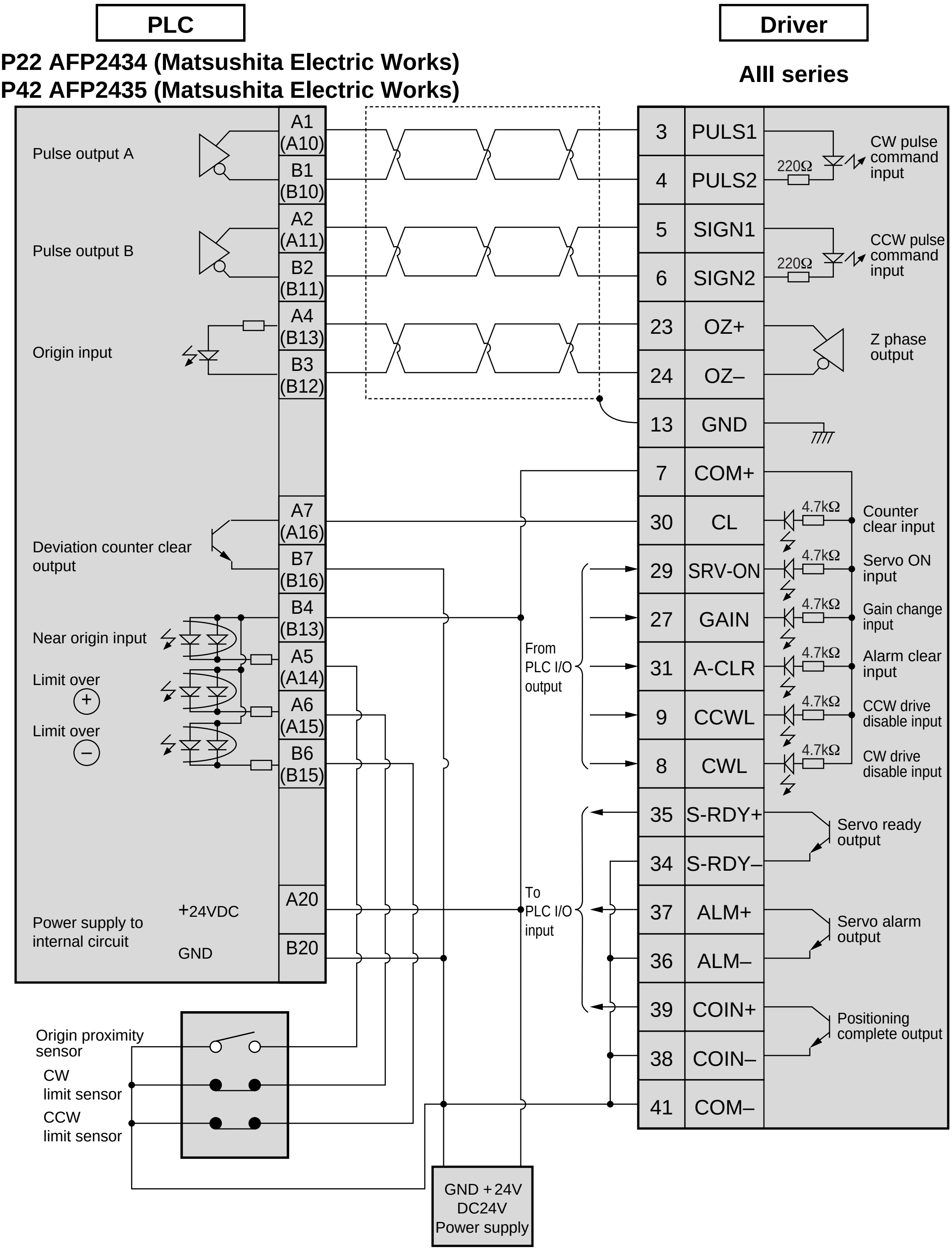
CN X5 Connector

Examples of connection to high order control equipment

Example 1 - PLC: FPG-C32T (Matsushita Electric Works)

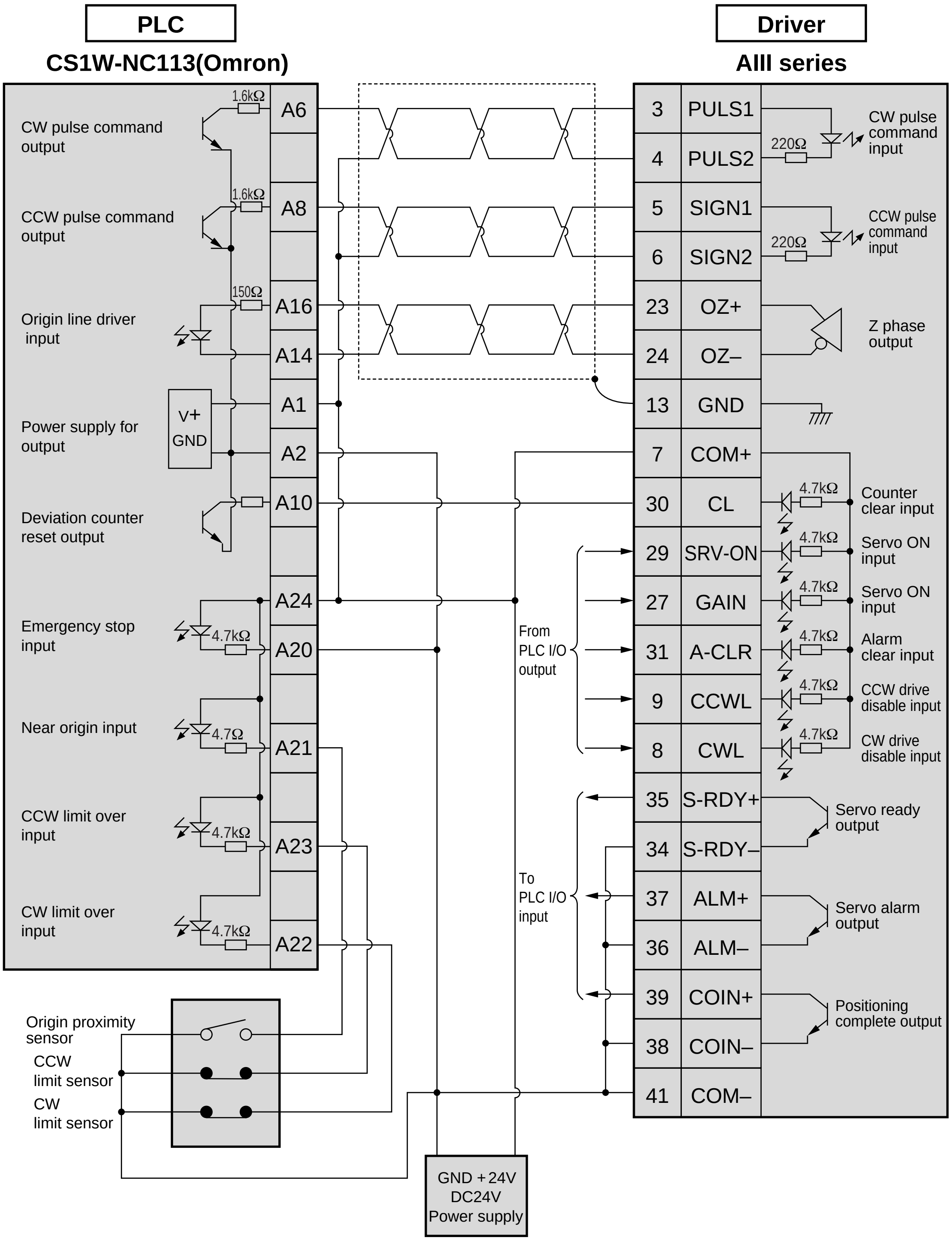


Example 2 - PLC: FP2-PP22 AFP2434/FP2-PP42 AFP2435 (Matsushita Electric Works)

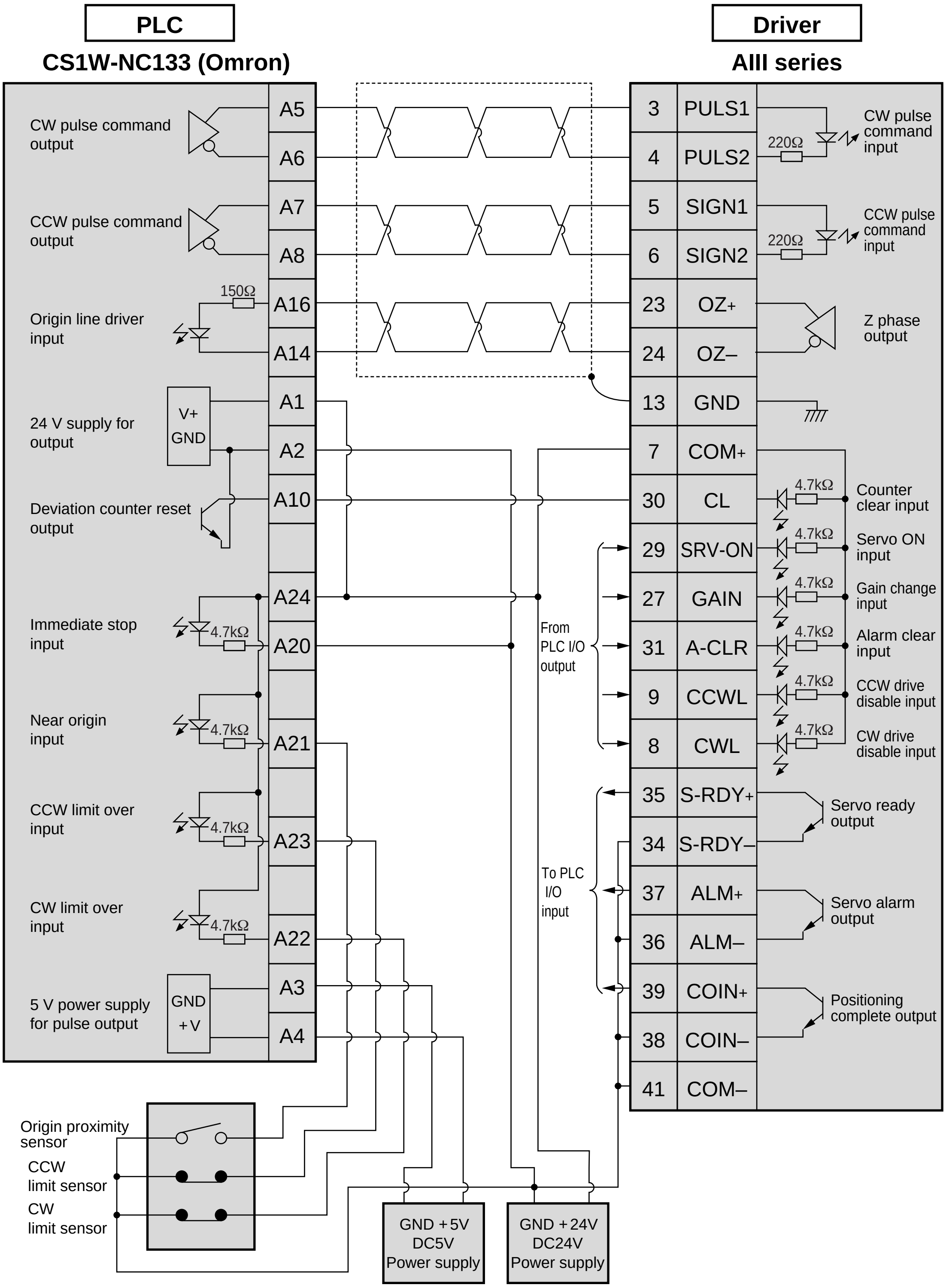


CN X5 Connector

Example 3 - PLC: CS1W-NC113 (Omron)

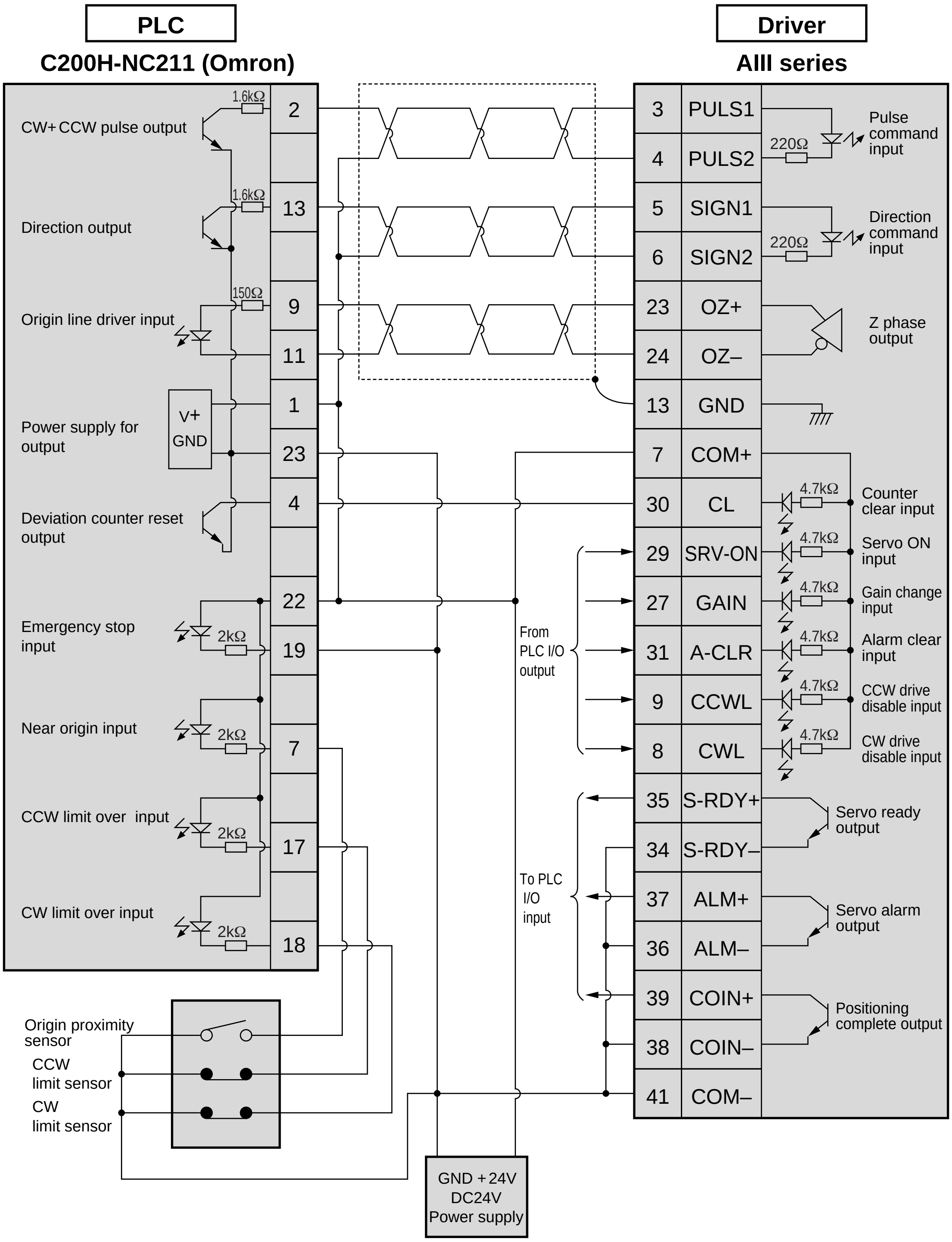


Example 4 - PLC: CS1W-NC133 (Omron)

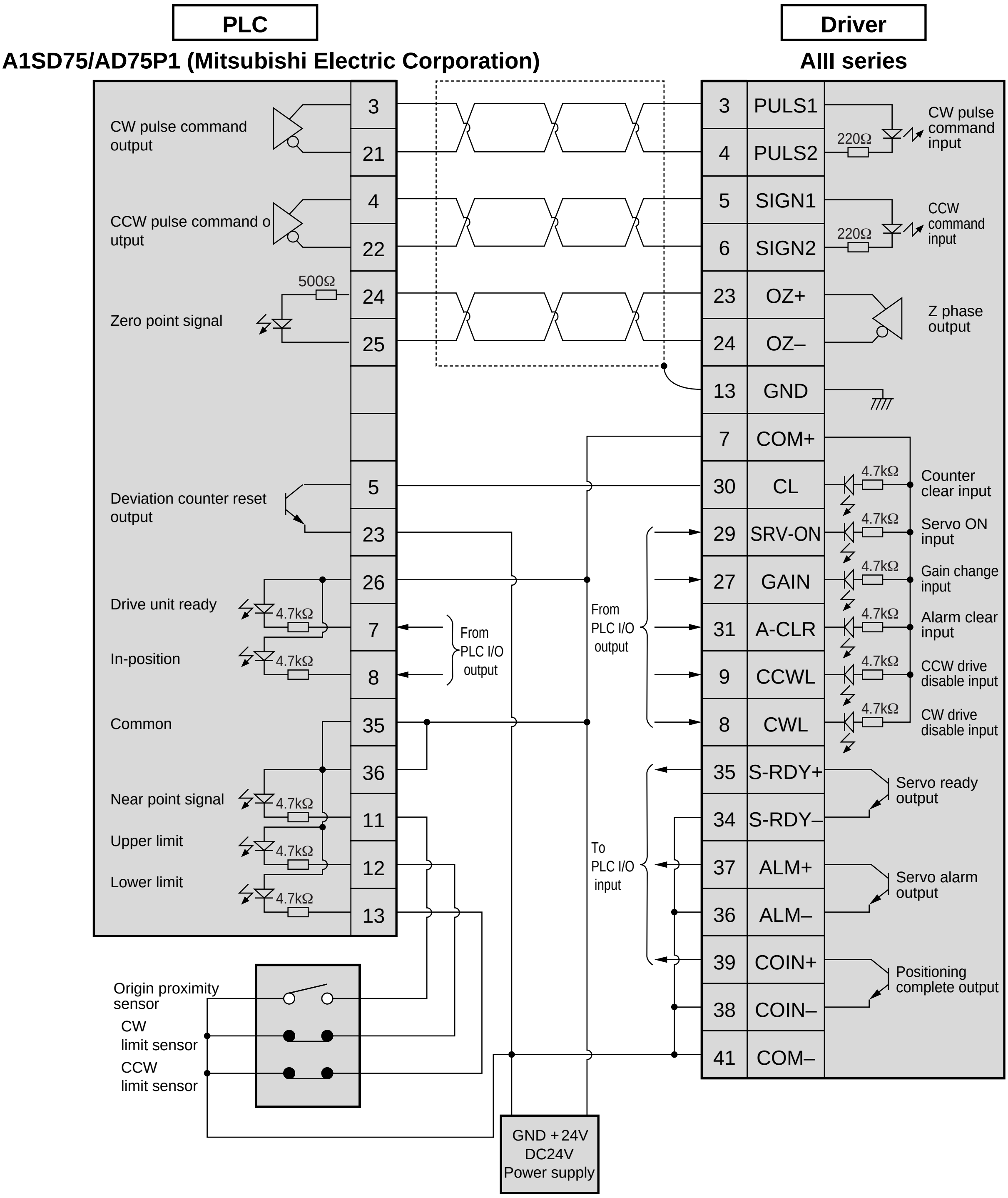


CN X5 Connector

Example 5 - PLC: C200H-NC211 (Omron)



Example 6 - PLC: A1SD75/AD75P1 (Mitsubishi Electric Corporation)



Trial run at Position Control Mode

Operation with CN X5 Connected

1) Connect CN X5.

2) Connect the control signal (COM+ /COM–) to the power supply (12 to 24 VDC) .

3) Turn the main power (driver) ON.

4) Check the defaults of the parameters.

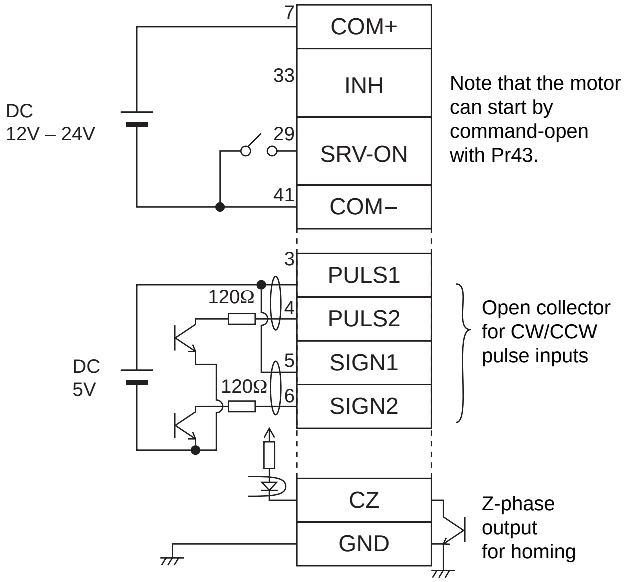
5) Connect between SRV-ON (CN X5 pin 29) and COM– (CN X5 pin 41) to make Servo-On active. The motor will be kept excited.

6) Set Pr42 (Command Pulse Input Mode Set-Up) according to the output form of the controller. Then write it down to EEPROM, followed by turning the power OFF and then ON again.

7) Send a low-frequency pulse signal from the controller to the to run the motor at low speed.

8) Check the motor speed at monitor mode.
- Make sure that the speed is per the set-up.
- Check if the motor stops when the command (pulse) is stopped.

Wiring Diagram



Parameters

PrNo.	Parameter description	Value
Pr02	Control mode set-up	0
Pr04	Overtravel input inhibit	1
Pr42	Command pulse input mode set-up	1
Pr43	Command pulse input inhibit	1

- Use the controller to send command pulses.

Input Signals Status

No.	Input signal	Monitor display	
0	Servo-ON	+ A	
2	CW overtravel inhibit	–	
3	CCW overtravel inhibit	–	
8	Command pulse input inhibit	–	Related to Pr43
A	Counter clear	–	

Set-up of motor speed and input pulse frequency

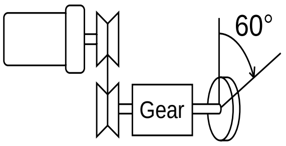
Input pulse frequency (pps)	Motor speed (r/min)	$\frac{\boxed{Pr46} \times 2^{\boxed{Pr4A}}}{\boxed{Pr4B}}$	
		17 bits	2500P/r
500k	3000	$\frac{\boxed{1} \times 2^{\boxed{17}}}{\boxed{10000}}$	$\frac{\boxed{10000} \times 2^{\boxed{0}}}{\boxed{10000}}$
250k	3000	$\frac{\boxed{1} \times 2^{\boxed{17}}}{\boxed{5000}}$	$\frac{\boxed{10000} \times 2^{\boxed{0}}}{\boxed{5000}}$
100k	3000	$\frac{\boxed{1} \times 2^{\boxed{17}}}{\boxed{2000}}$	$\frac{\boxed{10000} \times 2^{\boxed{0}}}{\boxed{2000}}$
500k	1500	$\frac{\boxed{1} \times 2^{\boxed{16}}}{\boxed{10000}}$	$\frac{\boxed{5000} \times 2^{\boxed{0}}}{\boxed{10000}}$

← **Preset value**

* Our preset value causes the motor shaft to rotate by one with 10,000 pulses input. Note that the maximum input pulse frequency is 500 kpps with line driver and 200 kpps with open collector.

* You can set any value by setting any value for the numerator and denominator. However, the motor action will not follow any extreme setting of the ratio. It is recommended to set within a range from 1/50 to 20 times.

Relationship between motor speed and input pulse frequency



Pulley ratio: 18/60
Gear ratio: 12/73
Overall reduction: 18/365

(Example) Rotate the motor by 60 degrees with an overall reduction ratio of 18/365

	Encoder pulse	
	17 bits	2500P/r
$\frac{\boxed{Pr46} \times 2^{\boxed{Pr4A}}}{\boxed{Pr4B}}$	$\frac{\boxed{365} \times 2^{\boxed{10}}}{\boxed{6912}}$	$\frac{\boxed{365} \times 2^{\boxed{0}}}{\boxed{108}}$
Theory	From the controller to the , enter a command with which the motor turns one revolution with 8192 (2^{13}) pulses.	From the controller to the , enter a command with which the motor turns one revolution with 10000 pulses.
Determining the parameter	$\frac{365}{18} \times \frac{1 \times 2^{17}}{2^{13}} \times \frac{60^\circ}{360^\circ}$ $= \frac{\boxed{365} \times 2^{\boxed{17}}}{\boxed{884736}}$ The numerator 47841280 is greater than 2621440, and the denominator is greater than 10,000. Thus, $\frac{365}{18} \times \frac{1 \times 2^{10}}{2^{6}} \times \frac{60^\circ}{360^\circ}$ $= \frac{\boxed{365} \times 2^{\boxed{10}}}{\boxed{6912}}$	$\frac{365}{18} \times \frac{10000}{10000} \times \frac{60^\circ}{360^\circ}$ $= \frac{\boxed{365} \times 2^{\boxed{0}}}{\boxed{108}}$

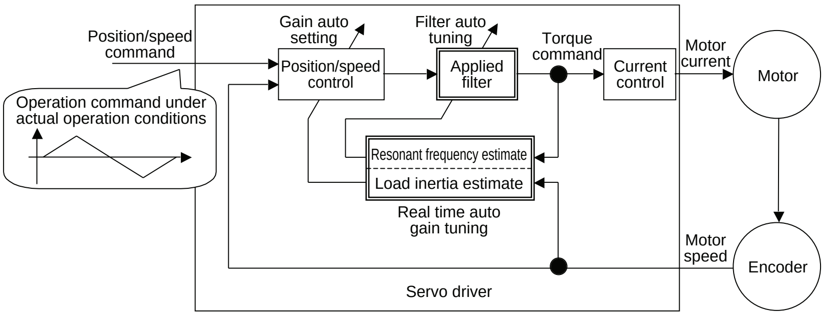
2^n	10 Decimal
2^0	1
2^1	2
2^2	4
2^3	8
2^4	16
2^5	32
2^6	64
2^7	128
2^8	256
2^9	512
2^{10}	1024
2^{11}	2048
2^{12}	4096
2^{13}	8192
2^{14}	16384
2^{15}	32768
2^{16}	65536
2^{17}	131072

* See also “ Description on Command Pulse Ratio for Parameter Setup” on page 264.

Real time auto gain tuning

Outline

Load inertia of the machine is estimated at real time, and the optimum gain is set up automatically based on the estimated result. A load, which has a resonance, also can be handled owing to the adaptive filter.



Application range

Under the following conditions, the real time auto gain tuning may not function properly.
In such case, use the normal mode auto gain tuning (see page 193 "Adjustments") or manual gain tuning (see page 197 "Adjustments").

	Conditions under which the real time auto gain tuning is prevented from functioning
Load inertia	• When the load inertia is smaller/larger than the rotor inertia (3 times or less; or 20 times or more) • When the load inertia fluctuates
Load	• When the machine stiffness is extremely low • When any unsecured part resides in such as backlash, etc.
Operation pattern	• In case of a continuous low speed operation under 100 [r/min] . • In case of soft acceleration/deceleration under 2000 [r/min] per 1 [s] . • When acceleration/deceleration torque is smaller than unbalanced load/viscous friction torque.

How to use

[1] Stop the motor (Servo-OFF).

[2] Set up Pr21 (Real-time auto tuning set-up) to 1 ~ 6.
Set up value before shipment is1.

Setting value	Real-time auto tuning	Changing degree of load inertia during operation	Adaptive filter
0	Not used	–	No
[1]	Used	Little change	Yes
2		Change slowly	
3		Change s haply	
4		Little change	No
5		Change slowly	
6		Change s haply	
7	Not used	–	Yes

When the changing degree of the load inertia is too large, set Pr21 to 3 or 6.
When the influence of resonance is conceivable, select “ adaptive filter YES” .

[3] Set 0 – 2 to Pr22 (real-time auto tuning machine stiffness).

[4] Turn the servo ON to operate the machine ordinarily.

[5] To increase the response performance, gradually increase Pr22 (Machine stiffness at real-time auto tuning). When any noise or vibration is found, decrease the Pr22 to a lower value soon.

[6] To store the result, write the data into the EEPROM.

Description of the adaptive filter

By setting Pr21 (Real-time auto tuning set-up) to 1 – 3 or 7, the adaptive filter is enabled.
In an actual operation state, resonance frequency is estimated based on the vibration component, which appears in motor speed, and resonance point vibration is reduced by removing resonance component from the torque command by the adaptive filter.
The adaptive filter may not function normally under the following conditions. In such a case, take anti-resonance measures using the 1 st . notch frequency (Pr1D and 1E) or second notch filter (Pr28 – 2A) in accordance with the manual tuning procedure.
For details on the notch filter, refer to “ To Reduce the Mechanical Resonance” on page 204.

	Conditions under which the adaptive filter is prevented from functioning
Resonance point	• When the resonance frequency is 300 [Hz] or less • When resonance peak is low, or control gain is low; and its influence does not appear on the motor speed • When plural resonance points reside in
Load	• When a motor speed fluctuation having a high frequency component is caused due to a non-linear element such as backlash etc
Command pattern	• When acceleration/deceleration is too sharp like 30000 [r/min] or more per 1 [s]

Parameters, which are set up automatically

The following parameters
are tuned automatically.

Parameter No.	Name
10	1st position loop gain
11	1st speed loop gain
12	1st speed loop integration time constant
13	1st speed detection filter
14	1st torque filter time constant
18	2nd position loop gain
19	2nd speed loop gain
1A	2nd speed loop integration time constant
1B	2nd speed detection filter
1C	2nd torque filter time constant
20	Inertia ratio
2F	Adaptive filter frequency

The following parameters are also set up
to the following fixed values automatically.

Parameter No.	Name	Set value
15	Speed feed forward	300
16	Feed forward filter time constant	50
17	1st position integration gain	0
1F	2nd position integration gain	0
27	Disturbance torque observer filter selection	0
30	2nd gain action set-up	1
31	Position control switching mode	10
32	Position control switching delay time	30
33	Position control switching level	50
34	Position control switching hysteresis	33
35	Position loop gain switching time	20

Caution

[1] Immediately after the first turning the servo ON at start up, or when Pr22 (Machine stiffness at real-time auto tuning) is stated up, sometimes a noise or vibration may be generated until the load inertia is determined or the adaptive filter is stabilized. But, when the machine gets stabilized soon, there is no problem. But, when such problem as vibration or noise continues during a period of 3 reciprocal operations, etc occurs frequently, take the following measures.
  1) Write the parameter of normal operation into the EEPROM.
  2) Decrease the Pr22 (Machine stiffness at real-time auto tuning).
  *3) Once set up Pr21 (Real-time auto tuning set-up) to 0 to disable the adaptive filter. Then, enable the real time auto tuning again. (resetting of inertia estimate adaptive operation)
  *4) Set up the notch filter manually.
    * When disabling he real time auto tuning, see page 196 "Disabling of auto tuning function" in Adjust ments.

[2] After a noise or vibration has occurred, Pr20 (Inertia ratio) and/or Pr2F (Adaptive filter frequency) may have been changed into an extreme value. In such a case also, take the above measures.

[3] Ithe results of the real time auto gain tuning, Pr20 (Inertia ratio) and Pr2F (Adaptive filter frequency) are written into the EEPROM every 30 minutes. And auto tuning is carried out using the data as the initial value.

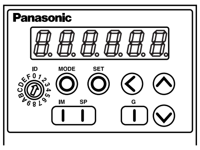
Parameter Setting

Parameters for Function Selection

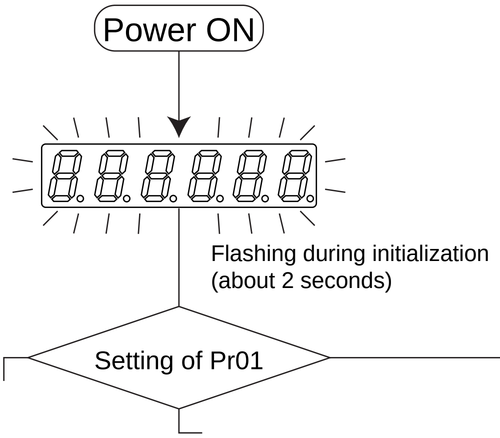
Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Function/Description
00	**Axis address**	0 – 15 [1]	In communications with a host device such as a personal computer that uses RS232C/485 with multiple axes, you should identify to which axis the host accesses and use this parameter to confirm axis address in terms of numerals.

- At power on, settings of the rotary switch ID on the front panel (0 – F) will be programmed into parameters of the driver.
- Settings of Pr00 can be changed only by means of the rotary switch ID.



Parameter No.	Parameter Name	Setting range	Function/Description
01	**LED display at power up**	0 – 15	In the initial condition after turning ON the control power, the following data displayed on the 7-segment LED can be selected.



Setting value	Description
0	Positional deviation
[1]	Motor revolving speed
2	Torque output
3	Control mode
4	I/O signal status
5	Error cause/record
6	Software version
7	Alarm
8	Regenerative load ratio
9	Overload load ratio
10	Inertia ratio
11	Feedback pulse sum
12	Command pulse sum
13	External scale deviation
14	External scale feedback pulse sum
15	Motor auto recognition

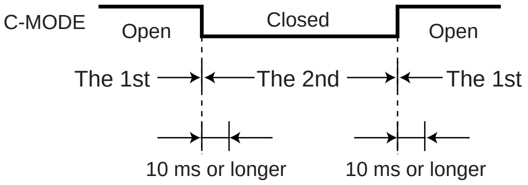
See page 56 "Front Panel Key Operations and Display".

Parameter No.	Parameter Name	Setting range	Function/Description
02	**Control mode**	0 – 14	Select the control mode of the servo driver.

Setting value	Control mode	
	The 1st Mode	The 2nd Mode* 1
0	Position control	–
[1]	Speed control	–
2	Torque control	–
3	Position	Speed control
4	Position	Torque control
5	Speed	Torque control
6	Semi-closed control	–
7	Full-closed control	–
8	Hybrid control	–
9	Speed	External encoder control
10	Speed	Semi-closed control
11	High-stiff equipment position control	–
12	Low-stiff equipment position control	–
13	Low-stiff equipment speed control	–
14	Second full-closed control	–

*1 A special control mode focused on the full-closed specification. For details, refer to " Full-Closed Control" volume on Page 000.

*2 When composite mode (Pr02 = 3,4,5,9,10) is set, you can switch the 1st and 2nd modes with the control mode switch input (C-MODE).



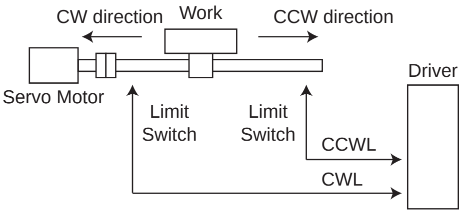
<Caution>
Enter a command after 10ms or longer have passed since C-MODE was entered.
Do not enter any command on position, speed or torque.

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Function/Description
03	**Torque limit selection**	0 – 1 [1]	The parameter is used to disable analog torque limit input (CCWTL, CWTL) signals. 0: Enabled 1: Disabled

If you do not use torque limit functions, set “ 1” to Pr03.
With Pr03 set to “ 0” and torque limit input (CCWTL, CWTL) open, no torque will be generated, and thus the motor does not rotate.

Parameter No.	Parameter Name	Setting range	Function/Description
04	**Overtravel input inhibit**	0 – 1	In the case of linear driving, in particular, to prevent mechanical damage due to overtraveling of work, you should provide limit switches on both ends of the axis, as shown below, whereby driving in a direction of switch action is required to be inhibited.



Setting value	CCWL/CWL Input			Action
		Input	Connection with COM-	
0	Enable	CCWL (CN X5-9 pin)	Connected	Normal condition in which the limit switch on CCW side is not operating.
			Open	CCW direction inhibited, CW direction allowed
		CWL (CN X5-8 pin)	Connected	Normal condition in which the limit switch on CW side is not operating.
			Open	CW direction inhibited, CCW direction allowed
[1]	Disable	Both CCWL and CWL inputs are ignored and they normally operate as no overtravel inhibit being set.		

<Cautions>

1. When you set 0 to Pr04 and do not connect both CCWL and CWL inputs to COM- (off), abnormal condition in which limits are exceeded in both CCW and CW directions is detected, and the driver will then trip due to “ abnormal overtravel input inhibit“ .
2. You can set whether or not to activate the dynamic brake when slowdown occurs because CCW or CW overtravel input inhibit has been enabled. For details, refer to descriptions on Pr66 (DB deactivation at overtravel input inhibit).
3. Work may repeat vertical motion as a result of absence of upward torque after you turned off the limit switch on the upper side of work on the vertical axis. In such a case, you should not use this function, and instead execute limit processing on the host controller side.

Parameter No.	Parameter Name	Setting range	Function/Description
07	**Speed monitor (SP) selection**	0 – 9	The parameter selects/sets a relationship between voltage output to the speed monitor signal output (SP: CN X5 43-pin) and the actual motor speed or command speed.

Setting value	SP Signals	Relationship between Output Voltage Level and Speed
0	Motor Actual Speed	6V / 47 r/min
1		6V / 187 r/min
2		6V / 750 r/min
[3]		6V / 3000 r/min
4		1.5V / 3000 r/min
5	Command Speed	6V / 47 r/min
6		6V / 187 r/min
7		6V / 750 r/min
8		6V / 3000 r/min
9		1.5V / 3000 r/min

Parameter Setting

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Function/Description</th></tr>
<tr><td>08</td><td>Torque monitor (IM) selection</td><td>0 – 12</td><td>The parameter selects/sets a relationship between voltage output to the torque monitor signal output (IM: CN X5 42-pin) and generated torque of the motor or number of deviation pulses.
<table>
<tr><th>Setting value</th><th>IM Signals</th><th>Relationship between output level and torque or number of deviation pulses</th></tr>
<tr><td>[0]</td><td>Torque</td><td>3V / rated (100%) torque</td></tr>
<tr><td>1</td><td rowspan="6">No. of Deviation Pulses</td><td>3V / 31Pulse</td></tr>
<tr><td>2</td><td>3V / 125Pulse</td></tr>
<tr><td>3</td><td>3V / 500Pulse</td></tr>
<tr><td>4</td><td>3V / 2000Pulse</td></tr>
<tr><td>5</td><td>3V / 8000Pulse</td></tr>
<tr><td>6 – 10</td><td>Enabled under full-closed control (See P156 –.)</td></tr>
<tr><td>11</td><td rowspan="2">Torque</td><td>3V / 200% torque</td></tr>
<tr><td>12</td><td>3V / 400% torque</td></tr>
</table></td></tr>
<tr><td>09</td><td>TLC output selection</td><td>0 – 5</td><td>The parameter allocates functions of output in torque limits (TLC: CN X5 40-pin).
<table>
<tr><th>Setting value</th><th>Functions</th><th>Remarks</th></tr>
<tr><td>[0]</td><td>Output in torque limit</td><td rowspan="6">For functional details of respective outputs listed left, refer to "Wiring to Connector CN X5" on page 78.</td></tr>
<tr><td>1</td><td>Output of zero-speed detection</td></tr>
<tr><td>2</td><td>Output of an alarm due to either of over-regeneration/overload/absolute battery</td></tr>
<tr><td>3</td><td>Output of over-regeneration alarm</td></tr>
<tr><td>4</td><td>Output of overload alarm</td></tr>
<tr><td>5</td><td>Output of absolute battery alarm</td></tr>
</table></td></tr>
<tr><td>0A</td><td>ZSP output selection</td><td>0 – 5</td><td>The parameter allocates functions of zero speed detection output (ZSP: CN X5 12-pin).
<table>
<tr><th>Setting value</th><th>Functions</th><th>Remarks</th></tr>
<tr><td>0</td><td>Output in torque limit</td><td rowspan="6">For functional details of respective outputs listed left, refer to "Wiring to Connector CN X5" on page 78.</td></tr>
<tr><td>[1]</td><td>Output of zero-speed detection</td></tr>
<tr><td>2</td><td>Output of an alarm due to either of over-regeneration/overload/absolute battery</td></tr>
<tr><td>3</td><td>Output of over-regeneration alarm</td></tr>
<tr><td>4</td><td>Output of overload alarm</td></tr>
<tr><td>5</td><td>Output of absolute battery alarm</td></tr>
</table></td></tr>
<tr><td>0B</td><td>Absolute encoder set up</td><td>0 – 2</td><td>Listed below are settings when you use the absolute encoder:
<table>
<tr><th>Setting value</th><th>Description</th></tr>
<tr><td>0</td><td>To use the absolute encoder as absolute.</td></tr>
<tr><td>[1]</td><td>To use the absolute encoder as incremental.</td></tr>
<tr><td>2</td><td>To use the absolute encode as absolute. In this case, multi-rotation excess counter is ignored.</td></tr>
</table></td></tr>
<tr><td>0C</td><td>Baud rate of RS232C</td><td>0 – 2</td><td>
<table>
<tr><th>Setting value</th><th>Baud Rate</th></tr>
<tr><td>0</td><td>2400bps</td></tr>
<tr><td>1</td><td>4800bps</td></tr>
<tr><td>[2]</td><td>9600bps</td></tr>
</table></td></tr>
<tr><td>0D</td><td>Baud rate of RS485</td><td>0 – 2</td><td>
<table>
<tr><th>Setting value</th><th>Baud Rate</th></tr>
<tr><td>0</td><td>2400bps</td></tr>
<tr><td>1</td><td>4800bps</td></tr>
<tr><td>[2]</td><td>9600bps</td></tr>
</table></td></tr>
</table>

Parameters for Time Constants of Gains and Filters: Related to Real Time Auto Tuning

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
10	**1st position loop gain**	0 – 32767 [63] *	1/s	• The parameter defines responsiveness of the position control system. Higher position gain would shorten time of positioning.
11	**1st velocity loop gain**	1 – 3500 [35] *	Hz	• The parameter defines responsiveness of the speed loop. You need to set this speed loop gain high so as to improve responsiveness of the entire servo system by increasing position loop gain.
12	**1st velocity loop integration time constant**	1 – 1000 [16] *	ms	• This parameter is an integration element of a speed loop and acts to drive quickly the subtle speed deviation into zero. The smaller the setting is, the faster deviation will be zeroed. • Setting of “ 1000” will remove effects of integration.
13	**1st speed detection filter**	0 – 6 [0] *	–	• The parameter sets in 6 phases (0 to 5) a time constant of the low-pass filter inserted after the block of converting an encoder signal into a speed signal. • Setting this parameter high would increase a time constant, thereby reducing noise of the motor. However, usually use the factory setting (0).
14	**1st torque filter time constant**	0 – 2500 [65] *	0.01ms	• The parameter sets a time constant of the primary delay filter inserted into the torque command unit. • It effects the control of vibration because of the torsion resonance.
15	**Velocity feed forward**	–2000 – 2000 [300] *	0.1%	• The parameter defines volume of speed feed forward under position control. Setting it to 100% would make positional deviation in operation at a constant rate almost 0. When you set it higher, positional deviation will decrease and responsiveness will be improved. Be careful, however, as overshooting is apt to occur.
16	**Feed forward filter time constant**	0 – 6400 [50] *	0.01ms	• The parameter sets a time constant of the primary delay filter inserted into the speed feed forward unit. • Inclusion of the feed forward function would cause speed overshooting/undershooting. Thus, this filter may make improvement when a positioning completion signal is chattering.
17	**1st position integration gain**	0 – 10000 [0] *	x 10/s^2	• The parameter sets integration gain of a position loop. • This is enabled only in control mode HP. **Note)** In order to prevent excessive oscillation, you may set the parameter only in the range that satisfies the following expression for Pr10. (Pr10)^2 ≧ 20 x Pr17
18	**2nd position loop gain**	0 – 32767 [73] *	1/s	• A position loop, speed loop, speed detection filter, and torque command filter, respectively, has 2 pairs of gains or time constants (the 1st and 2nd). • Each function/content is similar to the 1st gain/time constraint, described earlier. • For details on switching of the 1st and 2nd gains or time constants, refer to Adjustment volume on page 186. * Pr11 and Pr19 will be set in terms of (Hz) when Pr20 inertia ratio has been set correctly.
19	**2nd velocity loop gain**	1 – 3500 [35] *	Hz	
1A	**2nd velocity loop integration time constant**	1 – 1000 [1000] *	ms	
1B	**2nd speed detection filter**	0 – 6 [0] *	–	
1C	**2nd torque filter time constant**	0 – 2500 [65] *	0.01ms	
1D	**1st notch frequency**	100 – 1500 [1500]	Hz	• The parameter sets frequency of the resonance suppression notch filter. • You should set it about 10% lower than the resonance frequency of the mechanical system that has been found by the frequency characteristics analysis facility of the setup assisted software “ PANATERM®” . • Setting this parameter ” 1500” would disable the function of notch filter.
1E	**1st notch width selection**	0 – 4 [2]	–	• The parameter sets width of the resonance suppression notch filter in 5 steps. The higher the setting is, the greater the width is. • Normally, use a factory setting.
1F	**2nd position integration gain**	0 – 10000 [0] *	x 10/s^2	• This parameter should be set only when you use the gain switching function to execute optimal tuning. • The parameter sets integration gain. • It is enabled only under control mode HP. Refer to “ Adjustment upon switching gain” of Adjustment volume on page 202.

Note) Standard default setting in [ ] under "Setting range" and marked with * is automatically set during the real time auto gain tuning. To manually change the value, first disable the auto gain tuning feature be seeing page 196 "Disabling of auto tuning function" in Adjustments, and then enter the desired value.

Parameter Setting

Parameters for real time auto gain tuning

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>20</td><td>Inertia ratio</td><td>0 – 10000
[100] *</td><td>%</td><td>• Defines the ratio of load inertia to the motor's rotor inertia.
Pr20 = (rotor inertia / load inertia) x 100[%]
• When you execute auto gain tuning, load inertia will be estimated and the result will be reflected in this parameter.
Pr11 and Pr19 will be set in terms of (Hz) when inertia ratio has been set correctly. When Pr20 inertia ratio is greater than the actual ratio, setting of the speed loop gain will increase. When Pr20 inertia ratio is smaller than the actual ratio, setting of speed loop gain will decrease.</td></tr>
<tr><td>21</td><td>Real time auto tuning set up</td><td>0 – 7</td><td>–</td><td>• Defines the operation mode of real-time auto tuning. Increasing the set value (3, 6,...) provides higher response to the inertia change during operation. However, operation may become unstable depending on the operation pattern. Normally, set this parameter to "1" or "4".
• If you set this parameter to any value other than 0, Pr27 disturbance observer filter selection will be disabled (0). In addition, if you set the adaptive filter to disabled, Pr2F adaptive filter frequency will be reset to 0.
• When Pr20 is "0", Pr2F (Adaptive notch frequency) is reset to "0".
In the torque control mode, the adaptive notch filter is always invalid.
<table>
<tr><th>Setting value</th><th>Real-time Auto GainTuning</th><th>Degree of Changes in Load Inertia</th><th>Adaptive Filter</th></tr>
<tr><td>0</td><td>Not used</td><td>–</td><td>Absent</td></tr>
<tr><td>[1]</td><td>Used</td><td>Hardly changes.</td><td>Present</td></tr>
<tr><td>2</td><td></td><td>Changes moderately.</td><td></td></tr>
<tr><td>3</td><td></td><td>Changes sharply.</td><td></td></tr>
<tr><td>4</td><td></td><td>Hardly changes.</td><td>Absent</td></tr>
<tr><td>5</td><td></td><td>Changes moderately.</td><td></td></tr>
<tr><td>6</td><td></td><td>Changes sharply.</td><td></td></tr>
<tr><td>7</td><td>Not used</td><td>–</td><td>Present</td></tr>
</table>
• Note that any change in this parameter will be enabled when Servo OFF changes to Servo ON.</td></tr>
<tr><td>22</td><td>Machine stiffness at auto tuning</td><td>0 – 15
[4]</td><td>–</td><td>• Defines the machine stiffness during execution of real-time auto tuning.
Low ← Machine stiffness → High
Low ← Servo gain → High
Pr22 | 0 , 1- - - - - - - - - - - - 14, 15
Low ← Responsiveness → High
• If the parameter value is rapidly changed, the gain significantly changes, applying a shock to the machine. Be sure to set a small value first, and increase it gradually, while monitoring the operating condition.</td></tr>
<tr><td>23</td><td>Fit gain function set up</td><td>0 – 2
[2]</td><td>–</td><td>Operation mode of the fit gain function is set. It can be used in position control mode /semi-closed control mode only.
The larger value provides the finer optimum gain.
0: Disabled
(at the same time, Pr24: result of fit gain function tuning is cleared.)
1: Level 1 enabled (optimum rigidity is searched)
2: Level 2 enabled (optimum gain is searched)
See page 190 "Fit Gain Function" in Adjustments.</td></tr>
<tr><td>24</td><td>Result of fit gain function</td><td>–32768 – 32767
[0]</td><td>–</td><td>• The parameter displays the result of tuning of the fit gain function.
• This value is set automatically by the fit gain function; it can not be altered.</td></tr>
<tr><td>25</td><td>Normal auto tuning motion set up</td><td>0 – 7</td><td>–</td><td>• Defines the operation pattern of the normal mode auto tuning.
<table>
<tr><th>Set value</th><th>Number of revolutions</th><th>Revolving direction</th></tr>
<tr><td>[0]</td><td>2[revolution]</td><td>CCW → CW</td></tr>
<tr><td>1</td><td></td><td>CW → CCW</td></tr>
<tr><td>2</td><td></td><td>CCW → CCW</td></tr>
<tr><td>3</td><td></td><td>CW → CW</td></tr>
<tr><td>4</td><td>1[revolution]</td><td>CCW → CW</td></tr>
<tr><td>5</td><td></td><td>CW → CCW</td></tr>
<tr><td>6</td><td></td><td>CCW → CCW</td></tr>
<tr><td>7</td><td></td><td>CW → CW</td></tr>
</table>
Example) Setting this parameter to "0" provides two CCW revolutions and two CW revolutions.</td></tr>
</table>

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>26</td><td>Disturbance torque compensation gain</td><td>0 – 200
[0]</td><td>%</td><td>• When the control mode is HP, LP, LS or UPF, a gain, in which the torque command is multiplied by a disturbance torque estimate value, is set.
• By setting 100 [%] , a torque compensation that clears the disturbance torque is applied.
• When Pr21 real time auto tuning mode setting is altered, Pr26 changes to 0 (disabled).</td></tr>
<tr><td rowspan="2">27</td><td>Disturbance torque observer filter selection</td><td>0 –255</td><td>–</td><td>• Cut-off frequency of the filter for disturbance torque observer is set.
<table>
<tr><th>Set value</th><th>Cutoff Frequency</th></tr>
<tr><td>[0] *</td><td>Disturbance Observer Disabled</td></tr>
<tr><td>1 – 255</td><td>Enabled, filter cutoff frequency [Hz] = 3.7 x setting</td></tr>
</table></td></tr>
<tr><td colspan="4">A larger value provides stronger disturbance suppression; but a larger operation noise is emitted. When using this function, it is necessary to set Pr20 inertia ratio correctly. When Pr.21 real time auto tuning mode setting is altered, Pr27 changes to 0(disabled). Also, while the real time auto tuning is enabled (Pr21 is not 0 or 7), Pr27 is fixed to 0 and the disturbance observer is disabled.</td></tr>
<tr><td>28</td><td>2nd notch frequency</td><td>100 – 1500
[1500]</td><td>Hz</td><td>• Defines the notch frequency of the second resonance suppression notch filter.
• The unit is [Hz] . Match the notch frequency with the machine's resonance frequency.
100 to 1499: Filter enabled 1500: Filter disabled</td></tr>
<tr><td>29</td><td>2nd notch width selection</td><td>0 – 4
[2]</td><td>–</td><td>• Select the notch width of the second resonance suppression notch filter.
• Increasing the set value enlarges the notch width.</td></tr>
<tr><td>2A</td><td>2nd notch depth selection</td><td>0 – 99
[0]</td><td>–</td><td>• Select the notch depth of the second resonance suppression notch filter.
• Increasing the set value reduces the notch depth and the phase delay.</td></tr>
<tr><td>2B</td><td>Vibration suppression frequency</td><td>0 – 500
[0]</td><td>Hz</td><td>• Vibration suppression frequency of the vibration suppression for suppressing vibration at the front end of a load is set. Frequency of vibration at the front end of the load is measured and set. Unit: [Hz]
• Minimum setting frequency is 10 [Hz] . When it is set to 0 - 9, it is disabled.
• Before using this function, see page 211 "Vibration suppression control" in Adjustments.</td></tr>
<tr><td>2C</td><td>Vibration suppression filter</td><td>–20 – 250
[0]</td><td>Hz</td><td>• When setting Pr2B (vibration reducing frequency), if torque saturation occurs, set a larger value; if a faster operation is required, set a smaller value.
• Before using this function, see page 211 "Vibration suppression control" in Adjustments.</td></tr>
<tr><td>2F</td><td>Adaptive filter frequency</td><td>0 – 64
[0] *</td><td>–</td><td>• Table No. corresponding to the frequency of the applied filter is displayed. (See page 196)
• When the applied filter is enabled (when Pr21 (real time auto tuning mode setting) is 1-3,7), this parameter is set automatically and can not be altered.
0: Filter disabled 1 - 64: Filter enabled
Before using this function, see page 196 “ Disabling of auto tuning function” in adjustments.
• When the applied filter is enabled, the parameter is stored in the EEPROM every 30 minutes. And when the applied filter is enabled at turning ON the power next time, the data stored in the EEPROM is used as the initial value to adapt the operation.
• When clearing the parameter to reset the adapted operation due to unsatisfactory operation, once set the applied filter disabled (set Pr21 (real time auto tuning mode setting) to other than 1 - 3, 7), and make it enabled again.
Refer to “ Control of Vibration Damping” of Adjustment volume on page 211.</td></tr>
</table>

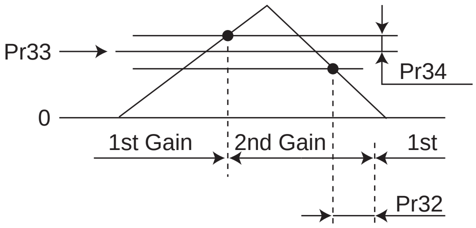
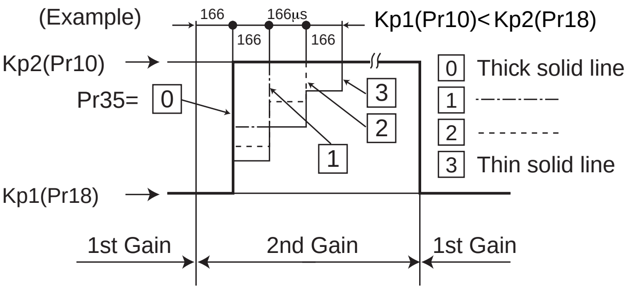
Note) Standard default setting in [ ] under "Setting range" and marked with * is automatically set during the real time auto gain tuning. To manually change the value, first disable the auto gain tuning feature be seeing page 196 "Disabling of auto tuning function" in Adjustments, and then enter the desired value.

Parameters for Switching to 2nd Gains

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>30</td><td>2nd gain action set up</td><td>0 – 1</td><td>–</td><td>• The parameter selects switching of PI/P operation and the 1st/2nd gain switching.
<table>
<tr><th>Setting value</th><th>Gain Selection/Switching</th></tr>
<tr><td>0</td><td>The 1st Gain (Possible to switch PI/P) *1</td></tr>
<tr><td>[1] *</td><td>Possible to switch the 1st/2nd gain *2</td></tr>
</table>
*1 Switching of 1 PI/P operation is done through gain switching input (GAIN CN X5 27-pin).
<table>
<tr><th>GAIN input</th><th>Operation of speed loop</th></tr>
<tr><td>Open with COM–</td><td>PI operation</td></tr>
<tr><td>Connect to COM–</td><td>P operation</td></tr>
</table>
*2 For conditions of switching between the 1st and 2nd gains, refer to “ Adjustment upon switching gain” of Adjustment volume on page 202.</td></tr>
<tr><td rowspan="3">31</td><td>Position control switching mode</td><td>0 –10</td><td>–</td><td>• The parameter selects conditions of switching the 1st and 2nd gains in position control mode.</td></tr>
<tr><td colspan="4">
<table>
<tr><th>Setting value</th><th>Conditions for Switching Gains</th></tr>
<tr><td>0</td><td>Fixed to the 1st gain.</td></tr>
<tr><td>1</td><td>Fixed to the 2nd gain.</td></tr>
<tr><td>2</td><td>The 2nd gain is selected with gain switching input (GAIN) turned ON (Pr30 needs setting of 1).</td></tr>
<tr><td>3 *3</td><td>Torque command variation is greater than setting of Pr33 (position control switching level) and Pr14, and the 2nd gain is selected.</td></tr>
<tr><td>4 *3</td><td>Fixed to the 1st gain.</td></tr>
<tr><td>5 *3</td><td>Command speed is greater than setting of Pr33 (position control switching level) and Pr14, and the 2nd gain is selected.</td></tr>
<tr><td>6 *3</td><td>Positional deviation is greater than setting of Pr33 (position control switching level) and Pr14, and the 2nd gain is selected.</td></tr>
<tr><td>7 *3</td><td>Position command is present and the 2nd gain is selected.
The 2nd gain is selected when the command pulse is 1 or higher in 166ms.</td></tr>
<tr><td>8 *3</td><td>The 2nd gain is selected with positioning not complete.
The 2nd gain is selected when a value of the positional deviation counter is greater than Pr60 (positioning completion range).</td></tr>
<tr><td>9 *3</td><td>Motor actual speed is greater than setting of Pr33 (position control switching level) and Pr34, and the 2nd gain is selected.</td></tr>
<tr><td>[10] * *3</td><td>Switching to the 2nd gain with position command present.
Switching to the 1st gain when absence of position command continues for Pr32 (x 166ms) and speed falls below Pr33 - Pr34 [r/min] .</td></tr>
</table>
</td></tr>
<tr><td></td><td></td><td></td><td>*3 For levels to be switching and timing, refer to "Adjustment upon switching gain" of Adjustment volume on page 202.</td></tr>
<tr><td>32</td><td>Position control switching delay time</td><td>0 – 10000
[30] *</td><td>x 166μs</td><td>• The parameter sets delay time of diversion from switching conditions set with Pr31 to actual return to the 1st gain, when Pr31 is enabled at settings of 3, 5, 6, 7, 9, and 10.</td></tr>
<tr><td>33</td><td>Position control switching level</td><td>0 – 20000
[50] *</td><td>–</td><td>• The parameter sets judgment level upon switching between the 1st and the 2nd gains, when Pr31 is enabled at settings of 3, 5, 6, 9, and 10.</td></tr>
</table>

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
34	**Position control switching hysteresis**	0 – 20000 [33] *	–	• The parameter sets width of hysteresis to be provided above and under the judgment level set with Pr33 mentioned above. • The following figure shows definitions of the above-mentioned Pr32 (delay), Pr33 (level) and Pr34 (hysteresis).  **<Caution>** Settings of Pr33 (level) and Pr34 (hysteresis) are enabled as an absolute value (positive/negative).
35	**Position gain switching time**	0 – 10000 [20] *	(Setting + 1) x 166μs	• The parameter sets stepped switching time only for position loop gain upon switching gains when the 2nd gain switching function has been enabled.  • Switching time should be provided only when a small position loop gain is switched to a large position loop gain (Kp1 → Kp2). (This is to alleviate impact on the machine due to rapid change of gain.) • You should set a value smaller than a difference of Kp2 and Kp1.

Parameters for Position Control

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Function/Description
40	**Command pulse multiplier set up**	1 – 4	• The parameter sets a multiply when “ 2-phase pulse input” has been selected as a command pulse form with Pr42 (command pulse input mode setting).
41	**Command pulse logic inversion**	0 – 3	• Each of logics of 2 pulse command input (PULS, SIGN) systems can be individually set inside the driver.

Setting value	Multiply when 2-phase pulse is input
1	x 1
2	x 2
3 or [4]	x 4

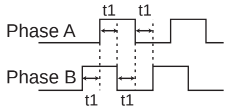
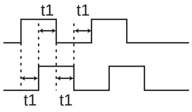
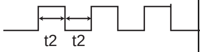
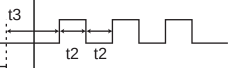
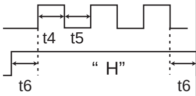
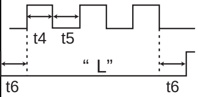
Setting value	“ PULS” Signal Logic	“ SIGN” Signal Logic
[0]	Non-inverting	Non-inverting
1	Inverting	Non-inverting
2	Non-inverting	Inverting
3	Inverting	Inverting

Note) Standard default setting in [ ] under "Setting range" and marked with * is automatically set during the real time auto gain tuning. To manually change the value, first disable the auto gain tuning feature be seeing page 196 "Disabling of auto tuning function" in Adjustments, and then enter the desired value.

Parameter Setting

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Function/Description
42	**Command pulse input mode**	0 – 3	• The parameter sets an input form of a command pulse to be given from the host device to the driver. Three types of forms listed in the following table can be set. Make selection in accordance with specifications of the host device.

Setting value	Command pulse form	Signal Name	CCW Command	CW Command
0 or 2	90° phase difference Two-phase pulse (Phase A + Phase B)	PULS SIGN	 Phase B advances 90° ahead of phase A.	 Phase B delays 90° from phase A
[1]	CW pulse train + CCW pulse train	PULS SIGN		
3	Pulse train + symbols	PULS SIGN		

Allowed maximum input frequency and required minimum time width of command pulse input signal

Input I/F of PULS/SIGN signals	Allowed maximum input frequency	Required minimum time width [µs]					
		t1	t2	t3	t4	t5	t6
Line driver interface	500kpps	2	1	1	1	1	1
Open collector interface	200kpps	5	2.5	2.5	2.5	2.5	2.5

Pulse rise/fall time of command pulse input signal should be set to no more than 0.1µs.

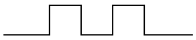
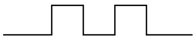
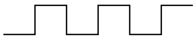
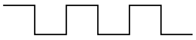
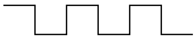
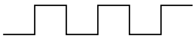
Parameter No.	Parameter Name	Setting range	Function/Description
43	**Command pulse inhibit input invalidation**	0 – 1	• The parameter selects enable/disable of command pulse inhibit input INH: CN X5 33-pin).

Setting value	INH Input
0	Enable
[1]	Disable

With INH input, connection with COM- will be open, and command pulse input will be inhibited. If you do not use INH input, set 1 to Pr43. You no longer need to connect INH (CN 1/F 33-pin) and COM- (41-pin) external to the driver.

Parameter No.	Parameter Name	Setting range	Function/Description
44	**Output pulses per single turn**	1 – 16384 [2500]	The parameter sets number of pulses per one revolution of encoder pulse to be output to the host device. The pulse will be set in dividing. You should directly set in this parameter the number of pulses per revolution needed for your device/system in terms of [Pulse/rev] .
45	**Pulse output logic inversion**	0 – 1	In a relationship of phases of output pulse from the rotary encoder, Phase B pulse is behind pulse A when the motor rotates in CW direction. (Phase B pulse advances ahead of phase A pulse, when the motor rotates in CCW direction.)

Inversion of logic of phase B pulse with this parameter could invert a phase relation of phase B pulse to phase A pulse.

Setting value		IWhen Motor is Rotating in CCW direction	IWhen Motor is Rotating in CW direction
	A pulse(OA)		
[0]	B pulse(OB) Non-inverting		
1	B pulse(OB) Inverting		

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Function/Description
46	Related to command pulse multiply division function (Pr46 to 4B)		
	1st numerator of command pulse ratio	1 – 10000 [10000]	
47	**2nd numerator of command pulse ratio**	1 – 10000 [10000]	
48	**3rd numerator of command pulse ratio**	1 – 10000 [10000]	
49	**4th numerator of command pulse ratio**	1 – 10000 [10000]	
4A	**Multiplier of numerator of command pulse ratio**	0 – 17 [0]	
4B	**Denominator of command pulse ratio**	1 – 10000 [10000]	

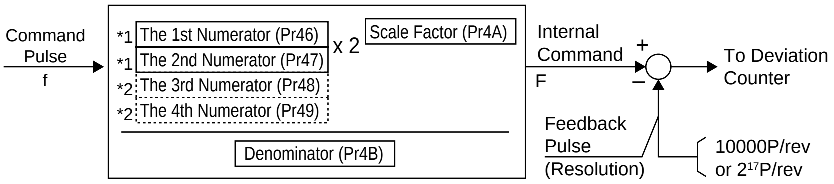
Command pulse multiply division (electronic gear) function

Purpose of Use

1) To arbitrarily set rotation/movement of the motor per unit input command pulse.

2) In the case predetermined motor speed cannot be achieved because of limited pulse oscillation capacity (highest possible output frequency) of the host device, multiply function should be used to increase seeming command pulse frequency.

- Block Diagram of Multiply Division Unit:



- An upper limit of computed value of a numerator will be 2621440. Note that even when you set a value higher than this, it will become invalid and 2621440 will be a numerator.

*1: Select the 1st or 2nd numerator by means of command multiply division switching (DIV:CN X5 28-pin).

DIV Off	Select the first numerator (Pr46).
DIV ON	Select the second numerator (Pr47).

*2: 3rd and 4th numerators are used for special specifications such as full-closed specification. For further information, refer to " Full-Closed Control" volume on page 156.

<Examples of Setting>

- It is basic to have a relation " a motor rotates once with command input (f) for resolution of an encoder" when the multiply division ratio is 1.
  Therefore, to rotate the motor once as an example of the case in which the encoder has resolution of 10000P/r, f=5000Pulse at multiply of 2 and f=40000Pulse at 1/4 division should be input.
- Pr46, Pr4A and Pr4B should be set so that internal command after multiply division will be equal to resolution of the encoder (i.e., 10000 or 2^{17}).

$$F = f \text{ x } \frac{Pr46 \text{ x } 2^{Pr4A}}{Pr4B} = 10000 \text{ or } 2^{17}$$

F: Number of internal command pulses for one revolution of the motor

f: Number of command pulses for one revolution of the motor

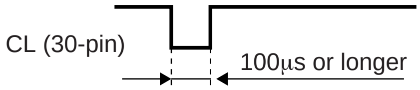
Resolution of Encoder	2^{17} (131072)	10000 (2500P/r x 4)
Example 1: When command input (f) is set to 5000 per revolution of the motor]	$\frac{Pr46\ \boxed{1} \text{ x } 2^{Pr4A\ \boxed{17}}}{Pr4B\ \boxed{5000}}$	$\frac{Pr46\ \boxed{10000} \text{ x } 2^{Pr4A\ \boxed{0}}}{Pr4B\ \boxed{5000}}$
Example 2: When command input (f) is set to 40000 per revolution of the motor]	$\frac{Pr46\ \boxed{1} \text{ x } 2^{Pr4A\ \boxed{15}}}{Pr4B\ \boxed{10000}}$	$\frac{Pr46\ \boxed{2500} \text{ x } 2^{Pr4A\ \boxed{0}}}{Pr4B\ \boxed{10000}}$

Note) Standard default setting in [ ] under "Setting range" and marked with * is automatically set during the real time auto gain tuning. To manually change the value, first disable the auto gain tuning feature be seeing page 196 "Disabling of auto tuning function" in Adjustments, and then enter the desired value.

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Function/Description</th></tr>
<tr><td>4C</td><td>Smoothing filter</td><td>0 – 7</td><td>A smoothing filter is a primary delay filter inserted after command multiply division unit of command pulse input unit.

Purpose of Smoothing Filter:
• Basically, it is to alleviate stepped movement of the motor when a command pulse is rough.
• Following are the specific examples in which a command pulse becomes rough:
1) When a multiply ratio is set for command multiply division (10 times or higher)
2) When command pulse frequency is low in some cases

• A time constant of the smoothing filter should be set in 8 steps with Pr4C.
<table>
<tr><th>Setting value</th><th>Time constant</th></tr>
<tr><td>0</td><td>No filter function</td></tr>
<tr><td>[1]</td><td>Small time constant</td></tr>
<tr><td>≀</td><td>↓</td></tr>
<tr><td>7</td><td>Great time constant</td></tr>
</table></td></tr>
<tr><td>4D</td><td>Counter clear input</td><td>0 – 1</td><td>The parameter sets clear conditions of counter clear input signal for clearing the deviation counter (CL: CNX5 30-pin).
<table>
<tr><th>Setting value</th><th>Clear Conditions</th></tr>
<tr><td>[0]</td><td>Clear at level (*1).</td></tr>
<tr><td>1</td><td>Clear at edge (falling edge).</td></tr>
</table>
*1: Minimum time width of CL signal

</td></tr>
<tr><td>4E</td><td>FIR filter 1 set up</td><td>0 – 31
[0]</td><td>• The parameter selects a FIR filter to be applied to a command pulse.
• This is enabled only when command mode is HP and LP.
• It will be a moving average filter for (setting + 1) times.
• Note that any change to this parameter will become valid only after you reset the power source.</td></tr>
<tr><td>4F</td><td>FIR filter 2 set up</td><td>0 – 31
[0]</td><td>• Select the FIR filter for speed feedforward.
• The parameter selects a FIR filter to be applied to the speed feed forward filter.
• This is enabled only when Control mode is HP.
• The filter is a moving average filter (the number of averaging: Set value + 1).
• Note that a change of this parameter becomes valid after the power supply is reset.</td></tr>
</table>

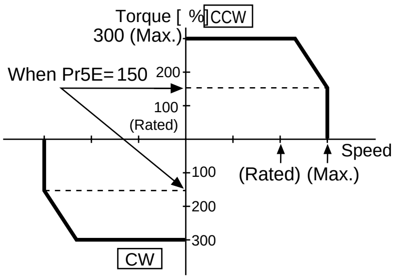
Parameters for Speed Control

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
57	**JOG speed set up**	0 —500 [300]	r/min	The parameter directly sets JOG speed in JOG run in motor trial run mode in terms of [r/min] . For details on JOG function, refer to Trial Run (JOG) of Preparations volume on page 68.

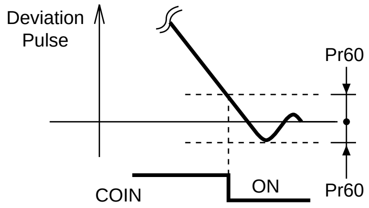
Parameters for Torque Control

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
5E	**Torque limit**	0 – 500	%	• This function limits maximum torque of the motor through setting of parameters within the driver. • In normal specifications, torque about 3 times higher than the rated is allowed for an instant. This parameter limits the maximum torque, however, if the triple torque may cause a trouble in the strength of motor load (machine). • Setting should be given as a % value to rated torque. • The right figure shows a case in which the maximum torque is limited to 150%. • Pr5E limits maximum torque in both CW and CCW directions simultaneously.  **<Caution>** You cannot set this parameter to a value above a factory setting of the system parameter (i.e., a factory set parameter that cannot be changed through of PANATERM® and panel manipulation) “ Maximum Output Torque Setting” . A factory setting may vary depending on a combination of an driver and motor. For further information, refer to “ Pr5E Setting of Torque Limit” of Preparations volume on page 55.

Parameters for various sequences

Default setting is shown by [ ]

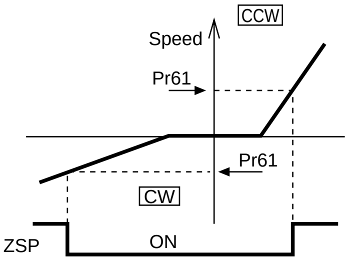
Parameter No.	Parameter Name	Setting range	Unit	Function/Description
60	**In-position range**	0 – 32767 [131]	Pluse	• The parameter sets timing to output a positioning completion signal (COIN: CN X5 39-pin) when movement of the motor (work) is complete after input of a command pulse ends. • A positioning completion signal (COIN) is output when the number of pulses of the deviation counter is within ± (setting). • A basic unit of deviation pulse is “ resolution” of an encoder you will use. Thus, be careful because it varies depending on an encoder, as shown below: 1) 17-bit encoder: 2^{17} = 131072 2) Encoder of 2500 P/rev: 4 x 2500 = 10000 **<Cautions>** 1.Setting Pr60 too small might extend time till COIN signal is output or cause chattering upon output. 2.Setting of “ Positioning Completion Range” will have no effect on final positioning precision. 

Parameter Setting

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>61</td><td>Zero speed</td><td>0 – 20000
[50]</td><td>r/min</td><td>
- The parameter directly sets timing to an output zero speed detection output signal (ZSP: CN X5 12-pin) in terms of [r/min] .
- A zero speed detection signal (ZSP) is output when motor speed falls below the speed set with this parameter Pr61.

- Setting of Pr61 acts on both CW and CCW directions, irrespective of rotating direction of the motor.
- There is hysteresis of 10rpm. The parameter should be set to 10 or greater.



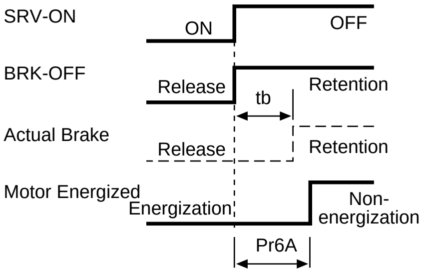
</td></tr>
<tr><td>63</td><td>Position error set up</td><td>1 – 32767
[25000]</td><td>–</td><td>
The parameter sets a detection level of “ protection against excessive positional deviation” function when it is determined that positional deviation is excessive, by using the number of residual pulses.

- Calculate a setting value following the expression shown below:

$$\text{Setting value} = \frac{\text{Positional deviation excess determination level [PULSE]}}{256}$$

<Note>
Note that setting this Pr63 too small, in particular, when positional gain is set low might activate protection against excessive positional deviation even though there was no abnormality.
</td></tr>
<tr><td>64</td><td>Position error invalidation</td><td>0 – 1</td><td>–</td><td>
This parameter disables “ protection against excessive positional deviation” .
<table>
<tr><th>Setting value</th><th>Protection against excessive positional deviation</th></tr>
<tr><td>[0]</td><td>Enabled</td></tr>
<tr><td>1</td><td>Disabled. Operation will continue without determining abnormality, even though positional deviation pulses exceed the judgment level set with Pr63.
If you make a mistake in phase sequence or wiring of the encoder, runaway may occur. You should install a safeguard against runaway in the device.</td></tr>
</table>
</td></tr>
<tr><td>65</td><td>Undervoltage error response at main power-off</td><td>0 – 1</td><td>–</td><td>
The parameter sets whether to enable the “ protection against main power source under-voltage” function when you shut down the main power of main and control power supplies.
<table>
<tr><th>Setting value</th><th>Main Power Source Under-voltage Protection Action</th></tr>
<tr><td>0</td><td>In this case, if you shut off the main power during Servo ON, it will be SERVO-OFF without a trip. Then, when the main power supply turns ON again, it will be recovered to Servo ON.</td></tr>
<tr><td>[1]</td><td>Shutting off main power during Servo ON will activate abnormal main power supply under-voltage (alarm code No.13) and cause a trip.</td></tr>
</table>
Refer to the timing chart “ At Power ON” of Preparations volume on page 40.
</td></tr>
<tr><td>66</td><td>Dynamic breke inhibition at overtravel limit</td><td>0 – 1</td><td>–</td><td>
The parameter sets driving conditions at decelerated operation after overtravel input inhibit (CCWL: connector CN X5 9-pin or CWL: connector CN X5 8-pin) has been activated and enabled.
<table>
<tr><th>Setting value</th><th>Driving Conditions from Deceleration to Stop</th></tr>
<tr><td>[0]</td><td>The motor decelerates and stops as the dynamic brake (DB) is operated. The motor will be in free condition after it stops.</td></tr>
<tr><td>1</td><td>Free running, the motor decelerates and stops. The motor will be in free condition after it stops.</td></tr>
</table>
</td></tr>
</table>

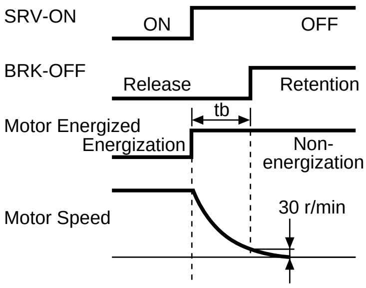
Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>67</td><td>Error response at main power-off</td><td>0 – 7</td><td>–</td><td>The parameter sets:
(1) Driving conditions during deceleration and after stopping; and
(2) Processing to clear content of the deviation counter
after the main power source is shut off.
<table>
<tr><th rowspan="2">Setting value</th><th colspan="2">Driving Conditions</th><th rowspan="2">Content of Deviation Counter</th></tr>
<tr><th>During Deceleration</th><th>After Stopped</th></tr>
<tr><td>[0]</td><td>DB</td><td>DB</td><td>Clear</td></tr>
<tr><td>1</td><td>Free Run</td><td>DB</td><td>Clear</td></tr>
<tr><td>2</td><td>DB</td><td>Free</td><td>Clear</td></tr>
<tr><td>3</td><td>Free Run</td><td>Free</td><td>Clear</td></tr>
<tr><td>4</td><td>DB</td><td>DB</td><td>Retention</td></tr>
<tr><td>5</td><td>Free Run</td><td>DB</td><td>Retention</td></tr>
<tr><td>6</td><td>DB</td><td>Free</td><td>Retention</td></tr>
<tr><td>7</td><td>Free Run</td><td>Free</td><td>Retention</td></tr>
</table>
DB: Activation of dynamic brake</td></tr>
<tr><td>68</td><td>Error response action</td><td>0 – 3</td><td>–</td><td>The parameter sets driving conditions during deceleration or following stop, after any of protective functions of the driver has been activated and alarm has been generated.
<table>
<tr><th rowspan="2">Setting value</th><th colspan="2">Driving Conditions</th><th rowspan="2">Content of Deviation Counter</th></tr>
<tr><th>During Deceleration</th><th>After Stopped</th></tr>
<tr><td>[0]</td><td>DB</td><td>DB</td><td>Clear</td></tr>
<tr><td>1</td><td>Free Run</td><td>DB</td><td>Clear</td></tr>
<tr><td>2</td><td>DB</td><td>Free</td><td>Clear</td></tr>
<tr><td>3</td><td>Free Run</td><td>Free</td><td>Clear</td></tr>
</table>
(DB: Activation of dynamic brake)
See also “ When Abnormality (Alarm) Occurs (Serve ON Command State)” of the timing chart, Preparations volume on page 41.</td></tr>
<tr><td>69</td><td>Sequence at Servo-OFF</td><td>0 – 7
[0]</td><td>–</td><td>• The parameter sets:
1) Driving conditions during deceleration or after stop
2) Processing to clear the deviation counter
following Servo off (SRV-ON signal: CN X5 29-pin turns On ‡ Off).
• A relationship between setting of Pr69 and driving conditions/deviation counter processing conditions is similar to that of Pr67 (Sequence at Main Power Off).
• See also “ Serve On/Off Operation When the Motor Stops” of the timing chart of Preparations volume on page 42.</td></tr>
<tr><td>6A</td><td>Mechanical brake delay at motor standstill</td><td>0 – 100
[0]</td><td>2ms</td><td>The parameter sets time till non-energization of motor (servo free) after the brake release signal (BRK-OFF) turns off (brake retained), at Serve Off while the motor stops.
• In order to prevent minor movement/drop of the motor (work) due to operation delay time of the brake (tb): Setting of Pr6A ≧ tb.
• See “ Serve On/Off Operation When the Motor Stops” of the timing chart on page 42.


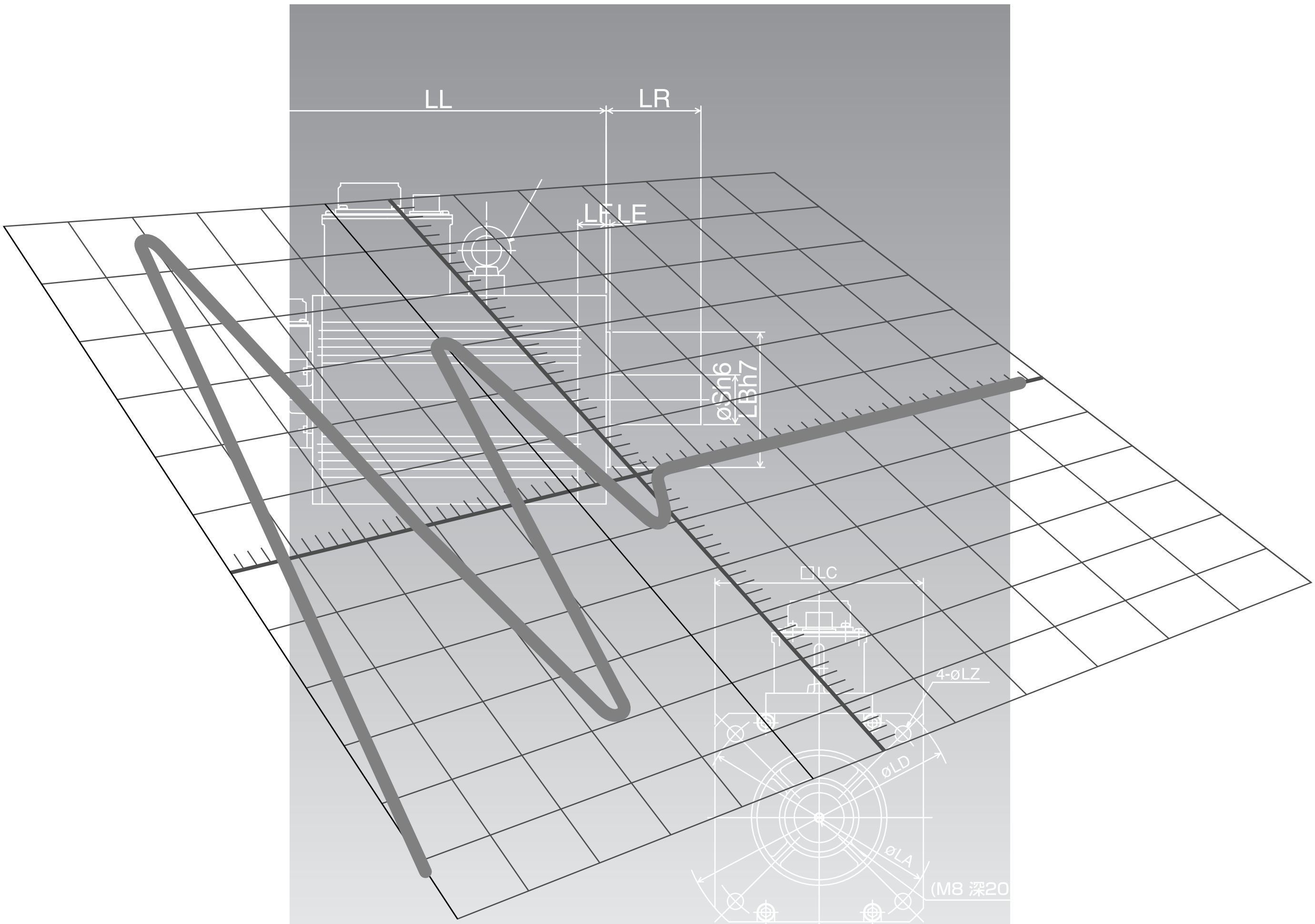
See also “ Serve On/Off Operation When the Motor Stops” of the timing chart of Preparations volume on page 43.</td></tr>
</table>

Parameter Setting

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>6B</td><td>**Mechanical brake delay at motor in motion**</td><td>0 – 100
[0]</td><td>2ms</td><td>Unlike Pr6A, the parameter sets time till brake release signal (BRK-OFF) turns off (brake retained) after motor non-energization (servo-free), at Servo off while the motor is rotating.
• This should be set to prevent deterioration of the brake due to revolutions of the motor.
• At Servo off while the motor is rotating, time tb in the right figure will be either set time of Pr6B or time till the motor rotational speed falls below approximately 30r/min, whichever is smaller.


• See “ Serve On/Off Operation When the Motor is Rotating” of the timing chart of on page 43.
See also “ Serve On/Off Operation When the Motor Stops” of the timing chart of Preparations volume on page 42.</td></tr>
<tr><td>6C</td><td>**External regenerative resister set up**</td><td>0 – 3</td><td>–</td><td>This parameter is set depending on whether to use regeneration resistance built in the driver, or to provide a regeneration resistance in the external (connect between RB1 and RB2 of connector CN X 2 in types A to D, and between terminal blocks P and B2 in types E - G).
<table>
<tr><th>Setting value</th><th>Regeneration Resistance to Use</th><th>Protection against Regeneration Resistance Overload</th></tr>
<tr><td>[0]</td><td>Built-in resistance</td><td>According to built-in resistance, (about 1% duty) protection against regeneration resistance overload works.</td></tr>
<tr><td>1</td><td>External resistance</td><td>This is activated with operating limits of the external resistance at 10% duty.</td></tr>
<tr><td>2</td><td>Built-in resistance</td><td>This is activated with operating limits of the external resistance at 100% duty.</td></tr>
<tr><td>3</td><td>External resistance</td><td>Regeneration resistance does not work, and a built-in condenser accommodates all regenerated power.</td></tr>
</table>
<Request>
When you use an external regeneration, you must install external safeguards such as a temperature fuse, etc.
Otherwise, as protection of regeneration resistance would be lost, causing abnormal heat generation and burnout.
<Caution>
Be careful not to touch an external regeneration resistance.
While you are using an external resistance, it may become hot and scald you. For type A, only external regeneration resistance is used.</td></tr>
<tr><td>6D</td><td>**Main power-off detection time**</td><td>0 – 32767
[35]</td><td>2ms</td><td>The parameter sets time to detect shut-off when shut-off of main power supply continues.</td></tr>
</table>



[Connections and Settings in Speed Control Mode]

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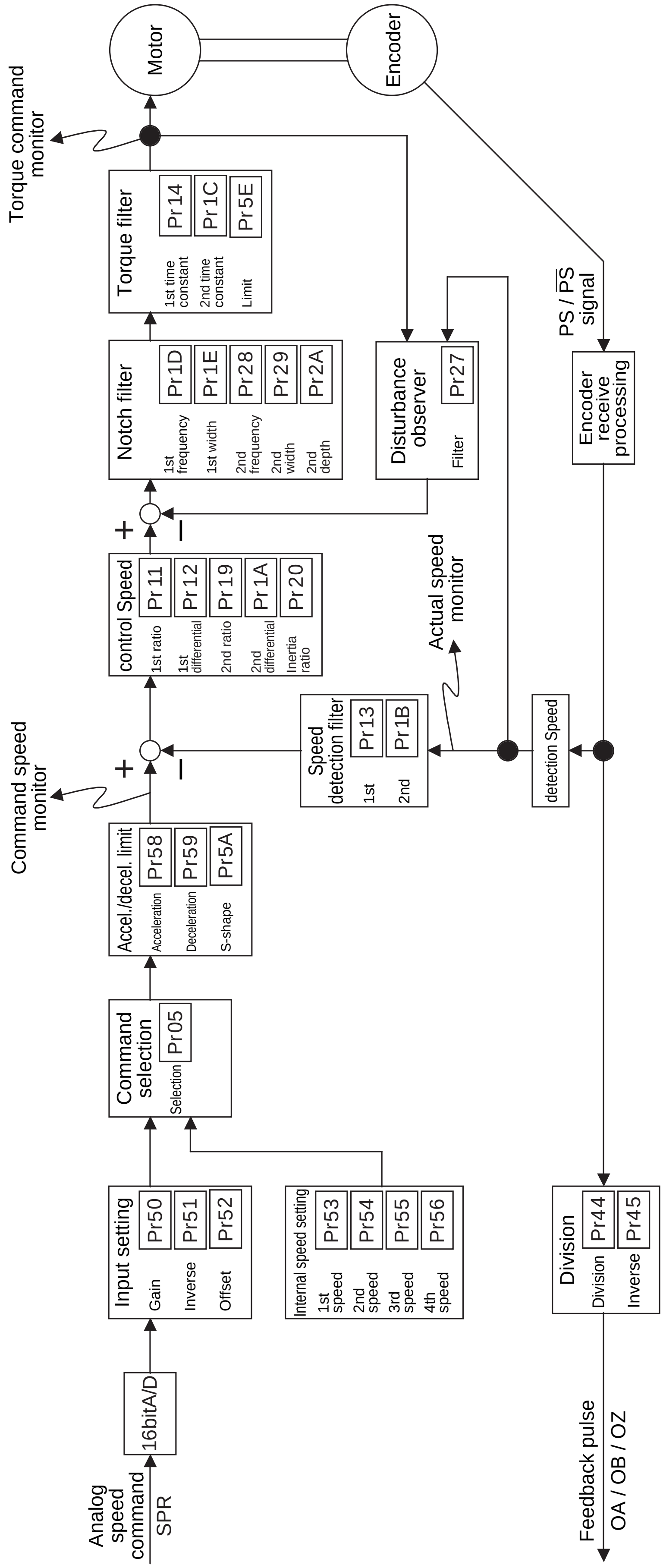
Speed control block diagram

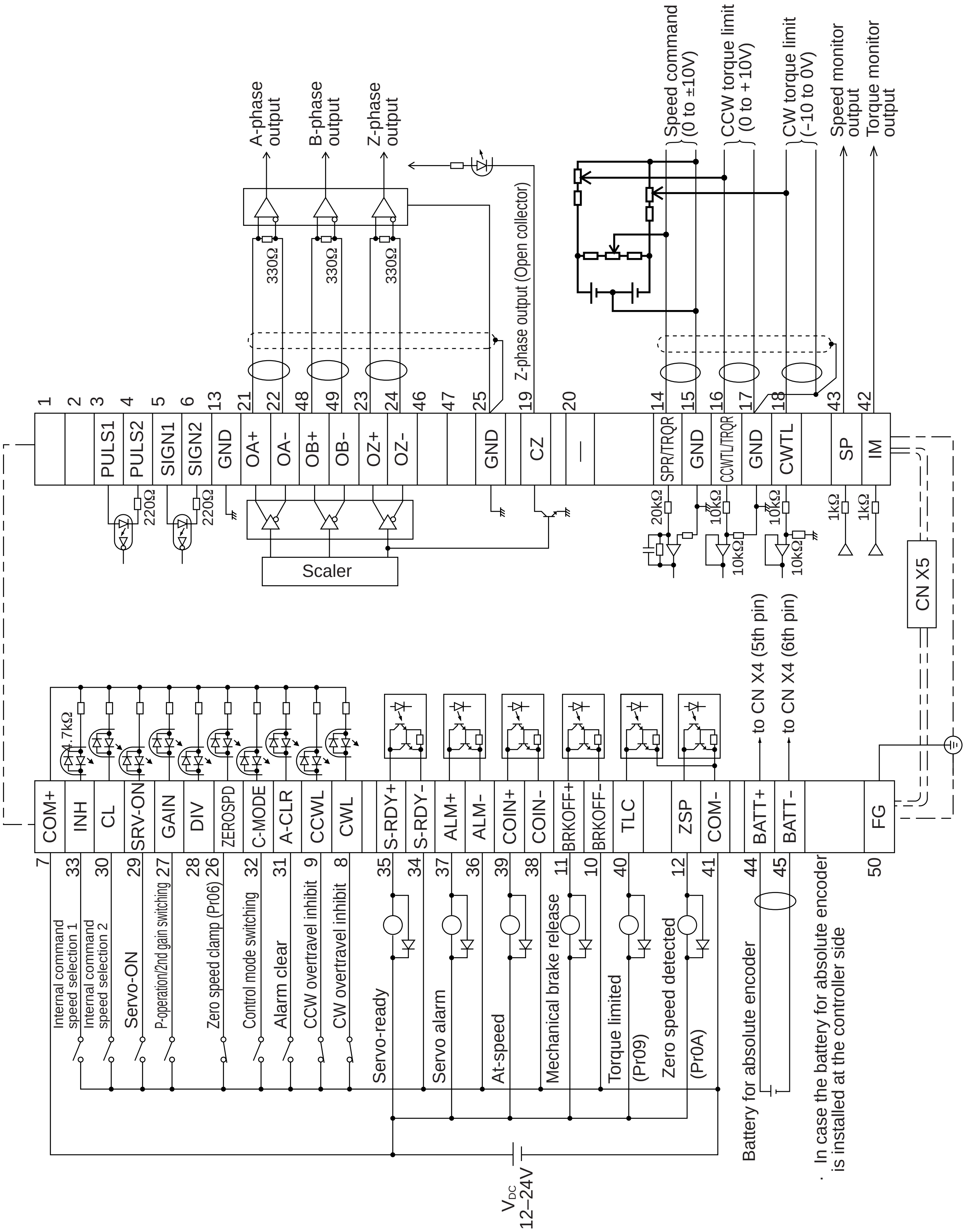
- **Control mode set-up: when Pr02 is [1]***



* For the block diagram showing "Control mode set-up parameter Pr02=[13] (speed control for low-stiffness equipment), see page 302 "Appendix".

CN X5 Connector

Circuits Available for Speed control mode



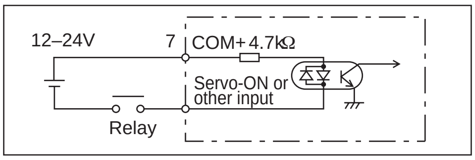
CN X5 Connector

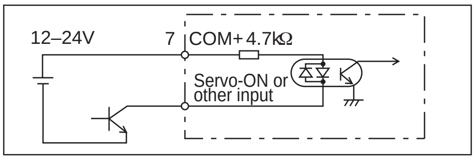
Interface Circuit

Input Circuit

SI SI Connecting to sequence input signals

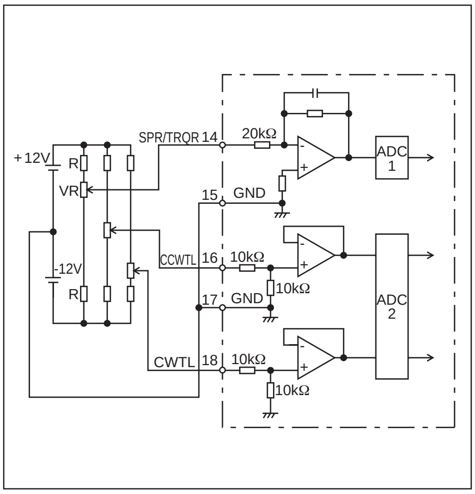
- Connect to a contact of switch and relay, or a transistor of an open collector output.
- Use a switch or relay for micro current so that insufficient contact can be avoided.
- Lower limit of the power supply (12 to 24V) should not be less than 11.4V in order to secure the appropriate level of primary current of the photo coupler.





AI AI Analogue Command Input

- There are three analogue command inputs of SPR/RTQR (14 pins), CCWTL (16 pins) and CWTL (18 pins).
- The maximum permissible input voltage is ±10V. For the input impedance of these inputs, see the right figure.
- If you make a simplified circuit comprising a variable resistor (VR) and resistor (R), refer to the right figure. When the variable range of each input is -10V to + 10V, the VR should be a B type resistor of 2kΩ (min.1/2W). The R should be 200Ω (min.1/2W).
- The A/D converters for these inputs should have the following resolution.

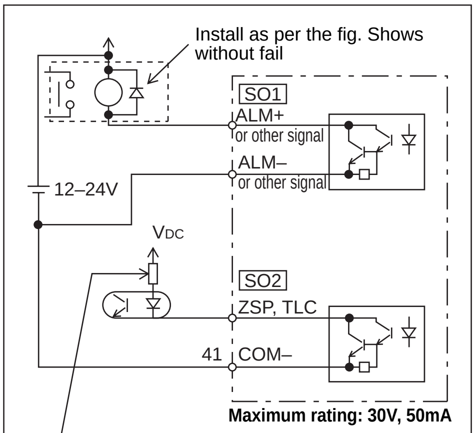


1) ADC1 (SPR and TRQR) : 16 bits (including one bit for sign)
2) ADC2 (CCWTL and CWTL) : 10 bits (including one bit for sign)

Output Circuit

SO1 SO2 Sequence output circuit

- This comprises a Darlington driver with an open collector. This is connected to a relay or photo coupler.
- There exists a collector-to-emitter voltage V_{CE}(SAT) of approx. 1V at transistor ON, because of Darlington connection of the out put transistor. Note that normal TTLIC can't be directly connected since this does not meet VIL requirement.
- This circuit has an independent emitter connection, or an emitter connection that is commonly used as the minus (–) terminal (COM–) of the control power.
- Calculate the value of R using the formula below so as the primary current of the photo coupler become approx. 10mA.



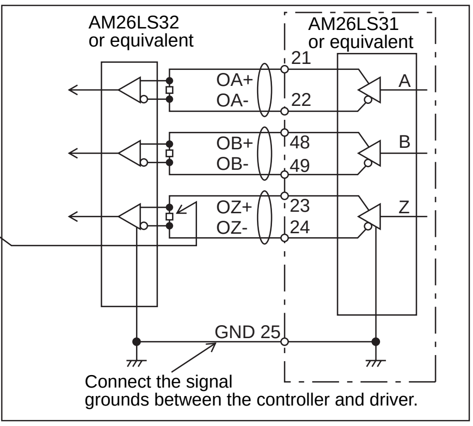
$$R\,[k\Omega] = \frac{V_{DC}[V] - 2.5[V]}{10}$$

For the recommended primary current value, check the data sheet on the equipment and photocoupler used.

PO1 Line Driver (Differential Output) Output

- Provides differential outputs of encoder signals (A, B and Z phases) that come from the scalar.
- Receive these signals with a line receivers. In this case, install a resistor of approx. 330Ω between the inputs.
- These outputs are non-insulated signals.

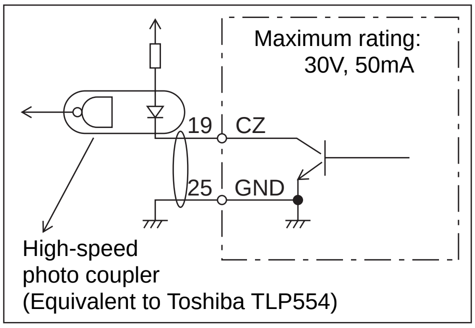
⊖ shows a pair of twisted wires.



PO2 Open Collector Output

- Outputs Z-phase signals among those from the encoder. The outputs are non-insulated.
- Receive these signal with high-speed photo coupler at controller side, since these Z-phase signal width is normally narrow.

⊖ shows a pair of twisted wires.

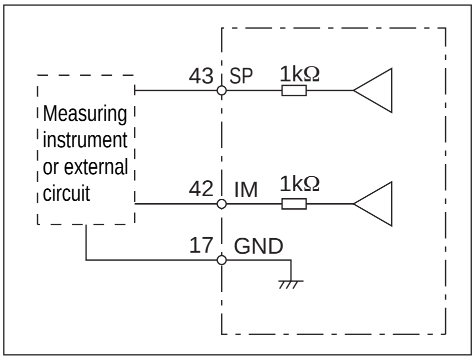


AO Analogue Monitor Output

- This output is the speed monitor signal (SP) or torque monitor signal (IM).
- The signal range is approx. 0 to ± 9V.
- The output impedance is 1kΩ. Pay attention to the input impedance of your measuring instruments and external circuits connected.

