




invertek IP66(NEMA 4X)AC Variable Speed Drive User Guide

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invertek IP66(NEMA 4X)AC Variable Speed Drive



WARNING!

- The Optidrive should **ONLY** be installed by a qualified electrician.
- In a residential environment, this product may cause radio interference in which case supplementary mitigation measures may be required.

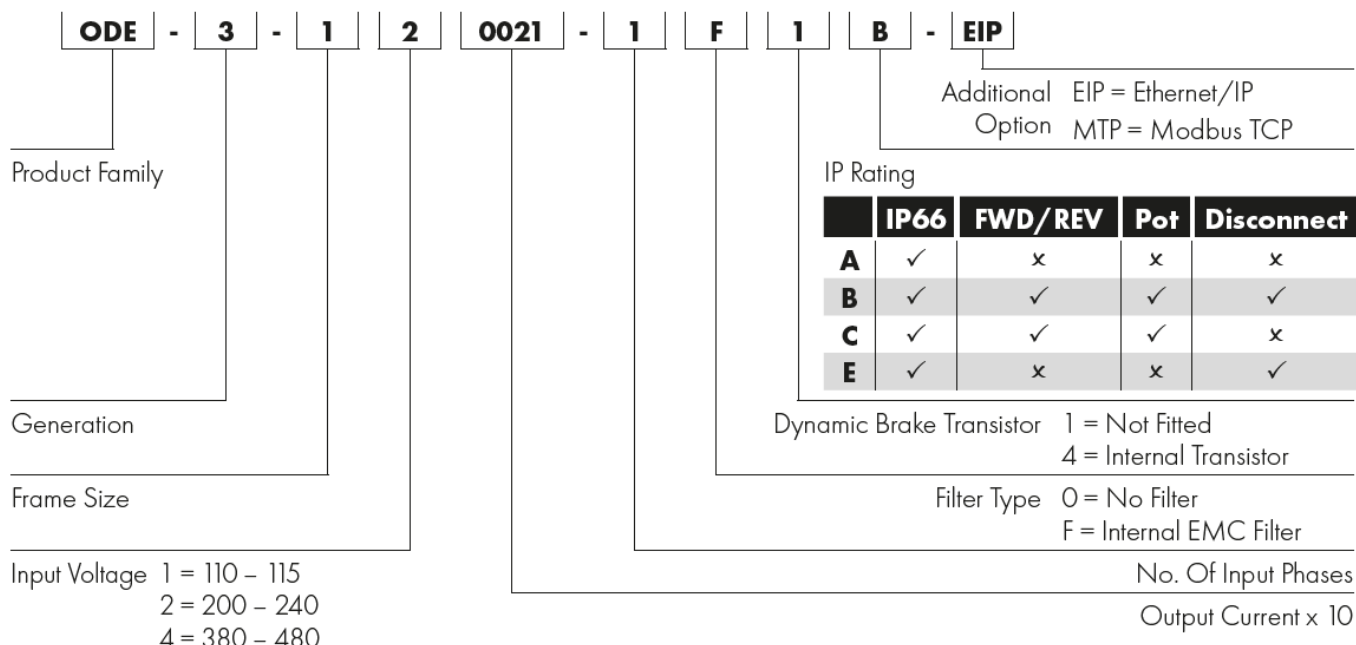
NOTE

This guide does not provide detailed installation, safety or operational instructions. See the Optidrive E3 IP66 Outdoor User Manual for complete information. Unpack and check the drive. Notify the supplier and shipper immediately of any damage.

CHECK

Identifying the Drive by Model Number

Each drive can be identified by its model number, as shown in the table below.



- When installing the drive on any power supply where the phase-ground voltage may exceed the phase-phase voltage (typically IT supply networks or Marine vessels) it is essential that the internal EMC filter ground and surge protection varistor ground (where fitted) are disconnected. If in doubt, refer to your Sales Partner for further information.
- This manual is intended as a guide for proper installation. Invertek Drives Ltd cannot assume responsibility for the compliance or the non-compliance to any code, national, local or otherwise, for the proper installation of this drive or associated equipment. A hazard of personal injury and/or equipment damage exists if codes are ignored during installation.
- This Optidrive contains high voltage capacitors that take time to discharge after removal of the main supply. Before working on the drive, ensure isolation of the main supply from line inputs. Wait ten (10) minutes for the capacitors to discharge to safe voltage levels. Failure to observe this precaution could result in severe bodily injury or loss of life.

NOTE

If the drive has been in storage for a period longer than 2 years, the DC link capacitors must be reformed. Refer to online documentation for further information.

PREPARE

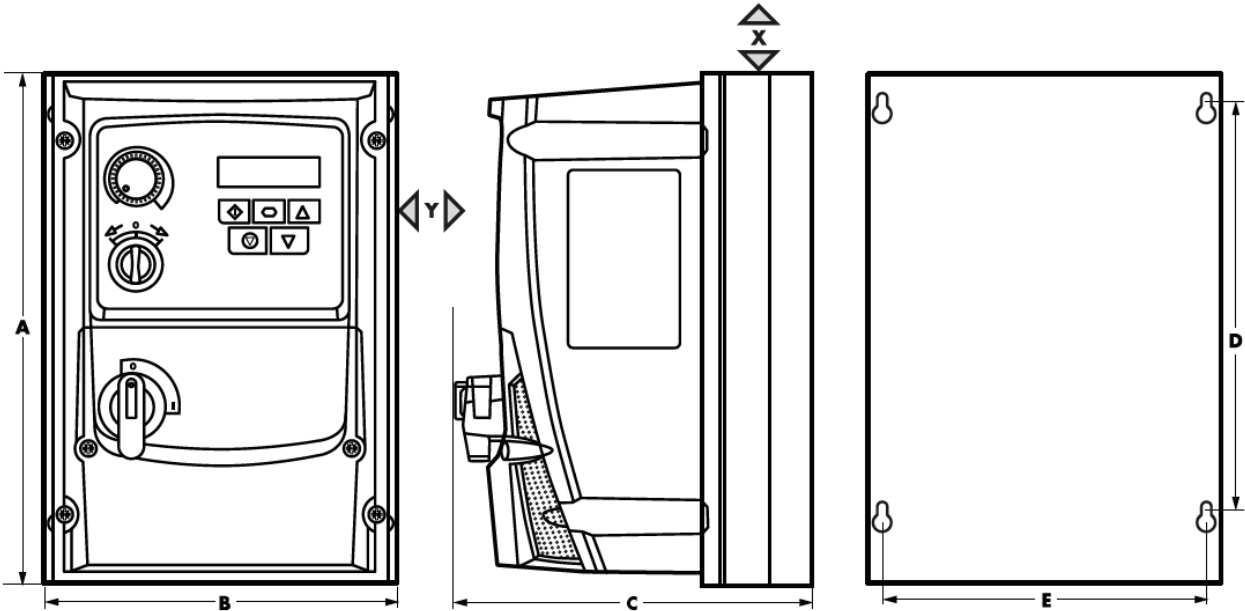
Prepare the Mounting Location

- The Optidrive must be mounted in a vertical position only.
- Installation should be on a suitable flat, flame-resistant surface. Do not mount flammable material close to the drive.
- Refer to Technical Data and ensure the chosen mounting location is within the drive specification.
- The mounting location should be free from vibration.
- Do not mount the drive in any area with excessive humidity, corrosive airborne chemicals or potentially dangerous dust particles.
- Avoid mounting close to high heat sources.
- The drive must not be mounted in direct sunlight. If necessary, install a suitable shade cover.

- The mounting location must be free from frost.
- Do not restrict the flow of air through the drive heatsink. The drive generates heat which must be naturally allowed to dissipate. Correct air clearance around the drive must be observed.
- If the location is subject to wide ambient temperature and air pressure variation, install a suitable pressure compensation valve in the drive gland plate.

