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690+ Series
AC Drive

Frame B, C, D, E & F

Product Manual

HA465492U005 Issue 6

Compatible with Version 5.x Software

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Cont.2

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, EMC considerations, 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 for the Inverter)*	☐ Component ☐ Relevant Apparatus
Unit fitted:	☐ Wall-mounted ☐ Enclosure

Application Area

The equipment described is intended for industrial motor speed control utilising DC motors, AC induction or AC synchronous 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.

Product Warnings

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

Safety Information



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 5 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 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".

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 Inverter 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.

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.

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.

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

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Chapter 1 GETTING STARTED

Introduction

The 690+ Series AC Drive is designed for speed control of standard 3-phase induction motors. Larger models are available in a range of ratings for constant torque and quadratic torque applications. This dual mode feature provides a cost effective solution to general industrial applications, as well as the control of pumps and fans.

- The unit can be controlled remotely using configurable analogue and digital inputs and outputs, requiring no optional equipment.
- Controlling the unit locally using the 6901 Keypad, or remotely using ConfigEd Lite (or other suitable PC programming tool) gives access to parameters, diagnostic messages, trip settings and full application programming. Other features also become available, such as the advanced sensorless vector control scheme which gives high torque, low speed operation; selectable switching frequencies; and a unique Quiet Pattern control system that minimises audible noise from the motor.
- Technology Options can be fitted to the drive to give serial communications, closed loop speed control, and the factory-fitted dynamic braking functions.
- A factory-fitted System Board enables the drive for high end web processing or mini PLC replacement applications.

The optional internal RFI filters offer enhanced EMC compliance without the need for additional external components (where fitted).

IMPORTANT: Motors used must be suitable for drive duty.

Note: *Do not attempt to control motors whose rated current is less than 25% of the drive rated current. Poor motor control or Autotune problems may occur if you do.*

Equipment Inspection

- Check for signs of transit damage
- Check the product code on the rating label conforms to your requirement.

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.

Refer to Chapter 2: “An Overview of the Drive” to check the rating label/product code.
Refer to Chapter 7: “Routine Maintenance and Repair” for information on returning damaged goods.

Packaging and Lifting Details

Caution
The packaging is combustible and, if disposed of in this manner incorrectly, may lead to the generation of lethal toxic fumes.

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

Use a safe and suitable lifting procedure when moving the drive. Never lift the drive by its terminal connections.

Prepare a clear, flat surface to receive the drive before attempting to move it. Do not damage any terminal connections when putting the drive down.

Refer to Chapter 3: “Installing the Drive” - Mechanical Installation for unit weights.

About this Manual

This manual is intended for use by the installer, user and programmer of the 690+ drive. It assumes a reasonable level of understanding in these three disciplines.

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

Enter the "Model Number" from the rating label into the table at the front of this manual. It is important that you pass these manuals on to any new user of this unit.

Initial Steps

Use the manuals to help you plan the following:

Installation

Know your requirements:

- certification requirements, CE/UL/CUL conformance
- wall-mount or enclosure?
- conformance with local installation requirements
- supply and cabling requirements

Operation

Know your operator:

- how is it to be operated, local and/or remote?
- what level of user is going to operate the unit?
- decide on the best menu level for the Keypad (where supplied)

Programming (Keypad or suitable PC programming tool only)

Know your application:

- install the most appropriate macro
- plan your "block diagram programming"
- enter a password to guard against illicit or accidental changes
- customise the keypad to the application

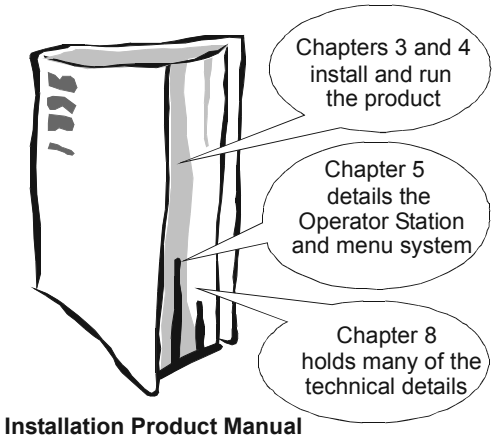
How the Manual is Organised

The information is arranged in to separate "Installation" and "Software" Product Manuals. The Installation Product Manual is considered to be Volume 1, the Software Product Manual is Volume 2. Each manual is divided into chapters and paragraphs. Page numbering restarts with every chapter, i.e. 5-3 is Chapter 5, page 3.

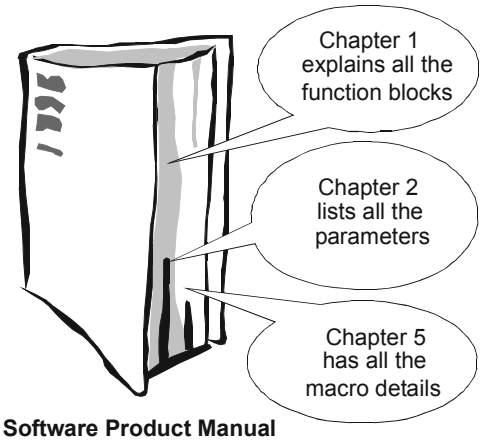
Application Block Diagrams

You will find the appropriate diagrams at the rear of each manual. The pages unfold to show a complete block diagram, these will become your programming tool as you become more familiar with the 690+ unit's software.

Quick-Start Guide



Installation Product Manual



Software Product Manual

Information for Users without a Keypad

DEFAULT

This symbol identifies important text for users operating the drive using the default (factory) set-up. If the text is italic, *such as this*, then the information is especially for users without the keypad or suitable PC programming tool.

Chapter 2 AN OVERVIEW OF THE DRIVE

Component Identification

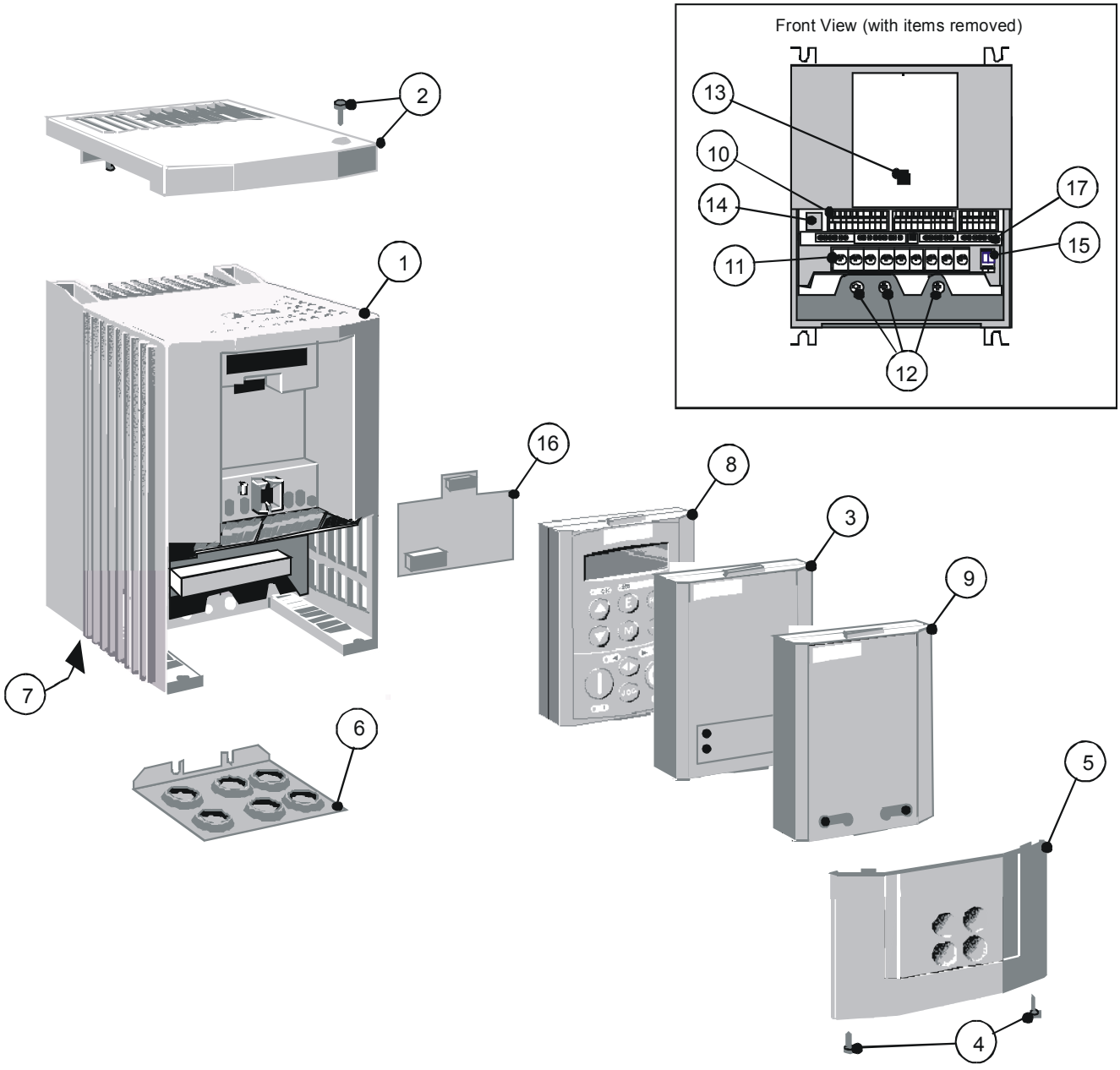


Figure Chapter 2 -1 690+ AC Drive, Frame B 0.75 - 4.0kW

1	Main drive assembly	**10**	Control terminals
2	Top cover (optional)	**11**	Power terminals
3	6053 technology box (optional)	**12**	Earth terminals
4	Terminal cover retaining screw	**13**	Keypad port (P3)
5	Terminal cover	**14**	Future communications option (P8)
6	Gland plate	**15**	Thermistor connection
7	Cooling fan	**16**	Speed feedback board (optional)
8	6901 Keypad	**17**	System Board (optional)
9	Blank cover		

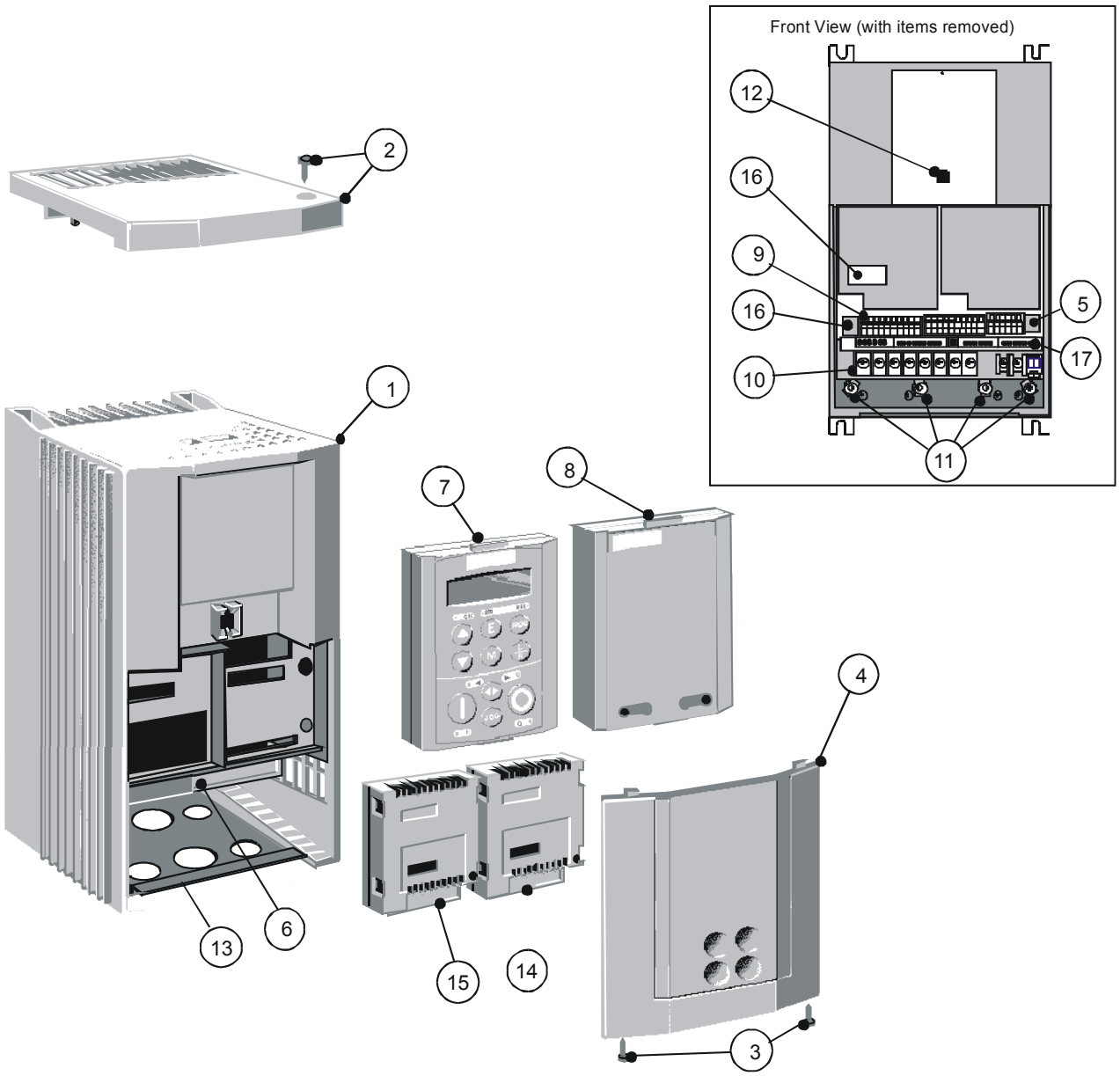


Figure Chapter 2 -2 690+ AC Drive, Frame C 5.5 - 11.0kW

1	Main drive assembly	**10**	Power terminals
2	Top cover (optional)	**11**	Earthing points
3	Terminal cover retaining screw	**12**	Keypad port (P3)
4	Terminal cover	**13**	Gland plate
5	RS232 programming port (P3)	**14**	Comms technology box (optional)
6	Power terminal shield	**15**	Speed feedback technology box (optional)
7	6901 Keypad	**16**	Future communications option (P8)
8	Blank cover	**17**	System Board (optional)
9	Control terminals		

Through-panel fixing plate and screws not illustrated

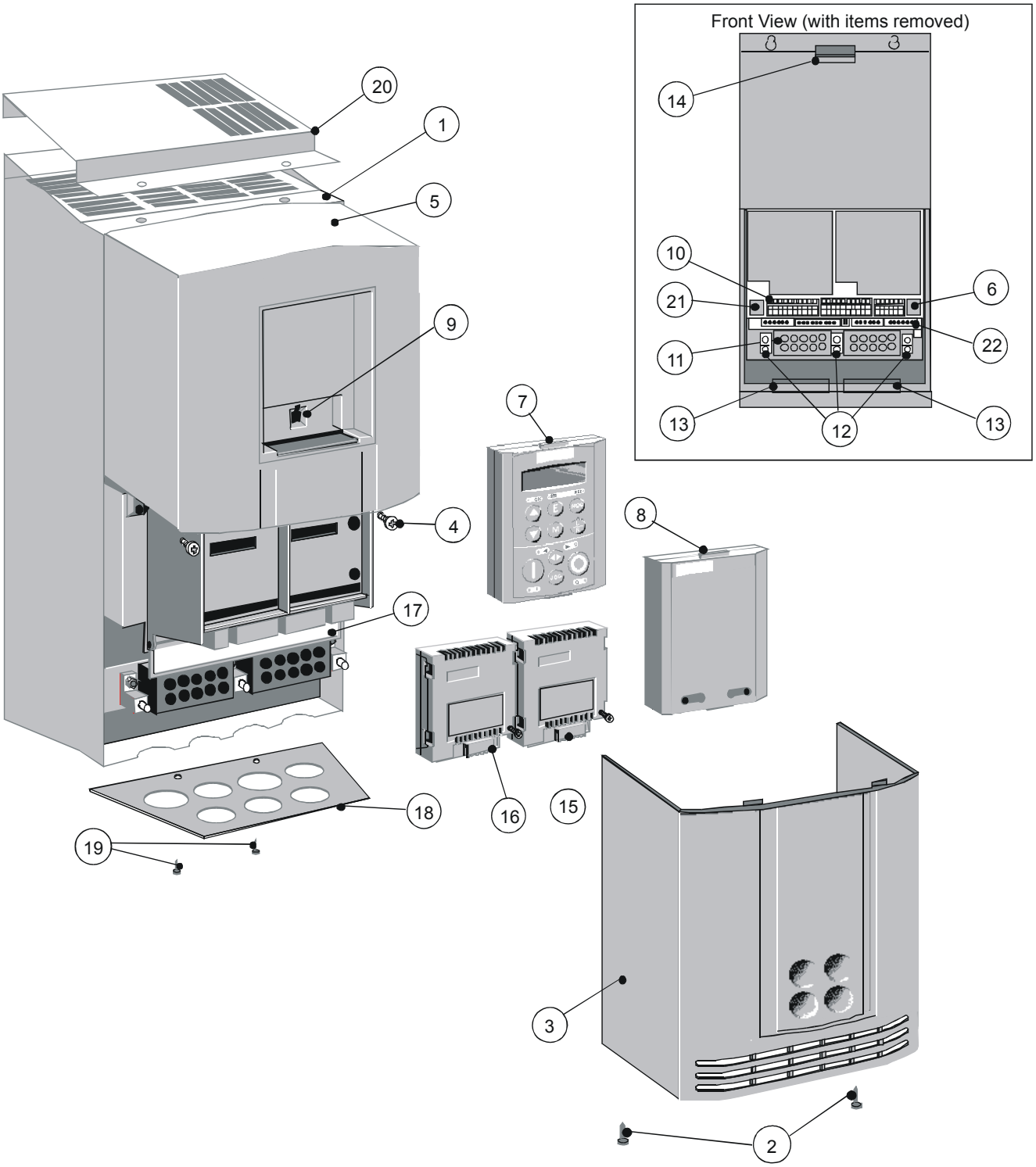


Figure Chapter 2 -3 690+ AC Drive, Frame D 15 - 22kW

1	Main drive assembly	**12**	Earthing points
2	Lower front cover retaining screw	**13**	Chassis fan
3	Lower front cover	**14**	Power board fan
4	Upper front cover retaining screw	**15**	Comms technology box (optional)
5	Upper front cover	**16**	Speed feedback technology box (optional)
6	RS232 programming port (P3)	**17**	Power terminal shield
7	6901 Keypad	**18**	Gland plate
8	Blank cover	**19**	Gland plate retaining screw
9	Keypad port (P3)	**20**	Top cover (optional)
10	Control terminals	**21**	Future communications option (P8)
11	Power terminals	**22**	System Board (optional)
			Through-panel fixing plate and screws not illustrated

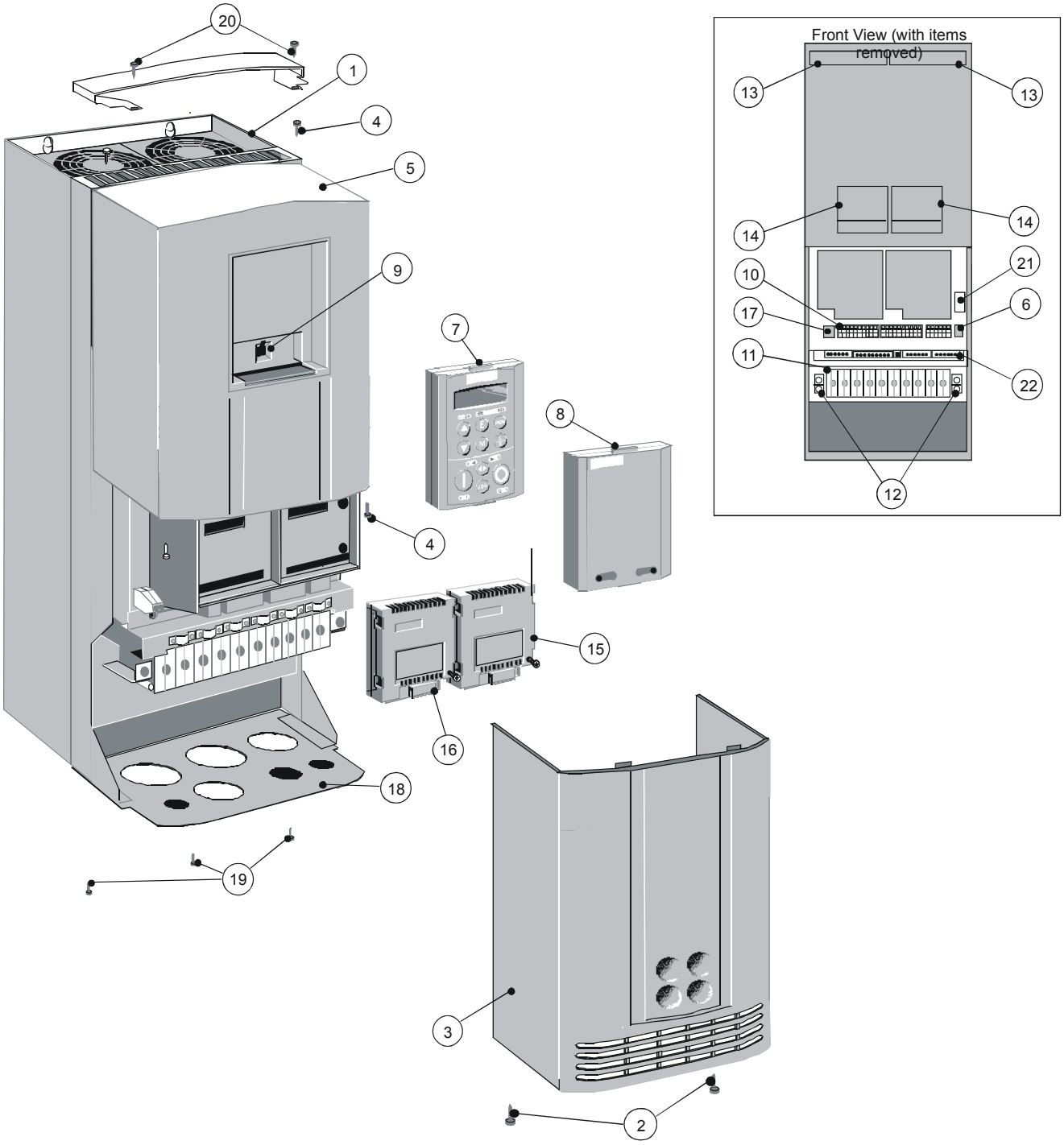


Figure Chapter 2 -4 690+ AC Drive, Frame E 30 - 45kW

1	Main drive assembly	**13**	Chassis fan
2	Lower front cover retaining screw	**14**	Power board fan
3	Lower front cover	**15**	Comms technology box (optional)
4	Upper front cover retaining screw	**16**	Speed feedback technology box (optional)
5	Upper front cover	**17**	Future communications option (P8)
6	RS232 programming port (P3)	**18**	Gland plate
7	6901 Keypad	**19**	Gland plate retaining screw
8	Blank cover	**20**	Top cover (optional)
9	Keypad port (P3)	**21**	Motor thermistor terminals
10	Control terminals	**22**	System Board (optional)
11	Power terminals		
12	Earthing points	*Through-panel fixing plate and screws not illustrated*	

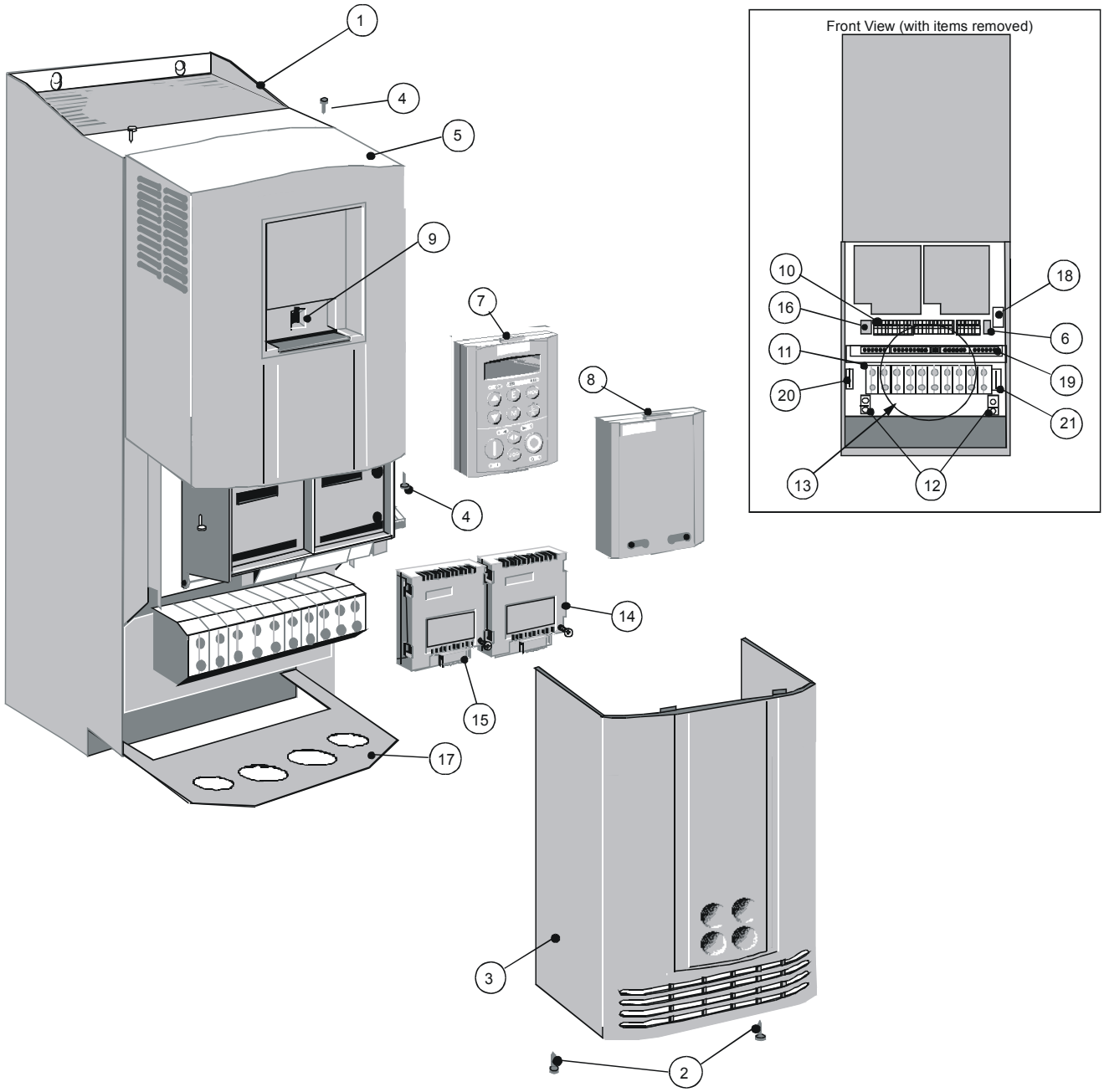


Figure Chapter 2 -5 690+ AC Drive, Frame F 55 - 90kW

1	Main drive assembly	**11**	Power terminals
2	Lower front cover retaining screw	**12**	Earthing points
3	Lower front cover	**13**	Chassis fan
4	Upper front cover retaining screw	**14**	Comms technology box (optional)
5	Upper front cover	**15**	Speed feedback technology box (optional)
6	RS232 programming port (P3)	**16**	Future communications option (P8)
7	6901 Keypad	**17**	Gland plate
8	Blank cover	**18**	Motor thermistor terminals
9	Keypad port (P3)	**19**	System Board (optional)
10	Control terminals	**20**	Auxiliary supply terminals (fan)
		21	Brake terminals

Control Features

The drive is fully-featured when controlled using the optional Keypad (or a suitable PC programming tool).

DEFAULT

The `General' control features below are not user-selectable when the unit is controlled using the analog and digital inputs and outputs.

General	Output Frequency	Selectable 0-500Hz, or 0-1000Hz ≥6kHz (V/Hz mode) Selectable 0-350Hz (closed loop vector mode) Selectable 0-120Hz (sensorless vector mode)
	Switching Frequency	*Constant Torque* : selectable 3kHz, 6kHz or 9kHz depending on power rating *Quadratic Torque* : 3kHz for all units
	Voltage Boost	0-25% (Fixed or Auto Boost)
	Flux Control	1. V/F control with linear or fan law profile 2. Sensorless vector with automatic flux control and slip compensation 3. Closed loop vector (with speed feedback Technology Box)
	Skip Frequencies	4 skip frequencies with adjustable skip band width
	Preset Speeds	8 presets with programmable ramp rates
	Stopping Modes	Ramp, ramp with hold, coast, dc injection, fast stop
	Ramps	Symmetric or asymmetric ramp up and down rates
	Raise/Lower	Programmable MOP function
	Jog	Programmable jog speed
	Logic Functions	10 programmable 3 input logic function blocks performing NOT, AND, NAND, OR, NOR and XOR functions
	Value Functions	10 programmable 3 input value function blocks performing IF, ABS, SWITCH, RATIO, ADD, SUB, RATIO, TRACK/HOLD, and BINARY DECODE functions
	Diagnostics	Full diagnostic and monitoring facilities
Protection	Trip Conditions	Output short line to line, and line to earth Overcurrent > 220% I*t overload 50-105% (adjustable) Heatsink overtemperature Motor Thermistor overtemperature Overvoltage and undervoltage
	Current Limit	Adjustable 50%-150% 180% shock load limit
	Voltage/ Frequency Profile	Linear Law Fan Law User Defined (v5.1 onwards)
Inputs/ Outputs	Analog Inputs	4 configurable inputs - voltage or current
	Analog Outputs	3 configurable outputs - voltage or current
	Digital Inputs	7 configurable 24V dc inputs, 1 fixed 24V dc inputs
	Relay Outputs	3 relay contacts (volt-free)

Table Chapter 2 -1 Control Features

Functional Overview

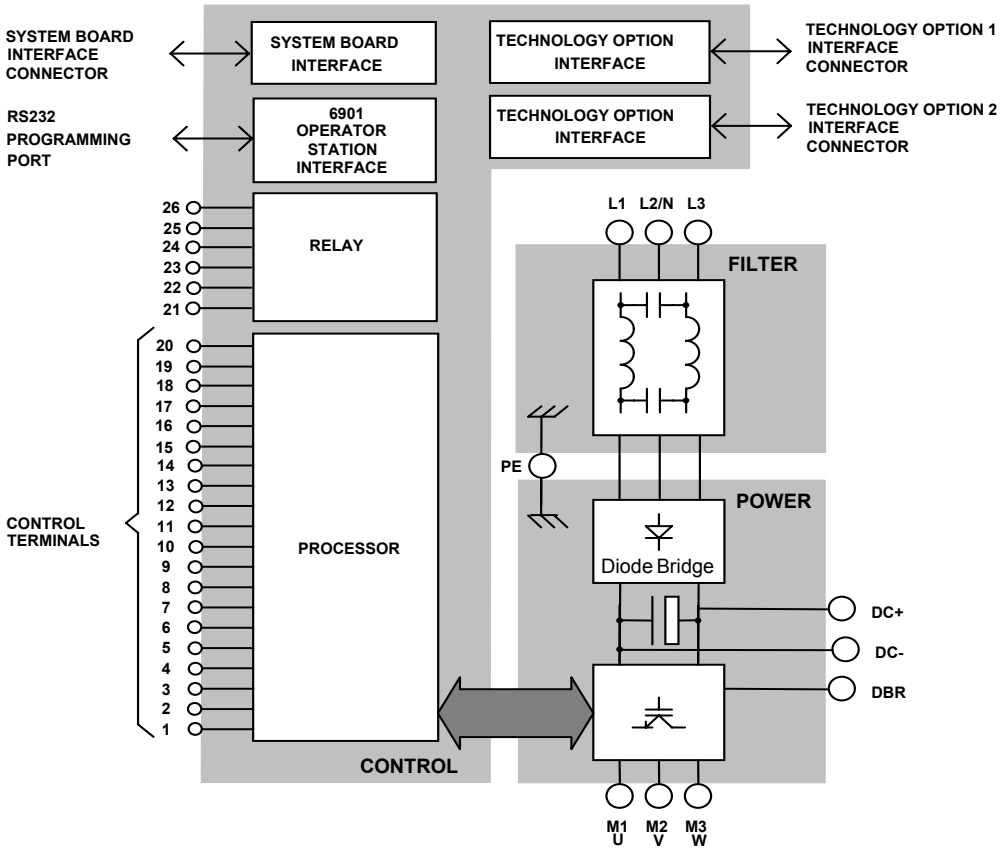


Figure Chapter 2 -6 Functional Block Diagram (Frame B)

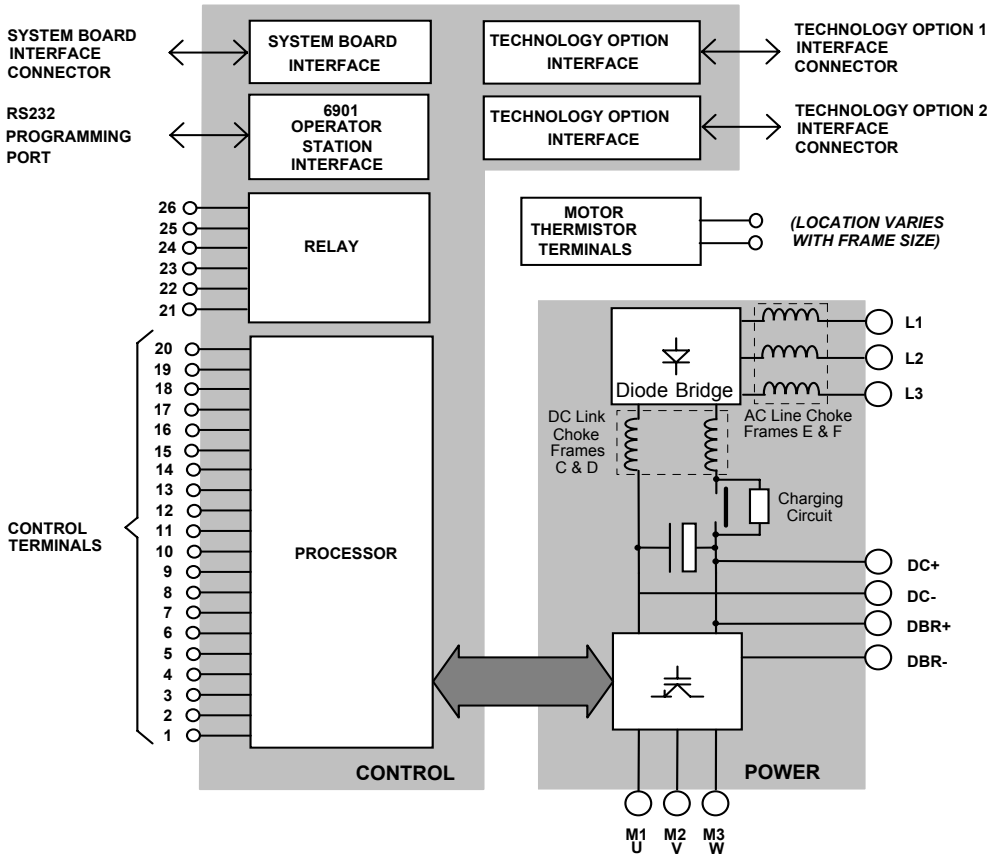


Figure Chapter 2 -7 Functional Block Diagram (Frames C, D, E, F)

Filter Board (Frame B only)

This two-stage filter consists of common and differential mode elements. It attenuates the drive noise produced on to the mains supply. Mains supply is applied to terminals L1, L2 (N) and L3.

Power Board/Stack

DC link capacitors smooth the dc voltage output prior to the drive power stage. The IGBT (Insulated Gate Bi-polar Transistor) output stage converts the dc input to a three phase output used to drive the motor.

Control Board

Processor

The processor provides for a range of analog and digital inputs and outputs, together with their reference supplies. For further details refer to Chapter 8: “Technical Specifications” - Control Terminals.

Technology Options

Comms Technology Box

This is a multi-way connector and processor bus interface with control signals allowing various Technology Box protocol options to be fitted to the drive.

Speed Feedback Technology Box/Board

Provides speed feedback for HTTL encoders. The option takes the form of a Technology Board in the case of the 690+ Frame B.

Keypad Interface

This is a non-isolated RS232 serial link for communication with the Keypad. Alternatively, a PC running Parker SSD Drives’ “DSE Lite” Windows-based configuration software (or some other suitable PC programming tool) can be used to graphically program and configure the drive.

System Board Interface

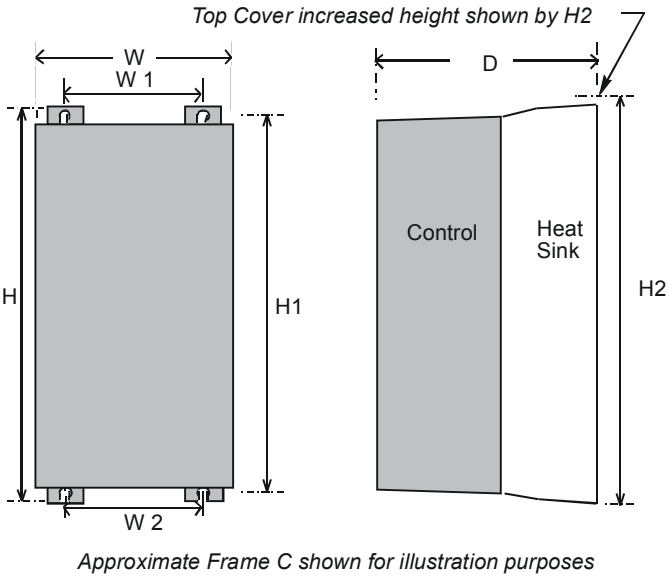
The System Board interface hosts the factory-fitted System Board which enhances the 690+ product in to a fully featured systems drive.

Chapter 3 INSTALLING THE DRIVE

IMPORTANT: Read Chapter 9: "Certification for the Drive" before installing this unit.

Mechanical Installation

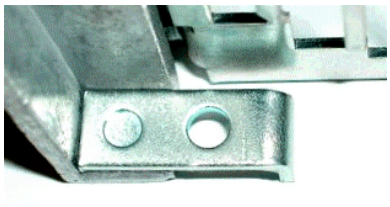
If wall-mounted, the unit must be fitted with the Top Cover firmly screwed into position.



Approximate Frame C shown for illustration purposes

Replacing an Existing Unit

The lower fixing centres for Frame B are now 150.0mm (5.90"). A new dimension "W2" is introduced in to the table.



If you find it necessary to use existing mounting holes, an adjustment clamp is available, part number BA469654. Two of these clamps are required for each drive.

Figure Chapter 3 -1 Mechanical Dimensions for 690+ Series

Models	Max. Weight kg/lbs	H	H1	H2	W	W1	W2	D	Fixings
Frame B	4.3/9.5	233.0 (9.17)	223.0 (8.78)	234.0 (9.20)	176.5 (6.95)	129.5 (5.09)	150.0 (5.90)	181.0* (7.15)	Slot 4.8mm wide Use M4 fixings
Frame C	9.3/20.5	348.0 (13.70)	335.0 (13.19)	365.0 (14.37)	201.0 (7.91)	150.0 (5.90)	150.0 (5.90)	208.0 (8.19)	Slot 7mm wide Use M5 or M6 fixings.
Frame D	18.4/40.6	453.0 (17.80)	440.0 (17.30)	471.0 (18.50)	252.0 (9.92)	150.0 (5.90)	150.0 (5.90)	245.0 (9.65)	Slot 7mm wide Use M5 or M6 fixings.
Frame E	32.5/72	668.6 (26.30)	630.0 (24.80)	676.0 (26.60)	257.0 (10.10)	150.0 (5.90)	150.0 (5.90)	312 (12.30)	Use M6 fixings
Frame F	41/90.4	720.0 (28.30)	700.0 (27.60)	Not applicable	257.0 (10.10)	150.0 (5.90)	150.0 (5.90)	355.0 (14.00)	Use M6 fixings

** 197.0 (8.04) when unit fitted with System Board*

All dimensions are in millimetres (inches)

Note: *For details of a through-panel mounting option for Frames D & E refer to pages 3-6 and 3-8 respectively.*

Mounting the Drive

The unit must be mounted vertically on a solid, flat, vertical surface. It can be wall-mounted, or mounted inside a suitable cubicle, depending upon the required level of EMC compliance - refer to Chapter 8: "Technical Specifications".

Ventilation

The drive gives off heat in normal operation and must therefore be mounted to allow the free flow of air through the ventilation slots and heatsink. Maintain minimum clearances for ventilation as given in the tables below to ensure adequate cooling of the drive, and that heat

generated by other adjacent equipment is not transmitted to the drive. Be aware that other equipment may have its own clearance requirements. When mounting two or more 690+ units together, these clearances are additive. Ensure that the mounting surface is normally cool.

Minimum Air Clearance (Frame B)

Cubicle-Mount Product/Application (Frame B)

(Europe: IP2x, USA/Canada: Open Type)

The drive, without the top cover fitted, must be mounted in a suitable cubicle.

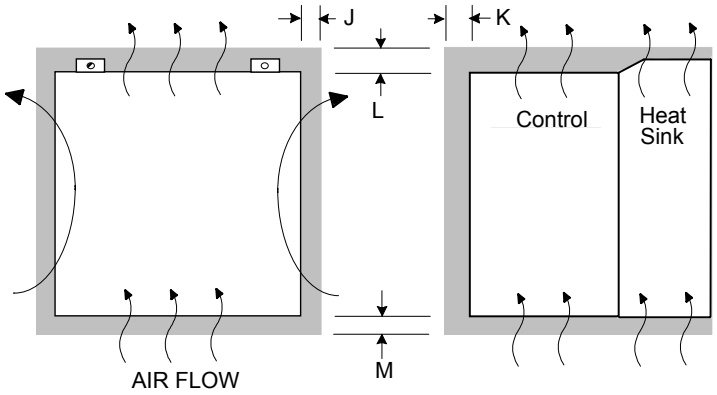


Figure Chapter 3 -2 Air Clearance for a Cubicle-Mount Product/Application

Model Recognition	Clearances for Standard Product without Top Cover (mm)			
	J	K	L	M
Frame B	15	15	70	80

Wall-Mount Product/Application (Frame B)

(Europe: IP2x plus IP4x top surface protection, USA/Canada: Type 1)

Wall-mounted 690+ units **must** have the top cover correctly fitted. The top cover fixing screw has a maximum tightening torque of 1.5Nm (1.2Nm recommended). Refer to Chapter 9: "Certification for the Drive" - Direct Wall-Mountable Models.

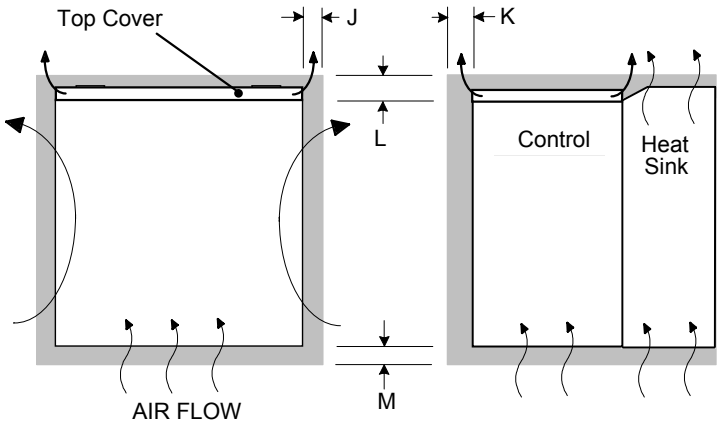


Figure Chapter 3 -3 Air Clearance for a Wall-Mount Product/Application

Model Recognition	Clearances for Standard Product fitted with Top Cover (mm)			
	J	K	L	M
Frame B	15	15	70	80

Minimum Air Clearance (Frame C)

Cubicle-Mount Product/Application (Frame C)

(Europe: IP2x, USA/Canada: Open Type).

The drive, without the top cover fitted, must be mounted in a suitable cubicle.

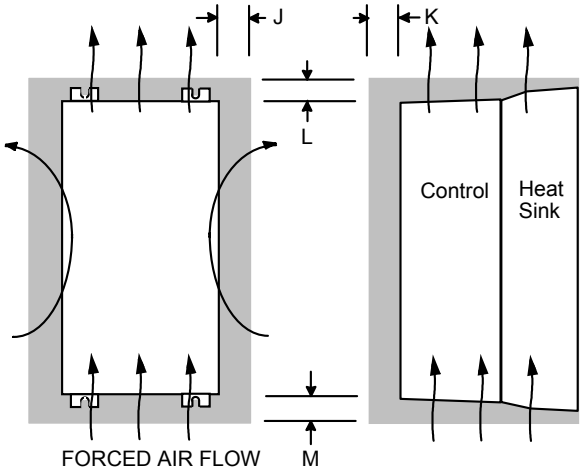


Figure Chapter 3 -4 Air Clearance for a Cubicle-Mount Product/Application

Model Recognition	Clearances for Standard Product without Top Cover (mm)			
	J	K	L	M
Frame C	15	15	70	70

Wall-Mount Product/Application (Frame C)

(Europe: IP2x plus IP4x top surface protection, USA/Canada: Type 1).

Wall-mounted 690+ units **must** have the top cover correctly fitted. The top cover fixing screw has a maximum tightening torque of 1.5Nm (1.2Nm recommended).

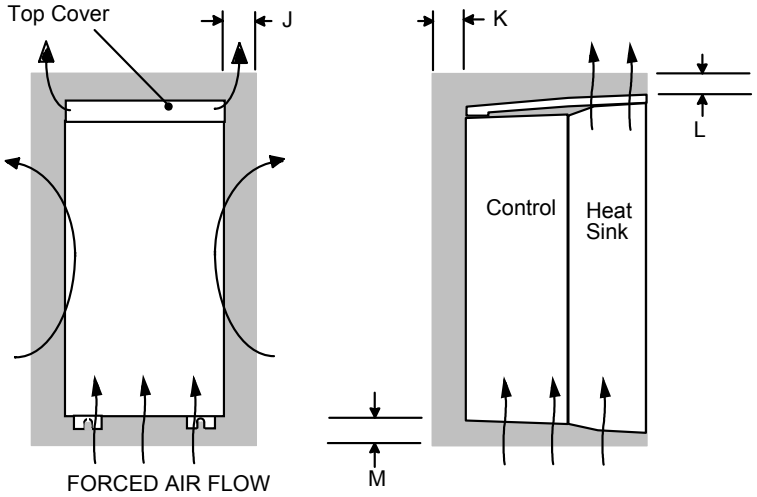


Figure Chapter 3 -5 Air Clearance for a Wall-Mount Product/Application

Model Recognition	Clearances for Standard Product fitted with Top Cover (mm)			
	J	K	L	M
Frame C	20	15	70	70

Through-Panel Mount Product/Application (Frame C)

(Europe: IP2x, USA/Canada: Open Type).

The drive, without the top cover fitted, can be mounted in a suitable cubicle.

