YASKAWA

A World of Automation Solutions™

VS-616PS5 Series
Installation & Quick-start Manual

Brushless Motor Drive

⚠ WARNING

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Under no circumstances should any YASKAWA product be incorporated into any product or design as the exclusive or sole safety control. Without exception, all controls should be designed to detect faults dynamically and fail safely under all circumstances. All products designed to incorporate a component part manufactured by YASKAWA must be supplied to the end user with appropriate warnings and instructions as to that part's safe use and operation. Any warnings provided by YASKAWA must be promptly provided to the end user.

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READ THIS ENTIRE MANUAL BEFORE INSTALLING OR OPERATING THE VS-616PS5!

WARNING!

The PS5 motor uses permanent magnets. **HIGH VOLTAGE** is generated by the motor whenever the rotor is turning, with or without a power supply. Make sure the motor is not turning before performing ANY service on the motor or on the inverter.

If there is a possibility that the motor can be turned by the load while inverter power is off, install a contactor or a manual disconnect to open the motor leads while servicing the inverter. Interlock the disconnect with the control circuits of the drive.

ONLY PERSONNEL WHO ARE EXPERIENCED IN WORKING WITH HIGH VOLTAGE, HIGH POWER EQUIPMENT SHOULD INSTALL OR SERVICE THIS EQUIPMENT.

Turn off the supply power to the VS-616PS5 AND make sure the motor is stopped AND the internal capacitors are discharged before connecting or disconnecting wires or touching any internal parts.

The VS-616PS5 internal capacitors remain charged even after the power supply is turned off. Wait at least five minutes after removing power. Make sure all LED's are off before servicing the inverter.

Do not use a Megger or other type of high withstand voltage tester on the VS-616PS5. Higher voltages can damage the semiconductors used in the inverter.

Do not connect or disconnect the operator or a computer while the VS-616PS5 is running.

FAILURE TO OBSERVE THE WARNINGS AND PRECAUTIONS IN THIS MANUAL CAN EXPOSE THE USER TO HIGH VOLTAGES, RESULTING IN DAMAGE TO EQUIPMENT, SERIOUS PERSONAL INJURY, OR EVEN DEATH.

POWER SUPPLY LIMITATIONS

The VS-616PS5 is suitable for use on a circuit capable of delivering not more than 65,000 RMS symmetrical amperes at 480 VAC maximum (for 460 VAC class units) or 240 VAC maximum (for 230 VAC class units).

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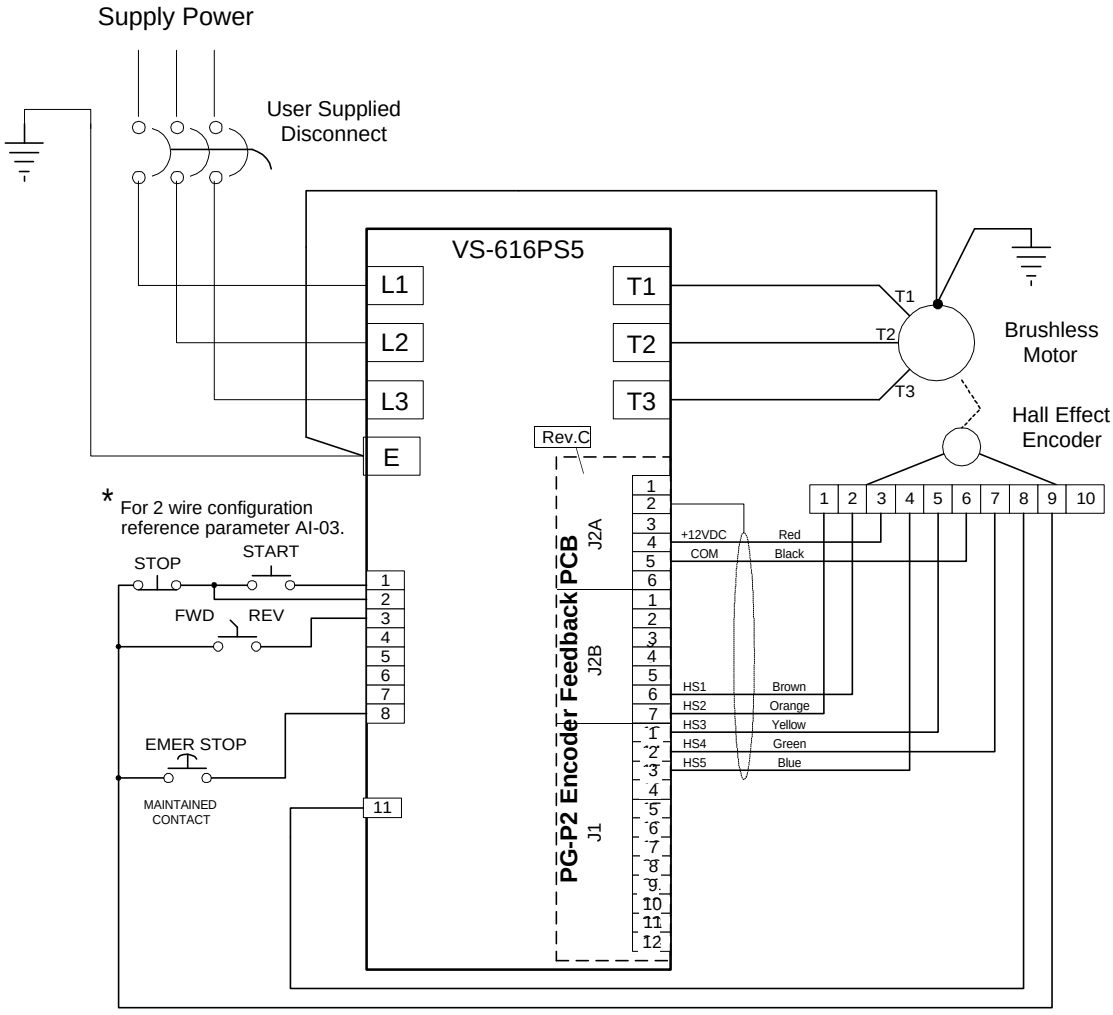
Every precaution has been taken in the preparation of this manual. Nevertheless, Yaskawa assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from the use of the information contained in this publication.

General Connection Diagram (3 Wire Control W/Standard Hall Sensor Fdbk)



* For this configuration, set parameter A1-03 =3330 prior to programming the inverter settings. This action re-initializes the inverter settings and configures the inverter for 3-wire control (as shown above).

If the inverter settings have already been programmed, setting parameter H1-01=0 configures the inverter for 3 -wire control without re-initializing the parameter settings.

The terminal layout shown on the PG-P2 Encoder Feedback Card applies to Revision C boards (Rev CO).

Example of Quick Start Motor Data Entry (See page 35 for complete explanation)

Parameter	Name	Description	Example
E1-01	Input Voltage Setting	Set equal to the input supply voltage in VAC RMS	230
E1-02	Motor Capacity	Set to 1000 for manual entry of the following “E1” parameters	1000
E1-03	Rated Motor Voltage	Set to 230 for motors with 320VDC BUS on the nameplate Set to 460 for motors with 640VDC BUS on the nameplate	230
E1-04	Motor Rated Current	Enter the motor nameplate full load current in AC Amps RMS	9.6
E1-05	Number of Poles	Set for the number of poles in motor (even number)	4
E1-06	Motor Maximum Speed	Set to the maximum speed desired being sure not to exceed the motor maximum RPM	1750
E1-07	Base Motor Speed	Set to nameplate base speed of the motor in RPM	1750
E1-08	Minimum Motor Speed	Set to the Minimum Motor Speed	30
E1-09	Motor Winding Resistance	Set to line to line winding resistance in ohms	0.102
E1-10	Motor d-axis Inductance	Set to Stator Inductance in millihenries	5.45
E1-11	Motor q-axis Inductance	Set equal to E1-10	5.45
E1-13	Induced Voltage Constant	Set to motor Generated voltage KV in VAC RMS (V/1000 RPM)	176.0
E1-17	Motor Connection	Set to 0 = 1D, 1 = 2D, 2 = 1Y, 3 = 2Y	0
F1-01	PG Feedback Rate	Set to number of pulses in one encoder speed channel (PPR)	30
F8-01	Speed Feedback Source	Set to “1” for Hall Sensors, set to “0” for encoder feedback	01

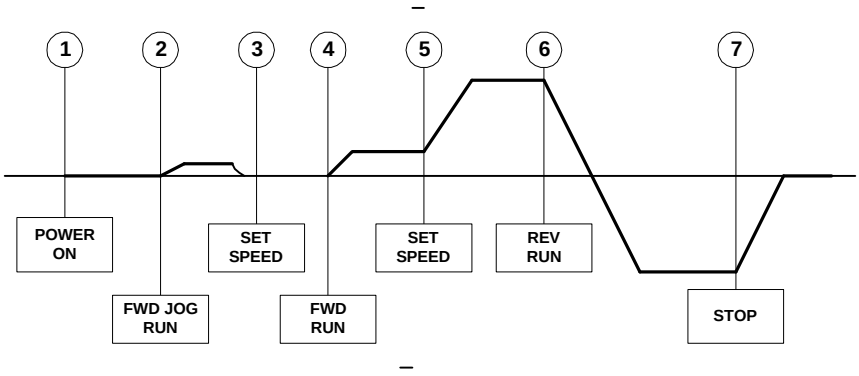
VS-616PS5 QUICK START

Personnel who are experienced in the use of VS-616PS5 inverters and motors may use this procedure.

NOTE: Do not use this procedure if the inverter has been programmed for a particular application by an Original Equipment Manufacturer or if the inverter has already been programmed for your application.

1. Remove the Digital Operator and cover from the inverter before installation (section 1.1).
2. Mount the inverter in a clean, dry location with adequate airflow for cooling (sections 2.1 and 2.2).
3. Connect the proper supply power through an approved power disconnect device to the input terminals (see section 3.2). Make sure the disconnecting device is off.
4. Connect the motor leads T1, T2, and T3 to their respective terminals on the drive. Connect a ground wire between the motor frame and the drive (see section 3.3).
5. Connect the proper motor feedback device. Make sure the feedback device is the correct one for the feedback card (i.e., hall effect device, commutation encoder, or resolver). See section 3.4 and Appendix C. Connect the control circuits according to the drawing generated for the installation. A typical installation with hall sensor feedback to the PG-P2 feedback card is shown on page 3, but the circuits will vary for each installation. Some installations may use only the digital operator. For guidance, see section 3.5.
6. Check input power connections, motor connections, and feedback wiring for unintentional grounds.
7. Re-install the cover and the Digital Operator.
8. Check the supply power to be sure it is correct for the unit installed.
9. Apply power by turning on the disconnecting device. Watch for lights on the digital operator to turn on. If no lights or indicators turn on within 30 seconds, turn power off and connect a DC voltmeter to the bus terminals (+ and -). Re-apply power and watch for DC voltage (340 VDC for 230VAC, or 640 VDC for 460VAC). If no voltage appears, disconnect any braking resistors and check incoming fuses.
10. After the inverter powers up, press the DRIVE/PRGM button on the digital operator to access parameter A1-01. If it is set to “0000” or “0001”, stop using this procedure and consult with your equipment manufacturer for start up procedures. Otherwise, set parameter A1-01 to “0002” (Quick Start Level). If you need help in operating the Digital Operator, read section 4.2 on pages 28 and 29.
11. If the control circuits use momentary START and STOP operators (3-wire operation) connected as shown on page 2, set parameter A1-03 to “3330” and press the “DATA/ENTER” button. This sets the inverter for start/stop control circuit operation and sets all other parameters to the factory defaults. If the inverter is being used in a system with maintained relay contacts or switches, enter “2220” in A1-01. Again, this sets all parameters to factory defaults. If the inverter settings have already been programmed, setting parameter H1-01=0 configures the inverter for 3- Wire control without re-initializing the parameter settings. Setting H1-01 to a value other than “0” configures the inverter for 2- Wire control.
12. Verify that the Emergency Stop button (or some type of emergency shutdown) is installed properly. See page 2 for a typical installation. This is a normally open, maintained contact (push ON / pull OFF) button connected to terminal 8 provided parameter H1-06 is programmed to a value of “8”(Normally open external baseblock). It should be used to shut off the inverter quickly if that action becomes necessary. If the Emergency Stop circuit is activated, press the inverter STOP button before resetting the emergency stop circuit.
13. Set parameters B1-01 and B1-02 to “0”. This enables operation from the digital operator.
14. Set parameter B1-03 to “1”. This causes the motor to coast to a stop (inverter off) on all stops.
15. Defaults for acceleration (C1-01) and deceleration (C1-02) are 10.0 seconds. These may be changed.
16. Preset references D1-01 through D1-04 and Jog reference D1-09 may be set.
17. Set parameter E1-01 to the input line AC RMS voltage (example: 230).
18. Enter the motor data. Enter the number “1000” for E1-02 and manually enter the motor parameters as shown in the table on page 4.
19. Make sure the motor is disconnected from the load and that it is safe to run the motor.
20. Set T1-03 to “1” and then, set T1-02 to 2”. Press the DRIVE/PROG key. The display should show “CAL12”. Press the RUN button on the digital operator. The motor should turn, and the display should blink, as the pulse generator is oriented to the drive. When the orientation is finished, the display will show “End”. If the display shows “Er-18” or “Zdev”, check the connections to the motor and feedback.
21. Once the drive has finished orienting the feedback, you can run the test run on page 6.

Operation Plan for Test Run



Description	Key Sequence	Digital Operator Display
(1) Power ON • Displays Frequency Reference Value		P 0 0. 0 0 REMOTE LED OFF FWD LED ON
Operation Source • Select LOCAL Mode	LOCAL/REMOTE	
Set JOG Reference • Set D1-09 to 10.00%		
(2) Forward Jog Run • Runs at JOG speed while key is pressed.	JOG	1 0. 0 0
(3) Speed Setting • Change Speed Reference Value	Change value with arrow keys	P 0 0. 0 0 Digit to be changed blinks
• ENTER the new value	DATA/ENTER	P 2 5. 0 0
• Select Speed display	DISPL	0 0. 0 0
(4) Forward RUN • Press RUN on operator	RUN RUN LED ON	2 5. 0 0
(5) Change Speed Reference • Select reference display	DISPL	P 2 5. 0 0 Digit to be changed blinks
• Change Reference value	Change value with arrow keys	P 1 0 0. 0
• ENTER the new value	DATA/ENTER	P 1 0 0. 0
• Select Speed display	DISPL	1 0 0. 0
(6) Reverse RUN • Press Reverse	FWD/REV	- 1 0 0. 0
(7) Stop • Press Stop Button	STOP	- 0 0 0. 0

Once this test run is completed, the inverter and motor are ready for service.

INTRODUCTION

The Model VS-616PS5 is a series of high quality, general purpose, inverters designed to control the current in a permanent magnet (PM) brushless motor. In the PM motor, current is directly related to torque.
With power outputs ranging from 0.5 to 500 horsepower (HP), the VS-616PS5 series is suitable for any application. The inverters provide full start-up torque, smooth low speed operation, and precise speed control from zero to full speed. The proprietary auto-tuning function allows the inverters to get the best performance from PM motors manufactured worldwide.
Some of Yaskawa's proprietary features of the VS-616PS5 inverter include torque control, automatic tuning to the motor characteristics, UL recognized electronic thermal motor overload, energy saving operation, PID loop control, and low noise operation. Also standard is a digital operator for simple programming. The design team has used the latest in microprocessor technology to produce the ***ultimate*** drive for ***any*** application.

This manual details installation, start-up, and diagnostic procedures for the PS5 series. For more details on programming, request the VS-616PS5 Programming manual (publication number YEA-TOA-S616-10.21) from your Yaskawa representative.

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SECTION 1

PREPARATION

1.1 Inspection

Receiving

After unpacking the VS-616PS5:

- Verify that the part numbers on the drive nameplate match the part numbers on your packing slip and the parts numbers on your purchase order.
- Check the unit for physical damage that may have occurred during shipping. If any part of the drive is damaged, notify the freight carrier and your Yaskawa representative immediately.
- Inspect the drive to determine if any parts have come loose during shipment. Check the screws, covers, components, etc. for tightness.
- If the drive is to be stored after you receive it, replace the unit in its original packaging and store it in an appropriate environment (see specifications, page 10). Storage instructions are also included in the original packaging or on the shipping container.

Checking the Nameplate

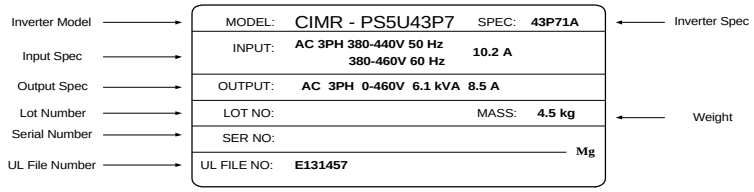


Figure 1 Nameplate Example

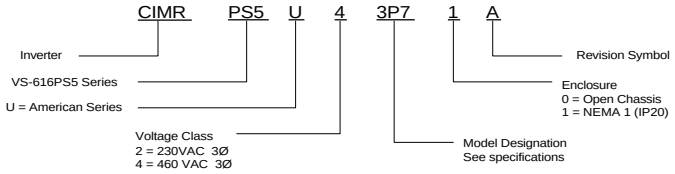


Figure 2 Nameplate Description

Identifying the Parts

Identifying the Parts

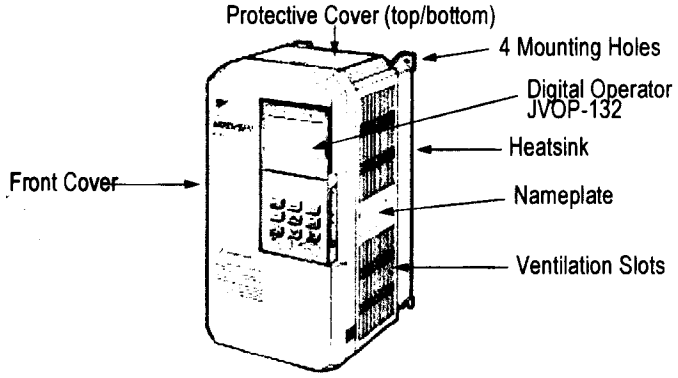


Figure 3 Parts Identification- Model CIMR-PS5U43P7

Removing the Digital Operator

To remove the digital operator from the unit:

- Push the operator retaining lever in the direction shown by arrow 1
- Lift the digital operator in the direction shown by arrow 2

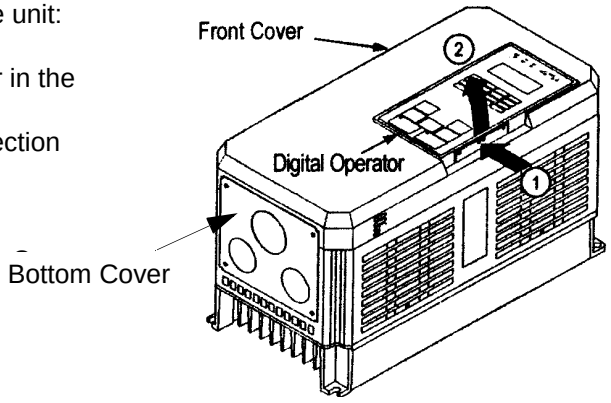


Figure 4 Removal of the operator

Removing the Cover

YOU MUST REMOVE THE DIGITAL OPERATOR BEFORE REMOVING THE COVER.

- Squeeze the cover on both sides in the directions shown by arrows 2
- Lift the cover in the direction shown by arrow 3.

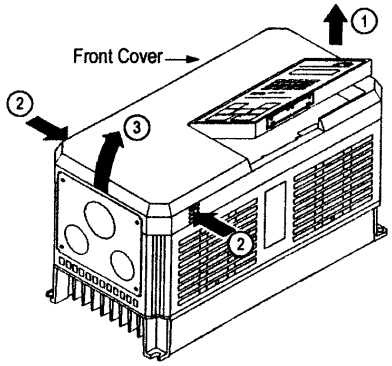


Figure 5 Removal of the inverter cover

1.2 Specifications

The Rated Current of the inverter must be equal to or greater than the Rated Current of the motor, regardless of the nominal horsepower ratings.

230 VAC Units 0.5 thru 20 HP

Inverter Model CIMR-PS5U	VS-616PS5								
	20P4	20P7	21P5	22P2	23P7	25P5	27P5	2011	2015
Output Characteristics									
Motor HP (NEMA)	0.5	1	2	3	5	7.5	10	15	20
Capacity (KVA)	1.2	2.3	3.0	402	6.7	9.5	13	19	24
Rated Current (AAC)	3.2	6	8	11	17.5	25	33	49	64
Maximum Voltage	200VAC to 230VAC, 3 phase (proportional to input voltage)								
Rated Frequency	200 Hertz maximum								
Overload Capacity	150% rated current for 1 minute								
Power Supply Characteristics									
Input Current (AAC)	3.9	7.2	9.6	13.2	21	30	40	59	77
Rated Voltage, Tolerance	3-phase, 200VAC to 230VAC, +/- 10%								
Rated Frequency, Tolerance	50/60 Hertz +/- 5%								

460 VAC Units 0.5 thru 30 HP

Inverter Model CIMR-PS5U	VS-616PS5										
	40P4	40P7	41P5	42P2	43P7	44P0	45P5	47P5	4011	4015	4018
Output Characteristics											
Motor HP (NEMA)	0.5	1	2	3	5	7.5	10	15	20	25	30
Capacity (KVA)	1.4	2.6	3.7	4.7	6.1	8.4	11	16	21	26	31
Rated Current (AAC)	1.9	3.6	5.1	6.6	8.5	11.7	14.8	21	28.6	34	41
Maximum Voltage	380VAC to 460VAC, 3 phase (proportional to input voltage)										
Rated Frequency	200 Hertz maximum										
Overload Capacity	150% rated current for 1 minute										
Power Supply Characteristics											
Input Current (AAC)	2.3	4.3	6.1	8	10.2	14	17.8	26	35	40	46
Rated Voltage,	3-phase, 380VAC to 460VAC +/- 10%										
Rated Frequency	50/60 Hertz +/- 5%										

460 VAC Units 40 thru 500 HP

Inverter Model CIMR-PS5U	VS-616PS5										
	4022	4030	4037	4045	4055	4075	4110	4160	4185	4220	4300
Output Characteristics											
Motor HP (NEMA)	40	50	60	75	100	125	150	200	250	350	500
Capacity (KVA)	40	50	61	73	98	130	170	230	260	340	460
Rated Current (AAC)	52	65	80	96	128	165	224	302	340	450	605
Maximum Voltage	380VAC to 460VAC, 3 phase (proportional to input voltage)										
Rated Frequency	200 Hertz maximum										
Overload Capacity	150% rated current for 1 minute										
Power Supply Characteristics											
Input Current (AAC)	58	72	88	106	141	182	247	330	408	540	726
Rated Voltage,	3-phase, 380VAC to 460VAC +/- 10%										
Rated Frequency	50/60 Hertz +/- 5%										

General Specifications

Control Characteristics	
Control Method	Sine Wave PWM, Flux Vector
Starting Torque	150% at 1% speed
Speed Control Range	100 : 1 (Constant Power Excluded)
Speed Control Accuracy	+/- 0.02%
Torque Limit	Independent Quadrant Settings 0 - 300%
Frequency Control Range	0.1 to 200 Hertz
Frequency Accuracy	Analog Speed Command 0.1% Digital Speed Command 0.01%
Frequency Setting Resolution	Digital Operator: 0.01 Hertz Analog Reference: 0.03 Hertz @ 60 Hz
Output Frequency Resolution	0.01 Hertz
Frequency Setting Signals	0 to +10 VDC (20 Kohm) 0 to +/-10 VDC (20 Kohm) 4 to 20 mA (250 ohm)
Accel/Decel Time Setting	0 to 6000.0 seconds, independent ramps
Braking Torque	Approximately 100% with optional resistor braking
Protection Functions	
Motor Overload Protection	UL Recognized Electronic Thermal Overload
Instantaneous Overcurrent	200% rated current, motor coasts to stop
Fuse Protection	Motor coasts to stop when fuse blows
Overload	Motor shuts off after 150% for 1 minute
Overvoltage	410 VDC (230VAC units) 820 VDC (460 VAC units)
Undervoltage	User adjustable value
Momentary Power Loss	TRIP after 15 ms continuous power loss
Heatsink Overheat	Thermistor Protection
Ground Fault	Electronic Overcurrent circuit
Power Charge Indicator	Charge LED ON above 50 VDC bus voltage
Phase Loss	Input/Output selectable power protection
Environmental Specifications	
Location	Indoors, clean and dry
Ambient Temperature	Open Chassis: +14 to 113 °F (-10 to 45 °C) NEMA 1: +14 to 104 °F (-10 to 40 °C)
Storage Temperature	-4 to 140 °F (-20 to 60 °C)
Humidity	95% Relative Humidity, non-condensing
Vibration	9.8 m/sec^2 (1G), less than 20 Hz // 1.96 m/sec^2 (0.2G) @ 20 to 50 Hz

SECTION 2

INSTALLATION

2.1 Mounting Considerations

Precautions

Observe these precautions to avoid damage to the equipment:

- Do NOT lift the VS-616PS5 by its cover, which may come loose. Handle the inverter unit only by its base.
- Do not mount the inverter on flammable material.
- Mount the inverter in a vertical orientation (fins vertical) to promote cooling. See the section below on clearances.
- The ambient temperature in an enclosure must be kept below 113 °F (45 °C). Install fans and enclosure cooling as necessary.

Choosing a location

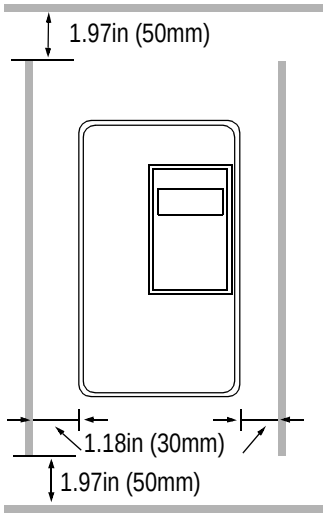
Be sure that the inverter is mounted in a location protected against the following conditions:

- Extreme heat or cold. Refer to the ambient temperature conditions on page 12.
- Direct sunlight. The inverter is not designed for outdoor use.
- Rain or excessive moisture.
- High humidity.
- Oil sprays or splashes.
- Salt spray.
- Dust or metallic particles in the air.
- Corrosive gases or liquids.
- Radioactive substances.
- Combustible solids, liquids, or gases.
- Severe physical shocks or vibrations. Refer to the vibration specs on page 12.
- Magnetic noise (e.g., welding machines and other large magnetic power devices).

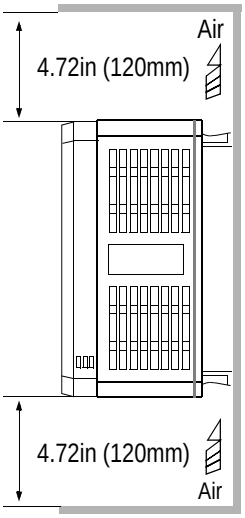
2.2 Thermal Considerations

Clearances

When mounting the VS-616PS5, allow sufficient clearances for effective cooling as shown below:



Front View



Side View

NOTES:

1. Required clearances at the top, bottom, and sides of the inverter apply to both open chassis and NEMA 1 enclosed models.
2. When inverter models 25 HP or less are mounted in an enclosure, remove the top and bottom covers to convert NEMA 1 units to open chassis.
3. Allowable ambient air temperature around the inverter must be within the “Ambient Temperature” limits in the specifications on page 12.
4. Temperatures in the enclosure may not exceed the ambient temperature ratings.

2.3 Dimensions and Heat Loss

Open Chassis Type (IP00)

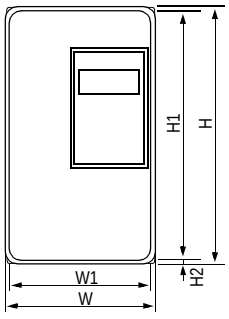
Note: All units up to model CIMR-PSU4045 are stocked and shipped as NEMA1 units.

Voltage	Model CIMR-PSU	Open Chassis Dimensions in inches (mm)						Mass Lbs (kg)	Heat loss (W)		
		W	H	D	W1	H1	H2		Heat Sink	Inside Unit	Total
230V	20P4	5.51 (140)	11.02 (280)	6.30 (160)	4.96 (126)	10.47 (266)	0.28(7)	6.5(3)	15	50	65
	20P7								25	65	90
	21P5								40	80	120
	22P2	5.51 (140)	11.02 (280)	7.09(180)	4.96 (126)	10.47 (266)	0.28 (7)	10 (4.5)	80	60	140
	23P7								135	80	215
	25P5	7.87 (200)	11.81 (300)	8.07 (205)	7.32 (186)	11.22 (285)	0.31 (8)	12 (5.5)	210	90	300
	27P5							13 (6)	235	110	345
	2011	9.84 (250)	14.96 (380)	8.86 (225)	9.29 (236)	14.37 (365)	0.30 (7.5)	24 (11)	425	160	585
	2015								525	200	725
460V	40P4	5.51 (140)	11.02 (280	6.30 (160)	4.96 (126)	10.47 (266)	0.28 (7)	6.5 (3)	10	50	60
	40P7								20	65	85
	41P5	5.51 (140)	11.02 (280)	7.09 (180)	4.96 (126)	10.47 (266)	0.28 (7)	8.8 (4)	30	80	110
	42P2							10 (4.5)	65	60	125
	43P7								80	65	145
	44P0								120	80	200
	45P5	7.87 (200)	11.81 (300)	8.07 (205)	7.32 (186)	11.22 (285)	0.30 (7.5)	13 (6)	135	85	220
	47P5								240	120	360
	4011	9.84 (250)	14.96 (380)	8.86 (225)	9.29 (236)	14.37 (365)	0.30 (7.5)	24 (11)	305	150	455
	4015								390	180	570
	4018	12.80 (325)	24.02 (610)	11.22 (285)	10.83 (275)	17.13 (435)	3.44 (87.5)	60 (27)	465	195	660
	4022								620	260	880
	4030	12.80 (325)	24.61(625)	11.22 (285)	10.83 (275)	24.02 (610)	0.30 (7.5)	97 (44)	705	315	1020
	4037								875	370	1245
	4045								970	415	1385
	4010	17.91 (455)	32.28 (820)	13.78 (350)	13.78 (350)	31.30 (795)	0.49 (12.5)	174 (79)	1110	710	1820
	4055							176 (80)	1430	890	2320
	4075	22.64 (575)	36.42 (925)	14.76 (375)	17.52 (445)	35.24 (895)	0.59 (15)	298 (135)	1870	1160	3030
	4160			15.75 (400)				320 (145)	2670	1520	4190
	4185	17.91 (455)	57.09 (1450)	17.13 (435)	29.53 (750)	55.12(1400)	0.98 (25)	794 (360)	3400	1510	4910
	4220								4740	2110	6850
	4300	37.80 (960)	62.99 (1600)	17.91 (455)	29.53 (750)	61.02 (1550)	0.98 (25)	926 (420)	6820	2910	9730

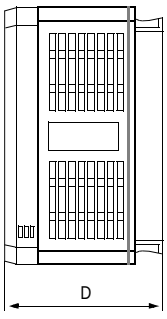
Enclosed Type NEMA 1 (IP20)

Note: All units up to model CIMR-PSU4045 are stocked and shipped as NEMA1 units.

