# 650S AC Drive

## Frame 1, 2 & 3

**HA500924U001 ISSUE 3**

Compatible with Version 2.x Software onwards



WARRANTY

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**Product Manual**

# Safety Information

**FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.**

- This document and other information from Parker-Hannifin Corporation, its subsidiaries and authorized distributors provide product or system options for further investigation by users having technical expertise.

- The user, through its own analysis and testing, is solely responsible for making the final selection of the system and components and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application, follow applicable industry standards, and follow the information concerning the product in the current product catalog and in any other materials provided from Parker or its subsidiaries or authorized distributors.

- To the extent that Parker or its subsidiaries or authorized distributors provide component or system options based upon data or specifications provided by the user, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the components or systems.

# Safety Information

## Requirements

***IMPORTANT*** ***Please read this information BEFORE installing the equipment.***

## Intended Users

This manual is to be made available to all persons who are required to install, configure or service equipment described herein, or any other associated operation.

The information given is intended to highlight safety issues, and to enable the user to obtain maximum benefit from the equipment.

Complete the following table for future reference detailing how the unit is to be installed and used.

| **INSTALLATION DETAILS** | | | |
|---|---|---|---|
| **Model Number** *(see product label)* | | **Where installed** *(for your own information)* | |
| **Unit used as a:** *(refer to "Certification")* | ☐ Component ☐ Relevant Apparatus | **Unit fitted:** | ☑ Enclosure |

## Application Area

The equipment described is intended for industrial motor speed control utilising AC synchronous permanent magnet machines

## Personnel

Installation, operation and maintenance of the equipment should be carried out by qualified personnel. A qualified person is someone who is technically competent and familiar with all safety information and established safety practices; with the installation process, operation and maintenance of this equipment; and with all the hazards involved.

# Safety Information

## Product Warnings

| | | |
|---|---|---|
|  **Caution** Risk of electric shock |  **Caution** Refer to documentation |  **Earth/Ground** Protective Conductor Terminal |

## Hazards

**DANGER! - Ignoring the following may result in injury**

1. This equipment can endanger life by exposure to rotating machinery and high voltages.
2. The equipment must be permanently earthed due to the high earth leakage current, and the drive motor must be connected to an appropriate safety earth.
3. Ensure all incoming supplies are isolated before working on the equipment. Be aware that there may be more than one supply connection to the drive.
4. There may still be dangerous voltages present at power terminals (motor output, supply input phases, DC bus and the brake, where fitted) when the motor is at standstill or is stopped.
5. For measurements use only a meter to IEC 61010 (CAT III or higher). Always begin using the highest range.
   CAT I and CAT II meters must not be used on this product.
6. Allow at least 10 minutes for the drive's capacitors to discharge to safe voltage levels (<50V). Use the specified meter capable of measuring up to 1000V dc & ac rms to confirm that less than 50V is present between all power terminals and between power terminals and earth.
7. Unless otherwise stated, this product must NOT be dismantled. In the event of a fault the drive must be returned. Refer to "Routine Maintenance and Repair".

# Safety Information

## WARNING! - Ignoring the following may result in injury or damage to equipment

### SAFETY

**Where there is conflict between EMC and Safety requirements, personnel safety shall always take precedence.**

- Never perform high voltage resistance checks on the wiring without first disconnecting the drive from the circuit being tested.
- Whilst ensuring ventilation is sufficient, provide guarding and /or additional safety systems to prevent injury or damage to equipment.
- When replacing a drive in an application and before returning to use, it is essential that all user defined parameters for the product's operation are correctly installed.
- All control and signal terminals are SELV, i.e. protected by double insulation. Ensure all external wiring is rated for the highest system voltage.
- Thermal sensors contained within the motor must have at least basic insulation.
- All exposed metalwork in the Drive is protected by basic insulation and bonded to a safety earth.
- RCDs are not recommended for use with this product but, where their use is mandatory, only Type B RCDs should be used.

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### EMC

- In a domestic environment this product may cause radio interference in which case supplementary mitigation measures may be required.
- This equipment contains electrostatic discharge (ESD) sensitive parts. Observe static control precautions when handling, installing and servicing this product.
- This is a product of the restricted sales distribution class according to IEC 61800-3.
- It is designated as "professional equipment" as defined in EN61000-3-2. Permission of the supply authority shall be obtained before connection to the low voltage supply.

# Safety Information

## CAUTION!

### APPLICATION RISK

- The specifications, processes and circuitry described herein are for guidance only and may need to be adapted to the user's specific application. We can not guarantee the suitability of the equipment described in this Manual for individual applications.
- It is advised that motors with significantly lower voltage ratings than the supply voltage are **NOT** used with the drive.

### RISK ASSESSMENT

Under fault conditions, power loss or unintended operating conditions, the drive may not operate as intended. In particular:

- Stored energy might not discharge to safe levels as quickly as suggested, and can still be present even though the drive appears to be switched off
- The motor's direction of rotation might not be controlled
- The motor speed might not be controlled
- The motor might be energised

A drive is a component within a drive system that may influence its operation or effects under a fault condition. Consideration must be given to:

- Stored energy
- Supply disconnects
- Sequencing logic
- Unintended operation

# Contents

Cont. 8

# Chapter 1: Getting Started

# Introduction

The 650S Series AC Drive provides simple, compact, and low-cost sensorless speed control for 3-phase PMAC motors with sinusoidal Back EMF.

This manual describes the low-power end of the 650S product range for the following motor power ratings:

| | Nominal Input Voltage | Phase | Drive Power | |
|---|---|---|---|---|
| Frame 1 | 230V | 1 | 0.25 – 0.75kW | 0.3 - 1.0 Hp |
| Frame 2 | 230V | 1 | 1.1 – 1.5kW | 1.5 - 2.0 Hp |
| Frame 2 | 400V | 3 | 0.37 – 2.2kW | 0.5 - 3.0 Hp |
| Frame 3 | 400V | 3 | 3.0 – 7.5kW | 4.0 - 10.0 Hp |

The drive features:

- Local or Remote mode operation
- SELV control terminals (Safe Extra Low Volts)
- Intelligent monitoring strategy to avoid nuisance tripping
- In-built protection of the unit against overloads, excessive voltages, phase-to-phase and phase-to-earth short circuits
- An internal RFI filter is fitted as standard
- An internal dynamic brake switch for connection to an external resistor (400V units only)
- Quiet operation
- Controlling the unit locally using the 6511 Keypad gives access to parameters, diagnostic messages, trip settings and full application programming.

***Note:*** **Do not attempt to control motors whose rated current is less than 50% of the drive rated current. Poor motor control may occur if you do.**

## Equipment Inspection

- Check for signs of transit damage
- Check the drive is suitable for your requirements by reading the Product Code on the rating label. Refer to Chapter 9: “Technical Specifications” - Understanding the Product Code.

If the unit is damaged, refer to Chapter 8: “Routine Maintenance and Repair” for information on returning damaged goods.

## Storage and Packaging

Save the packaging in case of return. Improper packaging can result in transit damage.

If the unit is not being installed immediately, store the unit in a well-ventilated place away from high temperatures, humidity, dust or metal particles.

# About this Manual

This manual is intended for use by the installer, user and programmer of the drive. It assumes a reasonable level of understanding in these three disciplines.

***Note:*** **Please read all Safety Information before proceeding with the installation and operation of this unit.**

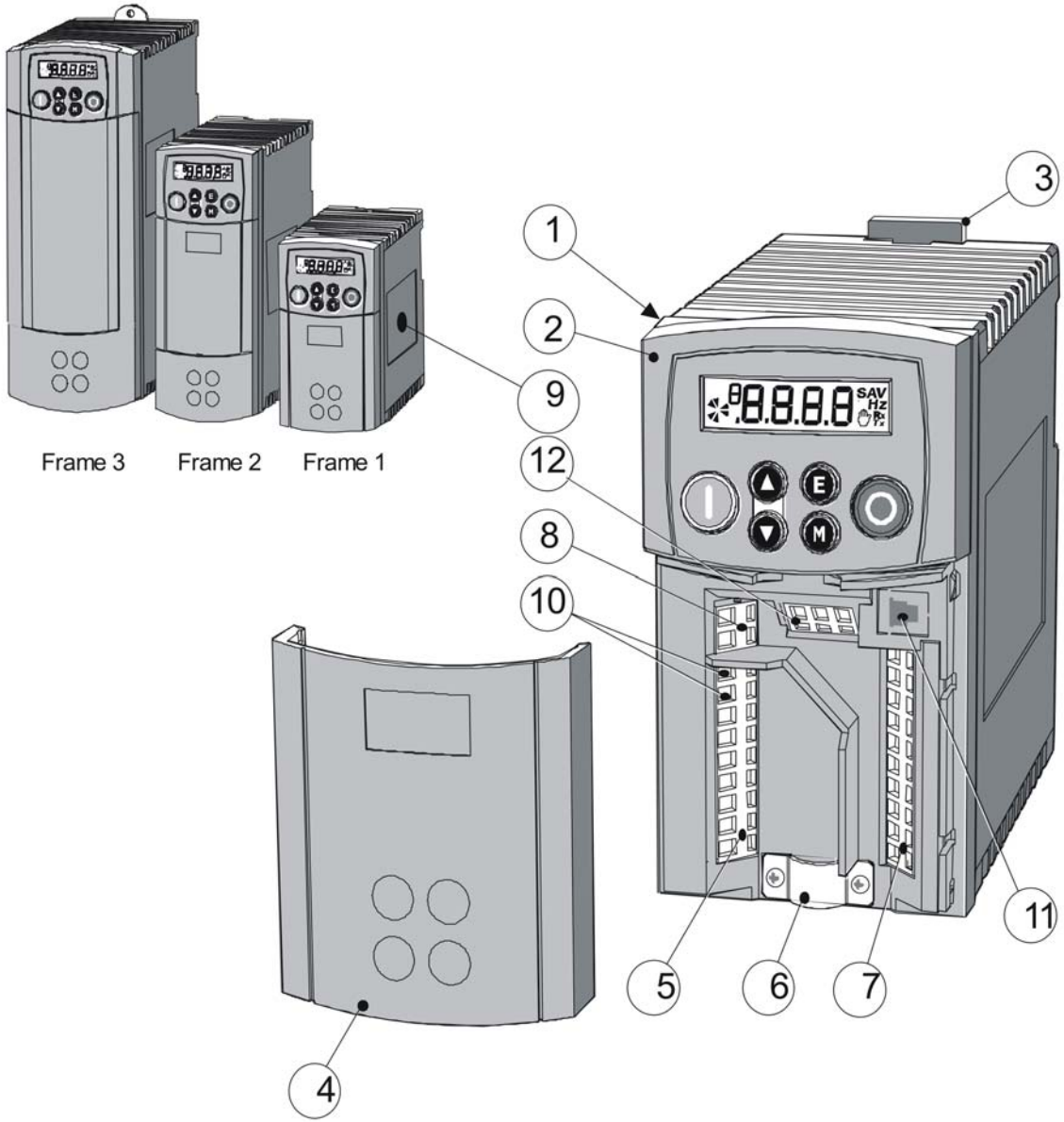
It is important that you pass the manual on to any new user of this unit.

## Software Product Manual

An accompanying Software Product Manual is available for download from the Parker SSD Drives website: www.parker.com/ssd .

# Chapter 2: Product Overview

## Component Identification



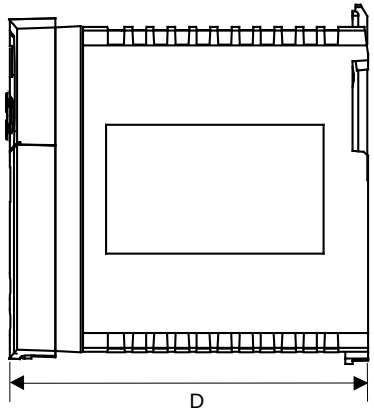

| | |
|---|---|
| 1 | Main drive assembly |
| 2 | Keypad |
| 3 | DIN clip/fixing bracket |
| 4 | Terminal cover |
| 5 | Power terminals |
| 6 | Motor cable screen clamp |
| 7 | Control terminals |
| 8 | Volt-free relay contacts |
| 9 | Product rating label |
| 10 | Motor thermistor terminals |
| 11 | RS232 programming port - P3 |
| 12 | Encoder/digital inputs |

Frame 1 Illustrated

# Chapter 3: Installing the Drive

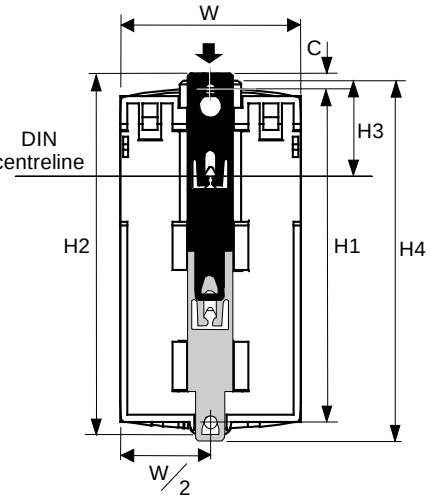
**IMPORTANT:** ***Read Chapter 10: "Certification for the Drive" before installing this unit.***

# Mechanical Installation

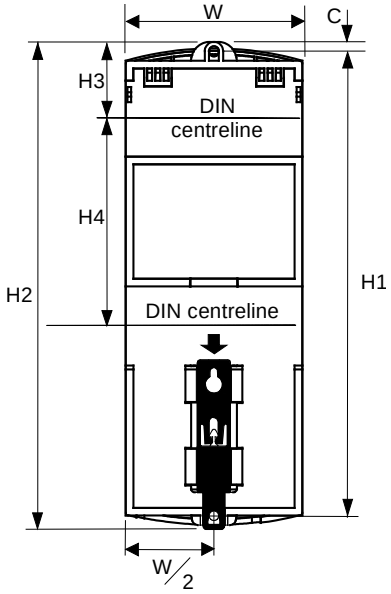



**SIDE VIEW - Frame 1 illustrated**

The DIN clip is repositioned on Frames 1 and 2
to provide the upper fixing hole when wall-mounting




**REAR VIEW - Frame 1 illustrated**
**(Frame 2 similar)**




**REAR VIEW - Frame 3**

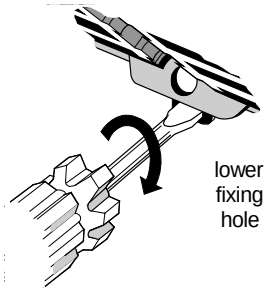
| | Fixing | Torque | Weight | H1 Fixing Centres | H2 | H3 | H4 | C | W | D |
|---|---|---|---|---|---|---|---|---|---|---|
| Frame 1 | M4 | 1.5Nm | 0.85kg(2 lbs) | 132(5.2″) | 143(5.6″) | 35(1.4″) | 139(5.5″) | 6(0.2″) | 73(2.9″) | 142(5.6″) |
| Frame 2 | M5 | 3.0Nm | 1.4kg(3 lbs) | 188(7.4″) | 201(7.9″) | 35(1.4″) | 194(7.7″) | 6.5(0.24″) | 73(2.9″) | 173(6.8″) |
| Frame 3 | M5 | 3.0Nm | 2.7kg(6 lbs) | 242(9.5″) | 260(10.2″) | 38(1.5″) | 112(4.4″) | 5(0.2″) | 96(3.8″) | 200(7.9″) |

Dimensions are in millimetres ( inches )

# Mounting the Drive

To maintain compliance with European Electrical Safety Standard VDE0160/EN50178 the unit must be mounted inside a control cubicle that requires a tool for opening. The cubicle should provide 15dB attenuation to radiated emissions between 30-100MHz.

M**ount the drive vertically** on a solid, flat, non-flammable, vertical surface. It can be panel-mounted, or rail-mounted on a rail complying with EN50022 (35mm DIN).




## DIN Mounting

To DIN mount the unit, hang the unit on the top DIN rail and push the unit onto the bottom DIN rail until it snaps in to position. Secure with a lower screw fixing. To release the unit, use a flat bladed screwdriver as shown.

# Ventilation

Maintain a minimum air clearance for ventilation of 100mm (4 inches) above and below the unit. When mounting two or more 650S units together, these clearances are additive. Ensure that the mounting surface is normally cool. Be aware that adjacent equipment may generate heat and also have clearance requirements. Provided the minimum clearance for ventilation is maintained, 650S drives may be mounted side-by-side.

# Electrical Installation

**IMPORTANT:** ***Read the Safety Information on page Cont. 2 before proceeding.***

## Wiring Instructions

### Local Control Wiring

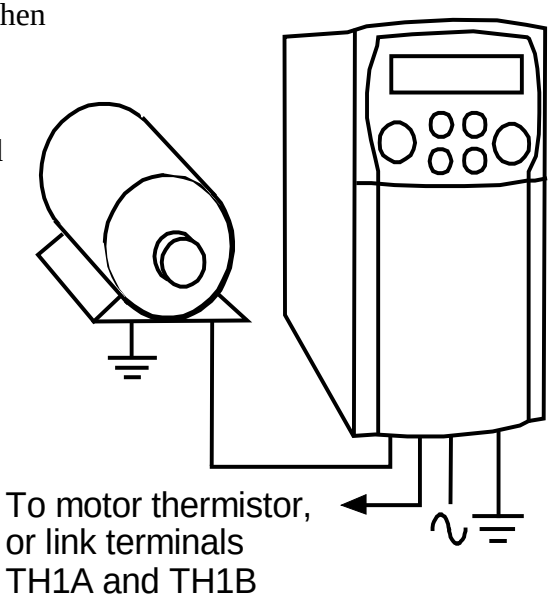
This is the simplest installation. Every new drive will operate in Local Control when first powered-up. The keypad is used to start and stop the drive.

Refer to the Connection Diagram and install the:

- Thermistor cable, or link/jumper terminals TH1A and TH1B (we recommend you do use a thermistor)
- Motor cable
- Supply cable
- Follow the earthing/grounding and screening advice

Refer to Chapter 4: "Operating the Drive"- Local Control Operation.

*Minimum Connections*



# Remote Control Wiring

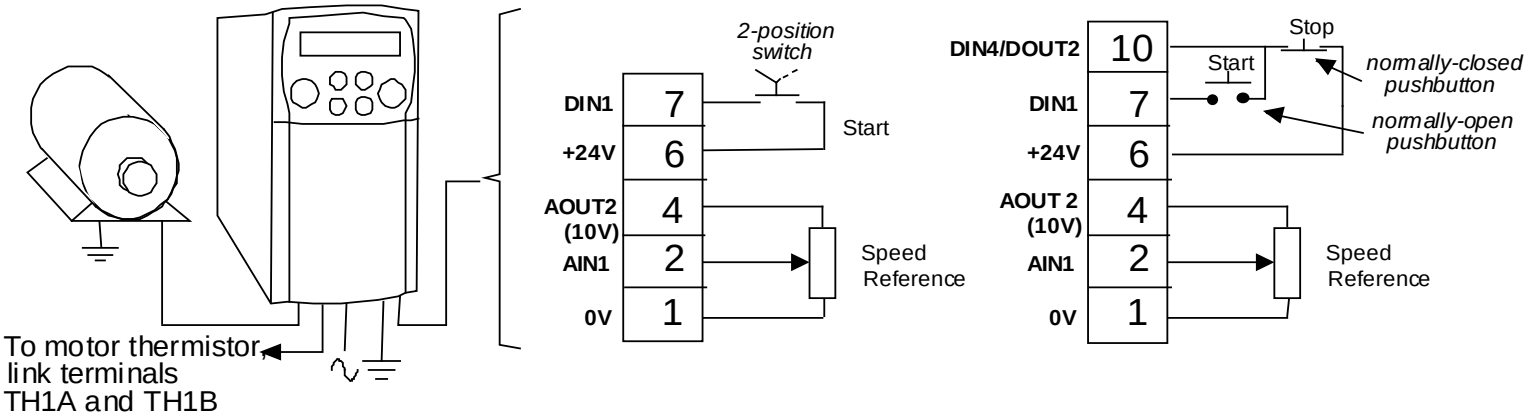
If operating in Remote Control you will use your control panel to start and stop the drive, via a speed potentiometer and switches or push-buttons.

The diagram below shows the **minimum** connections to operate the drive for single-wire (switch) starting, and push-button starting.

Referring to the Connection Diagram:

- Follow the instructions for Local Control Wiring, as detailed previous
- Install using minimum connections

**Minimum Connections for Application 1:**



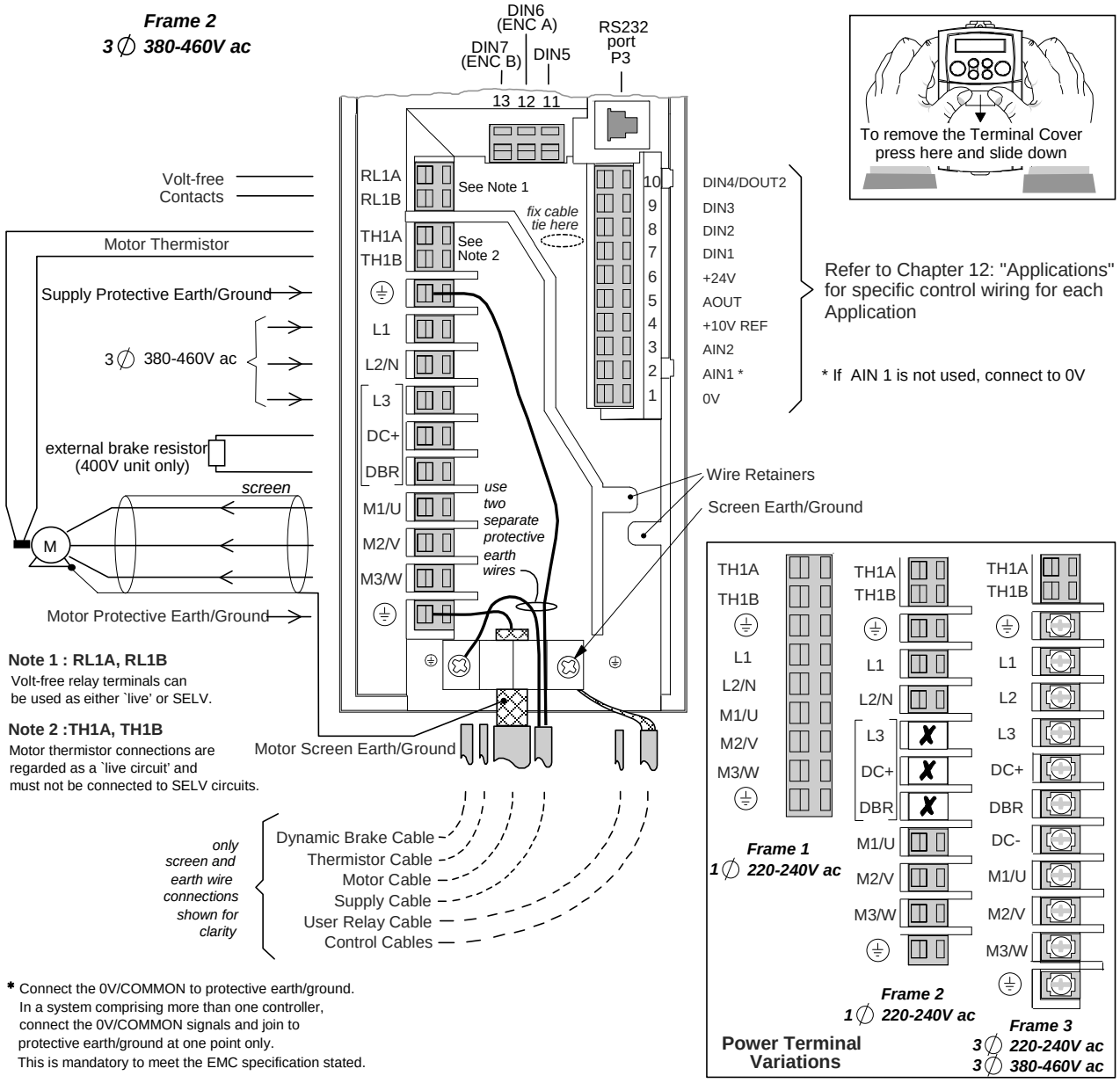

***Note:*** **You can still operate the drive in Local mode, if necessary, with any Application selected.**

Refer to Chapter 4: "Operating the Drive" and follow the relevant instructions for Single Wire Starting or Push-Button Starting.

**WARNING!**

This product is designated as "professional equipment"
as defined in EN61000-3-2. Where enforced, permission of the supply authority shall be obtained before connection to the low voltage domestic supply.
Ensure that all wiring is electrically isolated and cannot be made "live" unintentionally by other personnel.
The drive is suitable for use with both earth referenced supplies (TN) and non-earth referenced supplied (IT) when fitted with an internal ac supply EMC filter.

# Connection Diagram




***** Connect the 0V/COMMON to protective earth/ground. In a system comprising more than one controller, connect the 0V/COMMON signals and join to protective earth/ground at one point only. This is mandatory to meet the EMC specification stated.

### Wiring Instructions

1 Remove the terminal cover from the drive.

2 Loosen the motor cable screen clamp.

3 Connect the power supply cable, motor cable and control cables (if required).

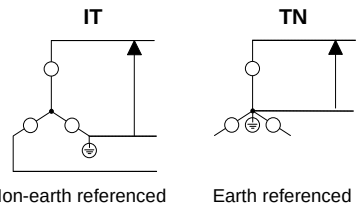
4 Fasten the motor cable in place with the motor cable screen clamp. Secure any control cable screen connections under the right hand screw.
*Frames 2 & 3 only : Secure control cables under the wire retainers.*

5 Connect the thermistor and user-relay if required.
*Frames 2 & 3 only: connect the dynamic brake if required (400V units only).*

6 Use a cable tie and secure all the control cables and user-relay cables (if fitted) as close to the control terminals as possible.

7 Connect the ancillary equipment as shown, for example, an external brake resistor.

8 Re-fit the terminal cover.




The drive is suitable for use with earth referenced supplies (TN) and non-earth referenced supplies (IT) when fitted with an internal ac supply EMC filter.

**IMPORTANT:**

Note that the 650S unit must be **permanently earthed** using two independent protective earth/ground incoming supply conductors.

# Control Wiring Connections

| Terminal (SELV) | Name | Application 1 Default Function (for other Applications refer to Chapter 12: "Applications") | Range |
|---|---|---|---|
| P3 | P3 | RS232 port for use with remote-mounted RS232 keypad or programming PC | - |
| RL1A | User Relay | Volt-free contact | 0-250Vac/24Vdc 4A |
| RL1B | User Relay | Volt-free contact | 0-250Vac/24Vdc 4A |
| 13 | DIN7 (ENC B) | Configurable digital input/encoder input | 0-24V |
| 12 | DIN6 (ENC A) | Configurable digital input/ encoder input | 0-24V |
| 11 | DIN5 | **Not Coast Stop** - configurable digital input: 0V = Stop, 24V = Coast Stop | 0-24V |
| 10 | DIN4/ DOUT2 | Configurable digital input/output **Not Stop** (input): 0V = No latching of Run (DIN1), 24V = Run latched | 0-24V Current sourcing * |
| 9 | DIN3/DOUT1 | Configurable digital input/output **Jog** – configurable digital input: 0V = Stop, 24V = Jog | 0-24V |
| 8 | DIN2 | **Direction** – configurable digital input: 0V = Forward, 24V = Reverse | 0-24V |
| 7 | DIN1 | **Run Forward** – configurable digital input: 0V=Stop, 24V=Run | 0-24V |
| 6 | +24V | 24V supply for digital I/O | 24V * |
| 5 | AOUT1 | **Ramp Output** – configurable analog output (10mA loading) | 0-10V |
| 4 | AOUT2 | **10V reference** configurable analog output (10mA maximum loading) | 0-10V |
| 3 | AIN2 | **Speed Trim** – analog input 2 | 0-10V, 4-20mA |
| 2 | AIN1 | **Speed Setpoint** – analog input 1. If AIN 1 is not used, connect to 0V. | 0-10V |
| 1 | 0V | 0V reference for analog/digital I/O | 0V |

** The total current available is 50mA, either individually or as the sum of terminal 6 & 10.*

# Power Wiring Connections

| Terminal | Description | Function | Range | |
|---|---|---|---|---|
| | | | 200V 1-Phase | 200V/400V 3-Phase |
| TH1A | Thermistor | Connection to motor thermistor | It is good practice to protect motors by fitting temperature sensitive resistors. A typical resistance (up to a reference temperature of 125°C) is 200Ω, rising rapidly to 2000Ω above this temperature. Connect devices in series between TH1A and TH1B. Link the terminals if temperature sensors are not used. | |
| TH1B | Thermistor | Connection to motor thermistor | | |
| ⏚ | Reference Terminal | Supply protective earth (PE). This terminal must be connected to a protective (earth) ground for **permanent earthing.** | | |
| L1 | Power Input | Single and three phase live connection | 220/240V ac ±10% rms with respect to L2/N. 50-60Hz (IT/TN) | 220/240V or 380/460V ac ±10% rms with respect to L2, L3 phase-to-phase. 50-60Hz (IT/TN) |
| L2/N<br>L2 | Power Input | Single phase neutral (or L2 three phase live connection) | 220/240V ac ±10% with respect to L1. 50-60Hz (IT/TN) | 220/240V or 380/460V ac ±10% with respect to L1, L3. 50-60Hz (IT/TN) |
| L3 | Power Input | Three phase live connection | Not applicable | 220/240V or 380/460V ac ±10% with respect to L1, L2. 50-60Hz (IT/TN) |
| DC- | *No user connection* | | | |
| DC+ | Dynamic Brake | Connection to external brake resistor | Not applicable | Frame 2 (high volt only) & 3. See "Internal Dynamic Brake Switch" table |
| DBR | Dynamic Brake | Connection to external brake resistor | Not applicable | Frame 2 (high volt only) & 3. See "Internal Dynamic Brake Switch" table |
| M1/U<br>M2/V<br>M3/W | Motor Outputs | Connection for motor | Motor rated at:<br>0 to 220/240V ac<br>0 to 500Hz | Motor rated at:<br>0 to 220/240V or 0 to 380/460V ac 0 to 500Hz |
| ⏚ | Reference Terminal | Supply protective earth (PE). This terminal must be connected to a protective(earth) ground for **permanent earthing.** | | |

# Terminal Block Acceptance Sizes

Wire sizes should be chosen with respect to the operating conditions and your local National Electrical Safety Installation Requirements. Local wiring regulations always take precedence.

| Frame Size | Power Terminals (maximum wire size) | Brake Terminals (maximum wire size) | Thermistor/Control Terminals (maximum wire size) |
|---|---|---|---|
| Frame 1 *230V* | 2.5mm$^2$/12 AWG | Not Applicable | 2.5mm$^2$/12 AWG |
| Frame 2 *230V* | 2.5mm$^2$/12 AWG | Not Applicable | 2.5mm$^2$/12 AWG |
| Frame 2 *400V* | 2.5mm$^2$/12 AWG | 2.5mm$^2$/12 AWG | 2.5mm$^2$/12 AWG |
| Frame 3 *230V* | 6.0mm$^2$/10 AWG | 6.0mm$^2$/10 AWG | 2.5mm$^2$/12 AWG |
| Frame 3 *400V* | 6.0mm$^2$/10 AWG | 6.0mm$^2$/10 AWG | 2.5mm$^2$/12 AWG |

## Power Wiring

***Note:*** **For specified EMC emission and immunity performance, install to EMC Installation Instructions. Refer to Chapter 10: "Certification for the Drive" - for more information**

Terminal tightening torque for Frame 3 power connections is 20 lb.in (2.26Nm).