<Resolution>

1) Speed monitor signal (SP): 8r/min./LSB calculated from 6V/3000r/min (Pr07 = 3)
2) Torque monitor signal (IM): 0.4%/LSB calculated from 3V/rated value (100%)



Input signal (common) assignment to CN X5 connector pins

Input Signals (Common) and their Functions

<table>
<tr><th>Signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Control signal power (+)</td><td>7</td><td>COM +</td><td>• Connect to (+) of an external power supply (12VDC to 24VDC).
• Use source voltage of 12V±10% – 24V±10%.</td><td rowspan="2">–</td></tr>
<tr><td>Control signal power (–)</td><td>41</td><td>COM –</td><td>• Connect to (–) of an external power supply (12VDC to 24VDC).
• The required capacity depends on the I/O circuit configuration. 0.5A or larger is recommended.</td></tr>
<tr><td rowspan="2">Servo-ON</td><td>29</td><td>SRV-ON</td><td>• When this signal is connected to COM–, the dynamic brake will be released and the driver is enabled. (Servo-ON).</td><td rowspan="2">SI
page 108</td></tr>
<tr><td colspan="3"><Notes>
1. This signal becomes effective about two seconds after power on (see the Timing Chart).
2. Don't use this Servo-ON or Servo-OFF signal to turn on or off the motor. See page 46 "Dynamic Brake" in Preparations.
• Allow at least 50ms delay after the driver is enabled before any command input is entered.
• By opening the connection to COM– , the driver will be disabled(Servo-OFF) and the current flow to the motor will be inhibited.
• Operation of the dynamic brake and clearing action of the position error counter can be selected using Pr69 (Sequence under Servo-OFF).</td></tr>
<tr><td rowspan="2">Control mode switching</td><td>32</td><td>C-MODE</td><td>• When Pr02 (Control Mode Selection) = 3, 4 or 5, the control mode is selected per the table below.</td><td rowspan="2">SI
page 108</td></tr>
<tr><td colspan="3">
<table>
<tr><th></th><th colspan="2">Connection with COM-</th></tr>
<tr><th>Pr02 value</th><th>open (1st)</th><th>closed (2nd)</th></tr>
<tr><td>3</td><td>Position control mode</td><td>Speed control mode</td></tr>
<tr><td>4</td><td>Position control mode</td><td>Torque control mode</td></tr>
<tr><td>5</td><td>Speed control mode</td><td>Torque control mode</td></tr>
</table>
</td></tr>
<tr><td>CW overtravel inhibit</td><td>8</td><td>CWL</td><td>• If COM– is opened when the movable part of the machine has moved to CW exceeding the limit, the motor does not generate torque.</td><td>SI
page 108</td></tr>
<tr><td>CCW overtravel inhibit</td><td>9</td><td>CCWL</td><td>• If COM– is opened when the movable part of the machine has moved CCW exceeding the limit, the motor does not generate torque.
• If you set 1 to Pr04 (Overtravel input inhibited invalid), CWL/CCWL input will be disabled. A factory setting is Disable (1).
• With Pr66 (DB deactivate when driving is inhibited), you can activate dynamic brake when CWL/CCWL input is enabled. According to a factory setting, dynamic brake operates (Pr66 is set to 0).</td><td>SI
page 108</td></tr>
<tr><td rowspan="2">Counter clear</td><td>30</td><td>CL</td><td>The function differs depending on the control mode.</td><td rowspan="2">SI
page 108</td></tr>
<tr><td colspan="3">
<table>
<tr><td>Position control</td><td>• Clears the position error counter.
Connect to COM– to clear the counter.
• Use Pr4D to select the clear mode.
<table>
<tr><th>Pr4D value</th><th>Meaning</th></tr>
<tr><td>0(Factory-setting)</td><td>LEVEL</td></tr>
<tr><td>1</td><td>EDGE</td></tr>
</table>
</td></tr>
<tr><td>Speed control</td><td>• With speed setting of the 2nd selection input, you can set 4 speeds in combination with INH.
• For details, see Pr05 (Speed Set-Up Switching) description.</td></tr>
<tr><td>Torque control</td><td>• Invalid</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Command pulse input inhibit</td><td>33</td><td>INH</td><td>The function differs depending on the control mode.
<table>
<tr><td>Position control</td><td>• Enter command pulse input inhibit.
• You can disable this input with Pr43 (disable command pulse input inhibit).
<table>
<tr><th>Pr43 value</th><th>Meaning</th></tr>
<tr><td>1(Factory-setting)</td><td>The INH signal (input) is disabled.</td></tr>
<tr><td>0</td><td>• With COM– closed, the pulse command signal (PULSE SIGN) is enabled.
• With COM– open, the pulse command signal (PULSE SIGN) is inhibited.</td></tr>
</table></td></tr>
<tr><td>Speed control</td><td>• With speed setting of the 1st selection input, you can set 4 speeds in combination with CL input.
• For details, see Pr05 (Speed Set-Up Switching) description.</td></tr>
<tr><td>Torque control</td><td>• Invalid</td></tr>
</table></td><td>SI
page 108</td></tr>
<tr><td>Speed z ero clamp</td><td>26</td><td>ZEROSPD</td><td>• With COM- open, the speed command is considered zero.
• This input can be made disabled using Pr06.
• With factory setting, disconnecting this pin from COM– sets the speed to zero.
<table>
<tr><th>Pr06 value</th><th>Meaning</th></tr>
<tr><td>0 (Factory-setting)</td><td>ZEROSPD is disabled.</td></tr>
<tr><td>1</td><td>ZEROSPD is enabled.</td></tr>
</table></td><td>SI
page 108</td></tr>
<tr><td>Gain switching</td><td>27</td><td>GAIN</td><td>• This is setting of Pr30 (2nd gain setting) and has the following 2 types of functions:
<table>
<tr><th>Pr30 value</th><th>Connection to COM–</th><th>Function</th></tr>
<tr><td rowspan="2">0 (Factory-setting)</td><td>Open</td><td>Speed loop: PI (Proportional / Integral) action</td></tr>
<tr><td>Close</td><td>Speed loop: P (Proportional) action</td></tr>
<tr><td rowspan="3">1</td><td>Open</td><td>• 1st gain selected (Pr10, 11, 12, 13 and 14)</td></tr>
<tr><td>Close</td><td>• 2nd gain selected (Pr18, 19, 1A, 1B, 1C)</td></tr>
<tr><td colspan="2">To use the second gain, set Pr31 to “ 2” .</td></tr>
</table>
• No.2 Gain change Funcutions, see page 202 "Adjustments ".</td><td>SI
page 108</td></tr>
<tr><td>Alarm clear</td><td>31</td><td>A-CLR</td><td>• If the COM– connection is kept closed for more than 120 ms, the alarm status will be cleared.
• For details about not cleared alarm, see page 216 "Protective Functions".</td><td>SI
page 108</td></tr>
</table>

CN X5 Connector

Input signal assignment to CN X5 connector pins - designation(logic)

Input Signals (Speed Control) and their Functions

Signal	Pin No.	Symbol	Function	I/F circuit
Speed (torque) command	**14** **(15)**	**SPR/TRQR** **(GND)**	**< At speed control >** • This becomes speed command input (analogue) **0~±10V** • You can set-up the relationship between the command voltage level and the motor speed, with Pr50 (Speed Command Input Gain) . • Use Pr51 to inverse the polarity of the command input. **< At torque control >*** • This becomes torque command input (analogue) **0~±10V** • You can set-up the relationship between the command voltage level and the motor torque, with Pr5C (Torque Command Input Gain) . • Use Pr5D to inverse the polarity of input signals. • Use Pr56 (4th Speed Set-up) to adjust the speed limit in torque control. **< Note >** SPR/TRQR are invalid in position control mode.	AI page 108
CCW torque limit	**16** **(17)**	**CCWTL/ TRQR*** **(GND)**	**< At speed and position control >** • You can limit the motor torque in the CCW direction by entering positive voltage (0 to +10V) to CCWTL. • You can limit the motor torque in the CW direction by entering negative voltage (–10 to 0V) to CWTL. • The torque limit value is proportional to the voltage with a factor of 100%/3V. • CCWTL and CWTL are valid when Pr03 (Torque Limit Input Inhibit) = 0. They are invalid when Pr03 = 1. **< At torque control >*** • Both of CCWTL and CWTL are invalid. • Use the 4th speed set-up(Pr56) to limit the speed.	AI page 108
CW torque limit	**18** **(17)**	**CWTL** **(GND)**		
Battery +	**44**	**BATT +**	• Connect a backup battery for absolute encoder (pole-sensitive !). • If the battery is connected directly to the driver, it is not necessary to connect a battery to this terminal.	–
Battery –	**45**	**BATT –**		

* When the torque control mode is selected at the velocity/torque switching mode (Pr02 = 5), the No.16 pin (CCWTL/TRQR) becomes the torque command input (analogue). You can set-up the relationship between the command voltage level and the motor torque with Pr5C (Torque Command Input Gain).

Output signal assignment to CN X5 connector pins - designation(logic)

Output Signals (Common) and their Functions

Signal	Pin No.	Symbol	Function	I/F circuit
Servo alarm output	**37** **36**	**ALM +** **ALM -**	• This output(transistor) turns OFF, when the driver detects and error(trip).	SO1 page 109
Servo-ready output	**35** **34**	**S-RDY +** **S-RDY -**	• This output(transistor) turns ON, when the main power is on(for both the driver and the motor) and no alarm is active.	SO1 page 109
Mechanical brake release output	**11** **10**	**BRK-OFF +** **BRK-OFF -**	• This is used to release the electromagnetic brake of the motor. • Turn the output transistor ON when releasing brake. • Refer to “ Timing Chart” on page 40, on Preparations. • This output(transistor) turns ON , when the brake is released. • See page 40 "Timing Chart".	SO1 page 109

<table>
<tr><th>Signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Zero speed detection</td><td>12</td><td>ZSP</td><td>• Signal which is selected at Pr0A (ZSP Output Selection) will be turned on.
<table>
<tr><th>Pr0A value</th><th>Function</th></tr>
<tr><td>0</td><td>Output(transistor) turns ON during the In-torque limiting.</td></tr>
<tr><td>1
(Factory-setting)</td><td>Output(transistor) turns ON when the motor speed becomes lower than that of the preset speed with Pr61(Zero speed).</td></tr>
<tr><td>2*</td><td>Output(transistor) turns ON when either one of over-regeneration, overload or battery warning is activated.</td></tr>
<tr><td>3*</td><td>Output(transistor) turns ON when the over-regeneration (more than 85% of permissible power of the internal regenerative discharge resistor) warning is activated.</td></tr>
<tr><td>4*</td><td>Output(transistor) turns ON when the overload (the effective torque is more than 85% of the overload trip level) warning is activated.</td></tr>
<tr><td>5*</td><td>Output(transistor) turns ON when the battery (the voltage of the backup battery becomes lower than approx. 3.2V at the encoder side) warning is activated.</td></tr>
</table>
* When the setting is a value between 2 and 5, the output transistor will be turned on for at least 1 second upon detecting an alarm condition.</td><td>SO2
page 109</td></tr>
<tr><td>Torque in-limit</td><td>40</td><td>TLC</td><td>• Signal which is selected by Pr09 (TLC Output Selection) will be turned ON. Factory-setting: 0
• See the above ZSP signal for the set-up of Pr09 and functions.</td><td>SO2
page 109</td></tr>
<tr><td>In-position/
At-speed</td><td>39
38</td><td>COIN +
COIN –</td><td>• Function changes at control mode.
<table>
<tr><td>Position</td><td>• In-position output
• Output(transistor) turns ON when the position error is below the preset value by Pr60 (In-Position Range).</td></tr>
<tr><td>Speed and torque</td><td>• At-speed output
• Output(transistor) turns ON when the motor speed reaches the preset value by Pr62 (At-Speed).</td></tr>
</table></td><td>SO1
page 109</td></tr>
<tr><td rowspan="2">A-phase output</td><td>21</td><td>OA +</td><td rowspan="6">• Provides differential outputs of the encoder signals (A, B and Z phases) that come from the driver (equivalent to RS422 signals).
• The logical relation between A and B phases can be selected by Pr45 (Output Pulse Logic Inversion).
• Not insulated</td><td rowspan="6">PO1
page 109</td></tr>
<tr><td>22</td><td>OA –</td></tr>
<tr><td rowspan="2">B-phase output</td><td>48</td><td>OB +</td></tr>
<tr><td>49</td><td>OB –</td></tr>
<tr><td rowspan="2">Z-phase output</td><td>23</td><td>OZ +</td></tr>
<tr><td>24</td><td>OZ –</td></tr>
<tr><td>Z-phase output</td><td>19</td><td>CZ</td><td>• Z-phase signal output in an open collector (not insulated)
• Not insulated</td><td>PO2
page 109</td></tr>
<tr><td>Velocity monitor output</td><td>43

(17)</td><td>SP

(GND)</td><td>• Outputs the motor speed, or voltage in proportion to the commanded speed with polarity.
+ : CCW rotation
– : CW rotation
• Use Pr07 (Speed Monitor Selection) to switch between actual and commanded speed, and to define the relation between speed and output voltage.</td><td>AO
page 109</td></tr>
<tr><td>Torque monitor output</td><td>42

(17)</td><td>IM

(GND)</td><td>• Outputs the output torque, or voltage in proportion to the position error with polarity.
+ : Fgenerating CCW-torque
– : Fgenerating CW-torque
• Use Pr08 (Torque Monitor Selection) to switch between torque and positional error, and to define the relation between torque/positional error and output voltage.</td><td>AO
page 109</td></tr>
</table>

Output Signals (Others) and their Functions

Signal	Pin No.	Symbol	Function	I/F circuit
Signal ground	**13, 15 17, 25**	**GND**	• Signal ground in the driver • Internally isolated from the control power (COM **–**).	–
Frame ground	**50**	**FG**	• Internally connected to the earth terminal.	–
(Not in use)	**1, 2, 20 46, 47**	**–**	• No connections should be made.	–

Trial run at Speed Control Mode

Operation with CN X5 Connected

1) Connect CN X5.

2) Connect the control signal (COM+ /COM–) to the power supply (12 – 24 VDC) .

3) Turn the main power (driver) ON.

4) Check the defaults of the parameters.

5) Connect between SRV-ON (CN X5 pin 29) and COM– (CN X5 pin 41) to make Servo-On active. The motor will be kept excited.

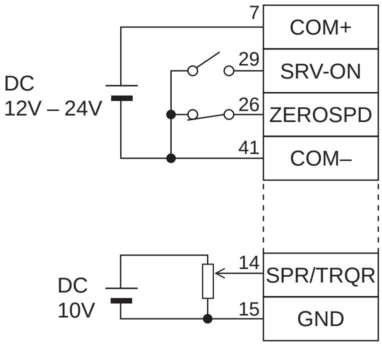
6) Apply a DC voltage between the speed command input SPR (CN X5 pin 14) and GND (CN X5 pin 15). Increase the voltage gradually from 0, and make sure that the motor runs and the speed change accordingly.

7) Select the Monitor Mode to monitor the motor speed.
   - Make sure that the motor speed is as per the commanded speed.
   - Set the command to 0 to see if the motor stops.

8) If the motor still runs at very low speed, even the command voltage is set to 0, use the Auxiliary Mode to correct the voltage of command input (see page 67 "Automatic offset adjustment" in Preparations).

9) To change the speed or direction, adjust the following parameters.
   Pr50 (Speed Command Input Gain)
   Pr51 (Speed Command Input Inversion)
   } see page 118 "Parameter Setting" in Speed control mode.

Wiring Diagram



ZEROSPD switch
Close: Run
Open: Stop

One way operation

For multi direction (CW and CCW) operation, use a bipolar power source.

Parameters

PrNo.	Parameter description	Value
Pr02	Control mode set-up	1
Pr04	Overtravel input inhibit	1
Pr06	ZEROSPD input selection	1
Pr50	Speed command input gain	Set as required
Pr58	Acceleration time set-up	
Pr59	Deceleration time set-up	
Pr5A	S-shaped accel/decel time set-up	

Input Signals Status

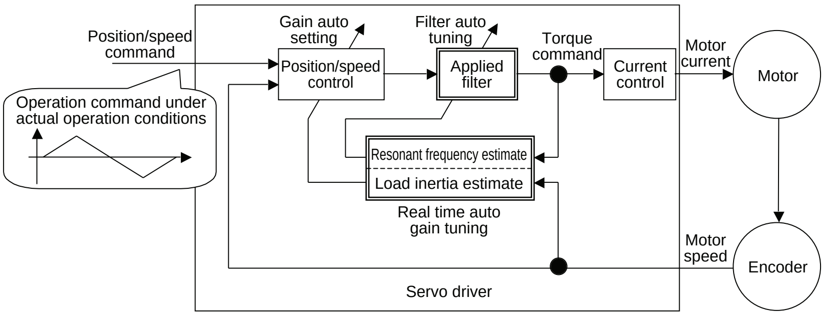
No.	Input signal	Monitor display	
0	Servo-ON	+ A	
2	CW overtravel inhibit	–	
3	CCW overtravel inhibit	–	
5	Speed zero clamp	–	Stop with + A

MEMO

Real time auto gain tuning

Outline

Load inertia of the machine is estimated at real time, and the optimum gain is set up automatically based on the estimated result. A load, which has a resonance, also can be handled owing to the adaptive filter.



Application range

Under the following conditions, the real time auto gain tuning may not function properly.
In such case, use the normal mode auto gain tuning (see page 193 "Adjustments") or manual gain tuning (see page 197 "Adjustments").

	Conditions under which the real time auto gain tuning is prevented from functioning
Load inertia	• When the load inertia is smaller/larger than the rotor inertia (3 times or less; or 20 times or more) • When the load inertia fluctuates
Load	• When the machine stiffness is extremely low • When any unsecured part resides in such as backlash, etc.
Operation pattern	• In case of a continuous low speed operation under 100 [r/min] . • In case of soft acceleration/deceleration under 2000 [r/min] per 1 [s] . • When acceleration/deceleration torque is smaller than unbalanced load/viscous friction torque.

How to use

[1] Stop the motor (Servo-OFF).

[2] Set up Pr21 (Real-time auto tuning set-up) to 1 – 6.
Set up value before shipment is 1.

Setting value	Real-time auto tuning	Changing degree of load inertia during operation	Adaptive filter
0	Not used	–	No
[1]	Used	Little change	Yes
2		Change slowly	
3		Change s haply	
4		Little change	No
5		Change slowly	
6		Change s haply	
7	Not used	–	Yes

When the changing degree of the load inertia is too large, set Pr21 to 3 or 6.
When the influence of resonance is conceivable, select “ adaptive filter YES” .

[3] Set 0 – 2 to Pr22 (real-time auto tuning machine stiffness).

[4] Turn the servo ON to operate the machine ordinarily.

[5] To increase the response performance, gradually increase Pr22 (Machine stiffness at real-time auto tuning). When any noise or vibration is found, decrease the Pr22 to a lower value soon.

[6] To store the result, write the data into the EEPROM.

Description of the adaptive filter

By setting Pr21 (Real-time auto tuning set-up) to 1 – 3 or 7, the adaptive filter is enabled.
In an actual operation state, resonance frequency is estimated based on the vibration component, which appears in motor speed, and resonance point vibration is reduced by removing resonance component from the torque command by the adaptive filter.
The adaptive filter may not function normally under the following conditions. In such a case, take anti-resonance measures using the 1st notch frequency (Pr1D and 1E) or second notch filter (Pr28 – 2A) in accordance with the manual tuning procedure.
For details on the notch filter, refer to “ To Reduce the Mechanical Resonance” on page 204.

	Conditions under which the adaptive filter is prevented from functioning
Resonance point	• When the resonance frequency is 300 [Hz] or less • When resonance peak is low, or control gain is low; and its influence does not appear on the motor speed • When plural resonance points reside in
Load	• When a motor speed fluctuation having a high frequency component is caused due to a non-linear element such as backlash etc
Command pattern	• When acceleration/deceleration is too sharp like 30000 [r/min] or more per 1 [s]

Parameters, which are set up automatically

The following parameters are tuned automatically.

Parameter No.	Name
11	1st speed loop gain
12	1st speed loop integration time constant
13	1st speed detection filter
14	1st torque filter time constant
19	2nd speed loop gain
1A	2nd speed loop integration time constant
1B	2nd speed detection filter
1C	2nd torque filter time constant
20	Inertia ratio
2F	Adaptive filter frequency

The following parameters are also set up to the following fixed values automatically.

Parameter No.	Name	Set value
27	Disturbance torque observer filter selection	0
30	2nd gain action set-up	1
36	Speed control switching mode	0

Caution

[1] Immediately after the first turning the servo ON at start up, or when Pr22 (Machine stiffness at real-time auto tuning) is stated up, sometimes a noise or vibration may be generated until the load inertia is determined or the adaptive filter is stabilized. But, when the machine gets stabilized soon, there is no problem. But, when such problem as vibration or noise continues during a period of 3 reciprocal operations, etc occurs frequently, take the following measures.

1) Write the parameter of normal operation into the EEPROM.
2) Decrease the Pr22 (Machine stiffness at real-time auto tuning).
3) Once set up Pr21 (Real-time auto tuning set-up) to 0 to disable the adaptive filter. Then, enable the real time auto tuning again. (resetting of inertia estimate adaptive operation)
4) Set up the notch filter manually.

* When disabling he real time auto tuning, see page 196 "Disabling of auto tuning function" in Adjustments.

[2] After a noise or vibration has occurred, Pr20 (Inertia ratio) and/or Pr2F (Adaptive filter frequency) may have been changed into an extreme value. In such a case also, take the above measures.

[3] Ithe results of the real time auto gain tuning, Pr20 (Inertia ratio) and Pr2F (Adaptive filter frequency) are written into the EEPROM every 30 minutes. And auto tuning is carried out using the data as the initial value.

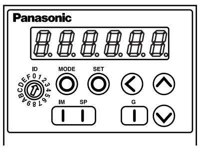
Parameter Setting

Parameters for Function Selection

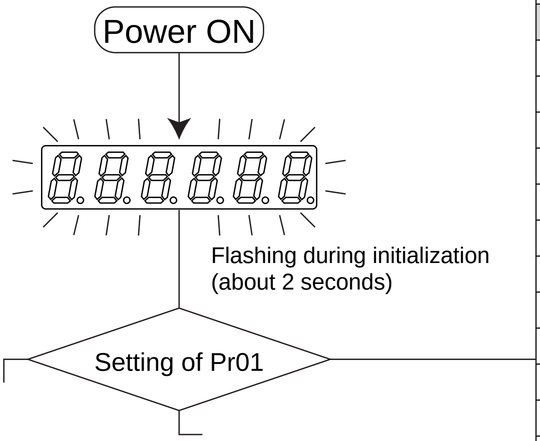
Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Function/Description
00	**Axis address**	0 – 15 [1]	In communications with a host device such as a personal computer that uses RS232C/485 with multiple axes, you should identify to which axis the host accesses and use this parameter to confirm axis address in terms of numerals.

- At power on, settings of the rotary switch ID on the front panel (0 – F) will be programmed into parameters of the driver.
- Settings of Pr00 can be changed only by means of the rotary switch ID.



Parameter No.	Parameter Name	Setting range	Function/Description
01	**LED display at power up**	0 – 15	In the initial condition after turning ON the control power, the following data displayed on the 7-segment LED can be selected.



Setting value	Description
0	Positional deviation
[1]	Motor revolving speed
2	Torque output
3	Control mode
4	I/O signal status
5	Error cause/record
6	Software version
7	Alarm
8	Regenerative load ratio
9	Overload load ratio
10	Inertia ratio
11	Feedback pulse sum
12	Command pulse sum
13	External scale deviation
14	External scale feedback pulse sum
15	Motor auto recognition

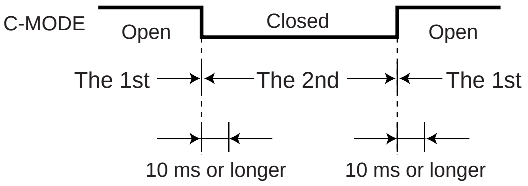
See page 56 "Front Panel Key Operations and Display".

Parameter No.	Parameter Name	Setting range	Function/Description
02	**Control mode**	0 – 14	Select the control mode of the servo driver.

Setting value	Control mode	
	The 1st Mode	**The 2nd Mode* 1**
0	Position control	–
[1]	Speed control	–
2	Torque control	–
3	Position	Speed control
4	Position	Torque control
5	Speed	Torque control
6	Semi-closed control	–
7	Full-closed control	–
8	Hybrid control	–
9	Speed	External encoder control
10	Speed	Semi-closed control
11	High-stiff equipment position control	–
12	Low-stiff equipment position control	–
13	Low-stiff equipment speed control	–
14	Second full-closed control	–

*1 A special control mode focused on the full-closed specification. For details, refer to “ Full-Closed Control” volume on Page 000.

*2 When composite mode (Pr02 = 3,4,5,9,10) is set, you can switch the 1st and 2nd modes with the control mode switch input (C-MODE).



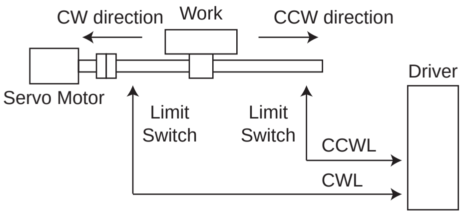
<Caution>

Enter a command after 10ms or longer have passed since C-MODE was entered.

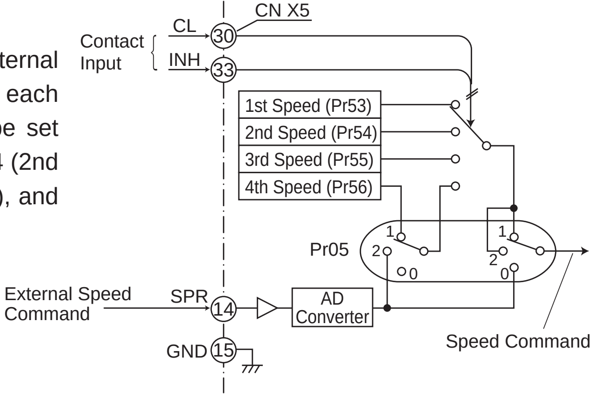
Do not enter any command on position, speed or torque.

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Function/Description</th></tr>
<tr><td>03</td><td>Torque limit selection</td><td>0 – 1
[1]</td><td>The parameter is used to disable analog torque limit input (CCWTL, CWTL) signals.
0: Enabled
1: Disabled

If you do not use torque limit functions, set “ 1” to Pr03.
With Pr03 set to “ 0” and torque limit input (CCWTL, CWTL) open, no torque will be generated, and thus the motor does not rotate.</td></tr>
<tr><td>04</td><td>Overtravel input inhibit</td><td>0 – 1</td><td>In the case of linear driving, in particular, to prevent mechanical damage due to overtraveling of work, you should provide limit switches on both ends of the axis, as shown below, whereby driving in a direction of switch action is required to be inhibited.


<table>
<tr><th rowspan="2">Setting value</th><th rowspan="2">CCWL/CWL Input</th><th>Input</th><th>Connection with COM-</th><th rowspan="2">Action</th></tr>
<tr><th></th><th></th></tr>
<tr><td rowspan="4">0</td><td rowspan="4">Enable</td><td rowspan="2">CCWL
(CN X5-9 pin)</td><td>Connected</td><td>Normal condition in which the limit switch on CCW side is not operating.</td></tr>
<tr><td>Open</td><td>CCW direction inhibited, CW direction allowed</td></tr>
<tr><td rowspan="2">CWL
(CN X5-8 pin)</td><td>Connected</td><td>Normal condition in which the limit switch on CW side is not operating.</td></tr>
<tr><td>Open</td><td>CW direction inhibited, CCW direction allowed</td></tr>
<tr><td>[1]</td><td>Disable</td><td colspan="3">Both CCWL and CWL inputs are ignored and they normally operate as no overtravel inhibit being set.</td></tr>
</table>
<Cautions>
1. When you set 0 to Pr04 and do not connect both CCWL and CWL inputs to COM- (off), abnormal condition in which limits are exceeded in both CCW and CW directions is detected, and the driver will then trip due to “ abnormal overtravel input inhibit“ .
2. You can set whether or not to activate the dynamic brake when slowdown occurs because CCW or CW overtravel input inhibit has been enabled. For details, refer to descriptions on Pr66 (DB deactivation at overtravel input inhibit).</td></tr>
<tr><td>05</td><td>Internal/external speed switching</td><td>0 – 2</td><td>This is equipped with the internal speed setting capability that can easily implement speed control only through input of a contact.
<table>
<tr><th>Setting value</th><th>Method of Setting Speed</th></tr>
<tr><td>[0]</td><td>External speed command</td></tr>
<tr><td>1</td><td>Internal speed control mode (4 speeds)</td></tr>
<tr><td>2</td><td>External speed control and internal speed control mode (3 speeds)</td></tr>
</table>
• This parameter sets whether to enable or disable internal speed setting.
• There are 4 types of internal speed commands, and each command data should be set to Pr53 (1st speed), Pr54 (2nd speed), Pr55 (3rd speed), and Pr56 (4th speed).

Block Diagram of
Internal/External Speed Setting Unit

 </td></tr>
</table>

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Function/Description</th></tr>
<tr><td>05
(Continued)</td><td>Internal/external speed switching</td><td>0 – 2</td><td>

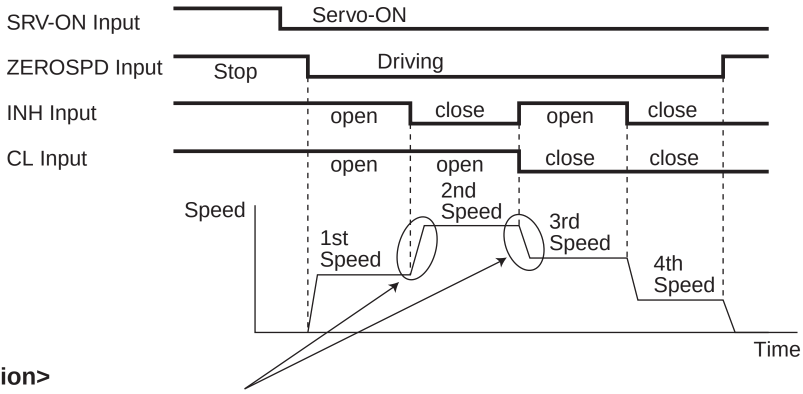
- Switching of 4 types of internal speed commands is executed through 2 types of contact inputs:

1) INH (CN X5, 33-pin): Selection and input of the 1st speed of speed setting
2) CL (CN X5, 30-pin): Selection and input of the 2nd speed of speed setting

<table>
<tr><th>Internal Speed</th><th>INH (33-pin)</th><th>CL (30-pin)</th></tr>
<tr><td>1st Speed (Pr53)</td><td>open</td><td>open</td></tr>
<tr><td>2nd Speed (Pr54)</td><td>close</td><td>open</td></tr>
<tr><td>3rd Speed (Pr55)</td><td>open</td><td>close</td></tr>
<tr><td>4th Speed (Pr56)</td><td>close</td><td>close</td></tr>
</table>

- Example of 4-shift run with internal speed command

In addition to CL/INH inputs, speed zero clamp input (ZEROSPD) and servo ON input (SRV-ON) are needed as input to control driving/stopping of the motor.



<Caution>

Using the following parameters, you can individually set acceleration time, deceleration time, and Sigmoid acceleration/deceleration time.

In this chapter, Pr58: Setting of acceleration time
Pr59: Setting of deceleration time
Pr5A: Setting of Sigmoid acceleration/deceleration time

</td></tr>
<tr><td>06</td><td>ZEROSPD input selection</td><td>0 – 1</td><td>

This switches enable/disable of speed zero clamp input (ZEROSPD, CN X5 26-pin).

<table>
<tr><th>Setting value</th><th>Functions of ZEROSPD Input (26-pin)</th></tr>
<tr><td>[0]</td><td>ZEROSPD input being ignored, it is determined that it is not speed zero clamp condition at all times.</td></tr>
<tr><td>2</td><td>ZEROSPD input has been enabled. If connection with COM- is opened, speed command will be regarded as zero.</td></tr>
</table>

</td></tr>
<tr><td>07</td><td>Speed monitor (SP) selection</td><td>0 – 9</td><td>

The parameter selects/sets a relationship between voltage output to the speed monitor signal output (SP: CN X5 43-pin) and the actual motor speed or command speed.

<table>
<tr><th>Setting value</th><th>SP Signals</th><th>Relationship between Output Voltage Level and Speed</th></tr>
<tr><td>0</td><td rowspan="5">Motor Actual Speed</td><td>6V / 47 r/min</td></tr>
<tr><td>1</td><td>6V / 188 r/min</td></tr>
<tr><td>2</td><td>6V / 750 r/min</td></tr>
<tr><td>[3]</td><td>6V / 3000 r/min</td></tr>
<tr><td>4</td><td>1.5V / 3000 r/min</td></tr>
<tr><td>5</td><td rowspan="5">Command Speed</td><td>6V / 47 r/min</td></tr>
<tr><td>6</td><td>6V / 188 r/min</td></tr>
<tr><td>7</td><td>6V / 750 r/min</td></tr>
<tr><td>8</td><td>6V / 3000 r/min</td></tr>
<tr><td>9</td><td>1.5V / 3000 r/min</td></tr>
</table>

</td></tr>
</table>

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Function/Description</th></tr>
<tr><td>08</td><td>Torque monitor (IM) selection</td><td>0 – 12</td><td>The parameter selects/sets a relationship between voltage output to the torque monitor signal output (IM: CN X5 42-pin) and generated torque of the motor or number of deviation pulses.
<table>
<tr><th>Setting value</th><th>IM Signals</th><th>Relationship between output level and torque or number of deviation pulses</th></tr>
<tr><td>[0]</td><td>Torque</td><td>3V / rated (100%) torque</td></tr>
<tr><td>1</td><td rowspan="6">No. of Deviation Pulses</td><td>3V / 31Pulse</td></tr>
<tr><td>2</td><td>3V / 125Pulse</td></tr>
<tr><td>3</td><td>3V / 500Pulse</td></tr>
<tr><td>4</td><td>3V / 2000Pulse</td></tr>
<tr><td>5</td><td>3V / 8000Pulse</td></tr>
<tr><td>6 – 10</td><td>Enabled under full-closed control (See P156 –.)</td></tr>
<tr><td>11</td><td rowspan="2">Torque</td><td>3V / 200% torque</td></tr>
<tr><td>12</td><td>3V / 400% torque</td></tr>
</table></td></tr>
<tr><td>09</td><td>TLC output selection</td><td>0 – 5</td><td>The parameter allocates functions of output in torque limits (TLC: CN X5 40-pin).
<table>
<tr><th>Setting value</th><th>Functions</th><th>Remarks</th></tr>
<tr><td>[0]</td><td>Output in torque limit</td><td rowspan="6">For functional details of respective outputs listed left, refer to "Wiring to Connector CN X5" on page 78.</td></tr>
<tr><td>1</td><td>Output of zero-speed detection</td></tr>
<tr><td>2</td><td>Output of an alarm due to either of over-regeneration/overload/absolute battery</td></tr>
<tr><td>3</td><td>Output of over-regeneration alarm</td></tr>
<tr><td>4</td><td>Output of overload alarm</td></tr>
<tr><td>5</td><td>Output of absolute battery alarm</td></tr>
</table></td></tr>
<tr><td>0A</td><td>ZSP output selection</td><td>0 – 5</td><td>The parameter allocates functions of zero speed detection output (ZSP: CN X5 12-pin).
<table>
<tr><th>Setting value</th><th>Functions</th><th>Remarks</th></tr>
<tr><td>0</td><td>Output in torque limit</td><td rowspan="6">For functional details of respective outputs listed left, refer to "Wiring to Connector CN X5" on page 78.</td></tr>
<tr><td>[1]</td><td>Output of zero-speed detection</td></tr>
<tr><td>2</td><td>Output of an alarm due to either of over-regeneration/overload/absolute battery</td></tr>
<tr><td>3</td><td>Output of over-regeneration alarm</td></tr>
<tr><td>4</td><td>Output of overload alarm</td></tr>
<tr><td>5</td><td>Output of absolute battery alarm</td></tr>
</table></td></tr>
<tr><td>0B</td><td>Absolute encoder set up</td><td>0 – 2</td><td>Listed below are settings when you use the absolute encoder:
<table>
<tr><th>Setting value</th><th>Description</th></tr>
<tr><td>0</td><td>To use the absolute encoder as absolute.</td></tr>
<tr><td>[1]</td><td>To use the absolute encoder as incremental.</td></tr>
<tr><td>2</td><td>To use the absolute encode as absolute. In this case, multi-rotation excess counter is ignored.</td></tr>
</table></td></tr>
<tr><td>0C</td><td>Baud rate of RS232C</td><td>0 – 2</td><td>
<table>
<tr><th>Setting value</th><th>Baud Rate</th></tr>
<tr><td>0</td><td>2400bps</td></tr>
<tr><td>1</td><td>4800bps</td></tr>
<tr><td>[2]</td><td>9600bps</td></tr>
</table></td></tr>
<tr><td>0D</td><td>Baud rate of RS485</td><td>0 – 2</td><td>
<table>
<tr><th>Setting value</th><th>Baud Rate</th></tr>
<tr><td>0</td><td>2400bps</td></tr>
<tr><td>1</td><td>4800bps</td></tr>
<tr><td>[2]</td><td>9600bps</td></tr>
</table></td></tr>
</table>

Parameter Setting

Parameters for Time Constants of Gains and Filters: Related to Real Time Auto Tuning

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
11	**1st velocity loop gain**	1 – 3500 [35] *	Hz	• The parameter defines responsiveness of the speed loop. You need to set this speed loop gain high so as to improve responsiveness of the entire servo system by increasing position loop gain.
12	**1st velocity loop integration time constant**	1 – 1000 [16] *	ms	• This parameter is an integration element of a speed loop and acts to drive quickly the subtle speed deviation into zero. The smaller the setting is, the faster deviation will be zeroed. • Setting of “ 1000” will remove effects of integration.
13	**1st speed detection filter**	0 – 6 [0] *	–	• The parameter sets in 6 phases (0 to 5) a time constant of the low-pass filter inserted after the block of converting an encoder signal into a speed signal. • Setting this parameter high would increase a time constant, thereby reducing noise of the motor. However, usually use the factory setting (0).
14	**1st torque filter time constant**	0 – 2500 [65] *	0.01ms	• The parameter sets a time constant of the primary delay filter inserted into the torque command unit. • It effects the control of vibration because of the torsion resonance.
19	**2nd velocity loop gain**	1 – 3500 [35] *	Hz	• A position loop, speed loop, speed detection filter, and torque command filter, respectively, has 2 pairs of gains or time constants (the 1st and 2nd). • Each function/content is similar to the 1st gain/time constraint, described earlier. • For details on switching of the 1st and 2nd gains or time constants, refer to Adjustment volume on page 186. * Pr11 and Pr19 will be set in terms of (Hz) when Pr20 inertia ratio has been set correctly.
1A	**2nd velocity loop integration time constant**	1 – 1000 [1000] *	ms	
1B	**2nd speed detection filter**	0 – 6 [0] *	–	
1C	**2nd torque filter time constant**	0 – 2500 [65] *	0.01ms	
1D	**1st notch frequency**	100 – 1500 [1500]	Hz	• The parameter sets frequency of the resonance suppression notch filter. • You should set it about 10% lower than the resonance frequency of the mechanical system that has been found by the frequency characteristics analysis facility of the setup assisted software “ PANATERM®” . • Setting this parameter ” 1500” would disable the function of notch filter.
1E	**1st notch width selection**	0 – 4 [2]	–	• The parameter sets width of the resonance suppression notch filter in 5 steps. The higher the setting is, the greater the width is. • Normally, use a factory setting.

Parameters for real time auto gain tuning

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
20	**Inertia ratio**	0 – 10000 [100] *	%	• Defines the ratio of load inertia to the motor's rotor inertia. Pr20 = (rotor inertia / load inertia) x 100[%] • When you execute auto gain tuning, load inertia will be estimated and the result will be reflected in this parameter. Pr11 and Pr19 will be set in terms of (Hz) when inertia ratio has been set correctly. When Pr20 inertia ratio is greater than the actual ratio, setting of the speed loop gain will increase. When Pr20 inertia ratio is smaller than the actual ratio, setting of speed loop gain will decrease.

Note) Standard default setting in [ ] under "Setting range" and marked with * is automatically set during the real time auto gain tuning. To manually change the value, first disable the auto gain tuning feature be seeing page 196 "Disabling of auto tuning function" in Adjustments, and then enter the desired value.

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>21</td><td>Real time auto tuning set up</td><td>0 – 7</td><td>–</td><td>• Defines the operation mode of real-time auto tuning. Increasing the set value (3, 6,...) provides higher response to the inertia change during operation. However, operation may become unstable depending on the operation pattern. Normally, set this parameter to "1" or "4".
• If you set this parameter to any value other than 0, Pr27 disturbance observer filter selection will be disabled (0). In addition, if you set the adaptive filter to disabled, Pr2F adaptive filter frequency will be reset to 0.
• When Pr20 is "0", Pr2F (Adaptive notch frequency) is reset to "0".
In the torque control mode, the adaptive notch filter is always invalid.
<table>
<tr><th>Setting value</th><th>Real-time Auto Gain Tuning</th><th>Degree of Changes in Load Inertia</th><th>Adaptive Filter</th></tr>
<tr><td>0</td><td>Not used</td><td>–</td><td>Absent</td></tr>
<tr><td>[1]</td><td>Used</td><td>Hardly changes.</td><td>Present</td></tr>
<tr><td>2</td><td></td><td>Changes moderately.</td><td></td></tr>
<tr><td>3</td><td></td><td>Changes sharply.</td><td></td></tr>
<tr><td>4</td><td></td><td>Hardly changes.</td><td>Absent</td></tr>
<tr><td>5</td><td></td><td>Changes moderately.</td><td></td></tr>
<tr><td>6</td><td></td><td>Changes sharply.</td><td></td></tr>
<tr><td>7</td><td>Not used</td><td>–</td><td>Present</td></tr>
</table>
• Note that any change in this parameter will be enabled when Servo OFF changes to Servo ON.</td></tr>
<tr><td>22</td><td>Machine stiffness at auto tuning</td><td>0 – 15
[4]</td><td>–</td><td>• Defines the machine stiffness during execution of real-time auto tuning.
Low ← Machine stiffness → High
Low ← Servo gain → High
<table>
<tr><td>Pr22</td><td>0 , 1- - - - - - - - - - - - 14, 15</td></tr>
</table>
Low ← Responsiveness → High
• If the parameter value is rapidly changed, the gain significantly changes, applying a shock to the machine. Be sure to set a small value first, and increase it gradually, while monitoring the operating condition.</td></tr>
<tr><td>25</td><td>Normal auto tuning motion set up</td><td>0 – 7</td><td>–</td><td>• Defines the operation pattern of the normal mode auto tuning.
<table>
<tr><th>Set value</th><th>Number of revolutions</th><th>Revolving direction</th></tr>
<tr><td>[0]</td><td>2[revolution]</td><td>CCW → CW</td></tr>
<tr><td>1</td><td></td><td>CW → CCW</td></tr>
<tr><td>2</td><td></td><td>CCW → CCW</td></tr>
<tr><td>3</td><td></td><td>CW → CW</td></tr>
<tr><td>4</td><td>1[revolution]</td><td>CCW → CW</td></tr>
<tr><td>5</td><td></td><td>CW → CCW</td></tr>
<tr><td>6</td><td></td><td>CCW → CCW</td></tr>
<tr><td>7</td><td></td><td>CW → CW</td></tr>
</table>
Example) Setting this parameter to "0" provides two CCW revolutions and two CW revolutions.</td></tr>
<tr><td>26</td><td>Disturbance torque compensation gain</td><td>0 – 200
[0]</td><td>%</td><td>• When the control mode is HP, LP, LS or UPF, a gain, in which the torque command is multiplied by a disturbance torque estimate value, is set.
• By setting 100 [%] , a torque compensation that clears the disturbance torque is applied.
• When Pr21 real time auto tuning mode setting is altered, Pr26 changes to 0 (disabled).</td></tr>
</table>

Parameter Setting

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td rowspan="2">27</td><td>Disturbance torque observer filter selection</td><td>0 –255</td><td>–</td><td>• Cut-off frequency of the filter for disturbance torque observer is set.<table><tr><th>Set value</th><th>Cutoff Frequency</th></tr><tr><td>[0] *</td><td>Disturbance Observer Disabled</td></tr><tr><td>1 – 255</td><td>Enabled, filter cutoff frequency [Hz] = 3.7 x setting</td></tr></table></td></tr>
<tr><td colspan="4">A larger value provides stronger disturbance suppression; but a larger operation noise is emitted. When using this function, it is necessary to set Pr20 inertia ratio correctly. When Pr.21 real time auto tuning mode setting is altered, Pr27 changes to 0(disabled). Also, while the real time auto tuning is enabled (Pr21 is not 0 or 7), Pr27 is fixed to 0 and the disturbance observer is disabled.</td></tr>
<tr><td>28</td><td>2nd notch frequency</td><td>100 – 1500
[1500]</td><td>Hz</td><td>• Defines the notch frequency of the second resonance suppression notch filter.
• The unit is [Hz] . Match the notch frequency with the machine's resonance frequency.
100 to 1499: Filter enabled 1500: Filter disabled</td></tr>
<tr><td>29</td><td>2nd notch width selection</td><td>0 – 4
[2]</td><td>–</td><td>• Select the notch width of the second resonance suppression notch filter.
• Increasing the set value enlarges the notch width.</td></tr>
<tr><td>2A</td><td>2nd notch depth selection</td><td>0 – 99
[0]</td><td>–</td><td>• Select the notch depth of the second resonance suppression notch filter.
• Increasing the set value reduces the notch depth and the phase delay.</td></tr>
<tr><td>2F</td><td>Adaptive filter frequency</td><td>0 – 64
[0] *</td><td>–</td><td>• Table No. corresponding to the frequency of the applied filter is displayed. (See page 196)
• When the applied filter is enabled (when Pr21 (real time auto tuning mode setting) is 1-3,7), this parameter is set automatically and can not be altered.
0: Filter disabled 1 - 64: Filter enabled
Before using this function, see page 196 “ Disabling of auto tuning function” in adjustments.
• When the applied filter is enabled, the parameter is stored in the EEPROM every 30 minutes. And when the applied filter is enabled at turning ON the power next time, the data stored in the EEPROM is used as the initial value to adapt the operation.
• When clearing the parameter to reset the adapted operation due to unsatisfactory operation, once set the applied filter disabled (set Pr21 (real time auto tuning mode setting) to other than 1 - 3, 7), and make it enabled again.
• Refer to “ Control of Vibration Damping” of Adjustment volume on page 211.</td></tr>
</table>

Parameters for Switching to 2nd Gains

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>30</td><td>2nd gain action set up</td><td>0 – 1</td><td>–</td><td>• The parameter selects switching of PI/P operation and the 1st/2nd gain switching.<table><tr><th>Setting value</th><th>Gain Selection/Switching</th></tr><tr><td>0</td><td>The 1st Gain (Possible to switch PI/P) *1</td></tr><tr><td>[1] *</td><td>Possible to switch the 1st/2nd gain *2</td></tr></table>*1 Switching of 1 PI/P operation is done through gain switching input (GAIN CN X5 27-pin).<table><tr><th>GAIN input</th><th>Operation of speed loop</th></tr><tr><td>Open with COM–</td><td>PI operation</td></tr><tr><td>Connect to COM–.</td><td>P operation</td></tr></table>*2 For conditions of switching between the 1st and 2nd gains, refer to “ Adjustment upon switching gain” of Adjustment volume on page 202.</td></tr>
</table>

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
36	**Speed control switching mode**	0 – 5	–	• The parameter sets conditions for switching the 1st and 2nd gains in speed control mode. • This is same as Pr31 (position control switching mode) except for position control.

Setting value	Conditions for Switching Gains
[0] *	Fixed to the 1st gain.
1	Fixed to the 2nd gain.
2	With gain switching input (GAIN) on, the 2nd gain is selected. (Pr30 should be set to 1.)
3 *1	With much variation of torque command, the 2nd gain is selected.
4 *1	With much variation of speed command, the 2nd gain is selected.
5 *1	With high command speed, the 2nd gain is selected.

*1 For details on levels to be switched, refer to “ Adjustment upon switching gain” of Adjustment volume on page 202.

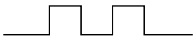
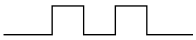
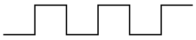
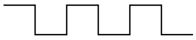
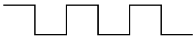
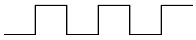
Parameter No.	Parameter Name	Setting range	Unit	Function/Description
37	**Speed control switching delay time**	0 – 10000 [0]	x 166μs	• This is same as content of: Pr32: Switching delay time Pr33: Switching level Pr34: Hysteresis at switching” in position control mode.
38	**Speed control switching level**	0 – 20000 [0]	–	
39	**Speed control switching hysteresis**	0 – 20000 [0]	–	

Parameters for Position Control

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Function/Description
44	**Output pulses per single turn**	1 – 16384 [2500]	The parameter sets number of pulses per one revolution of encoder pulse to be output to the host device. The pulse will be set in dividing. You should directly set in this parameter the number of pulses per revolution needed for your device/system in terms of [Pulse/rev] .
45	**Pulse output logic inversion**	0 – 1	In a relationship of phases of output pulse from the rotary encoder, Phase B pulse is behind pulse A when the motor rotates in CW direction. (Phase B pulse advances ahead of phase A pulse, when the motor rotates in CCW direction.)

Inversion of logic of phase B pulse with this parameter could invert a phase relation of phase B pulse to phase A pulse.

Setting value		IWhen Motor is Rotating in CCW direction	IWhen Motor is Rotating in CW direction
	A pulse(OA)		
[0]	B pulse(OB) Non-inverting		
1	B pulse(OB) Inverting		

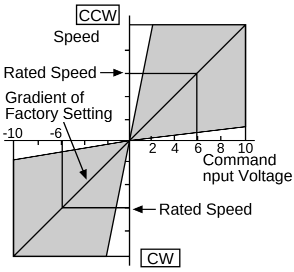
Parameter No.	Parameter Name	Setting range	Function/Description
4E	**FIR filter 1 set up**	0 – 31 [0]	• The parameter selects a FIR filter to be applied to a command pulse. • This is enabled only when command mode is HP and LP. • It will be a moving average filter for (setting + 1) times. • Note that any change to this parameter will become valid only after you reset the power source.

Note) Standard default setting in [ ] under "Setting range" and marked with * is automatically set during the real time auto gain tuning. To manually change the value, first disable the auto gain tuning feature be seeing page 196 "Disabling of auto tuning function" in Adjustments, and then enter the desired value.

Parameter Setting

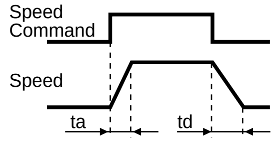
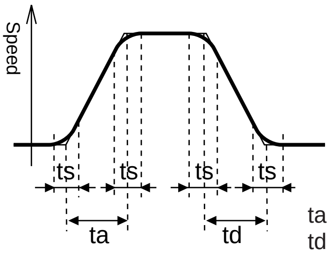
Parameters for Speed Control

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>50</td><td>Velocity command input gain</td><td>10 – 2000
[500]</td><td>(r/min)/V</td><td>The parameter sets a relationship between voltage applied to speed control input (SPR: CN X5 14-pin) and motor speed.
• Pr50 sets a “ gradient” in a relationship of command input voltage and rotational speed.
• As a standard factory setting is Pr50=500 [(r/min)/V] , the relation will be 3000r/min with input of 6V.


<Cautions>
1.Don’ t apply±10V or greater to speed command input (SPR).
2.When this driver is used in speed control mode and a position loop is established external to the driver, setting Pr50 varies positional gain of the entire servo system. You should be careful about oscillation due to too a high setting of Pr50.</td></tr>
<tr><td>51</td><td>Velocity command input logic inversion</td><td>0 – 1</td><td>–</td><td>The parameter inverts polarity of speed command input signal (SPR). Use this, for instance, when you wish to change the direction of rotation without changing the polarity of a command signal on the host device side.
<table>
<tr><th>Setting value</th><th>Direction of Motor Rotation</th></tr>
<tr><td>0</td><td>CCW direction viewed from the edge of axis for (+) command</td></tr>
<tr><td>[1]</td><td>CW direction viewed from the edge of axis for (+) command</td></tr>
</table>
<Notice>
A standard factory setting of this parameter is 1. With (+) command, the motor rotates in CW direction, and thus compatibility with the driver of each series of conventional MINAS is achieved.
<Caution>
When you configure the servo driving system by combining the driver set to speed control mode and external position unit, be careful as the motor may abnormally operate unless polarity of speed command signal from the position unit and polarity setting of this parameter agree.</td></tr>
<tr><td>52</td><td>Velocity command offset</td><td>–2047
– 2047
[0]</td><td>0.3mV</td><td>• This parameter adjusts offset of external analog speed command system including the host device.
• Offset volume will be approximately 0.3mV per a set value “ 1” .
• To adjust offset, there are 2 ways of (1) manual adjustment and (2) automatic adjustment.
1) Manual adjustment
• When you make offset adjustment with the driver only:
Using this parameter, set a value that prevents the motor from rotating, after you have correctly input 0V in speed command input (SPR/TRQR) (or connected to signal ground).
• When the host device establishes a position loop:
With servo locked, using this parameter, set a value so that deviation pulse will be zero.
2) Automatic Adjustment
• For details on operating instructions in automatic offset adjustment mode, refer to “ Details of Execution Display of Auxiliary Function Mode” of Preparations volume on page 66.
• When you execute automatic offset adjustment, the result will be reflected in this parameter Pr52.</td></tr>
</table>

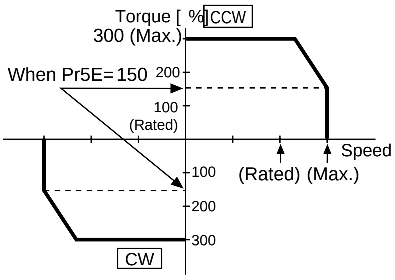
Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
53	**1st internal speed**	–20000 – 20000 [0]	r/min	The parameter directly sets the 1st to 4th speed of internal command speed of when setting of internal speed has been enabled with the parameter “ speed setting internal/external switching” (Pr05), to Pr53 to Pr56, respectively, in the unit of [r/min] . < Caution> Polarity of settings shows that of internal command speed. + CCW direction viewed from the edge of axis for (+) command – CW direction viewed from the edge of axis for (–) command Pr56 is a value of speed limits in torque control mode. **You should set this parameter in a range of rotational speeds of the motor to be used.**
54	**2nd internal speed**			
55	**3rd internal speed**			
56	**4th internal speed**			
57	**JOG speed set up**	0 – 500 [300]	r/min	The parameter directly sets JOG speed in JOG run in “ motor trial run mode” in terms of [r/min] . For details on JOG function, refer to “ Trial Run (JOG)” of Preparations volume on page 68.
58	**Acceleration time**	0 – 5000 [0]	2ms/ (1000r/min)	Speed control is possible by applying acceleration/deceleration to speed command in the driver in speed control mode. When you input stepped speed command or use in internal speed setting, you will have soft start/soft down actions.  ta : Pr58 x 2ms/(1000r/min) td : Pr58 x 2ms/(1000r/min) < Caution> When you use this in combination with a position loop external to the driver, you should not use acceleration/deceleration time. (Set 0 to both Pr58 and Pr59.)
59	**Deceleration time**	0 – 5000 [0]	2ms/ (1000r/min)	
5A	**S-shaped acceleration/ deceleration time**	0 – 500 [0]	2ms	This parameter enables smooth run by adding pseudo Sigmoid acceleration/deceleration to speed control, in applications in which acceleration at startup/stop considerably changes, thus causing a shock.  1. Pr58 and Pr59 set acceleration and deceleration time of basic linear portion, respectively. 2. Pr5A sets time of Sigmoid part in time width centered on inflection ta : Pr58 td : Pr59 ts : Pr5A $\frac{ta}{2} > ts$, and $\frac{td}{2} > ts$ To be used in Pr5A.
5B	**Speed command FIR filter set up**	0 – 31 [0]	Set value + 1	Select the filter for the analog speed command in the LS control mode. The filter is a moving average filter (the number of averaging: Set value + 1). Note that a change of this parameter becomes valid after the power supply is reset.

Parameter Setting

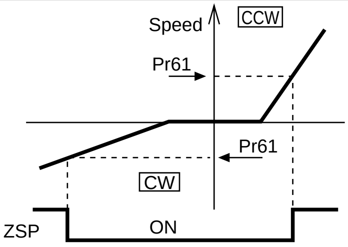
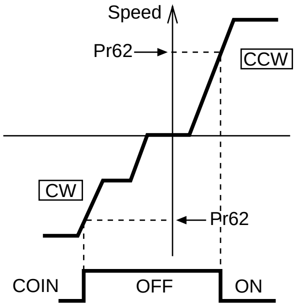
Parameters for Torque Control

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
5E	**Torque limit**	0 – 500	%	• This function limits maximum torque of the motor through setting of parameters within the driver. • In normal specifications, torque about 3 times higher than the rated is allowed for an instant. This parameter limits the maximum torque, however, if the triple torque may cause a trouble in the strength of motor load (machine). • Setting should be given as a % value to rated torque. • The right figure shows a case in which the maximum torque is limited to 150%. • Pr5E limits maximum torque in both CW and CCW directions simultaneously.  **<Caution>** You cannot set this parameter to a value above a factory setting of the system parameter (i.e., a factory set parameter that cannot be changed through of PANATERM® and panel manipulation) “ Maximum Output Torque Setting” . A factory setting may vary depending on a combination of an driver and motor. For further information, refer to “ Pr5E Setting of Torque Limit” of Preparations volume on page 55.

Parameters for various sequences

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
61	**Zero speed**	0 – 20000 [50]	r/min	• The parameter directly sets timing to an output zero speed detection output signal (ZSP: CN X5 12-pin) in terms of [r/min] . • A zero speed detection signal (ZSP) is output when motor speed falls below the speed set with this parameter Pr61. • Setting of Pr61 acts on both CW and CCW directions, irrespective of rotating direction of the motor. • There is hysteresis of 10rpm. The parameter should be set to 10 or greater. 
62	**At-speed**	0 – 20000 [1000]	r/min	• The parameter sets timing to output a at-speed signal (COIN;CN X5 39-pin) in speed control and torque control modes in terms of rotational speed [r/min] . • When the motor speed exceeds setting of this parameter Pr62, at-speed signal (COIN) will be output. • Setting of Pr61 acts on both CW and CCW directions, irrespective of rotating direction of the motor. • There is hysteresis of 10rpm. The parameter should be set to 10 or greater. 

Default setting is shown by [ ]

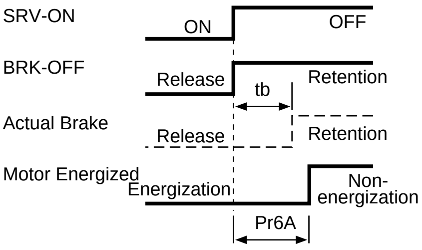
<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>65</td><td>Undervoltage error response at main power-off</td><td>0 – 1</td><td>–</td><td>The parameter sets whether to enable the “ protection against main power source under-voltage” function when you shut down the main power of main and control power supplies.
<table>
<tr><th>Setting value</th><th>Main Power Source Under-voltage Protection Action</th></tr>
<tr><td>0</td><td>In this case, if you shut off the main power during Servo ON, it will be SERVO-OFF without a trip. Then, when the main power supply turns ON again, it will be recovered to Servo ON.</td></tr>
<tr><td>[1]</td><td>Shutting off main power during Servo ON will activate abnormal main power supply under-voltage (alarm code No.13) and cause a trip.</td></tr>
</table>
Refer to the timing chart “ At Power ON” of Preparations volume on page 40.</td></tr>
<tr><td>66</td><td>Dynamic breke inhibition at overtravel limit</td><td>0 – 1</td><td>–</td><td>The parameter sets driving conditions at decelerated operation after over-travel input inhibit (CCWL: connector CN X5 9-pin or CWL: connector CN X5 8-pin) has been activated and enabled.
<table>
<tr><th>Setting value</th><th>Driving Conditions from Deceleration to Stop</th></tr>
<tr><td>[0]</td><td>The motor decelerates and stops as the dynamic brake (DB) is operated. The motor will be in free condition after it stops.</td></tr>
<tr><td>1</td><td>Free running, the motor decelerates and stops. The motor will be in free condition after it stops.</td></tr>
</table></td></tr>
<tr><td>67</td><td>Error response at main power-off</td><td>0 – 7</td><td>–</td><td>The parameter sets:
(1) Driving conditions during deceleration and after stopping; and
(2) Processing to clear content of the deviation counter
after the main power source is shut off.
<table>
<tr><th rowspan="2">Setting value</th><th colspan="2">Driving Conditions</th><th rowspan="2">Content of Deviation Counter</th></tr>
<tr><th>During Deceleration</th><th>After Stopped</th></tr>
<tr><td>[0]</td><td>DB</td><td>DB</td><td>Clear</td></tr>
<tr><td>1</td><td>Free Run</td><td>DB</td><td>Clear</td></tr>
<tr><td>2</td><td>DB</td><td>Free</td><td>Clear</td></tr>
<tr><td>3</td><td>Free Run</td><td>Free</td><td>Clear</td></tr>
<tr><td>4</td><td>DB</td><td>DB</td><td>Retention</td></tr>
<tr><td>5</td><td>Free Run</td><td>DB</td><td>Retention</td></tr>
<tr><td>6</td><td>DB</td><td>Free</td><td>Retention</td></tr>
<tr><td>7</td><td>Free Run</td><td>Free</td><td>Retention</td></tr>
</table>
DB: Activation of dynamic brake</td></tr>
<tr><td>68</td><td>Error response Action</td><td>0 – 3</td><td>–</td><td>The parameter sets driving conditions during deceleration or following stop, after any of protective functions of the driver has been activated and alarm has been generated.
<table>
<tr><th rowspan="2">Setting value</th><th colspan="2">Driving Conditions</th><th rowspan="2">Content of Deviation Counter</th></tr>
<tr><th>During Deceleration</th><th>After Stopped</th></tr>
<tr><td>[0]</td><td>DB</td><td>DB</td><td>Clear</td></tr>
<tr><td>1</td><td>Free Run</td><td>DB</td><td>Clear</td></tr>
<tr><td>2</td><td>DB</td><td>Free</td><td>Clear</td></tr>
<tr><td>3</td><td>Free Run</td><td>Free</td><td>Clear</td></tr>
</table>
(DB: Activation of dynamic brake)
See also “ When Abnormality (Alarm) Occurs (Serve ON Command State)” of the timing chart, Preparations volume on page 41.</td></tr>
<tr><td>69</td><td>Sequence at Servo-OFF</td><td>0 – 7
[0]</td><td>–</td><td>• The parameter sets:
1) Driving conditions during deceleration or after stop
2) Processing to clear the deviation counter
following Servo off (SRV-ON signal: CN X5 29-pin turns On ‡ Off).
• A relationship between setting of Pr69 and driving conditions/deviation counter processing conditions is similar to that of Pr67 (Sequence at Main Power Off).
• See also “ Serve On/Off Operation When the Motor Stops” of the timing chart of Preparations volume on page 42.</td></tr>
</table>

Parameter Setting

Default setting is shown by [ ]

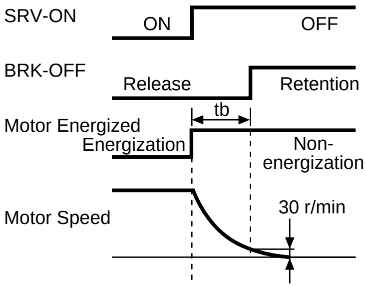
<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>6A</td><td>Mechanical brake delay at motor standstill</td><td>0 – 100
[0]</td><td>2ms</td><td>The parameter sets time till non-energization of motor (servo free) after the brake release signal (BRK-OFF) turns off (brake retained), at Serve Off while the motor stops.

- In order to prevent minor movement/drop of the motor (work) due to operation delay time of the brake (tb): Setting of Pr6A ≧ tb.
- See “ Serve On/Off Operation When the Motor Stops” of the timing chart on page 42.



See also “ Serve On/Off Operation When the Motor Stops” of the timing chart of Preparations volume on page 43.</td></tr>
<tr><td>6B</td><td>Mechanical brake delay at motor in motion</td><td>0 – 100
[0]</td><td>2ms</td><td>Unlike Pr6A, the parameter sets time till brake release signal (BRK-OFF) turns off (brake retained) after motor non-energization (servo-free), at Servo off while the motor is rotating.

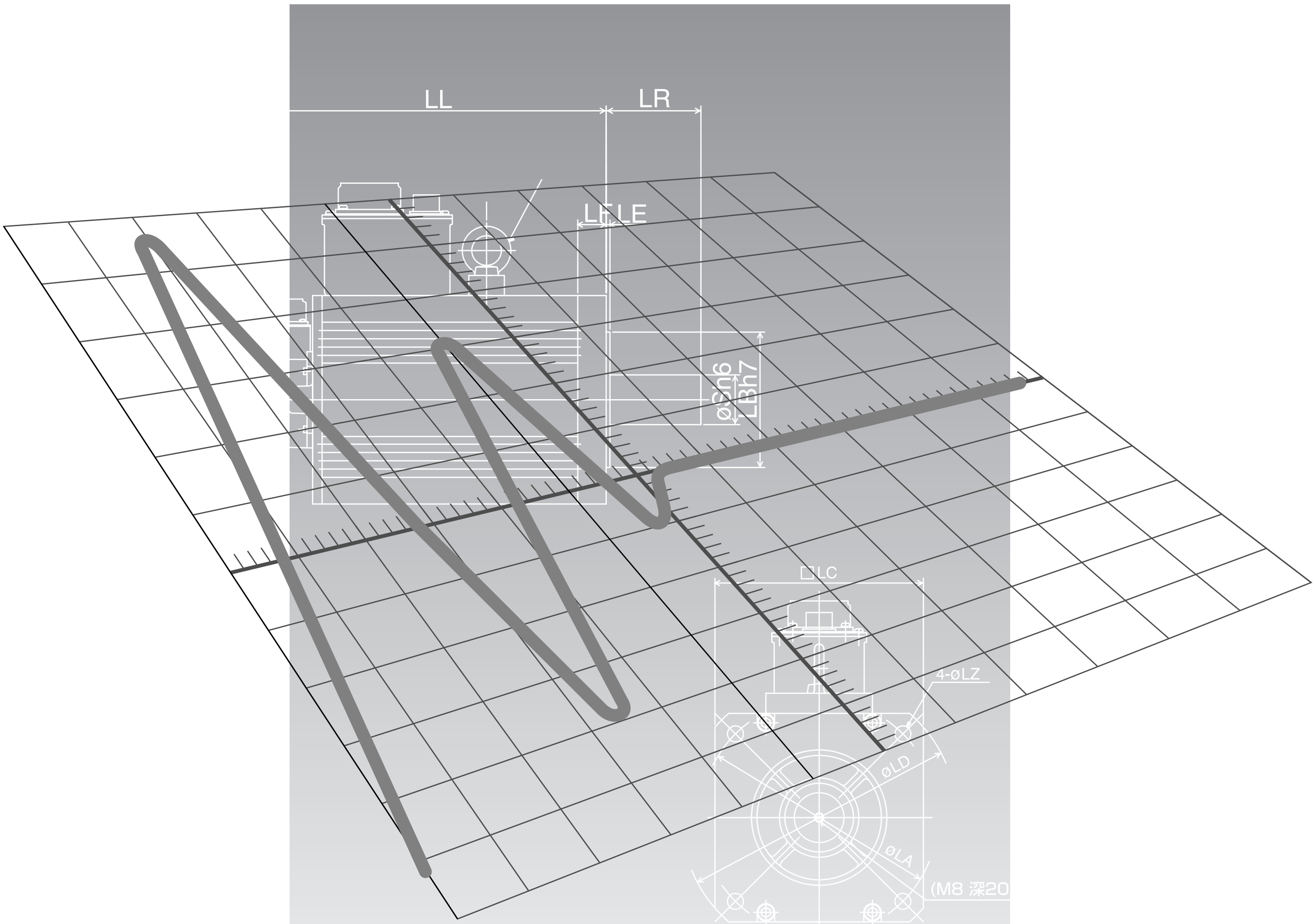
- This should be set to prevent deterioration of the brake due to revolutions of the motor.
- At Servo off while the motor is rotating, time tb in the right figure will be either set time of Pr6B or time till the motor rotational speed falls below approximately 30r/min, whichever is smaller.
- See “ Serve On/Off Operation When the Motor is Rotating” of the timing chart of on page 43.



See also “ Serve On/Off Operation When the Motor Stops” of the timing chart of Preparations volume on page 42.</td></tr>
<tr><td>6C</td><td>External regenerative resister set up</td><td>0 – 3</td><td>–</td><td>This parameter is set depending on whether to use regeneration resistance built in the driver, or to provide a regeneration resistance in the external (connect between RB1 and RB2 of connector CN X 2 in types A to D, and between terminal blocks P and B2 in types E - G).

<table>
<tr><th>Setting value</th><th>Regeneration Resistance to Use</th><th>Protection against Regeneration Resistance Overload</th></tr>
<tr><td>[0]</td><td>Built-in resistance</td><td>According to built-in resistance, (about 1% duty) protection against regeneration resistance overload works.</td></tr>
<tr><td>1</td><td>External resistance</td><td>This is activated with operating limits of the external resistance at 10% duty.</td></tr>
<tr><td>2</td><td>Built-in resistance</td><td>This is activated with operating limits of the external resistance at 100% duty.</td></tr>
<tr><td>3</td><td>External resistance</td><td>Regeneration resistance does not work, and a built-in condenser accommodates all regenerated power.</td></tr>
</table>

<Request>
When you use an external regeneration, you must install external safeguards such as a temperature fuse, etc.
Otherwise, as protection of regeneration resistance would be lost, causing abnormal heat generation and burnout.
<Caution>
Be careful not to touch an external regeneration resistance.
While you are using an external resistance, it may become hot and scald you. For type A, only external regeneration resistance is used.</td></tr>
<tr><td>6D</td><td>Main power-off detection time</td><td>0 – 32767
[35]</td><td>2ms</td><td>The parameter sets time to detect shut-off when shut-off of main power supply continues.</td></tr>
</table>



[Connections and Settings in Torque Control Mode]

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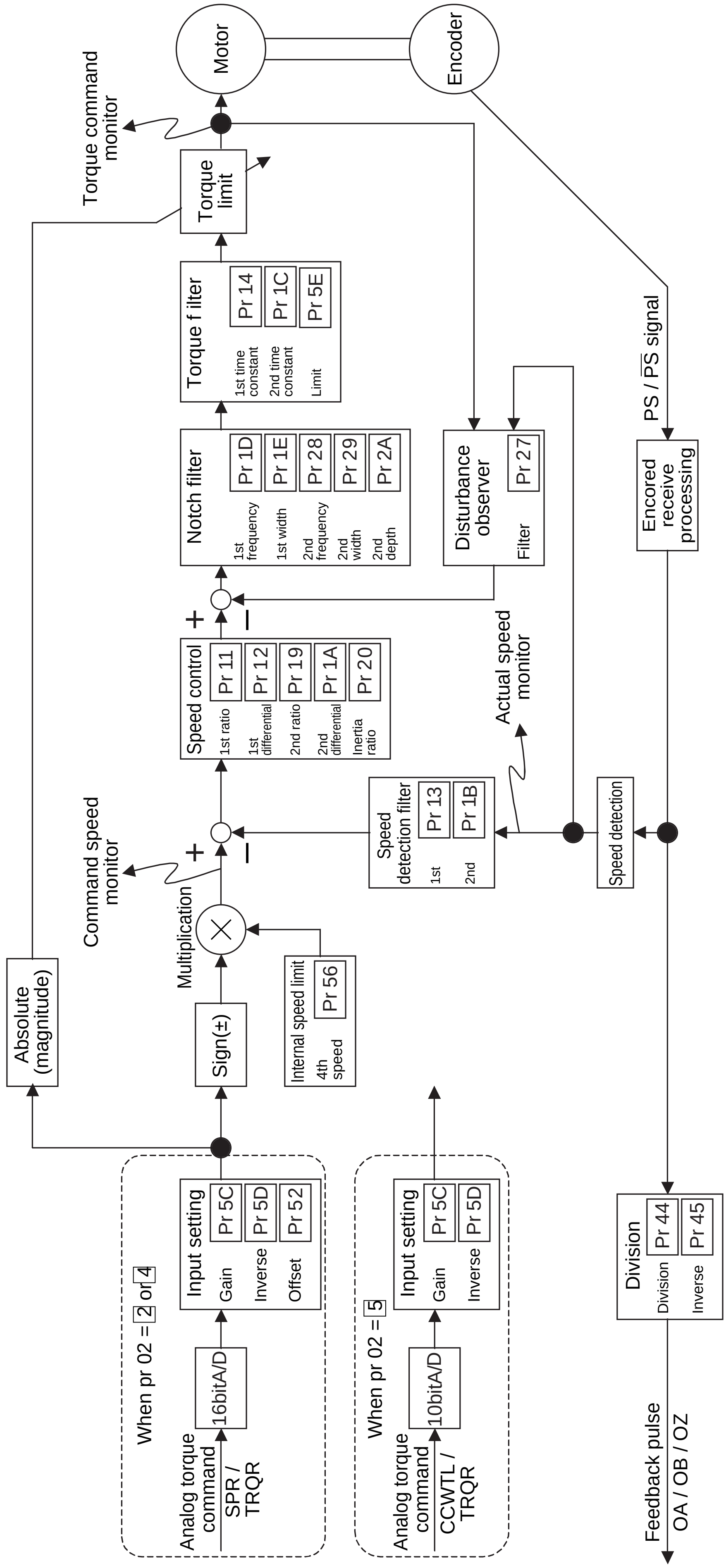
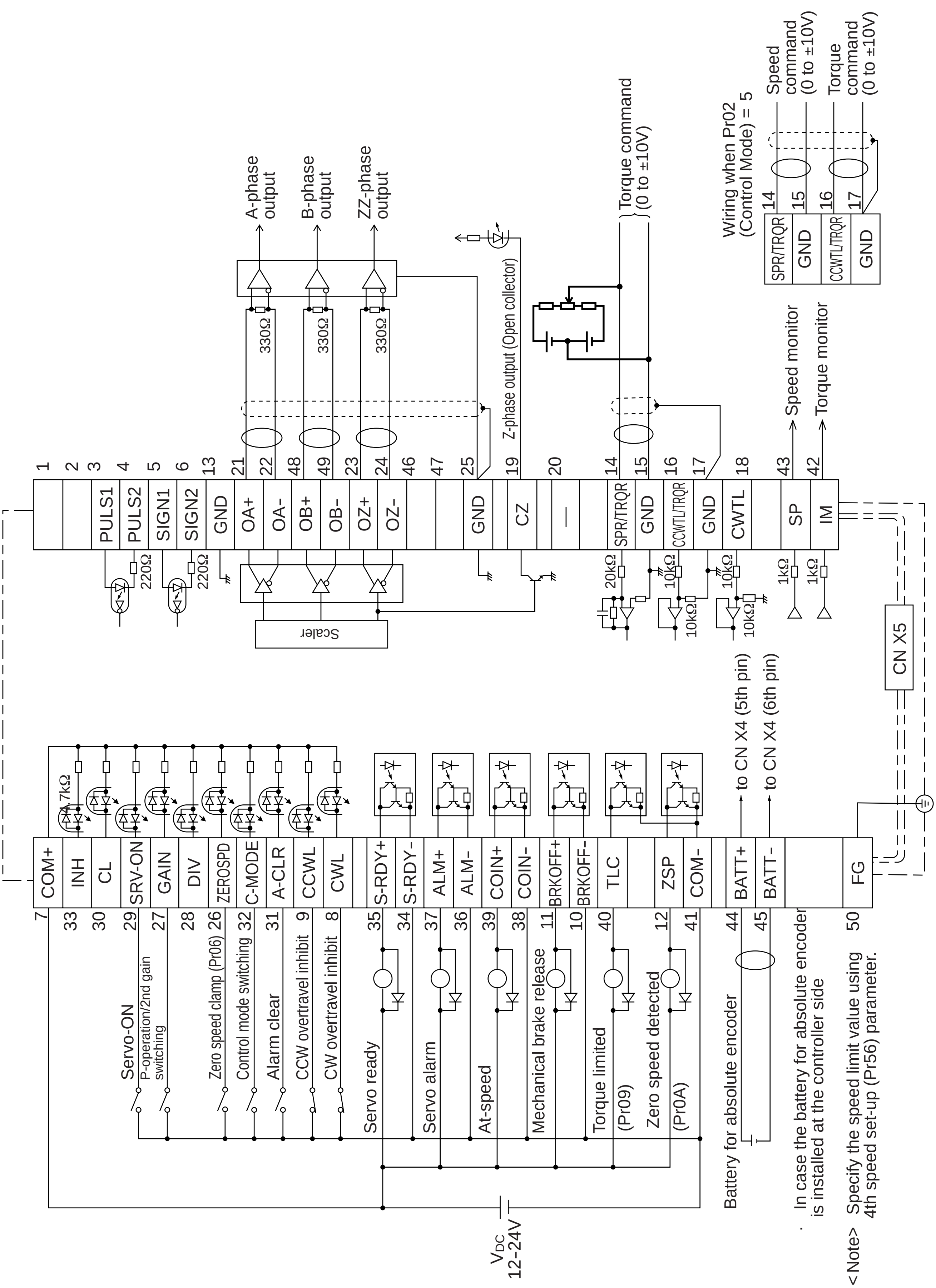
Torque control block diagram



CN X5 Connector

Circuits Available for Torque control mode



· In case the battery for absolute encoder is installed at the controller side

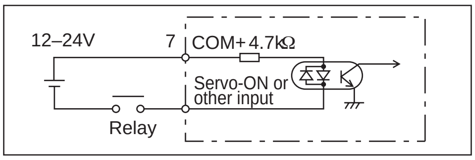
<Note> Specify the speed limit value using 4th speed set-up (Pr56) parameter.

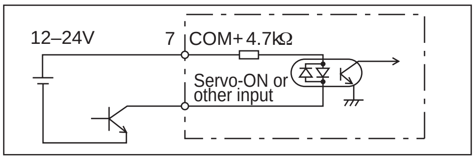
CN X5 Connector

Interface Circuit

Input Circuit

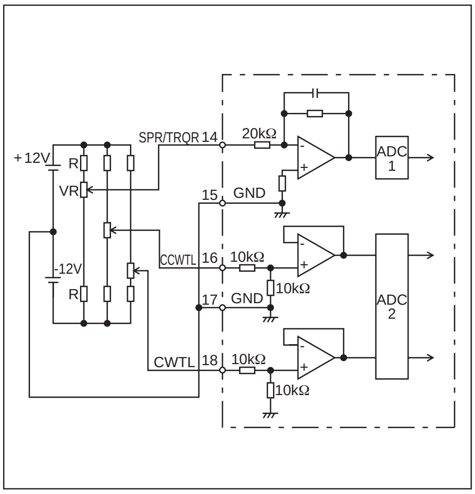
SI SI Connecting to sequence input signals





- Connect to a contact of switch and relay, or a transistor of an open collector output.
- Use a switch or relay for micro current so that insufficient contact can be avoided.
- Lower limit of the power supply (12 to 24V) should not be less than 11.4V in order to secure the appropriate level of primary current of the photo coupler.

AI AI Analogue Command Input



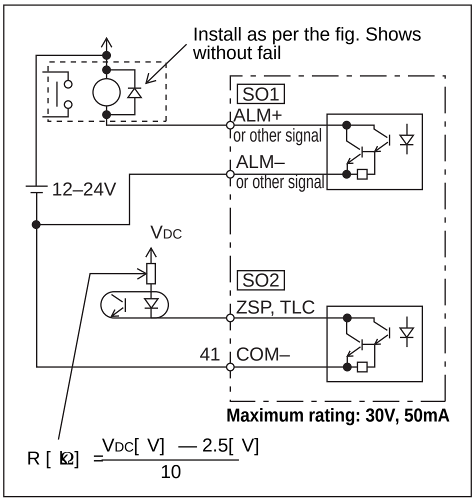
- There are three analogue command inputs of SPR/RTQR (14 pins), CCWTL (16 pins) and CWTL (18 pins).
- The maximum permissible input voltage is ±10V. For the input impedance of these inputs, see the right figure.
- If you make a simplified circuit comprising a variable resistor (VR) and resistor (R), refer to the right figure. When the variable range of each input is -10V to +10V, the VR should be a B type resistor of 2kΩ (min.1/2W). The R should be 200Ω (min.1/2W).
- The A/D converters for these inputs should have the following resolution.

1) ADC1 (SPR and TRQR) : 16 bits (including one bit for sign)
2) ADC2 (CCWTL and CWTL) : 10 bits (including one bit for sign)

Output Circuit

SO1 SO2 Sequence output circuit

- This comprises a Darlington driver with an open collector. This is connected to a relay or photo coupler.
- There exists a collector-to-emitter voltage V_{CE}(SAT) of approx. 1V at transistor ON, because of Darlington connection of the out put transistor. Note that normal TTLIC can't be directly connected since this does not meet VIL requirement.
- This circuit has an independent emitter connection, or an emitter connection that is commonly used as the minus (–) terminal (COM–) of the control power.
- Calculate the value of R using the formula below so as the primary current of the photo coupler become approx. 10mA.

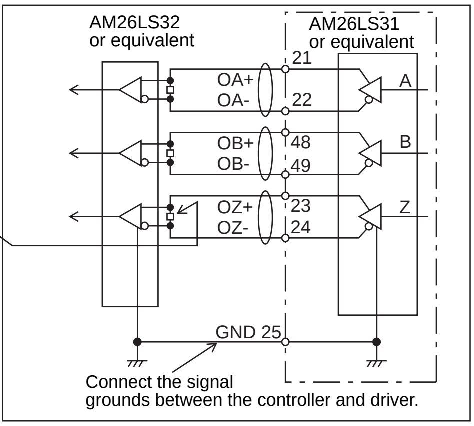


$$R[k\Omega] = \frac{V_{DC}[V] - 2.5[V]}{10}$$

For the recommended primary current value, check the data sheet on the equipment and photo-coupler used.

PO1 Line Driver (Differential Output) Output

- Provides differential outputs of encoder signals (A, B and Z phases) that come from the scalar.
- Receive these signals with a line receivers. In this case, install a resistor of approx. 330Ω between the inputs.
- These outputs are non-insulated signals.

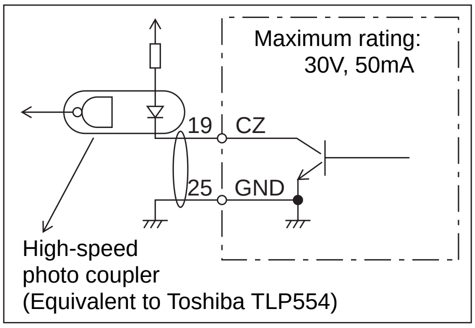


⊖ shows a pair of twisted wires.

PO2 Open Collector Output

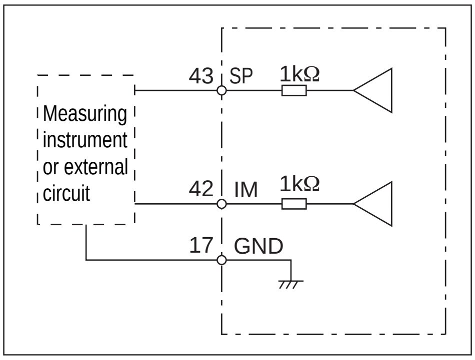
- Outputs Z-phase signals among those from the encoder. The outputs are non-insulated.
- Receive these signal with high-speed photo coupler at controller side, since these Z-phase signal width is normally narrow.

⊖ shows a pair of twisted wires.



AO Analogue Monitor Output

- This output is the speed monitor signal (SP) or torque monitor signal (IM).
- The signal range is approx. 0 to ± 9V.
- The output impedance is 1kΩ. Pay attention to the input impedance of your measuring instruments and external circuits connected.



<Resolution>

1) Speed monitor signal (SP): 8r/min./LSB calculated from 6V/3000r/min (Pr07 = 3)
2) Torque monitor signal (IM): 0.4%/LSB calculated from 3V/rated value (100%)

CN X5 Connector

Input signal (common) assignment to CN X5 connector pins

Input Signals (Common) and their Functions

<table>
<tr><th>Signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Control signal power (+)</td><td>7</td><td>COM +</td><td>• Connect to (+) of an external power supply (12VDC to 24VDC).
• Use source voltage of 12V±10% – 24V±10%.</td><td rowspan="2">–</td></tr>
<tr><td>Control signal power (–)</td><td>41</td><td>COM –</td><td>• Connect to (–) of an external power supply (12VDC to 24VDC).
• The required capacity depends on the I/O circuit configuration. 0.5A or larger is recommended.</td></tr>
<tr><td rowspan="2">Servo-ON</td><td>29</td><td>SRV-ON</td><td>• When this signal is connected to COM-, the dynamic brake will be released and the driver is enabled. (Servo-ON).</td><td rowspan="2">SI
page 134</td></tr>
<tr><td colspan="3"><Notes>
1. This signal becomes effective about two seconds after power on (see the Timing Chart).
2. Don't use this Servo-ON or Servo-OFF signal to turn on or off the motor. See page 46 "Dynamic Brake" in Preparations.
• Allow at least 50ms delay after the driver is enabled before any command input is entered.
• By opening the connection to COM– , the driver will be disabled(Servo-OFF) and the current flow to the motor will be inhibited.
• Operation of the dynamic brake and clearing action of the position error counter can be selected using Pr69 (Sequence under Servo-OFF).</td></tr>
<tr><td rowspan="2">Control mode switching</td><td>32</td><td>C-MODE</td><td>• When Pr02 (Control Mode Selection) = 3, 4 or 5, the control mode is selected per the table below.</td><td rowspan="2">SI
page 134</td></tr>
<tr><td colspan="3"><table>
<tr><th></th><th colspan="2">Connection with COM–</th></tr>
<tr><th>Pr02 value</th><th>open (1st)</th><th>closed (2nd)</th></tr>
<tr><td>3</td><td>Position control mode</td><td>Speed control mode</td></tr>
<tr><td>4</td><td>Position control mode</td><td>Torque control mode</td></tr>
<tr><td>5</td><td>Speed control mode</td><td>Torque control mode</td></tr>
</table></td></tr>
<tr><td>CW overtravel inhibit</td><td>8</td><td>CWL</td><td>• If COM– is opened when the movable part of the machine has moved to CW exceeding the limit, the motor does not generate torque.</td><td>SI
page 134</td></tr>
<tr><td>CCW overtravel inhibit</td><td>9</td><td>CCWL</td><td>• If COM– is opened when the movable part of the machine has moved CCW exceeding the limit, the motor does not generate torque.
• If you set 1 to Pr04 (Overtravel input inhibited invalid), CWL/CCWL input will be disabled. A factory setting is Disable (1).
• With Pr66 (DB deactivate when driving is inhibited), you can activate dynamic brake when CWL/CCWL input is enabled. According to a factory setting, dynamic brake operates (Pr66 is set to 0).</td><td>SI
page 134</td></tr>
<tr><td rowspan="2">Counter clear</td><td>30</td><td>CL</td><td>The function differs depending on the control mode.</td><td rowspan="2">SI
page 134</td></tr>
<tr><td colspan="3"><table>
<tr><td>Position control</td><td>• Clears the position error counter.
Connect to COM– to clear the counter.
• Use Pr4D to select the clear mode.
<table>
<tr><th>Pr4D value</th><th>Meaning</th></tr>
<tr><td>0(Factory-setting)</td><td>LEVEL</td></tr>
<tr><td>1</td><td>EDGE</td></tr>
</table></td></tr>
<tr><td>Speed control</td><td>• With speed setting of the 2nd selection input, you can set 4 speeds in combination with INH.
• For details, see Pr05 (Speed Set-Up Switching) description.</td></tr>
<tr><td>Torque control</td><td>• Invalid</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>**Command pulse input inhibit**</td><td>**33**</td><td>**INH**</td><td>The function differs depending on the control mode.
<table>
<tr><td>Position control</td><td>• Enter command pulse input inhibit.
• You can disable this input with Pr43 (disable command pulse input inhibit).
<table>
<tr><th>Pr43 value</th><th>Meaning</th></tr>
<tr><td>1(Factory-setting)</td><td>The INH signal (input) is disabled.</td></tr>
<tr><td>0</td><td>• With COM– closed, the pulse command signal (PULSE SIGN) is enabled.
• With COM– open, the pulse command signal (PULSE SIGN) is inhibited.</td></tr>
</table></td></tr>
<tr><td>Speed control</td><td>• With speed setting of the 1st selection input, you can set 4 speeds in combination with CL input.
• For details, see Pr05 (Speed Set-Up Switching) description.</td></tr>
<tr><td>Torque control</td><td>• Invalid</td></tr>
</table></td><td>SI
page 134</td></tr>
<tr><td>**Speed zero clamp**</td><td>**26**</td><td>**ZEROSPD**</td><td>• With COM– open, the speed command is considered zero.
• This input can be made disabled using Pr06.
• With factory setting, disconnecting this pin from COM– sets the speed to zero.
<table>
<tr><th>Pr06 value</th><th>Meaning</th></tr>
<tr><td>0 (Factory-setting)</td><td>ZEROSPD is disabled.</td></tr>
<tr><td>1</td><td>ZEROSPD is enabled.</td></tr>
</table></td><td>SI
page 134</td></tr>
<tr><td>**Gain switching**</td><td>**27**</td><td>**GAIN**</td><td>• This is setting of Pr30 (2nd gain setting) and has the following 2 types of functions:
<table>
<tr><th>Pr30 value</th><th>Connection to COM-</th><th>Function</th></tr>
<tr><td rowspan="2">0
(Factory-setting)</td><td>Open</td><td>Speed loop: PI (Proportional / Integral) action</td></tr>
<tr><td>Close</td><td>Speed loop: P (Proportional) action</td></tr>
<tr><td rowspan="3">1</td><td>Open</td><td>• 1st gain selected (Pr10, 11, 12, 13 and 14)</td></tr>
<tr><td>Close</td><td>• 2nd gain selected (Pr18, 19, 1A, 1B, 1C)</td></tr>
<tr><td colspan="2">To use the second gain, set Pr31 to “ 2” .</td></tr>
</table>
• No.2 Gain change Funcutions, see page 202 "Adjustments ".</td><td>SI
page 134</td></tr>
<tr><td>**Alarm clear**</td><td>**31**</td><td>**A-CLR**</td><td>• If the COM- connection is kept closed for more than 120 ms, the alarm status will be cleared.
• For details about not cleared alarm, see page 216 "Protective Functions".</td><td>SI
page 134</td></tr>
</table>

CN X5 Connector

Input signal assignment to CN X5 connector pins - designation(logic)

Input Signals (Speed Control) and their Functions

Signal	Pin No.	Symbol	Function	I/F circuit
Speed (torque) command	**14** **(15)**	**SPR/TRQR** **(GND)**	**< At speed control >** • This becomes speed command input (analogue) **0–±10V** • You can set-up the relationship between the command voltage level and the motor speed, with Pr50 (Speed Command Input Gain) . • Use Pr51 to inverse the polarity of the command input. **< At torque control >*** • This becomes torque command input (analogue) **0–±10V** • You can set-up the relationship between the command voltage level and the motor torque, with Pr5C (Torque Command Input Gain) . • Use Pr5D to inverse the polarity of input signals. • Use Pr56 (4th Speed Set-up) to adjust the speed limit in torque control. **< Note >** SPR/TRQR are invalid in position control mode.	AI page 134
CCW torque limit	**16** **(17)**	**CCWTL/TRQR*** **(GND)**	**< At speed and position control >** • You can limit the motor torque in the CCW direction by entering positive voltage (0 to +10V) to CCWTL. • You can limit the motor torque in the CW direction by entering negative voltage (-10 to 0V) to CWTL. • The torque limit value is proportional to the voltage with a factor of 100%/3V. • CCWTL and CWTL are valid when Pr03 (Torque Limit Input Inhibit) = 0. They are invalid when Pr03 = 1. **< At torque control >*** • Both of CCWTL and CWTL are invalid. • Use the 4th speed set-up(Pr56) to limit the speed.	AI page 134
CW torque limit	**18** **(17)**	**CWTL** **(GND)**		
Battery +	**44**	**BATT +**	• Connect a backup battery for absolute encoder (pole-sensitive !). • If the battery is connected directly to the driver, it is not necessary to connect a battery to this terminal.	–
Battery -	**45**	**BATT -**		

* When the torque control mode is selected at the speed/torque switching mode (Pr02 = 5), the No.16 pin (CCWTL/TRQR) becomes the torque command input (analogue). You can set-up the relationship between the command voltage level and the motor torque with Pr5C (Torque Command Input Gain).

Output signal assignment to CN X5 connector pins - designation(logic)

Output Signals (Common) and their Functions

Signal	Pin No.	Symbol	Function	I/F circuit
Servo alarm output	**37** **36**	**ALM +** **ALM –**	• This output(transistor) turns OFF, when the driver detects and error(trip).	SO1 page 135
Servo-ready output	**35** **34**	**S-RDY +** **S-RDY -**	• This output(transistor) turns ON, when the main power is on(for both the driver and the motor) and no alarm is active.	SO1 page 135
Mechanical brake release output	**11** **10**	**BRK-OFF +** **BRK-OFF –**	• This is used to release the electromagnetic brake of the motor. • Turn the output transistor ON when releasing brake. • Refer to “ Timing Chart” on page 40, on Preparations. • This output(transistor) turns ON , when the brake is released. • See page 40 "Timing Chart".	SO1 page 135

<table>
<tr><th>Signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td rowspan="2">Zero speed detection</td><td>12</td><td>ZSP</td><td>• Signal which is selected at Pr0A (ZSP Output Selection) will be turned on.</td><td rowspan="2">SO2
page 135</td></tr>
<tr><td colspan="3">
<table>
<tr><th>Pr0A value</th><th>Function</th></tr>
<tr><td>0</td><td>Output(transistor) turns ON during the In-toque limiting.</td></tr>
<tr><td>1
(Factory-setting)</td><td>Output(transistor) turns ON when the motor speed becomes lower than that of the preset speed with Pr61(Zero speed).</td></tr>
<tr><td>2*</td><td>Output(transistor) turns ON when either one of over-regeneration, overload or battery warning is activated.</td></tr>
<tr><td>3*</td><td>Output(transistor) turns ON when the over-regeneration (more than 85% of permissible power of the internal regenerative discharge resistor) warning is activated.</td></tr>
<tr><td>4*</td><td>Output(transistor) turns ON when the overload (the effective torque is more than 85% of the overload trip level) warning is activated.</td></tr>
<tr><td>5*</td><td>Output(transistor) turns ON when the battery (the voltage of the backup battery becomes lower than approx. 3.2V at the encoder side) warning is activated.</td></tr>
</table>
* When the setting is a value between 2 and 5, the output transistor will be turned on for at least 1 second upon detecting an alarm condition.
</td></tr>
<tr><td>Torque in-limit</td><td>40</td><td>TLC</td><td>• Signal which is selected by Pr09 (TLC Output Selection) will be turned ON. Factory-setting: 0
• See the above ZSP signal for the set-up of Pr09 and functions.</td><td>SO2
page 135</td></tr>
<tr><td rowspan="2">In-position/
At-speed</td><td>39
38</td><td>COIN +
COIN –</td><td>• Function changes at control mode.</td><td rowspan="2">SO1
page 135</td></tr>
<tr><td colspan="3">
<table>
<tr><td>Position</td><td>• In-position output
• Output(transistor) turns ON when the position error is below the preset value by Pr60 (In-Position Range).</td></tr>
<tr><td>Speed and torque</td><td>• At-speed output
• Output(transistor) turns ON when the motor speed reaches the preset value by Pr62 (At-Speed).</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">A-phase output</td><td>21</td><td>OA +</td><td rowspan="6">• Provides differential outputs of the encoder signals (A, B and Z phases) that come from the driver (equivalent to RS422 signals).
• The logical relation between A and B phases can be selected by Pr45 (Output Pulse Logic Inversion).
• Not insulated</td><td rowspan="6">PO1
page 135</td></tr>
<tr><td>22</td><td>OA –</td></tr>
<tr><td rowspan="2">B-phase output</td><td>48</td><td>OB +</td></tr>
<tr><td>49</td><td>OB –</td></tr>
<tr><td rowspan="2">Z-phase output</td><td>23</td><td>OZ +</td></tr>
<tr><td>24</td><td>OZ –</td></tr>
<tr><td>Z-phase output</td><td>19</td><td>CZ</td><td>• Z-phase signal output in an open collector (not insulated)
• Not insulated</td><td>PO2
page 135</td></tr>
<tr><td>Speed monitor output</td><td>43

(17)</td><td>SP

(GND)</td><td>• Outputs the motor speed, or voltage in proportion to the commanded speed with polarity.
+ : CCW rotation
– : CW rotation
• Use Pr07 (Speed Monitor Selection) to switch between actual and commanded speed, and to define the relation between speed and output voltage.</td><td>AO
page 135</td></tr>
<tr><td>Torque monitor output</td><td>42

(17)</td><td>IM

(GND)</td><td>• Outputs the output torque, or voltage in proportion to the position error with polarity.
+ : Fgenerating CCW-torque
– : Fgenerating CW-torque
• Use Pr08 (Torque Monitor Selection) to switch between torque and positional error, and to define the relation between torque/positional error and output voltage.</td><td>AO
page 135</td></tr>
</table>

Output Signals (Others) and their Functions

Signal	Pin No.	Symbol	Function	I/F circuit
Signal ground	**13, 15 17, 25**	**GND**	• Signal ground in the driver • Internally isolated from the control power (COM -).	–
Frame ground	**50**	**FG**	• Internally connected to the earth terminal.	–
(Not in use)	**1, 2, 20 46, 47**	**–**	• No connections should be made.	–

Trial run at Torque Control Mode

Operation with CN X5 Connected

1) Connect CN X5.

