



# OPTIDRIVE™

AC Variable Speed Drive

0.37kW – 22kW / 0.5HP – 30HP

110 – 480 Volt 1 & 3 Phase

Advanced Technical Manual



## Revision History

[illegible]

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# 1 About this Advanced Technical Manual

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## 1.1 Compatibility

**This Document is for use with version 3.05 Firmware.**

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.

The information in this user guide relates to the functionality of the firmware version as stated above. Prior versions of firmware may not fully support all functions as described. If necessary firmware updates may be carried out using Optitools Studio PC software.

## 1.2 Intended Audience

This Advanced Technical Manual is intended to be used in conjunction with the standard User Guide included with the product, and is intended to provide additional information for more advanced product applications and usage. The reader should be familiar with the contents of the standard product User Guide, and in particular, should observe all safety warnings and installation guidelines contained therein.

## 2 Optidrive E3 Parameter Set Overview

### 2.1 About this section

This document provides a list of the available parameters, and a description of their respective functions, for the Optidrive E3.

### 2.2 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.

## 2.3 Parameter Descriptions

### 2.3.1 Basic Parameters

| Par. | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Minimum                                    | Maximum                                                                                              | Default     | Units                                                                                                |     |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------------------------------------------------------------------------|-------------|------------------------------------------------------------------------------------------------------|-----|
| P-01 | <b>Maximum Frequency / Speed Limit</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | P-02                                       | 500.0                                                                                                | 50.0 (60.0) | Hz / RPM                                                                                             |     |
|      | Maximum output frequency or motor speed limit – Hz or RPM. If P-10 >0, the value entered / displayed is in RPM<br>The maximum possible value is limited by the lower of the following :- <ul style="list-style-type: none"><li>- 500.0Hz maximum limit</li><li>- P-09 x 5</li><li>- If P-10 &gt;0, (500 x 120) / Motor Poles RPM</li><li>- P-17 / 16</li></ul>                                                                                                                                                                                                                                                             |                                            |                                                                                                      |             |                                                                                                      |     |
|      | <b>Note</b><br>When P-10>0, slip compensation is automatically enabled, and P-01 is corrected to the synchronous speed of the motor.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                            |                                                                                                      |             |                                                                                                      |     |
| P-02 | <b>Minimum Frequency / Speed Limit</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 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 | <b>Acceleration Ramp Time</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0.00                                       | 600.0                                                                                                | 5.0         | s                                                                                                    |     |
|      | Acceleration ramp time from zero Hz / RPM to base frequency (P-09) in seconds.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                            |                                                                                                      |             |                                                                                                      |     |
| P-04 | <b>Deceleration Ramp Time</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0.00                                       | 600.0                                                                                                | 5.0         | s                                                                                                    |     |
|      | Deceleration ramp time from base frequency (P-09) to standstill in seconds. When set to 0.00, the value of P-24 is used.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                            |                                                                                                      |             |                                                                                                      |     |
| P-05 | <b>Stopping Mode</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                            | 0                                                                                                    | 3           | 0                                                                                                    | -   |
|      | <b>Setting</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Description</b>                         | <b>Behaviour on Disable (Stop)</b>                                                                   |             | <b>Behaviour on Mains Loss</b>                                                                       |     |
|      | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Ramp To Stop with Mains Loss Ride Through. | Ramp to stop, rate controlled by P-04.                                                               |             | Continue running by reducing the speed of the load to recover energy.                                |     |
|      | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Coast to Stop                              | Coast (freewheel) to stop                                                                            |             |                                                                                                      |     |
|      | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Ramp To Stop                               | Ramp to stop, rate controlled by P-04.                                                               |             | Ramp to stop using the P-24 decel ramp                                                               |     |
|      | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | AC Flux Braking                            | As setting 2, but AC flux braking is also applied, increasing the level of available braking torque. |             | As setting 2, but AC flux braking is also applied, increasing the level of available braking torque. |     |
|      | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Mains Loss function disabled               | No Action                                                                                            |             | No Action                                                                                            |     |
| P-06 | <b>Energy Optimisation</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                            | 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. |                                            |                                                                                                      |             |                                                                                                      |     |
|      | <b>Setting</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Motor Energy Optimiser</b>              | <b>Drive Energy Optimiser</b>                                                                        |             |                                                                                                      |     |
|      | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Disabled                                   | Disabled                                                                                             |             |                                                                                                      |     |
|      | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Enabled                                    | Disabled                                                                                             |             |                                                                                                      |     |
|      | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Disabled                                   | Enabled                                                                                              |             |                                                                                                      |     |
|      | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Enabled                                    | Enabled                                                                                              |             |                                                                                                      |     |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                            |                                                                                                      |             |                                                                                                      |     |
| P-07 | <b>Motor Rated Voltage / Back EMF at rated speed (PM / BLDC)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                            | 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 | <b>Motor Rated Current</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                            | 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 9.10.4                                                                                                                                                                                                                                                                                                                                |                                            |                                                                                                      |             |                                                                                                      |     |
| P-09 | <b>Motor Rated Frequency</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                            | 10                                                                                                   | 500         | 50 (60)                                                                                              | Hz  |
|      | This parameter should be set to the rated (nameplate) frequency of the motor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                            |                                                                                                      |             |                                                                                                      |     |
| P-10 | <b>Motor Rated Speed</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                            | 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><b>Note</b> 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                            | Drive<br>Dependent                                                                                                                                                          | 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.<br>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.<br>Frame Size 1 : 60 – 80% of motor rated current<br>Frame Size 2 : 50 – 60% of motor rated current<br>Frame Size 3 : 40 – 50% of motor rated current<br>Frame Size 4 : 35 – 45% of motor rated current<br>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.                                                                                     |                       |                   |                                                |
| P-13 | 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                |                                                                                                                                                                             |                       |                   |                                                |
|      | Operating Mode Select                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                | 0                                                                                                                                                                           | 2                     | 0                 | -                                              |
|      | Provides a quick set up to configure key parameters according to the intended application of the drive. Parameters are preset according to the table.<br>0: Industrial Mode. Intended for general purpose applications.<br>1: Pump Mode. Intended for centrifugal pump applications.<br>2: Fan Mode. Intended for Fan applications.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                |                                                                                                                                                                             |                       |                   |                                                |
|      | Setting                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Application                    | Current Limit (P-54)                                                                                                                                                        | Torque Characteristic | Spin Start (P-33) | Thermal Overload Limit Reaction (P-60 Index 2) |
|      | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | General                        | 150%                                                                                                                                                                        | Constant              | 0 : Off           | 0 : Trip                                       |
|      | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Pump                           | 110%                                                                                                                                                                        | Variable              | 0 : Off           | 1 : Current Limit Reduction                    |
|      | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Fan                            | 110%                                                                                                                                                                        | Variable              | 2 : On            | 1 : Current Limit Reduction                    |
| P-14 | Extended Menu Access code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                | 0                                                                                                                                                                           | 65535                 | 0                 | -                                              |
|      | Enables access to Extended and Advanced Parameter Groups. This parameter must be set to the value programmed in P-37 (default: 101) to view and adjust Extended Parameters and value of P-37 + 100 to view and adjust Advanced Parameters. The code may be changed by the user in P-37 if desired.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                |                                                                                                                                                                             |                       |                   |                                                |

## 2.3.2 Extended parameters

| Par.                                   | Description                                                                                                                                                                                                                                                                                                       | Minimum                                | Maximum                                                                                                                                            | Default | Units |          |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|---------|-------|----------|
| P-15                                   | Digital Input Function Select                                                                                                                                                                                                                                                                                     | 0                                      | 15                                                                                                                                                 | 0       | -     |          |
|                                        | Defines the function of the digital inputs depending on the control mode setting in P-12. See section 2.6 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 $\leq 0.0\%$                                         |         |       |          |
|                                        | 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 $\leq 0.0\%$ |         |       |          |
|                                        | A 0-20                                                                                                                                                                                                                                                                                                            | 0 to 20mA                              |                                                                                                                                                    |         |       |          |
|                                        | E 4-20                                                                                                                                                                                                                                                                                                            | 4 to 20mA                              | The drive will trip and show the fault code <b>4-20F</b> 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                                                                    |         |       |          |
|                                        | E 20-4                                                                                                                                                                                                                                                                                                            | 20 to 4mA                              | The drive will trip and show the fault code <b>4-20F</b> 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 $\leq 0.0\%$                   |         |       |          |
| 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 $\geq$ Limit          | The output frequency exceeds the adjustable limit set in P-19                                                                                      |         |       |          |
|                                        | 5                                                                                                                                                                                                                                                                                                                 | Output Current $\geq$ 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                                                                                     |         |       |          |
| 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                                                                                                                                                                                                                                       |                                        |                                                                                                                                                    |         |       |          |
|                                        | Preset Frequency / Speed 1                                                                                                                                                                                                                                                                                        |                                        | P-02                                                                                                                                               | P-01    | 5.0   | Hz / RPM |
|                                        | Preset Frequency / Speed 2                                                                                                                                                                                                                                                                                        |                                        | P-02                                                                                                                                               | P-01    | 25.0  | Hz / RPM |
|                                        | Preset Frequency / Speed 3                                                                                                                                                                                                                                                                                        |                                        | P-02                                                                                                                                               | P-01    | 40.0  | Hz / RPM |
|                                        | 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><b>Note</b> Changing the value of P-09 will reset all values to factory default settings                                     |                                        |                                                                                                                                                    |         |       |          |
|                                        | 2nd Deceleration Ramp Time (Fast Stop)                                                                                                                                                                                                                                                                            |                                        | 0.00                                                                                                                                               | 600.0   | 0.00  | 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 $\geq$ Limit          | The output frequency exceeds the adjustable limit set in P-19                                                                                      |         |       |          |
| 5                                      |                                                                                                                                                                                                                                                                                                                   | Output Current $\geq$ 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                                                                                                                                                                                                                  | 250 / 500                                                                                                                                                                                                                                                                                                | 0                                                                                                                                                                                                                                                                                                                                                                  | V        |   |
| P-29 | V/F Characteristic Adjustment Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0.0                                                                                                                                                                                                                | P-09                                                                                                                                                                                                                                                                                                     | 0.0                                                                                                                                                                                                                                                                                                                                                                | Hz       |   |
|      | 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                    |          |   |
|      | 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 | <b>Spin Start (S2 &amp; S3 Only) / DC Injection Time On Start (S1 Only)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                          | 0                                                                                                                                                                                                                                     | 2       | 0     |
|      | <b>Setting</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Function</b>                          | <b>Description</b>                                                                                                                                                                                                                    |         |       |
|      | 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.                                                                                                                                                   |         |       |
| P-34 | <b>Brake Chopper Enable (Not Size 1)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                          | 0                                                                                                                                                                                                                                     | 2       | 0     |
|      | <b>Setting</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Function</b>                          | <b>Description</b>                                                                                                                                                                                                                    |         |       |
|      | 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.                                                                                   |         |       |
| P-35 | <b>Analog Input 1 Scaling / Slave Speed Scaling</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                          | 0.0                                                                                                                                                                                                                                   | 2000.0  | 100.0 |
|      | <b>Analog Input 1 Scaling.</b> 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)                                                                                                                                                                                                                                                       |                                          |                                                                                                                                                                                                                                       |         | %     |
|      | <b>Slave Speed Scaling.</b> 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 | <b>Serial Communications Configuration</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                          | See Below                                                                                                                                                                                                                             |         |       |
|      | <b>Index 1 : Address</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                          | 0                                                                                                                                                                                                                                     | 63      | 1     |
|      | <b>Index 2 : Baud Rate</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                          | 9.6                                                                                                                                                                                                                                   | 1000    | 115.2 |
|      | <b>Index 3 : Communication loss protection</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                          | 0                                                                                                                                                                                                                                     | 3000    | 300   |
|      | This parameter has three sub settings used to configure the Modbus RTU Serial Communications. The Sub Parameters are                                                                                                                                                                                                                                                                                                                                                                                                    |                                          |                                                                                                                                                                                                                                       |         | ms    |
|      | <b>Index 1 : Drive Address :</b> Range : 0 – 63, default : 1                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                          |                                                                                                                                                                                                                                       |         |       |
|      | <b>Index 2 : Baud Rate &amp; Network type:</b> 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.                                                                                                                                                                                                                                    |                                          |                                                                                                                                                                                                                                       |         |       |
|      | <b>Index 3 : Watchdog Timeout:</b> Defines the time for which the drive will operate without receiving a valid command telegram to Register 1 (Drive Control Word) after the drive has been enabled. Setting 0 disables the Watchdog timer. Setting a value of 30, 100, 1000, 3000, 10000, 30000 or 60000 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 | <b>Access Code Definition</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          | 0                                                                                                                                                                                                                                     | 9999    | 101   |
|      | Defines the access code which must be entered in P-14 to access parameters above P-14                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                          |                                                                                                                                                                                                                                       |         | -     |
| P-38 | <b>Parameter Access Lock</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                          | 0                                                                                                                                                                                                                                     | 1       | 0     |
|      | <b>Setting</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Function</b>                          | <b>Description</b>                                                                                                                                                                                                                    |         |       |
|      | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Unlocked                                 | All parameters can be accessed and changed                                                                                                                                                                                            |         |       |
|      | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Locked                                   | Parameter values can be displayed, but cannot be changed except P-38.                                                                                                                                                                 |         |       |
| P-39 | <b>Analog Input 1 Offset</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                          | -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.                                                                                                                                                                                                                                                                                                |                                          |                                                                                                                                                                                                                                       |         | %     |
|      | The resultant value is defined as a percentage, according to the following :-<br>$P00-01 = (\text{Applied Signal Level}(\%) - P-39) \times P-35$                                                                                                                                                                                                                                                                                                                                                                        |                                          |                                                                                                                                                                                                                                       |         |       |
| P-40 | <b>Index 1 : Display Scaling Factor</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          | 0.000                                                                                                                                                                                                                                 | 16.000  | 0.000 |
|      | <b>Index 2 : Display Scaling Source</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          | 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.                                                                                                                                                                                                                                                                                                                |                                          |                                                                                                                                                                                                                                       |         | -     |
|      | <b>Index 1:</b> Used to set the scaling multiplier. The chosen source value is multiplied by this factor.                                                                                                                                                                                                                                                                                                                                                                                                               |                                          |                                                                                                                                                                                                                                       |         |       |
|      | <b>Index 2 :</b> Defines the scaling source as follows :-                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                          |                                                                                                                                                                                                                                       |         |       |
|      | <b>Setting</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Function</b>                          | <b>Description</b>                                                                                                                                                                                                                    |         |       |
|      | 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%                                                                                                                                          |         |       |
| P-41 | <b>PI Controller Proportional Gain</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                          | 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 | <b>PI Controller Integral Time</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                          | 0.0                                                                                                                                                                                                                                   | 30.0    | 1.0   |
|      | PI Controller Integral Time. Larger values provide a more damped response for systems where the overall process responds slowly                                                                                                                                                                                                                                                                                                                                                                                         |                                          |                                                                                                                                                                                                                                       |         | s     |

| Par. | Description                                                                                                                                                                                                                                                                                                                                                                                         |                              | Minimum                                                                                                                                                                    | Maximum | Default | Units |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|---------|-------|
| P-43 | <b>PI Controller Operating Mode</b>                                                                                                                                                                                                                                                                                                                                                                 |                              | 0                                                                                                                                                                          | 1       | 0       | -     |
|      | <b>Setting</b>                                                                                                                                                                                                                                                                                                                                                                                      | <b>Function</b>              | <b>Description</b>                                                                                                                                                         |         |         |       |
|      | 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. |         |         |       |
| P-44 | <b>PI Reference (Setpoint) Source Select</b>                                                                                                                                                                                                                                                                                                                                                        |                              | 0                                                                                                                                                                          | 1       | 0       | -     |
|      | Selects the source for the PID Reference / Setpoint                                                                                                                                                                                                                                                                                                                                                 |                              |                                                                                                                                                                            |         |         |       |
|      | <b>Setting</b>                                                                                                                                                                                                                                                                                                                                                                                      | <b>Function</b>              | <b>Description</b>                                                                                                                                                         |         |         |       |
|      | 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.                                                                                                  |         |         |       |
| P-45 | <b>PI Digital Setpoint</b>                                                                                                                                                                                                                                                                                                                                                                          |                              | 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.                                                                                                                                                                                                                                                          |                              |                                                                                                                                                                            |         |         |       |
| P-46 | <b>PI Feedback Source Select</b>                                                                                                                                                                                                                                                                                                                                                                    |                              | 0                                                                                                                                                                          | 5       | 0       | -     |
|      | Selects the source of the feedback signal to be used by the PI controller.                                                                                                                                                                                                                                                                                                                          |                              |                                                                                                                                                                            |         |         |       |
|      | <b>Setting</b>                                                                                                                                                                                                                                                                                                                                                                                      | <b>Function</b>              | <b>Description</b>                                                                                                                                                         |         |         |       |
|      | 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.                                                                                                  |         |         |       |
| P-47 | <b>Analog Input 2 Signal Format</b>                                                                                                                                                                                                                                                                                                                                                                 |                              | -                                                                                                                                                                          | -       | -       | U0-10 |
|      | <b>Setting</b>                                                                                                                                                                                                                                                                                                                                                                                      | <b>Signal Type</b>           | <b>Additional Information</b>                                                                                                                                              |         |         |       |
|      | U 0-10                                                                                                                                                                                                                                                                                                                                                                                              | 0 to 10 Volt                 |                                                                                                                                                                            |         |         |       |
|      | A 0-20                                                                                                                                                                                                                                                                                                                                                                                              | 0 to 20mA                    |                                                                                                                                                                            |         |         |       |
|      | E 4-20                                                                                                                                                                                                                                                                                                                                                                                              | 4 to 20mA                    | The drive will trip and show the fault code <b>4-20F</b> 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                                                                                                            |         |         |       |
|      | E 20-4                                                                                                                                                                                                                                                                                                                                                                                              | 20 to 4mA                    | The drive will trip and show the fault code <b>4-20F</b> 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-Eh                                                                                                                                                                                                                                                                                                                                                                                              | Motor Thermistor (PTC)       | Valid with any setting of P-15 that has Input 3 as E-Trip.                                                                                                                 |         |         |       |
| P-48 | <b>Standby Mode Timer</b>                                                                                                                                                                                                                                                                                                                                                                           |                              | 0.0                                                                                                                                                                        | 25.0    | 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 <b>Standby</b> , and the output to the motor is disabled.                                                                                                                          |                              |                                                                                                                                                                            |         |         |       |
| P-49 | <b>PI Control Wake Up Error Level</b>                                                                                                                                                                                                                                                                                                                                                               |                              | 0.0                                                                                                                                                                        | 100.0   | 0.0     | %     |
|      | 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. |                              |                                                                                                                                                                            |         |         |       |
| P-50 | <b>User Output Relay Hysteresis</b>                                                                                                                                                                                                                                                                                                                                                                 |                              | 0.0                                                                                                                                                                        | 10.0    | 5.0     | %     |
|      | Sets the hysteresis level for P-19 to prevent the output relay chattering when close to the threshold.                                                                                                                                                                                                                                                                                              |                              |                                                                                                                                                                            |         |         |       |

## 2.3.3 Advanced Parameters

| Par. | Description                                                                                                                                                                                                                                                                                                                                                                                       | Minimum                                                                                                                                                                                      | Maximum | Default | Units    |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|---------|----------|
| P-51 | <b>Motor Control Mode</b>                                                                                                                                                                                                                                                                                                                                                                         | 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 | <b>Motor Parameter Autotune</b>                                                                                                                                                                                                                                                                                                                                                                   | 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 <b>MUST</b> be carried out <b>AFTER</b> 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 | <b>Vector Mode Gain</b>                                                                                                                                                                                                                                                                                                                                                                           | 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 | <b>Maximum Current Limit</b>                                                                                                                                                                                                                                                                                                                                                                      | 0.1                                                                                                                                                                                          | 175.0   | 150.0   | %        |
|      | Defines the max current limit in vector control modes                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                              |         |         |          |
| P-55 | <b>Motor Stator Resistance</b>                                                                                                                                                                                                                                                                                                                                                                    | 0.0                                                                                                                                                                                          | 655.35  | -       | $\Omega$ |
|      | Motor stator resistance in Ohms. Determined by Autotune, adjustment is not normally required.                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                              |         |         |          |
| P-56 | <b>Motor Stator d-axis Inductance (Lsd)</b>                                                                                                                                                                                                                                                                                                                                                       | 0                                                                                                                                                                                            | 6553.5  | -       | mH       |
|      | Determined by Autotune, adjustment is not normally required.                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                              |         |         |          |
| P-57 | <b>Motor Stator q-axis Inductance (Lsq)</b>                                                                                                                                                                                                                                                                                                                                                       | 0                                                                                                                                                                                            | 6553.5  | -       | mH       |
|      | Determined by Autotune, adjustment is not normally required.                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                              |         |         |          |
| P-58 | <b>DC Injection Speed</b>                                                                                                                                                                                                                                                                                                                                                                         | 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 | <b>DC Injection Current</b>                                                                                                                                                                                                                                                                                                                                                                       | 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 | <b>Motor Overload Management</b>                                                                                                                                                                                                                                                                                                                                                                  | -                                                                                                                                                                                            | -       | -       | -        |
|      | <b>Index 1 : Thermal Overload Retention</b>                                                                                                                                                                                                                                                                                                                                                       | 0                                                                                                                                                                                            | 1       | 0       | 1        |
|      | 0 : Disabled<br>1: Enabled. When enabled, the drive calculated motor overload protection information is retained after the mains power is removed from the drive.                                                                                                                                                                                                                                 |                                                                                                                                                                                              |         |         |          |
|      | <b>Index 2 : Thermal Overload Limit Reaction</b>                                                                                                                                                                                                                                                                                                                                                  | 0                                                                                                                                                                                            | 1       | 0       | 1        |
|      | 0: It.trp. When the overload accumulator reaches the limit, the drive will trip on It.trp to prevent damage to the motor.<br>1: Current Limit Reduction. When the overload accumulator reaches 90% of, the output current limit is internally reduced to 100% of P-08 in order to avoid an It.trp. The current limit will return to the setting in P-54 when the overload accumulator reaches 10% |                                                                                                                                                                                              |         |         |          |

## 2.4 Alternative Parameter Functions for Single Phase Output Drives

Single phase output drives feature a number of changes in order to provide optimal operation with single phase motors. These changes are based around two key principles:-

- The Starting method for single phase motors requires the motor to be started at full speed in order to provide optimal starting torque. The starting boost parameters allow adjustment of this function to provide optimal motor starting.
- It is not possible to have reverse operation with a single phase motors, thereby all reverse functions are disabled in the drive firmware.

