BERGES

Operating manual

0.37–15 kW

ACP Micro 3000

Parameter Code Summary

PARA-METER	DESCRIPTION	FACTORY SETTING	RANGE	PAGE	CUSTOMER SETTING
02-RVLVL	Software Revision			35	
03-IRAT	Inverter Rated Current		A	35	
07-FLT3	Last Fault			36	
08-FLT2	Second Fault			36	
09-FLT1	First Fault			36	
12-FOUT	Motor Output Frequency		0.00–400.0 Hz	36	
13-VOUT	Motor Output Voltage		0–100% of line voltage	36	
14-IOUT	Motor Output Current		0.00–60.00 A	36	
15-LOAD	Inverter Load		0–200% of ***03-IRAT***	36	
17-TEMP	Inverter Temperature		0.00–110.0 °C	36	
1A-FSTAT	Stator-Frequency		(1) Hz	55	Read-only
21-MODE	Input Mode	3	(2) 0–11	36/55	
24-FSEL	Speed Setpoint Selector	0	(2) 0–19	38/55	
31-FMIN	Minimum Frequency	0.00 Hz	0.00–400.0 Hz	38	
32-FMAX	Maximum Frequency	50.00 Hz	20.00–400.0 Hz	38	
33-F2	Preset Frequency 2	5.00 Hz	0.00–400.0 Hz	38	
34-F3	Preset Frequency 3	20.00 Hz	0.00–400.0 Hz	38	
35-F4	Preset Frequency 4	40.00 Hz	0.00–400.0 Hz	38	
36-F5	Preset Frequency 5	50.00 Hz	0.00–400.0 Hz	38	
37-F6	Preset Frequency 6	0.00 Hz	0.00–400.0 Hz	38	
38-F7	Preset Frequency 7	0.00 Hz	0.00–400.0 Hz	38	
39-FTL	Minimum Frequency in Torque Limit	10.00 Hz	0.00–400.0 Hz	39	
41-RSEL	Ramp Selector	0	(2) 0–7	39/56	
42-ACC1	Acceleration Time 1	3.00 s	0.10–600.0 s	39	
43-DEC1	Deceleration Time 1	3.00 s	0.10–600.0 s	39	
44-ACC2	Acceleration Time 2	1.00 s	0.10–600.0 s	40	
45-DEC2	Deceleration Time 2	1.00 s	0.10–600.0 s	40	
46-DECTL	Deceleration Time in Torque Limit	1.00 s	0.10–30.00 s	40	
47-DCBRK	DC Brake Time	0.20 s	0.00–5.00 s	40	
48-DCVLT	DC Brake Voltage	2/3 of ***52-BOOST***	0–15%	40	
51-VSEL	V/Hz Characteristic Selector	0	0–5	40	
52-BOOST	Voltage Boost	8.00%	0.00–25.00%	41	
53-FKNEE	V/Hz Knee Frequency	50.00 Hz	26.00–400.0 Hz	42	
54-SKBND	Skip Frequency Hysteresis Band	1.00 Hz	0.20–20.00 Hz	42	
55-SK1	Skip Frequency 1	0.00 Hz	0.00–400.0 Hz	42	
56-SK2	Skip Frequency 2	0.00 Hz	0.00–400.0 Hz	42	
57-SK3	Skip Frequency 3	0.00 Hz	0.00–400.0 Hz	42	
59-MVOLT	Rated Motor Voltage	230/400 V	185–240 V; 370–480 V	42	
5B-MSAT	Motor Saturation Level	47%	15–80%	42	
61-LTLF	Load Torque Limit Forward	150%	10–150%	42	

PARA-METER	DESCRIPTION	FACTORY SETTING	RANGE	PAGE	CUSTOMER SETTING
62-LTLR	Load Torque Limit Reverse	150%	10–150%	42	
63-RTLF	Regenerative Torque Limit Forward	80%	10–110%	42	
64-RTLR	Regenerative Torque Limit Reverse	80%	10–110%	42	
65-SLIP	Slip Compensation	0.00%	(2) 0.00–12.00%	43/56	
66-STAB	Current Stability Adjustment	3	0–4	43	
67-TOL	Timed Overload Trip Point	0%	0–100%	43	
68-NRST	Trip Restart Number	0	0–8	44	
69-DRST	Restart Delay Time	0.00 s	0.00–60.00 s	44	
6A-TOLC	Timed Overload Characteristic	0	0–7	45	
70-MCAL	Analog Meter Output Calibration MET1	Set for10 VDC	0–255	45	
71-METER	Analog Meter Output Selector MET1	1	(2) 0–5	45/56	
72-ST1	Open Collector Output 1	7	0–10	46	
75-STR	Auxiliary Relay Output	1	0–10	46	
77-MOL	Motor Overload Input	2	0–3	47	
78-MCAL2	Analog Meter Output Calibration MET2	0–20 mA or 4–20 mA; set for 20 mA	0–255	47	
79-MET2	Analog Meter Output Selector MET2	3	(2) 0–15	47/56	
81-PRGNO	Special Program/PI Control Characteristics	0	0–9999	48/56	
82-START	Start Options	1	0–11	48	
83-PWM	PWM Carrier Frequency Selector	1	0–5	49	
84-DISP	Display Option Setting	0	0–3000	49	
87-ACODE	Security Access Code	0	0–999	50	
97-RVLVL2	Software Revision Level 2		0.00–12.75	50	Read-only
A1-FCORR	Frequency Correction		(1) 0.00–400.0 Hz	55	
A6-ERROR2	Final Error		(1) _	55	Read-only
A7-ERROR1	Initial Error		(1) _	55	Read-only
A8-SIPART	Integral Sum		(1) _	55	Read-only
B3-KP	Proportional Gain		(1) 0–255	55	
B4-KI	Integral Gain		(1) 0–255	55	
B5-KIN	VIN1 Scaling		(1) 0–255	55	

NOTES:

Level 1 Parameters shown shaded.

(1) **Additional** parameters that are **only** available when using the PI controller and when the ***81-PRGNO*** parameter is set to a value between 80 and 95 (see page 56). See chapter 6, from page 51 on, for further information about the PI controller.

(2) **Extended** parameters when using the PI controller. For further information about the PI controller, see chapter 6, as from page 51.

Table of Contents

Page

1 General Information

1.1 Explanation of Symbols and Notes

Work Safety Symbol

You will find this symbol next to all work safety notes in this operating manual if there is a risk of injury or death for persons involved. Pay attention to these notes and observe particular caution in such cases. Also pass on all work safety instructions to other users.

Voltage Warning

This symbol is shown wherever particular caution is necessary owing to occurring or applied voltages (e.g. DC voltages up to 650 V) and where special precautionary measures have to be taken. The inverter must always be isolated from the mains when working on it.

Caution Note

ATTENTION!

This note is shown in all parts of this operating manual to which particular attention must be paid to ensure that the guidelines, specifications, notes and the correct sequence of work will be obeyed and to prevent damage or destruction of the inverter and/or systems.

1.2 Safety and Operating Instructions for Drive Converters

1. General

In operation, drive converters, depending on their degree of protection, may have live, unisolated, and possibly also moving or rotating parts, as well as hot surfaces.

In case of inadmissible removal of the required covers, of improper use, wrong installation or maloperation, there is the danger of serious personal injury and damage to property.

For further information, see documentation.

All operations serving transport, installation and commissioning as well as maintenance are to be carried out by **skilled technical personnel** (Observe IEC 364 or CENELEC HD 384 or DIN VDE 0100 and IEC 664 or DIN/VDE 0110 and national accident prevention rules!).

For the purposes of these basic safety instructions, “skilled technical personnel” means persons who are familiar with the installation, mounting, commissioning and operation of the product and have the qualifications needed for the performance of their functions.

We draw attention to the fact that no liability can be assumed for damage and malfunctions resulting from failure to observe the operating manual.

Technical amendments of illustrations and data given in this operating manual are reserved in the interest of improving the unit and its functions.

2. Intended Use

The application of the drive converter described in this operating manual exclusively serves the purpose of continuously variable speed control of three-phase motors.

Drive converters are components designed for inclusion in electrical installations or machinery.

The drive converters are designed for installation in a switchgear cabinet and for permanent connection.

The operator of the system is solely liable for damage resulting from improper use of the drive converter.

Only items expressly approved by BERGES (e.g. mains filter, choke, external braking choppers and braking resistors etc.) may be used as accessories.

The installer of the system is liable for any damage resulting from the use of accessories that have not been approved expressly by BERGES. Please consult us in case of doubt.

In case of installation in machinery, commissioning of the drive converters (i.e. the starting of normal operation) is prohibited until the machinery has been proved to conform to the provisions of the directive 89/392/EEC (Machinery Safety Directive – MSD). Account is to be taken of EN 60204.

Commissioning (i.e. the starting of normal operation) is admissible only where conformity with the EMC directive (89/336/EEC) has been established.

The drive converters meet the requirements of the low-voltage directive 73/23/EEC. They are subject to the harmonized standards of the series prEN 50178/DIN VDE 0160 in conjunction with EN 60439-1/DIN VDE 0660, part 500, and EN 60146/DIN VDE 0558.

The technical data as well as information concerning the supply conditions shall be taken from the rating plate and from the documentation and shall be strictly observed.

3. Transport, Storage

The instructions for transport, storage and proper use shall be complied with.

Damage established after delivery must be notified to the transport company immediately. Where necessary, the supplier must also be notified before the damaged drive converter is put into operation.

The climatic conditions shall be in conformity with prEN 50178.

4. Installation

The installation and cooling of the appliances shall be in accordance with the specifications in the pertinent documentation.

The drive converters shall be protected against excessive strains. In particular, no components must be bent or isolating distances altered in the course of transportation or handling. No contact shall be made with electronic components and contacts.

Drive converters contain electrostatic sensitive components which are liable to damage through improper use. Electric components must not be mechanically damaged or destroyed (potential health risks).

5. Electrical Connection

When working on live drive converters, the applicable national accident prevention rules (e.g. VBG 4) must be complied with.

The electrical installation shall be carried out in accordance with the relevant requirements (e.g. cross-sectional areas of conductors, fusing, PE connection). For further information, see documentation.

Instructions for the installation in accordance with EMC requirements, like screening, earthing, location of filters and wiring, are contained in the drive converter documentation. They must always be complied with, also for drive converters bearing a CE marking. Observance of the limit values required by EMC law is the responsibility of the manufacturer of the installation or machine.

6. Operation

The components of the power section and certain elements of the control section are connected to the voltage mains when the drive converter is connected to the mains voltage. **Touching these components involves mortal danger!**

Always isolate the drive converter from the mains supply before performing any work on the electrical or mechanical part of the system.

Isolate the drive converter from the mains before removing the terminal cover or the housing (e.g. by removing or deactivating on-site fuses or by deactivating a master switch isolating all poles etc.).

After disconnection of the drive converters from the voltage supply, live appliance parts and power terminals must not be touched immediately because of possibly energized capacitors. In this respect, the corresponding signs and markings on the drive converter must be respected. After switching off the mains voltage, wait **for at least 5 minutes** before beginning work on or in the drive converter. Dangerous voltages are still present as long as the “STATUS” lamp is still lit. In the event of malfunctions, the discharge time of 5 minutes may be exceeded **substantially.**

The drive converter contains protective facilities that deactivate it in the event of malfunctions, whereby the motor is de-energized and comes to a standstill (so-called “coasting” of the motor is possible depending on the rotating mass of the type of drive involved). Standstill of the motor can, however, also be produced by mechanical blockage. Voltage fluctuations, and particularly mains power failures, may also lead to deactivation. In certain circumstances, the drive may start up automatically once the cause of the fault has been remedied. As a result of this, certain systems may be damaged or destroyed and there may be a risk for operators working on the system. Installations which include drive converters shall be equipped with additional control and protective devices in accordance with the relevant applicable safety requirements, e.g. Act respecting technical equipment, accident prevention rules etc. Changes to the drive converters by means of the operating software are admissible.

The motor may be stopped during operation by disabling it or by deactivating the setpoint, whereby the drive converter and motor may remain live. **If inadvertent start-up of the motor must be excluded to protect operating personnel, electronic interlocking by disabling the motor or by deactivating the setpoint is inadequate. This is why the drive converter must be isolated from the mains voltage.**

During operation, all covers and doors shall be kept closed.

Measuring instruments must be connected and disconnected only in de-energized condition.

Unauthorized conversions or modifications on or in the drive converter and its components and accessories will render all warranty claims void.

Please contact BERGES if conversions or modifications are necessary, particularly if electrical components are involved.

7. Maintenance and Servicing

The manufacturer's documentation shall be followed.

KEEP SAFETY INSTRUCTIONS IN A SAFE PLACE!

Before you read on, please check whether technical changes are attached in the annex to this operating manual!

1.3 Preface

The present manual contains the specifications, installation instructions, description of operation and troubleshooting procedures for ACP 3000 inverters. The information in this manual must be known before installation of the inverter in order to guarantee fault-free installation and thus maximum performance.

2 Technical Data

2.1 Model Identification Number

All ACP 3000 models bear a systematic identification number designating the rated input voltage, the rated power and the housing type. This model number appears both on the shipping carton label and the technical data label on the drive.

ACP 3611-0B ACP | 3 | 6 | 11-0 | B

BERGES inverter type: ACP 3

Nominal voltage: 3 = 230 V~
6 = 400 V~

KW: 11-0 = 11.0 kW

Housing: B = IP 21 (NEMA 1)

Example type marking

2.2 Power Specifications

Models with Supply Voltage 1 × 230 VAC

Model ACP	3300-3	3300-5	3300-7	3301-1	3301-5	3302-2
Kilowatt (kW)	0.37 kW	0.55 kW	0.75 kW	1.1 kW	1.5 kW	2.2 kW
Output Voltage	Three Phase 3.5–230 VAC					
Rated current	1.94 A	2.6 A	3.4 A	4.8 A	6.4 A	9.0 A
Maximum Output Current *	2.1 A	2.9 A	3.7 A	5.3 A	7.0 A	9.9 A
Input Volts (±10%)	208–230 V~					
Maximum Input Current	3.1 A	4.7 A	6.4 A	9.4 A	12.7 A	18.6 A

Table 2.1

Models with Supply Voltage 3 × 400 VAC

Model ACP	3600-7	3601-5	3602-2	3603-0	3604-0	3605-5	3607-5	3611-0	3615-0
Kilowatt (kW)	0.75 kW	1.5 kW	2.2 kW	3.0 kW	4.0 kW	5.5 kW	7.5 kW	11.0 kW	15.0 kW
Output Voltage	Three Phase 7.0–460 VAC								
Rated current	1.95 A	3.7 A	5.2 A	6.8 A	9.2 A	13.0 A	18.0 A	24.0 A	30.0 A
Maximum Output Current *	2.1 A	4.1 A	5.7 A	7.5 A	10.1 A	14.3 A	19.8 A	26.4 A	33.0 A
Input Volts (±10%)	400–460 V~								
Maximum Input Current	2.11 A	4.2 A	6.2 A	8.4 A	11.2 A	16.0 A	22.2 A	31.0 A	37.9 A

Table 2.2

* = Maximum inverter capacity. Value = 1.1 × ***03-IRAT*** (see page 35).

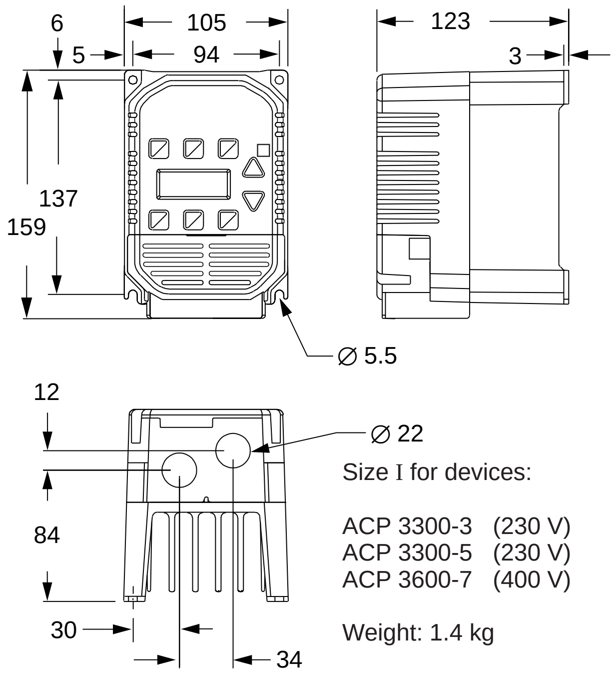
2.3 General Drive Specifications

Inverter Power Ratings	Input Frequency	50/60 Hz (±2%)
	Phase Imbalance (3 ∅ only)	±2%
	Overload Capacity	150% for 60 seconds
	Running Torque	100% at 3 Hz
	Starting Torque	Greater than 100%
Control Specifications	Control System	Sine-weighted voltage vector (PWM)
	PWM Frequency	4–16 kHz (plus Autoselect feature)
	Frequency Range	1.00–400.0 Hz programmable in 0.05 Hz increments (0.1 Hz above 99.95 Hz)
	Frequency resolution	0.05 Hz up 0.00 to 99.95 Hz, 0.1 Hz above 100.0 Hz
	Minimum Frequency	0.00–400.0 Hz
	Maximum Frequency	20.00–400.0 Hz
	Preset Speeds	Up to 8 available; programmable to maximum frequency
	Frequency Command Selections	0–5 VDC, 0–10 VDC, 0–20 mA, 4–20 mA, direct or inverted; Digital Keypad; Program Memory Unit; Remote Keypad Unit; external Potentiometer
	Acceleration and Deceleration Range	Programmable 0.1 to 600 seconds to maximum frequency (2 Each)
	V/Hz Ratio	0.19–9.23 V/Hz (230 VAC models) 0.39–18.46 V/Hz (400 VAC models)
	Torque Limit	Automatic or fixed adjustment possible
	Dynamic Braking	Up to 60% for 6 sec. with standard DB resistor; higher braking power values can be achieved by means of an external braking chopper (option)
Protection Features	Ground Fault	Protected from damage
	Short Circuit	Protected from damage
	Motor Overload	Programmable inverse time overload trip
	Torque Limit	All four quadrants individually programmable
	Overvoltage	Short voltage peaks are bridged; an error is triggered if an overvoltage lasts for longer than 500 ms
	Undervoltage	Short voltage dips are bridged; a defined “Restart” is performed if an undervoltage lasts for longer than 200 ms
	Over Temperature	Protected from damage, warning display
	MOL Input Terminal	Programmable for N.C. or N.O. contacts
Operating Features	Operating Controls	1. Keypad. 2. Remote keypad unit. 3. Terminal strip. 4. Program memory unit.

Operating Features	LED Indicators	Red and Green for operation and fault annunciation
	Keypad Display	6 digit, backlit LCD with special annunciators and unit symbols
	Auxiliary Relay	Programmable analog output; programmable status signalling relay
	Programming Levels	Level 1 – Operator Level 2 – Engineer
Inputs/Outputs	Inputs	6 Digital: Pull-up or pull-down logic 2 Analog: VIN1 Current or voltage; VIN2 Voltage only
	Outputs	2 Digital: 1 Open collector (internal or external power supply) up to 24 VDC; 1 Relay (Form C) 2 Analog: MET1 (0 to 10 VDC); MET2 (0/4 to 20 mA DC)
Ambient Conditions	Operating Temperature	0 °C to +40 °C (IP 21 models) 0 °C to +50 °C (with detached cover)
	Storage temperature	-20 °C to +60 °C
	Humidity	90% RH or less, non-condensing
	Vibration	0.6 G Maximum
	Elevation	1000 Meters (3,300 Feet) without derating
UL-/CSA-Certifications	Agency Listings	CE Marked, UL cUL UL/cUL listed, CSA-certified CSA®

Table 2.3

2.4 Dimensional Data (Size I)

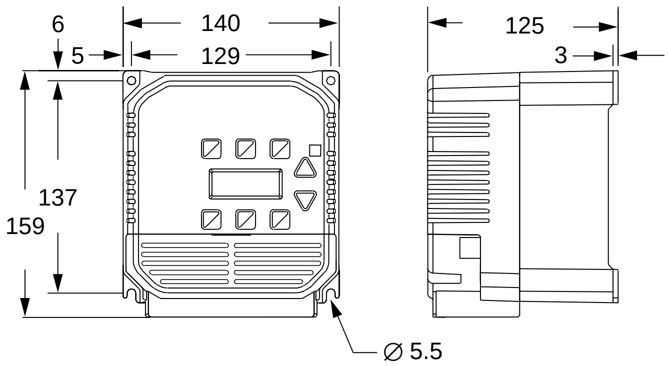


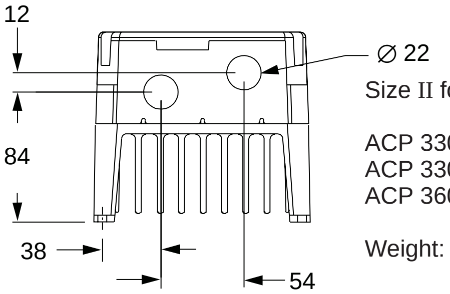
Size I for devices:

ACP 3300-3 (230 V)
ACP 3300-5 (230 V)
ACP 3600-7 (400 V)

Weight: 1.4 kg

2.4.1 Dimensional Data (Size II)



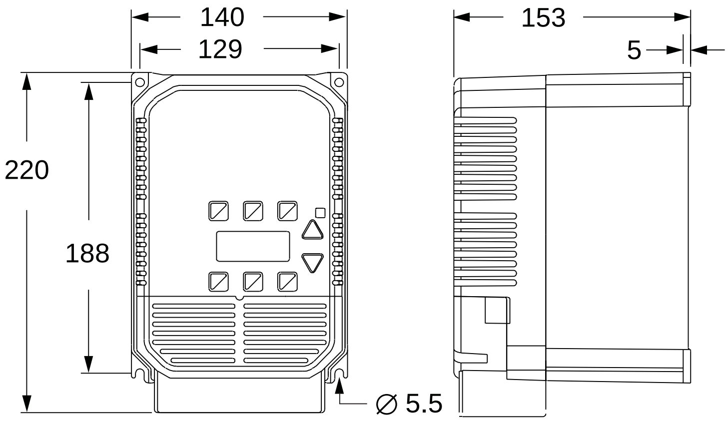


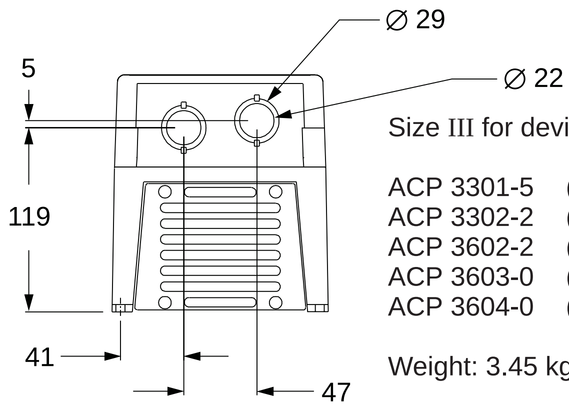
Size II for devices:

ACP 3300-7 (230 V)
ACP 3301-1 (230 V)
ACP 3601-5 (400 V)