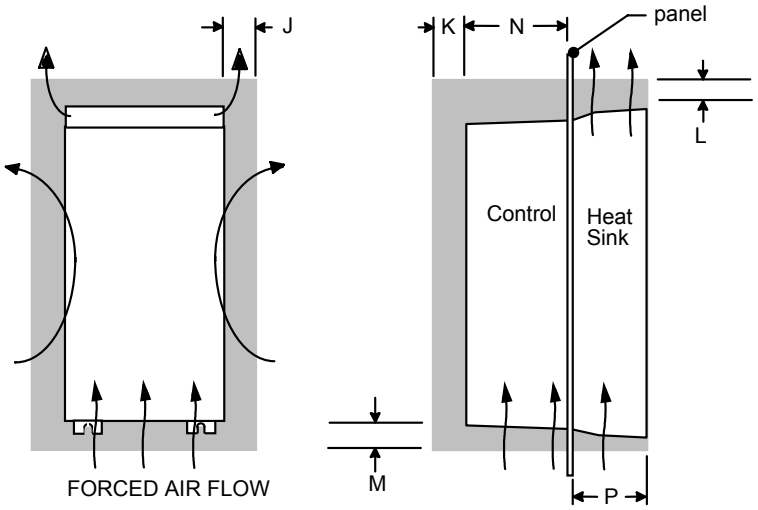
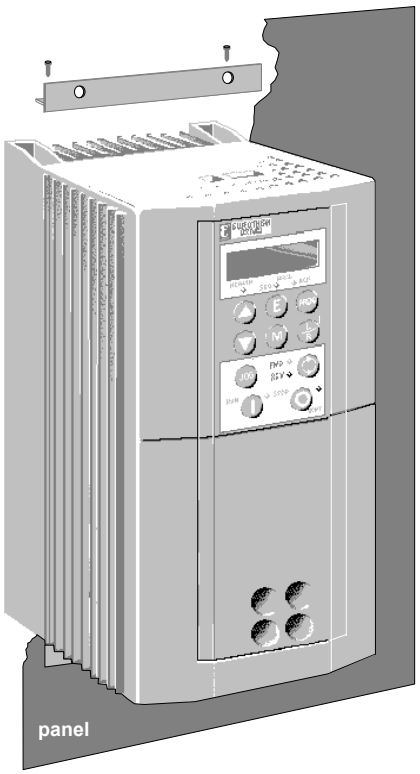


Figure Chapter 3 -6 Air Clearance for a Through-Panel Mount Product/Application

Model Recognition	Clearances for Through-Panel Mount Standard Product (mm)				Through-Panel Dimensions	
	J	K	L	M	N	P
Frame C	20	15	70	70	125	82



Through-Panel Mount Bracket Assembly (Frame C)

The through-panel kit is available as a separate item, part number LA465034U003.

Through-panel mounting a drive in a cubicle allows you to use a smaller cubicle because much of the heat generated by the drive is dissipated outside the cubicle.

- Cut the panel aperture to the dimensions given in the drawing at the end of this chapter.
- Screw the top and bottom brackets to the drive as shown, torque to 3Nm. When in position, these complete a mating face for the panel around the drive.
- Fit the top and bottom self-adhesive gasket material to the brackets making sure that the gasket covers the gap between the bracket and heatsink along the top and bottom edge of the drive.
- Fit a gasket to each side of the drive to complete the gasket seal. Ensure a complete seal is made; 2 extra side gaskets are provided.
- Offer up the drive to the panel and secure.

Refer to Through-Panel Cutout Details, page 3-9.

Minimum Air Clearance (Frame D)

Cubicle-Mount Product/Application (Frame D)

(Europe: IP2x, USA/Canada: Open Type).

The drive, without the top cover fitted, must be mounted in a suitable cubicle.

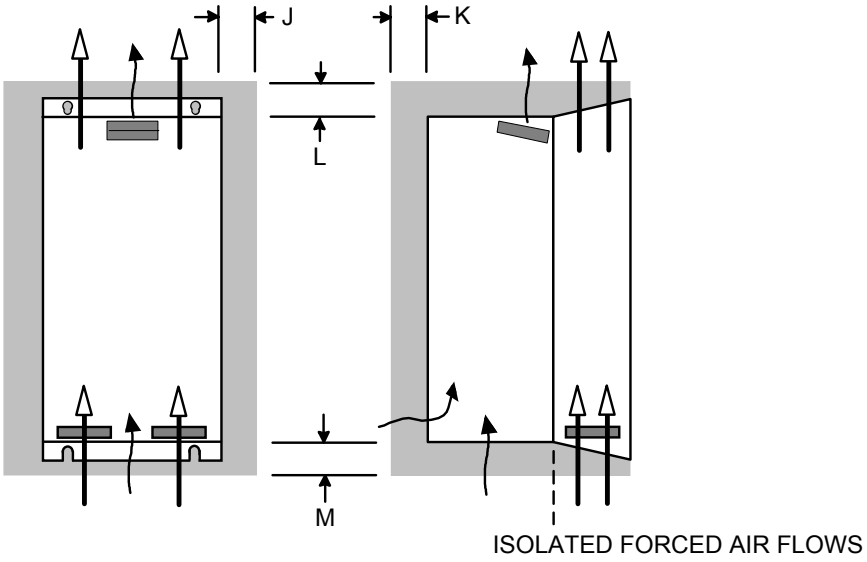


Figure Chapter 3 -7 Air Clearance for a Cubicle-Mount Product/Application

Model Recognition	Clearances for Standard Product without Top Cover (mm)			
	J	K	L	M
Frame D	15 LHS, 5 RHS	25	70	70

Wall-Mount Product/Application (Frame D)

(Europe: IP2x plus IP4x top surface protection, USA/Canada: Type 1).

Wall-mounted 690+ units **must** have the top cover correctly fitted. The top cover fixing screw has a maximum tightening torque of 1.5Nm (1.2Nm recommended).

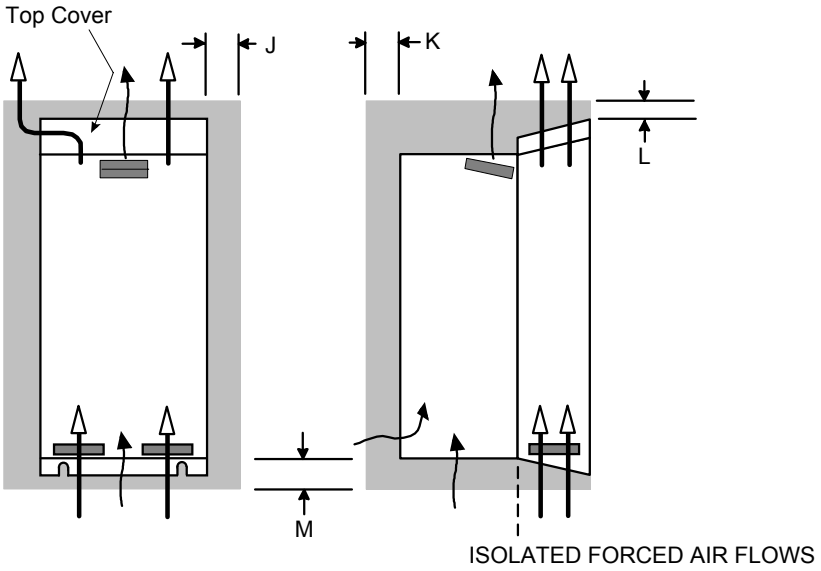


Figure Chapter 3 -8 Air Clearance for a Wall-Mount Product/Application

Model Recognition	Clearances for Standard Product fitted with Top Cover (mm)			
	J	K	L	M
Frame D	15 LHS, 5 RHS	25	70	70

Through-Panel Mount Product/Application (Frame D)

(Europe: IP2x, USA/Canada: Open Type).

The drive, without the top cover fitted, can be mounted in a suitable cubicle.

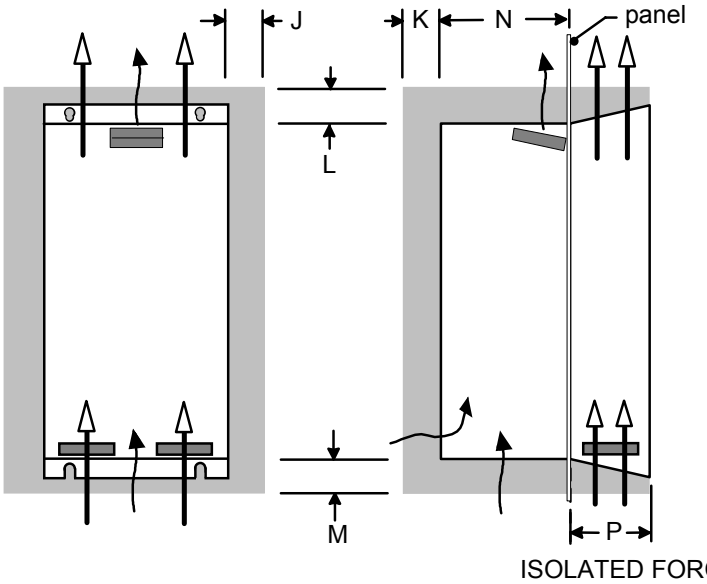
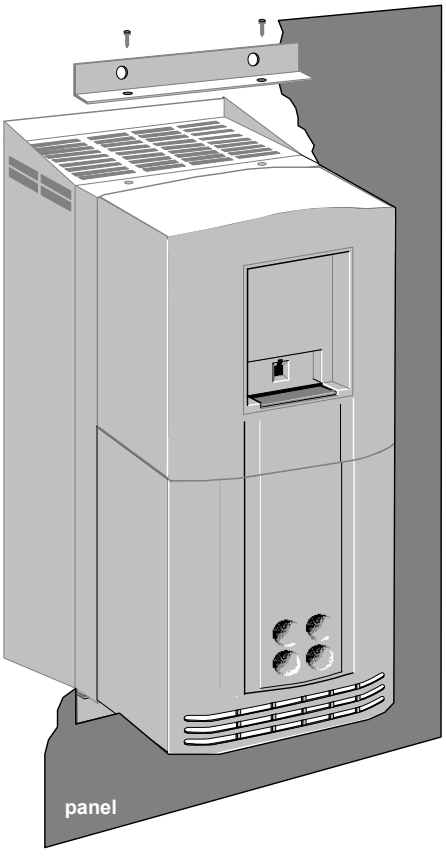


Figure Chapter 3 -9 Air Clearance for a Through-Panel Mount Product/Application

Model Recognition	Clearances for Through-Panel Mount Standard Product (mm)				Through-Panel Dimensions	
	J	K	L	M	N	P
Frame D	15 LHS, 5 RHS	25	100	100	141	104



Through-Panel Mount Bracket Assembly (Frame D)

The through-panel kit is available as a separate item, part number LA465048U003.

Through-panel mounting a drive in a cubicle allows you to use a smaller cubicle because much of the heat generated by the drive is dissipated outside the cubicle.

- Cut the panel aperture to the dimensions given in the drawing at the end of this chapter.
- Screw the top and bottom brackets to the drive as shown, torque to 4Nm. When in position, these complete a mating face for the panel around the drive.
- Fit the top and bottom gaskets to the panel, aligning the gasket holes with the holes in the panel for fixing the drive. Fit two side gaskets around the panel aperture so that an air-tight seal will be made between the drive and the panel; 2 extra side gaskets are provided.
- Offer up the drive to the panel and secure.

Refer to Through-Panel Cutout Details, page 3-9.

Minimum Air Clearance (Frame E)

Cubicle-Mount Product/Application (Frame E)

(Europe: IP2x, USA/Canada: Open Type).

The drive, without the top cover fitted, must be mounted in a suitable cubicle.

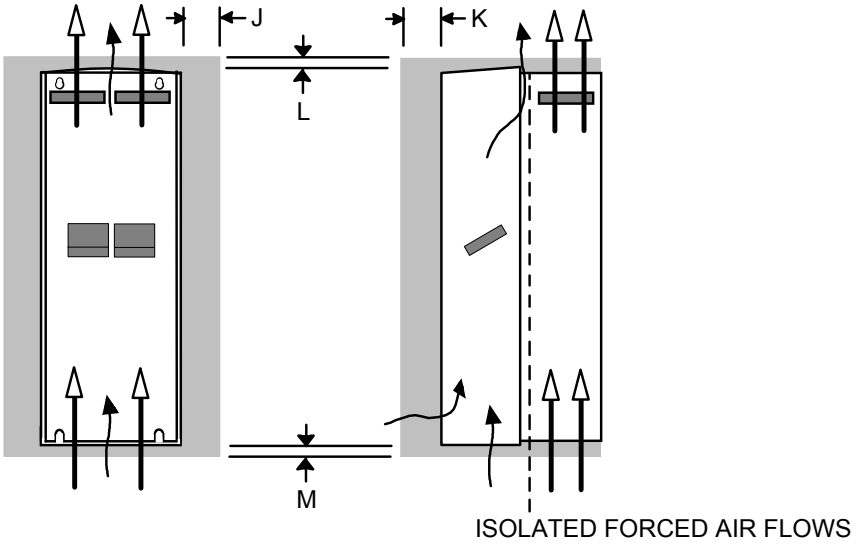


Figure Chapter 3 -10 Air Clearance for a Cubicle-Mount Product/Application

Model Recognition	Clearances for Standard Product without Top Cover (mm)			
	J	K	L	M
Frame E	0 (zero)	25	70	70

Wall-Mount Product/Application (Frame E)

(Europe: IP2x plus IP4x top surface protection, USA/Canada: Type 1).

Wall-mounted 690+ units **must** have the top cover correctly fitted. The top cover fixing screw has a maximum tightening torque of 1.5Nm (1.2Nm recommended).

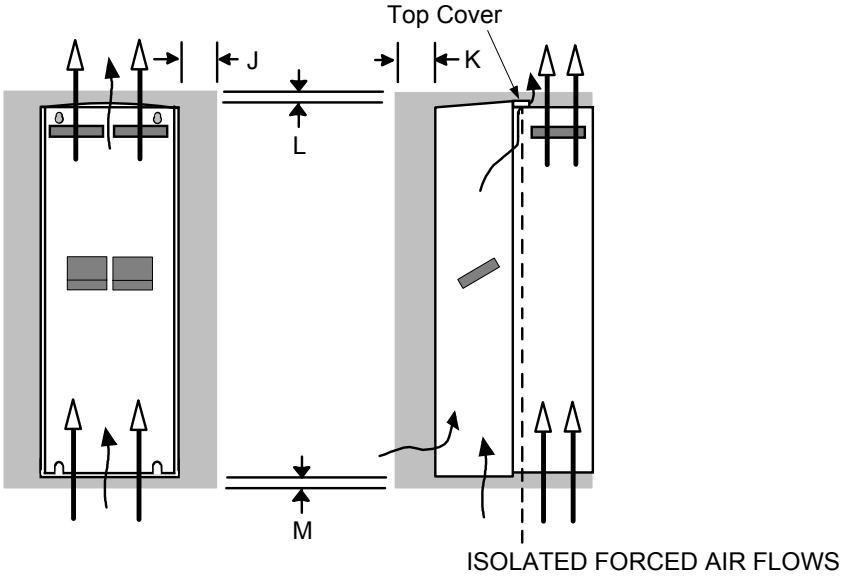


Figure Chapter 3 -11 Air Clearance for a Wall-Mount Product/Application

Model Recognition	Clearances for Standard Product fitted with Top Cover (mm)			
	J	K	L	M
Frame E	0 (zero)	25	70	70

Through-Panel Mount Product/Application (Frame E)

(Europe: IP2x, USA/Canada: Open Type).
The drive, without the top cover fitted, can be through-panel mounted in a suitable cubicle.

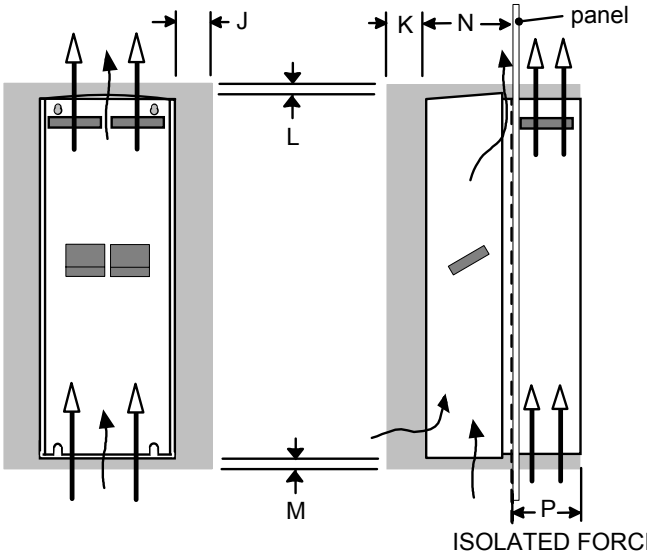
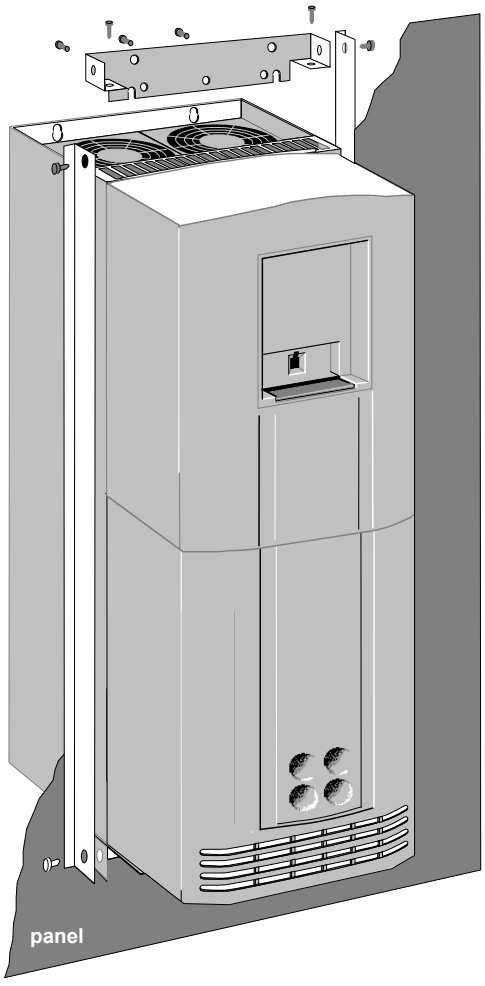


Figure Chapter 3 -12 Air Clearance for a Through-Panel Mount Product/Application

Model Recognition	Clearances for Through-Panel Mount Standard Product (mm)				Through-Panel Dimensions	
	J	K	L	M	N	P
Frame E	0 (zero)	25	70	70	180	129 (panel thickness not included, max. thickness 5mm



Through-Panel Mount Bracket Assembly (Frame E)

The through-panel kit is available as a separate item, part number LA465058U003.

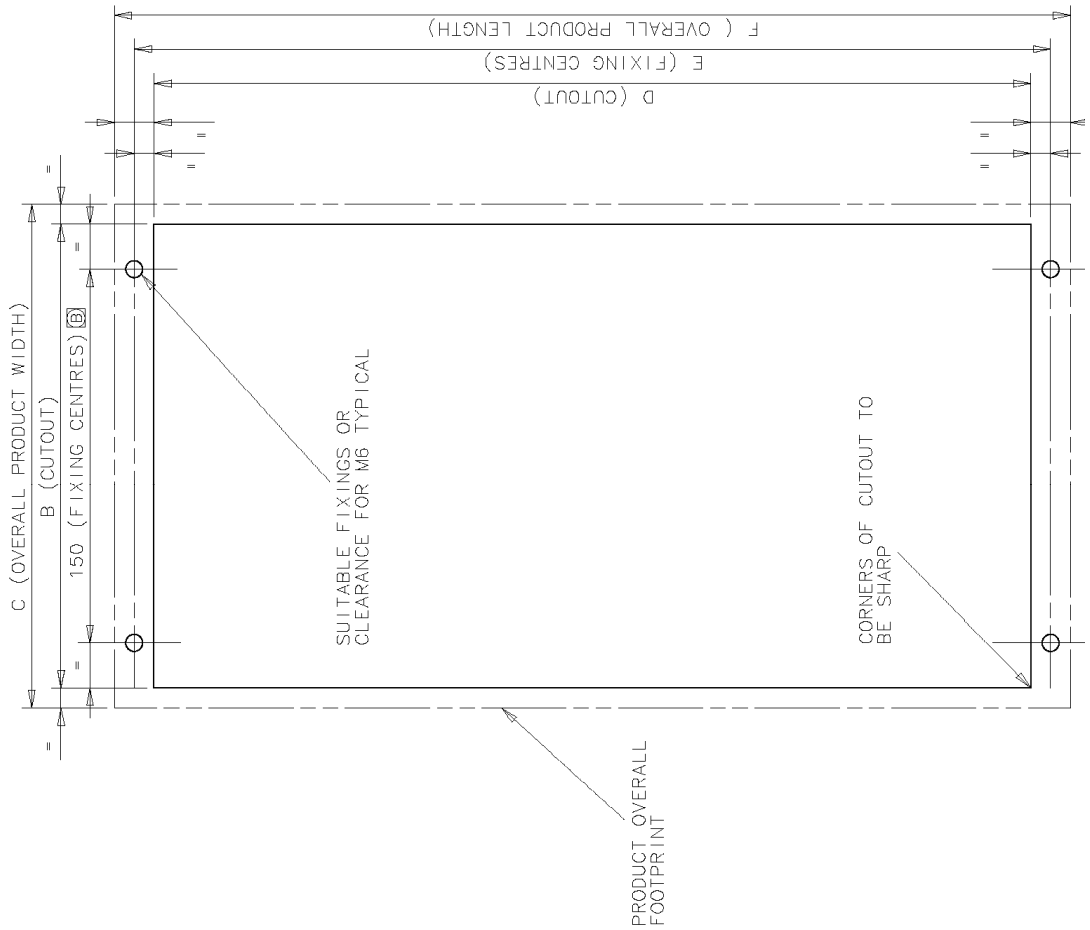
Through-panel mounting a drive in a cubicle allows you to use a smaller cubicle because much of the heat generated by the drive is dissipated outside the cubicle.

- Cut the panel aperture to the dimensions given in the drawing at the end of this chapter.
- Lay the drive on its back.
- Lightly screw the top and bottom brackets to the drive as shown.
- Fit the two side brackets to complete the frame and tighten all screws securely.
- Fit the self-adhesive gasket material to the mating face of the drive to produce an air-tight seal between the drive and the panel.
- Offer up the drive to the panel and secure.

Refer to Through-Panel Cutout Details, page 3-9.

Through-Panel Cutout Details

PRODUCT	DIM "B"	DIM "C"	DIM "D"	DIM "E"	DIM"F"
FRAME C	186	196	354	370	390
FRAME D	236	252	453	470	485
FRAME E	255	290	649	667.5	687



Minimum Air Clearance (Frame F)

Note: *There is no through panel-mount capability for the 690F.*

Cubicle-Mount Product/Application (Frame F)

(Europe: IP00 or IP20, USA/Canada: Open Type).

WARNING!

The drive must be mounted in a cubicle that is suitable for the environment. The drive is IP00 or IP20 and hence requires the further protection provided by the cubicle to avoid personal injury.

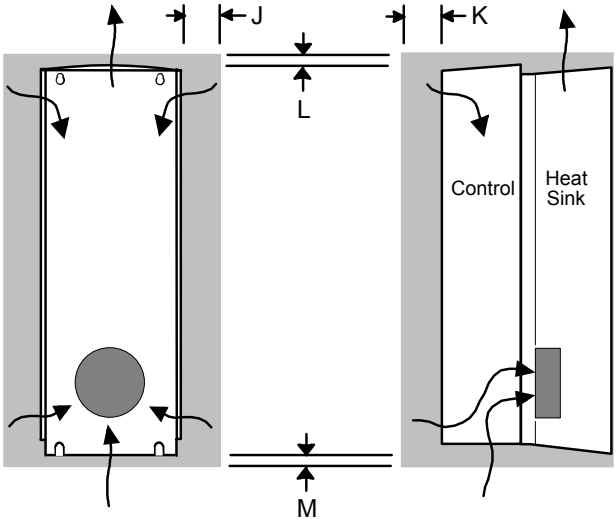


Figure Chapter 3 -13 Air Clearance for a Cubicle-Mount Product/Application

Model Recognition	Clearances for Standard Product (mm)			
	J	K	L	M
Frame F	0 (zero)	25	70	70

Duct Kit

A Duct kit, Part Number LA466717U003 is available for the 690+ Frame F drive.

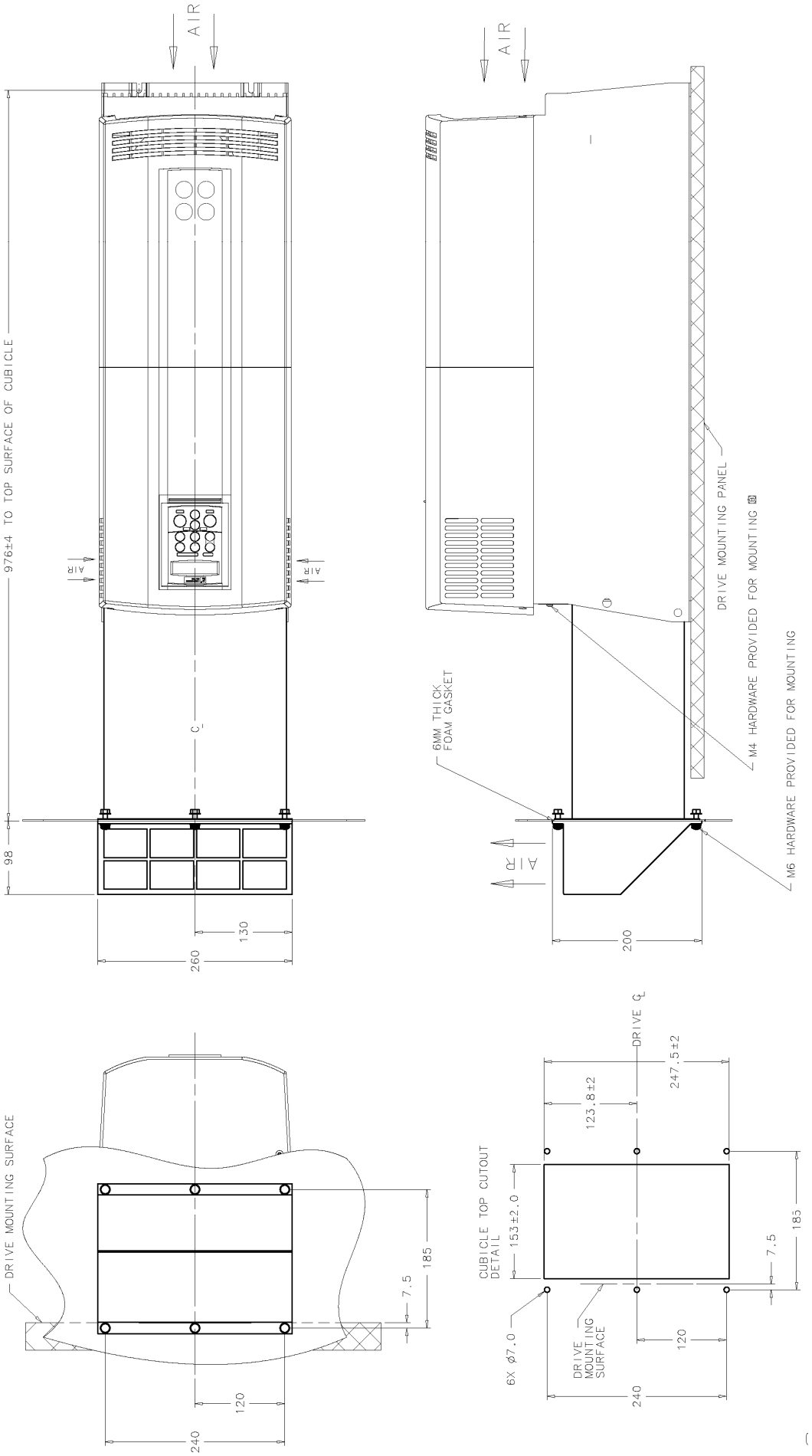
The installation diagram is provided on the following page.

Caution

Protect any equipment in the cubicle from swarf etc. Ensure all equipment is isolated.

- The duct length determines the vertical position of the drive in the cubicle. Drill the lower mounting panel hole centres for the drive at 976mm from the top of the cubicle. There is a generous tolerance of ±4mm.
- Cut-out the hole for the duct directly above where the drive sits. Project the position of the drive mounting surface inside the cubicle and mark it on the roof. From the drawing, you can calculate that the cut-out is made 8.5mm in front of the drive mounting surface (the centres for the cowling fixing holes will be 7.5mm behind the drive mounting surface). Draw the cut-out shape, check its position, and cut it out.
- Because of the weight of the drive, it may be better to secure the drive in the cubicle first, and lower the duct into the cubicle from above.
- Fix the duct to the drive using the M4 fasteners.
- Fit the gasket between the duct cowling and the top of the cubicle to provide a good seal. Drill through and secure all this with the M6 fasteners.

Duct Kit Installation Diagram



Electrical Installation

IMPORTANT: Please read the Safety Information on page Cont. 3 & 4 before proceeding.

WARNING!
Ensure that all wiring is electrically isolated and cannot be made "live" unintentionally by other personnel.

Note: *Refer to Chapter 8: "Technical Specifications" for additional Cabling Requirements and Terminal Block Wire Sizes.*

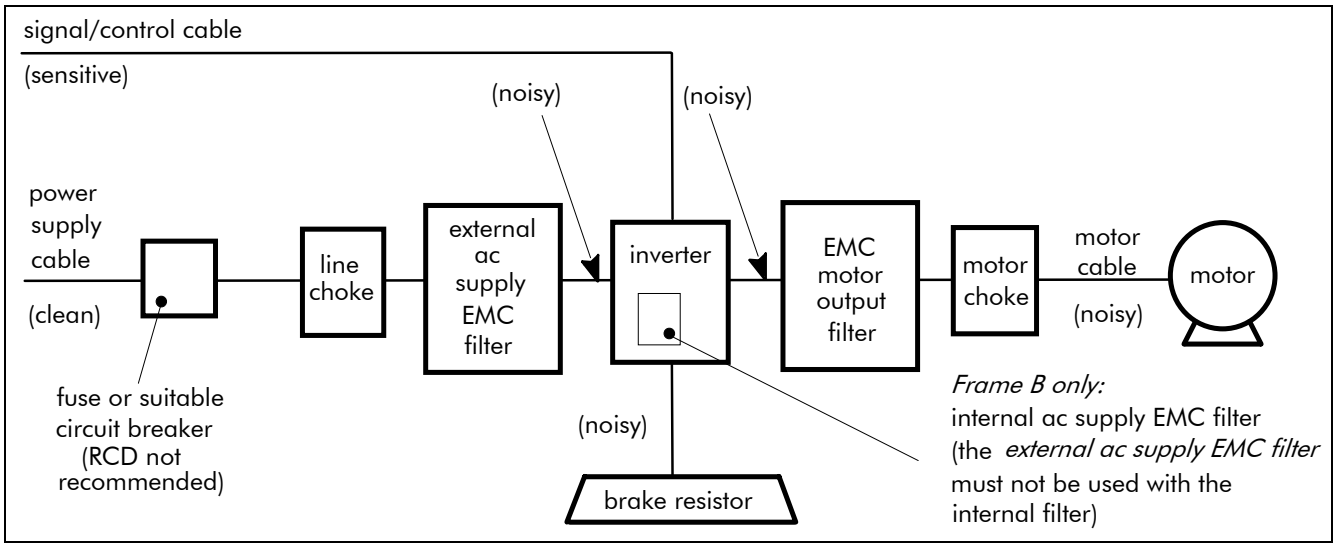


Figure Chapter 3 -14 Cabling Requirements

Cables are considered to be electrically *sensitive*, *clean* or *noisy*. You should already have planned your cable routes with respect to segregating these cables for EMC compliance. If not, refer to Chapter 9: "Certification for the Drive".

Gland Plate Details

Frame B The gland plate is fitted with grommets. Alternatively, the supplied screen termination clamps may be fitted.

The gland plate holes accept the following gland sizes:

- metric M20, PG16 and American ½" NPT cable gland sizes.

Frame C The gland plate holes accept the following gland sizes:

- 22.8mm to accept metric M20, PG16 and American ½" NPT cable gland sizes
- 28.6mm to accept M25, PG21 and American ¾" NPT cable gland sizes

Frame D The gland plate holes accept the following gland sizes:

- 28.6mm to accept metric M20, PG16 and American ½" NPT cable gland sizes
- 37.3mm to accept metric M32, PG29 and American 1" NPT

Frame E The gland plate holes accept the following gland sizes:

- 22.8mm to accept metric M20, PG16 and American ½" NPT cable gland sizes
- 28.6mm to accept metric M25, PG21 and American ¾" NPT cable gland sizes
- 47.3mm to accept metric M40, PG36 and American 1¼" NPT cable gland sizes
- 54.3mm to accept metric M50, PG42 and American 1½" NPT cable gland sizes

Frame F The gland plate holes accept the following gland sizes:

- 22.8mm to accept metric M20, PG16 and American ½" NPT cable gland sizes
- 28.6mm to accept M25, PG21 and American ¾" NPT cable gland sizes

Cable Gland Requirements

Use a metal gland to connect to the internally earthed gland plate. It must be capable of securing a 360 degree screened connection to give EMC compliance. A 360 degree screened connection can be achieved as shown.

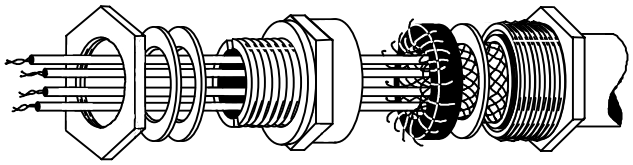


Figure Chapter 3 -15 360 Degree Screened Connection

Protective Earth (PE) Connections ⏚

The unit must be **permanently earthed** according to EN 50178 - see below. Protect the incoming mains supply using a suitable fuse or circuit breaker (circuit breaker types RCD, ELCB, GFCI are not recommended). Refer to "Earth Fault Monitoring Systems", page 3-30.

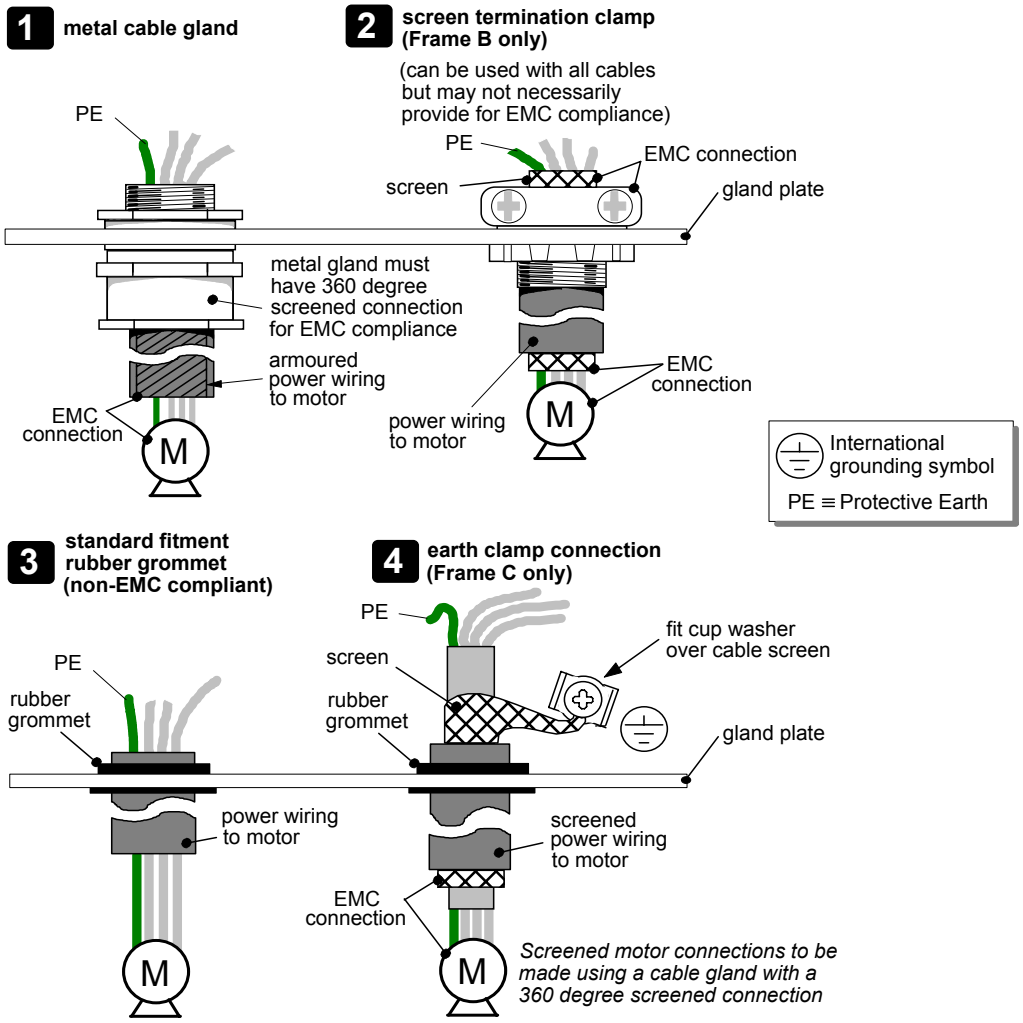
IMPORTANT: The drive is only suitable for earth referenced supplies (TN) when fitted with an internal filter. External filters are available for use on TN and IT (non-earth referenced) supplies.

The unit must be **permanently earthed** according to EN 50178:

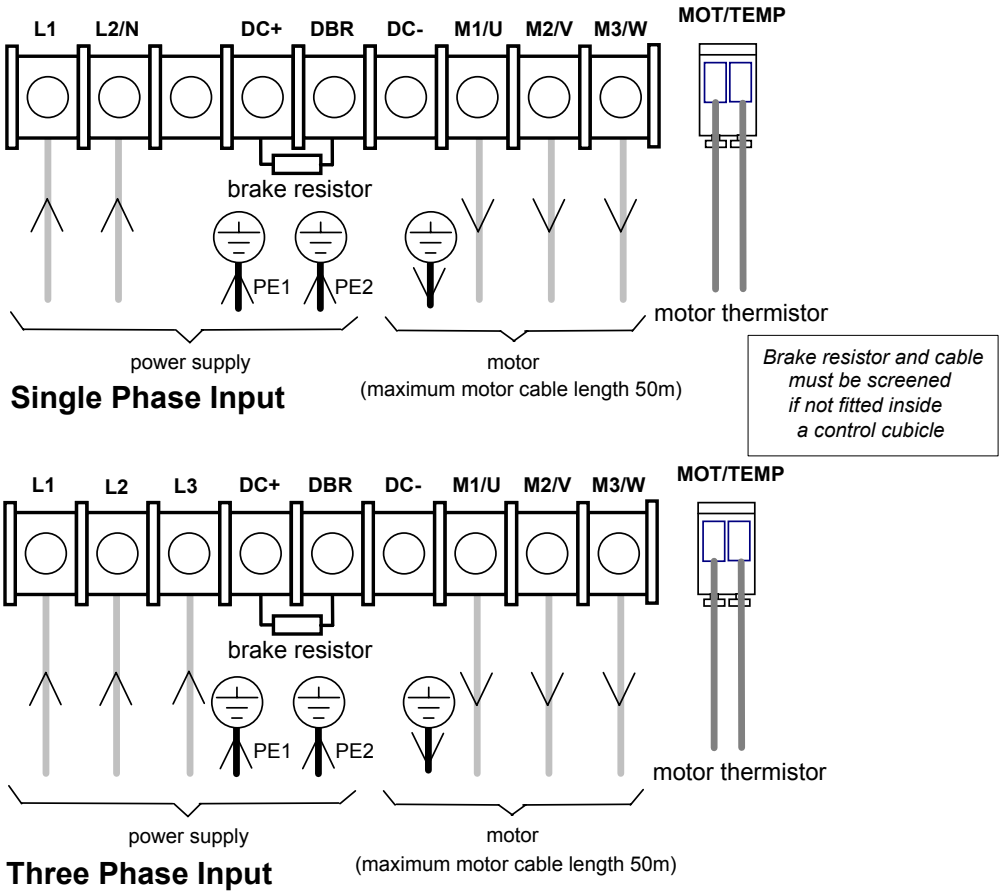
- A cross-section conductor of at least 10mm² is required. This can be achieved either by using a single conductor (PE) or by laying a second conductor though separate terminals (PE2 where provided) and electrically in parallel.

Refer to Chapter 9: "Certification for the Drive" - EMC Installation Options.

Motor Connections

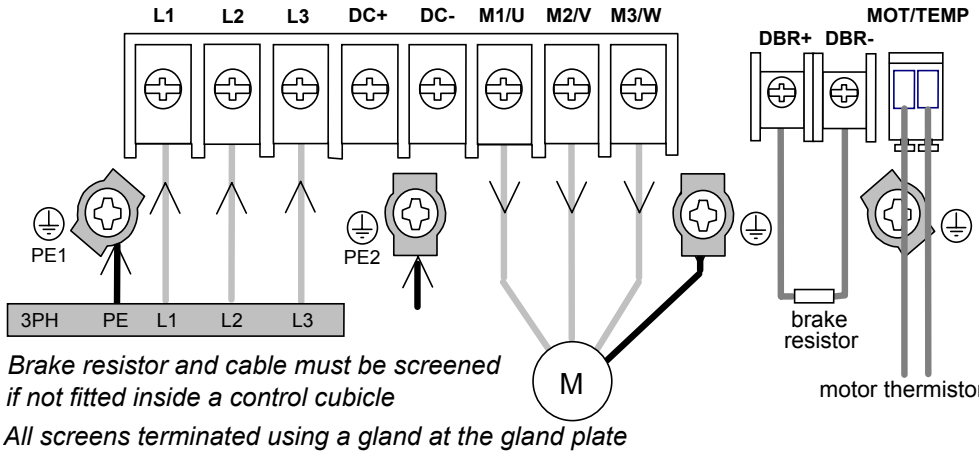


Power Wiring Connections (Frame B)



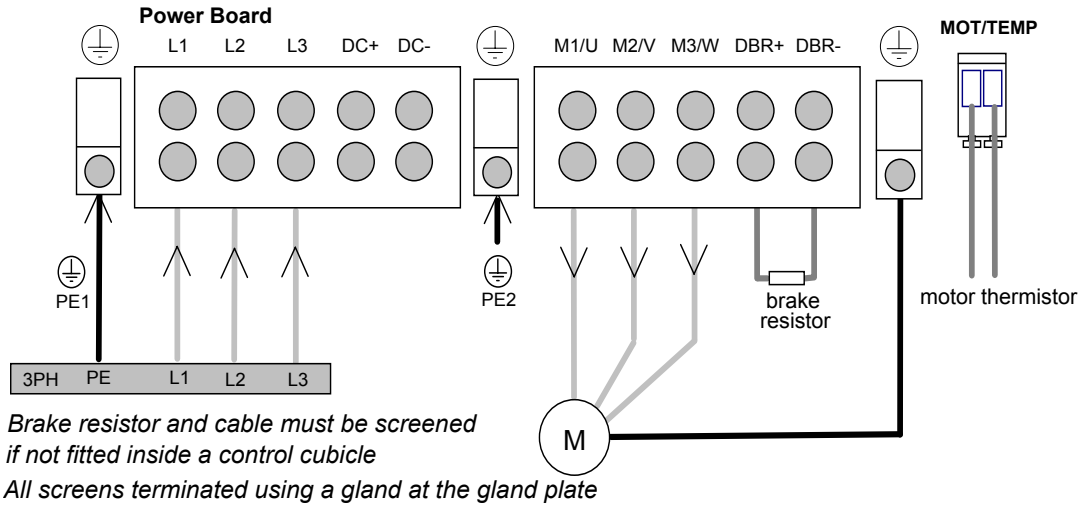
1. Remove the terminal cover retaining screws and lift off the terminal cover.
2. Feed the power supply and motor cables into the drive through the metal gland plate using the correct cable entries, and connect to the power terminals. Tighten all terminals to the correct tightening torque, refer to the Terminal Tightening Torques table.

Power Wiring Connections (Frame C)



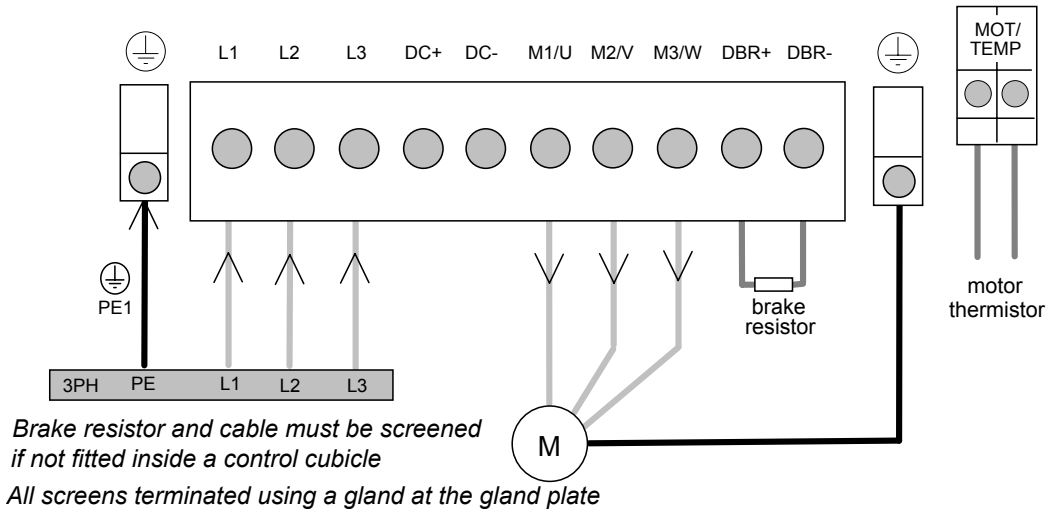
1. Remove the terminal cover retaining screws and lift off the terminal cover.
2. Lift the internal power terminal shield.
3. Feed the power supply and motor cables into the drive through the metal gland plate using the correct cable entries, and connect to the power terminals. Tighten all terminals to the correct tightening torque, refer to the Terminal Tightening Torques table.
4. Lower the internal power terminal shield.

Power Wiring Connections (Frame D)



1. Remove the terminal cover retaining screws and lift off the terminal cover.
2. Lift the internal power terminal shield.
3. Feed the power supply and motor cables into the drive through the metal gland plate using the correct cable entries, and connect to the power terminals. Tighten all terminals to the correct tightening torque, refer to the Terminal Tightening Torques table.
4. Lower the internal power terminal shield.

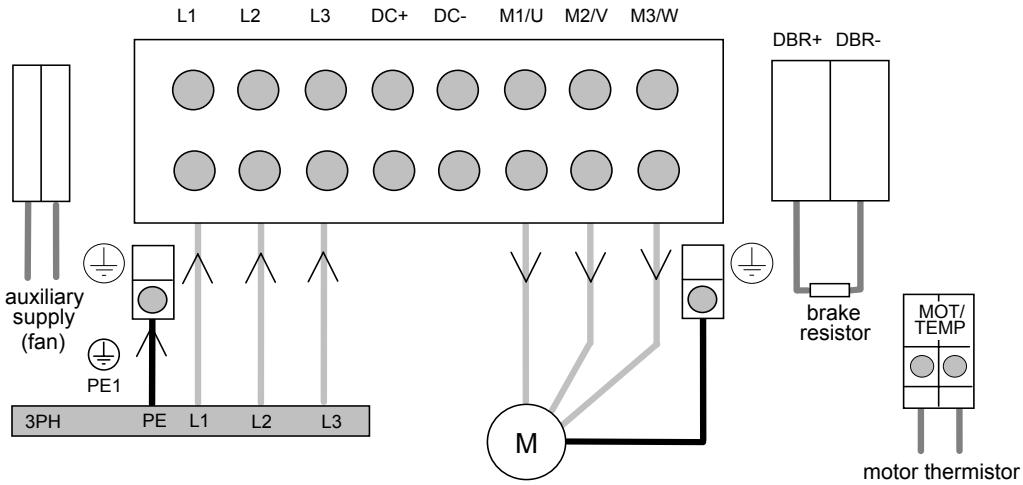
Power Wiring Connections (Frame E)



Note: *The standard Frame E terminals are not intended for flat busbar. A Power Terminal adaptor is available to enable wiring with flat busbar, part number BE465483.*

1. Remove the terminal cover retaining screws and lift off the terminal cover.
2. Feed the power supply and motor cables into the drive through the metal gland plate using the correct cable entries, and connect to the power terminals. Tighten all terminals to the correct tightening torque, refer to the Terminal Tightening Torques table.