### 2.4.1 Single Phase Output Drives – Alternative Parameters

| Par.               | Description                                                                                                                                                                                                                                                                                                                                                                                                                | Minimum             | Maximum                                                       | Default | Units    |   |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------------------------------------------------|---------|----------|---|
| P-05               | <b>Stopping Mode / Mains Loss Response</b>                                                                                                                                                                                                                                                                                                                                                                                 |                     | 0                                                             | 2       | 0        | - |
|                    | Selects the stopping mode of the drive, and the behaviour in response to a loss of mains power supply during operation.                                                                                                                                                                                                                                                                                                    |                     |                                                               |         |          |   |
|                    | <b>Setting</b>                                                                                                                                                                                                                                                                                                                                                                                                             | <b>On Disable</b>   | <b>On Mains Loss</b>                                          |         |          |   |
|                    | 0                                                                                                                                                                                                                                                                                                                                                                                                                          | Ramp to Stop (P-04) | Ride Through (Recover energy from load to maintain operation) |         |          |   |
|                    | 1                                                                                                                                                                                                                                                                                                                                                                                                                          | Coast               | Coast                                                         |         |          |   |
|                    | 2                                                                                                                                                                                                                                                                                                                                                                                                                          | Ramp to Stop (P-04) | Fast Ramp to Stop (P-24), Coast if P-24 = 0                   |         |          |   |
|                    | AC Flux braking is not possible with single phase motors.                                                                                                                                                                                                                                                                                                                                                                  |                     |                                                               |         |          |   |
| P-06               | <b>Reserved</b>                                                                                                                                                                                                                                                                                                                                                                                                            | -                   | -                                                             | -       | -        |   |
|                    | Energy optimiser feature is not suitable for Single Phase motors                                                                                                                                                                                                                                                                                                                                                           |                     |                                                               |         |          |   |
| P-11               | <b>Start Boost Voltage</b>                                                                                                                                                                                                                                                                                                                                                                                                 | 0.0                 | 100.0                                                         | 3.0     | %        |   |
|                    | This parameter sets the initial voltage applied to the motor following a start command. The inverter applied the voltage set in this parameter at the frequency set in P-32 initially, and then ramps to the motor rated voltage set in P-09 over the time period set in P-33. Excessive voltage boost levels may result in increased motor current and temperature, and can result in the drive tripping during starting. |                     |                                                               |         |          |   |
| P-13               | <b>Reserved</b>                                                                                                                                                                                                                                                                                                                                                                                                            | -                   | -                                                             | -       | -        |   |
|                    | Application Macro selection is not supported on single phase output drives.                                                                                                                                                                                                                                                                                                                                                |                     |                                                               |         |          |   |
| P-15               | <b>Digital Input Function Select</b>                                                                                                                                                                                                                                                                                                                                                                                       | 0                   | 17                                                            | 0       | -        |   |
|                    | This parameter has the same function as three phase output drives, however note that for single phase output drives, all reverse functions are disabled, and the inputs assigned have no function.                                                                                                                                                                                                                         |                     |                                                               |         |          |   |
| P-20               | <b>Preset Frequency / Speed 1</b>                                                                                                                                                                                                                                                                                                                                                                                          | 0.0                 | P-01                                                          | 5.0     | Hz / RPM |   |
| P-21               | <b>Preset Frequency / Speed 2</b>                                                                                                                                                                                                                                                                                                                                                                                          | 0.0                 | P-01                                                          | 25.0    | Hz / RPM |   |
| P-22               | <b>Preset Frequency / Speed 3</b>                                                                                                                                                                                                                                                                                                                                                                                          | 0.0                 | P-01                                                          | 40.0    | Hz / RPM |   |
| P-23               | <b>Preset Frequency / Speed 4</b>                                                                                                                                                                                                                                                                                                                                                                                          | 0.0                 | P-01                                                          | P-09    | Hz / RPM |   |
|                    | These parameters have alternative default settings compared to three phase drives, and are uni-directional only.                                                                                                                                                                                                                                                                                                           |                     |                                                               |         |          |   |
| P-32               | <b>Starting Boost Frequency</b>                                                                                                                                                                                                                                                                                                                                                                                            | 0.0                 | P-09                                                          | P-09    | Hz       |   |
|                    | Sets the frequency used during the starting boost phase of operation.                                                                                                                                                                                                                                                                                                                                                      |                     |                                                               |         |          |   |
| P-33               | <b>Boost Period Duration</b>                                                                                                                                                                                                                                                                                                                                                                                               | 0.0                 | 150                                                           | 5.0     | s        |   |
|                    | Time for which the start-up boost period is applied. During this period, the output frequency is set to P-32 and the voltage increases linearly from P-11 to P-07. Setting P-33 to zero disables boost.                                                                                                                                                                                                                    |                     |                                                               |         |          |   |
| P-51<br>To<br>P-59 | <b>Reserved</b>                                                                                                                                                                                                                                                                                                                                                                                                            | -                   | -                                                             | -       | -        |   |
|                    | These parameters are not present in single phase output drives.                                                                                                                                                                                                                                                                                                                                                            |                     |                                                               |         |          |   |

## 2.5 Parameter Group 0 – Monitoring Parameters (Read Only)

| Par.   | Description                                                                   | Explanation                                                                                                                                                                                                                 |
|--------|-------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P00-01 | 1 <sup>st</sup> Analog input value (%)                                        | 100% = max input voltage                                                                                                                                                                                                    |
| P00-02 | 2 <sup>nd</sup> 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 80°C                                                                                                                                     |
| 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                                                                                                                                                                                                              |

## 2.6 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.

### 2.6.1 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.<br>Acceleration and Deceleration Rates are controlled by P-03 and P-04 respectively.<br>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.<br>Acceleration and Deceleration Rates are also controlled by Modbus, P-03 and P-04 are disabled.<br>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.<br>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.<br>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.<br>Acceleration and Deceleration Rates are controlled by P-03 and P-04 respectively.<br>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.<br>Acceleration and Deceleration Rates are also controlled by Modbus, P-03 and P-04 are disabled.<br>Digital Input 1 must be closed to allow operation.               |
| 9    | Slave Mode                       | Master Drive       | From Master            |                                                                                                                                                                                                                                         |

### 2.6.2 Overview

Optidrive 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.

### 2.6.3 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. When the input opens momentarily, the drive trips showing <b>E-Err</b> or <b>Ptc-Err</b> depending on P-47 setting                                                                                               |
| Fire Mode            | Activates Fire Mode, see section 2.7.1 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                                                                                                                                                                                    |

## 2.6.4 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      | 11 |
|      |      |                              |                   |           |                  |             | 0                | 0        | P-20    |    |
|      |      |                              |                   |           |                  |             | 1                | 0        | P-21    |    |
|      |      |                              |                   |           |                  |             | 0                | 1        | P-22    |    |
|      |      |                              |                   |           |                  |             | 1                | 1        | P-23    |    |
| 15   | STOP | RUN                          | P-23 REF          | AI1       | Fire Mode        |             | Analog Input AI1 |          | 1       |    |
| 16   | STOP | RUN                          | P-23 REF          | P-21 REF  | Fire Mode        |             | FWD ⤴            | REV ⤵    | 2       |    |
| 17   | STOP | RUN                          | DI2               |           | Fire Mode        |             | DI2              | DI4      | PR      | 2  |
|      |      |                              |                   |           |                  |             | 0                | 0        | P-20    |    |
|      |      |                              |                   |           |                  |             | 1                | 0        | P-21    |    |
|      |      |                              |                   |           |                  |             | 0                | 1        | P-22    |    |
|      |      |                              |                   |           |                  |             | 1                | 1        | P-23    |    |
| 18   | STOP | RUN                          | FWD ⤴             | REV ⤵     | Fire Mode        |             | Analog Input AI1 |          | 1       |    |

### 2.6.5 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)-----^ |          |                   |           |           |                  |           |         |
| 8                  | STOP | RUN FWD ↻                    | STOP     | RUN REV ↻         | KPD REF   | AI1 REF   | Analog Input AI1 |           | 1       |
| 14                 | STOP | RUN                          | -        | -                 | E-TRIP ↓  | (NC)      | -                | -         |         |
| 15                 | STOP | RUN                          | PR REF   | KPD REF           | Fire Mode |           | P-23             | P-21      | 2       |
| 16                 | STOP | RUN                          | P-23 REF | KPD REF           | Fire Mode |           | FWD ↻            | REV ↻     | 2       |
| 17                 | STOP | RUN                          | KPD REF  | P-23 REF          | Fire Mode |           | FWD ↻            | REV ↻     | 2       |
| 18                 | STOP | RUN                          | AI1 REF  | KPD REF           | Fire Mode |           | Analog Input AI1 |           | 1       |
| 9,10,11,12, 13 = 0 |      |                              |          |                   |           |           |                  |           |         |

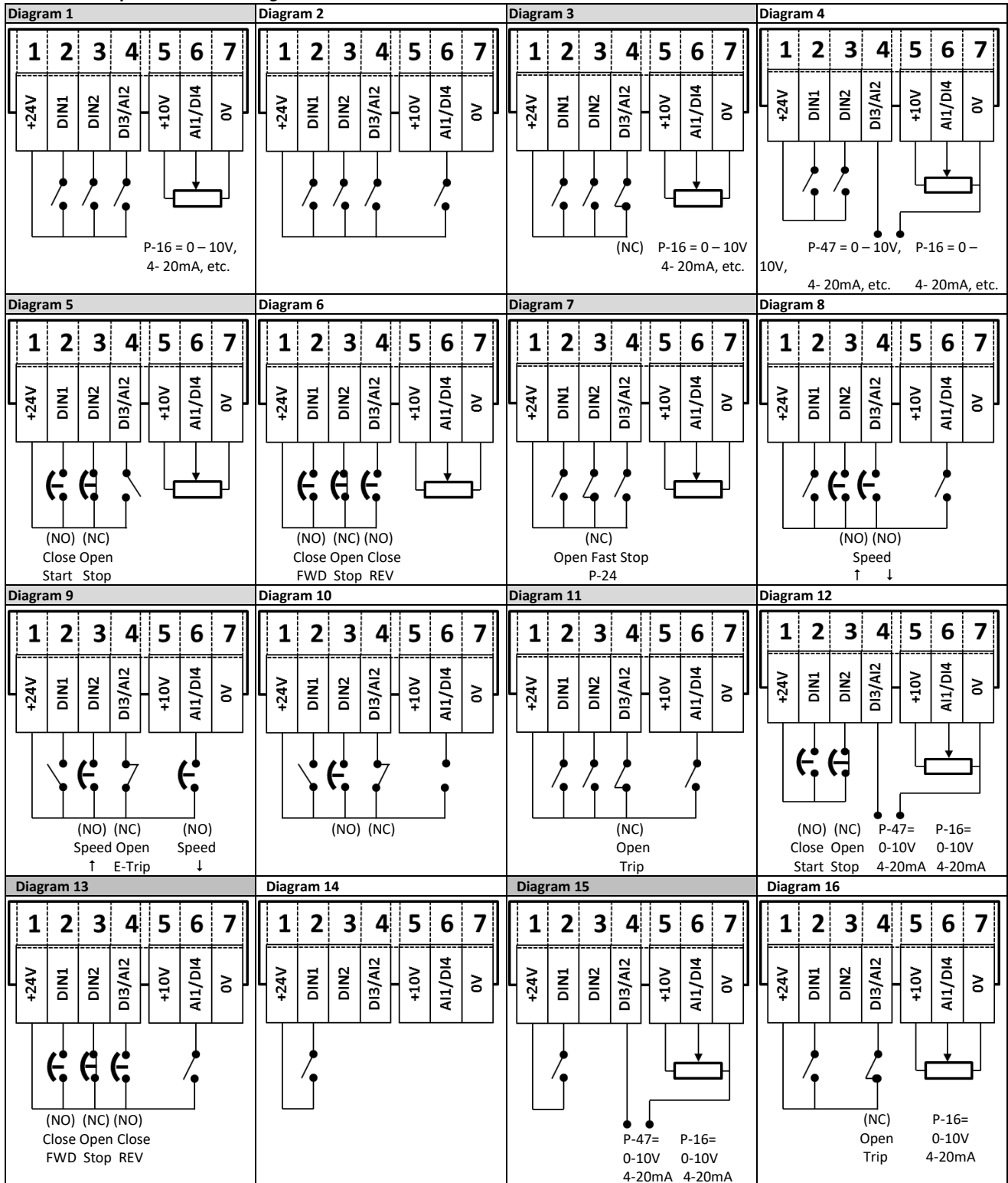
### 2.6.6 Macro Functions - Fieldbus Control Mode (P-12 = 3, 4, 7, 8 or 9)

| 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 |      |                                        |                                                                                    |          |           |      |                  |      |         |

### 2.6.7 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 (PI FB) |   | 1       |
| 2,9,10,11,12,13 = 0 |      |         |          |          |                          |          |                          |   |         |

## 2.6.8 Example Connection Diagrams



## 2.7 Software Functions

### 2.7.1 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

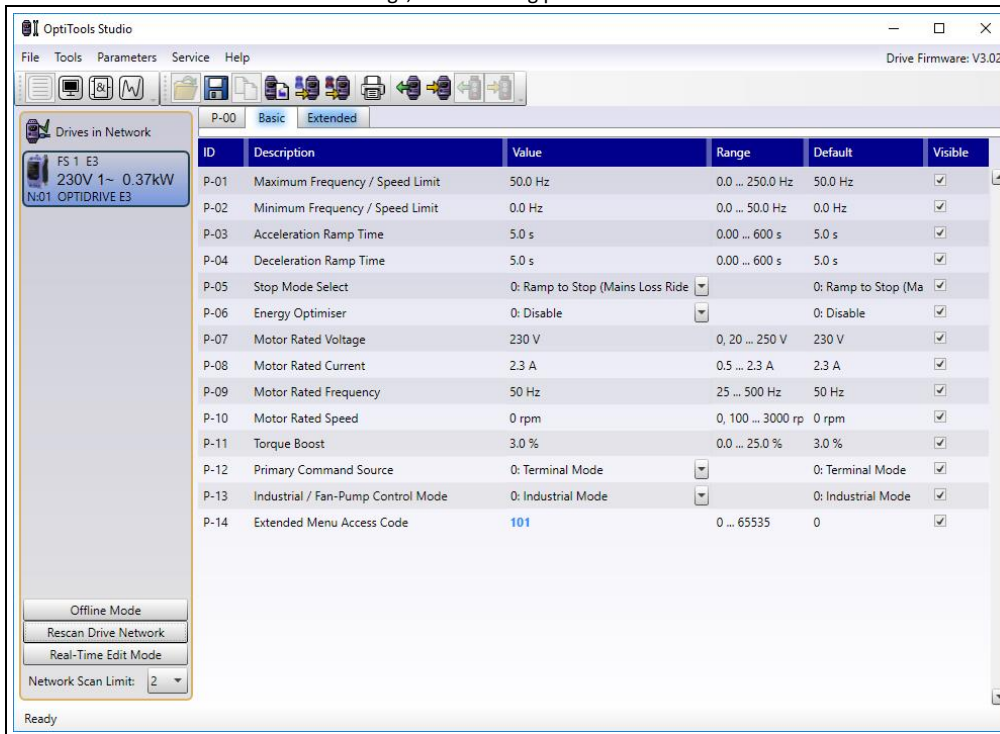
### 2.7.2 OEM / User Default Parameters

Optidrive 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.

#### 2.7.2.1 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.

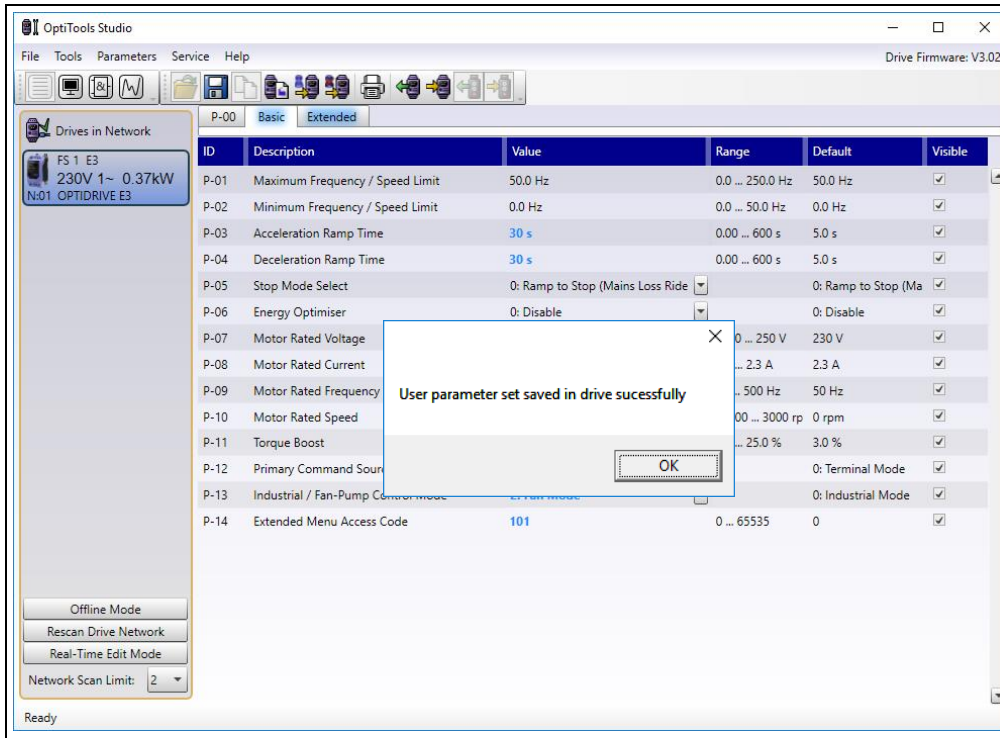
| ID   | Description                        | Value                             | Range              | Default              | Visible                             |
|------|------------------------------------|-----------------------------------|--------------------|----------------------|-------------------------------------|
| P-01 | Maximum Frequency / Speed Limit    | 50.0 Hz                           | 0.0 ... 250.0 Hz   | 50.0 Hz              | <input checked="" type="checkbox"/> |
| P-02 | Minimum Frequency / Speed Limit    | 0.0 Hz                            | 0.0 ... 50.0 Hz    | 0.0 Hz               | <input checked="" type="checkbox"/> |
| P-03 | Acceleration Ramp Time             | 30 s                              | 0.00 ... 600 s     | 5.0 s                | <input checked="" type="checkbox"/> |
| P-04 | Deceleration Ramp Time             | 30 s                              | 0.00 ... 600 s     | 5.0 s                | <input checked="" type="checkbox"/> |
| P-05 | Stop Mode Select                   | 0: Ramp to Stop (Mains Loss Ride) |                    | 0: Ramp to Stop (Ma) | <input checked="" type="checkbox"/> |
| P-06 | Energy Optimiser                   | 0: Disable                        |                    | 0: Disable           | <input checked="" type="checkbox"/> |
| P-07 | Motor Rated Voltage                | 230 V                             | 0, 20 ... 250 V    | 230 V                | <input checked="" type="checkbox"/> |
| P-08 | Motor Rated Current                | 1.8                               | 0.5 ... 2.3 A      | 2.3 A                | <input checked="" type="checkbox"/> |
| P-09 | Motor Rated Frequency              | 50 Hz                             | 25 ... 500 Hz      | 50 Hz                | <input checked="" type="checkbox"/> |
| P-10 | Motor Rated Speed                  | 0 rpm                             | 0, 100 ... 3000 rp | 0 rpm                | <input checked="" type="checkbox"/> |
| P-11 | Torque Boost                       | 3.0 %                             | 0.0 ... 25.0 %     | 3.0 %                | <input checked="" type="checkbox"/> |
| P-12 | Primary Command Source             | 0: Terminal Mode                  |                    | 0: Terminal Mode     | <input checked="" type="checkbox"/> |
| P-13 | Industrial / Fan-Pump Control Mode | 2: Fan Mode                       |                    | 0: Industrial Mode   | <input checked="" type="checkbox"/> |
| P-14 | Extended Menu Access Code          | 101                               | 0 ... 65535        | 0                    | <input checked="" type="checkbox"/> |

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

File Tools Parameters Service Help

- Load Parameter Set...
- Save Parameter Set
- Save Parameter Set As...
- Load Project Parameter Set...
- Save Project Parameter Set
- Recent Parameter Sets
- Restore Factory Defaults
- Save Current Parameters as User Defaults in Drive
- Clear User Default Parameters in Drive
- Copy Parameter Set
- Print...
- Export Parameter Set...
- Export Parameter Changes...
- Exit

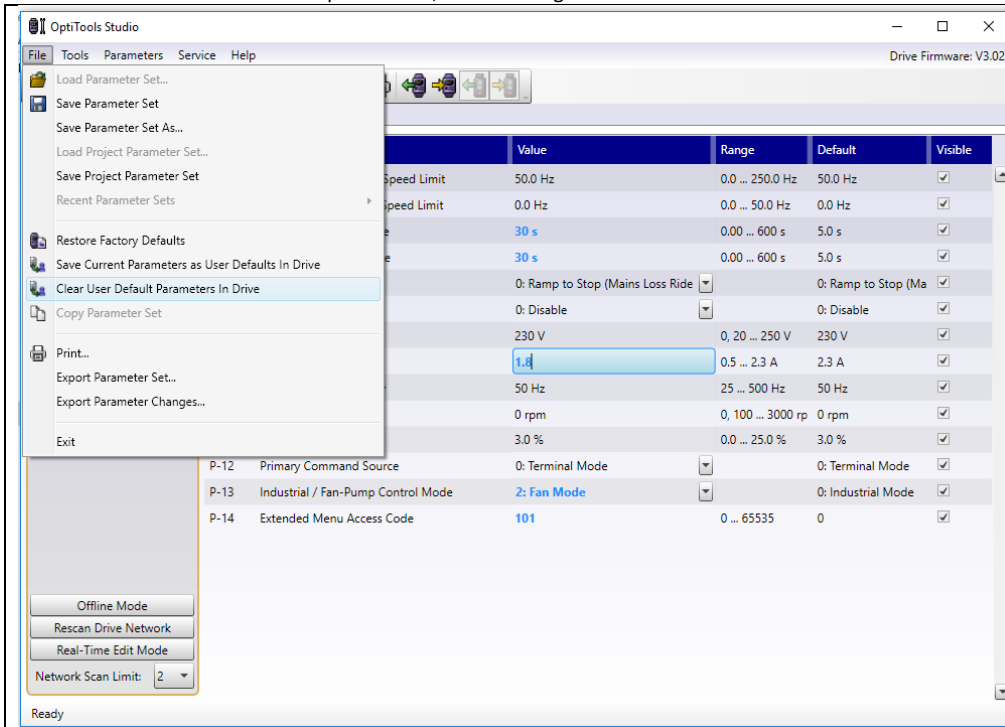
In the File menu, select "Save Current Parameters as User Defaults in Drive"



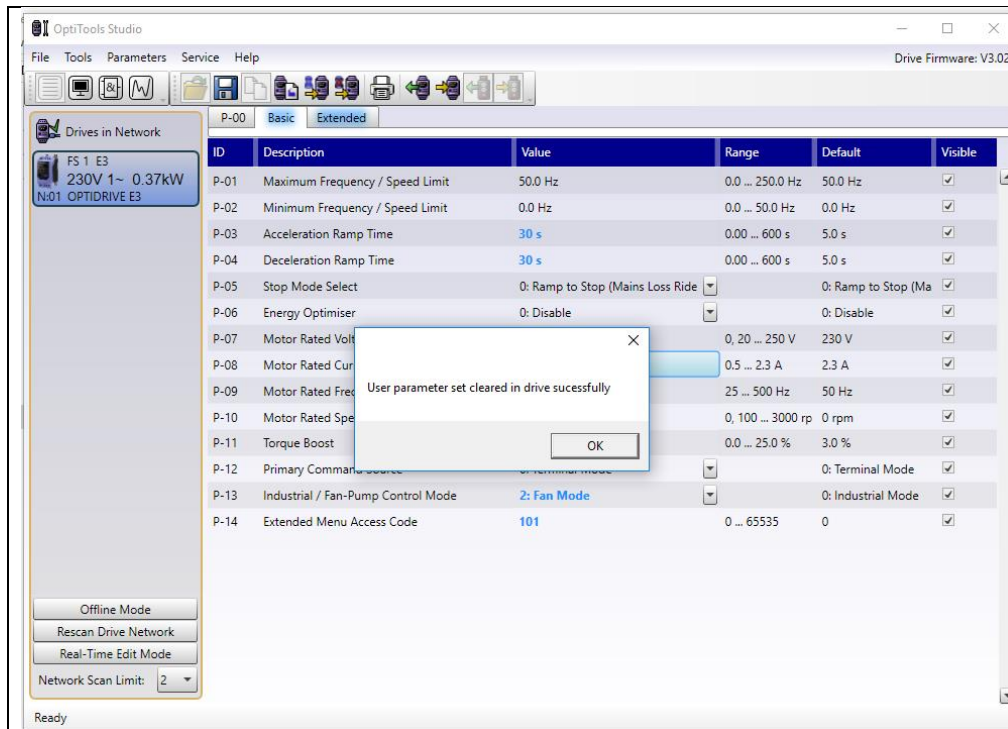
The confirmation message will appear.

### 2.7.2.2 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.

## 2.7.3 Automatic Switching Frequency Reduction

### 2.7.3.1 Heatsink Temperature Based Effective Switching Frequency Reduction

When the drive heatsink temperature exceeds preset threshold values, the output Effective Switching Frequency is automatically reduced below the value selected in P-17 to reduce the risk of over temperature trip. The threshold levels are shown in section 7.1 Thermal Management on page 46.

