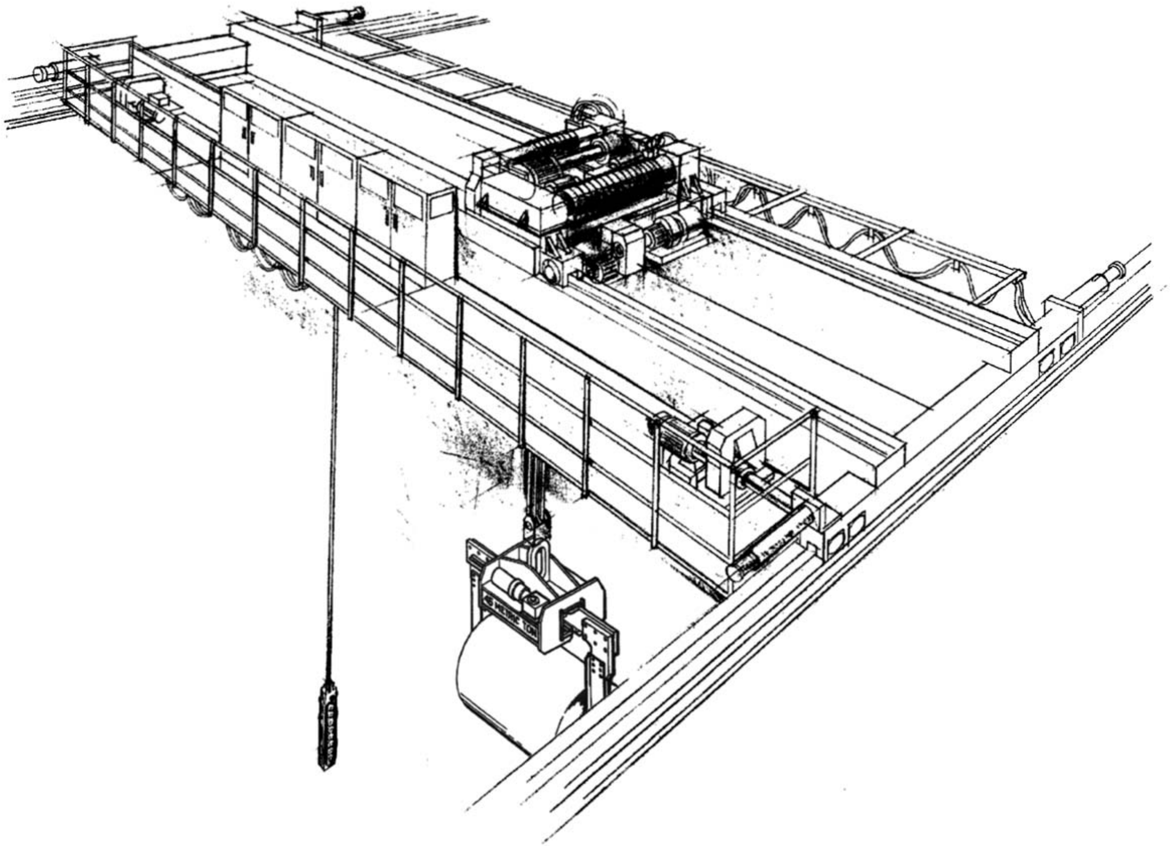

IMPULSE®•P³ Series 2

Adjustable Frequency Crane Controls

Advanced Instruction Manual

MAGNETEK
MATERIAL HANDLING

P3S2ADV-02A February 2008
Part Number: 005-1070-R1

DANGER, *WARNING*, *CAUTION*, and *NOTE* Statements

DANGER, *WARNING*, *CAUTION*, and *Note* statements are used throughout this manual to emphasize important and critical information. You must read these statements to help ensure safety and to prevent product damage. The statements are defined below.

DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.

WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTE: A NOTE statement is used to notify people of installation, operation, programming, or maintenance information that is important, but not hazard-related.

Disclaimer of Warranty

Electromotive Systems hereafter referred to as Company, assumes no responsibility for improper programming of a drive by untrained personnel. A drive should only be programmed by a trained technician who has read and understands the contents of this manual. Improper programming of a drive can lead to unexpected, undesirable, or unsafe operation or performance of the drive. This may result in damage to equipment or personal injury. Company shall not be liable for economic loss, property damage, or other consequential damages or physical injury sustained by the purchaser or by any third party as a result of such programming. Company neither assumes nor authorizes any other person to assume for Company any other liability in connection with the sale or use of this product.

WARNING

Improper programming of a drive can lead to unexpected, undesirable, or unsafe operation or performance of the drive.

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Chapter 1: Introduction

Chapter 2: Installation

Chapter 3: Wiring

Chapter 4: Keypad Operation

Chapter 5: Programming Basic Features

Chapter 6: Programming Advanced Features

Chapter 7: Troubleshooting

Appendix

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c h a p t e r 1

Introduction

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Introduction

The IMPULSE•P^3 Series 2 drive is the next generation of Electromotive Systems drives, providing compact and economical crane control. This drive offers a unique option to the customer of maintaining the look and feel of the original IMPULSE•P^3 drive or utilizing the expanded capabilities of the IMPULSE•P^3 Series 2 drive. As a default setting from the factory, IMPULSE•P^3 Series 2 programming and operation remains identical to the original IMPULSE•P^3 drive, providing an easy transition from the original IMPULSE•P^3 to the IMPULSE•P^3 Series 2.

With the IMPULSE•P^3 Series 2 drive configured to operate as an IMPULSE•P^3, the familiar control capabilities of this drive are readily accessible. These include:

- Volts/Hertz Control
- X-Press Programming
- Swift-Lift
- Reverse Plug Simulation
- Quick Stop

However, by the adjustment of a single parameter, the IMPULSE•P^3 Series 2 can be reconfigured to utilize many additional control features, including:

- Open-Loop Vector Control
- Micro-Speed Control
- Up to 16 Discrete Speed References
- End of Travel Limit Selection
- Load Check
- Expanded Programmable Input/Output Capabilities
- RS-485 Communications

This manual will provide support for the advanced IMPULSE•P^3 Series 2 software. For information on the basic IMPULSE•P^3 Series 2, please consult instruction manual 005-1069.

Specifications

230V Class

Model	2001	2003	2005	2008	2011	2017	2025	2033
Rated current (A)	1.6	3.0	5.0	8.0	11.0	17.5	25.0	33.0
Capacity (kVA)	0.6	1.1	1.9	3	4.2	6.7	9.5	13.0
Horsepower (Ref. Only)	0.25	0.5	1.0	2.0	3.0	5.0	7.5	10.0

460V Class

Model	4001	4002	4003	4004	4008	4014	4018
Rated current (A)	1.2	1.8	3.4	4.8	8.6	14.8	18.0
Capacity (kVA)	0.9	1.4	2.6	3.7	7	11	14
Horsepower (Ref. Only)	0.5	0.75	2.0	3.0	5.0	7.5	10.0

230V, 460V Classes

Specification	Specification Value and Information for All Models
Rated Input Voltage and Frequency	3 phase, 200-230V or 380 to 460V, 50 or 60 Hz
Allowable Voltage Fluctuation	-15% to +10%
Allowable Frequency Fluctuation	±5%
Control Method	Sine wave PWM (V/f control/voltage control selectable)
Frequency Control Range	40 to 1 (V/F), 100 to 1 (OLV)
Frequency Accuracy (Temperature Change)	Digital reference: ±0.01% (-10 to +50°C) Analog reference: ±0.5% (25±10°C)
Frequency Setting Resolution	Digital reference: 0.01Hz (less than 100Hz)/0.1Hz (100Hz or more) Analog reference: 1/1000 of max. output frequency
Overload Capacity	150% rated output current for one minute.
Frequency Reference Signal	0 to 10VDC (20kΩ), 4 to 20mA (250Ω) 0 to 20mA (250Ω), Digital
Accel/Decel Time	0.00 to 25.5 sec. (accel/decel times are independently programmed)
Braking Torque	Regenerative torque: (150% of VFD rating with braking resistor)
V/f Characteristics	Programmable
Motor Overload Protection	Electronic thermal overload relay
Instantaneous Overcurrent	Inverter output is shut off at 250% of inverter rated current
Overvoltage	Overvoltage occurs when DC Bus voltage exceeds 410V for 230V class or 820V for 460V class
Undervoltage	Undervoltage occurs when DC Bus voltage drops below 200V for 230V class or 400V for 460V class
Cooling Fin Overheat	Protected by electronic circuit
Ground Fault	Protected by electronic circuit (overcurrent level)
Power Charge Indication	ON until the DC bus voltage becomes 50V or less. RUN lamp stays ON or digital operator LED stays ON.
Ambient Temperature	14 to 122°F (-10 to +50°C)
Humidity	95% RH or less (non-condensing)
Storage Temperature	-4 to 140°F (-20 to 60°C)
Location	Indoor (free from corrosive gases or dust)
Vibration	Up to 9.8m/S^2 (1G) at less than 20 Hz, up to 2m/S^2 (0.2G) at less than 20 to 50Hz

c h a p t e r **2**

Installation

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Mounting

WARNING

- *Mount the drive on nonflammable material.*

- *The IMPULSE•P^3 Series 2 drive generates heat. For the most effective cooling possible, mount vertically.*

- *When mounting units in an enclosure, install a fan or other cooling device to keep the enclosure air temperature below 122°F (50°C).*

Mounting the Inverter

Be sure the inverter is protected from the following conditions:

- Extreme cold and heat. Use only within the ambient temperature range: 14 to 122°F (-10 to +50°C).
- Rain, moisture.
- Oil sprays, splashes.
- Salt spray.
- Direct sunlight. (Avoid using outdoors).
- Corrosive gases (e.g. sulfurous gas) or liquids.
- Dust or metallic particles in the air.
- Physical shock, vibration.
- Magnetic noise. (Example: welding machines, power devices, etc.)
- High humidity.
- Radioactive substances.
- Combustibles: thinner, solvents, etc.

IMPULSE®•P3 Series 2 Dimensions/Heat Loss

230 Volt

Model	Overall Dimensions in inches and (mm)			Mounting Dimensions in inches and (mm)				Total Heat Loss	
	W	H	D	W1	H1	d	Wt Lbs/(kg)	(W)	Fig.
2001-P3S2	2.68 (68)	5.04 (128)	2.99 (76)	2.20 (56)	4.65 (118)	M4	1.55 (0.7)	18.0	2-1
2003-P3S2	2.68 (68)	5.04 (128)	4.25 (108)	2.20 (56)	4.65 (118)	M4	2.20 (1.0)	28.1	2-1
2005-P3S2	2.68 (68)	5.04 (128)	5.04 (128)	2.20 (56)	4.65 (118)	M4	2.65 (1.2)	45.1	2-1
2008-P3S2	4.25 (108)	5.04 (128)	5.16 (131)	3.78 (96)	4.65 (118)	M4	3.53 (1.6)	72.8	2-2
2011-P3S2	4.25 (108)	5.04 (128)	5.51 (140)	3.78 (96)	4.65 (118)	M4	3.75 (1.7)	94.8	2-2
2017-P3S2	5.51 (140)	5.04 (128)	5.63 (143)	5.04 (128)	4.65 (118)	M4	5.30 (2.4)	149.1	2-2
2025-P3S2	7.09 (180)	10.24 (260)	6.70 (170)	6.46 (164)	9.61 (244)	M5	10.14 (4.6)	256.5	2-3
2033-P3S2	7.09 (180)	10.24 (260)	6.70 (170)	6.46 (164)	9.61 (244)	M5	10.58 (4.8)	308.9	2-3

460 Volt

Model	Overall Dimensions in inches and (mm)			Mounting Dimensions in inches and (mm)				Total Heat Loss	
	W	H	D	W1	H1	d	Wt Lbs/(kg)	(W)	Fig.
4001-P3S2	4.25 (108)	5.04 (128)	3.62 (92)	3.78 (96)	4.65 (118)	M4	2.65 (1.2)	23.1	2-2
4002-P3S2	4.25 (108)	5.04 (128)	4.33 (110)	3.78 (96)	4.65 (118)	M4	2.65 (1.2)	30.1	2-2
4003-P3S2	4.25 (108)	5.04 (128)	5.51 (140)	3.78 (96)	4.65 (118)	M4	3.75 (1.7)	54.9	2-2
4004-P3S2	4.25 (108)	5.04 (128)	6.14 (156)	3.78 (96)	4.65 (118)	M4	3.75 (1.7)	75.7	2-2
4008-P3S2	5.51 (140)	5.04 (128)	5.63 (143)	5.04 (128)	4.65 (118)	M4	5.30 (2.4)	117.9	2-2
4014-P3S2	7.09 (180)	10.24 (260)	6.70 (170)	6.46 (164)	9.61 (244)	M5	10.14 (4.6)	256.5	2-3
4018-P3S2	7.09 (180)	10.24 (260)	6.70 (170)	6.46 (164)	9.61 (244)	M5	10.58 (4.8)	308.9	2-3

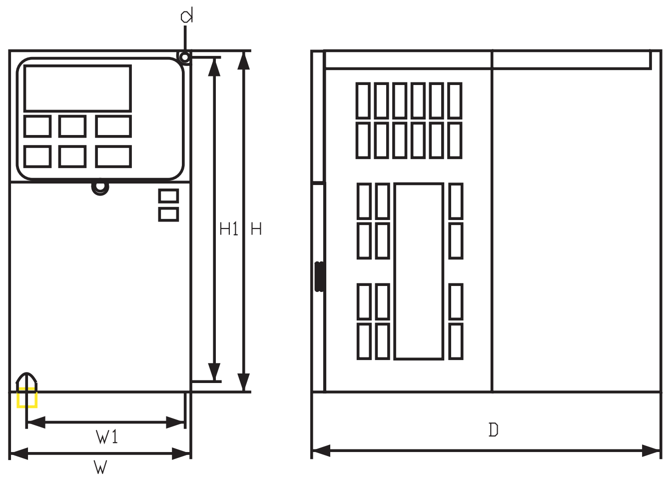

Figure 2-1

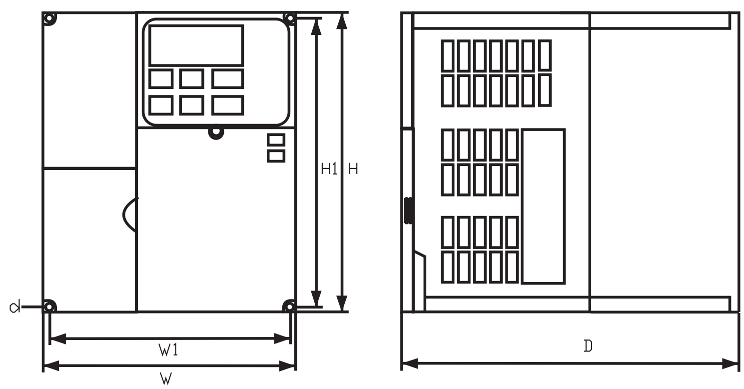

Figure 2-2

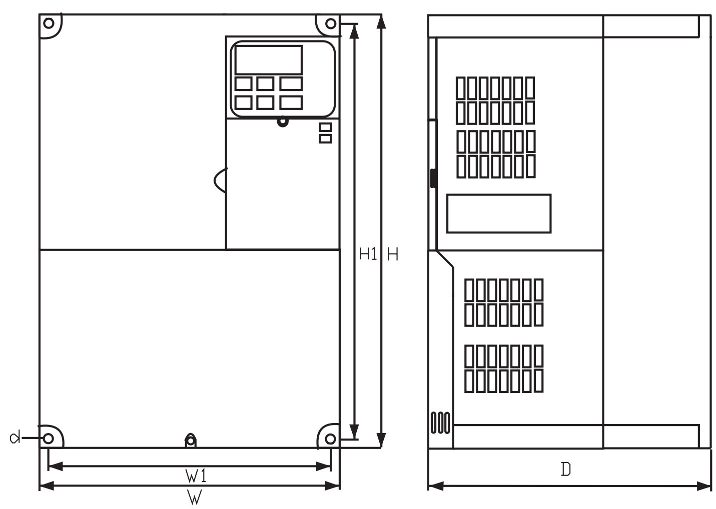

Figure 2-3

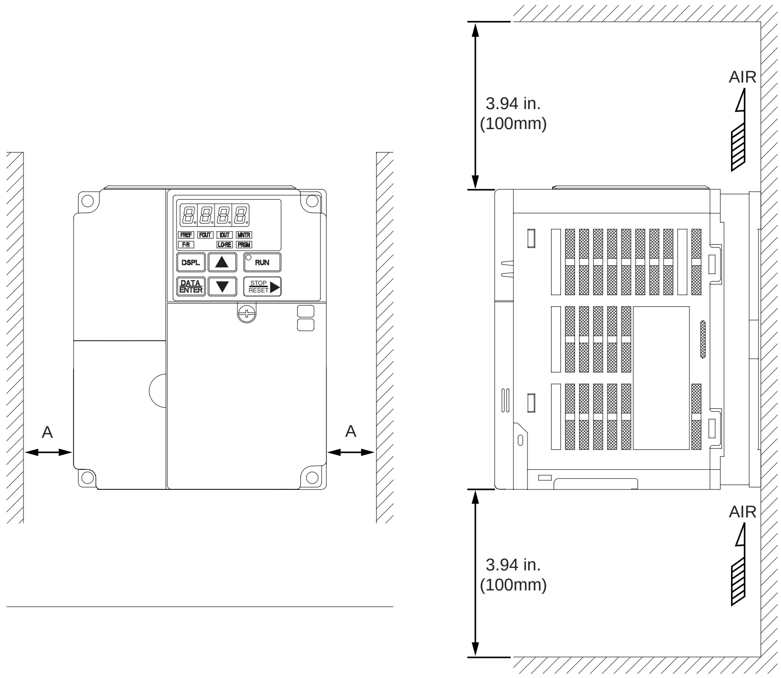

Figure 2-4: Mounting Clearances

Reference the table below for the recommended clearances to use when mounting the drive.

