BERGES

User's Manual

NOW WITH VARIABLE TORQUE RATINGS!

WF2 Sensorless Vector Drive featuring N models with NSF® and BISSC certification

0.75–55.0 kW

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1 General Information

1.1 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.

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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. line 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 name 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, GND 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 line voltage when the drive converter is connected to the line voltage. **Touching these components involves mortal danger!**

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

Disconnect the drive converter from the line voltage 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 line voltage, wait **for at least 5 minutes** before beginning work on or in the drive converter. Disconnect all power before servicing the drive. Then measure the DC bus capacitor charge between the B+ and B– terminals (or DB1 and B– terminals, depending on model; see page 31 for more information) to verify that the DC voltage is less than 45 V DC. **The DC Bus LED is not a definitive indication of the absence of DC voltage.** 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 line 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 line 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.

When installing an option board, observe the installation specification valid for this board.

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!

2 Introduction

2.1 Product Overview

The WF2 drive is powerful and versatile. Its standard NEMA 1/IP31 enclosure removes the need for mounting in a separate enclosure. It is also available in a NEMA 12/IP55 version for dusty environments and an IP66 version that complies with NSF® and BISSC certification (these are designated “N models”).

An “X” in the following table indicates the models that are currently available (see section 3.1 on page 10 for information about the model number for a particular model); all models except 18.5 to 55.0 kW models are available in NSF/BISSC-certified configurations.

KW rating	Input Voltage				
	115 V AC Single-Phase	230 V AC Single-Phase	230 V AC Three-Phase	460 V AC Three-Phase	575 V AC Three-Phase
0.75	X	X	X	X	X
1.5		X	X	X	X
2.2		X	X	X	X
3.7			X	X	X
5.5			X	X	X
7.5			X	X	X
11.0			X	X	X
15.0			X	X	X
18.5			X	X	X
22.0			X	X	X
30.0				X	X
37.0				X	X
45.0				X	X
55.0				X	X

With over 200 parameters, the WF2 drive is capable of handling a wide variety of applications. All parameters are available via the keypad on the drive; however, security may be enabled to prevent unauthorized access to the parameters.

2.2 Manual Overview

This manual contains specifications, receiving and installation instructions, configuration, description of operation, and troubleshooting procedures for WF2 drives.

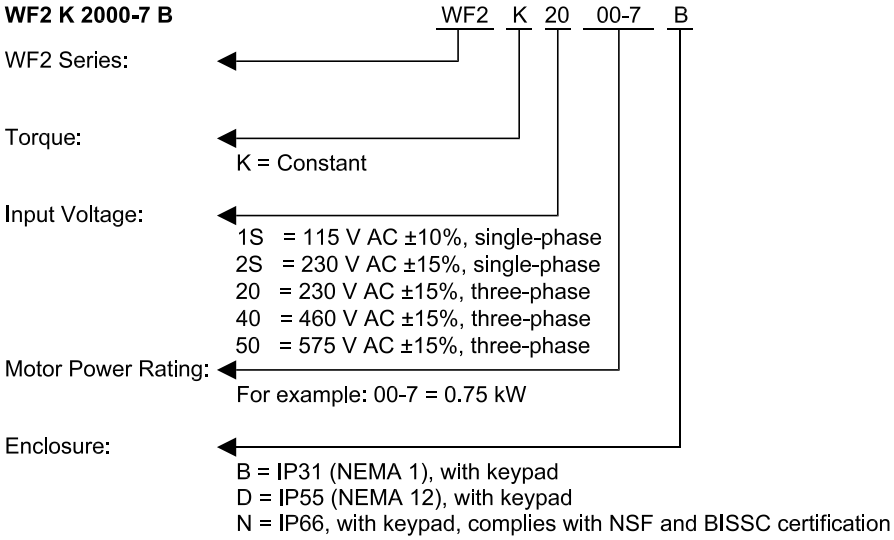
2.3 Publication History

Date	Publication	Nature of Change
08.05.02	08_GB	Version corresponds to TBW “Form 1346D“.
05.11.02	08_GB	Version corresponds to TBW “Form 1346E“.
07.11.03	08_GB	Version corresponds to TBW “Form 1346G“.

3 Technical Characteristics

3.1 Interpreting Model Numbers

The model number of the WF2 drive appears on the shipping carton label and on the technical data label affixed to the model. The information provided by the model number is shown below:



3.2 Power and Current Ratings

Model Number WF2K-	Motor Power				Input Voltage	Maximum Input Current (A)				Output Voltage	Output Current (A)			
	Constant Torque		Variable Torque			Constant Torque		Variable Torque			Constant Torque		Variable Torque	
	kW	HP	kW	HP		200 V AC	230 V AC	200 V AC	230 V AC		200 V AC	230 V AC	200 V AC	230 V AC
1S00-7x	0.75	1.0	0.75	1.0	1-phase 115 V AC, ±10%	–	15.0 [1]	–	15.0 [1]	0–230 V AC	–	4.2	–	4.2
2S00-7x	0.75	1.0	0.75	1.0	1-phase 200–230 V AC ±15%	8.9	8.0	8.9	8.0		4.8	4.2	4.8	4.2
2S01-5x	1.5	2.0	1.5	2.0		16.2	14.6	16.2	14.6		7.8	6.8	7.8	6.8
2S02-2x	2.2	3.0	2.2	3.0		23.0	20.7	23.0	20.7		11.0	9.6	11.0	9.6
2000-7x	0.75	1.0	1.1	1.5	3-phase 200–230 V AC ±15%	5.6	4.8	6.7	6.7		4.8	4.2	5.7	5.7
2001-5x	1.5	2.0	1.5	2.0		9.0	7.8	9.0	7.8		7.8	6.8	7.8	6.8
2002-2x	2.2	3.0	4.0	5.0		12.7	11.0	15.4	15.4		11.0	9.6	13.1	13.1
2003-7x	4.0	5.0	5.5	7.5		20.2	17.5	25.3	25.3		17.5	15.2	22.0	22.0
2005-5x	5.5	7.5	7.5	10.0		29.2	25.3	32.2	32.2		25.3	22.0	28.0	28.0
2007-5x	7.5	10.0	7.5	10.0		37.2	32.2	37.2	32.2		32.2	28.0	32.2	28.0
2011-0x	11.0	15.0	15.0	20.0		52.1	46.4	63.3	63.3		48.3	42.0	54.0	54.0
2015-0x	15.0	20.0	18.5	25.0		62.1	54.0	68.0	68.0		62.1	54.0	68.0	68.0
2018-5x	18.5	25.0	22.0	30.0		78.2	68.0	80.0	80.0		78.2	68.0	80.0	80.0
2022-0x	22.0	30.0	30.0	40.0		92.0	80.0	104.0	104.0		92.0	80.0	104.0	104.0

Table 1
115 and 230 V AC Models

[1] Input current is from the rated 115 V AC source.

Model Number WF2K-	Motor Power				Input Voltage	Maximum Input Current (A)				Output Voltage	Output Current (A)			
	Constant Torque		Variable Torque			Constant Torque		Variable Torque			Constant Torque		Variable Torque	
	kW	HP	kW	HP		380 V AC	460 V AC	380 V AC	460 V AC		380 V AC	460 V AC	380 V AC	460 V AC
4000-7x	0.75	1.0	1.1	1.5	3-phase 380–460 V AC ±15%	3.0	2.4	3.2	3.2	0–460 V AC	2.4	2.1	2.8	2.8
4001-5x	1.5	2.0	1.5	2.0		5.2	3.9	5.2	3.9		3.8	3.4	3.8	3.4
4002-2x	2.2	3.0	3.0	5.0		7.2	5.6	7.7	7.7		5.7	4.8	6.6	6.6
4003-7x	4.0	5.0	5.0	7.5		12.0	8.8	12.8	12.8		8.9	7.6	11.0	11.0
4005-5x	5.5	7.5	6.7	10.0		15.0	12.8	16.3	16.3		12.0	11.0	14.0	14.0
4007-5x	7.5	10.0	7.5	10.0		19.7	16.3	19.7	16.3		15.6	14.0	15.6	14.0
4011-0x	11.0	15.0	13.0	20.0		30.9	25.8	33.3	33.3		23.0	21.0	27.0	27.0
4015-0x	15.0	20.0	15.0	20.0		40.0	33.3	40.0	33.3		31.0	27.0	31.0	27.0
4018-5x	18.5	25.0	20.5	30.0		46.3	40.0	47.8	47.8		37.0	34.0	40.0	40.0
4022-0x	22.0	30.0	25.5	40.0		57.5	47.8	62.4	62.4		43.0	40.0	52.0	52.0
4030-0x	30.0	40.0	33.9	50.0		62.8	53.3	65.0	65.0		61.0	52.0	65.0	65.0
4037-0x	37.0	50.0	40.3	60.0		71.0	65.0	77.0	77.0		71.0	65.0	77.0	77.0
4045-0x	45.0	60.0	50.3	75.0		86.0	77.0	96.0	96.0		86.0	77.0	96.0	96.0
4055-0x	55.0	75.0	55.0	82.0		105.0	96.0	105.0	105.0		105.0	96.0	105.0	105.0

Table 2
460 V AC Models

Model Number WF2K-	Motor Power				Input Voltage	Maximum Input Current (A)		Output Voltage	Output Current (A)	
	Constant Torque		Variable Torque			Constant Torque	Variable Torque		Constant Torque	Variable Torque
	kW	HP	kW	HP		575 V AC	575 V AC		575 V AC	575 V AC
5000-7x	0.75	1.0	1.1	1.5	3-phase 575 V AC ±15%	2.0	3.1	0–575 V AC	1.7	2.3
5001-5x	1.5	2.0	1.5	2.0		3.6	3.6		2.7	2.7
5002-2x	2.2	3.0	4.0	5.0		5.0	6.8		3.9	5.3
5003-7x	4.0	5.0	4.0	5.0		7.6	7.6		6.1	6.1
5005-5x	5.5	7.5	7.5	10.0		10.4	14.1		9.0	11.0
5007-5x	7.5	10.0	7.5	10.0		14.1	14.1		11.0	11.0
5011-0x	11.0	15.0	15.0	20.0		20.8	27.8		17.0	22.0
5015-0x	15.0	20.0	18.5	25.0		27.8	33.4		22.0	27.0
5018-5x	18.5	25.0	22.0	30.0		33.4	39.1		27.0	32.0
5022-0x	22.0	30.0	22.0	30.0		39.1	39.1		32.0	32.0
5030-0x	30.0	40.0	37.0	50.0		52.0	65.2		41.0	52.0
5037-0x	37.0	50.0	45.0	60.0		52.0	62.0		52.0	62.0
5045-0x	45.0	60.0	55.0	75.0		62.0	77.0		62.0	77.0
5055-0x	55.0	75.0	75.0	100.0		77.0	99.0		77.0	99.0

Table 3
575 V AC Models

3.3 Environmental

Operating temperature	0 °C to +40 °C (32 °F to 104 °F) [1]
Storage temperature	–20 °C to +65 °C (-4 °F to 149 °F)
Maximum heatsink temperature	100 °C (212 °F)
Humidity	0% to 95% non-condensing
Altitude	1000 m (3300 ft) without derating
Maximum vibration	5.9 m/s^2 (19.2 ft/s^2) [0.6 G]
Acoustic noise	80 dba sound power at 1 m (3 ft)
Cooling	0.75 and 1.5 kW models and all N models: Natural convection. 2.2 to 55 kW NEMA 1 and NEMA 12 models: Forced air.

[1] On NEMA 1 models with conduit plate removed, the operating temperature is 0 °C to +55 °C (32 °F to 131 °F) for 230 and 460 V AC models and 0 °C to +50 °C (32 °F to 122 °F) for 575 V AC models. See section 4.4.1 on page 21 for further information.

3.4 Electrical

Voltage input	WF2K1Sx models: 115 V AC, 1 Phase, ±10% WF2K2Sx models: 230 V AC, 1 Phase, ±15% WF2K2x models: 200 to 230 V AC, 3 Phase, ±15% WF2K4x models: 380 to 460 V AC, 3 Phase, ±15% WF2K5x models: 575 V AC, 3 Phase, ±15%		
Line frequency	50/60 Hz, ±2 Hz		
DC bus voltage for: • Overvoltage trip • Dynamic Brake activation • Nominal undervoltage (UV) trip	115/230 V AC Models 407 V DC 391 V DC 202 V DC	460 V AC Models 814 V DC 782 V DC 404 V DC	575 V AC Models 1017 V DC 973 V DC 505 V DC
Control system	Voltage Vector pulse width modulation (PWM) Carrier frequency = 1 to 16 kHz in 0.1 kHz steps		
Output voltage	0 to 100% of line voltage, 3 Phase. 230 V AC for WF2K1Sx models		
Overload capacity	150% of rated rms for 60 seconds		
Starting torque	Up to 200% of nominal torque (motor dependent)		
Starting current	Up to 250% of drive rating for 20 s if the output frequency is less than 30 Hz		
Frequency range	0.1–320 Hz		
Frequency stability	0.01 Hz (digital), 0.1% (analog) over 24 h ±10 °C change		
Frequency setting	By keypad, by external signal (0 to 5 V DC, 0 to 10 V DC, 0 to 20 mA, 4 to 20 mA, or ±10 V DC), or by a pulse train of up to 100 kHz		
Agency listing	UL and CUL Listed, CE marked		

3.5 Control Features

A1 reference input	0 to 5 V DC, 0 to 10 V DC, ±10 V DC 0/4 to 20 mA (50 Ω or 250 Ω load)
A2 reference input pulse train	0 to 5 V DC, 0 to 10 V DC, 0/4 to 20 mA (250 Ω load) or up to 100 kHz pulse train
Reference voltage	10 V DC (10 mA maximum)
Digital inputs	Off = 0 to 3 V DC, On = 10 to 40 V DC (for Active High mode of operation)
Digital supply output	24 V DC (100 mA DC maximum)
Preset frequencies	3 inputs for seven preset frequencies (selectable)
Control output	2 SPDT relay outputs – 130 V AC, 1 A / 250 V AC, 0.5 A. 3 open collector outputs (rated up to 90 mA DC per device). 1 programmable pulse train with output proportional to frequency
Analog output	1 voltage, 0 to 10 V DC (2 mA DC maximum). 1 current, 0/4 to 20 mA. Software adjustable (programmable function)
Pulse train output	Pulse train is proportional to output frequency and programmable to either 6 x, 48 x, 96 x, or 3072 x the operating frequency of the drive.
DC injection braking	Off or on with adjustable voltage (0 to 30%), adjustable time (0 to 10 ms) or continuous, activation by terminal strip or by frequency (0 to 60 Hz)
Torque limit	Off or on, adjustable from 5 to 150% 150% of nominal torque. May be enabled on start cycle or on start/reference change
Current limit	Adjustable from 1 to 200% of drive rating
Speed ramps	Primary, alternate, and jog – 0.1 to 3200 s
Voltage boost	Adjustable 0 to 30% or auto-boost
Voltage characteristic	Linear or Quadratic
Timed overload	Off or on, adjustable inverse time trip, 15 to 110% of rated output for 10:1 or 2:1 speed range motors
Non-defeatable protective features	Overcurrent, overvoltage, overtemperature, ground fault, short circuit, Dynamic Brake overload
Defeatable protective features	Phase loss, timed overload, external fault, broken wire, loss of reference

3.6 Dimensions

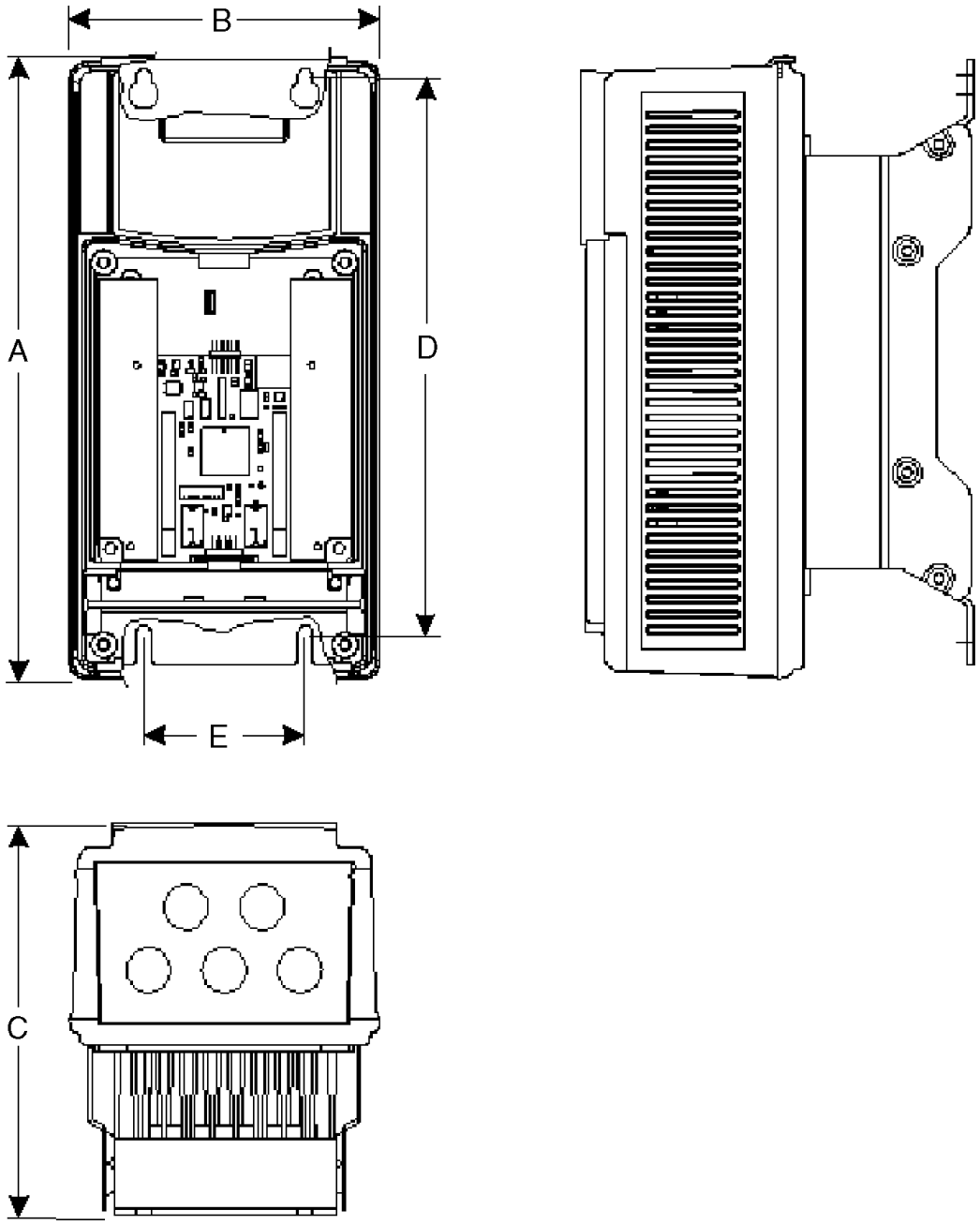


Figure 1
Dimensions of 0.75 to 7.5 kW IP31 and IP55 Models

KW	A	B	C	D	E
0.75–1.5	313.7	155.7	168.1	280.2	81.3
2.2–3.7	313.7	155.7	196.9	280.2	81.3
5.5–7.5	313.7	233.7	213.4	280.2	81.3

Dimensions in mm.

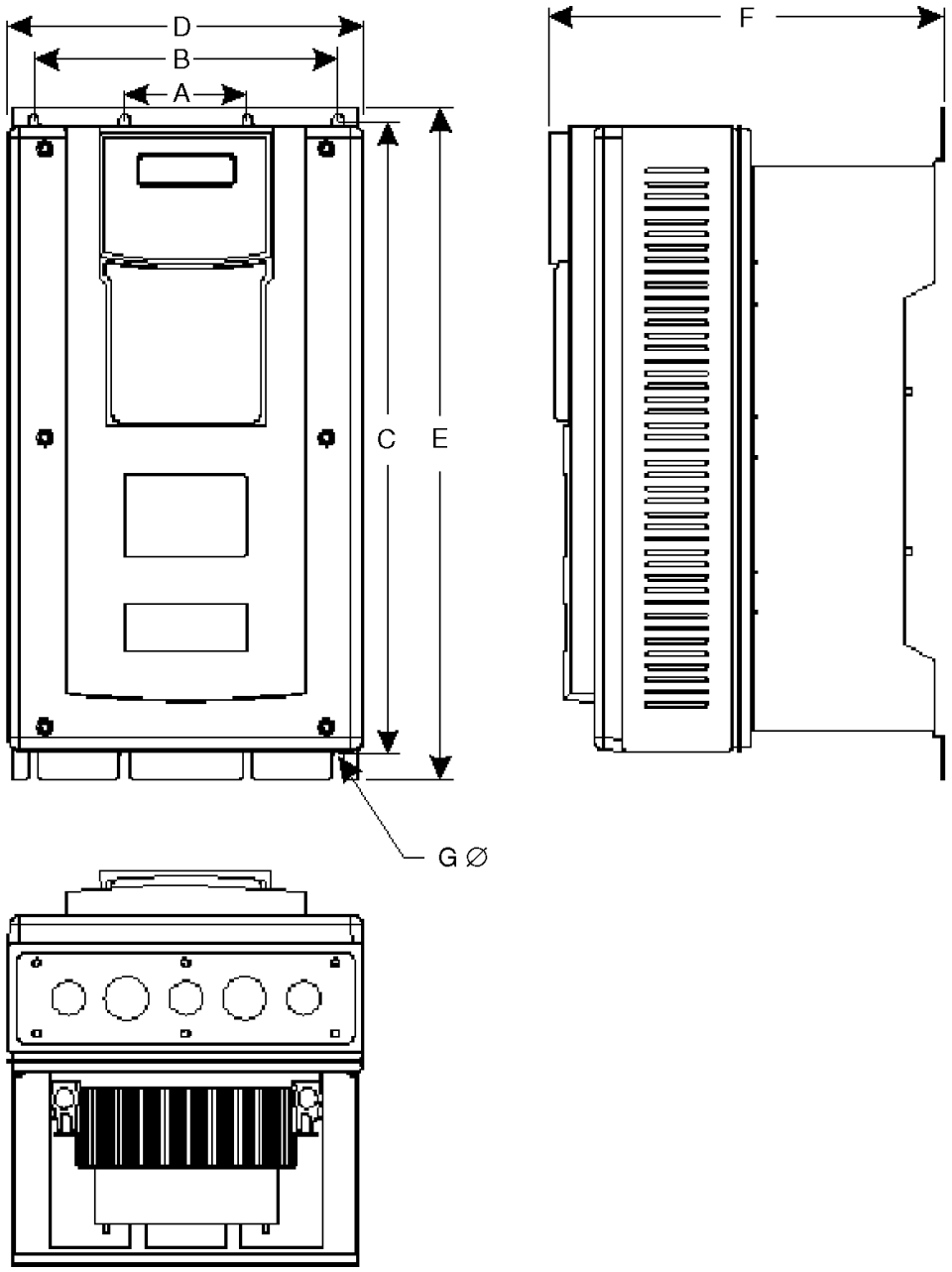


Figure 2
Dimensions of 11 to 55.0 kW IP31 and IP55 Models

KW	A	B	C	D	E	F	G
11.0–15.0 [1]	81.3	200.2	489.0	285.8	512.8	297.9	7.1
11.0–15.0 [2]	81.3	200.2	419.1	233.7	443.0	261.7	7.1
18.5–30.0 [2]	81.3	200.2	489.0	285.8	512.8	297.9	7.1
18,5–22,0 [1] **37,0–55,0** [2]	81.3	200.2	711.2	317.8	796.8 [3]	355.5	10.7

[1] Three-phase 230 V AC models.
[2] 460 V AC and 575 V AC models.
[3] Overall package height.

Dimensions in mm.

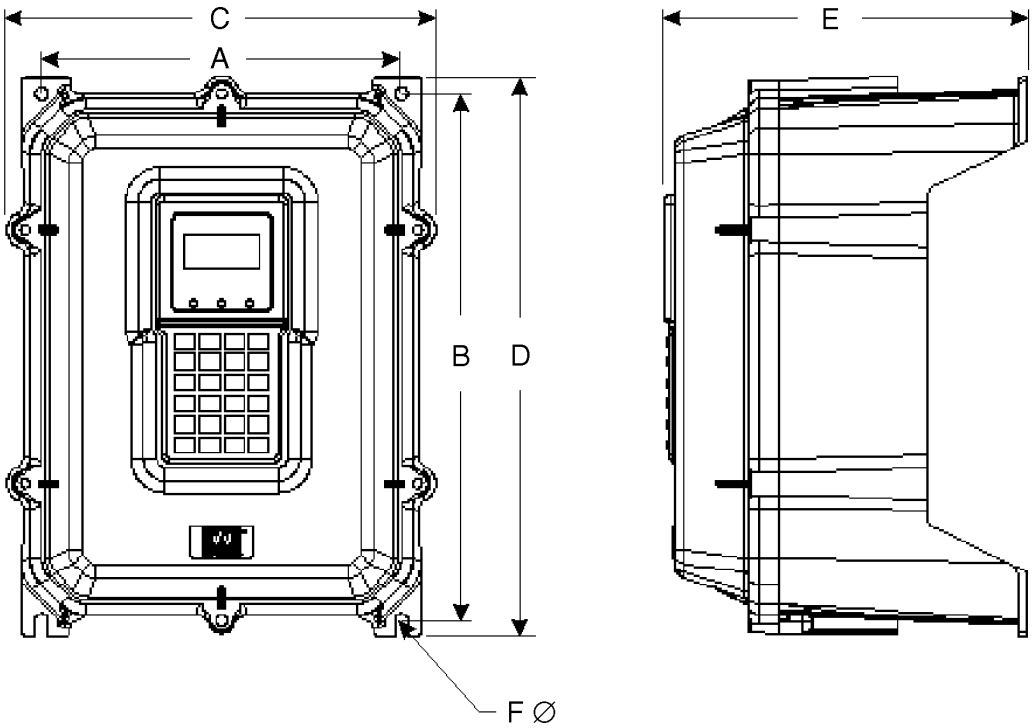


Figure 3
Dimensions of IP66, NSF/BISSC-certified Models

KW	A	B	C	D	E	F
0.75–3.7	200.2	280.2	248.9	327.9	241.8	6.9
5.5–7.5	260.3	381.0	310.8	404.4	263.4	9.6
11.0–15.0	330.2	431.8	380.2	455.2	265.9	9.6

Dimensions in mm.

3.7 Weights of Models

Power Rating (kW)		Weight (kg)
115 and 230 V AC	460 and 575 V AC	
0.75	0.75	4.3
1.5	1.5	5.0
2.2	2.2	4.5
3.7	3.7	4.8
5.5	5.5	6.6
7.5	7.5	6.8
11.0	22.0	12.7
15.0	30.0	27.2
18.5	37.0	48.6
22.0	45.0	48.6
	55.0	48.6

Table 4
IP31 and IP55 Models

Power Rating (kW)	Weight (kg)
0.75	7.7
1.5	7.7
2.2	7.7
3.7	7.7
5.5	15.9
7.5	15.9
11.0	21.8
15.0	21.8

Table 5
IP66, NSF/BISSC-certified Models

4 Installation

4.1 Preliminary Inspection

Before storing or installing the WF2 drive, thoroughly inspect the device for possible shipping damage. Upon receipt:

1. Remove the drive from its package and inspect exterior for shipping damage. If damage is apparent, notify the shipping agent and your sales representative.
2. Remove the cover and inspect the drive for any apparent damage or foreign objects. Ensure that all mounting hardware and terminal connection hardware is properly seated, securely fastened, and undamaged.
3. Read the technical data label affixed to the drive and ensure that the correct horsepower and input voltage for the application has been purchased.
4. If you will store the drive after receipt, place it in its original packaging and store in a clean, dry place free from direct sunlight or corrosive fumes, where the ambient temperature is not less than –20 °C (-4 °F) or greater than +65 °C (+149 °F).

⚠ CAUTION !

EQUIPMENT DAMAGE HAZARD

Do not operate or install any drive that appears damaged.

Failure to observe this instruction can result in injury or equipment damage.

4.2 Installation Precautions

Improper installation of the WF2 drive will greatly reduce its life. Be sure to observe the following precautions when selecting a mounting location. **Failure to observe these precautions may void the warranty!**

- Do not install the drive in a place subjected to high temperature, high humidity, excessive vibration, corrosive gases or liquids, or airborne dust or metallic particles. See section 3.3 on page 12 for temperature, humidity, and maximum vibration limits.
- Do not mount the drive near heat-radiating elements or in direct sunlight.
- Mount the drive vertically and do not restrict the air flow to the heat sink fins.
- The drive generates heat. Allow sufficient space around the unit for heat dissipation.

4.3 Considerations for Mounting IP31 and IP55 Models in Host Enclosures

HINT!

This section only applies to IP31 and IP55 models; it does not apply to IP66, NSF/BISSC-certified models.

The WF2 Sensorless Vector Drive is available from stock in a variety of enclosures that meet the requirements of almost any application. Yet, special applications (such as use in washdown environments or in integrated systems) may make it desirable to mount WF2 drives in a host enclosure.

When WF2 drives are mounted in a host enclosure, the watts dissipated by the drives must be dissipated by the host enclosure. If this is not accomplished, the control circuitry of the WF2 drives will be damaged.

Two techniques are available for mounting WF2 drives in a host enclosure:

- The drives may be entirely enclosed in the host enclosure; or

- The drives may be mounted with their cooling fins outside of the host enclosure.

The following sections discuss these two mounting techniques in greater detail.

4.3.1 IP31 and IP55 Models Entirely Enclosed in the Host Enclosure

When a WF2 drive is entirely enclosed in a host enclosure, the host enclosure must be properly sized to dissipate the heat generated by the drive and any other power-dissipating devices also mounted in the host enclosure. Table 6 on page 19 provides the watts dissipated by the various models of WF2 drives at various switching frequencies. Use this information to adequately size the host enclosure.

4.3.2 IP31 and IP55 Models with Fins External to the Host Enclosure

By mounting a WF2 drive so that its heatsink fins are outside of the host enclosure, you may select a smaller host enclosure than that required when the drive is mounted entirely inside the host enclosure. For most applications with this type of mounting, typically you will not need such additional cooling devices as fans, heat exchangers, or air conditioners.

The amount by which the load on the host enclosure is reduced is the amount of watts dissipated by the heatsinks of the drives. Table 7 on page 21 shows the watts dissipated by each WF2 model after deducting the amount of watts dissipated by the heatsinks of the model. Use the values shown in the table to adequately size the host enclosure.

For further information on mounting a drive with the fins outside of the host enclosure, see Form 1364 – “WF2 Fins-out Mounting Instructions”.

WF2 Model WF2K-	Switching Frequency			Max. Switching Frequency for Rated Current (kHz)
	Watts Dissipated at 4 kHz	Watts Dissipated at 7 kHz	Watts Dissipated at 10 kHz	
2S00-7x	37	44	51	10
2S01-5x	59	71	81	10
2S02-2x	77	92	106	10
2000-7x	37	44	51	10
2001-5x	59	71	81	10
2002-2x	77	92	106	10
2003-7x	112	135	156	10
2005-5x	162	212	220	10
2007-5x	195	251 [1]	–	6
2011-0x	267	312	354 [1]	9
2015-0x	276	361	–	7
2018-5x	597	655	676 [1]	8
2022-0x	642	685 [1]	–	5

Table 6
Required Dissipation for Models Entirely Inside an Enclosure

WF2 Model WF2K-	Switching Frequency			Max. Switching Frequency for Rated Current (kHz)
	Watts Dissipated at 4 kHz	Watts Dissipated at 7 kHz	Watts Dissipated at 10 kHz	
4000-7x	33	43	53	10
4001-5x	52	69	84	10
4002-2x	68	90	110	10
4003-7x	99	131	161	10
4005-5x	112	144	174	10
4007-5x	139	180	217	10
4011-0x	170	210	255 [1]	9
4015-0x	200	245 [1]	–	5
4018-5x	280	383	–	7
4022-0x	335	371 [1]	–	5
4030-0x	398 [1]	–	–	2.5
4037-0x	600	670 [1]	–	5
4045-0x	710	–	–	4
4055-0x	720 [1]	–	–	2
5000-7x	40	52	64	10
5001-5x	62	83	101	10
5002-2x	82	108	132	10
5003-7x	85	115	155	10
5005-5x	91	131	172	10
5007-5x	112	160	–	8
5011-0x	164	235	282 [1]	9
5015-0x	218	277 [1]	–	6
5018-5x	286	364 [1]	–	6
5022-0x	343	388 [1]	–	5
5030-0x	417	–	–	4
5037-0x	700	–	–	4
5045-0x	720 (1)	–	–	3
5055-0x	745 (1)	–	–	2

Table 6
Required Dissipation for Models Entirely Inside an Enclosure

[1] Dissipation at rated current and maximum switching frequency.

WF2 Model WF2K-	Watts Dissipated	WF2 Model WF2K-	Watts Dissipated	WF2 Model WF2K-	Watts Dissipated
2S00-7x	19	4000-7x	20	5000-7x	20
2S01-5x	20	4001-5x	21	5001-5x	21
2S02-2x	27	4002-2x	27	5002-2x	27
2000-7x	19	4003-7x	30	5003-7x	30
2001-5x	20	4005-5x	36	5005-5x	33
2002-2x	27	4007-5x	40	5007-5x	39
2003-7x	29	4011-0x	46	5011-0x	43
2005-5x	36	4015-0x	50	5015-0x	44
2007-5x	34	4018-5x	75	5018-5x	73
2011-0x	68	4022-0x	76	5022-0x	78
2015-0x	73	4030-0x	80	5030-0x	82
2018-5x	135	4037-0x	134	5037-0x	135
2022-0x	137	4045-0x	145	5045-0x	143
		4055-0x	150	5055-0x	152

Table 7
Required Dissipation When Fins Are External to the Enclosure

4.4 Maintenance/Environmental Integrity

4.4.1 Removal of the Conduit Plate on NEMA 1/IP31 Models

NEMA 1/IP31 models may be used in an expanded ambient temperature range if the conduit plate on the bottom of the unit is removed. Once the conduit plate is removed, 230 and 460 V AC models of 22 kW or less may be used where ambient temperatures range from 0 to 55 °C (32 to 131 °F), while 460 V AC models of 30 kW or greater and all 575 V AC models may be used where ambient temperatures range from 0 to 50 °C (32 to 122 °F). (Note that these ratings are limited to full nominal line installations on some models.)

On smaller frame sizes (0.75 to 7.5 kW models; see figure 1 on page 14), to access the screws holding the conduit plate in place, you must first remove the terminal access cover. Once the cover is removed, unscrew the screws securing the conduit plate and remove the conduit plate. With the conduit plate removed, additional air circulates through the unit assembly, which permits operation in the expanded temperature range.

On the larger frame sizes (11 to 55 kW models; see figure 2 on page 15), the screws securing the conduit plate are directly accessible from outside the unit. Simply unscrew the screws securing the conduit plate and then remove the conduit plate to permit operation in the expanded temperature range.

Also note that an IP21 conversion kit is available for NEMA 1/IP31 models. For more information, see section 9.2 on page 145.

4.4.2 Minimum Torque Values to Secure Cover

If you remove the cover of an IP55 or IP66 WF2 drive (models D or N), it is imperative that the cover be closed and re-secured with sufficient tightness to maintain environmental integrity. The table below specifies the torque values for the bolts that secure the covers on the various WF2 models.

WF2 Enclosure Type		Torque Value	
		Metric	English
IP55	0.75–7.5 kW, 115 and 230 V AC input	2.03 Nm	18 in-lbs
	11.0–22.0 kW, 230 V AC input	1.35 Nm	12 in-lbs
	0.75–15.0 kW, 460 and 575 V AC input	2.03 Nm	18 in-lbs
	18.5–55.0 kW, 460 and 575 V AC input	1.35 Nm	12 in-lbs
IP66	All versions	2.93 Nm	26 in-lbs

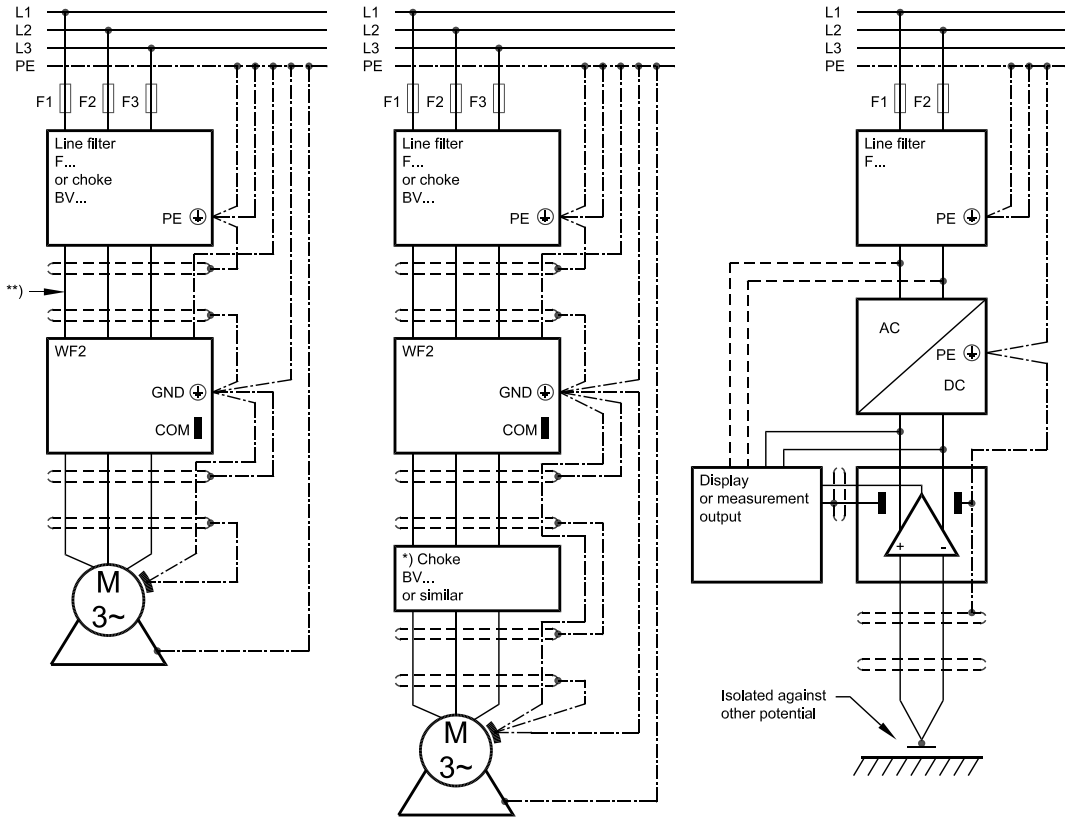
4.5 EMC (Electromagnetic Compatibility)

4.5.1 Limit Classes

With regard to interference suppression of machines or installations in conformity with EN 50081 Parts 1 and 2, or EN 55011, a distinction must be made between the limit classes “A” (industrial networks) and “B” (domestic networks).

In the case of “limit class A”, a line filter must be wired before every frequency inverter. In the case of “limit class B”, a filter must also be wired before it.

The inverters and accessories must be wired as shown in the following schematic. If applied consistently, the following suggested circuit will successfully render harmless the residual noise voltage on the GND conductor potential for “external measurement systems”.



To VDE 0875 LImIt class A | **To VDE 0875 LImIt class B** | **External measurement systems**

NOTES:

*) Choke only if required (e.g. owing to motor cable length >30 m). Please consult BERGES.

**) For cables shorter than 20 cm, an unscreened cable can be used between filter and inverter.

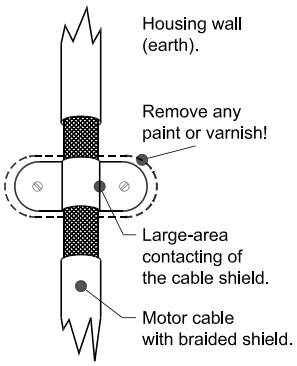
4.5.2 Interference Suppression Measures

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.**

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

The following notes refer to a line power supply that is not “contaminated” by high frequency interference. Other measures may be necessary to reduce or suppress interference if the line 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.



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 through 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 GND terminal of the inverter to the GND 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 line filter (option) or a line filter and a output choke (line filter [1] 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 chapter 4.5 (EMC (Electromagnetic Compatibility)).

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

If a line filter (option) 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 through screened cables earthed at both ends.

Screened signal cables should not be routed in parallel with power cables. An earthed metal cable duct is recommendable for these signal cables. If signal cables have to cross a power cable, they should cross at an angle of 90°.

Control wires longer than 3 feet (1 meter) must be run in shielded cable, and the shield must be terminated at common (CM) on the drive. Note that connection to CM, the circuit common, rather than earth ground, is allowed because WF2 drives have isolated control inputs. If the signal run exceeds 30 feet (9 meters), a 0–20 mA or 4–20 mA signal should be used, as it will have better noise immunity than a low level voltage.

Other loads connected to the line can cause voltage spikes which can impair the function of the inverter and can even damage it. Chokes or line filters (option) can be additionally used on the line side to protect the inverter against voltage spikes (resulting from the switching of large loads on the line). These chokes and filters are available as accessories.

If the drive is operated from switchgear devices or is in close proximity to switchgear devices (as in a common cabinet), the following procedures are recommended as a precaution to prevent these devices from interfering with the drive's operation:

- 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.

4.5.3 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, optional)
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 line lead/data line

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

- Preceding the unit by a line filter (option) or a line filter and a output choke (line filter [1] 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 chapter 4.5 (EMC (Electromagnetic Compatibility)).

As the aforementioned interference immunity tests are based on standardised line conditions, a loss of the inverter function can occur in extreme cases (minimum operational quality). This malfunction generally can be remedied with an inverter RESET.

5 Connections

⚠ DANGER !

HAZARDOUS VOLTAGE

- Read and understand this manual in its entirety before installing or operating the WF2 Sensorless Vector Drive. Installation, adjustment, repair, and maintenance of these drives must be performed by qualified personnel.
- Disconnect all power before servicing the drive. **WAIT 5 MINUTES** until the DC bus capacitors discharge. Then measure the DC bus capacitor charge between the B+ and B– terminals (or DB1 and B– terminals, depending on model; see page 31 for more information) to verify that the DC voltage is less than 45 V DC. **The DC Bus LED is not a definitive indication of the absence of DC voltage.**
- **DO NOT** short across DC bus capacitors or touch unshielded components or terminal strip screw connections with voltage present.
- Install all covers and close door before applying power or starting and stopping the drive.
- The user is responsible for conforming to all applicable code requirements for grounding all equipment.
- Many parts in this drive, including printed circuit boards, operate at line voltage. **DO NOT TOUCH.** Use only electrically-insulated tools.

Before servicing the electrical system:

- Disconnect all power.
- Place a “DO NOT TURN ON” label on the drive disconnect.
- Lock the disconnect in the open position.

Failure to observe these precautions will cause shock or burn, resulting in severe personal injury or death.

5.1 Introduction

This chapter provides information on connecting power and control wiring to the WF2 drive.

5.2 General Wiring Information

5.2.1 Wiring Practices

When making power and control connections, observe these precautions:

- Never connect input AC power to the motor output terminals T1/U, T2/V, or T3/W – or damage to the drive will result.
- Power wiring to the motor must have the maximum possible separation from all other power wiring. Do not run in the same conduit; this separation reduces the possibility of coupling electrical noise between circuits.
- Cross conduits at right angles whenever power and control wiring cross.
- Good wiring practice also requires separation of control circuit wiring from all power wiring. Since power delivered from the drive contains high frequencies which may cause interference with other equipment, do not run control wires in the same conduit or raceway with power or motor wiring.

5.2.2 Considerations for Power Wiring and Motor Lead Length

Power wiring refers to the line and load connections made to terminals L1/R, L2/S, L3/T, and T1/U, T2/V, T3/W respectively. Select power wiring as follows:

- Use only UL, CUL and VDE recognized wire.

- Wire voltage rating must be a minimum of 300 V for 230 V AC systems and 600 V (Class 1 wire) for 460 V AC and 575 V AC systems.
- Use circuit breakers on the incoming power lines.
- Grounding must be in accordance with VDE, NEC and CEC. If multiple WF2 drives are installed near each other, each must be connected to ground. Take care to not form a ground loop.
- Wire must be made of copper and rated 60/75 °C (unless otherwise specified in the table below). Refer to tables 8, 9, and 10 on pages 28 and 29 for recommended wire gauges and temperature ratings.

When selecting the distance from the WF2 drive to the motor, the following considerations should be kept in mind:

- The distance from the WF2 drive to the motor should not exceed 300 meters.
- If the leads for motor connections exceed 30 meters, the motor windings may be subjected to voltage stresses two to three times nominal values unless an output filter is utilized. Consult with the motor manufacturer to ensure compatibility.
- Output filters should be used to limit voltage problems experienced by the motor when the distance from the WF2 drive to the motor exceeds 300 meters and/or when the motor connections exceed 30 meters. Consult with BERGES for recommendations in this case.

5.2.3 Line 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 line terminals L1/R, N and PE or a three-phase system with a nominal voltage of 400 V (50/60 Hz) to terminals L1/R, L2/S, L3/T 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 line power through an isolating transformer (star point must be earthed).

The inverter will be destroyed if the line 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.

5.2.4 Use of Fault Current Safety Switches

Owing to leakage currents from anti-interference capacitors in the inverter and the motor lines, as well as due to d.c. components in the supply current, the protective function of a fault current safety switch can no longer be guaranteed (this also applies to FI safety switches that are AC/DC sensitive). All devices connected to such safety switches (and the people who come into contact with them) are no longer protected in such a situation. Consequently, please note the following:

FI safety switches are only to be installed between the supplying network and the inverter.

Frequency inverters must not be connected through a fault current safety switch as the sole protective measure!

The following exception permits the connection of a frequency inverter via a fault current safety switch as a single protective measure:

- Installing the latest model of an FI safety switch (≥300 mA) with **MOBILE connected frequency inverters up to 4 kVA (input voltage 1 × 230 V),** which controls alternating and pulsating DC leakage current (AC/DC sensitive). This type of FI safety switch has this symbol ⍨ .

When using a fault current protective device (FI safety switch), you should check its compatibility with the frequency inverter. Compatibility information for each device type:

- **1-phase devices:**
  Permissible are pulsed current sensitive FI safety switches (type A) or AC/DC sensitive safety switches (type B).
- **3-phase devices:**
  Only AC/DC sensitive safety switches (type B) are allowed.

Otherwise, another safety measure has to be deployed such as the use of double or reinforced isolation to disconnect from the environment, network disconnection or similar (EN 50178). The release current of the FI safety switch **must be amply** dimensioned, because capacitive compensating currents (cable screens, filters) can easily lead to accidental release.

Possible reasons why a fault current safety switch is triggered accidentally:

- Capacitive leakage currents of the line shielding occur during operation (especially in the case of long, shielded motor feed lines).
- Simultaneous connection of several inverters to the network.
- Use of additional line filters.

5.2.5 Considerations for Control Wiring

Control wiring refers to the wires connected to the control terminal strip. Select control wiring as follows:

- Shielded wire is recommended to prevent electrical noise interference from causing improper operation or nuisance tripping.
- Use only UL, CUL and VDE recognized wire.
- Wire voltage rating must be at least 300 V for 230 V AC systems.

Model Number WF2K-	208 V AC		230 V AC	
	Line (mm^2)	Motor (mm^2)	Line (mm^2)	Motor (mm^2)
2S00-7x	2.5	2.5	2.5	2.5
2S01-5x	4.0	4.0	4.0	4.0
2S02-2x	6.0	6.0	6.0	6.0
2000-7x	2.5	2.5	2.5	2.5
2001-5x	2.5	2.5	2.5	2.5
2002-2x	4.0	4.0	2.5	2.5
2003-7x	6.0	6.0	6.0	6.0
2005-5x	10.0	10.0	10.0	10.0
2007-5x	10.0 [1]	10.0 [1]	10.0	10.0

Table 8
Recommended Wire Gauges (230 V AC Models)

Model Number WF2K-	208 V AC		230 V AC	
	Line (mm^2)	Motor (mm^2)	Line (mm^2)	Motor (mm^2)
2011-0x	16.0 [1]	16.0 [1]	16.0 [1]	16.0 [1]
2015-0x	16.0 [1]	16.0 [1]	16.0 [1]	16.0 [1]
2018-5x	[2]	[2]	[2]	[2]
2022-0x	[2]	[2]	[2]	[2]

Table 8
Recommended Wire Gauges (230 V AC Models)

[1] Use wire rated 90 °C in an environment where the ambient temperature is greater than 40 °C (122 °F).
[2] Contact BERGES for further information.