Protect the incoming mains supply using the specified fuse, or RCD circuit breaker Type B.

**IMPORTANT:** ***We do not recommend the use of circuit breakers (e.g. RCD, ELCB, GFCI), however, where their use is mandatory, they must:***

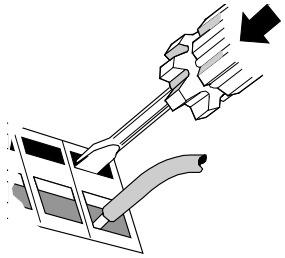
- Operate correctly with dc and ac protective earth currents (i.e. type B RCDs as in Amendment 2 of IEC755).
- Have adjustable trip amplitude and time characteristics to prevent nuisance tripping on switch-on.

## Control Wiring

Control wiring of between 0.08mm$^2$ (28AWG) and 2.5mm$^2$ (12AWG) can be used. Ensure all wiring is rated for the highest system voltage. All control terminals are SELV, i.e. double-insulated from power circuits.

## Using Cage Clamp Terminals

Strip wire insulation to 5-6mm (0.20-0.24 inches), or alternatively use wire-crimps. Use a flat-bladed screwdriver, maximum blade size 3.5mm. The cage provides the correct force for a secure connection.



**IMPORTANT:** ***DO NOT lever or turn the screwdriver.***

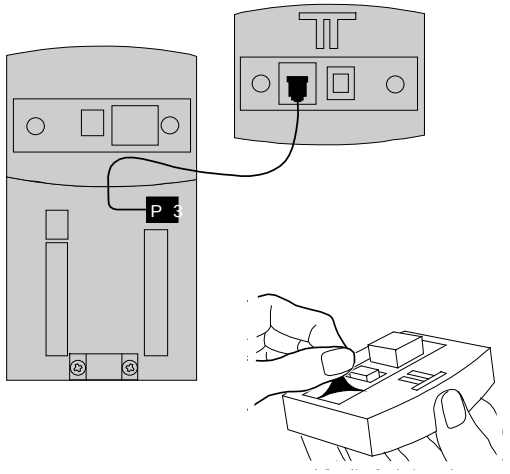
# Optional Equipment

## Fitting the Remote 6511 Keypad

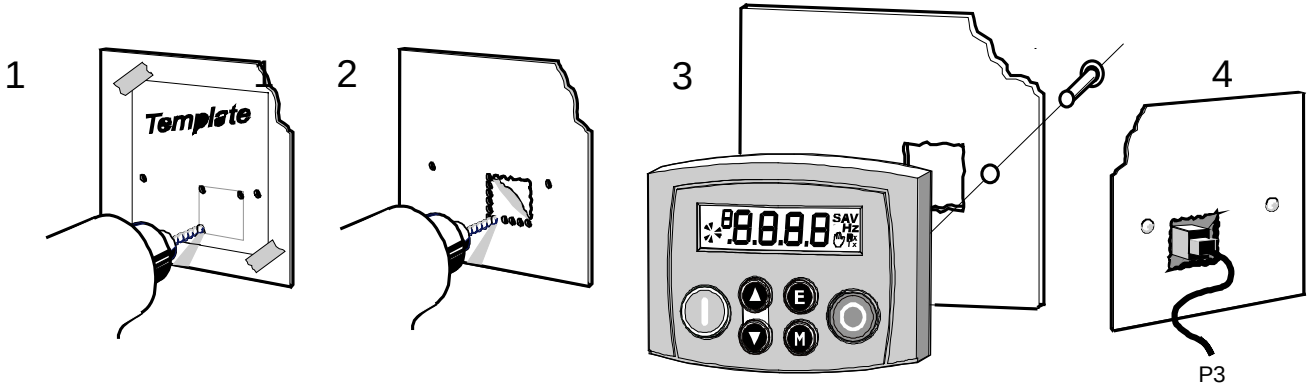
You can remote-mount the drive-mounted Keypad using:

- the RS232 (P3) port located under the terminal cover
- A standard P3 lead, Parker SSD Part Number CM057375U300, which is used to connect the Keypad to the drive.

Two self-tapping screws are provided with the Keypad. Remove the protective film from the gasket. An enclosure rating of IP20 is achieved for the remote Keypad when correctly mounted.

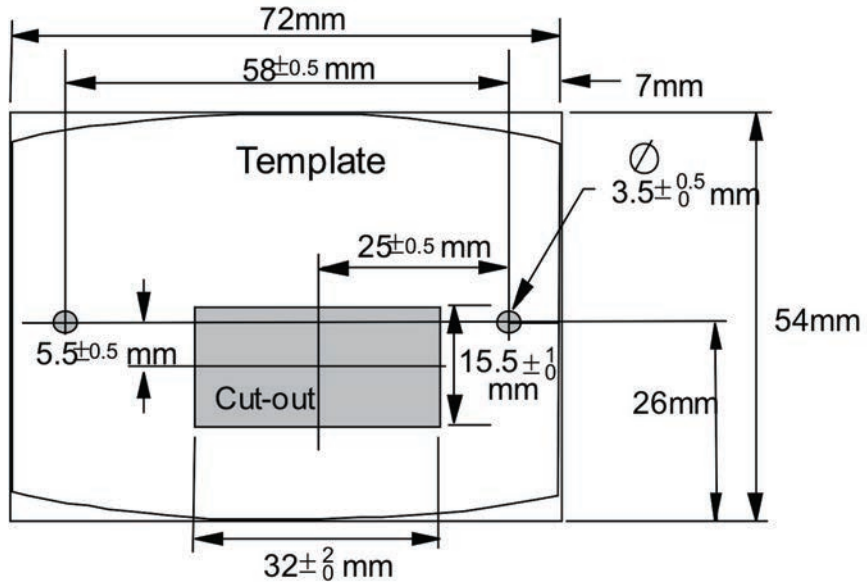



## Assembly Procedure



## Cut-out Dimensions

The drawing below can be photocopied actual size (100%) and used as a template.




# Additional Remote Keypad Options:

650S is also compatible with 6521/6901/6911 Opstations which all require a 6052 Mounting Kit, if door marked (IP20). The assembly procedure is supplied with the mounting kit.

# RS485/RS232 Communication Module

You can create a network of drives by linking a Master (PC/PLC) to one or more 650S drives fitted with this module.

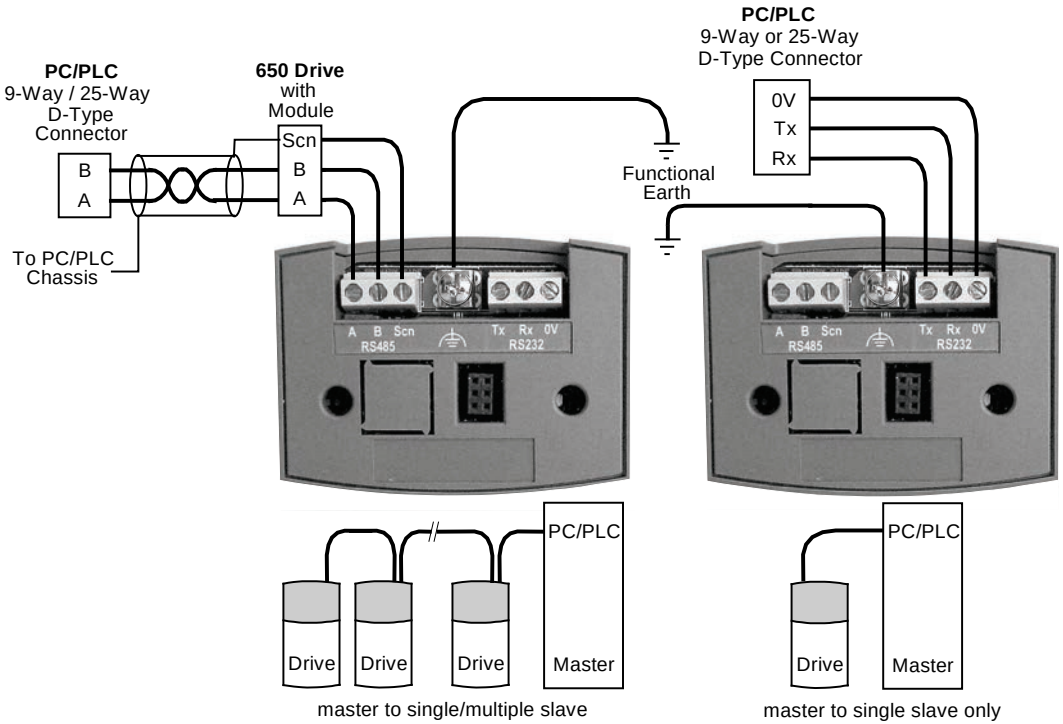
Plug this Communication Module on to the front of the 650S drive, replacing the keypad.

It converts signals from the host 650S drive into RS485 or RS232, and vice versa, so that information can be shared between the Master and 650S drive(s).

Wiring is very simple - all connections are SELV (Safe Extra Low Voltage). Select to use RS485 or RS232 by wiring to the appropriate terminal on the module.

***Note:*** **RS485 and RS232 terminals cannot be used simultaneously.**

We recommend you ground the module to the system earth using the Functional Earth terminal.



## Wiring Specifications

| | RS485 Connections | RS232 Connections |
|---|---|---|
| **Network Type** | 2-Wire Shielded Twisted-Pair | 3-Wire Un-Shielded Cable |
| **Connections** | A=RxA/TxA, B=RxB/TxB, Shield | Rx, Tx, Ground (0V) |
| **Signal Levels** | To RS485 Standard | To RS232 Standard |
| **Receiver Input Impedance** | ¼ Unit Load | 3 kΩ minimum<br>7kΩ maximum |
| **Maximum Cable Length** | 1200m (4000ft) | 3 metres |
| **Maximum Baud Rate** | 57.6kbaud | 57.6kbaud |
| **Maximum Number of Units** | 32 including slaves and masters | 2: 1 master and 1 slave only |

# LED Indications

The module has three LEDs providing diagnostic information about the 650S host drive's ‘Health’, ‘Receive’ and ‘Transmit’ activity.

HEALTH = Green, Rx = Red, Tx =Red

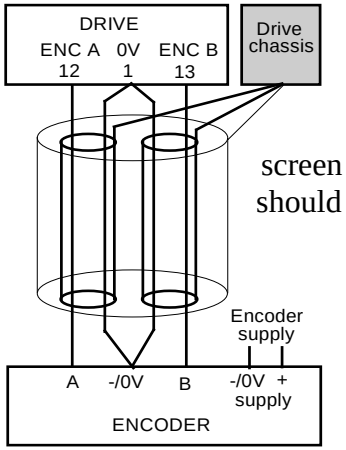

| LED Name | LED Duty | Drive State |
|---|---|---|
| HEALTH | SHORT FLASH | Re-configuration, or corrupted non-volatile memory at power-up |
| | EQUAL FLASH | Tripped |
| | ON | Healthy |
| | LONG FLASH | Braking |
| | OFF | No drive power, or serious hardware fault |
| Rx | INTERMITTENT | Indicates activity on the ‘receive’ line carrying data from the Master |
| Tx | INTERMITTENT | Indicates activity on the ‘transmit’ line carrying data to the Master |

# Configure the Drive

Before the module can be used you must configure the drive to your system. Set-up the parameters in the SERIAL menu as appropriate. Refer to Chapter 6: "Programming Your Application" - SET::SERL Menu, parameters $^{S}$SE01 to $^{S}$SE08.

For Tag number information refer to the 650S Software Product Manual, available on the Parker SSD Drives website: www.parker.com/ssd

# Encoder Connections




The drive is **only** suitable for use with single-ended encoders. Take special care wiring the encoder to the drive due to the low level of the signals.

All wiring to the drive should be made in screened cable. Use cable with an overall screen and a screen over each individual pair. To ensure compliance with the EMC Directive the overall cable screen should be connected to the drive chassis.

*Recommended cable (pairs individually screened):*

Belden equivalent 8777
Parker SSD Drives Part Number CM052666

The drive will operate with 5-24V encoders. Provide the correct supply for the encoder. Do not use the 10V or 24V supply from the drive.

The maximum input frequency of terminals 12 and 13 (ENCA and ENCB) is 100kHz.

# Chapter 4: Operating the Drive

## Pre-Operation Checks

**WARNING!**

Wait for 5 minutes after disconnecting power before working on any part of the system or removing the terminal cover from the drive.

### Initial checks before applying power:

- Check for damage to equipment.
- Mains power supply voltage is correct.
- Motor is of correct voltage rating
- Check all external wiring circuits - power, control, motor and earth connections.

  *Note:* **Completely disconnect the drive before point to point checking with a buzzer, or when checking insulation with a Meggar.**
- Check for loose ends, clippings, drilling swarf etc. lodged in the drive and system.
- If possible check that the motor can be turned freely, and that any cooling fans are intact and free from obstruction.

### Ensure the safety of the complete system before the drive is energised:

- Ensure that rotation of the motor in either direction will not cause damage.
- Ensure that nobody else is working on another part of the system which will be affected by powering up.
- Ensure that other equipment will not be adversely affected by powering up.

### Prepare to energise the drive and system as follows:

- Remove the supply fuses, or isolate using the supply circuit breaker.
- Disconnect the load from the motor shaft, if possible.
- If any of the drives control terminals are not being used, check whether these unused terminals need to be tied high or low.
- If the motor thermistor terminals are not connected to a motor thermistor, connect these terminals together.
- Check external run contacts are open. Check external speed setpoints are all zero.

### Re-apply power to the drive and system

# Initial Start-up Routines

*Note:* **Refer to Chapter 5: "The Keypad" to familiarise yourself with the keypad's indications, and how to use the keys and menu structure.**

**IMPORTANT**
When power is applied to the drive in Remote Control, it will immediately start running if the RUN signal is active.

**WARNING!**
Unpredictable motion, especially if motor parameters are incorrect.
Ensure no personnel are in the vicinity of the motor or any connected machinery.
Ensure that machinery connected to the motor will not be damaged by unpredictable motion.
Ensure that the emergency stop circuits function correctly before running the motor for the first time.

The drive can be started in either Remote Control or Local Control. **By default, the drive will start in Local Control.**

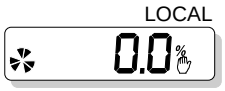
These routines assume that the drive's control terminals are wired as shown in the Control Wiring Connections in Chapter 3.

Connected in this way, a positive setpoint will rotate the motor in a clockwise direction when viewed down the shaft, looking toward the motor.

**If during the start-up routine the display shows either an alarm (indicated by the letter "A") or a flashing Warning message, refer to Chapter 7: "Trips and Fault Finding".**

A typical alarm

# Local Control Operation



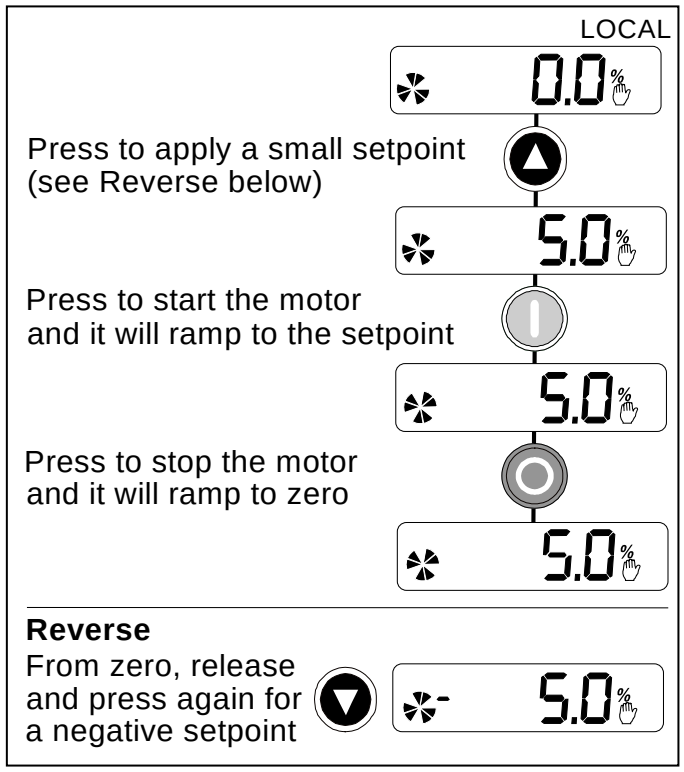

This is the simplest method of operating the drive. Connect the keypad to the drive and power-up the unit. The drive will display the Local screen. If not, refer to Chapter 5 and select Local Control.

Follow the instructions opposite to start and stop the motor.

**Reverse:** Instead of setting a negative setpoint, you can reverse the motor direction by pressing STOP + ▼, or START + ▼.
To change the direction to forwards, (the normal direction), press STOP + ▲ or START + ▲.

Note that the Setpoint parameter will not change sign to indicate this change, however the rotating indicator on the MMI will show the direction.

We recommend that you use the STOP key commands if the motor is stopped, and the START key commands if the motor is running. The keys should be pressed and released together.



# Remote Control Operation

REMOTE

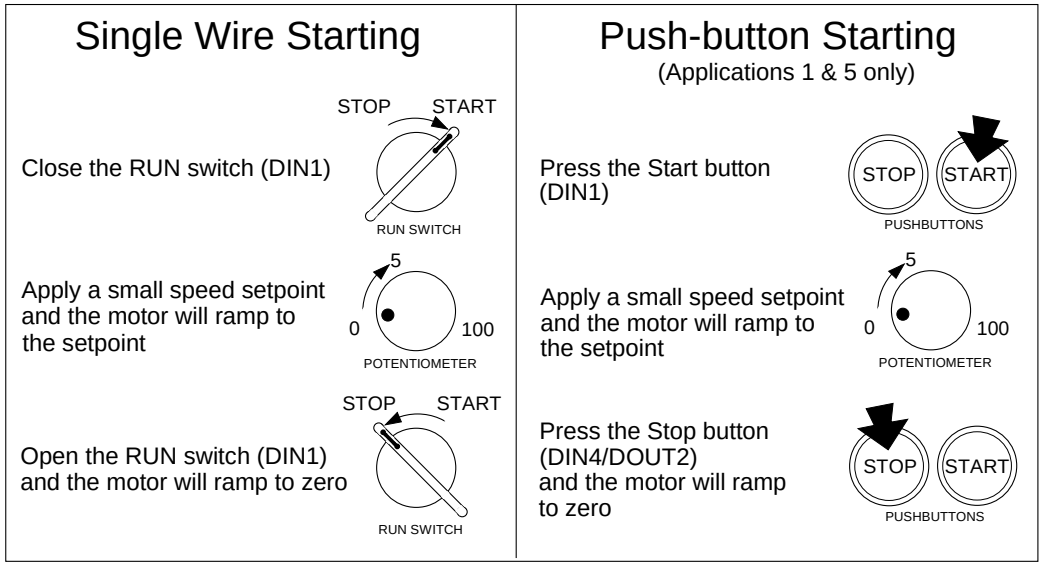

Connect the keypad to the drive and power-up the unit.

The drive will display the Local screen. Refer to Chapter 5 and select Remote Control.

**IMPORTANT:** ***Ensure that the speed potentiometer is set to zero.***

Follow the instructions below to start and stop the motor using your control panel.

Reverse the motor's direction of rotation using the DIN2 connection (0V = forward, +24V = reverse). Alternatively, swap two of the motor phases **(WARNING: Disconnect the mains supply first)**.




## *The installation of your drive is now complete:*

The drive will operate as a sensorless drive. It is programmed to control a PMAC motor of equivalent power, current, and voltage rating to the drive. Using the keypad (or other suitable programming tool) the drive must now be set-up.

# Set-up

The drive is operating in Sensorless Permanent Magnet AC (PMAC) Mode

The drive needs to know more about your system. You **MUST** enter "actual" values from your motor nameplate for the parameters listed below. These parameters are in the SET::PAC1 Menu. See Section 6.

| Display | Parameter | Default | Brief Description |
|---|---|---|---|
| SPA01 | MAX SPEED | 3200RPM | Set the maximum motor speed. |
| SPA02 | MAX CURRENT | 5.65A | Set the motor maximum current in Amps rms. |
| SPA03 | PERM CURRENT | 2.43A | Set the motor nominal current in Amps rms. |
| SPA04 | PERM TORQUE | 2.0Nm | Set the motor nominal torque in Nm. |
| SPA05 | POLES | 10 | Set the motor number of poles. |
| SPA06 | BACK EMF | 50.9V | Set the motor's Back EMF phase to phase, rms value (in Volts/1000RPM) |
| SPA07 | R | 6.58Ohms | Set the motor's resistance, between phase at 25°C. |
| SPA08 | L | 20.3mH | Set the motor's inductance, between phase at nominal current. |
| SPA09 | KT | 0.848NM/A | Set the motor's torque constant in Nm/Amps rms |
| SPA 10 | INERTIA | 0.070 | Set the motor's inertia. The units for this parameter are set by the INERTIA SCALE parameter. |
| SPA 11 | INERTIA SCALE | 0 | Set the motor's inertia scale:<br>0 = $gm^2$ 1 = $kgcm^2$ 2 = $kgm^2$ |
| SPA 12 | THERMAL TIME CST | 62s | This parameter is used for the motor protection, e.g. I2T motor load. It defines the thermal time constant of the motor that is used to protect the motor1 against overheating.<br>Refer to the PMAC MOT PROTECT for a definition. |
| SPA 13 | CUR LOOP BWDTH | 400Hz | Set the current loop bandwidth in Hz. This value will automatically generate the proportional gain of the PI corrector of the current loop. The proportional gain is calculated based on the 'L' motor 2 parameter.<br>Modifying this value could induce instability. Please contact Parker SSD Drives if you need to change it. |

| | | | |
|---|---|---|---|
| SPA 14 | INTEGRAL FREQ | 100Hz | Set the frequency of the I term of the PI current loop corrector. The ratio CUR LOOP BWDTH/INTEGRAL FREQ must be kept higher than 3.<br>Modifying this value could induce instability. Please contact Parker SSD Drives if you need to change it. |

You also needs to set up the speed loop parameters, mainly the parameters below, see the SET::CTRL Menu see Section 6 :

| Display | Parameter | Default | Brief Description |
|---|---|---|---|
| SCL91 | SPEED PROP GAIN | Default is Product Code dependent | Sets the proportional gain of the loop.<br>Speed error (revolutions per second) x proportional gain = torque percent. |
| SCL92 | SPEED INT TIME | Default is Product Code dependent | This is the integral time constant of the speed loop. A speed error which causes the proportional term to produce a torque demand T, will cause the integral term to also ramp up to a torque demand T after a time equal to “speed int time”. |

# Tuning the Drive to Your System

Finally, adjust the parameters below as necessary to tune the drive to your system. Refer to Chapter 6: "Programming Your Application" for details.

| Display | Parameter | Default | Brief Description |
|---|---|---|---|
| P 2 | MAX SPEED | Default is Product Code dependent | Set the speed in Hz at which the 650S will run when the maximum setpoint is applied. |
| P 3 | MIN SPEED | 0.0% | Set the minimum frequency at which the 650S will run, as a % of MAX SPEED |
| P 4 | ACCEL TIME | 10.0 s | Set the time taken for the 650S to ramp up from zero to MAX SPEED |
| P 5 | DECEL TIME | 10.0 s | Set the time taken for the 650S to ramp down from MAX SPEED to zero |
| P 8 | JOG SETPOINT | 10.0 % | Set the jogging speed setpoint, as a % of MAX SPEED |
| P 9 | RUN STOP MODE | 0 | Select the method by which the motor speed is reduced to zero |

# Chapter 5: The Keypad

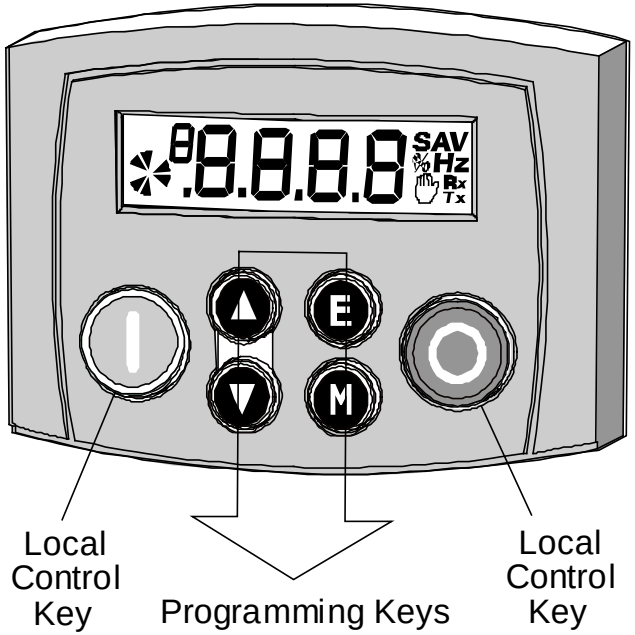
# The 6511 Keypad

The 6511 Keypad (Man-Machine Interface, MMI) provides for local control of the drive, monitoring, and complete access for application programming.

The 650S can be fitted with either a Standard or Remote Keypad. Both Keypads fit on the front of the drive, but the Remote Keypad (with its extra connector) can also be remote-mounted up to 3 metres away using a connecting lead: refer to Chapter 3: “Installing the Drive” – Fitting the Remote Keypad.

To remove a Keypad, simply pull it away from the drive. To refit it, push it back into place.

The product rating label identifies the Drive/Keypad type: refer to Chapter 9: “Technical Specifications” – Understanding the Product Code.




## The Power-Up Condition

On initial power-up, direct from the factory, the drive is in Local Control and the MMI will display the Local Setpoint, 0.0 Hz.

All parameters will be at factory default settings. Any changes to these conditions are automatically saved. The drive will initialise on subsequent power-ups with the previously saved settings and control mode, Local or Remote Control.

# Controlling the Drive using the Keypad

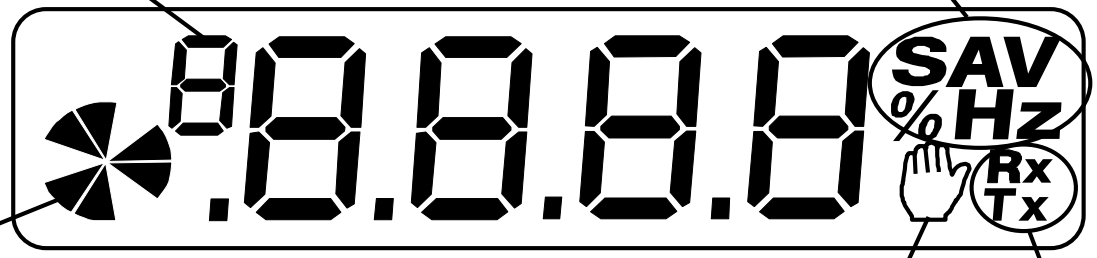
## Control Key Definitions

| Key | Operation | Description |
|---|---|---|
|  | Escape | *Navigation* – Displays the previous level's menu<br>*Parameter* – Returns to the parameter list<br>*Trip Display*– Removes Trip or Error message from display allowing investigation of parameters |
|  | Menu | *Navigation* – Displays the next menu level, or the first parameter of the current Menu<br>*Parameter* – Moves cursor to the left when the parameter is adjustable |
|  | Increment | *Navigation* – Move upwards through the menu system<br>*Parameter* – Increase value of the displayed parameter<br>*Local Mode* – Increase value of the local setpoint |
|  | Decrement | *Navigation* – Move down through the menu system<br>*Parameter* – Decrease value of the displayed parameter<br>*Local Mode* – Decrease value of the local setpoint |
|  | Run | *Local Mode* – Run the drive<br>*Trip Reset* – Resets trip condition allowing drive to resume operation |
|  | Stop | *Local Mode* – Stops the drive. Trip Reset in all modes<br>*Navigation* – Press and hold to toggle between Local and Remote Control modes (refer to page 5-9)<br>*Trip Reset* – Resets trip condition allowing drive to resume operation |

# Display Indications

d when in the Diagnostics menu
P when in the Parameter menu
S when in the Setup menu
A when displaying an Alarm code
- a negative parameter value

Displays the units for the value:
***S*** for time in seconds, ***A*** for current in Amps
***V*** for voltage in Volts, ***%*** for percentage
***Hz*** for frequency in Hertz




Represents a rotating shaft:
clockwise = drive running forward
anticlockwise = drive running in reverse

Indicates control via fieldbus communications

Indicates parameter numbers or values, trip information, error codes etc.
See "Drive Status Indications" below.

