Optidrive E3 Simple Set-Up Guide

(0.37kW~37kW)

V2.0.0

Contents

Safety Information
Please read and observe the safety information in **the Invertek Optidrive E3 Installation and Operating Instruction User Guide.**

This Set-Up Guide does not contain safety information as it is assumed that the customer has read and understood the safety information in the **Optidrive E3 Installation and Operating Instruction User Guide**.

General Information
The contents of this Set-Up Guide are believed to be correct at the time of printing. In the interests of continuous improvement, the authors reserve the right to change the contents of the Set-Up Guide without notice.

General information about this Set Up Guide
This set up guide gives basic information on setting up the Optidrive E3 in terminal and keypad control. It gives information on how to change the terminal configuration to suit a particular application requirement.

This set up guide gives information on the operation of various parameters to allow the user to set the drive up to their particular requirements.

Optidrive E3 Software
This set up guide was written with reference to the latest version of Optidrive E3 software – **V3.08**. Depending on the age of the drive, some of the features described in this set up guide may not be available.

E3 Basic Technical Data

All of the E3 drives below are 3 phase output

Model Number	Frame size	Input voltage	Number of input phases	Output voltage	kW	Output current	Internal EMC filter	Internal braking transistor
ODE-3-110023-101#	1	110 to 115VAC ±10%	1	0 to 230V (250V max) (Voltage doubler)	0.37	2.3	No	No
ODE-3-110043-101#	1				0.75	4.3	No	No
ODE-3-210058-104#	2				1.1	5.8	No	Yes
ODE-3-120023-1F1#	1	200 to 240VAC ±10%	1	0 to 230V (250V max)	0.37	2.3	Yes	No
ODE-3-120043-1F1#	1				0.75	4.3	Yes	No
ODE-3-120070-1F1#	1				1.5	7	Yes	No
ODE-3-220070-1F4#	2				1.5	7	Yes	Yes
ODE-3-220105-1F4#	2				2.2	10.5	Yes	Yes
ODE-3-320153-1&4#	3				4.0	15.3	No	Yes
ODE-3-120023-301#	1	200 to 240VAC ±10%	3	0 to 230V (250V max)	0.37	2.3	No	No
ODE-3-120043-301#	1				0.75	4.3	No	No
ODE-3-120070-301#	1				1.5	7	No	No
ODE-3-220070-3F4#	2				1.5	7	Yes	Yes
ODE-3-220105-3F4#	2				2.2	10.5	Yes	Yes
ODE-3-320018-3F4#	3				4.0	18	Yes	Yes
ODE-3-320240-3F4#	3				5.5	24	Yes	Yes
ODE-3-420300-3F4#	4				7.5	30	Yes	Yes
ODE-3-420460-3F4#	4				11	46	Yes	Yes
ODE-3-520610-3F42	5				15	61	Yes	Yes
ODE-3-520720-3F42	5				18.5	72	Yes	Yes
ODE-3-140022-3F1#	1	380 to 480VAC ±10%	3	0 to 400V (500V max)	0.75	2.2	Yes	No
ODE-3-140041-3F1#	1				1.5	4.1	Yes	No
ODE-3-240041-3F4#	2				1.5	4.1	Yes	Yes
ODE-3-240058-3F4#	2				2.2	5.8	Yes	Yes
ODE-3-240095-3F4#	2				4	9.5	Yes	Yes
ODE-3-340140-3F4#	3				5.5	14	Yes	Yes
ODE-3-340180-3F4#	3				7.5	18	Yes	Yes
ODE-3-340240-3F4#	3				11	24	Yes	Yes
ODE-3-440300-3F4#	4				15	30	Yes	Yes
ODE-3-440390-3F4#	4				18.5	39	Yes	Yes
ODE-3-440460-3F4#	4				22	46	Yes	Yes
ODE-3-540610-3F42	5				30	61	Yes	Yes
ODE-3-540720-3F42	5				37	72	Yes	Yes

For IP20: Replace # with a '2'

For IP66 Non-switched: Replace # with a 'A'

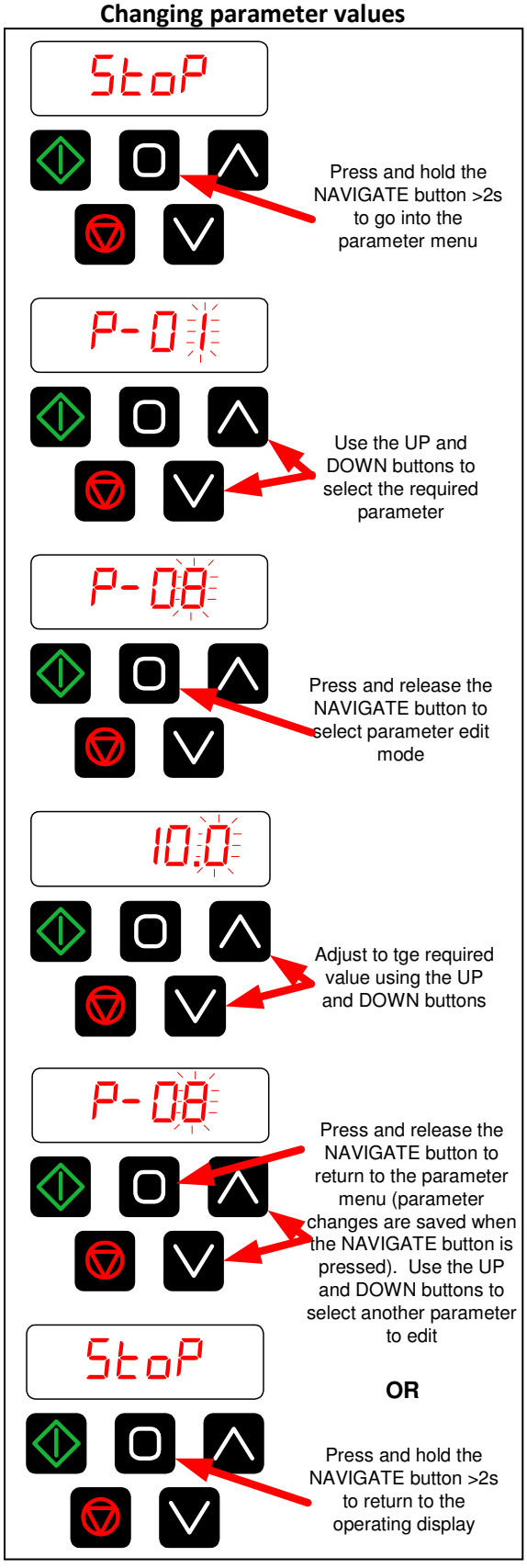
For IP66 switched: Replace # with a 'B'

ODE-3-320153-1&4#: Replace '&' with a '0' for IP20 – no internal EMC filter. Replace '&' with 'F' for IP66 – internal EMC filter fitted

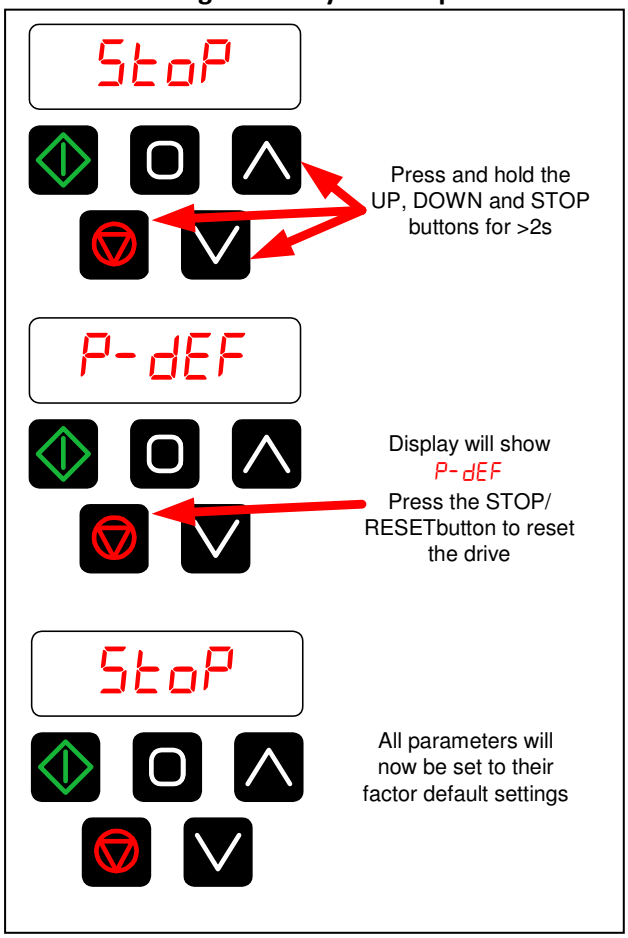
Display and Keypad

The Optidrive E3 has a LED display and 5 push buttons that allow the user to monitor the drives operation, adjust parameter values, reset a drive trip and also control the drive in keypad control (IP66 Outdoor rated keypad shown)

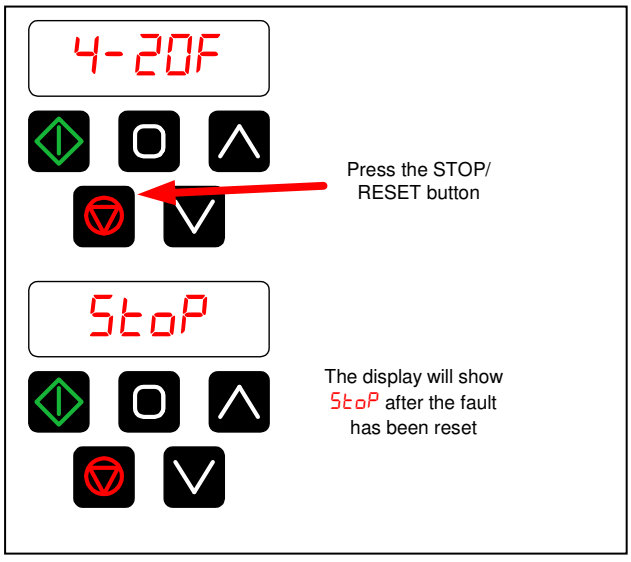
Changing parameter values



Resetting to factory default parameters



Resetting a trip

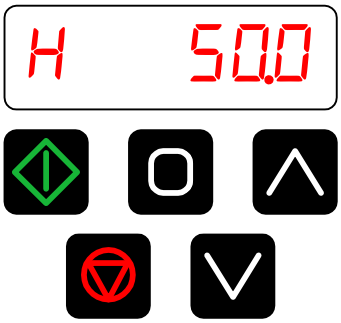


3 Display & Keypad

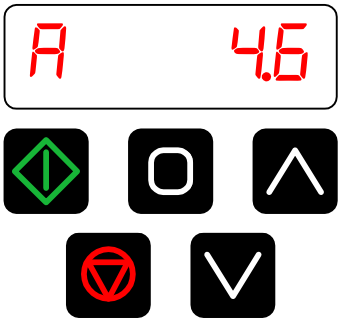
The display can also be used to monitor:

- Output frequency
- Output speed
- Output current
- Output power

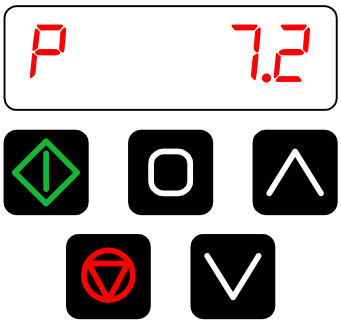
From default settings, when the drive is enabled, the display will show output frequency:



Press and release the NAVIGATE button, the display will show Output current:

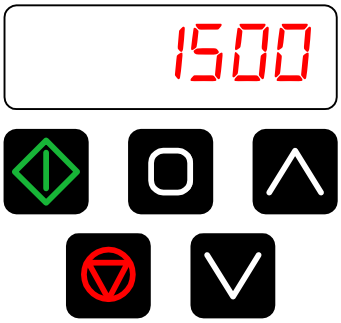


Press and release the NAVIGATE button, the display will show Output power:



The display can also show motor RPM.

To show RPM on the display, set the motor rated speed into parameter P-10:



When the NAVIGATE button is pressed, the display will cycle from:

- Output frequency
- Output RPM
- Output Current
- Output Power
- Output frequency…….

NOTE: On high inertia loads (fans/flywheels etc.), if the display is required to show RPM, set parameter P-10 to the synchronous speed of the motor:

2 pole – 3000
4 pole – 1500
6 pole – 1000
8 pole – 750

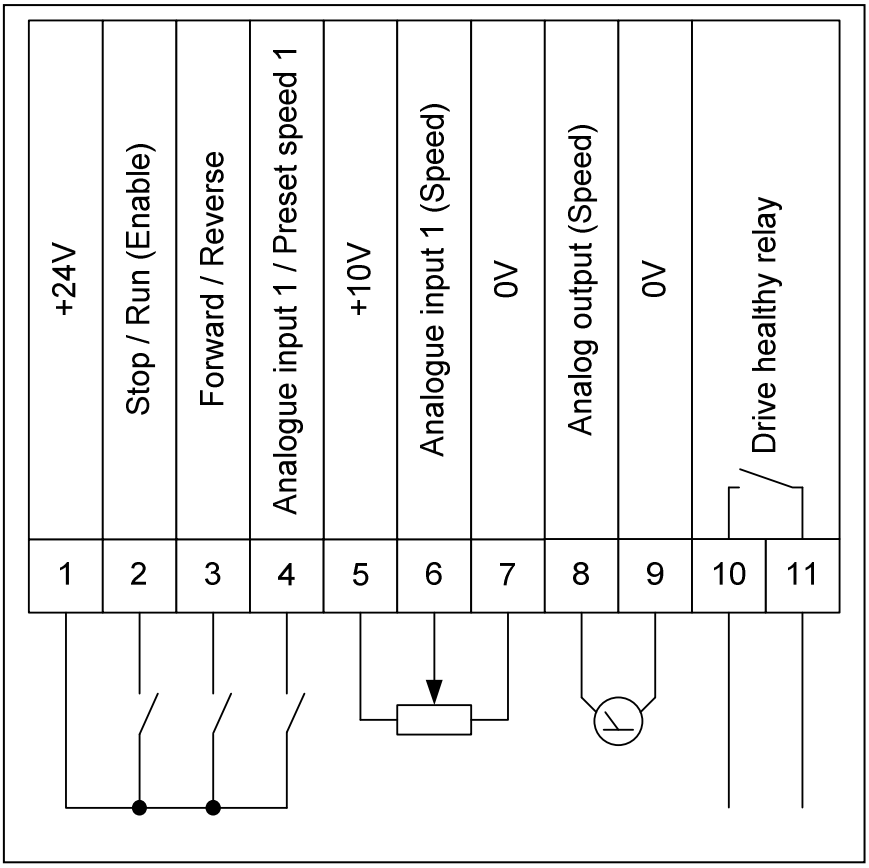
4 Control Terminals

Control Terminal Specification

All digital inputs are positive logic i.e. they must be connected to 24VDC to make them active.

Terminal	Signal	Description
1	+24VDC User Output	+24VDC, 100mA maximum
2	Digital input 1	Logic 1: Input voltage range: 8V to 30VDC Logic 0: Input voltage range: 0V to 4VDC
3	Digital input 2	
4	Digital input 3 / Analogue input 2	When used as a digital input – as above When used as an analogue input: 0V to +10V, 0 to 20mA, 4 to 20mA
5	+10VDC User output	+10VDC, 10mA maximum (1kΩ minimum pot resistance)
6	Analogue input 1 / Digital input 4	When used as an analogue input: 0V to +10V, 0 to 20mA, 4 to 20mA When used as a digital input – as above
7	0V	0V common, internally connected to terminal 9
8	Analogue output / Digital output	Analogue output: 0 to 10V, 20mA maximum Digital output: 0 to 24VDC, 20mA maximum
9	0V	0V common, internally connected to terminal 7
10	Status relay common	Contact: 250VAC, 6A 30VDC, 5A
11	Status relay normally open contact	

Control terminal connection diagram – factory default functionality



Control terminals – Factory default functionality

Terminal 1
+24VDC User supply (100mA maximum)

Terminal 2: Stop / Run (Enable)
Switch Open: Drive stopped
Switch Closed: Drive running / enabled

Terminal 3: Forward / Reverse
Switch Open: Motor running in forward direction of rotation
Switch Closed: Motor running in reverse direction of motor rotation

Terminal 4: Analogue speed reference / Preset speed 1
Switch Open: Motor speed controlled by analogue input 1 (potentiometer input)
Switch Closed: Motor speed controlled by setting of preset speed 1 (parameter P-20)

Terminal 5: +10V Reference power supply
Speed potentiometer +10V reference

Terminal 6: Analogue input 1
Speed potentiometer wiper: 0 to +10V

Terminal 7: 0V
Speed potentiometer 0V reference
(internally connected to Terminal 9)

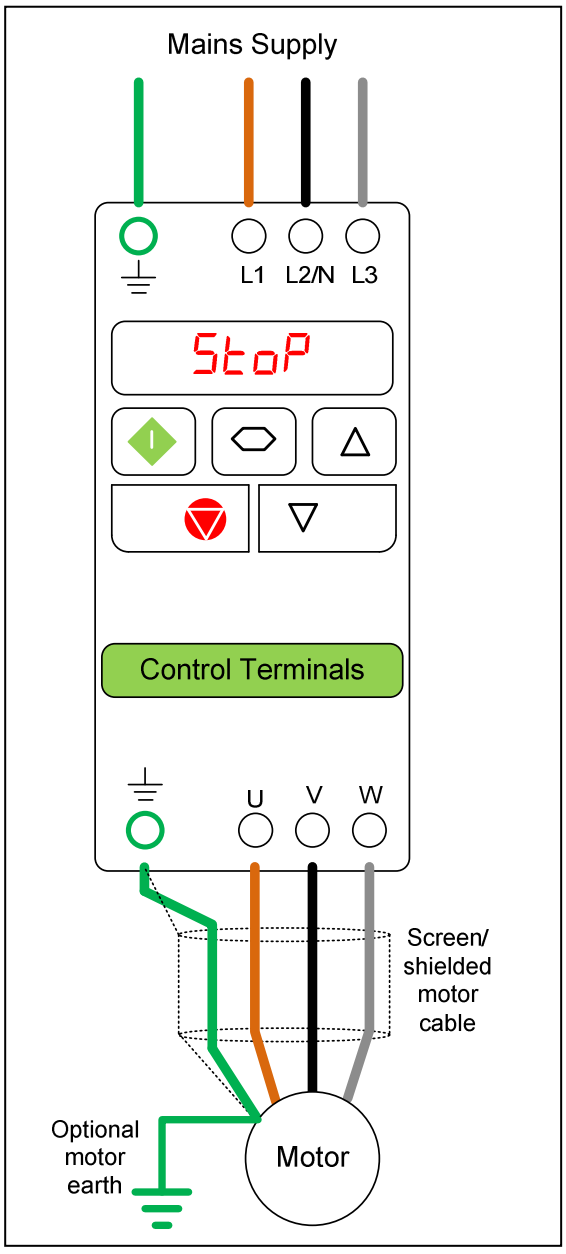
Terminal 8: Analogue output – motor speed
0 to +10VDC output proportional to motor speed
(0 to 50Hz = 0 to +10V) (20mA maximum)

Terminal 9: 0V
0V reference
(internally connected to Terminal 7)

Terminals 10 & 11: Drive healthy relay (NO - Normally Open)
Relay Open: Drive fault
Relay closed: Drive healthy