Power Wiring Connections (Frame F)



Terminate all control cable screens using a gland at the gland plate

Bond the motor cable screen to the drive and motor, as close as possible to both terminals

Note: *For cooling fan details, refer to Chapter 8: "Technical Specifications" - Cooling Fan (Frame F).*

Note: *The standard Frame F terminals are not intended for flat busbar. A Power Terminal adaptor is available to enable wiring with flat busbar, part number BE465483.*

1. Remove the terminal cover retaining screws and lift off the terminal cover.
2. Feed the motor cables into the cubicle using the correct cable entry glands ensuring the screen is connected (see Figure Chapter 3 -14 Cabling Requirements, page 3-12).
3. Feed the power supply and motor cables into the drive through the large aperture in the metal gland plate and connect to the power terminals. Tighten all terminals to the correct tightening torque, refer to the Terminal Tightening Torques table.

Motor Thermistor Connections

This input is provided to detect over-temperature in motors fitted with an internal thermistor. There is no polarity to the thermistor connections.

MMI Menu Map

1 SETUP
2 TRIPS
3 I/O TRIPS
INVERT THERMIST

IMPORTANT: This input provides "Basic" insulation only to the SELV control circuits and assumes the motor has "Basic" insulation to the windings/mains circuits.

The thermistor type supported is PTC `Type A' as defined in IEC 34-11 Part 2. The drive uses the following resistance thresholds:

Rising temperature trip resistance:	1650 to 4000Ω
Falling temperature trip reset resistance:	750 to 1650Ω

If the motor is not fitted with an internal thermistor, you should disable the thermistor trip function either by setting INVERT THERMIST to be TRUE, or by linking the thermistor terminals.

Control Wiring Connections

All 690+ Series AC Drives have the same control wiring connections.

Note: *Use screened control cables to comply with EMC requirements. All screens terminated using a gland at the gland plate.*

1. Feed the control cables into the drive through the metal gland plate and connect to the control terminals. The diagram below shows the typical control connections required for operation as a simple speed controller.

   Each bank of cables (1-10, 11-20 and 21-26) **must** be secured together with a cable tie as close to the terminals as possible.
2. Refit and secure the terminal cover using the retaining screws.

IMPORTANT: The control board 0V must be connected to protective earth outside of the product to meet EMC and safety requirements.

Note: *Refer to Chapter 8: "Technical Specifications" for Control Terminal information*

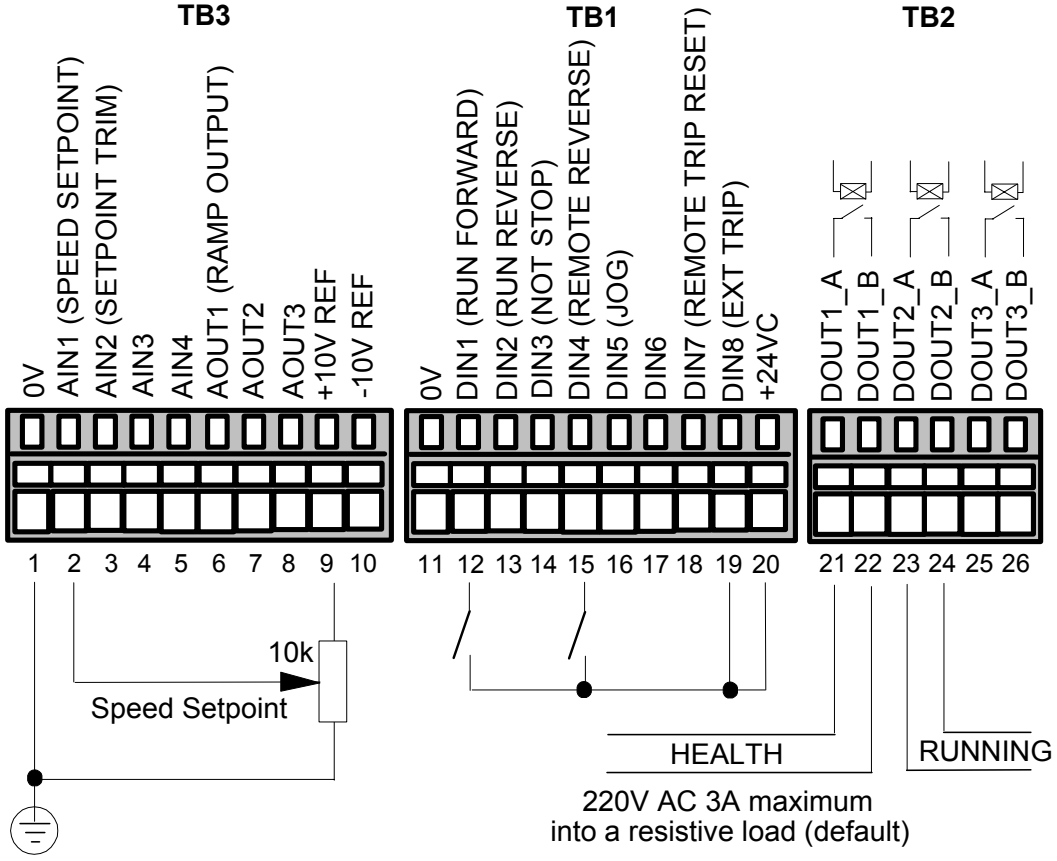


Figure Chapter 3 -16 Typical Connection to the Control Terminals

Terminal Block Acceptance Sizes

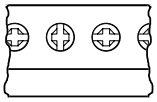
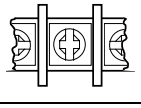
Wire sizes for Europe should be chosen with respect to the operating conditions and your local National Electrical Safety Installation Requirements. Local wiring regulations always take precedence. For North American UL wire sizes refer to Chapter 9: "Certification for the Drive" - Requirements for UL Compliance.

Product Code	Power Terminals (minimum/maximum acceptance for aperture)		Control Terminals including Thermistor Terminals	System Board Terminals (option)
690-xxxxxxB (690PB/...)	0.75 / 6mm^2		2.5 mm^2	2.5 mm^2
690-xxxxxxC (690PC/...)	0.75 / 10mm^2 (*16mm^2)		2.5 mm^2	2.5 mm^2
690-xx2310D (690PD/0150/...) 690-xx2380D (690PD/0180/...) 690-xx2450D (690PD/0220/...)	2.5 / 16mm^2 (* 25mm^2)		2.5 mm^2	2.5 mm^2
690-xx2590D (690PD/0300/...)	2.5 / 25mm^2 (* 35mm^2)		2.5 mm^2	2.5 mm^2
	Solid	Stranded		
690-xxxxxxE (690PE/...)	16 / 50mm^2	25 / 50mm^2 (* 70mm^2)	2.5 mm^2	2.5 mm^2
690-xxxxxxF (690PF/...)	25/120mm^2	35 / 95mm^2 (*120mm^2)	2.5 mm^2	2.5 mm^2

***Note**: The standard Frame E and Frame F terminals are not intended for flat busbar. A Power Terminal adaptor is available to enable wiring with flat busbar, part number BE465483.*

** The larger wire sizes can be used provided a crimp is fitted to the wire*

Terminal Tightening Torques

Frame Size	Model Recognition Product Code (Block 2)	Thermistor & fan supply	Power Terminals	Brake Terminals	Ground Terminals
Frame B	All	N/A	1.04Nm (9.2lb-in)	1.04Nm (9.2lb-in)	1.5Nm (13.3 lb-in)
Frame C 230V	690-232220C.. (0055/230) 690-232280C.. (0075/230)	N/A	1.35Nm (12 lb-in)	1.35Nm (12 lb-in)	2.5Nm (22 lb-in)
Frame C 400/500V	690-432120C.. (0055/400) 690-532110C.. (0055/500)	N/A	1.35Nm (12 lb-in)	1.35Nm (12 lb-in)	2.5Nm (22 lb-in)
Frame C 400/500V	690-432160C.. (0075/400) 690-432230C.. (0110/400) 690-432300C.. (0150/400) 690-532140C.. (0075/500) 690-532210C.. (0110/500) 690-532270C.. (0150/500)	N/A	1.35Nm (12 lb-in) *enclosed terminal type*  1.8Nm (16 lb-in) *open terminal type* 	1.35Nm (12 lb-in)	2.5Nm (22 lb-in)
Frame D	All	N/A	4Nm (35 lb-in)	4Nm (35 lb-in)	4.5Nm (40 lb-in)
Frame E	All	0.7Nm (6.1 lb-in)	6-8Nm (53-70 lb-in)	6-8Nm (53-70 lb-in)	6-8Nm (53-70 lb-in)
Frame F	All	0.7Nm (6.1 lb-in)	15-20Nm (132-177 lb-in)	0.7Nm (6.1 lb-in)	42Nm (375 lb-in)

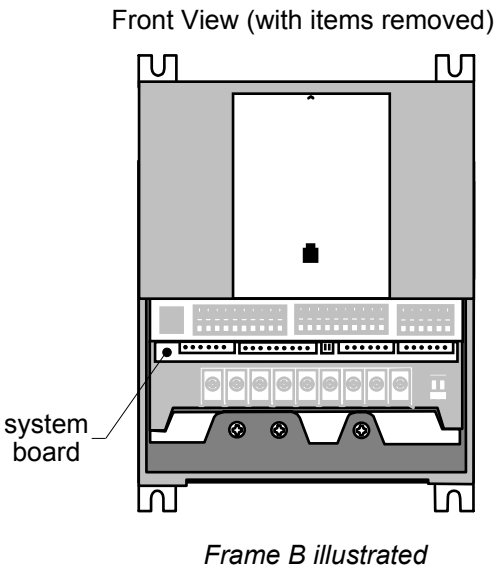
Optional Equipment

System Board

With this factory-fitted expansion board, the 690+ drive is suitable for high-end web processing and mini PLC replacement applications.

The following features are provided:

- Converts AIN1-4 in to high resolution (12-bit plus sign) non-isolated analog inputs
- 5 configurable fully-isolated digital inputs/outputs (for PLC applications), individually selectable to input or output
- Supplies variable voltage, isolated encoder power supply
- Decoding logic to interface the encoder to the microprocessor
- Master Encoder Input (isolated HTTL), A, B and Z
- Slave Encoder Input (isolated HTTL), A, B and Z
- Encoder Re-Transmit (isolated HTTL), A, B and Z



External Power Supply

An external 0V and 24V dc (±10%) 1A power supply is required for the board to operate and supply the digital I/O and encoder power supply at maximum loading.

Encoder Input Specification

Maximum Pulse Rate	250kHz
Receiver Current	≤10mA per channel
Input Format	Two differential channels in quadrature
Differential Input Threshold	3V ±1
Encoder Supply	Maximum load = 200mA. Voltage adjustable 12-24V by switches SW1 & SW2

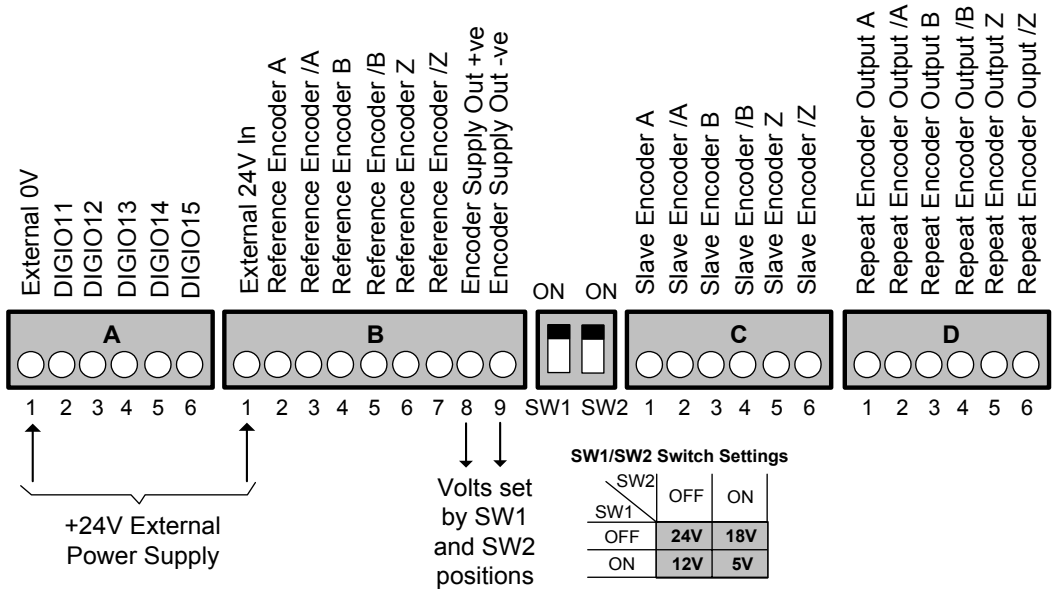


Figure Chapter 3 -17 System Board Terminals

Encoder Connections

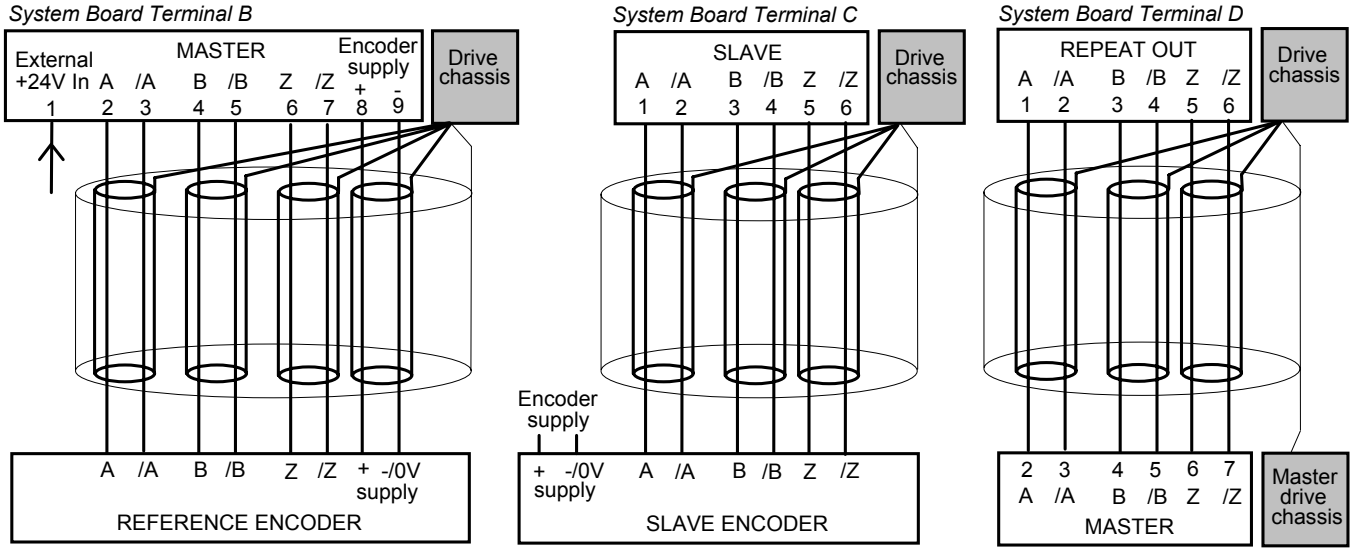
Take special care wiring the encoders to the system board due to the low level of the signals.

All wiring to the system board 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 encoder body and to the drive chassis.

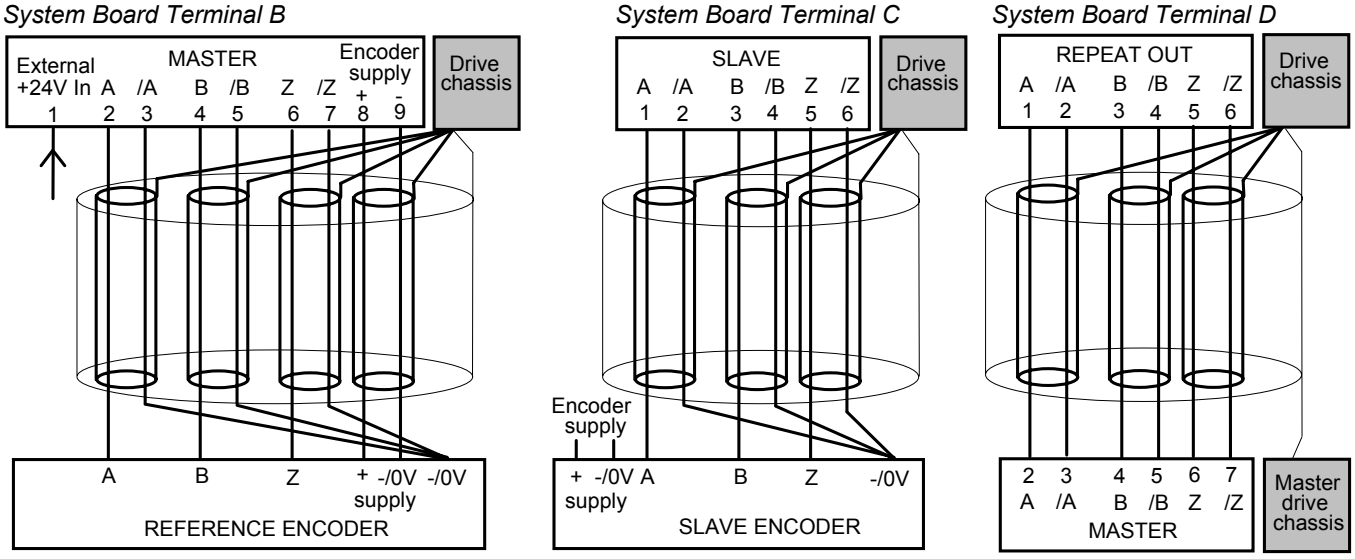
Recommended cable (pairs individually screened):

Belden equivalent 8777
Parker SSD Drives Part Number CM052666

Differential Encoders



Single-Ended Encoders



Parker SSD Drives Approved Encoders

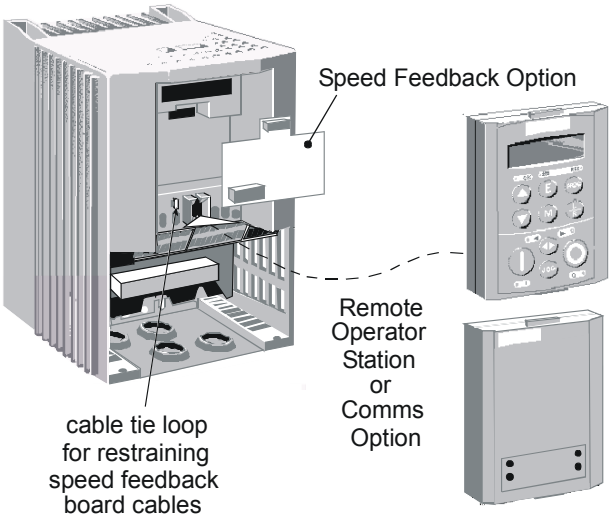
Operation with 5V encoders is not recommended. We recommend using 10-24V differential encoders, as shown below.

Recommended Encoder (12mm bore)	Hengstler: Parker SSD Drives Part Number:	RI 58TD//2048ED.37IF DD464475U012
Alternative Encoders (20mm bore)	Hengstler: Parker SSD Drives Part Number:	RI 76TD/2048ED-4N20IF DD464475U020

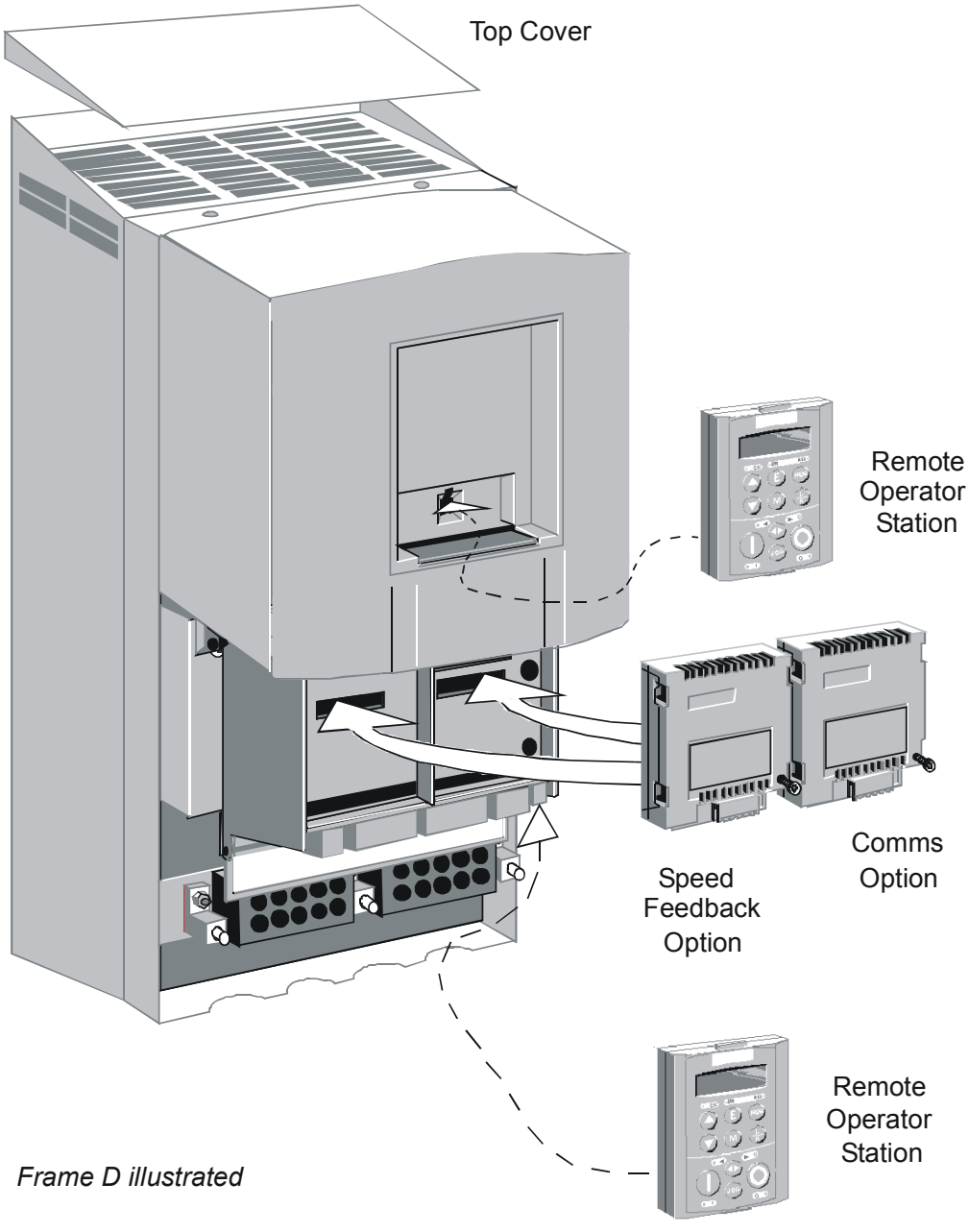
Encoders are available from Hengstler in other accuracy's such as 500 lines/rev or 2000 lines/rev to suit the application.

Technology Options

Note: *Optional equipment is fitted to Frames C, D, E and F in very similar ways, but because of its compact size, Frame B is a special case.*



Frame B illustrated



Frame D illustrated

WARNING!
Isolate the drive before fitting or removing the option.

There are two Technology Options:

1. Speed Feedback
2. Communications

These are plugged into the two positions, as illustrated on the previous page.

All Technology Options are designed as plug-in technology boxes, except for the Frame B Speed Feedback option which is a plug-in board.

You can operate the drive with the Speed Feedback and/or Communications Technology Options, but you **cannot** use two options of the same kind.

Note: *Refer to the appropriate Technology Option Technical Manual for further information.*

Technology Box

Remove a technology box option by carefully pushing a long screwdriver (for instance) under the option and gently prising it out. The pins are protected by the option moulding.

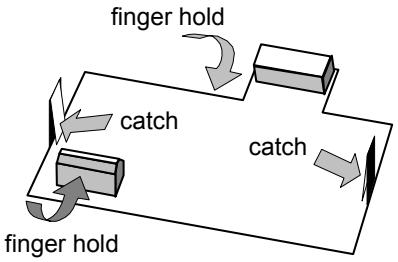


Speed Feedback Technology Board (Frame B)

Caution
Observe static control precautions when handling and installing the board.

Fit the technology option by pushing into location until the catches click in position.

Remove the Speed Feedback Board by pushing in the catches and pulling the board away from the drive using the finger holds shown to grip.



Item	Part No: Frame B	Part No: Frames C to F
TB1 Comms Technology Option *Plug-in field bus communications interface options.*		
Profibus	6053/PROF	6055/PROF
Profibus Technology Option manual	HA463561U001	HA463561U001
RS485/RS422/Modbus/EI Bisynch	6053/EI00	6055/EI00
RS485 Technology Option manual	HA463560U001	HA463560U001
Link	6053/LINK	6055/LINK
Link Technology Option manual	HA470237	HA470237
Device Net	6053/DNET	6055/DNET
Device Net Technology Option Manual	HA463575U001	HA463575U001
TB2 Speed Feedback Technology Option *Plug-in speed feedback HTTL Encoder option.*		
* Technology Board (Frame B)	LA467461	
* Technology Box (Frames C, D, E & F)		6054/HTTL

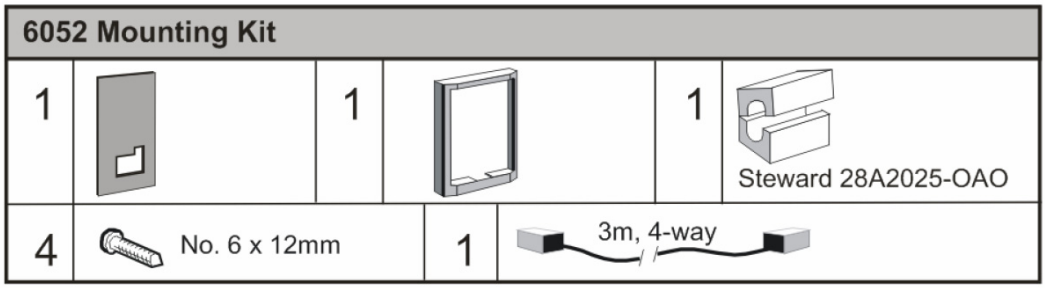
Fitting the Remote 6901/6911 Keypad

The 6052 Mounting Kit is required to remote-mount a 6901/6911 Keypad. It is possible to:

- Remote-mount the drive-mounted Keypad using the port(s) illustrated
- Remote-mount an additional Keypad in the lower port (not Frame B) - in this case, both Keypads are fully functional
- Remote-mount both Keypads as illustrated (not Frame B) - in this case, both Keypads are fully functional

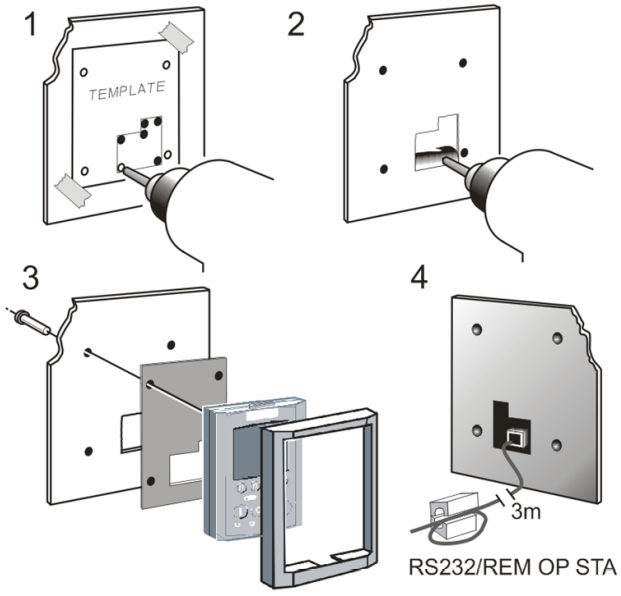
You can also replace any Keypad for a PC running ConfigEd Lite (or other suitable PC programming tool) in all of the options above. Refer to the Software Product Manual: "Serial Communications".

6052 Mounting Kit Parts for the Remote Keypad



Assembly Procedure

Remove the factory-fitted P3 lead from the P3 port under the terminal cover which connects the fitted keypad. Fit the ferrite to one end of the 3m connector lead, passing the cable through the ferrite twice as shown below. Plug the 3m connector lead from the remote-mounted keypad into the P3 port (see the diagram on the previous page) ensuring that the ferrite is at the drive end of the lead and is as close to the drive as possible.





Cutout Dimensions

An actual size template is provided with Keypad/6052 Mounting Kit.

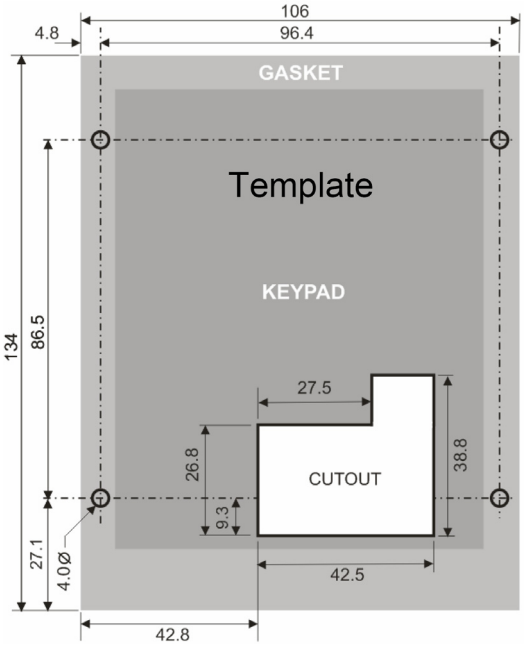


Figure 3-18 Mounting Dimensions for the Remote-Mounted Keypad 6901/6911

Top Cover

This can be fitted to wall-mounted 690+ units to give improved compliance ratings. Refer to Chapter 8: "Technical Specifications" - Environmental Details.

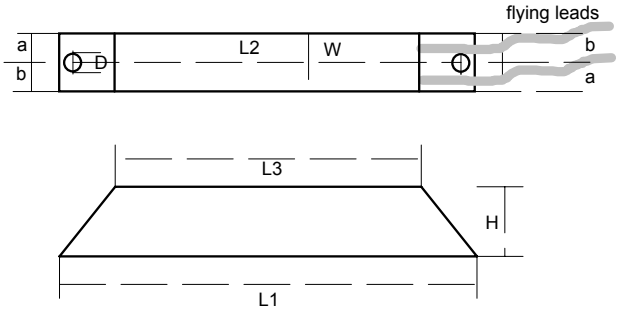
The top cover must be correctly fitted and secured with screw(s).

Note: *The maximum operating temperature of the drive is reduced by fitting the top cover. Refer to Chapter 8: "Technical Specifications" - Environmental Details.*

Item	Part Number
Top Cover Kit (UL Type 1 / IP4x), including screws *A protective cover fitted to wall-mounted units to give improved compliance ratings*	
• Frame B	LA467452
• Frame C	LA465034U002
• Frame D	LA465048U002
• Frame E	LA465058U002

External Brake Resistor

Three standard power resistors are available from Parker SSD Drives. These resistors should be mounted on a heatsink (back panel) and covered to prevent injury from burning.



Part Number	CZ389853	CZ463068	CZ388396
Models used on	Frame B	Frames B, C, D, E, F	Frames C, D, E, F
Resistance	100Ω	56Ω	36Ω
Maximum Wattage	100W	200W	500W
5 second rating	500%	500%	500%
3 second rating	833%	833%	833%
1 second rating	2500%	2500%	2500%
Dimensions L1 (mm)	165	165	335
L2 (mm)	152	146	316
L3 (mm)	125	125	295
W (mm)	22	30	30
H (mm)	41	60	60
D (mm)	4.3	5.3	5.3
a (mm)	10	13	13
b (mm)	12	17	17
Flying lead length (mm)	500	500	500
Electrical Connection	M4 spade	M5 spade	M5 ring

North American Standard Dynamic Braking Resistor Kits

The Dynamic Braking Resistor kits were designed for stopping a motor at full load current from base speed with two times motor inertia, three times in rapid succession in accordance with NEMA ICS 3-302.62 Dynamic Braking Stop option.

	230Vac dynamic braking resistor kit with cover CONSTANT & VARIABLE TORQUE		
Hp	Ohms	kW	Catalog No.
3	45	0.28	CZ470637
5	27	0.35	CZ353192

	460 VAC Dynamic Braking Resistor Kit with Cover CONSTANT TORQUE			460 VAC Dynamic Braking Resistor Kit with Cover VARIABLE TORQUE		
Hp	Ohms	kW	Catalog No.	Ohms	kW	Catalog No.
3	100	0.1	CZ389853	100	0.1	CZ389853
5	100	0.26	CZ353179	100	0.26	CZ353179
7.5	100	0.2	CZ353179	100	0.2	CZ353179
10	54	0.7	CZ353181	100	0.7	CZ353179
15	54	0.84	CZ353181	54	0.84	CZ353181
20	30	1.26	CZ353182	54	1.26	CZ353181
25	30	1.17	CZ353182	30	1.17	CZ353182
30	30	1.56	CZ353182	30	1.56	CZ353182
40	26	2.03	CZ353183	30	2.03	CZ353182
50	18.4	2.36	CZ353185	26	2.36	CZ353183
60	12	2.0	CZ353186	18.4	2.92	CZ353185
75	9	3.39	CZ353188	12	3.39	CZ353186
100	7	3.39	CZ353189	9	3.39	CZ353188
125	5.5	3.39	CZ353190	7	3.39	CZ353189
150	5.5	3.39	CZ353190	5.5	3.39	CZ353190

Brake Resistor Selection

Note: *Parker SSD Drives can supply suitable brake resistors.*

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

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

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

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 in Chapter 8: "Technical Specifications" - Internal Dynamic Brake Switch.

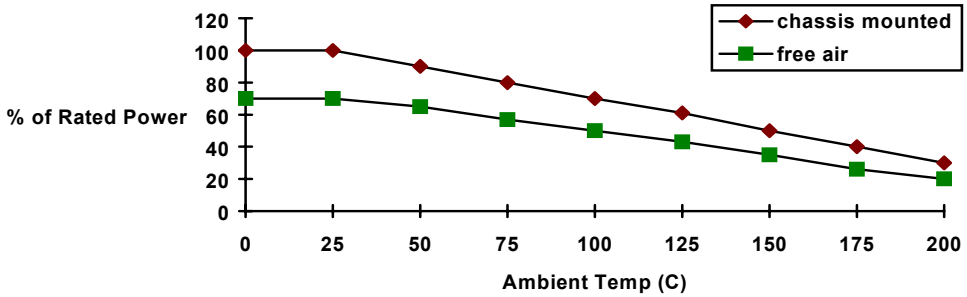


Figure Chapter 3 -19 Brake Resistor Derating Graph

External AC Supply EMC Filter

WARNING!

Do not use an internal ac supply EMC filter with supplies that are not balanced with respect to earth (IT). They must only be used with earth referenced supplies (TN).

External filters are available for use with TN and IT supplies. Please check for suitability in Chapter 8: "Technical Specifications" - External AC Supply (RFI) Filters.

Do not touch filter terminals or cabling for at least 3 minutes after removing the ac supply.

Only use the ac supply filter with a permanent earth connection.

IMPORTANT: Do not use an external filter on a drive supplied with an internal ac supply EMC filter.

Mount the filter as close as possible to the drive.

Note: *Follow the cabling requirements given in Chapter 8: "Technical Specifications"*
Refer to Chapter 8: "External AC Supply (RFI) Filters" for further information.

Footprint/Bookcase Mounting Filters for Frame B, C, D, E & F

These filters can be both footprint and bookcase mounted. They are suitable for wall or cubicle mount, but the filter must be fitted with the appropriate gland box when wall mounted.

The filters for Frames C, D and E look similar. The Frame D filter drawing is given in the following pages. Size variations for the frames are given in the table below.

The Frame F drawing and sizes are also supplied.

Filter Description	Filter Part Number	Terminal Block	Earth Terminal	Gland Mounting	Dimensions	Fixing Centres	Weight
Frame B							
500V IT/TN	CO467842U020	10mm^2	4mm	4 x 4mm	283 x 168x 45mm	272 x 143mm	1.7kg
Gland Plate : BA467840U020							
Frame C							
500V IT/TN	CO467842U044	10mm^2	5mm	4 x 4mm	400 x 178x 55mm	384 x 150mm	2.1kg
Gland Plate : BA467840U044							
Frame D							
500V IT/TN	CO467842U084	25mm^2	6mm	4 x 4mm	513 x 233 x 70mm	495 x 208mm	4.2kg
Gland Plate : BA467840U084							
Frame E							
500V IT/TN	CO467842U105	50mm^2	8mm	4 x 4mm	698 x 250 x 80mm	680 x 216mm	6.2kg
Gland Plate : BA467840U105							
Frame F							
500V IT/TN	CO467842U215	95mm^2	8mm	not applicable	825 x 250 x 115mm	795 x 216mm	
Gland Plate : Not applicable							

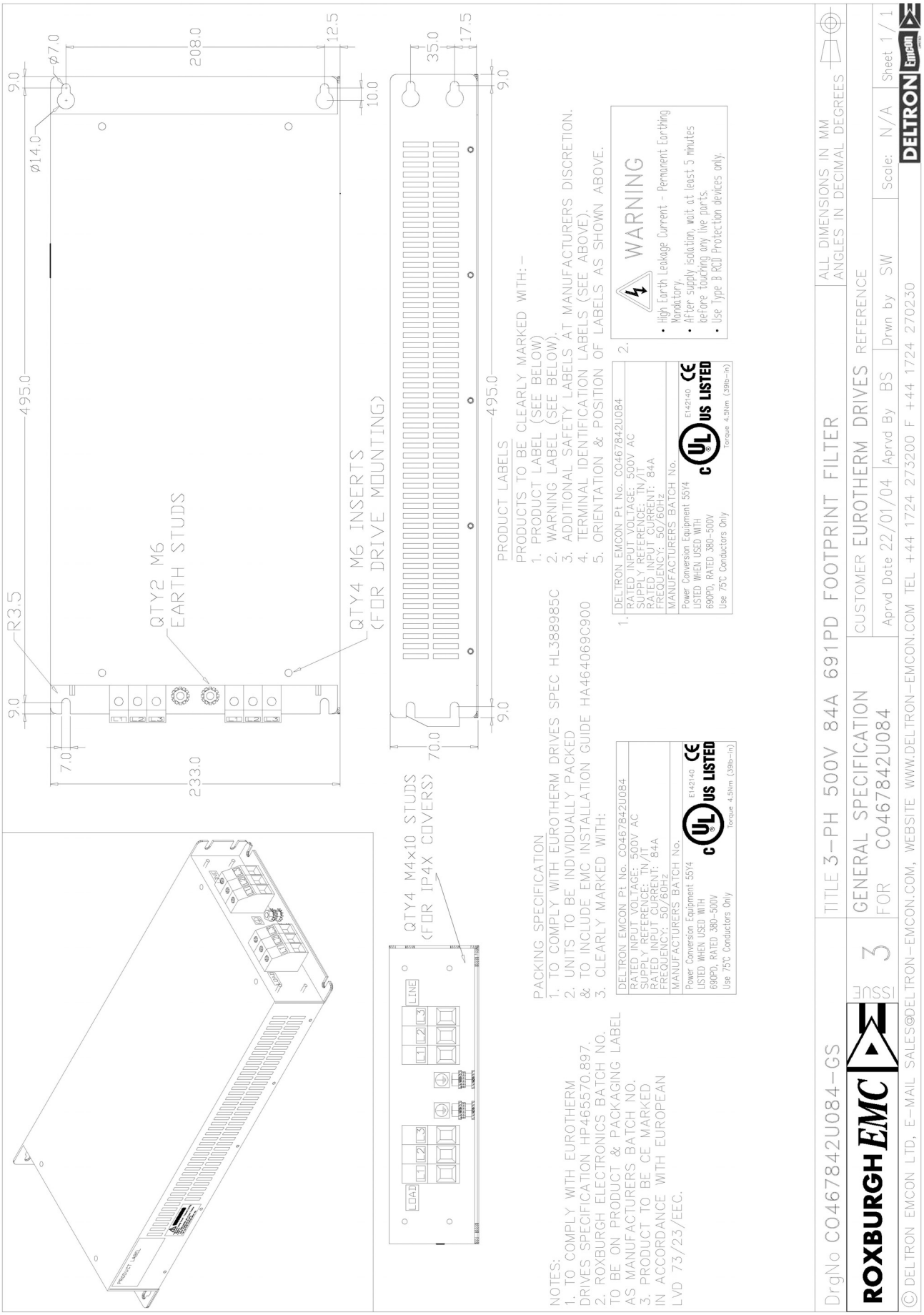


Figure 3-20 Footprint/Bookcase Mounting Filters (generic drawing)

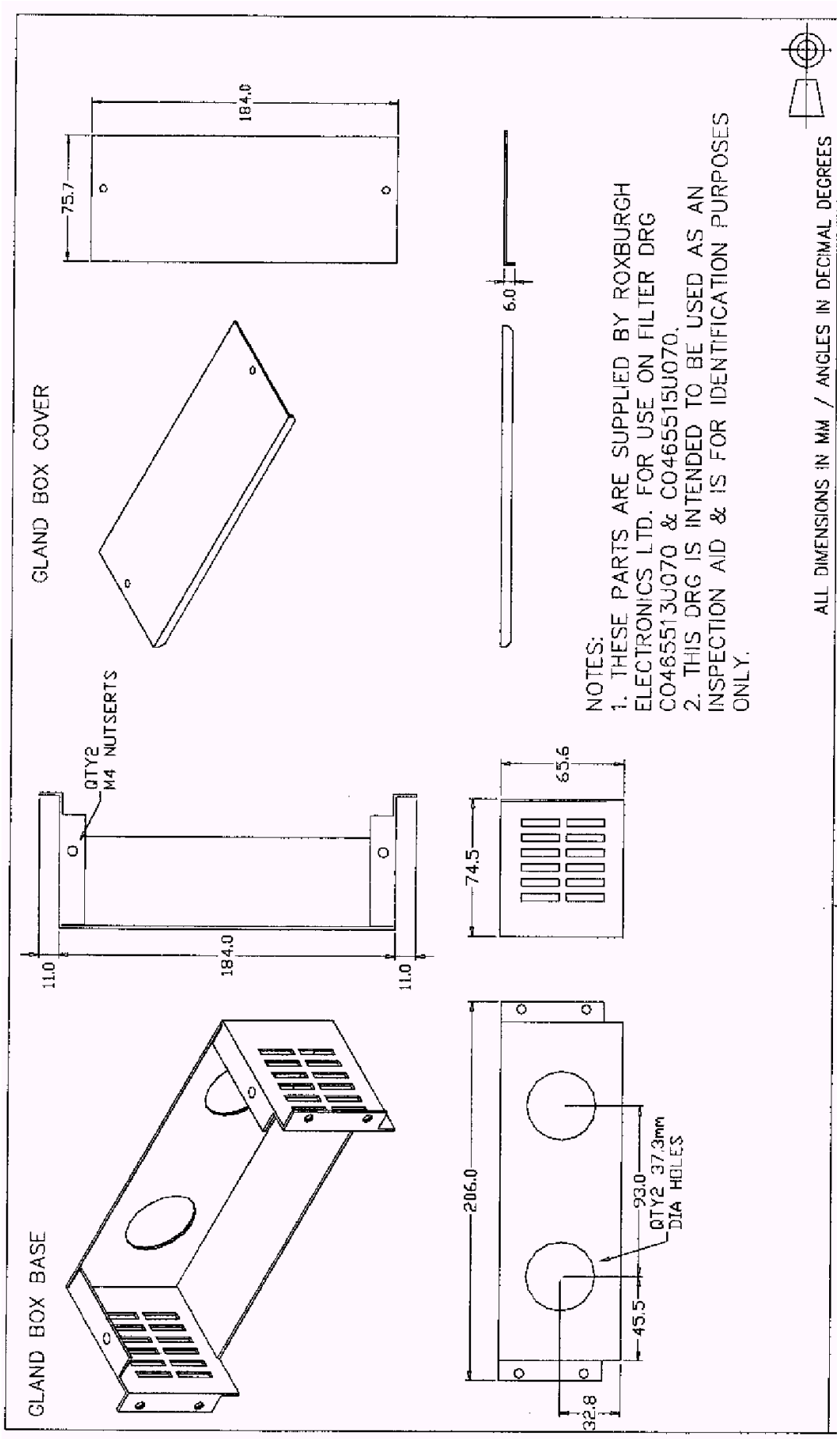


Figure 3-21 Gland Box for Footprint/Bookcase Mounting Filters (generic drawing)

EMC Motor Output Filter

This can help the drive achieve EMC and filter thermal conformance. It also ensures longer motor life by reducing the high voltage slew rate and overvoltage stresses. Mount the filter as close to the VSD as possible. Please refer to Parker SSD Drives for the selection of a suitable filter.

Output Contactors

Output contactors can be used, although we recommend that this type of operation is limited to emergency use only, or in a system where the drive can be inhibited before closing or opening this contactor.

Earth Fault Monitoring Systems

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

- 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.

When the ac supply is switched on, a pulse of current flows to earth to charge the internal/external ac supply EMC filter's internal capacitors which are connected between phase and earth. This has been minimised in Parker SSD Drives' filters, but may still trip out any circuit breaker in the earth system. In addition, high frequency and dc components of earth leakage currents will flow under normal operating conditions. Under certain fault conditions larger dc protective earth currents may flow. The protective function of some circuit breakers cannot be guaranteed under such operating conditions.

WARNING!

Circuit breakers used with VSDs and other similar equipment are not suitable for personnel protection. Use another means to provide personal safety. Refer to EN50178 / VDE0160 / EN60204-1

Line Chokes (input)

Line chokes may be used to reduce the harmonic content of the supply current where this a particular requirement of the application or where greater protection from mains borne transients is required. Line chokes are fitted internally to Frames E and F. Please refer to Parker SSD Drives for the selection of a suitable line choke for Frames B, C and D.

AC Motor Choke (output)

Maximum Motor dv/dt = 10,000V/µs. This can be reduced by adding a motor choke in series with the motor.

Installations with long cable runs may suffer from nuisance overcurrent trips, refer to Chapter 8: "Technical Specifications" - Cabling Requirements for maximum cable lengths. A choke may be fitted in the drive output to limit capacitive current. Screened cable has a higher capacitance and may cause problems in shorter runs. Contact Parker SSD Drives for recommended choke values.

5703/1 Speed Repeater Support

The 5703/1 unit provides the facility to run a line of drives in speed-lock. For accurate speed holding, encoder feedback is required. Ratioed speed-locking is supported.

A 16-bit signal is passed between the drives using a fibre optic link connected to the P3 port on each drive. The P3 port operates RS232 compatible signal levels. The 5703/1 unit converts these signals into a fibre optic signal for transmission, and from the converted optical signal to RS232 for reception.

Refer to the manual supplied with the 5703/1 Speed Repeater.

Note: *The P3 port is configured for 5703/1 support using the MMI. Refer to the Software Product Manual, Chapter 1: "Programming Your Application"*

Chapter 4 OPERATING THE DRIVE

DEFAULT

By default, the drive will operate in Remote Start/Stop and Remote Speed Control. Analog and digital inputs and outputs are selected to control the unit.

The drive will operate as an open-loop drive. No set-up or tuning is required. It is programmed to control an induction motor of equivalent power, current and voltage rating to the drive.