Indicates the drive is in Local control.
*Drive is in remote control when not visible.*

# Drive Status Indications

The keypad can display the following status information:

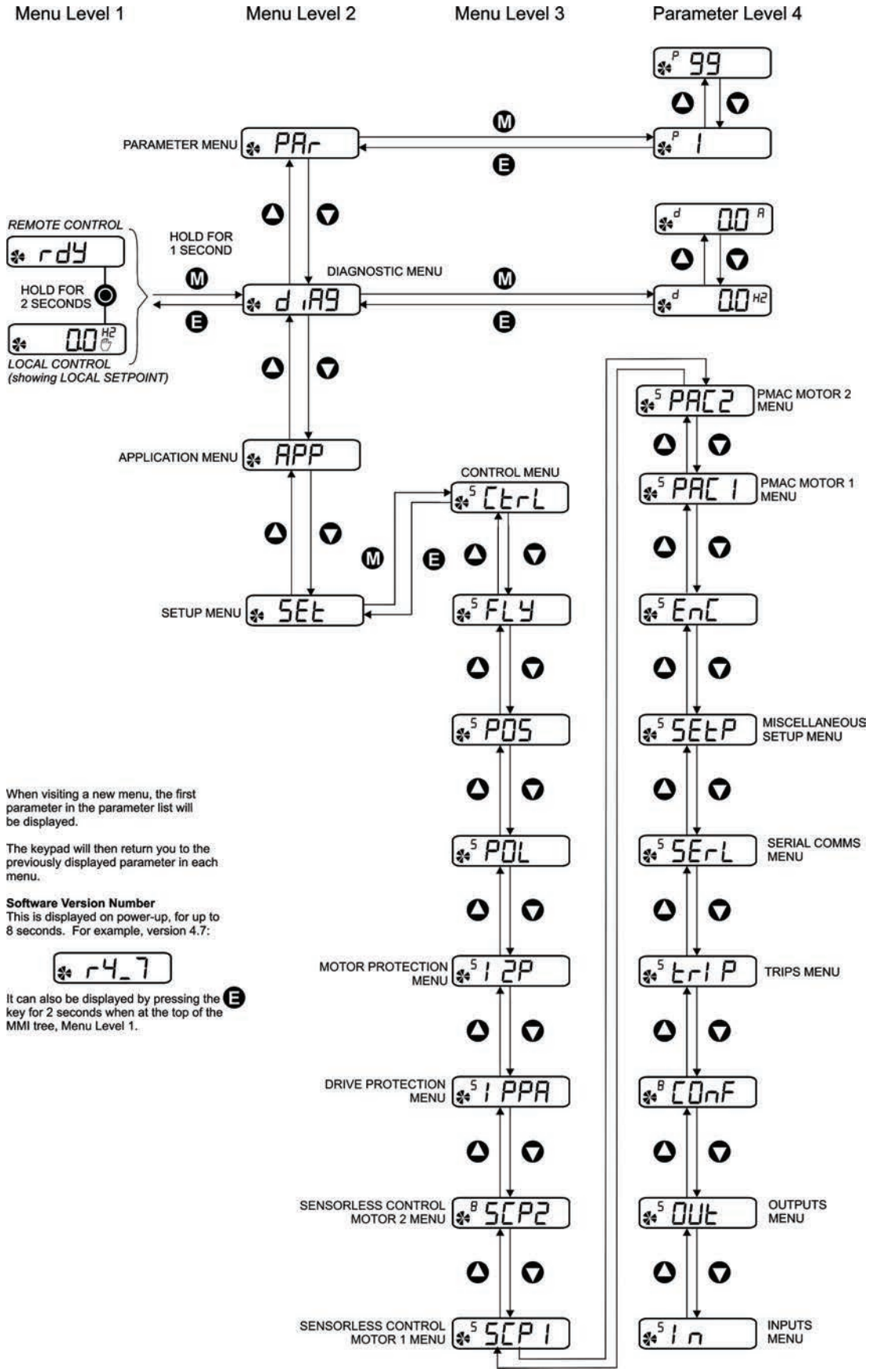
| Display | Status Indication and Meaning | Possible Cause |
|---|---|---|
| rdy | READY/HEALTHY No alarms present. Remote mode selected | |
| PASS | PASSWORD Current password must be entered before this parameter may be altered. | Enter password to change the parameter. Refer to page 5-10 |
| LOC | LOCAL Local Control selected, healthy, no alarms present | Added or removed from the display letter-by-letter to indicate entering or leaving Local Control |
| StOP | STOP Coast Stop or Prog Stop active | Jog (6901 op station only) or Run pressed while Coast Stop or Prog Stop lines are active, (low), on the sequencing block. Local control only. |
| run | RUN Not possible to change between Local/Remote mode | The drive is running in Local mode or the Remote run signal is active |
| JOG | JOG Not possible to change between Local/Remote mode | The Remote jog signal is active |
| EnbL | ENABLE Pressed RUN or JOG key in Local mode while Enable signal is low | The drive Enable signal is inactive, (low) |

# The DIAGNOSTICS Menu

| Display | Name | Description |
|---|---|---|
| 0.0 Hz | FREQUENCY | The current output frequency in Hertz |
| 0.0 % | SPEED SETPOINT | The set point as a percentage of MAX SPEED |
| 0.0 V | DC LINK VOLTS | Vac (rms) x √2 = dc link Volts<br>(when motor stopped) |
| 0.0 A | MOTOR CURRENT | The current load value in Amps |

# The Menu System

The menu system is divided into a “tree” structure with 3 menu levels



# How To Change a Parameter Value

You can change the values of parameters stored in the PAr and SEt menus. Refer to Chapter 6: "Programming Your Application" – Configurable Parameters for further information.

- View the parameter to be edited and press M to display the parameter's value.
- Select the digit to be changed (pressing the M key moves the cursor from right to left).
- Use the ▲ ▼ keys to adjust the value. Hold the key momentarily to adjust the value marginally, or hold the key to make rapid changes; the rate of change varies with the time held.
- Press E to return to the parameter display. The new value is stored.

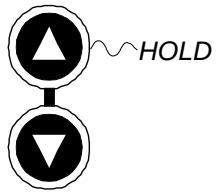
# Special Menu Features

## Resetting to Factory Defaults (2-button reset)

Power-up the drive whilst holding the keys as shown to return to factory default settings.

This loads Application 1. Then press the E key.

*Hold down the keys opposite:*
*Power-up the drive, continue to hold for at least 1 second*

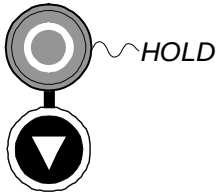



## Changing the Drive Operating Frequency

Power-up the drive whilst holding the keys as shown to display the Engineers Menu.

**IMPORTANT:** ***This menu contains sensitive parameters that can dramatically alter the running of the drive.***

*Hold down the keys opposite:*
*Power-up the drive, continue to hold for at least 1 second*




This displays parameter $^{E}$0.01. Press the ▲ key to navigate to $^{E}$0.02. Press the M key to edit the parameter: 0 = 50Hz (default), 1 = 60Hz. Select the required frequency then press the E key.

Power-down the drive. No permanent change has been made to the drive at this point. To save the change to parameter $^{E}$0.02, you must now perform a 2-button reset (as above). Please note that this will return the drive to its factory default settings for the selected default frequency.

# Selecting Local or Remote Control

The drive can operate in one of two ways:

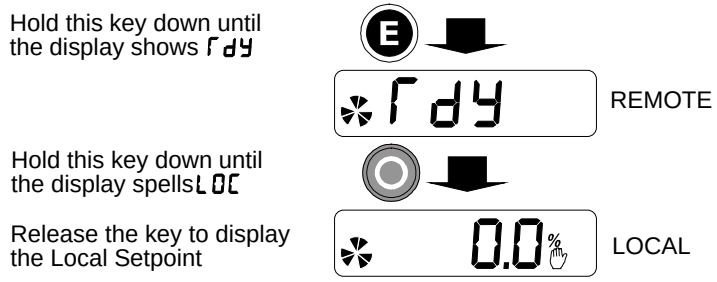
**Remote Control:** Allowing access for application programming using digital and analog inputs and outputs

**Local Control:** Providing local control and monitoring of the drive using the Keypad

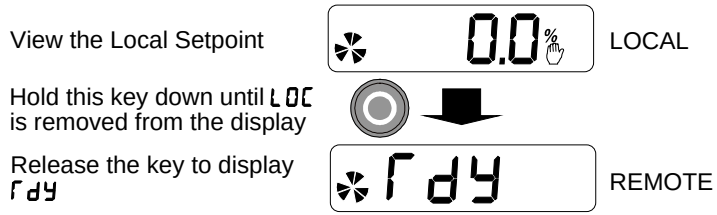
Local control keys are inactive when Remote Control is selected.

In Remote Control, the drive uses a remote setpoint. In Local Control, it uses the Local Setpoint parameter whose value is adjusted on the MMI.

***Note:*** **You can only change between Local and Remote Control when the drive is "stopped", and either rdy or the Local Setpoint is displayed.**




## Remote to Local Control:




## Local to Remote Control:

***Note:*** **For safety reasons, the drive will not return to Remote Control if this will cause the drive to start. Check RUN and JOG inputs are low.**

# Password Protection

When activated, an odd-numbered password prevents unauthorised parameter modification by making all parameters read-only. The local setpoint is not made read-only if an even-numbered password is used. Password protection is set-up using the P 99 parameter

| Steps | ACTIVATE | | TEMPORARY DE-ACTIVATION | | REMOVE PASSWORD | |
|---|---|---|---|---|---|---|
| | Actions | Display | Actions | Display | Actions | Display |
| 1 | Go to P 99<br>Press M | 0000 | Try to edit any parameter with password activated | PASS →<br>0000 | Go to P 99<br>Press M | PASS →<br>0000 |
| 2 | Enter new password using ▲ ▼ | 0001<br>for example | Enter current password using ▲ ▼ | 0001<br>for example | Enter current password using ▲ ▼ | 0001<br>for example |
| 3 | Press E repeatedly until top of menu is reached | rdy, Remote Setpoint or Local Setpoint | Press E | Original parameter displayed, password de-activated | Press E<br>Reset to 0000 using ▲ ▼ | 0000 |
| 4 | Press E to activate password | rdy, Remote Setpoint or Local Setpoint | *A drive will power-up with the last password status. Temporary de-activation is lost on power-down.* | | Press E to remove password | P 99 |
| | *Default = 0000, de-activated*<br>*Any other value is a password* | | | | | |

# Selecting the Menu Detail

For ease of operation the drive can display full or reduced menus. Refer to Chapter 6 to see how the setting changes the displayed menu. Additional parameters are indicated with F in the table.

Navigate to the ST99 parameter (SET::SETP::ST99) and press the M key. This toggles full or partial menu detail. The default setting of 0 provides partial menu detail. Set the parameter to 1 for full menu detail.

# Chapter 6: Programming Your Application

# Programming Your Application

You can program the drive to your specific application. This programming simply involves changing parameter values.

If necessary, there are three parameters for tuning your drive. Refer to PID - Tuning Your Drive, page 6-31.

## Saving Your Modifications

When parameter values are modified, the new settings are saved automatically. The drive will retain the new settings during power-down.

# MMI Parameters

This table provides information about each parameter accessible using the keypad, or MMI (Man Machine Interface). For more information about these and additional parameters accessible using ConfigEd Lite (or other suitable programming tool), refer to the 650S Software Product Manual on our website: www.SSDdrives.com.

## Key to MMI Parameters Table

| | |
|---|---|
| F | Parameters indicated with F are visible with full menus only. Refer to the DETAILED MENUS parameter ( $^{ST}$99). |
| M | Parameters indicated with M are Motor Parameters. They are not reset by changing Application using parameter $^{P}$1; all other parameters are reset to default values. |

**NOTE The "Range" for a parameter value is given in the Configurable Parameters Table. Ranges for outputs are given as "—.xx %", for example, indicating an indeterminate integer for the value, to two decimal places.**

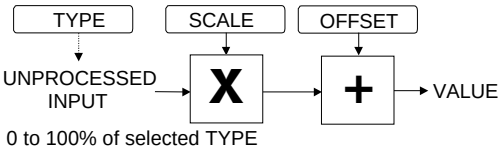
# MMI Parameters Table

| MMI Parameters Table | | | | |
|---|---|---|---|---|
| Display | Parameter | Description | Range | Default |
| | | **DIAG Menu** | | |
| 0.0 Hz | FREQUENCY | **The current output frequency in Hertz** | | |
| 0.0 % | SPEED SETPOINT | The set point as a percentage of MAX SPEED | | |
| 0.0 V | DC LINK VOLTS | Vac (rms) x √2 = dc link Volts<br>(when motor stopped) | | |
| 0.0 A | MOTOR CURRENT | The current load value in Amps | | |
| | | **DIAG::INPUTS Menu** | | |
| 0000 | DIN WORD | **Four-digit Hexadecimal number to identify the digital input value:**<br>0x0001 is digital input 1value<br>0x0002 is digital input 2 value<br>0x0004 is digital input 3 value<br>0x0008 is digital input 4 value<br>0x0010 is digital input 5 value<br>0x0020 is digital input 6 value<br>0x0040 is digital input 7 value | ——— | ——— |
| 0.0 % | AIN 1 VALUE | The input reading with scaling and offset applied | —.x% | —.x% |
| 0.0 % | AIN 2 VALUE | The input reading with scaling and offset applied | —.x% | —.x% |
| | | **DIAG::OUTPUTS Menu** | | |
| 0000 | DOUT WORD | **Four-digit Hexadecimal number to identify the digital output value:**<br>0x0001 is digital output 1<br>0x0002 is digital output 2<br>0x0004 is digital output 3 | ——— | ——— |
| 0.0 % | AOUT 1 VALUE | The output value with output and offset applied | —.x% | —.x% |
| 0.0 % | AOUT 2 VALUE | The output value with output and offset applied) | —.x% | —.x% |

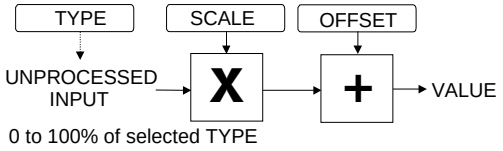
| MMI Parameters Table | | | | |
|---|---|---|---|---|
| Display | Parameter | Description | Range | Default |
| | | DIAG::TRIPS Menu | | |
| tH 1 | TRIP1 | Records the most recent trip that caused the drive to stop<br>The value displayed is the Trip ID number that can be found in the table 'Hexadecimal Representation of Trips', chapter 7 | | 0 |
| tH2 | TRIP2 | Records the second most recent trip that caused the drive to stop<br>The value displayed is the Trip ID number that can be found in the table 'Hexadecimal Representation of Trips', chapter 7 | | 0 |
| tH3 | TRIP3 | Records the third most recent trip that caused the drive to stop<br>The value displayed is the Trip ID number that can be found in the table 'Hexadecimal Representation of Trips', chapter 7 | | 0 |
| tH4 | TRIP4 | Records the fourth most recent trip that caused the drive to stop<br>The value displayed is the Trip ID number that can be found in the table 'Hexadecimal Representation of Trips', chapter 7 | | 0 |
| tH5 | TRIP5 | Records the fifth most recent trip that caused the drive to stop<br>The value displayed is the Trip ID number that can be found in the table 'Hexadecimal Representation of Trips', chapter 7 | | 0 |
| tH6 | TRIP6 | Records the sixth most recent trip that caused the drive to stop<br>The value displayed is the Trip ID number that can be found in the table 'Hexadecimal Representation of Trips', chapter 7 | | 0 |
| tH7 | TRIP7 | Records the seventh most recent trip that caused the drive to stop<br>The value displayed is the Trip ID number that can be found in the table 'Hexadecimal Representation of Trips', chapter 7 | | 0 |
| tH8 | TRIP8 | Records the eighth most recent trip that caused the drive to stop<br>The value displayed is the Trip ID number that can be found in the table 'Hexadecimal Representation of Trips', chapter 7 | | 0 |
| tH9 | TRIP9 | Records the ninth most recent trip that caused the drive to stop<br>The value displayed is the Trip ID number that can be found in the table 'Hexadecimal Representation of Trips', chapter 7 | | 0 |
| tH 10 | TRIP10 | Records the tenth most recent trip that caused the drive to stop<br>The value displayed is the Trip ID number that can be found in the table 'Hexadecimal Representation of Trips', chapter 7 | | 0 |

## MMI Parameters Table

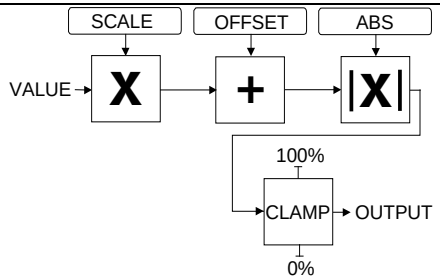
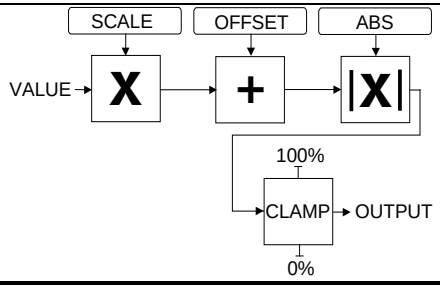
| Display | Parameter | Description | Range | Default |
|---|---|---|---|---|
| | | **SET::CTRL Menu** | | |
| SCL82 | POS TORQUE LIMIT | This parameter sets the maximum allowed level of positive motor torque. | -500.0 to 500.0% | 200.0% |
| SCL83 | NEG TORQUE LIMIT | This parameter sets the maximum allowed level of negative motor torque. | -500.0 to 500.0% | -200.0% |
| SCL84 | STALL TRIP TYPE **F** | This parameter determines whether the stall trip operates on motor torque or motor current. FALSE = TORQUE, TRUE = CURRENT | 0= FALSE<br>1= TRUE | 1 |
| SCL91 | SPEED PROP GAIN **F M** | Sets the proportional gain of the loop. Speed error (revolutions per second) x proportional gain = torque percent. | 0.00 to 300.00 | product code dependent |
| SCL92 | SPEED INT TIME **F M** | This is the integral time constant of the speed loop. A speed error which causes the proportional term to produce a torque demand T, will cause the integral term to also ramp up to a torque demand T after a time equal to “speed int time”. | 1 to 15000ms | product code dependent |
| SCL93 | SPEED POS LIMIT **F** | This sets the upper limit of the speed demand. | -110.00 to 110.00% | 110.00% |
| SCL94 | SPEED NEG LIMIT **F** | This sets the lower limit of the speed demand. | -110.00 to 110.00% | -110.00% |

| Display | Parameter | Description | Range | Default |
|---|---|---|---|---|
| | | **SET::IN Menu** | | |
| SIPd1 | DIN 1 INVERT | Inverts the value of the signal, TRUE or FALSE. | 0= FALSE<br>1= TRUE | 0 |
| SIPd2 | DIN 2 INVERT | As SIP01 | As SIP01 | 0 |
| SIPd3 | DIN 3 INVERT | As SIP01 | As SIP01 | 0 |
| SIPd4 | DIN 4 INVERT | As SIP01 | As SIP01 | 0 |
| SIPd5 | DIN 5 INVERT | As SIP01 | As SIP01 | 1 |
| SIPd6 | DIN 6 INVERT | As SIP01 | As SIP01 | 0 |
| SIPd7 | DIN 7 INVERT | As SIP01 | As SIP01 | 0 |
| SIP11 | AIN 1 SCALE |  | -300.0 to 300.0% | 100.0% |
| SIP12 | AIN 1 OFFSET | | -300.0 to 300.0% | 0.0% |
| SIP13 | AIN 1 TYPE | | 0= 0-10V<br>1= 0-5V | 0 |

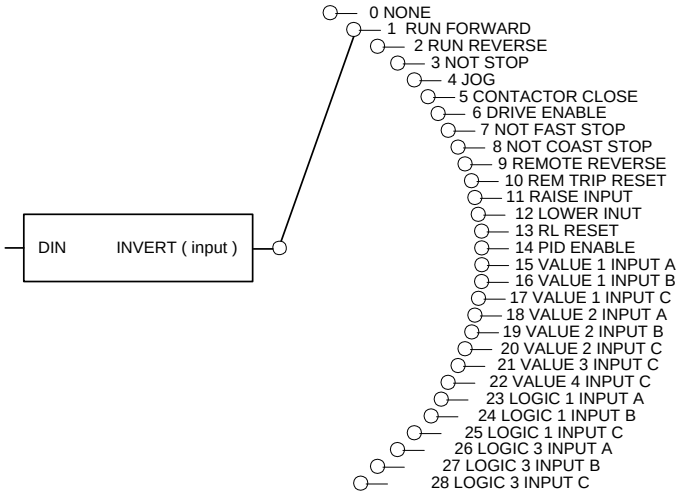
## MMI Parameters Table

| Display | Parameter | Description | Range | Default |
|---|---|---|---|---|
| S1P21 | AIN 2 SCALE |   | -300.0 to 300.0% | 100.0% |
| S1P22 | AIN 2 OFFSET | | -300.0 to 300.0% | 0.0% |
| S1P23 | AIN 2 TYPE | | 0= 0-10V<br>1= 0-5V<br>2= 0-20mA<br>3= 4-20mA | 3 |

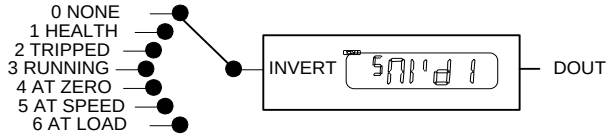
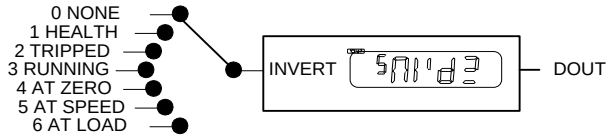
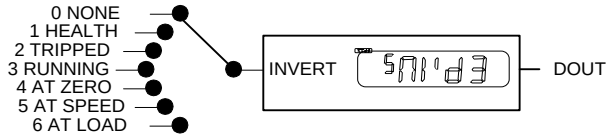
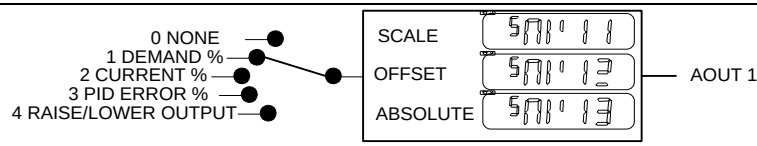
## SET::OUT Menu

| | | | | |
|---|---|---|---|---|
| SOPd1 | DOUT 1 INVERT | Inverts the value of the signal, TRUE or FALSE. | 0= FALSE<br>1= TRUE | 0 |
| SOPd2 | DOUT 2 INVERT | Inverts the value of the signal, TRUE or FALSE. | 0= FALSE<br>1= TRUE | 0 |
| SOPd3 | RELAY INVERT | Inverts the value of the signal, TRUE or FALSE. | 0=FALSE<br>1=TRUE | 0 |
| SOP11 | AOUT 1 SCALE |   | -300.00 to 300.00% | 100.00% |
| SOP12 | AOUT 1 OFFSET | | -300.00 to 300.00% | 0.00% |
| SOP13 | AOUT 1 ABSOLUTE | | 0= FALSE (not absolute)<br>1= TRUE (absolute) | 1 |
| SOP21 | AOUT 2 SCALE |   | -300.00 to 300.00% | 100.00% |
| SOP22 | AOUT 2 OFFSET | | -300.00 to 300.00% | 0.00% |
| SOP23 | AOUT 2 ABSOLUTE | | 0= FALSE (not absolute)<br>1= TRUE (absolute) | 1 |

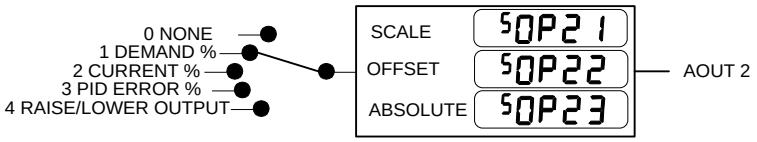
## MMI Parameters Table

| Display | Parameter | Description | Range | Default |
|---|---|---|---|---|
| | | **SET::CONF Menu** | | |
| S IPd 1 | F |  | O : NONE<br>1 : RUN FORWARD<br>2 : RUN REVERSE<br>3 : NOT STOP<br>4 : JOG<br>5 : CONTACTOR CLOSE<br>6 : DRIVE ANABLE<br>7 : NOT FAST STOP<br>.....<br>28 LOGIC 3 INPUT C | 1 : RUN FORWARD |
| S IPd2 | DIN 2 DESTINATION<br>F | Same as DIN 1 DESTINATION | Same as DIN1 DESTINATION | 2 : RUN REVERSE |
| S IPd3 | F | Same as DIN 1 DESTINATION | Same as DIN1 DESTINATION | 4 : JOG |
| S IPd4 | F | Same as DIN 1 DESTINATION | Same as DIN1 DESTINATION | 3 : NOT STOP |
| S IPd5 | F | Same as DIN 1 DESTINATION | Same as DIN1 DESTINATION | 8 : NOT COAST STOP |
| S IPd6 | F | Same as DIN 1 DESTINATION | Same as DIN1 DESTINATION | 0 : NONE |
| S IPd7 | F | Same as DIN 1 DESTINATION | Same as DIN1 DESTINATION | 0 : NONE |

## MMI Parameters Table

| Display | Parameter | Description | Range | Default |
|---|---|---|---|---|
| SOPd1 | F | NONE : Relay is open<br>*Relay is closed when:*<br>HEALTH : the Run signal is not present, or no trip is active<br>TRIPPED : a trip is present<br>RUNNING : the motor is running<br>AT ZERO : the output frequency is below 1% of MAX SPEED (P2)<br>AT SPEED : the output frequency is at or near Setpoint and within ±1% of MAX SPEED, set by (P2). For example: if MAX SPEED = 50Hz and Setpoint = 30Hz, then 1% of MAX SPEED = 0.5Hz. So AT LOAD is True between 30 ±0.5Hz.<br>AT LOAD : the magnitude of the output torque is greater than or equal to the torque level set in ST42<br>  | 0 : NONE<br>1 : HEALTH<br>2 : TRIPPED<br>3 : RUNNING<br>4 : AT ZERO<br>5 : AT SPEED<br>6 : AT LOAD | 0 : NONE |
| SOPd2 | Refer to Configuring Terminals 9 & 10 (Digital Input/Output), page 6-29<br>F |  | 0 : NONE<br>1 : HEALTH<br>2 : TRIPPED<br>3 : RUNNING<br>4 : AT ZERO<br>5 : AT SPEED<br>6 : AT LOAD | 0 : NONE |
| SOPd3 | F |  | 0 : NONE<br>1 : HEALTH<br>2 : TRIPPED<br>3 : RUNNING<br>4 : AT ZERO<br>5 : AT SPEED<br>6 : AT LOAD | 1 : HEALTH |
| SOPA1 | F |  | 0 : NONE<br>1 : DEMAND<br>2 : CURRENT<br>3 : PID ERROR<br>4 : RAISE/LOWER | 1 : DEMAND |

## MMI Parameters Table

| Display | Parameter | Description | Range | Default |
|---|---|---|---|---|
| SOPA2 | F |  | 0 : NONE<br>1 : DEMAND<br>2 : CURRENT<br>3 : PID ERROR<br>4 : RAISE/LOWER | 0 : NONE |

## SET::TRIP Menu

| | | | | |
|---|---|---|---|---|
| SLOOP | DISABLE LOOP | Disables LOST I LOOP trip (4-20mA) | 0= TRIP ENABLED<br>1= TRIP DISABLED | 1 |
| S t 3 | AIN2 OVERLOAD | Disables the overload trip (Terminal 3) | As SLOOP | 0 |
| SStLL | DISABLE STALL | Disables STALL trip | As SLOOP | 0 |
| SOt | DISABLE MOTOR OVERTEMP | Disables the motor thermistor trip | As SLOOP | 0 |
| SI t | INVERSE TIME | Disables the inverse time trip | As SLOOP | 1 |
| Sdb r | DYNAMIC BRAKE RESISTOR | Disables the dynamic brake resistor trip | As SLOOP | 1 |
| Sdb S | DYNAMIC BRAKE SWITCH | Disables the dynamic brake switch trip | As SLOOP | 1 |
| SSPd | SPEED FEEDBACK | Disables the speed feedback trip | As SLOOP | 0 |
| SOSPd | OVERSPEED | Disables the overspeed trip | As SLOOP | 0 |
| SdI SP | DISPLAY (KEYPAD) | Disables the display (keypad) trip | As SLOOP | 0 |
| SdCrP | DC LINK RIPPLE<br>F | Disables the DC link ripple trip | As SLOOP | 0 |