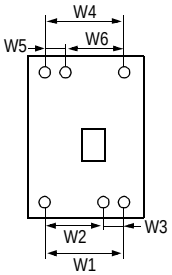
Voltage	Model CIMR-PSU	NEMA 1 Dimensions in inches (mm)						Mass Lbs (kg)
		W	H	D	W1	H1	H2	
230V	20P4	5.51 (140)	11.02 (280)	6.30 (160)	4.96 (126)	10.47 (266)	0.28(7)	6.5(3)
	20P7							
	21P5							
	22P2	5.51 (140)	11.02 (280)	7.09(180)	4.96 (126)	10.47 (266)	0.28 (7)	10 (4.5)
	23P7							
	25P5	7.87 (200)	1.81 (300)	8.07 (205)	7.32 (186)	11.22 (285)	0.31 (8)	12 (5.5)
	27P5							13 (6)
	2011	9.84 (250)	14.96 (380)	8.86 (225)	9.29 (236)	14.37 (365)	0.30 (7.5)	24 (11)
	2015						1.08 (27.5)	
460V	40P4	5.51 (140)	11.02 (280)	6.30 (160)	4.96 (126)	10.47 (266)	0.28 (7)	6.5 (3)
	40P7							
	41P5	5.51 (140)	11.02 (280)	7.09 (180)	4.96 (126)	10.47 (266)	0.28 (7)	8.8 (4)
	42P2							10 (4.5)
	43P7							
	44P0							
	45P5	7.87 (200)	11.81 (300)	8.07 (205)	7.32 (186)	11.22 (285)	0.31 (8)	13 (6)
	47P5							
	4011	9.84 (250)	14.96 (380)	8.86 (225)	9.29 (236)	14.37 (365)	0.30 (7.5)	24 (11)
	4015							
	4018	12.99 (330)	24.02 (610)	11.22 (285)	10.83 (275)	17.13 (435)	3.44 (87.5)	68 (31)
	4022							
	4030	12.99 (330)	30.91(785)	11.22 (285)	10.83 (275)	24.02 (610)	3.44 (87.5)	106 (48)
	4037							
	4045		33.46 (850)				6.00 (152.5)	
	4055	18.11 (460)	44.49 (1130)	13.78 (350)	13.78 (350)	31.30 (795)	8.37 (212.5)	187 (85)
	4075							190 (86)
	4110	22.83 (580)	50.79 (1290)	14.76 (375)	17.52 (445)	35.24 (895)	10.63 (270)	320 (145)
	4160			15.75 (400)				342 (155)



Front View



Side View



Model CIMR-PS5U	W1	W2	W3	W4	W5	W6
4185, 4220	29.53 (750)	17.32 (440)	12.20 (310)	33.46 (850)	11.22 (285)	22.24 (565)
4300	29.53 (750)	17.32 (440)	12.20 (310)	34.37 (873)	11.73 (298)	22.64 (575)

Models PS5U4185~4300

VS-616PS5 Dimension Diagram

SECTION 3

WIRING

3.1 Wiring Considerations

Precautions

Observe these guidelines to avoid damage to the equipment and/or injury to personnel:

- The National Electric Code (NEC) governs the installation of electrical equipment. The provisions of the NEC and other national, state and local codes must be observed.
- Do not connect or disconnect wiring while power is on.
- Do not connect or disconnect test equipment while the power is on.
- Connect the main power supply ONLY to L1 (R), L2 (S), and L3 (T). DO NOT connect main power supply wiring to output terminals T1, T2, and T3.
- Connect motor power wires to T1 (U), T2 (V), and T3 (W) ONLY.
- ***Never*** touch the output circuit directly or place output wires in contact with the inverter enclosure or any metal surface.
- Do not use power correction capacitors on the output of the drive.
- Motor wiring must be less than 328 feet (100 meters) in length.
- Motor wiring must be run in conduit separately from control and signal wires. If there is sensitive equipment in the vicinity of the drive or motor, the conduit must be metallic, properly grounded.
- Control wiring must be less than 164 feet (50 meters) and in separate conduit or cable. Low voltage wiring shall be wired with Class 1 wiring.

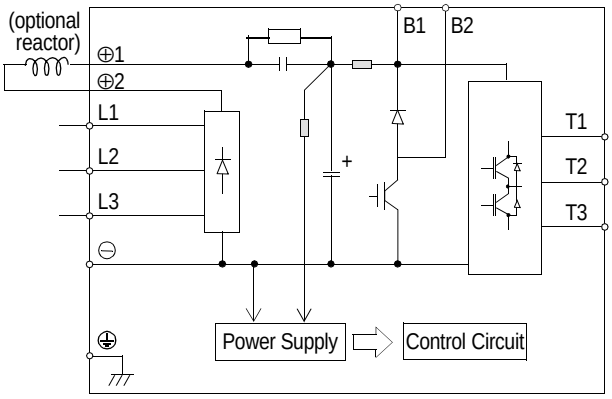
Inspection

After wiring is completed and at regular intervals, check:

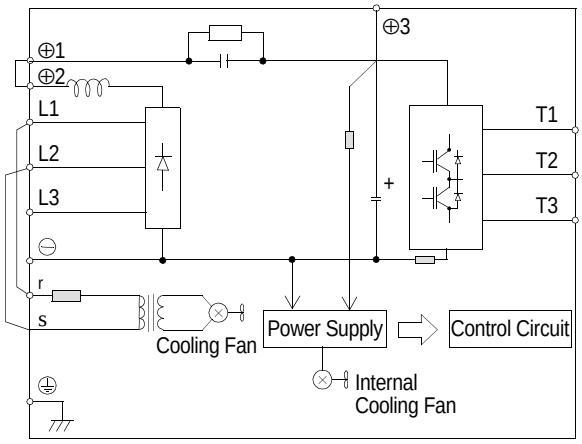
- that all wiring is correctly installed
- that there are no loose screws or wire clippings inside the drive or enclosure
- that all screws are securely fastened
- that there are no loose strands in contact with other wires or other terminals.

Main Circuit Diagrams

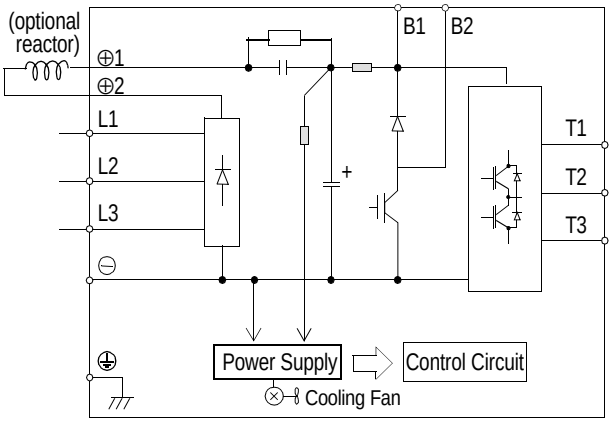
PS5U20P4 thru 21P5, PS5U40P4 thru 41P5



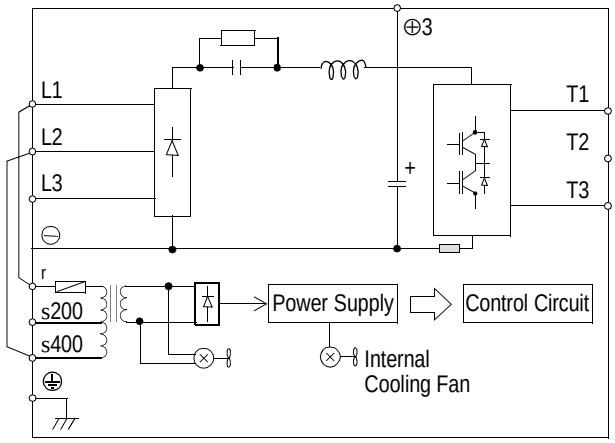
PS5U4018 thru 4045



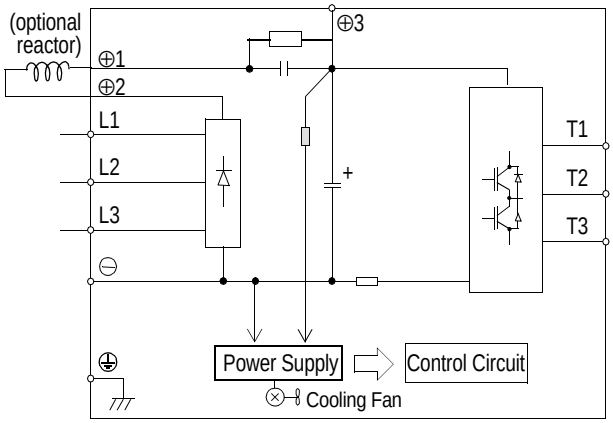
PS5U22P2 thru 27P5, PS5U42P2 thru 4015



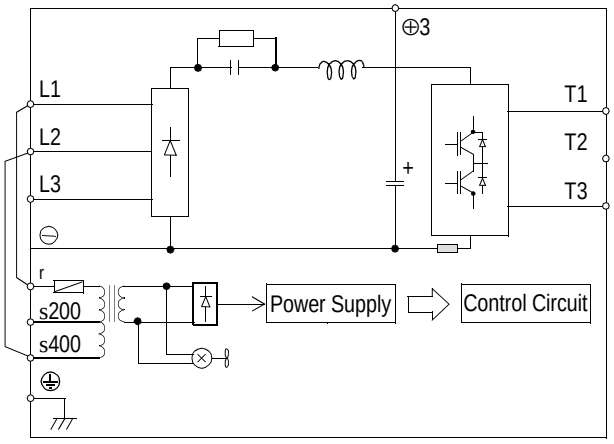
PS5U4055 thru 4160



PS5U2011 thru 2015



PS5U4185 thru 4300



3.2 Connecting the Power Supply

Input Circuit Requirements

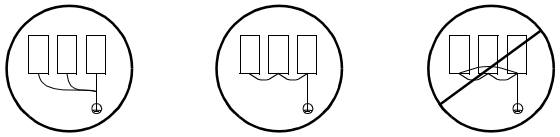
The input power supply phases (L1, L2, and L3) may be connected in any sequence.

1. Circuit Breaker or Disconnect
   - The user must supply a circuit breaker or disconnect with properly sized fuses to protect the input wiring to the VS-616PS5 inverter.
   - Input currents to the inverters are listed in section 1.2.
   - Recommended wire sizes are listed in the Wire Size Tables in Appendix A. Circuit Breakers and fuses must be sized via the NEC standards according to the wire size.
2. Ground Fault Interrupter
   - Select a ground fault interrupter not affected by high frequencies for use on the input.
   - Example: NV Series by Mitsubishi Electric Company
   - Example: EGSG series by Fuji Electric Co., Ltd.
3. Magnetic Contactors
   - A magnetic contactor may be used as a disconnecting device on the input side of the inverter. The user must still supply fuses to protect the wiring and a circuit breaker or disconnecting device to remove power from the input side of the contactor.
   - The VS-616PS5 may be started/stopped by closing/opening the magnetic contactor on the power input; however, frequent operation may cause an inverter malfunction.
   - When a magnetic contactor is opened on the input side, dynamic braking does not function and the motor coasts to a stop.
   - When using a braking resistor unit, use an input side contactor to prevent damage to the braking resistors in the event of a braking resistor overload.
4. Reactors and Transformers
   - The use of reactors on the power supply side will improve the input side power factor.
   - DC reactors may be connected to VS-616PS5 units 15 KW or less between the + 1 and +2 terminals on the inverter (after removing factory installed shorting bar).
   - AC reactors may be used on the input. They should not exceed 5% impedance.
   - Transformers or reactors must be used with 15 KW units or smaller to limit instantaneous current of a mains power supply 600 KVA or larger.
   - If power factor correction is used on the mains supply, a transformer or reactor must be used to limit peak currents into the converter section of the drive.
5. Surge Suppressors
   - A surge suppressor must be used on the coil of an input contactor.
   - Magnetic solenoids, valves, etc. must have surge suppressors across their inputs.

Grounding

The PS5 Controller must be grounded properly not only for safety, but also to insure proper operation.

1. Ground Resistance: 230 VAC class = 100 ohms or less 460 VAC class = 10 ohms or less
2. Never ground the VS-616PS5 in common with high current electrical equipment.
3. Do not use metallic conduit as a grounding conductor.
4. Size ground wires according to the “Wire and Terminal Screw Sizes” table in Appendix A.
5. The length of ground wires should be as short as possible.
6. When several units are used, do not loop ground wires.



(a) Acceptable *(b) Acceptable* *(c) Not Acceptable*

Input Fuse Protection

The input diode bridge should be protected from failure, in the event of a short circuit in the inverter, by installing high-speed fuses (Semiconductor Type) on the input. These fuses are for short circuit protection only. They DO NOT take the place of the protection for the wiring, which is supplied by the approved fused disconnect or circuit breaker discussed previously, and is sized according to national, state, and local electrical codes.

Drive Model	Fuse Number	FLA		Drive Model	Fuse Number	FLA		Drive Model	Fuse Number	FLA
20P4	A50P30	30		40P4	A70P20	20		4022	A70P80	80
20P7	A50P30	30		40P7	A70P20	20		4030	A70P100	100
21P5	A50P30	30		41P5	A70P20	20		4037	A70P125	125
22P2	A50P40	40		42P2	A70P25	25		4045	A70P150	150
23P7	A50QS70	70		43P7	A70P25	25		4055	A70P200	200
25P5	A50QS70	70		44P0	A70P25	25		4075	A70P225	225
27P5	A50QS100	100		45P5	A70P30	30		4110	A70P300	300
2011	A50QS125	125		47P5	A70P30	30		4160	A70P350	350
2015	A50QS150	150		4011	A70P50	50		4185	A70P700	700
				4015	A70P60	60		4220	A70P700	700
				4018	A70P70	70		4300	A70P1000	1000

Fuse numbers given are Gould-Shawmut Amp-Trap® part numbers. Substitutes must be equivalent.

3.3 Connecting the Motor

Output Circuit Considerations

The VS-616PS5 is not suitable for running multiple motors on its output.

1. **Motor Power Connections**
   - Motor lead T1 must be connected to T1 (U) on the inverter, T2 to T2 (V), and T3 to T3 (W). This is NOT an induction motor. You cannot reverse rotation by swapping phases.
   - Refer to the wire size tables in Appendix A for wire sizes.
   - Make sure that the nameplate current of the motor does not exceed the nameplate current of the VS-616PS5.
   - The motor leads shall not be run in the same conduit as the feedback signals.
   - Around sensitive instrumentation, metallic conduit must be used for motor power leads.
2. **Motor Starters**
   - Opening or closing a magnetic contactor in the output of an inverter while it is running will cause the inverter to malfunction.
   - If a magnetic contactor is used on the output of the inverter, it must be interlocked with the inverter in such a way that it is closed before the inverter output is turned on, and opened only after the inverter output is turned off.
3. **Thermal Overload Relays**
   - The VS-616PS5 inverter incorporates a UL Recognized electronic overload function.
   - If this overload function is disabled (L1-01 = “0”), an external thermal overload relay must be installed.
4. **Wiring Distances**
   - Excessively long motor wiring and a high carrier frequency may adversely affect the inverter and peripheral devices.
   - For distances of up to 328 feet (100 meters), the carrier frequency may be set as high as 8 kilohertz. If the distance is greater than 328 feet, the inverter carrier frequency should be lowered to less than 5 kilohertz. The carrier frequency is set by parameter C6-02. NOTE: Setting the carrier frequency higher than the default frequency for any model requires de-rating. Consult the factory for de-rating information.
   - For distances greater than 328 feet, increase the wire size by 1 AWG wire gauge for each additional 100 feet.

3.4 Connecting the Feedback

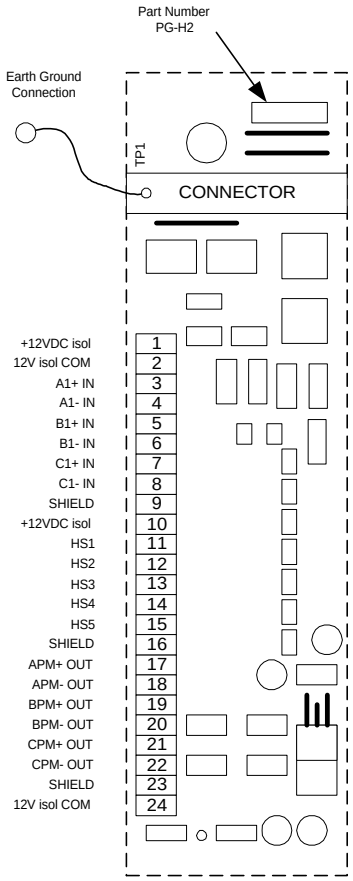
The PS5 operates in a closed loop control method only. A PG feedback option PCB is therefore required. Refer to the following information to properly select and configure the feedback option. Additional connection diagrams are located in Appendix C.

Types of Feedback Device

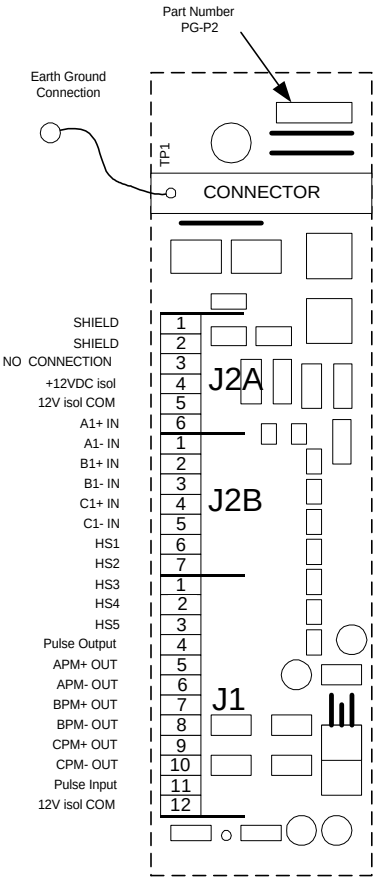
1. **Hall Effect Sensor Device**
   - 3 commutation channels, 60° separation, sinking
   - 2 speed channels, 30 or 60 PPR, quadrature, sinking
2. **Commutation Encoder**
   - 3 commutation channels, 60° separation, line driver
   - 2 speed channels, 500 to 4096 PPR, quadrature, line driver
   - 1 marker channel, 1 PPR, line driver
3. **Resolver**
   - 6 kHz or 6.5 kHz reference frequency
   - Sine channel, 0.5:1 or 0.333:1, differential output
   - Cosine channel, 0.5:1 or 0.333:1, differential output

Types of Feedback Card

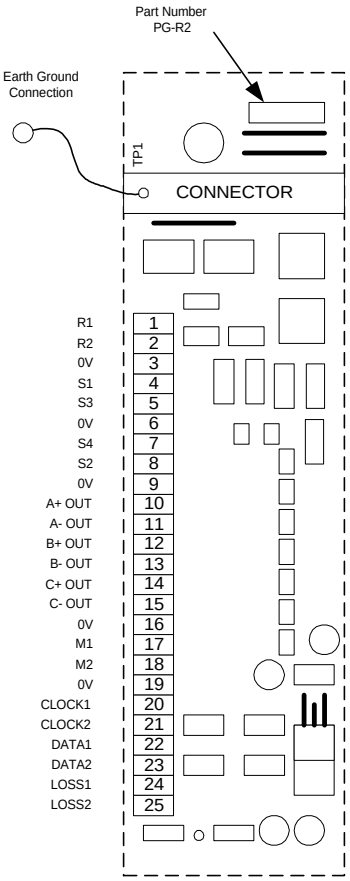
PG-H2 Hall Sensor Feedback Card



PG-P2 Encoder Feedback Card

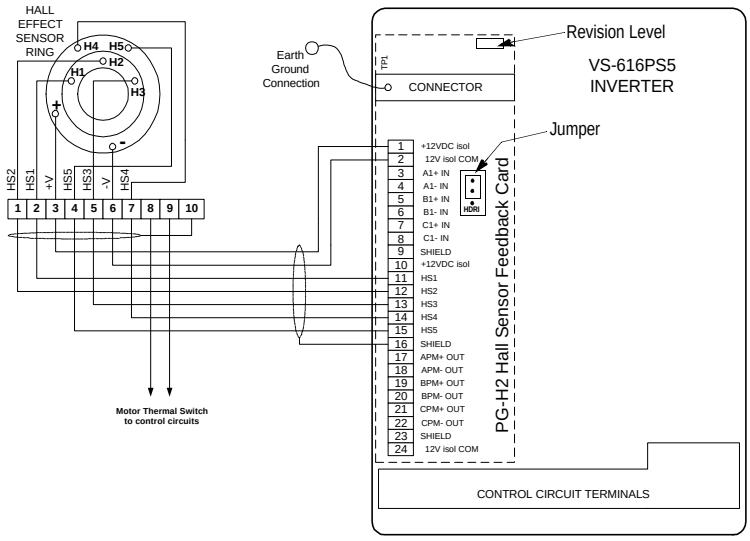


PG-R2 Resolver Feedback Card



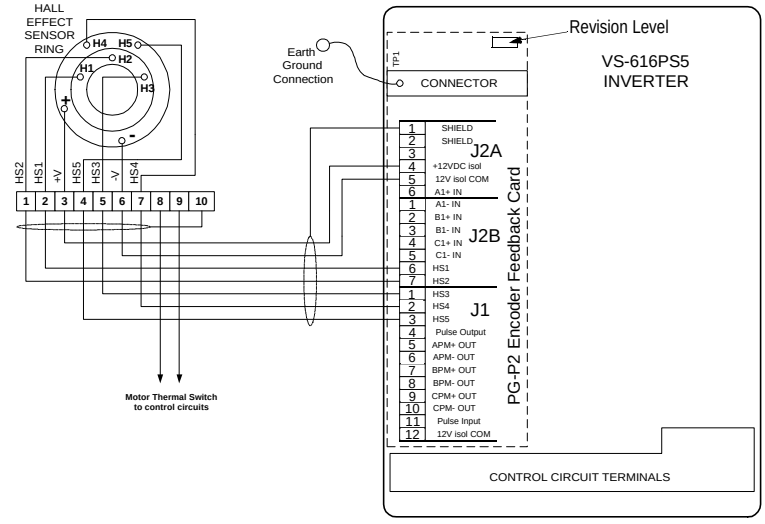
PG-H2 Hall Sensor Feedback Card

The PG-H2 is intended for use with Permanent Magnet motors with integrated Hall-effect sensors. It uses 3 commutation channels with 120 electrical degree separation, and 2 speed channels in quadrature. All outputs of the Hall-effect feedback device are in a sinking configuration. Three encoder (line driver type) input channels are also standard for the encoder speed feedback option. When using the encoder inputs, a 12 Volt, differential encoder with channels A, $\overline{A}$, B, $\overline{B}$ and C, $\overline{C}$ is required. When using a PG-H2, make sure the jumper is on the upper 2 pins of header HDRI (as shown below).



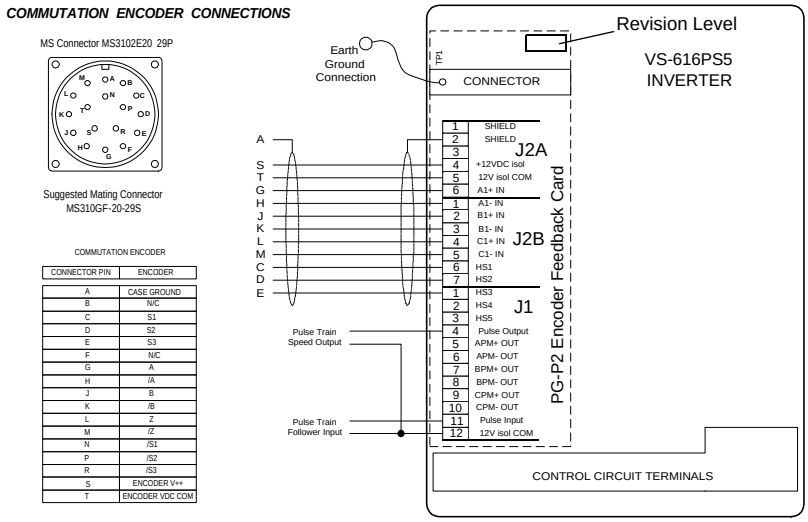
PG-P2 Encoder Feedback Card and Hall Effect Sensors (PG-P2 Revision C)

The Hall Effect Sensor device can also be used with the PG-P2 encoder card. The PG-P2 card has a pulse input for following applications. There is also a pulse train output. The PG-P2 terminal markings shown apply to revision C boards. Refer to Appendix C for connection details.



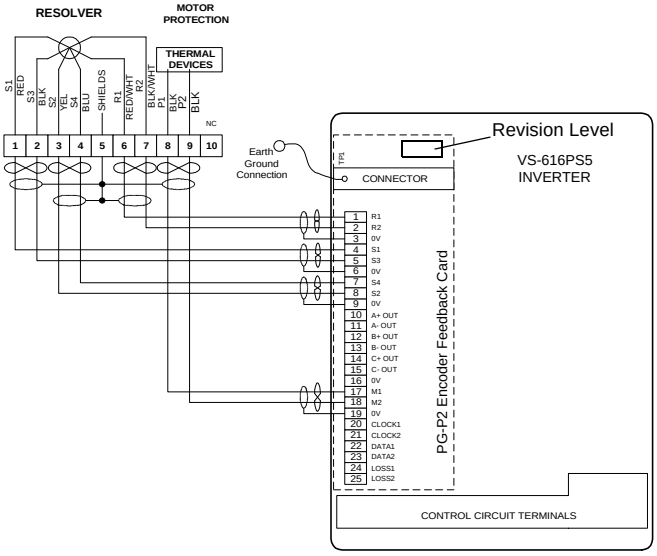
PG-P2 Encoder Feedback Card with Commutation Encoder (PG-P2 revision C)

The PG-P2 Encoder Feedback card accepts line driver signals from a commutation encoder. The commutation channels S1, S2, and S3 are wired to HS1, HS2, and HS3. The speed and direction channels are wired to the A, B, and Z line driver outputs of the encoder. The PG-P2 terminal markings shown apply to revision C boards. Refer to Appendix C for connection details.



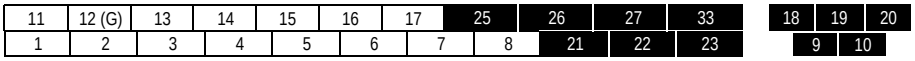
PG-R2 Resolver Feedback Card (Future)

The PG-R2 Resolver Feedback Card accepts the Sine and Cosine signals from a resolver mounted on the motor. Shown below is a typical connection scheme.



3.5 Connecting the Control Circuits

Control Terminals Layout

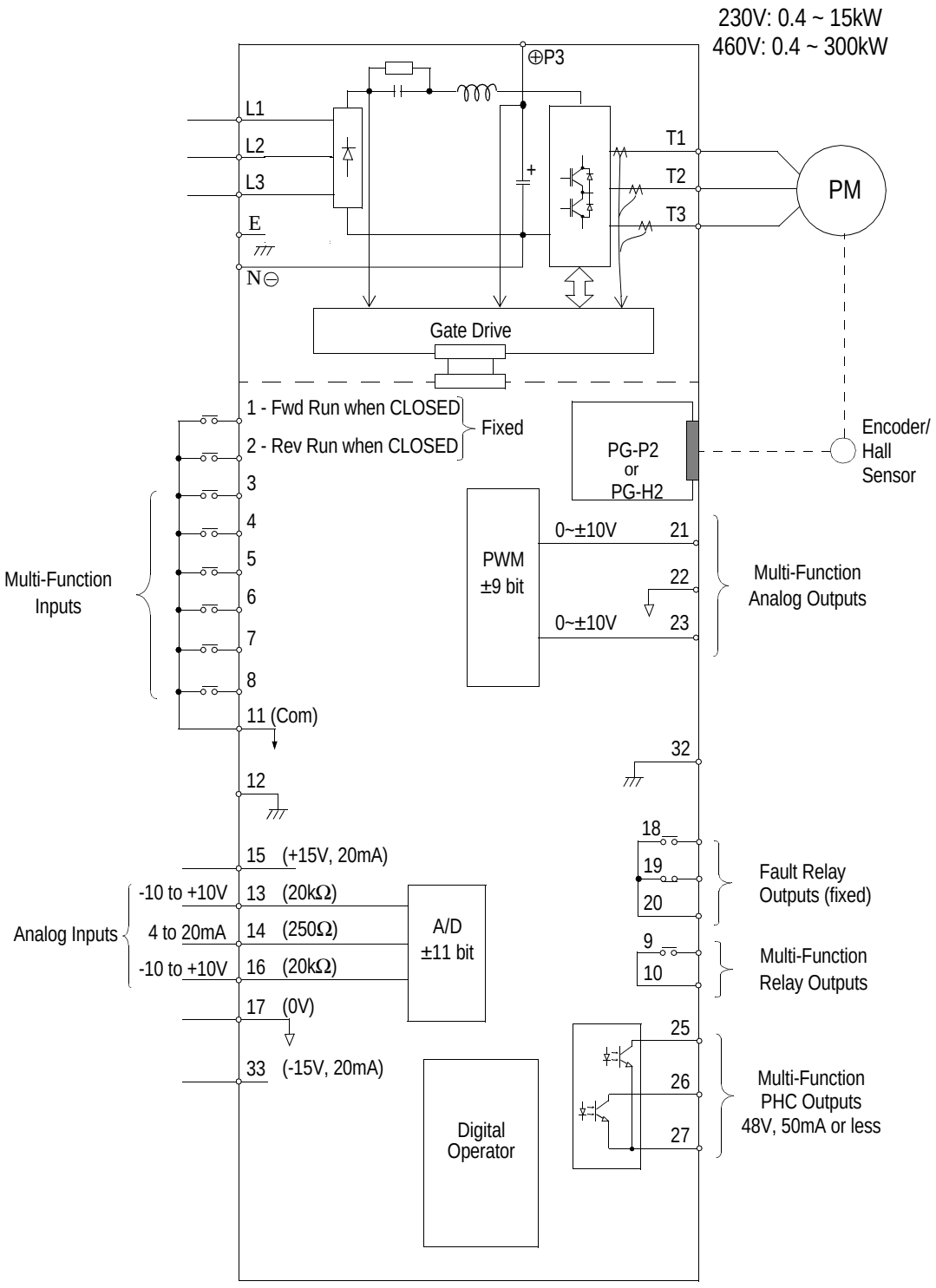


Control Circuit Wiring

The table below outlines the functions of the control circuit terminals.