In this chapter, refer to Control Philosophy, Initial Start-up Routine, (Routine 1: Remote Control using Control Terminals*) and The Start/Stop Mode Explained.*

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:

- Mains power supply voltage is correct.
- Motor is of correct voltage rating and is connected in either star or delta, as appropriate.
- 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 Megger.*

- Check for damage to equipment.
- 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:

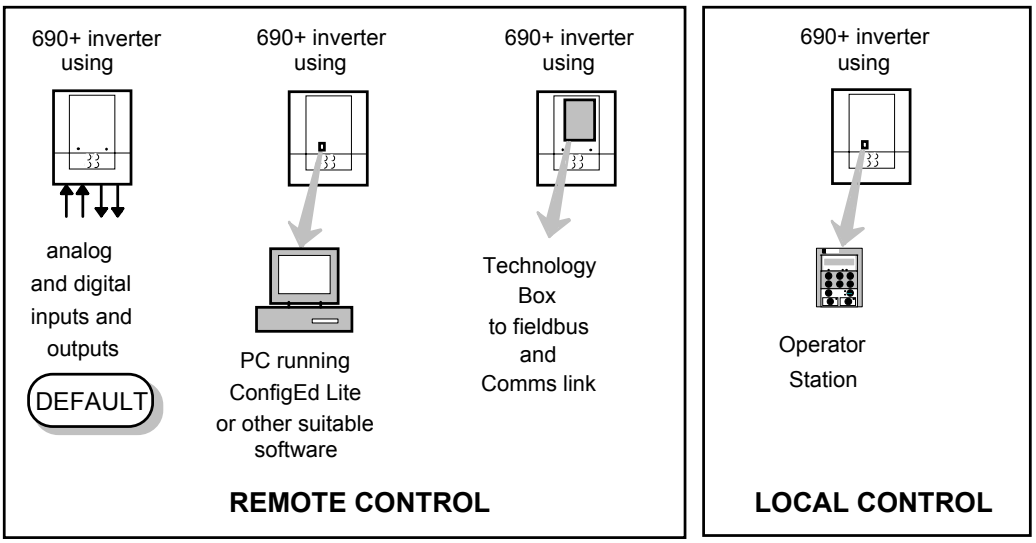
- Remove the supply fuses, or isolate using the supply circuit breaker.
- Disconnect the load from the motor shaft, if possible.
- If any of the drive's control terminals are not being used, check whether these unused terminals need to be tied high or low. Refer to Chapter 8: Technical Specifications - Control Terminals.
- Check external run contacts are open.
- Check external speed setpoints are all zero.

Re-apply power to the drive and system

The drive has Macro 1 installed as the factory default. If you are controlling the drive in Remote control, refer to the Software Product Manual: "Application Macros" for details of other macros.

Control Philosophy

There are four ways to control the drive using Remote and Local control:



Frame B illustrated

Figure Chapter 4 -1 Remote and Local Control Modes

Start/Stop and Speed Control

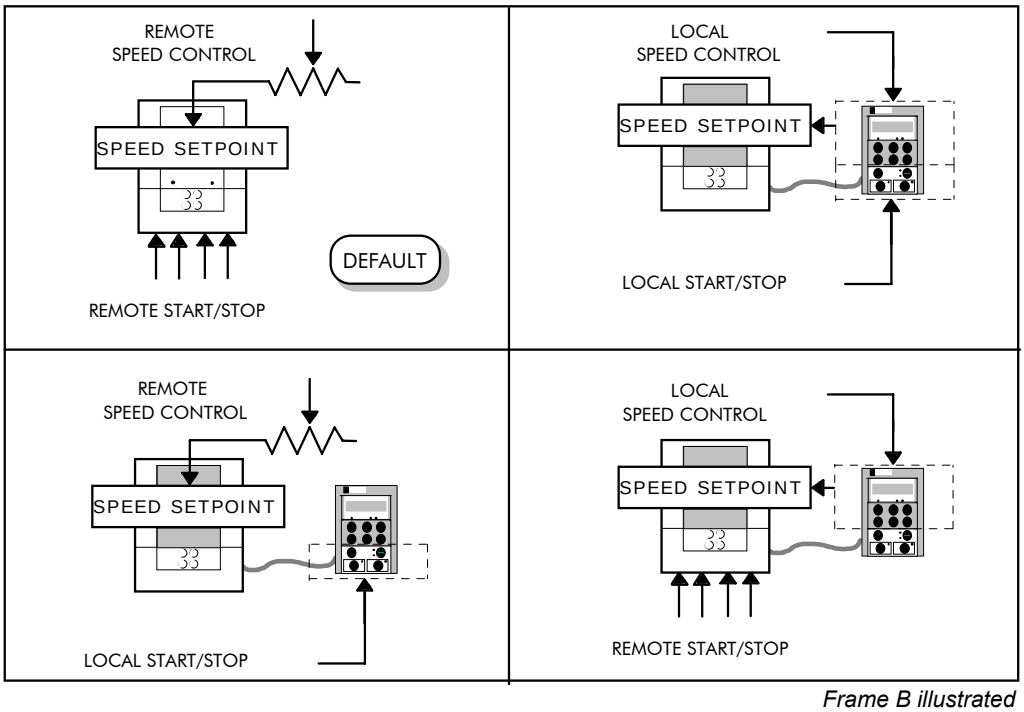
There are two forms of control in operation at any time: *Start/Stop* and *Speed Control*. Each can be individually selected to be under either Local or Remote Control.

- **Local or Remote Start/Stop** decides how you will start and stop the drive.
- **Local or Remote Speed Control** determines how you will control the motor speed.

In each case, Local and Remote control are offered by using the following:

Local: The Keypad
Remote: Analog and digital inputs and outputs, RS232 Port or the 6053 Technology Box

Thus the drive can operate in one of four combinations of local and remote modes:



Frame B illustrated

Figure Chapter 4 -2 The Four Combinations of Local and Remote Control

Note: *Start/Stop is also known as "Sequencing".*
Speed Control is also known as "Reference Generation".

Selecting Local or Remote Control

If the default combination of remote Start/Stop and Speed Control is not suitable for your application, follow the instructions below using the Keypad or a suitable PC programming tool to select suitable combinations of local or remote control.

Note: *You can only change between Local and Remote control when the drive is "stopped".*

To change a combination the Keypad must have FULL VIEW selected; allowing you to view enough of the menu structure to make the change. Refer to Chapter 5: "The Keypad" - Menu Viewing Levels.

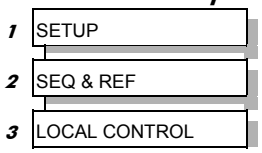
The **L/R** key on the Keypad toggles between **Local** and **Remote** control, changing both Start/Stop and Speed Control modes at the same time.

However, you can "fix" either or both modes in software to be either Local or Remote control. This makes the **L/R** key inoperative for that mode. In this way, you can select a combination where both Local and Remote modes are present.

To do this, go to the LOCAL CONTROL menu at level 4 and select either:

LOCAL ONLY	Sets Local control
REMOTE ONLY	Sets Remote control
LOCAL/REMOTE	Gives selection powers back to the **L/R** key.

MMI Menu Map



Fixing only one of the modes will mean that the **L/R** key will still toggle the other mode between Local and Remote control.

LED Indications

The mode of control is indicated by the "LOCAL" LEDs on the Keypad:

SEQ = Start/Stop
REF = Speed Control

If the LED is illuminated (●), then LOCAL mode is in force.

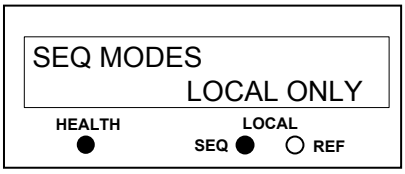


Figure Chapter 4 -3 Control Mode LED Indications

Note: *The default is for the **L/R** key to be operative for both Sequencing and Reference Generation, and to be set for Remote control, i.e. both LEDs will be off.*

Initial Start-up Routines

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 no machinery connected to the motor will be damaged by unpredictable motion.
Ensure that the emergency stop circuits function correctly before running the motor for the first time.

Replace the supply fuses or circuit breaker and apply power to the drive.

The routine below will run the drive in the default V/F fluxing control mode (VOLTS / HZ) to begin with using either the Control Terminals, or the Keypad (if supplied).

Routine 1: Remote Control using Control Terminals

DEFAULT

This is the simplest method of operating the drive. No Set-up or tuning is required. The drive can only operate in V/F Fluxing control mode (VOLTS / HZ).

This routine assumes that the drive's control terminals are wired as shown in Figure 3-15 "Typical Connection to the Control Terminals".

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

1. Power-up the unit. The HEALTH LED will light (the RUN LED remains off).
   If the HEALTH LED flashes, the drive has tripped. Refer to Chapter 6: "Trips and Fault Finding" to investigate and remove the cause of the trip. Reset the unit by momentarily closing either the RESET switch or the RUN switch. The HEALTH LED will now light.

2. Close the RUN switch. The RUN LED will flash if the setpoint is at zero. Turn the speed potentiometer up a little to apply a small speed setpoint. The RUN LED will light and the motor will rotate slowly.

Reverse the motor's direction of rotation either by pressing the DIR key, or by swapping two of the motor phases (**WARNING: Disconnect the mains supply first**).

Reading the Status LEDs

The HEALTH and RUN LEDs indicate status. The LEDs are considered to operate in five different ways:

- OFF
- SHORT FLASH
- EQUAL FLASH
- LONG FLASH
- ON

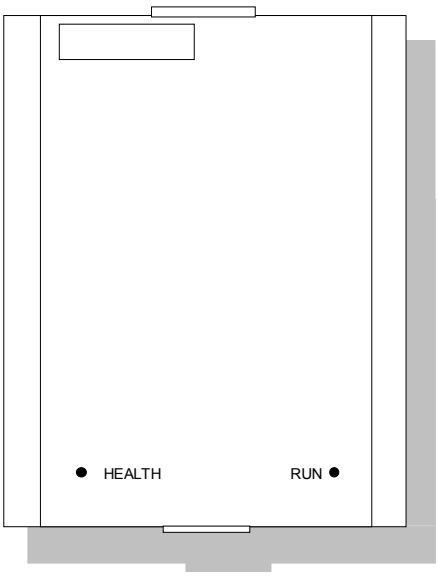


Figure Chapter 4 -4 Blank Cover showing LED Operation

HEALTH	RUN	Drive State
○●	○●	Re-configuration, or corrupted non-volatile memory at power-up
○■	○	Tripped
○■	○●	Auto Restarting, waiting for trip cause to clear
○■	○■	Auto Restarting, timing
■	○	Stopped
■	■○	Running with zero reference, enable false or contactor feedback false
■	■	Running
■	○■	Stopping
■○	■○	Braking and running with zero speed demand
■○	■	Braking and running
■○	○■	Braking and stopping

Table Chapter 4 -1 Status indications given by the Blank Cover Health and Run LEDs

Routine 2: Local Control using the Keypad

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

This routine assumes that the drive's control terminals are wired as shown in Figure 3-15 "Typical Connection to the Control Terminals" and the Keypad is fitted.

1. Power-up the unit. The display will show the power-up screen, "AC MOTOR DRIVE". After a few seconds, SETPOINT (REMOTE) will appear on the display. The HEALTH, STOP, and FWD LEDs will light.

   If the HEALTH LED flashes, the drive has tripped. The display will indicate the reason for the trip. Refer to Chapter 6: "Trips and Fault Finding" to investigate and remove the cause of the trip. Reset the trip condition by pressing the ***Stop/Reset*** *key on the keypad. The HEALTH LED will now light.*

2. Press the **L/R** (Local/Remote) key to enable Local control. Both the LOCAL SEQ and LOCAL REF LEDs will light when Local control in enabled.

3. Press the **RUN** key. The RUN LED will light and the motor will rotate slowly. (The RUN LED would flash if the setpoint was at zero.)

4. Reverse the motor's direction of rotation by pressing either the **DIR** key, or by swapping two of the motor phases **(WARNING: Disconnect the mains supply first)**.

Using the Keypad (or other suitable programming tool) the drive must now be set-up:

- as a simple Open-loop Drive (V/F fluxing)
- in Sensorless Vector Fluxing mode
- in Closed-Loop Vector mode

Set-up as an Open-loop Drive (V/F Fluxing)

The parameters from the QUICK SETUP menu most likely to require attention in this control mode (VOLTS / HZ) are shown below.

MMI Menu Map

1 QUICK SETUP

Tag	QUICK SET-UP Parameters	Default	Brief Description
1105	CONTROL MODE	VOLTS / HZ	Selects the control mode for the drive
106	BASE FREQUENCY	* 50.0 Hz	Frequency at which maximum output volts is generated
1032	MAX SPEED	* 1500 RPM	Max speed clamp and scale factor for other speed parameters
337	MIN SPEED	-100.00 %	Min speed clamp
258	RAMP ACCEL TIME	10.0 s	Acceleration time from 0Hz to max speed
259	RAMP DECEL TIME	10.0 s	Deceleration time from max speed to 0Hz
104	V/F SHAPE	LINEAR LAW	Constant torque V to F characteristic
50	QUADRATIC TORQUE	FALSE	Selects between Constant or Quadratic mode of operation
64	MOTOR CURRENT	** 11.3 A	Calibrates drive to motor full load current
365	CURRENT LIMIT	100.00%	Level of motor current as % of FULL LOAD CALIB
107	FIXED BOOST	** 0.00 %	Boosts starting torque by adding volts at low speed
279	RUN STOP MODE	RAMPED	Ramp to standstill when RUN signal removed
246	JOG SETPOINT	10.0 %	Drive speed setpoint whilst jogging
13	ANALOG INPUT 1	0..+10 V	Input range and type
22	ANALOG INPUT 2	0..+10 V	Input range and type
712	ANALOG INPUT 3	0..+10 V	Input range and type
719	ANALOG INPUT 4	0..+10 V	Input range and type
231	DISABLED TRIPS	0000 >>	Sub-menu to set disabled trips
742	DISABLED TRIPS +	0040 >>	Sub-menu to set disabled trips
1083	MOTOR BASE FREQ	** 50.0 Hz	Frequency at which drive gives maximum output volts
1084	MOTOR VOLTAGE	** 400.0 V	Maximum motor output voltage
65	MAG CURRENT	** 3.39 A	Calibrates drive to motor no load current
83	NAMEPLATE RPM	** 1445 RPM	Motor nameplate speed
84	MOTOR POLES	** 4	Number of motor poles

Set-up using the Sensorless Vector Fluxing Mode

The drive must be tuned to the motor in use by matching the motor parameters in the drive to those of the motor being controlled.

MMI Menu Map

1 QUICK SETUP

IMPORTANT: You MUST use the Autotune feature.

Enter values for the following parameters in the QUICK SETUP menu.

Tag	QUICK SET-UP Parameters	Default	Brief Description
1105	CONTROL MODE	SENSORLESS VEC	Selects the control mode for the drive
1032	MAX SPEED	* 1500 RPM	Max speed clamp and scale factor for other speed parameters
64	MOTOR CURRENT	** 11.3 A	Calibrates drive to motor full load current
365	CURRENT LIMIT	100.00%	Level of motor current as % of FULL LOAD CALIB
1083	MOTOR BASE FREQ	** 50.0 Hz	Frequency at which drive gives maximum output volts
1084	MOTOR VOLTAGE	** 400.0 V	Maximum motor output voltage
83	NAMEPLATE RPM	** 1445 RPM	Motor nameplate speed (motor synchronous speed (rpm) minus full load slip)
84	MOTOR POLES	** 4	Number of motor poles
124	MOTOR CONNECTION	** STAR	Type of motor connection
603	AUTOTUNE ENABLE	FALSE	Enables the Autotune feature
For more information refer to Chapter 5: “The Keypad” - The QUICK SETUP Menu.			

Set-up using the Closed-loop Vector Mode

WARNING!
When the drive is run for the first time the direction of rotation will be unknown, the drive may run inconsistently, and the speed control may not operate.

In this mode, speed feedback signals from the motor shaft encoder are processed to determine the rotational speed of the shaft. A PI algorithm within the software uses this information to produce varying gate drive signals to the drive circuits. These signals cause the drive to output the required voltage and frequency for a particular motor speed.

If the encoder is to be fitted to the System Board option rather than the Speed Feedback option, set SPD LOOP SPD FBK to SLAVE ENCODER.

MMI Menu Map

1 SETUP
2 SYSTEM BOARD
3 PHASE CONFIGURE
SPD LOOP SPD FBK

IMPORTANT: You MUST use the Autotune feature.

Enter values for the following parameters in the QUICK SETUP menu.

MMI Menu Map

1 QUICK SETUP

Tag	QUICK SET-UP Parameters	Default	Brief Description
1105	CONTROL MODE	CLOSED-LOOP VEC	Selects the control mode for the drive
1032	MAX SPEED	* 1500 RPM	Max speed clamp and scale factor for other speed parameters
64	MOTOR CURRENT	** 11.3 A	Calibrates drive to motor full load current
365	CURRENT LIMIT	100.00%	Level of motor current as % of FULL LOAD CALIB
566	ENCODER LINES	** 2048	Set to the number of lines used by the encoder
1083	MOTOR BASE FREQ	** 50.0 Hz	Frequency at which drive gives maximum output volts
1084	MOTOR VOLTAGE	** 400.0 V	Maximum motor output voltage
83	NAMEPLATE RPM	** 1445 RPM	Motor nameplate speed (motor synchronous speed (rpm) minus full load slip)
84	MOTOR POLES	** 4	Number of motor poles
124	MOTOR CONNECTION	** STAR	Type of motor connection
567	ENCODER INVERT	FALSE	Encoder direction
603	AUTOTUNE ENABLE	FALSE	Enables the Autotune feature
For more information refer to Chapter 5: “The Keypad” - The QUICK SETUP Menu.			

The Autotune Feature

IMPORTANT: You MUST carry out an Autotune if you intend to use the drive in either of the two vector control modes. If you are using it in Volts/Hz control an Autotune is not necessary.

The Autotune feature identifies motor characteristics to allow the drive to control the motor. It loads the values into the parameters below, which are in the QUICK SETUP menu.

Parameter	Description	Note
ENCODER INVERT	Encoder direction	Parameter is only set up if drive is configured to run as Closed-loop Vector Not measured by Stationary Autotune
MAG CURRENT	Magnetising current	Not measured by Stationary Autotune
STATOR RES	Per phase stator resistance	
LEAKAGE INDUC	Per phase stator leakage inductance	
MUTUAL INDUC	Per phase mutual inductance	
ROTOR TIME CONST	Rotor time constant	This is identified from magnetising current and motor nameplate rpm

For further information on the functions of all parameters, refer to the Product Manual, Chapter 1: "Programming your Application".

Stationary or Rotating Autotune?

Will the motor spin freely, i.e. not connected to a load, during the Autotune?

- If it can spin freely, use a Rotating Autotune (preferred)
- If it cannot spin freely, use a Stationary Autotune

	Action	Requirements
Rotating Autotune ***Preferred method***	Spins the motor up to the maximum speed set by the user to identify all necessary motor characteristics	Motor must spin freely during Autotune
Stationary Autotune *Only used when the motor cannot spin freely during the Autotune feature*	Motor does not spin during Autotune. A limited set of motor characteristics are identified	You must enter the correct value of magnetising current Do not subsequently operate the drive above base speed In Closed-loop Vector Mode set up the encoder direction parameter

Necessary Data

You **MUST** enter values for the following parameters, found in the QUICK SETUP menu, before an Autotune can be carried out:

MMI Menu Map

1 QUICK SETUP

MOTOR CURRENT
MOTOR BASE FREQ
MOTOR VOLTAGE (maximum motor output voltage)
NAMEPLATE RPM (motor nameplate speed)
MOTOR POLES (the number of motor poles)
ENCODER LINES (if an encoder is fitted, enter the number of lines used by the encoder)

Performing a Rotating Autotune

Check that the motor can rotate freely in the forward direction. Ensure also that the motor is unloaded. Ideally, the motor shaft should be disconnected completely. This includes disconnection from a gearbox, where fitted.

1. In the QUICK SETUP menu, set MAX SPEED to the maximum speed at which you will operate the drive in normal operation. The Autotune will characterise the motor up to 30% above this speed. If you later wish to run faster than this, you will need to carry out another Autotune.

MMI Menu Map

1 QUICK SETUP

2. Set AUTOTUNE ENABLE to TRUE, and start the drive. The drive will carry out a Rotating Autotune, indicated by the Run and Stop led's flashing. This may take several minutes, during which the motor will be accelerated to maximum speed and then brought to a stop. When complete, the drive is returned to the stopped condition and the AUTOTUNE ENABLE parameter is reset to FALSE. In Closed-loop Vector mode (with an encoder) the encoder sign has been adjusted by the Autotune feature.

IMPORTANT: Now perform a SAVE CONFIG to save your new settings. Refer to Chapter 5: "The Keypad" - SAVE CONFIG.

Performing a Stationary Autotune

Before starting the stationary Autotune, you **MUST** enter the value of magnetising current for the motor. This may be available on the motor nameplate. If not, you may need to contact the motor supplier.

1. In the AUTOTUNE menu, set the MODE parameter to STATIONARY.
2. Set ENABLE to TRUE, and start the drive. The drive will carry out a stationary Autotune, injecting current into the motor but not turning the shaft. The Run and Stop led's will flash. When complete, the drive is returned to the stopped condition and the AUTOTUNE ENABLE parameter is reset to FALSE.

MMI Menu Map

1 SETUP
2 MOTOR CONTROL
3 AUTOTUNE
ENABLE
MODE

IMPORTANT: Now perform a SAVE CONFIG to save your new settings. Refer to Chapter 5: "The Keypad" - SAVE CONFIG.

- If the drive is configured to run in Sensorless Vector mode, set-up is complete.
- If the drive is configured to run in Closed-loop Vector mode, i.e. using an encoder, then the encoder direction must be set up. Refer to "Setting the Encoder Sign" below.

Setting the Encoder Sign

If you have performed a Stationary Autotune in Closed-loop Vector mode, you should check the encoder direction as follows:

Look and listen to the motion of the motor when the drive is running at a speed demand of between 5 - 10%.

As a test, use the **Up** (♦) control key to increase the speed to about double the original figure. Change the direction of rotation using the **FWD/REV** control key.

If ENCODER INVERT is correct, the motor will rotate smoothly and will respond to the changes in speed demand and direction.

If ENCODER INVERT is incorrect, the motor will rotate in a jerky and/or noisy manner. Alternatively, it may rotate smoothly at a very low speed but not respond to changes in speed demand or direction.

- Change the setting of ENCODER INVERT to change the encoder sign.
- Change the direction of rotation back to the original direction. Re-set the speed demand.

The encoder sign is now correct for the original motor direction.

If however the direction of the motor is incorrect at this point, then power down the entire drive, wait for 3 minutes (for the dc link capacitors to discharge) and then swap the motor drive cables M1/U and M2/V. Change the setting of ENCODER INVERT.

The encoder sign is now correct for the new motor direction.

The Start/Stop Mode Explained

The default configuration below shows the drive in Remote control, (using the analog and digital inputs and outputs). This example will be referred to in the following explanations.

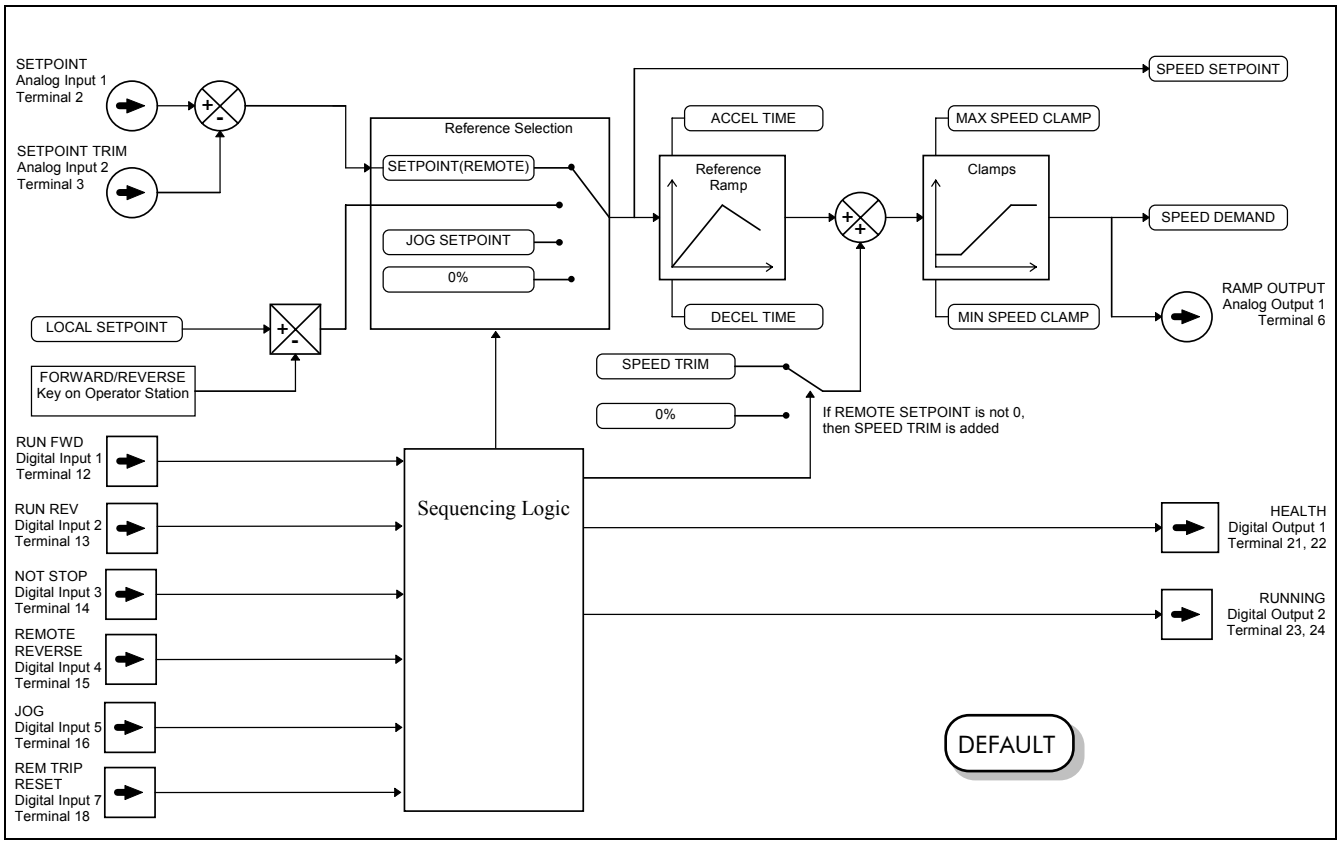


Figure Chapter 4 -5 Portion of the Default Configuration

Start/Stop Controlled Remotely

DEFAULT

In the configuration shown, the reference value is obtained by summing ANALOG INPUT 1 and ANALOG INPUT 2. The direction of rotation is controlled by DIGITAL INPUT 4. When the RUN input (DIGITAL INPUT 1) is TRUE, the SPEED DEMAND ramps up to the reference value at a rate controlled by ACCEL TIME. The drive will continue to run at the reference value while the RUN input remains TRUE.

Similarly when the JOG input (DIGITAL INPUT 5) is TRUE, the SPEED DEMAND ramps up to the JOG SETPOINT at a ramp rate set by JOG ACCEL TIME (not shown in the diagram). The drive will continue to run at the JOG SETPOINT while the JOG input remains TRUE.

Start/Stop Controlled Locally

The reference value is set by the SETPOINT (LOCAL) parameter. The direction of rotation is controlled by the DIR key (forward/reverse) on the Keypad. When the RUN key is pressed the SPEED DEMAND ramps up to the reference value at a rate controlled by ACCEL TIME. The drive will continue to run at the reference value even when the RUN key is released. Press the STOP key to "stop" the drive.

When the JOG key is pressed and held, the SPEED DEMAND ramps up to the JOG SETPOINT at a ramp rate set by JOG ACCEL TIME (not shown in the diagram). Release the JOG key to "stop" the drive.

Interaction between RUN and JOG

Only one of these signals can be in effect at any one time; the other signal is ignored. The drive must be "stopped" to change from running to jogging, or vice versa.

Start/Stop Mode Diagnostics

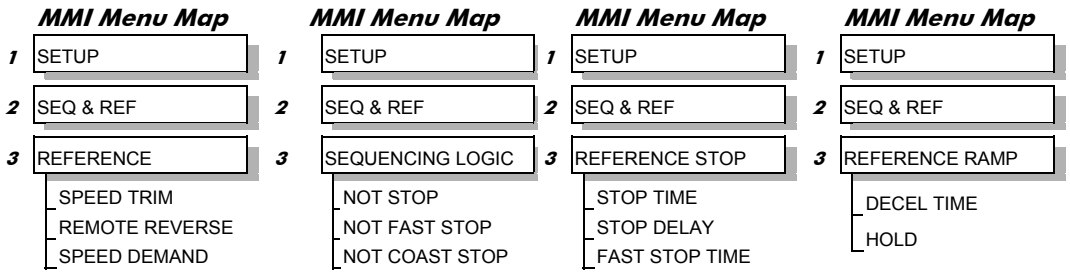
In the configuration shown, Start/Stop mode provides two DIGITAL OUTPUT signals (RUNNING and HEALTH).

The RUNNING signal is TRUE from the time a start command is processed until a stop sequence is completed. This normally means the time between the drive starting until the power stack is quenched. Refer to the Software Product Manual, Chapter : "Sequencing Logic States" for a more detailed description.

The HEALTH output is TRUE when the drive is not tripped.

Additional diagnostic parameters are available when using the Keypad. These are described in the Software Product Manual, Chapter 4: "Programming Your Application" and "Sequencing Logic States".

Starting and Stopping Methods



Note: *Refer to the Software Product Manual, Chapter 1: "Programming Your Application" - REFERENCE, SEQUENCING LOGIC, REFERENCE STOP and REFERENCE RAMP, for explanations of parameters.*

Normal Stopping Methods

DEFAULT

Macro 1 is set to "Ramp to Stop" (at STOP TIME, set to 10.0s).

- To "stop" the locally controlled drive press the STOP key on the Keypad
- To "stop" the remotely controlled drive remove the 24V from the RUN FWD input, terminal 12

With the Keypad, or suitable programming tool, the drive can be selected to "Ramp to Stop", or to "Coast to Stop" at one of two rates (STOP TIME or FAST STOP TIME).

Ramp to Stop

When a stop command is received, the drive decelerates from its actual speed towards zero for the programmed DECEL TIME time. When this time has elapsed, SPEED TRIM is ramped to 0% in the programmed STOP TIME time.

Note: *If SPEED TRIM does not operate, SPEED DEMAND is reduced to 0% in DECEL TIME.*

The power stack remains energised until the STOP DELAY period has elapsed.

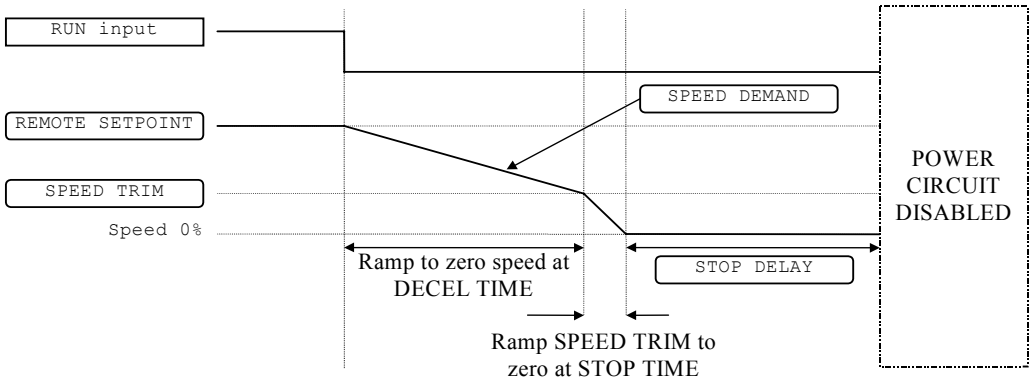


Figure Chapter 4 -6 Ramp to Stop with a Remote Reference

A special case exists when the DECEL TIME is set to 0.0 seconds, or when the HOLD parameter is TRUE. In both these situations the SPEED DEMAND will ramp down to zero at the STOP TIME.

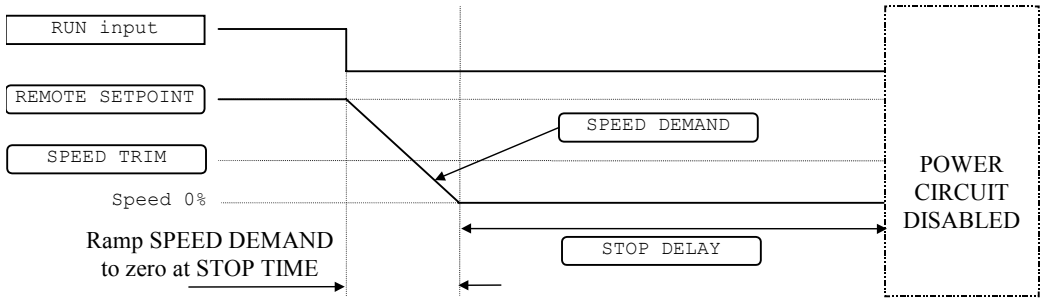


Figure Chapter 4 -7 Remote to Stop with a Remote Reference: no DECEL TIME

Coast to Stop

In this mode the DECEL TIME ramp and the STOP TIME ramp are both ignored. Thus the SPEED DEMAND changes immediately to 0% as soon as the Stop command is given. The power stack is also immediately disabled at this time, causing the load to coast.

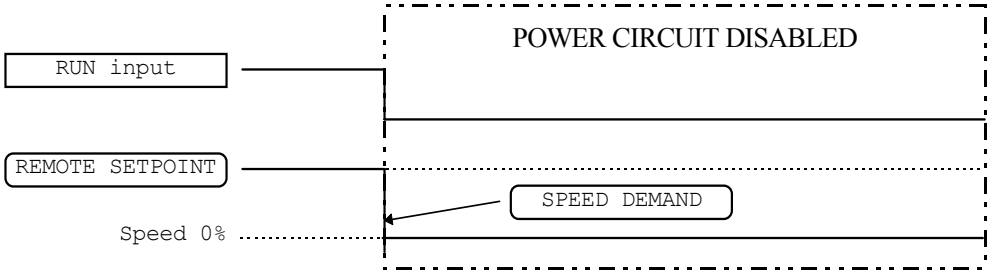


Figure Chapter 4 -8 Coast to Stop with a Remote Reference

Advanced Stopping Methods

The drive can be selected to NOT FAST STOP or to NOT COAST STOP. The stopping procedure is unaffected by Local or Remote Sequencing options.

Forced Fast Stop

The Not Fast Stop mode overrides the RUN FWD, RUN REV and JOG inputs in Remote mode, and the RUN and JOG Keypad keys in Local mode. It is selected by setting NOT FAST STOP to TRUE.

The Fast Stop mode can be set to either RAMP or COAST. The stopping sequence starts when the NOT FAST STOP input goes FALSE, regardless of the state of the RUN input.

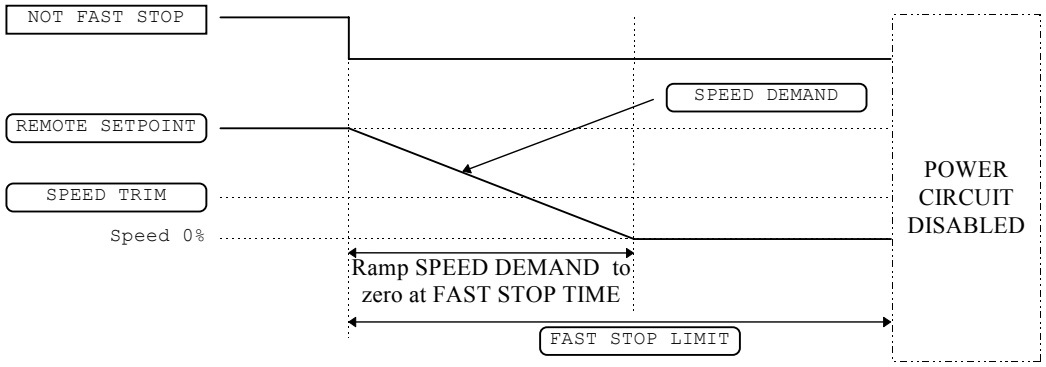


Figure Chapter 4 -9 Forced Fast Stop RAMP Mode example

Forced Coast Stop

Using the Not Coast Stop mode immediately disables the power stack, causing the load to coast to a stop. The drive gives priority to the NOT COAST STOP signal. The NOT FAST STOP signal is therefore ignored while NOT COAST STOP is active.

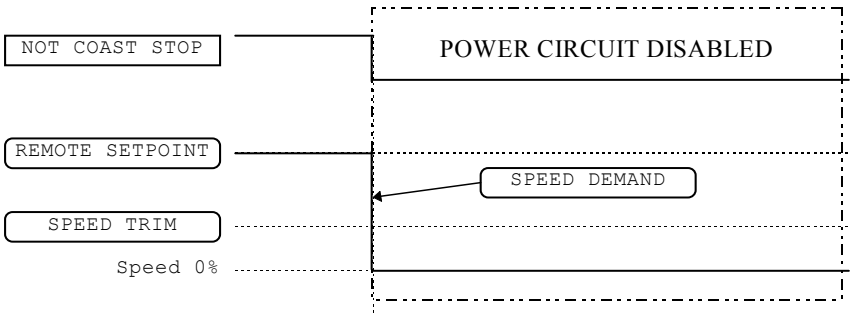


Figure Chapter 4 -10 Forced Coast Stop example

The Trip Condition

When a trip condition is detected, a similar stopping method to NOT COAST STOP is used. The power stack cannot be re-enabled until the trip condition has been cleared and successfully reset.
Refer to Chapter 6: “Trips and Fault Finding” for further details.

Logic Stopping

The drive can be stopped by setting the NOT STOP to FALSE for a short time, (>100 ms). The stop sequence continues even if the NOT STOP signal goes inactive before the drive is stopped. Various combinations of stop logic are shown below.

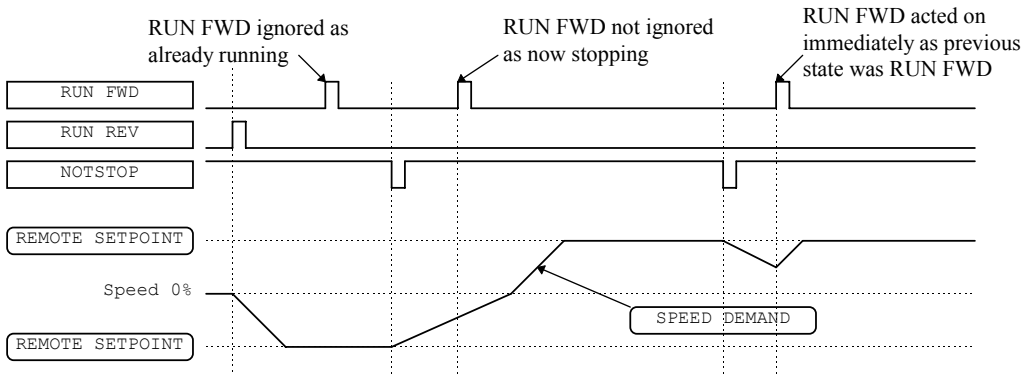


Figure Chapter 4 -11 Interaction between RUN FWD, RUN REV and NOT STOP

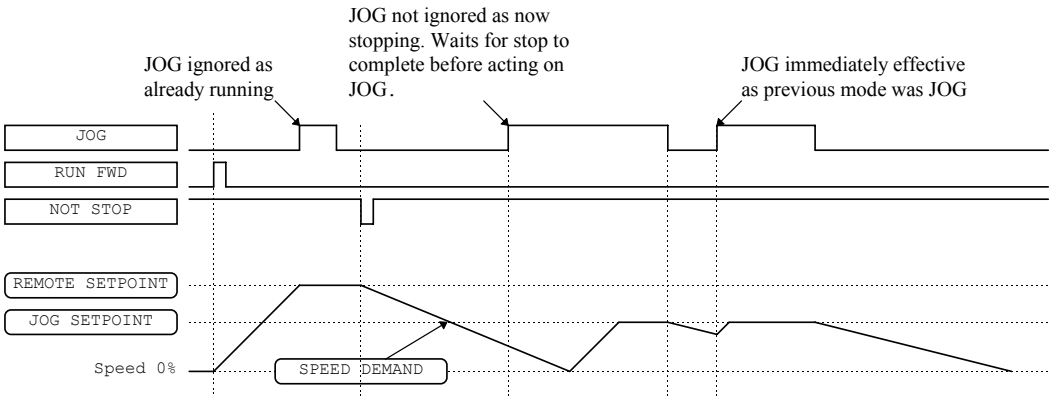


Figure Chapter 4 -12 Example of the Interaction between RUN and JOG Parameters

Starting Methods

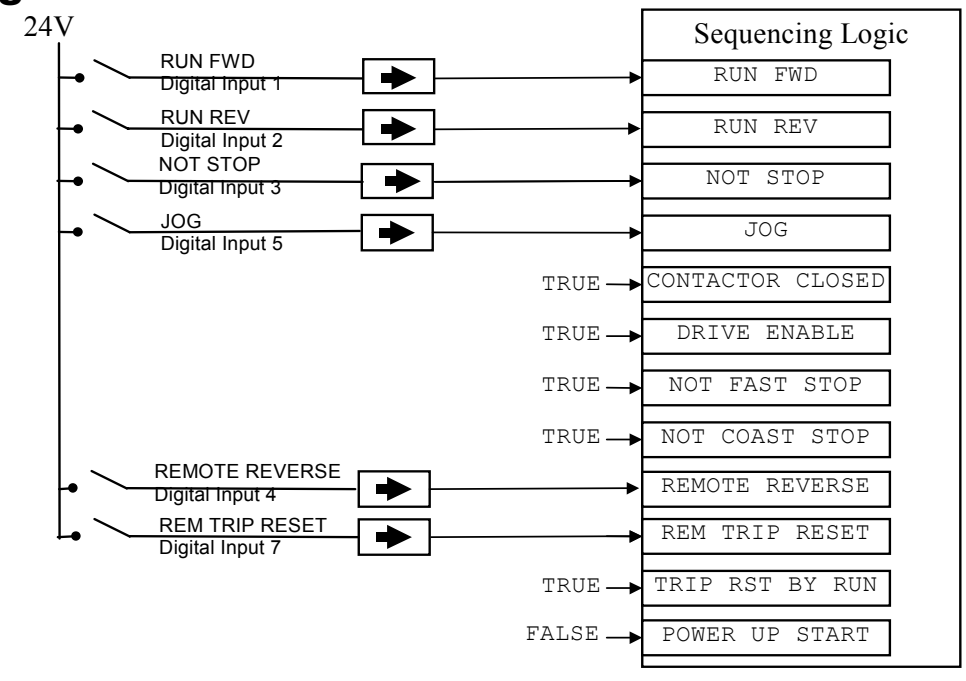


Figure Chapter 4 -13 Default Sequencing Wiring (Macro 1)

The methods below can be used when the drive has Macro 1, 2, 3 or 4 installed.

DEFAULT

The default configuration view above caters for Single, Two, and Three Wire Logic Starting without rewiring. Note that the NOT STOP parameter is active (FALSE - not wired to), meaning that the drive will only run while the relevant RUN parameters are held TRUE.

Starting Several Drives Simultaneously

IMPORTANT: We do not recommend that the DRIVE ENABLE signal is used to start a drive in "normal" use.

Use the DRIVE ENABLE parameter to control the output power stack. When this parameter is FALSE, the power stack is disabled regardless of the state of any other parameters. In conjunction with the HEALTH output parameter, DRIVE ENABLE can synchronise several drives on power-up.

Single Wire Logic Starting

Use just DIGITAL INPUT 1 when the motor direction will always be the same. All other digital inputs are FALSE (0V). The motor will run while the RUN FWD switch is closed, and will stop when it is open.

Two Wire Logic Starting

This uses two inputs; RUN FWD and RUN REV. The drive can operate in forward and reverse depending upon which switch is closed. If both RUN FWD and RUN REV are TRUE (24V) at the same time, both are ignored and the drive will stop.

Three Wire Logic Starting

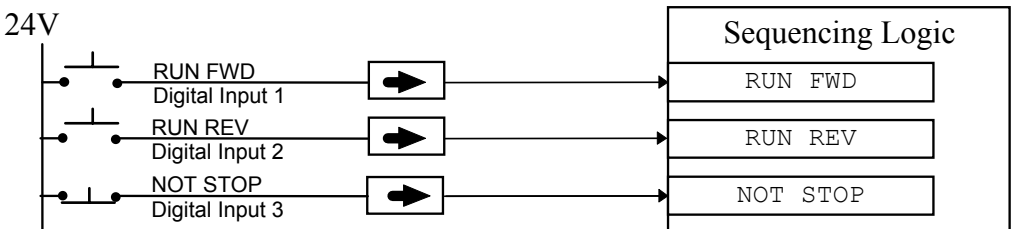


Figure Chapter 4 -14 Wiring for Three Wire Logic Starting

This example uses three inputs; RUN FWD, RUN REV and NOT STOP.

- Fit normally-open push button switches to RUN FWD and RUN REV.
- Fit a normally-closed push button switch to NOT STOP, thus NOT STOP is held TRUE (24V). When TRUE, the action of NOT STOP is to latch the RUN FWD and RUN REV signals. When FALSE, these signals are not latched.

For example, operating the RUN FWD switch starts the drive running forward. Operating the RUN REV switch causes the drive to run in reverse. Operating the NOT STOP switch (making "NOT STOP" FALSE) at any time causes the drive to stop running.

Note: *The JOG parameter is never latched in this way. The drive only jogs while the JOG parameter is TRUE.*

Chapter 5 THE KEYPAD

Connecting the Keypad

The Keypad is a plug-in MMI (Man-Machine Interface) option that allows full use of the drive's features.

It provides for local control of the drive, monitoring, and complete access for application programming.

Insert the Keypad into the front of the drive (replacing the blank cover and plugging into the RS232 programming port); or mount it up to 3 metres away using the optional panel mounting kit with connecting lead: refer to Chapter 3: "Installing the Drive" - Fitting the Remote 6901 Keypad.

Two Keypads (or one and a PC running suitable programming software) can be used simultaneously. In this case each Keypad runs independently.

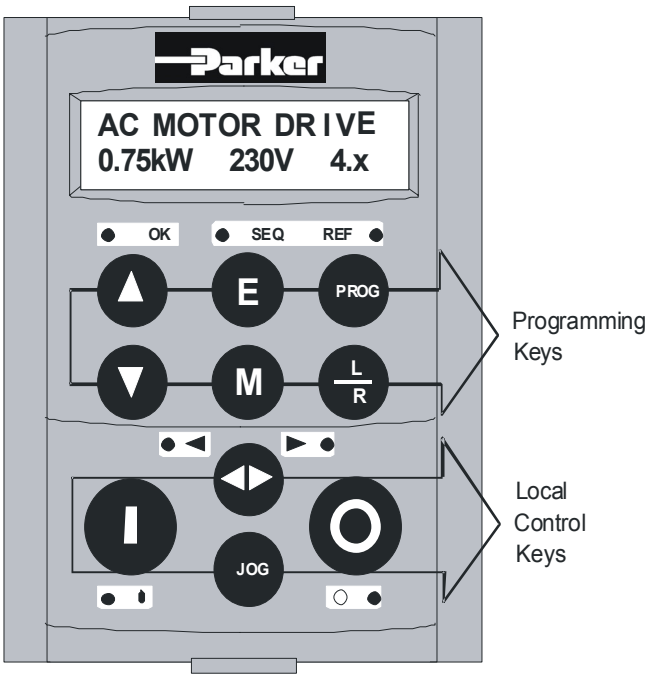


Figure 5-1 Keypad displaying Welcome screen

The drive can operate in one of two modes:

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

Local Control Mode: Providing local control and monitoring of the drive using the Keypad, or PC running suitable programming software

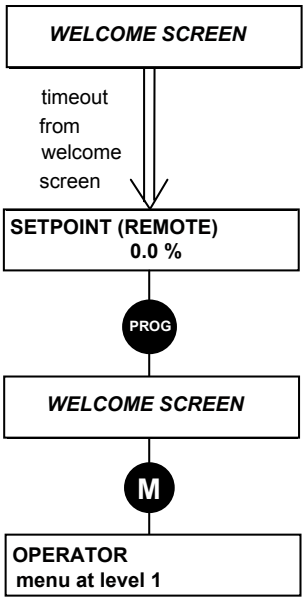
Local control keys are inactive when Remote control mode is selected and vice versa, with one exception; the **L/R** key toggles Local or Remote control modes and so is always operative.

HINT: Customise the action of the Keypad to create an effective working tool.

The Power-Up Condition

On power-up, a default Welcome screen is displayed for several seconds showing the product description; power rating, voltage and software version of the drive. After a few seconds the display changes to the SETPOINT (REMOTE) parameter.