Model Number WF2K-	460 V AC	
	Line (mm^2)	Motor (mm^2)
4000-7x	2.5	2.5
4001-5x	2.5	2.5
4002-2x	2.5	2.5
4003-7x	2.5	2.5
4005-5x	4.0	4.0
4007-5x	4.0	4.0
4011-0x	6.0	6.0
4015-0x	6.0 [1]	6.0 [1]
4018-5x	10.0 [1]	10.0 [1]
4022-0x	16.0 [1]	16.0 [1]
4030-0x	16.0 [1]	16.0 [1]
4037-0x	[2]	[2]
4045-0x	[2]	[2]
4055-0x	[2]	[2]

Table 9
Recommended Wire Gauges (460 V AC Models)

[1] Use wire rated 90 °C in an environment where the ambient temperature is greater than 40 °C (122 °F).
[2] Contact BERGES for further information.

Model Number WF2K-	575 V AC	
	Line (mm^2)	Motor (mm^2)
5000-7x	2.5	2.5
5001-5x	2.5	2.5
5002-2x	2.5	2.5
5003-7x	2.5	2.5
5005-5x	2.5	2.5
5007-5x	4.0	4.0
5011-0x	6.0	6.0
5015-0x	10.0	10.0

Table 10
Recommended Wire Gauges (575 V AC Models)

Model Number WF2K-	575 V AC	
	Line (mm^2)	Motor (mm^2)
5018-5x	10.0	10.0
5022-0x	10.0	10.0
5030-0x	16.0 [1]	16.0 [1]
5037-0x	[2]	[2]
5045-0x	[2]	[2]
5055-0x	[2]	[2]

Table 10
Recommended Wire Gauges (575 V AC Models)

[1] Use wire rated 90 °C in an environment where the ambient temperature is greater than 40 °C (122 °F).
[2] Contact BERGES for further information.

5.3 Input Line Requirements

5.3.1 Line Voltage

See the Power and Current Ratings table on page 10 for the allowable fluctuation of AC line voltage for your particular WF2 model. A supply voltage above or below the limits given in the table will cause the drive to trip with either an overvoltage or undervoltage fault.

When supplying line voltages other than the factory default values (either 230 V AC, 460 V AC, or 575 V AC depending on the model), set the **Supply Voltage** parameter (see page 106) to the appropriate value.

Exercise caution when applying the WF2 drive on low-line conditions.

For example, a WF2 2000 series inverter will operate properly on a 208 V AC line – but the maximum output voltage will be limited to 208 V AC. Now if a motor rated for 230 V AC line voltage is controlled by this drive, higher motor currents and increased heating will result.

Therefore, ensure that the voltage rating of the motor matches the applied line voltage. If other than 60 Hz output is desired, proper V/Hz can be programmed into the WF2 drive by setting the **Nom Mtr Voltage** and **Nom Mtr Freq** parameters (see page 104 for more information).

5.3.2 Line Capacity

If the source of AC power to the WF2 drive is greater than 10 times the kVA rating shown in table 11, an isolation transformer or line reactor is recommended. Consult BERGES for assistance in sizing the reactor.

Drive (kW)	0.75	1.5	2.2	3.7	5.5	7.5	11.0
Transformer (kVA)	2	4	5	9	13	18	23
Drive (kW)	15.0	18.5	22.0	30.0	37.0	45.0	55.0
Transformer (kVA)	28	36	42	56	70	90	112

Table 11
Transformer Sizing for the WF2 Sensorless Vector Drive

NOTE:

E-trAC WF2 Sensorless Vector Drives are suitable for use on a circuit capable of delivering not more than 2500 rms symmetrical amperes at 10% above the maximum rated voltage.

5.3.3 Use of Isolation Transformers and Line Reactors

In nearly all cases, the WF2 drive may be connected directly to a power source. However, in the following cases, a properly–sized isolation transformer or line reactor should be utilized to minimize the risk of drive malfunction or damage:

- When the line capacity exceeds the requirements of the drive (see Section 5.3.2).
- When power factor correction capacitors are used on the drive's power source.
- When the power source experiences transient power interruptions or voltage spikes.
- When the power source supplying the drive also supplies large devices (such as DC drives) that contain controlled rectifiers.

5.3.4 Phase Imbalance

Phase voltage imbalance of the input AC source can cause unbalanced currents and excessive heat in the drive's input rectifier diodes and DC bus capacitors. Phase imbalance can also damage motors running directly across the line.

⚠ CAUTION !

EQUIPMENT DAMAGE HAZARD

Never use power-factor correction capacitors on motor terminals T1/U, T2/V, or T3/W of the E-trAC WF2 Sensorless Vector Drive. Doing so will damage the semiconductors.

Failure to observe this instruction can result in injury or equipment damage.

5.3.5 Power System Configuration

Before connecting line power to a WF2 drive, determine the configuration of the power system. If the configuration cannot be determined with exactitude, at least have a solid understanding of how the power system is configured. Numerous configurations of distribution transformers are in use today throughout the world. The principal difference between these various configurations is the means used to introduce a connection to earth ground.

The primary consideration should be to measure the voltages from line to line (all combinations in a three-phase system) and the voltage from each line connection to earth ground. Ensure that each voltage measurement does not exceed the input voltage rating (including tolerance) for your particular model.

If you discover different results than expected, contact BERGES for assistance. **Failure to observe these precautions may void the warranty.**

5.4 Terminals Found on the WF2 Power Board

5.4.1 Description of the Terminals

Figure 4 shows the power terminals for the WF2 drive. Table 12 describes the terminals.

Terminal	Description
GND	Earth ground (PE).
L1/R L2/S L3/T	These terminals are the line connections for three-phase models. (Single-phase models will only have the L1/R terminal, with the other two terminals being replaced by a terminal labeled N.)

Table 12
Description of WF2 Power Terminals

Terminal	Description
B– B+ **or** B– DB1	The B–/B+ terminals or B–/DB1 terminals (depending on the model [1]) provide a connection to the DC Bus. They may be used for common DC Bus connections or for powering the drive from a DC source. (If the drive is powered from a DC source, disable phase failure detection by setting parameter **Input Phase Flt** to disabled; see page 122 for more information.) Alternately, by connecting a dynamic brake unit to these terminals, braking capacity may be enhanced. See page 34 for more information.
DB B+ **or** DB DB1	The DB/B+ terminals or DB/DB1 terminals (depending on the model [1]) are the connection points for the internal dynamic brake resistor. If an external resistor is used for dynamic braking, the internal resistor must be disconnected; see page 34 for more information.
T1/U T2/V T3/W	These terminals are for motor connections.

Table 12
Description of WF2 Power Terminals

[1] The sixth terminal from the left is labeled “B+” on 230 V AC models of 15 kW or less (WF2K2S00-7x – WF2K2S02-2x and WF2K2000-7x – WF2K2015-0x) as well as 460 V AC and 575 V AC models of 30 kW or less (WF2K4000-7x – WF2K4030-0x and WF2K5000-7x – WF2K5030-0x).
On the remaining, larger-horsepower models, this terminal is labeled “DB1.”
The function of the terminal does not change.

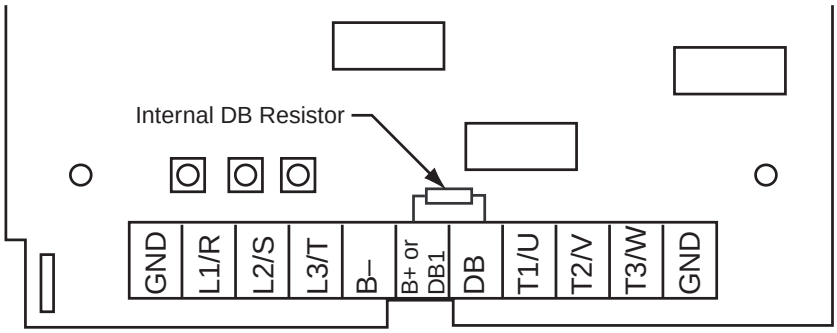


Figure 4
WF2 Power Terminals

5.4.2 Typical Power Connections

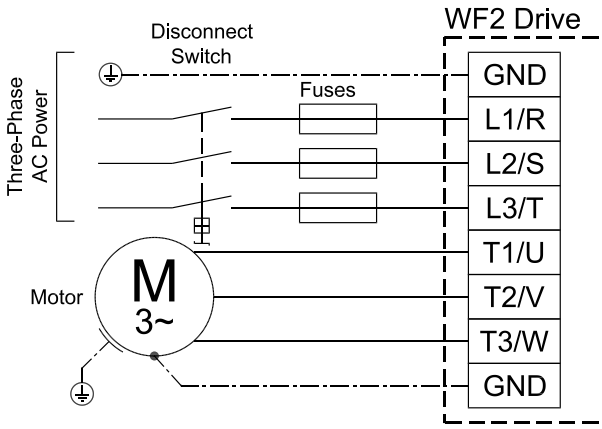


Figure 5
Connections for Power Wiring

Figure 5 shows the terminal connections for line power and motor output. See section 5.3 starting on page 30 for input line requirements.

Note that when testing for a ground fault, do not short any motor lead (T1/U, T2/V, or T3/W) back to an input phase (L1/R, L2/S, or L3/T).

As shown in figure 5, it is necessary to provide fuses and a disconnect switch for the input AC line in accordance with all applicable electrical codes. The WF2 drive is able to withstand a 150% overload for 60 s. For maximum protection of the drive, use the fuses listed in tables 13, 14, and 15 found below and on the next page. The recommended supplier is Bussman.

Model Number WF2K-	Fuse Size 208 V AC JJS/JJN [1]	Fuse Size 230 V AC JJS/JJN [1]
2S00-7x	15	10
2S01-5x	20	20
2S02-2x	30	30
2000-7x	10	6
2001-5x	15	10
2002-2x	20	15
2003-7x	30	25
2005-5x	40	35
2007-5x	50	40
2011-0x	70	60
2015-0x	70	60
2018-5x	[2]	[2]
2022-0x	[2]	[2]

Table 13
Recommended Fuses (230 V AC Models)

[1] For sizes up to and including 30 A, KTK fuses may be substituted.
[2] Contact BERGES for further information.

Model Number WF2K-	Fuse Size 380 V AC JJS	Fuse Size 460 V AC JJS
4000-7x	6	6
4001-5x	6	6
4002-2x	10	10
4003-7x	15	15
4005-5x	20	20
4007-5x	20	20
4011-0x	40	35
4015-0x	50	40

Table 14
Recommended Fuses (460 V AC Models)

Model Number WF2K-	Fuse Size 380 V AC JJS	Fuse Size 460 V AC JJS
4018-5x	60	50
4022-0x	70	60
4030-0x	80	70
4037-0x	[1]	[1]
4045-0x	[1]	[1]
4055-0x	[1]	[1]

Table 14
Recommended Fuses (460 V AC Models)

[1] Contact BERGES for further information.

Model Number WF2K-	Fuse Size 575 V AC JJS
5000-7x	6
5001-5x	6
5002-2x	10
5003-7x	10
5005-5x	15
5007-5x	20
5011-0x	30
5015-0x	35
5018-5x	50
5022-0x	50
5030-0x	70
5037-0x	[1]
5045-0x	[1]
5055-0x	[1]

Table 15
Recommended Fuses (575 V AC Models)

[1] Contact BERGES for further information.

5.5 Dynamic Braking

The WF2 Sensorless Vector Drive is supplied with an integrated dynamic braking (DB) resistor, and is designed to have adequate dynamic braking for most applications. In cases where short stopping times or high inertia loads require additional braking capacity, two approaches may be taken:

- Purchase and install an external DB unit; or
- Purchase and install an external resistor.

These methods are described in more detail in the following sections.

5.5.1 Dynamic Braking Units

One method for adding braking capacity is to purchase a dynamic braking unit, either model WDB211 (for 230 V AC WF2 drives), model WDB411 (for 460 V AC WF2 drives), or model WDB510 (for 575 V AC WF2 drives).

These units allow the addition of braking capacity by utilizing off-the-shelf options. Braking capacity is added in 7.5 kW increments, and multiple units may be connected to a single drive.

To add a DB unit to a WF2 drive, connect it to the B– and B+ or B– and DB1 terminals (the terminals are labeled differently depending on the horsepower rating of the drive; see page 31 for more information) and set parameter **DB Config** to Ext DB WDB (see page 106 for more information on this parameter). See Form 1021 for further instructions on installing and using a DB unit.

5.5.2 User-Supplied External Resistor

Rather than using a dynamic braking unit to increase braking capacity, an external resistor (supplied by the user) may be used.

The drive may be configured to protect the external resistor by entering the resistor's value, thermal resistance, and thermal capacitance into parameters **DB Res Value**, **DB Cth Value**, and **DB Rth Value** (see page 107 for the default values and additional information on these parameters). (The thermal specifications for the external resistor can be obtained from the resistor's manufacturer.) Table 16 provides the minimum DB resistance for each model.

To use an external resistor, first disconnect the internal DB resistor and properly terminate the wires leading to it. Then, connect the external resistor to the B+ and DB or DB1 and DB terminals (the terminals are labeled differently depending on the horsepower rating of the drive; see page 31 for more information). Finally, set parameter **DB Config** to Ext DB Res and configure the **DB Res Value**, **DB Cth Value**, and **DB Rth Value** parameters for the external resistor used.

Model WF2K-	Min. DB Resistor (Ω)	Peak Power (kW)	Model WF2K-	Min. DB Resistor (Ω)	Peak Power (kW)	Model WF2K-	Min. DB Resistor (Ω)	Peak Power (kW)
1S00-7x	56	3	**4000-7x**	120	5	**5000-7x**	160	6
2S00-7x	56	3	**4001-5x**	120	5	**5001-5x**	160	6
2S01-5x	56	3	**4002-2x**	82	8	**5002-2x**	110	9
2S02-2x	43	4	**4003-7x**	82	8	**5003-7x**	110	9
2000-7x	56	3	**4005-5x**	47	13	**5005-5x**	62	16
2001-5x	56	3	**4007-5x**	47	13	**5007-5x**	62	16
2002-2x	43	4	**4011-0x**	47	13	**5011-0x**	62	16
2003-7x	27	6	**4015-0x**	33	20	**5015-0x**	62	16
2005-5x	30	6	**4018-5x**	24	26	**5018-5x**	33	30
2007-5x	30	6	**4022-0x**	24	26	**5022-0x**	33	30
2011-0x	13	12	**4030-0x**	24	26	**5030-0x**	33	30
2015-0x	13	12	**4037-0x**	8,2	75	**5037-0x**	12	80
2018-5x	4,3	36	**4045-0x**	8,2	75	**5045-0x**	12	80
2022-0x	4,3	36	**4055-0x**	8,2	75	**5055-0x**	12	80

Table 16
Minimum Dynamic Brake (DB) Resistor Values

5.6 Terminals Found on the WF2 Control Board

5.6.1 Description of the Control Terminals

Figure 6 shows the control terminals found on the I/O board of the WF2 drive. (The actual control board cannot be accessed by the user.)

Note that due to labeling constraints, the labels for some terminals start on the left (either on the side or top of the terminal block), are interrupted by the terminal screw, and then finish on the right (either on the side or top of the terminal block). For example, terminal A11 is labeled with A on the left side of the block and 11 to the right of the terminal screw on top of the block. Similarly, terminal NC2 is labeled with N to the left of the terminal screw on top of the block and then C2 on the right side of the block.

As is shown in the figure, the terminals are divided into four terminal blocks, each of which pulls apart for ease of field wiring:

- TB1 – analog input, analog output, and digital output terminals.
- TB2 – output relay 1 (R1).
- TB3 – output relay 2 (R2).
- TB4 – digital input terminals.

See page 13 for specification information concerning these features. Table 17 describes the control terminals.

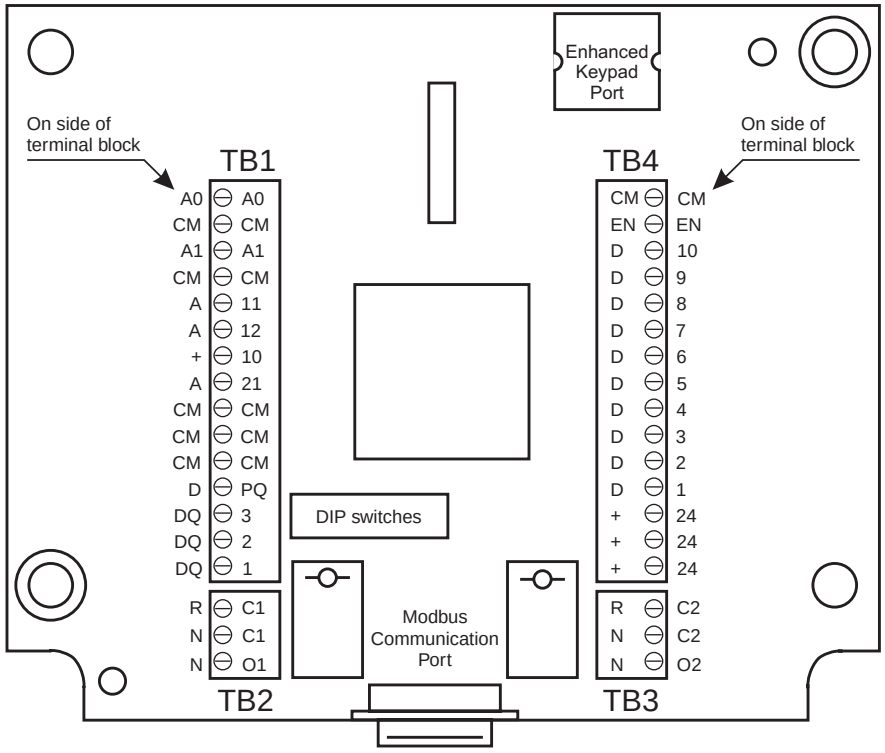


Figure 6
WF2 Control Terminals

Terminal	Description
TB1 Terminal Block	
A0	Analog output 1. This terminal may output 0 to 10 V DC (5 mA DC maximum). The type of signal output from this terminal is set with parameter **AQ1 Configure** (see page 120 for more information), with the default setting being Motor Spd (motor speed).
A1	Analog output 2. This terminal outputs 0 to 20 mA DC by default, but may be re-configured to 4 to 20 mA DC by using parameter **AQ2 Output Type** (see page 121). The type of signal output from this terminal is set with parameter **AQ2 Configure** (see page 120 for more information), with the default setting being Out Torque.
A11 A12	These two terminals comprise Analog Input 1, with A11 being the positive input and A12 being the negative input. The default setting for this input is Normal; this may be changed by re-configuring parameter **A1 Configure** (see page 113). The input signal may be 0 to 10 V DC, 0 to 5 V DC, ±10 V DC, 0 to 20 mA DC, or 4 to 20 mA DC. These input signals provide speed references; DIP switch bank SW1 on the I/O board selects the type of input signal (see table 18 on page 39 for information on setting the DIP switch). If a 0 to 20 mA DC input signal is configured, the burden may be set to either 50 Ω or 250 Ω via the DIP switch. The 50 Ω setting is intended for current loop applications where multiple drives are chained together in series on one analog current reference. A potentiometer with a minimum value of 1 kΩ may be used for this input.
+10	This terminal is the reference supply for a potentiometer used in conjunction with A1 or A2. The supply voltage is +10 V DC, with a maximum current capacity of 10 mA.
A21	This terminal is Analog Input 2. It is single-ended, and so the other lead from the circuit must be connected to a CM terminal. The input range is configured with parameter **A2 Configure** (see page 114), and may be an analog input or a pulse train up to 100 kHz. The default setting for this input is Normal. This terminal may also be used as a Pulse Train Input function. This signal may be an external pulse tach signal, or it may be the DPQ signal from another WF2 drive or WFC inverter. (A pull-up 4.7 kΩ, 0.5 W resistor may need to be connected between the A2 and +10 terminals for a signal from a WFC inverter; consult with BERGES for further information.) The input signal may be 0 to 10 V DC, 0 to 5 V DC, or 0/4 to 20 mA DC.The burden for this terminal can only be 250 Ω. (See table 18 on page 39 for more information.) A potentiometer with a minimum value of 1 kΩ may be used for this input.
DPQ (formerly 6FS)	Open collector pulse train output. The output from this terminal is the drive's output frequency multiplied by 6 (default), 48, 96, or 3072 as set by parameter **DPQ Scaling** (see page 118). Output is 50% duty cycle, and may be used with voltages up to 24 V DC. A 5 kΩ pull-up resistor may be necessary in some installations; contact BERGES for details.
DQ1 to DQ3	Digital outputs 1 through 3. These are open collectors with external pull-up resistors. Each output is capable of sinking up to 90 mA DC. They require power to operate, either 24 V DC from the drive or 10 V DC to 35 V DC from an external power supply. They are configured by parameters **DQ1 Configure** (default setting is Drive Rdy), **DQ2 Configure** (default setting is At Speed), and **DQ3 Configure** (default setting is Run Rev); see page 117 for more information.

Table 17
Description of WF2 Control Terminals

Terminal	Description
TB2 Terminal Block	
RC1	Common terminal for the first auxiliary relay. The function of the relay is set by parameter **R1 Configure** (see page 118). The default setting is for the relay to activate when a fault is detected (Drv Flted). The contact ratings are 115 V AC at 1 A or 230 V AC at 0.5 A.
NC1	Normally-closed contact for the first auxiliary relay. It will open when the relay is activated.
NO1	Normally-open contact for the first auxiliary relay. It will close when the relay is activated.
TB3 Terminal Block	
RC2	Common terminal for the second auxiliary relay. The function of the relay is set by parameter **R2 Configure** (see page 118). The default setting is for the relay to activate when the drive is running. The contact ratings are 115 V AC at 1 A or 230 V AC at 0.5 A.
NC2	Normally-closed contact for the second auxiliary relay. It will open when the relay is activated.
NO2	Normally-open contact for the second auxiliary relay. It will close when the relay is activated.
TB4 Terminal Block	
EN	Enable terminal. A jumper is placed between this terminal and the +24 terminal at the factory. You may replace this with a contact if desired. The circuit from EN to +24 must be closed for the drive to operate. Note that unlike all other terminals, this terminal cannot be configured for "pull-down logic." That is, a high input to this terminal is always regarded as true – and must be present if the drive is to operate.
D3 to D10	Digital inputs. The function of a digital input is configured by the parameter with the same name as the digital input in the Digital Inputs Group; see pages 111 and 113 for more information. Figure 7 on page 39 provides an illustration of a typical digital input configuration.
D2	Digital input. In 3-wire control, this must be a Stop input. In 2-wire control, it may be configured to another function with parameter **D2 Configure**; see page 110 for more information. Figure 7 on page 39 provides an illustration of a typical digital input configuration.
D1	Digital input. This must be a Start or Run input. Figure 7 on page 39 provides an illustration of a typical digital input configuration.

Table 17
Description of WF2 Control Terminals

5.6.2 Configuring the Type and Range of Analog Inputs

Either a 0 to 10 V DC, 0 to 5 V DC, ±10 V DC, or a 0/4 to 20 mA DC input signal may be sent to Analog Input 1 and Analog Input 2. The selection of whether the input signal is voltage or current, as well as the voltage range and burden, is made via the DIP switch bank labeled SW1 located near terminal DQ3 (see figure 6 on page 36).

When connecting process current inputs, pay particular attention to the input impedance for the drive (see table 18 and table 19 on page 39). If one process control device must be connected to multiple WF2 drives, Analog Input 1 should be used, with input terminals A11 and A12 connected in series between the drives (that is, terminal A12 on drive 1 connects to terminal A11 on drive 2). Selection of 50 ohm input impedance may be best depending on the characteristics of the device connected to the WF2 drive.

The settings of the switches in the SW1 DIP switch bank depend on the PC number listed on the input/output board. For input/output boards labeled PC587, PC687, or PC762 the SW1 DIP switch bank has eight DIP switches (SW1-1 to SW1-8). Use the settings shown in table 18 on page 39 to configure this version of the SW1 DIP switch bank.

For input/output boards labeled PC653 or PC655, the SW1 DIP switch bank has six DIP switches (SW1-1 to SW1-6). Use the settings shown in table 19 on page 40 to configure this version of the SW1 DIP switch bank.

If you are unsure about the type of board, consult BERGES before setting the DIP switches.

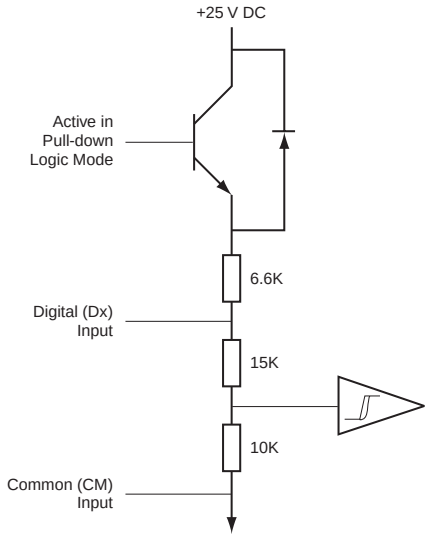


Figure 7
Typical Digital Input Configuration

Type of Input Signal and Range	SW1-1	SW1-2	SW1-3	SW1-4	SW1-5	SW1-6	SW1-7	SW1-8
Analog Input 1								
0 to 10 V DC (10 kΩ)			On	On	Off	Off	On	On
0 to 5 V DC (10 kΩ)			Off	On	Off	Off	On	Off
±10 V DC (10 kΩ)			On	On	Off	Off	On	On
0/4 to 20 mA DC (50 Ω)			Off	Off	On	Off	Off	Off
0/4 to 20 mA DC (250 Ω)			Off	On	Off	On	On	Off
Analog Input 2								
0 to 10 V DC (10 kΩ)	Off	Off						
0 to 5 V DC (10 kΩ)	On	Off						
0/4 to 20 mA DC (250 Ω)	On	On						

Table 18
DIP Switch Settings (PC587, PC687, and PC762)

Type of Input Signal and Range	SW1-1	SW1-2	SW1-3	SW1-4	SW1-5	SW1-6
Analog Input 1						
0 to 10 V DC [1]			Off	Off	Off	Off
0 to 5 V DC [1]			On	Off	Off	Off
±10 V DC [1]			Off	Off	Off	Off
0/4 to 20 mA DC (50 Ω)			Off	On	On	Off
0/4 to 20 mA DC (250 Ω)			On	Off	Off	On
Analog Input 2						
0 to 10 V DC [1]	Off	Off				
0 to 5 V DC [1]	On	Off				
0/4 to 20 mA DC (250 Ω)	On	On				

Table 19
DIP Switch Settings (PC653 and PC655)

[1] The analog input impedance for voltage signals for PC653 input/output boards is 10 kΩ.
The analog input impedance for voltage signals for PC655 input/output boards is 100 kΩ.

5.6.3 Control Wiring Connections (Active-High Logic)

This section provides information on making typical control wiring connections when the digital inputs use Active-High logic (“pull-up logic”). This is the default type of logic used by the WF2 drive.

If desired, Active-Low logic may be utilized by setting parameter **Active Logic** to Active Low; see page 110 for more information. Section 5.6.4 starting on page 48 provides connection drawings that utilize active-low logic.

Single-Direction Control

The WF2 drive supports either 2- or 3-wire control. Figure 8 shows the connections to the digital input terminals for both types of control.

The default mode is 2-wire control. In this mode, digital input D1 is configured as the Run input and is not programmable, although additional Run inputs may be configured by using other digital inputs. An input on D1 will start the drive provided the Enable circuit is closed. (The Enable circuit is the connection between terminals EN and +24V, which may be either the factory-installed jumper or a normally-closed disconnect switch supplied by the customer.)

Also note that line-start lockout is enabled by default. With this feature, the drive will not start if a Run command is active when power is applied. To disable line-start lockout, configure parameter **Start Mode** to Auto Start; see page 84 for more information.

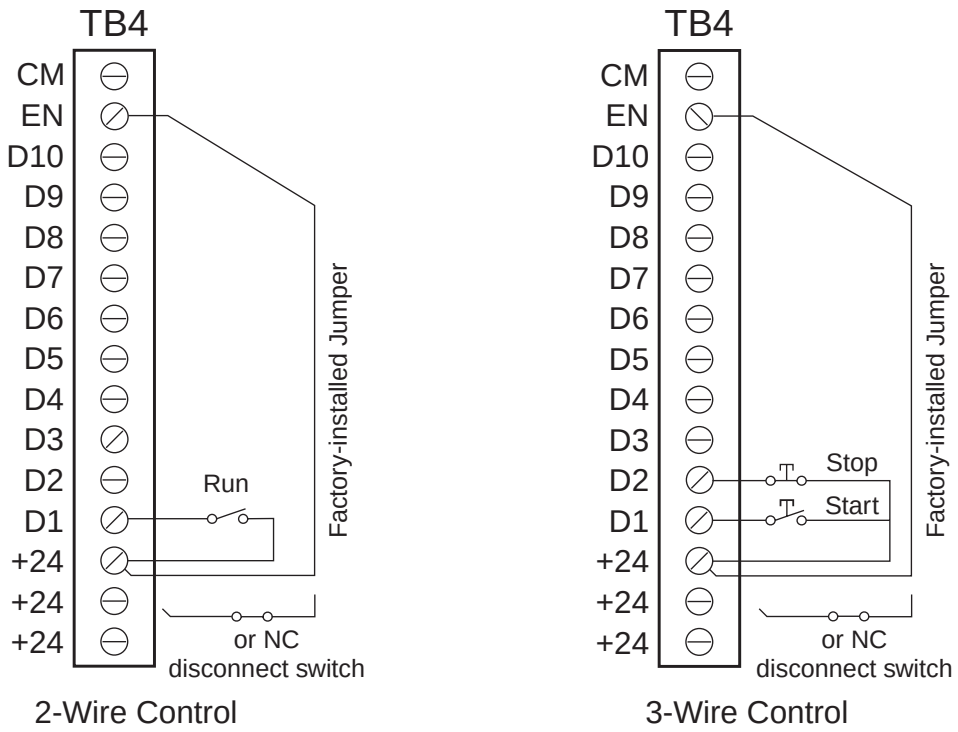


Figure 8
2- and 3-Wire Control (Active-High Logic)

Setting parameter **2-Wire/3-Wire** (see page 83) to 3-wire selects 3-wire control. In this type of control, the drive is started based on the rising edge of a pulse on the Start digital input – which must be digital input D1. You cannot use another digital input for the Start input. In addition, the Enable circuit must be closed for the drive to be started.

The drive is stopped on the falling edge of a pulse on the Stop digital input – which must be digital input D2. You cannot use another digital input for the Stop input when 3-wire control is utilized.

Forward and Reverse Control

An additional digital input may be added to the basic, single-direction 2-wire and 3-wire control discussed in the previous section to allow control in two directions. The WF2 drive supports two types of directional control: Forward/Reverse DI or Run Forward/Run Reverse. The choice between the two is determined by the setting of parameter **Reverse Mode**, which configures how digital inputs command Forward and Reverse; see page 85 for more information on the **Reverse Mode** parameter.

In Forward/Reverse DI mode, one digital input initiates Run and a second digital input selects whether the direction is Forward or Reverse. The starting and stopping of the drive is accomplished in the same manner and using the same digital inputs as in the previous section.

In Run Forward/Run Reverse mode, a digital input is assigned to be the Run Reverse input. The required D1 digital input for starting then becomes the Run Forward input by default. Figure 9 shows an example of this type of two-direction control with D5 assigned as the Run Reverse input.

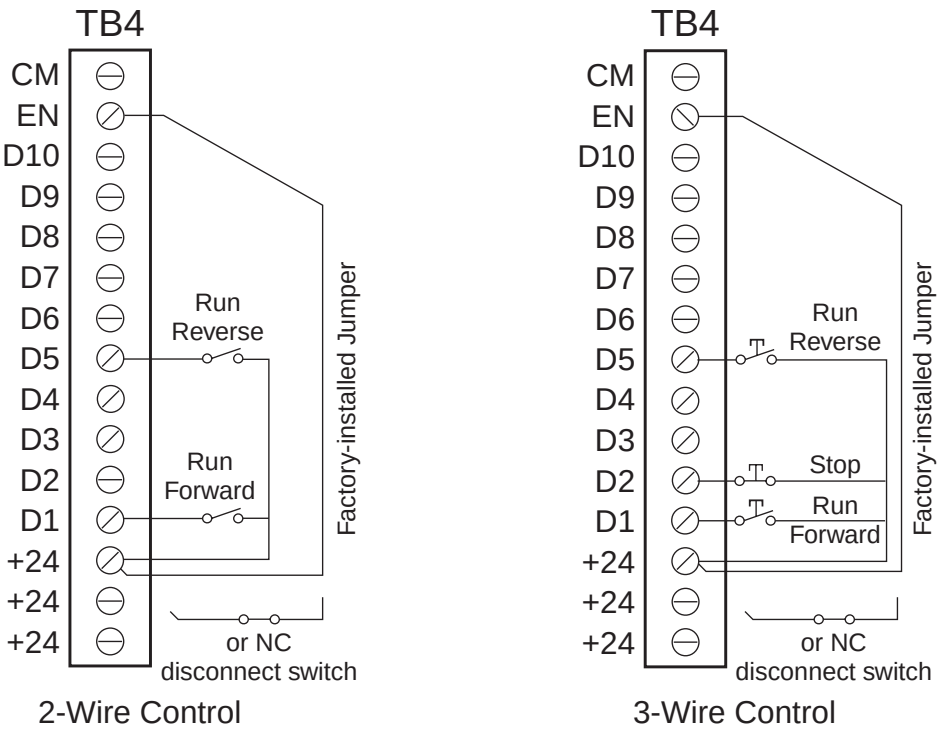


Figure 9
Example of Run Forward/Run Reverse Control (Active-High Logic)

NOTE: Inputs D3 to D10 are programmable; see page 111 for configuration information.

An input on D1 will cause the drive to begin running in the Forward direction (provided the Enable circuit is closed). Similarly, an input on D5 (in this example) will cause the drive to begin running in the Reverse direction. Note that if both inputs are active, the Run Forward input has priority regardless of which one was activated first.

Jogging Operation

The WF2 drive supports Jog operations for both 2- and 3-wire control. Two jogging modes are available: Run/Jog DI or Pushbutton Jog, with parameter **Jog Mode** selecting which is used. (See page 84 for information on this parameter.)

Jogging operations are controlled by a digital input (D2 to D10 for 2-wire control or D3 to D10 for 3-wire control, with D3 being the default choice). The selected digital input also needs to be configured for the type of jogging (see the Digital Inputs Group starting on page 110 for more information).

In the Run/Jog DI mode, a maintained-contact digital input is required. Figure 10 shows an example of the connections for this mode with digital input D4 assigned to jogging.

In this example for 2-wire control, if the drive is running, activating D4 will cause the drive to ramp from the normal reference to the Jog reference using the appropriate acceleration or deceleration Jog ramp. When D4 is deactivated, the drive will ramp back to the normal reference using the appropriate acceleration or deceleration Jog ramp.

If the drive is stopped rather than running, activating D4 and then activating the Run digital input (D1) will cause the drive to start and ramp to the Jog reference using the Jog acceleration ramp. When D1 is deactivated (and D4 is still activated), the drive will ramp to stop using the Jog deceleration ramp.

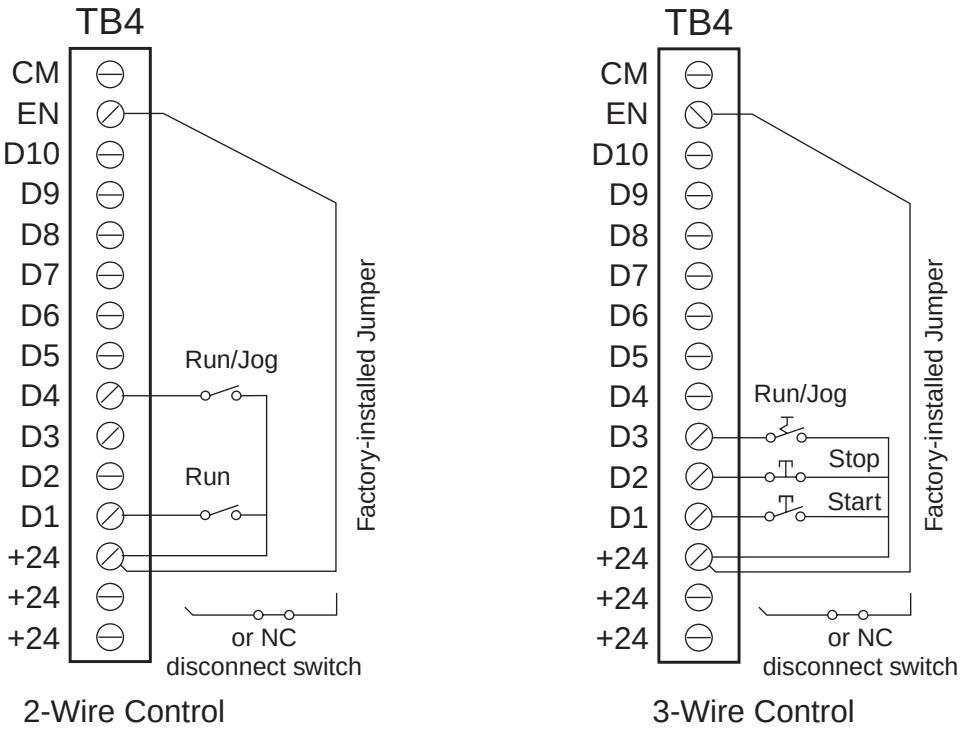


Figure 10
Example of Connections for the Run/Jog Mode (Active-High Logic)

NOTE: Inputs D3 to D10 are programmable; see page 111 for configuration information.

In this example for 3-wire control, when D4 is active, jogging operations may occur. The jog speed and ramp are enabled as set by the appropriate parameters. While D4 is active, pressing the Start pushbutton causes a ramp to the jogging reference speed and releasing the Start pushbutton causes the speed to go to zero using the jog ramp.

Note that if the jog input is opened (returned to Run) while Start is pressed, the drive will ramp back to the normal reference speed without first stopping.

In the second type of jogging (Pushbutton Jog), a pushbutton is incorporated into the control scheme to initiate jogging. Figure 11 on page 44 shows an example of this type of jogging.

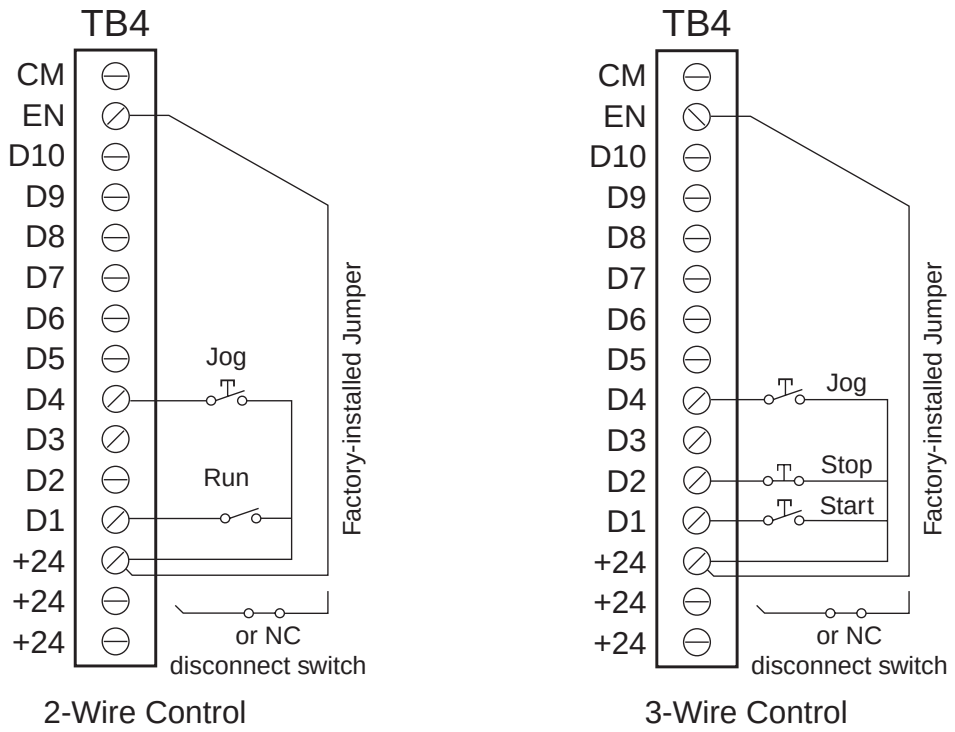


Figure 11
Example of Connections for the Pushbutton Jog Mode, Forward Operation Only (Active-High Logic)

NOTE: Inputs D3 to D10 are programmable; see page 111 for configuration information.

In this example, in both 2- and 3-wire control, if the drive is already running, pressing the jog pushbutton will have no effect. When the drive is stopped and the input to D4 is activated by pressing the pushbutton, the drive will ramp to the jogging reference speed (set by parameter **Jog Ref Config**; see page 90) in the time set by parameter **Jog Accel Time**. When the input is deactivated, the drive speed goes to zero in the time set by parameter **Jog Decel Time**.

Note that these examples showed 2- and 3-wire control systems running in one direction. Jogging may also be incorporated into control systems that run in two directions. For these applications, two digital inputs are required – one for Forward Jog and one for Reverse Jog with the particular type of jogging selected by parameter configuration (Run/Jog DI or Pushbutton Jog) controlling the jog operations. Figure 12 on page 45 shows examples of Forward and Reverse jogging operations.

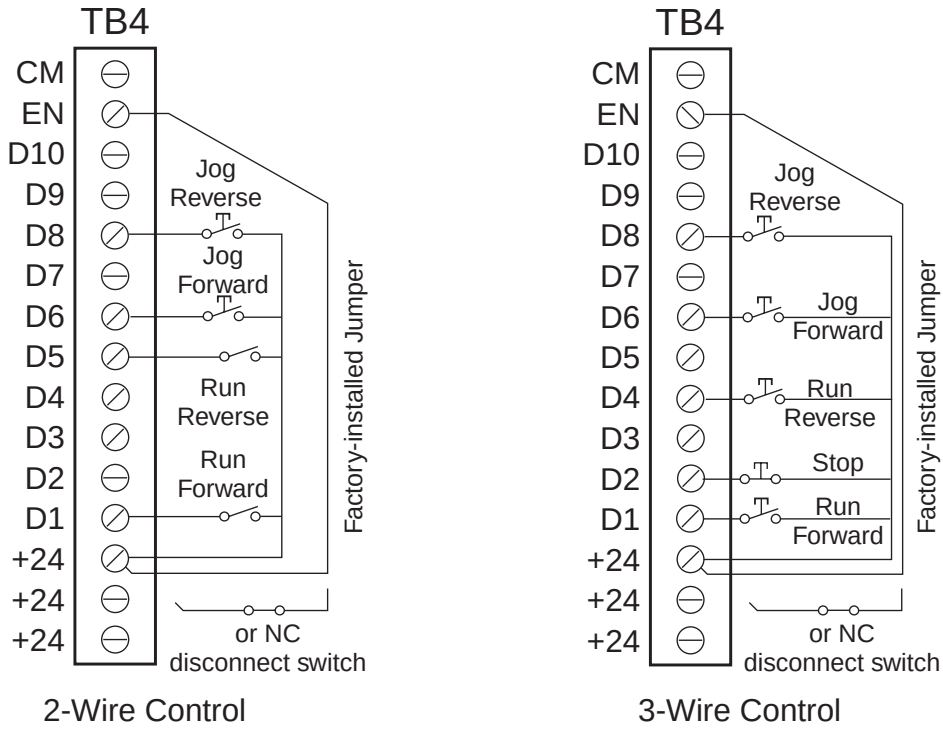


Figure 12
Example of Connections for Forward and Reverse Jogging (Active-High Logic)

NOTE: Inputs D3 to D10 are programmable; see page 111 for configuration information.

Preset Speeds

The WF2 drive supports up to seven preset speeds, which are in addition to the reference speed of the drive. The preset speeds may be selected by using digital inputs or serial communication to set bits 5, 6, and 7 of **Cntl Word 1** (see page 133 for information on this parameter). Figure 13 shows an example of connections for seven preset speeds using three digital inputs.

If digital inputs are used, the number of preset speeds available is determined by the number of digital inputs assigned this functionality:

- If three digital inputs are used, all seven preset speeds are available.
- If two digital inputs are used, only **Preset Speed 1**, **Preset Speed 2**, and **Preset Speed 3** are available.
- If only one digital input is used, only **Preset Speed 1** is available.

(See parameters **D2 Configure** through **D10 Configure** on pages 110 through 113 for more information on assigning digital inputs to selection of preset speeds.)

The preset speeds are configured by parameters **Preset Speed 1** to **Preset Speed 7** found in the Preset Speeds parameter group (see page 96 for more information on the Preset Speeds Group). Note that the speeds are in addition to the reference speed of the drive, and that when selected, they only change the active reference speed not the actual speed of the drive.

A particular speed is selected by the combination of inputs on the terminals assigned to the preset speeds. Tables 20, 21, and 22 on page 46 show what speeds are selected by an input combination depending on the number of digital inputs used.

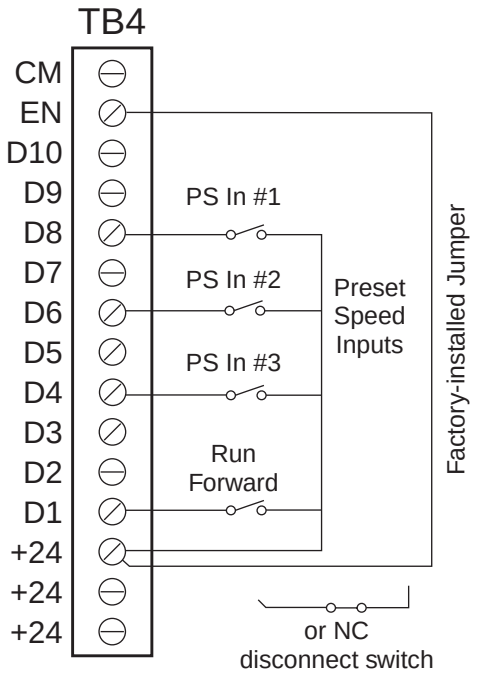


Figure 13
Example of Connections for Seven Preset Speeds (Active-High Logic)

NOTE: Inputs D3 to D10 are programmable; see page 111 for configuration information.

For commanding preset speeds via serial communication, the speeds are selected much as when three digital inputs are configured. A combination of on and off states (1s and 0s) of bits 5, 6, and 7 of **Cntl Word 1** determine the active preset speed. Table 23 on page 47 shows how the settings of the bits combine to select an active preset speed.

Note that if fewer than seven preset speeds are desired, you do not need to set all three preset speed bits. By leaving one (or two) of the bits in its default state of 0, and only varying the value of the other two (or one) bits, fewer preset speeds could be commanded.

For example, table 23 on page 47 shows that if bit 7 remained at 0 while serial communications changed the values of the other two bits, only preset speeds 1 through 3 (plus the reference speed) would be available.

Digital Input Configured as "PS In #1"	Speed Selected
0	Reference Speed
1	Preset Speed 1

Table 20
Selection of Preset Speeds – One Digital Input

Digital Input Configured as "PS In #2"	Digital Input Configured as "PS In #1"	Speed Selected
0	0	Reference Speed
0	1	Preset Speed 1
1	0	Preset Speed 2
1	1	Preset Speed 3

Table 21
Selection of Preset Speeds – Two Digital Inputs

Digital Input Configured as "PS In #3"	Digital Input Configured as "PS In #2"	Digital Input Configured as "PS In #1"	Speed Selected
0	0	0	Reference Speed
0	0	1	Preset Speed 1
0	1	0	Preset Speed 2
0	1	1	Preset Speed 3
1	0	0	Preset Speed 4
1	0	1	Preset Speed 5
1	1	0	Preset Speed 6
1	1	1	Preset Speed 7

Table 22
Selection of Preset Speeds – Three Digital Inputs

State of Bit 7 of Cntl Word #1	State of Bit 6 of Cntl Word #1	State of Bit 5 of Cntl Word #1	Speed Selected
0	0	0	Reference Speed
0	0	1	Preset Speed 1
0	1	0	Preset Speed 2
0	1	1	Preset Speed 3
1	0	0	Preset Speed 4
1	0	1	Preset Speed 5
1	1	0	Preset Speed 6
1	1	1	Preset Speed 7

Table 23
Selection of Preset Speeds Using Serial Communication

DC Injection Braking by DI

The WF2 drive supports DC injection braking to assist in stopping high-inertia loads. A digital input (D2 to D10 for 2-wire control or D3 to D10 for 3-wire control; see page 110) may be selected as the input to activate DC injection braking, and the parameter that controls the functionality of the selected input is set for DC injection braking.