## SET::SERL Menu

| | | | | |
|---|---|---|---|---|
| SSE01 | REMOTE COMMS SEL<br>F | Selects the type of remote communications mode:<br>0 : FALSE, and in REMOTE mode then control is from the terminals.<br>1 : TRUE, and in REMOTE mode then control is from the communications. | 0=FALSE<br>1=TRUE | 0 |
| SSE02 | COMMS TIMEOUT<br>F | Sets the maximum time allowed between refreshing the COMMS COMMAND parameter. The drive will trip if this time is exceeded. Set the time to 0.00 seconds to disable this feature. | 0.0 to 600.0s | 0.0s |
| SSE03 | COMMS ADDRESS<br>F | The drives identity address.<br>Note: if set to 0, it will only respond to broadcast messages. | 0 to 255 | 0 |

| MMI Parameters Table | | | | |
|---|---|---|---|---|
| Display | Parameter | Description | Range | Default |
| SE04 | BAUD RATE<br>F | Selects the Baud Rate for the MODBUS protocol. | 0 : 1200<br>1 : 2400<br>2 : 4800<br>3 : 7200<br>4 : 9600<br>5 : 14400<br>6 : 19200<br>7 : 38400<br>8 : 57600 | 4 |
| SE05 | PARITY<br>F | Selects the Parity for the MODBUS protocol. | 0= NONE<br>1= ODD<br>2= EVEN | 0 |
| SE06 | REPLY DELAY ms | The time in milliseconds between the drive receiving the complete request from the communications master (PLC/PC) and replying to this request. | 0 to 200 | 5 |
| SE07 | OP PORT PROTOCOL<br>F | Selects the protocol to be used by the keypad port on the front of the drive. When EIBISYNC ASCII is selected, BAUD RATE is 19200 and PARITY is EVEN. FIELDBUS is reserved for future use. | 0= AUTOMATIC<br>1= KEYPAD<br>2=EIBISYNC ASCII<br>3= MODBUS<br>4= FIELDBUS | 0 |
| SE08 | P3 PORT PROTOCOL<br>F | Selects the protocol to be used by the RS232 programming port on the drive's control board. When EIBISYNC ASCII is selected, BAUD RATE is 19200 and PARITY is EVEN. FIELDBUS is reserved for future use. | As SE07 | 0 |

| SET::SETP Menu | | | | |
|---|---|---|---|---|
| St01 | JOG ACCEL TIME | As P4, for Jog | 0.0 to 3000.0s | 1.0 |
| St02 | JOG DECEL TIME | As P5, for Jog | 0.0 to 3000.0s | 1.0 |
| St03 | RAMP TYPE | Selects the ramp type | 0=LINEAR<br>1=S | 0 |
| St04 | S RAMP JERK | Rate of change of acceleration of the curve in units per second$^3$ | 0.01 to 100.00 s3 | 10.00 |
| St05 | S RAMP CONTINUOUS | When TRUE and the S ramp is selected, forces a smooth transition if the speed setpoint is changed when ramping. The curve is controlled by the S RAMP JERK parameter. When FALSE, there is an immediate transition from the old curve to the new curve | 0=FALSE<br>1=TRUE | 1 |
| St06 | MIN SPEED MODE | Selects a mode to determine how the drive will follow a reference: Proportional : minimum limit, Linear : between minimum and maximum. | 0=PROP.W/MIN.<br>1=LINEAR (used by the 601 product) | 0 |
| St11 | SKIP FREQUENCY 1 | This parameter contains the centre frequency of skip band 1 in Hz | 0.0 to 240.0 Hz | 0.0 |

## MMI Parameters Table

| Display | Parameter | Description | Range | Default |
|---|---|---|---|---|
| SSt 12 | SKIP FREQUENCY BAND 1 | The width of skip band 1 in Hz | 0.0 to 60.0 Hz | 0.0 |
| SSt 13 | SKIP FREQUENCY 2 | This parameter contains the centre frequency of skip band 2 in Hz | 0.0 to 240.0 Hz | 0.0 |
| SSt 14 | SKIP FREQUENCY BAND 2 | The width of skip band 2 in Hz | 0.0 to 60.0 Hz | 0.0 |
| SSt21 | AUTO RESTART ATTEMPTS | Determines the number of restarts that will be permitted before requiring an external fault reset | 0 to 10 | 0 |
| SSt22 | AUTO RESTART DELAY | Determines the delay between restart attempts for a trip included in AUTO RESTART TRIGGERS and AUTO RESTART TRIGGERS+. The delay is measured from all error conditions clearing | 0.0 to 600.0 s | 10.0 |
| SSt23 | AUTO RESTART TRIGGERS | Allows Auto Restart to be enabled for a selection of trip conditions. Refer to Chapter 7: "Trips and Fault Finding" - Hexadecimal Representation of Trips | 0x0000 to 0xFFFF | 0x0000 |
| SSt24 | AUTO RESTART TRIGGERS+ | Allows Auto Restart to be enabled for a selection of trip conditions. Refer to Chapter 7: "Trips and Fault Finding" - Hexadecimal Representation of Trips | 0x0000 to 0xFFFF | 0x0000 |
| SSt31 | DB ENABLE | Enables operation of the dynamic braking. | 0=FALSE<br>1=TRUE | 1 |
| SSt32 | DB RESISTANCE | The value of the load resistance. | 1 to 1000 | product code dependent |
| SSt33 | DB POWER | The power that the load resistance may continually dissipate. | 0.1 to 510.0 kW | product code dependent |
| SSt34 | DB OVER-RATING | Multiplier that may be applied to DB POWER for power overloads lasting no more than 1 second. | 1 to 40 | 25 |
| SSt51 | LOCAL MIN SPEED **F** | The magnitude of the minimum setpoint that will be used when running in Local Mode. | 0.0 to 100.0 % | 0.0 % |
| SSt52 | ENABLED KEYS **F** | The following keys on the 6901 keypad can be enabled or disabled separately. The combination produces the parameter setting as in the table below. The default of FFFF enables all keys. | 0000 to FFFF | FFFF |

## MMI Parameters Table

| Display | Parameter | Description | | | | Range | Default |
|---|---|---|---|---|---|---|---|
| | Parameter Setting | RUN | L/R | JOG | DIR | | |
|  6901 | 0000 | - | - | - | - | | |
| | 0010 | - | - | - | ENABLED | | |
| | 0020 | - | - | ENABLED | - | | |
| | 0030 | - | - | ENABLED | ENABLED | | |
| | 0040 | - | ENABLED | - | - | | |
| | 0050 | - | ENABLED | - | ENABLED | | |
| | 0060 | - | ENABLED | ENABLED | - | | |
|  6911 | 0070 | - | ENABLED | ENABLED | ENABLED | | |
| | 0080 | ENABLED | - | - | - | | |
| | 0090 | ENABLED | - | - | ENABLED | | |
| | 00A0 | ENABLED | - | ENABLED | - | | |
| | 00B0 | ENABLED | - | ENABLED | ENABLED | | |
| | 00C0 | ENABLED | ENABLED | - | - | | |
| | 00D0 | ENABLED | ENABLED | - | ENABLED | | |
| | 00E0 | ENABLED | ENABLED | ENABLED | - | | |
| | 00F0 | ENABLED | ENABLED | ENABLED | ENABLED | | |
|  6511 | | When using the standard 6511 and 6521 keypad, disabling the **DIR** key prevents the local setpoint going negative (for reverse). Similarly, disabling the **L/R** key prevents the drive being changed from Local to Remote, or Remote to Local modes. | | | | | |
|  6521 | | | | | | | |
| SSt 98 | APPLICATION LOCK **F** | Setting this parameter to TRUE prevents editing of parameter P1. Set this parameter to FALSE to edit parameter P1. | | | | 0=FALSE 1=TRUE | 0 |
| SSt 99 | DETAILED MENUS | Selects Full menu detail when TRUE. The additional parameters in the Full menus are indicated in this table by | | | | 0=FALSE 1=TRUE | 0 |

## MMI Parameters Table

| Display | Parameter | Description | Range | Default |
|---|---|---|---|---|
| | | **SET::ENC Menu** | | |
| SEN01 | ENC MODE<br>F | Set this parameter to the requirements for your encoder:<br>0 : QUADRATURE (using digital inputs 6 & 7, ENCA and ENCB respectively)<br>1 : CLOCK/DIR (using digital inputs 6 & 7, ENCA and ENCB respectively)<br>2 : CLOCK (using digital input 6, ENCA) | 0= QUADRATURE<br>1= CLOCK/DIR<br>2= CLOCK | 0 |
| SEN02 | ENC RESET<br>F | When TRUE the POSITION and SPEED outputs are set (and held) at zero. | 0=FALSE<br>1=TRUE | 0 |
| SEN03 | ENC INVERT<br>F | When TRUE, changes the sign of the measured speed and the direction of the position count. | 0=FALSE<br>1=TRUE | 0 |
| SEN04 | ENC LINES<br>F | The number of lines must be set to match the type of encoder being used. Incorrect setting of this parameter will result in an erroneous speed measurement. | 100 to 10000 | 100 |
| SEN05 | ENC SPEED SCALE<br>F | This parameter allows the output "speed" to be scaled to any value the user requires. With a default value of 1.00, the output "speed" is measured in revs per second. Changing the ENC SPEED SCALE value to 60.00 will provide an output in revs per minute.<br>To provide an output in percent of the motor maximum speed, where maximum speed is the maximum speed your motor will run in rpm, the ENC SPEED SCALE parameter should be set to the result of:<br>$\frac{6000}{\text{maximum speed (rpm)}}$ | 0.00 to 300.00 | 1.00 |
| SEN06 | ENC SPEED<br>F | Speed feedback, in units defined by the ENC SPEED SCALE parameter. | ——.x | ——.x |
| SEN08 | ENC SOURCE<br>F | Allow choosing the feedback source (external encoder or internal feedback from the motor control's sensorless algorithm) | 0= EXTERNAL<br>1= INTERNAL | 0 |
| SEN09 | ENC POS SCALE<br>F | Allow scaling the position and speed feedback (in user-defined units) from the raw measure. Expressed in number of lines per unit. | 1 to 30000 | 1 |
| SEN 10 | ENC MODULO<br>F | Allow limiting the actual position (POS UNITS) range. Expressed in user-defined units. | 0 to 30000 | 0 |
| SEN 11 | ENC SPEED UNITS<br>F | Speed feedback, in user-defined units (using POS SCALE). | ——.xx | ——.xx |
| SEN 12 | ENC POS UNITS<br>F | Position feedback, in user-defined units (using POS SCALE). | ——.xx | ——.xx |
| SEN 13 | ENC PRESET VALUE<br>F | Value, in user-defined units, used to preset the actual position (POS UNITS) when RESET is TRUE | -32768 to 32768 | 0 |

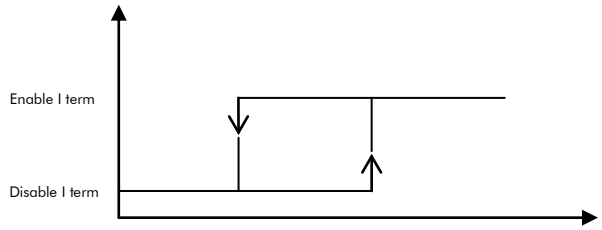
| MMI Parameters Table | | | | |
|---|---|---|---|---|
| Display | Parameter | Description | Range | Default |
| | | SET::PAC1 Menu | | |
| SPA01 | MAX SPEED MOTOR1 **M** | Set the maximum motor 1 speed. | 0 to 30000 RPM | 3200RPM |
| SPA02 | MAX CURRENT MOTOR1 **M** | Set the motor 1 maximum current in Amps rms. | 1.0 to 512.0 Arms | 5.65A |
| SPA03 | PERM CURRENT MOTOR1 **M** | Set the motor 1nominal current in Amps rms. | 1.0 to 512.0 Arms | 2.43A |
| SPA04 | PERM TORQUE MOTOR1 **M** | Set the motor 1 nominal torque in Nm. | 1.0 to 512.0 Nm | 2.0Nm |
| SPA05 | POLES MOTOR1 **M** | Set the motor 1 number of poles. | 0 to 400 | 10 |
| SPA06 | BACK EMF MOTOR1 **M** | Set the motor1's Back EMF phase to phase, rms value (in Volts/1000RPM) | 0 to 8192 Vrms/1000RPM | 50.9V |
| SPA07 | R MOTOR1 **M** | Set the motor1's resistance, between phase at 25°C. | 0 to 50 Ohms | 6.58Ohms |
| SPA08 | L MOTOR1 **M** | Set the motor1's inductance, between phase at nominal current. | 0 to 1000mH | 20.3mH |
| SPA09 | KT MOTOR1 **M** | Set the motor1's torque constant in Nm/Amps rms | 0 to 100 NM/Arms | 0.848NM/A |
| SPA 10 | INERTIA MOTOR1 **M** | Set the motor1's inertia. The units for this parameter are set by the INERTIA SCALE parameter. | 0 to 100 | 0.070 |
| SPA 11 | INERTIA SCALE MOTOR1 **M** | Set the motor1's inertia scale:<br>0 = $gm^2$<br>1 = $kgcm^2$<br>2 = $kgm^2$ | | 0 |
| SPA 12 | THERMAL TIME CST MOTOR1 **M** | This parameter is used for the motor1 protection, e.g. I2T motor load. It defines the thermal time constant of the motor1 that is used to protect the motor1 against overheating.<br>Refer to the PMAC MOT PROTECT for a definition. | 0 to 10000 s | 62s |

| MMI Parameters Table | | | | |
|---|---|---|---|---|
| Display | Parameter | Description | Range | Default |
| SPA 13 | CUR LOOP BWDTH MOTOR1 **M** | Set the current loop bandwidth in Hz. This value will automatically generate the proportional gain of the PI corrector of the current loop. The proportional gain is calculated based on the 'L' motor 2 parameter.<br>Modifying this value could induce instability. Please contact Parker SSD Drives if you need to change it. | 10 to 1500 Hz | 400Hz |
| SPA 14 | INTEGRAL FREQ MOTOR1 **M** | Set the frequency of the I term of the PI current loop corrector. The ratio CUR LOOP BWDTH/INTEGRAL FREQ must be kept higher than 3.<br>Modifying this value could induce instability. Please contact Parker SSD Drives if you need to change it. | 1 to 600 Hz | 100Hz |
| SPA 15 | SELECT MOTOR1 **M** | Used to select the motor to run:<br>**0** = motor 2 is selected, e.g. SV Motor Data 2 and SV Motor Ctrl 2 parameters are used by the drive<br>**1** = motor 1 is selected, e.g. SV Motor Data 1 and SV Motor Ctrl 1 parameters are used by the drive | | 1 |

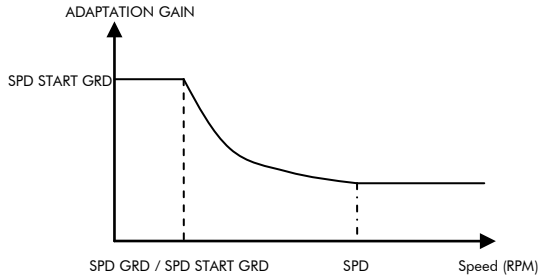
| SET::PAC2 Menu | | | | |
|---|---|---|---|---|
| SPAS 1 | MAX SPEED MOTOR2 **M** | Set the maximum motor 2 speed. | 0 to 30000 RPM | 4000RPM |
| SPAS2 | MA X CURRENT MOTOR2 **M** | Set the motor 2 maximum current in Amps rms. | 1.0 to 512.0 Arms | 10.6A |
| SPAS3 | PERM CURRENT MOTOR2 **M** | Set the motor 2 nominal current in Amps rms. | 1.0 to 512.0 Arms | 5.24A |
| SPAS4 | PERM TORQUE MOTOR2 **M** | Set the motor 2 nominal torque in Nm. | 1.0 to 512.0 Nm | 5.5Nm |
| SPAS5 | POLES MOTOR2 **M** | Set the motor 2 number of poles. | 0 to 400 | 10 |
| SPAS6 | BACK EMF MOTOR2 **M** | Set the motor2's Back EMF phase to phase, rms value (in Volts/1000RPM) | 0 to 8192 Vrms/1000RPM | 65.5V |
| SPAS7 | R MOTOR2 **M** | Set the motor2's resistance, between phase at 25°C. | 0 to 50 Ohms | 2.19Ohms |

## MMI Parameters Table

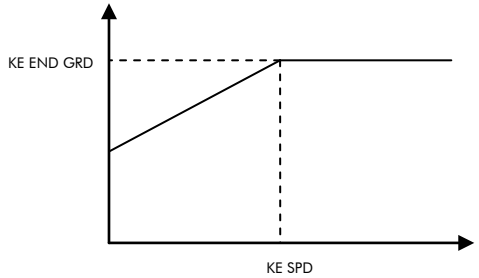
| Display | Parameter | Description | Range | Default |
|---|---|---|---|---|
| SPA58 | L<br>MOTOR2<br>**M** | Set the motor2's inductance, between phase at nominal current. | 0 to 1000mH | 10.9mH |
| SPA59 | KT<br>MOTOR2<br>**M** | Set the motor2's torque constant in Nm/Amps rms | 0 to 100 NM/Arms | 1.075Nm/A |
| SPA60 | INERTIA<br>MOTOR2<br>**M** | Set the motor2's inertia. The units for this parameter are set by the INERTIA SCALE parameter. | 0 to 100 | 0.40 |
| SPA61 | INERTIA SCALE<br>MOTOR2<br>**M** | Set the motor2's inertia scale:<br>0 = $gm^2$<br>1 = $kgcm^2$<br>2 = $kgm^2$ | | 0 |
| SPA62 | THERMAL TIME CST<br>MOTOR2<br>**M** | This parameter is used for the motor2 protection, e.g. I2T motor load. It defines the thermal time constant of the motor1 that is used to protect the motor1 against overheating.<br>Refer to the PMAC MOT PROTECT for a definition. | 0 to 10000 s | 76.4s |
| SPA63 | CUR LOOP BWDTH<br>MOTOR2<br>**M** | Set the current loop bandwidth in Hz. This value will automatically generate the proportional gain of the PI corrector of the current loop. The proportional gain is calculated based on the 'L' motor 2 parameter.<br>Modifying this value could induce instability. Please contact Parker SSD Drives if you need to change it. | 10 to 1500 Hz | 400Hz |
| SPA64 | INEGRAL FREQ<br>MOTOR2<br>**M** | Set the frequency of the I term of the PI current loop corrector. The ratio CUR LOOP BWDTH/INTEGRAL FREQ must be kept higher than 3.<br>Modifying this value could induce instability. Please contact Parker SSD Drives if you need to change it. | 1 to 600 Hz | 100Hz |

| MMI Parameters Table | | | | |
|---|---|---|---|---|
| Display | Parameter | Description | Range | Default |
| | | SET::SCP1 Menu | | |
| SSC01 | TRIP INHIBIT MOTOR1 | This parameter is used to inhibit/enable the SV trip. | 0=FALSE<br>1=TRUE | 0 |
| SSC02 | LPF SPEED MOTOR1 | Set the Low Pass Filter frequency applied on the estimated speed. The default value is appropriate for most motors. | 0.1 to 1000.0 Hz | 60Hz |
| SSC03 | PI GAIN MOTOR1 | Set the Proportional gain of the PI corrector used for extracting speed and position. The default value is appropriate for most motors. | 0 to 2000 | 1 |
| SSC04 | PI INTEGRAL MOTOR1 | Set the Integral frequency of the PI corrector used for extracting speed and position. The default value is appropriate for most motors | 1 to 2000 Hz | 20Hz |
| SSC05 | SPD THRESHOLD MOTOR1 | Set the threshold value used to enable/disable the I term of the PI corrector (used for extracting speed and position).<br>  <br><br>The default value is appropriate for most motors (2000 to 6000RPM). It can be changed to the Nominal motor speed divided by 20 to 30. | 0 to 30000 RPM | 200RPM |

## MMI Parameters Table

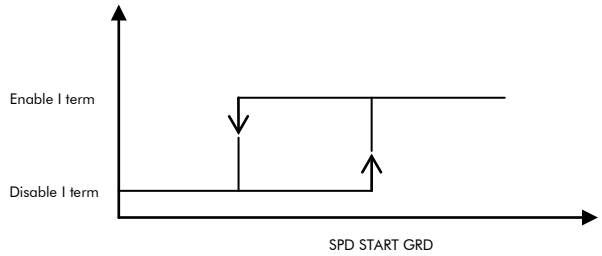
| Display | Parameter | Description | Range | Default |
|---|---|---|---|---|
| SSC06 | SPD START GRAD MOTOR1 | The gain of the PI corrector varies as 1 over speed. To maintain the PI gain at a constant value over the whole range of the speed, the gain is internally varied as a function of the speed. This parameter is used to determine where the 1/X variation is starting to work (because of zero and low speed behaviour of the estimation). The default value is 5, and is considered appropriate for most applications.<br>  <br><br>The total gain applied is:PI GAIN * ADAPTATION GAIN<br>With:<br>ADAPTATION GAIN = SPD START GRD from 0 to SPD GRD/SPD START GRD<br>ADAPTATION GAIN = SPD GRD/real_speed (RPM) from SPD GRD/SPD START GRD to SPD GRD<br>ADAPTATION GAIN = 1 above SPD GRD | 0.1 to 100 | 5 |
| SSC08 | SPD GRD MOTOR1 | The gain of the PI corrector varies as 1 over speed. To maintain the PI gain at a constant value over the whole range of the speed, the gain is internally varied as a function of the speed.<br>This parameter is used to select the speed where the GAIN_ADAPTATION is kept constant and equal to 1 (see graph below). This value must be set to the nominal motor or application speed. | -32000 to 32000 RPM | 4000RPM |

## MMI Parameters Table

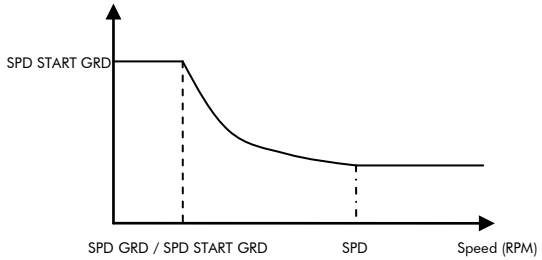
| Display | Parameter | Description | Range | Default |
|---|---|---|---|---|
| SSC09 | KE START GRD MOTOR1 | This parameter is used to vary the Back EMF versus speed used in the SV algorithm.<br>The default value of 0.2 is considered appropriate for most applications.<br>  | 0 to 100 | 0.2 |
| SSC 10 | KE END GRD MOTOR1 | This parameter is used to vary the Back EMF versus speed used in the SV algorithm.<br>The default value of 1.0 is considered appropriate for most applications. | 0 to 100 | 1 |
| SSC 11 | KE SPD MOTOR1 | This parameter is used to vary the Back EMF versus speed used in the SV algorithm. It defines the speed at which the variation stops. The default value is 50 RPM, and is considered appropriate for most applications.<br>As it is mostly used to start the motor, a very low value (between 0 to 100RPM) must be selected if changed from the default value. | -32000 to 32000 RPM | 50RPM |
| SSC 12 | ENABLE STARTUP MOTOR1 | Start the motor with a high friction load<br>This parameter is used to enable/disable a specific startup procedure when the motor/drive is switched ON (starting rotation). This is mainly used where applications need to start the motor with a high inertia and/or friction load and the standard start is ineffective.<br>This parameter is also used to work in up – down motion, where we need to go down to zero speed or crossing the zero speed point. | 0=FALSE<br>1=TRUE | FALSE |

## MMI Parameters Table

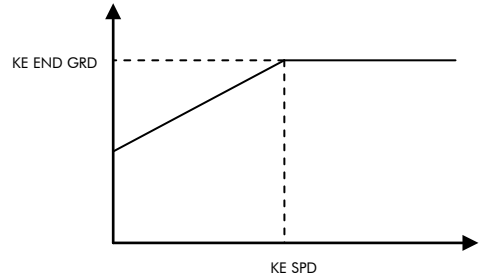
| Display | Parameter | Description | Range | Default |
|---|---|---|---|---|
| SSC 13 | STARTUP TIME MOTOR1 | This parameter is used in conjunction with the ENABLE STARTUP parameter. It selects the duration of Step 1 and Step 2 in the startup procedure used for starting motors with a high inertia and/or friction load:<br>- half the time for the current ramping<br>- half the time for the position variation on one electrical turn<br>The value is dependant upon the motor inertia + load inertia. | 0 to 100s | 0.5s |
| SSC 14 | STARTUP CURRENT MOTOR1 | This parameter is used in conjunction with the ENABLE STARTUP parameter. It selects the current level during the startup procedure used for starting motors with a high inertia and/or friction load.<br>The percentage value is a percentage of the nominal motor current (I0 of the PMAC MOTOR function block)<br>This value cannot be higher than 150% of the drive rating.<br>The default value of 10% is considered appropriate for most applications. | 0 to 200% | 10% |
| SSC 15 | STARTUP SPEED MOTOR1 | This parameter is used in conjunction with the ENABLE STARTUP parameter. It selects the speed setpoint at which the speed control is switched from an open loop mode to a closed loop mode during the startup procedure used for starting motors with a high inertia and/or friction load..<br>The percentage value is a percentage of the maximum application speed (MAX SPEED of the REFERENCE function block )<br>In open loop mode, the system is not controlled in speed mode. It must only be used to 'start' the motor under heavy conditions, or to transitorily reach the zero speed or crossing the zero speed setpoint. It is not intended to be used to control accurately a motion. | 0 to 100% | 5% |

| MMI Parameters Table | | | | |
|---|---|---|---|---|
| Display | Parameter | Description | Range | Default |
| | | SET::SCP2 Menu | | |
| SSC51 | TRIP INHIBIT MOTOR2 | This parameter is used to inhibit/enable the SV trip. | 0=FALSE<br>1=TRUE | 0 |
| SSC52 | LPF SPEED MOTOR2 | Set the Low Pass Filter frequency applied on the estimated speed. The default value is appropriate for most motors. | 0.1 to 1000.0 Hz | 60Hz |
| SSC53 | PI GAIN MOTOR2 | Set the Proportional gain of the PI corrector used for extracting speed and position. The default value is appropriate for most motors. | 0 to 2000 | 1 |
| SSC54 | PI INTEGRAL MOTOR2 | Set the Integral frequency of the PI corrector used for extracting speed and position. The default value is appropriate for most motors | 1 to 2000 Hz | 20Hz |
| SSC55 | SPD THRESHOLD MOTOR2 | Set the threshold value used to enable/disable the I term of the PI corrector (used for extracting speed and position).<br>  <br><br>The default value is appropriate for most motors (2000 to 6000RPM). It can be changed to the Nominal motor speed divided by 20 to 30. | 0 to 30000 RPM | 200RPM |

## MMI Parameters Table

| Display | Parameter | Description | Range | Default |
|---|---|---|---|---|
| 5SC56 | SPD START GRAD MOTOR2 | The gain of the PI corrector varies as 1 over speed. To maintain the PI gain at a constant value over the whole range of the speed, the gain is internally varied as a function of the speed. This parameter is used to determine where the 1/X variation is starting to work (because of zero and low speed behaviour of the estimation). The default value is 5, and is considered appropriate for most applications.<br>  <br><br>The total gain applied is:PI GAIN * ADAPTATION GAIN<br>With:<br>ADAPTATION GAIN = SPD START GRD from 0 to SPD GRD/SPD START GRD<br>ADAPTATION GAIN = SPD GRD/real_speed (RPM) from SPD GRD/SPD START GRD to SPD GRD<br>ADAPTATION GAIN = 1 above SPD GRD | 0.1 to 100 | 5 |
| 5SC58 | SPD GRD MOTOR2 | The gain of the PI corrector varies as 1 over speed. To maintain the PI gain at a constant value over the whole range of the speed, the gain is internally varied as a function of the speed.<br>This parameter is used to select the speed where the GAIN_ADAPTATION is kept constant and equal to 1 (see graph below). This value must be set to the nominal motor or application speed. | -32000 to 32000 RPM | 4000RPM |