Power Terminals – E3 IP20

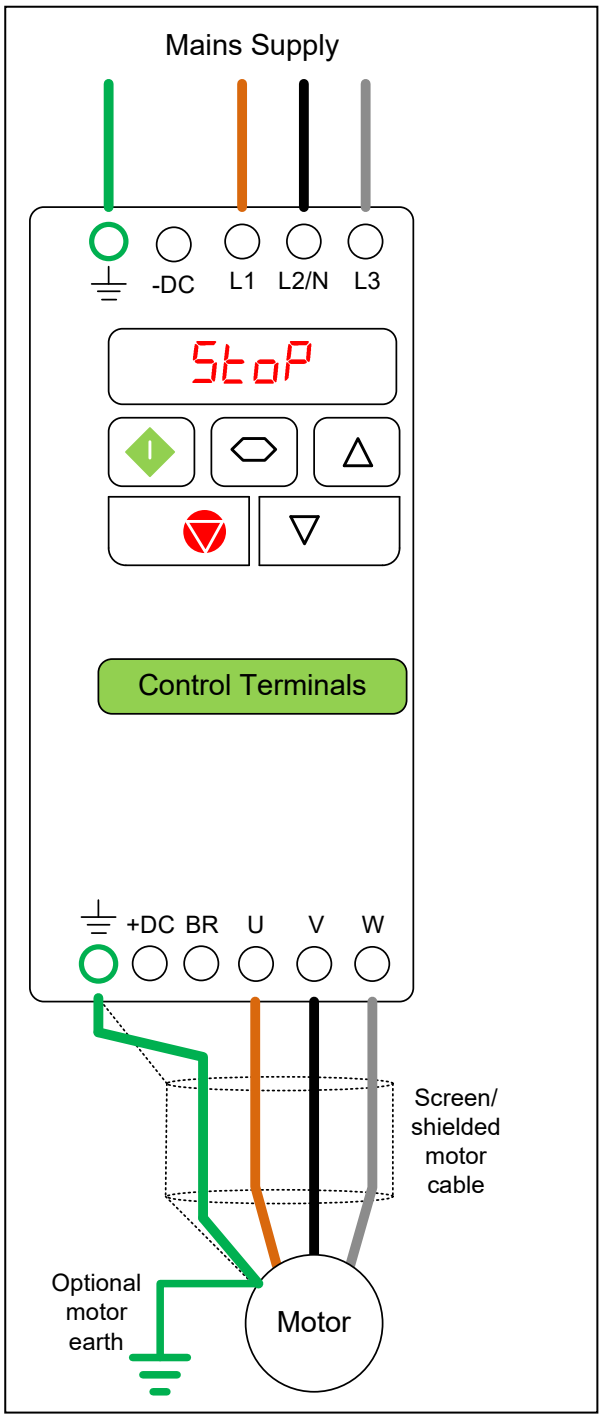
Size 1 – Mains supply - model dependant
200V single phase input
200V three phase input
400V three phase input



NOTE: Dynamic braking is not available on size 1 drives

NOTE: For information on connecting a braking resistor, see Section 15 – Dynamic Braking

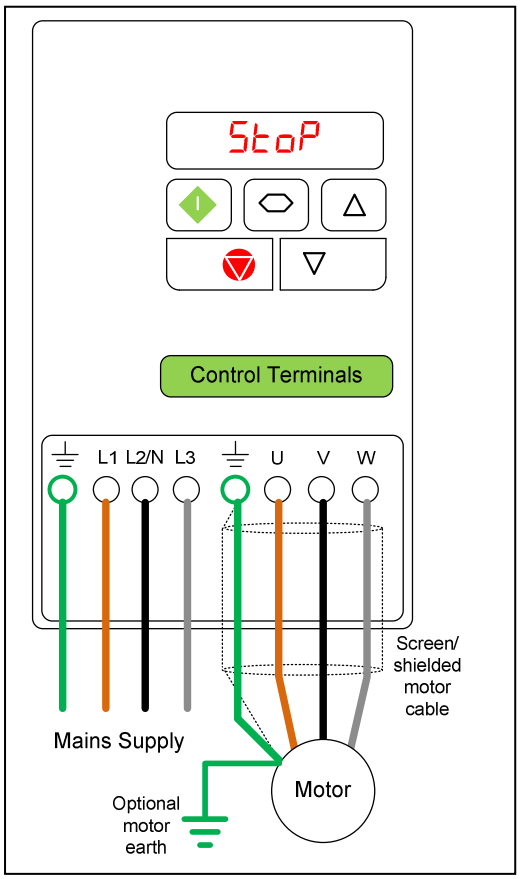
Size 2, 3, 4 & 5 – Mains supply - model dependant
200V single phase
200V three phase
400V three phase



NOTE: On E3 size 4 & 5, there are earth connections on the drives heatsink at the top and bottom of the drive

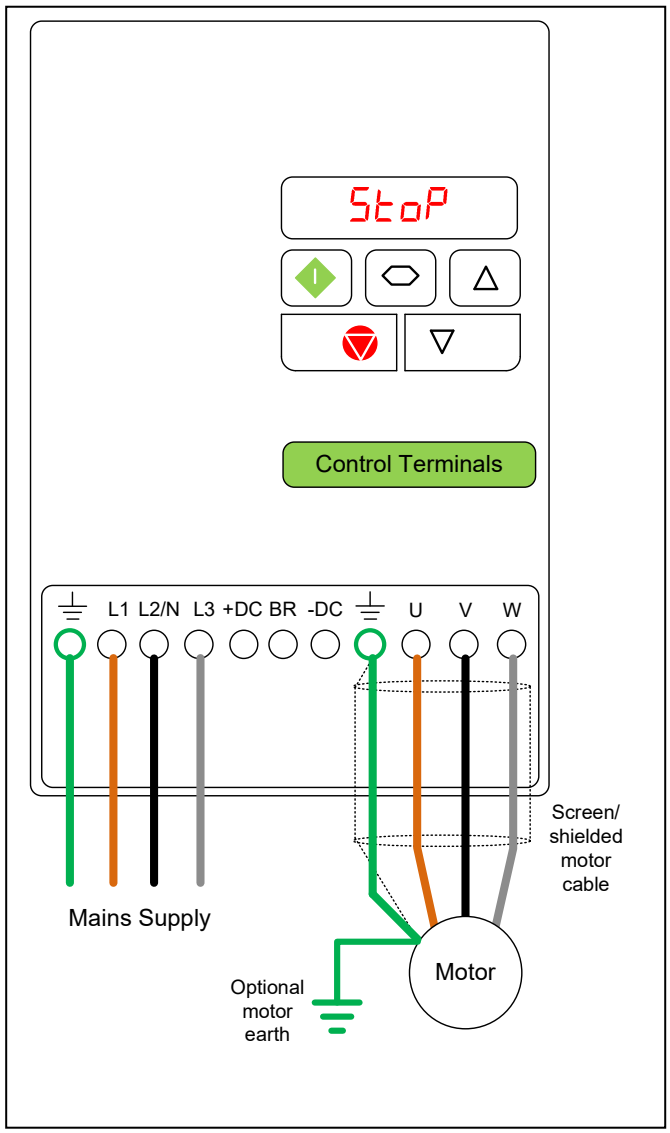
Power Terminals – E3 IP66

Size 1 – Mains supply – Model dependant
200V single phase
200V three phase
400V three phase



NOTE: Dynamic braking is not available on size 1 drives

Size 2, 3 & 4 – Mains supply – Model dependant
200V single phase
200V three phase
400V three phase



NOTE: For information on connecting a braking resistor, see Section 15 – Dynamic Braking

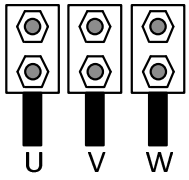
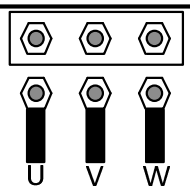
Motor Connections

When connecting a 3 phase motor to an AC inverter drive, it is important that the motor terminal box connections are correct for the supply voltage being used.

Generally up to 3kW, the motor is wound for 230V delta, 400V star.

Generally above 3kW, the motor is wound for 400V delta, 690V star.

Please check your motor nameplate for the correct connection.

Inverter Supply Voltage	Motor Nameplate Voltages	Connections	
230V	230V / 400V	Delta △	
400V	400V / 690V		
400V	230V / 400V	Star ⅄	

The usual issues when the wrong connections are made:

230V AC drive connected to a 400V star connected motor or 400V AC drive connected to a 690V star connected motor:
The motor will probably run if starting a lightly loaded motor. If the motor tries to start a heavy load or if a heavy load is applied to the motor while running, the motor will stall due to a lack of torque and the drive will trip on an over current or I x t trip.

400V AC drive connected to a 230V delta connected motor:
On enable, the drive will either trip on an over current trip or the drive will go into current limit and trip on an I x t trip.

Basic EMC Information

This section of this document gives some basic EMC information for the Optidrive E3.

Overview

The electromagnetic compatibility describes – according to the definition of the EMC directive – the "capability of a device to work satisfactorily in an electromagnetic environment without itself causing electromagnetic interference which is unacceptable for other devices present in this environment". To guarantee that the appropriate EMC standards are observed, the devices must demonstrate a sufficiently high noise immunity, and also the emitted interference must be limited to acceptable values.

Product standard EN 61800-3 describes the EMC requirements placed on "Variable-speed drive systems".

A variable-speed drive system (or Power Drive System PDS) consists of the Control/Power Module plus the relevant electric motors including connecting cables.

The driven machine is not part of the drive system.

Environments

EN 61800-3 defines different requirements depending on the location where the drive is installed, designated as a first and second environment. Residential buildings or locations where the drive system is directly connected to a public low-voltage supply without intermediate transformer are defined as the **first environment**. All locations outside a residential area are defined as the **second environment**. These are basically industrial areas which are supplied from the medium-voltage network via their own transformers.

Category C1: Drive systems for rated voltages < 1000 V for unlimited use in the first environment.

Category C2: Stationary drive systems for rated voltages < 1000 V for use in the second environment. Use in the first environment is possible if the drive system is operated and installed by qualified personnel. The warning information and installation instructions supplied by the manufacturer must be observed.

Category C3: Drive systems for rated voltages < 1000 V for exclusive use in the second environment.

Optidrive E3 EMC Compliant Installation

Category	Supply Cable Type	Motor Cable Type	Control Cables	Maximum Permissible Motor Cable Length
C1 [6]	Shielded [1]	Shielded [1,5]	Shielded [4]	1m / 5m [7]
C2	Shielded [2]	Shielded [1,5]	Shielded [4]	5m / 25m [7]
C3	Unshielded [3]	Shielded [2]	Shielded [4]	25m / 100m [7]

1. A screened (shielded) cable suitable for fixed installation with the relevant mains voltage in use. Braided or twisted type screened cable where the screen covers at least 85% of the cable surface area, designed with low impedance to HF signals. Installation of a standard cable within a suitable steel or copper tube is also acceptable.

2. A cable suitable for fixed installation with relevant mains voltage with a concentric protection wire. Installation of a standard cable within a suitable steel or copper tube is also acceptable.

3. A cable suitable for fixed installation with relevant mains voltage. A shielded type cable is not necessary.

4. A shielded cable with low impedance shield. Twisted pair cable is recommended for analogue signals.

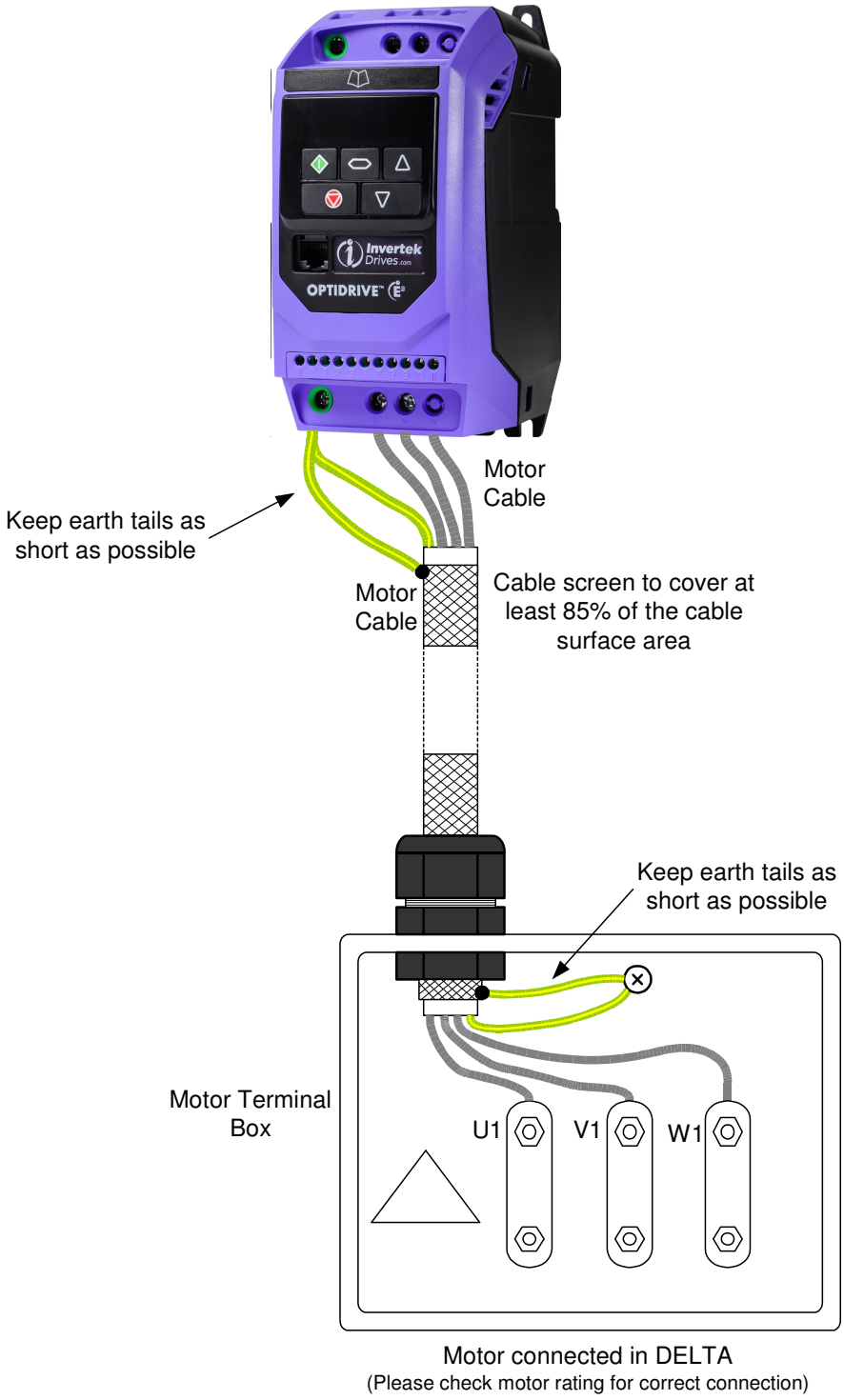
5. The cable screen should be terminated at the motor end using an EMC type gland allowing connection to the motor body through the largest possible surface area. Where drives are mounted in a steel control panel enclosure, the cable screen may be terminated directly to the control panel using a suitable EMC clamp or gland, as close to the drive as possible.

6. Compliance with category C1 conducted emissions only is achieved. For compliance with category C1 radiated emissions, additional measures may be required, contact your Sales Partner for further assistance.

7. Permissible cable length with additional external EMC filter.

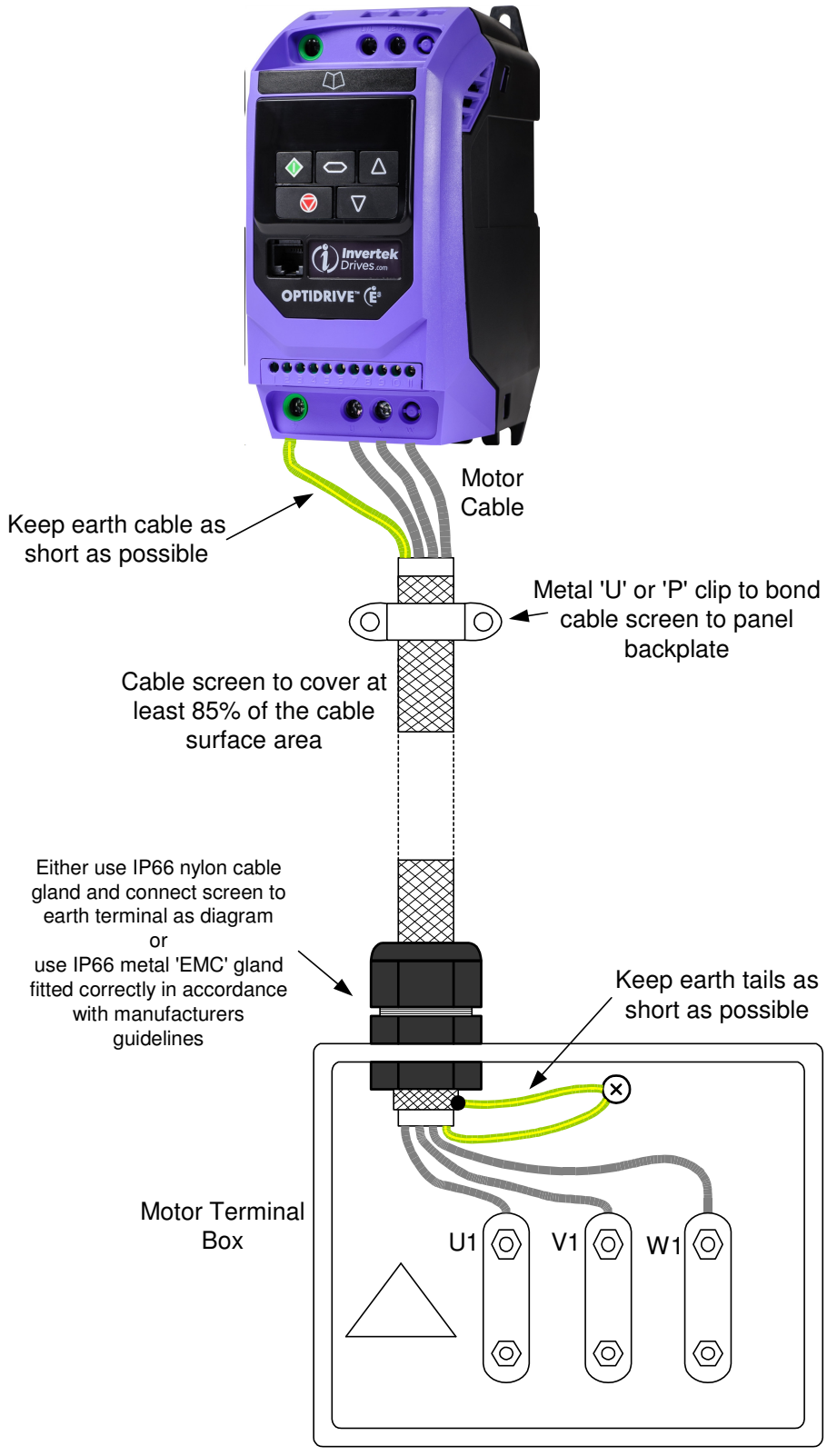
The following diagrams gives examples of connecting the E3 IP20 and IP66 Outdoor rated units for good EMC performance

IP20 Power Wiring – Method 1



Motor connected in DELTA
(Please check motor rating for correct connection)

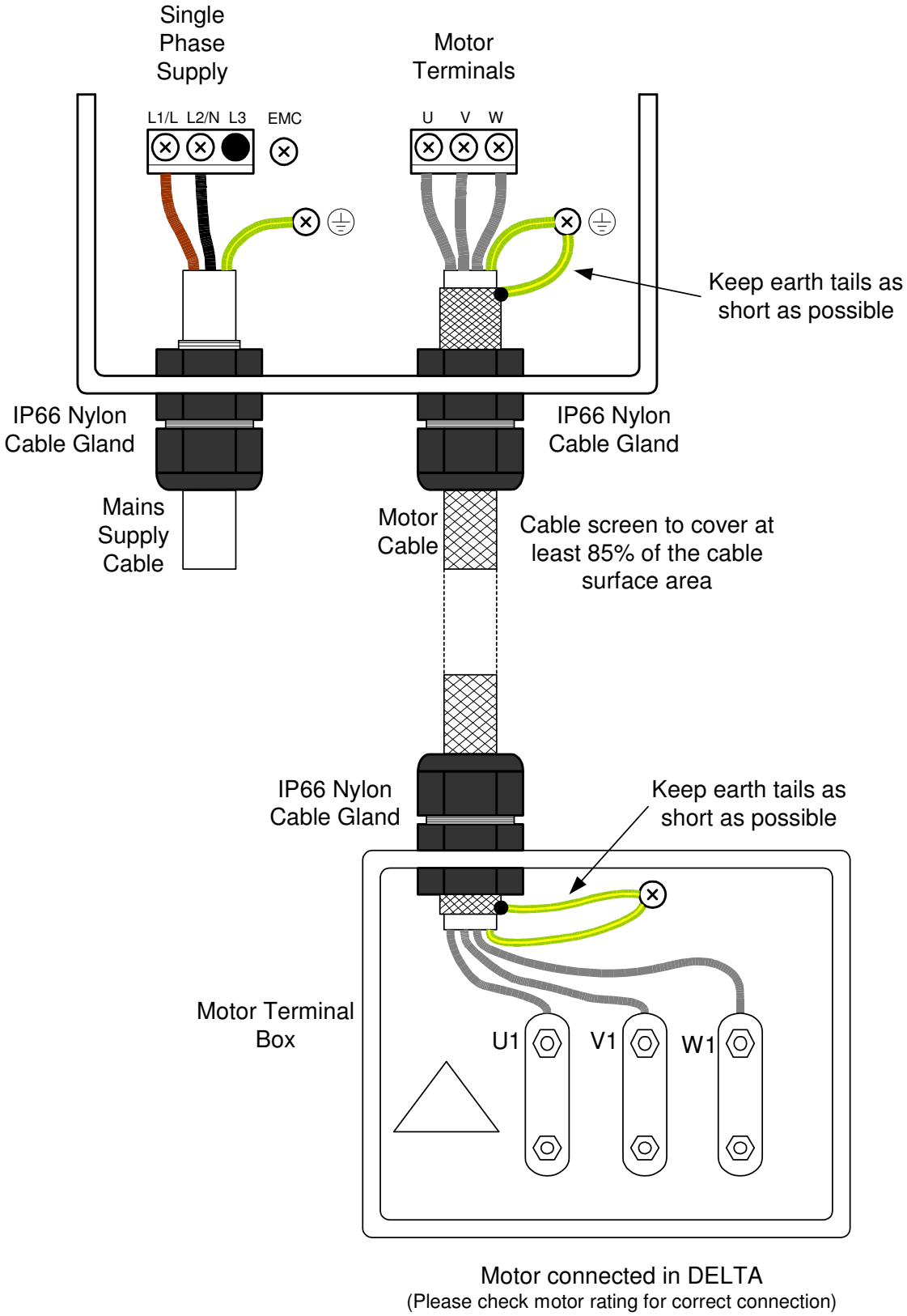
IP20 Power Wiring – Method 2



Motor connected in DELTA
(Please check motor rating for correct connection)