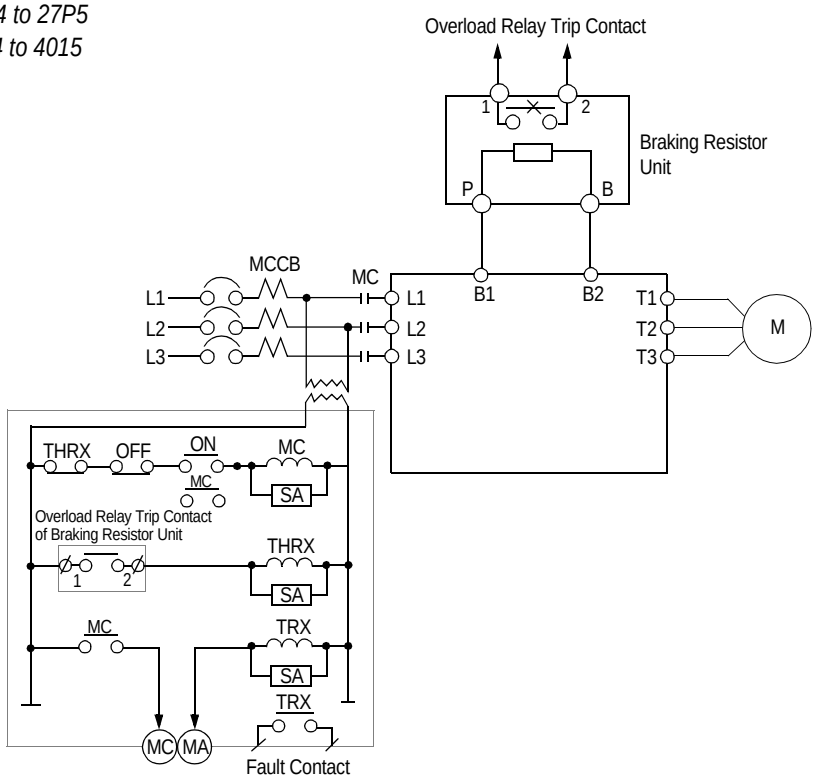
Classification	Terminal	Signal Function	Description		Signal Level
Sequence Input Signal	1	Forward run/stop	Forward run when closed, stop when open		Photo-coupler insulated Input: +24VDC 8mA
	2	Reverse run/stop	Reverse run when closed, stop when open		
	3	External fault input	Fault when closed, normal state when open	Multi-function contact inputs (*H1-01* to *H1-06*)	
	4	Fault reset input	Reset when closed		
	5	Master/Aux. change Multi-step speed ref.1)	Aux. freq. ref. when closed		
	6	Multi-step speed ref.2	Effective when closed		
	7	Jog reference	Jog run when closed		
	8	External base block	Inv. output stop when closed		
	11	Sequence control input common terminal	--		
Analog Input Signal	15	+15V Power supply output	For analog command +15V power supply		+15V (Allowable current 20mA max.)
	33	-15V Power supply output	For analog command -15V power supply		-15V (Allowable current 20mA max.)
	13	Master freq. ref. (voltage)	±10V/±100% 0 to +10V/100%		±10V (20kΩ) 0 to +10V/(20kΩ)
	14	Master freq. ref. (current)	4 to 20mA/100%.		4 to 20mA (250Ω)
	16	Multi-function analog input	± 10V/±100% 0 to +10V/100%	Aux. analog input (H3-05)	±10V (20kΩ) 0 to +10V/(20kΩ)
	17	Common terminal for control circuit	0V		--
	12	Connection to shield sheath of signal lead	--		--
Sequence Output Signal	9	During running (NO contact)	Closed when running	Multi-function output	Dry contact Contact capacity: 250VAC, 1A or less 30VDC, 1A or less
	10				
	25	Zero speed detection	Activates at min. freq. *(E1-09)* or less		Open collector output 48V, 50mA or less
	26	Speed agree detection	Activates when freq. reaches ±1Hz of set freq.		
	27	Open collector output common			--
	18	Fault contact output (NO/NC contact)	Fault when closed between terminals 18 and 20 Fault when open between terminals 19 and 20		Dry contact Contact capacity: 250VAC 1A or less 30VDC 1A or less
	19				
	20				
Analog Output Signal	21	Frequency meter output	0 to ±10V/100% frequency	Multi-function analog monitor 1 *(H4-01, H4-02)*	0 to ±11V Max. ±5% 2mA or less
	22	Common			
	23	Current monitor	5V/inverter rated current	Multi-function analog monitor 2 *(H4-04, H4-05)*	

VS-616PS5 Standard Connection Diagram



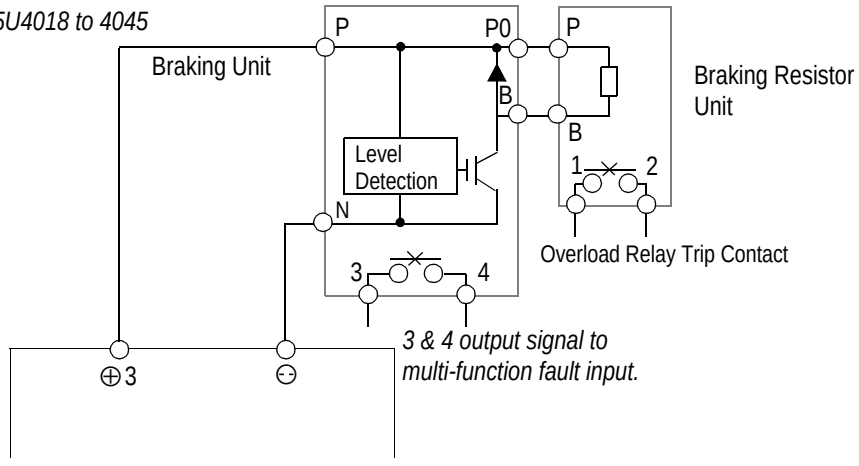
3.6 Connecting Resistor Braking Units

230V: PS5U20P4 to 27P5
460V: PS5U40P4 to 4015



Braking Unit

230V: PS5U2011 to 2015
460V: PS5U4018 to 4045



SECTION 4

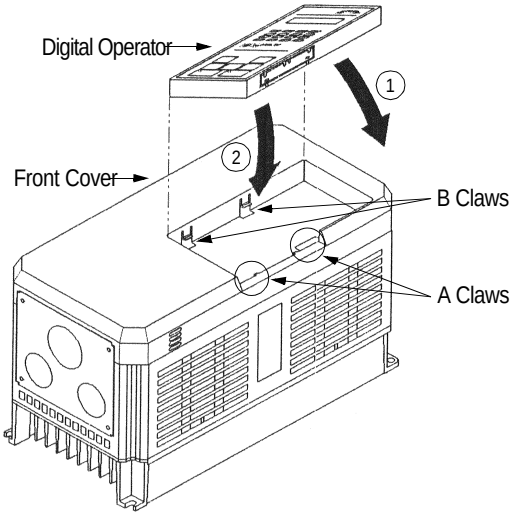
INITIAL OPERATION

4.1 Operational Concerns

Before Initial Operation

1. Replace the cover and Digital Operator on the unit before applying power to the inverter.
2. Make sure that the automatic re-start function is disabled (parameter L5-01 = 0).
3. The initial operation of the motor should be performed with the motor disconnected from its mechanical load.
4. Make sure the motor is securely fastened to its base and all personnel are clear before energizing the inverter.
5. Install and check an Emergency Stop button before operation. Install a Normally Closed, momentary, Emergency Stop push button between control terminals 11 and 4. Set parameter H1-02 to 25.
6. Do not change any parameters unless you are instructed to do so, or unless you have read and understood what the change in the parameter will do.

Replacing the Digital Operator

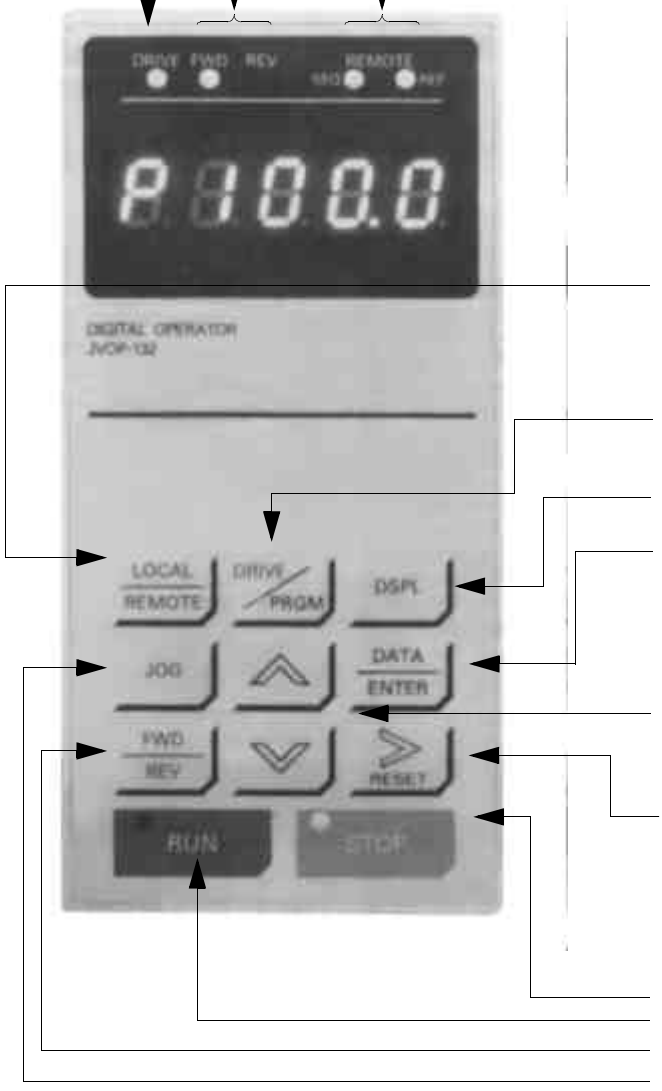


To replace the digital operator:
- connect the operator to the A claws in the direction shown by arrow 1
- then connect the B claws in the direction shown by arrow 2, locking the digital operator into place.

4.2 Digital Operator

Orientation

All functions of the VS-616PS5 are accessed using the digital operator. Below are descriptions of the display and keypad sections.



Mode Indicator LEDs

DRIVE Mode LED
Lights when selecting drive mode (operation is possible). OFF when selecting any other mode.

Rotation Direction LEDs
FWD: Lights at forward run.
REV: Lights at reverse run.

REMOTE Mode LEDs
Lights when selecting input mode from the control circuit terminal or serial communication.
SEQ: Lights when selecting run command from the control circuit terminal or serial communication.
REF: Lights when selecting frequency reference from the control circuit terminals 13 or 14, or serial communication.

Display
Displays set values of each function or monitoring value such as output frequency or current (5 characters).

Operation Mode Selection Key (LOCAL/REMOTE)
The operation mode is alternated with REMOTE and LOCAL (digital operator) when operational instruction and frequency references are set at the control circuit terminal.

Mode Selection Key (DRIVE/PRGM)
Alternates drive or program mode (even during run). In drive mode, DRIVE LED lights at mode indicator.

Display Selection Key (DSPL)
Selects monitoring items.

Read/Write Key (DATA ENTER)
Selects mode, group, function, or constant name. Displays each constant set value while displaying a constant name. By pressing this key again, the set value is written in.

Menu/Set Value Changing Keys
Selects mode, group, function, parameter or set value.
Ù: Increment key
Ú: Decrement key

Digit Selection Key (>RESET)
Selects a digit of a set value to be changed. The selected digit blinks. Resets operation at faults.

Run Command Keys
Run command keys for use by the digital operator. These are enabled only in the drive mode.
STOP: Red LED lights after depressing STOP key.
RUN: Red LED lights after depressing RUN key.
FWD/REV: Selects forward or reverse run.
JOG: Jog run is enabled while depressing this key.

Parameter Entry

When power is applied, the display defaults to the reference setting: **P 00.00**

Press the DRIVE/PRGM key to access the parameters. **A1-01** is displayed.

Press the DATA/ENTER key to display the value. The default is: **0002**

The first 0 will be blinking. This is the value for access to the Quick Start parameters.

We want to keep this value, so press DISPL to go back to: **A1-01**

Press the  key to go to the next parameter: **A1-03**.

Press the DATA/ENTER key to display the value. The default is: **0000**

We want to enter 3330 for 3-wire operation. The first zero will be blinking.

Press the  key three times to change the first number to 3.

Now the display will show: **3000** with the 3 blinking.

Press the  key to go to the next digit. Now the second digit is blinking.

Press the  key three times to change the second number to 3: **3300**

Use the  and  keys to change the third digit to 3: **3330**

Press the DATA/ENTER key to enter the number. Press the DISPL key to return to **A1-03**

Press the DRIVE/PRGM key to return to the reference entry (normal) mode.

The display is now ready for a speed reference entry: **P 00.00**

The digit to be changed is blinking.

Use the  ,  ,  , and DATA/ENTER keys to set the desired reference in percent speed.

Press the DISPL key to see the speed display.

4.3 Entering the Initial Data

Quick Start Parameters

Parameter **A1-01** sets the access level for the parameters. Setting it to "**0000**" disables access to any other changeable parameters. Setting **A1-01** to "**0002**", which is the factory default setting, enables access to the Quick Start parameters, which are used to initially get the inverter and motor into operation.

The user can scroll through the Quick Start parameters using the increment key on the digital operator.
NOTE: only the settings involved in Quick Start Menu are explained here. See the programming section for other settings for these parameters.

A1-03 Initialization

- Set to "0000" (default) for no initialization
- Set to "2220" for 2-wire initialization (terminal 1 = FWD RUN, terminal 2 = REV RUN)
- Set to "3330" for 3-wire initialization (terminal 1 = RUN, terminal 2 = STOP, terminal 3 = FWD/REV)
- In the 2-wire and 3-wire case, all other parameters are set to the factory defaults.

A1-04 Password

- Allows entry of a password for access to masked parameters.

B1-01 Frequency Reference Source

- Set to "00" to set the speed reference from the digital operator only.
- Set to "01" (default) to set the speed reference from the inverter terminals 13 (+) and 17 (-)

B1-02 Operation Control Source

- Set to "00" to start/stop/jog the inverter from the digital operator only.
- Set to "01" (default) to start/stop/jog the inverter from the inverter control terminals.

NOTE: B1-01 and B1-02 do not have to be set to the same source; they may be set for different sources.

When **B1-01** and **B1-02** are set to "01", the **LOCAL/REMOTE** key on the operator controls the sources. **LOCAL** mode allows only digital operator operation; **REMOTE** allows operation from control terminals or digital operator (determined by the settings of parameter B1-01 and B1-02).
If you disconnect the digital operator, **B1-01** and **B1-02** must be set to something other than "00". When the power to the inverter is cycled, these parameters will control the reference and control sources.

C1-01 Acceleration Time 1
C1-02 Deceleration Time 2

- The default time for these is 10.0 seconds. They may be changed for Quick Start, if desired.

D1-01 Preset Frequency Reference 1
D1-02 Preset Frequency Reference 2
D1-03 Preset Frequency Reference 3
D1-04 Preset Frequency Reference 4

- With the factory default settings, Presets 1 and 2 are not used.
- Preset 3 can be selected by closing input terminal 6 (factory default).
- Preset 4 can be selected by closing terminals 5 and 6 (factory default).

D1-09 Jog Frequency Reference

- The factory default is 10.0%. It may be changed if desired.

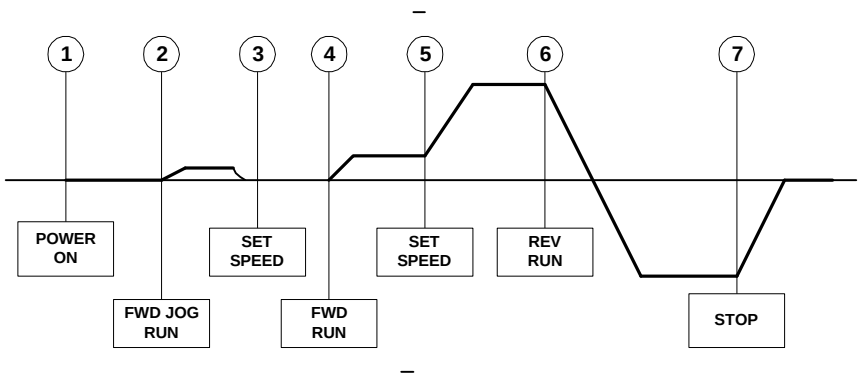
E1-01 through F1-01 Motor Parameters

- See the table on page 4 and item 19 of the VS-616PS5 QUICK START PROCEDURE on page 5.

T1-02 and T1-03 Auto Tuning Parameters

- See items 20 through 22 of the VS-616PS5 QUICK START PROCEDURE on page 5.

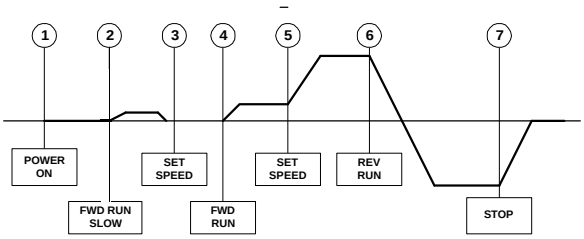
4.4 Initial Operation by Digital Operator



Description	Key Sequence	Digital Operator Display
(1) Power ON • Displays Frequency Reference Value		P 0 0. 0 0 REMOTE LED OFF FWD LED ON
Operation Source • Select LOCAL Mode	LOCAL REMOTE	
Set JOG Reference • Set D1-09 to 10.00% • Press Display Key	DISPL	0 0. 0 0
(2) Forward Jog Run • Runs at JOG speed while key is pressed.	JOG	1 0. 0 0
• Press Display Key	DISPL	P 0 0. 0 0
(3) Speed Setting • Change Speed Reference Value	Change value with arrow keys	Digit to be changed blinks
• ENTER the new value	DATA ENTER	P 2 5. 0 0
• Select Speed display	DISPL	0 0. 0 0
(4) Forward RUN • Press RUN on operator	RUN RUN LED ON	2 5. 0 0
(5) Change Speed Reference • Select reference display	DISPL	P 2 5. 0 0
• Change Reference value	Change value with arrow keys	Digit to be changed blinks P 1 0 0. 0
• ENTER the new value	DATA ENTER	P 1 0 0. 0
• Select Speed display	DISPL	1 0 0. 0
(6) Reverse RUN • Press Reverse	FWD REV	- 1 0 0. 0
(7) Stop • Press Stop Button	STOP	- 0 0 0. 0

4.5 Initial Operation by Control Circuits

For operation from the control input terminals, B1-01 must be set to 0001 and B1-02 must be set to 0001. Select REMOTE operation on the digital operator (SEQ and REF LED's on operator should be ON).



Description	Control Inputs	Digital Operator Display
1 Power ON • Displays Reference Value		Displays Operator Speed P 1 0. 0 0 REMOTE LED OFF FWD LED ON
Operation Source • Select REMOTE Mode	LOCAL / REMOTE	Displays input analog reference P 0 0. 0 0
Set Speed Reference • Set analog input to 10%	Set analog reference voltage at terminals 13 (+) and 17 (-) to 1.0VDC	P 1 0. 0 0
• Press DISPL button	DISPL	0 0. 0 0
2 Forward Run slowly • Start motor for slow run	Press operator RUN Button	1 0. 0 0
• Stop Motor	Press Operator STOP Button	0 0. 0 0
3 Speed Setting • Select Reference display	DISPL	P 1 0. 0 0
• Set analog reference to 25%	Set analog reference voltage at terminals 13 (+) and 17 (-) to 2.5 VDC	P 2 5. 0 0
• Select Speed display	DISPL	0 0. 0 0
4 Forward RUN • Start Motor	Press operator RUN Button RUN LED ON	2 5. 0 0
5 Change Speed Reference • Select reference display	DISPL	P 2 5. 0 0
• Change Reference value	Set analog reference voltage at terminals 13 (+) and 17 (-) to 10.0 VDC	P 1 0 0. 0
• Select Speed display	DISPL	1 0 0. 0
6 Reverse RUN • Set Operator Reverse switch	Change operator from FWD to REV	- 1 0 0. 0
7 Stop • Press Stop Button		- 0 0 0. 0

SECTION 5

PROGRAMMING

Note: Changing parameters while in operation may have drastic consequences.

5.1 Initializing

The inverter parameters are arranged in groups to simplify the task of placing the inverter into service. Almost all of the parameters have default values that will serve well in the vast majority of applications. This minimizes the number of parameters that need to be set just to get a motor running.
The parameters are further broken down into access levels. The number of parameters needed to get a motor running is far fewer than the number of parameters to make a drive work in a system, in a complex application, or to do complicated actions.

A1 – 01 Parameter Access Level

When power is applied, and the DRIVE/PRGM button is pushed on the operator, parameter A1-01 is the first parameter to appear. This parameter determines the parameter set available for programming.

Setting	Explanation	Default
0000	Allows access to this parameter and monitor (“U”) parameters only	
0001	Accesses special OEM parameters (A2-01 through A2-32)	
0002	Quick Start parameters – described in section 5.2	X
0003	Basic Parameters – briefly described in section 5.3	
0004	Advanced parameters – described in the VS-616PS5 Programming manual	

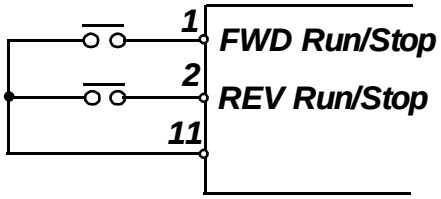
A1 – 03 Operator Status

Use this parameter to reset the inverter to the factory defaults before initial operation, after changing the Control PCB, or when changing the motor to a different type. The selection of this parameter depends on the type of control circuit connections used.

Setting	Explanation	Default
0000	No initialization activation	X
2220	2-wire initialization (terminal 1 = FWD run, terminal 2 = REV run) All other parameters are restored to the factory default settings.	
3330	3-wire initialization (terminal 1 = RUN, terminal 2 = STOP, terminal 5 = FWD/ REV) All other parameters are restored to the factory default settings.	

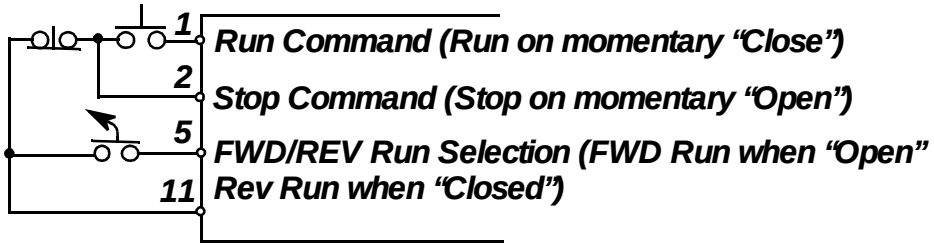
Upon executing an initialization, parameter A1-03 reverts back to the default setting.

When A1-03 is set to 2220, the control terminals will be set for two wire control.



2 Wire Control

When A1-03 is set to 3330, the control terminals will be set for three wire control.



3 Wire Control

A1 – 04 Password Entry

This parameter allows the entry of a password to view masked parameters. Consult the factory prior to adjusting this parameter.

5.2 Quick Start Programming

The Quick Start Program is a set of parameters that are the minimum necessary to get the motor running in the majority of stand-alone applications. This set is activated when “0002” is entered into parameter A1-01. The Quick Start parameters are scrolled in order when the DRIVE/PRGM key is pressed after power up and the increment key is pressed repeatedly. Refer to Appendix D for a complete parameter list.

Application Parameters

B1 – 01 Speed Reference Source Selection

B1 – 02 Operating Control Source Selection

These two parameters are used to determine the source of the speed command (B1-01) and the source of control inputs (B1-02). They use a common selection table, but they DO NOT need to be set to the same number. The speed and control may come from different sources.

Setting	Explanation	Default
00	The source is the Digital Operator	
01	The source is the control circuit input terminals	X
02	The source is serial communications	
03	The source is an option card (2CN or 3CN)	
04	The source is a CP-717 (personal computer interface)	
06	The source is a pulse train input on the feedback card (for B1-01 only)	

The Digital Operator has a LOCAL/REMOTE function.
LOCAL: The speed and control functions are under control of the digital operator.
REMOTE: The sources of operation are chosen by B1-01 and B1-02.

When power is applied to the inverter, the REMOTE function is activated, so power should be cycled if the operator is disconnected.

B1 – 03 Stopping Method Selection

This parameter selects the method of stopping the motor on a normal stop operation.

Setting	Explanation	Default
00	RAMP - deceleration under ramped speed control according to decel rate 1 (C1-02)	X
01	COAST – power to the motor is shut off and the motor coasts to a stop.	
02	TIMED – power to motor is removed, motor coasts to a stop, timer inhibits restart	

RAMP: Upon removal of the RUN command, the speed of the motor is decreased under power at a rate determined by the time set in parameter C1-02. If the deceleration time is short, or the inertial load on the motor is large, an overvoltage fault (OV) may occur while ramping. In this case, either the deceleration time must be increased or an optional braking unit must be installed.
COAST: Upon removal of the RUN command, the power to the motor is shut off and the motor and load slow down to a stop in a time determined by the speed before stopping, the inertia of the motor and load, and the amount of friction in the system. If the motor takes too long to stop, it may be necessary to install a mechanical brake on the motor or load. Alternatively, passive resistance dynamic braking may be installed.
TIMED: Upon removal of the RUN command, the motor slows down as in the COAST method. A new RUN command will not be accepted until the deceleration time (C1-02) has elapsed.

Tuning Parameters

The only tuning parameters available in the Quick Start Program are Acceleration Rate 1 and Deceleration Rate 1.

C1 – 01 Acceleration Time 1

C1 – 02 Deceleration Time 1

Minimum	Maximum	Description	Default Setting
0000.0	6000.0	Acceleration/Deceleration Time in Seconds	6000.0

Acceleration Time 1: Sets the amount of time the inverter will take to accelerate from zero speed to the maximum speed (E1-06). The amount of time it takes to go from a lower speed (which may be zero) to a higher speed (which may be maximum) is proportional to the amount of the actual speed change versus the total range from zero to maximum.

Deceleration Time 1: Sets the amount of time the inverter will take to decelerate from maximum speed (E1-06) to zero speed. The amount of time it takes to go from a higher speed (which may be the maximum) to a lower speed (which may be zero) is proportional to the amount of the actual speed change versus the total range from maximum to zero.

C2 – 13 PG Marker Pulse Offset Angle

Indicates the electrical angle between the rotor magnetic pole position and the marker pulse after auto-tuning has been performed. The offset angle is derived from using the marker pulse (encoder speed feedback method) or calculated marker pulse (hall effect speed feedback method) along with the rotor pole position as detected during auto-tuning.

Minimum	Maximum	Description	Default Setting
-180.0º	+180.0º	PG Marker Pulse Offset Angle	--

Reference Parameters

The preset speed references in the Quick Start program are entered into D1-01 through D1-04, and into parameter D1-09 for the JOG speed reference

D1 – 01 Preset Speed Reference 1

D1 – 02 Preset Speed Reference 2

D1 – 03 Preset Speed Reference 3

D1 – 04 Preset Speed Reference 4

Minimum	Maximum	Description	Default Setting
000.00	100.00	Reference Parameters	000.00

Multi-function input terminals 6 and 7 control the application of preset speed references in Quick Start mode. The following table shows how they can be used in Quick Start mode:

Terminal 5	Terminal 6	Selected Speed Reference
OPEN	OPEN	Speed Reference 1 - determined by B1-01
CLOSED	OPEN	Speed Reference 2 - active only if H3-05 and H3-09 is not equal to 0
OPEN	CLOSED	Speed Reference 3 – D1-03 supplies speed reference
CLOSED	CLOSED	Speed Reference 4 – D1-04 supplies speed reference

NOTE: Up to nine presets are available in advanced modes.

D1 – 09 Preset JOG Speed Reference

The JOG speed reference is set in the same manner as the other presets. This is the speed at which the motor will run when the digital operator is in LOCAL mode and the JOG button is pressed.

To use the JOG speed reference when the digital operator is in REMOTE (or disconnected), close terminal 7 at the same time as the RUN command is applied. The JOG speed command has priority over all other reference commands.

Motor Parameters

The motor parameters must be entered before attempting operation of the motor. Motor information is obtained from the nameplate of the motor and from Appendix B of this manual (partial listing only). Older motors do not have all their characteristics listed on their nameplates. It may be necessary to contact the motor manufacturer to obtain the data for programming parameters E1-03 thru E1-17.

E1 – 01 Input Voltage

Enter the nominal power supply voltage supplied to the inverter.

Minimum	Maximum	Inverter Type	Default Setting
155	255	230V class PS5 inverter	230
310	510	460V class PS5 inverter	460

E1 – 02 Motor Capacity Selection

Enter “1000” for custom motor data. Entering numbers greater than 1000 access stored motor characteristics that load most of the “E” parameters (future addition- reference Appendix B). Used in conjunction with motor connection selection, parameter E1-17, to automatically load parameters, E1-03 thru E1-13. Set E1-17 to the correct winding configuration prior to programming E1-02 to the desired winding code.

Minimum	Maximum	Description	Default Setting
1000	1999	Winding number - obtained from motor model number	1000

E1 – 03 Rated Motor Voltage

Enter the motor voltage according to the nameplate bus voltage.

Minimum	Maximum	Inverter Type	Setting
0	255	320 VDC bus voltage motors	230
0	510	640 VDC bus voltage motors	460

E1 – 04 Motor Rated Current

Enter the rated motor current (from nameplate). The maximum value that can be entered for an inverter is equal to inverter rated current (nameplate value).

Minimum	Maximum	Description	Default Setting
000.00	605.0	Rated Motor Current FLA from nameplate – 7.5 Kw or less resolution 0.01A 11 Kw or more resolution 0.1A	- -

E1 – 05 Number of Motor Poles

Enter the number of motor poles according to the nameplate.

Minimum	Maximum	Description	Default Setting
2	8	Winding number - obtained from motor model number	1000

E1 – 06 Motor Maximum Speed

Enter the maximum speed of the motor.

Minimum	Maximum	Description	Default Setting
0000	6000	Maximum Speed of motor – set by application	E1-07

E1 – 07 Motor Base Speed

Enter the base speed of the motor (from nameplate).

Minimum	Maximum	Description	Default Setting
0000	6000	Base Speed of motor - obtained from motor nameplate	- -

E1 – 08 Minimum Motor Speed

Enter the minimum speed of the motor (in RPM).

Minimum	Maximum	Description	Default Setting
0000	6000	Minimum Speed of motor – set by application	30

E1 – 09 Motor Resistance

Enter the resistance of the motor (in Ohms).

Minimum	Maximum	Description	Default Setting
00.000	65.535	Motor Line to line resistance value	- -

E1 – 10 Motor d-axis Inductance

Enter the real inductance of the motor (in mH).

Minimum	Maximum	Description	Default Setting
000.00	600.00	Motor Line to line real axis inductance value	- -

E1 – 11 Motor q-axis Inductance

Enter the real inductance of the motor (in mH). Under most circumstances, the same value will be entered here as is entered in E1-10.

Minimum	Maximum	Description	Default Setting
000.00	600.00	Motor Line to line quadrature axis inductance value	- -

E1 – 13 Induced Voltage Constant

Enter the induced voltage constant (KV or KE) of the motor.

Minimum	Maximum	Description	Default Setting
0000	6000	Motor Induced Voltage (KV AC RMS/1000 RPM)	- -

E1 – 17 Motor Connection Selection

Enter the winding connection of the motor (used only if E1-02 is not equal to 1000). Used in conjunction with parameter E1-02 to automatically load the motor parameters (See Appendix B).

Minimum	Maximum	Description	Default Setting
00	03	Connection: 0 = 1-delta, 1 = 2-delta, 2 = 1-wye, 3 = 2-wye	0

PG Option Set-up

F1 – 01 PG Pulses Per Revolution

Enter the number of pulses per revolution of the speed feedback device (hall sensor or encoder).

Minimum	Maximum	Description	Default Setting
0	10000	Speed Feedback device PPR	30

F1 – 05 PG Rotation Selection

Enter the relationship between the motor rotation and the PG polarity (hall sensor 4 & 5 or encoder A & B channels).

Settings	Description	Default
0	HS5 leads HS4/Channel B leads A in FWD direction	
1	HS4 leads HS5/Channel A leads B in FWD direction	X

F8 – 01 Speed Feedback Selection

Select between hall sensor and encoder signals as the speed feedback method.

Settings	Description	Default
0	Speed feedback from encoder input (A & B)	
1	Speed feedback from hall sensor inputs (HS4 & HS5)	X

Automatic Tuning

T1 - 03 Tuning Operation

This parameter sets up the scope of the tuning operation.

Setting	Description	Default
00	All parameters are subject to Auto Tuning (Future Enhancement)	
01	PG Orientation only (Pole position tuning)	X

T1 - 02 Tuning Mode

The tuning mode is set up in this parameter.

Setting	Description	Default
00	Normal Running Mode	X
02	Auto Tuning Mode	

Auto Tuning is initiated by setting T1-02 to “02”, exiting the PRGM mode and pressing the RUN button on the digital operator. After the sequence is completed, T1-02 is automatically reset to “00”. Be sure to uncouple the motor from the load prior to performing the Auto-Tuning.

NOTICE: Once the Auto Tuning sequence has been initiated, do not touch the motor or the inverter as long as the display is showing **“CAL12”**.

When this parameter is set to “02” and the drive is returned to the operation mode (by pressing the DRIVE/PRGM key), the display will read **“CAL12”**. Press the RUN button. The display will flash on and off and the motor shaft will begin turning. If the Auto Tuning sequence is successful, the display will show **“End”** after the motor stops turning. If it is not successful it will display an error code:

Display	Error	Explanation
PGO	PG open Circuit	Pulse generator circuit is broken.
dEV	Speed Deviation	The difference between speed command and actual speed is too great.
ZdEV	Phase Z pulse fault	Incomplete PG origin pulse adjustment.
Er-04	Motor Speed	Motor speed is much higher than commanded speed.
Er-10	Stop Command	The sequence was interrupted by the operator
Er-11	Resistance	Item not completed within tuning time.
Er-12	Y-axis Voltage Offset	Item not completed within tuning time.
Er-14	Induced Voltage	Item not completed within tuning time.
Er-15	d-axis Inductance	Item not completed within tuning time.
Er-17	Control Axis Comp	Item not completed within tuning time.
Er-18	Phase Comp Amount	Tuning not completed within the allotted time.

NOTE: Major faults that may occur during tuning will be displayed and will interrupt the tuning sequence. In this case, other error codes may be displayed. See the Diagnostics section

When “PGO”, “dEV”, or “ZdEV” is displayed, check the hall sensor and/or encoder connections. Also, verify the load is disconnected from the motor shaft.

When T1-03 is set to “01”, the most common fault seen will be Er-18. When Er-18 is displayed, shut off power and check the connections to the motor and to the hall sensor and/or encoder.

If two or more attempts to orient the encoder fail (i.e., “End” is not displayed at the end of the sequence), you will need to change parameter F1-05 and re-initiate the auto tuning process as described above. It may be necessary to change A1-03 to “0003” (Basic Parameter Group) to access this parameter (depends on Software version).

