Invertek Drives.com

# User Guide

# Compact 2-E3

**AC Variable Speed Drive**
**0.37 – 4.0kW (0.5 – 5HP)**
**230V-480V**

**Engineering Guide**

**1. Important Safety Information ..... 5**
**2. Product Overview ..... 6**
*2.1. General Information 6*
*2.2. Model Code Definition 6*
*2.3. Available Models 7*
*2.4. Power Module Output Current Capacity 7*
**3. Mechanical Information and Mounting ..... 8**
*3.1. General 8*
*3.2. Mechanical Dimensions and Mounting 8*
*3.3. Removing/Changing the Control Module. 10*
*3.4. Heatsink Capacity Calculation 10*
*3.5. Maximum Permissible Heatsink Temperature 10*
*3.6. Typical Heatsink Requirement 11*
**4. Electrical Power Wiring and Installation ..... 13**
*4.1. Connection Diagram 13*
*4.2. Protective Earth (PE) Connection 14*
*4.3. Incoming Power Connection 14*
*4.4. Motor Connection 15*
*4.5. Motor Terminal Box Connections 15*
*4.6. EMC Compliant Installation 15*
**5. Control Wiring ..... 16**
*5.1. Control Terminal Wiring 16*
*5.2. Control Terminal Connections 16*
*5.3. Analog Output 16*
*5.4. Relay Output 16*
*5.5. Analog Inputs 16*
*5.6. Digital Inputs 16*
*5.7. Motor Thermistor Connection 16*
*5.8. Internal Thermal Overload Protection 16*
**6. Parameter Set Overview ..... 17**
*6.1. About this section 17*
*6.2. Parameter Structure Overview and Access 17*
*6.3. Additional Information 17*
*6.4. Parameter Descriptions 18*
*6.5. Parameter Group 0 – Monitoring Parameters (Read Only) 25*
**7. Control Terminal Connections ..... 26**
*7.1. P-12 Function 26*
*7.2. Overview 27*
*7.3. Macro Function Guide 27*
*7.4. Example Connection Diagrams 32*
*7.5. Software Functions 33*
**8. Serial Communications ..... 37**
*8.1. Overview 37*
*8.2. Modbus RTU 37*
*8.3. CAN Open 37*
**9. Additional Options ..... 46**
*9.1. Managing the remote Keypad. 46*
*9.2. Changing Parameters 46*
*9.3. Read Only Parameter Access 46*
*9.4. Resetting Parameters 46*
*9.5. Resetting a Trip 46*
**10. Technical Data ..... 47**
*10.1. Environmental 47*
*10.2. Electrical Data 47*
*10.3. Digital & Analog I/O 47*
*10.4. Mechanical 47*
*10.5. Response Times 48*
*10.6. Motor Control Performance 48*
*10.7. Output Current Limit 48*
*10.8. Under / Over Voltage Trip Levels 49*
*10.9. Effective Switching Frequency Operating Temperature 49*
*10.10. Electrical Rating Tables 49*
**11. Diagnostic & Status Information ..... 50**

*11.1. Status Indication LEDs* *50*
*11.2. Fault Code Messages* *50*
**12. Revision History** ..... **51**

### *Declaration of Conformity*

Invertek Drives Ltd hereby states that the Optidrive Compact 2 product range conforms to the relevant safety provisions of the following council directives:

2014/30/EU (EMC) and 2014/35/EU (LVD)

Designed and manufacture is in accordance with the following harmonised European standards:

| | |
|---|---|
| EN 61800-5-1: 2007 | Adjustable speed electrical power drive systems. Safety requirements. Electrical, thermal and energy. |
| EN 61800-3: 2004 /A1 2012 | Adjustable speed electrical power drive systems. EMC requirements and specific test methods |
| EN 55011: 2007 | Limits and Methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment (EMC) |

### Electromagnetic Compatibility

All Optidrives are designed with high standards of EMC in mind. All versions suitable for operation on Single Phase 230 volt and Three Phase 400 volt supplies and intended for use within the European Union are fitted with an internal EMC filter. This EMC filter is designed to reduce the conducted emissions back into the mains supply via the power cables for compliance with the above harmonised European standards.
It is the responsibility of the installer to ensure that the equipment or system into which the product is incorporated complies with the EMC legislation of the country of use, and the relevant category. Within the European Union, equipment into which this product is incorporated must comply with the EMC Directive 2014/30/EU. This User Guide provides guidance to ensure that the applicable standards may be achieved.

### *Copyright Invertek Drives Ltd © 2017*



### *Warranty*

All Invertek Optidrive units carry a 2 year warranty against manufacturing defects from the date of manufacture. The manufacturer accepts no liability for any damage caused during or resulting from transport, receipt of delivery, installation or commissioning. The manufacturer also accepts no liability for damage or consequences resulting from inappropriate, negligent or incorrect installation, incorrect adjustment of the operating parameters of the drive, incorrect matching of the drive to the motor, incorrect installation, unacceptable dust, moisture, corrosive substances, excessive vibration or ambient temperatures outside of the design specification.

The local distributor may offer different terms and conditions at their discretion, and in all cases concerning warranty, the local distributor should be contacted first.
**This user guide is the "original instructions" document. All non-English versions are translations of the "original instructions".**

The contents of this User Guide are believed to be correct at the time of printing. In the interest of a commitment to a policy of continuous improvement, the manufacturer reserves the right to change the specification of the product or its performance or the contents of the User Guide without notice.

***This User Guide is for use with version 2.01 Firmware.***

***Engineering Guide Issue 07 (02/18)***

Invertek Drives Ltd adopts a policy of continuous improvement and whilst every effort has been made to provide accurate and up to date information, the information contained in this User Guide should be used for guidance purposes only and does not form the part of any contract.

| | |
|---|---|
|  | **This manual is intended as a guide for proper installation. Invertek Drives Ltd cannot assume responsibility for the compliance or the non-compliance to any code, national, local or otherwise, for the proper installation of this drive or associated equipment. A hazard of personal injury and/or equipment damage exists if codes are ignored during installation.** |
|  | **This Optidrive contains high voltage capacitors that take time to discharge after removal of the main supply. Before working on the drive, ensure isolation of the main supply from line inputs. Wait ten (10) minutes for the capacitors to discharge to safe voltage levels. Failure to observe this precaution could result in severe bodily injury or loss of life.** |
|  | **Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.** |

# 1. Important Safety Information

**Please read the IMPORTANT SAFETY INFORMATION below, and all Warning and Caution information elsewhere.**

| | |
|---|---|
|  | **Danger : Indicates a risk of electric shock, which, if not avoided, could result in damage to the equipment and possible injury or death.** |
|  | **Danger : Indicates a potentially hazardous situation other than electrical, which if not avoided, could result in damage to property.** |
|  | The Compact 2 variable speed drive product is intended for professional incorporation into complete equipment or systems as part of a fixed installation. If installed incorrectly it may present a safety hazard. The drive uses high voltages and currents, carries a high level of stored electrical energy, and is used to control mechanical plant that may cause injury. Close attention is required to system design and electrical installation to avoid hazards in either normal operation or in the event of equipment malfunction. Only qualified electricians are allowed to install and maintain this product. |
| | System design, installation, commissioning and maintenance must be carried out only by personnel who have the necessary training and experience. They must carefully read this safety information and the instructions in this Guide and follow all information regarding transport, storage, installation and use of the drive, including the specified environmental limitations. |
| | Do not perform any flash test or voltage withstand test on the drive. Any electrical measurements required should be carried out with the drive disconnected. |
| | Electric shock hazard! Disconnect and ISOLATE the drive before attempting any work on it. High voltages are present at the terminals and within the drive for up to 10 minutes after disconnection of the electrical supply. Always ensure by using a suitable multimeter that no voltage is present on any drive power terminals prior to commencing any work. |
| | Where supply to the drive is through a plug and socket connector, do not disconnect until 10 minutes have elapsed after turning off the supply. |
| | Ensure correct earthing connections. The earth cable must be sufficient to carry the maximum supply fault current which normally will be limited by the fuses or MCB. Suitably rated fuses or MCB should be fitted in the mains supply to the drive, according to any local legislation or codes. |
| | Ensure correct earthing connections and cable selection as per defined by local legislation or codes. The drive may have a leakage current of greater than 3.5mA; furthermore the earth cable must be sufficient to carry the maximum supply fault current which normally will be limited by the fuses or MCB. Suitably rated fuses or MCB should be fitted in the mains supply to the drive, according to any local legislation or codes. |
| | Do not carry out any work on the drive control cables whilst power is applied to the drive or to the external control circuits. |
|  | Within the European Union, all machinery in which this product is used must comply with Directive 2006/42/EC, Safety of Machinery. In particular, the machine manufacturer is responsible for providing a main switch and ensuring the electrical equipment complies with EN60204-1. |
| | The level of integrity offered by the Compact 2 control input functions – for example stop/start, forward/reverse and maximum speed is not sufficient for use in safety-critical applications without independent channels of protection. All applications where malfunction could cause injury or loss of life must be subject to a risk assessment and further protection provided where needed. |
| | The driven motor can start at power up if the enable input signal is present. |
| | The STOP function does not remove potentially lethal high voltages. ISOLATE the drive and wait 10 minutes before starting any work on it. Never carry out any work on the Drive, Motor or Motor cable whilst the input power is still applied. |
| | The drive can be programmed to operate the driven motor at speeds above or below the speed achieved when connecting the motor directly to the mains supply. Obtain confirmation from the manufacturers of the motor and the driven machine about suitability for operation over the intended speed range prior to machine start up. |
| | Do not activate the automatic fault reset function on any systems whereby this may cause a potentially dangerous situation. |
| | The drive must be installed in a pollution degree 2 environment, mounted in a cabinet with IP54 or better. |
| | The Compact 2 is intended for indoor use only. |
| | When mounting the drive, ensure that sufficient cooling is provided. Do not carry out drilling operations with the drive in place, dust and swarf from drilling may lead to damage. |
| | The entry of conductive or flammable foreign bodies should be prevented. Flammable material should not be placed close to the drive |
| | Relative humidity must be less than 95% (non-condensing). |
| | Ensure that the supply voltage, frequency and no. of phases (1 or 3 phase) correspond to the rating of the Compact 2 as delivered. |
| | Never connect the mains power supply to the Output terminals U, V, W. |
| | Do not install any type of automatic switchgear between the drive and the motor |
| | Wherever control cabling is close to power cabling, maintain a minimum separation of 100 mm and arrange crossings at 90 degrees<br>Ensure that all terminals are tightened to the appropriate torque setting |
| | Do not attempt to carry out any repair of the Compact 2. In the case of suspected fault or malfunction, contact your local Invertek Drives Sales Partner for further assistance. |

# 2. Product Overview

## 2.1. General Information

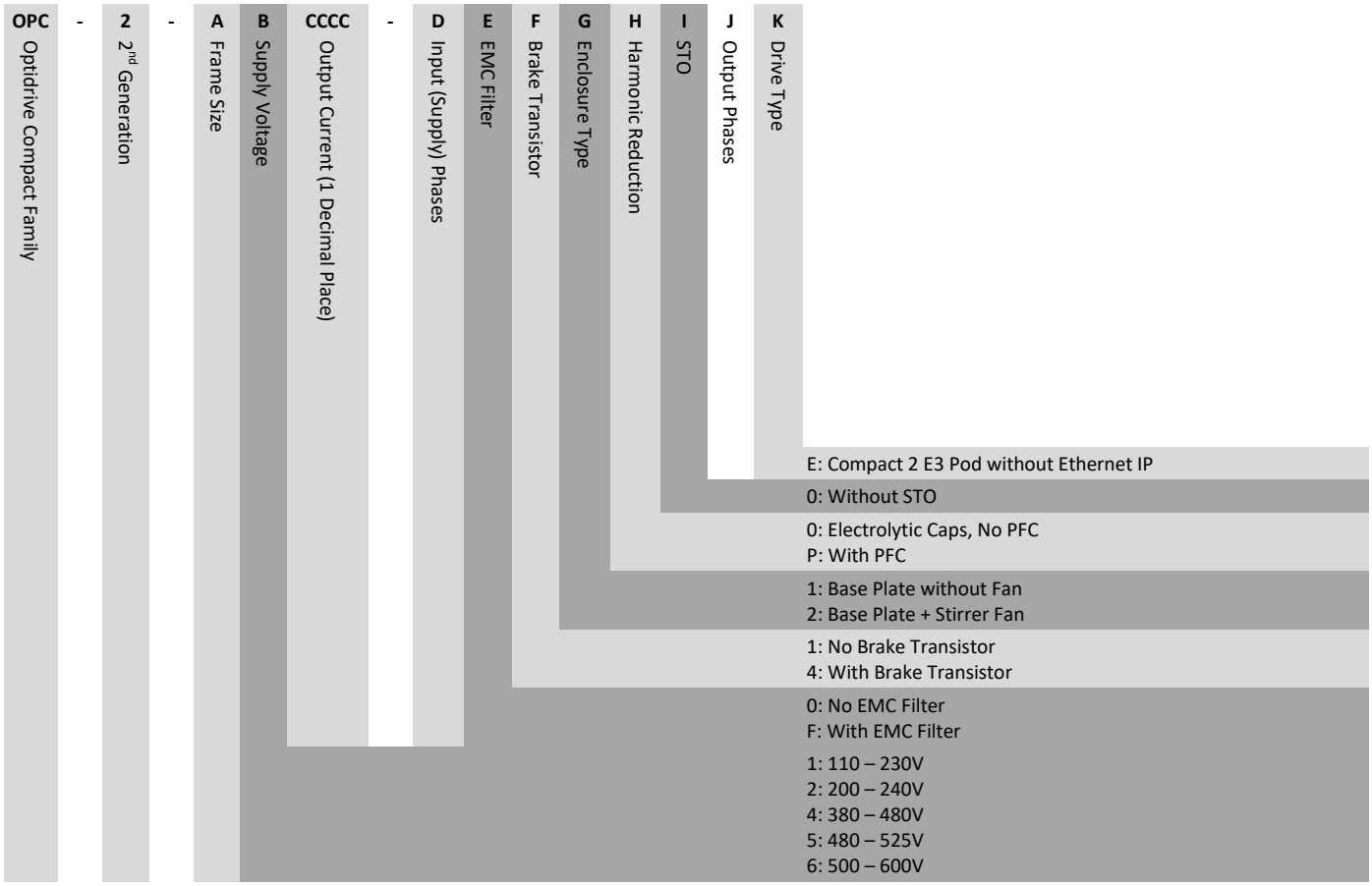
The Optidrive Compact 2 is a dedicated range of products intended for integration directly into a machine design. All units consist of a base Power Module (PM) and Control Module (CM) which, when combined together become a complete drive unit. This construction method provides enhanced flexibility.

In addition, an optional fieldbus interface may be added, allowing direct connection to fieldbus networks.

Power Modules feature a flat base surface, intended to be mounted to a suitable heat conductive surface which can provide heatsink capability. The required cooling must be catered for by the installation.

Control modules feature an interface to allow connection of a remote keypad / display for commissioning purposes, or alternatively a PC interface may be used.

## 2.2. Model Code Definition



## 2.3. Available Models

### 2.3.1. Standard Units

| 110 – 115 + 10% / - 10%, 1 Phase Input, 3 Phase 230V Output (Voltage Doubler) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Output Voltage** | **Output Phases** | **Output Current** | **kW** | **HP** | **Frame Size** | **Brake Transistor** | **Model Code - Filtered** | **Model Code - Unfiltered** |
| 230 | 3 | 2.3A | 0.37 | 0.5 | 1A | No | OPC-2-110023-1F11003E | OPC-2-110023-1011003E |
| 230 | 3 | 4.3A | 0.75 | 1 | 1B | No | OPC-2-110043-1F12003E | OPC-2-110043-1012003E |
| **200 – 240 + 10% / - 10%, 1 Phase Input, 3 Phase Output** | | | | | | | | |
| **Output Voltage** | **Output Phases** | **Output Current** | **kW** | **HP** | **Frame Size** | **Brake Transistor** | **Model Code - Filtered** | **Model Code - Unfiltered** |
| 230 | 3 | 2.3A | 0.37 | 0.5 | 1A | No | OPC-2-120023-1F11003E | OPC-2-120023-1011003E |
| 230 | 3 | 4.3A | 0.75 | 1 | 1A | No | OPC-2-120043-1F11003E | OPC-2-120043-1011003E |
| 230 | 3 | 7.0A | 1.5 | 2 | 1B | No | OPC-2-120070-1F12003E | OPC-2-120070-1012003E |
| **200 – 240 + 10% / - 10%, 3 Phase Input, 3 Phase Output** | | | | | | | | |
| **Output Voltage** | **Output Phases** | **Output Current** | **kW** | **HP** | **Frame Size** | **Brake Transistor** | **Model Code - Filtered** | **Model Code - Unfiltered** |
| 230 | 3 | 2.3A | 0.37 | 0.5 | 1A | No | OPC-2-120023-3F11003E | OPC-2-120023-3011003E |
| 230 | 3 | 4.3A | 0.75 | 1 | 1A | No | OPC-2-120043-3F11003E | OPC-2-120043-3011003E |
| 230 | 3 | 7.0A | 1.5 | 2 | 1B | No | OPC-2-120070-3F12003E | OPC-2-120070-3012003E |
| **380 – 480 + 10% / - 10%, 3 Phase Input, 3 Phase Output** | | | | | | | | |
| **Output Voltage** | **Output Phases** | **Output Current** | **kW** | **HP** | **Frame Size** | **Brake Transistor** | **Model Code - Filtered** | **Model Code - Unfiltered** |
| 400 / 460 | 3 | 2.2A | | | 1A | No | OPC-2-140022-3F11003E | OPC-2-140022-3011003E |
| 400 / 460 | 3 | 4.1A | | | 1A | No | OPC-2-140041-3F11003E | OPC-2-140041-3011003E |
| 400 / 460 | 3 | 4.1A | | | 2 | Yes | OPC-2-240041-3F41003E | OPC-2-240041-3042003E |
| 400 / 460 | 3 | 5.8A | | | 2 | Yes | OPC-2-240058-3F41003E | OPC-2-240058-3042003E |
| 400 / 460 | 3 | 9.5A | | | 2 | Yes | OPC-2-240095-3F41003E | OPC-2-240095-3042003E |

Note: Models which do not have an internal stirrer fan fitted as standard (Frame Size 1A) are optionally available with a stirrer fan if this is required by the application to maintain the temperatures within acceptable limits. In this case, the dimensions including the fan are as Frame Size 1B.

### 2.3.2. Active PFC Units

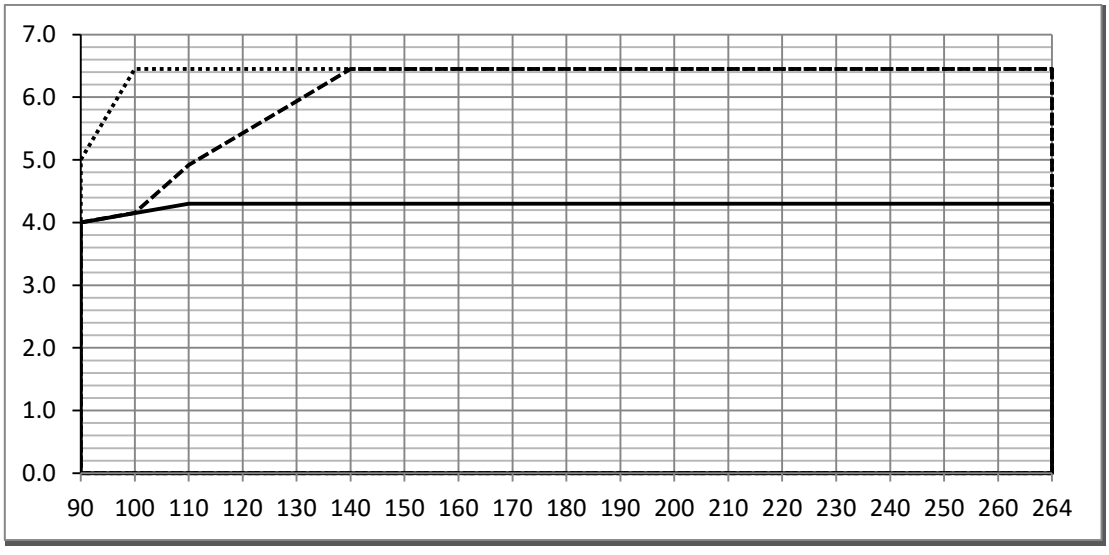
| 110 – 230 + 10% / - 20%, 1 Phase Input, 3 Phase 230V Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Output Voltage** | **Output Phases** | **Output Current** | **kW** | **HP** | **Frame Size** | **Brake** | **EMC Filter** | **Model Code** |
| 230 | 3 | 4.3A | 0.75 | 1 | 1C | No | Yes | OPC-2-110043-1F11P03E |
| **200 – 240 + 10% / - 10%, 1 Phase Input, 3 Phase Output** | | | | | | | | |
| **Output Voltage** | **Output Phases** | **Output Current** | **kW** | **HP** | **Frame Size** | **Brake** | **EMC Filter** | **Model Code** |
| 230 | 3 | 7.0A | 1.5 | 2 | 1C | No | Yes | OPC-2-120070-1F11P03E |

## 2.4. Power Module Output Current Capacity

### 2.4.1. Output Current Capacity Relative to Supply Voltage

***OPC-2-110043-1F11P03#***

This unit can operate with a supply voltage range from 90 – 264VAC.
When the supply voltage is below 110 Volt, continuous output current capacity and available overload current are reduced as shown below.




| | |
|---|---|
| Continuous Output Current Capacity | ——— |
| Permissible Overload at 40Hz Output Frequency for 60 Seconds | – – – – – – – |
| Permissible Overload at 50Hz Output Frequency for 60 Seconds | ····· |

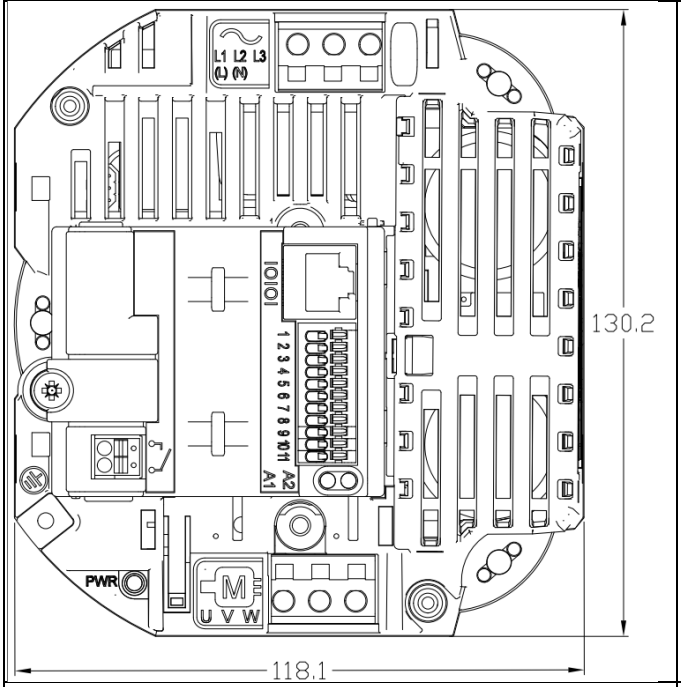
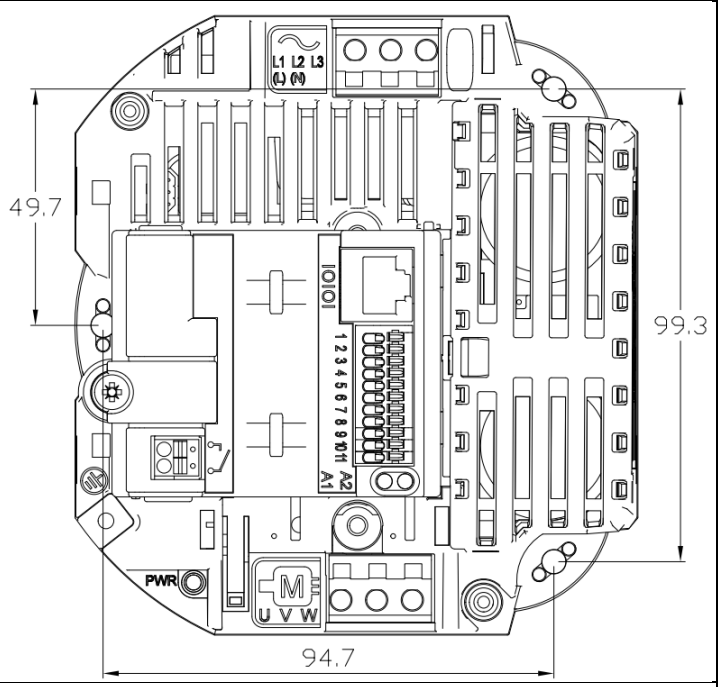
# 3. Mechanical Information and Mounting

## 3.1. General

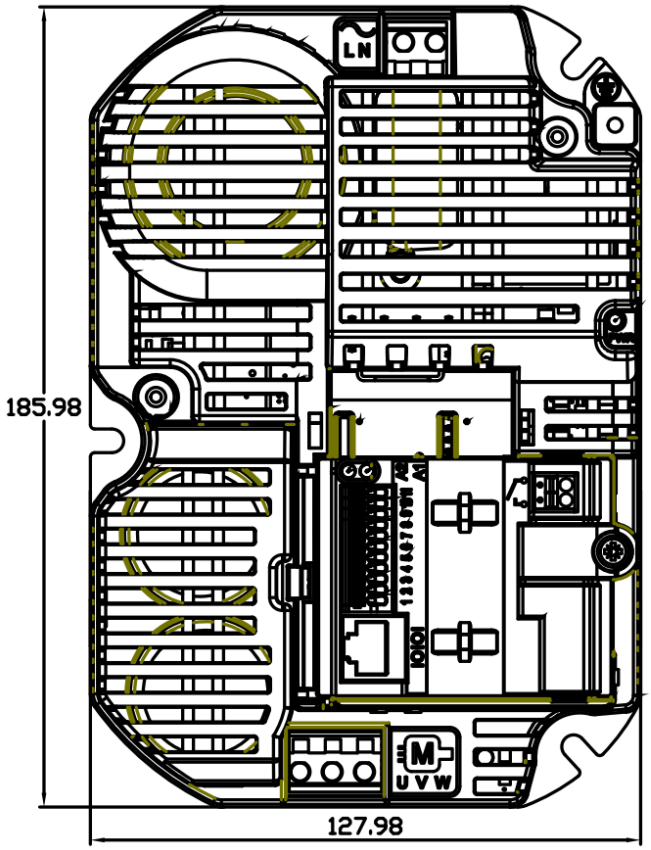
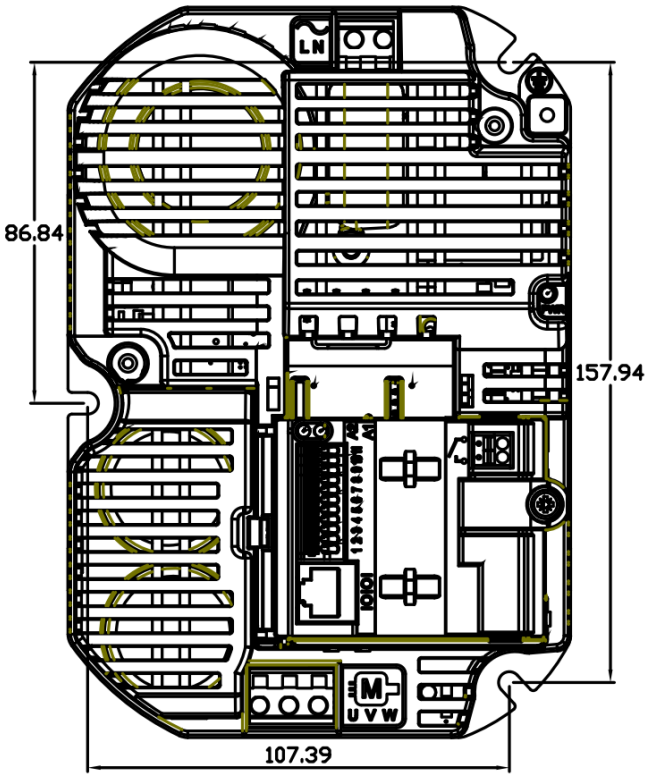
- Compact 2 Power Modules must be mounted onto a suitable flat metallic surface with sufficiently low thermal resistance to allow dissipation of the heat produced.
- Surface flatness must be =<+ / - 0.2mm over the mounting area
- The chosen mounting location must ensure the unit is not subject to vibration levels in excess of the limits specified in section 10.4.1.
- Units should be mounted only using the integral mounting holes.
- The Compact 2 must be installed in a pollution degree 1 or 2 environment only.
- Maximum ambient air temperature allowed around the unit is 50°C.
- Do not mount flammable material close to the Compact 2.
- Ensure that the ambient temperature range around the unit does not exceed the permissible limits for the Compact 2 given in section 10.1.
- Units may be mounted in any orientation.