2) Connect the control signal (COM+ /COM–) to the power supply (12 to 24 VDC) .

3) Turn the main power (driver) ON.

4) Check the defaults of the parameters.

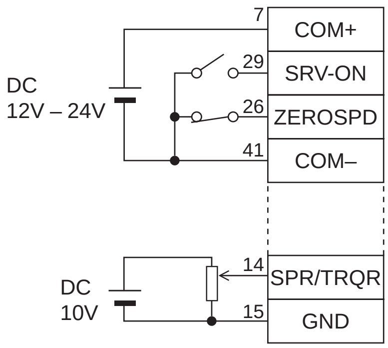
5) Connect between SRV-ON (CN X5 pin 29) and COM- (CN X5 pin 41) to make Servo-On active. The motor will be kept excited.

6) Apply an appropriate DC voltage between Torque command input TRQR (CN X5 pin 14) and GND (CN X5 pin 15) and verify the motor rotating direction (CW/CCW) and then reverse the voltage polarity and then verify reversed motor rotation. Also check the speed set by Pr56.

7) To change torque Pr5C, direction Pr5D and speed limit Pr56 in response to the command voltage, modify the following parameter.
Pr56: 4th speed
Pr5C: torque command input gain
Pr5D: torque command input inversion

See page 144 "Parameter setting" in Torgue control mode.

Wiring Diagram



ZEROSPD switch
Close: Run
Open: Stop

One way operation

For multi direction (CW and CCW) operation, use a bipolar power source.

Parameters

PrNo.	Parameter description	Value
Pr02	Control mode set-up	2
Pr04	Overtravel input inhibit	1
Pr06	ZEROSPD input selection	0
Pr56	4th internal speed	Set as required
Pr5C	Torque command input gain	
Pr5D	Torque command input inversion	

- Use the controller to send command pulses.

Input Signals Status

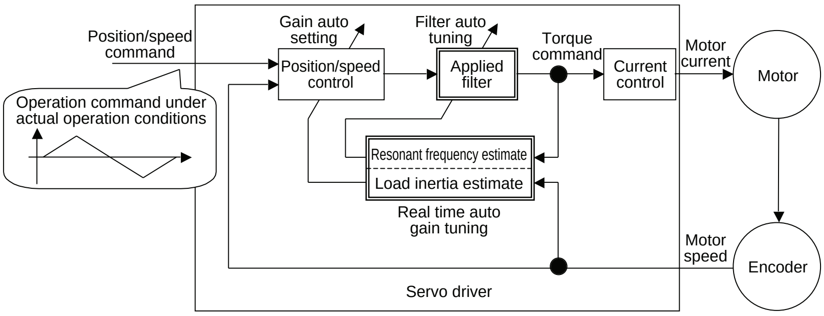
No.	Input signal	Monitor display
0	Servo-ON	+ A
2	CW overtravel inhibit	–
3	CCW overtravel inhibit	–
5	Speed zero clamp	–

MEMO

Real time auto gain tuning

Outline

Load inertia of the machine is estimated at real time, and the optimum gain is set up automatically based on the estimated result. A load, which has a resonance, also can be handled owing to the adaptive filter.



Application range

Under the following conditions, the real time auto gain tuning may not function properly.
In such case, use the normal mode auto gain tuning (see page 193 "Adjustments") or manual gain tuning (see page 197 "Adjustments").

	Conditions under which the real time auto gain tuning is prevented from functioning
Load inertia	• When the load inertia is smaller/larger than the rotor inertia (3 times or less; or 20 times or more) • When the load inertia fluctuates
Load	• When the machine stiffness is extremely low • When any unsecured part resides in such as backlash, etc.
Operation pattern	• In case of a continuous low speed operation under 100 [r/min] . • In case of soft acceleration/deceleration under 2000 [r/min] per 1 [s] . • When acceleration/deceleration torque is smaller than unbalanced load/viscous friction torque.

How to use

[1] Stop the motor (Servo-OFF).

[2] Set up Pr21 (Real-time auto tuning set-up) to 1 – 6.
Set up value before shipment is1.

Setting value	Real-time auto tuning	Changing degree of load inertia during operation	Adaptive filter
0	Not used	–	No
[1]	Used	Little change	Yes
2		Change slowly	
3		Change s haply	
4		Little change	No
5		Change slowly	
6		Change s haply	
7	Not used	–	Yes

When the changing degree of the load inertia is too large, set Pr21 to 3 or 6.
When the influence of resonance is conceivable, select “ adaptive filter YES” .

[3] Set 0 – 2 to Pr22 (real-time auto tuning machine stiffness).

[4] Turn the servo ON to operate the machine ordinarily.

[5] To increase the response performance, gradually increase Pr22 (Machine stiffness at real-time auto tuning). When any noise or vibration is found, decrease the Pr22 to a lower value soon.

[6] To store the result, write the data into the EEPROM.

Parameters, which are set up automatically

The following parameters are tuned automatically.

Parameter No.	Name
11	1st speed loop gain
12	1st speed loop integration time constant
13	1st speed detection filter
14	1st torque filter time constant
19	2nd speed loop gain
1A	2nd speed loop integration time constant
1B	2nd speed detection filter
1C	2nd torque filter time constant
20	Inertia ratio

The following parameters are also set up to the following fixed values automatically.

Parameter No.	Name	Set value
27	Disturbance torque observer filter selection	0
30	2nd gain action set-up	1
3A	Torque control switching mode	0

Caution

[1] Immediately after the first servo ON at startup or when Pr22 (machine stiffness at real-time auto tuning) is increased, abnormal noise or oscillation may be generated before load inertia is determined. This is not anomaly if it is stabilized shortly. However when such problems as oscillation or noise that continues for 3 reciprocal operations or longer is encountered frequently, take the following measures:
1) Write the parameter of normal operation into the EEPROM.
2) Decrease the Pr22 (Machine stiffness at real-time auto tuning).
3) Once set up Pr21 (Real-time auto tuning set-up) to 0 to disable the adaptive filter. Then, enable the real time auto tuning again. (resetting of inertia estimate adaptive operation)

[2] After abnormal noise or oscillation, Pr20 (inertial ratio) may be changed to an extreme value. In such case, also take the above measures.

[3]Among results of real-time auto gain tuning, Pr20 (inertia ratio) is programmed into EEPROM every 30 minutes. When you turn on the power again, auto tuning will be executed using the data as initial value.

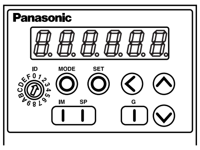
Parameter Setting

Parameters for Function Selection

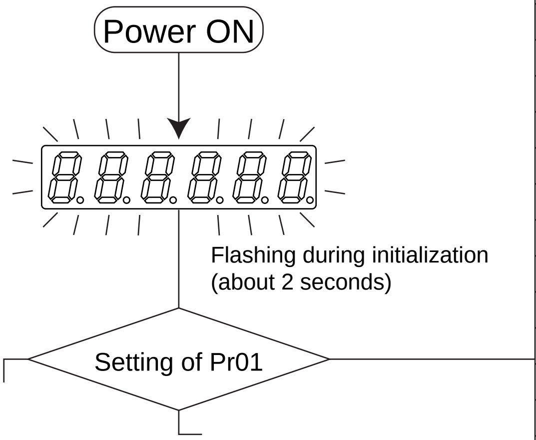
Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Function/Description
00	**Axis address**	0 – 15 [1]	In communications with a host device such as a personal computer that uses RS232C/485 with multiple axes, you should identify to which axis the host accesses and use this parameter to confirm axis address in terms of numerals.

- At power on, settings of the rotary switch ID on the front panel (0 – F) will be programmed into parameters of the driver.
- Settings of Pr00 can be changed only by means of the rotary switch ID.



Parameter No.	Parameter Name	Setting range	Function/Description
01	**LED display at power up**	0 – 15	In the initial condition after turning ON the control power, the following data displayed on the 7-segment LED can be selected.



Setting value	Description
0	Positional deviation
[1]	Motor revolving speed
2	Torque output
3	Control mode
4	I/O signal status
5	Error cause/record
6	Software version
7	Alarm
8	Regenerative load ratio
9	Overload load ratio
10	Inertia ratio
11	Feedback pulse sum
12	Command pulse sum
13	External scale deviation
14	External scale feedback pulse sum
15	Motor auto recognition

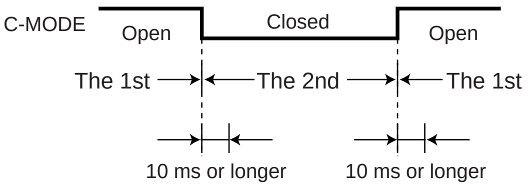
See page 56 "Front Panel Key Operations and Display".

Parameter No.	Parameter Name	Setting range	Function/Description
02	**Control mode**	0 – 14	Select the control mode of the servo driver.

Setting value	Control mode	
	The 1st Mode	The 2nd Mode* 1
0	Position control	–
[1]	Speed control	–
2	Torque control	–
3	Position	Speed control
4	Position	Torque control
5	Speed	Torque control
6	Semi-closed control	–
7	Full-closed control	–
8	Hybrid control	–
9	Speed	External encoder control
10	Speed	Semi-closed control
11	High-stiff equipment position control	–
12	Low-stiff equipment position control	–
13	Low-stiff equipment speed control	–
14	Second full-closed control	–

*1 A special control mode focused on the full-closed specification. For details, refer to " Full-Closed Control" volume on Page 000.

*2 When composite mode (Pr02 = 3,4,5,9,10) is set, you can switch the 1st and 2nd modes with the control mode switch input (C-MODE).



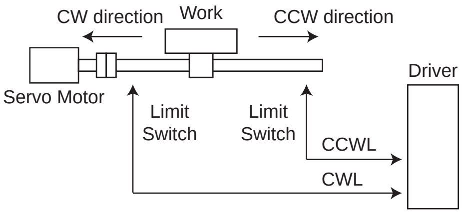
<Caution>

Enter a command after 10ms or longer have passed since C-MODE was entered.

Do not enter any command on position, speed or torque.

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Function/Description</th></tr>
<tr><td>04</td><td>Overtravel input inhibit</td><td>0 – 1</td><td>In the case of linear driving, in particular, to prevent mechanical damage due to overtraveling of work, you should provide limit switches on both ends of the axis, as shown below, whereby driving in a direction of switch action is required to be inhibited.



<table>
<tr><th rowspan="2">Setting value</th><th rowspan="2">CCWL/CWL Input</th><th colspan="2"></th><th rowspan="2">Action</th></tr>
<tr><th>Input</th><th>Connection with COM-</th></tr>
<tr><td rowspan="4">0</td><td rowspan="4">Enable</td><td rowspan="2">CCWL
(CN X5-9 pin)</td><td>Connected</td><td>Normal condition in which the limit switch on CCW side is not operating.</td></tr>
<tr><td>Open</td><td>CCW direction inhibited, CW direction allowed</td></tr>
<tr><td rowspan="2">CWL
(CN X5-8 pin)</td><td>Connected</td><td>Normal condition in which the limit switch on CW side is not operating.</td></tr>
<tr><td>Open</td><td>CW direction inhibited, CCW direction allowed</td></tr>
<tr><td>[1]</td><td>Disable</td><td colspan="3">Both CCWL and CWL inputs are ignored and they normally operate as no overtravel inhibit being set.</td></tr>
</table>

<Cautions>

1. When you set 0 to Pr04 and do not connect both CCWL and CWL inputs to COM- (off), abnormal condition in which limits are exceeded in both CCW and CW directions is detected, and the driver will then trip due to “ abnormal overtravel input inhibit“ .
2. You can set whether or not to activate the dynamic brake when slowdown occurs because CCW or CW overtravel input inhibit has been enabled. For details, refer to descriptions on Pr66 (DB deactivation at overtravel input inhibit).</td></tr>
<tr><td>06</td><td>ZEROSPD input selection</td><td>0 – 1</td><td>This sets switching of enable and disable of speed zero clamp input (ZEROSPD, CNX5 26-pin).

<table>
<tr><th>Setting value</th><th>Function of ZEROSPD Input (26-pin)</th></tr>
<tr><td>[0]</td><td>ZEROSPD input being ignored, it is determined that it is not speed zero clamp state at all times.</td></tr>
<tr><td>1</td><td>ZEROSPD input has been enabled. If connection with COM- is opened, speed command will be regarded as zero.</td></tr>
</table></td></tr>
<tr><td>07</td><td>Speed monitor (SP) selection</td><td>0 – 9</td><td>The parameter selects/sets a relationship between voltage output to the speed monitor signal output (SP: CN X5 43-pin) and the actual motor speed or command speed.

<table>
<tr><th>Setting value</th><th>SP Signals</th><th>Relationship between Output Voltage Level and Speed</th></tr>
<tr><td>0</td><td rowspan="5">Motor Actual Speed</td><td>6V / 47 r/min</td></tr>
<tr><td>1</td><td>6V / 187 r/min</td></tr>
<tr><td>2</td><td>6V / 750 r/min</td></tr>
<tr><td>[3]</td><td>6V / 3000 r/min</td></tr>
<tr><td>4</td><td>1.5V / 3000 r/min</td></tr>
<tr><td>5</td><td rowspan="5">Command Speed</td><td>6V / 47 r/min</td></tr>
<tr><td>6</td><td>6V / 187 r/min</td></tr>
<tr><td>7</td><td>6V / 750 r/min</td></tr>
<tr><td>8</td><td>6V / 3000 r/min</td></tr>
<tr><td>9</td><td>1.5V / 3000 r/min</td></tr>
</table></td></tr>
</table>

Parameter Setting

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Function/Description</th></tr>
<tr><td>08</td><td>Torque monitor (IM) selection</td><td>0 – 12</td><td>The parameter selects/sets a relationship between voltage output to the torque monitor signal output (IM: CN X5 42-pin) and generated torque of the motor or number of deviation pulses.
<table>
<tr><th>Setting value</th><th>IM Signals</th><th>Relationship between output level and torque or number of deviation pulses</th></tr>
<tr><td>[0]</td><td>Torque</td><td>3V / rated (100%) torque</td></tr>
<tr><td>1</td><td rowspan="6">No. of Deviation Pulses</td><td>3V / 31Pulse</td></tr>
<tr><td>2</td><td>3V / 125Pulse</td></tr>
<tr><td>3</td><td>3V / 500Pulse</td></tr>
<tr><td>4</td><td>3V / 2000Pulse</td></tr>
<tr><td>5</td><td>3V / 8000Pulse</td></tr>
<tr><td>6 – 10</td><td>Enabled under full-closed control (See P156 –.)</td></tr>
<tr><td>11</td><td rowspan="2">Torque</td><td>3V / 200% torque</td></tr>
<tr><td>12</td><td>3V / 400% torque</td></tr>
</table></td></tr>
<tr><td>09</td><td>TLC output selection</td><td>0 – 5</td><td>The parameter allocates functions of output in torque limits (TLC: CN X5 40-pin).
<table>
<tr><th>Setting value</th><th>Functions</th><th>Remarks</th></tr>
<tr><td>[0]</td><td>Output in torque limit</td><td rowspan="6">For functional details of respective outputs listed left, refer to "Wiring to Connector CN X5" on page 78.</td></tr>
<tr><td>1</td><td>Output of zero-speed detection</td></tr>
<tr><td>2</td><td>Output of an alarm due to either of over-regeneration/overload/absolute battery</td></tr>
<tr><td>3</td><td>Output of over-regeneration alarm</td></tr>
<tr><td>4</td><td>Output of overload alarm</td></tr>
<tr><td>5</td><td>Output of absolute battery alarm</td></tr>
</table></td></tr>
<tr><td>0A</td><td>ZSP output selection</td><td>0 – 5</td><td>The parameter allocates functions of zero speed detection output (ZSP: CN X5 12-pin).
<table>
<tr><th>Setting value</th><th>Functions</th><th>Remarks</th></tr>
<tr><td>0</td><td>Output in torque limit</td><td rowspan="6">For functional details of respective outputs listed left, refer to "Wiring to Connector CN X5" on page 78.</td></tr>
<tr><td>[1]</td><td>Output of zero-speed detection</td></tr>
<tr><td>2</td><td>Output of an alarm due to either of over-regeneration/overload/absolute battery</td></tr>
<tr><td>3</td><td>Output of over-regeneration alarm</td></tr>
<tr><td>4</td><td>Output of overload alarm</td></tr>
<tr><td>5</td><td>Output of absolute battery alarm</td></tr>
</table></td></tr>
<tr><td>0B</td><td>Absolute encoder set up</td><td>0 – 2</td><td>Listed below are settings when you use the absolute encoder:
<table>
<tr><th>Setting value</th><th>Description</th></tr>
<tr><td>0</td><td>To use the absolute encoder as absolute.</td></tr>
<tr><td>[1]</td><td>To use the absolute encoder as incremental.</td></tr>
<tr><td>2</td><td>To use the absolute encode as absolute. In this case, multi-rotation excess counter is ignored.</td></tr>
</table></td></tr>
<tr><td>0C</td><td>Baud rate of RS232C</td><td>0 – 2</td><td>
<table>
<tr><th>Setting value</th><th>Baud Rate</th></tr>
<tr><td>0</td><td>2400bps</td></tr>
<tr><td>1</td><td>4800bps</td></tr>
<tr><td>[2]</td><td>9600bps</td></tr>
</table></td></tr>
<tr><td>0D</td><td>Baud rate of RS485</td><td>0 – 2</td><td>
<table>
<tr><th>Setting value</th><th>Baud Rate</th></tr>
<tr><td>0</td><td>2400bps</td></tr>
<tr><td>1</td><td>4800bps</td></tr>
<tr><td>[2]</td><td>9600bps</td></tr>
</table></td></tr>
</table>

Parameters for Time Constants of Gains and Filters: Related to Real Time Auto Tuning

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
11	**1st Velocity loop gain**	1 – 3500 [35] *	Hz	• The parameter defines responsiveness of the speed loop. You need to set this speed loop gain high so as to improve responsiveness of the entire servo system by increasing position loop gain.
12	**1st Velocity loop integration time constant**	1 – 1000 [16] *	ms	• This parameter is an integration element of a speed loop and acts to drive quickly the subtle speed deviation into zero. The smaller the setting is, the faster deviation will be zeroed. • Setting of “ 1000” will remove effects of integration.
13	**1st speed detection filter**	0 – 6 [0] *	–	• The parameter sets in 6 phases (0 to 5) a time constant of the low-pass filter inserted after the block of converting an encoder signal into a speed signal. • Setting this parameter high would increase a time constant, thereby reducing noise of the motor. However, usually use the factory setting (0).
14	**1st torque filter time constant**	0 – 2500 [65] *	0.01ms	• The parameter sets a time constant of the primary delay filter inserted into the torque command unit. • It effects the control of vibration because of the torsion resonance.
19	**2nd Velocity loop gain**	1 – 3500 [35] *	Hz	• A position loop, speed loop, speed detection filter, and torque command filter, respectively, has 2 pairs of gains or time constants (the 1st and 2nd). • Each function/content is similar to the 1st gain/time constraint, described earlier. • For details on switching of the 1st and 2nd gains or time constants, refer to Adjustment volume on page 186. * Pr11 and Pr19 will be set in terms of (Hz) when Pr20 inertia ratio has been set correctly.
1A	**2nd Velocity loop integration time constant**	1 – 1000 [1000] *	ms	
1B	**2nd speed detection filter**	0 – 6 [0] *	–	
1C	**2nd torque filter time constant**	0 – 2500 [65] *	0.01ms	
1D	**1st notch frequency**	100 – 1500 [1500]	Hz	• The parameter sets frequency of the resonance suppression notch filter. • You should set it about 10% lower than the resonance frequency of the mechanical system that has been found by the frequency characteristics analysis facility of the setup assisted software “ PANATERM®” . • Setting this parameter ” 1500” would disable the function of notch filter.
1E	**1st notch width selection**	0 – 4 [2]	–	• The parameter sets width of the resonance suppression notch filter in 5 steps. The higher the setting is, the greater the width is. • Normally, use a factory setting.

Note) Standard default setting in [ ] under "Setting range" and marked with * is automatically set during the real time auto gain tuning. To manually change the value, first disable the auto gain tuning feature be seeing page 196 "Disabling of auto tuning function" in Adjustments, and then enter the desired value.

Parameters for real time auto gain tuning

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>20</td><td>Inertia ratio</td><td>0 – 10000
[100] *</td><td>%</td><td>• Defines the ratio of load inertia to the motor's rotor inertia.
Pr20 = (rotor inertia / load inertia) x 100[%]
• When you execute auto gain tuning, load inertia will be estimated and the result will be reflected in this parameter.
Pr11 and Pr19 will be set in terms of (Hz) when inertia ratio has been set correctly. When Pr20 inertia ratio is greater than the actual ratio, setting of the speed loop gain will increase. When Pr20 inertia ratio is smaller than the actual ratio, setting of speed loop gain will decrease.</td></tr>
<tr><td>21</td><td>Real time auto tuning set up</td><td>0 – 7</td><td>–</td><td>• Defines the operation mode of real-time auto tuning. Increasing the set value (3, 6,...) provides higher response to the inertia change during operation. However, operation may become unstable depending on the operation pattern. Normally, set this parameter to "1" or "4".
• If you set this parameter to any value other than 0, Pr27 disturbance observer filter selection will be disabled (0). In addition, if you set the adaptive filter to disabled, Pr2F adaptive filter frequency will be reset to 0.
• When Pr20 is "0", Pr2F (Adaptive notch frequency) is reset to "0".
In the torque control mode, the adaptive notch filter is always invalid.
<table>
<tr><th>Setting value</th><th>Real-time Auto Gain Tuning</th><th>Degree of Changes in Load Inertia</th><th>Adaptive Filter</th></tr>
<tr><td>0</td><td>Not used</td><td>–</td><td>Absent</td></tr>
<tr><td>[1]</td><td>Used</td><td>Hardly changes.</td><td>Present</td></tr>
<tr><td>2</td><td></td><td>Changes moderately.</td><td></td></tr>
<tr><td>3</td><td></td><td>Changes sharply.</td><td></td></tr>
<tr><td>4</td><td></td><td>Hardly changes.</td><td>Absent</td></tr>
<tr><td>5</td><td></td><td>Changes moderately.</td><td></td></tr>
<tr><td>6</td><td></td><td>Changes sharply.</td><td></td></tr>
<tr><td>7</td><td>Not used</td><td>–</td><td>Present</td></tr>
</table>
• Note that any change in this parameter will be enabled when Servo OFF changes to Servo ON.</td></tr>
<tr><td>22</td><td>Machine stiffness at auto tuning</td><td>0 – 15
[4]</td><td>–</td><td>• Defines the machine stiffness during execution of real-time auto tuning.
Low ← Machine stiffness → High
Low ← Servo gain → High
<table>
<tr><td>Pr22</td><td>0 , 1- - - - - - - - - - - - 14, 15</td></tr>
</table>
Low ← Responsiveness → High
• If the parameter value is rapidly changed, the gain significantly changes, applying a shock to the machine. Be sure to set a small value first, and increase it gradually, while monitoring the operating condition.</td></tr>
<tr><td>25</td><td>Normal auto tuning motion set up</td><td>0 – 7</td><td>–</td><td>• Defines the operation pattern of the normal mode auto tuning.
<table>
<tr><th>Set value</th><th>Number of revolutions</th><th>Revolving direction</th></tr>
<tr><td>[0]</td><td>2[revolution]</td><td>CCW → CW</td></tr>
<tr><td>1</td><td></td><td>CW → CCW</td></tr>
<tr><td>2</td><td></td><td>CCW → CCW</td></tr>
<tr><td>3</td><td></td><td>CW → CW</td></tr>
<tr><td>4</td><td>1[revolution]</td><td>CCW → CW</td></tr>
<tr><td>5</td><td></td><td>CW → CCW</td></tr>
<tr><td>6</td><td></td><td>CCW → CCW</td></tr>
<tr><td>7</td><td></td><td>CW → CW</td></tr>
</table>
Example) Setting this parameter to "0" provides two CCW revolutions and two CW revolutions.</td></tr>
</table>

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>27</td><td>Disturbance torque observer filter selection</td><td>0 –255</td><td>–</td><td>• Cut-off frequency of the filter for disturbance torque observer is set.<table><tr><th>Set value</th><th>Cutoff Frequency</th></tr><tr><td>[0] *</td><td>Disturbance Observer Disabled</td></tr><tr><td>1 – 255</td><td>Enabled, filter cutoff frequency [Hz] = 3.7 x setting</td></tr></table></td></tr>
<tr><td></td><td colspan="4">A larger value provides stronger disturbance suppression; but a larger operation noise is emitted. When using this function, it is necessary to set Pr20 inertia ratio correctly. When Pr.21 real time auto tuning mode setting is altered, Pr27 changes to 0(disabled). Also, while the real time auto tuning is enabled (Pr21 is not 0 or 7), Pr27 is fixed to 0 and the disturbance observer is disabled.</td></tr>
<tr><td>28</td><td>2nd notch frequency</td><td>100 – 1500
[1500]</td><td>Hz</td><td>• Defines the notch frequency of the second resonance suppression notch filter.
• The unit is [Hz] . Match the notch frequency with the machine's resonance frequency.
100 to 1499: Filter enabled 1500: Filter disabled</td></tr>
<tr><td>29</td><td>2nd notch width selection</td><td>0 – 4
[2]</td><td>–</td><td>• Select the notch width of the second resonance suppression notch filter.
• Increasing the set value enlarges the notch width.</td></tr>
<tr><td>2A</td><td>2nd notch depth selection</td><td>0 – 99
[0]</td><td>–</td><td>• Select the notch depth of the second resonance suppression notch filter.
• Increasing the set value reduces the notch depth and the phase delay.</td></tr>
<tr><td>2F</td><td>Adaptive filter frequency</td><td>0 – 64
[0] *</td><td>–</td><td>• Table No. corresponding to the frequency of the applied filter is displayed. (See page 196)
• When the applied filter is enabled (when Pr21 (real time auto tuning mode setting) is 1-3,7), this parameter is set automatically and can not be altered.
0: Filter disabled 1 - 64: Filter enabled
Before using this function, see page 196 “ Disabling of auto tuning function” in adjustments.
• When the applied filter is enabled, the parameter is stored in the EEPROM every 30 minutes. And when the applied filter is enabled at turning ON the power next time, the data stored in the EEPROM is used as the initial value to adapt the operation.
• When clearing the parameter to reset the adapted operation due to unsatisfactory operation, once set the applied filter disabled (set Pr21 (real time auto tuning mode setting) to other than 1 - 3, 7), and make it enabled again.
• Refer to “ Control of Vibration Damping” of Adjustment volume on page 211.</td></tr>
</table>

Note) Standard default setting in [ ] under "Setting range" and marked with * is automatically set during the real time auto gain tuning. To manually change the value, first disable the auto gain tuning feature be seeing page 196 "Disabling of auto tuning function" in Adjustments, and then enter the desired value.

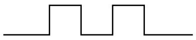
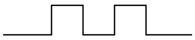
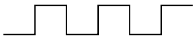
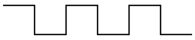
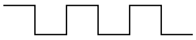
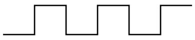
Parameters for Switching to 2nd Gains

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>30</td><td>2nd gain action set up</td><td>0 – 1</td><td>–</td><td>
• The parameter selects switching of PI/P operation and the 1st/2nd gain switching.
<table>
<tr><th>Setting value</th><th>Gain Selection/Switching</th></tr>
<tr><td>0</td><td>The 1st Gain (Possible to switch PI/P) *1</td></tr>
<tr><td>[1] *</td><td>Possible to switch the 1st/2nd gain *2</td></tr>
</table>
*1 Switching of 1 PI/P operation is done through gain switching input (GAIN CN X5 27-pin).
<table>
<tr><th>GAIN input</th><th>Operation of speed loop</th></tr>
<tr><td>Open with COM–</td><td>PI operation</td></tr>
<tr><td>Connect to COM–.</td><td>P operation</td></tr>
</table>
*2 For conditions of switching between the 1st and 2nd gains, refer to “ Adjustment upon switching gain” of Adjustment volume on page 202.
</td></tr>
<tr><td>3A</td><td>Torque control switching mode</td><td>0 – 3</td><td>–</td><td>
• The parameter selects conditions for switching between the 1st and 2nd gains in torque control mode.
• This is same as Pr31 except parts related to position and speed control.
<table>
<tr><th>Setting value</th><th>Conditions for Switching Gains</th></tr>
<tr><td>[0] *</td><td>Fixed to the 1st gain.</td></tr>
<tr><td>1</td><td>Fixed to the 2nd gain.</td></tr>
<tr><td>2</td><td>With the gain switching input (GAIN) turned ON, 2nd gain is selected. (Pr30 should be set to 1.)</td></tr>
<tr><td>3 *1</td><td>With much variation of torque command, the 2nd gain is selected.</td></tr>
</table>
*1 For details on levels to be switched, refer to “ Adjustment upon switching gain” of Adjustment volume on page 202.
</td></tr>
<tr><td>3B</td><td>Torque control switching delay time</td><td>0 – 10000
[0]</td><td>x 166μs</td><td rowspan="3">• This is same as content of:
Pr32: Switching delay time
Pr33: Switching level
Pr34: Hysteresis at switching”
in position control mode.</td></tr>
<tr><td>3C</td><td>Torque control switching level</td><td>0 – 20000
[0]</td><td>–</td></tr>
<tr><td>3D</td><td>Torque control switching hysteresis</td><td>0 – 20000
[0]</td><td>–</td></tr>
</table>

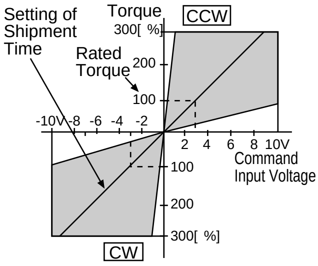
Parameters for Position Control

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Function/Description</th></tr>
<tr><td>44</td><td>Output pulses per single turn</td><td>1 – 16384
[2500]</td><td>The parameter sets number of pulses per one revolution of encoder pulse to be output to the host device. The pulse will be set in dividing.
You should directly set in this parameter the number of pulses per revolution needed for your device/system in terms of [Pulse/rev] .</td></tr>
<tr><td>45</td><td>Pulse output logic inversion</td><td>0 – 1</td><td>
In a relationship of phases of output pulse from the rotary encoder, Phase B pulse is behind pulse A when the motor rotates in CW direction. (Phase B pulse advances ahead of phase A pulse, when the motor rotates in CCW direction.)
Inversion of logic of phase B pulse with this parameter could invert a phase relation of phase B pulse to phase A pulse.
<table>
<tr><th rowspan="2">Setting value</th><th></th><th>IWhen Motor is Rotating in CCW direction</th><th>IWhen Motor is Rotating in CW direction</th></tr>
<tr><td>A pulse(OA)</td><td></td><td></td></tr>
<tr><td>[0]</td><td>B pulse(OB)
Non-inverting</td><td></td><td></td></tr>
<tr><td>1</td><td>B pulse(OB)
Inverting</td><td></td><td></td></tr>
</table>
</td></tr>
</table>

Parameters for Speed Control

Default setting is shown by [ ]

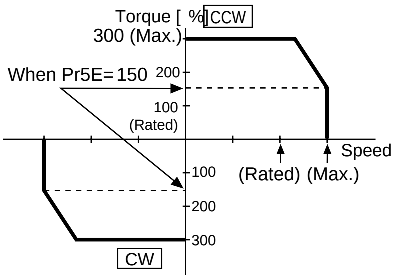
<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>52</td><td>Velocity command offset</td><td>–2047
– 2047
[0]</td><td>0.3mV</td><td>
• This parameter adjusts offset of external analog speed command system including the host device.
• Offset volume will be approximately 0.3mV per a set value “ 1” .
• To adjust offset, there are 2 ways of (1) manual adjustment and (2) automatic adjustment.
1) Manual adjustment
• When you make offset adjustment with the driver only:
Using this parameter, set a value that prevents the motor from rotating, after you have correctly input 0V in torque command input (SPR/TRQR) (or connected to signal ground).
• When the host device establishes a position loop:
With servo locked, using this parameter, set a value so that deviation pulse will be zero.
2) Automatic Adjustment
• For details on operating instructions in automatic offset adjustment mode, refer to “ Details of Execution Display of Auxiliary Function Mode” of Preparations volume on page 66.
• When you execute automatic offset adjustment, result will be reflected in this parameter Pr52.
</td></tr>
<tr><td>56</td><td>4th internal speed</td><td>–20000
– 20000
[0]</td><td>r/min</td><td>
The parameter directly sets the 1st to 4th speed of internal command speed of when setting of internal speed has been enabled with the parameter “ speed setting internal/external switching” (Pr05), to Pr53 to Pr56, respectively, in the unit of [r/min] .
<Caution>
Polarity of settings shows that of internal command speed.
<table>
<tr><td>+</td><td>CCW direction viewed from the edge of axis for (+) command</td></tr>
<tr><td>–</td><td>CW direction viewed from the edge of axis for (-) command</td></tr>
</table>
Pr56 is a value of speed limits in torque control mode.
You should set this parameter in a range of rotational speeds of the motor to be used.
</td></tr>
<tr><td>57</td><td>JOG speed set up</td><td>0 – 500
[300]</td><td>r/min</td><td>
The parameter directly sets J OG speed in J OG run in “ motor trial run mode” in terms of [r/min] .
For details on J OG function, refer to “ Trial Run (J OG)” of Preparations volume on page 68.
</td></tr>
<tr><td>5C</td><td>Torque command input gain</td><td>10 – 100
[30]</td><td>0.1V/
100%</td><td>
The parameter sets a relationship between voltage applied to the torque command input (TRQR: CN X5 14-pin) in torque control mode and generated torque of the motor.
• Setting is in the unit of [0.1V/100%] and used to set a value of input voltage necessary for calculating rated torque.
• At a factory setting of 30, the relationship will be 3V/100%.


</td></tr>
<tr><td>5D</td><td>Torque command input inversion</td><td>0 – 1</td><td>–</td><td>
The parameter inverts polarity of the torque command input signal (TRQR: CN X5 14-pin).
In speed/torque switching mode (when Pr02 is 5), torque command input under torque control will be 16-pin of the connector CN X5.
<table>
<tr><th>Setting value</th><th>Direction of Generation of Motor Torque</th></tr>
<tr><td>[0]</td><td>CCW direction viewed from the edge of axis for (+) command</td></tr>
<tr><td>1</td><td>CW direction viewed from the edge of axis for (+) command</td></tr>
</table>
</td></tr>
</table>

Parameter Setting

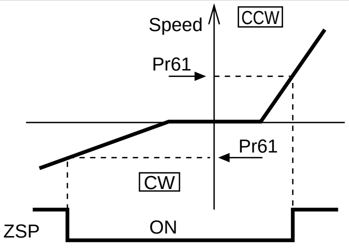
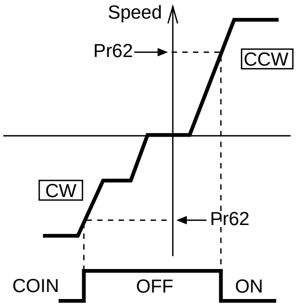
Parameters for Torque Control

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
5E	**Torque limit**	0 – 500	%	• This function limits maximum torque of the motor through setting of parameters within the driver. • In normal specifications, torque about 3 times higher than the rated is allowed for an instant. This parameter limits the maximum torque, however, if the triple torque may cause a trouble in the strength of motor load (machine). • Setting should be given as a % value to rated torque. • The right figure shows a case in which the maximum torque is limited to 150%. • Pr5E limits maximum torque in both CW and CCW directions simultaneously.  **<Caution>** You cannot set this parameter to a value above a factory setting of the system parameter (i.e., a factory set parameter that cannot be changed through of PANATERM® and panel manipulation) “ Maximum Output Torque Setting” . A factory setting may vary depending on a combination of an driver and motor. For further information, refer to “ Pr5E Setting of Torque Limit” of Preparations volume on page 55.

Parameters for various sequences

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
61	**Zero speed**	0 – 20000 [50]	r/min	• The parameter directly sets timing to an output zero speed detection output signal (ZSP: CN X5 12-pin) in terms of [r/min] . • A zero speed detection signal (ZSP) is output when motor speed falls below the speed set with this parameter Pr61. • Setting of Pr61 acts on both CW and CCW directions, irrespective of the rotating direction of the motor. 
62	**At-speed**	0 – 20000 [1000]	r/min	• The parameter sets timing to output a at-speed signal (COIN;CN X5 39-pin) in speed control and torque control modes in terms of rotational speed [r/min] . • When the motor speed exceeds setting of this parameter Pr62, at-speed signal (COIN) will be output. • Setting of Pr61 acts on both CW and CCW directions, irrespective of the rotating direction of the motor. 

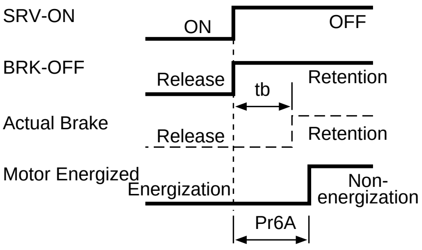
Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>65</td><td>Undervoltage error response at main power-off</td><td>0 – 1</td><td>–</td><td>The parameter sets whether to enable the “ protection against main power source under-voltage” function when you shut down the main power of main and control power supplies.
<table>
<tr><th>Setting value</th><th>Main Power Source Under-voltage Protection Action</th></tr>
<tr><td>0</td><td>In this case, if you shut off the main power during Servo ON, it will be SERVO-OFF without a trip. Then, when the main power supply turns ON again, it will be recovered to Servo ON.</td></tr>
<tr><td>[1]</td><td>Shutting off main power during Servo ON will activate abnormal main power supply under-voltage (alarm code No.13) and cause a trip.</td></tr>
</table>
Refer to the timing chart “ At Power ON” of Preparations volume on page 40.</td></tr>
<tr><td>66</td><td>Dynamic breke inhibition at overtravel limit</td><td>0 – 1</td><td>–</td><td>The parameter sets driving conditions at decelerated operation after overtravel input inhibit (CCWL: connector CN X5 9-pin or CWL: connector CN X5 8-pin) has been activated and enabled.
<table>
<tr><th>Setting value</th><th>Driving Conditions from Deceleration to Stop</th></tr>
<tr><td>[0]</td><td>The motor decelerates and stops as the dynamic brake (DB) is operated. The motor will be in free condition after it stops.</td></tr>
<tr><td>1</td><td>Free running, the motor decelerates and stops. The motor will be in free condition after it stops.</td></tr>
</table></td></tr>
<tr><td>67</td><td>Error response at main power-off</td><td>0 – 7</td><td>–</td><td>The parameter sets:
(1) Driving conditions during deceleration and after stopping; and
(2) Processing to clear content of the deviation counter
after the main power source is shut off.
<table>
<tr><th rowspan="2">Setting value</th><th colspan="2">Driving Conditions</th><th rowspan="2">Content of Deviation Counter</th></tr>
<tr><th>During Deceleration</th><th>After Stopped</th></tr>
<tr><td>[0]</td><td>DB</td><td>DB</td><td>Clear</td></tr>
<tr><td>1</td><td>Free Run</td><td>DB</td><td>Clear</td></tr>
<tr><td>2</td><td>DB</td><td>Free</td><td>Clear</td></tr>
<tr><td>3</td><td>Free Run</td><td>Free</td><td>Clear</td></tr>
<tr><td>4</td><td>DB</td><td>DB</td><td>Retention</td></tr>
<tr><td>5</td><td>Free Run</td><td>DB</td><td>Retention</td></tr>
<tr><td>6</td><td>DB</td><td>Free</td><td>Retention</td></tr>
<tr><td>7</td><td>Free Run</td><td>Free</td><td>Retention</td></tr>
</table>
DB: Activation of dynamic brake</td></tr>
<tr><td>68</td><td>Error response action</td><td>0 – 3</td><td>–</td><td>The parameter sets driving conditions during deceleration or following stop, after any of protective functions of the driver has been activated and alarm has been generated.
<table>
<tr><th rowspan="2">Setting value</th><th colspan="2">Driving Conditions</th><th rowspan="2">Content of Deviation Counter</th></tr>
<tr><th>During Deceleration</th><th>After Stopped</th></tr>
<tr><td>[0]</td><td>DB</td><td>DB</td><td>Clear</td></tr>
<tr><td>1</td><td>Free Run</td><td>DB</td><td>Clear</td></tr>
<tr><td>2</td><td>DB</td><td>Free</td><td>Clear</td></tr>
<tr><td>3</td><td>Free Run</td><td>Free</td><td>Clear</td></tr>
</table>
(DB: Activation of dynamic brake)
See also “ When Abnormality (Alarm) Occurs (Serve ON Command State)” of the timing chart, Preparations volume on page 41.</td></tr>
<tr><td>69</td><td>Sequence at Servo-OFF</td><td>0 – 7
[0]</td><td>–</td><td>• The parameter sets:
1) Driving conditions during deceleration or after stop
2) Processing to clear the deviation counter
following Servo off (SRV-ON signal: CN X5 29-pin turns On ‡ Off).
• A relationship between setting of Pr69 and driving conditions/deviation counter processing conditions is similar to that of Pr67 (Sequence at Main Power Off).
• See also “ Serve On/Off Operation When the Motor Stops” of the timing chart of Preparations volume on page 42.</td></tr>
</table>

Default setting is shown by [ ]

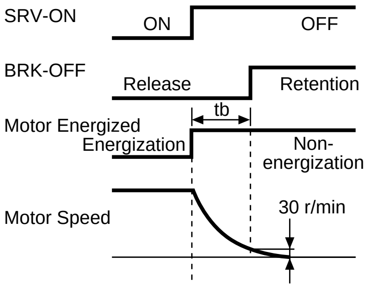
<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>6A</td><td>Mechanical brake delay at motor standstill</td><td>0 – 100
[0]</td><td>2ms</td><td>The parameter sets time till non-energization of motor (servo free) after the brake release signal (BRK-OFF) turns off (brake retained), at Serve Off while the motor stops.

- In order to prevent minor movement/drop of the motor (work) due to operation delay time of the brake (tb): Setting of Pr6A ≧ tb.
- See “ Serve On/Off Operation When the Motor Stops” of the timing chart on page 42.



See also “ Serve On/Off Operation When the Motor Stops” of the timing chart of Preparations volume on page 43.</td></tr>
<tr><td>6B</td><td>Mechanical brake delay at motor in motion</td><td>0 – 100
[0]</td><td>2ms</td><td>Unlike Pr6A, the parameter sets time till brake release signal (BRK-OFF) turns off (brake retained) after motor non-energization (servo-free), at Servo off while the motor is rotating.

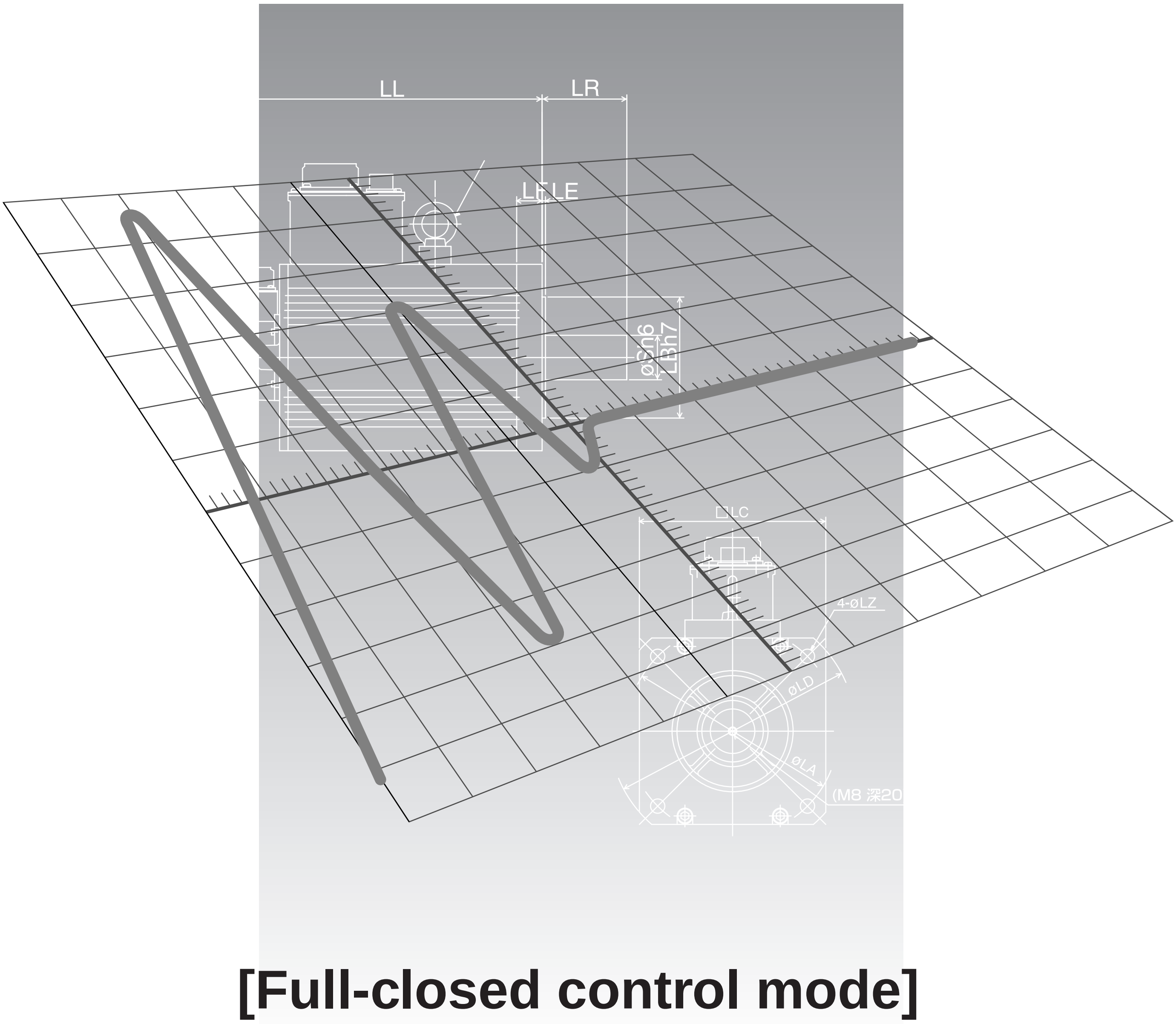
- This should be set to prevent deterioration of the brake due to revolutions of the motor.
- At Servo off while the motor is rotating, time tb in the right figure will be either set time of Pr6B or time till the motor rotational speed falls below approximately 30r/min, whichever is smaller.
- See “ Serve On/Off Operation When the Motor is Rotating” of the timing chart of on page 43.



See also “ Serve On/Off Operation When the Motor Stops” of the timing chart of Preparations volume on page 42.</td></tr>
<tr><td>6C</td><td>External regenerative resister set up</td><td>0 – 3</td><td>–</td><td>This parameter is set depending on whether to use regeneration resistance built in the driver, or to provide a regeneration resistance in the external (connect between RB1 and RB2 of connector CN X 2 in types A to D, and between terminal blocks P and B2 in types E - G).

<table>
<tr><th>Setting value</th><th>Regeneration Resistance to Use</th><th>Protection against Regeneration Resistance Overload</th></tr>
<tr><td>[0]</td><td>Built-in resistance</td><td>According to built-in resistance, (about 1% duty) protection against regeneration resistance overload works.</td></tr>
<tr><td>1</td><td>External resistance</td><td>This is activated with operating limits of the external resistance at 10% duty.</td></tr>
<tr><td>2</td><td>Built-in resistance</td><td>This is activated with operating limits of the external resistance at 100% duty.</td></tr>
<tr><td>3</td><td>External resistance</td><td>Regeneration resistance does not work, and a built-in condenser accommodates all regenerated power.</td></tr>
</table>

<Request>
When you use an external regeneration, you must install external safeguards such as a temperature fuse, etc.
Otherwise, as protection of regeneration resistance would be lost, causing abnormal heat generation and burnout.
<Caution>
Be careful not to touch an external regeneration resistance.
While you are using an external resistance, it may become hot and scald you. For type A, only external regeneration resistance is used.</td></tr>
<tr><td>6D</td><td>Main power-off detection time</td><td>0 – 32767
[35]</td><td>2ms</td><td>The parameter sets time to detect shut-off when shut-off of main power supply continues.</td></tr>
</table>



[Full-closed control mode]

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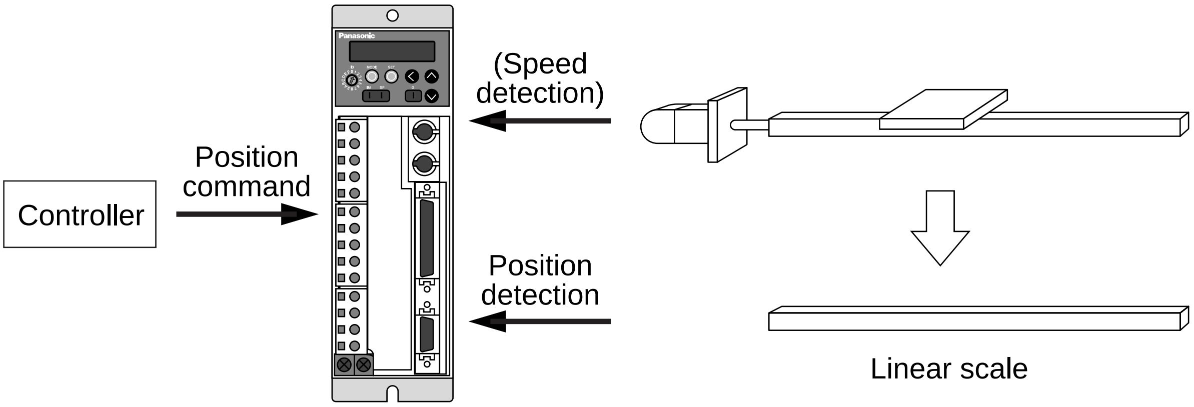
Outline of Full-closed control

What is full-closed control

Full-closed control detects the position of the machine to be controlled directly using an external linear scale and feeds it back to perform position control. Full-closed control provides control that is free from influence of positional fluctuation due to, for example, an error of ball screw or temperature etc.
By building full-closed control system, a high precise positioning of sub-micron order can be obtained.



For division ratio of a linear scale, we recommend 1/16 ≦ linear scale division ratio ≦ 32.

Control mode

Full-closed control of the AIII series provides four control modes as listed below.
In order to maintain compatibility with the Matsushita A-series, full-closed control, hybrid control and external encoder control modes are given.
In AIII series, it is recommended to use second full-closed control mode. For each control mode, see also " Block Diagram by Control Mode" of Preparations volume on page 298.

Control mode	Position control	Speed control	Characteristics	Corresponding Encoders
Full-closed control	External scale	Encoder	A control in which external scale position is used as feedback for position control, and encoder (motor) speed is used as feedback for speed control. Be careful that the unit of the ordinary position control and the unit of position loop gain are different from each other.	2500 P/r 17-bit
Hybrid control	Encoder/ external scale	Encoder	A mixed control mode of full-closed control and semi-closed control. When the full-closed control mode is used, in case of low machine stiffness, compared to semi-closed control mode, there may be a case that sufficient control gain can not be obtained resulting in a failure in obtaining required operation. Hybrid control is a control mode that provides both of response performance of the semi-closed control mode and accuracy of full-closed control mode in which, while the semi-closed control is always performed, position command is corrected on the basis of a deviation between the encoder and the external scale at predetermined timing when the machine comes to a stop.	2500 P/r 17-bit
External encoder control	External scale	External scale	A control mode in which both position control and speed control uses external scale position/speed as feedback data.	2500 P/r 17-bit
Second full-closed control	External scale	Encoder	Although second full-closed control mode is the same as the full-closed control mode in the point that external scale position is used as feedback for position control and encoder (motor) speed is used as feedback for speed control, the unit of the position loop gain is the same as that of the ordinary position control mode. Torsion correction function using Pr7B and Pr7C and status feedback function using Pr7C-Pr7E are available.	Only 17-bit

Selecting among full-closed modes

Semi-closed control mode: second control mode of Pr02= 06 or Pr02= 10

Speed control and position control is performed on the basis of the feedback of the encoder.
A part of the function of the interface connector CN X5 is different from the ordinary position control mode.
Input the command pulse based on the encoder.

<Caution>

(1) If you set control mode setting parameter Pr02 = 9, 10, and switch to speed control, functions of I/O ports will also be switched simultaneously. Thus, refer to " List of Function Switching by Control Mode of Interface Connector CN X5" on page 160 and be careful in using.

Full-closed control mode: Pr02= 7

Speed control is performed based on the feedback of the encoder, and position control is performed based on the feedback of the external scale.
Input the command pulse based on the external scale.

<Caution>

(1) Command 1 pulse equals to 1 pulse of the external scale. Be careful that the setting of the command division scale ratio is different from that of the semi-closed control mode.

(2) With respect to the setting value of the position loop gain (Pr10, 18), the value, which is actually used for control, is obtained by:
Particularly, be careful that the actual position loop gain becomes larger than the set value when the number of external scale pulses is larger than the number of the encoder pulses per 1 rotation of the encoder.

$$\text{Position loop gain (Pr10,18)} \times \frac{\text{Number of external scale per 1 rotation of motor}}{\text{Number of feedback pluses of encoder}}$$

Hybrid control mode: Pr02 = 8

During normal operation at the reference speed (Pr70) or higher speed, both speed control and position control are based on the encoder's feedback signal (as in the semi-closed control mode). If the reference speed or lower speed continued for the specified period (Pr71), high-precision positioning is performed through position correction based on the external scale's feedback signal for the specified control period (Pr72).
Normally, even if the mechanical stiffness between the motor and external scale is low, stable operation is ensured as in the semi-closed control mode. During positioning control, the servo driver corrects position data through the external scale, enabling high-precision positioning.
Set Pr70 (hybrid switching speed) and Pr71 (hybrid switching time) so that correction will start when vibration of the motor at setting deadens.
Input a command pulse based on the external scale' s reference signal.

<CAUTION>

(1) Note that the command multiply division ratio of full-closed specification differs from that of semi-closed control mode because command 1 pulse is one pulse of an external scale.

(2) If the ratio of the encoder pulse to the external scale pulse is large (x20 or more), or the ratio cannot be defined by Pr74 to Pr76, particularly when moving distance is long, the internal position error data may overflow, resulting in a position error. Adjust the mechanical and control systems so that the position error for each encoder does not exceed 32767.

Outline of Full-closed control

External encoder control mode: Pr02 = 9 (Second control mode)

Execute full-closed control by using speed.
Input a command pulse according to the external scale standard.

<CAUTION>

(1) Note that the command multiply division ratio of full-closed specification differs from that of semi-closed control mode because command 1 pulse is one pulse of an external scale.

(2) In the external encoder control mode or the speed control mode in combination with the external encoder control mode, the gain switching function cannot be used. Be sure to set up the relevant parameters as listed below.

Pr30 2nd gain operation setup	1
Pr31 Position control switching mode	1
Pr36 Speed control switching mode	0

With the above parameter settings, the gain for the speed control mode, and the gain for the external encoder control mode are fixed to "Gain 1" (P10 to Pr14) and "Gain 2" (Pr18 to Pr1C), respectively.

(3) When the control mode is switched between the external encoder control mode and the speed control mode, speed data may rapidly change. To prevent a trouble during the switching time, stop the motor before switching the control mode. (Mode switching time: 1 to 5 ms)
Although speed loop gain (Pr19) when the external encoder control is selected is actually used in the control to setting [Hz] , it differs from:

$$\text{Speed Loop Gain (Pr19)} \times \frac{\text{Number of External Scale Pulses per Revolution of Motor}}{\text{Number of Encoder Pulses per Revolution of Motor}}$$

Be careful because oscillation may take place, in particular, when the number of external scale pulse is greater than that of encoder pulses per revolution of the motor, or when it is too small.

(4) If you set control mode setting parameter Pr02 = 9, 10, and switch to speed control, in particular, functions of I/O ports will also be switched simultaneously. Thus, refer to “ List of Function Switching by Control Mode of Interface Connector CN X5” and be careful in using.

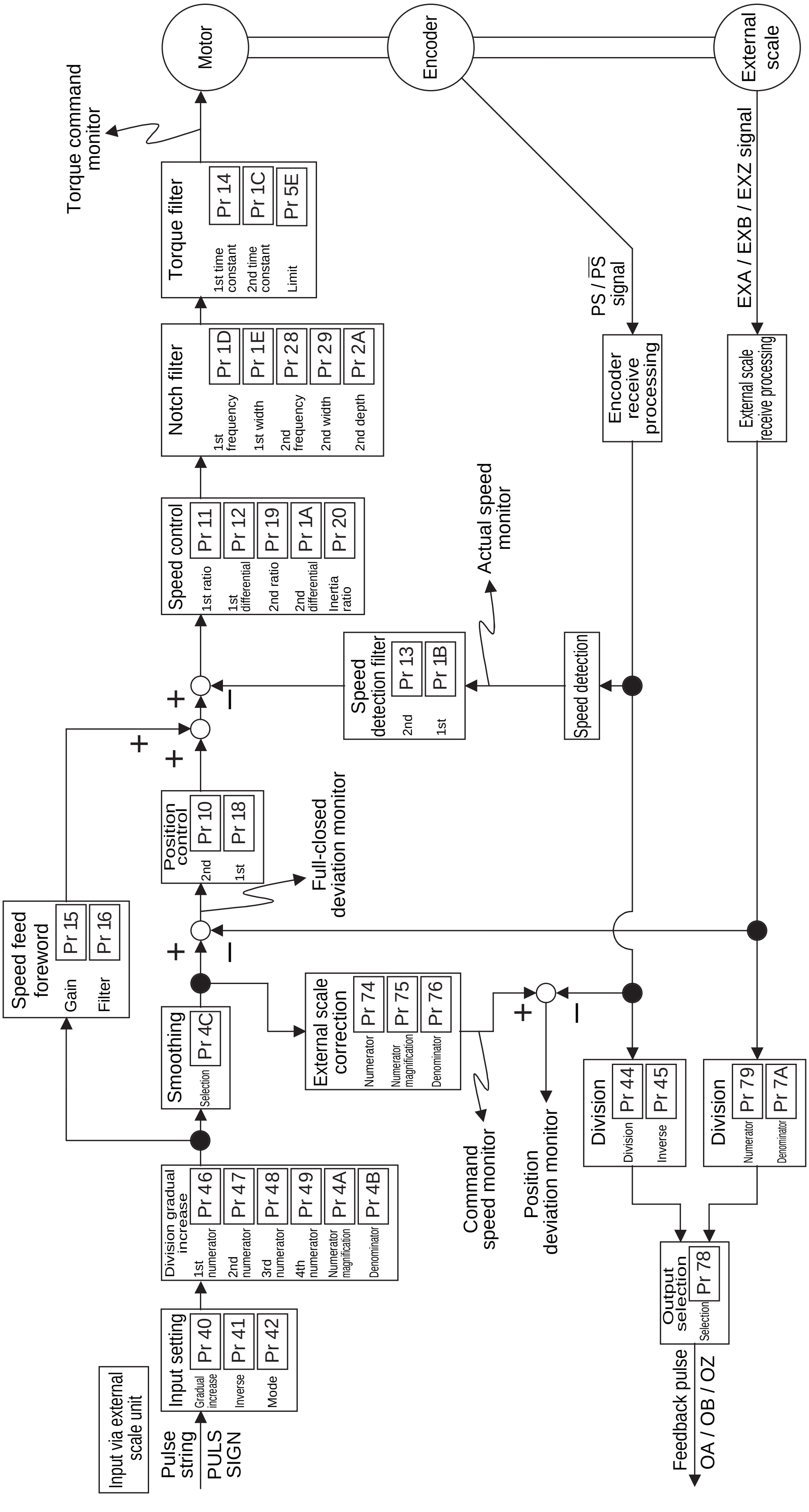
2nd full-closed control mode: Pr02 = 14

The 2nd full-closed control mode is same as normal full-closed control in that speed control is executed through feedback of the encoder, while position control is done through feedback of external scale. An improvement is that conversion of a position loop gain that needs correction can be made at the driver. A user can select the 2nd full-closed control mode only when a 17-bit absolute/incremental shared encoder is used.
Input a command pulse based on the external scale' s reference signal.

Full-closed control block diagram [Full-closed control mode]

- **Control mode set-up: when Pr02 is [7]**

*As the output from the external scale deviation counter drops down within the range set by the Pr60, the position complete output is turned on.



CN X5 Connector

Functional selection of interface connector CN X5 by control mode

Input Circuit

Signal (symbol)	Pin No.	I/F circuit	Control mode setting (Pr02)						Parameter related to port setting
			6: Semi-closed control	7: Full-closed control	8: Hybrid control	9: Speed/external encoder control	10: Speed/semi-closed control	14: the 2nd full-closed	
SPR/TRQR	14	AI	–	–	–	Speed command	Speed command	–	Speed command enabled with Pr05=0.2
CCWTL/TRQR	16	AI	CCW torque limit	CCW torque limit	CCW torque limit	CCW torque limit	CCW torque limit	CCW torque limit	CCW torque limit enabled with Pr03=0
CWTR	18	AI	CW torque limit	CW torque limit	CW torque limit	CW torque limit	CW torque limit	CW torque limit	CW torque limit enabled with Pr03=0
PULS1.2	3,4	PI	Command pulse	Command pulse	Command pulse	–/Command pulse	–/Command pulse	Command pulse	
SIGN1.2	5,6	PI	Command sign	Command sign	Command sign	–/Command sign	–/Command sign	Command sign	
SRV-ON	29	SI	Servo on	Servo on	Servo on	Servo on	Servo on	Servo on	
GAIN	27	SI	P action (2nd gain) changeover	P action (2nd gain) changeover	P action (2nd gain) changeover	1st gain fixed /2nd gain fixed	P action (2nd gain) changeover	P action (2nd gain) changeover	Pr30=0:P action changeover Pr30=1 and Pr31= 2, Pr36=2, Pr3A=2:2nd gain change over
DIV	28	SI	Command div/ multi changeover 1	Command div/ multi changeover 1	Command div/ multi changeover 1	Command div/ multi changeover 1	Command div/ multi changeover 1	–	
ZEROSPD	26	SI	Speed zero clamp	Speed zero clamp	Speed zero clamp	Speed zero clamp	Speed zero clamp	–	Speed zero clamp enabled with Pr06=1
CL//INTSPD2	30	SI	Counter clear	Counter clear	Counter clear	Internal speed selection 2/ counter clear	Internal speed selection 2/ counter clear	Counter clear	Counter clear input: level/edge selection with Pr4D
INH/INTSPDI/SC-ERR	33	SI	Command pulse input disable	Scale error	Scale error	Internal speed selection 1/ scale error	Internal speed selection 1/ command pulse input disable	Command pulse input disable	Command pulse input disable is active with Pr43=0
C-MODE	32	SI	Control mode changeover	–	–	Control mode changeover	Control mode changeover	–	
CWL/SMOOTH	8	SI	Smoothing filter	Smoothing filter	Smoothing filter	CW drive disable /smoothing filter	CW drive disable /smoothing filter	CW drive disable	CW drive disable is active with Pr04=0
CCWL/DIV2	9 3	SI	Command div/ multi changeover 2	Command div/ multi changeover 2	Command div/ multi changeover 2	CCW drive disable/ command div/ multi changeover 2	CCW drive disable/ command div/ multi changeover 2	CCW drive disable	CCW drive disable is active with Pr04=0
A-CLR	1	SI	Alarm clear	Alarm clear	Alarm clear	Alarm clear	Alarm clear	Alarm clear	
S-RDY+,-	35,34	SI	Servo ready	Servo ready	Servo ready	Servo ready	Servo ready	Servo ready	
Mode specific precautions						Set to: Pr30=1, Pr31=1, Pr36=0			
Precautions common to modes			1) In the above control modes, you cannot use frequency characteristics analysis from auto gain tuning or PANATERM®. If you wish to use it, execute the control mode at 0: position control mode. In this case, be careful because functions of the above ports will also be switched. 2) Pr50, 51 can set speed command input gain/reverse and Pr5C/5D can set torque command input gain/reverse. 3) Pr77=1 disables scale error input.						

Output Circuit

Signal (symbol)	Pin No.	I/F circuit	Control mode setting(Pr02)						Parameter related to port setting
			6: Semi-closed control	7: Full-closed control	8: Hybrid control	9: Speed/external encoder control	10: Speed/semi-closed control	14: the 2nd full-closed	
ALM+,-	37,36	SO1	Servo alarm	Servo alarm	Servo alarm	Servo alarm	Servo alarm	Servo alarm	
COIN+,-	39,38	SO1	Positioning complete	Positioning complete	Positioning complete	Speed reached/ positioning complete	Speed reached/ positioning complete	Positioning complete	Pr60 sets positioning compte; Pr62 sets reached speed
BRK-OFF+,-	11,10	SO1	External brake release	External brake release	External brake release	External brake release	External brake release	External brake release	
ZSP	12	SO2	Zero speed detect	Zero speed detect	Zero speed detect	Zero speed detect	Zero speed detect	Zero speed detect	Pr0A selects output type
TLC	40	SO2	Torque limited	Torque limited	Torque limited	Torque limited	Torque limited	Torque limited	Pr09 selects output type
IM	42	AO	Torque monitor	Torque monitor	Torque monitor	Torque monitor	Torque monitor	Torque monitor	Pr08 selects the range of command torque/ positional deviation/ external scale deviation
SPM	43	AO	Speed monitor	Speed monitor	Speed monitor	Speed monitor	Speed monitor	Speed monitor	Pr07 selects the range of actual speed/ command speed
OA+,-	21,22	PO1	Encoder Phase A	Encoder phase A (external encoder phase A)	Encoder phase A (external encoder phase A)	Encoder phase A (external encoder phase A)	Encoder Phase A	Encoder phase A (external encoder phase A)	Pr78 selects between encoder/ external encoder
OB+,-	48,49	PO1	Encoder Phase B	Encoder phase B (external encoder phase B)	Encoder phase B (external encoder phase B)	Encoder phase B (external encoder phase B)	Encoder Phase B	Encoder phase B (external encoder phase B)	Pr78 selects between encoder/ external encoder Pr45 adjusts phase
OZ+,-	23,24	PO1	Encoder Phase Z	Encoder phase Z (external encoder phase Z)	Encoder phase Z (external encoder phase Z)	Encoder phase B (external encoder phase B)	Encoder Phase Z	Encoder phase B (external encoder phase B)	Pr78 selects between encoder/ external encoder
CZ	19	PO2	Encoder Phase Z	Encoder phase Z (external encoder phase Z)	Encoder phase B (external encoder phase Z)	Encoder phase Z (external encoder phase Z)	Encoder Phase Z	Encoder phase Z (external encoder phase Z)	Pr78 selects between encoder/ external encoder
Precautions common to modes			1) In the above control modes, you cannot use frequency characteristics analysis from auto gain tuning or PANATERM®. If you wish to use it, execute the control mode at 0: position control mode. In this case, be careful because functions of the above ports will also be switched.						

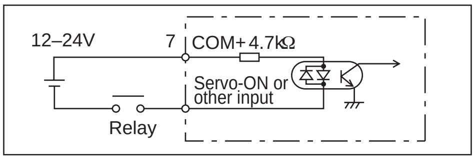
CN X5 Connector

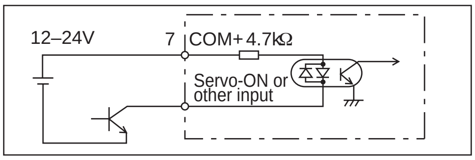
Interface Circuit

Input Circuit

SI SI Connecting to sequence input signals

- Connect to a contact of switch and relay, or a transistor of an open collector output.
- Use a switch or relay for micro current so that insufficient contact can be avoided.
- Lower limit of the power supply (12 to 24V) should not be less than 11.4V in order to secure the appropriate level of primary current of the photo coupler.





PI PI Command pulse input circuit

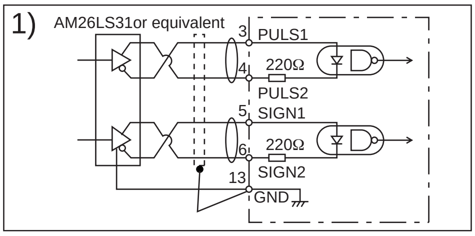
1) Line Driver I/F
- This is a good signal transmission method that is less sensitive to noises. We recommend you to use this to maintain the reliability of signals.

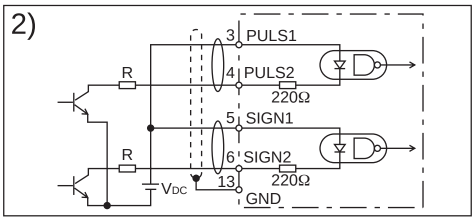
2) Open Collector I/F
- This uses an external control power supply(V_{DC}).
- This requires a current-limiting resistor (R) corresponding to the capacity of the V_{DC} value.

V_{DC}	R value
12V	1kΩ 1/2W
24V	2kΩ 1/2W

$$\frac{V_{DC}-1.5}{R+220} \fallingdotseq 10mA$$

⊖ shows a pair of twisted wires.



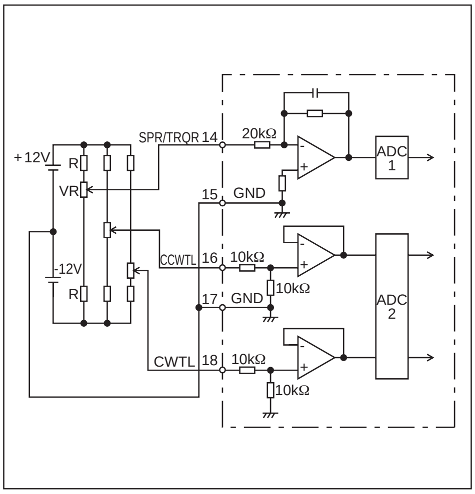


Max. input voltage DC24V
Rated current 10mA

AI AI Analogue Command Input

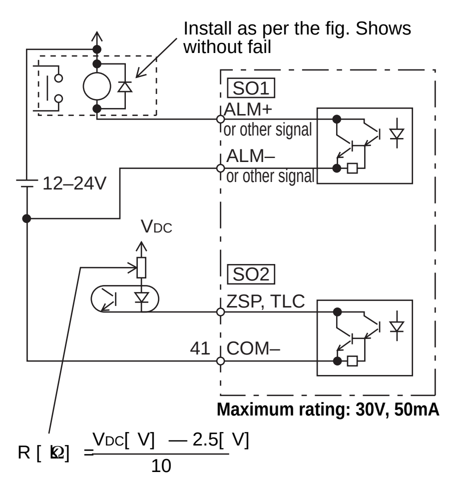
- There are three analogue command inputs of SPR/RTQR (14 pins), CCWTL (16 pins) and CWTL (18 pins).
- The maximum permissible input voltage is ±10V. For the input impedance of these inputs, see the right figure.
- If you make a simplified circuit comprising a variable resistor (VR) and resistor (R), refer to the right figure. When the variable range of each input is -10V to +10V, the VR should be a B type resistor of 2kΩ (min.1/2W). The R should be 200Ω (min.1/2W).
- The A/D converters for these inputs should have the following resolution.

1) ADC1 (SPR and TRQR) : 16 bits (including one bit for sign)
2) ADC2 (CCWTL and CWTL) : 10 bits (including one bit for sign)



Output Circuit

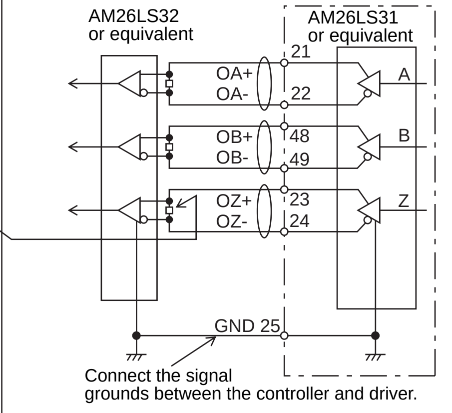
SO1 SO2 Sequence output circuit



- This comprises a Darlington driver with an open collector. This is connected to a relay or photo coupler.
- There exists a collector-to-emitter voltage V_{CE}(SAT) of approx. 1V at transistor ON, because of Darlington connection of the out put transistor. Note that normal TTLIC can't be directly connected since this does not meet VIL requirement.
- This circuit has an independent emitter connection, or an emitter connection that is commonly used as the minus (–) terminal (COM–) of the control power.
- Calculate the value of R using the formula below so as the primary current of the photo coupler become approx. 10mA.

For the recommended primary current value, check the data sheet on the equipment and photocoupler used.

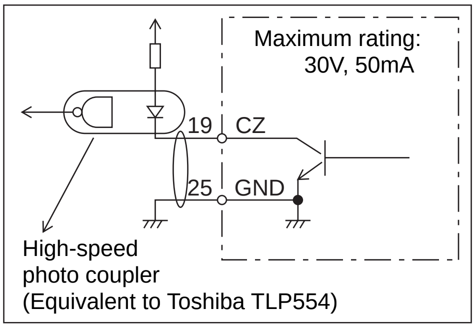
PO1 Line Driver (Differential Output) Output



- Provides differential outputs of encoder signals (A, B and Z phases) that come from the scalar.
- Receive these signals with a line receivers. In this case, install a resistor of approx. 330Ω between the inputs.
- These outputs are non-insulated signals.

⊖ shows a pair of twisted wires.

PO2 Open Collector Output

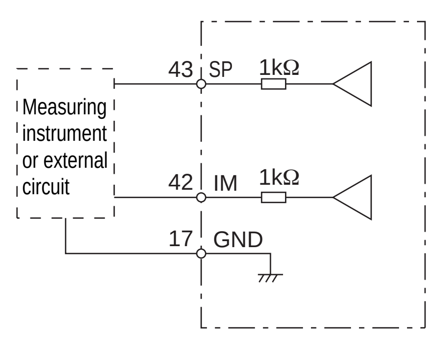


High-speed photo coupler (Equivalent to Toshiba TLP554)

- Outputs Z-phase signals among those from the encoder. The outputs are non-insulated.
- Receive these signal with high-speed photo coupler at controller side, since these Z-phase signal width is normally narrow.

⊖ shows a pair of twisted wires.

AO Analogue Monitor Output



- This output is the speed monitor signal (SP) or torque monitor signal (IM).
- The signal range is approx. 0 to ± 9V.
- The output impedance is 1kΩ. Pay attention to the input impedance of your measuring instruments and external circuits connected.

<Resolution>

1) Speed monitor signal (SP): 8r/min./LSB calculated from 6V/3000r/min (Pr07 = 3)
2) Torque monitor signal (IM): 0.4%/LSB calculated from 3V/rated value (100%)

CN X5 Connector

Connector CN X4

Power supply for the external scale should be prepared by the user. Alternatively, encoder power supply shown below can be used (250 mA max.).

Application	Connector pin No.	Function
		7-Wire
Encoder power supply output	1, 2	E0V
	3, 4	+5V power source
Battery (+) (for absolute encoder)	5	Battery (+)
Battery (–) (for absolute encoder)	6	Battery (–)
Encoder/external scale signal input (phase A)	7	EXA
	8	$\overline{\text{EXA}}$
Encoder/external scale signal input (phase B)	9	EXB
	10	$\overline{\text{EXB}}$
Encoder/external scale signal input (phase Z)	11	EXZ
	12	$\overline{\text{EXZ}}$
Encoder signal I/O (Serial signal)	17	PS
	18	$\overline{\text{PS}}$
Frame ground	20	FG

<NOTE>

"0 V" of the encoder power supply output is connected to the ground terminal of the control circuit that is connected to Connector X5 .

<Requests>

1) Pins Nos. 13, 14, 15, 16 and 19 (not listed above) must not be connected.
2) When you use the absolute encoder or absolute/incremental-shared encoder as an incremental encoder, you do not have to connect battery between 5- and 6-pin.

Connector CN X5

When the Pr02 control mode is set to one of 6-10 and full-closed control mode is selected, some pin functions are changed. For pin function changes, see the table below and pages 160 and 161 "Functional selection of interface connector CN X5 by control mode".

Input Signals and their Functions

Signal	Pin No.	Symbol	Function	I/F circuit
Control signal power supply	**7**	**COM +**	Positive terminal of control signal power supply (12 ~ 24 V)	–
	41	**COM –**	Negative terminal of control signal power supply (12 ~ 24 V)	
Signal ground	**13,15 17,25**	**GND**	Driver circuit signal ground.	–
Frame ground	**50**	**FG**	This is a signal ground internal to the driver.	–
Serve on input	**29**	**SRV-ON**	Enables Servo-on when it is connected to COM–.	$\boxed{\text{SI}}$ page 162
Control mode changeover input	**32**	**C-MODE**	With Pr02 (control mode setting) set to 3, 4, 5, 9, and 10, when connection with COM- is open and then the 1st control mode shorts, the 2nd control mode will be selected.	$\boxed{\text{SI}}$ page 162
Alarm clear input	**31**	**A-CLR**	Clears the alarm condition and returns to operation mode when connected to COM–. (This pin is active only when there is an alarm that can be cleared.) See page 216 "Protective functions" in "Encountering Difficulties?"	$\boxed{\text{SI}}$ page 162

<table>
<tr><th>Signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>CCW drive disable input</td><td>9</td><td>CCWL/
DIV2</td><td>Serves as the command div./multi. changeover 2 input with selection of semi-closed control, full-closed control, hybrid control or external encoder control. For selection of command div./multi., see the table "Command div./multi. numerator selection" shown below.
<table>
<tr><th colspan="2">CN X5 connector pin No.</th><th rowspan="2">Command div./multi.setting</th></tr>
<tr><th>Pin 28 DIV</th><th>Pin 9 DIV2(CCWL)</th></tr>
<tr><td>Open</td><td>Open</td><td>$\frac{\text{1st command div./multi. numerator (Pr46)} \times 2^{\text{command div./multi. numerator scale factor (Pr4A)}}}{\text{Command div./multi. denominator (Pr4B)}}$</td></tr>
<tr><td>Short circuit</td><td>Open</td><td>$\frac{\text{2nd command div./multi. numerator (Pr47)} \times 2^{\text{command div./multi. numerator scale factor (Pr4A)}}}{\text{Command div./multi. denominator (Pr4B)}}$</td></tr>
<tr><td>Open</td><td>Short circuit</td><td>$\frac{\text{3rd command div./multi. numerator (Pr48)} \times 2^{\text{command div./multi. numerator scale factor (Pr4A)}}}{\text{Command div./multi. denominator (Pr4B)}}$</td></tr>
<tr><td>Short circuit</td><td>Short circuit</td><td>$\frac{\text{4th command div./multi. numerator (Pr49)} \times 2^{\text{2 command div./multi. numerator scale factor (Pr4A)}}}{\text{Command div./multi. denominator (Pr4B)}}$</td></tr>
</table>
When performing auto gain tuning, frequency response analysis by PANATERM®, functions as CCW drive disable input regardless of setting of Pr02 (control mode setting).
When this pin is disconnected from COM–, CCW torque is not generated in any mode other than above-mentioned.
(Active only when Pr04 is set at 0.)</td><td>SI
page 162</td></tr>
<tr><td>CW drive disable input</td><td>8</td><td>CWL/
SMOOTH</td><td>Enables or disables Smoothing filter while the control is either semi-closed control, full-closed control, hybrid control or external encoder control - enables the smoothing filter when connected to COM–.
When performing auto gain tuning, frequency response analysis by PANATERM®, functions as CW drive disable input regardless of setting of Pr02 (control mode setting).
When this pin is disconnected from COM–, CW torque is not generated in any mode other than above-mentioned.
(Active only when Pr04 is set at 0.)</td><td>SI
page 162</td></tr>
<tr><td>Gain changeover input</td><td>27</td><td>GAIN</td><td>Input of the gain changeover timing when the gain changeover function is active.
Connecting this pin to COM– while the gain changeover function is not active (Pr30, 2nd gain operation setting), the speed driver operates only in proportional mode (P action).</td><td>SI
page 162</td></tr>
<tr><td rowspan="2">Reserved for manufacturer</td><td>1</td><td rowspan="2">–</td><td rowspan="2">Not available for user
Leave this pin open (NC).</td><td rowspan="2">–</td></tr>
<tr><td>2</td></tr>
<tr><td>CW torque limit input</td><td>18</td><td>CWTL</td><td>Limits the CW torque in proportion to the negative input (0 to –10 V). (Rated torque at approx. –3 V)</td><td>SI
page 162</td></tr>
<tr><td>CCW torque limit input</td><td>16</td><td>CCWTL
/TRQR</td><td>Limits the CCW torque in proportion to the positive input (0 to +10 V). (Rated torque at approx. +3 V).
With the speed/torque control is selected (Pr02 (control mode setting) is set to 5, torque control), this pin serves as the torque command input (approx.+3 V/rated torque).</td><td>SI
page 162</td></tr>
<tr><td>Speed zero clamp input</td><td>26</td><td>ZEROSPD</td><td>Speed command is set to zero when this pin is disconnected from COM–.
Active when Pr06 (ZEROSPD input select) is 1.
External speed command input for speed control.</td><td>SI
page 162</td></tr>
<tr><td>Speed command input</td><td>14</td><td>SPR/TRQR</td><td>The gain and polarity of the command are set by the Pr50 (speed command input gain) and Pr51 (speed command input reverse), respectively. The input is the torque command when torque control or position torque control is selected.
The gain and polarity of the command are set by the Pr5C (torque command input gain) and Pr5D (torque command input reverse), respectively.</td><td>SI
page 162</td></tr>
</table>

CN X5 Connector

Signal	Pin No.	Symbol	Function	I/F circuit
Command dive./multi. changeover input	**28**	**DIV**	For the semi-closed control, full-closed control, hybrid control and external encoder control, refer to the table, "Command div./multi. numerator selection" shown below.	$\boxed{\text{SI}}$ page 162

CN X5 connector pin No.		Command div./multi.setting
Pin 9 DIV2(CCWL)	**Pin 28 DIV**	
Open	Open	$\frac{\text{1st command div./multi. numerator (Pr46)} \times 2^{\text{command div./multi. numerator scale factor (Pr4A)}}}{\text{Command div./multi. denominator (Pr4B)}}$
Open	Short circuit	$\frac{\text{2nd command div./multi. numerator (Pr47)} \times 2^{\text{command div./multi. numerator scale factor (Pr4A)}}}{\text{Command div./multi. denominator (Pr4B)}}$
Short circuit	Open	$\frac{\text{3rd command div./multi. numerator (Pr48)} \times 2^{\text{command div./multi. numerator scale factor (Pr4A)}}}{\text{Command div./multi. denominator (Pr4B)}}$
Short circuit	Short circuit	$\frac{\text{4th command div./multi. numerator (Pr49)} \times 2^{\text{2 command div./multi. numerator scale factor (Pr4A)}}}{\text{Command div./multi. denominator (Pr4B)}}$

When this pin is connected to COM–, command div./multi. numerator is changed from Pr46 (1st command div./multi. numerator) to Pr47 (2nd command div./multi. numerator).

Signal	Pin No.	Symbol	Function	I/F circuit
Command pulse input disable	**33**	**INH/ INTSPD1 /SC-ERR**	Scale error input during full-closed control, hybrid control or external encoder control. Disconnecting this pin from COM- causes trip due to scale error (Err28). When designing an external protection circuit, use this input. Pr77=1 ignores scale error input. Disconnecting this pin from COM– during semi-closed control or position control ignores the position command pulse. This is active when Pr43 (command pulse input disable) is 0. During the speed control mode, this pin acts as the internal speed select 1 input. See the table "Internal speed selection" below.	$\boxed{\text{SI}}$ page 162

CN X5 connector pin No.	Pr05 set value		
Pin 33 INTSPD1 (INH, SC-ERR)	0	1	2
Open	Analog speed command (CN X5 pin 14)	Speed setting 1st speed (Pr53)	Speed setting 1st speed (Pr53)
Short circuit	Analog speed command (CN X5 pin 14)	Speed setting 2st speed (Pr54)	Speed setting 2st speed (Pr54)
Open	Analog speed command (CN X5 pin 14)	Speed setting 3st speed (Pr55)	Speed setting 3st speed (Pr55)
Short circuit	Analog speed command (CN X5 pin 14)	Speed setting 41st speed (Pr56)	Analog speed command (CN X5 pin 14)

Signal	Pin No.	Symbol	Function	I/F circuit
Counter clear	**30**	**CL/ INTSPD2**	Connecting this pin to COM– clears the deviation counter. Pr4D (counter clear input mode) selects the level and falling edge. This pin serves as the internal speed select 2 input during speed control mode. See the table below, "Internal speed selection".	$\boxed{\text{SI}}$ page 162

CN X5 connector pin No.	Pr05 set value		
Pin 30 INTSPD2 (INH, SC-ERR)	0	1	2
Open	Analog speed command (CN X5 pin 14)	Speed setting 1st speed (Pr53)	Speed setting 1st speed (Pr53)
Open	Analog speed command (CN X5 pin 14)	Speed setting 2st speed (Pr54)	Speed setting 2st speed (Pr54)
Short circuit	Analog speed command (CN X5 pin 14)	Speed setting 3st speed (Pr55)	Speed setting 3st speed (Pr55)
Short circuit	Analog speed command (CN X5 pin 14)	Speed setting 41st speed (Pr56)	Analog speed command (CN X5 pin 14)

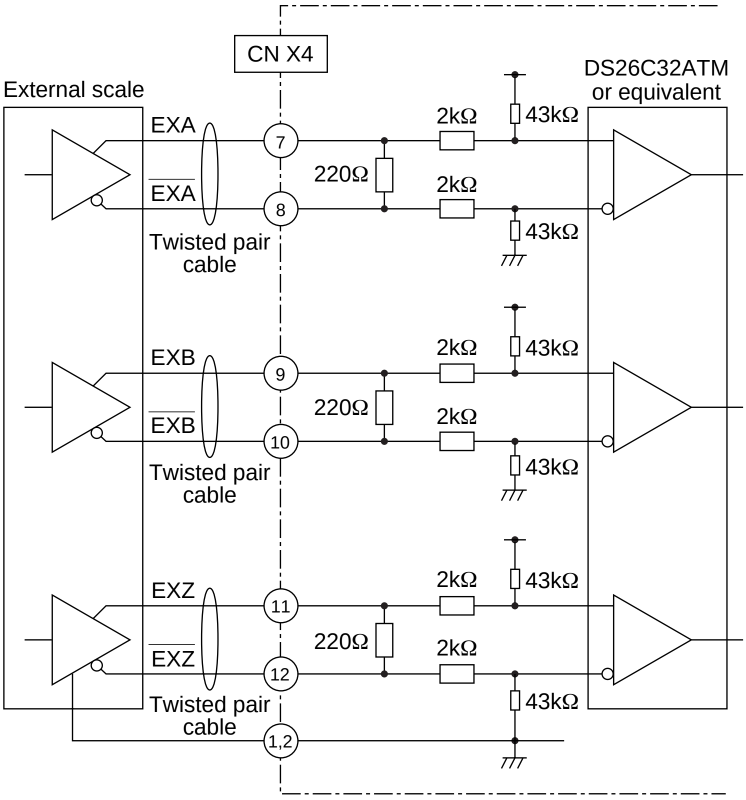
Signal	Pin No.	Symbol	Function	I/F circuit
Command pulse input	**3**	**PULS1**	Enter a position command pulse. The driver receives the pulse through a high-speed photo-coupler. Input impedance is 220Ω. Through Pr42, one of three input formats is selected: 1) 2-phase input (phase A (PULS)/phase B (SIGN)); 2) CW (PULS)/CCW (SIGN) pulse input; and 3) command pulse (PULS) input/sign (SIGN) input.	PI page 162
	4	**PULS2**		
Command sign input	**5**	**SIGN1**		
	6	**SIGN2**		
Absolute encoder battery	**44**	**BATT+**	Connect the absolute encoder backup battery to this pin. Leave this pin open when the battery is directly connected to the driver. Recommended battery: ER6V 3.6 V (Toshiba Battery)	–
	45	**BATT–**		

Output Signals and their Functions

Signal		Pin No.	Symbol	Function	I/F circuit
Servo alarm output		**37** **36**	**ALM+** **ALM–**	Turns off as the error is detected and protection starts.	SO1 page 163
Servo ready output		**35** **34**	**S-RDY+** **S-RDY–**	Turns on as control/main power supply are established without alarm condition.	SO1 page 163
Positioning complete /speed achieved output		**39** **38**	**COIN+** **COIN–**	In full-closed control/hybrid control/external encoder control, the output signal turns ON when a value of the external scale deviation counter falls within the range set by Pr60 (positioning completion range). It also turns ON when a value of the deviation counter falls within the range set by Pr60 in semi-closed control/position control. In speed control, the signal turns ON when the motor actual speed reaches speed set by Pr62 (Reached Speed).	SO1 page 163
External brake release output		**11** **10**	**BRK-OFF+** **BRK-OFF–**	This output signal controls the external mechanical brake. Configure the external circuit which releases the brake when this signal turns on.	SO1 page 163
Torque limiting output		**40** **(41)**	**TLC** **(COM–)**	Selects the signal output by Pr09 (TLC output select). With the default setting, outputs this signal at 0.	SO1 page 163
Zero speed detect output		**12** **(41)**	**ZSP** **(COM–)**	Selects the signal output by Pr0A (ZSP output select). With the default setting, outputs this signal at 1.	SO1 page 163
Pulse output	Phase A	**21**	**OA+**	• Output the divided encoder differential output or external scale differential output pulse through the line driver. • Logical relationship between phase A pulse and phase B pulse can be selected by Pr45 (pulse output logic reverse).	PO1 page 163
		22	**OA–**		
	Phase B	**48**	**OB+**		PO1 page 163
		49	**OB–**		
	Phase Z	**23**	**OZ+**		PO1 page 163
		24	**OZ–**		
	Phase Z	**19**	**CZ**	Open collector signal output with respect to common GND.	PO1
Speed monitor signal		**43**	**SP**	Selects the analog signal to be monitored by using Pr07 (speed monitor select). Factory setting is 3 which outputs motor actual speed in approx. 6 V/3000 rpm/min. Positive voltage is for CCW and negative voltage for CW. The output impedance is 1 kΩ.	AO page 163
Torque motor signal		**42**	**IM**	Selects the analog signal to be monitored by using Pr08 (torque monitor select). Factory setting is 0 which outputs command torque of approx. 3 V/rated torque to the motor. Positive voltage is for CCW and negative voltage for CW. The output impedance is 1 kΩ.	AO page 163
Reserved for manufacturer		**46** **47**	**TX+** **TX–**	Not available for the user. Leave this pin open.	–
Reserved for manufacturer		**20**	**–**	Not available for the user. Leave this pin open.	–

Connections to external scale CN X4

External scale interface specification



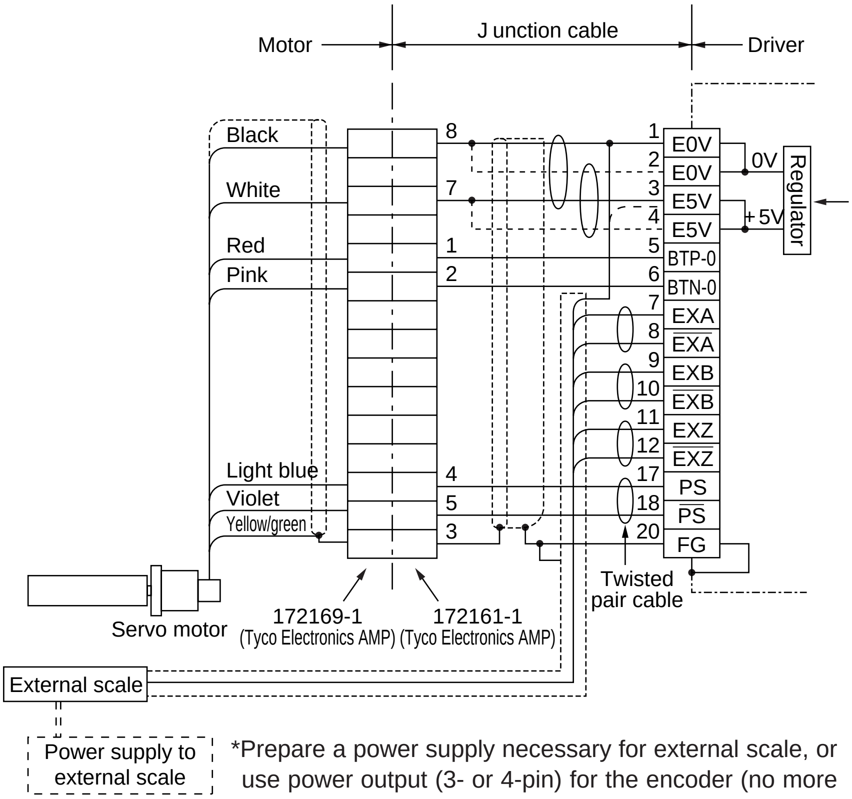
*Connect a signal land to pin 1 or 2.

External scale connection CN X4

Connect the signals from the external scale to the encoder connector CN X4.

1) Use shielded twisted pair cable of 0.18 mm^2 conductors for connecting to the encoder and external scale.
2) The maximum length of the cable must be 20 m. If 5 V supply is to be fed through a longer cable, additional cable should be connected in parallel to reduce voltage drop.
3) Connect together the shields (sheathes) of the lead wires from the motor and those from encoder. The sheath of the driver lead wires must be connected to the FG (pin 20) of the CN X4.
4) In the case of Cannon plug specification, connect a sheath of shield on the motor side of the encoder cable to terminal J .
5) Signal cables must be well separated (30 cm or more) from power lines (L1, L2, L3, L1C (r), L2C (t), U, V, W and ⏚). Do not run these signal wires in a duct together with power cables.
6) Leave blank pins on the CN X4 NC.
7) Power supply for the external scale should be prepared by the user. Alternatively, encoder power supply can be used (250 mA max.).

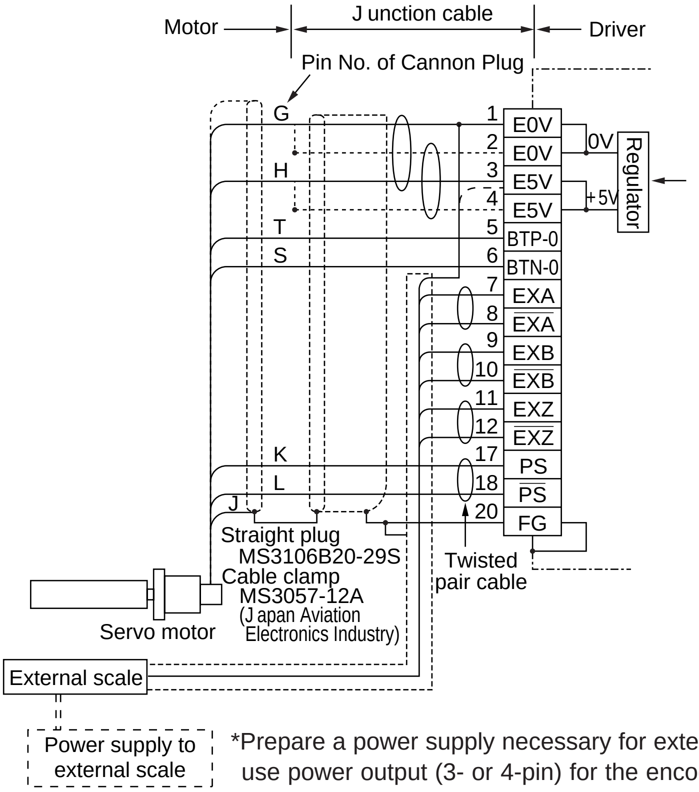
Example: 7-core absolute encoder (motor connector: Tyco Electronics AMP)



*Prepare a power supply necessary for external scale, or use power output (3- or 4-pin) for the encoder (no more than 250mA).

Note: Pins 5 and 6 should be left unused the encoder is incremental type.

Example: 7-core absolute encoder (Motor Connector: Cannon Plug)



*Prepare a power supply necessary for external scale, or use power output (3- or 4-pin) for the encoder (no more than 250mA).

Note: Pins 5 and 6 should be left unused the encoder is incremental type.

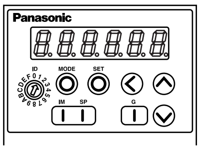
Parameter Setting

Parameters for Function Selection

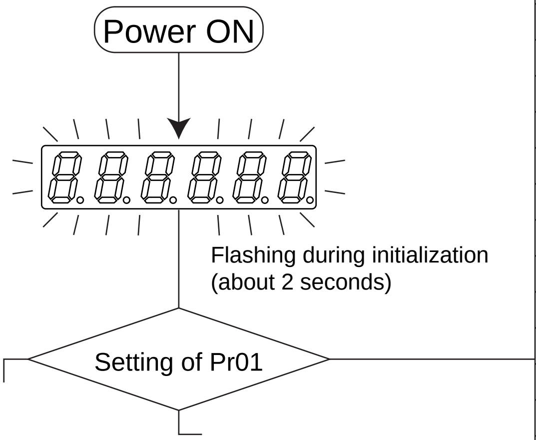
Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Function/Description
00	**Axis address**	0 – 15 [1]	In communications with a host device such as a personal computer that uses RS232C/485 with multiple axes, you should identify to which axis the host accesses and use this parameter to confirm axis address in terms of numerals.

- At power on, settings of the rotary switch ID on the front panel (0 – F) will be programmed into parameters of the driver.
- Settings of Pr00 can be changed only by means of the rotary switch ID.



Parameter No.	Parameter Name	Setting range	Function/Description
01	**LED display at power up**	0 – 15	In the initial condition after turning ON the control power, the following data displayed on the 7-segment LED can be selected.



Setting value	Description
0	Positional deviation
[1]	Motor revolving speed
2	Torque output
3	Control mode
4	I/O signal status
5	Error cause/record
6	Software version
7	Alarm
8	Regenerative load ratio
9	Overload load ratio
10	Inertia ratio
11	Feedback pulse sum
12	Command pulse sum
13	External scale deviation
14	External scale feedback pulse sum
15	Motor auto recognition

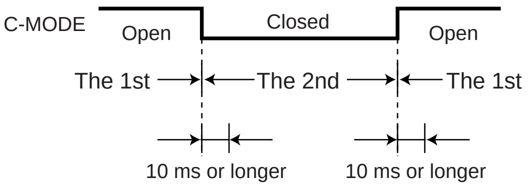
See page 56 "Front Panel Key Operations and Display".