Note: *By default the drive always initialises in Remote control mode, with the Local control keys inactive, making it unlikely that the motor could be started accidentally.*



Remote Mode (default)

Controlling the Drive using the Keypad

Control Key Definitions

Note: *Refer to Chapter 4: "Operating the Drive" for more detail about Remote and Local modes.*

Keys for Programming the Drive

Note: *See "Navigating the Menu System", page 5-4 for a quick-start to using the menu.*

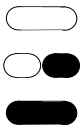
UP 	*Navigation* - Moves upwards through the list of parameters. *Parameter* - Increments the value of the displayed parameter. *Command Acknowledge* - Confirms action when in a command menu.
DOWN 	*Navigation* - Moves downwards through the list of parameters. *Parameter* - Decrements the value of the displayed parameter.
ESCAPE 	*Navigation* - Displays the previous level's Menu. *Parameter* - Returns to the parameter list. *Trip Acknowledge* - Acknowledges displayed Trip or Error message.
MENU 	*Navigation* - Displays the next Menu level, or the first parameter of the current Menu. *Parameter* - Allows a writable parameter to be modified (this is indicated by → appearing on the left of the bottom line).
PROG 	*Navigation* - Toggles between current locations within the Operator menu and any other menu.
LOCAL/ REMOTE 	*Control* - Toggles between Remote and Local Control for both Start/Stop (Seq) and Speed Control (Ref). When toggling, the display automatically goes to the relevant SETPOINT screen, and the SETPOINT (LOCAL) screen will have the ♦ and ♦ keys enabled to alter the setpoint.

Keys for Operating the Drive Locally

FORWARD/ REVERSE 	*Control* - Changes the direction of motor rotation. Only operates when the drive is in Local Speed Control mode.
JOG 	*Control* - Runs the motor at a speed determined by the JOG SETPOINT parameter. When the key is released, the drive returns to "stopped". Only operates when the drive is "stopped" and in Local Start/Stop mode.
RUN 	*Control* - Runs the motor at a speed determined by the LOCAL SETPOINT or REMOTE SETPOINT parameter. *Trip Reset* - Resets any trips and then runs the motor as above. Only operates when the drive is in Local Start/Stop (Seq) mode.
STOP/RESET 	*Control* - Stops the motor. Only operates when the drive is in Local Sequence mode. *Trip Reset* - Resets any trips and clears displayed message if trip is no longer active.

LED Indications

There are seven LEDs that indicate the status of the drive. Each LED is considered to operate in three different ways:



The LEDs are labelled HEALTH, LOCAL (as SEQ and REF), FWD, REV, RUN, and STOP. Combinations of these LEDs have the following meanings:

HEALTH	RUN	STOP	Drive State
			Re-Configuration
			Tripped
			Stopped
			Stopping
			Running with zero speed demand or enable false or contactor feedback false
			Running
			Autotuning
			Auto Restarting, waiting for trip cause to clear
			Auto Restarting, timing

FWD	REV	Forward / Reverse State
		Requested direction and actual direction are forward
		Requested direction and actual direction are reverse
		Requested direction is forward but actual direction is reverse
		Requested direction is reverse but actual direction is forward

LOCAL SEQ	LOCAL REF	Local / Remote Mode
		Start/Stop (Seq) and Speed Control (Ref) are controlled from the terminals
		Start/Stop (Seq) is controlled using the RUN, STOP, JOG and FWD/REV keys. Speed Control (Ref) is controlled from the terminals
		Start/Stop (Seq) is controlled from the terminals Speed Control (Ref) is controlled using the up (♦) and down (♦) keys
		Start/Stop (Seq) and Speed Control (Ref) are controlled using the Keypad keys

The Menu System

The menu system is divided into a `tree' structure with 5 menu levels. Menu Level 1 is at the top of the tree.

The Keypad has selectable "viewing levels" which can restrict the view of the menu system.

Below is a simple description of the menus at Menu Level 1:

- OPERATOR: a customised view of selected parameters contained in the SETUP menu. You can create a working list of parameters for operating your drive.
- DIAGNOSTICS: a view of important diagnostic parameters contained in the SETUP menu.
- QUICK SETUP: contains all the parameters necessary for the drive to turn the motor.
- SETUP: contains all the function block parameters for programming your application.
- SYSTEM: Macro selection.

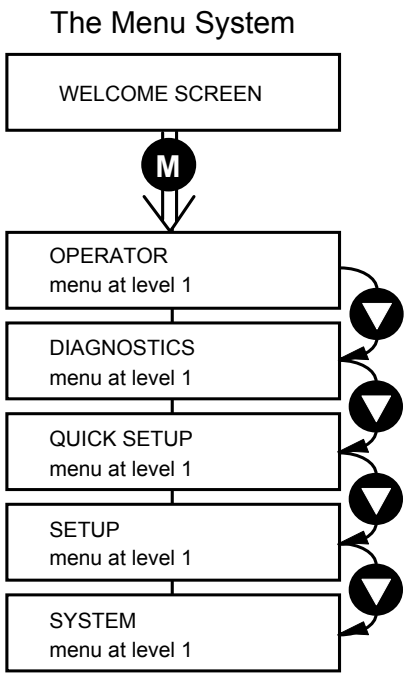


Figure Chapter 5 -2 The Menu System showing Menus at Level 1

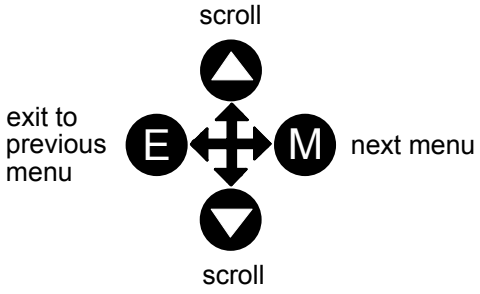
Navigating the Menu System

On power-up, the Keypad defaults into the OPERATOR menu, timing out from the Welcome screen. You can skip the timeout by pressing the **M** key immediately after power-up which will take you directly to the OPERATOR menu.

The menu system can be thought of as map which is navigated using the four keys shown opposite.

*Keys **E** and **M** navigate through the menu levels. The up (♦) and down (♦) keys scroll through the Menu and Parameter lists.*

Refer to "The Menu System Map" to see how the full menu is mapped.



NAVIGATING THE MENU

HINT: Remember that because the Menu and Parameter lists are looped, the ♦ key can quickly move you to the last Menu or Parameter in the loop.

Menu Viewing Levels

For ease of operation there are three `viewing levels' for the Keypad. The setting for the VIEW LEVEL parameter decides how much of the menu system will be displayed. The choice of menu for each has been designed around a type of user, hence we have the Operator, Basic and Advanced viewing levels.

MMI Menu Map

1 QUICK SETUP

VIEW LEVEL

In the QUICK SETUP menu, press the ▲ key to quickly move to VIEW LEVEL, the last parameter in the menu.

Note: *The contents of the OPERATOR menu remains unchanged for all view levels.*

Refer to "The Menu System Map", page 5-6 to see how VIEW LEVEL changes the menu.

Changing a Parameter Value

Refer to "The Menu System Map to see how the full menu is mapped.

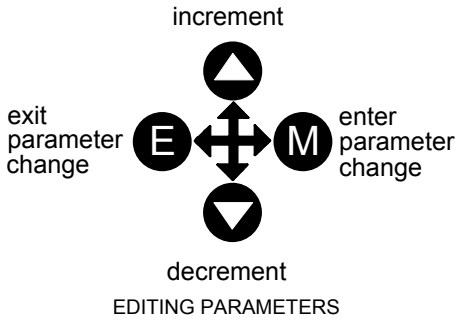
Each menu contains parameters.

*With the Parameter you want on view, press **M** to begin editing.*

The up (♦) and down (♦) keys will now change the parameter/function value.

*Press **E** to finish editing.*

The four keys will once again navigate around the Menus. Refer back to "Navigating the Menu System", page 5-4.



EDITING PARAMETERS

Note: *When viewing a "number" value, i.e. 100.00%, pressing the M key moves the cursor along the number for editing of that character by the up (♦) and down (♦) keys. "Alphanumeric" values, i.e. PUMP 2, are produced and edited in a similar way.*

What do the Symbols mean next to some Parameters?

Parameter Status Information → ← =

→	Pressing M in a parameter displays → on the left of the bottom line to indicate that the up and down keys will now change parameter values. Pressing E removes the symbol and reverts the up and down keys to scrolling through the parameters.
←	A writable parameter may be non-writable if it is the destination of a link. In this case it will be indicated by ← appearing on the left of the bottom line.
←	A Feedback Link is indicated by ← appearing on the right of the bottom line. Refer to the Software Product Manual, Chapter 1: "Programming Your Application".
=	Non-writable parameters are identified by = appearing on the left of the bottom line. *Note that some parameters become non-writable when the drive is running.*

Expanded Menu Information >>

The parameters listed below are followed by >> to the right of the bottom display line indicating that there is more information. Press the **M** key to display a further list of parameters.

AUTO RESTART menu at level 4:	AR TRIGGERS 1, AR TRIGGERS+ 1, AR TRIGGERS 2 AR TRIGGERS+ 2
TRIPS STATUS menu at level 4:	DISABLED TRIPS, DISABLED TRIPS+, ACTIVE TRIPS, ACTIVE TRIPS+, TRIP WARNINGS, TRIP WARNINGS+
OP STATION menu at level 4:	ENABLED KEYS

Alert Message Displays

A message will be displayed on the Keypad when either:

- A requested operation is not allowed:
  The top line details the illegal operation, while the bottom line gives the reason or cause. See example opposite.

*** KEY INACTIVE ***
REMOTE SEQ

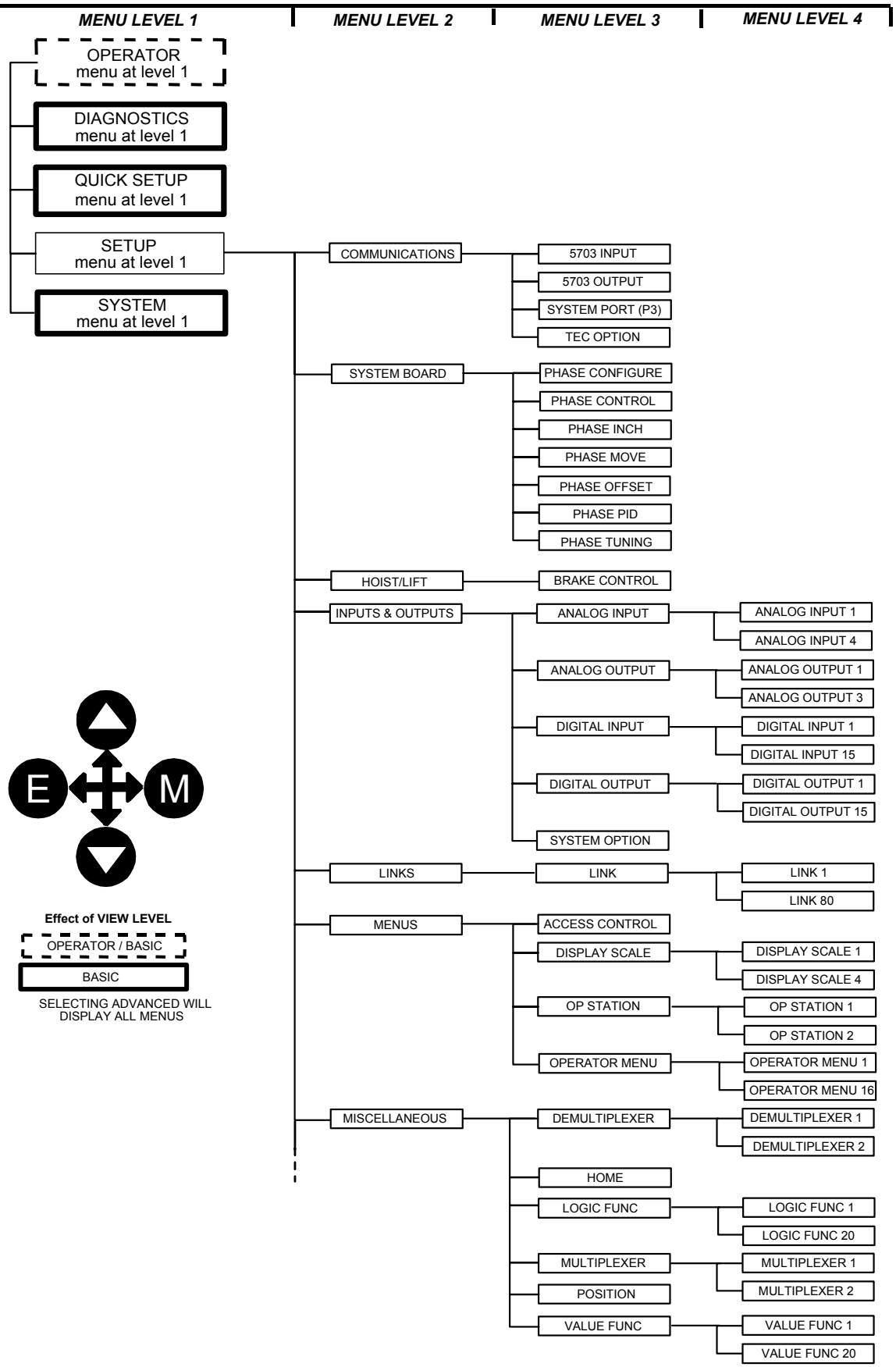
- The drive has tripped:
  The top line indicates a trip has occurred while the bottom line gives the reason for the trip. See example opposite.

*** * * TRIPPED * * ***
HEATSINK TEMP

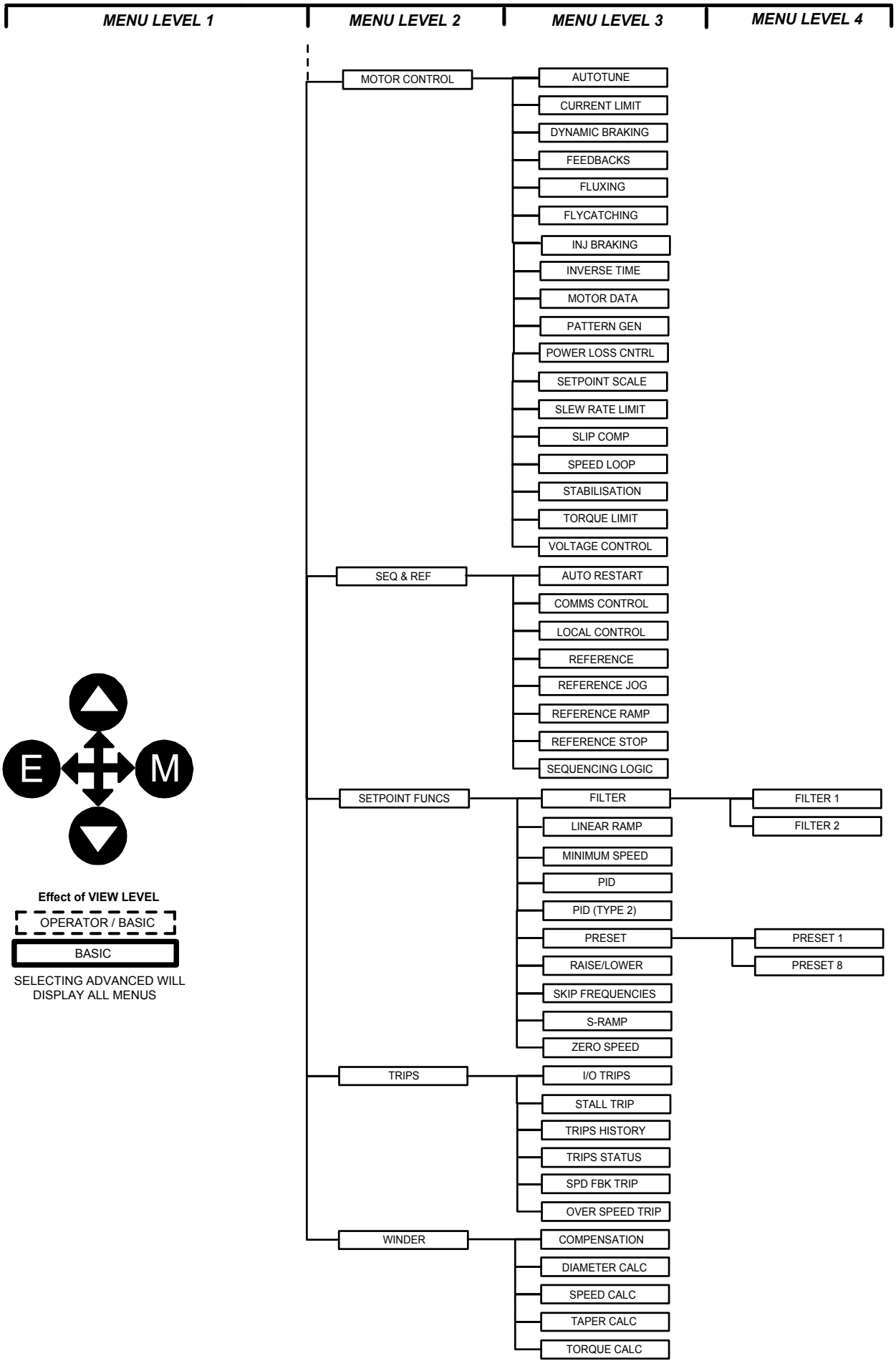
Most messages are displayed for only a short period, or for as long as an illegal operation is tried, however, trip messages must be acknowledged by pressing the **E** key.

Experience will show how to avoid most messages. They are displayed in clear, concise language for easy interpretation. Refer to Chapter 6: "Trips and Fault Finding" for trip messages and reasons.

The Menu System Map



Note: *When VIEW LEVEL is set to OPERATOR, the PROG key also toggles to the VIEW LEVEL parameter in the QUICK SETUP menu. This can be password protected.*


MENU LEVEL 1
MENU LEVEL 2
MENU LEVEL 3
MENU LEVEL 4
MOTOR CONTROL
AUTOTUNE
CURRENT LIMIT
DYNAMIC BRAKING
FEEDBACKS
FLUXING
FLYCATCHING
INJ BRAKING
INVERSE TIME
MOTOR DATA
PATTERN GEN
POWER LOSS CNTRL
SETPOINT SCALE
SLEW RATE LIMIT
SLIP COMP
SPEED LOOP
STABILISATION
TORQUE LIMIT
VOLTAGE CONTROL
SEQ & REF
AUTO RESTART
COMMS CONTROL
LOCAL CONTROL
REFERENCE
REFERENCE JOG
REFERENCE RAMP
REFERENCE STOP
SEQUENCING LOGIC
SETPOINT FUNCS
FILTER
FILTER 1
FILTER 2
LINEAR RAMP
MINIMUM SPEED
PID
PID (TYPE 2)
PRESET
PRESET 1
PRESET 8
RAISE/LOWER
SKIP FREQUENCIES
S-RAMP
ZERO SPEED
TRIPS
I/O TRIPS
STALL TRIP
TRIPS HISTORY
TRIPS STATUS
SPD FBK TRIP
OVER SPEED TRIP
WINDER
COMPENSATION
DIAMETER CALC
SPEED CALC
TAPER CALC
TORQUE CALC
E
M
Effect of VIEW LEVEL
OPERATOR / BASIC
BASIC
SELECTING ADVANCED WILL DISPLAY ALL MENUS

The PROG Key

The **PROG** key toggles between the OPERATOR menu and any other menu, remembering and returning to previous positions in each menu. As you press the **PROG** key, the title of the menu you are about to enter is displayed, i.e. OPERATOR or for example DIAGNOSTICS. Releasing the key clears the display and releases you into that menu.

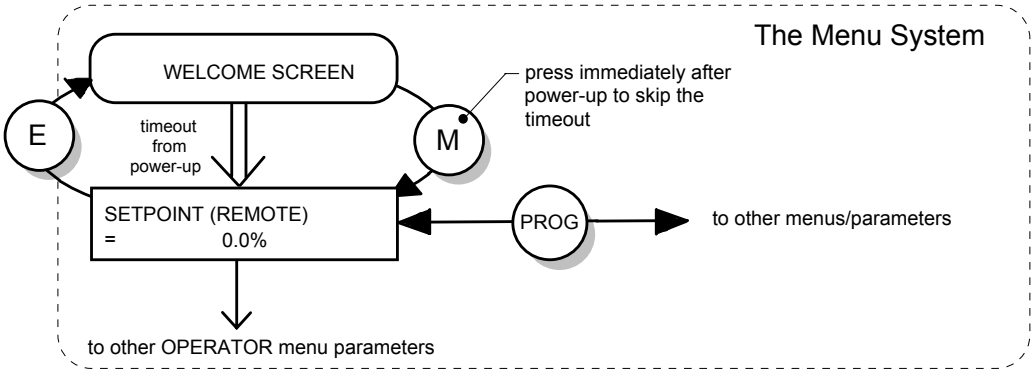


Figure 5-3 The Menu System showing Operation of the E, M and PROG Keys

Holding the PROG key for approximately three seconds takes you to the SAVE CONFIG menu. Refer to "Quick Save Feature", page 5-18.

The L/R Key

The **L/R** key (LOCAL/REMOTE) toggles between Remote and Local Control. In doing so, the view of the SETPOINT parameter in the OPERATOR menu toggles between SETPOINT (LOCAL) and SETPOINT (REMOTE. The default is for the SETPOINT (REMOTE) parameter to be displayed.

Note: *A different naming convention is applied in the OPERATOR menu for these parameters when displayed as the first parameter entry:*

- *REMOTE SETPOINT is displayed as SETPOINT (REMOTE)*
- *LOCAL SETPOINT is displayed as SETPOINT (LOCAL)*
- *COMMS SETPOINT is displayed as SETPOINT (COMMS)*
- *JOG SETPOINT is displayed as SETPOINT (JOG)*

Pressing the L/R key when in Remote mode takes you directly to the SETPOINT (LOCAL) parameter with the Edit mode enabled. Press the PROG key to return to the previous display.

The OPERATOR Menu

You can create 16 “custom screens” for display in the OPERATOR menu at level 1.

MMI Menu Map

1 OPERATOR

Each screen contains:

- a top line of sixteen characters
- user-definable units
- user-selectable scaling factor
- user selectable limits
- user selectable coefficients

This feature may be used to re-display the setpoint, for example, in more convenient units.

To add an item to the Operator Menu select a parameter (as shown below) in an OPERATOR MENU function block. You can also give the parameter a new name, and set the scaling and units to be displayed.

Note: *If PARAMETER is set to NULL, the Operator Menu item is not included in the Operator Menu.*

Parameter Selection

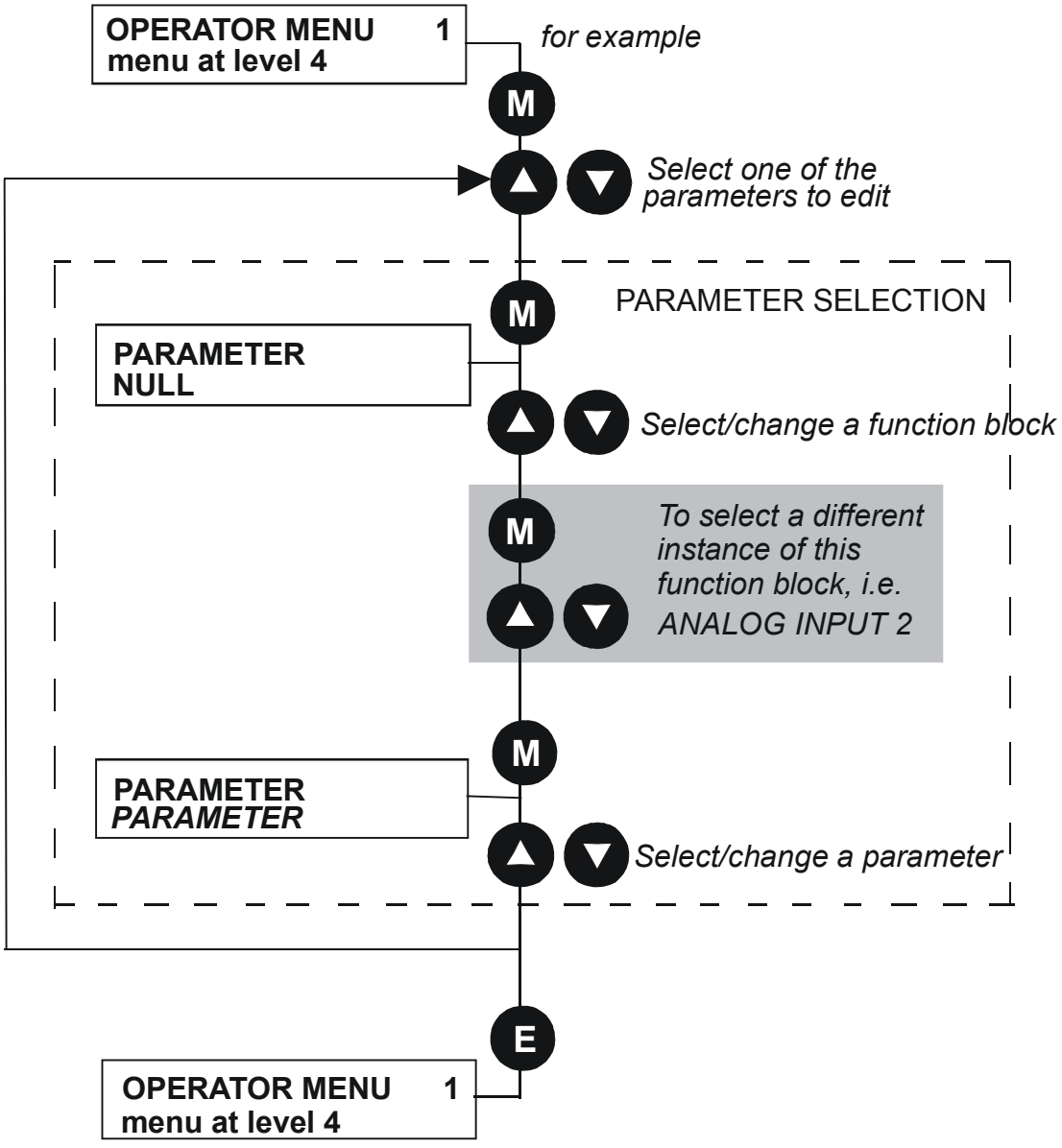


Figure Chapter 5 -4 Parameter Selection

String Entry

Customising the Parameter Name

To enter a string:

- Press the **M** key to begin entering a character.
- Use the (♦) and down (♦) keys to scroll through the character set for each of the character spaces. If a key is not pressed within 2 seconds, the cursor will progressively move to the left of the screen.
- Press the **M** key to move to the next character within 2 seconds.
- Press the **E** key to exit parameter editing.

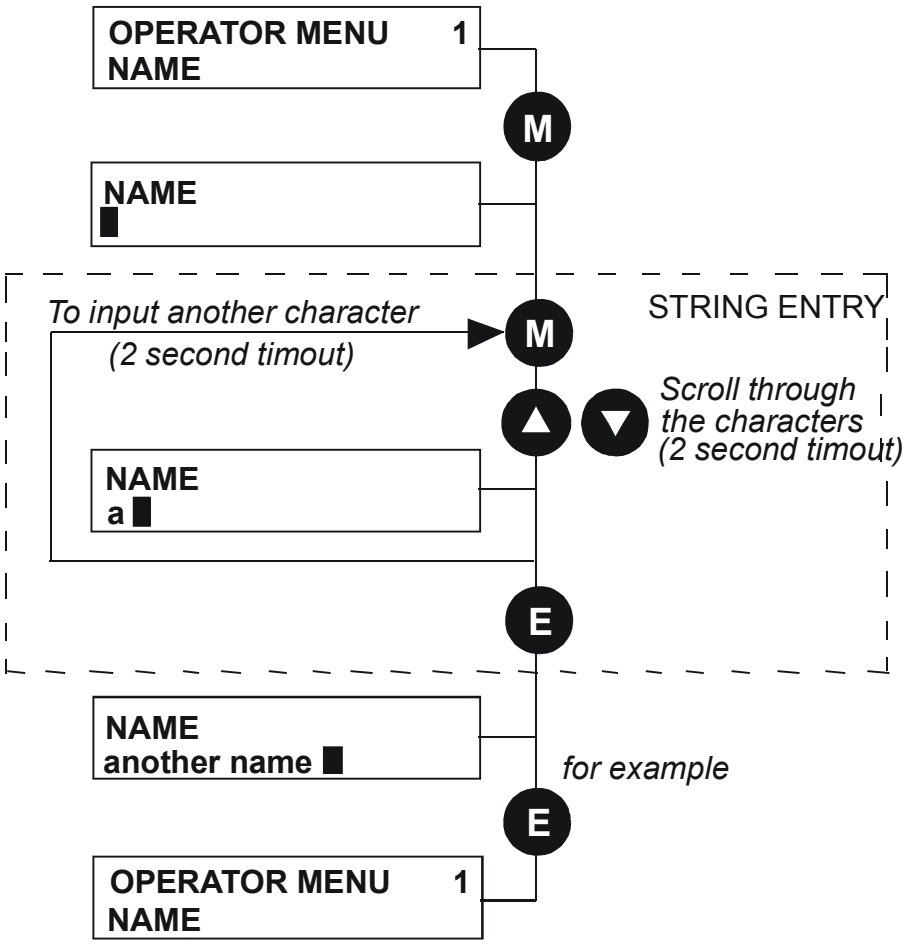


Figure Chapter 5 -5 String Entry

Note: *For details about user-definable units, scaling factors, limits and coefficients refer to the Software Product Manual, Chapter 1: Programming Your Application - OPERATOR MENU and DISPLAY SCALE function blocks.*

The DIAGNOSTICS Menu

Diagnostics are used to monitor the status of the drive, internal variables, and its inputs and outputs.

MMI Menu Map

1 DIAGNOSTICS

The table below describes the parameters contained in the DIAGNOSTICS menu at level 1.

Ranges are given as "—.xx %", for example, indicating an indeterminate integer for the value.

(Note the reference in brackets to the function block where each parameter is stored. Refer to the Software Product Manual).

The DIAGNOSTICS Menu

SPEED DEMAND	Tag No. 255	***Range:*** *—.xx %*

Indicates actual speed demand. This is the input to the frequency controller.

(Refer to the REFERENCE function block)

REMOTE SETPOINT	Tag No. 245	***Range:*** *—.xx %*

This is the target reference that the drive will ramp to in remote reference mode (not including trim), direction is taken from REMOTE REVERSE and the sign of REMOTE SETPOINT.

(Refer to the REFERENCE function block)

COMMS SETPOINT	Tag No. 770	***Range:*** *—.xx %*

This setpoint is the target reference that the drive will ramp to in Remote Reference Comms mode (not including trim). The direction is always positive, i.e. forward.

(Refer to the REFERENCE function block)

LOCAL SETPOINT	Tag No. 247	***Range:*** *—.xx %*

Indicates the Keypad setpoint. It is always a positive quantity; saved on power down. Direction is taken from LOCAL REVERSE.

(Refer to the REFERENCE function block)

JOG SETPOINT	Tag No. 246	***Range:*** *—.xx %*

The setpoint is the target reference that the drive will ramp to.

(Refer to the REFERENCE function block)

TOTAL SPD DMD RPM	Tag No. 1203	***Range:*** *—.xx rpm*

The final value of speed demand obtained after summing all sources.

(Refer to the SPEED LOOP function block)

TOTAL SPD DMD %	Tag No. 1206	***Range:*** *—.xx %*

The final value of speed demand obtained after summing all sources.

(Refer to the SPEED LOOP function block)

SPEED FBK RPM	Tag No. 569	***Range:*** *—.xx rpm*

The mechanical speed of the motor shaft in revolutions per minute.

(Refer to the FEEDBACKS function block)

SPEED FBK %	Tag No. 749	***Range:*** *—.xx %*

Shows the mechanical speed of the motor shaft as a percentage of the maximum speed setting.

(Refer to the FEEDBACKS function block)

SPEED ERROR	Tag No. 1207	***Range:*** *—.xx %*

The difference between the demanded speed and the actual speed.

(Refer to the SPEED LOOP function block)

DRIVE FREQUENCY	Tag No. 591	***Range:*** *—.xx Hz*

Shows the drive output frequency in Hz.

(Refer to the PATTERN GEN function block)

The DIAGNOSTICS Menu

DIRECT INPUT Tag No. 1205 ***Range:*** *—.xx %*

The value of the direct input, after scaling and clamping.

(Refer to the SPEED LOOP function block)

TORQ DMD ISOLATE Tag No. 1202 ***Range****: FALSE / TRUE*

Speed Control mode and Torque Control mode selection. Torque Control mode = TRUE.

(Refer to the SPEED LOOP function block)

ACTUAL POS LIM Tag No. 1212 ***Range:*** *—.xx %*

The final actual positive torque limit.

(Refer to the TORQUE LIMIT function block)

ACTUAL NEG LIM Tag No. 1213 ***Range:*** *—.xx %*

The final actual negative torque limit.

(Refer to the TORQUE LIMIT function block)

AUX TORQUE DMD Tag No. 1193 ***Range:*** *—.xx %*

The auxiliary motor torque as a percentage of rated motor torque.

(Refer to the SPEED LOOP function block)

TORQUE DEMAND Tag No. 1204 ***Range:*** *—.xx %*

The demanded motor torque as a percentage of rated motor torque.

(Refer to the SPEED LOOP function block)

TORQUE FEEDBACK Tag No. 70 ***Range:*** *—.xx %*

The estimated motor torque, as a percentage of rated motor torque.

(Refer to the FEEDBACKS function block)

FIELD FEEDBACK Tag No. 73 ***Range:*** *—.xx %*

A value of 100% indicates the motor is operating at rated magnetic flux (field).

(Refer to the FEEDBACKS function block)

MOTOR CURRENT % Tag No. 66 ***Range:*** *—.xx %*

This diagnostic contains the level of rms line current being drawn from the drive and is seen as a % of the MOTOR CURRENT parameter setting in the MOTOR DATA function block.

(Refer to the FEEDBACKS function block)

MOTOR CURRENT A Tag No. 67 ***Range:*** *—.x A*

This diagnostic contains the level of rms line current being drawn from the drive.

(Refer to the FEEDBACKS function block)

DC LINK VOLTS Tag No. 75 ***Range:*** *—. V*

The internal dc voltage tested by the FEEDBACKS block.

(Refer to the FEEDBACKS function block)

TERMINAL VOLTS Tag No. 1020 ***Range:*** *—. V*

This shows the rms voltage, between phases, applied by the drive to the motor terminals.

(Refer to the FEEDBACKS function block)

BRAKING Tag No. 81 ***Range:*** *FALSE / TRUE*

A read-only parameter indicating the state of the brake switch.

(Refer to the DYNAMIC BRAKING function block)

DRIVE FREQUENCY Tag No. 591 ***Range:*** *—.x Hz*

The drive output frequency.

(Refer to the PATTERN GEN function block)

The DIAGNOSTICS Menu

ACTIVE TRIPS Tag No. 4 ***Range:*** *0000 to FFFF*

Indicates which trips are currently active. These parameters are a coded representation of the trip status.

(Refer to the TRIPS STATUS function block)

ACTIVE TRIPS + Tag No. 740 ***Range:*** *0000 to FFFF*

Indicates which trips are currently active. These parameters are a coded representation of the trip status.

(Refer to the TRIPS STATUS function block)

FIRST TRIP Tag No. 6 ***Range:*** *Enumerated - refer to block*

From when a trip occurs until that trip is reset, this parameter indicates the trip source. When several trips have occurred, this parameter indicates the first one that was detected.

(Refer to the TRIPS STATUS function block)

ANALOG INPUT 1 Tag No. 16 ***Range:*** *—.xx %*

(VALUE) The input reading with scaling and offset applied.

(Refer to the ANALOG INPUT function block)

ANALOG INPUT 2 Tag No. 25 ***Range:*** *—.xx %*

(VALUE) The input reading with scaling and offset applied.

(Refer to the ANALOG INPUT function block)

ANALOG INPUT 3 Tag No. 715 ***Range:*** *—.xx %*

(VALUE) The input reading with scaling and offset applied.

(Refer to the ANALOG INPUT function block)

ANALOG INPUT 4 Tag No. 722 ***Range:*** *—.xx %*

(VALUE) The input reading with scaling and offset applied.

(Refer to the ANALOG INPUT function block)

DIGITAL INPUT 1 Tag No. 31 ***Range:*** *FALSE / TRUE*

(VALUE) The TRUE or FALSE input, (after any inversion).

(Refer to the DIGITAL INPUT function block)

DIGITAL INPUT 2 Tag No. 34 ***Range:*** *FALSE / TRUE*

(VALUE) The TRUE or FALSE input, (after any inversion).

(Refer to the DIGITAL INPUT function block)

DIGITAL INPUT 3 Tag No. 37 ***Range:*** *FALSE / TRUE*

(VALUE) The TRUE or FALSE input, (after any inversion).

(Refer to the DIGITAL INPUT function block)

DIGITAL INPUT 4 Tag No. 40 ***Range:*** *FALSE / TRUE*

(VALUE) The TRUE or FALSE input, (after any inversion).

(Refer to the DIGITAL INPUT function block)

DIGITAL INPUT 5 Tag No. 43 ***Range:*** *FALSE / TRUE*

(VALUE) The TRUE or FALSE input, (after any inversion).

(Refer to the DIGITAL INPUT function block)

DIGITAL INPUT 6 Tag No. 726 ***Range:*** *FALSE / TRUE*

(VALUE) The TRUE or FALSE input, (after any inversion).

(Refer to the DIGITAL INPUT function block)

The DIAGNOSTICS Menu

DIGITAL INPUT 7	Tag No. 728	***Range:*** *FALSE / TRUE*

(VALUE) The TRUE or FALSE input, (after any inversion).

(Refer to the DIGITAL INPUT function block)

EXTERNAL TRIP	Tag No. 234	***Range:*** *FALSE / TRUE*

(EXTERNAL) A general purpose signal designed to be internally wired to a digital input block. When this signal goes TRUE this causes an EXTERNAL TRIP to occur, (unless this trip is disabled within the TRIPS area). This parameter is not saved in the drive's non-volatile memory and thus is reset to the default setting at power-up.

(Refer to the I/O TRIPS function block)

ANALOG OUTPUT 1	Tag No. 45	***Range:*** *—.xx %*

(VALUE) The demanded value to output.

(Refer to the ANALOG OUTPUT function block)

ANALOG OUTPUT 2	Tag No. 731	***Range:*** *—.xx %*

(VALUE) The demanded value to output.

(Refer to the ANALOG OUTPUT function block)

ANALOG OUTPUT 3	Tag No. 800	***Range:*** *—.xx %*

(VALUE) The demanded value to output.

(Refer to the ANALOG OUTPUT function block)

DIGITAL OUTPUT 1	Tag No. 52	***Range:*** *FALSE / TRUE*

(VALUE) The TRUE or FALSE output demand.

(Refer to the DIGITAL OUTPUT function block)

DIGITAL OUTPUT 2	Tag No. 55	***Range:*** *FALSE / TRUE*

(VALUE) The TRUE or FALSE output demand.

(Refer to the DIGITAL OUTPUT function block)

DIGITAL OUTPUT 3	Tag No. 737	***Range:*** *FALSE / TRUE*

(VALUE) The TRUE or FALSE output demand.

(Refer to the DIGITAL OUTPUT function block)

The QUICK SETUP Menu

By loading a different macro, you are installing the default settings for that macro's application. Once a macro has been loaded (or the default Macro 1 is used), the parameters most likely to require attention are contained in the QUICK SETUP menu at level 1.

MMI Menu Map

1 QUICK SETUP

The Default values in the table below are correct for when the UK country code is selected and a 400V 5.5kW Frame C power board is fitted. Some parameters in the table are marked:

* Value dependent upon the Language field of the Product Code, e.g. UK
** Value dependent upon the overall "power-build", e.g. 400V, 5.5kW
The values may be different for your drive/application.

Tag	QUICK SET-UP Parameters	Default	Brief Description
1105	CONTROL MODE	VOLTS / HZ	Selects the control mode for the drive
1032	MAX SPEED	* 1500 RPM	Max speed clamp and scale factor for other speed parameters
337	MIN SPEED	-100.00 %	Min speed clamp
258	RAMP ACCEL TIME	10.0 s	Acceleration time from 0Hz to max speed
259	RAMP DECEL TIME	10.0 s	Deceleration time from max speed to 0Hz
279	RUN STOP MODE	RAMPED	Ramp to standstill when RUN signal removed
246	JOG SETPOINT	10.0 %	Drive speed setpoint whilst jogging
106	VHZ BASE FREQ	** 50.0 Hz	Determines the frequency at which maximum output volts is generated
104	V/F SHAPE	LINEAR LAW	Constant torque V to F characteristic
50	QUADRATIC TORQUE	FALSE	Selects between Constant or Quadratic mode of operation
64	MOTOR CURRENT	** 11.3 A	Calibrates drive to motor full load current
107	FIXED BOOST	** 6.00 %	Boosts starting torque by adding volts at low speed
365	CURRENT LIMIT	100.00%	Level of motor current as % of FULL LOAD CALIB
1159	MOTOR BASE FREQ	** 50.0 Hz	Frequency at which drive gives maximum output volts
1160	MOTOR VOLTAGE	** 400.0 V	Maximum motor output voltage
83	NAMEPLATE RPM	** 1445 RPM	Motor nameplate speed
84	MOTOR POLES	** 4	Number of motor poles
124	MOTOR CONNECTION	** STAR	Type of motor connection
761	ENCODER SUPPLY	10.0V	Set to supply voltage required by the encoder
566	ENCODER LINES	** 2048	Set to the number of lines used by the encoder
567	ENCODER INVERT	FALSE	Encoder direction
603	AUTOTUNE ENABLE	FALSE	Enables the Autotune feature
65	MAG CURRENT	** 3.39 A	Calibrates drive to motor no load current
119	STATOR RES	** 1.3625 Ω	Motor per-phase stator resistance
120	LEAKAGE INDUC	** 43.37 mH	Motor per-phase stator leakage inductance
121	MUTUAL INDUC	** 173.48 mH	Motor per-phase stator mutual (magnetising) inductance
1163	ROTOR TIME CONST	** 276.04 ms	The motor model rotor time constant as determined by Autotune
1187	SPEED PROP GAIN	20.00	Sets the proportional gain of the loop
1188	SPEED INT TIME	100 ms	The integral time constant of the speed loop
13	AIN 1 TYPE	0..+10 V	Input range and type
22	AIN 2 TYPE	0..+10 V	Input range and type
712	AIN 3 TYPE	0..+10 V	Input range and type
719	AIN 4 TYPE	0..+10 V	Input range and type
231	DISABLE TRIPS	0000 >>	Sub-menu to set disabled trips
742	DISABLE TRIPS +	0040 >>	Sub-menu to set disabled trips
876	VIEW LEVEL	TRUE	Selects full menu for MMI display

Table Chapter 5 -1 Parameters for setting-up the drive

The SYSTEM Menu

Saving/Restoring/Deleting Your Application

Caution
On power-up, the drive will always run APPLICATION.

HINT: The default APPLICATION supplied with the drive is a copy of Macro 1. Saving your current configuration to APPLICATION will ensure that it is always ready to run on power-up.

SAVE CONFIG

The SAVE CONFIG menu saves your current settings to the displayed config name.

MMI Menu Map

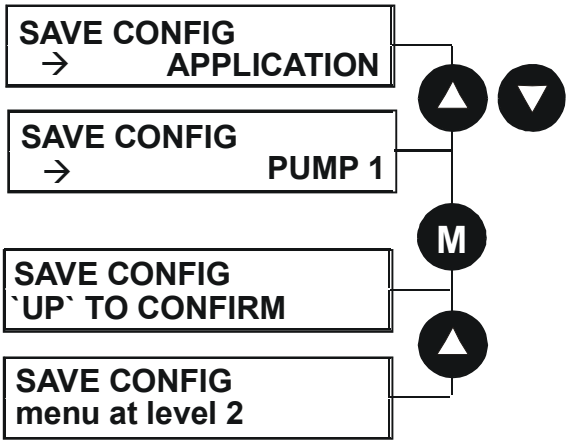
1 SYSTEM
2 SAVE CONFIG
SAVE CONFIG

You can save to any config name listed. Saving to an existing config name, rather than a newly created config name, will overwrite the previous information.

By default, the only name in this list will be APPLICATION. As you create new config names, they will be added to this list. If you also save the new config into APPLICATION, it will always be restored on power-up.

Note: *Because factory macros are read-only, they do not appear in the SAVE CONFIG menu.*

To save an application see below.



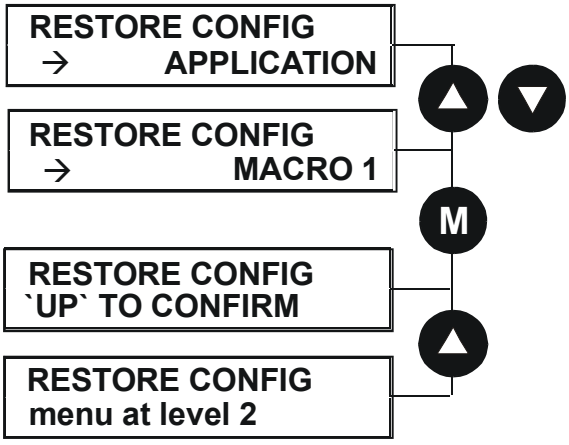
RESTORE CONFIG

This menu restores the displayed application/macro to the drive.

MMI Menu Map

1 SYSTEM
2 RESTORE CONFIG
RESTORE CONFIG

To restore an application/macro see below.



NEW CONFIG NAME

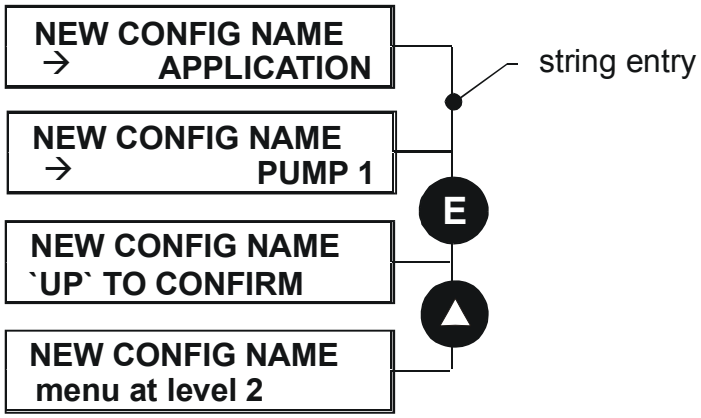
Use the NEW CONFIG NAME parameter to create a new config name.

MMI Menu Map

1 SYSTEM
2 NEW CONFIG NAME
NEW CONFIG NAME

The Keypad provides a default name, APPLICATION, for you to save your application in. You can save more than one application using different names, e.g. PUMP 1, PUMP 2.

To enter a config name see below. Refer to "Figure Chapter 5 -5 String Entry", page 5-10 for details of how to enter a string.



DELETE CONFIG

You can delete your own applications in this menu.

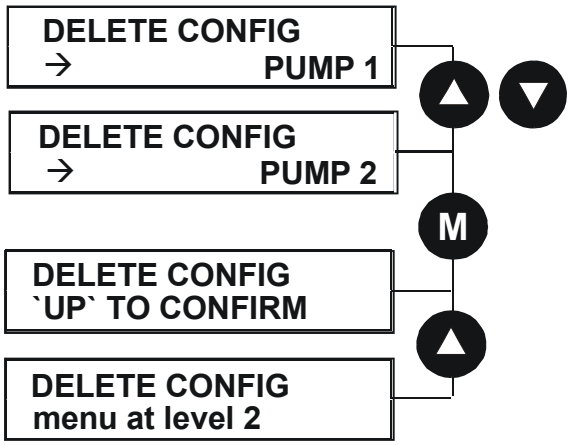
MMI Menu Map

1 SYSTEM
2 DELETE CONFIG
DELETE CONFIG

Note: *If you delete APPLICATION, don't worry. Software always provides a new APPLICATION on power-up which will be the same as MACRO 1.*

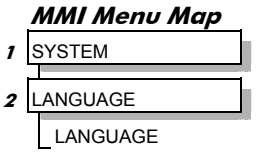
You cannot delete the factory macros.