IP66 Power Wiring – Method 1

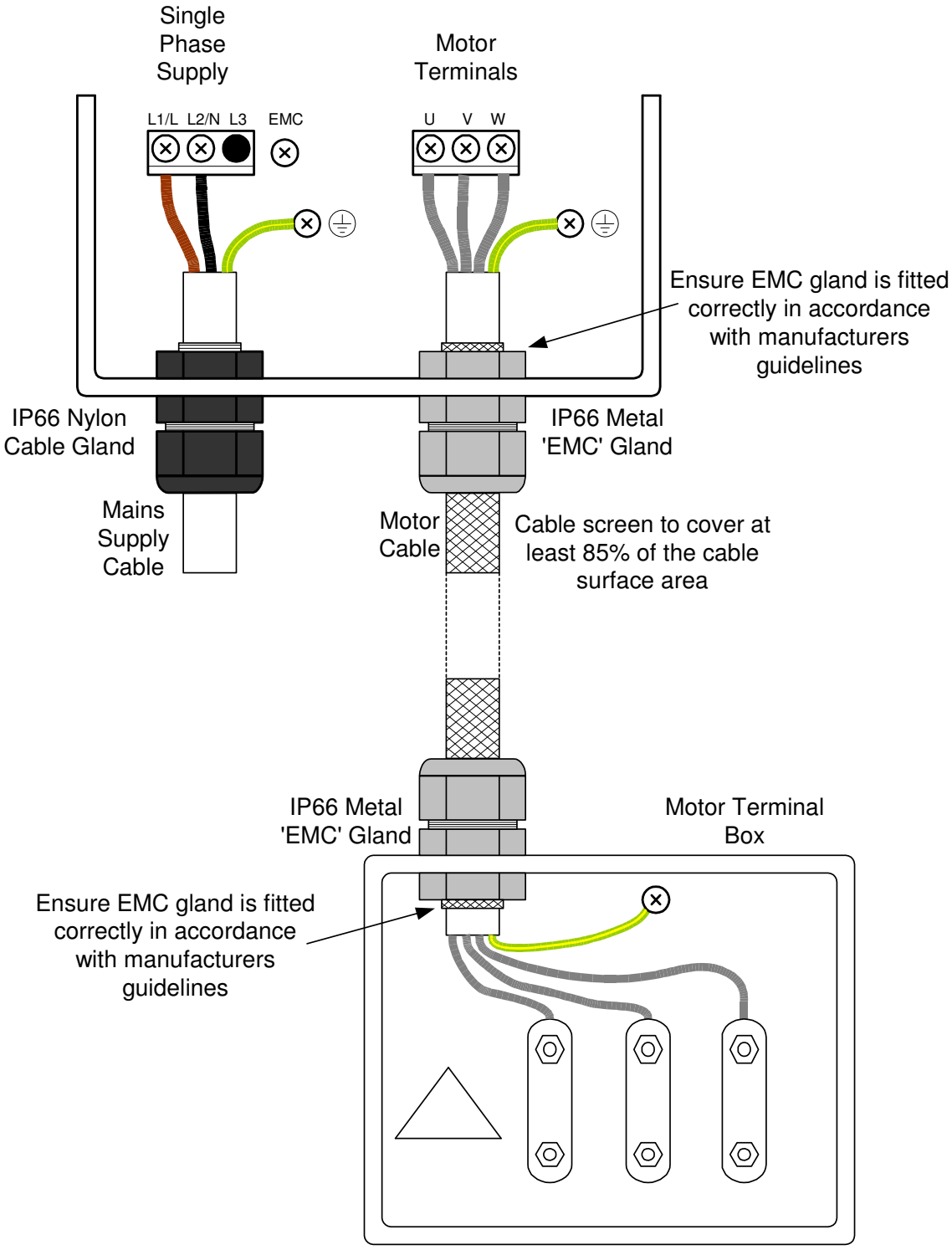
NOTE: Single phase input drive shown. Motor connections are the same for 3-phase drives.



Motor connected in DELTA
(Please check motor rating for correct connection)

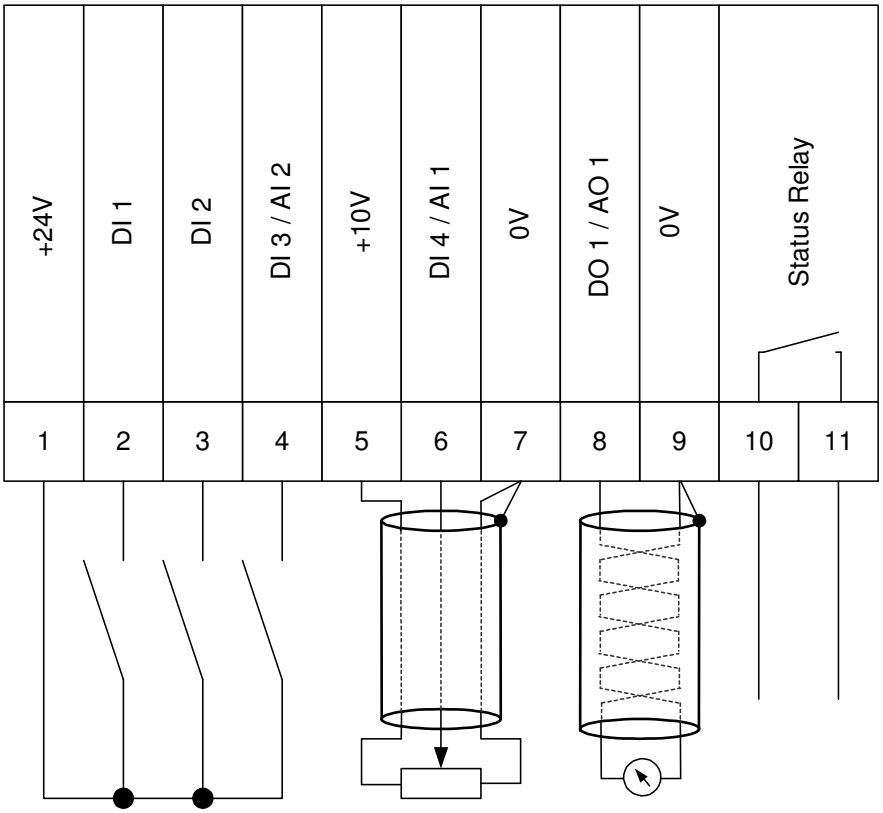
IP66 Power Wiring – Method 2

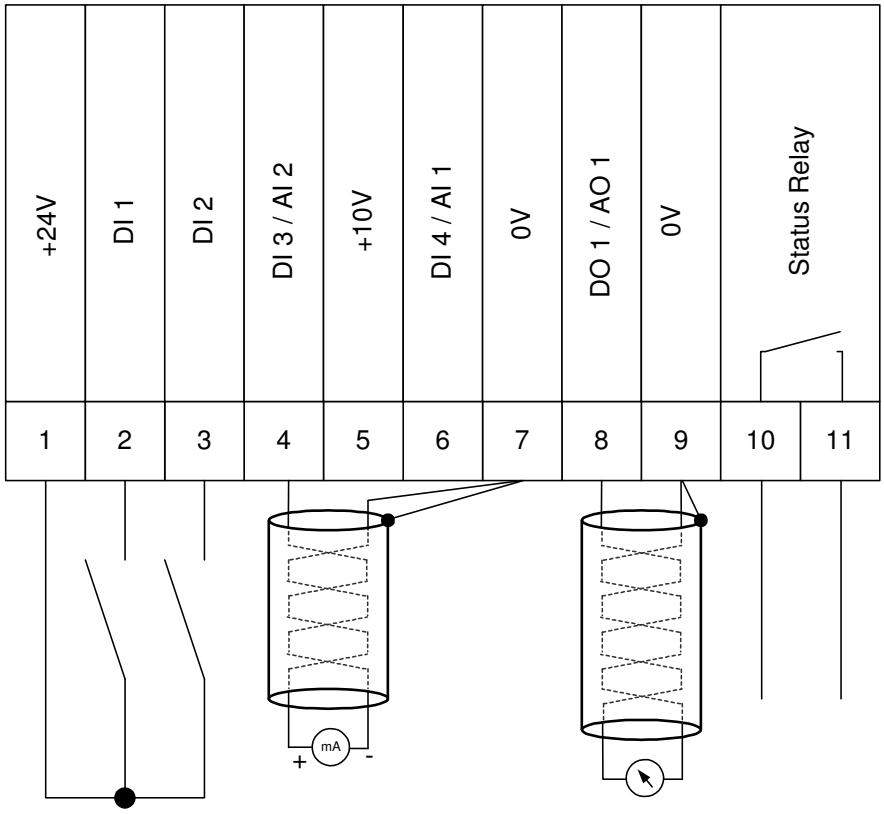
NOTE: Single phase input drive shown. Motor connections are the same for 3-phase drives.



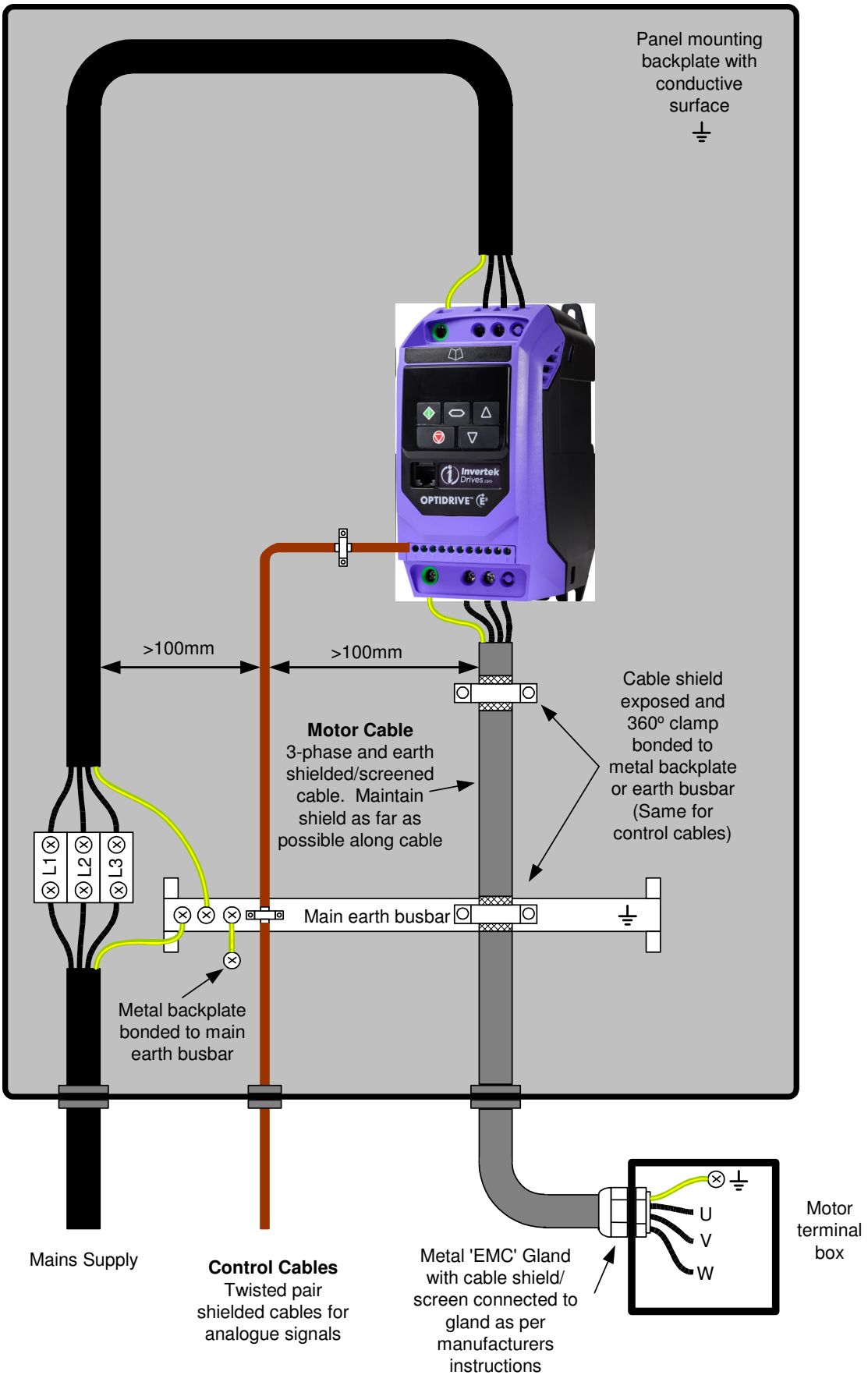
Control Wiring

The following diagrams give examples of control wiring for good EMC performance

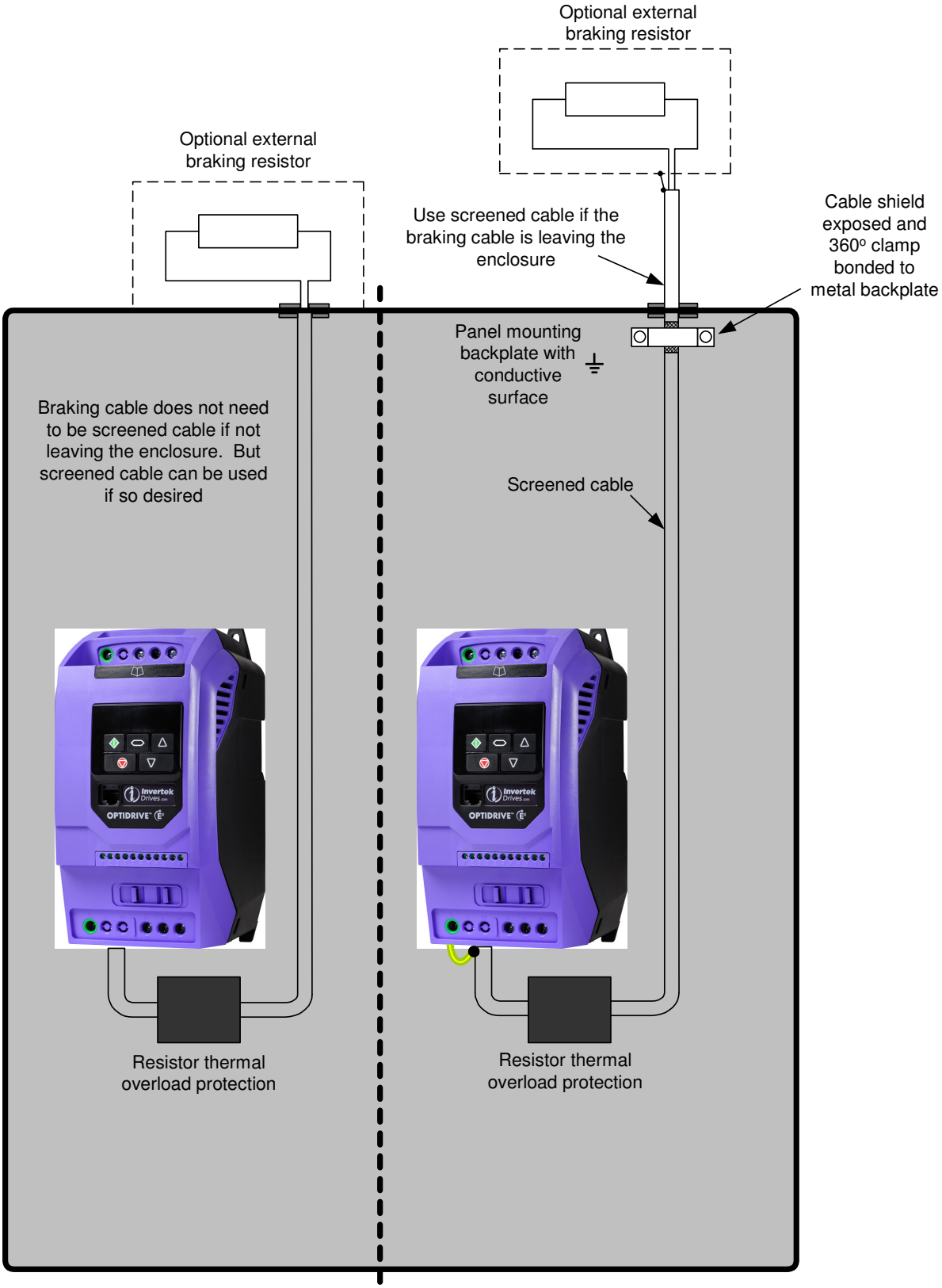




General requirements for good EMC practice



Braking resistor connections for good EMC practice

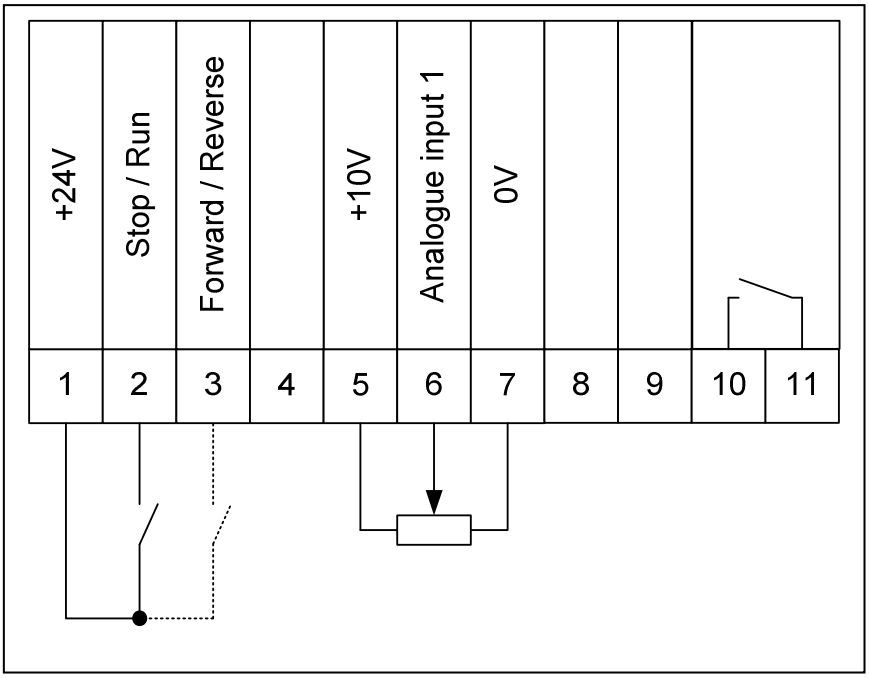


Note: Some earth cables have been omitted for clarity. Please make sure braking resistor and case are properly earthed.