MOUNT

Mechanical Dimensions



Dimensions

Drive Size	A		B		C		D		E		Weight	
	mm	in	mm	in	mm	in	mm	in	mm	in	kg	lb
1	232	9.13	161	6.34	162	6.37	189	7.44	148.5	5.85	2.3	5
2	257	10.12	188	7.4	182	7.16	200	7.87	178	7.00	3.5	7.7
3	310	12.2	211	8.3	235	9.25	252	9.92	197	7.75	6.6	14.5
4	360	14.17	240	9.44	271	10.67	300	11.81	227	8.94	9.5	20.9

Mounting Clearance

Drive Size		X Above & Below		Y Either Side	
		mm	in	mm	in
All Frame Sizes		200	7.87	10	0.39
NOTE	Typical drive heat losses are approximately 3% of operating load conditions.				
	Above are guidelines only and the operating ambient temperature of the drive MUST be maintained below the maximum limit at all times.				

Mounting Bolts & Tightening Torques

Mounting Bolts	
Frame Size	
All Frame Sizes	4 x M4 (#8)

Tightening Torques		
Frame Size	Control Terminals	Power Terminals
1, 2, 3	0.5 Nm (4.4 lb-in)	0.8 Nm (7 lb-in)
4	0.5 Nm (4.4 lb-in)	2 Nm (19 lb-in)

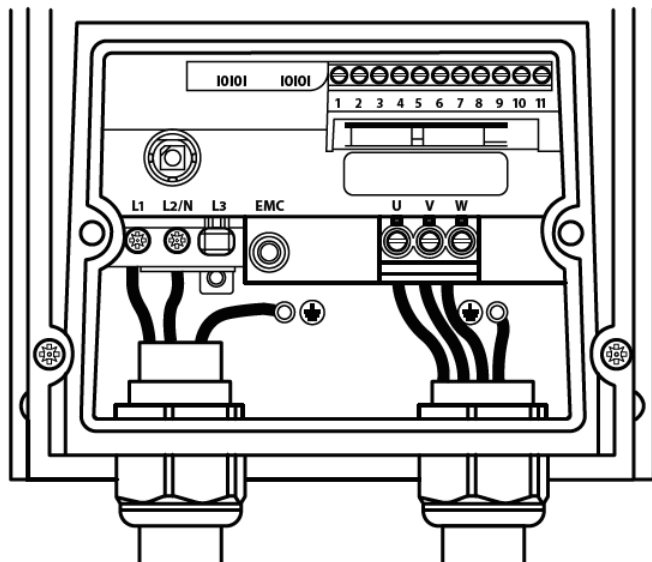
CONNECT

Cable Selection

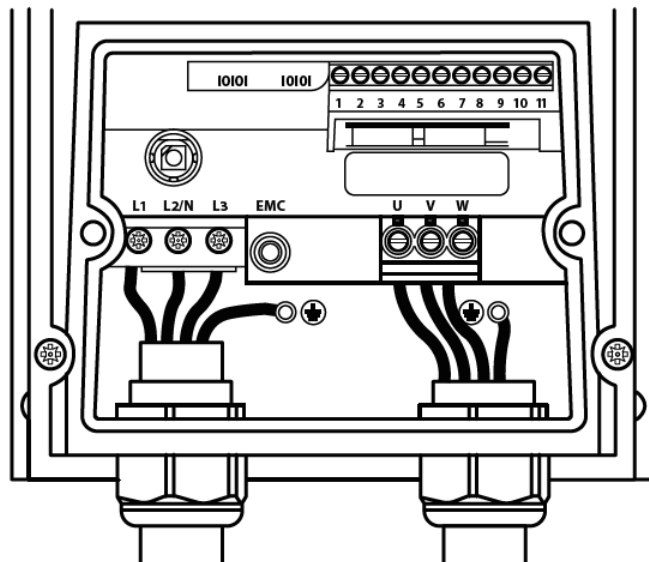
- For 1 phase supply (Sizes 1-3 only), the mains power cables should be connected to L1/L, L2/N.
For 3-phase supplies, the main power cables should be connected to L1, L2, and L3. Phase sequence is not important.
- For compliance with CE and C Tick EMC requirements, refer to online documentation.
- A fixed installation is required according to IEC61800-5-1 with a suitable disconnecting device installed between the Optidrive and the AC Power Source. The disconnecting device must conform to the local safety code/regulations (e.g. within Europe, EN60204-1, Safety of machinery).
- The cables should be dimensioned according to any local codes or regulations. Maximum dimensions are given in the Rating Tables section of this Quick Start Guide.

Install the Power Wiring

Single phase supply



3 phase supply



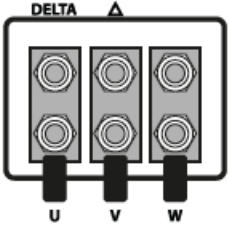
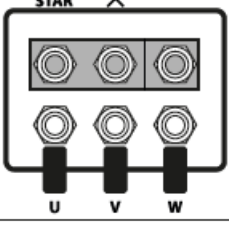
Drive Size	Power & Motor Cables		
	Hole Size	Recommended PG Gland	Alternative Metric Gland
Size 1	22	PG16	M20
Size 2 & 3	27	PG21	M25
Size 4	37	PG29	—

For drives with Ethernet, 4 hole plate is fitted.

Size	Power Cable Glands	Control Cable Glands
1	20.4mm / PG13.5 / M20	20.4mm / PG13.5 / M20
2 & 3	27 m / PG21 / M25	20.4mm / PG13.5 / M20
4	37mm / PG29	20.4mm / PG13.5 / M20

Motor Terminal Box Connections

Most general-purpose motors are wound for operation on dual voltage supplies. This is indicated on the nameplate of the motor. This operational voltage is normally selected when installing the motor by selecting either STAR or DELTA connection. STAR always gives the higher of the two voltage ratings.

Incoming Supply Voltage	Motor Nameplate Voltages	Connection	
230	230 / 400	Delta	
400	400 / 690		
400	230 / 400	Star	

Information for UL Compliance

Optidrive E3 is designed to meet the UL requirements. For an up-to-date list of UL-compliant products, please refer to UL listing NMMS.E226333. In order to ensure full compliance, the following must be fully observed.

Input Power Supply Requirements	
Supply Voltage	200 – 240 RMS Volts for 230 Volt rated units, + /- 10% variation allowed. 240 Volt RMS Maximum.
	380 – 480 Volts for 400 Volt rated units, + / – 10% variation allowed, Maximum 500 Volts RMS.
Frequency	50 – 60Hz + / – 5% Variation
Short Circuit Capacity	All drives are suitable for use on a circuit capable of delivering not more than indicated in the table below, maximum short-circuit Amperes symmetrical with the specified maximum supply voltage when protected by Class J fuses.
Mechanical Installation Requirements	
All Optidrive E3 units are intended for installation within controlled environments which meet the condition limits shown in the Environment section of this Quick Start Guide.	
The drive can be operated within an ambient temperature range as stated in the Environment section of this Quick Start Guide.	
Electrical Installation Requirements	
Incoming power supply connection must be according to the Install the Wiring section of this Quick Start Guide.	
Suitable power and motor cables should be selected according to the data shown in Rating Tables section of this Quick Start Guide and the National Electrical Code or other applicable local codes.	
Motor Cable	75°C Copper must be used.
Power cable connections and tightening torques are shown in the Mechanical Dimensions section of this Quick Start Guide.	
Integral Solid State short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the national electrical code and any additional local codes. Ratings are shown in the Rating Tables section of this Quick Start Guide.	

For installations in Canada transient surge suppression must be installed on the line side of this equipment and shall be rated 480Volt (phase to ground), 480 Volt (phase to phase), suitable for over voltage category iii and shall provide protection for a rated impulse withstand voltage peak of 2.5kV.

UL Listed ring terminals/lugs must be used for all bus bar and grounding connections.

General Requirements

Optidrive E3 provides motor overload protection, set at 150% of full load, in accordance with the National Electrical Code (US). Where a motor thermistor is not fitted, or not utilised, Thermal Overload Memory Retention must be enabled by setting P-60 = 1.

Where a motor thermistor is fitted and connected to the drive, connection must be carried out according to the information shown in the Motor Thermistor Connection section of the Quick Start Guide.

UL rated ingress protection ("Type") is only met when cables are installed using a UL-recognized bushing or fitting for a flexible conduit system which meets the required level of protection ("Type").

For conduit installations the conduit entry holes require standard opening to the required sizes specified per the NEC.