Parameter No.	Parameter Name	Setting range	Function/Description
02	**Control mode**	0 – 14	Select the control mode of the servo driver.

Setting value	Control mode	
	The 1st Mode	The 2nd Mode* 1
0	Position control	–
[1]	Speed control	–
2	Torque control	–
3	Position	Speed control
4	Position	Torque control
5	Speed	Torque control
6	Semi-closed control	–
7	Full-closed control	–
8	Hybrid control	–
9	Speed	External encoder control
10	Speed	Semi-closed control
11	High-stiff equipment position control	–
12	Low-stiff equipment position control	–
13	Low-stiff equipment speed control	–
14	Second full-closed control	–

*1 A special control mode focused on the full-closed specification. For details, refer to “ Full-Closed Control” volume on Page 000.

*2 When composite mode (Pr02 = 3,4,5,9,10) is set, you can switch the 1st and 2nd modes with the control mode switch input (C-MODE).



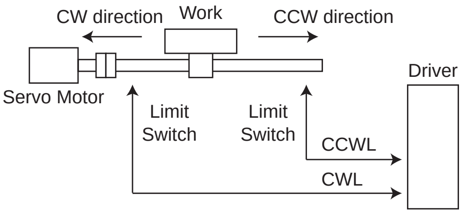
<Caution>

Enter a command after 10ms or longer have passed since C-MODE was entered.

Do not enter any command on position, speed or torque.

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Function/Description</th></tr>
<tr><td>03</td><td>Torque limit selection</td><td>0 – 1
[1]</td><td>The parameter is used to disable analog torque limit input (CCWTL, CWTL) signals.
0: Enabled
1: Disabled

If you do not use torque limit functions, set “ 1” to Pr03.
With Pr03 set to “ 0” and torque limit input (CCWTL, CWTL) open, no torque will be generated, and thus the motor does not rotate.</td></tr>
<tr><td>04</td><td>Overtravel input inhibit</td><td>0 – 1</td><td>In the case of linear driving, in particular, to prevent mechanical damage due to overtraveling of work, you should provide limit switches on both ends of the axis, as shown below, whereby driving in a direction of switch action is required to be inhibited.


<table>
<tr><th rowspan="2">Setting value</th><th rowspan="2">CCWL/CWL Input</th><th colspan="2"></th><th rowspan="2">Action</th></tr>
<tr><th>Input</th><th>Connection with COM-</th></tr>
<tr><td rowspan="4">0</td><td rowspan="4">Enable</td><td rowspan="2">CCWL
(CN X5-9 pin)</td><td>Connected</td><td>Normal condition in which the limit switch on CCW side is not operating.</td></tr>
<tr><td>Open</td><td>CCW direction inhibited, CW direction allowed</td></tr>
<tr><td rowspan="2">CWL
(CN X5-8 pin)</td><td>Connected</td><td>Normal condition in which the limit switch on CW side is not operating.</td></tr>
<tr><td>Open</td><td>CW direction inhibited, CCW direction allowed</td></tr>
<tr><td>[1]</td><td>Disable</td><td colspan="3">Both CCWL and CWL inputs are ignored and they normally operate as no overtravel inhibit being set.</td></tr>
</table>

<Cautions>
1. When you set 0 to Pr04 and do not connect both CCWL and CWL inputs to COM- (off), abnormal condition in which limits are exceeded in both CCW and CW directions is detected, and the driver will then trip due to “ abnormal overtravel input inhibit“ .
2. You can set whether or not to activate the dynamic brake when slowdown occurs because CCW or CW overtravel input inhibit has been enabled. For details, refer to descriptions on Pr66 (DB deactivation at overtravel input inhibit).
3. Work may repeat vertical motion as a result of absence of upward torque after you turned off the limit switch on the upper side of work on the vertical axis. In such a case, you should not use this function, and instead execute limit processing on the host controller side.</td></tr>
<tr><td>07</td><td>Speed monitor (SP) selection</td><td>0 – 9</td><td>The parameter selects/sets a relationship between voltage output to the speed monitor signal output (SP: CN X5 43-pin) and the actual motor speed or command speed.
<table>
<tr><th>Setting value</th><th>SP Signals</th><th>Relationship between Output Voltage Level and Speed</th></tr>
<tr><td>0</td><td rowspan="5">Motor Actual Speed</td><td>6V / 47 r/min</td></tr>
<tr><td>1</td><td>6V / 187 r/min</td></tr>
<tr><td>2</td><td>6V / 750 r/min</td></tr>
<tr><td>[3]</td><td>6V / 3000 r/min</td></tr>
<tr><td>4</td><td>1.5V / 3000 r/min</td></tr>
<tr><td>5</td><td rowspan="5">Command Speed</td><td>6V / 47 r/min</td></tr>
<tr><td>6</td><td>6V / 187 r/min</td></tr>
<tr><td>7</td><td>6V / 750 r/min</td></tr>
<tr><td>8</td><td>6V / 3000 r/min</td></tr>
<tr><td>9</td><td>1.5V / 3000 r/min</td></tr>
</table></td></tr>
</table>

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Function/Description</th></tr>
<tr><td>08</td><td>Torque monitor (IM) selection</td><td>0 – 12</td><td>The parameter selects/sets a relationship between voltage output to the torque monitor signal output (IM: CN X5 42-pin) and generated torque of the motor or number of deviation pulses.
<table>
<tr><th>Setting value</th><th>IM Signals</th><th>Relationship between output level and torque or number of deviation pulses</th></tr>
<tr><td>[0]</td><td>Torque</td><td>3V / rated (100%) torque</td></tr>
<tr><td>1</td><td rowspan="5">No. of Deviation Pulses</td><td>3V / 31Pulse</td></tr>
<tr><td>2</td><td>3V / 125Pulse</td></tr>
<tr><td>3</td><td>3V / 500Pulse</td></tr>
<tr><td>4</td><td>3V / 2000Pulse</td></tr>
<tr><td>5</td><td>3V / 8000Pulse</td></tr>
<tr><td>6</td><td rowspan="5">No. of full-closed deviation pulse</td><td>3V / 31Pulse</td></tr>
<tr><td>7</td><td>3V / 125Pulse</td></tr>
<tr><td>8</td><td>3V / 500Pulse</td></tr>
<tr><td>9</td><td>3V / 2000Pulse</td></tr>
<tr><td>10</td><td>3V / 8000Pulse</td></tr>
<tr><td>11</td><td rowspan="2">Torque</td><td>3V / 200% torque</td></tr>
<tr><td>12</td><td>3V / 400% torque</td></tr>
</table></td></tr>
<tr><td>09</td><td>TLC output selection</td><td>0 – 5</td><td>The parameter allocates functions of output in torque limits (TLC: CN X5 40-pin).
<table>
<tr><th>Setting value</th><th>Functions</th><th>Remarks</th></tr>
<tr><td>[0]</td><td>Output in torque limit</td><td rowspan="6">For functional details of respective outputs listed left, refer to "Wiring to Connector CN X5" on page 78.</td></tr>
<tr><td>1</td><td>Output of zero-speed detection</td></tr>
<tr><td>2</td><td>Output of an alarm due to either of over-regeneration/overload/absolute battery</td></tr>
<tr><td>3</td><td>Output of over-regeneration alarm</td></tr>
<tr><td>4</td><td>Output of overload alarm</td></tr>
<tr><td>5</td><td>Output of absolute battery alarm</td></tr>
</table></td></tr>
<tr><td>0A</td><td>ZSP output selection</td><td>0 – 5</td><td>The parameter allocates functions of zero speed detection output (ZSP: CN X5 12-pin).
<table>
<tr><th>Setting value</th><th>Functions</th><th>Remarks</th></tr>
<tr><td>0</td><td>Output in torque limit</td><td rowspan="6">For functional details of respective outputs listed left, refer to "Wiring to Connector CN X5" on page 78.</td></tr>
<tr><td>[1]</td><td>Output of zero-speed detection</td></tr>
<tr><td>2</td><td>Output of an alarm due to either of over-regeneration/overload/absolute battery</td></tr>
<tr><td>3</td><td>Output of over-regeneration alarm</td></tr>
<tr><td>4</td><td>Output of overload alarm</td></tr>
<tr><td>5</td><td>Output of absolute battery alarm</td></tr>
</table></td></tr>
<tr><td>0B</td><td>Absolute encoder set up</td><td>0 – 2</td><td>Listed below are settings when you use the absolute encoder:
<table>
<tr><th>Setting value</th><th>Description</th></tr>
<tr><td>0</td><td>To use the absolute encoder as absolute.</td></tr>
<tr><td>[1]</td><td>To use the absolute encoder as incremental.</td></tr>
<tr><td>2</td><td>To use the absolute encode as absolute. In this case, multi-rotation excess counter is ignored.</td></tr>
</table></td></tr>
<tr><td>0C</td><td>Baud rate of RS232C</td><td>0 – 2</td><td>
<table>
<tr><th>Setting value</th><th>Baud Rate</th></tr>
<tr><td>0</td><td>2400bps</td></tr>
<tr><td>1</td><td>4800bps</td></tr>
<tr><td>[2]</td><td>9600bps</td></tr>
</table></td></tr>
<tr><td>0D</td><td>Baud rate of RS485</td><td>0 – 2</td><td>
<table>
<tr><th>Setting value</th><th>Baud Rate</th></tr>
<tr><td>0</td><td>2400bps</td></tr>
<tr><td>1</td><td>4800bps</td></tr>
<tr><td>[2]</td><td>9600bps</td></tr>
</table></td></tr>
</table>

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
10	**1st position loop gain**	0 – 32767 [63] *	1/s	• The parameter defines responsiveness of the position control system. Higher position gain would shorten time of positioning.
11	**1st Velocity loop gain**	1 – 3500 [35] *	Hz	• The parameter defines responsiveness of the speed loop. You need to set this speed loop gain high so as to improve responsiveness of the entire servo system by increasing position loop gain.
12	**1st Velocity loop integration time constant**	1 – 1000 [16] *	ms	• This parameter is an integration element of a speed loop and acts to drive quickly the subtle speed deviation into zero. The smaller the setting is, the faster deviation will be zeroed. • Setting of “ 1000” will remove effects of integration.
13	**1st speed detection filter**	0 – 6 [0] *	–	• The parameter sets in 6 phases (0 to 5) a time constant of the low-pass filter inserted after the block of converting an encoder signal into a speed signal. • Setting this parameter high would increase a time constant, thereby reducing noise of the motor. However, usually use the factory setting (0).
14	**1st torque filter time constant**	0 – 2500 [65] *	0.01ms	• The parameter sets a time constant of the primary delay filter inserted into the torque command unit. • It effects the control of vibration because of the torsion resonance.
15	**Velocity feed forward**	–2000 – 2000 [300] *	0.1%	• The parameter defines volume of speed feed forward under position control. Setting it to 100% would make positional deviation in operation at a constant rate almost 0. When you set it higher, positional deviation will decrease and responsiveness will be improved. Be careful, however, as overshooting is apt to occur.
16	**Feed forward filter time constant**	0 – 6400 [50] *	0.01ms	• The parameter sets a time constant of the primary delay filter inserted into the speed feed forward unit. • Inclusion of the feed forward function would cause speed overshooting/undershooting. Thus, this filter may make improvement when a positioning completion signal is chattering.
18	**2nd position loop gain**	0 – 32767 [73] *	1/s	• A position loop, speed loop, speed detection filter, and torque command filter, respectively, has 2 pairs of gains or time constants (the 1st and 2nd). • Each function/content is similar to the 1st gain/time constraint, described earlier. • For details on switching of the 1st and 2nd gains or time constants, refer to Adjustment volume on page 186. * Pr11 and Pr19 will be set in terms of (Hz) when Pr20 inertia ratio has been set correctly.
19	**2nd Velocity loop gain**	1 – 3500 [35] *	Hz	
1A	**2nd Velocity loop integration time constant**	1 – 1000 [1000] *	ms –	
1B	**2nd speed detection filter**	0 – 6 [0] *		
1C	**2nd torque filter time constant**	0 – 2500 [65] *	0.01ms	
1D	**1st notch frequency**	100 – 1500 [1500]	Hz	• The parameter sets frequency of the resonance suppression notch filter. • You should set it about 10% lower than the resonance frequency of the mechanical system that has been found by the frequency characteristics analysis facility of the setup assisted software “ PANATERM®” . • Setting this parameter ” 1500” would disable the function of notch filter.
1E	**1st notch width selection**	0 – 4 [2]	–	• The parameter sets width of the resonance suppression notch filter in 5 steps. The higher the setting is, the greater the width is. • Normally, use a factory setting.

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>20</td><td>Inertia ratio</td><td>0 – 10000
[100]</td><td>%</td><td>• Defines the ratio of load inertia to the motor's rotor inertia.
Pr20 = (rotor inertia / load inertia) x 100[%]
• When you execute auto gain tuning, load inertia will be estimated and the result will be reflected in this parameter.
Pr11 and Pr19 will be set in terms of (Hz) when inertia ratio has been set correctly. When Pr20 inertia ratio is greater than the actual ratio, setting of the speed loop gain will increase. When Pr20 inertia ratio is smaller than the actual ratio, setting of speed loop gain will decrease.</td></tr>
<tr><td>26
* 1</td><td>Disturbance torque compensation gain</td><td>0 – 200
[0]</td><td>%</td><td>• When the control mode is HP, LP, LS or UPF, a gain, in which the torque command is multiplied by a disturbance torque estimate value, is set.
• By setting 100 [%] , a torque compensation that clears the disturbance torque is applied.
• When Pr21 real time auto tuning mode setting is altered, Pr26 changes to 0 (disabled).</td></tr>
<tr><td rowspan="2">27
* 1</td><td>Disturbance torque observer filter selection</td><td>0 –255</td><td>–</td><td>• Cut-off frequency of the filter for disturbance torque observer is set.
<table>
<tr><th>Set value</th><th>Cutoff Frequency</th></tr>
<tr><td>[0] *</td><td>Disturbance Observer Disabled</td></tr>
<tr><td>1 – 255</td><td>Enabled, filter cutoff frequency [Hz] = 3.7 x setting</td></tr>
</table></td></tr>
<tr><td colspan="4">A larger value provides stronger disturbance suppression; but a larger operation noise is emitted. When using this function, it is necessary to set Pr20 inertia ratio correctly. When Pr.21 real time auto tuning mode setting is altered, Pr27 changes to 0(disabled). Also, while the real time auto tuning is enabled (Pr21 is not 0 or 7), Pr27 is fixed to 0 and the disturbance observer is disabled.</td></tr>
<tr><td>28</td><td>2nd notch frequency</td><td>100 – 1500
[1500]</td><td>Hz</td><td>• Defines the notch frequency of the second resonance suppression notch filter.
• The unit is [Hz] . Match the notch frequency with the machine's resonance frequency.
100 to 1499: Filter enabled 1500: Filter disabled</td></tr>
<tr><td>29</td><td>2nd notch width selection</td><td>0 – 4
[2]</td><td>–</td><td>• Select the notch width of the second resonance suppression notch filter.
• Increasing the set value enlarges the notch width.</td></tr>
<tr><td>2A</td><td>2nd notch depth selection</td><td>0 – 99
[0]</td><td>–</td><td>• Select the notch depth of the second resonance suppression notch filter.
• Increasing the set value reduces the notch depth and the phase delay.</td></tr>
</table>

*1: Enabled only in the 2nd full-closed control

Parameters for Switching to 2nd Gains

Default setting is shown by [ ]

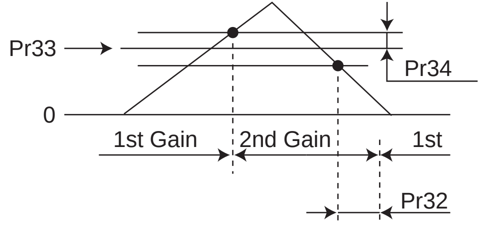
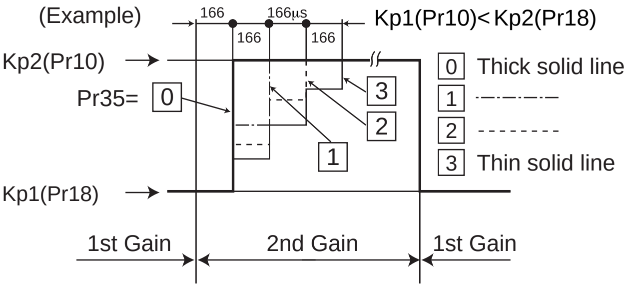
<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>30</td><td>2nd gain action set up</td><td>0 – 1</td><td>–</td><td>• The parameter selects switching of PI/P operation and the 1st/2nd gain switching.
<table>
<tr><th>Setting value</th><th>Gain Selection/Switching</th></tr>
<tr><td>0</td><td>The 1st Gain (Possible to switch PI/P) *1</td></tr>
<tr><td>[1] *</td><td>Possible to switch the 1st/2nd gain *2</td></tr>
</table>
*1 Switching of 1 PI/P operation is done through gain switching input (GAIN CN X5 27-pin).
<table>
<tr><th>GAIN input</th><th>Operation of speed loop</th></tr>
<tr><td>Open with COM–</td><td>PI operation</td></tr>
<tr><td>Connect to COM–.</td><td>P operation</td></tr>
</table>
*2 For conditions of switching between the 1st and 2nd gains, refer to “ Adjustment upon switching gain” of Adjustment volume on page 202.</td></tr>
</table>

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
31	**Position control switching mode**	0 –10	–	• The parameter selects conditions of switching the 1st and 2nd gains in position control mode.

Setting value	Conditions for Switching Gains
0	Fixed to the 1st gain.
1	Fixed to the 2nd gain.
2	The 2nd gain is selected with gain switching input (GAIN) turned ON (Pr30 needs setting of 1).
3 *3	Torque command variation is greater than setting of Pr33 (position control switching level) and Pr14, and the 2nd gain is selected.
4 *3	Fixed to the 1st gain.
5 *3	Command speed is greater than setting of Pr33 (position control switching level) and Pr14, and the 2nd gain is selected.
6 *3	Positional deviation is greater than setting of Pr33 (position control switching level) and Pr14, and the 2nd gain is selected.
7 *3	Position command is present and the 2nd gain is selected. The 2nd gain is selected when the command pulse is 1 or higher in 166ms.
8 *3	The 2nd gain is selected with positioning not complete. The 2nd gain is selected when a value of the positional deviation counter is greater than Pr60 (positioning completion range).
9 *3	Motor actual speed is greater than setting of Pr33 (position control switching level) and Pr34, and the 2nd gain is selected.
[10] * *3	Switching to the 2nd gain with position command present. Switching to the 1st gain when absence of position command continues for Pr32 (x 166ms) and speed falls below Pr33 - Pr34 [r/min] .

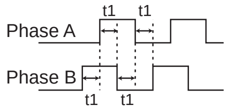
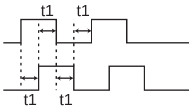
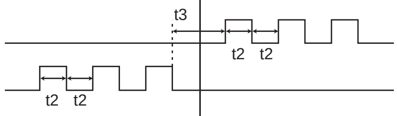
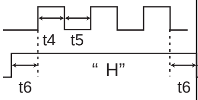
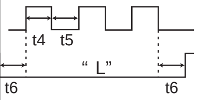
*3 For levels to be switching and timing, refer to "Adjustment upon switching gain" of Adjustment volume on page 202.

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
32	**Position control switching delay time**	0 – 10000 [30] *	x 166μs	• The parameter sets delay time of deviation from switching conditions set with Pr31 to actual return to the 1st gain.
33	**Position control switching level**	0 – 20000 [50] *	–	• The parameter is enabled when Pr31 is set to 3 – 8, and sets a determination level when No.1 and No.2 gain are switched.
34	**Position control switching hysteresis**	0 – 20000 [33] *	–	• The parameter sets width of hysteresis to be provided above and under the judgment level set with Pr33 mentioned above. • The following figure shows definitions of the above-mentioned Pr32 (delay), Pr33 (level) and Pr34 (hysteresis).  **<Caution>** Settings of Pr33 (level) and Pr34 (hysteresis) are enabled as an absolute value (positive/negative).
35	**Position gain switching time**	0 – 10000 [20] *	(Setting + 1) x 166μs	• The parameter sets stepped switching time only for position loop gain upon switching gains when the 2nd gain switching function has been enabled.  • Switching time should be provided only when a small position loop gain is switched to a large position loop gain (Kp1 → Kp2). (This is to alleviate impact on the machine due to rapid change of gain.) • You should set a value smaller than a difference of Kp2 and Kp1.

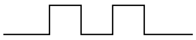
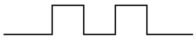
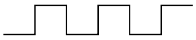
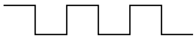
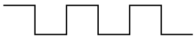
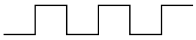
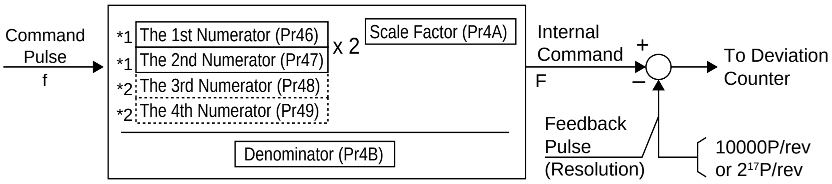
Parameter Setting

Parameters for Position Control

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Function/Description</th></tr>
<tr><td>40</td><td>Command pulse multiplier set up</td><td>1 – 4</td><td>
• The parameter sets a multiply when “ 2-phase pulse input” has been selected as a command pulse form with Pr42 (command pulse input mode setting).
<table>
<tr><th>Setting value</th><th>Multiply when 2-phase pulse is input</th></tr>
<tr><td>1</td><td>x 1</td></tr>
<tr><td>2</td><td>x 2</td></tr>
<tr><td>3 or [4]</td><td>x 4</td></tr>
</table>
</td></tr>
<tr><td>41</td><td>Command pulse logic inversion</td><td>0 – 3</td><td>
• Each of logics of 2 pulse command input (PULS, SIGN) systems can be individually set inside the driver.
<table>
<tr><th>Setting value</th><th>“ PULS” Signal Logic</th><th>“ SIGN” Signal Logic</th></tr>
<tr><td>[0]</td><td>Non-inverting</td><td>Non-inverting</td></tr>
<tr><td>1</td><td>Inverting</td><td>Non-inverting</td></tr>
<tr><td>2</td><td>Non-inverting</td><td>Inverting</td></tr>
<tr><td>3</td><td>Inverting</td><td>Inverting</td></tr>
</table>
</td></tr>
<tr><td>42</td><td>Command pulse input mode</td><td>0 – 3</td><td>
• The parameter sets an input form of a command pulse to be given from the host device to the driver. Three types of forms listed in the following table can be set. Make selection in accordance with specifications of the host device.
<table>
<tr><th>Setting value</th><th>Command pulse form</th><th>Signal Name</th><th>CCW Command</th><th>CW Command</th></tr>
<tr><td>0 or 2</td><td>90° phase difference
Two-phase pulse
(Phase A + Phase B)</td><td>PULS
SIGN</td><td> Phase B advances 90° ahead of phase A.</td><td> Phase B delays 90° from phase A</td></tr>
<tr><td>[1]</td><td>CW pulse train
+
CCW pulse train</td><td>PULS
SIGN</td><td colspan="2"> </td></tr>
<tr><td>3</td><td>Pulse train
+
symbols</td><td>PULS
SIGN</td><td> </td><td> </td></tr>
</table>
Allowed maximum input frequency and required minimum time width of command pulse input signal
<table>
<tr><th rowspan="2">Input I/F of PULS/SIGN signals</th><th rowspan="2">Allowed maximum input frequency</th><th colspan="6">Required minimum time width [μs]</th></tr>
<tr><th>t1</th><th>t2</th><th>t3</th><th>t4</th><th>t5</th><th>t6</th></tr>
<tr><td>Line driver interface</td><td>500kpps</td><td>2</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Open collector interface</td><td>200kpps</td><td>5</td><td>2.5</td><td>2.5</td><td>2.5</td><td>2.5</td><td>2.5</td></tr>
</table>
Pulse rise/fall time of command pulse input signal should be set to no more than 0.1μs.
</td></tr>
<tr><td>43</td><td>Command pulse inhibit input invalidation</td><td>0 – 1</td><td>
• The parameter selects enable/disable of command pulse inhibit input INH: CN X5 33-pin).
<table>
<tr><th>Setting value</th><th>INH Input</th></tr>
<tr><td>0</td><td>Enable</td></tr>
<tr><td>[1]</td><td>Disable</td></tr>
</table>
With INH input, connection with COM- will be open, and command pulse input will be inhibited. If you do not use INH input, set 1 to Pr43. You no longer need to connect INH (CN 1/F 33-pin) and COM- (41-pin) external to the driver.
</td></tr>
</table>

Default setting is shown by [ ]

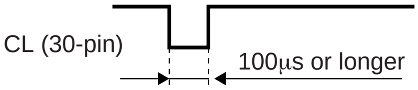
<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Function/Description</th></tr>
<tr><td>44</td><td>Output pulses per single turn</td><td>1 – 16384
[2500]</td><td>The parameter sets number of pulses per one revolution of encoder pulse to be output to the host device. The pulse will be set in dividing.
You should directly set in this parameter the number of pulses per revolution needed for your device/system in terms of [Pulse/rev] .</td></tr>
<tr><td>45</td><td>Pulse output logic inversion</td><td>0 – 1</td><td>In a relationship of phases of output pulse from the rotary encoder, Phase B pulse is behind pulse A when the motor rotates in CW direction. (Phase B pulse advances ahead of phase A pulse, when the motor rotates in CCW direction.)
Inversion of logic of phase B pulse with this parameter could invert a phase relation of phase B pulse to phase A pulse.
<table>
<tr><th>Setting value</th><th></th><th>IWhen Motor is Rotating in CCW direction</th><th>IWhen Motor is Rotating in CW direction</th></tr>
<tr><td></td><td>A pulse(OA)</td><td></td><td></td></tr>
<tr><td>[0]</td><td>B pulse(OB)
Non-inverting</td><td></td><td></td></tr>
<tr><td>1</td><td>B pulse(OB)
Inverting</td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td rowspan="2">46</td><td colspan="3">Related to command pulse multiply division function (Pr46 to 4B)</td></tr>
<tr><td>1st numerator of command pulse ratio</td><td>1 – 10000
[10000]</td><td rowspan="6">Command pulse multiply division (electronic gear) function
Purpose of Use
1) To arbitrarily set rotation/movement of the motor per unit input command pulse.
2) In the case predetermined motor speed cannot be achieved because of limited pulse oscillation capacity (highest possible output frequency) of the host device, multiply function should be used to increase seeming command pulse frequency.
• Block Diagram of Multiply Division Unit:


• An upper limit of computed value of a numerator will be 2621440. Note that even when you set a value higher than this, it will become invalid and 2621440 will be a numerator.
*1: Select the 1st or 2nd numerator by means of command multiply division switching (DIV:CN X5 28-pin).
<table>
<tr><td>DIV Off</td><td>Select the first numerator (Pr46).</td></tr>
<tr><td>DIV ON</td><td>Select the second numerator (Pr47).</td></tr>
</table>
*2: 3rd and 4th numerators are used for special specifications such as full-closed specification. For further information, refer to “ Full-Closed Control” volume on page 156.
<Examples of Setting>
• It is basic to have a relation “ a motor rotates once with command input (f) for resolution of an encoder” when the multiply division ratio is 1.
Therefore, to rotate the motor once as an example of the case in which the encoder has resolution of 10000P/r, f=5000Pulse at multiply of 2 and f=40000Pulse at 1/4 division should be input.
• Pr46, Pr4A and Pr4B should be set so that internal command after multiply division will be equal to resolution of the encoder (i.e., 10000 or 2^{17}).
$F = f \times \frac{Pr46 \times 2\ Pr4A}{Pr4B} = 10000 \text{ or } 2^{17}$
F: Number of internal command pulses for one revolution of the motor
f: Number of command pulses for one revolution of the motor</td></tr>
<tr><td>47</td><td>2nd numerator of command pulse ratio</td><td>1 – 10000
[10000]</td></tr>
<tr><td>48</td><td>3rd numerator of command pulse ratio</td><td>1 – 10000
[10000]</td></tr>
<tr><td>49</td><td>4th numerator of command pulse ratio</td><td>1 – 10000
[10000]</td></tr>
<tr><td>4A</td><td>Multiplier of numerator of command pulse ratio</td><td>0 – 17
[0]</td></tr>
<tr><td>4B</td><td>Denominator of command pulse ratio</td><td>1 – 10000
[10000]</td></tr>
</table>

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Function/Description</th></tr>
<tr><td>46</td><td colspan="3">Related to command pulse multiply division function (Pr46 to 4B)</td></tr>
<tr><td>(Continued)</td><td>1st numerator of command pulse ratio</td><td>1 – 10000
[10000]</td><td rowspan="6">(Continued)
<table>
<tr><th>Resolution of Encoder</th><th>2^{17} (131072)</th><th>10000 (2500P/r x 4)</th></tr>
<tr><td>Example 1:
When command input (f) is set to 5000 per revolution of the motor]</td><td>$\frac{\text{Pr46 } \boxed{1} \text{ x } 2^{\text{Pr4A } \boxed{17}}}{\text{Pr4B } \boxed{5000}}$</td><td>$\frac{\text{Pr46 } \boxed{10000} \text{ x } 2^{\text{Pr4A } \boxed{0}}}{\text{Pr4B } \boxed{5000}}$</td></tr>
<tr><td>Example 2:
When command input (f) is set to 40000 per revolution of the motor]</td><td>$\frac{\text{Pr46 } \boxed{1} \text{ x } 2^{\text{Pr4A } \boxed{15}}}{\text{Pr4B } \boxed{10000}}$</td><td>$\frac{\text{Pr46 } \boxed{2500} \text{ x } 2^{\text{Pr4A } \boxed{0}}}{\text{Pr4B } \boxed{10000}}$</td></tr>
</table></td></tr>
<tr><td>47</td><td>2nd numerator of command pulse ratio</td><td>1 – 10000
[10000]</td></tr>
<tr><td>48</td><td>3rd numerator of command pulse ratio</td><td>1 – 10000
[10000]</td></tr>
<tr><td>49</td><td>4th numerator of command pulse ratio</td><td>1 – 10000
[10000]</td></tr>
<tr><td>4A</td><td>Multiplier of numerator of command pulse ratio</td><td>0 – 17
[0]</td></tr>
<tr><td>4B</td><td>Denominator of command pulse ratio</td><td>1 – 10000
[10000]</td></tr>
<tr><td>4C</td><td>Smoothing filter</td><td>0 – 7</td><td>A smoothing filter is a primary delay filter inserted after command multiply division unit of command pulse input unit.

Purpose of Smoothing Filter:
• Basically, it is to alleviate stepped movement of the motor when a command pulse is rough.
• Following are the specific examples in which a command pulse becomes rough:
1) When a multiply ratio is set for command multiply division (10 times or higher)
2) When command pulse frequency is low in some cases

• A time constant of the smoothing filter should be set in 8 steps with Pr4C.
<table>
<tr><th>Setting value</th><th>Time constant</th></tr>
<tr><td>0</td><td>No filter function</td></tr>
<tr><td>[1]</td><td>Small time constant</td></tr>
<tr><td>≀</td><td>↓</td></tr>
<tr><td>7</td><td>Great time constant</td></tr>
</table></td></tr>
<tr><td>4D</td><td>Counter clear input</td><td>0 – 1</td><td>The parameter sets clear conditions of counter clear input signal for clearing the deviation counter (CL: CNX5 30-pin).
<table>
<tr><th>Setting value</th><th>Clear Conditions</th></tr>
<tr><td>[0]</td><td>Clear at level (*1).</td></tr>
<tr><td>1</td><td>Clear at edge (falling edge).</td></tr>
</table>
*1: Minimum time width of CL signal

</td></tr>
</table>

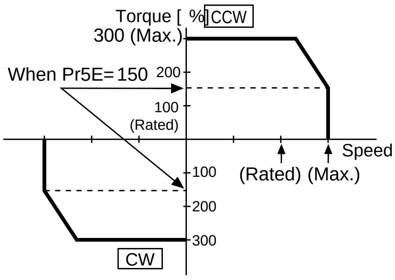
Parameters for Speed Control

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
57	**JOG speed set up**	0 – 500 [300]	r/min	The parameter directly sets JOG speed in JOG run in “motor trial run mode” in terms of [r/min]. For details on JOG function, refer to “Trial Run (JOG)” of Preparations volume on page 68.

Parameters for Torque Control

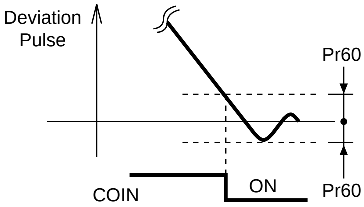
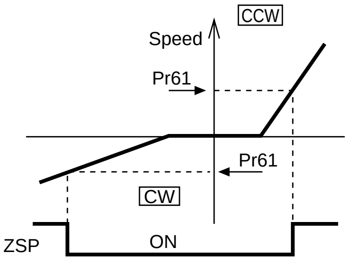
Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
5E	**Torque limit**	0 – 500	%	• This function limits maximum torque of the motor through setting of parameters within the driver. • In normal specifications, torque about 3 times higher than the rated is allowed for an instant. This parameter limits the maximum torque, however, if the triple torque may cause a trouble in the strength of motor load (machine). • Setting should be given as a % value to rated torque. • The right figure shows a case in which the maximum torque is limited to 150%. • Pr5E limits maximum torque in both CW and CCW directions simultaneously.  **<Caution>** You cannot set this parameter to a value above a factory setting of the system parameter (i.e., a factory set parameter that cannot be changed through of PANATERM® and panel manipulation) “Maximum Output Torque Setting”. A factory setting may vary depending on a combination of an driver and motor. For further information, refer to “Pr5E Setting of Torque Limit” of Preparations volume on page 55.

Parameter Setting

Parameters for various sequences

Default setting is shown by [ ]

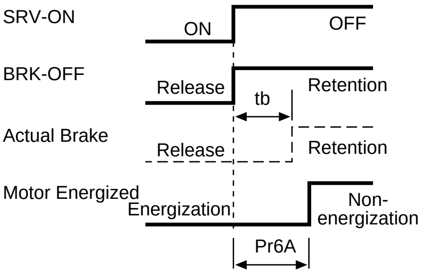
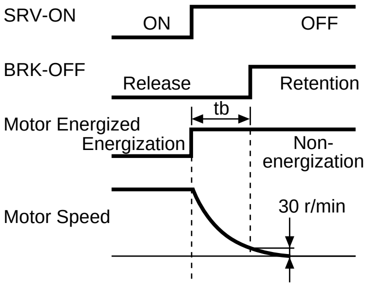
<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>60</td><td>In-position range</td><td>0 – 32767
[131]</td><td>Pluse</td><td>• The parameter sets timing to output a positioning completion signal (COIN: CN X5 39-pin) when movement of the motor (work) is complete after input of a command pulse ends.
• A positioning completion signal (COIN) is output when the number of pulses of the deviation counter is within ± (setting).
• A basic unit of deviation pulse is “ resolution” of an encoder you will use. Thus, be careful because it varies depending on an encoder, as shown below:
1) 17-bit encoder: 2^{17} = 131072
2) Encoder of 2500 P/rev: 4 x 2500 = 10000
<Cautions>
1.Setting Pr60 too small might extend time till COIN signal is output or cause chattering upon output.
2.Setting of “ Positioning Completion Range” will have no effect on final positioning precision.

 </td></tr>
<tr><td>61</td><td>Zero speed</td><td>0 – 20000
[50]</td><td>r/min</td><td>• The parameter directly sets timing to an output zero speed detection output signal (ZSP: CN X5 12-pin) in terms of [r/min] .
• A zero speed detection signal (ZSP) is output when motor speed falls below the speed set with this parameter Pr61.
• Setting of Pr61 acts on both CW and CCW directions, irrespective of rotating direction of the motor.
• There is hysteresis of 10rpm. The parameter should be set to 10 or greater.

 </td></tr>
<tr><td>63</td><td>Position error set up</td><td>1 – 32767
[25000]</td><td>–</td><td>The parameter sets a detection level of “ protection against excessive positional deviation” function when it is determined that positional deviation is excessive, by using the number of residual pulses.
• Calculate a setting value following the expression shown below:
$$\text{Setting value} = \frac{\text{Positional deviation excess determination level [PULSE]}}{256}$$
<Note>
Note that setting this Pr63 too small, in particular, when positional gain is set low might activate protection against excessive positional deviation even though there was no abnormality.</td></tr>
<tr><td>64</td><td>Position error invalidation</td><td>0 – 1</td><td>–</td><td>This parameter disables “ protection against excessive positional deviation” .
<table><tr><th>Setting value</th><th>Protection against excessive positional deviation</th></tr><tr><td>[0]</td><td>Enabled</td></tr><tr><td>1</td><td>Disabled. Operation will continue without determining abnormality, even though positional deviation pulses exceed the judgment level set with Pr63.
If you make a mistake in phase sequence or wiring of the encoder, runaway may occur. You should install a safeguard against runaway in the device.</td></tr></table></td></tr>
</table>

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>65</td><td>Undervoltage error response at main power-off</td><td>0 – 1</td><td>–</td><td>The parameter sets whether to enable the “ protection against main power source under-voltage” function when you shut down the main power of main and control power supplies.
<table>
<tr><th>Setting value</th><th>Main Power Source Under-voltage Protection Action</th></tr>
<tr><td>[0]</td><td>In this case, if you shut off the main power during Servo ON, it will be SERVO-OFF without a trip. Then, when the main power supply turns ON again, it will be recovered to Servo ON.</td></tr>
<tr><td>1</td><td>Shutting off main power during Servo ON will activate abnormal main power supply under-voltage (alarm code No.13) and cause a trip.</td></tr>
</table>
Refer to the timing chart “ At Power ON” of Preparations volume on page 40.</td></tr>
<tr><td>66
* 1</td><td>Dynamic breke inhibition at overtravel limit</td><td>0 – 1</td><td>–</td><td>The parameter sets driving conditions at decelerated operation after over-travel input inhibit (CCWL: connector CN X5 9-pin or CWL: connector CN X5 8-pin) has been activated and enabled.
<table>
<tr><th>Setting value</th><th>Driving Conditions from Deceleration to Stop</th></tr>
<tr><td>[0]</td><td>The motor decelerates and stops as the dynamic brake (DB) is operated. The motor will be in free condition after it stops.</td></tr>
<tr><td>1</td><td>Free running, the motor decelerates and stops. The motor will be in free condition after it stops.</td></tr>
</table></td></tr>
<tr><td>67</td><td>Error response at main power-off</td><td>0 – 7</td><td>–</td><td>The parameter sets:
(1) Driving conditions during deceleration and after stopping; and
(2) Processing to clear content of the deviation counter
after the main power source is shut off.
<table>
<tr><th rowspan="2">Setting value</th><th colspan="2">Driving Conditions</th><th rowspan="2">Content of Deviation Counter</th></tr>
<tr><th>During Deceleration</th><th>After Stopped</th></tr>
<tr><td>[0]</td><td>DB</td><td>DB</td><td>Clear</td></tr>
<tr><td>1</td><td>Free Run</td><td>DB</td><td>Clear</td></tr>
<tr><td>2</td><td>DB</td><td>Free</td><td>Clear</td></tr>
<tr><td>3</td><td>Free Run</td><td>Free</td><td>Clear</td></tr>
<tr><td>4</td><td>DB</td><td>DB</td><td>Retention</td></tr>
<tr><td>5</td><td>Free Run</td><td>DB</td><td>Retention</td></tr>
<tr><td>6</td><td>DB</td><td>Free</td><td>Retention</td></tr>
<tr><td>7</td><td>Free Run</td><td>Free</td><td>Retention</td></tr>
</table>
DB: Activation of dynamic brake</td></tr>
<tr><td>68</td><td>Error response action</td><td>0 – 3</td><td>–</td><td>The parameter sets driving conditions during deceleration or following stop, after any of protective functions of the driver has been activated and alarm has been generated.
<table>
<tr><th rowspan="2">Setting value</th><th colspan="2">Driving Conditions</th><th rowspan="2">Content of Deviation Counter</th></tr>
<tr><th>During Deceleration</th><th>After Stopped</th></tr>
<tr><td>[0]</td><td>DB</td><td>DB</td><td>Clear</td></tr>
<tr><td>1</td><td>Free Run</td><td>DB</td><td>Clear</td></tr>
<tr><td>2</td><td>DB</td><td>Free</td><td>Clear</td></tr>
<tr><td>3</td><td>Free Run</td><td>Free</td><td>Clear</td></tr>
</table>
(DB: Activation of dynamic brake)
See also “ When Abnormality (Alarm) Occurs (Serve ON Command State)” of the timing chart, Preparations volume on page 41.</td></tr>
</table>

*1: Enabled only in the 2nd full-closed control

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
69	**Sequence at Servo-OFF**	0 – 7 [0]	–	• The parameter sets: 1) Driving conditions during deceleration or after stop 2) Processing to clear the deviation counter following Servo off (SRV-ON signal: CN X5 29-pin turns On ‡ Off). • A relationship between setting of Pr69 and driving conditions/deviation counter processing conditions is similar to that of Pr67 (Sequence at Main Power Off). • See also " Serve On/Off Operation When the Motor Stops" of the timing chart of Preparations volume on page 42.
6A	**Mechanical brake delay at motor standstill**	0 – 100 [0]	2ms	The parameter sets time till non-energization of motor (servo free) after the brake release signal (BRK-OFF) turns off (brake retained), at Serve Off while the motor stops. • In order to prevent minor movement/drop of the motor (work) due to operation delay time of the brake (tb): Setting of Pr6A ≧ tb. • See " Serve On/Off Operation When the Motor Stops" of the timing chart on page 42.  See also " Serve On/Off Operation When the Motor Stops" of the timing chart of Preparations volume on page 43.
6B	**Mechanical brake delay at motor in motion**	0 – 100 [0]	2ms	Unlike Pr6A, the parameter sets time till brake release signal (BRK-OFF) turns off (brake retained) after motor non-energization (servo-free), at Servo off while the motor is rotating. • This should be set to prevent deterioration of the brake due to revolutions of the motor. • At Servo off while the motor is rotating, time tb in the right figure will be either set time of Pr6B or time till the motor rotational speed falls below approximately 30r/min, whichever is smaller.  • See " Serve On/Off Operation When the Motor is Rotating" of the timing chart of on page 43. See also " Serve On/Off Operation When the Motor Stops" of the timing chart of Preparations volume on page 42.

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
6C	**External regenerative resister set up**	0 – 3	–	This parameter is set depending on whether to use regeneration resistance built in the driver, or to provide a regeneration resistance in the external (connect between RB1 and RB2 of connector CN X 2 in types A to D, and between terminal blocks P and B2 in types E - G). **<Request>** When you use an external regeneration, you must install external safeguards such as a temperature fuse, etc. Otherwise, as protection of regeneration resistance would be lost, causing abnormal heat generation and burnout. **<Caution>** Be careful not to touch an external regeneration resistance. While you are using an external resistance, it may become hot and scald you. For type A, only external regeneration resistance is used.
6D	**Main power-off detection time**	0 – 32767 [35]	2ms	The parameter sets time to detect shut-off when shut-off of main power supply continues.

Setting value	Regeneration Resistance to Use	Protection against Regeneration Resistance Overload
[0]	Built-in resistance	According to built-in resistance, (about 1% duty) protection against regeneration resistance overload works.
1	External resistance	This is activated with operating limits of the external resistance at 10% duty.
2	Built-in resistance	This is activated with operating limits of the external resistance at 100% duty.
3	External resistance	Regeneration resistance does not work, and a built-in condenser accommodates all regenerated power.

Parameters for Full-closed Control

Default setting is shown by [ ]

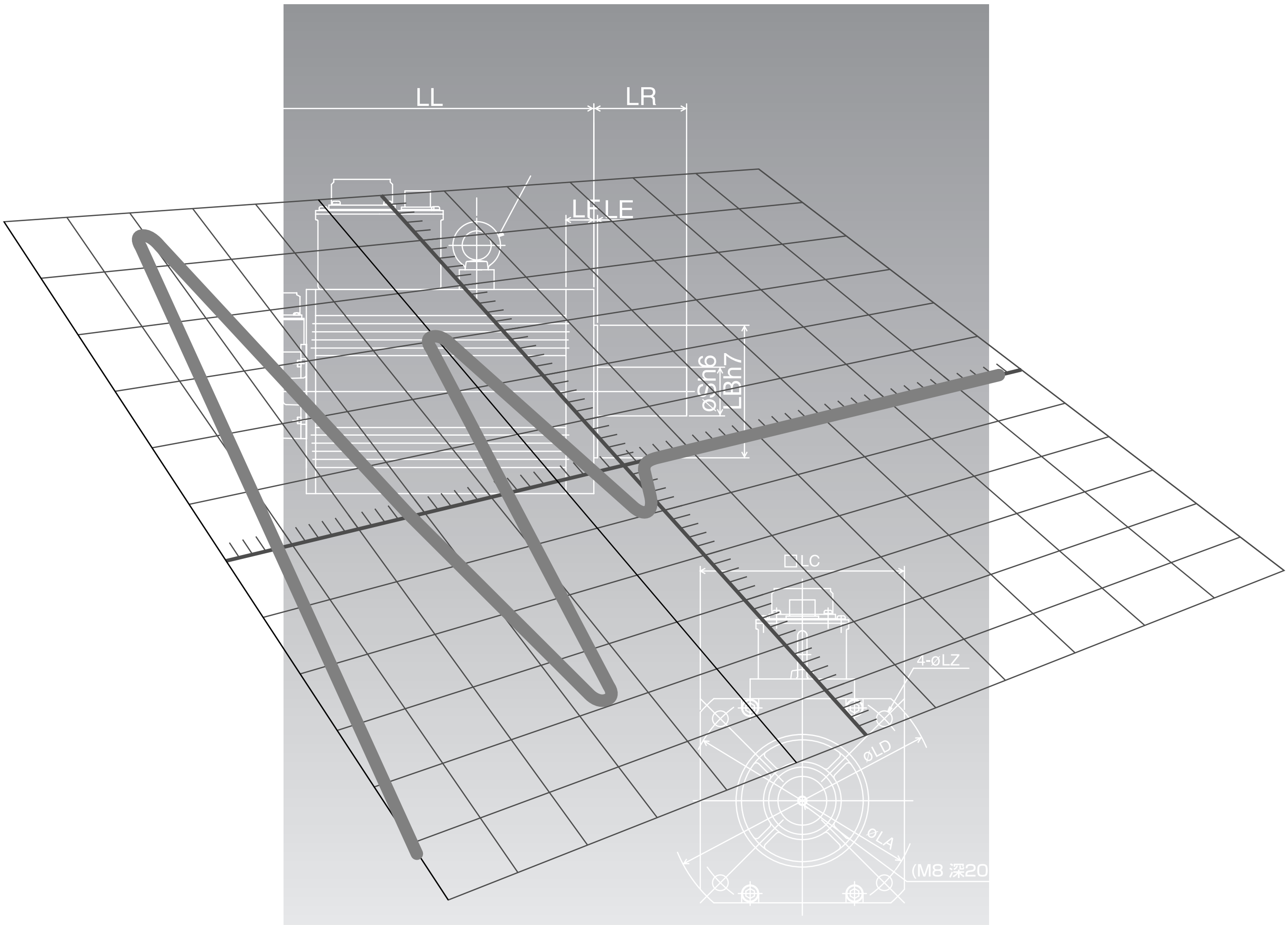
Parameter No.	Parameter Name	Setting range	Unit	Function/Description
70 *2	**Hybrid switching speed**	1 – 20000 [10]	r/min	• Speed for determining the timing of switching from ordinary semi-closed control to hybrid control after stoppage is set.
71 *2	**Hybrid shifting delay time**	0 – 10000 [0]	2ms	• When a status that the speed is less than a value set by Pr70 (hybrid switching speed) continues for a period longer than the time set by this parameter, the mode shifts to hybrid control.
72 *2	**Hybrid control period**	1 – 10000 [10]	2ms	• Cycle for adding correction pulse of the hybrid control is set.
73	**Hybrid error limit excess**	1 – 10000 [100]	Resolution of external scale	• Defines the allowable difference between the current motor position and the current position of the external scale, when an external scale is used for control.
74	**Numerator of external ratio**	1 – 10000 [1]	–	• Defines the numerator of the ratio of encoder pulse to external scale pulse. • The actual numerator is the nth power of the numerator of the external scale pulse ratio (Pr74) multiplied by 2. (n = Set value) • The upper limit of the actual numerator calculation is 131072. If the calculated value exceeds this limit, it becomes invalid, and the actual numerator is set to 131072. This parameter must be changed during Servo-OFF.

*2: Enabled only in the Hybrid control

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>75</td><td>Multiplier of numerator of external scale ratio</td><td>0 – 17
[17]</td><td>2^n</td><td>• Defines the numerator of the ratio of encoder pulse to external scale pulse.
• The actual numerator is the nth power of the numerator of the external scale pulse ratio (Pr74) multiplied by 2. (n = Pr75 Set value)
• The upper limit of the actual numerator calculation is 131072. If the calculated value exceeds this limit, it becomes invalid, and the actual numerator is set to 131072.
• This parameter must be changed during Servo-OFF.</td></tr>
<tr><td>76</td><td>Denominator of external scale ratio</td><td>1 – 10000
[10000]</td><td>–</td><td>• Defines the denominator of the ratio of encoder pulse to external scale pulse.
• This parameter must be changed during Servo-OFF.</td></tr>
<tr><td>77</td><td>Scale error cancel</td><td>0 – 3</td><td>–</td><td>• The parameter sets enable/disable of scale error input (X5 SC-ERR:33-pin) and EXZ input disconnection detection in full-closed control, hybrid control, external encoder control mode, and the 2nd full-closed control.
<table>
<tr><th>Setting value</th><th>SC-ERR</th><th>EXZ disconnection</th></tr>
<tr><td>0</td><td>Enabled</td><td>Enabled</td></tr>
<tr><td>[1]</td><td>Disabled</td><td>Enabled</td></tr>
<tr><td>2</td><td>Enabled</td><td>Disabled</td></tr>
<tr><td>3</td><td>Disabled</td><td>Disabled</td></tr>
</table></td></tr>
<tr><td>78</td><td>Pulse output selection</td><td>0 – 1
[0]</td><td>–</td><td>• In full-closed control, hybrid control, external encoder control, or 2nd full-closed control mode, original signal for the pulse output signal (X5 0A+: 21-pin, 0A-: 22-pin, 0B+: 48pin, 0B-: 49-pin) is selected.
0: External scale (EXA, EXB, EXZ-phase) 1: Encoder (A, B, Z-phase)
In a control mode other than the above, this parameter is disabled and encoder (A, B, Z-phase) outputs pulses.</td></tr>
<tr><td>79</td><td>Numerator of external scale pulse output ratio</td><td>1 – 10000
[10000]</td><td>–</td><td>• Defines the numerator of the pulse output scale ratio when Pr78 (Pulse output selection) is set to "0".
• Set up this parameter so that the scale ratio is "1" or less.</td></tr>
<tr><td>7A</td><td>Denominator of external scale pulse output ratio</td><td>1 – 10000
[10000]</td><td>–</td><td>• The parameter sets a denominator of division ratio of pulse output when Pr78 pulse output selection is 0.
• Set up this parameter so that the scale ratio is "1" or less.</td></tr>
<tr><td>7B
*1</td><td>Torsion correction gain</td><td>–2000
– 2000
[0]</td><td>1/s</td><td>• Difference (torsion amount) between the motor and load position is filtered through a high-pass filter detemined by Pr7C; and the obtained value is multiplied by this gain and is sbtracted from the speed command.
Note) When using Pr7B, set Pr7D and Pr7E to 0.</td></tr>
<tr><td>7C
*1</td><td>Torsion/ Differential speed detection filter</td><td>0 – 255
[0]</td><td>3.7Hz</td><td>• Defines the high-pass filter's response to the torsion multiplied by the Pr7B set value, and the low-pass filter's response to the differential speed multiplied by the Pr7E set value.
0: Disabled 1 to 255: Enabled
• The filter's cutoff frequency is (Set value x 3.7 [Hz]).</td></tr>
<tr><td>7D</td><td>Torsion feedback gain</td><td>–2047
– 2047
[0]</td><td>–</td><td>• Difference (torsion amount) between the motor and load position is multiplued by this gain/256; and the obtained value is added to the torque command (2000 = rated torque).
Note) When using Pr7D and Pr7E, set Pr7B to 0.</td></tr>
<tr><td>7E</td><td>Differential speed feedback gain</td><td>–2047
– 2047
[0]</td><td>–</td><td>• Difference (differential speed) between the motor and load speed is filtered through a low-pas filter determined by Pr7C; and the obtained value is multiplied by this gain/2 and is added to torque command (2000 = rated torque).
Note) When using Pr7D and Pr7E, set Pr7B to 0.</td></tr>
</table>

*1: Enabled only in the 2nd full-closed control
*2: Enabled only in the Hybrid control



[Adjustments]

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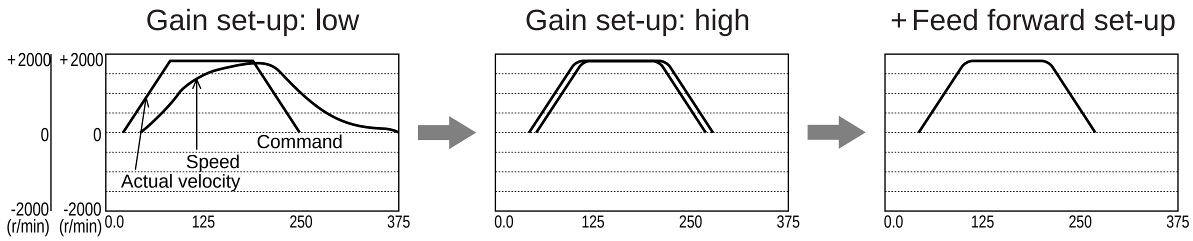
Gain tuning

Gain Adjustment

Purposes of

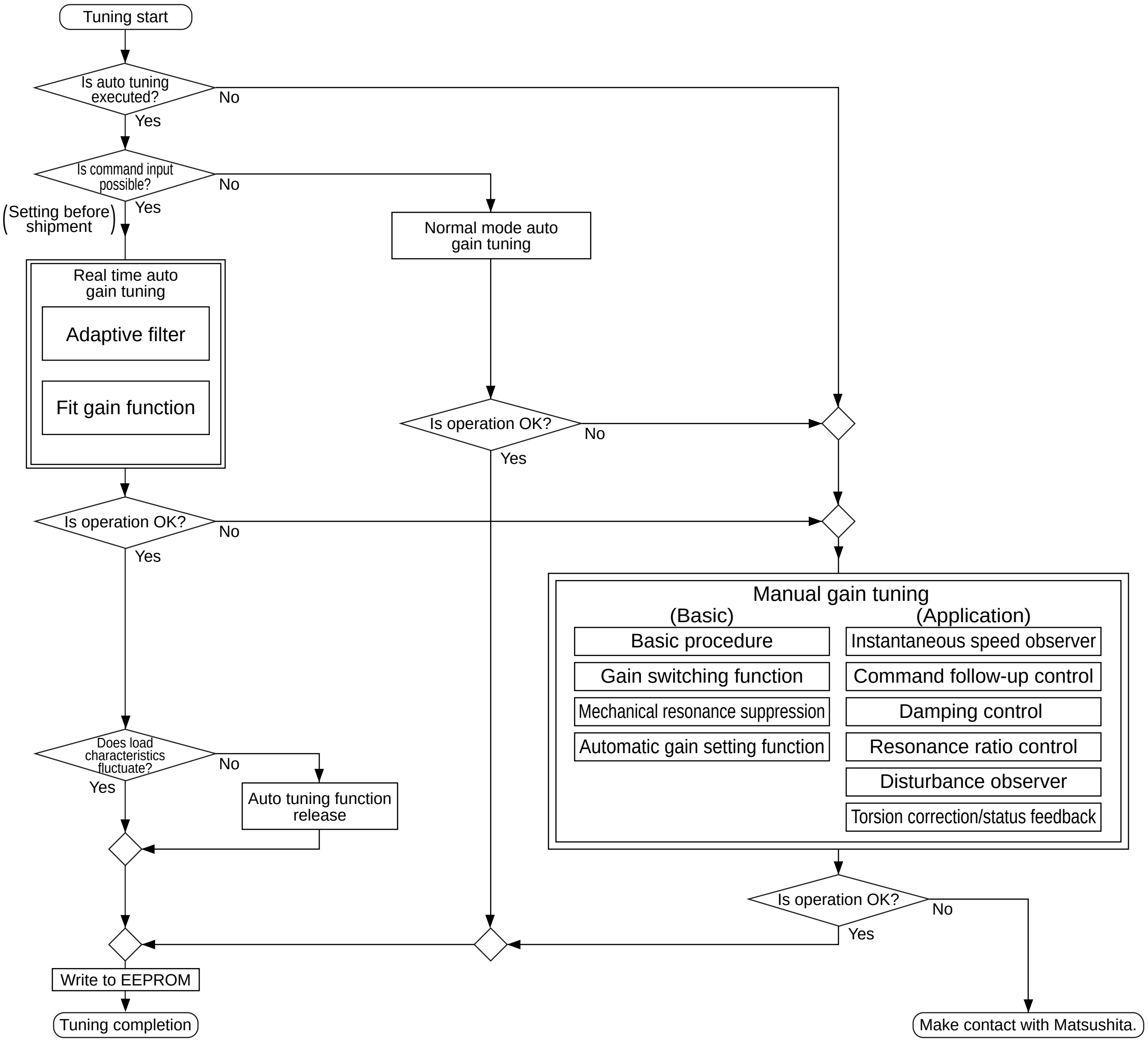
The motor is required to act per any command without any time delay, or without missing any commands. To provide the motor operation more resemble to the command pulse and obtain the best performance of the machine, perform gain adjustment.

<Example: ball screw>



Position loop gain	: 20	Position loop gain	: 100	Position loop gain	: 100
Speed loop gain	: 100	Speed loop gain	: 50	Speed loop gain	: 50
Speed loop integration time constant	: 50	Speed loop integration time constant	: 50	Speed loop integration time constant	: 50
Speed feed forward	: 0	Speed feed forward	: 0	Speed feed forward	: 50
Inertia ratio	: 100	Inertia ratio	: 100	Inertia ratio	: 100

How to Adjust Gain



Function			Description	Refaerence Page
Automatic tuning	Real time automatic gain tuning		This function estimates machine's load inertia in real time, and automatically specifies the optimum gain according to the result.	P.188
		Adaptive filter	This function estimates resonance frequency from the frequency component appearing in motor speed in actual operating condition, and reduces vibration at resonance point by automatically specifying the coefficient of the notch filter that eliminates resonance component from torque command.	P.189
		Fit gain function	To improve accuracy of real-time automatic gain tuning for position control, this function automatically searches for the gain that provides the shortest stabilization time when operation of a specified pattern is repeatedly input.	P.190
	Normal mode automatic gain tuning		When the motor is operated based on a command pattern automatically generated by the driver, this function estimates load inertia from the torque required for the operation, and automatically specifies the optimum gain.	P.193
	Disabling of auto tuning function		This function indicates precautions for executing real-time automatic gain tuning with default settings, or for disabling the adaptive filter.	P.196
Manual tuning	Manual gain tuning (Basic)		If automatic gain tuning cannot be executed because of limitation on control mode or load condition, or to ensure the maximum response according to each load, manual tuning should be executed.	P.197
		Basic procedure	For position control	P.198
			For speed control	P.200
			For torque control	P.200
			For full-closed control	P.201
			For hybrid control	P.201
		Gain switching function	By switching gain based on internal data or external signal, this function can reduce vibration at stop, shorten stabilization time, and improve command follow-up performance.	P.202
		Mechanical resonance suppression	When mechanical stiffness is low, resonance due to axial torsion may generate vibration or sound, disabling higher gain setting. In such a condition, this function can suppress resonance by using two types of filters.	P.204
		Automatic gain setting function	This function initializes control parameter or gain switching parameter to the value defined depending on automatic tuning stiffness parameter before execution of manual tuning.	P.206
	Manual gain tuning (Application)		When specifications cannot be satisfied through basic tuning, the following application tuning functions are available to improve performance.	P.207
		Instantaneous speed observer	This function improves the speed detection accuracy by estimating the motor speed with a load model, to ensure balance between high response speed and reduction in vibration at stop.	P.207
		Command follow-up control	This control method maintains position error at nearly "0", and sets the positioning stabilizing time to "0" by improving position command follow-up performance through position integration and feedforward control.	P.208
		Damping control	When vibration occurs with the end of the machine, this function eliminates vibration frequency component from command to suppress vibration.	P.211
		Resonance ratio control	When resonance vibration occurs, this function estimates the axial torque between the motor and load, and corrects the motor torque so that the torsion can be reduced, thus lowering the resonance peak to suppress vibration.	P.212
		Disturbance observer	Using disturbance torque value estimated by the disturbance observer, this function reduces influence of disturbance torque to suppress vibration.	P.213
		Torsion correction/status feedback	Through addition or subtraction of encoder position and external scale position data with speed command or torque command, this function reduces the torsion between the motor and load to suppress vibration.	P.214

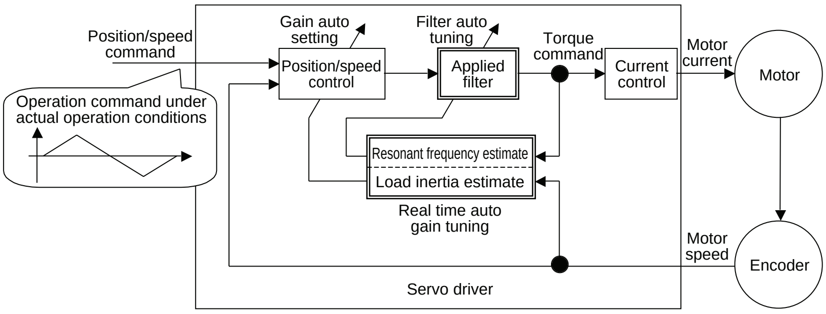
<Note>

- Pay extra attention to safety.
- If the machine enter to oscillation (abnormal sound and vibration) , shut off the power immediately, or change to Servo-OFF.

Real time auto gain tuning

Outline

Load inertia of the machine is estimated at real time, and the optimum gain is set up automatically based on the estimated result. A load, which has a resonance, also can be handled owing to the adaptive filter.



Real-time auto gain tuning is applicable to the following control modes:

Control Modes	Pr02= 0: Position control Pr02= 1: Speed control Pr02= 2: Torque control	Pr02= 3:Position/speed control Pr02= 4: Position/torque control Pr02= 5: Speed/torque control	Pr02= 6: Speed control Pr02= 10: Speed/semi-closed control

Application range

Under the following conditions, the real time auto gain tuning may not function properly.
In such case, use the normal mode auto gain tuning (see page 193 "Adjustments") or manual gain tuning(see page 197 "Adjustments").

	Conditions under which the real time auto gain tuning is prevented from functioning
Load inertia	• When the load inertia is smaller/larger than the rotor inertia (3 times or less; or 20 times or more) • When the load inertia fluctuates
Load	• When the machine stiffness is extremely low • When any unsecured part resides in such as backlash, etc.
Operation pattern	• In case of a continuous low speed operation under 100 [r/min] . • In case of soft acceleration/deceleration under 2000 [r/min] per 1 [s] . • When acceleration/deceleration torque is smaller than unbalanced load/viscous friction torque.

How to use

[1] Stop the motor (Servo-OFF).

[2] Set up Pr21 (Real-time auto tuning set-up) to 1 – 6.
Set up value before shipment is1.

Setting value	Real-time auto tuning	Changing degree of load inertia during operation	Adaptive filter
0	Not used	–	No
[1]	Used	Little change	Yes
2		Change slowly	
3		Change s haply	
4		Little change	No
5		Change slowly	
6		Change s haply	
7	Not used	–	Yes

When the degree of changes in load inertia is large, set 3 or 6 to Pr21.
When the influence of resonance is conceivable, select " adaptive filter YES" .

[3] Set 0 – 2 to Pr22 (machine stiffness at real-time auto tuning)

[4] Turn the servo ON to operate the machine ordinarily.

[5] To improve responsiveness, gradually increase Pr22 (machine stiffness at real-time auto tuning). When you encounter with any abnormal noise or oscillation, however, immediately reset it to a lower value.

[6] To store the result, write the data into the EEPROM.

Description of the adaptive filter

By setting Pr21 (Real-time auto tuning set-up) to 1 – 3 or 7, the adaptive filter is enabled.
In an actual operation state, resonance frequency is estimated based on the vibration component, which appears in motor speed, and resonance point vibration is reduced by removing resonance component from the torque command by the adaptive filter.
The adaptive filter may not function normally under the following conditions. In such a case, take anti-resonance measures using the 1 st . notch frequency (Pr1D and 1E) or second notch filter (Pr28 ~ 2A) in accordance with the manual tuning procedure.
For further information on the notch filter, refer to “ To Reduce the Mechanical Resonance” on page 204.

	Conditions under which the adaptive filter is prevented from functioning
Resonance point	• When the resonance frequency is 300 [Hz] or less • When resonance peak is low, or control gain is low; and its influence does not appear on the motor speed • When plural resonance points reside in
Load	• When a motor speed fluctuation having a high frequency component is caused due to a non-linear element such as backlash etc
Command pattern	• When acceleration/deceleration is too sharp like 30000 [r/min] or more per 1 [s]

Parameters, which are set up automatically

The following parameters are tuned automatically.

Parameter No.	Name
10	1st position loop gain
11	1st velocity loop gain
12	1st velocity loop integration time constant
13	1st speed detection filter
14	1st torque filter time constant
18	2nd position loop gain
19	2nd velocity loop gain
1A	2nd velocity loop integration time constant
1B	2nd speed detection filter
1C	2nd torque filter time constant
20	Inertia ratio
2F	Adaptive filter frequency

In addition, the following parameters are also automatically set.

Parameter No.	Name	Set value
15	Velocity feed forward	300
16	Feed forward filter time constant	50
17	1st position integration gain	0
1F	2nd position integration gain	0
27	Disturbance torque observer filter selection	0
30	2nd gain action set-up	1
31	Position control switching mode	10
32	Position control switching delay time	30
33	Position control switching level	50
34	Position control switching hysteresis	33
35	Position loop gain switching time	20
36	Speed control switching mode	0
3A	Torque control switching mode	0

Caution

[1] Immediately after the first turning the servo ON at start up, or when Pr22 (Machine stiffness at real-time auto tuning) is stated up, sometimes a noise or vibration may be generated until the load inertia is determined or the adaptive filter is stabilized. But, when the machine gets stabilized soon, there is no problem. But, when such problem as vibration or noise continues during a period of 3 reciprocal operations, etc occurs frequently, take the following measures.

1) Write the parameter of normal operation into the EEPROM.
2) Decrease the Pr22 (Machine stiffness at real-time auto tuning).
*3) Once set up Pr21 (Real-time auto tuning set-up) to 0 to disable the adaptive filter. Then, enable the real time auto tuning again. (resetting of inertia estimate adaptive operation)
*4) Set up the notch filter manually.

* When disabling he real time auto tuning, see page 196 "Disabling of auto tuning function" in Adjustments.

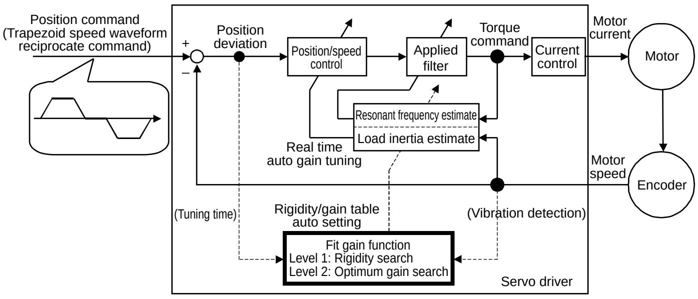
[2] After a noise or vibration has occurred, Pr20 (Inertia ratio) and/or Pr2F (Adaptive filter frequency) may have been changed into an extreme value. In such a case also, take the above measures.

[3]Among results of real-time auto gain tuning, Pr20 (Inertia ratio) and Pr2F (Adaptive filter frequency) are programmed into EEPROM every 30 minutes. When you turn on the power again, auto tuning will be executed using the data as initial value.

Real time auto gain tuning

Fit gain function

Outline



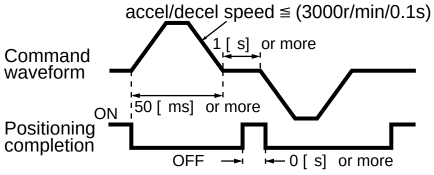
The MINAS-AIII series is equipped with the fit gain function, whereby optimization fitted to devices is further conducted when real-time auto gain tuning is used in position control. Through repetition of certain reciprocal operations in position control, optimal gain setting will be searched full automatically.
In the fit gain function, a user can select 2 ways of searching. In level 2 (stiffness) search, gain will be further fine-tuned so that the shortest settling time will be achieved, after automatic search of optimal real-time stiffness No. with less vibration.

Level 1 Search ⟶ Real-time Stiffness No. Search

Level 2 Search ⟶ Real-time Stiffness No. Search + Fine-tuning of Optimal Gain

Applicable range

This function cannot be applied unless the following conditions, in addition to those for applying real-time auto gain tuning conditions, are met.

	Conditions under which the fit gain function works.
Real time auto gain tuning operation	Real time auto gain tuning works normally.
Control mode	• Position control mode or semi-closed control mode is selected. Pr02 = 0: Position control Pr02 = 3: First control mode of position/speed control Pr02 = 4: First control mode of position/torque control The 2nd control mode of Pr02 =6 or Pr02=10: Semi-closed control • Position command that performs reciprocate operation.
Operation pattern	• One position control should continue for 2 revolutions of the motor or longer. • Period of one position command is 50 [ms] or more. • Time interval from completion of a position command to a next position command should be 1[s] . • Acceleration/deceleration should be not more than 3000r/min/0.1s. • The lowest frequency of a position command should be 1 [kpps] or more. (Necessary for starting and ending of a command) 
Others	• Should be servo ON state.

Before Use

Before starting the fit gain function, set the following with parameter set mode on the front panel or setup assisted software " PANATERM®" :

Parameter	Set value	Remarks
Pr21 (Real-time auto tuning mode setting)	Any of 1 to 3: 1: Almost no change in load inertia and the adaptive filter enabled. 2: Moderate change in load inertia and the adaptive filter enabled. 3: Sharp change in load inertia and the adaptive filter enabled.	The parameters shown to the left can also be set in execution display of the real-time auto gain tuning screen on the front panel. (See page 63)
Pr22 (Real-time auto tuning machine stiffness selection)	0: Real-time stiffness No.0	
Pr23 (Fit gain function mode setting)	1: Level 1 (stiffness) search 2: Level 2 (optimal gain) search	
Pr23 (Positioning completion range)	In the case of a 17-bit encoder, it shall be 20 pulses or more. In the case of a 2500 P/r encoder, it shall be 10 pulses or more.	

Operating Instructions

Operating Procedures

1) Change the display on the front panel to execution display of real-time auto gain tuning screen. (For details on manipulations on the front panel, see pages 57 and 65.)

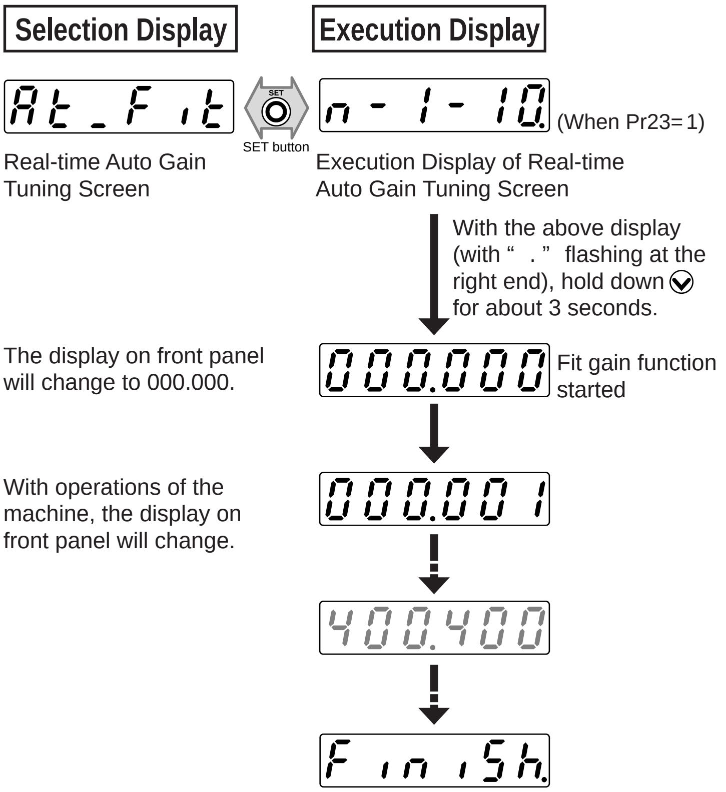
2) Holding down ⌄ on the front panel for about 3 seconds, start the fit gain function.
3) Give a position command that satisfies operating pattern condition of scope on page 190.

(Caution 1)
In the fit gain operation, there will be about 50 reciprocal operations at the maximum in level 1 search, and about 250 operations at the maximum in level 2 search. Normally, the fit gain function ends when searching of optimal real-time stiffness No. and fine-tuning of gain are completed.

4) When the fit gain function normally ends, Error. appears. If it abnormally ends, FinISh. is displayed. (You clear display of Error. through manipulation of some key.)

(Caution 2)
Error. is displayed in the following cases:
Level 1 search: Real-time stiffness No. with no vibration and minor vibration could not be found.
Level 2 search: Settling time has not fallen below 1 second.
Others: There was key manipulation on the front panel during fit gain operation, or conditions for application were not met.

Example of Display on Front Panel



(When Pr23= 1)

Real-time Auto Gain Tuning Screen

Execution Display of Real-time Auto Gain Tuning Screen

With the above display (with “ . ” flashing at the right end), hold down ⌄ for about 3 seconds.

The display on front panel will change to 000.000.

Fit gain function started

With operations of the machine, the display on front panel will change.

Result of Fit Gain

When the fit gain function normally ends, data on real-time stiffness No. and gain will be saved in Pr24 (fit gain function tuning result). If you wish to apply the result obtained through fit gain after power reset, program it into EEPROM (See the description below).
If you do not apply the result, program into EEPROM after clearing the fit gain result with the following procedures:

[Execution Display] Programming or Clearing Result on Real-time Auto Tuning Screen

n.- 1 - 10

If you hold down ⌄ on the front panel for about 3 seconds with “ n.” displayed, fit gain result and current setting will be programmed into EEPROM.
If you hold down ⌃ on the front panel for about 3 seconds with “ F.” displayed, fit gain result will be cleared (Set “ 0” to Pr23).

Real time auto gain tuning

Parameters, which are set up automatically

The following parameters
are tuned automatically.

Parameter No.	Name
10	1st position loop gain
11	1st velocity loop gain
12	1st velocity loop integration time constant
13	1st speed detection filter
14	1st torque filter time constant
18	2nd position loop gain
19	2nd velocity loop gain
1A	2nd velocity loop integration time constant
1B	2nd speed detection filter
1C	2nd torque filter time constant
20	Inertia ratio
22	Machine stiffness at auto tuning
2F	Adaptive filter frequency
33	Position control switching level
34	Position control switching hysteresis

In addition, the following parameters
are also automatically set.

Parameter No.	Name	Set value
15	Velocity feed forward	300
16	Feed forward filter time constant	50
17	1st position integration gain	0
1F	2nd position integration gain	0
27	Disturbance observer filter setting	0
30	2nd gain action set-up	1
31	Position control switching mode	10
32	Position control switching delay time	30
35	Position loop gain switching time	20
36	Speed control switching mode	0
3A	Torque control switching mode	0

Cautions

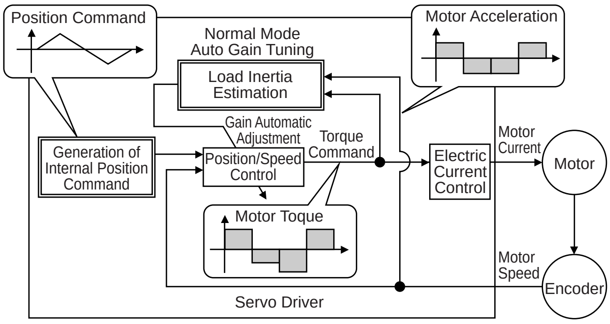
During fit gain operation, some sound or vibration may be generated. Normally, they will cause no problem, because gain will be lowered automatically. However, sound or vibration continues, press any button on the front panel to suspend fit gain.
In addition, if abnormal behavior occurs after execution fit gain, change Pr23 (fit gain function mode setting) to “ 0” (disable) or clear the result of fit gain on the fit gain screen.

Nomal mode auto gain tuning

Fit gain function

Outline

The motor is operated using a command pattern, which is automatically generated by the driver to estimate the load inertia based on the required torque, and proper gain is set up automatically.



Applicable range

This function operates under the following conditions:

	Conditions under which the nomal auto gain tuning works.
Control mode	• Control mode set-up (Pr02) is any one of the following conditions. Pr02 = 0: Position control Pr02 = 1: Speed control Pr02 = 2: Torque control Pr02 = 3: Position /speed control Pr02 = 4: Position /torque control Pr02 = 5: Speed /torque control The 2nd control mode of Pr02= 6 or Pr02= 10: Semi-closed control
Others	• Servo-ON status • Deviation counter clear signal is not inputted.

Cautions

Under the following conditions, normal mode auto gain tuning may not function normally.
In such case, set up the data in manual gain tuning mode.

	Conditions under which normal mode auto gain tuning is prevented from functioning.
Load inertia	• Load inertia is smaller/larger than the rotor inertia (Less than 3 times, or larger 20 times) • Load inertia fluctuates
Load	• Extremely low machine stiffness • Unsecured part such as backlash etc resides in

- When an error, servo-OFF or deviation counter clear has occurred during auto gain tuning operation, it results in a tuning error.
- Even when the auto gain tuning has carried out, when it has failed in estimating the load inertia value, the gain value is not changed and the previous data remains as it was.
- Motor output torque during auto gain tuning operation is permitted up to the maximum output torque that has been set up by Pr5E (torque limit set-up), and CW/CCW drive prohibition input is ignored.

Be very careful of the safety. If vibration occurs, turn OFF the power or the servo promptly, and return the gain to the set value before shipment with the parameter.

Nomal mode auto gain tuning

Auto gain tuning operation

[1] In the normal mode auto tuning, the response performance is set up by means of machine stiffness number.

> Machine stiffness numbers
> - Machine stiffness numbers are for setting the degree of machine stiffness of the user machine. Setting range is 0-15.
> - A machine, which has higher machine stiffness, allows setting a larger value to obtain a higher gain.
> - Usually, repeat auto gain tuning by increasing stiffness No. in ascending order and stop it when you reach a level in which no oscillation/abnormal noise/vibration will be generated.

[2] Operation pattern set by Pr25 (normal mode auto tuning set-up) is repeated up to 5 cycles. Operation acceleration increases by 2 times per 1 cycle from the third cycle. Depending on the load status, the operation may be terminated without performing 5 cycles, or the operation acceleration may not change. It is not an error.

How to oprate

[1] Set the operation pattern to Pr25.

[2] Move the load to a position where is safe even when the motor performs a operation pattern set up by Pr.25.

[3] Prohibit the command.

[4] Turn the servo ON.

[5] Start the auto gain tuning operation.
Start the operation using the front panel or PANATERM®.
For operating instructions of the front panel, refer to the next page.

[6] Adjust the machine stiffness number so that a desired response is obtained within a level in which any vibration does not occur.

[7] When no problem is found in the result, write the data into the EEPROM.

Parameters, which are set up automatically

The following parameters are tuned automatically.

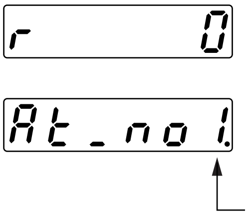
Pr No.	Name
Pr10	1st position loop gain
Pr11	1st velocity loop gain
Pr12	1st velocity loop integration time constant
Pr13	1st speed detection filter
Pr14	1st torque filter time constant
Pr18	2nd position loop gain
Pr19	2nd velocity loop gain
Pr1A	2nd velocity loop integration time constant
Pr1B	2nd speed detection filter
Pr1C	2nd torque filter time constant
Pr20	Inertia ratio

The following parameters are also set up to the following fixed values automatically.

Pr No.	Name	Set value
Pr15	Velocity feed forward	300
Pr16	Feed forward filter time constant	50
Pr17	1st position integration gain	0
Pr1F	2nd position integration gain	0
Pr30	2nd gain action set up	1
Pr31	Position control switching mode	10
Pr32	Position control switching delay time	30
Pr33	Position control switching level	50
Pr34	Position control switching hysteresis	33
Pr35	Position loop gain switching time	20
Pr36	Velocity control switching mode	0
Pr3A	Torque control switching mode	0
Pr7B	Torsion correction gain	0
Pr7C	Torsion and Differential speed detection filter	0
Pr7D	Torsion feedback gain	0
Pr7E	Differential speed feedback gain	0

Operation on front panel

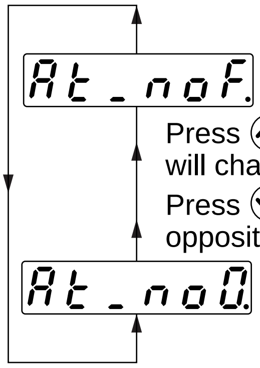
1) Select the Normal Auto Gain Tuning Mode.
Press SET button once and press MODE switching button three times.
See page 56 "Operating procedure" in Preparations.



Motor speed display (initial display)

Mechanical stiffness value

2) Press ∨ or ∧ button to select the stiffness of the machine.



Mechanical stiffness (higher)

Press ∧ , and machine stiffness No. will change in the arrow direction.
Press ∨ , and it will change in the opposite direction.

Mechanical stiffness (lower)

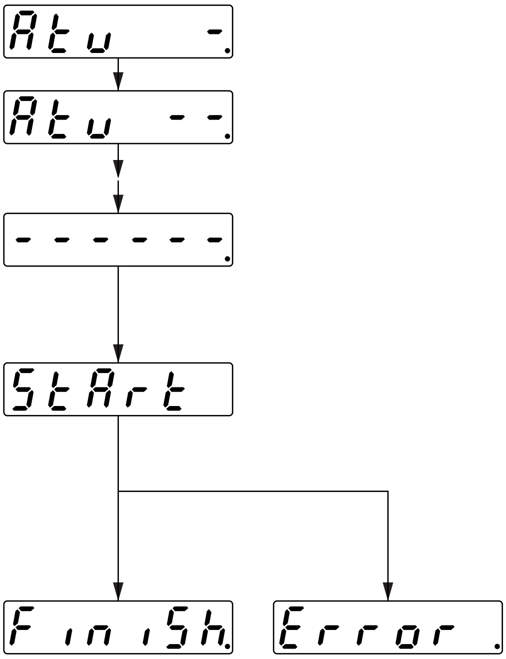
Driving method	Machine Stiffness No.
Ball screw direct connection	8 – 14
Ball screw + timing belt	6 – 12
Timing belt	4 – 10
Gear, or rack & pinion	2 – 8
Other machines with low stiffness	2 – 8

3) Press SET ◎ button to turn to the monitor/execution mode.

4) Operation at the monitor/execution mode:
Keep pressing ∧ button until  appears.
- The connector CN X5 29-pin is in servo ON state.
- Pr1D (notch frequency) is set to 1500.

Keep pressing ∧ button
(approx. three seconds).
The horizontal bar increases as shown in the right figure.

The motor has started rotating.
Then, for about 15 seconds, the motor rotates twice in CCW/CW directions, which will be regarded as one cycle. The motor rotates up to 5 cycles. Even when it stops before reaching 5 cycles, it will not be abnormality.



5) Program a gain value into EEPROM so that it will not be lost during shutoff of the power source.

<Caution>
DDo not use the motor driver alone for normal mode auto gain tuning. Pr20 (inertia ratio) will be 0.

<Notes>

Symptom	Cause	Remedy
Error message displayed	Either one of Alarm, Servo-Off or Position Error Counter Clear activated.	• Avoid operation near the limit switch or home position sensor. • Turn to Servo-ON. • Cancel the Position Error Counter Clear.
Values such as Pr10 related to gain, etc. remains same as a value before execution.	The load inertia cannot be calculated.	• Retry by changing Pr10 to 10, and Pr11 to 50. • Execute the manual adjustment.
Motor does not rotate	CL (30pin) of CN X5 is input.	• Turn on CL (30pin) of CN X5.

Disabling of auto tuning function

Outline

Following are the points to note when you disable real-time auto gain tuning of factory setting or adaptive filer.

Cautions

When you disable the auto adjustment function, do so while the motor stops its operation (servo off).

Disabling of the real time auto gain tuning

By setting Pr21 (Real-time auto tuning set-up) to 0 or 7 (adaptive filter only enabled), the auto estimate of Pr20 (Inertia ratio) is terminated and the real time auto gain tuning is disabled.
(However, this change will become valid once the servo turns OFF and then ON again.)
In case that the parameter get an apparently incorrect value due to the remaining estimate result of Pr20 (Inertia ratio), set up an appropriate value manually using the normal mode auto tuning or calculating the value.

Disabling of the adaptive filter

By setting Pr21 (real-time auto tuning set-up) to 0 or to 4-6 (real time auto gain tuning only enabled), the adaptive filter function, which automatically follows up the load resonance, stops.
If the adaptive filter is disabled during operating properly, influence of the suppressed resonance may appear resulting in a noise or vibration etc.
Therefore, when you disable the adaptive filter, on the fit gain screen of the front panel (refer to “ Fit Gain Screen” of Preparations volume on page 65), copy frequency of adaptive filter setting (Pr2F) to the 1st notch filter (Pr1D), and disable after suppressing resonance with the 1st notch filter (see page 65) or manually setting Pr1D (the 1st notch frequency) from Pr2F (adaptive filter frequency) by means of the table below.
However, when you execute copy function, Pr1E (first notch selection) will be set to "2".

Pr2F	The 1st Notch Frequency [Hz]
0	1800 (1499)
1	1731 (1499)
2	1666 (1499)
3	1602 (1499)
4	1541 (1499)
5	1482
6	1426
7	1372
8	1319
9	1269
10	1221
11	1174
12	1130
13	1087
14	1045
15	1005
16	967
17	930
18	895
19	861
20	828
21	796
22	766
23	737
24	709
25	682
26	656
27	631
28	607
29	584
30	562
31	540
32	520
33	500
34	481
35	462
36	445
37	428
38	412
39	396
40	381
41	366
42	352
43	339
44	326
45	314
46	302
47	290
48	279
49	269
50	258
51	248
52	239
53	230
54	221
55	213
56	205
57	197
58	189
59	182
60	175
61	169
62	162
63	156
64	150

* By executing the copy function when Pr2 Fis set up to 0-4, the frequency within the ( ) is set up

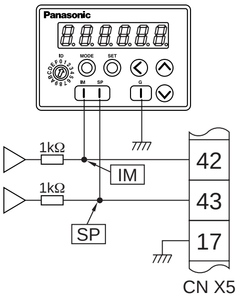
Manual gain turning (Basic)

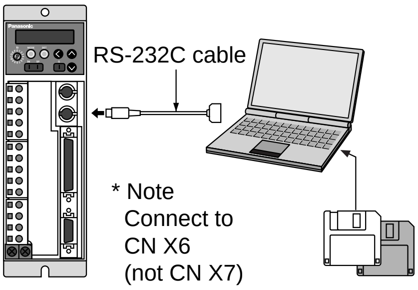
MINAS- AIII series provides the above d escribed auto gain tuning function. However, theremay be a case that fine tuning is required when it is failed to obtain a desired gain aftercarrying out the auto gain tuning due to the load conditions etc; or in a case that the optimumresponse performance or stability is required in accordance with the respective loads, and soon.
In this section, the steps of manual gain tuning will be described on each control mode andfunction.

Before Adjustment

Although adjustment is possible with the motor (machine) behavior or sound, you can achieve quick and reliable adjustment by observing analog waveforms using the monitor function.

1. Analog Monitor Output
   You can measure motor actual speed, command speed, torque and number of deviation pulses by using the oscilloscope at analog voltage level. Use Pr07 (speed monitor selection) and Pr08 (torque monitor selection) to set a type of signal to be output or output voltage level.
   For further information, refer " Wiring to Connector CN X5" and " Parameter Settings" for each control mode.
2. Waveform Graphic Function of PANATERM®
   You can measure command to the motor and behavior of the motor (speed, torque, and deviation pulse) as waveforms on the display of personal computer. For details, refer to " Outline of Setup Assisted Software PANATERM®" of Reference volume on page 236.





* Note
Connect to
CN X6
(not CN X7)

Guidance Values of Gains, and How to Adjust

See the table below for the guidance values of gains, if the inertia ratio has been set correctly.

Machine	Position loop gain Pr10	Speed loop gain Pr11	Speed loop integration time constant Pr12
Ball screw	100	50	50
Timing belt	50	25	50
Rack & pinion	50	25	200 – 500

Adjust the
1) Speed loop gain Pr11.
2) Position loop gain, Pr10 ≦ 2 x speed loop gain Pr11 as guidance of operation.
3) Once the position loop gain Pr10 > 5 x speed loop gain Pr11, hunting or oscillation may occur.

<Note>

You cannot adjust the current loop gain.

Functions of Each Control Mode

In each control mode, you can use the functions listed in the following table:

Command	Control mode	Gain switching	Instantaneous speed observer	Command follow-up control	Vibration suppression control	Resonance ratio control	Disturbance observer	Torsion correction	Status FB
Position	Position	○			○		○		
	Semi-closed	○			○		○		
	Position for high-stiffness equipment	○	○	○			○		
	Position for low-stiffness equipment	○			○	○			
Speed	Speed	○					○		
	Speed forlow-stiffness equipment	○	○			○			
Torque	Torque	○							
Full closed loop	Full closed loop	○							
	Hybrid	○							
	External encoder								
	Second full-closed	○	○			○		○	○

Manual gain tuning (Basic)

Tuning of position control mode

Position control system of the MINAS-AIII series is as shown in the following block diagram (see page 72). In this section, the basic tuning procedure circled with double frame, in which parameter is used but gain switching is not used, will be described.

[1] Initial setting of parameter

Return the parameter to the preset value before shipment.

- In case that vibration occurs with the preset value before shipment, reduce the 1st speed loop gain (Pr11) and the 1st position loop gain (Pr10) by the same value.

[2] Setting of inertia ratio

Set up the inertia ratio (Pr20).

- When the inertia ratio (Pr20) has been obtained by the real time auto gain tuning, use the Pr20 set value as it is.
- When the inertia ratio is known by means of calculation etc, input the calculated value.
- When the inertia ratio is unknown, execute the normal mode auto gain tuning to measure the inertia. After the measurement, since the control gain also has been altered, return to the step [1] and carry out initial setting of the parameter.

[3] Upper limit search of speed loop gain

Increase the 1st speed loop gain (Pr11) by 10-increment.

- At this time, increase the 1st position loop gain (Pr10) also to the same value as the 1st speed loop gain (Pr11).
- When vibration begins to be generated, proceed to the step [4] Setting of notch filter.
- When vibration occurs, decrease the 1st speed loop gain (Pr11) promptly, and then decrease the 1st position loop gain (Pr10) to the same value as Pr11, and proceed to the step [4] .

[4] Setting of notch filter

Measure the vibration frequency of the torque command using the waveform graphic function or frequency characteristics measurement function etc of the monitor output / Set up support software PANATERM®.

- Based on the measured vibration frequency, carry out one of the steps (A)-(C).
- After the step above, since the upper limit of the 1st speed loop gain (Pr11) may have been change, carry out the step [3] again to check the upper limit.
  Compare the values before and after the above step, continue the tuning using the setting by which the 1st speed loop gain (Pr11) increases more largely.

(A) When the vibration frequency is 1.5 kHz or more

Set up a larger 1st. torque filter time constant (Pr14)

- For the absolute encoder (7-core 17-bit) , set up Pr14 to approx. 25; for the incremental encoder (5-core 2500P/r), set up Pr14 to approx. 63 as a reference target, increase the value until the vibration falls in allowable range.
- When the 1st torque filter time constant (Pr14) is set up too large, vibration of lower frequency may become large. In this case, reduce the value of the 1st speed loop gain (Pr11).

(B) When the vibration frequency is 600 Hz – 1500 Hz

Set up the 1st notch frequency (Pr1D) to the value of vibration frequency.

- When the vibration is not reduced, slightly change the value of Pr1D and 1E.
- Resonance peak can be measured using the frequency characteristic function of the set up support software PANATERM®. Set up the notch filter so as to reduce the resonance peak.
- When vibration of 600Hz or more is still generated, set up the 1st torque filter time constant (Pr14) to a larger value.

(C) When the vibration frequency is 400 – 600Hz

- Measure the resonance frequency using the frequency characteristic function etc of the set up support software PANATERM®.

Set up the 1st notch frequency (Pr1D) to the value of resonance frequency.

- Measure the frequency characteristics again and check that the resonance peak is reduced.
- When the resonance peak is not reduced, adjust the 1st notch width selection (Pr1E) and the 1st notch frequency (Pr1D) so that the resonance peak is reduced.
- As for vibration of which resonance peak is in low frequency and is lower than the anti- resonance frequency, set the 1st speed loop gain (Pr11) to a smaller value.
- When the resonance frequency falls in approx. 350 – 450 Hz, increase the value of the 1st speed loop gain (Pr11) and set the notch filter at a point that vibration begin to be generated. The vibration may be reduced.
- When the vibration is not reduced, disable the notch filter. Determine the value of the first speed loop gain as the upper limit value.

[5] Setting of torque filter time constant

When any operation noise is heard, gradually increase the value of the 1st torque filter time constant (Pr14).
To increase the response, gradually reduce the value of the 1st torque filter time constant (Pr14) and increase the value of the 1st speed loop gain (Pr11).

- As a reference value of the minimum value, it is recommended to set the value, for the absolute encoder (7-core 17-bit), to10; for the incremental encoder (5-core 2500P/r), to 25.

[6] Setting of 1st speed detection filter (Pr13)

To increase the response, gradually reduce the value of the 1st speed detection filter (Pr13) and increase the value of the 1st speed loop gain (Pr11).
In the case that high frequency noise is generated when the value of the 1st speed detection filter (Pr13) is reduced, measure the resonance frequency using the waveform graphic function etc of the Matsushita set up support software PANATERM® and adjust the notch filter in step [4] or the torque filter in step [5].

[7] Setting of 1st position loop gain (Pr10)

Input a value of approx. the value of the first speed loop gain (Pr11) x 1.5 to the 1st position loop gain (Pr10). Then, roughly set up the value of Pr10 so that the positioning setting time is shortened at a certain degree.

- To change the parameter, execute it at a timing of which positional deviation is small.

Manual gain tuning (Basic)

[8] Setting of 1st speed loop integration time constant (Pr12)

Lower the 1st speed loop integration time constant (Pr12) from the following initial values:

- We recommend that you use an initial value of Pr12=15000/(2p x Pr11).
- Lower Pr12 ≧ 30 by 10.
  Lower 30 > Pr12≧ 15 by 5.
  Lower Pr12< 15 by 1.
- By setting the first speed loop integration time constant to a smaller value, although it is possible to make the deviation at the positioning closer to 0, the time to reach to the stabilization range may become slower.
- In such a case, by setting the value of the 2nd speed loop integration time constant (Pr1A) during operation to 1000 (disabled) using the gain switching function, it may be increased.

[9] Setting of speed feed forward (Pr15)

Set the speed feed forward (Pr15) to 500 (300 – 700).

- When the value of the speed feed forward (Pr15), although the positional deviation during operation is reduced and the positional deviation after completion of command output is converged sooner, overshoot or vibration becomes to occur more frequently.
- When the operation noise has become larger after setting this parameter, set the feed forward filter setting (Pr17) and the smoothing filter setting (Pr4C) to a larger value respectively.

Tuning of speed control mode

Speed control system of the MINAS- AIII series is as shown in the f ollowing block diagram (see page 106). The tuning steps in speed control is almost the same as that of the position control mode in page 198. Excluding the setting of [7] position loop gain and [9] speed feed forward, follow the steps [1] – [6] and [8] t carry out the tuning.

Tuning of torque control mode

Torque control system of the MINAS-AIII series is as shown in the f ollowing block diagram (page 132). The torque control system is structured based on the speed control loop using Pr56: 4th internal speed as the speed limit. In this section, the setting procedure of the speed limit value will be described.

• Setting of speed limit value

Set up a speed limit value to the 4th Internal speed (Pr56)

- When the motor speed becomes closer to the speed limit value, the control is switched from the torque control mode, in which the control follows up the analogue torque command, to the speed control mode, in which the speed limit value depending on the 4th internal speed (Pr56) is used as the command.
- To obtain an stable operation in the speed limit mode, it is necessary to carry out control gain and filter setting in accordance with the tuning of the speed control mode described above..
- In the case that the speed limit value = 4th internal speed (Pr56) is too low, the speed loop gain is too low or the speed loop integration time constant is set up to 1000 (disabled), since the input to the torque limit shown in the above diagram becomes smaller, there may be a case that torque according to the analogue torque command is not obtained.

Tuning of full closed loop control mode

Full-closed control system of the MINAS-AIII series is as shown in the following block diagram (see page 159).
In the full-closed control mode, excluding the cautions (difference in command unit, unit conversion of the position loop gain is necessary and difference in command division scale ratio etc) as described in page 156 "Full-closed control", the tuning can be carried out by following the same steps as "Tuning of position control mode" in page 198.
In this section, the setting of the external scale ratio, the hybrid error and the hybrid control in the initial setting of the full-closed control will be described.

• Setting of external scale ratio

Set up the external scale ratio using the numerator of external scale ratio (Pr74), the multiplier of numerator of external scale ratio (Pr75) and the denominator of external scale ratio (Pr76).

- Check the number of encoder pulses per motor rotation and the number of external scale pulses per motor rotation, set up the numerator of external scale ratio (Pr74), multiplier of numerator of external scale ratio (Pr75) and denominator of external scale ratio (Pr76) so that the following formula is fulfilled.

$$\frac{\text{Pr74 } \boxed{1} \text{ x } 2^{\text{Pr75}\boxed{17}}}{\text{Pr74 } \boxed{5000}} = \frac{\text{Number of encoder pulses per motor rotation}}{\text{Number of external scale pulses per motor rotation}}$$

- If the ratio is incorrect, the difference between the position calculated from the encoder pulse and the position calculated from the external scale pulse is increased. Particularly, when it is driven a long distance, a hybrid error (Err25) occurs.