## 3.2. Mechanical Dimensions and Mounting

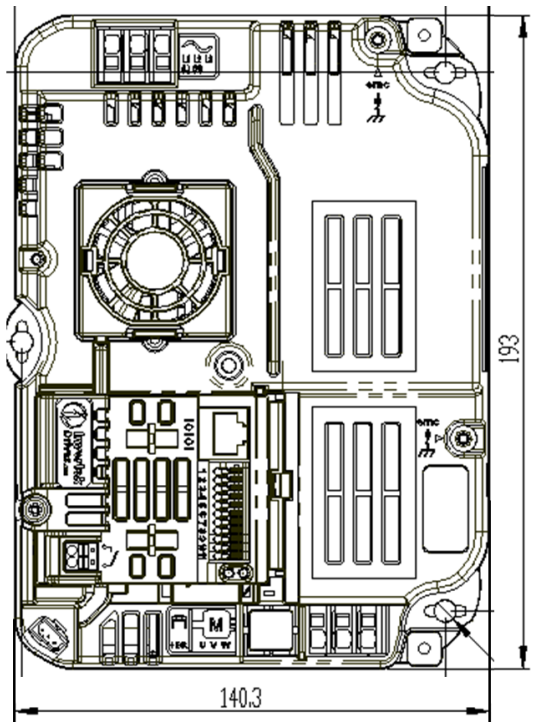
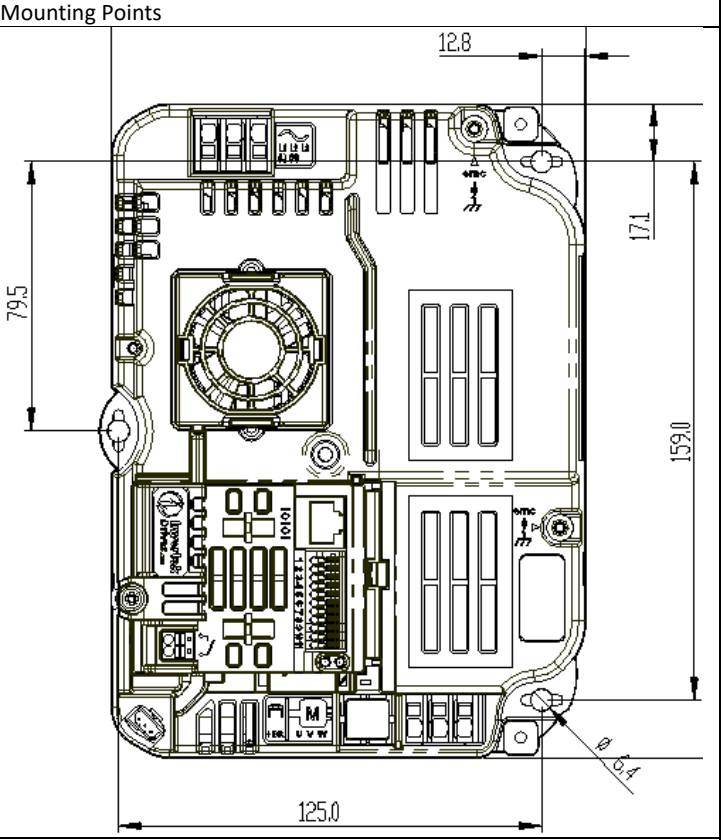
### 3.2.1. Frame Size 1A and 1B– Non PFC Drives

| Overall Dimensions | Mounting Points |
|---|---|
|  |  |
| Depth : Frame Size 1A : 74mm, Frame Size 1B : 85mm | Use 3 x M4 (No. 8) bolts or screws, tightening torque : 4Nm / 3ft-lb |
| **Weight** \| 0.7kg, 1.54lb | |

### 3.2.2. Frame Size 1C –PFC Drives

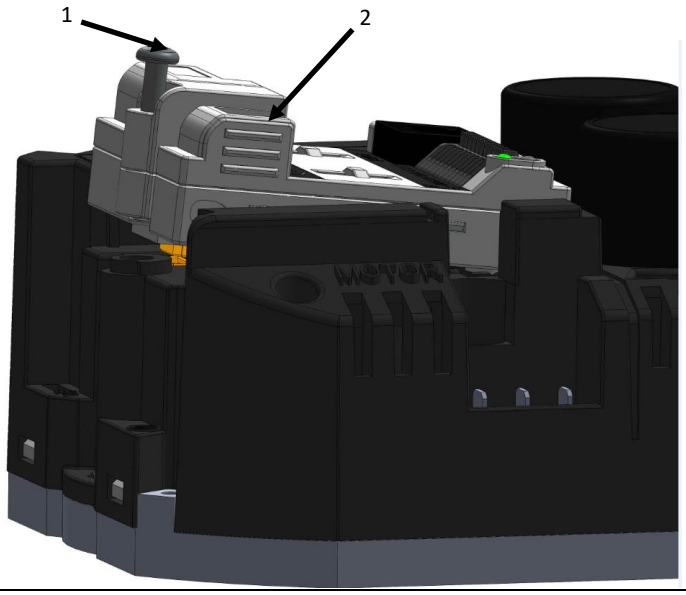
| Overall Dimensions | Mounting Points |
|---|---|
|  |  |
| Depth : | Use 3 x M4 (No. 8) bolts or screws, tightening torque : 4Nm / 3ft-lb |
| **Weight** 0.7kg, 1.54lb | |

### 3.2.3. Frame Size 2

| Overall Dimensions | Mounting Points |
|---|---|
|  |  |
| Depth : 89mm | Use 3 x M4 (No. 8) bolts or screws, tightening torque : 4Nm / 3ft-lb |
| **Weight** | |

## 3.3. Removing/Changing the Control Module.

| Control Module removal. |
|---|
| 1. Fully unscrew the cross head screw.<br>2. Press finger grips and Lift the Control module from the screw side.<br>3. Rotate towards the control terminal side as shown. |




## 3.4. Heatsink Capacity Calculation

Optidrive E3 Compact Units are designed to be mounted to a metallic, heat conducting surface in order to maintain the unit operating temperature. Thermostrate or heatsink compound must be added to ensure optimal heat transfer and minimum thermal resistance.
In order to calculate the necessary heatsink requirement, the following formula can be used. Example values based on typical conditions are given in the table below.

- Determine the maximum ambient air temperature around the heatsink, $T_{AMB}$
- Select the desired PWM operating frequency from the available options in Parameter P-17
- From the table in section 10.9 on page 49 determine the maximum permissible heatsink temperature, $T_{MAX}$
- Determine the maximum allowed Temperature Rise
  - $T_{RISE} = T_{MAX} - T_{AMB}$
- Calculate the motor absorbed electrical power, $P_{MOT}$, based on the motor rated voltage, current and efficiency
  - $P_{MOT} = \sqrt{3} * \text{Rated Voltage} * \text{Rated Current} * \text{Power Factor} * \text{Efficiency}$
- Calculate the losses in the drive, $P_{LOSS}$, based on the required motor power
  - $P_{LOSS} = P_{MOT} * (1 - \text{Drive Efficiency})$
  - Typical drive efficiency values are shown in the table below for each available effective switching frequency
- Calculate the required heatsink maximum thermal resistance $R_{MAX}$
  - $R_{MAX} = T_{RISE} / P_{LOSS}$

## 3.5. Maximum Permissible Heatsink Temperature

The maximum permissible heatsink temperature allowed for the Compact 2E3 drive is linked to the desired effective switching frequency selected by parameter P-17. In order to maintain operation at a certain switching frequency, the heatsink temperature must be maintained below the threshold level shown in the table below. If the temperature exceeds the threshold, the switching frequency will automatically reduce.

| Temperature Threshold | Action |
|---|---|
| 70 $^{O}$C | Auto reduce from 32kHz to 24kHz |
| 75 $^{O}$C | Auto reduce from 24kHz to 16kHz |
| 80 $^{O}$C | Auto reduce from 16kHz to 12kHz |
| 85 $^{O}$C | Auto reduce from 12kHz to 8kHz |
| 90 $^{O}$C | Auto reduce from 8kHz to 4kHz |
| 97 $^{O}$C | Over temperature trip |

## 3.6. Typical Heatsink Requirement

The table below provides typical values for heatsink thermal resistance.

### 3.6.1. Single Phase Input 110 – 115VAC Supply Models

| Base Unit Model Code | Effective Switching Frequency (kHz) | Typical Rated Output Power (W) | Approximate Efficiency | Maximum Heatsink Temperature (°C) | Recommended Maximum Heatsink Thermal Resistance (K/W) |
|---|---|---|---|---|---|
| OPC-2-110023-1#11003E | 4 | 370 | | 95 | |
| | 8 | 370 | | 90 | |
| | 12 | 370 | | 85 | |
| | 16 | 370 | | 80 | |
| | 24 | 370 | | 75 | |
| | 32 | 370 | | 70 | |
| OPC-2-110043-1#11003E | 4 | 750 | | 95 | |
| | 8 | 750 | | 90 | |
| | 12 | 750 | | 85 | |
| | 16 | 750 | | 80 | |
| | 24 | 750 | | 75 | |
| | 32 | 750 | | 70 | |

### 3.6.2. Single Phase Input 200 – 240VAC Supply Models

| Base Unit Model Code | Effective Switching Frequency (kHz) | Typical Rated Output Power (W) | Approximate Efficiency | Maximum Heatsink Temperature (°C) | Recommended Maximum Heatsink Thermal Resistance (K/W) |
|---|---|---|---|---|---|
| OPC-2-120023-1#11003E | 4 | 370 | 96.0% | 95 | 2.5 |
| | 8 | 370 | 95.9% | 90 | 2.2 |
| | 12 | 370 | 95.9% | 85 | 1.9 |
| | 16 | 370 | 95.7% | 80 | 1.6 |
| | 24 | 370 | 95.7% | 75 | 1.3 |
| | 32 | 370 | 95.6% | 70 | 1.0 |
| OPC-2-120043-1#11003E | 4 | 750 | 96.0% | 95 | 1.2 |
| | 8 | 750 | 95.9% | 90 | 1.0 |
| | 12 | 750 | 95.9% | 85 | 0.9 |
| | 16 | 750 | 95.7% | 80 | 0.7 |
| | 24 | 750 | 95.7% | 75 | 0.6 |
| | 32 | 750 | 95.6% | 70 | 0.5 |
| OPC-2-120070-1#12003E | 4 | 1500 | | 95 | |
| | 8 | 1500 | | 90 | |
| | 12 | 1500 | | 85 | |
| | 16 | 1500 | | 80 | |
| | 24 | 1500 | | 75 | |
| | 32 | 1500 | | 70 | |

### 3.6.3. Three Phase Input 200 – 240VAC Supply Models

| Base Unit Model Code | Effective Switching Frequency (kHz) | Typical Rated Output Power (W) | Approximate Efficiency | Maximum Heatsink Temperature (°C) | Recommended Maximum Heatsink Thermal Resistance (K/W) |
|---|---|---|---|---|---|
| OPC-2-120023-3#11003E | 4 | 370 | | 95 | |
| | 8 | 370 | | 90 | |
| | 12 | 370 | | 85 | |
| | 16 | 370 | | 80 | |
| | 24 | 370 | | 75 | |
| | 32 | 370 | | 70 | |
| OPC-2-120043-3#11003E | 4 | 750 | | 95 | |
| | 8 | 750 | | 90 | |
| | 12 | 750 | | 85 | |
| | 16 | 750 | | 80 | |
| | 24 | 750 | | 75 | |
| | 32 | 750 | | 70 | |

**Three Phase Input 380 – 480VAC Supply Models**

| Base Unit Model Code | Effective Switching Frequency (kHz) | Typical Rated Output Power (W) | Approximate Efficiency | Maximum Heatsink Temperature (°C) | Recommended Maximum Heatsink Thermal Resistance (K/W) |
|---|---|---|---|---|---|
| OPC-2-140022-3#10003e | 4 | 750 | 97.7% | 95 | 2.3 |
| | 8 | 750 | 97.3% | 90 | 1.7 |
| | 12 | 750 | 96.8% | 85 | 1.3 |
| | 16 | 750 | 97.0% | 80 | 1.2 |
| | 24 | 750 | 96.5% | 75 | 0.8 |
| | 32 | 750 | 96.0% | 70 | 0.6 |
| OPC-2-140041-3#10003E | 4 | 1500 | 97.7% | 95 | 1.1 |
| | 8 | 1500 | 97.3% | 90 | 0.8 |
| | 12 | 1500 | 96.8% | 85 | 0.6 |
| | 16 | 1500 | 97.0% | 80 | 0.6 |
| | 24 | 1500 | 96.5% | 75 | 0.4 |
| | 32 | 1500 | 96.0% | 70 | 0.3 |
| OPC-2-240058-3#10003E | 4 | 2200 | 97.6% | 95 | 0.64 |
| | 8 | 2200 | 97.2% | 90 | 0.49 |
| | 12 | 2200 | 96.8% | 85 | 0.37 |
| | 16 | 2200 | 96.4% | 80 | 0.28 |
| | 24 | 2200 | 95.4% | 75 | 0.18 |
| OPC-2-240095-3#10003E | 4 | 4000 | 97.3% | 95 | 0.33 |
| | 8 | 4000 | 96.9% | 90 | 0.26 |
| | 12 | 4000 | 96.5% | 85 | 0.20 |
| | 16 | 4000 | 96.0% | 80 | 0.15 |
| | 24 | 4000 | 94.9% | 75 | 0.10 |

### 3.6.5. Single Phase Input 110 – 230VAC Supply PFC Model

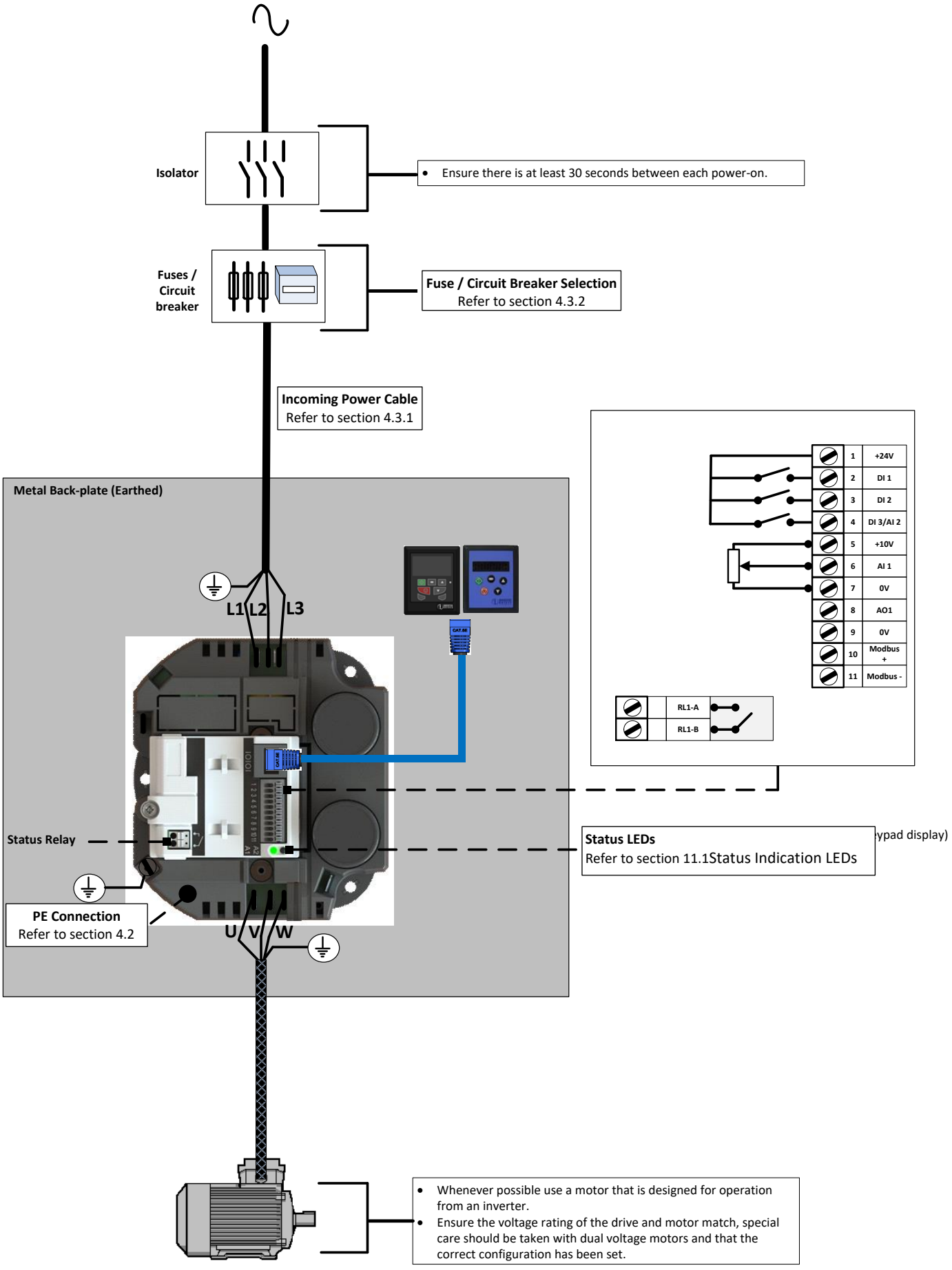
| Base Unit Model Code | Effective Switching Frequency (kHz) | Typical Rated Output Power (W) | Approximate Efficiency | Maximum Heatsink Temperature (°C) | Recommended Maximum Heatsink Thermal Resistance (K/W) |
|---|---|---|---|---|---|
| OPC-2-110043-1F11P03E | 4 | 750 | 95.0% | 95 | 0.9 |
| | 8 | 750 | 94.7% | 90 | 0.8 |
| | 12 | 750 | 94.4% | 85 | 0.6 |
| | 16 | 750 | 94.1% | 80 | 0.5 |
| | 24 | 750 | 93.4% | 75 | 0.4 |
| | 32 | 750 | 92.0% | 70 | 0.3 |

### 3.6.6. Single Phase Input 200 – 240VAC Supply Models

| Base Unit Model Code | Effective Switching Frequency (kHz) | Typical Rated Output Power (W) | Approximate Efficiency | Maximum Heatsink Temperature (°C) | Recommended Maximum Heatsink Thermal Resistance (K/W) |
|---|---|---|---|---|---|
| OPC-2-120070-1F11P03E | 4 | 1500 | 95.0% | 95 | 0.4 |
| | 8 | 1500 | 94.7% | 90 | 0.4 |
| | 12 | 1500 | 94.4% | 85 | 0.3 |
| | 16 | 1500 | 94.1% | 80 | 0.2 |
| | 24 | 1500 | 93.4% | 75 | 0.2 |
| | 32 | 1500 | 92.0% | 70 | 0.1 |

# 4. Electrical Power Wiring and Installation

## 4.1. Connection Diagram



## 4.2. Protective Earth (PE) Connection

### Grounding Guidelines

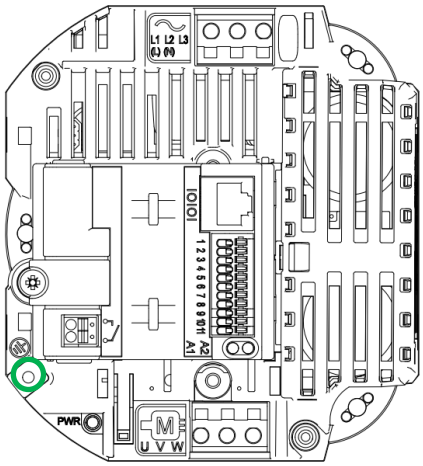
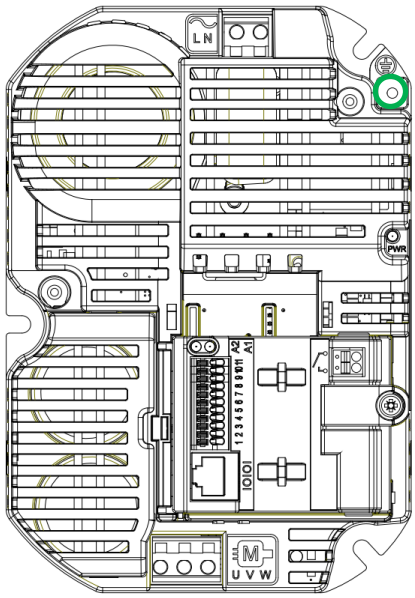
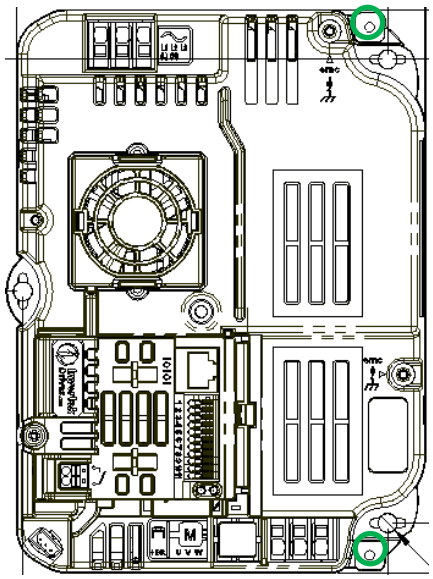
- The ground terminal of each Optidrive should be individually connected DIRECTLY to the site ground bus bar (through the filter if installed). Optidrive ground connections should not loop from one drive to another, or to, or from any other equipment.
- Ground loop impedance must confirm to local industrial safety regulations.
- To meet UL regulations, UL approved ring crimp terminals should be used for all ground wiring connections.
- The drive Safety Ground must be connected to system ground.
- Ground impedance must conform to the requirements of national and local industrial safety regulations and/or electrical codes.
- The integrity of all ground connections should be checked periodically.

### Protective Earth Conductor

- The Cross sectional area of the PE Conductor must be at least equal to that of the incoming supply conductor.

### PE Connection

The PE connection must be directly connected to ground. PE connection locations for each model are highlighted below.

| Frame Size 1A and 1B | Frame Size 1C | Frame Size 2 |
|---|---|---|
|  |  |  |

### Safety Ground

This is the safety ground for the drive that is required by code. One of these points must be connected to adjacent building steel (girder, joist), a floor ground rod, or bus bar. Grounding points must comply with national and local industrial safety regulations and/or electrical codes.

### Motor Ground

The motor ground must be connected to one of the ground terminals on the drive.