### 2.7.3.2 Output Frequency based Effective Switching Frequency Reduction

At low output frequency, Effective Switching Frequency is automatically reduced. Hysteresis is applied to prevent continuous switching. The operation is according to the following table:

| P-17                                                                      | 32kHz | 24kHz | 16kHz | 12kHz | 8kHz | 4kHz |
|---------------------------------------------------------------------------|-------|-------|-------|-------|------|------|
| Effective Switching Frequency increases when Output Frequency exceeds     | 9.0Hz | 7.0Hz | 5.0Hz | 3.0Hz | N/A  | N/A  |
| Effective Switching Frequency reduces when Output Frequency reduces below | 7.0Hz | 5.0Hz | 3.0Hz | 1.0Hz | N/A  | N/A  |

### 2.7.3.3 Output Current Based Effective Switching Frequency Reduction

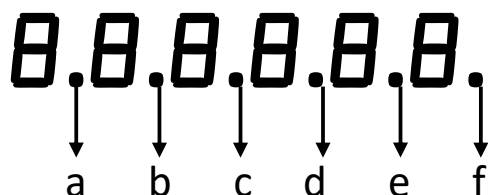
Effective Switching Frequency is automatically reduced based on motor load current as follows:

- All ODE-3-240095-3F4# models:
  - If P-17 = 12kHz, 16kHz, 24kHz, Effective switching frequency is reduced to 8kHz when motor current exceeds 10.45A (110% of the drive rated current). Switching frequency will return to the value set in P-17 when motor current reduces below 7.6A (80% of drive rated current)
  - If P-17 = 32kHz, Effective switching frequency is reduced to 8kHz when motor current exceeds 10.45A (110% of drive rated current). Switching frequency changes to 24kHz when motor current reduces below 7.6A (80% of drive rated current). Switching frequency will return to the value set in P-17 when motor current reduces below 6.7A (70% of drive rated current)
- All other models:
  - Effective switching frequency is reduced to 8kHz when motor current exceeds 140% of the drive rated current. Switching frequency will return to the value set in P-17 when motor current reduces below 110% of drive rated current.

## 2.8 LED Display

Optidrive E3 has a built in 6 Digit 7 Segment LED Display. In order to display certain warnings, the following methods are used:-

### 2.8.1 LED Display Layout



**2.8.2 LED Display Meanings**

| LED Segments | Behaviour             | Meaning                                         |
|--------------|-----------------------|-------------------------------------------------|
| a,b,c,d,e,f  | Flashing all together | Overload, motor output current exceeds P-08     |
| a and f      | Flashing alternately  | Mains Loss (Incoming AC power has been removed) |
| a            | Flashing              | Fire Mode Active                                |

### 3 Drive Model Specific Parameter Variations

#### 3.1 Available Effective Switching Frequency Options

| 110 Volt, 1 Phase Models (Voltage Doubler) |      |     |         |         |         |
|--------------------------------------------|------|-----|---------|---------|---------|
| Frame                                      | kW   | HP  | Default | Minimum | Maximum |
| 1                                          | 0.37 | 0.5 | 8 kHz   | 4 kHz   | 32 kHz  |
| 1                                          | 0.75 | 1   | 8 kHz   | 4 kHz   | 32 kHz  |
| 2                                          | 1.1  | 1.5 | 8 kHz   | 4 kHz   | 32 kHz  |
| 230 Volt, 1 Phase Models                   |      |     |         |         |         |
| Frame                                      | kW   | HP  | Default | Minimum | Maximum |
| 1                                          | 0.37 | 0.5 | 8 kHz   | 4 kHz   | 32 kHz  |
| 1                                          | 0.75 | 1   | 8 kHz   | 4 kHz   | 32 kHz  |
| 1                                          | 1.5  | 2   | 8 kHz   | 4 kHz   | 32 kHz  |
| 2                                          | 1.5  | 2   | 8 kHz   | 4 kHz   | 32 kHz  |
| 2                                          | 2.2  | 3   | 8 kHz   | 4 kHz   | 32 kHz  |
| 3                                          | 4    | 5   | 8 kHz   | 4 kHz   | 24 kHz  |
| 230 Volt, 3 Phase Models                   |      |     |         |         |         |
| Frame                                      | kW   | HP  | Default | Minimum | Maximum |
| 1                                          | 0.37 | 0.5 | 8 kHz   | 4 kHz   | 32 kHz  |
| 1                                          | 0.75 | 1   | 8 kHz   | 4 kHz   | 32 kHz  |
| 1                                          | 1.5  | 2   | 8 kHz   | 4 kHz   | 32 kHz  |
| 2                                          | 1.5  | 2   | 8 kHz   | 4 kHz   | 32 kHz  |
| 2                                          | 2.2  | 3   | 8 kHz   | 4 kHz   | 32 kHz  |
| 3                                          | 3    | 4   | 8 kHz   | 4 kHz   | 24 kHz  |
| 3                                          | 4    | 5   | 8 kHz   | 4 kHz   | 24 kHz  |
| 4                                          | 5.5  | 7.5 | 8 kHz   | 4 kHz   | 24 kHz  |
| 4                                          | 7.5  | 10  | 8 kHz   | 4 kHz   | 24 kHz  |
| 4                                          | 11   | 15  | 8 kHz   | 4 kHz   | 24 kHz  |
| 400 Volt, 3 Phase Models                   |      |     |         |         |         |
| Frame                                      | kW   | HP  | Default | Minimum | Maximum |
| 1                                          | 0.75 | 1   | 8 kHz   | 4 kHz   | 32 kHz  |
| 1                                          | 1.5  | 2   | 8 kHz   | 4 kHz   | 32 kHz  |
| 2                                          | 1.5  | 2   | 8 kHz   | 4 kHz   | 32 kHz  |
| 2                                          | 2.2  | 3   | 8 kHz   | 4 kHz   | 32 kHz  |
| 2                                          | 4    | 5   | 8 kHz   | 4 kHz   | 32 kHz  |
| 3                                          | 5.5  | 7.5 | 8 kHz   | 4 kHz   | 24 kHz  |
| 3                                          | 7.5  | 10  | 8 kHz   | 4 kHz   | 24 kHz  |
| 3                                          | 11   | 15  | 8 kHz   | 4 kHz   | 24 kHz  |
| 4                                          | 15   | 20  | 8 kHz   | 4 kHz   | 24 kHz  |
| 4                                          | 18.5 | 25  | 8 kHz   | 4 kHz   | 24 kHz  |
| 4                                          | 22   | 30  | 8 kHz   | 4 kHz   | 24 kHz  |

### 3.2 V/F Mode Voltage Boost Setting Options

| 110 Volt, 1 Phase Input Models (Voltage Doubler) |      |     |         |         |
|--------------------------------------------------|------|-----|---------|---------|
| Frame                                            | kW   | HP  | Default | Maximum |
| 1                                                | 0.37 | 0.5 | 3.0%    | 25.0%   |
| 1                                                | 0.75 | 1   | 3.0%    | 25.0%   |
| 2                                                | 1.1  | 1.5 | 2.5%    | 20.0%   |
| 230 Volt, 1 Phase Input Models                   |      |     |         |         |
| Frame                                            | kW   | HP  | Default | Maximum |
| 1                                                | 0.37 | 0.5 | 3.0%    | 25.0%   |
| 1                                                | 0.75 | 1   | 3.0%    | 25.0%   |
| 1                                                | 1.5  | 2   | 3.0%    | 25.0%   |
| 2                                                | 1.5  | 2   | 2.5%    | 20.0%   |
| 2                                                | 2.2  | 3   | 2.5%    | 20.0%   |
| 3                                                | 4    | 5   | 2.0%    | 15.0%   |
| 230 Volt, 3 Phase Input Models                   |      |     |         |         |
| Frame                                            | kW   | HP  | Default | Maximum |
| 1                                                | 0.37 | 0.5 | 3.0%    | 25.0%   |
| 1                                                | 0.75 | 1   | 3.0%    | 25.0%   |
| 1                                                | 1.5  | 2   | 3.0%    | 25.0%   |
| 2                                                | 1.5  | 2   | 2.5%    | 20.0%   |
| 2                                                | 2.2  | 3   | 2.5%    | 20.0%   |
| 3                                                | 3    | 4   | 2.0%    | 15.0%   |
| 3                                                | 4    | 5   | 2.0%    | 15.0%   |
| 4                                                | 5.5  | 7.5 | 1.5%    | 10.0%   |
| 4                                                | 7.5  | 10  | 1.5%    | 10.0%   |
| 4                                                | 11   | 15  | 1.5%    | 10.0%   |
| 400 Volt 3 Phase Input Models                    |      |     |         |         |
| Frame                                            | kW   | HP  | Default | Maximum |
| 1                                                | 0.75 | 1   | 3.0%    | 25.0%   |
| 1                                                | 1.5  | 2   | 3.0%    | 25.0%   |
| 2                                                | 1.5  | 2   | 2.5%    | 20.0%   |
| 2                                                | 2.2  | 3   | 2.5%    | 20.0%   |
| 2                                                | 4    | 5   | 2.5%    | 20.0%   |
| 3                                                | 5.5  | 7.5 | 2.0%    | 15.0%   |
| 3                                                | 7.5  | 10  | 2.0%    | 15.0%   |
| 3                                                | 11   | 15  | 2.0%    | 15.0%   |
| 4                                                | 15   | 20  | 1.5%    | 10.0%   |
| 4                                                | 18.5 | 25  | 1.5%    | 10.0%   |
| 4                                                | 22   | 30  | 1.5%    | 10.0%   |

## 4 Fieldbus Interface Support

### 4.1 Fieldbus Support Overview

Optidrive E3 provides support for the following fieldbus networks and functions

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

### 4.2 Modbus RTU

Optidrive E3 supports Modbus RTU communication, using the 03 Read Holding Registers and 06 Write Single Holding Register commands.

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 Address                       | 1 | Byte   | Slave Response                 | Length  |
| Function Code (03)                  | 1 | Byte   | Slave Address                  | 1 Byte  |
| 1 <sup>st</sup> Register Address    | 2 | Bytes  | Starting Address               | 1 Byte  |
| No. Of Registers                    | 2 | Bytes  | 1 <sup>st</sup> Register Value | 2 Bytes |
| CRC Checksum                        | 2 | Bytes  | 2 <sup>nd</sup> Register Value | 2 Bytes |
|                                     |   |        | Etc...                         |         |
|                                     |   |        | CRC Checksum                   | 2 Bytes |

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

### 4.3 Profibus DP

Profibus DP communication is supported through an external gateway. Operation is explained further in section 5 Fieldbus Gateways on page.37

### 4.4 DeviceNet

DeviceNet communication is supported through an external gateway. Operation is explained further in section 5 Fieldbus Gateways on page.37

### 4.5 CAN Open

The CANopen communication profile in the Optidrive E3 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 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.                                                                                    |
| PDO1 (RX)     | 200h + Node address | PDO1 is pre-mapped and enabled by default.                                                              |
| PDO2 (TX)     | 280h + Node address | COB-ID can be configured to other value.                                                                |
| PDO2 (RX)     | 300h + Node address | PDO2 is pre-mapped and disabled by default.<br>Transmission mode, COB-ID and mapping can be configured. |
| 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.              |

#### 4.5.1.1 Note

- The Optidrive E3 SDO channel only supports expedited transmission.
- The Optidrive E3 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.

#### 4.5.2 PDO Default Mapping

|            | Objects No. | Mapped Object | Length      | Mapped Function           | Transmission Type                       |
|------------|-------------|---------------|-------------|---------------------------|-----------------------------------------|
| RX<br>PDO1 | 1           | 2000h         | Unsigned 16 | Control command register* | 254<br>Valid immediately                |
|            | 2           | 2001h         | Integer 16  | Speed reference           |                                         |
|            | 3           | 2003h         | Unsigned 16 | User ramp reference       |                                         |
|            | 4           | 0006h         | Unsigned 16 | Dummy                     |                                         |
| TX<br>PDO1 | 1           | 200Ah         | Unsigned 16 | Drive status register     | 254<br>Send after receiving<br>RX PDO 1 |
|            | 2           | 200Bh         | Integer 16  | Motor speed Hz            |                                         |
|            | 3           | 200Dh         | Unsigned 16 | Motor current             |                                         |
|            | 4           | 2010h         | Integer 16  | Drive temperature         |                                         |
| RX<br>PDO2 | 1           | 0006h         | Unsigned 16 | Dummy                     | 254                                     |
|            | 2           | 0006h         | Unsigned 16 | Dummy                     |                                         |
|            | 3           | 0006h         | Unsigned 16 | Dummy                     |                                         |
|            | 4           | 0006h         | Unsigned 16 | Dummy                     |                                         |
| TX<br>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.

#### 4.5.3 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.                                                      |

## 4.5.4 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       | ODE3              |
| 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 param 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         |
| 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         |

## 4.6 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

### 4.6.1 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    |                                                           |

| Modbus RTU Register | CAN Open Index | Sub Index | PDO Map | Parameter Number | Upper byte                      | Lower Byte | Format | Min | Max   | Type | Scaling               |
|---------------------|----------------|-----------|---------|------------------|---------------------------------|------------|--------|-----|-------|------|-----------------------|
| -                   | 27D6h          | 0         | N       | P00-13           | Trip 1 Time – Hours             |            | U16    | 0   | 65535 | R    | 1 = 1 Hour            |
| -                   | 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    |                       |

## 4.6.2 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                             | 0: Ramp to stop + Mains Loss Ride Through<br>1: Coast to stop<br>2: Ramp to stop + Fast Stop<br>3: AC Flux Braking + Fast Stop                                                                                                                                          |
| 134                 | 206Ah          | 06   | Energy Optimiser              | U16    | 0         | 1                             | 0: Disabled<br>1: Enabled                                                                                                                                                                                                                                               |
| 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         | 60 * P-09                     | RPM                                                                                                                                                                                                                                                                     |
| 139                 | 206Fh          | 11   | Boost Value                   | U16    | 0         | Drive Rating Dependent        | 1dp, e.g. 100 = 10.0%                                                                                                                                                                                                                                                   |
| 140                 | 2070h          | 12   | Control mode                  | U16    | 0         | 6                             | 0: Terminal Control<br>1: Keypad forward only<br>2: Keypad forward and reverse<br>3: Modbus control mode<br>4: Modbus control with ramp control<br>5: PID control<br>6: PID control with analog speed sum<br>7: CAN Open<br>8: CAN Open + Ramp Control<br>9: Slave Mode |
| 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 section 2.6 for function 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   | 2 <sup>nd</sup> Ramp          | U16    | 0         | 60000                         | 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                             | 0: Unlocked<br>1: Locked                                                                                                                                                                                                                                                |
| 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                                                                                                                                                                                                                                   |

| Modbus RTU Register | CAN Open Index | Par. | Description                          | Format | Min | Max   | Data format / scaling                                                                                      |
|---------------------|----------------|------|--------------------------------------|--------|-----|-------|------------------------------------------------------------------------------------------------------------|
| 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   | 1dp, e.g. 250 = 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%                                                                                      |
| 179                 | 2097h          | 51   | Motor Control Mode                   | U16    | 0   | 5     | 0: IM Vector<br>1: V/F<br>2: PM Motor<br>3: BLDC Motor<br>4: SynRM Motor                                   |
| 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   | Thermal Overload Retention           | U16    | 0   | 1     |                                                                                                            |

## 4.7 Additional Information

### 4.7.1 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 2<sup>nd</sup> 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).

### 4.7.2 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.

### 4.7.3 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.

### 4.7.4 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.

#### 4.7.5 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)

#### 4.7.6 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.

#### 4.7.7 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 |

#### 4.7.8 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 |   |   |   |   |   |   |   |

#### 4.7.9 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 |   |   |   |   |   |   |   |

#### 4.7.10 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 |

**4.7.11 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 |   |   |   |   |   |   |   |

**4.8 Modbus RTU Indirect Parameter Access**

Optidrive E3 allows Read / Write access to all user adjustable parameters using a simple method as detailed below. This is achieved using the following two Modbus registers.

**4.8.1.1 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)

**4.8.1.2 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.

**4.8.2 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

**4.8.3 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

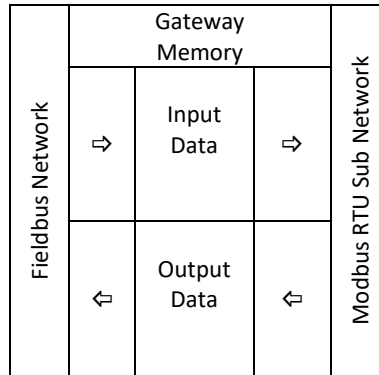
- Write 1 to Register 44
- Register 45 will return the present value of P-01, which can be Read if required
- Referring to the parameter table shown in 4.6.2, apply any scaling necessary
  - In this case, 60.0Hz = 3600
- Write the scaled value to Register 45. P-01 now changes to 60.0Hz, or an exception code may be returned.

## 5 Fieldbus Gateways

### 5.1 Gateway Concept

The fieldbus gateway acts as an interface between the Modbus RTU interface embedded into the Optidrive E3, and a high level fieldbus network such as Profibus DP or DeviceNet. The gateway supports multiple drive connection up to 8 drives, providing a cost effective method to connect Optidrive E3 units to a Profibus network.

The gateway internally consists of two segments of memory. Data transferred from the fieldbus Master System is written to the first memory area, and the fieldbus Master may Read data from the second memory area.



The fieldbus Master can normally be configured to Read and Write the entire gateway memory area in a single transaction, or separate transaction per drive may be configured. The gateway is pre-configured by Invertek to carry out the necessary individual Modbus RTU transactions to communicate with the Sub Network of connected drives.

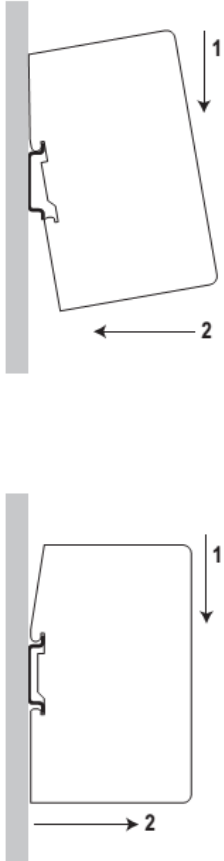
### 5.2 Gateway Included Components

Each gateway is supplied with the following:-

- Anybus Communicator Profibus AB7000 OR Anybus Communicator DeviceNet AB7001
- Anybus Communicator Resource CD (Includes configuration software, manuals, GSD / EDS file and application notes)
- Female DB9-RJ10 Black RS232 configuration cable
- Male DB9-RJ45 Blue Subnetwork Connection Cable

Note: PROFIBUS / DeviceNet network cable and connector are not included.

### 5.3 Gateway Installation



- Mount the gateway on to the DIN-rail
- The DIN-rail mechanism works as follows:
  - To snap the gateway on, first press it downwards (1) to compress the spring in the DIN-rail mechanism, then push it against the DIN-rail as to
  - make it snap on (2)
  - To snap the gateway off, push it downwards (1) and pull it out from the DIN-rail (2), as to make it snap off from the DIN-rail
- Connect the Anybus Communicator to the PROFIBUS-DP / DeviceNet network
- For Profibus, set the PROFIBUS node ID (see "Module Front" on page 42)
- Connect the gateway to the serial subnetwork using the supplied Blue Male DB9-RJ45 Subnetwork Connection Cable
- For a network with multiple drives, refer to „Multi Drive Network Example“ on page 38
- Gateways supplied by Invertek drives are pre-configured to operate with 4 connected E3 drives, unless an alternative number is specified when ordering.
- If an alternative number of slaves are required, configuration files to suit between one and 4 slaves may be downloaded from the Invertek Drives website. The user may then load the desired slave configuration to the gateway as follows :-
  - Connect the gateway to the PC via the configuration cable
  - Connect the power cable and apply power
  - Start the Anybus Configuration Manager program on the PC
  - (The Anybus Configuration Manager software attempts to detect the serial port automatically. If not successful, select the correct port manually in the "Port"-menu)
  - Configure the gateway using the Anybus Configuration Manager and download the relevant configuration to suit the number of connected slave drives.
  - Set up the PROFIBUS communication in accordance with the configuration

## 5.4 Subnetwork Connection

The drive sub network connects to the connector on the bottom of the gateway, using the supplied DB9-RJ45 cable. For a single drive installation, the cable can be connected directly from the gateway to the Optidrive. For a network of multiple drives, the network can be easily constructed using suitable RJ45 cables and splitters available from your Invertek Drives Sales Partner.

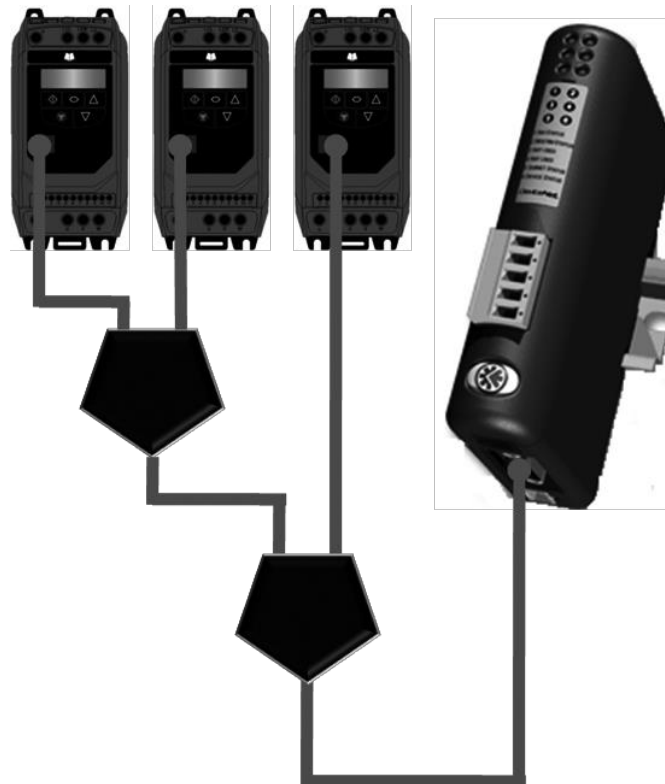
### 5.4.1 Single Drive Network Example

The gateway is connected to the drive using the supplied Blue Male DB9-RJ45 Subnetwork Connection Cable.



### 5.4.2 Multi Drive Network Example

The network can be constructed using firstly the supplied Blue Male DB9-RJ45 Subnetwork Connection Cable, and in addition, RJ45 Splitters (OPT-2-J45SP-IN) and RJ45 cables (0.5m – OPT-2J\$505-IN, 1m – OPT-J4510-IN, 3m – OPT-2-J4530-IN). Alternative cables may be used; Invertek recommend to use Cat 6 shielded twisted pair cables with pin to pin construction.



## 5.5 Commissioning Drive Parameter Settings

### 5.5.1 P-36 Communication Configuration

The Optidrive communication parameters are set using P-36, which has three indices as follows:-

|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P-36 | <b>Serial Communications Configuration</b>                                                                                                                                                                                                                                                                                                                                                                                                                       |
|      | <b>Index 1 : Address</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|      | Range : 0 – 63, default : 1<br>For a single drive network, the address must be set to 1.<br>For multiple drives, the addresses must be set sequentially starting from 1.                                                                                                                                                                                                                                                                                         |
|      | <b>Index 2 : Baud Rate</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|      | Selects the baud rate and network type for the internal RS485 communication port.<br>When using the gateway, the baud rate must be set to 57.6kbps.                                                                                                                                                                                                                                                                                                              |
|      | <b>Index 3 : Communication loss protection</b>                                                                                                                                                                                                                                                                                                                                                                                                                   |
|      | Defines the time for which the drive will operate without receiving a valid command telegram to Register 1 (Drive Control Word) after the drive has been enabled. 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 'C' suffix means that the drive will coast stop (output immediately disabled) but will not trip. |

### 5.5.2 P-12 Command Source Selection

Modbus RTU is enabled at all times on Optidrive E3, allowing the gateway to provide remote monitoring of the drive by a remote Profibus Master device regardless of the control configuration of the drive.