• Setting of hybrid error

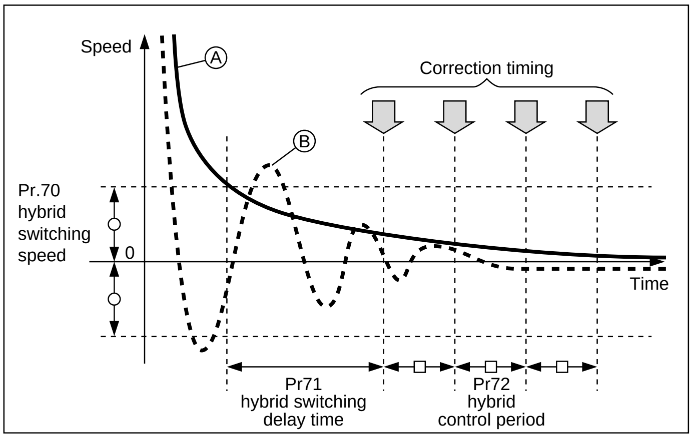
Set up the hybrid error (Pr73) in a range of minimum value in which the difference between the motor (encoder) position and the load (external scale) position is determined as " too-large" .

- Check an excessive hybrid error (Err.25) as in addition to the above-mentioned factor, reverse connection or loose connection between the motor and load, etc. may also cause it.

Setting for hybrid control

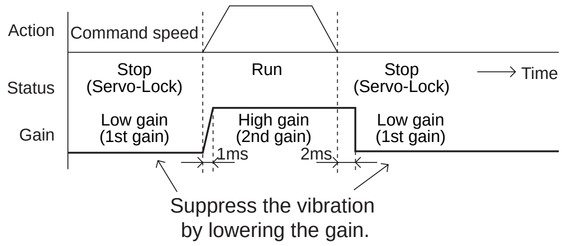
Setting for hybrid control at Pr02 = 8 is as shown in the block diagram below (see page 298).
In this section, the setting of hybrid correction switching will be described.

- Hybrid control is a control mode intended to ensure the response performance during operation and the external scale accuracy during a stop, in which, while constantly operating in semi-closed control mode, and after a motor stop, the difference between the external scale position and the encoder position is calculated at a specific period and is added to the position command as the correction command.
- In a state that the command pulse is not fed, as shown in the diagram below, from a point of time when a state of Pr70 (hybrid switching speed) or less has passed the point of Pr71 (hybrid shifting delay time), the above-described correction is applied at period of Pr72 (hybrid control period).
- The following diagram shows a case in which speed changes smoothlyⒶ. However, as a case ofⒷ, when the hybrid correction is applied before the vibration is converged, a large correction amount may cause vibration resulting in an oscillation adversely. In such a case, set up the Pr71(hybrid shifting delay time) longer to start the correction operation later.



Manual gain tuning (Basic)

Adjustment upon switching gain



You can set not only the 1st gain but also 2nd gain manually. You can utilize the function of switching from the 1st to 2nd gain in a machine with higher responsiveness.

<Example>

This is the example in which you reduce noise by switching to low gain setting after the motor stops (servo lock), when you feel uneasy about sound during stoppage of the motor.

Parameter No.	Parameter	Guideline	How to adjust
Pr10	1st position Loop Gain	Same as 2nd position loop gain	–
Pr11	1st speed loop gain	Same as 2nd speed loop gain	If the motor does not generate abnormal sound when it stops (servo lock), the parameter setting is acceptable. If the motor generates abnormal sound, reduce the set value.
Pr12	1st speed integration time constant	50	If the motor normally operates, the parameter setting is acceptable. Reducing the set value provides improved motor response. However, if the parameter setting is too low, oscillation occurs.
Pr13	1st speed detection filter	0	Fixed
Pr14	1st torque filter time constant	Same as 2nd torque filter constant	If the motor does not generate abnormal sound when it stops (servo lock), the parameter setting is acceptable. If the motor generates abnormal sound, change the set value.
Pr18	2nd position loop gain	50	If the motor normally operates, the parameter setting is acceptable. Increasing the set value provides improved motor response. However, if the parameter setting is too high, oscillation occurs.
Pr19	2nd speed loop gain	30	If the motor does not generate abnormal sound during operation, the parameter setting is acceptable. If the motor generates abnormal sound, reduce the set value.
Pr20	Inertia ratio		**Set up this parameter correctly at first.**
Pr30	2nd gain action set-up	1	–
Pr31	Position control switching mode	7	–
Pr1A	2nd speed integration time constant	1000	–
Pr1B	2nd speed detection filter	0	Fixed
Pr1C	2nd torque filter time constant	50	If the motor does not generate abnormal sound during operation, the parameter setting is acceptable. If the motor generates abnormal sound, change the set value.

Gain Switching Conditions

• Position Control Mode

(○: the parameter valid, – : invalid)

Gain switching conditions			Parameters for position control		
			Delay time * 1	Level	Hysteresis * 2
Pr31	Switching conditions	Figure	Pr32	Pr33	Pr34
0	Fixed to 1st gain		—	—	—
1	Fixed to 2nd gain		—	—	—
2	Gain switching input, 2nd gain selected with GAIN On		—	—	—
3	2nd gain selected with a large torque command differential	A	○	○*3 [0.05%/166μs]	○*3 [0.05%/166μs]
4	Fixed to 1st gain		—	—	—
5	Large target speed commanded	C	○	○[r/min]	○[r/min]
6	Large position error	D	○	○[pulse] *4	○[pulse] *4
7	Position command existing	E	○	—	—
8	Positioning incomplete	F	○	—	—
9	Speed	A	○	○[r/min]	○[r/min]
10	Presence of a command + speed	G	○	○[r/min] *6	○[r/min] *6

• Speed Control Mode

Gain switching conditions			Parameters for speed control		
			Delay time * 1	Level	Hysteresis * 2
Pr36	Switching conditions	Figure	Pr37	Pr38	Pr39
0	Fixed to 1st gain		—	—	—
1	Fixed to 2nd gain		—	—	—
2	Gain switching input, 2nd gain selected with GAIN On		—	—	—
3	2nd gain selected with a large torque command differential	A	○	○*3 [0.05%/166μs]	○*3 [0.05%/166μs]
4	2nd gain selected with a large speed command differential	B	○	○*5 [10(r/min)/s]	○*5 [10(r/min)/s]
5	Large speed command	C	○	○[r/min]	○[r/min]

- **Torque Control Mode**

Gain switching conditions			Parameters for speed control		
			Delay time * 1	Level	Hysteresis * 2
Pr3A	**Switching conditions**	**Figure**	**Pr3B**	**Pr3C**	**Pr3D**
0	Fixed to 1st gain		—	—	—
1	Fixed to 2nd gain		—	—	—
2	Gain switching input, 2nd gain selected with GAIN On		—	—	—
3	2nd gain selected with a large torque command differential	A	○	○*3 [0.05%/166μs]	○*3 [0.05%/166μs]

*1 Delay time (parameters Pr32, Pr37 and Pr3B) become effective when returning from 2nd gain to 1st gain.

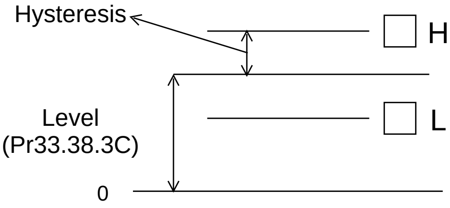
*2 For the definitions of hysteresis parameters (Pr34, Pr39 and Pr3D), see the right figure.

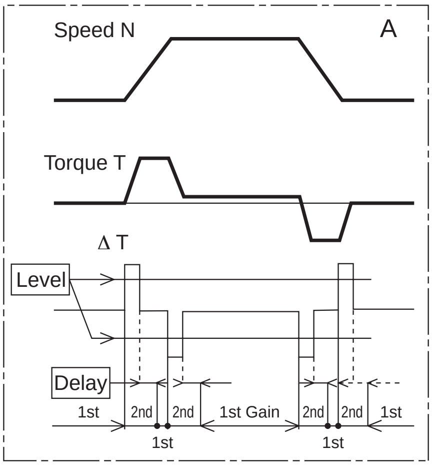
*3 Set the value 200 in the case that 10% torque-fluctuation happens within 166μs.
10% / 166μs = Setting value $\boxed{200}$ x [0.05% / 166μs]

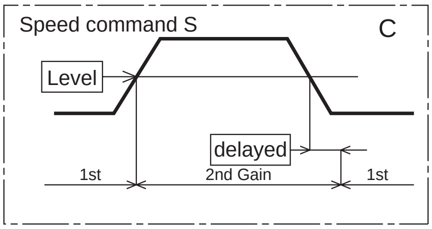
*4 Resolution of encoders

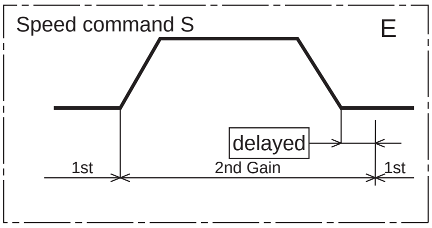
*5 Set the value 1 in the case that 10r/min speed changes within 1s.

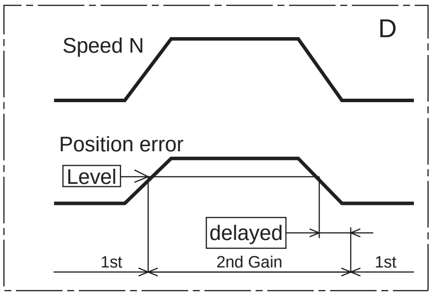
*6 When Pr31=10, delay time, level and hysteresis have different meaning than usual (See Figure G).

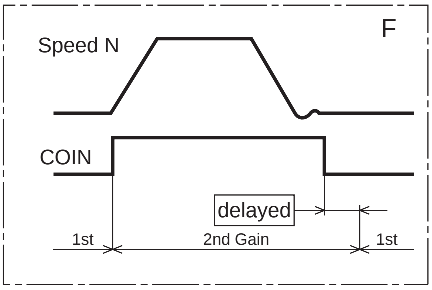


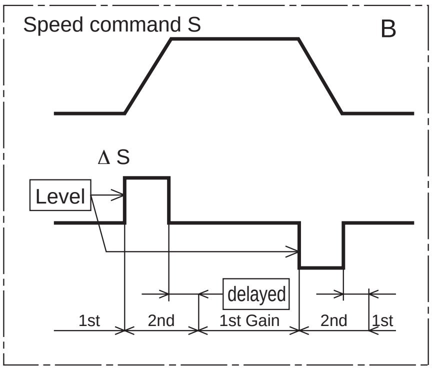


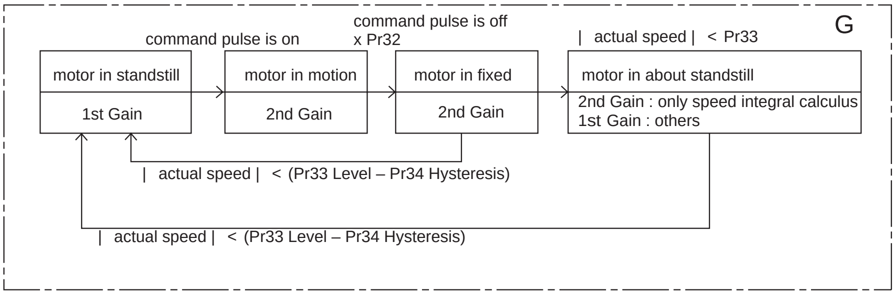












<Notes>

The figures above do not reflect the gain switching timing delay caused by hysteresis (parameters Pr34, Pr39 and Pr3D) .

Manual gain tuning (Basic)

To Reduce the Mechanical Resonance

If the machine is not stiff, vibration and noise may be generated due to the resonance by shaft torsion, which may interfere to set-up the higher gains. You can suppress the resonance by 2 types of the filters.

1. Torque command filter (Pr14 and Pr1C)

Set a filter time constant so that attenuation takes place around resonance frequency. You can determine cutoff frequency with the following expression:

Cutoff Frequency (Hz) fc = 1/(2p x parameter set value x 0.00001)

2. Notch filter

- Adaputive filter (Pr21 and Pr2F)

In MINAS-A III series, vibration at load that is difficult to accommodate with the conventional notch filter or torque filter, for instance, because a resonance point varies for every device can be controlled by using an adaptive filter. You can enable the adaptive filter by setting 1-3 or 7 to Pr21 (real-time auto gain tuning mode setting).

Pr21	Real time auto tuning set up	1~3 and 7 : adptive filter actived

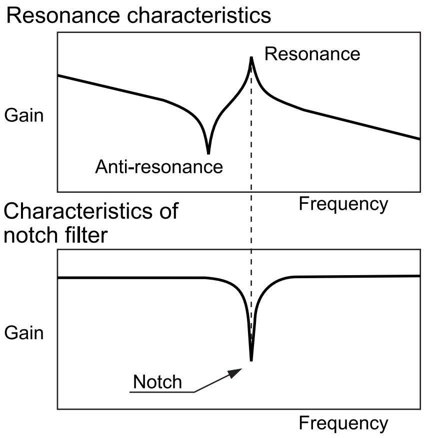
Pr2F	Adaptive filter frequency	disply the table number of adaptive filter frequency (can not change)

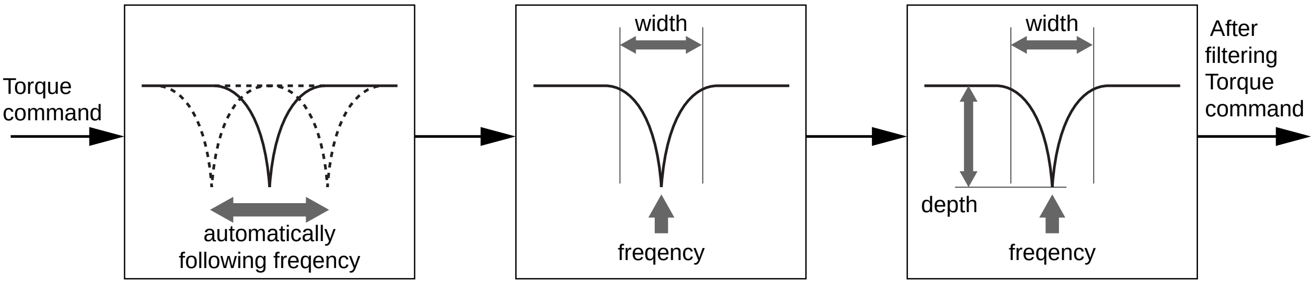
- 1st and 2nd notch filter (Pr1D, Pr1E, Pr28, Pr29 and Pr2A)

MINAS-AIII series is equipped with 2 normal notch filters: the 1st notch filter makes it possible to adjust frequency and width, while the 2nd notch filter makes it possible to adjust by frequency, width, and depth parameters.

Pr1D	1st notch frequency	Set this about 10% lower than the resonance frequency measured by the frequency characteristics analysis function of PANATERM®.
Pr1E	1st notch width selection	Setting by the resonance frequency characteristics.

Pr28	2nd notch frequency	Set this about 10% lower than the resonance frequency measured by the frequency characteristics analysis function of PANATERM®.
Pr29	2nd notch width selection	Setting by the resonance frequency characteristics.
Pr2A	2nd notch depth selection	



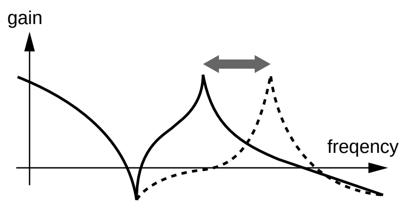


Adaptive filter
(Suppress resonance points in an instance)

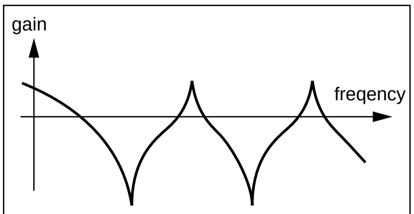
1st notch filter
(Present adaptive filter setting is copied to the first notch filter. (See page 196))

2nd notch filter
(Adjastable freqency, width and depth)

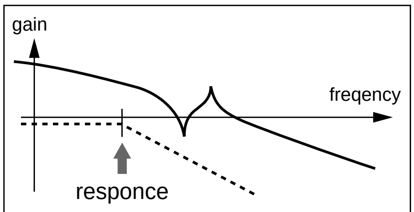
Applications



Machine chenges resonance points by difference of each machine or machine aging



Machine have some resonance points



Machine has a little peak near the responce point

How to measure the resonance frequency of a machine system

1) Log-on PANATERM® and open the frequency characteristics screen.
2) Set the following parameters and measuring conditions. Note that the values shown below are for reference only.
   - Decrease the value of Pr11 (1st speed loop gain) to 25 (to make the resonance frequency more distinguishable).
   - Set the amplitude to 50 r/min (so that the torque may not saturate).
   - Set the offset to 100 r/min. (to increase the amount of speed detection information, and run the motor in one-way rotation).
   - Polarities: (+) for CCW and (–) for CW.
   - Set the sampling rate to 1 (from a range between 0 and 7).
3) Start the frequency characteristics analysis function.

<Notes>

- Before starting the measurement, make sure that the machine does not move beyond the limit.
  Approximate speed = Offset (r/min.) x 0.017 x (Sampling rate + 1)
  With a larger offset value, good results can be obtained, though the speed becomes higher.
- Set-up Pr22 (Real time auto tuning mode set-up) to 0.

<Notes>

- Set-up the offset larger than the amplitude setting, and with one-way rotation so that you can obtain better results.

Relationship between Gain Adjustment and Mechanical Stiffness

To increase the mechanical stiffness,

1) The machine (motor load) should be firmly secured to a rigid foundation.
2) The coupling between the motor and machine should be designed with high stiffness for servo motors.
3) The timing belt should have a larger width. The tension of the timing belt should be adjusted according to the allowable axial load of the motor.
4) The gears should have a smaller backlash.
   - The inherent frequency (resonance) of the machine significantly affects the gain adjustment of the servo motor.

   If the machine has a lower resonance frequency (i.e. lower stiffness), you can't set the high response of the servo system.

Manual gain tuning (Basic)

Gain auto setting function

Outline

Gain auto setting function is for initializing the control parameter/gain switching parameter to a gain setting of the auto tuning corresponding to the stiffness before carrying out manual tuning.

Cautions

Before executing the gain auto setting function, terminate the operation.

How to use

Refer to “ Real-time Auto Gain Tuning Screen” of Preparations volume on page 65.

[1] Once stop the operation.

[2] Start gain automatic setting function on the real-time auto gain tuning screen.

[3] When gain automatic setting normally ends, Finish appears. If it abnormally ends, Error is displayed. (You can clear these displays through some key manipulation.)

Parameters, which are set up automatically.

The following parameters are tuned automatically.

Parameter No.	Parameters for position control
Pr10	1st position loop gain
Pr11	1st velocity loop gain
Pr12	1st velocity loop integration time constant
Pr13	1st speed detection filter
Pr14	1st torque filter time constant
Pr18	2nd position loop gain
Pr19	2nd velocity loop gain
Pr1A	2nd velocity loop integration time constant
Pr1B	2nd speed detection filter
Pr1C	2nd torque filter time constant
Pr20	Inertia ratio

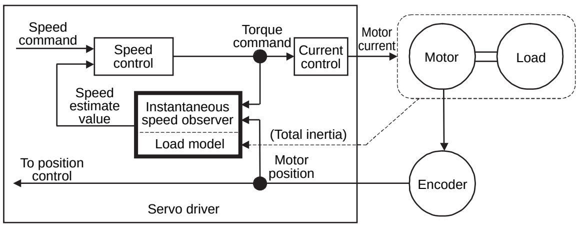
The following parameters are also set up to the following fixed values automatically.

Parameter No.	Parameters for position control	Set value
Pr15	Velocity feed forward	300
Pr16	Feed forward filter time constant	50
Pr17	1st position integration gain	0
Pr1F	2nd position integration gain	0
Pr30	2nd gain action set-up	1
Pr31	Position control switching mode	10
Pr32	Position control switching delay time	30
Pr33	Position control switching level	50
Pr34	Position control switching hysteresis	33
Pr35	Position loop gain switching time	20
Pr36	Speed control switching mode	0
Pr3A	Torque control switching mode	0
Pr7B	Torsion correction gain	0
Pr7C	Torsion and Differential speed detection filter	0
Pr7D	Torsion feedback gain	0
Pr7E	Differential speed feedback gain	0

Instantaneous speed observer

Outline

Instantaneous speed observer is a function in which the speed detection accuracy is increased by estimating motor speed using a load model to increase the response performance and to reduce the vibration after a stop.



Applicable range

This function is applicable under the following condition.

	Conditions under which the instantaneous speed observer functions
Control mode	• Any one of the position control for high-stiffness equipment, speed control forlow-stiffness equipment or second full-closed control. • The combined motor encoder shall be a 17-bit absolute/increment. Pr02 = 11: position control for high-stiffness equipment Pr02 = 13: speed control for low-stiffness equipment Pr02 = 14: second full-closed control

Cautions

Under the following conditions, the function may not work normally, or the intended effect may not be obtained.

	Conditions under which the effect of the instantaneous speed observer is prevented
Load	• Compared to the inertia load including the motor and load as a unit, error is too different from that of the actual equipment . • Example) A large resonance point resides in the frequency zone of 300 [Hz] or less; A non-linear factor such as large backlash etc resides in, and so on. • Load inertia changes • An external disturbance torque of large high frequency component is applied
Other	• Positioning setting range is too narrow

How to use

[1] Setting of inertia ratio (Pr20)

Set up an inertia ratio as precise as possible.

- When an applicable inertia ratio (Pr20) has been already obtained through the real time auto gain tuning during an ordinary position control etc, use it as the setting value of Pr20 as it is.
- When the inertia ratio is known via calculation etc, input the calculated value.
- When the inertia ratio is unknown, once change to the ordinary position control (Pr02 = 0) to carry out the normal mode auto gain tuning and measure the inertia.

[2] Tuning in ordinary position control

- See page 198 "Tuning of position control mode".

[3] Setting of the 1st/2nd speed detection filter (Pr13 and Pr1B)

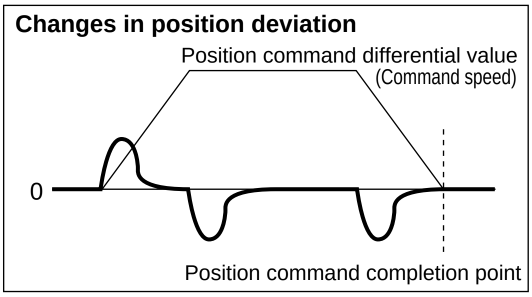
- Setting 6 to the 1st/2nd speed detection filter (Pr13 and Pr1B) switches the speed detection method to instantaneous speed observer.
- Then, if variations in torque waveforms or operating sound increases, immediately reset to original setting and recheck cautions and (1) described above.
- If some effects such as decreased torque waveforms variations or operating sound, etc., have been achieved, find setting where variations are minimized, by fine-tuning inertia ratio (Pr20) while observing position deviation waveforms or actual speed waveforms. In addition, since an optimal value of inertia ratio (Pr20) may change when you have made a change to a position loop gain or speed loop gain, execute fine-tuning again.
- If you use gain switching, change in ascending order of operating time of the 1st/2nd gain. As sound may be generated at timing of switching, select setting that is used for both as far as possible.

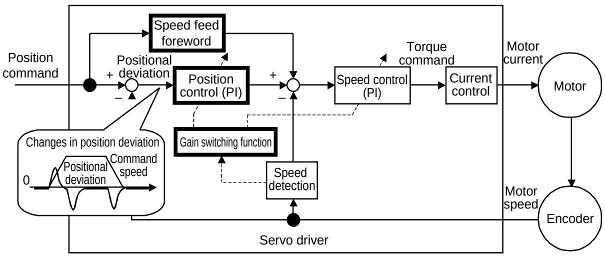
Manual gain tuning (Application)

Command follow-up control

Outline

Command follow-up control is a control mode in which, by utilizing the position integration function and the feed forward function, the follow-up performance to the position command is increased, and by controlling the position error so as to become close to 0, the stabilizing time is made zero.





Applicable range

This function is applicable to the following condition.

	Condition under which the command follow-up control functions
Control mode	• Position control for high-stiffness equipment • The combined motor encoder shall be a 17-bit absolute/increment. Pr02 = 11: position control for high-stiffness equipment

Cautions

Under the following conditions, the function may not work normally, or the intended effect may not be obtained.

	Condition under which the effect of the command follow-up control is prevented
Command pattern	• A command pattern in which the command speed comes to 0 before the positionerror is converged during deceleration Example) a small shift amount; a large command acceleration/deceleration, etc
Load	• Stiffness of the load is low Example) A large resonance point resides in the frequency band of 300 [Hz] or less, etc

- In the command follow-up control, a positional deviation is always around 0 even during operation. Thus, COIN (positioning completion signal) may continue to be ON. Determine on completion of positioning in terms of command pulse output signal of the host controller.

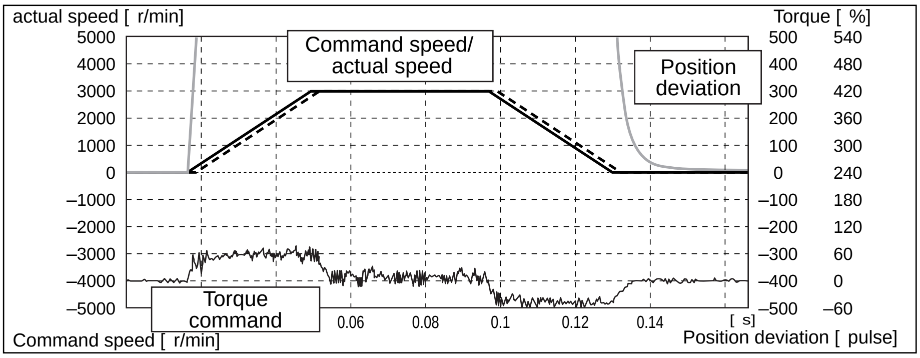
How to use

[1] Tuning in ordinary position control
- See page 198 "Tuning of position control mode".

[2] Gain switching setting
- Referring to sect.11-6-5, set up the following items.
  Pr18 – 1C (2nd gain) = Pr10 – 14 (1st gain)
  Pr17 (1st position integration gain) = 0
  Pr1F (2nd position integration gain) = 0
  Pr30 (2nd gain action set-up) = 1
  Pr31 (Position control switching mode) = 7
  Pr32 (Position control switching delay time) = 0
  Pr33 (Position control switching level) = 0
  Pr34 (Position control switching hysteresis) = 0
  Pr35 (Position loop gain switching time) = 0

[3] Setting of speed integration gain
- Set up Pr12 (1st speed loop integration time constant) using the following formula as a reference.
  Pr12 = 50000/(Pr11 x 2π)
- Enable the Pr1A (2nd speed loop integration time constant).
  Pr12 = 1000

Example 1) By carrying out the tuning up to this point, the response waveform during trapezoid drive be comes as shown below.



[4] Setting of FIR filter 1

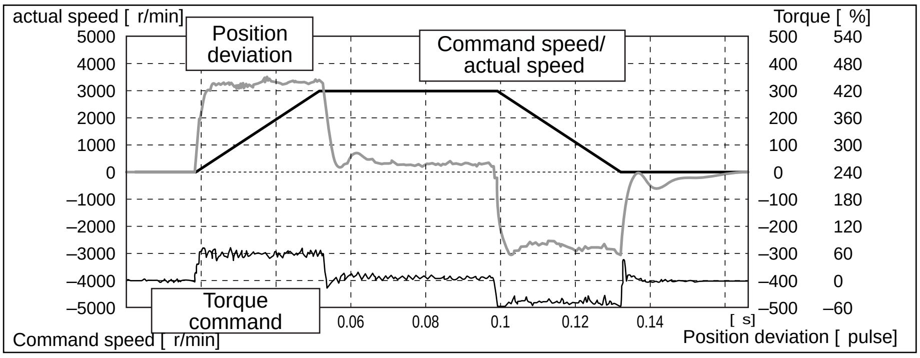
- Check the position command input using the command speed monitor etc of the Matsushita set up support software PANATERM®, and check that the command speed changes smoothly at every sampling.
- When the fluctuation of the command waveform are too large, measure the cycle of the fluctuation and turn the servo OFF once. Then, set up Pr4E (FIR filter 1 setting) so as to fulfill the following formula, and reset the control power.

(Pr4E (FIR filter 1setting) setting value + 1) x 166.6 [μs] ≦ fluctuation cycle [s]

[5] Setting of speed feed forward

- Set up Pr15 (Speed feed forward) to 1000.
- In the case that operation noise becomes larger again when inputting a command, turn the servo OFF once. Then, set up Pr4F (FIR filter 2 setting) to a larger value and reset the control power to check for operation noise.

Example 2) By carrying out the tuning up to this point, the response waveform during trapezoid drive becomes as shown below.

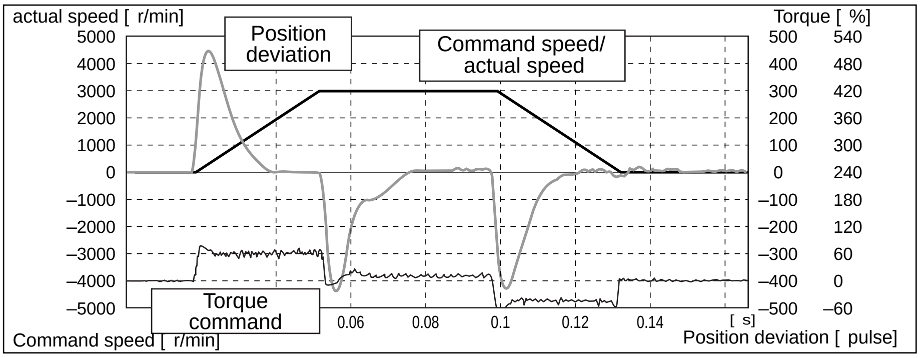


[6] Setting of position integration gain

- Set up Pr1F (2nd position integration gain) using the following formula as a reference.

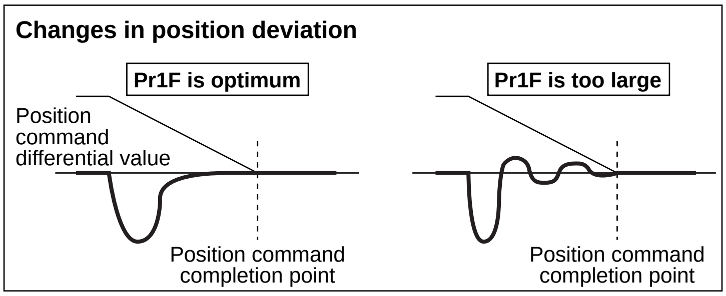
Pr1F = (Pr18 x 2)/30

Example 3) By carrying out the tuning up to this point, the response waveform during trapezoid drive becomes as shown below.



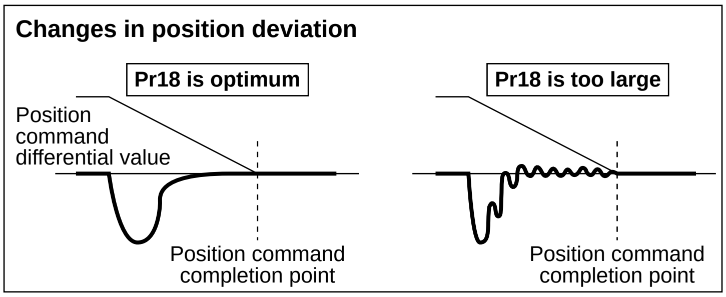
Manual gain tuning (Application)

[7] Fine-tuning of Pr1F (2nd position integration gain)



- Tune Pr1F (2nd position integration gain) to converge the position error to 0 swiftly.
- Gradually increase Pr1F to set it up so as to converge the position command without fluctuation like the waveform shown in the right diagram before the position command completes. If Pr1F is too large, a fluctuation is caused like the waveform shown in the right diagram.
- When the viscous friction is too large, the convergence value of the position error deviates from 0. In such case, as shown in "the case of too-large viscous friction", tune Pr1A (2nd speed loop integration time constant) so that the convergence value is 0.

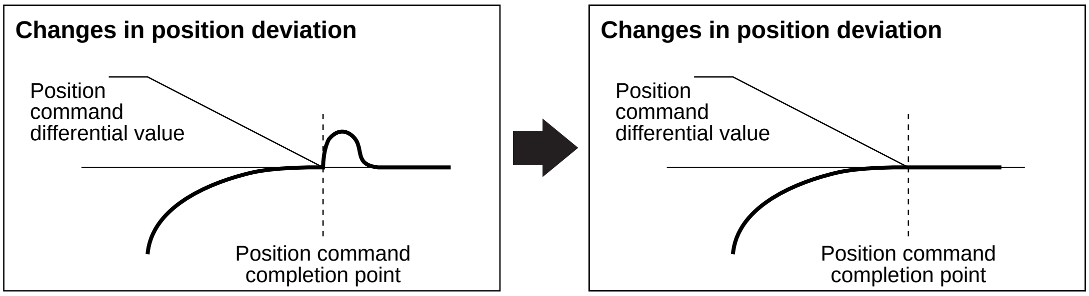
[8] Fine-tuning of Pr18 (2nd position loop gain)



- When position error during operation converges to a target value too late, tune Pr18 (2nd position loop gain).
- By setting Pr18 and Pr1F (2nd position integration gain), the position error converges to the target value swiftly. However, too-large value causes vibration as shown in the right diagram. Set up them to an appropriate value free from vibration. Also, tune Pr1A (2nd speed loop integration time constant) so that the convergence value of the position error becomes 0.

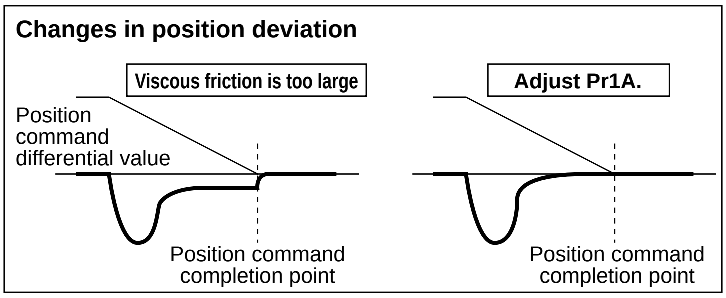
[9] Fine-tuning of gain switching timing

- To reduce fluctuation during setting, tune the gain switching timing.
- After setting Pr31 (Position control switching mode) to 5 (switching via command speed), increase or decrease Pr33 (Position control switching level) to tune the timing of the gain switching. While gradually increasing Pr31 from approx. 20 by10 increments, and set it to a value at which the vibration becomes minimum.



[10] Fine tuning of Pr1A (2nd speed loop integration time constant)

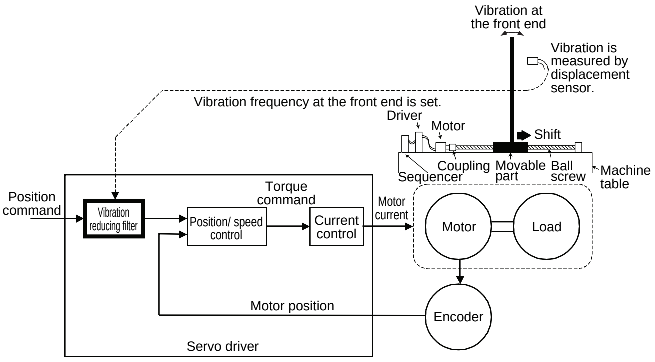
When the viscous friction is too large, the convergence value of the position error immediately before the position command completes varies as shown in the right diagram. In this case, the convergence value can be adjusted via Pr1A (2nd speed loop integration time constant). Adjust Pr1A so that the convergence value of the position error immediately before the position command completes become 0. The larger viscous friction requires the smaller value of Pr1A.



Vibration suppression control

Outline

Vibration suppression control is a function by which, when the front end of a tool vibrates, the vibration is reduced by removing vibration frequency component from the command.



Applicable range

This function is applicable to the following conditions.

	Command under which the command slave control functions
Control mode	• Any one of the position control, semi-closed control or position control for low-stiffness equipment Pr02 = 0: position control Pr02 = 3: first control mode of position / speed control Pr02 = 4: first control mode of position / torque control second control mode of Pr02 = 6 or Pr02 = 10: semi-closed control Pr02 = 12: position control (for low stiffness load)

Cautions

Before changing parameter setting, make sure to stop the operation.

- Under the following conditions, the function may not work normally, or the intended effect may not be obtained.

	Conditions under which the effect of the vibration suppression control is prevented
Load	• When vibration is generated by a cause (external force etc.) other than the command • When the ratio between the resonance frequency and anti-resonance frequency is too large • Vibration frequency is too high (100 [Hz] or more).

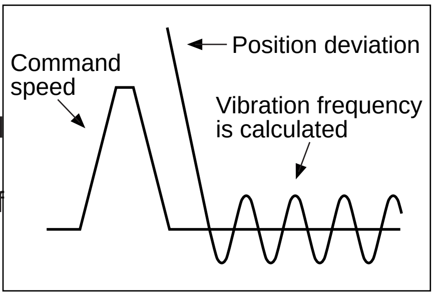
How to use

[1] Setting of vibration suppression frequency (Pr2B)

Measure the vibration frequency at the front end of the tool.

When the vibration can be directly measured using a laser displacement meter etc, read the vibration frequency [Hz] from the measured waveform and input to the vibration suppression frequency (Pr2B).

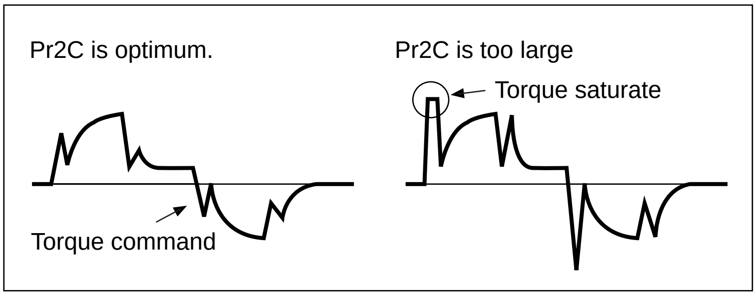
When there is no measuring equipment, read the frequency [Hz] of the residual vibration from position error waveform as shown in the diagram below using the waveform graphic function of the Matsushita set up support software PANATERM®, and set up the value.



[2] Setting of vibration suppression filter setting (Pr2C)

First, set up the value to 0.

By setting a large value, although the stabilizing time can be shortened, torque ripples increase at the changing point of the command as shown in the diagram below. Set up the value within a range that torque saturation does not occur under actually used conditions. If torque saturation occurs, the vibration suppression performance is decreased.

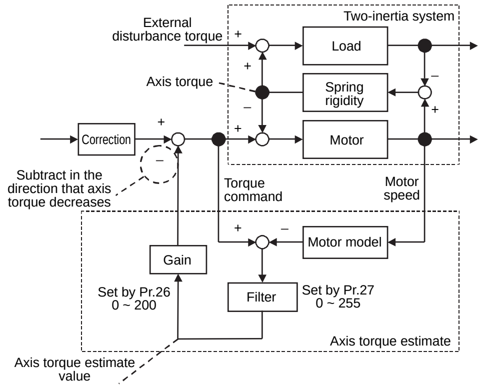


Manual gain tuning (Application)

Resonance ratio control

Outline

Resonance ratio control is a function by which, when vibration is caused by resonance, the resonance peak and vibration are reduced by estimating shaft torque between the motor and the load, and the motor torque is corrected so that the torsion becomes small.



Applicable range

This function is applicable to the following conditions.

	Conditions under which the resonance ratio control functions
Control mode	• Any one of the position control for low-stiffness equipment, speed control for low-stiffness equipment or second full-closed control • The combined motor encoder shall be a 17-bit absolute/increment. Pr02 = 12: position control for low-stiffness equipment Pr02 = 13: speed control for low-stiffness equipment Pr02 = 14: second full-closed control

Cautions

Under the following conditions, the function may not work normally, or the intended effect may not be obtained.

	Conditions under which the effect of the resonance ratio control is prevented
Load	• Vibration frequency is too high (200 [Hz] or more) • Plural resonance points reside in a low frequency zone.

How to use

[1] Setting of disturbance torque observer filter selection (Pr27)

Measure the frequency [Hz] at the resonance point using the frequency characteristics measurement function of the Matsushita set up support software PANATERM®, and set up the disturbance torque observer filter selection (Pr27) so that the cutoff frequency [Hz] of the filter is larger than that value.

Cutoff frequency [Hz] = disturbance torque observer filter selection (Pr27) x 3.7[Hz]

Cutoff frequency [Hz] ≧ frequency [Hz] at the resonance point

A larger filter setting value provides an estimation of shaft torque with smaller delay resulting in an enhanced resonance suppression performance, but operation noise is increased.

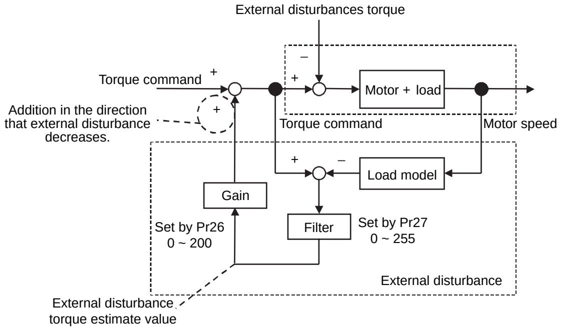
[2] Setting of disturbance torque compensation gain (Pr26)

While operating the actual machine, check the position error and torque waveform etc and gradually increase the disturbance torque compensation gain (Pr26). A larger value of the gain provides an enhanced resonance suppression performance, but operation noise is increased. In this case, alter the disturbance torque observer filter setting (Pr27) to search the optimum setting in which well-balance is obtained.

Disturbance observer

Outline

Disturbance observer is a function by which, using a disturbance torque estimate value which is estimated by the disturbance observer, influence of disturbance torque and vibration are reduced.



Applicable range

This function is applicable to the following conditions.

	Conditions under which the disturbance observer functions
Control mode	• Any one of the position control, speed control, semi-closed control or position control for high-stiffness equipment Pr02 = 0: position control Pr02 = 1: speed control Pr02 = 3: both of position and speed control Pr02 = 4: first control mode of position / torque control Pr02 = 5: first control mode speed /torque control Second control mode of Pr02 = 6 or Pr02 = 10: semi-closed control Pr02 = 11: position control for high-stiffness equipment

Cautions

Under the following conditions, the intended effect may not be obtained.

	Conditions under which the effect of the disturbance observer is prevented
Command pattern	• In a control mode other than Pr02 = 11: position control for high-stiffness equipment, when the motor speed [r/min] is less than the following values For 17bit (131072 resolution 7-serial) encoder: 50 [r/min] For 2500P/r (10000resolution 5-serial) encoder: 600 [r/min]
Load	• When the resonance point resides under the cutoff frequency estimated by disturbance observer • High frequency component is included in the disturbance torque

How to use

[1] Setting of disturbance torque observer filter selection (Pr27)

While operating the actual machine, in a state that influence of an disturbance appears, gradually increase the setting value of the disturbance torque observer filter selection (Pr27).

Cutoff frequency [Hz] = Disturbance torque observer filter selection (Pr27) x 3.7 [Hz]

By setting a larger filter setting value, a disturbance torque with less delay can be estimated resulting in an enhanced suppression performance against the influence of the disturbance, but operation noise is increased. Search a well-balanced setting.

[2] Setting of disturbance torque compensation gain (Pr26)

(Position control for high-stiffness equipment (Pr02 = 11) only requires to be set up)

For position control for high-stiffness equipment (Pr02 = 11), after setting the disturbance torque observer filter selection (Pr27), set a larger value to the disturbance torque compensation gain (Pr26).

By setting the gain to a larger value, an enhanced suppression performance against the external disturbance, but operation noise is increased. In combination with the disturbance torque observer filter selection (Pr27), search a well-balanced setting.

Manual gain tuning (Application)

Torsion correction / Status feed back control

Outline

Status feed back control is a function in which, by adding the difference (torsion) between the encoder position and the external scale position from speed command or torque command, torsion between the motor and the load is reduced to reduce the vibration.

Applicable range

This function is applicable to the following conditions.

	Condition under which the torsion correction/ status feedback control functions
Control mode	• Second full-closed control mode • The combined motor encoder shall be a 17-bit absolute/increment. Pr02 = 14 : second full-closed control

Cautions

Under the following conditions, the intended effect may not be obtained.

	Conditions under which the torsion correction/status feedback control is prevented from functioning
Load	• When resonance point resides in a frequency zone of 200 [Hz] or more • Torsion is too small

The torsion correction and the status feedback control commonly use Pr7C as the filter setting. Therefore, use the respective functions separately.

How to use [1] : Torsion correction

[1] Setting of torsion and Differential speed detection filter (Pr7C)

Set the initial value for the torsion and Differential speed detection filter (Pr7C) in accordance with the following formula:

Torsion and Differential speed detection filter (Pr7C) = 1st position loop gain (Pr10) x 2

[2] Setting of torsion correction gain (Pr7B)

While driving in the second full-closed control mode, gradually increase the torsion correction gain(Pr7B), check the changes in response of the full-closed position error.

When the response performance is increased, while tuning the torsion and differential speed detection filter (Pr7C), search an appropriate combination that the optimum repose is obtained.

How to use [2] : Status feedback control

[1] Setting of torsion and differential speed detection filter (Pr7C)

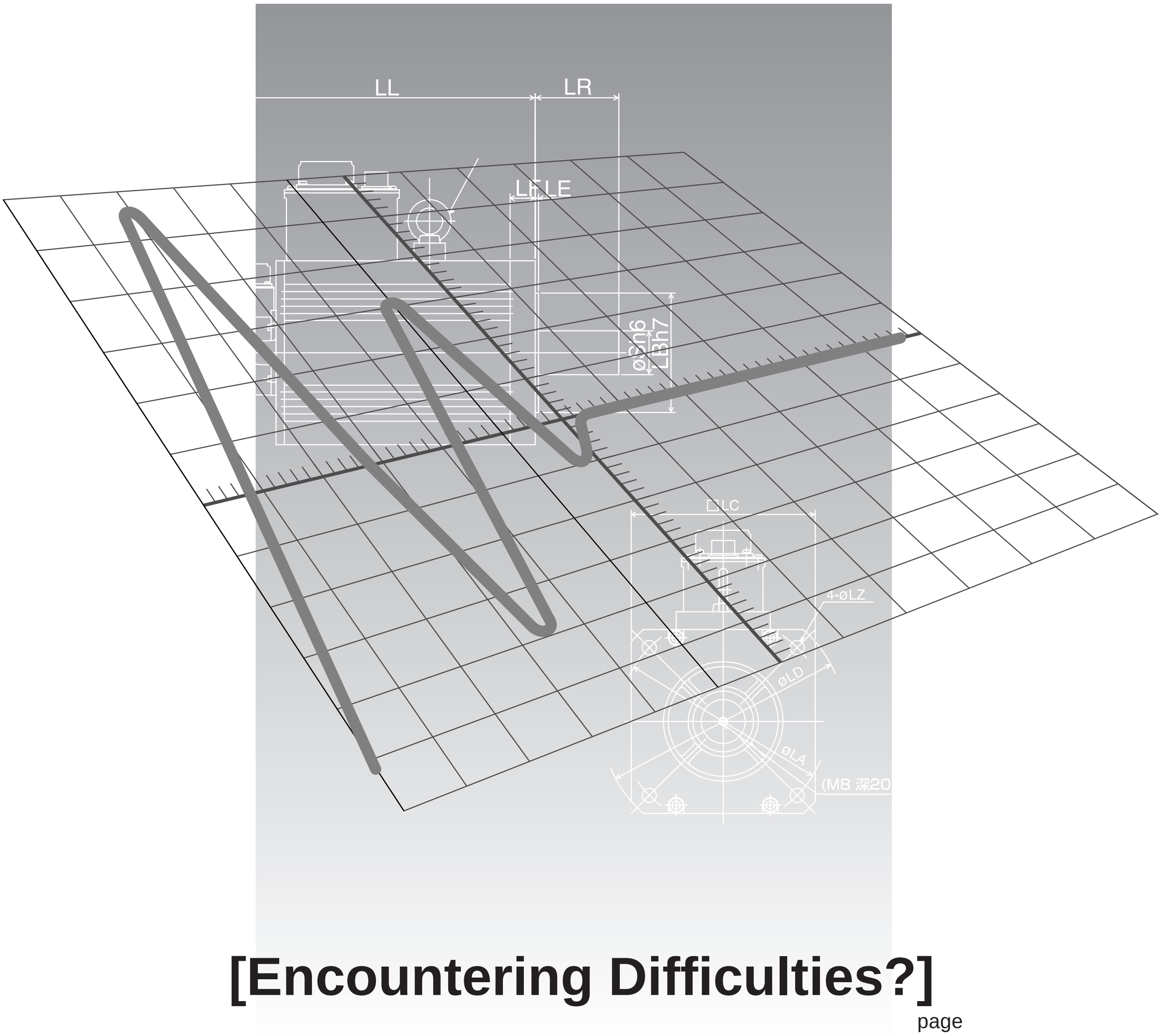
Set up the initial value using the following formula:

Torsion and Differential speed detection filter (Pr7C) = 1st position loop gain (Pr10) x 2

[2] Setting of torsion feedback gain (Pr7D) and differential speed feedback gain (Pr7E)

While driving in the second full-closed control, scale ratio the values of torsion feedback gain (Pr7D) and the differential speed feedback gain (Pr7E), check the changes of the response of the full-closed position error.

When the response performance is increased, while tuning the torsion and differential speed detection filter (Pr7C) also, search an appropriate combination that the optimum repose is obtained.



[Encountering Difficulties?]

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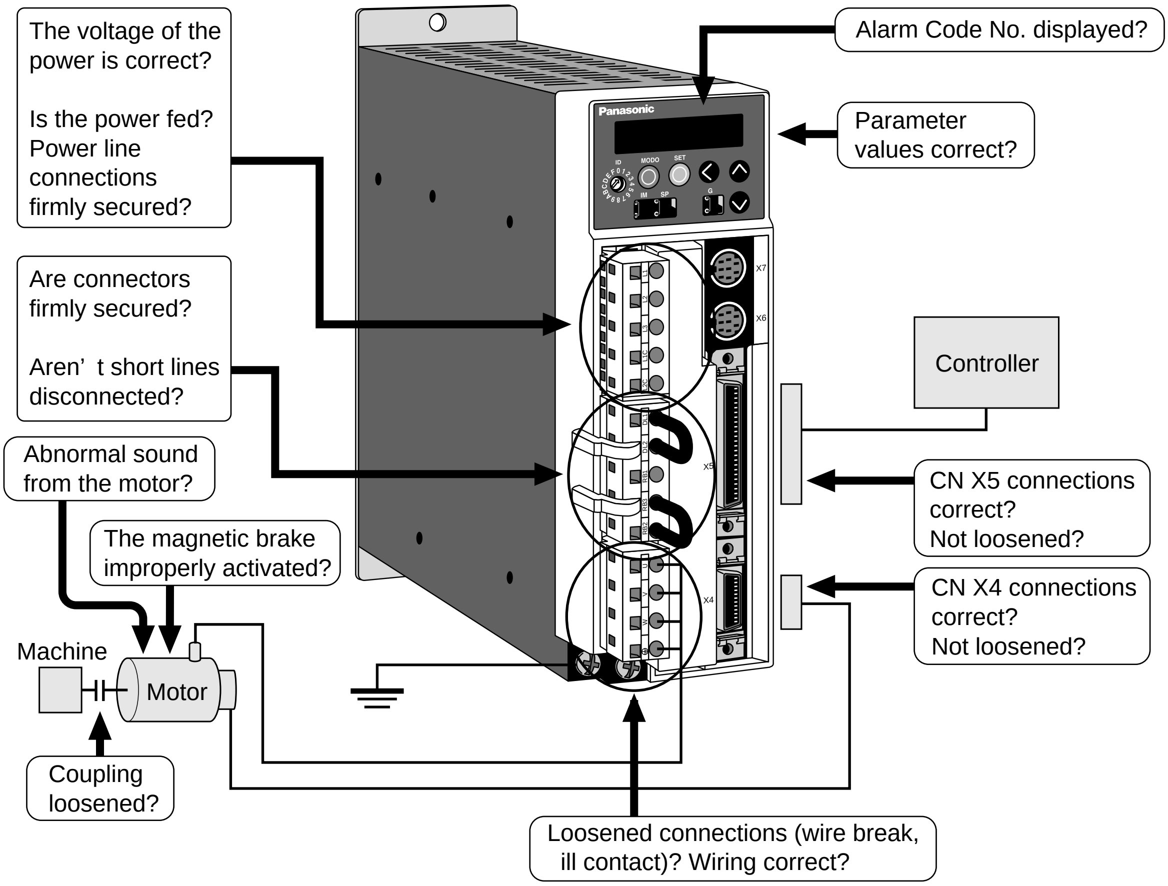
Identifying Problem

Check Points



Protective Functions (What are Alarm codes?)

The driver has various protective functions. When one of the protections is activated, the motor trips according to the timing chart shown in page 41, and the Servo Alarm Output (ALM) is turned off.

Actions to be taken after trip events

- After a trip event, the LED touch panel displays an alarm code no., and no Servo-ON occurs.
- Any trip status is cleared by keeping A-CLR (Alarm Clear Input) on for at least 120 ms after A-CLR off.
- The overload protective (protection against overload) function is activated based on the time limit characteristic when effective current reaches or exceeds 115% of rated current. Ensure that effective current does not exceed rated current of the servo driver. You can clear alarm with an alarm clear signal (A-CLR) 10 seconds or longer after the alarm has occurred, when the overload protective (protection against overload) function has been activated. When control current of the driver between L1C and L2C or r and t is turned off, the time limit characteristic is cleared.
- The alarms mentioned above can also be cleared with the LED touch panel. See page 66 "Alarm Clear".
- The alarms mentioned above can also be cleared by using PANATERM®.

<Notes>

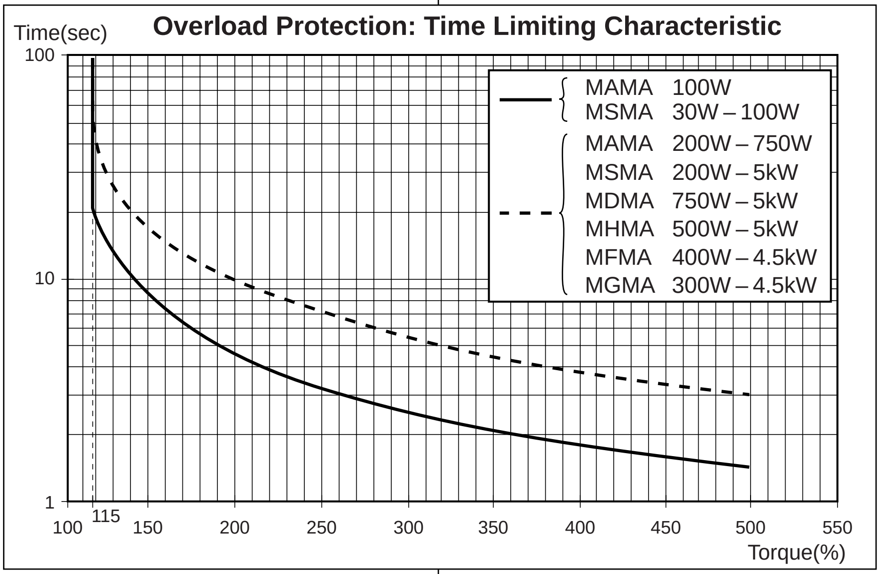
- Protections marked with * cannot be cleared with A-CLR (Alarm Clear Input). They should be cleared by turning the power off, removing the causes, and then turning the power on again.
- these alarm will not be recorded.

Control power undervoltage	(Alarm code No.11)
Main power undervoltage	(Alarm code No.13)
EEPROM parameter error	(Alarm code No.36)
EEPROM check code error	(Alarm code No.37)
Overtravel inhibit input error	(Alarm code No.38)
Motor automatic recognition error protection	(Alarm code No.95)
Motor auto recognition error	(Alarm code No.97)

Protective Functions (Details of Alarm Codes)

Protection	Alarm Code No.	Cause	Countermeasures
Control power undervoltage	11	The P-N voltage of the control power converter is lower than the specified value. Or the control voltage is too low due to an instantaneous outage or shortage of power capacity.	Measure the P-N voltage to check whether the voltage is correct or not. Modify the control voltage to an acceptable value, and/or increase the power capacity.
Overvoltage	12	The line voltage is larger than the specified acceptable range, so that the P-N voltage of the converter is larger than the specified value, or the line voltage was raised by a condensive load or UPS (Uninterruptible Power Supply). 1) The internal regenerative discharge resistor is disconnected. 2) The external regenerative discharge resistor is not suitable so that regenerative energy cannot be absorbed. 3) The driver (circuit) failed.	Measure the terminal-to-terminal voltages (between L1, L2 and L3). Remove the causes, and input the correct voltage. 1) Measure the P-B1 resistance of the driver using a circuit tester. If it read ∞, the connec-tion is broken. Replace the driver. Insert an external regenerative discharge resistor between the P and B2 terminals. 2) Use a resistor having the specified resistance for specified Watt. 3) Replace with a new driver (that is working correctly for another axis).
Main power undervoltage	13	The P-N voltage of the main power converter is lower than the specified value during Servo-ON. 1) The main power line voltage is too low, an instantaneous outage occurred, the power source is too small, the main power is turned off, or the main power is not fed. 2) Shortage of power source: the line voltage dropped due to the inrush current at power on. 3) Lack of phase Power source has been operated at single phase. 4) Servo-on at main power source off. 5) driver damage (circuit damage) 6) With the short line (short bar) between the connector X2 or DL1 – DL2 (B1-B2) disconnected, a user turned the servo ON.	Measure the terminal-to-terminal voltages (between L1, L2 and L3). 1) Increase the capacity supply voltage. Change power source. Remove the source that caused the electromagnetic contractor to drop, and turn the power on again. 2) Increase the capacity of the main power. For the required capacity, see page 30 "List of drivers and Combatible Peripheral Equipment". 3) Correct the phase (L1, L2 and L3) connections of the main power. If the main power is signle-phase 100V. use L1 and L3. 4) Check the timing of power-on (for both the main power and control power). After the servo ready signal is output, activates servo-on. See page 40 the “ Timing Chart” . 5) Replace to a new driver (which is operated at another axis) 6) Ensure that the short line (short bar) between the connector CN X2 or DL-DL2 is not disconnected.
* Overcurrent and ground fault	14	The current flowing in the converter is larger than the specified value. 1) The driver failed (due to defective circuits or IGBT parts). 2) Motor wires (U, V and W) are shorted. 3) Motor wires (U, V and W) are grounded. 4) Motor burned 5) Poor connection of Motor wires 6) The relay for the dynamic brake is melted and stuck due to the frequent Servo-ON/OFF. 7) The motor is not compatible with the driver. 8) The timing of the pulse input and servo-on is the same, or the pulse is faster.	1) Disconnect the motor wires, and enter Servo-ON. If this trouble happens immediately, replace the driver with a new one (that is working correctly). 2) Check if the U. V and W wires are shorted at the connections. Reconnect them, if necessary. 3) Measure the insulation resistance between U/V/W and earth wire. If the resistance is not correct, replace the motor with a new one. 4) Measure the resistance between U,V and W. If they are unbalanced, replace the motor with a new one. 5) Check if the U/V/W connector pins are firmly secured with screws. Loosened pins should be fixed firmly. 6) Replace the driver with a new one. Do not start or stop the motor by entering Servo-ON or OFF. 7) Check the capacity of the motor and driver on the nameplate. If the motor is not compatible with the driver, replace it with a correct one. 8) Input the pulse at least 50 ms after servo-on. See page 41 the “ Timing Chart” .

Identifying Problem

Protection	Alarm Code No.	Cause	Countermeasures
* Motor and/ or Drive Overtemp.	15	The radiator is heated up to exceed the limit temperature. The power elements of the driver is overheated. Overload.	Check the ambient temperature and cooling conditions. Check the load rate. Make the environment under which the driver operates. Reduce the load.
Overload (Discharge)	16	Overload protection is activated based on the specified time limiting operation when the integration of a torque command exceeds the specified overload level. Caused by a long operation with a torque that exceeds the specified torque limit. (table of characteristics) 1) Long operation with more load and torque than the rating. 2) Vibration or hunting due to incorrect gains. Cause vibration and/or abnormal sound. 3) Motor wires connected wrong or broken 4) The machine is hit against a heavy thing, or suddenly becomes heavy in operation. The machine is entangled. 5) The electromagnetic brake is ON. 6) In a system of multiple drivers, some motors are wired incorrectly to other axis.  	Monitor the torque (current wave) using an oscilloscope to check whether the torque is surging or not. Check the load factor and overload alarm messages. 1) Increase the capacity of the driver and motor. Lengthen the ramp time of acceleration/deceleration. Reduce the motor load. 2) Readjust the gains. 3) Correct the motor wiring per the wiring diagrams. Replace cables. 4) Free the machine of any tangle. Reduce the motor load. 5) Measure the voltage at the brake wiring connections. Turn off the brake. 6) Correct the motor and encoder wiring to eliminate the mismatching between the motors and axis.
* Regenerative resistor overload	18	The regenerative energy is larger than the capacity of the regenerative discharge resistor. 1) When the load inertia is too large,the converter voltage increases due to the large energy regenerated during deceleration, and increases more due to the shortage of energy consumption by the regenerative discharge resistor. 2) When the speed of the motor is too high, the regenerative energy cannot be consumed within the specified deceleration time.	Check the load rate of the regenerative resistor in the Monitor mode. The driver should not be used with continuous regenerative braking. 1) Check the operation pattern (using the velocity monitor). Check the load rate of the regenerative resistor and the over-regeneration alarm on display. Increase the capacity of the driver and motor. Increase the deceleration time. Use an external regenerative resistor. Check the connection wire between DL1 – DL2 (B1 and B2) terminals. 2) Check the operation pattern (using the speed monitor). Check the load rate of the regenerative resistor and the over-regeneration alarm on display. Increase the capacity of the driver and motor. Increase the deceleration time. Reduce the motor speed. Use an external regenerative resistor.

Protection	Alarm Code No.	Cause	Countermeasures
* Encoder communication error	21	Due to communication breakdown between the encoder and driver, the detective function for broken encoder wires is activated. **<Caution>** If the above has occurred before power-on, be careful as the motor automatic recognition of and protection against abnormality (alarm code No.95) will be activated.	Correct the encoder wiring per the wiring diagram. Correct the connection of the pins.
* Encoder communication data error	23	The encoder sends an erroneous data mainly due to noises. The encoder is connected correctly, though the data is not correct. **<Caution>** If the above has occurred before power-on, be careful as the motor automatic recognition of and protection against abnormality (alarm code No.95) will be activated.	Make sure that the power of the encoder is 5VDC ± 5% (4.75 to 5.25V). Especially when the wire length is long, it is important to meet this requirement. You should not bundle the encoder wires and motor wires together. Connect the shield to FG. See the encoder wiring diagram.
Position deviation error	24	The position error pulse is larger than Pr63 (position error limit). The motor operation does not respond to the commands.	Check whether the motor operates per the position command pulse or not. See the torque monitor to check if the output torque is saturated. Readjust the gains. Maximize the value of Pr5E (torque limit set-up). Correct the encoder wiring per the wiring diagram. Increase the acceleration and deceleration time. Reduce the load and speed.
* Hybrid deviation error	25	When the driver of the full-closed version is under the full-closed and hybrid control with an external encoder, the load position detected by the external encoder and the motor position detected by the motor encoder are beyond the limit specified by Pr73 (hybrid error limit).	Check the connection between the motor and load. Check the connection between the external encoder and driver. Correct the values of the external scale numerator and denominator regarding parameters Pr74, Pr75, Pr 76 and Pr77. Increase the value of Pr73 Increase the value of Pr71 (hybrid switching time).
Overspeed	26	The motor speed exceeds the specified limit.	Decrease the target speed (command values). Decrease the value of Pr50 (speed command input gain). Adjust the scale ratio so that the frequency of the command pulse is 500 kpps or less. If an overshoot occurs, readjust the gains. Correct the encoder wiring per the wiring diagram.
Command scaling error	27	The command pulse is larger than 500 kpps at the entrance of the position error counter. The scale ratios set by Pr46 through Pr4B (numerator of 1st to 4th command scale) are not correct.	Reduce the multiplication factor by adjusting the values of Pr46 through Pr4B, and then adjust the scale ratios so that the command pulse frequency is 500 kpps or less.
* External scale communication data error	28	When Pr76 (scale error invalidation) = 0, and the driver is operated under the full-closed and hybrid control with an external encoder, the scale error input is OFF.	Check the reason why the CN X5 Pin 33 is OFF.
Deviation counter overflow	29	The value of the position error counter is over 2^{27} (134217728).	Check that the motor operates per the position command pulse. See the torque monitor to check that the output torque does not get saturated. Readjust the gains. Maximize the value of Pr5E (torque limit set-up). Correct the encoder wiring per the wiring diagram.
* External scale communication error	35	The external scale is disconnected, or the scale fails.	Check the power supply for the external scale. Properly connect the external scale cable and the CN X4 cable according to the wiring diagram.
* EEPROM parameter error	36	The data contained in the parameter storage area of the EEPROM is broken, so erroneous data is retrieved.	Set all the parameters again. If this error occurs frequently, the driver may have been broken. Replace the driver with a new one. Return the old driver to the sales agent for repair.
* EEPROM check code error	37	The check code of the EEPROM is broken, so erroneous data is retrieved.	The driver may have been broken. Replace the driver with a new one. Return the old driver to the sales agent for repair.
Overtravel inhibit input error	38	Both the CW and CCW over-travel limits are not active.	Check if the switch, cable and power supply for the CW/CCW overtravel inhibit input are normal. Check that the control power (12 to 24VDC) can be established without delay. Check the value of Pr04. Correct the wiring, if necessary.

Identifying Problem

Protection	Alarm Code No.	Cause	Countermeasures
Absolute encoder system down error	40	Voltage of the battery for the absolute encoder has dropped below a specified value.	Check the voltage of the battery. Connect to the battery, and then clear the encoder using the absolute encoder clear mode contained in the auxiliary function (see page 231 "Setup of the absolute encoder (initialization)" in Appendix).
* Absolute encoder counter overflow	41	The data of the multi-turn counter of the encoder exceeds the specified limit.	Limit the movable range to ±32767 revolutions (15 bits) from the initial position. Adjust the value of Pr0B.
Absolute encoder overspeed	42	The encoder rotates faster than the specified rate when it is battery-powered.	Connect the power to the encoder and then make sure that the encoder voltage is 5V±5%. Correct CN X4 connections, if necessary.
* Absolute encoder single-rotation counter error	44	The encoder detects an error of the single-turn counter.	Turn off the power and turn it on again. If the error cannot be eliminated, the motor and/or driver may be broken. Disconnect the power supply of these equipment, and replace them with new ones. Return the old equipment to the sales agent for repair.
* Absolute encoder multi-rotation counter error	45	2500P/r The encoder has detected abnormality of the single rotation counter.	
		17 bit The encoder has detected abnormality of the multi-rotation counter.	
Absolute encoder status error	47	The encoder detects an internal status error. After the control power on, the encoder rotates faster than the specified rate.	Prevent the motor from rotating before output of servo ready (S-RDY) since control power supply of the driver turned on.
* Encoder Z-phase error	48	Pulse dropouts in phase Z of 2500 [P/r] 5 serial encoders have been detected. The encoder is defective.	Turn off the power and turn it on again. If the error cannot be eliminated, the motor and/or driver may be broken. Disconnect the power supply of these equipment, and replace them with new ones. Return the old equipment to the sales agent for repair.
* Encoder commutation signal error	49	Abnormal logic of CS signal of 2500 [P/r] 5 serial encoders have been detected. The encoder is defective.	Turn off the power and turn it on again. If the error cannot be eliminated, the motor and/or driver may be broken. Disconnect the power supply of these equipment, and replace them with new ones. Return the old equipment to the sales agent for repair.
* Motor auto recognition error	95	(1) The motor is not compatible with the servo driver. (2) When power is turned on, the encoder has not been connected. **<Cautions>** Before power-on, if (1) the encoder line has been disconnected, or (2) data from the encoder has caused abnormal communications, be careful as the motor automatic recognition of and protection against abnormality (alarm code No.95) will be activated, after power is turned on. In the case of (1) or (2) above, execute processing of alarm codes No.21 and 23.	(1) Replace the motor with one that matches the servo driver. (2) Check connection of the encoder.
* Control mode setting error	97	The selected control mode cannot be used in combination with the encoder. The control mode does not support use of the encoder.	Set up Pr02 (Control mode setup) properly.
* Other errors	EEEEEE 333333 FFFFFF ꟻꟻꟻꟻꟻꟻ	The control circuit operates incorrectly due to large noises or any other reasons.	Turn off the power and turn it on again. If the error cannot be eliminated, the motor and/or driver may be broken. Disconnect the power supply of these equipment, and replace them with new ones. Return the old equipment to the sales agent for repair.
* Other errors	Numbers other than the above	The driver's self-diagnosing function is activated, because an error happens in the driver.	

The motor does not rotate.

Category	Causes	Countermeasures
Parameters	The control mode selected is not correct.	Check the value of Pr02 (control mode set-up). 0: position control, 1: speed control, 2: torque control
	The internal speed command (switching between internal and external commands) does not work.	Check the value of Pr05 (Internal speed swiching). 0: At analogue speed command set-up, Change the value to 1 or 2.
	The torque limit inhibition setting is not correct.	Check the value of Pr03 (Analog torque limit inhibit). 0: torque cannot be produced, so the motor does not rotate. Change the value to 1.
	The torque limit has been set to 0.	Check the value of Pr5E (torque limit set-up). Change the value to 300 (default).
	The zero speed clamp is ON, so the motor does not operate.	Check the value of Pr06 (ZERPSPD input selection). Change the value to 0. If the value is 1, the zero clamp function is valid. If you desire to set the parameter to 1, enable the zero speed clamp input, and adjust the wiring so that the zero speed clamp input can be turned on correctly.
	The internal speed setting parameter is not input.	Check the Pr53 ~ 56. Set to the speed desired.
Wiring	CW/CCW overtravel inhibit input of CN X5 is open.	Check the value of Pr04. If the value is 0, connect between CN X5 pins 9 and 41, and 8 and 41.
	CN X5 Servo-ON signal is not received.	Connect (short circuit) between CN IX5 pins 29 and 41.
	CN X5 Counter clear is ON (shorted).	Disconnect between CN IX5 pins 30 and 41.
	CN X5 command pulse input inhibit is active, so the motor does not operate.	Check the value of Pr43 If the value is 0, connect between CN X5 pins 33 and 41. If the value is 1, the command pulse input inhibition is disregarded, so the motor will rotate according to command pulses.
Installation	Bearing lock	Turn off the power. Disconnect the motor. Rotate the motor shaft by hand to make sure that the motor rotates freely. If the motor is fitted with an electromagnetic brake, rotate the shaft by hand while applying a voltage (24VDC) to the brake. If the motor does not rotate, consult the sales agent to repair it.

The rotation is not smooth.

The motor rotates slowly even if the target speed is z ero in the speed control mode.

Category	Causes	Countermeasures
Parameters	The control mode selection is not correct.	With the position control mode selected, if Pr02 is set to other than 0, the motor will rotate slowly because speed command offset governs the operation of the motor. Change the value of Pr02 to 0.
Adjustment	The gains are not appropriate.	Increase the value of Pr11 (1st speed loop gain). Insert a torque filter (Pr14) and then further increase the value of Pr11.
	Speed and position commands are not stable.	Check the condition of the motor using the check pin on the LED touch panel and the wave form graphics function of PANATERM®. Check the wiring and its connections. Check the controller.
Wiring	CN X5 signals are chattering. 1) Servo-ON signal	1) Check the wiring and connections between CN X5 pins 29 and 41 by monitoring the display of input and output signals status. Modify the wiring so that Servo-ON signals can be made active correctly. Check the controller.
	2) CW/CCW torque limit input signal	2) Check the wiring and connections between CN X5 pins 17 and 18, and 16 and 17 using a circuit tester and/or oscilloscope. Modify the wiring so that CW/CCW torque limit input can be made active correctly. Check the controller.
	3) Counter clear input signal	3) Check the wiring and connections between CN X5 pins 30 and 41 by monitoring the display of input and output signals status. Modify the wiring so that Position Error Counter input can be made active correctly. Check the controller.

Category	Causes	Countermeasures
Wiring	4) Speed zero clamp signal 5) Command pulse input inhibit signal	4) Check the wiring and connections between CN X5 pins 26 and 41 by monitoring the display of input and output signals status. Modify the wiring so that Zero Speed Clamp input can be made active correctly. Check the controller. 5) Check the wiring and connections between CN X5 pins 33 and 41 by monitoring the display of input and output signals status. Modify the wir-ing so that Command Pulse Input Inhibit can be made active correctly. Check the ontroller.
	Speed commands contain noises.	Use shielded cables for connection to CN X5. Power and signal cables should be separated by at least 30 cm and put in duct.
	Improper offset	Measure the voltage between CN X5 pins 14 and 15 (speed command inputs) using a circuit tester and/or oscilloscope. Adjust the value of Pr52 so that the motor can stop.
	Speed commands contain noises.	Use shielded cables for connection to CN X5. Power and signal cables should be separated by at least 30 cm and put in duct.

Positioning accuracy is bad.

Category	Causes	Countermeasures
System	Position commands (amount of command pulses) are not correct.	Count the number of feedback pulses while repeating to travel back and forth within a fixed distance. If the number of feedback pulses varies, adjust the controller. Take measures to reduce the noise on the command pulse.
	Reading of in-position signals occurs at the edge.	Use the check pin (IM), to monitor the position error when the in-position signals are received. Read the in-position signals at a mid point on the time span, not at the edge.
	The form and width of the command pulses deviate from the specified values.	If the command pulses are deformed or narrowed, adjust the pulse generation circuit. Take measures to reduce the noise on the command pulse.
Adjustment	The position loop gain is too small.	Check the amount of position error in the monitor mode. Increase the value of Pr10 to the extent that no oscillation occurs.
Parameter	The setting of in-position detection range is too large.	Decease the value of Pr60 (in-position range) to the extent that the in-position signals do not chatter.
	The command pulse frequency exceeds 500 kpps.	Decrease the command pulse frequency. Change the values of Pr46 through Pr4B (numerator of 1st to 4th command scale).
	The scale is not appropriate.	Check the repetition accuracy. If repeated without fluctuation, increase the capacity of the motor and driver.
Wiring	CN X5 signals are chattering: 1) Servo-ON signals 2) Counter clear input signal 3) CW/CCW torque limit input signal 4) Command pulse input inhibit signal	1) Check the wiring and connections between CN X5 pins 29 and 41 by monitoring the display of input and output signals status. Modify the wiring so that Servo-ON signals can be made active correctly. Check the controller. 2) Check the wiring and connections between CN X5 pins 30 and 41 by monitoring the display of input and output signals status. Modify the wiring so that Position Error Counter input can be made active correctly. Check the controller. 3) Check the wiring and connections between CN X5 pins 17 and 18, and 16 and 17 using a circuit tester and/or oscilloscope. Modify the wiring so that CW/CCW torque limit input can be made active correctly. Check the controller. 4) Check the wiring and connections between CN X5 pins 33 and 41 by monitoring the display of input and output signals status. Modify the wiring so that Command Pulse Input Inhibit can be made active correctly. Check the controller.
Installation	Load inertia is large.	Check the overshoot at stop using the wave form graphics function of PANATERM®. Adjust the gains. If this is not effective, increase the capacity of the driver and motor.

The initial (home) position varies.

Category	Causes	Countermeasures
System	When calculating the initial (home) position, the Z-phase output is not detected.	Check that the Z-phase accords to the center of the proximity dog. Perform initialization correctly according to the controller.
	Creep speed to initial position is too high.	Decrease the return speed near the initial (home) position, or lengthen the initialization sensor.
Wiring	The output of the initial (home) position proximity sensor (Proximity dog sensor) is chattering.	Check the input to the sensor using an oscilloscope. Modify the wiring around the sensor. Take measures to reduce the noise.
	Noise on encoder wires	Take measures to reduce the noise (noise filters, ferrite cores, etc.). Properly connect the shield wires of I/F cables. Use twist-paired wires. Separate the signal and power wires.
	Z-phase signal is not output.	Monitor the Z-phase signal using an oscilloscope. Check that CN X5 Pin 13 is connected to the ground terminal of the controller. Connect the open collector to the ground of the driver. Replace the driver and controller, or repair them.
	The circuit for Z-phase signal is not correct.	Check that the line driver is connected at the both sides. If the controller does not have a differential input, use CZ output (open collector). Check that the line driver is connectdt at the both sides.

The motor produces an abnormal sound and/or vibration.

Category	Causes	Countermeasures
Wiring	Speed commands contain noises.	Check the wiring between CN X5 Pins 14 and 15 (speed command inputs) using an oscilloscope. Take measures to reduce the noise (noise filters, ferrite cores, etc.). Properly connect the shield wires of I/F cables. Use twist-paired wires. Separate the signal and power wires.
Adjustment	The gains are too large.	Decrease the values of Pr10 (speed loop gain) and Pr11 (position loop gain).
	The speed detection filter is not correct.	Increase the value of Pr13 (speed detection filter) until the sound decreases to an acceptable level, or return the value to 4 (default).
Installation	Resonance between the machine and motor occurs.	Adjust the value of Pr14 (torque filter). Check the mechanical resonance using the frequency characteristics analysis program in PANATERM®. If a resonance occurs, set Pr10(notch frequency).
	Motor bearing	Operate the motor without load in order to check the sound and vibration near the bearing. Replace the motor and operate it to do the same checks. Repair the motor, if necessary.
	Electromagnetic sound, gear sound, braking sound, hub sound, rubbing sound from the encoder, etc.	Operate the motor without load in order to check the sound. Repair the motor, if necessary.

Troubleshooting

Overshoot or undershoot

The motor overheats (burnt)

Category	Causes	Countermeasures
Adjustment	Gains are not correct.	Check the gains using the wave form graphics monitoring function of PANATERM®, speed monitor (SP) and/or torque monitor (IM). Adjust the gains. See "Adjustments" chapter.
Installation	Load inertia is too large.	Check the load inertia using the wave form graphics monitoring function of PANATERM®, speed monitor. Adjust the gains correctly. Increase the wattage of the motor and the driver. Reduce the inertia ratio. Use gears.
	Rattling or slip of the machine	Check the coupling between the motor and machine.
	Environment (ambient temperature, etc.)	If the ambient temperature is higher than the specified value, install a cooling fan.
	The cooling fan does not work. The air intake is dirty.	Check the cooling fans of the driver and machine. The cooling fan of the driver should be replaced at regular cycles. This replacement should be done by a service engineer of the sales agent.
	Mismatch between the driver and motor	Check the nameplates of the driver and motor. For available combinations between driver and motor, see the instruction manuals or catalogues.
	Motor bearings fail.	Turn off the power. Rotate the motor shaft by hand to check whether abnormal sound (rumbling) occurs or not. If it rumbles, replace it with a new one, or repair it.
	The electromagnetic brake is ON (failure to release the brake).	Check the voltage at the brake terminal. Apply 24VDC to release the brake.
	The motor fails (due to oil, water, etc.).	Avoid high temperature/humidity, oil, dust and iron powders.
	The motor is operated by external forces while the dynamic brake is activated.	Check the operation pattern, use and working status. This kind of operation should be avoided.

The motor speed does not increase up to the specified value.

The speed (movement) is too large or small.

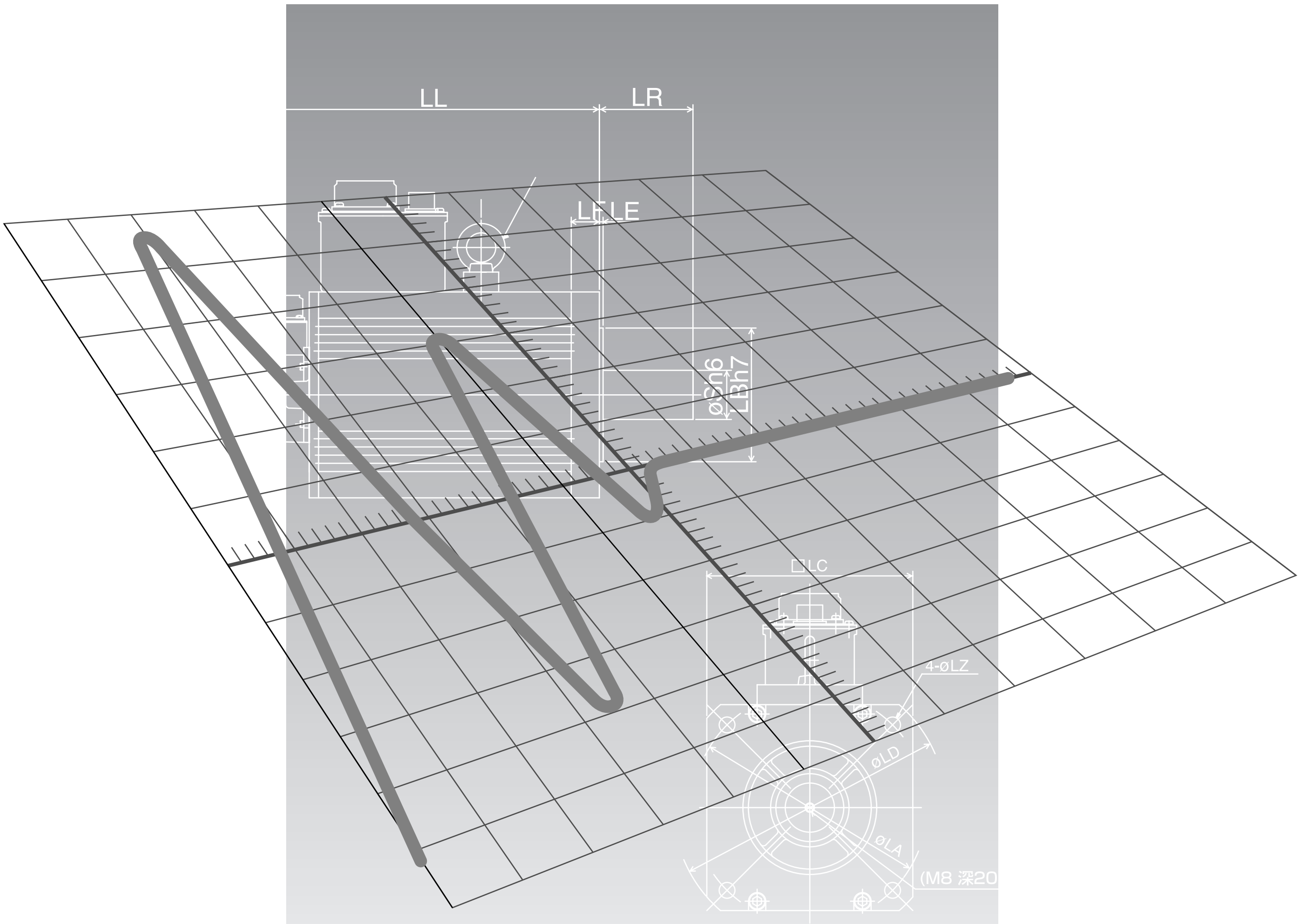
Category	Causes	Countermeasures
Parameter	The speed command input gain is not correct.	Check that the value of Pr50 (speed command input gain) is 500 (i.e. 3000r/min/6V).
Adjustment	The position loop gain is too small.	Adjust the value of Pr10 (position loop gain) to approximately 100.
	The scale is not appropriate.	Correct the values of Pr46 (numerator of 1st command pulse ratio), Pr4A (Multiplier of numerator of command pulse radio) and Pr4B (denominator of pulse command scale). See "Parameter settings" for the mode in topic.

Parameter values change to the former value.

Category	Causes	Countermeasures
Parameter	Parameter values are not downloaded into EEPROM before power off.	See page 63 "Writing parameter into EEPROM" in Preparations.

PANATERM®, a message " communication port or driver cannot be detected" appears.

Category	Causes	Countermeasures
Wiring	The communication cable (RS232C) is connected to CN X7.	The communication cable (RS232C) must be connected to CN X6.



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Absolute System

Outline

An absolute system based on an absolute encoder eliminates the necessity of origin return upon power up. This is an advantageous feature when the application includes operation of robot etc.

When the MINAS-AIII of absolute and/or incremental is connected to a motor containing an encoder fed by dedicated battery and the parameter Pr0B is set to 0, the upper unit (host controller) can obtain accurate positioning information once the absolute system is powered up.

After initial connection of the battery, return the system to its origin, and then reset the absolute encoder to clear revolution data. In the subsequent operation, absolute position is detected without first returning to the home position.

The upper device can connect up to 16 MINAS-AIII units and acquire current position data through RS232C or RS485 serial communication links; and then, based on the data, can determine the absolute position of individual shafts.

Components of absolute system

Drivers and motors

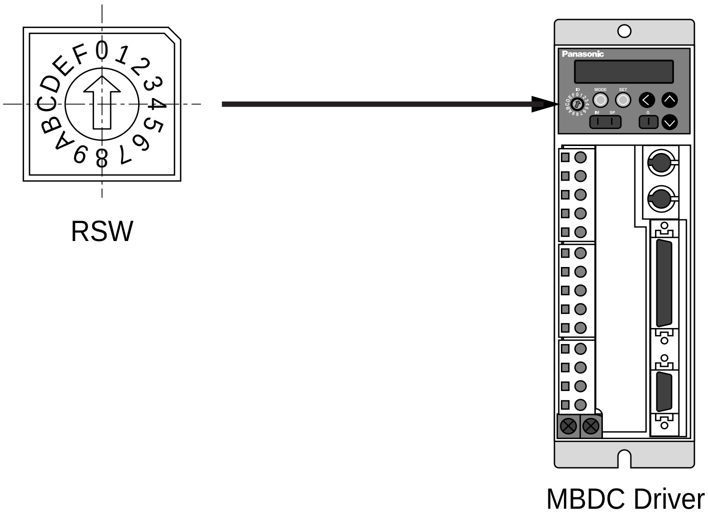
Driver	Motor		
	Model	Resolutions of encoder	Lead wire
M*DC******	M*MA***S**	17 bits (131072)	7 conductors

Absolute specification

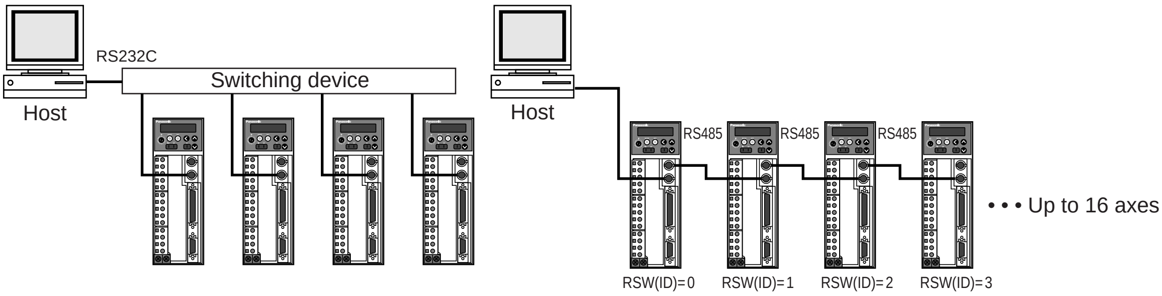
The MINAS-AIII driver can be connected to the upper unit (host) in one of the three ways shown below, based on specification of the host interface and the number of MINAS-AIIIs connected together, if any. When two or more MINAS-AIIIs are to be connected to a single host through a communication line, allocate the module ID to each RSW.

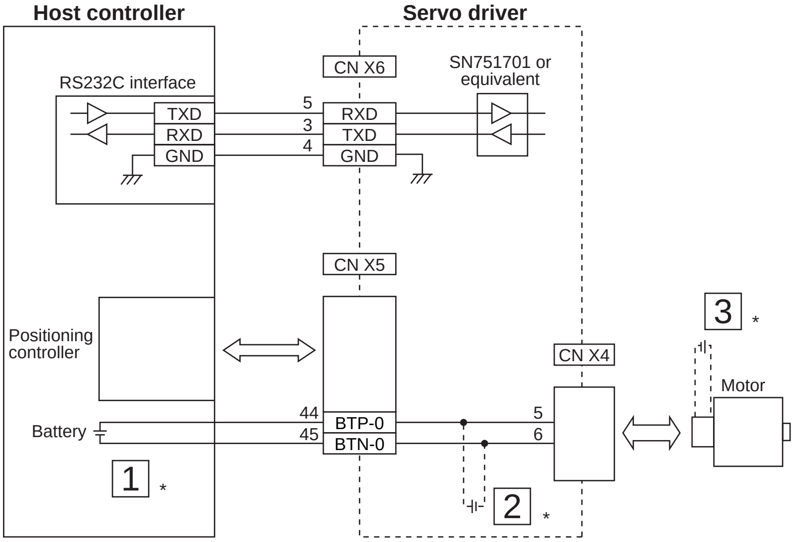
Module ID (RSW)

- Up to 16 MINAS-AIII can be connected to the host though RS232C interface by allocating unique ID (0 to F) to them.
- When a MINAS-AIII connected to the host through RS232C is also connected to other MINAS-AIIIs through RS485, it must be given an ID 0, while the remaining devices from 1, 2,,,(F).
- Alternatively, up to MINAS-AIIIs can be connected to the host through RS485 interface. If this is the case, module ID 0 is allocated to the host and 1 ,,, (F) to MINAS-AIIIs. (Up to 15 units can be connected.)



Configuration of the absolute system using the RS232C interface



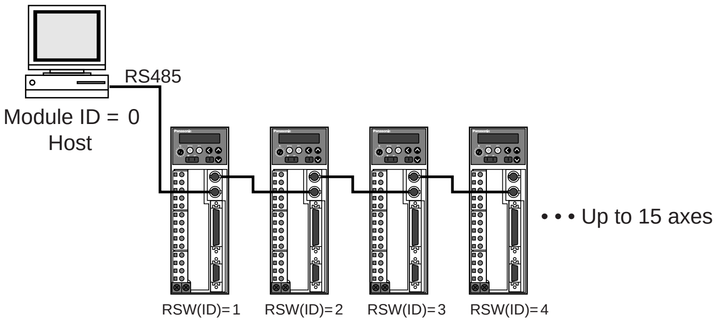


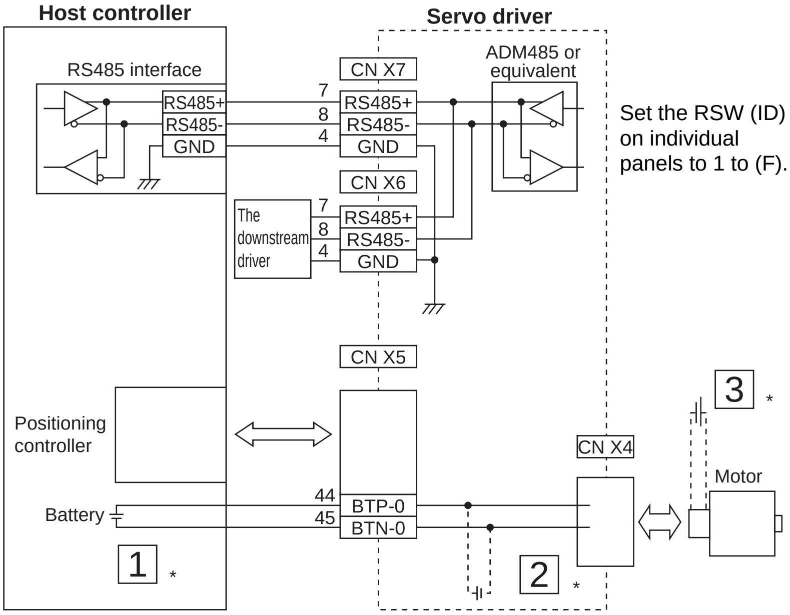
* To store revolutions data in the encoder, a backup battery is required which should be connected to:

1. When installed on the upper controller, Connect to $\boxed{1}$.
2. When installed on the driver, Connect to $\boxed{2}$. See page 228 "Battery installation".
3. When the control system is separated from the mechanical system, e.g. robot, Connect to $\boxed{3}$.

* For battery connecting procedure, see "Battery installation" described on the next page.

Configuration of the absolute system using the RS485 interface





* To store revolutions data in the encoder, a backup battery is required which should be connected to:

1. When installed on the upper controller, Connect to $\boxed{1}$.
2. When installed on the driver, Connect to $\boxed{2}$. See page 228 "Battery installation".
3. When the control system is separated from the mechanical system, e.g. robot, Connect to $\boxed{3}$.

* For battery connecting procedure, see "Battery installation" described on the next page.

Absolute System

Battery installation

Initial installation

Connect the lead wire from the battery unit top to its own connector. Wait for 5 minutes and then install the battery to the servo driver which should have been turned on for at least 1 hour. (This is because excessive charging current rushes to the encoder internal capacitor after the power to the driver is first turned on.) After installing the battery by following the procedure shown below, set up the absolute encoder in accordance with page 231 "Setup of the absolute encoder (initialization).

Keep the battery in good condition by turning on the main power daily for appropriate period.

Replacing the battery unit

The battery unit must be replaced with a new one upon a battery alarm.

Follow one of the replacement procedures described below.

1) Replace the battery while keeping the driver control power supply turned on.
2) Turn on the driver control power supply and then off after it fully charges the encoder internal capacitor (for at least 1 hour); and then start the replacement procedure.

Because the internal capacitor has limited capacity, replacement according to step 2) above must be finished within the period as described below.

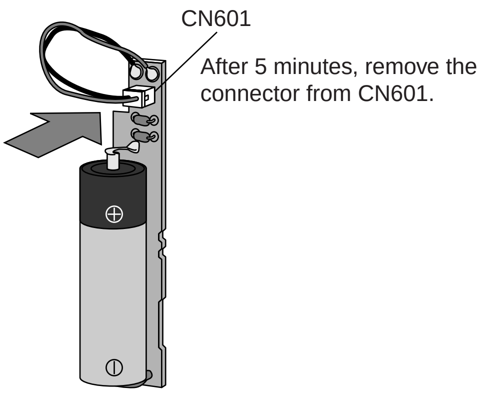
- Data retention time with the internal capacitor:
  New capacitor: 1
  Note that the life expectancy of the capacitor depends on working and storage temperature.

After battery replacement, reset the battery warning.Refer to P.235, "How to Reset the Battery Warning".

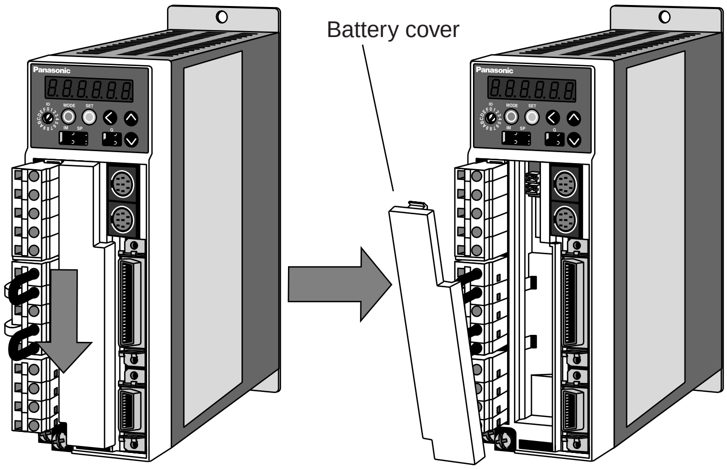
If the battery unit replacement is not finished before the backup capacitor discharges to a low voltage level, an absolute system down error occurs. Should this happen, the absolute encoder must be initialized again. See page 231 "Setup of the absolute encoder (initialization).

• AIII Series Type B ~ Type D

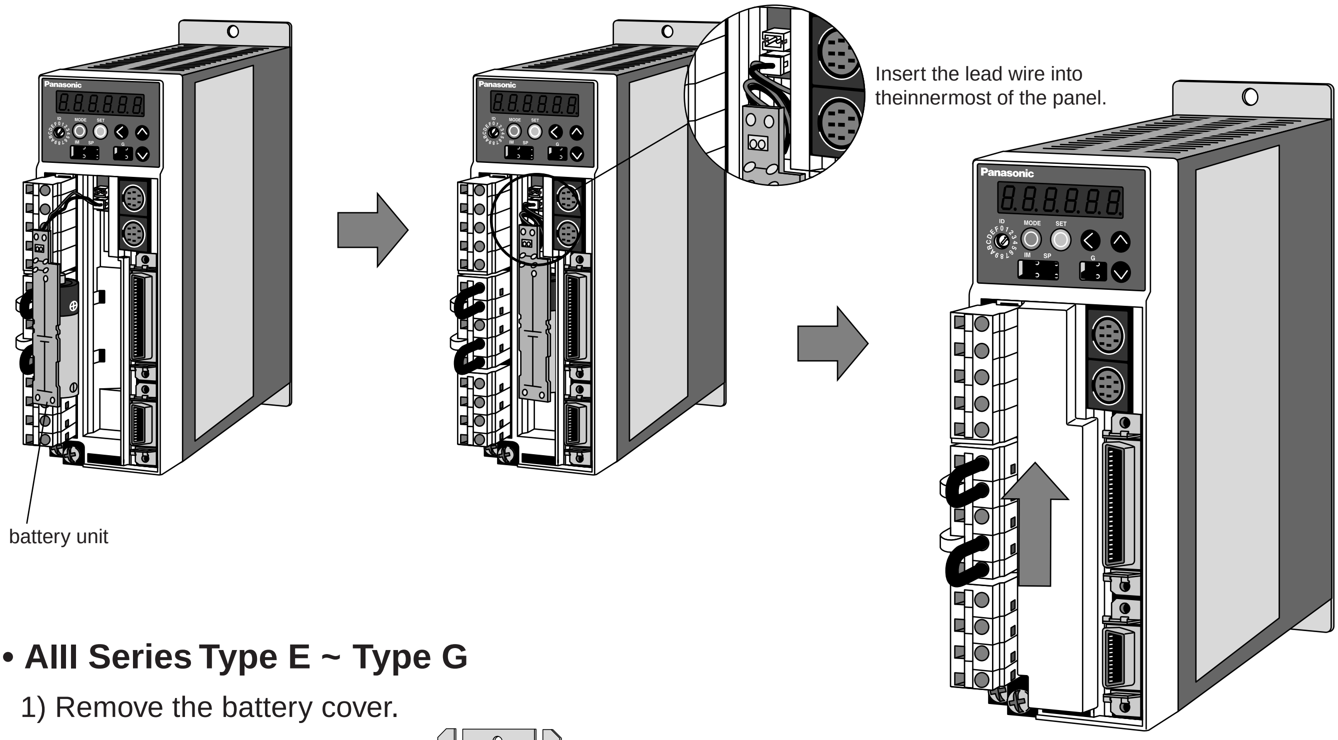
1) Refresh the new battery unit. Connect the upper lead connector of the battery unit to CN601, and leave it for 5 minutes. After 5 minutes, remove the connector from CN601.