Operation Monitoring

In the Quick Start program, most of the monitoring parameters are available to peek into what the inverter is doing internally. These parameters, the “U” parameters may be used to monitor normal operation or to troubleshoot abnormal operation. There are three groups:

1. U1 – Monitor
2. U2 – Fault Trace
3. U3 – Fault History

Monitor Parameters

Number	Description	Units	Explanation
U1-01	Speed Reference	%	Displays speed reference in percent
U1-02	Output Frequency	Hz	Displays fundamental output frequency to motor
U1-03	Output Current	AAC	Displays current output to motor in RMS Amperes
U1-05	Motor Speed	%	Displays motor speed in percent of maximum speed
U1-06	Output Voltage	VAC	Displays output voltage to motor in Volts AC RMS
U1-07	DC Bus Voltage	VDC	Displays DC Bus Voltage in Volts DC
U1-08	Output Power	KW	Displays Output power in Kilowatts
U1-09	Internal Torque Reference	%	Displays Internal Torque Reference Command

Number	Description	Units	Explanation
U1-10	Input Terminal Status	- -	Displays status of input terminals

Parameter U1-10 represents the status of the input terminals with a letter “C” followed by a series of vertical bars. The bars represent terminals 1 through 8 from right to left.

The first character in the digital operator display is a letter “C”: 

If terminals 1, 2, 5, and 8 are ON, the display will look like this: 

Number	Description	Units	Explanation
U1-11	Output Terminal Status	- -	Displays status of output terminals

Parameter U1-11 represents the status of the output terminals with a letter “o” followed by a series of vertical bars in a manner much like U1-10 displays the input terminals. The display is for the following outputs:

Terminal Contacts	Display
9 - 10	_ _ _ _ _ _ _ **1**
25 - 27	_ _ _ _ _ _ **1** _
26 - 27	_ _ _ _ _ **1** _ _

Number	Description	Units	Explanation
U1-12	Internal Control Status	- -	Same as U1-10 and U1-11 for internal status

The explanation of these bits is beyond the scope of this manual.

Number	Description	Units	Explanation
U1-13	Elapsed Time	H	Displays inverter operating time in hours
U1-14	Flash ID Number	- -	Displays firmware revision number

Fault Tracing Parameters

Number	Description	Units	Explanation
U2-01	Existing Fault	- -	Displays a currently existing fault
U2-02	Previous Fault	- -	Displays the last fault detected
U2-03	Speed at time of fault	%	Displays the speed percentage when last fault occurred
U2-04	Frequency at time of fault	Hz	Displays output fundamental frequency at time of last fault
U2-05	Output current at fault	AAC	Displays output current at time of last fault
U2-06	Motor speed at fault	%	Displays the speed at time of last fault
U2-07	Output voltage at fault	VAC	Displays output voltage at time of last fault
U2-08	Bus Voltage at Fault	VDC	Displays bus voltage at time of last fault
U2-09	Output Power at fault	KW	Displays output power at time of last fault
U2-10	Torque Reference at fault	%	Displays internal torque reference at time of last fault
U2-11	Input status at time of fault	- -	Displays state of input terminals at time of last fault
U2-12	Output status at time of fault	- -	Displays state of output terminals at time of last fault
U2-13	Drive Status before fault	- -	Displays state of drive internally before last fault occurred
U2-14	Elapsed time since fault	H	Displays elapsed time when last fault was detected

Fault History

Number	Description	Units
U3-01	Most Recent Fault	- -
U3-02	2nd Most Recent Fault	- -
U3-03	3rd Most Recent Fault	- -
U3-04	4th Most Recent Fault	- -
U3-05	Time since Most Recent Fault	H
U3-06	Time since 2nd Most Recent Fault	H
U3-07	Time since 3rd Most Recent Fault	H
U3-08	Time since 4th Most Recent Fault	H

Fault Tracing and Fault History are retained when power is lost.

5.3 Basic Programming

When parameter **A1-01** is changed to **"0003"**, additional programming parameters become available. These additional parameters give the user more options to use the features of the inverter without the burden of dealing with all of the options available. Refer to Appendix D for a complete parameter list.

Changing of the programming level from Quick Start to Basic and the setup of these additional parameters should not be attempted until the Quick Start Program has been completed and the motor is in operation at the Quick Start level.

Additional Monitor Options

Number	Description	Units	Explanation
U1-15	Terminal 13 input voltage	%	Displays speed reference in percent at terminal 13
U1-16	Terminal 14 input voltage	%	Displays speed reference in percent at terminal 14
U1-17	Terminal 15 input voltage	%	Displays speed reference in percent at terminal 15
U1-18	Motor Torque Current	%	Displays the motor torque producing current (I_q) in percent
U1-19	Motor Excitation Current	%	Displays the motor excitation current (I_d) in percent

Additional Fault Tracing Options

Number	Description	Units	Explanation
U2-15	Motor Torque Current	%	Displays the motor torque producing current (I_q) at fault
U2-16	Motor Excitation Current	%	Displays the motor excitation current (I_d) at fault

Additional Application Options

B1 - 04 Prohibition of Reverse Motor Operation

This parameter allows the user to prevent the motor from operating in the reverse direction.

Setting	Explanation	Default
00	Reverse operation enabled	X
01	Reverse operation prohibited	

B2 – 01 Zero Speed Level

This parameter allows the user to set the speed at which the drive senses zero speed. This affects terminal outputs and shutoff after decelerating.

Minimum	Maximum	Description	Default Setting
00.00	020.00	Zero speed detection level	00.50

VS-616PS5 Parameter Tree

	Group	Function	Parameter No.		
			Quick-start	Basic	Advanced
U Monitor	U1	Monitor	01-03, 05-14	15-19	20-22,27-33,41-47, 49,50,53,54,55
A Initialize	U2	Fault Trace	01-14	15,16	17-22
B Application	U3	Fault History	01-08		
	A1	Initialize	01, 03, 04		
	B1	Sequence	01-03	04	05-06
C Tuning	B2	Zero Speed Level		01	
	B3	Magnetic Pull-in			02, 04, 05
	B4	Delay Timers			01, 02
	B5	Pid Control			01-08
D Reference	B6	Reference Hold			01-04
	B7	Droop Control			01, 02
	C1	Accel/decel	01, 02	03, 04, 09	05-08, 10, 11
E Motor	C2	PG Origin Pulse Comp.			13
F Option	C3	Voltage Limit Control			05
	C5	Asr Tuning		01-04	05-07
	C6	Carrier Frequency			02
	D1	Preset Reference	01-04, 09	05-08	
H Terminal	D2	Reference Limit		01, 02	
	D3	Jump Speed		01-04	
	D4	Hold Reference Memory			01
L Protection	D5	Torque Control			01-06
	E1	Motor Constant	01,02,04,09-11,13		03, 05-08, 15-17
	F1	PG Option Set-up	01	02-05	08-11, 13
O Operator	F2	AI-14 Set-up		01	
	F3	DI-08, 16 Set-up		01	
T Tuning	F4	AO-08, 12 Set-up		01-06	
	F5	DO-02 Set-up		01, 02	
	F6	DO-08 Set-up		01	
	F9	CP-916 Set-up		01-06	
	H1	Digital Inputs		01-06	
	H2	Digital Outputs		01-03	
	H3	Analog Inputs		01-07	08-12
	H4	Analog Outputs		01-07	

Additional Tuning Options

C1 – 03 Acceleration Time 2

C1 – 04 Deceleration Time 2

These parameters are set to provide different ramp times when one of the input terminals (3 through 8) is programmed to “Multi-accel/decel 1” (setting “7”). See parameters H1-01 through H1-06. This allows the user to program different acceleration and deceleration rates for various conditions.

Minimum	Maximum	Description	Default Setting
0000.0	6000.0	Acceleration/Deceleration Time 2 Setting	0010.0

C1 – 09 Fast Stop Time

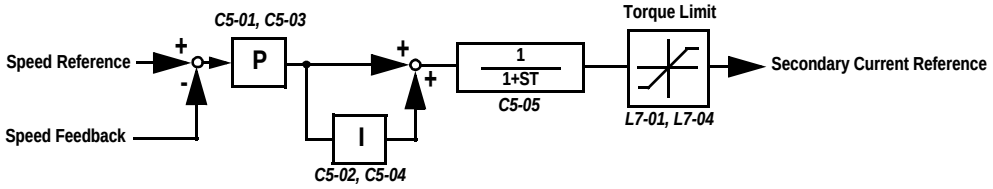
This parameter is set to provide a ramp time when one of the input terminals (3 through 8) is programmed to “Fast Stop Command” (setting “15”). See parameters H1-01 through H1-06. This allows the user to program a rapid deceleration rates for a quicker than normal stop.

Minimum	Maximum	Description	Default Setting
0000.0	6000.0	Fast Stop Time	0010.0

NOTE: Attempting to stop the motor faster than it will coast to a stop by itself (with power off) may require the addition of a resistor-braking unit.

ASR Tuning Options

The Automatic Speed Regulator (ASR) allows the user to adjust for optimum performance during changes in motor speed or load.



C5 – 01 ASR Proportional Gain 1

C5 – 03 ASR Proportional Gain 2

The Proportional Gain adjusts the speed in response to a speed deviation, and softens the effects of load changes. Response becomes more noticeable as the gain is increased. High levels may cause instability.
ASR Proportional Gain 2 is activated by programming one of the input terminals (3 through 8) to “ASR Gain Switch (setting “77”) and closing a contact to it.

Minimum	Maximum	Description	Default Setting
000.00	300.00	Automatic Speed Regulator Gain	020.00

C5 – 02 ASR Integral Gain 1

C5 – 04 ASR Integral Gain 2

The Integral Gain adjusts the speed of response to a load change. Response become more noticeable as the gain is decreased. Low levels may cause instability.
ASR Integral Gain 2 is an additional integral gain adjustment.

Minimum	Maximum	Description	Default Setting
00.000	10.000	Automatic Speed Regulator Integral Time	00.500

Additional Reference Parameters

D1 – 05 Preset Speed Reference 5

D1 – 06 Preset Speed Reference 6

D1 – 07 Preset Speed Reference 7

D1 – 08 Preset Speed Reference 8

Minimum	Maximum	Description	Default Setting
000.00	100.00	Preset Speed References	000.00

There are now eight preset speed references available, which can be controlled by the input terminals.

Terminal 5 Set H1-03 = 3	Terminal 6 Set H1-04 = 6	Terminal 7 Set H1-05 = 7	Selected Speed Reference
OPEN	OPEN	OPEN	Speed Reference 1 - D1-01 supplies speed reference
CLOSED	OPEN	OPEN	Speed Reference 2 - D1-02 supplies speed reference
OPEN	CLOSED	OPEN	Speed Reference 3 - D1-03 supplies speed reference
CLOSED	CLOSED	OPEN	Speed Reference 4 - D1-04 supplies speed reference
OPEN	OPEN	CLOSED	Speed Reference 5 - D1-05 supplies speed reference
CLOSED	OPEN	CLOSED	Speed Reference 6 - D1-06 supplies speed reference
OPEN	CLOSED	CLOSED	Speed Reference 7 - D1-07 supplies speed reference
CLOSED	CLOSED	CLOSED	Speed Reference 8 - D1-08 supplies speed reference

Reference Limits

D2 – 01 Reference Upper Limit

Sets the maximum reference as a percent of maximum speed, E7-06.

Minimum	Maximum	Description	Default Setting
000.0	110.0	Speed Reference Upper Limit	100.0

D2 – 02 Reference Lower Limit

Sets the minimum reference as a percent of maximum speed as entered in E1-06.

Minimum	Maximum	Description	Default Setting
000.0	100.0	Speed Reference Upper Limit	100.0

PG Option Set-up

F1 – 02 Disconnection Detection Stopping Method

Selects the stopping method when a disconnected PG is detected.

Setting	Description
0	Ramp to stop - according to C1-02. (Declaration time 1)
1	Coast to stop ***(factory default).***
2	Fast - stop - according to C1-09.
3	Alarm flashes, operation continues.

F1 – 03 Overspeed Detection Stopping Method

Selects the stopping method when an overspeed condition is detected.

Setting	Description
0	Ramp to stop - according to C1-02 (Declaration time 1).
1	Coast to stop ***(factory default)***.
2	Fast-stop - according to C1-09.
3	Alarm flashes, operation continues. (

F1 – 04 Deviation Detection Stopping Method

Selects the stopping method when excessive speed deviation is detected.

Setting	Description
0	Ramp to stop - according to C1-02 (Declaration time 1).
1	Coast to stop.
2	Fast-stop - according to C1-09.
3	Alarm flashes, operation continues ***(factory default).***

PG-P2 Setup

F8 – 02 Pulse Input Moving Average Value

Sets the number of scans the pulse input reference signal is averaged over. A larger number will provide a more stable reference (internal). However, the inverter response to a rapid change in the pulse train frequency may be slow. A setting of “0” or “1”means no moving average will be used, and the pulse input reference will be updated every scan.

Minimum	Maximum	Description	Default Setting
0	50	Pulse Input moving Scan width.	0

Terminal Designation Options

When the inverter is initialized (A1-03) to “2220” (2-wire operation), terminal 1 is FWD RUN, and terminal 2 is REV RUN. Connecting either input with a contact to terminal 11 causes the inverter to run in that direction as long as the contact is closed, and to stop running when the contact is opened.

When the inverter is initialized (A1-03) to “3330” (3-wire operation), terminal 1 is the START input and terminal 2 is the STOP input. The inverter runs after START is connected momentarily to terminal 11 provided STOP is already connected to terminal 11. The inverter will continue to run until the STOP input is opened. Terminal (5) will be set to “00” to act as a FORWARD/REVERSE input.

H1 – 01 to H1 - 06 Multifunction Input Terminals Selection

Default assignments are as follows (all contact closures are to terminal 11):

Input Terminal	Parameter	Default Setting	Default Function
3	H1-01	24	External Fault – close contact to trip inverter off
4	H1-02	14	Fault Reset – close contact to reset faults in inverter
5	H1-03	3	Preset Reference Selector 1 – close contact to select preset speeds
6	H1-04	4	Preset Reference Selector 2 – close contact to select preset speeds
7	H1-05	6	Jog Reference – close contact to select preset jog speed reference
8	H1-06	8	External Baseblock (N.O.) – close contact to disable inverter output

The following settings are available for the terminals. Unless otherwise indicated, closing a normally open contact to terminal 11 activates the input terminal function.

Setting	Function	
0	3-wire control	The terminal set to “0” becomes the Forward/Reverse input
1	Local/Remote	Selects the operation mode (open = Local). Inverter must be stopped.
2	Internal/Option	Selects Reference source (open = internal, closed = option card)
3	Preset Reference 1	Selects Preset Speed Reference when closed (see D1-01 thru D1-08)
4	Preset Reference 2	Selects Preset Speed Reference when closed (see D1-01 thru D1-08)
5	Preset Reference 3	Selects Preset Speed Reference when closed (see D1-01 thru D1-08)
6	JOG Reference	Selects Jog Preset Reference when closed. RUN input must be active
7	Accel/Decel Select 1	Selects alternate Accel/Decel rates when closed (see C1-03 and C1-04)
8	External Baseblock NO	Disables output of inverter when contact closes
9	External Baseblock NC	Disables output of inverter when contact opens
A	Accel/Decel Ramp Hold	Stops ramping when closed, resumes ramping when opened
B	Inverter OH2 Alarm	External temperature alarm input, causes display to blink “OH2”
C	Terminal 16 Enable	Enables the analog input at terminal 16 when closed
E	ASR Integral Reset	Resets Integral control values of inverter when closed
F	No Operation	Terminal is not being used
10	MOP Increase	Accelerate while closed with MOP decrease open, otherwise no effect
11	MOP Decrease	Decelerate while closed with MOP increase open, otherwise no effect
12	Forward JOG	Run forward at Jog preset speed reference D1-09 while closed
13	Reverse JOG	Run reverse at Jog preset speed reference D1-09 while closed
14	Fault Reset	Resets Inverter faults while closed; must be opened to run again
15	Fast Stop	Causes inverter to stop at Fast Stop decel rate (C1-09)
1A	Accel/Decel Select 2	Selects alternate Accel/Decel rates when closed
1B	Program Lockout	Prohibits changing of PS5 parameters while open
1E	Reference Sample Hold	Samples frequency reference if closed for 100 ms or longer
1F	Terminal 13/14 Switch	Selects terminal 13 input (open) or terminal 14 input(closed)
24	External Fault	Shuts off inverter when closed, displays “oPE_” on operator
71	Speed/Torque Control	Selects Speed control (open) or torque control (closed)
77	ASR Gain Switch	Switches Gain values in ASR (see C5-01 / C5-02)

Consult the VS-616PS5 Programming Manual for more comprehensive discussions of the parameters.

H2 – 01 to H2 – 03 Digital Outputs

Default assignments are as follows:

Output Terminals	Parameter	Default Setting	Default Function
9 – 10	H2-01	0	RUN output – closes while inverter is running
25 – 27	H2-02	1	Zero Speed output – closes while output speed is less than E1-09
26 - 27	H2-03	2	Up to Speed – closes when set speed is attained within tolerance (L4-02)

Listed below are other settings for the digital outputs:

Setting	Function	
3	Speed Match	Speed Matches Setting – closes when output speed = L4-01 +/- L4-02
4	Speed Low	Speed Below setting – closes while output speed < L4-01
5	Speed High	Speed Above Setting – closes while output speed > L4-01
6	Inverter Ready	Ready to Run – closes when inverter has no faults or alarms
7	DC Bus Undervoltage	Closes when DC Bus level or power supply is below trip level
8	Baseblock 1	Closes when inverter output is disabled by a Baseblock command
9	Speed from Operator	Closes while the speed reference is supplied from the digital operator
A	Control from Operator	Closes when the RUN command comes from the digital operator
B	Over Torque Detection	Closes when torque output exceeds setting
C	Reference Loss	Closes when speed reference drops 90% in less than 400 ms
D	DBR Overheat	Closes while Dynamic Braking resistor is overheated or on DB fault
E	Fault	Closes when a fault occurs
F	No Operation	Output is not being used

Consult the VS-616PS5 Programming Manual for more settings and more comprehensive descriptions.

H3 – 01 to H3 – 03 Analog Input 1

These parameters set up Analog input 1 (Terminal 13), with terminal 17 common

Parameter	Function	Units	Range	Default
H3-01	Terminal 13 Signal 0: 0 to 10 VDC 1: +/-10 VDC	- -	0/1	0
H3-02	Terminal 13 Reference % Gain	%	0.0 – 1000.0	100.0
H3-03	Terminal 13 Reference +/- Bias	%	+/-100.0	0.0

Consult the VS-616PS5 Programming Manual for the setup of Analog Input 2 and Analog Input 3.

H4 – 01 to H4 – 07 Analog Outputs

These parameters set up Analog input 1, with terminal 17 common

Parameter	Description	Units	Range	Default	Default Function
H4-01	Terminal 21 Analog Output Signal	- -	0…53	5	Motor Speed
H4-02	Terminal 21 Output Gain	- -	0.00 – 2.50	1.00	Gain = 1
H4-03	Terminal 21 Output Bias	%	0.0 – 10.0	0.0	Bias = 0
H4-04	Terminal 23 Analog Output Signal	- -	0…53	3	Output Current
H4-05	Terminal 23 Output Gain	- -	0.0 – 1000.0	1.00	Gain = 1
H4-06	Terminal 23 Output Bias	%	0.0 – 10.0	0.0	Bias = 0
H4-07	Output Signal Selection (both)	- -	0/1	0	0 – 10 VDC

Consult the VS-616PS5 Programming Manual for further information on the Analog Outputs.

L2 Power Loss Ride-through

When momentary power loss occurs, Power Loss Ride-through function is disabled.

L2-01 Momentary Power Loss Ride-through

Selects whether the inverter stops when power loss is detected or “rides through” a momentary power loss. When ride-through operation is selected, speed search starts from the current output frequency.

Setting	Explanation	Default
0	Momentary Power Loss Disabled	X
1	Momentary Power Loss Enabled	

Momentary power loss ride-through is disabled ***(factory default)***. When momentary power loss is detected, a fault contact trips, stopping the inverter.

L2-02 Momentary Power Loss Ride-through Time

Minimum	Maximum	Description	Default Setting
0.0	2.0	Momentary Power Loss Ride through Time (Sec).	Model Dependant

Sets the ride-through time allowed before the inverter trips, after momentary power loss. This setting is activated when ***L2-01*** is set to “1.” If power is restored within this time, operation restarts automatically. If power is not restored within this time, a fault contact trips, stopping the inverter.

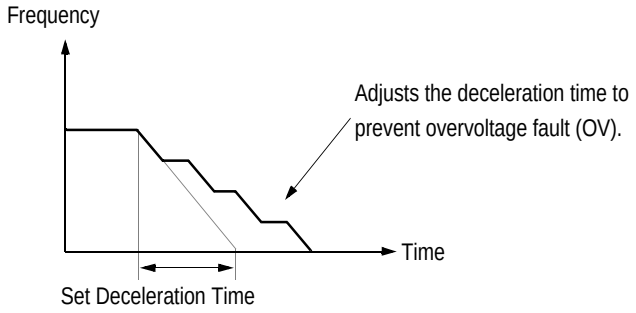
L3 Stall Prevention/Current Limit

This function automatically adjusts the deceleration rates in order to continue operation without tripping the inverter.

L3-01 Over-voltage Protection (Stall Prevention During Deceleration)

If deceleration times are set too short for load conditions, the inverter automatically extends the deceleration time according to the main circuit DC bus voltage level. When using an optional braking resistor for the VS-616PS5, set parameter L3-01 to"0".

Setting	Explanation	Default
0	Stall prevention during deceleration is disabled. An excessively short deceleration time will generate an overvoltage fault (OV), and the motor will coast.	
1	Stall prevention during deceleration is enabled *(factory default)*. The DC bus voltage level is monitored, and the deceleration rate is automatically extended to prevent an overvoltage condition. This deceleration time may be longer than the set value (C1-02).	X



L4 Reference Detection

Used in conjunction with the multi-function digital outputs to indicate speed agree conditions.

Refer to section ***H2***, ***Digital Outputs***, for more detailed information on setting these functions.

L4-01 Speed Agree Detection Level (without sign)

Sets the detection level for the desired frequency agree 1 and frequency detection 1 & 2 functions. The set detection level is effective during both FWD and REV operation.

Minimum	Maximum	Description	Default Setting
0.0	100.0	Speed agree Detection Level (without sign).	0.0

L4-02 Speed Agree Detection Width

Sets the detection width for frequency and desired frequency agree 1 and frequency detection 1 & 2 functions.

Minimum	Maximum	Description	Default Setting
0.0	100.0	Speed agree Detection Width.	2.0

L5 Fault Restart

After a fault occurs, the inverter and its fault detection circuit can be reset. The automatic restart function allows the inverter to continue operation after certain faults.

L5-01 Number of Automatic Restart Attempts

Sets the number of automatic restart attempts. Setting to “0” disables this function.

Minimum	Maximum	Description	Default Setting
0.0	10	Number of Automatic Restart Attempts.	0

The inverter can be set to automatically restart after the following faults occur:
Overcurrent (OC)
Overvoltage (OV)
Undervoltage PUV (UV1)
Ground fault (GF)
Regenerative transistor fault (rr)

L5-02 Automatic Restart Operation Selection

Selects whether a fault contact output is activated during automatic restart.

Setting	Explanation	Default
0	No fault relay *(factory default)*	X
1	Fault relay is active	

L6 Torque Detection

The overtorque detection circuit activates when the motor load causes the motor current (or torque) to exceed the overtorque detection level ***(L6-02)***.

L6-01 Overtorque Detection 1 Selection

Activates overtorque detection, and selects whether detection generates an alarm or a fault.

Setting	Explanation	Default
0	Overtorque detection is disabled.	X
1	Overtorque detection is enabled whenever at the speed agree level (when inverter is not accelerating or decelerating). Continue running after detection (OL3 alarm).	
2	Overtorque detection is enabled always. Continue running after detection (OL3 alarm).	
3	Overtorque detection is enabled whenever at the speed agree level. Coast to a stop after detection (OL3 fault).	
4	Overtorque detection is enabled always. Coast to a stop after detection (OL3 fault).	

Notes:

1. To detect torque during acceleration or deceleration, set to "2" or "4."
2. To continue operation after overtorque detection, set to "1" or "2." During detection, the digital operator displays an "OL3" alarm (blinking).
3. To stop the inverter after an overtorque detection fault, set to "3" or "4." During detection, the digital operator displays an "OL3" fault.

L6-02 Overtorque Detection 1 Level

Sets the overtorque detection level as a percentage of motor rated torque.

Minimum	Maximum	Description	Default Setting
0	300	Overtorque Detection 1 Level.	150

L6-03 Overtorque Detection 1 Time

The overtorque detection delay time inserts a delay, between the time motor current (or torque) exceeds the overtorque detection level ***(L6-02)*** and when the overtorque detection function is enabled. The digital operator then displays "OL3."

Minimum	Maximum	Description	Default Setting
0.0	10.0	Overtorque Detection 1 Time.	0.1

L7 Torque Limit

The torque limit function limits the amount of motor torque in all four quadrants of vector control operation:

- Forward Motoring
- Reverse Motoring
- Forward Regenerating
- Reverse Regenerating

Torque limit is activated in both the speed and torque control modes.

L7-01 Forward Torque Limit

Sets the motoring side torque limit value during FWD run.

Minimum	Maximum	Description	Default Setting
0	300	Forward Torque Limitl.	150

L7-02 Reverse Torque Limit

Sets the motoring side torque limit value during REV run.

Minimum	Maximum	Description	Default Setting
0	300	Reverse Torque Limit.	150

L7-03 Regenerative Forward Torque Limit

Sets the regenerating side torque limit value during FWD run.

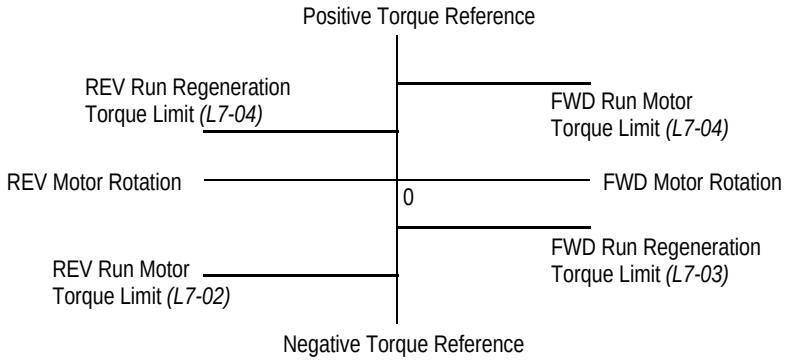
Minimum	Maximum	Description	Default Setting
0	300	Regenerative Forward Torque Limit.	150

L7-04 Regenerative Reverse Torque Limit

Sets the regenerating side torque limit value during REV run

.

Minimum	Maximum	Description	Default Setting
0	300	Regenerative Reverse Torque Limit.	150



O Operator Parameters

O1-01 Monitor Selection

The operation menu allows the viewing of four monitor variables. These are N_{ref}, N_{out}, I_{out}, and a user-selected monitor. Using the table below, set this parameter to the setting corresponding to the monitor item desired for the user monitor.

Setting	Description
5	Motor speed
6	Output voltage *(factory default)*
7	DC bus voltage
8	Output power
9	Torque reference (internal)
15	Terminal 13 input voltage level
16	Terminal 14 input voltage or current level
17	Terminal 16 input voltage level
18	Motor secondary current (Iq)
19	Motor excitation current (Id)
20	SFS output frequency
21	ASR input
22	ASR output
27	Voltage reference (Vd output)
28	CPU ID number
29	Voltage limit control output
30	qAxis current control output
31	dAxis current control output
32	Output voltage reference (Vq)
33	Output voltage reference (Vd)
41	LED check
42	Internal control status 2
43	Command 1 from option
44	Command 2 from option
45	External torque reference
46	Torque compensation value
47	DO-08H output status
48	Momentary power loss decrease capacity
49	Control section software number
50	Speed detection PG counter value
51	PID feedback
52	DI-16H input status

O1-02 Monitor Selection After Power-up

Selects the monitor to be displayed on the digital operator immediately after the power supply is turned ON.

Setting	Description
1	Displays frequency reference *(factory default)*.
2	Displays output frequency.
3	Displays output current.
4	Displays the monitor item set in *O1-01*.

O1-03 Reverse Torque Limit

Units for parameters and monitors related to frequency can be scaled as shown below.

Setting	Description
1	Unit: 0.01%. Speed reference is displayed as P□□.□□
2 ~ 39	• Unit: rpm (Enter the # of poles in the motor). • The speed reference is displayed as n □□□□
40 ~ 3999	Digits: 5th 4th 3rd 2nd 1st 0 0 0 0 0 The 1st through 4th digits determine the set value at 100% output frequency. The decimal point position is set with the 5th digit of O1-03, as follows: 5th digit = 0: displayed as □□□□ 5th digit = 1: displayed as □□□.□ 5th digit = 2: displayed as □□.□□ 5th digit = 3: displayed as □.□□□ (Example 1) If 100% output speed is equal to 200.0 units: Set *O1-03* = "12000" 100% of this reference is displayed as 200.0 and 60% of this reference is displayed as 120.0. Example 2 If 100% output speed is equal to 65.00: Set *O1-03* = "26500" 60% of this reference is displayed as 39.00.

O2 Key Selection

O2-01 Local/Remote Key

Enables/disables the digital operator LOCAL/REMOTE key.

Setting	Explanation	Default
0	Local/Remote key is disabled.	
1	Local/Remote key is enabled *(factory default)*. Depressing the Local/Remote key switches operation commands between the digital operator and the settings of *B1-01* & *B1-02*.	X

O2-02 STOP Key During External Terminal Operation

Enables/disables the digital operator STOP key, during operation from the external terminals and during serial communication.

Setting	Explanation	Default
0	The digital operator STOP key is disabled when Run command does *not* come from the digital operator	X
1	The digital operator STOP key is always enabled. The STOP key is enabled even during external terminal operation and serial communication.	

O2-04 Inverter Model Selection

Sets the inverter capacity, according to the model number. Control parameters with defaults specific to the inverter's capacity are set automatically (i.e. carrier frequency, motor data, etc.). This parameter does ***not*** need changing, unless the control board is replaced.

Minimum	Maximum	Description	Default Setting
00	FF	Inverter Model Selection.	--

SECTION 6

DIAGNOSTICS

6.1 Precautions

WARNING!

THE VS-616PS5 INVERTER USES AND GENERATES HIGH VOLTAGES WHICH MAY BE LETHAL. MAINTENANCE AND SERVICE MUST BE PERFORMED BY EXPERIENCED PERSONNEL.

1. ***Turn OFF power to the inverter and wait until all LED's are off before removing any covers.***
2. ***Before touching any power terminals, test for voltage:***
   - ***between terminals you might touch***
   - ***between terminals and ground***
3. ***Replace all covers and guards before turning on power to the inverter.***

CAUTION!

THE VS-616PS5 INVERTER EMPLOYS STATIC SENSITIVE COMPONENTS. MAINTENANCE AND SERVICE MUST BE PERFORMED BY EXPERIENCED PERSONNEL.

1. ***DO NOT touch any printed circuit boards while power is on.***
2. ***DO NOT connect or disconnect any wires or connectors while power is on.***
3. ***Use static safe procedures when changing boards***

Failure to observe safety precautions will expose the user to high voltages, which may result in equipment damage, serious personal injury, or death!

6.2 Maintenance and Inspection

Periodic Inspection

The VS-616PS5 will supply extended, reliable, service if it is kept clean, cool, and dry, and if it is well maintained. Periodic inspections should be made to ensure that all of the guidelines and precautions in this manual have been followed.
To prevent electrical shock, turn off power and wait five minutes before servicing the inverter. Inspect the inverter according to the following table:

Component	Check for	Corrective Action
External Terminals Connectors Mounting Screws	Loose screws or connectors	Securely Tighten all screws and connectors.
Heatsink	Build up of dust and dirt	Clean off any foreign material
Printed Circuit Boards	Accumulation of conductive residue	Clean off board or replace board.
Cooling Fan	Abnormal noise or vibration	Replace Fan
Power Components	Accumulation of dust and dirt	Clean off any foreign material
Smoothing Capacitors	Discoloration, deformation, or odor	Replace capacitor

When cleaning the components, use clean, dry compressed air at the least pressure necessary, but in no case greater than 90 PSI (6 kg/cm^2).