## MMI Parameters Table

| Display | Parameter | Description | Range | Default |
|---|---|---|---|---|
| 5SC59 | KE START GRD MOTOR2 | This parameter is used to vary the Back EMF versus speed used in the SV algorithm.<br>The default value of 0.2 is considered appropriate for most applications.<br>  | 0 to 100 | 0.2 |
| 5SC60 | KE END GRD MOTOR2 | This parameter is used to vary the Back EMF versus speed used in the SV algorithm.<br>The default value of 1.0 is considered appropriate for most applications. | 0 to 100 | 1 |
| 5SC61 | KE SPD MOTOR2 | This parameter is used to vary the Back EMF versus speed used in the SV algorithm. It defines the speed at which the variation stops. The default value is 50 RPM, and is considered appropriate for most applications.<br>As it is mostly used to start the motor, a very low value (between 0 to 100RPM) must be selected if changed from the default value. | -32000 to 32000 RPM | 50RPM |
| 5SC62 | ENABLE STARTUP MOTOR2 | Start the motor with a high friction load<br>This parameter is used to enable/disable a specific startup procedure when the motor/drive is switched ON (starting rotation). This is mainly used where applications need to start the motor with a high inertia and/or friction load and the standard start is ineffective.<br>This parameter is also used to work in up – down motion, where we need to go down to zero speed or crossing the zero speed point. | 0=FALSE<br>1=TRUE | FALSE |
| 5SC63 | STARTUP TIME MOTOR2 | This parameter is used in conjunction with the ENABLE STARTUP parameter. It selects the duration of Step 1 and Step 2 in the startup procedure used for starting motors with a high inertia and/or friction load:<br>- half the time for the current ramping<br>- half the time for the position variation on one electrical turn<br>The value is dependant upon the motor inertia + load inertia. | 0 to 100s | 0.5s |

| MMI Parameters Table | | | | |
|---|---|---|---|---|
| Display | Parameter | Description | Range | Default |
| SSC64 | STARTUP CURRENT MOTOR2 | This parameter is used in conjunction with the ENABLE STARTUP parameter. It selects the current level during the startup procedure used for starting motors with a high inertia and/or friction load.<br><br>The percentage value is a percentage of the nominal motor current (I0 of the PMAC MOTOR function block)<br><br>This value cannot be higher than 150% of the drive rating.<br><br>The default value of 10% is considered appropriate for most applications. | 0 to 200% | 10% |
| SSC65 | STARTUP SPEED MOTOR2 | This parameter is used in conjunction with the ENABLE STARTUP parameter. It selects the speed setpoint at which the speed control is switched from an open loop mode to a closed loop mode during the startup procedure used for starting motors with a high inertia and/or friction load..<br><br>The percentage value is a percentage of the maximum application speed (MAX SPEED of the REFERENCE function block )<br><br>In open loop mode, the system is not controlled in speed mode. It must only be used to 'start' the motor under heavy conditions, or to transitorily reach the zero speed or crossing the zero speed setpoint. It is not intended to be used to control accurately a motion. | 0 to 100% | 5% |

| SET::IPPA Menu | | | | |
|---|---|---|---|---|
| S IP01 | AIMING POINT | Determines the final level of the inverse time current limit after a period of prolonged motor overload. | 50 to 150% | 105% |
| S IP02 | DELAY | Determines the maximum overload duration before inverse time current limit action is taken | 5 to 60s | 30s |
| S IP03 | DOWN TIME | Determines the rate at which the inverse time current limit is ramped down to the AIMING POINT after a period of prolonged overload. | 1 to 10s | 1s |
| S IP04 | UP TIME | Determines the rate at which the inverse time current limit is ramped back to the maximum current. | 0.5 to 100s | 1s |
| S IP05 | IT LIMITING | This diagnostic indicates if the drive protection is active. | 0=FALSE<br>1=TRUE | |
| S IP06 | INV TIME OP | This diagnostic indicates the actual current level limit. | ---% | |
| S IP07 | IT WARNING | This diagnostic indicates that the drive will reach its maximum overload level. | 0=FALSE<br>1=TRUE | |

## MMI Parameters Table

| Display | Parameter | Description | Range | Default |
|---|---|---|---|---|
| | | **SET::I2P Menu** | | |
| S2P01 | I2T INHIBIT | Inhibit/enable the action of the motor protection. | 0=FALSE<br>1=TRUE | FALSE |
| S2P02 | I2T LIMIT MOTOR | This is diagnostic information:<br>0 : motor load level is lower than 100%<br>1 : motor load level is higher than 100% | 0/1 | |
| S2P03 | I2T LIMIT LOAD | This is a diagnostic information.<br>Indicates the percentage of motor load. This value is based on PERM CURRENT (permanent motor current). The time variation is based on THERMAL TIM CST | ---% | |
| S2P04 | I2T MOTOR TRIP | State of the I2T trip, reported as MOTOR OVERTEMP:<br>0: the motor is running, the motor load level is lower than 100%<br>1: the motor is stopped; the motor load level is higher than 100% | 0=FALSE<br>1=TRUE | |
| | | **SET::POL Menu** | | |
| SP001 | POLARISATION | Set this parameter to enter the motor polarisation mode<br>Clear it for standard SV control mode | 0=FALSE<br>1=TRUE | |
| SP002 | POLAR START | Set this parameter to enable the motor polarisation mode<br>Clear it to disable the motor polarisation mode | 0=FALSE<br>1=TRUE | |
| SP003 | MOTOR PHASE | Select on which motor phases the motor polarisation is applied.<br>When the motor polarisation is enabled, changing the motor phase allows to rotate the motor like a stepper motor.<br>That gives the possibility to verify the correct motor phase connection to get a clockwise direction for a positive speed setpoint | 0=U PHASE<br>1=V PHASE<br>2=W PHASE | |
| SP004 | CURRENT | This diagnostic gives the current setpoint applied to the motor during the motor polarisation mode. | ---A | |
| | | **SET::POS Menu** | | |
| SPS01 | START | A False to True transition starts the move command. | 0=FALSE<br>1=TRUE | |
| SPS02 | ABORT | When True the ongoing move is aborted (null speed set-point) and no further move command can be started. | 0=FALSE<br>1=TRUE | |
| SPS03 | TARGET | Specify the move command target. Depending of the move type it is an absolute, a relative or a travel distance. | -32768 to 32768 | 0 |

## MMI Parameters Table

| Display | Parameter | Description | Range | Default |
|---|---|---|---|---|
| SP504 | TYPE | Specify the move command type. | 0= ABSOLUTE<br>1= RELATIVE<br>2= STOP MARK | 0 |
| SP505 | DIRECTION | Specify the move command direction. This parameter is relevant only if the move type is ABSOLUTE and MODULO is not null. | 0= POSITIVE<br>1= NEGATIVE<br>2= SHORTEST | 0 |
| SP506 | MAX SPEED | Specify the maximum speed (in user-defined units/s) allowed during the move. | 0.00 to 32768.00 | 1000.00 |
| SP507 | POS WINDOWS | Used to set/reset the TARGET REACHED diagnostic. | 0.01 to 1000.00 | 1.00 |
| SP508 | REDUCED SPEED | Allow reducing the speed set-point at the end of the move command. | 0.01 to 1000.00 | 1.00 |
| SP509 | REDUCED WINDOW | Define the position window length in which the speed set-point is reduced. | 0.00 to 1000.00 | 0.00 |
| SP5 10 | GAIN | Set the position loop proportional gain. | 0.10 to 100.00 | 10.00 |
| SP5 11 | MARK INPUT | Specify which digital input is used as the mark input. | 0= NONE<br>1= DIN1<br>2= DIN2<br>3= DIN3<br>4= DIN4<br>5= DIN5<br>6= DIN6<br>7= DIN7 | 0 |
| SP5 12 | ACTIVE | True if there is an ongoing move. | 0= FALSE<br>1= TRUE | |
| SP5 13 | LOCKED | True if the position loop is closed. | 0= FALSE<br>1= TRUE | |
| SP5 14 | TARGET REACHED | True if the position error is smaller than the position window. | 0= FALSE<br>1= TRUE | |
| SP5 15 | MARK POSITION | Show the actual position sampled on the last rising edge of the mark input. | ---.xx | |
| SP5 19 | PRESET ON MARK | If True, the actual position will be preset on the next rising edge of the mark input. | -32768.00 to 32768.00 | 0.00 |

## MMI Parameters Table

| Display | Parameter | Description | Range | Default |
|---|---|---|---|---|
| | | **SET::FLY Menu** | | |
| SFL01 | VECTOR ENABLE | This parameter is used to indicate whether or not the speed search is on the way.<br>TRUE : The drive is searching for the actual motor speed.<br>FALSE : The drive is running a standard mode | 0=FALSE<br>1=TRUE | 0 |
| SFL05 | ACTIVE | This parameter is used to indicate the speed in electrical Hertz that was found during the preceding flycatching search. | 0=FALSE<br>1=TRUE | |
| SFL06 | SETPOINT | This parameter is used to enable/disable the fly-catching feature.<br>TRUE : Fly-catching is enabled. The motor will search the rotating speed at each torque switch on and start to control the motor from this speed.<br>FALSE : Fly-catching is disabled. The motor will start to control the motor based on an initial zero speed at each torque switch on. | -32768 to 32768 | |
| | | **PAR Menu** | | |
| P 1 | APPLICATION | This parameter selects and loads the Application to be used. APP 0 will not control a motor. APP 6, 7 & 8 are for future use. You can edit an Application in DSELite and, then set this parameter to CUSTOM to produce your own custom Application.<br>Refer to the 650S Software Product Manual, Chapter 5: "Applications" which gives detailed information about each Application.<br>***Note:*** **Parameter values are changed to factory settings by loading a new Application, except Motor Parameters (indicated M)** | 0= NULL<br>1= STANDARD<br>2= LOCAL/REM (AUTO/MANUAL)<br>3= PRESETS<br>4= RAISE/LOWER<br>5= PID<br>6= APP 6<br>7= APP 7<br>8= APP 8<br>9= CUSTOM | 1 |
| P 2 | MAX SPEED M | The frequency at which the 650V will run when maximum setpoint is applied. The default is Product Code dependent | 7.5 to 300Hz | 50 or 60Hz |
| P 3 | MIN SPEED | The minimum frequency at which the 650V will run, as a percentage of the MAX SPEED parameter | -100.0 to 100.0% | 0.0% |
| P 4 | ACCEL TIME | The time taken for the 650V output frequency to ramp up from zero to MAX SPEED | 0.0 to 3000.0s | 10.0s |
| P 5 | DECEL TIME | The time taken for the 650V output frequency to ramp down from MAX SPEED to zero | 0.0 to 3000.0s | 10.0s |
| P 8 | JOG SETPOINT | Speed the 650V will run at if the Jog input is high, as a percentage of the MAX SPEED parameter | -100.0 to 100.0% | 10.0% |

| MMI Parameters Table | | | | |
|---|---|---|---|---|
| Display | Parameter | Description | Range | Default |
| P 9 | RUN STOP MODE | RAMPED : The motor speed is reduced to zero at a rate set by DECEL TIME (P5). A 2 second DC pulse is applied at end of ramp<br>COAST : The motor is allowed to freewheel to a standstill<br>DC INJECTION : On a stop command, the motor volts are rapidly reduced at constant frequency to deflux the motor. A low frequency braking current is then applied until the motor speed is almost zero. This is followed by a timed DC pulse to hold the motor shaft. | 0=RAMPED<br>1=COAST<br>2=DC INJECTION | 0 |
| P 99 | PASSWORD | A password may be set to prohibit unauthorised adjustment of parameters. When P99 is set to non-zero you will be required to match this value before parameters can be adjusted | 0000 – FFFF | 0000 |

| APP Menu | | | | |
|---|---|---|---|---|
| **Parameters visible when Application 3 is selected in parameter P1** | | | | |
| AP01 | PRESET 0 | A user-adjustable speed preset, set by potentiometer | -100.00 to 100.00 | - |
| AP02 | PRESET 1 | A user-adjustable speed preset | -100.00 to 100.00 | 20.00 |
| AP03 | PRESET 2 | A user-adjustable speed preset | -100.00 to 100.00 | 50.00 |
| AP04 | PRESET 3 | A user-adjustable speed preset | -100.00 to 100.00 | 100.00 |
| AP05 | PRESET 4 | A user-adjustable speed preset | -100.00 to 100.00 | -10.00 |
| AP06 | PRESET 5 | A user-adjustable speed preset | -100.00 to 100.00 | -20.00 |
| AP07 | PRESET 6 | A user-adjustable speed preset | -100.00 to 100.00 | -50.00 |
| AP08 | PRESET 7 | A user-adjustable speed preset | -100.00 to 100.00 | -100.00 |
| *Parameters visible when Application 4 is selected in parameter P1* | | | | |
| AP01 | R/L RAMP TIME | The time taken to ramp the Raise/Lower output from 0.00% to 100.00% of its value | 0.0 to 600.0s | 10.0s |
| AP02 | R/L MAX VALUE | The maximum value for the ramp output | -100.00 to 100.00% | 100.00% |
| AP03 | R/L MIN VALUE | The minimum value for the ramp output | -100.00 to 100.00% | 0.00% |
| AP04 | R/L RESET VALUE | The value the output is set to when Reset is TRUE, when DIN4 (terminal 10) is 24V in Application 4 | -100.00 to 100.00% | 0.00% |
| *Parameters visible when Application 5 is selected in parameter P1* | | | | |
| AP01 | PI P GAIN | The PI proportional gain | 0.00 to 100.00 | 0.10 |
| AP02 | PI I GAIN | The PI integral gain | 0.00 to 100.00 | 1.00 |

MMI Parameters Table

| Display | Parameter | Description | Range | Default |
|---|---|---|---|---|
| AP03 | PID D GAIN | The PID derivative gain | 0.00 to 100.00 | 0.00 |
| AP04 | PID D FILTER TC | In order to help attenuate high frequency noise on the derivative term, a first order lag has been provided. This parameter determines the filter time constant. | 0.05 to 10.00s | 0.05s |
| AP05 | PID FEEDBACK GAIN | A multiplier applied to the feedback signal of the PID | -10.00 to 10.00 | 1.00 |
| AP06 | PID LIMIT | Determines the maximum positive and negative excursion (Limit) of the PID output | 0.00 to 300.00% | 300.00% |
| AP07 | PID SCALING | This parameter represents an overall scaling factor which is applied after the PID positive and negative limit clamps | -3.0000 to 3.0000 | 1.0000 |
| AP08 | PID ERROR | The result of SETPOINT - FEEDBACK x FEEDBACK GAIN | —.xx % | —.xx% |
| AP09 | PID OUTPUT | The output of the PID function block | —.xx % | —.xx % |

# Configuring Terminals 9 & 10 (Digital Input/Output)

Terminal 10 can be operated as digital input DIN 4 or digital output DOUT2. It is configured via the keypad or ConfigEd Lite (or other suitable programming tool). The default for terminal 10 is to operate as a digital input, and the input logic is non-inverted.

Terminal 9 can be operated as digital input DIN3 or digital output DOUT1, however, it can only be configured via ConfigEd Lite (or other suitable programming tool). The default for terminal 9 is to operate as a digital input, and the input logic is non-inverted.

## Configure for use as a Digital Input (default)

For example, to use terminal 10 as an input, the output circuitry must be disabled by setting DOUT 2 SOURCE and DOUT 2 INVERT to zero. You can invert this logic using parameter DIN 4 INVERT.

| Parameter | Setting |
|---|---|
| DOUT2 SOURCE | 0 |
| DOUT2 INVERT | 0 |
| DIN4 INVERT | Default is 0, setting to 1 inverts the input logic |

## Configure for use as a Digital Output

For example, to use terminal 10 as an output, select DOUT 2 SOURCE to be 1, 2, 3, 4, 5 or 6. For instance, you could set parameter DOUT 2 SOURCE to 3 to have the output go high (24V) whenever the motor is running, operating an external relay or lamp. You can invert this logic using parameter DOUT 2 INVERT.

| Parameter | Setting | |
|---|---|---|
| DOUT2 SOURCE | | *The output is high when:* |
| | 1 = HEALTH | The Run signal is not present, or no trip is active |
| | 2 = TRIPPED | A trip is present |
| | 3 = RUNNING | The motor is running |
| | 4 = AT ZERO | The output frequency is below 1% of MAX SPEED (P2) |
| | 5 = AT SPEED | The output frequency is at or near Setpoint and within ±1% of MAX SPEED, set by (P2). |
| | 6 = AT LOAD | |
| | Always set DIN 4 INVERT to 0 if using Applications 1 and 5 – refer to Chapter 12. | |
| DOUT2 INVERT | Default is 0, setting to 1 inverts the output logic | |

# PID - Tuning Your Drive

PID is used to control the response of any closed loop system. It is used specifically in system applications involving the control of drives to provide zero steady state error between Setpoint and Feedback, together with good transient performance.

## Proportional Gain (PAP01)

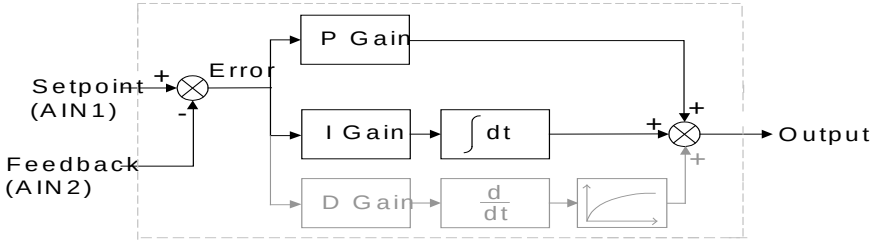
This is used to adjust the basic response of the closed loop control system. The PI error is multiplied by the Proportional Gain to produce an output.

## Integral (PAP02)

The Integral term is used to reduce steady state error between the setpoint and feedback values of the PI. If the integral is set to zero, then in most systems there will always be a steady state error.

## Derivative (PAP03)

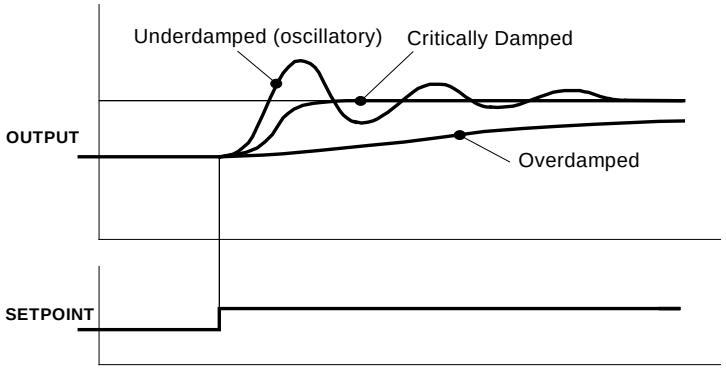
This is used to correct for certain types of control loop instability, and therefore improve response. It is sometimes used when heavy or large inertia rolls are being controlled. The derivative term has an associated filter to suppress high frequency signals.




- Functions as P, PI, PID controller
- Single symmetric limit on output

### A Method for Setting-up the PI Gains

The gains should be set-up so that a critically damped response is achieved for a step change in setpoint. An underdamped or oscillatory system can be thought of as having too much gain, and an overdamped system has too little.




To set up the P gain, set the I gain to zero. Apply a step change in setpoint that is typical for the System, and observe the response. Increase the gain and repeat the test until the system becomes oscillatory. At this point, reduce the P gain until the oscillations disappear. This is the maximum value of P gain achievable.

If a steady state error is present, i.e. the feedback never reaches the setpoint value, the I gain needs to be increased. As before, increase the I gain and apply the step change. Monitor the output. If the output becomes oscillatory, reduce the P gain slightly. This should reduce the steady state error. Increasing the I gain further may reduce the time to achieve zero steady state error.

These values of P and I can now be adjusted to provide the exact response required for this step change.

## Auto Restart

Parameters $^{S}$ST21 to $^{S}$ST24 provide the facility to automatically reset a choice of trip events and restart the drive with a programmed number of attempts. If the drive is not successfully started, a manual or remote trip reset is required.

The number of attempted restarts are recorded. This count is cleared after a trip-free period of operation (5 minutes or 4 x AUTO RESTART DELAY, whichever is the longer); or after a successful manual or remote trip reset; or by removing the Run signal (Terminal 7, DIN1).

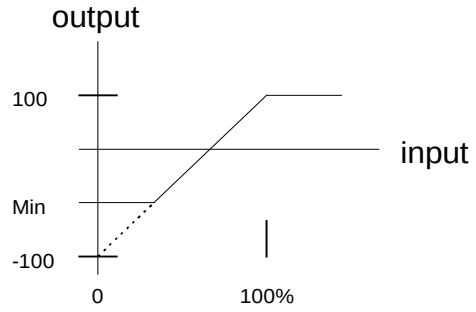
Refer to Chapter 7: "Trips and Fault Finding" - Hexadecimal Representation of Trips.

# Minimum Speed Mode

There are two operating modes for the minimum speed feature.

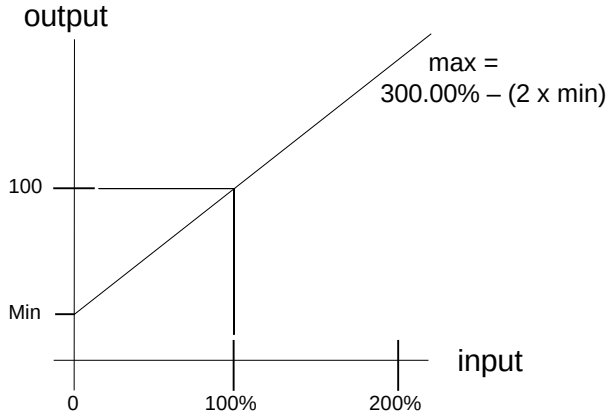
## Proportional with Minimum

In this mode the speed setpoint is clamped to be between the minimum speed value (P3) and 100%. This is the default for the minimum speed feature.




## Linear

In this mode the speed setpoint is first clamped to be in the range 0 to 100%. It is then rescaled so that the output goes linearly between the minimum speed value (P3) and 100% for an input setpoint that goes between 0% and 100%. If the minimum speed value (P3) is negative the speed setpoint will be internally set to 0%.




# Product-Related Default Values

All examples given in this book are based on a UK, 230V, 50Hz, 0.25kW drive. This manual provides information about each parameter accessible using the keypad, or MMI (Man Machine Interface). For more information about these and additional parameters accessible using ConfigEd Lite (or other suitable programming tool), refer to the 650S Software Product Manual on our web site: www.parker.com/ssd.

# * Frequency Dependent Parameters

These parameter values (marked with “*” in the Application diagrams) are dependent upon the drive’s "default frequency".

Changing the "default frequency" parameter from 50Hz to 60Hz, and vice versa, causes the values of the parameters in the table below to be changed.

To change the "default frequency", power-down the drive. Power-up the drive holding down the “E” and DOWN keys on the keypad. Release the keys to display the $^{e}$ 0.01 parameter.

---

**Caution**

You are now in a menu containing some sensitive and important parameters.

---

Press the UP key to display the $^{e}$ 0.02 parameter. Press the M key. The values for this parameter are: 0 = 50Hz default, 1 = 60Hz default. Select the setting using the UP/DOWN keys and then press the E key. Power-down the drive and power-up again holding down the UP and DOWN keys. This resets **ALL** parameters to their correct default values, including Motor Parameters.

| Frequency Dependent Defaults | | | | | |
|---|---|---|---|---|---|
| Display | Parameter | Function Block | Tag | 50Hz Operation | 60Hz Operation |
| P 2 | MAX SPEED | REFERENCE | 57 | 250Hz | 250Hz |
| # The correct value is selected for the size of drive - refer to the Power Dependent Parameters table below<br>* The correct value is selected for the drive, however, when 60Hz is selected the 400V unit = 460V | | | | | |

# ** Power Dependent Parameters

These parameters (marked with "**" in the Application diagrams) are set to a value depending on the drive's overall "power-build" indicated by the Product Code. We recommend that you do not change the Product Code.

| 230V Build Power Dependent Defaults | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Frame 1 | | | | Frame 2 | |
| Parameter | Function Block | Tag | 0.25kW | 0.37kW | 0.55kW | 0.75kW | 1.1kW | 1.5kW |
| ACCEL TIME | REFERENCE RAMP | 258 | 10.0 s | 10.0 s | 10.0 s | 10.0 s | 10.0 s | 10.0 s |
| DECEL TIME | REFERENCE RAMP | 259 | 10.0 s | 10.0 s | 10.0 s | 10.0 s | 10.0 s | 10.0 s |
| SPEED PROP GAIN | SPEED LOOP | 1187 | 20 | 20 | 20 | 20 | 20 | 20 |
| SPEED INT TIME | SPEED LOOP | 1188 | 500. ms | 500. ms | 500. ms | 500. ms | 500. ms | 500. ms |
| BRAKE RESISTANCE | DYNAMIC BRAKING | 77 | 500 | 500 | 500 | 500 | 500 | 500 |

| 400V Build Power Dependent Defaults | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Frame 2 | | | | | |
| Parameter | Function Block | Tag | 0.37kW | 0.55kW | 0.75kW | 1.1kW | 1.5kW | 2.2kW |
| ACCEL TIME | REFERENCE RAMP | 258 | 10.0 s | 10.0 s | 10.0 s | 10.0 s | 10.0 s | 10.0 s |
| DECEL TIME | REFERENCE RAMP | 259 | 10.0 s | 10.0 s | 10.0 s | 10.0 s | 10.0 s | 10.0 s |
| SPEED PROP GAIN | SPEED LOOP | 1187 | 20 | 20 | 20 | 20 | 20 | 20 |
| SPEED INT TIME | SPEED LOOP | 1188 | 500. ms | 500. ms | 500. ms | 500. ms | 500. ms | 500. ms |
| BRAKE RESISTANCE | DYNAMIC BRAKING | 77 | 500 | 500 | 500 | 200 | 200 | 200 |

| 400V Build Power Dependent Defaults | | | | | | |
|---|---|---|---|---|---|---|
| | | | Frame 3 | | | |
| Parameter | Function Block | Tag | | | | |
| ACCEL TIME | REFERENCE RAMP | 258 | 10.0 s | 10.0 s | 10.0 s | 10.0 s |
| DECEL TIME | REFERENCE RAMP | 259 | 10.0 s | 10.0 s | 10.0 s | 10.0 s |
| SPEED PROP GAIN | SPEED LOOP | 1187 | 20 | 20 | 20 | 20 |
| SPEED INT TIME | SPEED LOOP | 1188 | 500. ms | 500. ms | 500. ms | 500. ms |
| BRAKE RESISTANCE | DYNAMIC BRAKING | 77 | 100 | 100 | 56 | 56 |

# Chapter 7: Trips and Fault Finding

The drive may trip in order to protect itself. To restart the drive, you will need to clear the trip(s). This chapter provides a list of trips, as displayed by the 6901, 6511, 6521 and 6911 keypads.

# Trips

## Trip Warning Message

The trip display message is flashed repeatedly on the screen to warn of an imminent trip. Some trip conditions need time to take effect. The warning can allow you time to rectify the situation.

The message will clear when you use the keypad, but after a short time will reappear until the problem is resolved, or the drive trips.

## What Happens when a Trip Occurs

When a trip occurs, the drive's power stage is immediately disabled causing the motor and load to coast to a stop. The trip is latched until action is taken to reset it. This ensures that trips due to transient conditions are captured and the drive is disabled, even when the original cause of the trip is no longer present.

### Keypad Indications

If a trip condition is detected the activated alarm is displayed on the MMI display.

## Resetting a Trip Condition

All trips must be reset before the drive can be re-enabled. A trip can only be reset once the trip condition is no longer active, i.e. a trip due to a heatsink over-temperature will not reset until the temperature is below the trip level.

You can reset the trip as follows:

1. Press the  (STOP) key to reset the trip and clear the alarm from the display.
2. Remove and then re-apply the RUN command and the drive will run normally.

In remote mode, success is indicated by displaying rdy.

# Using the Keypad to Manage Trips

## Trip Messages

If the drive trips, then the display immediately shows a message indicating the reason for the trip. The possible trip messages are given in the table below.

| ID | Trip Name | Possible Reason for Trip |
|---|---|---|
| 1 | OVERVOLTAGE<br>A dCH 1 | *The drive internal dc link voltage is too high:*<br>• The supply voltage is too high<br>• Trying to decelerate a large inertia load too quickly; DECEL TIME time too short<br>The brake resistor is open circuit |
| 2 | UNDERVOLTAGE<br>A dCL0 | *DC link low trip:*<br>Supply is too low/power down |
| 3 | OVERCURRENT<br>A OC | *The motor current being drawn from the drive is too high:*<br>• Trying to accelerate a large inertia load too quickly; ACCEL TIME time too short<br>• Trying to decelerate a large inertia load too quickly; DECEL TIME time too short<br>• Application of shock load to motor<br>• Short circuit between motor phases<br>• Short circuit between motor phase and earth<br>• Motor output cables too long<br>• |
| 4 | HEATSINK<br>A HOt | *Drive heatsink temperature > 100°C:*<br>• The ambient air temperature is too high<br>Poor ventilation or spacing between drives |

| ID | Trip Name | Possible Reason for Trip |
|---|---|---|
| 5 | EXTERNAL TRIP<br>AEt | *The external trip input is high:*<br>• Check configuration to identify the source of the signal (non-standard configuration) |
| 6 | INVERSE TIME<br>A It | *A prolonged overload condition, exceeding the Inverse Time allowance, has caused the trip:*<br>• Remove the overload condition - refer to Chapter 5: P12 |
| 7 | CURRENT LOOP<br>ALOOP | *A current of less than 1mA is present when 4-20mA setpoint is selected:*<br>• Look for a wire break |
| 8 | MOTOR STALLED<br>AStLL | *The motor has stalled (not rotating)*<br>• SV trip validated, and speed lower than 5% of the maximum motor speed<br>• Too much friction to start rotating the motor |
| 9 | ANIN FAULT<br>At 3 | *AIN2 overload on terminal 3:*<br>• Overcurrent applied in Current mode to terminal 3 |
| 10 | BRAKE RESISTOR<br>Adb r | *External dynamic brake resistor has been overloaded:*<br>• Trying to decelerate a large inertia too quickly or too often |
| 11 | BRAKE SWITCH<br>Adb S | *Internal dynamic braking switch has been overloaded:*<br>• Trying to decelerate a large inertia too quickly or too often |
| 12 | DISPLAY/KEYPAD<br>Ad ISP | *Keypad has been disconnected from drive whilst drive is running in Local Control:*<br>• Keypad accidentally disconnected from drive (indicated over Comms, or by second keypad) |

| ID | Trip Name | Possible Reason for Trip |
|---|---|---|
| 13 | LOST COMMS<br>A SCI | *Lost communications:*<br>• COMMS TIMEOUT parameter set too short<br>• Master device failed<br>• Wiring broken<br>• Incorrect Comms setup |
| 14 | CONTACTOR FBK<br>A CntC | *Contactor feedback signal lost:*<br>• Check connection to the terminal wired to "contactor closed" parameter in Sequencing Logic (non-standard configuration) |
| 15 | SPEED FEEDBACK<br>A SPd | *Speed feedback:*<br>• SPEED ERROR > 50.00% for 10 seconds |
| 17 | MOTOR OVERTEMP<br>A Ot | *The motor temperature is too high:*<br>• Excessive load ( Thermal switch )<br>• Excessive load ( I2T software protection )<br>• Motor voltage rating incorrect<br>• Prolonged operation of the motor at low speed without forced cooling<br>• Break in motor thermistor connection |
| 18 | CURRENT LIMIT<br>A I HI | *Software overcurrent trip:*<br>• If the current exceeds 180% of stack rated current for a period of 1 second, the drive will trip. This is caused by shock loads. Remove the shock load.<br>• ACCEL TIME and/or FIXED BOOST set too high<br>• DECEL TIME set too low |
| 21 | LOW SPEED OVER I<br>A LSPd | • *The motor is drawing too much current (>100%) at zero output frequency* |

| ID | Trip Name | Possible Reason for Trip |
|---|---|---|
| 22 | 10V FAULT<br>AL 4 | *10V fault:*<br>• +10V REF overload warning (terminal 4) - 10mA maximum |
| 25 | DC LINK RIPPLE<br>AdCrP | *The dc link ripple voltage is too high:*<br>• Check for a missing input phase |
| 27 | OVERSPEED<br>AOSPd | *Overspeed:*<br>• >150% base speed when in Sensorless Vector mode |
| 28 | ANOUT FAULT<br>AL 5 | *AOUT overload on terminal 5:*<br>• 10mA maximum |
| 29 | DIGIO 1 (T9) FAULT<br>AL 9 | *DIN3 overload on terminal 9:*<br>• 20mA maximum |
| 30 | DIGIO 2 (T10) FAULT<br>AL 10 | *DOUT2 overload on terminal 10:*<br>• 50mA maximum |
| 31 | UNKNOWN<br>ALrIP | Unknown trip |
| 32 | OTHER<br>ALr32 | "OTHER" trip is active (Trip ID 34 to 44 inclusive) |
| - | Product Code Error<br>ACOdE | Switch unit off/on. If persistent, return unit to factory |
| - | Calibration Data Error<br>ACAL | Switch unit off/on. If persistent, return unit to factory |
| - | Configuration Data Error<br>AdAtA | Press the E key to accept the default configuration. If persistent, return unit to factory |

# Hexadecimal Representation of Trips

The tables below show the possible parameter values for the AUTO RESTART TRIGGERS and AUTO RESTART TRIGGERS+ parameters, SST23 and SST24 respectively. Refer to the 650S Software Product Manual, "Trips Status" (on our website: www.SSDdrives.com) for additional trip information that is available over the Comms.