If it is desired to control the drive from the Profibus network, P-12 must be set as follows:-

|      |                                                                                                                 |   |   |   |   |
|------|-----------------------------------------------------------------------------------------------------------------|---|---|---|---|
| P-12 | <b>Primary Command Source</b>                                                                                   | 0 | 9 | 0 | - |
|      | <b>3: Modbus Network Control.</b> Control via the fieldbus using the internal Accel / Decel ramps (P-03 / P-04) |   |   |   |   |
|      | <b>4: Modbus Network Control.</b> Control via the fieldbus with Accel / Decel ramps updated via Modbus          |   |   |   |   |

## 5.6 Gateway Memory Mapping

The PLC programmer can read/write the PLC memory mapping to gateway memory in order to monitor/control drives in the sub network.

### 5.6.1 Input memory

This part of the memory contains the real-time drive information that can be read by the PLC.

| Drive | Data              | Start Address | Data Length | Data Range    | Unit | Description                                 |
|-------|-------------------|---------------|-------------|---------------|------|---------------------------------------------|
| 1     | Trip code         | 0x0000        | 8 bits      | 0 to 11       |      | Refer to drive User Guide                   |
|       | Drive status      | 0x0001        | 8bits       | 0, 1, 2,      |      | Refer to Drive Status Word on page 41       |
|       | Motor speed in Hz | 0x0002        | 16 bits     | -P-01 to P-01 | Hz   | One decimal place (500 = 50.0Hz)            |
|       | Motor current     | 0x0004        | 16 bits     | 0 to 10000    | A    | One decimal place (76 = 7.6A)               |
|       | Not Used          | 0x0006        | 16 bits     | -             | -    |                                             |
| 2     | Trip code         | 0x0008        | 8 bits      | 0 to 11       |      | See error code list for further information |
|       | Drive status      | 0x0009        | 8bits       | 0, 1, 2,      |      | Refer to Drive Status Word on page 41       |
|       | Motor speed in Hz | 0x000A        | 16 bits     | -P-01 to P-01 | Hz   | One decimal place (500 = 50.0Hz)            |
|       | Motor current     | 0x000C        | 16 bits     | 0 to 10000    | A    | One decimal place (76 = 7.6A)               |
|       | Not Used          | 0x000E        | 16 bits     | -             | -    |                                             |
| 3     | Trip code         | 0x0010        | 8 bits      | 0 to 11       |      | See error code list for further information |
|       | Drive status      | 0x0011        | 8bits       | 0, 1, 2,      |      | Refer to Drive Status Word on page 41       |
|       | Motor speed in Hz | 0x0012        | 16 bits     | -P-01 to P-01 | Hz   | One decimal place (500 = 50.0Hz)            |
|       | Motor current     | 0x0014        | 16 bits     | 0 to 10000    | A    | One decimal place (76 = 7.6A)               |
|       | Not Used          | 0x0016        | 16 bits     | -             | -    |                                             |
| 4     | Trip code         | 0x0018        | 8 bits      | 0 to 11       |      | See error code list for further information |
|       | Drive status      | 0x0019        | 8bits       | 0, 1, 2,      |      | Refer to Drive Status Word on page 41       |
|       | Motor speed in Hz | 0x001A        | 16 bits     | -P-01 to P-01 | Hz   | One decimal place (500 = 50.0Hz)            |
|       | Motor current     | 0x001C        | 16 bits     | 0 to 10000    | A    | One decimal place (76 = 7.6A)               |
|       | Not Used          | 0x001E        | 16 bits     | -             | -    |                                             |
| 5     | Trip code         | 0x0020        | 8 bits      | 0 to 11       |      | See error code list for further information |
|       | Drive status      | 0x0021        | 8bits       | 0, 1, 2,      |      | Refer to Drive Status Word on page 41       |
|       | Motor speed in Hz | 0x0022        | 16 bits     | -P-01 to P-01 | Hz   | One decimal place (500 = 50.0Hz)            |
|       | Motor current     | 0x0024        | 16 bits     | 0 to 10000    | A    | One decimal place (76 = 7.6A)               |
|       | Not Used          | 0x0026        | 16 bits     | -             | -    |                                             |
| 6     | Trip code         | 0x0028        | 8 bits      | 0 to 11       |      | See error code list for further information |
|       | Drive status      | 0x0029        | 8bits       | 0, 1, 2,      |      | Refer to Drive Status Word on page 41       |
|       | Motor speed in Hz | 0x002A        | 16 bits     | -P-01 to P-01 | Hz   | One decimal place (500 = 50.0Hz)            |
|       | Motor current     | 0x002C        | 16 bits     | 0 to 10000    | A    | One decimal place (76 = 7.6A)               |
|       | Not Used          | 0x002E        | 16 bits     | -             | -    |                                             |
| 7     | Trip code         | 0x0030        | 8 bits      | 0 to 11       |      | See error code list for further information |
|       | Drive status      | 0x0031        | 8bits       | 0, 1, 2,      |      | Refer to Drive Status Word on page 41       |
|       | Motor speed in Hz | 0x0032        | 16 bits     | -P-01 to P-01 | Hz   | One decimal place (500 = 50.0Hz)            |
|       | Motor current     | 0x0034        | 16 bits     | 0 to 10000    | A    | One decimal place (76 = 7.6A)               |
|       | Not Used          | 0x0036        | 16 bits     | -             | -    |                                             |
| 8     | Trip code         | 0x0038        | 8 bits      | 0 to 11       |      | See error code list for further information |
|       | Drive status      | 0x0039        | 8bits       | 0, 1, 2,      |      | Refer to Drive Status Word on page 41       |
|       | Motor speed in Hz | 0x003A        | 16 bits     | -P-01 to P-01 | Hz   | One decimal place (500 = 50.0Hz)            |
|       | Motor current     | 0x003C        | 16 bits     | 0 to 10000    | A    | One decimal place (76 = 7.6A)               |
|       | Not Used          | 0x003E        | 16 bits     | -             | -    |                                             |

### 5.6.2 Output memory

This part of the memory contains the control command information to allow the PLC to control the drives.

| Drive | Data                  | Start Address | Data Length | Data Range    | Unit | Description                                                                                           |
|-------|-----------------------|---------------|-------------|---------------|------|-------------------------------------------------------------------------------------------------------|
| 1     | Control command       | 0x0200        | 16 bits     | -             |      | Refer to Drive Control Word on page 41                                                                |
|       | Speed reference in HZ | 0x0202        | 16 bits     | -P-01 to P-01 | Hz   | Drive digital speed reference. Including one decimal place. (500 = 50.0Hz)                            |
|       | No Function           | 0x0204        | 16 bits     |               |      |                                                                                                       |
|       | Ramp Time             | 0x0206        | 16 bits     | 0 - 60000     | s    | Ramp time in seconds x 100 (250 = 2.5s) simultaneously applied to acceleration and deceleration ramps |
| 2     | Control command       | 0x0208        | 16 bits     | -             |      | Refer to Drive Control Word on page 41                                                                |
|       | Speed reference in HZ | 0x020A        | 16 bits     | -P-01 to P-01 | Hz   | Drive digital speed reference. Including one decimal place. (500 = 50.0Hz)                            |
|       | No Function           | 0x020C        | 16 bits     |               |      |                                                                                                       |
|       | Ramp Time             | 0x020E        | 16 bits     | 0 - 60000     | s    | Ramp time in seconds x 100 (250 = 2.5s) simultaneously applied to acceleration and deceleration ramps |
| 3     | Control command       | 0x0210        | 16 bits     | -             |      | Refer to Drive Control Word on page 41                                                                |
|       | Speed reference in HZ | 0x0212        | 16 bits     | -P-01 to P-01 | Hz   | Drive digital speed reference. Including one decimal place. (500 = 50.0Hz)                            |
|       | No Function           | 0x0214        | 16 bits     |               |      |                                                                                                       |
|       | Ramp Time             | 0x0216        | 16 bits     | 0 - 60000     | s    | Ramp time in seconds x 100 (250 = 2.5s) simultaneously applied to acceleration and deceleration ramps |
| 4     | Control command       | 0x0210        | 16 bits     | -             |      | Refer to Drive Control Word on page 41                                                                |
|       | Speed reference in HZ | 0x0212        | 16 bits     | -P-01 to P-01 | Hz   | Drive digital speed reference. Including one decimal place. (500 = 50.0Hz)                            |
|       | No Function           | 0x0214        | 16 bits     |               |      |                                                                                                       |
|       | Ramp Time             | 0x0216        | 16 bits     | 0 - 60000     | s    | Ramp time in seconds x 100 (250 = 2.5s) simultaneously applied to acceleration and deceleration ramps |
| 5     | Control command       | 0x0220        | 16 bits     | -             |      | Refer to Drive Control Word on page 41                                                                |
|       | Speed reference in HZ | 0x0222        | 16 bits     | -P-01 to P-01 | Hz   | Drive digital speed reference. Including one decimal place. (500 = 50.0Hz)                            |
|       | No Function           | 0x0224        | 16 bits     |               |      |                                                                                                       |
|       | Ramp Time             | 0x0226        | 16 bits     | 0 - 60000     | s    | Ramp time in seconds x 100 (250 = 2.5s) simultaneously applied to acceleration and deceleration ramps |
| 6     | Control command       | 0x0228        | 16 bits     | -             |      | Refer to Drive Control Word on page 41                                                                |
|       | Speed reference in HZ | 0x022A        | 16 bits     | -P-01 to P-01 | Hz   | Drive digital speed reference. Including one decimal place. (500 = 50.0Hz)                            |
|       | No Function           | 0x022C        | 16 bits     |               |      |                                                                                                       |
|       | Ramp Time             | 0x022E        | 16 bits     | 0 - 60000     | s    | Ramp time in seconds x 100 (250 = 2.5s) simultaneously applied to acceleration and deceleration ramps |
| 7     | Control command       | 0x0230        | 16 bits     | -             |      | Refer to Drive Control Word on page 41                                                                |
|       | Speed reference in HZ | 0x0232        | 16 bits     | -P-01 to P-01 | Hz   | Drive digital speed reference. Including one decimal place. (500 = 50.0Hz)                            |
|       | No Function           | 0x0234        | 16 bits     |               |      |                                                                                                       |
|       | Ramp Time             | 0x0236        | 16 bits     | 0 - 60000     | s    | Ramp time in seconds x 100 (250 = 2.5s) simultaneously applied to acceleration and deceleration ramps |
| 8     | Control command       | 0x0230        | 16 bits     | -             |      | Refer to Drive Control Word on page 41                                                                |
|       | Speed reference in HZ | 0x0232        | 16 bits     | -P-01 to P-01 | Hz   | Drive digital speed reference. Including one decimal place. (500 = 50.0Hz)                            |
|       | No Function           | 0x0234        | 16 bits     |               |      |                                                                                                       |
|       | Ramp Time             | 0x0236        | 16 bits     | 0 - 60000     | s    | Ramp time in seconds x 100 (250 = 2.5s) simultaneously applied to acceleration and deceleration ramps |

### 5.6.3 Drive Control Word

The drive Control Word format is the same as used for Modbus RTU, explained in section 4.7.1 Drive Control Word Format on page 34.

### 5.6.4 Drive Status Word

The drive Status Word format is the same as used for Modbus RTU, explained in section 0

Drive status and error code Word on page 35.

## 5.7 Controlling the Optidrive(s)

The following points should be noted when attempting to control the Optidrive(s):-

- The drive must be set for Modbus RTU control using P-12
- Digital Input, which acts as a hardware enable must be ON in order for the drive to start, otherwise the drive will not enable, and the Sub Network Status LED will illuminate Red when the user tries to start the drive.
- The Enable / Run signal is Edge triggered, and so the drive must receive a control word with Bit 0 = 0, followed by a control word with Bit 0 = 1 in order to start.
- If P-12 = 3 and the user writes any data to the Ramp Time memory area, the gateway will indicate a Sub Network Status error (red flash), as the drive rejects the data which cannot be used.

## 5.8 Profibus DP Gateway Features – OD-PROFB-IN

- Complete PROFIBUS-DP slave functionality according to IEC 61158
- Supports all common baud rates up to 12 Mbit (detected automatically)
- Up to 64 bytes of I/O data in each direction, allowing up to 8 Optidrives to be connected to a single gateway.
- Galvanically isolated bus electronics

### 5.8.1 Installation

#### 5.8.1.1 Overview - Module Front

**LED Indicators**

1 Online (Green)

2 Offline (Red)

3 Not Used (-)

4 Fieldbus Diagnostics

5 Subnet Status

6 Device Status

**Configuration Switches**

A, B

**PROFIBUS Connector**

| Indicator | State                   | Description                                 |
|-----------|-------------------------|---------------------------------------------|
| 1         | Green                   | Online                                      |
| 1         | Off                     | Not Online                                  |
| 2         | Red                     | Offline                                     |
| 2         | Off                     | Not Offline                                 |
| 3         | -                       | -                                           |
| 4         | Off                     | No diagnostics present                      |
| 4         | Red, Flashing 1Hz       | Configuration Error                         |
| 4         | Red, Flashing 2Hz       | User parameter data error                   |
| 4         | Red, Flashing 4Hz       | Initialisation Error                        |
| 5         | Flashing Green          | Running, but one or more transaction errors |
| 5         | Green                   | Running                                     |
| 5         | Red                     | Transaction error / subnet stopped          |
| 6         | Off                     | Power Off                                   |
| 6         | Alternating Red / Green | Invalid / missing configuration             |
| 6         | Green                   | Initialising                                |
| 6         | Flashing Green          | Running                                     |
| 6         | Red                     | Bootloader Mode                             |
| 6         | Flashing Red            | Diagnostic Code                             |

**A** Set the PROFIBUS node address by using the switches as follows:  
Node address = (switch B \* 10) + (switch A \* 1)

**B**

**Example:**  
Setting node address 42

Switch A

2

Switch B

4

**Bottom View**

**PC Connector:**

1. GND

2. GND

3. RS232 Rx

4. RS232 Tx

**Power:**

1. +24 V DC

2. GND

**PROFIBUS Connector**

| Pin no  | Description |
|---------|-------------|
| 1       | Shield      |
| 3       | B-line      |
| 4       | RTS         |
| 5       | GND bus     |
| 6       | +5V bus out |
| 8       | A-line      |
| 2, 7, 9 | NC          |

**DB9**

|   |                      |
|---|----------------------|
| 1 | +5V                  |
| 2 | RS232 Rx (Not Used)  |
| 3 | RS232 Tx (Not Used)  |
| 4 | NC                   |
| 5 | Signal 0V            |
| 6 | RS422 Rx+ (Not Used) |
| 7 | RS422 Rx- (Not Used) |
| 8 | RS485+ Modbus RTU    |
| 9 | RS485- Modbus RTU    |

**Power**

|   |               |
|---|---------------|
| 1 | +24VDC, 300mA |
| 2 | 0V            |

### 5.8.2 Profibus Master Configuration

The latest applicable GSD file may be downloaded from the HMS website, [www.anybus.com](http://www.anybus.com).

The actual configuration process will differ for different Profibus Master Systems, and is not possible to explain in this document. Example configurations for Siemens PLC are provided on the HMS website.

When configuring the communication between the Master System and the gateway, 4 words of Input Process Data and 4 words of Output Process Data should be allocated per drive connected the gateway, up to a maximum of 32 Input and Output words. If necessary, a configuration may be chosen in the Profibus Master which supports more than the connected number of drives, e.g. if 3 drives are connected to the gateway, the Master System can be configured for 12, 16 or even 32 words of Input and Output process data. The additional words will simply not contain any data.

## 5.9 DeviceNet Gateway Features – OD-DEVNT-IN

- Communications Adapter, profile no. 12
- Group two server
- MacID and baud rate configuration via on-board switches
- Polled, Change-of-state and Bit strobed I/O

### 5.9.1 Installation

#### 5.9.1.1 Overview - Module Front

**LED Indicators**

1 2  
3 4  
5 6

**Configuration Switches**

Mac ID

Baud rate

| Indicator               | Status                          | Meaning                                     |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
|-------------------------|---------------------------------|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----------|-------------------------|---------------------------------|-------|--------------|----------------|---------|-----|-----------------|--------------|
| 1                       | Off                             | Not online                                  |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
|                         | Green                           | Link ok, online, connected                  |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
|                         | Flashing Green                  | Online, not connected                       |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
|                         | Red                             | Critical link failure                       |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
|                         | Flashing Red                    | Connection timeout                          |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
| 2                       | Off                             | No power                                    |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
|                         | Green                           | Device operational                          |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
|                         | Flashing Green                  | Data size bigger than configured            |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
|                         | Red                             | Unrecoverable fault                         |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
|                         | Flashing Red                    | Minor fault                                 |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
| 3                       | Not Used                        | -                                           |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
| 4                       | Not Used                        | -                                           |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
| 5                       | Flashing Green                  | Running, but one or more transaction errors |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
|                         | Green                           | Running                                     |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
|                         | Red                             | Transaction error / subnet stopped          |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
|                         | 6                               | Device Status                               | <table border="1"> <tr> <td>Off</td> <td>Power Off</td> </tr> <tr> <td>Alternating Red / Green</td> <td>Invalid / missing configuration</td> </tr> <tr> <td>Green</td> <td>Initialising</td> </tr> <tr> <td>Flashing Green</td> <td>Running</td> </tr> <tr> <td>Red</td> <td>Bootloader Mode</td> </tr> <tr> <td>Flashing Red</td> <td>Diagnostic Code</td> </tr> </table> | Off | Power Off | Alternating Red / Green | Invalid / missing configuration | Green | Initialising | Flashing Green | Running | Red | Bootloader Mode | Flashing Red |
| Off                     | Power Off                       |                                             |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
| Alternating Red / Green | Invalid / missing configuration |                                             |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
| Green                   | Initialising                    |                                             |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
| Flashing Green          | Running                         |                                             |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
| Red                     | Bootloader Mode                 |                                             |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |
| Flashing Red            | Diagnostic Code                 |                                             |                                                                                                                                                                                                                                                                                                                                                                            |     |           |                         |                                 |       |              |                |         |     |                 |              |

**5.9.1.2 Configuration Switches – Baud Rate**

| Switch 1 | Switch 2 | Baud Rate |
|----------|----------|-----------|
| OFF      | OFF      | 125k      |
| OFF      | ON       | 250k      |
| ON       | OFF      | 500k      |
| ON       | ON       | N/A       |

**5.9.1.3 Configuration Switches – MAC ID**

| MAC ID | Switch 3 | Switch 4 | Switch 5 | Switch 6 | Switch 7 | Switch 8 |
|--------|----------|----------|----------|----------|----------|----------|
| 0      | OFF      | OFF      | OFF      | OFF      | OFF      | OFF      |
| 1      | OFF      | OFF      | OFF      | OFF      | OFF      | ON       |
| 2      | OFF      | OFF      | OFF      | OFF      | ON       | OFF      |
| 3-62   | ...      | ...      | ...      | ...      | ...      | ...      |
| 63     | ON       | ON       | ON       | ON       | ON       | ON       |

**Bottom View**

PC Connector:

1. GND  
2. GND  
3. RS232 Rx  
4. RS232 Tx

Power:

1. +24 V DC  
2. GND

| DB9 | Signal               |
|-----|----------------------|
| 1   | +5V                  |
| 2   | RS232 Rx (Not Used)  |
| 3   | RS232 Tx (Not Used)  |
| 4   | NC                   |
| 5   | Signal 0V            |
| 6   | RS422 Rx+ (Not Used) |
| 7   | RS422 Rx- (Not Used) |
| 8   | RS485+ Modbus RTU    |
| 9   | RS485- Modbus RTU    |

| Power | Signal        |
|-------|---------------|
| 1     | +24VDC, 300mA |
| 2     | 0V            |

**DeviceNet Connector**

| Pin no | Description |
|--------|-------------|
| 1      | V-          |
| 2      | CAN L       |
| 3      | Shield      |
| 4      | CAN H       |
| 5      | V+          |

### 5.9.2 DeviceNet Master Configuration

The latest version of the EDS file may be downloaded from the HMS website, [www.anybus.com](http://www.anybus.com).

The actual configuration process will differ for different DeviceNet Master Systems, and is not possible to explain in this document. Example configurations for Rockwell PLC are provided on the HMS website.

When configuring the communication between the Master System and the gateway, 4 words of Input Process Data and 4 words of Output Process Data should be allocated per drive connected the gateway, up to a maximum of 32 Input and Output words. If necessary, a configuration may be chosen in the Master which supports more than the connected number of drives, e.g. if 3 drives are connected to the gateway, the Master System can be configured for 12, 16 or even 32 words of Input and Output process data. The additional words will simply not contain any data.

## 5.10 Diagnostics and Troubleshooting

| Symptom                                                                      | Suggested Actions                                                                                                                                                                                                           |
|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| No Communication,<br>Master > Gateway                                        | Check all network cables<br>Check correct bus termination<br>Check correct node address on gateway<br>Check GSD / EDS file is recognised and used by the Master<br>Check the Status LEDs 1 and 2                            |
| Profibus Communication<br>OK,<br>Not possible to control<br>the Optidrive(s) | Check the subnetwork Status LED<br>Check all sub network connections<br>Check correct baud rate set in drives<br>Check drives are addressed sequentially from 1<br>Check that data is written to the correct memory area(s) |

## 6 Diagnostic and Fault Messages

### 6.1 Fault Messages

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

### 6.2 Resetting a Fault

When the drive trips, and a fault message is displayed, it can be reset in one of the following ways:-

- Completely remove the incoming power supply, and allow the power to dissipate completely. Re-apply the power.
- Remove and reapply the enable input
- Press the stop / Reset button
- If Modbus or CAN are in use, set the reset bit in the control word from 0 to 1

In the event of O-I, hO-I or I.t-trp faults, in order to prevent damage that may occur through repeatedly enabling the drive into a fault condition, these trips cannot be reset immediately. A delay time according to the following table must be allowed before reset is possible.

|                  |                                           |
|------------------|-------------------------------------------|
| First Trip       | 2 seconds delay before reset is possible  |
| Second Trip      | 4 seconds delay before reset is possible  |
| Third Trip       | 8 seconds delay before reset is possible  |
| Fourth Trip      | 16 seconds delay before reset is possible |
| Fifth Trip       | 32 seconds delay before reset is possible |
| Subsequent Trips | 64 seconds delay before reset is possible |

## 7 Rated Temperatures and De-rating curves

### 7.1 Thermal Management

The Optidrive E3 product range has an integrated Thermal Management function. This function allows the drive to automatically reduce the drive output switching frequency when operating at higher heatsink temperatures to avoid the risk of an over temperature trip. The table below shows the heatsink temperature threshold points at which thermal management occurs.

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

#### NOTE

The available range of switching frequencies is subject to the drive frame size, power rating and voltage rating. Refer to section 3.1 Available Effective Switching Frequency Options for further information.