Weight: 1.9 kg

2.4.2 Dimensional Data (Size III)



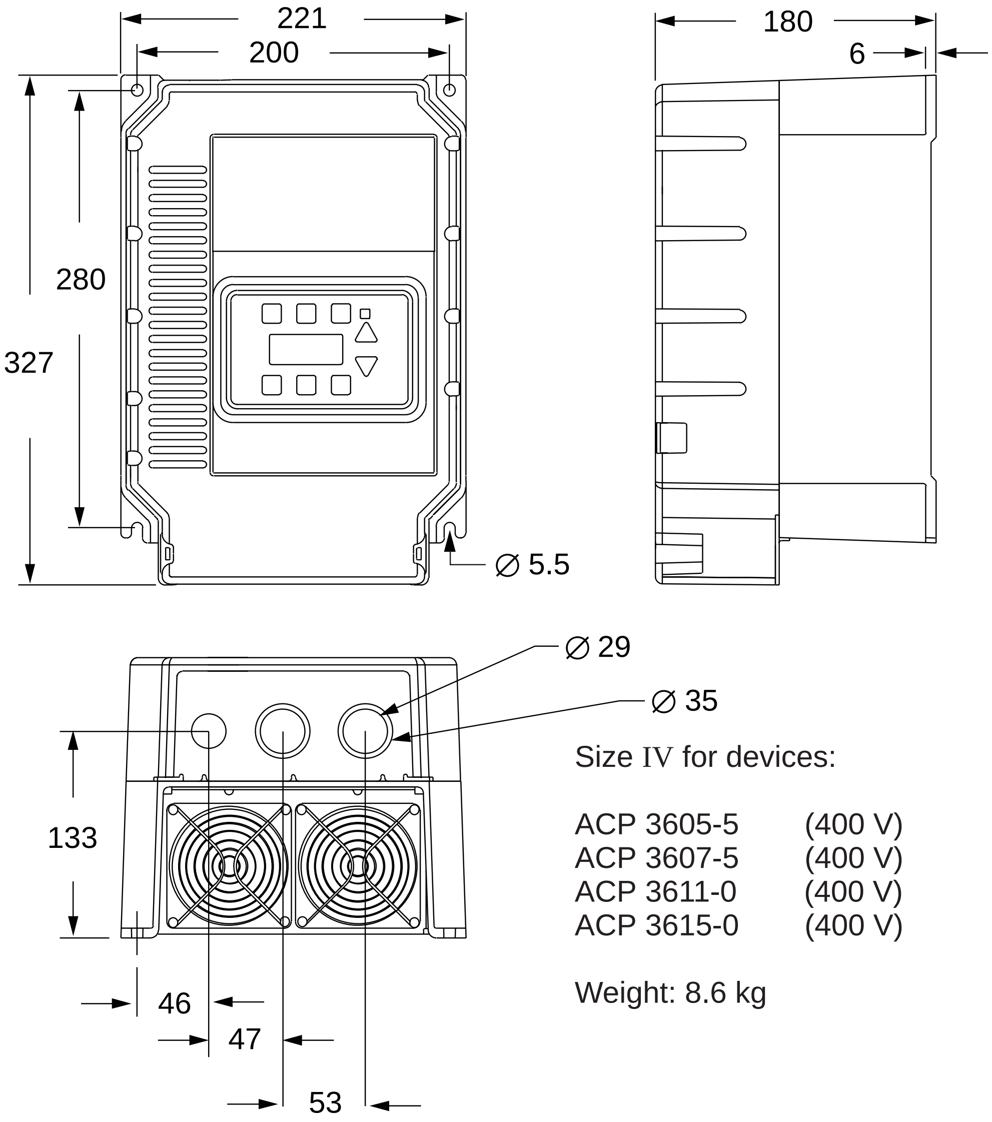


Size III for devices:

ACP 3301-5 (230 V)
ACP 3302-2 (230 V)
ACP 3602-2 (400 V)
ACP 3603-0 (400 V)
ACP 3604-0 (400 V)

Weight: 3.45 kg

2.4.3 Dimensional Data (Size IV)



Size IV for devices:

ACP 3605-5	(400 V)
ACP 3607-5	(400 V)
ACP 3611-0	(400 V)
ACP 3615-0	(400 V)

Weight: 8.6 kg

3 Installation

3.1 Inspection

A. Upon receipt, unpack and carefully inspect for any damage sustained in transit (depression in the enclosure, damage to parts, missing parts).

B. Remove the cover (see page 25) and inspect the inverter for any apparent damage or foreign objects. Ensure that all mounting hardware and terminal connection hardware is properly seated, securely fastened, and undamaged.

C. Read the technical data label and ensure that the correct rated output and input voltage for the application has been purchased.

D. If the inverter is to be stored for a long period of time, repack and store in a clean, dry place, free from direct sunlight or corrosive fumes, and in a location where the ambient temperature will not be less then -20 °C nor more than +60 °C.

3.2 General Rules for Installation

Improper installation of the inverter will greatly effect its life. Be sure to observe the following points when selecting a mounting location. **VIOLATING THE CONDITIONS LISTED BELOW MAY VOID THE WARRANTY!**

A. Mount the unit vertically and do not restrict the airflow to the heat sink fins on the back of the controller. The fan and fins allow cooling of internal components. Any air restriction could greatly reduce the life of the inverter, as well as resulting in nuisance overtemperature trips.

B. The ACP inverter generates heat, and therefore there must be a sufficient amount of free space around the unit (see Figure 3.1). If the unit is accommodated in a housing together with a different unit, the prescribed minimum distances must be observed so that adequate ventilation can be ensured.

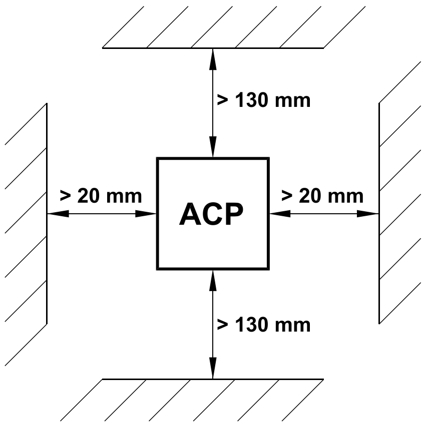


Figure 3.1

C. If the inverter has to be installed in a different position, external cooling is required for full capacity utilization. In certain circumstances, the internal air circulation does not suffice when installing the unit in a control cabinet with a small volume. Therefore, when installing the unit, you must ensure that a heat buildup is prevented.

D. Do not mount the ACP near heat generating equipment, or in direct sunlight. BERGES inverters are generally designed so that they can be operated at ambient temperatures of 0 °C to +50 °C (IP 00) or 0 °C to 40 °C (IP 21) and at a relative humidity of up to 90%.

The occurrence of condensate must be avoided!

E. Do not install the inverter in a place subjected to high temperature, high humidity, or excessive vibration (see Table 2.3, “Ambient Conditions”)

F. The units should never be installed in the proximity of corrosive or flammable gases, conductive dust or large magnetic and electric fields.

G. Pay close attention during installation to ensuring that no objects (such as drilling swarf, wire or anything else) fall into the unit. Otherwise, a device fault cannot be excluded, even after longer periods of operation.

ATTENTION!

H. Do not use wire end ferrules for the control terminals. The terminals are designed so that the wires can be inserted in the terminals after twisting the individual wires.

I. Table 3.1 shows the watts generated by the inverter when at full current. The heat generated is dependent on the carrier frequency used. For carrier frequencies other than those shown in Table 3.1, consult BERGES or use the worst-case scenario (16 kHz carrier).

HEAT GENERATED BY INVERTER (IN WATTS)		
Inverter Model Number	**@ 4 kHz Carrier**	**@ 16 kHz Carrier**
3300-3	19	27
3300-5	37	42
3300-7	66	75
3301-1	66	75
3301-5	70	79
3302-2	129	154
3600-7	40	62
3601-5	67	99
3602-2	118	186
3603-0	184	281
3604-0	184	281
3605-5	280	640
3607-5	360	790
3611-0	470	1120
3615-0	610	1400

Table 3.1

3.3 EMC (Electromagnetic Compatibility)

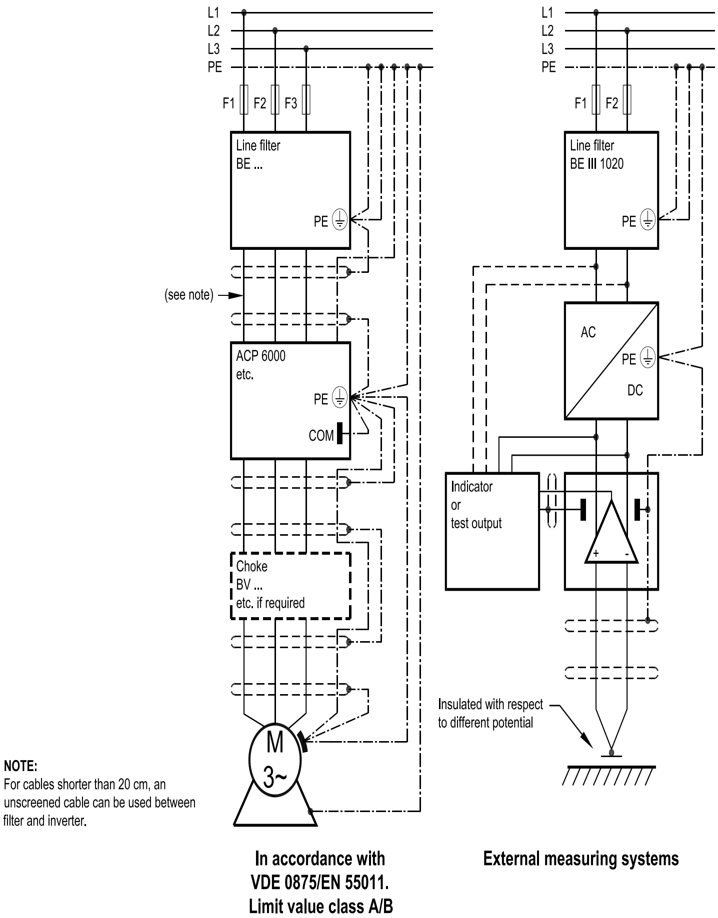
3.3.1 Suggestion on how to solve the Problem of Radio Frequency Interference Suppression of Frequency Converters to VDE 0875/EN 55011

It is necessary to connect a mains filter type “BE/(xxx) xxxx” before every frequency converter. The size (xxx) depends on the rated current of the unit. A motor choke can be dispensed with.

HINT!

The motor choke type BV... may be necessary as from a cable length in excess of 20 m and when operating several motors in parallel on one frequency converter output. This choke attenuates the capacitive earth leakage currents and considerably reduces wire-borne interference voltages.

The converter and accessories must be wired in accordance with the following schematic. To render the remaining interference voltage at the PE conductor potential ineffective for "external measurement systems", the following proposed circuit will achieve successful results if applied consistently.

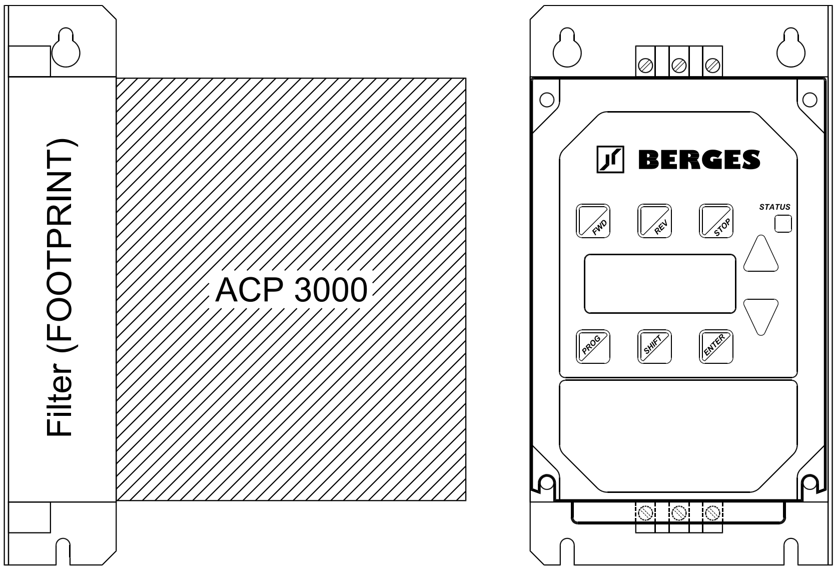


3.3.2 Mains Filters/Output Chokes

ACP 3000							
DEVICE TYPE	**MAINS FILTER**	**ARTICLE NO.**	**INPUT PHASES**	**VOLTAGE (V)**	**CURRENT (A)**	**WEIGHT (kg)**	**FOOTPRINT**
ACP 3300-3	BE I 1005	32501739	1~	250	5	0.60	(1)
ACP 3300-5	BE I 1005	32501739	1~	250	5	0.60	(1)
ACP 3300-7	BE II 1010	32501740	1~	250	10	0.70	(1)
ACP 3301-1	BE II 1010	32501740	1~	250	10	0.70	(1)
ACP 3301-5	BE III 1020	32501741	1~	250	20	1.05	(1)
ACP 3302-2	BE III 1020	32501741	1~	250	20	1.05	(1)
ACP 3600-7	BE I 3003	32501742	3~	380/480	3	0.75	(1)
ACP 3601-5	BE II 3005	32501743	3~	380/480	5	0.80	(1)
ACP 3602-2	BE III 3012	32501744	3~	380/480	12	1.15	(1)
ACP 3603-0	BE III 3012	32501744	3~	380/480	12	1.15	(1)
ACP 3604-0	BE III 3012	32501744	3~	380/480	12	1.15	(1)
ACP 3605-5	BE IV 3038	32501745	3~	380/480	38	1.90	(1)
ACP 3607-5	BE IV 3038	32501745	3~	380/480	38	1.90	(1)
ACP 3611-0	BE IV 3038	32501745	3~	380/480	38	1.90	(1)
ACP 3615-0	BE IV 3038	32501745	3~	380/480	38	1.90	(1)

(1) FOOTPRINT means that these filters have been prepared for the installation of an ACP converter on the filter (securing).

ACP 3000							
DEVICE TYPE	**CHOKE**	**ARTICLE NO.**	**INPUT PHASES**	**VOLTAGE (V)**	**CURRENT (A)**	**WEIGHT (kg)**	**FOOTPRINT**
ACP 3300-3	BV 20394/307	32501345	–	440	7	0.25	–
ACP 3300-5	BV 20394/307	32501345	–	440	7	0.25	–
ACP 3300-7	BV 20394/307	32501345	–	440	7	0.25	–
ACP 3301-1	BV 20394/307	32501345	–	440	7	0.25	–
ACP 3301-5	BV 20394/307	32501345	–	440	7	0.25	–
ACP 3302-2	BV 20394/313	32501346	–	440	13	0.70	–
ACP 3600-7	BV 20394/307	32501345	–	440	7	0.25	–
ACP 3601-5	BV 20394/307	32501345	–	440	7	0.25	–
ACP 3602-2	BV 20394/307	32501345	–	440	7	0.25	–
ACP 3603-0	BV 20394/307	32501345	–	440	7	0.25	–
ACP 3604-0	BV 20394/313	32501346	–	440	13	0.70	–
ACP 3605-5	BV 20394/313	32501346	–	440	13	0.70	–
ACP 3607-5	BV 20394/325	32501347	–	440	25	1.10	–
ACP 3611-0	BV 20394/325	32501347	–	440	25	1.10	–
ACP 3615-0	BV 20394/330	32501348	–	440	30	1.15	–

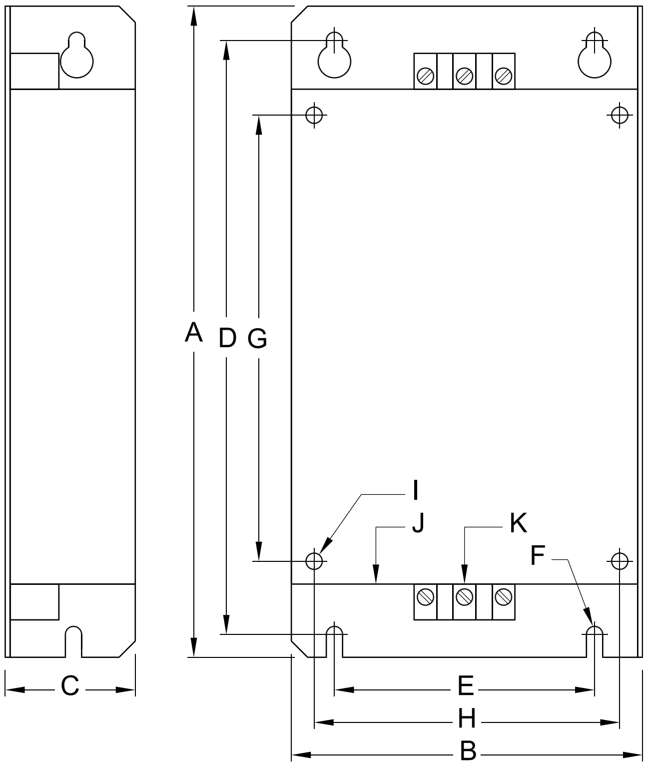


3.3.3 Filter Specifications

All BERGES line filters are provided in IP20 enclosures. They can operate over a temperature range of -10 to +50 °C (-23 to +122 °F). The filters can be mounted parallel or perpendicular to the control panel. The filter is supplied with the correct mounting hardware for mounting the inverter on top of the filter enclosure (Footprint).

ATTENTION!

The mains filters and chokes must be installed and connected in conformity with the recommendations given in chapters 3.3.1 (page 12), 3.3.4 (page 15) and 3.6.3 (page 22).



TYPE	OUTER DIMENSIONS			SECURING			SECURING ON THE INVERTER			CONNECTIONS		FOOT-PRINT
	A	B	C	D	E	F	G	H	I	J (PE)	K	
BE I 1005	200	108	40	183	80	M5	137	94	M5	M4	2,5 mm^2	(1)
BE II 1010	200	145	40	183	110	M5	137	129	M5	M4	2,5 mm^2	(1)
BE III 1020	250	145	45	235	110	M5	188	129	M5	M4	2,5 mm^2	(1)
BE I 3003	200	108	40	183	80	M5	137	94	M5	M4	2,5 mm^2	(1)
BE II 3005	200	145	40	183	110	M5	137	129	M5	M4	2,5 mm^2	(1)
BE III 3012	250	145	45	235	110	M5	188	129	M5	M5	2,5 mm^2	(1)
BE IV 3038	360	222	50	342	160	M6	280	200	M6	M5	16 mm^2	(1)
BE V 3012	360	222	50	342	160	M6	280	200	M6	M5	16 mm^2	(1)
BE VI 3040	496	232	50	478	180	M6	419	200	M6	M5	16 mm^2	(1)

Table 3.2

NOTE: Dimensions in mm.

3.3.4 Interference Suppression Measures

Electrical/electronic devices are capable of influencing or disturbing each other through connecting cables or other metallic connections. “Electromagnetic compatibility” consists of the factors “interference resistance” and “interference emission”. **Correct installation of the inverter in conjunction with any possible local interference suppression measures has a crucial effect on minimizing or suppressing mutual interference.**

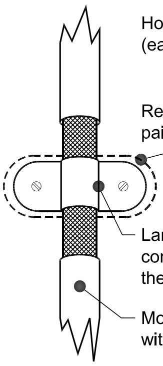
(1) FOOTPRINT means that these filters have been prepared for the installation of an ACP converter on the filter (securing).

The scope of noise suppression measures depends on the limit value class, the local situation and the application.

The following notes refer to a mains power supply that is not “contaminated” by high frequency interference. Other measures may be necessary to reduce or suppress interference if the mains voltage is “contaminated”. No generally valid recommendations can be given in such cases. Please consult BERGES if all recommended interference suppression measures should not produce the desired result.

Basically, it is **not the cross section** of the conductor that is important for radio-frequency interference suppression **but the surface area.** Since the high-frequency interference does not flow through the entire cross section but mainly on the outer surface of the conductor (skin effect), **braided copper tapes of corresponding cross section** should be used.

All conductive housing parts must be interconnected using corresponding lines. Minimum cross sections are prescribed for a fault case at 50 Hz (referred to the range of the safety regulations) which must be observed under all circumstances.



The inverter and all other components used for interference suppression (especially also the shield of the motor cable) should be contacted over as large an area as possible when connected to metal (control panels, switchgear cabinets and similar) (skin effect). **Remove the paint at the respective areas to ensure good contacting over a large area!**

A central earthing point should be used for interference suppression (e.g. equipotential bonding strip or centrally at an interference suppression filter). The earthing lines are routed to the respective terminals **radially** from this point. Conductor loops of the earthing lines are impermissible and can lead to unnecessary interference.

The shield cross section must not be reduced when the shield is connected to continuing lines. This would give rise to RF resistance at a cross section reduction, and the resulting RF energy would consequently not be discharged but radiated. Shields – particularly shields of control lines – must not be contacted via pin contacts of plug connectors. In these cases, the metallic hand guard of the plug connector should be used for large-area connection of the shield.

Use a shielded motor cable (earthed over a large area at both sides). The shield should be routed **uninterrupted** from the PE terminal of the inverter to the PE terminal of the motor. If a shielded motor line cannot be used, the unshielded motor line should be laid in a metal duct. The metal duct must be uninterrupted and adequately earthed. The following points are prescribed if radio interference suppression is to be realized in accordance with EN 55011, EN 55014 and EN 50081-1:

- Preceding the unit by a mains filter or a mains filter and a output choke (mains filter and output choke not included in the scope of delivery).
- Laying the motor cable in a shielded configuration.
- Laying the control cable in a shielded configuration.
- Observe general RFI suppression measures (refer to the chapters 3.3.1 and 3.3.4).

Lay motor, mains power and signal cables as far away from each other as possible and separately.

If a mains filter is used, the **smallest possible** spatial distance from the frequency inverter must be selected so that both units can be connected by short connection leads.

If an output choke is used (option), it must be fitted **in the direct vicinity** of the inverter and connected to the inverter via screened cables earthed at both ends.

Shielded signal cables should be laid at a minimum distance of 10 cm from power cables running parallel. A separate earthed metal cable duct is advisable for such signal cables. If signal cables intercept with a power cable, they should do so at an angle of 90°.

Control lines longer than 1 m must be laid with a shield and earthed at one side on the frequency inverter. The screen is earthed via terminal “**CM**” in the case of pull-up logic and pull-down logic (see “Connection Diagrams”, chapters 7.1 to 7.7). If cables have lengths in excess of 10 m, use a 0–20 mA control signal because of the possibility of parasitics. The inverter can be switched over to this mode of operation. See parameter ***24-FSEL*** (chapter 5.2, page 38).

Other loads connected to the mains may produce voltage spikes that may interfere with functioning of the inverter or may even damage it. Chokes or mains filters can be used on the mains side to protect the inverter against voltage spikes (resulting from switching large loads to the mains). Such chokes and filters are available as accessories.

If inverters are operated in switchgear devices or in their close proximity (e.g. in one common control cabinet) in connection with the same power mains, we recommend the following precautionary measures to suppress interference in the switchgear:

- Wire the coils of contactors, switchgear devices and relay combinations with “RC elements” or with free-wheel diodes.
- Use shielded cables for external control and measuring cables.
- Lay disturbing cables (e.g. power and contactor control circuits) separately and at a distance from the control cables.

3.4 EMC Ordinance (EMC Directive, 89/336 EEC)

The frequency inverters were tested in the form of a practical test set-up in a switchgear cabinet (in accordance with our interference suppression measures in these operating instructions: “EMC (electromagnetic compatibility)”. The limit values of the standards below were fulfilled under these conditions:

EMA (Electromagnetic Emission)

EN 50081-1	Basic specification “Emitted interference” (Limit value class A)
or	
EN 50081-2	Basic specification “Emitted interference” (Limit value class B)
EN 55011	Emitted interference

EMB (Electromagnetic Interference)

EN 50082-2	Basic specification “Interference immunity”
EN 50140	Electromagnetic fields
EN 60801	Static discharge (ESD)
IEC 801-4	Burst on mains lead/data line

HINT!