Voltage	Max. Applicable Motor Output HP	A
230V 3-Phase 460V 3-Phase	Less than 5 HP	More than 1.18in. (30mm)
230V 3-Phase 460V 3-Phase	7.5 HP 10 HP	More than 1.97in. (50mm)

c h a p t e r **3**

Wiring

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IMPULSE®•P³ Series 2 Wiring Practices

WARNING

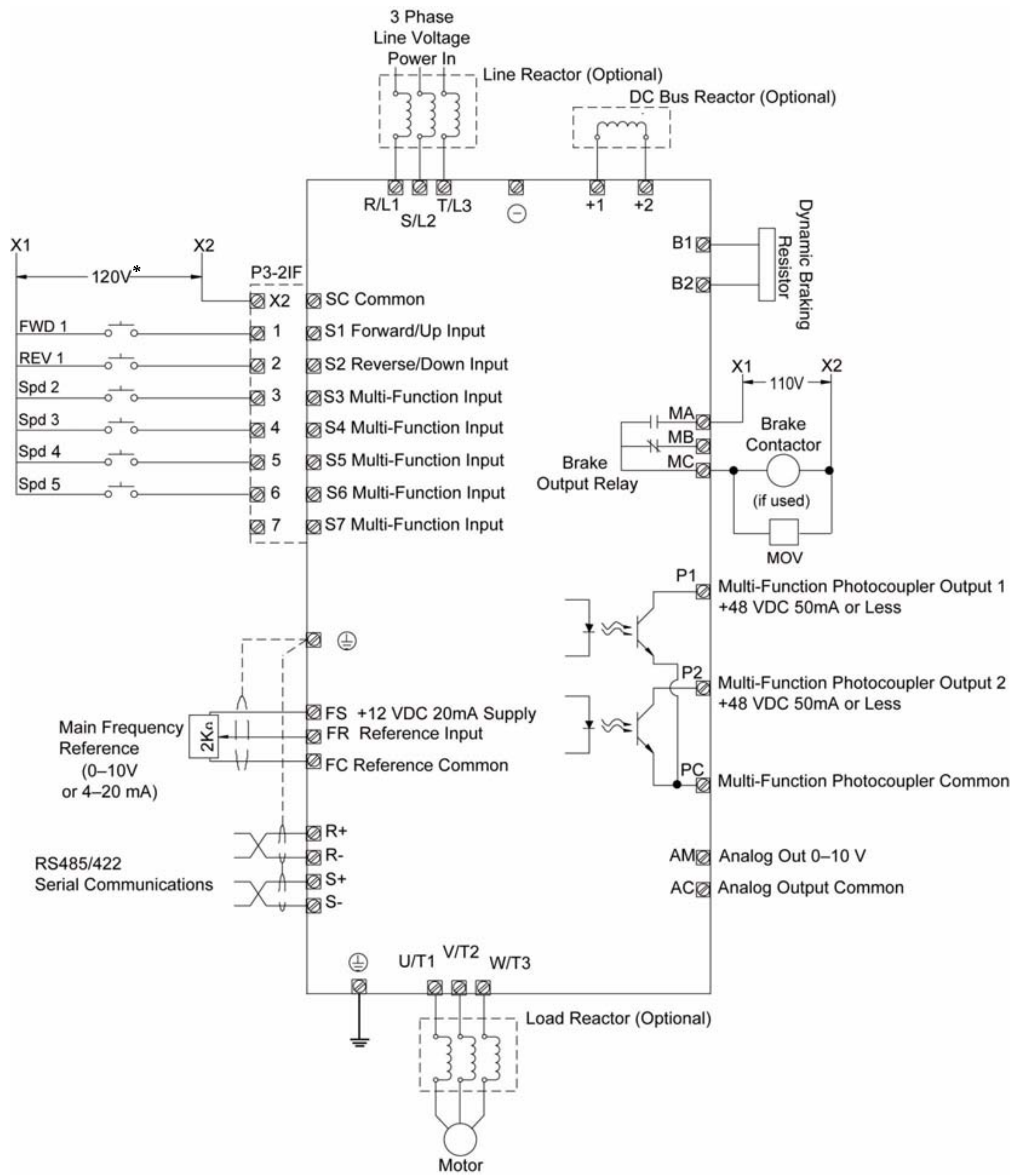
Before you wire the drive, review the following practices to ensure that your system is wired properly.

- Connect the incoming three-phase AC source to terminals R/L1, S/L2, T/L3.
- Connect the Motor leads to terminals U/T1, V/T2, W/T3.
- Ensure that the drive-to-motor wiring distance is less than 150 ft. unless appropriate reactors and/or filters are used.
- On external user input devices, use hard contact inputs rather than solid-state inputs.
- If the user input device is a solid state device or a PLC TRIAC output, use a 5KΩ, 10W resistor in parallel with the signal and X2.
- If the power source is 500 kVA or greater, or more than 10 times the inverter kVA rating, ensure that there is at least 3 percent impedance between the power source and the drive input. To accomplish this, you can install a DC reactor between inverter terminals +1 and +2, or use an AC line reactor on the input of the drive. If you don't provide enough impedance, excessive peak currents could damage the input power supply circuit.
- If the user input device is a PLC TRIAC output, use a 5KΩ, 10W resistor between the signal and L2 (x2).
- Comply with "Suggested Circuit Protection Specifications and Wire Size."
- Use time delay fuses, which are sized at 150% of drive's continuous-rated current, for drive input protection.
- Use appropriate R-C or MOV type surge absorbers across the coil of all contactors and relays in the system. Failure to do so could result in noise-related, nuisance fault incidents.
- Ensure that the drive is solidly grounded to the enclosure sub-panel and that all ground leads are as short as possible. (Refer to Grounding on page 3-7).
- Use external dynamic braking resistors for all applications.
- Do not ground the drive with any large-current machines.
- Before using any welding or high-current equipment near the drive, disconnect all wires from the drive and ground wiring.
- Do not use output contactors between the drive and the motor.
- Do not let the wiring leads come in contact with the drive enclosure.
- Do not connect power factor correction capacitors to the drive input or output.
- Hard-wire the drive and motor (e.g., festoon cable). Do not use sliding collector bars.
- If you have a user input device or interface board that is remote, use shielded cable between the drive input terminals and the interface output terminals or use input device(s).
- Before turning on the drive, check the output circuit (U/T1, V/T2 and W/T3) for possible short circuits and ground faults.

- Use shielded cable for all low-level DC speed reference signals (0 to 10VDC, 4 to 20 mA). Ground the shield only at the drive side.
- Increase wire size by one size for every 250 feet (76.2 meters) between the drive and motor; suggested for center driven cranes, trolleys, and bridges. (Volage drop is especially significant at low carrier frequencies)

Failure to observe these warnings may result in equipment damage.

Standard Wiring



***** A 120VAC interface is standard. 24VAC and 48VAC interface cards are optional and must be specified.*

Figure 3-1: Standard Wiring Diagram

Terminal Description

Type			Terminal	Name	Function (Signal Level)	
Main Circuit			R/L1, S/L2, T/L3	AC power supply input	AC power supply input	
			U/T1, V/T2, W/T3	Inverter output	Inverter output	
			B1, B2	Braking resistor connection	Braking resistor connection	
			+2, +1	DC reactor connection	When connecting optional DC reactor, remove the main circuit short-circuit bar between +2 and +1.	
			+1, (–)	DC power supply input	DC power supply input (+1: positive –: negative)	
			⏚	Grounding	Ground to local grounding codes	
Control Circuit	Input	Sequence	S1	Multi-function input selection 1	FWD run when closed, stop when open	Photo-coupler insulation 24VDC, 8mA.
			S2	Multi-function input selection 2	REV run when closed, stop when open	
			S3	Multi-function input selection 3	Inputs are programmable	
			S4	Multi-function input selection 4		
			S5	Multi-function input selection 5		
			S6	Multi-function input selection 6		
			S7	Multi-function input selection 7		
			SC	Multi-function input selection common	Common for control signal	
		Frequency reference	FS	Power for frequency setting	+12V (permissible current 20mA max.)	
			FR	Master speed frequency reference	0 to +10VDC (20kΩ), 4 to 20mA (250Ω) or 0 to 20mA (250Ω)	
			FC	Frequency reference common	0V	
	Output	Multi-function contact output	MA	NO contact output	Factory setting: brake output	Contact capability 250VAC 1A or less, 30VDC 1A or less
			MB	NC contact output		
			MC	Contact output common		
			P1	Photo-coupler output 1	Outputs are programmable	Photo-coupler output +48VDC, 50mA or less
			P2	Photo-coupler output 2		
			PC	Photo-coupler output common	0V	
			AM	Analog monitor output	Factory setting: Output frequency 0 to +10V	+10VDC, 2mA or less, 8-bit resolution
			AC	Analog monitor common	0V	
Communication Circuit Terminal		MEMOBUS communications	R+	Communications input (+)	MEMOBUS communication Run through RS-485 or RS-422.	RS-485/422 MEMOBUS protocol, 19.2 kps max.
			R-	Communications input (-)		
			S+	Communications output (+)		
			S-	Communications output (-)		

Suggested Circuit Protection Specifications and Wire Size

In order to comply with most safety standards, some circuit protective device should be used between the incoming three-phase power supply and the IMPULSE•P^3 Series 2 drive. This device can be thermal, magnetic, or molded-case breakers (MCCB); or time delay type fuses such as "CCMR" or "J."

CAUTION:

The following guidelines are only suggested values. Always conform to NEC and your local electrical codes and wiring practices.

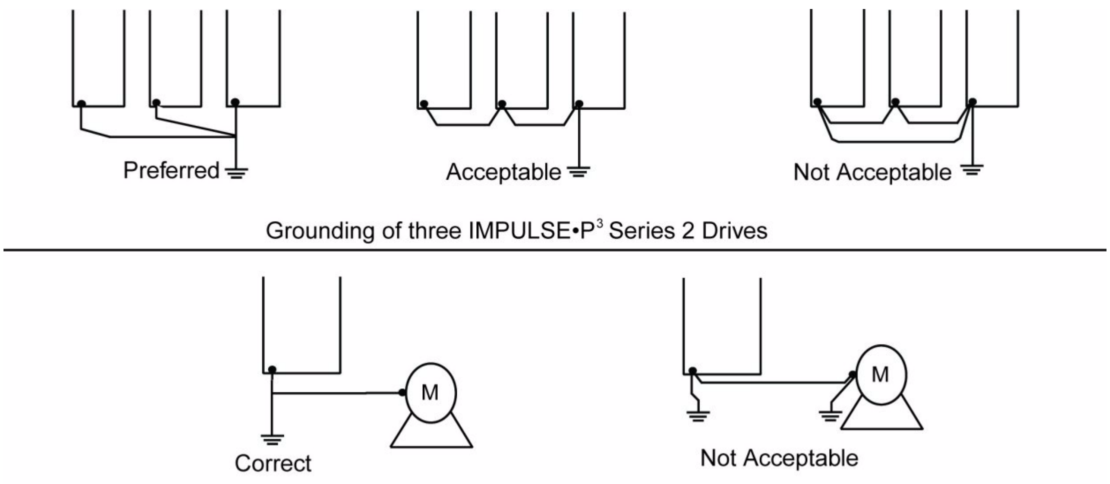
	Rated Current(A)		Time Delay	Inverse Time	Wiring Size (AWG)		
Model #	**Drive**	**InputFuse**	**Input Fuse Class**	**Molded/Case Circuit Breaker**	**Power Circuit Wiring**	**Control Wiring**	**Ground Copper**
230VClass							
2001-P3S2	1.6	3	CC	10	14	18/16	14
2003-P3S2	3	5	CC	10	14	18/16	14
2005-P3S2	5	8	CC	10	14	18/16	14
2008-P3S2	8	15	CC	15	14	18/16	14
2011-P3S2	11	20	CC	20	12	18/16	10
2017-P3S2	17.5	30	J	35	10	18/16	10
2025-P3S2	25	40	J	50	8	18/16	10
2033-P3S2	33	50	J	70	6	18/16	8
460VClass							
4001-P3S2	1.2	2	CC	10	14	18/16	14
4002-P3S2	1.8	3	CC	10	14	18/16	14
4003-P3S2	3.4	6	CC	10	14	18/16	14
4004-P3S2	4.8	8	CC	10	14	18/16	14
4008-P3S2	8.6	15	CC	15	14	18/16	14
4014-P3S2	14.8	25	CC	30	10	18/16	10
4018-P3S2	18.8	30	J	40	10	18/16	10

Grounding

(Use ground terminal ⏚)

Make sure to ground the ground terminal according to the local grounding code. Never ground the IMPULSE•P[3] Series 2 in common with welding machines, motors, or other electrical equipment.

When several IMPULSE•P[3] Series 2 units are used side by side, ground each unit as shown in examples. Do not loop the ground wires.



Motor Thermal Overload Relay

(When Used)

To prevent the motor from overheating, IMPULSE•P[3] Series 2 can be programmed to provide motor overload protection.

When multiple motors are being operated in parallel using a single IMPULSE•P[3] Series 2 , separate thermal overload relays may be used to provide motor overload protection for each motor. In this case, programmable, electronic motor overload protection may be disabled.

A thermal overload relay is not required when the motor(s) has thermal detector(s) embedded in its windings. Because operating fan-cooled motors at low speeds may overheat the motor (even at rated current), the use of thermal detectors in the motor is recommended when using IMPULSE•P[3] Series 2 with fan cooled motors. Although this is not the case with non-ventilated type motors, thermal detectors will always provide a level of protection not available with conventional thermal overload relays. It is recommended that programmable overload protection be enabled when motor thermal detectors are provided.

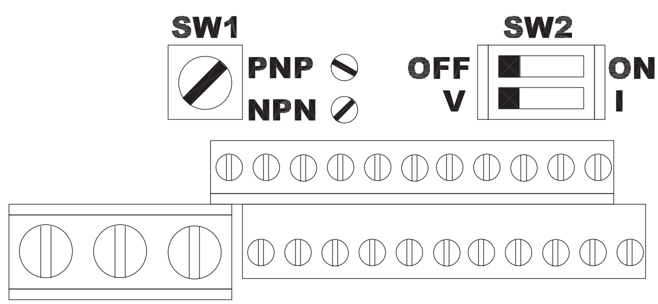
Wiring The Control Circuit

Control Circuit Terminals

The IMPULSE•P3 Series 2 is shipped with a 120V control interface card, allowing direct connection of 120V user input devices. The interface card connects to drive terminals S1-S7 and SC, and the user input device then connects to terminals 1-7 and X2 on the interface card. Terminals 1 and 2 are used for the forward (up) and reverse (down) run commands, and the remaining terminals are programmable for speed control or other functions.

Due to variations in the physical dimensions of the drives with different ratings, two different interface cards are available.

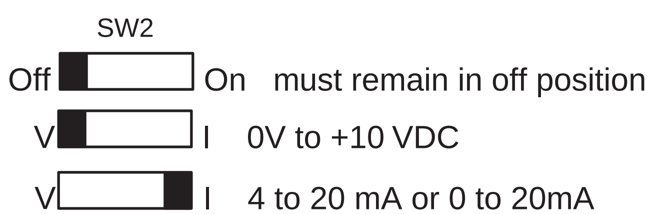
Drive Model Number	Interface Card	Drive Model Number	Interface Card
2001-P3S2	P3-2IF2	4001-P3S2	P3-2IF1
2003-P3S2	P3-2IF2	4002-P3S2	P3-2IF1
2005-P3S2	P3-2IF2	4003-P3S2	P3-2IF1
2008-P3S2	P3-2IF1	4004-P3S2	P3-2IF1
2011-P3S2	P3-2IF1	4008-P3S2	P3-2IF1
2017-P3S2	P3-2IF1	4014-P3S2	P3-2IF2
2025-P3S2	P3-2IF2	4018-P3S2	P3-2IF2
2033-P3S2	P3-2IF2		



Switch (SW1) can be changed according to the sequence input signal (S1 to S7) polarity.

NOTE: Switch (SW1) must remain at NPN setting for use with 120V interface cards.

Switch (SW2) sets the mode of speed reference input on terminals FR and FC.



The IMPULSE•P3 Series 2 is shipped with the interface card already attached. The figures below are provided in the event the board needs to be reattached.