### Ground Fault Monitoring

As with all inverters, a leakage current to earth can exist. The Optidrive is designed to produce the minimum possible leakage current whilst complying with worldwide standards. The level of current is affected by motor cable length and type, the effective switching frequency, the earth connections used and the type of RFI filter installed. If an ELCB (Earth Leakage Circuit Breaker) is to be used, the following conditions apply: -

- A Type B Device must be used
- The device must be suitable for protecting equipment with a DC component in the leakage current
- Individual ELCBs should be used for each Optidrive

### *Shield Termination (Cable Screen)*

The safety ground terminal provides a grounding point for the motor cable shield. The motor cable shield connected to this terminal (drive end) should also be connected to the motor frame (motor end). Use a shield terminating or EMI clamp to connect the shield to the safety ground terminal.

## 4.3. Incoming Power Connection

Optidrive Compact Drive models are Over Voltage Category III according to EN60664-1:2007. Auxiliary circuits must be Over Voltage category II.

### 4.3.1. Cable Selection

- For 1 phase supply, the mains power cables should be connected to L1/L, L2/N.
- For 3 phase supplies, the mains power cables should be connected to L1, L2, and L3. Phase sequence is not important.
- The cables should be dimensioned according to any local codes or regulations. Maximum dimensions are given in section 10.10 Electrical Rating Tables on page 49.
- The cable must be sufficient to carry the drive load current. Refer to section10.10 Electrical Rating Tables on page 49.
- For compliance with CE and C Tick EMC requirements, refer to section 4.6 EMC Compliant Installation on page 15.
- A fixed installation is required according to IEC61800-5-1 with a suitable disconnecting device installed between the Optidrive and the AC Power Source. The disconnecting device must conform to the local safety code / regulations (e.g. within Europe, EN60204-1, Safety of machinery).
- For UL compliant installation, cables must be rated for continuous conductor temperature of 75°C, copper only.

**Fuse / Circuit Breaker Selection**

- Suitable fuses to provide wiring protection of the input power cable should be installed in the incoming supply line, according to the data in section 10.10 Electrical Rating Tables on page 49. The fuses must comply with any local codes or regulations in place. In general, type gG (IEC 60269) or UL type J fuses are suitable; however in some cases type aR fuses may be required. The operating time of the fuses must be below 0.5 seconds.
- Where allowed by local regulations, suitably dimensioned type B MCB circuit breakers of equivalent rating may be utilised in place of fuses, providing that the clearing capacity is sufficient for the installation.
- The maximum permissible short circuit current at the Optidrive Power terminals as defined in IEC60439-1 is 5kA.

### 4.3.3. Optional Input Choke

- An optional Input Choke is recommended to be installed in the supply line for drives where any of the following conditions occur:-
  - The incoming supply impedance is low or the fault level / short circuit current is high
  - The supply is prone to dips or brown outs
  - An imbalance exists on the supply (3 phase drives)
  - The power supply to the drive is via a busbar and brush gear system (typically overhead Cranes).
- In all other installations, an input choke is recommended to ensure protection of the drive against power supply faults. Part numbers are shown in the table.

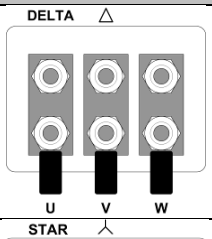
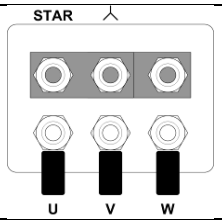
| Supply | Frame Size | AC Input Inductor |
|---|---|---|
| 230 Volt, 1 Phase | 1 | OPT-2-L1016-20 |
| 400 Volt, 3 Phase | 1 | OPT-2-L3006-20 |
| | 2 | OPT-2-L3010-20 |

## 4.4. Motor Connection

- The drive inherently produces fast switching of the output voltage (PWM) to the motor compared to the mains supply, for motors which have been wound for operation with a variable speed drive then there is no preventative measures required, however if the quality of insulation is unknown then the motor manufacturer should be consulted and preventative measures may be required.
- The motor should be connected to the Optidrive U, V, and W terminals using a suitable 3 or 4 core cable. Where a 3 core cable is utilised, with the shield operating as an earth conductor, the shield must have a cross sectional area at least equal to the phase conductors when they are made from the same material. Where a 4 core cable is utilised, the earth conductor must be of at least equal cross sectional area and manufactured from the same material as the phase conductors.
- The motor earth must be connected to one of the Optidrive earth terminals.

## 4.5. Motor Terminal Box Connections

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

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

## 4.6. 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 / 1M[7] |
| C2 | Shielded[2] | Shielded[1, 5] | | 3M / 3M[7] |
| C3 | Unshielded[3] | Shielded[2] | | 10M / 10M[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 analog 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 are 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.

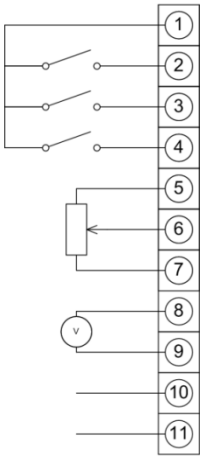
# 5. Control Wiring

## 5.1. Control Terminal Wiring

- All analog signals should be connected using suitably shielded, twisted pair cables.
- Power and Control Signal cables should be routed separately where possible, and must not be routed parallel to each other.
- Signal levels of different voltages e.g. 24 Volt DC and 110 Volt AC, should not be routed in the same cable.
- Control Cable entries accept a single conductor, maximum size: 0.05 – 0.5mm$^2$ / 20 – 26 AWG.

## 5.2. Control Terminal Connections

**Default Connections**




| Control Terminal | Signal | Description | |
|---|---|---|---|
| 1 | +24V User Output, | +24V, 100mA. | |
| 2 | Digital Input 1 | Positive logic<br>“Logic 1” input voltage range: 8V … 30V DC<br>“Logic 0” input voltage range: 0V … 4V DC | |
| 3 | Digital Input 2 | | |
| 4 | Digital Input 3 / Analog Input 2 | Digital: Logic 1 = 8 to 30V<br>Analog: 0 to 10V, 0 to 20mA or 4 to 20mA | |
| 5 | +10V User Output | +10V, 10mA, 1kΩ minimum | |
| 6 | Analog Input 1 / Digital Input 4 | Analog: 0 to 10V, 0 to 20mA or 4 to 20mA<br>Digital: 8 to 30V | |
| 7 | 0V | 0 Volt Common, internally connected to terminal 9 | |
| 8 | Analog Output / Digital Output | Analog: 0 to 10V,<br>Digital: 0 to 24V | 20mA maximum |
| 9 | 0V | 0 Volt Common, internally connected to terminal 7 | |
| 10 | Modbus RTU - | | |
| 11 | Modbus RTU + | | |
| | | | |
| RL1-A | Relay Common | | |
| RL1-B | Relay NO Contact | Contact 250Vac, 6A / 30Vdc, 5A | |

## 5.3. Analog Output

The analog output function may be configured using parameter P-25, which is described in section 6.4.2 Extended parameters on page 20.
The output has two operating modes, dependent on the parameter selection.

- Analog Mode
  - The output is a 0 – 10 volt DC signal, 20mA max load current
- Digital Mode
  - The output is 24 volt DC, 20mA max load current

## 5.4. Relay Output

The relay output function may be configured using parameter P-18, which is described in section 6.4.2 Extended parameters on page 20.

## 5.5. Analog Inputs

Two analog inputs are available, which may also be used as Digital Inputs if required. The signal formats are selected by parameters as follows

- Analog Input 1 Format Selection Parameter P-16
- Analog Input 2 Format Selection Parameter P-47

These parameters are described more fully in section 6.4.2 Extended parameters on page 20.
The function of the analog input, e.g. for speed reference or PID feedback for example is defined by parameters P-12 and P-15. The function of these parameters and available options are described in section 7.3 Macro Function Guide on page 27.

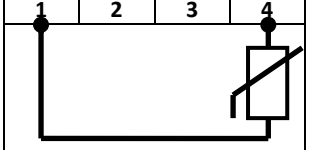
## 5.6. Digital Inputs

Up to four digital inputs are available. The function of each input is defined by parameters P-12 and P-15, which are explained in section 7.3 Macro Function Guide on page 27.

## 5.7. Motor Thermistor Connection

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

Control Terminal Strip




Additional Information

- Compatible Thermistor : PTC Type
- Trip Level: >=2.5kΩ
- Reset Level: =<1.9 kΩ
- The thermistor input is monitored at all times, except during Fire Mode operation. The drive may trip even if it is disabled.
- Use suitable settings of P-12 and P-15 which have Input 3 function as External Trip, e.g. P-12 = 0, P-15 = 3. Refer to section 7 for further information.
- Set P-47 = “PtC-tH". If this setting is not used, the drive will display “E-trp” only if the thermistor exceeds the threshold level during operation.

## 5.8. Internal Thermal Overload Protection

The drive has an in-built motor thermal overload function; this is in the form of an “I.t-trP” trip after delivering >100% of the value set in P-08 for a sustained period of time (e.g. 150% for 60 seconds).

# 6. Parameter Set Overview

## 6.1. About this section

This document provides a list of the available parameters, and a description of their respective functions, for the Optidrive Compact. Access to the parameters requires one of the following

- Optiport LED Remote Keypad
- Optipad OLED Remote Keypad
- Optitools Studio PC Software

## 6.2. Parameter Structure Overview and Access

The parameter set is arranged in Groups according to the following structure

| Parameter Group | Range | Access Level | Access Type |
|---|---|---|---|
| P00 | P00-01 to P00-20 | Extended | Read Only |
| | P00-21 to P00-50 | Advanced | Read Only |
| Basic Parameters | P-01 to P-14 | Basic | Read / Write |
| Extended Parameters | P-15 to P-50 | Extended | Read / Write |
| Advanced Parameters | P-51 to P-60 | Advanced | Read / Write |

Access to all parameter groups is controlled by setting P-14 as follows
P-14 = P-37 (Factory setting: 101) Allows Extended Parameter Access
P-14 = P-37 + 100 (Factory Setting: 201) Allows Advanced Parameter Access

In order to prevent possible damage to the drive and connected machinery, certain parameters are locked during operation of the drive to prevent change. In the case that the drive is enabled, and the user tries to change the parameter, an “L” is shown on the left of the display.

## 6.3. Additional Information

### 6.3.1. Speed Related Parameters – Working With Hz or RPM

Optidrive Compact provides the user the option to work with all speed related parameters in Hz or RPM.

- If Parameter P-10 (Motor Rated Speed) = 0, all speed related parameters are set in Hz.
- If P-10 > 0
  - Slip Compensation is automatically enabled
  - All speed related parameters are converted to RPM values
  - Maximum speed at motor rated frequency is automatically corrected to match the synchronous operating speed of the motor
  - E.g.
    - If P-01 (Maximum Output Frequency) = 50Hz
    - P-09 (Motor Rated Frequency) = 50Hz
    - The user then adjusts P-10 (Motor Rated Speed) = 1450RPM
    - The drive firmware will automatically apply slip frequency compensation, and P-01 value will automatically be adjusted to 1500RPM

The following parameters will use RPM whenever P-10 > 0.

- P-01
- P-02
- P-20
- P-21
- P-22
- P-26
- P-27
- P-29
- P-58

In addition, P-40 (Display Scaling Source) will also use RPM.

## 6.4. Parameter Descriptions

### 6.4.1. Basic Parameters

| Par. | Description | Minimum | Maximum | Default | Units |
|---|---|---|---|---|---|
| **P-01** | **Maximum Frequency / Speed Limit** | P-02 | 500.0 | 50.0 (60.0) | Hz / RPM |
| | Maximum output frequency or motor speed limit set in Hz or RPM.<br>The maximum possible value is limited by the lower of the following :-<br>- 500.0Hz maximum limit<br>- If P-10 >0, (500 x 120) / Motor Poles RPM<br>- P-17 / 16 Hz<br>**Note**<br>When P-10>0, slip compensation is automatically enabled, and P-01 is corrected to the synchronous speed of the motor. | | | | |
| **P-02** | **Minimum Frequency / Speed Limit** | 0.0 | P-01 | 0.0 | Hz / RPM |
| | Minimum speed limit – Hz or RPM. If P-10 >0, the value entered / displayed is in RPM | | | | |
| **P-03** | **Acceleration Ramp Time** | 0.0 | 6000.0 | 5.0 | s |
| | Acceleration ramp time from zero Hz / RPM to base frequency (P-09) in seconds. | | | | |
| **P-04** | **Deceleration Ramp Time** | 0.0 | 6000.0 | 5.0 | s |
| | Deceleration ramp time from base frequency (P-09) to standstill in seconds. When set to 0.0, the value of P-24 is used. | | | | |
| **P-05** | **Index 1: Stopping Mode** | 0 | 2 | 0 | - |
| | **Setting** / **Description**<br>**0** Ramp to Stop<br>**1** Coast to Stop<br>**2** AC Flux Braking | | | | |
| | **Index 2: Mains Loss Reaction** | 0 | 2 | 0 | - |
| | **Setting** / **Description**<br>**0** Mains Loss Ride Through. Continue running by reducing the speed of the load to recover energy.<br>**1** Coast to Stop<br>**2** Fast Ramp To Stop using the P-24 decel ramp | | | | |
| **P-06** | **Energy Optimisation** | 0 | 1 | 0 | - |
| | Enables / Disables the Energy Optimisation functions of the Optidrive E3 as follows.<br>Motor Energy Optimisation: Reduces energy losses in the motor under part load conditions by reducing motor flux. This function should not be used in applications which have large sudden load step changes, or for PI control applications, as it may cause instability in the control or over current trip.<br>Optidrive Energy Optimiser: Reduces the energy losses in the drive at higher output frequencies by reducing switching losses. This may lead to vibration or instability in the motor under light load conditions.<br>**Setting** / **Motor Energy Optimiser** / **Drive Energy Optimiser**<br>**0** **Disabled** **Disabled**<br>**1** **Enabled** **Disabled**<br>**3** **Disabled** **Enabled**<br>**4** **Enabled** **Enabled** | | | | |
| **P-07** | **Motor Rated Voltage / Back EMF at rated speed (PM / BLDC)** | 0 | 250 / 500 | 230 / 400 | V |
| | For Induction Motors, this parameter should be set to the rated (nameplate) voltage of the motor (Volts).<br>For Permanent Magnet or Brushless DC Motors, it should be set to the Back EMF at rated speed. | | | | |
| **P-08** | **Motor Rated Current** | Drive Rating Dependent | | | A |
| | This parameter should be set to the rated (nameplate) current of the motor. This parameter cannot be adjusted greater than the continuous current rating of the drive.<br>When the motor nameplate value is entered, thermal overload protection is enabled, as described in section 10.7.4 | | | | |
| **P-09** | **Motor Rated Frequency** | 10 | 500 | 50 (60) | Hz |
| | This parameter should be set to the rated (nameplate) frequency of the motor | | | | |
| **P-10** | **Motor Rated Speed** | 0 | 30000 | 0 | RPM |
| | This parameter can optionally be set to the rated (nameplate) RPM of the motor. When set to the default value of zero, all speed related parameters are displayed in Hz, and the slip compensation for the motor is disabled. Entering the value from the motor nameplate enables the slip compensation function, and the Optidrive display will now show motor speed in estimated RPM. All speed related parameters, such as Minimum and Maximum Speed, Preset Speeds etc. will also be displayed in RPM.<br>**Note** If P-09 value is changed, P-10 value is reset to 0. | | | | |

| Par. | Description | Minimum | Maximum | Default | Units |
|---|---|---|---|---|---|
| P-11 | **Low Frequency Torque Boost Current** | 0.0 | 25.0 | 3.0 | % |

Low Frequency Torque Boost is used to increase the applied motor voltage and hence current at low output frequencies. This can improve low speed and starting torque. Increasing the boost level will increase motor current at low speed, which may result in the motor temperature rising - force ventilation of the motor may then be required. In general, the lower the motor power, the higher the boost setting that may be safely used.
For IM motors, when P-51 = 0 1 or 1, a suitable setting can usually be found by operating the motor under very low or no load conditions at approximately 5Hz, and adjusting P-11 until the motor current is approximately the magnetising current (if known) or in the range shown below.
Frame Size 1 : 60 – 80% of motor rated current
Frame Size 2 : 50 – 60% of motor rated current
Frame Size 3 : 40 – 50% of motor rated current
Frame Size 4 : 35 – 45% of motor rated current
This parameter is also effective when using alternative motor types, P-51 = 2, 3 or 4. In this case, the boost current level is defined as 4*P-11*P-08

| P-12 | **Primary Command Source** | 0 | 6 | 0 | - |
|---|---|---|---|---|---|

| Setting | Function | Description |
|---|---|---|
| **0** | **Terminal Control** | The drive responds directly to signals applied to the control terminals. |
| **1** | **Uni-directional Keypad Control** | The drive can be controlled in the forward direction only using an external or remote Keypad |
| **2** | **Bi-directional Keypad Control** | The drive can be controlled in the forward and reverse directions using an external or remote Keypad. Pressing the keypad START button toggles between forward and reverse. |
| **3** | **Modbus Network Control** | Control via Modbus RTU (RS485) using the internal Accel / Decel ramps |
| **4** | **Modbus Network Control** | Control via Modbus RTU (RS485) interface with Accel / Decel ramps updated via Modbus |
| **5** | **PI Control** | User PI control with external feedback signal |
| **6** | **PI Analog Summation Control** | PI control with external feedback signal and summation with analog input 1 |
| **7** | **CAN open Control** | Control via CAN (RS485) using the internal Accel / Decel ramps |
| **8** | **CAN open Control** | Control via CAN (RS485) interface with Accel / Decel ramps updated via CAN |
| **9** | **Slave Mode** | Control via a connected Invertek drive in Master Mode. Slave drive address must be > 1. |

**NOTE** When P-12 = 1, 2, 3, 4, 7, 8 or 9, an enable signal must still be provided at the control terminals, digital input 1

| P-13 | **Operating Mode Select** | 0 | 2 | 0 | - |
|---|---|---|---|---|---|

| Setting | Function | Description |
|---|---|---|
| **0** | **General Purpose** | Intended for most standard applications, parameters are configured for constant torque operation with 150% overload allowed for 60 seconds, spin start is disabled. |
| **1** | **Pump Mode** | Intended for pump applications, parameters are configured for variable torque operation with 110% overload allowed for 60 seconds, spin start is disabled. |
| **2** | **Fan Mode** | Intended for Fan applications, parameters are configured for variable torque operation with 110% overload allowed for 60 seconds, spin start is enabled. |

| P-14 | **Extended Menu Access code** | 0 | 65535 | 0 | - |
|---|---|---|---|---|---|

Enables access to Extended and Advanced Parameter Groups. This parameter must be set to the value programmed in P-37 (default: 101) to view and adjust Extended Parameters and value of P-37 + 100 to view and adjust Advanced Parameters. The code may be changed by the user in P-37 if desired.

### 6.4.2. Extended parameters

| Par. | Description | Minimum | Maximum | Default | Units |
|---|---|---|---|---|---|
| P-15 | **Digital Input Function Select** | 0 | 18 | 0 | - |
| | Defines the function of the digital inputs depending on the control mode setting in P-12. See section 7 Control Terminal Connections for more information. | | | | |
| P-16 | **Analog Input 1 Signal Format** | See Below | | U0-10 | - |

| Setting | Function | Description |
|---|---|---|
| U 0- 10 | 0 to 10V Uni-direction | The drive will remain at P-01 if the analog reference after scaling and offset are applied is =<0.0% |
| b 0- 10 | 0 to 10V bi-directional | The drive will operate the motor in the reverse direction of rotation if the analog reference after scaling and offset are applied is <0.0% |
| A 0-20 | 0 to 20mA | |
| t 4-20 | 4 to 20mA | The drive will trip and show the fault code 4-20F if the signal level falls below 3mA |
| r 4-20 | 4 to 20mA | The drive will run at Preset Speed 1 (P-20) if the signal level falls below 3mA |
| t 20-4 | 20 to 4mA | The drive will trip and show the fault code 4-20F if the signal level falls below 3mA |
| r 20-4 | 20 to 4mA | The drive will run at Preset Speed 1 (P-20) if the signal level falls below 3mA |
| U 10-0 | 10 to 0V | The drive will operate at Maximum Frequency / Speed if the analog reference after scaling and offset are applied is =<0.0% |

| | | | | | |
|---|---|---|---|---|---|
| P-17 | **Maximum Effective Switching Frequency** | 4 | 32 | 8 | kHz |
| | Sets maximum effective switching frequency of the drive. If "rEd" is displayed, the switching frequency has been reduced to the level in P00-32 due to excessive drive heatsink temperature. | | | | |
| P-18 | **Output Relay Function Select** | 0 | 9 | 1 | - |
| | Selects the function assigned to the relay output. The relay has two output terminals, Logic 1 indicates the relay is active, and therefore terminals 10 and 11 will be connected. | | | | |

| Setting | Function | Logic 1 when |
|---|---|---|
| 0 | **Drive Enabled (Running)** | The motor is enabled |
| 1 | **Drive Healthy** | Power is applied to the drive and no fault exists |
| 2 | **At Target Frequency (Speed)** | The output frequency matches the setpoint frequency |
| 3 | **Drive Tripped** | The drive is in a fault condition |
| 4 | **Output Frequency >= Limit** | The output frequency exceeds the adjustable limit set in P-19 |
| 5 | **Output Current >= Limit** | The motor current exceeds the adjustable limit set in P-19 |
| 6 | **Output Frequency < Limit** | The output frequency is below the adjustable limit set in P-19 |
| 7 | **Output Current < Limit** | The motor current is below the adjustable limit set in P-19 |
| 8 | **Analog Input 2 > Limit** | The signal applied to analog input 2 exceeds the adjustable limit set in P-19 |
| 9 | **Drive Ready to Run** | The drive is ready to run, no trip present. |

| | | | | | |
|---|---|---|---|---|---|
| P-19 | **Relay Threshold Level** | 0.0 | 200.0 | 100.0 | % |
| | Adjustable threshold level used in conjunction with settings 4 to 7 of P-18 | | | | |
| P-20 | **Preset Frequency / Speed 1** | P-02 | P-01 | 5.0 | Hz / RPM |
| P-21 | **Preset Frequency / Speed 2** | P-02 | P-01 | 25.0 | Hz / RPM |
| P-22 | **Preset Frequency / Speed 3** | P-02 | P-01 | 40.0 | Hz / RPM |
| P-23 | **Preset Frequency / Speed 4** | P-02 | P-01 | P-09 | Hz / RPM |
| | Preset Speeds / Frequencies selected by digital inputs depending on the setting of P-15<br>If P-10 = 0, the values are entered as Hz. If P-10 > 0, the values are entered as RPM.<br>**Note** Changing the value of P-09 will reset all values to factory default settings | | | | |
| P-24 | **2nd Deceleration Ramp Time (Fast Stop)** | 0.00 | 6000.0 | 0.0 | s |
| | This parameter allows an alternative deceleration ramp down time to be programmed into the Optidrive, which can be selected by digital inputs (dependent on the setting of P-15) or selected automatically in the case of a mains power loss if P-05 = 2 or 3.<br>When set to 0.00, the drive will coast to stop. | | | | |
| P-25 | **Analog Output Function Select** | 0 | 11 | 8 | - |

**Digital Output Mode. Logic 1 = +24V DC**

| Setting | Function | Logic 1 when… |
|---|---|---|
| 0 | **Drive Enabled (Running)** | The Optidrive is enabled (Running) |
| 1 | **Drive Healthy** | No Fault condition exists on the drive |
| 2 | **At Target Frequency (Speed)** | The drive is in a fault condition |
| 3 | **Drive Tripped** | |
| 4 | **Output Frequency >= Limit** | The output frequency exceeds the adjustable limit set in P-19 |
| 5 | **Output Current >= Limit** | The motor current exceeds the adjustable limit set in P-19 |
| 6 | **Output Frequency < Limit** | The output frequency is below the adjustable limit set in P-19 |
| 7 | **Output Current < Limit** | The motor current is below the adjustable limit set in P-19 |