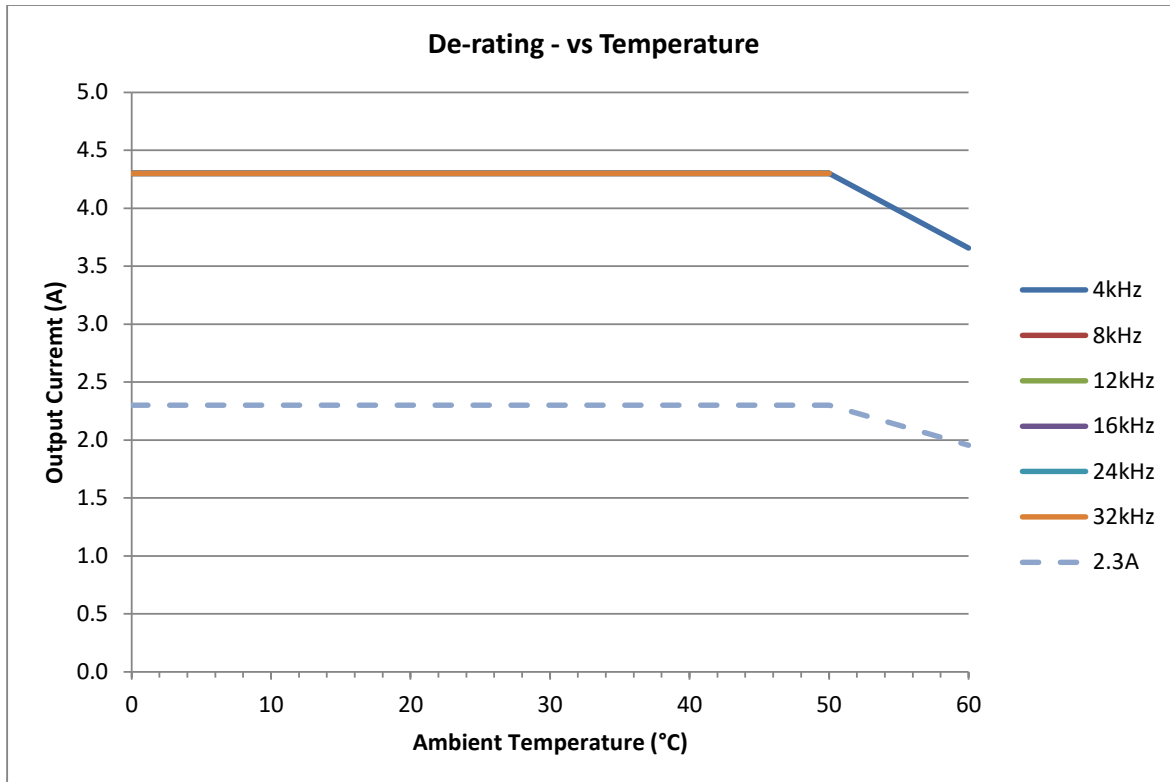
### 7.2 De-rating Curves Explained

The following graphs each show the maximum available continuous output current against the drive ambient temperature. Separate graphs are shown for each frame size, supply voltage rating and enclosure type. In each graph the solid lines represent the performance of the drive with the highest available output current capability in each case. Where units are available with a lower output current rating, these are shown as dotted lines. Where the solid line is lower than the dotted line, the current limitation applies also to the lower output current rated drive at the relevant effective switching frequency.

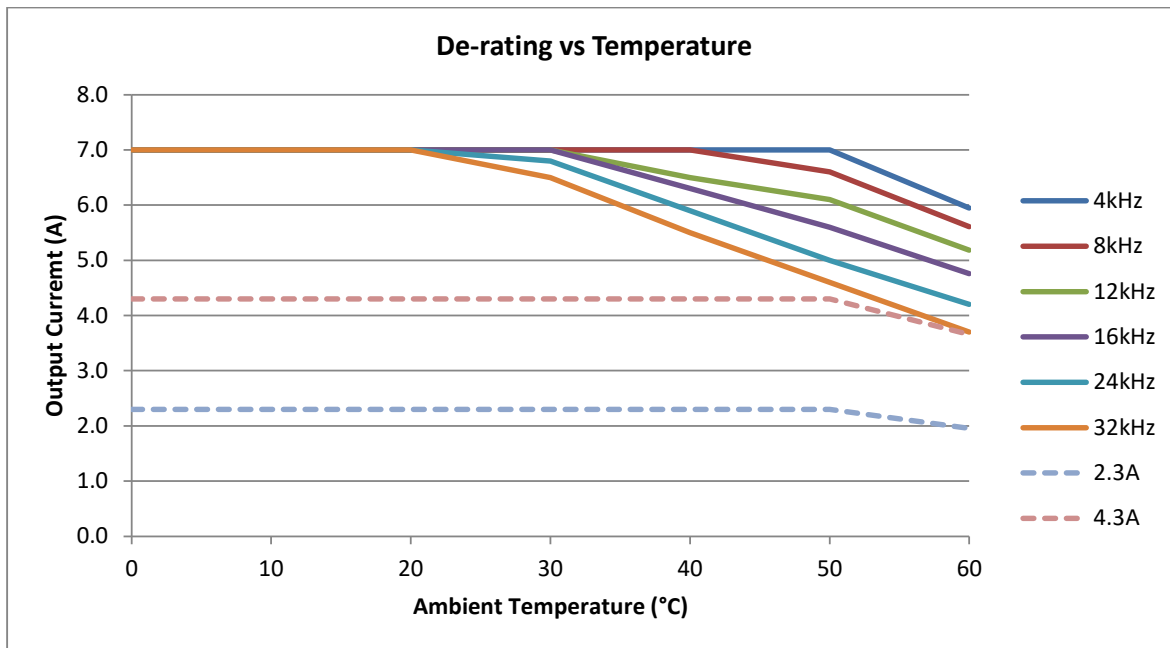
### 7.3 Derating Graphs

#### 7.3.1 IP20, Three Phase Output Drives

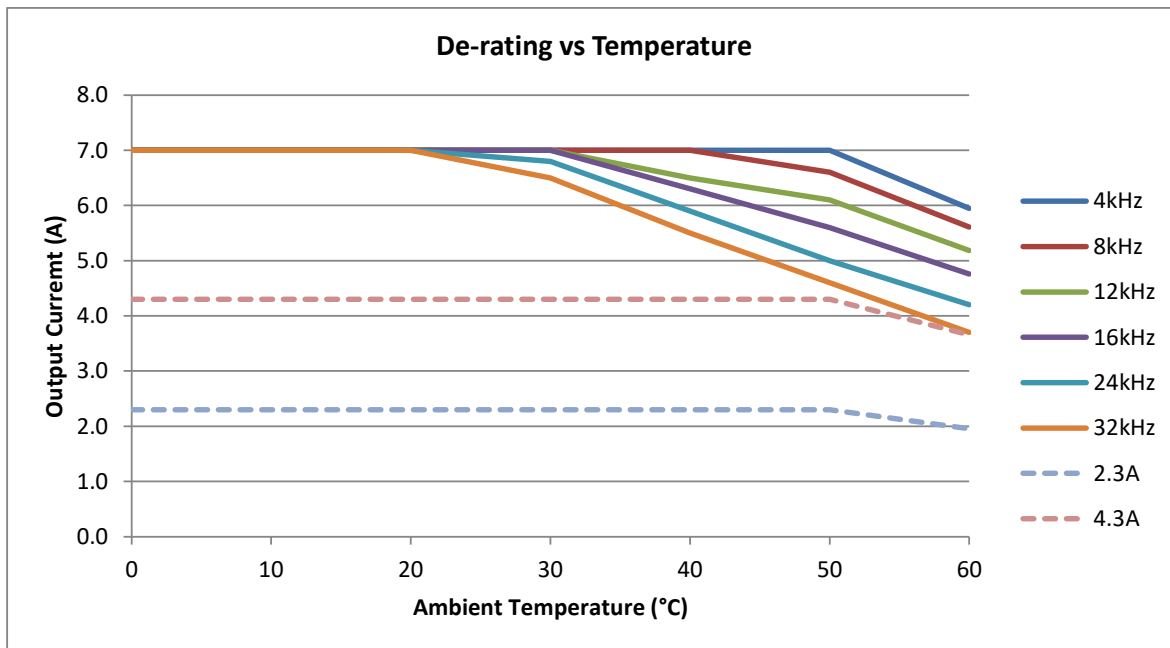
##### 7.3.1.1 Frame Size 1, IP20, 110-115V 1Phase Input, 230V 3 Phase Output (Voltage Doubler), 2.3A & 4.3A



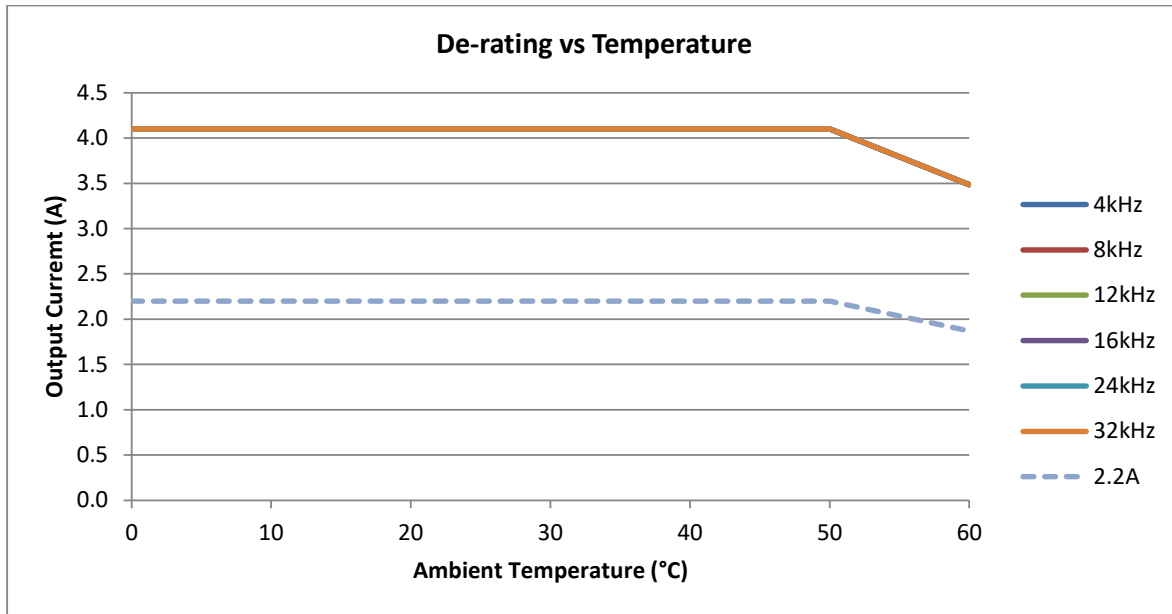
### 7.3.1.2 Frame Size 1, IP20, 200-240V 1Phase Input, 3Phase Output, 2.3A, 4.3A & 7A



### 7.3.1.3 Frame Size 1, IP20, 200-240V 3Phase Input, 3Phase Output, 2.3A, 4.3A & 7A



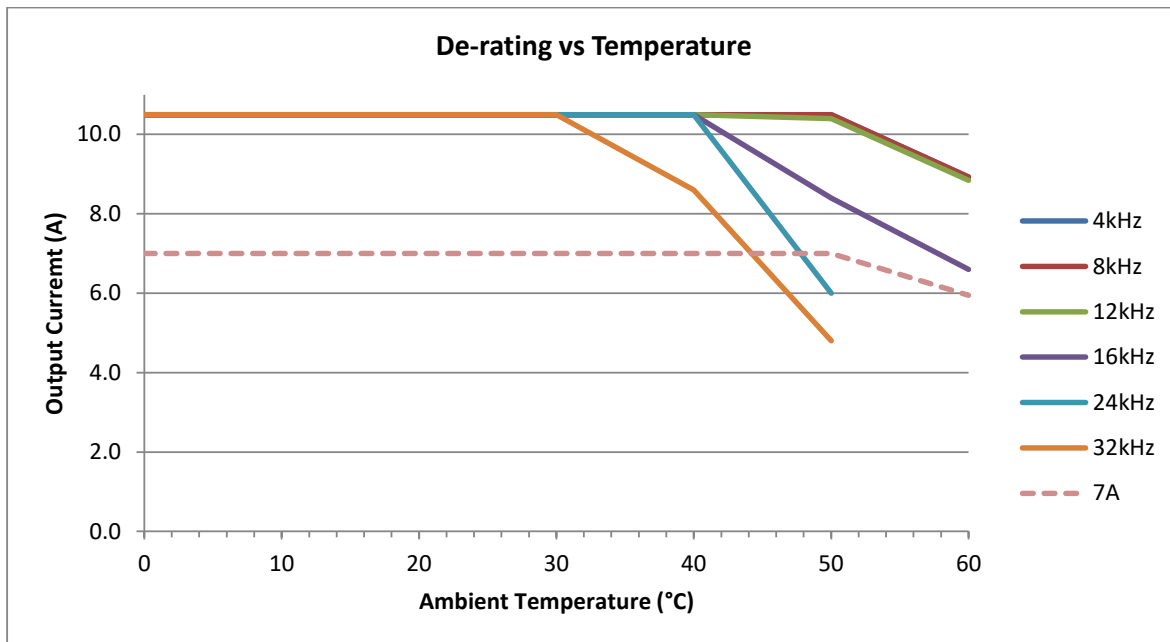
7.3.1.4 Frame Size 1, IP20, 380-480V 3Phase Input, 3 Phase Output, 2.2A & 4.1A



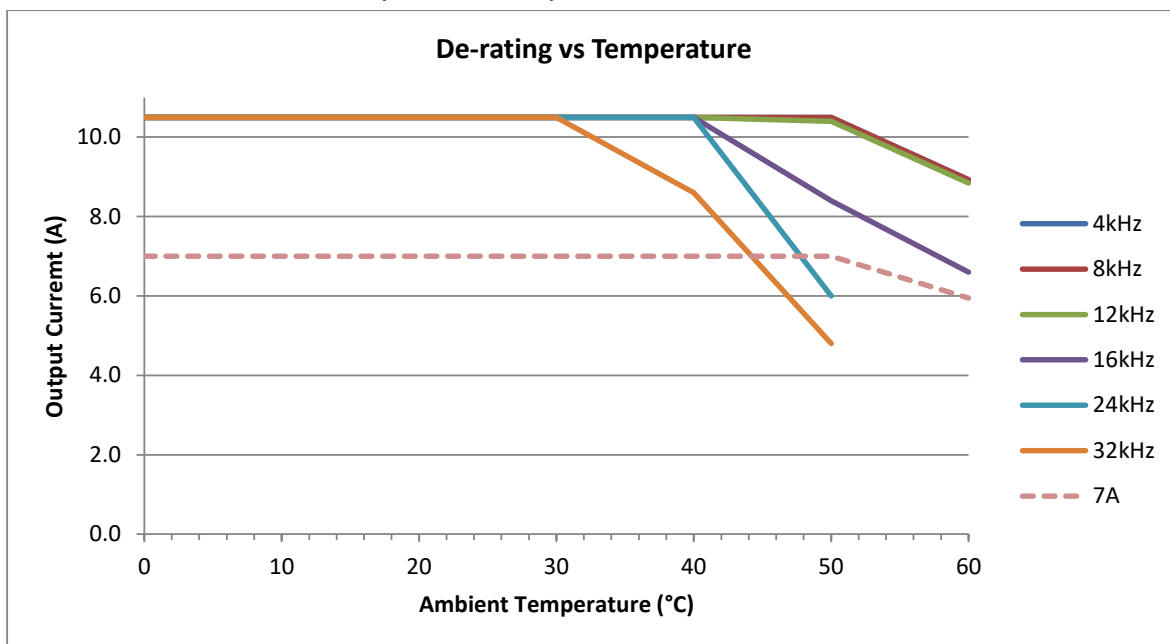
7.3.1.5 Frame Size 2, IP20, 110-115V 1Phase Input, 230V 3Phase Output Voltage Doubler, 5.8A

Information TBC

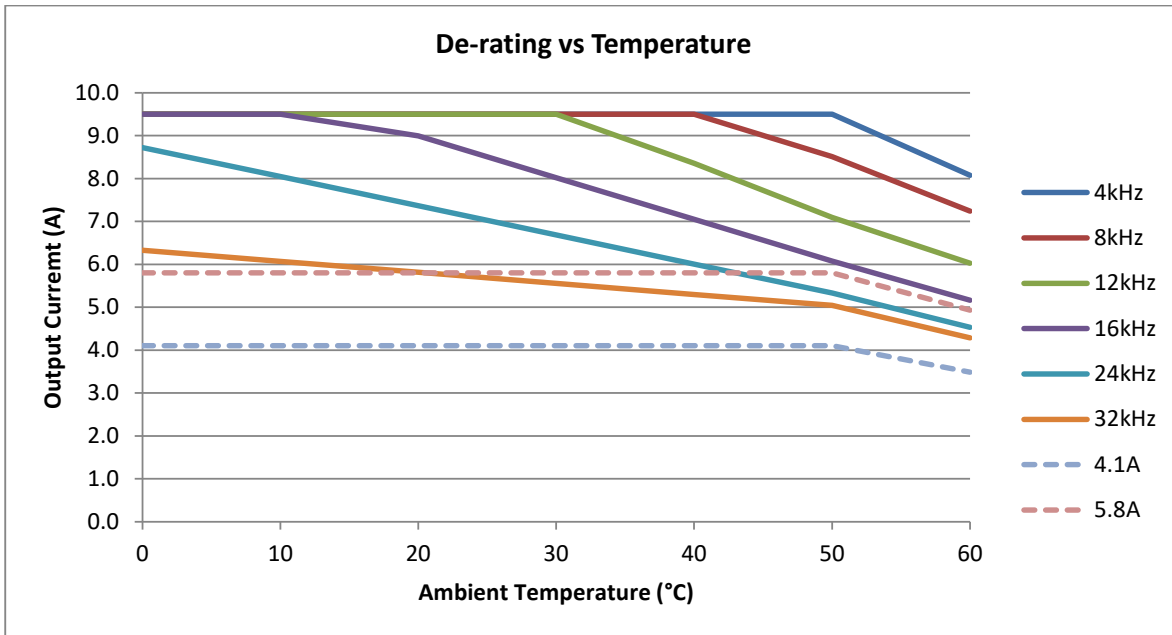
7.3.1.6 Frame Size 2, IP20, 200-240V 1Phase Input, 3Phase Output, 7A & 10.5A



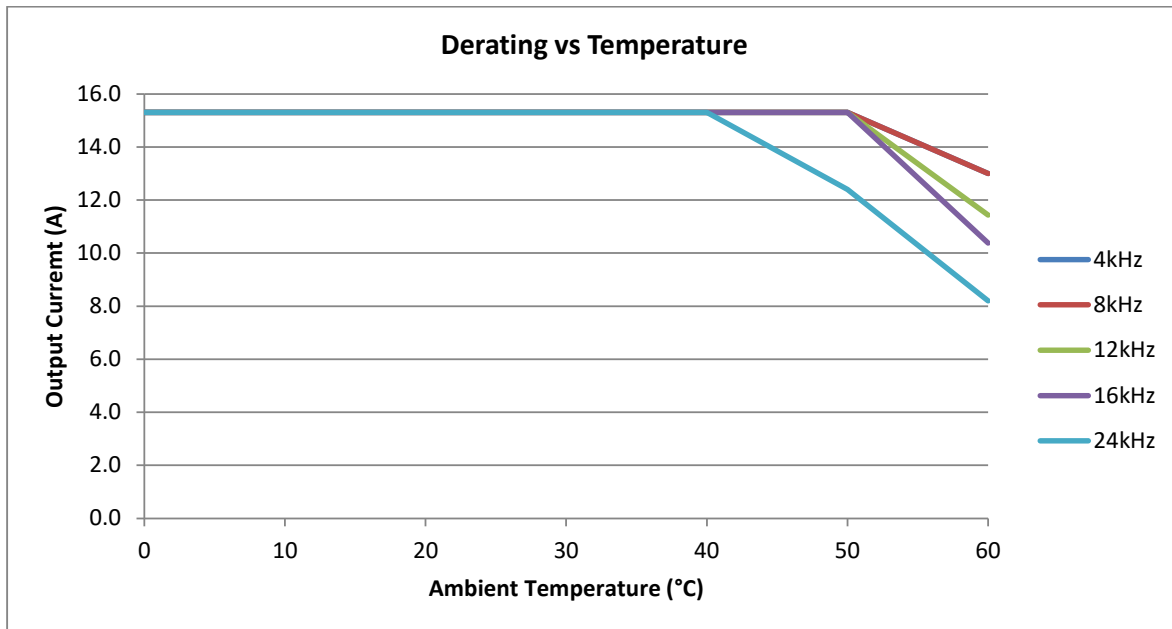
7.3.1.7 Size 2, IP20, 200-240V 3Phase Input, 3Phase Output, 7A & 10.5A



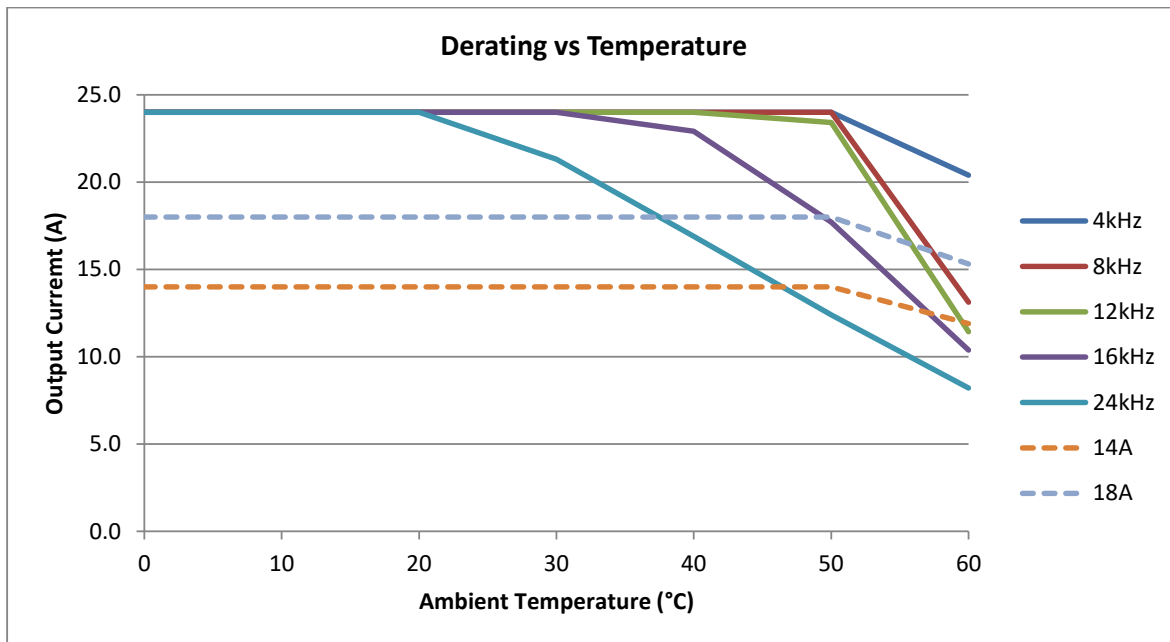
7.3.1.8 Frame Size 2, IP20, 380-480V 3Phase Input, 3Phase Output, 4.1A, 5.8A, 9.5A



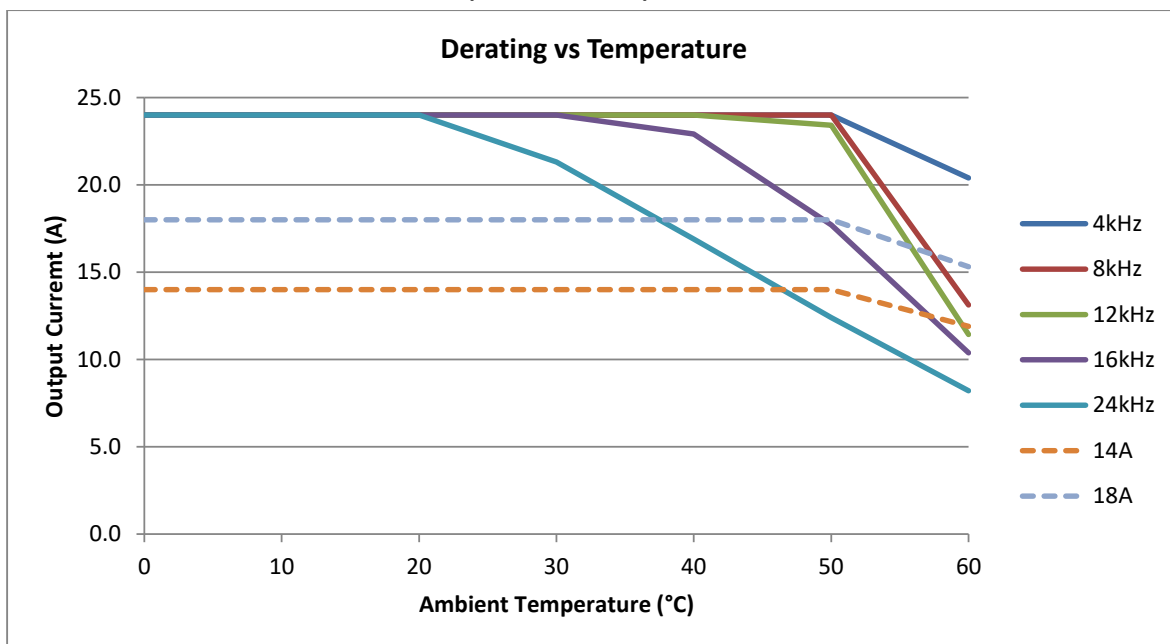
7.3.1.9 Frame Size 3, IP20, 200 – 240V 1Phase Input, 3 Phase Output, 15.3A