Not intended for installation using rigid conduit system.

WARNING: The opening of the branch-circuit protective device may be an indication that a fault has been interrupted. To reduce the risk of fire or electric shock, current-carrying parts and other components of the controller should be examined and replaced if damaged. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced.

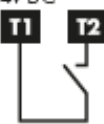


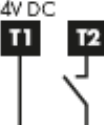


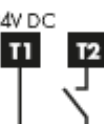

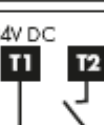

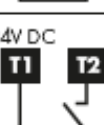










Input Power Supply Requirements

Supply Voltage	200 – 240 RMS Volts for 230 Volt rated units, + /- 10% variation allowed.	
	380 – 480 Volts for 400 Volt rated units, + / – 10% variation allowed.	
Imbalance	Maximum 3% voltage variation between phase – phase voltages allowed.	
	All Optidrive E3 units have phase imbalance monitoring. A phase imbalance of > 3% will result in the drive tripping. For input supplies which have supply imbalance greater than 3% (typically the Indian sub-continent & parts of Asia Pacific including China) Invertek Drives recommends the installation of input line reactors. Alternatively, the drives can be operated as a single phase supply drive with 50% derating.	
Frequency	50 – 60Hz + / – 5% Variation.	
Maximum Supply Short-Circuit Current Capacity	The maximum permissible short circuit current at the Optidrive Power terminals as defined in IEC 60439-1 is:	
	230V single-phase input drives	5kA
	230V three-phase input drives	100kA
	400V three-phase input drives	100kA

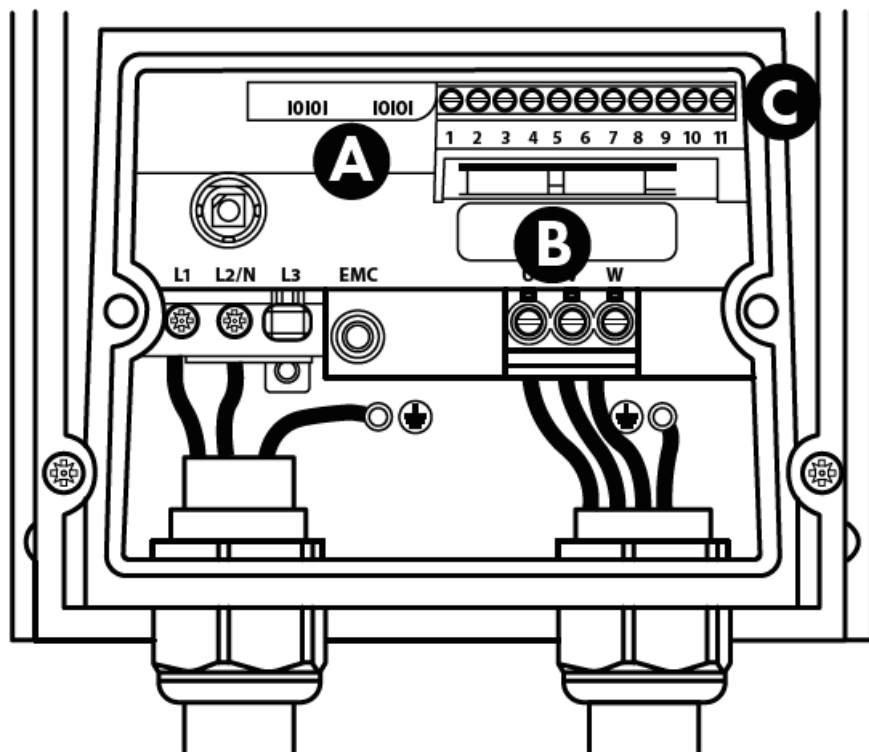
Default functions of the control switches

Switch Position			POT	Notes
				Factory Default Configuration. Run Forward or Reverse with speed controlled from the Local POT.
Run Reverse	STOP	Run Forward	Sets the output frequency	

Switch Configuration

P-64 = 0	T2 OR D11 = Switch REV OR Switch FWD	+24V DC 	VFD Control Terminals External User Switches	OR		OR	
P-64 = 1	D11 = T2 only	+24V DC 	VFD Control Terminals External User Switches				
	Drive Switch is disabled						
P-64 = 2	T2 OR D11 = Switch FWD	+24V DC 	VFD Control Terminals External User Switches	OR			
P-64 = 3	T2 AND Switch FWD OR T2 AND Switch REV	+24V DC 	VFD Control Terminals External User Switches	AND			
		+24V DC 	VFD Control Terminals External User Switches	AND			
P-64 = 4	T2 AND D11 = Switch FWD	+24V DC 	VFD Control Terminals External User Switches	AND			
P-65 = 0	T3 OR D12 = Switch REV	+24V DC 	VFD Control Terminals External User Switches	OR			
P-65 = 1	D12 = T3 only	+24V DC 	VFD Control Terminals External User Switches				
	Drive Switch is disabled						
P-65 = 2	T3 AND D12 = Switch REV	+24V DC 	VFD Control Terminals External User Switches	AND			

Control Connections



A	Serial RS485 Port
B	Ethernet Ports (Factory fit option)
C	Control Terminals

Control Terminal Wiring

- All analog signal cables should be suitably shielded. Twisted pair cables are recommended.
- Power and Control Signal cables should be routed separately where possible, and must not be routed parallel to each other.
- Signal levels of different voltages e.g. 24 Volt DC and 110 Volt AC, should not be routed in the same cable.
- The maximum control terminal tightening torque is 0.5Nm.
- Control Cable entry conductor size: 0.05 – 2.5mm² / 30 – 12 AWG.

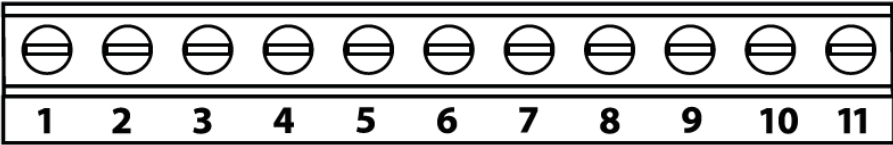
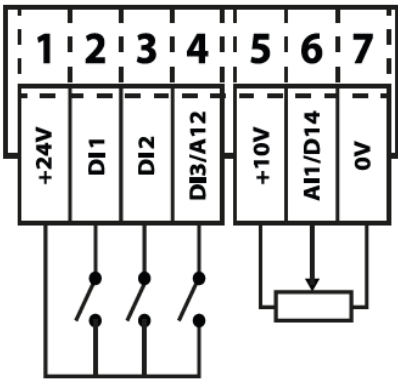
Control Terminal Connections

Control Switched Units: May use the built-in control switch and potentiometer, or external control signals connected to the control terminals.

Non-Switched Units:

Require external control signals to be connected to the control terminals.

Using the Control Terminals

										
										
+24 VDC	DI1	DI2	DI3 AI2	+10 VDC	DI4 AI1	0V	A0	0V	RL1	RL2
No.	Purpose					Function				
1	+24VDC 100mA Output DI1 Digital Input 1 DI2 Digital Input 2 DI3 Digital Input 3/AI2 Analog Input 2 +10VDC 10mA Output					24 VDC Output				
2						Function defined by P-12 & P-15.				
3						See below for further info				
4										
5						10 VDC Output for external potentiometer				
6	DI4 Digital Input 4/AI1 Analog Input 1					Function defined by P-12 & P-15. Signal format selected by P-16				
7	0VDC Common									
8	AO Analog Output/Digital Output					Function selected by P-25. See Parameter List				
9	0VDC Common RL1A Output Relay RL1B Output Relay									
10										
11						Function defined by P-18. See Parameter List				

Factory Default Functions

No.	Description		
DI1	0/1	Open: Stop	Closed: Run
DI2	P/Q	Open: Forward Rotation	Closed: Reverse Rotation
DI3	Analog Speed Reference / Preset Speed	Open: Speed Reference set by Analog Speed Reference Closed: Speed Reference set by Preset Speed 1 (P-20)	
AI1	Analog Speed Reference Input	Sets the Speed Reference NOTE For Switched units, the internal pot is selected by default in P-16. For Non-switched units, an external pot or 0 – 10 V reference may be connected. Other signal types may also be used, set P-16 to the correct format.	
NOTE	Additional functions are possible, refer to the online documentation for further information.		