Getting Started - Terminal Control (Factory default settings)

This section of the Set up guide gives basic information for connecting and setting up the drive to control the speed of the motor in terminal control from factory default settings.

Minimum control terminal connections



1. **Before powering up, check:**
   - The correct mains supply voltage is connected to the drive.
   - The motor connections are correct for Y or △ (Star or delta).
   - The motor is connected to the drive (U to U, V to V & W to W for forward direction of motor rotation).
   - The RUN signal is **not** given, terminal 2 open.
   - The speed potentiometer is set to minimum.

2. **Power up the drive:**
   - The display should show: StoP

3. **Enter the minimum and maximum speeds (if required to be different from default settings):**
   - Parameter P-01: Maximum frequency – Default: 50.0Hz.
   - Parameter P-02: Minimum frequency – Default: 0.0Hz.

50Hz is equivalent to:
2 pole motor: 3000rpm
4 pole motor: 1500rpm
6 pole motor: 1000rpm
8 pole motor: 750rpm

4. **Enter the acceleration and deceleration ramps (if required to be different from default settings):**
   - Parameter P-03: Acceleration ramp – Default: 5.0s.
   - Parameter P-04: Deceleration ramp – Default: 5.0s.

NOTE: The acceleration and deceleration ramps should be set according to the load type. Heavy starting torque and high inertia type loads require longer acceleration and deceleration ramp times.

5. **Enter the motor nameplate details:**
   - Parameter P-07: Motor rated voltage – Default: 230V / 400V.
     - Usually the default settings are OK for standard motors.
   - Parameter P-08: Motor rated current – Default: Dependent on drive rating.
     - Enter the nameplate current. This provides motor thermal current overload protection (I^2t).
   - Parameter P-09: Motor rated frequency – Default: 50Hz.
     - Usually the default setting is OK for standard motors.

NOTE: For the majority of applications, especially high inertia loads (fans), P-10 (Motor rated speed) does not need to be set.

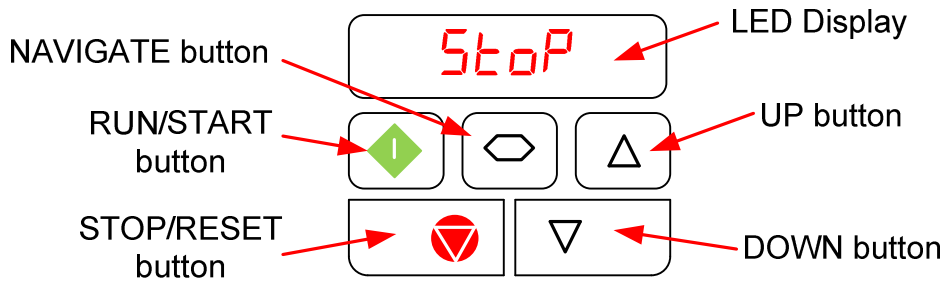
6. **Run (Enable) the drive:**
   - Close the connection between terminal 1 (24VDC) and terminal 2 (Stop/Run).
   - The display should show: H 0.0

7. **Turn the speed potentiometer:**
   - Turning the speed potentiometer will increase and decrease the speed of the motor.
   - While the motor is running, opening the connection between terminals 1 and 2 will cause the drive to decelerate to a stop and then disable.

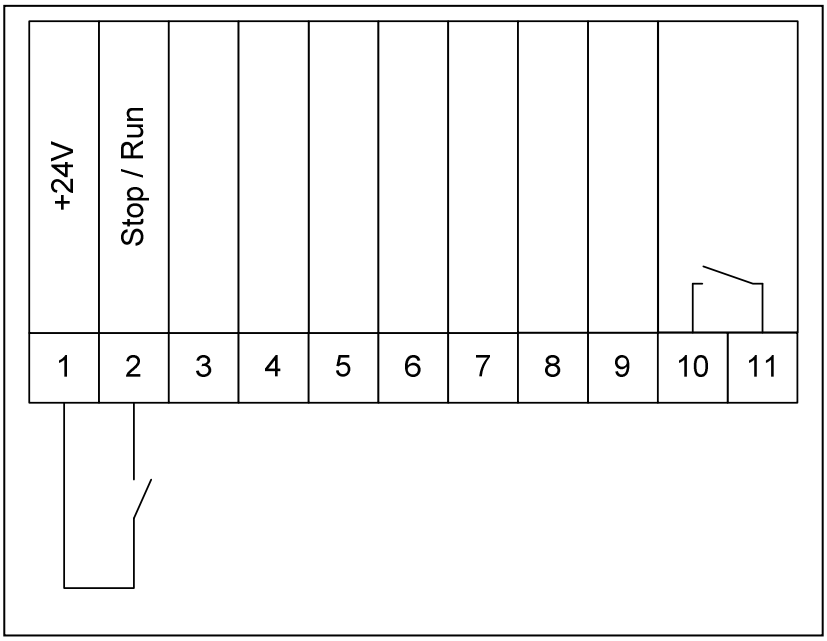
8. **To change motor direction of rotation:**
   - To change the motor direction of rotation (forward to reverse) make a connection between terminal 1 (24V) and terminal 3 (Forward/Reverse).

Getting Started - Keypad Control

This section of the Set up guide gives basic information for connecting and setting up the drive to control the speed of the motor in keypad control.



Minimum control terminal connections



1. **Before powering up, check:**
   - The correct mains supply voltage is connected to the drive.
   - The motor connections are correct for Y or △ (Star or delta).
   - The motor is connected to the drive (U to U, V to V & W to W for forward direction of motor rotation).
   - The RUN signal is **not** given, terminal 2 open.

2. **Power up the drive:**
   - The display should show: StoP

3. Enter the minimum and maximum speeds (if required to be different from default settings):

- Parameter P-01: Maximum frequency – Default: 50.0Hz.
- Parameter P-02: Minimum frequency – Default: 0.0Hz.

50Hz is equivalent to:
2 pole motor: 3000rpm
4 pole motor: 1500rpm
6 pole motor: 1000rpm
8 pole motor: 750rpm

4. Enter the acceleration and deceleration ramps (if required to be different from default settings):

- Parameter P-03: Acceleration ramp – Default: 5.0s.
- Parameter P-02: Deceleration ramp – Default: 5.0s.

NOTE: The acceleration and deceleration ramps should be set according to the load type. Heavy starting torque and high inertia type loads require longer acceleration and deceleration ramp times.

5. Enter the motor nameplate details:

- Parameter P-07: Motor rated voltage – Default: 230V / 400V.
  - Usually the default settings are OK for standard motors.
- Parameter P-08: Motor rated current – Default: Dependent on drive rating.
  - Enter the nameplate current. This provides motor thermal current overload protection (I^2t).
- Parameter P-09: Motor rated frequency – Default: 50Hz.
  - Usually the default setting is OK for standard motors.

NOTE: For the majority of applications, especially high inertia loads (fans), P-10 (Motor rated speed) does not need to be set.

6. Set the primary control mode:

- Set the primary control mode, Parameter P-12 (Default = 0, terminal control).
  - P-12 = 1: Uni-directional keypad control (Forward only).
  - P-12 = 2: Bi-directional keypad control (Forward and reverse).

7. Run (Enable) the drive:

- Close the connection between terminal 1 (24VDC) and terminal 2 (Stop/Run).
- Press the Green RUN button on the drives keypad. The display should show: H 0.0
- Press the UP button to increase the speed of the motor.
- Press the DOWN button to decrease the speed of the motor.
- Pressing the Red STOP button will cause the motor to ramp to a stop.
- If P-12 = 2, while running at speed, if the Green RUN button is pressed, the motor will decelerate to zero speed and then accelerate back up to speed in the reverse direction of motor rotation.
- While running, if the connection between terminals 1 and 2 is opened, the drive will decelerate to zero speed and then disable.

8. Drive Reset

- If the drive trips, it can be reset by pressing the RED Stop/Reset button or by opening and closing the connection between terminals 1 and 2.

Control Terminal Functionality

Overview
Optidrive E3 uses a macro approach to simplify the configuration of the analogue and digital inputs.
There are two key parameters which determine the input functions and the drive behavior:

Parameter P-12
Selects the main drive control source and determines the primary control of the drives output frequency.

P-12 = 0: Terminal control (default)
P-12 = 1: Keypad control (motor forward direction of rotation only)
P-12 = 2: Keypad control (motor forward and reverse directions of rotation)

Parameter P-15
P-15 Assigns the functionality to the digital and analogue inputs (terminals 2, 3, 4 and 6).

Additional parameters can be used to further adapt the terminal set up:

Parameter P-16: Used to determine the format of the input signal connected to analogue input 1 (terminal 6). E.g. 0 to 10V, 4 to 20mA, 20 to 4mA etc.

Parameter P-30: Determines whether the drive should automatically run following a power on if the enable input is present.

Parameter P-30 also determines the input logic for Fire Mode operation.

Parameter P-31 determines the keypad start mode – terminal or keypad control.

Parameter P-47: Used to determine the format of the input signal connected to analogue input 2 (terminal 4). E.g. 0 to 10V, 4 to 20mA, 20 to 4mA etc.

The following section gives information on the terminal set up when parameter P-12 = 0 (terminal control) and P-15 is used to change the terminal set up.

NOTE: Parameters P-12 and P-15 cannot be changed while the drive is running. The drive must be stopped to allow these parameters to be adjusted.

Parameter 15 – Control Terminal Input Function Select

Parameter P-15 can be used to change the functionality of the control terminals in order to realise a specific terminal set up. Parameter P-15 sets up Digital inputs 1, 2 and 3 and analogue input 1 (terminals 2, 3, 4 and 6) as described in the following information.

To access P-15:
Set parameter P-14 = 101 to access parameters P-01 to P-50
Set parameter P-14 = 201 to access parameters P-01 to P-60

P-15 = 0 (Default)

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
0	Open: Stop (disable) Closed: Run (enable)	Open: Forward Closed: Reverse	Open: Analogue input 1 Closed: Preset speed 1 (P-20)	Analogue input 1

P-15 = 1

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
1	Open: Stop (disable) Closed: Run (enable)	Open: Analogue input 1 Closed: Preset speed 1 (P-20)	Open: Preset speed 1 (P-20) Closed: Preset speed 2 (P-21)	Analogue input 1

P-15 = 2

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Preset speed selected	Analogue input 1 Terminal 6
2	Open: Stop (disable) Closed: Run (enable)	Open	Open	Preset speed 1 (P-20)	Open: Preset speed 1 to 4 Closed: Maximum speed (P-01)
		Closed	Open	Preset speed 2 (P-21)	
		Open	Closed	Preset speed 3 (P-22)	
		Closed	Closed	Preset speed 4 (P-23)	

NOTE: 4 preset speeds selectable. Analogue input 1 used as a digital input.

P-15 = 3

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
3	Open: Stop (disable) Closed: Run (enable)	Open: Analogue input 1 Closed: Preset speed 1 (P-20)	**External trip input** Open: Trip Closed: Run (No trip)	Analogue input 1

NOTE: For motor thermistor, connect PTC between 24V and digital input 3 (Terminals 1 and 4) and set parameter P-47 = PtC-th

P-15 = 4

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
4	Open: Stop (disable) Closed: Run (enable)	Open: Analogue input 1 Closed: Analogue input 2	Analogue input 2	Analogue input 1

NOTE: When P-15 = 4, Digital input 3 (terminal 4) is set up as analogue input 2

P-15 = 5

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
5	Open: Stop (disable) Closed: Run forward	Open: Stop (disable) Closed: Run reverse	Open: Analogue input 1 Closed: Preset speed 1 (P-20)	Analogue input 1

NOTE: Closing digital inputs 1 and 2 (terminals 2 and 3) together carried out a Fast Stop (parameter P-24)

P-15 = 6

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
6	Open: Stop (disable) Closed: Run (enable)	Open: Forward Closed: Reverse	**External trip input** Open: Trip Closed: Run (No trip)	Analogue input 1

NOTE: For motor thermistor, connect PTC between 24V and digital input 3 (terminal 1 and 4) and set parameter P-47 = PtC-th

P-15 = 7

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
7	Open: Stop (disable) Closed: Run forward	Open: Stop (disable) Closed: Run reverse	**External trip input** Open: Trip Closed: Run (No trip)	Analogue input 1

NOTE: For motor thermistor, connect PTC between 24V and digital input 3 (terminals 1 and 4) and set parameter P-47 = PtC-th

NOTE: Closing digital inputs 1 and 2 (terminals 2 and 3) together carried out a Fast Stop (parameter P-24)

P-15 = 8

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6	Preset speed selected
8	Open: Stop (disable) Closed: Run (enable)	Open: Forward Closed: Reverse	Open	Open	Preset speed 1 (P-20)
			Closed	Open	Preset speed 2 (P-21)
			Open	Closed	Preset speed 3 (P-22)
			Closed	Closed	Preset speed 4 (P-23)

NOTE: 4 preset speeds selectable. Analogue input 1 used as a digital input.

P-15 = 9

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6	Preset speed selected
9	Open: Stop (disable) Closed: Run forward	Open: Stop (disable) Closed: Run reverse	Open	Open	Preset speed 1 (P-20)
			Closed	Open	Preset speed 2 (P-21)
			Open	Closed	Preset speed 3 (P-22)
			Closed	Closed	Preset speed 4 (P-23)

NOTE: 4 preset speeds selectable. Analogue input 1 used as a digital input.

NOTE: Closing digital inputs 1 and 2 (terminals 2 and 3) together carried out a Fast Stop (parameter P-24)

P-15 = 10

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
10	Normally Open (NO) Momentary close to run	Normally Closed (NC) Momentary open to stop	Open: Analogue input 1 Closed: Preset speed 1 (P-20)	Analogue input 1

P-15 = 11

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
11	Normally Open (NO) Momentary close to run forward	Normally Closed (NC) Momentary open to stop	Normally Open (NO) Momentary close to run reverse	Analogue input 1

NOTE: Closing digital inputs 1 and 3 (terminals 2 and 4) together carried out a Fast Stop (parameter P-24)

P-15 = 12

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
12	Open: Stop (disable) Closed: Run (enable)	Open: Fast stop active Closed: Run	Open: Analogue input 1 Closed: Preset speed 1 (P-20)	Analogue input 1

NOTE: Digital input 2 (terminal 3) closed: Normal acceleration and deceleration ramps (P-03 & P-04).
Digital input 2 (terminal 3) open: Fast stop (P-24)

P-15 = 13

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
13	Normally Open (NO) Momentary close to run forward	Normally Closed (NC) Momentary open to stop	Normally Open (NO) Momentary close to run reverse	Open: keypad reference Closed: Preset speed 1 (P-20)

NOTE: Analogue input 1 used as a digital input.
NOTE: Closing digital inputs 1 and 3 (terminals 2 and 4) together carried out a Fast Stop (parameter P-24)

P-15 = 14

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6	Preset speed selected
14	Open: Stop (disable) Closed: Run (enable)	Open	**External trip input** Open: Trip Closed: Run (No trip)	Open	Preset speed 1 (P-20)
		Closed		Open	Preset speed 2 (P-21)
		Open		Closed	Preset speed 3 (P-22)
		Closed		Closed	Preset speed 4 (P-23)

NOTE: For motor thermistor, connect PTC between 24V and digital input 3 (terminals 1 and 4) and set parameter P-47 = Ptc-th
NOTE: Analogue input 1 used as a digital input.
NOTE: 4 preset speeds selectable using digital input 2 and analogue input 1 (terminals 3 and 6).

P-15 = 15

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
15	Open: Stop (disable) Closed: Run (enable)	Open: Preset speed 4 (P23) Closed: Analogue input 1	Fire mode activation (Logic set in P-30)	Analogue input 1

P-15 = 16

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
16	Open: Stop (disable) Closed: Run (enable)	Open: Preset speed 4 (P-23) Closed: Preset speed 2 (P-21)	Fire mode activation (Logic set in P-30)	Open: Forward Closed: Reverse

NOTE: Analogue input 1 used as a digital input.

P-15 = 17

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6	Preset speed selected
17	Open: Stop (disable) Closed: Run (enable)	Open	Fire mode activation (Logic set in P-30)	Open	Preset speed 1 (P-20)
		Closed		Open	Preset speed 2 (P-21)
		Open		Closed	Preset speed 3 (P-22)
		Closed		Closed	Preset speed 4 (P-23)

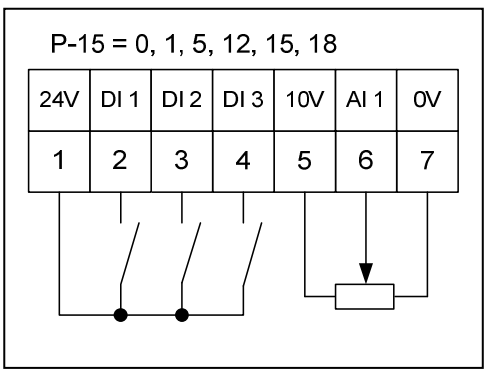
NOTE: Analogue input 1 used as a digital input.
NOTE: 4 preset speeds selectable using digital input 2 and analogue input 1 (terminals 3 and 6).

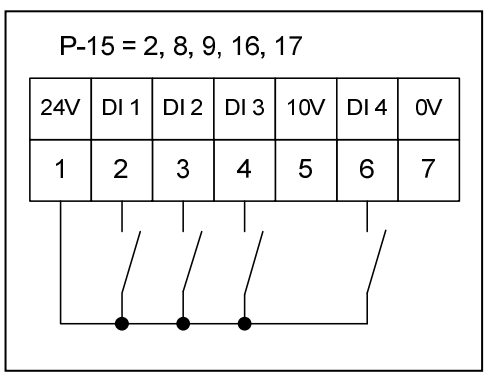
P-15 = 18

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
18	Open: Stop (disable) Closed: Run (enable)	Open: Forward Closed: Reverse	Fire mode activation (Logic set in P-30)	Analogue input 1

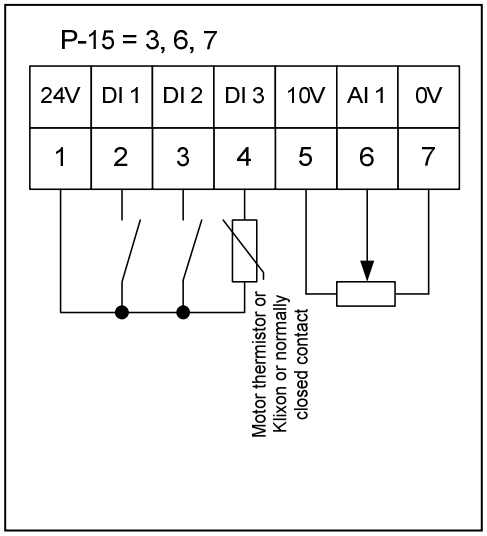
NOTES
- Negative preset speeds will be inverted if Run Reverse is selected.
- When a motor thermistor is set up, the drive will trip on F-Ptc if the thermistor resistance exceeds 3kΩ. The trip cannot be reset until the resistance falls below 1kΩ.

Connection diagrams for P-15
NOTE: These connection diagrams only show the connections for Digital inputs 1, 2 & 3 and analogue input 1 (Terminals 2, 3, 4 and 6).