When controlled by a digital input, DC injection braking is not a timed function. As long as the selected digital input is active, direct current will be injected into the motor.

Speed Potentiometer

A speed potentiometer may be connected to Analog Input 2 (the A21 terminal), as shown in figure 14. (Analog Input 1, the A11 and A12 terminals, may also be configured to accept a speed potentiometer input.)

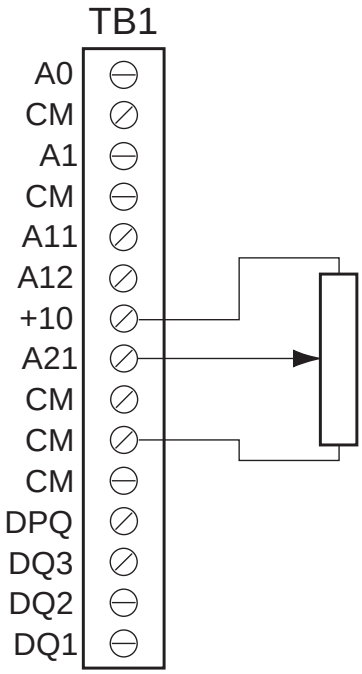


Figure 14
Connections for a Typical Speed Potentiometer

5.6.4 Control Wiring Connections (Active-Low Logic)

The previous section described typical wiring connections when Active-High logic is used for the digital inputs. In this section provides, starting on the next page, the typical control wiring connections when the digital inputs use Active-Low logic ("pull-down logic"). (Active-Low logic is selected by setting parameter **Active Logic** to Active Low; see page 110 for more information.) Note that this section only provides the connection diagrams; for a discussion of the function diagrammed, see the previous section.

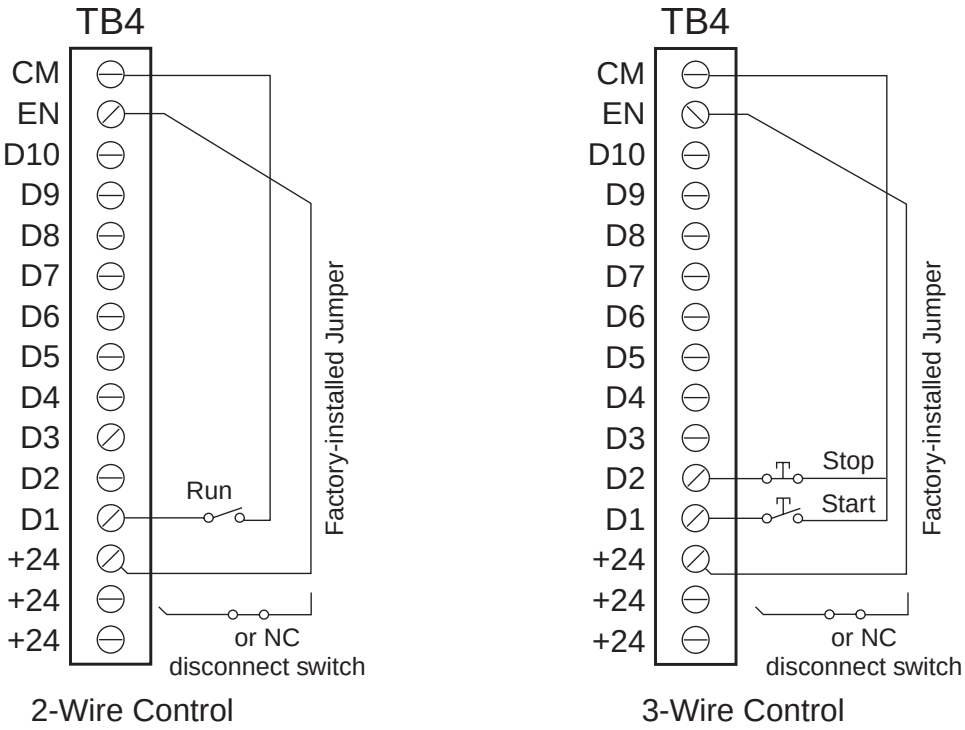


Figure 15
Connections for 2- and 3-wire Control (Active-Low Logic)

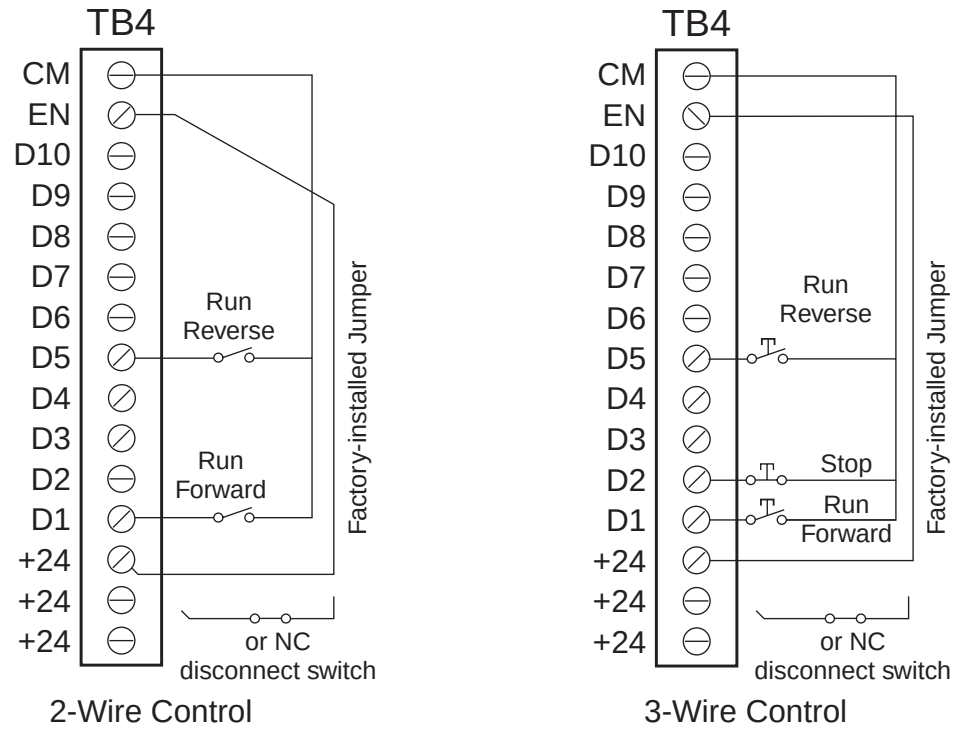


Figure 16
Example of Run Forward/Run Reverse Control (Active-Low Logic)

NOTE: Inputs D3 to D10 are programmable; see page 111 for configuration information.

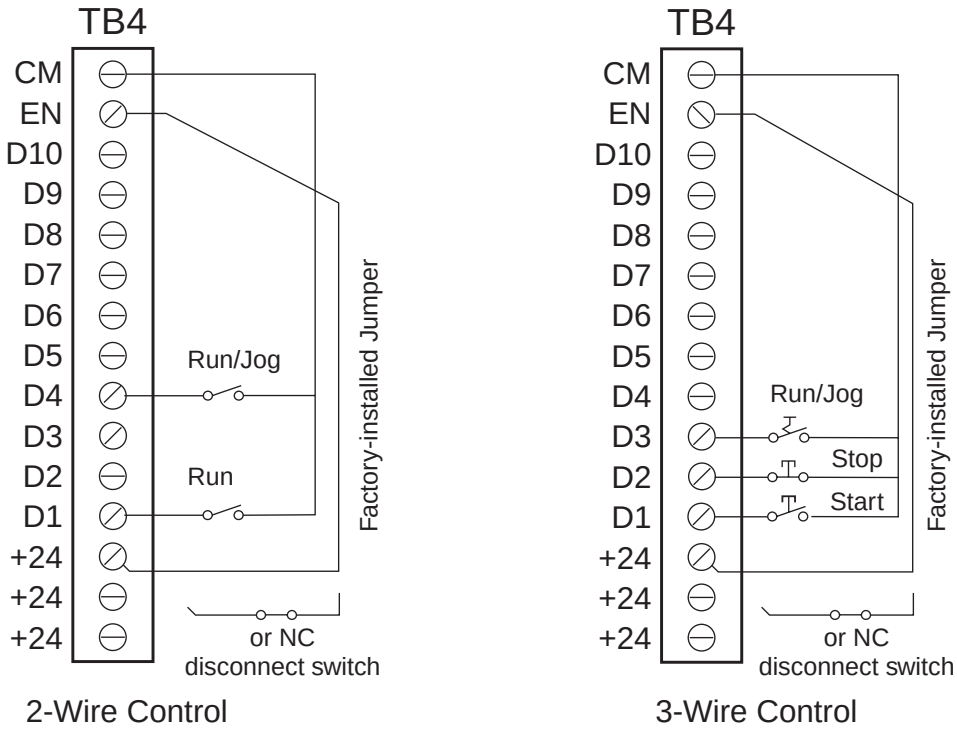


Figure 17
Example of Connections for Run/Jog DI Mode (Active-Low Logic)

NOTE: Inputs D3 to D10 are programmable; see page 111 for configuration information.

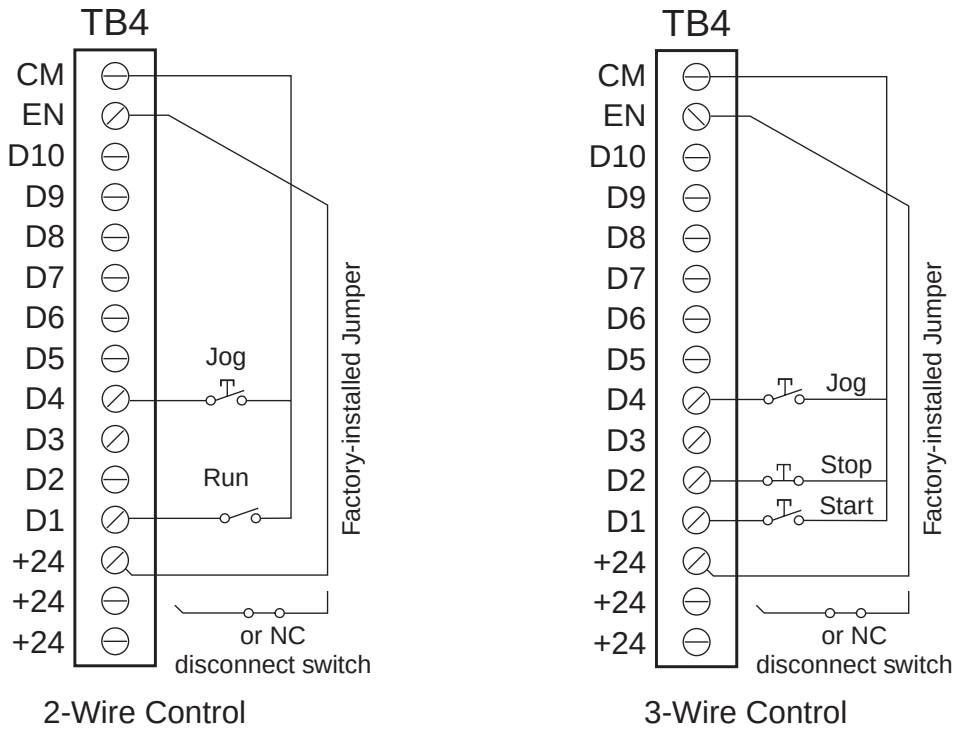


Figure 18
Example of Connections for the Pushbutton Jog Mode, Forward Operation Only (Active-Low Logic)

NOTE: Inputs D3 to D10 are programmable; see page 111 for configuration information.

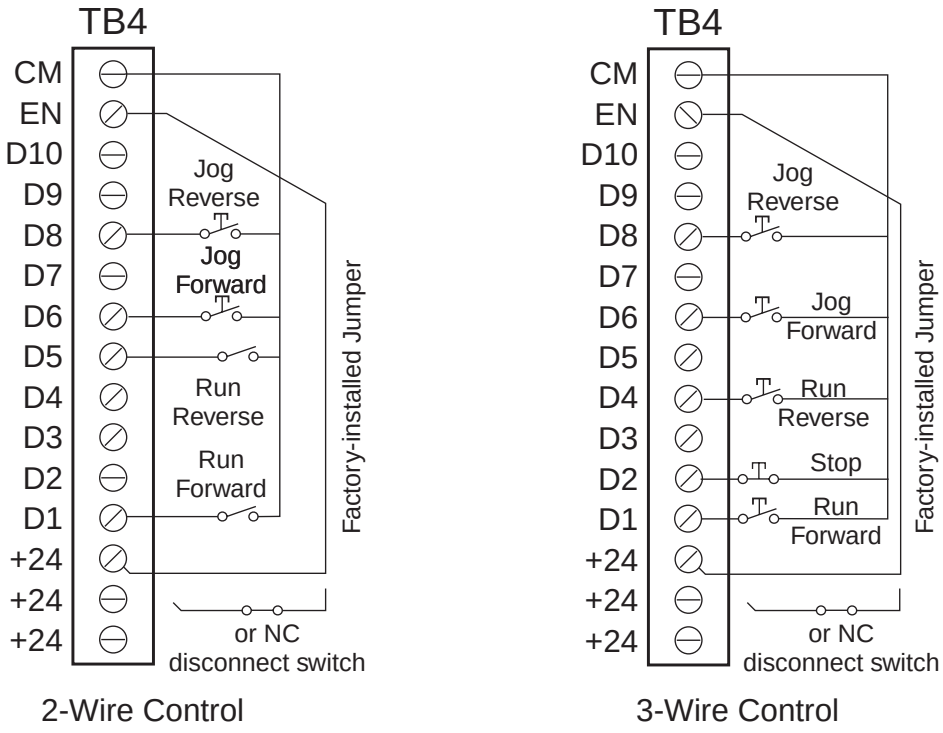


Figure 19
Example of Connections for the Forward and Reverse Jogging (Active-Low Logic)

NOTE: Inputs D3 to D10 are programmable; see page 111 for configuration information.

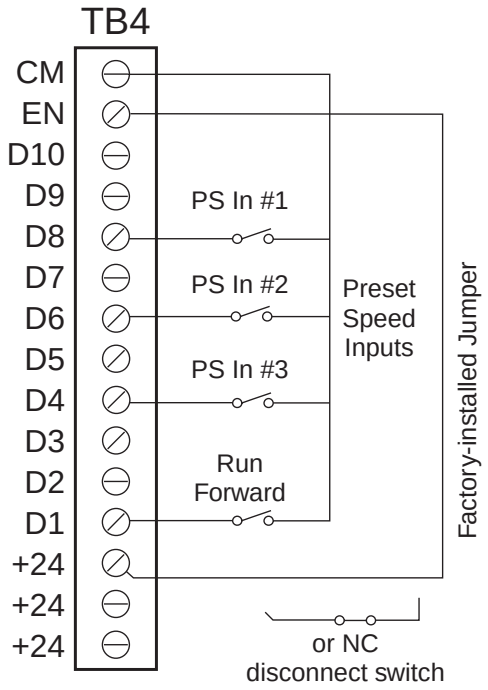


Figure 20
Example of Connections for Seven Preset Speeds (Active-Low Logic)

NOTE: Inputs D3 to D10 are programmable; see page 111 for configuration information.

5.7 Modbus Connection

The WF2 drive supports Modbus communication. The Modbus communication port is located at the bottom of the I/O board (see Figure 6 on page 36). The pin-out for this connection is shown in Figure 21.

The Communication parameter group contains the parameters that configure the type of Modbus communication (the description of the parameters starts on page 131).

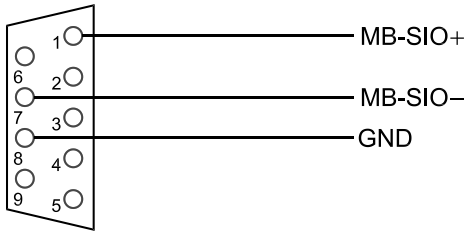


Figure 21
Pin-out Diagram for the Modbus Connection

6 Set-up and Getting Started

6.1 Introduction

The WF2 drive provides a comprehensive set of parameters to allow you to use the drive in nearly any industrial application. While the drive can meet the requirements of many applications right out of the box, customization of parameter values to better suit your particular application is easily accomplished with the standard keypad, with the enhanced keypad, or via serial communication.

This section describes the two keypads and remote communication as well as setting up security for the WF2 drive and programming control paths.

6.2 Description of the Standard Keypad

6.2.1 Overview

The standard keypad is shipped with non-NSF-certified WF2 models. It is located on the face of the WF2 drive, and provides local control and programming of the drive. Figure 22 shows the keypad.

This keypad provides access to a comprehensive set of parameters that allow the WF2 drive to meet the needs of almost any application. To make customization as simple as possible, two levels of programming are available.

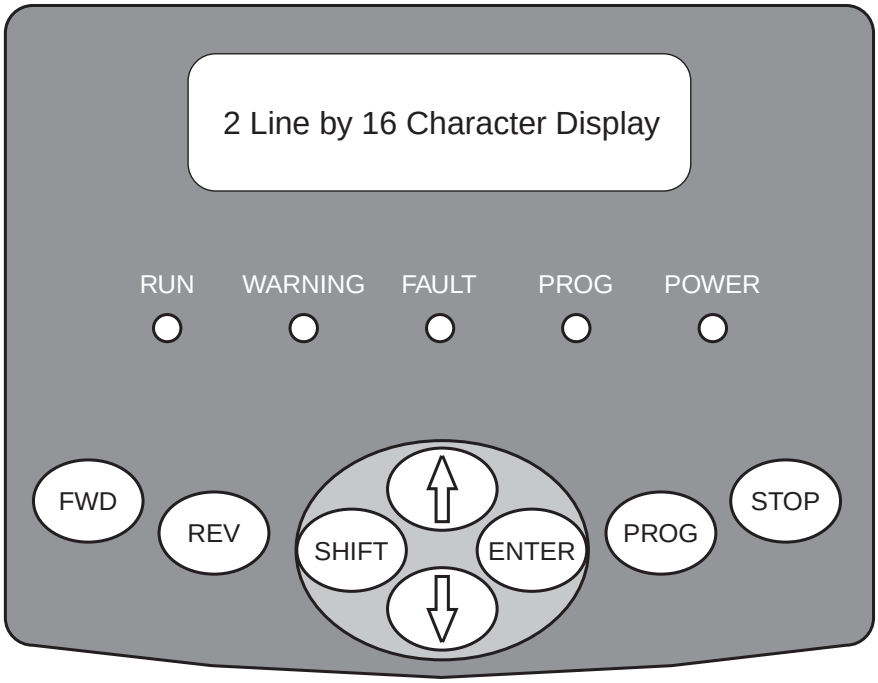


Figure 22
The Standard Keypad for WF2 Drives

The first level, called Level 1 Programming, provides access to the most often needed parameters. The second level, called Level 2 Programming, provides access to all WF2 parameters – including those found in Level 1 Programming. See section 7 starting on page 74 for more information on these two programming levels.

In addition, if desired, security may be enabled to limit a user's access to drive parameters. Security is discussed in greater detail in section 6.5 starting on page 68.

6.2.2 Description of the Keys on the Standard Keypad

The following table describes the keys found on the keypad:

Key	Function
FWD	This key causes the drive to begin operating in the Forward direction unless keypad control is disabled by parameter **Terminal/Keypad** (see page 85 for more information).
REV	This key causes the drive to begin operating in the Reverse direction unless keypad control is disabled by parameter **Terminal/Keypad** (see page 85) or parameter **Reverse Mode** is not set to Run FwdRev (which enables the REV key; see page 85 for more information).
SHIFT	The SHIFT key is used in a variety of ways: • When used in conjunction with the PROG key, SHIFT initiates Level 2 programming. The display will then show the last parameter group accessed or the Security group if this is the first time Level 2 programming has been initiated since the last power-up. • When programming, SHIFT returns one level and discards any changes that were made to parameter values. For example, when a list of parameters in a group is displayed, SHIFT displays the list of parameter groups. • When the Operate display is shown, SHIFT is used in conjunction with the ENTER key to show the Active Faults and Fault History displays. • SHIFT may be used in conjunction with the up or down arrow key to increase the scroll rate for parameter values.
↑	This key, the up arrow key, is used in a variety of ways: • It increases the speed of the drive when the keypad is the source for the speed reference. • It scrolls forward through a list of parameter groups or parameters within a group. (When the last group or parameter is highlighted, it scrolls to the beginning of the list.) The rate of scrolling may be increased by holding the key down for 5 s or pressing the SHIFT key along with the up arrow key. • When a parameter's value is shown, it increases the value. The scroll rate may be increased as described in the preceding bullet. • When a list of faults is displayed, it moves from one fault to the next. After the last fault is displayed, it returns to the beginning.
↓	This key, the down arrow key, is used in a variety of ways: • It decreases the speed of the drive when the keypad is the source for the speed reference. • It scrolls backward through a list of parameter groups or parameters within a group. (When the first group or parameter is highlighted, it scrolls to the end of the list.) The rate of scrolling may be increased by holding the key down for 5 s or pressing the SHIFT key along with the down arrow key. • When a parameter's value is shown, it decreases the value. The scroll rate may be increased as described in the preceding bullet. • When a list of faults is displayed, it moves from one fault to the previous fault. After the first fault is displayed, it returns to the end.

Table 24
Functions of the Keys on the Standard Keypad

Key	Function
ENTER	The ENTER key is used in a variety of ways: • As described above for the SHIFT key, it is used in conjunction with SHIFT to access Active Fault and Fault History displays. (You may want to reset the fault from the Active Fault display by pressing the STOP key.) • When a parameter group is highlighted, ENTER accesses the first parameter in that group (if this is the first time that the parameter group was accessed) or the last parameter accessed. • When a parameter is highlighted in the list of parameters in a group, ENTER displays the current setting for the parameter. • When a parameter's value is shown and a new value is set, ENTER stores the new value in memory and returns to the list of parameters. • Parameter **Enter Key** may be configured to allow this key to act as a toggle switch between Local or Remote modes, or between Terminal Strip and Keypad control modes; see page 88 for more information on this parameter.
PROG	The PROG key is used in a variety of ways: • When pressed by itself, it initiates Level 1 programming. The display will then show the first parameter in the Level 1 group (**Output Freq**; see table 28 on page 75) if this is the first time that Level 1 programming has been initiated, or the last parameter accessed will be shown. • When PROG is used in conjunction with the SHIFT key, Level 2 programming is initiated. See the description of the SHIFT key on the previous page. • When the list of parameter groups, or the list of parameters within a group, is displayed, PROG causes the Operate display to be shown. • When a parameter's value is displayed, PROG discards any changes made to the value and causes the Operate display to be shown. • When PROG is used in conjunction with the STOP key, the drive enters Reflash Mode; see page 59 for more information on this mode.
STOP	The Stop key halts the operation of the WF2 drive unless it is disabled by parameter **Stop Key**. This parameter also determines the type of stop (coast or ramp) that occurs when the Stop key is pressed; see page 88 for more information. Note that parameter **Man Fault Reset** (see page 122) may be configured to allow the Stop key to be used to manually reset the drive after a fault. To use the Stop key in this way, an active fault/warning display must be shown in the keypad window; the Stop key will not reset the drive if the Operate or Programming display is shown.

Table 24
Functions of the Keys on the Standard Keypad

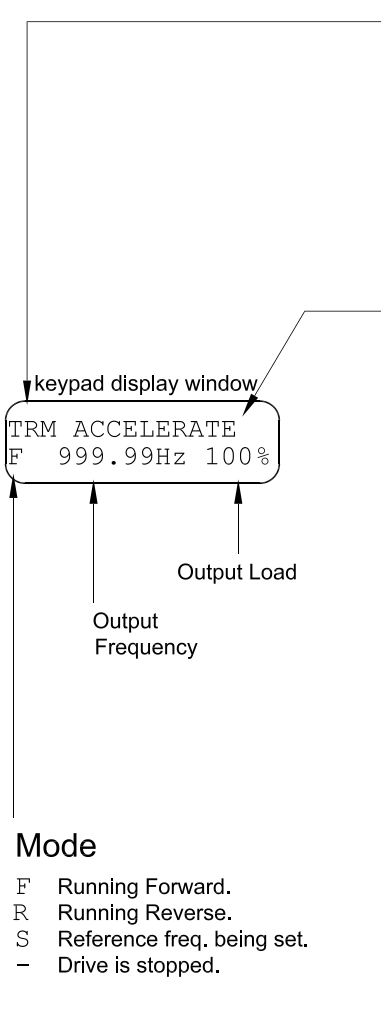
6.2.3 Modes and Displays of the Standard Keypad

The standard keypad provides a 2 line by 16 character display. The display varies by the mode in which the drive is placed, which may be:

- Operate Mode
- Programming Mode
- Active Faults and Fault History Mode

The displays for these modes will be described in the following sections.

Note that the default language used for displays is English. This may be changed by setting parameter **Language** to a different value. See page 128 for information on this parameter.



3-Letter Code for Control Path

KST	Keypad sets ref. frequency, drive control via terminal strip.
KYP	Keypad (if Local/Remote switching not enabled).
LOC	Local Mode.
REM	Remote Mode.
SLC	Serial link is in complete control.
SLP	Serial link is in partial control.
TRM	Terminal strip (if Local/Remote switching not enabled).
TSK	Ref. frequency set via terminal strip, drive control via keypad.

Status of the Drive

Listed in order from highest to lowest priority; if more than one status is active, the higher-priority status is displayed.

FAULTED	Drive is faulted.
AUTO-RESET	A fault occurred that may be auto-reset.
NO DRV EN	No drive enable.
NOT READY	Drive is not ready (drive enable active).
READY	Drive is ready (drive enable active).
OVERVOLTAGE	Input voltage is too high.
LOW VOLTAGE	Input voltage is too low.
CURRENT LIM	Drive is in Current Limit.
TORQUE LIM	Drive is in Torque Limit.
HI CURRENT	High-current warning.
HI TEMP	High-temperature warning.
JOG	Jog operation is active.
ZERO SPEED	Run command active, but no reference.
ACCELERATE	Drive is accelerating.
DECELERATE	Drive is decelerating.
FORWARD	Drive is at speed in Forward direction.
REVERSE	Drive is at speed in Reverse direction.
DC INJECT	DC injection braking is active.
KPAD STOP	Drive stopped from the keypad.
LS LOCKOUT	Line-start lockout.
FLY CATCH	Catch-on-the-fly start in progress.
MAINS LOSS	Power is not being applied to mains input (that is, it's feeding via the DC bus).

Figure 23
Sample Operate Display and What Information May Be Shown

Operate Mode

The Operate mode is entered automatically approximately one second after the power-up display is shown, which provides information about the software version of the drive.

The Operate mode is the principal mode for the standard keypad. The display for this mode provides operational information about the WF2 drive. Figure 23 on the previous page shows a typical Operate display and notes what the various codes shown in the display mean. Note that if more than one status is active, the higher-priority status will be shown.

Also note that you may select a different display for the Operate mode. Parameter **Display Mode** allows you to select a display that shows a custom unit instead of output frequency. Alternately, this parameter allows you to choose to display retention time. See page 127 for more information on this parameter.

Programming Mode

As described in table 24 on page 54, Programming mode is entered by pressing either the PROG key (to access Level 1 parameters) or SHIFT+PROG (to access Level 2 parameters). (See page 75 for the parameters in each programming level.) Programming is slightly different for each level, as explained in the following paragraphs. Note that if no keys are pressed for 10 minutes while Programming mode is active, the drive will automatically revert to the Operate mode.

To program a parameter's value in Level 1 programming, perform the following steps:

1. Press PROG to initiate Level 1 programming.

   The Operate display will change to the list of parameters in Level 1 programming. An arrowhead indicates which one is selected.

2. If the desired parameter is indicated by the arrowhead, press ENTER to select the parameter and display its current value. If the indicated parameter is not the one you want to program, use the up or down arrow keys to move the arrowhead to the desired parameter, and then press ENTER to select the parameter and display its current value.

   After the ENTER key is pressed, the value for the parameter will be displayed. The WF2 drive uses two types of parameters. One type is assigned a numerical value, while the second type is assigned a function.

   For example, parameter **Minimum Freq** may range from 0 to 320 Hz, and you may configure any value within that range for the minimum frequency of the drive. This is the first type of parameter, where the parameter is assigned a numerical value. On the other hand, parameter **Stop Mode** only allows you to choose one of two functions: Ramp to Stop or Coast to Stop. This is an example of the second type of parameter.

   The displays for these two types of parameters are slightly different, as shown in figure 24 on the next page.

3. If the parameter is unlocked, use the up or down arrow keys to change the parameter's value to the desired value.

4. Press ENTER to save the new value. (If you do not wish to save the new value, press SHIFT.)

   The new value is stored, or discarded, and then the list of parameters is shown.

5. You may now select another parameter or return to the Operate mode by pressing the PROG key.

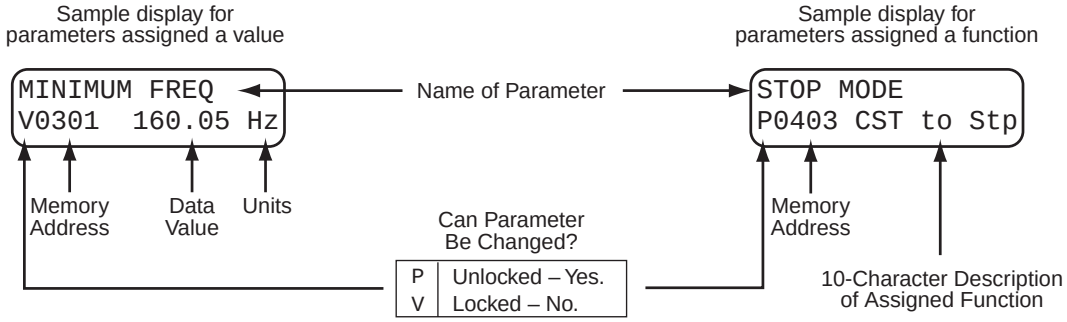


Figure 24
Standard Keypad Display for the Two Types of Parameters

NOTE: The display of the memory address is optional, and by default is not shown. Parameter **Show Param #** sets whether the address is displayed; see page 129.

To program a parameter's value in Level 2 programming, perform the following steps:

1. Press SHIFT+PROG to initiate Level 2 programming.

   The Operate display will change to the list of parameters groups. An arrowhead indicates which one is selected.

2. If the desired parameter group is indicated by the arrowhead, press ENTER to select the groups and display the parameters in that group. If the indicated group is not the one you want to program, use the up or down arrow keys to move the arrowhead to the desired group, and then press ENTER to select the group and display its parameters.

3. If the desired parameter is indicated by the arrowhead, press ENTER to select the parameter and display its current value. If the indicated parameter is not the one you want to program, use the up or down arrow keys to move the arrowhead to the desired parameter, and then press ENTER to select the parameter and display its current value.

   After the ENTER key is pressed, the value for the parameter will be displayed. The WF2 drive uses two types of parameters. One type is assigned a numerical value, while the second type is assigned a function. See figure 24 for how the two types of parameters are displayed.

4. If the parameter is unlocked, use the up or down arrow keys to change the parameter's value to the desired value.

5. Press ENTER to save the new value. (If you do not wish to save the new value, press SHIFT to return to the list of parameters or PROG to return to the Operate mode.)

6. The list of parameters will now be shown. You may select another parameter, or you may return to the list of parameter groups by pressing SHIFT. If you are finished programming and wish to return to the Operate mode, press PROG.

Active Fault/Warning and Fault History Mode

When a fault or warning occurs, the Operate mode automatically changes to the Active Fault mode. The drive stores up to three active faults or warnings, and provides a separate display for each. Figure 25 provides a sample display for an active fault.

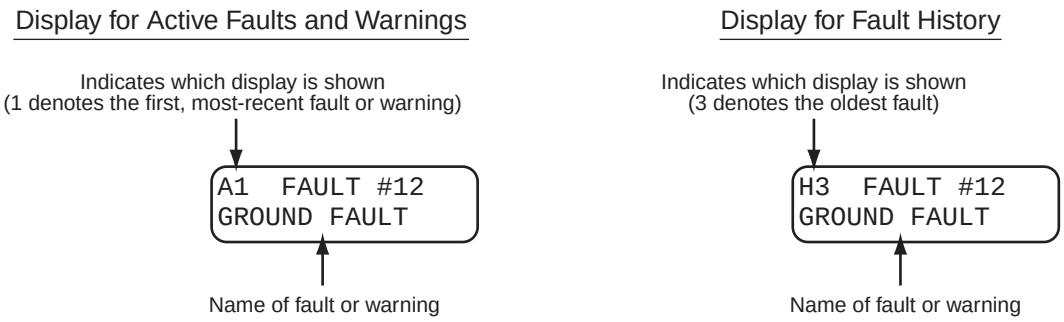


Figure 25
Display for Active Faults and Warnings

Once the active fault display is shown, you must correct the condition causing the fault and then reset the drive to return to the Operate mode. However, if all three active fault displays only show warnings, you may return to the Operate mode by pressing SHIFT+ENTER.

In addition to the active faults, the drive maintains a history of faults. The three most-recent faults are kept in the fault history log. The log is accessed by pressing SHIFT+ENTER. As shown figure 25, the display is the same as for active faults, except that an H is shown in the upper left corner. (See table 29 on page 141 for a description of fault codes.)

After viewing the fault history log, return to the Operate mode by pressing SHIFT+ENTER.

6.2.4 Description of the LEDs on the Standard Keypad

The display window on the digital keypad has five LEDs. The LEDs provide information about the drive's operating condition as shown in the table below:

LED Name	Duration	Operating Condition
RUN	Continuous	The WF2 drive is operating.
WARNING	Continuous	Abnormal operation is detected, but the abnormality is not severe enough to cause a fault.
FAULT	Continuous	Abnormal operation is detected, but the abnormality is greater than a warning. The drive will halt operation when a fault is detected.
PROG	Continuous	The drive is ready to be programmed.
	Flashing	The drive is ready to be reflashed (see chapter 6.2.5 (Upgrading Firmware by Reflashing), page 59).
POWER	Continuous	The drive is powered-up.

6.2.5 Upgrading Firmware by Reflashing

The firmware of the WF2 Sensorless Vector Drive can be upgraded by a process called “reflashing.” This allows the latest features to be implemented in existing hardware. For more information on this capability, refer to Form 1232, “Reflash Procedures for the E-trAC WF2 Series Sensorless Vector Drive”.

6.3 Quick Start

This section is for those users who would like to get up and running quickly without extensive research through this manual. For a quick start, follow these steps:

1. Read sections 5.1 through 5.4 as well as 6.1 and 6.2 before proceeding.

   In many cases, your drive will perform perfectly without making any changes to the factory settings.

   The factory setting is for the drive to run a typical NEMA B induction motor to a maximum speed of 60.00 Hz with acceleration and deceleration times of 3 s. The jog frequency is set for 5.0 Hz. The REV key on the keypad is disabled.

2. Perform all procedures for installation as specified in section 4. **Double-check that the proper voltage is available for the drive before applying power.**

3. Apply AC power to the input terminals.

   For approximately 1 s, the display will indicate the model number of the unit along with the MCP software revision number. If an enhanced keypad is connected to the unit, the software revision number for the keypad will also be shown. After showing this information, the display will change to that for the Operate mode, and only the Power LED will be lit.

4. Press the FWD key on the keypad.

5. Press the up arrow key to increase the desired running frequency.

   When the motor starts to turn, check the direction of rotation. If the motor is turning in the wrong direction, stop the drive. Remove AC power and wait five minutes. Then reverse any two motor leads at M1, M2, or M3, and restore AC power.

Use the up and down arrow keys, along with the STOP and FWD keys, to control the operation of the drive.

6.4 Description of the Enhanced Keypad

6.4.1 Introduction

The WF2 enhanced keypad is standard with NSF-certified models and optional on other models rated 11 kW and above. The enhanced keypad is also available for use in hand-held and remote door-mount installations; see section 9 for further information. It offers a significantly different look and feel for programming. It also allows you to monitor important WF2 parameters. Figure 26 shows the enhanced keypad.

The enhanced keypad provides a 4 line by 16 character display (twice as large as that found on the standard keypad), three LEDs for status information, a 0–9 numeric keypad (with decimal), and several function keys that are used for navigation and control. The following sections describe the keys found on the enhanced keypad and explain how to navigate to various displays.

6.4.2 Keys on the Enhanced Keypad

Table 25 on page 61 describes the functions of the keys found on the enhanced keypad when the keypad is the active control source.

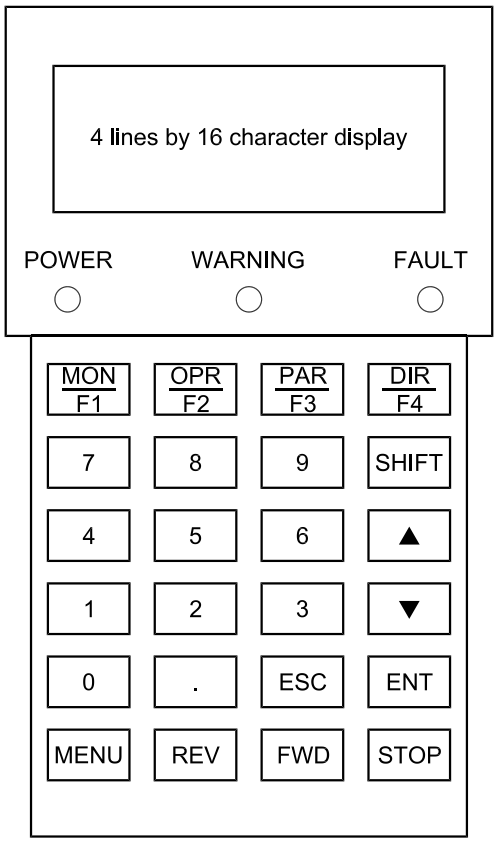


Figure 26
The Enhanced Keypad for WF2 Drives

Key	Description
MON / F1	This key performs two functions: • When pressed by itself, it acts as the F1 function key, the function of which is defined by parameter **F1 Key Config** (see page 129). • When SHIFT is pressed at the same time as this key, the keypad enters Monitor Mode (see page 62 for more information on this mode).
OPR / F2	This key performs two functions: • When pressed by itself, it acts as the F2 function key, the function of which is defined by parameter **F2 Key Config** (see page 129). • When SHIFT is pressed at the same time as this key, the keypad enters Operate Mode (see page 62 for more information on this mode).
PAR / F3	This key performs two functions: • When pressed by itself, it acts as the F3 function key, the function of which is defined by parameter **F3 Key Config** (see page 129). • When SHIFT is pressed at the same time as this key, the keypad enters Parameter Mode (see page 63 for more information on this mode).
DIR / F4	This key performs two functions: • When pressed by itself, it acts as the F4 function key, the function of which is defined by parameter **F4 Key Config** (see page 129). • When SHIFT is pressed at the same time as this key, the keypad enters Direct Parameter Access Mode (see page 65 for more information on this mode).
0 – 9 .	When the keypad is in the Direct Parameter Access Mode, the numeric keypad allows you to set the value of a parameter by keying in the value rather than by scrolling to the desired value.
▲	The function of this key, the up arrow key, is dependent on the mode of the keypad: • In modes other than programming, the up arrow key moves the arrowhead from one menu selection to the next selection. • When programming the value of a parameter, it increases the value of the parameter. If the key is held down, the rate of scrolling will increase. The rate of scrolling will increase still further if the SHIFT key is pressed along with the up arrow key.
▼	The function of this key, the down arrow key, is dependent on the mode of the keypad: • In modes other than programming, the down arrow key moves the arrowhead from one menu selection to the previous selection. • When programming the value of a parameter, it decreases the value of the parameter. If the key is held down, the rate of scrolling will increase. The rate of scrolling will increase still further if the SHIFT key is pressed along with the down arrow key.
ESC	The ESC key is used to discard any changes made and move up one level.
ENT	The ENT key is used to save the new value of a parameter. After saving the new value, the display moves up one level.
MENU	This key causes the Menu Display to be shown, from which other keypad modes may be selected. See page 66 for more information.

Table 25
Functions of the Keys on the Enhanced Keypad

Key	Description
REV	The REV key, if enabled by parameter **Reverse Mode** (see page 85), commands the motor to begin running in the Reverse direction.
FWD	The FWD key commands the motor to begin running in the Forward direction.
STOP	The STOP key, if enabled by parameter **Stop Key** (see page 88), commands the motor to stop using the type of stop configured by parameter **Stop Mode** (see page 84) and using the active deceleration ramp. If a fault occurs, the STOP key resets the fault.

Table 25
Functions of the Keys on the Enhanced Keypad

6.4.3 Modes and Displays of the Enhanced Keypad

The enhanced keypad provides a variety of modes to assist you in monitoring and controlling a WF2 drive. The principal modes of the enhanced keypad are as follows:

- The Operate Mode
- The Monitor Mode
- The Parameter Mode
- The Direct Parameter Access Mode
- The Menu Display Mode

This section describes each of the modes and the displays that are shown for each.

Note, that while each display is specially tailored to the mode in which its shown, the fourth line of the display is common to all modes except the Operate Mode. The fourth line shows status information (drive status, output frequency, and active control source). Figure 27 on page 63 shows the fourth line of the display along with the codes that may appear on this line and what each means.

The Operate Mode

The Operate Mode is the primary mode of the enhanced keypad. The keypad automatically enters this mode after power-up and a short delay. In this mode, operational information about the WF2 drive is displayed. From this mode, you may branch to other modes either via the Menu Display Mode or by pressing one of the navigation keys on the keypad. To return to this mode from other modes, press SHIFT+OPR/F2.

Figure 28 on page 64 shows a sample display of the Operate Mode along with the various codes that may be displayed and what each means.

The Monitor Mode

In Monitor Mode, you may observe the value of selected parameters while the WF2 drive is running. This mode is activated by pressing SHIFT+MON/F1, or by navigating to this mode from the Menu Display Mode.

The parameters that may be monitored are as follows:

- **Output Freq**
- **Output Current**
- **Drive Temp**
- **Out Torque (%)**
- **Active Spd Ref**
- **Output Voltage**

- **Drive Load**
- **Motor Temp**
- **Output Power**
- **Motor RPM**
- **Out Torque (Nm)**

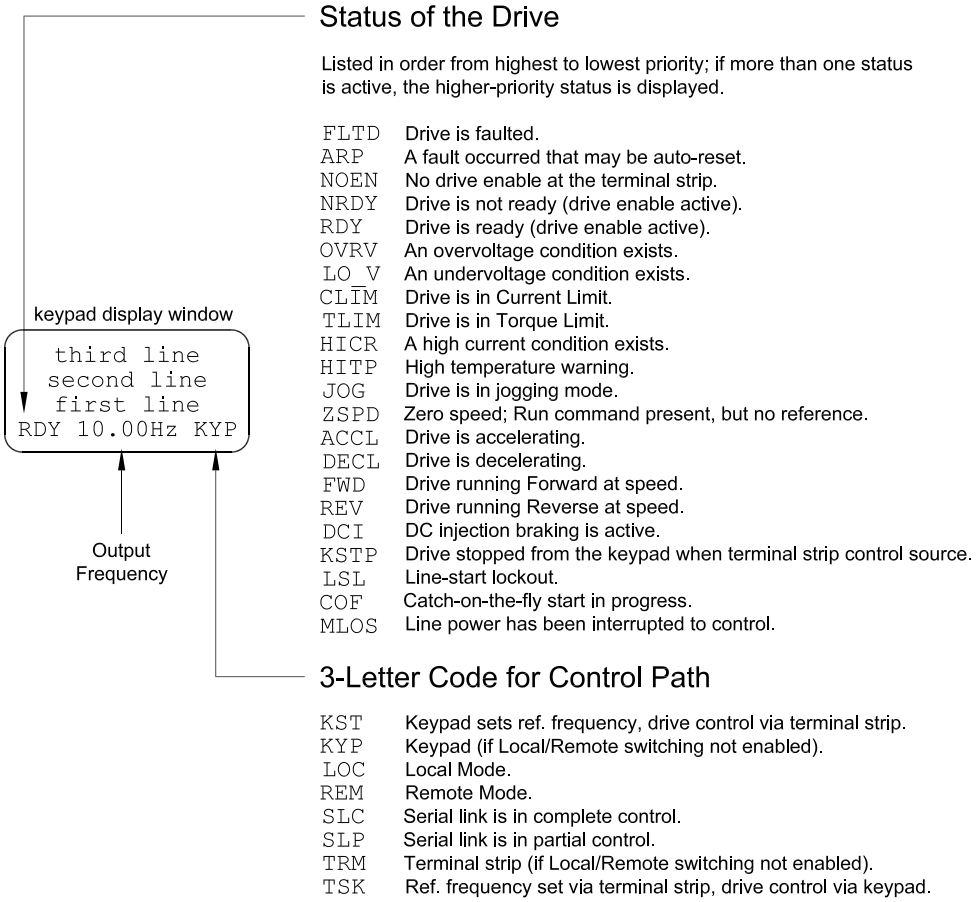
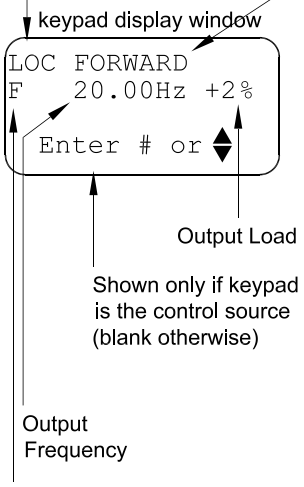


Figure 27
Common Status Line for Displays in All Modes Except the Operate Mode

When this mode is first entered, the current value of parameter **Output Freq** will be shown. To view the other parameter values, use the down arrow key to scroll through the parameters. (Of course, you may use the up arrow key to return to a parameter shown earlier.)

The Parameter Mode

In the Parameter Mode, you may configure the value of a parameter by scrolling. This manner of configuration is similar to that with the standard keypad. You may access this mode by pressing SHIFT+PAR/F3 or by selecting “Parameter Mode” from the Menu Display Mode.



3-Letter Code for Control Path

KST	Keypad sets reference frequency, drive control via terminal strip.
KYP	Keypad (if Local/Remote switching not enabled).
LOC	Local Mode.
REM	Remote Mode.
SLC	Serial link is in complete control.
SLP	Serial link is in partial control.
TRM	Terminal strip (if Local/Remote switching not enabled).
TSK	Reference frequency set via terminal strip, drive control via keypad.

Status of the Drive

Listed in order from highest to lowest priority; if more than one status is active, the higher-priority status is displayed.

FAULTED	Drive is faulted.
AUTO-RESET	Drive is faulted, but an automatic re-start is pending.
NO DRV EN	No drive enable.
NOT READY	Drive is not ready (drive enable active).
READY	Drive is ready (drive enable active).
OVERVOLTAGE	Input voltage is too high.
LOW VOLTAGE	Input voltage is too low.
CURRENT LIM	Drive is in Current Limit.
TORQUE LIM	Drive is in Torque Limit.
HI CURRENT	High-current warning.
HI TEMP	High-temperature warning.
JOG	Jog operation is active.
ZERO SPEED	Run command active, but no reference.
ACCELERATE	Drive is accelerating.
DECELERATE	Drive is decelerating.
FORWARD	Drive is at speed in Forward direction.
REVERSE	Drive is at speed in Reverse direction.
DC INJECT	DC injection braking is active.
KPAD STOP	Drive stopped from the keypad.
LS LOCKOUT	Line-start lockout.
FLY CATCH	Catch-on-the-fly start in progress.
MAINS LOSS	Power is not being applied to mains input (that is, it's feeding via the DC bus).

Mode

F	Running Forward.
R	Running Reverse.
S	Reference freq. being set.
–	Drive is stopped.