2) Remove the battery cover by sliding it downward.



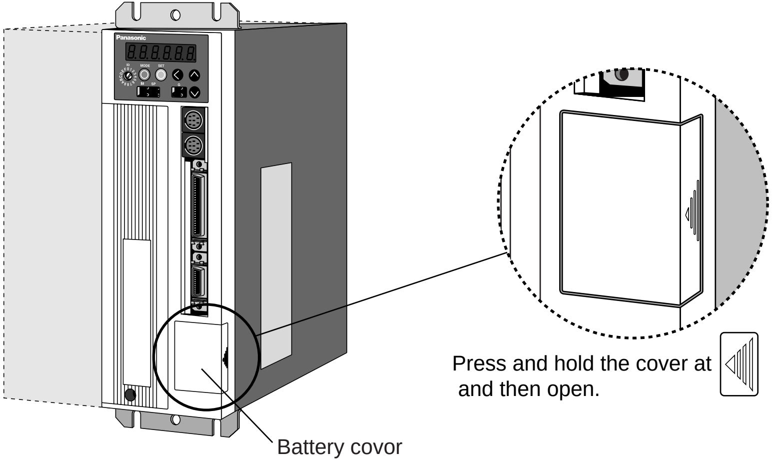
3) Mount the new battery unit to the panel with attention not to catch the lead wire, and mount the battery cover. (After inserting the battery cover from the bottom of the panel, slide the cover upward.)



Insert the lead wire into theinnermost of the panel.

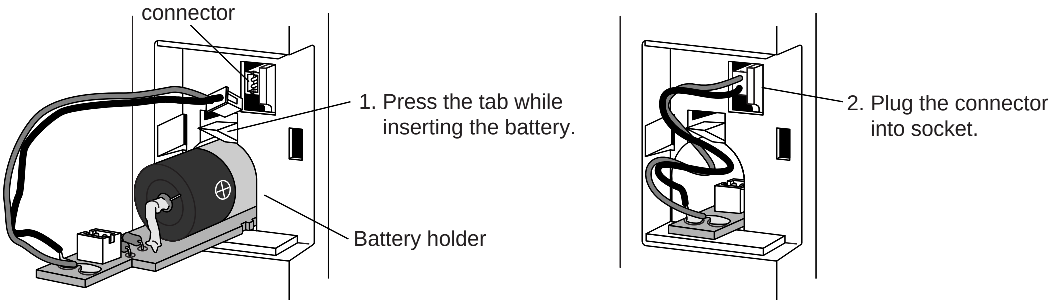
• AIII Series Type E ~ Type G

1) Remove the battery cover.



Press and hold the cover at ◁ and then open.

2) Insert the battery into the battery holder,



1. Press the tab while inserting the battery.

2. Plug the connector into socket.

3) Mount the battery cover.

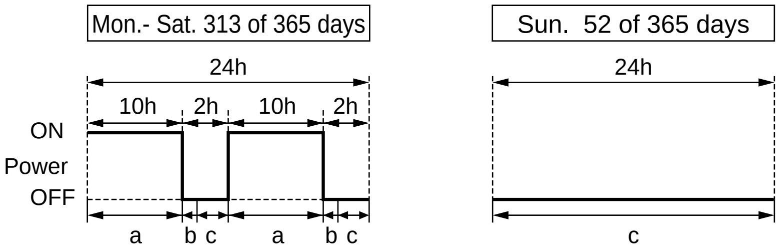
<Warning>

1. For Type A, a battery unit is specified to be externally attached. Connect it to Connector CN X5 (44- and 45-pin) or connect it on the host controller side.
2. If battery is installed on both the upper controller and drive, confliction of two power circuits leads to dangerous malfunction.
3. Battery and battery connector must be positively engaged to avoid loose connection.
4. Use the following battery:
   Lithium ER6V 3.6 V 2000 mAh, Toshiba Battery Co., Ltd. Part No.: DVOP2990

Absolute System

<Reference>
The below calculates the expected lift of a lithium battery, taking Toshiba Battery Co., Ltd. ER6V 3.6 V 2000 mAh as an example.
Since the battery life depends on the application (in this example, robot) and working/storage conditions, the calculated life below may not be guaranteed.

(1) 2 cycles/day operation



a: current consumption in the normal mode, 3.6[μA]
b: current consumption in interruption timer mode, 280[μA]
[Interruption timer mode: the unit can response up to the maximum revolutions for 5 seconds after power is turned off]
c: current consumption in interruption mode, 110[μA]

Amount of discharges per year = (10h x a + 0.0014h x b + 2h x c) x 2 x 313days + 24h x c x 52days
= 297.8[mAh]

Battery life = 2000[mAh] /297.8 [mAh/year] = 6.7 (6.7159) [year]

(2) 1 cycle/day operation
The life expectancy of the battery as shown in 1) above, but the 2nd cycle is not employed.

Amount of discharges per year = (10h x a + 0.0014h x b + 14h x c) x 313days + 24h x c x 52days
= 630.6[mAh]

Battery life = 2000[mAh] /630.6[mAh/year] = 3.1(3.1715) [year]

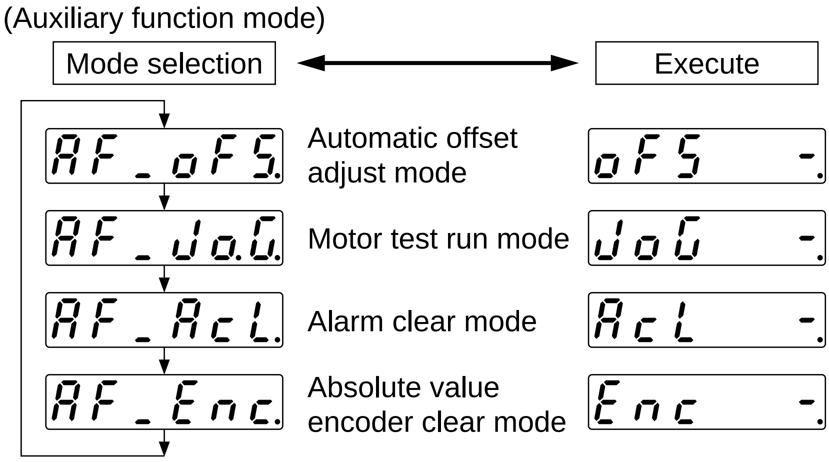
Setup of the absolute encoder(initialization)

Set up the absolute encoder in the following cases:

- When the machine is first started
- Absolute system down error (alarm 40) is generated
- Encoder cable is disconnected

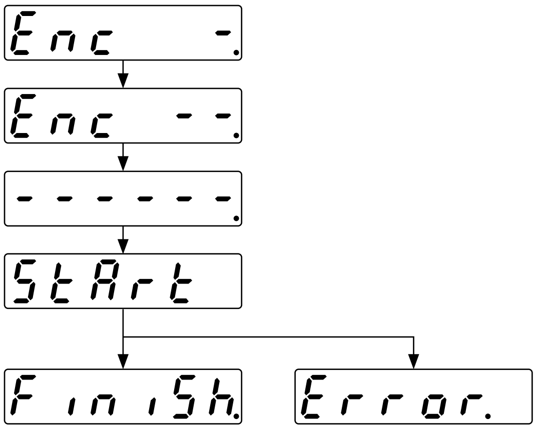
To do so, return to the machine to the origin, clear the absolute encoder to release the encoder error and reset the revolution data to 0. The absolute encoder can be cleared from the front control panel or PANATERM®. Turn off the control power to store the data and then turn it again.

Setting up the absolute encoder



1) Turn power on. Return the machine to the home position. Automatic offset adjust mode
2) Set control on the front panel to the auxiliary function mode. Display "Absolute encoder clear mode" on the execution screen. See page 56 "Setting parameters and mode".

3) On the execution screen, operate the keys as follows:



Press and hold ∧ for approx. 3 seconds until the screen indicates "- - - - -" and "Start".

The absolute encoder clearing operation starts.

In a moment, the screen indicates that the encoder is cleared.

Note: If the encoder is not an absolute encoder but an incremental type, the screen will display Error. .

4) Turn off the driver control power supply and then turn it on again.

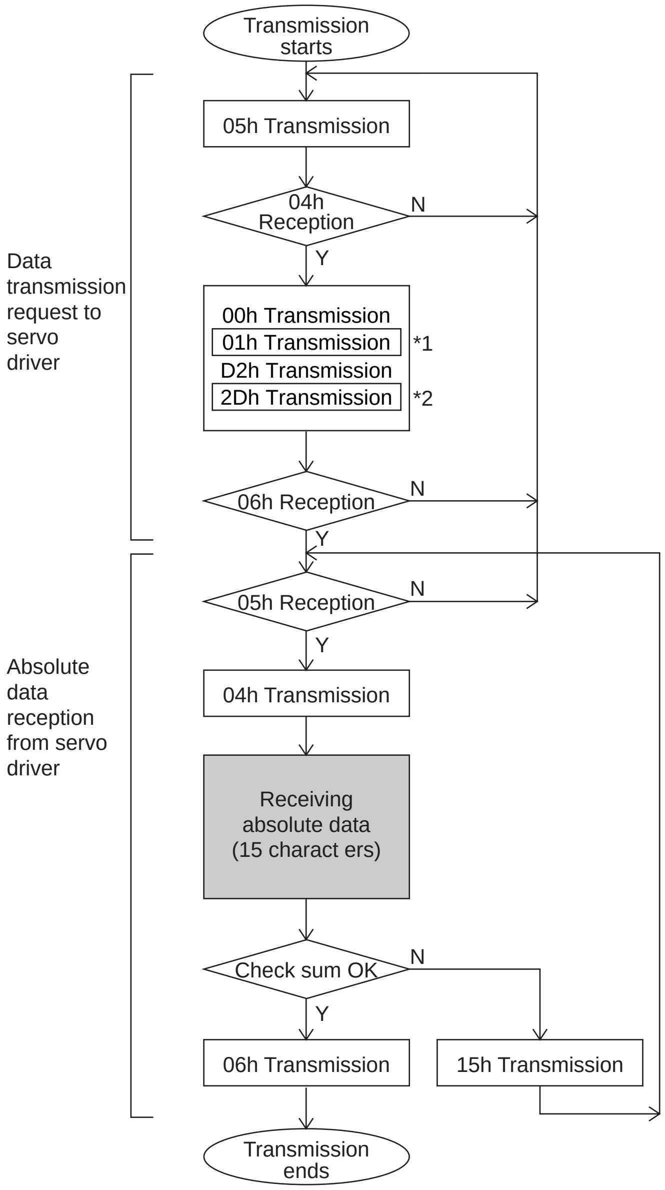
Absolute System

Absolute data delivery sequence

Approx. 2 seconds after turning on of the control power supply, servo ready is turned on. While the servo ready is on, turn motor servo off, and keep the motor locked by using the brake (the motor fully stops). Transfer the absolute data by following the procedure below.

Communications through RS232C interface

For the transmitting and receiving procedure, see the instruction manual for the upper device.



The data marked with * 1 and * 2 are defined by setting RSW (ID) on the servo driver front panel.

RSW(ID)	Data * 1	Data* 2
0	00h	2Eh
1	01h	2Dh
2	02h	2Ch
3	03h	2Bh
4	04h	2Ah
5	05h	29h
6	06h	28h
7	07h	27h
8	08h	26h
9	09h	25h
A	0Ah	24h
B	0Bh	23h
C	0Ch	22h
D	0Dh	21h
E	0Eh	20h
F	0Fh	1Fh

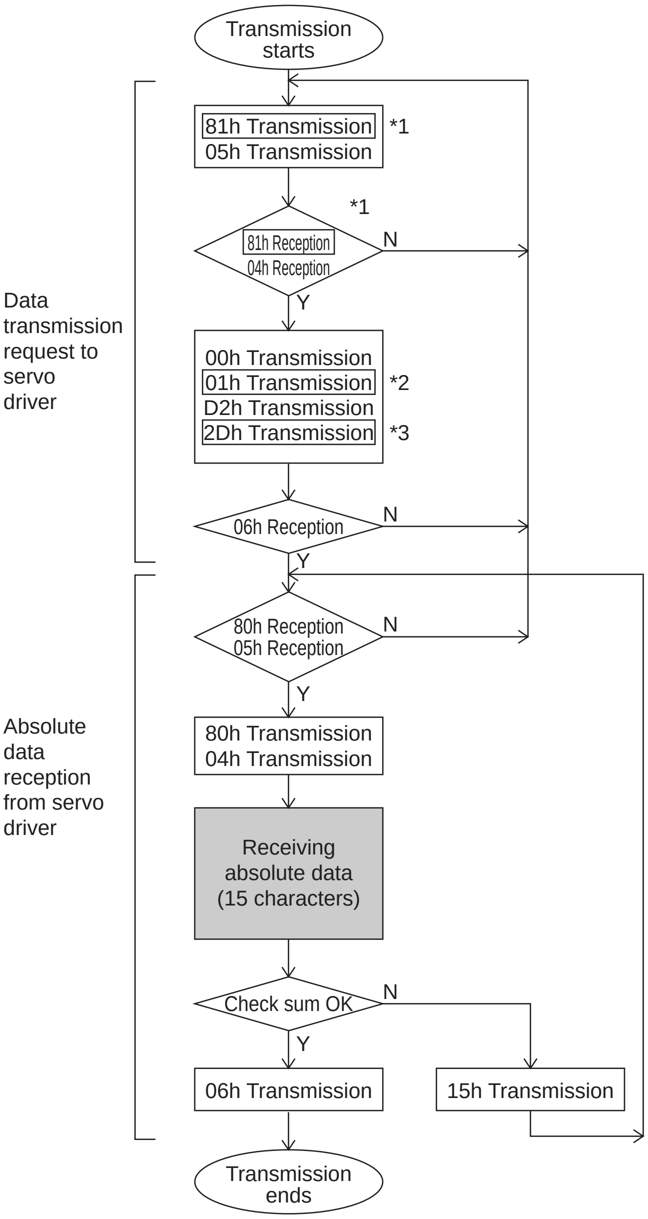
If the low-order 8 bits of the sum of the received absolute data (15 characters) are "0", the check sum is judged acceptable.

On the host, enter the RSW value of the destination driver into axis(data *1) of the command block and send the command according to the RS232C transfer protocol. For further information on the communications, see page 238 "Communication".

To read data on two or more axes, wait for at least 500 ms before accessing the next axis data.

Communications through RS485 interface

For the transmitting and receiving procedure, see the instruction manual for the upper device.
The below illustrates communication sequence between RSW(ID) 1 and driver.



The data marked with * 1, * 2 and * 3 are defined by setting RSW (ID) on the servo driver front panel.

RSW(ID)	Data * 1	Data * 2	Data * 3
0	The RS485 interface cannot be used.		
1	81h	01h	2Dh
2	82h	02h	2Ch
3	83h	03h	2Bh
4	84h	04h	2Ah
5	85h	05h	29h
6	86h	06h	28h
7	87h	07h	27h
8	88h	08h	26h
9	89h	09h	25h
A	8Ah	0Ah	24h
B	8Bh	0Bh	23h
C	8Ch	0Ch	22h
D	8Dh	0Dh	21h
E	8Eh	0Eh	20h
F	8Fh	0Fh	1Fh

If the low-order 8 bits of the sum of the received absolute data (15 characters) are "0", the check sum is judged acceptable.

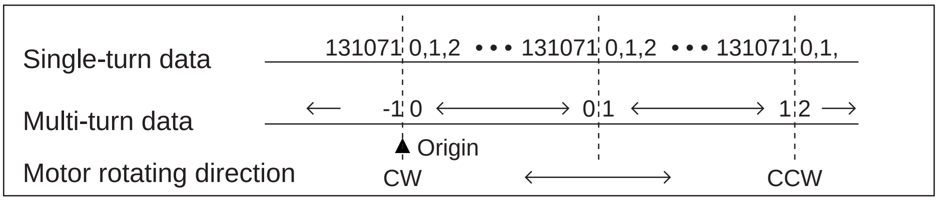
From the host, send the command to the destination driver by following transfer protocol of RS485.
For further information on the communications, see page 238 "Communication".

To read data on two or more axes, wait for at least 500 ms before accessing the next axis data.

Absolute System

Structure of Absolute Data

The absolute data consist of:Single-turn data that defines the absolute position of the motor, and Multi-turn data that counts the number of turns after the latest clearing operation of the encoder.

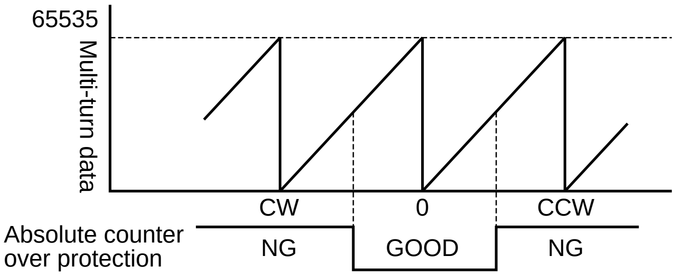


The single- and multi-turn data consist of 15-character data (hexadecimal binary code) from the RS232C or RS485 communication interface.

Absolute data (15 characters) received

0Bh	
RSW (ID)	← RSW (ID) value defined on the front panel
D2h	
Maker code	
Maker code	
Encoder status (L)	See "Encoder status" on the next page.
Encoder status (H)	
Single-turn data (L)	Single-turn data = Single-turn data (H) x 10000h + Single-turn data (M) x 100h + Single-turn data (L)14
Single-turn data (M)	
Single-turn data (H)	
Multi-turn data (L)	Multi-turn data = Multi-turn data (H) x 100h + Multi-turn data (L)
Multi-turn data (H)	(Data: 0-65535, Range: -32767 to 32767)
00h	
Error code	← After communication is executed, this value is 0. If not 0, read again the absolute data from the driver.
Checksum	

• Multi-turn data timing



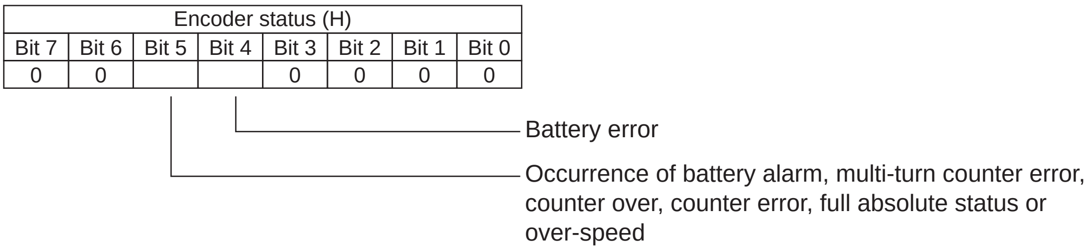
Note: If the multi-turn data in the figure above is from 32768 to 65535, subtract 65536 and convert the result to signed data.

• Encoder status (L) (1 means the occurrence of an error)

Encoder status (L)							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
			0				

Bit 0	Over-speed	→ Err42 (absolute over-speed error)
Bit 1	Full absolute status	→ Err47 (absolute status error)
Bit 2	Count error	→ Err44 (absolute single-turn counter error)
Bit 3	Counter overflow	→ Err41 (absolute counter overflow error)
Bit 5	Multi-turn counter error	→ Err45 (absolute multi-turn counter error)
Bit 6	Battery error	→ Err40 (absolute system down error)
Bit 7	Battery alarm	→ Battery alarm

• Encoder status (H) (1 means the occurrence of an error)



Encoder status (H)							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0			0	0	0	0

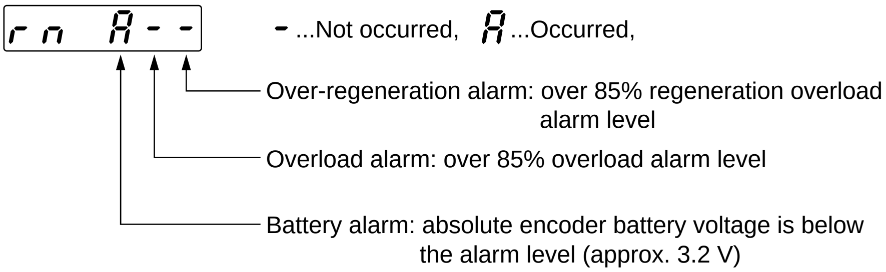
Battery error

Occurrence of battery alarm, multi-turn counter error, counter over, counter error, full absolute status or over-speed

Note: For details of encoder errors refer to "Protective Functions" in "Encountering Difficulties?", on page 216. For details of warning, see "Battery warning display" shown below.

Battery warning display

From the front panel, select monitor mode, alarm, execution.
The alarm as shown below will be displayed.



- ...Not occurred, A ...Occurred,

Over-regeneration alarm: over 85% regeneration overload alarm level

Overload alarm: over 85% overload alarm level

Battery alarm: absolute encoder battery voltage is below the alarm level (approx. 3.2 V)

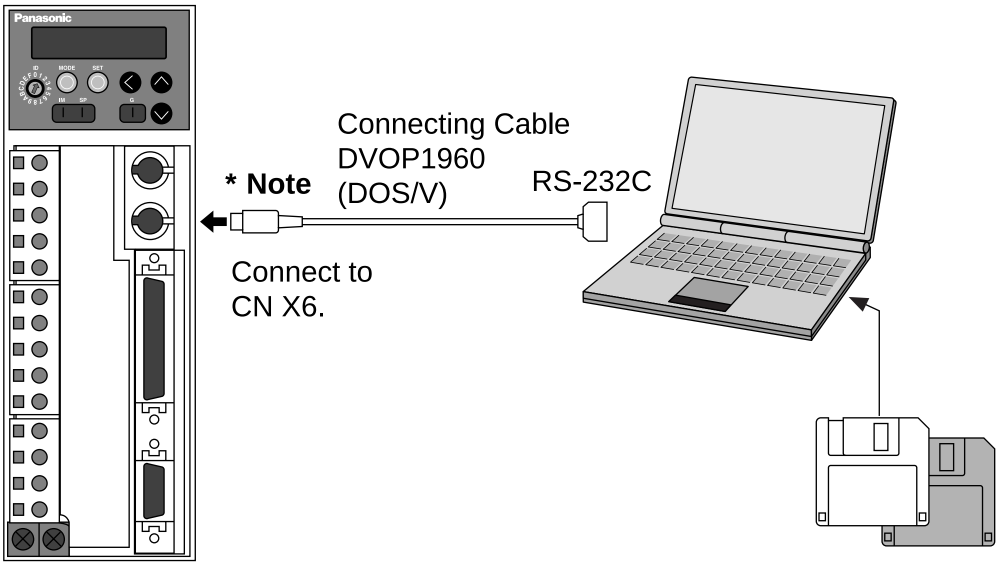
How to Reset the Battery Warning

When the battery alarm is generated, replace the absolute encoder battery by seeing page 228 "Battery installation". After replacement, reset the battery warning in the following 3 methods.

(a) "CN X5" Connecting Alarm clear input (A-CLR) to COM– for more than 120ms.
(b) Executing the alarm clear function in auxiliaty function mode by using the console (option).
(c) Click the "Battery warning" Clear button, after select the "Absolute encoder" tab in the monitor display window by using the PANATERM® (option).

Set up support software PANATERM®

How to Connect



Setup disc of Set up support software “PANATERM®”
DV0P3170 (Japanese version)
OS : Windows®95, Windows®98, Windows®NT,
Windows®2000, Windows®Me
(Japanese version)
DV0P3180 (English version)
OS : Windows®95, Windows®98, Windows®NT,
Windows®2000, Windows®Me
(English version)

<Note>

* Do not connect to CN X7. Otherwise an error message meaning that “PANATERM®” cannot detect the communication port or driver will appear.

Installing PANATERM® on a hard disc

<Notes>

1. The memory capacity of the hard disc should be 15MB or more. Prepare Windows®95 (or 98, NT, 2000, Me) as OS.
2. Install “PANATERM®” with setup discs, otherwise the software does not work.
3. Product No. of “PANATERM®” may change in response to version upgrade. For the latest product numbers, refer to the catalogue.

Installation Procedure

1) Turn on the power of personal computer and start corresponding OS.
2) Insert the “PANATERM®” Setup Disc 1 into the floppy disc drive.
3) Start Explorer, and switch to (select) the floppy disc drive. (For the procedure for starting the Explorer program, see the instructions for corresponding OS.)
4) Double click on "Setup.exe" (“PANATERM®” Setup program will start).
5) Click on OK to start the setup program.
6) Keep the operation according to the guide of the setup program.
(Prompted to change to the setup disk 2 along the path, follow it.)
7) Click on **Start installing?** to start the setup routine.
8) Confirm an message "Setup completed". Then click on OK .
9) Close all the applications. Then restart Windows®. “PANATERM®” will be added to the program menu.

Starting PANATERM®

<Notes>

1. Once you install “PANATERM®” on your hard disc, you do not have to install it again for next use.
2. Before using “PANATERM®”, the driver, power supply, motor and encoder should be connected. For the procedure for starting “PANATERM®”, see the Windows® manual.

Procedure

1) Turn on your personal computer. Start corresponding OS.
2) Turn on the driver.
3) Click on the start button of Windows® (see the corresponding OS manual).
4) Select (click on) “PANATERM®” from the program menu.
5) An opening splash will be displayed for two seconds, and then “PANATERM®” screen will appear.

For the operation, functions and other details about “PANATERM®”, see the Instructions for the “PANATERM®” program.

* Windows®, Windows®95, Windows®98, Windows®NT, Windows®2000, Windows®Me are the trademarks of Microsoft Co., Ltd.

Communication

Outline of Communication

When a PC or host NC is connected with up to sixteen MINAS-AIII drivers via the RS232C and RS485 serial interfaces, the following functions are provided:

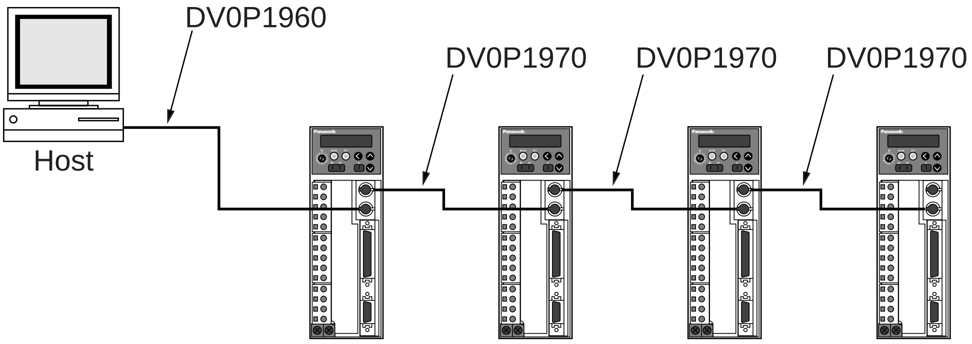
1) Parameter change
2) Alarm data and history browse/clear
3) Control monitor including status and I/O monitor
4) Absolute data browse
5) Parameter save/load

Advantages

- All parameters can be loaded from a host at machine start-up.
- Since machine's operating conditions are displayed, maintainability can be improved.
- Multi-axis absolute position control system can be configured with simple wiring.

For the MINAS-AIII series, the following PC application software and cables are available. For the PANATERM® operating procedures, refer to the PANATERM® Operation Manual.

PANATERM® (J apanese version)	DV0P3170
PANATERM® (English version)	DV0P3180
PC (DOS/V) connection cable	DV0P1960
driver connection cable	DV0P1970 (200[mm])
	DV0P1971 (500[mm])
	DV0P1972 (1000[mm])



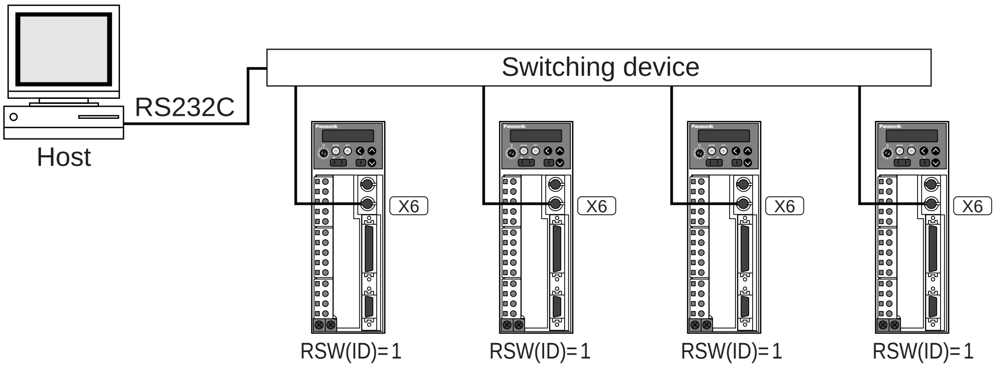
Communication Specifications

Connection of Communication Line

The MINAS-AIII series provides two communication ports, enabling the following three types of connections between the host and individual drivers.

- **RS232C Communication**

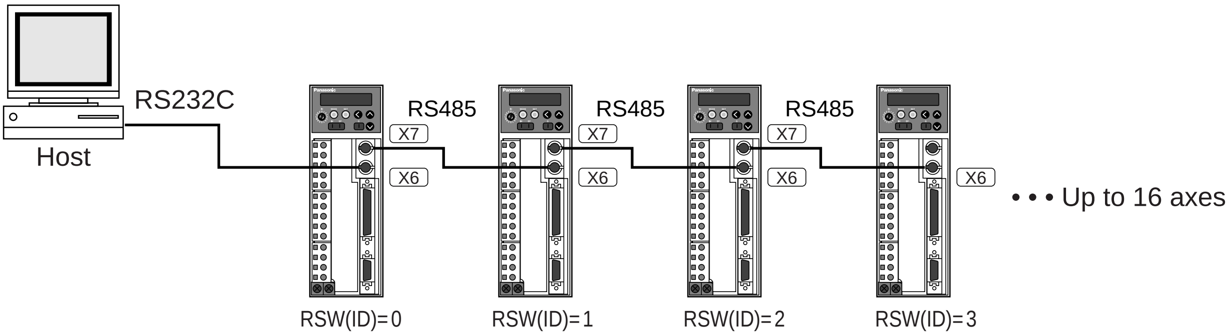
  For communication according to the RS232C transmission protocol, a host is connected to a MINAS-AIII driver via the RS232C interface.



A MINAS-AIII module ID is assigned to the RSW on the front panel. In the above case, specify any code between "0" and "F" for the module ID. If there is no particular problem on host control, the same module ID can be assigned to several MINAS-AIII drivers.

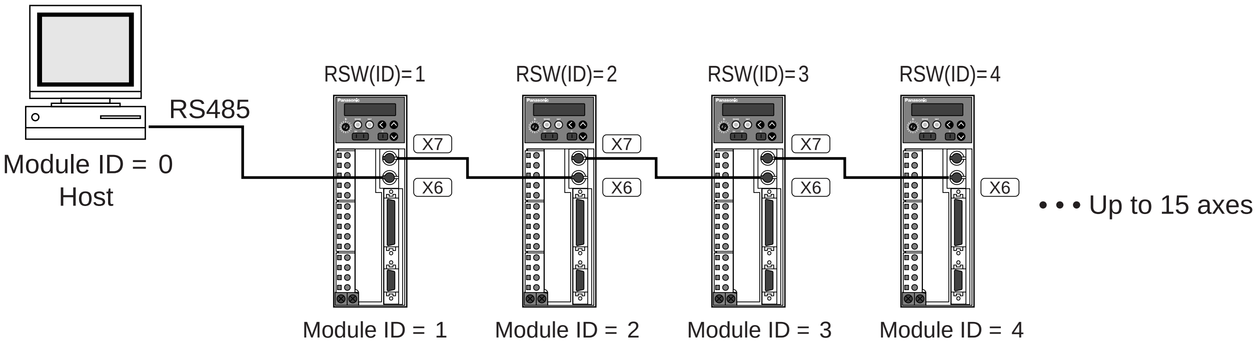
- **RS232C and RS485 Communications**

  When a host communicates with several MINAS-AIII drivers, the host is connected to the driver's [X6] connector via the RS232C interface, and several MINAS-AIII drivers are connected with each other via the RS485 interface. "0" is assigned to the RSW on the MINAS-AIII front panel directly connected to the host, and different codes between "1" and "F" are assigned to other MINAS-AIII drivers.



- **RS485 Communication**

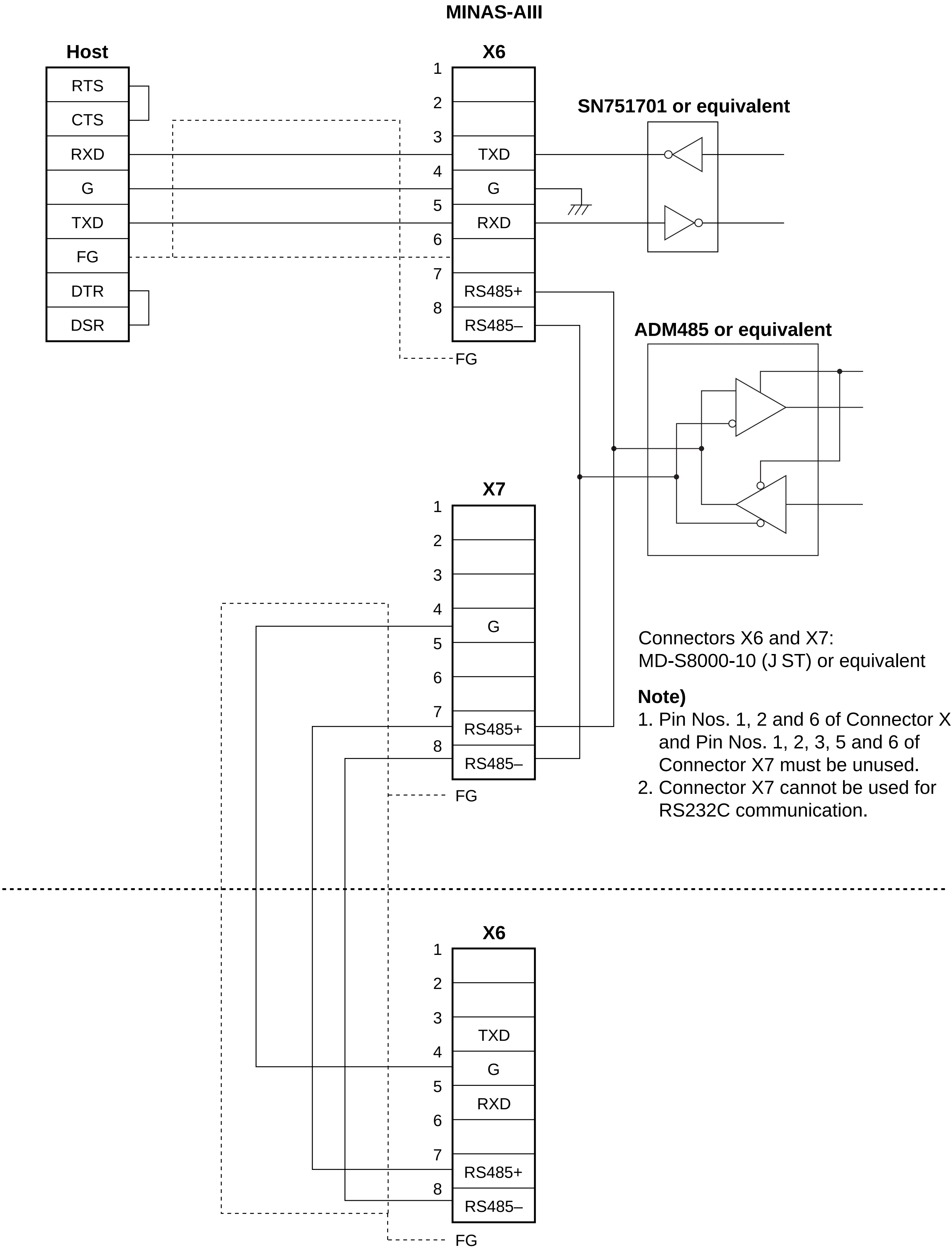
  A host is connected to several MINAS-AIII drivers via the RS485 interface, and any code between "1" and "F" is assigned to the RSW on each MINAS-AIII front panel.



To read multi-axis data, provide 500 ms or longer axis-switching intervals.

Communication Connector Interface

• Connecting Host via RS232C Interface

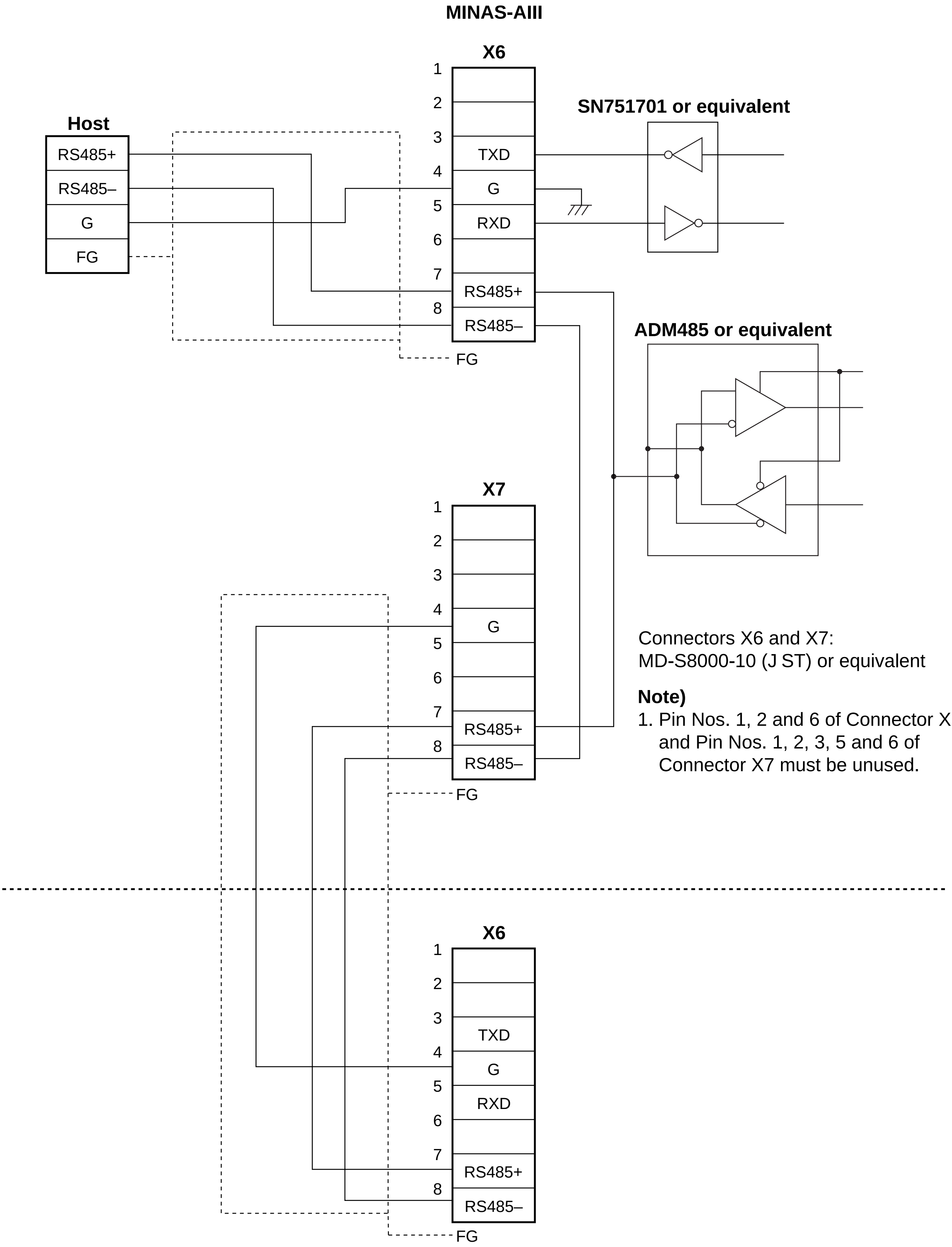


Connectors X6 and X7:
MD-S8000-10 (J ST) or equivalent

Note)

1. Pin Nos. 1, 2 and 6 of Connector X6, and Pin Nos. 1, 2, 3, 5 and 6 of Connector X7 must be unused.
2. Connector X7 cannot be used for RS232C communication.

• Coonecting Host via RS485 Interface



Connectors X6 and X7:
MD-S8000-10 (J ST) or equivalent

Note)

1. Pin Nos. 1, 2 and 6 of Connector X6, and Pin Nos. 1, 2, 3, 5 and 6 of Connector X7 must be unused.

Communication

Communication Method

	RS232C	RS485
	Full-duplex, start-stop transmission	Half-duplex, start-stop transmission
Baud rate	2400/4800/9600 bps	2400/4800/9600 bps
Data	8 bits	8 bits
Parity	None	None
Start bit	1 bit	1 bit
Stop bit	1 bit	1 bit

- To set up the RS232C and RS485 communication baud rates, use "Pr0C" and "Pr0D" respectively. Changes in these parameters become valid after the control power supply is turned ON. For details, refer to the communication parameter list below.

Communication Parameter List

Pr No.	Parameter name	Setting range	Function/Description
00	Axis name	0 – 15	Used to conform the ID assigned to the front panel RSW at power-ON of the control power supply. This value indicates the axis number for serial communication. This parameter setting has no influence on the servo motor's operation.
0C	RS232C baud rate setup	0 – 2	Used to define the RS232C communication speed. 0: 2400 (bps), 1: 4800 (bps), 2: 9600 (bps) A change in this parameter becomes valid after the control power supply is turned ON.
0D	RS485 baud rate setup	0 – 2	Used to define the RS485 communication speed. 0: 2400 (bps), 1: 4800 (bps), 2: 9600 (bps) A change in this parameter becomes valid after the control power supply is turned ON.

- The data transmission time per byte is calculated from the following formula: Example) When the baud rate is 9600 (bps):

$$(1000/9600) \text{ x } (\underbrace{1}_{\text{Start bit}}+\underbrace{8}_{\text{Data}}+\underbrace{1}_{\text{Stop bit}}) = 1.04 \text{ [ms/byte]}$$

  When the baud rate is 2400 (bps) and 4800 (bps), the data transmission time per byte are 4.17 [ms/byte] and 2.08 [ms/byte] , respectively.
  Note) For calculation of the actual communication time, received command processing time and the line and transmission/receiving control switching time are additionally required.

• Handshaking Control Code

For line control, the following codes are used:

Name	Code	Function
ENQ	(Target module identification byte)05h	Transmission request
EOT	(Target module identification byte)04h	Ready to receive
ACK	06h	Acknowledgement
NAK	15h	Negative acknowledgement

ENQ: When a module contains transmission data, it will send ENQ.

EOT: When a module is ready to receive a command block, it will send EOT. When a module receives EOT after sending ENQ, it will enter the transmission mode. When a module sends EOT after receiving ENQ, it will enter the receiving mode.

ACK: When a received block is judged valid, ACK will be returned.

NAK: When a received block is judged invalid, NAC will be returned. The validity is judged by checksum and timeout.

<NOTE>

For RS485 communication, the following module identification byte (one byte) is added to the ENQ and EOT. Module identification byte: The value assigned to the front panel RSW indicates the module ID. The module identification byte is the data whose bit 7 is set to "1".

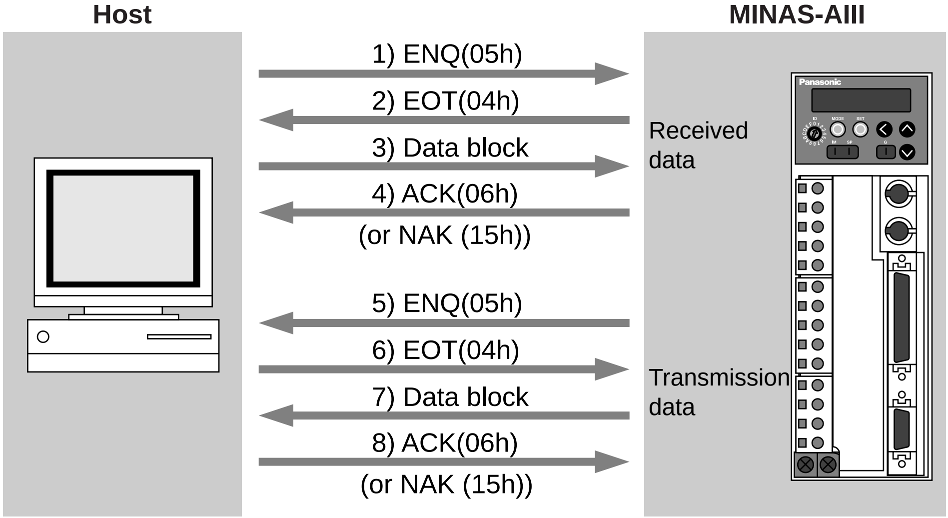
bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
1	0	0	0	Module ID			

Module ID: For RS485 communication, the MINAS-AIII front panel RSW setting must be any code between "1" and "F", because the host module ID is "0".

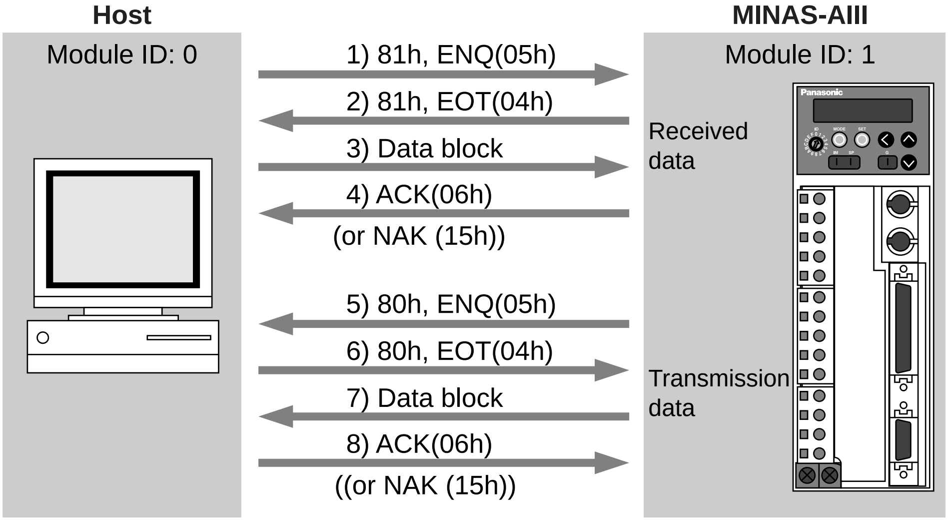
Transmission Sequence

• Transmission Protocol

<RS232>



<RS485>



- **Line control**

  Direction of transmission and priority at conflict are defined.
  Receiving mode: When a module sends EOT after receiving ENQ, it enters the receiving mode.
  Transmission mode: When a module receives EOT after sending ENQ, it enters the transmission mode.
  At conflict between transmitting and receiving modules: When a slave receives ENQ when waiting for EOT after sending ENQ, priority is given to ENQ sent from a master, and the slave enters the receiving mode.

- **Transmission control**

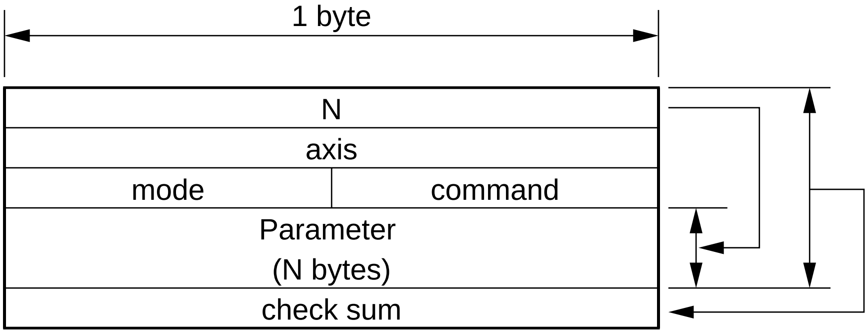
  A module in the transmission mode continuously sends command blocks, and then waits for ACK. When the module receives ACK, the transmission mode is completed. If a command byte number transmission error occurs, ACK may not be returned. When ACK is not returned within the T2 period, or when NAC or any code other than ACK is returned, transmission retry will be executed.
  Transmission retry will be started with ENQ.

- **Receiving control**

  A module in the receiving mode continuously receives command blocks. It obtains a command byte number from the first byte, and receives command blocks as many as the specified byte number + 3. When the sum of the received data becomes "0", it judges that the receiving mode is normally completed, and returns ACK. If a checksum error or character transmission timeout error occurs, NAK will be returned.

• Configuration of Data Block

The data block transmitted on physical phase is configured as follows:



N:	Command byte number (0 to 240), which indicates the number of parameters required for a command.
axis:	Defines the value (0 to 15) assigned to the RSW on the driver front panel. Module ID can be confirmed via Pr.00 (axis address).
command:	Control command (0 to 15)
mode:	Command execution mode (0 to 15). The set value varies depending on the command to be executed.
checksum:	Two's complement of the total number of bytes, ranging from the first byte to the byte imme diately before the checksum byte.

• Protocol Parameters

The following parameters are used for block transmission control. For these parameters, a desired value can be specified with the INIT command described later.

Name	Function		Initial value	Setting range	Unit
T1	Character transmission timeout		5 (0.5 sec)	1 to 255	0.1 sec
T2	Protocol time out	RS232C	10 (10 sec)	1to 255	1 sec
		RS485	2 (2 sec)		
RTY	Retry limit		1 (Once)	1 to 8	Once
M/S	Master/Slave		0 (Slave)	0, 1 (Master)	

T1:
- Allowable wait time between module identification byte and ENQ/EOT reception, or for receiving the next character code after receiving a character code in a data block. If the specified time is exceeded, it is judged as a timeout error, and NAK is returned to the transmitting module.

T2:
- Allowable wait time for receiving EOT after sending ENQ. If the specified is exceeded, it means that the receiving module is not ready to receive data, or that the ENQ code cannot be received for any reason. In this case, the ENQ code is re-sent to the receiving module. (Retry number)
- Allowable wait time for receiving the first character after sending EOT. If the specified time is exceeded, NAK is returned, and the receiving mode ends.
- Allowable wait time for receiving ACK after sending checksum byte. If the specified time is ex ceeded, the ENQ code is re-sent to the receiving module, as in the case with NAK reception.

RTY: Maximum retry number. If this number is exceeded, it is judged as a transmission error.

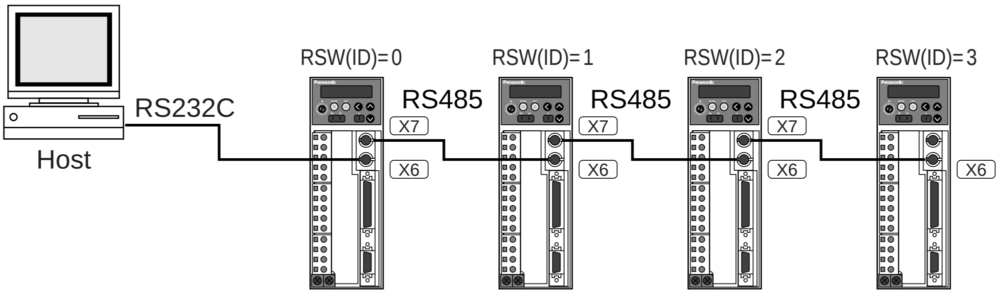
M/S: Master/Slave switching parameter. If ENQ transmission conflicts, this parameter determines which is given priority. (0 = Slave mode, 1 = Master mode) Transmission priority is given to the module defined as master.

Example of Data Communication

• Browsing Absolute Data (Example)

This section describes an example of communication data flow for acquisition of absolute data on Model ID = 1, wherein a host is connected to a MINAS-AIII driver via the RS232C interface and the MINAS-AIII driver is connected to several drivers via the RS485 interface.

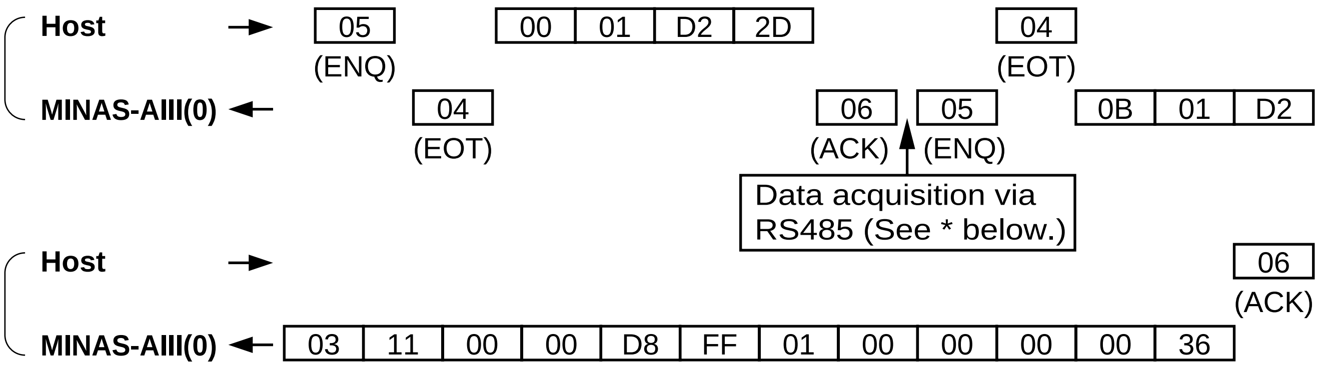
Configuration



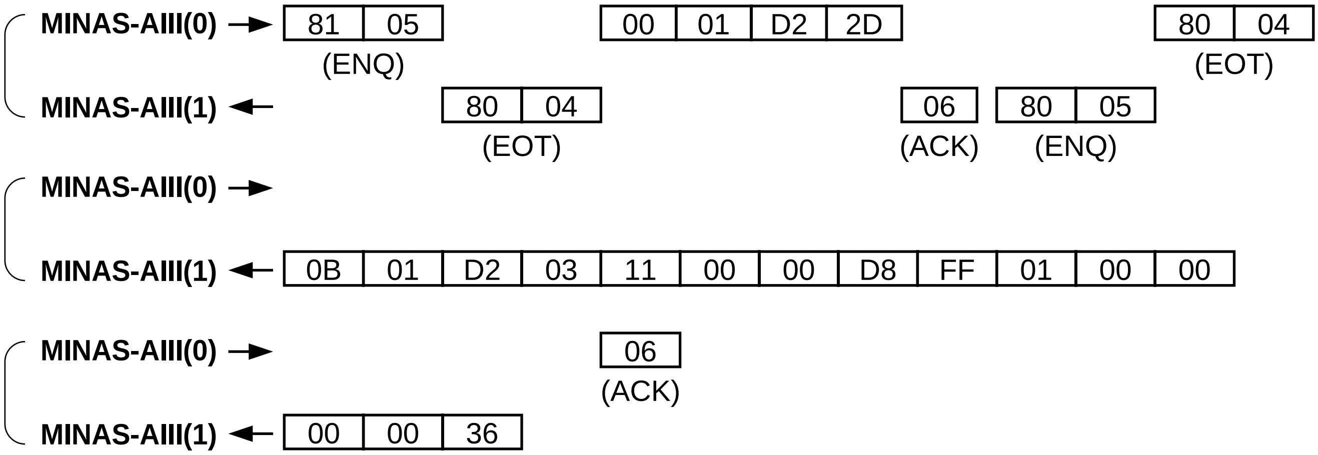
Example of Absolute Data Acquisition

This following is the time-series communication data flow for absolute data acquisition. Data are expressed by hexadecimal numbers.

RS232C communication



* **RS485 communication**



Note) The acquired data are expressed as follows:

For the data configuration, see page 251 <Reading Absolute Encoder> on "Communication Command Details" .

Multi-revolution data : 0000h = 0

Single-revolution data :01FFD8h = 131032

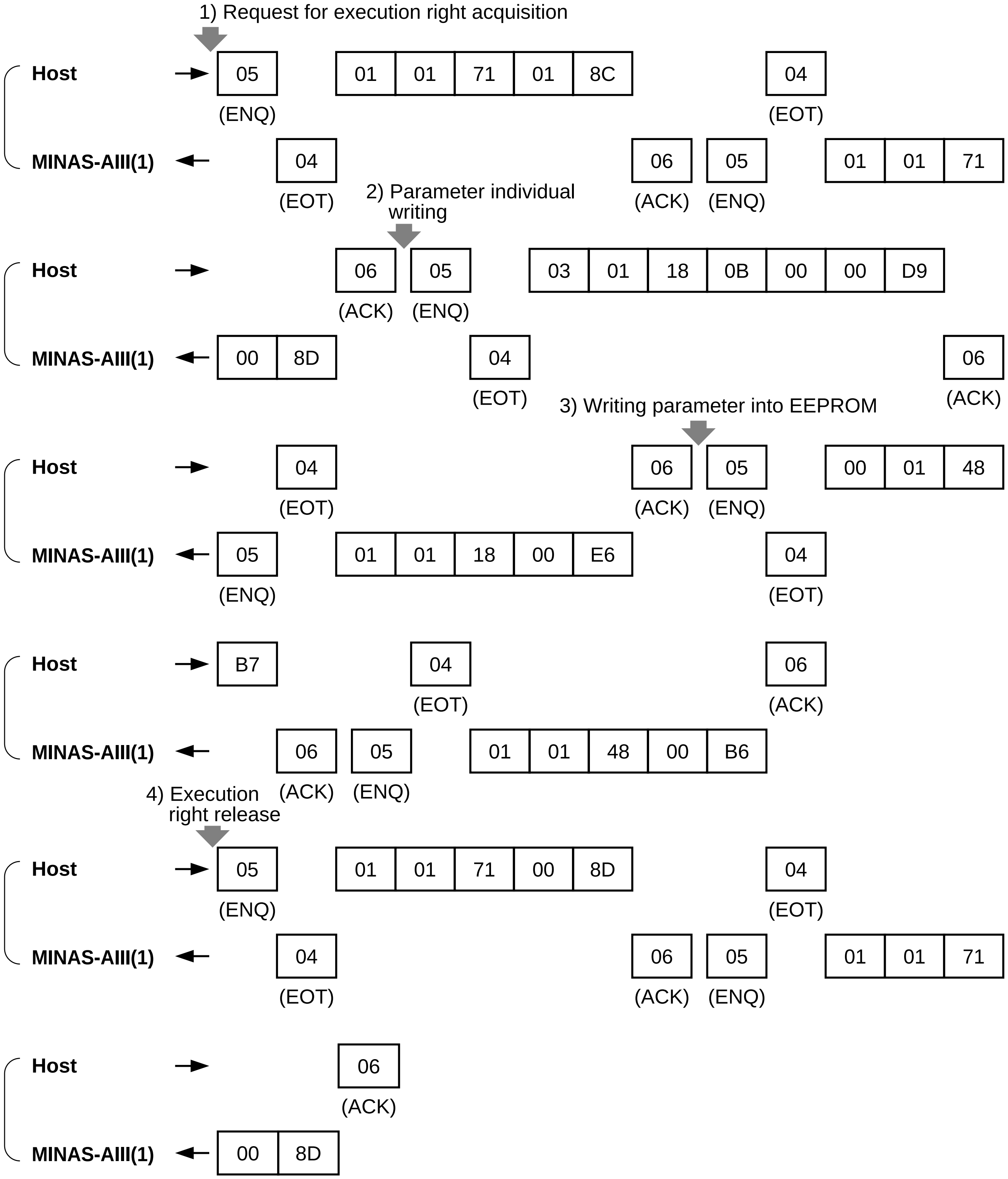
To read multi-axis data, provide 500 ms or longer axis-switching intervals.

• Example of Parameter Change

The following is the time-series communication data flow for parameter change.
Generally, communication is conducted in the following sequence:

1) Request for execution right acquisition,
2) Parameter individual writing,
3) Writing parameter into EEPROM (if parameter must be saved), and
4) Execution right release.

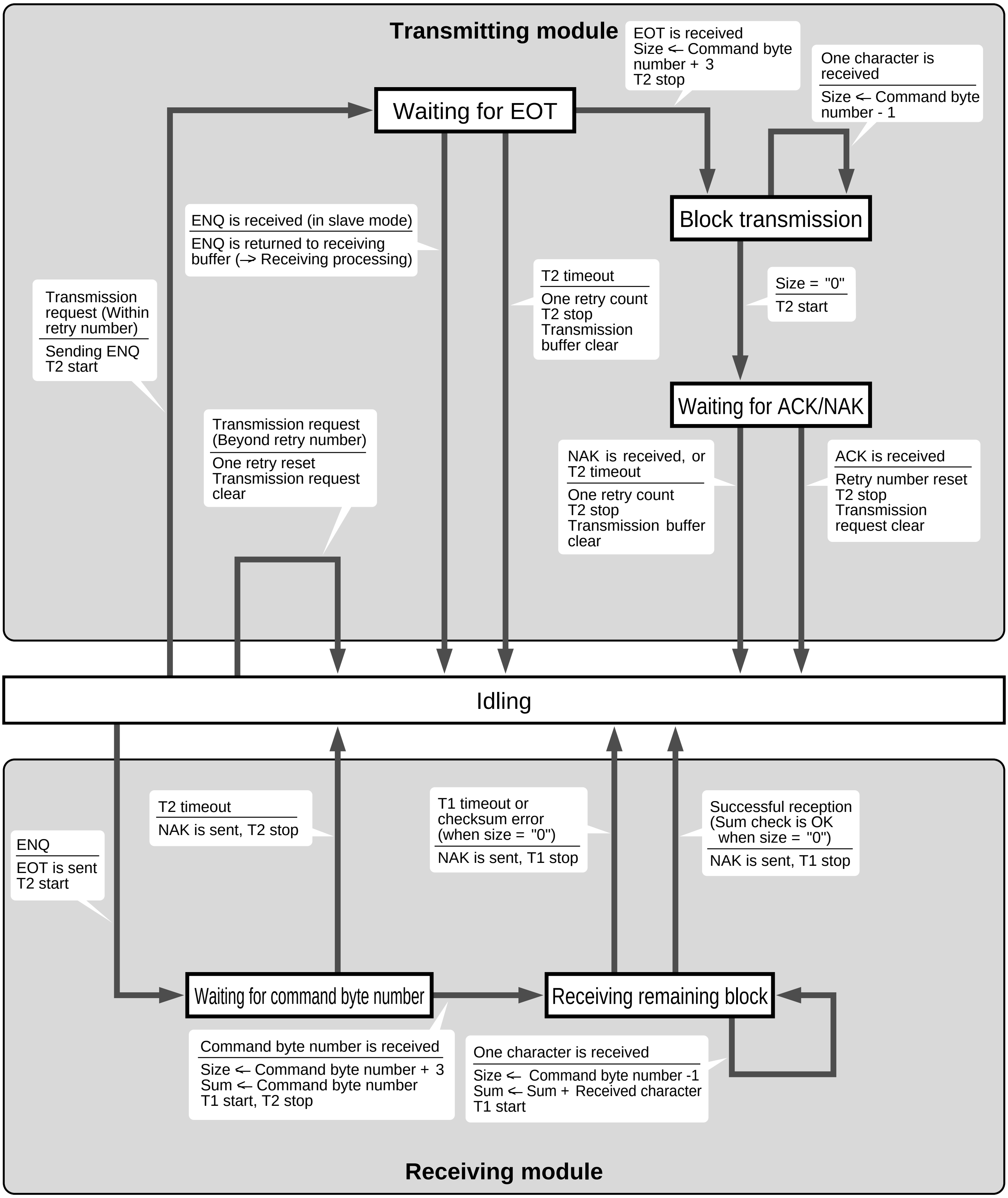
This example shows that a MINAS-AIII driver (User ID = 1) is directly connected to a host via the RS232C interface. The data are expressed by hexadecimal numbers.



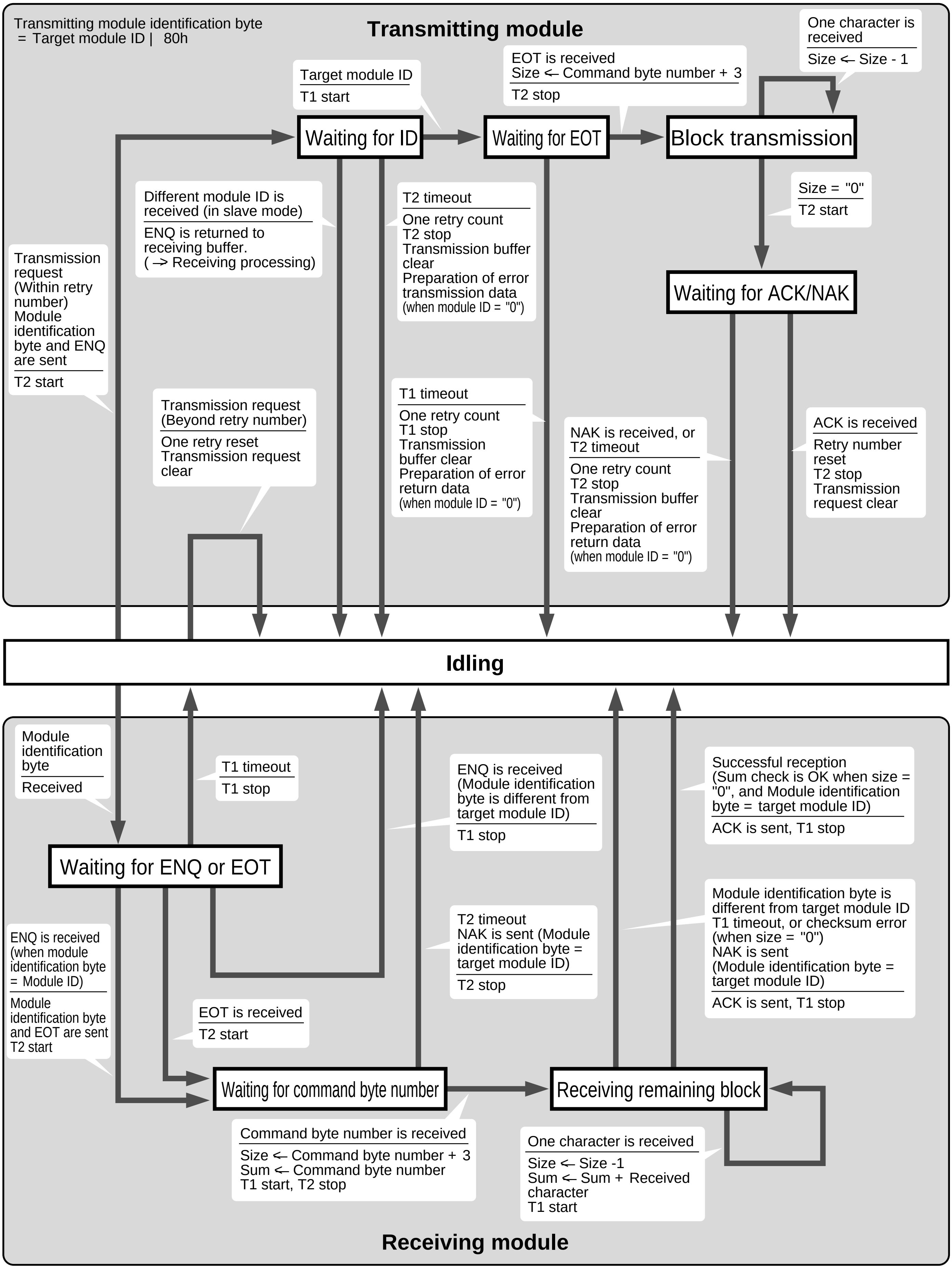
Note) For details on the commands, see page 245 "Communication Command Details".

Status Transition Chart

- **RS232C communication**

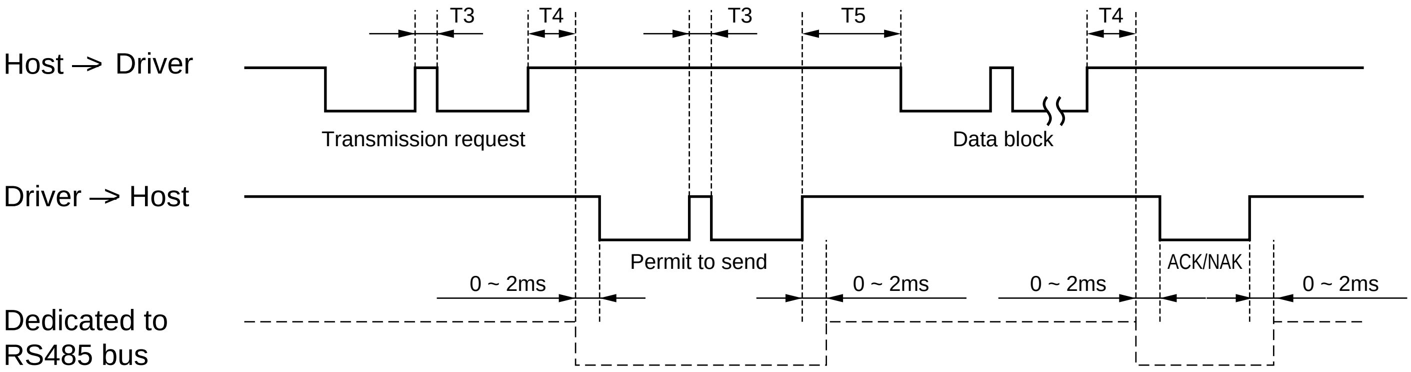


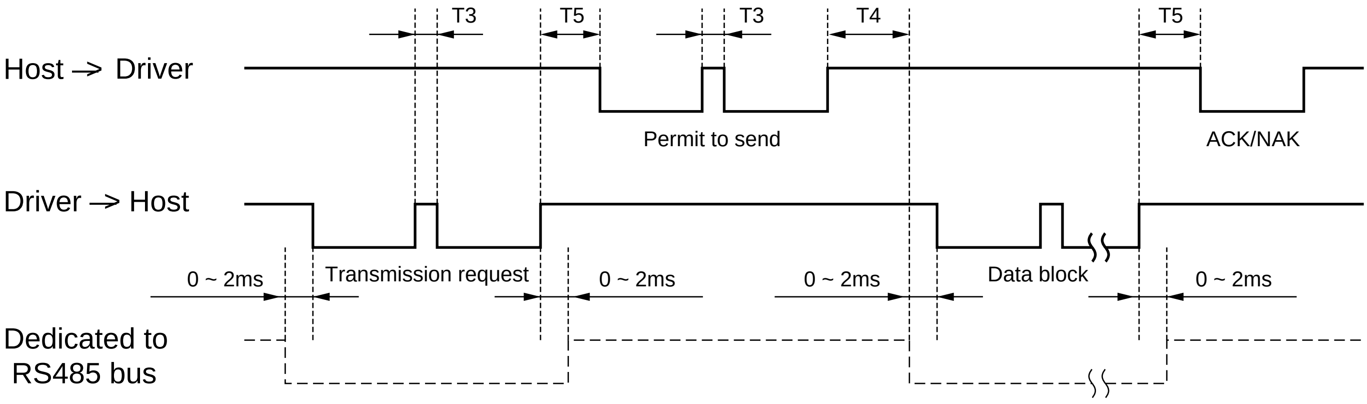
• RS485 communication



Communication Timing

• RS485 communication (Same as for RS232 communication)





Code	Name	Minimum	Maximum
T3	Continuous character transmission time	Stop bit length	Protocol parameter T1
T4	Driver response time	4ms	Protocol Parameter T2
T5	Host response time	2ms	Protocol Parameter T2

<CAUTION>

The specified time indicates the period from the stop bit rising edge.

Communication

Communication Command List

command	mode	Description
0		NOP
	1	Reading CPU1 Version
	2	Reading CPU2 Version
	5	Reading Driver Model
	6	Reading Motor Model
1		INIT
	1	RS232C Protocol Parameter Setup
	2	RS485 Protocol Parameter Setup
	7	Execution Right Acquisition/Release
2		POS, STATUS, I/O
	0	Reading Status
	1	Reading Command Pulse Counter
	2	Reading Feedback Pulse Counter
	4	Reading Current Speed
	5	Reading Current Torque Output
	6	Reading Current Error Counter
	7	Reading Input Signal
	8	Reading Output Signal
	9	Reading Current Speed/Torque/Error Counter
	A	Reading Status/Input Signal/Output Signal
	D	Reading Absolute Encoder
8		PARAMETER
	0	Parameter Individual Reading
	1	Parameter Individual Writing
	4	Writing Parameter into EEPROM
9		ALARM
	0	Reading Current Alarm Data
	1	User Alarm History Individual Reading
	2	User Alarm History Batch Reading
	3	User Alarm History Clear (from EEPROM)
	4	Alarm Clear
	B	Absolute Encoder Clear
B		PARAMETER
	0	User Parameter Individual Reading
	1	User Parameter Page Reading
	2	User Parameter Page Writing

Be sure to use the above commands only. If unspecified commands are used, the driver's operation cannot be guaranteed.

Communication Command Details

command	mode
0	1

• Reading CPU 1 Version Information

Received data

0	
axis	
1	0
checksum	

Transmission data

3	
axis	
1	0
Version (High-order)	
(Low-order)	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error				

- The version information (Ver. X.XX) is divided into high-order data and low-order data. (The decimal point is expressed by "0" in the least -significant 4 bits of the high-order data.)
- The version information is expressed by numbers between "0" and "9". (Example: "Version 3.13" is expressed by "30h" (high-order data) and "13h" (low-order data).)
- The version information indicates the CPU1 version No.

command	mode
0	2

• Reading CPU 2 Version Information

Received data

0	
axis	
2	0
checksum	

Transmission data

3	
axis	
2	0
Version (High-order)	
(Low-order)	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error				

- The version information (Ver. X.XX) is divided into high-order data and low-order data. (The decimal point is expressed by "0" in the least -significant 4 bits of the high-order data.)
- The version information is expressed by numbers between "0" and "9". (Example: "Version 3.13" is expressed by "30h" (high-order data) and "13h" (low-order data).)
- The version information indicates the CPU2 version No.

command	mode
0	5

• Reading Driver Model

Received data

0	
axis	
5	0
checksum	

Transmission data

0Dh	
axis	
5	0
Driver model (High-order)	
Driver model (Low-order)	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error				

- Driver model is expressed by twelve characters (ASCII codes).
  Ex. "MSDCT1503***"

command	mode
0	6

• Reading Motor Model

Received data

0	
axis	
6	0
checksum	

Transmission data

0Dh	
axis	
6	0
Motor model (High-order)	
Motor model (Low-order)	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error				

- Motor model is expressed by twelve characters (ASCII codes).
  Ex. "MSMA012S1**"

command	mode
1	1

• RS232C Protocol Parameter Setup

Received data

3	
axis	
1	1
T1	
T2	
M/S	RTY
checksum	

Transmission data

1	
axis	
1	1
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error	RTY error	T2 error	T1 error	M/S error

- The previous protocol parameter setting remains valid until execution of this command is completed. After execution of this command is completed, the updated parameter setting becomes valid when the next command is executed.
  M/S = 0 indicates "SLAVE" mode, and M/S = 1 indicates "MASTER" mode.
- The RTY code is 4 bits, and the M/S code is 1 bit.
- The units of T1 and T2 are "0.1 sec" and "1 sec", respectively.

command	mode
1	2

• RS485 Protocol Parameter Setup

Received data

3	
axis	
2	1
T1	
T2	
M/S	RTY
checksum	

Transmission data

1	
axis	
2	1
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error	RTY error	T2 error	T1 error	M/S error

- The previous protocol parameter setting remains valid until execution of this command is completed.
  After execution of this command is completed, this parameter setting becomes valid when the next command is executed.
  M/S = 0 indicates "SLAVE" mode, and M/S = 1 indicates "MASTER" mode.
- The RTY code is 4 bits, and the M/S code is 1 bit.

command	mode
1	7

• Execution Right Acquisition/Release

Received data

1	
axis	
7	1
mode	
checksum	

Transmission data

1	
axis	
7	1
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error	00	Command error	RS485 error	mode error			Used

- Before writing parameter (into EEPROM), the execution right acquisition request is executed. After writing parameter is completed, the execution right release request is executed.
- mode = 1: Execution right acquisition request
  mode = 0: Execution right release request
- If the execution right acquisition request ends in failure, the "Used" error code is transmitted.

command	mode
2	0

• Reading Status

Received data

0	
axis	
0	2
checksum	

Transmission data

3	
axis	
0	2
Control mode	
Status	
Error code	
checksum	

Status

bit7	6	5	4	3	2	1	0
		CCW torque output	CW torque output	CCW revolution	CW revolution	Under DB permission speed	Torque limitation

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error				

- The control modes are defined as follows:

0	Position control mode
1	Speed control mode
2	Torque control mode
3	Semi-closed control mode
4	Hybrid control mode
5	Full-closed control mode
6	External encoder control mode

7	Position control (for high stiffness)
8	Position control (for low stiffness)
9	Speed control (for low stiffness)
10	2nd full-closed control mode

command	mode
2	1

• Reading Command Pulse Counter

Received data

0	
axis	
1	2
checksum	

Transmission data

5	
axis	
1	2
Counter value L	
	H
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error				

- The current command position is expressed by the absolute coordinates from the starting point.
  (Cumulative sum of command pulse numbers)
- The counter value is 32 bits.
- For the counter value, "-" indicates CW, and "+" indicates CCW.

command	mode
2	2

• Reading Feedback Pulse Counter

Received data

0	
axis	
2	2
checksum	

Transmission data

5	
axis	
2	2
Counter value L	
H	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error				

- The current position of the feedback pulse counter is expressed by the absolute coordinates from the starting point.
- For the counter value, "-" indicates CW, and "+" indicates CCW.
- The feedback pulse counter indicates a cumulative sum of the position detector's pulse numbers, which corresponds to the actual motor position.

command	mode
2	4

• Reading Current Speed

Received data

0	
axis	
4	2
checksum	

Transmission data

3	
axis	
4	2
Data (Current speed) L	
H	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error				

- This command is used to read the current speed. (Unit: r/min)
- The output value is 16 bits.
- For the speed value, "-" indicates CW, and "+" indicates CCW.

command	mode
2	5

• Reading Current Torque Output

Received data

0	
axis	
5	2
checksum	

Transmission data

3	
axis	
5	2
Data (Torque) L	
H	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error				

- This command is used to read the current torque output. (Unit: conversion from rated torque = 2000)
- The output value is 16 bits.

command	mode
2	6

• Reading Current Error Counter

Received data

0	
axis	
6	2
checksum	

Transmission data

5	
axis	
6	2
Data (Error) L	
H	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error				

- This command is used to read the current value of the error counter. (Unit: pulse)
- The output value is 32 bits.
- "+" indicates that the encoder is in the CW direction, and "-" indicates that the encoder is in the CCW direction relative to the position command.

command	mode
2	7

• Reading Input Signal

Received data

0	
axis	
7	2
checksum	

Transmission data

5	
axis	
7	2
Data L	
Data H	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error				

Data

bit7	6	5	4	3	2	1	0
Command pulse ratio switching 2	Command pulse ratio switching 1	Speed zero clamp	Control mode switching	CCW drive inhibited	CW drive inhibited	Alarm clear	Servo ON

bit15	14	13	12	11	10	9	8
Scale error	Reserve	Internal speed command selection 2	Internal speed command selection 1	Reserve	Counter clear	Gain switching	Command pulse input inhibited

bit23	22	21	20	19	18	17	16
Reserve	Reserve	Reserve	Reserve	Reserve	Smoothing selection	Reserve	Reserve

bit31	31	29	28	27	26	25	24
Reserve	Reserve	Reserve	Reserve	Reserve	Reserve	Reserve	Reserve

- For the "CCW drive inhibited", "CW drive inhibited", "Speed zero clamp" and "Command pulse input inhibited" input signals, "1" indicates the open status. For other input signals, "0" indicates the open status.

Communication

command	mode
2	8

• Reading Output Signal

Received data

0	
axis	
8	2
checksum	

Transmission data

7	
axis	
8	2
Data L	
Data H	
Alarm data L	
H	
Error code	
checksum	

Alarm data

bit 7 Overload
bit 5 Over-regenerative
bit 0 Battery

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error				

Data

bit7	6	5	4	3	2	1	0
Reserve	Reserve	Torque limitation	Zero speed detection	Mechanical brake reset	In-position	Servo alarm	Serve ready

bit15	14	13	12	11	10	9	8
Reserve	Reserve	Dynamic brake ON	Reserve	Reserve	Full-closed positioning complete	At-speed	Reserve

bit23	22	21	20	19	18	17	16
Reserve	Reserve	Reserve	Reserve	Reserve	Reserve	Reserve	Reserve

bit31	31	29	28	27	26	25	24
Reserve	Reserve	Reserve	Reserve	Reserve	Reserve	Reserve	Reserve

- The following table shows the relation between each signal and operation.

Signal name	0	1
Servo ready	Not ready	Ready
Servo alarm	Normal	Error
In-position	Not finished	Finished
Mechanical brake OFF	ON	OFF
Zero speed detection	Not detected	Detected
Torque limitation	Not limited	Limited
At-speed	Not reached	Reached
Dynamic brake ON	OFF	ON

command	mode
2	9

• Reading Current Speed/Torque/Error Counter

Received data

0	
axis	
9	2
checksum	

Transmission data

9	
axis	
9	2
Data L	
(Speed) H	
Data L	
(Torque) H	
Data L	
(Error) H	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error				

- The speed and torque output values are 16 bits, and the error output value is 32 bits.
- The unit and sign of the output data are same as those for Command Nos. 24, 25 and 26.

command	mode
2	A

• Reading Status/Input Signal/Output Signa

Received data

0	
axis	
A	2
checksum	

Transmission data

0Dh	
axis	
A	2
Control mode	
Status	
Input signal L	
Input signal H	
Output signal L	
Output signal H	
Alarm data L	
Alarm data H	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error				

- For control mode, status, input signal, output signal and alarm data, the meanings of individual bits are same as those for Command Nos. 20 (command=2, mode=0), 27 (mode=7) and 28 (mode=8).

command	mode
2	D

• Reading Absolute Encoder

Received data

0	
axis	
D	2
checksum	

Transmission data

0BH	
axis	
D	2
Encoder ID (L)	
(H)	
Status (L)	
(H)	
(L)	
Single-revolution data	
(H)	
Multi-revolution data (L)	
(H)	
0	
Error code	
checksum	

	Encoder ID (L)	Encoder ID (H)
17-bit absolute encoder	3	0x11

Status (L)

bit7	6	5	4	3	2	1	0
Battery alarm	Battery error	Multi-revolution error	0	Counter overflow	Count error	Full absolute status	Over-speed

Status (H)

- bit 4: Battery error
- bit 5: OR signal of Battery alarm, Multi-revolution error, Counter overflow, Count error, Full absolute status and Over-speed

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error				

- bit 5: When received data are not matched or the encoder is set in incremental mode

command	mode
8	0

• Parameter Individual Reading

Received data

1	
axis	
0	8
Parameter No.	
checksum	

Transmission data

3	
axis	
0	8
Parameter value L	
H	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error	No. error			

command	mode
8	1

• Parameter Individual Writing

Received data

3	
axis	
1	8
Parameter No.	
Parameter value L	
H	
checksum	

Transmission data

1	
axis	
1	8
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error	Data error	Command error	RS485 error	No. error			

- This command is used to change a parameter setting only temporarily. To save the changed parameter into the EEPROM, execute the <Writing Parameter into EEPROM> command (mode=4).
- For unused parameters, be sure to set "0": Otherwise, data error will occur.

command	mode
8	4

• Writing Parameter into EEPROM

Received data

0	
axis	
4	8
checksum	

Transmission data

1	
axis	
4	8
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error	Data error	Command error	RS485 error			Control LV	

- This command is used to write a parameter setting into the EEPROM.
- After the parameter setting is written into the EEPROM, the transmission data will be returned.
  Writing parameter may take approx. 5 seconds max. (if all parameters are changed).
- If writing parameter ends in failure, data error will occur.
- When control power supply LV is detected, the "Control LV" error code will be returned, and parameter writing is disabled.

command	mode
9	0

• Reading Current Alarm Data

Received data

0	
axis	
0	9
checksum	

Transmission data

2	
axis	
0	9
Alarm No.	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error				

- When no alarm is raised, Alarm No. is set to "0".
  (For details on Alarm No., refer to "Protective Functions (Alarm Codes)" on p. 216.)

command	mode
9	1

• Alarm History Individual Reading

Received data

1	
axis	
1	9
History No.	
checksum	

Transmission data

3	
axis	
1	9
History No.	
Alarm No.	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error	No. error			

- History Nos. 1 to 14 indicates the 1st to 14th previous alarm history, respectively.

command	mode
9	2

• Alarm History Batch Reading

Received data

0	
axis	
2	9
checksum	

Transmission data

	0Fh	
	axis	
	2	9
1st previous	Alarm No.	
2nd previous	Alarm No.	
	~	
14th previous	Alarm No.	
	Error code	
	checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error				

- This command is used to read 14 previous alarm events.

command	mode
9	3

• User Alarm History Clear

Received data

0	
axis	
3	9
checksum	

Transmission data

1	
axis	
3	9
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error	Data error	Command error	RS485 error			Control LV	

- This command clears the history of alarm data.
- If alarm clear processing ends in failure, data error will occur.
- When control power supply LV is detected, the "Control LV" error code will be returned, and parameter writing is disabled.

command	mode
9	4

• Alarm Clear

Received data

0	
axis	
4	9
checksum	

Transmission data

1	
axis	
4	9
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error				

- This command clears the current alarm. (Only applicable to the alarms that can be cleared)

command	mode
9	B

• Absolute Encoder Clear

Received data

0	
axis	
B	9
checksum	

Transmission data

1	
axis	
B	9
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error				

- This command clears absolute encoder's error and multi-revolution data.

command	mode
B	0

• User Parameter Individual Reading

Received data

1	
axis	
0	B
Parameter No.	
checksum	

Transmission data

9	
axis	
0	B
Parameter value L	
H	
MIN value L	
H	
MAX value L	
H	
Attribute L	
H	
Error code	
checksum	

Attribute

bit7	6	5	4	3	2	1	0
Unused parameter	Display inhibited	Privileged user	Change at initialization	System-related			

bit15	14	13	12	11	10	9	8
							Read only

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error	RS485 error	No. error			

command	mode
B	1

• User Parameter Page Reading

Received data

1	
axis	
1	B
Page No.	
checksum	

Transmission data

82h	
axis	
1	B
Page No.	
Parameter value L	
(No.0) H	
MIN value L	
(No.0) H	
MAX value L	
(No.0) H	
Attribute L	
(No.0) H	
≈	
Parameter value L	
(No.0fh) H	
MIN value L	
(No.0fh) H	
MAX value L	
(No.0fh) H	
Attribute L	
(No.0fh) H	
Error code	
checksum	

Attribute

bit7	6	5	4	3	2	1	0
Unused parameter	Display inhibited	Privileged user	Change at initialization	System-related			

bit15	14	13	12	11	10	9	8
							Read only

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error	Data error	Command error	RS485 error	No. error			

- For designation of page No., set a value between "0" and "7". With each page No. setting, 16 parameters can be read out.

command	mode
B	2

• User Parameter Page Writing

Received data

33	
axis	
2	B
Page No.	
Parameter L	
(No. 0 value) H	
Parameter value L	
(No.1 value) H	
~	
Parameter value L	
(No.0th value) H	
checksum	

Transmission data

00	
axis	
2	B
Page No.	
Error code	
checksum	

Error code

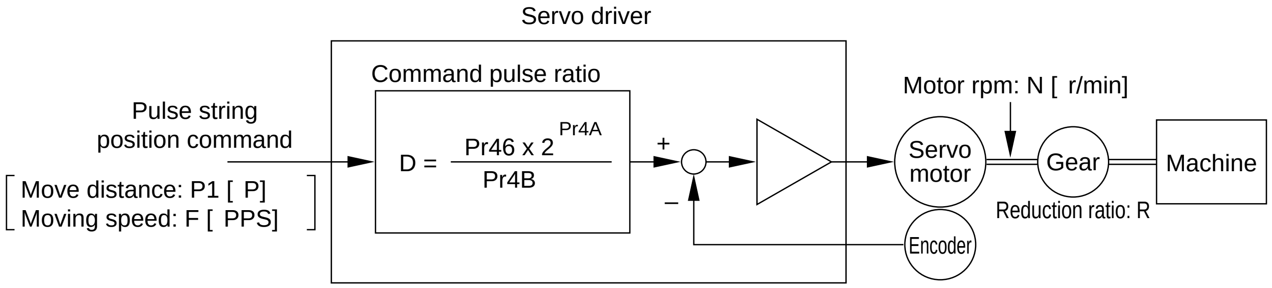
bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error	Data error	Command error	RS485 error	No. error			

- 16 parameters are written at once.
- For unused parameters, be sure to set "0": Otherwise, data error will occur.

MEMO

Description on Command Pulse Ratio for Parameter Setup

Relation between Positional Resolution/Moving Speed and Command Pulse Ratio



Number of encoder pulses: E [P/r]
* 10000 (= A/B phase 2500 [P/r] x 4)
* 131072 (=17 bit)

Ball Thread Drive Using Servo Motor (Example)

As an example of a machine, a ball thread driving system is described here.
When the lead of the ball thread is L [mm] , the actual move distance of the ball thread (M [mm]) according to the move distance command (P1 [P]) is expressed by Formula (1):

$$M = P1 \times (D/E) \times (1/R) \times L \quad \cdots\cdots\cdots\cdots \quad (1)$$

Therefore, the positional resolution (move distance ΔM per command pulse) is expressed by Formula (2):

$$\Delta M = (D/E) \times (1/R) \times L \quad \cdots\cdots\cdots\cdots \quad (2)$$

Through transformation of Formula (2), command pulse ratio D is calculated from Formula (3):

$$D = (\Delta M \times E \times R) / L \quad \cdots\cdots\cdots\cdots \quad (3)$$

The actual moving speed of the ball thread (V [mm/s]) according to the moving speed command (F) is expressed by Formula (4), and the corresponding motor rpm (N) is calculated from Formula (5):

$$V = F \times (D/E) \times (1/R) \times L \quad \cdots\cdots\cdots\cdots \quad (4)$$

$$N = F \times (D/E) \times 60 \quad \cdots\cdots\cdots\cdots \quad (5)$$

Through transformation of Formula (5), command pulse ratio D is calculated from Formula (6):

$$D = (N \times E) / (F \times 60) \quad \cdots\cdots\cdots\cdots \quad (6)$$

<Note>

1) Set the positional resolution (ΔM) at approx. 1/5 to 1/10 of the machine's positioning accuracy ($\Delta \varepsilon$), in view of mechanical errors.
2) For Pr46 and Pr4B, set any value between 1 and 10000.
3) The command pulse ratio can be freely specified depending on the denominator and numerator settings. However, if an extremely high or low pulse ratio is specified, the motor operation cannot be guaranteed. The command pulse ratio should be specified in the range of 1/50 to 20.
4)

2^{n}	Decimal number
2^{0}	1
2^{1}	2
2^{2}	4
2^{3}	8
2^{4}	16
2^{5}	32
2^{6}	64
2^{7}	128
2^{8}	256
2^{9}	512
2^{10}	1024
2^{11}	2048
2^{12}	4096
2^{13}	8192
2^{14}	16384
2^{15}	32768
2^{16}	65536
2^{17}	131072

	Command pulse ratio $D = \dfrac{\Delta M \times E \times R}{L}$	$D = \dfrac{Pr46 \times 2^{Pr4A}}{Pr4B}$
Lead of ball thread: L= 10 mm Reduction ratio: R = 1 Positional resolution: $\Delta M = 0.005$ mm Number of encoder pulses: 2500 P/r (E = 10000 P/r)	$\dfrac{0.005 \times 10000 \times 1}{10} = 5$ $\dfrac{10000 \times 2^{0}}{2000}$	Pr46 = 10000 Pr4A = 0 Pr4B = 2000
Lead of ball thread: L=20mm Reduction ratio: R = 1 Positional resolution: $\Delta M = 0.0005$ mm Number of encoder pulses: 2500 P/r (E = 10000 P/r)	$\dfrac{0.0005 \times 10000 \times 1}{20} = 0.25$ Because D < 1, 17-bit encoder should be used.	"D=1" is the requirement for the minimum resolution.
When 17-bit encoder is used (E=2^{17} P/r)	$\dfrac{0.0005 \times 2^{17} \times 1}{20} = \dfrac{1 \times 2^{17}}{40000} = \dfrac{1 \times \cancel{2^{2}} \times 2^{15}}{\cancel{2^{2}} \times 10000}$	Pr46 = 1 Pr4A = 15 Pr4B = 10000

<table>
<tr><td></td><td colspan="2">Motor rpm (r/min) $N = F \times \dfrac{D}{E} \times 60$</td></tr>
<tr><td>Lead of ball thread: L = 20 mm
Reduction ratio: R = 1
Positional resolution: $\Delta M = 0.0005$ mm
Line driver pulse input: 500 kpps
When 17-bit encoder is used</td><td colspan="2">$50\cancel{0000} \times \dfrac{1 \times 2^{15}}{\cancel{10000}} \times \dfrac{1}{\cancel{2}^{17}} \times 60 = 50 \times 60 \times \dfrac{1}{2^{2}} = 750$</td></tr>
<tr><td rowspan="4">To set the motor speed at 2000 r/min under the above conditions:</td><td>Command pulse ratio $D = \dfrac{N \times E}{F \times 60}$</td><td>$D = \dfrac{Pr46 \times 2P^{Pr4A}}{Pr4B}$</td></tr>
<tr><td>$D = \dfrac{2000 \times 2^{17}}{500000 \times 60} = \dfrac{2^{1} \times 1000 \times 2^{17}}{30000\cancel{000}}$
$= \dfrac{1 \times \cancel{2}^{3} \times 2^{15}}{\cancel{2}^{3} \times 3750} = \dfrac{1 \times 2^{15}}{3750}$</td><td>Pr46 = 1
Pr47 = 15
Pr48 = 3750</td></tr>
<tr><td colspan="2">Move distance per command pulse (mm)
(Positional resolution)
$\Delta M = \dfrac{D}{E} \times \dfrac{1}{R} \times L$</td></tr>
<tr><td colspan="2">$\dfrac{2^{15}}{3750} \times \dfrac{1}{2^{17}} \times \dfrac{1}{1} \times 20 = \dfrac{1}{3750} \times \dfrac{20}{2^{2}} \times \dfrac{20}{3750 \times 4} = 0.00133$mm</td></tr>
</table>

Conformance to EC Directives and UL Standards

EC Directives

The EC Directives apply to all such electronic products as those having specific functions and directly sold to general consumers in EU countries. These products are required to meet the EU unified standards and to be furnished with CE Marking.
Our product, AC servo, has specific functions, but is not sold directly to general consumers, i.e. this product is regarded as a component that constitutes a machine or equipment. Therefore, the product (AC servo) is not required to be furnished with CE Marking.
However, our AC servos meet the EC Directives for Low Voltage Equipment so that the machine or equipment comprising our AC servos can meet relevant EC Directives.

EMC Directives

Our servo systems can meet EMC Directives and related standards. However, to meet these requirements, the systems must be limited with respect to configuration and other aspects, e.g. the distance between the servo driver and motor is restricted, and some special wiring conditions must be met. This means that in some cases machines and equipment comprising our servo systems may not satisfy the requirements for wiring and grounding conditions specified by the EMC Directives. Therefore, conformance to the EMC Directives (especially the requirements for emission noise and noise terminal voltage) should be examined based on the final products that include our servo drivers and servo motors.

Applicable Standards

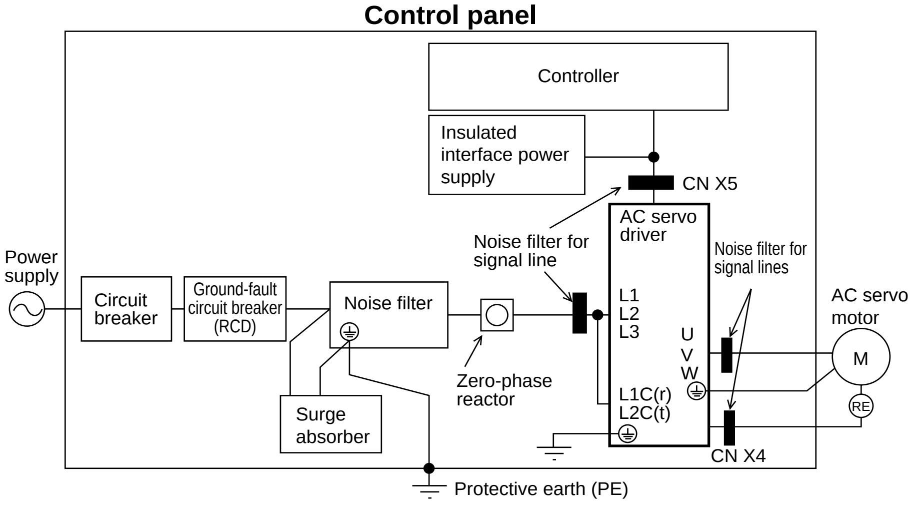
Subject	Applicable standard	
Motor	IEC60034-1 IEC60034-5	Standards referenced by Low-Voltage Directive
Motor and driver	EN50178	
	IEC61800-3 EMC Requirements for Variable Speed Electric Power Driven Systems	Standards referenced by EMC Directives
	EN55011 Radio Disturbance Characteristics of Industrial,	
	Scientific and Medical (ISM) Radio-Frequency Equipment	
	IEC61000-4-2 Electrostatic Discharge Immunity Test	
	IEC61000-4-3 Radio Frequency Electromagnetic Field Immunity Test	
	IEC61000-4-4 Electric High-Speed Transition Phenomenon - Burst Immunity Test	
	IEC61000-4-5 Lightning Surge Immunity Test	
	IEC61000-4-6 High Frequency Conduction - Immunity Test	
	IEC61000-4-11 Instantaneous Outage- Immunity Test	

IEC: International Electrical Commission
EN Europaischen Normen
EMC: Electromagnetic Compatibility

Configuration of Peripheral Equipment

Installation environment

Use the servo driver in an environment corresponding to Pollution Degree 1 or 2 prescribed in IEC60664-1. (Example: Install the servo driver in a control panel with IP54 protection structure.)