Each trip has a unique, four-digit hexadecimal number as shown in the tables below.

| SST23 : AUTO RESTART TRIGGERS | | | | |
|---|---|---|---|---|
| ID | Trip Name (MMI 6901) | Trip Name (MMI 6511 & 6521) | Mask | User Disable |
| 1 | OVERVOLTAGE | DCHI | 0x0001 | |
| 2 | UNDERVOLTAGE | DCLO | 0x0002 | |
| 3 | OVERCURRENT | OC | 0x0004 | |
| 4 | HEATSINK | HOT | 0x0008 | |
| 5 | EXTERNAL TRIP | ET | 0x0010 | ✓ |
| 6 | INVERSE TIME | SIt | 0x0020 | ✓ |
| 7 | CURRENT LOOP | SLOOP | 0x0040 | ✓ |
| 8 | MOTOR STALLED | SStLL | 0x0080 | ✓ |
| 9 | ANIN FAULT | S t 3 | 0x0100 | ✓ |
| 10 | BRAKE RESISTOR | Sdb r | 0x0200 | ✓ |
| 11 | BRAKE SWITCH | Sdb S | 0x0400 | ✓ |
| 12 | DISPLAY/KEYPAD | SdI SP | 0x0800 | ✓ |
| 13 | LOST COMMS | SCI | 0x1000 | ✓ |
| 14 | CONTACTOR FBK | CNTC | 0x2000 | ✓ |
| 15 | SPEED FEEDBACK | SSPd | 0x4000 | ✓ |

| $^{S}$ST24 : AUTO RESTART TRIGGERS+ | | | | |
|---|---|---|---|---|
| ID | Trip Name (MMI 6901) | Trip Name (MMI 6511 & 6521) | Mask + | User Disable |
| 17 | MOTOR OVERTEMP | $^{S}$Ot | 0x0001 | ✓ |
| 18 | CURRENT LIMIT | I HI | 0x0002 | |
| 21 | LOW SPEED OVER I | LSPD | 0x0010 | |
| 22 | 10V FAULT | T 4 | 0x0020 | ✓ |
| 25 | DC LINK RIPPLE | DCRP | 0x0100 | ✓ |
| 27 | OVERSPEED | $^{S}$OSPd | 0x0400 | ✓ |
| 28 | ANOUT FAULT | T 5 | 0x0800 | ✓ |
| 29 | DIGIO 1 (T9) FAULT | T 9 | 0x1000 | ✓ |
| 30 | DIGIO 2 (T10) FAULT | T 10 | 0x2000 | ✓ |
| 31 | UNKNOWN | TRIP | 0x4000 | |
| 32 | OTHER | TR32 | 0x8000 | |
| 34 | MAX SPEED LOW | ATN1 | 0x8000 | N/A |
| 35 | MAIN VOLTS LOW | ATN2 | 0x8000 | N/A |
| 36 | NOT AT SPEED | ATN3 | 0x8000 | N/A |
| 37 | MAG CURRENT FAIL | ATN4 | 0x8000 | N/A |
| 38 | NEGATIVE SLIP F | ATN5 | 0x8000 | N/A |
| 39 | TR TOO LARGE | ATN6 | 0x8000 | N/A |
| 40 | TR TOO SMALL | ATN7 | 0x8000 | N/A |
| 41 | MAX RPM DATA ERR | ATN8 | 0x8000 | N/A |
| 42 | MOTOR TURNING ERR | ATNA | 0x8000 | N/A |
| 43 | MOTOR STALL ERR | ATNB | 0x8000 | N/A |
| 44 | LEAKGE L TIMEOUT | ATN9 | 0x8000 | N/A |

## Keypads (MMIs):

Trips shown as MMI displays in the tables above, i.e. 5L00P , can be disabled using the keypads in the TRIPS menu. Other trips, as indicated, can be disabled over the Comms.

6901

6511

6521

6911

# Hexadecimal Representation of Trips

When more than one trip is to be represented at the same time then the trip codes are simply added together to form the value displayed. Within each digit, values between 10 and 15 are displayed as letters A to F

| Decimal number | Display |
|---|---|
| 10 | A |
| 11 | B |
| 12 | C |
| 13 | D |
| 14 | E |
| 15 | F |

For example referring to the tables above, if the AUTO RESTART TRIGGERS parameter is set to **04A0,** then this represents:

a "**4**" in digit 3

an "8" and a "2" in digit 2
(8+2 = 10, displayed as **A**)

an "**0**" in digit 1

This in turn represents the trips BRAKE SWITCH, ANIN FAULT, MOTOR STALLED and INVERSE TIME.

In the same way, the AUTO RESTART TRIGGERS+ parameter set to **04A0** would represent OVERSPEED, ANIN FAULT, DESAT OVER I and 10V FAULT.

# Fault Finding

| Problem | Possible Cause | Remedy |
|---|---|---|
| Drive will not power-up | Fuse blown | Check supply details, fit correct fuse. |
| | | Check Product Code against Model Number. |
| | Faulty cabling | Check all connections are correct/secure. |
| | | Check cable continuity. |
| Drive fuse keeps blowing | Faulty cabling or connections wrong | Check for problem and rectify before replacing with correct fuse. |
| | Faulty drive | Contact Parker SSD Drives. |
| Cannot obtain power-on state | Incorrect or no supply available | Check supply details. |
| Motor will not run at switch-on | Motor jammed | Stop the drive and clear the jam. |
| Motor runs and stops | Motor becomes jammed | Stop the drive and clear the jam. |
| | Open circuit speed reference potentiometer | Check terminal. |

# Chapter 8: Routine Maintenance and Repair

The drive may trip in order to protect itself. To restart the drive, you will need to clear the trip(s). This chapter provides a list of trips, as displayed by the 6901, 6511, 6521 and 6911 keypads.

# Routine Maintenance

Periodically inspect the drive for build-up of dust or obstructions that may affect ventilation of the unit. Remove this using dry air.

# Repair

There are no user-serviceable components.

***IMPORTANT*** ***MAKE NO ATTEMPT TO REPAIR THE UNIT - RETURN IT TO PARKER SSD DRIVES.***

## Saving Your Application Data

In the event of a repair, application data will be saved whenever possible. However, we advise you to copy your application settings before returning the unit.

## Returning the Unit to Parker SSD Drives

Please have the following information available:

- The model and serial number - see the unit's rating label
- Details of the fault

Contact your nearest Parker SSD Drives Service Centre to arrange return of the item.

You will be given a *Returned Material Authorisation.* Use this as a reference on all paperwork you return with the faulty item. Pack and despatch the item in the original packing materials; or at least an anti-static enclosure. Do not allow packaging chips to enter the unit.

# Disposal

This product contains materials which are consignable waste under the Special Waste Regulations 1996 which complies with the EC Hazardous Waste Directive - Directive 91/689/EEC.

We recommend you dispose of the appropriate materials in accordance with the valid environmental control laws. The following table shows which materials can be recycled and which have to be disposed of in a special way.

| Material | Recycle | Disposal |
|---|---|---|
| Metal | yes | no |
| plastics material | yes | no |
| printed circuit board | no | yes |

The printed circuit board should be disposed of in one of two ways:

1. High temperature incineration (minimum temperature 1200°C) by an incinerator authorised under parts A or B of the Environmental Protection Act
2. Disposal in an engineered land fill site that is licensed to take aluminium electrolytic capacitors. Do not dispose of in a land fill site set aside for domestic waste.

# Packaging

During transport our products are protected by suitable packaging. This is entirely environmentally compatible and should be taken for central disposal as secondary raw material.

# Chapter 9: Technical Specifications

# Understanding the Product Code

## Model Number

The unit is fully identified using a four block alphanumeric code which records how the drive was calibrated, and its various settings when despatched from the factory.

The Product Code appears as the “Model No.” on the product rating label. Each block of the Product Code is identified as below:

| | | Block 1 | Block 2 | Block 3 | Block4 |
|---|---|---|---|---|---|
| Example: | | 650S | - 21140010 | - B01P00 | - A1 |
| **Family** | **650S Sensorless PMAC ( frames 1-3 )** | 650S | | | |
| | Supply Voltage / kW / Output Current / Frame Size | | | | |
| **Rating Data** | 230v 1ph | | 21 | | |
| | 0.75 / 4.0 / 1 | | 1400 1 | | |
| | 1.5 / 7.0 / 2 | | 1700 2 | | |
| | 400/460v 3ph | | 43 | | |
| | 0.75 / 2.5 / 2 | | 1250 2 | | |
| | 2.2 / 5.5 / 2 | | 1550 2 | | |
| | 4.0 / 9.0 / 3 | | 1900 3 | | |
| | 7.5 / 16.0 / 3 | | 2160 3 | | |
| **Auxiliary supply** | Not required (Frames 1-3) | | 0 | | |
| **Brake Switch** | Not Fitted (mandatory on Frame 1 & Frame 2 230V products) | | | 0 | |
| | **B**rake switch fitted (mandatory on Frame 2 400V products & all Frame 3 & C products) | | | B | |
| **Filter** | Not fitted (Optional on Frames 1-3) | | | 0 | |
| | **F**ilter fitted (Optional on Frames 1-3 only) | | | F | |
| **Comms** | RS232 port fitted | | | 1 | |
| **Mechanical style** | **P**anel Mount | | | P | |
| **Special Option** | None | | | 00 | |
| | Documented special options (01-99) | | | | |
| **Destination** | English (50Hz) | | | | A |
| **Keypad** | 6511 TTL fitted (option on Frames 1-3 only) | | | | 1 |

| Environmental Details | |
|---|---|
| Operating Temperature | 0°C to 40°C<br>Output power is derated linearly at 2% per degree centigrade for temperature exceeding the maximum rating ambient of maximum 50°C |
| Storage Temperature | -25°C to +55°C |
| Shipping Temperature | -25°C to +70°C |
| Product Enclosure Rating | IP20 (UL Open Type) suitable for cubicle mount only |
| Cubicle Rating | Cubicle to provide 15dB attenuation to radiated emissions between 30-100MHz. It must also require a security tool for opening |
| Altitude | If greater than 1000m above sea level, derate Motor Power Rating by 1% per 100m to a maximum of 2000m |
| Humidity | Maximum 85% relative humidity at 40°C non-condensing |
| Atmosphere | Non flammable, non corrosive and dust free |
| Climatic Conditions | Class 3k3, as defined by EN50178 |
| Vibration | Test Fc of EN60068-2-6<br>10Hz<=f<=57Hz sinusoidal 0.075mm amplitude<br>57Hz<=f<=150Hz sinusoidal 1g<br>10 sweep cycles per axis on each of three mutually perpendicular axis |
| Safety<br>Pollution Degree<br>Overvoltage Category | <br>Pollution Degree II (non-conductive pollution, except for temporary condensation)<br>Overvoltage Category III (numeral defining an impulse withstand level) |

| Power Details | |
|---|---|
| 1-Phase Supply | 220-240V ac ±10%,50/60Hz ±10%, ground referenced (TN) or non-ground referenced (IT) |
| 3-Phase Supply | 220-240V ac or 380-460V ac ±10%,50/60Hz ±10%, ground referenced (TN) or non-ground referenced (IT) * |
| Supply Power Factor (lag) | 0.9 (@ 50/60Hz) |
| Output Frequency | 0 – 500Hz |
| Overload | 150% for 30 seconds |
| Supply Short Circuit Rating | 220-240V 1ϕ product -5000A, 220-240V ac 3ϕ product - 7500A<br>380-460V 3ϕ product -10000A |

* An optional internal RFI filter offering full electromagnetic compatibility (EMC) for the majority of applications.

# Electrical Ratings

Motor power, output current and input current must not be exceeded under steady state operating conditions.

Maximum Motor dv/dt = 10,000V/µs. This can be reduced by adding a motor choke in series with the motor. Contact Parker SSD Drives for recommended choke details.

Local wiring regulations always take precedence. Select cable rated for the drive.

The supply must be protected with a fuse (or Type B RCD) rated to the supply cable.

**FRAME 1 : 1-Phase (IT/TN), 230V**

| Drive Power (kW/hp) | Input Current @ 5kA | | Output Current @ 40°C (A) ac | Maximum Power Loss (W) |
|---|---|---|---|---|
| | Surge Current peak/rms for 10ms (A) | (A) | | |
| 0.25/0.3 | 19/12 | 4.2 | 1.5 | 26 |
| 0.37/0.5 | 19/12 | 6.2 | 2.2 | 32 |
| 0.55/0.75 | 20/14 | 7.9 | 3.0 | 41 |
| 0.75/1.0 | 22/15 | 10.5 | 4.0 | 52 |

**FRAME 2 : 1-Phase (IT/TN), 230V**

| Drive Power (kW/hp) | Input Current @ 5kA | | Output Current @ 40°C (A) ac | Maximum Power Loss (W) |
|---|---|---|---|---|
| | Surge Current peak/rms for 10ms (A) | (A) | | |
| 1.1/1.5 | 24/17 | 13.8 | 5.5 | 65 |
| 1.5/2.0 | 25/18 | 16.0 | 7.0 | 82 |

**FRAME 2 : 3-Phase (IT/TN), 400V**

| Drive Power (kW/hp) | Input Current @ 10kA (A) | Output Current @ 40°C (A) ac | Maximum Power Loss (W) |
|---|---|---|---|
| 0.37/0.5 | 2.5 | 1.5 | 26 |
| 0.55/0.75 | 3.3 | 2.0 | 32 |
| 0.75/1.0 | 4.1 | 2.5 | 40 |
| 1.1/1.5 | 5.9 | 3.5 | 55 |
| 1.5/2.0 | 7.5 | 4.5 | 61 |
| 2.2/3.0 | 9.4 | 5.5 | 70 |

# Electrical Ratings

Motor power, output current and input current must not be exceeded under steady state operating conditions.

Maximum Motor dv/dt = 10,000V/µs. This can be reduced by adding a motor choke in series with the motor. Contact Parker SSD Drives for recommended choke details.

Local wiring regulations always take precedence. Select cable rated for the drive.

The supply must be protected with a fuse (or Type B RCD) rated to the supply cable.

**FRAME 3 : 1-Phase (IT/TN), 230V**

| Drive Power (kW/hp) | Input Current @ 7.5kA (A) | Output Current @ 40°C (A) ac | Maximum Power Loss (W) |
|---|---|---|---|
| 2.2/3.0 | 22.0 | 9.6 | 112 |

**FRAME 3 : 3-Phase (IT/TN), 230V**

| Drive Power (kW/hp) | Input Current @ 7.5kA (A) | Output Current @ 40°C (A) ac | Maximum Power Loss (W) |
|---|---|---|---|
| 2.2/3.0 | 14.3 | 9.6 | 103 |
| 3.0/4.0 | 18.1 | 12.3 | 133 |
| 4.0/5.0 | 23.1 | 16.4 | 180 |

**FRAME 3 : 3-Phase (IT/TN), 400V**

| Drive Power (kW/hp) | Input Current @ 10kA (A) | Output Current @ 40°C (A) ac | Maximum Power Loss (W) |
|---|---|---|---|
| 3.0/4.0 | 11.1 | 6.8 | 80 |
| 4.0/5.0 | 13.9 | 9.0 | 100 |
| 5.5/7.5 | 18.0 | 12.0 | 136 |
| 7.5/10.0 | 23.6 | 16.0 | 180 |

# Supply Short Circuit Rating

Products may be used on 50kA supplies provided an additional supply inductor is fitted, see tables below for further information:

**230V**

| Frame Size | Motor Power | SSD Drives Part Number | MTE Part Number | Inductance mH | Rated amps |
|---|---|---|---|---|---|
| 1 | 0.75kW 1Hp | CO470653 | RL-00401 | 3.00 | 4 |
| 2 | 1.5kW 2Hp | CO353011 | RL-00801 | 1.50 | 8 |

**460V**

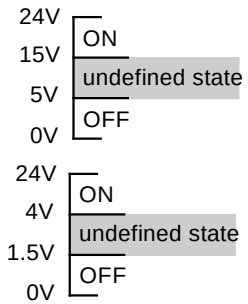
| Frame Size | Motor Power | SSD Drives Part Number | MTE Part Number | Inductance mH | Rated amps |
|---|---|---|---|---|---|
| 2 | 0.75kW 1Hp | CO470650 | RL-00201 | 12.00 | 2 |
| 2 | 1.5kW 2Hp | CO470651 | RL-00402 | 6.50 | 4 |
| 2 | 2.2kW 3Hp | CO352782 | RL-00803 | 5.00 | 8 |
| 3 | 4kW 5Hp | CO470652 | RL-00802 | 3.00 | 8 |
| 3 | 5.5kW 7.5Hp | CO352783 | RL-01202 | 2.50 | 12 |
| 3 | 6.0kW 10Hp | CO352785 | RL-01802 | 1.50 | 18 |
| 3 | 7.5kW 10Hp | CO352785 | RL-01802 | 1.50 | 18 |

| **User Relay**<br>RL1A, RL1B. | |
|---|---|
| Maximum Voltage | 250Vac |
| Maximum Current | 4A resistive load |
| Sample Interval | 10ms |

| **Analog Inputs/Outputs**<br>AIN1, AIN2, AOUT. | | |
|---|---|---|
| | Inputs | Output |
| Range | 0-10V and 0-5V (no sign) set via parameter $^{S}$IP13 (AIN1)<br>0-10V, 0-5V, 0-20mA or 4-20mA (no sign) set via parameter $^{S}$IP23 (AIN2)<br>Absolute maximum input current 25mA in current mode<br>Absolute maximum input voltage 24V dc in voltage mode | 0-10V (no sign)<br>Maximum rated output current 10mA, with short circuit protection |
| Impedance | Voltage input 20kΩ<br>Current Input <6V @ 20mA | |
| Resolution | 10 bits (1 in 1024) | 10 bits (1 in 1024) |
| Dynamic Response | Sampled every 10ms | Bandwidth 15Hz |

## Digital Inputs

| | |
|---|---|
| Operating Range | DIN1, DIN2, DIN3, DIN4, DIN5:<br>0-5V dc = OFF, 15-24V dc = ON<br>(absolute maximum input voltage ±30V dc)<br>IEC1131<br><br>DIN6, DIN7:<br>0-1.5V dc = OFF, 4-24V dc = ON<br>(absolute maximum input voltage ±30V dc)<br>IEC1131 |
| Input Current | 7.5mA @ 24V |
| Sample Interval | 10ms |




## Digital Outputs

DOUT1 and DOUT2 (DOUT1 is only configurable using DSELite or other suitable programming tool).

| | |
|---|---|
| Nominal Open Circuit Output Voltage | 23V (minimum 19V) |
| Nominal Output Impedance | 33Ω |
| Rated Output Current | 50mA |

# Cabling Requirements for EMC Compliance

| | Power Supply Cable | Motor Cable | Brake Resistor Cable | Signal/Control Cable |
|---|---|---|---|---|
| **Cable Type (for EMC Compliance)** | Unscreened | Screened/armoured | Screened/armoured | Screened |
| **Segregation** | From all other wiring (clean) | From all other wiring (noisy) | | From all other wiring (sensitive) |
| **Length Limitations With Internal AC Supply EMC Filter** | Unlimited | *25 metres | 25 metres | 25 metres |
| **Length Limitations Without Internal AC Supply EMC Filter** | Unlimited | 25 metres | 25 metres | 25 metres |
| **Screen to Earth Connection** | | Both ends | Both ends | Drive end only |
| **Output Choke** | | 300 metres maximum | | |
| * Maximum motor cable length under any circumstances | | | | |

# Internal Dynamic Braking Circuit

The dynamic braking circuit is intended for with short term stopping or braking.

| Motor Power (kW/Hp) | Brake Switch Peak Current (A) | Brake Switch Continuous Current (A) | Peak Brake Dissipation (kW/Hp) | Minimum Brake Resistor Value (Ω) |
|---|---|---|---|---|
| **Frame 2 : 3 Phase (IT/TN), 400V, 100% duty** DC link brake voltage : 750V | | | | |
| 0.37/0.5 | 1.5 | 1.5 | 1.1/1.5 | 500 |
| 0.55/0.75 | 1.5 | 1.5 | 1.1/1.5 | 500 |
| 0.75/1.0 | 1.5 | 1.5 | 1.1/1.5 | 500 |
| 1.1/1.5 | 1.5 | 1.5 | 1.1/1.5 | 500 |
| 1.5/2.0 | 3.75 | 3.75 | 2.8/3.75 | 200 |
| 2.2/3.0 | 3.75 | 3.75 | 2.8/3.75 | 200 |
| **Frame 3 : 1 Phase (IT/TN), 230V, 100% duty** | | | | |
| 2.2/3.0 | 7.0 | 7.0 | 2.72 | 56 |
| **Frame 3 : 3 Phase (IT/TN), 230V, 100% duty** DC link brake voltage : 390V | | | | |
| 2.2/3.0 | 7.0 | 7.0 | 2.72 | 56 |
| 3.0/4 | 10.8 | 10.8 | 4.23 | 36 |
| 4.0/5 | 14.0 | 14.0 | 5.44 | 28 |
| **Frame 3 : 3 Phase (IT/TN), 400V, 30% duty** DC link brake voltage : 750V | | | | |
| 3.0/4 | 7.5 | 2.3 | 5.6/7.5 | 100 |
| 4.0/5 | 7.5 | 2.3 | 5.6/7.5 | 100 |
| 5.5/7.5 | 13.5 | 4.0 | 10/13.4 | 56 |
| 7.5/10 | 13.5 | 4.0 | 10/13.4 | 56 |

# External Brake Resistor

All 650S units are supplied without braking resistors. The dynamic brake switch terminals (where fitted) allow easy connection to an external resistor. These resistors should be mounted on a heatsink (back panel) and covered to prevent injury from burning.

## Recommended Brake Resistors

The following brake resistors are available from Parker SSD Drives:

Brake Resistor Value : Frame 2 : 200Ω, 100W - CZ467714; 500Ω, 60W - CZ467715

Frame 3 : 28Ω, 500W (2 x 56Ω in parallel) - CZ467716; 36Ω, 500W - CZ388396; 56Ω, 500W - CZ467716; 100Ω, 200W - CZ467717

## Alternative Brake Resistor Selection

Brake resistor assemblies must be rated to absorb both peak braking power during deceleration and the average power over the repeated cycles.

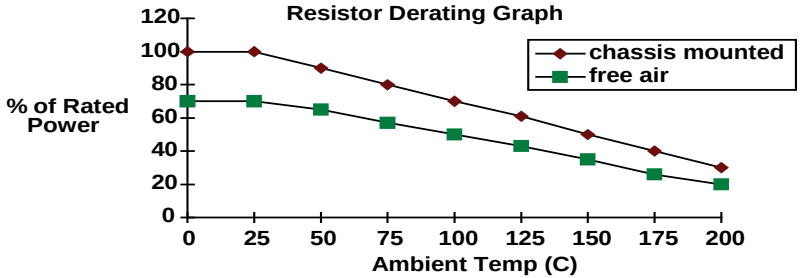
Peak braking power $P_{pk} = \frac{0.0055 \times J \times (n_1^2 - n_2^2)}{t_b}$ (W)

Average braking power $P_{av} = \frac{P_{pk}}{t_c} \times t_b$

$J$ - total inertia ($kgm^2$)
$n_1$ - initial speed (rpm)
$n_2$ - final speed (rpm)
$t_b$ - braking time (s)
$t_c$ - cycle time (s)

Obtain information on the peak power rating and the average power rating of the resistors from the resistor manufacturer. If this information is not available, a large safety margin must be incorporated to ensure that the resistors are not overloaded. By connecting these resistors in series and in parallel the braking capacity can be selected for the application.