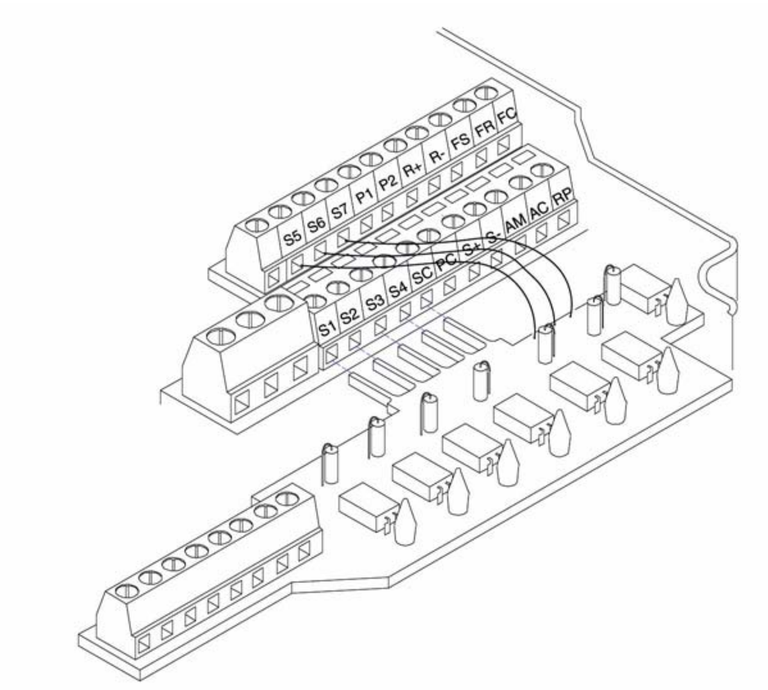


Figure 3-2: P3-2IF1 Interface Card

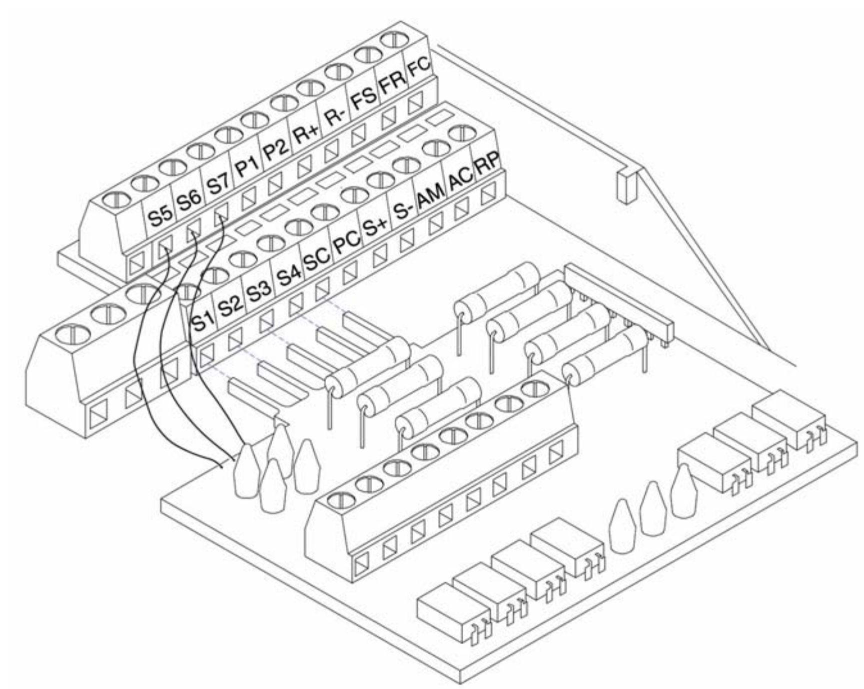
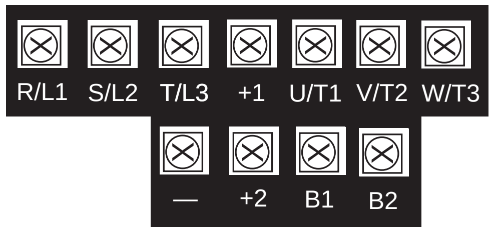
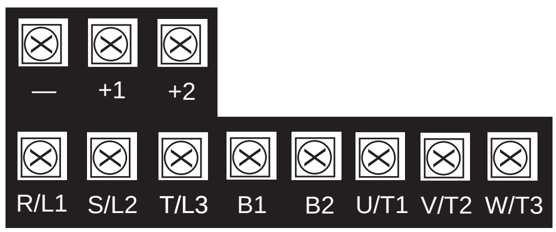


Figure 3-3: P3-2IF2 Interface Card

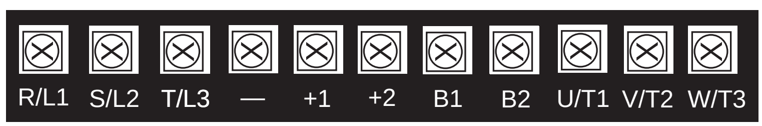
Power Circuit Terminal Arrangement



Models 2001-P3S2, 2003-P3S2 and 2005-P3S2



Models 2008-P3S2, 2011-P3S2, 4001-P3S2 thru 4004-P3S2



Models 2017-P3S2, 4008-P3S2

Models 2025-P3S2, 2033-P3S2, 4014-P3S2 and 4018-P3S2

Figure 3-4: Power Circuit Terminal Arrangement

Surge Absorber Selection

Install appropriate R-C or MOV type surge suppressor across the coils of any contactors installed in the drive's control panel enclosure.

Wiring Inspection

After wiring is complete, check the following:

- Wiring is properly connected.
- Wire clippings or screws are not left inside the unit.
- Screws are securely tightened
- Bare wires in the terminal do not come in contact with other terminals.

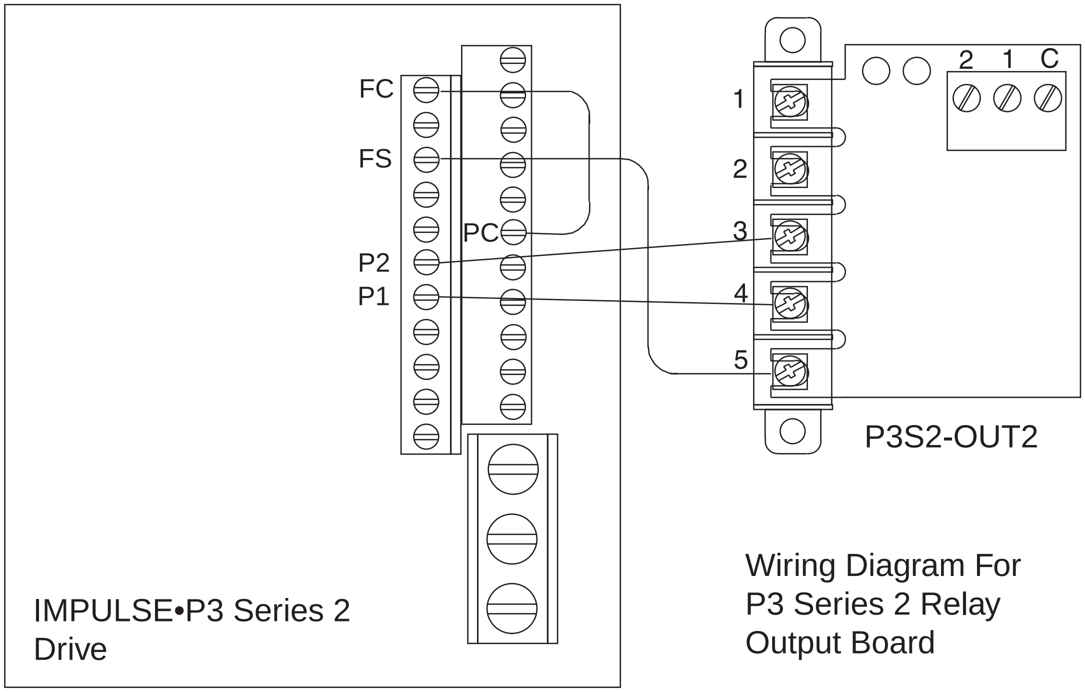


Figure 3-5: P3S2-OUT2 Interface Card

Optional Relay Outputs

Interface Card P3S2-OUT2 provides two 240 VAC, 1.5 Amp rated solid-state relay outputs. Each relay is independently programmable. Constant n148 and n149 (see page 6-17 for programming) will configure these digital outputs.

c h a p t e r **4**

Keypad Operation

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Using The Keypad

All functions of the drive are accessed using the keypad. The operator can enter information into the drive memory to configure the drive's application, by using the Function LEDs.

Keypad Functions

The keypad has a 4-digit LED display. Both numeric and alpha-numeric data can appear on the display.

Indicators and keys on the keypad are described in Figure 4-1.

NOTE: The STOP key is always active and will cause any run command to stop according to the method selected in n120.

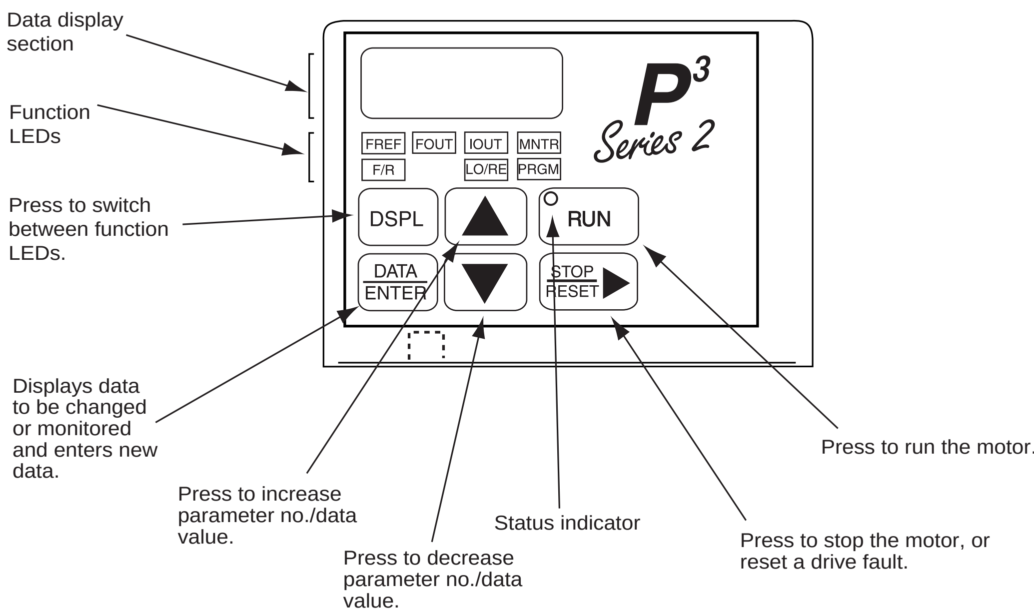

Figure 4-1: IMPULSE•P^3 Series 2 Keypad

Description of Function LEDs

By pressing the DSPL key on the keypad, the operator can step to each of the seven Function LEDs and its associated display/setting function:

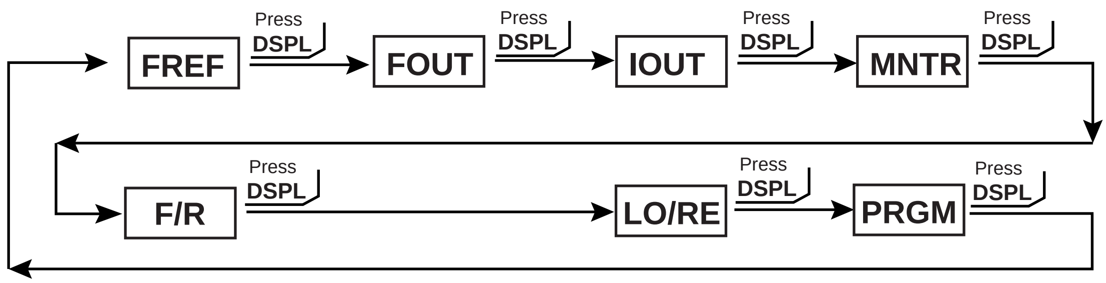

Figure 4-2: Function LEDs

FREF	**Frequency Reference Setting** Sets/Displays the drive operation speed (Hz).
FOUT	**Output Frequency Monitor** Displays the output frequency (Hz) at which the drive is currently operating. This is a **monitor only** function; the operator cannot change the displayed value by use of the keypad.
IOUT	**Output Current Monitor** Displays the level of output current (Amps) that the drive is currently producing. This is a **monitor only** function; the operator cannot change the displayed value by use of the keypad.
MNTR	**Monitor Selection** Pressing ENTER allows access to the various Monitor parameters, ***U1-01*** through ***U1-11***. These are monitor-only functions; the operator cannot change the displayed value. Accessible during run command. See page 4-5. for complete listing of all monitor parameters.
F/R	**FWD/REV Run Selection** Sets the rotation direction of the motor when a Run command is given by the Digital Operator keypad. Display of ***For***=forward run, ***rEv***=reverse run.
LO/RE	**Local/Remote Selection** This toggles between the Local (keypad) and Remote modes of operation. This affects both the start/stop functions, as well as the frequency reference.
PRGM	**Parameter Programming** Selects or reads data using parameter number (***nXXX***). Data is displayed by pressing the ENTER key, and can be changed by pressing the “up arrow” or “down arrow” keys. Any changes can be saved by again pressing the **ENTER** key. Pressing the **DSPL** key exits the programming mode.

Status LEDs

There are two indicator LEDs on the front of the drive. The drive status is indicated by various combinations of ON, Blinking and Off conditions of these two LEDs:

Condition	(Green) ○ RUN	(Red) ○ ALARM
Operation Ready (during stop)	Blinking	Off
Ramp To Stop (during decel)	Long Blinking	Off
Normal Operation (running)	On	Off
Alarm	Blinking or ON	Blinking
Fault	Off	On

For details of how the status indicator LEDs function during a drive fault, refer to the “Troubleshooting” section.

Monitor Function

When using the Monitor Function, a variety of information can be displayed on the keypad. The Up/Down arrow keys scroll through each of the U-XX parameters listed below. Pressing the Data/Enter key will cause the display to show the data in the monitor parameter currently displayed.

Parameter U-	Monitored Item	Display Example
01	Frequency reference (Hz)	60.0
02	Output frequency(Hz)	60.0
03	Output current (A)	12.5
04	AC Output Voltage (V)	230
05	DC Bus Voltage (VDC)	325
06	Input Terminal Status	(See diagram 1 below)
07	Output Terminal Status	(See diagram 2 below)
08	Motor Torque (%) (Open loop vector only)	72
09	Fault record (Press the up or down arrow keys to view the last four faults)	oC
10	Software number **XXXX**	5171
11	Output Power (KW)	99.9

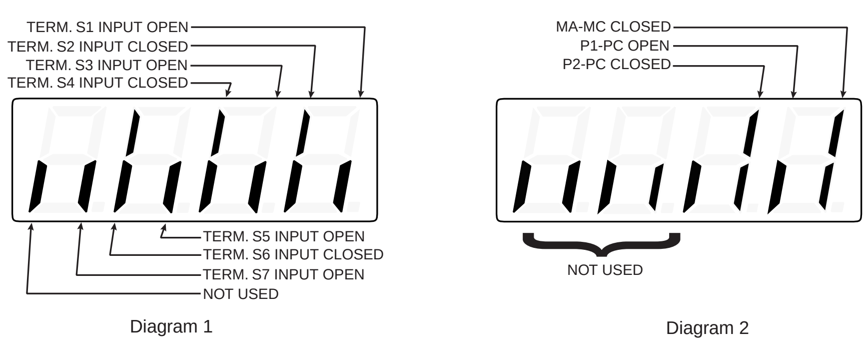

Figure 4-3: Monitor Function

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c h a p t e r ***5***

Programming Basic Features

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Overview

This chapter explains the programming basics in order to get up and running with minimum effort. A description of basic parameters necessary to begin operation of the drive are included.

NOTE: This chapter describes programming options available when n060=1. Refer to manual #005-1069, when n060=0.

Speed Control Methods

X-Press Programming allows for quick setup of the drive. By setting a single parameter, the drive settings can be configured for many common methods of operation. If discrete inputs and speed references are desired, one of the Multi-Step Speed Control methods should be selected. The IMPULSE•P^3 Series 2 provides 2-Step, 3-Step or 5-Step Multi-Step control methods. A sample timing diagram for 5-Step control is shown below. For each input that is energized, the drive begins to operate at the corresponding frequency set in parameter n104–n108. If 2 or 3-Step is desired, then the frequency reference for the 2nd or 3rd step will be set at the maximum desired speed of operation.

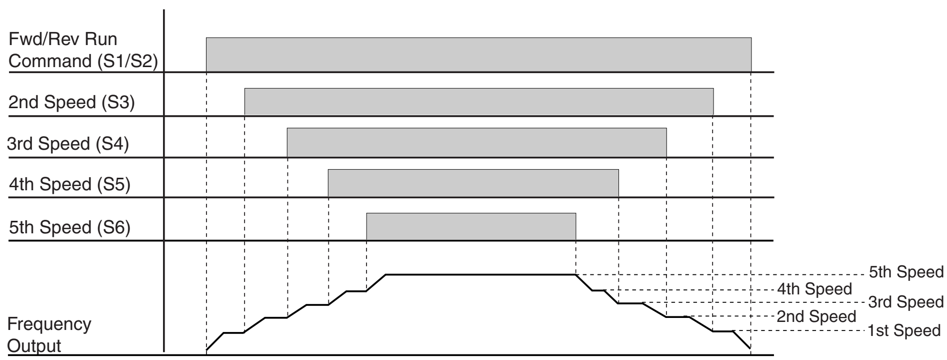


Figure 5-1: 5-Speed Multi-Step Speed Control

In addition to discrete speed control, true infinitely variable speed control can be configured. The IMPULSE•P^3 Series 2 has two ways in which infinitely variable control can be configured, 2-Step Infinitely Variable and 3-Step Infinitely Variable control. Sample timing diagrams for both methods are given.

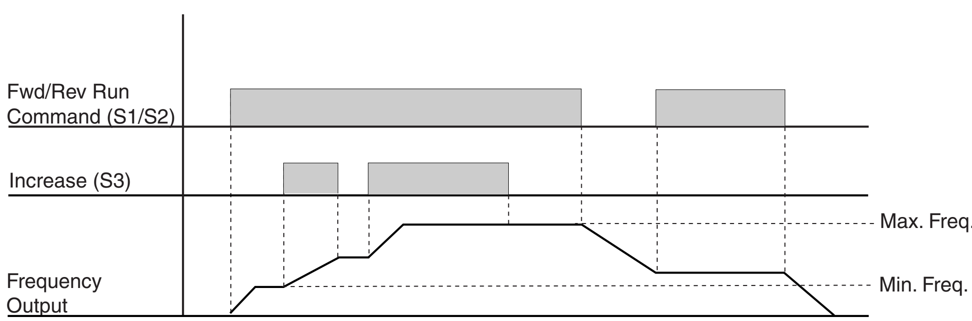


Figure 5-2: 2-Step Infinitely Variable Speed Control

NOTE: Shown with stopping method set to ramp to stop. If the stopping method is base-block to stop (as in hoisting applications), the frequency output is immediately set to zero and the brake is set when the run command is removed rather than ramping down to minimum frequency.