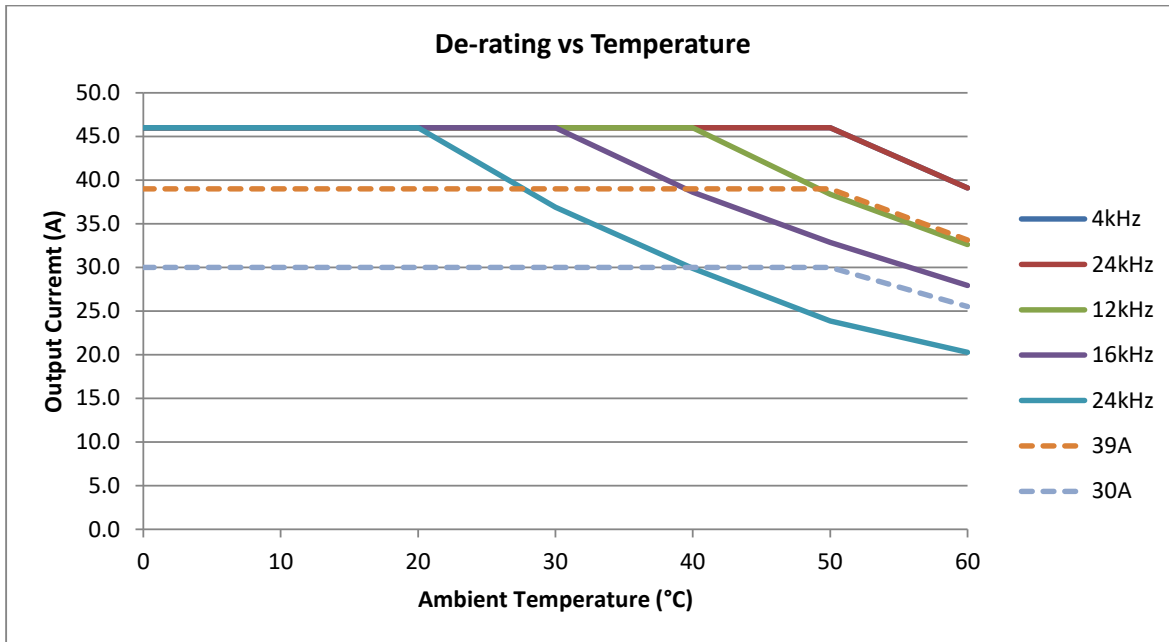
7.3.1.10 Frame Size 3, IP20, 200 – 240V 3Phase Input, 3 Phase Output, 24A



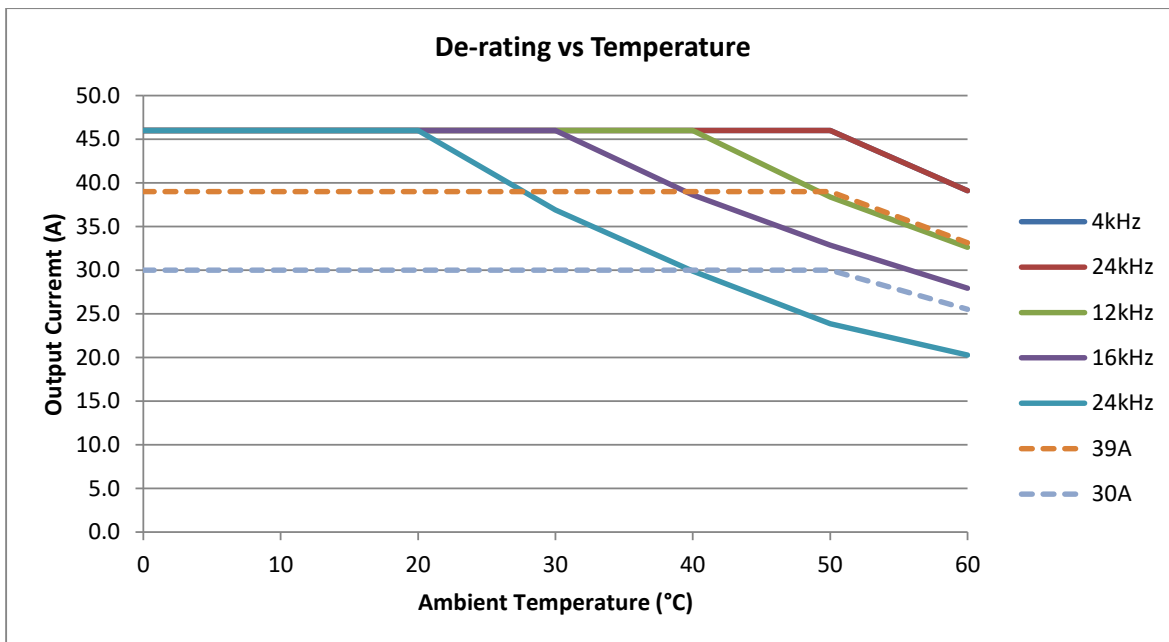
7.3.1.11 Frame Size 3, IP20, 380 – 480V 3Phase Input, 3 Phase Output, 24A



7.3.1.12 Frame Size 4, IP20, 200 – 240V 3Phase Input, 3Phase Output, 30A, 39A & 46A

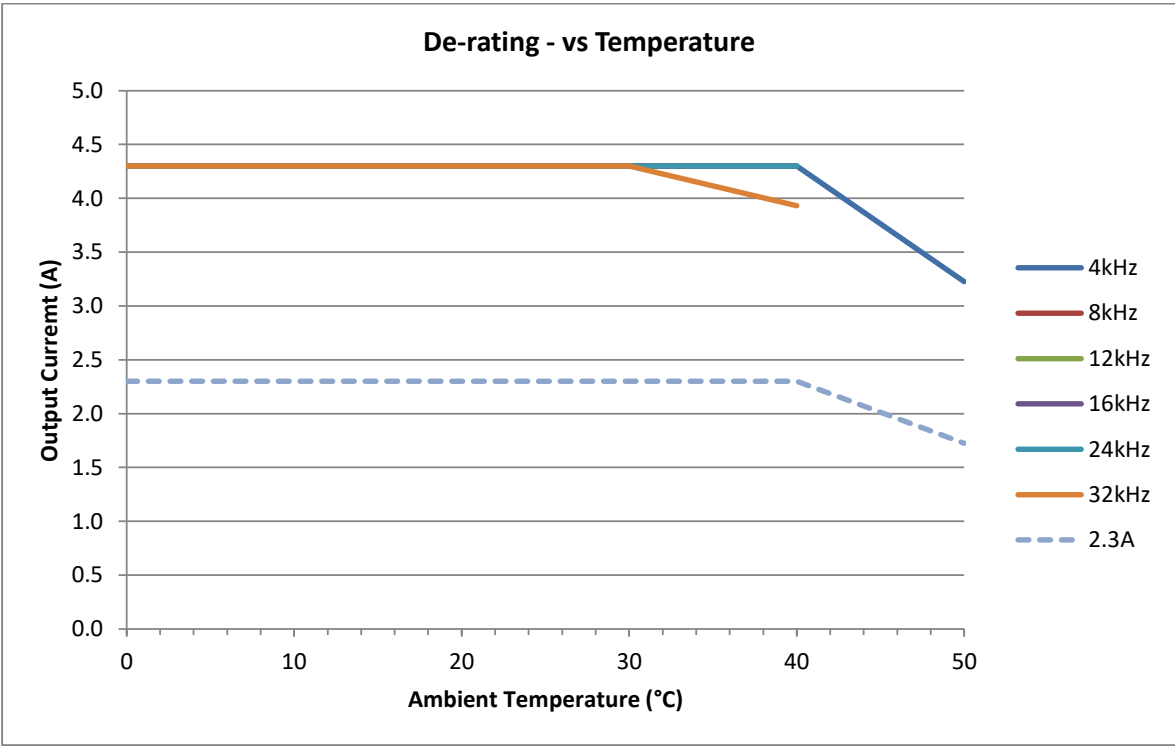


7.3.1.13 Frame Size 4, IP20, 380 – 480V 3Phase Input, 3Phase Output, 30A, 39A & 46A

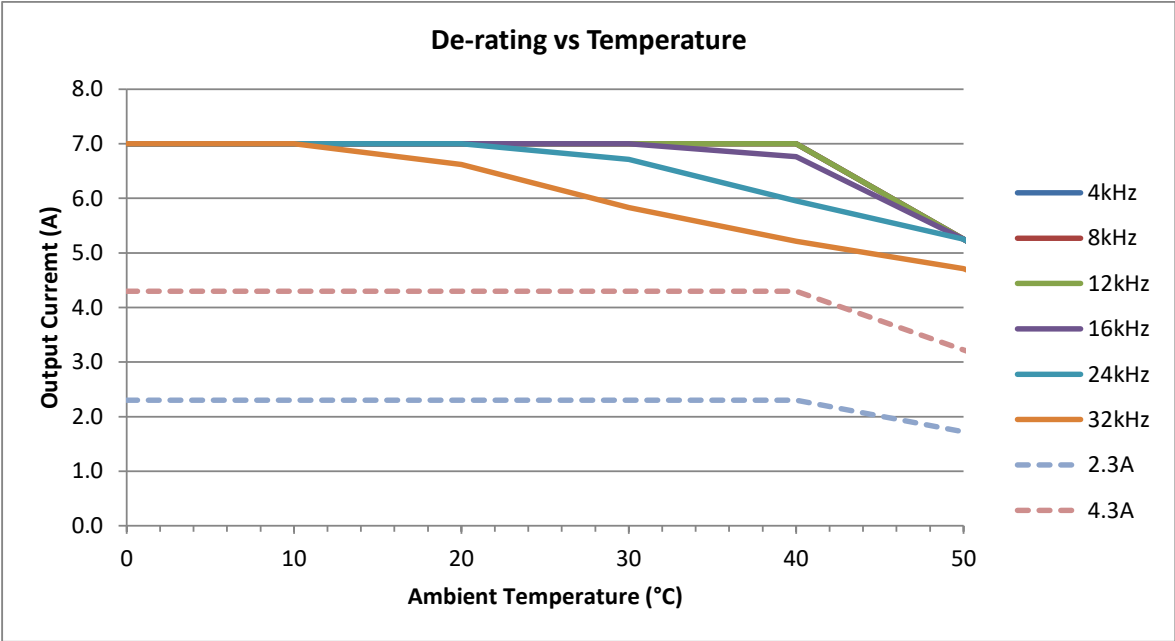


### 7.3.2 IP66 Three Phase Output Drives

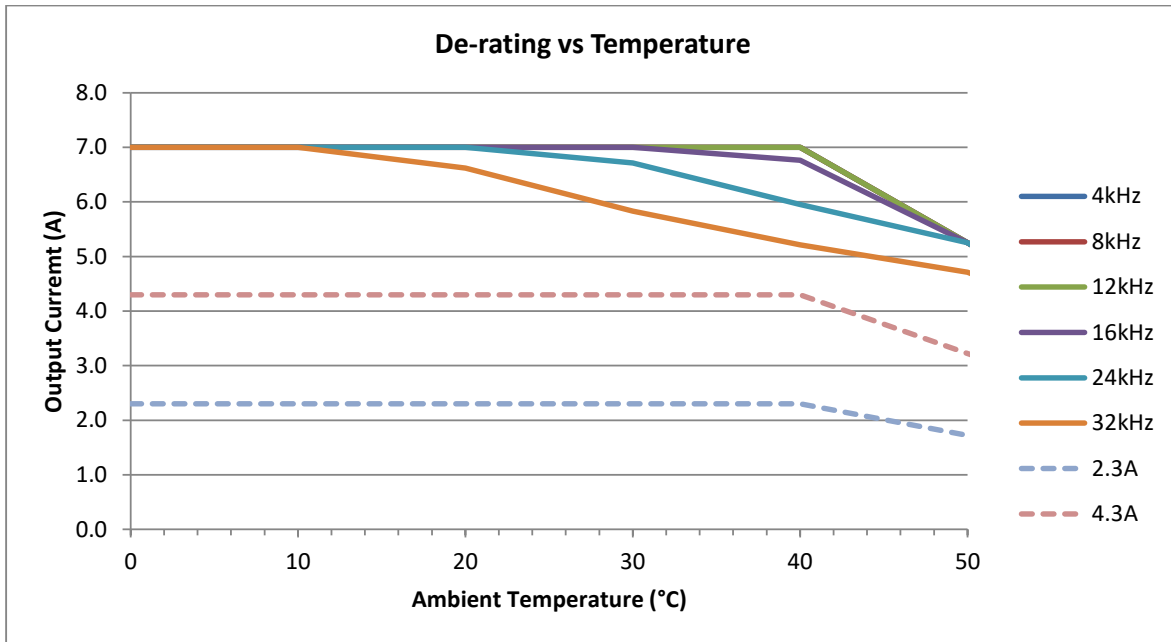
#### 7.3.2.1 Frame Size 1, IP66, 110-115V 1Phase Input, 230V 3 Phase Output (Voltage Doubler), 2.3A & 4.3A



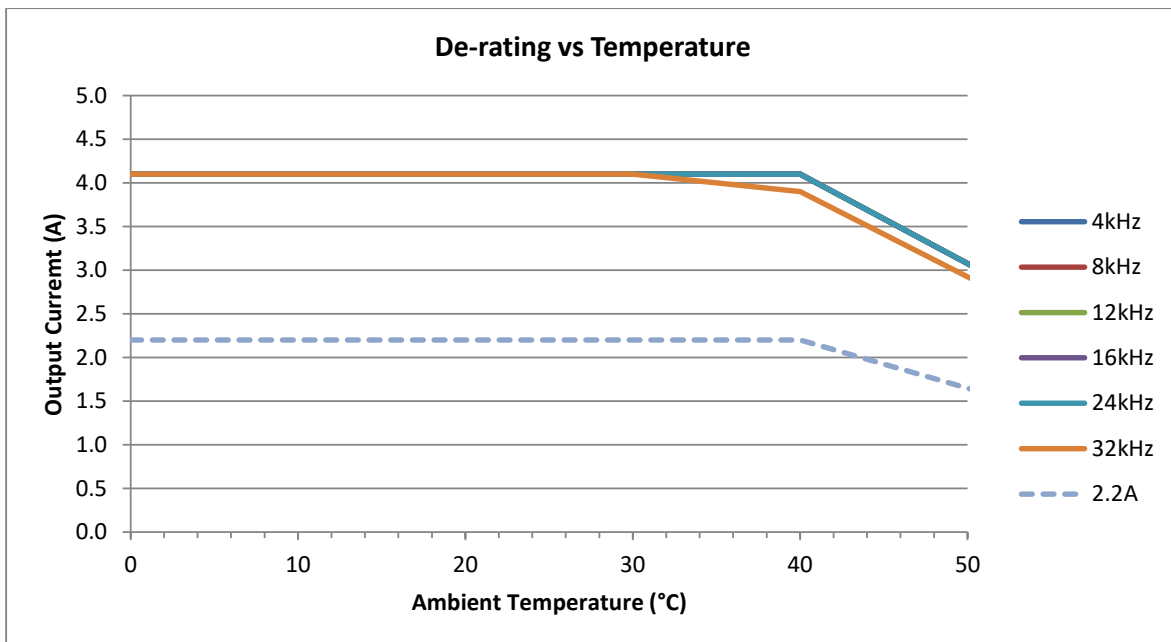
#### 7.3.2.2 Frame Size 1, IP66, 200 – 240V 1Phase Input, 3Phase Output, 2.3A, 4.3A & 7A



7.3.2.3 Frame Size 1, IP66, 200 – 240V 3Phase Input, 3Phase Output, 2.3A, 4.3A & 7A



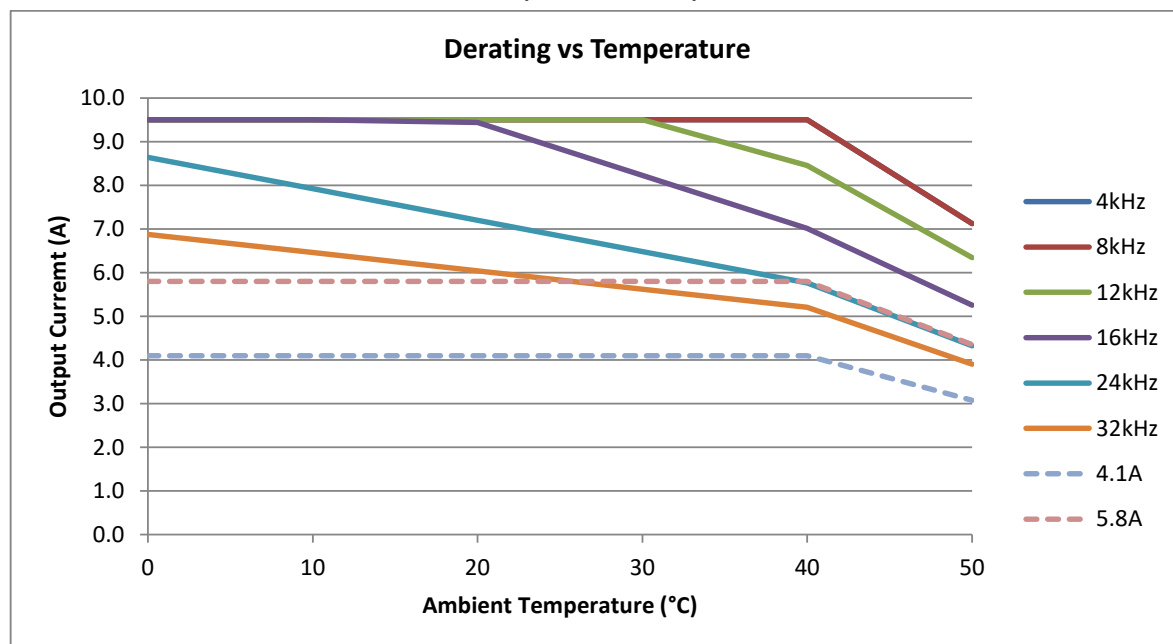
7.3.2.4 Frame Size 1, IP66, 380-480V 3Phase Input, 3 Phase Output, 2.2A & 4.1A



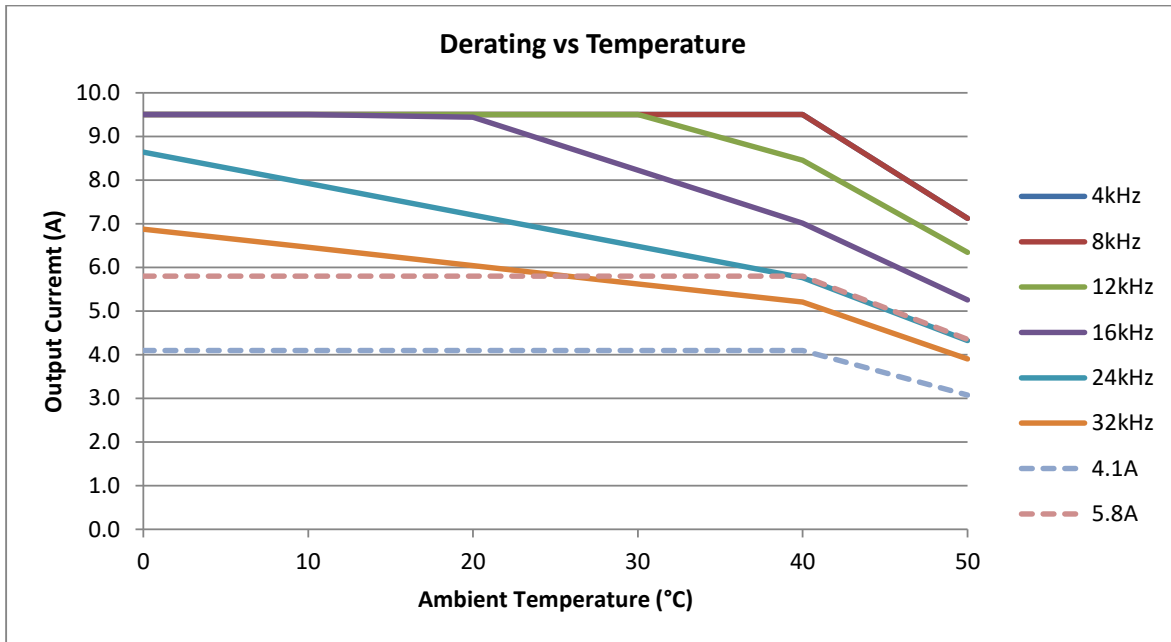
### 7.3.2.5 Frame Size 2, IP66, 110 – 115V 1 Phase Input, 230V 3 Phase Output (Voltage Doubler), 5.8A

Information TBC

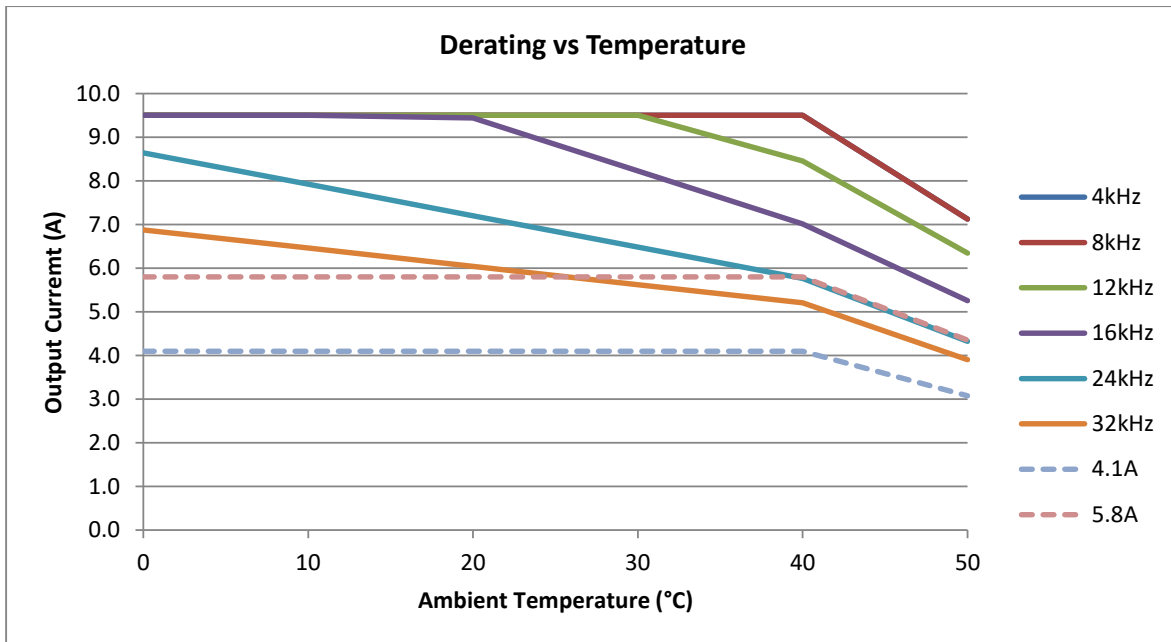
### 7.3.2.6 Frame Size 2, IP66, 200-240V 1Phase Input, 3Phase Output, 7A & 10.5A