**IMPORTANT:** ***The minimum resistance of the combination and maximum dc link voltage must be as specified.***



## Supply Harmonic Analysis (230V filtered)

Assumptions: (Short circuit fault to Neutral)

5kA short circuit supply capability at 230V 1ϕ, equivalent to 146µH supply impedance
7.5kA short circuit supply capability at 230V 3ϕ, equivalent to 56µH supply impedance
10kA short circuit supply capability at 400V 3ϕ, equivalent to 73µH supply impedance

$$THD(V) \times 100 = \frac{\sqrt{\sum_{h=40}^{h=2} Q_{h^2}}}{Q_{1n}} \%$$

where $Q_{1n}$ is the rated rms value of the fundamental voltage of the supply transformer.
The results conform to stage 1 and stage 2 of the Engineering Recommendation G.5/4 February 2001, Classification 'C': Limits for Harmonics in the UK Electricity Industry.

| Drive Type | 650S | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Motor Power (kW) | 0.25 | 0.37 | 0.55 | 0.75 | 1.1 | 1.5 | 2.2 | 3.0 | 4.0 |
| Fundamental Voltage (V) | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 |
| Typical Motor Efficiency % | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 |
| Harmonic No. | RMS Current (A) | | | | | | | | |
| 1 | 7.4 | 7.5 | 7.8 | 8.2 | 9.0 | 10.3 | TBA | TBA | TBA |
| 3 | 1.4 | 0.2 | 1.9 | 2.2 | 2.9 | 3.9 | | | |
| 5 | 2.9 | 0.4 | 4.4 | 4.6 | 4.8 | 5.2 | | | |
| 7 | 1.1 | 0.5 | 1.9 | 2.0 | 2.3 | 2.5 | | | |
| 9 | 0.2 | 0.2 | 0.2 | 0.3 | 0.4 | 0.4 | | | |
| 11 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.3 | | | |
| 13 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | | | |
| 15 | 0.1 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | | | |
| 17 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | | | |
| 19 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | | | |
| 21 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | | | |
| 23 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| 25 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| 27 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| 29 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| 31 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| 33 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| 35 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| 37 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| 39 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| 40 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| Total RMS Current (A) | 8.2 | 7.5 | 9.3 | 9.9 | 10.9 | 12.5 | | | |
| THD (V) % | 0.3559 | 0.0972 | 0.5426 | 0.5733 | 0.6277 | 0.7055 | | | |

## Supply Harmonic Analysis (400V filtered)

Assumptions: (Short circuit fault to Neutral)

5kA short circuit supply capability at 230V 1ϕ, equivalent to 146µH supply impedance
7.5kA short circuit supply capability at 230V 3ϕ, equivalent to 56µH supply impedance
10kA short circuit supply capability at 400V 3ϕ, equivalent to 73µH supply impedance

$$THD(V) \times 100 = \frac{\sqrt{\sum_{h=40}^{h=2} Q_{h^2}}}{Q_{1n}} \%$$

where $Q_{1n}$ is the rated rms value of the fundamental voltage of the supply transformer.
The results conform to stage 1 and stage 2 of the Engineering Recommendation G.5/4 February 2001, Classification 'C': Limits for Harmonics in the UK Electricity Industry.

| Drive Type | 650S | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Motor Power (kW) | 0.37 | 0.55 | 0.75 | 1.1 | 1.5 | 2.2 | 3.0 | 4.0 | 5.5 | 7.5 |
| Fundamental Voltage (V) | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 |
| Typical Motor Efficiency % | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 |
| Harmonic No. | RMS Current (A) | | | | | | | | | |
| 1 | 0.6 | 1.0 | 1.3 | 1.9 | 2.6 | 3.8 | 5.2 | 6.9 | 9.5 | 12.9 |
| 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 5 | 0.6 | 0.9 | 1.2 | 1.8 | 2.4 | 3.5 | 4.7 | 6.2 | 8.3 | 11.1 |
| 7 | 0.6 | 0.9 | 1.2 | 1.7 | 2.3 | 3.3 | 4.3 | 5.5 | 7.3 | 9.5 |
| 9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 11 | 0.5 | 0.8 | 1.0 | 1.5 | 1.9 | 2.6 | 3.3 | 3.9 | 4.8 | 5.7 |
| 13 | 0.0 | 0.7 | 0.9 | 1.3 | 1.6 | 2.2 | 2.7 | 3.0 | 3.5 | 3.9 |
| 15 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 17 | 0.4 | 0.6 | 0.7 | 1.0 | 1.1 | 1.4 | 1.6 | 1.5 | 1.4 | 1.2 |
| 19 | 0.0 | 0.5 | 0.6 | 0.9 | 0.9 | 1.1 | 1.1 | 0.9 | 0.8 | 0.7 |
| 21 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 23 | 0.2 | 0.3 | 0.4 | 0.6 | 0.5 | 0.5 | 0.4 | 0.3 | 0.5 | 0.7 |
| 25 | 0.0 | 0.3 | 0.3 | 0.4 | 0.3 | 0.3 | 0.2 | 0.4 | 0.5 | 0.7 |
| 27 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 29 | 0.1 | 0.2 | 0.2 | 0.2 | 0.1 | 0.2 | 0.3 | 0.4 | 0.4 | 0.4 |
| 31 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 |
| 33 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 35 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 |
| 37 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.1 | 0.1 | 0.2 | 0.3 |
| 39 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 40 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total RMS Current (A) | 1.4 | 2.1 | 2.8 | 4.0 | 5.1 | 7.2 | 9.5 | 12.0 | 15.8 | 20.8 |
| THD (V) % | 0.1561 | 0.2158 | 0.2776 | 0.3859 | 0.4393 | 0.5745 | 0.6994 | 0.8111 | 0.9899 | 1.2110 |

## Supply Harmonic Analysis (230V unfiltered)

Assumptions: (Short circuit fault to Neutral)

5kA short circuit supply capability at 230V 1ϕ, equivalent to 146µH supply impedance
7.5kA short circuit supply capability at 230V 3ϕ, equivalent to 56µH supply impedance
10kA short circuit supply capability at 400V 3ϕ, equivalent to 73µH supply impedance

$$THD(V) \times 100 = \frac{\sqrt{\sum_{h=40}^{h=2} Q_{h^2}}}{Q_{1n}} \%$$

where $Q_{1n}$ is the rated rms value of the fundamental voltage of the supply transformer.
The results conform to stage 1, stage 2 and stage 3 of the Engineering Recommendation G.5/3 September 1976, Classification 'C': Limits for Harmonics in the UK Electricity Industry.

| Drive Type | 650S | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Motor Power (kW) | 0.25 | 0.37 | 0.55 | 0.75 | 1.1 | 1.5 | 2.2 | 3.0 | 4.0 |
| Fundamental Voltage (V) | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 |
| Typical Motor Efficiency % | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 |
| Harmonic No. | RMS Current (A) | | | | | | | | |
| 1 | 1.3 | 2.0 | 2.9 | 3.9 | 5.7 | 7.8 | TBA | TBA | TBA |
| 3 | 1.3 | 1.9 | 2.9 | 3.8 | 5.5 | 7.4 | | | |
| 5 | 1.2 | 1.9 | 2.7 | 3.5 | 5.0 | 6.7 | | | |
| 7 | 1.1 | 1.7 | 2.5 | 3.1 | 4.4 | 5.4 | | | |
| 9 | 1.1 | 1.6 | 2.2 | 2.7 | 3.7 | 4.6 | | | |
| 11 | 1.0 | 1.4 | 1.9 | 2.2 | 2.9 | 3.4 | | | |
| 13 | 0.8 | 1.2 | 1.6 | 1.6 | 2.1 | 2.3 | | | |
| 15 | 0.7 | 1.0 | 1.3 | 1.2 | 1.4 | 1.4 | | | |
| 17 | 0.6 | 0.8 | 1.0 | 0.8 | 0.8 | 0.7 | | | |
| 19 | 0.5 | 0.7 | 0.7 | 0.4 | 0.4 | 0.3 | | | |
| 21 | 0.4 | 0.5 | 0.5 | 0.2 | 0.2 | 0.4 | | | |
| 23 | 0.3 | 0.3 | 0.3 | 0.2 | 0.3 | 0.4 | | | |
| 25 | 0.2 | 0.2 | 0.1 | 0.2 | 0.3 | 0.4 | | | |
| 27 | 0.1 | 0.1 | 0.1 | 0.2 | 0.3 | 0.3 | | | |
| 29 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | | | |
| 31 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | | | |
| 33 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | | | |
| 35 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | | | |
| 37 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | | | |
| 39 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | | | |
| 40 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| Total RMS Current (A) | 3.2 | 4.8 | 6.7 | 8.3 | 11.7 | 15.3 | | | |
| THD (V) % | 0.5633 | 0.8016 | 1.0340 | 1.0944 | 1.4611 | 1.7778 | | | |

## Supply Harmonic Analysis (400V unfiltered)

Assumptions: (Short circuit fault to Neutral)

5kA short circuit supply capability at 230V 1ϕ, equivalent to 146µH supply impedance
7.5kA short circuit supply capability at 230V 3ϕ, equivalent to 56µH supply impedance
10kA short circuit supply capability at 400V 3ϕ, equivalent to 73µH supply impedance

$$THD(V) \times 100 = \frac{\sqrt{\sum_{h=40}^{h=2} Q_{h^2}}}{Q_{1n}} \%$$

where $Q_{1n}$ is the rated rms value of the fundamental voltage of the supply transformer.
The results conform to stage 1, stage 2 and stage 3 of the Engineering Recommendation G.5/3 September 1976, Classification 'C': Limits for Harmonics in the UK Electricity Industry.

| Drive Type | 650S | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Motor Power (kW) | 0.37 | 0.55 | 0.75 | 1.1 | 1.5 | 2.2 | 3.0 | 4.0 | 5.5 | 7.5 |
| Fundamental Voltage (V) | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 |
| Typical Motor Efficiency % | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 |
| Harmonic No. | RMS Current (A) | | | | | | | | | |
| 1 | 0.6 | 0.9 | 1.3 | 1.9 | 2.6 | 3.8 | 5.2 | 6.9 | 9.5 | 12.7 |
| 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 5 | 0.6 | 0.9 | 1.2 | 1.8 | 2.4 | 3.6 | 4.7 | 6.3 | 8.4 | 11.0 |
| 7 | 0.6 | 0.9 | 1.2 | 1.7 | 2.3 | 3.3 | 4.3 | 5.7 | 7.4 | 9.5 |
| 9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 11 | 0.5 | 0.8 | 1.0 | 1.5 | 1.9 | 2.6 | 3.3 | 4.2 | 4.9 | 5.8 |
| 13 | 0.5 | 0.7 | 0.9 | 1.3 | 1.6 | 2.2 | 2.7 | 3.4 | 3.7 | 4.0 |
| 15 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 17 | 0.4 | 0.6 | 0.7 | 0.9 | 1.2 | 1.5 | 1.6 | 1.9 | 1.5 | 1.3 |
| 19 | 0.4 | 0.5 | 0.6 | 0.8 | 0.9 | 1.1 | 1.1 | 1.3 | 0.8 | 0.7 |
| 21 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 23 | 0.3 | 0.4 | 0.4 | 0.5 | 0.5 | 0.5 | 0.4 | 0.4 | 0.5 | 0.7 |
| 25 | 0.2 | 0.3 | 0.3 | 0.3 | 0.4 | 0.3 | 0.2 | 0.3 | 0.5 | 0.7 |
| 27 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 29 | 0.1 | 0.2 | 0.2 | 0.2 | 0.1 | 0.2 | 0.2 | 0.3 | 0.4 | 0.4 |
| 31 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 |
| 33 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 35 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 |
| 37 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.1 | 0.2 | 0.2 |
| 39 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 40 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total RMS Current (A) | 1.5 | 2.1 | 2.8 | 4.0 | 5.1 | 7.4 | 9.5 | 12.4 | 16.0 | 20.6 |
| THD (V) % | 0.1634 | 0.2209 | 0.2817 | 0.3569 | 0.4444 | 0.5886 | 0.7107 | 0.8896 | 1.0127 | 1.2138 |

# Chapter 10: Certification for the Drive

This Chapter outlines the additional steps that may be required to achieve EMC conformance.

# Requirements for EMC Compliance

## Earthing Requirements

**IMPORTANT:** ***Protective earthing always takes precedence over EMC earthing.***

### Protective Earth (PE) Connections

***Note:*** **In accordance with installations to EN60204, only one protective earth conductor is permitted at each protective earth terminal contacting point.**

Local wiring regulations may require the protective earth connection of the motor to be connected locally, i.e. not as specified in these instructions. This will not cause shielding problems because of the relatively high RF impedance of the local earth connection.

### EMC Earth Connections

For compliance with EMC requirements, the “0V/signal ground” is to be separately earthed. When a number of units are used in a system, these terminals should be connected together at a single, local earthing point.

Control and signal cables connections should be made with screeened cables, with the screen connected only at the VSD end. However, if high frequency noise is still a problem, earth screen at the non VSD end via a 0.1μF capacitor.

***Note:*** **Connect the screen (at the VSD end) to the VSD protective earth point⏚, and not to the control board terminals.**

# Requirements for UL Compliance

## Solid-State Motor Overload Protection

These devices provide Class 10 motor overload protection. The maximum internal overload protection level (current limit) is 150% for 30 seconds.

An external motor overload protective device must be provided by the installer where the motor has a full-load ampere rating of less than 50% of the drive output rating.

Motor over temperature sensing is required. Motors used in conjunction with the drive controller shall be protected with PTC sensor(s) or relays suitable for use with the variable speed drive. Technical details can be found in chapter 3 Installing the Drive.

## Short Circuit Rating

The following drives are suitable for use on a circuit capable of delivering not more than:

220-240V product, 1ϕ - 5000 RMS Symmetrical Amperes
220-240V product, 3ϕ - 7500 RMS Symmetrical Amperes
380-460V product, 3ϕ -10000 RMS Symmetrical Amperes

## Solid-State Short-Circuit Protection

These devices are provided with Solid-State Short-Circuit (output) Protection. Branch circuit protection requirements must be in accordance with the latest edition of the National Electrical Code NEC/NFPA-70.

## Recommended Branch Circuit Protection

It is recommended that UL Listed (JDDZ) non-renewable cartridge fuses, Class K5 or H; or UL Listed (JDRX) renewable cartridge fuses, Class H, are installed upstream of the drive.

## Motor Base Frequency

The motor base frequency rating is 500Hz maximum.

## Field Wiring Temperature Rating

Use 75°C Copper conductors only.

## Field Wiring Terminal Markings

For correct field wiring connections that are to be made to each terminal refer to Chapter 3: “Installing the Drive”.

## Terminal Tightening Torque

Refer to Chapter 3: “Installing the Drive” – Terminal Tightening Torque.

## Terminal/Wire Sizes

North American wire sizes (AWG) are based on NEC/NFPA-70 for ampacities of thermoplastic-insulated (75ºC) copper conductors.

Power input and output wire sizes should allow for an ampacity of 125% of the rated input and output amperes for motor branch-circuit conductors as specified in NEC/NFPA-70. Refer to Chapter 3: “Installing the Drive” – Terminal Block Acceptance Sizes.

## Field Grounding Terminals

The field grounding terminals are identified with the International Grounding Symbol 
(IEC Publication 417, Symbol 5019).

## Operating Ambient Temperature

Devices are considered acceptable for use in a maximum ambient temperature of 40°C (can be derated up to 50°C, see page 9-3 “Operating Temperature”).

# Input Fuse Ratings

If fitted, fuses should be in accordance with NEC/NFPA-70.

| **FRAME 1 : 1-Phase (IT/TN), 230V** | | |
|---|---|---|
| Drive Power (kW/hp) | Input Current @ 5kA (A) | Supply Fuse Rating (A) 10 x 38mm |
| 0.25/0.3 | 4.2 | 10 |
| 0.37/0.5 | 6.2 | 10 |
| 0.55/0.75 | 7.9 | 10 |
| 0.75/1.0 | 10.5 | 15 |
| **FRAME 2 : 1-Phase (IT/TN), 230V** | | |
| Drive Power (kW/hp) | Input Current @ 5kA (A) | Supply Fuse Rating (A) 10 x 38mm |
| 1.1/1.5 | 13.8 | 20 |
| 1.5/2.0 | 16.0 | 20 |
| **FRAME 2 : 3-Phase (IT/TN), 400V** | | |
| Drive Power (kW/hp) | Input Current @ 10kA (A) | Supply Fuse Rating (A) 10 x 38mm |
| 0.37/0.5 | 2.5 | 10 |
| 0.55/0.75 | 3.3 | 10 |
| 0.75/1.0 | 4.1 | 10 |
| 1.1/1.5 | 5.9 | 10 |
| 1.5/2.0 | 7.5 | 10 |
| 2.2/3.0 | 9.4 | 15 |
| **FRAME 3 : 1-Phase (IT/TN), 230V** | | |
| Drive Power (kW/hp) | Input Current @ 7.5kA (A) | Supply Fuse Rating (A) 10 x 38mm |
| 2.2/3.0 | 22.0 | 30 |
| **FRAME 3 : 3-Phase (IT/TN), 230V** | | |
| Drive Power (kW/hp) | Input Current @ 7.5kA (A) | Supply Fuse Rating (A) 10 x 38mm |
| 2.2/3.0 | 14.3 | 15 |
| 3.0/4.0 | 18.1 | 20 |
| 4.0/5.0 | 23.1 | 25 |
| **FRAME 3 : 3-Phase (IT/TN), 400V** | | |
| Drive Power (kW/hp) | Input Current @ 10kA (A) | Supply Fuse Rating (A) 10 x 38mm |
| 3.0/4 | 11.1 | 15 |
| 4.0/5 | 13.9 | 20 |
| 5.5/7.5 | 18.0 | 25 |
| 7.5/10 | 23.6 | 30 |

# European Directives and the CE Mark

## CE Marking for Low Voltage Directive

When installed in accordance with this manual, the 650S AC Drive is CE marked by Parker Hannifin Ltd, Automation Group, SSD Drives Europe, in accordance with the low voltage directive (S.I. No. 3260 implements this LVD directive into UK law). An EC Declaration of Conformity (low voltage directive) is included at the end of this chapter.

## CE Marking for EMC - Who is Responsible?

***Note:*** **The specified EMC emission and immunity performance of this unit can only be achieved when the unit is installed to the EMC Installation Instructions given in this manual.**

According to S.I. No. 2373 which implements the EMC directive into UK law, the requirement for CE marking this unit falls into two categories:

1. Where the supplied unit has an intrinsic/direct function to the end user, then the unit is classed as ***relevant apparatus***. In this situation the responsibility for certification rests with Parker Hannifin Ltd, Automation Group, SSD Drives Europe. The Declaration of Conformity is included at the end of this Chapter.
2. Where the supplied unit is incorporated into a higher system/apparatus or machine which includes (at least) the motor, cable and a driven load but is unable to function without this unit, then the unit is classed as a ***component***. In this circumstance, the reponsibility rests with the manufacturer/supplier/installer of the system/apparatus/machine.

# EMC Compliance

| | |
|---|---|
| **All Models**<br>All models are compliant with BS EN61800-3. | |
| **Radiated Emissions** | EN61000-6-3 and EN61800-3 unrestricted distribution when mounted inside the specified cubicle, see above. Control and motor cables must be screened and correctly fitted with glands where they exit the cubicle. Control 0V must be connected to protective earth/ground. |
| **Immunity** | EN61800-3, EN61000-6-2 |
| **FRAME 1 & 2: 1-Phase (TN only),** | |
| Conducted Emissions | EN61000-6-3, EN61800-3 unrestricted distribution, maximum motor cable length: 25m |
| **FRAME 2 & 3 : 3-Phase, FRAME 3 : 1-Phase (TN only)** | |
| Conducted Emissions | EN61000-6-4, EN61800-3 restricted distribution maximum motor cable length: 25m |

# Certificates

Issued for compliance with the EMC Directive when the unit is used as *relevant apparatus*.

This is provided to aid your justification for EMC compliance when the unit is used as a component.

## 650S 0.25 – 2.0kW 230V

CE

### EC Declarations of Conformity

Date CE marked first applied: 19/10/2009

#### EMC Directive

In accordance with the EEC Directive 2004/108/EC

We Parker Hannifin Ltd., Automation Group, SSD Drives Europe, address as below, declare under our sole responsibility that the above Electronic Products when installed and operated with reference to the instructions in the Product Manual (provided with each piece of equipment) is in accordance with the relevant clauses from the following standard:-

BSEN61800-3 (2004)

#### Low Voltage Directive

In accordance with the EEC Directive 2006/95/EC

We Parker Hannifin Ltd., Automation Group, SSD Drives Europe, address as below, declare under our sole responsibility that the above Electronic Products when installed and operated with reference to the instructions in the Product Manual (provided with each piece of equipment), is in accordance with the following standard :-

EN50178 (1998)

### Manufacturers Declarations

#### EMC Declaration

We Parker Hannifin Ltd., Automation Group, SSD Drives Europe, address as below, declare under our sole responsibility that the above Electronic Products when installed and operated with reference to the instructions in the Product Manual (provided with each piece of equipment) is in accordance with the relevant clauses from the following standard:-

BSEN61800-3 (2004)

#### Machinery Directive

The above Electronic Products are components to be incorporated into machinery and may not be operated alone. The complete machinery or installation using this equipment may only be put into service when the safety considerations of the Directive 2006/42/EC are fully adhered to.
Particular reference should be made to EN60204-1 (Safety of Machinery - Electrical Equipment of Machines).
All instructions, warnings and safety information of the Product Manual must be adhered to.

Dr Martin Payn (Conformance Officer)

**PARKER HANNIFIN LIMITED, AUTOMATION GROUP, SSD DRIVES EUROPE**
NEW COURTWICK LANE, LITTLEHAMPTON, WEST SUSSEX BN17 7RZ
TELEPHONE: +44(0)1903 737000 FAX: +44(0)1903 737100

Registered Number: 4806503 England. Registered Office: 55 Maylands Avenue, Hemel Hempstead, Herts HP2 4SJ

The drive is CE marked in accordance with the low voltage directive for electrical equipment and appliances in the voltage range when installed correctly.

Since the potential hazards are mainly electrical rather than mechanical, the drive does not fall under the machinery directive. However, we do supply a manufacturer's declaration for when the drive is used (as a component) in machinery.

Issued for compliance with the EMC Directive when the unit is used as *relevant apparatus*.

This is provided to aid your justification for EMC compliance when the unit is used as a component.

## 650S 0.37 - 10kW 400V

CE

## EC Declarations of Conformity

Date CE marked first applied: 19/10/2009

### EMC Directive

In accordance with the EEC Directive 2004/108/EC

We Parker Hannifin Ltd., Automation Group, SSD Drives Europe, address as below, declare under our sole responsibility that the above Electronic Products when installed and operated with reference to the instructions in the Product Manual (provided with each piece of equipment) is in accordance with the relevant clauses from the following standard:-

BSEN61800-3 (2004)

### Low Voltage Directive

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EN50178 (1998)

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### Machinery Directive

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# Chapter 11: Serial Communications

# Connection to the P3 Port

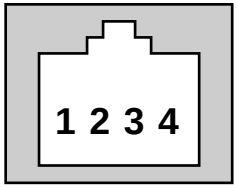
**IMPORTANT:** *The drive MUST be earthed**. Failure to do so could damage your communications ports.***

The port is an un-isolated RS232, 19200 Baud, supporting the standard EI bisynch ASCII communications protocol. Contact Parker SSD Drives for further information.

The P3 port is located under the terminal cover and is used only by the remote-mounted RS232 Keypad.

## P3 Port

A standard P3 lead is used to connect to the drive.




| P3 Port Pin | Lead | Signal |
|---|---|---|
| 1 | Black | 0V |
| 2 | Red | 5V |
| 3 | Green | TX |
| 4 | Yellow | RX |

***Note:*** **There is 5V present on pin 2 of the P3 port - do not connect this to your PC.**

# Chapter 12: Applications

# The Default Application

The drive is supplied with 6 Applications, Application 0 to Application 5. Each Application recalls a pre-programmed structure of internal links when it is loaded.

DEFAUL

- Application 0 will not control a motor. Loading Application 0 removes all internal links.
- Application 1 is the factory default application, providing for basic speed control
- Application 2 supplies speed control using a manual or auto setpoint
- Application 3 supplies speed control using preset speeds
- Application 4 is a set-up providing speed control with Raise/Lower Trim
- Application 5 supplies speed control with Run Forward/Run Reverse

**IMPORTANT:** ***Refer to Chapter 5: The Keypad – Special Menu Features to reset the drive to factory default values which are suitable for most applications.***

# How to Load an Application

In the PAr menu, go to P 1 and press the M key twice.

The Applications are stored in this menu.

Use the ▲ ▼ keys to select the appropriate Application by number.

Press the E key to load the Application.

# Application Description

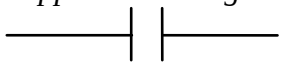
## Control Wiring for Applications

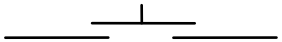
The large Application Diagrams on the following pages show the full wiring for push-button starting. The diagrams on the reverse show the full wiring for single wire starting.

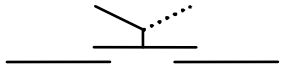
For the minimum connections to make the drive run refer to Chapter 3: "Installing the Drive" - Electrical Installation; the remaining connections can be made to suit your system.

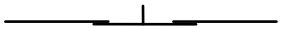
When you load an Application, the input and output parameters shown in these diagrams default to the settings shown. For alternative user-settings refer to the Software Product Manual, Chapter 6 "Programming Your Application".

*Key to Application Diagrams*

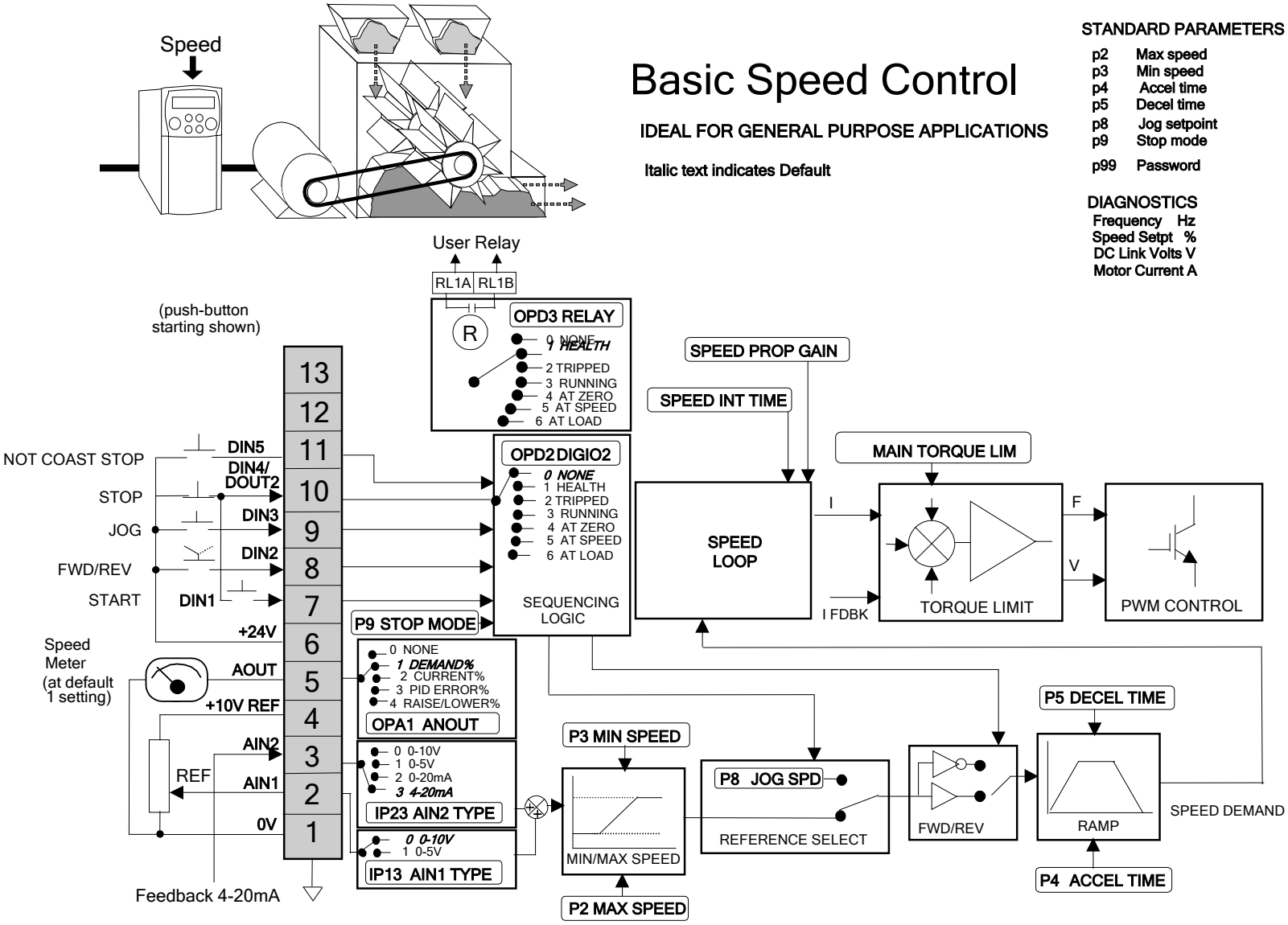

normally open contact (relay)


normally open push-button


2-position switch

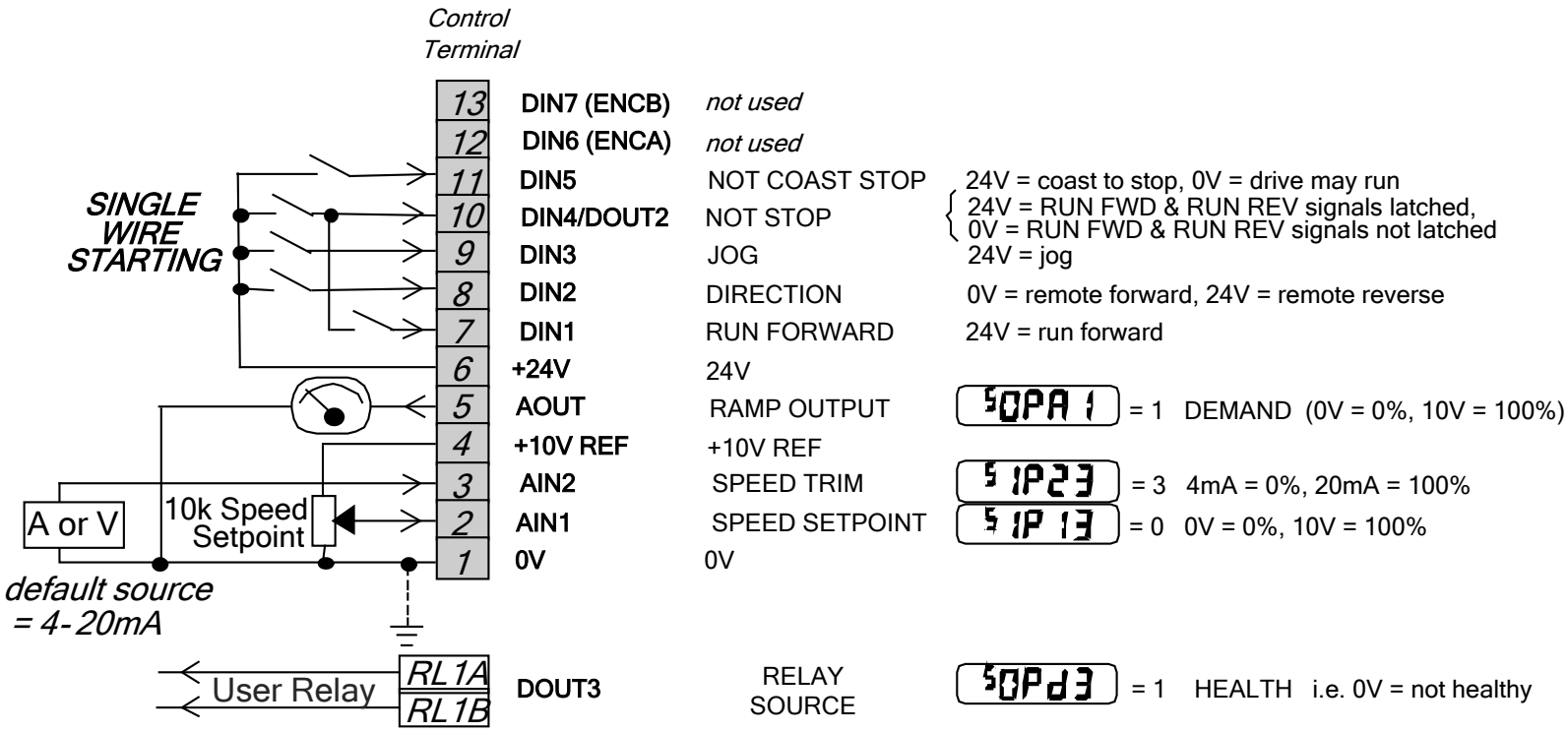

normally closed push-button

# Application 1 : Basic Speed Control (default)

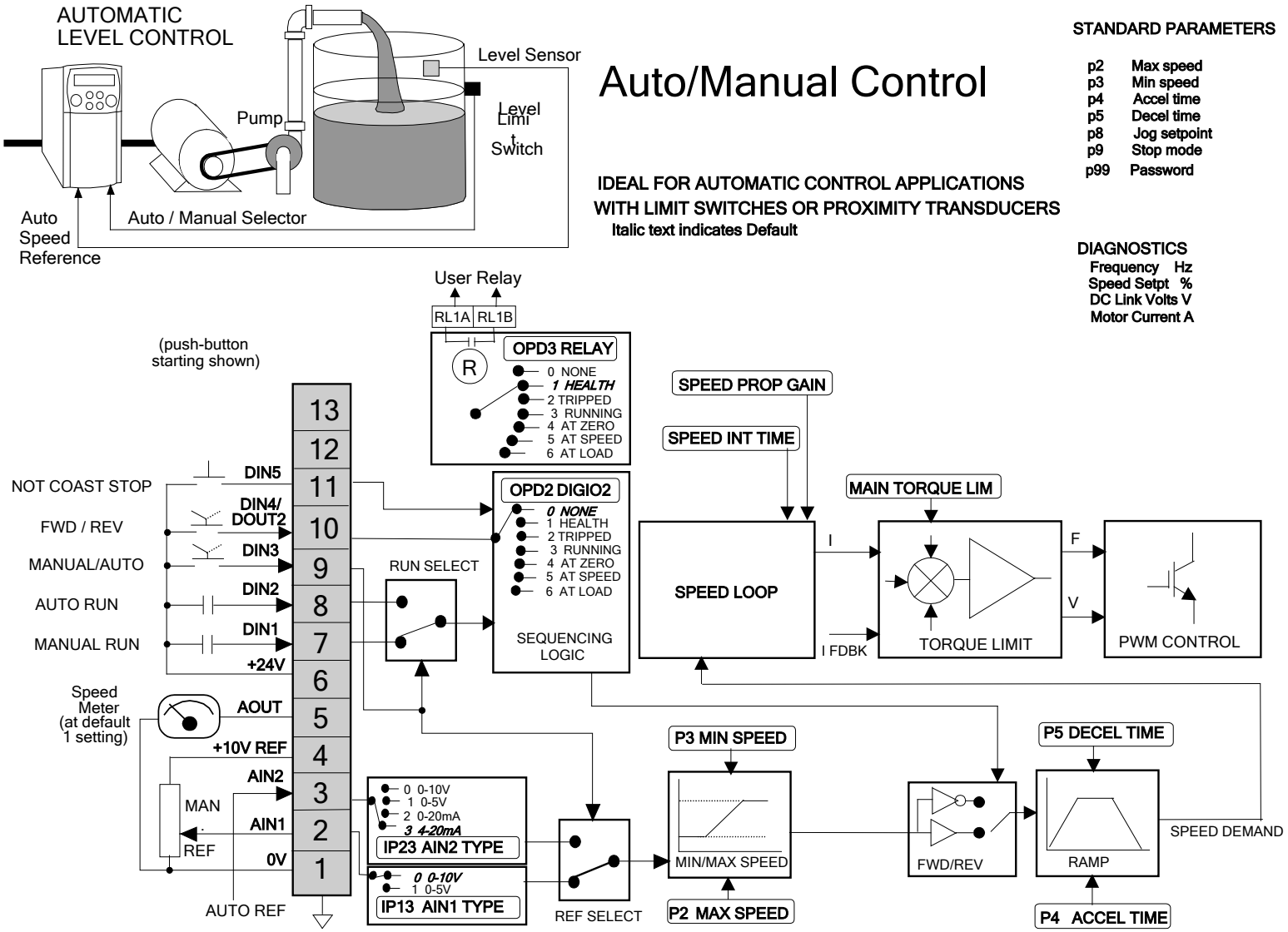


# Application 1: Basic Speed Control (default)

This Application is ideal for general purpose applications. It provides push-button or switched start/stop control. The setpoint is the sum of the two analogue inputs AIN1 and AIN2, providing Speed Setpoint + Speed Trim capability.