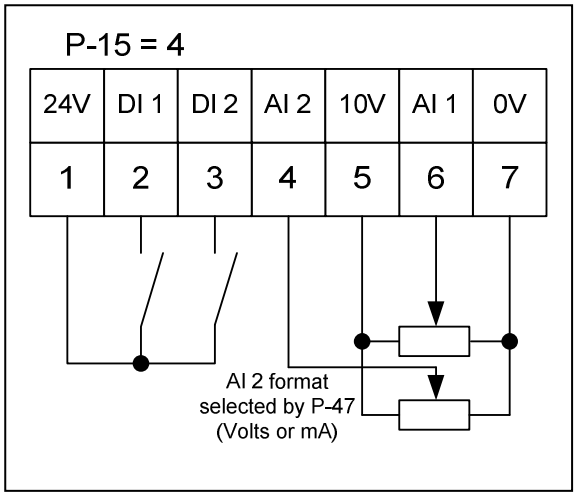




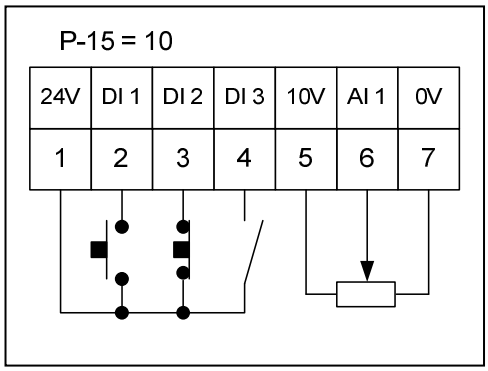
P-15 = 3, 6, 7



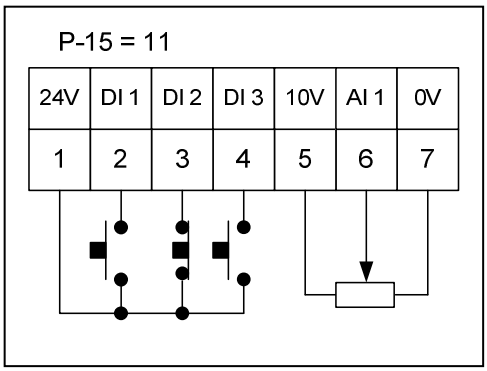
P-15 = 4



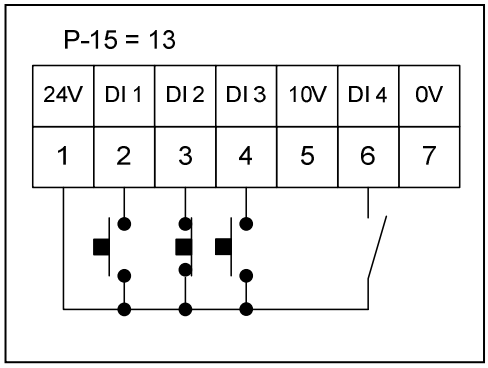
P-15 = 10



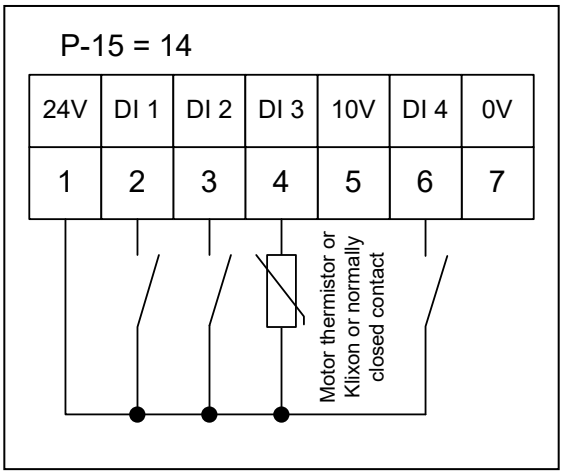
P-15 = 11



P-15 = 13



P-15 = 14



Keypad Control

The Keypad on the Optidrive E3 can be used to control the starting (running), stopping and speed of the motor. In keypad control, the drives control terminals remain active and various configurations can be implemented.
Optidrive E3 uses a macro approach to simplify the configuration of the analogue and digital inputs when in keypad control.

See the Getting Started section of this guide for basic Keypad Control information.

This section of the guide gives information of the way the control terminals function in keypad control.

Parameter P-12
Selects the main drive control source and determines the primary control of the drives output frequency.

P-12 = 1: Keypad control (forward only)
P-12 = 2: Keypad control (forward and reverse)

Parameter P-15
Assigns the functionality to the digital and analogue inputs (terminals 2, 3, 4 and 6).

To access P-15:
Set parameter P-14 = 101 to access parameters P-01 to P-50
Set parameter P-14 = 201 to access parameters P-01 to P-60

P-15 = 0 (Default)

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
0	Open: Stop (disable) Closed: Run (enable)	Open: No function Closed: Increase speed	Open: No function Closed: Decrease speed	Open: Forward Closed: Reverse

NOTE: Analogue input 1 used as a digital input.
NOTE: Parameter P-15 = 9, 10, 11, 12 & 13 has the same functionality as P-15 = 0.

P-15 = 1

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
1	Open: Stop (disable) Closed: Run (enable)	No function	PI Control feedback	No function

NOTE: Digital input 3 (terminal 4) is used as an analogue input.

P-15 = 2

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
2	Open: Stop (disable) Closed: Run (enable)	Open: No function Closed: Increase speed	Open: No function Closed: Decrease speed	Open: Keypad speed ref Closed: Preset speed 1 (P-20)

NOTE: Analogue input 1 used as a digital input.

P-15 = 3

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
3	Open: Stop (disable) Closed: Run (enable)	Open: No function Closed: Increase speed	**External trip input** Open: Trip Closed: Run (No trip)	Open: No function Closed: Decrease speed

NOTE: For motor thermistor, connect PTC between 24V and digital input 3 (Terminals 1 and 4) and set parameter P-47 = Ptc-th
NOTE: Analogue input 1 used as a digital input.

P-15 = 4

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
4	Open: Stop (disable) Closed: Run (enable)	Open: No function Closed: Increase speed	Open: Keypad speed ref Closed: Analogue input 1	Analogue input 1

P-15 = 5

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
5	Open: Stop (disable) Closed: Run (enable)	Open: Forward Closed: Reverse	Open: Keypad speed ref Closed: Analogue input 1	Analogue input 1

P-15 = 6

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
6	Open: Stop (disable) Closed: Run (enable)	Open: Forward Closed: Reverse	**External trip input** Open: Trip Closed: Run (No trip)	Open: Keypad speed ref Closed: Preset speed 1 (P-20)

NOTE: For motor thermistor, connect PTC between 24V and digital input 3 (Terminals 1 and 4) and set parameter P-47 = Ptc-th
NOTE: Analogue input 1 used as a digital input.

P-15 = 7

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
7	Open: Stop (disable) Closed: Run Forward	Open: Stop (disable) Closed: Run Reverse	**External trip input** Open: Trip Closed: Run (No trip)	Open: Keypad speed ref Closed: Preset speed 1 (P-20)

NOTE: For motor thermistor, connect PTC between 24V and digital input 3 (Terminals 1 and 4) and set parameter P-47 = Ptc-th
NOTE: Analogue input 1 used as a digital input.
NOTE: Closing digital inputs 1 and 2 (terminals 2 and 3) together carried out a Fast Stop (parameter P-24)

P-15 = 8

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
8	Open: Stop (disable) Closed: Run Forward	Open: Stop (disable) Closed: Run Reverse	Open: Keypad speed ref Closed: Analogue input 1	Analogue input 1

P-15 = 14

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
14	Open: Stop (disable) Closed: Run (enable)	Speed Step +	**External trip input** Open: Trip Closed: Run (No trip)	Speed Step -

NOTE: For motor thermistor, connect PTC between 24V and digital input 3 (Terminals 1 and 4) and set parameter P-47 = PtC-th

The speed step inputs will add or subtract a speed step on each rising edge. The speed step is defined by parameter P-20.
Speed step changes are only applied while the enable input is present. When the drive is disabled, the Speed Step inputs have no function.

P-15 = 15

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
15	Open: Stop (disable) Closed: Run (enable)	Open: Preset speed 1 or 2 Closed: Keypad reference	Fire mode activation (Logic set in P-30)	Open: Preset speed 4 (P-23) Closed: Preset speed 2 (P-21)

NOTE: Analogue input 1 used as a digital input.

P-15 = 16

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
16	Open: Stop (disable) Closed: Run (enable)	Open: Preset speed 3 (P-23) Closed: Keypad reference	Fire mode activation (Logic set in P-30)	Open: Forward Closed: Reverse

NOTE: Analogue input 1 used as a digital input.

P-15 = 17

P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
17	Open: Stop (disable) Closed: Run (enable)	Open: Preset speed 3 (P-23) Closed: Keypad reference	Fire mode activation (Logic set in P-30)	Open: Forward Closed: Reverse

NOTE: Analogue input 1 used as a digital input.

P-15 = 18

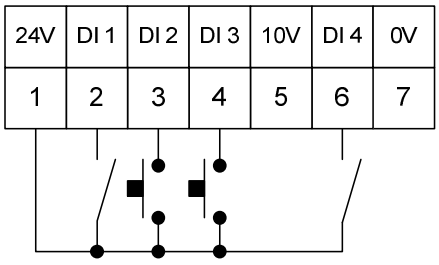
P-15	Digital input 1 Terminal 2	Digital input 2 Terminal 3	Digital input 3 Terminal 4	Analogue input 1 Terminal 6
18	Open: Stop (disable) Closed: Run (enable)	Open: Analogue input 1 Closed: Keypad reference	Fire mode activation (Logic set in P-30)	Analogue input 1

NOTE: Analogue input 1 used as a digital input.

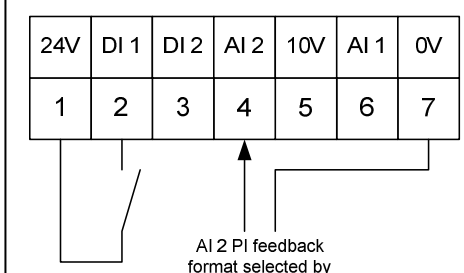
NOTE: If **P-12 = 2** (Keypad control with forward and reverse) is selected and reverse is selected so the motor is running in the reverse direction of rotation, if reverse is also selected via a terminal (For example: P-15 = 0 and terminal 6 connected to 24V), the motor will change direction and run in the forward direction of motor rotation even though reverse was selected via keypad control.

Connection diagrams for P-15 when P-12 = 1 or 2
NOTE: These connection diagrams only show the connections for Digital inputs 1, 2 & 3 and analogue input 1 (Terminals 2, 3, 4 and 6).

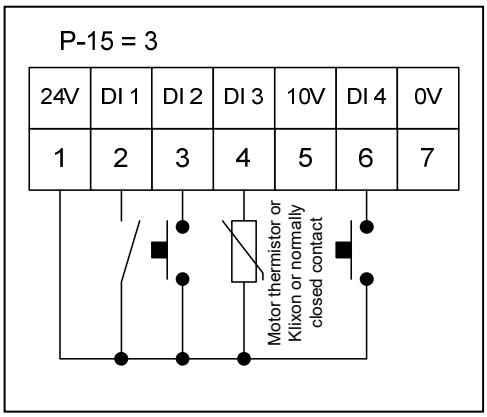
P-15 = 0, 2



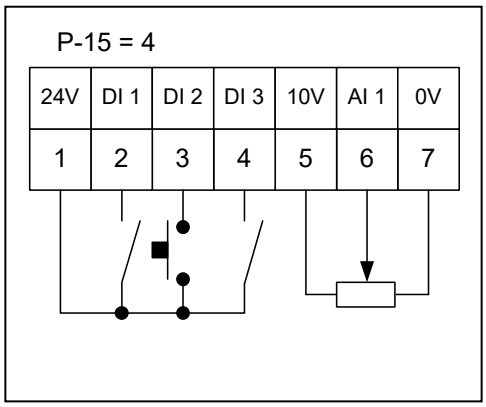
P-15 = 1



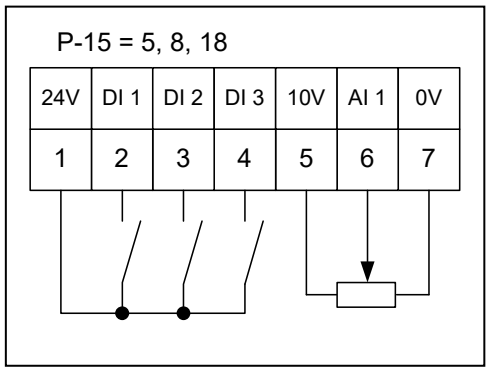
P-15 = 3



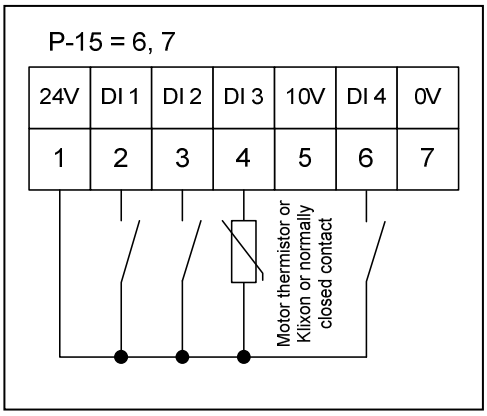
P-15 = 4

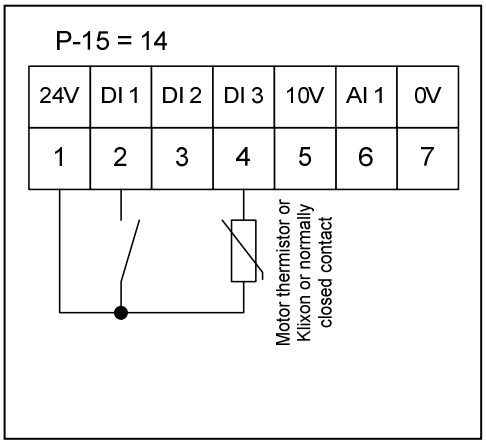


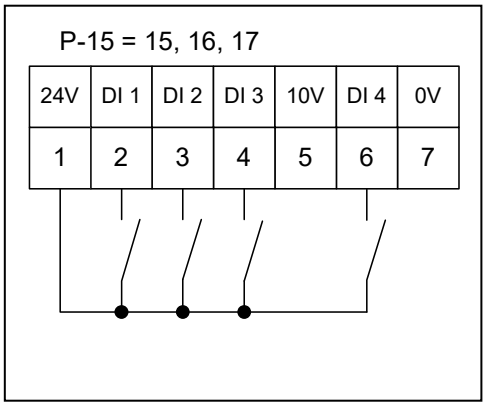
P-15 = 5, 8, 18



P-15 = 6, 7







Keypad Start Mode Select – Parameter P-31

Keypad start mode select is active only when operating in keypad mode (P-12 = 1 or 2).
When settings 0, 1, 4 or 5 are used, the keypad Run/Start and Stop buttons are active and control terminals 1 and 2 (24V and Enable/Run) must be connected together.
When settings 2, 3, 6 and 7 are used, the drive can be run from control terminals directly and the keypad Run/Start and Stop buttons are ignored.

Setting	Description	Explanation
0	Minimum speed, Keypad start	When the keypad Run/Start button is pressed, the drive will Run/Enable at the minimum speed set in parameter P-02.
1 (Default)	Previous speed, Keypad start	When the keypad Run/Start button is pressed, the drive will Run/Enable at the speed it was running at before the Stop button was pressed or before the drive was powered off.
2	Minimum speed, Terminal start	When terminals 1 and 2 are connected together, the drive will Run/Enable at the minimum speed set in parameter P-02.
3	Previous speed, Terminal start	When terminals 1 and 2 are connected together, the drive will Run/Enable at the speed it was running at before the Stop button was pressed or before the drive was powered off.
4	Current speed, Keypad start	When the keypad Run/Start button is pressed, the drive will Run/Enable at the current speed reference selected by the configuration of the control terminals.
5	Preset speed 4, Keypad start	When the keypad Run/Start button is pressed, the drive will Run/Enable at the frequency set in Preset Speed 4 (P-23).
6	Current speed, Terminal start	When terminals 1 and 2 are connected together, the drive will Run/Enable at the current speed reference selected by the configuration of the control terminals.
7	Preset speed 4, Terminal start	When terminals 1 and 2 are connected together, the drive will Run/Enable at the frequency set in Preset Speed 4 (P-23).

Analogue Inputs

Optidrive E3 has two analogue inputs that are selected depending on the setting of P-15:

Analogue input 1 – terminal 6
Analogue input 2 – terminal 4

The format of these inputs can be changed to suit the particular input requirement.

Analogue input 1 format – Parameter P-16

Setting	Description	Further information
U 0-10 **(Default)**	Unipolar 0 to 10V signal	0V = minimum speed (P-02) and 10V = maximum speed (P-01) with default settings
b 0-10	Unipolar 0 to 10V signal, bi-directional operation	The drive can operate the motor in the reverse direction from a unipolar input signal (0 to 10V). Set P-35 = 200.0% and P-39 = 50.0% 0V = -50.0Hz 5V = 0.0Hz 10V = +50.0Hz
A 0-20	0 to 20mA signal	0 to 20mA input signal
t 4-20	4 to 20mA signal with trip	The drive will trip on 4-20F if the input signal level falls below 3mA
r 4-20	4 to 20mA signal	The drive will run at preset speed 1 (P-20) if the input signal falls below 3mA
t 20-4	20 to 4mA signal with trip	The drive will trip on 4-20F if the input signal level falls below 3mA
r 20-4	20 to 4mA signal	The drive will run at preset speed 1 (P-20) if the input signal falls below 3mA
U 10-0	Unipolar 10 to 0V signal	10V = minimum speed (P-02) and 0V = maximum speed (P-01) with default settings
In-Pot **(Default on IP66 switched units)**	Integral potentiometer speed control (IP66 switched units only)	0V = minimum speed (P-02) and 10V = maximum speed (P-01) with default settings

Analogue input 2 format – Parameter P-47

Setting	Description	Further information
U 0-10 **(Default)**	Unipolar 0 to 10V signal	0V = minimum speed (P-02) and 10V = maximum speed (P-01) with default settings
A 0-20	0 to 20mA signal	0 to 20mA input signal
t 4-20	4 to 20mA signal with trip	The drive will trip on 4-20F if the input signal level falls below 3mA
r 4-20	4 to 20mA signal	The drive will run at preset speed 1 (P-20) if the input signal falls below 3mA
t 20-4	20 to 4mA signal with trip	The drive will trip on 4-20F if the input signal level falls below 3mA
r 20-4	20 to 4mA signal	The drive will run at preset speed 1 (P-20) if the input signal falls below 3mA
Ptc-th	Motor thermistor input	Valid when terminal 4 is set up as an Et trip input. Trip level: 3kΩ, Reset level: 1kΩ

NOTE: Analogue input 1 and 2 will be configured automatically as digital inputs depending on the setting of parameter P-15.

Analogue / Digital Output

Optidrive E3 has one analogue / digital output on terminal 8.

Analogue mode: 0 to 10V, 20mA maximum
Digital mode: 0 to 24V, 20mA maximum

The mode and function of the output can be changed using parameter P-25

Setting	Description	Further information
Digital output mode – Logic 1 = +24V		
0	Drive enabled (running)	Logic 1 when the drive is enabled (running)
1	Drive healthy	Logic 1 when the drive is healthy (no fault exists)
2	At target frequency (speed)	Logic 1 when the drives output frequency matches the frequency set point
3	Drive tripped	Logic 1 when the drive is in a tripped / fault condition
4	Output frequency >= Limit	Logic 1 when the drives output frequency exceeds the adjustable limit set in P-19
5	Output current >= Limit	Logic 1 when the drives motor current exceeds the adjustable limit set in P-19
6	Output frequency < Limit	Logic 1 when the drives output frequency is below the adjustable limit set in P-19
7	Output current < Limit	Logic 1 when the drives motor current is below the adjustable limit set in P-19
Analogue output mode – 0 to 10V		
8 (Default)	Output frequency (speed)	0 to 10V proportional to output frequency (speed). 10V = P-01 (maximum frequency)
9	Output (motor) current	0 to 10V proportional to output (motor) current. 0 to 200% of P-08 (motor rated current) Therefore 5V @ 100% motor current Update rate: 256ms
10	Output (motor) power	0 to 10V proportional to output power. 0 to 200% of drive rated power Therefore 5V @ 100% output power
11	Load Current (Torque)	0 to 10V proportional to load current (torque). 0 to 200% of P-08 (motor rated current) Therefore 5V @ 100% load current (torque) Update rate: 64ms

In modes 4 to 7, parameter P-19 is the adjustable threshold level.

When parameter P-19 is used with modes 4 and 6: 100% = P-01 – maximum frequency

When parameter P-19 is used with modes 5 and 7: 100% = P-08 – motor rated current

12 Relay Output

Relay Output

Optidrive E3 has one relay output on terminals 10 & 11.

The relay is a normally open relay (NO)
250VAC, 6A
30VDC, 5A
0.5A, AC-15 Inductive load Cos ø = 0.4

NOTE: If the relay is to control an inductive load such as a motor brake/solenoid etc, the relay should control an external power relay/contactor and should not drive the motor brake/solenoid directly.