Parts Replacement Schedule

To extend the operating life of the VS-616PS5 inverter, replace parts according to the following schedule. Doing so may help to avoid an unexpected shutdown.

Part	Approximate Interval	Remarks
Cooling Fan	2 to 3 years	Replace with new fan
Smoothing Capacitor(s)	5 years	Replace with new capacitors
Breakers or Relays	As Needed	If inspection warrants replacement
Fuses	10 years	Replace with new ones
Aluminum Electrolytic Capacitors on Printed Circuit Boards	5 years	Replace with new capacitors or replace PCB

Optimum Operating Conditions

- Ambient Temperature: 86°F yearly average
- Load Factor: 80% or below
- Operation time: 12 hours per day or less

Consult the motor manufacturer's manual for inspection and maintenance instructions of the motor.

6. 3 Alarms and Fault Displays

Fault Classes

A: MAJOR Fault
- Motor coasts to a stop.
- Operation Indicator lights.
- Fault Output (terminals 18 and 19) is activated

B: FAULT
- Operation continues
- Operation indicator lights
- Multi-function output (if selected) activates
- Fault Output (terminals 18 and 19) is NOT activated

C: ALARM (warning)
- Operation cannot be performed
- Operation Indicator lights
- No fault outputs

When the VS-616PS5 detects a major fault, the fault is displayed on the digital operator and activates a fault contact output, after which the motor coasts to a stop. Check the causes listed by the fault code in the following tables and take the corrective actions necessary.

To restart the inverter, remove any RUN commands present, and reset the inverter with the digital operator or an input, if selected. Cycling the power will also reset the inverter. If the corrective actions suggested do not clear the problem, contact your representative.

Alarms do not activate fault contact outputs. Once the cause of the alarm is removed, the inverter clears the alarm status.

Fault Display	Name	Description	Corrective Action	Class
UV1 DC Bus Undervoltage	Main circuit undervoltage (PUV)	Undervoltage in the DC main circuit during running. Detection level: 230V class: Approx. 190V or less 460V class: Approx. 380V or less	• Check the power supply wiring. • Correct the line voltage	A
UV2 CTL PS Undervoltage	Control circuit undervoltage (CUV)	Undervoltage in the control circuit during running.		A
UV3 MC Answerback	MC fault	The pre-charge contactor opened during running.		A
UV Under Voltage	Momentary power loss	• The main circuit DC voltage fell below the PUV level. • The control power source fell below the CUV level. • The pre-charge contactor opened.	–	C
OC Overcurrent	Overcurrent (OC)	The inverter output current exceeded the OC level. (~ 200% Inverter rating)	• Check the motor coil resistance. • Extend the accel/decel time. • Check the motor insulation. • Multi-meter check.	A

Fault Diagnosis and Corrective Actions (continued)

Fault Display	Name	Description	Corrective Action	Class
GF Ground Fault	Ground fault (GF)	Inverter output grounding current exceeded 50% of inverter rated current.	Check that motor insulation has not deteriorated. Check that connection between inverter and motor is not damaged.	A
OV Overvoltage	Overvoltage (OV)	The main circuit direct current voltage exceeded the OV level. Detection level: 230 V class: Approx. 400 V 460 V class: Approx. 800 V	Extend the deceleration time, add braking circuit.	A
SC Short Circuit	Load short-circuit (SC)	Inverter output (load) is short-circuited.	Check the motor coil resistance. Check the motor installation.	A
PUF DC Bus Fuse Open	Fuse blown (FU)	The DC bus fuse is blown. The output transistors were damaged.	Check for damaged transistor, load side short circuit, grounding, etc.	A
OH Heatsink Over temp	Heatsink overheat (OH1)	The transistor heatsink temperature exceeded the allowable value.	Check the fan and ambient temperature.	A
OL1 Motor Overloaded	Motor overload (OL1)	Inverter output exceeded the motor overload level.	Reduce the load.	A
OL2 Inv Overloaded	Inverter overload (OL2)	Inverter output exceeded the inverter overload level (thermo switch).	Reduce the load, extend the acceleration time.	A
OL3 Overtorque 1	Overtorque	The torque reference exceeded the detection level for longer than the specified time.	Verify the parameter setting, reduce the load at the motor.	A
OL4 Overtorque 2				B
PF Input Phase Loss	Input open-phase	Inverter input power supply has open phase. Large unbalance in input voltage.	Check the line voltage. Re-tighten the input terminal screws.	A
LF Output Phase Loss	Output open-phase	Inverter output has open-phase.	Check the output wiring. Check the motor impedance. Re-tighten the output terminal screws.	A
RR Dyn Brk Transistor	Braking transistor failure	The braking transistor has failed.	The inverter requires repair.	A
RH Dyn Brk Resistor	Braking resistor unit overheat	The braking resistor unit temperature has exceeded the allowable value. (Protects only inverter built-in type)	Reduce the regenerative load.	A
OS Over Speed	Overspeed (OS)	The motor speed exceeded the overspeed level. (F1-08)	-	A
PGO PG open	PG open circuit (PGO)	The PG line is broken.	Check the PG line. Check the condition of the motor lock or excessive load.	A

Fault Display	Name	Description	Corrective Action	Class
dEv Speed Deviation	Speed deviation (DEV)	The deviation of the speed reference and speed feedback exceeded the regulation level. (F1-10)	Check the load.	B
STO Step Out	Stepout	Motor has pulled out of synchronization with the applied stator field.	• Check the motor constants. • Check the motor temperature. • Reduce the ASL gain (C5-01). • Reduce the acceleration (C1-01).	A
zdEv Phase Z Pulse Fault	Phase Z pulse fault (Marker Pulse)	An uncontrolled motor state results from an incomplete PG origin pulse adjustment or from a failed initial magnetic pole estimation.	• Check the PG cable connection. • Repeat auto-tuning (set T1-03 = 1, then T1-02 = 2, and press the digital operator RUN key).	A
EF External Fault	Simultaneous forward/ reverse run commands	Both FWD and REV run commands are simultaneously input for 500ms or longer.	Check sequence circuit.	B
bb Base Block	External base block	External base block command is input from control circuit terminal.	Check sequence circuit.	B
EF3 External Fault 3	External fault at terminal 3	Fault occurred in the external control circuit.	Check the condition of the input terminal. If the LED lights when the input is not activated, then the inverter requires repair.	A
EF4 External Fault 4	External fault at terminal 4	Fault occurred in the external control circuit.	Check the condition of the input terminal. If the LED lights when terminal is not connected, then the inverter requires repair.	B
EF5 External Fault 5	External fault at terminal 5			
EF6 External Fault 6	External fault at terminal 6			
EF7 External Fault 7	External fault at terminal 7			
EF8 External Fault 8	External fault at terminal 8			
oPE01 kVA Selection	kVA setting error (OPE01)	Inverter kVA setting error.	Check and set the parameter data *(O2-04)*.	C
oPE02 Limit	Parameter setting range error (OPE02)	Parameter data is out of range.	Check the parameter data settings.	C
oPE03 Terminal	Multi-function input setting error (OPE03)	Multi-function input settings in *H1-01* to *H1-06* are not in ascending order. Or, set values other than “F” are overlapping	Check the function selection.	C
oPE05	Option reference selection fault (OPE05)	• C-option is not connected although run command from C-option is selected • C-option is not connected although frequency reference from C-option is selected	• Check and set the contstant data. • Connect the C-option.	D
oPE06	Control method selection fault (OPE06)	PG control card is not connected during flux vector control.	Connect PG control card.	D

Fault Display	Name	Description	Corrective Action	Class
oPE07	Multi-function analog input selection fault (OPE07)	C-option is A1-14B and option/inverter change is selected.	Check and set the constant data.	D
oPE08	Multi-function input/ output selection fault (OPE08)	Any of the following setting faults has occurred: • The setting unused in the control method is selected for F4-01 and F4-04. • The setting unused in the control method is selected for F5-01 and F4-02. • The setting unused in the control method is selected for H1-01 and H1-06. • The setting unused in the control method is selected for H2-01 and H2-03. • The setting unused in the control method is selected for H3-05 and H3-09. • The setting unused in the control method is selected for H4-01 and H4-04. • The setting unused in the control method is selected for o1-01.	Check and set the constant data.	D
oPE10	R/min setting fault (OPE10)	The settings of E1-06 to E1-08 do not satisfy the following conditions: E1-06 ≧ E1-07 ≧ E1-08	Check and set the constant data.	D
oPE12	Energy-saving control constants setting fault	Energy-saving control constant values are out of range.	Check and set the constant data.	D
oPR	Digital operator fault (OPr)	The digital operator was disconnected during operation by run command from the digital operator.	• Check the wiring cable and the digital operator connection. • Replace the control card.	A
ERR EEPROM R/W Err	EEPROM writing fault (ERR)	EEPROM internal data did not match when initializing the parameter.	Replace the control board.	B
CPF00 COM-ERR (OP&INV)	Control circuit fault 1 (CPF00) Digital operator transmission fault	Transmission between the inverter and digital operator cannot be established 5 seconds after supplying power. MPU peripheral element check fault (on-line)	Insert the operator connector again. Check the wiring of control circuit. Replace the control board.	A
CPF01 COM-ERR (OP&INV)	Control circuit fault 2 (CPF01) Digital operator transmission fault	Transmission between the inverter and digital operator is established once after supplying power, but later transmission is interrupted for more than 2 seconds. MPU peripheral element check fault (on-line).	Insert the digital operator connector again. Check the digital control circuit wiring. Replace the control board.	A
CPF02 BB Circuit Err	Base block circuit fault (CPF02)	Inverter PCB control board fault.	Replace the control board.	A
CPF03 EEPROM Error	EEPROM fault (CPF03)			
CPF04 Internal A/D Err	CPU internal A/D converter fault (CPF04)			
CPF05 External A/D Err	CPU external A/D converter fault (CPF05)			

Fault Display	Name	Description	Corrective Action	Class
CPF06 Option Error	Option connection fault (CPF06)	The option card is not installed correctly.	Install the option card again.	A
CPF20 Option A/D Error	A/D converter fault in analog speed reference card (CPF20)	Option card (AI-14B) A/D converter fault	Replace the option card.	A
CPF23	Cross-diagnose fault between transmission option and control card (CPF23)	Diagnosis data has not been updated for more than 0.2 seconds between the transmission option and the control card.	• Check the transmission option contact part. • Replace the transmission option.	A
BUS	Transmission fault with transmission option (bUS)	Transmission fault with transmission option (detected when the fault continued for 2.5 seconds).	Check the transmission devices and the transmission signals.	A
EF0	External fault from transmission option (EFO)	External fault was input from the transmission option.	External fault, defined by user specification, was input from the transmission option. Find the external fault items from the I/O list and correct it.	B

Motor Faults

If a motor fault occurs, follow the checkpoints listed in the table below and take the corresponding corrective actions. If taking the corrective actions described does not solve the problem, contact your Yaskawa representative immediately.

Motor Faults and Corrective Actions

Fault	Check Point	Corrective Action
Motor does not rotate	Power supply voltage applied to power supply terminals L1, L2, L3? Charge LED is ON?	• Turn ON power supply. • Turn OFF power supply, and then ON again. • Check power supply voltage. • Make sure terminal screws are tight.
	Use rectifier type voltmeter to test. Voltage output to output terminals T1, T2, T3 correct?	Turn OFF power supply, then turn ON again.
	Motor locks due to excessive load?	Reduce the load and release the lock.
	Fault displayed in operator display?	Check troubleshooting table on page 52.
	FWD or REV run command entered?	Check the wiring.
	Frequency setting voltage entered (when using terminals 13 or 14)?	• Check the wiring. • Check frequency setting voltage.
	Are reference and run source settings correct?	Check reference and run source selections *(B1-01, B1-02)*.
Motor rotation reverses	Wiring of terminals T1, T2, T3 correct?	Match wiring to the phase order of the motor leads T1, T2, T3.
	FWD and REV wiring run signals entered?	Correct the wiring.
Motor rotates, but variable speed not available.	Wiring of frequency setting circuit correct?	Correct the wiring.
	Are reference and run source settings correct?	Check reference and run source selections *(B1-01, B1-02)*.
	Load excessively large?	Reduce the load.

APPENDIX A

WIRING TABLES

A.1 Terminal Functions

230V Class Terminal Functions

Model CIMR-PS5U	20P4 to 27P5	2011 to 2015
Nominal Motor Output	0.5 to 10 HP	15 to 20 HP
L1, L2, L3	Main power supply input: 200 to 230 VAC, 3 Ø, 50/60 Hz	
T1, T2, T3	Inverter output: 200 to 230 VAC, 3 Ø, 200 Hz max	
B1, B2	Braking Resistor Unit	
-	DC Power Supply +1 to -	DC Power Supply +1 to -
+ 1	DC Reactor +1 to +2	DC Reactor +1 to +2
+ 2		Braking Unit +3 to -
+ 3	- -	
GND	Earth Ground Terminal (Resistance to earth = 100 ohms or less)	

460V Class Terminal Functions

Model CIMR-PS5U	40P4 to 4015	4018 to 4045	4055 to 4160	4185 to 4300
Nominal Motor Output	0.5 to 25 HP	30 to 75 HP	100 to 200 HP	250 to 500 HP
L1, L2, L3	Main power supply input: 380 to 460 VAC, 3 Ø, 50/60 Hz			
T1, T2, T3	Inverter output: 380 to 460 VAC, 3 Ø, 200 Hz max			
B1, B2	Braking Resistor Unit			
-	DC Power Supply +1 to -	DC Power Supply +1 to -	Braking Unit +3 to –	Braking Unit +3 to -
+ 1	DC Reactor +1 to +2	Braking Unit +3 to -		
+ 2			(No +1 or +2 terminals	
+ 3	- -		provided)	
S		Cooling Fan Power Supply	- -	
R	- -		Control power Supply R to S200: 200 to 230 VAC 1Ø R to S400: 380 to 460 VAC 1Ø	
S200		– –		
S400				
GND	Earth Ground Terminal (Resistance to earth = 10 ohms or less)			

A.2 Wire Sizes and Terminal Screw Sizes

230V Class Wire Size

Circuit	Model CIMR-	Terminal Symbol	Terminal Screw	Wire Size *		Max. Torque lb-in (N·m)	Wire Type
				AWG	mm^2		
Main	PS5U20P4	L1, L2, L3, ⊖, ⊕1, ⊕2, B1, B2, T1, T2, T3	M4	14 - 10	2 - 5.5	12.4 (1.4)	Power cable: 600V vinyl sheathed wire or equivalent
		⏚					
	PS5U20P7	L1, L2, L3, ⊖, ⊕1, ⊕2, B1, B2, T1, T2, T3	M4	14 - 10	2 - 5.5	12.4 (1.4)	
		⏚					
	PS5U21P5	L1, L2, L3, ⊖, ⊕1, ⊕2, B1, B2, T1, T2, T3	M4	14 - 10	2 - 5.5	12.4 (1.4)	
		⏚		12 - 10	3.5 - 5.5		
	PS5U22P2	L1, L2, L3, ⊖, ⊕1, ⊕2, B1, B2, T1, T2, T3	M4	12 - 10	3.5 - 5.5	12.4 (1.4)	
		⏚					
	PS5U23P7	L1, L2, L3, ⊖, ⊕1, ⊕2, B1, B2, T1, T2, T3	M4	10	5.5	12.4 (1.4)	
		⏚					
	PS5U25P5	L1, L2, L3, ⊖, ⊕1, ⊕2, B1, B2, T1, T2, T3	M5	8	8	22.1 (2.5)	
		⏚		10 - 8	5.5 - 8		
	PS5U27P5	L1, L2, L3, ⊖, ⊕1, ⊕2, B1, B2, T1, T2, T3	M5	8	8	22.1 (2.5)	
		⏚		10 - 8	5.5 - 8		
	PS5U2011	L1, L2, L3, ⊖, ⊕1, ⊕2, ⊕3, T1, T2, T3	M6	4	22	45.1 (5.1)	
		⏚		8	8		
	PS5U2015	L1, L2, L3, ⊖, ⊕1, ⊕2, ⊕3, T1, T2, T3	M8	3	30	90.3 (10.2)	
		⏚	M6	8	8	45.1 (5.1)	
Control	Common to all models	1-33	M3.5	20 - 16	Stranded 0.5 - 1.25 Solid 0.5 - 1.25	-	
		G	M3.5	20 - 14	0.5 - 2	8.9 (1.0)	

* Wire sizes are based on 75°C copper wire.

460V Class Wire Size

Circuit	Model CIMR-	Terminal Symbol	Terminal Screw	Wire Size *		Max. Torque lb-in (N·m)	Wire Type
				AWG	mm^2		
Main	PS55U40P4	L1, L2, L3, ⊖, ⊕1, ⊕2, B1, B2, T1, T2, T3	M4	14 - 10	2 - 5.5	12.4 (1.4)	Power cable: 600V vinyl sheathed wire or equivalent
		⏚					
	PS55U40P7	L1, L2, L3, ⊖, ⊕1, ⊕2, B1, B2, T1, T2, T3	M4	14 - 10	2 - 5.5	12.4 (1.4)	
		⏚		12 - 10	3.5 - 5.5		
	PS55U41P5	L1, L2, L3, ⊖, ⊕1, ⊕2, B1, B2, T1, T2, T3	M4	14 - 10	2 - 5.5	12.4 (1.4)	
		⏚		12 - 10	3.5 - 5.5		
	PS55U42P2	L1, L2, L3, ⊖, ⊕1, ⊕2, B1, B2, T1, T2, T3	M4	14 - 10	2 - 5.5	12.4 (1.4)	
		⏚		12 - 10	3.5 - 5.5		
	PS55U43P7	L1, L2, L3, ⊖, ⊕1, ⊕2, B1, B2, T1, T2, T3	M4	14 - 10	2 - 5.5	12.4 (1.4)	
		⏚		12 - 10	3.5 - 5.5		
	PS55U44P0	L1, L2, L3, ⊖, ⊕1, ⊕2, B1, B2, T1, T2, T3	M4	12 - 10	3.5 - 5.5	12.4 (1.4)	
		⏚					
	PS55U45P5	L1, L2, L3, ⊖, ⊕1, ⊕2, B1, B2, T1, T2, T3	M4	12 - 10	3.5 - 5.5	12.4 (1.4)	
		⏚					
	PS55U47P5	L1, L2, L3, ⊖, ⊕1, ⊕2, B1, B2, T1, T2, T3	M5	8 - 6	8 - 14	22.1 (2.5)	
		⏚					
	PS55U4011	L1, L2, L3, ⊖, ⊕1, ⊕2, B1, B2, T1, T2, T3	M5	8 - 6	8 - 14	22.1 (2.5)	
		⏚	M6	8	8	45.1 (5.1)	
	PS55U4015	L1, L2, L3, ⊖, ⊕1, ⊕2, B1, B2, T1, T2, T3	M5	8 - 6	8 - 14	22.1 (2.5)	
		⏚	M6	8	8	45.1 (5.1)	
	PS55U4018	L1, L2, L3, ⊖, ⊕1, ⊕2, ⊕3, T1, T2, T3	M6	6	14	45.1 (5.1)	
		⏚	M8	8	8	90.3 (10.2)	
		r, S	M4	20 - 10	0.5 - 5	12.4 (1.4)	
	PS55U4022	L1, L2, L3, ⊖, ⊕1, ⊕2, ⊕3, T1, T2, T3	M6	4	22	45.1 (5.1)	
		⏚	M8	8	8	90.3 (10.2)	
		r, S	M4	20 - 10	0.5 - 5	12.4 (1.4)	
	PS55U4030	L1, L2, L3, ⊖, ⊕1, ⊕2, ⊕3, T1, T2, T3	M8	4	22	90.3 (10.2)	
		⏚		8	8		
		r, S	M4	20 - 10	0.5 - 5	12.4 (1.4)	
	PS55U4037	L1, L2, L3, ⊖, ⊕1, ⊕2, ⊕3, T1, T2, T3	M8	3	30	90.3 (10.2)	
		⏚		6	14		
		r, S	M4	20 - 10	0.5 - 5	12.4 (1.4)	
	PS55U4045	L1, L2, L3, ⊖, ⊕1, ⊕2, ⊕3, T1, T2, T3	M8	1	50	90.3 (10.2)	
		⏚		6	14		
		r, S	M4	20 - 10	0.5 - 5	12.4 (1.4)	
	PS55U4055	L1, L2, L3, T1, T2, T3	M10	4/0	100	203.6 (23.0)	
		⏚, ⊖, ⊕3	M8	4	22	90.3 (10.2)	
		r, S 200, S 400	M4	20 - 10	0.5 - 5	12.4 (1.4)	
	PS55U4075	L1, L2, L3, T1, T2, T3	M10	1/0 x 2P	60 x 2P	203.6 (23.0)	
		⏚, ⊖ , ⊕3	M8	4	22	90.3 (10.2)	
		r, S 200, S 400	M4	20 - 10	0.5 - 5	12.4 (1.4)	
	PS55U4110	L1, L2, L3, T1, T2, T3	M10	1/0 x 2P	60 x 2P	203.6 (23.0)	
		⏚, ⊖, ⊕3	M8	3	30	90.3 (10.2)	
		r, S 200, S 400	M4	20 - 10	0.5 - 5	12.4 (1.4)	
	PS55U4160	L1, L2, L3, T1, T2, T3	M12	4/0 x 2P	100 x 2P	349.6 (39.5)	
		⏚, ⊖, ⊕3	M8	1	50	90.3 (10.2)	
		r, S 200, S 400	M4	20 - 10	0.5 - 5	12.4 (1.4)	
	PS55U4185	L1, L2, L3, ⊖, ⊕1, ⊕3, T1, T2, T3	M16	650MCM x 2P	325 x 2P	867.4 (98.0)	
		⏚	M8	1	50	90.3 (10.2)	
		r, S 200, S 400	M4	20 - 10	0.5 - 5.5	12.4 (1.4)	
	PS55U4220	L1, L2, L3, ⊖, ⊕1, ⊕3, T1, T2, T3	M16	650MCM x 2P	325 x 2P	867.4 (98.0)	
		⏚	M8	1/0	60	90.3 (10.2)	
		r, S 200, S 400	M4	20 - 10	0.5 - 5.5	12.4 (1.4)	
	PS55U4300	L1, L2, L3, ⊖, ⊕1, ⊕3, T1, T2, T3	M16	650MCM x 2P	325 x 2P	867.4 (98.0)	
		⏚	M8	1/0	60	90.3 (10.2)	
		r, S 200, S 400	M4	20 - 10	0.5 - 5.5	12.4 (1.4)	
Control	Common to all models	1-33	M3.5	20 - 16	Stranded 0.5 - 1.25 Solid 0.5 - 1.25	-	Twisted shielded wire with Class 1 wiring
		G	M3.5	20 - 14	0.5 - 2	8.9 (1.0)	

A.3 JST Closed Loop Connectors

JST Closed Loop Connectors

Wire Size *		Terminal Screw	JST Closed-Loop Connectors (Lugs)	Max. Torque lb-in (N·m)
AWG	mm^2			
20	0.5	M3.5	1.25 - 3.5	8.9 (1.0)
		M4	1.25 - 4	12.4 (1.4)
18	0.75	M3.5	1.25 - 3.5	8.9 (1.0)
		M4	1.25 - 4	12.4 (1.4)
16	1.25	M3.5	1.25 - 3.5	8.9 (1.0)
		M4	1.25 - 4	12.4 (1.4)
14	2	M3.5	2 - 3.5	8.9 (1.0)
		M4	2 - 4	12.4 (1.4)
		M5	2 - 5	22.1 (2.5)
		M6	2 - 6	45.1 (5.1)
		M8	2 - 8	90.3 (10.2)
12 - 10	3.5 - 5.5	M4	5.5 - 4	12.4 (1.4)
		M5	5.5 - 5	22.1 (2.5)
		M6	5.5 - 6	45.1 (5.1)
		M8	5.5 - 8	90.3 (10.2)
8	8	M5	8 - 5	22.1 (2.5)
		M6	8 - 6	45.1 (5.1)
		M8	8 - 8	90.3 (10.2)
6	14	M6	14 - 6	45.1 (5.1)
		M8	14 - 8	90.3 (10.2)
4	22	M6	22 - 6	45.1 (5.1)
		M8	22 - 8	90.3 (10.2)
3 - 2	30 - 38	M8	38 - 8	90.3 (10.2)
1 - 1/0	50 - 60	M8	60 - 8	90.3 (10.2)
		M10	60 - 10	203.6 (23.0)
3/0	80	M10	80 - 10	203.6 (23.0)
4/0	100		100 - 10	203.6 (23.0)
4/0	100	M12	100 - 12	349.6 (39.5)
300MCM	150		150 - 12	349.6 (39.5)
400MCM	200		200 - 12	349.6 (39.5)
650MCM	325	M12 x 2	325 - 12	349.6 (39.5)
		M16	325 - 16	867.4 (98.0)

Note 1:

The use of a JST closed-loop connector (lug) is recommended to maintain proper clearances. Please contact your Yaskawa representative for more information.

Note 2:

Voltage drop should be considered when determining wire size. Voltage drop can be calculated using the following equation:

Phase-to phase voltage drop (V)

$= \sqrt{3}$ wire resistance (Ω/km) x wiring distance (m) x current (A) x 10^{-3}

Select a wire size so that voltage drop will be less than 2% of the normal rated voltage.

APPENDIX B

POWERTEC MOTOR SETUP

POWERTEC Industrial Motors of Rock Hill, South Carolina manufactures Brushless DC motors from fractional to 300 HP. These motors are the motors for which the PS5 was originally designed. For information on the Brushless DC motors, call POWERTEC at 803-328-1888, or fax to 803-328-1870.

B.1 POWERTEC Motors Winding Determination

E and F Series Motors

POWERTEC motor model numbers beginning with “E” or “F” give the motor frame size in the second and third positions. The stack length is given in the fourth position. Refer to the attached charts of Ferrite motors and PAC-TORQ (rare earth) motors.

Once the frame size has been determined, the letter in the fifth position of the model number gives the winding letter. Using the frame size and the winding letter, you can obtain the motor winding data to be entered into the “E” parameters with the “POWERTEC Frame Size and Winding Code Table”. This will give you the four-digit code designating the winding data.

Enter the four digit number in the E1-02 parameter. If the number is rejected (indicating the number is not in the drive database), Enter “1000” (CUSTOM) into the E1-02 parameter, and enter the table data into the “E” parameters as shown in the POWERTEC Winding Data Tables.

A, B, C, D, and L Series Motors

POWERTEC motor model numbers beginning with “A”, “B”, “C”, “D”, or “L” give the motor frame size in the second and third positions. The stack length is given in the **fifth** position. The following table, with reference to the number in the second and third positions, finds the stack length:

S (small)	**M** (medium)	**L** (large)	**X** (extra large)	**Y** (really large)
143	145	L145		
182	184	1810		
213	215	219		
254	256	259	2512	
287	288	2810	2812	
		328	3211	3213

Once the frame size has been determined, the letter in the **fourth** position of the model number gives the winding letter. Using the frame size and the winding letter, you can obtain the motor winding data to be entered into the “E” parameters with the “POWERTEC Frame Size and Winding Code Table”. This will give you the four-digit code designating the winding data.

Enter the four digit number in the E1-02 parameter. If the number is rejected (indicating the number is not in the drive database), Enter “1000” (CUSTOM) into the E1-02 parameter, and enter the table data into the “E” parameters as shown in the POWERTEC Winding Data Tables.

Primary Feedback Device

The primary feedback PPR is given on the nameplate on “E” and “F” series motors.

The primary feedback device is designated in the 11th position of the model number on “E” and “F” series motors. Refer to the charts attached.

The primary feedback device is designated in the 10th position of the earlier series motors. A “0” indicates that the primary feedback is the hall effect switches. Other designations may require a consultation with POWERTEC.

Standard POWERTEC Ferrite motors have a Hall effect sensor installed with three feedback channels for commutation (HS1, HS2, and HS3), and two channels for Speed and Direction (HS4 and HS5). The Hall sensor PPR is given in the attached POWERTEC Winding Data tables as “PG Constant”.

Secondary Feedback Device

The commutation encoder PPR is given in the 13th position of the model number of “E” series and “F” series motors. The PPR is given on the nameplate. Otherwise, refer to the following table for the PPR:

LTR	PPR		LTR	PPR		LTR	PPR
0	NONE		G	360		P	1500
A	100		H	400		Q	2000
B	120		J	500		R	2048
C	200		K	600		S	2500
D	250		L	1000		T	5000
E	256		M	1024		X	Special
F	300		N	1200			

B.2 POWERTEC Motors Frame Size and Winding Code Table

POWERTEC Motors Frame Size and Winding Code Table

FRAME	LTR	CODE	FRAME	LTR	CODE	FRAME	LTR	CODE	FRAME	LTR	CODE
CUSTOM		1000									
B42	A	1140	215	A	1051	287	A	1094	3211	C	1099
B42	B	1141	215	B	1052	287	B	1074	3211	D	1100
C42	A	1142	215	C	1053	287	C	1055	3211	Y	1225
C42	B	1143	215	D	1054	287	D	1056	3211	Z	1226
143	A	1104	215	H	1198	287	W	1211	3213	G	1162
143	b	1105	215	k	1029	287	Y	1213	3213	Y	1227
145	A	1106	215	M	1027	287	Z	1214	3213	Y	1228
145	B	1107	215	V	1250	288	A	1115	E182	E	1253
L145	A	1108	219	E	1176	288	B	1078	E184	E	1240
L145	B	1109	254	A	1001	288	C	1057	E184	F	1277
182	A	1013	254	B	1002	288	D	1058	E184	Z	1271
182	B	1014	254	C	1003	288	V	1237	E213	E	1255
182	C	1015	254	D	1004	288	Y	1217	E213	F	1285
182	D	1016	254	V	1248	288	Z	1218	E215	E	1256
182	V	1244	254	Y	1201	328	C	1097	E218	E	1257
182	Y	1185	256	A	1063	328	D	1098	E218	F	1279
184	A	1017	256	B	1006	328	Y	1223	E254	E	1268
184	B	1018	256	C	1064	328	Z	1224	E256	E	1259
184	C	1019	256	D	1008	504	F	1165	E2810	E	1262
184	D	1020	256	H	1203	508	F	1154	E2810	H	1272
184	E	1132	256	V	1239	2512	F	1161	E2812	E	1263
184	H	1242	256	Y	1205	2810	B	1075	E2812	Z	1273
184	Y	1189	256	Z	1206	2810	C	1059	E3211	E	1265
213	A	1047	259	A	1065	2810	D	1060	E3213	E	1241
213	A	1047	259	B	1010	2810	Y	1219	E3213	M	1292
213	B	1048	259	C	1066	2810	Z	1220	E328	E	1264
213	B	1048	259	D	1012	2812	C	1067	EL259	E	1281
213	C	1049	259	F	1133	2812	D	1068	ES184	E	1254
213	D	1050	259	Y	1209	2812	F	1136	ES259	E	1260
213	H	1193	259	Z	1210	2812	V	1251	ES259	E	1261
						2812	Y	1221			
						2812	Z	1222			

POWERTEC Windings Data

In order to use the following winding data tables, first set E1-17 to the appropriate winding connection configuration. Then set E1-02 to the desired winding type. Performing this sequence automatically loads parameters, E1-03 thru E1-13 along with F1-01 to the values specified in the following tables. One must manually program E1-06 and E1-07 to the maximum and base speed, respectively before operation is allowed.