Analog and Digital Input Macro Configurations

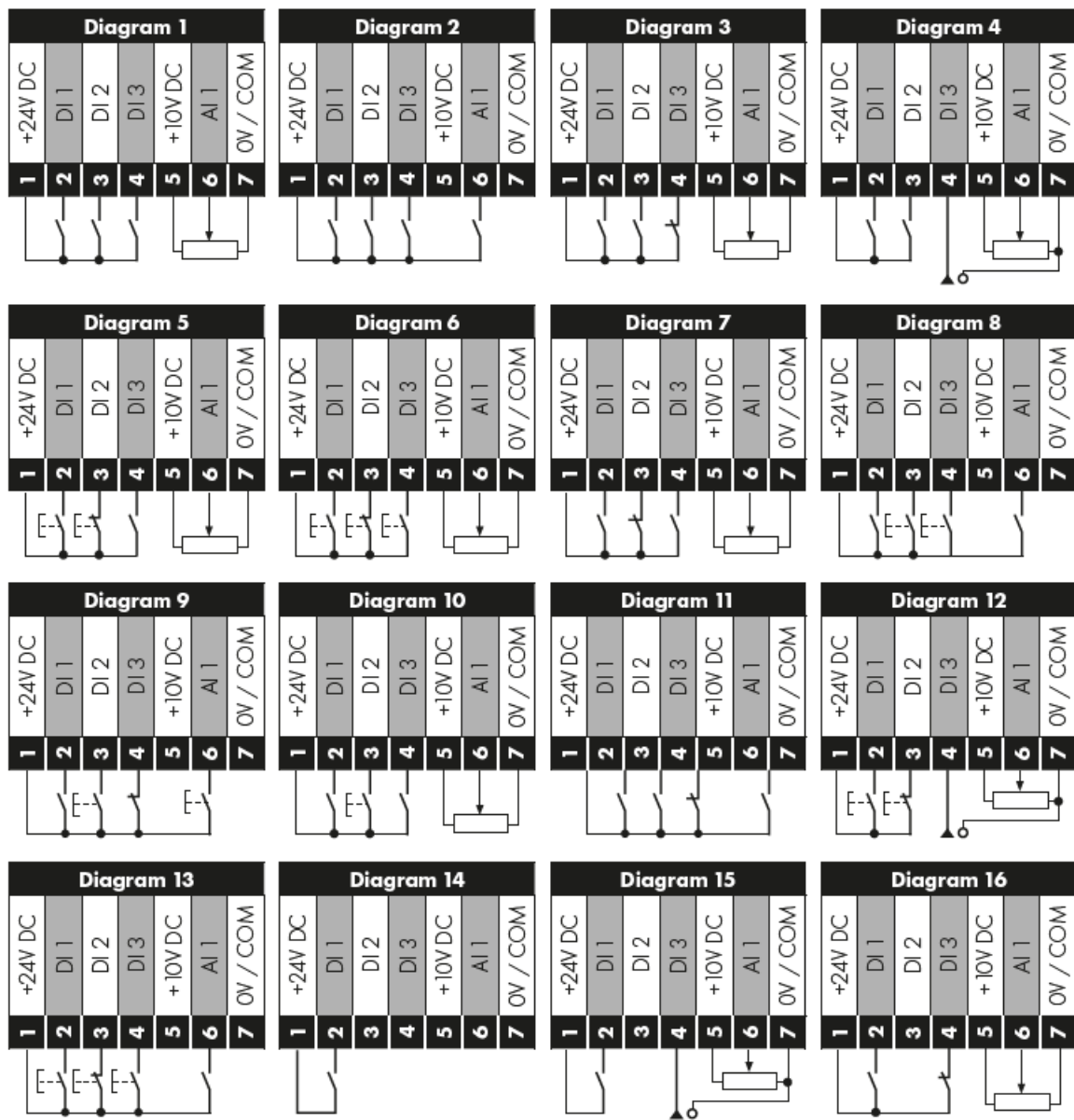
Overview

Optidrive E3 uses a Macro approach to simplify the configuration of the Analog and Digital Inputs. There are two key parameters that determine the input functions and drive behavior:

- P-12 Selects the main drive control source and determines how the output frequency of the drive is primarily controlled.
- P-15 Assigns the Macro function to the analog and digital inputs.



Additional parameters can then be used to further adapt the settings, e.g.

- P-16 is Used to select the format of the analog signal to be connected to analog input 1, e.g. 0 – 10 Volt, 4 – 20mA.
- P-30 Determines whether the drive should automatically start following a power on if the Enable Input is present.
- P-31 When Keypad Mode is selected, determine at what output frequency/speed the drive should start following the enable command, and also whether the keypad start key must be pressed or if the Enable input alone should start the drive.
- P-47 Used to select the format of the analog signal to be connected to analog input 2, e.g. 0 – 10 Volt, 4 – 20mA. Example Connection Diagrams
- The diagrams below provide an overview of the functions of each terminal macro function and a simplified connection diagram for each.



Macro Functions Guide Key

The table below should be used as a key on the following pages.

Function	Explanation
STOP	Latched Input, Open the contact to STOP the drive
RUN	Latched input, Close the contact to Start, the drive will operate as long as the input is maintained
FWD 	Latched Input, selects the direction of motor rotation FORWARD
REV 	Latched Input, selects the direction of motor rotation REVERSE
RUN FWD 	Latched Input, Close to Run in the FORWARD direction, Open to STOP
RUN REV 	Latched Input, Close to Run in the REVERSE direction, Open to STOP
ENABLE	Hardware Enable Input. In Keypad Mode, P-31 determines whether the drive immediately starts, or the keypad start key must be pressed. In other modes, this input must be present before the start command is applied via the fieldbus interface.
START 	Normally Open, Rising Edge, Close momentarily to START the drive (NC STOP Input must be maintained)
^ START ^	Simultaneously applying both inputs momentarily will START the drive (NC STOP Input must be maintained)
STOP 	Normally Closed, Falling Edge, Open momentarily to STOP the drive
START  FWD 	Normally Open, Rising Edge, Close momentarily to START the drive in the forward direction (NC STOP Input must be maintained)
START  REV 	Normally Open, Rising Edge, Close momentarily to START the drive in the reverse direction (NC STOP Input must be maintained)
^ FAST STOP (P-24) ^	When both inputs are momentarily active simultaneously, the drive stops using Fast Stop Ramp Time P-24
FAST STOP  (P-24)	Normally Closed, Falling Edge, Open momentarily to FAST STOP the drive using Fast Stop Ramp Time P-24
E-TRIP	Normally Closed, External Trip input. When the input opens momentarily, the drive trips showing E-trIP or P-trIP depending on P-47 setting
Fire Mode	Activates Fire Mode
Analog Input AI1	Analog Input 1, signal format selected using P-16
Analog Input AI2	Analog Input 2, signal format selected using P-47
AI1 REF	Analog Input 1 provides the speed reference
AI2 REF	Analog Input 2 provides the speed reference
P-xx REF	Speed reference from the selected preset speed
PR-REF	Preset speeds P-20 – P-23 are used for the speed reference, selected according to other digital input status
PI-REF	PI Control Speed Reference
PI FB	Analog Input used to provide a Feedback signal to the internal PI controller
KPD REF	Keypad Speed Reference selected
FB REF	Selected speed reference from Fieldbus (Modbus RTU / CAN Open / Master depending on P-12 setting)
(NO)	Input is Normally Open, Close momentarily to activate the function
(NC)	Input is Normally Closed, Open momentarily to activate the function
INC SPD 	Normally Open, Rising Edge, Close momentarily to increase the motor speed by value in P-20
DEC SPD 	Normally Open, Rising Edge, Close momentarily to decrease the motor speed by value in P-20

Macro Functions – Terminal Mode (P-12 = 0)