The mode and function of the relay output can be changed using parameter P-18

Setting	Description	Further information
Logic 0 = Relay Open : Logic 1 = Relay Closed		
0	Drive enabled (running)	Logic 1 when the drive is enabled (running)
1 (Default)	Drive healthy	Logic 1 when the drive is healthy (no fault exists)
2	At target frequency (speed)	Logic 1 when the drives output frequency matches the frequency set point
3	Drive tripped	Logic 1 when the drive is in a tripped / fault condition
4	Output frequency >= Limit	Logic 1 when the drives output frequency exceeds the adjustable limit set in P-19
5	Output current >= Limit	Logic 1 when the drives motor current exceeds the adjustable limit set in P-19
6	Output frequency < Limit	Logic 1 when the drives output frequency is below the adjustable limit set in P-19
7	Output current < Limit	Logic 1 when the drives motor current is below the adjustable limit set in P-19
8*	Analogue input 2 > Limit	Logic 1 when analogue input 2 (terminal 4) is above the adjustable limit set in P-19
9	Drive ready to run	Logic 1 when the drive is ready to run, no trip present

In modes 4 to 8, parameter P-19 is the adjustable threshold level.

When parameter P-19 is used with modes 4 and 6: 100% = P-01 – maximum frequency

When parameter P-19 is used with modes 5 and 7: 100% = P-08 – motor rated current

When parameter P-19 is used with mode 8: Limit is value in P00-02 – Analogue input value

* If setting 8 is used, the relay will operate on the setting of analogue input 2 and the value in P-19 even if the drive is stopped/disabled/tripped.

Start Mode & Auto Restart

The start mode on Optidrive E3 can be configured by the user as follows using parameter P-30:

Start Mode	Description
EdGE-r **(Default)**	Following a power on or keypad reset, the drive will not start if digital input 1 (terminal) remains closed. The input must be opened and then closed after a power on or keypad reset to allow the drive to run.
AUto-0	Following a power on or keypad reset, the drive will automatically run if digital input 1 (terminal 2) is closed.
AUto- 1 to AUto-5	Auto restart – see description below

Terminal Reset

Digital input 1 (terminal 2) is used as a RESET terminal when parameter P-15 is set to modes 0, 1, 2, 3, 4, 6, 8, 14, 15, 16, 17 & 18.

Digital input 1 (terminal 2) or Digital input 2 (terminal 3) is used as a RESET terminal when parameter P-15 is set to modes 5, 7 & 9.

To reset the drive in momentary control when P-15 is set to 10, 11 or 13, the normally closed (NC) STOP terminal must be toggled (opened and closed) and then the drive will run when the normally open (NO) run pushbutton is pressed.

NOTE: If the drive is set up in with P-15 in any mode apart from the momentary modes (P-15 = 10, 11 or 13) and P-30 is set to EdGE-r or AUto-0 mode, if the drive trips and digital input 1 or digital input 2 is used to reset the drive, as soon as digital input 1 or 2 is opened and then closed, the drive will enable and run.

Auto Restart

If parameter P-30 is set to AUto- 1 to AUto-5 the drive will operate and reset the same as if AUto-0 was set. In addition, following a trip, the drive will make up to 5 attempts to restart at 20 seconds intervals. The number of restart attempts are counted and if the drive fails to start on the final attempt, the drive will trip with a fault code on the display and will require the user to manually reset the fault. The drive must be powered down to reset the Auto restart counter.

NOTE: Parameter 30 contains another 2 indexes (parameters). These parameters are associated with Fire Mode. If fire mode is not being used, these 2 indexes can be ignored.

Motor Control Parameters

This section gives information on various parameters which are used to control the motor.

Overview
As default, the Optidrive E3 is set up in a simple vector control mode (parameter P-51 = 0). For most open loop, general purpose applications, this mode gives good motor starting torque performance without the need for any complex set up.

For some applications which have a high starting torque requirement, this mode along with carrying out an autotune on the motor will give good motor torque performance.

For some applications which are even more demanding, parameter P-11, Low Frequency Torque Boost, can be adjusted to try to give even better starting torque performance.

The Optidrive E3 can also be used for fan and pump applications. The E3 has a number of settings which can be used to help with energy saving in fan and pump type applications.

The following section of this User Guide gives information on the various parameters that can influence motor performance.

Energy Optimiser – Parameter P-06

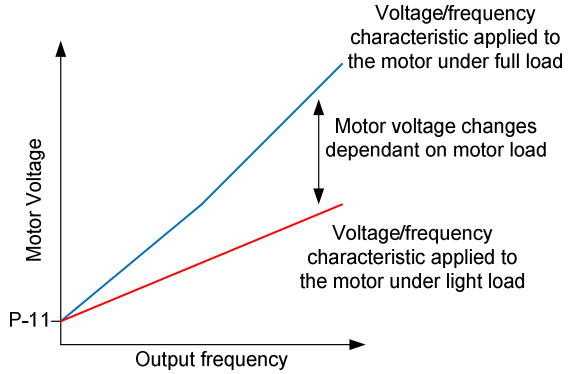
Setting	Motor Energy Optimisation	Optidrive E3 Energy Optimisation
0	Disabled	Disabled
1	Enabled	Disabled
2	Disabled	Enabled
3	Enabled	Enabled

Parameter P-06 = 0
With both the motor energy optimizer and Optidrive E3 energy optimizer disabled, the drive will output a linear V/f (Voltage to frequency) characteristic.

Motor Energy Optimiser
This is intended for use in applications where the motor operates for extended timer periods at constant speed with light load. The E3 will automatically adjust its output voltage based on motor load to reduce motor energy consumption.

Optidrive E3 Energy Optimisation
This function reduces the drives internal heat losses increasing efficiency. However this may result in some vibrations in the motor during light load operation.

NOTE: P-06 can be used for fan and pump applications when P-13 is not used.
NOTE: P-06 should not be used on dynamic applications where the load changes quickly.



Low frequency torque boost – Parameter P-11

Low frequency torque boost is used to increase the applied motor voltage and hence motor current & torque at low motor output frequencies. **In most applications, the default boost setting along with simple vector mode is adequate to provide good starting torque performance.**

Increasing the low frequency torque boost can improve low speed starting torque especially on high starting torque loads e.g. loaded conveyors or mixers etc. It can also improve low speed torque in applications where high levels of low speed torque is required.

In general, the lower the motor power, the higher the boost setting require although caution must be taken not to set the boost value too high.

A method for achieving a suitable setting for low frequency torque boost is to run the motor at 0Hz and adjust parameter P-11 until the motor current is approximately the motor magnetizing current (if known) or as suggested in the table or in the range as shown below:

Model Number	Frame size	Input voltage	Number of input phases	Output voltage	kW	Motor rated current in P-08 (A)	Suggested magnetising current value (A)
ODE-3-120023-1F1#	1	200 to 240VAC ±10%	1	0 to 230V (250V max)	0.37	2.3	**1.4**
ODE-3-120043-1F1#	1				0.75	4.3	**2.5**
ODE-3-120070-1F1#	1				0.75	7.0	**4.2**
ODE-3-220070-1F4#	2				1.5	7.0	**4.2**
ODE-3-220105-1F4#	2				2.2	10.5	**5.2**
ODE-3-320153-1#4#	3				4	15.3	**7.2**
ODE-3-140022-3F1#	1	380 to 480VAC ±10%	3	0 to 400V (500V max)	0.75	2.2	**1.3**
ODE-3-140041-3F1#	1				1.5	4.1	**2.4**
ODE-3-240041-3F4#	2				1.5	4.1	**2.4**
ODE-3-240058-3F4#	2				2.2	5.8	**2.9**
ODE-3-240095-3F4#	2				4	9.5	**4.4**
ODE-3-340140-3F4#	3				5.5	14	**6.5**
ODE-3-340180-3F4#	3				7.5	18	**8.1**
ODE-3-340240-3F4#	3				11	24	**10.5**
ODE-3-340300-3F4#	4				15	30	**14.0**
ODE-3-340390-3F4#	4				18.5	39	**18.2**
ODE-3-340460-3F4#	4				22	46	**21.5**
ODE-3-440610-3F42	5				30	61	**27.6**
ODE-3-440720-3F42	5				37	72	**31.5**

NOTE: The above magnetizing current figures are based on the drives maximum motor rated current value set in P-08. These values may need adjusting based on the actual motor rated current.

E3 frame size 1: 60% to 80% of motor rated current
E3 frame size 2: 50% to 60% of motor rated current
E3 frame size 3: 40% to 50% of motor rated current
E3 frame size 4: 35% to 45% of motor rated current
E3 frame size 5: 35% to 45% of motor rated current

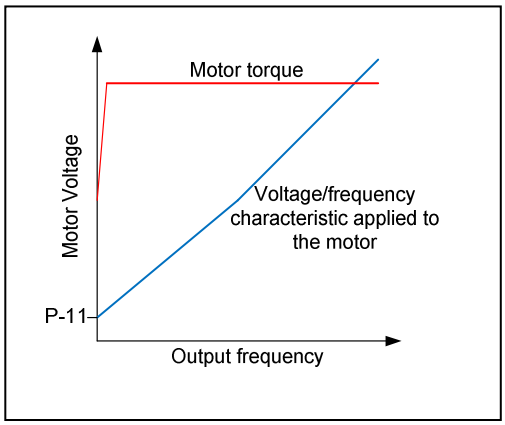
Caution: If the low frequency torque boost is increased too high, the motor can be over magnetised and this will cause the motor to stall while trying to start the load.

Operating Mode – Parameter P-13

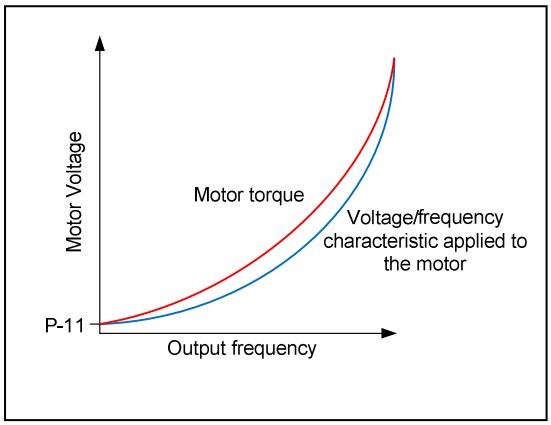
Parameter P-13 provides a quick method of configuring the drive according to the intended application. The drive will automatically set certain parameters depending on which mode is set:

Setting	Application	Current limit (P-54)	Torque characteristic	Spin start (P-33)	Thermal Overload Limit Reaction (P-60 index 2)
0 (Default)	General industrial	150% for 60s	Constant	0 : Off	0: Trip
1	Centrifugal Pumps	110% for 60s	Variable	0 : Off	1: Current limit reduction
2	Fans	110% for 60s	Variable	1 : On	1: Current limit reduction

Constant Torque Characteristic



Variable Torque Characteristic



NOTE: If parameter P-13 is set to 1 or 2 (pump or fan mode), setting parameter P-06 (Energy optimizer) to a 1 will have no effect. If P-06 = 2 or 3, the Optidrive E3 energy optimization is enabled.

Spin Start – P-33

Setting	Description	Explanation
0 (Default)	Disabled	
1	Enabled	On run (enable) the drive will attempt to determine if the motor is already rotating and if it is, will control the motor from its current rotating speed. A small time delay may be observed when starting a motor which is not rotating.
2	Enabled on trip, brown out or coast stop	Spin start is only enabled after a drive trip or a brown out (mains dip/loss) or after a coast to stop. Otherwise the drive will not perform a spin start on run (enable).

Motor Control Mode – P-51

Setting	Description	Explanation
0 (Default)	Simple vector speed control mode	Internal drive motor map used to give good motor performance.
1	V/f mode	Voltage to frequency output. Used if a motor output choke is used or for multiple motor applications or high speed motor applications
2	PM motor vector speed control	AC Permanent Magnet (ACPM) motor control
3	BLDC motor vector speed control	Brushless DC motor control
4	SR motor vector speed control	Synchronous Reluctance motor control
5	LSPM motor vector speed control	Line start permanent magnet motor

NOTE: This document only covers Simple vector speed control mode and V/f mode.

Motor Autotune – P-52

Setting	Description	Explanation
0 (Default)	Disabled	
1	Enabled	Ensure all motor parameters are set correctly before carrying out an autotune. P-07 – Motor rated voltage P-08 – Motor rated current P-09 – Motor rated frequency **NOTE: For the majority of applications, especially high inertia loads (fans), P-10 (Motor rated speed) does not need to be set.** When enabled, the drive immediately carries out a non-rotating autotune to measure required data for optimal motor operation.

NOTES:

- The autotune should be carried out on a cold motor
- If an autotune has been carried out and the motor or motor cable is changed, it is advisable to re-autotune the drive to the motor
- An autotune can be used when P-51 = 0 – Simple vector speed control mode
- An autotune is not required when P-51 = 1 – V/f mode.
- If a motor output choke is used, V/f mode must be used – P-51 = 1 (V/f control)
- If multiple motors are connected to the output of the drive, use P-51 = 1 (V/f control)
- If high speed motors are connected to the output of the drive, use P-51 = 1 (V/f control)

Maximum current limit – P-54

As default, the current limit set in P-54 is 150% for P-13 = 0 or 110% if P-13 = 1 or 2.

The current limit is a % of motor rated current set in P-08. So when P-08 is reduced from its default value to match the motor nameplate value, the current limit follows P-08.

P-54 can be set to 0. This means that the current limit is set to 150% of drive rated current (default setting of P-08).

This can allow a higher peak current to be achieved where the motor rated current is less than the drive rated current for applications which require a high, short term peak current on starting.

Motor Overload Management – P-60

Setting	Description	Explanation
Index 1: Thermal overload retention		
0 (Default)	Disabled	
1	Enabled	When enabled, the drive calculated motor overload protection information is retained after the mains power is removed from the drive.
Index 2: Thermal overload limit reaction		
0 (Default)	It.trp	When the overload accumulator reaches the limit, the drive will trip on It.trp to prevent damage to the motor.
1	Current limit reduction	When the overload accumulator reaches 90%, the output current limit is internally reduced to 100% of P-08 in order to avoid an It.trp. The current limit will return to the setting of P-54 when the overload accumulator reaches 10%.

DC Injection Braking

The following parameters are used to configure the DC injection braking:

Parameter P-32

Index	Setting	Description	Explanation
Index 1	**0.0** to **25.0s** (Default 0.0s)	Duration	Defines the time for which the DC current is injected into the motor.
Index 2	**0 (Default)**	DC injection on Stop	Defines when the DC injection current is applied to the motor.
	1	DC injection on Start	
	2	DC injection on Start and Stop	

DC injection braking on Stop

If P-58 is set to 0.0Hz (default):
Following a Stop command, the output frequency will ramp down set by the time in P-04. When it reaches 0.0Hz, DC is injected into the motor at the current level set in P-59 for the time set in index 1 of P-32. After the DC injection braking time has elapsed, the drive will disable.

If P-58 is set to 25.0Hz:
Following a Stop command, the output frequency will ramp down set by the time in P-04. When it reaches 25.0Hz, DC is injected into the motor at the current level set in P-59 for the time set in index 1 of P-32. After the DC injection braking time has elapsed, the drive will disable.

If P-58 is set to P-01:
Following a Stop command, DC is injected immediately into the motor at the current level set in P-59 for the time set in index 1 of P-32. After the DC injection braking time has elapsed, the drive will disable.

DC injection braking on Start
Following the run (enable) command, DC will be injected into the motor at the current level set in P-59 for the time set in index 1 of P-32. After the DC injection braking time has elapsed, the drive will ramp up to the set speed.

DC Injection braking on Start and Stop
The DC will be injected following a Run (Enable) command and following a Stop command as described above.

DC Injection Braking Speed – P-58

Setting	Default	Explanation
0.0 to P-01	0.0Hz	Sets the speed at which DC injection braking current is applied during the deceleration ramp. If P-58 is set to the same value as P-01 (maximum speed) the drive will inject DC as soon as the Stop command is given.

DC Injection Braking Current – P-59

Setting	Default	Explanation
0.0 to 100% of P-08 (motor rated current)	20.0%	Sets the level of DC injection braking current applied depending on the setting of P-32 in % of motor rated current (P-08).

For a given inertia, the higher the DC injection braking current, the less time will be required to stop the motor.

The DC injection braking can be a useful feature to ensure that a motor is at standstill before the drive acceleration ramp is applied or to make sure the motor is at standstill after the deceleration ramp has been applied.

NOTES:
DC injection braking is only initiated on a Start/Run or Stop command.

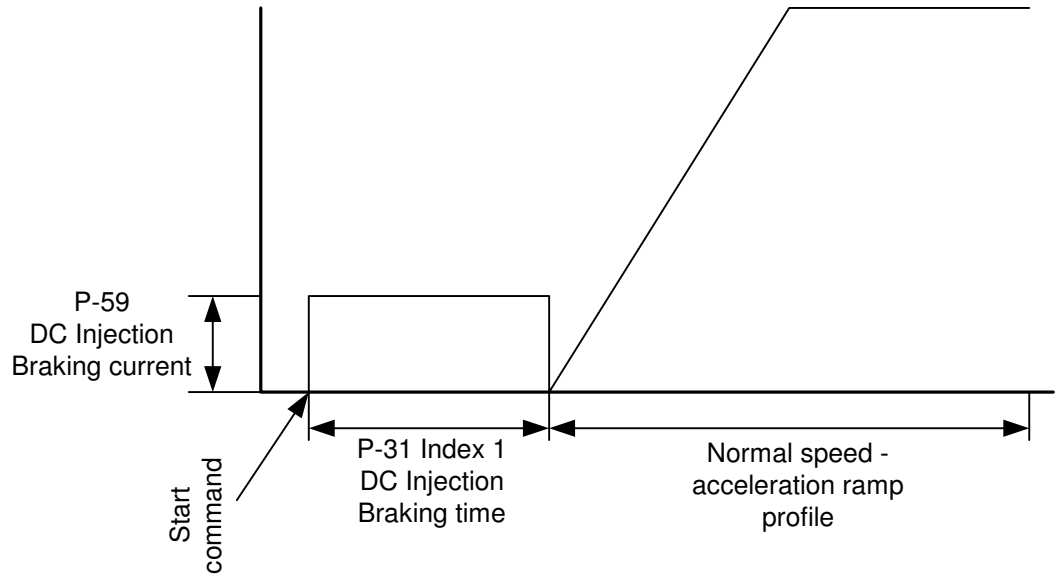
When DC injection braking on start has been set, if the run command is removed during the DC injection braking phase, the drive will disable.

When DC injection braking on stop has been set, if the run command is re-applied during the DC injection braking phase, the DC injection phase must be complete before the drive will re-enabled.

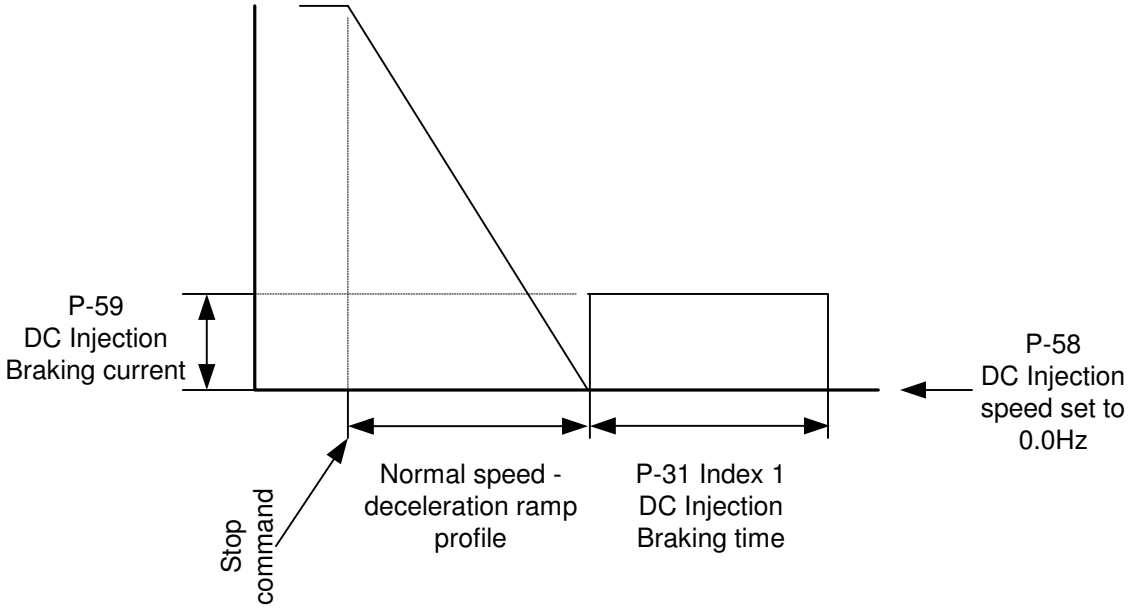
The following diagrams give examples of what happens when DC injection braking is initiate on start and stop.