Figure 28
Enhanced Keypad Display and Information Shown for the Operate Mode

To configure the value of a parameter in this mode, follow these steps:

1. When the Parameter Mode is first entered after power-up, the parameter groups will be listed in the order shown in table 27 on page 75 starting with the first group, Security. On subsequent entries to this mode, the parameter groups will appear in the same order but will start with the last parameter group accessed.
2. Use the down arrow key to move the cursor down the list until the desired parameter group is reached.
3. Press ENT.
4. The parameters in the selected parameter group will now be displayed starting with the first parameter in the group. Use the down arrow key to scroll to the desired parameter.
5. Press ENT.
6. The value of the parameter will now be shown on the second line of the display. Note that this value may be an actual number (such as 120 Hz) or a function (such as 2-wire). If the value is an actual number, the fourth line will show the range for the parameter. If the value is a function, a range is not provided. Typical displays for parameter values are shown below:

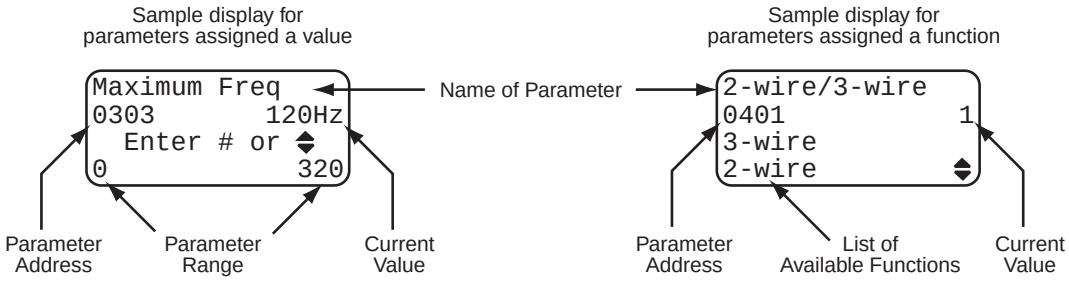


Figure 29
Enhanced Keypad Display of the Two Types of Parameters

7. Change the displayed value to the desired value. For parameters that configure a function, use the up or down arrow key to move the cursor to the desired function and then press ENT. Note that the second line does not show the function just configured; instead it shows a number corresponding to its position in the function list (with 0 being the first function listed). For example, in figure 29, the number 1 for the current value indicates that 2-wire is selected, not 3-wire.

   For parameters that are assigned a value, you may also scroll to the desired value by using the up and/or down arrow keys and then pressing ENT to store the new value. Alternately, you could use the numeric keypad to type the parameter's value.

   With either type of values, if you change your mind and do not wish to save the selected value (and you have not yet pressed ENT), press ESC to abort and return to the display showing the parameters in the parameter group.

8. After configuring the value of the parameter, the list of parameters will return to the display. You may now select another parameter from the same group to configure, or press ESC to return to the list of parameter groups. To return to the Operate Mode, press SHIFT+OPR/F2 (or navigate to it via the Menu Display mode).

The Direct Parameter Access Mode

In the Direct Parameter Access Mode, you may navigate directly to a parameter by entering the parameter's address. (Parameter addresses are shown in section 7 and 11.) You access this mode by pressing SHIFT+DIR/F4 or by selecting "Direct Params" from the Menu Display Mode. Once this mode is active, you may enter a new value for the parameter by keying in the value on the numeric keypad (rather than scrolling to the desired value). Note that if no keys are pressed for 10 minutes while this mode is active, the drive will automatically revert to the Operate mode.

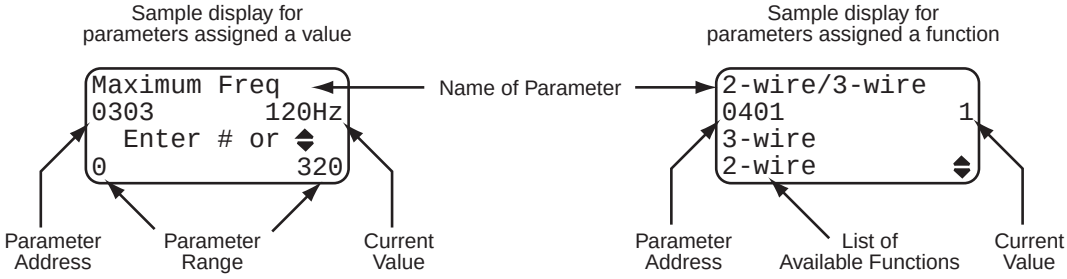
To configure the value of a parameter in this mode, follow these steps:

1. When the Direct Parameter Access Mode is entered, the display will ask you for the address of the desired parameter number as shown below:

```
Direct Params
 Param Number?
XXXX
RDY  30.00Hz LOC
```

2. Obtain the parameter address from chapter 11 and type the address. As you type the address, it will appear on the third line of the display.
3. Press ENT.

4. The parameter will be displayed and will show its current value. Note that this value may be an actual number (such as 120 Hz) or a function (such as 2-wire). If the value is an actual number, the fourth line will show the range for the parameter. If the value is a function, a range is not provided. Typical displays for these two types of parameter values are shown below:



5. Change the displayed value to the desired value. For parameters that configure a function, use the up or down arrow key to move the cursor to the desired function and then press ENT. Note that the second line does not show the function just configured; instead it shows a number corresponding to its position in the function list (with 0 being the first function listed).

   For parameters that are assigned a value, use the numeric keypad to key in the parameter's value. (Alternately, you may scroll to the desired value by using the up or down arrow keys.)

6. Press ENT to save the new value. (If you do not wish to save the selected value, press ESC to abort and return to the display showing the parameters in the parameter group.)

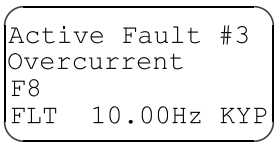
7. After configuring the value of the parameter, the list of parameters will return to the display. You may now select another parameter to configure, or press ESC to return to the list of parameter groups. To return to the Operate Mode, press SHIFT+OPR/F2 (or navigate to it via the Menu Display mode).

The Menu Display Mode

The Menu Display Mode may be thought of as the hub on which all the other modes are mounted. Once you navigate to this mode by pressing the MENU key on the keypad, you may highlight the desired mode (by pressing the up or down arrow key) and then pressing the ENT key. The selected mode will then become active, and the display for the mode will be shown on the keypad.

The Active Faults Mode

When a fault occurs, the Active Faults mode automatically activates. The display for Active Faults shows the phrase "Active Fault" followed a sequential number. The second line shows the description of the fault, while line three shows the fault code number. (See table 29 on page 141 for a list of fault descriptions and codes, as well as suggestions for recovering from the fault condition.) A typical display would appear as follows:



To recover from a fault, correct the condition causing the fault and then press STOP.

The Fault History Mode

The enhanced keypad stores the four most-recent faults, and these are viewed in the Fault History mode. This mode is accessed by navigating to the Menu Display Mode and then selecting Fault History.

The display for Fault History shows the phrase “Fault Hist” followed a sequential number, with number 1 indicating the most-recent fault. The second line shows the description of the fault, while line three shows the fault code number. (See table 29 on page 141 for a list of fault descriptions and codes, as well as suggestions for recovering from the fault condition.)A typical display would appear as follows:

```
Fault Hist #1
Motor Overload
F20
RDY  10.00Hz KYP
```

Upload/Download Mode

For MCP software revisions of 3.71 or greater and enhanced keypads with software revision 4.00 or greater, an enhanced keypad (EKP) may be used to store a complete parameter set from a WF2 drive. This becomes particularly useful when using an enhanced keypad as a hand-held controller/programmer.

To use this facility, the customer's parameter set must first be stored in the WF2 via parameter **Param STO/RCL**. The customer set of parameters may then be uploaded to the EKP for transport to another WF2 drive.

To upload the parameter set, perform the following steps:

1. On the EKP, press the MENU button.
2. Use the cursor to navigate to the keypad setup screen.
3. Press ENT.
4. Highlight the option entitled “UPLoad EEPROM”, which is the upload parameter.
5. Press the ENT key twice to execute the upload operation. During the transfer, the display looks like this:

   DRV>>>>EKP

   When the upload completes successfully, line 3 of the keypad will show “STORED” and line 4 will provide a BERGES application number such as “w01V131”. If the upload is not successful, the display will indicate “Flash Prog Error”.

You may now connect the EKP to the WF2 drive to which the parameter set will be downloaded. To download the parameter set, perform the following steps:

1. On the EKP, press the MENU button.
2. Use the cursor to navigate to the keypad setup screen.
3. Press ENT.
4. Highlight the option entitled “DNload EEPROM”, which is the download parameter.
5. Press the ENT key twice to execute the download operation. When the download operation starts, the display will show the following information:

   The model number of the source drive - for example, WF2C1S010;
   The MCP code revision of the source drive - for example, MCP3.90; and
   The application number being transferred - for example, W01V131.

   During the download operation, the display will indicate:

EKP>>>>DRV

6. Once the download operation is complete, activate the downloaded parameter set in the destination drive by loading it from the stored customer set. To accomplish this, navigate to parameter **Param STO/RCL** and select “Load Param”. The downloaded parameter will then become the active parameter set.

NOTE:

Some model specific adjustments may be required if the model number of the source and destination drives are not identical.

6.4.4 LEDs on the Enhanced Keypad

The enhanced keypad features three LEDs to provide status information. The following table describes these three LEDS.

LED Name	Duration	Operating Condition
POWER	Continuous	The drive is powered-up.
WARNING	Continuous	Abnormal operation is detected, but the abnormality is not severe enough to cause a fault.
FAULT	Continuous	Abnormal operation is detected, but the abnormality is greater than a warning. The drive will halt operation when a fault is detected.

6.5 Security

6.5.1 Access Levels

The WF2 drive allows you to configure access levels to prevent unauthorized access. Two levels of access are available:

- Configure Access – a user may read all WF2 parameters, and configure the non-read-only parameters, provided the drive is stopped. This is the default setting for access.
- Configure Run Access – a user may read all WF2 parameters, and configure the non-read-only parameters, whether the drive is running or stopped (although some parameters may only be configured if the drive is stopped).

An access level is assigned by setting the value of parameter **Access Level** found in the Security Group; see page 76 for more information on this parameter. The password (actually, a four-digit “pass-number”) for the security level is set by parameter **Set Password**; see page 76.

6.5.2 Gaining Access when Security Enabled

Standard Keypad

When security is enabled and the PROG key or SHIFT+PROG keys are pressed to enter programming mode, all parameters (except the **Enter Password** parameter) will be locked.

To unlock the parameters that are available at the configured security level, press SHIFT+PROG to initiate Level 2 programming and then navigate to the **Enter Password** parameter, which is in the Security Group.

Once this parameter is displayed, press the up or down key to set the displayed value to the value of the password, and then press the Enter key.

After the Enter key is pressed, the drive compares the value of **Enter Password** with that in the **Set Password** parameter. If they match, the user is granted access at the level set by the **Access Level** parameter. (If they do not match, access is granted, but with Read-Only status.)

Note that if the WF2 drive is power-cycled while the parameters are unlocked or if the Programming mode reverts to the Operate mode due to inactivity, the parameters will become locked again. You must re-enter the password to configure the settings of the accessible parameters.

Enhanced Keypad

When a user attempts to navigate to the Parameter mode or Direct Parameter Access mode, a prompt will appear asking for the password. Type the password and press ENTER. If the password is accepted, the desired mode is entered.

Note that if the WF2 drive is power-cycled while the parameters are unlocked or if the Parameter mode or Direct Parameter Access mode reverts to the Operate mode due to inactivity, the parameters will become locked again. You must re-enter the password to configure the settings of the accessible parameters.

6.5.3 Disabling Security

Standard Keypad

To disable security, perform the following steps:

1. Unlock all available parameters.

   This is accomplished by pressing SHIFT+PROG to initiate Level 2 programming and then navigating to the **Enter Password** parameter. Once the parameter is displayed, use the up or down arrow keys to set the displayed value to the value of the password, and then press the Enter key. If the correct password is entered, all parameters at the configured security level will be available.

2. Navigate to the **Set Password** parameter, which is also in the Security Group. Set the displayed value of this parameter to zero, and then press the Enter key.

3. Navigate to the **Enter Password** parameter, which is also in the Security Group. Set the displayed value of this parameter to zero, and then press the Enter key.

4. Security is now disabled. All parameters, not just those of the configured security level, will be available for programming.

Enhanced Keypad

To disable security with the enhanced keypad, navigate to the **Set Password** parameter in the Security group and set the value of this parameter to 0.

6.6 Control Paths

6.6.1 Overview of Control Paths

Control paths are the means for sending the frequency (speed) reference and start/stop commands to the WF2 drive. The control path may be the same for both the frequency reference and start/stop commands, or different paths may be used for each.

The WF2 drive provides three control paths: the keypad (either standard or enhanced), the terminal strip, and the serial link. The table below further elaborates these control paths.

Control Path	Frequency Reference	Start/Stop Commands
Keypad	When in the Operate mode, the up and down keys are used to set the frequency.	When in the Operate mode, the FWD, REV, and STOP keys control the drive.
Terminal Strip	A combination of analog and digital inputs sets the frequency.	A combination of analog and digital control the drive.
Serial Link	Commands arriving via remote communications set the frequency.	Commands arriving via remote communications control the drive.

Table 26
WF2 Control Paths

You may determine which control paths are currently active by reading two parameters. These read-only parameters are **Freq Ref Ctrl** and **Start Stop Ctrl**; see page 80 for more information on these parameters.

6.6.2 Selection of Control Paths

The WF2 drive provides two methods for selecting the control path for the frequency reference and start/stop commands.

Method 1: Selection via Parameters Terminal/Keypad and Cntl Word 1

The first method is to set the **Terminal/Keypad** parameter to a value that corresponds to the desired control path or override this parameter by setting bits 0 and/or 1 of parameter **Cntl Word 1** to 1 to allow the serial link to be used to select the control path.

As shown on page 85 where the **Terminal/Keypad** parameter is described, the first four functions for this parameter allow you to select the control path directly (in the first two functions, the control path is the same for frequency reference and start/stop commands; the next two functions permit different control paths for each):

Kypd-C & R: The keypad is both the source for control functions and for the reference frequency. The Operate display on the keypad shows KYP to denote this selection.

TS-C & R: Inputs to the terminal strip are the source for both control functions and the reference frequency. The Operate display on the keypad shows TRM to denote this selection.

KP-C/TS-R: The keypad is the source for control functions, while inputs to the terminal strip are the source for the reference frequency. The Operate display on the keypad shows KST to denote this selection.

TS-C/KP-R: Inputs to the terminal strip perform control functions, while the keypad is the source for the reference frequency. The Operate display on the keypad shows TSK to denote this selection.

These four settings are particularly useful when the application does not require a control path that can be altered “on the fly”. They assign the control path for the reference frequency and start/stop commands to either the keypad or the terminal strip, and this assignment cannot be altered except by re-configuring the **Terminal/Keypad** parameter.

The remaining functions that may be configured for the **Terminal/Keypad** parameter permit greater flexibility by allowing you to select the control path “on the fly”. These functions essentially configure a “switch” to select whether the keypad or the terminal strip is the control path. Note that this is an “either/or” selection - you cannot configure “mixed modes” as with the two settings described earlier (TS-C/KP-R and KP-C/TS-R). The last three functions that may be assigned to the **Terminal/Keypad** parameter are:

T/K by DI: A digital input is configured to switch between the keypad as the source for both the reference frequency and start/stop commands and inputs to the terminal strip as the source for both the reference frequency and start/stop commands. When the digital input is open or false, the control path is the keypad; when the digital input is closed or true, the terminal strip is the control path.

T/K by Fkey: A function key on the enhanced keypad is configured to switch the control path between the keypad and the terminal strip (see parameters **F1 Key Config** through **F4 Key Config** on page 129 for more information).

T/K by SerLnk: Serial communication is used to set bit 11 of parameter **Cntl Word 1** to 0 or 1. When bit 11 is set to 0, the control path is the keypad; when bit 11 is set to 1, the terminal strip is the control path.

The setting of parameter **Terminal/Keypad** may be overridden, which allows the serial link to be used to select the control path. This is accomplished by writing to bits 0 and 1 of parameter **Cntl Word 1**.

As described on page 133 where parameter **Cntl Word 1** is described, Bit 0 determines how the control path for start/stop commands is selected. When the bit is set to 0, the control path for start/stop commands is selected using the means set by parameter **Terminal/ Keypad**. When the bit is set to 1, the control path for start/stop commands is the serial link.

Similarly, Bit 1 determines how the control path for the reference frequency is selected. When the bit is set to 0, the control path for the reference frequency is selected using the means set by parameter **Terminal/Keypad**. When the bit is set to 1, the control path for the reference frequency is the serial link.

If only one of the two bits is set to 1, the Operate display will show SLP to denote that the serial link is only partially the control path. If both bits are set to 1, the Operate display will show SLC to denote that the serial link is entirely the control path.

Note that you may temporarily halt serial link control by configuring a digital input to perform the SLO (serial link override) function. When the configured digital input becomes true, the status of bits 0 and 1 are ignored, control via the serial link is halted, and the selection of the control path reverts to parameter **Terminal/Keypad**.

Method 2: Selection via Parameters Local/Remote, Local Config, and Remote Config

The second, alternate method is to set the **Local/Remote** parameter to a value other than None, with the other values for this parameter being the means to switch between Local and Remote modes. Once the means for switching modes is selected, the current mode and the settings of parameters **Local Config** and **Remote Config** determine the control path.

Note that if you use this method for specifying control paths, the SLO function is unavailable.

As described on page 86 where the **Local/Remote** parameter is described, three means are available to switch between Local and Remote modes:

L/R by DI: A digital input is configured to switch between Local and Remote modes. When the digital input is open or false, the drive is in Local mode; when the digital input is closed or true, the drive is in Remote mode.

L/R by Fkey: A function key on the enhanced keypad is configured to switch between Local and Remote modes (see parameters **F1 Key Config** through **F4 Key Config** on page 129 for more information).

L/R by SerLnk: Serial communication is used to switch between Local and Remote modes. When Bit 10 of parameter **Cntl Word 1** is set to 0, the drive is in Local mode; when Bit 10 is set to 1, the drive is in Remote mode.

The Operate display will show either LOC (Local) or REM (Remote) to denote what mode is currently active.

Once the drive is placed in Local or Remote mode, the settings of parameters **Local Config** and **Remote Config** (respectively) determine how the control path is selected.

As described on page 86, the following functions may be assigned to the **Local Config** parameter to specify the control path:

Kypd-C&R: The keypad is the control path for both the reference frequency and start/stop commands.

Ser-C&R: The serial link is the control path for both the reference frequency and start/stop commands.

Nm-R/Ser-C: The control path for the reference frequency is as defined by parameter **Terminal/Keypad**, while the serial link is the control path for start/stop commands.

Nm non-Ser: When Local mode is active, the control path for both reference frequency and start/stop commands is set by the **Terminal/Keypad** parameter (although control via the serial link may be asserted if desired); when Remote mode is active, the serial link is used to select the control path and cannot be overridden using the SLO bit of **Cntl Word 1**. (Note that this setting forces the **Remote Config** parameter to Serial Lnk.)

Similarly, as described on page 87, the following functions may be assigned to the **Remote Config** parameter to specify the control path:

TS-C&R: The terminal strip is the control path for both the reference frequency and start/stop commands.

Kpd-R/TS-C: The terminal strip is the control path for start/stop commands, while the keypad is the control path for the reference frequency.

TS-R/Kpd-C: The keypad is the control path for start/stop commands, while the terminal strip is the control path for the reference frequency.

Nm-R/Ser-C: The control path for the reference frequency is as specified by the **Terminal/Keypad** parameter, while the serial link is the control path for start/stop commands.

TS-C/Ser-R: The serial link is the control path for the reference frequency, while the terminal strip is the control path for start/stop commands.

Serial Lnk: When Local mode is active, the control path is set by the **Terminal/Keypad** parameter (although control via the serial link may be asserted if desired); when Remote mode is active, the serial link sets the control path and cannot be overridden using the SLO bit of **Cntl Word 1**. (This setting forces the **Local Config** parameter to Nm non-Ser.)

6.7 Serial Link Communication

The WF2 drive provides a serial link to support remote communication. The serial link supports ASCII or RTU communication utilizing Modbus protocol. Modbus functions 3, 6, and 16 are supported by the WF2 drive.

In addition, DeviceNet®, Metasys N2, and Siemens P1 protocols are supported by the WF2 drive. See page 145 for further information on the DeviceNet option. Consult BERGES for more information on the Siemens P1 and Metasys N2 options.

The communication interface is RS485, and allows up to 247 slaves to be connected to one master (with repeaters when the number of drops exceeds 31). The pin-out diagram for the Modbus communication port is shown in Figure 21 on page 52.

6.7.1 Configuration of the Serial Link

The Communication parameter group contains the parameters that govern the baud rate, watchdog timer, and protocol selection for the serial interface. See page 131 for information on the parameters in this parameter group.

All addresses from 1 to 247 are allowed for WF2 drives. Address 0 is a broadcast address understood by all drives; however, no reply is returned for messages sent to this address.

6.7.2 Parameter Addresses

Each parameter is assigned a unique memory address to permit easy reading and configuration. Section 7 and 11 list all WF2 parameters and the memory address assigned to each.

Note that for the standard keypad, by default parameter addresses are not shown. They may be displayed by setting **Show Param #** to Enabled (see page 129). For the enhanced keypad, addresses are always shown.

6.7.3 Drive Control via the Serial Link

As explained in Section 6.6 starting on page 69, the serial link may be configured to be the control path for the reference frequency, for start/stop commands, or for both. This is accomplished by setting Bit 0 and/or Bit 1 of parameter **Cntl Word 1** to 1. See section 6.6 for more information.

When either of these bits are set to 1, the SLO (serial link override) function also becomes available, which is used to temporarily halt serial link control of the drive (see the next section for more information on the SLO function).

Once Bit 1 is set to 1, the reference frequency is determined by Bit 4 of parameter **Cntl Word 1**. When this bit is set to 0, the value of parameter **Ext Freq Ref 1** determines the reference frequency; when the bit is set to 1, the value of parameter **Ext Freq Ref 2** determines the reference frequency.

6.7.4 Override of Serial Link Control

You may temporarily halt serial link control by assigning a digital input to perform the SLO (serial link override) function. See page 110 for information on configuring digital inputs.

When the digital input assigned to the SLO function becomes true, the status of Bit 0 and Bit 1 of parameter **Cntl Word 1** are ignored, serial link control is halted, and the control path reverts to that specified by parameter **Terminal/Keypad**.

Note that if serial link is explicitly assigned in either the **Local Config** or **Remote Config** parameter, the SLO function is not available. Should serial link control be lost, the drive will either fault (if the **Comm Timeout** parameter is set; see page 132) or will continue running at the last speed reference received.

7 Parameters

7.1 Introduction

The WF2 drive incorporates a large number of parameters that allow you to configure the drive to meet the special requirements of your particular application. The parameters are organized into groups of related functionality, and within the groups the parameters are identified by a short, descriptive name.

As described in the previous chapter, the parameters may be broadly grouped into two types: those assigned a value (such as the minimum frequency) and those assigned a function (such as the type of stop to be performed, either ramp or coast). The manner in which these two types are displayed is slightly different, as shown in figure 24 on page 57 (for the standard keypad) and figure 29 on page 65 (for the enhanced keypad).

This chapter describes the available parameters, the groups in which they are located, and the values or functions that may be assigned to them. Chapter 11 (starting on page 156) provides a summary of all parameters including their ranges and default values. This chapter also notes the memory address of each parameter, which is useful for serial communication.

7.2 Parameter Groups

The WF2 drive provides 23 parameter groups, all of which are accessible with either the standard or enhanced keypad (provided security conditions are met). (Note, however, that the last group – Seq Configure – only becomes available when parameter **Application** in the Special parameter group is set to “Sequencer” to make the Sequencer application available; see section 10 for more information on this application.)

In addition, for the standard keypad, a 24th group is also available. This group contains the most often needed parameters from the other 23 groups. This 24th group is available as Level 1 Programming, with the remaining 23 groups are available as Level 2 Programming. See page 55 for more information on these two levels of programming.

The names of the parameter groups are shown in table 27 on page 75. Note that the order in which the groups are shown in the table is from the first group displayed to the last, which corresponds to what is displayed as you scroll through the parameter groups with either keypad. For the standard keypad, table 28 on page 75 lists the parameters found in the Level 1 Programming group. Since these parameters are duplicates of those found in the other 23 parameter groups, see the noted page number for the description of the parameter.

Display Order	Displayed Group Name	See Page	Display Order	Displayed Group Name	See Page
1	Security	75	13	Braking Options	106
2	Drive ID	76	14	Digital Inputs	110
3	Drive Status	78	15	Analog Inputs	113
4	Input Status	81	16	Digital Outputs	117
5	Control Modes	83	17	Analog Outputs	120
6	Speed Reference	88	18	Fault Management	122
7	Ramps	92	19	Display Options	127
8	Preset Speeds	96	20	Special	130
9	Skip Freq	97	21	Communication	131
10	Torque Limits	98	22	PID Configure	135
11	Drive Output	100	23	Seq Configure	148
12	Motor Setup	103			

Table 27
The Parameter Groups for the WF2 Drive

Display Order	Parameter Name	See Page	Display Order	Parameter Name	See Page
1	Output Freq	78	11	Minimum Freq	88
2	Output Voltage	78	12	Maximum Freq	89
3	Output Current	78	13	Accel Time 1	92
4	Drive Load	78	14	Decel Time 1	92
5	Drive Temp	79	15	Preset Speed 1	96
6	DC Bus Voltage	79	16	Preset Speed 2	96
7	2-Wire/3-Wire	83	17	Preset Speed 3	96
8	Jog Mode	84	18	A1 Configure	113
9	Reverse Mode	85	19	R1 Configure	118
10	Terminal/Keypad	85	20	R2 Configure	118

Table 28
Parameters Available in Level 1 Programming (Standard Keypad Only)

7.3 Security Group

This parameter group allows you to configure security for the drive. See page 68 for more information on security.

Enter Password **Address: 0298**

If the **Set Password** parameter is set to a non-zero value, security is enabled and a user must enter a password to gain entry. The **Enter Password** parameter is set by the user to the value of the password, which is then compared to the value in the **Set Password** parameter. If they match, access is granted.

◊ Range: 0–9999 Default: 0

Set Password **Address: 0299**

If this parameter is set to a non-zero value, security is enabled. A user must enter the value of this parameter in the **Enter Password** parameter to program the parameters that are made available by the **Access Level** parameter.

◊ Range: 0–9999 Default: 0

Access Level **Address: 0297**

The WF2 drive provides two levels of access. This parameter sets which access level is enabled, which in turn determines which parameter groups may be accessed and adjusted.

The functions that may be assigned to this parameter, and what each signifies, are shown below:

Display	Function
Configure	You may read all parameters, and configure the non-read-only parameters, if the drive is stopped.
Config Run	You may read all parameters, and configure the non-read-only parameters, whether the drive is stopped or running, although some parameters (such as those for digital inputs) may only be configured when the drive is stopped.

◊ Range: see table Default: Configure

7.4 Drive ID Group

This parameter group shows information about the WF2 drive including its serial number and the versions of software installed.

Drive Type **(Read-Only)** **Address: 0999**

This parameter displays the type of drive. The following values may be displayed for this parameter:

Displayed Name	Type of Drive
WF2C	A constant-horsepower rated WF2 drive.
WF2K	A constant-kilowatt rated WF2 drive.
WF2C(N)	A constant-horsepower rated, NSF-certified WF2 drive.
WF2K(N)	A constant-kilowatt rated, NSF-certified WF2 drive.

◊ Range: – Default: –

Catalog Number **(Read-Only)** **Address: 0001**

This parameter contains the portion of the WF2 model number related to voltage and horsepower. The number has the format vvhhf, where vv is the code for the input voltage (19 = 115 V AC singlephase; 29 = 230 V AC, single-phase; 20 = 230 V AC, three-phase; 40 = 460 V AC, three-phase; 50 = 575 V AC, three-phase), hh is the horsepower, and f is the fractional part of the horsepower.

For example, 29010 indicates a 230 V AC, single-phase, 1.0 HP model.

◊ Range: 0–65535 Default: –

Serial No 1 **(Read-Only)** **Address: 0005**

This parameter contains a four-digit number that corresponds to the year and week in which the WF2 drive was manufactured.

◊ Range: 0–9952 Default: –

Serial No 2 **(Read-Only)** **Address: 0006**

This parameter contains a four-digit number that is the remainder of the serial number (parameter **Serial No 1** is the first part of the number; see above).

◊ Range: 0–32767 Default: –

MCP Sw Version **(Read-Only)** **Address: 0007**

This parameter shows the version of the Motor Control Processing (MCP) program loaded in the WF2 drive.

◊ Range: 0.00–327.67 Default: –

TSP Sw Version **(Read-Only)** **Address: 0009**

This parameter shows the version of the user interface software loaded in the drive.

◊ Range: 0.00–327.67 Default: –

Appl Sw Version **(Read-Only)** **Address: 0010**

This parameter shows the version of the application software loaded in the WF2 drive.

◊ Range: 0.00–327.67 Default: –

Drive Temp Trip **(Read-Only)** **Address: 0015**

When the temperature of the heatsink (as found in parameter **Drive Temp**; see page 79) exceeds the value set in parameter **Drive Temp Lvl** (see page 119), a warning will be given. If the temperature exceeds the value set in this parameter (**Drive Temp Trip**), an overtemperature fault will occur and the drive will stop.

◊ Range: 0–125 °C Default: –

Drv Nom Current **(Read-Only)** **Address: 0013**

This parameter shows the nominal current of the WF2 drive.

◊ Range: 0–250 A Default: –

Comm Option **(Read-Only)** **Address: 0003**

This parameter shows the type of communication option board attached to the WF2 drive. The following values may be displayed for this parameter:

Displayed Name	Type of Communication Board
None	A communication board is not attached to the WF2 drive.
DeviceNet	A DeviceNet Option Board is attached to the WF2 drive.
Siemens P1	A Siemens P1 communication board is attached to the drive.
Metasys N2	A Metasys N2 communication board is attached to the drive.

◊ Range: see table Default: –

Option Board (Read-Only) Address: 0004

This parameter shows whether an option board is attached to the WF2 drive by identifying the type of option board installed. The following values may be displayed for this parameter:

Displayed Name	Type of Option Board
None	An option board is not attached to the WF2 drive.
WF2AIO-01	The WF2AIO-01 option board is attached to the drive.

◊ Range: – Default: –

7.5 Drive Status Group

This parameter group contains parameters that are concerned with the basic operating values of the WF2 drive and attached motor.

Output Freq (Read-Only) Address: 0020

This parameter contains the frequency output to the motor. It is not modified by slip compensation (parameter **Slip Comp**; see page 102).

◊ Range: 0.00–320.00 Hz Default: –

Output Voltage (Read-Only) Address: 0022

This parameter shows the voltage being output to the motor.

◊ Range: 0 V to Line Voltage Default: –

Output Current (Read-Only) Address: 0023

This parameter contains the current output to the motor.

◊ Range: 0 to 250% of Drive Rating in Amps Default: –

Drive Load (Read-Only) Address: 0024

This parameter shows the percentage of maximal load relative to the drive's capacity.

◊ Range: –250%...+250% Default: –

Drive Temp **(Read-Only)** **Address: 0025**

This parameter shows the actual temperature of the drive's heatsink. Note that an overtemperature fault will be generated when the heatsink temperature reaches the value of parameter **Drive Temp Trip** (see page 77). If desired, you may configure a digital output to change state when the temperature exceeds the value of parameter **Drive Temp Lvl** – which, in effect, allows you to configure a warning of an impending overtemperature fault.

◊ Range: –20...125 °C Default: –

DC Bus Voltage **(Read-Only)** **Address: 0026**

This parameter shows the DC bus voltage.

◊ Range: 0–1000 V DC Default: –

Motor Temp **(Read-Only)** **Address: 0027**

This parameter shows the estimated temperature of the motor as a percentage of the theoretical thermal capacity of the motor. The estimated temperature and the thermal capacity are derived from a thermal model that utilizes the parameter values found in the Motor Setup Group (see page 103) and on the estimated load on the motor.

◊ Range: 0–250 °C Default: –

Out Torque (%) **(Read-Only)** **Address: 0028**

This parameter shows the estimated torque being supplied to the motor as a percentage of the nominal motor torque. The estimation is based on the parameter values found in the Motor Setup Group (see page 103) and on the estimated load on the motor.

◊ Range: –250%...+250% Default: –

Out Torque (Nm) **(Read-Only)** **Address: 0039**

This parameter shows the estimated torque being supplied to the motor in Newton meters (Nm), with precision equal to 0.1 Nm. The estimation is based on the parameter values found in the Motor Setup Group (see page 103) and on the estimated load on the motor.

◊ Range: varies Default: –

Output Power **(Read-Only)** **Address: 0029**

This parameter shows the power being delivered to the motor, which is derived from the parameter values of the Motor Setup group and the estimated load on the motor.

◊ Range: 0–250% Default: –

Active Spd Ref **(Read-Only)** **Address: 0031**

This parameter shows the speed reference that is currently in use. The source for the setting of the speed reference may be from the keypad, the terminal strip, or the serial link depending on the configuration of parameters **Terminal/Keypad** (see page 85) and **Local/Remote** (see page 86).

◊ Range: 0.00–320.00 Hz Default: –

Motor RPM	(Read-Only)	Address: 0033

This parameter contains the estimated current speed of the motor in revolutions per minute. The estimation is based on the parameter values found in the Motor Setup Group (see page 103) and on the estimated load on the motor.

◊ Range: 0–5000 RPM Default: –

Start Stop Ctrl	(Read-Only)	Address: 0053

This parameter shows the active source for Start/Stop control. It is highly dynamic, and changes as online conditions change. If you read this parameter via the serial link, 0 indicates the terminal strip; 1 indicates the keypad; and 2 indicates the serial link.

◊ Range: – Default: –

Freq Ref Ctrl	(Read-Only)	Address: 0054

This parameter shows the active source for the setting of the reference frequency. It is highly dynamic, and changes as online conditions change. If you read this parameter via the serial link, 0 indicates the terminal strip; 1 indicates the keypad; and 2 indicates the serial link.

◊ Range: – Default: –

Drive Lifetime	(Read-Only)	Address: 0890
Drv Life Format	(Read-Only)	Address: 0891

These parameters work together to display the number of days that the WF2 drive has been under power. When this parameter is read from a keypad, the display will show the number of days properly formatted. However, when the parameter is read via serial communication, you must also read parameter **Drv Life Format** to properly format the value. To format the value, divide the value shown for parameter **Drive Lifetime** by:

- 1 if parameter **Drv Life Format** is 50;
- 10 if parameter **Drv Life Format** is 51; or
- 100 if parameter **Drv Life Format** is 52.

The value of the **Drive Lifetime** parameter cannot be reset.

◊ Range: 0–65535 **Drive Lifetime** Default: –

◊ Range: 50, 51 or 52 **Drv Life Format** Default: –

Elapsed Runtime	(Read-Only)	Address: 0892
Runtime Format	(Read-Only)	Address: 0893

These parameters work together to display the number of hours that the WF2 drive has been operating. When this parameter is read from a keypad, the display will show the number of hours properly formatted. However, when the parameter is read via serial communication, you must also read parameter **Runtime Format** to properly format the value. To format the value, divide the value shown for parameter **Elapsed Runtime** by:

- 1 if parameter **Runtime Format** is 50;
- 10 if parameter **Runtime Format** is 51; or
- 100 if parameter **Runtime Format** is 52.

The **Elapsed Runtime** parameter's value may be reset by setting parameter **Program Number** to 10.

◊ Range: 0–65535 **Elapsed Runtime** Default: –

◊ Range: 50, 51 or 52 **Runtime Format** Default: –

MWh Lifetime	(Read-Only)	Address: 0894
MWh Life Format	(Read-Only)	Address: 0895

These parameters work together to display the amount of power that the WF2 drive has consumed over its lifetime. When this parameter is read from a keypad, the display will show the amount of power consumed properly formatted. However, when the parameter is read via serial communication, you must also read parameter **MWh Life Format** to properly format the value. To format the value, divide the value shown for parameter **MWh Lifetime** by:

- 10 if parameter **MWh Life Format** is 51;
- 100 if parameter **MWh Life Format** is 52; or
- 1000 if parameter **MWh Life Format** is 53.

The value of the **MWh Lifetime** parameter cannot be reset.

◊ Range: 0–65535 **MWh Lifetime** Default: –

◊ Range: 51, 52, or 53 **MWh Life Format** Default: –

Elapsed MWh	(Read-Only)	Address: 0896
MWh Format	(Read-Only)	Address: 0897

These parameters work together to display the amount of power that the WF2 drive has consumed since parameter **Elapsed MWh** was reset. When this parameter is read from a keypad, the display will show the amount of power consumed properly formatted. However, when the parameter is read via serial communication, you must also read parameter **MWh Format** to properly format the value. To format the value, divide the value shown for parameter **Elapsed MWh** by:

- 10 if parameter **MWh Format** is 51;
- 100 if parameter **MWh Format** is 52; or
- 1000 if parameter **MWh Format** is 53.

The **Elapsed MWh** parameter's value may be reset by setting parameter **Program Number** to 20.

◊ Range: 0–65535 **Elapsed MWh** Default: –

◊ Range: 51, 52, or 53 **MWh Format** Default: –

7.6 Input Status Group

This parameter group provides status information about the various inputs to the drive.

D1 Status	(Read-Only)	Address: 0150
D2 Status	(Read-Only)	Address: 0151
D3 Status	(Read-Only)	Address: 0152
D4 Status	(Read-Only)	Address: 0153
D5 Status	(Read-Only)	Address: 0154

D6 Status	**(Read-Only)**	**Address: 0155**
D7 Status	**(Read-Only)**	**Address: 0156**
D8 Status	**(Read-Only)**	**Address: 0157**
D9 Status	**(Read-Only)**	**Address: 0158**
D10 Status	**(Read-Only)**	**Address: 0159**
EN Status	**(Read-Only)**	**Address: 0160**

These eleven parameters show the status of the ten digital inputs and also the status of the enable circuit (the circuit connected to the EN terminal).

◊ Range: Off or On Default: –

A1 Level	**(Read-Only)**	**Address: 0164**

This parameter contains a value representing the measured input signal at the A11 (analog input 1) terminal as a percentage of the maximum input signal. For example, if A11 was configured to range from 0 to 10 V DC and the measured voltage was 2 V, then this parameter would show 20% (2/10).

◊ Range: –100%...+100% Default: –

A2 Level	**(Read-Only)**	**Address: 0165**

This parameter contains a value representing the measured input signal at the A21 (analog input 2) terminal as a percentage of the maximum input signal. For example, if A21 was configured to range from 0 to 20 mA DC and the measured current was 15 mA, then this parameter would show a value of 75% (15/20).

◊ Range: 0–100% Default: –

DQ1 Status	**(Read-Only)**	**Address: 0167**
DQ2 Status	**(Read-Only)**	**Address: 0168**
DQ3 Status	**(Read-Only)**	**Address: 0169**
R1 Status	**(Read-Only)**	**Address: 0170**
R2 Status	**(Read-Only)**	**Address: 0171**

These five parameters show the status of the three digital outputs and also the status of the two output relays.

◊ Range: Off or On Default: –

AQ1 Level	**(Read-Only)**	**Address: 0174**

This parameter contains a value representing the measured voltage at the A0 (analog output 1) terminal as a percentage of the maximum output voltage. For example, if this parameter showed 50%, then the voltage being output at A0 would be 5 V DC (50% of 10 V DC, the maximum value).

◊ Range: 0–100% Default: –

AQ2 Level	(Read-Only)	Address: 0175

This parameter contains a value representing the measured current at the A1 (analog output 2) terminal as a percentage of the maximum output current. For example, if this parameter showed 25%, then the process output current at A1 would be 5 mA DC (if the current range was 0 to 20 mA DC) or 8 mA DC (if the current range was 4 to 20 mA DC). (The current range is selected with parameter **AQ2 Output Type**; see page 121.)

◊ Range: 0–100% Default: –

AINA Level	(Read-Only)	Address: 0264
AINB Level	(Read-Only)	Address: 0269
AINC Level	(Read-Only)	Address: 0274

These parameters contain a value representing the measured input signal at the A, B, or C terminal of the Analog Input/Output Option Board as a percentage of the maximum input signal. For example, if terminal AINC was configured to range from 0 to 20 mA DC and the measured current was 5 mA, then this parameter would show a value of 25% (5/20).

◊ Range: 0–100% Default: –

AQA Level	(Read-Only)	Address: 0278
AQB Level	(Read-Only)	Address: 0282

These parameters contain a value representing the measured voltage at the A, B, or C terminal of the Analog Input/Output Option Board as a percentage of the maximum output voltage. For example, if this parameter showed 70%, then the voltage being output at terminal AQB would be 7 V DC (70% of 10 V DC, the maximum value).

◊ Range: 0–100% Default: –

RA Status	(Read-Only)	Address: 0285
RB Status	(Read-Only)	Address: 0286

These parameters show the status of the two output relays found on the Analog Input/Output Option Board.

◊ Range: Off or On Default: –

7.7 Control Modes Group

This parameter group contains parameters that configure how the drive is controlled.

2-Wire/3-Wire	Address: 0401

This parameter allows you to select whether 2-wire or 3-wire control will be used. See page 40 for more information on 2-wire and 3-wire control including sample connection diagrams. Note that if 3-wire control is selected, digital input D2 is forced to act as a Stop input; it cannot be configured to perform another function. (See page 110 for more information on configuring the functionality of D2.) The following functions may be assigned to this parameter:

Display	Function
2-Wire	2-wire control is utilized.
3-Wire	3-wire control is utilized.

◊ Range: see table Default: 2-Wire

Start Mode **Address: 0402**

This parameter allows you to select whether the drive will automatically start when line power is applied (if a Run command is active from the terminal strip). The following functions may be assigned to this parameter:

Display	Function
Line Str L	Line Start Lock-Out. The drive will not automatically start when line power is applied and a Run command is active. Instead, a new Run command must be given.
Auto Start	The drive will automatically start when line power is applied and a Run command is active.

◊ Range: see table Default: Line Str L

Stop Mode **Address: 0403**

This parameter allows you to configure whether a ramp-to-stop or a coast-to-stop occurs when a Stop command is issued. In a ramp-to-stop, the drive remains operational and may assist in the stopping. In coast-to-stop, the drive turns off when the Stop command occurs, and the load stops at a rate determined by friction and inertia.

Instead of these two types of stopping, you may specify that direct current be applied just before the shaft stops turning (zero speed). The length of time that direct current is applied is set by parameter **DC Inj Time-Stp** (see page 109). (Note that if **DC Inj Time-Stp** is set to zero, braking continues until the EN (enable) input is toggled.) The following functions may be assigned to this parameter:

Display	Function
Rmp to Stp	A ramp-to-stop is performed.
Cst to Stp	A coast-to-stop is performed.
DCI to Stp	A DC pulse is applied near zero speed.

◊ Range: see table Default: Rmp to Stp

Jog Mode **Address: 0404**

This parameter allows you to configure whether jog operations will be allowed and the type of jog control utilized. The following functions may be assigned to this parameter:

Display	Function
No Jogging	Jogging is not configured.
Run/Jog DI	A maintained-contact is used to initiate jogging; see page 42.
Jog Pshbutton	A pushbutton is used to initiate jogging. See page 42 for more information.

◊ Range: see table Default: No Jogging

Reverse Mode **Address: 0405**

This parameter allows you to configure whether the drive may operate in Reverse and, if so, how the direction is controlled. The following functions may be assigned to this parameter:

Display	Function
Non-revers	The drive cannot operate in Reverse; the REV key on the keypad is disabled.
For/Rev DI	The drive may operate in Reverse, but only via digital inputs. One digital input initiates Run, and a second digital input selects the direction. See page 41 for more information.
Run FwdRev	The drive may operate in Reverse whether commanded from the keypad or via digital inputs. One digital input initiates Run Forward, and a second digital input initiates Run Reverse. See page 41 for more information.

◊ Range: see table Default: Non-revers

Terminal/Keypad **Address: 0406**

This parameter allows you to configure whether reference speed (Reference) and control functions (Control) come from the keypad, inputs on the terminal strip, or a combination of the two. Settings are also provided for switching between the two control paths. See page 69 for information on configuring control paths by using this parameter. The following functions may be assigned to this parameter:

Display	Function
Kypd-C & R	**Keypad Control & Reference:** The keypad is the source for both the reference speed (by the up and down keys) and control inputs (by the FWD, REV [if enabled], and STOP keys).
TS-C & R	**Terminal Strip Control & Reference:** Inputs from the terminal strip set the reference speed and control operation.
TS-C/KP-R	**Terminal Strip Control & Keypad Reference:** The reference speed is set from the keypad and operation is controlled by digital inputs of the terminal strip.
KP-C/TS-R	**Keypad Control & Terminal Strip Reference:** The reference speed is set by inputs from the terminal strip, while the keys on the keypad control drive operation.
T/K by DI	**Terminal Strip / Keypad Switching by DI:** A digital input selects whether the keypad or the terminal strip is the source for control and the reference speed.
T/K by Fkey	**Terminal Strip / Keypad Switching by Enhance Keypad FKey:** Transfer of control and reference from the terminal strip to the keypad is accomplished by pressing the enhanced keypad function key (MON/F1, OPR/F2, PAR/F3, or DIR/F4) configured for this function; see page 129.

Display	Function
T/K SerLnk	**Terminal Strip / Keypad Switching by Serial Link:** Serial communication is used to set Bit 11 of parameter **Cntl Word 1** (see page 133) to 0 or 1, with 0 selecting the keypad as the control path and 1 selecting the terminal strip as the control path.

◊ Range: see table Default: Kypd-C & R

Local/Remote **Address: 0407**

This parameter determines whether Local and Remote modes will be active and how switching between the two modes is accomplished. See page 70 for information on how Local and Remote modes may be used to determine control paths.

Display	Function
None	Local and Remote modes are not used (parameters **Terminal/Keypad** and **Cntl Word 1** determine the control path).
L/R by DI	A digital input selects between Local and Remote modes.
L/R by Fkey	Transfer of control between Local and Remote modes is accomplished by pressing the enhanced keypad function key (MON/F1, OPR/F2, PAR/F3, or DIR/F4) configured for this function; see page 129.
L/R SerLnk	Serial communication is used to set Bit 10 of parameter **Cntl Word 1** (see page 133) to 0 or 1, with 0 selecting Local mode and 1 selecting Remote mode.

◊ Range: see table Default: None

Local Config **Address: 0408**

This parameter sets the source for reference speed and control functions when Local mode is active (see the **Local/Remote** parameter on the previous page for more information). The following functions may be assigned to this parameter:

Display	Function
Keypd-C&R	**Keypad Control and Reference:** The keypad is the source for both the reference speed (by the up and down keys) and control functions (by the FWD, REV [if enabled], and STOP keys).
Ser-C & R	**Serial Link Control and Reference:** Commands sent via serial communication initiate control functions and set the reference speed. Since the serial link is explicitly configured as the control path, the SLO (serial link override) function is not available.
Ser-C/Nm-R	**Serial Link Control and Keypad Reference:** The up and down arrow keys on the keypad set the reference speed, while the control functions are commanded from the serial link.

Display	Function
Nm-non ser	**Keypad or Serial Link Control and Reference:** The keypad is the source for control functions and the reference speed. However, by setting bits 0 or 1 of **Cntl Word 1** to 1, the control path may be switched to the serial link. The SLO function is also available for overriding serial link control. Note that if this setting is selected, the **Remote Config** parameter is automatically set to Serial Lnk.

◊ Range: see table Default: Keypd-C&R

Remote Config **Address: 0409**

This parameter sets the source for reference speed and control functions when Remote mode is active (see the **Local/Remote** parameter on page 86 for more information).The following functions may be assigned to this parameter:

Display	Function
TS-C & R	**Terminal Strip Control & Reference:** Inputs from the terminal strip set the reference speed and control operation.
Kpd-R/TS-C	**Keypad Reference and Terminal Strip Control:** The reference speed is set from the keypad and operation is controlled by digital inputs.
TS-R/Kpd-C	**Terminal Strip Reference and Keypad Control:** The reference speed is controlled by digital inputs and operation is set from the keypad.
NM-R/Ser-C	**Non-Serial Link Reference and Serial Link Control:** The reference speed is set by either the keypad or terminal strip and operation is controlled by commands sent via serial communication.
TS-C/Ser-R	**Serial Link Reference and Terminal Strip Control:** The reference speed is set via communication across the serial link and operation is controlled by inputs to the terminal strip.
Serial Lnk	**Serial Link Control and Reference:** Commands sent via serial communication initiate control functions and set the reference speed. Note that if this value is selected, the **Local Config** parameter is set to Nm - non ser.