P-15	DI1		DI2		DI3 / AI2		DI4 / AI1		Diagram	
	0	1	0	1	0	1	0	1		
0	STOP	RUN	FWD ⤴	REV ⤵	AI1 REF	P-20 REF	Analog Input AI1		1	
1	STOP	RUN	AI1 REF	PR-REF	P-20	P-21	Analog Input AI1		1	
2	STOP	RUN	DI2	DI3	PR		P-20 - P-23	P-01	2	
			0	0	P-20					
			1	0	P-21					
			0	1	P-22					
			1	1	P-23					
3	STOP	RUN	AI1	P-20 REF	E-TRIP	OK	Analog Input AI1		3	
4	STOP	RUN	AI1	AI2	Analog Input AI2		Analog Input AI1		4	
5	STOP	RUN FWD ⤴	STOP	RUN REV ⤵	AI1	P-20 REF	Analog Input AI1		1	
		^-----FAST STOP (P-24)-----^								
6	STOP	RUN	FWD ⤴	REV ⤵	E-TRIP	OK	Analog Input AI1		3	
7	STOP	RUN FWD ⤴	STOP	RUN REV ⤵	E-TRIP	OK	Analog Input AI1		3	
		^-----FAST STOP (P-24)-----^								
8	STOP	RUN	FWD ⤴	REV	DI3	DI4	PR		2	
					0	0	P-20			
					1	0	P-21			
					0	1	P-22			
					1	1	P-23			
9	STOP	START FWD ⤴	STOP	START REV ⤵	DI3	DI4	PR		2	
		^-----FAST STOP (P-24)-----^			0	0	P-20			
					1	0	P-21			
					0	1	P-22			
					1	1	P-23			
10	(NO)	START ⬇	STOP	(NC)	AI1 REF	P-20 REF	Analog Input AI1		5	
11	(NO)	START ⬇ FWD ⤴	STOP	(NC)	(NO)	START ⬇ REV ⤵	Analog Input AI1		6	
		^-----FAST STOP (P-24)-----^								
12	STOP	RUN	FAST STOP (P-24)	OK	AI1 REF	P-20 REF	Analog Input AI1		7	
13	(NO)	START FWD ⤴	STOP	(NC)	(NO)	START REV ⤵	KPD REF	P-20 REF	13	
		^-----FAST STOP (P-24)-----^								
14	STOP	RUN	DI2		E-TRIP	OK	DI2	DI4	PR	11
							0	0	P-20	
							1	0	P-21	
							0	1	P-22	
							1	1	P-23	
15	STOP	RUN	P-23 REF	AI1	Fire Mode		Analog Input AI1		1	
16	STOP	RUN	P-23 REF	P-21 REF	Fire Mode		FWD	REV	2	
17	STOP	RUN	DI2		Fire Mode		DI2	DI4	PR	2
							0	0	P-20	
							1	0	P-21	
							0	1	P-22	
							1	1	P-23	
18	STOP	RUN	FWD ⤴	REV ⤵	Fire Mode		Analog Input AI1		1	
19	STOP	RUN	AI1 REF	P-20 REF	-	Fire Mode & Run	Analog Input AI1		1	

Macro Functions – Keypad Mode (P-12 = 1 or 2)

P-15	DI1		DI2		DI3 / AI2		DI4 / AI1		Diagram
	0	1	0	1	0	1	0	1	
0	STOP	ENABLE	-	INC SPD ↑ ^-----START-----^	-	DEC SPD ↓	FWD ↻	REV ↻	8
1	STOP	ENABLE	PI Speed Reference						2
2	STOP	ENABLE	-	INC SPD ↑ ^-----START-----^	-	DEC SPD ↓	KPD REF	P-20 REF	8
3	STOP	ENABLE	-	INC SPD ↑ ^-----START-----^	E-TRIP	OK	-	DEC SPD ↓	9
4	STOP	ENABLE	-	INC SPD ↑	KPD REF	AI1 REF	AI1		10
5	STOP	ENABLE	FWD ↻	REV ↻	KPD REF	AI1 REF	AI1		1
6	STOP	ENABLE	FWD ↻	REV ↻	E-TRIP	OK	KPD REF	P-20 REF	11
7	STOP	RUN FWD ^-----FAST STOP (P-24)-----^	STOP	RUN REV ↻	E-TRIP	OK	KPD REF	P-20 REF	11
8	STOP	RUN FWD ↻	STOP	RUN REV ↻	KPD REF	AI1 REF	AI1		1
14	STOP	ENABLE	-	INC SPD ↑	E-TRIP	OK	-	DEC SPD ↓	
15	STOP	ENABLE	PR REF	KPD REF	Fire Mode		P-23	P-21	2
16	STOP	ENABLE	P-23 REF	KPD REF	Fire Mode		FWD ↻	REV ↻	2
17	STOP	ENABLE	KPD REF	P-23 REF	Fire Mode		FWD ↻	REV ↻	2
18	STOP	ENABLE	AI1 REF	KPD REF	Fire Mode		AI1		1
19	STOP	ENABLE	KPD REF	P-20 REF	-	Fire Mode & Run	-	-	-
9, 10, 11, 12, 13 = Behavior as per setting 0									
NOTE	<p>When P15=4 in keypad mode, DI2 & DI4 are edge triggered. Digital pot speed will be increased or decreased once for each rising edge. The step of each speed change is defined by the absolute value of Pre-set Speed 1 (P-20).</p> <p>Speed change only happens during normal running condition (no stop command etc.). Digital pot will be adjusted between minimum speed (P-02) and maximum speed (P-01).</p>								

Macro Functions – Fieldbus Control Mode (P-12 = 3, 4, 7, 8 or 9)

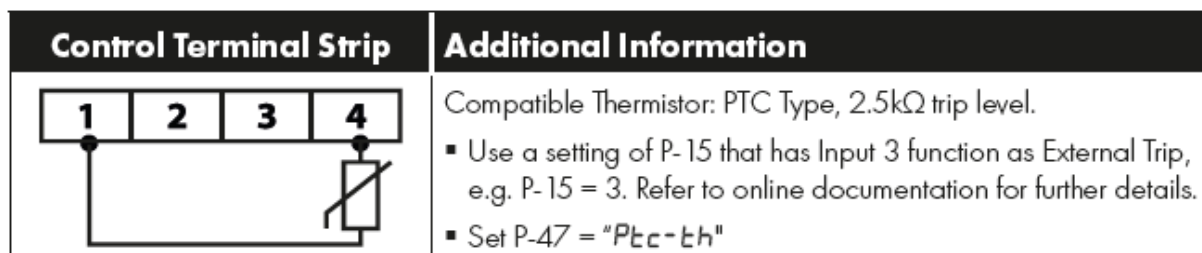
P-15	DI1		DI2		DI3 / AI2		DI4 / AI1		Diagram
	0	1	0	1	0	1	0	1	
0	STOP	ENABLE	FB REF (Fieldbus Speed Reference, Modbus RTU / CAN / Master-Slave defined by P-12)						14
1	STOP	ENABLE	PI Speed Reference						15
3	STOP	ENABLE	FB REF	P-20 REF	E-TRIP	OK	Analog Input AI1		3
5	STOP	ENABLE	FB REF	PR REF	P-20	P-21	Analog Input AI1		1
		^—START (P-12 = 3 or 4 Only)— ^							
6	STOP	ENABLE	FB REF	AI1 REF	E-TRIP	OK	Analog Input AI1		3
		^—START (P-12 = 3 or 4 Only)— ^							
7	STOP	ENABLE	FB REF	KPD REF	E-TRIP	OK	Analog Input AI1		3
		^—START (P-12 = 3 or 4 Only)— ^							
14	STOP	ENABLE	—	—	E-TRIP	OK	Analog Input AI1		16
15	STOP	ENABLE	PR REF	FB REF	Fire Mode		P-23	P-21	2
16	STOP	ENABLE	P-23 REF	FB REF	Fire Mode		Analog Input AI1		1
17	STOP	ENABLE	FB REF	P-23 REF	Fire Mode		Analog Input AI1		1
18	STOP	ENABLE	AI1 REF	FB REF	Fire Mode		Analog Input AI1		1
2, 4, 8, 9, 10, 11, 12, 13, 19 = Behavior as per setting 0									

Macro Functions – User PI Control Mode (P-12 = 5 or 6)