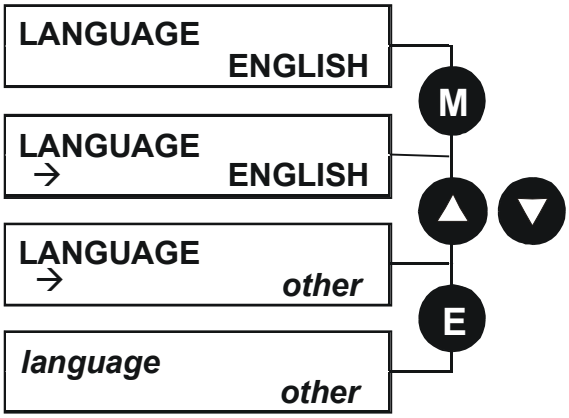
To delete an application see below.



Selecting the Language

This option selects a different display language.



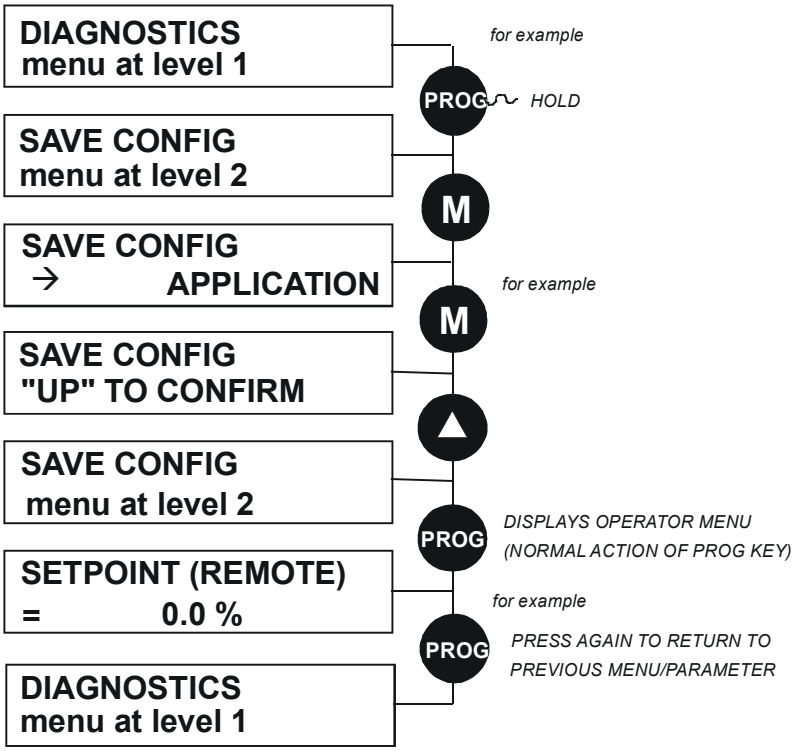


The available languages are: ENGLISH, GERMAN, FRENCH, SPANISH, ITALIAN, SWEDISH, POLISH, and PORTUGUESE.

Special Menu Features

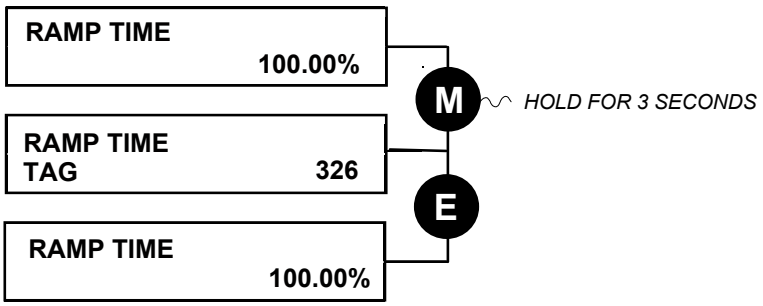
Quick Save Feature

From anywhere in the menu system, hold down the **PROG** key for approximately 3 seconds to move quickly to the SAVE CONFIG menu. You can save your application and return conveniently to your original display.



Quick Tag Information

With a parameter displayed, hold down the **M** key for approximately 3 seconds to display the parameter's tag number (a message may be displayed during this time).

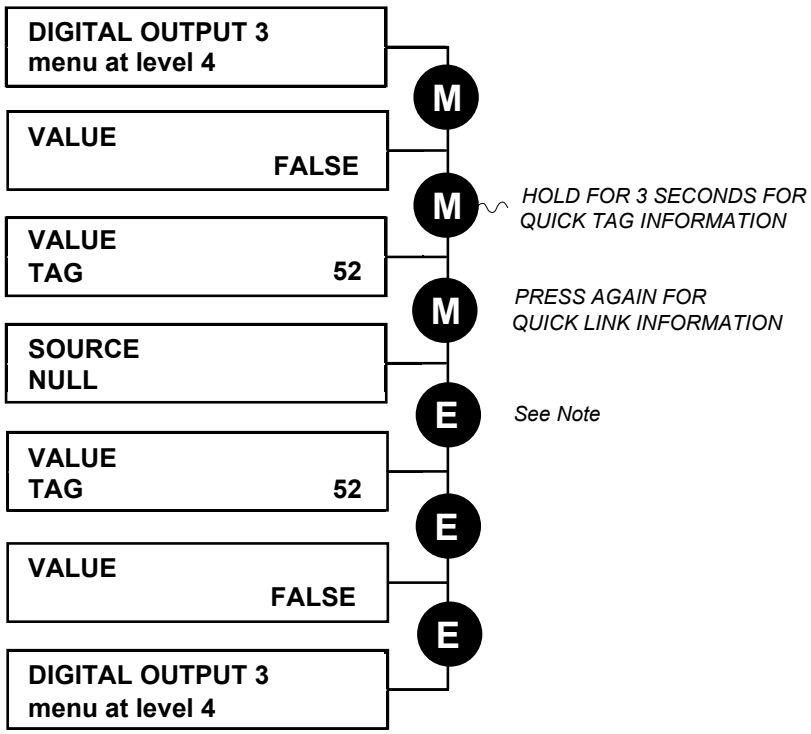


Quick Link Information

When in Advanced view level and with the Quick Tag Information on display, press the **M** key in any *configurable* parameter to display link information about that parameter.

The drive is in Parameterisation Mode and links cannot be edited.

Note: *Quick Link Information is not available for parameters that are non-configurable.*



Note: *The drive must be in Configuration mode before links can be edited. Pressing the **M** key at this point will display the ENABLE CONFIG page. Refer to the Software Product Manual, Chapter 1: "Programming Your Application" - Making and Breaking Links in Configuration Mode.*

Password Protection

When activated, the password prevents unauthorised parameter modification by making all parameters "read-only". If you attempt to modify a password protected parameter, you will be prompted for the password.

The password protection is activated/deactivated using the PASSWORD parameter.

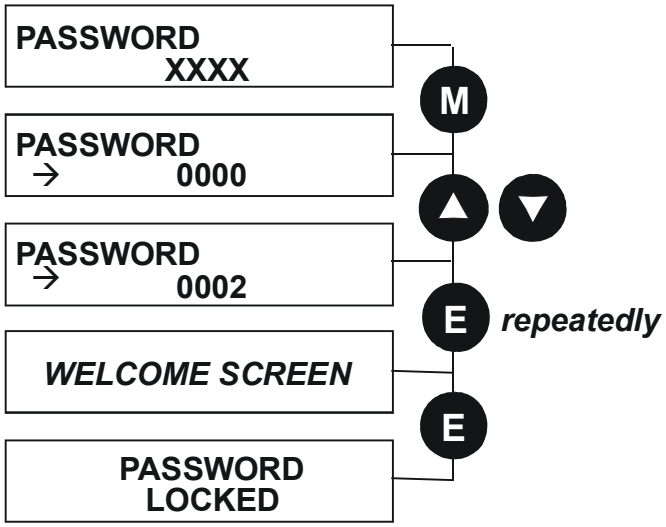
MMI Menu Map

1 SETUP
2 MENUS
3 ACCESS CONTROL
PASSWORD

To Activate Password Protection

By default the password feature is deactivated, i.e. 0000.

1. Enter a new password in the PASSWORD parameter (anything other than the default value of 0000), for example 0002.
2. Press the **E** key repeatedly until the Welcome screen is displayed. Pressing the **E** key again activates password protection.



Note: *Perform a SAVE CONFIG if you need the password to be saved on power-down.*

To De-activate Password Protection

If you try to change the value of a parameter with password protection activated, the PASSWORD screen is displayed for you to enter the current password. If you enter the password correctly password protection is temporarily de-activated.

To Re-activate Password Protection

Re-activate an existing password by pressing the **E** key repeatedly until the PASSWORD LOCKED screen is displayed.

Note: *You can choose to have the password protect individual parameters in the OPERATOR menu. Under default conditions these are not protected. Refer to the Software Product Manual, Chapter 1: "Programming Your Application" - OPERATOR MENU::IGNORE PASSWORD and ACCESS CONTROL::NO SETPOINT PWRD.*

To Remove Password Protection (default status)

Navigate to the PASSWORD parameter and enter the current password. Press the **E** key. Reset the password to 0000. Password protection is now removed.

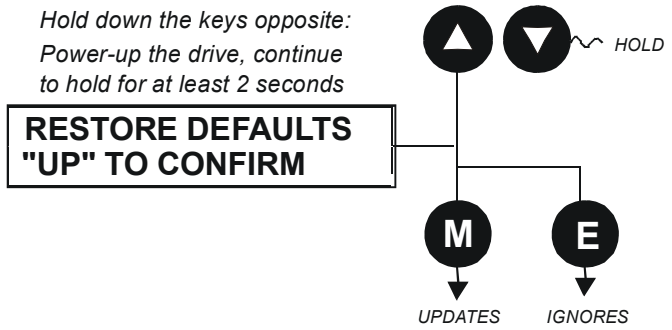
You can check that password protection has been removed by repeatedly pressing the **E** key until the Welcome screen is displayed. Pressing the **E** key again will NOT display the PASSWORD LOCKED screen.

Note: *Perform a SAVE CONFIG if you need "no password" to be saved on power-down.*

Power-up Key Combinations

Resetting to Factory Defaults (2-button reset)

A special key combination restores to the drive the current product code default values and Macro 1 parameter values. This feature is only available at power-up as a security measure.

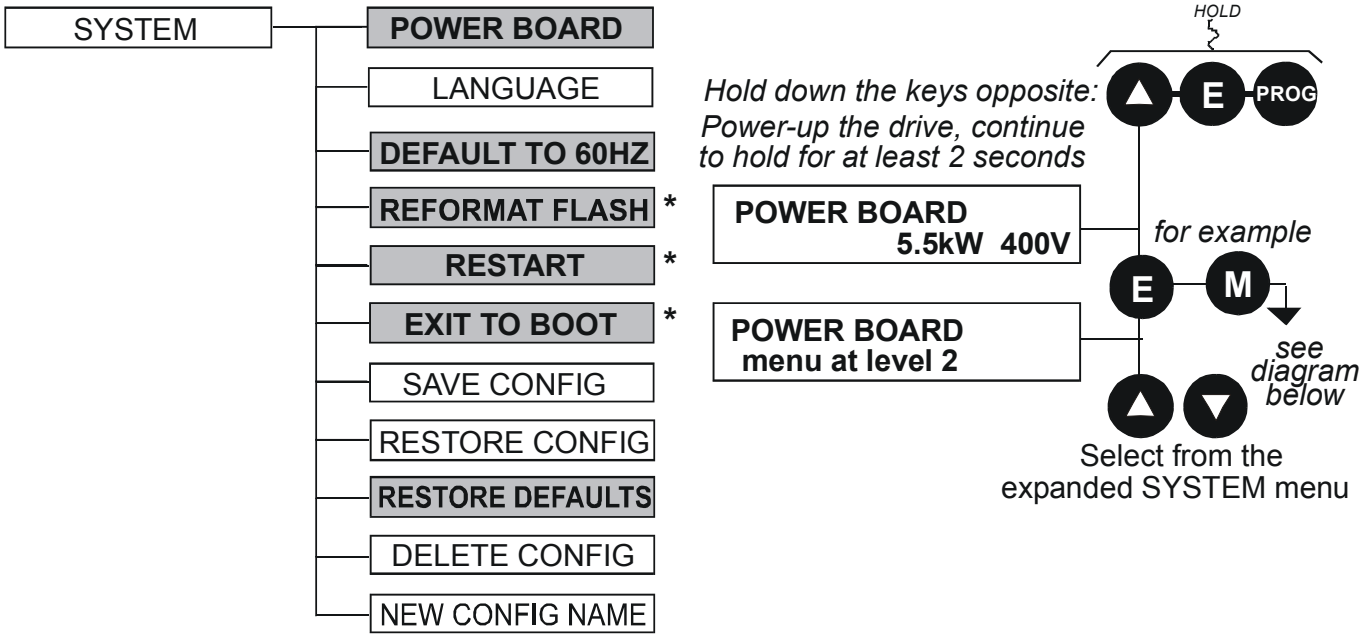


Changing the Product Code (3-button reset)

On rare occasions it may be necessary to change the default settings by changing the Product Code. The Product Code is referred to in Chapter 2.

A special key combination is required to change the product code. This feature is only available at power-up as a security measure.

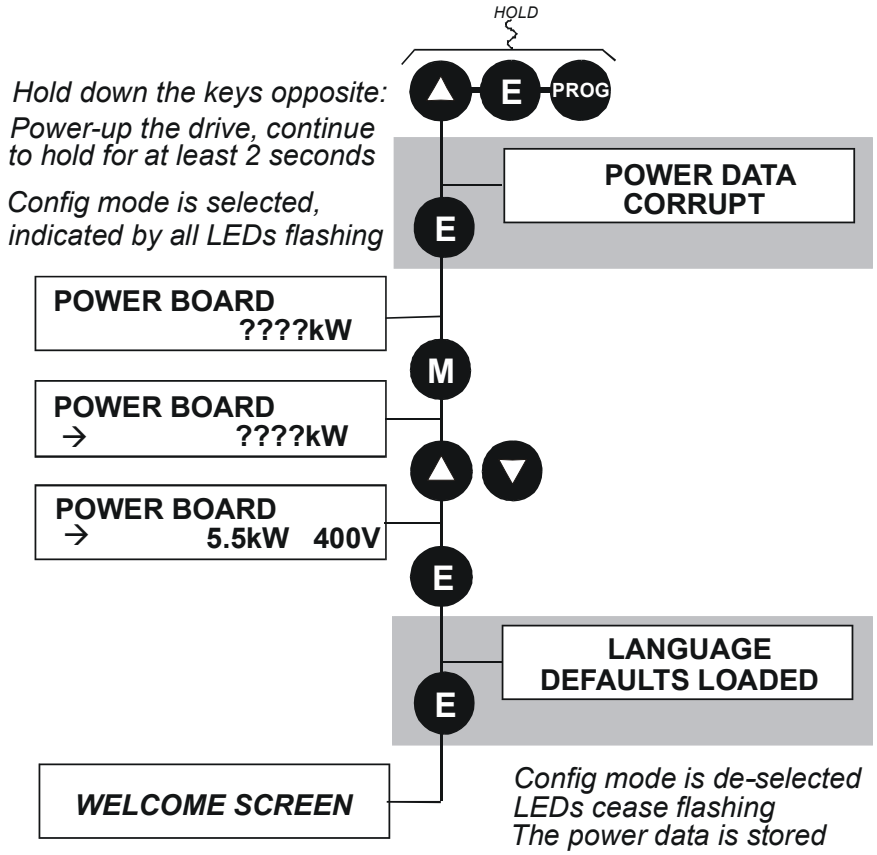
The 3-button reset will take you to the POWER BOARD menu in the expanded SYSTEM menu (highlighted in the diagram below).



IMPORTANT: We recommend the menus marked *above are only used by Parker SSD Drives or suitably qualified personnel.

Refer to The SYSTEM Menu, page 5-16 for all non-highlighted menus.

POWER BOARD



The diagram above shows a 3-button reset when there is no power data stored in the drive. If the drive has power data stored, then the "Power Data Corrupt" and "Language Defaults Loaded" alert messages will not be displayed, also the display will show the current power board selection, instead of "????kW ???V".

DEFAULT TO 60HZ

The setting of this parameter selects the drive operating frequency. It affects those parameters whose values are dependent upon the default base frequency of the drive. Settings will only be updated following a "restore macro" operation.

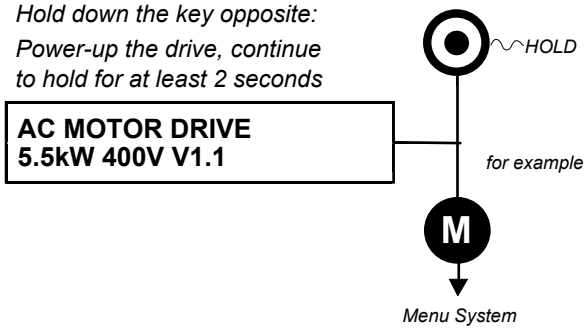
Refer to the Software Product Manual, Chapter 2: "Parameter Specification" - Frequency Dependent Defaults.

RESTORE DEFAULTS

Refer to "Resetting to Factory Defaults (2-button reset)", page 5-21.

Quick Enter Configuration Mode

You can initialise the drive in Configuration Mode by holding the **STOP** key during power-up.



Chapter 6 TRIPS AND FAULT FINDING

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

Drive Indications

If a trip condition is detected the unit displays and performs the following actions.

1. The HEALTH LED flashes indicating a Trip condition has occurred. (Investigate, find and remove the cause of the trip.)
2. DEFAULT The programming block SEQ & REF::SEQUENCING LOGIC::TRIPPED signal is set to TRUE

The DIGITAL OUTPUT 1 (HEALTH) digital output changes between TRUE/FALSE, depending on the output logic.

Keypad Indications (when connected)

If a trip condition is detected the MMI displays and performs the following actions.

1. The HEALTH LED on the Keypad flashes indicating a Trip condition has occurred and a trip message is displayed stating the cause of the trip.
2. The programming block SEQ & REF::SEQUENCING LOGIC::TRIPPED signal is set to TRUE.
   The DIGITAL OUTPUT 1 (HEALTH) digital output changes between TRUE/FALSE, depending on the output logic.
3. The trip message(s) must be acknowledged by pressing the **STOP** key. The trip message may be cleared by pressing the **E** key. Refer to Chapter 5: "The Keypad" - Alert Message Displays.

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.

Note: *More than one trip can be active at any time. For example, it is possible for both the HEATSINK and the OVERVOLTAGE trips to be active. Alternatively it is possible for the drive to trip due to an OVERCURRENT error and then for the HEATSINK trip to become active after the drive has stopped (this may occur due to the thermal time constant of the heatsink).*

DEFAULT Reset the trip(s) using the remote trip reset input, or by pressing the **STOP** key on the Keypad.

Success is indicated by the HEALTH LED (on the unit or MMI) ceasing to flash and returning to a healthy "ON" state. The programming block SEQ & REF::SEQUENCING LOGIC::TRIPPED output is reset to FALSE.

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.

Trip Message and Meaning	Possible Reason for Trip
OVERVOLTAGE	
The drive internal dc link voltage is too high	The supply voltage is too high Trying to decelerate a large inertia load too quickly The brake resistor is open circuit
UNDERVOLTAGE	
The drive internal dc link voltage is too low	The supply voltage is too low The supply has been lost A supply phase is missing
OVERCURRENT	
The motor current being drawn from the drive is too high	Trying to accelerate a large inertia load too quickly Trying to decelerate a large inertia load too quickly Application of shock load to motor Short circuit between motor phases Short circuit between motor phase and earth Motor output cables too long or too many parallel motors connected to the drive Fixed or auto boost levels are set too high
HEATSINK	
The drive heatsink temperature is too high	The ambient air temperature is too high Poor ventilation or spacing between drives
EXTERNAL TRIP	
User trip caused via control terminals	+24V not present on external trip (e.g. terminal 19, Macro 1).
INPUT 1 BREAK	
A signal break has been detected on analog input 1 (terminal 1)	Analog input is incorrectly configured for 4-20mA operation Break in external control wiring
INPUT 2 BREAK	
A signal break has been detected on analog input 2 (terminal 2)	Analog input is incorrectly configured for 4-20mA operation Break in external control wiring
MOTOR STALLED	
The motor has stalled (not rotating)	Motor loading too great Current limit level is set too low Stall trip duration is set too low Fixed or auto boost levels are set too high
INVERSE TIME	The inverse time current limit is active: • motor loading is too great: motor current >150% for 60s in Constant duty motor current >110% for 60s in Quadratic duty • fixed or autoboost levels are too high
BRAKE RESISTOR	
External dynamic braking resistor has been overloaded	Trying to decelerate a large inertia load too quickly or too often
BRAKE SWITCH	
Internal dynamic braking switch has been overloaded	Trying to decelerate a large inertia load too quickly or too often

Trip Message and Meaning	Possible Reason for Trip
OP STATION Keypad has been disconnected from drive whilst drive is running in local control	Keypad accidentally disconnected from drive
LOST COMMS	COMMS TIMEOUT parameter set too short (refer to COMMS CONTROL menu at level 3)
CONTACTOR FBK	The CONTACTOR CLOSED input in the SEQUENCING LOGIC function block remained FALSE after a run command was issued
SPEED FEEDBACK	SPEED ERROR > 50.00% for 10 seconds
AMBIENT TEMP	The ambient temperature in the drive is too high
MOTOR OVERTEMP The motor temperature is too high	Excessive load Motor voltage rating incorrect FIXED BOOST and/or AUTO BOOST set too high Prolonged operation of the motor at low speed without forced cooling Check setting of INVERT THERMIST parameter in I/O TRIPS menu at level 3. Break in motor thermistor connection
CURRENT LIMIT 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 cause of the shock load
24V FAILURE The 24V customer output has fallen below 17V	24V customer output is short circuited Excessive loading
TRIP 19	*Reserved*
LOW SPEED OVER I The motor is drawing too much current (>100%) at zero output frequency	FIXED BOOST and/or AUTO BOOST set too high (refer to FLUXING menu at level 4)
PHASE FAIL	One or more phases of the 3-phase supply is missing. Check supply connections. Check fuses.
ENCODER 1 FAULT	The Error input on the Encoder TB is in the Error state
DESAT (OVER I)	Instantaneous overcurrent. Refer to OVERCURRENT in this table
VDC RIPPLE	The dc link ripple voltage is too high. Check for a missing input phase.
BRAKE SHORT CCT Brake resistor overcurrent	Check resistance brake resistor value is greater than minimum allowed
OVERSPEED	Speed feedback has exceeded the THRESHOLD for a period greater than DELAY.
ANALOG INPUT ERR	Analog input is incorrectly configured for 4-20mA operation. Short circuit in external control wiring. Extreme over-range of remote sensor.
TRIP 29	*Reserved*

Trip Message and Meaning	Possible Reason for Trip
TRIP 30	*Reserved*
UNKNOWN	An unknown trip - refer to Parker SSD Drives
OTHER	One or more of the trips listed below have tripped.
MAX SPEED LOW	During Autotune the motor is required to run at the nameplate speed of the motor. If MAX SPEED RPM limits the speed to less than this value, an error will be reported. Increase the value of MAX SPEED RPM up to the nameplate rpm of the motor (as a minimum). It may be reduced, if required, after the Autotune is complete.
MAINS VOLTS LOW	The mains input voltage is not sufficient to carry out the Autotune. Re-try when the mains has recovered.
NOT AT SPEED	The motor was unable to reach the required speed to carry out the Autotune. Possible reasons include: • motor shaft not free to turn • the motor data is incorrect
MAG CURRENT FAIL	It was not possible to find a suitable value of magnetising current to achieve the required operating condition for the motor. Check the motor data is correct, especially nameplate rpm and motor volts. Also check that the motor is correctly rated for the drive.
NEGATIVE SLIP F	Autotune has calculated a negative slip frequency, which is not valid. Nameplate rpm may have been set to a value higher than the base speed of the motor. Check nameplate rpm, base frequency, and pole pairs are correct.
TR TOO LARGE	The calculated value of rotor time constant is too large. Check the value of nameplate rpm.
TR TOO SMALL	The calculated value of rotor time constant is too small. Check the value of nameplate rpm.
MAX RPM DATA ERR	This error is reported when the MAX SPEED RPM is set to a value outside the range for which Autotune has gathered data. Autotune gathers data on the motor characteristics up to 30% beyond "max speed rpm". If MAX SPEED RPM is later increased beyond this range, the drive had no data for this new operating area, and so will report an error. To run the motor beyond this point it is necessary to re-autotune with MAX SPEED RPM set to a higher value.
STACK TRIP	The drive was unable to distinguish between an overcurrent/Dsat or overvoltage trip
LEAKGE L TIMEOUT	The leakage inductance measurement requires a test current to be inserted into the motor. It has not been possible to achieve the required level of current. Check that the motor is wired correctly.
POWER LOSS STOP	Power Loss Stop sequence has ramped Speed Setpoint to zero or timed out
MOTR TURNING ERR	The motor must be stationary when starting the Autotune
MOTR STALLED ERR	The motor must be able to rotate during Autotune

Table 6-1 Trip Messages

Automatic Trip Reset

Using the Keypad, the drive can be configured to automatically attempt to reset a trip when an attempt is made to start driving the motor, or after a preset time once the trip condition has occurred. The following function blocks (MMI menus) are used to enable automatic trip resets.

Seq & Ref::Auto Restart (Auto-Reset)
Seq & Ref::Sequencing Logic

Setting Trip Conditions

The following function blocks (MMI menus) are used to set trip conditions:

Trips::I/O Trips
Trips::Trips Status

Viewing Trip Conditions

The following function blocks (MMI menus) can be viewed to investigate trip conditions:

Seq & Ref::Sequencing Logic
Trips::Trips History
Trips::Trips Status

Checksum Fail

When the drive powers-up, non-volatile memory is checked to ensure that it has not been corrupted. In the rare event of corruption being detected, the drive will not function. This may occur when replacing the control board with an unprogrammed control board.

Drive Indications

DEFAULT

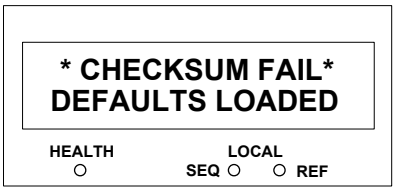
The failure is indicated by the HEALTH and RUN LEDs showing SHORT FLASH, ○●.

Referring to Chapter 4: “Operating the Drive” - Reading the Status LEDs, you will note that this also indicates Re-configuration mode, but this mode (and hence the indication) is not available to the drive unless controlled by an MMI or Comms link.

Because you are controlling the drive locally (no MMI or Comms link etc.), the unit must be returned to Parker SSD Drives for reprogramming, refer to Chapter 7: “Routine Maintenance and Repair”. However, if you have access to a Keypad or suitable PC programming tool, the unit can be reset.

Keypad Indications (when connected)

The MMI displays the message opposite.



Acknowledge the message by pressing the **E** key. This action automatically loads and saves Macro 1 default parameters and the ENGLISH 50Hz Product Code.

If your unit was using a different Product Code or macro, you must reload the Product Code of your choice, reload the macro of your choice, and perform a Parameter Save (SAVE/COMMAND menu) in that order.

If data will not save correctly, the Keypad will display a failure message. In this case, the drive has developed a fault and must be returned to Parker SSD Drives. Refer to Chapter 7: “Routine Maintenance and Repair".

Fault Finding

Problem	Possible Cause	Remedy
Drive will not power-up	Fuse blown	Check supply details, replace with correct fuse.
		Check Product Code against Model No.
	Faulty cabling	Check all connections are correct and 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 HEALTH 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
Motor won't rotate or runs in reverse	Encoder fault	Check encoder connections
	Open circuit speed reference potentiometer	Check terminal

Table 6-2 Fault Finding

Chapter 7 ROUTINE MAINTENANCE AND REPAIR

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 8 TECHNICAL SPECIFICATIONS

Understanding the Product Code

Manufacturing Product Codes

The unit is fully identified using an alphanumeric code which records how the Drive was calibrated, it's various settings when despatched from the factory, and the country of origin.

For conformal coated PCB's add a "C" in front of the product code e.g., **C**690-21…….

The Product Code appears as the "Model No". Each block of the Product Code is identified as below.

AC690+ Series (230V) Integrator Series Drive

					Block 1	Block 2		Block 3					Block4			
					690	-	-					-				
				Example:	690	- 21	1400	B	0	-	0	0	S	W	00	- A	0	0	C
Family	**690 inverter range**				690											
		Constant Torque 230v ratings														
	Supply Voltage	**kW**	**Output Current**	**Frame Size**												
Current/Power Rating	**230v 1ph**					**21**										
		0.75	4.0	B			**1400**	**B**								
		1.5	7.0	B			**1700**	**B**								
		2.2	10.5	B			**2105**	**B**								
	230v 3ph					**23**										
		0.75	4.0	B			**1400**	**B**								
		1.5	7.0	B			**1700**	**B**								
		2.2	10.5	B			**2105**	**B**								
		4.0	16.5	B			**2165**	**B**								
		5.5	22	C			**2220**	**C**								
		7.5	28	C			**2280**	**C**								
		11	42	D			**2420**	**D**								
		15	54	D			**2540**	**D**								
		18.5	68	D			**2680**	**D**								
		22	80	E			**2800**	**E**								
		30	104	F			**3104**	**F**								
		37	130	F			**3130**	**F**								
		45	154	F			**3154**	**F**								
Auxiliary supply	Not required (frames B-E)							**0**								
	115v 1ph (Frame F-J only)							**1**								
	230v 1ph (Frame F-J only)							**2**								
Brake Switch	Not Fitted (optional on Frame D-J)								**0**							
	Brake switch fittedFitted (mandatory on frames B & C, optional on frames D-J)								**B**							
Filter	Not fitted (Optional on frame B, mandatory on frames C-F)									**0**						
	Filter fitted (Optional on frames B only)									**F**						
System Board	Not fitted										**0**					
	System Board fitted										**S**					
Mechanical Style	**P**anel Mount (Option on Frames B-E, mandatory on Frames F-J)											**P**				
	Wall Mount (Option on Frames B-E only)											**W**				
	Through Panel Mount (Option on Frames C-E only)											**T**				
Special Option	None												**00**			
	Documented special options (01-99)															
Destination	English (50Hz)													**A**		
	English (60Hz)													**B**		
	German													**D**		
	Spanish													**E**		
	French													**F**		
	Portuguese													**G**		
	Italian													**I**		
	Polish													**L**		
	Swedish													**S**		
Keypad	None (Option on Frames B-F)														**0**	
	6901 Keypad fitted (option on Frames B-F, mandatory on frames G-J)														**4**	
Speed Feedback	None															**0**
	HTTL Encoder															**3**
Comms	None															**0**
	ControlNet															**C**
	DeviceNet															**D**
	Ethernet															**E**
	Johnson Metasys															**J**
	Link															**L**
	ModBus +															**M**
	Ca**n**Open															**N**
	Profibus															**P**
	RS485 (EI Bisynch)															**R**
	Siemens Apogee															**S**
	Lon**W**orks															**W**

AC690+ Series (400/460V) Integrator Series Drive

						Block 1		Block 2				Block 3						Block4			
						690	-				-						-				
						Example:	690	-	43	1250	B	0	-	0	0	0	W	00	-	A	0	0	C
Family	**690 inverter range**					690																	
		Constant Torque 400v rating		**Constant Torque 460v ratings**																			
	Supply Voltage	**kW**	**Output Current**	**HP**	**Output Current**	**Frame Size**																	
Current/Power Rating	**400/460v 3ph**							43															
		0.75	2.5	1.0	2.5	B			**1250**	**B**													
		1.5	4.5	2.0	4.5	B			**1450**	**B**													
		2.2	5.5	3.0	5.5	B			**1550**	**B**													
		4.0	9.5	5.0	9.5	B			**1950**	**B**													
		5.5	12.0	7.5	11.0	B			**2120**	**B**													
		5.5	12.0	7.5	12.0	C			**2120**	**C**													
			14.0	10	14.0	B			**2140**	**B**													
		7.5	16.0	10	14.0	C			**2160**	**C**													
		11	23.0	15	21.0	C			**2230**	**C**													
		15	30.0	20	27.0	C			**2300**	**C**													
		15	31.0	20	31.0	D			**2310**	**D**													
		18.5	38.0	25	38.0	D			**2380**	**D**													
		22	45.0	30	45.0	D			**2450**	**D**													
		30	59.0	40	52.0	D			**2590**	**D**													
		30	59.0	40	59.0	E			**2590**	**E**													
		37	73.0	50	73.0	E			**2730**	**E**													
		45	87.0	60	87.0	E			**2870**	**E**													
		55	105	75	100	F			**3105**	**F**													
		75	145	100	130	F			**3145**	**F**													
		90	180	125	156	F			**3156**	**F**													
		90	180	150	180	F			**3180**	**F**													
Auxiliary supply	Not required (frames B-E)										**0**												
	115v 1ph (Frame F-J only)										**1**												
	230v 1ph (Frame F-J only)										**2**												
Brake Switch	Not Fitted (optional on Frame D-J)											**0**											
	Brake switch fittedFitted (mandatory on frames B & C, optional on frames D-J)											**B**											
Filter	Not fitted (Optional on frame B, mandatory on frames C-F)												**0**										
	Filter fitted (Optional on frames B only)												**F**										
System Board	Not fitted													**0**									
	System Board fitted													**S**									
Mechanical Style	**P**anel Mount (Option on Frames B-E, mandatory on Frames F-J)														**P**								
	Wall Mount (Option on Frames B-E only)														**W**								
	Through Panel Mount (Option on Frames C-E only)														**T**								
Special Option	None															**00**							
	Documented special options (01-99)																						
Destination	English (50Hz)																**A**						
	English (60Hz)																**B**						
	German																**D**						
	Spanish																**E**						
	French																**F**						
	Portuguese																**G**						
	Italian																**I**						
	Polish																**L**						
	Swedish																**S**						
Keypad	None (Option on Frames B-F)																	**0**					
	6901 Keypad fitted (option on Frames B-F, mandatory on frames G-J)																	**4**					
Speed Feedback	None																		**0**				
	HTTL Encoder																		**3**				
Comms	None																			**0**			
	ControlNet																			**C**			
	DeviceNet																			**D**			
	Ethernet																			**E**			
	Johnson Metasys																			**J**			
	Link																			**L**			
	ModBus +																			**M**			
	Ca**n**Open																			**N**			
	Profibus																			**P**			
	RS485 (EI Bisynch)																			**R**			
	Siemens Apogee																			**S**			
	Lon**W**orks																			**W**			

AC690+ Series (400/500V) Integrator Series Drive

						Block 1		Block 2				Block 3					Block4			
						690	-				-					-				
						Example:	690	-	43	1250	B	0	-	0	0	0	W	00	-	A	0	0	C
Family	**690 inverter range**					690														
		Constant Torque 400v rating		**Constant Torque 460v ratings**																
	Supply Voltage	**kW**	**Output Current**	**HP**	**Output Current**	**Frame Size**														
Current/Power Rating	**400/460v 3ph**							43												
		0.75	2.5	1.0	2.5	B			**1250**	**B**										
		1.5	4.5	2.0	4.5	B			**1450**	**B**										
		2.2	5.5	3.0	5.5	B			**1550**	**B**										
		4.0	9.5	5.0	9.5	B			**1950**	**B**										
		5.5	12.0	7.5	11.0	B			**2120**	**B**										
		5.5	12.0	7.5	12.0	C			**2120**	**C**										
			14.0	10	14.0	B			**2140**	**B**										
		7.5	16.0	10	14.0	C			**2160**	**C**										
		11	23.0	15	21.0	C			**2230**	**C**										
		15	30.0	20	27.0	C			**2300**	**C**										
		15	31.0	20	31.0	D			**2310**	**D**										
		18.5	38.0	25	38.0	D			**2380**	**D**										
		22	45.0	30	45.0	D			**2450**	**D**										
		30	59.0	40	52.0	D			**2590**	**D**										
		30	59.0	40	59.0	E			**2590**	**E**										
		37	73.0	50	73.0	E			**2730**	**E**										
		45	87.0	60	87.0	E			**2870**	**E**										
		55	105	75	100	F			**3105**	**F**										
		75	145	100	130	F			**3145**	**F**										
		90	180	125	156	F			**3156**	**F**										
		90	180	150	180	F			**3180**	**F**										
Auxiliary supply	Not required (frames B-E)										**0**									
	115v 1ph (Frame F-J only)										**1**									
	230v 1ph (Frame F-J only)										**2**									
Brake Switch	Not Fitted (optional on Frame D-J)											**0**								
	Brake switch fittedFitted (mandatory on frames B & C, optional on frames D-J)											**B**								
Filter	Not fitted (Optional on frame B, mandatory on frames C-F)												**0**							
	Filter fitted (Optional on frames B only)												**F**							
System Board	Not fitted													**0**						
	System Board fitted													**S**						
Mechanical Style	**P**anel Mount (Option on Frames B-E, mandatory on Frames F-J)														**P**					
	Wall Mount (Option on Frames B-E only)														**W**					
	Through Panel Mount (Option on Frames C-E only)														**T**					
Special Option	None															**00**				
	Documented special options (01-99)																			
Destination	English (50Hz)																**A**			
	English (60Hz)																**B**			
	German																**D**			
	Spanish																**E**			
	French																**F**			
	Portuguese																**G**			
	Italian																**I**			
	Polish																**L**			
	Swedish																**S**			
Keypad	None (Option on Frames B-F)																	**0**		
	6901 Keypad fitted (option on Frames B-F, mandatory on frames G-J)																	**4**		
Speed Feedback	None																		**0**	
	HTTL Encoder																		**3**	
Comms	None																			**0**
	ControlNet																			**C**
	DeviceNet																			**D**
	Ethernet																			**E**
	Johnson Metasys																			**J**
	Link																			**L**
	ModBus +																			**M**
	Ca**n**Open																			**N**
	Profibus																			**P**
	RS485 (EI Bisynch)																			**R**
	Siemens Apogee																			**S**
	Lon**W**orks																			**W**

US Model Number & Legacy Product Codes

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

The Product Code appears as the "Model No.". Each block of the Product Code is identified as below:

Typical example:

690PD/0110/400/0011/GR/0/PROF/BO/0/0

This is a Frame D 690+, 11kW, rated at 400V supply, standard livery, IP20, with Keypad fitted displaying German language, no encoder feedback option, Profibus Option card fitted and braking option fitted.

Frame B – Model Number (Europe)		
Block No.	**Variable**	**Description**
1	690PB	Generic product (C690PB = Conformal Coated PCB's)
2	XXXX	Four numbers specifying the power output: 0007 = 0.75kW 0015 = 1.5kW 0022 = 2.2kW 0040 = 4.0kW 0055 = 5.5kW 0075 = 7.5kW
3	XXX	230 220 to 240V (±10%) 50/60Hz 400 380 to 460V (±10%) 50/60Hz 500 380 to 500V (±10%) 50/60Hz
4	X	One digit specifying the supply phases 1 = Single 3 = Three
5	X	One character specifying the use of the Internal RFI Filter: F = Internal Supply Filter fitted 0 = Not fitted
6	XXXX	Four digits specifying mechanical package including livery and mechanical package style, and any keypad (see Note): First two digits Livery 00 Standard Parker SSD Drives livery 05 Distributor livery 01-04,06-99 Defined customer liveries Third digit Mechanical packaging style 1 Standard (IP20), protected panel mounting with gland plate 2 IP20 and falling dirt protection (UL Type 1) Fourth digit Keypad 0 No Keypad 1 6901 Keypad fitted
7	XX	Two Characters specifying the user interface language including operating frequency. These characters are the same as used for computer keyboard specifications: FR French (50Hz) GR German (50Hz) IT Italian (50Hz) PL Polish (50Hz) PO Portuguese (50Hz) SP Spanish (50Hz) SW Swedish (50Hz) UK English (50Hz) US English (60Hz)

Frame B – Model Number (Europe)		
Block No.	**Variable**	**Description**
8	X	Characters specifying any feedback option installed over and above the standard features of the product. 0 No option fitted HTTL 605B encoder card fitted behind the Keypad/Tech Box Option site
9	X	Characters specifying the communications option (see Note): 0 No technology option fitted EI00 RS485 Comms option PROF Profibus protocol LINK LINK protocol DNET DeviceNet
10	X	Characters specifying the comms board fitted internally. 0 Not fitted
11	X	Characters specifying the system board fitted internally. 0 Not fitted SHTTL Fitted – Dual Encoder Option
12	X	Digits specifying engineering special options. 0 No special option
Note: *The Keypad and the Comms Technology Box occupy the same physical position in the product and are therefore mutually exclusive.*		

Frame C, D, E, F – Model Number (Europe)		
Block No.	**Variable**	**Description**
1	690PC 690PD 690PE 690PF	Characters specifying the generic product: (C690PC = Conformal Coated PCB's) 690PC = Frame C 690PD = Frame D 690PE = Frame E 690PF = Frame F
2	XXXX	Four numbers specifying the power output: Frame C: 0055 = 5.5kW; 0075 = 7.5kW; 0110 = 11kW; 0150 = 15kW Frame D: 0110 = 11kW; 0150 = 15kW; 0180 = 18.5kW; 0220 = 22kW; 0300 = 30kW Frame E: 0220 = 22kW; 0300 = 30kW; 0370 = 37kW; 0450 = 45kW Frame F: 0300 = 30kW; 0370 = 37kW; 0450 = 45kW; 0550 = 55kW; 0750 = 75kW; 0900 = 90kW; 0910 = 90kW (150Hp)
3	XXX	Three numbers specifying the nominal input voltage rating: 230 220 to 240V (±10%) 50/60Hz 400 380 to 460V (±10%) 50/60Hz 500 380 to 500V (±10%) 50/60Hz

Frame C, D, E, F – Model Number (Europe)		
Block No.	**Variable**	**Description**
4	XXXX	Four digits specifying the mechanical package including livery and mechanical package style: First two digits Livery 00 Standard Parker SSD Drives livery 05 Distributor livery (01-04, 06-99 - Defined customer liveries) Third digit Mechanical packaging style 1 Standard (IP20), protected panel mounting with gland plate (IP00 or IP20 only for Frame F) 2 IP20 and falling dirt protection (UL Type 1) 3 Enclosed (IP20), with through-panel mounting kit Fourth digit Keypad 0 No Keypad 1 6901 Keypad option fitted
5	XX	Two characters specifying the user interface language including operating frequency. These characters are the same as used for computer keyboard specifications: FR French (50Hz) GR German (50Hz) IT Italian (50Hz) PL Polish (50Hz) PO Portuguese (50Hz) SP Spanish (50Hz) SW Swedish (50Hz) UK English (50Hz) US English (60Hz)
6	X	Characters specifying the speed feedback option (Technology Box 1) installed over and above the standard features of the product: 0 No additional option fitted HTTL Wire ended encoder feedback HTTL
7	X	Characters specifying the communications option (Technology Box 2): 0 No technology option fitted EI00 RS485 Comms option PROF Profibus protocol LINK LINK protocol DNET DeviceNet
8	X	Characters specifying the Comms board fitted internally: 0 Not fitted
9	X	Characters specifying the system board fitted internally: 0 Not fitted SHTTL Fitted – Dual Encoder Option
10	X	Characters specifying the braking option: 0 Brake power switch not fitted (Frames D, E & F only) BO Brake power switch fitted - no braking resistors supplied Note: External braking resistors should be specified and ordered separately.
11	X	Characters specifying the auxiliary mains power supply. 0 No auxiliary supply required (Frame C – E) 115 110 to 120V (±10%), 50/60Hz (Frame F) 230 220 to 240V (±10%), 50/60Hz (Frame F)
12	X	Digits specifying engineering special options: 0 No special option

Catalog Number (North America)

The unit is identified using a 6 block alphanumeric code which records how the drive was calibrated, and its various settings when dispatched from the factory.

The Product Code appears as the "Cat No.". Each block of the Product Code is identified as below:

Typical example:

690+0010/460/1BN

This is a 10Hp 690+ Frame C, rated at 460 Volts supply, NEMA 1, Braking option fitted, No System board.

Frame B, C, D, E, F – Catalog Number (North America)

Block No.	Variable	Description
1	690+	Generic product (C690+ = Conformal Coated PCB's)
2	X	Characters specifying the power output in Hp: Frame B 0001 = 1Hp 0002 = 2Hp 0003 = 3Hp 0005 = 5Hp 0007B = 7.5Hp 0010B = 10Hp Frame C 0007 = 7.5Hp 0010 = 10Hp 0015 = 15Hp 0020C = 20Hp Frame D 0020 = 20Hp 0025 = 25Hp 0030 = 30Hp 0040D = 40Hp Frame E 0040 = 40Hp 0050 = 50Hp 0060 = 60Hp Frame F 0075 = 75Hp 0100 = 100Hp 0125 = 125Hp 0150 = 150Hp
3	XXX	Three numbers specifying the nominal input voltage rating: 230 230 (±10%) 50/60Hz 460 380 to 460V (±10%) 50/60Hz
4	XXX	Enclosure options: 1 - Nema 1 (IP20 and falling dirt protection (UL Type 1) C - Chassis (IP20 only)
5	XX	Characters specifying the braking option: N Brake power switch not fitted (Frames D & E only) B Brake power switch fitted - no braking resistors supplied Note: External braking resistors should be specified and ordered separately.
6	XX	Characters specifying the systems board: N Not fitted S System board fitted

Environmental Details

Operating Temperature	Operating temperature is defined as the ambient temperature to the immediate surround of the drive, when the drive and other equipment adjacent to it is operating at worst case conditions.	
CONSTANT QUADRATIC	0°C to 45°C (0°C to 40°C with top cover fitted), derate up to a maximum of 50°C 0°C to 40°C (0°C to 35°C with top cover fitted), derate up to a maximum of 50°C	
	Output power is derated linearly at 2% per degree centigrade for temperature exceeding the maximum rating ambient for the drive.	
Storage Temperature	-25°C to +55°C	
Shipping Temperature	-25°C to +70 °C	
Product Enclosure Rating	Wall Mounted (top cover must be fitted)	IP40 - top cover surface (Europe) IP20 - remainder of surfaces (Europe) UL (c-UL) Type 1 (North America/Canada)
	Cubicle Mounted (without top cover fitted)	IP20 (IP00 or IP20 only for Frame F) UL (c-UL) Open Type (North America/Canada)
	Through-panel Mounted (without top cover fitted)	IP20 UL (c-UL) Open Type (North America/Canada)
Altitude	If greater than 1000m above sea level, derate 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 10Hz<=f<=57Hz sinusoidal 0.075mm amplitude 57Hz<=f<=150Hz sinusoidal 1g 10 sweep cycles per axis on each of three mutually perpendicular axis	
Safety		
Overvoltage Category	Overvoltage Category III (numeral defining an impulse withstand level)	
Pollution Degree	Pollution Degree II (non-conductive pollution, except for temporary condensation) Pollution Degree III (dirty air rating for through-panel mounted parts)	
Europe	When fitted inside a cubicle, or when wall-mounted and the top cover is firmly screwed in position, this product conforms with the Low Voltage Directive 2006/95/EC using EN50178 to show compliance.	
North America/Canada	Without the top cover fitted, complies with the requirements of UL508C as an open-type drive. When the top cover is fitted, complies with the requirements of UL508C as Type 1 Enclosed (for direct wall mounting applications) when specified with Model Number Block 6 (Frame B) or Modle Number Block 4 (Frame C, D, E, F) designation xx20 or xx21 only.	
Conformal Coated Product	Conformal coating increases the product's resistance to certain climatic conditions. Note: conformal coating, where effective, will only mitigate the effects being considered.	