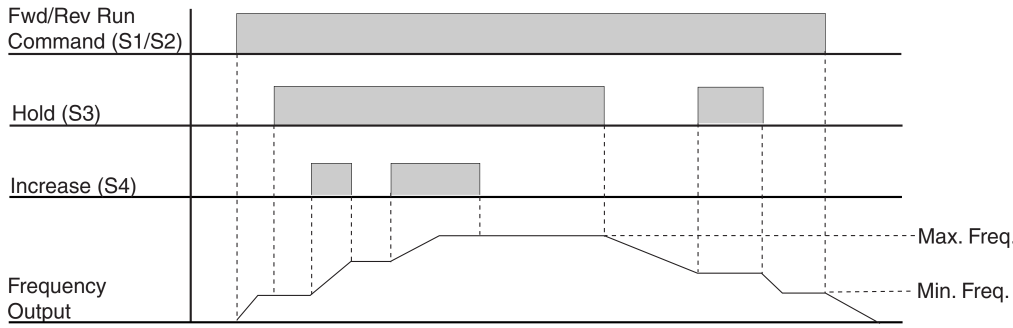


Figure 5-3: 3-Step Infinitely Variable Speed Control

Parameter	Name	Data	Function	Initial Value	Data Range
n060	Parameter Switchover	0	P3 Emulation (manual 005-1069)	1	0, 1
		1	P3 Series 2 Advanced		
n100	X-Press Programming –	00	Initialize for traverse/two-speed multi-step control	07	00-0C
		01	Initialize for traverse/three-speed multi-step control		
		02	Initialize for traverse/five-speed multi-step control		
		03	Initialize for traverse/two-step infinitely variable control		
		04	Initialize for traverse/three-step infinitely variable control		
		05	Initialize for traverse/analog reference		
		06	Initialize for hoist/two-speed multi-step control		
		07	Initialize for hoist/three-speed multi-step control		
		08	Initialize for hoist/five-speed multi-step control		
		09	Initialize for hoist/two-step infinitely variable control		
		0A	Initialize for hoist/three-step infinitely variable control		
		0B	Initialize for hoist/analog reference		
		0C	Initialize advanced parameters to drive default settings		
		20	Initialize all parameters to drive default settings		
n101	Control Method	0	V/F Control	0	0-1
		1	Open Loop Vector		
n102	Motor Rated Current –	Set to motor name plate current		kVA Dependent	0-150% Rated Current
n103	Password	00	Reading Parameters n100-n122 is enabled, setting is disabled (except n103)		
		01	Reading Parameters n100-n122 is enabled, setting parameters n100-n103 is enabled		
		02	Reading Parameters n100-n179 is enabled, setting parameters n100-n179 is enabled		
		03	Reading and setting all parameters are enabled		
		07	Clears fault history		

Parameters Changed by X-Press Programming

Table 5-1: n060=1: n100=0-5: Traverse Motion

Parameter		Setting/Description	n104 Freq. Ref 1	n105 Freq. Ref. 2	n106 Freq. Ref. 3	n107 Freq. Ref. 4	n108 Freq. Ref 5	n111 Accel Time 1	n112 Decel Time 1	n118 Freq. Ref. Selection	n119 Stop Method	n142 S3 Function	n143 S4 Function	n144 S5 Function	n145 S6 Function	n161 Max. Output Freq.	n165 Mid/Volt Output Freq.	n167 Min/Volt Output Freq.
n100	0	2-Speed Multi-Step	20.0	60.0				5.0	5.0	1	0	00	17	17	17	60.0	16.1/32.2	9.2/18.4
	1	3-Speed Multi-Step	15.0	30.0	60.0			5.0	5.0	1	0	00	01	17	17	60.0	16.1/32.2	9.2/18.4
	2	5-Speed Multi-Step	6.0	15.0	30.0	45.0	60.0	5.0	5.0	1	0	00	01	02	03	60.0	16.1/32.2	9.2/18.4
	3	2-Step Infinitely Variable	6.0					5.0	5.0	1	0	05	17	17	17	60.0	16.1/32.2	9.2/18.4
	4	3-Step Infinitely Variable	6.0					5.0	5.0	1	0	04	05	17	17	60.0	16.1/32.2	9.2/18.4
	5	Analog Reference						5.0	5.0	2	0	17	17	17	17	60.0	16.1/32.2	9.2/18.4

Table 5-2: n060=1: n100=6-B: Hoist Motion

Parameter		Setting/Description	n104 Freq. Ref 1	n105 Freq. Ref. 2	n106 Freq. Ref. 3	n107 Freq. Ref. 4	n108 Freq. Ref 5	n111 Accel Time 1	n112 Decel Time 1	n118 Freq/Ref Selection	n119 Stop Method	n142 S3 Function	n143 S4 Function	n144 S5 Function	n145 S6 Function	n161 Max. Output Freq.	n165 Mid Volt Output Freq.	n167 Min/Volt Output Freq.
n100	6	2-Speed Multi-Step	20.0	60.0				5.0	3.0	1	1	00	17	17	17	60.0	19.5/39	12.6/25.2
	7	3-Speed Multi-Step	15.0	30.0	60.0			5.0	3.0	1	1	00	01	17	17	60.0	19.5/39	12.6/25.2
	8	5-Speed Multi-Step	6.0	15.0	30.0	45.0	60.0	5.0	3.0	1	1	00	01	02	03	60.0	19.5/39	12.6/25.2
	9	2-Step Infinitely Variable	6.0					5.0	3.0	1	1	05	17	17	17	60.0	19.5/39	12.6/25.2
	A	3-Step Infinitely Variable	6.0					5.0	3.0	1	1	04	05	17	17	60.0	19.5/39	12.6/25.2
	B	Analog Reference						5.0	3.0	2	1	17	17	17	17	60.0	19.5/39	12.6/25.5

Shaded cell indicates this parameter will not change if this setting is selected

For n165 and n167 left side indicates 230V setting and right side indicates 460V setting.

Preset Frequency References

When utilizing X-Press Programming to set up multi-step control for discrete frequency references, the desired reference is programmed into n104-n108. Additionally, n109 and n110 provide (as a percentage of n161, maximum frequency) the lower and upper frequency reference limits for the drive can operate.

NOTE: *The actual output frequency is limited by n161 (max. frequency) and n166 (min. frequency). If the frequency reference limits (n109 and n110) are outside of the output frequency limits (n161 and n166), the drive will only run at the output frequency limit.*

One of the added capabilities of the IMPULSE•P3 Series 2 is the ability to program up to 16 distinct speed references. This is accomplished by first setting X-Press Programming to 5 Speed Multi-Step Control. Then, by using binary combinations of the digital inputs, the different speed references are selected. The following table lists the necessary combinations of the digital inputs and their corresponding speed reference parameters.

Frequency Reference	Multi-Step Speed 2 Input	Multi-Step Speed 3 Input	Multi-Step Speed 4 Input	Multi-Step Speed 5 Input
n104-Speed 1	0	0	0	0
n105-Speed 2	1	0	0	0
n106-Speed 3	1	1	0	0
n107-Speed 4	1	1	1	0
n108-Speed 5	1	1	1	1
n217-Speed 6	0	1	0	0
n218-Speed 7	0	1	1	0
n219-Speed 8	0	0	1	0
n220-Speed 9	0	1	1	1
n221-Speed 10	0	0	1	1
n222-Speed 11	0	0	0	1
n223-Speed 12	1	0	0	1
n224-Speed 13	1	1	0	1
n225-Speed 14	0	1	0	1
n226-Speed 15	1	0	1	0
n227-Speed 16	1	0	1	1

NOTE: 0=Off and 1= On

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n104	Freq. Reference 1	–	–	Setting Unit=0.01 Hz (<100Hz), 0.1 Hz (≥ 100 Hz)	*	0.00~150.0
n105	Freq. Reference 2	–	–	Setting Unit=0.01 Hz (<100Hz), 0.1 Hz (≥ 100 Hz)	*	0.00~150.0
n106	Freq. Reference 3	–	–	Setting Unit=0.01 Hz (<100Hz), 0.1 Hz (≥ 100 Hz)	*	0.00~150.0
n107	Freq. Reference 4	–	–	Setting Unit=0.01 Hz (<100Hz), 0.1 Hz (≥ 100 Hz)	*	0.00~150.0
n108	Freq. Reference 5	–	–	Setting Unit=0.01 Hz (<100Hz), 0.1 Hz (≥ 100 Hz)	*	0.00~150.0

**Initial value is determined by X-Press Programming tables 5-1 and 5-2.*

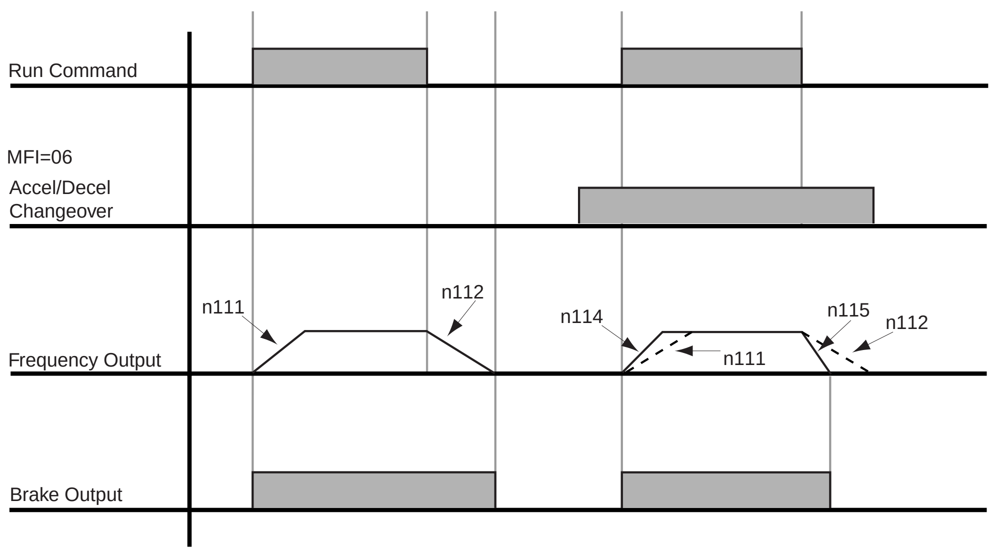
Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n109	Freq. Ref. Upper Limit	–	–	Setting Unit=1% (as percentage of n161)	100%	0~110%
n110	Freq. Ref. Lower Limit	–	–	Setting Unit=1% (as percentage of n161)	2%	0~110%
n217	Freq. Reference 6	–	–	Setting Unit=0.01 Hz (<100Hz), 0.1 Hz (≥ 100 Hz)	0.00	0.00~150.0
n218	Freq. Reference 7	–	–	Setting Unit=0.01 Hz (<100Hz), 0.1 Hz (≥ 100 Hz)	0.00	0.00~150.0
n219	Freq. Reference 8	–	–	Setting Unit=0.01 Hz (<100Hz), 0.1 Hz (≥ 100 Hz)	0.00	0.00~150.0
n220	Freq. Reference 9	–	–	Setting Unit=0.01 Hz (<100Hz), 0.1 Hz (≥ 100 Hz)	0.00	0.00~150.0
n221	Freq. Reference 10	–	–	Setting Unit=0.01 Hz (<100Hz), 0.1 Hz (≥ 100 Hz)	0.00	0.00~150.0
n222	Freq. Reference 11	–	–	Setting Unit=0.01 Hz (<100Hz), 0.1 Hz (≥ 100 Hz)	0.00	0.00~150.0
n223	Freq. Reference 12	–	–	Setting Unit=0.01 Hz (<100Hz), 0.1 Hz (≥ 100 Hz)	0.00	0.00~150.0
n224	Freq. Reference 13	–	–	Setting Unit=0.01 Hz (<100Hz), 0.1 Hz (≥ 100 Hz)	0.00	0.00~150.0
n225	Freq. Reference 14	–	–	Setting Unit=0.01 Hz (<100Hz), 0.1 Hz (≥ 100 Hz)	0.00	0.00~150.0
n226	Freq. Reference 15	–	–	Setting Unit=0.01 Hz (<100Hz), 0.1 Hz (≥ 100 Hz)	0.00	0.00~150.0
n227	Freq. Reference 16	–	–	Setting Unit=0.01 Hz (<100Hz), 0.1 Hz (≥ 100 Hz)	0.00	0.00~150.0
n228	Jog Freq. Reference	–	–	Setting Unit=0.01 Hz (<100Hz), 0.1 Hz (≥ 100 Hz)	0.00	0.00~150.0

Acceleration/Deceleration

The acceleration time is the time needed to accelerate from 0 Hz up to maximum frequency, n161. The deceleration time is the time needed to decelerate from the maximum output frequency, n161 to 0 Hz. The default set of accel/decel times used is n111/n112. There is also a second set of accel/decel times, n114/n115, which may be activated by using a programmable digital input. In order to provide smooth transition during accel/decel, s-curves are provided. The length of the s-curve is adjusted by n126.

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n111	Acceleration Time 1	–	–	Setting Unit According to n234	*	0.0~25.5
n112	Deceleration Time 1	–	–	Setting Unit According to n234	*	0.0~25.5
n114	Acceleration Time 2	–	–	Setting Unit According to n234	1.5	0.0~25.5
n115	Deceleration Time 2	–	–	Setting Unit According to n234	1.5	0.0~25.5
n126	S-Curve Accel/Decel Selection	–	0	S-Curve not provided	2	0~3
		–	1	S-Curve is 0.2 seconds		
		–	2	S-Curve is 0.5 seconds		
		–	3	S-Curve is 1.0 seconds		
n234	Accel/Decel Time Units	–	0	0.1 Sec. Unit	0	0-1
		–	1	0.01 Sec. Unit		

** Initial value is determined by X-Press Programming tables 5-1 and 5-2.*



NOTE: Stopping method is set to "Ramp to Stop"

Figure 5-4: Normal Accel/Decel Time and Multiple Accel/Decel Changeover

c h a p t e r ***6***

Programming Advanced Features

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Overview

The IMPULSE•P³ Series 2 provides several advanced features, some of which are common to variable frequency drives and others that have been specifically designed to improve the performance of this drive in the overhead material handling industry. This chapter includes the programming details for these features.

Run/Reference Source

The drive's default setting is to receive both its run and reference from the digital inputs. The drive may also be configured to receive a reference from analog input, serial communications or from the keypad. In addition, the run command may also be configured to be generated from the keypad or from serial communication. If the drive is run from the keypad, the RUN button must be maintained. When the RUN button is released, the drive will come to an immediate stop.

WARNING

Because of the additional potential hazards that are introduced when any drive is operated locally, we advise you to avoid operating it this way. If you do operate the drive locally, be aware that the crane or hoist will move when you press the RUN button. If you have questions contact Electromotive Systems.

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n117	Run Signal Selection	–	0	Run by keypad	1	0~3
		–	1	Run by External Terminals		
		–	2	Run by Serial Communications (unless MFI Data 28 is input)		
		–	3	Run by Communication Option Card		
n118	Frequency Reference Selection	–	1	Frequency ref. by digital input (n104~n108 and n217~n227)	*	1~6
		–	2	Frequency ref. by voltage input (0~10V)**		
		–	3	Frequency ref. by current input (4~20 ma)**		
		–	4	Frequency ref. by current input (0~20 ma)**		
		–	5	Frequency ref. by Serial Communication		
		–	6	Communication Option Card		
n150	Analog Frequency Ref. Gain	–	–	Setting Unit =1%	100%	00~255%
n151	Analog Frequency Ref. Bias	–	–	Setting Unit =1%	0%	±100%
n152	Analog Frequency Filter Time	–	–	Setting Unit =0.01 Sec.	0.10 Sec.	0.00~2.00 Sec.

** Initial value is determined by X-Press Programming tables 5-1 and 5-2.*

*** See page 3-8 for the proper setting of SW2 if an analog frequency reference is used. Digital reference has priority over analog reference. When n118 is set to a value other than 1, the selected frequency reference will be overridden by a digital reference input.*

Stopping Method

The IMPULSE•P³ Series 2 allows stopping by either utilizing a deceleration ramp or by an immediate stop. Care should be taken when using the deceleration ramp to ensure adequate stopping distance based on the programmed deceleration time. The stopping method for operation from the digital inputs is set in n119. Additionally, the stopping method used when the STOP key on the keypad is pressed can be individually set in n120. The STOP key is set to immediate stop by default, and it is recommended that this parameter remain set for immediate stop as operation by keypad is typically only used during setup or troubleshooting and an immediate stop is generally desired.

Additionally, DC injection is also utilized at the end of a deceleration ramp to bring the motor to a complete stop before the brake is set. DC injection is configured using n136-n138.

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n119	Stopping Method Selection Terminal/Comm. Mode	–	0	Deceleration to Stop	*	0~1
		–	1	Base Block to Stop		
n120	Stopping Method Selection Stop Key of Keypad	–	0	Deceleration to Stop	1	0~2
		–	1	Base Block to Stop		
		–	2	Deceleration by n116 to Stop		
n136	DC Injection Braking Current	–	–	Setting Unit =1%	50%	0~100%
n137	DC Injection Time at Stop	–	–	Setting Unit = 0.1 Sec.	0.5 Sec.	0.0~25.5 Sec.
n138	DC Injection Delay Time	–	–	Setting Unit =0.01 Sec.	0.00 Sec.	0.00~2.55 Sec.