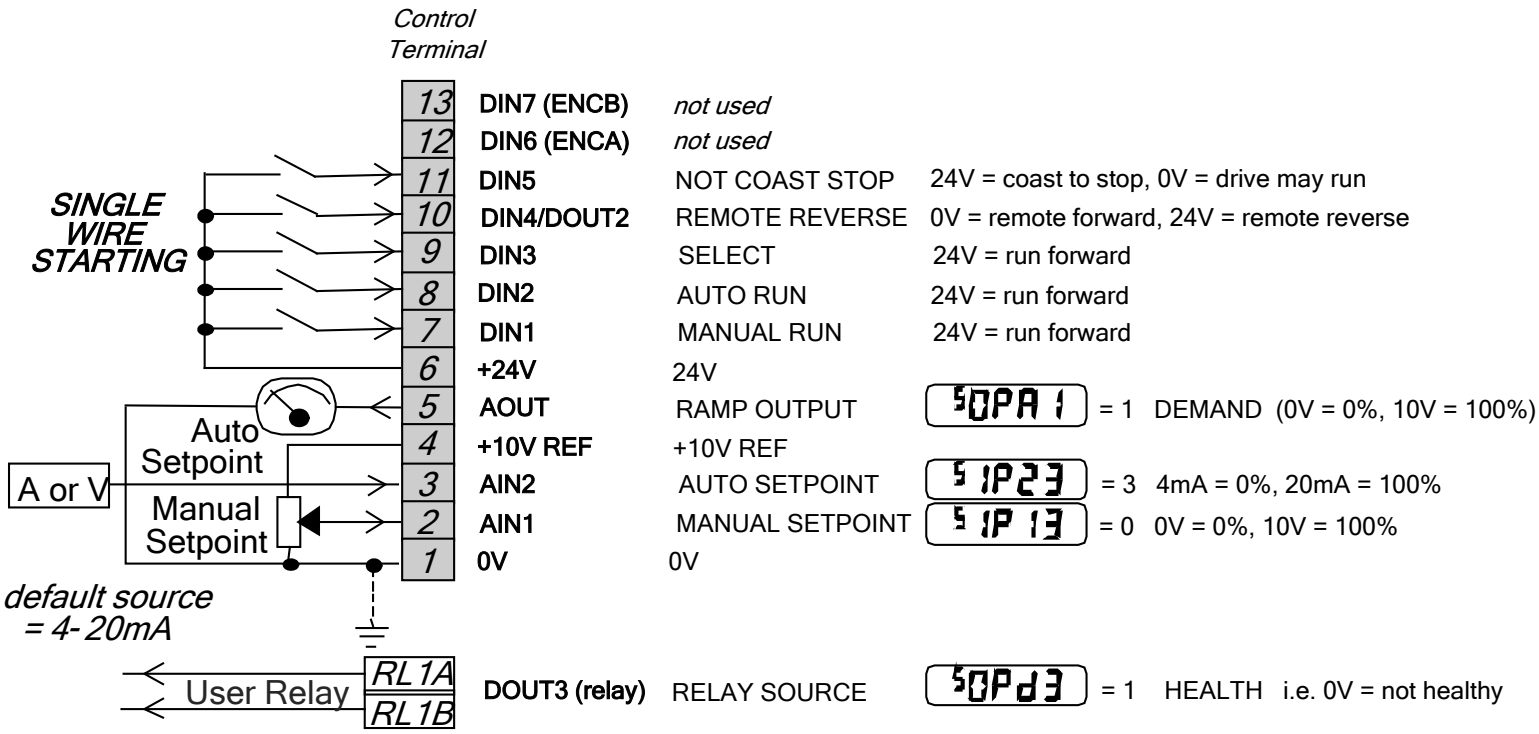
# Application 2 : Auto/Manual Control



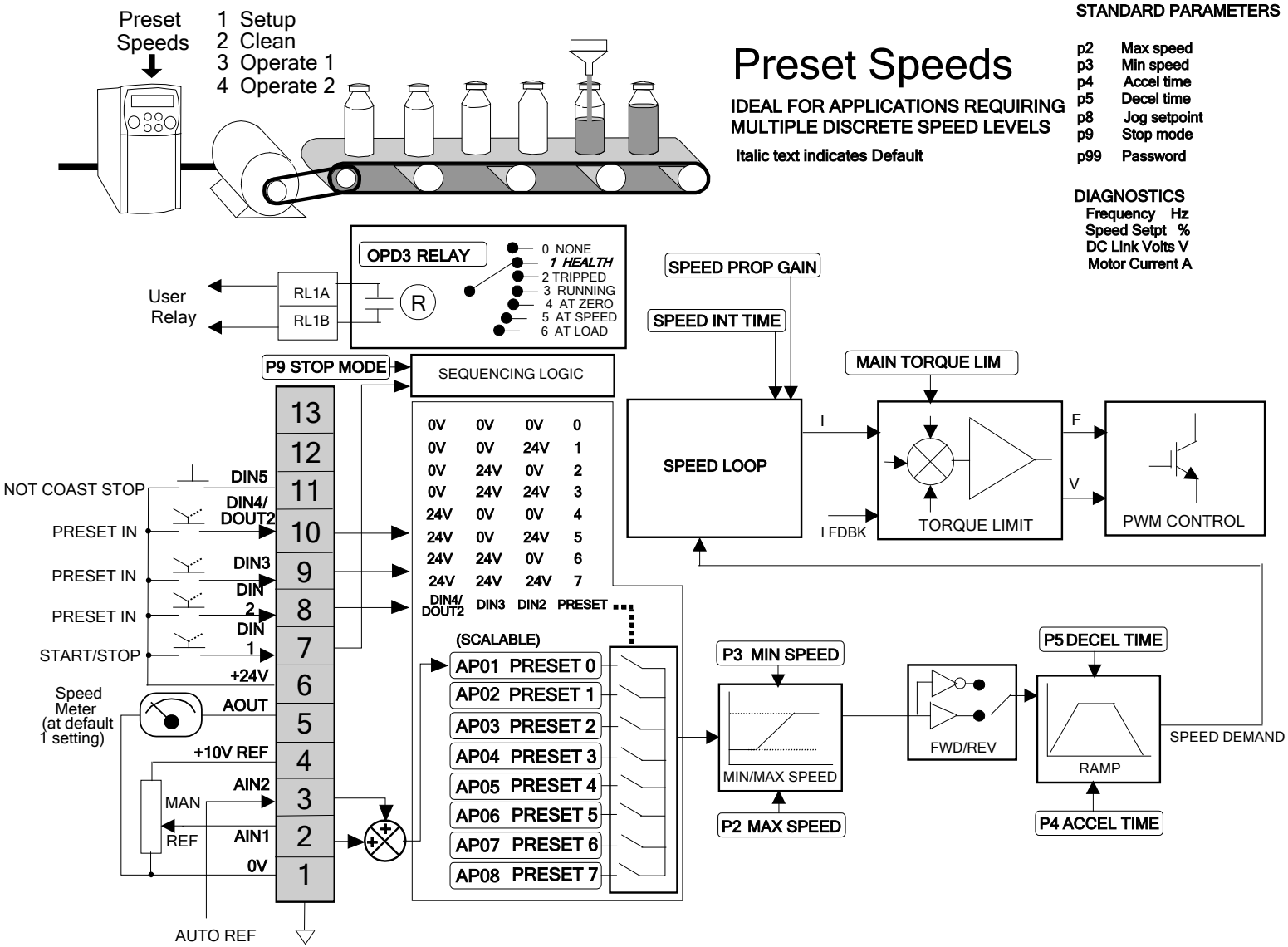
# Application 2: Auto/Manual Control

Two Run inputs and two Setpoint inputs are provided. The Auto/Manual switch selects which pair of inputs is active.

The Application is sometimes referred to as Local/Remote.



# Application 3 : Preset Speeds

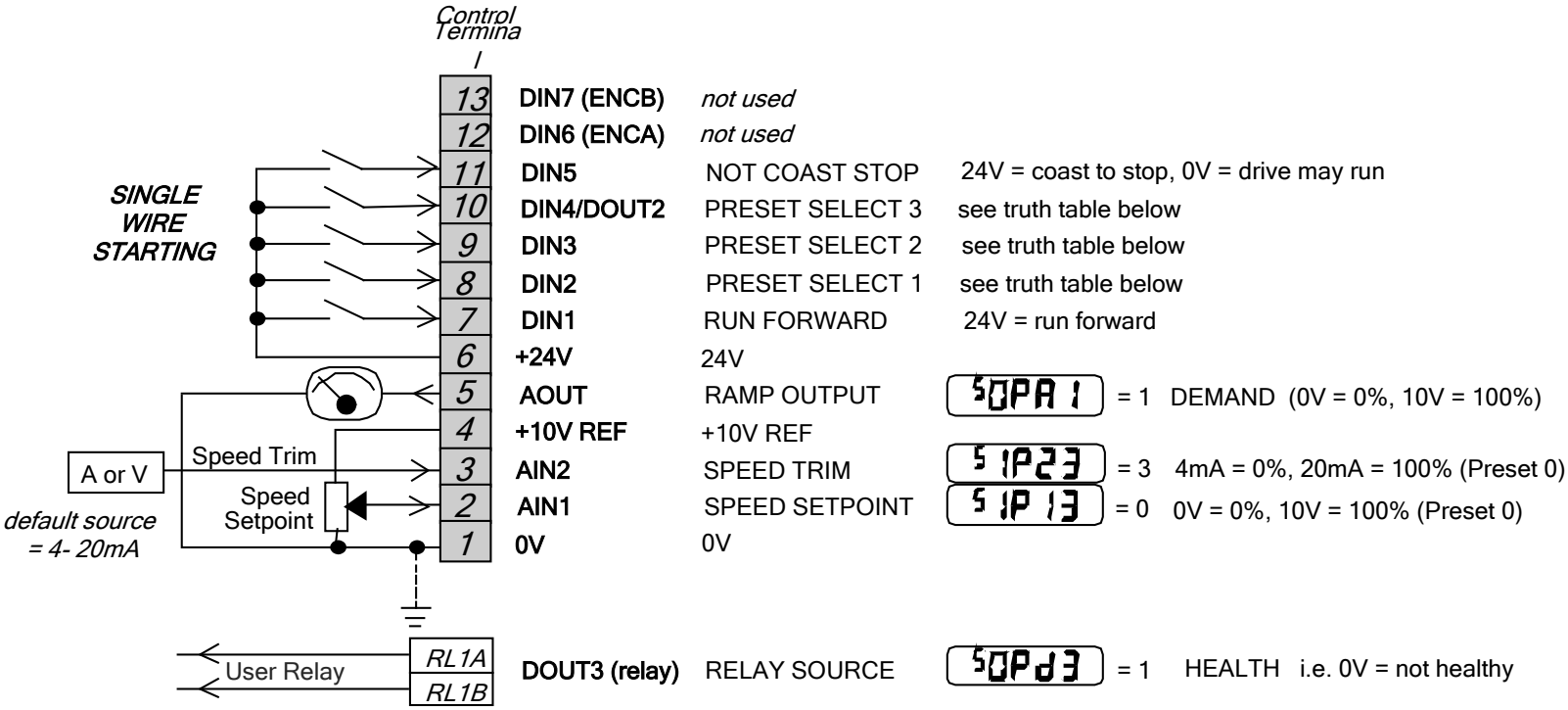


# Application 3: Preset Speeds

This is ideal for applications requiring multiple discrete speed levels.

The setpoint is selected from either the sum of the analogue inputs, (as in Application 1 and known here as PRESET 0), or as one of up to seven other pre-defined speed levels. These are selected using DIN2, DIN3 and DIN4, refer to the Truth Table below.

Edit parameters P302 to P308 on the keypad to re-define the speed levels of PRESET 1 to PRESET 7. Reverse direction is

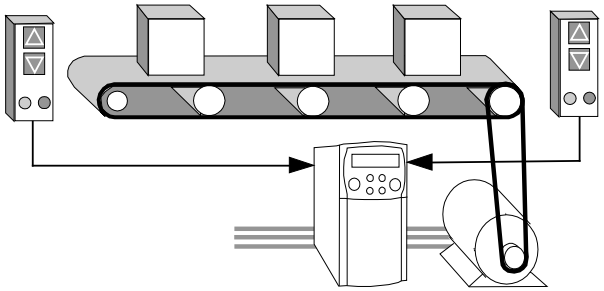



achieved by entering a negative speed setpoint.

## Preset Speed Truth Table

| DIN4/DOUT2 | DIN3 | DIN2 | Preset |
|---|---|---|---|
| 0V | 0V | 0V | 0 |
| 0V | 0V | 24V | 1 |
| 0V | 24V | 0V | 2 |
| 0V | 24V | 24V | 3 |
| 24V | 0V | 0V | 4 |
| 24V | 0V | 24V | 5 |
| 24V | 24V | 0V | 6 |
| 24V | 24V | 24V | 7 |

# Application 4 : Raise/Lower Trim



## Raise/Lower

**IDEAL FOR APPLICATIONS REQUIRING SPEED CONTROL FROM MULTIPLE LOCATIONS**

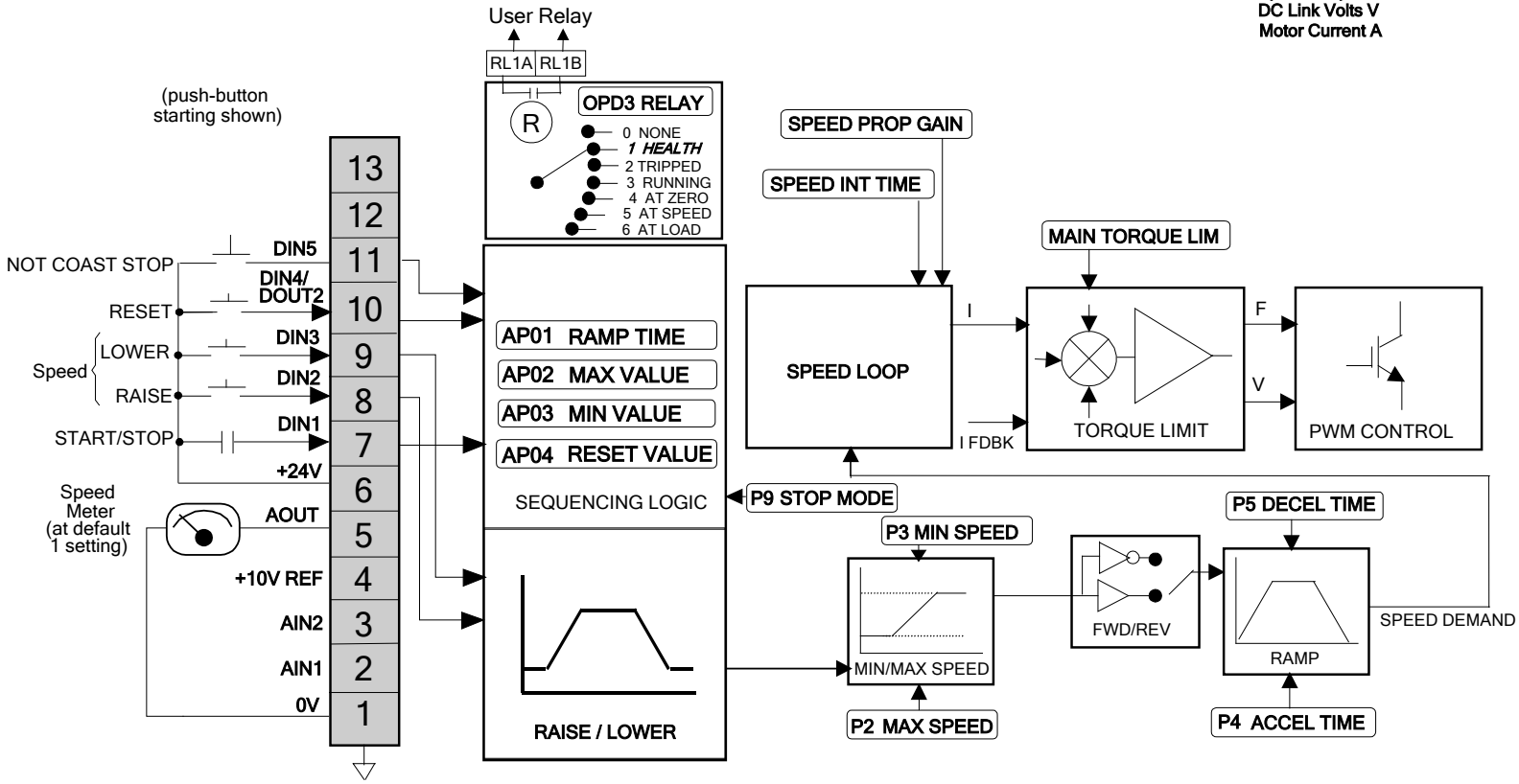
**Italic text indicates Default**

**STANDARD PARAMETERS**

| | |
|---|---|
| p2 | Max speed |
| p3 | Min speed |
| p4 | Accel time |
| p5 | Decel time |
| p8 | Jog setpoint |
| p9 | Stop mode |
| p99 | Password |

**DIAGNOSTICS**

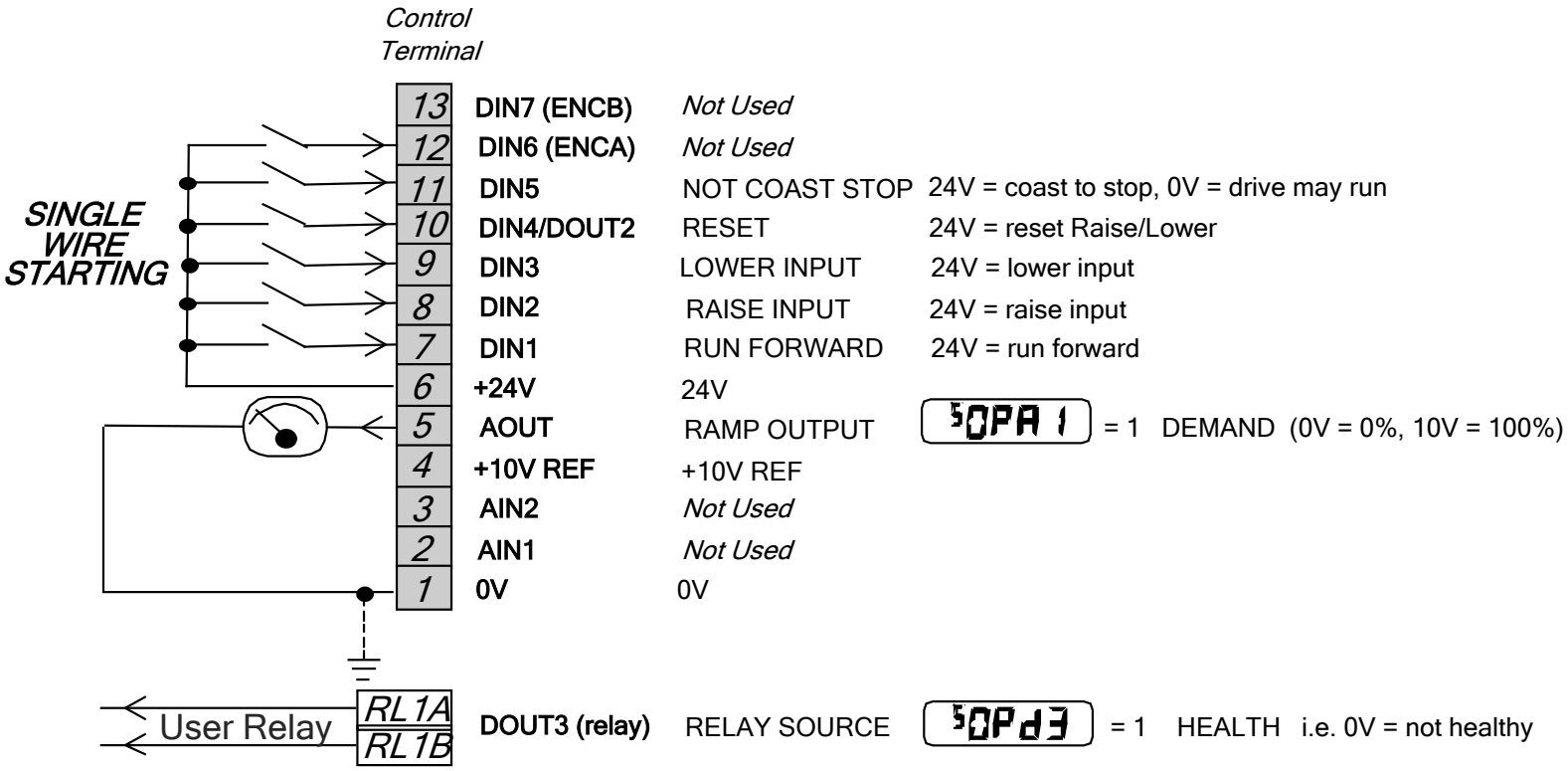
Frequency Hz
Speed Setpt %
DC Link Volts V
Motor Current A



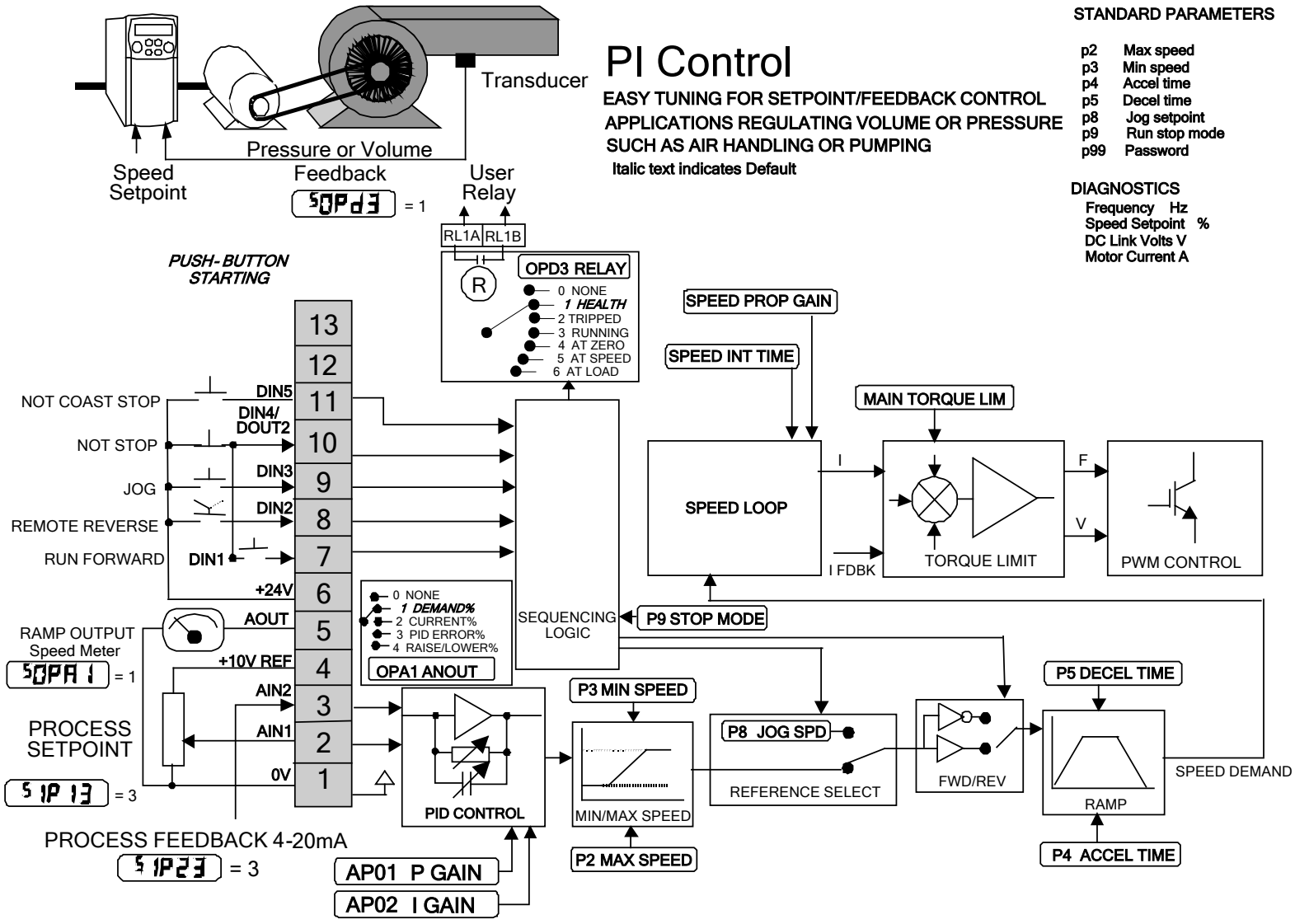
# Application 4: Raise/Lower Trim

This Application mimics the operation of a motorised potentiometer. Digital inputs allow the setpoint to be increased and decreased between limits. The limits and ramp rate can be set using the keypad.

The Application is sometimes referred to as Motorised Potentiometer.



# Application 5 : PID



# Application 5: PID

A simple application using a Proportional-Integral-Derivative 3-term controller. The setpoint is taken from AIN1, with feedback signal from the process on AIN2. The scale and offset features of the analogue input blocks may be used to correctly scale these signals. The difference between these two signals is taken as the PID error. The output of the PID block is then used as the drive setpoint.