P-15	DI1		DI2		DI3 / AI2		DI4 / AI1		Diagram
	0	1	0	1	0	1	0	1	
0	STOP	RUN	PI REF	P-20 REF	AI2		AI1		4
1	STOP	RUN	PI REF	AI1 REF	AI2 (PI FB)		AI1		4
3, 7	STOP	RUN	PI REF	P-20	E-TRIP	OK	AI1 (PI FB)		3
4	(NO)	START	(NC)	STOP	AI2 (PI FB)		AI1		12
5	(NO)	START	(NC)	STOP	PI REF	P-20 REF	AI1 (PI FB)		5
6	(NO)	START	(NC)	STOP	E-TRIP	OK	AI1 (PI FB)		
8	STOP	RUN	FWD P	REV Q	AI2 (PI FB)		AI1		4
14	STOP	RUN	–	–	E-TRIP	OK	AI1 (PI FB)		16
15	STOP	RUN	P-23 REF	PI REF	Fire Mode		AI1 (PI FB)		1
16	STOP	RUN	P-23 REF	P-21 REF	Fire Mode		AI1 (PI FB)		1
17	STOP	RUN	P-21 REF	P-23 REF	Fire Mode		AI1 (PI FB)		1
18	STOP	RUN	AI1 REF	PI REF	Fire Mode		AI1 (PI FB)		1
2, 9, 10, 11, 12, 13, 19 = Behavior as per setting 0									
NOT E	P1 Setpoint source is selected by P-44 (default is fixed value in P-45, AI 1 may also be selected) . P1 Feedback source is selected by P-46 (default is AI 2, other options may be selected).								

Motor Thermistor Connection

Where a motor thermistor is to be used, it should be connected as follows:



COMMISSION

Operation

Managing the Keypad

The drive is configured and its operation is monitored via the keypad and display.

START

When in keypad mode, used to Start a stopped drive or to reverse the direction of rotation if bi-directional keypad mode is enabled.

UP

Used to increase speed in real-time mode or to increase parameter values in parameter edit mode.

DOWN

Used to decrease speed in real-time mode or to decrease parameter values in parameter edit mode.

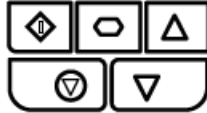




NAVIGATE

Used to display real-time information, to access and exit parameter edit mode and to store parameter changes.







RESET/STOP

Used to reset a tripped drive. When in Keypad mode is used to Stop a running drive.







Operating Displays

				
Drive Stopped / Disabled	Drive is enabled / running, display shows the output frequency (Hz)	Press the Navigate key for < 1 second. The display will show the motor current (Amps)	Press the Navigate key for < 1 second. The display will show the motor power (kW)	If P-10 > 0, pressing the Navigate key for < 1 second will display the motor speed (RPM)

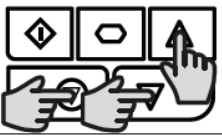
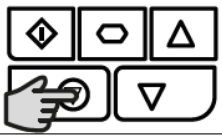
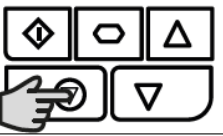
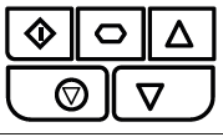
Changing Parameters

					
Press and hold the Navigate key > 2 seconds	Use the up and down keys to select the required parameter	Press the Navigate key for < 1 second	Adjust the value using the Up and Down keys	Press for < 1 second to return to the parameter menu	Press for > 2 seconds to return to the operating display

Read Only Parameter Access

					
Press and hold the Navigate key > 2 seconds	Use the up and down keys to select P-00	Press the Navigate key for < 1 second	Use the up and down keys to select the required Read Only parameter	Press the Navigate key for < 1 second to display the value	Press and hold the Navigate key > 2 seconds to return to the operating display

Resetting Parameters

			
To reset parameter values to their factory default settings, press and hold Up, Down and Stop buttons for > 2 seconds. The display will show "P-dEF"	Press the Stop key. The display will show "Stop"	Press the Stop key. The display will show "Stop"	

OPERATE

Parameters

Standard Parameters

P a r.	Description			Min	Max	Defa ult	Unit s
P - 0 1	Maximum Frequency/Speed Limit			P-02	500. 0	50.0 (60. 0)	Hz/ RP M
P - 0 2	Minimum Frequency/Speed Limit			0.0	P-01	0.0	Hz/ RP M
P - 0 3	Acceleration Ramp Time			0.00	600. 0	5.0	s
P - 0 4	Deceleration Ramp Time			0.00	600. 0	5.0	s
P - 0 5	Stopping Mode/Mains Loss Response			0	4	0	–
		Se tti ng	On Disable	On Mains Loss			
		0	Ramp to Stop (P-0 4)	Ride Through (Recover energy from load to maintain operation)			
		1	Coast	Coast			
		2	Ramp to Stop (P-0 4)	Fast Ramp to Stop (P-24), Coast if P-24 = 0			
		3	Ramp to Stop (P-0 4) with AC Flux Bra king	Fast Ramp to Stop (P-24), Coast if P-24 = 0			
	4	Ramp to Stop (P-0 4)	No action				
P - 0 6	Energy Optimiser			0	3	0	–
P - 0 7	Motor Rated Voltage/Back EMF at rated speed (PM/BLDC)			0	250/ 500	230/ 400	V
P - 0 8	Motor Rated Current			Drive Rating Dep endent			A

P-09	Motor Rated Frequency		10	500	50 (60)	Hz
P-10	Motor Rated Speed		0	3000 0	0	RPM
	Optidrive E3 normally uses frequency for all speed-related parameters, e.g. Minimum and Maximum Output Frequency. It is also possible to work directly in RPM, by setting P-10 to the rated speed from the motor nameplate.					
	When set to the default value of zero, all speed-related parameters are displayed in Hz.					
	Entering the value from the motor nameplate enables the slip compensation function, and the Optidrive display will also now show motor speed in RPM. All speed-related parameters, such as Minimum and Maximum Speed, Preset Speeds etc. will also be displayed in RPM. NOTE If P-09 value is changed, P-10 value is reset to 0.					
P-11	Low-Frequency Torque Boost		0.0	Drive Dependent		%
P-12	Primary Command Source		0	9	0	-
	0: Terminal Control 5: PI Control					
	1: Uni-directional Keypad Control 6: PI Analog Summation Control					
	2: Bi-directional Keypad Control 7: CAN Control					
	3: Fieldbus Network Control 8: CAN Control					
	4: Fieldbus Network Control 9: Slave Mode					
	NOTE When P-12 = 1, 2, 3, 4, 7, 8 or 9, an enable signal must still be provided at the control terminals, digital input 1.					
P-13	Operating Mode Select		0	2	0	-
	0: Industrial Mode 1: Pump Mode 2: Fan Mode					
	Setting	Application	Current Limit (P-54)	Torque Characteristic	Spin Start (P-33)	Thermal Overload Limit Reaction (P-60 Index 2)
	0	General	150%	Constant	0: Off	0: Trip
	1	Pump	110%	Variable	0: Off	1: Current Limit Reduction
	2	Fan	110%	Variable	2: On	1: Current Limit Reduction
P-14	Extended Menu Access code		0	65535	0	-
Enables access to Extended and Advanced Parameter Groups. This parameter must be set to the value programmed in P-37 (default: 101) to view and adjust Extended Parameters and value of P-37 + 100 to view and adjust Advanced Parameters. The code may be changed by the user in P-37 if desired.						