At least the following conditions must be fulfilled for compliance with the limit values of the aforementioned standards:

- Installation of a mains filter or a mains filter and a motor choke (mains filter and motor choke are not included in the scope of delivery).
- Laying the motor cable in a shielded configuration.
- Laying the control cable in a shielded configuration.
- Observe general RFI suppression measures (refer to the chapters 3.3.1 and 3.3.4).

As the aforementioned interference resistance tests are based on standardised mains conditions, in extreme cases it may happen that the function of the inverter will be lost (minimum operating quality). This malfunction can generally be remedied by a RESET of the inverter. Refer to the chapter entitled “Resetting a Fault” and “Fault Codes” on page 63.

Detailed information and technical data relating to adapted mains filters and chokes can be found in the chapters 3.3.2, “Mains Filters/Output Chokes” and 3.3.3, “Filter Specifications”.

3.5 Wiring Practices

3.5.1 Applicable Codes

Pay conscientious attention to ensuring that the installation wiring is installed at least in conformity with the NEC standards. Where local codes exceed these requirements, they must be followed.

All models are listed by the Underwriters Laboratories, Inc. (UL) and are certified by the Canadian Underwriters Laboratories (cUL) and therefore conform to the requirements of NEC and CEC. Installations that are to meet the requirements of UL and cUL must be realised in conformity with the UL and cUL specifications. Refer to the corresponding electrical data on the rating plates of the ACP 3000 unit and the motor.

3.5.2 Power Wiring

Power wiring are those wires which are connected during installation to the power circuit terminals, L1, N, L2, L3, M1, M2, and M3. Power wiring must be selected as follows:

1. Use only VDE, UL or cUL recognized wire.
2. Wire voltage rating must be a minimum of 300 V for 230 VAC systems, and 600 V for 400 VAC systems.
3. The core cross section and the associated fuse are given in the tables in chapter 3.6.2, page 22. The wires must consist of copper and be designed for insulation temperatures of 60 °C or 75 °C.
4. Grounding must be in accordance with VDE, NEC and CEC.

NOTES:

ATTENTION!

Never connect input AC power to the motor output terminals M1, M2 and M3 or damage to the drive will result.

The output voltage of variable-frequency controllers contains high-frequency components that might cause disturbances in other installations. Therefore, avoid laying control cables and mains input cables in the same cable duct or conduit together with the output cables from the converter to the motor (see also chapter 3.3.4, “Interference Suppression Measures”).

3.5.3 Control Wiring/Interface

ATTENTION!

All interfaces or control inputs and outputs possess only basic insulation by the mains and must be incorporated in a further protective measure.

Use a dummy plug as additional protection if interface J22 is not allocated.

This is wiring connected to the control terminal strip (20 terminals). It must be selected as follows:

1. Shielded wire is recommended to prevent electrical noise interference from causing improper operation or nuisance tripping. Only connect the screen on one end to the “CM” terminal on the converter’s control terminal strip (see also chapter 3.3.4, “Interference Suppression Measures”).
2. Use only VDE, UL or cUL recognized wire.
3. Wire voltage rating must be a minimum of 300 V for 230 VAC systems, and 600 V for 400 VAC systems. This is Class 1 wire.
4. Never run the control wiring in the same conduit or raceway with power wiring.

5. **Do not use wire end ferrules for the control terminals. The terminals are designed so that the wires can be inserted in the terminals after twisting the individual wires.**

3.6 Mains Power Connection

The frequency inverters are designed for installation in a switchgear cabinet and for permanent connection.

To guarantee lasting operating safety and reliability, the inverter must be connected expertly in accordance with the valid electrical standards. Attention must be paid to good insulation from earth potential on the power terminals.

An AC system with a nominal voltage of 230 V (50/60 Hz) must be connected to mains terminals L1, N and PE or a three-phase system with a nominal voltage of 400 V (50/60 Hz) to terminals L1, L2, L3 and PE (pay attention to rating plate). The neutral point must be earthed (TN-C system).

Ensure a voltage balanced to earth or phase to phase when feeding in the mains power through an isolating transformer (star point must be earthed).

Frequency inverters must not be connected via a residual-current-operated circuit-breaker as the sole protective measure!

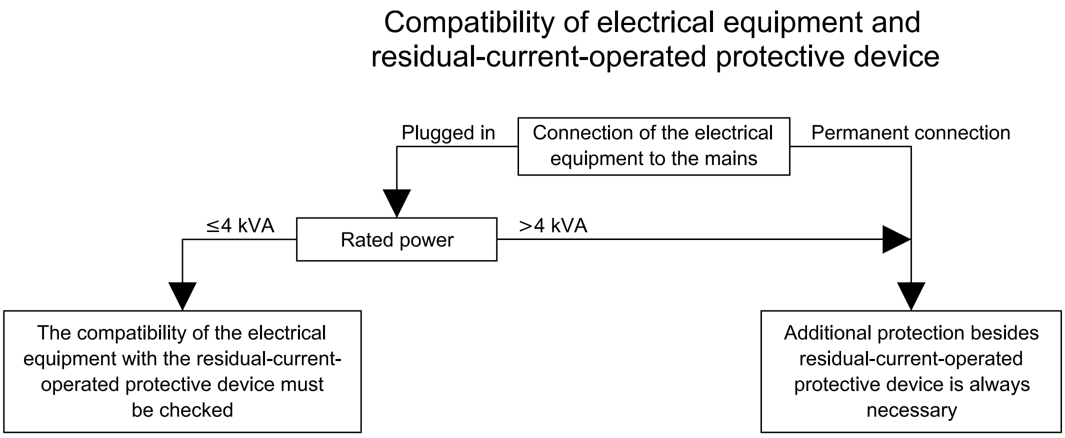
The single exception below permits connection of a frequency inverter via a residual-current-operated circuit-breaker as the sole protective measure:

- Installation of a residual-current-operated circuit-breaker of the newest design **for frequency inverters up to 4 kVA (input voltage 1 × 230 V) with MOBILE connection.** This residual current-operated circuit breaker must be suitable for alternating and pulsating DC leakage current. Residual-current-operated circuit-breakers of this type bear the symbol .

Reliable tripping of the residual-current-operated circuit-breaker is not ensured in the case of frequency inverters up to 4 kVA (input voltage 3 × 400 V) with MOBILE connection; an additional protective measure must be used for this reason. Also see the diagram below.

In the case of frequency inverters with PERMANENT connection (input voltage 1 × 230 V and 3 × 400 V), another protective measure must always be used in addition to the residual-current-operated protective device. Also see the diagram below.

The protective function of the residual-current-operated circuit-breaker is no longer ensured due to leakage currents from interference suppression capacitors in the inverter and DC components in the fault current. All devices connected to this residual-current-operated circuit-breaker (and persons touching them) are no longer protected in the event of a fault.



Flow diagram of the requirements relating to the combination of frequency inverter and residual-current-operated protective device

The inverter will be destroyed if the mains feeder is confused with the motor cable.

The DC link capacitors must be reformed if the inverter you wish to connect has been out of operation for more than a year. To do this, connect the inverter to voltage for approx. 30 minutes. The inverter should not be loaded by connected motors during forming.

3.6.1 Mains Conditions

Permissible fluctuation of the mains voltage amounts to around ±10% of the rated voltage. If the mains voltage should exceed or fall below these limits, the inverter will be deactivated automatically as the result of the undervoltage or overvoltage.

When applying the inverter to line voltages other than the factory default values (230 VAC or 460 VAC), be sure to set parameter ***59-MVOLT*** to the proper value. Refer to page 42.

Adaptation to rated line voltages outside the permissible range is possible by means of autotransformers. Calculation according to the formula below is recommend:

$$P_T = P_D \left(1 - \frac{U_2}{U_1}\right)$$

$$P_D = U_2 \times I_2 \times \sqrt{3}$$

P_T = Equivalent two-winding kVA rating (kVA)
P_D = Continuous output (kVA)
U_1 = Rated line voltage (V)
U_2 = Rated voltage, frequency inverter (V)
I_2 = Input current (A) as per table 2.1 and 2.2

NOTE:

Exercise caution when using the ACP 3000 under the conditions of a low-voltage network. An inverter from the ACP 3000 series is fully functional when connected to an alternating current of 370 V, for example. However, the maximum output voltage is limited to 370 VAC. If the motor is rated for a mains voltage of 400 VAC, this can lead to higher motor currents and overheating of the motor. **It must be ensured that the connected mains voltage corresponds to the rated voltage of the motor.**

If other than 50 Hz output can be tolerated, proper volts/hertz can be programmed into the inverter by the ***53-FKNEE*** and ***32-FMAX*** parameters. If you are unsure about this feature, consult section 5.2 or BERGES.

Phase voltage imbalance of the input AC source can cause unbalanced currents and excessive heat in the input rectifier diodes and in the DC bus capacitors of the ACP. Phase imbalance is calculated by the following method:

Assume:
The voltage from L1 to L2 = L_a
The voltage from L2 to L3 = L_b
The voltage from L3 to L1 = L_c
The average line voltage = L_{avg}

$$L_{avg} = \frac{L_a + L_b + L_c}{3} = \frac{395 + 400 + 405}{3} = 400$$

Determine the absolute value of the difference between each of the line voltages (L_a, L_b and L_c) and L_{avg}. (Subtract the two values and disregard the sign of the result.) Consider the results of this calculation to be L_{aa}, L_{ba}, and L_{ca}.

$$\text{Phase Imbalance} = \frac{L_{aa} + L_{ba} + L_{ca}}{2\ (L_{avg})} \times 100\% = \frac{5 + 0 + 5}{2 \times 400} \times 100\% = 1.25\%$$

Example: Measured phase voltages of 395, 400, and 405 would result in a calculated phase imbalance of 1.25%.

If the resulting phase imbalance exceeds 2%, consult your local power company or plant maintenance personnel and ask them to investigate this problem and recommend methods of correcting this condition.

Phase imbalance can also cause damage to motors running direct on line. A 2% imbalance requires a 5% derating factor on the motor, 3% imbalance requires a 10% derating. 4% requires an 18% derating.

ATTENTION!

NEVER USE POWER-FACTOR IMPROVEMENT CAPACITORS ON THE ACP MOTOR TERMINALS, M1, M2, AND M3, OR DAMAGE TO THE INVERTER'S SEMICONDUCTORS WILL RESULT!

3.6.2 Line Protection

It is necessary to provide either a circuit breaker or a fused disconnect switch on the input AC line in accordance with all applicable electrical codes. The following rules should be used to select the correct size of the input line fuses or circuit breaker.

A. Sizing

The ACP inverter is able to withstand a 150% overload for 60 seconds. Minimum voltage rating for the protection device should be 250 VAC for models 3300-3 to 3302-2, and 600 VAC for models 3600-7 to 3615-0.

B. Fuse Type

To guarantee a maximum protection of the inverter fuses should be used for current Limitation. These fuses should have a breaking capacity of 200,000 A_{eff}. The following tables shows the recommended values in amps for all ACP-inverters.

ATTENTION!

For 230/400 V mains supplies we recommend time-lag type NEOZED-fuses.

SUPPLY VOLTAGE 1 × 230 VAC						
Type	**3300-3**	**3300-5**	**3300-7**	**3301-1**	**3301-5**	**3302-2**
Inverter power (kW)	0.37	0.55	0.75	1.1	1.5	2.2
Rated current, fuse (A)	4	6	6	10	10	16
Cable cross section, mains lead (mm^2)	1.5	1.5	1.5	1.5	1.5	2.5
Cable cross section, motor lead (mm^2)	1.5	1.5	1.5	1.5	1.5	1.5

SUPPLY VOLTAGE 3 × 400 VAC									
Type	**3600-7**	**3601-5**	**3602-2**	**3603-0**	**3604-0**	**3605-5**	**3607-5**	**3611-0**	**3615-0**
Inverter power (kW)	0.75	1.5	2.2	3.0	4.0	5.5	7.5	11.0	15.0
Rated current, fuse (A)	2	4	6	6	10	16	16	25	32
Cable cross section, mains lead (mm^2)	1.5	1.5	1.5	1.5	1.5	2.5	2.5	4	6
Cable cross section, motor lead (mm^2)	1.5	1.5	1.5	1.5	1.5	1.5	2.5	4	6

For mains supplies with rated voltage exceeding 415 V the semi-lag fuses type “Bussmann FRS-R” are recommended. The typical disconnection times are 150–250 sec. for 2 times the overcurrent and 180–1500 msec. for 10 times the overcurrent.

3.6.3 Using Mains Filters

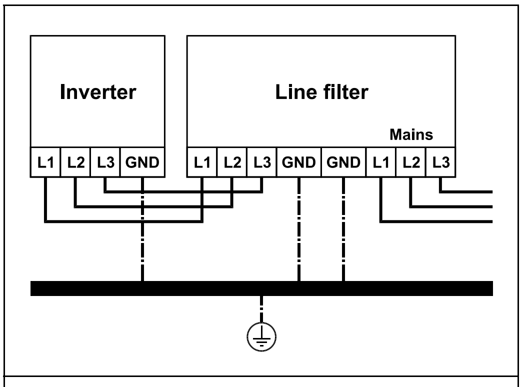
Special protective measures must be observed when using mains filters:

Owing to the leakage current involved (>3.5 mA), attention must be paid to EN 50178 when using BERGES mains filters. **One** of the following protective measures **must** be taken:

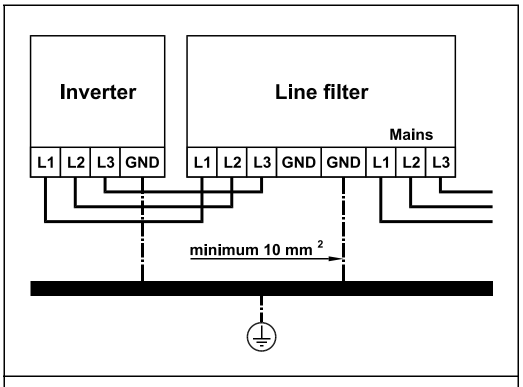
- The mains filter must be connected separately by laying a second cable that is electrically parallel with the PE conductor; this conductor must meet the requirements of IEC 364-5-543 on its own.
- The PE conductor must have a cross section of at least 10 mm^2 (refer to the following diagrams).
- The PE conductor must be monitored by a facility that isolates the inverter from the mains in the event of a fault (PE conductor monitoring).

ATTENTION!

The inverter must always be connected permanently (EN 50178) when using mains filters (leakage current >3.5 mA).



Mains filter connection with a second parallel PE conductor



Mains filter connection with at least 10 mm^2 PE conductor cross section

3.6.4 Line Starting

ACP 3000 is designed to provide controlled starting and stopping of AC motors by use of the keypad or external contacts connected to the control terminal strip. The drive may also be started by using a maintained contact (2-wire operation). To prevent accidental starting of the motor, the inverter has linestart-lockout as a standard feature. This provision can be defeated by programming ***82-START*** (see page 48).

The inverter may be started once every two (2) minutes in this mode.

3.7 Motor Connection

Connect the motor cable to the “M1, M2, M3” and “PE” terminals.

The inverter will be deactivated if shorted to the motor terminals.

ATTENTION!

The output of the drive will always be three phase. Do not connect single-phase motors to the inverter output terminals M1, M2 or M3.

Never use power factor correction capacitors on the motor terminals M1, M2 and M3, or damage to the semi-conductors will result.

We recommend PTC evaluation using commercially available devices to achieve effective protection of the motor.

If interrupting contacts (e.g. contactors or motor protection switches etc.) have to be installed between the motor and inverter, the circuit must be configured so as to ensure that the “Enable” signal (terminals V+ and FWD/REV by pull-up logic, terminals CM and FWD/REV by pull-down logic) is deactivated **before** separation of the inverter/motor connection. A relay switching time of approx. 30 ms suffices.

In the case of special motors, the corresponding Volt/Hz values can be programmed on the inverter by means of the parameters ***53-FKNEE*** and ***32-FMAX***. In cases of doubt, please contact BERGES or refer to chapters 5.2 and 9.1.

3.8 Reducing Current Surges and Voltage Transients

Voltage spikes caused by coils (inductors operated on the same mains as the inverter) can lead to malfunctions of the inverter. In cases of this kind, the affected windings of contactors and relays operated on the 230 VAC mains must be damped by fuses in the form of an RC series circuit:

- Main Circuit Contactors and Solenoids: C = 0.2 MFD, 500 VDC; R = 500 W, 5 Watts.
- Auxiliary Control Circuit Relays: C = 0.1 MFD, 500 VDC; R = 200 W, 2 Watts.

Connection Diagram for AC and DC Relay Coils and Solenoids:

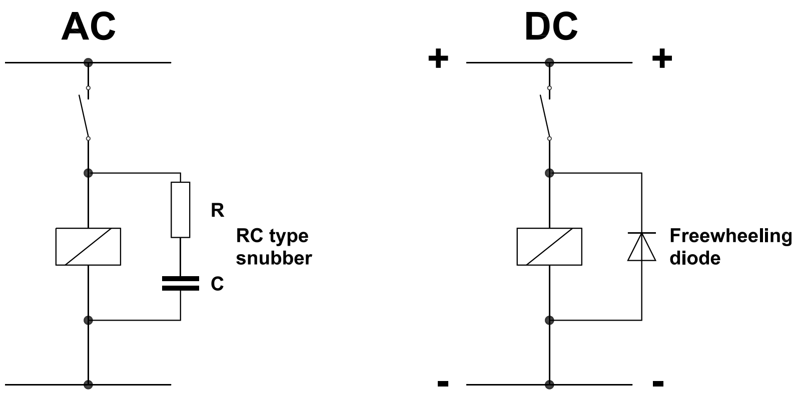


Figure 3.2

Free-wheeling diodes must be used on contactors, relays and solenoid coils operated with direct current. The diodes in question should be fast types with short recovery time. The diode must be connected in blocking direction in parallel with the winding (see Figure 3.2). The rated current and voltage of the diode can be calculated using the formulae below:

$$\text{Diode Current Rating (A)} \geq \frac{\text{Coil Capacity (VA)}}{\text{Rated Voltage of Coil (V)}}$$

$$\text{Diode Voltage Rating (V)} \geq \text{Rated Voltage of Coil (V)} \times 2$$

3.9 Function and Use of Terminals

Refer to section 7.1 to 7.7 – Connection Diagrams for power and control wiring examples.

A. Power Circuit Terminals

Power terminals are located on the power module of the ACP 3000 inverter. They are labelled L1, L2, and L3 for incoming three phase AC line power (L1 and N for incoming single-phase AC line power), and M1, M2, and M3 for the motor connections.

Two ground connections (GND) are provided on the end plate of 0.37 to 4.0 kW IP 21 models (see Figures 3.4 and 3.5), and along the power terminal strip of 5.5 to 15.0 kW IP 21 models (Figure 3.6). Ground connections can be made to the heat sink on chassis models. The ground screws must be connected to earth ground in accordance with the NEC.

5.5 to 15.0 kW inverters also have two terminals, B+ and B-, that provide access to the DC bus rails for the addition of external dynamic braking kits, or extra bus capacitors for custom applications.

B. Control Terminals

The control terminals are located on the bottom edge of the inverter's control board. See Figures 3.4 to 3.6, page 26/27 and chapter 3.15. These terminals are available for use with external devices.

The 20-pole control terminal strip of the units, 0.37–4.0 kW, is plugged in and can be removed in the upward direction to connect the control cables. To do this, place a flat screwdriver on the metal tabs of the cover securing element and carefully lever off the terminal strip in the upward direction.

NOTE:

Control input signals must not exceed 24 VDC ±20% potential to ground.

Logic Input Levels:

LOGIC TYPE	PULL-UP	PULL-DOWN
Active	10–24 VDC	0–3 VDC
Inactive	0–3 VDC	10–24 VDC

The input logic is compatible with either 12 or 24 VDC logic. **J20** selects active High or Low control inputs.

3.10 Terminal Access Cover Removal

Hazard of electrical shock.
Disconnect power before working on this drive.
Dangerous voltages exist until the STATUS Indicator is off.

A. IP 21 Enclosures

IP 21 versions of the ACP 3000 inverter are designed to prevent accidental removal of the terminal access cover. The cover mounting meets UL and NEC specifications for safety.

To remove the access cover from 0.37 to 4.0 kW inverters, loosen the two screws mounted at the lower corners of the cover (see Figure 3.3). When replacing the cover, a snug fit only is required. **Do not torque the screws** or damage to the cover may result.

To remove the access cover from 5.5 to 15.0 kW inverters, insert a small blade screwdriver into the slots located on the lower left and right corners of the cover. Use a slight twisting motion while lifting upward to loosen one side then the other, and then lift the cover off the inverter. To replace, hook the cover onto the two retainers on top of the inverter base and snap the cover into place.

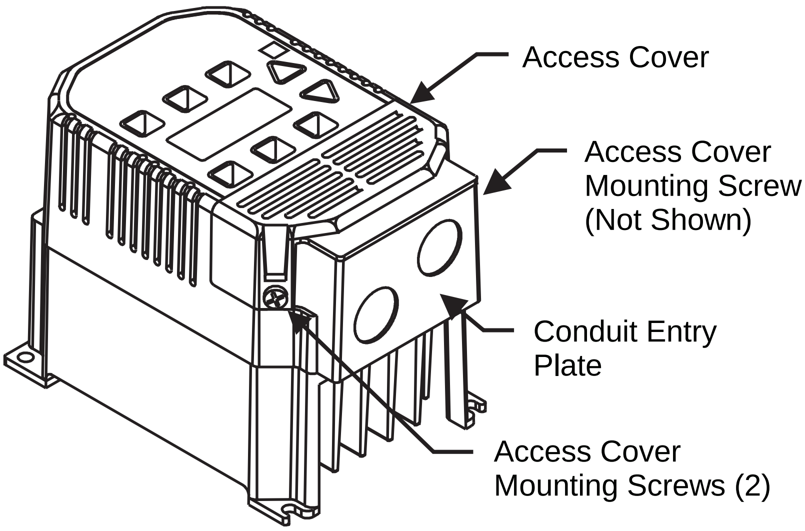


Figure 3.3

3.11 Terminal Assignment (Mains supply 1 × 230 VAC, 0.37–4.0 kW)

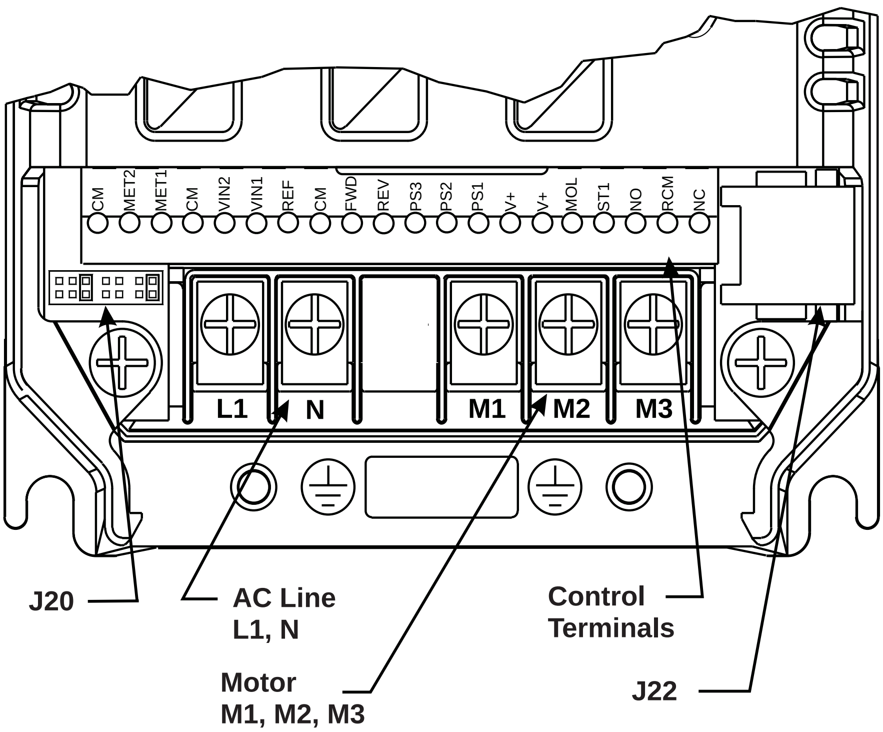


Figure 3.4 (1)

3.12 Terminal Assignment (Mains supply 3 × 400 VAC, 0.37–4.0 kW)

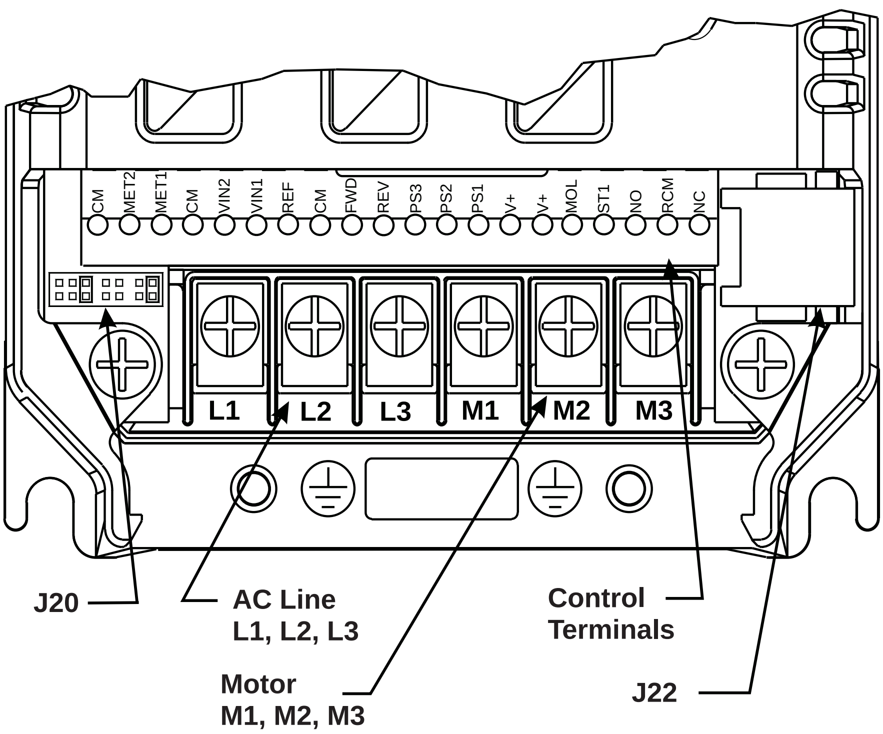


Figure 3.5 (1)

(1) Power Terminals torque to 3.4 Nm max.
Control Terminals torque to 0.28 Nm max.