** Initial value is determined by X-Press Programming tables 5-1 and 5-2.*

Micro-Positioning Control™

The Micro-Positioning Control function is designed to provide operation over a reduced speed range in order to allow precise positioning. This function is enabled by programmable input and multiplies the normal speed reference by the gain set by parameter n229 or n230. The gains act independently and are controlled by separate inputs; however, if both inputs are on simultaneously, then micro-speed gain 1 has priority.

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n229	Micro Speed Gain 1 Affects all Frequency References	–	–	Setting Unit =0.01	0.10	0.00~2.55
n230	Micro Speed Gain 2 Affects all Frequency References	–	–	Setting Unit =0.01	0.50	0.00~2.55

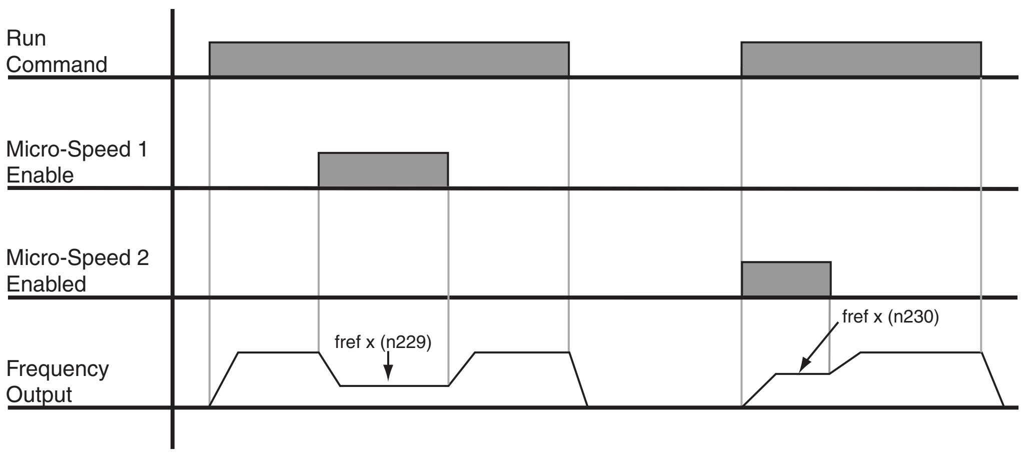

Figure 6-1: Micro-Positioning Control

End of Travel Limits

This function is designed to force the crane to slow down or stop as it approaches the travel limits. The upper/lower limit 1 function is used to decelerate the drive to a programmed speed (n189/n193) in a given time (n190/n194). The upper/lower limit 2 function is used to stop the drive either by base block or by decelerating to zero speed according to the setting of n191/n195.

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n189	Upper Limit 1 Speed	–	–	Setting Unit =0.01 Hz	6.00 Hz	0.00~25.50 Hz
n190	Upper Limit 1 Decel Time	–	–	Setting Unit =0.1 Sec.	1.0 Sec.	0.0~25.5 Sec.
n191	Action at Upper Limit 2	–	0	Base Block to Stop	*0	0~1
		–	1	Decel to Stop by n192		
n192	Upper Limit 2 Stopping Time	–	–	Setting Unit =0.1 Sec.	0.5 Sec.	0.0~25.5 Sec.
n193	Lower Limit 1 Speed	–	–	Setting Unit =0.01 Hz	6.00 Hz	0.00~25.50 Hz
n194	Lower Limit 1 Decel Time	–	–	Setting Unit =0.1 Sec.	1.0 Sec.	0.0~25.5 Sec.
n195	Action at Lower Limit 2	–	0	Base Block to Stop	*0	0~1
		–	1	Decel to Stop by n196		
n196	Lower Limit 2 Stopping Time	–	–	Setting Unit =0.1 Sec.	0.5 Sec.	0.0~25.5 Sec.
n197	Travel Limit Reset	–	0	Reset limit fault when run in opposite direction, or reset limit fault when limit input is removed	0	0~1
		–	1	Reset limit fault when run in opposite direction		

* When X-Press Programming (n100=6-9, A or B) is set for hoist, constants n191 and n195 have no effect. Stopping Method when limit 2 is enabled will be base block.

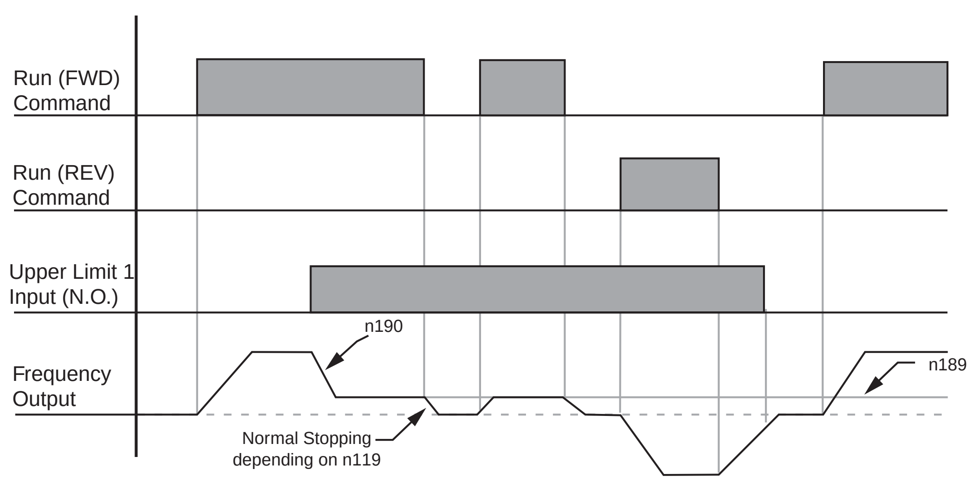

Figure 6-2: Upper Limit (UL1)

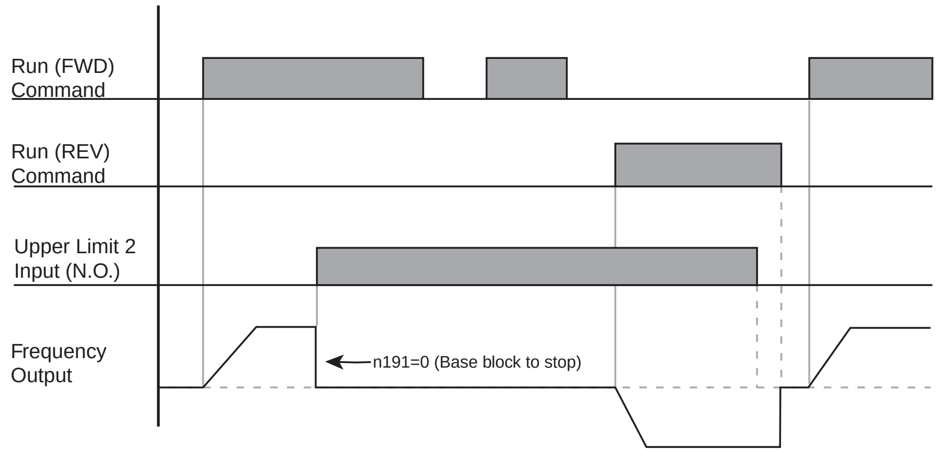

Figure 6-3: Upper Limit 2

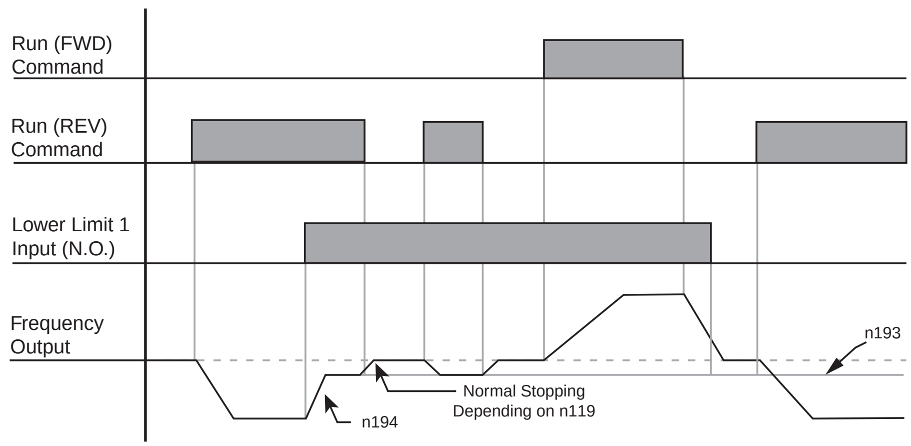

Figure 6-4: Lower Limit 1

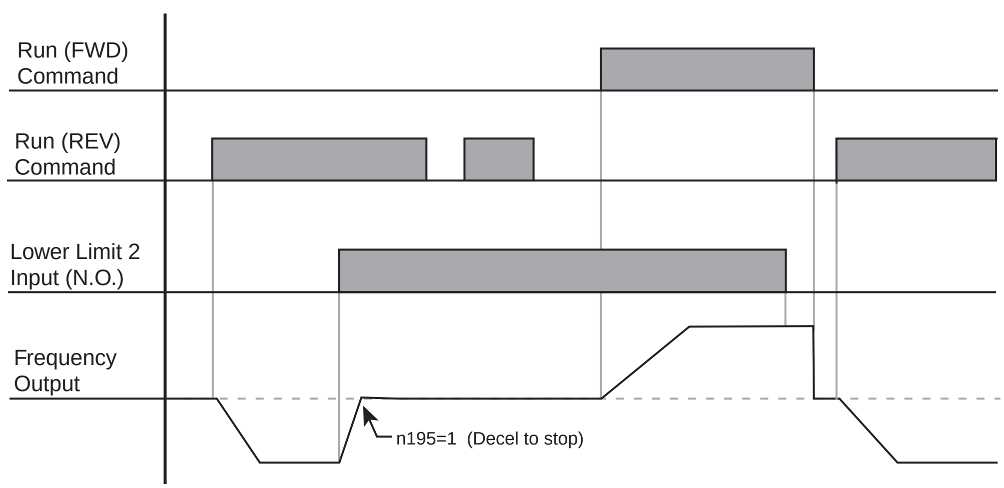

Figure 6-5: Lower Limit 2

Quick Stop™

This function is designed to provide an alternate deceleration time when the run command is removed. If n113 bit 1 is set to a 1, the drive will decelerate according to n116 rather than using n112.

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n113	Special Functions	1	0	Quick Stop Disabled	0000 (Binary)	0000~ 1111 (Binary)
			1	Quick Stop Enabled (Stopping by n116 time)		
n116	Quick Stop Time	–	–	Setting Unit = 0.1 Sec.	1.0	0.0~25.5

Reverse Plug Simulation™

Reverse Plug Simulation utilizes alternate accel (n114)/decel (n115) times if the speed reference suddenly changes direction. This function is designed to closely simulate the operation of a system using reversing contactor type control. It provides the rapid deceleration and acceleration that occur when the commanded direction of an induction motor is suddenly reversed. It is enabled by setting bit 2 of n113.

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n113	Special Functions	2	0	Reverse Plug Simulation Disabled	0000 (Binary)	0000~ 1111 (Binary)
			1	Reverse Plug Simulation Enabled		
n114	Acceleration Time 2	–	–	Setting Unit according to n234	1.5	0.0~25.5
n115	Deceleration Time 2	–	–	Setting Unit according to n234	1.5	0.0~25.5

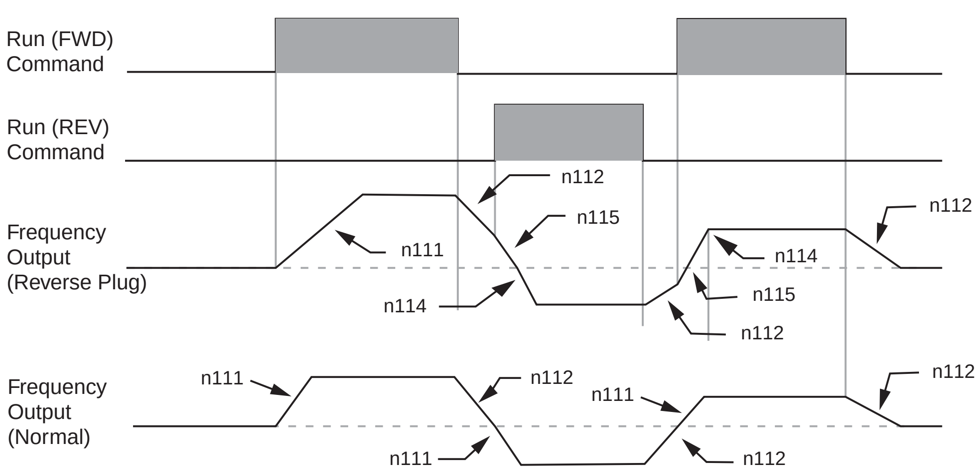

Figure 6-6: Reverse Plug Simulation

Swift Lift™

Swift Lift provides the ability to operate at increased speeds under light load or no load conditions. This feature will compare the torque required to raise a load against a preset value. If the torque is less than the preset value, the drive will be allowed to increase the frequency reference to the designated over-speed value.

There are two methods that may be utilized to enable Swift Lift. First, Swift Lift can be enabled to automatically occur whenever the load permits by setting n113 to 01XX (XX indicates these two bits have no effect on Swift Lift operation). Swift Lift may also be enabled manually by setting n113 to 10XX. Manual enabling of Swift Lift requires one of the programmable inputs set to 18. If the input is on then the torque comparison occurs and it is possible to run at the Swift Lift frequency. If the input is off, the drive will never perform the torque comparison and only run up to the rated maximum frequency.

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n113	Special Functions	4,3	00	Swift Lift Disabled	0000 (Binary)	0000~ 1111 (Binary)
			01	Swift Lift Enabled Automatically		
			10	Swift Lift Enabled by MFI		
			11	No Function		
n130	Swift Lift Forward Speed	–	–	Setting Unit =1Hz	60 Hz	0~150Hz
n131	Swift Lift Reverse Speed	–	–	Setting Unit =1Hz	60 Hz	0~150Hz
n132	Swift Lift Enabling Current at Forward	–	–	Setting Unit =1% Inverter Rated Current	50%	0~100%
n133	Swift Lift Enabling Current at Reverse	–	–	Setting Unit =1% Inverter Rated Current	0%	0~100%
n134	Swift Lift Threshold Speed	–	–	Setting Unit =1Hz	60 Hz	0~150Hz
n135	Swift Lift Delay Time at threshold Speed	–	–	Setting Unit =0.1 Sec.	2.0 Sec.	0~25.5 Sec.

Enable Swift Lift Function:

1. Set n113 to enable the **Swift Lift Function**. If enabling **Swift Lift** with MFI, program MFI for 18.
2. Set **Maximum Frequency** (n161) ≥ desired **Swift Lift** frequency.
3. Set n130 and n131 to determine the maximum FOR/REV output frequency during **Swift Lift**.
4. Set n132 and n133 to determine the maximum output current level to enable **Swift Lift**.
   Setting n132 or n133 = 0 disables the **Swift Lift Function** in that direction.
5. Set the **Swift Lift Threshold Speed (n134)** one or two hertz below the maximum normal running speed reference.
   For example: If the maximum normal running frequency is at 60 Hz, set n134 to 59 Hz or 58 Hz.

2, 3 Step Infinitely Variable

6. If the system is using the **2-Step or 3-Step Infinitely Variable** speed control method, the following formula is used to adjust n109 (frequency reference upper limit).
   n109=(max. normal running frequency) x 100/n161

Analog Frequency Reference

7. If the system is using an analog frequency reference, the following formula is used to adjust n150 (Analog frequency reference gain).
   n150=(max. normal running frequency) x 100/n161.

WARNING

Motors and drive machinery must be capable of operating above motor base speed. Consult the motor/gearbox/hoist manufacturer before enabling Swift Lift function. Failure to observe this warning may result in damage to equipment and possible injury or death to personnel.

Volts/Hertz Setup

Maintaining the correct relationship between the output voltage and frequency is critical for proper operation of the motor. Having the correct V/f pattern allows the drive to provide full load torque across its entire operating range and prevents excessive current and heating in the motor.

If increased starting torque is required, the V/f pattern may be increased to help increase the torque. Care must be taken to avoid raising the voltage too high as this will result in higher motor currents and heating. The default V/f patterns for both the traverse and hoisting applications are listed, as well as a suggested pattern for use when increased starting torque is required.

Application	Max. Volts	Max. Freq.	Mid Freq.	Mid Volts	Min Freq.	Min. Volts
	n162	n163	n164	n165	n166	n167
Traverse	460	60	3.0	32.2	1.5	18.4
Hoist	460	60	3.0	39.0	1.5	25.2
High Torque	460	60	3.0	43.7	1.5	29.9

NOTE: The values listed are for 460V operation. All voltages in the table must be divided by 2 for 230V operation.