The actual stopping time is dependant on the level of DC injection braking current and the inertia of the load. The higher the DC injection braking current the shorter the stopping time for a given inertia.

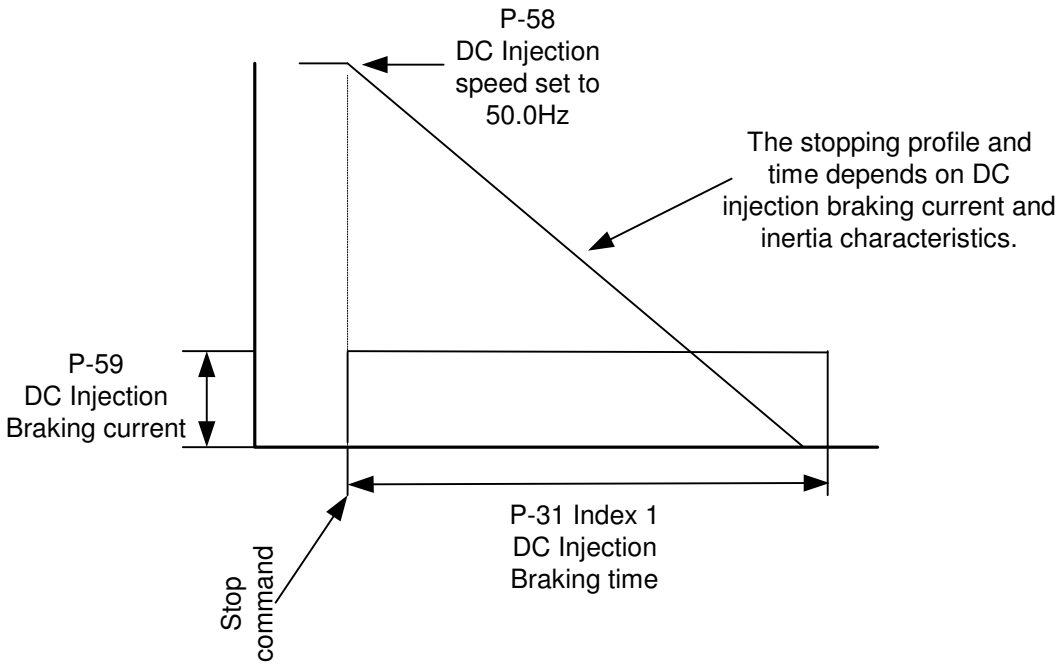
DC Injection Braking on Start



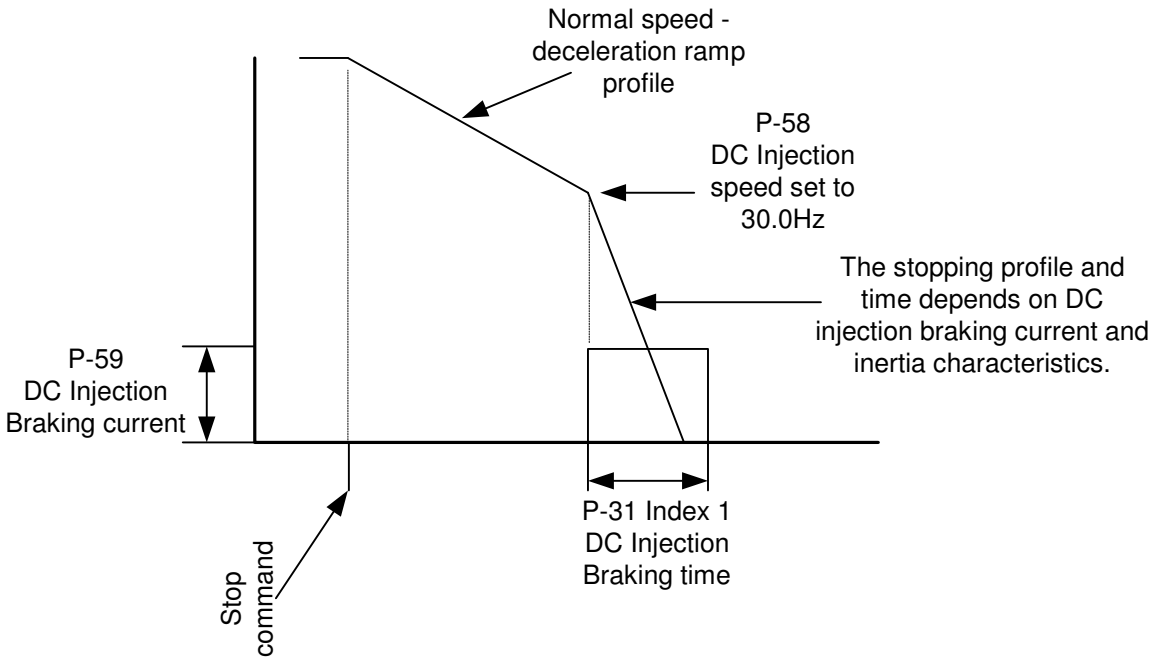
DC Injection Braking On Stop (Inject DC at zero speed)



DC Injection Braking On Stop (Inject DC at 50Hz)



DC Injection Braking On Stop (Inject DC at 30Hz)



Dynamic Braking

Dynamic braking is enabled by parameter P-34.

Setting	Description	Explanation
0 (Default)	Disabled	
1	Enabled with software protection	Enables the internal brake chopper with software protection for the 200W continuous rated resistor.
2	Enabled without software protection	Enables the internal brake chopper without software protection. An external thermal protection device should be fitted.
3	Enabled with software protection	As setting 1, however the brake chopper is only enabled during a change of frequency set-point and is disabled during constant speed operation.
4	Enabled without software protection	As setting 2, however the brake chopper is only enabled during a change of frequency set-point and is disabled during constant speed operation.

Dynamic braking is used dissipate any regenerated energy, usually from an inertia load, when it is slowed down and stopped. The regenerated energy is dissipated as heat in a braking resistor.

The software protection when enabled on the Invertek 200W (size 2 & 3) or 500W (size 4) internally mounted braking resistor (OD-BR100-IN & OD-BRES4-IN) will trip the drive on OL-br if the resistor is overloaded. The OD-BR100-IN and OD-BRES4-IN are fail safe resistors and do not require an external thermal overload device.

If the software protection is disabled and an external braking resistor used, a thermal protection device (thermal overload) should be used to protect the resistor from overheating and causing a potential fire hazard. The thermal overload should remove input power from the drive.

Some braking resistors may not require a thermal protection device as they are designed to be failsafe in the event of an overload. Please consult the resistor manufacturer for details on the resistor being used.

Connect the braking resistor between the **BR** and **+DC** power terminals.

NOTE:
Dynamic braking is not available on Optidrive E3 size 1 drives.

WARNING:
Braking resistors can reach high temperatures. Locate the braking resistors so that damage cannot result. Use cable having insulation that can withstand high temperatures.

Optidrive E3 minimum and recommended braking resistor values

Part number	Drive kW rating	Minimum braking resistor value (Ω)	Recommended braking resistor value (Ω)	Approx. braking power with recommended resistor (kW)
ODE-3-210105-1F42-01	0.55	25	50	0.7
ODE-3-220105-1F42-01	1.1	25	100	1.5
ODE-3-210058-1042	1.1	25	100	1.5
ODE-3-220070-1F42	1.5	25	75	2
ODE-3-220105-1F42	2.2	25	50	3
ODE-3-320153-1042	4	25	25	6
ODE-3-240041-3F42	1.5	75	250	2.4
ODE-3-240058-3F42	2.2	75	200	3
ODE-3-240095-3F42	4	75	100	6
ODE-3-340140-3F42	5.5	25	75	8
ODE-3-340180-3F42	7.5	25	50	12
ODE-3-340240-3F42	11	25	40	15
ODE-3-440300-3F42	15	30	30	20
ODE-3-440390-3F42	18.5	22	22	27.5
ODE-3-440460-3F42	22	22	22	27.5
ODE-3-540610-3F42	30	12	15	40.5
ODE-3-440720-3F42	37	12	12	50.7

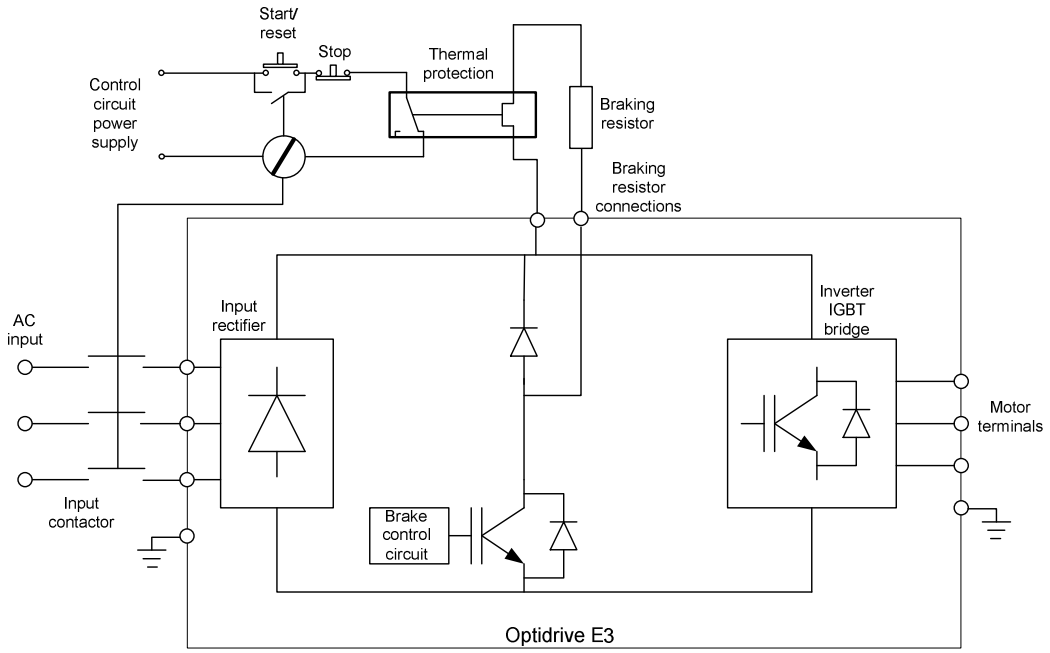
The recommended braking resistor will allow the drive to produce 150% braking torque although in most applications, this level of braking torque is not required.

The power rating of the resistor depends on the application and the average braking power to be dissipated. If the application is a small inertia which stops once a day, the braking resistor power rating can be small when compared to a large inertia which is stopped 20 times a day.

Usually a worse case resistor size for arduous applications is ‘drive kW rating X 40%’ so for a 2.2kW drive, a 1kW resistor should satisfy most applications.

Below is an example circuit of how to connect the braking resistor thermal protection so that it removes power from the inverter in the event of a resistor overload.

Basic Connection Diagram



17 Read Only Status Parameters

Read Only Status Parameters - P00.xx

The Optidrive E3 has a number of read only status parameters which can be used for monitoring and an aid to fault finding within the system.

The read only parameters are accessed through parameter P-00.

Set P-14 to 101 to access P00-01 to P00-30 or P-14 to 201 to access P00-01 to P00-50.
Go to P-00 and press the Navigate button, P00-01 will be shown on the display.

The table below shows the most useful read only status parameters. Please see the E3 User Guide for a full list of the read only status parameters.

Parameter	Description	Explanation
P00-01	Analogue input 1 value (%)	0 to 10V / 4 to 20mA = 0 to 100%
P00-02	Analogue input 2 value (%)	0 to 10V / 4 to 20mA = 0 to 100%
P00-03	Speed ref input (Hz/RPM)	Pre-ramp speed reference in Hz or RPM if P-10>0
P00-04	Digital input status	Displays the status of the digital inputs
P00-05	PI controller output (%)	Displays the output of the PI controller (0 to 100%)
P00-06	DC bus voltage ripple (VDC)	Measured DC bus voltage ripple
P00-07	Applied motor voltage (VAC)	Displays the RMS voltage being applied to the motor
P00-08	DC Bus voltage (VDC)	Displays the drives internal DC bus voltage
P00-09	Heatsink temperature (°C)	Displays the drives internal heatsink temperature
P00-10	Run time since date of manufacture	Displays the run time since date of manufacture. This parameter is not affected by setting factory defaults.
P00-13	Trip log	Displays the 4 most recent trips with time stamp
P00-20	Internal drive temperature	Internal drive ambient temperature in °C.
P00-26	kWh/MWh meters	Displays the kWh and MWh consumed by the drive
P00-28	Software version & checksum	Displays the drives control processor and power stage processor software versions and checksum
P00-29	Drive type identifier	Displays the drive rating, frame size, voltage output phases
P00-30	Drive serial number	Displays the drives unique 11 digit serial number
P00-32	Actual switching frequency	Displays the drives actual switching frequency (See P00-09)

P00-01 & P00-02 – Analogue input 1 & 2 value
P00-01 & P00-02 display the value of the analogue inputs (terminal 4 and 6) as a percentage of the input.
0 to 10V: 0V = 0%, 10V = 100%
4 to 20mA: 4mA = 0%, 20mA = 100%
0 to 20mA: 0mA = 0%, 20mA = 100%

P00-03 – Pre-ramp reference
P00-03 displays the speed reference before the acceleration or deceleration ramps are applied to it. The speed reference maybe from an analogue input or preset speed etc.

P00-04 – Digital input status

P00-04 indicates the status of the digital inputs.

As default with no terminals connected, P00-04 will show **0000**. This means terminals are inactive.

When a digital input is active, the individual digits will show a logic 1.

0000 / **1**000 - The left hand digit shows the status of digital input 1 – terminal 2

0**0**00 / 0**1**00 - The 2nd digit shows the status of digital input 2 – terminal 3

00**0**0 / 00**1**0 - The 3rd digit shows the status of digital input 3 – terminal 4

000**0** / 000**1** - The right hand digit shows the status of digital input 4 – terminal 6

Note: Terminal 4 and terminal 6 can be both digital and analogue inputs depending on the setting of parameter P-15. When terminals 4 and 6 are analogue inputs, the associated digit in P00-04 changes state at approx. 5V input.

P00-05 – PI Control output

P00-05 displays the value of the PI controller output as a %.

This parameter becomes active when the PI controller is enabled by setting P-12 = 5.

See MCW Knowledge Base document MCW-E3-027 for information on the E3 PI controller set up.

P00-06 – DC bus voltage ripple

P00-06 displays the E3 internal DC bus ripple voltage (Only applicable to 3 phase input drives).

The drive monitors the voltage ripple on the drives internal DC bus in conjunction with the input phase loss circuitry to protect the drive in the event of one input phase being lost.

With one input phase missing with no motor load, the DC ripple is very small. As the motor load increases, the DC bus ripple will increase. At approx. 50% motor load, the DC bus ripple will increase above the trip threshold and the drive will trip on **FLt-dc** - DC bus ripple too high trip.

Possible causes of **FLt-dc** trips are a faulty circuit breaker, blown fuse or a voltage in-balance between supply phases.

P00-07 – Applied motor voltage (VAC rms)

P00-07 displays the value of motor voltage that is being outputted by the drive and applied to the motor terminals.

P00-08 – DC bus voltage

P00-08 displayed the drives internal DC bus voltage. The DC bus voltage is internally filtered within the E3 so this parameter may not display fast transient rises in DC bus voltage.

The DC bus voltage can be calculated from: AC input voltage x $\sqrt{2}$

P00-09 – Heatsink temperature (°C)

P00-09 displays the drives heatsink temperature in °C.

The heatsink temperature is used to automatically reduce the drives switching frequency (P-17) in order to try to stop the drive tripping on heatsink over-temperature. P00-32 displays the actual switching frequency if the switching frequency has been reduced.

If the switching frequency has been reduced to the minimum and the heatsink temperature reaches 95°C, the drive will trip on **O-t** – heatsink over-temperature.

P00-10 – Run time since date of manufacture

P00-10 displays the drives run time since date of manufacture in Hours – Minutes – Seconds. This is the time the drive has been enabled/running and not the power up time. (P00-43 displays the power up time).
When P00-10 is accessed, the display will show run time in hours. Press the UP button to show Minutes and Seconds.

P00-13 – Trip log

P00-13 displays the drives 4 most recent trips with the newest trip first and oldest trip last. (See section 18 for a list of Trip Codes).
This parameter can also display the run time stamp when the drive tripped.
When P00-13 is accessed, the display will show the newest trip. Press the UP button to display later trips.
When older trips are displayed, decimal points on the display will flash to show which trip is being displayed.

Last trip – no decimal points flashing
2nd last trip – 1 decimal point flashing
3rd last trip – 2 decimal points flashing
Oldest trip – 3 decimal points flashing
To show the trip time stamp, access the trip required and press the UP and DOWN buttons together. When the UP and DOWN buttons are pressed, the display will show the time stamp in Hours. To display the time stamp Minutes – Seconds, press the UP button. To return to the trip log, press the UP and DOWN buttons together.

P00-20 – Internal drive temperature

P00-20 displays the drives internal ambient temperature in °C. If the drives internal ambient temperature increases about the trip level, the drive will trip on **O-hEAt**.

P00-26 – kWh & MWh (KiloWatt hours & MegaWatt hours)

P00-26 displays the kWh & MWh consumed by the drive.
When P00-26 is accessed, kWh is displayed. To display MWh, press the UP button.

P00-28 – Software versions and checksums

P00-28 displays the drives control processor and power processor software versions and checksums.
When P00-28 is accessed, the display will show the control software version. The left hand side of the display will show a '1' to indicate control software. Press the UP button to show the control software checksum.
Press the UP button again to show the power processor software version. The left hand side of the display will show a '2' to indicate power software. Press the UP button again to show the power software checksum.

P00-29 – Drive type identifier

Displays the drive rating, frame size, voltage output phases.
When P00-29 is accessed, the drive kW rating is displayed.
Press the UP button to display the frame size and voltage rating.
Press the UP button again to display the number of output phases (1P-out or 3P-out).

P00-30 – Drive serial number

P00-30 displays the drives unique 11 digit serial number.
When P00-30 is accessed, the first 6 digits of the serial number are displayed. Press the UP button to show the last 5 digits of the serial number.

P00-32 – Actual switching frequency

P00-32 displays the actual switching frequency. See P00-09 – Heatsink temperature.

Fire Mode

The Fire Mode function is designed to ensure continuous operation of the drive in emergency conditions until the drive is no longer capable of sustaining operation. The Fire Mode input may be a normally open (Close to Activate Fire Mode) or Normally Closed (Open to Activate Fire Mode) according to the setting of P-30 Index 2. In addition, the input may be momentary or maintained type, selected by P-30 Index 3.

This fire mode input on the drive may be linked to a fire control system to allow maintained operation in emergency conditions, e.g. to clear smoke or maintain air quality within that building.
The fire mode function is enabled when P-15 = 15, 16, 17 or 18, with Digital Input 3 assigned to activate fire mode. (See section 7 – Control Terminal Functionality)

Fire Mode disables the following protection features in the drive:

- O-t - Heat-sink Over-Temperature
- U-t - Drive Under Temperature
- th-FLt - Faulty Thermistor on Heat-sink
- E-trIP - External Trip
- 4-20F - 4-20mA fault
- PhIb - Phase Imbalance
- P-LOSS - Input Phase Loss Trip
- SC-trP - Communications Loss Trip
- It-trP - Accumulated overload Trip

The following faults will result in a drive trip, auto reset and restart:

- O-Vo It - Over Voltage on DC Bus
- U-Vo It - Under Voltage on DC Bus
- hO- I - Fast Over-current Trip
- O- I - Instantaneous over current on drive output
- OutF - Drive output fault, Output stage trip

Parameter P-30 Fire Mode Settings

Setting	Description	Explanation
P-30 – Index 2: Fire Mode Input Logic		
0	Normally Closed (NC) Input	Fire mode active if input is open
1	Normally Open (NO) Input	Fire mode active if input is closed
P-30 – Index 3: Fire Mode Input type		
0	Maintained input	The drive will remain in fire mode as long as the fire mode signal remains active
1	Momentary input	Fire mode is activated by a momentary signal on the fire mode input. The drive will remain in fire mode until it is disabled or powered off

Fire Mode Speed Reference
When Fire Mode is activated, the drive will run at the selected speed reference depending on the setting of parameter P-15. There is no specific Fire Mode speed reference parameter.