◊ Range: see table Default: TS-C & R

Catch on Fly **Address: 0620**

This parameter sets whether the “catch on the fly” feature is enabled. When it is enabled, a Run command will cause the drive to match its output to the speed of a freewheeling load and then begin running. When the feature is disabled, a Run command causes the drive to start from zero speed. The following functions may be assigned to this parameter:

Display	Function
Disabled	The drive will not perform a “catch on the fly”.
Enabled	The drive will perform a “catch on the fly”.

◊ Range: see table Default: Disabled

Stop Key **Address: 0950**

This parameter sets the type of stop that occurs when the drive is running under terminal strip control and the STOP key on the keypad is pressed. The following functions may be assigned to this parameter:

Display	Function
Disabled	The STOP key is disabled.
Rmp to Stp	A ramp-to-stop is performed.
Cst to Stp	A coast-to-stop is performed.

◊ Range: see table Default: Cst to Stp

Enter Key **Address: 0978**

This parameter allows you to use the ENTER key on the keypad as a toggle switch between different control or operating states. The following functions may be assigned to this parameter:

Display	Function
Disabled	The ENTER key does not work as a toggle switch.
L/R Switch	Switches between Local and Remote modes.
T/K Switch	Switches the control path between the terminal strip and the keypad.
PID Enable	Enables PID control.
SL Override	Overrides serial link control.

◊ Range: see table Default: Disabled

7.8 Speed Reference Group

This group contains parameters that allow you to configure the reference speed for the drive as well as for jogging operations.

Minimum Freq **Address: 0301**

This parameter sets the minimum frequency that may be output to the motor. Note that the resolution is 1 Hz. Also note that if the value of this parameter is changed, the value of parameters **A1 Span** and **A2 Span** will be affected as well. See pages 114 and 115 for more information on these parameters.

◊ Range: 0 Hz to **Maximum Freq** Default: 0 Hz

Maximum Freq **Address: 0303**

This parameter sets the maximum frequency that may be output to the motor. Note that the resolution is 1 Hz. Also note that if the value of this parameter is changed, the value of parameters **A1 Span** and **A2 Span** will be affected as well. See pages 114 and 115 for more information on these parameters.

◊ Range: **Minimum Freq** to 320 Hz Default: 60 Hz

Main Speed Ref **Address: 0800**

This parameter configures the reference speed for the drive. The reference speed results from inputs on the analog input terminals (A11/A12 and A21) and how parameters **Ref1 Config**, **Ref2 Config**, and **Ref3 Config** are set; see page 90 for more information about these three parameters.

Display	Function
Spd - Rf 1	Reference 1.
Spd - Rf 2	Reference 2.
Spd - Rf 3	Reference 3.
Spd -R1+R2	The summation of references 1 and 2.
Spd -R1+R3	The summation of references 1 and 3.
S -R1+R2+R3	The summation of all references.
Spd -R2+R3	The summation of references 2 and 3.
S-R1+k*R2	Reference 2 is scaled by factor k and then summed with reference 1. The value of k is set by parameter **Set k-Factor** (see page 92).
Spd-R1-R2	The difference between references 1 and 2.
Spd-R2-R1	The difference between references 2 and 1.
Spd-R1-R3	The difference between references 1 and 3.
Spd-R3-R1	The difference between references 3 and 1.
Spd-R2-R3	The difference between references 2 and 3.
Spd-R3-R2	The difference between references 3 and 2.
S-R1+R2-R3	The summation of references 1 and 2 less reference 3.
S-R1+R3-R2	The summation of references 1 and 3 less reference 2.
Spd-Fixed	The speed reference is constant and is set by parameter **Set Fixed Speed** (see page 91).
8Bit DI PS	The speed reference is set by the binary word consisting of D3 through D10, with D3 being the least significant bit and D10 the most significant bit. All digital inputs must be properly configured for proper function. If a digital input is not configured, that input is considered inactive (0). The output frequency is computed by using the following formula to convert the 8-bit binary word (“8bbw” in the formula) into a decimal value: $\text{Output Frequency} = 8\text{bbw} \times \frac{\text{Max. Frequency} - \text{Min. Frequency}}{255}$
Spd-R1+R3	The summation of references 1 and 3.

◊ Range: see table Default: Spd - Rf 2

Jog Ref Config **Address: 0803**

This parameter configures the reference speed for jogging operations. As with the setting of the main reference speed for the drive, an analog input may be used to control jogging speed.

Display	Function
Spd - Rf 1	Reference 1.
Spd - Rf 2	Reference 2.
Spd - Rf 3	Reference 3.
Spd -R1+R2	The summation of references 1 and 2.
Spd -R1+R3	The summation of references 1 and 3.
S -R1+R2+R3	The summation of all references.
Spd -R2+R3	The summation of references 2 and 3.
S-R1+k*R2	Reference 2 is scaled by factor k and then summed with reference 1. The value of k is set by parameter **Set k-Factor** (see page 92).
Spd-R1-R2	The difference between references 1 and 2.
Spd-R2-R1	The difference between references 2 and 1.
Spd-R1-R3	The difference between references 1 and 3.
Spd-R3-R1	The difference between references 3 and 1.
Spd-R2-R3	The difference between references 2 and 3.
Spd-R3-R2	The difference between references 3 and 2.
S-R1+R2-R3	The summation of references 1 and 2 less reference 3.
S-R1+R3-R2	The summation of references 1 and 3 less reference 2.
Spd-Fixed	The speed reference is constant and is set by parameter **Set Fixed Speed** (see page 91).
8Bit DI PS	The speed reference is set by the binary word consisting of D3 through D10, with D3 being the least significant bit and D10 the most significant bit. All digital inputs must be properly configured for proper function. If a digital input is not configured, that input is considered inactive (0). The output frequency is computed by using the following formula to convert the 8-bit binary word (“8bbw” in the formula) into a decimal value: $\text{Output Frequency} = 8\text{bbw} \times \frac{\text{Max. Frequency} - \text{Min. Frequency}}{255}$

◊ Range: see table Default: Spd-Fixed

Ref1 Config **Address: 0810**

Ref2 Config **Address: 0811**

Ref3 Config **Address: 0812**

These parameters establish which analog input sets the reference indicated in the parameter name. The values that may be assigned to this parameter are as follows:

Display	Function
AI #1	Analog input 1 of the WF2 drive.
AI #2	Analog input 2 of the WF2 drive.
AI #A	Analog input A of the Analog Input/Output Option Board.
AI #B	Analog input B of the Analog Input/Output Option Board.
AI #C	Analog input C of the Analog Input/Output Option Board.

◊ Range: see table **Ref1 Config** Default: AI #1
Ref2 Config Default: AI #2
Ref3 Config Default: AI #2

EMOP Config **Address: 0420**

The WF2 drive supports a variety of configurations for EMOP operation. The configurations are based on whether the digital inputs on the terminal strip may be used to change the EMOP reference speed or whether the Up and Down Arrow keys on the digital keypad may also be used to change the EMOP reference speed. To use a digital input, configure two digital inputs using the parameters in the Digital Inputs Group (see page 110).

In addition to configuring what controls the EMOP reference speed, you may configure whether the reference speed is reset when a Stop or a power cycle occurs, or only when a power cycle occurs, or does not reset. If the reference speed is reset, the reference speed upon a re-start is the minimum frequency. The following functions may be assigned to this parameter:

Display	Function
None	EMOP is not utilized.
TS no Mem	Digital inputs are used to change EMOP reference speed, and the EMOP reference speed is lost upon Stop or a power-cycle.
TS w/ Mem	Digital inputs are used to change EMOP reference speed, and the reference speed is retained upon Stop but not when power is cycled.
TS w/ MemP	Digital inputs are used to change EMOP reference speed, and the reference speed is retained through a Stop or when power is cycled.
T/K no Mem	Same as TS no Mem except the keypad also may be used to change the EMOP reference speed.
T/K w/ Mem	Same as TS w/ Mem except the keypad also may be used to change the EMOP reference speed.
T/K MemP	Same as TS w/ MemP except the keypad also may be used to change the EMOP reference speed.

◊ Range: see table Default: None

Set Fixed Speed **Address: 0804**

When parameter **Main Speed Ref** or **Jog Ref Config** is set to Spd-Fixed, this parameter specifies the speed.

◊ Range: 0.0–320.0 Hz Default: 5.0 Hz

Set k-Factor **Address: 0801**

When **Main Speed Ref** is set to S-R1+k*R2, this parameter sets the value of k, which is the scale factor by which reference 2 is multiplied before being added to reference 1.

◊ Range: 0.0–100.0% Default: 10.0%

7.9 Ramps Group

This parameter group provides access to the parameters concerned with establishing the various acceleration and deceleration ramps of the drive. (The drive supports three ramps plus a jogging ramp.) Parameters are also available to set the shape of the ramps.

Accel Time 1 **Address: 0310**

This parameter sets the length of time to accelerate from 0 Hz to the maximum frequency (parameter **Maximum Freq**) for the primary ramp.

◊ Range: 0.1–3200.0 s Default: 3.0 s

Decel Time 1 **Address: 0311**

This parameter sets the length of time to decelerate from the maximum frequency (parameter **Maximum Freq**) to 0 Hz for the primary ramp.

◊ Range: 0.1–3200.0 s Default: 3.0 s

Accel Time 2 **Address: 0312**

This parameter sets the length of time to accelerate from 0 Hz to the maximum frequency (parameter **Maximum Freq**) for Alternate Ramp 1.

◊ Range: 0.1–3200.0 s Default: 1.0 s

Decel Time 2 **Address: 0313**

This parameter sets the length of time to decelerate from the maximum frequency (parameter **Maximum Freq**) to 0 Hz for Alternate Ramp 1.

◊ Range: 0.1–3200.0 s Default: 1.0 s

Accel Time 3 **Address: 0314**

This parameter sets the length of time to accelerate from 0 Hz to the maximum frequency (parameter **Maximum Freq**) for Alternate Ramp 2.

◊ Range: 0.1–3200.0 s Default: 10.0 s

Decel Time 3 **Address: 0315**

This parameter sets the length of time to decelerate from the maximum frequency (parameter **Maximum Freq**) to 0 Hz for Alternate Ramp 2.

◊ Range: 0.1–3200.0 s Default: 10.0 s

EMOP Ramp Time **Address: 0316**

This parameter sets the length of time for acceleration (0 Hz to the EMOP reference speed) and deceleration (EMOP reference speed to 0 Hz) when EMOP is active.

◊ Range: 0.1–200.0 s Default: 30.0 s

AR1 Configure **Address: 0450**

This parameter selects when Alternate Ramp 1 (AR1) is invoked. Parameters **Accel Time 2** and **Decel Time 2** (see page 92 for information on these parameters) configure the slope of the ramp, while **AR1 Ramp Type** determines the shape of the ramp (see page 94). The following functions may be assigned to this parameter:

Display	Function
None	AR1 is not available.
AR1 on DI	A digital input is used to select AR1. While the input is true, AR1 is in use.
AR1 by Frq	When the drive reaches a preset frequency, AR1 is invoked and remains in effect until the frequency drops below the threshold. The frequency is set by parameter **AR1 Switch Freq**; see page 95 for more information.
AR1-Strt	When a Start command occurs, AR1 is invoked and remains in effect until the reference speed is reached. Once an At Speed condition is attained, the main ramp is used for reference changes. When a Stop command occurs, AR1 is invoked and remains in effect until zero speed is reached.
AR1-Fwd/Rv	When the drive begins operation in Reverse, AR1 is invoked and remains in effect until the direction changes.

◊ Range: see table Default: AR1 on DI

AR2 Configure **Address: 0451**

This parameter selects when Alternate Ramp 2 (AR2) is invoked. Parameters **Accel Time 3** and **Decel Time 3** (see page 92 for information on these parameters) configure the slope of the ramp, while **AR2 Ramp Type** determines the shape of the ramp (see below). The following functions may be assigned to this parameter:

Display	Function
None	AR2 is not available.
AR2 on DI	A digital input is used to select AR2. While the input is true, AR2 is in use.
AR2 by Frq	When the drive reaches a preset frequency, AR2 is invoked and remains in effect until the frequency drops below the threshold. The frequency is set by parameter **AR2 Switch Freq**; see page 95 for more information.
AR2-Strt	When a Start command occurs, AR2 is invoked and remains in effect until the reference speed is reached. Once an At Speed condition is attained, the main ramp is used for reference changes. When a Stop command occurs, AR2 is invoked and remains in effect until zero speed is reached.

Display	Function
AR2-Fwd/Rv	When the drive begins operation in Reverse, AR2 is invoked and remains in effect until the direction changes.

◊ Range: see table Default: AR2 on DI

Main Ramp Type **Address: 0452**

This parameter determines the shape of the primary ramp determined by parameters **Accel Time 1** and **Decel Time 1**. The following functions may be assigned to this parameter:

Display	Function
Linear	The shape of the ramp is a straight line.
S-Curve	The shape of the ramp is curved at the beginning and end, with the middle portion linear. The degree of curvature is set by parameter **Main S-Rounding** (see the next page).

◊ Range: see table Default: Linear

Main S-Rounding **Address: 0453**

If parameter **Main Ramp Type** is set to S-Curve, this parameter sets the amount of curvature at either end of the ramp. A value of 0 s produces a linear curve, while a value of 10 s produces a maximally rounded S-shaped curve.

◊ Range: 0.0–10.0 s Default: 0.0 s

AR1 Ramp Type **Address: 0454**

This parameter determines the shape of Alternate Ramp 1 (AR1). The following functions may be assigned to this parameter:

Display	Function
Linear	The shape of the ramp is a straight line.
S-Curve	The shape of the ramp is curved at the beginning and end, with the middle portion linear. The degree of curvature is set by parameter **AR1 S-Rounding** (see below).

◊ Range: see table Default: Linear

AR1 S-Rounding **Address: 0455**

If parameter **AR1 Ramp Type** is set to S-Curve, this parameter determines the amount of curvature at either end of the ramp. A value of 0 s produces a linear curve, while a value of 10 s produces a maximally rounded S-shaped curve.

◊ Range: 0.0–10.0 s Default: 0.0 s

AR1 Switch Freq **Address: 0462**

This parameter sets the frequency reference during acceleration and deceleration when the AR1 ramp is active. Note that it is accurate to the hundredths place (0.01), and that if set to 0.00 the reference frequency defaults to the value of parameter **Maximum Freq**.

◊ Range: 0.00–320.00 Hz Default: 0.00 Hz

AR2 Ramp Type **Address: 0456**

This parameter determines the shape of Alternate Ramp 2 (AR2). The following functions may be assigned to this parameter:

Display	Function
Linear	The shape of the ramp is a straight line.
S-Curve	The shape of the ramp is curved at the beginning and end, with the middle portion linear. The degree of curvature is set by parameter **AR2 S-Rounding** (see below).

◊ Range: see table Default: Linear

AR2 S-Rounding **Address: 0457**

If parameter **AR2 Ramp Type** is set to S-Curve, this parameter determines the amount of curvature at either end of the ramp. A value of 0 s produces a linear curve, while a value of 10 s produces a maximally rounded S-shaped curve.

◊ Range: 0.0–10.0 s Default: 0.0 s

AR2 Switch Freq **Address: 0464**

This parameter sets the frequency reference during acceleration and deceleration when the AR2 ramp is active. Note that it is accurate to the hundredths place (0.01), and that if set to 0.00 the reference frequency defaults to the value of parameter **Maximum Freq**.

◊ Range: 0.00–320.00 Hz Default: 0.00 Hz

Jog Accel Time **Address: 0458**

This parameter sets the acceleration time during jogging operations.

◊ Range: 0.0–3200.0 Hz Default: 1.0 Hz

Jog Decel Time **Address: 0459**

This parameter sets the deceleration time during jogging operations.

◊ Range: 0.0–3200.0 Hz Default: 1.0 Hz

Ramp Ref Frq **Address: 0460**

This parameter sets the frequency reference range during which the acceleration or deceleration time is active. For example, if this parameter is set to 30 Hz and the acceleration time is set to 10 s, then the acceleration ramp will have the slope of a 30 Hz increase in 10 s.

Note that it is accurate to the hundredths place (0.01), and that if set to 0.00, the reference frequency range is the difference between parameter **Maximum Freq** and parameter **Minimum Freq**. For example, if the minimum frequency was 20 Hz and the maximum was 60 Hz, then the acceleration and deceleration times correspond to the lengths of time to accelerate or decelerate by 40 Hz (60 minus 20 Hz).

For most applications, it is recommended that this parameter be left at its default value of 0.00 Hz.

◊ Range: 0.00–320.00 Hz Default: 0.00 Hz

7.10 Preset Speeds Group

This parameter group provides access to the parameters used to configure the preset reference speeds for the drive. A preset speed is selected via a combination of digital inputs or by setting the bits of the control word appropriately (see page 45 for more information).

Preset Speed 1 **Address: 0350**

This parameter sets the first (of seven) preset speed. The speed is selected by a combination of digital inputs or settings of bits 5, 6, and 7 in parameter **Cntl Word 1**; see page 45 for a discussion of preset speeds and how each is selected.

◊ Range: 0.00 Hz to **Maximum Freq** Default: 5.00 Hz

Preset Speed 2 **Address: 0352**

This parameter sets the second (of seven) preset speed. The speed is selected by a combination of digital inputs or settings of bits 5, 6, and 7 in parameter **Cntl Word 1**; see page 45 for a discussion of preset speeds and how each is selected.

◊ Range: 0.00 Hz to **Maximum Freq** Default: 10.00 Hz

Preset Speed 3 **Address: 0354**

This parameter sets the third (of seven) preset speed. The speed is selected by a combination of digital inputs or settings of bits 5, 6, and 7 in parameter **Cntl Word 1**; see page 45 for a discussion of preset speeds and how each is selected.

◊ Range: 0.00 Hz to **Maximum Freq** Default: 20.00 Hz

Preset Speed 4 **Address: 0356**

This parameter sets the fourth (of seven) preset speed. The speed is selected by a combination of digital inputs or settings of bits 5, 6, and 7 in parameter **Cntl Word 1**; see page 45 for a discussion of preset speeds and how each is selected.

◊ Range: 0.00 Hz to **Maximum Freq** Default: 30.00 Hz

Preset Speed 5 **Address: 0358**

This parameter sets the fifth (of seven) preset speed. The speed is selected by a combination of digital inputs or settings of bits 5, 6, and 7 in parameter **Cntl Word 1**; see page 45 for a discussion of preset speeds and how each is selected.

◊ Range: 0.00 Hz to **Maximum Freq** Default: 40.00 Hz

Preset Speed 6 **Address: 0360**

This parameter sets the sixth (of seven) preset speed. The speed is selected by a combination of digital inputs or settings of bits 5, 6, and 7 in parameter **Cntl Word 1**; see page 45 for a discussion of preset speeds and how each is selected.

◊ Range: 0.00 Hz to **Maximum Freq** Default: 50.00 Hz

Preset Speed 7 **Address: 0362**

This parameter sets the seventh (last) preset speed. The speed is selected by a combination of digital inputs or settings of bits 5, 6, and 7 in parameter **Cntl Word 1**; see page 45 for a discussion of preset speeds and how each is selected.

◊ Range: 0.00 Hz to **Maximum Freq** Default: 60.00 Hz

7.11 Skip Freq Group

This group contains parameters that allow you to configure up to five frequency bands that are “skipped” during drive operation. The WF2 drive will not establish a steady-state at any frequency within a skip band; instead, it will ramp through the band.

Skip 1 Low Lim **Address: 0480**

This parameter sets the lower frequency of the first frequency band to be skipped.

◊ Range: 0.0 Hz to **Maximum Freq** Default: 0.0 Hz

Skip 1 Hi Lim **Address: 0481**

This parameter sets the upper frequency of the first frequency band to be skipped.

◊ Range: **Skip 1 Low Lim** to **Maximum Freq** Default: 0.0 Hz

Skip 2 Low Lim **Address: 0482**

This parameter sets the lower frequency of the second frequency band to be skipped.

◊ Range: 0.0 Hz to **Maximum Freq** Default: 0.0 Hz

Skip 2 Hi Lim **Address: 0483**

This parameter establishes the upper frequency of the second frequency band to be skipped.

◊ Range: **Skip 2 Low Lim** to **Maximum Freq** Default: 0.0 Hz

Skip 3 Low Lim **Address: 0484**

This parameter establishes the lower frequency of the third frequency band to be skipped.

◊ Range: 0.0 Hz to **Maximum Freq** Default: 0.0 Hz

Skip 3 Hi Lim **Address: 0485**

This parameter establishes the upper frequency of the third frequency band to be skipped.

◊ Range: **Skip 3 Low Lim** to **Maximum Freq** Default: 0.0 Hz

Skip 4 Low Lim **Address: 0486**

This parameter establishes the lower frequency value of the fourth frequency band to be skipped.

◊ Range: 0.0 Hz to **Maximum Freq** Default: 0.0 Hz

Skip 4 Hi Lim **Address: 0487**

This parameter establishes the upper frequency value of the fourth frequency band to be skipped.

◊ Range: **Skip 4 Low Lim** to **Maximum Freq** Default: 0.0 Hz

Skip 5 Low Lim **Address: 0488**

This parameter establishes the lower frequency value of the fifth frequency band to be skipped.

◊ Range: 0.0 Hz to **Maximum Freq** Default: 0.0 Hz

Skip 5 Hi Lim **Address: 0489**

This parameter establishes the upper frequency value of the fifth frequency band to be skipped.

◊ Range: **Skip 5 Low Lim** to **Maximum Freq** Default: 0.0 Hz

7.12 Torque Limits Group

This group contains parameters that allow you to configure the torque limits for the drive. Limits may be set for both forward and reverse operation as well as for pulling a load (“motoring”) or being pulled by a load (“regenerative”).

Current Limit **Address: 0331**

For some applications, it is of benefit to limit the current output of the drive.This parameter allows you to limit the current output by configuring the maximum motor current from the drive expressed as a percentage of nominal current rating.

◊ Range: 1–200% Default: 150%

Trq Limit Type **Address: 0601**

The WF2 drive provides a Torque Limit feature. When this feature is enabled, the drive's frequency is automatically reduced when operating in motoring mode to keep the measured torque within limits. When operating in regenerative mode, the output frequency may be automatically increased for the same reason.

Note that in addition to the torque limit parameters that activate the Torque Limit mode, two additional torque limits are available. These are **Torque Level 1** and **Torque Level 2** (see page 119), and you may configure a digital output to become true when either of these limits is exceeded (see page 117 for information on the parameters that configure the digital outputs).

This parameter (**Trq Limit Type**) establishes how the feature will be enabled. The following functions may be assigned to this parameter:

Display	Function
Disabled	Torque limiting will not be used.
Fixed Lvls	When the measured torque exceeds the limit set by either **Trq Lim Mtr Fwd**, **Trq Lim Reg Fwd**, **Trq Lim Mtr Rev**, or **Trq Lim Reg Rev** (depending on what the motor and drive are doing), torque limiting is enabled. See page 99 for a description of these parameters.
By DI	Torque limiting is enabled when a digital input is true. See page 98 for information on configuring a digital input to limit torque.
Follow AI	The analog input identified in parameter **Trq Lim AI** (see page 100) is monitored and as it changes, so does the value of each of the four torque limits named for Fixed Lvls. The values of the limits are found by multiplying the percentage of full-scale being input on the analog input by the configured torque limits. For example, if **Trq Lim Mtr Fwd** is set to 150% and A2 is at half-scale, then the actual torque limit when motoring forward is 75%.
On Freq	When the drive's output frequency is greater than the value set by **Trq Lim Freq** (see page 100), torque limiting is enabled.

◊ Range: see table Default: Disabled

Trq Lim Mtr Fwd **Address: 0332**

This parameter sets the torque limiting point when the drive is in motoring mode in the Forward direction. The limit is expressed as a percentage of the torque load.

◊ Range: 1–200% Default: 150%

Trq Lim Reg Fwd **Address: 0333**

This parameter sets the torque limiting point when the drive is in regenerative mode in the Forward direction. The limit is expressed as a percentage of the torque load.

◊ Range: 1–200% Default: 80%

Trq Lim Mtr Rev **Address: 0334**

This parameter sets the torque limiting point when the drive is in motoring mode in the Reverse direction. The limit is expressed as a percentage of the torque load.

◊ Range: 1–200% Default: 150%

Trq Lim Reg Rev **Address: 0335**

This parameter sets the torque limiting point when the drive is in regenerative mode in the Reverse direction. The limit is expressed as a percentage of the torque load.

◊ Range: 1–200% Default: 80%

Trq Lim Freq **Address: 0602**

When parameter **Trq Limit Type** is set to On Freq, the Torque Limit feature will activate when a certain frequency threshold is exceeded. This parameter, **Trq Lim Freq**, sets the threshold frequency.

◊ Range: 0.0–320.0 Hz Default: 0.0 Hz

Trq Lim AI **Address: 0603**

When parameter **Trq Limit Type** is set to Follow AI, an analog input is used to set the torque limits. This parameter, **Trq Lim AI**, sets which analog input will be used. The following values may be assigned to this parameter.

Display	Function
AI #1	Analog input 1 of the WF2 drive.
AI #2	Analog input 2 of the WF2 drive.
AI #A	Analog input A of the Analog Input/Output Option Board.
AI #B	Analog input B of the Analog Input/Output Option Board.
AI #C	Analog input C of the Analog Input/Output Option Board.

◊ Range: see table Default: AI #1

Regen Timeout **Address: 0605**

This parameter sets the limit for the amount of time that the drive may continue to run in regenerative current limit after a Stop command is issued. If the configured time duration expires and the drive is not yet at zero speed, Fault 59 (Regen Timeout) occurs and the drive coasts to a stop.

◊ Range: 0–60 s Default: 1 s

7.13 Drive Output Group

This group contains parameters that allow you to configure the SVC and V/Hz algorithms used in the drive. Figure 30 on page 101 shows how the parameters of this group determine a V/Hz curve.

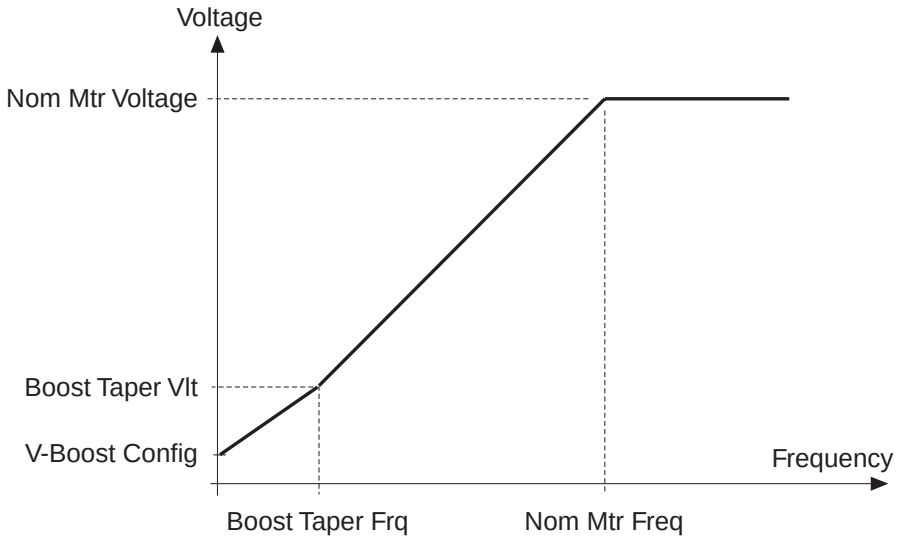


Figure 30
How a V/Hz Curve Is Determined

Torque Type — Address: 0500

This parameter selects the control algorithms used by the WF2 drive. The following functions may be assigned to this parameter (note that all SVC control modes require optimum setup of motor parameters; see section 7.14 [Motor Setup Group] on page 103 for more information):

Display	Function
CT - SVC	Sensorless vector control (SVC), constant torque characteristic. This setting forces **Set V-Boost** and **Slip Comp** parameters to Automatic, and they cannot be set to another function.
VT - SVC	Variable torque with SVC-type quadratic voltage characteristic. This setting forces **Set V-Boost** and **Slip Comp** parameters to Automatic, and they cannot be set to another function.
CT - SVC 2pc	Constant torque with SVC-type two-piece voltage characteristic. This setting forces **Set V-Boost** and **Slip Comp** parameters to Automatic. However, parameter **V-Boost Config** may be set to provide additional starting torque, with parameters **Boost Taper Frq** and **Boost Taper Vlt** defining the point on the theoretical curve where boost ceases.
CT - V/Hz	Constant torque with V/Hz control and linear voltage characteristic. Parameter **Set V-Boost** is set to None, but may be changed to Automatic (with boost ceasing at the field weakening point). Parameter Slip Comp is set to None, but may be changed to Automatic.
VT - V/Hz	Variable torque with V/Hz control and quadratic voltage characteristic. Parameter **Set V-Boost** is set to Automatic, but may be changed to None (with boost ceasing at the field weakening point). Parameter **Slip Comp** is set to None, but may be changed to Automatic.
CT - V/Hz 2pc	Constant torque with V/Hz linear two-piece voltage characteristic. Parameter **Set V-Boost** is set to Automatic, but it may be changed to None (with parameters **Boost Taper Frq** and **Boost Taper Vlt** defining the point on the theoretical curve where boost ceases). Parameter Slip Comp is set to None, but may be changed to Automatic.

◊ Range: see table — Default: CT - V/Hz 2pc

Carrier Freq **Address: 0501**

This parameter configures the switching (or carrier) frequency for the drive. Lower frequencies produce better torque, but produce more audible noise from the motor. Higher switching frequencies produce less audible noise, but cause more heating in the drive and motor. The factory default setting for a particular model is the frequency rated to produce continuous full-load current within rated temperatures.

◊ Range: 1.0–16.0 kHz Default: varies

Auto-Carrier **Address: 0502**

This parameter allows you to enable or disable the auto-carrier feature. When enabled, the setting of the **Carrier Freq** parameter is ignored. Instead, the drive uses the optimum switching frequency, which is the highest frequency for the load that does not cause overheating.

Display	Function
Disabled	Function auto-carrier is disabled.
Enabled	Function auto-carrier is enabled.

◊ Range: see table Default: Disabled

Slip Comp **Address: 0551**

This parameter sets the amount of slip compensation, which may provide more constant motor speed under changing load conditions. The following functions may be assigned to this parameter:

Display	Function
None	Slip compensation is not utilized.
Automatic	The drive calculates how much slip compensation is needed depending on the load and motor speed.

◊ Range: see table Default: None

V-Boost Config **Address: 0553**

This parameter sets the amount of boost (expressed as a percentage of nominal motor voltage) to be applied at zero frequency. The amount configured then tapers linearly as frequency increases, reaching zero at the point specified by parameters **Boost Taper Frq** and **Boost Taper Vlt**.

The default values are model dependent:

Model Number	Default	Model Number	Default	Model Number	Default
WF2K2S00-7x	2.0%	WF2K4000-7x	2.0%	WF2K5000-7x	2.0%
WF2K2S01-5x	1.5%	WF2K4001-5x	1.5%	WF2K5001-5x	1.5%
WF2K2S02-2x	1.5%	WF2K4002-2x	1.5%	WF2K5002-2x	1.5%
WF2K2000-7x	2.0%	WF2K4003-7x	1.5%	WF2K5003-7x	1.5%
WF2K2001-5x	1.5%	WF2K4005-5x	1.0%	WF2K5005-5x	1.0%

Model Number	Default	Model Number	Default	Model Number	Default
WF2K2002-2x	1.5%	WF2K4007-5x	1.0%	WF2K5007-5x	1.0%
WF2K2003-7x	1.5%	WF2K4011-0x	1.0%	WF2K5011-0x	1.0%
WF2K2005-5x	1.0%	WF2K4015-0x	1.0%	WF2K5015-0x	1.0%
WF2K2007-5x	1.0%	WF2K4018-5x	0.5%	WF2K5018-5x	0.5%
WF2K2011-0x	1.0%	WF2K4022-0x	0.5%	WF2K5022-0x	0.5%
WF2K2015-0x	1.0%	WF2K4030-0x	0.5%	WF2K5030-0x	0.5%
WF2K2018-5x	1.0%	WF2K4037-0x	0.5%	WF2K5037-0x	0.5%
WF2K2022-0x	1.0%	WF2K4045-0x	0.5%	WF2K5045-0x	0.5%
		WF2K4055-0x	0.5%	WF2K5055-0x	0.5%

◊ Range: 0.00–30.00% Default: varies

Set V-Boost **Address: 0554**

This parameter determines whether a voltage boost is applied. Voltage boost is the amount of voltage added at zero frequency (expressed as a percentage of nominal motor voltage), which is the start of the V/Hz curve. The boost tapers linearly to zero at the point set in parameters **Boost Taper Frq** and **Boost Taper Vlt** (see below):

Display	Function
None	No voltage boost.
Automatic	The WF2 drive calculates the amount of boost required.

◊ Range: see table Default: None

Boost Taper Frq **Address: 0555**

This parameter works with the **Set V-Boost** parameter. When voltage boost is applied at the start of the V/Hz curve, the amount of boost tapers linearly and reaches zero at the point established by the frequency set in this parameter and the voltage set in parameter **Boost Taper Vlt** (see below).

◊ Range: 0.00 Hz to **Maximum Freq** Default: 60.00 Hz

Boost Taper Vlt **Address: 0557**

This parameter works with the **Set V-Boost** parameter. When voltage boost is applied at the start of the V/Hz curve, the amount of boost tapers linearly and reaches zero at the point established by the voltage set in this parameter and the frequency set in parameter **Boost Taper Frq** (see above).

◊ Range: 0.00–100.00% Default: varies

7.14 Motor Setup Group

This group contains parameters that allow you to configure aspects of the motor attached to the WF2 drive such as nominal motor current and voltage.

Nom Mtr Current **Address: 0520**

This parameter configures the nominal motor current, and is obtained from the nameplate on the attached motor.

NOTE: The proper setting of these values greatly influence the proper operation of the drive when in the SVC operating mode as well as the accuracy of overload protection.

◊ Range: varies Default: varies

Nom Mtr Voltage **Address: 0521**

This parameter configures the voltage delivered to the motor terminals by the drive at the field weakening point.

NOTE: The proper setting of these values greatly influence the proper operation of the drive when in the SVC operating mode as well as the accuracy of overload protection.

◊ Range: 100–690 V Default: varies

Nom Mtr Freq **Address: 0522**

This parameter sets the nominal motor frequency, as obtained from the motor's nameplate, and also defines the frequency at the field weakening point.

NOTE: The proper setting of these values greatly influence the proper operation of the drive when in the SVC operating mode as well as the accuracy of overload protection.

◊ Range: 25.00–320.00 Hz Default: 60.00 Hz

Nom Mtr RPM **Address: 0524**

This parameter sets the nominal motor speed in revolutions per minute, and is obtained from the nameplate of the motor attached to the drive. It is important that this be entered accurately as it is used in sensorless vector control (SVC) calculations and in slip compensation.

For 50 Hz mains, the default is 1450 rpm. For 60 Hz mains, the default is 1760 rpm.

NOTE: The proper setting of these values greatly influence the proper operation of the drive when in the SVC operating mode as well as the accuracy of overload protection.

◊ Range: 0–10000 RPM Default: varies

Mtr Ovld Scale **Address: 0611**

This parameter injects a supplemental de-rating factor into the overload calibration of the drive / motor combination. The value for this parameter should be left at its default value except when you wish to compensate for sensitive powertrain components (such as plastic chain) or where sensitive media may be stretched in an overload condition.

◊ Range: 0.0–100.0% Default: 100.0%

Mtr Ovld Time **Address: 0612**

This parameter sets the amount of time that the measured motor current may exceed by 150% the threshold set by parameter **Mtr Ovld Scale** before an overload trip occurs.

NOTE: If the value of this parameter is set to 0.0 s, this function is disabled. If this parameter is set to a value of 0.1 s, a shear-pin function will be configured. When the calculated overload value exceeds that set in the **Mtr Ovld Scale** parameter, a fault will immediately occur and the drive will stop.

◊ Range: 0.0–300.0 s Default: 60.0 s

Motor RS **Address: 0525**

This parameter represents the motor line-to-line stator resistance, and should only be modified by advanced users. The default value for this parameter is calculated by the WF2 drive by using the DC pulse that occurs before a start.

To modify this parameter, you must first disable the **DC Puls-Start** start by setting parameter DC Pulse-Start to None (see below). Then, you may set the value of parameter **Motor RS** to the desired value. If the DC pulse at start is not disabled, any value set for parameter **Motor RS** will be overwritten when the WF2 measures a new value at the next start.

◊ Range: – Default: Measured by Drive

DC Puls-Start **Address: 0540**

This parameter selects whether a DC pulse will be applied before starting. This pulse is used to determine motor parameters before beginning operation. The amount of current to be pulsed is set by parameter **DC Inj Cur Lvl** (see page 108), and the duration of the pulse is set by parameter **DC Pulse-Time** (see below).

Display	Function
None	No DC pulse before Start.
DC at Strt	DC pulse before Start.

◊ Range: see table Default: DC at Strt

DC Pulse-Time **Address: 0541**

If parameter **DC Puls-Start** is enabled (see above), this parameter configures the duration of the pulse at start-up. (Note that motor RS is not calculated if the value of this parameter is less than 1 s.)

◊ Range: 0.00–25.00 s Default: 1.00 s

SVC Lo Spd Comp **Address: 0542**

This parameter provides a compensating factor to enable the drive to more accurately perform sensorless vector control (SVC) at low speeds.

NOTE: The proper setting of these values greatly influence the proper operation of the drive when in the SVC operating mode as well as the accuracy of overload protection.

◊ Range: 0–1280 Default: 256

Motor Type **Address: 0610**

This parameter configures what type of motor is attached to the WF2 drive. This is used for modeling thermal performance, which determines when the drive will trip due to motor overloading. The following data codes may be assigned to this parameter:

Display	Function
No Thermal Prot	The motor overload trip is disabled.
Std Induction	The attached motor is a standard induction (self-cooled) motor.
Blower Cooled	The attached motor uses a constant-speed fan for forced cooling.

◊ Range: see table Default: No Thermal Prot

Supply Voltage **Address: 0549**

This parameter configures the supply voltage. Only the following values may be assigned to this parameter (the value in parentheses is the data code for serial communication):

230 V AC Models	460 V AC Models	575 V AC Models
180 (4)	380 (11)	480 (16)
200 [1] (5)	400 (12)	500 (17)
208 (6)	415 (13)	525 (18)
220 (7)	440 (14)	575 (19)
230 (8)	460 (15)	600 (20)
240 (9)	480 (16)	
250 (10)		

[1] This setting is only available with units having MCP software revisions greater than 1.59.

◊ Range: see table Default: varies

7.15 Braking Options Group

This parameter group contains parameters that are used to configure the various braking options for the drive.

DB Config **Address: 0630**

The drive provides an internal dynamic brake (DB) to assist in stopping. If desired, a TB Wood's WDB-type external brake may be connected to the B–/B+ terminals (or B–/DB1 terminals, depending on model) on the power board (see page 31 for more information). The following functions may be assigned to this parameter:

Display	Function
Disabled	Neither an internal dynamic brake or external device is used.
Int DB Res	The internal dynamic brake is enabled.
Ext DB WDB	A TB Wood's WDB-type external braking kit is attached to the WF2 drive for additional braking capacity; see page 145 for more information.
Ext DB Res	An external resistor is used for additional braking capacity. The characteristics of the external resistor are specified in the following three parameters. See page 34 for a discussion of dynamic braking for the WF2 drive and how to add an external resistor to the drive.

◊ Range: see table Default: Int DB Res

DB Res Value **Address: 0632**

DB Rth Value **Address: 0633**

DB Cth Value **Address: 0634**

These parameters establish the value of the external resistor used to augment braking capacity, its thermal resistance, and its thermal capacitance, respectively.

Note that the value for **DB Res Value** is the actual resistance of the resistor, displayed to the nearest 0.1 Ω resolution.

Also note that the default Cth values are for software versions 1.63 and greater; earlier software versions (1.59–1.62) have Cth values that are twice as large. (This manual is intended for MCP revision 2.86 and greater).

The default values for these parameters varies by model as shown in the table below:

Model (WF2K-)	DB Res Value	DB Rth Value	DB Cth Value
2S00-7B/D	250	19	65000
2S01-5B/D	125	60	8000
2S02-2B/D	125	22	5000
2S00-7N thru 2S02-2N	125	30	12500
2000-7B/D	250	19	65000
2001-5B/D	125	60	8000
2002-2B/D and 2003-7B/D	125	22	5000
2005-5B/D and 2007-5B/D	60	45	3000
2011-0B/D and 2015-0B/D	120	87	2200
2018-5B/D and 2022-0B/D	30	125	1900
2000-7N thru 2003-7N	125	30	12500
2005-5N and 2007-5N	60	12	13500
2011-0N	60	12	13500
4000-7B/D	1000	19	65000
4001-5B/D	500	60	8000
4002-2B/D and 4003-7B/D	500	22	5000
4005-5B/D and 4007-5B/D	120	45	3000
4011-0B/D and 4015-0B/D	120	150	3000
4018-5B/D thru 4030-0B/D	60	220	900
4037-0B/D thru 4055-0B/D	60	250	900
4000-7N thru 4003-7N	500	30	12500
4005-5N and 4007-5N	120	12	13500
4011-0N and 4015-0N	120	12	13500
5000-7B/D thru 5003-7B/D	500	28	12500
5005-5B/D and 5007-5B/D	120	45	3000
5011-0B/D and 5015-0B/D	120	150	3000
5018-5B/D thru 5030-0B/D	60	220	900

Model (WF2K-)	DB Res Value	DB Rth Value	DB Cth Value
5037-0B/D thru 5055-0B/D	60	250	900
5000-7N thru 5003-7N	500	30	12500
5005-5N and 5007-5N	120	12	13500
5011-0N and 5015-0N	120	12	13500

◊ **DB Res Value** Range: 0–3276.6 Ω Default: varies
DB Rth Value Range: 0–16383 Default: varies
DB Cth Value Range: 0–65535 Default: varies

DC Inj Config Address: 0411

DC injection braking may be used to stop the motor more quickly than is possible by either a ramp-to-stop or a coast-to-stop. The WF2 drive allows DC braking to be initiated either when a digital input assigned to DC braking becomes true, or when bit 12 of parameter **Cntl Word 1** is set to 1, or when a specified frequency is reached, or when any of these occur.

When using a digital input for DC braking, one of the DI parameters (see page 110) must be used to configure the selected digital input for DC braking. The amount of braking force is set by parameter **DC Inj Cur Lvl**. The length of time that the braking force is applied is determined by the time that the selected digital input is active.

The second type of DC injection braking supported by the WF2 drive is where DC braking occurs at a specified frequency.

With this type of braking, as the drive slows down after a Stop command, DC braking begins when the frequency reaches the value specified in **DC Inj Freq**. (If the frequency at the time of a Stop command is less than that of **DC Inj Freq**, DC braking begins immediately.) The braking continues for the time period specified by parameter **DC Inj Time-Frq**. Once the time period elapses, the drive may be re-started.

NOTE: If DC **DC Inj Time-Frq** is set to zero, braking is applied until the enable input, DI EN, is de-activated. To re-start, the enable input must be restored to its active condition and then the Run command re-issued.)

The following functions may be assigned to this parameter:

Display	Function
None	DC injection braking is not utilized.
DCI on Frq	At the frequency specified by parameter **DC Inj Freq**, DC braking is initiated.
DCI by DI	DC braking occurs when the digital input configured for DC braking is true or pulsed.
DCI-DI/Frq	Either the specified frequency or a digital input initiates DC braking, with digital input taking precedence.

◊ Range: see table Default: None

DC Inj Cur Lvl Address: 0412

This parameter configures the amount of DC current to be injected into the motor windings, which acts as a braking force. The amount of current is expressed as a percentage of nominal motor current. The braking force may be applied when starting or stopping.

For starting, see parameter **DC Puls-Start** on page 105. For stopping, see parameter **DC Inj Config** on page 108.

◊ Range: 0.0–150.0% Default: 50.0%

DC Inj Time-Stp **Address: 0413**

If parameter **Stop Mode** is set to DCI to Stp (see page 84), direct current will be applied to the motor. This parameter, **DC Inj Time-Stp**, determines how long the direct current will be applied, which varies with the speed of the motor. The relationship between the speed of the motor and the length of time that direct current is applied is linear until the output frequency is 10% or less of the maximum frequency. At that point, the length of time that direct current is applied to the motor is always 20% of the setting of **DC Inj Time-Stp**.

For example, if **DC Inj Time-Stp** is set to 20 s and the drive is running at maximum frequency, direct current will be applied for the entire 20 s when a Stop command occurs. If the drive was only running at half the maximum frequency, direct current would be applied for only one-half of the time specified by **DC Inj Time-Stp** (in this example, 10 s). Finally, if the drive was running at one-tenth of the maximum frequency, direct current would be applied for only 2 seconds (10% of 20 s).

NOTE: If this parameter is set to zero, direct current will be applied until the enable input, DI EN, is de-activated. To re-start, the enable input must be restored to its active condition and then the Run command re-issued.)

This parameter is independent of the **DC Inj Config** parameter and the other parameters associated with that parameter. In other words, the time period configured by this parameter, **DC Inj Time-Stp**, does not determine how long DC injection braking will be active. When DC injection braking is controlled by a digital input or by setting bit 12 of **Cntl Word 1**, the braking continues as long as the digital input or bit is true; when it is controlled by frequency, it continues for the length of time set by parameter **DC Inj Time-Frq**.

◊ Range: 0.00–60.00 s Default: 0.20 s

DC Inj Freq **Address: 0414**

If parameter **DC Inj Config** is set to DCI on Frq or DCI-DI/Frq, a frequency threshold is used for DC braking. This parameter sets the value of the frequency threshold. See parameter **DC Inj Config** on page 108 for more information.

◊ Range: 0.00–25.00 Hz Default: 0.00 Hz

DC Inj Time-Frq **Address: 0416**

If parameter **DC Inj Config** is set to DCI on Frq or DCI-DI/Frq, a frequency threshold is used for DC braking. Once the threshold is crossed, DC braking is initiated and continues for the amount of time specified by this parameter, **DC Inj Time-Frq**.

NOTE: If this parameter is set to zero, braking is applied until the enable input, DI EN, is de-activated. To re-start, the enable input must be restored to its active condition and then the Run command re-issued.)

See parameter **DC Inj Config** on page 108 for more information.

◊ Range: 0.00–60.00 s Default: 0.20 s

7.16 Digital Inputs Group

This group contains parameters that allow you to configure the functions of the digital inputs (control terminal group TB4; see figure 6 on page 36).

Active Logic **Address: 0700**

This parameter determines whether high input is regarded as true or low input is regarded as true. A “high input” is input voltage between 10 and 24 V DC; a “low input” is voltage between 0 and 3 V DC. Input voltage cannot exceed 40 V DC.

Note that the EN (Enable) terminal on the TB4 terminal group is not effected by the setting of this parameter. A high input to the EN terminal is always regarded as true. Thus, if the input to the terminal goes low, the drive will not operate – even if pull-down logic is configured. The following functions may be assigned to this parameter:

Display	Function
Active Low	Low input is true (“pull-down logic”).
Active Hgh	High input is true (“pull-up logic”).

◊ Range: see table Default: Active Hgh

D2 Configure **Address: 0704**

This parameter configures what function is performed by digital input D2.

If 3-wire control is selected in parameter **2-Wire/3-Wire** (see page 83) or if the Sequencer application is turned on (that is, parameter **Application** is set to Sequencer), the D2 terminal is forced to act as a Stop input; it should not be configured to perform any other function.

However, if 2-wire control is selected, any of the following functions may be assigned to this parameter provided the Sequencer application is not turned on:

Display	Function
Not Assign	No input on terminal D2.
Forward	Command the Forward direction.
Stop	Command a Stop.
Jog	Start jogging operation.
Reverse	Command the Reverse direction.
Jog Revers	Start jogging operation in Reverse.
PS In #1	Set reference to Preset Speed 1.
PS In #2	Set reference to Preset Speed 2.
PS In #3	Set reference to Preset Speed 3.
Alt Rmp #1	Activate Alternate Ramp 1.
Alt Rmp #2	Activate Alternate Ramp 2.
EMOP +Spd	EMOP increase speed.
EMOP -Spd	EMOP decrease speed.
T/K Switch	Switch from terminal strip to keypad control.
L/R Switch	Switch from Local to Remote mode.