Extended Parameters

Par.	Description	Min	Max	Default	Units
P-15	Digital Input Function Select	0	17	0	-
P-16	Analog Input 1 Signal Format	See Below		U0-10	-
	U 0-10 : Unidirectional, External 0 – 10Volt reference / pot b 0-10 : Bi-directional, External 0 – 10Volt reference / pot A 0-20 : External 0 – 20mA signal t 4-20 : External 4 – 20mA signal, trip on loss r 4-20 : External 4 – 20mA signal, P-20 on loss t 20-4 : External 20 – 4mA signal, trip on loss r 20-4 : External 20 – 4mA signal U 10-0 : External 10 – 0 Volt signal I n-Pot : Switched units only : Internal pot				
P-18	Output Relay Function Select	0	9	1	-
	0: Drive Enabled (Running) 1: Drive Healthy 2: At Target Frequency (Speed) 3: Drive Tripped 4: Output Frequency ≥ Limit 5: Output Current ≥ Limit 6: Output Frequency < Limit 7: Output Current < Limit 8: Analog Input 2 > Limit 9: Drive Ready to Run 10: Fire Mode Active 11: Output Frequency > Limit & NOT Fire Mode 12: Fieldbus PDO0 Bit 8				
P-20	Preset Frequency / Speed 1	-P-01	P-01	5.0	Hz/RPM
P-21	Preset Frequency / Speed 2	-P-01	P-01	25.0	Hz/RPM
P-22	Preset Frequency / Speed 3	-P-01	P-01	40.0	Hz/RPM
P-23	Preset Frequency / Speed 4	-P-01	P-01	P-09	Hz/RPM
P-24	2nd Ramp Time (Fast Stop)	0.00	600.0	0.00	s
P-25	Analog Output Function Select	0	11	8	-
	Digital Output Mode. Logic 1 = +24V DC 0: Drive Enabled (Running) 1: Drive Healthy 2: At Target Frequency (Speed) 3: Drive Tripped 4: Output Frequency ≥ Limit 5: Output Current ≥ Limit 6: Output Frequency < Limit 7: Output Current < Limit Analog Output Mode 8: Output Frequency (Motor Speed) 9: Output (Motor) Current 10: Output Power 11: Load Current 12: Digital Fieldbus PDO0 Bit 9 13: Analog Fieldbus PDO2				
P-30	Start/ Restart / Fire Mode Configuration				
	Index 1: Start Mode / Auto Restart	N/A		Edge-r	-
	Edge-r: Following Power on or reset, the drive will not start if Digital Input 1 remains closed. The Input must be closed after a power on or reset to start the drive. Auto-0: Following a Power On or Reset, the drive will automatically start if Digital Input 1 is closed. Auto-1 To Auto-5: Following a trip, the drive will make up to 5 attempts to restart at 20 second intervals.				
	Index 2: Fire Mode Input Logic	0	1	0	-
	0: Normally Closed (NC) input. Fire Mode active if input is open. 1: Normally Open (NO) input. Fire Mode active if input is closed.				
	Index 3: Fire Mode Input Latch	0	1	0	-
	0: Latched input. The drive will remain in Fire Mode, only as long the fire mode input signal remains. 1: Momentary input. Fire Mode is activated by a momentary signal on the input. Normally Open or Normally Closed operation is supported depending on Index 2 setting. 2: Normally Closed (NC) Input, Preset Speed 4 (P-23). 3: Normally Open (NO) Input, Preset Speed 4 (P-23).				
P-31	Keypad Start Mode Select	0-3	7	1	-
	0: Minimum Speed, Keypad Start 1: Previous Speed, Keypad Start 2: Minimum Speed, Terminal Enable 3: Previous Speed, Terminal Enable 4: Current Speed, Keypad Start 5: Preset Speed 4, Keypad Start 6: Current Speed, Terminal Start 7: Preset Speed 4, Terminal Start				
P-33	Spin Start	0	2	0	-
	0: Disabled 1: Enabled 2: Enabled on Trip, Brown Out or Coast Stop				

Par.	Description	Min	Max	Default	Units
P-34	Brake Chopper Enable (Not Size 1)	0	4	0	-
	0: Disabled 1: Enabled With Software Protection 2: Enabled Without Software Protection 3: Enabled With Software Protection 4: Enabled Without Software Protection				
P-38	Parameter Access Lock	0	1	0	-
	0: Unlocked 1: Locked				
P-39	Analog Input 1 Offset	-500.0	500.0	0.0	%
P-40	Index 1: Display Scaling Factor	0.000	16.000	0.000	-
	Index 2: Display Scaling Source	0	3	0	-
P-41	PI Controller Proportional Gain	0.0	30.0	1.0	-
P-42	PI Controller Integral Time	0.0	30.0	1.0	s
P-43	PI Controller Operating Mode	0	3	0	-
	0: Direct Operation 1: Inverse Operation 2: Direct Operation, Wake at Full Speed 3: Reverse Operation, Wake at Full Speed				
P-44	PI Reference (Setpoint) Source Select	0	1	0	-
	0: Digital Preset Setpoint 1: Analog Input 1 Setpoint 2: Fieldbus PDO2				
P-45	PI Digital Setpoint	0.0	100.0	0.0	%
P-46	PI Feedback Source Select	0	5	0	-
	0: Analog Input 2 1: Analog Input 1 2: Motor Current 3: DC Bus Voltage 4: Analog 1 – Analog 2 5: Largest (Analog 1, Analog 2)				
P-47	Analog Input 2 Signal Format	-	-	-	U0-10
	U 0-10 : Unidirectional, External 0 – 10Volt reference / pot R 0-20 : External 0 – 20mA signal E 4-20 : External 4 – 20mA signal, trip on loss r 4-20 : External 4 – 20mA signal, P-20 on loss E 20-4 : External 20 – 4mA signal, trip on loss r 20-4 : External 20 – 4mA signal Ptc-th : Motor thermistor				
P-48	Standby Mode Timer	0.0	25.0	0.0	s
P-49	PI Control Wake Up Error Level	0.0	100.0	5.0	%
P-50	User Output Relay Hysteresis	0.0	100.0	0.0	%

Advanced Parameters

P a r.	Description	Min	Max	Defa ult	Unit s
	Motor Control Mode	0	5	0	–
P - 5 1	0: Vector speed control mode 1: V/f mode 2: PM motor vector speed control 3: BLDC motor vector speed control 4: Synchronous Reluctance motor vector speed control 5: LSPM motor vector speed control				
P - 5 2	Motor Parameter Autotune	0	1	0	–
	0: Disabled 1: Enabled				
P - 5 4	Maximum Current Limit	0	175	150	%
	Defines the max current limit in vector control modes				
P - 6 1	Ethernet Service Option	0	1	0	–
	0: Disabled 1: Enabled				
P - 6 2	Ethernet Service Timeout	0	60	0	Mins
	0: Disabled >0: Timeout in minutes				
P - 6 3	Modbus Mode Selection	0	1	0	–
	0: Standard1 1: Advanced2				

Par.	Description	Min	Max	Default	Units
	IP66 DI1 Source	0	4	0	–
P-6 4	Visible only on IP66 Switched Drives 0: Terminal 2 OR Switch Forward OR Switch Reverse 1: Terminal 2 Only 2: Terminal 2 OR Switch Forward 3: Terminal 2 AND (S-Forward OR Switch R 4: Terminal 2 AND Switch Forward				
	IP66 DI2 Source	0	2	0	–
P-6 5	Visible only on IP66 Switched Drive 0: Terminal 3 OR Switch Reverse 1: Terminal 3 Only 2: Terminal 3 AND Switch Reverse				

Asynchronous Induction Motors (IM) Vector Control

Optidrive E3 factory default parameters are intended for use with IM motors where the power rating of the motor is approximately the same or slightly less than the indicated power rating of the drive. In this case, it should be possible to operate the motor without any parameter adjustment at all for initial testing.

For optimum performance, the drive parameters should be adjusted to match the motor ratings. This will also ensure correct protection of the motor from damage due to overload.

The basic parameters that should be adjusted are:

- P-07: Motor Rated Voltage (V)
- P-08: Motor Rated Current (A)
- P-09: Motor Rated Frequency (Hz)

In addition, it is also possible to set:

- P-10: Motor Rated Speed (RPM)

When this parameter is adjusted, slip compensation is activated. Slip compensation attempts to compensate the motor speed relative to the load applied, such that when operating at a constant speed with different loads, the motor shaft speed should remain approximately the same.

To further improve the performance of the motor, the following additional steps can be followed:

- **Carry out an Autotune.**

- This requires Advanced Parameter Access, $P-14 = P-37 + 100$ (Default : 201).
- After the correct nameplate information is entered from the motor, the drive can additionally measure some electrical characteristics of the motor to further optimize the motor control to suit the connected motor.
- This is achieved by setting $P-52 = 1$. The autotune will begin IMMEDIATELY following the setting of this parameter!
- The drive output will be enabled, and the motor shaft may move. It is important to ensure this is safe before carrying out the autotune.
- For IM motors, the autotune takes only a few seconds and measures only the motor stator resistance. Parameter P-55 will be updated with the new value.