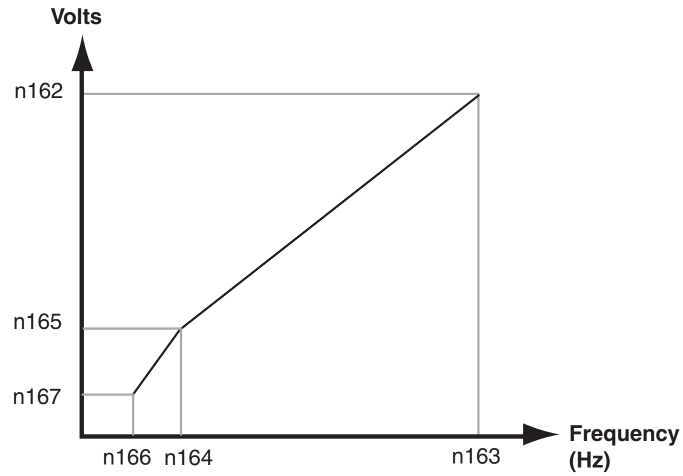

Figure 6-7

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n161	Max. Output Frequency	–	–	Setting Unit = 0.1 Hz	60.0	50.0~ 150.0 Hz
n162	Max. Output Voltage	–	–	Setting Unit = 0.1 V	230/460V	0.1~255.0V or 0.2~510.0V
n163	Frequency at Max. Voltage	–	–	Setting Unit = 0.1 Hz	60.0	0.2~150.0 Hz
n164	Frequency at Mid. Voltage	–	–	Setting Unit = 0.1 Hz	3.0 Hz	0.1~ 149.9 Hz
n165	Mid Output Voltage	–	–	Setting Unit = 0.1V	*	0.1~255.0V or 0.2~510.0V
n166	Frequency at Min. Voltage	–	–	Setting Unit = 0.1 Hz	1.5 (V/F) 1.0 (OLV)	0.1~10.0 Hz
n167	Min Output Voltage	–	–	Setting Unit = 0.1 V	*	0.1~50.0V or 0.1~100.0V

** Initial value is determined by X-Press Programming tables 5-1 and 5-2.*

Open Loop Vector Control Setup

Precaution for open loop vector control application

Open loop vector control requires accurate motor parameters to operate correctly. Therefore, some initial setup is required when selecting open loop vector control mode. Set the following parameters so that they match the motor parameters.

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n101	Control Method	–	0	V/F Control	0	0~1
			1	Open Loop Vector		
n102	Motor Rated Current	–	–	Setting Unit = 0.1 Amps	Kva Dependent	0~150%
n203	Torque Compensation Gain	–	–	Setting Unit = 0.1	1.0	0.0~2.5
n204	Time Constant at Torque Compensation	–	–	Setting Unit = 0.1 Watt ≤ 1000W/1 W > 1000W	Kva Dependent	0.0~6550
n205	Torque Compensation Iron Loss	–	–	Setting Unit = 0.1 Hz	Kva Dependent	0.0~20.0 Hz
n206	Motor Rated Slip	–	–	Setting Unit = 0.1 Hz	Kva Dependent	0.0~20.0Hz
n207	Motor Phase Resistance	–	–	Setting Unit=0.001 Ω/0.01Ω	Kva Dependent	0.000~65.50
n208	Motor Leakage Inductance	–	–	Setting Unit=0.01mH≤100mH/ 0.1mH>100mH	Kva Dependent	0.00~ 655.0mH
n209	Torque Boost (OLV)	–	–	Setting Unit = 1%	150%	0~250%
n210	Motor No-Load Current	–	–	Setting Unit=1%	Kva Dependent	0~99%
n211	Slip Compensation Gain	–	–	Setting Unit = 0.1	0	0.0~2.5
n212	Slip Compensation Delay Time	–	–	Setting Unit=0.1 Sec.	2.0 Sec.	0.0~25.5 Sec.
n213	Slip Compensation Select during Regeneration (OLV)	–	0	Slip Compensation during Regeneration is Disabled	0	0~1
			1	Slip Compensation during Regeneration is Enabled		

Motor parameter calculation

The following shows an example of motor parameter calculation:

1. Motor rated slip (n206)

$$\frac{\text{(Motor Synchronous Speed – Motor Speed at 100\% Load) x Motor Poles}}{120}$$

Example: $$\frac{(1800 – 1780) \times 4}{120}$$

2. Motor resistance for one phase (n207)
   Calculations are based on line-to-line resistance and motor test report.

$$\text{Motor resistance per phase } \Omega = \frac{\text{Motor resistance line-to-line } (\Omega)}{2}$$

3. Motor rated current (n102)=Rated current at motor rated frequency (Hz)*1 in amps.
4. Motor no-load current (n210)

$$= \frac{\text{No-load current (A) at motor rated frequency (Hz)}^{*1}}{\text{Rated current (A) at motor rated frequency (Hz)}^{*1}} \times 100\%$$

*1 Base frequency (Hz) for rated output current.
*2 Rated speed (rev/min) at base frequency during rated output current.

Set n206 (motor rated slip), n102 (motor rated current), n207 (motor resistance per phase), n208 (motor leakage inductance) and n210 (motor no-load current) according to the motor test report. When connecting a reactor between the inverter and the motor, set n208 to the value of n208 (motor leaking inductance) initial value + externally-mounted reactor inductance.

V/f Pattern During Open Loop Vector Control

Set V/f pattern as follows during open loop vector control. The following examples are for 230V class motors. When using 460V class motors, double voltage settings (n162, n165, n167)

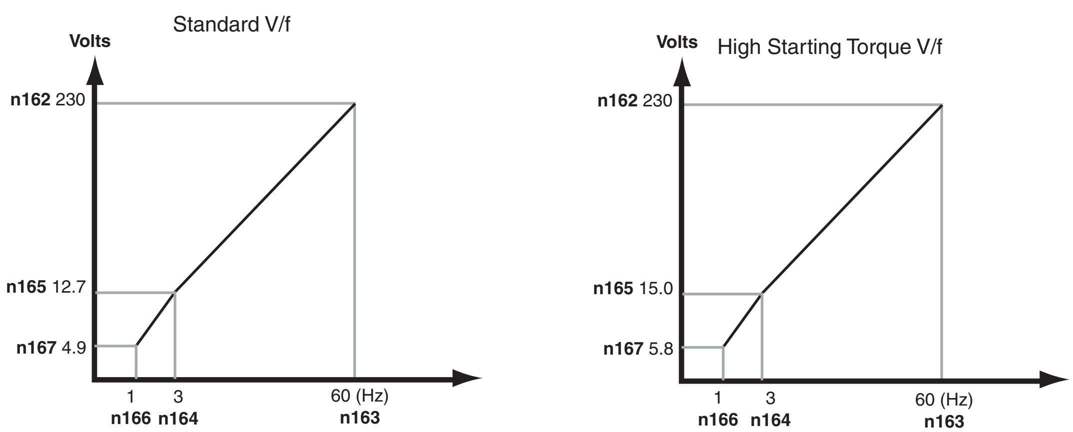

Figure 6-8: V/f Pattern During Open Loop Vector Control

Programmable Digital Inputs

The IMPULSE•P3 Series 2 has five programmable digital inputs that may be configured as desired. The functions of the inputs are programmed using n142-n146. A list of the functions and a short description are provided.

NOTE: These terminals are configured by X-Press Programming when n100 is changed.

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n142	Terminal S3 Select		00	Multi Step Speed Control-Speed 2	*	00~31
			01	Multi-Step Speed Control-Speed 3		
			02	Multi-Step Speed Control-Speed 4		
			03	Multi-Step Speed Control-Speed 5		
			04	Speed Hold (For 3 Step Infinitely Variable Speed Mode)		
			05	Accel Command (for 2 or 3 Step Infinitely Variable Mode)		
			06	Accel/Decel Time Changeover		
			07	Upper Limit 1 (N/O-Action @ Closed)		
			08	Upper Limit 2 (N/O-Action @ Closed)		
			09	Lower Limit 1 (N/O-Action @ Closed)		
			10	Lower Limit 2 (N/O-Action @ Closed)		
			11	Upper Limit 1 (N/C-Action @ Open)		
			12	Upper Limit 2 (N/C-Action @ Open)		
			13	Lower Limit 1 (N/C-Action @ Open)		
			14	Lower Limit 2 (N/C-Action @ Open)		
			15	Micro Speed Gain 1		
			16	Micro Speed Gain 2		
			17	Not Used		
			18	Swift Lift Enable		
			19	Forward Jog (1=Run at n228/0=Stop by n116)		
			20	Reverse Jog (1=Run at n228/0=Stop by n116)		
			21	External Fault (N/O-Action at Closed)		
			22	External Fault (N/C-Action at Open)		
			23	External Alarm (N/O-Action at Closed)		
			24	External Alarm (N/C-Action at Open)		
			25	Fault Reset (N/O-Action at Closed)		
			26	Fault Reset (N/C-Action at Open)		
			27	Base Block Alarm (N/O-Action at Closed)		
			28	Base Block Alarm (N/C-Action at Open)		
			29	Auxiliary Reference Select		
			30	Digital Reference Changeover		
			31	DC Injection Command		
n143	Terminal S4 Select (S4 Function)		–	Menu same as n142	*	00~31

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n144	Terminal S5 Select (S5 Function)		–	Menu same as n142	*	00~31
n145	Terminal S6 Select (S6 Function)		–	Menu same as n142	*	00~31
n146	Terminal S7 Select (S7 Function)		–	Menu same as n142	17	00~31

** Initial value is determined by X-Press Programming tables 5-1 and 5-2.*

Programmable Digital Input Descriptions:

Function	Description
Multi-Step Speed Control	These inputs are used to command the different speed references in 2, 3 and 5 step multi-step speed control methods.
Speed Hold	This input maintains the current frequency reference when operating in 3 step infinitely variable speed control.
Accel Command	This input is used to accelerate to maximum speed in both 2 and 3 step infinitely variable speed control methods.
Accel/Decel Changeover	This input will cause the 2nd Accel/Decel times to be used when the input is on and the 1st Accel/Decel times to be used when the input is off.
Limit Inputs	A variety of limit inputs are available to correspond to the input used on the crane. The ‘Limit 1’ function is utilized to slow down the crane and the ‘Limit 2’ function is used to stop the crane. Additionally, it is possible to program the inputs for either a normally open or normally closed limit switch. The behavior of the limit functions is controlled by n189-n197.
Micro-speed	When one of these inputs is used, the speed reference will be multiplied by the corresponding gain as programmed by n229 or n230.
Swift-Lift Enable	This input allows the Swift-Lift feature to only be activated when desired. To activate Swift-Lift via this input, the automatic Swift-Lift enable needs to be off (n113), the Swift-Lift parameters need to be properly programmed (n130-n135) and then the input must be energized.
Jog Fwd/Rev	A forward and reverse jog feature is available when the programmed input is energized. The drive will operate at the jog frequency (n228).
External Fault/Alarm	An input may be programmed to generate a fault or alarm in the drive. In addition the input may be either normally open or normally closed.
Fault Reset	An input may be programmed to reset a fault condition in the drive. In addition the input may be either normally open or normally closed.
Base Block	An input may be programmed to generate a base block condition in the drive. In addition the input may be either normally open or normally closed.
Auxiliary Reference Select	This input utilizes the programmable analog input to allow a secondary reference to be selected. When the input is energized and the programmable analog input (n177) is enabled, the reference from the programmable analog input will be used, otherwise the reference indicated by n118 will be used.
Digital Reference Changeover	This function allows a secondary digital control to be used. When this input is on, the run command and frequency reference will come from digital inputs. If a run command is given, the drive will run at the first reference as programmed in n104. If there are other programmable inputs assigned for multi-step speed control, then additional corresponding frequency references will be available.
DC Injection	When this input is energized, the drive will inject DC current into the motor according to the level set in n136.

Programmable Analog Input

The IMPULSE•P[3] Series 2 has one programmable analog input (CN2 terminal on the keypad) that may be configured as desired. The functions of the input are programmed using n177.

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n168	Analog Voltage Input Gain	–	–	Setting Unit =1%	100%	-255~255%
n169	Analog Voltage Input Bias	–	–	Setting Unit =1%	0%	-100~100%
n170	Analog Voltage Input Filter Time	–	–	Setting Unit =0.01 Sec.	0.10 Sec.	0.00~2.00 Sec.
n171	Analog Current Input Gain	–	–	Setting Unit =1%	100%	-255~255%
n172	Analog Current Input Bias	–	–	Setting Unit =1%	0%	-100~100%
n173	Analog Current Input Filter Time	–	–	Setting Unit =0.01 Sec.	0.10 Sec.	0.00~2.00 Sec.
n177	Multi-Function Analog Input Function Selection	–	0	Multi-Function analog input disabled	0	0~4
			1	Auxiliary frequency reference		
			2	Frequency reference gain		
			3	Frequency reference bias		
			4	Output voltage bias		
n178	Multi-Function Analog Input Signal Selection	–	0	Voltage Ref. (0-10V)	0	0~1
			1	Current Ref. (4-20mA)		
n179	Multi-Function Analog Input Frequency Bias	–	–	Setting Unit= 1%	10%	0~50%

NOTE: The analog input connector and cable assembly option is required to interface with CN2 on the keypad.

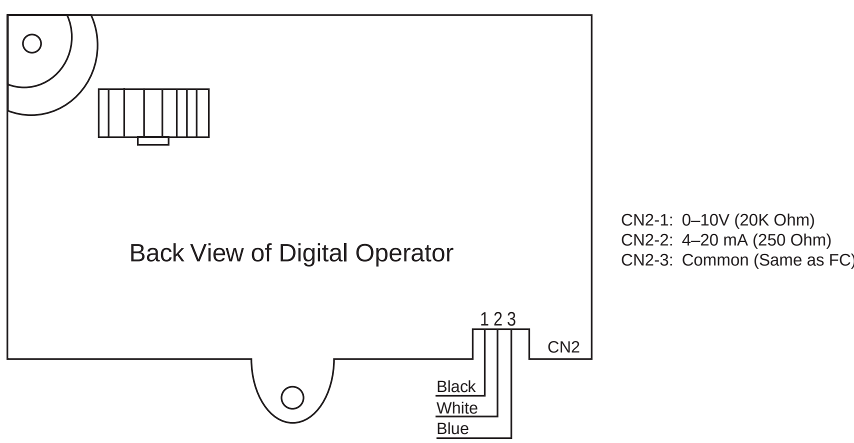

Figure 6-9: CN2 Wiring Diagram

Programmable Digital Outputs

The IMPULSE•P[3] Series 2 has three programmable digital outputs that may be used to monitor many conditions in the drive. These outputs are programmed using n147-n149 and a list of what can be monitored is provided.

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n147	Multi-Function Output 1 Contact Output Function Terminal MA-MB-MC		00	Brake Output	00	00~27
			01	Zero Speed		
			02	Inverter Ready		
			03	Frequency Detection 1 (≥ n157)		
			04	Frequency Detection 2 (≤ n157)		
			05	DC Bus Undervoltage		
			06	Fault Output		
			07	Alarm Output		
			08	Reset Command Active		
			09	Forward Direction		
			10	Reverse Direction		
			11	Overtorque Detection (N/O Contact Output)		
			12	Overtorque Detection (N/C Contact Output)		
			13	Auto Reset Enabled		
			14	Overload (OL1)		
			15	Stall Prevention Output		
			16	Fault Re-Start		
			17	Base Blocked		
			18	Frequency Agree		
			19	Data Output by Memobus		
			20	Upper Limit 1 Output		
			21	Upper Limit 2 Output		
			22	Lower Limit 1 Output		
			23	Lower Limit 2 Output		
			24	Upper Limits 1 or 2 Output		
			25	Lower Limits 1 or 2 Output		
			26	Upper/Lower Limits 1 or 2 Output		
			27	No Function		
n148	Multi-Function Output 2 (P1 Function)		–	Menu same as n147	00	00~27
n149	Multi-Function Output 3 (P2 Function)		–	Menu same as n147	27	00~27

Pulse Monitor Frequency Selection

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n250	Pulse Monitor Output Frequency Selection	–	0	1140 Hz/Max. Frequency (n161)	0	0, 1, 6, 12, 24, 36
			1	Output Frequency x 1		
			6	Output Frequency x 6		
			12	Output Frequency x 12		
			24	Output Frequency x 24		
			36	Output Frequency x 36		

Pulse Monitor Frequency Selection Description

When n250 = 0 and n155 = 1, the frequency of the pulse monitor output will equal 1140 Hz when the motor output frequency is equal to maximum output frequency (n161).

When n250 = (1, 6, 12, 24, 36) and n155 = 1, the frequency of the pulse monitor output will be equal to the setting of n250 multiplied by the motor output frequency.

When connecting peripheral devices the following load limitations must be considered.

When using output as a sourcing output:

Max Output Voltage (V)	Load Impedence (K Ohms)
+5V	1.5K Ohms to 3.499K Ohms
+8V	3.5K Ohms to 9.99K Ohms
+10V	10K Ohms or More

When used as a sinking input:

External Power Supply (V)	+12VDC +/-5%
Sinking Current (mA)	16mA or Less

Programmable Analog Output

The IMPULSE•P3 Series 2 has one programmable analog output that may be used to monitor many conditions in the drive. This output is programmed using n153 and a list of what can be monitored is provided.

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n153	Multi-Function Analog Output	–	0	Output Frequency	0	0~9
			1	Output Current		
			2	DC Bus Voltage		
			3	Torque Monitor (O.L.V. only)		
			4	Output Power		
			5	Frequency Reference		
			6	Analog Input Level		
			7	Pulse Train Monitor		
			8	Data Output by Memobus		
			9	No Function		
n154	Multi-Function Analog Output Gain	–	–	Setting Unit =0.01	1.00	0.00~2.00
n155	Multi-Function Analog Output Selection	–	0	Analog Monitor Output	0	0, 1
			1	Pulse Monitor Output		

Jump Frequency

This function prevents the drive from commanding certain programmed frequencies as the output frequency. Some systems may exhibit a mechanical resonance at certain frequencies. This function is designed to prevent the drive from operating at these frequencies.

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n183	Jump Frequency 1	–	–	Setting unit =0.01Hz (<100Hz), 0.1Hz (≥ 100 Hz)	0.00	0.00~150.0
n184	Jump Frequency 2	–	–	Setting unit =0.01Hz (<100Hz), 0.1 Hz (≥100 Hz)	0.00	0.00~150.0
n185	Jump Frequency 3	–	–	Setting Unit =0.01Hz (<100Hz), 0.1Hz (≥ 100Hz)	0.00	0.00~150.0
n186	Jump Frequency Deadband	–	–	Setting Unit =0.01 Hz	0.00	0.00~25.50 Hz.