Display	Function
DC Inject	Begin DC injection braking.
Torque Lim	Activate Torque Limit mode.
SL Override	Takes control away from the serial link.
PID Enable	Enables PID control.
Flt Reset	Resets a fault.
Ext Fault	Monitor for an external fault. Note that you must also configure parameter **External Fault** to generate a warning or fault; see page 122.

◊ Range: see table Default: Stop

D3 Configure **Address: 0705**

When the Sequencer application is not turned on (that is, parameter **Application** is not set to Sequencer), this parameter configures what function is performed by the D3 terminal. (When the Sequencer application is turned on, D3 is set to Seq Enable and cannot be changed.) The following functions may be assigned to this parameter when the Sequencer application is not turned on:

Display	Function
Not Assign	No input on terminal D3.
Forward	Command the Forward direction.
Stop	Command a Stop.
Jog	Start jogging operation.
Reverse	Command the Reverse direction.
Jog Revers	Start jogging operation in Reverse.
PS In #1	Set reference to Preset Speed 1.
PS In #2	Set reference to Preset Speed 2.
PS In #3	Set reference to Preset Speed 3.
Alt Rmp #1	Activate Alternate Ramp 1.
Alt Rmp #2	Activate Alternate Ramp 2.
EMOP +Spd	EMOP increase speed.
EMOP -Spd	EMOP decrease speed.
T/K Switch	Switch from terminal strip to keypad control.
L/R Switch	Switch from Local to Remote mode.
DC Inject	Begin DC injection braking.
Torque Lim	Activate Torque Limit mode.
SL Override	Takes control away from the serial link.
PID Enable	Enables PID control.
Flt Reset	Resets a fault.
Ext Fault	Monitor for an external fault. Note that you must also configure parameter **External Fault** to generate a warning or fault; see page 122.

Display	Function
8Bit DI PS	Activates the 8-bit Digital Input Reference Mode. D3 functions as the least significant bit of the eight bits in the word, with inputs D4 through D10 (the most significant bit) being assigned to the remaining bits. If a digital input is not configured, that input is considered inactive (0). See parameter **Main Speed Ref** on page 89 for information on how the binary word is translated into a decimal value for the output frequency.

◊ Range: see table Default: Jog

D4 Configure **Address: 0706**

This parameter configures what function is performed by the D4 terminal. The functions that may be assigned to this parameter are the same as those that may be assigned to parameter **D3 Configure** provided that the Sequencer application is not turned on.

If the Sequencer application is turned on, D4 is set to Seq Run and cannot be changed.

◊ Range: see **D3 Configure** Default: Reverse

D5 Configure **Address: 0707**

This parameter configures what function is performed by the D5 terminal. The functions that may be assigned to this parameter are the same as those that may be assigned to parameter **D3 Configure** provided that the Sequencer application is not turned on.

If the Sequencer application is turned on, D5 is set to Seq Reset and cannot be changed.

◊ Range: see **D3 Configure** Default: Jog Revers

D6 Configure **Address: 0708**

This parameter configures what function is performed by the D6 terminal. The functions that may be assigned to this parameter are the same as those that may be assigned to parameter **D3 Configure**. When the Sequencer application is loaded, the function Step Chg is also available.

◊ Range: see **D3 Configure** Default: PS In #1

D7 Configure **Address: 0709**

This parameter configures what function is performed by the D7 terminal. The functions that may be assigned to this parameter are the same as those that may be assigned to parameter **D3 Configure**. When the Sequencer application is loaded, the function Step Chg is also available.

◊ Range: see **D3 Configure** Default: PS In #2

D8 Configure **Address: 0710**

This parameter configures what function is performed by the D8 terminal. The functions that may be assigned to this parameter are the same as those that may be assigned to parameter **D3 Configure**. When the Sequencer application is loaded, the function Step Chg is also available.

◊ Range: see **D3 Configure** Default: PS In #3

D9 Configure **Address: 0711**

This parameter configures what function is performed by the D9 terminal. The functions that may be assigned to this parameter are the same as those that may be assigned to parameter **D3 Configure**. When the Sequencer application is loaded, the function Step Chg is also available.

◊ Range: see **D3 Configure** Default: Alt Rmp #1

D10 Configure **Address: 0712**

This parameter configures what function is performed by the D10 terminal. The functions that may be assigned to this parameter are the same as those that may be assigned to parameter **D3 Configure**. When the Sequencer application is loaded, the function Step Chg is also available.

◊ Range: see **D3 Configure** Default: Alt Rmp #2

Filter Time **Address: 0701**

This parameter sets the amount of time in which the WF2 drive will recognize a change in the signal to a digital input. For example, for the default value of 5 ms, when a digital input transitions from low to high, a 5 ms delay will occur before the digital input is recognized by the drive as having transitioned.

◊ Range: 1–255 ms Default: 5 ms

7.17 Analog Inputs Group

This group contains parameters that allow you to configure the functions of the analog inputs (found in control terminal group TB1; see figure 6 on page 36).

A1 Configure **Address: 0741**

This parameter configures what type of signal is being sent to terminals A11 and A12 (analog input 1). The following functions may be assigned to this parameter:

Display	Function
Normal	Signal is not altered. Note that a 4–20 mA DC signal may be input with this selection, but parameters **A1 Span** and **A1 Offset** may need to be adjusted to provide the desired drive performance.
Broken Wire Det	Monitor for broken wire from potentiometer.
Bipolar	Both positive and negative values sent.
4-20 mA	Range is 4 to 20 mA DC. A fixed offset of 20% and span of 100% are included with this selection. Parameters **A1 Offset** and **A1 Span** may be used to refine input calibration.
0-10 Bipolar	Bi-directional speed command from uni-directional reference. 5 V DC = zero speed.

◊ Range: see table Default: Normal

A1 Invert **Address: 0742**

This parameter configures whether the signal being sent to terminals A11 and A12 (analog input 1) is inverted – that is, whether the minimum input corresponds to the maximum frequency. The following functions may be assigned to this parameter:

Display	Function
Normal	Not inverted; minimum input is minimum frequency.
Inverted	Inverted; minimum input is maximum frequency.

◊ Range: see table Default: Normal

A1 Span **Address: 0743**

Provided parameter **A1 Configure** is not set to 4-20 mA, this parameter is used to alter the range of the input being sent to terminals A11 and A12 (analog input 1). For example, with a 0 to 10 V DC input, setting this parameter to a value of 50% alters the range to 0 to 5 V DC.

If parameter **A1 Configure** is set to 4-20 mA, the setting of this parameter is ignored.

NOTES: The minimum difference between offset and span will be limited to 10%. If offset is set to a value greater than span, zero speed output will result.

◊ Range: 0.0–200.0% Default: 100.0%

A1 Offset **Address: 0744**

Provided parameter **A1 Configure** is not set to 4-20 mA, this parameter is used to alter the starting value of the input being sent to terminals A11 and A12 (analog input 1). For example, with a 0 to 10 V DC input, setting this parameter to a value of 10% alters the range to 1 to 10 V DC.

If parameter **A1 Configure** is set to 4-20 mA, the setting of this parameter is ignored.

NOTE: The minimum difference between offset and span will be limited to 10%. If offset is set to a value greater than span, zero speed output will result.

◊ Range: 0.0–100.0% Default: 0.0%

A1 Filter Time **Address: 0745**

This parameter sets the filter time for the analog input signal to terminals A11 and A12. Longer filter times better reduce noise disturbances, but may slow the signal response time.

◊ Range: 1–1000 ms Default: 5 ms

A2 Configure **Address: 0751**

This parameter configures what type of signal is being sent to terminal A21 (analog input 2). The following functions may be assigned to this parameter:

Display	Function
Normal	Signal is not altered. Note that a 4-20 mA DC signal may be input with this selection, but parameters **A2 Span** and **A2 Offset** may need to be adjusted to provide the desired drive performance.

Display	Function
4-20 mA	Range is 4 to 20 mA DC. A fixed offset of 20% and span of 100% are included with this selection. Parameters **A2 Offset** and **A2 Span** may be used to refine input calibration.
Pls in 1kHz	Up to 1 kHz pulse trains are accepted.
Pls in 5kHz	Up to 5 kHz pulse trains are accepted.
Pls in 20kHz	Up to 20 kHz pulse trains are accepted.
Pls in 100kHz	Up to 100 kHz pulse trains are accepted.

◊ Range: see table Default: Normal

A2 Invert **Address: 0752**

This parameter configures whether the signal being sent to terminal A21 is inverted – that is, whether the minimum input corresponds to the maximum frequency. The following functions may be assigned to this parameter:

Display	Function
Normal	Not inverted; minimum input is minimum frequency.
Inverted	Inverted; minimum input is maximum frequency.

◊ Range: see table Default: Normal

A2 Span **Address: 0753**

Provided parameter **A2 Configure** is not set to 4-20 mA, this parameter is used to alter the range of the input being sent to terminal A21. For example, with a 0 to 10 V DC input, setting this parameter to a value of 50% alters the range to 0 to 5 V DC.

If parameter **A2 Configure** is set to 4-20 mA, the setting of this parameter is ignored.

NOTES: The minimum difference between offset and span will be limited to 10%. If offset is set to a value greater than span, zero speed output will result.

◊ Range: 0.0–200.0% Default: 100.0%

A2 Offset **Address: 0754**

Provided parameter **A2 Configure** is not set to 4-20 mA, this parameter is used to alter the starting value of the input being sent to terminal A21. For example, with a 0 to 20 mA DC input, setting this parameter to a value of 20% alters the range to 4 to 20 mA DC.

If parameter **A2 Configure** is set to 4-20 mA, the setting of this parameter is ignored.

NOTE: The minimum difference between offset and span will be limited to 10%. If offset is set to a value greater than span, zero speed output will result.

◊ Range: 0.0–100.0% Default: 0.0%

A2 Filter Time **Address: 0755**

This parameter sets the filter time for the analog input signal to terminal A21. Longer filter times better reduce noise disturbances, but may slow the signal response time.

◊ Range: 1–1000 ms Default: 5 ms

AINA Invert **Address: 0260**

AINB Invert **Address: 0265**

AINC Invert **Address: 0270**

These parameters configure whether the signal being sent to the A, B, or C analog input terminal of the Analog Input/Output Option Board is inverted – that is, whether the minimum input corresponds to the maximum frequency. The following functions may be assigned to this parameter:

Display	Function
Normal	Not inverted; minimum input is minimum freq.
Inverted	Inverted; minimum input is maximum freq.

◊ Range: see table Default: Normal

AINA Offset **Address: 0261**

AINB Offset **Address: 0266**

AINC Offset **Address: 0271**

These parameters are used to alter the starting value of the input being sent to the A, B, or C analog input terminal of the Analog Input/Output Option Board. For example, with a 0 to 10 V DC input, setting this parameter to a value of 10% alters the range to 1 to 10 V DC.

NOTE: The minimum difference between offset and span will be limited to 10%. If offset is set to a value greater than span, zero speed output will result.

◊ Range: 0.0–100.0% Default: 0.0%

AINA Span **Address: 0262**

AINB Span **Address: 0267**

AINC Span **Address: 0272**

These parameters are used to alter the range of the input being sent to the A, B, or C analog input terminal of the Analog Input/Output Option Board. For example, with a 0 to 10 V DC input, setting this parameter to a value of 50% alters the range to 0 to 5 V DC.

NOTE: The minimum difference between offset and span will be limited to 10%. If offset is set to a value greater than span, zero speed output will result.

◊ Range: 0.0–200.0% Default: 100.0%

AINA Filter Time **Address: 0263**

AINB Filter Time **Address: 0268**

AINC Filter Time **Address: 0273**

These parameters set the filter time for the analog input signal being sent to the A, B, or C analog input terminal of the Analog Input/Output Option Board. Longer filter times better reduce noise disturbances, but may slow the signal response time.

◊ Range: 1–1000 ms Default: 5 ms

7.18 Digital Outputs Group

This group contains parameters that allow you to configure the functions of the digital outputs and output relays (found in control terminal groups TB1, TB2, and TB3; see figure 6 on page 36). In addition, this group contains parameters which configure the various thresholds of the drive.

DQ1 Configure **Address: 0770**

This parameter configures what action or state causes digital output 1 (terminal DQ1) to become active (true); note that only Active High (pull-up) logic is available. The following functions may be assigned:

Display	Function
Not Assign	Digital output 1 is not used.
Drive Run	Drive enters Run mode.
Run Fwd	Drive is running in Forward.
Run Rev	Drive is running in Reverse.
Drive Rdy	Drive is powered-up, but not running.
At Speed	Drive has reached reference speed.
Drv Flted	A fault occurs.
Drv NotFlt	A fault has not occurred.
Kpd in Ctl	The keypad is the control path for reference speed and control functions.
Drv in Rem	Drive is in Remote mode.
Jogging	Jogging operation begins.
Curr Lvl 1	Value of parameter **Current Level 1** is exceeded.
Curr Lvl 2	Value of parameter **Current Level 2** is exceeded.
Trq Lvl 1	Value of parameter **Torque Level 1** is exceeded.
Trq Lvl 2	Value of parameter **Torque Level 2** is exceeded.
Frq Lvl 1	Value of parameter **Freq Level 1** is exceeded.
Frq Lvl 2	Value of parameter **Freq Level 2** is exceeded.
Frq Lvl 3	Value of parameter **Freq Level 3** is exceeded.
Temp Lvl	Value of parameter **Drive Temp Lvl** is exceeded.
In Cur Lim	Current Limit mode is active.
In Trq Lim	Torque Limit mode is active.
Loss Ref	Loss of 4 to 20 mA DC follower.
In Ser L Ctrl	Serial link is the control path.
In Ser L Ovrd	Control by serial link is overridden.
Zero Speed	The drive is in Run mode, but the speed reference is 0 Hz.
Frq Low Th	The output frequency falls below parameter **Low Freq Thres**.
PID High	The output from the PID loop exceeds parameter **PID High Alarm**.
PID Low	The output from the PID loop falls below parameter **PID Low Alarm**.
By Ser Lnk	Parameter **Cntl Word 2** controls the output.
Auto-Reset	An automatic reset of a fault is pending.

◊ Range: see table Default: Drive Rdy

DQ2 Configure **Address: 0771**

This parameter configures what action or state causes digital output 2 (terminal DQ2) to become active (true). The functions that may be assigned to this parameter are the same as those that may be assigned to parameter **DQ1 Configure**; see page 117 for the available functions.

◊ Range: see **DQ1 Configure** Default: At Speed

DQ3 Configure **Address: 0772**

This parameter configures what action or state causes digital output 3 (terminal DQ3) to become active (true). The functions that may be assigned to this parameter are the same as those that may be assigned to parameter **DQ1 Configure**; see page 117 for the available functions.

◊ Range: see **DQ1 Configure** Default: Run Rev

R1 Configure **Address: 0780**

This parameter configures what action or state causes output relay 1 (terminals RC1, NC1, NO1) to become active. The functions that may be assigned to this parameter are the same as those that may be assigned to parameter **DQ1 Configure**; see page 117 for the available functions.

◊ Range: see **DQ1 Configure** Default: Drv Flted

R2 Configure **Address: 0781**

This parameter configures what action or state causes output relay 2 (terminals RC2, NC2, NO2) to become active. The functions that may be assigned to this parameter are the same as those that may be assigned to parameter **DQ1 Configure**; see page 117 for the available functions.

◊ Range: see **DQ1 Configure** Default: Drive Run

DPQ Scaling **Address: 0789**

This parameter selects the multiplier that is used to determine the output frequency at the DPQ terminal (see figure 6 on page 36). The DPQ output is the product of the drive's frequency and the value of this parameter.

◊ Range: 6, 48, 96, or 3072 times the frequency Default: 6

Current Level 1 **Address: 0830**

This parameter sets the first threshold, expressed as a percentage of the nominal drive current.

◊ Range: 0–200% Default: 0%

Current Level 2 **Address: 0831**

This parameter sets the second threshold, expressed as a percentage of the nominal drive current.

◊ Range: 0–200% Default: 0%

Torque Level 1 **Address: 0832**

This parameter sets the first torque threshold, expressed as a percentage of the nominal torque.

◊ Range: 0–200% Default: 0%

Torque Level 2 **Address: 0833**

This parameter sets the second torque threshold, expressed as a percentage of the nominal torque.

◊ Range: 0–200% Default: 0%

Freq Level 1 **Address: 0834**

This parameter sets the first frequency threshold.

◊ Range: 0.0 Hz to **Maximum Freq** Default: 0.0 Hz

Freq Level 2 **Address: 0835**

This parameter sets the second frequency threshold.

◊ Range: 0.0 Hz to **Maximum Freq** Default: 0.0 Hz

Freq Level 3 **Address: 0836**

This parameter sets the third frequency threshold.

◊ Range: 0.0 Hz to **Maximum Freq** Default: 0.0 Hz

Drive Temp Lvl **Address: 0837**

This parameter sets the temperature threshold at which a digital output may be configured to change state – which, in effect, allows you to configure a warning of an impending overtemperature fault. It is expressed as a percentage of the overtemperature trip point (parameter **Drive Temp Trip**; see page 77), which is the temperature at which an overtemperature fault will be generated.

0% corresponds to –20 °C (–4 °F) and 100% corresponds to parameter **Drive Temp Trip**.

◊ Range: 0–100% Default: 100%

Low Freq Thres **Address: 0841**

This parameter sets the low frequency threshold.

◊ Range: 0.0 Hz to **Maximum Freq** Default: 0.0 Hz

RA Configure **Address: 0283**

RB Configure **Address: 0284**

These parameters configure what action or state causes output relay A or B of the Analog Input/Output Option Board to become active. The functions that may be assigned to these parameters are the same as those that may be assigned to parameter **DQ1 Configure**; see page 117 for the available functions.

◊ Range: see **DQ1 Configure** Default: –

7.19 Analog Outputs Group

This group contains parameters that allow you to configure the functions of the analog outputs (found in control terminal group TB1; see figure 6 on page 36).

AQ1 Configure **Address: 0790**

This parameter configures what variable governs the output of analog output 1 (terminal A0). The following functions may be assigned to this parameter:

Display	Function	Range Limit
Not Assigned	Analog output 1 is not used.	–
Motor Spd	Speed of the attached motor.	Parameter **Maximum Freq**.
Motor Curr	Current being supplied to the motor.	250% of drive rating.
Out Torque	Estimated torque.	250% of motor nominal rating.
Out Volt	Voltage being supplied to the motor.	Rated motor voltage.
Out Power	Calculated power output of the drive.	250% of drive rating.
Out Freq	Output frequency of the drive.	Parameter **Maximum Freq**.
Ref Freq	Commanded frequency.	100% of the input configuration.
Motor Temp	Calculation of the motor's temperature.	250% of motor model.
PID Fback	The percentage of PID feedback	100% of maximum feedback.

◊ Range: see table Default: Motor Spd

AQ1 Calibrate **Address: 0791**

This parameter is used to calibrate the output being sent from analog output 1 (terminal A0). For example, configuring this parameter to 100% equals a 10 V full scale.

◊ Range: 0–105% Default: 100%

AQ2 Configure **Address: 0792**

This parameter configures what variable governs the output of analog output 2 (terminal A1). The functions that may be assigned to this parameter are the same as those for **AQ1 Configure**:

◊ Range: see **AQ1 Configure** Default: Out Torque

AQ2 Calibrate **Address: 0793**

This parameter is used to calibrate the output being sent from analog output 2 (terminal A1). For example, configuring this parameter to 100% equals a 10 V full scale.

◊ Range: 0–105% Default: 100%

AQ2 Output Type **Address: 0794**

This parameter determines the current range output from terminal A1. The following functions may be assigned to this parameter:

Display	Function
0 - 20 mA	The current range output from A1 is 0 to 20 mA.
4 - 20 mA	The current range output from A1 is 4 to 20 mA.

◊ Range: see table Default: 0 - 20 mA

AQ2 Offset **Address: 0795**

When parameter **AQ2 Output Type** (see above) is set to 4 - 20 mA, this parameter adjusts the low-end offset. For example, if the value of this parameter was set to 50%, the range for A1 would start at 10 mA rather than 4 mA.

◊ Range: 0–100% Default: 20%

AQA Configure **Address: 0275**

AQB Configure **Address: 0279**

These parameters configure what variable governs the output of analog output A or B of the Analog Input/Output Option Board. The functions that may be assigned to this parameter are the same as those for **AQ1 Configure**.

◊ Range: see **AQ1 Configure** Default: –

AQA Calibrate **Address: 0276**

AQB Calibrate **Address: 0280**

These parameters are used to calibrate the output being sent from analog output A or B of the Analog Input/Output Option Board. For example, configuring this parameter to 100% equals a 10 V full scale.

◊ Range: 0–105% Default: 100%

AQA Offset **Address: 0277**

AQB Offset **Address: 0281**

These parameters adjust the low-end offset for analog output A or B of the Analog Input/Output Option Board. For example, if the value of this parameter was set to 50%, the range for A would start at 10 mA rather than 4 mA.

◊ Range: 0–100% Default: 20%

7.20 Fault Management Group

This group contains parameters that configure what faults are available, the optional dynamic brake, and how one recovers from fault conditions.

Man Fault Reset **Address: 0864**

When a fault occurs and auto-resetting is not enabled, this parameter configures how the fault may be reset manually. Note that if you configure the STOP key to reset faults, an active fault display must be shown on the keypad for the STOP key to reset a fault.The following functions may be assigned to this parameter:

Display	Function
None	Faults cannot be reset manually.
By DI	A digital input is configured to act as a fault reset. See page 110 for information on configuring a digital input for this purpose.
By Keypad	The STOP key on the digital keypad on the drive is used to reset faults.
By Ser Lnk	A command via the serial link resets faults.
By DI/Kypd	Either a digital input or the STOP key is used to reset faults.
By DI/Ser Lnk	Either a digital input or a command via the serial link is used to reset faults.
By Kpd/Ser Lnk	Either the Stop key or a command via the serial link is used to reset faults.
By DI/Ser/Kypd	Either a digital input, a command via the serial link, or the Stop key on the digital keypad is used to reset faults.

◊ Range: see table Default: By DI/Kypd

Input Phase Flt **Address: 0851**

This parameter configures whether the drive will monitor for an input phase failure.

HINT!

If the drive is fed direct current through the B+ / B– terminals (or DB1/B– terminals, depending on model; see page 31 for more information), the message “Mains Missing” will be displayed. This is not a fault; rather it is a message that will cease being displayed if the value of this parameter is set to Disabled.

The following functions may be assigned:

Display	Function
Disabled	The drive will not detect input phase failure. You must assign this function if a 3-phase 230 V AC WF2 model is used on a 1-phase 230 V AC line.
Fault	When an input phase failure is detected, a fault occurs (the drive will stop).

◊ Range: see table Default: Fault

External Fault **Address: 0853**

When a digital input is configured for an external fault (see pages 111 and 113), this parameter configures whether the fault is treated as a warning or a fault. The following functions may be assigned:

Display	Function
Disabled	The drive will not detect external faults.
Warning	When an external fault is detected, a warning is issued (the drive continues to operate).
Fault	When an external fault is detected, a fault occurs (the drive will stop).

◊ Range: see table Default: Disabled

Motor Thrm Prot **Address: 0854**

This parameter configures whether the drive will monitor for excessive temperature, and whether excessive temperature is treated as a warning or fault. The following functions may be assigned:

Display	Function
Disabled	The drive will not detect excessive temperature.
Warning	When an overtemperature condition is detected, a warning is issued (and the drive continues to operate).
Fault	When an overtemperature condition is detected, a fault occurs (and the drive stops).

◊ Range: see table Default: Fault

Reference Fault **Address: 0859**

This parameter configures what action is taken, if any, when the drive loses the AI2 signal to determine the reference speed. The following functions may be assigned:

Display	Function
No Action	The drive does not take any action.
Retain Spd	The last known reference speed will remain in effect.
Preset Lvl	The drive will ramp to the frequency set by parameter **Loss Ref Freq** (see below).
Fault	A fault is generated and the drive stops.

◊ Range: see table Default: No Action

Loss Ref Freq **Address: 0860**

If parameter **Reference Fault** (see above) is set to Preset Lvl, then the drive will ramp to the frequency set by this parameter when the AI2 signal is lost.

◊ Range: 0 Hz to **Maximum Freq** Default: 0 Hz

Fan Loss Fault **Address: 0862**

This parameter configures what action is taken, if any, when the drive senses the loss of one of its cooling fans (either external or internal). The following functions may be assigned:

Display	Function
Disabled	The drive does not take any action.
Warning	A warning is generated, but the drive continues to operate.
Fault	A fault is generated and the drive stops.

◊ Range: see table Default: Warning

OV Auto-Reset **Address: 0865**

When an overvoltage (OV) fault is detected, this parameter configures whether the fault is automatically reset or whether a manual reset will be required.

If you select automatic resetting, after a fault is detected, the drive will stop and wait for the duration configured by **Auto Reset Time** (see page 125).

After pausing for the specified duration, the drive will attempt to perform a ramp-type or a catch-on-the-fly start (depending on the setting of the **Auto Reset Strt** parameter; see page 125). If the attempt is unsuccessful, the process of waiting and attempting a re-start will repeat up to the number of attempts set by parameter **Fault Lockout #** (see page 125). Once the number of attempts is exceeded, a manual reset and re-start must be performed.

The following functions may be assigned to this parameter:

Display	Function
Disabled	The drive will not automatically reset and re-start; it must be reset manually.
Enabled	The drive will automatically reset and attempt to re-start.

◊ Range: see table Default: Disabled

OC Auto-Reset **Address: 0867**

When an overcurrent (OC) fault is detected, this parameter configures whether the fault is automatically reset or whether a manual reset will be required. See the discussion of automatic resetting and re-starting found under parameter **OV Auto-Reset** (page 124) for more information.

The following functions may be assigned to this parameter:

Display	Function
Disabled	The drive will not automatically reset and re-start; it must be reset manually.
Enabled	The drive will automatically reset and attempt to re-start.

◊ Range: see table Default: Disabled

OT Auto-Reset **Address: 0868**

When an overtemperature (OT) fault is detected (that is, the temperature exceeds the value set in parameter **Drive Temp Trip** – see page 77), this parameter configures whether the fault is automatically reset or whether a manual reset will be required. See the discussion of automatic resetting and re-starting found under parameter **OV Auto-Reset** (page 124) for more information.

The following data codes may be assigned to this parameter:

Display	Function
Disabled	The drive will not automatically reset and re-start; it must be reset manually.
Enabled	The drive will automatically reset and attempt to re-start.

◊ Range: see table Default: Disabled

Fault Lockout # Address: 0871

This parameter sets the number of faults that may occur before automatic resetting is disabled. Once the number set by this parameter is exceeded, a manual reset of the fault will be required. (A manual reset is accomplished by displaying an active fault display and then pressing the STOP key on the keypad, or by using a digital input.)

◊ Range: 0–10 Default: 0

Auto Reset Time Address: 0872

When automatic resetting of certain types of faults is enabled by one of the auto-reset parameters (for example, **OV Auto-Reset**, **OC Auto-Reset**, or **OT Auto-Reset**), this parameter defines the autoreset lockout interval. During the auto-reset lockout interval, the drive will reset certain faults up to the limit set with parameter **Fault Lockout #** and execute a start in accordance with the settings of parameter **Auto Reset Strt** (see below). Once the auto-reset lockout interval is exceeded, the fault count will be reset to zero and auto-resetting will continue as though it were the first occurrence.

◊ Range: 0–3600 s Default: 0 s

Auto Reset Strt Address: 0874

When automatic resetting of certain types of faults is enabled by one of the auto-reset parameters (**OV Auto-Reset**, **OC Auto-Reset**, **OT Auto-Reset**), this parameter specifies the type of start to be performed after the time delay set by parameter Auto Reset Time elapses. Note that automatic restarting of the drive can only be accomplished if a 2-wire (maintained Run) control scheme is used.

The following functions may be assigned to this parameter:

Display	Function
Ramping	The drive uses the active acceleration ramp to accelerate from zero speed to the commanded speed.
Flying start	The drive matches the commanded speed and then enters Run mode.

◊ Range: see table Default: Ramping

Net Timeout Flt Address: 0876

This parameter configures what action, if any, is taken when the drive is configured for serial link control of either direction or speed and it does not sense a valid serial communication telegram within the period of time specified by parameter **Comm Timeout** (see page 132) when operating in a Modbus environment. When operating in a DeviceNet environment, the time duration is supplied by the DeviceNet network.

The following data codes may be assigned to this parameter:

Display	Function
Disabled	The drive does not take any action.
Warning	A warning is generated, but the drive continues to operate.
Fault	A fault is generated and the drive stops.

◊ Range: see table Default: Disabled

DC Volt Flt Cfg **Address: 0877**

This parameter configures what action, if any, is taken when the drive senses that the DC voltage is outside of normal limits on power-up.

The following functions may be assigned to this parameter:

Display	Function
Disabled	The drive does not take any action. (The drive will display NOT READY.)
Warning	A warning is generated. When the condition clears, the drive will resume operation.
Fault	A fault is generated and the drive stops.

◊ Range: see table Default: Fault

Auto Res Delay **Address: 0878**

This parameter imposes a delay in the drive's process of auto-resetting a fault. (This is often needed to accommodate the limitations of a driven machine.) Once the time duration of the imposed delay elapses, a re-start will be attempted using the type of start specified by the **Auto Reset Strt** parameter (see page 125).

◊ Range: 0.1–3600.0 s Default: 1.0 s

DB Flt AR **Address: 0866**

This parameter allows you to make the fault for the dynamic brake circuit (F15) capable of being auto-reset. The following functions may be assigned to this parameter:

Display	Function
Disabled	The fault cannot be auto-reset.
Enabled	The fault can be auto-reset.

◊ Range: see table Default: Disabled

Loss Ref AR **Address: 0869**

This parameter allows you to make the fault for the loss of the reference signal (F36) capable of being auto-reset. The following functions may be assigned to this parameter:

Display	Function
Disabled	The fault cannot be auto-reset.
Enabled	The fault can be auto-reset.

◊ Range: see table Default: Disabled

Ext Flt AR **Address: 0870**

This parameter allows you to make the external fault or warning (F7) capable of being auto-reset. The following functions may be assigned to this parameter:

Display	Function
Disabled	The fault cannot be auto-reset.
Enabled	The fault can be auto-reset.

◊ Range: see table Default: Disabled

Mtr Ovld AR **Address: 0879**

This parameter allows you to make the motor overload fault (F20) capable of being auto-reset. The following functions may be assigned to this parameter:

Display	Function
Disabled	The fault cannot be auto-reset.
Enabled	The fault can be auto-reset.

◊ Range: see table Default: Disabled

7.21 Display Options Group

This parameter group contains parameters that configure the functionality of the keypad display as well as the language used for the display.

Display Mode **Address: 0955**

This parameter configures what information is shown on the display of the digital keypad in Operate mode. The following functions may be assigned to this parameter:

Display	Function
Std Disply	The output frequency is shown in the display. (See figure 23 on page 56 for an example of this display.)
User Units	A custom unit may be created using the **User Units Mult**, **User Units Div**, **User Label 1**, **User Label 2**, and **User Label 3** parameters and displayed on the keypad. See below for information on these parameters.

Display	Function
Reten Time	The display shows retention time, which is a reciprocal function of the normal speed/frequency proportional output. The displayed value for the retention time (RDV) is derived by dividing the value of User Units Mult (UUM) by the value of User Units Div (UUD), and then multiplying the result by the quotient of the Maximum Frequency (FMAX) divided by 10 times the operating frequency (FOUT). As an equation, this is represented as follows: $RDV = \frac{UUM}{UUD} \times \frac{\text{Maximum Frequency}}{(10 \times FOUT)}$

◊ Range: see table Default: Std Disply

User Units Mult **Address: 0956**

This parameter may be used in creating a custom unit that is displayed on the keypad. The value stored in this parameter multiplies the displayed frequency value.

For example, to show speed in revolutions per minute for an 1800 rpm motor, the **Display Mode** parameter would be set to User Units and the **User Units Mult** parameter would be set to 30. (The default value for the **User Units Div** parameter is 1, and so it does not need to be altered for this example.)

◊ Range: 1–32767 Default: 1

User Units Div **Address: 0957**

This parameter may be used in creating a custom unit that is displayed on the keypad. The displayed frequency is divided by the value stored in this parameter.

◊ Range: 1–32767 Default: 1

User Label 1 **Address: 0958**

User Label 2 **Address: 0959**

User Label 3 **Address: 0960**

The custom unit created with the above parameters may have a three-character label applied to it. These three parameters specify the first through the third characters, respectively. A character is selected by using the Up or Down arrow keys to scroll to the desired character and then pressing ENTER. The characters supported by the WF2 drive are upper and lower case A through Z, 0 through 9, blank (space), and # % + – . / : < = > _ , @ ^ &

When using serial communication, the data codes for these characters are as follows: A–Z (0–26), a–z (27–52), 0–9 (53–62), # (63), % (64), + (65), – (66), . (67), / (68), : (69), < (70), = (71), > (72), _ (73), , (75), @ (76), ^ (77), & (78).

◊ Range: – Default: 0 (space)

Language **Address: 0980**

This parameter sets the language used for displays. The following languages may be assigned to this parameter:

Display	Function
English	Displays are in English.
Espanol	Displays are in Spanish.
Italiano	Displays are in Italian.
Deutsch	Displays are in German.

◊ Range: see table Default: English

Show Param # Address: 0961

This parameter allows you to display the memory address of a parameter in the standard keypad display window (see figure 24 on page 57). The following functions may be assigned to this parameter:

Display	Function
Disabled	Memory addresses are not shown in the keypad display.
Enabled	Memory addresses are shown in the keypad display.

◊ Range: see table Default: Disabled

F1 Key Config Address: 0961

F2 Key Config Address: 0962

F3 Key Config Address: 0963

F4 Key Config Address: 0964

These parameters allow you to configure the function performed by the function keys found on the enhanced keypad (MON/F1, OPR/F2, PAR/F3, DIR/F4). The following functions may be assigned to these parameters:

Display	Function
Disabled	The function key does not perform any special functions (although it will, when used with the SHIFT key, navigate to the named mode).
Loc/Rem	The function key acts as a toggle switch between Local and Remote modes.
Term/Kpd	The function key acts as a toggle switch to switch the control path between the terminal strip and the keypad.
PID Enable	The function key enables PID control.
SL Override	The function key overrides serial link control.

◊ Range: see table Default: Disabled

Keypad Control Address: 0875

This parameter configures the type of keypad that is connected to the WF2 drive (either standard, enhanced, or both) and the response of the drive if communication with the keypad is lost. The following functions may be assigned to this parameter:

Display	Function
SKP	This is only available for B and D models, and denotes that a standard keypad is attached to the drive. If communication with the keypad is lost, fault code 40 will be generated. This is the default value for models other than N models.
Both	This is only available for B and D models, and denotes that both a standard and an enhanced keypad are connected to the drive. Fault code 40 is generated if communication with either keypad is lost.
Both No Flt [1]	Same as Both, except that if communication is lost with either keypad, a fault will not be generated and the drive will continue to operate.
EKP	This is only available for N models, and denotes that an enhanced keypad is connected to the drive. Fault code 40 is generated if communication with the enhanced keypad does not occur in the amount of time specified in parameter **EKP Timeout** (see page 133). This is the default value for N models.
No Flt [1]	Same as EKP, except that a fault will not be generated if communication with the keypad does not occur in the specified amount of time.

[1] **NOTE:** When the keypad is the primary control mechanism, if this function is selected and communication is interrupted (that is, temporarily lost and then restored), then the drive may not recognize the pressing of the Stop key even if the keypad is communicating with the drive.

◊ Range: see table Default: varies

7.22 Special Group

This parameter group contains parameters that perform special functions, such as the storing of parameter values.

Param STO/RCL **Address: 0982**

This parameter is of assistance in debugging abnormal drive behavior. The following data codes may be assigned to this parameter:

Display	Function
Select....	No action is performed.
Factry Rst	All parameters are reset to the factory defaults (see chapter 11 on page 156 for default values).
Store Parm	The customer's parameter values are stored in non-volatile memory.
Load Param	All parameters are set to the values stored in non-volatile memory.

◊ Range: see table Default: Select....

Application **Address: 0981**

This parameter allows you to select special operating modes of the WF2 drive. The following data codes may be assigned to this parameter.

Display	Function
Normal	Standard WF2 drive operation.
Sequencer	Makes the Sequencer application available by enabling the Seq Configure parameter group and re-configuring other parameters to support the Sequencer application. See section 10 on page 146 for more information.

◊ Range: – Default: –

Program Number **Address: 0983**

This parameter allows you to perform special operations on the WF2 drive. The following data codes may be assigned to this parameter:

Displayed Code	Special Operation
10	Resets the **Elapsed Runtime** parameter to zero.
20	Resets the **Elapsed MWh** parameter to zero.

◊ Range: – Default: –

7.23 Communication Group

This group provides parameters for utilizing Modbus or DeviceNet® protocol for serial link communications. It also provides access to status parameters so you may check on a drive's performance as well as the external frequency references for the drive. Finally, for troubleshooting, the actual control words being written over the serial link may be viewed by reading the control word found in this parameter group.

Note that the status and control words are represented by four hexadecimal values, which are then translated to binary values (see chapter 12 on page 179). The binary values are then compared to the bit positions to derive status information. (The significance of each bit is indicated in the table below).

For example, you might write hexadecimal value 0013 for **Cntl Word 1**. Translated to a binary value, this is 0000 0000 0001 0011. Only the ones are important, and these are found in bit positions 4, 1, and 0. As shown by the key for **Cntl Word 1**, the serial link is the control path for control functions and the reference speed (bits 0 and 1) and the value of parameter **Ext Freq Ref 2** is the reference speed (bit 4).

The parameters in this group are shown in the order in which they are displayed on the keypad. See page 52 for the pin-out diagram for the Modbus communication port.

Comm Protocol **Address: 0900**

This parameter determines whether RTU or ASCII Modbus protocol will be used for serial link communications, or whether the DeviceNet® protocol will be used. If set to DeviceNet, Siemens P1, or Metasys N2, internal set-up of the respective option board automatically occurs.

◊ Range: RTU, ASCII, DeviceNet, Siemens P1, Metasys N2 Default: RTU

Comm Baudrate **Address: 0901**

This parameter sets the baud rate for serial communication. The following baud rates may be assigned:

Display	Function
Disabled	Serial communication is not being utilized.
1200	1200 bps. [1]
2400	2400 bps. [1]
4800	4800 bps. [1]
9600	9600 bps (default for Modbus communication). [1]
19.2K	19.2K bps. [1]
38.4K	38.4K bps. [2]
125K	125k bps [2] (default for DeviceNet communication). [3]
250K	250K bps. [2]
500K	500K bps. [2]

[1] Only available for Modbus communication (parameter **Comm Protocol** set to RTU or ASCII).
[2] Only available for DeviceNet communication (a DeviceNet option board is installed and parameter **Comm Protocol** is set to DeviceNet).
[3] The default setting for DeviceNet may be changed to either 250K or 500K, but the change will not take effect until power is cycled.

◊ Range: see table Default: –

Comm Parity **Address: 0902**

This parameter sets the parity and the number of data and stop bits recognized by the serial communication port. If parameter **Comm Protocol** is set to DeviceNet, the value of this parameter cannot be changed from its default value. The following may be assigned:

Display	Function
N81	No parity, 8 data bits, 1 stop bit.
N82	No parity, 8 data bits, 2 stop bits.
E81	Even parity, 8 data bits, 1 stop bit.
O81	Odd parity, 8 data bits, 1 stop bit.

◊ Range: see table Default: N81

Comm Drop # **Address: 0903**

This parameter sets the drop number of the serial communication port. If parameter **Comm Protocol** is set to RTU or ASCII, the range is from 1 to 247 (with a default of 1); if it is set to DeviceNet, the range is 0 to 63 (with a default of 63).

Note that when DeviceNet protocol is used, you may change the drop number set in this parameter, but the change will not take effect until power is cycled.

◊ Range: 1–247 or 0–63 Default: 1 or 63

Comm Timeout **Address: 0904**

The serial communication interface may be monitored by a watchdog function. The WF2 drive's watchdog function is enabled by setting the value of parameter **Net Timeout Flt** to either Warning or Fault (see page 125).

When the watchdog function is set to Fault and the drive is configured for serial link control of either direction or speed, the drive must sense a valid telegram within the duration set by **Net Timeout Flt**. If a valid telegram is not sensed within the configured time period, the drive will generate Fault 42 (Ser Lnk Timeout) and coast to a stop.

If the watchdog function is set to Warning instead of Fault, the drive must still sense a valid telegram within the duration set by **Net Timeout Flt**. However, if a valid telegram is not received in the configured time period, then the drive will generate Fault Code 58 (Ser Lnk TimeOut Warning) and keep running.

◊ Range: 1–60 s Default: 5 s

EKP Baudrate **Address: 0906**

This parameter sets baud rate for communication with the enhanced keypad, and may be set to either 9600 or 19200 bps.

◊ Range: 9600 or 19.2K Default: 19.2K

EKP Timeout **Address: 0907**

This parameter configures a watchdog timer for communication with an enhanced keypad. If the enhanced keypad does not respond in the configured amount of time and parameter **Keypad Control** is set to EKP Loss or SKP or EKP (see page 129), fault code 40 will be generated.

◊ Range: 2.0–60.0 s Default: 2.0 s

Cntl Word 1 **Address: 0201**

The bits of the word represented by this parameter perform the following actions (note that if parameter Application is set to Sequencer to invoke the Sequencer application, Bits 10 and 11 are inactivated):

							+0								**+1**
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**

Bit	When Set to 1 Signifies	Bit	When Set to 1 Signifies
8	Command Alternate Ramp #1	0	Send commands via serial link
9	Command Alternate Ramp #2	1	Set reference frequency by serial link
10	Switch to Remote mode	2	Command Forward direction
11	Set terminal strip as control path	3	Command Reverse direction
12	Initiate DC injection braking	4	Use FEXT2 value as reference frequency
13	Perform a freewheel stop	5	Command Preset Speed (bit 1)
14	not used	6	Command Preset Speed (bit 2)
15	Reset inverter	7	Command Preset Speed (bit 3)

◊ Range: 0–65535 Default: 0

Cntl Word 2 **Address: 0202**

The bits of the word represented by this parameter perform the following actions (note that if parameter **Application** is set to “Sequencer” to invoke the Sequencer application, Bit 0 enables this application for use; otherwise, Bit 0 enables PID control. Also, Bits 13 and 14 will be inactivated since network communication is not permitted when the Sequencer application is invoked):

							+0								+1
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	When Set to 1 Signifies	Bit	When Set to 1 Signifies
8	Activate digital output DQ1	0	Enable PID control or Sequencer app.
9	Activate digital output DQ2	1	Pause Sequencer application
10	Activate digital output DQ3	2	Reset Sequencer application
11	Activate relay RA	3	not used
12	Activate relay RB	4	not used
13	NetNetwork Timeout Fault	5	not used
14	NetNetwork Timeout Warning	6	Activate relay R1
15	NetNetwork Forced Fault	7	Activate relay R2

◊ Range: 0–65535 Default: 0

Ext Freq Ref 1 **Address: 0203**

This parameter sets the frequency for the first external frequency reference (FEXT1).

◊ Range: 0.00 Hz to **Maximum Freq** Default: 0.00 Hz

Ext Freq Ref 2 **Address: 0205**

This parameter sets the frequency for the second external frequency reference (FEXT2).

◊ Range: 0.00 Hz to **Maximum Freq** Default: 0.00 Hz

Status Word 1 **(Read-Only)** **Address: 0050**

The bits of the word represented by this parameter provide the following information (note that if parameter **Application** is set to “Sequencer” to invoke the Sequencer application, Bit 10 will be set to zero and cannot be changed because Remote mode is disabled):

							+0								+1
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	When Set to 1 Signifies	Bit	When Set to 1 Signifies
8	Alternate ramp 1 is active	0	SLC active, SLO is available
9	Alternate ramp 2 is active	1	SLF active, SLO is available
10	Drive is in Remote	2	Drive is running in Forward
11	Keypad controls direction	3	Drive is running in Reverse
12	DC injection braking is active	4	FEXT2 is active serial link reference
13	Drive is jogging	5	Drive is accelerating
14	Run commanded, zero speed	6	Drive is decelerating
15	Drive is faulted (locked-out)	7	Drive is at speed

◊ Range: 0–65535 Default: –

Status Word 3 (Read-Only) Address: 0052

The bits of the word represented by this parameter provide the following information:

							+0								+1
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	When Set to 1 Signifies	Bit	When Set to 1 Signifies
8	Sequencer application enabled	0	Drive is ready to run (EN is active)
9	Sequencer application running	1	State of EN input
10	Sequencer application paused	2	Forced Local control is active
11	not used	3	A warning is active
12	not used	4	Drive is operating in Current Limit
13	Drive is in the undervoltage state	5	Drive is operating in Torque Limit
14	Overtemperature warning	6	Loss of 4-20 mA follower detected
15	Drive is faulted (not locked-out)	7	Broken wire detection activated

◊ Range: 0–65535 Default: –

7.24 PID Configure Group

This group contains parameters that configure the PID control function of the WF2 drive. When configuring PID control loops, you should bear in mind that the acceleration and deceleration ramps will affect closed loop operation. For optimum performance, the ramps should be set to the smallest values possible without causing nuisance tripping. Chapter 13 provides further information on configuring and tuning PID control loops.

PID Configure **Address: 0650**

This parameter determines what means are used to enable PID control as well as the type of PID control that is enabled. The following values may be assigned to this parameter:

Display	PID Control is Enabled by	Type of PID Control
No PID	PID control is always inactive.	–
Feed-Fwd	When Run condition exists.	Feed-forward.
F-fwd DI	Digital input.	Feed-forward.
F-fwd Fkey	Function key on enhanced keypad.	Feed-forward.
F-fwd Ser	Serial communication.	Feed-forward.
Full-Range	When Run condition exists.	Full-range.
Full DI	Digital input.	Full-range.
Full Fkey	Function key on enhanced keypad.	Full-range.
Full Ser	Serial communication.	Full-range.

If you select a digital input or function key as the means to enable PID control, remember to configure the parameter that sets the function of the digital input or function key to enable PID control to complete the implementation. For further information on using serial communication to enable PID control, see parameter **Cntl Word 2** on page 134.

◊ Range: see table Default: No PID

PID Direct Type **Address: 0651**

This parameter sets whether the PID control loop is direct-acting or reverse-acting (inverse-acting). Direct-acting systems are characterized by the process variable (sensed by the transducer) diminishing as the setpoint is approached. Conversely, reverse-acting systems are characterized by the process variable increasing as the setpoint is approached.The following values may be assigned to this parameter:

Display	Function
Direct	Direct-acting PID control loop.
Reverse	Reverse-acting PID control loop.

◊ Range: see table Default: Direct

Feedback Config **Address: 0652**

This parameter configures the source of the feedback signal, which may be either Ref 1, Ref 2, or Ref 3. These references are in turn configurable to be set by analog input 1 or 2 of the WF2 drive or analog input A, B, or C of the Analog Input/Output Option Board; see page 90 for more information. The following sources may be assigned to this parameter:

Display	Function
Ref 1	Reference 1.
Ref 2	Reference 2.
Ref 3	Reference 3.

◊ Range: see table Default: Ref 1

PID Prop Gain **Address: 0653**

This parameter configures the short-term response of the drive to incremental change in the feedback signal. The range of this parameter is 0 to 1000 corresponding to 0.0% to 100.0% of the maximum frequency.

◊ Range: 0–2000 Default: 0

PID Int Gain **Address: 0654**

This parameter sets the long-term response of the drive to a change in the feedback signal. (This is sometimes called “averaging time”.)

By setting this parameter appropriately, the drive may be calibrated to ignore short-term perturbations seen in the transducer signal (that may be considered either noise or insignificant) – while still responding to longer-term effects reflected in the signal.

The range of this parameter is 0 to 1000, with 0 being inactive and 1000 being the quickest response time.

◊ Range: 0–10000 Default: 0

PID Deriv Gain **Address: 0655**

This parameter sets the gain of the derivative term in the drive’s response to changes in the feedback input. The range of this parameter is 0 to 1000, with 0 being inactive and 1000 being maximum derivative gain.