**Analog Output Mode**

| Setting | Description | Range |
|---|---|---|
| 8 | **Output Frequency (Motor Speed)** | 0 to P-01, resolution 0.1Hz |
| 9 | **Output (Motor) Current** | 0 to 200.0% of P-08, updated every 256ms |
| 10 | **Output Power** | 0 – 200.0% of drive rated power |
| 11 | **Load Current (Torque)** | 0 – 200.0% of P-08, updated every 64ms |

| Par. | Description | Minimum | Maximum | Default | Units |
|---|---|---|---|---|---|
| P-26 | **Skip frequency hysteresis band** | 0.0 | P-01 | 0.0 | Hz / RPM |
| P-27 | **Skip Frequency Centre Point** | 0.0 | P-01 | 0.0 | Hz / RPM |
| | The Skip Frequency function is used to avoid the Optidrive operating at a certain output frequency, for example at a frequency which causes mechanical resonance in a particular machine. Parameter P-27 defines the centre point of the skip frequency band, and is used in conjunction with P-26. The Optidrive output frequency will ramp through the defined band at the rates set in P-03 and P-04 respectively, and will not hold any output frequency within the defined band. If the frequency reference applied to the drive is within the band, the Optidrive output frequency will remain at the upper or lower limit of the band. | | | | |
| P-28 | **V/F Characteristic Adjustment Voltage** | 0.0 | 100.0 | 0.0 | % |
| P-29 | **V/F Characteristic Adjustment Frequency** | 0.0 | 100.0 | 0.0 | % |
| | This parameter in conjunction with P-28 sets a frequency point at which the voltage set in P-29 is applied to the motor. Care must be taken to avoid overheating and damaging the motor when using this feature. | | | | |
| P-30 | **Start Mode, Automatic Restart, Fire Mode Configuration** | | | | |
| | **Index 1 : Start Mode & Automatic Restart** | See Below | | EdgE-r | - |
| | Selects whether the drive should start automatically if the enable input is present and latched during power on. Also configures the Automatic Restart function. | | | | |

| Setting | Start Function | Auto Restarts | Description |
|---|---|---|---|
| EdgE-r | Edge Run | 0 | Following Power on or reset, the drive will not start if Digital Input 1 remains closed. The Input must be closed after a power on or reset to start the drive. |
| AUto-0 | Auto | 0 | Following a Power On or Reset, the drive will automatically start if Digital Input 1 is closed. |
| AUto-1 | Auto | 1 | As AUto-0. In addition, following a trip, the drive will make up to 5 attempts to restart at 20 second intervals. The numbers of restart attempts are counted, and if the drive fails to start on the final attempt, the drive will trip with a fault, and will require the user to manually reset the fault. The drive must be powered down to reset the counter. |
| AUto-2 | Auto | 2 | |
| AUto-3 | Auto | 3 | |
| AUto-4 | Auto | 4 | |
| AUto-5 | Auto | 5 | |

| | | | | | |
|---|---|---|---|---|---|
| | **Index 2 : Fire Mode Input Logic** | 0 | 1 | 0 | - |
| | Defines the operating logic when a setting of P-15 is used which includes Fire Mode, e.g. settings 15, 16 & 17. | | | | |

| Setting | Input Type | Fire Mode Active When |
|---|---|---|
| 0 | **Normally Closed (NC)** | Input is open |
| 1 | **Normally Open (NO)** | Input is closed |

| | | | | | |
|---|---|---|---|---|---|
| | **Index 3 : Fire Mode Input Type** | 0 | 1 | 0 | - |
| | Defines the input type when a setting of P-15 is used which includes Fire Mode, e.g. settings 15, 16 & 17. | | | | |

| Setting | Input Type | Description |
|---|---|---|
| 0 | **Maintained Input** | The drive will remain in Fire Mode, only as long the fire mode input signal remains (Normally Open or Normally Closed operation is supported depending on Index 2 setting). |
| 1 | **Momentary Input** | Fire Mode is activated by a momentary signal on the input. Normally Open or Normally Closed operation is supported depending on Index 2 setting. The drive will remain in Fire Mode until disabled or powered off. |

| | | | | | |
|---|---|---|---|---|---|
| P-31 | **Keypad Start Mode Select** | 0 | 3 | 1 | - |
| | This parameter is active only when operating in Keypad Control Mode (P-12 = 1 or 2) or Modbus Mode (P-12 = 3 or 4). When settings 0 or 1 are used, the Keypad Start and Stop keys are active, and control terminals 1 and 2 must be linked together. Settings 2 and 3 allow the drive to be started from the control terminals directly, and the keypad Start and Stop keys are ignored. | | | | |

| Setting | Start At | Enable From |
|---|---|---|
| 0 | Minimum Speed | Keypad |
| 1 | Previous Speed | Keypad |
| 2 | Minimum Speed | Terminal |
| 3 | Previous Speed | Terminal |
| 4 | Present Speed | Keypad |
| 5 | Preset Speed 4 (P-23) | Keypad |
| 6 | Present Speed | Terminal |
| 7 | Preset Speed 4 (P-23) | Terminal |

| | | | | | |
|---|---|---|---|---|---|
| P-32 | **Index 1 : Duration** | 0.0 | 25.0 | 0.0 | s |
| | **Index 2 : DC Injection Mode** | 0 | 2 | 0 | - |
| | **Index 1:** Defines the time for which a DC current is injected into the motor. DC Injection current level may be adjusted in P-59. | | | | |
| | **Index 2 :** Configures the DC Injection Function as follows :- | | | | |

| Setting | Function | Description |
|---|---|---|
| 0 | **DC Injection on Stop** | DC is injected into the motor at the current level set in P-59 following a stop command, after the output frequency has reached 0.0Hz for the time set in Index 1. This can be useful to ensure the motor has reached a complete stop before the drive disables. |
| 1 | **DC Injection on Start** | DC is injected into the motor at the current level set in P-59 for the time set in Index 1 immediately after the drive is enabled, prior to the output frequency ramping up. The output stage remains active during this phase. This can be used to ensure the motor is at standstill prior to starting. |
| 2 | **DC Injection on Start & Stop** | DC injection applied as both settings 0 and 1 above. |

| Par. | Description | Minimum | Maximum | Default | Units |
|---|---|---|---|---|---|
| P-33 | **Spin Start (S2 & S3 Only) / DC Injection Time On Start (S1 Only)** | 0 | 2 | 0 | - |

| Setting | Function | Description |
|---|---|---|
| 0 | Disabled | |
| 1 | Enabled | When enabled, on start up the drive will attempt to determine if the motor is already rotating, and will begin to control the motor from its current speed. A short delay may be observed when starting motors which are not turning. |
| 2 | Enabled on Trip, Brown Out or Coast Stop | Spin start is only activated following the events listed, otherwise it is disabled. |

| Par. | Description | Minimum | Maximum | Default | Units |
|---|---|---|---|---|---|
| P-34 | **Brake Chopper Enable (Not Size 1)** | 0 | 2 | 0 | - |

| Setting | Function | Description |
|---|---|---|
| 0 | Disabled | |
| 1 | Enabled With Software Protection | Enables the internal brake chopper with software protection for a 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 the frequency setpoint, 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 the frequency setpoint, and is disabled during constant speed operation. |

| Par. | Description | Minimum | Maximum | Default | Units |
|---|---|---|---|---|---|
| P-35 | **Analog Input 1 Scaling / Slave Speed Scaling** | 0.0 | 2000.0 | 100.0 | % |
| | **Analog Input 1 Scaling**. The analog input signal level is multiplied by this factor, e.g. if P-16 is set for a 0 – 10V signal , and the scaling factor is set to 200.0%, a 5 volt input will result in the drive running at maximum frequency / speed (P-01)<br>**Slave Speed Scaling**. When operating in Slave Mode (P-12 = 9), the operating speed of the drive will be the Master speed multiplied by this factor, limited by the minimum and maximum speeds. | | | | |
| P-36 | **Serial Communications Configuration** | See Below | | | |
| | **Index 1 : Drive Address** | 1 | 63 | 1 | - |
| | **Index 2 : Baud Rate & Network Type** | 9.6 | 1000 | 115.2 | kbps |
| | **Index 3 : Modbus RTU / Optibus Communication loss timeout protection** | 0 | 60000 | 300 | ms |
| | This parameter has three sub settings used to configure the Modbus RTU Serial Communications. The Sub Parameters are | | | | |
| | **Index 1 : Drive Address** : Range : 0 – 63, default : 1 | | | | |
| | **Index 2 : Baud Rate & Network type** : Selects the baud rate and network type for the internal RS485 communication port.<br>For Modbus RTU : Baud rates 9.6, 19.2, 38.4, 57.6, 115.2 kbps are available.<br>For CAN Open : Baud rates 125, 250, 500 & 1000 kbps are available. | | | | |
| | **Index 3 : Modbus RTU / Optibus Communication loss timeout protection**: Defines the time for which the drive will operate without receiving a valid command telegram after the drive has been enabled. This applies to Modbus RTU networks and Optibus networks (e.g. keypad control or Master Slave operation) only. CAN communication loss function is enabled via CAN objects 100Ch and 100Dh. Setting 0 disables the Watchdog timer. Setting a value of 30, 100, 1000, or 3000 defines the time limit in milliseconds for operation. A '**t**' suffix selects trip on loss of communication. An '**r**' suffix means that the drive will coast stop (output immediately disabled) but will not trip. | | | | |
| P-37 | **Access Code Definition** | 0 | 9999 | 101 | - |
| | Defines the access code which must be entered in P-14 to access parameters above P-14 | | | | |
| P-38 | **Parameter Access Lock** | 0 | 1 | 0 | - |

| Setting | Function | Description |
|---|---|---|
| 0 | Unlocked | All parameters can be accessed and changed |
| 1 | Locked | Parameter values can be displayed, but cannot be changed except P-38. |

| Par. | Description | Minimum | Maximum | Default | Units |
|---|---|---|---|---|---|
| P-39 | **Analog Input 1 Offset** | -500.0 | 500.0 | 0.0 | % |
| | Sets an offset, as a percentage of the full scale range of the input, which is applied to the analog input signal. This parameter operates in conjunction with P-35, and the resultant value can be displayed in P00-01.<br>The resultant value is defined as a percentage, according to the following :-<br>P00-01 = (Applied Signal Level(%) - P-39) x P-35) | | | | |
| P-40 | **Index 1 : Display Scaling Factor** | 0.000 | 16.000 | 0.000 | - |
| | **Index 2 : Display Scaling Source** | 0 | 3 | 0 | - |
| | Allows the user to program the Optidrive to display an alternative output unit scaled from either output frequency (Hz), Motor Speed (RPM) or the signal level of PI feedback when operating in PI Mode. | | | | |
| | **Index 1 :** Used to set the scaling multiplier. The chosen source value is multiplied by this factor. | | | | |
| | **Index 2 :** Defines the scaling source as follows :- | | | | |

| Setting | Function | Description |
|---|---|---|
| 0 | Motor Speed | Scaling is applied to the output frequency if P-10 = 0, or motor RPM if P-10 > 0. |
| 1 | Motor Current | Scaling is applied to the motor current value (Amps) |
| 2 | Analog Input 2 Signal Level | Scaling is applied to analog input 2 signal level, internally represented as 0 – 100.0% |
| 3 | PI Feedback | Scaling is applied to the PI feedback selected by P-46, internally represented as 0 – 100.0% |

| Par. | Description | Minimum | Maximum | Default | Units |
|---|---|---|---|---|---|
| P-41 | **PI Controller Proportional Gain** | 0.0 | 30.0 | 1.0 | - |
| | PI Controller Proportional Gain. Higher values provide a greater change in the drive output frequency in response to small changes in the feedback signal. Too high a value can cause instability | | | | |
| P-42 | **PI Controller Integral Time** | 0.0 | 30.0 | 1.0 | s |
| | PI Controller Integral Time. Larger values provide a more damped response for systems where the overall process responds slowly. | | | | |

| Par. | Description | Minimum | Maximum | Default | Units |
|---|---|---|---|---|---|
| P-43 | **PI Controller Operating Mode** | 0 | 1 | 0 | - |

| Setting | Function | Description |
|---|---|---|
| **0** | **Direct Operation** | Use this mode if when the feedback signal drops, the motor speed should increase. When the drive restarts following standby, the PID controller will restart from zero. |
| **1** | **Inverse Operation** | Use this mode if when the feedback signal drops, the motor speed should decrease. When the drive restarts following standby, the PID controller will restart from zero. |
| **2** | **Direct Operation** | Use this mode if when the feedback signal drops, the motor speed should increase. When the drive restarts following standby, the PID controller will restart from maximum. |
| **3** | **Inverse Operation** | Use this mode if when the feedback signal drops, the motor speed should decrease. When the drive restarts following standby, the PID controller will restart from maximum. |

| Par. | Description | Minimum | Maximum | Default | Units |
|---|---|---|---|---|---|
| P-44 | **PI Reference (Setpoint) Source Select** | 0 | 1 | 0 | - |

Selects the source for the PID Reference / Setpoint

| Setting | Function | Description |
|---|---|---|
| **0** | **Digital Preset Setpoint** | P-45 is used |
| **1** | **Analog Input 1 Setpoint** | Analog input 1 signal level, readable in P00-01 is used for the setpoint. |

| Par. | Description | Minimum | Maximum | Default | Units |
|---|---|---|---|---|---|
| P-45 | **PI Digital Setpoint** | 0.0 | 100.0 | 0.0 | % |

When P-44 = 0, this parameter sets the preset digital reference (setpoint) used for the PI Controller as a % of the feedback signal range.

| Par. | Description | Minimum | Maximum | Default | Units |
|---|---|---|---|---|---|
| P-46 | **PI Feedback Source Select** | 0 | 5 | 0 | - |

Selects the source of the feedback signal to be used by the PI controller.

| Setting | Function | Description |
|---|---|---|
| **0** | **Analog Input 2** | (Terminal 4) Signal level readable in P00-02. |
| **1** | **Analog Input 1** | (Terminal 6) Signal level readable in P00-01 |
| **2** | **Motor Current** | Scaled as % of P-08 |
| **3** | **DC Bus Voltage** | Scaled 0 – 1000 Volts = 0 – 100% |
| **4** | **Analog 1 – Analog 2** | The value of Analog Input 2 is subtracted from Analog 1 to give a differential signal. The value is limited to 0. |
| **5** | **Largest (Analog 1, Analog 2)** | The larger of the two analog input values is always used for PI feedback. |

| Par. | Description | Minimum | Maximum | Default | Units |
|---|---|---|---|---|---|
| P-47 | **Analog Input 2 Signal Format** | - | - | - | U0-10 |

| Setting | Signal Type | Additional Information |
|---|---|---|
| U 0-10 | 0 to 10 | |
| A 0-20 | 0 to 20mA | |
| t 4-20 | 4 to 20mA | The drive will trip and show the fault code 4-20F if the signal level falls below 3mA |
| r 4-20 | 4 to 20mA | The drive will ramp to stop if the signal level falls below 3mA |
| t 20-4 | 20 to 4mA | The drive will trip and show the fault code 4-20F if the signal level falls below 3mA |
| r 20-4 | 20 to 4mA | The drive will ramp to stop if the signal level falls below 3mA |
| Ptc-th | Motor PTC (Thermistor) | Valid with any setting of P-15 that has Input 3 as E-Trip. |

| Par. | Description | Minimum | Maximum | Default | Units |
|---|---|---|---|---|---|
| P-48 | **Standby Mode Timer** | 0.0 | 60.0 | 0.0 | s |

When standby mode is enabled by setting P-48 > 0.0, the drive will enter standby following a period of operating at minimum speed (P-02) for the time set in P-48. When in Standby Mode, the drive display shows StndbY, and the output to the motor is disabled.

| Par. | Description | Minimum | Maximum | Default | Units |
|---|---|---|---|---|---|
| P-49 | **PI Control Wake Up Error Level** | 0.0 | 100.0 | 5.0 | % |

When the drive is operating in PI Control Mode (P-12 = 5 or 6), and Standby Mode is enabled (P-48 > 0.0), P-49 can be used to define the PI Error Level (E.g. difference between the setpoint and feedback) required before the drive restarts after entering Standby Mode. This allows the drive to ignore small feedback errors and remain in Standby mode until the feedback drops sufficiently.

| Par. | Description | Minimum | Maximum | Default | Units |
|---|---|---|---|---|---|
| P-50 | **User Output Relay Hysteresis** | 0.0 | 100.0 | 0.0 | % |

Sets the hysteresis level for P-19 to prevent the output relay chattering when close to the threshold.

### 6.4.3. Advanced Parameters

| Par. | Description | Minimum | Maximum | Default | Units |
|---|---|---|---|---|---|
| P-51 | **Motor Control Mode** | 0 | 5 | 0 | - |
| | **Setting** / **Control Method**: **0** Vector speed control mode for Induction Motors; **1** V/f mode for Induction Motors; **2** PM vector speed control for Permanent Magnet Motors; **3** BLDC vector speed control for Brushless DC Motors; **4** SR vector speed control for Synchronous Reluctance Motors; **5** LSPM vector speed control for Line Start Permanent Magnet Motors | | | | |
| P-52 | **Motor Parameter Autotune** | 0 | 1 | 0 | - |
| | This parameter can be used to optimise the performance when P-51 = 0. Autotune is not required if P-51 = 1. For settings 2 – 5 of P-51, autotune MUST be carried out AFTER all other required motor settings are entered. | | | | |
| | **Setting** / **Function** / **Description**: **0** Disabled; **1** Enabled — When enabled, the drive immediately measures required data from the motor for optimal operation. Ensure all motor related parameters are correctly set first before enabling this parameter. | | | | |
| P-53 | **Vector Mode Gain** | 0.1 | 200.0 | 50.0 | % |
| | Single Parameter for Vector speed loop tuning. Affects P & I terms simultaneously. Not active when P-51 = 1. | | | | |
| P-54 | **Maximum Current Limit** | 0.1 | 175.0 | 150.0 | % |
| | Defines the max current limit in vector control modes | | | | |
| P-55 | **Motor Stator Resistance** | 0.0 | 655.35 | - | Ω |
| | Motor stator resistance in Ohms. Determined by Autotune, adjustment is not normally required. | | | | |
| P-56 | **Motor Stator d-axis Inductance (Lsd)** | 0 | 6553.5 | - | mH |
| | Determined by Autotune, adjustment is not normally required. | | | | |
| P-57 | **Motor Stator q-axis Inductance (Lsq)** | 0 | 6553.5 | - | mH |
| | Determined by Autotune, adjustment is not normally required. | | | | |
| P-58 | **DC Injection Speed** | 0.0 | P-01 | 0.0 | Hz / RPM |
| | Sets the speed at which DC injection current is applied during braking to Stop, allowing DC to be injected before the drive reaches zero speed if desired. | | | | |
| P-59 | **DC Injection Current** | 0.0 | 100.0 | 20.0 | % |
| | Sets the level of DC injection braking current applied according to the conditions set in P-32 and P-58. | | | | |
| P-60 | **Index 1: Thermal Overload Retention** | 0 | 1 | 0 | - |
| | **Setting** / **Function** / **Description**: **0** 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 Reaction** | 0 | 1 | 0 | - |
| | **Setting** / **Function** / **Description**: **0** It.trip — When the motor thermal overload accumulator reaches 100%, the drive will trip and display it.trp; **1** Reduce Output Frequency — When the motor thermal overload accumulator reaches 90%, enabled, output current will be limited to 100% of the value of P-08, which will result in output frequency reduction. This can be used in applications such as fans and pumps where it is desired to have triples operation, and the current limiting / frequency reduction can protect against transient high loads without affecting the normal operation of the application. | | | | |

## 6.5. Parameter Group 0 – Monitoring Parameters (Read Only)

| Par. | Description | Explanation |
|---|---|---|
| **P00-01** | 1st Analog input value (%) | 100% = max input voltage |
| **P00-02** | 2nd Analog input value (%) | 100% = max input voltage |
| **P00-03** | Speed reference input (Hz / RPM) | Displayed in Hz if P-10 = 0, otherwise RPM |
| **P00-04** | Digital input status | Drive digital input status |
| **P00-05** | User PI output (%) | Displays value of the User PI output |
| **P00-06** | DC bus ripple (V) | Measured DC bus ripple |
| **P00-07** | Applied motor voltage (V) | Value of RMS voltage applied to motor |
| **P00-08** | DC bus voltage (V) | Internal DC bus voltage |
| **P00-09** | Heatsink temperature (°C) | Temperature of heatsink in °C |
| **P00-10** | Run time since date of manuf. (Hours) | Not affected by resetting factory default parameters |
| **P00-11** | Run time since last trip (1) (Hours) | Run-time clock stopped by drive disable (or trip), reset on next enable only if a trip occurred. Reset also on next enable after a drive power down. |
| **P00-12** | Run time since last trip (2) (Hours) | Run-time clock stopped by drive disable (or trip), reset on next enable only if a trip occurred (under-volts not considered a trip) – not reset by power down / power up cycling unless a trip occurred prior to power down |
| **P00-13** | Trip Log | Displays most recent 4 trips with time stamp |
| **P00-14** | Run time since last disable (Hours) | Run-time clock stopped on drive disable, value reset on next enable |
| **P00-15** | DC bus voltage log (V) | 8 most recent values prior to trip, 256ms sample time |
| **P00-16** | Heatsink temperature log (V) | 8 most recent values prior to trip, 30s sample time |
| **P00-17** | Motor current log (A) | 8 most recent values prior to trip, 256ms sample time |
| **P00-18** | DC bus ripple log (V) | 8 most recent values prior to trip, 22ms sample time |
| **P00-19** | Internal drive temperature log (°C) | 8 most recent values prior to trip, 30 s sample time |
| **P00-20** | Internal drive temperature (°C) | Actual internal ambient temperature in °C |
| **P00-21** | CANopen process data input | Incoming process data (RX PDO1) for CANopen: PI1, PI2, PI3, PI4 |
| **P00-22** | CANopen process data output | outgoing process data (TX PDO1) for CANopen: PO1, PO2, PO3, PO4 |
| **P00-23** | Accumulated time with heatsink > 85°C (Hours) | Total accumulated hours and minutes of operation above heatsink temp of 85°C |
| **P00-24** | Accumulated time with drive internal temp > 80°C (Hours) | Total accumulated hours and minutes of operation with drive internal ambient above 80C |
| **P00-25** | Estimated rotor speed (Hz) | In vector control modes, estimated rotor speed in Hz |
| **P00-26** | kWh meter / MWh meter | Total number of kWh / MWh consumed by the drive. |
| **P00-27** | Total run time of drive fans (Hours) | Time displayed in hh:mm:ss. First value displays time in hrs, press up to display mm:ss. |
| **P00-28** | Software version and checksum | Version number and checksum. "1" on LH side indicates I/O processor, "2" indicates power stage |
| **P00-29** | Drive type identifier | Drive rating, drive type and software version codes |
| **P00-30** | Drive serial number | Unique drive serial number |
| **P00-31** | Motor current Id / Iq | Displays the magnetising current (Id) and torque current (Iq). Press UP to show Iq |
| **P00-32** | Actual PWM switching frequency (kHz) | Actual switching frequency used by drive |
| **P00-33** | Critical fault counter – O-I | These parameters log the number of times specific faults or errors occur, and are useful for diagnostic purposes. |
| **P00-34** | Critical fault counter – O-Volts | |
| **P00-35** | Critical fault counter – U-Volts | |
| **P00-36** | Critical fault counter – O-temp (h/sink) | |
| **P00-37** | Critical fault counter – b O-I (chopper) | |
| **P00-38** | Critical fault counter – O-hEAt (control) | |
| **P00-39** | Modbus comms error counter | |
| **P00-40** | CANbus comms error counter | |
| **P00-41** | I/O processor comms errors | |
| **P00-42** | Power stage uC comms errors | |
| **P00-43** | Drive power up time (life time) (Hours) | Total lifetime of drive with power applied |
| **P00-44** | Phase U current offset & ref | Internal value |
| **P00-45** | Phase V current offset & ref | Internal value |
| **P00-46** | Phase W current offset & ref | Internal value |
| **P00-47** | Index 1 : Fire mode total active time<br>Index 2 : Fire Mode Activation Count | Total activation time of Fire Mode<br>Displays the number of times Fire Mode has been activated |
| **P00-48** | Scope channel 1 & 2 | Displays signals for first scope channels 1 & 2 |
| **P00-49** | Scope channel 3 & 4 | Displays signals for first scope channels 3 & 4 |
| **P00-50** | Bootloader and motor control | Internal value |

# 7. Control Terminal Connections

For standard applications and operation, the basic control of the drive and functions of all drive input terminals can be configured using just two parameters, P-12 and P-15. P-12 is used to define the source of all control commands and the primary speed reference source. P-15 then allows fast selection of Analog and Digital Input functions based on a selection table.

## 7.1. P-12 Function

P-12 is used to select the main control source of the drive and the main speed reference according to the following table

| P-12 | Function | Control Source | Main Speed Reference | Notes |
|---|---|---|---|---|
| 0 | Terminal Control | Terminals | Analog Input 1 | All control signals are applied to the control terminals. Functions are determined by P-15 Macro setting. |
| 1 | Keypad Control | Keypad / Terminals | Motorised Pot / Keypad | When keypad mode is selected, the default operation of the drive requires the keypad Start & Stop buttons are used to control the drive. This can be changed using P-31 to allow the drive to be started from Digital Input 1 directly. |
| 2 | Keypad Control | Keypad / Terminals | Motorised Pot / Keypad | |
| 3 | Modbus RTU | Modbus RTU | Modbus RTU | Control of the drive operation is through the Modbus RTU Interface. Acceleration and Deceleration Rates are controlled by P-03 and P-04 respectively. Digital Input 1 must be closed to allow operation. |
| 4 | Modbus RTU | Modbus RTU | Modbus RTU | Control of the drive operation is through the Modbus RTU Interface. Acceleration and Deceleration Rates are also controlled by Modbus, P-03 and P-04 are disabled. Digital Input 1 must be closed to allow operation. |
| 5 | PI Control | Terminals | PI Output | Enable / Disable control of the drive is through the drive control terminal strip. Output frequency is set by the output of the PI Controller |
| 6 | PI Control with Analog Summation | Terminals | PI Output Added to AI1 | Enable / Disable control of the drive is through the drive control terminal strip. Output frequency is set by the output of the PI Controller, added to the value of analog input 1. |
| 7 | CAN Open | CAN Open | CAN | Control of the drive operation is through the CAN Open Interface. Acceleration and Deceleration Rates are controlled by P-03 and P-04 respectively. Digital Input 1 must be closed to allow operation. |
| 8 | CAN Open | CAN Open | CAN | Control of the drive operation is through the CAN Open Interface. Acceleration and Deceleration Rates are also controlled by Modbus, P-03 and P-04 are disabled. Digital Input 1 must be closed to allow operation. |
| 9 | Slave Mode | Master Drive | From Master | |

## 7.2. Overview

Optidrive Compact 2-E3 uses a Macro approach to simplify the configuration of the Analog and Digital Inputs. There are two key parameters which determine the input functions and drive behaviour:-

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

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

- **P-16** – Used to select the format of the analog signal to be connected to analog input 1, e.g. 0 – 10 Volt, 4 – 20mA
- **P-30** – Determines whether the drive should automatically start following a power on if the Enable Input is present
- **P-31** – When Keypad Mode is selected, determines at what output frequency / speed the drive should start following the enable command, and also whether the keypad start key must be pressed or if the Enable input alone should start the drive.
- **P-47** – Used to select the format of the analog signal to be connected to analog input 2, e.g. 0 – 10 Volt, 4 – 20mA

The diagrams below provide an overview of the functions of each terminal macro function, and a simplified connection diagram for each.