Earthing/Safety Details

Earthing	Permanent earthing is mandatory on all units. • Use a copper protective earth conductor 10mm² minimum cross-section, or install a second conductor in parallel with the protective conductor to a separate protective earth terminal • The conductor itself must meet local requirements for a protective earth conductor
Input Supply Details (TN) and (IT)	Drives without filters are suitable for earth (TN) or non-earth referenced (IT) supplies. The drive is only suitable for earth referenced supplies (TN) when fitted with an internal filter. External filters are available for use on TN and IT (non-earth referenced) supplies.
Prospective Short Circuit Current (PSCC)	Refer to the appropriate Electircal Ratings table.
Earth Leakage Current	>10mA (all models)

Cabling Requirements for EMC Compliance

	Power Supply Cable	Motor Cable	External AC Supply EMC Filter to Drive Cable	Brake Resistor Cable	Signal/Control Cable
Cable Type (for EMC Compliance)	Unscreened	Screened/ armoured	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 (Frame B)	Unlimited	0.25 - 4.0kW = 50m* 5.5 - 6.0kW = 25m		25 metres	25 metres
Length Limitations With External AC Supply EMC Filter	Unlimited	50 metres	0.3 metres	25 metres	25 metres
Screen to Earth Connection		Both ends	Both ends	Both ends	Drive end only
Output Choke		300 metres maximum			

* Maximum motor cable length under any circumstances

Cooling Fans

The forced-vent cooling of the drive is achieved by 1, or in some cases 2 fans. The Fan Rating gives the volume of air venting from the drive. All except the Frame F fans are internally-supplied 24V fans.

Drive Product Code	Drive Catalog Code	Fan Ratings
FRAME B		
690-211400.., 690-211700.., 690-212105.. & 690-232165..	690P-211400.., 690P-211700.., 690P-212105.. & 690P-232165..	24cfm (41 m³/hr)
690-432120.. & 690-432140..	690P-432120.. & 690P-432140..	30cfm (51 m³/hr)
FRAME C		
690-232220..	690P-232220..	42.5cfm (72 m³/hr)
690-232280..	690P-232280..	25cfm (42.5 m³/hr)
690-432230.. & 690-432300..	690P-432230.. & 690P-432300..	35cfm (59.5 m³/hr)
FRAME D		
690-232540.., 690-232680.. & 690-432450..	690P-232540.., 690P-232680.. & 690P-432450..	55cfm (93.4 m³/hr)
690-432590..	690P-432590..	81cfm (138 m³/hr)
FRAME E		
All models	All models	160cfm (272 m³/hr)
FRAME F One single phase fan is provided, supplied from an auxiliary input. There are two voltage variants, either 115V ac or 220Vac. The fan is powered from a single phase supply which uses a capacitor to generate the quadrature phase. Protect the fan using a 3A fuse. 110/120V : 130W, 10µF, Stator - 16Ω 220/240V : 140W, 2.5µF, Stator - 62Ω		
All models	All models	270cfm (459 m³/hr)

Electrical Ratings (230V Build Variant)

Power Supply = 220-240V ±10%, 50/60Hz ±5%

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

Operation at 208V ±10% (Frames C, D, E & F)

Nominal motor powers are reduced by 10% when operated at 208V ±10%. Output currents remain unchanged.

Model Number (Europe)	Catalog Number (North America)	Motor Power	Output Current (A)	Input Current (A)	Heatsink Power Loss (W)	Total Power Loss (W)	Maximum Switching Frequency (kHz)	Input Bridge I^2t (A^2s)
FRAME B : Input currents for kW ratings are at 230V 50Hz ac input and for Hp ratings at 460V 60Hz ac input. Prospective short circuit rating 10kA.								
Constant (Output Overload Motoring 150% for 60s, 180% for 0.5s short term rating)								
690-244400...		0.75kW	4.0	11		80	3, 6, 9	425
	690+0001/230../1	1Hp	4.0	11		80	3, 6, 9	425
690-211700...		1.5kW	7.0	19		120	3, 6, 9	425
	690+0002/230../1	2Hp	7.0	19		120	3, 6, 9	425
690-212105...		2.2kW	10.5	24		170	3, 6, 9	425
	690+0003/230../1	3Hp	10.5	24		170	3, 6, 9	425
690-231400...		0.75kW	4.0	6		70	3, 6, 9	425
	690+0001/230..	1Hp	4.0	6		70	3, 6, 9	425
690-231700...		1.5kW	7.0	10		100	3, 6, 9	425
	690+0002/230..	2Hp	7.0	10		100	3, 6, 9	425
690-232105...		2.2kW	10.5	13		150	3, 6, 9	425
	690+0003/230..	3Hp	10.5	13		150	3, 6, 9	425
690-232165...		4kW	16.5	20		200	3	425
690-232165...		4kW	14.5	20		200	6	425
690-232165...		4kW	13.0	20		200	9	425
	690+0005/230..	5Hp	16.5	20		200	3	425
	690+0005/230..	5Hp	14.5	20		200	6	425
	690+0005/230..	5Hp	13.0	20		200	9	425
FRAME C : Input currents for kW ratings are at 230V 50Hz ac input and for Hp ratings at 460V 60Hz ac input. Prospective short circuit rating 10kA.								
Constant (Output Overload Motoring 150% for 60s, 180% for 0.5s short term rating)								
690-232220...		5.5kW	22	25	270	330	3	4000
	690+0007/230..	7.5Hp	22	25	270	330	3	4000
690-232280...		7.5kW	28	33	290	350	3	6000
	690+0010/230..	10Hp	28	33	290	350	3	6000
Quadratic (Output Overload Motoring 110% for 60s, 130% for 0.5s short term rating)								
690-232220...		7.5kW	28	31	330	390	3	4000
	690+0007/230..	10Hp	28	31	330	390	3	4000
690-232280...		11kW	42	49.3	500	560	3	6000
	690+0010/230..	15Hp	42	49.3	500	560	3	6000

Electrical Ratings (230V Build Variant)

Power Supply = 220-240V ±10%, 50/60Hz ±5%

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

Operation at 208V ±10% (Frames C, D, E & F)

Nominal motor powers are reduced by 10% when operated at 208V ±10%. Output currents remain unchanged.

Model Number (Europe)	Catalog Number (North America)	Motor Power	Output Current (A)	Input Current (A)	Heatsink Power Loss (W)	Total Power Loss (W)	Maximum Switching Frequency (kHz)	Input Bridge I^2t (A^2s)
FRAME D : Input currents for kW ratings are at 230V 50Hz ac input and for Hp ratings at 460V 60Hz ac input. Prospective short circuit rating 10kA.								
Constant (Output Overload Motoring 150% for 60s, 180% for 0.5s short term rating)								
690-232420...		11kW	42	45	570	640	3	6000
	690+0015/230..	15Hp	42	45	570	640	3	6000
690-232540...		15kW	54	53	670	740	3	6000
	690+0020/230..	20Hp	54	53	670	740	3	6000
690-232680...		18.5kW	68	65	850	920	3	6000
	690+0025/230..	25Hp	68	65	850	920	3	6000
Quadratic (Output Overload Motoring 110% for 60s, 130% for 0.5s short term rating)								
690-232120...		15kW	54	54	750	820	3	6000
	690+0015/230..	20Hp	54	54	750	820	3	6000
690-232540...		18.5kW	68	65	850	920	3	6000
	690+0020/230..	25Hp	68	65	850	920	3	6000
FRAME E : Input currents for kW ratings are at 230V 50Hz ac input and for Hp ratings at 460V 60Hz ac input. Prospective short circuit current 18kA.								
Constant (Output Overload Motoring 150% for 60s, 180% for 0.5s short term rating)								
690-232800...		22kW	80	91	800	920	3	18000
	690+0030/230..	30Hp	80	91	800	920	3	18000
Quadratic (Output Overload Motoring 110% for 60s, 130% for 0.5s short term rating)								
690-232800..		30kW	104	116	1050	1200	3	18000
	690+0030/230..	40Hp	104	116	1050	1200	3	18000
FRAME F : Input currents for kW ratings are at 230V 50Hz ac input and for Hp ratings at 460V 60Hz ac input. Prospective short circuit current 18kA.								
Constant (Output Overload Motoring 150% for 60s, 180% for 0.5s short term rating)								
690-233104..		30kW	104	102	850	1100	3	100000
	690+0040/230..	40Hp	104	102	850	1100	3	100000
690-233130..		37kW	130	126	1100	1450	3	100000
	690+0050/230..	50Hp	130	126	1100	1450	3	100000
690-233154..		45kW	154	148	1200	1650	3	100000
	690+0060/230..	60Hp	154	148	1200	1650	3	100000
Quadratic (Output Overload Motoring 110% for 60s, 125% for 0.5s short term rating)								
690-233104..		37kW	130	126	1150	1500	3	100000
	690+0040/230..	50Hp	130	126	1150	1500	3	100000
690-233130..		45kW	154	148	1350	1800	3	100000
	690+0050/230..	60Hp	154	148	1350	1800	3	100000
690-233154..		55kW	192	184	1600	2100	3	100000
	690+0060/230..	75Hp	192	184	1600	2100	3	100000

Electrical Ratings (400V Build Variant)

Power Supply = 380-460V ±10%, 50/60Hz ±5%

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

Model Number (Europe)	Catalog Number (North America)	Motor Power	Output Current (A)	Input Current (A)	Heatsink Power Loss (W)	Total Power Loss (W)	Maximum Switching Frequency (kHz)	Input Bridge I^2t (A^2s)
FRAME B : Input currents for kW ratings are at 400V 50Hz ac input and for Hp ratings at 460V 60Hz ac input. Prospective short circuit current 10kA.								
Constant (Output Overload Motoring 150% for 60s, 180% for 1s short term rating)								
690-431250..		0.75kW	2.5	3.7		70	3, 6, 9	340
	690+0001/460/..	1Hp	2.5	2.9		65	3, 6, 9	340
690-431450..		1.5kW	4.5	6		100	3, 6, 9	340
	690+0002/460/..	2Hp	4.5	5		95	3, 6, 9	340
690-431550..		2.2kW	5.5	8		130	3, 6, 9	340
	690+0003/460/..	3Hp	5.5	6.6		120	3, 6, 9	340
690-431950..		4kW	9.5	12.6		200	3	340
690-431950..		4kW	8.5	12.6		200	6	340
690-431950..		4kW	7.5	12.6		200	9	340
	690+0005/460/..	5Hp	9.5	10.2		190	3	340
	690+0005/460/..	5Hp	8.5	10.2		190	6	340
	690+0005/460/..	5Hp	7.5	10.2		190	9	340
690-432120..		5.5kW	12	18		220	3	1150
	690+0007/460/..	7.5Hp	11	15		200	3	1150
690-432140..		6.0kW	14	19		260	3	1150
	690+0010/460/..	10Hp	14	19		250	3	1150
FRAME C : Input currents for kW ratings are at 400V 50Hz ac input, and for Hp ratings at 460V 60Hz ac input. Prospective short circuit current 10kA. * For UL Listed products rated at 15kW/20Hp, a supply voltage of 460V is required. The higher current ratings are applicable to non UL applications only.								
Constant (Output Overload Motoring 150% for 60s, 180 % for 0.5s short term rating)								
690-432120..		5.5kW	12	14.7	170	220	3, 6	1250
	690+0007/460/..	7.5Hp	12	12.4	155	205	3, 6	1250
690-432160..		7.5kW	16	19	240	290	3, 6	4000
	690+0010/460/..	10Hp	14	16	225	275	3, 6	4000
690-432230..		11kW	23	26.1	280	330	3, 6	4000
	690+0015/460/..	15Hp	21	22.1	260	310	3, 6	4000
690-432300..		15kW	30	37	440	500	3	6000
	690+0020/460/..	20Hp	27	31.2	410	470	3	6000
Quadratic (Output Overload Motoring 110% for 60s)								
690-432120..		7.5kW	16	18.9	260	310	3	1250
	690+0007/460/..	10Hp	16	15.6	245	295	3	1250
690-432160..		11kW	23	26.1	300	350	3	4000
	690+0010/460/..	15Hp	21	22.1	280	320	3	4000
690-432230..		15kW	30	33.6	440	500	3	4000
	* 690+0015/460/..	20Hp	27	28.5	410	470	3	4000
690-432300..		18.5kW	37	44	550	610	3	6000
	690+0020/460/..	25Hp	34	38	530	580	3	6000

Electrical Ratings (400V Build Variant)

Power Supply = 380-460V ±10%, 50/60Hz ±5%

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

Model Number (Europe)	Catalog Number (North America)	Motor Power	Output Current (A)	Input Current (A)	Heatsink Power Loss (W)	Total Power Loss (W)	Maximum Switching Frequency (kHz)	Input Bridge I^2t (A^2s)
FRAME D : Input currents for kW ratings are at 400V 50Hz ac input and for Hp ratings at 460V 60Hz ac input. Prospective short circuit current 10kA. * For UL Listed products rated at 30kW/40Hp, a supply voltage of 460V is required. The higher current ratings are applicable to non UL applications only.								
Constant (Output Overload Motoring 150% for 60s, 180% for 0.5s short term rating)								
690-432310..		15kW	31	34.8	420	480	3, 6	4000
	690+0020/460/..	20Hp	31	28.5	400	460	3, 6	4000
690-432380..		18.5kW	38	40.5	545	605	3, 6	6000
	690+0025/460/..	25Hp	38	34.2	515	575	3, 6	6000
690-432450..		22kW	45	47.2	670	730	3, 6	6000
	690+0030/460/..	30Hp	45	40	640	700	3, 6	6000
690-432590..		30kW	59	66	760	860	3	15000
	690+0040/460/..	40Hp	52	56	740	830	3	15000
Quadratic (Output Overload Motoring 110% for 60s)								
690-432310..		18.5kW	38	40.5	545	605	3	4000
	690+0020/460/..	25Hp	38	34.2	515	575	3	4000
690-432380..		22kW	45	47.2	670	730	3	6000
	690+0025/460/..	30Hp	45	40	640	700	3	6000
690-432450..		30kW	59	61	760	860	3	6000
	* 690+0030/460/..	40Hp	52	51	740	830	3	6000
690-432590..		37kW	73	84	920	1030	3	15000
	690+0040/460/..	50Hp	65	68	890	980	3	15000
FRAME E : Input currents for kW ratings are at 400V 50Hz ac input and for Hp ratings at 460V 60Hz ac input. Prospective short circuit current 18kA. * For UL Listed products rated at 30kW/40Hp, a supply voltage of 460V is required. The higher current ratings are applicable to non UL applications only.								
Constant (Output Overload Motoring 150% for 60s, 180% for 0.5s short term rating)								
690-432590..		30kW	59	68	590	690	3, 6	15000
	690+0040/460/..	40Hp	59	57	590	690	3, 6	15000
690-432730..		37kW	73	81	730	850	3, 6	18000
	690+0050/460/..	50Hp	73	68	730	850	3, 6	18000
690-432870..		45kW	87	95	880	880	3, 6	18000
	690+0060/460/..	60Hp	87	80	880	880	3, 6	18000
Quadratic (Output Overload Motoring 110% for 60s)								
690-432590..		37kW	73	81	733	848	3	15000
	690+0040/460/..	50Hp	73	68	733	848	3	15000
690-432730..		45kW	87	95	901	1029	3	18000
	690+0050/460/..	60Hp	87	80	901	1029	3	18000
690-432870..		55kW	105	110	1094	1242	3	18000
	690+0060/460/..	75Hp	105	95	1094	1242	3	18000

Electrical Ratings (400V Build Variant)

Power Supply = 380-460V ±10%, 50/60Hz ±5%

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

Model Number (Europe)	Catalog Number (North America)	Motor Power	Output Current (A)	Input Current (A)	Heatsink Power Loss (W)	Total Power Loss (W)	Maximum Switching Frequency (kHz)	Input Bridge I^2t (A^2s)
FRAME F : Input currents for kW ratings are at 400V 50Hz ac input and for Hp ratings at 460V 60Hz ac input. Prospective short circuit current 18kA.								
Constant (Output Overload Motoring 150% for 60s, 180% for 0.5s short term rating)								
690-433105..		55kW	105	114	920	1220	3	100,000
	690+0075/460/..	75Hp	100	99	900	1130	3	100,000
690-433145..		75kW	145	143	1320	1670	3	100,000
	690+0100/460/..	100Hp	130	124	1200	1500	3	100,000
690-433156..		90kW	180	164	1490	1950	3	100,000
	690+0125/460/..	125Hp	156	148	1340	1780	3	100,000
690-433180..		90kW	180	164	1490	1950	3	100,000
	690+0150/460/..	150Hp	180	169	1670	2180	3	100,000
Quadratic (Output Overload Motoring 110% for 60s)								
690-433105..		75kW	145	143	1400	1670	3	100,000
	690+0075/460/..	100Hp	125	124	1200	1500	3	100,000
690-433145..		90kW	165	164	1580	1950	3	100,000
	690+0100/460/..	125Hp	156	148	1340	1780	3	100,000
690-433156..		110kW	205	195	1800	1950	3	100,000
	690+0125/460/..	150Hp	180	169	1670	2180	3	100,000
690-433180..		110kW	205	195	1800	1950	3	100,000
	690+0150/460/..	150Hp	180	169	1670	2180	3	100,000

Electrical Ratings (500V Build Variant)

Power Supply = 380-500V ±10%, 50/60Hz ±5%

500V unit full power ratings are only available at 500V. The unit can be operated between 380-500V supply voltage with reduced output power below 500V.

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

Note: *The improved ratings offered by software versions 5.4 onwards are made possible by internal hardware changes to the drive. The ratings are not achievable on older drives running software versions 5.4 onwards.*

Model Number (Europe)	Catalog Number (North America)	Motor Power	Output Current (A)	Input Current (A)	Heatsink Power Loss (W)	Total Power Loss (W)	Maximum Switching Frequency (kHz)	Input Bridge I^2t (A^2s)
FRAME B : Input currents for kW ratings are at 500V 50Hz ac input. Prospective short circuit current 10kA.								
Constant (Output Overload Motoring 150% for 60s, 180% for 1s short term rating)								
690-531500..		2.2kW	5	6.5		110	3	1150
690-531800..		4kW	8	10.4		165	3	1150
690-532110..		5.5kW	11	15.3		200	3	1150
FRAME C : Input currents for kW ratings are at 500V 50Hz ac input. Prospective short circuit current 10kA.								
Constant (Output Overload Motoring 150% for 60s, 180% for 0.5s short term rating)								
690-532110..		5.5kW	11	14	155	275	3, 6	1250
690-532140..		7.5kW	14	22	225	310	3, 6	4000
690-532210..		11kW	21	26	260	470	3, 6	4000
690-532270..		15kW	27	29.7	410	605	3	6000
Quadratic (Output Overload Motoring 110% for 60s)								
690-532110..		7.5kW	14	20	225	300	3	1250
690-532140..		11kW	21	26	260	350	3	4000
690-532210..		15kW	27	32	410	310	3	4000
690-532270..		18.5kW	34	36	545	470	3	6000
FRAME D : Input currents for kW ratings at 500V 50Hz ac input. Prospective short circuit current 10kA.								
Constant (Output Overload Motoring 150% for 60s, 180% for 0.5s short term rating)								
690-532280..		15kW	28	27	420	480	3, 6	4000
690-532360..		18.5kW	36	33	545	605	3, 6	6000
690-532420..		22kW	42	39	670	730	3, 6	6000
690-532520..		30kW	52	54	740	830	3	15000
Quadratic (Output Overload Motoring 110% for 60s)								
690-532280..		18.5kW	36	33	420	480	3, 6	4000
690-532360..		22kW	42	39	545	605	3, 6	6000
690-532420..		30kW	52	50	670	730	3, 6	6000
690-532520..		37kW	65	68	890	980	3	15000

Electrical Ratings (500V Build Variant)

Power Supply = 380-500V ±10%, 50/60Hz ±5%

500V unit full power ratings are only available at 500V. The unit can be operated between 380-500V supply voltage with reduced output power below 500V.

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

Note: *The improved ratings offered by software versions 5.4 onwards are made possible by internal hardware changes to the drive. The ratings are not achievable on older drives running software versions 5.4 onwards.*

Model Number (Europe)	Catalog Number (North America)	Motor Power	Output Current (A)	Input Current (A)	Heatsink Power Loss (W)	Total Power Loss (W)	Maximum Switching Frequency (kHz)	Input Bridge I^2t (A^2s)
FRAME E : Input currents for kW ratings at 500V 50Hz ac input. Prospective short circuit current 18kA.								
Constant (Output Overload Motoring 150% for 60s, 180% for 0.5s short term rating)								
690-532540..		30kW	54	55	647	749	3, 6	15000
690-532730..		37kW	67	69	799	911	3, 6	18000
690-532870..		45kW	79	82	957	1083	3, 6	18000
Quadratic (Output Overload Motoring 110% for 60s)								
690-532540..		37kW	67	67	623	738	3	15000
690-532730..		45kW	79	82	766	894	3	18000
690-532870..		55kW	98	98	930	1078	3	18000
FRAME F : Input currents for kW ratings at 500V 50Hz ac input. Prospective short circuit current 18kA.								
Constant (Output Overload Motoring 150% for 60s, 180% for 0.5s short term rating)								
690-533105..		55kW	100	93	900	1130	3	100,000
690-533145..		75kW	125	118	1200	1500	3	100,000
690-533156..		90kW	156	140	1340	1780	3	100,000
Quadratic (Output Overload Motoring 110% for 60s)								
690-533105..		75kW	125	118	1200	1500	3	100,000
690-533145..		90kW	156	140	1340	1780	3	100,000
690-533156..		110kW	180	166	1670	2180	3	100,000

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
B	0.75kW 1Hp	CO470653	RL-00401	3.00	4
B	1.5kW 2Hp	CO353011	RL-00801	1.50	8
B	2.2kW 3Hp	CO470638	RL-01201	1.25	12
B	4kW 5HP	CO353012	RL-01801	0.80	18
C	5.5kW 7.5Hp	CO353013	RL-02501	0.50	25
C	7.5kW 10Hp	CO353014	RL-03501	0.40	35
D	11kW 15Hp	CO353015	RL-04501	0.30	45
D	15kW 20Hp	CO353016	RL-05501	0.25	55
D	18.5kW 25Hp	CO535017	RL-08001	0.20	80
E	22kW 30Hp	CO353017	RL-08001	0.20	80
F	30kW 40Hp	CO470654	RL-10001	0.15	100
F	37kW 50Hp	CO353018	RL-13001	0.10	130
F	45kW 60Hp	CO471264	RL-16001	0.075	160

460V

Frame Size	Motor Power	SSD Drives Part Number	MTE Part Number	Inductance mH	Rated amps
B	0.75kW 1Hp	CO470650	RL-00201	12.00	2
B	1.5kW 2Hp	CO470651	RL-00402	6.50	4
B	2.2kW 3Hp	CO352782	RL-00803	5.00	8
B	4kW 5Hp	CO470652	RL-00802	3.00	8
B	5.5kW 7.5Hp	CO352783	RL-01202	2.50	12
B	6.0kW 10Hp	CO352785	RL-01802	1.50	18
C	7.5kW 10Hp	CO352785	RL-01802	1.50	18
C	11kW 15Hp	CO352786	RL-02502	1.20	25
C	15kW 20Hp	CO352901	RL-03502	0.80	35
D	18.5kW 25Hp	CO352901	RL-03502	0.80	35
D	22kW 30Hp	CO352902	RL-04502	0.70	45
D	30kW 40Hp	CO352903	RL-05502	0.50	55
E	37kW 50Hp	CO352904	RL-08002	0.40	80
E	45kW 60Hp	CO352904	RL-08002	0.40	80
F	55kW 75Hp	CO352905	RL-10002	0.30	100
F	75kW 100Hp	CO352906	RL-13002	0.20	130
F	90kW 125Hp	CO470057	RL-16002	0.15	160
F	90kW 150Hp	CO470045	RL-20002	0.11	200
G	132kW 200Hp	CO470046	RL-25002	0.09	250
G	160kW 250Hp	CO470047	RL-32002	0.075	320
G	180kW 300Hp	CO470048	RL-40002	0.06	400
H	220kW 350Hp	CO470049	RL-50002	0.05	500
H	250kW 400Hp	CO470049	RL-50002	0.05	500
H	280kW 450Hp	CO470050	RL-60002	0.04	600
J	315kW 500Hp	CO470050	RL-60002	0.04	600

Input Fuse Ratings (Europe)

Refer to Chapter 9 for North American fuse ratings.

Product Code	Input Fuse Rating (A)		Product Code	Input Fuse Rating (A)	
Model Number	Constant	Quadratic	Model Number	Constant	Quadratic
230V BUILD VARIANT 220-240V ±10%, 45-65Hz *					
Frame B			Frame C		
690-211400..	12	-	690-232220..	25	32
690-211700..	20	-	690-232280..	40	50
690-212105..	25	-			
690-231400..	10	-			
690-231700..	12	-			
690-232105..	16	-			
690-232165..	20	-			
Frame D			Frame E		
690-232420..	50	63	690232800..	100	125
690-232540..	63	80			
690-232680..	80	-			
Frame F					
690-233104..	125	160			
690-233130..	160	160			
690-233154..	160	200			
400V BUILD VARIANT 380-460V ±10%, 45-65Hz *					
Frame B			Frame C		
690-431250..	6	-	690-432120..	16	20
690-431450..	8	-	690-432160..	20	32
690-431550..	10	-	690-432230..	32	40
690-431950..	16	-	690-432300..	40	50
690-432120..	20	-			
690-432140..	20	-			
Frame D			Frame E		
690-432310..	40	50	690-432590..	80	100
690-432380..	50	50	690-432730..	100	100
690-432450..	50	63	69043-2870..	100	125
690-432590..	80	100			
Frame F					
690-433205..	125	160			
690-433145..	160	200			
690-433156..	200	200			
690-433180..	200	200			
500V BUILD VARIANT 380-500V ±10%, 45-65Hz *					
Frame B			Frame C		
690-531500..	8	-	690-532110..	16	20
690-531800..	12	-	690-532140..	25	32
690-532110..	16	-	690-532210..	32	32
			690-532270..	32	40
Frame D			Frame E		
690-532280..	32	40	690-532540..	63	80
690-532360..	40	40	690-532730..	80	100
690-532420..	40	50	690-532870..	100	100
690-532520..	63	80			
Frame F					
690-533105..	100	125			
690-533145..	125	160			
690-533156..	160	200			

*** Note : Frame B only is 50Hz ±5% or 60Hz ±5%**

External AC Supply (RFI) Filters

Drive	Filter Part No.	Motor Power (kW/Hp)	Phase	Watt Loss (W)	Fault Leakage Current (mA)	Current (A)	Maximum Supply Voltage (V)	EMC Performance Class	Maximum Motor Cable Length (m)
Frame B	CO467842U020 (TN/IT Filter)	0.75-6/1-10 constant	3	10	38	20	500	B	50
Frame C	CO467842U044 (TN/IT Filter)	5.5-15/7.5-20 constant 7.5-18.5/10-25 quadratic	3	22	80	44	500	B	50
Frame D	CO467842U084 (TN/IT Filter)	15-30/20-40 constant 18.5-37/25-50 quadratic	3	30	86	84	500	B	50
Frame E	CO467842U105 (TN/IT Filter)	30-45/40-60 constant 37-55/50-75 quadratic	3	36	200	105	500	B	50
Frame F	CO467842U215 (TN/IT Filter)	55-90/75-150 constant 75-110/100-150 quadratic	3	67	450	215	500	B	50
Filters suitable for 50-60Hz ±5%, switching frequency 3 kHz only									

EMC Compliance

Standard EN 61800-3		Frame B	Frame C	Frame D	Frame E	Frame F
Conducted emissions Table 14	Unrestricted Distribution Category C1	Up to 4.0kW when fitted with the internal filter Over 4.0kW when fitted with the specified external filter	When fitted with the specified external filter	When fitted with the specified external filter	When fitted with the specified external filter	When fitted with the specified external filter
Conducted emissions Table 14	Category C2 Restricted Distribution	Over 4.0kW when fitted with the internal filter	When fitted with the specified external filter	When fitted with the specified external filter	When fitted with the specified external filter	When fitted with the specified external filter
Radiated Emissions Table 15	Category C1 Unrestricted Distribution	Up to 4.0kW	No	No	No	No
Radiated Emissions Table 15	Category C2 Restricted Distribution	Above 4.0kW	Yes	Yes	Yes	Yes
Conducted emissions Table 17	Category C3 Where I<=100A	Yes	Yes	Yes	Yes	Yes
Conducted emissions Table 17	Category C3 Where I>=100A	N/A	N/A	N/A	N/A	Yes
Radiated Emissions Table 18	Category C3 Second environment	Yes	Yes	Yes	Yes	Yes

Internal Dynamic Brake Switch (Frame B)

Model Number (Europe)	Motor Power (kW/hp)	Brake Switch Peak Current (A)	Peak Brake Dissipation (kW/hp)	Minimum Brake Resistor Value (Ω)
		100% duty continuous		
230V Build Variant: 220-240V ±10% DC link brake voltage: 390V				
690-211400..	0.75/1	10	4/5	56
690-211700..	1.5/2	10	4/5	56
690-212105..	2.2/3	10	4/5	56
690-231400..	0.75/1	10	4/5	56
690-231700..	1.5/2	10	4/5	56
690-232105..	2.2/3	10	4/5	56
690-232165..	4/5	15	6/8	33
400V Build Variant: 380-460V ±10% DC link brake voltage: 750V				
690-431250..	0.75/1	10	7.5/10	100
690431450..	1.5/2	10	7.5/10	100
690-431550..	2.2/3	10	7.5/10	100
690-431950..	4/5	10	7.5/10	100
690-432120..	5.5/7.5	10	7.5/10	80
690-432140..	6.0/10	10	7.5/10	80
500V Build Variant: 500V ±10% DC link brake voltage: 750V				
690-531500..	2.2/3	10	7.5/10	100
690-531800..	4/5	10	7.5/10	100
690-532110..	5.5/7.5	10	7.5/10	90

Internal Dynamic Brake Switch (Frame C)

Model Number (Europe)	Motor Power (kW/hp)	Brake Switch Peak Current (A)	Peak Brake Dissipation (kW/hp)	Brake Switch Continuous Current (A)	Continuous Brake Dissipation (kW/hp)	Minimum Brake Resistor Value (Ω)
		20s maximum, 30% duty				
230V Build Variant: 220-240V ±10% DC link brake voltage: 390V						
690-232220..	5.5/7.5	13.5	5.2/6.9	4.0	1.6/2.1	29
690-232280..	7.5/10	17.7	6.9/9.2	5.3	2.1/2.8	22
400V Build Variant: 380-460V ±10%, 45-65Hz DC link brake voltage: 750V						
690-432120..	5.5/7.5	7.5	5.5/7.5	2.3	1.7/2.3	100
690-432160..	7.5/10	15	11/15	4.5	3.4/4.5	50
690-432230..	11/15	15	11/15	4.5	3.4/4.5	50
690-432300..	15/20	15	11/15	4.5	3.4/4.5	50
500V Build Variant: 500V ±10%, 45-65Hz DC link brake voltage: 815V						
690-532110..	5.5/7.5	7.5	6.1/8.2	2.25	1.8/2.5	100
690-532140..	7.5/10	15	12.2/16.3	4.5	3.7/4.9	50
690-532210..	11/15	15	12.2/16.3	4.5	3.7/4.9	50
690-532270..	15/20	15	12.2/16.3	4.5	3.7/4.9	50

Internal Dynamic Brake Switch (Frame D)

Model Number (Europe)	Motor Power (kW/hp)	Brake Switch Peak Current (A)	Peak Brake Dissipation (kW/hp)	Brake Switch Continuous Current (A)	Continuous Brake Dissipation (kW/hp)	Minimum Brake Resistor Value (Ω)
		20s maximum, 30% duty				
230V Build Variant: 220-240V ±10% DC link brake voltage: 390V						
690-232420..	11/15	28	10.9/14.5	8.4	3.3/4.4	14
690-232540..	15/20	39	15.2/20.3	11.7	4.6/6.1	10
690-232680..	18.5/25	49	19.0/25.3	14.7	5.7/7.6	8
400V Build Variant: 380-460V ±10%, 45-65Hz DC link brake voltage: 750V						
690-232540..	15/20	30	22/30	9.5	7/10	27
690-232680..	18.5/25	30	22/30	9.5	7/10	27
690-432450..	22/30	30	22/30	9.5	7/10	27
690-432590..	30/37	37	30/40	12.5	9/12	21
500V Build Variant: 500V ±10%, 45-65Hz DC link brake voltage: 815V						
690-532280..	15/20	27	22/30	8.5	7/10	33
690-532360..	18.5/25	27	22/30	8.5	7/10	33
690-532420..	22/30	27	22/30	8.5	7/10	33
690-532520..	30/37	34	30/40	11	9/12	24

Internal Dynamic Brake Switch (Frame E)

Model Number (Europe)	Motor Power (kW/hp)	Brake Switch Peak Current (A)	Peak Brake Dissipation (kW/hp)	Brake Switch Continuous Current (A)	Continuous Brake Dissipation (kW/hp)	Minimum Brake Resistor Value (Ω)
		20s maximum, 30% duty				
230V Build Variant: 220-240V ±10% DC link brake voltage: 390V						
690-232800..	22/30	56	21.7/28.9	16.8	6.5/8.7	7
400V Build Variant: 380-460V ±10%, 45-65Hz DC link brake voltage: 750V						
690-432590..	30/40	40	30/40	12	9/12	19
690-432730..	37/50	50	37/50	15	10.5/14	15
690-432870..	45/60	60	45/60	18	13.5/18	12
500V Build Variant: 500V ±10%, 45-65Hz DC link brake voltage: 820V						
690-532540..	30/40	37	30/40	11	9/12	22
690-532730..	37/50	46	37/50	14	10.5/14	18
690-532870..	45/60	55	45/60	17	13.5/18	15

Internal Dynamic Brake Switch (Frame F)						
Model Number (Europe)	Motor Power (kW/hp)	Brake Switch Peak Current (A)	Peak Brake Dissipation (kW/hp)	Brake Switch Continuous Current (A)	Continuous Brake Dissipation (kW/hp)	Minimum Brake Resistor Value (Ω)
		20s maximum, 25% duty				
230V Build Variant: 220-240V ±10% DC link brake voltage: 390V						
690-233104..	30/40	94	30/41	23.4	23/12	5
690-233130..	37/50	107	38/51	29.4	11/15	4
690-233154..	45/60	125	51/68	39.0	15/20	3
400V Build Variant: 380-460V ±10%, 45-65Hz DC link brake voltage: 750V						
690-433105..	55/75	94	62/83	25	18/25	8
690-433145..	75/100	125	90/125	32	24/32	6
690-433156..	90/125	136	102/137	32	24/32	5.5
690-433180..	90/150	136	102/137	32	24/32	5.5
500V Build Variant: 500V ±10%, 45-65Hz DC link brake voltage: 820V						
690-533105..	55/75	82	68	25	20.5/27	10
690-533145..	75/100	102	83	31	25.5/34	8
690-533156..	90/125	102	83	31	25.5/34	8

Control Terminals

Terminal No.	Name	Range	Description (Default functions are for Macro 1)
	ANALOG I/O TERMINAL BLOCK This is a 10-way connector carrying all customer analog I/O.		
1	0V		0V reference for analog i/o
2	AIN1 (SPEED)	0-10V, ±10V, 0-20V 0-20mA, 4-20mA	Configurable analog input Default function = Speed Setpoint
3	AIN2 (TRIM)	0-10V, ±10V, 0-20V 0-20mA, 4-20mA	Configurable analog input Default function = Speed Trim
4	AIN3	0-10V, ±10V, 0-20V	Configurable analog input
5	AIN4	0-10V, ±10V, 0-20V	Configurable analog input
6	AOUT1 (RAMP)	0-10V, 0-20mA, 4-20mA	Configurable analog output Default function = Ramp Output
7	AOUT2	±10V	Configurable analog output No default function
8	AOUT3	±10V	Configurable analog output No default function
9	+10V REF	10V	10V reference for analog i/o Load 10mA maximum
10	-10V REF	-10V	-10V reference for analog i/o Load 10mA maximum
	DIGITAL INPUT TERMINAL BLOCK This is a 10-way connector carrying all digital inputs.		
11	0V		All inputs below 24V=high , 0V=low
12	DIN1 (RUN FWD)	0-24V	Configurable digital input Default function = RUN FWD 0V = Stop, 24V = Run
13	DIN2 (RUN REV)	0-24V	Configurable digital input Default function = RUN REV 0V = Stop, 24V = Run
14	DIN3 (NOT STOP)	0-24V	Configurable digital input Default function = NOT STOP 0V = Stop, 24V = Run
15	DIN4 (REMOTE REVERSE)	0-24V	Configurable digital input Default function = DIRECTION 0V = Forward, 24V = Reverse
16	DIN 5 (JOG)	0-24V	Configurable digital input Default function = JOG 24V = Jog, 0V = Stop
17	DIN6	0-24V	Configurable digital input No default function
18	DIN7 (REMOTE TRIP RESET)	0-24V	Configurable digital input Default function = TRIP RESET 24V = Reset
19	DIN8 (EXT TRIP)	0-24V	Non-configurable digital input Default function = EXTERNAL TRIP (active low) 24V = No Trip, 0V = Trip
20	+24VC		Customer +24V (max load 150mA)
	RELAY OUTPUT TERMINAL BLOCK Relay outputs are volt free, normally open contacts. Rated to 230V 3A resistive load. Alternatively they may be used down to 1mA, 12V levels. This is a 6-way connector.		
21 22	DOUT1_A DOUT1_B	normally-open relay contacts	Default function DOUT1 closed = healthy
23 24	DOUT2_A DOUT2_B	normally-open relay contacts	Default function DOUT2 closed = running
25 26	DOUT3_A DOUT3_B	normally-open relay contacts	No default function

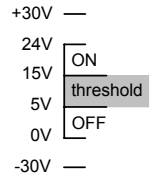
System Board Terminals (option)

Terminal No.	Name	Range	Description (Default functions are for Macro 1)
	 **Terminal A** 1 2 3 4 5 6		
1	External 0V		User-supplied 0V reference
2	DIGIO11	If driving a relay coil with a digital output we recommend to fit a flywheel diode across the coil.	Configurable digital input/output
3	DIGIO12		Configurable digital input/output
4	DIGIO13		Configurable digital input/output
5	DIGIO14		Configurable digital input/output
6	DIGIO15		Configurable digital input/output
	 **Terminal B** 1 2 3 4 5 6 7 8 9		
1	External 24V In	24V dc (±10%) 1A	User-supplied power supply
2	Reference Encoder A		Input
3	Reference Encoder /A		Input
4	Reference Encoder B		Input
5	Reference Encoder /B		Input
6	Reference Encoder Z		Input
7	Reference Encoder /Z		Input
8	Encoder Supply Out	5V, 12V, 18V, 24V	User selectable (max load 500mA)
9	External 0V		User-supplied 0V reference
	 **Terminal C** 1 2 3 4 5 6		
1	Slave Encoder A		Input
2	Slave Encoder /A		Input
3	Slave Encoder B		Input
4	Slave Encoder /B		Input
5	Slave Encoder Z		Input
6	Slave Encoder /Z		Input
	 **Terminal D** 1 2 3 4 5 6		
1	Repeat Encoder Output A		Output (repeats Slave Encoder)
2	Repeat Encoder Output /A		Output (repeats Slave Encoder)
3	Repeat Encoder Output B		Output (repeats Slave Encoder)
4	Repeat Encoder Output /B		Output (repeats Slave Encoder)
5	Repeat Encoder Output Z		Output (repeats Slave Encoder)
6	Repeat Encoder Output /Z		Output (repeats Slave Encoder)

Analog Inputs/Outputs

	Inputs	Output
Range	0-10V, ±10V, 0-20mA or 4-20mA (range set in software)	0-10V (10mA maximum), 0-20mA or 4-20mA (range set in software)
Impedance	Voltage range = 47kΩ Current range = 220Ω	Voltage range = 100Ω Recommended Load - 220Ω
Resolution	10 bits (1 in 1024)	10 bits (1 in 1024)
Sample Rate	5ms (one selected input can be 1ms)	5ms
System Board With System Board option fitted, the ±10V range is enhanced as follows:		
Range	±10V (range set in software)	
Impedance	Voltage range = 14kΩ	
Resolution	12 bit + sign (1 in 8192)	
Sample Rate	5ms (one selected input can be 1ms)	

Digital Inputs

Operating Range	0-5V dc = OFF, 15-24V dc = ON (-30V dc absolute minimum, +30V dc absolute maximum) 
Input Impedance	6.8kΩ
Sample Rate	5ms

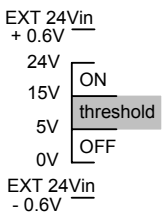
Digital Outputs

These are volt-free relay contacts. 50V dc max, 0.3A max (for inductive loads up to L/R=40ms, a suitable freewheel diode must be used).

Maximum Voltage	230V ac
Maximum Current	3A resistive load

System Board Digital Inputs/Outputs (DIGIO11-15)

These are individually, user-configurable as an Input or Output. Refer to the Software Product Manual, Chapter 1: "Programming Your Application" – DIGITAL INPUTS and DIGITAL OUTPUTS.

	Input	Output
Maximum Voltage	EXT 24Vin + 0.6V	24V dc
Maximum Current		100mA
Operating Range	0-5V dc = OFF, 15-24V dc = ON (-30V dc absolute minimum, +30V dc absolute maximum) 	24V dc = ON * 0V dc = OFF * range: 19.1V (full load) to 25.1V (no load)
Input Impedance	6.8kΩ	
Sample Rate	5ms	5ms

Supply Harmonic Analysis (Frame B Constant)

(With or without the internal filter)

Assumptions: 10000A short circuit supply capability, equivalent to 73µH supply impedance at 400V 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.

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

Fundamental Voltage (V)	230							400						500		
Drive Type	Single Phase			Three Phase												
Motor Power (kW)	0.75	1.5	2.2	0.75	1.5	2.2	4.0	0.75	1.5	2.2	4.0	5.5	6.0	2.2	4.0	5.5
Typical Motor Efficiency %	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
Harmonic No.	RMS Current (A)															
1	3.8	7.5	11.0	2.1	4.2	6.2	11.4	1.2	2.5	3.6	6.5	8.9	9.7	2.8	5.2	7.1
3	3.7	7.2	10.5	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	3.5	6.7	9.6	2.0	3.9	5.7	10.0	1.2	2.3	3.4	6.0	8.1	8.8	2.7	4.8	6.6
7	3.3	6.1	8.4	1.9	3.6	5.1	8.9	1.1	2.2	3.2	5.6	7.4	8.0	2.5	4.5	6.1
9	3.0	5.3	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	2.6	4.4	5.5	1.7	2.9	3.9	5.9	1.0	1.9	2.6	4.4	5.5	5.9	2.1	3.6	4.8
13	2.2	3.5	4.0	1.5	2.5	3.1	4.4	0.9	1.8	2.3	3.8	4.5	4.8	1.9	3.1	4.0
15	1.9	2.6	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	1.5	1.8	1.5	1.2	1.6	1.8	1.8	0.8	1.5	1.6	2.5	2.6	2.7	1.3	2.1	2.6
19	1.1	1.1	0.6	1.0	1.3	1.2	0.9	0.7	1.3	1.3	1.9	1.7	1.8	1.1	1.6	1.9
21	0.8	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.5	0.2	0.4	0.7	0.6	0.4	0.5	0.5	0.9	0.7	0.9	0.6	0.5	0.7	0.8	0.8
25	0.3	0.2	0.5	0.5	0.4	0.3	0.6	0.5	0.7	0.5	0.5	0.3	0.3	0.5	0.5	0.5
27	0.1	0.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.1	0.3	0.3	0.3	0.2	0.3	0.5	0.3	0.4	0.2	0.2	0.4	0.5	0.2	0.2	0.3
31	0.1	0.3	0.2	0.2	0.2	0.3	0.3	0.2	0.3	0.2	0.2	0.4	0.5	0.2	0.2	0.3
33	0.1	0.2	0.1	0.0	0.0	0.0	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	0.2	0.2	0.2	0.1	0.2	0.2	0.3	0.3	0.3	0.2	0.3	0.3
37	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3
39	0.1	0.1	0.2	0.0	0.0	0.0	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	0.0	0.0	0.0	0.0	0.0	0.0
41	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.0	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.2
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.0	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total RMS Current (A)	**8.9**	**16.2**	**22.4**	**4.6**	**8.1**	**11.2**	**19.2**	**2.8**	**5.4**	**7.2**	**12.4**	**16.2**	**17.5**	**5.8**	**10.0**	**13.5**
THD (V) %	0.37	0.64	0.80	0.46	0.67	0.83	1.22	0.19	0.33	0.37	0.58	0.68	0.73	0.31	0.48	0.62

Supply Harmonic Analysis (Frame C Constant)

Assumptions: 10000A short circuit supply capability, equivalent to 73µH supply impedance at 400V 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.

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

Fundamental Voltage (V)	230		400				500			
Drive Type	Three Phase									
Motor Power (kW)	5.5	7.5	5.5	7.5	11.0	15.0	5.5	7.5	11.0	15.0
Typical Motor Efficiency %	90	90	90	90	90	90	90	90	90	90
Harmonic No.	RMS Current (A)									
1	18.5	23.8	10.1	13.0	18.6	25.1	9.7	17.8	18.6	19.5
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	13.0	18.0	7.9	10.3	14.2	19.9	7.7	13.9	14.4	15.9
7	8.9	13.3	6.1	8.1	10.8	15.6	6.0	10.7	11.0	12.8
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	2.2	4.6	2.4	3.6	4.0	6.8	2.6	4.3	4.3	6.2
13	1.2	2.0	1.2	1.9	1.8	3.5	1.4	2.1	2.1	3.5
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	1.0	1.5	0.6	0.8	1.2	1.5	0.6	1.2	1.2	1.2
19	0.6	1.3	0.6	0.9	1.1	1.5	0.6	1.1	1.1	1.3
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.5	0.6	0.3	0.5	0.5	0.9	0.3	0.6	0.6	0.9
25	0.4	0.6	0.3	0.3	0.5	0.6	0.3	0.5	0.5	0.6
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.3	0.4	0.2	0.3	0.4	0.6	0.2	0.4	0.4	0.5
31	0.3	0.3	0.2	0.3	0.3	0.5	0.2	0.3	0.3	0.5
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.2	0.3	0.1	0.2	0.2	0.3	0.1	0.2	0.3	0.3
37	0.2	0.3	0.1	0.2	0.2	0.3	0.1	0.2	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
41	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.2
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.2
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.2
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.2
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total RMS Current (A)	**24.5**	**33.2**	**14.5**	**18.9**	**26.2**	**36.5**	**14.2**	**25.5**	**26.5**	**29.2**
THD (V) %	0.57	0.86	0.40	0.54	0.70	1.03	0.40	0.70	0.72	0.87

Supply Harmonic Analysis (Frame C Quadratic)

Assumptions: 10000A short circuit supply capability, equivalent to 73µH supply impedance at 400V 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.

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

Fundamental Voltage (V)	230		400				500			
Drive Type	Three Phase									
Motor Power (kW)	5.5	7.5	5.5	7.5	11.0	15.0	5.5	7.5	11.0	15.0
Typical Motor Efficiency %	90		90	90	90	90	90	90	90	90
Harmonic No.	RMS Current (A)									
1	23.7		13.3	18.2	25.1	30.7	14.2	16.2	23.1	24.3
3	0.0		0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
5	15.9		10.1	14.0	18.6	23.9	10.8	12.7	17.5	19.4
7	10.4		7.5	10.6	13.5	18.4	8.2	9.9	13.0	15.3
9	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	2.1		2.7	4.0	4.3	7.3	3.0	4.2	4.6	6.8
13	1.6		1.2	1.8	1.8	3.4	1.4	2.1	2.0	3.6
15	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	1.1		0.8	1.2	1.5	1.8	0.9	1.1	1.5	1.5
19	0.7		0.7	1.0	1.2	1.8	0.8	1.1	1.3	1.6
21	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.6		0.3	0.5	0.6	0.8	0.4	0.5	0.6	0.9
25	0.5		0.3	0.5	0.6	0.7	0.4	0.4	0.6	0.7
27	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.3		0.2	0.4	0.4	0.7	0.3	0.4	0.4	0.6
31	0.3		0.2	0.3	0.3	0.5	0.2	0.3	0.3	0.5
33	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.2		0.2	0.2	0.3	0.4	0.2	0.2	0.3	0.3
37	0.3		0.1	0.2	0.2	0.4	0.2	0.2	0.2	0.3
39	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
41	0.1		0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.3
42	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.2		0.1	0.1	0.2	0.2	0.1	0.1	0.2	0.2
44	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.1		0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.2
48	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.2		0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.2
50	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total RMS Current (A)	**30.6**		**18.6**	**25.7**	**34.4**	**43.9**	**19.9**	**23.4**	**32.2**	**35.6**
THD (V) %	0.68		0.4848	0.6858	0.8634	1.1883	0.5286	0.6545	0.8396	1.0236

Supply Harmonic Analysis (Frame D Constant)

Assumptions: 10000A short circuit supply capability, equivalent to 73µH supply impedance at 400V 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.