Frame	Letter	Type	Voltage	Rated AMP	Poles	Base Speed	Min Speed	Stator Res	Stator Ind	KV VAC/rpm	Connection		PG Const.
		E1-02	E1-03	E1-04	E1-05	E1-06,07	E1-08	E1-09	E1-10,11	E1-13	E-17		F1-01
254	A	1001	230.0	0	4	1	30	0.115	3.40	77.0	0	=1D	30
			230.0	0	4	1	30	0.029	0.85	38.5	1	=2D	30
			230.0	0	4	1	30	0.345	10.20	133.4	2	=1Y	30
			230.0	0	4	1	30	0.086	2.55	66.7	3	=2Y	30
254	B	1002	230.0	0	4	1	30	0.260	7.67	57.7	0	=1D	30
			230.0	0	4	1	30	0.065	1.92	28.9	1	=2D	30
			230.0	0	4	1	30	0.780	23.01	99.9	2	=1Y	30
			230.0	0	4	1	30	0.195	5.75	50.0	3	=2Y	30
254	C	1003	460.0	0	4	1	30	0.460	13.60	154.6	0		30
			460.0	0	4	1	30	0.115	3.40	77.3	1	=2D	30
			460.0	0	4	1	30	1.380	40.80	267.8	2	=1Y	30
			460.0	0	4	1	30	0.345	10.20	133.9	3	=2Y	30
254	D	1004	460.0	0	4	1	30	1.033	30.67	230.9	0		30
			460.0	0	4	1	30	0.258	7.67	115.5	1	=2D	30
			460.0	0	4	1	30	3.099	92.01	399.9	2	=1Y	30
			460.0	0	4	1	30	0.775	23.00	200.0	3	=2Y	30
256	B	1006	230.0	0	4	1	30	0.145	5.00	118.0	0		30
			230.0	0	4	1	30	0.036	1.25	59.0	1	=2D	30
			230.0	0	4	1	30	0.435	15.00	204.4	2	=1Y	30
			230.0	0	4	1	30	0.109	3.75	102.2	3	=2Y	30
256	D	1008	460.0	0	4	1	30	0.580	20.10	236.0	0		30
			460.0	0	4	1	30	0.145	5.03	118.0	1	=2D	30
			460.0	0	4	1	30	1.740	60.30	408.8	2	=1Y	30
			460.0	0	4	1	30	0.435	15.08	204.4	3	=2Y	30
259	B	1010	230.0	0	4	1	30	0.100	3.75	120.0	0		30
			230.0	0	4	1	30	0.025	0.94	60.0	1	=2D	30
			230.0	0	4	1	30	0.300	11.25	207.8	2	=1Y	30
			230.0	0	4	1	30	0.075	2.81	73.2	3	=2Y	30
259	D	1012	460.0	0	4	1	30	0.400	15.00	36.6	0		30
			460.0	0	4	1	30	0.100	3.75	126.8	1	=2D	30
			460.0	0	4	1	30	1.200	45.00	63.4	2	=1Y	30
			460.0	0	4	1	30	0.300	11.25	120.0	3	=2Y	30
182	A	1013	230.0	0	4	1	30	1.210	13.30	73.2	0		30
			230.0	0	4	1	30	0.303	3.33	36.6	1	=2D	30
			230.0	0	4	1	30	3.630	39.90	126.8	2	=1Y	30
			230.0	0	4	1	30	0.908	9.98	63.4	3	=2Y	30
182	B	1014	230.0	0	4	1	30	3.370	36.50	120.0	0		30
			230.0	0	4	1	30	0.843	9.13	60.0	1	=2D	30
			230.0	0	4	1	30	10.110	109.50	207.8	2	=1Y	30
			230.0	0	4	1	30	2.528	27.38	103.9	3	=2Y	30
182	C	1015	460.0	0	4	1	30	4.850	53.30	146.0	0		30
			460.0	0	4	1	30	1.213	13.33	73.0	1	=2D	30
			460.0	0	4	1	30	14.550	159.90	252.9	2	=1Y	30
			460.0	0	4	1	30	3.638	39.98	126.4	3	=2Y	30
182	D	1016	460.0	0	4	1	30	14.200	145.90	241.0	0		30
			460.0	0	4	1	30	3.550	36.48	120.5	1	=2D	30
			460.0	0	4	1	30	42.600	437.70	417.4	2	=1Y	30
			460.0	0	4	1	30	10.650	109.43	208.7	3	=2Y	30
184	A	1017	230.0	0	4	1	30	0.410	6.00	75.0	0		30
			230.0	0	4	1	30	0.103	1.50	37.5	1	=2D	30
			230.0	0	4	1	30	1.230	18.00	129.9	2	=1Y	30
			230.0	0	4	1	30	0.308	4.50	65.0	3	=2Y	30
184	B	1018	230.0	0	4	1	30	1.000	14.30	115.5	0		30
			230.0	0	4	1	30	0.250	3.58	57.8	1	=2D	30
			230.0	0	4	1	30	3.000	42.90	200.1	2	=1Y	30
			230.0	0	4	1	30	0.750	10.73	100.0	3	=2Y	30
184	C	1019	460.0	0	4	1	30	1.630	24.00	150.0	0		30
			460.0	0	4	1	30	0.408	6.00	75.0	1	=2D	30
			460.0	0	4	1	30	4.890	72.00	259.8	2	=1Y	30
			460.0	0	4	1	30	1.223	18.00	129.9	3	=2Y	30
184	D	1020	460.0	0	4	1	30	4.013	57.07	254.0	0		30
			460.0	0	4	1	30	1.003	14.27	127.0	1	=2D	30
			460.0	0	4	1	30	12.039	171.21	439.9	2	=1Y	30
			460.0	0	4	1	30	3.010	42.80	220.0	3	=2Y	30

POWERTEC Windings Data (continued)

Frame	Letter	Type	Voltage	Rated AMP	Poles	Base Speed	Min Speed	Stator Res	Stator Ind	KV VAC/rpm	Connection		PG Const.
		E1-02	E1-03	E1-04	E1-05	E1-06,07	E1-08	E1-09	E1-10,11	E1-13	E-17		F1-01
215	M	1027	230.0	0	4	1	30	0.770	18.40	134.4	0		30
			230.0	0	4	1	30	0.192	4.60	67.2	1	=2D	30
			230.0	0	4	1	30	2.310	55.20	232.7	2	=1Y	30
			230.0	0	4	1	30	0.577	13.80	116.4	3	=2Y	30
215	K	1029	230.0	0	4	1	30	0.133	3.37	69.3	0		30
			230.0	0	4	1	30	0.033	0.84	34.7	1	=2D	30
			230.0	0	4	1	30	0.400	10.11	120.0	2	=1Y	30
			230.0	0	4	1	30	0.100	2.53	60.0	3	=2Y	30
213	A	1047	230.0	0	4	1	30	0.343	6.70	80.7	0		30
			230.0	0	4	1	30	0.086	1.68	40.3	1	=2D	30
			230.0	0	4	1	30	1.029	20.10	139.7	2	=1Y	30
			230.0	0	4	1	30	0.257	5.30	69.9	3	=2Y	30
213	B	1048	230.0	0	4	1	30	0.680	13.50	114.3	0		30
			230.0	0	4	1	30	0.170	3.38	57.2	1	=2D	30
			230.0	0	4	1	30	2.040	40.50	198.0	2	=1Y	30
			230.0	0	4	1	30	0.510	10.13	99.0	3	=2Y	30
213	C	1049	460.0	0	4	1	30	1.372	26.80	161.3	0		30
			460.0	0	4	1	30	0.343	6.70	80.7	1	=2D	30
			460.0	0	4	1	30	4.116	80.40	279.4	2	=1Y	30
			460.0	0	4	1	30	1.029	20.10	139.7	3	=2Y	30
213	D	1050	460.0	0	4	1	30	2.720	54.00	228.6	0		30
			460.0	0	4	1	30	0.680	13.50	114.3	1	=2D	30
			460.0	0	4	1	30	8.160	162.00	395.9	2	=1Y	30
			460.0	0	4	1	30	2.040	40.50	198.0	3	=2Y	30
215	A	1051	230.0	0	4	1	30	0.243	5.63	89.1	0		30
			230.0	0	4	1	30	0.061	1.41	44.6	1	=2D	30
			230.0	0	4	1	30	0.729	16.89	154.3	2	=1Y	30
			230.0	0	4	1	30	0.182	4.22	77.2	3	=2Y	30
215	B	1052	230.0	0	4	1	30	0.430	10.00	119.0	0		30
			230.0	0	4	1	30	0.108	2.50	59.5	1	=2D	30
			230.0	0	4	1	30	1.290	30.00	206.1	2	=1Y	30
			230.0	0	4	1	30	0.323	7.50	103.1	3	=2Y	30
215	C	1053	460.0	0	4	1	30	0.973	22.50	178.2	0		30
			460.0	0	4	1	30	0.243	5.63	89.1	1	=2D	30
			460.0	0	4	1	30	2.919	67.50	308.7	2	=1Y	30
			460.0	0	4	1	30	0.730	16.88	154.3	3	=2Y	30
215	D	1054	460.0	0	4	1	30	1.736	40.00	237.8	0		30
			460.0	0	4	1	30	0.434	10.00	118.9	1	=2D	30
			460.0	0	4	1	30	5.208	120.00	411.9	2	=1Y	30
			460.0	0	4	1	30	1.302	30.00	205.9	3	=2Y	30
287	C	1055	460.0	0	8	1	30	0.145	2.94	167.0	0		60
			460.0	0	8	1	30	0.036	0.74	83.5	1	=2D	60
			460.0	0	8	1	30	0.435	8.82	289.3	2	=1Y	60
			460.0	0	8	1	30	0.109	2.21	144.6	3	=2Y	60
287	D	1056	460.0	0	8	1	30	0.280	5.86	236.0	0		60
			460.0	0	8	1	30	0.070	1.47	118.0	1	=2D	60
			460.0	0	8	1	30	0.840	17.58	408.8	2	=1Y	60
			460.0	0	8	1	30	0.210	4.40	204.4	3	=2Y	60
288	C	1057	230.0	0	8	1	30	0.089	2.16	180.8	0		60
			230.0	0	8	1	30	0.022	0.54	90.4	1	=2D	60
			230.0	0	8	1	30	0.267	6.48	313.2	2	=1Y	60
			230.0	0	8	1	30	0.067	1.62	156.6	3	=2Y	60
288	D	1058	460.0	0	8	1	30	0.201	4.86	271.2	0		60
			460.0	0	8	1	30	0.050	1.22	135.6	1	=2D	60
			460.0	0	8	1	30	0.603	14.58	469.7	2	=1Y	60
			460.0	0	8	1	30	0.151	3.65	234.9	3	=2Y	60
2810	C	1059	460.0	0	8	1	30	0.048	1.27	161.7	0		60
			460.0	0	8	1	30	0.012	0.32	80.9	1	=2D	60
			460.0	0	8	1	30	0.144	3.81	280.1	2	=1Y	60
			460.0	0	8	1	30	0.036	0.95	140.0	3	=2Y	60
2810	D	1060	460.0	0	8	1	30	0.109	2.85	243.0	0		60
			460.0	0	8	1	30	0.027	0.71	121.5	1	=2D	60
			460.0	0	8	1	30	0.327	8.55	420.9	2	=1Y	60
			460.0	0	8	1	30	0.082	2.14	210.4	3	=2Y	60

POWERTEC Windings Data (continued)

Frame	Letter	Type	Voltage	Rated AMP	Poles	Base Speed	Min Speed	Stator Res	Stator Ind	KV VAC/rpm	Connection		PG Const.
		E1-02	E1-03	E1-04	E1-05	E1-06,07	E1-08	E1-09	E1-10,11	E1-13	E-17		F1-01
256	A	1063	230.0	0	4	1	30	0.071	2.38	80.8	0		30
			230.0	0	4	1	30	0.018	0.60	40.4	1	=2D	30
			230.0	0	4	1	30	0.213	7.14	139.9	2	=1Y	30
			230.0	0	4	1	30	0.053	1.79	70.0	3	=2Y	30
256	C	1064	460.0	0	4	1	30	0.284	9.52	161.8	0		30
			460.0	0	4	1	30	0.071	2.38	80.9	1	=2D	30
			460.0	0	4	1	30	0.852	28.56	280.2	2	=1Y	30
			460.0	0	4	1	30	0.213	7.14	140.1	3	=2Y	30
259	A	1065	230.0	0	4	1	30	0.043	1.67	79.7	0		30
			230.0	0	4	1	30	0.011	0.42	39.9	1	=2D	30
			230.0	0	4	1	30	0.129	5.01	138.0	2	=1Y	30
			230.0	0	4	1	30	0.032	1.25	69.0	3	=2Y	30
259	C	1066	460.0	0	4	1	30	0.173	6.67	159.4	0		30
			460.0	0	4	1	30	0.043	1.67	79.7	1	=2D	30
			460.0	0	4	1	30	0.519	20.01	276.1	2	=1Y	30
			460.0	0	4	1	30	0.130	5.00	138.0	3	=2Y	30
2812	C	1067	230.0	0	8	1	30	0.044	1.20	178.0	0		60
			230.0	0	8	1	30	0.011	0.30	89.0	1	=2D	60
			230.0	0	8	1	30	0.132	3.60	308.3	2	=1Y	60
			230.0	0	8	1	30	0.033	0.90	154.2	3	=2Y	60
2812	D	1068	460.0	0	8	1	30	0.091	2.45	254.0	0		60
			460.0	0	8	1	30	0.023	0.61	127.0	1	=2D	60
			460.0	0	8	1	30	0.273	7.35	439.9	2	=1Y	60
			460.0	0	8	1	30	0.068	1.84	220.0	3	=2Y	60
287	B	1074	230.0	0	8	1	30	0.070	1.46	118.0	0		60
			230.0	0	8	1	30	0.018	0.37	59.0	1	=2D	60
			230.0	0	8	1	30	0.210	4.38	204.4	2	=1Y	60
			230.0	0	8	1	30	0.053	1.10	102.2	3	=2Y	60
2810	B	1075	230.0	0	8	1	30	0.270	0.71	121.2	0		60
			230.0	0	8	1	30	0.068	0.18	60.6	1	=2D	60
			230.0	0	8	1	30	0.810	2.13	209.9	2	=1Y	60
			230.0	0	8	1	30	0.203	0.53	105.0	3	=2Y	60
288	B	1078	230.0	0	8	1	30	0.050	1.21	135.1	0		60
			230.0	0	8	1	30	0.013	0.30	67.6	1	=2D	60
			230.0	0	8	1	30	0.150	3.63	234.0	2	=1Y	60
			230.0	0	8	1	30	0.038	0.91	117.0	3	=2Y	60
287	A	1094	230.0	0	8	1	30	0.037	0.74	83.7	0		60
			230.0	0	8	1	30	0.009	0.19	41.9	1	=2D	60
			230.0	0	8	1	30	0.111	2.22	145.0	2	=1Y	60
			230.0	0	8	1	30	0.028	0.56	72.5	3	=2Y	60
328	C	1097	460.0	0	8	1	30	0.040	1.08	184.4	0		60
			460.0	0	8	1	30	0.010	0.27	92.2	1	=2D	60
			460.0	0	8	1	30	0.120	3.24	319.4	2	=1Y	60
			460.0	0	8	1	30	0.030	0.81	159.7	3	=2Y	60
328	D	1098	460.0	0	8	1	30	0.076	2.05	253.0	0		60
			460.0	0	8	1	30	0.019	0.51	126.5	1	=2D	60
			460.0	0	8	1	30	0.228	6.15	438.2	2	=1Y	60
			460.0	0	8	1	30	0.057	1.54	219.1	3	=2Y	60
3211	C	1099	460.0	0	8	1	30	0.029	0.81	187.3	0		60
			460.0	0	8	1	30	0.007	0.20	93.7	1	=2D	60
			460.0	0	8	1	30	0.087	2.43	324.4	2	=1Y	60
			460.0	0	8	1	30	0.022	0.61	162.2	3	=2Y	60
3211	D	1100	460.0	0	8	1	30	0.050	1.44	250.0	0		60
			460.0	0	8	1	30	0.013	0.36	125.0	1	=2D	60
			460.0	0	8	1	30	0.150	4.32	433.0	2	=1Y	60
			460.0	0	8	1	30	0.038	1.08	216.5	3	=2Y	60
143	A	1104	230.0	0	4	1	30	5.020	40.40	86.3	0		30
			230.0	0	4	1	30	1.255	10.10	43.2	1	=2D	30
			230.0	0	4	1	30	15.060	121.20	149.5	2	=1Y	30
			230.0	0	4	1	30	3.765	30.30	74.7	3	=2Y	30
143	B	1105	230.0	0	4	1	30	10.000	80.80	122.0	0		30
			230.0	0	4	1	30	2.500	20.20	61.0	1	=2D	30
			230.0	0	4	1	30	30.000	242.40	211.3	2	=1Y	30
			230.0	0	4	1	30	7.500	60.60	105.7	3	=2Y	30

POWERTEC Windings Data (continued)

Frame	Letter	Type	Voltage	Rated AMP	Poles	Base Speed	Min Speed	Stator Res	Stator Ind	KV VAC/rpm	Connection		PG Const.
		E1-02	E1-03	E1-04	E1-05	E1-06,07	E1-08	E1-09	E1-10,11	E1-13	E-17		F1-01
145	A	1106	230.0	0	4	1	30	1.940	20.30	86.6	0		30
			230.0	0	4	1	30	0.485	5.08	43.3	1	=2D	30
			230.0	0	4	1	30	5.820	60.90	150.0	2	=1Y	30
			230.0	0	4	1	30	1.455	15.23	75.0	3	=2Y	30
145	B	1107	230.0	0	4	1	30	3.860	40.70	123.3	0		30
			230.0	0	4	1	30	0.965	10.18	61.7	1	=2D	30
			230.0	0	4	1	30	11.580	122.10	213.6	2	=1Y	30
			230.0	0	4	1	30	2.895	30.53	106.8	3	=2Y	30
L145	A	1108	230.0	0	4	1	30	0.840	11.55	88.1	0		30
			230.0	0	4	1	30	0.210	2.89	44.1	1	=2D	30
			230.0	0	4	1	30	2.520	34.65	152.6	2	=1Y	30
			230.0	0	4	1	30	0.630	8.66	76.3	3	=2Y	30
L145	B	1109	230.0	0	4	1	30	1.940	24.40	128.0	0		30
			230.0	0	4	1	30	0.485	6.10	64.0	1	=2D	30
			230.0	0	4	1	30	5.820	73.20	221.7	2	=1Y	30
			230.0	0	4	1	30	1.455	18.30	110.9	3	=2Y	30
288	A	1115	230.0	0	8	1	30	0.023	0.54	90.1	0		60
			230.0	0	8	1	30	0.006	0.14	45.1	1	=2D	60
			230.0	0	8	1	30	0.069	1.62	156.1	2	=1Y	60
			230.0	0	8	1	30	0.017	0.41	78.0	3	=2Y	60
184	E	1132	230.0	0	4	1	30	0.227	4.00	67.2	0		30
			230.0	0	4	1	30	0.057	1.00	33.6	1	=2D	30
			230.0	0	4	1	30	0.682	12.00	116.4	2	=1Y	30
			230.0	0	4	1	30	0.170	3.00	58.2	3	=2Y	30
259	F	1133	460.0	0	4	1	30	0.050	1.86	90.1	0		30
			460.0	0	4	1	30	0.012	0.46	45.1	1	=2D	30
			460.0	0	4	1	30	0.149	5.57	156.1	2	=1Y	30
			460.0	0	4	1	30	0.037	1.39	78.0	3	=2Y	30
2812	F	1136	460.0	0	8	1	30	0.069	1.96	228.7	0		60
			460.0	0	8	1	30	0.017	0.49	114.3	1	=2D	60
			460.0	0	8	1	30	0.206	5.88	396.1	2	=1Y	60
			460.0	0	8	1	30	0.052	1.47	198.0	3	=2Y	60
B42	A	1140	230.0	0	4	1	30	14.400	75.30	86.0	0		30
			230.0	0	4	1	30	3.600	18.83	43.0	1	=2D	30
			230.0	0	4	1	30	43.200	225.90	149.0	2	=1Y	30
			230.0	0	4	1	30	10.800	56.48	74.5	3	=2Y	30
B42	B	1141	230.0	0	4	1	30	25.800	150.00	122.0	0		30
			230.0	0	4	1	30	6.450	37.50	61.0	1	=2D	30
			230.0	0	4	1	30	77.400	450.00	211.3	2	=1Y	30
			230.0	0	4	1	30	19.350	112.50	105.7	3	=2Y	30
C42	A	1142	230.0	0	4	1	30	7.180	45.70	86.0	0		30
			230.0	0	4	1	30	1.795	11.43	43.0	1	=2D	30
			230.0	0	4	1	30	21.540	137.10	149.0	2	=1Y	30
			230.0	0	4	1	30	5.385	34.28	74.5	3	=2Y	30
C42	B	1143	230.0	0	4	1	30	12.900	92.30	122.0	0		30
			230.0	0	4	1	30	3.225	23.08	61.0	1	=2D	30
			230.0	0	4	1	30	38.700	276.90	211.3	2	=1Y	30
			230.0	0	4	1	30	9.675	69.23	105.7	3	=2Y	30
508	F	1154	460.0	0	8	1	30	0.045	2.36	537.1	0		60
			460.0	0	8	1	30	0.011	0.59	268.6	1	=2D	60
			460.0	0	8	1	30	0.135	7.08	930.3	2	=1Y	60
			460.0	0	8	1	30	0.034	1.77	465.0	3	=2Y	60
2512	F	1161	460.0	0	4	1	30	0.049	1.99	97.0	0		30
			460.0	0	4	1	30	0.012	0.50	48.5	1	=2D	30
			460.0	0	4	1	30	0.147	5.96	168.0	2	=1Y	30
			460.0	0	4	1	30	0.037	1.49	84.0	3	=2Y	30
3213	G	1162	460.0	0	8	1	30	0.041	1.41	259.9	0		60
			460.0	0	8	1	30	0.010	0.35	130.0	1	=2D	60
			460.0	0	8	1	30	0.123	4.23	450.1	2	=1Y	60
			460.0	0	8	1	30	0.031	1.06	225.0	3	=2Y	60
504	F	1165	460.0	0	8	1	30	0.058	2.60	424.1	0		60
			460.0	0	8	1	30	0.014	0.65	212.0	1	=2D	60
			460.0	0	8	1	30	0.173	7.80	734.5	2	=1Y	60
			460.0	0	8	1	30	0.043	1.95	367.2	3	=2Y	60

POWERTEC Windings Data (continued)

Frame	Letter	Type	Voltage	Rated AMP	Poles	Base Speed	Min Speed	Stator Res	Stator Ind	KV VAC/rpm	Connection		PG Const.
		E1-02	E1-03	E1-04	E1-05	E1-06,07	E1-08	E1-09	E1-10,11	E1-13	E-17		F1-01
219	E	1176	460.0	0	4	1	30	0.058	1.47	57.3	0		30
			460.0	0	4	1	30	0.015	0.37	28.6	1	=2D	30
			460.0	0	4	1	30	0.173	4.41	99.2	2	=1Y	30
			460.0	0	4	1	30	0.043	1.10	49.6	3	=2Y	30
182	Y	1185	460.0	0	4	1	30	9.314	98.73	231.5	0		30
			460.0	0	4	1	30	2.328	24.68	115.8	1	=2D	30
			460.0	0	4	1	30	27.943	296.20	401.0	2	=1Y	30
			460.0	0	4	1	30	6.986	74.05	200.4	3	=2Y	30
184	Y	1189	460.0	0	4	1	30	2.695	47.43	231.5	0		30
			460.0	0	4	1	30	0.674	11.86	115.8	1	=2D	30
			460.0	0	4	1	30	8.085	142.29	401.0	2	=1Y	30
			460.0	0	4	1	30	2.021	35.57	200.4	3	=2Y	30
213	H	1193	460.0	0	4	1	30	3.153	63.70	248.7	0		30
			460.0	0	4	1	30	0.789	15.93	124.3	1	=2D	30
			460.0	0	4	1	30	9.460	191.10	430.7	2	=1Y	30
			460.0	0	4	1	30	2.365	47.78	215.4	3	=2Y	30
215	H	1198	460.0	0	4	1	30	3.556	85.00	346.4	0		30
			460.0	0	4	1	30	0.889	21.25	173.2	1	=2D	30
			460.0	0	4	1	30	10.669	255.00	600.0	2	=1Y	30
			460.0	0	4	1	30	2.667	63.75	300.0	3	=2Y	30
254	Y	1201	460.0	0	4	1	30	1.199	35.97	250.6	0		30
			460.0	0	4	1	30	0.300	8.99	125.3	1	=2D	30
			460.0	0	4	1	30	3.597	107.90	434.0	2	=1Y	30
			460.0	0	4	1	30	0.899	26.98	217.0	3	=2Y	30
256	H	1203	460.0	0	4	1	30	0.162	5.69	125.7	0		30
			460.0	0	4	1	30	0.040	1.42	62.8	1	=2D	30
			460.0	0	4	1	30	0.486	17.07	217.7	2	=1Y	30
			460.0	0	4	1	30	0.122	4.27	108.9	3	=2Y	30
256	Y	1205	460.0	0	4	1	30	0.649	22.77	250.6	0		30
			460.0	0	4	1	30	0.162	5.69	125.3	1	=2D	30
			460.0	0	4	1	30	1.946	68.32	434.0	2	=1Y	30
			460.0	0	4	1	30	0.487	17.08	217.0	3	=2Y	30
256	Z	1206	460.0	0	4	1	30	1.403	49.23	369.7	0		30
			460.0	0	4	1	30	0.351	12.31	184.9	1	=2D	30
			460.0	0	4	1	30	4.208	147.70	640.4	2	=1Y	30
			460.0	0	4	1	30	1.052	36.93	320.2	3	=2Y	30
259	Y	1209	460.0	0	8	1	30	0.402	15.00	239.6	0		60
			460.0	0	8	1	30	0.100	3.75	119.8	1	=2D	60
			460.0	0	8	1	30	1.205	45.00	415.0	2	=1Y	60
			460.0	0	8	1	30	0.301	11.25	207.5	3	=2Y	60
259	Z	1210	460.0	0	8	1	30	0.904	33.75	359.1	0		60
			460.0	0	8	1	30	0.226	8.44	179.6	1	=2D	60
			460.0	0	8	1	30	2.712	101.25	622.0	2	=1Y	60
			460.0	0	8	1	30	0.678	25.31	311.0	3	=2Y	60
287	W	1211	460.0	0	8	1	30	0.077	1.72	127.6	0		60
			460.0	0	8	1	30	0.019	0.43	63.8	1	=2D	60
			460.0	0	8	1	30	0.231	5.16	221.0	2	=1Y	60
			460.0	0	8	1	30	0.058	1.29	110.5	3	=2Y	60
287	Y	1213	460.0	0	8	1	30	0.286	6.37	245.4	0		60
			460.0	0	8	1	30	0.071	1.59	122.7	1	=2D	60
			460.0	0	8	1	30	0.857	19.10	425.0	2	=1Y	60
			460.0	0	8	1	30	0.214	4.78	212.5	3	=2Y	60
287	Z	1214	460.0	0	8	1	30	0.497	11.09	323.0	0		60
			460.0	0	8	1	30	0.124	2.77	161.5	1	=2D	60
			460.0	0	8	1	30	1.492	33.27	559.4	2	=1Y	60
			460.0	0	8	1	30	0.373	8.32	279.7	3	=2Y	60
288	Y	1217	460.0	0	8	1	30	0.165	4.33	255.2	0		60
			460.0	0	8	1	30	0.041	1.08	127.6	1	=2D	60
			460.0	0	8	1	30	0.496	13.00	442.0	2	=1Y	60
			460.0	0	8	1	30	0.124	3.25	221.0	3	=2Y	60
288	Z	1218	460.0	0	8	1	30	0.277	7.26	331.4	0		60
			460.0	0	8	1	30	0.069	1.82	165.7	1	=2D	60
			460.0	0	8	1	30	0.831	21.78	574.0	2	=1Y	60
			460.0	0	8	1	30	0.208	5.45	287.0	3	=2Y	60

POWERTEC Windings Data (continued)

Frame	Letter	Type	Voltage	Rated AMP	Poles	Base Speed	Min Speed	Stator Res	Stator Ind	KV VAC/rpm	Connection		PG Const.
		E1-02	E1-03	E1-04	E1-05	E1-06,07	E1-08	E1-09	E1-10,11	E1-13	E-17		F1-01
254	V	1248	230.0	0	4	1	30	0.177	5.31	96.7	0		30
			230.0	0	4	1	30	0.044	1.32	48.3	1	=2D	30
			230.0	0	4	1	30	0.531	15.94	167.5	2	=1Y	30
			230.0	0	4	1	30	0.133	3.98	83.7	3	=2Y	30
215	V	1250	460.0	0	4	1	30	0.890	21.27	173.2	0		30
			460.0	0	4	1	30	0.223	5.32	86.6	1	=2D	30
			460.0	0	4	1	30	2.669	63.80	300.0	2	=1Y	30
			460.0	0	4	1	30	0.667	15.95	150.0	3	=2Y	30
2812	V	1251	460.0	0	8	1	30	0.086	2.45	254.0	0		60
			460.0	0	8	1	30	0.021	0.61	127.0	1	=2D	60
			460.0	0	8	1	30	0.258	7.36	440.0	2	=1Y	60
			460.0	0	8	1	30	0.065	1.84	220.0	3	=2Y	60
E182	E	1253	460.0	0	6	1	30	2.168	25.80	239.0	0		30
			460.0	0	6	1	30	0.542	6.45	119.5	1	=2D	30
			460.0	0	6	1	30	6.504	77.40	414.0	2	=1Y	30
			460.0	0	6	1	30	1.626	19.35	207.0	3	=2Y	30
ES184	E	1254	460.0	0	6	1	30	1.250	16.75	239.0	0		30
			460.0	0	6	1	30	0.313	4.19	119.5	1	=2D	30
			460.0	0	6	1	30	3.750	50.25	414.0	2	=1Y	30
			460.0	0	6	1	30	0.937	12.56	207.0	3	=2Y	30
E213	E	1255	460.0	0	4	1	30	0.577	11.42	256.2	0		30
			460.0	0	4	1	30	0.144	2.85	128.1	1	=2D	30
			460.0	0	4	1	30	1.730	34.25	443.7	2	=1Y	30
			460.0	0	4	1	30	0.432	8.56	221.9	3	=2Y	30
E215	E	1256	460.0	0	4	1	30	0.357	7.64	248.0	0		30
			460.0	0	4	1	30	0.089	1.91	124.0	1	=2D	30
			460.0	0	4	1	30	1.071	22.92	429.5	2	=1Y	30
			460.0	0	4	1	30	0.268	5.73	124.0	3	=2Y	30
E218	E	1257	460.0	0	6	1	30	0.248	5.67	247.5	0		30
			460.0	0	6	1	30	0.062	1.42	123.7	1	=2D	30
			460.0	0	6	1	30	0.742	17.00	428.6	2	=1Y	30
			460.0	0	6	1	30	0.186	4.25	214.3	3	=2Y	30
E256	E	1259	460.0	0	8	1	30	0.132	3.20	245.7	0		60
			460.0	0	8	1	30	0.033	0.80	122.9	1	=2D	60
			460.0	0	8	1	30	0.395	9.60	425.6	2	=1Y	60
			460.0	0	8	1	30	0.099	2.40	212.8	3	=2Y	60
ES259	E	1260	460.0	0	8	1	30	0.081	2.07	229.0	0		60
			460.0	0	8	1	30	0.020	0.52	114.5	1	=2D	60
			460.0	0	8	1	30	0.244	6.22	396.6	2	=1Y	60
			460.0	0	8	1	30	0.061	1.56	198.3	3	=2Y	60
ES259	E	1261	460.0	0	8	1	30	0.075	1.90	245.4	0		60
			460.0	0	8	1	30	0.018	0.47	122.7	1	=2D	60
			460.0	0	8	1	30	0.223	5.69	425.0	2	=1Y	60
			460.0	0	8	1	30	0.056	1.42	212.5	3	=2Y	60
E2810	E	1262	460.0	0	8	1	30	0.046	1.16	223.0	0		60
			460.0	0	8	1	30	0.011	0.29	111.5	1	=2D	60
			460.0	0	8	1	30	0.137	3.49	386.2	2	=1Y	60
			460.0	0	8	1	30	0.034	0.87	193.1	3	=2Y	60
E2812	E	1263	460.0	0	8	1	30	0.036	0.99	238.9	0		60
			460.0	0	8	1	30	0.009	0.25	119.5	1	=2D	60
			460.0	0	8	1	30	0.109	2.97	413.8	2	=1Y	60
			460.0	0	8	1	30	0.027	0.74	206.9	3	=2Y	60
E328	E	1264	460.0	0	8	1	30	0.130	4.36	505.8	0		60
			460.0	0	8	1	30	0.033	1.09	252.9	1	=2D	60
			460.0	0	8	1	30	0.391	13.09	876.0	2	=1Y	60
			460.0	0	8	1	30	0.098	3.27	438.0	3	=2Y	60
E3211	E	1265	460.0	0	8	1	30	0.095	3.36	485.8	0		60
			460.0	0	8	1	30	0.024	0.84	242.9	1	=2D	60
			460.0	0	8	1	30	0.284	10.08	841.4	2	=1Y	60
			460.0	0	8	1	30	0.071	2.52	420.7	3	=2Y	60
E254	E	1268	460.0	0	8	1	30	0.354	7.75	347.3	0		60
			460.0	0	8	1	30	0.089	1.94	173.6	1	=2D	60
			460.0	0	8	1	30	1.062	23.26	601.5	2	=1Y	60
			460.0	0	8	1	30	0.266	5.82	300.8	3	=2Y	60