3.13 Terminal Assignment (Mains supply 3 × 400 VAC, 5.5–15.0 kW)

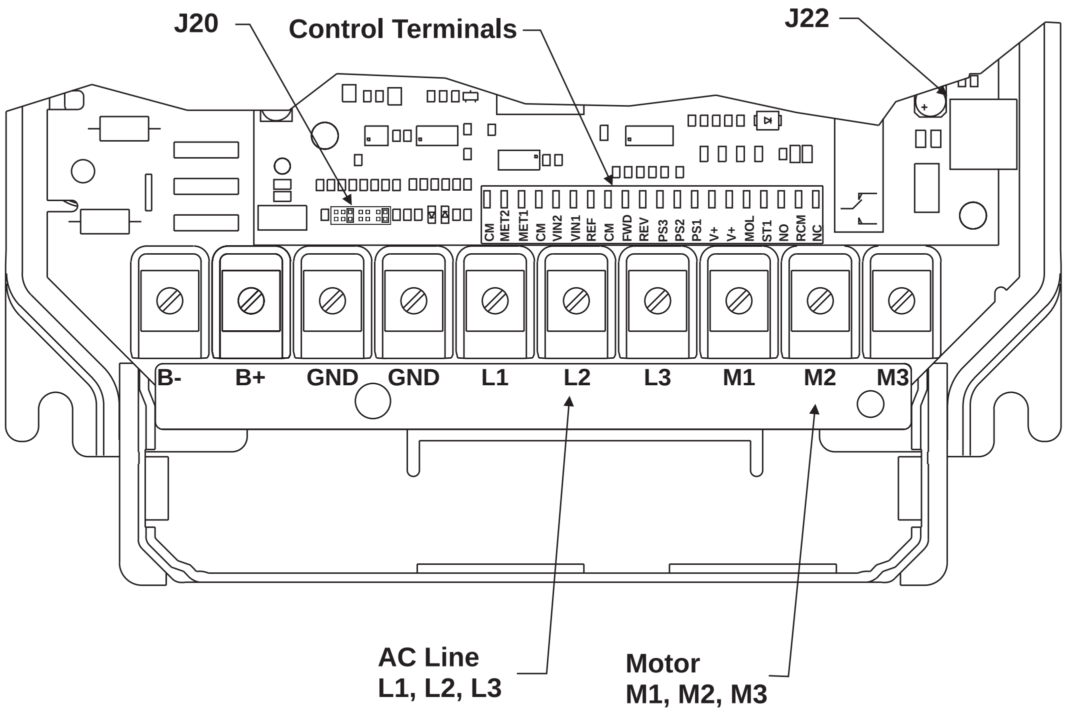


Figure 3.6 (1)

(1) Power Terminals torque to 3.4 Nm max.
Control Terminals torque to 0.28 Nm max.

3.14 Remote Keypad/Program Memory Unit Connector (J22)

Connector J22, located on the right side of the ACP 3000 micro-inverter, is used with either the Remote Keypad Unit (XRK01) or Program Memory Unit (XPM01), both sold separately. Both options are battery or AC line adapter powered and can be used with any ACP 3000 model to allow remote programming and control of the inverter. The Remote Keypad Unit can be mounted on another enclosure up to 100 m from the inverter. Programmer options allow storage of up to ten separate parameter sets.

3.15 Control Terminal Description

The ACP 3000 series micro-inverter has a 20 position control terminal block. Some functions are defined by the setting of jumper J20, while others are defined by programming. Refer to section 7.1 to 7.7 and Figures 3.4 to 3.6.

DESCRIPTION OF TERMINALS	
CM	Circuit Common, isolated from ground.
MET1	Analog meter output 1. Provides a 0 to 10 VDC (1 mA maximum) signal proportional to output frequency, load, or current through setting of ***71-METER***. May be calibrated while inverter is running by programming ***70-MCAL*** (page 45). Output impedance is 475 Ω.
MET2	Analog meter output 2. Provides a 0 to 20 mA or 4–20 mA signal proportional to output frequency, load, or current through setting of ***79-MET2***. May be calibrated while inverter is running by programming ***78-MCAL2*** (page 47). Output impedance is 10 Ω.

DESCRIPTION OF TERMINALS	
VIN1	Analog speed input 1. Selectable through jumper J20 for 0–5 VDC, 0–10 VDC, or 0/4–20 mA DC. A 4 mA offset is programmed by ***24-FSEL***. Only VIN1 is active with functions 0–4. If a function between 4 and 7 selected, the reference value is the **sum** of the two analog inputs or, if ***24-FSEL*** has been programmed accordingly (page 38), it is the **difference** between VIN1 and VIN2 (functions 8–11). Functions 12–15 switch between VIN1 and VIN2. VIN1/VIN2 changeover via PS3.
VIN2	Analog speed input 2. Selectable through jumper J20 for 0–5 VDC or 0–10 VDC. Only VIN1 is active with functions 0–4. If a function between 4 and 7 selected, the reference value is the **sum** of the two analog inputs or, if ***24-FSEL*** has been programmed accordingly (page 38), it is the **difference** between VIN1 and VIN2 (functions 8–11). Functions 12–15 switch between VIN1 and VIN2. VIN1/VIN2 changeover via PS3.
REF	5.2 VDC reference voltage, 3 mA maximum load. **USE ONLY FOR A FREQUENCY CONTROL POTENTIOMETER** (5 kΩ recommend).
FWD	Digital input for Forward operation. May be programmed for maintained (standard) or momentary contacts by ***21-MODE***. See page 36.
REV	Digital input for Reverse operation. May be programmed for maintained (standard) or momentary contacts by ***21-MODE***. See page 36.
V+	Positive nominal 12 VDC voltage. Only for use with digital inputs (see pages 59 to 61). **NO OTHER USE IS ALLOWED.**
MOL	Motor Overload relay input. May be configured to generate a fault on opening or closing. May also be configured to command a Coast-to-Stop on opening or closing. See page 47, ***77-MOL***.
PS1 PS2 PS3	Digital inputs normally used for preset speed selection. Jumper J20 selects pull-up or pull-down logic (see page 29). PS3 can be defined as a Run/Jog selector or VIN1/VIN2 switch by ***21-MODE*** (see page 36), or as the ART selector by ***41-RSEL*** (see page 39), unless the PI Regulator is enabled and PS3 is used as an ON/OFF switch. Eight preset speeds are available if all 3 inputs are used, and four are available if PS3 is redefined via ***21-MODE*** or ***41-RSEL***.

PS1	PS2	PS3	Effective Speed Reference
0	0	0	Basic speed setpoint (keypad or terminals)
1	0	0	33-F2
0	1	0	34-F3
1	1	0	35-F4
0	0	1	36-F5
1	0	1	37-F6
0	1	1	38-F7
1	1	1	32-FMAX

PS1 PS2 (1)

PS1	PS2	PS3	Effective Speed Reference
0	0	N/A	Basic speed setpoint (keypad or terminals)
1	0	N/A	33-F2
0	1	N/A	34-F3
1	1	N/A	35-F4

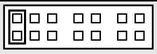
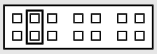
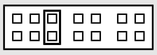
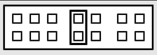
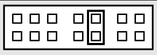
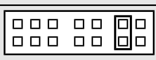
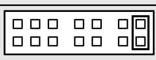
ST1	Digital output (open collector transistor). May be set to activate under one of ten conditions. See ***72-ST1*** (page 46). Maximal load: 24 VDC, 50 mA.
NO	Normally open contact for the Auxiliary Relay. Will close when the relay is activated. Rating is 115/240 VAC at 1 Ampere.
RCM	Auxiliary relay common terminal. May release by appropriate adjustment at one of ten preset conditions. See page 46, ***75-STR***.
NC	Normally closed contact for the Auxiliary Relay. Will open when the relay is activated. Rating is 115/240 VAC at 1 Ampere.

Table 3.3

(1) These settings will be utilized when PS3 is redefined via parameter ***21-MODE*** or ***41-RSEL***, or when the PI Regulator is enabled and PS3 is used as an ON/OFF switch.

3.16 J20 Configuration

Jumpers J20, on the bottom left edge of the control module (see Figures 3.4–3.6), enable changeover of analog value specification and the switching logic of the digital control inputs. It has seven (7) positions and two movable shorting jumpers. One jumper selects the analog speed reference used and the second jumper selects the active state (High or Low) of the digital inputs. A pair of small needle nose pliers will prove useful for moving these jumpers. **REMOVE AC POWER AND WAIT FOR ALL INDICATORS TO GO OUT BEFORE CHANGING THIS JUMPERS.**

JUMPER SETTINGS	FUNCTION	DESCRIPTION
	VIN1: 0–10 VDC	**Terminal input VIN1:** This configures the drive to accept an external 0–10 VDC speed reference signal. ***24-FSEL*** selects direct or inverse operation. Input impedance is 95 kΩ.
	VIN1: 0–20 mA or 4–20 mA	**Terminal input VIN1:** This configures the drive for either a 0–20 mA or a 4–20 mA input from an external source. 0–20 mA or 4–20 mA is selected by ***24-FSEL***. Input impedance is 250 kΩ.
	VIN1: 0–5 VDC	**Terminal input VIN1:** (DEFAULT SETTING) This configures the drive for an external 0–5 VDC signal, or a speed potentiometer powered from the REF terminal on the control terminal strip. ***24-FSEL*** selects direct or inverse operation. Input impedance is 48 kΩ.
	VIN2: 0–10 VDC	**Terminal input VIN2:** This configures the drive to accept an external 0–10 VDC speed reference signal. ***24-FSEL*** selects direct or inverse operation. Input impedance is 95 kΩ.
	VIN2: 0–5 VDC	**Terminal input VIN2:** This configures the drive for an external 0–5 VDC signal, or a speed potentiometer powered from the REF terminal on the control terminal strip. ***24-FSEL*** selects direct or inverse operation. Input impedance is 48 kΩ.
	Pull-Down Logic	This configures the digital inputs for pull-down logic. That is, active when connected to terminal CM. Inputs are high, and are pulled low to activate.
	Pull-Up Logic	(**DEFAULT SETTING)** This configures the digital inputs for pull-up logic. That is, active when connected to terminal V+, or to an external power supply with it's common connected to CM. Inputs are low and require a positive voltage to activate them. 0 to 3 VDC is INACTIVE, 10 to 24 VDC is ACTIVE.

4 Getting Started

4.1 General Information

Some ACP 3000 Series micro-inverters do not have a digital keypad as standard equipment. These models are programmed to operate via the control terminal strip. Use either option XRK01 (Remote Keypad Unit) or XPM01 (Program Memory Unit) to re-program the inverter.

Your ACP 3000 micro-inverter is pre-programmed to run a standard 4-pole AC induction motor; in many cases no additional programming is required.

The advanced digital keypad controls all operations of the inverter. The eight input keys allow "Press and Run" operation of the motor and straight forward programming of the parameters. To simplify the programming further, the parameters are separated into two Program Levels:

LEVEL 1 Easily entered by pressing the PROG key at any time. Limits access to the most commonly used parameters for operator convenience.

LEVEL 2 Accesses all parameters including those in Level 1. Used when the more advanced features are needed. It is entered by pressing and holding the SHIFT key then pressing the PROG key.

Parameters may be only be programmed when the drive is stopped, with the exception of ***70-MCAL*** and ***78-MCAL2*** which may be programmed at any time (see section 5.2).

4.2 Digital Keypad

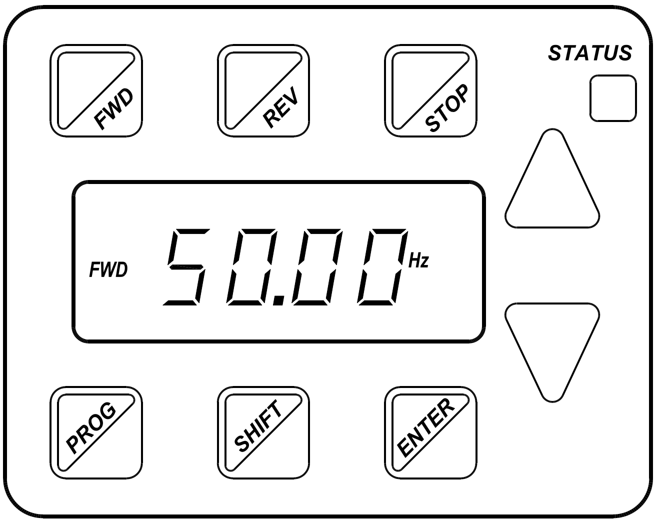


Figure 4.1

4.3 Keypad Operation

When ***21-MODE*** is set to 0 or 10, start/stop and speed commands are accepted from the keypad. The keys are used to operate the inverter as described in section 4.4.

4.4 Operation Mode (RUN and STOP Modes)

KEY	FUNCTION
FWD	Initiates forward run when pressed momentarily. If the drive is running in reverse when FWD is pressed, it will decelerate to zero speed, change direction, and accelerate to the set speed.
REV	Initiates reverse run when pressed momentarily. If the drive is running in forward when REV is pressed, it will decelerate to zero speed, change direction, and accelerate to the set speed.
STOP	Causes Ramp-To-Stop. Programmable to Coast-To-Stop by ***41-RSEL***.
△	In the Stop mode, pressing this key increases the desired running speed of the drive. In the Run mode, pressing this key increases the actual running speed of the drive. Setting resolution is 0.05 Hz up to 99.95 Hz and 0.1 Hz above this frequency. The display will scroll at an increased rate after holding the key for five seconds. Pressing SHIFT while holding the UP Arrow bypasses the delay.
▽	In the Stop mode, pressing this key decreases the desired running speed of the drive. In the Run mode, pressing this key decreases the actual running speed of the drive. Setting resolution is 0.05 Hz up to 99.95 Hz and 0.1 Hz above this frequency. The display will scroll at an increased rate after holding the key for five seconds. Pressing SHIFT while holding the DOWN Arrow bypasses the delay.
ENTER	In the Stop or Run modes, pressing this key will store the selected frequency as the initial operating frequency when the inverter is powered up. The frequency is maintained until another frequency is entered.
PROG	When the inverter is running, pressing this key accesses the Level 1 parameters for viewing only. Holding SHIFT and then pressing PROG accesses the Level 2 parameters for viewing. Any attempt to program (other than ***70-MCAL*** and ***78-MCAL2***) results in a display that shows "– – – –". In Stop mode, programming is allowed in both Level 1 and Level 2. See section 4.5, page 31.

Table 4.1

4.5 Program Mode

KEY	FUNCTION
PROG	When in Stop mode, pressing this key will enter the Program mode at Level 1. Pressing the key at any time while in the Program mode will return the unit to the Operation mode. Pressing and holding SHIFT while pressing PROG will access Level 2. If an Access Code has been invoked, it must be entered to change Data Code. See page 50, ***87-ACODE***.
△	In the Program mode, pressing this key will move forward through the successive parameters. If the PRG indicator is flashing it increases the Data Code. The ENTER key must be pressed to store the Data Code.
▽	In the Program mode, pressing this key will move backward through the successive parameter addresses. If the PRG indicator is flashing it decreases the Data Code. The ENTER key must be pressed to store the Data Code.
	NOTE: If the PRG indicator is flashing, momentarily pressing and releasing both the UP and DOWN arrows simultaneously will return the Data Code to factory defaults. Press ENTER to store the new code.
SHIFT	Pressing this key while a parameter is displayed will allow that parameter to have its Data Code changed by use of the UP and DOWN arrow keys. The PRG indicator flashes to show that the parameter can be programmed.
ENTER	This key must be pressed after the Data Code has been changed to store the new code. The display will show STOred for one second indicating that the Data Code has been entered into memory.

Table 4.2

4.6 Status Indicator

The STATUS indicator consists of two LEDs, one green and one red located in the upper right corner of the control board. They are visible through a lens in the upper right corner of the keypad on IP 21 models. The following table defines the STATUS indicator state for the various operating conditions of the inverter:

STATUS INDICATION		OPERATING CONDITION
COLOUR	DURATION	
Green and Red	**Continuous**	Power on, restart (2 Seconds)
Red	**Continuous**	Stop, running in torque limit
Green	**Continuous**	Run
Green and Red	**Flashing**	Running in and out of torque limit
Red	**Flashing**	Fault condition, Emergency Stop, line start lock-out, or low-voltage
Green	**Flashing**	Running in and out of an overvoltage or undervoltage condition

Table 4.3

4.7 Description of Displays

The back-lit, LCD display provides information on drive operation and programming. The four large 7-segment displays show drive output and programming data. The two smaller digits are used to indicate parameter numbers in the Program mode. Special symbols and displays provide further clarification of drive operation. Figure 4.2 shows all segments displayed. In normal operation only those segments that are active are displayed.

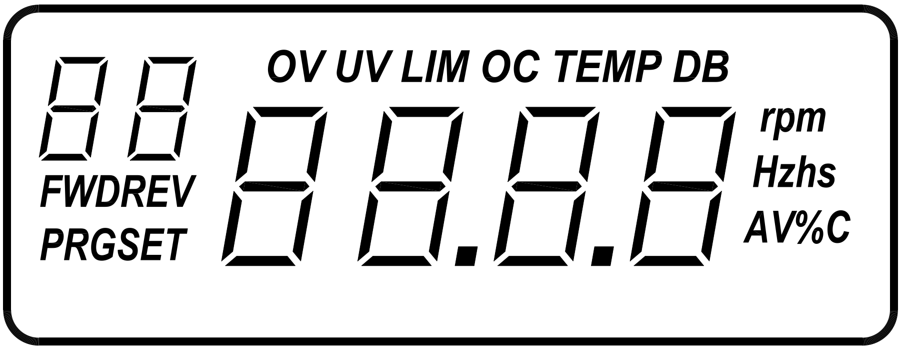


Figure 4.2

Table 4.4 lists the special annunciators and their meaning:

SYMBOL	DESCRIPTION
FWD	Forward direction commanded
REV	Reverse direction commanded
PRG	Continuous: Program mode selected. Flashing: Data Code may be changed
SET	Inverter is stopped, or is having the running frequency set
OV	Inverter is in an overvoltage condition
UV	Inverter is in an undervoltage condition

SYMBOL	DESCRIPTION
LIM	Inverter is running in torque limit
OC	Continuous: Inverter has tripped due to an overcurrent condition. Flashing: Inverter is in an overcurrent condition
TEMP	Continuous: Inverter has tripped due to an overtemperature condition. Flashing: Inverter is near an overtemperature condition
DB	The standard Dynamic Brake circuit is active
rpm	Revolutions per minute indication
Hz	Frequency in Hertz
h	Time in hours
s	Time in seconds
A	Output current indication in Amperes
V	Output voltage indication in Volts
%	Display is in percent of units
C	Degrees centigrade

Table 4.4

4.8 Programming Tips

Accessing Parameters

- When the PROG (or SHIFT-PROG) key is pressed after the application of power or a fault reset, ***21-MODE*** will always be the first parameter displayed.
- If a different parameter is accessed and the Program mode is exited, that parameter is the first one displayed the next time Program mode is entered.
- The inverter remembers a different “last parameter accessed” for Levels 1 and 2.
- If no key is pressed for 10 minutes while in the Program mode, the drive will automatically revert back to the operating mode.

Changing Display Scroll Rate

Three scroll rates are used to speed data entry.

- If either the UP or DOWN arrow is pressed and held for five seconds, the scroll rate will increase.
- If the SHIFT key is momentarily pressed while pressing one of the arrow keys, the five second delay will be bypassed.
- If the SHIFT key is pressed a second time while pressing an arrow key the display will scroll at the fastest rate.

Restoring Factory Settings

- Whenever a parameter Data Code is being changed (noted by PRG blinking) the original factory setting for **that** parameter can be restored by pressing and releasing both the UP and DOWN arrows simultaneously and then pressing the ENTER key.
- To restore **all** parameters to factory settings, or to recall a previously stored parameter set, see page 48, ***81-PRGNO***.

Help

- For Application Assistance, call BERGES electronic at 02264/17-160, 02264/17-102 and 02264/17-109.

4.9 Quick Start

This section is for operators with simple applications who would like to get up and running quickly and with a minimum amount of reading of the manual. Be sure to read sections 4.1 through 4.8 before proceeding. In many cases your ACP 3000 will perform perfectly without making any changes to the factory settings.

A. Perform all procedures for installation as specified in section 3 – Installation.
RE-VERIFY THAT THE PROPER VOLTAGE IS CONNECTED TO THE INVERTER BEFORE APPLYING POWER. FAILURE TO DO THIS CAN RESULT IN PERSONAL INJURY AND EQUIPMENT FAILURE!