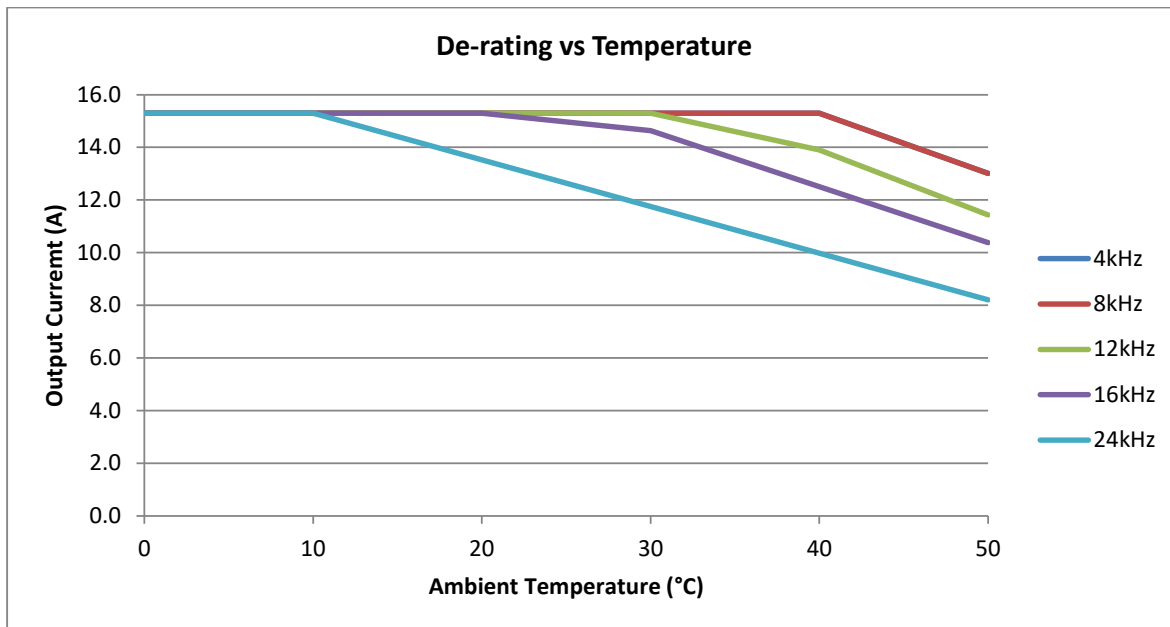
7.3.2.7 Frame Size 2, IP66, 200-240V 3Phase Input, 3Phase Output, 7A & 10.5A



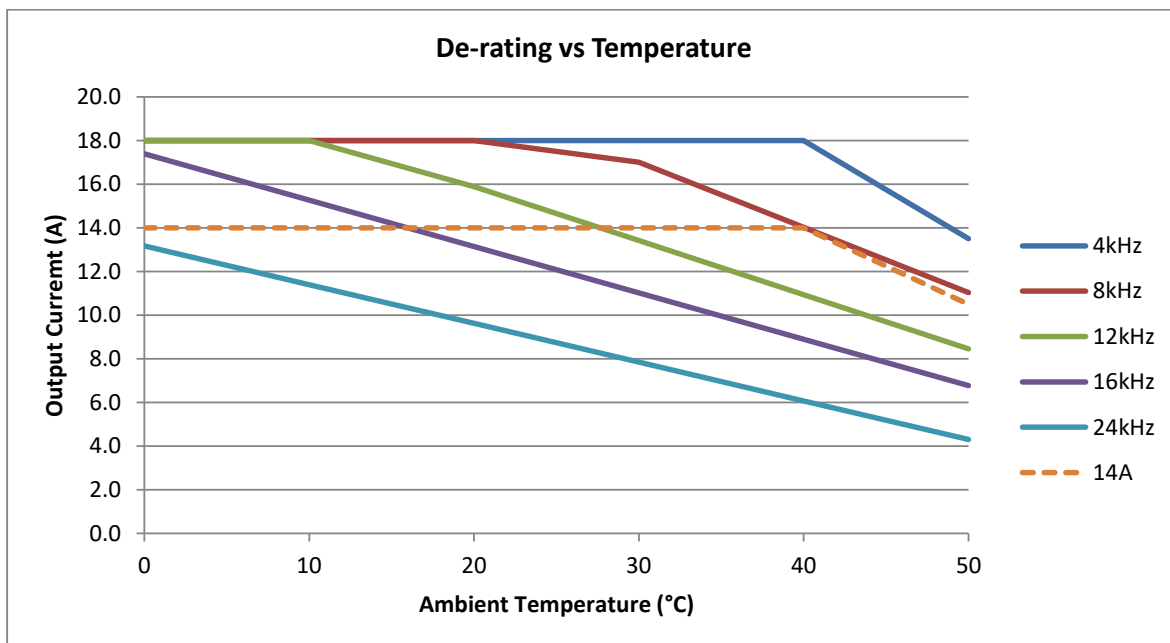
7.3.2.8 Frame Size 2, IP66, 380 – 480V 3Phase Input, 3Phase Output, 4.1A, 5.8A, 9.5A



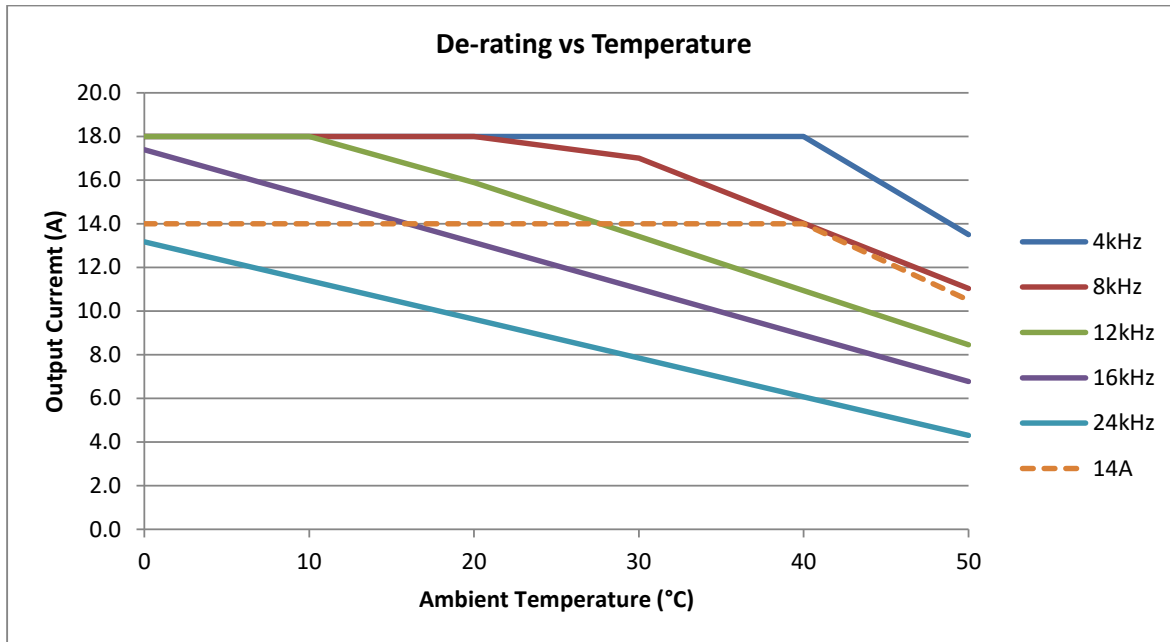
7.3.2.9 Frame Size 3, IP66, 200 – 240V 1Phase Input, 3Phase Output, 15.3A



7.3.2.10 Frame Size 3, IP66, 200 – 240V 3Phase Input, 3Phase Output, 18A

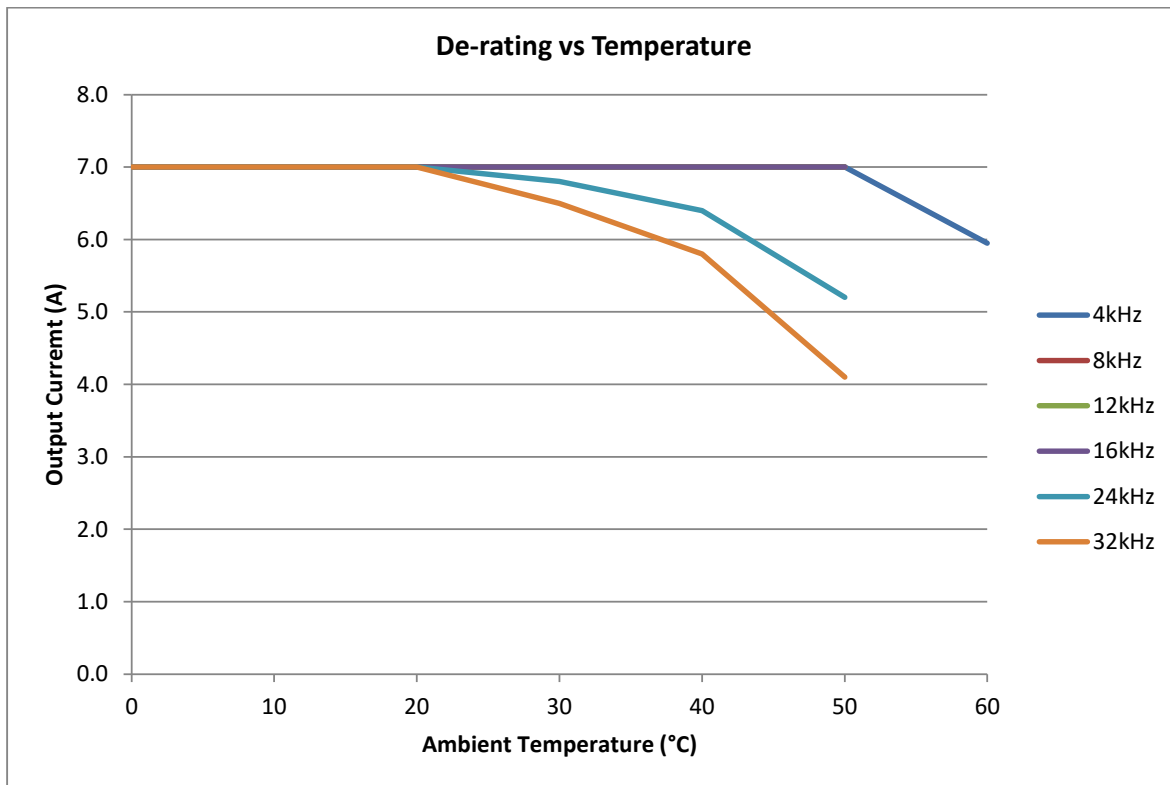


## 7.3.2.11 Frame Size 3, IP66, 380 – 480V 3Phase Input, 3Phase Output, 18A

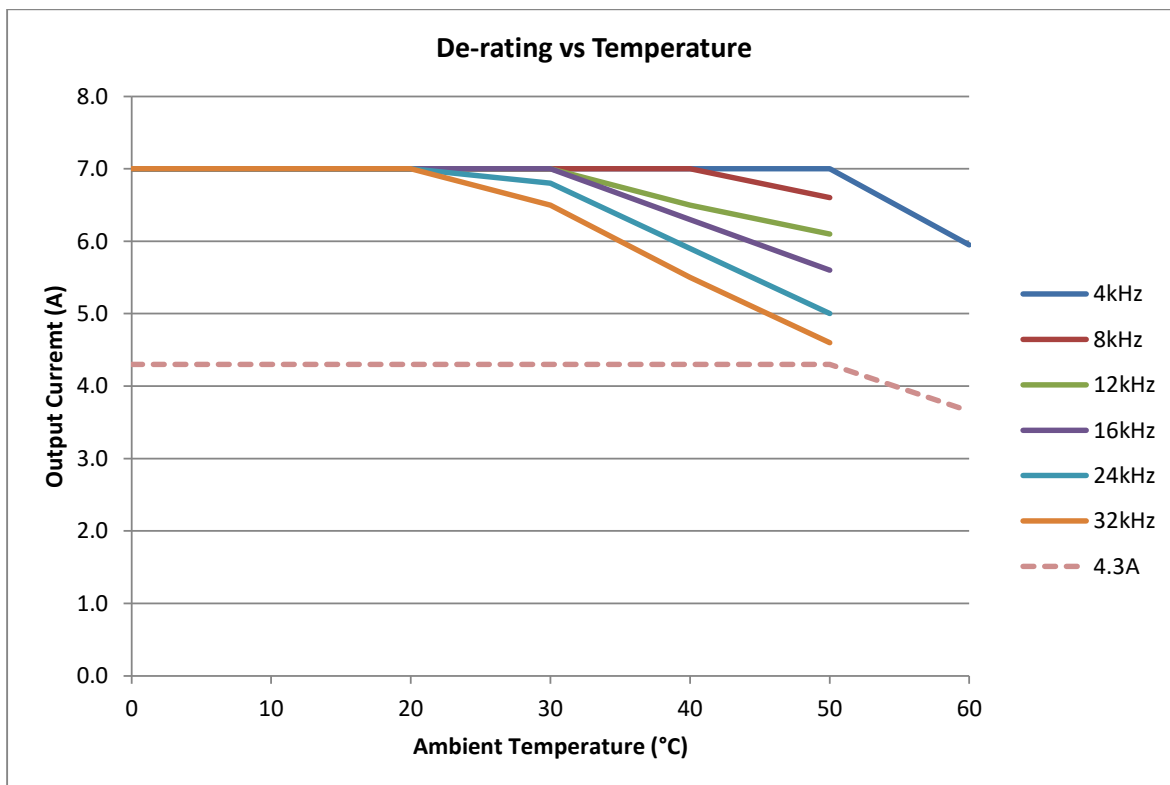


### 7.3.3 IP20 Single Phase Output Drives

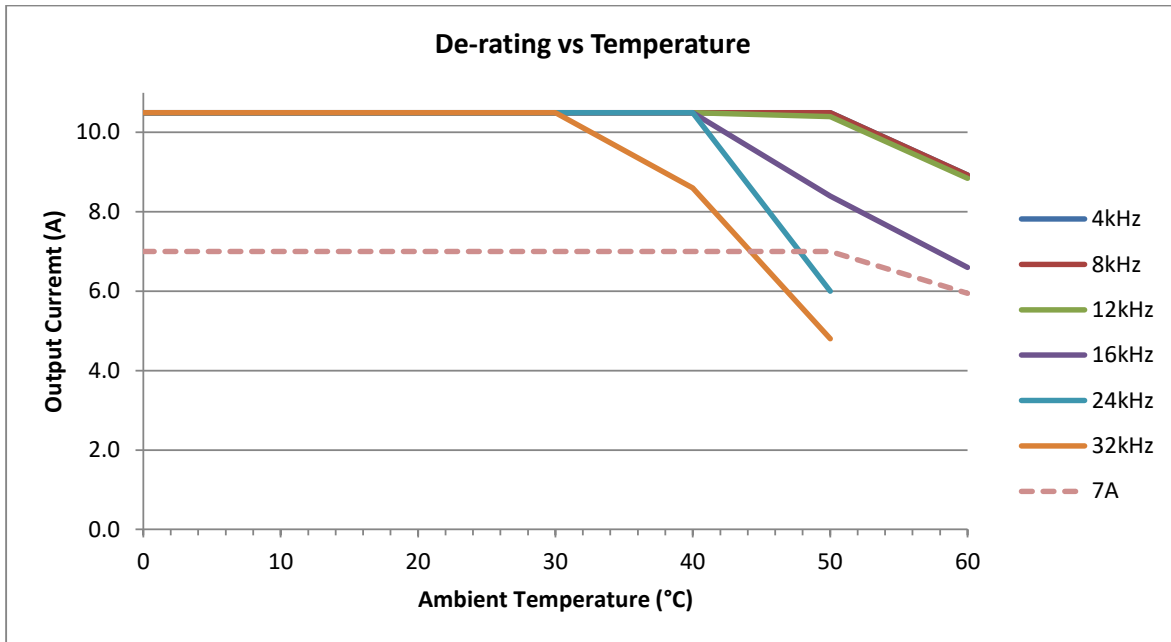
#### 7.3.3.1 Size 1, IP20, 110 – 115V 1Phase Input, 1 Phase Output, 7A



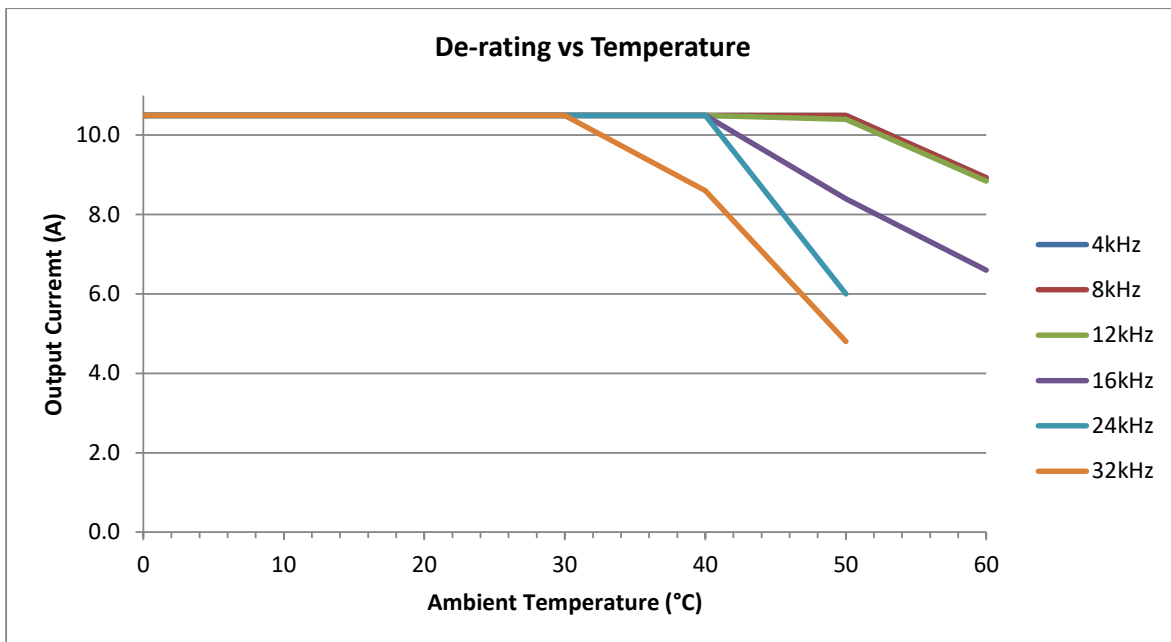
#### 7.3.3.2 Frame Size 1, IP20, 200-240V 1Phase Input, 1Phase Output, 4.3A & 7A



7.3.3.3 Frame Size 2, IP20, 110-115V 1Phase Input, 1Phase Output, 5.8A

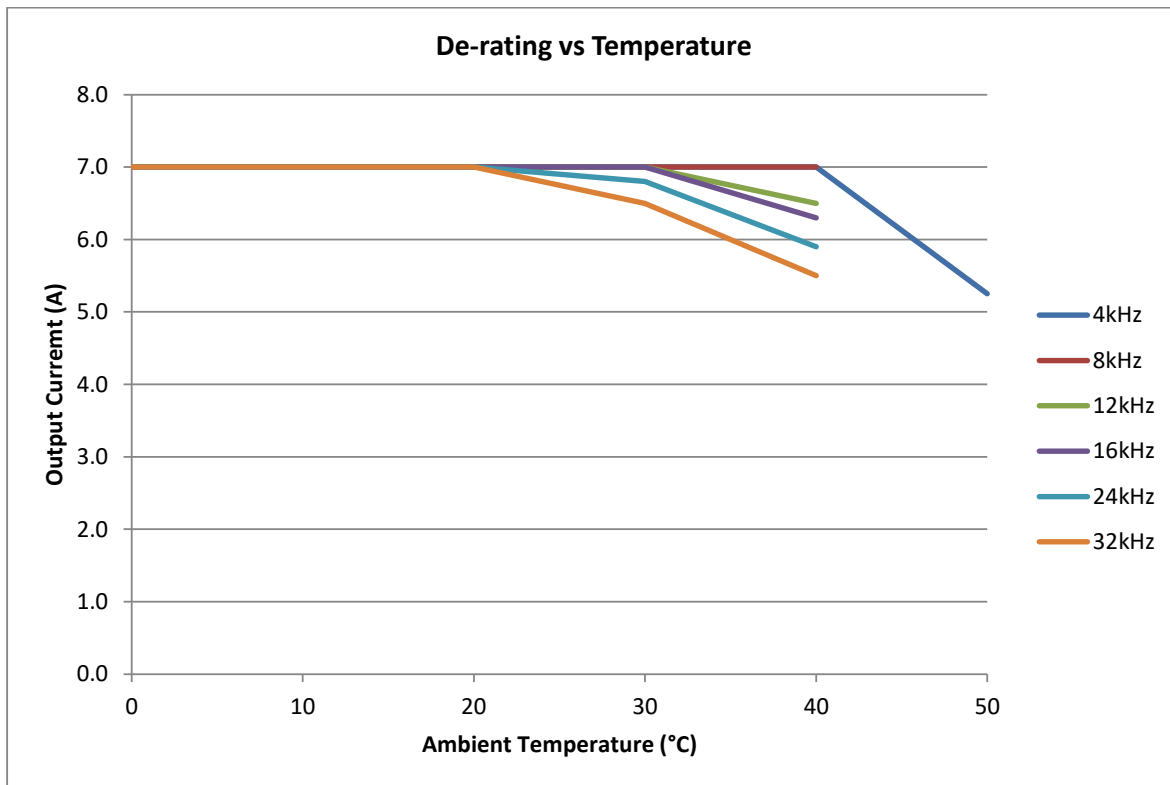


7.3.3.4 Frame Size 2, IP20, 200-240V 1Phase Input, 1Phase Output, 10.5A

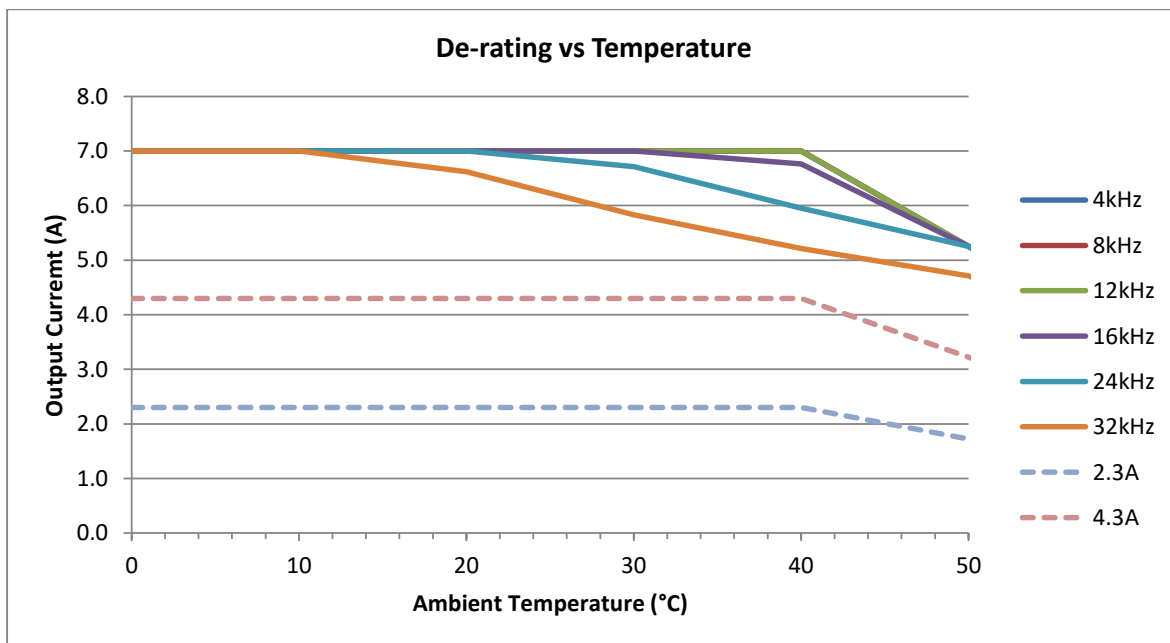


### 7.3.4 IP66 Single Phase Output Drives

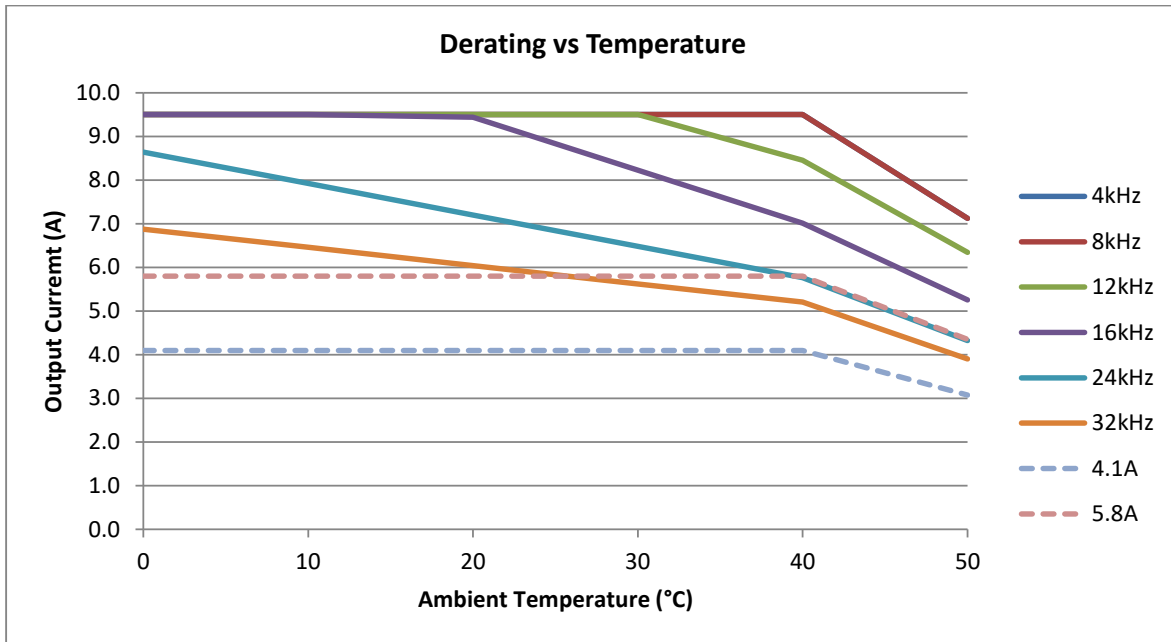
#### 7.3.4.1 Size 1, IP66, 110 – 115V 1Ph Input, 1 Ph. Output, 7A