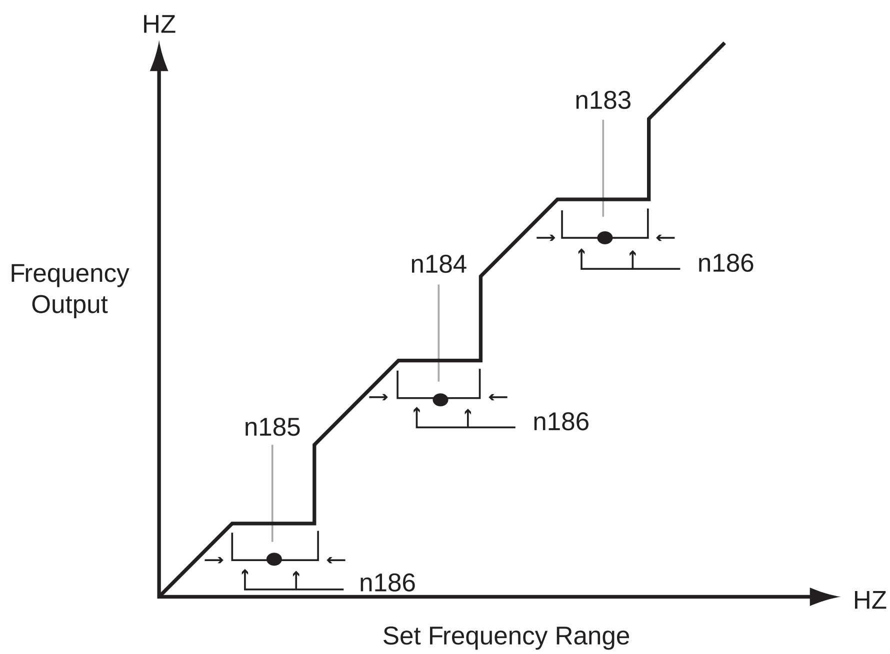

Figure 6-10: Jump Frequencies

Load Check

This function is a load-limiting feature that is designed to prevent the limit of the drive from being exceeded, in order to prevent the potential loss of control over a load exceeding rated capacity. This function compares the output current/torque against pre-programmed levels (n237, n239 and n241) at their respective speed references (n236, n238 and n240). The drive allows a setting time (n243) for the current/torque at each of the speed set points. The current/torque is then compared against the level for the given speed, and if the output current/torque exceeds that level for the detect time (n244), the drive will prevent further raising of the load and post an LCI fault. The drive may be run in the down direction in order to set down the load. In order for the drive to accept a raise command, the LCI fault needs to be reset. The LCI fault can be reset by cycling drive power, using the stop/reset button on the keypad, or by remote fault reset at terminals.

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n235	Load Check Enable/Disable	–	0	Load Check Disabled	0	0~1
			1	Load Check Enabled		
n236	Load Check Look Speed 1	–	–	Setting Unit =0.01 Hz	6.00 Hz.	0.00~150.00 Hz
n237	Load Check Current/Torque Ref. 1	–	–	Setting Unit =1% Inverter Rated Current	160%	10~200%
n238	Load Check Look Speed 2	–	–	Setting Unit =0.01 Hz	20.00 Hz	0.00~150.00 Hz
n239	Load Check Current/Torque Ref. 2	–	–	Setting Unit =1% Inverter Rated Current	160%	10~200%
n240	Load Check Look Speed 3	–	–	Setting Unit =0.01 Hz	60.00 Hz	0.00~150.00 Hz
n241	Load Check Current/Torque Ref. 3	–	–	Setting Unit = 1% Inverter Rated Current	160%	10~200%
n242	Load Check Current/Torque Ref. 4	–	–	Setting Unit =1% Inverter Rated Current	160%	10~200%
n243	Load Check Hold Time	–	–	Setting Unit =0.1 Sec.	0.2 Sec.	0.0~25.5 Sec.
n244	Load Check Detect Time	–	–	Setting Unit =0.1 Sec.	0.2 Sec.	0.0~25.5 Sec.
n245	Load Check Vector Torque Reference	–	0	*Check by Torque	0	0~1
			1	Check by Current		

* When n101 is programmed for V/Hz, Load Check is compared to output current regardless of n245 setting.

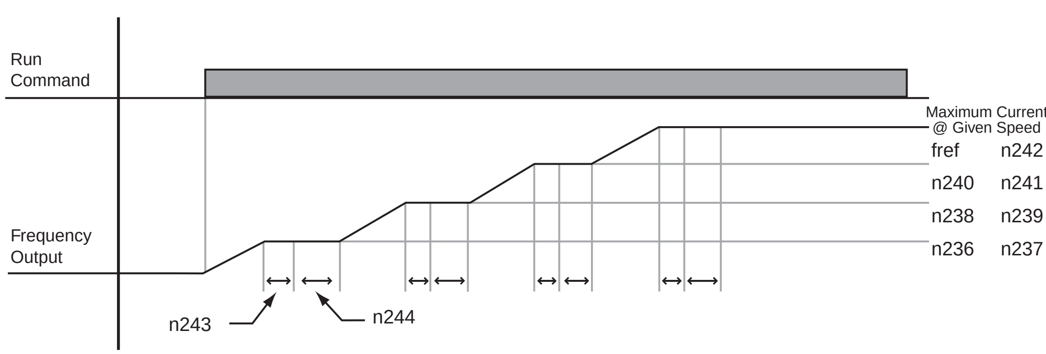

Figure: 6-11: Load Check

Auto Reset

When a fault occurs in the IMPULSE•P[3] Series 2, the drive may be configured to auto reset the fault. Once the run command is removed, the drive will wait for the time set in n125 and then attempt to reset the fault. If the fault condition no longer exists, the drive will reset and a new run command will be allowed.

If the fault reoccurs on the new run, the drive will continue to attempt auto resets of the drive up to the number of fault occurrences programmed in n123. After the fault has reoccurred more consecutive times than set in n123, the drive will no longer attempt to auto reset, and a reset command must be given from a terminal, the keypad or power must be cycled. The following table demonstrates how to configure the auto reset feature utilizing the default setting of 8080.

	Digit 4				Digit 3				Digit 2				Digit 0			
Hex	8				0				8				0			
Bin	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Fault	UV1	UV2	OC	OV	OH	OL1	OL2	OL3	CE	OPR	EFx	GF	OS	DEV	Not Used	Not Used

*NOTE: In the **Bin** row, assign a 1 to each fault that will be auto reset and a 0 to each fault that will not be auto reset.*

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n123	Number of Auto-Reset Attempts	–	–	Setting Unit =1	3	0~10
		15	–	Undervoltage 1 (UV1)		
		14	–	Undervoltage 2 (UV2)		
		13	–	Overcurrent (OC)		
		12	–	Overvoltage (OV)		
		11	–	Overheat (OH)		
		10	–	Overload 1 (OL1)		
		9	–	Overload 2 (OL2)		
		8	–	Overload 3 (OL3)		
n124	Auto-Reset Selection	7	–	Communications Error (CE)	8080	0000~FFFF
		6	–	Operator Disconnect (OPR)		
		5	–	External Fault (Any of S3~S7)		
		4	–	Ground Fault (GF)		
		3	–	Overspeed (OS)		
		2	–	Deviation (DEV)		
		1	–	Reserved for Future Use		
		0	–	Reserved for Future Use		
n125	Time Delay for Auto Reset	–	–	Setting Unit =0.1 Sec.	2.0 Sec.	0.0~25.5 Sec.

Binary to Hex Conversion Table

Binary	Hex
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7

Binary	Hex
1000	8
1001	9
1010	A
1011	B
1100	C
1101	D
1110	E
1111	F

Overtorque Detection

The over torque detection feature is designed to monitor the torque level and compare it against a programmed set point. The drive can be configured to monitor only during constant speed operation or while any run command is active. Either a fault or alarm message may be posted as a result of exceeding the set point for the programmed length of time.

Constant	Name	Bit	Data/ Function	Function	Initial Value	Data Range
n127	Overtorque Detection 1	–	0	Overtorque Detection disabled	0	0~4
			1	Detected at Constant Speed, Operation continues		
			2	Detected at Constant Speed, Fault Output		
			3	Detected at ALL Times, Operation Continues		
			4	Detected at ALL Times, Fault Output		
n128	Overtorque Detection Level	–	–	Setting Unit =1%	*100%	30~200%
n129	Overtorque Detection Delay Time	–	–	Setting Unit =0.1 Sec.	0.2	0.0~10.0 Sec.

* n128 is a percentage of the inverter rated output current.

Miscellaneous Parameters

Constant	Name	Bit/ Settings	Data/ Settings	Function	Initial Value	Data Range
n121	Electronic Thermal Motor Protection	–	0	General Purpose Motor	1	0~2
			1	Inverter Rated Motor		
			2	Thermal Protection is NOT Provided		
n122	Thermal Protection Motor Time Constant	–	–	Setting Unit = 1 Minute	5	1~60
n139	Stall Prevention at Accel	–	–	Setting Unit = 1%	150%	30~ 200%
n140	Stall Prevention at Decel	–	0	Enabled	0	0~1
		–	1	Disabled		
n141	Stall Prevention During Run	–	–	Setting Unit = 1%	160%	30~ 200%
n156	Frequency Detection Width	–	–	Setting Unit = 0.01 Hz	1.00	0.00~ 2.00
n157	Frequency Detection Level	–	–	Setting Unit = 0.01 Hz	0.00 Hz	150.0 Hz
n158	Carrier Frequency	–	–	Setting Unit = 1 (1=2.5 kHz)	1	1~4
n159	Fault History	–	–	First Digit = Fault Number Digits 2~4 = Fault Code (“---” = No Fault)	n/a	n/a
n160	Software Number	–	–	Last 4 Digits of Software Number are Displayed	n/a	n/a
n180	Digital Operator Connection Fault Selection	–	0	Digital Operator Connection Fault is NOT Detected	0	0~1
			1	Digital Operator Connection Fault IS Detected		
n215	Stall Prevention Auto Decrease	–	0	Disable: Stall Prevention Level Based on Setting of n141	0	0~1
			1	Enable: Stall Prevention Level is n141 x 0.4 at maximum frequency		
n216	Accel/Decel Selection at Stall Prevention During Run	–	0	Disable: Follow Accel/Decel Time #1	0	0~1
			1	Enable: Follow Accel/Decel Time #2		
n231	Frequency Reference Setting/ Display Unit Selection	–	0	0.01 Hz (<100 Hz)/0.1Hz (>100 Hz) units	0	0~3999
			1	0.1% Units		
n233	Frequency Reference Setting Method	–	0	Freq. Ref. setting from the operator is enabled with Enter key.	0	0~1
			1	Freq. Ref. setting from the operator does not require the Enter key		
n246	Input Phase Loss Detect Level	–	–	Setting Unit = 1%	0%	0~100%
n247	Input Phase Loss Detect Time	–	–	Setting Unit = 1 Sec.	0	0~255 sec.
n248	Output Phase Loss Detect Level	–	–	Setting Unit = 1%	0%	0~100%
n249	Output Phase Loss Detect Time	–	–	Setting Unit = 0.1 sec.	0	0.0~2.0 sec.

c h a p t e r **7**

Troubleshooting IMPULSE•P^3 Series 2

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Drive Faults and Indicators

: ON : Blinking : OFF

Alarm Display and Contents

Alarm Display		Explanation	Causes and Corrective Actions
Digital Operator	**RUN (Green) ALARM (Red)**		
Uv Blinking		UV (DC bus under voltage) Main circuit DC voltage drops below the low-voltage detection level while the inverter output is OFF. 230V: Occurs at DC bus voltage below approx. 200V 460V: Occurs at DC bus voltage below approx. 400V.	Check the following: Line voltage Branch fuses Terminal screws are securely tightened.
ov Blinking		OV (DC bus overvoltage) Main circuit DC voltage exceeds the over voltage detection level while the inverter output is OFF. Detection level: 230V class: Approx 410V or more 460V class: Approx 820V or more	Check the line voltage.
oH Blinking		OH (Cooling fin overheat) Intake air temperature rises while the inverter output is OFF.	Check the intake air temperature.
oH3 Blinking		OH3(Inverter overheating pre-alarm)	
OPx Blinking		OPx: Parameter setting error, when the parameter setting is performed through Modbus, IMPULSE•Link or X-Press Programming	Check Parameter values and correct any setting errors.
		OP1: Two or more values are set for multi-function input selection (parameters n142-n146).	
		OP2: Relationship among V/Hz parameters is incorrect (n161-n167).	
		OP3: Setting value of Motor Rated Current (n102) exceeds 150% of drive rated current.	
		OP4: Upper/lower limit of frequency reference is reversed. (Parameters n109, n110).	
		OP5: Jump frequency parameter setting error (parameters n183>=n184>=n185).	
		OP8: Swift Lift FWD/REV Speed (n130, n131, n134 are set above maximum frequency (n161).	
		OP9: Carrier frequency setting is incorrect. (parameter n158).	

Alarm Display			
Digital Operator	**RUN (Green) ALARM (Red)**	**Explanation**	**Causes and Corrective Actions**
oL3 Blinking		OL 3 (Over torque detection) Motor current exceeded the preset value in parameter n128.	Reduce the load and expand the accel/decel time.
bb Blinking		BB (External baseblock) Baseblock command at multi-function input terminal is active. The inverter output is shut OFF (motor coasting). Fault is cleared when input is removed.	Check the external circuit. Check proper programming of n142–n146.
EF Blinking		EF (Simultaneous FWD/REV run commands) When FWD and REV run commands are simultaneously input for over 500ms, the inverter stops according to parameter n119.	Check the control input wiring.
Err Blinking	or	Setting out of range	Parameter setting is out of range.
STP Blinking		STP (Operator function stop) STOP/RESET button on keypad is pressed during running. The inverter stops according to parameter n120.	Open FWD/REV command of control circuit terminals.
FAn Blinking		FAN (Cooling fan fault) Cooling fan is locked.	Check the following: Cooling fan is jammed Cooling fan wiring is not connected.

Fault Display			
Digital Operator	**RUN (Green) ALARM (Red)**	**Explanation**	**Causes and Corrective Actions**
oC	● ☼	OC (Over current) Inverter output current momentarily exceeds approx. 250% of rated current.	Check for short circuit in the motor wiring Extend the accel/decel time (parameters n111, n112 and n114, n115) Do not start the motor during coasting
SC		SC (Short-circuit) The Inverter output or load was short circuited.	Disconnect the motor from the inverter. Check for short circuit in the motor wiring.
GF		GF (Ground Fault) The ground fault current at the Inverter output exceeded approximately 50% of the Inverter rated output current.	Disconnect the motor from the inverter. Check for short circuit in the motor wiring.
oV		OV (DC bus overvoltage) Main circuit DC voltage exceeds the detection level because of excessive regenerative energy from the motor. Detection level: 230V:Approx. 410V or more 460V:Approx. 820V or more	Insufficient decel time (parameters n112 and n115). Lowering of heavy load causing excessive regeneration. Incorrect braking resistor.
UL1 Upper Limit 1 Err		UL1 (Upper Limit 1)–SLOW DOWN Indicator. Upper Limit 1–SLOW DOWN switch status is changed	May not require corrective action. Check the limit switches location. Check the limit switches condition.
UL2 Upper Limit 2 Err		UL2 (Upper Limit 2)–STOP Indicator. Upper Limit 2–STOP switch status is changed.	May not require corrective action. Check the limit switches location. Check the limit swtiches condition.
LL1 Lower Limit 1 Err		LL1 (Lower Limit 1)–SLOW DOWN Indicator. Lower Limit 1–SLOW DOWN is input (switch status is changed).	May not require corrective action. Check the limit switches position. Check the limit switches condition.
LL2 Lower Limit 2 Err		LL2 (Lower Limit 2)–STOP Indicator. Lower Limit 2–STOP is input (switch status is changed).	May not require corrective action. Check the limit switches position. Check the limit switches condition.
LCI Load Check ERR		LCI (Load Check Fault). Load is greater than specified amount.	Reduce load. Check load check sequence set-up. (n235-n245).
Uv1		UV1 (DC bus undervoltage) Main circuit DC voltage drops below the low voltage detection level while the inverter output is ON. 230V: Below approx. 200V 460V:Below approx. 400V	Check for the following: Open phase of line voltage Occurrence of momentary power loss Open branch fuse(s) Terminal screws are securely tightened.

Fault Display			
Digital Operator	**RUN (Green) ALARM (Red)**	**Explanation**	**Causes and Corrective Actions**
Uv2		UV2 (Control power supply fault) Voltage fault of control power supply is detected.	Cycle power. If the fault remains, replace the inverter.
PF		PF (Input Phase Loss)	An open-phase occurred in the input power supply. A momentary power loss occurred. The voltage fluctuations in the input power supply are too large. The line voltage balance is bad.
LF	● ☼	LF (Output Phase Loss) An open-phase occurred at the Inverter output.	There is a broken wire in the output cable. There is a broken wire in the motor winding. The output terminals are loose.
oH		OH (Cooling fin overheat) Temperature rise because of inverter overload operation or intake air temperature rise.	Excessive Duty Cycle Improper V/f pattern setting Insufficient accel time if the fault occurs during acceleration Intake air temperature exceeding 122°F (50°C) Cooling fan has failed
oL1		OL1 (Motor overload) Motor overload by electronic thermal overload protection.	Check the load size or V/f pattern setting (parameters n161-n167) Set the motor rated current shown on the nameplate by parameter n102. If the drive is configured for OLV control mode and nuisance OL1 faults occur, reduce the setting of n203 to 0.5.
oL2	● ☼	OL2 (Inverter overload) Inverter output exceeded the inverter overload level.	Check the load size or V/f pattern setting (parameters n161–n167) Check the inverter capacity
oL3		OL3 (Over torque detection) Inverter output current exceeded the preset value in parameter n128. When over torque is detected, inverter performs operation according to the setting of parameter n127.	Check for proper programming of n128. Reduce the load.
EFx		EF1-7: External fault input command from corresponding input terminal S1-S7	Check the external circuit
F0x	● ☼	CPF-00 Inverter cannot communicate with the keypad for 5 sec. or more when power is turned ON.	Cycle power after checking the keypad is securely mounted. Reinitialize the drive by setting n000 to 0A. If the fault remains, replace the keypad or inverter.
		CPF-04 EEPROM fault of inverter control circuit is detected.	
		CPF-05 A/D converter fault is detected	
		CPF-07 Operator control circuit (EEPROM or A/D converter) fault	

Power Section Check

WARNING

Do NOT touch any circuit components while AC main power is on or immediately after the main AC power is disconnected from the unit. You must wait until the red "CHARGE" lamp is extinguished. It may take as long as 10 minutes for the charge on the main DC bus capacitors to drop to a safe level. Failure to adhere to this warning could result in serious injury.