B. Apply AC power to the input terminals. For about two seconds the display will show all segments active (see Figure 4.2). The STATUS indicator will then turn red (indicating a Stop condition) and the display will change to:

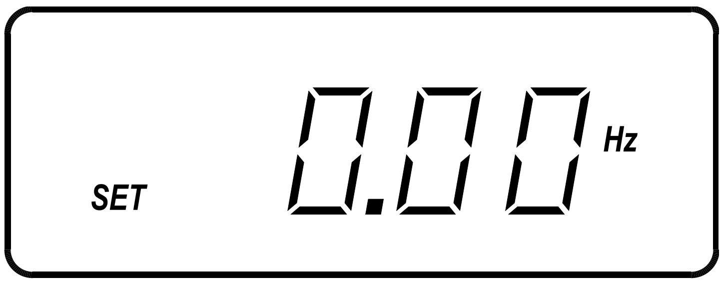


Figure 4.3

C. The factory settings correspond to control via the analog input VIN1. Activate terminal FWD or REV. The FWD and REV keys are thus ineffective. The display will e.g. change to:

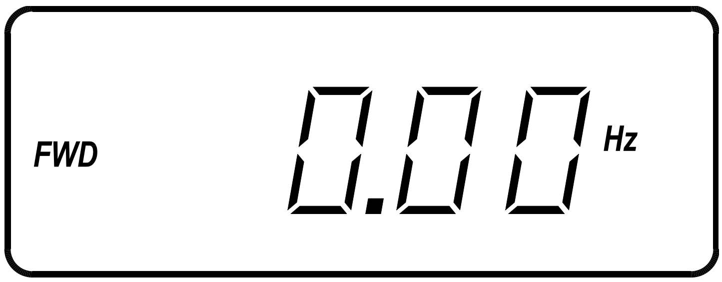


Figure 4.4

D. Control the VIN1 terminal with 0–5/10 V or 0/4–20 mA. When the display gets to 0.1 Hz, the inverter will start to produce an output. The motor will already begin to run with a correspondingly low load. When the motor starts to turn, check the rotation. If the motor is turning in the wrong direction, **PRESS STOP, REMOVE AC POWER AND WAIT FOR ALL INDICATORS TO GO OUT.** After the STATUS indicator has gone out, reverse any two of the motor leads at M1, M2 or M3.

E. The inverter is preset to run a standard 4-pole AC induction motor to a maximum speed of 50.00 Hz with both Acceleration and Deceleration times set to 3.0 seconds. See section 9.1, “Parameter Code Summary” for a complete list of all factory settings.

5 Parameter Configuration and Description

Level 1 – Accesses only basic operator parameters.

Level 2 – Accesses all parameters including those in Level 1.

5.1 Programming

Refer to Figures 4.1 and 5.1. To change the default Data Code in a given parameter:

A. Press the STOP key to stop the inverter if running.

B. Press the PROGram key to enter Level 1 Program mode. To enter Level 2 press and hold the SHIFT key and then the PROGram key. The PRG indicator will turn on.

C. Press the UP/DOWN arrow keys to access the desired parameter. The parameter number will be displayed in the upper left corner of the digital display.

D. Press the SHIFT key to allow the Data Code to be changed. PRG will starts to blink.

E. Press the UP/DOWN arrows to select the new Data Code.

F. Press the ENTER key to store the new Data Code. The display shows STOred for one second.

G. Press the PROGram key to exit the Program mode or the UP/DOWN arrows to select a new parameter.

Figure 5.1

5.2 Parameter Descriptions

The following section contains functional descriptions of all parameters. The number in the “LEVEL” column indicates the programming level in which access to the parameter in question is possible. Access to all parameters is possible in level 2 (also to parameter in level 1). A “V” means that this parameter only has a view function, while “P” stands for programmable.

PARAMETER	DESCRIPTION	UNIT	LEVEL
02-RVLVL	**– Software Revision**		**2V**
	This parameter holds the identification code of the Read Only Memory.		
03-IRAT	**– Inverter Rated Current**	**[A]**	**2V**
	This defines the nominal output current of the inverter and serves as the 100% reference for all current measurements. Continuous drive capacity is 1.1 times 03-IRAT. Your ACP 3000 inverter can provide 110% of this rating continuously without damage or tripping.		

MODEL NUMBER	VALUE OF *03-IRAT*	MODEL NUMBER	VALUE OF *03-IRAT*
3300-3	2.0 A	**3602-2**	5.5 A
3300-5	3.6 A	**3603-0**	9.0 A
3300-7	6.8 A	**3604-0**	9.0 A
3301-1	6.8 A	**3605-5**	13.0 A
3301-5	9.6 A	**3607-5**	18.0 A
3302-2	15.2 A	**3611-0**	24.0 A
3600-7	2.0 A	**3615-0**	30.0 A
3601-5	3.7 A		

Table 5.1

07-FLT3 – Last Fault 1V

This defines the most recent faults. The two left most digits are the fault code, and the right most is elapsed time in 0.1 hr increments since the last restart of the drive, 0.9 hours max. See chapter 8.2, page 62.

08-FLT2 – Second Fault 2V

09-FLT1 – First Fault 2V

12-FOUT – Motor Output Frequency [Hz] 1V

Inverter output frequency (Hz) applied to the motor.

◊ Value range: 0.00–400.0 Hz

13-VOUT – Motor Output Voltage [%] 1V

Motor output voltage calculated as a percent of applied line input voltage.

◊ Value range: 0–100% of the mains voltage

14-IOUT – Motor Output Current [A] 1V

Motor phase current computed to an accuracy of ±20%.

◊ Value range: 0.00–60.00 A

15-LOAD – Inverter Load [%] 1V

True part of motor current. Output current measurement with motor power factor applied. Accuracy is ±20%. Load reading is positive in motoring mode, and negative in regenerative mode.

◊ Value range: 0–200% of ***03-IRAT***

17-TEMP – Inverter Temperature [°C] 1V

Inverter heatsink temperature. The inverter will turn off when this temperature exceeds its maximum allowed temperature. Accuracy is ±3 °C.

◊ Value range: 0.00–110.0 °C

21-MODE – Input Mode 1P

The ***21-MODE*** parameter defines the source for speed reference and Run/Stop control input.

DATA CODE	SPEED CONTROL	START/STOP CONTROL
0	Keypad	Keypad (FWD only)
1	VIN Terminals [1)]	Keypad (FWD only)
2	Keypad	Terminals (2-Wire Maintained Contact)
3	VIN Terminals [1)]	Terminals (2-Wire Maintained Contact)
4	Keypad	Terminals (3-Wire Momentary, RUN/JOG via PS3)
5	VIN Terminals	Terminals (3-Wire Momentary, RUN/JOG via PS3)
6	EMOP [2)] (Electronic motor potentiometer)	Terminals
	(2-Wire, see section 7.7, page 61 and table below)	
7	EMOP [2)] (Electronic motor potentiometer)	Terminals
	(3-Wire, see section 7.7, page 61 and table below)	
8	EMOP1 [2)] (Electronic motor potentiometer)	Terminals
	(2-Wire, see section 7.7, page 61 and table below)	
9	EMOP1 [2)] (Electronic motor potentiometer)	Terminals
	(3-Wire, see section 7.7, page 61 and table below)	
10	Keypad	Keypad (FWD and REV)
11	VIN Terminals [1)]	Keypad (FWD and REV)

NOTES:

1) VIN1/VIN2 changeover via PS3.

2) Data codes 6 up to 9 select the ACP EMOP control programs. With codes 6 or 7 (EMOP) selected, commanded output frequency returns to ***31-FMIN*** when the drive is stopped. With codes 8 or 9 (EMOP1) selected, commanded output frequency remains at the previous setpoint. See table above for proper usage.

◊ Value range: 0–11 Default: 3

EMOP/EMOP1 Control Terminal Logic Table (Electronic Motor Potentiometer)

DESCRIPTION	FWD	REV	PS1	PS2
STOP	0	0	X	X
Speed = 0	1	1	X	X
FWD Decrease	1	0	1	X
FWD Hold	1	0	0	0
FWD Increase	1	0	0	1
REV Decrease	0	1	1	X
REV Hold	0	1	0	0
REV Increase	0	1	0	1
0 = inactive 1 = active X = ignored				

24-FSEL – Speed Setpoint Selector 2P

DATA RANGE	DESCRIPTION
0–3	With these settings, only VIN1 is active. Selects the speed setpoint characteristics and the offset if required (see following table). See chapter 3.16, “J20 Configuration”, page 29.
4–7	Defines reference as VIN1 **plus** VIN2. VIN1 can be adapted to suit customer requirements (see following table).
8–11	Defines reference as VIN1 **minus** VIN2. VIN1 can be adapted to suit customer requirements (see following table).
12–15	Changeover for VIN1/VIN2: PS3 = 0 ⇒ VIN1 active. PS3 = 1 ⇒ VIN2 active. VIN1 can be adapted to suit customer requirements (see following table).

VIN1 ADJUSTMENT			
DATA CODES	**OPERATION**	**OFFSET**	**INPUT SIGNAL VIN1**
0, 4, 8, 12	DIRECT	None	0–10 VDC, 0–5 VDC, 0–20 mA
1, 5, 9, 13	INVERSE	None	0–10 VDC, 0–5 VDC, 0–20 mA
2, 6, 10, 14	DIRECT	20%	4–20 mA
3, 7, 11, 15	INVERSE	20%	4–20 mA

NOTE:

DIRECT = Maximum output (***32-FMAX***) at maximum input.
INVERSE = Minimum output (***31-FMIN***) at maximum input.

◊ Value range: 0–19 Default: 0

31-FMIN – Minimum Frequency [Hz] 1P

Sets the minimum frequency to the motor. Programmable from 0.00 to 99.95 Hz in 0.05 Hz increments and 0.1 Hz above this frequency. Minimum programmable output frequency is 0.00 Hz.

◊ Value range: 0.00–400.0 Hz Default: 0.00 Hz

32-FMAX – Maximum Frequency [Hz] 1P

Sets the maximum frequency to the motor. Programmable from 20.00 to 99.95 Hz in 0.05 Hz increments and 0.1 Hz above this frequency. Consult motor manufacturer if frequency is in excess of motor nameplate rating.

◊ Value range: 20.00–400.0 Hz Default: 50.00 Hz

33-F2 to 38-F7 – Preset Frequencies [Hz] 2P

Programmable from 0.00 to 99.95 Hz in 0.05 Hz increments and 0.1 Hz above this frequency. Selected with input terminals PS1, PS2 and PS3 (see section 3.15 and 7.7, page 27 and 61). May be set to a frequency greater than ***32-FMAX***, but the output will not exceed ***32-FMAX*** when running. Consult motor manufacturer if frequency is in excess of motor nameplate rating.

◊ ***33-F2*** Value range: 0.00–400.0 Hz Default: 5.00 Hz
34-F3 Value range: 0.00–400.0 Hz Default: 20.00 Hz
35-F4 Value range: 0.00–400.0 Hz Default: 40.00 Hz
36-F5 Value range: 0.00–400.0 Hz Default: 50.00 Hz
37-F6 Value range: 0.00–400.0 Hz Default: 0.00 Hz
38-F7 Value range: 0.00–400.0 Hz Default: 0.00 Hz

39-FTL – Minimum Frequency in Torque Limit [Hz] 2P

This parameter sets the lowest frequency that the drive will decelerate to when in torque limit. If the load is large enough to drive the inverter below this threshold, the drive will trip on overcurrent. The rate of deceleration is set by ***46-DECTL***. Programmable from 0.00 to 400.00 Hz. Factory set for 10.00 Hz. To disable Torque Limit, set this to a Data Code greater than ***32-FMAX***.

◊ Value range: 0.00–400.0 Hz Default: 10.00 Hz

41-RSEL – Ramp Selector 2P

Selects the Acceleration and Deceleration ramps that control the motor and also enables the coast-to-stop function.

DATA CODE	DEFINITION
0	Ramp-to-stop with 42-ACC1 and ***43-DEC1*** active.
1	***42-ACC1***/***43-DEC1*** active in Forward, ***44-ACC2***/***45-DEC2*** active in Reverse.
2	***42-ACC1***/***43-DEC1*** active when the output frequency is **less** than preset frequency ***37-F6***, ***44-ACC2***/***45-DEC2*** active when output frequency is equal to or **greater** than ***37-F6***.
3	When ***21-MODE*** is set to 2, 3, or 6, PS3 is re-defined as the Alternate Ramp Time (ART) selector, unless the PI Controller is utilized. When this terminal is active, ***44-ACC2*** and ***45-DEC2*** are active. Note that PS3 cannot be used as a preset speed selector when ***41-RSEL*** is set to 3 or when the PI Controller is enabled and PS3 is used as an ON/OFF switch. (See Table 3.3 on page 28; also see ***21-MODE*** on page 36.)
4	Same as 0, except coast-to-stop is selected when stopping.
5	Same as 1, except coast-to-stop is selected when stopping.
6	Same as 2, except coast-to-stop is selected when stopping.
7	Same as 3, except coast-to-stop is selected when stopping.

◊ Value range: 0–7 Default: 0

42-ACC1 – Acceleration Time 1 [s] 1P

Sets the length of time to accelerate from 0 Hz to ***32-FMAX***. To be programmed in steps from 0.05 seconds to 99,95 seconds and, in excess of this amount, in steps of 0.1 second. Extremely short acceleration times may result in nuisance fault trips (see ***41-RSEL***, page 39).

◊ Value range: 0.10–600.0 s Default: 3.00 s

43-DEC1 – Deceleration Time 1 [s] 1P

Sets the length of time to decelerate from ***32-FMAX*** to 0 Hz. To be programmed in steps from 0.05 seconds to 99,95 seconds and, in excess of this amount, in steps of 0.1 second. Extremely short deceleration times may result in nuisance fault trips (see ***41-RSEL***, page 39). Higher braking performance can be achieved with an additional external braking chopper (option BC6000).

◊ Value range: 0.10–600.0 s Default: 3.00 s

44-ACC2 – Acceleration Time 2 [s] 2P

Alternate Acceleration Ramp. Same adjustment range as of ***42-ACC1*** (see ***41-RSEL***, page 39).

◊ Value range: 0.10–600.0 s Default: 1.00 s

45-DEC2 – Deceleration Time 2 [s] 2P

Alternate Deceleration Ramp. Same adjustment range as of ***43-DEC1*** (see ***41-RSEL***, page 39).

◊ Value range: 0.10–600.0 s Default: 1.00 s

46-DECTL – Deceleration Time in Torque Limit [s] 2P

This parameter sets the deceleration rate when the drive is operating in torque limit mode. Programmable from 0.10 to 30.00 seconds. It also serves as the acceleration rate when the drive is in torque limit due to a regenerative condition (see also ***39-FTL***, page 39.

◊ Value range: 0.10–30.00 s Default: 1.00 s

47-DCBRK – DC Brake Time [s] 2P

This is the time in seconds that DC current will be applied to the motor windings with the following conditions:

Data Code = 0.00 s:

DC braking disabled in all modes.

Data Code = 0.05–4.95 s (Timed DC braking):

1. In terminal strip Stop/Start, when both FWD and REV terminals are active.
2. In FWD or REV run mode and the speed reference is reduced to less than 0.1 Hz.
3. A Stop command is given and the output frequency decelerates to less than 0.1 Hz.

Data Code = 5.00 s (Continuous DC braking):

1. In terminal strip Start/Stop, as long as both FWD and REV terminals are held active.
2. In FWD or REV run mode and the speed reference is reduced to less than 0.1 Hz.
3. There is no DC braking after a normal decelerate to stop.

◊ Value range: 0.00–5.00 s Default: 0.20 s

48-DCVLT – DC Brake Voltage [%] 2P

This controls the amount of DC voltage applied to the motor windings by ***47-DCBRK***. Programmable from 0.00 to 15.00% of the setting of ***52-BOOST***.

ATTENTION!

If DC Braking is used as a holding brake, excessive motor heating may result.

◊ Value range: 0.00–15.00% Default: 2/3 of ***52-BOOST*** (%)

51-VSEL – V/Hz Characteristic Selector 2P

Three V/Hz characteristics (constant torque, pump and fan curves) and two starting torque boost features may be selected.

DATA CODE	DESCRIPTION
0	Linear V/Hz, with Auto-Boost, used with constant torque applications. With Auto-Boost, the optimum boost will be selected depending on load and motor conditions, parameter ***52-BOOST*** sets the maximum boost applied.

DATA CODE	DESCRIPTION
1	Linear V/Hz, with constant boost fixed by ***52-BOOST***.
2	Mixed (linear/quadratic) V/Hz, with Auto-Boost, typical of pumping applications.
3	Mixed V/Hz, with constant boost fixed by ***52-BOOST***.
4	Quadratic V/Hz, with Auto-Boost, for fan-law applications.
5	Quadratic V/Hz, with constant boost fixed by ***52-BOOST***.

◊ Value range: 0–5 Default: 0

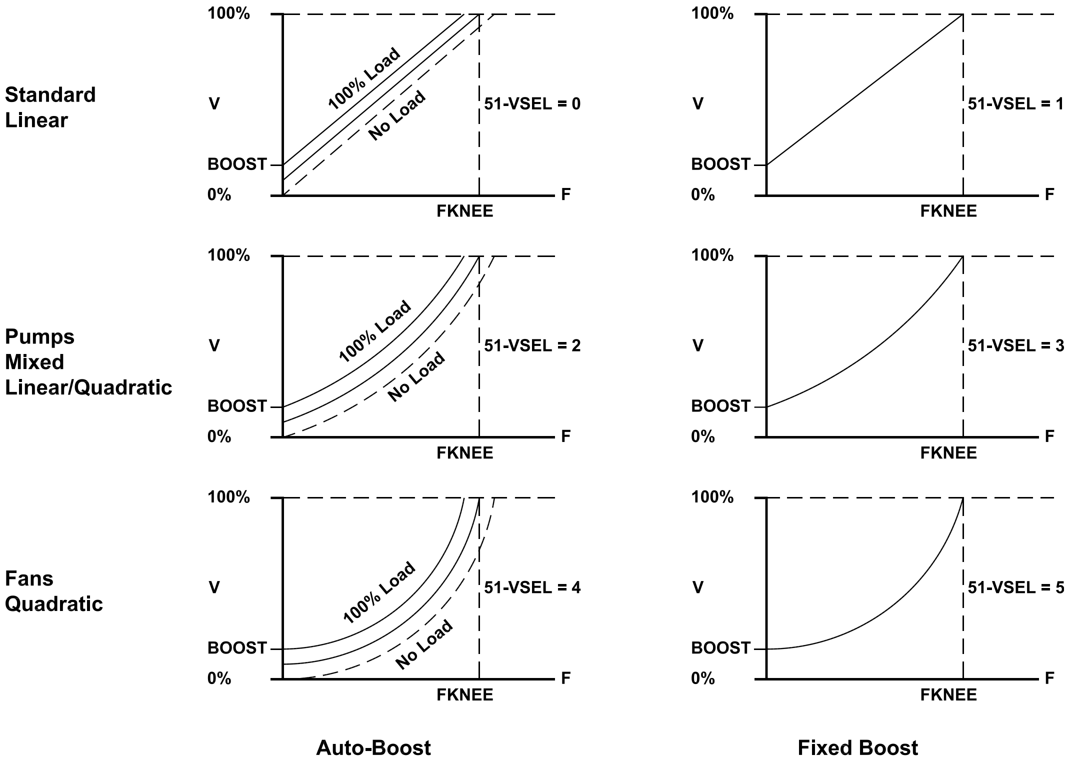


Figure 5.2

52-BOOST – Voltage Boost [%] 1P

This parameter increases motor voltage at low speed as a percent of nominal voltage to increase the starting torque of the motor. Voltage boost will linearly decrease with increasing speed. Default Boost settings vary between models.

ATTENTION!

Care must be exercised with this adjustment. Too much boost may cause excessive motor currents and motor heating. Use only as much boost as is necessary to start the motor. AUTO-BOOST may be selected at parameter *51-VSEL* to provide the optimum value of boost to suit the load automatically. Some 2-pole (3000 RPM synchronous speed) have proven to require less than the default value of *52-BOOST*.

◊ Value range: 0.00–25.00% Default: 8.00%

53-FKNEE – V/Hz Knee Frequency [Hz] 2P

This parameter is used to set the frequency at which full voltage is delivered to the motor. Thereby, the output volts/hertz ratio of the inverter is adjusted. Programmable from 26.00 to 400.0 Hz. It is factory set to the base frequency of the motor, which is 50 Hz for most European made induction motors. Setting FKNEE to a higher value can reduce motor losses at low frequencies.

◊ Value range: 26.00–400.0 Hz Default: 50.00 Hz

54-SKBND – Skip Frequency Hysteresis Band [Hz] 2P

This parameter sets the range of frequencies (above and below) associated with each of the skip frequencies. Skip bands are used to avoid mechanical resonances in a drive system. The deviation is adjustable in 0.05 Hz increments from 0.20 Hz to 20.00 Hz. The factory setting is 1.00 Hz equating to an overall 2 Hz band.

◊ Value range: 0.20–20.00 Hz Default: 1.00 Hz

55-SK1 – Skip Frequency 1 [Hz] 2P

56-SK2 – Skip Frequency 2 [Hz] 2P

57-SK3 – Skip Frequency 3 [Hz] 2P

These three (3) parameters set the center frequency of the skip bands over which normal operation will not be allowed. The inverter will ramp through these frequencies, but not settle on them. Programmable from 0.00 to 99.95 Hz in 0.05 Hz increments and 0.1 Hz above this frequency.

◊ Value range: 0.00–400.0 Hz Default: 0.00 Hz

59-MVOLT – Rated Motor Voltage [V] 2P

This sets the voltage the inverter delivers to the motor terminals at the setting of ***53-FKNEE***.

230 V models are programmable from 185 to 240 volts, and 400 V models from 370 to 480 volts. The inverter attempts to regulate the output voltage with a changing input voltage to better than 5%.

◊ Value ranges: 185–240 V; 370–480 V Default: 230 or 400 V

5B-MSAT – Motor Saturation Level [%] 2P

-If the inverter is used to control a motor that is significantly smaller than the drive rating, the motor may draw excessive current in an unloaded condition. This will be evident by a ***15-LOAD*** reading that is high when the motor is unloaded and reduces when a load is applied. If this condition occurs, adjust parameter ***5B-MSAT***, in small increments, to a lower percentage until parameter ***15-LOAD*** reads 30–45% in an unloaded condition. Consult BERGES for more information.

◊ Value range: 15–80% Default: 47%

61-LTLF – Load Torque Limit Forward [%] 2P

62-LTLR – Load Torque Limit Reverse [%] 2P

63-RTLF – Regenerative Torque Limit Forward [%] 2P

64-RTLR – Regenerative Torque Limit Reverse [%] 2P

These four parameters set the torque limiting points for the inverter in both motoring and regenerative modes with individual settings for forward and reverse operation. Programmable from 10–150% in steps of 1% (110% in the case of regenerative operation). In order to deactivate the torque limit, define a data code for ***39-FTL*** that is larger than ***32-FMAX***. To disable torque limiting set ***39-FTL*** to a value greater than ***32-FMAX***.

◊ ***61-LTLF***	Value range: 10–150%	Default: 150%
62-LTLR	Value range: 10–150%	Default: 150%
63-RTLF	Value range: 10–110%	Default: 80%
64-RTLR	Value range: 10–110%	Default: 80%

65-SLIP – Slip Compensation [%] 1P

The slip of standard asynchronous motors ca be compensated for using this parameter. Programmable from 0.00 to 12.00%. This function is automatically disabled when the PI Regulator is enabled.

ATTENTION!

DO NOT USE THIS FUNCTION WITH SYNCHRONOUS MOTORS, AS GROSS INSTABILITY MAY OCCUR.