## 7.3. Macro Function Guide

| Function | Explanation |
|---|---|
| STOP | Latched Input, Open the contact to STOP the drive |
| RUN | Latched input, Close the contact to Start, the drive will operate as long as the input is maintained |
| FWD↻ | Latched Input, selects the direction of motor rotation FORWARD |
| REV↺ | Latched Input, selects the direction of motor rotation REVERSE |
| RUN FWD↻ | Latched Input, Close to Run in the FORWARD direction, Open to STOP |
| RUN REV↺ | Latched Input, Close to Run in the REVERSE direction, Open to STOP |
| ENABLE | Hardware Enable Input.<br>In Keypad Mode, P-31 determines whether the drive immediately starts, or the keypad start key must be pressed.<br>In other modes, this input must be present before the start command is applied via the fieldbus interface. |
| START⤴ | Normally Open, Rising Edge, Close momentarily to START the drive (NC STOP Input must be maintained) |
| ^- START -^ | Simultaneously applying both inputs momentarily will START the drive (NC STOP Input must be maintained) |
| STOP ⤵ | Normally Closed, Falling Edge, Open momentarily to STOP the drive |
| START⤴FWD↻ | Normally Open, Rising Edge, Close momentarily to START the drive in the forward direction (NC STOP Input must be maintained) |
| START⤴REV↺ | Normally Open, Rising Edge, Close momentarily to START the drive in the reverse direction (NC STOP Input must be maintained) |
| ^-FAST STOP (P-24)-^ | When both inputs are momentarily active simultaneously, the drive stops using Fast Stop Ramp Time P-24 |
| FAST STOP⤵ (P-24) | Normally Closed, Falling Edge, Open momentarily to FAST STOP the drive using Fast Stop Ramp Time P-24 |
| E-TRIP⤵ | Normally Closed, External Trip input. This input may be used for:<br>○ External Trip function<br>○ Motor thermistor connection (see section 5.7 Motor Thermistor Connection)<br>When the input opens momentarily, the drive trips showing External Fault or Thermistor Over Temperature depending on P-47 setting. |
| Fire Mode | Activates Fire Mode, see section 7.5.1 Fire Mode |
| Analog Input AI1 | Analog Input 1, signal format selected using P-16 |
| Analog Input AI2 | Analog Input 2, signal format selected using P-47 |
| AI1 REF | Analog Input 1 provides the speed reference |
| AI2 REF | Analog Input 2 provides the speed reference |
| P-xx REF | Speed reference from the selected preset speed |
| PR-REF | Preset speeds P-20 – P-23 are used for the speed reference, selected according to other digital input status |
| PI-REF | PI Control Speed Reference |
| PI FB | Analog Input used to provide a Feedback signal to the internal PI controller |
| KPD REF | Keypad Speed Reference selected |
| INC SPD↑ | Normally Open, Close the input to Increase the motor speed |
| DEC SPD↓ | Normally Open, Close input to Decrease motor speed |
| FB REF | Selected speed reference from Fieldbus (Modbus RTU / CAN Open / Master depending on P-12 setting) |
| (NO) | Input is Normally Open, Close momentarily to activate the function |
| (NC) | Input is Normally Closed, Open momentarily to activate the function |

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

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

**Note:**

- For information on the External Trip (E-TRIP↴) and motor thermistor monitoring function, see section 5.7 Motor Thermistor Connection.
- Fire Mode input logic (Normally Open or Normally Closed) and latching mode are selected by P-30. When the input mode is set to latched, the enable signal must be removed to reset the latch.

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

| P-15 | DI1 | | DI2 | | DI3 / AI2 | | DI4 / AI1 | | Diagram |
|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| 0 | STOP | ENABLE | - | INC SPD ↑ | - | DEC SPD ↓ | FWD ↻ | REV ↺ | 8 |
| | | | | ^---------- START ----------^ | | | | | |
| 1 | STOP | ENABLE | PI REF | | | | | | |
| 2 | STOP | ENABLE | - | INC SPD ↑ | - | DEC SPD ↓ | KPD REF | P-20 REF | 8 |
| | | | | ^---------- START ----------^ | | | | | |
| 3 | STOP | ENABLE | - | INC SPD ↑ | E-TRIP ↴ | (NC) | - | DEC SPD ↓ | 9 |
| | | | | ^---------- START ----------^ | | | | | |
| 4 | STOP | ENABLE | - | INC SPD ↑ | KPD REF | AI1 REF | Analog Input AI1 | | 10 |
| 5 | STOP | ENABLE | FWD ↻ | REV ↺ | KPD REF | AI1 REF | Analog Input AI1 | | 1 |
| 6 | STOP | ENABLE | FWD ↻ | REV ↺ | E-TRIP ↴ | (NC) | KPD REF | P-20 REF | 11 |
| 7 | STOP | RUN FWD ↻ | STOP | RUN REV ↺ | E-TRIP ↴ | (NC) | KPD REF | P-20 REF | 11 |
| | | ^----------FAST STOP (P-24)----------^ | | | | | | | |
| 14 | STOP | ENABLE | - | - | E-TRIP ↴ | (NC) | - | - | |
| 15 | STOP | ENABLE | PR REF | KPD REF | Fire Mode | | P-23 | P-21 | 2 |
| 16 | STOP | ENABLE | P-23 REF | KPD REF | Fire Mode | | FWD ↻ | REV ↺ | 2 |
| 17 | STOP | ENABLE | KPD REF | P-23 REF | Fire Mode | | FWD ↻ | REV ↺ | 2 |
| 18 | STOP | ENABLE | AI1 REF | KPD REF | Fire Mode | | Analog Input AI1 | | 1 |
| **8,9,10,11,12, 13 = 0** | | | | | | | | | |

**Note:**

- When operating the drive in keypad mode with Digital Pot speed reference (shown as KPD REF in the table above), the motorised pot setpoint may be adjusted by the following methods:
  - Digital inputs using external pushbuttons or other method to increase the speed (shown as INC SPD ↑ in the table above) or reduce the speed (shown as DEC SPD ↓ in the table above).
  - The UP and DOWN keys on a connected remote keypad.
- When changing from any other speed reference (e.g. preset speed or analog speed) back to keypad speed reference (digital pot value) whilst the drive is running, P-31 controls the behaviour as follows:
  - P-31 = 0 or 2: Digital pot speed value will be set to Minimum Speed (P-02).
  - P-31 = 1 or 3: Digital pot will retain the previous value from last time it was selected as the speed reference.
  - P-31 = 4 or 6: Digital pot value will be updated to be the same as current motor running speed.
  - P-31 = 5 or 7: Digital pot value will be set to Preset Speed 4 (P-23).
- When the drive is not enabled:
  - P-31 = 0, 2, 4 or 6: Digital pot speed value will be set to Minimum Speed (P-02).
  - P-31 = 1 or 3: Digital pot will retain the previous value from last time it was selected as the speed reference.
  - P-31 = 5 or 7: Digital pot value will be set Preset Speed 4 (P-23).
- When P-31 = 2, 3, 6 or7
  - Closing digital input 1 (or digital input 2 if P-15 = 7) will start the drive (Auto-run).
  - The keypad START and STOP buttons have no function in this case.
  - The keypad speed can still be adjusted using the UP and DOWN buttons.
- When P-12 = 1 motor rotation direction can be selected by the following methods:
  - Preset Speed reference selected where the preset speed has a negative value.
  - Analog Input 1 speed reference selected with Analog Input 1 programmed in bidirectional mode (P-16 = b 0-10) and a suitable reference applied.
  - Using a setting of P-15 where one digital input has Reverse or Run Reverse function, and using this digital input to select rotation direction.
- When P-12 = 2, in addition to the methods described above, motor rotation direction can be changed by pressing the START button on a connected remote keypad whilst the drive is already running.
- When the remote keypad is used to adjust the speed, there is a momentary delay after the first adjustment step to allow fine setting of the speed reference. When external inputs are used, no single-step delay is present.
- For information on the External Trip (E-TRIP↴) and motor thermistor monitoring function, see section 5.7 Motor Thermistor Connection.
- Fire Mode input logic (Normally Open or Normally Closed) and latching mode are selected by P-30. When the input mode is set to latched, the enable signal must be removed to reset the latch.

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

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

**Note:**

- When P-31 = 0, 1, 4 or 5:
  - Digital Input 1 must be closed to allow the drive to operate.
  - Start and Stop Commands are through the selected fieldbus interface dependent on P-12 setting.
  - In Slave Mode (P-12 = 9), Start and Stop control is always determined by the Master drive operating status regardless of P-31 setting
- When P-31=2, 3, 6 or 7:
  - Start / Stop operation is controlled by Digital Input 1.
  - Communication loss trip action for Modbus RTU is disabled.
- In addition, the following applies:
  - P-15 = 5: When the Preset Speeds are selected as the speed reference (e.g. Digital Input 2 is ON):
    - Communication loss trip is disabled
    - Start / Stop operation is by Digital Input 1.
  - P-15 = 6: When Analog Input 1 is selected as the speed reference(e.g. Digital Input 2 is ON):
    - Communication loss trip is disabled.
    - Start / Stop operation is by Digital Input 1.
  - P-15 = 7: When the Keypad is selected as the speed reference(e.g. Digital Input 2 is ON):
    - Communication loss trip is disabled.
    - Start / Stop operation is by Digital Input 1.
- Communication loss control is always disabled when fire mode is active.
- For information on the External Trip (E-TRIP↴) and motor thermistor monitoring function, see section 5.7 Motor Thermistor Connection.
- Fire Mode input logic (Normally Open or Normally Closed) and latching mode are selected by P-30. When the input mode is set to latched, the enable signal must be removed to reset the latch.

### 7.3.4. Macro Functions - User PI Control Mode (P-12 = 5 or 6)

| P-15 | DI1 | | DI2 | | DI3 / AI2 | | DI4 / AI1 | | Diagram |
|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| 0 | STOP | ENABLE | PI REF | P-20 REF | Analog Input AI2 | | Analog Input AI1 | | 4 |
| 1 | STOP | ENABLE | PI REF | AI1 REF | Analog Input AI2 (PI FB) | | Analog Input AI1 | | 4 |
| 3, 7 | STOP | ENABLE | PI REF | P-20 | E-TRIP ↴ | (NC) | Analog Input AI1 (PI FB) | | 3 |
| 4 | (NO) | START ↥ | (NC) | STOP ↴ | Analog Input AI2 (PI FB) | | Analog Input AI1 | | 12 |
| 5 | (NO) | START ↥ | (NC) | STOP ↴ | PI REF | P-20 REF | Analog Input AI1 (PI FB) | | 5 |
| 6 | (NO) | START ↥ | (NC) | STOP ↴ | E-TRIP ↴ | (NC) | Analog Input AI1 (PI FB) | | |
| 8 | STOP | RUN | FWD ↻ | REV ↺ | Analog Input AI2 (PI FB) | | Analog Input AI1 | | 4 |
| 14 | STOP | RUN | - | - | E-TRIP ↴ | (NC) | Analog Input AI1 (PI FB) | | 16 |
| 15 | STOP | RUN | P-23 REF | PI REF | Fire Mode | | Analog Input AI1 (PI FB) | | 1 |
| 16 | STOP | RUN | P-23 REF | P-21 REF | Fire Mode | | Analog Input AI1 (PI FB) | | 1 |
| 17 | STOP | RUN | P-21 REF | P-23 REF | Fire Mode | | Analog Input AI1 (PI FB) | | 1 |
| 18 | STOP | RUN | AI1 REF | PI REF | Fire Mode | | Analog Input AI1 | | 1 |
| **2,9,10,11,12,13 = 0** | | | | | | | | | |

- For information on the External Trip (E-TRIP↴) and motor thermistor monitoring function, see section 5.7 Motor Thermistor Connection.
- Fire Mode input logic (Normally Open or Normally Closed) and latching mode are selected by P-30. When the input mode is set to latched, the enable signal must be removed to reset the latch.

## 7.4. Example Connection Diagrams

**Diagram 1**

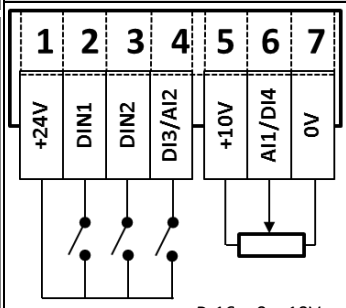



**Diagram 2**

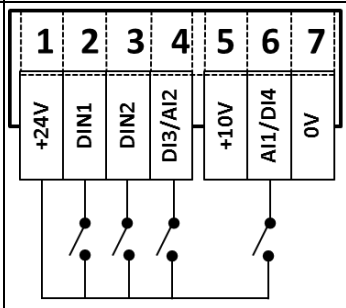



**Diagram 3**

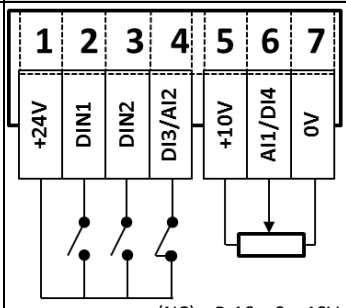



**Diagram 4**

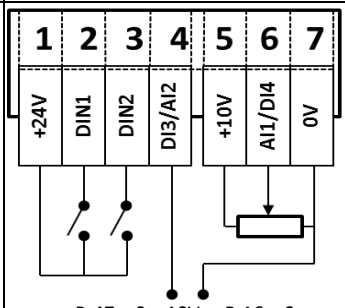



**Diagram 5**

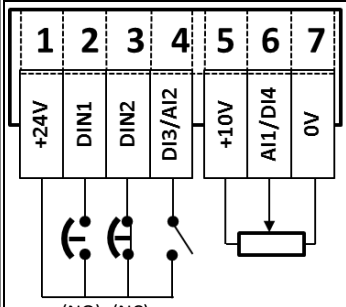



**Diagram 6**

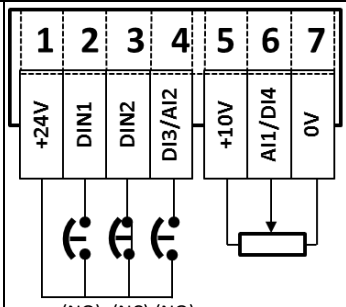



**Diagram 7**

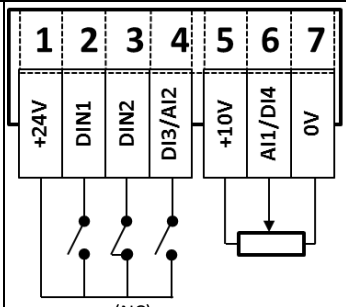



**Diagram 8**

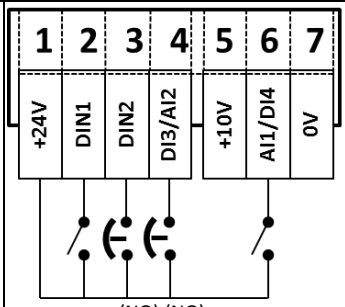



**Diagram 9**

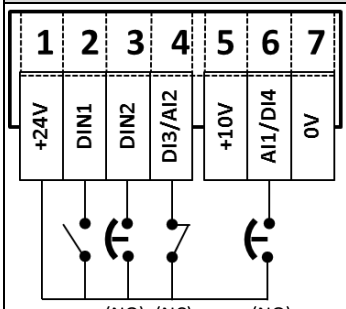



**Diagram 10**

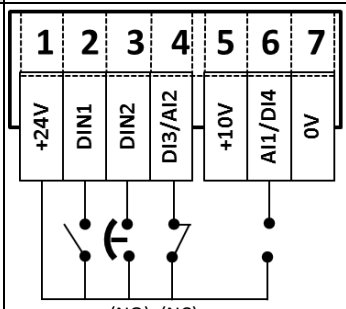



**Diagram 11**

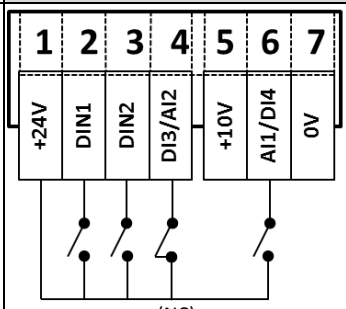



**Diagram 12**

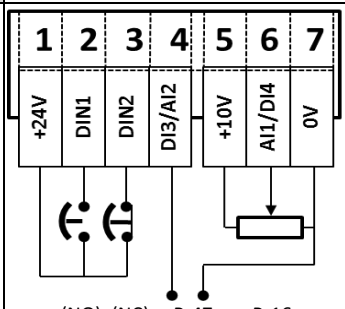



**Diagram 13**

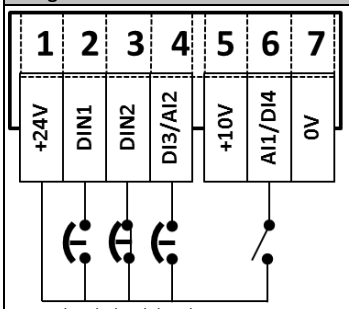



**Diagram 14**

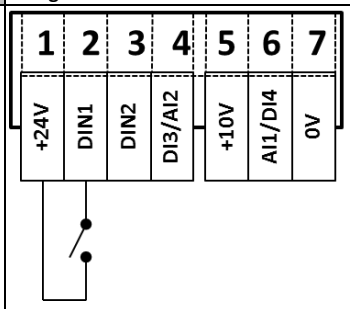



**Diagram 15**

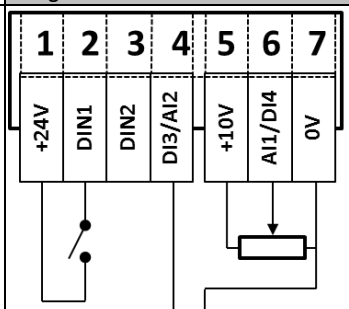
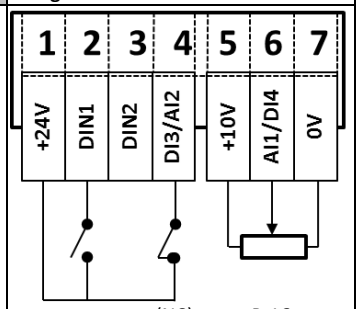



**Diagram 16**



## 7.5. Software Functions

### 7.5.1. 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 input 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 or 17, with Digital Input 3 assigned to activate fire mode.
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
- 4-20 F 4-20mA fault
- Ph-Ib Phase Imbalance
- P-Loss Input Phase Loss Trip
- SC-trp Communications Loss Trip
- It-trp Accumulated overload Trip
- Out-F Drive output fault, Output stage trip

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

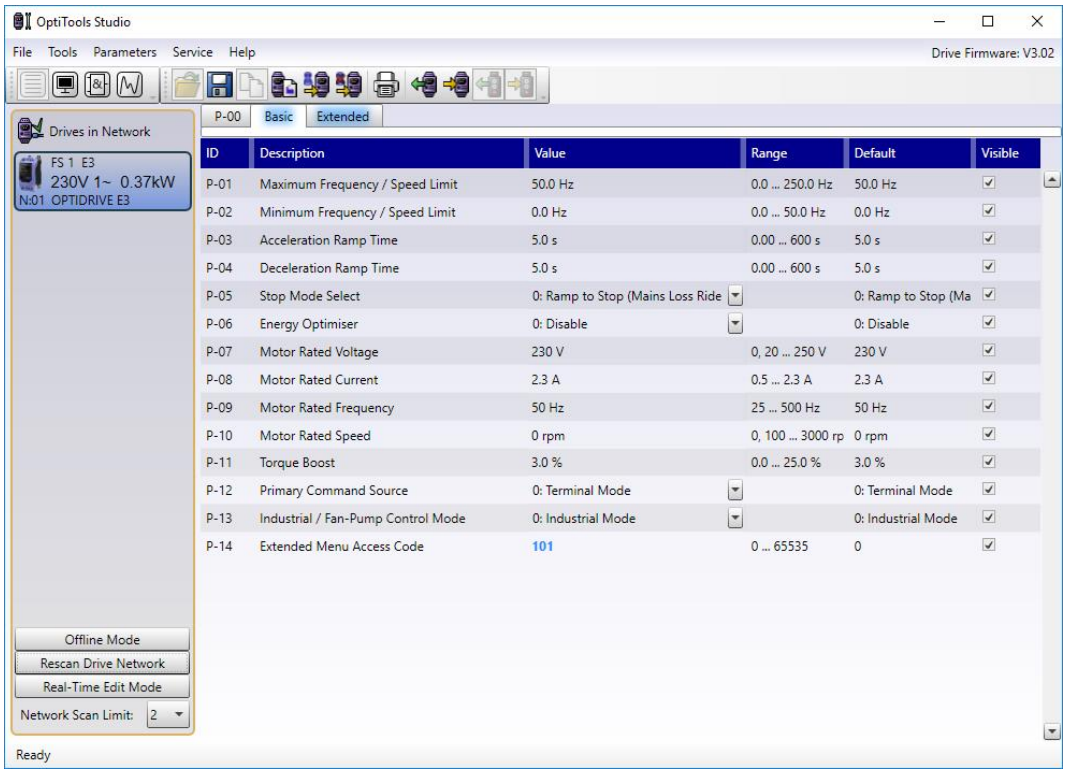
- O-Volt Over Voltage on DC Bus
- U-Volt Under Voltage on DC Bus
- h O-I Fast Over-current Trip
- O-I Instantaneous over current on drive output

### 7.5.2. OEM / User Default Parameters

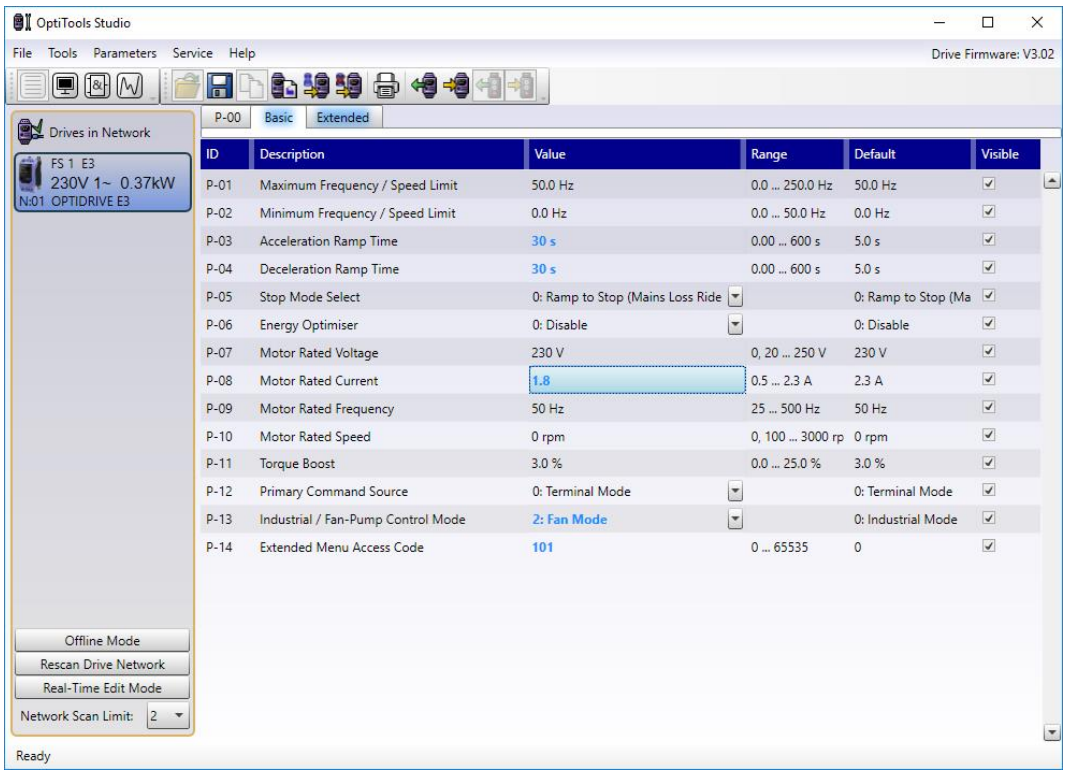
Optidrive Compact 2-E3 includes an embedded function to allow the user to create their own “default” parameters. This means that if a factory reset is carried out, the drive will return to these parameters, as opposed to the Invertek Drive factory default parameters.
This feature is accessed using Optitools Studio PC software only, which may be freely downloaded from the Invertek Drives website.