Power supply

100V system: Single-phase $100\text{V}^{+10\%}_{-15\%}$ – $115\text{V}^{+10\%}_{-15\%}$ 50/60Hz

200V system: Single-phase / Three-phase $200\text{V}^{+10\%}_{-15\%}$ – $240\text{V}^{+10\%}_{-15\%}$ 50/60Hz
(Type A – TypeD)
200V system: Single-phase / Three-phase $200\text{V}^{+10\%}_{-15\%}$ – $230\text{V}^{+10\%}_{-15\%}$ 50/60Hz
(Type E – TypeG)

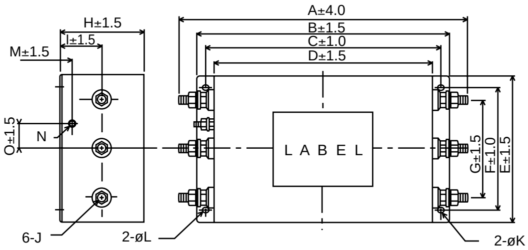
(1) Use the power supply in an environment corresponding to Overvoltage Category III prescribed in IEC60664-1.
(2) For the interface, use a 12 to 24 VDC insulated power supply conforming to the CE Marking or EN standard (EN60950).

Circuit Breaker

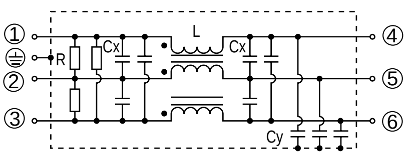
Be sure to connect a circuit breaker conforming to the IEC and UL standards (LISTED / Ⓤⓛ mark applied) between the power supply and the noise filter.

Noise Filter

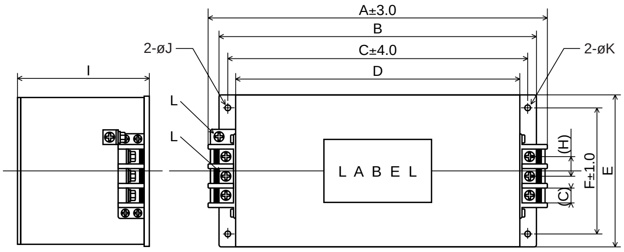
To provide a noise filter for the power supply when several servo drivers are connected, consult the noise filter manufacturer.



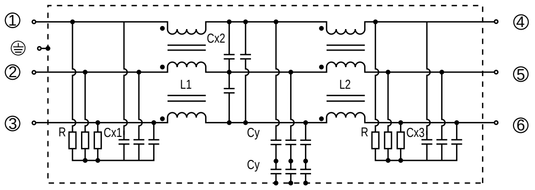
Circuit diagram



Optional Part No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Manufacturer's Product No.	Manufacturer
DV0P1441	188	160	145	130	110	95	70	55	25	M5	4.5	ø4.5 x 7	10	M4	17.5	3SUP-A10H-ER-4	Okaya Electric Industries Co., Ltd.
DV0P1442	228	200	185	170	110	95	70	60	30	M6	4.5	ø4.5 x 7	10	M4	17.5	3SUP-A30H-ER-4	
DV0P1443	272	240	220	200	140	110	70	80	40	M6	6.5	ø6.5 x 8	15	M4	20	SSUP-A50H-ER-4	



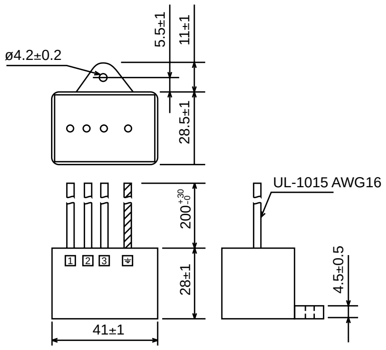
Circuit diagram



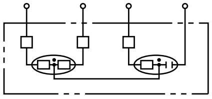
Optional Part No.	A	B	C	D	E	F	G	H	I	J	K	L	Manufacturer's Product No.	Manufacturer
DV0P3390	246	230	215	200	100	85	13	18	140	5.5 x 7	5.5	M4	3SUP-HL30-ER-6B	Okaya Electric Industries Co., Ltd.
DV0P3410	286	270	255	240	120	90	13	18	150	5.5 x 7	5.5	M6	3SUP-HL50-ER-6B	

Surge Absorber

Connect a surge absorber in the noise filter's primary side.



Circuit diagram

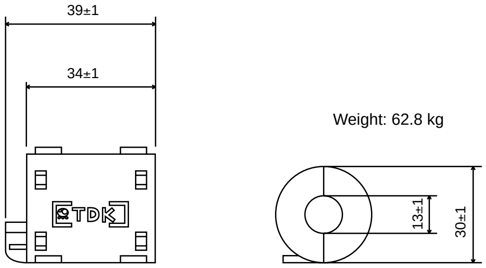


Optional Part No.	Manufacturer's Product No.	Manufacturer
DV0P1450	R · A · V-781BXZ-4	Okaya Electric Industries Co., Ltd.

<NOTE>
To conduct a withstand voltage test for a machine or equipment, be sure to remove the surge absorber. Otherwise, the surge absorber may be damaged.

Noise filter for signal line

Attach noise filter for signal line to every cable (power cable, motor cable, encoder cable, interface cable).
For frame-D, attach three noise filters to the power line.



Optional Part No.	Manufacturer's Product No.	Manufacturer
DV0P1460	ZCAT3035-1330	TDK Corporation

Grounding

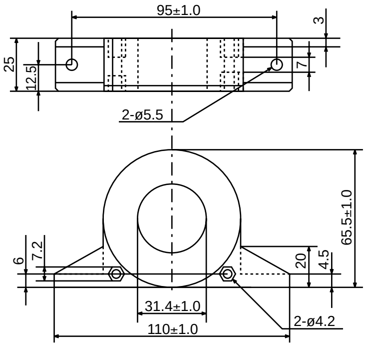
(1) To prevent an electric shock, be sure to connect the servo driver's protective earth terminal (⏚ with the control panel's protective earth terminal (PE).
(2) The servo driver provides two protective earth terminals. Do not connect these terminals together.

Ground-fault circuit breaker

Install a type B ground-fault circuit breaker (RCD) on the primary circuit.

Zero-phase reactor

Attach a zero-phase reactor to the secondary side of the noise filter.
For the Type A: 2 turns; for Type B, C, E, F and G: 7 turns
The Type D does not use any zero-phase reactor.



Optional Part No.	Manufacturer's Product No.	Manufacturer
DV0P3400	RZR-6020N	Okaya Electric Industries Co., Ltd.

Peripheral Devices Applicable to Drivers (EC Directives)

Please see page 26 – 29 "System Configuration and Wiring".

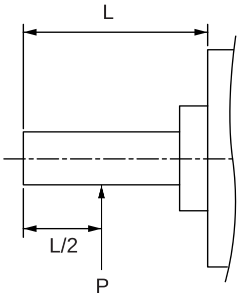
Conform to UL Standards

The noise filters conform to UL508C (File No. E164620) to satisfy the following conditions.

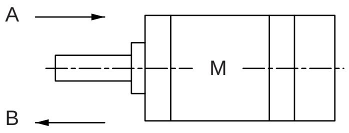
1) The servo driver should be used under Contamination Level 2 or 1 specified by IEC60664-1 (housing the driver in an IP54 control box).
2) Install a circuit breaker or fuse between the power supply and noise filter. The circuit breaker or fuse should be a UL listed ⓊⓁ marked) type. The current rating of the circuit breaker or fuse should be per the table in page 30 "List of Drivers and Compatible Peripheral Equipment".

Acceptable Loads on Output Axes

Radial load (P)



Thrust load (A and B)



Unit: N (1 kgf = 9.8 N)

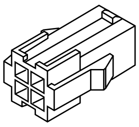
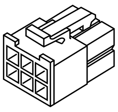
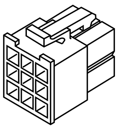
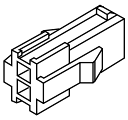
Motor series	Motor capacity	Design			Acceptable during operation	
		Radial load	Thrust load		Radial load	Thrust load (A or B direction)
			A direction	B direction		
MSMA	30W	147	88	117.6	49	29.4
	50W, 100W				68.6	58.8
	200W, 400W	392	147	196	245	98
	750W	686	294	392	392	147
MAMA	100W	147	88	117.6	68.6	49
	200W, 400W	392	147	196	245	68.6
	750W	686	294	392	392	68.6
MSMA	1kW	686	392	490	392	147
	1.5kW ~ 3.5kW	980	588	686	490	196
	4kW ~ 5kW				784	343
MDMA	750W	686	392	490	392	147
	1kW ~ 2kW	980	588	686	490	196
	2.5kW, 3kW				784	343
	3.5kW, 4kW	1666	784	980		
	4.5kW, 5kW					
MHMA	500W ~ 1.5kW	980	588	686	490	196
	2kW ~ 5kW	1666	784	980	784	343
MFMA	400W	980	588	686	392	147
	750W, 1.5kW				490	196
	2.5kW ~ 4.5kW	1862	686		784	294
MGMA	300W ~ 600W 900W	980	588		490	196
					686	
	1.2kW	1666	784	980	784	343
	2.0kW				1176	490
	3kW ~ 4.5kW	2058	980	1176	1470	

Optional Parts

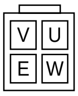
Motor connectors and plugs

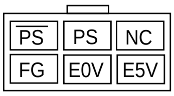
MSMA 30W ~ 750W, MQMA 100W ~ 400W

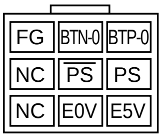
- **Plug specification**
  - Motor
    AMP plug 172167-1
    Pin 170360-1
  - 2500P/r incremental encoder
    AMP plug 172168-1
    Pin 170359-1
  - 17-bit absolute encoder
    AMP plug 172169-1
    Pin 170359-1
  - Brake (option)
    AMP plug 172165-1
    Pin 170360-1

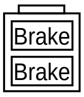





- **Connector specification**





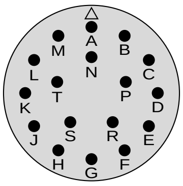




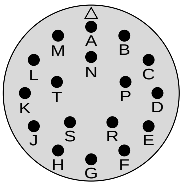
NC: No connection - leave the pin open

MSMA 1kW– 5.0kW, MDMA 750W– 5.0kW, MFMA 400W– 4.5kW, MHMA 500W– 5.0kW, MGMA 300W– 4.5kW

- **Encoder connector specification (Common to MSMA, MDMA, MFMA, MHMA, MGMA)**



Detector: MS3102A 20-29P



Detector: MS3102A 20-29P

- 2500P/r incremental encoder specification

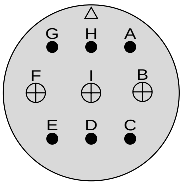
Pin No.	Description
A	NC
B	NC
C	NC
D	NC
E	NC
F	NC
G	E0V
H	E5V
J	Frame GND
K	PS
L	$\overline{PS}$
M	NC
N	NC
P	NC
R	NC
S	NC
T	NC

- 17-bit encoder specification

Pin No.	Description
A	NC
B	NC
C	NC
D	NC
E	NC
F	NC
G	E0V
H	E5V
J	Frame GND
K	PS
L	$\overline{PS}$
M	NC
N	NC
P	NC
R	NC
S	BTP-0 *
T	BTN-0 *

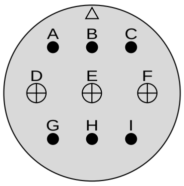
* Leave pins S and T unconnected when the encoder is incremental.

- **Motor brake connector specification**



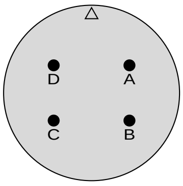
Motor(w/brake; w/o brake)
J L04V-2E20-18PE-B(J AE)
or equivalent

Pin No.	Description
G	w/Brake (wo/Brake) NC
H	w/Brake (wo/Brake) NC
A	NC
F	U phase
I	V phase
B	W phase
E	E-GND
D	E-GND
C	NC



Motor(w/brake; w/o brake)
J L04V-2E24-11PE-B(J AE) or equivalent
J L04V-2E22-22PE-B(J AE) or equivalent

Pin No.	Description
A	w/Brake (wo/Brake) NC
B	w/Brake (wo/Brake) NC
C	NC
D	U phase
E	V phase
F	W phase
G	E-GND
H	E-GND
I	NC



Pin No.	Description
A	U phase
B	V phase
C	W phase
D	E-GND

Motor(w/o brake)
J L04V-2E20-4PE-B(J AE) or equivalent
J L04V-2E22-22PE-B(J AE) or equivalent

- Connector pins and compatible models

Motor (kW)	MSMA		MDMA		MFMA		MHMA		MGMA	
Brake	1.0 – 2.5	3.0 – 5.0	0.75 – 2.5	3.0 – 5.0	0.4 – 1.5	2.5 – 4.5	0.5 – 1.5	2.0 – 5.0	0.3 – 0.9	1.2 – 4.5
Yes	20-18P	24-11P	20-18P	24-11P	20-18P	24-11P	20-18P	24-11P	20-18P	24-11P
No	20- 4P	22-22P	20- 4P	22-22P	20-18P	24-11P	20-4P	22-22P	20-4P	22-22P

Junction cables for MINAS-AIII series

Motor type	Junction cable	Part No.	fig No.
MSMA 30 – 750W MAMA 100 – 750W (*)	Encoder cable (17 bits, 7 wires) for absolute/incremental encoders	MFECAO * * OLAA	1-1
	Encoder cable (2500 pulses, 5 wires), incremental encoders	MFECAO * * OEAC	2-1
	Motor cable	MFMCAO * * OEEB	3-1
	Brake cable	MFMCBO * * OGET	4-1
MGMA 300W (*)	Encoder cable (17 bits, 7 wires) for absolute/incremental encoders	MFECAO * * OLSA	1-2
	Encoder cable (2500 pulses, 5 wires), incremental encoders		
	Motor cable	MFMCDO * * 2ECB	3-6
	Brake cable	MFMCAO * * 2FCC	4-2
MSMA 1.0 – 2.5kW MDMA 750W – 2.5kW MHMA 500W – 1.5kW MGMA 600 – 900W (*)	Encoder cable (17 bits, 7 wires) for absolute/incremental encoders	MFECAO * * OLSA	1-2
	Encoder cable (2500 pulses, 5 wires), incremental encoders		
	Motor cable	MFMCDO * * 2ECT	3-2
	Brake cable	MFMCAO * * 2FCT	4-3
MSMA 3.0 – 5.0kW MDMA 3.0 – 5.0kW MHMA 2.0 – 5.0kW MGMA 1.2 – 4.5kW	Encoder cable (17 bits, 7 wires) for absolute/incremental encoders	MFECAO * * OLSA	1-2
	Encoder cable (2500 pulses, 5 wires), incremental encoders		
	Motor cable	MFMCAO * * 3ECT	3-4
	Brake cable	MFMCAO * * 3FCT	4-4
MFMA 400W (*)	Encoder cable (17 bits, 7 wires) for absolute/incremental encoders	MFECAO * * OLSA	1-2
	Encoder cable (2500 pulses, 5 wires), incremental encoders		
	Motor cable	MFMCAO * * 2ECB	3-5
	Brake cable	MFMCAO * * 2FCC	4-2
MFMA 750W – 1.5kW (*)	Encoder cable (17 bits, 7 wires) for absolute/incremental encoders	MFECAO * * OLSA	1-2
	Encoder cable (2500 pulses, 5 wires), incremental encoders		
	Motor cable	MFMCAO * * 2ECT	3-3
	Brake cable	MFMCAO * * 2FCT	4-3
MFMA 2.5 – 4.5kW	Encoder cable (17 bits, 7 wires) for absolute/incremental encoders	MFECAO * * OLSA	1-2
	Encoder cable (2500 pulses, 5 wires), incremental encoders		
	Motor cable	MFMCDO * * 3ECT	3-7
	Brake cable	MFMCAO * * 3FCT	4-4

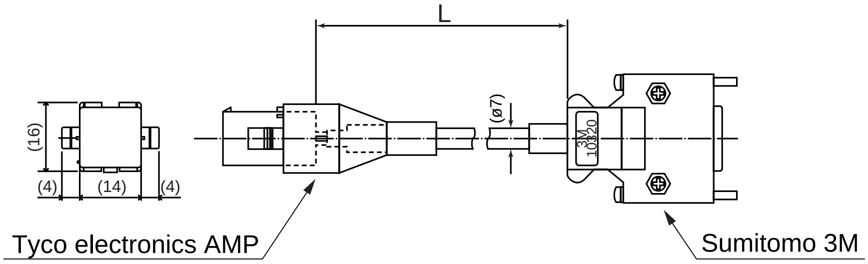
(*) D type driver

Motor type	Junction cable	Part No.	fig No.
MSMA 750W MAMA 750W	Encoder cable (17 bits, 7 wires) for absolute/incremental encoders	MFECAO * * OLAA	1-1
	Encoder cable (2500 pulses, 5 wires), incremental encoders	MFECAO * * OEAC	2-1
	Motor cable	MFMCAO * * OEEB	3-1
	Brake cable	MFMCBO * * OGET	4-1
MSMA 1.0 – 1.5kW MDMA 750W – 1.5kW MHMA 500W – 1.5kW MGMA 300 – 900W	Encoder cable (17 bits, 7 wires) for absolute/incremental encoders	MFECAO * * OLSA	1-2
	Encoder cable (2500 pulses, 5 wires), incremental encoders		
	Motor cable	MFMCDO * * 2ECB	3-6
	Brake cable	MFMCAO * * 2FCC	4-2
MFMA 400W – 1.5kW	Encoder cable (17 bits, 7 wires) for absolute/incremental encoders	MFECAO * * OLSA	1-2
	Encoder cable (2500 pulses, 5 wires), incremental encoders		
	Motor cable	MFMCAO * * 2ECB	3-5
	Brake cable	MFMCAO * * 2FCC	4-2

Optional Parts

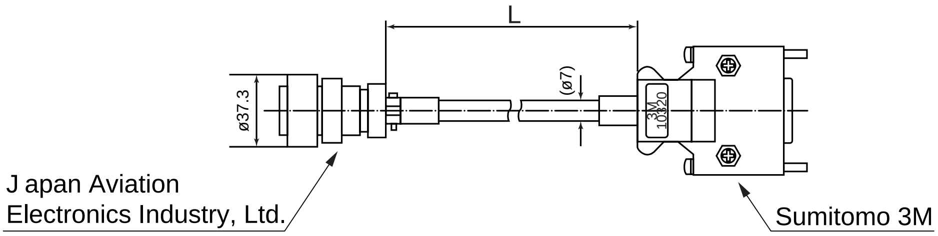
Encoder junction cable

fig 1-1 **MFECA0 * * 0LAA**



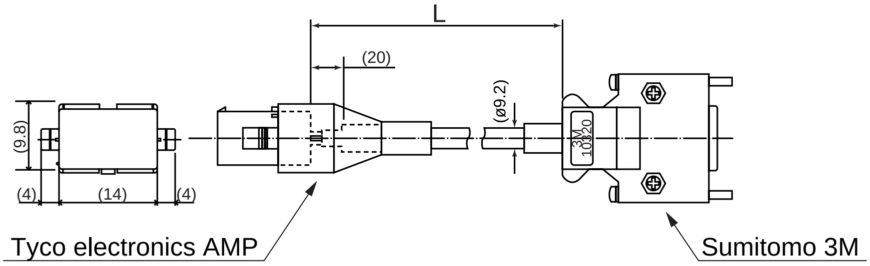
L (m)	Part No.
3	MFECA0030LAA
5	MFECA0050LAA
10	MFECA0100LAA
20	MFECA0200LAA

fig 1-2 **MFECA0 * * 0LSA**



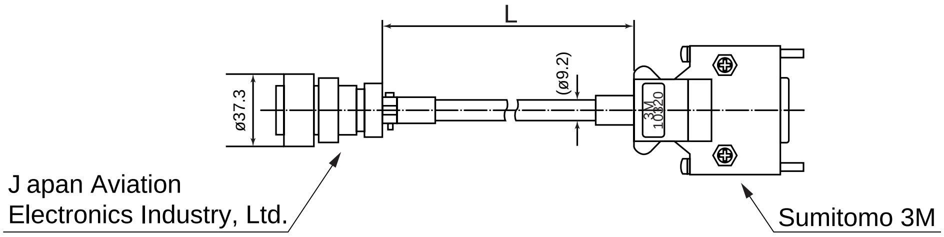
L (m)	Part No.
3	MFECA0030LSA
5	MFECA0050LSA
10	MFECA0100LSA
20	MFECA0200LSA

fig 2-1 **MFECA0 * * 0EAC**



L (m)	Part No.
3	MFECAO030EAC
5	MFECAO050EAC
10	MFECAO100EAC
20	MFECAO200EAC

fig 2-2 **MFECA0 * * OESA**

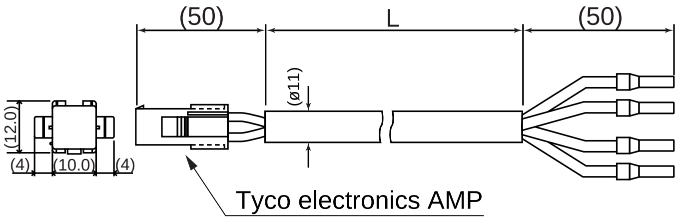


L (m)	Part No.
3	MFECAO030ESA
5	MFECAO050ESA
10	MFECAO100ESA
20	MFECAO200ESA

Motor junction cable (Robotop®, 600V . DP)

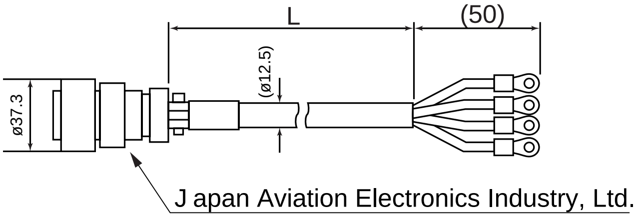
Robotop® is the trademark of Sumitomo Denso.

fig 3-1 **MFMCA0 * * 0EEB**



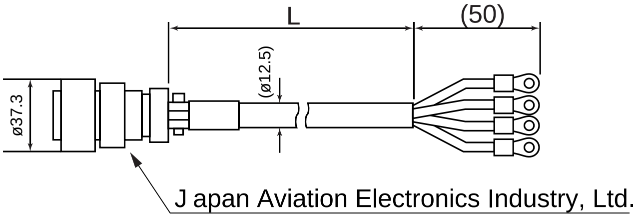
L (m)	Part No.
3	MFMCA0030EEB
5	MFMCA0050EEB
10	MFMCA0100EEB
20	MFMCA0200EEB

fig 3-2 **MFMCD0 * * 2ECT**



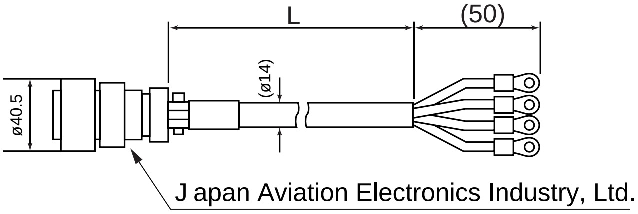
L (m)	Part No.
3	MFMCD0032ECT
5	MFMCD0052ECT
10	MFMCD0102ECT
20	MFMCD0202ECT

fig 3-3 **MFMCA0 * * 2ECT**



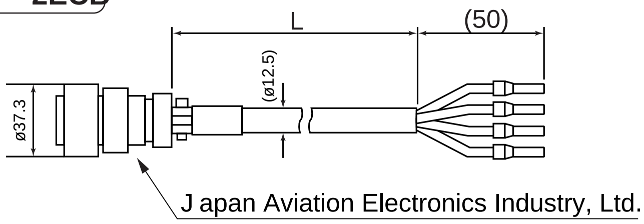
L (m)	Part No.
3	MFMCA0032ECT
5	MFMCA0052ECT
10	MFMCA0102ECT
20	MFMCA0202ECT

fig 3-4 **MFMCA0 * * 3ECT**



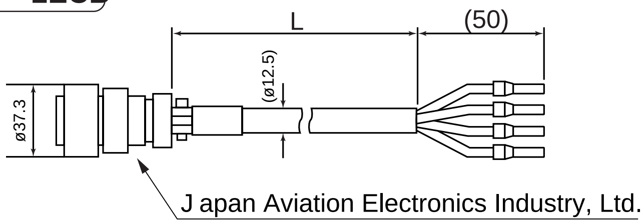
L (m)	Part No.
3	MFMCA0033ECT
5	MFMCA0053ECT
10	MFMCA0103ECT
20	MFMCA0203ECT

fig 3-5 **MFMCA0 * * 2ECB**



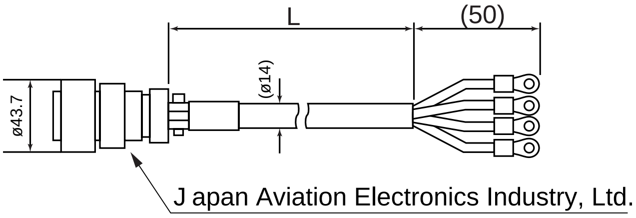
L (m)	Part No.
3	MFMCA0032ECB
5	MFMCA0052ECB
10	MFMCA0102ECB
20	MFMCA0202ECB

fig 3-6 **MFMCD0 * * 2ECB**



L (m)	Part No.
3	MFMCD0032ECB
5	MFMCD0052ECB
10	MFMCD0102ECB
20	MFMCD0202ECB

fig.3-7 **MFMCD0 * * 3ECT**

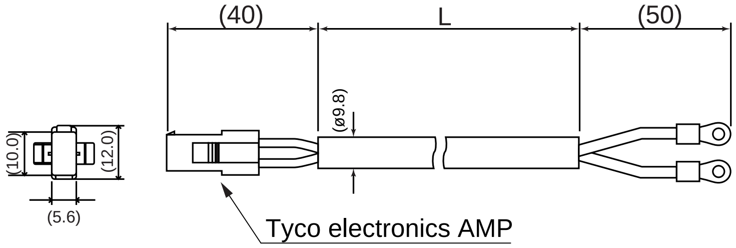


L (m)	Part No.
3	MFMD0033ECT
5	MFMD0053ECT
10	MFMD0103ECT
20	MFMD0203ECT

Optional Parts

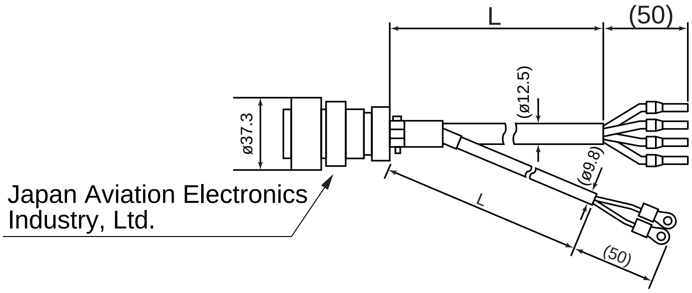
Motor (with Brake) junction cables (Robotop® , 600V • DP)

fig 4-1 **MFMCB0 * * 0GET** (Brake cable)



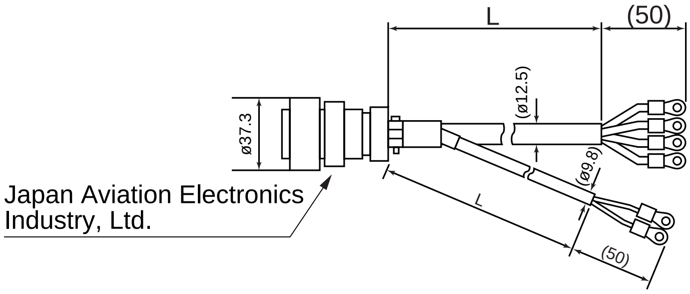
L (m)	Part No.
3	MFMCB0030GET
5	MFMCB0050GET
10	MFMCB0100GET
20	MFMCB0200GET

fig 4-2 **MFMCA0 * * 2FCC**



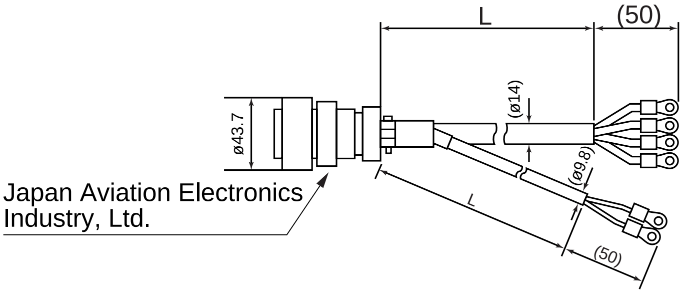
L (m)	Part No.
3	MFMCA0032FCC
5	MFMCA0052FCC
10	MFMCA0102FCC
20	MFMCA0202FCT

fig 4-3 **MFMCA0 * * 2FCT**



L (m)	Part No.
3	MFMCA0032FCT
5	MFMCA0052FCT
10	MFMCA0102FCT
20	MFMCA0202FCT

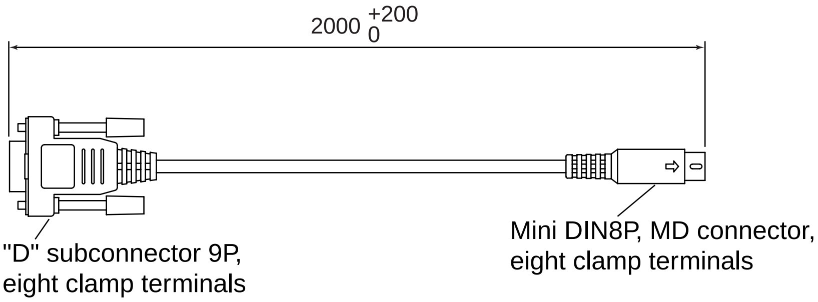
fig 4-4 **MFMCA0 * * 3FCT**



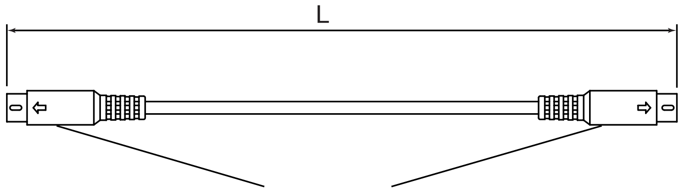
L (m)	Part No.
3	MFMCA0033FCT
5	MFMCA0053FCT
10	MFMCA0103FCT
20	MFMCA0203FCT

Communication Cables (for connection to personal computer)

1) Part No. DV0P1960 (for DOS/V)



Communication Cables (for RS485)



Mini DIN8P, MD connector,
eight clamp terminals

Part No.	L [mm]
DVOP1970	200
DVOP1971	500
DVOP1972	1000

Set up support software PANATERM®

1) Part No. DV0P3170(Japanese version), DV0P3180(English version)
2) Supply Media: 3.5 inch floppy disc (2 disks)

<Note>

For the operating environment and other details, see the Instructions for PANATERM®.

Connector Kits for Motor and Encoder

- **Used for:** MSMA 30W – 750W, MAMA 100W – 750W [with a17-bit absolute encoder]

1) Part No. DV0P2110
2) Components

Item	Manufacturer' s Part No.	Quantity	Manufacturer	Remarks
Connector	10120-3000VE	1	Sumitomo 3M	For CN X4 (20pin)
Connector cover	10320-52A0-008	1		
Connector (9P)	172161-1	1	Tyco electronics AMP	For encoder cable (9 pins)
Connector pin	170365-1	9		
Connector (4P)	172159-1	1		For motor cable (4 pins)
Connector pin	170366-1	4		

3) Recommended tool to fix socket (Prepare by customer)

Item	Manufacturer' s Part No.	Manufacturer
For encoder cable	755330-1	Tyco electronics AMP
For motor cable	755331-1	

- **Used for:** MSMA 30W – 750W, MAMA 100W – 750W [with a 2500-pulse, 5-wire incremental encoder]

1) Part No. DV3430
2) Components

Item	Manufacturer' s Part No.	Quantity	Manufacturer	Remarks
Connector	10120-3000VE	1	Sumitomo 3M	For CN X4 (20pin)
Connector cover	10320-52A0-008	1		
Connector (6P)	172160-1	1	Tyco electronics AMP	For encoder cable (6 pins)
Connector pin	170365-1	6		
Connector (4P)	172159-1	1		For motor cable (4 pins)
Connector pin	170366-1	4		

3) Recommended tool to fix socket (Prepare by customer)

Item	Manufacturer' s Part No.	Manufacturer
For encoder cable	755330-1	Tyco electronics AMP
For motor cable	755331-1	

Optional Parts

- **Used for:** MSMA 1.0kW – 2.5kW
  MDMA 750W – 2.5kW
  MHMA 500W – 1.5kW
  MGMA 300W – 900W
  [with a 17-bit absolute/incremental encoder
  or 2500-pulse incremental encoder] without brake

1) Part No. DV0P0960
2) Components

Item	Manufacturer' s Part No.	Quantity	Manufacturer	Remarks
Connector	10120-3000VE	1	Sumitomo 3M	For CN X4 (20pin)
Connector cover	10320-52A0-008	1		
Straight plug	MS3106B20-29S	1	Japan Aviation Electronics Industry, Ltd.	For encoder cable
Cable clamp	MS3057-12A	1		
Straight plug	MS3106B20-4S	1		For motor cable
Cable clamp	MS3057-12A	1		

- **Used for:** MSMA 3.0kW – 5.0kW
  MDMA 3.0kW – 5.0kW
  MHMA 2.0kW – 5.0kW
  MGMA 1.2kW – 4.5kW
  [with a 17-bit absolute/incremental encoder
  or 2500-pulse incremental encoder] without brake

1) Part No. DV0P1510
2) Components

Item	Manufacturer' s Part No.	Quantity	Manufacturer	Remarks
Connector	10120-3000VE	1	Sumitomo 3M	For CN X4 (20pin)
Connector cover	10320-52A0-008	1		
Straight plug	MS3106B20-29S	1	Japan Aviation Electronics Industry, Ltd.	For encoder cable
Cable clamp	MS3057-12A	1		
Straight plug	MS3106B22-22S	1		For motor cable
Cable clamp	MS3057-12A	1		

- **Used for:** MSMA 1.0kW – 2.5kW
  MDMA 750W – 2.5kW
  MHMA 500W – 1.5kW
  MGMA 300W – 900W
  [with a 17-bit absolute/incremental encoder
  or 2500-pulse incremental encoder] without brake

  MFMA 0.4kW – 1.5kW [with a 17-bit absolute/incremental encoder
  or 2500-pulse incremental encoder] [without brake
  with brake]

1) Part No. DV0P0690
2) Components

Item	Manufacturer' s Part No.	Quantity	Manufacturer	Remarks
Connector	10120-3000VE	1	Sumitomo 3M	For CN X4 (20pin)
Connector cover	10320-52A0-008	1		
Straight plug	MS3106B20-29S	1	Japan Aviation Electronics Industry, Ltd.	For encoder cable
Cable clamp	MS3057-12A	1		
Straight plug	MS3106B20-18S	1		For motor cable
Cable clamp	MS3057-12A	1		

- **Used for:** MSMA 3.0kW – 5.0kW
MDMA 3.0kW – 5.0kW
MHMA 2.0kW – 5.0kW
MGMA 1.2kW – 4.5kW
[with a 17-bit absolute/incremental encoder or 2500-pulse incremental encoder] with brake

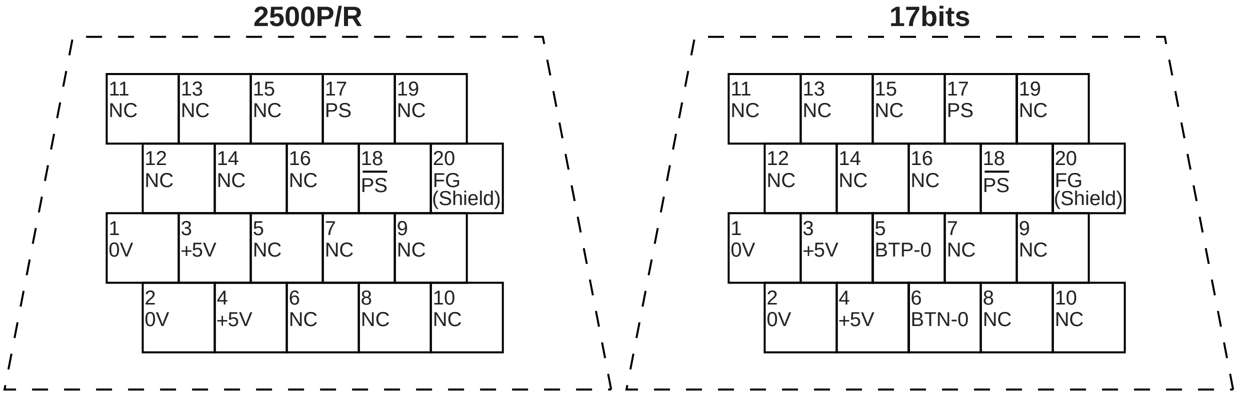
MFMA 2.5kW – 4.5kW [with a 17-bit absolute/incremental encoder or 2500-pulse incremental encoder] without brake / with brake

1) Part No. DV0P0970
2) Components

Item	Manufacturer' s Part No.	Quantity	Manufacturer	Remarks
Connector	10120-3000VE	1	Sumitomo 3M	For CN X4 (20pin)
Connector cover	10320-52A0-008	1		
Straight plug	MS3106B20-29S	1	Japan Aviation Electronics Industry, Ltd.	For encoder cable
Cable clamp	MS3057-12A	1		
Straight plug	MS3106B24-11S	1		For motor cable
Cable clamp	MS3057-16A	1		

<Notes>

1. For components such as a connector, connector cover, etc., you may use products of other manufacturers equivalent to item numbers mentioned above.
2. Pin Arrangement of Connector CN X4 (20-pin)



2500P/R

11 NC	13 NC	15 NC	17 PS	19 NC	
	12 NC	14 NC	16 NC	18 $\overline{PS}$	20 FG (Shield)
1 0V	3 +5V	5 NC	7 NC	9 NC	
	2 0V	4 +5V	6 NC	8 NC	10 NC

17bits

11 NC	13 NC	15 NC	17 PS	19 NC	
	12 NC	14 NC	16 NC	18 $\overline{PS}$	20 FG (Shield)
1 0V	3 +5V	5 BTP-0	7 NC	9 NC	
	2 0V	4 +5V	6 BTN-0	8 NC	10 NC

Notes>

1. The tables above show the pins alignment, looking from where the plugs are soldered.
Also check pin No. imprinted on the connector body and be sure that there is no wrong wiring.
2. The pin 20 (FG) should be connected to the shield of the shielded wire. Pins marked with NC should be left unconnected.
3. For cable connections, see page 36 "System Configuration and Wiring: CN X4 Connector (For Encoder)" in Preparations.

Optional Parts

Connector Kits for External Equipment

1) Part No. DV0P0980
2) Components

Item	Manufacturer' s Part No.	Quantity	Manufacturer	Remarks
Connector	10150-3000VE	1	SUMITOMO 3M	For CN X5 (50 pins)
Connector cover	10350-52A0-008	1		

3) Alignment of CN X5 (50 pins) (Looking from where the plug is soldered)

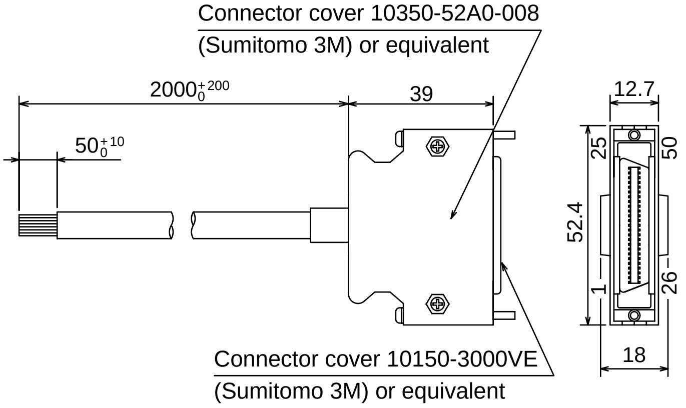
26 ZERO SPD	28 DIV	30 CL	32 C-MODE	34 S-RDY–	36 ALM–	38 COIN–	40 TLC	42 IM	44 BATT+	46 NC	48 OB+	50 FG
27 GAIN	29 SRV-ON	31 A-CLR	33 INH	35 S-RDY+	37 ALM+	39 COIN+	41 COM–	43 SPM	45 BATT–	47 NC	49 OB–	
1 NC	3 PULS1	5 SIGN1	7 COM+	9 CCWL	11 BRK-OFF+	13 GND	15 GND	17 GND	19 CZ	21 OA+	23 OZ+	25 GND
2 NC	4 PULS2	6 SIGN2	8 CWL	10 BRK-OFF–	12 ZSP	14 SPR/TRQR	16 CCWTL / TRQR	18 CWTL	20 NC	22 OA–	24 OZ–	

<Notes>

1. Before making connections, check the Pin Numbers stamped on the plugs.
2. For the symbols that indicate the above signal names and the signal functions,see "CN X5 connector wiring" for the specific control mode.
3. Pins marked with NC should be left unconnected.

Interface Cables

1) Part No. DV0P2190
2) Dimension


Connector cover 10350-52A0-008 (Sumitomo 3M) or equivalent

Connector cover 10150-3000VE (Sumitomo 3M) or equivalent

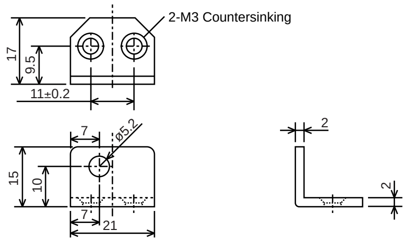
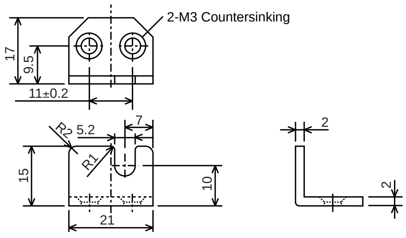
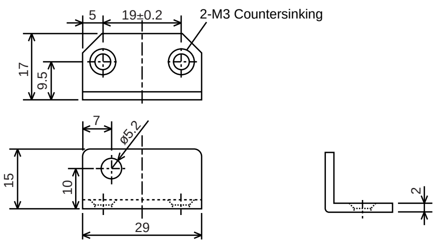
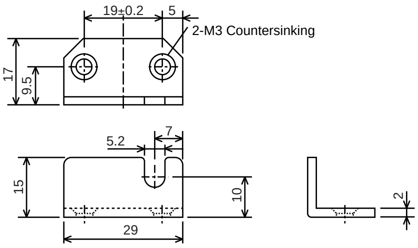
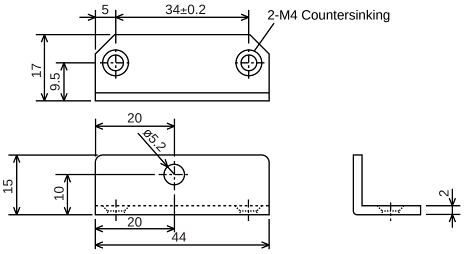
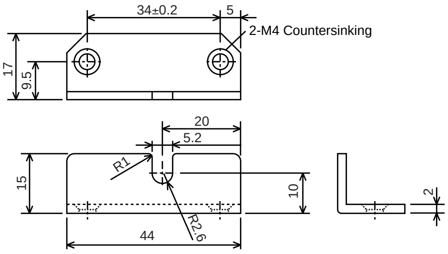
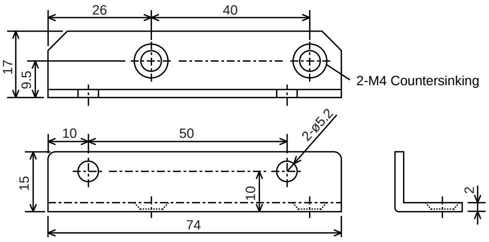
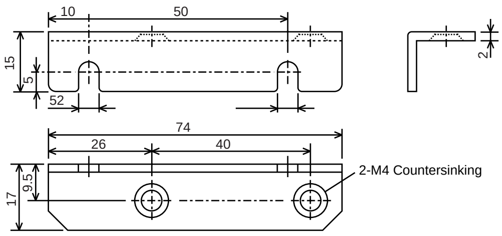
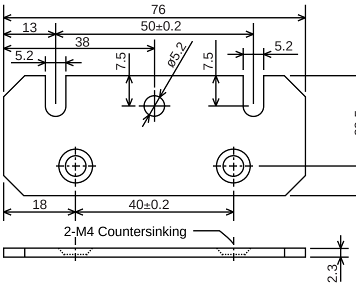
3) Wire table

Pin No.	Wire color	Pin No.	Wire color	Pin No.	Wire color	Pin No.	Wire color	Pin No.	Wire color
1	Orange (Red 1)	11	Orange (Black 2)	21	Orange (Red 3)	31	Orange (Red 4)	41	Orange (Red 5)
2	Orange (Black1)	12	Yellow (Black 1)	22	Orange (Black3)	32	Orange (Black4)	42	Orange (Black5)
3	Gray (Red 1)	13	Gray (Red 2)	23	Gray (Red 3)	33	Gray (Red 4)	43	Gray (Red 5)
4	Gray (Black 1)	14	Gray (Black 2)	24	Gray (Black 3)	34	White (Red 4)	44	White (Red 5)
5	White (Red 1)	15	White (Red 2)	25	White (Red 3)	35	White (Black4)	45	White (Black5)
6	White (Black 1)	16	Yellow (Red 2)	26	White (Black3)	36	Yellow (Red 4)	46	Yellow (Red 5)
7	Yellow (Red 1)	17	Yellow (Black1) Pink (Black 2)	27	Yellow (Red 3)	37	Yellow (Black4)	47	Yellow (Black5)
8	Pink (Red 1)	18	Pink (Red 2)	28	Yellow (Black3)	38	Pink (Red 4)	48	Pink (Red 5)
9	Pink (Black 1)	19	White (Black2)	29	Pink (Red 3)	39	Pink (Black 4)	49	Pink (Black 5)
10	Orange (Red2)	20	—	30	Pink (Black 3)	30	Gray (Black 4)	50	Gray (Black 5)

<Notes>

For example, Orange (Red 1) for Pin No.1 means that the lead wire is colored in orange with one dot mark in red.

Brackets for Mounting the Driver

Driver type	Part No.	Screws	Outer dimension	
			Upper brackets	lower brackets
Type A	DV0P 3050	M3 x 8 pan head screw x 4 pcs.		
Type B	DV0P 3000	M3 x 8 pan head screw x 4 pcs.		
Type C	DV0P 3010	M4 x 6 pan head screw x 4 pcs.		
Type D	DV0P 3270	M4 x 6 pan head screw x 4 pcs.		
Type E Type F	DV0P 2102	M4 x 6 pan head screw x 4 pcs.		

<Notes>

The driver in Type G can be installed on both front and rear by replacing ancillary L-shaped brackets.

Optional Parts

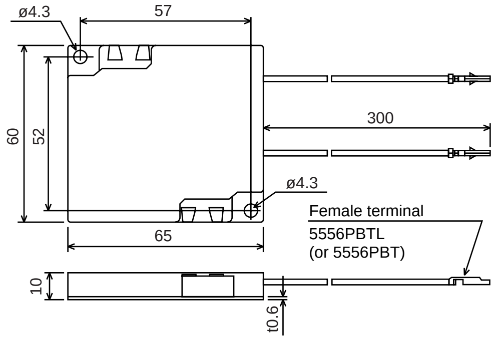
External Regenerative Discharge Resistor

Part.No.	Product number	Model		Internal thermal fuse melting temperature
		Specifications	Resistance	
DV0P3630	45M03	50Ω	10W	130 ±2˚C
DV0P3631	45M03	100Ω	10W	130 ±2˚C
DV0P1980	RH150M	50Ω	90W	Non
DV0P1981	RH150M	100Ω	90W	Non
DV0P1982	RH220M	30Ω	120W	Non
DV0P1983	RH500M	20Ω	300W	Non

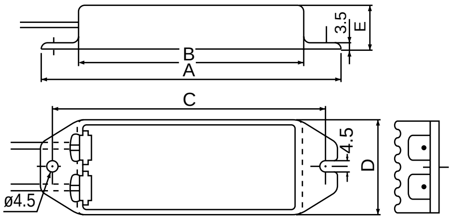
Manufacturer: IWAKI MUSEN KENKYUSHO CO., LTD.

Type	Input Supply Voltage	
	Single-phase 100V	Single-phase 200V/Three-phase 200V
A	DV0P3630	DV0P3631 1 unit
B	DV0P1980	DV0P1980 1 unit
C		
D	—	Arrange 2 DV0P 1982 in a line or place 1 DV0P 1983.
E		
F		
G	—	Arrange 2 – 3 DV0P 1982 in a line or place 1 DV0P 1983.

DV0P3630, DV0P3631



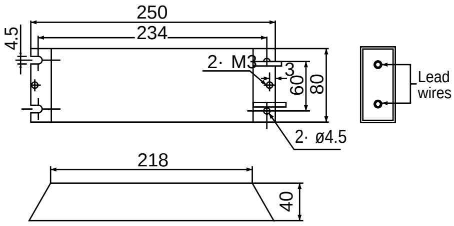
DV0P1980, DV0P1981, DV0P1982



Lead wires : 300mm

	A	B	C	D	E
DV0P1980 DV0P1981	212	180	202	44	30
DV0P1982	230	200	220	60	20

DV0P1983



Lead wires : 450mm

<Caution>

Be careful not to touch the external regeneration resistance.
It may be hot and scald you while using.

Take preventions against a fire and burn.
Do not mount the regenerative discharge resistor near an inflammable object, or in a place where an operator may touch it by hand.

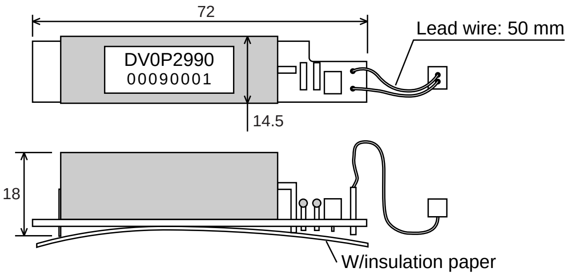
<Request>

When you use an external regeneration, you must install external safeguards such as a temperature fuse, etc.
Otherwise, as protection of regeneration resistance would be lost, causing abnormal heat generation and burnout.

Battery and Battery Holder for Absolute Encoder

Battery (for driver types B to G)

1) Part No. DV0P2990
2) Lithium battery, Toshiba Battery make ER6V, 3.6V, 2000mAh



<Notice>

Type A: connect ER6V using battery pins on the interface connector.

Reactor

fig 1

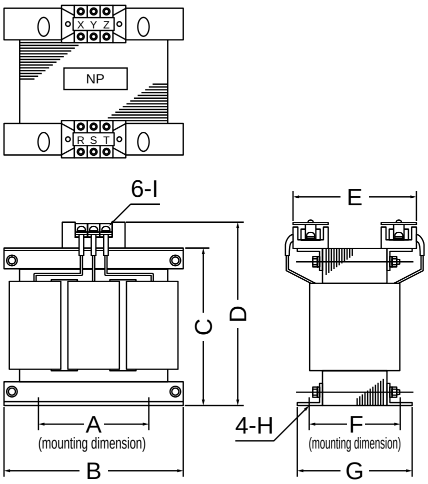
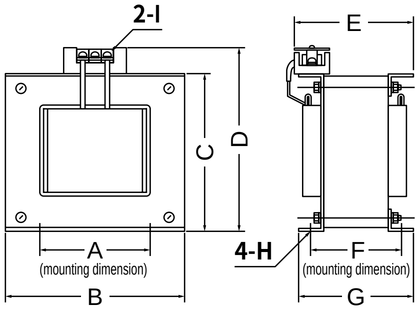


fig 2



	Part No.	A	B	C	D	E	F	G	H	I	Inductance (mH)	Rated current (A)
fig 1	DV0P220	65	125	83	118	145	70	85	W7 x L12	M4	6.81	3
	DV0P221	60	150	113	137	120	60	75	W7 x L12	M4	4.02	5
	DV0P222	60	150	113	137	130	70	95	W7 x L12	M4	2	8
	DV0P223	60	150	113	137	140	79	95	W7 x L12	M4	1.39	11
	DV0P224	60	150	113	137	145	84	100	W7 x L12	M4	0.848	16
	DV0P225	60	150	113	137	160	100	115	W7 x L12	M5	0.557	25
fig 2	DV0P226	55	80	68	90	90	41	55	ø7	M4	6.81	3
	DV0P227	55	80	68	90	90	41	55	ø7	M4	4.02	5
	DV0P228	55	80	68	90	95	46	60	ø7	M4	2	8
	DV0P229	55	80	68	90	105	56	70	ø7	M4	1.39	11

- Agency of Natural Resources and Energy of Ministry of International Trade and Industry at the time, established a higher harmonics suppression guidelines in Sept. 1994.
  1) Drivers rated 4 kW or below are subject to "Higher harmonics suppression guidelines for home electric and general purpose appliances".
  2) Drivers rated more than 4 kW are subject to "Higher harmonics suppression guidelines for high voltage and special customers".
- Ministry of Economy, Trade and Industry strongly supports enforcement of the harmonics preventing measure.
  To meet the suppression level requirements, connect a power-factor improvement reactor (L) for drivers rated 4 kW or below. As for drivers rated over 4 kW, determine the harmonics level according to the guideline, and if necessary, design and install a suitable suppression measure.

Motor Series	Voltage Specifications	Rated Output	Reactor Product No.
MSMA	Single-phase 100V	30W–100W	DVOP227
MSMA		200W–400W	DVOP228
MSMA	Single-phase 100V	30W–200W	DVOP220
MAMA		100W–200W	
MHMA		500W	
MFMA		400W	
MGMA		300W	
MSMA		400W–750W	DVOP221
MAMA		400W–750W	
MDMA		750W	
MFMA		750W	
MGMA		600W	
MSMA	Three-phase 200V	30W–400W	DVOP220
MAMA		100W–400W	
MGMA		300W	
MFMA		400W	
MHMA		500W	
MGMA		600W	DVOP221
MSMA		750W	
MAMA			
MFMA			

Motor Series	Voltage Specifications	Rated Output	Reactor Product No.
MGMA	Three-phase 200V	900W, 1.2kW	DVOP222
MSMA		1.0kW 1.5kW	
MDMA			
MHMA			
MFMA		1.5kW	
MSMA		2.0kW	DVOP223
MDMA			
MHMA			
MGMA		2.0kW	DVOP224
MSMA		2.5kW	
MDMA			
MFMA			
MSMA		3.0kW	
MDMA			
MHMA			
MGMA			
MSMA		3.5kW	
MDMA			
MFMA			
MSMA		4.0kW	DVOP225
MDMA			
MFMA			

<Reference>

[Harmonics suppression technical guideline] , JEAG 9702-1995, Japan Electric Association

[Harmonic current calculation procedure for general-purpose inverter at special customers] , JEM-TR201-1996, Japa
Electrical Manufacturers' Association

[Servo driver (input current 20 A or lower) harmonic current suppression procedure guideline] , JEM-TR199, Japa
Electrical Manufacturers' Association

Recommended Parts

Surge Absorber for Motor Brake

Motor	Surge absorber for brake
MSMA 30W – 1.0kW	• C-5A2 or Z15D151 Ishizuka.co.
MAMA 100W – 750W	
MHMA 2.0kW – 5.0kW	
MGMA 600W – 2.0kW	
MSMA 1.5kW – 5.0kW	• C-5A3 or Z15D151 Ishizuka.co.
MDMA 750W	
MDMA 3.5kW – 5.0kW	
MFMA 750W – 1.5kW	
MGMA 3.0kW – 4.5kW	
MDMA 1.0kW – 3.0kW	• TNR9G820K NIPPON CHEMI_CON CO.
MFMA 400W	
MFMA 2.5kW – 4.5kW	
MHMA 500W – 1.5kW	
MGMA 300W	

- The recommended parts are those specified for measurement of brake release time.

Peripheral Equipment Manufacturers

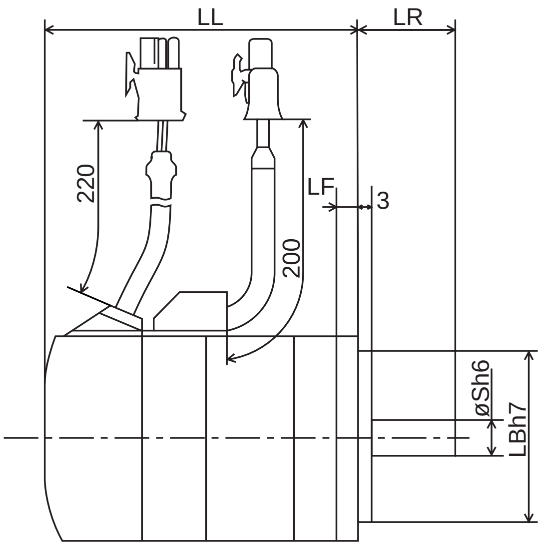
1.2002.present

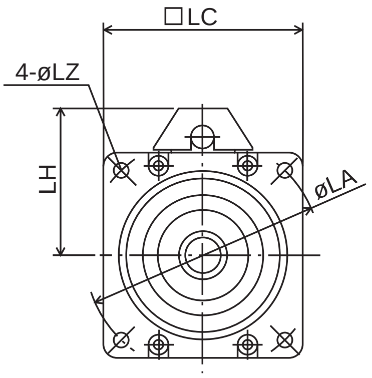
Manufacturer/agent	Tel	Equipment
Matsushita Electric Works, Ltd. Automation Controls Company	81-6-6908-1131	No-fuse breaker magnetic contact surge absorber
IWAKI MUSEN KENKYUSHO Co., Ltd.	81-44-833-4311	Regenerative discharge resistor
NIPPON CHEMI_ CON CORPORATION	Kantou Area 81-3-5436-7608 Chubu Area 81-52-772-8551 Kansai Area 81-6-6338-2331	Surge absorber for Brake
Ishizuka Electronics Corporation	Kantou Area 81-3-3621-2703 Chubu Area 81-52-777-5070 Kansai Area 81-6-6391-6491	
HITACHI Semiconductor and Devices Sales	81-6-6263-2031	Diode for Brake
TDK Corporation	Kantou Area 81-3-5201-7229 Chubu Area 81-52-971-1712 Kansai Area 81-6-6245-7333	Noise filter for signal line
Okaya Electric Industries Co., Ltd.	East J apan 81-3-3424-8120 West J apan 81-6-6392-1781	Surge absorber for Brake Noise filter Reactor
J apan Aviation Electronics Industry, Ltd.	Kantou Area 81-3-3780-2717 Chubu Area 81-52-953-9520 Kansai Area 81-6-6447-5259	Connector
Sumitomo 3M	Kantou Area 81-3-5716-7290 Chubu Area 81-52-322-9652 Kansai Area 81-6-6447-3944	
Tyco electronics AMP	Kantou Area 81-44-844-8111 Chubu Area 81-565-29-0890 Kansai Area 81-6-6533-8232	
Molex Incorporated	046-261-4500	
WAGO Company of J apan., Ltd.	Tokyo 03-5627-2050 Nagoya 052-701-7171 Osaka 06-6386-5573 Fukuoka 092-762-1141	
SUMITOMO Denso	81-6-6229-1960	Cable

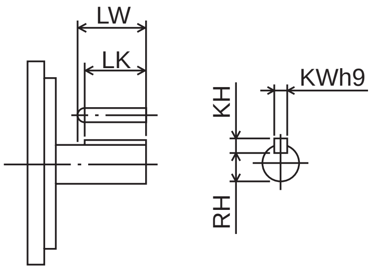
MEMO

Dimensions

MSMA Series 30W – 750W







(Keyed version)

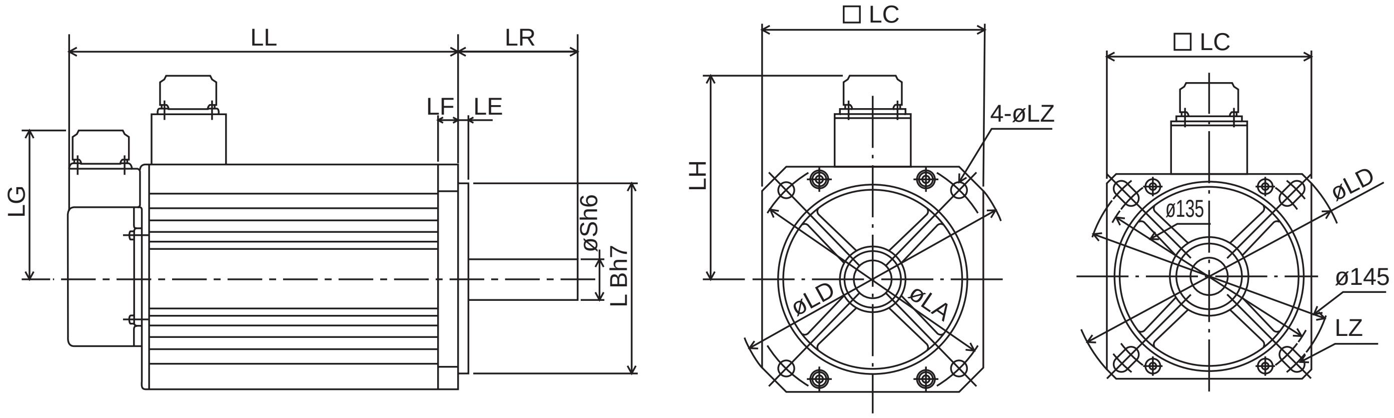
- Encoder specifications P 2500 P/r incremental encoder
  S 17 bits absolute/incremental encoder

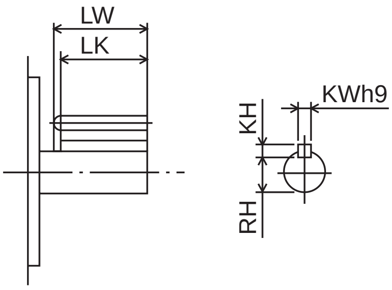
		Model	Output(W)	LL	S	LB	LF	LR	LA	LC	LH	LZ	LW	LK	KW	KH	RH	Weight(kg)
MSMA	without brake	MSMA3AZP1□	30	65	7	30	6	25	45	38	32	3.4	13	12	2		5.8	0.27
		MSMA5AZP1□	50	73	8								14	12.5	3		6.2	0.34
		MSMA01□P1□	100	103														0.56
		MSMA02□P1□	200	94	11	50	7	30	70	60	34	4.5	20	18	4		8.5	1.0
		MSMA04□P1□	400	123.5	14								25	22.5	5		11	1.6
		MSMA082P1□	750	142.5	19	70	8	35	90	80	53	6		22	6		15.5	3.2
		MSMA3AZS1□	30	82	7	30	6	25	45	38	32	3.4	13	12	2		5.8	0.33
		MSMA5AZS1□	50	90	8								14	12.5	3		6.2	0.40
		MSMA01□S1□	100	120														0.62
		MSMA02□S1□	200	109	11	50	7	30	70	60	34	4.5	20	18	4		8.5	1.1
		MSMA04□S1□	400	138.5	14								25	22.5	5		11	1.7
		MSMA082S1□	750	157.5	19	70	8	35	90	80	53	6		22	6		15.5	3.3
	with brake	MSMA3AZP1□	30	97	7	30	6	25	45	38	32	3.4	13	12	2		5.8	0.47
		MSMA5AZP1□	50	105	8								14	12.5	3		6.2	0.53
		MSMA01□P1□	100	135														0.76
		MSMA02□P1□	200	127	11	50	7	30	70	60	34	4.5	20	18	4		8.5	1.4
		MSMA04□P1□	400	156.5	14								25	22.5	5		11	2.0
		MSMA082P1□	750	177.5	19	70	8	35	90	80	53	6		22	6		15.5	3.9
		MSMA3AZS1□	30	114	7	30	6	25	45	38	32	3.4	13	12	2		5.8	0.53
		MSMA5AZS1□	50	122	8								14	12.5	3		6.2	0.59
		MSMA01□S1□	100	152														0.82
		MSMA02□S1□	200	142	11	50	7	30	70	60	34	4.5	20	18	4		8.5	1.5
		MSMA04□S1□	400	171.5	14								25	22.5	5		11	2.1
		MSMA082S1□	750	192.5	19	70	8	35	90	80	53	6		22	6		15.5	4.0

MSMA Series 1.0 – 5.0kW

MSMA1.0 – 2.5kW
4.0 – 5.0kW

MSMA3.0 – 3.5kW





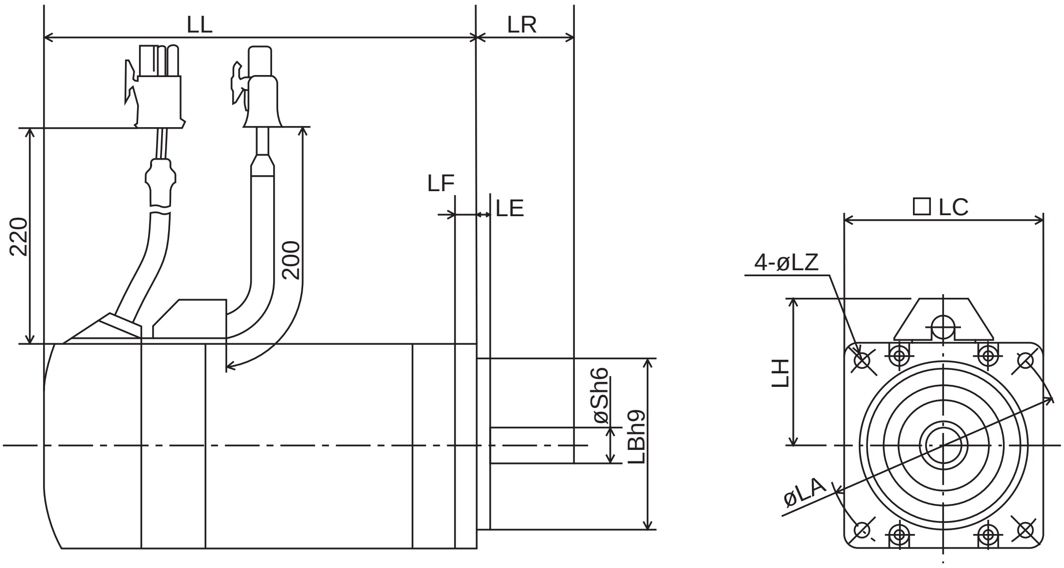
(Keyed version)

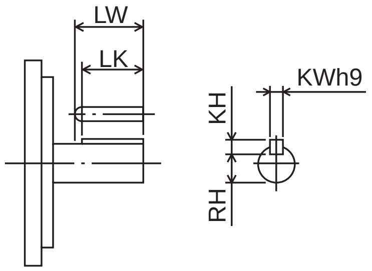
- Encoder specifications P 2500 P/r incremental encoder
  S 17 bits absolute/incremental encoder

		Model	Output(W)	LL	S	LB	LE	LF	LR	LA	LC	LD	LG	LH	LZ	LW	LK	KW	KH	RH	Weight(kg)
MSMA	without brake	MSMA102P1□	1.0	175	19	80	3	7	55	100	90	120	84	98	6.6	45	42	6	6	15.5	4.5
		MSMA152P1□	1.5	180		95		10		115	100	135		103	9						5.1
		MSMA202P1□	2.0	205																	6.5
		MSMA252P1□	2.5	230																	7.5
		MSMA302P1□	3.0	217	22	110		12		—	120	162		111	Wide9		41	8	7	18	9.3
		MSMA352P1□	3.5	237																	10.9
		MSMA402P1□	4.0	240	24		6		65	145	130	165		118	9	55	51			20	12.9
		MSMA452P1□	4.5	260																	15.1
		MSMA502P1□	5.0	280																	17.3
		MSMA102S1□	1.0	175	19	80	3	7	55	100	90	120	84	98	6.6	45	42	6	6	15.5	4.5
		MSMA152S1□	1.5	180		95		10		115	100	135		103	9						5.1
		MSMA202S1□	2.0	205																	6.5
		MSMA252S1□	2.5	230																	7.5
		MSMA302S1□	3.0	217	22	110		12		—	120	162		111	Wide9		41	8	7	18	9.3
		MSMA352S1□	3.5	237																	10.9
		MSMA402S1□	4.0	240	24		6		65	145	130	165		118	9	55	51			20	12.9
		MSMA452S1□	4.5	260																	15.1
		MSMA502S1□	5.0	280																	17.3
	with brake	MSMA102P1□	1.0	200	19	80	3	7	55	100	90	120	84	98	6.6	45	42	6	6	15.5	5.1
		MSMA152P1□	1.5	205		95		10		115	100	135		103	9						6.5
		MSMA202P1□	2.0	230																	7.9
		MSMA252P1□	2.5	255																	8.9
		MSMA302P1□	3.0	242	22	110		12		—	120	162		111	Wide9		41	8	7	18	11.0
		MSMA352P1□	3.5	262																	12.6
		MSMA402P1□	4.0	265	24		6		65	145	130	165		118	9	55	51			20	14.8
		MSMA452P1□	4.5	285																	17.0
		MSMA502P1□	5.0	305																	19.2
		MSMA102S1□	1.0	200	19	80	3	7	55	100	90	120	84	98	6.6	45	42	6	6	15.5	5.1
		MSMA152S1□	1.5	205		95		10		115	100	135		103	9						6.5
		MSMA202S1□	2.0	230																	7.9
		MSMA252S1□	2.5	255																	8.9
		MSMA302S1□	3.0	242	22	110		12		—	120	162		111	Wide9		41	8	7	18	11.0
		MSMA352S1□	3.5	262																	12.6
		MSMA402S1□	4.0	265	24		6		65	145	130	165		118	9	55	51			20	14.8
		MSMA452S1□	4.5	285																	17.0
		MSMA502S1□	5.0	305																	19.2

Dimensions

MAMA Series 100W – 750W



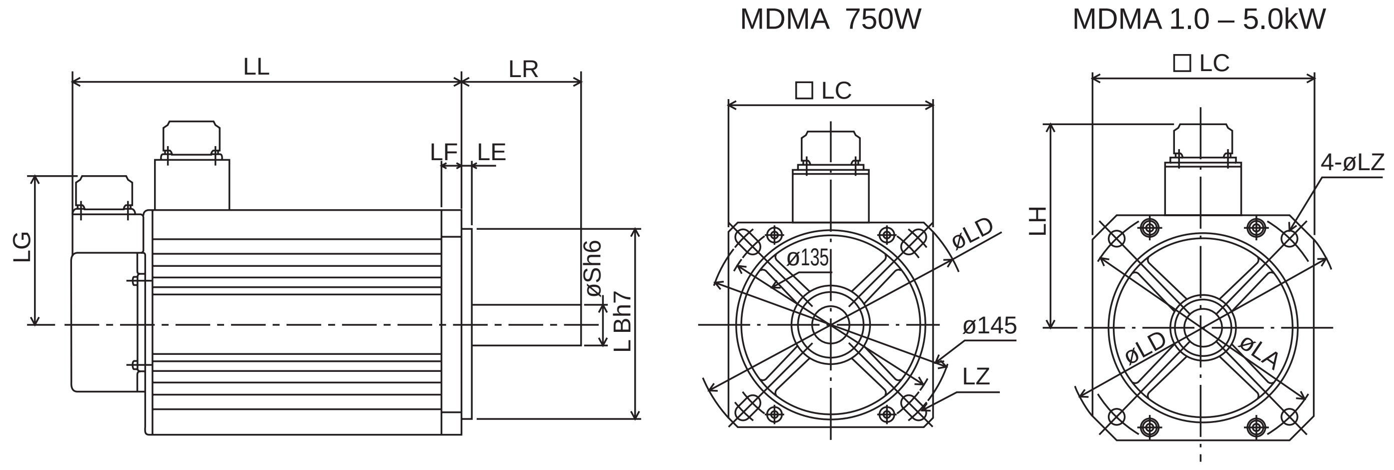


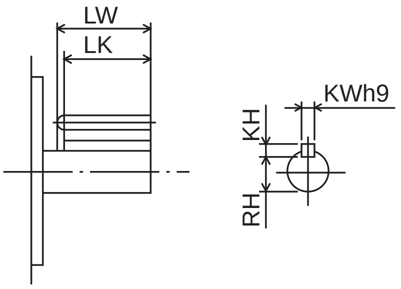
(Keyed version)

• Encoder specifications P 2500 P/r incremental encoder
S 17 bits absolute/incremental encoder

		Model	Output(W)	LL	S	LB	LE	LF	LR	LA	LC	LH	LZ	LW	LK	KW	KH	RH	Weight(kg)
MAMA	without brake	MAMA012P1□	100	110.5	8	22	2	7	24	48	42	34	3.4	14	12.5	3		6.2	0.65
		MAMA022P1□	200	111	11	50	3		30	70	60	43	4.5	20	18	4		8.5	1.1
		MAMA042P1□	400	139	14									25	22.5	5		11	1.5
		MAMA082P1□	750	160	19	70		8	35	90	80	53	5		20	6		15.5	3.3
		MAMA012S1□	100	127	8	22	2	7	24	48	42	34	3.4	14	12.5	3		6.2	0.71
		MAMA022S1□	200	126	11	50	3		30	70	60	43	4.5	20	18	4		8.5	1.2
		MAMA042S1□	400	125	14									25	22.5	5		11	1.6
		MAMA082S1□	750	175	19	70		8	35	90	80	53	5		20	6		15.5	3.4
	with brake	MAMA012P1□	100	138	8	22	2	7	24	48	42	34	3.4	14	12.5	3		6.2	0.85
		MAMA022P1□	200	139	11	50	3		30	70	60	43	4.5	20	18	4		8.5	1.5
		MAMA042P1□	400	167	14									25	22.5	5		11	1.9
		MAMA082P1□	750	192.5	19	70		8	35	90	80	53	5		20	6		15.5	4.0
		MAMA012S1□	100	154.5	8	22	2	7	24	48	42	34	3.4	14	12.5	3		6.2	0.91
		MAMA022S1□	200	154	11	50	3		30	70	60	43	4.5	20	18	4		8.5	1.6
		MAMA042S1□	400	182	14									25	22.5	5		11	2.0
		MAMA082S1□	750	207.5	19	70		8	35	90	80	53	5		20	6		15.5	4.1

MDMA Series 750W – 5.0kW





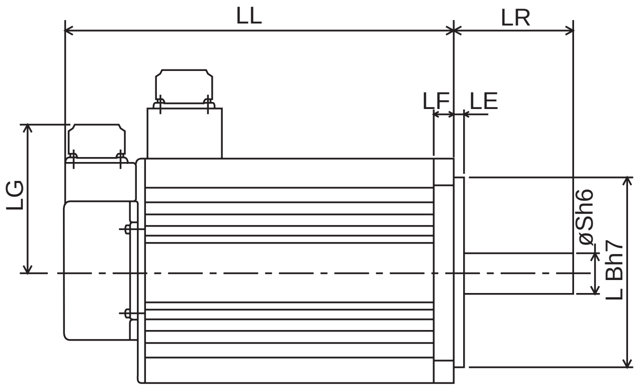
(Keyed version)

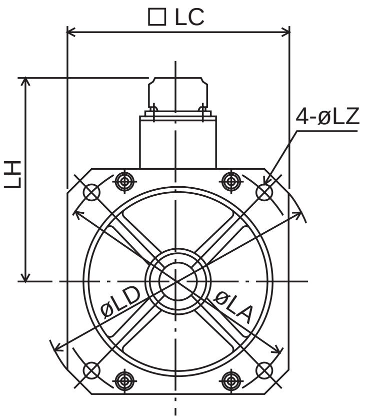
- Encoder specifications P 2500 P/r incremental encoder
  S 17 bits absolute/incremental encoder

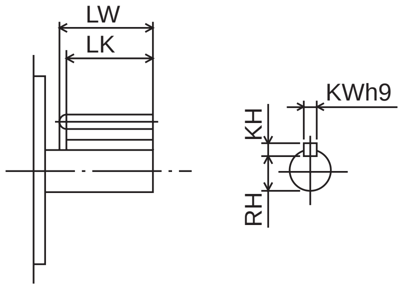
		Model	Output(W)	LL	S	LB	LE	LF	LR	LA	LC	LD	LG	LH	LZ	LW	LK	KW	KH	RH	Weight(kg)
MDMA	without brake	MDMA082P1□	0.75	147	19	110	3	12	55	—	120	162	84	111	Wide9	45	42	6	6	15.5	4.8
		MDMA102P1□	1.0	150	22		6			145	130	165		118	9		41	8	7	18	6.8
		MDMA152P1□	1.5	175																	8.5
		MDMA202P1□	2.0	200																	10.6
		MDMA252P1□	2.5	225	24				65							55	51			20	12.8
		MDMA302P1□	3.0	250																	14.6
		MDMA352P1□	3.5	222	28	130	3.2	18		165	150	190		128	11					24	16.2
		MDMA402P1□	4.0	242																	18.8
		MDMA452P1□	4.5	205	35	114.3			70	200	176	233		143	13.5		50	10	8	30	21.5
		MDMA502P1□	5.0	225																	25.0
		MDMA082S1□	0.75	147	19	110	3	12	55	—	120	162	84	111	Wide9	45	42	6	6	15.5	4.8
		MDMA102S1□	1.0	150	22		6			145	130	165		118	9		41	8	7	18	6.8
		MDMA152S1□	1.5	175																	8.5
		MDMA202S1□	2.0	200																	10.6
		MDMA252S1□	2.5	225	24				65							55	51			20	12.8
		MDMA302S1□	3.0	250																	14.6
		MDMA352S1□	3.5	222	28	130	3.2	18		165	150	190		128	11					24	16.2
		MDMA402S1□	4.0	242																	18.8
		MDMA452S1□	4.5	205	35	114.3			70	200	176	233		143	13.5		50	10	8	30	21.5
		MDMA502S1□	5.0	225																	25.0
	with brake	MDMA082P1□	0.75	172	19	110	3	12	55	—	120	162	84	111	Wide9	45	42	6	6	15.5	6.5
		MDMA102P1□	1.0	175	22		6			145	130	165		118	9		41	8	7	18	8.7
		MDMA152P1□	1.5	200																	10.1
		MDMA202P1□	2.0	225																	12.5
		MDMA252P1□	2.5	250	24				65							55	51			20	14.7
		MDMA302P1□	3.0	275																	16.5
		MDMA352P1□	3.5	247	28	130	3.2	18		165	150	190		128	11					24	18.7
		MDMA402P1□	4.0	267																	21.3
		MDMA452P1□	4.5	230	35	114.3			70	200	176	233		143	13.5		50	10	8	30	25.0
		MDMA502P1□	5.0	250																	28.5
		MDMA082S1□	0.75	172	19	110	3	12	55	—	120	162	84	111	Wide9	45	42	6	6	15.5	6.5
		MDMA102S1□	1.0	175	22		6			145	130	165		118	9		41	8	7	18	8.7
		MDMA152S1□	1.5	200																	10.1
		MDMA202S1□	2.0	225																	12.5
		MDMA252S1□	2.5	250	24				65							55	51			20	14.7
		MDMA302S1□	3.0	275																	16.5
		MDMA352S1□	3.5	247	28	130	3.2	18		165	150	190		128	11					24	18.7
		MDMA402S1□	4.0	267																	21.3
		MDMA452S1□	4.5	230	35	114.3			70	200	176	233		143	13.5		50	10	8	30	25.0
		MDMA502S1□	5.0	250																	28.5

Dimensions

MHMA Series 500W – 5.0kW





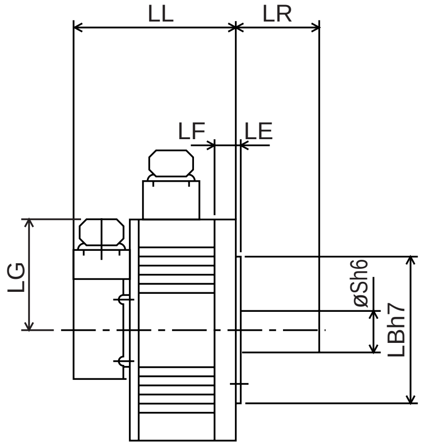


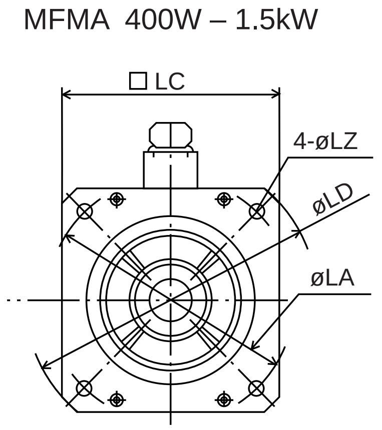
(Keyed version)

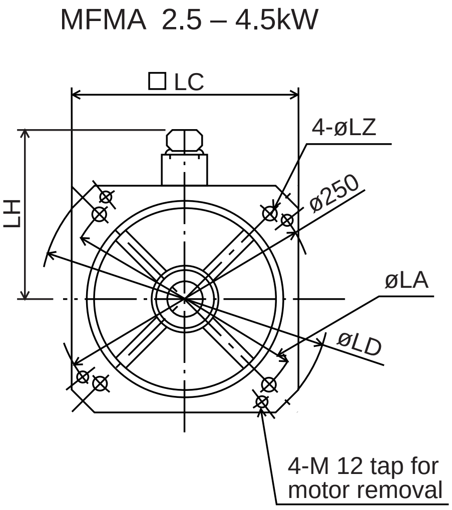
- Encoder specifications P 2500 P/r incremental encoder
  S 17 bits absolute/incremental encoder

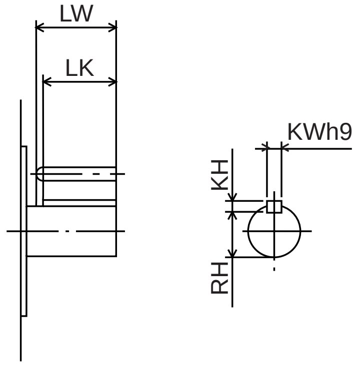
		Model	Output(W)	LL	S	LB	LE	LF	LR	LA	LC	LD	LG	LH	LZ	LW	LK	KW	KH	RH	Weight(kg)
MHMA	without brake	MHMA052P1□	0.5	150	22	110	6	12	70	145	130	165	84	118	9	45	41	8	7	18	5.3
		MHMA102P1□	1.0	175																	8.9
		MHMA152P1□	1.5	200																	10.0
		MHMA202P1□	2.0	190	35	114.3	3.2	18	80	200	176	233		143	13.5	55	50	10	8	30	16.0
		MHMA302P1□	3.0	205																	18.2
		MHMA402P1□	4.0	230																	22.0
		MHMA502P1□	5.0	255																	26.7
		MHMA052S1□	0.5	150	22	110	6	12	70	145	130	165	84	118	9	45	41	8	7	18	5.3
		MHMA102S1□	1.0	175																	8.9
		MHMA152S1□	1.5	200																	10.0
		MHMA202S1□	2.0	190	35	114.3	3.2	18	80	200	176	233		143	13.5	55	50	10	8	30	16.0
		MHMA302S1□	3.0	205																	18.2
		MHMA402S1□	4.0	230																	22.0
		MHMA502S1□	5.0	255																	26.7
	with brake	MHMA052P1□	0.5	175	22	110	6	12	70	145	130	165	84	118	9	45	41	8	7	18	6.9
		MHMA102P1□	1.0	200																	9.5
		MHMA152P1□	1.5	225																	11.6
		MHMA202P1□	2.0	215	35	114.3	3.2	18	80	200	176	233		143	13.5	55	50	10	8	30	19.5
		MHMA302P1□	3.0	230																	21.7
		MHMA402P1□	4.0	255																	25.5
		MHMA502P1□	5.0	280																	30.2
		MHMA052S1□	0.5	175	22	110	6	12	70	145	130	165	84	118	9	45	41	8	7	18	6.9
		MHMA102S1□	1.0	200																	9.5
		MHMA152S1□	1.5	225																	11.6
		MHMA202S1□	2.0	215	35	114.3	3.2	18	80	200	176	233		143	13.5	55	50	10	8	30	19.5
		MHMA302S1□	3.0	230																	21.7
		MHMA402S1□	4.0	255																	25.5
		MHMA502S1□	5.0	280																	25.5

MFMA Series 400W – 4.5kW









(Keyed version)

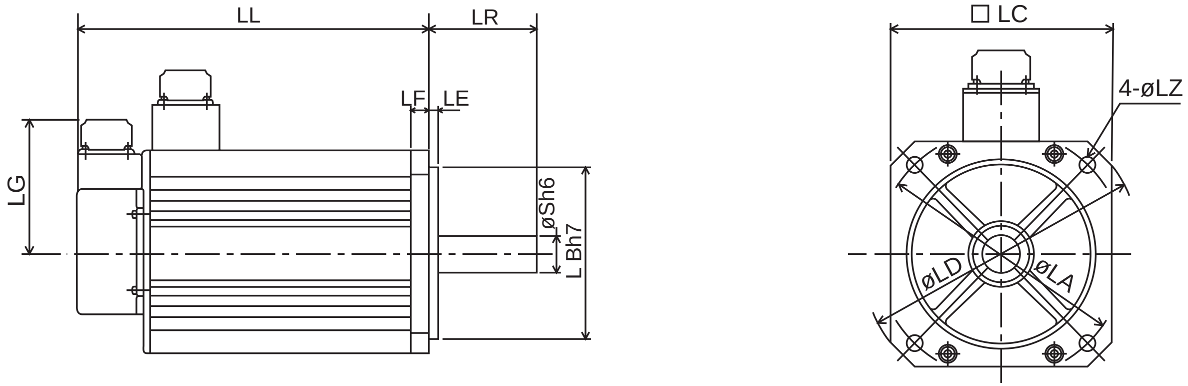
- Encoder specifications P 2500 P/r incremental encoder
  S 17 bits absolute/incremental encoder

		Model	Output(W)	LL	S	LB	LE	LF	LR	LA	LC	LD	LG	LH	LZ	LW	LK	KW	KH	RH	Weight(kg)
MFMA	without brake	MFMA042P1□	0.4	120	19	110	6	12	55	145	130	165	84	118	9	45	42	6	6	15.5	4.7
		MFMA082P1□	0.75	125	22	114.3	3.2	18		200	176	233		143	13.5		41	8	7	18	8.6
		MFMA152P1□	1.5	145	35				65							55	50	10	8	30	11.0
		MFMA252P1□	2.5	139		200	4	16		235	220	268		164							14.8
		MFMA352P1□	3.5	147																	15.5
		MFMA452P1□	4.5	163					70												19.9
		MFMA042S1□	0.4	120	19	110	6	12	55	145	130	165	84	118	9	45	42	6	6	15.5	4.7
		MFMA082S1□	0.75	125	22	114.3	3.2	18		200	176	233		143	13.5		41	8	7	18	8.6
		MFMA152S1□	1.5	145	35				65							55	50	10	8	30	11.0
		MFMA252S1□	2.5	139		200	4	16		235	220	268		164							14.8
		MFMA352S1□	3.5	147																	15.5
		MFMA452S1□	4.5	163					70												19.9
	with brake	MFMA042P1□	0.4	145	19	110	6	12	55	145	130	165	84	118	9	45	42	6	6	15.5	6.7
		MFMA082P1□	0.75	150	22	114.3	3.2	18		200	176	233		143	13.5		41	8	7	18	10.6
		MFMA152P1□	1.5	170	35				65							55	50	10	8	30	14.0
		MFMA252P1□	2.5	166		200	4	16		235	220	268		164							17.5
		MFMA352P1□	3.5	174																	19.2
		MFMA452P1□	4.5	194					70												24.3
		MFMA042S1□	0.4	145	19	110	6	12	55	145	130	165	84	118	9	45	42	6	6	15.5	6.7
		MFMA082S1□	0.75	150	22	114.3	3.2	18		200	176	233		143	13.5		41	8	7	18	10.6
		MFMA152S1□	1.5	170	35				65							55	50	10	8	30	14.0
		MFMA252S1□	2.5	166		200	4	16		235	220	268		164							17.5
		MFMA352S1□	3.5	174																	19.2
		MFMA452S1□	4.5	194					70												24.3

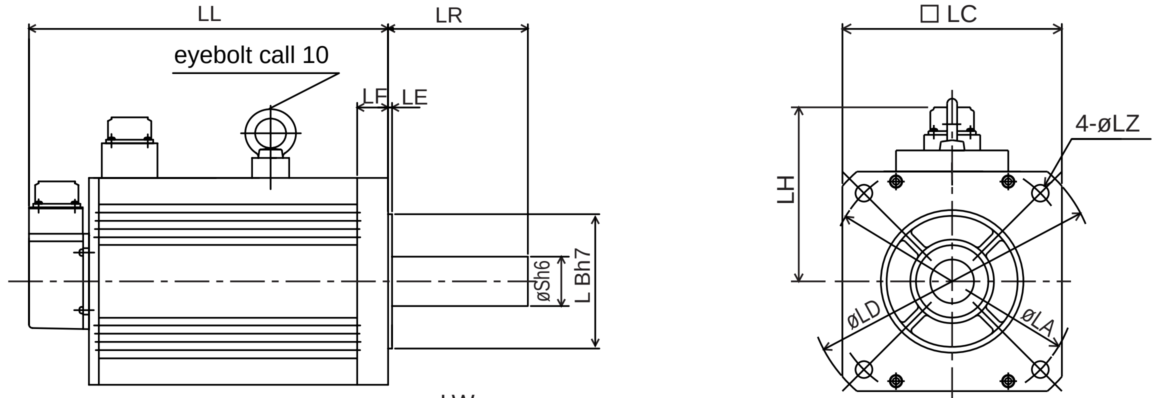
Dimensions

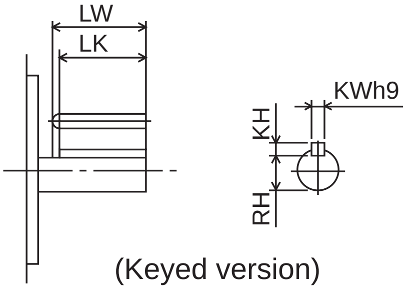
MGMA Series 300W – 4.5kW

MGMA 300W – 3.0kW



MGMA 4.5kW





(Keyed version)

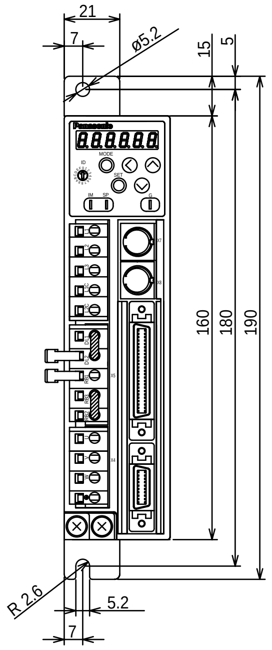
- Encoder specifications P 2500 P/r incremental encoder
  S 17 bits absolute/incremental encoder

		Model	Output(W)	LL	S	LB	LE	LF	LR	LA	LC	LD	LG	LH	LZ	LW	LK	KW	KH	RH	Weight(kg)
MGMA	without brake	MGMA032P1□	0.3	125	22	110	6	12	70	145	130	165	84	118	9	45	41	8	7	18	5.1
		MGMA062P1□	0.6	150																	6.8
		MGMA092P1□	0.9	175																	8.5
		MGMA122P1□	1.2	162.5	35	114.3	3.2	18	80	200	176	233		143	13.5	55	50	10	8	30	15.5
		MGMA202P1□	2.0	182.5																	17.5
		MGMA302P1□	3.0	222.5																	25.0
		MGMA452P1□	4.5	300.5	42			24	113							96	90	12		37	34.0
		MGMA032S1□	0.3	125	22	110	6	12	70	145	130	165	84	118	9	45	41	8	7	18	5.1
		MGMA062S1□	0.6	150																	6.8
		MGMA092S1□	0.9	175																	8.5
		MGMA122S1□	1.2	162.5	35	114.3	3.2	18	80	200	176	233		143	13.5	55	50	10	8	30	15.5
		MGMA202S1□	2.0	182.5																	17.5
		MGMA302S1□	3.0	222.5																	25.0
		MGMA452S1□	4.5	300.5	42			24	113							96	90	12		37	34.0
	with brake	MGMA032P1□	0.3	150	22	110	6	12	70	145	130	165	84	118	9	45	41	8	7	18	6.7
		MGMA062P1□	0.6	175																	8.4
		MGMA092P1□	0.9	200																	10.0
		MGMA122P1□	1.2	187.5	35	114.3	3.2	18	80	200	176	233		143	13.5	55	50	10	8	30	19.0
		MGMA202P1□	2.0	207.5																	21.0
		MGMA302P1□	3.0	271																	28.5
		MGMA452P1□	4.5	337.5	42			24	113							96	90	12		37	39.5
		MGMA032S1□	0.3	150	22	110	6	12	70	145	130	165	84	118	9	45	41	8	7	18	6.7
		MGMA062S1□	0.6	175																	8.4
		MGMA092S1□	0.9	200																	10.0
		MGMA122S1□	1.2	187.5	35	114.3	3.2	18	80	200	176	233		143	13.5	55	50	10	8	30	19.0
		MGMA202S1□	2.0	207.5																	21.0
		MGMA302S1□	3.0	271																	38.5
		MGMA452S1□	4.5	337.5	42			24	113							96	90	12		37	39.5

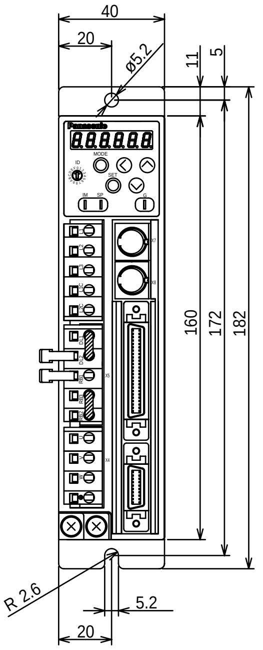
MEMO

Dimensions

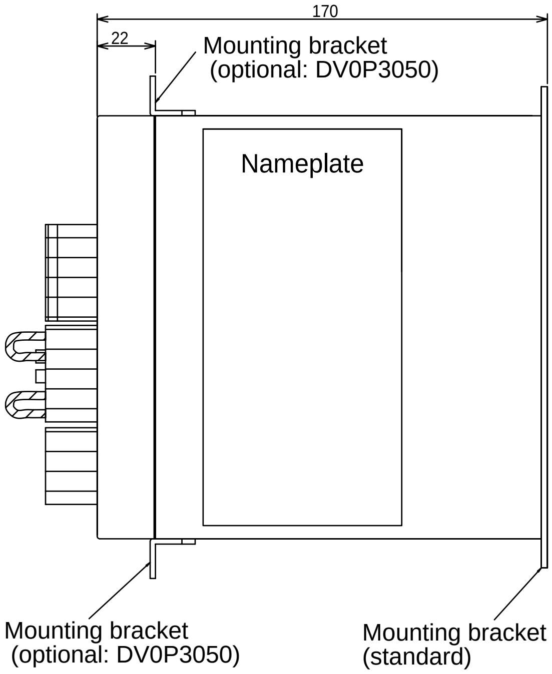
Driver Type A   Approximate weight : 1.0 kg

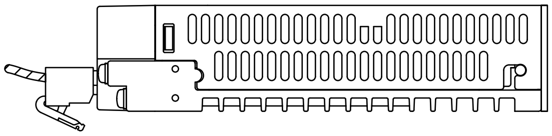


Front panel mount type
(optional: front panel mount)



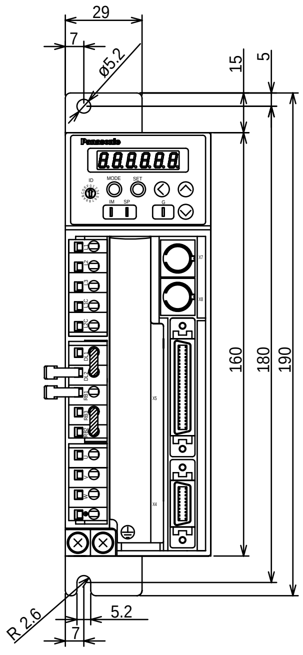
Back panel mount type
(standard: back panel mount)



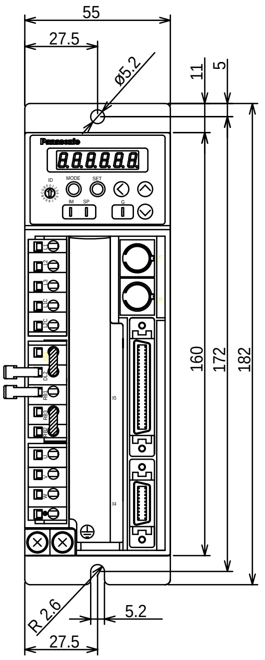


* When using mounting bracket for an optional part, see page 279 "Brackets for Mounting the Driver" in "Optional Parts".