Slip compensation is calculated as follows:

$$\text{65-SLIP} = \text{SLIP} \times \frac{\text{IRAT}}{\text{FLA}} \times 100$$

Where:

IRAT = Data Code in ***03-IRAT***.
FLA = Motor Nameplate Current.

$$\text{SLIP} = \frac{\text{Sync. Speed} - \text{Nameplate Speed}}{\text{Sync. Speed}}$$

This parameter is inactive for 65-SLIP = 0.

◊ Value range: 0.00–12.00% Default: 0.00%

66-STAB – Current Stability Adjustment 2P

Lightly loaded motors may oscillate and become unstable due to electromechanical relationships in the motor. This may be more prevalent when the inverter capacity is larger than the motor. Current Stability adjustment stabilizes the motor current in these conditions. The value of ***66-STAB*** is adjustable between 0 and 4, with the factory default being 3.

◊ Value range: 0–4 Default: 3

67-TOL – Timed Overload Trip Point [%] 1P

67-TOL is the timed overload trip point. This parameter defines the load point beyond which a timed electronic overload trip can occur. The trip time depends on the amount of overload and is 1 minute for 150% of the setting, longer for lesser degrees of overload. A 10% overload will not cause the drive to trip. Parameter ***67-TOL*** is adjustable in 1% increments from 5 to 100% of drive capacity. The factory setting is 0, inactive.

The action of ***67-TOL*** is presented graphically in the Trip Time chart to the follow. See also parameter ***6A-TOLC*** for information on setting timed overload appropriately for your motor.

The proper setting of parameter ***67-TOL*** is calculated by using the value stored at ***03-IRAT*** and the motor nameplate current (I_m) according to the following formula:

$$\text{67-TOL} = \frac{I_m}{\text{IRAT}} \times 100$$

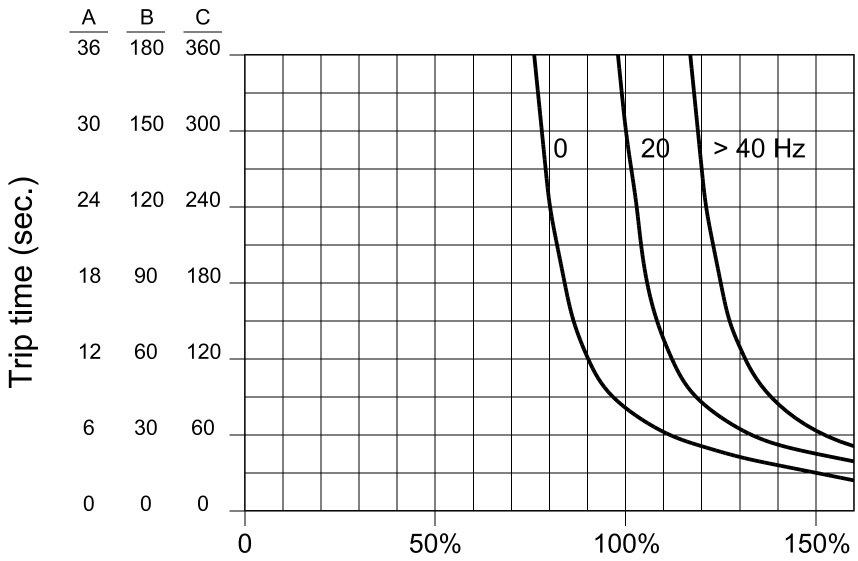


Figure 5.3
Percent Load

Motor protection by means of the parameter ***67-TOL*** is recommended for single motor drives.

ATTENTION!

When operating multiple motors from a single inverter, use a separate external motor protection device on each motor and set parameter 67-TOL to it's factory setting of 0 (disabled).

◊ Value range: 0–100% Default: 0%

68-NRST	– Trip Restart Number	2P

THIS FUNCTION REQUIRES MAINTAINED CONTACT RUN/STOP CONTROL TO FUNCTION.
IF THE SETTING OF *68-NRST* HAS BEEN EXCEEDED AND FAULT F10 IS DISPLAYED, RESETTING THE FAULT WILL RESULT IN AN IMMEDIATE START. ENSURE THAT AUTOMATIC RESTARTING WILL NOT CAUSE INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

The inverter will automatically perform a reset, after delay set by ***69-DRST***, from 1 to 8 times when any fault trip with a code of F11 and greater has occurred. If the FWD or REV terminal is still active (2-wire operation) the inverter will attempt a restart (see ***21-MODE*** and section 7.2). The count will reset if a another fault is not incurred within 10 minutes. If the programmed count is exceeded within 10 minutes, the inverter will not restart, but will display a fault trip message F10. **RESETTING THE FAULT CAN RESULT IN INSTANT STARTING. SEE WARNING ABOVE.**

This function is inactive for 68-NRST = 0.

◊ Value range: 0–8 Default: 0

69-DRST	– Restart Delay Time	[s]	2P

After a fault trip of F11 or greater has occurred, and ***68-NRST*** is greater than zero, the inverter will wait for the specified number of seconds before attempting a restart. Programmable from 0.00 to 60.00 seconds in 0.05 second increments. Restart will be controlled by the setting of ***82-START***.

◊ Value range: 0.00–60.00 s Default: 0.00 s

6A-TOLC – Timed Overload Characteristic 2P

6A-TOLC works in conjunction with ***67-TOL*** to customize the overload characteristics of the inverter to the driven motor. Refer to the graphic presented with parameter 67 for a more in-depth understanding of this parameter.

Data codes "0" through "3" provide for the use of a "standard" motor that typically has a limited continuous constant torque operating speed range. With these data codes, the degree of overload permitted by the drive depends on the output frequency. Lesser degrees of overload are permitted at lower speeds.

Data codes "4" through "7" provide for the use of an "inverter duty" motor that has a more extensive continuous constant torque operating speed range. With these data codes, the overload performance follows the curve designated ">40 Hz" regardless of operating frequency.

As you adjust between "0" & "3" and "4" & "7", you get various inverse time characteristics. Data codes "0" and "4" give you the characteristic depicted by the scale designated "C". Data codes "1" and "5" work on scale "B" and codes "2" and "6" on scale "A". With data codes "3" and "7", the parameter ***67-TOL*** works as an adjustable electronic "shear pin" with no inverse time characteristic.

DATA CODE	TRIPPING CHARACTERISTIC	TRIP TIME (s)	SCALE (Fig. 5.3)	MOTOR TYPE
0	Normal – Reduced threshold below 40 Hz	* 60	C	Standard Induction
1	Medium – Reduced threshold below 40 Hz	* 30	B	Standard Induction
2	Fast – Reduced threshold below 40 Hz	* 6	A	Standard Induction
3	"Shear Pin" – Reduced threshold below 40 Hz	** 0	–	Standard Induction
4	Normal – Constant torque	* 60	C	Inverter Duty
5	Medium – Constant torque	* 30	B	Inverter Duty
6	Fast – Constant torque	* 6	A	Inverter Duty
7	"Shear Pin" – Constant torque	** 0	–	Inverter Duty

* Trip time is at 150% of ***67-TOL*** setting.
** Trip time is at 110% of ***67-TOL*** setting.

◊ Value range: 0–7 Default: 0

70-MCAL – Analog Meter Output Calibration MET1 1P

This parameter adjusts the meter output value at terminal MET1. The setting range is 0–255. ***70-MCAL*** can be programmed while the inverter is running.

Factory default is for 10 VDC at terminal MET1, at nominal full scale output.

◊ Value range: 0–255 Default: 210

71-METER – Analog Meter Output Selector MET1 1P

This parameter selects the analog output signal to be indicated at terminal MET1. The factory full scale setting is 10 VDC but can be changed using parameter ***70-MCAL***.

DATA CODE	DESCRIPTION
0	Output off.
1	Output proportional to output frequency (***12-FOUT***), with full scale at ***32-FMAX***.
2	Output proportional to output current (***14-IOUT***), with full scale at 200% of rated current.

DATA CODE	DESCRIPTION
3	Output proportional to inverter load (***15-LOAD***), with full scale at 200% of rated load.
4	Output proportional to output voltage (***13-VOUT***), with full scale at 100% of input voltage.

◊ Value range: 0–5 Default: 1

72-ST1 – Open Collector Output ST1 1P

By means of appropriate programming, the open collector output is capable of reacting to one of the 10 conditions listed below.

DATA CODE	DESCRIPTION
0	Off.
1	Ready. The output becomes active when the inverter is ready. It is inactive in Fault, Low Voltage, Idle and Program modes.
2	Fault. The output becomes active on Fault. See Note below.
3	Motor running Forward or Reverse, and output frequency above 0.5 Hz.
4	Motor running Reverse, and output frequency above 0.5 Hz.
5	Motor running Forward, and output frequency above 0.5 Hz.
6	Motor Speed = less than 0.5 Hz.
7	Motor at commanded speed.
8	Motor speed greater than preset speed ***36-F5***.
9	In Torque Limit.
10	Over temperature warning. Temperature is within 10 °C of maximum temperature.

NOTE: When automatic fault reset and restart are used (***68-NRST***), a fault greater than F10 will not be indicated until ***69-DRST*** has been exceeded.
Maximal load: 24 VDC, 50 mA.

◊ Value range: 0–10 Default: 7

75-STR – Auxiliary Relay Output 1P

The relay furnished with the inverter may be programmed to respond to any of the 10 conditions listed below:

DATA CODE	DESCRIPTION
0	Off.
1	Ready. The relay becomes active when the inverter is ready. It is inactive in Fault, Low Voltage, Idle and Program modes.
2	Fault. The relay becomes active on Fault. See Note below.
3	Motor running Forward or Reverse, and output frequency above 0.5 Hz.
4	Motor running Reverse, and output frequency above 0.5 Hz.
5	Motor running Forward, and output frequency above 0.5 Hz.
6	Motor Speed = less than 0.5 Hz.

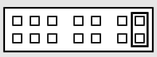
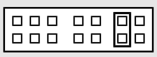
DATA CODE	DESCRIPTION
7	Motor at commanded speed.
8	Motor speed greater than preset speed ***36-F5***.
9	In Torque Limit.
10	Over temperature warning. Temperature is within 10 °C of maximum temperature.

NOTE: When automatic fault reset and restart are used (***68-NRST***), a fault greater than F10 will not be indicated until ***69-DRST*** has been exceeded.

◊ Value range: 0–10 Default: 1

77-MOL – Motor Overload Input 2P

Sets motor overload input function and polarity. This parameter, along with J20 jumper selection, define the function of the MOL input terminal. It can be defined to generate an F07 fault or a Coast-to-Stop condition using either normally open or normally closed contacts. J20 sets the input terminals for pull-up or pull-down logic (see section 3.16, page 29).

J20	DATA CODE	DESCRIPTION (MOL CONNECTION)
	0	High input (V+) or external signal (max. +24 VDC referenced to CM) will generate an F07 Fault (N.O. operation).
	1	Removal of high input (V+) or external signal will generate an F07 Fault (N.C. operation).
	2	High input (V+) or external signal (max. +24 VDC referenced to CM) will generate a Coast-to-Stop (N.O. operation).
	3	Removal of high input (V+) or external signal will generate a Coast-to-STOP (N.C. operation).
	0	Connecting MOL to CM will generate an F07 Fault (N.O. operation).
	1	Opening MOL-CM connection will generate an F07 Fault (N.C. operation).
	2	Connecting MOL to CM will generate a Coast-to-Stop (N.O. operation).
	3	Opening MOL-CM connection will generate a Coast-to-Stop (N.C. Operation).

NOTE:
External thermal overload relay rating = 1.1 × motor continuous nameplate amps.

◊ Value range: 0–3 Default: 2

78-MCAL2 – Analog Meter Output Calibration MET2 1P

This parameter adjusts the meter output value at terminal MET2. The setting range is 0–255. ***78-MCAL2*** can be programmed while the inverter is running. See ***79-MET2*** for MET2 selection.

Factory default is for 20 mA at terminal MET2, at nominal full scale output.

◊ Value range: 0–255 Default: 210

79-MET2 – Analog Meter Output Selector MET2 1P

This parameter selects the analog output signal to be indicated at terminal MET2. The factory full scale setting is 0–20 mA but can be changed using parameter ***78-MCAL2.***

DATA CODE	OUTPUT RANGE	DESCRIPTION
0	–	Output off.
1	0–20 mA DC	Output proportional to output frequency (***12-FOUT***), with full scale at ***32-FMAX***.
2	0–20 mA DC	Output proportional to output current (***14-IOUT***), with full scale at 200% of rated current.
3	0–20 mA DC	Output proportional to inverter load (***15-LOAD***), with full scale at 200% of rated load.
4	–	Output proportional to output voltage; full scale = input line voltage. Meter calibration must be set to 189 for this option.
11	4–20 mA DC	Output proportional to output frequency (***12-FOUT***), with full scale at ***32-FMAX***.
12	4–20 mA DC	Output proportional to output current (***14-IOUT***), with full scale at 200% of rated current.
13	4–20 mA DC	Output proportional to inverter load (***15-LOAD***), with full scale at 200% of rated load.
14	–	Output proportional to output voltage; full scale input line voltage.

◊ Value range: 0–15 Default: 3

81-PRGNO – Special Program 2P

This parameter allows for storing and resetting parameters and activating special functions. The function will be executed upon exiting the Program mode:

DATA CODE	DESCRIPTION
0	Standard Program
1	Reset parameters to factory settings (Display = **SETP**)
2	Store customer parameter settings (Display = **STOC**)
3	Recall customer parameter settings (Display = **SETC**)
80–95	Enables the PI Controller; see chapter 6 on page 51 for further information.

◊ Value range: 0–9999 Default: 0

82-START – Start Options 2P

Controls the operation of line start lock-out and/or Auto-Start into a rotating motor. Additionally enables or disables both the STOP key as an E-Stop when operating from the terminal strip and the Stop function due to a disconnection of a remote device connected to the drive through connector J22. See section 8.1 for special display indications used with this parameter.

ATTENTION!

NOTE: STARTING INTO A ROTATING MOTOR.
When this function is selected, the inverter will attempt to run the motor at 50 Hz output and reduced voltage. It then lowers that frequency until output current is minimized and the motor and frequency are synchronized.

ENSURE THAT THIS OPERATION WILL NOT CAUSE INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

◊ Value range: 0–11 Default: 1

DATA CODE	DESCRIPTION
0	**Line Start Lock-out.** If maintained contact run operators are used, they must be opened and then re-closed for the drive to start after application of AC power. STOP key active as Emergency, Coast-To-Stop, for ***21-MODE*** = 2–9. To reset an E-Stop, press the STOP key again. No Stop with signal loss at connector J22.
1	**Auto-Start.** Will start on power-up if direction connection is made at the control terminals after application of AC power. STOP key active as Emergency, Coast-To-Stop, for ***21-MODE*** = 2–9. To reset an E-Stop, press the STOP key again. No Stop with signal loss at connector J22.
2	**Start into a rotating motor with Line Start Lock-out.** (See Note on starting into a rotating motor). STOP key active as Emergency, Coast-To-Stop, for ***21-MODE*** = 2–9. To reset an E-Stop, press the STOP key again. No Stop with signal loss at connector J22.
3	**Start into a rotating motor with Auto-Start.** STOP key active as Emergency, Coast-To-Stop, for ***21-MODE*** = 2–9. To reset an E-Stop, press the STOP key again. No Stop with signal loss at connector J22.
4–7	Same Start functions as Data Codes 1–3, but Keypad STOP key will be disabled if Start/Stop is defined as terminals by ***21-MODE***. No Stop with signal loss at connector J22.
8–11	Same Start functions as Data Codes 1–3, but drive will initiate a Stop function (as defined by ***41-RSEL***) if a remote device signal is sensed at connector J22 and then lost.

83-PWM – PWM Carrier Frequency Selector 2P

This parameter sets the carrier frequency of the Pulse-Width-Modulation wave form supplied to the motor. Low carrier frequencies provide better low end torque but produce some audible noise from the motor. Higher carrier frequencies produce less audible noise but cause more heating in the inverter. The ACP 3000 is rated to produce continuous full load current at rated ambient temperatures when parameter ***83-PWM*** is set to carrier frequencies of 4, 6 or 8 kHz.

NOTE:
12 and 16 kHz levels automatically shift to 6 and 8 kHz respectively in the event of low output voltage or if derating is exceeded. In Autoselect, the inverter runs at 16 kHz then automatically shifts to 8 kHz in the event of low output voltage, if the derating is exceeded, or if inverter temperature exceeds 70 °C. If inverter temperature further exceeds 85 °C, the inverter shifts to 4 kHz. Upshifting occurs if the temperatures drop below these thresholds.

DATA CODE	CARRIER FREQUENCY (KHZ)	DATA CODE	CARRIER FREQUENCY (KHZ)
0	Autoselect	**3**	8
*** 1**	4	**4**	12
2	6	**5**	16

* = Factory Setting.

◊ Value range: 0–5 Default: 1

84-DISP – Display Option Setting 2P

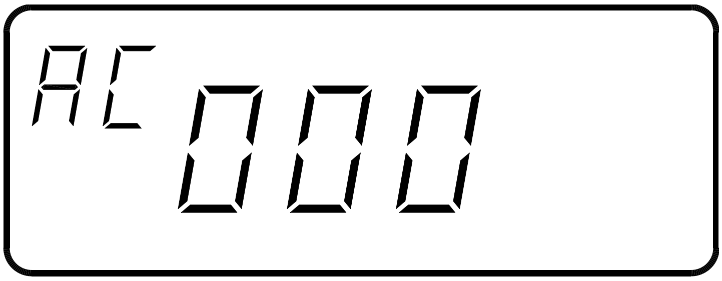
This parameter determines information displayed on the LCD readout during Run operation. The display will always show frequency in the Stop mode and while the speed is being set.

DATA CODE	BESCHREIBUNG
0	Output Frequency in Hz (value of ***12-FOUT***).
1	Output Current in Amps (value of ***14-IOUT***).
2	Drive Load in percent (value of ***15-LOAD***).
3	FSTAT (stator frequency); see ***71-METER*** for definition.
3–3000	Display indicates rpm. The rated speed of the motor is multiplied by 20 and divided by the rated frequency for calculation. The result is the **data code to be set,** e.g.: $\frac{1500\ \text{rpm} \times 20}{50\ \text{Hz}} = 600$ **NOTE:** Data Code must be rounded to nearest whole number.

◊ Value range: 0–3000 Default: 0

87-ACODE – Security Access Code 2P

Entering a number between 1 and 999 provides controlled access to program parameters (both Level 1 and Level 2). After an access code has been entered, the initial display will indicate:



After an access code has been entered, the user must enter that number to be allowed to re-program any parameter. If the wrong number is entered, all parameters can be viewed but not changed. Consult factory for over-ride code if access code has been lost. Access is allowed for 10 minutes after the last keystroke or until the drive goes through a restart sequence. Press the PROG key twice within two seconds after programming to immediately re-instate the access code.

◊ Value range: 0–999 Default: 0

97-RVLVL2 – Software Revision Level 2 2V

This parameter displays the secondary software revision level.

◊ Value range: 0.00–12.75

6 PI Controller

6.1 Introduction

ACP 3000 inverters have a built-in PI (Proportional-Integral) Controller that makes it possible to control a process by adjusting motor speed using a reference input and a feedback input. When PI control is enabled, several new parameters (as well as new data codes for some existing parameters) become available to support PI control.

This section first provides an overview of how PI control operates. Following this discussion, the new parameters and data codes are described.

6.2 Overview of PI Control

Figure 6.1 on the next page provides a flowchart of PI control. The characteristics of PI control are set with the ***81-PRGNO*** parameter (see page 56). The data codes for parameter ***81-PRGNO*** allow you to select:

Direct- or Reverse-Acting Loop

- In a direct-acting loop, a positive error will cause an increase in output frequency. Conversely, in a reverse-acting loop, a positive error will cause a decrease in output frequency.

Slow or Fast Rate of Integration

- A slow rate of integration is usually selected for processes with long time constraints (for example, thermal and fluid level controls). On the other hand, a fast integration rate is utilized for processes with short time constraints (such as mechanical systems and pressure loops).

Whether Feed-Forward is Active

- Feed-forward is useful in situations where the reference value has a direct relation to the feedback signal, such as controlling motor speed in a closed loop. Note that feed-forward should be enabled when attempting to close a speed loop.

Whether the PI Controller is turned on and off via the PS3 input.

Separate parameters are also available for adjusting proportional gain (parameter ***B3-KP***), integral gain (parameter ***B4-KI***), and scaling for the feedback terminal VIN1 (parameter ***B5-KIN***). These parameters may be adjusted while the inverter is operating.

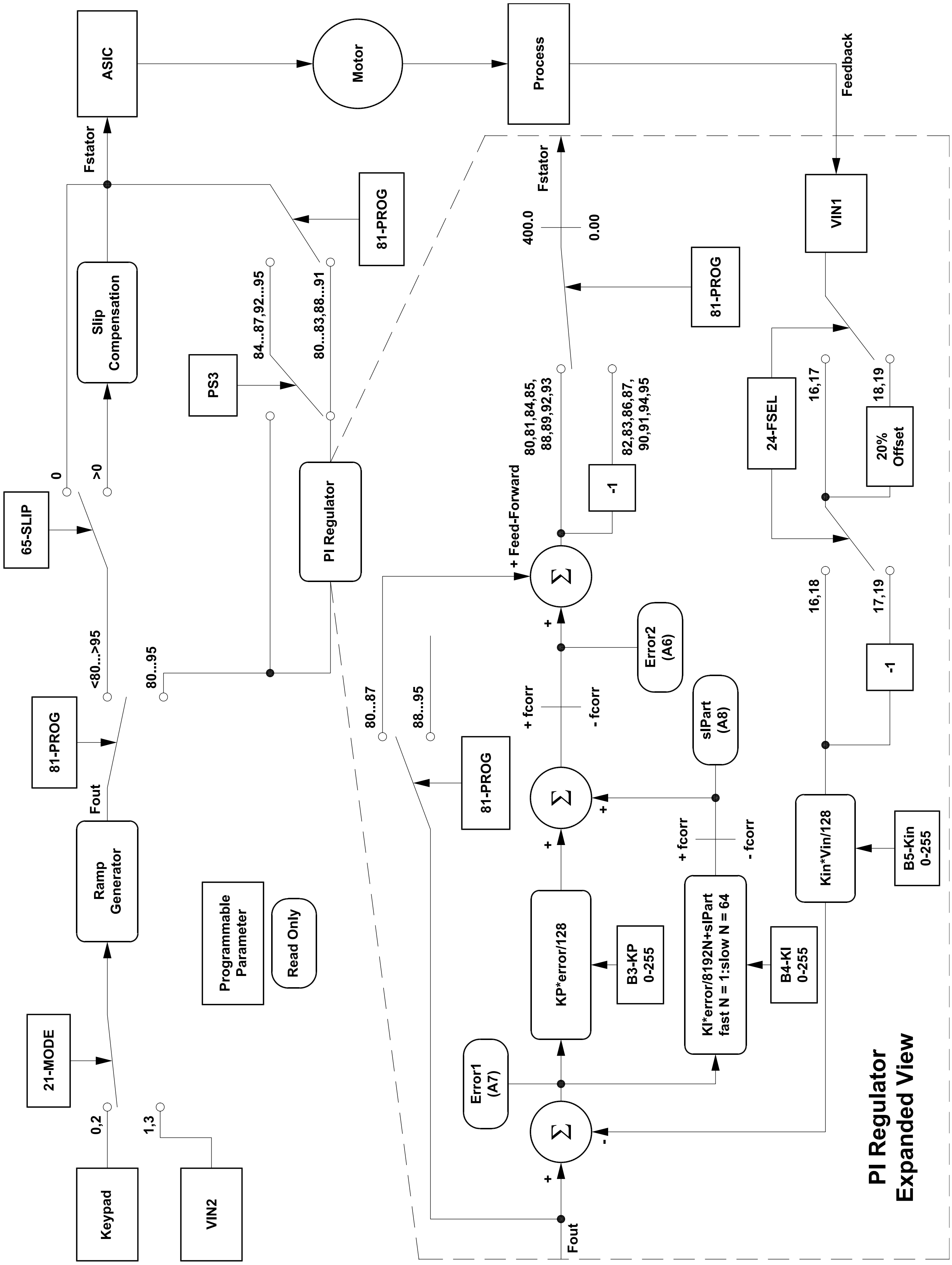


Figure 6.1
PI Controller Functional Diagram

The PI Controller operates within the limits set by parameter ***A1-FCORR***, the value of which establishes the frequency band across which the value of the integrator and the output of the PI Controller may vary. If Feed-Forward is active, the output of the PI Controller is the reference frequency ***12-FOUT*** ± ***A1-FCORR***, and the integrator's value is ± ***A1-FCORR***. Note that the final output of the PI Controller cannot be less than 0.00 Hz nor greater than 400.00 Hz.