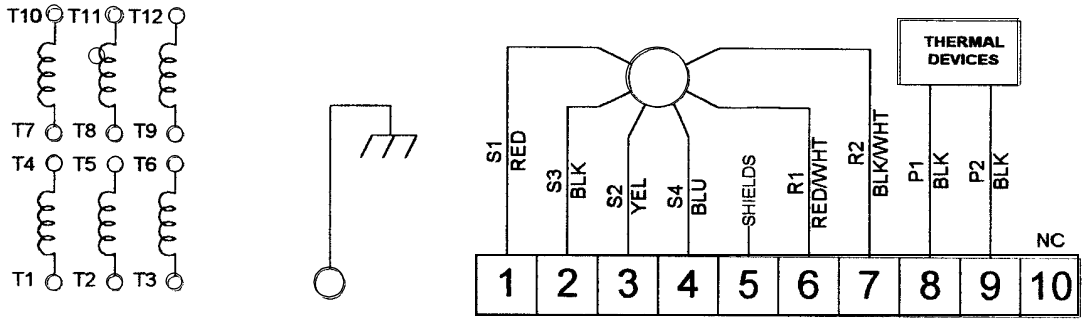
POWERTEC Windings Data (continued)

Frame	Letter	Type	Voltage	Rated AMP	Poles	Base Speed	Min Speed	Stator Res	Stator Ind	KV VAC/rpm	Connection		PG Const.
		E1-02	E1-03	E1-04	E1-05	E1-06,07	E1-08	E1-09	E1-10,11	E1-13	E-17		F1-01
E184	Z	1271	460.0	0	6	1	30	0.391	6.10	167.4	0		30
			460.0	0	6	1	30	0.098	1.53	83.7	1	=2D	30
			460.0	0	6	1	30	1.173	18.30	290.0	2	=1Y	30
			460.0	0	6	1	30	0.294	4.58	145.0	3	=2Y	30
E2810	H	1272	460.0	0	8	1	30	0.066	1.68	254.0	0		60
			460.0	0	8	1	30	0.017	0.42	127.0	1	=2D	60
			460.0	0	8	1	30	0.198	5.04	440.0	2	=1Y	60
			460.0	0	8	1	30	0.050	1.26	220.0	3	=2Y	60
E2812	Z	1273	460.0	0	8	1	30	0.082	2.23	337.2	0		60
			460.0	0	8	1	30	0.021	0.56	168.6	1	=2D	60
			460.0	0	8	1	30	0.246	6.68	584.0	2	=1Y	60
			460.0	0	8	1	30	0.061	1.67	292.0	3	=2Y	60
E184	F	1277	460.0	0	6	1	30	0.192	2.99	117.5	0		30
			460.0	0	6	1	30	0.048	0.75	58.7	1	=2D	30
			460.0	0	6	1	30	0.575	8.97	203.5	2	=1Y	30
			460.0	0	6	1	30	0.144	2.24	101.8	3	=2Y	30
E218	F	1279	460.0	0	6	1	30	0.133	3.05	178.2	0		30
			460.0	0	6	1	30	0.033	0.76	89.1	1	=2D	30
			460.0	0	6	1	30	0.399	9.14	308.6	2	=1Y	30
			460.0	0	6	1	30	0.100	2.29	154.3	3	=2Y	30
EL259	E	1281	460.0	0	8	1	30	0.161	4.27	358.0	0		60
			460.0	0	8	1	30	0.040	1.07	179.0	1	=2D	60
			460.0	0	8	1	30	0.482	12.81	620.0	2	=1Y	60
			460.0	0	8	1	30	0.120	3.20	310.0	3	=2Y	60
E213	F	1285	460.0	0	6	1	30	0.901	17.84	330.0	0		30
			460.0	0	6	1	30	0.225	4.46	165.0	1	=2D	30
			460.0	0	6	1	30	2.703	53.52	571.6	2	=1Y	30
			460.0	0	6	1	30	0.676	13.38	285.8	3	=2Y	30
E3213	M	1292	460.0	0	8	1	30	0.057	2.12	444.6	0		60
			460.0	0	8	1	30	0.014	0.53	222.3	1	=2D	60
			460.0	0	8	1	30	0.170	6.35	770.0	2	=1Y	60
			460.0	0	8	1	30	0.043	1.59	385.0	3	=2Y	60

CUSTOM		1000	0.0	0	4	1	30	0.000	0.00	0.0	0		30
			0.0	0	4	1	30	0.000	0.00	0.0	1	=2D	30
			0.0	0	4	1	30	0.000	0.00	0.0	2	=1Y	30
			0.0	0	4	1	30	0.000	0.00	0.0	3	=2Y	30

B.3 POWERTEC Motors Resolver Information

RESOLVER MOTORS - CONNECTIONS AND TERMINAL MARKINGS



MOTOR / RESOLVER LEADS

Motors are shipped with nameplate connections (i.e., 1-Y, 1-D, 2Y, or 2-D)
Check Motor nameplate for correct connections.
See page 5 for standard connection diagrams.
Consult drive manual for motor/drive interconnections.
Check shipping documentation for special connections.

SPACE HEATERS

When supplied, will have leads tagged H1 and H2. Check nameplate for voltage and current ratings.

OTHER ACCESSORIES

Check motor nameplate and accessories nameplates for connections and ratings.

CAUTION:

Connect cable shields to designated points only. DO NOT connect shields to ground.

THERMISTORS AND THERMAL SWITCHES

Motors with R3 Resolvers have two thermal switches connected in series embedded in the windings.
Motors equipped with R1 and R2 Resolvers have two Negative Temperature Coefficient (NTC) thermister probes. They are 10,000 ohms each @25ºC, connected in parallel to terminals 8 and 9 in the motor junction box. Thermistor leads are labeled P1 and P2. At room temperature (25º C) the resistance between P1 and P2 should be 5000 ohms.

The Overtemperature threshold for totally enclosed motors is 145º C (104.2 Ohms). The threshold for drip proof and blower ventilated motors is 130ºC (150.5 ohms)

Since the potential exists for a thermistor to open up, Motor Overtemperature Warnings should be set no higher than 80% of Fault Temperature on totally enclosed motors, and no higher than 80% for drip proof and blower ventilated motors.

NTS Thermistor Resistance Table

Nominal Resistance between P1 and P2 in ohms
Resistance tolerance is +1-5%

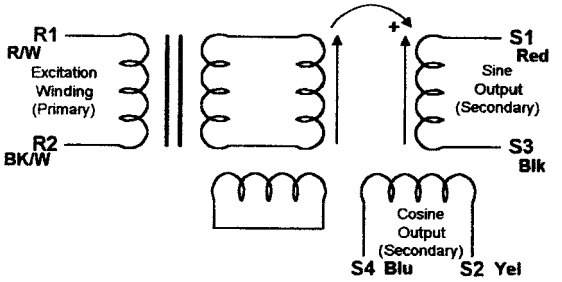
Winding Temp.	R_{P1-P2}	Winding Temp.	R_{P1-P2}
ºC	ohms	ºC	ohms
-30	88500	90	459
-20	48535	100	340
-10	27665	110	255.5
0	16325	120	194.5
10	9950	130	150.5
20	6250	140	117.5
30	4028	150	92.5
40	2663	160	74
50	1801	170	59.5
60	1244	180	48.5
70	876	190	39.7
80	629	200	32.8

RESOLVER EQUIPPED MOTORS

The resolver supplied with **POWERTEC** motors is a frameless, single speed, transmitter type, mounted on the back of the motor. The rotor element is mounted on the shaft.

See the table at the right for resolver specifications

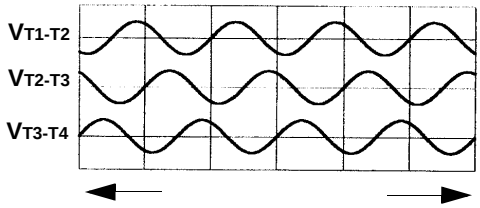
Resolver Wiring Configuration



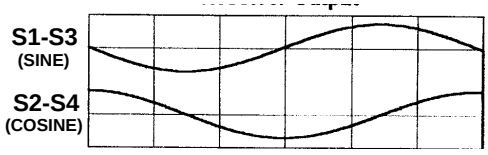
Positive resolver rotation is CW facing the resolver end of the motor

Phasing Voltage for 8 Pole Motor

for clockwise rotation at drive end



1 Mechanical Revolution



Primary Feedback Devices - Technical Data

Frameless Resolvers

typical output@25ºC

Parameter	Units	R1	R2	R3
Frame Size		37	49	37
Type		Transmitter	Transmitter	Transmitter
Primary		Rotor	Rotor	Rotor
Speeds		1	1	1
Input Voltage	Vms	8	8	6
Frequency	kHz	6.5	6.5	6
Input Current, max	mA	68	85	70
Input Power, nom	mW	404	510	250
Transformation Ratio		0.5:1	0.5:1	0.333:1
Phase Shift	Deg	-3	-5	-5
Impendances				
ZRO	ohms	87+j82	84+j59	82+j72
ZRS	ohms	82+j79	87+j82	79+j70
ZSO	ohms	298+j519	905+j1860	147+j247
ZSS	ohms	278+j497	885+j850	139+j278
DC Resistances				
Stator	ohms	42	195	28
Rotor	ohms	57	62	56
Null Voltage	mV	±45	±30	±60
Max Electrical Error	minutes	20	20	20
Output Voltage	Vms	4.0	4.0	2.0
Weight	lb.	1	2.43	1

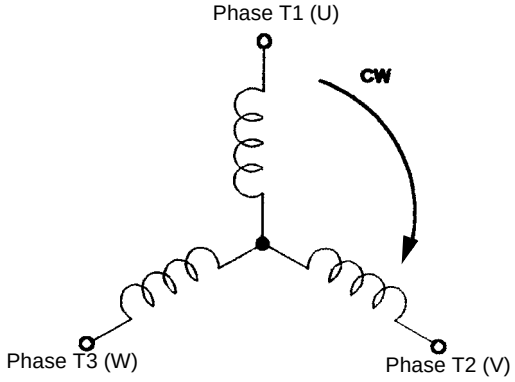
NOTES:

R1 resolvers are used in standard motors except as follows: R2 resolvers are used in all double shaft and TEFC 280 and 320 frames.

R3 resolvers are used with Control Techniques drives.

Data is for estimation purposes only. For certified data, consult the factory.

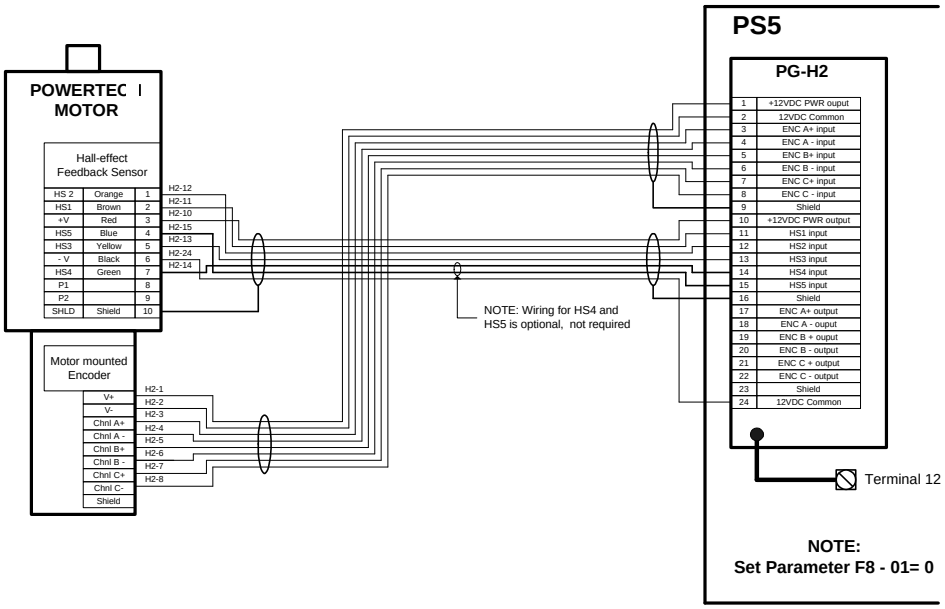
PHASING DIAGRAM OF MOTOR STATOR



APPENDIX C

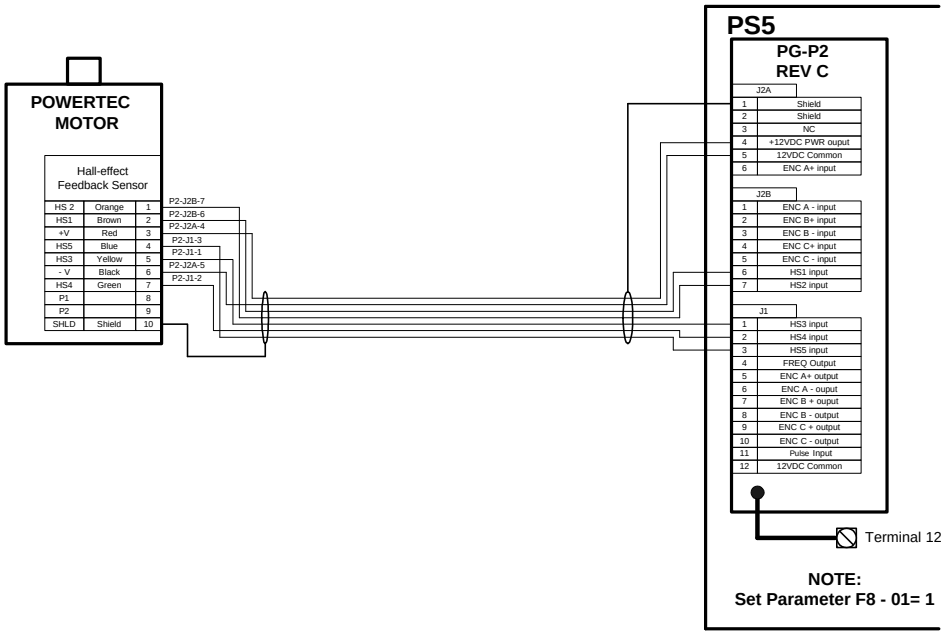
PG Feedback Connection Diagrams

C.1 PG-H2 Connection Diagram

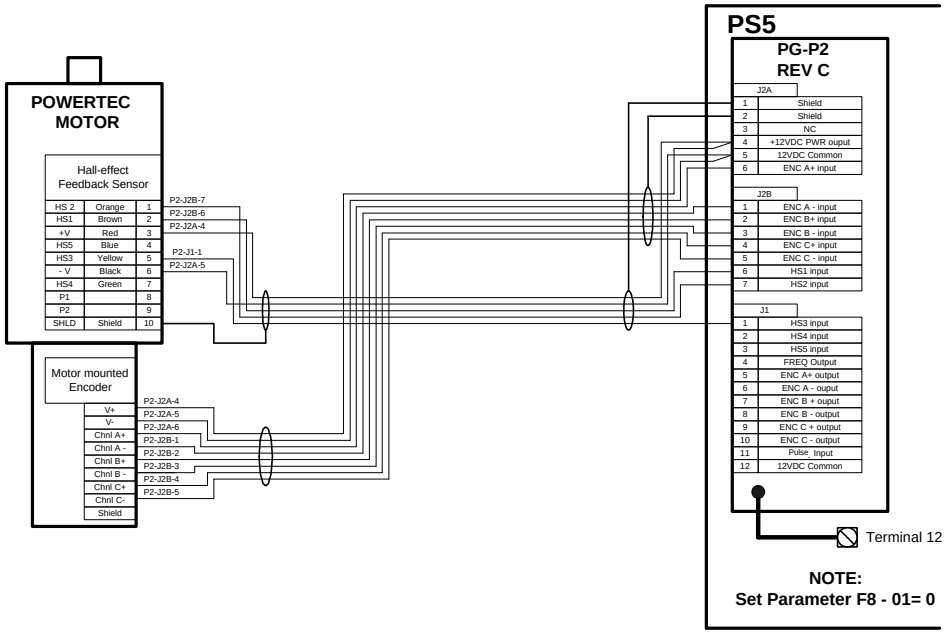


PG-H2 Connection Diagram for PS5
POWERTEC motor/w aux. encoder

C.2 PG-P2 Rev C Connection Diagrams

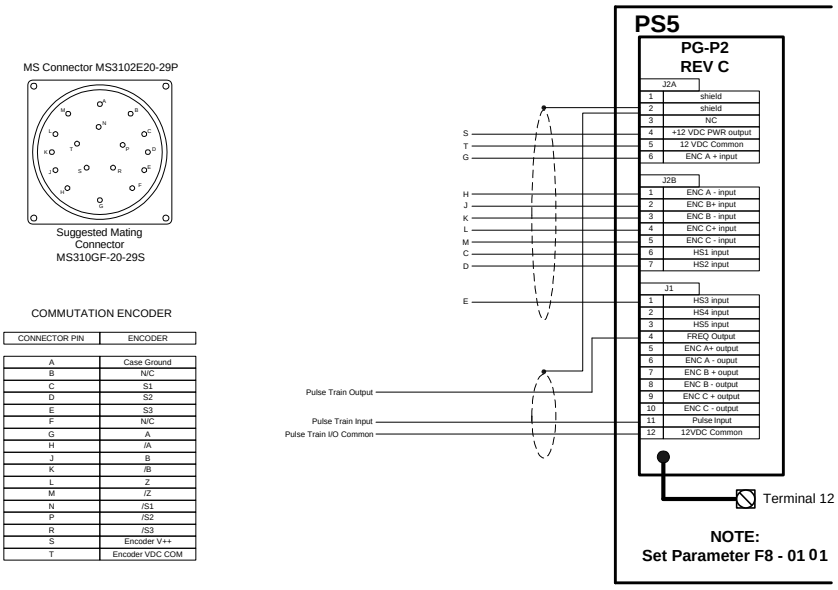


PG-P2 Rev C Connection Diagram for PS5
POWERTEC motor basic

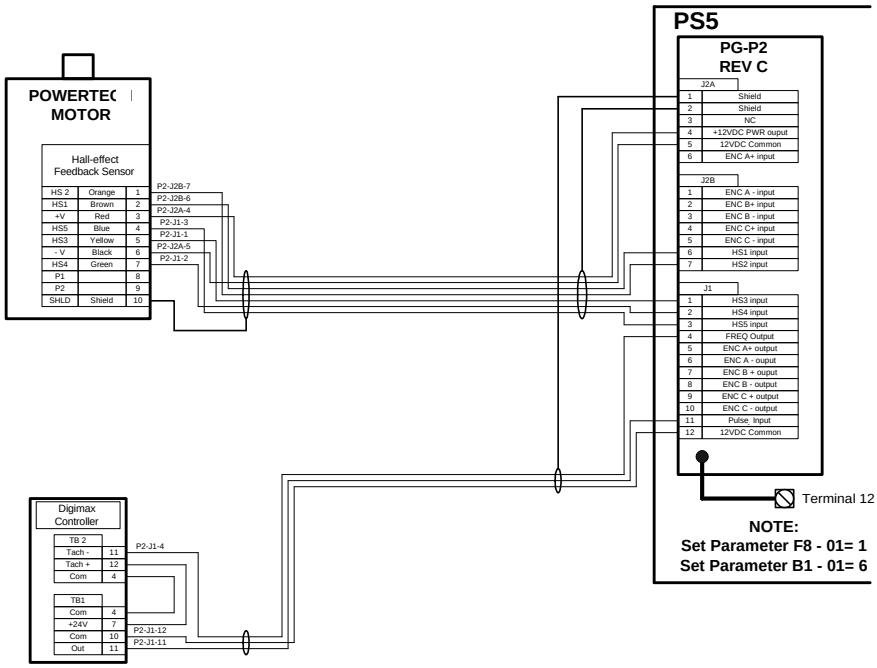


PG-P2 Rev C Connection Diagram for PS5
POWERTEC motor/w aux. encoder

C.2 PG-P2 Rev C Connection Diagrams (continued)

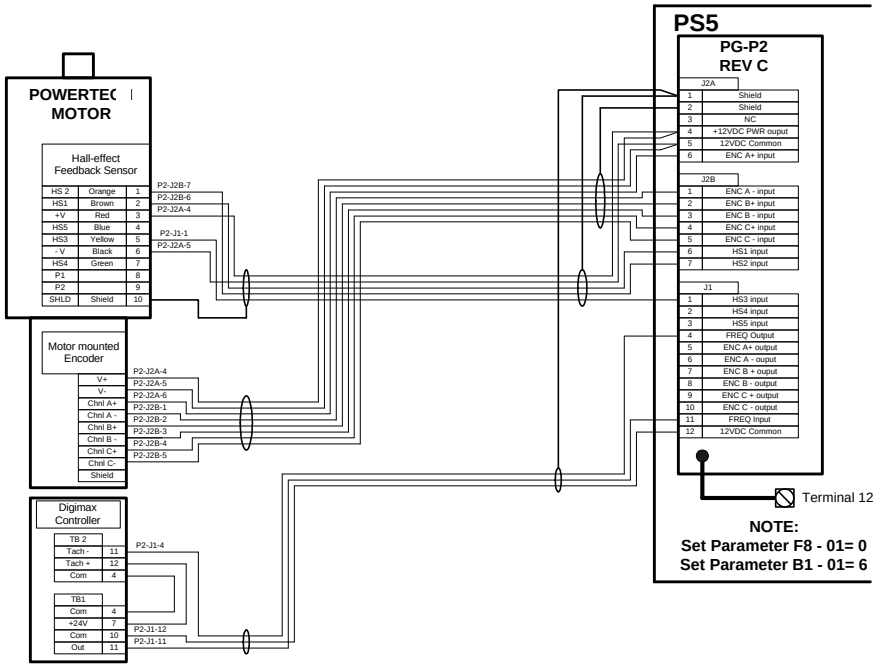


PG-P2 Rev C Connection Diagram for PS5
POWERTEC motor w/com encoder

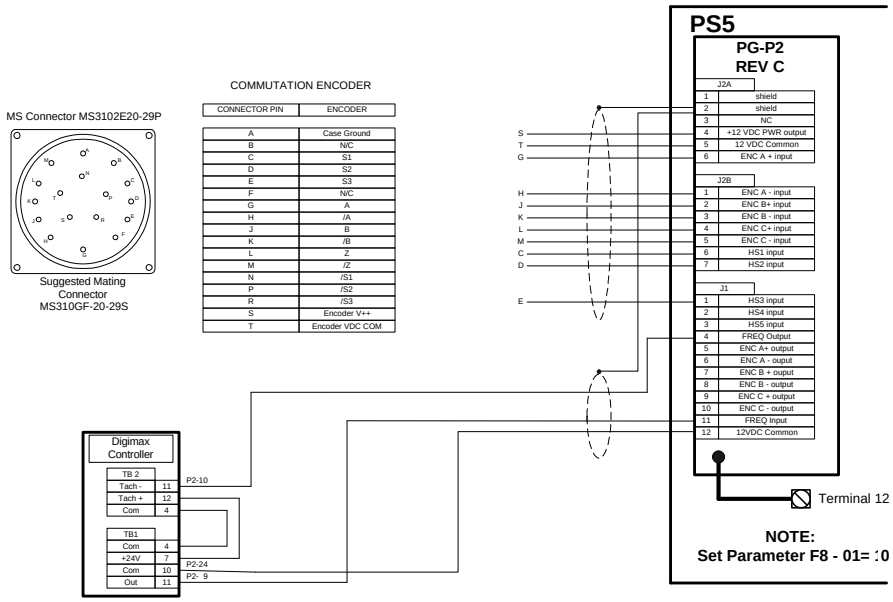


PG-P2 Rev C Connection Diagram for PS5
POWERTEC motor and Digimax controller

C.2 PG-P2 Rev C Connection Diagrams (continued)

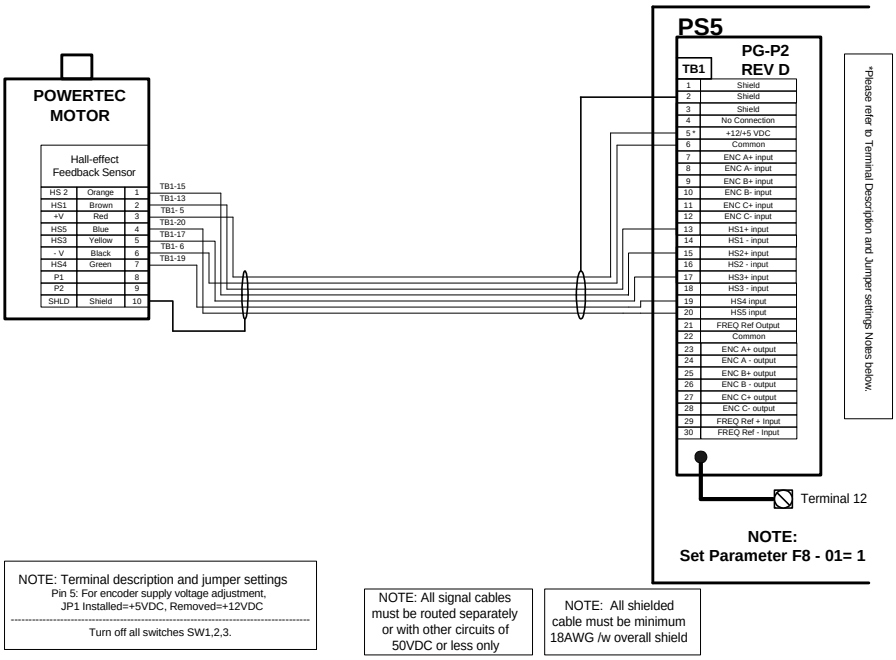


PG-P2 Rev C Connection Diagram for PS5
POWERTEC motor/w aux. encoder and Digimax controller

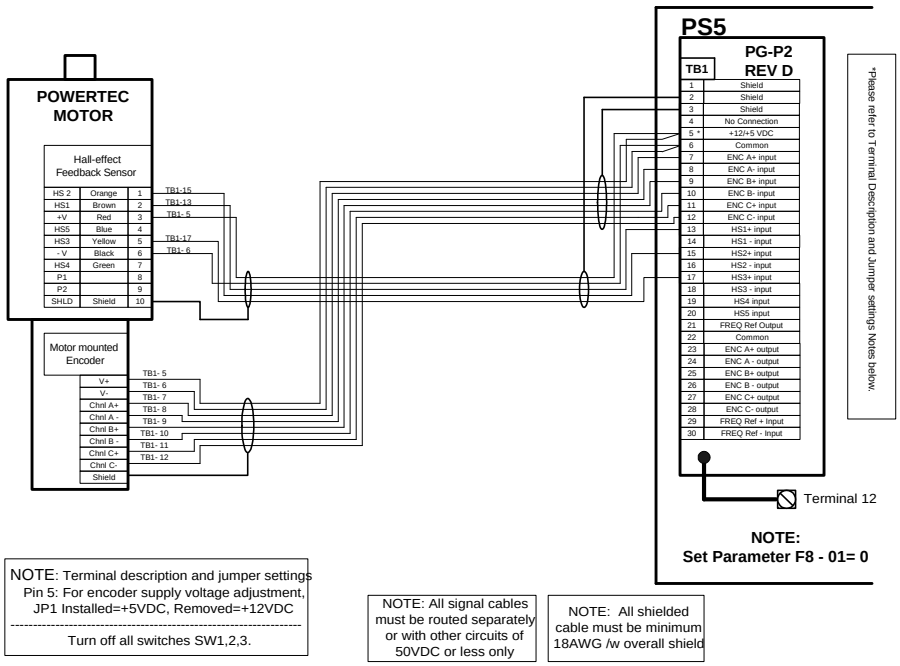


PG-P2 Rev C Connection Diagram for PS5
POWERTEC motor/w com encoder and Digimax controller

C.3 PG-P2 Rev D Connection Diagrams

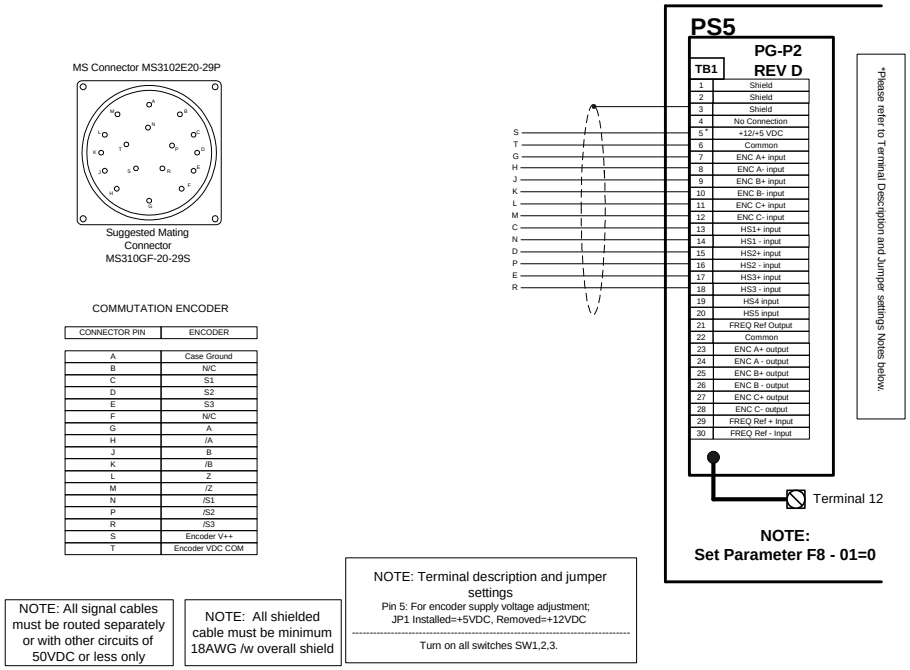


PG-P2 Rev D Connection Diagram for PS5
POWERTEC motor basic

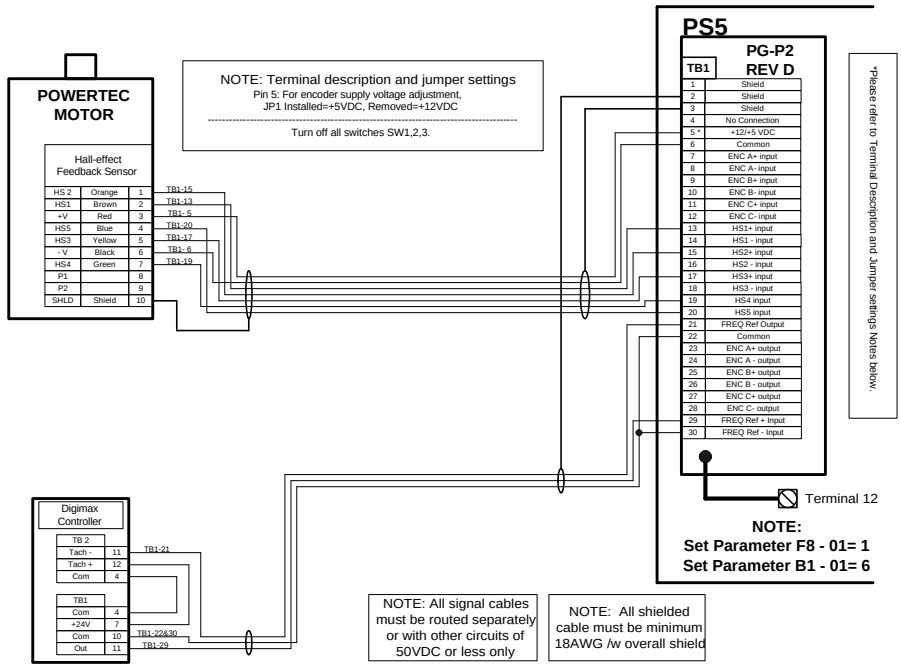


PG-P2 Rev D Connection Diagram for PS5
POWERTEC motor/w aux. encoder

C.3 PG-P2 Rev D Connection Diagrams (continued)