- **Adjust the Low-Frequency Torque Boost**

- IM motors require some additional voltage at low frequency to improve the low-speed operation and torque.
- By adjusting P-11, it is possible to optimize the low-speed operation.
- If P-11 is increased too far, excessive motor heating or over-current trips may result.

- **Speed regulation and response to load changes may be improved by adjusting P-11 Vector Gain to suit the motor and connected load.**

- Higher values will provide a more dynamic behavior at the risk of instability.

NOTE For other motor types refer to online document.

Technical Data

Environment

Operational ambient temperature range

- Enclosed Drives: -20 ... 40°C (frost and condensation free)
- Storage ambient temperature range: -40 ... 60°C
- Maximum altitude: 2000m. Derate above 1000m: 1% / 100m
- Maximum humidity: 95%, non-condensing

Rating Tables

Frame Size	kW	HP	Input Current	Fuse/MCB (Type B)		Maximum Cable Size		Output Current	Recommended Brake Resistance
				Non UL	UL	mm ²	AWG	A	Ω
110 – 115 (+ / – 10%) V 1 Phase Input, 230V 3 Phase Output (Voltage Doubler)									
1	0.37	0.5	7.8	10	10	8	8	2.3	–
1	0.75	1	15.8	25	20	8	8	4.3	–
2	1.1	1.5	21.9	32	30	8	8	5.8	100
200 – 240 (+ / – 10%) V 1 Phase Input, 3 Phase Output									
1	0.37	0.5	3.7	10	6	8	8	2.3	–
1	0.75	1	7.5	10	10	8	8	4.3	–
1	1.5	2	12.9	16	17.5	8	8	7	–
2	1.5	2	12.9	16	17.5	8	8	7	100
2	2.2	3	19.2	25	25	8	8	10.5	50
3	4	5	29.2	40	40	8	8	15.3	25
4	5.5	7.5	55	80	70	35	2	24	15
4	7.5	10	66	80	80	35	2	30	15
200 – 240 (+ / – 10%) V 3 Phase Input, 3 Phase Output									
1	0.37	0.5	3.4	6	6	8	8	2.3	–
1	0.75	1	5.6	10	10	8	8	4.3	–
1	1.5	2	8.9	16	15	8	8	7	–
2	1.5	2	8.9	16	15	8	8	7	100
2	2.2	3	12.1	16	17.5	8	8	10.5	50
3	4	5	20.9	32	30	8	8	18	25
3	5.5	7.5	26.4	40	35	8	8	24	20
4	7.5	10	33.3	40	45	16	5	30	15
4	11	15	50.1	63	70	16	5	46	10
380 – 480 (+ / – 10%) V 3 Phase Input, 3 Phase Output									

1	0.75	1	3.5	6	6	8	8	2.2	–
1	1.5	2	5.6	10	10	8	8	4.1	–
2	1.5	2	5.6	10	10	8	8	4.1	250
2	2.2	3	7.5	16	10	8	8	5.8	200
2	4	5	11.5	16	15	8	8	9.5	120
3	5.5	7.5	17.2	25	25	8	8	14	100
3	7.5	10	21.2	32	30	8	8	18	80
3	11	15	27.5	40	35	8	8	24	50
4	15	20	34.2	40	45	16	5	30	30
4	18.5	25	44.1	50	60	16	5	39	22
4	22	30	51.9	63	70	16	5	46	22

NOTE

Cable sizes shown are the maximum possible that may be connected to the drive. Cables should be selected according to local wiring codes or regulations at the point of installation.

Troubleshooting

Fault Code Messages

Fault Code	No.	Description	Suggested Remedy
no-FLt	00	No Fault	Not required.
Ol-b	01	Brake channel over current	Check external brake resistor condition and connection wiring.
OL-br	02	Brake resistor overload	The drive has tripped to prevent damage to the brake resistor.
O-I	03	Output Over Current	Instantaneous Over current on the drive output. Excess load or shock load on the motor. NOTE Following a trip, the drive cannot be immediately reset. A delay time is inbuilt, which allows the power components of the drive time to recover to avoid damage.
I-t-trP	04	Motor Thermal Overload (I2t)	The drive has tripped after delivering >100% of value in P-08 for a period of time to prevent damage to the motor.
O-uOLt	06	Over voltage on DC bus	Check the supply voltage is within the allowed tolerance for the drive. If the fault occurs on deceleration or stopping, increase the deceleration time in P-04 or install a suitable brake resistor and activate the dynamic braking function with P-34.
U-uOLt	07	Under voltage on DC bus	The incoming supply voltage is too low. This trip occurs routinely when power is removed from the drive. If it occurs during running, check the incoming power supply voltage and all components in the power feed line to the drive.
O-t	08	Heatsink over temperature	The drive is too hot. Check the ambient temperature around the drive is within the drive specification. Ensure sufficient cooling air is free to circulate around the drive.
U-t	09	Under temperature	The drive temperature is below the minimum limit and must be increased to operate the drive.
P-dEF	10	Factory Default parameters loaded	
E-tr iP	11	External trip	E-trip requested on digital input 3. Normally closed contact has opened. If motor thermistor is connected check if the motor is too hot.
SC-ObS	12	Optibus comms loss	Check communication link between drive and external devices. Make sure each drive in the network has its unique address.
FLt-dc	13	DC bus ripple too high	Check incoming supply phases are all present and balanced.
P-LOSS	14	Input phase loss trip	Check incoming power supply phases are present and balanced.
h O-I	15	Output Over Current	Check for short circuits on the motor and connection cable. NOTE Following a trip, the drive cannot be immediately reset. A delay time is inbuilt, which allows the power components of the drive time to recover to avoid damage.
th-FLt	16	Faulty thermistor on heatsink	
dRAr-F	17	Internal memory fault (IO)	Press the stop key. If the fault persists, consult you supplier.
4-20 F	18	4-20mA Signal Lost	Check the analog input connection(s).
dRAr-E	19	Internal memory fault (DSP)	Press the stop key. If the fault persists, consult you supplier.
F-Ptc	21	Motor PTC thermistor trip	Connected motor thermistor over temperature, check wiring connections and motor.
FAn-F	22	Cooling Fan Fault (IP66 only)	Check / replace the cooling fan.
O-hERt	23	Drive internal temperature too high	Drive ambient temperature too high, check adequate cooling air is provided.
OUT-F	26	Output Fault	Indicates a fault on the output of the drive, such as one phase missing, motor phase currents not balanced. Check the motor and connections.

Fault Code	No.	Description	Suggested Remedy
AtF-02	41	Autotune Fault	The motor parameters measured through the autotune are not correct. Check the motor cable and connections for continuity. Check all three phases of the motor are present and balanced.
SC-F01	50	Modbus comms loss fault	Check the incoming Modbus RTU connection cable. Check that at least one register is being polled cyclically within the timeout limit set in P-36 Index 3.
SC-F02	51	CAN comms loss trip	Check the incoming CAN connection cable. Check that cyclic communications take place within the timeout limit set in P-36 Index 3.


NOTE

Following an over-current or overload trip (1, 3, 4, 15), the drive may not be reset until the reset time delay has elapsed to prevent damage to the drive.

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Documents / Resources

 <p>Invertek Drives OPTIDRIVE E3 AC Variable Speed Drive Pkg 3000-60 1000V-2000V / 100A-200A IP66 NEMA 4X 2015.4.2015.5.1 Rev 1.0</p>	<p>invertek IP66(NEMA 4X)AC Variable Speed Drive [pdf] User Guide IP66 NEMA 4X AC Variable Speed Drive, AC Variable Speed Drive, Speed Drive</p>
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References

- [Documentation For Optidrive E3 Variable Frequency Drive | Variable Speed Drive | AC Drive | Invertek Drives](#)
- [Variable Frequency Drive Manufacturer | Variable Speed Drives | AC Drives | Invertek Drives](#)