Power Off Checks

To perform a power section check, remove the drives main and control wiring from the terminal strips. Obtain reading as specified in the table below and ensure that the reading falls within the normal reading range.

Test equipment - Analog Ohmmeter set R x 1 scale or digital multimeter set to the diode check.

Device	VOM (on RX1 Scale)		Normal Reading (Analog Meter)	Normal Reading (Digital Meter)
	Positive Lead	**Negative Lead**		
Input Rectifier Bridge *1	L1	+	7–100Ω	Approximately 0.5 V
	L2	+		
	L3	+		
	–	L1		
	–	L2		
	–	L3		
	L1	–	Infinite Ω	OL Displayed
	L2	–		
	L3	–		
	+	L1		
	+	L2		
	+	L3		
Bus Capacitors	+	–	Observe gradually increasing resistance	Observe gradually increasing voltage to OL
Pre-charge Resistor *4	B1	+	100 Ω or less	–
Output Transistors *2 *3	T1	+	7-100 Ω	Approximately 0.5V
	T2	+		
	T3	+		
	–	T1		
	–	T2		
	–	T3		
	T1	–	Infinite Ω	OL Displayed
	T2	–		
	T3	–		
	+	T1		
	+	T2		
	+	T3		
Braking Diode	B2	B1	10 Ω	0.5 V
	B1	B2	Infinite Ω	OL Displayed

*1. "+" could be any one of two (+) terminals which are labeled as ⊕1 and ⊕2.

*2. If the bus fuse is blown you must install a jumper across the fuse terminals to get accurate resistance measurements.

*3. If the pre-charge resistor is open, you will read infinite Ω between + and any output terminal unless you install a temporary jumper across the resistor.

*4. If using a digital multimeter, set to the ohms scale to measure the pre-charge resistor.

Appendix

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Appendix A: Service

This chapter includes information pertaining to on-call service, drive identification, troubleshooting, and warranty. Before you install, troubleshoot, or service the drive, we highly recommend that you read this entire chapter. Doing this will help assure quick service response, minimize your on-site repair costs, and reduce crane downtime.

Your *IMPULSE•P*^{3} Series 2 drive includes a two-year warranty from date of shipment. The warranty is described in detail later in this chapter.

On-Call Service

If you ever require our assistance, contact us at (866) 624-7378; our fax number is (800) 298-3508. Technical support is available 24 hours a day, seven days a week, and 365 days a year. If necessary, we can arrange to have a Service Technician visit your site to evaluate the situation.

Identifying Your Drive

If you ever have to contact Electromotive Systems about your drive, first determine the model and serial numbers of your drive by looking at the nameplate. This nameplate is normally located on the side of the drive.

Service Policy For Small Drives, DBUs, and Other Electrical Components

Should your *IMPULSE* product fail during the warranty period, Electromotive Systems will repair or replace your unit within 72 hours (3 working days). In most cases, we can supply a replacement unit within 24 hours (1 working day). If the problem is not covered under warranty, you are responsible for the cost of the repairs and the shipping charges.

To return a failed unit (or part):

1. Request a Return Authorization (RA) from Electromotive Systems' Service Department, as a condition for us to repair or replace the unit. Return the failed unit to Electromotive Systems **via pre-paid freight**. When you call, please have the serial number of the drive available.
2. A purchase order or credit card is required to cover the cost of the replacement unit or repairs to a returned unit.

Electromotive Systems will inspect the failed unit and determine if the unit is covered under warranty.

- If the unit is covered under warranty, Electromotive Systems will credit the cost of the replacement unit and/or repairs and reimburse for all reasonable freight charges.

  NOTE: Freight charges incurred from sources other than common ground carriers WILL NOT be reimbursed unless pre-approved by Electromotive Systems.

- If the unit is not covered under warranty, Electromotive Systems will bill you for the cost of the replacement unit or the cost of repairs. Electromotive Systems will also bill you for a $125.00 inspection fee (this fee will be waived if repairs are made to the unit) and any freight charges incurred by Electromotive Systems.

Electromotive Systems Limited Warranty

Electromotive Systems, hereafter referred to as Company, guarantees all items manufactured by it against any defects of material and/or workmanship for a period of two years from the date of shipment. Company makes NO OTHER WARRANTY, EXPRESSED OR IMPLIED, AS TO THE MERCHANTABILITY OR FITNESS OF THE ITEMS FOR THEIR INTENDED USE OR AS TO THEIR PERFORMANCE. Any statement, description or specification in Company's literature is for the sole purpose of identification of items sold by the Company and imparts no guarantee, warranty or undertaking by company of any kind. Components and accessories not manufactured by Electromotive Systems are not included in this warranty and are warranted separately by their respective manufacturers.

Company's sole liability shall be to repair at its factory, or replace any item returned to it within two years from date of shipment, which Company finds to contain defective material or workmanship. All items to be repaired or replaced shall be shipped to Company (Note: return authorization by Company is required) within said two year period, freight prepaid, as a condition to repair or replace defective material or workmanship. Company's herein assumed responsibility does not cover defects resulting from improper installation, maintenance, or improper use. Any corrective maintenance performed by anyone other than the Company during the warranty period shall void the warranty. Company shall not be liable for damages of any kind from any cause whatsoever beyond the price of the defective Company supplied items involved. Company shall not be liable for economic loss, property damage, or other consequential damages or physical injury sustained by the purchaser or by any third party as a result of the use of any Company supplied items or material.

Company neither assumes nor authorizes any other person to assume for Company any other liability in connection with the sale or use of items sold by Company.

Materials or items may not be returned for credit, without the prior written consent of the Company. Any authorized return of materials or items shall be subject to a restocking charge equal to 25% of the net invoiced amount ($100 minimum charge for all control products) after Company determines that the material or item is in resalable condition. If upon receipt of the material or items returned, the Company determines that said material or items cannot be resold without alteration or service, the Company reserves the right to reject the returned materials or items and to send the same back to said purchaser at purchaser's expense.

Any claim for errors in shipment or for material or time shortages must be received by Company within 30 days of shipment and must be accompanied by copies of the bill of lading and packing slip.

Appendix B: IMPULSE®•P3 Series 2 External Resistor Specifications

	IMPULSE•P3 Series 2 Drive Model No.	Traverse Resistor Part# CMAA Class A, B, C	Resistance	Traverse Resistor Part# CMAA Class D	Resistance	Hoist w/ Mechanical Load Brake CMAA Class A, B, C, D Resistor Part #	Resistance
230 Volts	2001-P3S2	EDB2001CT	220	EDB2001DTP	220	EDB2001CT	220
	2003-P3S2	EDB2001CT	220	EDB2001DTP	220	EDB2001CT	220
	2005-P3S2	EDB2003CT	110	EDB2004DTP	100	EDB2003CT	110
	2008-P3S2	EDB2006CT	58	EDB2006DTP	44	EDB2003CT	110
	2011-P3S2	EDB2009CT	37	EDB2011DTP	31	EDB2006CT	58
	2017-P3S2	EDB2015CT	25	EDB2015DTP	25	EDB2009CT	37
	2025-P3S2	EDB2022CT	14	EDB2022DT	14	EDB2015CT	25
	2033-P3S2	EDB2028CT	13	EDB2028DT	12	EDB2015CT	25
460 Volts	4001-P3S2	EDB4001CT	440	EDB4001DTP	440	EDB4001CT	440
	4002-P3S2	EDB4001CT	440	EDB4002DTP	354	EDB4001CT	440
	4003-P3S2	EDB4003CT	230	EDB4004DTP	187	EDB4001CT	440
	4004-P3S2	EDB4004CT	150	EDB4005DTP	133	EDB4003CT	230
	4008-P3S2	EDB4007CT	100	EDB4008DTP	84	EDB4004CT	150
	4014-P3S2	EDB4011CT	59	EDB4011DT	47	EDB4007CT	100
	4018-P3S2	EDB4014CT	46	EDB4014DT	37	EDB4007CT	100

If Electromotive Systems resistors are not used, this table should be used to determine the minimum resistance values.

Appendix C: IMPULSE•P^3 Series 2 Parameter Listing

No.	Parameter Name	Initial Value	Ref Page#
n060	Parameter Switchover	0	5-4
n100	X-Press Programming	7	5-4, 5-5
n101	Control Method	0	5-4, 6-12
n102	Motor Rated Current	note 1	5-4, 6-12
n103	Access Level	0000	5-4
n104	Freq. Ref. 1 Master Reference	note 2	5-6
n105	Freq. Ref. 2	note 2	5-6
n106	Freq. Ref. 3	note 2	5-6
n107	Freq. Ref. 4	note 2	5-6
n108	Freq. Ref. 5	note 2	5-6
n109	Frequency Reference Upper Limit	100%	5-7
n110	Frequency Reference Lower Limit	2%	5-7
n111	Acceleration Time 1	note 2	5-8
n112	Deceleration Time 1	note 2	5-8
n113	Special Functions	0000	6-8, 6-9
n114	Acceleration Time 2	1.5	5-8, 6-8
n115	Deceleration Time 2	1.5	5-8, 6-8
n116	Quick Stop Time	1.0	6-8
n117	Run Signal Selection 1	1	6-3
n118	Frequency Reference Selection 1	note 2	6-3
n119	Terminal/Comm. Mode: Stopping Method Selection	note 2	6-4
n120	STOP Key of Keypad: Stopping Method Selection	1	6-4
n121	Electronic Thermal Motor Protection	1	6-24
n122	Thermal Protection Motor Time Constant	5	6-24
n123	Auto-Reset Attempts	3	6-22
n124	Auto-Reset Selection	8080	6-22
n125	Time Delay for Auto Reset	2.0 Sec.	6-22
n126	S-Curve Accel/Decel Selection	2	5-8
n127	Overtorque Detection 1	0	6-23
n128	Overtorque Detection Level	100%	6-23
n129	Overtorque Detection Delay Time	0.2 Sec.	6-23
n130	Swift Lift Forward Speed	60 Hz	6-9
n131	Swift Lift Reverse Speed	60 Hz	6-9
n132	Swift Lift Enabling Current at Forward	50%	6-9
n133	Swift Lift Enabling Current at Reverse	0%	6-9
n134	Swift Lift Threshold Speed	60 Hz	6-9

No.	Parameter Name	Initial Value	Ref Page#
n135	Swift Lift Delay Time at Threshold speed	2.0 Sec.	6-9
n136	DC Injection Braking Current	50%	6-4
n137	DC Injection Time at Stop	0.5 Sec.	6-4
n138	DC Injection Decay Time	0.00 Sec.	6-4
n139	Stall Prevention at Accel	150%	6-24
n140	Stall Prevention at Decel	0	6-24
n141	Stall Prevention During Run	160%	6-24
n142	Terminal S3 Select	note 2	6-14
n143	Terminal S4 Select	note 2	6-14
n144	Terminal S5 Select	note 2	6-15
n145	Terminal S6 Select	note 2	6-15
n146	Terminal S7 Select	25	6-15
n147	Multi-Function Output 1 Contact Output Function Terminal MA-MB-MC	00	6-17
n148	Multi-Function Output 2	00	6-17
n149	Multi-Function Output 3	27	6-17
n150	Analog Frequency Reference Gain	100%	6-3
n151	Analog Frequency Reference Bias	0%	6-3
n152	Analog Frequency Filter Time	0.10 Sec.	6-3
n153	Multi-Function Analog Output	9	6-19
n154	Multi-Function Analog Output Gain	1.00	6-19
n155	Multi-Function Analog Output Select	0	6-19
n156	Frequency Detection Width	1.00 Hz	6-24, 6-15
n157	Frequency Detection Level	0.00 Hz	6-24, 6-15
n158	Carrier Frequency	1	6-24
n159	Fault History	–	6-24
n160	Software Number	–	6-24
n161	Max. Output Frequency	60.0	6-11
n162	Max. Output Voltage	230.0/ 460.0	6-11
n163	Max. Voltage Output Freq.	60.0	6-11
n164	Mid. Output Freq.	3.0	6-11
n165	Mid. Output Freq. Voltage	note 2	6-11
n166	Min. Output Frequency	note 3	6-11
n167	Min. Output Freq. Voltage	note 2	6-11
n168	Analog Voltage Input Gain	100%	6-16
n169	Analog Voltage Input Bias	0%	6-16
n170	Analog Voltage Input Filter Time	0.10 Sec.	6-16
n171	Analog Current Input Gain	100%	6-16
n172	Analog Current Input Bias	0%	6-16
n173	Analog Current Input Filter Time	0.10 Sec.	6-16

No.	Parameter Name	Initial Value	Ref Page#
n177	Multi-Function Analog Input Function Selection	0	6-16
n178	Multi-Function Analog Input Signal Selection	0	6-16
n179	Multi-Function Analog Input Signal Selection	10%	6-16
n180	Digital Operator Connection Fault Selection	0	6-24
n183	Jump Frequency 1	0.00	6-20
n184	Jump Frequency 2	0.00	6-20
n185	Jump Frequency 3	0.00	6-20
n186	Jump Frequency Deadband	0.00	6-20
n189	Upper Limit 1 Speed	6.00 Hz.	6-6
n190	UL1 Decel Time	1.0 Sec.	6-6
n191	Action at UL2	0	6-6
n192	UL2 Stopping Time	0.5 Sec.	6-6
n193	Lower Limit 1 Speed	6.00 Hz.	6-6
n194	LL1 Decel Time	1.0 Sec.	6-6
n195	Action at LL2	0	6-6
n196	LL2 Stopping Time	0.5 Sec.	6-6
n197	Travel Limit Auto Reset Enable/ Disable	1	6-6
n203	Torque Compensation Gain	1.0	6-12
n204	Time Constant at Torque Compensation	note 3	6-12
n205	Torque Compensation Iron Loss	note 1	6-12
n206	Motor Rated Slip	note 1	6-12
n207	Motor Phase Resistance	note 1	6-12
n208	Motor Leak Inductance	note 3	6-12
n209	Torque Boost (OLV)	150%	6-12
n210	Motor No-Load Current	note 1	6-12
n211	Slip Compensation Gain	note 3	6-12
n212	Slip Compensation Delay Time	note 3	6-12
n213	Slip Compensation Select During Regeneration (OLV)	0	6-12
n215	Stall Prevention Auto Decrease	0	6-23
n216	Accel/Decel Selection at Stall Prevention During Run	0	6-23
n217	Freq. Ref. 6	0.00	5-6, 5-7
n218	Freq. Ref. 7	0.00	5-6, 5-7
n219	Freq. Ref. 8	0.00	5-6, 5-7
n220	Freq. Ref. 9	0.00	5-6, 5-7
n221	Freq. Ref. 10	0.00	5-6, 5-7
n222	Freq. Ref. 11	0.00	5-6, 5-7
n223	Freq. Ref. 12	0.00	5-6, 5-7
n224	Freq. Ref. 13	0.00	5-6, 5-7

No.	Parameter Name	Initial Value	Ref Page#
n225	Freq. Ref. 14	0.00	5-6, 5-7
n226	Freq. Ref. 15	0.00	5-6, 5-7
n227	Freq. Ref. 16	0.00	5-6, 5-7
n228	Jog Freq. Reference	6.00	5-7
n229	Micro Speed Gain 1	0.10	6-5
n230	Micro Speed Gain 2	0.50	6-5
n231	Frequency Reference Setting/ Display Unit Selection	0	6-23
n233	Frequency Reference Setting Method	0	6-23
n234	Accel/Decel Setting Unit Selection	0	5-8
n235	Load Check Enable/Disable	0	6-19
n236	Load Check Look Speed 1	6.00 Hz	6-21
n237	Load Check Current Ref. 1	160%	6-21
n238	Load Check Look Speed 2	20.00 Hz.	6-21
n239	Load Check Current Ref. 2	160%	6-21
n240	Load Check Look Speed 3	60.00 Hz.	6-21
n241	Load Check Current Ref. 3	160%	6-21
n242	Load Check Current Ref. 4	160%	6-21
n243	Load Check Hold Time	0.2 Sec.	6-21
n244	Load Check Detect Time	0.2 Sec.	6-21
n245	Load Check Vector Torque Reference	0	6-21
n246	Input Phase Loss Detect Level	0%	6-23
n247	Input Phase Loss Detect Time	0	6-23
n248	Output Phase Loss Detect Level	0%	6-23
n249	Output Phase Loss Detect Time	0 Sec.	6-23
n250	Pulse Monitor Output Frequency Selection	0	6-18

*Note 1: Initial value is determined by drive capacity.

*Note 2: Initial value is determined by n100 (X-Press Programming).

*Note 3: Initial value is determined by n101 (Control Method).