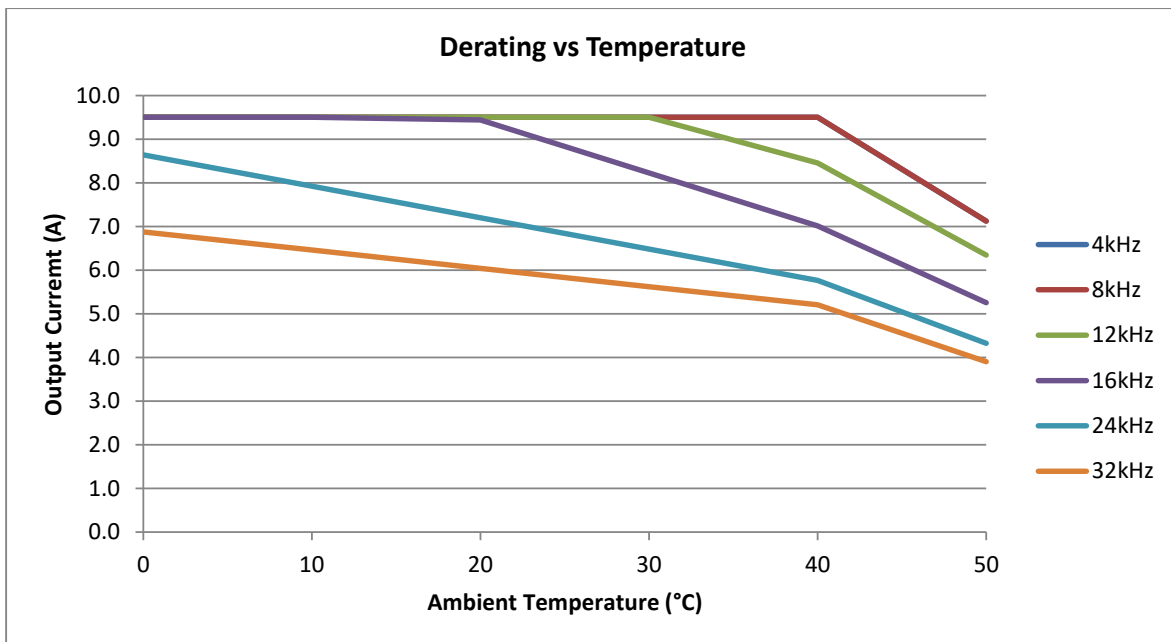
#### 7.3.4.2 Size 1, IP66, 200-240V 1Ph Input, 1Ph Output, 4.3A & 7A



7.3.4.3 Size 2, IP66, 110-115V 1Ph Input, 1Ph Output, 5.8A



7.3.4.4 Frame Size 2, IP66, 200-240V 1Phase Input, 1Phase Output, 10.5A



## 8 Immunity Tests

### 8.1 Electrostatic Discharge (ESD)

The Optidrive E3 product range has been designed and tested to comply with the limits defined in EN 61800-3:2004+A1-2012. The test techniques used are as defined in EN 61000-4-2:2009.

| Application | Test points               | Test Method       | Level |
|-------------|---------------------------|-------------------|-------|
| Direct      | Control Terminals         | Contact Discharge | ±4kV  |
|             |                           | Air Discharge     | ±8kV  |
|             | Power Terminals           | Air Discharge     | ±8kV  |
| Indirect    | Vertical coupling plane   | Contact Discharge | ±4kV  |
|             | Horizontal coupling plane | Contact Discharge | ±4kV  |

### 8.2 Electrical Fast Transient Burst (EFT/B)

The Optidrive E3 product range has been designed and tested to comply with the limits defined in EN 61800-3: 2004+A1-2012. The test techniques used are as defined in EN 61000-4-4:2004.

| Test points                 | Test Method                 | Level        |
|-----------------------------|-----------------------------|--------------|
| Control Terminals           | Capacitive clamp            | ±1kV at 5kHz |
| Motor Power Terminals       | Capacitive clamp            | ±2kV at 5kHz |
| 1-PH Supply Power Terminals | Coupling Decoupling Network | ±2kV at 5kHz |
| 3-PH Supply Power Terminals | Capacitive clamp            | ±4kV at 5kHz |

### 8.3 Surge

The Optidrive E3 product range has been designed and tested to comply with the limits defined in EN 61800-3: 2004+A1-2012. The test techniques used are as defined in EN 61000-4-5:2006.

| Drive Type | Test Method           | Level |
|------------|-----------------------|-------|
| 200-240V   | Line to Line/Neutral  | ±1kV  |
|            | Line/Neutral to Earth | ±2kV  |
| 380-480V   | Line to Line          | ±2kV  |
|            | Line to Earth         | ±4kV  |

### 8.4 Dielectric strength (Flash)

The Optidrive E3 product range has been designed and tested to comply with the limits defined in EN 61800-5-1: 2007. The test techniques used are as defined in EN 61800-5-1: 2007.

| Drive Type | Level |
|------------|-------|
| 200-240V   | 1.5kV |
| 380-480V   | 2.5kV |

## 9 General Technical and Performance Data

### 9.1 Electrical Data

|                                   |                                                                                                                                           |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| <b>9.1.1 Mains Supply Details</b> |                                                                                                                                           |
| 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                             |
| <b>9.1.2 Motor Control</b>        |                                                                                                                                           |
| 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     | Refer to section 3.1                                                                                                                      |
| Acceleration Time                 | 0 – 600 seconds, 0.01s resolution                                                                                                         |
| Deceleration Time                 | Two deceleration ramps<br>0 – 600 seconds, 0.01s resolution                                                                               |
| <b>9.1.3 Overload Capacity</b>    |                                                                                                                                           |
| Overload Capacity                 | 150% of rated current for 60 seconds, repeat cycle every 10 minutes.<br>175% / 4 seconds                                                  |

### 9.2 Input Output Current Ratings

#### 9.2.1 110V Input

| Frame Size | Supply Voltage | Power Rating (kW) | Input Current (A) | iTHD (%) | AC Line Choke  | Input Current (A) | iTHD (%) | Output Current (A) |
|------------|----------------|-------------------|-------------------|----------|----------------|-------------------|----------|--------------------|
| 1          | 110V, 1 Ph.    | 0.37              | 7.8               |          | OPT-2-L1016-20 | 7.1               |          | 2.3                |
|            |                | 0.75              | 15.8              | <60.0    | OPT-2-L1016-20 | 15.0              |          | 4.3                |
| 2          | 110V, 1 Ph.    | 1.1               | 21.9              |          | OPT-2-L1025-20 | 20.1              |          | 5.8                |

The data above is provided to show typical values. Results measured at the point of installation may vary according to the installation site and load conditions Test results are measured under the following conditions:-

- 400 Volt RMS AC Supply Voltage
- Operating IE2 motor with matching power rating according to the drive
- Operated at full rated output current capacity

**9.2.2 230V Input**

| Frame Size | Supply Voltage | Power Rating (kW) | Input Current (A) | iTHD (%) | AC Line Choke  | Input Current (A) | iTHD (%) | Output Current (A) |
|------------|----------------|-------------------|-------------------|----------|----------------|-------------------|----------|--------------------|
| 1          | 230V, 1ph      | 0.37              | 3.7               | <175%    | OPT-2-L1016-20 | 2.9               |          | 2.3                |
|            |                | 0.75              | 7.5               | <175%    | OPT-2-L1016-20 | 6.6               |          | 4.3                |
|            |                | 1.5               | 12.9              | <175%    | OPT-2-L1016-20 | 9.7               |          | 7.0                |
|            | 230V, 3ph      | 0.37              | 3.4               | <85.0    | OPT-2-L3006-20 | 3.4               |          | 2.3                |
|            |                | 0.75              | 5.6               | <85.0    | OPT-2-L3006-20 | 5.6               |          | 4.3                |
|            |                | 1.5               | 9.5               | <85.0    | OPT-2-L3010-20 | 6.3               |          | 7.0                |
| 2          | 230V, 1ph      | 1.5               | 12.9              | <125.0   | OPT-2-L1016-20 | 11.4              |          | 7.0                |
|            |                | 2.2               | 19.2              | <100.0   | OPT-2-L1025-20 | 17.0              |          | 10.5               |
|            | 230V, 3ph      | 1.5               | 8.9               | <85.0    | OPT-2-L3006-20 | 7.0               |          | 7.0                |
|            |                | 2.2               | 12.1              | <85.0    | OPT-2-L3010-20 | 9.9               |          | 10.5               |
| 3          | 230V, 1ph      | 4.0               | 29.2              | <125.0   | -              | 25.9              |          | 15.3               |
|            | 230V, 3ph      | 4.0               | 20.9              | <85.0    | OPT-2-L3036-20 | 13.5              |          | 18                 |
|            |                | 5.5               | 26.4              | <85.0    | OPT-2-L3036-20 | 17.4              |          | 24                 |
| 4          | 230V, 3ph      | 5.5               | 26.9              | <85.0    | OPT-2-L3036-20 | 22.0              |          | 24                 |
|            |                | 7.5               | 33.3              | <85.0    | OPT-2-L3036-20 | 27.7              |          | 30                 |
|            |                | 11                | 50.1              | <85.0    | OPT-2-L3050-20 | 41.7              |          | 46                 |

The data above is provided to show typical values. Results measured at the point of installation may vary according to the installation site and load conditions Test results are measured under the following conditions:-

- 230 Volt RMS AC Supply Voltage
- Operating IE2 motor with matching power rating according to the drive
- Operated at full rated output current capacity

**9.2.3 400 / 460 Volt Input**

| Frame Size | Supply Voltage | Power Rating (kW) | Input Current (A) | iTHD (%) | AC Line Choke  | Input Current (A) | iTHD (%) | Output Current (A) |
|------------|----------------|-------------------|-------------------|----------|----------------|-------------------|----------|--------------------|
| 1          | 400V, 3ph      | 0.75              | 3.5               | <85.0    | OPT-2-L3006-20 | 1.5               |          | 2.2                |
|            |                | 1.5               | 5.6               | <85.0    | OPT-2-L3006-20 | 2.7               |          | 4.1                |
| 2          |                | 1.5               | 5.6               | <85.0    | OPT-2-L3006-20 | 4.5               |          | 4.1                |
|            |                | 2.2               | 7.5               | <85.0    | OPT-2-L3006-20 | 5.5               |          | 5.8                |
|            |                | 4.0               | 11.5              | <85.0    | OPT-2-L3010-20 | 9.2               |          | 9.5                |
| 3          |                | 5.5               | 17.2              | <85.0    | OPT-2-L3036-20 | 14.5              |          | 14                 |
|            |                | 7.5               | 21.2              | <85.0    | OPT-2-L3036-20 | 17.2              |          | 18                 |
|            |                | 11                | 27.5              | <85.0    | OPT-2-L3036-20 | 21.7              |          | 24                 |
| 4          |                | 15                | 34.2              | <85.0    | OPT-2-L3036-20 | 27.0              |          | 30                 |
|            |                | 18.5              | 44.1              | <85.0    | OPT-2-L3050-20 | 34.8              |          | 39                 |
|            |                | 22                | 51.9              | <85.0    | OPT-2-L3050-20 | 40.9              |          | 46                 |

The data above is provided to show typical values. Results measured at the point of installation may vary according to the installation site and load conditions Test results are measured under the following conditions:-

- 400 Volt RMS AC Supply Voltage
- Operating IE2 motor with matching power rating according to the drive
- Operated at full rated output current capacity

**9.3 Standby Power Consumption**

The following table shows the power consumption of the drive under the following conditions.

- Drive is powered from the nominal rated mains supply voltage (e.g. 230 or 400 Volt)
- Output disabled
- Cooling fan off
- No external power drawn from the control terminals

| Frame Size | Voltage | Phase | Consumption |
|------------|---------|-------|-------------|
| 1          | 230     | 1     | 3.07W       |
|            | 230     | 3     | 3.07W       |
|            | 400     | 3     | 4.55W       |
| 2          | 230     | 1     | 4.51W       |
|            | 230     | 3     | 4.51W       |
|            | 400     | 3     | 6.44W       |
| 3          | 230     | 1     | 5.16W       |
|            | 230     | 3     | 5.16W       |
|            | 400     | 3     | 6.42W       |
| 4          | 230     | 3     | 7.54W       |
|            | 400     | 3     | 14.6W       |

## 9.4 DC Bus Discharge Time

DC Bus discharge times are based on maximum continuous rated DC bus voltage. In compliance with EN 61800-5-1:2007, all drives have a caution on the rating labels stating “Power down for 5 minutes before removing cover”

| Frame Size | Supply Voltage | DC Bus Voltage |          |           | Time to reach 50V |
|------------|----------------|----------------|----------|-----------|-------------------|
|            |                | Max            | after 5s | after 60s |                   |
| 1          | 240Vac +10%    | 375            | 323      | 24.8      | 26 sec            |
|            | 480Vac +10%    | 680            | 510      | 36        | 34 sec            |
| 2          | 240Vac +10%    | 375            | 332      | 27.3      | 42 sec            |
|            | 480Vac +10%    | 680            | 564      | 24.5      | 48 sec            |
| 3          | 240Vac +10%    | 375            | 324      | 36.4      | 27 sec            |
|            | 480Vac +10%    | 680            | 601      | 59.6      | 109 sec           |
| 4          | 240Vac +10%    | 375            | 301      | 28.6      | 46 sec            |
|            | 480Vac +10%    | 680            | 610      | 40.2      | 58 sec            |

## 9.5 Earth Leakage Current (Touch Current)

The Optidrive E3 product range has been designed and tested to comply with the limits defined in EN 61800-5-1: 2007. The test techniques used are as defined in EN 60990:2000.

As stated in the standard 61800-5-1:2007, 5.2.3.5 the motor does not have to be loaded, however, the motor type, cable type and length can have a significant impact on the results.

| Frame Size | Typical Supply Conditions |                         | Maximum Supply Conditions |                         |
|------------|---------------------------|-------------------------|---------------------------|-------------------------|
|            | Supply Voltage            | I <sub>Touch</sub> (mA) | Supply Voltage            | I <sub>Touch</sub> (mA) |
| 1          | 1ph 230V 50Hz             | 3.5                     | 1ph 240V +10% 60Hz        | 4.8                     |
|            | 3ph 230V 50Hz             | 4.6                     | 3ph 240V +10% 60Hz        | 7.5                     |
|            | 3ph 400V 50Hz             | 8                       | 3ph 480V +10% 60Hz        | 13                      |
| 2          | 1ph 230V 50Hz             | 3.5                     | 1ph 240V +10% 60Hz        | 4.8                     |
|            | 3ph 230V 50Hz             | 4.7                     | 3ph 240V +10% 60Hz        | 7.2                     |
|            | 3ph 400V 50Hz             | 8.1                     | 3ph 480V +10% 60Hz        | 12.6                    |
| 3          | 1ph 230V 50Hz             | 3.5                     | 1ph 240V +10% 60Hz        | 4.7                     |
|            | 3ph 230V 50Hz             | 4.7                     | 3ph 240V +10% 60Hz        | 6.8                     |
|            | 3ph 400V 50Hz             | 8.1                     | 3ph 480V +10% 60Hz        | 12.7                    |
| 4          | 3ph 230Vac 50Hz           | 4.8                     | 3ph 240V +10% 60Hz        | 6.9                     |
|            | 3ph 400Vac 50Hz           | 8.2                     | 3ph 480V +10% 60Hz        | 12.9                    |

### NOTE

The Touch Current value is based on:-

- Normal operating conditions, i.e. all phases balanced and connected correctly with the motor running
- Drive fitted with integrated EMC filter

## 9.6 Digital & Analog I/O

### 9.6.1 Digital Inputs Specification

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

### 9.6.2 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

### 9.6.3 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

### 9.6.4 Relay Output

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

## 9.7 Environmental Data

|                                             |                                                                                                                            |                                                                                                                                                                                                                                        |
|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>9.7.1 Temperature Range</b>              |                                                                                                                            |                                                                                                                                                                                                                                        |
| Ambient Temperature Range : Operation       | IP20 Drives : -10 - +50°C (14 - 122°F) without derating<br>IP55 & IP66 Drives : -10 - + 40°C (14 - 104°F) without derating |                                                                                                                                                                                                                                        |
| Note : No frost or condensation permissible |                                                                                                                            |                                                                                                                                                                                                                                        |
| Ambient Temperature Range : Storage         | -40 ... 60 °C. No Frost or Condensation                                                                                    |                                                                                                                                                                                                                                        |
| <b>9.7.2 Altitude</b>                       |                                                                                                                            |                                                                                                                                                                                                                                        |
| Maximum Altitude (No derating)              | 1000m Derate above 1000m by 1% per 100m                                                                                    |                                                                                                                                                                                                                                        |
| Maximum Altitude (UL Approved)              | 2000m                                                                                                                      |                                                                                                                                                                                                                                        |
| Maximum Altitude                            | 4000m                                                                                                                      |                                                                                                                                                                                                                                        |
| <b>9.7.3 Relative Humidity</b>              |                                                                                                                            |                                                                                                                                                                                                                                        |
| Relative Humidity Limit                     | 95% Maximum, non-condensing                                                                                                |                                                                                                                                                                                                                                        |
| <b>9.7.4 Contamination Levels</b>           |                                                                                                                            |                                                                                                                                                                                                                                        |
| Standard                                    | IEC 721-3-3, Non-conductive dust allowed                                                                                   |                                                                                                                                                                                                                                        |
| Transportation                              | Class 1C2 (chemical gases),<br>Class 1S2 (solid particles)                                                                 |                                                                                                                                                                                                                                        |
| Storage                                     | Class 2C2 (chemical gases),<br>Class 2S2 (solid particles)                                                                 |                                                                                                                                                                                                                                        |
| Operation                                   | Class 3C2 (chemical gases),<br>Class 3S2 (solid particles)                                                                 |                                                                                                                                                                                                                                        |
| <b>9.7.5 Vibration Levels</b>               |                                                                                                                            |                                                                                                                                                                                                                                        |
| Shock Test                                  | Pulse Shape<br>Peak Acceleration<br>Duration<br>Axes Tested<br>Number of Shocks<br>Configuration                           | Half-Sine<br>15g<br>11ms<br>3 Orthogonal<br>3 in each direction (18 in total)<br>Non-operational throughout                                                                                                                            |
| Sinusoidal vibration test                   | Frequency Range<br>Severity<br><br>Sweep Rate<br>Axes Tested<br>Number of Cycles<br>Configuration                          | 10Hz – 150Hz<br>10Hz – 57.55Hz: 0.15mm peak-peak displacement<br>57.55Hz – 150Hz: 1g peak acceleration<br>1 octave/minute<br>3 Orthogonal<br>10 cycles/axis (1 cycle consists of an up and a down sweep)<br>Non-operational throughout |

## 9.8 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             |

## 9.9 Motor Control Performance

### 9.9.1 V/F Mode

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

### 9.9.2 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%

## 9.10 Output Current Limit

### 9.10.1 Overload Operation

Optidrive E3 provides the following overall limits:

- 150% Output current / 60 Seconds Maximum
- 175% Output current / 3.75 Seconds Maximum

### 9.10.2 Overview

Optidrive 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.

Ixt 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.

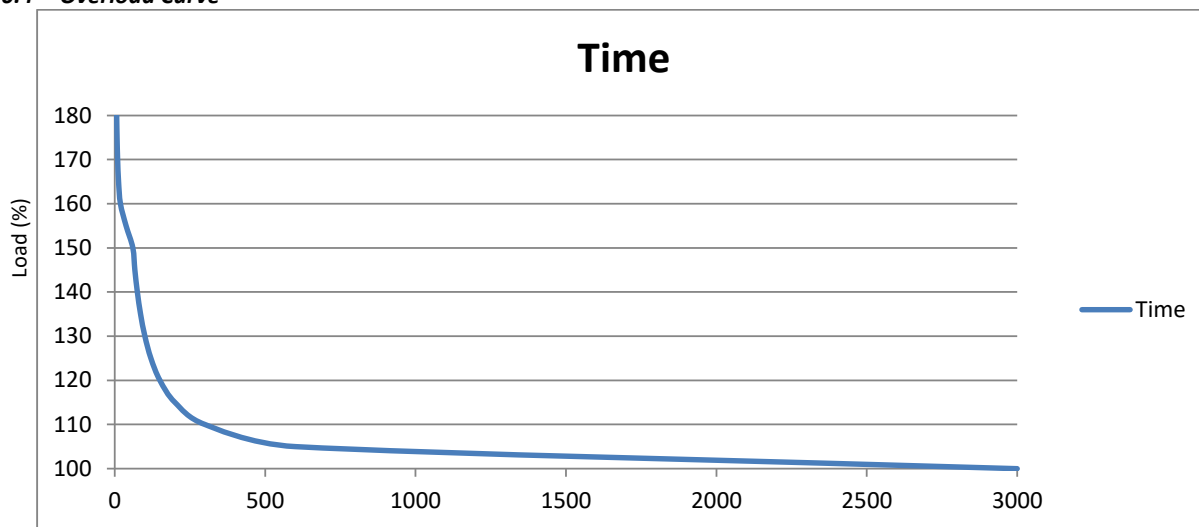
Peak over current trip levels are shown in the table below.

### 9.10.3 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

### 9.10.4 Overload Curve



### 9.10.5 Additional Special Case Overload Operation

For ODE-3-240095-3F4# models, when output frequency <5Hz, overload accumulation is 2.5 times faster.

## 9.11 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 | Drive Type          | DC Bus Voltage Level (Volts DC) |                   |                    |                                     |                   |
|----------------------------|---------------------|---------------------------------|-------------------|--------------------|-------------------------------------|-------------------|
|                            |                     | Brake Chopper On                | Brake Chopper Off | Under Voltage Trip | Minimum Operating (Inrush Disabled) | Over Voltage Trip |
| 110 – 115 Volts AC         | Single Phase Output | 195                             | 189               | 80                 | 113                                 | 208               |
| 110 – 115 Volts AC         | Voltage Doubler     | 390                             | 378               | 160                | 239                                 | 418               |
| 200 – 240 Volts AC         | All                 | 390                             | 378               | 160                | 239                                 | 418               |
| 380 – 480 Volts AC         | All                 | 780                             | 756               | 320                | 478                                 | 835               |