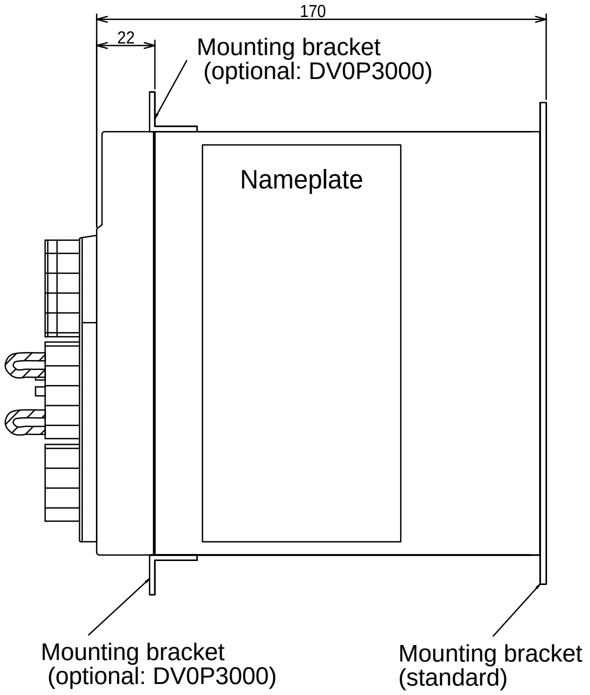
Driver Type B   Approximate weight : 1.1 kg

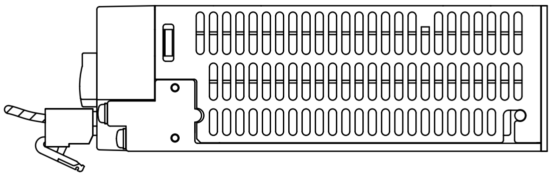


Front panel mount type
(optional: front panel mount)



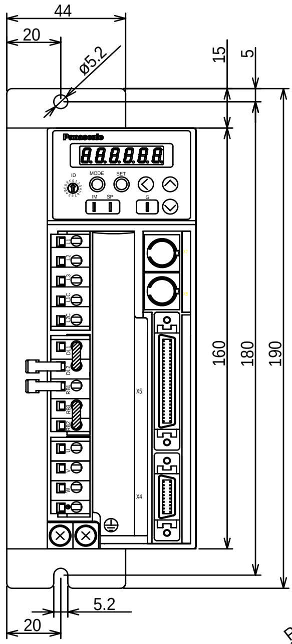
Back panel mount type
(standard: back panel mount)



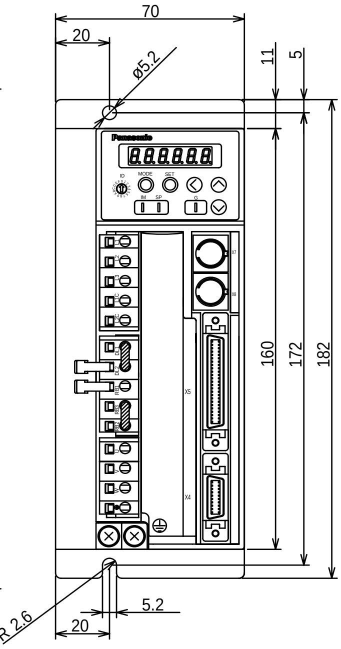


* When using mounting bracket for an optional part, see page 279 "Brackets for Mounting the Driver" in "Optional Parts".

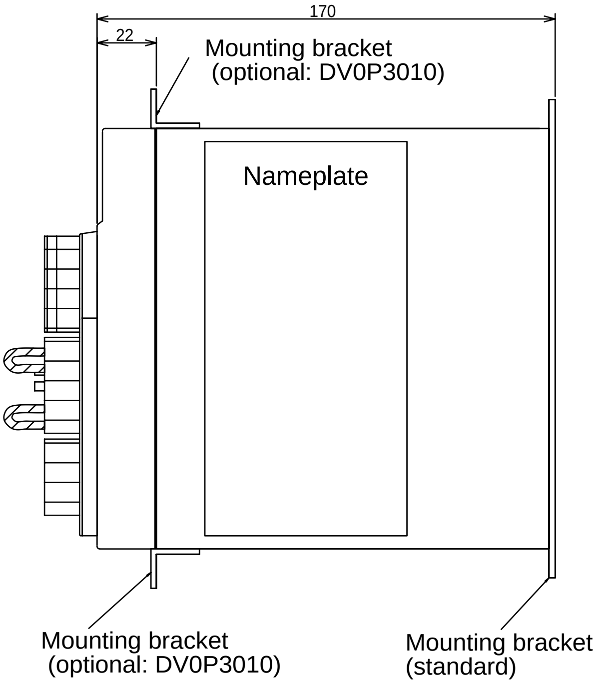
Driver Type C Approximate weight : 1.4 kg

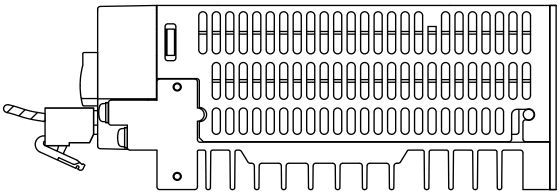


Front panel mount type
(optional: front panel mount)



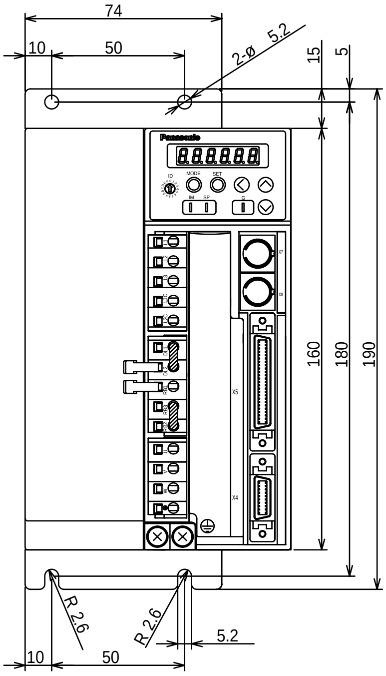
Back panel mount type
(standard: back panel mount)



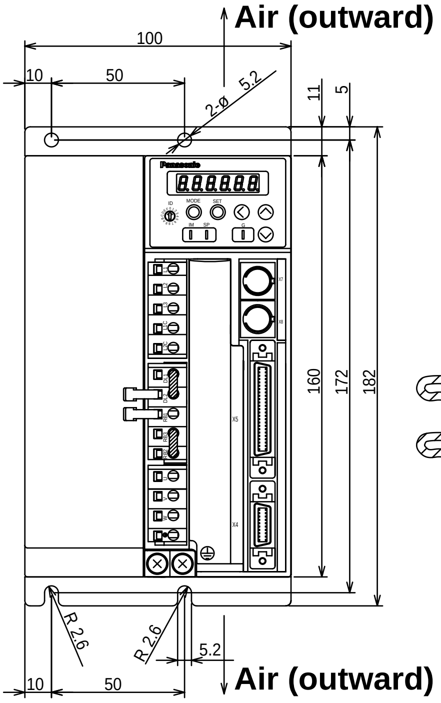


* When using mounting bracket for an optional part, see page 279 "Brackets for Mounting the Driver" in "Optional Parts".

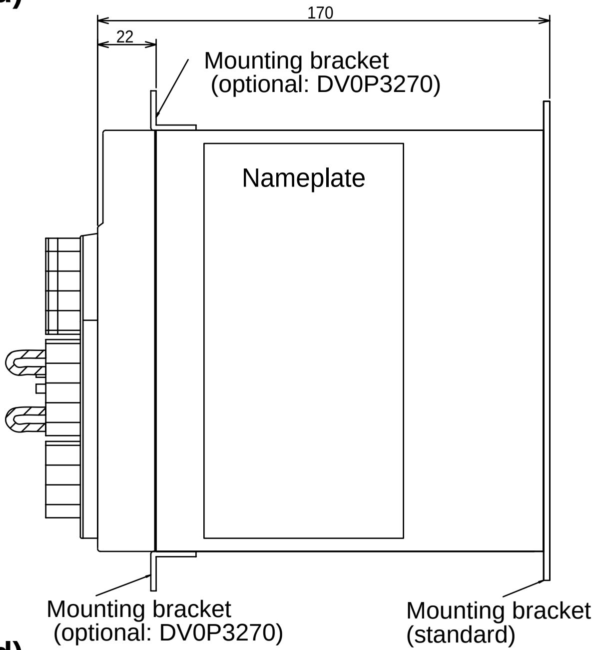
Driver Type D Approximate weight : 3.8 kg

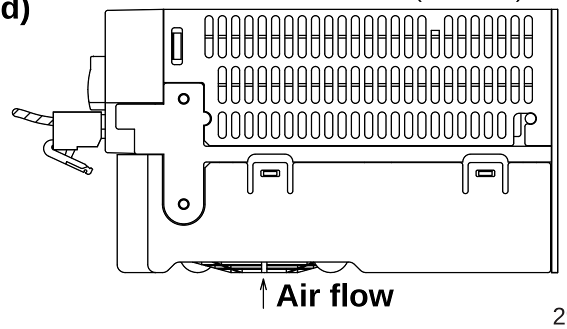


Front panel mount type
(optional: front panel mount)



Back panel mount type
(standard: back panel mount)

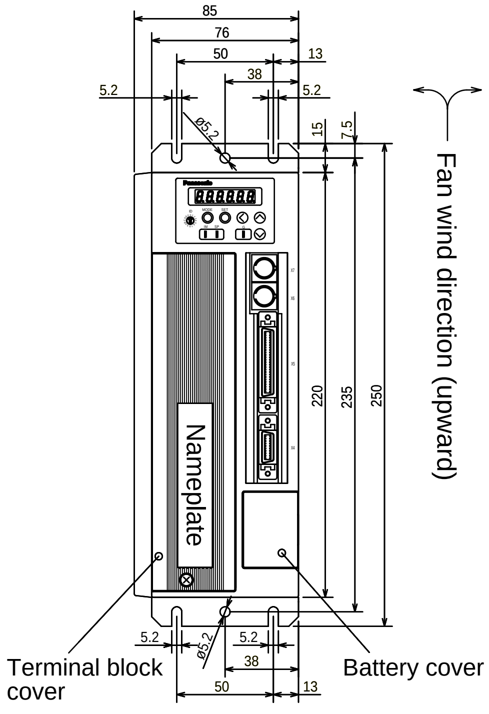


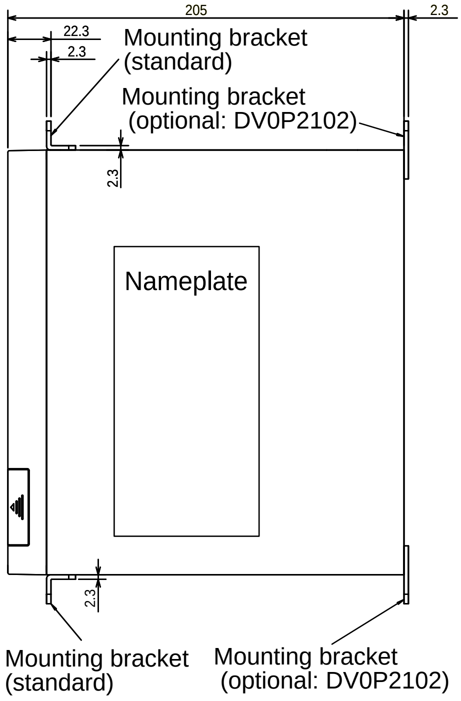


* When using mounting bracket for an optional part, see page 279 "Brackets for Mounting the Driver" in "Optional Parts".

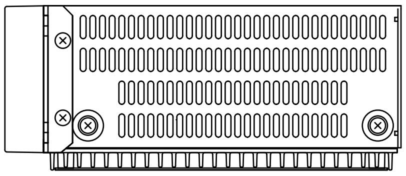
Dimensions

Driver Type E Approximate weight : 4.2 kg

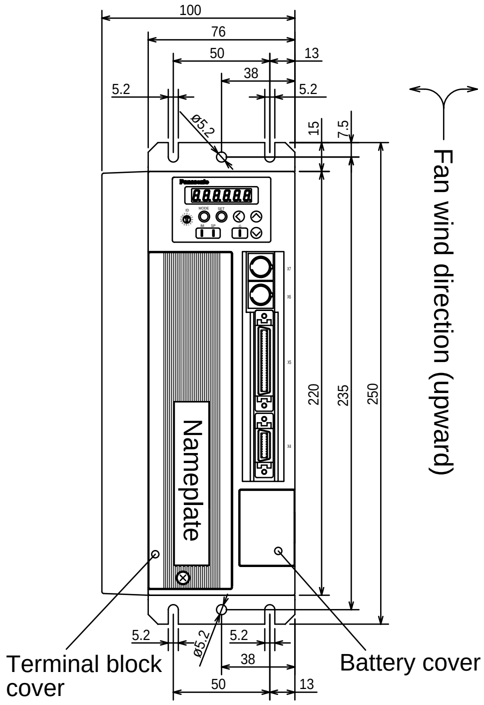


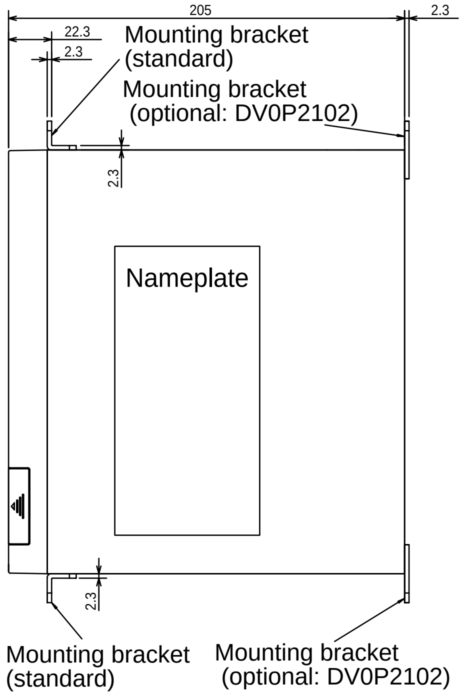


* When using mounting bracket for an optional part, see page 279 "Brackets for Mounting the Driver" in "Optional Parts".

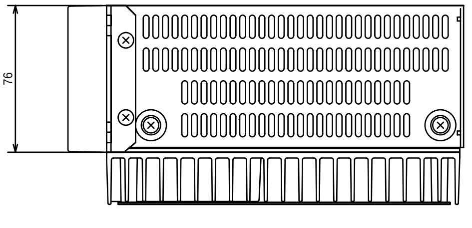


Driver Type F Approximate weight : 8 kg

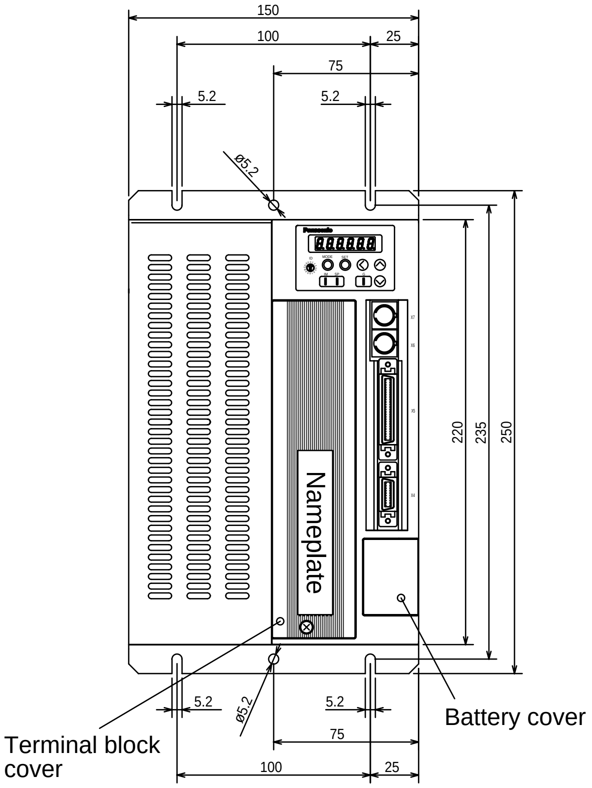


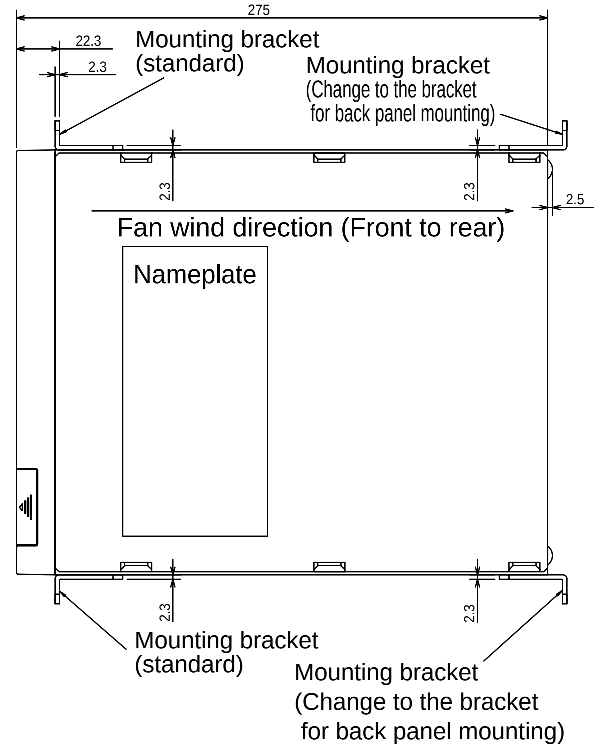


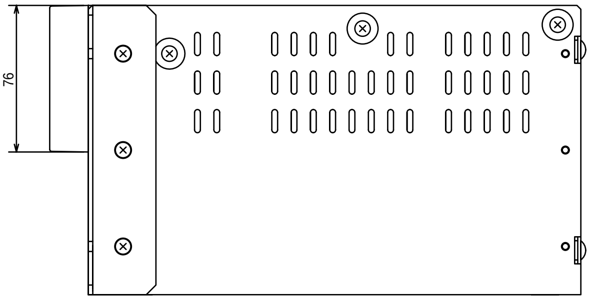
* When using mounting bracket for an optional part, see page 279 "Brackets for Mounting the Driver" in "Optional Parts".



Driver Type G   Approximate weight : 18 kg

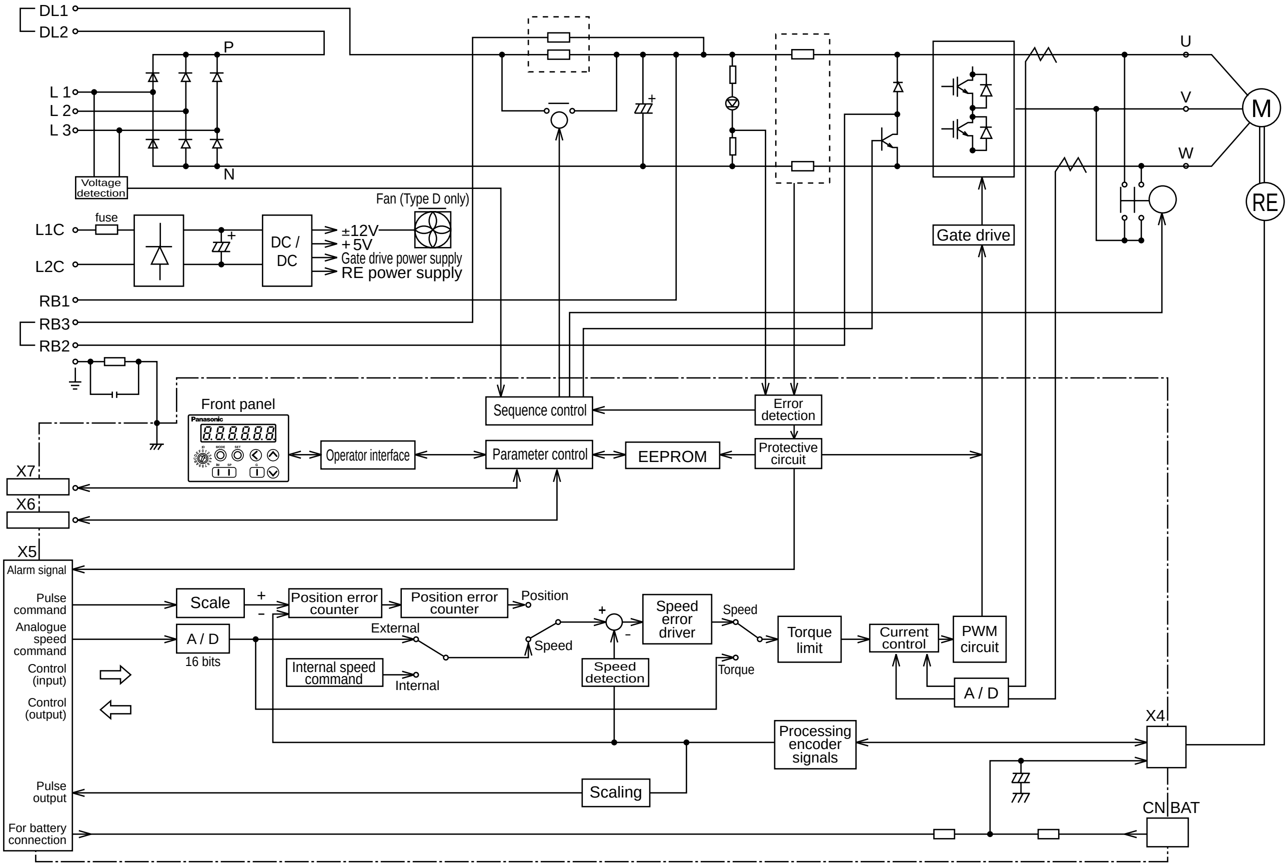




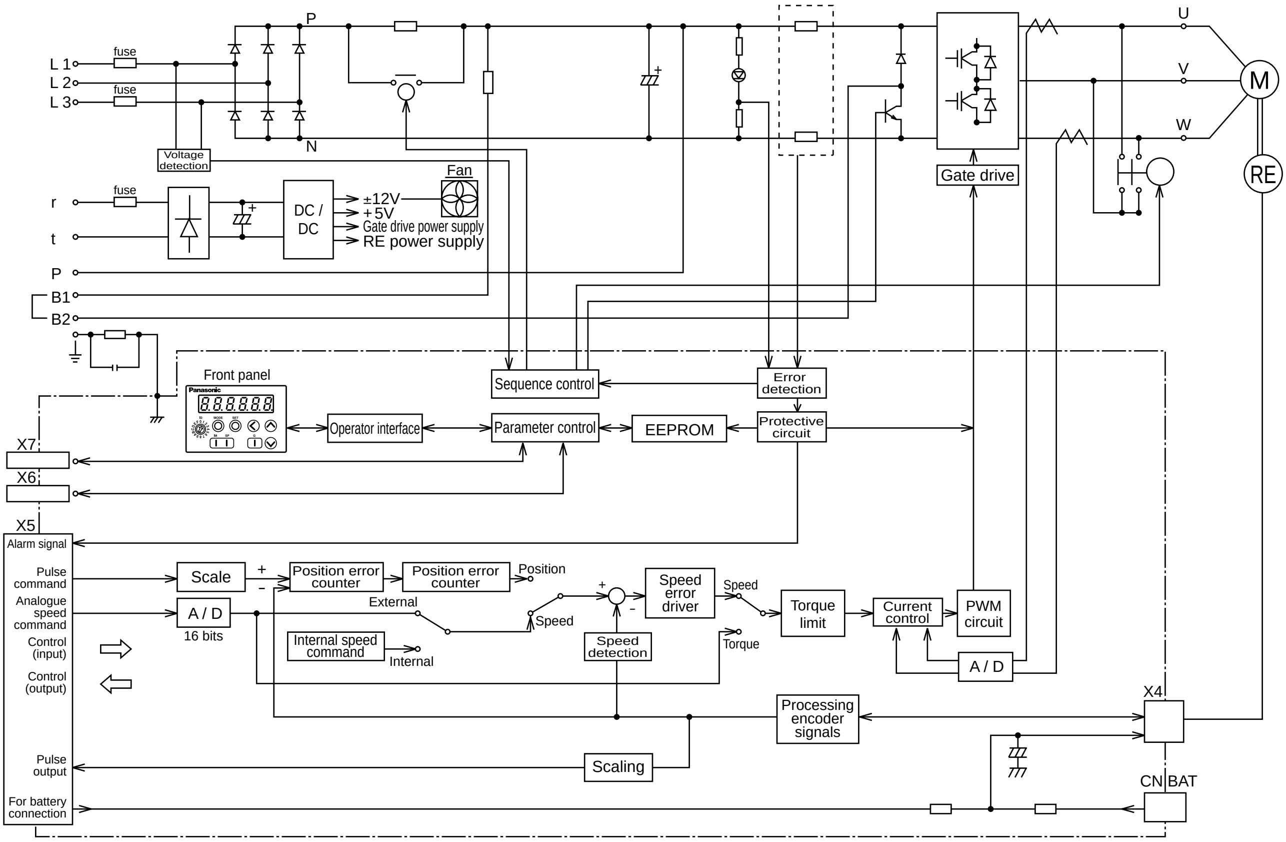


Driver Block Diagram

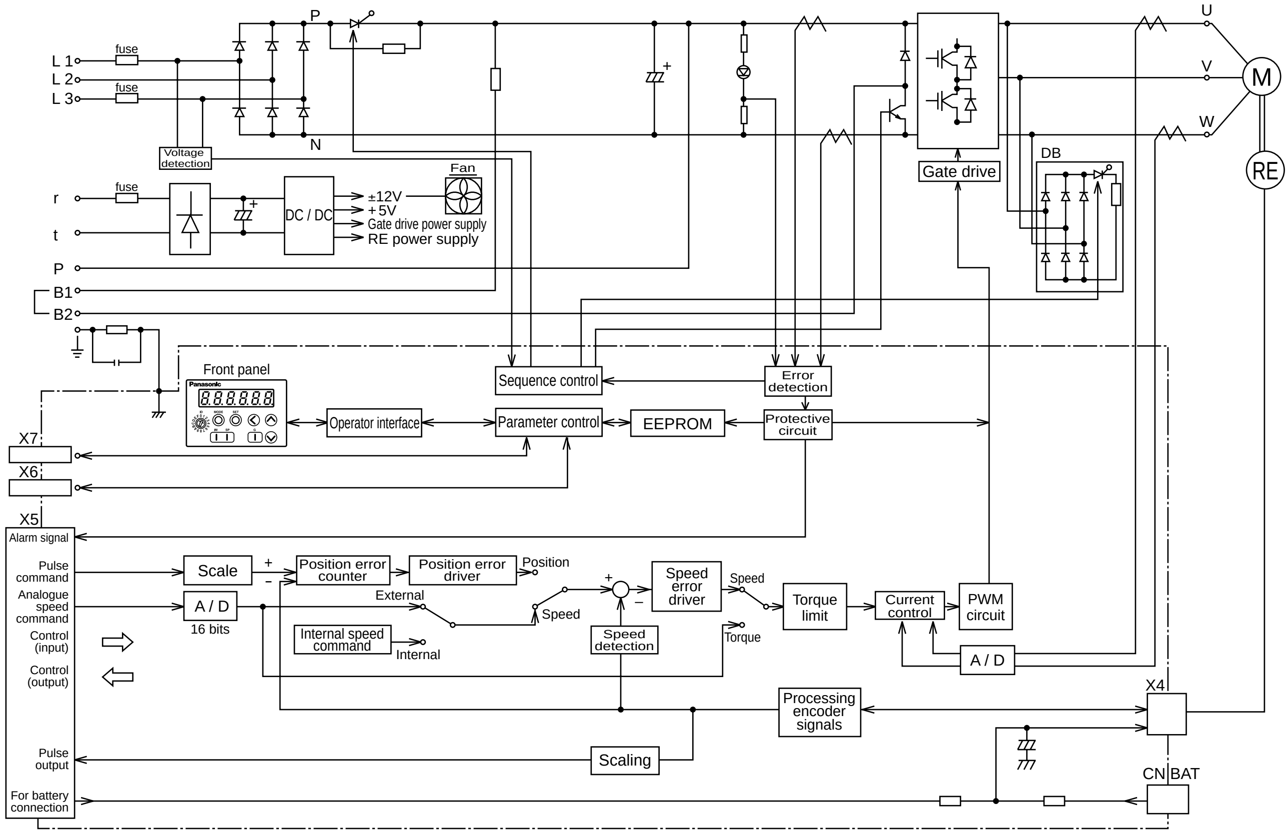
Internal Block Diagram of MINAS-AIII Driver (Types A, B, C, D)



Internal Block Diagram of MINAS-AIII Driver (Types E, F)



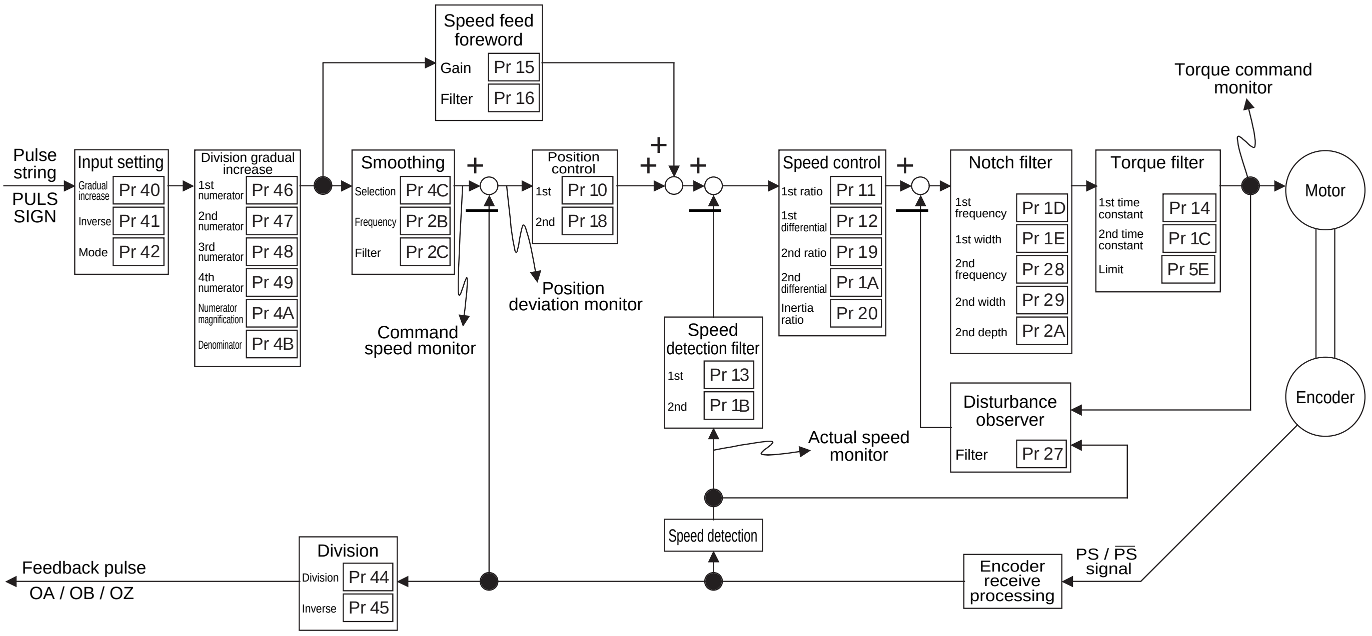
Internal Block Diagram of MINAS-AIII Driver (Type G)



Control block diagrams

Semi-closed control block diagram

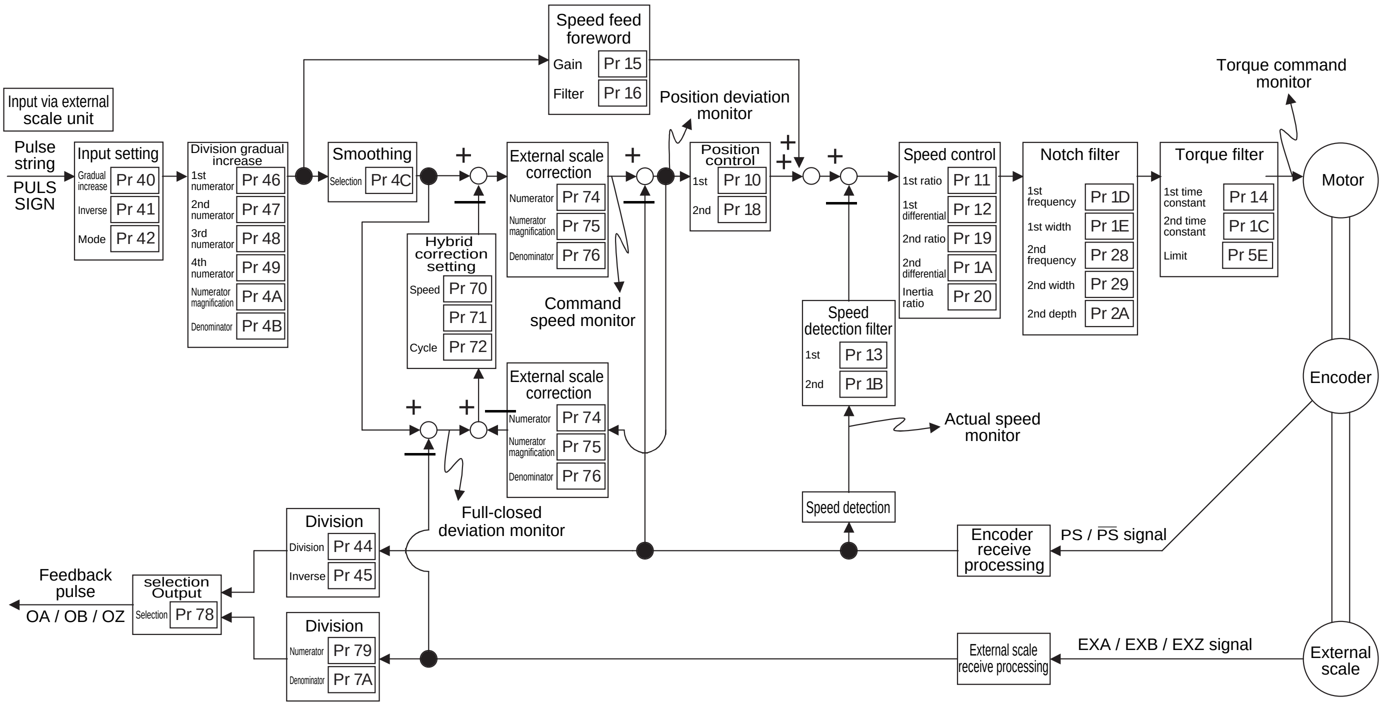
• Control mode set-up: when Pr02 is [6]



Hybrid control block diagram

• Control mode set-up: when Pr02 is [8]

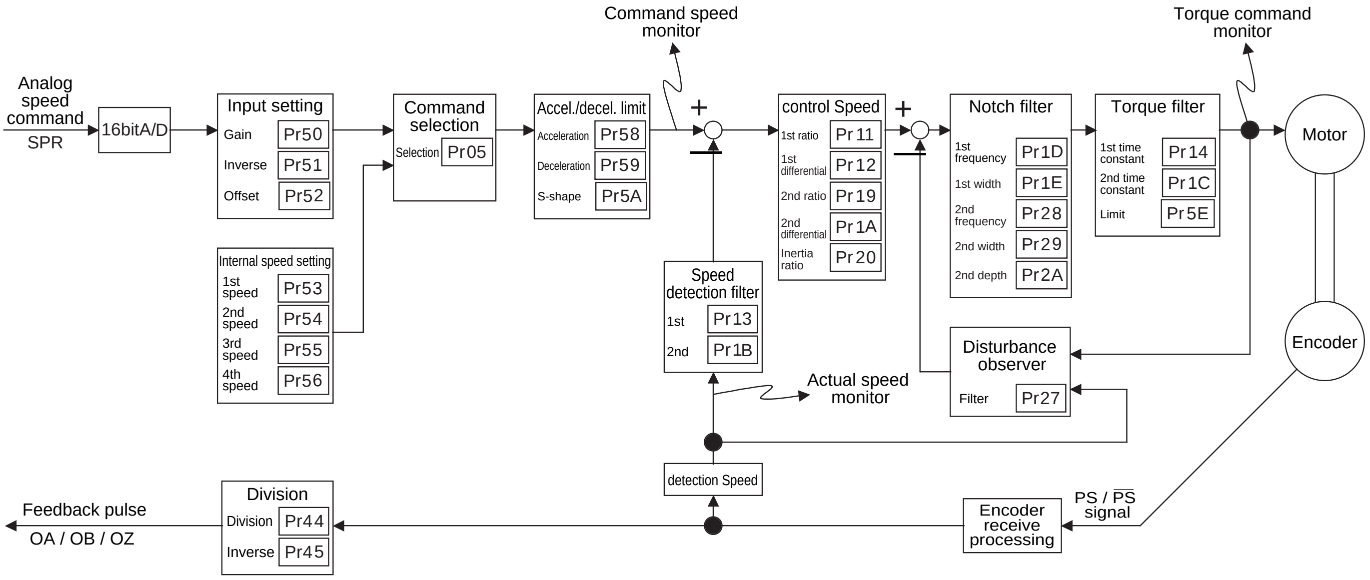
* The positioning complete output is turned on as the output from the external scale deviation counter is equal to or below the value set by Pr60.



Speed/external encoder control mode - Speed control block diagram

• Control mode set-up: when Pr02 is [9] (case 1)

- Gain changeover function is not available in this mode.
  To use 1st gain [Pr10] -[Pr14] , set [Pr30] to 1 and [Pr36] to 0. Do not change these settings.

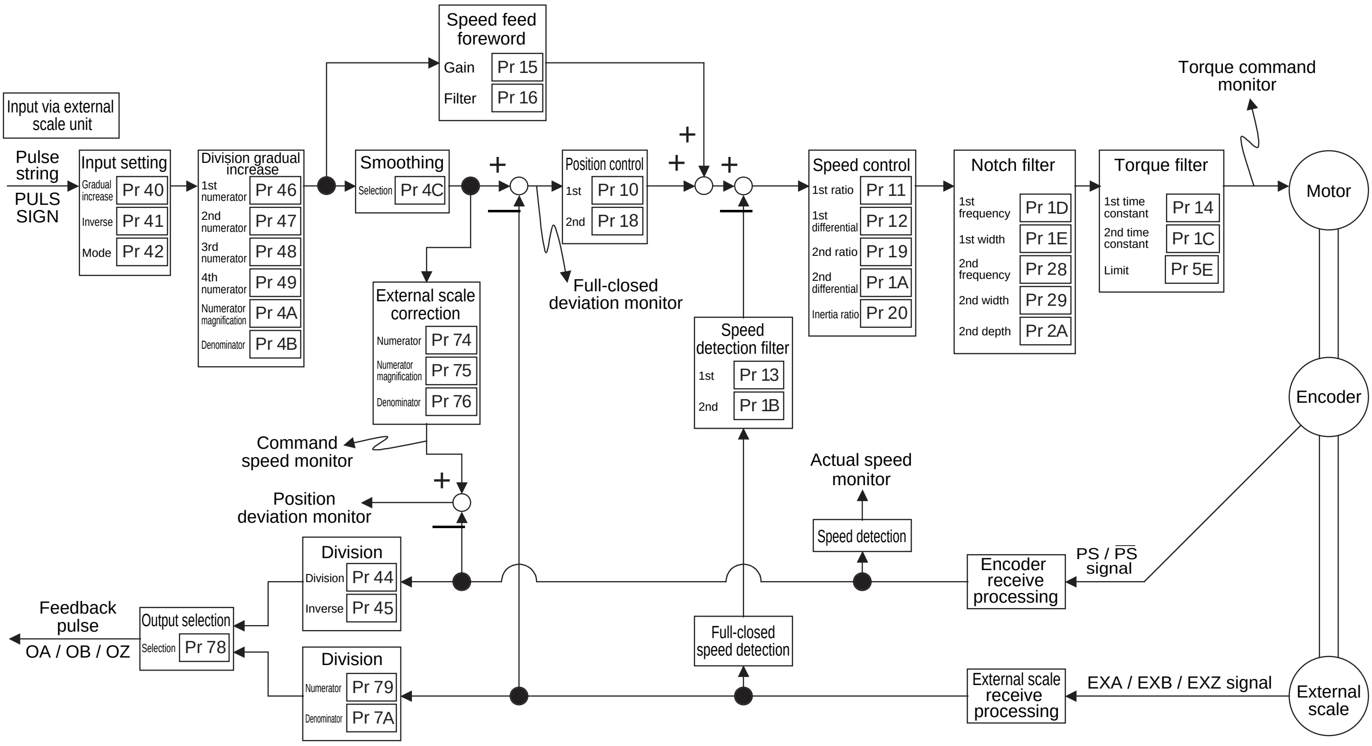


Speed/external encoder control mode - External encoder control block diagram

• Control mode set-up: when Pr02 is [9] (case 2)

- Gain changeover function is not available in this mode.
  To use 2nd gain [Pr18] -[Pr1C] , set [Pr30] to 1 and [Pr31] to 1. Do not change these settings.

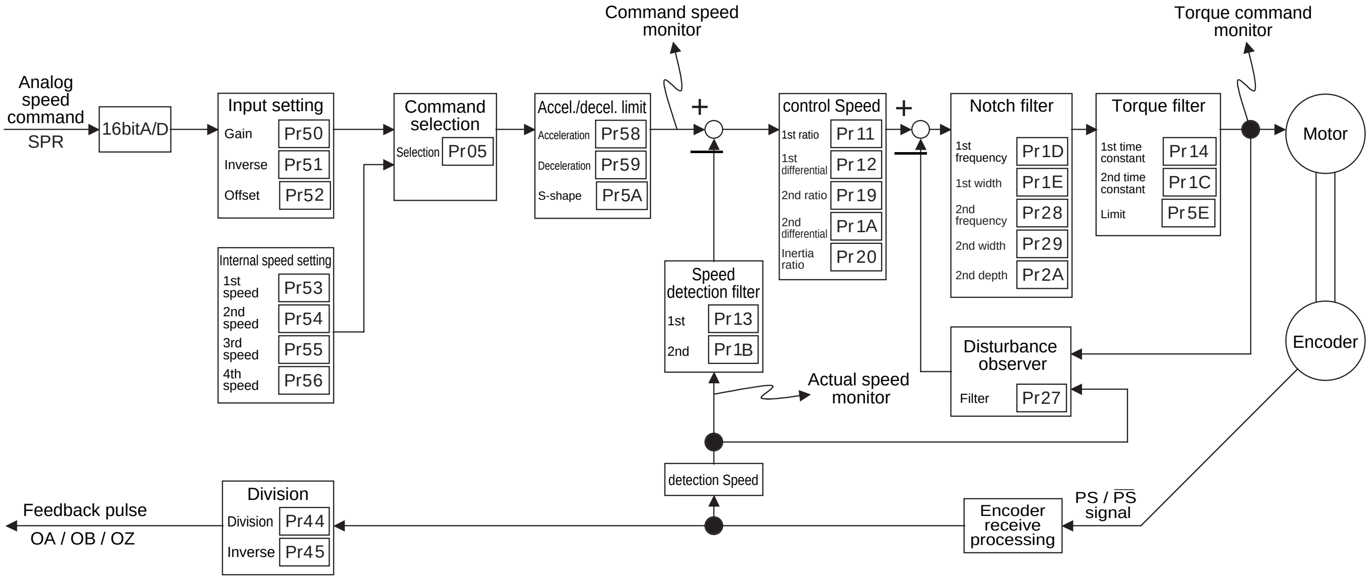
* The positioning complete output is turned on as the output from the external scale deviation counter is equal to or below the value set by Pr60.



Control block diagrams

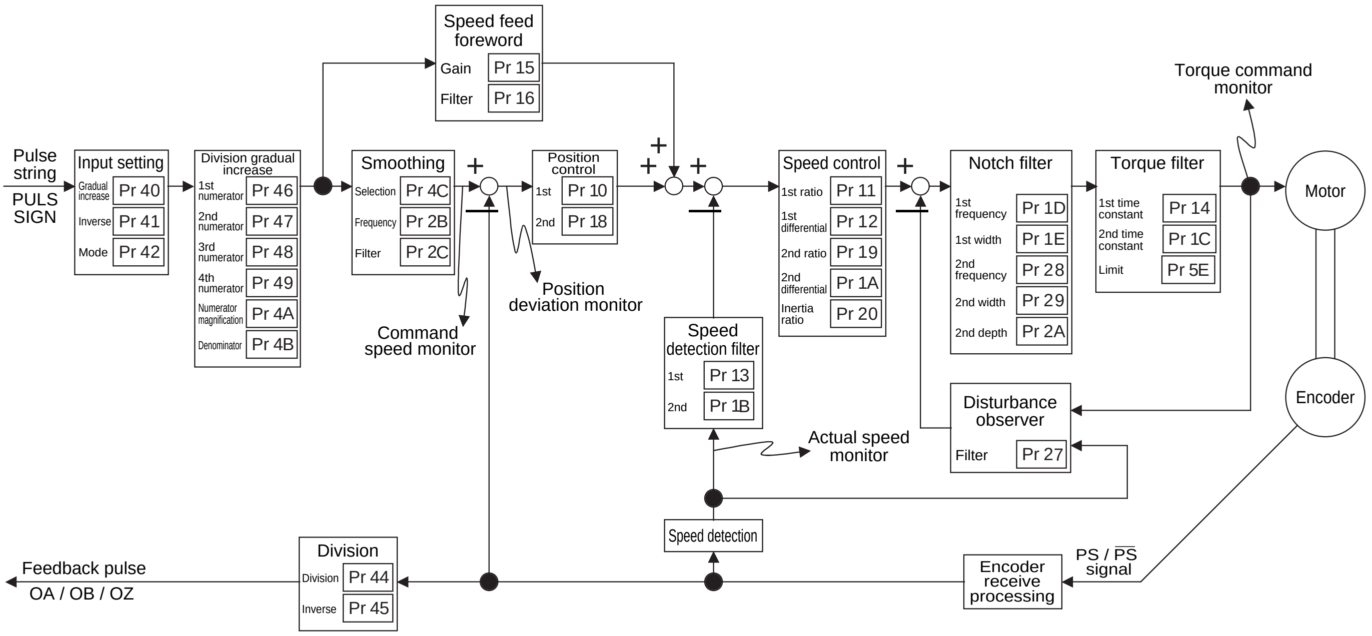
Speed/semi-closed control mode - Speed control block diagram

• Control mode set-up: when Pr02 is [10] (case 1)



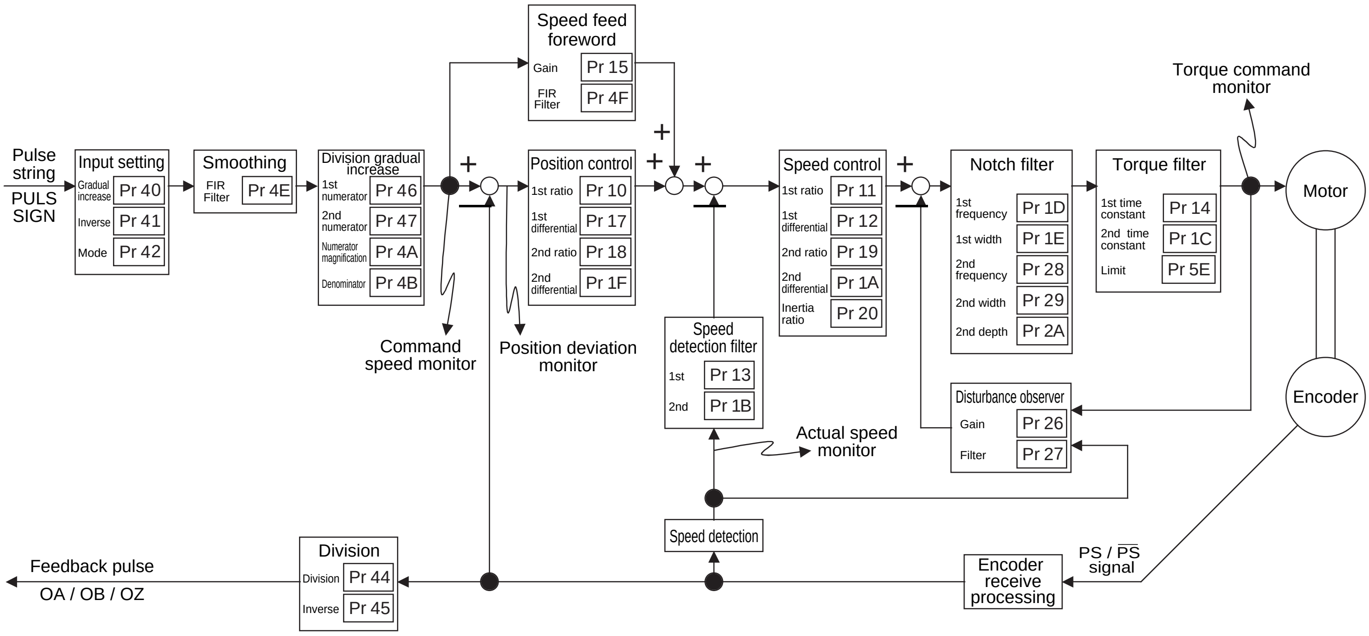
Speed/semi-closed control mode - Semi-closed control block diagram

• Control mode set-up: when Pr02 is [10] (case 2)



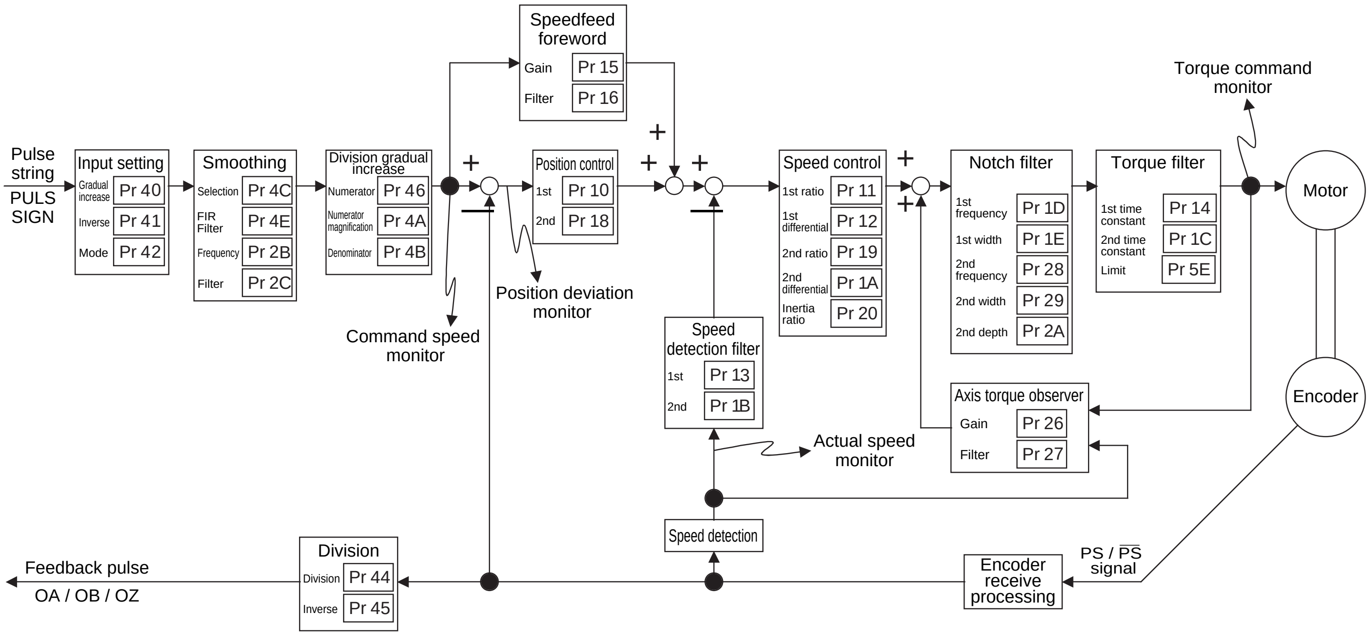
Position control for high-stiffness equipment block diagram

• Control mode set-up: when Pr02 is [11]



Position control for low-stiffness equipment block diagram

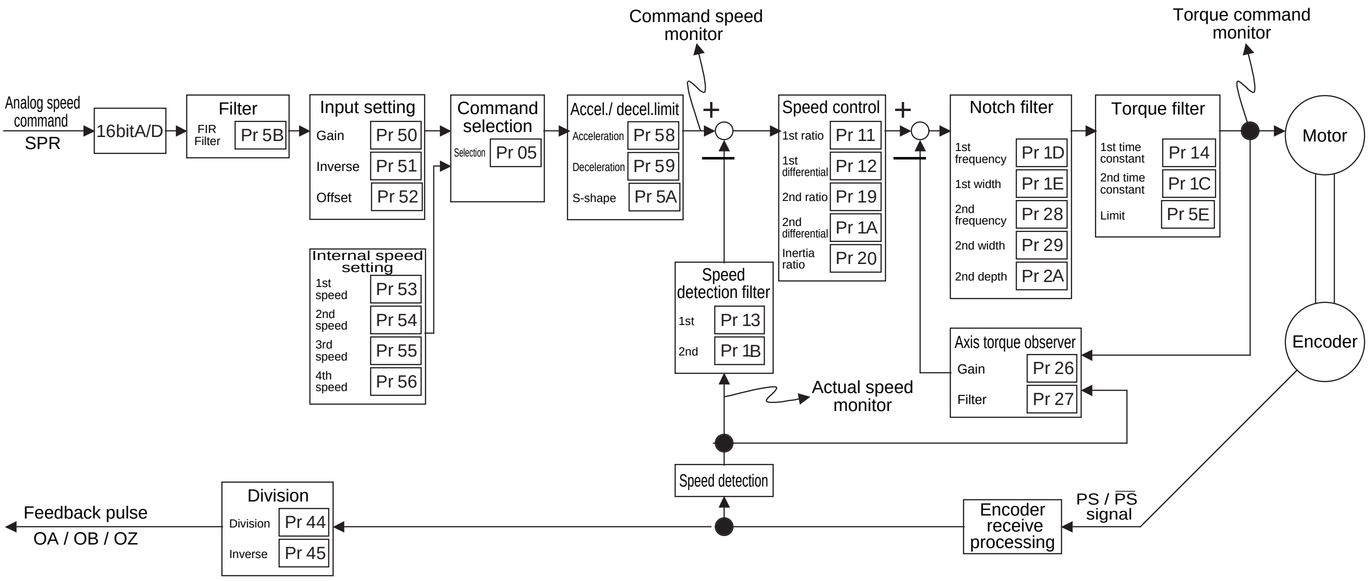
• Control mode set-up: when Pr02 is [12]



Control block diagrams

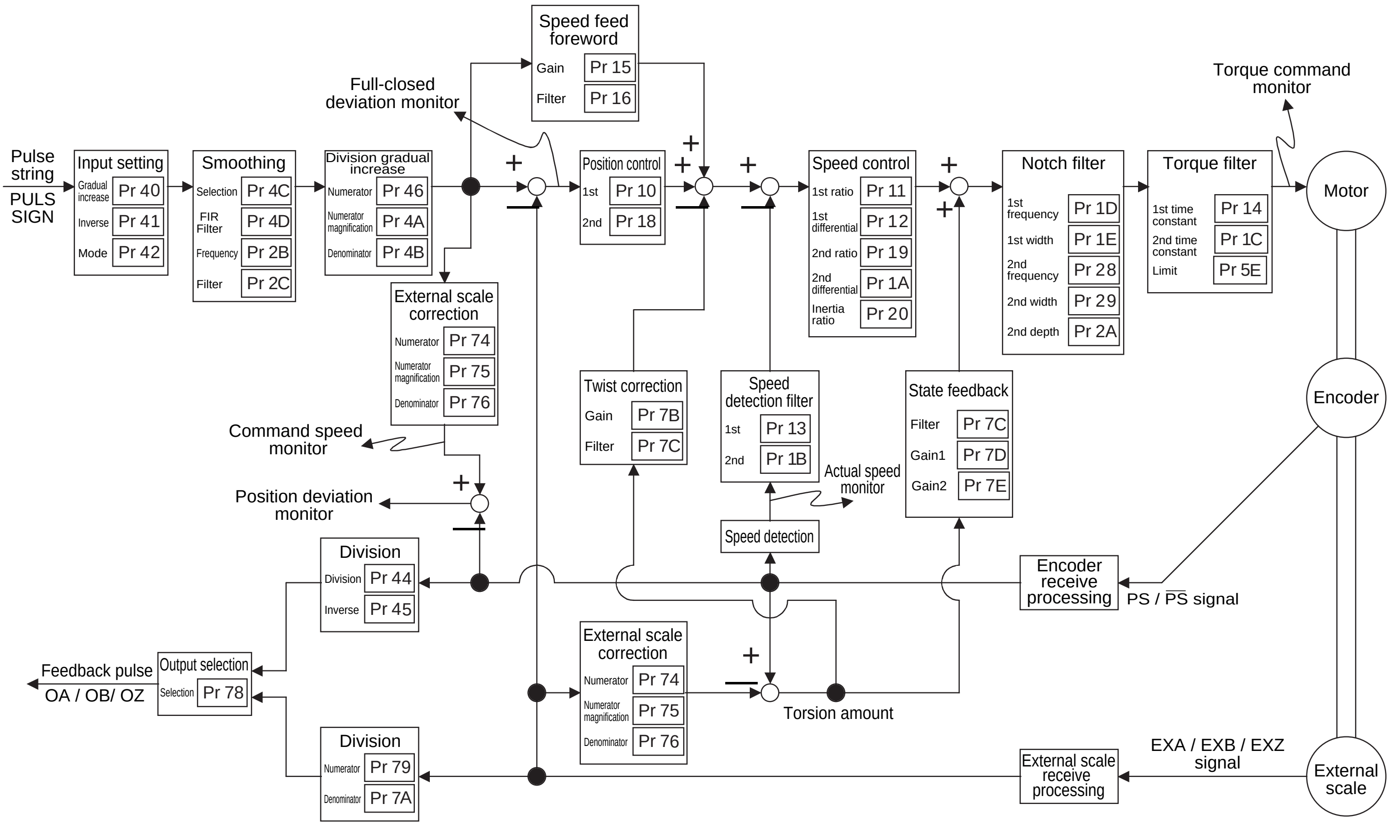
Speed control for low-stiffness equipment block diagram

• Control mode set-up: when Pr02 is 13



Second full-closed control block diagram

• Control mode set-up: when Pr02 is 14



MEMO

Specifications (Driver)

Basic specifications	Input power supply	100V-line	Main circuit power		Single-phase 100 – 115V +10% –15% 50 / 60 Hz
			Control circuit power		Single-phase 100 – 115V +10% –15% 50 / 60 Hz
		200V-line	Main circuit power	Type A – D	Single/three-phase 200 – 240V +10% –15% 50 / 60 Hz
				Type E – G	Three-phase 200 – 230V +10% –15% 50 / 60 Hz
			Control circuit power	Type A – D	Single-phase 200 – 240V +10% –15% 50 / 60 Hz
				Type E – G	Single-phase 200 – 240V +10% –15% 50 / 60 Hz
	Operation conditions	Temperature			Operation temperature : 0 – 55 ˚C Storage temperature : –20 – 80 ˚C
		Humidity			Operation/storage humidity 90 % RH or less (no condensation)
		Height above the sea			Height above the sea level : 1000 m or less
		Vibration			5.88 m/s^2 or less, 10 – 60 Hz (Continuous operation at resonance point is not allowed)
	Control method				IGBT PWM method, sinusoidal drive
	Encoder feedback				17 Bit (resolution : 131072) absolute encoder / incremental encoder 2500 P / r (resolution : 10000) incremental encoder
	External scale feedback				Linear scale / encoder signal can be input for outputting 2-phase (A/B) square-wave to line driver.
	Control signal	Input			10-input [1] Servo-ON [2] Control mode select [3] Gain select [4] Alarm clear Other inputs depend on the control mode.
		Output			6-output [1] Servo alarm [2] Servo ready [3] External brake release signal [4] Zero-speed detection [5] In torque control Other outputs depend on the control mode.
	Analogue signal	Input			3-input (16 bit A / D 1 input, 10 bit A / D 2 input)
		Output			2-output (for monitor) [1] Speed monitor (Actual speed of the motor or command speed can be monitored. Contents of the monitor and scale is selected by parameter.) [2] Torque monitor (torque command (approx. 3 V / rated torque), deviation counter, or full - closed deviation can bemonitored. Contents of the monitor and scale is selected by parameter.)
	Pulse signal	Input			2-input Both of the line driver I / F and open collector I / F are available by means of photocoupler input
		Output			4-output Encoder pulse (A / B / Z-phase) or external scale pulse (EXA / EXB / EXZ-phase) is output by the line driver. For Z-phase or EXZ-phase pulse, an open collector output is also available.
	Communication function	RS232C			1:1 communication is available using a device having an RS232C interface as a host.
		RS485			1:n communication up to 15 axes is available using a device having an RS485 interface as a host.
	Front panel				[1] 5 keys (MODE, SET, UP, DOWN. SHIFT) [2] LED 6 figures
	Regeneration				Type A : No internal regenerative resist (external only) Type B – G : internal regenerative resist (external is also available)
	Dynamic brake				Internal
	Control mode				Selectable from the following 15 mode using parameters : [1] position control [2] speed control [3] torque control [4] position / speed control [5] position / torque control [6] speed / torque control [7] semi-closed control [8] full-closed control [9] hybrid control [10] speed / external encoder control [11] speed / semi-closed control [12] position control for high-rigidity equipment [13] *position control for low-rigidity equipment [14] *speed control for low-rigidity equipment [15] *second full-closed control For a motor of which encoder specification is 17-Bit (131072 resolution). For a motor of 2500 p / r (resolution : 10000, 5 - serial), 11 modes only excluding item marked with (*) are available.

Function	Position control	Control input		[5] CW drive prohibition [6] CCW drive prohibition [7] Deviation counter clear [8] Command pulse input prohibition [9] Command dividing gradual increase switching
		Control output		[6] positioning completion
		Pulse input	Max.command pulse frequency	500 kpps (when line driver I / F is used)
			Input pulse string mode	Differential input. Selectable with parameters. ([1] CCW / CW [2] A / B-phase [3] Command / direction)
			Command pulse division gradual increase (electronic gear ratio setting)	Applicable setting range : (1 – 10000 x $2^{(0-17)}$) / (1 – 10000)
			Smoothing filter	Primary delay filter is applicable to command input. R-type filter is selectable for [12] position control for high-rigidity equipment and [13] position control for low-rigidity equipment.
		Analogue input	Torque limit command input	Torque can be limited separately in CW / CCW direction (3 V / rated torque)
		Command follow-up control		Applicable to [12] position control for high-rigidity equipment
		Instantaneous speed observer		Applicable to [12] position control for high-rigidity equipment
		Vibration reducing control		Applicable to [13] position control for low-rigidity equipment
		Resonance ratio control		Applicable to [13] position control for low-rigidity equipment
	Speed control	Control input		[5] CW drive prohibition [6] CCW drive prohibition [7] Internal command speed selection 1 [8] Internal command speed selection 2 [9] Speed zero clamp
		Control output		[6] Rached speed
		Analogue input	Speed command input	Speed command can be input with analogue voltage Scale setting and command polarity depend on the parameter. (Standard setting before shipment : 6 V / rated revolving speed)
			Torque limit command input	Torque can be limited separately in CW / CCW direction. (3 V / rated torque)
		Internal speed command		Internal speed is selectable from 4 steps by control input
		Soft start/down function		0 – 10 s / 1000 r / min acceleration / deceleration can be set separately. S-acceleration/deceleration is also available.
		Zero speed clamp		Internal speed command can be clamped to zero by speed zero clamp input
		Instantaneous speed observer		Applicable to [14] speed control for low-rigidity equipment
		Resonance ratio control		Applicable to [14] speed control for low-rigidity equipment
		Speed command FIR filter		Applicable to [14] speed control for low-rigidity equipment
	Torque control	Control input		[5] CW drive prohibition [6] CCW drive prohibition [7] speed zero clamp
		Control output		[6] Reached speed
		Analogue input	Torque command input	Torque command can be input by analogue voltage. Scale setting and command polarity depend on the parameter. (Standard setting before shipment : 3 V / rated torque)
		Speed limit function		Speed limit value can be set using parameters
	Full-closed related	Control input		[5] Smoothing filter switching [6] Scale error input [7] Deviation counter clear [8] Command pulse input prohibition [9] Command division gradual increase switching 1 [10] Command division gradual increase switching 2
		Control output		[6] full-closed positioning completion
		Pulse input	Max.command pulse frequency	500 kpps (when line driver I / F is used)
			Input pulse string mode	Differential input Selectable with parameter. ([1] CCW / CW [2] A / B-phase [3] Command / direction)
			Command pulse division gradual increase (electronic gear ratio setting)	Applicable setting range : (1–10000 x $2^{(0-17)}$) / (1–10000)
			Smoothing filter	Primary delay filter is applicable to command input
		Analogue input	Torque limit command input	Torque cab be limited separately in CW / CCW direction (3 V / rated torque).
		External scale division gradual increase setting range		Ratio between the encoder pulse (denominator) and the external scale pulse (numerator) can be set within the setting range : (1 – 10000 x $2^{(0-17)}$) / (1 – 10000)
		Twist amount correction function		Applicable to [15] 2nd full-closed control
		Status feedback function		Applicable to [15] 2nd full-closed control
	Common	Auto tuning	Real time	Load inertia is determined at real time in the state of actual operation and gain corresponding to the rigidity is set automatically. Applicable to the follwing seven modes : [1] position control [2] speed control [3] torque control [4] position / speed control [5] position / torque control [6] speed / torque control [7] semi-closedd control
			Normal mode	Load inertia is determined by driving the equipment with operation command within the driver and gain corresponding to the rigidity is set automatically. Applicable to [1] position control or [7] semi-closed control
			Fit gain function	Optimum gain setting is seached automatically by repeating reciprocating operation in position control mode Applicable to [1] position control or [7] semi-closed control .
		Unnecessary wiring mask function		The following control input signal can be masked : [1] drive prohibition input [2] torque limit input [3] command pulse prohibition input [4] speed zero clamp input
		Division function of encoder feedback pulse		1 P / r ~ 16384 P / r (at the maximum encoder pulse)
		Protection function	Hardware error	Overload, undervoltage, overspeed, overload, overheat, over current, encoder error, etc.
			Software error	Large positional deviation, command pulse division, EEPROM error, etc.
		Alarm data trace back function		Tracable up to 14 alarm data reversely including present alarm data.

Motor characteristics

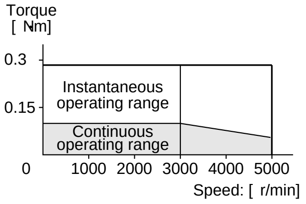
- Motor characteristics depend on whether the oil seal and/or brake is used or not used.
- Continuous torque vs ambient temperature characteristics are measured with our standard aluminum L flange (angle approx. twice the motor flange size) installed.

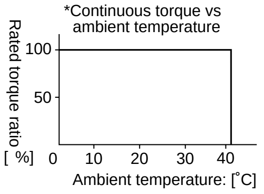
MSMA series (30 W – 100 W)

Without oil seal

- **MSMA3AZ*****

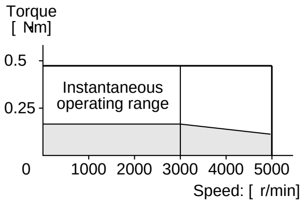
Driver power supply: 100/200 VAC

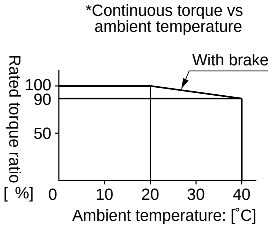




- **MSMA5AZ*****

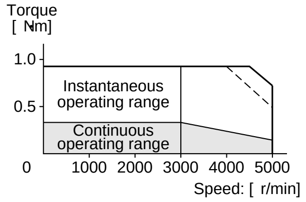
Driver power supply: 100/200 VAC

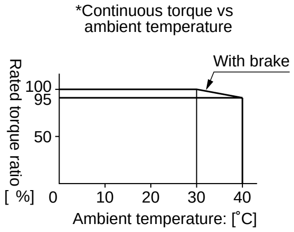




- **MSMA011*****

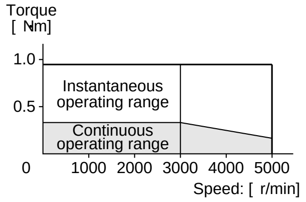
Driver power supply: 100 VAC
(Dotted line: when the supply voltage drops by 10%)

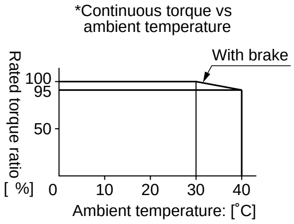




- **MSMA012*****

Driver power supply: 200 VAC

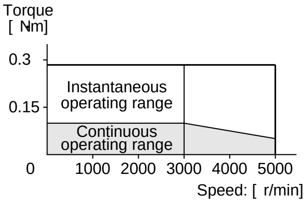


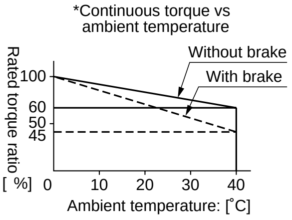


With oil seal

- **MSMA3AZ*****

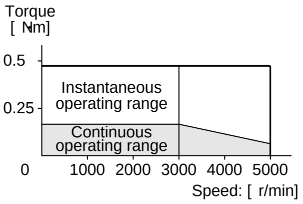
Driver power supply: 100/200 VAC

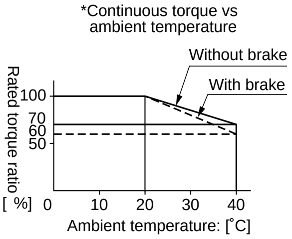




- **MSMA5AZ*****

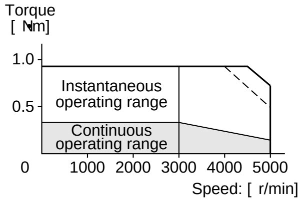
Driver power supply: 100/200 VAC

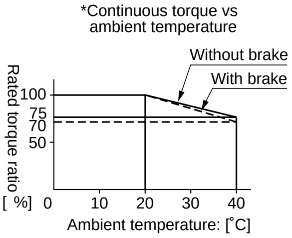




- **MSMA011*****

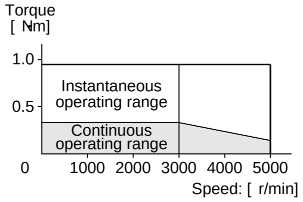
Driver power supply: 100 VAC
(Dotted line: when the supply voltage drops by 10%)

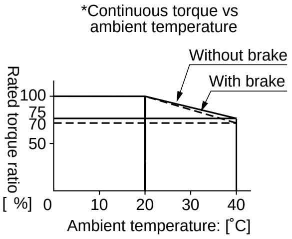




- **MSMA012*****

Driver power supply: 200 VAC





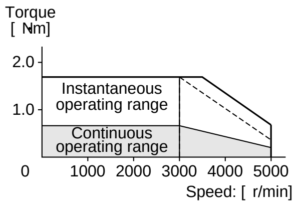
* Information on this page is subject to change: for the latest design, consult us. * Rated torque ratio is 100% at 40˚C without oil seal and brake.

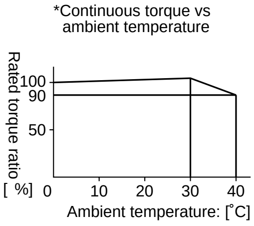
MSMA series (200 W – 750 W)

Without oil seal

- MSMA021***

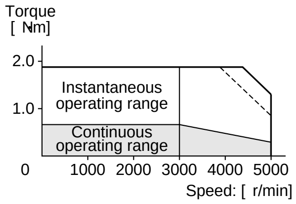
Driver power supply: 100 VAC
(Dotted line: when the supply voltage drops by 10%)

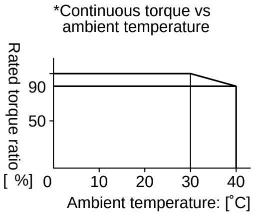




- MSMA022***

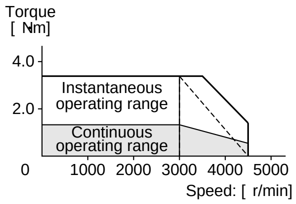
Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)

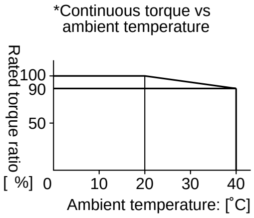




- MSMA041***

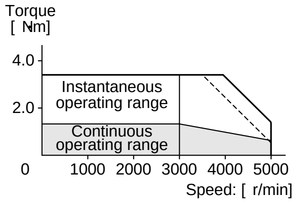
Driver power supply: 100 VAC
(Dotted line: when the supply voltage drops by 10%)

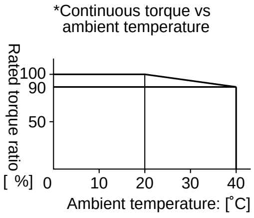




- MSMA042***

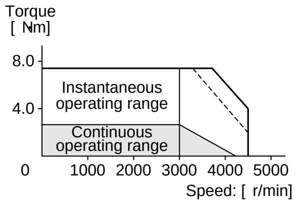
Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)

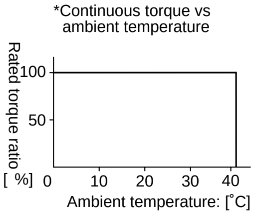




- MSMA082***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)

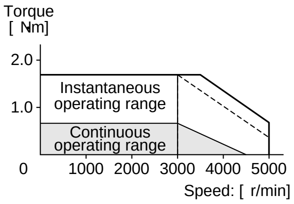


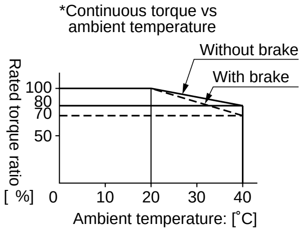


With oil seal

- MSMA021***

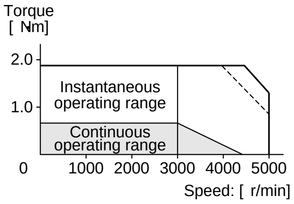
Driver power supply: 100 VAC
(Dotted line: when the supply voltage drops by 10%)

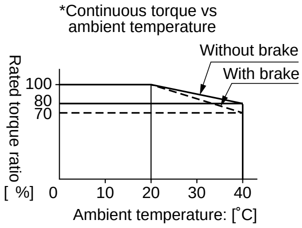




- MSMA022***

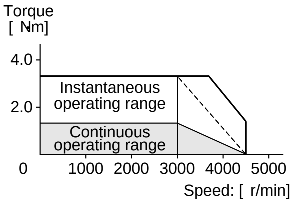
Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)

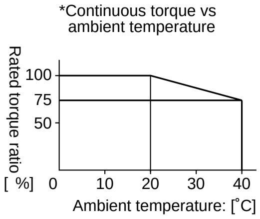




- MSMA041***

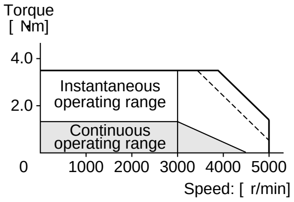
Driver power supply: 100 VAC
(Dotted line: when the supply voltage drops by 10%)

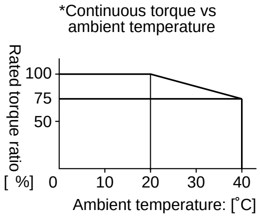




- MSMA042***

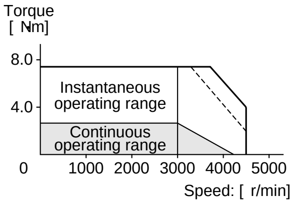
Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)

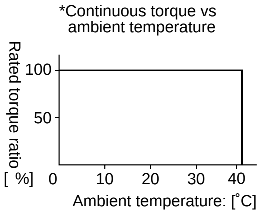




- MSMA082***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)





* Information on this page is subject to change: for the latest design, consult us.

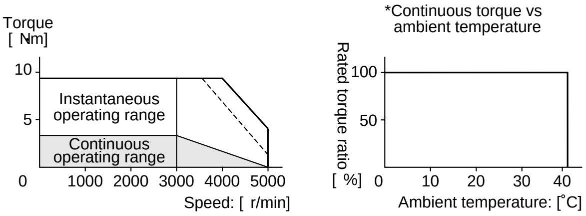
Motor characteristics

MSMA series (1 kW – 5 kW)

With oil seal

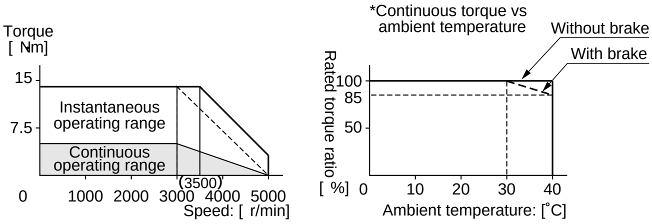
- MSMA102***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)


*Continuous torque vs ambient temperature

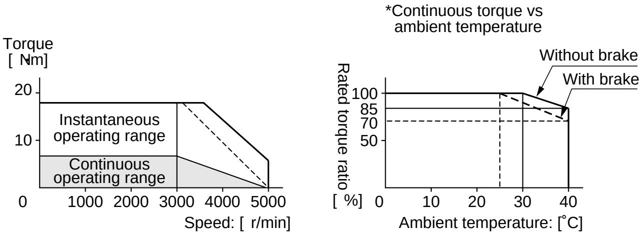
- MSMA152***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)


*Continuous torque vs ambient temperature

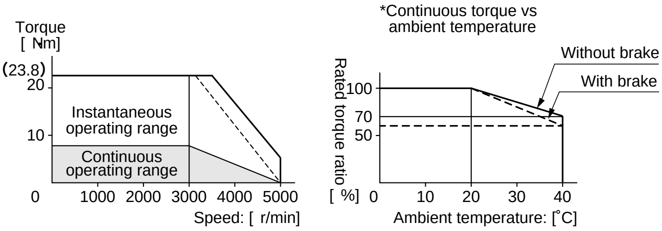
- MSMA202***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)


*Continuous torque vs ambient temperature

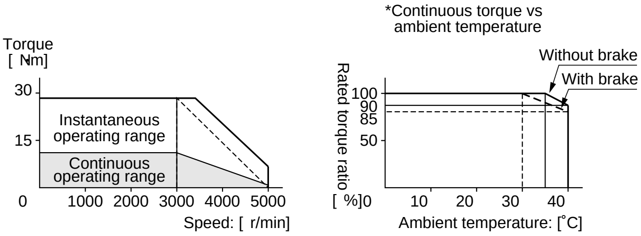
- MSMA252***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)


*Continuous torque vs ambient temperature

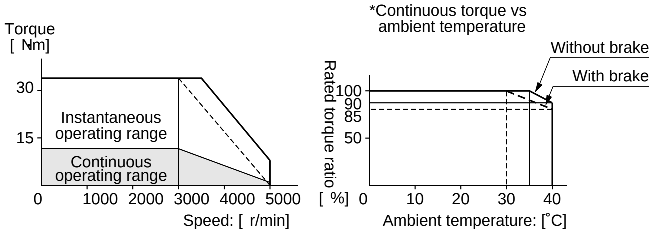
- MSMA302***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)


*Continuous torque vs ambient temperature

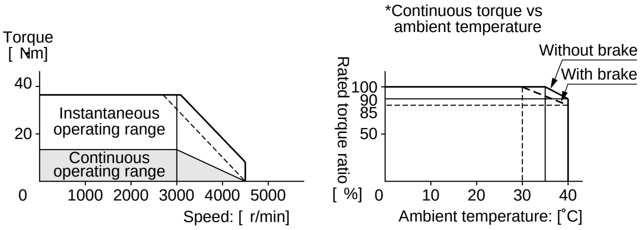
- MSMA352***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)


*Continuous torque vs ambient temperature

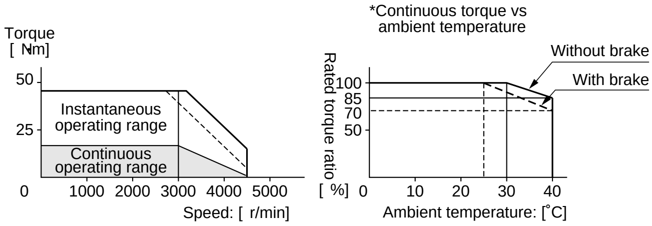
- MSMA402***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)


*Continuous torque vs ambient temperature

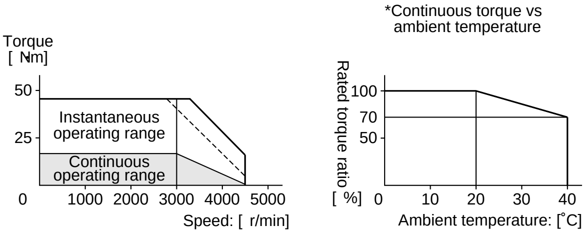
- MSMA452***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)


*Continuous torque vs ambient temperature

- MSMA502***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)


*Continuous torque vs ambient temperature

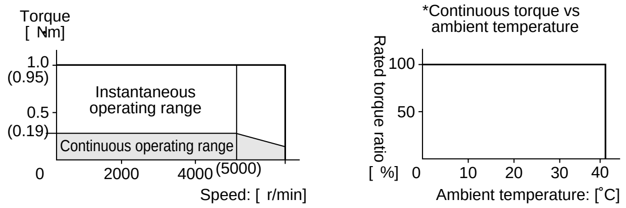
* Information on this page is subject to change: for the latest design, consult us.

MAMA series (100 W – 750 W)

Without oil seal

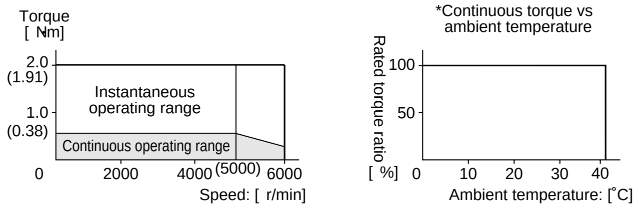
- MAMA012***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)



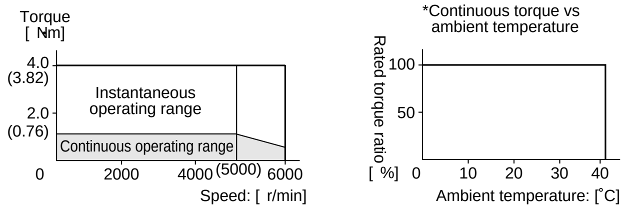
- MAMA022***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)



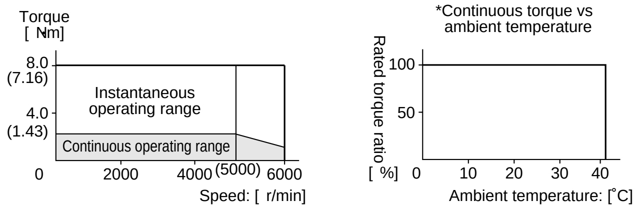
- MAMA042***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)



- MAMA082***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)

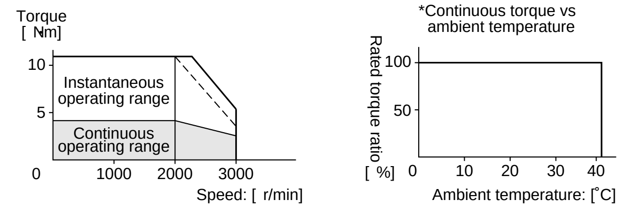


MDMA series (750 W – 2.0 kW)

With oil seal

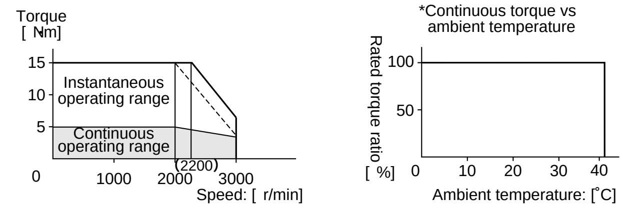
- MDMA082***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)



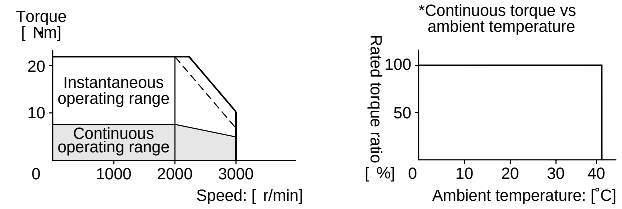
- MDMA102***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)



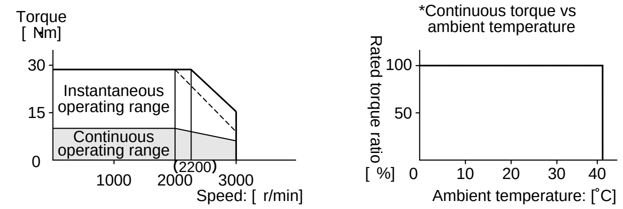
- MDMA152***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)



- MDMA202***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)



* Information on this page is subject to change: for the latest design, consult us.

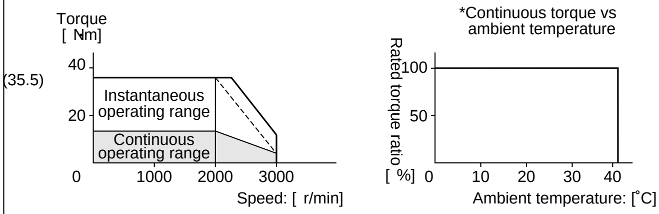
Motor characteristics

MDMA series (2.5 W – 5 kW)

With oil seal

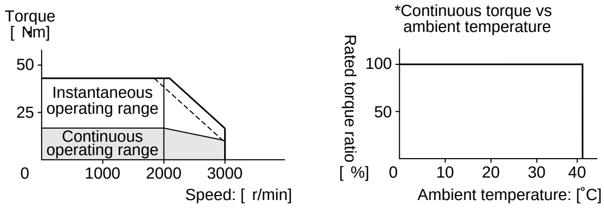
- MDMA252***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)



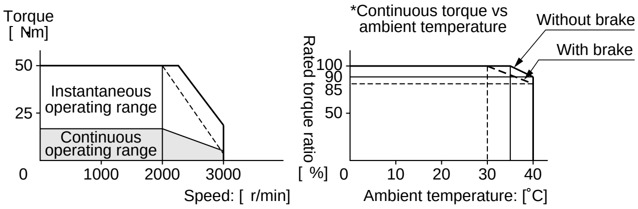
- MDMA302***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)



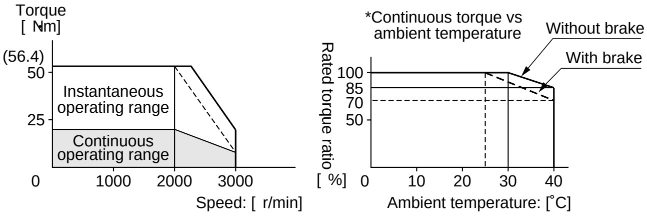
- MDMA352***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)



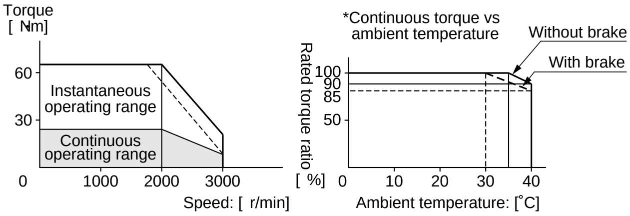
- MDMA402***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)



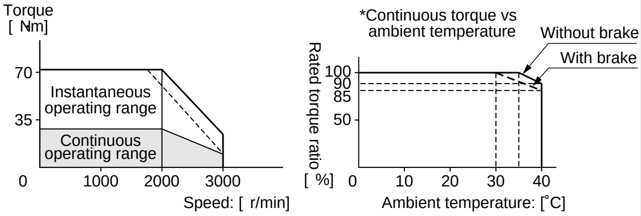
- MDMA452***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)



- MDMA502***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)

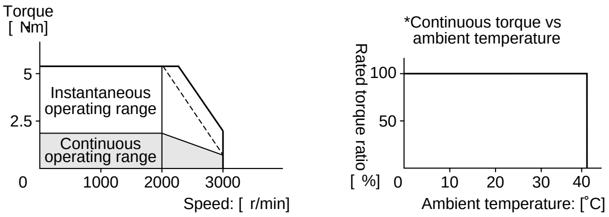


MFMA series (400 W – 2.5 kW)

With oil seal

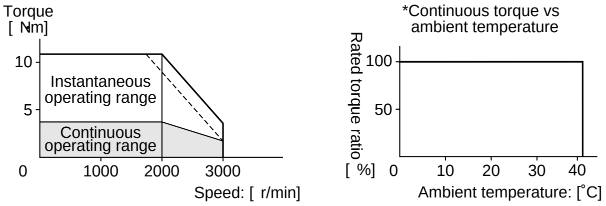
- MFMA042***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)



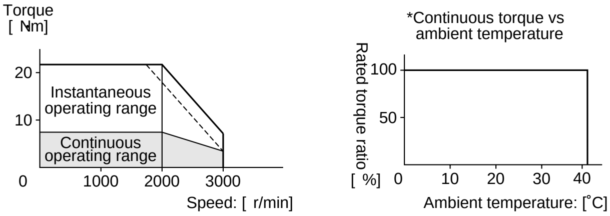
- MFMA082***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)



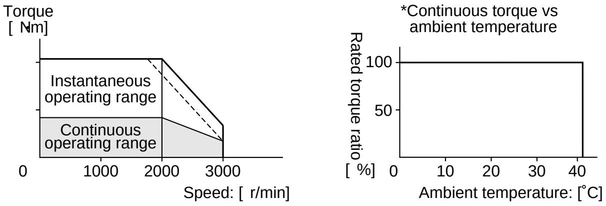
- MFMA152A***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)



- MFMA252A***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)



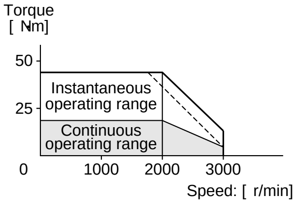
* Information on this page is subject to change: for the latest design, consult us.

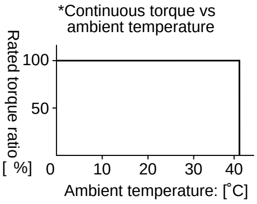
MFMA series (3.5 kW – 4.5 kW)

With oil seal

- MFMA352***

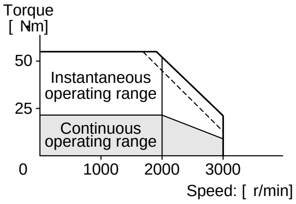
Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)

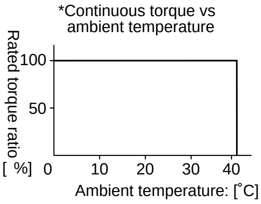



*Continuous torque vs ambient temperature

- MFMA452***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)



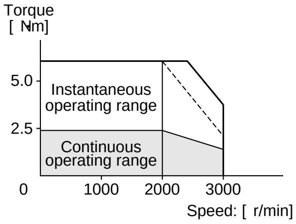

*Continuous torque vs ambient temperature

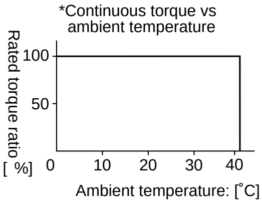
MHMA series (500 W – 5 kW)

With oil seal

- MHMA052***

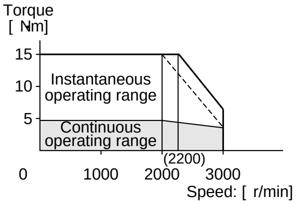
Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)

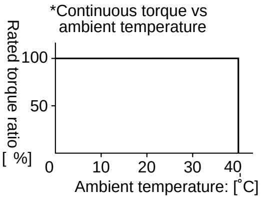



*Continuous torque vs ambient temperature

- MHMA102***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)




*Continuous torque vs ambient temperature

- MHMA152***

Driver power supply: 200 VAC
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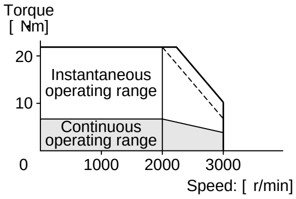
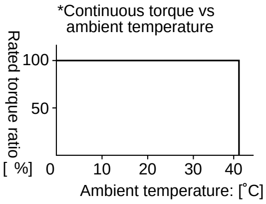
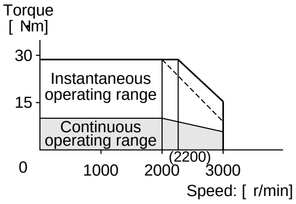
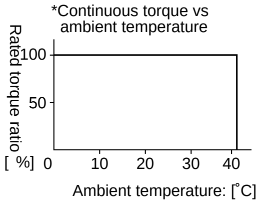



*Continuous torque vs ambient temperature

- MHMA202***

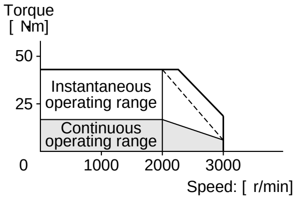
Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)

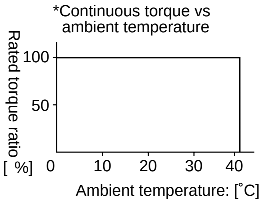



*Continuous torque vs ambient temperature

- MHMA302***

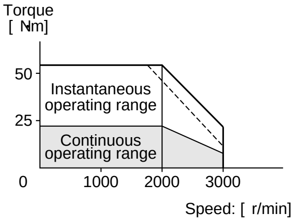
Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)

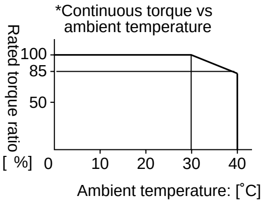



*Continuous torque vs ambient temperature

- MHMA402***

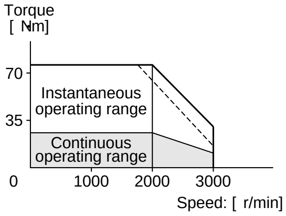
Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)

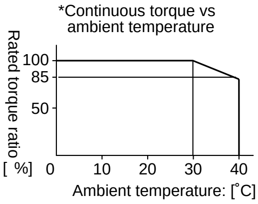



*Continuous torque vs ambient temperature

- MHMA502***

Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)




*Continuous torque vs ambient temperature

* Information on this page is subject to change: for the latest design, consult us.

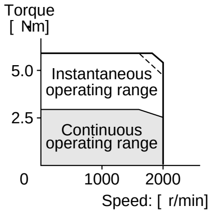
Motor characteristics

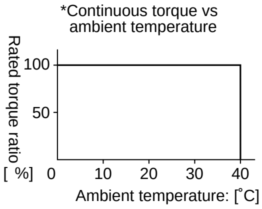
MGMA series (300 W – 4.5 kW)

With oil seal

- MGMA032***

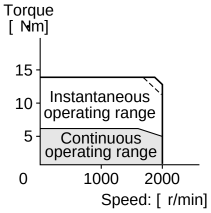
Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)

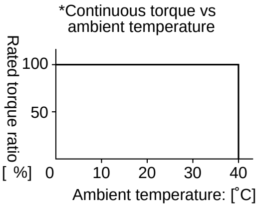




- MGMA062***

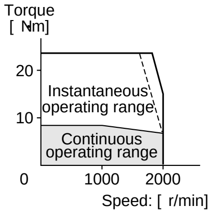
Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)

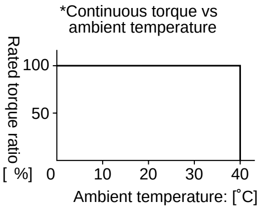




- MGMA092***

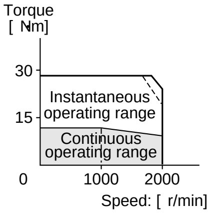
Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)

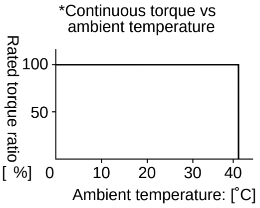




- MGMA122***

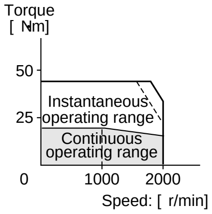
Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)

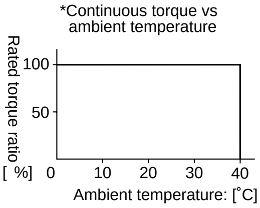




- MGMA202***

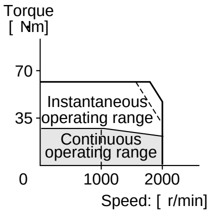
Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)

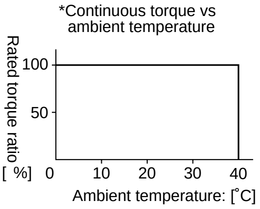




- MGMA302***

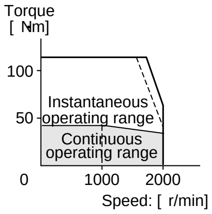
Driver power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)

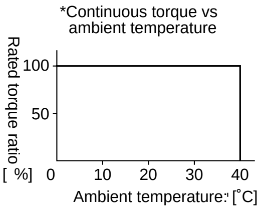




- MGMA452***

power supply: 200 VAC
(Dotted line: when the supply voltage drops by 10%)





* Information on this page is subject to change: for the latest design, consult us.

MEMO

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MEMO

Reference

Motor Company, Matsushita Erectric Industrial Co.,Ltd.Marketeing Group

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Osaka:	1-1, Morofuku 7-chome, Daito, Osaka 574-0044	TEL (072)870-3065 FAX (072)870-3151

After-Sale Service (Repair)

Repair

Consult to a dealer from whom you have purchased the product for details of repair.
When the product is incorporated to the machine or equipment you have purchased, consult to the manufacture or the dealer of the machine or equipment.

Cautions for Proper Use

- This product is intended to be used with a general industrial product, but not designed or manufactured to be used in a machine or system that may cause personal death when it is failed.
- Install a safety equipments or apparatus in your application, when a serious accident or loss of property is expected due to the failure of this product.
- Consult us if the application of this product is under such special conditions and environments as nuclear energy control, aerospace, transportation, medical equipment, various safety equipments or equipments which require a lesser air contamination.
- We have been making the best effort to ensure the highest quality of the products, however, application of exceptionally larger external noise disturbance and static electricity, or failure in input power, wiring and components may result in unexpected action. It is highly recommended that you make a fail-safe design and secure the safety in the operative range.
- If the motor shaft is not electrically grounded, it may cause an electrolytic corrosion to the bearing, depending on the condition of the machine and its mounting environment, and may result in the bearing noise. Checking and verification by customer is required.
- Failure of this product depending on its content, may generate smoke of about one cigarette. Take this into consideration when the application of the machine is clean room related.
- Please be careful when using in an environment with high concentrations of sulphur or sulphuric gases, as sulphuration can lead to disconnection from the chip resistor or a poor contact connection.
- Take care to avoid inputting a supply voltage which significantly exceeds the rated range to the power supply of this product. Failure to heed this caution may result in damage to the internal parts, causing smoking and/or a fire and other trouble.

Technical information

Electric data of this product (Instruction Manual, CAD data) can be downloaded from the following web site.
http://industrial.panasonic.com/ww/i_e/25000/motor_fa_e/motor_fa_e.html

MEMO (Fill in the blanks for reference in case of inquiry or repair.)

Date of purchase		**Model No.**	**M ☐ DC** ________ **M ☐ MA** ________
Dealer			
	Tel : ( ) -		

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