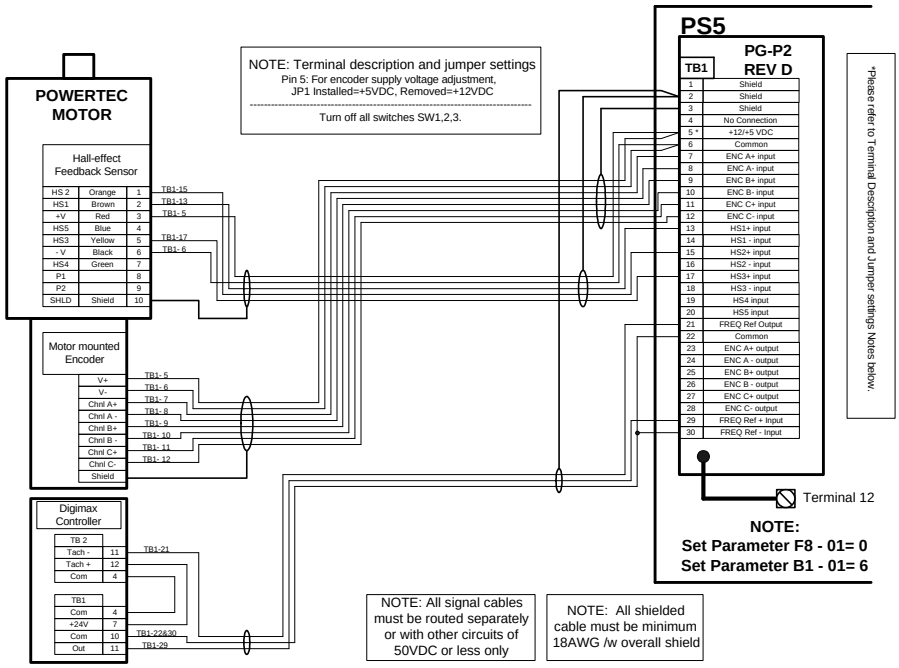


PG-P2 Rev D Connection Diagram for PS5
POWERTEC motor w/com encoder

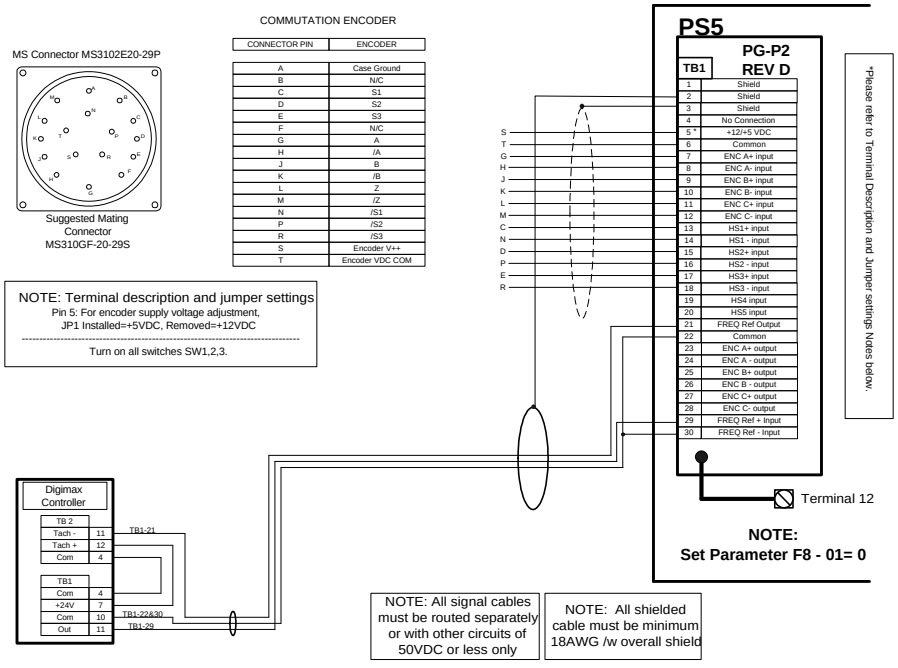


PG-P2 Rev D Connection Diagram for PS5
POWERTEC motor and Digimax controller

C.3 PG-P2 Rev D Connection Diagrams (continued)



PG-P2 Rev D Connection Diagram for PS5
POWERTEC motor/w aux. encoder and Digimax controller



PG-P2 Rev D Connection Diagram for PS5
POWERTEC motor/w com encoder and Digimax controller

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APPENDIX D

Parameter List

D.1 Parameter List

No.	Parameter Description	Unit	Setting Range	Default	Access Level	User Setting
Operation						
U	**Operation**					
U1	**Monitor**					
U1-01	Speed reference	%	0.0~100.0	0.0	Q	
U1-02	Output frequency	Hz	-	-	Q	
U1-03	Inverter output current	A	-	-	Q	
U1-05	Motor speed	%	-	-	Q	
U1-06	Output voltage	V_{ac}	-	-	Q	
U1-07	DC bus voltage	V_{dc}	-	-	Q	
U1-08	Output power	kW	-	-	Q	
U1-09	Torque reference (internal)	%	-	-	Q	
U1-10	Input terminal status	-	-	-	Q	
U1-11	Output terminal status	-	-	-	Q	
U1-12	Internal control status 1	-	-	-	Q	
U1-13	Elapsed time	H	-	-	Q	
U1-14	Flash ID number	-	-	-	Q	
U1-15	External terminal 13 input voltage	%	-	-	B	
U1-16	External terminal 14 input voltage	%	-	-	B	
U1-17	External terminal 16 input voltage	%	-	-	B	
U1-18	Motor torque current (I_q)	%	-	-	B	
U1-19	Motor excitation current ($I_{d)}$	%	-	-	B	
U1-20	Primary frequency after SFS	%	-	-	A	
U1-21	Speed controller ASR input	%	-	-	A	
U1-22	Speed controller ASR output	%	-	-	A	
U1-27	q Axis current control reference	%	-	-	A	
U1-28	d Axis current control reference	%	-	-	A	
U1-29	Voltage limit control output	%	-	-	A	
U1-30	q Axis current control output	%	-	-	A	
U1-31	d Axis current control output)	%	-	-	A	
U1-32	Output voltage reference (V_q)	V	-	-	A	
U1-33	Output voltage reference (V_d)	V	-	-	A	
U1-41	LED check	-	-	-	A	
U1-42	Internal control status 2	-	-	-	A	
U1-43	Command 1 from option	-	-	-	A	
U1-44	Command 2 from option	-	-	-	A	
U1-45	External torque reference	%	-	-	A	
U1-46	Torque compensation value	%	-	-	A	
U1-47	DO-08H output status	-	-	-	A	

No.	Parameter Description	Unit	Setting Range	Default	Access Level	User Setting
U1-49	Control section software number	-	-	-	A	
U1-50	Speed detection PG counter value	-	-	-	A	
U1-53	PID feedback	%	-	-	A	
U1-54	DI-16H input status	-	-	-	A	
U1-55	Hall Sensor Status	-	-	-		
U2	**Fault Trace**					
U2-01	Existing detected fault	-	-	-	Q	
U2-02	Previous detected fault	-	-	-	Q	
U2-03	Frequency reference when fault was detected	%	-	-	Q	
U2-04	Output frequency when fault was detected	Hz	-	-	Q	
U2-05	Output current when fault was detected	A	-	-	Q	
U2-06	Motor speed reference	%	-	-	Q	
U2-07	Output voltage when fault was detected	V_{ac}	-	-	Q	
U2-08	DC bus voltage	V_{dc}	-	-	Q	
U2-09	Output power	kW	-	-	Q	
U2-10	Torque reference at fault	%	-	-	Q	
U2-11	Input terminal status	-	-	-	Q	
U2-12	Output terminal status	-	-	-	Q	
U2-13	Drive status before fault was detected	-	-	-	Q	
U2-14	Elapsed time since fault was detected	H	-	-	Q	
U2-15	Motor magnetizing current (I_q) at fault	%	-	-	B	
U2-16	Motor magnetizing current (I_d) at fault	%	-	-	B	
U2-17	Internal control status 2 at fault	-	-	-	A	
U2-18	Command 1 from option at fault	-	-	-	A	
U2-19	Command 2 from option at fault	-	-	-	A	
U2-20	External torque reference at fault	%	-	-	A	
U2-21	Torque compensation at fault	%	-	-	A	
U2-22	Speed controller ASR output at fault	-	-	-	A	
U3	**Fault History**					
U3-01	Most recent fault code	-	-	-	Q	
U3-02	2nd most recent fault code	-	-	-	Q	
U3-03	3rd most recent fault code	-	-	-	Q	
U3-04	4th most recent fault code	-	-	-	Q	
U3-05	Elapsed time since most recent fault	H	-	-	Q	
U3-06	Elapsed time since 2nd most recent fault	H	-	-	Q	
U3-07	Elapsed time since 3rd most recent fault	H	-	-	Q	
U3-08	Elapsed time since 4th most recent fault	H	-	-	Q	
Initialization						
A	**Initialization**					
A1	**Initialization Set-up**					
A1-01	Parameter access level 0: Operation only 3: Basic level 1: User program 4: Advanced level 2: Quick start level	-	0~4	2	Q	
A1-03	Operator status 0: No initialization 3330: 3-Wire initialization 2220: 2-Wire initialization	-	0~9999	0	Q	
A1-04	Password entry	-	0000~9999	-	Q	

No.	Parameter Description	Unit	Setting Range	Default	Access Level	User Setting
Programming						
B	**Application**					
B1	**Sequence**					
B1-01	Frequency reference selection 0: Operator 3: Option PCB 1: Terminals 4: CP-717 2: Serial communication	-	0~4	1	Q	
B1-02	Operation method selection 0: Operator 3: Option PCB 1: Terminals 4: CP-717 2: Serial communication	-	0~4	1	Q	
B1-03	Stopping method selection 0: Ramp to stop 3: Coast with timer 1: Coast to stop	-	0~3	0	Q	
B1-04	Prohibition of reverse operation 0: Reverse enabled 1: Reverse disabled	-	0/1	0	B	
B1-05	Operation selection at zero speed 0: RUN at freq. ref 2: RUN at min freq. 1: Stop 3: RUN at zero rpm	-	0~3	1	A	
B1-06	Local/Remote run select 0: Cycle extra RUN 1: Accept extra RUN	-	0/1	1	A	
B2	**Servo Speed Level**					
B2-01	Zero speed level (BB starting speed)	%	0.0~20.0	0.5	B	
B3	**Magnetic Pull-in**					
B3-02	Magnetic pull-in current	%	0~150	50	A	
B3-04	Current ramp-up time	s	0.0~5.0	1.0	A	
B3-05	Magnetic pull-in time	s	0.0~5.0	1.0	A	
B4	**Delay Timers**					
B4-01	On-delay timer	s	0.0~300.0	0.0	A	
B4-02	Off-delay timer	s	0.0~300.0	0.0	A	
B5	**PID Control**					
B5-01	PID control mode selection 0: Disabled 1: Enabled D = feedback 2: Enabled D = feedfwd	-	0~2	0	A	
B5-02	PID control proportional gain	-	0.00~25.00	1.00	A	
B5-03	PID control integral time	s	0.00~360.0	1.00	A	
B5-04	PID control integral limit	%	0.0~100.0	100.0	A	
B5-05	PID control derivative time	s	0.00~10.00	0.00	A	
B5-06	PID control limit	%	0.0~100.0	100.0	A	
B5-07	PID control offset	%	±100.0	0.0	A	
B5-08	PID control output primary delay time	s	0.00~10.00	0.00	A	
B6	**Reference Hold**					
B6-01	Dwell reference at start (dwell level)	%	0.0~100.00	0.00	A	
B6-02	Dwell time at start (dwell time)	s	0.0~10.0	0.0	A	
B6-03	Dwell reference at stop (dwell level)	%	0.0~100.00	0.00	A	
B6-04	Dwell time at stop (dwell time)	s	0.0~10.0	0.0	A	
B7	**Droop Control**					
B7-01	Droop capacity	%	0.0~100.0	0.0	A	
B7-02	Droop delay time	s	0.00~1.00	0.10	A	

No.	Parameter Description	Unit	Setting Range	Default	Access Level	User Setting
C	**Tuning Parameters**					
C1	**Accel/Decel**					
C1-01	Acceleration time 1	s	0.00~6000.0	10.0	Q	
C1-02	Deceleration time 1	s	0.00~6000.0	10.0	Q	
C1-03	Acceleration time 2	s	0.00~6000.0	10.0	B	
C1-04	Deceleration time 2	s	0.00~6000.0	10.0	B	
C1-05	Acceleration time 3	s	0.00~6000.0	10.0	A	
C1-06	Deceleration time 3	s	0.00~6000.0	10.0	A	
C1-07	Acceleration time 4	s	0.00~6000.0	10.0	A	
C1-08	Deceleration time 4	s	0.00~6000.0	10.0	A	
C1-09	Fast-stop time	s	0.00~6000.0	10.0	B	
C1-10	Accel/decel time setting units 0: 0.01 seconds 1: 0.1 seconds	-	0/1	1	A	
C1-11	Accel/decel time switching speed level	%	0.0~100.0	0.0	A	
C2	**PG Origin Pulse Compensation**					
C2-13	PG origin pulse compensation value	degrees	±180°	-	Q	
C3	**Voltage Limit Control**					
C3-05	Voltage limit control selection	-	0/1	0	A	
C5	**ASR Tuning**					
C5-01	ASR proportional gain 1	-	0.00~300.00	5.00	B	
C5-02	ASR integral time 1	s	0.000~10.000	0.500	B	
C5-03	ASR proportional gain 2	-	0.00~300.00	5.00	B	
C5-04	ASR integral time 2	s	0.000~10.000	0.500	B	
C5-05	ASR output primary delay time	s	0.000~0.500	0.004	A	
C5-06	ASR switching speed level	%	0.00~100.00	0.00	A	
C5-07	ASR p gain at start	-	0.00~300.00	5.00	A	
C6	**Carrier Frequency**					
C6-02	Carrier frequency	kHz	2,4,6,8,12	*	A	
C6-13	Pulse Reference Ratio Denominator Value	-	0~1000	0	A	
C6-14	Pulse Reference Ratio Numerator Value	-	0~1000	0	A	
C7	**S-Curve Accel/Decel Characteristics**					
C7-01	S-Curve characteristic time at start of acceleration	s	0.00~250.0	0.00	A	
C7-02	S-Curve characteristic time at end of acceleration	s	0.00~250.0	0.00	A	
C7-03	S-Curve characteristic time at start of deceleration	s	0.00~250.0	0.00	A	
C7-04	S-Curve characteristic time at end of deceleration	s	0.00~250.0	0.00	A	
D	**Reference Parameters**					
D1	**Preset References**					
D1-01	Preset reference 1	%	0.00~100.00	0.00	Q	
D1-02	Preset reference 2	%	0.00~100.00	0.00	Q	
D1-03	Preset reference 3	%	0.00~100.00	0.00	Q	
D1-04	Preset reference 4	%	0.00~100.00	0.00	Q	
D1-05	Preset reference 5	%	0.00~100.00	0.00	B	
D1-06	Preset reference 6	%	0.00~100.00	0.00	B	
D1-07	Preset reference 7	%	0.00~100.00	0.00	B	
D1-08	Preset reference 8	%	0.00~100.00	0.00	B	
D1-09	Jog frequency reference	%	0.00~100.00	10.00	Q	

*KVA dependant parameter

No.	Parameter Description	Unit	Setting Range	Default	Access Level	User Setting
D2	**Reference Limits**					
D2-01	Reference upper limit	%	0.0~110.0	100.0	B	
D2-02	Reference lower limit	%	0.0~100.0	0.0	B	
D3	**Jump Frequencies**					
D3-01	Jump frequency reference 1	%	0.0~200.0	0.0	A	
D3-02	Jump frequency reference 2	%	0.0~200.0	0.0	A	
D3-03	Jump frequency reference 3	%	0.0~200.0	0.0	A	
D3-04	Jump frequency reference bandwidth	%	0.0~200.0	1.0	A	
D4	**Hold reference memory**					
D4-01	Hold reference memory selection - Up/Down 0: Disabled 1: Enabled	-	0/1	0	A	
D5	**Torque Control**					
D5-01	Torque control selection 0: Speed control 1: Torque control	-	0/1	0	A	
D5-02	Torque limit primary delay time	ms	0~1000	0	A	
D5-03	Speed limit input selection 1: Analog Input 2: Program Setting	-	1/2	1	A	
D5-04	Speed limit value	%	±120	0	A	
D5-05	Speed limit bias	%	0~120	5	A	
D5-06	Reference delay time	ms	0~1000	50	A	
E	**Motor Parameters**					
E1	**Motor Constant**					
E1-01	Input voltage setting	V	180~230	230	Q	
E1-02	Motor capacity selection	-	1000~1239	1000	Q	
E1-03	Motor rated voltage	V	0.0~255.0	*	Q	
E1-04	Motor rated current	A	0.0~200.0	*	Q	
E1-05	Number of motor poles	-	2, 4, 6, 8	*	Q	
E1-06	Maximum motor speed	rpm	0~6000	*	Q	
E1-07	Base motor speed	rpm	0~6000	*	Q	
E1-08	Minimum motor speed	rpm	0~6000	*	Q	
E1-09	Motor armature resistance	Ω	0.000~65.535	*	Q	
E1-10	Motor d axis inductance	mH	0.00~600.00	*	Q	
E1-11	Motor q axis inductance	mH	0.00~600.00	*	Q	
E1-13	Induced voltage constant	mV/rpm	20.0~500.0	*	Q	
E1-15	Motor mechanical loss	%	0.0~10.0	*	A	
E1-16	Motor feeder resistance	%	0.0~10.0	*	A	
E1-17	Motor connection selection 0: 1D 2: 1Y 1: 2D 3: 2Y	-	0~3	0	Q	
F	**Option Parameters**					
F1	**PG Option Setup**					
F1-01	PG pulses per revolution	-	0~10000	30	Q	
F1-02	PG disconnection detection stopping method 0: Ramp to stop 2: Fast-stop 1: Coast to stop 3: Alarm only	-	0~3	1	B	
F1-03	Overspeed detection stopping method 0: Ramp to stop 2: Fast-stop 1: Coast to stop 3: Alarm only	-	0~3	1	B	

No.	Parameter Description	Unit	Setting Range	Default	Access Level	User Setting
F1-04	PG deviation detection stopping method 0: Ramp to Stop 2: Fast-Stop 1: Coast to Stop 3: Alarm Only	-	0~3	3	B	
F1-05	PG rotation selection 0: CCW 1: CW	-	0/1	1	Q	
F1-08	Overspeed detection level	%	0~120	115	A	
F1-09	Overspeed detection time	s	0~2.0	0.0	A	
F1-10	PG deviation detection level	%	0~50	10	A	
F1-11	PG deviation detection time	s	0~10.0	0.5	A	
F1-13	PG open phase detection delay time	s	0.0~10.0	3.0	A	
F2	**A1-14B Setup**					
F2-01	Bipolar or unipolar input selection 0: 3-channel individual 1: 3-channel additional	-	0/1	0	A	
F3	**D1-08/DI-16H Setup**					
F3-01	Digital input option 0: BCD 1% 2: BCD 0.01% 1: BCD 0.1% 7: Binary	-	0~7	0	A	
F4	**AO-08/AO-12 Setup**					
F4-01	Analog output Channel 1 selection 1: Speed reference 2: Output frequency 3: Inverter output current 5: Motor speed 6: Output voltage 7: DC bus voltage 8: Output power 9: Torque reference (internal) 15: External terminal 13 input voltage 16: External terminal 14 input voltage 17: External terminal 16 input voltage 18: Motor secondary current (I_q) 19: Motor excitation current (I_d) 20: Primary frequency after SFS 21: Speed controller ASR input 22: Speed controller ASR output 27: q Axis current control reference 28: d Axis current control reference 29: Voltage limit control output 30: q Axis current control output 31: d Axis current control output 32: Output voltage reference (V_q) 33: Output voltage reference (V_d) 45: External torque reference 46: Torque compensation value 49: Control section software number 50: Speed detection PG counter value 53: PID feedback	-	1~60	5	A	
F4-02	Analog output channel 1 gain	-	±300.0	1.0	A	
F4-03	Analog output channel 1 bias	%	±109.2	0.0	A	
F4-04	Analog output channel 2 selection (same as F4-01)	-	1~60	3	A	
F4-05	Analog output channel 2 gain	-	±300.0	1.0	A	

No.	Parameter Description	Unit	Setting Range	Default	Access Level	User Setting
F4-06	Analog output channel 2 bias	-	±109.2	0.0	A	
F5	**DO-02 Setup**					
F5-01	DO-02C digital output channel 1 selection 0: During RUN 1 1: Zero speed 2: Fref/Fout agree 1 3: Fref/Set agree 1 4: Frequency detection 1 5: Frequency detection 2 6: Inverter Ready 7: DC bus undervoltage 8: Baseblock 1 9: Option reference A: Remote operation B: Torque detection 1 (N.O.) C: Loss of reference D: DB overheat E. Fault F: Not used 10: Minor fault 11: Reset command active 12: Timer output 13: Fref/Fout agree 2 14: Fref/Set agree 2 15: Frequency detection 3 16: Frequency detection 4 17: Torque detection 1 (N.C.) 18: Torque detection 2 (N.O.) 19: Torque detection 2 (N.C.) 1A: Reverse direction 1B: Baseblock 2 1D: Regenerating 1E: Restart enabled 1F: Overload (OL1) 20: OH prealarm 30: Current/Torque limit 31: Speed limit 37: During RUN 2	-	0~FF	0	A	
F5-02	DO-02C digital output Channel 2 selection (same as F5-01)	-	0~3F	1	A	
F6	**DO-08 Set-up**					
F6-01	DO-08 digital output selection 0: 8-channel Individual 1: Binary Output	-	0/1	0	A	
F8	**PG-P2/H2 Set-up**					
F8-01	Speed feedback method selection 0: Encoder inputs 1: Hall sensor input	-	0/1	1	Q	
F8-02	Pulse train moving average value 0=1 Scan (5msec)	-	0-50	0	B	
F9	**CP-916 Set-up**					
F9-01	External fault input level from communication option	-	0/1	0	A	
F9-02	External fault from communication level	-	0/1	0	A	
F9-03	Operation at external fault input from communication option 0: Ramp to stop 2: Fast-stop 1: Coast to stop 3: Alarm only	-	0~3	1	A	

No.	Parameter Description	Unit	Setting Range	Default	Access Level	User Setting
F9-04	Trace sampling of option	-	0~60000	0	A	
F9-05	Torque reference selection from communication option 0: Torque reference/limit from terminal 1: Torque reference/limit from option	-	0/1	0	A	
F9-06	Operation at bus error detection 0: Ramp to stop 2: Fast-stop 1: Coast to stop 3: Alarm only	-	0~3	1	A	
H	**Control Circuit Terminal Parameters**					
H1	**Digital Inputs**					
H1-01	Multi-function input terminal 3 selection 0: 3-Wire control 1: Local/Remote selection 2: Option/Inverter selection 3: Multi-step reference 1 4: Multi-step reference 2 5: Multi-step reference 3 6: Jog frequency reference 7: Multi-accel/decel 1 8: External baseblock N.O. 9: External baseblock N.C. A: Accel/Decel ramp hold B: OH2 alarm signal C: Terminal 16 enable E: ASR integral reset F: Terminal not used 10: MOP increase 11: MOP decrease 12: Forward jog 13: Reverse jog 14: Fault reset 15: Fast-stop 18: Timer function 19: PID disable 1A: Multi-accel/decel 2 1B: Program lockout 1E: Reference sample hold 1F: Terminal 13/14 switch 24: external Fault 71: Speed/Torque control change 77: ASR gain switch	-	0~FF	24	B	
H1-02	Multi-function input terminal 4 selection (same as H1-01)	-	0~FF	14	B	
H1-03	Multi-function input terminal 5 selection (same as H1-01)	-	0~FF	3	B	
H1-04	Multi-function input terminal 6 selection (same as H1-01)	-	0~FF	4	B	
H1-05	Multi-function input terminal 7 selection (same as H1-01)	-	0~FF	6	B	
H1-06	Multi-function input terminal 8 selection (same as H1-01)	-	0~FF	8	B	
H2	**Digital Outputs**					
H2-01	Multi-function output 1 selection (terminal 9, 10) (same as F5-01)	-	0~FF	0	B	

No.	Parameter Description	Unit	Setting Range	Default	Access Level	User Setting
H2-02	Multi-function output 2 selection (terminal 25, 27) (same as F5-01)	-	0~FF	1	B	
H2-03	Multi-function output 3 (terminal 26, 27) (same as F5-01)	-	0~3F	2	B	
H3	**Analog Inputs**					
H3-01	Terminal 13 signal selection 0: 0 to 10V_{dc} 1: ±10V_{dc}	-	0/1	0	B	
H3-02	Terminal 13 reference % gain	%	0.0~1000.0	100.0	B	
H3-03	Terminal 13 reference ±% bias	%	±100.0	0.0	B	
H3-04	Terminal 16 signal selection 0: 0 to 10V_{dc} 1: ±10V_{dc}	-	0/1	0	A	
H3-05	Terminal 16 multi-function selection 0: Auxiliary reference 1: Frequency gain 2: Frequency bias 7: Overtorque level 9: Reference lower limit A: Jump frequency B: PID feedback 10: Forward torque limit 11: Reverse torque limit 12: Regenerative torque limit 13: Torque reference 14: Torque compensation 15: Forward/reverse torque limit	-	0~1F	0	A	
H3-06	Terminal 16 reference % gain)	%	0.0~1000.0	100.0	A	
H3-07	Terminal 16 reference ±% bias	%	±100.0	0.0	A	
H3-08	Terminal 14 signal selection 0: 0 to 10V 2: 4 to 20mA 1: ±10V	-	0~2	2	A	
H3-09	Terminal 14 multi-function selection (same as H3-05)	-	0~1F	1F	A	
H3-10	Terminal 14 reference % gain	%	0.0~1000.0	100.0	A	
H3-11	Terminal 14 reference ±% bias	%	±100.0	0.0	A	
H3-12	Analog input filter time constant (terminals 13, 14 & 16)	s	0.00~2.00	0.00	A	
H4	**Analog Outputs**					
H4-01	Terminal 21 analog output selection (same as F4-01)	-	1~60	5	B	
H4-02	Terminal 21 analog output gain	-	±300.0	1.0	B	
H4-03	Terminal 21 analog output bias	%	±109.2	0.0	B	
H4-04	Terminal 23 analog output selection (same as F4-01)	-	1~60	3	B	
H4-05	Terminal 23 analog output gain	-	±300.0	1.0	B	
H4-06	Terminal 23 analog output bias	%	±109.2	0.0	B	
H4-07	Analog output signal selection 0: 0 to 10V_{dc} 1: ±10V_{dc}	-	0/1	0	B	
H5	**Serial Communications**					
H5-01	Serial communication station address	1	0-20	1F	A	
H5-02	Serial communication speed selection 0: 1200 bps, 1: 2400 bps, 2: 4800 bps, 3: 9600 bps	1	0-3	3	A	

No.	Parameter Description	Unit	Setting Range	Default	Access Level	User Setting
H5-03	Serial communication speed selection 0: No parity, 1: Even parity, 2: Odd parity	1	0-2	0	A	
H5-04	Stopping method after communication error 0: Ramp to stop, 1: Coast to stop, 2: Fast stop, 3: Alarm only	1	0-3	3	A	
H5-05	Serial communication timeover detection 0: Disabled , 1: Enabled	1	0,1	1	A	
L	**Protection Parameters**					
L2	**Power Loss Ride through**					
L2-01	Momentary power loss ride through 0: Disabled	-	0	0	B	
L2-02*	Momentary power loss ride through time	s	0.0~2.0	0.7	B	
L2-05	Undervoltage detection level	V	150~210	190	A	
L3	**Stall Prevention/Current Limit**					
L3-01	Overvoltage protection (stall prevention during decel) 0: Disabled 1: Enabled	-	0~1	1	B	
L4	**Reference Detection**					
L4-01	Speed agree detection level (without sign)	%	0.0~100.0	0.0	B	
L4-02	Speed agree detection width	%	0.0~100.0	2.0	B	
L4-03	Speed agree detection level (with sign)	%	0~±100.0	0.0	A	
L4-04	Speed agree detection width	%	0.0~100.0	2.0	A	
L4-05	Operation when frequency reference is missing 0: Stop 1: Run at 80% of previous reference	-	0/1	0	A	
L5	**Fault Restart**					
L5-01	Number of automatic restart attempts	-	0~10	0	B	
L5-02	Automatic restart operation selection 0: No fault relay 1: Fault relay active	-	0/1	0	B	
L6	**Torque Detection**					
L6-01	Overtorque detection 1 selection 0: Disabled 3: Fault at speed agree 1: Alarm at speed agree 4: Fault at run 2: Alarm at run	-	0~4	0	B	
L6-02	Overtorque detection 1 level	%	0~300	150	B	
L6-03	Overtorque detection 1 time	s	0.0~10.0	0.1	B	
L6-04	Overtorque detection 2 selection 0: Disabled 3: Fault at speed agree 1: Alarm at speed agree 4: Fault at run 2: Alarm at run	-	0~4	0	A	
L6-05	Overtorque detection 2 level	%	0~300	150	A	
L6-06	Overtorque detection 2 time	s	0.0~10.0	0.1	A	
L7	**Torque Limit**					
L7-01	Forward torque limit	%	0~300	150	B	
L7-02	Reverse torque limit	%	0~300	150	B	
L7-03	Regenerative forward torque limit	%	0~300	150	B	
L7-04	Regenerative reverse torque limit	%	0~300	150	B	
L8	**Hardware Protection**					
L8-01	Protection selection for internal DB resistor 0: Not Provided 1: Provided	-	0/1	0	A	
L8-02	OH pre-alarm level	ºC	50~110	95	A	

***Default for Parameter L2-02 is model dependant. For clarification, please refer to Parameter 02-04: Inverter Model Selection

No.	Parameter Description	Unit	Setting Range	Default	Access Level	User Setting
L8-03	Stopping method selection after OH pre-alarm 0: Ramp to stop 2: Fast-stop 1: Coast to stop 3: Alarm only	-	0~3	3	A	
L8-05	Input phase loss protection 0: Disabled 1: Enabled	-	0/1	0	A	
L8-07	Output phase loss protection 0: Disabled 1: Enabled	-	0/1	0	A	
L8-10	Ground fault protection selection 0: Disabled 1: Enabled	-	0/1	1	A	
O	**Operator Parameters**					
O1	**Monitor Selection**					
O1-01	Analog output Channel 1 selection 5: Motor speed 6: Output voltage 7: DC bus voltage 8: Output power 9: Torque reference (internal) 15: External terminal 13 input voltage 16: External terminal 14 input voltage 17: External terminal 16 input voltage 18: Motor secondary current (I_q) 19: Motor excitation current (I_d) 20: Primary speed after SFS 21: Speed controller ASR input 22: Speed controller ASR output 27: q Axis current control reference 28: d Axis current control reference 29: Voltage limit control output 30: q Axis current control output 31: d Axis current control output 32: Output voltage reference (V_q) 33: Output voltage reference (V_d) 45: External torque reference 46: Torque compensation value 49: Control section software number 50: Speed detection PG counter value 53: PID feedback 54: DI-16H input status	-	5~53	6	B	
O1-02	Monitor selection after power-up 1: Speed reference 3: Output current 2: Output speed 4: User monitor	1	1~4	1	B	
O1-03	Scale for setting and monitoring frequency	-	0~39999	1	B	
O2	**Key Selection**					
O2-01	Local/remote key 0: Disabled 1: Enabled	-	0/1	1	B	
O2-02	STOP key during external terminal operation 0: Disabled 1: Enabled	-	0/1	0	B	
O2-04	Inverter model selection	-	00~FF	kVA dependent	B	
O2-05	Digital operator M.O.P. mode selection 0: Disabled 1: Enabled	-	0/1	0	A	
O2-06	Digital operator disconnection detection 0: Disabled 1: Enabled	-	0/1	0	A	
O2-07	Operation time setting	H	0~65535	0	A	

No.	Parameter Description	Unit	Setting Range	Default	Access Level	User Setting
O2-08	Cumulative 0peration time selection 0: Power-ON time 1: Running time	-	0/1	0	A	
T	**Tuning**					
T1	**Auto-tuning**					
T1-02	Tuning mode 0: Normal running mode 2: Auto-tuning mode	-	0/2	0	Q	
T1-03	Tuning operation selection 0: Auto-tuning procedures are performed for all parameters 1: Only PG origin pulse adjustment is performed	-	0/1	1	Q	

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