The output of the PI Controller is sent to the ASIC after the proper frequency conversion. The controller works in one direction of rotation which must be set by FWD and REV commands. A change in direction while the controller is active yields unpredictable results.

The PI controller is limited in its application by the minimum resolution available through the feedback terminal. Since the feedback terminal voltage is scaled through an 8-bit analog-to-digital converter, the reaction of the PI loop is reduced.

For example, if the inverter is set to run from 0.00 to 60.00 Hz and the feedback is coming from a tachometer rated at 50 V/1000 rpm and conditioned to be between 0–10 V with 2000 RPM being full scale, then the minimum change that the 8-bit A/D converter can register is 8 rpm. This means that, worst case, the speed can drop by 8 rpm when a load is applied, but typical accuracy is ±2%.

Input CTS or a STOP command (or inputs FWD and REV active at the same time) stops the inverter and resets the integrator part (sIPart) of the PI Controller when the value of ***12-FOUT*** falls below 0.10 Hz.

6.3 Reference and Feedback Inputs

A. Configuration of Inputs

The PI reference value is input from either the keypad or the VIN2 terminal. The PI feedback value is input from the VIN1 terminal. An error signal is calculated by the microprocessor which adjusts the speed of the inverter within a range limited by the ***A1-FCORR*** parameter.

The PI feedback input (VIN1) is selectable through J20 as 0 to5 VDC, 0-10 VDC, 0 to 20 mA, or 4 to 20 mA. The PI reference input (VIN2) is selectable through J20 as 0 to 5 VDC or 0 to 10 VDC.

Parameter ***24-FSEL*** is used to set the feedback input to be direct, inverted, or a 20% offset from the minimum. This parameter must also be set to 16, 17, 18, or 19 to use VIN2 as the reference input. Enabling the PI Controller without properly setting ***24-FSEL*** could result in the use of a combination of VIN1 and VIN2 as the reference signal which will give unpredictable results.

B. Scaling the Feedback Input

The feedback input (VIN1) is scaled between 0.00 Hz and 1.125 times FMAX. For example, if VIN1 is set to “direct” and FMAX is 60.00 Hz, then a full scale feedback signal will correspond to 67.50 Hz.

This feedback input can also be scaled, via ***B5-KIN***, from 0 to 255 which corresponds to a range of 0 to 1.99. For example, if B5-KIN = 64, then a full scale feedback signal would correspond to 33.75 Hz.

The function of scaling is to compensate the input for conditioning difficulties of the feedback signal. For instance, if the feedback is from an analog tachometer that gives a 50 V / 1000 rpm signal and the inverter is set up to have an FMAX of 60.0 Hz (which means that VIN1 needs to read a signal of 67.5 Hz), then the maximum voltage from the tachometer will be 101.25 V.

This means that a voltage divider scaled to 0.0987 must be used if a maximum input voltage of 10 V is desired. Since voltage dividers are rarely exact, parameter ***B5-KIN*** can be used to compensate. In this case, the divider gain was actually 0.100. This means that the input will be off scale by a factor of 1.01 which can be compensated by scaling to 0.987 or ***B5-KIN*** set to 126. See page 54 for an equation for calculating ***B5-KIN***.

NOTE: Setting ***B5-KIN*** less than 128 or a scale less than 1 will limit the maximum speed that the feedback terminal can read and therefore could cause unpredictable results. See page 54 for an equation for calculating the maximum feedback terminal.

6.4 Calculating PI Controller Values

The integral part of the PI controller output is calculated as follows:

$$\text{sIPart:} = \text{sIPart} + \left[\frac{\text{kI} \times \text{e}}{8192 \times \text{N}}\right]$$

N = 1 for fast integrator, 64 for slow integrator.
e = Fout-Feedback (error signal calculated by PI Controller).
kP, kI, kIN = 0–255.

Actual output speed of PI controller is calculated as follows:

$$\text{Actual Output Speed} = \text{sIPart} + \left[\frac{\text{kP} \times \text{e}}{128}\right]$$

To calculate maximum feedback:

$$\text{Maximum Feedback} = \left[\frac{\text{kIN}}{128}\right] \times \left[\frac{9 \times \text{FMAX}}{8}\right]$$

To calculate actual feedback:

$$\text{Actual Feedback} = \text{Fin} \times \left[\frac{\text{kIN}}{128}\right] \times \left[\frac{9 \times \text{FMAX}}{8}\right]$$

FIN is % of full scale voltage or current.

To calculate ***B5-KIN*** (calculated voltage scaling ratio of feedback signal):

$$A_{DIV} = \frac{V_{MAX}}{[33.75 \times \text{FMAX} \times P_V]}$$

$$K_{IN} = 128 \times \frac{A_{DIV}}{V_{DIVA}}$$

P_V = Process Parameter in Volts/RPM.
V_{MAX} = Maximum input Voltage (5 V or 10 V).
A_{DIVA} = Actual Voltage Divider Ratio.

6.5 Parameters for PI Control

A. Additional Parameters for PI Control

The following parameters become available when PI control is enabled; they are not available when PI control is not utilized.

PARAMETER		RANGE OR UNITS	LEVEL	DESCRIPTION
1A-FSTAT	Stator Frequency	–	2	Shows the stator frequency; the value may only be read; it cannot be altered.
A1-FCORR	Frequency Correction	0.00–400.0 Hz	2	Used to limit the variation of the PI Regulator around the value of parameter ***12-FOUT***.
A6-ERROR2	Final Error	–	2	This parameter is the Final Error of the PI Regulator. It is calculated from PI output minus the value of ***12-FOUT***. The value may only be read.
A7-ERROR1	Initial Error	–	2	This parameter is the Initial Error of the PI Regulator. It is calculated from ***12-FOUT*** minus feedback. The value may only be read.
A8-SIPART	Integral Sum	–	2	This parameter is the sum of the integral term of the PI Regulator. The value may only be read.
B3-KP	Proportional Gain	0–255	2	This parameter sets the proportional gain.
B4-KI	Integral Gain	0–255	2	This parameter sets the integral gain.
B5-KIN	VIN1 Scaling	0–255	2	This parameter sets the scaling for feedback terminal VIN1.

B. Parameters Re-Defined for PI Control

HINT!

This section describes amendments to existing parameters when the PI Controller is utilized.

21-MODE – Input Mode 1P

This parameter defines the source for speed reference and Run/Stop control input. The values shown below replace those given on page 36.

DATA CODE	SPEED CONTROL SOURCE	RUN/STOP CONTROL
0	Keypad	Keypad (Forward only)
1	VIN2 Terminals	Keypad (Forward only)
2	Keypad	Terminals (2-wire maintained contact)
3	VIN2 Terminals	Terminals (2-wire maintained contact)

◊ Value range: 0–11 Default: 3

24-FSEL – Speed Setpoint Selector 2P

This parameter defines the speed setpoint selector. The values shown below are in addition to those given on page 38.

DATA CODE	DESCRIPTION
16	Both VIN1 and VIN2 are direct.
17	VIN1 is inverted and VIN2 is direct.
18	VIN1 is direct with a 20% offset and VIN2 is direct.
19	VIN1 is inverted with a 20% offset and VIN2 is direct.

NOTE:

DIRECT = Maximum output (***32-FMAX***) at maximum input.
INVERSE = Minimum output (***31-FMIN***) at maximum input.

◊ Value range: 0–19 Default: 0

41-RSEL – Ramp Selector 2P

This parameter selects the acceleration and deceleration ramps that control the motor and whether Ramp-to-Stop or Coast-to-Stop is utilized. When PS3 is used as an ON/OFF switch for the PI Regulator, it cannot be used for the Alternate Ramp Time (ART) configured by data codes 3 and 7. See page 39 for the other data codes that may be assigned to parameter ***41-RSEL***.

DATA CODE	DEFINITION
3	Not available.
7	Not available.

◊ Value range: 0–7 Default: 0

65-SLIP – Slip Compensation [%] 1P

When the PI Regulator is enabled, slip compensation is automatically disabled. See page 43 for further information about this parameter.

◊ Value range: 0.00–12.00% Default: 0.00%

71-METER – Analog Meter Output Selector MET1 1P

This parameter selects the analog output signal to be indicated at terminal MET1. The factory full scale setting is 10 VDC, but can be changed using parameter 70-MCAL. In addition to the values shown on page 45, the following data codes are added when the PI Regulator is enabled.

DATA CODE	DESCRIPTION
5	The output is proportional to actual stator frequency (***1A-FSTATOR***), with full scale at ***32-FMAX***.

◊ Value range: 0–5 Default: 1

79-MET2 – Analog Meter Output Selector MET2 1P

This parameter selects the analog output signal to be indicated at terminal MET2. The factory full scale setting is 0–20 mA, but can be changed using parameter ***78-MCAL2***.

DATA CODE	OUTPUT RANGE	DESCRIPTION
5	0–20 mA DC	The output is proportional to actual stator frequency (***1A-FSTATOR***), with full scale at ***32-FMAX***.
15	4–20 mA DC	The output is proportional to actual stator frequency (***1A-FSTATOR***), with full scale at ***32-FMAX***.

◊ Value range: 0–15 Default: 3

81-PRGNO – PI Control Characteristics 1P

This parameter selects the characteristics of the PI Controller. By selecting the appropriate data code, you may select direct- or reverse-acting loop, slow or fast rate of integration, whether feed-forward is active, and whether on/off control is via PS3 (see page 51 for more information). The values shown here replace those given on page 48.

DATENCODE	TYPE OF LOOP	INTEGRATION RATE	FEED-FORWARD	PI ENABLED BY PS3?
80	Direct	Slow	Active	No
81	Direct	Fast	Active	No
82	Reverse	Slow	Active	No
83	Reverse	Fast	Active	No
84	Direct	Slow	Active	Yes
85	Direct	Fast	Active	Yes
86	Reverse	Slow	Active	Yes
87	Reverse	Fast	Active	Yes
88	Direct	Slow	Inactive	No
89	Direct	Fast	Inactive	No
90	Reverse	Slow	Inactive	No
91	Reverse	Fast	Inactive	No
92	Direct	Slow	Inactive	Yes
93	Direct	Fast	Inactive	Yes
94	Reverse	Slow	Inactive	Yes
95	Reverse	Fast	Inactive	Yes

◊ Value range: 0–9999 Default: 0

7 Connection Diagrams

The following show some of the commonly used connections for operating the ACP 3000 from external devices. Refer to section 3.15, page 27 for more information on the control input terminals.

7.1 AC Line and Motor Connections (Mains supply 1 × 230 VAC and 3 × 400 VAC)

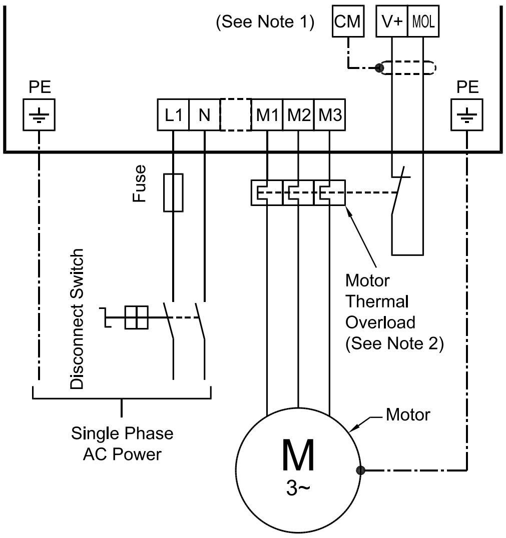


Figure 7.1

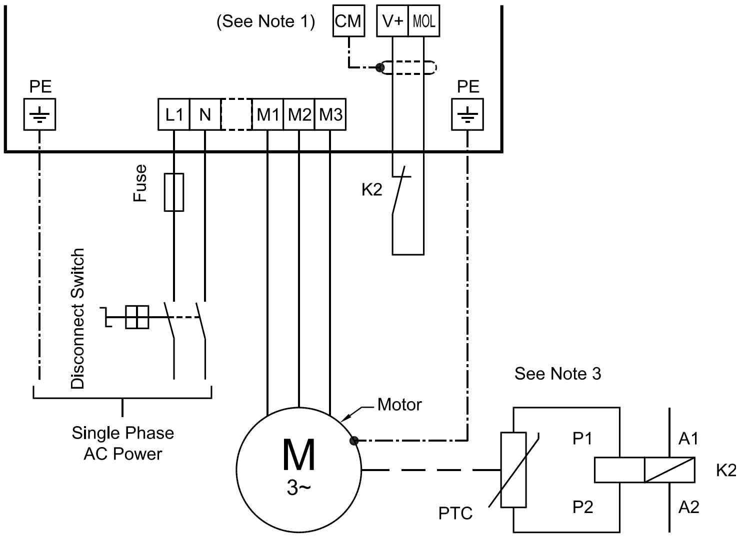


Figure 7.2

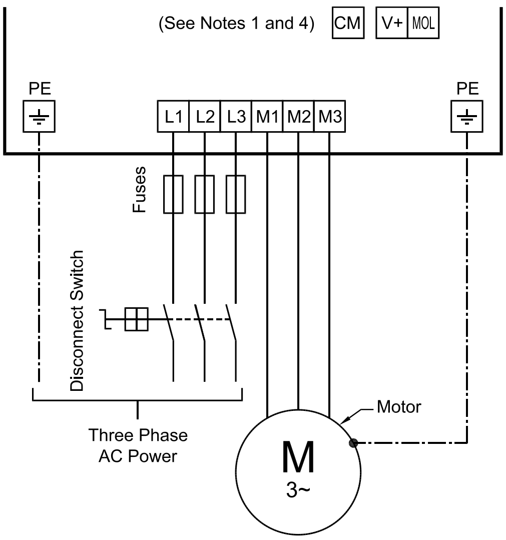


Figure 7.3

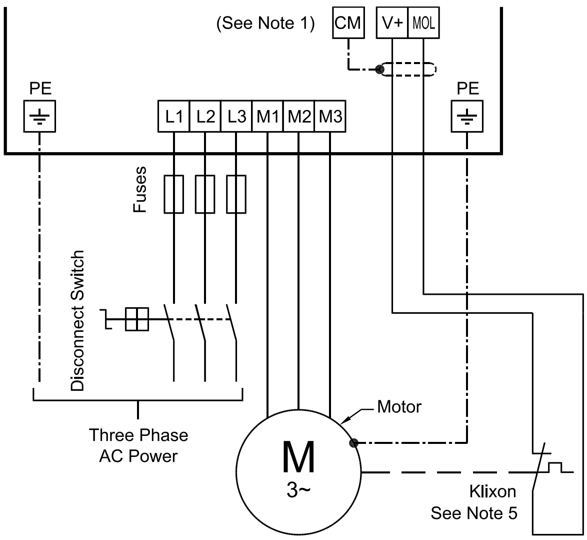


Figure 7.4

NOTES (FIGURES 7.1 UP TO 7.4):

1) See section 7.4, “Auxiliary Relay Output and Digital Output ST1” and 7.5, “MOL Terminal Connections” for other connection schemes.
2) See parameter ***67-TOL***.
3) Motor protection by external PTC evaluation.
4) Motor protection by means of the parameter ***67-TOL*** is recommended for single motor drives (STANDARD).
5) Motor protection by temperature switch (Klixon).

ATTENTION! **Frequency inverters must not be connected via a residual-current-operated circuit-breaker as the sole protective measure! (refer to chapter 3.6, page 19)**

7.2 2-Wire Run/Stop Connections

Pull-Up Logic **Pull-Down Logic**

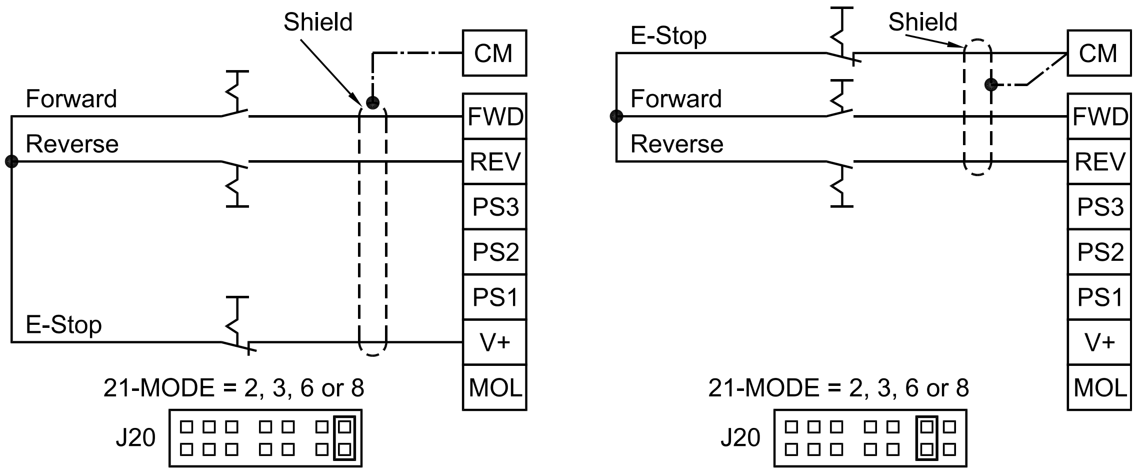


Figure 7.5

7.3 3-Wire Run/Stop Connections

Pull-Up Logic **Pull-Down Logic**

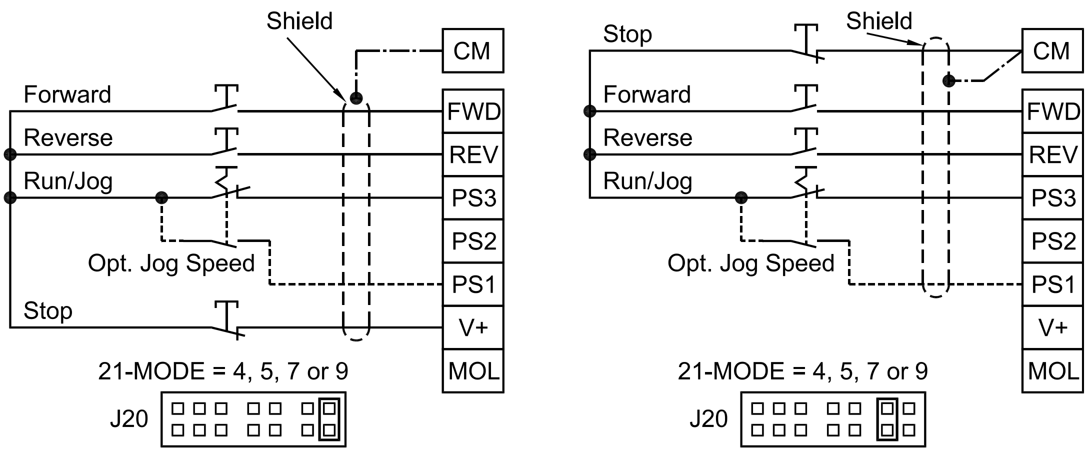
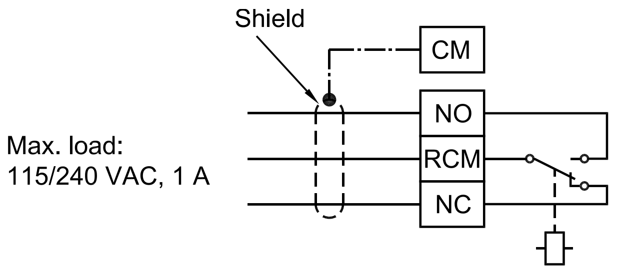


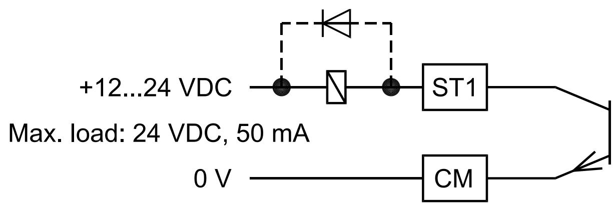
Figure 7.6

7.4 Auxiliary Relay Output and Digital Output ST1



Auxiliary Relay output adjustment via parameter 75-STR

Figure 7.7

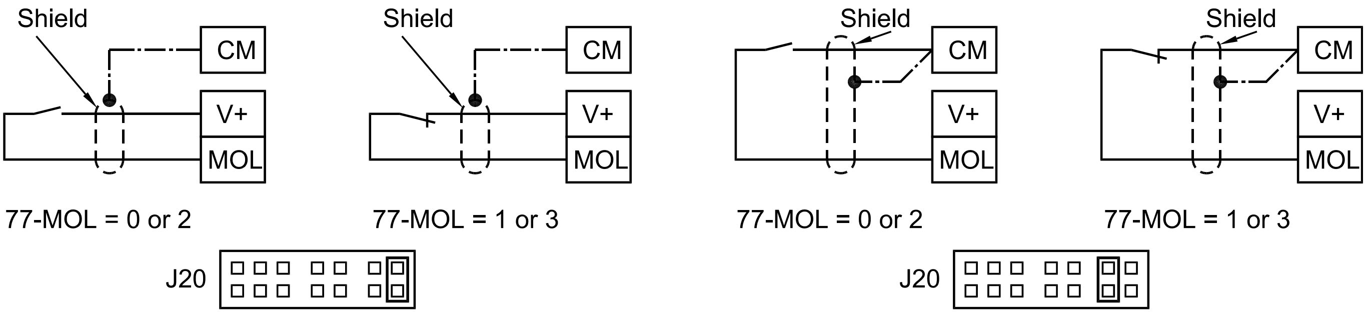


Digital output ST1 (open collector transistor).
See parameter 72-ST1 (Open Collector Output ST1).