**Creating the default parameter set**

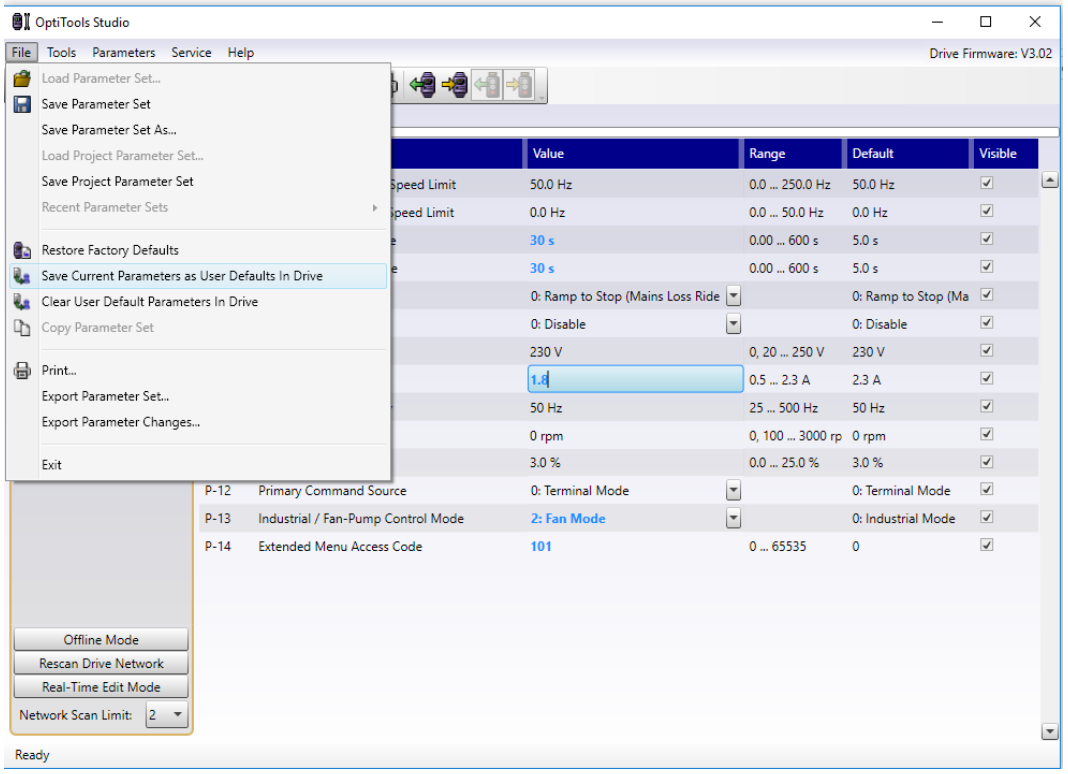
In order to create the User Default settings, the following process should be used.



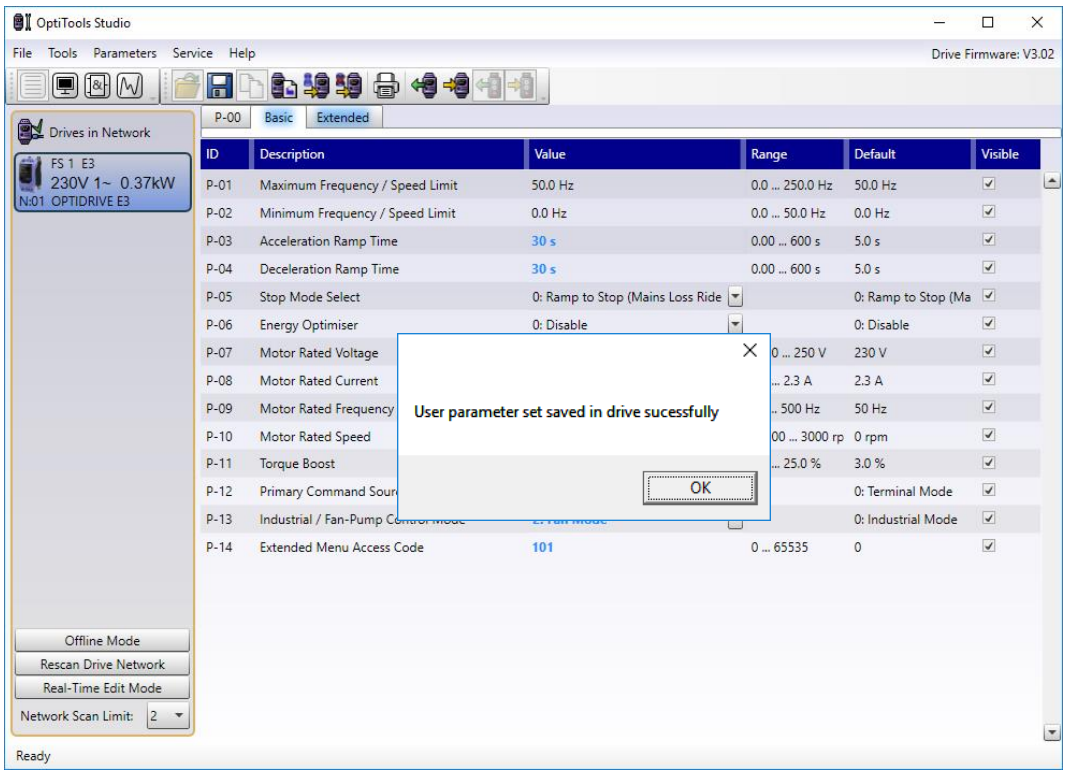

In Optitools Studio, ensure communication is established with the connected drive.




Make any changes to the parameter set as required. Changes from Invertek factory default settings are highlighted in blue.



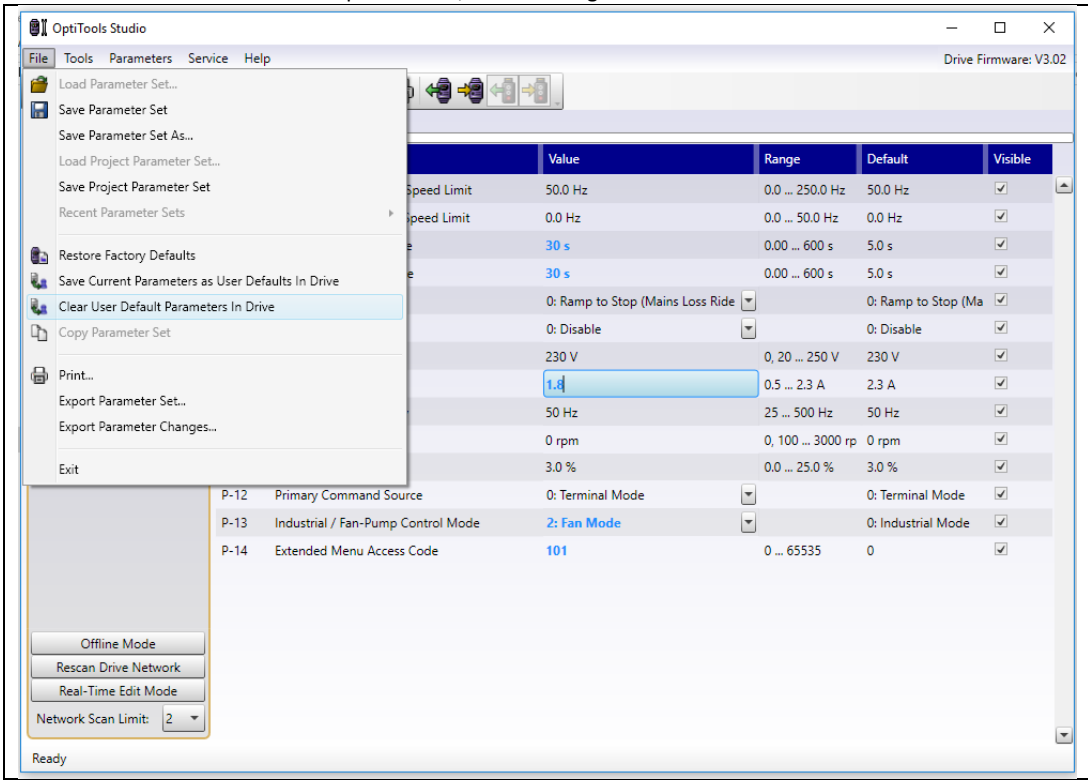

In the File menu, select "Save Current Parameters as User Defaults in Drive"



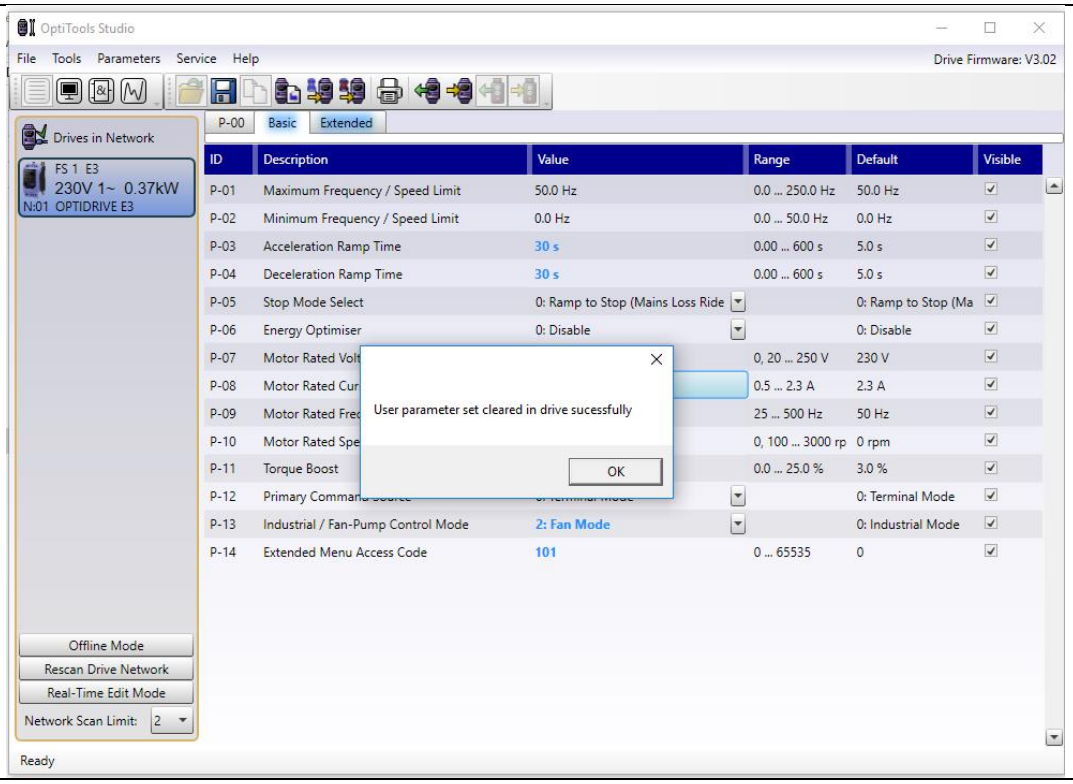

The confirmation message will appear.

## Clearing User Default Parameters

In order to clear the User Default parameters, the following method is used.




From the File menu, select “Clear User Default Parameters in Drive”




The confirmation message will appear to show the user defaults are now cleared, and resetting the drive will return it to Invertek Drives Factory default settings.

# 8. Serial Communications

## 8.1. Overview

OPC-2-CON-E-IN provides support for the following fieldbus networks and functions:-

| Fieldbus | Interface | Availability | Drive Control | Drive Parameter Access |
|---|---|---|---|---|
| Modbus RTU | On-board RJ45 | From Launch | Yes | Access to all Writable Parameters |
| CAN bus | On-board RJ45 | From Launch | Yes | Access to all Writable Parameters |

## 8.2. Modbus RTU

OPC-2-CON-E-IN supports Modbus RTU communication, using the 03 Read Holding Registers and 06 Write Single Holding Register commands. In addition, Control Registers 1 – 4 may be written to using the 16 Write Multiple Holding Registers. Many Master devices treat the first Register address as Register 0; therefore it may be necessary to convert the register numbers listed below by subtracting 1 to obtain the correct Register address. The telegram structure is as follows:-

| **Command 03 – Read Holding Registers** | | | | | | |
|---|---|---|---|---|---|---|
| Master Telegram | Length | | | Slave Response | Length | |
| Slave Address | 1 | Byte | | Slave Address | 1 | Byte |
| Function Code (03) | 1 | Byte | | Starting Address | 1 | Byte |
| 1st Register Address | 2 | Bytes | | 1st Register Value | 2 | Bytes |
| No. Of Registers | 2 | Bytes | | 2nd Register Value | 2 | Bytes |
| CRC Checksum | 2 | Bytes | | Etc... | | |
| | | | | CRC Checksum | 2 | Bytes |

| **Command 06 – Write Single Holding Register** | | | | | | |
|---|---|---|---|---|---|---|
| Master Telegram | Length | | | Slave Response | Length | |
| Slave Address | 1 | Byte | | Slave Address | 1 | Byte |
| Function Code (06) | 1 | Byte | | Function Code (06) | 1 | Byte |
| Register Address | 2 | Bytes | | Register Address | 2 | Bytes |
| Value | 2 | Bytes | | Register Value | 2 | Bytes |
| CRC Checksum | 2 | Bytes | | CRC Checksum | 2 | Bytes |
| | | | | | | |

The table shows the Modbus RTU register number corresponding to each parameter value. All values are holding registers.
All User Adjustable parameters are accessible by Modbus, except those that would directly affect the Modbus communications, e.g.

- P-36 Index 1 Drive Fieldbus Address
- P-36 Index 2 Baud Rate
- P-36 Index 3 Comms Loss Timeout

All parameter values can be read from the drive and written to, depending on the operating mode of the drive – some parameters cannot be changed whilst the drive is enabled for example.

## 8.3. CAN Open

The CANopen communication profile in the OPC-2-CON-E-IN is implemented according to the specification DS301 version 4.02 of CAN in automation (www.can-cia.de). Specific device profiles such as DS402 are not supported.
The CANopen communication function is enabled by default after power up. However in order to use any control functions through CANopen, this requires P-12 = 7 or 8.
The CAN communication baud rate can be set by using parameter P-36. Available baud rates are: 125kbps, 250kbps, 500kbps, 1Mbps. (with default settings as 500kbps).
The Node ID is set up through drive address parameter P-36 as well with the default value of 1.
The tables below show the Index and Sub Index required to address each parameter. All User Adjustable parameters are accessible by CAN, except those that would directly affect the communications.
All parameter values can be read from the drive and written to, depending on the operating mode of the drive – some parameters may be changed whilst the drive is enabled for example.
Optidrive Compact 2-E3 provides the following default COB-ID and functions:

| Type | COB-ID | Function |
|---|---|---|
| NMT | 000h | Network management |
| Sync | 080h | Synchronous message<br>COB-ID can be configured to other value. |
| Emergency | 080h + Node address | Emergency message |
| PDO1 (TX) | 180h + Node address | Process data object.<br>PDO1 is pre-mapped and enabled by default.<br>COB-ID can be configured to other value.<br>PDO2 is pre-mapped and disabled by default.<br>Transmission mode, COB-ID and mapping can be configured. |
| PDO1 (RX) | 200h + Node address | |
| PDO2 (TX) | 280h + Node address | |
| PDO2 (RX) | 300h + Node address | |
| SDO (TX) | 580h + Node address | SDO channel can be used for drive parameter access. |
| SDO (RX) | 600h + Node address | |
| Error Control | 700h + Node address | Guarding and Heartbeat function are supported.<br>COB-ID can be configured to other value. |

***Note***

- The OPC-2-CON-E-IN SDO channel only supports expedited transmission.
- The OPC-2-CON-E-IN can only support up to 2 Process Data Objects (PDO). All PDOs are pre-mapped; however PDO2 is disabled by default. The table below gives the default PDO mapping information.
- Customer configuration (mapping) will NOT be saved during power down. This means that the CANopen configuration will restore to its default condition each time the drive is powered up.

### 8.3.1. PDO Default Mapping

| | Objects No. | Mapped Object | Length | Mapped Function | Transmission Type |
|---|---|---|---|---|---|
| RX PDO1 | 1 | 2000h | Unsigned 16 | Control command register* | 254 Valid immediately |
| | 2 | 2001h | Integer 16 | Speed reference | |
| | 3 | 2003h | Unsigned 16 | User ramp reference | |
| | 4 | 0006h | Unsigned 16 | Dummy | |
| | | | | | |
| TX PDO1 | 1 | 200Ah | Unsigned 16 | Drive status register | 254 Send after receiving RX PDO 1 |
| | 2 | 200Bh | Integer 16 | Motor speed Hz | |
| | 3 | 200Dh | Unsigned 16 | Motor current | |
| | 4 | 2010h | Integer 16 | Drive temperature | |
| | | | | | |
| RX PDO2 | 1 | 0006h | Unsigned 16 | Dummy | 254 |
| | 2 | 0006h | Unsigned 16 | Dummy | |
| | 3 | 0006h | Unsigned 16 | Dummy | |
| | 4 | 0006h | Unsigned 16 | Dummy | |
| | | | | | |
| TX PDO2 | 1 | 2011h | Unsigned 16 | DC bus voltage | 254 |
| | 2 | 2012h | Unsigned 16 | Digital input status | |
| | 3 | 2013h | Integer 16 | Analog input 1 (%) | |
| | 4 | 2014h | Integer 16 | Analog input 2 (%) | |

***** Drive control can only be achieved when P-12=7 or 8 provided that P-31 = 0, 1, 4 or 5.

### 8.3.2. PDO transmission type

Various transmission modes can be selected for each PDO. For RX PDO, the following modes are supported:-

| Transmission Type | Mode | Description |
|---|---|---|
| 0 – 240 | Synchronous | The received data will be transferred to the drive active control register when the next sync message is received. |
| 254, 255 | Asynchronous | The received data will be transferred to the drive active control register immediately without delay. |

For TX PDO, the following modes are supported:-

| Transmission Type | Mode | Description |
|---|---|---|
| 0 | Acyclic synchronous | TX PDO will only be sent out if the PDO data has changed and PDO will be transmitted on reception of SYNC object |
| 1-240 | Cyclic synchronous | TX PDO will be transmitted synchronously and cyclically. The transmission type indicates the number of SYNC object that are |
| 254 | Asynchronous | TX PDO will only be transferred once corresponding RX PDO has been received. |
| 255 | Asynchronous | TX PDO will only be transferred anytime if PDO data value has changed. |

**CAN Open Specific Object Table**

| Index | Sub Index | Function | Access | Type | PDO Map | Default Value |
|---|---|---|---|---|---|---|
| 1000h | 0 | Device Type | R | U32 | N | 0 |
| 1001h | 0 | Error Register | R | U8 | N | 0 |
| 1002h | 0 | Manufacturer Status Register | R | U16 | N | 0 |
| 1005h | 0 | COB-ID Sync | RW | U32 | N | 00000080h |
| 1008h | 0 | Manufacturer Device Name | R | String | N | |
| 1009h | 0 | Manufacturer Hardware Version | R | String | N | x.xx |
| 100Ah | 0 | Manufacturer Software Version | R | String | N | x.xx |
| 100Ch | 0 | Guard Time (1ms) | RW | U16 | N | 0 |
| 100Dh | 0 | Life Time Factor | RW | U8 | N | 0 |
| 1014h | 0 | COB-ID EMCY | RW | U32 | N | 00000080h+Node ID |
| 1015h | 0 | Inhibit Time Emergency (100µs) | RW | U16 | N | 0 |
| 1017h | 0 | Producer Heartbeat Time (1ms) | RW | U16 | N | 0 |
| 1018h | 0 | Identity Object No. Of entries | R | U8 | N | 4 |
| | 1 | Vendor ID | R | U32 | N | 0x0000031A |
| | 2 | Product Code | R | U32 | N | Drive Dependent |
| | 3 | Revision Number | R | U32 | N | x.xx |
| | 4 | Serial Number | R | U32 | N | Drive Dependent |
| 1200h | 0 | SDO Parameter No. Of entries | R | U8 | N | 2 |
| | 1 | COB-ID Client -> Server (RX) | R | U32 | N | 00000600h+Node ID |
| | 2 | COB-ID Server -> Client (TX) | R | U32 | N | 00000580h+Node ID |
| 1400h | 0 | RX PDO1 comms param. no. of entries | R | U8 | N | 2 |
| | 1 | RX PDO1 COB-ID | RW | U32 | N | 40000200h+Node ID |
| | 2 | RX PDO transmission type | RW | U32 | N | 254 |
| 1401h | 0 | RX PDO2 comms param. no. of entries | R | U8 | N | 2 |
| | 1 | RX PDO2 COB-ID | RW | U32 | N | C0000300h+Node ID |
| | 2 | RX PDO2 transmission type | RW | U8 | N | 0 |
| 1600h | 0 | RX PDO1 1 mapping / no. of entries | RW | U8 | N | 4 |
| | 1 | RX PDO1 1st mapped object | RW | U32 | N | 20000010h |
| | 2 | RX PDO1 2nd mapped object | RW | U32 | N | 20010010h |
| | 3 | RX PDO1 3rd mapped object | RW | U32 | N | 20030010h |
| | 4 | RX PDO1 4th mapped object | RW | U32 | N | 00060010h |
| 1601h | 0 | RX PDO2 1 mapping / no. of entries | RW | U8 | N | 4 |
| | 1 | RX PDO2 1st mapped object | RW | U32 | N | 00060010h |
| | 2 | RX PDO2 2nd mapped object | RW | U32 | N | 00060010h |
| | 3 | RX PDO2 3rd mapped object | RW | U32 | N | 00060010h |
| | 4 | RX PDO2 4th mapped object | RW | U32 | N | 00060010h |
| 1800h | 0 | TX PDO1 comms parameter number of entries | R | U8 | N | 3 |
| | 1 | TX PDO1 COB-ID | RW | U32 | N | 40000180h+Node ID |
| | 2 | TX PDO1 transmission type | RW | U8 | N | 254 |
| | 3 | TX PDO1 Inhibit time (100µs) | RW | U16 | N | 0 |
| 1801h | 0 | TX PDO2 comms parameter no. of entries | R | U8 | N | 3 |
| | 1 | TX PDO2 COB-ID | RW | U32 | N | C0000280h+Node ID |
| | 2 | TX PDO2 transmission type | RW | U8 | N | 0 |
| | 3 | TX PDO2 Inhibit time (100µs) | RW | U16 | N | 0 |
| 1A00h | 0 | TX PDO1 mapping / no. of entries | RW | U8 | N | 4 |
| | 1 | TX PDO1 1st mapped object | RW | U32 | N | 200A0010h |
| | 2 | TX PDO1 2nd mapped object | RW | U32 | N | 200B0010h |
| | 3 | TX PDO1 3rd mapped object | RW | U32 | N | 200D0010h |
| | 4 | TX PDO1 4th mapped object | RW | U32 | N | 20100010h |
| 1A01h | 0 | TX PDO2 mapping / no. of entries | RW | U8 | N | 4 |
| | 1 | TX PDO2 1st mapped object | RW | U32 | N | 20110010h |
| | 2 | TX PDO2 2nd mapped object | RW | U32 | N | 20120010h |
| | 3 | TX PDO2 3rd mapped object | RW | U32 | N | 20130010h |
| | 4 | TX PDO2 4th mapped object | RW | U32 | N | 20140010h |

### 8.3.4. Parameter Access Overview

The accessible parameter numbers and respective scaling are listed in the following tables. The method to access the parameters depends on the fieldbus type in use as described in the following section.