Fire Mode Read Only Parameters

P00-47 index 1: Fire Mode total active time.
P00-47 index 2: Fire Mode activation counter.

Trip Codes

O I-b - Instantaneous over current on dynamic brake output (+BR)
OL-br - Braking resistor overload
O- I - Instantaneous over current on drive output
I.t-trP- Accumulated overload trip
O-Uo It- Over voltage on DC bus
U-Uo It- Under voltage on DC bus
O-t- Heat-sink over-temperature
U-t - Drive under temperature
P-dEF - Factory default parameters loaded (Press the Stop/Reset button)
E-tr iP - External trip
SC-ObS - Optibus serial communications loss trip
FLt-dc - DC bus ripple too high
P-LOSS - Input phase loss trip
hO- I - Fast over-current trip on drive output
th-FLt - Faulty thermistor on heat-sink
dAtA-F - Internal memory fault (IO PCB processor)
4-20 F - 4-20mA analogue input signal loss
dAtA-E - Internal memory fault (Power PCB processor)
F-Ptc - Motor PTC thermistor trip
FAn-F- Internal cooling fan fault (IP66 units only)
O-hEAt - Drive internal temperature too high
AtF-O I to AtF-O5 - Autotune fault
SC-FO I - Modbus serial communications fault
SC-FO2 - CANOpen serial communications fault
Out-F - Drive output fault, output stage trip
FAULtY - Internal drive communication issue between control and power processors

Fault Finding

Fault Code	Possible cause and corrective actions
O- I	*Drive software instantaneous over current trip.* • Usually caused by accelerating or decelerating the motor/load too quickly or by shock loads on the motor/load. • Check motor star/delta connection correct for drive output voltage. • Check motor not seized and motor brake is releasing (if used). • Make sure motor brake is not connected to drives output. • Incorrect drive set up. Check motor nameplate parameters P-07, P-08 & P-09 are correct for the motor. • Check torque boost setting in P-11 and reduce if necessary. • If an autotune has been carried out and then the motor and/or motor cable has been changed, re-autotune the drive to the motor. • Check correct setting of Motor Control Mode P-51. • If multi-motor application or motor choke fitted, make sure P-51 = 1 (V/f mode). • Check connections between inverter output and motor for loose connections etc. • Disconnect motor to check that drive runs without motor connected.
hO- I	*Drive hardware instantaneous over current trip.* • Usually caused by a phase to phase or phase to earth fault on the drive output. • Check motor cable and motor for faults. • Disconnect motor to check that drive runs without motor connected. • Make sure motor brake is not connected to drives output. • Check connections between inverter output and motor for loose connections etc. • See information for O- I trip. **NOTE:** O-I and hO-I trips cannot be reset for at least 4s after a trip occurs
Out-F	*Drive output fault.* • Can indicate a possible phase to earth fault on motor/motor cable. • Can indicate an output power stage internal fault within the drive. • Remove motor cables from drive, power down and back up to see if fault clears. If fault remains, contact the supplier of your drive.
I.t-trP	*Motor thermal overload trip.* • The drive has tripped after delivering >100% of the value in P-08 for a period of time to prevent damage to the motor. • Load to large for motor/drive rating. Check actual motor current and compare to setting of P-08. • Check motor star/delta connection is correct for drive output voltage. • Check motor not seized and motor brake releasing (if used). • Incorrect drive set up. Check motor nameplate parameters P-07, P-08 & P-09 are correct for the motor. (Check P-09 is correct if high frequency/speed motor) • Increase acceleration and deceleration ramps in P-03 and P-04. • Check torque boost setting in P-11 and reduce if necessary. • If an autotune has been carried out and then the motor and/or motor cable has been changed, re-autotune the drive to the motor. • Check correct setting of Motor Control Mode P-51. • Check setting of P-54 – Current limit. • If multi-motor application or motor choke fitted, make sure P-51 = 1 (V/f mode). • If P-13 has been set to fan or pump mode, is application a variable torque load? Check application characteristics. Possibly set P-13=0, constant torque load.
O-Uo lt	*Over voltage on drives DC bus.* • Check mains supply voltage is within tolerance. • If trip occurs during deceleration, increase deceleration ramp time in P-04. • Install a suitably rated braking resistor to dissipate regenerated energy. • Makes sure braking resistor function is enabled in P-34.

U-Uo lt	*Under voltage on drives DC bus.* • An under voltage trip will occur normally when the mains power supply is removed from the drive. • Check the mains supply voltage is within tolerance. • Check all components in the mains power supply to the drive.
FLt-dc	*Voltage ripple on drive DC bus above allowable level (See P00-06)* *(DC bus ripple voltage increases with load so trip more likely at higher loads)* • Check that all mains supply phases are preset and balanced. • Check all components in the mains power supply to the drive. • >50VDC on 200V product, >90VDC on 400V product
P-LOSS	*Mains supply input phase loss.* • Only measured on input phase L1. • Check that all mains supply phases are preset and balanced. • Check all components in the mains power supply to the drive.
O-t	*Heatsink over temperature (See P00.09 <95°C).* • Check drive cooling fan is working and that the fan/heatsink air path isn't blocked. • Check ambient air temperature around drive. • Ensure sufficient cooling and ventilation in enclosure.
U-t	*Heatsink under temperature (See P00.09 <-20°C).* • Occurs when heatsink temperature is <-20°C. • Heatsink temperature must be raised above -20°C in order to run the drive.
E-trIP	*External trip requested on digital input 3 (terminal 4).* • Normally closed contact between 24V and terminal 4 has opened for some reason. • Check correct setting of parameter P-15. • If motor thermistor is connected to terminal 4 (check setting of P-47) check motor is not too hot.
th-FLt	*Faulty heatsink thermistor.* • If trip persists and cannot be reset, contact supplier of drive.
4-20 F	*4-20mA signal lost (<3mA)(See P-16 and P-47).* • When current (mA) analogue input signal is used on terminals 4 or 6 and P-16 or P-47 is set to a mA trip mode, signal has fallen below 3mA. • Check control cabling. • Check analogue input signal (See P00.01 and P00.02)
F-Ptc	*Motor PTC thermistor trip (See P-15 and P-47).* • Excessive motor temperature. • Check thermistor wiring. • Check motor wiring (drive is correctly connected in star/delta)
O-hEAt	*Drive internal ambient temperature too high (See P00.20).* • Check ambient air temperature around drive. • Ensure sufficient cooling and ventilation in enclosure.
P-dEF	*Factory default parameters loaded.* • Initiated by pressing the UP, DOWN & STOP keys for >2s. • Press the STOP key and this will reset the P-dEF trip.
O I-b	*Brake channel over current.* • Brake resistor too small an ohmic value or short circuit. • Check that the braking resistor value is greater than the recommended minimum value. • Check brake resistor condition and cabling.

OL-br	*Brake resistor overload (See P-34).* • The drive will trip on OL-br if P-34 = 1 or 3 and the 200W Invertek brake resistor has been overloaded. • Increase the deceleration ramp in P-04. • The resistor power rating is too small for the regenerated energy. Increase resistor power rating and set P-34 = 2 or 4.
FAn-F	*Internal cooling fan fault (IP66 units only).* • There is an internal cooling fan on the IP66 units. This fan is monitored to make sure that it is rotating. If the fan stops rotating, the drive will trip on FAn-F. • If trip persists and cannot be reset, contact supplier of drive.
SC-Obs	*Optibus serial communications loss.* • Check the communications link between the drives RJ45 connector and external devices. • Make sure each drive has its own unique serial comms address (See P-36)
SC-F01	*Modbus RTU serial communications loss.* • Check the Modbus RTU cable connections. • Check that at least one register is being polled cyclically within the timeout limit set in P-36 index 3.
SC-F02	*CANopen serial communications loss.* • Check the CANopen cable connections. • Check that cyclic communications takes place within the timeout limit set in P-36 index 3.
dAtA-F	*Internal memory fault (Control PCB processor).* • Try setting default parameters. • If trip persists and cannot be reset, contact supplier of drive.
dAtA-E	*Internal memory fault (Power PCB processor).* • Try setting default parameters. • If trip persists and cannot be reset, contact supplier of drive.
AtF-01 to AtF-05	*Autotune fault (See P-52).* • The motor parameters measured during an autotune are incorrect. • Check the motor cable and connection between the drive and motor. • Check the motor cable for continuity between drive and motor. • Check all 3 motor phases are present and balanced.
FAULtY	*Drive communications fault between control and power microprocessors* • Power cycle the drive to see if this clears the fault. • If trip persists and cannot be reset, contact supplier of drive.

Other issues and solutions

Motor runs at low speed when high speed requested	• Has a RPM value been set in P-10 which changes the frequency parameters to RPM and then a low RPM value been set in P-01 – Maximum speed. • The drive is in current limit which will hold the drives output frequency at a low value. Check actual output current compared to 1.1 X P-08 (fan/pump) or 1.5 X P-08 (industrial). See I.t-trP trip information above.

When drive is powered up with a connection between control terminals 1 & 2, drive remains in StoP	• Check value of P-30. As default, P-30 is set to EdgE-r so the drive is expecting a signal transition between 0V and 24V to allow it to run. If a hardwire connection is between control terminals 1 & 2, the drive will not run. • Either open and close the connection between terminals 1 & 2 or change P-30 to AUto-0. With P-30 at AUto-0, the drive will enable and run as soon as power is applied to it.

Not enough starting torque for application	• See Knowledge Base document *MCW-E3-044* • Carry out an autotune (See parameter P-52) • Increase P-11 – Torque boost voltage in small increments.

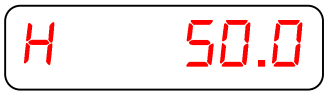
The drive does not react to signals on the analogue or digital inputs	• See Knowledge Base document *MCW-E3-037* • Analogue inputs – Check P00.01 (AI 1 – terminal 6) and P00.02 (AI 2 – Terminal 4). These should go from 0 to 100% = 0 to 10V/4-20mA etc. • Digital inputs – Check P00.04 (Digits should change from 0 to 1 when digital inputs are connected to 24V.

The drive trips on O-Uo It (over voltage) on a fan applications	• Set P-10 (motor rated speed) to 0 RPM. • If it is required to see RPM on the display, set P-10 to the synchronous speed of the motor (3000, 1500, 1000, 750 RPM)

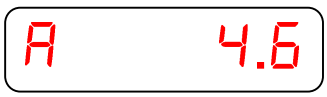
Display indications

Display shows STOP to indicate that no enable/run signal has been applied to the drive.

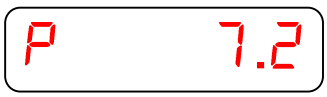
Display shows output frequency in Hz



Display shows output current in Amps



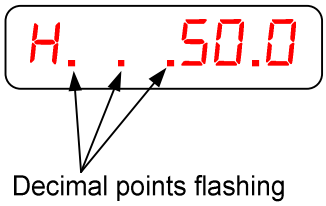
Display shows output power in kW



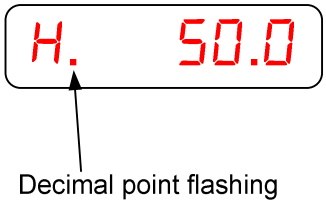
Display shows output speed in RPM

Display shows customer defined units. See parameter P-40

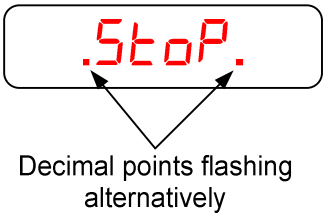
Drive is in overload. Motor current is greater than current value set in parameter P-08



Fire mode is active. See parameters P-15 = 15, 16, 17 & 18

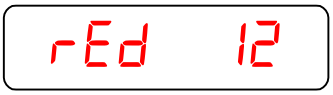


Mains loss is active. The voltage applied to L1 input phase is low or has been lost.
When mains loss is active, the drive will remain in STOP mode.



Drive is in Standby mode. See parameter P-48.

Switching frequency has been reduced
If parameter P-17 is viewed and it shows the following **rEd** message, it means that the drive has automatically switched down the switching frequency due to excessive heatsink temperature.



The drive does this to try to keep the drive running and prevent the drive from tripping on heatsink over temperature.

Parameter P00-32 shows the actual switching frequency the drive is running at.

IP66 Switched Unit Integral Switch and Potentiometer

As default on the IP66 Outdoor Rated switched units, the integral speed potentiometer and Forward-Stop-Reverse switch are enabled. This allows the user to control the motor direction and speed without having to connect any external switches or potentiometers.

These functions can be disabled if required so that for example, the integral potentiometer can be used in conjunction with external Stop/Start control or the integral switch can be used with an external analogue input speed reference.

NOTES:

As default, when the integral potentiometer is enabled, analogue input 1 (terminal 6) is disabled.

When the integral switch is enabled, the control terminals are still enabled. The function of the integral switch and terminals is controlled by the settings of parameters P-12 & P-15.

Because the control terminal functions are still enabled when using the integral switch, any connections to terminal 2 and 3 (DI 2 & DI 3) can override or adjust the operation of the drive.

Care should be taken if using the integral potentiometer with external terminal control as the integral switch operation can override the external terminal control. When using external terminal control, disabling the internal switch should be considered.

It is not possible to modify the potentiometer or switch function as per the older E3 'Indoor Rated' product.

Integral Speed Potentiometer
Parameter **P-16** is used to select the analogue input format of analogue input 1 (terminal 6). It is also used to enable and disable the integral potentiometer.

On the IP66 switched units, **P-16 = In-Pot** (default setting). When **P-16 = In-Pot**, terminal 6 is disabled.

(On IP20 units, the default setting for P-16 = U01-0)

To disable the integral switch, select a different value for **P-16**, see table below:

Setting	Description	Further information
U 0-10	Unipolar 0 to 10V signal	0V = minimum speed (P-02) and 10V = maximum speed (P-01) with default settings
b 0-10	Unipolar 0 to 10V signal, bi-directional operation	The drive can operate the motor in the reverse direction from a unipolar input signal (0 to 10V). Set P-35 = 200.0% and P-39 = 50.0% 0V = -50.0Hz 5V = 0.0Hz 10V = +50.0Hz
A 0-20	0 to 20mA signal	0 to 20mA input signal
t 4-20	4 to 20mA signal with trip	The drive will trip on 4-20F if the input signal level falls below 3mA
r 4-20	4 to 20mA signal	The drive will run at preset speed 1 (P-20) if the input signal falls below 3mA
t 20-4	20 to 4mA signal with trip	The drive will trip on 4-20F if the input signal level falls below 3mA
r 20-4	20 to 4mA signal	The drive will run at preset speed 1 (P-20) if the input signal falls below 3mA
U 10-0	Unipolar 10 to 0V signal	10V = minimum speed (P-02) and 0V = maximum speed (P-01) with default settings
In-Pot	Integral potentiometer on IP66 switch units enabled	0V = minimum speed (P-02) and 10V = maximum speed (P-01) with default settings

Integral Forward-Stop-Reverse Switch

To disable / re-enable the Forward-Stop-Reverse switch:

- Make sure the drive is in the **STOP** condition (not running or tripped)
- Set the correct value into **P-14** to enable advanced parameter access e.g. **101** or **201**
- Go to **P-00**
- Press and hold the **STOP** button for approx. 1s
- The display will show **Lc-OFF** (default setting)
  - **Lc-OFF** means integrated switch is enabled
  - **Lc-On** means integrated switch is disabled
  - **ALtErn** means integral switch is enabled but function as per table below
- Use the **UP** or **DOWN** buttons to select the setting required
- Press the **STOP** button to exit and save the setting

Lc-On – Internal switch disabled
Lc-OFF – Internal switch enabled and works as per E3 IP66 'indoor rated'.
ALtErn – Internal switch enabled and new mode as per table below

Switch position	P-00 & STOP for 1s Setting					
	Lc-On		Lc-OFF		ALtErn	
	DI 1	DI 2	DI 1	DI 2	DI 1	DI 2
Left (Reverse)	0	0	1	1	0	1
Middle (Stop)	0	0	0	0	0	0
Right (Forward)	0	0	1	0	1	0

Using the REV/0/FWD switch for different set-ups

By adjusting parameters P-12 and P-15, the E3 switch can be configured for multiple applications and not just Forward/Reverse. See table below for details:

Switch Position			Parameters to set		Notes
			P-12	P-15	
Run reverse	STOP	Run forward	0	0	Factory default configuration. Run forward or reverse with speed controlled from local potentiometer.
STOP	STOP	Run forward	0	5 or 7	Run forward with speed controlled from local potentiometer. Reverse disabled.
Preset speed 1	STOP	Run forward	0	1	Run forward with speed controlled from local potentiometer. Preset speed 1 provides a 'Jog' speed set in P-20.
Run in AUTO	STOP	Run in HAND	0	4	Run in HAND – speed controlled from local potentiometer. Run in AUTO – speed controlled using analogue input 2 e.g. from PLC with 4-20mA signal, format set in P-47.
Run in speed control	STOP	Run in PI control	5	1	In speed control, the speed is controlled from local potentiometer. In PI control, local potentiometer controls PI set point.
Run in preset speed control	STOP	Run in PI control	5	0, 2, 4, 5, 8….12	In preset speed control P-20 sets the preset speed. In PI control, local potentiometer can control the PI set point.
Run in HAND	STOP	Run in AUTO	3	6	Run in HAND – speed controlled from local potentiometer. Run in AUTO – speed controlled from Modbus
Run in HAND	STOP	Run in AUTO	3	3	Run in HAND – speed controlled by preset speed 1 – P-20. Run in AUTO – speed controlled from Modbus

Parameter List

The following table can be used by the user to keep a record of parameter settings:

Drive model number :……
Drive Serial Number :……
Application reference :……..

Par.	Parameter Name	Setting	Par.	Parameter Name	Setting
P-01	Maximum speed		P-33	Spin start	
P-02	Minimum speed		P-34	Brake chopper enable	
P-03	Acceleration time		P-35	Analogue input 1 scaling	
P-04	Deceleration time		P-36 - 1	Serial comms address	
P-05	Stopping mode		P-36 - 2	Serial comms baud rate	
P-06	Energy optimizer		P-36 - 3	Serial comms loss protection	
P-07	Motor rated voltage		P-37	Access code definition	
P-08	Motor rated current		P-38	Parameter access lock	
P-09	Motor rated frequency		P-39	Analogue input 1 offset	
P-10	Motor rated speed		P-40 - 1	Display scaling factor	
P-11	Low speed voltage boost		P-40 - 2	Display scaling source	
P-12	Primary command source		P-41	PI controller P gain	
P-13	Operating mode select		P-42	PI controller I gain	
P-14	Extended menu access		P-43	PI controller operating mode	
P-15	Digital input function select		P-44	PI setpoint source	
P-16	Analogue input 1 format		P-45	PI digital setpoint	
P-17	Switching frequency		P-46	PI feedback source select	
P-18	Output relay function select		P-47	Analogue input 2 format	
P-19	Relay threshold level		P-48	Standby mode timer	
P-20	Preset speed 1		P-49	PI controller wake up error level	
P-21	Preset speed 2		P-50	Output relay hysteresis	
P-22	Preset speed 3		P-51	Motor control mode	
P-23	Preset speed 4		P-52	Motor autotune	
P-24	2nd Deceleration ramp time		P-53	Vector mode gain	
P-25	Analogue output function select		P-54	Maximum current limit	
P-26	Skip frequency hysteresis band		P-55	Motor stator resistance	
P-27	Skip frequency centre point		P-56	Motor stator d inductance	
P-28	V/f characteristic adjustment voltage		P-57	Motor stator q inductance	
P-29	V/f characteristic adjustment frequency		P-58	DC injection braking speed	
P-30 - 1	Start mode and automatic reset		P-59	DC injection braking current	
P-30 - 2	Fire mode input logic		P-60 - 1	Thermal overload retention	
P-30 - 3	Fire mode input type		P-60 - 2	Thermal overload limit reaction	
P-31	Keypad start mode select				
P-32 - 1	DC injection brake duration				
P-32 - 2	DC injection braking mode				

Standard Parameters

Parameter	Parameter Name	Parameter	Parameter Name
P-01	Maximum speed	P-08	Motor rated current
P-02	Minimum speed	P-09	Motor rated frequency
P-03	Acceleration time	P-10	Motor rated speed
P-04	Deceleration time	P-11	Low speed voltage boost
P-05	Stopping mode	P-12	Primary command source
P-06	Energy optimizer	P-13	Operating mode select
P-07	Motor rated voltage	P-14	Extended menu access

Default Control Terminal Connections