ATTENTION!

UNSTABLE OPERATION.

Changing the value of this parameter to a number greater than 0 may result in unstable operation. Since most applications only require integral feedback conditioning (not derivative feedback conditioning, which is accomplished with this parameter), adjustment of this parameter should only be performed by experienced personnel and with great care.

Failure to observe this warning may result in injury or equipment damage.

◊ Range: 0–1000 Default: 0

Feedback Gain **Address: 0656**

This parameter provides a scaling factor for the feedback signal. The range is 0 to 2000 corresponding to 0.0% to 200.0% of the maximum frequency.

◊ Range: 0–2000 Default: 0

PID High Limit **Address: 0657**

This parameter sets the high limit of PID output. The range is 0.00 to 100.00% of the maximum frequency.

◊ Range: 0.00–100.00% Default: 100.00%

PID Low Limit **Address: 0658**

This parameter sets the low limit of PID output. The range is 0.00 to 100.00% of the maximum frequency.

◊ Range: 0.00–100.00% Default: 0.00%

PID High Alarm **Address: 0659**

When the PID output exceeds the value of this parameter (which is a percentage of the reference frequency), a digital output or relay may be configured to provide notification.

◊ Range: 0.00–100.00% Default: 100.00%

PID Low Alarm **Address: 0660**

When the PID output falls below the value of this parameter (which is a percentage of the reference frequency), a digital output or relay may be configured to provide notification.

◊ Range: 0.00–100.00% Default: 0.00%

PID Reference **(Read-Only)** **Address: 0670**

This parameter shows the setpoint for the PID control loop. The setpoint is expressed as a percentage of the maximum frequency. The value shown in this parameter can be used to determine whether the control path of the drive is configured correctly as well as whether the analog input is configured correctly with respect to span and offset.

◊ Range: 0–100% Default: –

PID Feedback **Address: 0671**

This parameter establishes the setpoint for the feedback signal as a percentage of the maximum frequency. This parameter may be used to provide analog input scaling of the feedback signal. It can also be sent to either the AQ1 or AQ2 analog output terminal if the analog output is configured to show the PID feedback signal (see page 120 for more information).

◊ Range: 0–100% Default: 0%

PID Error **(Read-Only)** **Address: 0672**

This parameter shows the value of the error between PID feedback and PID reference. The error is expressed as a percentage of the maximum frequency.

◊ Range: 0–100% Default: –

PID Output **(Read-Only)** **Address: 0673**

This parameter shows the sum of P-Part, + I-Part, and + D-Part components. The sum is limited by parameters **PID High Limit** and **PID Low Limit**.

◊ Range: 0–100% Default: –

PID P-Part **(Read-Only)** **Address: 0674**

This parameter shows the amount of the proportional contribution to the total output, expressed as a percentage of the maximum frequency.

◊ Range: 0–100% Default: –

PID I-Part	(Read-Only)	Address: 0675

This parameter shows the amount of the integral contribution to the total output, expressed as a percentage of the maximum frequency.

◊ Range: 0–100% Default: –

PID D-Part	(Read-Only)	Address: 0676

This parameter shows the amount of the derivative contribution to the total output, expressed as a percentage of the maximum frequency.

◊ Range: 0–100% Default: –

7.25 Ungrouped Parameters

The following parameters are not found in a parameter group, and cannot be read with the simple keypad nor with the enhanced keypad when it is in the Parameter mode. Instead, these parameters may be read with the enhanced keypad when it is in the Direct Parameter Access mode by entering the parameter address – or via serial communication.

Drive Family	(Read-Only)	Address: 0998

This parameter stores a code signifying the drive family. For the WF2 inverter, it is set to 6 to signify a WF2-series inverter.

◊ Range: 0–10 Default: –

Fault History 1	(Read-Only)	Address: 0100
Fault History 2	(Read-Only)	Address: 0101
Fault History 3	(Read-Only)	Address: 0102
Fault History 4	(Read-Only)	Address: 0103
Fault History 5	(Read-Only)	Address: 0104
Fault History 6	(Read-Only)	Address: 0105
Fault History 7	(Read-Only)	Address: 0106
Fault History 8	(Read-Only)	Address: 0107
Fault History 9	(Read-Only)	Address: 0108

These parameters comprise a fault history log. Each parameter stores a code signifying the fault that occurred; see Section 8 for the list of fault codes. The code for the most recent fault is stored in parameter **Fault History 1**; the code for the oldest fault is stored in parameter **Fault History 9**.

When a new fault occurs, the value of parameter **Fault History 1** is moved to **Fault History 2**; the former value of **Fault History 2** is moved to **Fault History 3**; and so on up to **Fault History 9**. The code that was stored in parameter **Fault History 9** is discarded.

◊ Range: 0–100 Default: –

Active Fault 1	**(Read-Only)**	**Address: 0110**
Active Fault 2	**(Read-Only)**	**Address: 0111**
Active Fault 3	**(Read-Only)**	**Address: 0112**
Active Fault 4	**(Read-Only)**	**Address: 0113**
Active Fault 5	**(Read-Only)**	**Address: 0114**
Active Fault 6	**(Read-Only)**	**Address: 0115**

These parameters store the codes of up to six faults that are currently active. (See Section 8 for the list of fault codes.) If more than six faults are active, the remaining faults are not recorded. These parameters will be cleared when the drive is reset.

◊ Range: 0–100 Default: –

8 Troubleshooting

8.1 WF2 Fault Codes

Table 29 shows the fault codes that may be displayed, along with suggestions for recovering from the fault condition.

Fault Code	Fault Name	Possible Cause(s)	How to Recover
01	Watch Dog Trip	Contact BERGES for further information.	Contact BERGES for further information.
02	Power Bridge Id	• Ribbon cable not correctly seated between the power and control boards. • Electrical noise.	• Ensure that the ribbon cable is correctly seated. • Determine the source of the noise and eliminate it.
03	Current Calibr	Current sensors have an offset problem.	Contact BERGES for further information.
04	TSP 24V Supply	Overloaded +24 V DC supply.	Check the loading on the +24 V DC supply and remove any excess load.
05	DC Volt Calibr	DC voltage is outside of normal limits on power-up. This may be caused by: • High or low line voltage. • **Supply Voltage** parameter incorrectly set.	• Check line voltage. • Check the **Supply Voltage** parameter (see page 106).
06	IOC Trip	Output short-circuit. May also be caused by a ground fault (see Fault Code 11 below).	• Check motor wiring. • Extend acceleration ramp. • Reduce boost. • Check for ground faults.
07	Ext Flt/Warning (Fault)	The configured input sensed an external fault.	Investigate why the external fault occurred and correct.
09	Inter-Proc Comm	Loss of communication with the control terminal strip.	Reset the drive by pressing the Stop key for more than 1 second. If problem persists, consult BERGES.
11	Ground Fault	The drive detected that the sum of the motor phases' current is not zero. This may be caused by insulation failure in the motor or the cables.	• Check motor wiring. • Check for and remove any capacitive load. • Check the motor and cabling for shorts to ground.
12	Input Phase Loss	Current measurement detected an input phase with no current.	Check input power cables.
13	Overvoltage	The voltage of the internal DC-link has exceeded 135% of the nominal voltage. This may be caused by incorrect deceleration time or high overvoltage spikes on line.	• Adjust deceleration time. • Add dynamic braking module.
14	Under Voltage	The DC bus voltage fell below 65% of the nominal voltage. This may be due to line supply failure or internal failure of the drive.	Reset fault and attempt to restart. Check the line for proper supply. If fault persists, an internal fault has occurred; contact BERGES.
15	DB Crct Failure	The dynamic brake (DB) is overloaded.	• Check for an open DB resistor. • Check for a shorted DB transistor. • Consult BERGES.

Table 29

Fault Code	Fault Name	Possible Cause(s)	How to Recover
16	Motor Over Temp (Fault)	The drive's motor temperature model detected motor overheating severe enough to cause a fault.	Decrease motor loading. If the motor is not overheated, check the temperature model parameters.
17	Output Fault	The output sensor detected an error.	• Check motor wiring. • Check for and remove any capacitive load. • Check the motor and cabling for shorts to ground.
18	Overcurrent	The drive has measured excessive current in the motor output. This may be caused by: • Sudden, heavy load increase. • Short circuit in the motor cables. • Unsuitable motor.	• Check the load, motor size, and cables. • Review the settings for acceleration and deceleration times.
19	Drive Over Temp	Temperature of the drive's heatsink is too high.	• Check the air flow. • Check that the heatsink is not clogged. • Check the ambient temperature. • Check that the switching frequency is not too high compared to ambient temperature and load.
20	Motor OverLoad	Excessive load on the motor (for example, a jammed load).	Check the motor and load.
21	Drive Under Temp	• Temperature of the drive's heatsink is below –10 °C (14 °F). • Ribbon cable not correctly seated between the power and control boards.	• Increase the ambient temperature. • Ensure that the ribbon cable is correctly seated.
22	Motor Stall (Fault)	The motor's stall protection sensed a stall severe enough to cause a fault.	Check the motor.
23	Motor Underload (Fault)	The load on the motor is so insufficient (for example, a broken conveyor belt) that a fault occurs.	Check the motor and load.
24	TSP 10V Ref	10 V reference for the analog input is overloaded.	• Ensure that the total load on the +10 terminal does not exceed 20 mA DC. • Check for correct connection of devices to the +10 terminal. • Check for short circuits associated with devices connected to the +10 terminal. • Consult BERGES.
25	EE Ref Checksum	Parameter restoring error due to interference fault or component failure.	Reset the fault and attempt a restart. If fault persists, contact BERGES.
26	EE Par Checksum	Parameter restoring error due to interference fault or component failure.	Reset the fault and attempt a restart. If fault persists, contact BERGES.
27	EEPROM Checksum	Parameter restoring error due to interference fault or component failure.	Reset the fault and attempt a restart. If fault persists, contact your local distributor or BERGES.
28	Outpt Phase Loss	Current measurement detected a motor phase with no current.	Check motor cables.
29	Precharge Fault	Consult BERGES.	Consult BERGES.

Table 29

Fault Code	Fault Name	Possible Cause(s)	How to Recover
30	TRIN Flt (ASIC)	Consult BERGES.	Consult BERGES.
31	Satur Flt (ASIC)	Consult BERGES.	Consult BERGES.
32	Empty Trp (ASIC)	Consult BERGES.	Consult BERGES.
33	Appl Change	Consult BERGES.	Consult BERGES.
34	High Unbal Curr	Consult BERGES.	Consult BERGES.
35	MCP Software	Consult BERGES.	Consult BERGES.
36	Loss Freq Ref (Fault)	The drive detected the loss of the reference signal.	Restore the reference signal.
37	Loss Freq Ref (Warning)	The drive detected the loss of the reference signal.	Restore the reference signal.
38	Broken Wire Trip (Fault)	The drive detected a broken wire to Analog Input 1.	Check the control wiring for a broken wire and replace.
39	Broken Wire Trip (Warning)	The drive detected a broken wire to Analog Input 1.	Check the control wiring for a broken wire and replace.
40	Loss of Keypad	Communication with the keypad is lost while keypad control is active.	Investigate and correct communication problem.
41	Ext Flt/Warning (Warning)	The configured input sensed an external fault.	Investigate why the external fault occurred and correct.
42	Ser Lnk TimeOut (Fault)	The programmed value of parameter **Comm Timeout** (see page 132) was exceeded.	Reset and restore serial link communications.
43	DI Logic Not Set	DI active logic is not set.	Set DI active logic via **Active Logic** parameter (see page 110).
44	DI Logic Changed	Consult BERGES.	Consult BERGES.
45	DB Res Over Temp (Fault)	The internal dynamic brake (DB) resistor is too hot due to a peak overload.	• Reduce the amount of time that the DB is applied. • Reduce how often the dynamic brake is used. • Check that parameters **DB Res Value**, **DB Rth Value**, and **DB Cth Value** (see page 107) are correctly set. • Reduce the load. • Consult BERGES.
46	DB Res Over Temp (Warning)	The internal DB resistor is too hot due to a peak overload.	• Reduce the amount of time that the DB is applied. • Reduce how often the dynamic brake is used. • Check that parameters **DB Res Value**, **DB Rth Value**, and **DB Cth Value** (see page 107) are correctly set. • Reduce the load. • Consult BERGES.
47	DB Res Over Load (Fault)	Due to continuous overload, the load is more than the DB can safely handle.	• Reduce the load. • Consult BERGES.
48	DB Res Over Load (Warning)	Due to continuous overload, the load is more than the DB can safely handle.	• Reduce the load. • Consult BERGES.

Table 29

Fault Code	Fault Name	Possible Cause(s)	How to Recover
50	Fan Fault	The cooling fan on the drive's enclosure is drawing too much current, which may indicate that the fan is jammed or has failed.	• Remove obstruction. • Replace fan.
51	Fan Warning	The cooling fan on the drive's enclosure is drawing excessive current, but not enough to generate a fault. This may indicate that the fan is jammed.	• Remove obstruction.
52	Motor Over Temp (Warning)	The drive's motor temperature model detected motor overheating, but not severe enough to generate a fault.	Decrease motor loading. If the motor is not overheated, check the temperature model parameters.
53	Motor Stall (Warning)	The motor's stall protection sensed a stall, but not severe enough to cause a fault.	Check the motor.
54	Motor Underload (Warning)	The load on the motor is insufficient, but not so low that a fault occurs.	Check the motor and load.
55	Comm Timeout (Fault)	No communication has occurred in the specified amount of time, and a fault occurs.	Reset and restore communication. See the communication option manual for further information.
56	Comm Timeout (Warning)	No communication has occurred in the specified amount of time, and a fault occurs.	Reset and restore communication. See the communication option manual for further information.
57	Network Ext Fault	The external communication network delivered a command to the drive that is forcing a system-wide error.	Reset and restore DeviceNet communication.
58	Ser Lnk TimeOut (Warning)	The programmed value of parameter **Comm Timeout** (see page 132) was exceeded.	Reset and restore serial link communications.
59	Regen Timeout	After a Stop command, the drive has been operating in regenerative current limit for a time period in excess of the setting of parameter **Regen Timeout**.	Re-adjust regenerative torque limit parameters or add dynamic braking capacity to the drive.
60	DC Volt Calibr (Warning)	DC voltage is outside of normal limits on power-up. This may be caused by: • High or low line voltage. • The **Supply Voltage** parameter is incorrectly set.	• Check line voltage. • Check the setting of the **Supply Voltage** parameter (see page 106).

Table 29

9 WF2 Options

9.1 Remote Keypad Kits

The enhanced keypad is available for remote mounting or hand-held use in your application. It is available in either a white (part number EKPW-01) or gray configuration (part number EKPG-01). It affords all the flexibility described in section 6 of this manual.

9.2 IP31–IP21 Conversion Kits

The IP31 model may optionally be fitted with a kit for terminating shielded cable. Four kits are available, depending on the size of the model (the part numbers for the kits are W2CP01, W2CP02, W2CP03, and W2CP04).

These kits contain four clamps that slide into slots on the included cable plate. The clamps are used to terminate shielded cable. The cable plate easily replaces the conduit plate on the bottom of the IP31 model.

9.3 SIOC02 Serial Port Converter

This product allows the standard RS-232 serial port of a computer to be interfaced with the drive's industrially-rated RS-485 communication port.

9.4 Reflash Tool

The Reflash Tool allows you to upgrade the firmware of the WF2 Sensorless Vector Drive. This allows the latest features to be implemented in existing hardware. For more information on this capability, refer to Form 1322 "Reflash Procedures for the E-trAC WF2 Series Sensorless Vector Drive".

9.5 Dynamic Braking Units

To augment the braking capacity of the WF2 drive, TB Wood's makes three dynamic braking units that may be added to the drive:

- Model WDB211 dynamic braking unit (for 230 V AC models),
- Model WDB411 dynamic braking unit (for 460 V AC models), and
- Model WDB510 dynamic braking unit (for 575 V AC models).

See page 34 for more information on adding a dynamic braking unit to a WF2 drive.

9.6 DeviceNet Option Board

The DeviceNet® Option Board (part number WF2DN01) provides an RS485 interface to a DeviceNet network. It supports baud rates up to 500K. Contact BERGES for further information.

9.7 Analog Input/Output Option Board

The Analog Input/Output Option Board (part number WF2AIO-01) provides up to three additional analog input channels, two additional analog output channels, and two additional relays for the WF2 inverter. Contact BERGES for further information.

10 Sequencer Application

10.1 Introduction

The WF2 drive provides a powerful feature for performing sequences of operations, the Sequencer application. The Sequencer application provides ten fully configurable steps that comprise the program for the sequencer.

This application is made available (“loaded”) by setting parameter **Application** to the value Sequencer (see page 130 for more information). This allows the Seq Configure parameter group to be capable of being displayed and also re-configures other parameters to support the Sequencer application. New parameters become available, while other parameters are no longer needed and cease to be displayed. In addition, the functionality of some parameters is modified to support the application. Note that the values of all parameters are reset to the factory defaults when the Sequencer application is loaded.

Once the application is loaded by changing the value of parameter **Application**, setting the value of the **Seq Enable** parameter to “Always” turns the application on permanently. Alternately, you may elect to turn the sequencer application on and off as needed by using a digital input, function key (if an enhanced keypad is connected to the WF2 drive), or remote communication via the serial link.

Once the application is turned on, it may be run via input from the keypad or the terminal strip. Once running, it may be paused at a particular step by using a digital input, function key (if an enhanced keypad is connected to the WF2 drive), or remote communication via the serial link. These means may also be used to reset the application.

The digital input and function key forms of control may also be used to force the sequencer to move from one step to the next if automated stepping is not desired. If automated stepping is desired, each step may be configured to start when the input signal on either analog input 1 or analog input 2 crosses a high or low threshold, a certain amount of time has elapsed, or a combination of these criteria (including a combination between time duration and digital input or function key).

The following sections describe the modifications that occur when parameter **Application** is set to Sequencer.

10.2 Parameters Modified by the Application

10.2.1 Parameters No Longer Available

When the Sequencer application is loaded, the following WF2 functions and parameters are no longer supported:

- Local/Remote modes: parameters **Local/Remote**, **Local Config**, and **Remote Config**. Further, all data values for switching between Local and Remote modes (for example, “L/R Switch” for parameter **D2 Configure**) are unavailable.
- EMOP operation: parameters **EMOP Config** and **EMOP Ramp Time**. Further, all data values for EMOP operation (for example, “EMOP +Spd” for parameter **D3 Configure**) are unavailable.
- The third, fourth, and fifth skip-frequency bands: parameters **Skip 3 Low Lim**, **Skip 3 Hi Lim**, **Skip 4 Low Lim**, **Skip 4 Hi Lim**, **Skip 5 Low Lim**, and **Skip 5 Hi Lim**.
- Configurability of alternate acceleration and deceleration ramps (the AR1 and AR2 ramps are forced to be linear with no S-rounding): parameters **AR1 Ramp Type**, **AR1 S-Rounding**, **AR2 Ramp Type**, and **AR2 S-Rounding**.

- Configurability of the D2, D3, D4, and D5 digital inputs (D2 is set as Stop, D3 is set as Seq Enable, D4 is set as Seq Run, and D5 is set as Seq Reset): parameters **D2 Configure**, **D3 Configure**, **D4 Configure**, and **D5 Configure**.
- PID functionality is disabled so all parameters in the PID Configure group are not available.
- The parameters that support configuration of the Analog Input/Output Option Board (WF2AIO-01) are not available.
- DeviceNet communication is not permitted.

10.2.2 Parameters With Changed Functionality

Due to the added requirements of the application, the following modifications are made when the Sequencer application is loaded:

- Parameters **Accel Time 3** and **Decel Time 3** are combined into one parameter called Acc/Dec Time 3. The default value of this new parameter is 10 s (if a non-default value was set for either of the old parameters, that value is discarded).
- Parameters **Jog Accel Time** and **Jog Decel Time** are combined into one parameter called **Jog Acc/Dec Time**. The default value of this new parameter is 1 s (if a non-default value was set for either of the old parameters, that value is discarded).
- The ability to switch between terminal strip and keypad control modes via Bit 11 of parameter **Cntl Word 1** is disabled.
- Bit 0 of parameter **Cntl Word 2** ceases to enable PID control and instead is used to turn the Sequencer application on or off. In addition, Bits 13 and 14 are ignored because DeviceNet communication is not permitted.
- The assignable values for parameters **D6 Configure** through **D10 Configure** as well as **Enter Key** are modified to include Stp Change, Seq Reset, Seq Pause, and Seq Enable.
- The parameters for configuring the function keys of the enhanced keypad are modified to allow control of the Sequencer application.

10.3 Parameters Added by the Application

When the Sequencer application is loaded, several new parameters (in various groups) become available as well as a new parameter group called Seq Configure. The following sections describe the new parameters and parameter group.

10.3.1 Parameters Added to the Drive Status Group

Two new parameters are made available at the end (after the **Freq Ref Ctrl** parameter) of the Drive Status group.

Seq Start Ctrl	**(Read-Only)**	**Address: 3007**

This parameter shows the source for start/stop commands when the Sequencer application is running.

◊ Range: varies Default: –

Current Step (Read-Only) **Address: 3003**

This parameter shows the current step that is active.

◊ Range: 1–10 Default: –

Step Time (Min) (Read-Only) **Address: 3005**

This parameter shows the length of time (in minutes) that the current step has been running.

◊ Range: 0–65535 min Default: –

Step Time (Sec) (Read-Only) **Address: 3006**

This parameter shows the length of time (in seconds) that the current step has been running.

◊ Range: 0–60 s Default: –

10.3.2 Parameters Added to the Ramps Group

Two new parameters are inserted in the Ramps group (between parameters **Accel Time 3**/**Decel Time 3** and **Main Ramp Type**).

Acc/Dec Time 4 **Address: 0318**

This parameter sets the length of time to accelerate from 0 Hz to the maximum frequency as well as to decelerate from the maximum frequency to 0 Hz for Alternate Ramp 3 (AR3).

◊ Range: 0.1–3200.0 s Default: 1.0 s

Acc/Dec Time 5 **Address: 0320**

This parameter sets the length of time to accelerate from 0 Hz to the maximum frequency as well as to decelerate from the maximum frequency to 0 Hz for Alternate Ramp 4 (AR4).

◊ Range: 0.1–3200.0 s Default: 1.0 s

10.3.3 Seq Configure Group

A new parameter group becomes available to allow you to configure the steps of the Sequencer application. This is the Seq Configure group, and is placed at the end of the list of parameter groups (after the Communications group).

Seq Enable **Address: 3000**

This parameter determines the means by which the Sequencer application is turned on. The following may be assigned to this parameter:

Display	Function
Disabled	Disabled.
Always	Permanently turned on.

Display	Function
By DI	Turned on or off by digital input D3, which is hard-coded for this function; a different digital input cannot be used instead of D3.
By F-key	Turned on or off by a function key on the enhanced keypad. The parameter that configures the operation of the actual function key to be used for turning the Sequencer application on or off must be set appropriately; see page 129 for more information.
By Ser Lnk	Turned on by setting Bit 0 of **Cntl Word 2** to 1 via the serial link.

◊ Range: see table Default: Disabled

Seq Run Source **Address: 3001**

Once the Sequencer application is turned on, this parameter determines the means by which the application is run. The following may be assigned to this parameter:

Display	Function
Keypad	Input from the keypad.
Term Strip	Input from the terminal strip.

NOTE: Parameter **Cntl Word 2** (see page 134), which may be used to enable and control the Sequencer application via the serial link, takes precedence over the setting of this parameter.

◊ Range: see table Default: Keypad

Seq Pause **Address: 3004**

This parameter determines the means by which the Sequencer application may be stopped at a particular step. The following may be assigned to this parameter:

Display	Function
Disabled	Disabled (the Sequencer application cannot be paused).
By DI	Digital input D4, which is hard-coded for this function; a different digital input cannot be used instead of D4.
By F-key	A function key on the enhanced keypad. The parameter that configures the operation of the actual function key to be used to pause the Sequencer application must be set appropriately; see page 129 for more information.
By Ser Lnk	Setting Bit 1 of **Cntl Word 2** to 1 via the serial link.

◊ Range: see table Default: Disabled

Seq Reset **Address: 3002**

This parameter determines the means by which the Sequencer application is reset. The following may be assigned to this parameter:

Display	Function
Disabled	Disabled (the application cannot be reset even if enabled and running).
By DI	By digital input D5, which is hard-coded for this function; a different digital input cannot be used instead of D5.
By F-key	By a function key on the enhanced keypad. The parameter that configures the operation of the actual function key to be used for resetting the application must be set appropriately; see page 129 for more information.
By Ser Lnk	By setting Bit 2 of **Cntl Word 2** to 1 via the serial link.

Each of the ten steps of the Sequencer application are configured with the same parameters, with the parameters being made unique with the addition of a number at the end of the parameter name that corresponds to the step. For example, parameter **Freq Config 1** sets the reference frequency for step 1, while **Freq Config 8** sets the reference frequency for step 8.

In the following description of the parameters, the step number is replaced with the letter n. See chapter 11 for the address of each of the parameters.

◊ Range: see table Default: Disabled

Freq Config n **Address: See chapter 11**

This parameter configures the reference frequency for step n of the Sequencer application. The following reference frequencies may be assigned to this parameter:

Display	Function
Spd - Rf 1	Reference 1.
Spd - Rf 2	Reference 2.
Spd - Rf 3	Reference 3.
Spd -R1+R2	The summation of references 1 and 2.
Spd -R1+R3	The summation of references 1 and 3.
S -R1+R2+R3	The summation of all references.
Spd -R2+R3	The summation of references 2 and 3.
S-R1+k*R2	Reference 2 is scaled by factor k and then summed with reference 1. The value of k is set by parameter **Set k-Factor** (see page 92).
Spd-R1-R2	The difference between references 1 and 2.
Spd-R2-R1	The difference between references 2 and 1.
Spd-R1-R3	The difference between references 1 and 3.
Spd-R3-R1	The difference between references 3 and 1.
Spd-R2-R3	The difference between references 2 and 3.
Spd-R3-R2	The difference between references 3 and 2.
S-R1+R2-R3	The summation of references 1 and 2 less reference 3.
S-R1+R3-R2	The summation of references 1 and 3 less reference 2.
Spd-Fixed	The speed reference is constant and is set by parameter **Fixed Freq n** (see below).

◊ Range: see table Default: Spd Fixed

Fixed Freq n **Address: See chapter 11**

When parameter **Freq Config n** is set to Spd-Fixed, this parameter specifies the frequency.

◊ Range: 0.00–320.00 Hz Default: 0 Hz

Dir Control n **Address: See chapter 11**

This parameter sets the direction of rotation for step n of the Sequencer application. The following directions may be assigned to this parameter:

Display	Function
Stop	The shaft does not turn.
Forward	The shaft turns in the Forward direction.
Reverse	The shaft turns in the Reverse direction.

◊ Range: see table Default: Stop

Seq Time(min) n **Address: See chapter 11**

If parameter **Go Next Step n** or **Goto X Step n** uses a time duration (either alone or in combination with other criteria; see pages 152 and 153), this parameter sets the number of minutes that step n will run (partial minutes are set with the following parameter).

◊ Range: 0–65535 min Default: 0 min

Seq Time(sec) n **Address: See chapter 11**

If parameter **Go Next Step n** or **Goto X Step n** uses a time duration (either alone or in combination with other criteria; see pages 152 and 153), this parameter sets the number of seconds in addition to the number of minutes configured in parameter **Seq Time(min) n** that step n will run.

◊ Range: 0–60 s Default: 0 s

Ramp Select n **Address: See chapter 11**

This parameter configures the acceleration and deceleration ramps for step n of the Sequencer application. The following may be assigned to this parameter:

Display	Function
Main Ramps	Parameters **Accel Time 1** and **Decel Time 1**.
AR1	Parameters **Accel Time 2** and **Decel Time 2** (Alternate Ramp 1).
AR2	Parameter **Accel Time 3 Decel Time 3** (Alternate Ramp 2).
AR3	Parameter **Acc/Dec Time 4** (Alternate Ramp 3).
AR4	Parameter **Acc/Dec Time 5** (Alternate Ramp 4).

◊ Range: see table Default: Main Ramps

Go Next Step n **Address: See chapter 11**

This parameter configures the condition that will cause the Sequencer application to move from step n to the next step. The following conditions may be assigned to this parameter:

Display	Condition Causing Advancement to Step n+1
Disabled	The Sequencer application does not advance.
DI6	Digital input D6. Parameter **D6 Configure** must also be set to Step Change.
DI7	Digital input D7. Parameter **D7 Configure** must also be set to Step Change.
DI8	Digital input D8. Parameter **D8 Configure** must also be set to Step Change.
DI9	Digital input D9. Parameter **D9 Configure** must also be set to Step Change.
DI10	Digital input D10. Parameter **D10 Configure** must also be set to Step Change.
AI1 Low	The frequency input to analog input 1 goes below the value set in parameter **AI Low Thres n**.
AI1 High	The frequency input to analog input 1 goes above the value set in parameter **AI High Thres n**.
AI2 Low	The frequency input to analog input 2 goes below the value set in parameter **AI Low Thres n**.
AI2 High	The frequency input to analog input 2 goes above the value set in parameter **AI High Thres n**.
AI1L/AI1H	Either the signal input to analog input 1 goes below the value set in parameter **AI Low Thres n** or above that set in parameter **AI High Thres n**.
DI10/AI1L	Either digital input D10 (set to Step Change) or the input to analog input 1 goes below the value set in parameter **AI Low Thres n**.
DI9/AI2H	Either digital input D9 (set to Step Change) or the input to analog input 2 goes above the value set in parameter **AI High Thres n**.
F1 Key	Function key F1 on the enhanced keypad. Parameter **F1 Key Config** must also be set to Step Change.
F2 Key	Function key F2 on the enhanced keypad. Parameter **F2 Key Config** must also be set to Step Change.
F3 Key	Function key F3 on the enhanced keypad. Parameter **F3 Key Config** must also be set to Step Change.
F4 Key	Function key F4 on the enhanced keypad. Parameter **F4 Key Config** must also be set to Step Change.
Enter Key	The Enter key. Parameter **Enter Key** must also be set to Step Change.
Time	After the duration specified by parameters **Seq Time(min) n** and **Seq Time(sec) n**.
DI6/Time	Either digital input D6 (set to Step Change) or the configured time elapses.
DI7/Time	Either digital input D7 (set to Step Change) or the configured time elapses.

Display	Condition Causing Advancement to Step n+1
DI8/Time	Either digital input D8 (set to Step Change) or the configured time elapses.
DI9/Time	Either digital input D9 (set to Step Change) or the configured time elapses.
DI10/Time	Either digital input D10 (set to Step Change) or the configured time elapses.
AI1L/Time	Either the signal input to analog input 1 goes below the value set in parameter **AI Low Thres n** or the configured time elapses.
AI2H/Time	Either the signal input to analog input 2 goes above the value set in parameter **AI High Thres n** or the configured time elapses.
F1/Time	Either function key 1 (set to Step Change) or the configured time elapses.
F2/Time	Either function key 2 (set to Step Change) or the configured time elapses.

◊ Range: see table Default: Disabled

Goto X Step n **Address: See chapter 11**

This parameter configures the condition that will cause the Sequencer application to move from step n to step x, where x is the step set in parameter **X Step n** (see page 155). The following conditions may be assigned to this parameter:

Display	Condition Causing Advancement to Step X
Disabled	The Sequencer application does not advance.
DI6	Digital input D6. Parameter **D6 Configure** must also be set to Step Change.
DI7	Digital input D7. Parameter **D7 Configure** must also be set to Step Change.
DI8	Digital input D8. Parameter **D8 Configure** must also be set to Step Change.
DI9	Digital input D9. Parameter **D9 Configure** must also be set to Step Change.
DI10	Digital input D10. Parameter **D10 Configure** must also be set to Step Change.
AI1 Low	The frequency input to analog input 1 goes below the value set in parameter **AI Low Thres n**.
AI1 High	The frequency input to analog input 1 goes above the value set in parameter **AI High Thres n**.
AI2 Low	The frequency input to analog input 2 goes below the value set in parameter **AI Low Thres n**.
AI2 High	The frequency input to analog input 2 goes above the value set in parameter **AI High Thres n**.
AI1L/AI1H	Either the signal input to analog input 1 goes below the value set in parameter **AI Low Thres n** or above that set in parameter **AI High Thres n**.

Display	Condition Causing Advancement to Step X
DI10/AI1L	Either digital input D10 (set to Step Change) or the input to analog input 1 goes below the value set in parameter **AI Low Thres n**.
DI9/AI2H	Either digital input D9 (set to Step Change) or the input to analog input 2 goes above the value set in parameter **AI High Thres n**.
F1 Key	Function key F1 on the enhanced keypad. Parameter **F1 Key Config** must also be set to Step Change.
F2 Key	Function key F2 on the enhanced keypad. Parameter **F2 Key Config** must also be set to Step Change.
F3 Key	Function key F3 on the enhanced keypad. Parameter **F3 Key Config** must also be set to Step Change.
F4 Key	Function key F4 on the enhanced keypad. Parameter **F4 Key Config** must also be set to Step Change.
Enter Key	The Enter key. Parameter **Enter Key** must also be set to Step Change.
Time	After the duration specified by parameters **Seq Time(min) n** and **Seq Time(sec) n**.
DI6/Time	Either digital input D6 (set to Step Change) or the configured time elapses.
DI7/Time	Either digital input D7 (set to Step Change) or the configured time elapses.
DI8/Time	Either digital input D8 (set to Step Change) or the configured time elapses.
DI9/Time	Either digital input D9 (set to Step Change) or the configured time elapses.
DI10/Time	Either digital input D10 (set to Step Change) or the configured time elapses.
AI1L/Time	Either the signal input to analog input 1 goes below the value set in parameter **AI Low Thres n** or the configured time elapses.
AI2H/Time	Either the signal input to analog input 2 goes above the value set in parameter **AI High Thres n** or the configured time elapses.
F1/Time	Either function key 1 (set to Step Change) or the configured time elapses.
F2/Time	Either function key 2 (set to Step Change) or the configured time elapses.

◊ Range: see table Default: Disabled

AI Low Thres n **Address: See chapter 11**

This parameter configures the lower threshold, expressed as a percentage of the full analog input range, for an analog input signal. When the input signal at analog input 1 or 2 falls below the value in this parameter, that condition may be used to advance the Sequencer from step n to another step. See parameters **Go Next Step n** and **Goto X Step n** for more information.

◊ Range: 0.00–100.00% Default: 0.00%

AI High Thres n **Address: See chapter 11**

This parameter configures the upper threshold, expressed as a percentage of the full analog input range, for an analog input signal. When the input signal at analog input 1 or 2 goes above the value in this parameter, that condition may be used to advance the Sequencer from step n to another step. See parameters **Go Next Step n** and **Goto X Step n** for more information.

◊ Range: 0.00–100.00% Default: 0.00%

X Step n **Address: See chapter 11**

This parameter specifies the step to which to advance when the condition of parameter **Goto X Step n** is met. The following may be assigned to this parameter:

Display	Function
Disabled	The Sequencer will not advance.
Step 1	Step 1.
Step 2	Step 2.
Step 3	Step 3.
Step 4	Step 4.
Step 5	Step 5.
Step 6	Step 6.
Step 7	Step 7.
Step 8	Step 8.
Step 9	Step 9.
Step 10	Step 10.

◊ Range: see table Default: Disabled

11 Summary of WF2 Parameters

11.1 Parameter Groups

Display Order	Displayed Group Name	See Page	Display Order	Displayed Group Name	See Page
1	Security	75	13	Braking Options	106
2	Drive ID	76	14	Digital Inputs	110
3	Drive Status	78	15	Analog Inputs	113
4	Input Status	81	16	Digital Outputs	117
5	Control Modes	83	17	Analog Outputs	120
6	Speed Reference	88	18	Fault Management	122
7	Ramps	92	19	Display Options	127
8	Preset Speeds	96	20	Special	130
9	Skip Freq	97	21	Communication	131
10	Torque Limits	98	22	PID Configure	135
11	Drive Output	100	23	Seq Configure	148
12	Motor Setup	103			

Table 30
The Parameter Groups for the WF2 Drive

11.2 Parameters Available in Level 1 Programming (Standard Keypad Only)

Display Order	Parameter Name	See Page	Display Order	Parameter Name	See Page
1	Output Freq	78	11	Minimum Freq	88
2	Output Voltage	78	12	Maximum Freq	89
3	Output Current	78	13	Accel Time 1	92
4	Drive Load	78	14	Decel Time 1	92
5	Drive Temp	79	15	Preset Speed 1	96
6	DC Bus Voltage	79	16	Preset Speed 2	96
7	2-Wire/3-Wire	83	17	Preset Speed 3	96
8	Jog Mode	84	18	A1 Configure	113
9	Reverse Mode	85	19	R1 Configure	118
10	Terminal/Keypad	85	20	R2 Configure	118

Table 31
Parameters Available in Level 1 Programming (Standard Keypad Only)

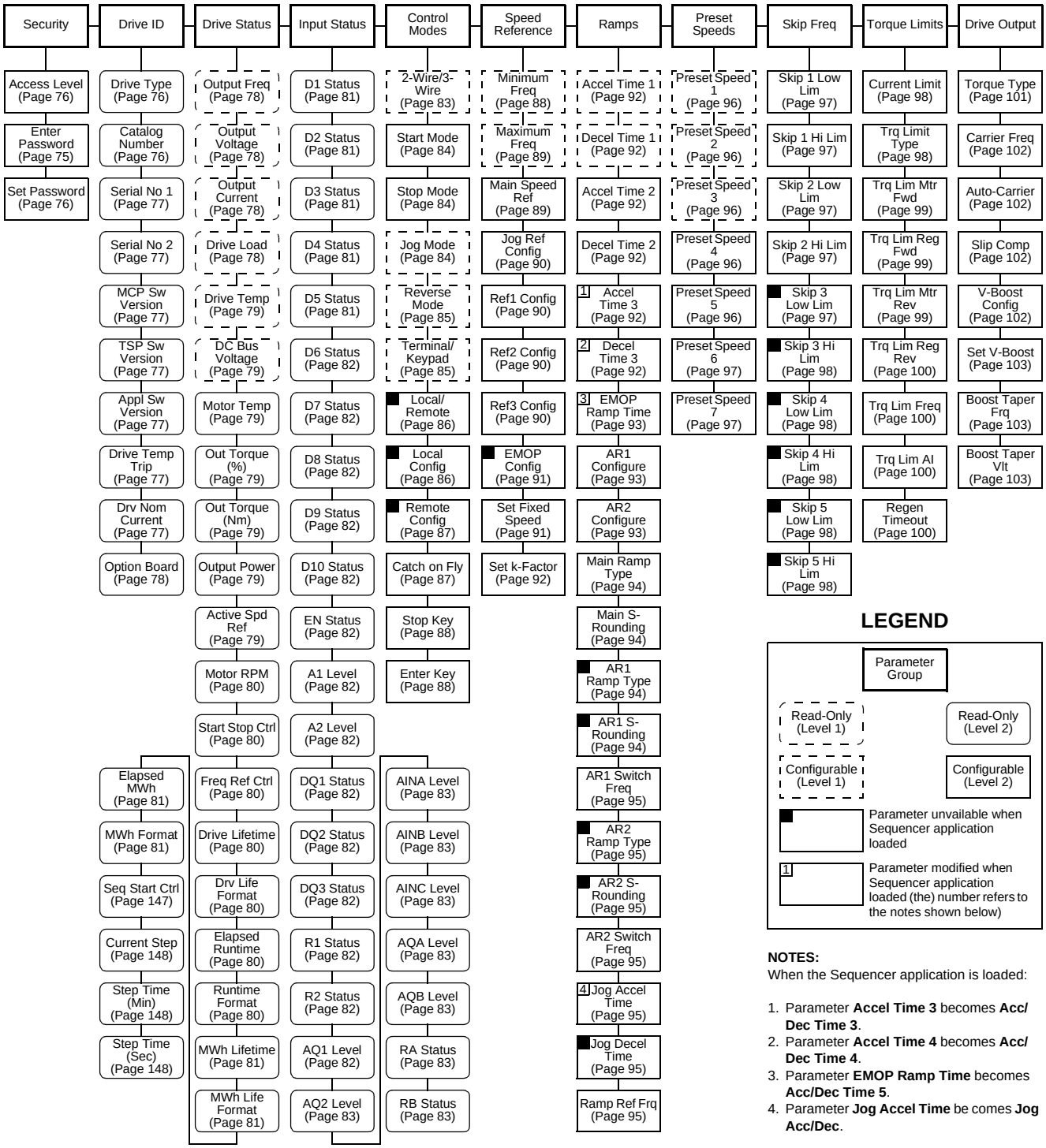
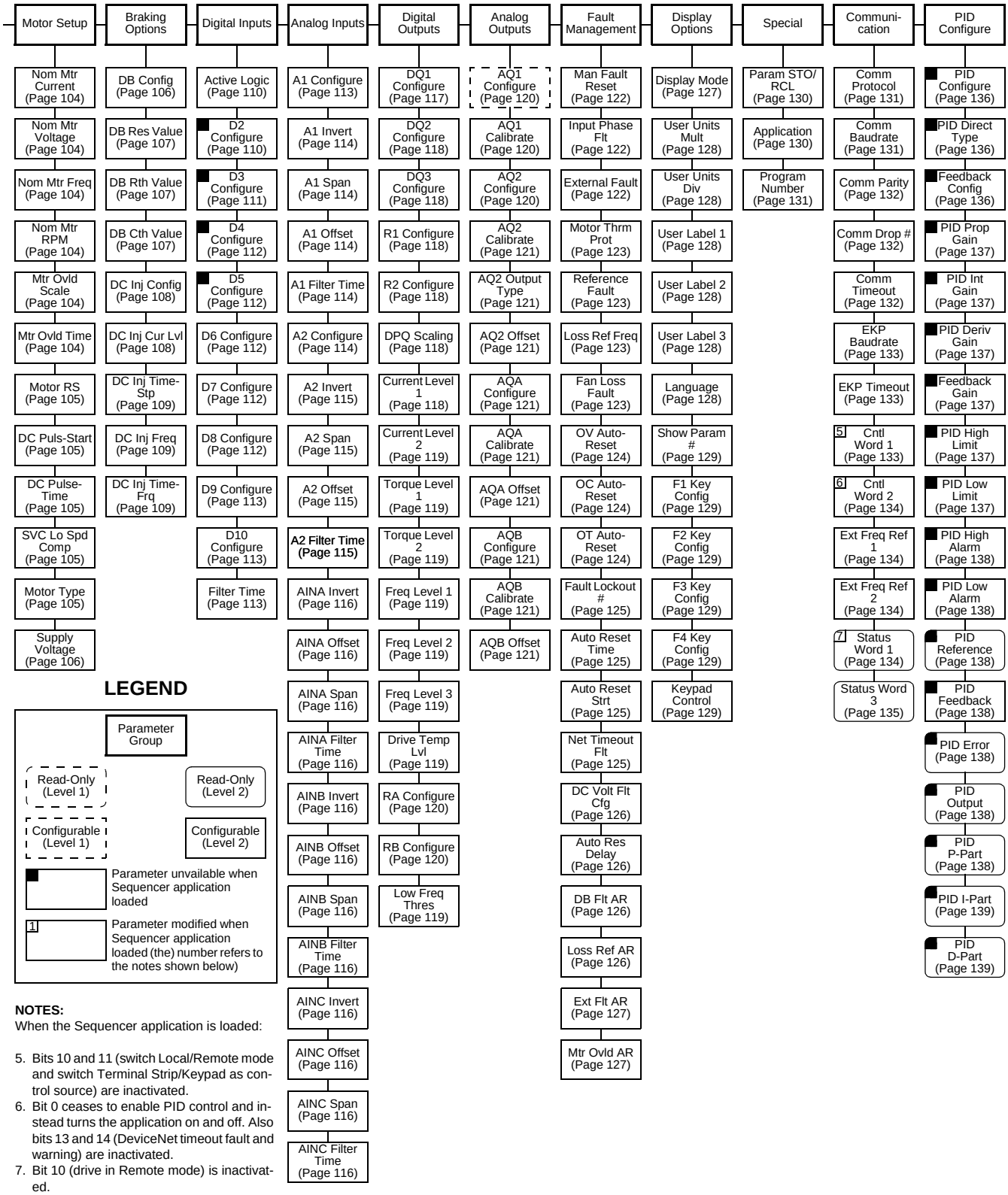


Figure 31
Arrangement of WF2 Parameters (First 11 Groups)



NOTES:
When the Sequencer application is loaded:

5. Bits 10 and 11 (switch Local/Remote mode and switch Terminal Strip/Keypad as control source) are inactivated.
6. Bit 0 ceases to enable PID control and instead turns the application on and off. Also bits 13 and 14 (DeviceNet timeout fault and warning) are inactivated.
7. Bit 10 (drive in Remote mode) is inactivated.