The R/W column indicates whether the values are Writeable as well as readable (R/W) or Read Only (R)

The data types for the parameter are defined as follows:-

WORD Hexadecimal Word

U16 Unsigned 16 Bit Value

S16 Signed 16 Bit Value

### 8.3.5. Modbus RTU Register / CAN Open Index Data – Control & Monitoring

| Modbus RTU Register | CAN Open Index | Sub Index | PDO Map | Parameter Number | Upper byte | Lower Byte | Format | Min | Max | Type | Scaling |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2000h | 0 | Y | - | Control Word | | WORD | - | - | R/W | See Below |
| 2 | 2001h | 0 | Y | - | Frequency Setpoint | | S16 | -5000 | 5000 | R/W | 1dp, e.g. 100 = 10.0Hz |
| 3 | 2002h | 0 | Y | - | Reserved | | - | - | - | R/W | No function |
| 4 | 2003h | 0 | Y | - | Modbus ramp control time | | U16 | 0 | 60000 | R/W | 2dp, e.g. 500 = 5.00s |
| 5 | 2004h | 0 | Y | - | High Resolution Frequency Setpoint | | S16 | -30000 | 30000 | R | See Below |
| 6 | 200Ah | 0 | Y | - | Error code | Drive status | WORD | - | - | R | See Below |
| 7 | 200Bh | 0 | Y | - | Output Frequency | | S16 | 0 | 5000 | R | 1dp, e.g. 100 = 10.0Hz |
| 8 | 200Dh | 0 | Y | - | Motor Current | | U16 | 0 | - | R | 1dp, e.g. 100 = 10.0A |
| 9 | 200Eh | 0 | Y | - | Motor Torque | | S16 | 0 | 2000 | R | 1dp, e.g. 100 = 10.0% |
| 10 | 200Fh | 0 | Y | - | Motor Power | | U16 | 0 | - | R | 2dp, e.g. 100 = 1.00kW |
| 11 | 2012h | 0 | Y | P00-04 | Digital Input Status | | WORD | - | - | R | See Below |
| 12 | - | - | | P00-20 | Rating ID | | U16 | - | - | R | Internal Value |
| 13 | - | - | | P00-20 | Power rating | | U16 | - | - | R | 2dp, e.g. 37 = 0.37kW / HP |
| 14 | - | - | | P00-20 | Voltage rating | | U16 | - | - | R | See Below |
| 15 | 27E8h | 0 | N | P00-18 | IO processor software version | | U16 | - | - | R | 2dp, e.g. 300 = 3.00 |
| 16 | 27EAh | 0 | N | P00-18 | Motor control processor software version | | U16 | - | - | R | 2dp, e.g. 300 = 3.00 |
| 17 | - | - | | P00-20 | Drive type | | U16 | - | - | R | Internal Value |
| 18 | 201Ch | 0 | Y | P00-48 | Scope Channel 1 Data | | S16 | - | - | R | Internal Format |
| 19 | 201Dh | 0 | Y | P00-48 | Scope Channel 2 Data | | S16 | - | - | R | Internal Format |
| - | 201Eh | 0 | Y | P00-49 | Scope Channel 3 Data | | S16 | | | R | Internal Format |
| - | 201Fh | 0 | Y | P00-49 | Scope Channel 4 Data | | S16 | | | R | Internal Format |
| 20 | 2013h | 0 | Y | P00-01 | Analog 1 input result | | U16 | 0 | 1000 | R | 1dp, e.g. 500 = 50.0% |
| 21 | 2014h | 0 | Y | P00-02 | Analog 2 input result | | U16 | 0 | 1000 | R | 1dp, e.g. 500 = 50.0% |
| - | 2015h | 0 | Y | - | Analog Output % | | U16 | 0 | 1000 | R | 1dp, e.g. 500 = 50.0% |
| 22 | - | - | | P00-03 | Pre Ramp Speed Reference Value | | S16 | 0 | 5000 | R | 1dp, e.g. 500 = 50.0Hz |
| 23 | 2011h | 0 | Y | P00-08 | DC Bus Voltage | | U16 | 0 | 1000 | R | 600 = 600 Volts |
| 24 | - | | | P00-09 | Drive Power Stage Temperature | | S16 | -10 | 150 | R | 50 = 50°C |
| - | 2043h | 0 | Y | - | Control board temperature | | S16 | -10 | 150 | R | 50 = 50°C |
| 25 | - | - | | P00-30 | Drive Serial Number 4 | | U16 | - | - | R | See Below |
| 26 | - | - | | P00-30 | Drive Serial Number 3 | | U16 | - | - | R | |
| 27 | - | - | | P00-30 | Drive Serial Number 2 | | U16 | - | - | R | |
| 28 | - | - | | P00-30 | Drive Serial Number 1 | | U16 | - | - | R | |
| 29 | 2017h | 0 | Y | - | Relay Output Status | | WORD | 0 | 1 | R | Bit 0 Indicates Relay Status<br>1 = Relay Contacts Closed |
| 30 | - | - | | - | Reserved | | - | - | - | R | No Function |
| 31 | - | - | | - | Reserved | | - | - | - | R | No Function |
| 32 | 203Ch | 0 | Y | P00-26 | kWh Meter | | U16 | 0 | 9999 | R | 1dp, e.g. 100 = 10.0kWh |
| 33 | 203Dh | 0 | Y | P00-26 | MWh Meter | | U16 | 0 | | R | 10 = 10MWh |
| 34 | 203Eh | 0 | Y | P00-10 | Running Time – Hours | | U16 | | | R | 1 = 1 Hour |
| 35 | 203Fh | 0 | Y | P00-10 | Running Time – Minutes & Seconds | | U16 | | | R | 100 = 100 Seconds |
| 36 | 2040h | 0 | Y | P00-14 | Run time since last enable – Hours | | U16 | | | R | 1 = 1 Hour |
| 37 | 2041h | 0 | Y | P00-14 | Run time since last enable – Minutes & seconds | | U16 | | | R | 100 = 100 Seconds |
| 38 | - | - | | - | Reserved | | U16 | | | R | No Function |
| 39 | 2010h | 0 | Y | P00-20 | Internal Drive Temperature | | S16 | -10 | 100 | R | 20 = 20C |
| 40 | 2044h | 0 | Y | - | Speed Reference (Internal Format) | | U16 | 0 | P-01 | R | 3000 = 50Hz |
| 41 | - | - | | - | Reserved | | - | - | - | R | No Function |
| 42 | 2046h | 0 | Y | | Digital Pot / Keypad Reference | | U16 | 0 | P-01 | R | 3000 = 50Hz |
| 43 | 2048h | 0 | Y | P00-07 | Output Voltage | | U16 | 0 | - | R | 100 = 100 Volts AC RMS |
| 44 | - | - | | - | Parameter Access Index | | U16 | 1 | 60 | R | See Below |
| 45 | - | - | | - | Parameter Access Value | | S16 | - | - | R | See Below |
| - | 2049h | 0 | Y | P00-05 | PI Output | | U16 | 0 | 1000 | R | 1000 = 100.0% |
| - | 23E8h | 0 | N | - | Scope Index 12 | | | | | RW | |
| - | 23E9h | 0 | N | - | Scope Index 34 | | | | | RW | |
| - | 27D0h | 0 | N | P00-11 | Run Time Since Last Trip 1 – Hours | | U16 | 0 | 65535 | R | 1 = 1 Hour |
| - | 27D1h | 0 | N | P00-11 | Run Time Since Last Trip 1 - Seconds | | U16 | 0 | 3599 | R | 100 = 100 Seconds |
| - | 27D2h | 0 | N | P00-12 | Run Time Since Last Trip 2 – Hours | | U16 | 0 | 65535 | R | 1 = 1 Hour |
| - | 27D3h | 0 | N | P00-12 | Run Time Since Last Trip 2 - Seconds | | U16 | 0 | 3599 | R | 100 = 100 Seconds |
| - | 27D4h | 0 | N | P00-13 | Trip Log 2 & 1 | | WORD | - | - | R | |
| - | 27D5h | 0 | N | P00-13 | Trip Log 4 & 3 | | WORD | - | - | R | |
| - | 27D6h | 0 | N | P00-13 | Trip 1 Time – Hours | | U16 | 0 | 65535 | R | 1 = 1 Hour |

| Modbus RTU Register | CAN Open Index | Sub Index | PDO Map | Parameter Number | Upper byte | Lower Byte | Format | Min | Max | Type | Scaling |
|---|---|---|---|---|---|---|---|---|---|---|---|
| - | 26D7h | 0 | N | P00-13 | Trip 1 Time - Seconds | | U16 | 0 | 3599 | R | 100 = 100 Seconds |
| - | 27D8h | 0 | N | P00-13 | Trip 2 Time – Hours | | U16 | 0 | 65535 | R | 1 = 1 Hour |
| - | 27D9h | 0 | N | P00-13 | Trip 2 Time - Seconds | | U16 | 0 | 3599 | R | 100 = 100 Seconds |
| - | 27DAh | 0 | N | P00-13 | Trip 3 Time – Hours | | U16 | 0 | 65535 | R | 1 = 1 Hour |
| - | 27DBh | 0 | N | P00-13 | Trip 3 Time - Seconds | | U16 | 0 | 3599 | R | 100 = 100 Seconds |
| - | 27DCh | 0 | N | P00-13 | Trip 4 Time – Hours | | U16 | 0 | 65535 | R | 1 = 1 Hour |
| - | 27DDh | 0 | N | P00-13 | Trip 4 Time - Seconds | | U16 | 0 | 3599 | R | 100 = 100 Seconds |
| - | 27DEh | 0 | N | P00-23 | Time Heatsink > 85°C – Hours | | U16 | 0 | 65535 | R | 1 = 1 Hour |
| - | 27DFh | 0 | N | P00-23 | Time Heatsink > 85°C - Seconds | | U16 | 0 | 3599 | R | 100 = 100 Seconds |
| - | 27E0h | 0 | N | P00-24 | Time Internal > 80°C – Hours | | U16 | 0 | 65535 | R | 1 = 1 Hour |
| - | 27E1h | 0 | N | P00-24 | Time Internal > 80°C - Seconds | | U16 | 0 | 3599 | R | 100 = 100 Seconds |
| - | 27E2h | 0 | N | P00-27 | Fan Run Time – Hours | | U16 | 0 | 65535 | R | 1 = 1 Hour |
| - | 27E3h | 0 | N | P00-27 | Fan Run Time - Seconds | | U16 | 0 | 3599 | R | 100 = 100 Seconds |
| - | 27E4h | 0 | N | - | Fire Mode Active Time – Hours | | U16 | 0 | 65535 | R | 1 = 1 Hour |
| - | 27E5h | 0 | N | - | Fire Mode Active Time - Seconds | | U16 | 0 | 3599 | R | 100 = 100 Seconds |
| - | 27E6h | 0 | N | - | Power On Time – Hours | | U16 | 0 | 65535 | R | 1 = 1 Hour |
| - | 27E7h | 0 | N | - | Power On Time - Seconds | | U16 | 0 | 3599 | R | 100 = 100 Seconds |
| - | 27E9h | 0 | N | P00-28 | IO Checksum | | WORD | - | - | R | |
| - | 27EBh | 0 | N | P00-28 | DSP Checksum | | WORD | - | - | R | |
| - | 27ECh | 0 | N | P00-19 | Ambient Temperature Log 1 | | S16 | -10 | 150 | R | 50 = 50°C |
| - | 27Edh | 0 | N | P00-19 | Ambient Temperature Log 2 | | S16 | -10 | 150 | R | 50 = 50°C |
| - | 27EEh | 0 | N | P00-19 | Ambient Temperature Log 3 | | S16 | -10 | 150 | R | 50 = 50°C |
| - | 27EFh | 0 | N | P00-19 | Ambient Temperature Log 4 | | S16 | -10 | 150 | R | 50 = 50°C |
| - | 27F0h | 0 | N | P00-19 | Ambient Temperature Log 5 | | S16 | -10 | 150 | R | 50 = 50°C |
| - | 27F1h | 0 | N | P00-19 | Ambient Temperature Log 6 | | S16 | -10 | 150 | R | 50 = 50°C |
| - | 27F2h | 0 | N | P00-19 | Ambient Temperature Log 7 | | S16 | -10 | 150 | R | 50 = 50°C |
| - | 27F3h | 0 | N | P00-19 | Ambient Temperature Log 8 | | S16 | -10 | 150 | R | 50 = 50°C |
| - | 27F4h | 0 | N | P00-15 | DC Bus Voltage Log 1 | | U16 | 0 | 1000 | R | 600 = 600 Volts |
| - | 27F5h | 0 | N | P00-15 | DC Bus Voltage Log 2 | | U16 | 0 | 1000 | R | 600 = 600 Volts |
| - | 27F6h | 0 | N | P00-15 | DC Bus Voltage Log 3 | | U16 | 0 | 1000 | R | 600 = 600 Volts |
| - | 27F7h | 0 | N | P00-15 | DC Bus Voltage Log 4 | | U16 | 0 | 1000 | R | 600 = 600 Volts |
| - | 27F8h | 0 | N | P00-15 | DC Bus Voltage Log 5 | | U16 | 0 | 1000 | R | 600 = 600 Volts |
| - | 27F9h | 0 | N | P00-15 | DC Bus Voltage Log 6 | | U16 | 0 | 1000 | R | 600 = 600 Volts |
| - | 27FAh | 0 | N | P00-15 | DC Bus Voltage Log 7 | | U16 | 0 | 1000 | R | 600 = 600 Volts |
| - | 27FBh | 0 | N | P00-15 | DC Bus Voltage Log 8 | | U16 | 0 | 1000 | R | 600 = 600 Volts |
| - | 27FCh | 0 | N | P00-16 | Heatsink Temperature Log 1 | | S16 | -10 | 150 | R | 50 = 50°C |
| - | 27FDh | 0 | N | P00-16 | Heatsink Temperature Log 2 | | S16 | -10 | 150 | R | 50 = 50°C |
| - | 27FEh | 0 | N | P00-16 | Heatsink Temperature Log 3 | | S16 | -10 | 150 | R | 50 = 50°C |
| - | 27FFh | 0 | N | P00-16 | Heatsink Temperature Log 4 | | S16 | -10 | 150 | R | 50 = 50°C |
| - | 2800h | 0 | N | P00-16 | Heatsink Temperature Log 5 | | S16 | -10 | 150 | R | 50 = 50°C |
| - | 2801h | 0 | N | P00-16 | Heatsink Temperature Log 6 | | S16 | -10 | 150 | R | 50 = 50°C |
| - | 2802h | 0 | N | P00-16 | Heatsink Temperature Log 7 | | S16 | -10 | 150 | R | 50 = 50°C |
| - | 2803h | 0 | N | P00-16 | Heatsink Temperature Log 8 | | S16 | -10 | 150 | R | 50 = 50°C |
| - | 2804h | 0 | N | P00-17 | Motor Current Log 1 | | U16 | 0 | - | R | 1dp, e.g. 100 = 10.0A |
| - | 2805h | 0 | N | P00-17 | Motor Current Log 2 | | U16 | 0 | - | R | 1dp, e.g. 100 = 10.0A |
| - | 2806h | 0 | N | P00-17 | Motor Current Log 3 | | U16 | 0 | - | R | 1dp, e.g. 100 = 10.0A |
| - | 2807h | 0 | N | P00-17 | Motor Current Log 4 | | U16 | 0 | - | R | 1dp, e.g. 100 = 10.0A |
| - | 2808h | 0 | N | P00-17 | Motor Current Log 5 | | U16 | 0 | - | R | 1dp, e.g. 100 = 10.0A |
| - | 2809h | 0 | N | P00-17 | Motor Current Log 6 | | U16 | 0 | - | R | 1dp, e.g. 100 = 10.0A |
| - | 280Ah | 0 | N | P00-17 | Motor Current Log 7 | | U16 | 0 | - | R | 1dp, e.g. 100 = 10.0A |
| - | 280Bh | 0 | N | P00-17 | Motor Current Log 8 | | U16 | 0 | - | R | 1dp, e.g. 100 = 10.0A |
| - | 280Ch | 0 | N | P00-18 | DC Ripple Log 1 | | U16 | 0 | - | R | 1 = 1 Volt |
| - | 280Dh | 0 | N | P00-18 | DC Ripple Log 2 | | U16 | 0 | - | R | 1 = 1 Volt |
| | 280Eh | 0 | N | P00-18 | DC Ripple Log 3 | | U16 | 0 | - | R | 1 = 1 Volt |
| - | 280Fh | 0 | N | P00-18 | DC Ripple Log 4 | | U16 | 0 | - | R | 1 = 1 Volt |
| - | 2810h | 0 | N | P00-18 | DC Ripple Log 5 | | U16 | 0 | - | R | 1 = 1 Volt |
| - | 2811h | 0 | N | P00-18 | DC Ripple Log 6 | | U16 | 0 | - | R | 1 = 1 Volt |
| - | 2812h | 0 | N | P00-18 | DC Ripple Log 7 | | U16 | 0 | - | R | 1 = 1 Volt |
| - | 2813h | 0 | N | P00-18 | DC Ripple Log 8 | | U16 | 0 | - | R | 1 = 1 Volt |
| - | 2814h | 0 | N | P00-25 | Estimated Rotor Speed | | S16 | - | - | R | |
| - | 2815h | 0 | N | P00-32 | Actual PWM Frequency | | U16 | - | - | R | |
| - | 2816h | 0 | N | P00-31 | Motor Current iD | | U16 | 0 | - | R | |
| - | 2817h | 0 | N | P00-31 | Motor Current iQ | | U16 | 0 | - | R | |
| - | 2818h | 0 | N | P00-33 | O-I Trip Counter | | U16 | 0 | - | R | |
| - | 2819h | 0 | N | P00-34 | O-V Trip Counter | | U16 | 0 | - | R | |
| - | 281Ah | 0 | N | P00-35 | U-V Trip Counter | | U16 | 0 | - | R | |
| - | 281Bh | 0 | N | P00-36 | O-T Trip Counter | | U16 | 0 | - | R | |
| - | 281Ch | 0 | N | P00-37 | bO-I Trip Counter | | U16 | 0 | - | R | |
| - | 281Dh | 0 | N | P00-38 | O-Heat Trip Counter | | U16 | 0 | - | R | |

## Modbus RTU / CAN Open Index – Parameters

| Modbus RTU Register | CAN Open Index | Par. | Description | Format | Min | Max | Data format / scaling |
|---|---|---|---|---|---|---|---|
| 129 | 2065h | 01 | Max speed limit | U16 | 0 | 5*P-09 | Internal value (3000 = 50.0Hz) |
| 130 | 2066h | 02 | Min speed limit | U16 | 0 | P-01 | Internal value (3000 = 50.0Hz) |
| 131 | 2067h | 03 | Accel ramp time | U16 | 0 | 60000 | 2dp, e.g. 300=3.00s |
| 132 | 2068h | 04 | Decel ramp time | U16 | 0 | 60000 | 2dp, e.g. 300=3.00s |
| 133 | 2069h | 05 | Stop Mode | U16 | 0 | 3 | See parameter description for details |
| 134 | 206Ah | 06 | Energy Optimiser | U16 | 0 | 1 | See parameter description for details |
| 135 | 206Bh | 07 | Motor rated voltage | U16 | 0 | 250<br>500 | 400 = 400 Volts |
| 136 | 206Ch | 08 | Motor rated current | U16 | 0 | Drive Rating Dependent | 1dp, e.g. 100 = 10.0A |
| 137 | 206Dh | 09 | Motor rated frequency | U16 | 25 | 500 | Data unit is in Hz |
| 138 | 206Eh | 10 | Motor rated speed | U16 | 0 | 30000 | Maximum value equals to the sync speed of a typical 2-pole motor |
| 139 | 206Fh | 11 | Boost Value | U16 | 0 | Drive Rating Dependent | 1dp, e.g. 100 = 10.0% |
| 140 | 2070h | 12 | Control mode | U16 | 0 | 9 | See parameter description for details |
| 141 | 2071h | 13 | Application Mode | U16 | 0 | 2 | 0 : Industrial Mode<br>1 : Pump Mode<br>2 : Fan Mode |
| 142 | 2072h | 14 | Access code | U16 | 0 | 9999 | No Scaling |
| 143 | 2073h | 15 | Digital input function | U16 | 0 | 17 | See parameter description for details |
| 144 | 2074h | 16 | Analog input format | U16 | 0 | 7 | 0: 0...10V<br>1: b 0...10V<br>2: 0...20mA<br>3: t 4...20mA<br>4: r 4...20mA<br>5: t 20...4mA<br>6: r 20...4mA<br>7 : 10...0V |
| 145 | 2075h | 17 | Effective switching frequency | U16 | 0 | 5<br>(Drive Rating Dependent) | 0 = 4KHz<br>1 = 8KHz<br>2 = 12Khz<br>3 =16KHz<br>4 = 24KHz<br>5 = 32KHz |
| 146 | 2076h | 18 | Relay Output Function | U16 | 0 | 9 | See parameter description for details |
| 147 | 2077h | 19 | Digital Threshold | U16 | 0 | 1000 | 100 = 10.0% |
| 148 | 2078h | 20 | Preset Speed 1 | U16 | -P-01 | P-01 | Internal value (3000 = 50.0Hz) |
| 149 | 2079h | 21 | Preset Speed 2 | U16 | -P-01 | P-01 | Internal value (3000 = 50.0Hz) |
| 150 | 207Ah | 22 | Preset Speed 3 | U16 | -P-01 | P-01 | Internal value (3000 = 50.0Hz) |
| 151 | 207Bh | 23 | Preset Speed 4 | U16 | -P-01 | P-01 | Internal value (3000 = 50.0Hz) |
| 152 | 207Ch | 24 | 2nd Ramp | U16 | 0 | 2500 | 2dp e.g. 250 = 2.50s |
| 153 | 207Dh | 25 | Analog Output Function | U16 | 0 | 10 | See user guide for function details |
| 154 | 207Eh | 26 | Skip Frequency Centre | U16 | 0 | P-01 | Internal value (3000 = 50.0Hz) |
| 155 | 207Fh | 27 | Skip Frequency Band | U16 | 0 | P-01 | Internal value (3000 = 50.0Hz) |
| 156 | 2080h | 28 | V/F Adjust Voltage | U16 | 0 | P-07 | 100 = 100V |
| 157 | 2081h | 29 | V/F Adjust Frequency | U16 | 0 | P-09 | 50 = 50Hz |
| 158 | 2082h | 30 | Start Mode Select | WORD | See Below | | |
| 159 | 2083h | 31 | Keypad restart mode | U16 | 0 | 7 | See parameter description for details |
| 160 | 2084h | 32 | DC Injection | WORD | See Below | | |
| 161 | 2085h | 33 | Spin Start Enable | U16 | 0 | 2 | See parameter description for details |
| 162 | 2086h | 34 | Brake circuit enable | U16 | 0 | 4 | See parameter description for details |
| 163 | 2087h | 35 | Analog Input / Slave Scaling | U16 | 0 | 20000 | 1000 = 100.0% |
| 164 | 2088h | 36 | Communication Settings | WORD | See Below | | |
| 165 | 2089h | 37 | Access code definition | U16 | 0 | 9999 | |
| 166 | 208Ah | 38 | Parameter lock | U16 | 0 | 1 | See parameter description for details |
| 167 | 208Bh | 39 | Analog input offset | U16 | -5000 | 5000 | 1dp, e.g. 300=30.0% |
| 168 | 208Ch | 40 | Display Scaling Function | WORD | See Below | | |
| 169 | 208Dh | 41 | User PI P gain | U16 | 1 | 300 | 1dp, e.g. 10 = 1.0 |
| 170 | 208Eh | 42 | User PI I time constant | U16 | 0 | 300 | 1dp, e.g. 10 = 1.0s |
| 171 | 208Fh | 43 | User PI mode select | U16 | 0 | 1 | See parameter description for details |
| 172 | 2090h | 44 | User PI reference select | U16 | 0 | 1 | See parameter description for details |
| 173 | 2091h | 45 | User PI digital reference | U16 | 0 | 1000 | 1dp, e.g. 100 =10.0% |
| 174 | 2092h | 46 | User PI feedback select | U16 | 0 | 3 | See parameter description for details |
| 175 | 2093h | 47 | Analog Input 2 Format | U16 | 0 | 6 | 0: 0...10V<br>1: 0...20mA<br>2: t 4...20mA<br>3: r 4...20mA<br>4: t 20...4mA<br>5: r 20...4mA<br>6: Ptc-th |
| 176 | 2094h | 48 | Standby Mode Timer | U16 | 0 | 250 | 3dp, e.g. 25000 = 25.0s |
| 177 | 2095h | 49 | PI Wake Up Error Level | U16 | 0 | 1000 | 1dp, e.g. 50 = 5.0% |
| 178 | 2096h | 50 | User Relay Output Hysteresis | U16 | 0 | 1000 | 1dp e.g. 100 = 10.0% |

| Modbus RTU Register | CAN Open Index | Par. | Description | Format | Min | Max | Data format / scaling |
|---|---|---|---|---|---|---|---|
| 179 | 2097h | 51 | Motor Control Mode | U16 | 0 | 4 | See parameter description for details |
| 180 | 2098h | 52 | Motor Parameter Autotune | U16 | 0 | 1 | |
| 181 | 2099h | 53 | Vector Mode Gain | U16 | 0 | 2000 | 1dp, e.g. 500 = 50.0% |
| 182 | 209Ah | 54 | Maximum Current Limit | U16 | 0 | 1750 | 1dp, e.g. 1000 = 100.0% |
| 183 | 209Bh | 55 | Motor Stator Resistance | U16 | 0 | 65535 | 2dp, e.g. 100 = 1.00R |
| 184 | 209Ch | 56 | Motor Stator d-axis Inductance (Lsd) | U16 | 0 | 65535 | 1dp, e.g. 1000 = 100.0mH |
| 185 | 209Dh | 57 | Motor Stator q-axis Inductance (Lsq) | U16 | 0 | 65535 | 1dp, e.g. 1000 = 100.0mH |
| 186 | 209Eh | 58 | DC Injection Speed | U16 | 0 | P-01 | 3000 = 50.0Hz |
| 187 | 209Fh | 59 | DC Injection Current | U16 | 0 | 1000 | 1dp, e.g. 100 = 10.0% |
| 188 | 20A0h | 60 | Motor Overload Configuration | U16 | 0 | 4 | See Below |

### 8.3.7. Additional Information

***Drive Control Word Format***

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| High byte | | | | | | | | Low byte | | | | | | | |

Bit 0: Run/Stop command: Set to 1 to enable the drive. Set to 0 to stop the drive.

Bit 1: Fast stop request. Set to 1 to enable drive to stop with 2nd deceleration ramp.

Bit 2: Reset request. Set to 1 in order to reset the drive if drive is under trip condition.

User must clear this bit when drive is under normal condition to prevent un-expected reset.

Bit 3: Coast stop request. Set to 1 to issue a coast stop command.

For normal operation, Bit 3 has the highest priority, bit 0 has the lowest priority (bit 3>bit 1>bit 0). For example if user set command as 0x0009, drive will do a coast stop rather than run. For normal run/start, just set this register to 1.

Note that stat/stop (bit 0), fast stop (bit 1) and coast stop (bit 3) only works if P-31= 0 or 1. Otherwise, start/stop function is controlled by drive control terminals. Reset function (bit 2) works all the time as long as drive is operated under Modbus control mode (P-12=3 or 4).

***Speed Reference Format (Standard resolution)***

Speed reference value is transferred with one decimal place (200 = 20.0Hz). The maximum speed reference value is limited by P-01. Either register 2 or register 5 can be used for speed reference control, however only one reference should be used in any control system, otherwise unexpected behaviour can result.

***Acceleration / Deceleration Ramp Time***

Active only when P-12 = 4, this register specifies the drive acceleration and deceleration ramp time. The same value is applied simultaneously to the acceleration and deceleration ramp times. The value has two decimal places, e.g. 500 = 5.00 seconds.

***High Resolution Speed Reference***

This register allows the user to set the speed reference value in the internal format, e.g. 3000 = 50.0Hz. This allows control resolution to 1 RPM with a 2 pole motor. The maximum allowed value is limited by P-01.

Either register 2 or register 5 can be used for speed reference control, however only one reference should be used in any control system, otherwise unexpected behaviour can result.

***Drive status and error code Word***

High byte gives drive error code. (Valid when the drive is tripped, see 0 for further details)

Low byte gives drive status information as follows:-

- Bit 0: 0 =Drive Stopped, 1 = Drive Running
- Bit 1: 0 = OK, 1 = Drive Tripped
- Bit 5: 0 = OK, 1 = In Standby Mode
- Bit 6: 0 = Not Ready, 1 = Drive Ready to Run (not tripped, hardware enabled and no mains loss condition)

***Scope Channel Data Values***

These registers show the scope present data sample value for the first two scope channels. The channel data source selection is carried out through Optitools Studio.