Figure 7.8

7.5 MOL Terminal Connections

Pull-Up Logic **Pull-Down Logic**



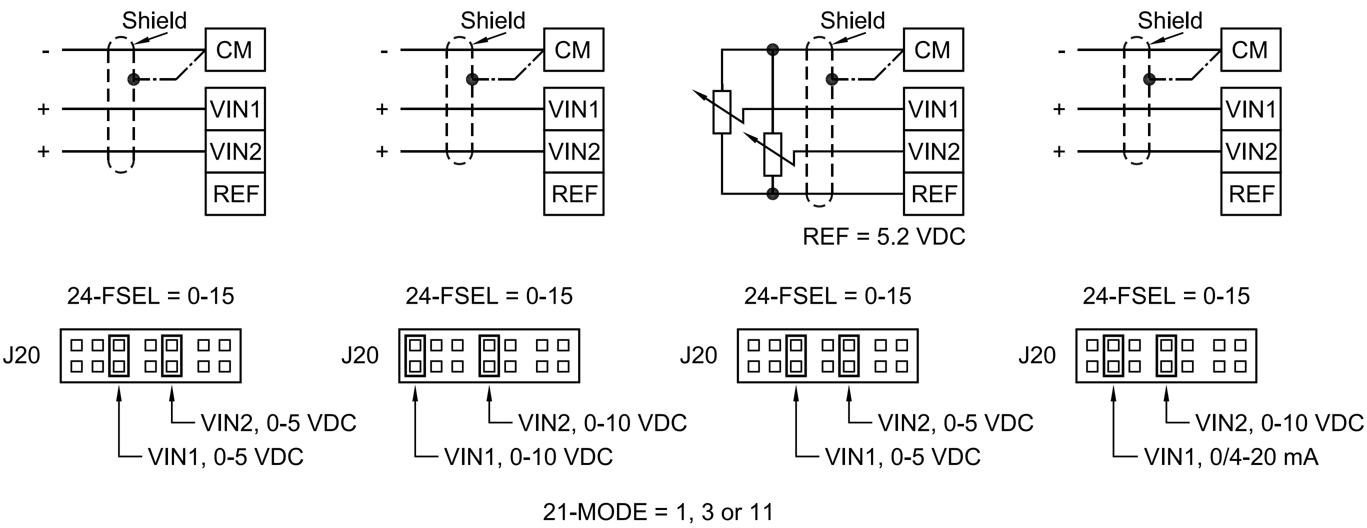
NOTES:

77-MOL = 0 or 1 used for F07 fault trip
77-MOL = 2 or 3 used for Coast-To-Stop

Figure 7.9

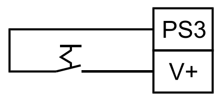
7.6 Analog Speed Input Connections (VIN1/VIN2)

External Speed Reference | **External Speed Reference** | **Speed Potentiometer** | **Current Reference**



NOTES:

VIN1 = Analog speed input 1
VIN2 = Analog speed input 2
PS3/V+ = VIN1/VIN2 changeover via PS3.
See parameter 21-MODE, 24-FSEL and Table 3.3.

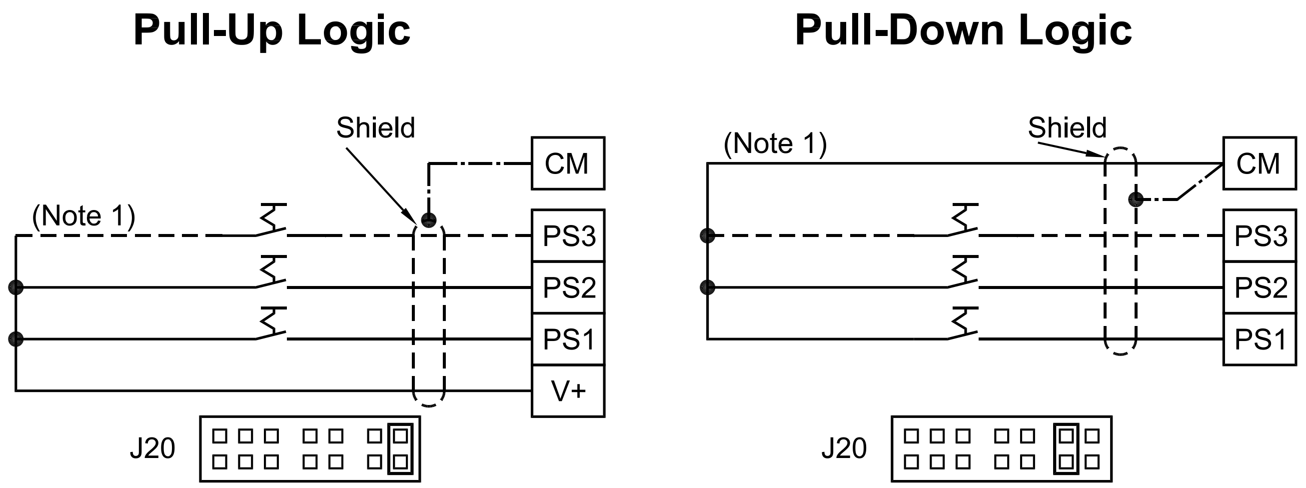


24-FSEL = 12-15
21-MODE = 1, 3 or 11

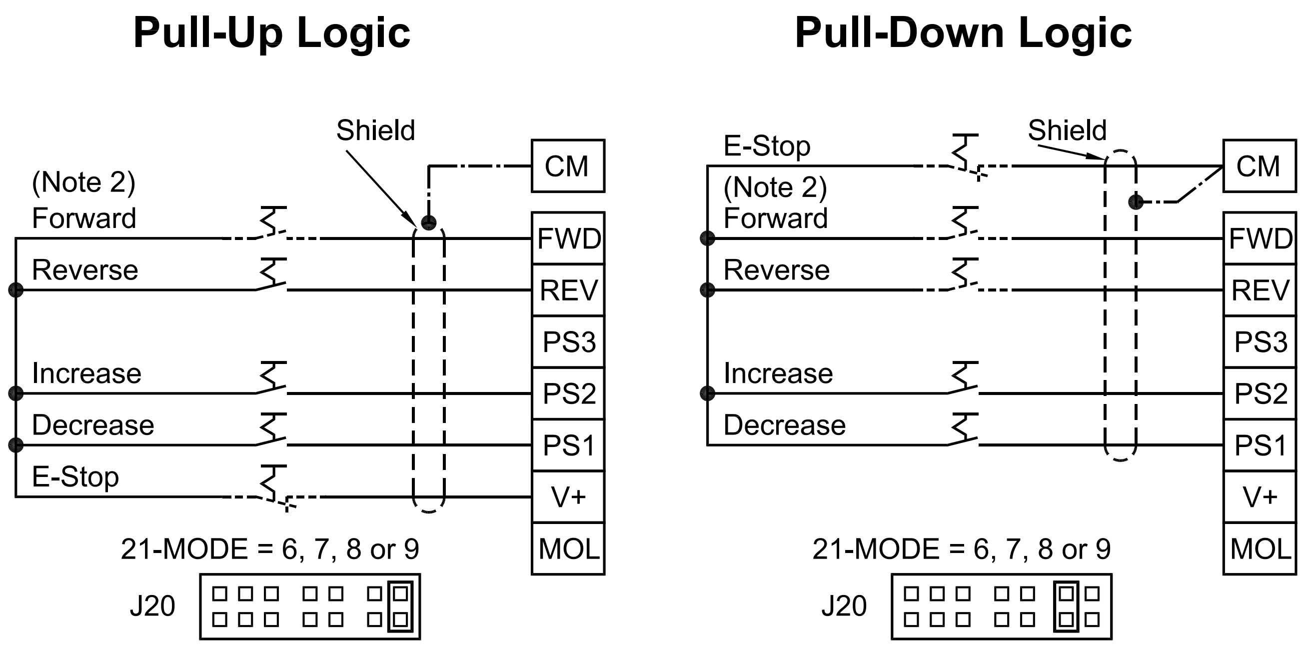
Figure 7.10

7.7 Optional Connections

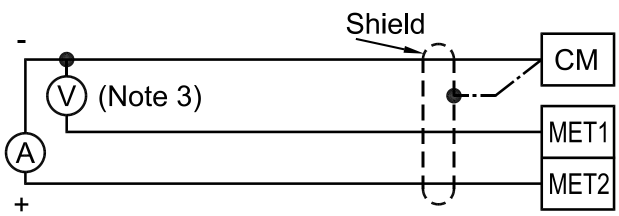
Preset Speed Selection



EMOP Selection (Note 4)



Analog Meter



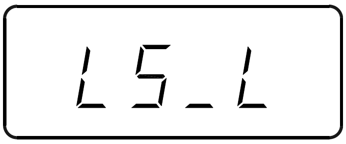
NOTES:

1. See Table 3.3
2. See parameter 21-MODE
   21-MODE = 6 or 8 used for 2-Wire operation
   21-MODE = 7 or 9 used for 3-Wire operation
3. See parameter 71-METER, 79-MET2
   and Table 3.3
4. EMOP-Function = Electronic motor
   potentiometer

8 Troubleshooting

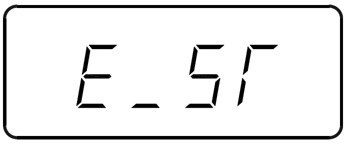
8.1 Special Indications

In addition to the standard operation and programming displays several special displays may appear:



Line Start Lockout.
See ***82-START***, page 48.

Figure 8.1



Emergency Stop.
See ***82-START***, page 48.

Figure 8.2

Low Voltage.
AC line voltage is too low.

Figure 8.3

8.2 Fault Trip Indications

In the event of a fault trip, the STATUS indicator will begin to blink red (See section 4.6, page 32 and the display will show the fault code and cause as shown in Figure 8.4.

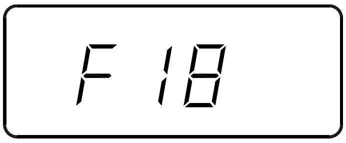


Figure 8.4

Pressing the UP arrow before the fault is reset will display the status of the drive at the time of the fault as shown in Figure 8.5. Note that more than one annunciator may be displayed to better define the cause of the fault. Additional information concerning the drive status at the time of the fault is available by pressing the PRG key and viewing parameters 12 through 17.

Figure 8.5

8.3 Resetting a Fault

Faults can be reset in any one of four (4) ways:

A. Pressing the STOP key on the keypad.

B. Activating and then deactivating both the FWD and REV terminals simultaneously.

C. Removing and restoring AC power.

D. Using the automatic restart function ***68-NRST***, see page 44.

8.4 Fault Codes

FAULT	CAUSE	REMEDY
F01	Computer Malfunction	1. Reset the drive using the stop key for longer than 1 second. 0. If the problem persists, consult BERGES.
F02	Parameter Block Fault	1. Restore all parameters to factory settings by entering ***81-PROG*** = 1. 0. If the problem persists, consult BERGES.
F03	Bus Current Measurement Fault	1. Reset the fault by pressing the stop key for longer than 1 second. 0. If the problem persists, consult BERGES.
F04	Power Supply Overload	1. Check for excessive loading on control terminals REF and V+ (see section 3.15, page 27.
F05	No DC Bus Voltage	1. Check for proper source voltage. 0. Check for DB component or output transistor failure. 0. Check for shorted DC bus.
F06	Output Short Circuit	1. Check motor wiring. 0. Reduce ***52-BOOST***. 0. Extend ***42-ACC1*** accel. ramp.
F07	External Fault Mechanism (i.e. Motor Overload Relay) tripped	1. Check motor temperature. 0. Verify the sizing of MOL.
F09	Loss of Communication with Control Terminal Strip	1. Reset the inverter using the stop key for longer than 1 second. 0. If the problem persists, consult BERGES.
F10	Auto-Restart (***68-NRST***) number exceeded	1. Check the fault log (***07-FLT3***, ***08-FLT2***, and ***09-FLT1***). 0. Initiate corrective action for those faults. **NOTE:** **RESETTING THIS FAULT MAY CAUSE INSTANT STARTING. ENSURE THAT DOING SO WILL NOT CAUSE HARM TO PERSONNEL OR DAMAGE TO EQUIPMENT.**
F11	Ground Fault	1. Check motor wiring. 0. Check for and remove any capacitive load.
F13	Overvoltage on DC Bus	1. Verify line voltage. 0. Check for excessive regenerative load. 0. Increase deceleration time. 0. Install perhaps optional external DB package.
F15	DB Overload	1. Reduce braking duty cycle. 0. Install optional external DB package. 0. Verify line voltage.
F16	Acceleration Overcurrent	1. Increase acceleration ramp time. 0. Check motor wiring for short circuit. 0. Check for “normal” operation with motor disconnected.

FAULT	CAUSE	REMEDY
F17	Deceleration Overcurrent	1. Increase deceleration ramp time. 0. Install perhaps optional external DB package.
F18	Running Overcurrent	1. Locate cause of mechanical overload on the motor.
F19	Heat sink Over Temperature	1. Check for excessive overload. 0. Verify the proper sizing of the drive for the application. 0. Locate the drive in a cooler location, out of direct sunlight.
F20	Timed Overload	1. Check programming of ***67-TOL***. 0. Check for overload on the motor.

NOTES:

1. Faults F01–F11 are checked during the power-up sequence.
   F02 is also checked during programming.
2. Faults F11-F20 will be reset and the inverter restarted if the Auto-Restart function is selected (see ***68-NRST***).

PROBLEM	CHECK POINT	CORRECTIVE ACTION
Motor is not running	Incorrect wiring	1. Check all power and control wiring.
	External frequency command (if used)	1. Verify that the external frequency control signal is properly connected. 0. Verify the integrity of the frequency control potentiometer (if used).
	Programming selections	1. Verify that the proper programming selections have been made for the application.
	Fault	1. Verify that the inverter has not shutdown due to a fault condition. 0. Consult section 8.4, page 63.
	Motor stall	1. Release any overload on the motor. 0. Verify that adequate torque boost is available.
Motor speed fluctuation	Loose terminal connection	1. Stop the inverter, turn off power, and tighten all terminal screws. 0. Check for tightness of all connections within the drive.
	Frequency control potentiometer erratic	1. Replace frequency control potentiometer.
Motor speed too high or too low	Frequency profile	1. Verify that the setting of ***31-FMIN***, ***32-FMAX***, and ***53-FKNEE*** are correct for the motor specification and application.
	Frequency control signal	1. Verify the input signal level.
	Motor nameplate specifications	1. Verify that the motor selection is proper for the application.

9 Appendix

9.1 Parameter Code Summary

PARA-METER	DESCRIPTION	FACTORY SETTING	RANGE	PAGE	CUSTOMER SETTING
02-RVLVL	Software Revision			35	
03-IRAT	Inverter Rated Current		A	35	
07-FLT3	Last Fault			36	
08-FLT2	Second Fault			36	
09-FLT1	First Fault			36	
12-FOUT	Motor Output Frequency		0.00–400.0 Hz	36	
13-VOUT	Motor Output Voltage		0–100% of line voltage	36	
14-IOUT	Motor Output Current		0.00–60.00 A	36	
15-LOAD	Inverter Load		0–200% of ***03-IRAT***	36	
17-TEMP	Inverter Temperature		0.00–110.0 °C	36	
1A-FSTAT	Stator-Frequency		(1) Hz	55	Read-only
21-MODE	Input Mode	3	(2) 0–11	36/55	
24-FSEL	Speed Setpoint Selector	0	(2) 0–19	38/55	
31-FMIN	Minimum Frequency	0.00 Hz	0.00–400.0 Hz	38	
32-FMAX	Maximum Frequency	50.00 Hz	20.00–400.0 Hz	38	
33-F2	Preset Frequency 2	5.00 Hz	0.00–400.0 Hz	38	
34-F3	Preset Frequency 3	20.00 Hz	0.00–400.0 Hz	38	
35-F4	Preset Frequency 4	40.00 Hz	0.00–400.0 Hz	38	
36-F5	Preset Frequency 5	50.00 Hz	0.00–400.0 Hz	38	
37-F6	Preset Frequency 6	0.00 Hz	0.00–400.0 Hz	38	
38-F7	Preset Frequency 7	0.00 Hz	0.00–400.0 Hz	38	
39-FTL	Minimum Frequency in Torque Limit	10.00 Hz	0.00–400.0 Hz	39	
41-RSEL	Ramp Selector	0	(2) 0–7	39/56	
42-ACC1	Acceleration Time 1	3.00 s	0.10–600.0 s	39	
43-DEC1	Deceleration Time 1	3.00 s	0.10–600.0 s	39	
44-ACC2	Acceleration Time 2	1.00 s	0.10–600.0 s	40	
45-DEC2	Deceleration Time 2	1.00 s	0.10–600.0 s	40	
46-DECTL	Deceleration Time in Torque Limit	1.00 s	0.10–30.00 s	40	
47-DCBRK	DC Brake Time	0.20 s	0.00–5.00 s	40	
48-DCVLT	DC Brake Voltage	2/3 of ***52-BOOST***	0–15%	40	
51-VSEL	V/Hz Characteristic Selector	0	0–5	40	
52-BOOST	Voltage Boost	8.00%	0.00–25.00%	41	
53-FKNEE	V/Hz Knee Frequency	50.00 Hz	26.00–400.0 Hz	42	
54-SKBND	Skip Frequency Hysteresis Band	1.00 Hz	0.20–20.00 Hz	42	
55-SK1	Skip Frequency 1	0.00 Hz	0.00–400.0 Hz	42	
56-SK2	Skip Frequency 2	0.00 Hz	0.00–400.0 Hz	42	
57-SK3	Skip Frequency 3	0.00 Hz	0.00–400.0 Hz	42	
59-MVOLT	Rated Motor Voltage	230/400 V	185–240 V; 370–480 V	42	

PARA-METER	DESCRIPTION	FACTORY SETTING	RANGE	PAGE	CUSTOMER SETTING
5B-MSAT	Motor Saturation Level	47%	15–80%	42	
61-LTLF	Load Torque Limit Forward	150%	10–150%	42	
62-LTLR	Load Torque Limit Reverse	150%	10–150%	42	
63-RTLF	Regenerative Torque Limit Forward	80%	10–110%	42	
64-RTLR	Regenerative Torque Limit Reverse	80%	10–110%	42	
65-SLIP	Slip Compensation	0.00%	(2) 0.00–12.00%	43/56	
66-STAB	Current Stability Adjustment	3	0–4	43	
67-TOL	Timed Overload Trip Point	0%	0–100%	43	
68-NRST	Trip Restart Number	0	0–8	44	
69-DRST	Restart Delay Time	0.00 s	0.00–60.00 s	44	
6A-TOLC	Timed Overload Characteristic	0	0–7	45	
70-MCAL	Analog Meter Output Calibration MET1	Set for10 VDC	0–255	45	
71-METER	Analog Meter Output Selector MET1	1	(2) 0–5	45/56	
72-ST1	Open Collector Output 1	7	0–10	46	
75-STR	Auxiliary Relay Output	1	0–10	46	
77-MOL	Motor Overload Input	2	0–3	47	
78-MCAL2	Analog Meter Output Calibration MET2	0–20 mA or 4–20 mA; set for 20 mA	0–255	47	
79-MET2	Analog Meter Output Selector MET2	3	(2) 0–15	47/56	
81-PRGNO	Special Program/PI Control Characteristics	0	0–9999	48/56	
82-START	Start Options	1	0–11	48	
83-PWM	PWM Carrier Frequency Selector	1	0–5	49	
84-DISP	Display Option Setting	0	0–3000	49	
87-ACODE	Security Access Code	0	0–999	50	
97-RVLVL2	Software Revision Level 2		0.00–12.75	50	Read-only
A1-FCORR	Frequency Correction		(1) 0.00–400.0 Hz	55	
A6-ERROR2	Final Error		(1) _	55	Read-only
A7-ERROR1	Initial Error		(1) _	55	Read-only
A8-SIPART	Integral Sum		(1) _	55	Read-only
B3-KP	Proportional Gain		(1) 0–255	55	
B4-KI	Integral Gain		(1) 0–255	55	
B5-KIN	VIN1 Scaling		(1) 0–255	55	

NOTES:

Level 1 Parameters shown shaded.

(1) **Additional** parameters that are **only** available when using the PI controller and when the ***81-PRGNO*** parameter is set to a value between 80 and 95 (see page 56). See chapter 6, from page 51 on, for further information about the PI controller.

(2) **Extended** parameters when using the PI controller. For further information about the PI controller, see chapter 6, as from page 51.

9.2 Parameters Added or Amended when PI Control is Utilized

The following table lists the parameters that become available when PI control is enabled by setting parameter ***81-PRGNO*** to a value between 80 and 95 (see page 56). It also lists those parameters where data codes change due to the enabling of P1 control. For further information on PI control, see section 6 starting on page 51.

PARAMETER		LEVEL	RANGE (DEFAULT)	USER SETTING	SEE PAGE
Parameters That Are Added When PI Control Is Enabled:					
1A-FSTAT	Stator Frequency	2	–	Read-only	55
A1-FCORR	Frequency Correction	2	0.00–400.0 Hz		55
A6-ERROR2	Final Error	2	–	Read-only	55
A7-ERROR1	Initial Error	2	–	Read-only	55
A8-SIPART	Integral Sum	2	–	Read-only	55
B3-KP	Proportional Gain	2	0–255		55
B4-KI	Integral Gain	2	0–255		55
B5-KIN	VIN1 Scaling	2	0–255		55
Parameters That Are Amended When PI Control Is Enabled:					
21-MODE	Input Mode	1	If PS3 is used for on/off control, preset speed switch and jog/run are not available.		55
24-FSEL	Speed Setpoint Selector	2	Four data codes area added; range is now 0–3 and 16–19.		55
41-RSEL	Ramp Selector	2	If PS3 is used for on/off control, Alternate Ramp Time (ART) is not available. Range is now 0–2 and 4–6 (data codes 3 & 7 are disabled).		56
65-SLIP	Slip Compensation	1	This parameter is disabled.		56
71-METER	Analog Meter Output Selector MET1	1	Data codes 5 is added; the range is now 0–5.		56
79-MET2	Analog Meter Output Selector MET2	1	Two data codes are added; the range is now 0–5 and 11–15.		56
81-PRGNO	Special Program	2	Data codes 80–95 added to select type of PI control desired.		56

9.3 Options

A. XRK01 – Remote Keypad Unit

The XRK01 – Remote Keypad Unit (RKU) is a portable, hand held accessory. When connected to an ACP 3000-inverter, it will function in parallel with an existing keypad or allow a chassis model to be controlled and programmed. The RKU is powered by a 9 V alkaline battery (supplied) or an optional AC adapter (PA24DC). Auto Power Down and backlight control features conserve battery life by automatically turning the RKU off after a specified time period and allowing selected use of the display backlight.

B. XPM01 – Program Memory Unit

The XPM01 – Program Memory Unit (PMU) is another portable, handheld accessory. When connected to an ACP 3000-inverter with software revision 13.1 or greater, it allows operation and programming like the RKU. In addition, it allows up to ten different parameter sets to be stored internally. Any one can be downloaded to the inverter's active memory or customer parameter set. Uploading parameter sets from an inverter to a PMU memory location is also possible. The PMU is powered by a 9 V alkaline battery or the AC adapter (both supplied). Auto Power Down and backlight control features conserve battery life by automatically turning the PMU off after a specified time period and allowing selected use of the display backlight.

C. XRP01 – Remote Panel Keypad

The XRP01 Remote Panel Keypad is a IP 54 rated, panel mountable accessory. When properly installed, the XRP01 seals into the host enclosure, assuring that the IP 54 integrity is preserved. When connected to an ACP 3000 Series inverter, it will function in parallel with the existing keypad to allow the inverter to be controlled and programmed. The XRP01 is self powered and can be powered by an optional external AC adapter (PA24DC) or a customer supplied +24 VDC source.

D. XRP02 – Remote Panel Programmer

The XRP02 Remote Panel Programmer is a IP 54 rated, panel-mountable accessory. When properly installed, the XRP02 seals into the host enclosure, assuring that the IP 54 integrity is preserved. When connected to an ACP 3000 Series inverter with software revision 13.1 or greater, it allows operation and programming like the XRP01. In addition, it allows up to ten different parameter sets to be stored internally. Any one can be downloaded to the inverter's active memory or customer parameter set. Uploading parameter sets from an inverter to an on board memory location is also possible. The XRP02 is self powered and can be powered by an optional external AC adapter (PA24DC) or a customer supplied +24 VDC source.

BERGES electronic GmbH
Industriestraße 13 • D–51709 Marienheide-Rodt
Postfach 1140 • D–51703 Marienheide
Tel. (0 22 64) 17-0 • Fax (0 22 64) 1 71 26
http://www.berges.de • e-mail: Info_BEL@berges.de