Figure 32
Arrangement of WF2 Parameters (Remaining 11 Groups)

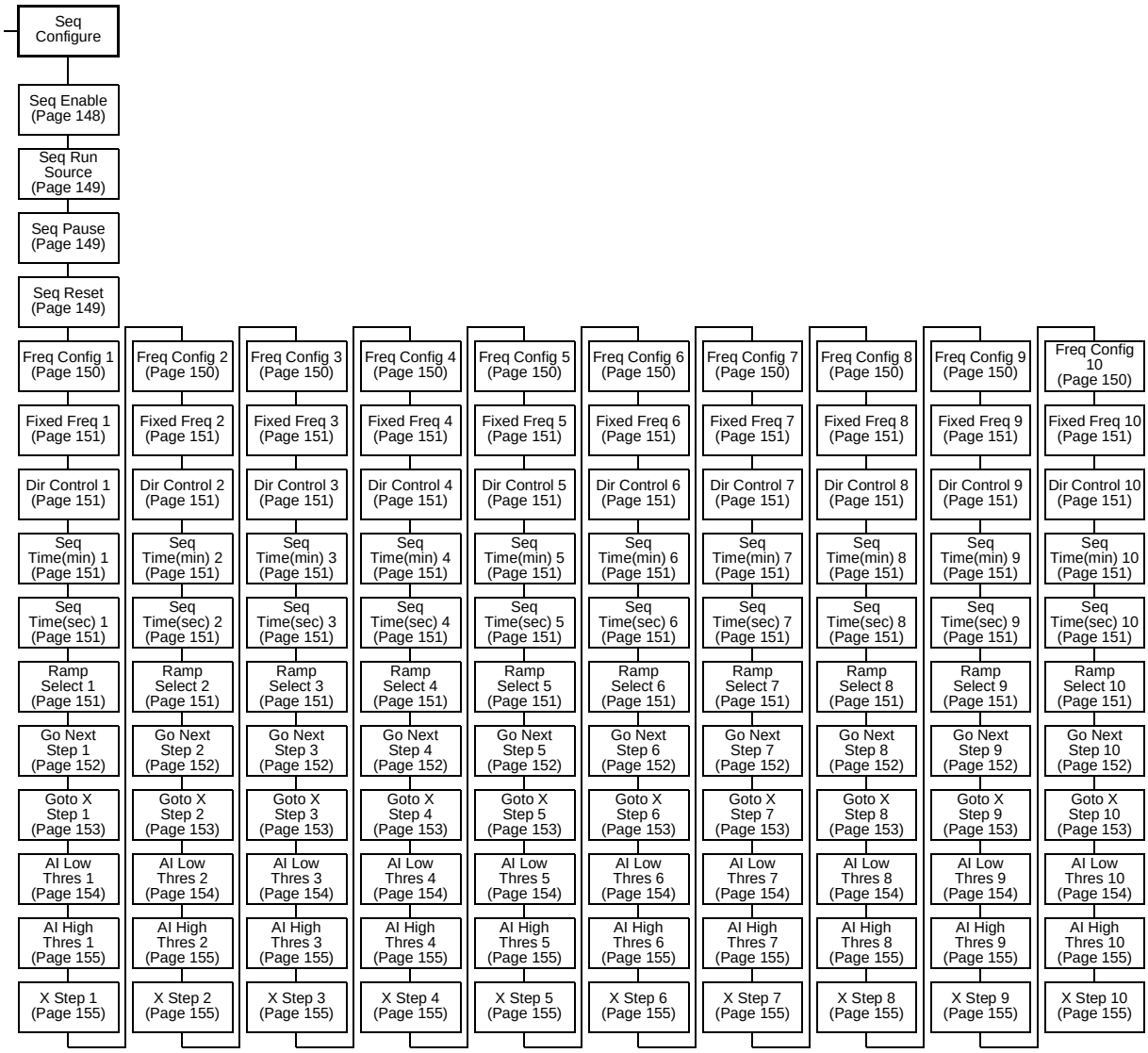


Figure 33
Seq Configure Parameters

Parameter Name	Memory Address	Range	Default	See Page	User Setting
Security Group					
Enter Password	0298	0–9999	0	75	
Set Password	0299	0–9999	0	76	
Access Level	0297	Configure (1) Config Run (2)	Configure	76	
Drive ID Group					
Drive Type	0999	WF2C (0) WF2K (2) WF2C(N) (4) WF2K(N) (6)	Read-Only	76	
Catalog Number	0001	0–65535	Read-Only	76	
Serial No 1	0005	0–9952	Read-Only	77	
Serial No 2	0006	0–32767	Read-Only	77	
MCP Sw Version	0007	0.00–327.67	Read-Only	77	
TSP Sw Version	0009	0.00–327.67	Read-Only	77	
Appl Sw Version	0010	0.00–327.67	Read-Only	77	
Drive Temp Trip	0015	0–125 °C	Read-Only	77	
Drv Nom Current	0013	0–250 A	Read-Only	77	
Comm Option	0003	None (0) DeviceNet (1) Siemens P1 (2) Metasys N2 (3)	Read-Only	77	
Option Board	0004	None (0) WF2AIO01 (1)	Read-Only	78	
Drive Status Group					
Output Freq	0020	0.00–320.00 Hz	Read-Only	78	
Output Voltage	0022	0 V to Line Voltage	Read-Only	78	
Output Current	0023	0 to 250% of Drive Rating in Amps	Read-Only	78	
Drive Load	0024	–250% to +250%	Read-Only	78	
Drive Temp	0025	–20 to 125 °C	Read-Only	79	
DC Bus Voltage	0026	0–1000 V DC	Read-Only	79	
Motor Temp	0027	0–250%	Read-Only	79	
Out Torque (%)	0028	–250% to +250%	Read-Only	79	
Out Torque (Nm)	0039	Varies by model	Read-Only	79	
Output Power	0029	0–250%	Read-Only	79	
Active Spd Ref	0031	0.00–320.00 Hz	Read-Only	79	
Motor RPM	0033	0–5000 RPM	Read-Only	80	
Start Stop Ctrl	0053	Term Strip (0) Keypad (1) Ser Lnk (2)	Read-Only	80	

Table 32

Parameter Name	Memory Address	Range	Default	See Page	User Setting
Freq Ref Ctrl	0054	Term Strip (0) Keypad (1) Ser Lnk (2)	Read-Only	80	
Drive Lifetime	0890	0–65535	Read-Only	80	
Drv Life Format	0891	50, 51, or 52	Read-Only	80	
Elapsed Runtime	0892	0–65535	Read-Only	80	
Runtime Format	0893	50, 51, or 52	Read-Only	80	
MWh Lifetime	0894	0–65535	Read-Only	81	
MWh Life Format	0895	51, 52, or 53	Read-Only	81	
Elapsed MWh	0896	0–65535	Read-Only	81	
MWh Format	0897	51, 52, or 53	Read-Only	81	
Seq Start Ctrl	3007	Varies	Read-Only	147	
Current Step	3003	1–10	Read-Only	148	
Step Time (Min)	3005	0–65535 min	Read-Only	148	
Step Time (Sec)	3006	0–60 s	Read-Only	148	
Input Status Group					
D1 Status	0150	Off or On (0 or 1)	Read-Only	81	
D2 Status	0151	Off or On (0 or 1)	Read-Only	81	
D3 Status	0152	Off or On (0 or 1)	Read-Only	81	
D4 Status	0153	Off or On (0 or 1)	Read-Only	81	
D5 Status	0154	Off or On (0 or 1)	Read-Only	81	
D6 Status	0155	Off or On (0 or 1)	Read-Only	82	
D7 Status	0156	Off or On (0 or 1)	Read-Only	82	
D8 Status	0157	Off or On (0 or 1)	Read-Only	82	
D9 Status	0158	Off or On (0 or 1)	Read-Only	82	
D10 Status	0159	Off or On (0 or 1)	Read-Only	82	
EN Status	0160	Off or On (0 or 1)	Read-Only	82	
A1 Level	0164	–100%...+100%	Read-Only	82	
A2 Level	0165	0–100%	Read-Only	82	
DQ1 Status	0167	Off or On (0 or 1)	Read-Only	82	
DQ2 Status	0168	Off or On (0 or 1)	Read-Only	82	
DQ3 Status	0169	Off or On (0 or 1)	Read-Only	82	
R1 Status	0170	Off or On (0 or 1)	Read-Only	82	
R2 Status	0171	Off or On (0 or 1)	Read-Only	82	
AQ1 Level	0174	0–100%	Read-Only	82	
AQ2 Level	0175	0–100%	Read-Only	83	
AINA Level	0264	0–100%	Read-Only	83	
AINB Level	0269	0–100%	Read-Only	83	
AINC Level	0274	0–100%	Read-Only	83	
AQA Level	0278	0–100%	Read-Only	83	

Table 32

Parameter Name	Memory Address	Range	Default	See Page	User Setting
AQB Level	0282	0–100%	Read-Only	83	
RA Status	0285	Off or On (0 or 1)	Read-Only	83	
RB Status	0286	Off or On (0 or 1)	Read-Only	83	
Control Modes Group					
2-Wire/3-Wire	0401	2-Wire (0) 3-Wire (1)	2-Wire	83	
Start Mode	0402	Line Start L (0) Auto Start (1)	Line Start L	84	
Stop Mode	0403	Rmp to Stp (0) Cst to Stp (1) DCI to Stp (2)	Rmp to Stp	84	
Jog Mode	0404	No Jogging (0) Run/Jog DI (1) Jog Pshbutton (2)	No Jogging	84	
Reverse Mode	0405	Non-revers (0) For/Rev DI (1) Run FwdRev (2)	Non-revers	85	
Terminal/Keypad	0406	Kypd-C & R (0) TS-C & R (1) TS-C/KP-R (2) KP-C/TS-R (3) T/K by DI (4) T/K Fkey (5) T/K SerLnk (6)	Kypd-C & R	85	
Local/Remote	0407	None (0) L/R by DI (1) L/R Fkey (2) L/R SerLnk (3)	None	86	
Local Config	0408	Kypd-C & R (0) Ser-C & R (1) Ser-C/Nm-R (2) Nm-non ser (3)	Kypd-C & R	86	
Remote Config	0409	TS-C & R (0) Kpd-R/TS-C (1) TS-R/Kpd-C (2) NM-R/Ser-C (3) TS-C/Ser-R (4) Serial Lnk (5)	TS-C & R	87	
Catch on Fly	0620	Disabled (0) Enabled (1)	Disabled	87	
Stop Key	0950	Disabled (0) Rmp to Stp (1) Cst to Stp (2)	Cst to Stp	88	

Table 32

Parameter Name	Memory Address	Range	Default	See Page	User Setting
Enter Key	0978	Disabled (0) L/R Switch (1) T/K Switch (2) PID Enable (3) SL Override (4)	Disabled	88	
Speed Reference Group					
Minimum Freq	0301	0 Hz to **Maximum Freq**	0 Hz	88	
Maximum Freq	0303	**Minimum Freq** to 320 Hz	60 Hz	89	
Main Speed Ref	0800	Spd - Rf 1 (0) Spd - Rf 2 (1) Spd - Rf 3 (2) Spd -Rf1+R2 (3) Spd -Rf1+R3 (4) Spd -R1+R2+R3 (5) Spd -R2+R3 (6) S-R1+k*R2 (7) Spd-R1-R2 (8) SpdR2-R1 (9) Spd-R1-R3 (10) Spd-R3-R1 (11) Spd-R2-R3 (12) SpdR3-R2 (13) S-R1+R2-R3 (14) S-R1+R3-R2 (15) Spd-Fixed (16) 8bit DI PS (17) Spd-R1+R3 (24)	Spd - Rf 2	89	
Jog Ref Config	0803	Same as **Main Speed Ref**	Spd-Fixed	90	
Ref1 Config	0810	AI #1 (0) AI #2 (1) AI #A (2) AI #B (3) AI #C (4)	AI #1	90	
Ref2 Config	0811	AI #1 (0) AI #2 (1) AI #A (2) AI #B (3) AI #C (4)	AI #2	90	
Ref3 Config	0812	AI #1 (0) AI #2 (1) AI #A (2) AI #B (3) AI #C (4)	AI #2	90	

Table 32

Parameter Name	Memory Address	Range	Default	See Page	User Setting
EMOP Config	0420	None (0) TS no Mem (1) TS w/ Mem (2) TS w/ MemP (3) T/K no Mem (4) T/K w/ Mem (5) T/K w/ MemP (6)	None	91	
Set Fixed Speed	0804	0.0–320.0 Hz	5.0 Hz	91	
Set k-Factor	0801	0.0–100.0%	10.0%	92	
Ramps Group					
Accel Time 1	0310	0.1–3200.0 s	3.0 s	92	
Decel Time 1	0311	0.1–3200.0 s	3.0 s	92	
Accel Time 2	0312	0.1–3200.0 s	1.0 s	92	
Decel Time 2	0313	0.1–3200.0 s	1.0 s	92	
Accel Time 3	0314	0.1–3200.0 s	10.0 s	92	
Decel Time 3	0315	0.1–3200.0 s	10.0 s	92	
Acc/Dec Time 4	3018	0.1–3200.0 s	10.0 s	148	
Acc/Dec Time 5	3020	0.1–3200.0 s	10.0 s	148	
EMOP Ramp Time	0316	0.1–200.0 s	30.0 s	93	
AR1 Configure	0450	None (0) AR1 on DI (1) AR1 by Frq (2) AR1-Strt (3) AR1-Fwd/Rv (4)	AR1 on DI	93	
AR2 Configure	0451	None (0) AR2 on DI (1) AR2 by Frq (2) AR2-Strt (3) AR2-Fwd/Rv (4)	AR2 on DI	93	
Main Ramp Type	0452	Linear (0) S-Curve (1)	Linear	94	
Main S-Rounding	0453	0.0–10.0 s	0.0 s	94	
AR1 Ramp Type	0454	Linear (0) S-Curve (1)	Linear	94	
AR1 S-Rounding	0455	0.0–10.0 s	0.0 s	94	
AR1 Switch Freq	0462	0.00–320.00 Hz	0.00 Hz	95	
AR2 Ramp Type	0456	Linear (0) S-Curve (1)	Linear	95	
AR2 S-Rounding	0457	0.0–10.0 s	0.0 s	95	
AR2 Switch Freq	0464	0.00–320.00 Hz	0.00 Hz	95	
Jog Accel Time	0458	0.0–3200.0 s	1.0 s	95	
Jog Decel Time	0459	0.0–3200.0 s	1.0 s	95	
Ramp Ref Frq	0460	0.00–320.00 Hz	0.00 Hz	95	

Table 32

Parameter Name	Memory Address	Range	Default	See Page	User Setting
Preset Speeds Group					
Preset Speed 1	0350	0.00 Hz to **Maximum Freq**	5.00 Hz	96	
Preset Speed 2	0352	0.00 Hz to **Maximum Freq**	10.00 Hz	96	
Preset Speed 3	0354	0.00 Hz to **Maximum Freq**	20.00 Hz	96	
Preset Speed 4	0356	0.00 Hz to **Maximum Freq**	30.00 Hz	96	
Preset Speed 5	0358	0.00 Hz to **Maximum Freq**	40.00 Hz	96	
Preset Speed 6	0360	0.00 Hz to **Maximum Freq**	50.00 Hz	97	
Preset Speed 7	0362	0.00 Hz to **Maximum Freq**	60.00 Hz	97	
Skip Freq Group					
Skip 1 Low Lim	0480	0.0 Hz to **Maximum Freq**	0.0 Hz	97	
Skip 1 Hi Lim	0481	**Skip 1 Low Lim** to **Maximum Freq**	0.0 Hz	97	
Skip 2 Low Lim	0482	0.0 Hz to **Maximum Freq**	0.0 Hz	97	
Skip 2 Hi Lim	0483	**Skip 2 Low Lim** to **Maximum Freq**	0.0 Hz	97	
Skip 3 Low Lim	0484	0.0 Hz to **Maximum Freq**	0.0 Hz	97	
Skip 3 Hi Lim	0485	**Skip 3 Low Lim** to **Maximum Freq**	0.0 Hz	98	
Skip 4 Low Lim	0486	0.0 Hz to **Maximum Freq**	0.0 Hz	98	
Skip 4 Hi Lim	0487	**Skip 4 Low Lim** to **Maximum Freq**	0.0 Hz	98	
Skip 5 Low Lim	0488	0.0 Hz to **Maximum Freq**	0.0 Hz	98	
Skip 5 Hi Lim	0489	**Skip 5 Low Lim** to **Maximum Freq**	0.0 Hz	98	
Torque Limits Group					
Current Limit	0331	1–200%	150%	98	
Trq Limit Type	0601	Disabled (0) Fixed Lvls (1) By DI (2) Follow AI (3) On Freq (4)	Disabled	98	
Trq Lim Mtr Fwd	0332	1–200%	150%	99	
Trq Lim Reg Fwd	0333	1–200%	80%	99	
Trq Lim Mtr Rev	0334	1–200%	150%	99	
Trq Lim Reg Rev	0335	1–200%	80%	100	
Trq Lim Freq	0602	0.0–320.0 Hz	0.0 Hz	100	
Trq Lim AI	0603	AI #1 (0) AI #2 (1) AI #A (2) AI #B (3) AI #C (4)	AI #1	100	
Regen Timeout	0605	0–60 s	1 s	100	

Table 32

Parameter Name	Memory Address	Range	Default	See Page	User Setting
Drive Output Group					
Torque Type	0500	CT - SVC (0) VT - SVC (1) CT - SVC 2pc (2) CT - V/Hz (3) VT - V/Hz (4) CT - V/Hz 2pc (5)	CT - V/Hz 2pc	101	
Carrier Freq	0501	1.0–16.0 kHz	Varies	102	
Auto-Carrier	0502	Disabled (0) Enabled (1)	Disabled	102	
Slip Comp	0551	None (0) Automatic (1)	None	102	
V-Boost Config	0553	0.00–30.00%	Varies by model	102	
Set V-Boost	0554	None (0) Automatic (1)	None	103	
Boost Taper Frq	0555	0.00 Hz to **Maximum Freq**	60.00 Hz	103	
Boost Taper Vlt	0557	0.00–100.00%	Varies by model	103	
Motor Setup Group					
Nom Mtr Current	0520	Model dependent	Varies by model	104	
Nom Mtr Voltage	0521	100–690 V AC	Varies by model	104	
Nom Mtr Freq	0522	25.00–320.00 Hz	60.00 Hz	104	
Nom Mtr RPM	0524	0–10000 RPM	Varies by model	104	
Mtr Ovld Scale	0611	0.0–100.0%	100.0%	104	
Mtr Ovld Time	0612	0.0–300.0 s	60.0 s	104	
Motor RS	0525		Measured by drive	105	
DC Puls-Start	0540	None (0) DC at Strt (1)	DC at Strt	105	
DC Pulse-Time	0541	0.00–25.00 s	1.00 s	105	
SVC Lo Spd Comp	0542	0–1280	256	105	
Motor Type	0610	No Thermal Prot (0) Std Induction (1) Blower Cooled (2)	No Thermal Prot	105	
Supply Voltage	0549	See page 106	Varies by model	106	
Braking Options Group					
DB Config	0630	Disabled (0) Int DB Res (1) Ext DB WDB (2) Ext DB Res (3)	Int DB Res	106	
DB Res Value	0632	0–3276.6 Ω	Varies	107	
DB Rth Value	0633	0–16383	Varies	107	
DB Cth Value	0634	0–65535	Varies	107	

Table 32

Parameter Name	Memory Address	Range	Default	See Page	User Setting
DC Inj Config	0411	None (0) DCI on Frq (1) DCI by DI (2) DCI-DI/Frq (3)	None	108	
DC Inj Cur Lvl	0412	0.0–150.0%	50.0%	108	
DC Inj Time-Stp	0413	0.00–60.00 s	0.20 s	109	
DC Inj Freq	0414	0.00–25.00 Hz	0.00 Hz	109	
DC Inj Time-Frq	0416	0.00–60.00 s	0.20 s	109	
Digital Inputs Group					
Active Logic	0700	Active Low (0) Active Hgh (1)	Active Hgh	110	
D2 Configure	0704	Not Assign (0) Forward (1) Stop (2) Jog (3) Reverse (4) Jog Revers (5) PS In #1 (6) PS In #2 (7) PS In #3 (8) Alt Rmp #1 (9) Alt Rmp #2 (10) EMOP +Spd (11) EMOP -Spd (12) T/K Switch (13) L/R Switch (14) DC Inject (15) Torque Lim (16) SL Override (17) PID Enable (18) Flt Reset (25) Ext Fault (26) 8Bit DI PS [1] (27) Step Chg [2]	Stop	110	
D3 Configure	0705		Jog	111	
D4 Configure	0706		Reverse	112	
D5 Configure	0707		Jog Revers	112	
D6 Configure	0708		PS In #1	112	
D7 Configure	0709		PS In #2	112	
D8 Configure	0710		PS In #3	112	
D9 Configure	0711		Alt Rmp #1	113	
D10 Configure	0712		Alt Rmp #2	113	
Filter Time	0701	1–255 ms	5 ms	113	
Analog Inputs Group					
A1 Configure	0741	Normal (0) Broken Wire Det (1) Bipolar (2) 4-20 mA (3) 0-10 Bipolar (4)	Normal	113	

Table 32

NOTES:

[1] Not available for D2.

[2] Added to parameters **D6 Configure** – **D10 Configure** when the Sequencer application is loaded. This application also limits other functionality; see section 10 for further information.

Parameter Name	Memory Address	Range	Default	See Page	User Setting
A1 Invert	0742	Normal (0) Inverted (1)	Normal	114	
A1 Span	0743	0.0–200.0%	100.0%	114	
A1 Offset	0744	0.0–100.0%	0.0%	114	
A1 Filter Time	0745	1–1000 ms	5 ms	114	
A2 Configure	0751	Normal (0) 4-20 mA (1) Pls in 1kHz (2) Pls in 5kHz (3) Pls in 20kHz (4) Pls in 100kHz (5)	Normal	114	
A2 Invert	0752	Normal (0) Inverted (1)	Normal	115	
A2 Span	0753	0.0–200.0%	100.0%	115	
A2 Offset	0754	0.0–100.0%	0.0%	115	
A2 Filter Time	0755	1–1000 ms	5 ms	115	
AINA Invert	0260	Normal (0) Inverted (1)	Normal	116	
AINA Offset	0261	0.0–100.0%	0.0%	116	
AINA Span	0262	0.0–200.0%	100.0%	116	
AINA Filter Time	0263	1–1000 ms	5 ms	116	
AINB Invert	0265	Normal (0) Inverted (1)	Normal	116	
AINB Offset	0266	0.0–100.0%	0.0%	116	
AINB Span	0267	0.0–200.0%	100.0%	116	
AINB Filter Time	0268	1–1000 ms	5 ms	116	
AINC Invert	0270	Normal (0) Inverted (1)	Normal	116	
AINC Offset	0271	0.0–100.0%	0.0%	116	
AINC Span	0272	0.0–200.0%	100.0%	116	
AINC Filter Time	0273	1–1000 ms	5 ms	116	

Table 32

Parameter Name	Memory Address	Range	Default	See Page	User Setting
Digital Outputs Group					
DQ1 Configure	0770	Not Assign (0) Drive Run (1) Run Fwd (2) Run Rev (3) Drive Rdy (4) At Speed (5) Drive Flted (6) Drive NotFlt (7) Kpd in Ctl (8) Drv in Rem (9) Jogging (10) Curr Lvl 1 (11) Curr Lvl 2 (12) Trq Lvl 1 (13) Trq Lvl 2 (14) Frq Lvl 1 (15) Frq Lvl 2 (16) Frq Lvl 3 (17) Temp Lvl (18) In Curr Lim (19) In Trq Lim (20) Loss Ref (21) In Ser L Ctrl (22) In Ser L Ovrd (23) Zero Speed (24) Frq Low Th (25) PID High (26) PID Low (27) By Ser Lnk (28) Auto-Reset (29)	Drive Rdy	117	
DQ2 Configure	0771		At Speed	118	
DQ3 Configure	0772		Run Rev	118	
R1 Configure	0780		Drv Flted	118	
R2 Configure	0781		Drive Run	118	
DPQ Scaling	0789	6 / 48 / 96 / 3072 times frequency	6	118	
Current Level 1	0830	0–200%	0%	118	
Current Level 2	0831	0–200%	0%	119	
Torque Level 1	0832	0–200%	0%	119	
Torque Level 2	0833	0–200%	0%	119	
Freq Level 1	0834	0.0 Hz to **Maximum Freq**	0.0 Hz	119	
Freq Level 2	0835	0.0 Hz to **Maximum Freq**	0.0 Hz	119	
Freq Level 3	0836	0.0 Hz to **Maximum Freq**	0.0 Hz	119	
Drive Temp Lvl	0837	0–100%	100%	119	
Low Freq Thres	0841	0.0 Hz to **Maximum Freq**	0.0 Hz	119	
RA Configure	0283	Same as **R1 Configure**	Drv Flted	120	
RB Configure	0284	Same as **R1 Configure**	Drv Flted	120	

Table 32

Parameter Name	Memory Address	Range	Default	See Page	User Setting
Analog Outputs Group					
AQ1 Configure	0790	Not Assigned (0) Motor Spd (1) Motor Curr (2) Out Torque (3) Out Volt (4) Out Power (5) Out Freq (6) Ref Freq (7) Motor Temp (8) PID Fback (9)	Motor Spd	120	
AQ1 Calibrate	0791	0–105%	100%	120	
AQ2 Configure	0792	Same as **AQ1 Configure**	Out Torque	120	
AQ2 Calibrate	0793	0–105%	100%	121	
AQ2 Output Type	0794	0 - 20 mA (0) 4 - 20 mA (1)	0 - 20 mA	121	
AQ2 Offset	0795	0–100%	20%	121	
AQA Configure	0275	Same as **AQ1 Configure**	–	121	
AQA Calibrate	0276	0–105%	100%	121	
AQA Offset	0277	0–100%	20%	121	
AQB Configure	0279	Same as **AQ1 Configure**	–	121	
AQB Calibrate	0280	0–105%	100%	121	
AQB Offset	0281	0–100%	20%	121	
Fault Management Group					
Man Fault Reset	0864	None (0) By DI (1) By Keypad (2) By Ser Lnk (3) By DI/Kypd (4) By DI/Ser Lnk (5) By Kypd/Ser Lnk (6) By DI/Ser/Kypd (7)	By DI/Kypd	122	
Input Phase Flt	0851	Disabled (0) Fault (2)	Fault	122	
External Fault	0853	Disabled (0) Warning (1) Fault (2)	Disabled	122	
Motor Thrm Prot	0854	Disabled (0) Warning (1) Fault (2)	Fault	123	
Reference Fault	0859	No Action (0) Retain Spd (1) Preset Lvl (2) Fault (3)	No Action	123	
Loss Ref Freq	0860	0 Hz to **Maximum Freq**	0 Hz	123	

Table 32

Parameter Name	Memory Address	Range	Default	See Page	User Setting
Fan Loss Fault	0862	Disabled (0) Warning (1) Fault (2)	Warning	123	
OV Auto-Reset	0865	Disabled (0) Enabled (1)	Disabled	124	
OC Auto-Reset	0867	Disabled (0) Enabled (1)	Disabled	124	
OT Auto-Reset	0868	Disabled (0) Enabled (1)	Disabled	124	
Fault Lockout #	0871	0–10	0	125	
Auto Reset Time	0872	0–36000 s	600 s	125	
Auto Reset Strt	0874	Ramping (0) Flying start (1)	Ramping	125	
Net Timeout Flt	0876	Disabled (0) Warning (1) Fault (2)	Disabled	125	
DC Volt Flt Cfg	0877	Disabled (0) Warning (1) Fault (2)	Fault	126	
Auto Res Delay	0878	0.1–3600.0 s	1.0 s	126	
DB Flt AR	0866	Disabled (0) Enabled (1)	Disabled	126	
Loss Ref AR	0869	Disabled (0) Enabled (1)	Disabled	126	
Ext Flt AR	0870	Disabled (0) Enabled (1)	Disabled	127	
Mtr Ovld AR	0879	Disabled (0) Enabled (1)	Disabled	127	
Display Options Group					
Display Mode	0955	Std Disply (0) User Units (1) Reten Time (2)	Std Disply	127	
User Units Mult	0956	1–32767	1	128	
User Units Div	0957	1–32767	1	128	
User Label 1	0958	See page 128	0 (space)	128	
User Label 2	0959	See page 128	0 (space)	128	
User Label 3	0960	See page 128	0 (space)	128	
Language	0980	English (0) Espanol (1) Italiano (2) Deutsch (3)	English	128	
Show Param #	0979	Disabled (0) Enabled (1)	Disabled	129	

Table 32

Parameter Name	Memory Address	Range	Default	See Page	User Setting
F1 Key Config	0961	Disabled (0) Loc/Rem (1) Term/Kpd (2) PID Enable (3) SL Override (4)	Disabled	129	
F2 Key Config	0962	Disabled (0) Loc/Rem (1) Term/Kpd (2) PID Enable (3) SL Override (4)	Disabled	129	
F3 Key Config	0963	Disabled (0) Loc/Rem (1) Term/Kpd (2) PID Enable (3) SL Override (4)	Disabled	129	
F4 Key Config	0964	Disabled (0) Loc/Rem (1) Term/Kpd (2) PID Enable (3) SL Override (4)	Disabled	129	
Keypad Control	0875	SKP (0) Both (1) Both No Flt (2) EKP (3) No Flt (4)	Varies	129	
Special Group					
Param STO/RCL	0982	Select.... (0) Factry Rst (1) Store Parm (2) Load Param (3)	Select....	130	
Application	0981	Sequencer (1) Normal (2)	Normal	130	
Program Number	0983	Reset **Elapsed Runtime** (10) Reset **Elapsed MWh** (20)		131	
Communication Group					
Comm Protocol	0900	RTU (0) ASCII (1) DeviceNet (2) Siemens P1 (3) Metasys N2 (4)	RTU	131	

Table 32

Parameter Name	Memory Address	Range	Default	See Page	User Setting
Comm Baudrate	0901	Disabled (0) 1200 (1) 2400 (2) 4800 (3) 9600 (4) 19.2K (5) 38.4K (6) 125K (7) 250K (8) 500K (9)	Depends on Protocol	131	
Comm Parity	0902	N81 (0) N82 (1) E81 (2) O81 (3)	N81	132	
Comm Drop #	0903	1–247 or 0–63	1 or 63	132	
Comm Timeout	0904	1–60 s	5 s	132	
EKP Baudrate	0906	9600 (4) 19.2K (5)	19.2K	133	
EKP Timeout	0907	2.0–60.0 s	2.0 s	133	
Cntl Word 1	0201	0–65535	0	133	
Cntl Word 2	0202	0–65535	0	134	
Ext Freq Ref 1	0203	0.00 Hz to **Maximum Freq**	0.00 Hz	134	
Ext Freq Ref 2	0205	0.00 Hz to **Maximum Freq**	0.00 Hz	134	
Status Word 1	0050	0–65535	Read-Only	134	
Status Word 3	0052	0–65535	Read-Only	135	
PID Configure Group					
PID Configure	0650	No PID (0) Feed-Fwd (1) F-fwd DI (2) F-fwd Fkey (3) F-fwd Ser (4) Full-Range (5) Full DI (6) Full Fkey (7) Full Ser (8)	No PID	136	
PID Direct Type	0651	Direct (0) Reverse (1)	Direct	136	
Feedback Config	0652	Ref 1 (0) Ref 2 (1) Ref 3 (2)	Ref 1	136	
PID Prop Gain	0653	0–2000	0	137	
PID Int Gain	0654	0–10000	0	137	
PID Deriv Gain	0655	0–1000	0	137	
Feedback Gain	0656	0–2000	0	137	
PID High Limit	0657	0.00–100.00%	100.00%	137	

Table 32

Parameter Name	Memory Address	Range	Default	See Page	User Setting
PID Low Limit	0658	0.00–100.00%	0.00%	137	
PID High Alarm	0659	0.00–100.00%	100.00%	138	
PID Low Alarm	0660	0.00–100.00%	0.00%	138	
PID Reference	0670	0–100%	Read-Only	138	
PID Feedback	0671	0–100%	0%	138	
PID Error	0672	0–100%	Read-Only	138	
PID Output	0673	0–100%	Read-Only	138	
PID P-Part	0674	0–100%	Read-Only	138	
PID I-Part	0675	0–100%	Read-Only	139	
PID D-Part	0676	0–100%	Read-Only	139	
Seq Configure Group					
Seq Enable	3000	Disabled (0) Always (1) By DI (2) By F-key (3) By Ser Lnk (4)	Disabled	148	
Seq Run Source	3001	Keypad (0) Term Strip (1)	Keypad	149	
Seq Pause	3004	Disabled (0) By DI (1) By F-key (2) By Ser Lnk (3)	Disabled	149	
Seq Reset	3002	Disabled (0) By DI (1) By F-key (2) By Ser Lnk (3)	Disabled	149	
Freq Config 1 Freq Config 2 Freq Config 3 Freq Config 4 Freq Config 5 Freq Config 6 Freq Config 7 Freq Config 8 Freq Config 9 Freq Config 10	3010 3030 3050 3070 3090 3110 3130 3150 3170 3190	Spd - Rf 1 (0) Spd - Rf 2 (1) Spd - Rf 3 (2) Spd -Rf1+R2 (3) Spd -Rf1+R3 (4) Spd -R1+R2+R3 (5) Spd -R2+R3 (6) S-R1+k*R2 (7) Spd-R1-R2 (8) SpdR2-R1 (9) Spd-R1-R3 (10) Spd-R3-R1 (11) Spd-R2-R3 (12) SpdR3-R2 (13) S-R1+R2-R3 (14) S-R1+R3-R2 (15) Spd-Fixed (16)	Spd Fixed	150	

Table 32

Parameter Name	Memory Address	Range	Default	See Page	User Setting
Fixed Freq 1 Fixed Freq 2 Fixed Freq 3 Fixed Freq 4 Fixed Freq 5 Fixed Freq 6 Fixed Freq 7 Fixed Freq 8 Fixed Freq 9 Fixed Freq 10	3011 3031 3051 3071 3091 3111 3131 3151 3171 3191	0.00–320.00 Hz	0 Hz	151	
Dir Control 1 Dir Control 2 Dir Control 3 Dir Control 4 Dir Control 5 Dir Control 6 Dir Control 7 Dir Control 8 Dir Control 9 Dir Control 10	3012 3032 3052 3072 3092 3112 3132 3152 3172 3192	Stop (0) Forward (1) Reverse (2)	Stop	151	
Seq Time(min) 1 Seq Time(min) 2 Seq Time(min) 3 Seq Time(min) 4 Seq Time(min) 5 Seq Time(min) 6 Seq Time(min) 7 Seq Time(min) 8 Seq Time(min) 9 Seq Time(min) 10	3013 3033 3053 3073 3093 3113 3133 3152 3173 3193	0–65535 min	0 min	151	
Seq Time(sec) 1 Seq Time(sec) 2 Seq Time(sec) 3 Seq Time(sec) 4 Seq Time(sec) 5 Seq Time(sec) 6 Seq Time(sec) 7 Seq Time(sec) 8 Seq Time(sec) 9 Seq Time(sec) 10	3014 3034 3054 3074 3094 3114 3134 3154 3174 3194	0–60 s	0 s	151	
Ramp Select 1 Ramp Select 2 Ramp Select 3 Ramp Select 4 Ramp Select 5 Ramp Select 6 Ramp Select 7 Ramp Select 8 Ramp Select 9 Ramp Select 10	3015 3035 3055 3075 3095 3115 3135 3155 3175 3195	Main Ramps (0) AR1 (1) AR2 (2) AR3 (3) AR4 (4)	Main Ramps	151	

Table 32

Parameter Name	Memory Address	Range	Default	See Page	User Setting
Go Next Step 1 Go Next Step 2 Go Next Step 3 Go Next Step 4 Go Next Step 5 Go Next Step 6 Go Next Step 7 Go Next Step 8 Go Next Step 9 Go Next Step 10	3016 3036 3056 3076 3096 3116 3136 3156 3176 3196	Disabled (0) DI6 (1) DI7 (2) DI8 (3) DI9 (4) DI10 (5) AI1 Low (6) AI1 High (7) AI2 Low (8) AI2 High (9) AI1L/AI1H (10) DI10/AI1L (11) DI9/AI2H (12) F1 Key (13) F2 Key (14) F3 Key (15) F4 Key (16) Enter Key (17) Time (18) DI6/Time (19) DI7/Time (20) DI8/Time (21) DI9/Time (22) DI10/Time (23) AI1L/Time (24) AI2H/Time (25) F1/Time (26) F2/Time (27)	Disabled	152	

Table 32

Parameter Name	Memory Address	Range	Default	See Page	User Setting
Goto X Step 1 Goto X Step 2 Goto X Step 3 Goto X Step 4 Goto X Step 5 Goto X Step 6 Goto X Step 7 Goto X Step 8 Goto X Step 9 Goto X Step 10	3017 3037 3057 3077 3097 3117 3137 3157 3177 3197	Disabled (0) DI6 (1) DI7 (2) DI8 (3) DI9 (4) DI10 (5) AI1 Low (6) AI1 High (7) AI2 Low (8) AI2 High (9) AI1L/AI1H (10) DI10/AI1L (11) DI9/AI2H (12) F1 Key (13) F2 Key (14) F3 Key (15) F4 Key (16) Enter Key (17) Time (18) DI6/Time (19) DI7/Time (20) DI8/Time (21) DI9/Time (22) DI10/Time (23) AI1L/Time (24) AI2H/Time (25) F1/Time (26) F2/Time (27)	Disabled	153	
AI Low Thres 1 AI Low Thres 2 AI Low Thres 3 AI Low Thres 4 AI Low Thres 5 AI Low Thres 6 AI Low Thres 7 AI Low Thres 8 AI Low Thres 9 AI Low Thres 10	3018 3038 3058 3078 3098 3118 3138 3158 3178 3198	0.00–100.00%	0.00%	154	
AI High Thres 1 AI High Thres 2 AI High Thres 3 AI High Thres 4 AI High Thres 5 AI High Thres 6 AI High Thres 7 AI High Thres 8 AI High Thres 9 AI High Thres 10	3019 3039 3059 3079 3099 3119 3139 3159 3179 3199	0.00–100.00%	0.00%	155	

Table 32

Parameter Name	Memory Address	Range	Default	See Page	User Setting
X Step 1 X Step 2 X Step 3 X Step 4 X Step 5 X Step 6 X Step 7 X Step 8 X Step 9 X Step 10	3020 3040 3060 3080 3100 3120 3140 3160 3180 3200	Disabled (0) Step 1 (1) Step 2 (2) Step 3 (3) Step 4 (4) Step 5 (5) Step 6 (6) Step 7 (7) Step 8 (8) Step 9 (9) Step 10 (10)	Disabled	155	
Ungrouped Parameters					
Drive Family	0998	0–10	Read-Only	139	
Fault History 1	0100	0–100	Read-Only	139	
Fault History 2	0101	0–100	Read-Only	139	
Fault History 3	0102	0–100	Read-Only	139	
Fault History 4	0103	0–100	Read-Only	139	
Fault History 5	0104	0–100	Read-Only	139	
Fault History 6	0105	0–100	Read-Only	139	
Fault History 7	0106	0–100	Read-Only	139	
Fault History 8	0107	0–100	Read-Only	139	
Fault History 9	0108	0–100	Read-Only	139	
Active Fault 1	0110	0–100	Read-Only	140	
Active Fault 2	0111	0–100	Read-Only	140	
Active Fault 3	0112	0–100	Read-Only	140	
Active Fault 4	0113	0–100	Read-Only	140	
Active Fault 5	0114	0–100	Read-Only	140	
Active Fault 6	0115	0–100	Read-Only	140	

Table 32

12 Hexadecimal to Binary Conversion

The WF2 drive utilizes hexadecimal numbers to display and store the binary values of some parameters. These parameters are read and written as four-digit hexadecimal values. The hexadecimal values are then translated to binary values, with the binary values being compared to the “key” provided for each parameter to determine what status is shown or what action is commanded.

The following table shows the sixteen hexadecimal values and the corresponding binary values. The binary values are divided into four columns so you may more readily see which bits of the status or control words are affected by the binary values.

Hexadecimal Value	Binary Value			
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
A	1	0	1	0
B	1	0	1	1
C	1	1	0	0
D	1	1	0	1
E	1	1	1	0
F	1	1	1	1
	15 11 7 3	14 10 6 2	13 9 5 1	12 8 4 0
	Corresponding Bit Positions of Parameter Words			

13 Fundamentals of PID Control

13.1 Introduction

WF2 drives have a built-in PID (Proportional-Integral-Derivative) Controller that makes it possible to control a process by adjusting motor speed using a reference input and a feedback input. When the drive is configured to operate with feedback from a transducer, the WF2 drive essentially ceases to be a frequency controller and instead becomes a process controller.

Several WF2 parameters are specifically designed for PID control. These include:

- **PID Configure**
- **PID Direct Type**
- **Feedback Config**
- **Feedback Gain**
- **PID Prop Gain**
- **PID Int Gain**
- **PID Deriv Gain**

The function performed by each of these parameters is described in the following section. Figure 34 on page 181 provides a flowchart of PID control and shows the interaction of these parameters.

13.2 Configuration of PID Control Parameters

This section discusses the parameters used for PI control and provides advice on how best to configure these parameters for your particular application.

13.2.1 Parameter PID Configure

Parameter PID Configure determines whether feed-forward is enabled and whether the loop is operated via digital inputs. The following paragraphs discuss these characteristics in more detail:

Feed-forward

Feed-forward is usually enabled when there is very little difference between the process speed and the feedback signal.

For example, feed-forward is useful in “speed regulation” situations, such as controlling motor speed in a closed loop. Note that feed-forward should be enabled when attempting to close a speed loop.

Feed-forward is not suited to applications such as pressure regulation systems because generally the process speed and the process variable are vastly different.

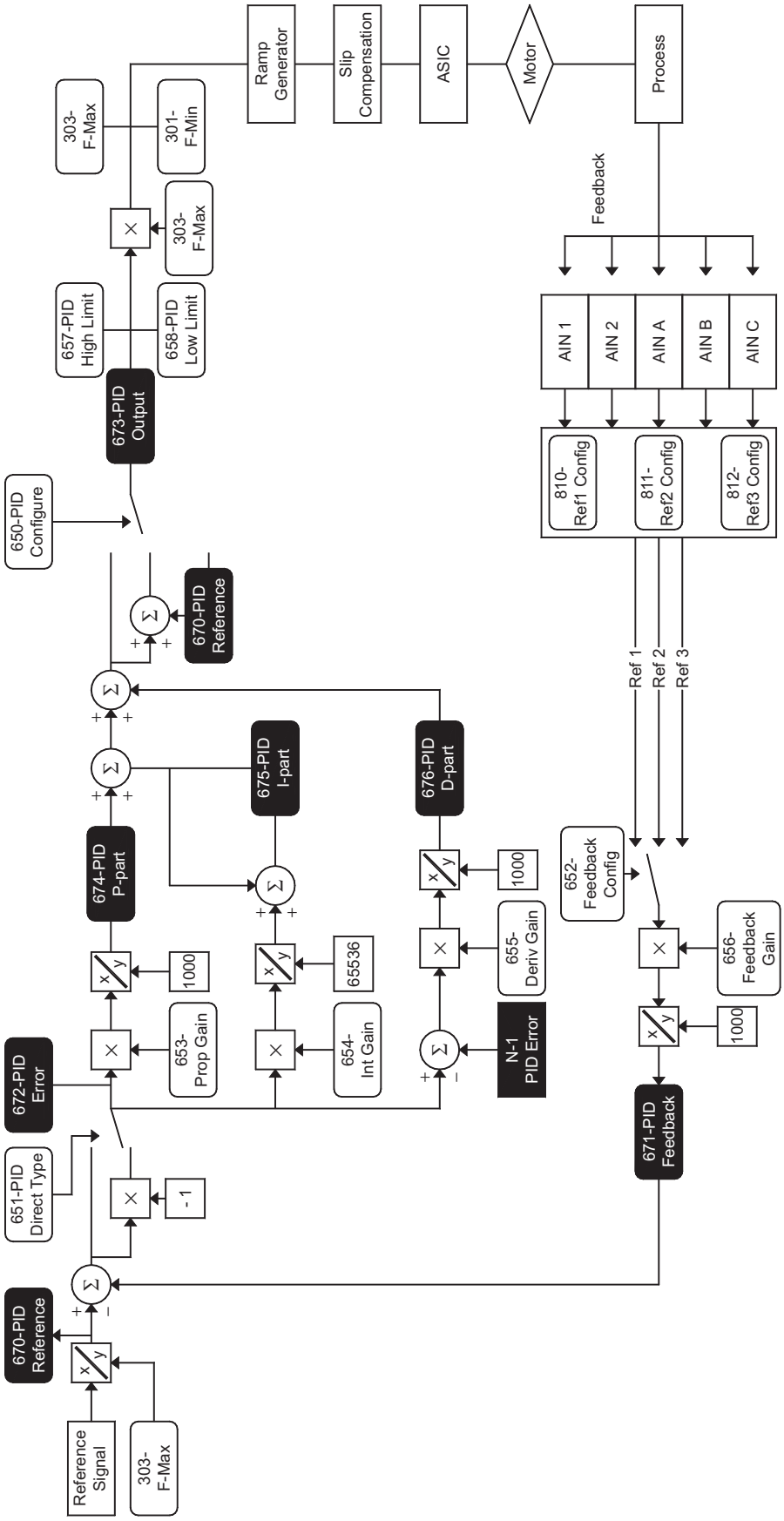


Figure 34
PID Controller Functional Diagram

Enabling PID control via a remote input

A digital input or the Enter key, when properly configured via the corresponding parameter, may be used to toggle PID control.

Generally, a remote input is used when the process will be operated as both a closed and an open loop and/or when circumstances may arise where you would want to override the process speed as determined by the process variable and reference.

Remember: to complete the implementation, you must configure a remote input separately to invoke PID control.

13.2.2 Parameter PID Direct Type

Parameter **PID Direct Type** configures another characteristic of PID control – whether the loop is direct-acting or reverse-acting (also known as inverse-acting).

In a direct-acting loop, as the process speed increases, the feedback signal will decrease and cause a corresponding decrease in the process speed as it approaches the regulation point. In other words, as the regulation point is approached, the error between the reference signal and the feedback signal decreases, resulting in a decrease in the process speed. This type is typically employed in pump applications where level control is the process variable.

Conversely, in an inverse-acting loop, as the process speed increases, the feedback signal increases but causes a corresponding decrease in the process speed as it approaches the regulation point. In other words, as the regulation point is approached, if the error between the reference signal and the feedback signal increases due to an increase in the feedback signal, then the process speed will increase. This type is typically employed in supply pump applications where pressure is the process variable.

13.2.3 Parameter Feedback Config

Parameter **Feedback Config** allows you to configure the source for the feedback signal. This source may be Ref 1, Ref 2, or Ref 3. Each of these sources are configurable to map to either the A1 or A2 analog input of the WF2 drive or analog inputs A, B, or C of the Analog Input/Output Option Board. By default, Ref 1 maps to the A1 analog input, while Ref 2 and Ref 3 map to the A2 analog input. For further information, see the discussion of the **Ref1 Config**, **Ref2 Config**, and **Ref3 Config** parameters on page 90. For further information on the Analog Input/Output Option Board, see page 145.

13.2.4 Parameter Feedback Gain

Parameter **Feedback Gain** is the feedback scaling factor. It is used to scale the signal supplied by the transducer – thereby optimizing the effect of the signal on the drive.

13.2.5 Parameter PID Prop Gain

Parameter **PID Prop Gain** is the proportional feedback gain for the process control loop. It determines the overall effect on the process for an incremental change in the feedback signal.

Generally, when configuring this parameter, you must observe the drive's response to an incremental change in the feedback input, and then decide if this response is sufficient.

For example, if the feedback input changes 1 V (or 1 mA), what is the drive's response? Is it enough or too much?

13.2.6 Parameter PID Int Gain

Parameter **PID Int Gain** is the integral feedback gain for the process control loop. This parameter determines the short-term effects of a change in the feedback signal over a certain amount of time. (This is sometimes referred to as the “averaging time.”)

Generally, when configuring this parameter, you must observe the drive’s response to an incremental change in the feedback input over a certain length of time, and then decide if this response is acceptable.

For example, if the feedback input changed 1 V (or 1 mA) for 5 seconds, what is the drive’s response? Is it acceptable? Would you prefer to have the drive ignore a change over such a short time period, but still react to longer time durations (say, 8 to 10 seconds)? (If so, decreasing the integral gain by reducing the value for parameter **PID Int Gain** would have that effect.)

13.2.7 Parameter PID Deriv Gain

Parameter **PID Deriv Gain** is the derivative feedback gain for the process control loop. This parameter calibrates the magnitude of a step response to a change in the feedback signal.

⚠ CAUTION !

UNSTABLE OPERATION

Changing the value of this parameter to a number greater than 0 may result in unstable operation. Since most applications only require integral feedback conditioning (not derivative feedback conditioning, which is accomplished with this parameter), adjustment of this parameter should only be performed by experienced personnel and with great care.

Failure to observe this instruction can result in injury or equipment damage.

13.3 Tuning the PID Control Loop

Once the parameters are initially configured, you should tune them so the process control loop operates as optimally as possible. To make tuning easier, the following recommendations should be observed:

- If your application does not require enabling by digital input, for the duration of tuning you should select a value for parameter **PID Configure** which does allow a digital input to enable PID control. Once tuning is finished, you can restore the parameter to its original value.
- Install a switch to select closed loop and open loop performance.
- Connect a calibration signal to the drive to simulate the effects of the transducer’s signal. While this is not absolutely required, it can be very helpful.

Once the preparations for tuning are complete, enable PID control via the digital input and set the switch to open loop. Then operate the drive, utilizing any necessary instrumentation (for example, pressure gauges, meters, etc.) to characterize the range of the signal supplied from the transducer (for example, at 3 PSI, the transducer provides 1 V). This will aid in better understanding the operation of the system and make calibration easier.

Select a mid-range operating point for the system and inject a signal close to that which the transducer would provide at that point. With closed-loop selected, vary the signal by the value determined by the set-up technician and determine whether the proportional response of the system is appropriate. If the questions posed in the previous section are answered correctly and your initial assumptions prove correct, a combination of input scaling and proportional gain should make the performance match the system.

Next, examine the transient or short-term effects that are common on all real-world systems. Use the calibrator to change the feedback signal by some value for a measured interval, with the value and duration approximating the real system.

For example, say 1 V for 5 seconds was selected. By monitoring parameter **PID Feedback** (either via the keypad or via an analog output configured for PID feedback), the effect of the feedback signal may be observed. The value of this parameter should increase and then settle back to its original value, or perhaps go below that value (negative). The value of the parameter may go positive and negative a number of times as a response to repeated 5 second transients. Tune parameter **PID Int Gain** to optimize this effect to suit the circumstances.

If necessary, and with due caution, use a similar technique to adjust the derivative gain. Note that parameter **PID Deriv Gain** will immediately produce an incremental change when the feedback signal changes. Set the parameter to a value that produces the desired amount of change in response to a change in the feedback signal. Any changes made to this parameter should be minor as instabilities in loop performance will result if the parameter is adjusted inappropriately.

Finally, put the transducer into the circuit and review the results. The results will likely show that the value of parameters **PID Int Gain** and **PID Deriv Gain** (if necessary) need to be modified to complete the implementation. Minor adjustment of the other PID control parameters may also be necessary.

Once the process control loop is optimally functioning, if you changed the value of parameter **PID Configure** for tuning, restore it to its original value. Also, it is strongly recommended that the custom settings for the parameters be saved by using parameter Param **Param STO/RCL** (see page 130 for more information).

If you need further assistance or advice, please contact BERGES.

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