### *Modbus RTU Registers 25 - 28: Drive Serial Number*

The drive serial number may be read using these four registers. The serial number has 11 digits, stored as follows:-

| Register 28 | | Register 27 | | | | Register 26 | | Register 25 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| x | x | x | x | x | x | x | x | x | x | x |

e.g.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Register 25 | 1 | | | | | | | | | | |
| Register 26 | 1 | | | | | | | | | | |
| Register 27 | 8745 | | | | | | | | | | |
| Register 28 | 57 | | | | | | | | | | |
| Drive Serial Number | 5 | 7 | 8 | 7 | 4 | 5 | 0 | 1 | 0 | 0 | 1 |

### *Start Mode, Auto Restart & Fire Mode Configuration (P-30)*

This parameter contains 3 values, stored as follows :-

| High Byte | | | | | | | | Low Byte | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Input Type<br>0 : Constant<br>1 : Momentary Start | | | | Input Sense<br>0 : Normally Closed (Open Fire Mode)<br>1 : Normally Open (Closed Fire Mode) | | | | Start Mode / Auto Restart as :-<br>0 : Edge-r<br>1: Auto-0<br>2 : Auto-1<br>3 : Auto-2<br>4 : Auto-3<br>5 : Auto-4<br>6 : Auto-5 | | | | | | | |

### *DC Injection Configuration (P-32)*

The parameter value is stored as a combined 16 bit word which is constructed as follows:-

| High Byte | | | | | | | | Low Byte | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| DC Injection Mode<br>0 : DC Injection on Start<br>1 : DC Injection on Stop<br>2 : DC Injection on Start & Stop | | | | | | | | DC Injection Duration : 1dp, e.g. 0 – 250 = 0.0 – 25.0s | | | | | | | |

### *Communications Configuration (P-36)*

This Register entry contains multiple data entries, as follows:-

| High Byte | | | | | | | | Low Byte | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Trip Configuration | | | | Baud Rate | | | | Drive Address | | | | | | | |

Data values can be interpreted as follows:-

| | | | |
|---|---|---|---|
| Drive Address | 1 to 63 | | |
| Baud Rate | **Setting** | **Modbus RTU** | **CAN Open** |
| | 0 | 115k2 | 500 |
| | 1 | 115k2 | 500 |
| | 2 | 9k6 | 500 |
| | 3 | 19k2 | 500 |
| | 4 | 38k4 | 500 |
| | 5 | 57k6 | 500 |
| | 6 | 115k2 | 500 |
| | 7 | 115k2 | 125 |
| | 8 | 115k2 | 250 |
| | 9 | 115k2 | 500 |
| | 10 | 115k2 | 1000 |
| Trip Time Set-up | 0 | Comms Loss Trip Disabled | |
| | 1 | 30ms Watchdog, Trip on Comms Loss | |
| | 2 | 300ms Watchdog, Trip on Comms Loss | |
| | 3 | 1000ms Watchdog, Trip on Comms Loss | |
| | 4 | 3000ms Watchdog, Trip on Comms Loss | |
| | 5 | 30ms Watchdog, Ramp to Stop on Comms Loss | |
| | 6 | 300ms Watchdog, Ramp to Stop on Comms Loss | |
| | 7 | 1000ms Watchdog, Ramp to Stop on Comms Loss | |
| | 8 | 3000ms Watchdog, Ramp to Stop on Comms Loss | |

### *Display Scaling (P-40)*

The parameter value is stored as a combined 16 bit word which is constructed as follows:-

| High Byte | | | | | | | | Low Byte | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Display Scaling Source<br>0 : Motor Speed<br>1 : Motor Current<br>2 : Analog Input 2 Signal<br>3 : PI Feedback | | Display Scaling Factor : 3dp, e.g. 0 – 16000 = 0.000 – 16.000 | | | | | | | | | | | | | |

***Motor Overload Configuration (P-60)***

This parameter is stored as follows :-

| High Byte | | | | | | | | Low Byte | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Reserved | | | | | | | | | | | | | | | |
| I x t Reaction<br>0 : It.trp<br>1 : Current Limit Reduction | | | | | | | | | | | | | | | |
| UL Thermal Overload Retention<br>0 : Disabled<br>1 : Enabled | | | | | | | | | | | | | | | |

### 8.3.8. Modbus RTU Indirect Parameter Access

Read / Write access to all user adjustable parameters is possible by using only two Modbus registers as shown below.

***Register 44: Drive parameter index***

This index value will be used by register 45 to carry out parameter read and write function. The valid range of this parameter is from 1 to 60 (maximum number of drive user adjustable parameters)

***Register 45: Drive parameter value***

When reading this register, the value represents the drive parameter value which index is specified by register 44.

When writing to this register, the value will be written to the drive parameter number specified by register 44.

***Parameter Read Method***

In order to read a parameter, firstly write the parameter number to register 44, then read the value from register 45, e.g. to Read the Value of P-01

- Write 1 to Register 44
- Read the Value of Register 45

***Parameter Write Method***

Writing parameter values can be achieved by the same method, however Register 45 is used to write the parameter value after the parameter number has been selected using Register 44, e.g. to Write a Value of 60.0Hz to parameter P-01

- Write 1 to Register 44
- Register 45 will return the present value of P-01, which can be Read if required
- Referring to the parameter table shown in 8.3.6, apply any scaling necessary
    - In this case, 60.0Hz = 3600
- Write the scaled value to Register 45. P-01 now changes to 60.0Hz, or an exception code may be returned.

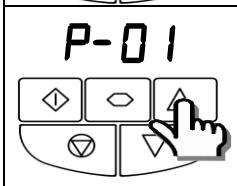
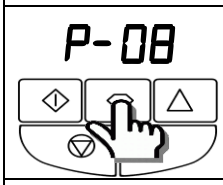
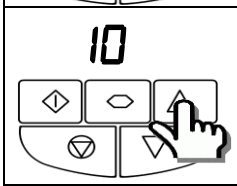
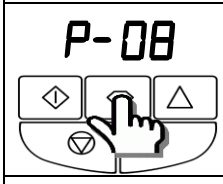
# 9. Additional Options

## 9.1. Managing the remote Keypad.

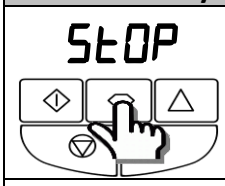
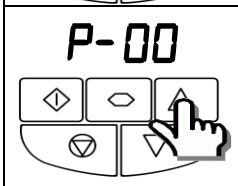
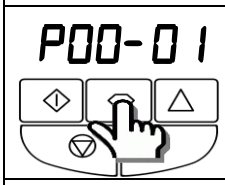
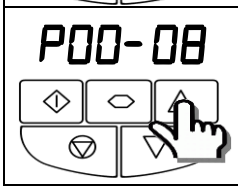
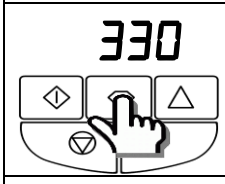
The drive is configured and its operation monitored via the keypad and display.

| | | |
|---|---|---|
| | NAVIGATE | Used to display real-time information, to access and exit parameter edit mode and to store parameter changes |
| | UP | Used to increase speed in real-time mode or to increase parameter values in parameter edit mode |
| | DOWN | Used to decrease speed in real-time mode or to decrease parameter values in parameter edit mode |
| | RESET / STOP | Used to reset a tripped drive.<br>When in Keypad mode is used to Stop a running drive. |
| | START | When in keypad mode, used to Start a stopped drive. |

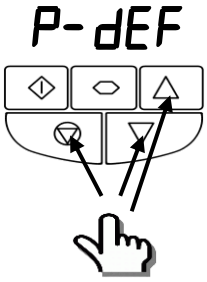
## 9.2. Changing Parameters

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

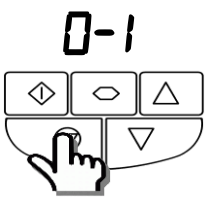
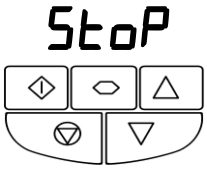
## 9.3. Read Only Parameter Access

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

## 9.4. Resetting Parameters

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

## 9.5. Resetting a Trip

| | |
|---|---|
|  | Press the Stop key.<br>The display will show "StoP" |
|  | |

# 10. Technical Data

## 10.1. Environmental

Operational ambient temperature range : -10 … 50°C (frost and condensation free)
Storage ambient temperature range : -40 … 60°C
Maximum altitude : 2000m. Derate above 1000m : 1% / 100m
Maximum humidity : 95%, non-condensing

## 10.2. Electrical Data

| 10.2.1. Mains Supply Details | |
|---|---|
| Supply Voltage Range | 110 Volt Units – 110 – 115 Volt +10% / -10%<br>230 Volt Units – 200 – 240 Volt +10% / -10%<br>400 Volt Units – 380 – 480 Volt +10% / -10% |
| Supply Frequency | 48 – 62Hz |
| Inrush Current | < rated input current |
| Power Up Cycles | >120x /hr, evenly spaced |
| Single Phase Operation | Three phase drives can be operated from a single phase supply with 50% derating of the maximum output current |
| Earth Leakage | When operating from a balanced three phase supply with the permissible supply voltage range, touch current according to IEC61800-5-1 does not exceed 3.5mA. |
| **10.2.2. Motor Control** | |
| Output Frequency Range | 0 to 500Hz in 0.1 Hz steps<br>Max Output Frequency = Max Switching Frequency / 16. |
| Output Voltage Range | 0 to Supply Voltage |
| Speed Regulation | Open Loop < 2% motor rated speed |
| Torque Control | 0 – 175% of rated torque, + / -5% accuracy, Response time <10ms |
| Effective Switching Frequency | 4 – 32kHz |
| Acceleration Time | 0 – 600 seconds, 0.01s resolution |
| Deceleration Time | Two deceleration ramps<br>0 – 600 seconds, 0.01s resolution |

## 10.3. Digital & Analog I/O

### 10.3.1. Digital Inputs Specification

Voltage Range 8 – 30 V dc, Internal or External supply, NPN (positive logic)
Response Time < 8ms

### 10.3.2. Analog Inputs Specification

Range Current : 0-20mA, 4-20mA. 20mA max input current
Voltage: -10-10V (Analog Input 1 Only), 0-10V, 0-5V, 0/24V, 30V max input
Resolution Analog Input 1: 12-bit, <16ms response time (Uni-Polar)
Analog Input 2: 12-bit, <16ms response time (Uni-Polar)
Accuracy better than 1% of full scale
Scaling & Offset Parameter adjustable
Impedance Current Mode : 500R
Voltage Mode : > 100kR

### 10.3.3. Analog Output Specification

Range Current : 0..20mA, 4..20mA, 20mA max
Analog : 0..10V, 0 / 24V (digital), 20mA max
Resolution 10-bit
Accuracy better than 1% of full scale

### 10.3.4. Relay Output

Maximum Switching Voltage : 250VAC, 30 VDC
Maximum Switching Current : 5A at 30 Volt DC, 6A at 250 Volt AC

## 10.4. Mechanical

### 10.4.1. Vibration

When mounted, all Compact 2 drive units should not be subjected to vibration levels in excess of the limits defined under EN61800-5-1.

## 10.5. Response Times

| Command Source | Response Time |
|---|---|
| Digital Input | <8ms |
| Analog Input | <16ms |
| Modbus RTU Interface | <8ms From receipt of valid command |
| CAN Open Interface | <8ms From receipt of valid command |
| Master / Slave Function | <8ms, response, 60ms cycle |
| Power Stage | <10ms to enable output |

## 10.6. Motor Control Performance

### 10.6.1. V/F Mode

Speed Regulation : + / - 20% of motor slip with slip compensation enabled

### 10.6.2. Vector Mode

Static Speed Accuracy: + / - 0.033%
Speed Regulation 0 – 100% Load Range : + / - 1%
Torque Response : 1- 8ms
Torque Linearity (10 – 90% of motor rated speed, 20 – 100% load torque range) : + / - 5%

## 10.7. Output Current Limit

### 10.7.1. Overload Operation

Optidrive Compact 2-E3 provides the following maximum permissible overload current :-

- 150% Output current / 60 Seconds Maximum
- 175% Output current / 2.5 Seconds Maximum

In addition, maximum continuous output current available and maximum permissible overload time may be adjusted according to the following

- PWM Switching Frequency Selected
- Low Output Frequency
- High Ambient Temperature

These functions are described more fully below.

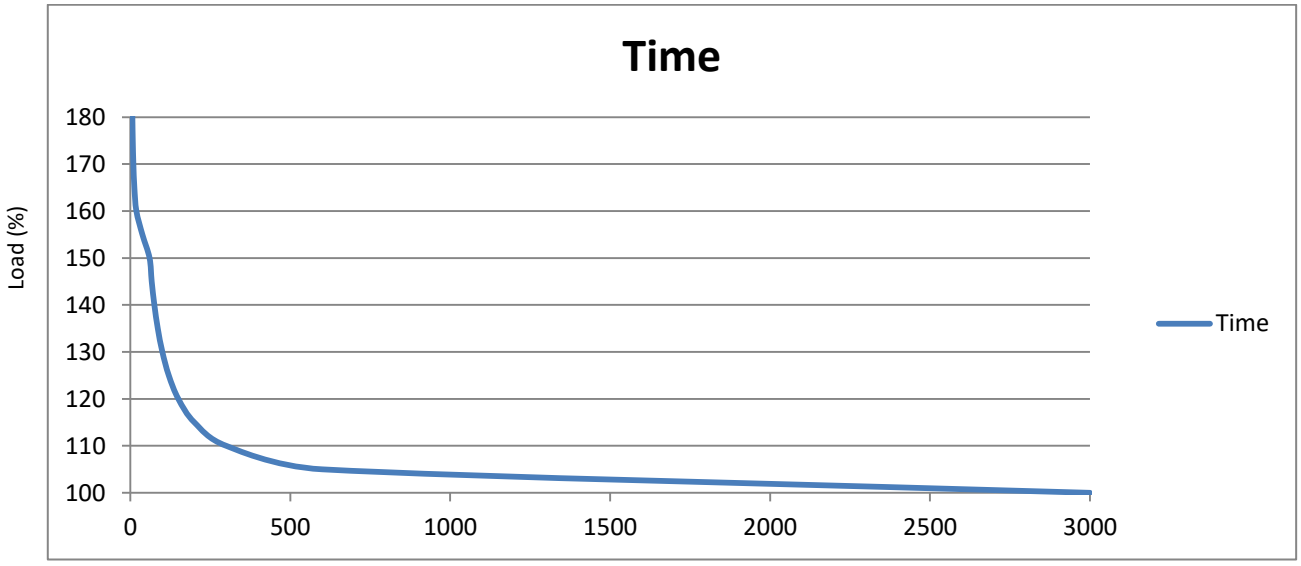
### 10.7.2. Overview

Optidrive Compact2-E3 features both hardware and software protection of the output stage to prevent damage. In addition, an Ixt system is used to monitor motor overload condition and prevent damage to the motor due to operation for prolonged periods at high load.
I x t protection is software based, using the value for motor rated current programmed in P-08. An internal accumulator register is used to estimate the point at which damage may occur to the motor, and operates as follows
Motor Current < P-08
The accumulator value reduces towards zero. The time required depends on the actual load current as explained further below.
Motor Current = 100% P-08
The accumulator value remains static.
Motor Current > 100% P-08 < 150% P-08
The accumulator value increases at a rate proportional to the overload level, e.g. (Motor Current / Rated current) – 100%. If the overload limit is reached, the drive will trip, displaying it.trp. to protect the motor.
Motor Current > 150% P-08
For high current levels, the accumulator operates 16 times faster than for current levels below 150% of P-08.
Peak over current trip levels are shown in the table below.

### 10.7.3. Example Operation

Maximum overload operation is 150% of motor rated current for 60 seconds. As this represents an overload of 50%, the accumulator trip level is 3000. This means that if the drive operates with 125% load current, the time can be calculated as 3000 / (125 – 100) = 120 Seconds.
Above 150% load, accumulation is 16 times faster, hence for 160% load current, the time is 3000 / 16 / (160 – 150) = 18.75 seconds

### 10.7.4. Overload Curve



## 10.8. Under / Over Voltage Trip Levels

The following levels are not user adjustable, and define the operating voltage levels of the drive and brake chopper circuit.

| Drive Rated Supply Voltage | Frame Size | Drive Type | DC Bus Voltage Level (Volts DC) | | | | |
|---|---|---|---|---|---|---|---|
| | | | Brake Chopper On | Brake Chopper Off | Under Voltage Trip | Minimum Operating (Inrush Disabled) | Over Voltage Trip |
| 100 – 115 Volts AC | FS1 | Voltage Doubler | N/A | N/A | 160 | 239 | 418 |
| 110 – 240 Volts AC | FS1 | PFC | N/A | N/A | 160 | 239 | 418 |
| 200 – 240 Volts AC | FS1 | All | N/A | N/A | 160 | 239 | 418 |
| 380 – 480 Volts AC | FS1 | All | N/A | N/A | 320 | 478 | 835 |
| 380 – 480 Volts AC | FS2 | All | 780 | 756 | 320 | 478 | 835 |

## 10.9. Effective Switching Frequency Operating Temperature

The user can select the desired effective switching frequency in parameter P-17. If the heatsink temperature increases beyond the threshold shown in the table below, the drive will automatically reduce the effective switching frequency to reduce the heat losses.
The switching frequency will return to the user set level the next time the drive is enabled, providing that the heatsink temperature is below the threshold limit shown below.

| Temperature Threshold | Action |
|---|---|
| 70 $^{O}$C | Auto reduce from 32kHz to 24kHz |
| 75 $^{O}$C | Auto reduce from 24kHz to 16kHz |
| 80 $^{O}$C | Auto reduce from 16kHz to 12kHz |
| 85 $^{O}$C | Auto reduce from 12kHz to 8kHz |
| 90 $^{O}$C | Auto reduce from 8kHz to 4kHz |
| 97 $^{O}$C | Over temp trip |

## 10.10. Electrical Rating Tables

| Frame Size | kW | HP | Input Current | Fuse / MCB (Type B) | | Maximum Cable Size[1] | | Output Current |
|---|---|---|---|---|---|---|---|---|
| | | | | Non UL | UL[2, 3, 4] | mm | AWG | A |
| **110 - 240 (+ / - 10%) V 1 Phase Input, 230 Volt 3 Phase Output (Voltage Doubler) with Integrated PFC** | | | | | | | | |
| 1B | 0.75 | 1 | TBC | 16 | 15 | 2.5 | 14 | 4.3 |
| **200 - 240 (+ / - 10%) V 1 Phase Input, 3 Phase Output** | | | | | | | | |
| 1A | 0.37 | 0.5 | TBC | TBC | N/A | 2.5 | 14 | TBC |
| 1A | 0.75 | 1 | TBC | TBC | N/A | 2.5 | 14 | 4.3 |
| **200 - 240 (+ / - 10%) V 1 Phase Input, 3 Phase Output with Integrated PFC** | | | | | | | | |
| 1B | 1.5 | 2 | 8.3 | 16 | 15 | 2.5 | 14 | TBC |
| **380 - 480 (+ / - 10%)V 3 Phase Input, 3 Phase Output** | | | | | | | | |
| 1A | 0.75 | 1 | 3.5 | 6 | 6 | 2.5 | 14 | 2.3 |
| 1A | 1.5 | 2 | 5.6 | 10 | 10 | 2.5 | 14 | 4.1 |
| 2 | 2.2 | 3 | TBC | 10 | 10 | 2.5 | 14 | 5.8 |
| 2 | 4 | 5 | TBC | 16 | 15 | 2.5 | 14 | 9.5 |

**Note**

1. Cable sizes shown are the maximum possible that may be connected to the drive. Cables should be selected according to local wiring codes or regulations applicable at the point of installation
2. Refer to the UL Online Certification Directory for a list of UL Recognised products, File Number E226333
3. The integral overload protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with applicable local regulations and the National Electrical Code.
4. Fuse type : UL JDDZ Class J
5. Where permitted, equivalent circuit breakers may be used

# 11. Diagnostic & Status Information

## 11.1. Status Indication LEDs

Each control module features two status LED's, labelled A1 and A2, these indicate the drive status as follows .

### 11.1.1. LED A1 indication

This LED has three colours, and indicates the drive status as follows :-

| Drive Status | LED Status | | |
|---|---|---|---|
| | Green | Red | Yellow |
| Stop/Inhibit | Slow flashing | Off | On if fire mode active |
| Running | Constant On | Off | On if fire mode active Slow flashing if overload |
| Standby | Constant On | Off | Blink every 3s |
| Trip / Fault | Off | Constant On | On if fire mode active |
| Base & Control Module not compatible | Off | Blink every 3s | Off |
| Internal Comms Loss | Off | Red and Yellow slow alternate flashing | |
| Control Module to base communication link fault | Off | Slow flashing | Off |
| External 24V | Green and Yellow slow flashing at same time | Off | Green and Yellow slow flashing at same time |
| Optistick Transfer Pass | Fast flashing 2s | Off | Off |
| Optistick Transfer Fail | Off | Fast flashing 2s | Off |
| Optistick Fail Other[4)] | Off | Off | Fast flashing 2s |
| Power Upgrade | All three LEDs lights up in order (Green->Yellow->Red->Yellow->…) | | |
| IO Upgrade | All LEDs on with weak light – uncontrolled due to bootloader | | |

### 11.1.2. LED A2 Indication

This LED illuminates when the RJ45 communication interface is active.

## 11.2. Fault Code Messages

In the event of a trip, the following is a list of potential codes. The fault code will be shown on a connected Optipad or Optiport, and the fault no. will be transferred in the high byte of the drive status word when an external serial communication is used.

| Fault Code | No. | Description | | Fault Code | No. | Description |
|---|---|---|---|---|---|---|
| **no-Flt** | 00 | No Fault | | **dAtA-F** | 17 | Internal memory fault. (IO) |
| **OI-b** | 01 | Brake channel over current | | **4-20 F** | 18 | 4-20mA Signal Lost |
| **OL-br** | 02 | Brake resistor overload | | **dAtA-E** | 19 | Internal memory fault. (DSP) |
| **O-I** | 03 | Instantaneous over current | | **U-dEF** | 20 | User Default Parameters Loaded |
| **I.t-trp** | 04 | Motor Thermal Overload (I2t) | | **F-Ptc** | 21 | Motor PTC thermistor trip |
| **O-Volt** | 06 | Over voltage on DC bus | | **FAN-F** | 22 | Cooling Fan Fault |
| **U-Volt** | 07 | Under voltage on DC bus | | **O-hEAt** | 23 | Environmental temperature too high |
| **O-t** | 08 | Heatsink over temperature | | **Out-F** | 26 | Drive output fault |
| **U-t** | 09 | Under temperature | | **Out-Ph** | 49 | Output (Motor) phase loss |
| **P-dEF** | 10 | Factory Default parameters have been loaded | | **SC-F01** | 50 | Modbus comms loss fault |
| **E-trip** | 11 | External trip | | **SC-F02** | 51 | CANopen comms loss trip |
| **SC-ObS** | 12 | Optibus comms loss | | **AtF-01** | 40 | Measured motor stator resistance varies between phases. |
| **FLt-dc** | 13 | DC bus ripple too high | | **AtF-02** | 41 | Measured motor stator resistance is too large. |
| **P-LOSS** | 14 | Input phase loss trip | | **AtF-03** | 42 | Measured motor inductance is too low. |
| **h O-I** | 15 | Instantaneous over current on drive output. | | **AtF-04** | 43 | Measured motor inductance is too large. |
| **th-Flt** | 16 | Faulty thermistor on heatsink. | | **Out-Ph** | 44 | Output (motor) phase missing |

# 12. Revision History

| Issue | Note | Section | Date |
|---|---|---|---|
| 01 | Pre Release | | 05/01/16 |
| 02 | Firmware version number added | - | 15/11/16 |
| | Revision number updated | - | |
| | Changed description of mounting surface | 3.1 | |
| | Revised power module part numbers | 2.3 | |
| | Added PFC unit mounting and dimensions | 3.2.2 | |
| | Added section relating to operating with Hz / RPM | 6.3.1 | |
| | Ambient temperature limit raised to 50°C | 10.1 | |
| | Overload operating times corrected, further detail added | 10.7.1 | |
| | Added PFC Rating data | 10.10 | |
| | Added fuse ratings | | |
| 03 | Added 110 Volt Voltage Doubler with PFC Unit | 10.10 | 7/12/16 |
| | Corrected depth measurement of frame size 1B PFC unit | 2.3 | |
| | Added units to heatsink data table | 3.6 | |
| | Add note for support of Modbus command 16 | 8.2 | |
| 04 | Added 110V PFC Model | 2.3.2 | 13/2/17 |
| | Added 230V 2.3 & 4.3A versions | 2.3.1 | |
| | Corrected Modbus terminal connections | 5.1 | |
| 05 | Additional model codes added | 2.3 | 27/3/17 |
| | Further information for heatsink calculation added | 3.4 | |
| | Revised data for DC Bus voltage levels | 10.8 | |
| | Added technical data for further models | 10.10 | |
| | Additional notes added relating to UL approved products and fusing | 10.10 | |
| | Removed old overload section to avoid duplication of information | | |
| | Added heatsink temperature switching frequency reduction thresholds | 3.5 | |
| 06 | Added additional power module model codes | 2.3 | 21/8/17 |
| | Added further heatsink calculation information | 3.4 | |
| | Added additional fault diagnosis info for status LEDs | 11.1 | |
| | Added Mounting Torque | 3.2 | |
| 07 | Added additional available model codes | 2.3.1 | 19/2/18 |
| | Improved model code guide | 2.2 | |
| | Added Frame Size 2 Mounting Dimensions | 3.2.3 | |
| | Revised heat loss data based on latest testing | 3.6.4 | |
| | Separate section for EMC disconnect location | 4.2 | |
| | P-05 description updated to match latest firmware | 6.4.1 | |
| | Improved P-36 description | 6.4.2 | |
| | P-48 Standby time maximum setting increased | 6.4.2 | |
| | Added notes to digital input function operation to further explain functions | 7.3 | |
| | Added option 18 to I/O tables | 7.3 | |
| | Removed non-supported codes from fault code table | 11.2 | |