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

Fundamental Voltage (V)	230			400				500			
Drive Type	Three Phase										
Motor Power (kW)	11.0	15.0	18.0	15.0	18.0	22.0	30.0	15.0	18.0	22.0	30.0
Typical Motor Efficiency %	90	90	90	90	90	90	90	90	90	90	90
Harmonic No.	RMS Current (A)										
1	37.4	46.7	59.2	25.8	30.6	36.3	51.5	19.4	24.2	29.0	*
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	
5	20.8	21.1	23.3	18.6	21.6	24.8	34.2	14.9	17.9	20.9	
7	12.7	11.5	11.5	13.1	14.7	16.4	21.8	11.3	13.0	14.7	
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
11	2.5	3.4	4.4	3.7	3.7	3.6	4.2	4.3	4.2	4.2	
13	2.5	2.6	3.0	1.8	2.0	2.4	3.4	2.1	2.0	2.1	
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
17	1.4	1.9	2.5	1.6	1.7	1.8	2.2	1.4	1.7	1.8	
19	1.2	1.4	1.7	1.1	1.1	1.1	1.4	1.2	1.2	1.3	
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
23	0.9	1.2	1.6	0.7	0.9	1.0	1.3	0.6	0.7	0.8	
25	0.7	0.9	1.2	0.7	0.7	0.8	0.9	0.5	0.7	0.8	
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
29	0.7	0.9	1.1	0.4	0.5	0.6	0.7	0.4	0.4	0.4	
31	0.5	0.7	0.9	0.4	0.5	0.5	0.6	0.3	0.4	0.4	
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
35	0.5	0.6	0.8	0.3	0.3	0.3	0.5	0.3	0.3	0.3	
37	0.4	0.5	0.7	0.2	0.3	0.3	0.5	0.3	0.3	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	
41	0.4	0.5	0.6	0.2	0.2	0.2	0.3	0.2	0.2	0.2	
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
43	0.3	0.4	0.5	0.2	0.2	0.2	0.3	0.2	0.2	0.2	
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
47	0.3	0.4	0.4	0.2	0.2	0.2	0.2	0.1	0.1	0.2	
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
49	0.2	0.3	0.4	0.1	0.2	0.2	0.3	0.1	0.1	0.2	
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total RMS Current (A)	**44.9**	**52.8**	**65.0**	**34.8**	**40.5**	**47.2**	**65.8**	**27.5**	**33.2**	**39.1**	
THD (V) %	0.90	0.93	1.05	0.85	0.96	1.08	1.44	0.74	0.85	0.96	

* Please contact Parker SSD Drives.

Supply Harmonic Analysis (Frame D Quadratic)

Assumptions: 10000A short circuit supply capability, equivalent to 73µH supply impedance at 400V 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.

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

Fundamental Voltage (V)	230			400				500			
Drive Type	Three Phase										
Motor Power (kW)	11.0	15.0	18.0	15.0	18.0	22.0	30.0	15.0	18.0	22.0	30.0
Typical Motor Efficiency %	90	90		90	90	90	90	90	90	90	90
Harmonic No.	RMS Current (A)										
1	47.2	59.2		30.6	36.3	48.2	67.7	23.4	29.0	38.6	*
3	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.1	0.0	
5	22.5	23.3		21.6	24.8	31.0	41.7	17.6	20.9	26.6	
7	12.5	11.5		14.7	16.4	19.6	25.5	13.0	14.7	17.8	
9	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	
11	3.3	4.4		3.7	3.6	3.4	4.0	4.5	4.2	4.1	
13	2.7	3.0		2.0	2.4	3.3	4.7	2.1	2.1	2.6	
15	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	
17	1.8	2.5		1.7	1.8	1.8	2.1	1.6	1.8	2.0	
19	1.3	1.7		1.1	1.1	1.4	1.9	1.3	1.3	1.2	
21	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	
23	1.2	1.6		0.9	1.0	1.0	1.3	0.6	0.8	1.1	
25	0.9	1.2		0.7	0.8	0.8	1.1	0.6	0.8	0.8	
27	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	
29	0.8	1.1		0.5	0.6	0.6	0.9	0.4	0.4	0.6	
31	0.7	0.9		0.5	0.5	0.6	0.7	0.4	0.4	0.5	
33	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	
35	0.6	0.8		0.3	0.3	0.4	0.6	0.3	0.3	0.4	
37	0.5	0.7		0.3	0.3	0.5	0.5	0.3	0.3	0.4	
39	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	
41	0.4	0.6		0.2	0.2	0.2	0.5	0.2	0.2	0.3	
42	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	
43	0.4	0.5		0.2	0.2	0.4	0.4	0.2	0.2	0.2	
44	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	
45	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	
46	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	
47	0.3	0.4		0.2	0.2	0.2	0.3	0.1	0.2	0.2	
48	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	
49	0.3	0.4		0.2	0.2	0.3	0.3	0.1	0.2	0.2	
50	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total RMS Current (A)	**54.0**	**65.0**		**40.5**	**47.2**	**60.8**	**83.8**	**32.6**	**39.1**	**50.5**	
THD (V) %	0.97	1.05		0.96	1.08	1.30	1.72	0.85	0.96	1.16	

* Please contact Parker SSD Drives.

Supply Harmonic Analysis (Frame E Constant)

Assumptions: 10000A short circuit supply capability, equivalent to 73µH supply impedance at 400V 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.

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

Fundamental Voltage (V)	230	400			500		
Drive Type	Three Phase						
Motor Power (kW)	22.0	30.0	37.0	45.0	30.0	37.0	45.0
Typical Motor Efficiency %	90	90	90	90	90	90	90
Harmonic No.	RMS Current (A)						
1	76.7	52.3	62.8	75.5	41.1	52.4	64.4
3	0.0	0.0	0.0	0.0	0.1	0.1	0.0
5	42.4	35.3	42.2	48.4	29.3	36.7	43.1
7	22.2	22.9	27.2	29.4	20.2	24.8	27.6
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	4.4	4.5	5.2	4.9	5.3	5.9	5.5
13	4.3	3.2	3.8	4.9	2.7	3.4	4.3
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	2.0	2.3	2.7	2.5	2.5	2.9	2.9
19	1.7	1.4	1.6	1.9	1.6	1.8	1.8
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1.2	1.3	1.5	1.5	1.1	1.4	1.6
25	0.9	0.9	1.1	1.0	1.0	1.2	1.1
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.7	0.7	0.8	0.9	0.6	0.8	0.9
31	0.5	0.6	0.7	0.7	0.6	0.7	0.8
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.5	0.4	0.5	0.6	0.4	0.5	0.6
37	0.4	0.4	0.5	0.5	0.4	0.5	0.5
39	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
41	0.4	0.3	0.3	0.4	0.3	0.4	0.4
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.3	0.3	0.3	0.3	0.3	0.3	0.4
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.3	0.2	0.2	0.3	0.2	0.3	0.3
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.2	0.2	0.2	0.3	0.2	0.2	0.3
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total RMS Current (A)	**90.7**	**67.5**	**80.8**	**94.7**	**54.8**	**69.1**	**82.6**
THD (V) %	1.65	2.58	3.70	3.41	1.31	1.61	1.82

Supply Harmonic Analysis (Frame E Quadratic)

Assumptions: 10000A short circuit supply capability, equivalent to 73µH supply impedance at 400V 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.

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

Fundamental Voltage (V)	230	400			500		
Drive Type	Three Phase						
Motor Power (kW)	22.0	30.0	37.0	45.0	30.0	37.0	45.0
Typical Motor Efficiency %	90	90	90	90	90	90	90
Harmonic No.	RMS Current (A)						
1	102.1	64.3	74.8	89.1	51.5	63.6	75.5
3	0.1	0.1	0.1	0.1	0.1	0.0	0.0
5	49.1	41.9	48.7	55.2	35.4	43.1	48.9
7	21.7	26.0	30.3	32.2	23.3	28.0	30.1
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	6.3	4.4	5.0	5.1	5.1	5.7	5.4
13	4.1	4.0	4.6	5.9	3.3	4.1	5.1
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	2.8	2.3	2.7	2.5	2.6	3.0	2.8
19	1.7	1.6	1.8	2.3	1.5	1.8	2.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1.6	1.4	1.6	1.5	1.4	1.6	1.6
25	1.0	0.9	1.1	1.2	1.0	1.2	1.1
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	1.0	0.8	1.0	1.0	0.7	0.9	1.0
31	0.7	0.6	0.7	0.8	0.7	0.8	0.7
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.7	0.5	0.6	0.7	0.4	0.6	0.6
37	0.5	0.5	0.5	0.6	0.4	0.6	0.5
39	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
41	0.5	0.4	0.4	0.5	0.3	0.4	0.4
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.4	0.3	0.4	0.4	0.3	0.4	0.4
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.3	0.2	0.3	0.3	0.2	0.3	0.3
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.3	0.2	0.3	0.4	0.2	0.3	0.3
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total RMS Current (A)	**115.6**	**81.3**	**94.6**	**110.0**	**67.1**	**82.2**	**95.2**
THD (V) %	1.84	2.98	3.46	3.84	1.52	1.84	1.02

Supply Harmonic Analysis (Frame F Constant)

Assumptions: 10000A short circuit supply capability, equivalent to 73µH supply impedance at 400V 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.

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

Fundamental Voltage (V)	230			400				500		
Drive Type	Three Phase									
Motor Power (kW)	30.0	37.0	45.0	55.0	75.0	90.0	90.0 (150HP)	55.0	75.0	90.0
Typical Motor Efficiency %	90	90	90	90	90	90	90	90	90	90
Harmonic No.	RMS Current (A)									
1	94.7	118.2	140.1	99.2	132.1	152.1	156.6	79.7	104.8	126.7
3	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.1
5	35.9	41.6	45.9	44.9	53.4	57.8	58.9	42.4	49.3	54.5
7	11.9	11.9	11.8	19.5	19.5	19.1	19.0	22.1	22.5	22.2
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
11	6.5	7.7	8.5	6.9	9.0	10.0	10.3	5.7	7.5	8.9
13	2.9	3.5	4.2	4.0	4.3	4.6	4.7	4.6	4.6	4.7
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	2.7	3.1	3.2	3.1	3.9	4.2	4.3	2.6	3.3	3.9
19	1.6	2.1	2.4	1.8	2.2	2.6	2.7	1.8	2.0	2.2
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1.4	1.4	1.4	1.7	2.0	2.1	2.1	1.5	1.9	2.1
25	1.1	1.3	1.4	1.1	1.5	1.7	1.7	1.0	1.2	1.4
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.7	0.8	0.8	1.0	1.1	1.1	1.1	0.9	1.1	1.2
31	0.7	0.8	0.7	0.8	1.0	1.1	1.1	0.6	0.8	1.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.4	0.5	0.6	0.6	0.6	0.7	0.7	0.6	0.7	0.7
37	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.4	0.6	0.7
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
41	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.4	0.5	0.5
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.5	0.5
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.3
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total RMS Current (A)	**102.3**	**126.2**	**148.2**	**110.9**	**144.3**	**164.3**	**168.9**	**93.3**	**118.4**	**140.2**
THD (V) %	1.33	1.52	1.66	1.71	1.98	2.12	2.15	1.67	1.90	2.06

Supply Harmonic Analysis (Frame F Quadratic)

Assumptions: 10000A short circuit supply capability, equivalent to 73µH supply impedance at 400V 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.

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

Fundamental Voltage (V)	230			400				500		
Drive Type	Three Phase									
Motor Power (kW)	30.0	37.0	45.0	55.0	75.0	90.0	90.0 (150HP)	55.0	75.0	90.0
Typical Motor Efficiency %	90	90	90	90	90	90	90	90	90	90
Harmonic No.	RMS Current (A)									
1	118.2	140.1	175.5	132.0	151.6	184.4	156.6	104.8	126.7	152.5
3	0.1	0.0	0.0	0.0	0.2	0.1	0.0	0.1	0.1	0.1
5	40.9	45.9	52.3	52.6	57.8	64.7	58.9	48.5	54.5	60.5
7	11.5	11.8	12.3	18.8	19.1	18.6	19.0	21.9	22.2	21.7
9	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
11	7.6	8.5	9.5	9.0	10.1	11.5	10.3	7.5	8.9	10.5
13	3.5	4.2	5.3	4.2	4.6	5.4	4.7	4.5	4.7	4.9
15	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
17	3.0	3.2	3.1	3.8	4.2	4.5	4.3	3.3	3.9	4.5
19	2.1	2.4	2.8	2.3	2.6	3.2	2.7	2.0	2.2	2.6
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1.4	1.4	1.4	2.0	2.1	2.0	2.1	1.9	2.1	2.3
25	1.3	1.4	1.3	1.5	1.7	1.9	1.7	1.2	1.4	1.7
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.7	0.8	1.0	1.1	1.1	1.1	1.1	1.1	1.2	1.3
31	0.7	0.7	0.8	1.0	1.1	1.1	1.1	0.8	1.0	1.1
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.5	0.6	0.7	0.6	0.7	0.8	0.7	0.7	0.7	0.8
37	0.5	0.5	0.6	0.7	0.7	0.7	0.7	0.6	0.7	0.8
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
41	0.4	0.4	0.4	0.4	0.5	0.6	0.5	0.5	0.5	0.5
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.3	0.4	0.4	0.4	0.5	0.5	0.4	0.4	0.5	0.5
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.4
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.3	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.3	0.3
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total RMS Current (A)	**125.9**	**148.2**	**183.9**	**143.8**	**163.8**	**196.8**	**168.9**	**118.0**	**140.2**	**166.0**
THD (V) %	1.49	1.66	1.87	1.95	2.13	2.34	2.15	1.87	2.06	2.25

Chapter 9 CERTIFICATION FOR THE DRIVE

Requirements for EMC Compliance

All Variable Speed Drives (VSDs) potentially produce electrical emissions which are radiated into the environment and conducted back into the ac supply. VSDs are inherently immune to any additional external electrical noise. The following information is provided to maximise the Electro Magnetic Compatibility (EMC) of VSDs and systems in their intended operating environment, by minimising their emissions and maximising their immunity.

Minimising Radiated Emissions

EN50081-1/EN50081-2 /EN55011/EN55022 radiated emission measurements are made between 30MHz and 1GHz in the far field at a distance of 10 to 30 metres. Limits lower than 30MHz or in close proximity are not specified. Emissions from individual components tend to be additive.

- Use a screened/armoured cable between VSD/cubicle and motor containing the motor protective earth (PE) connection. It should have a 360° screen termination. Earth screen at both ends connecting to the motor frame and cubicle (or gland box if wall mounted). Maintain the screen integrity using 360° terminations.

Note: *Some hazardous area installations may preclude direct earthing at both ends of the screen, in this case earth one end via a 1µF 50Vac capacitor, and the other as normal.*

- Keep unshielded cable as short as possible inside the cubicle.
- Always maintain the integrity of the shield.
- If the cable is interrupted to insert contactors etc., re-connect the screen using the shortest possible route.
- Keep the length of screen stripped-back as short as possible when making screen connections.
- Ideally use 360° screen terminations using cable glands or 'U' clips on power screen rails.

If a shielded cable is not available, lay unshielded motor cables in a metal conduit which will act as a shield. The conduit must be continuous with a direct electrical contact to the VSD and motor housing. If links are necessary, use braid with a minimum cross sectional area of $10mm^2$.

Note: *Some motor gland boxes and conduit glands are made of plastic, if this is the case, then braid must be connected between the screen and the chassis. In addition at the motor end, ensure that the screen is electrically connected to the motor frame since some terminal boxes are insulated from the frame by gasket/paint.*

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, we recommend that the "0V/signal ground" is 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 for the encoder, all analog inputs, and communications require screening 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.*

Cabling Requirements

Note: *Refer to Chapter 8: "Technical Specifications" for additional Cabling Requirements.*

Planning Cable Runs

- Use the shortest possible motor cable lengths.
- Use a single length of cable to a star junction point to feed multiple motors.
- Keep electrically noisy and sensitive cables apart.
- Keep electrically noisy and sensitive parallel cable runs to a minimum. Separate parallel cable runs by at least 0.25 metres. For runs longer than 10 metres, separation should be increased proportionally. For example if the parallel runs were 50m, then the separation would be (50/10) x 0.25m = 1.25m.
- Sensitive cables should cross noisy cables at 90°.
- Never run sensitive cables close or parallel to the motor, dc link and braking chopper circuit for any distance.
- Never run supply, dc link or motor cables in the same bundle as the signal/control and feedback cables, even if they are screened.
- Ensure EMC filter input and output cables are separately routed and do not couple across the filter.

Increasing Motor Cable Length

Because cable capacitance and hence conducted emissions increase with motor cable length, conformance to EMC limits is only guaranteed with the specified ac supply filter option using a maximum cable length as specified in Chapter 11: "Technical Specifications".

This maximum cable length can be improved using the specified external input or output filters. Refer to Chapter 8: "Technical Specifications" - External AC Supply (RFI) Filters.

Screened/armoured cable has significant capacitance between the conductors and screen which increases linearly with cable length (typically 200pF/m but varies with cable type and current rating).

Long cable lengths may have the following undesirable effects:

- Tripping on `overcurrent' as the cable capacitance is charged and discharged at the switching frequency.
- Producing increased conducted emissions which degrade the performance of the EMC filter due to saturation.
- Causing RCDs (Residual Current Devices) to trip due to increased high frequency earth current.
- Producing increased heating inside the EMC ac supply filter from the increased conducted emissions.

These effects can be overcome by adding chokes or output filters at the output of the VSD.

EMC Installation Options

The unit, when installed for Class A or Class B operation, will be compliant with EN55011/ EN55022 for radiated emissions, as described below.

Screening & Earthing (wall mounted, Class A)

IMPORTANT: This unit must be fitted with the optional top cover.

The unit is installed for Class A operation when wall mounted using the recommended ac supply filter and having complied with all cabling requirements.

Note: *The installation requirements of local safety standards must be achieved regarding the safety of electrical equipment for machines.*

- A single-star point earthing policy as shown in Figure Chapter 9 -2 is required.
- The protective earth connection (PE) to the motor must be run inside the screened cable between the motor and VSD and be connected to the protective earth terminal in the gland box, or on the VSD.
- The internal/external ac supply filter must be permanently earthed. Refer to Chapter 8: "Technical Specifications" - Earthing/Safety Details.
- The signal/control cables should be screened.

Note: *Refer to Chapter 8: "Technical Specifications" for details on Cabling Requirements.*

Screening & Earthing (cubicle mounted, Class B)

Note: *The installation requirements of local safety standards must be achieved regarding the safety of electrical equipment for machines.. Refer to Chapter 3: "Installing the Drive" - Protective Earth (PE) Connections* ⏚.

The unit is installed for Class B operation when mounted inside a cubicle having 10dB attenuation between 30 and 100MHz (typically the attenuation provided by a metal cabinet with no aperture of dimension greater than 0.15m), using the recommended ac supply filter and having met all cabling requirements.

Note: *Radiated magnetic and electric fields inside the cubicle will be high and any components fitted inside must be sufficiently immune.*

The VSD, external filter and associated equipment are mounted onto a conducting, metal mounting panel. Do not use cubicle constructions that use insulating mounting panels or undefined mounting structures. Cables between the VSD and motor must be screened or armoured and terminated at the VSD or locally on the back panel.

Single VSD - Single Motor

Apply a single point series earthing strategy for a single VSD mounted in a cubicle as shown.

The protective earth connection (PE) to the motor must be run inside the screened cable between the motor and VSD and be connected to the motor protective earth terminal on the VSD.

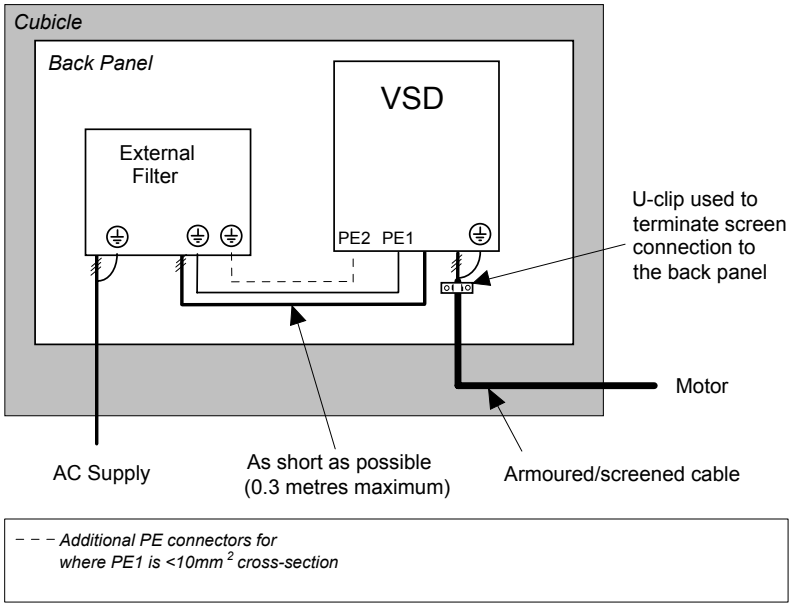


Figure Chapter 9 -1 EMC and Safety Earthing Cabling

Single VSD - Multiple Motors

Note: *Refer to Chapter 10: "Application Notes" - Using Multiple Motors on a Single Drive.*

If connecting multiple motors to a single VSD, use a star junction point for motor cable connections. Use a metal box with entry and exit cable glands to maintain shield integrity. Refer to Chapter 10: Application Notes" - Using Multiple Motors on a Single Drive.

Star Point Earthing

A star-point earthing policy separates 'noisy' and 'clean' earths. Four separate earth busbars (three are insulated from the mounting panel) connect to a single earth point (star point) near the incoming safety earth from the main supply. Flexible, large cross-section cable is used to ensure a low HF impedance. Busbars are arranged so that connection to the single earth point is as short as possible.

1 Clean Earth Busbar (insulated from the mounting panel)

Used as a reference point for all signal and control cabling. This may be further subdivided into an analog and a digital reference busbar, each separately connected to the star earthing point. The digital reference is also used for any 24V control.

Note: *The 690+ uses a single clean earth busbar for analog and digital.*

2 Dirty Earth Busbar (insulated from the mounting panel)

Used for all power earths, i.e. protective earth connection. It is also used as a reference for any 110 or 220V control used, and for the control transformer screen.

3 Metal Work Earth Busbar

The back panel is used as this earth busbar, and should provide earthing points for all parts of the cubicle including panels and doors. This busbar is also used for power screened cables which terminate near to (10cm) or directly into a VSD - such as motor cables, braking choppers and their resistors, or between VSDs - refer to the appropriate product manual to identify these. Use U-clips to clamp the screened cables to the back panel to ensure optimum HF connection.

4 Signal/Control Screen Earth Busbar (insulated from the mounting panel)

Used for signal/control screened cables which **do not** go directly to the VSD. Place this busbar as close as possible to the point of cable entry. 'U' clamp the screened cables to the busbars to ensure an optimum HF connection.

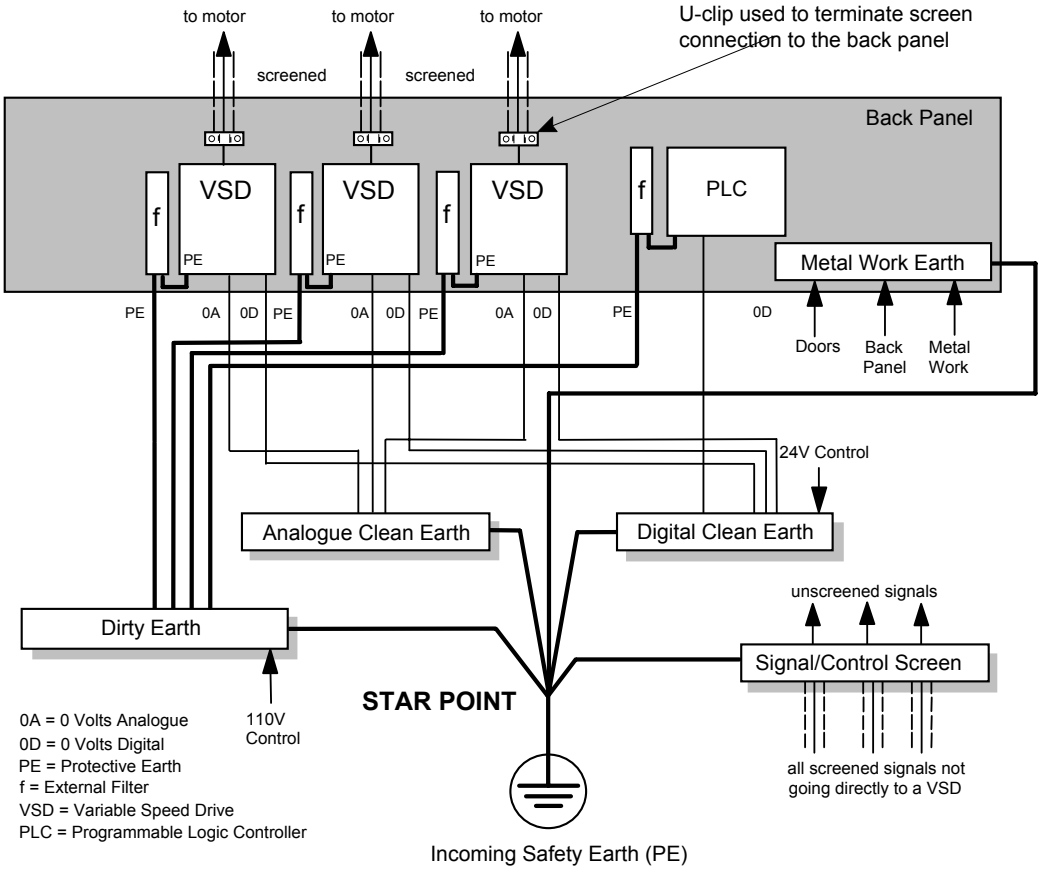


Figure Chapter 9 -2 Star Point Earthing

Sensitive Equipment

The proximity of the source and victim circuit has a large effect on radiated coupling. The electromagnetic fields produced by VSDs falls off rapidly with distance from the cabling/cubicle. Remember that the radiated fields from EMC compliant drive systems are measured at least 10m from the equipment, over the band 30-1000MHz. Any equipment placed closer than this will see larger magnitude fields, especially when very close to the drive.

Do not place magnetic/electric field sensitive equipment within 0.25 metres of the following parts of the VSD system:

- Variable Speed Drive (VSD)
- EMC output filters
- Input or output chokes/transformers
- The cable between VSD and motor (even when screened/armoured)
- Connections to external braking chopper and resistor (even when screened/armoured)
- AC/DC brushed motors (due to commutation)
- DC link connections (even when screened/armoured)
- Relays and contactors (even when suppressed)

From experience, the following equipment is particularly sensitive and requires careful installation.

- Any transducers which produce low level analog outputs (<1V) , e.g. load cells, strain gauges, thermocouples, piezoelectric transducers, anemometers, LVDTs
- Wide band width control inputs (>100Hz)
- AM radios (long and medium wave only)
- Video cameras and closed circuit TV
- Office personal computers
- Capacitive devices such as proximity sensors and level transducers
- Mains borne communication systems
- Equipment not suitable for operation in the intended EMC environment, i.e. with insufficient immunity to new EMC standards

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 60 seconds in Constant mode, and 110% for 60s in Quadratic mode. Refer to the Software Product Manual, Chapter 1: Programming Your Application - CURRENT LIMIT for user current limit adjustment information.

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; or when the MOTOR STALLED trip is TRUE (TRIPS STATUS::DISABLE TRIPS>> MOTOR STALLED); or when the STALL TIME parameter is increased above 480 seconds (refer to the 690+ Software Manual, Chapter 1 : STALL TRIP).

Short Circuit Rating

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

Frame B: 10,000 RMS Symmetrical Amperes, 230/460/500V maximum (as appropriate)
Frame C: 10,000 RMS Symmetrical Amperes, 230/460/500V maximum (as appropriate)
Frame D: 10,000 RMS Symmetrical Amperes, 230/460/500V maximum (as appropriate)
Frame E: 18,000 RMS Symmetrical Amperes, 230/460/500V maximum (as appropriate)
Frame F: 18,000 RMS Symmetrical Amperes, 230/460/500V maximum (as appropriate)

Solid-State Short-Circuit Protection

These devices are provided with Solid-State Short-Circuit (output) Protection. Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection requirements must be in accordance with the latest edition of the National Electrical Code NEC/NFPA-70 and any additional local codes.

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. Refer to Chapter 8: “Technical Specifications” - Power Details for recommended fuse ratings.

Motor Base Frequency

The motor base frequency rating is 480Hz 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” - Power Wiring Connections, and Control Wiring Connections.

Terminal Tightening Torques

Refer to Chapter 3: "Installing the Drive" - Terminal Tightening Torques.

Recommended Wire Sizes

North American wire sizes (AWG) are based on NEC/NFPA-70 for ampacities of thermoplastic-insulated (75ºC) copper conductors assuming not more than three current-carrying conductors in raceway or cable, based on ambient temperature of 30ºC.
The wire sizes allow for an ampacity of 125% of the rated input and output amperes for motor branch-circuit conductors as specified in NEC/NFPA-70.

FRAME B Terminal acceptance range: 18-10 AWG			
Model Catalog Code for North America	Power Input AWG	Power Output AWG	Brake Output AWG
230V Build Variant: 220-240V ±10%			
CONSTANT			
690+/0001/230/../1	14	14	14
690+/0002/230/../1	10	14	14
690+/0003/230/../1	10	14	14
690+/0001/230/..	14	14	14
690+/0002/230/..	14	14	14
690+/0003/230/..	12	14	14
690+/0005/230/..	10	10	10
400V Build Variant: 460V ±10%			
CONSTANT			
690+/0001/460/..	14	14	14
690+/0002/460/..	14	14	14
690+/0003/460/..	14	14	14
690+/0005/460/..	14	14	14
690+/0007/460/..	12	14	12
690+/0010/460/..	10	12	10

FRAME C Terminal acceptance range: 18-6 AWG			
Model Catalog Code for North America	Power Input AWG	Power Output AWG	Brake Output AWG
230V Build Variant: 220-240V ±10%			
CONSTANT			
690+/0007/230/..	8	10	12
690+/0010/230/..	8	8	12
QUADRATIC			
690+/0007/230/..	8	8	14
690+/0015/230/..	6	6	14
400V Build Variant: 460V ±10%			
CONSTANT			
690+/0007/460/..	12	14	12
690+/0010/460/..	12	12	12
690+/0015/460/..	10	10	12
690+/0020/460/..	8	8	12
QUADRATIC			
690+/0007/460/..	12	12	14
690+/0010/460/..	10	10	12
690+/0015/460/..	8	8	12
690+/0020/460/..	8	8	12

FRAME D Terminal acceptance range: 14-4 AWG			
Model Catalog Code for North America	Power Input AWG	Power Output AWG	Brake Output AWG
230V Build Variant: 220-240V ±10%			
CONSTANT			
690+/0015/230/..	6	6	10
690+/0020/230/..	4	4	10
690+/0025/230/..	4	4	10
QUADRATIC			
690+/0015/230/..	4	4	10
690+/0020/230/..	4	4	10
400V Build Variant: 460V ±10%			
CONSTANT			
690+/0020/460/..	8	8	10
690+/0025/460/..	8	8	10
690+/0030/460/..	8	6	10
690+/0040/460/..	4	6	10
QUADRATIC			
690+/0020/460/..	8	8	10
690+/0025/460/..	8	6	10
690+/0030/460/..	6	6	10
690+/0040/460/..	4	4	10

FRAME E Terminal acceptance range: 6-1/0 AWG			
Model Catalog Code for North America	Power Input AWG	Power Output AWG	Brake Output AWG
230V Build Variant: 220-240V ±10%			
CONSTANT			
690+/0030/230/..	2	3	8
QUADRATIC			
690+/0030/230/..	1/0	1	8
400V Build Variant: 460V ±10%			
CONSTANT			
690+/0040/460/..	4	4	8
690+/0050/460/..	4	3	8
690+/0060/460/..	3	2	8
QUADRATIC			
690+/0040/460/..	4	3	8
690+/0050/460/..	3	2	8
690+/0060/460/..	1	1	8

FRAME F Terminal acceptance range: 2AWG-250kcmil			
Model Catalog Code for North America	Power Input AWG	Power Output AWG	Brake Output AWG
230V Build Variant: 220-240V ±10%			
CONSTANT			
690+/0040/230/..	1	1	8
690+/0050/230/..	2/0	2/0	8
690+/0060/230/..	3/0	3/0	8
QUADRATIC			
690+/0040/230/..	2/0	2/0	8
690+/0050/230/..	3/0	3/0	8
690+/0060/230/..	4/0	250kcmil	8
400V Build Variant: 460V ±10%			
CONSTANT			
690+0075/460/..	1	1	8
690+0100/460/..	2/0	2/0	8
690+0125/460/..	3/0	3/0	8
690+0150/460/..	4/0	4/0	8
QUADRATIC			
690+0075/460/..	2/0	2/0	8
690+0100/460/..	3/0	3/0	8
690+0125/460/..	4/0	4/0	8
690+0150/460/..	4/0	4/0	8

Field Grounding Terminals

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

Operating Ambient Temperature

Constant Duty	Open Type	Cubicle Mounted	45°C
	UL Type 1 Enclosed	Wall Mounted with top cover	40°C
Quadratic Duty	Open Type	Cubicle Mounted	40°C
	UL Type 1 Enclosed	Wall Mounted with top cover	35°C

Direct Wall-Mountable Models

All models of this drive with a Product Code Block 6 (Frame B) or Block 4 (Frames C, D, E) designation xx2x are suitable for direct wall mounting applications as they have a "Type 1 Enclosure" rating.

In order to preserve this enclosure rating, it is important to maintain the environmental integrity of the enclosure. Therefore, the installer must provide correct Type 1 closures for all unused clearance holes provided within the drive's glandplate.

Type 1 Enclosed models are suitable for use in no worse than a Pollution Degree 2 environment.

Input Fuse Ratings (North America)

c UL us LISTED

Catalog Number	Input Fuse Rating (A)		Catalog Number	Input Fuse Rating (A)	
	Constant	Quadratic		Constant	Quadratic
230V BUILD VARIANT 220-240V ±10%, 45-65Hz *					
Frame B			**Frame C**		
690+/0001/230../1	15	-	690+/0007/230..	30	35
690+/0002/230../1	25	-	690+/0010/230..	35	50
690+/0003/230../1	30	-			
690+/0001/230..	10	-			
690+/0002/230..	15	-			
690+/0003/230..	15	-			
690+/0005/230..	25	-			
Frame D			**Frame E**		
690+/0015/230..	50	60	690+/0030/230..	100	125
690+/0020/230..	60	70			
690+/0025/230..	70	-			
Frame F					
690+/0040/230..	110	150			
690+/0050/230..	150	150			
690+/0060/230..	150	200			
400V BUILD VARIANT 380-460V ±10%, 45-65Hz *					
Frame B			**Frame C**		
690+0001/460/..	6	-	690+/0007/460/..	15	20
690+0002/460/..	10	-	690+/0010/460/..	20	25
690+0003/460/..	10	-	690+/0015/460/..	25	30
690+0005/460/..	15	-	690+/0020/460/..	35	40
690+0007/460/..	20	-			
690+0010/460/..	25	-			
Frame D			**Frame E**		
690+/0020/460/..	30	40	690+/0040/460/..	60	70
690+/0025/460/..	40	45	690+/0050/460/..	70	90
690+/0030/460/..	45	60	690+/0060/460/..	90	100
690+/0040/460/..	60	70			
Frame F					
690+/0075/460/..	110	125			
690+/0100/460/..	125	150			
690+/0125/460/..	150	175			
690+/0150/460/..	175	175			
* Note : Frame B only is 50Hz ±5% or 60Hz ±5%					

European Directives and the CE Mark

The following information is supplied to provide a basic understanding of the EMC and low voltage directives CE marking requirements. The following literature is recommended for further information:

- *Recommendations for Application of Power Drive Systems (PDS), European Council Directives - CE Marking and Technical Standardisation* - (CEMEP)

  Available from your local trade association or Parker SSD Drives office

The European machines and drives manufacturers via their national trade associations have formed the European Committee of Manufacturers of Electrical Machines and Power Electronics (CEMEP). Parker SSD Drives and other major European drives manufacturers are working to the CEMEP recommendations on CE marking. The CE mark shows that a product complies with the relevant EU directives, in our case the Low Voltage Directive and, in some instances, the EMC Directive.

CE Marking for Low Voltage Directive

When installed in accordance with this manual, the 690+ AC Drive is CE marked by Parker SSD Drives 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***.
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***.

■ *Relevant Apparatus* - Parker SSD Drives Responsibility

Occasionally, say in a case where an existing fixed speed motor - such as a fan or pump - is converted to variable speed with an add-on drive module *(relevant apparatu*s), it becomes the responsibility of Parker SSD Drives to apply the CE mark and issue an EC Declaration of Conformity for the EMC Directive. This declaration and the CE mark is included at the end of this chapter.

■ *Component* - Customer Responsibility

The majority of Parker SSD Drives' products are classed as *components* and therefore we cannot apply the CE mark or produce an EC Declaration of Conformity in respect of EMC. It is therefore the manufacturer/supplier/installer of the higher system/apparatus or machine who must conform to the EMC directive and CE mark.

Legal Requirements for CE Marking

IMPORTANT: Before installation, clearly understand who is responsible for conformance with the EMC directive. Misappropriation of the CE mark is a criminal offence.

It is important that you have now defined who is responsible for conforming to the EMC directive, either:

■ Parker SSD Drives Responsibility

You intend to use the unit as *relevant apparatus.*

When the specified EMC filter is correctly fitted to the unit following EMC installation instructions, it complies with the relevant standards indicated in the following tables. The fitting of the filter is mandatory for the CE marking of this unit to apply.

The relevant declarations are to be found at the end of this chapter. The CE mark is displayed on the EC Declaration of Conformity (EMC Directive) provided at the end of this chapter.

■ Customer Responsibility

You intend to use the unit as a *component,* therefore you have a choice:

1. To fit the specified filter following EMC installation instructions, which may help you gain EMC compliance for the final machine/system.
2. Not to fit the specified filter, but use a combination of global or local filtering and screening methods, natural migration through distance, or the use of distributed parasitic elements of the existing installation.

Note: *When two or more EMC compliant components are combined to form the final machine/system, the resulting machine/system may no longer be compliant, (emissions tend to be additive, immunity is determined by the least immune component). Understand the EMC environment and applicable standards to keep additional compliance costs to a minimum.*

Applying for CE Marking for EMC

We have supplied a Manufacturer's EMC Declaration at the end of this chapter that you can use as a basis for your own justification of overall compliance with the EMC directive. There are three methods of demonstrating conformity:

1. Self-certification to a relevant standard
2. Third party testing to a relevant standard
3. Writing a technical construction file stating the technical rationale as to why your final machine/system is compliant. An EMC "competent body" must then assess this and issue a technical report or certificate to demonstrate compliance.
   Refer to Directive 2004/108/EC.

With EMC compliance, an EC Declaration of Conformity and the CE mark will be issued for your final machine/system.

IMPORTANT: Professional end users with EMC expertise who are using drive modules and cubicle systems defined as components who supply, place on the market or install the relevant apparatus must take responsibility for demonstrating EMC conformance and applying the CE mark and issuing an EC Declaration of Conformity.

Which Standards Apply?

Power Drive Product Specific

The standards that may apply to this unit come under two broad categories:

1. Emission - these standards limit the interference caused by operating (this) drive module.
2. Immunity - these standards limit the effect of interference (on this unit) from other electrical and electronic apparatus.

Conformance can be demonstrated using the Product Specific Standard.

Certificates

690P

EC DECLARATIONS OF CONFORMITY

Date CE marked first applied: 01.04.2000

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

EMC Directive

In accordance with the EEC Directive

2004/108/EC

We Parker SSD Drives, 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

Low Voltage Directive

In accordance with the EEC Directive

2006/95/EC

We Parker SSD Drives, 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 :-

EN50178

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

MANUFACTURERS DECLARATIONS

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

EMC Declaration

We Parker SSD Drives, 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

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 89/392/EEC 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.

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.



Dr Martin Payn (Conformance Officer)

* *Compliant with the immunity requirements of the Standard without specified EMC filters.*
* *690PB only when fitted with an internal or external filter.*

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Chapter 10 APPLICATION NOTES

Application advice is available through our Technical Support Department, who can also arrange for on-site assistance if required. Refer to the back cover of this manual for the address of your local Parker SSD Drives company.

- Always use gold flash relays, or others designed for low current operation (5mA), on all control wiring.
- Remove all power factor correction equipment from the motor side of the drive before use.
- Avoid using motors with low efficiency and small cos ø (power factor) as they require a larger kVA rated drive to produce the correct shaft kW.

Synchronous Motor Control

Although intended primarily for use with induction (asynchronous) motors, drives can also be used for speed control of synchronous motors. Synchronous motors can offer economic solutions in applications where tight control of speed is required together with the low maintenance characteristics of an ac motor.

The two most common types of synchronous ac motor are *permanent magnet* and *wound rotor*.

In contrast to induction motors, synchronous motors run at synchronous speed whether on full load or no load. Synchronous speed is set by the frequency of the supply applied to the stator. The stator flux can be kept constant by keeping the stator volts/frequency ratio constant, as with an induction motor.

Torque is produced in the motor by an increase in load angle between the stator and rotor fluxes. Maximum torque occurs when the load angle approaches 90°. If the load angle exceeds this value then torque drops and the motor will stall. Systems involving synchronous motors need careful design to ensure that the motor can accelerate the load and handle transient load changes without stalling.

Brake Motors

Brake motors are used in applications requiring a mechanical brake for safety or other operational reasons. The motor can be a standard induction motor fitted with an electro-mechanical brake, or it could be a special conical rotor machine. In the case of a conical rotor machine the spring-loaded brake is controlled by the motor terminal voltage as follows:

- At rest the motor is braked.
- When the motor is energised an axial component of the magnetic field due to the conical air-gap overcomes the force of the brake spring and draws the rotor into the stator. This axial displacement releases the brake and allows the motor to accelerate like a normal induction motor.
- When the motor is de-energised the magnetic field collapses and the brake spring displaces the rotor, pushing the brake disc against the braking surface.

Drives can be used to control the speed of conical rotor brake motors since the linear V/F characteristic maintains the motor magnetic field constant over the speed range. It will be necessary to set the FIXED BOOST parameter to overcome motor losses at low speed (see FLUXING menu at level 3).

Using Line Chokes

Line chokes are not required to limit input current to Parker SSD Drives Inverters. Controllers from 5.5kW (400v) or 2.2kW (230v) upwards are fitted with DC link chokes to limit the ripple current seen by the DC link capacitors and thus prolong their life.

Line chokes may be used to reduce the harmonic content of the supply current where this a particular requirement of the application or where greater protection from mains borne transients is required.

Using Output Contactors

The use of output contactors is permitted. It is recommended that this type of operation be limited to emergency use only or in a system where the drive can be inhibited before closing or opening this contactor.

Using Motor Chokes

Installations with motor cable runs in excess of 50m may suffer from nuisance overcurrent trips. This is due to the capacitance of the cable causing current spikes to be drawn from the drive output. A choke may be fitted in the drive output which limits the capacitive current. Screened cable has a higher capacitance and may cause problems in shorter runs. The recommended choke values are shown in Table 13.1.

Motor Power (kW)	Choke Inductance	RMS Current Rating	Parker SSD Part No.
0.75	2mH	7.5A	CO055931
1.1			
1.5			
2.2			
4.0	0.9mH	22A	CO057283
5.5			
7.5			
11	0.45mH	33A	CO057284
15			
18	0.3mH	44A	CO057285
22	50µH	70A	CO055193
30			
37	50µH	99A	CO055253
45	50µH	99A	CO055253
55	50µH	243A	CO057960
75	50µH	360A	CO387886
90	50µH	360A	CO387886
110	50µH	360A	CO387886

Table Chapter 10 -1 Recommended Choke Values for Cables up to 300 Metres

Using Multiple Motors on a Single Drive

A single large drive can be used to supply several smaller motors provided that each individual motor has overload protection.

Note: *Conventional V/F control strategy must be enabled for use with parallel motors. (Sensorless vector control strategy cannot be used). See the VECTOR ENABLE parameter under VECTOR SET-UP menu at level 2.*

The drive must be rated to supply the **total motor current**. It is not sufficient to simply sum the power ratings of the motors, since the drive has also to supply the magnetising current for each motor.

Note that the overload device will not prevent the motor overheating due to inadequate cooling at low speed. Force vented motors may be required; consult your motor supplier.

WARNING!
All motors should be connected to the drive output before the START command is given.

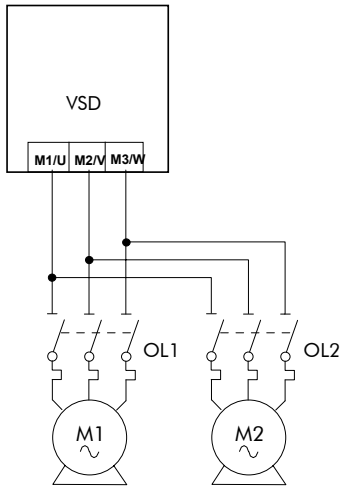


Figure Chapter 10 -1 Single Drives supplying multiple Motors

Caution
Restrict the total cable length on multiple motor installations as follows:

50 metres with no output choke fitted,
300 metres with choke.

Dynamic Braking

During deceleration, or with an overhauling load, the motor acts as a generator. Energy flows back from the motor into the dc link capacitors within the drive. This causes the dc link voltage to rise. If the dc link voltage exceeds 810V for the 400V build (or 890V for the 500V build) then the drive will trip to protect the capacitors and the drive power devices. The amount of energy that can be absorbed in the capacitors is relatively small; typically more than 20% braking torque will cause the drive to trip on overvoltage. Dynamic braking increases the braking capability of the drive by dissipating the excess energy in a high power resistor connected across the dc link, see above. Refer to the Power Wiring Connection Diagrams in Chapter 3.

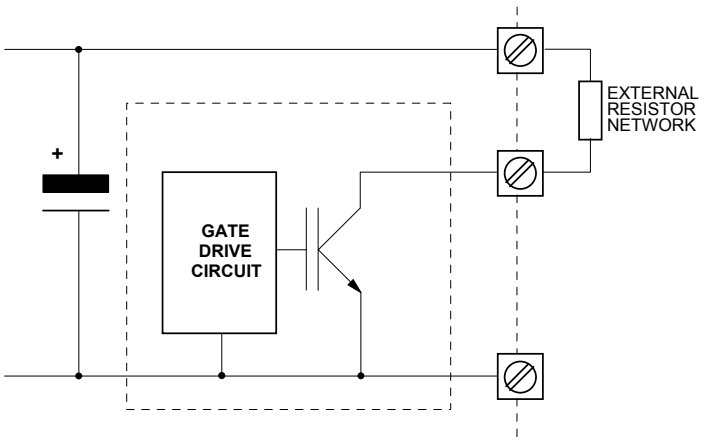


Figure Chapter 10 -2 Dynamic Braking Circuit

The Dynamic Braking Option is a PCB with an extra IGBT power device fitted. It is fitted inside the drive package and is connected to the negative side of the dc link.

When the dc link voltage rises above that specified for each Frame size (Chapter 8: "Technical Specifications" - Internal Dynamic Brake Switch) the brake unit switches the external resistor network across the dc link. The brake unit switches off again when the dc link voltage falls below the threshold level. The amount of energy produced by the motor during regeneration depends upon the DECEL TIME parameter (refer to the REFERENCE RAMP and DYNAMIC BRAKING function blocks) and the inertia of the load.

Refer to Chapter 3: "Installing the Drive" - External Brake Resistor for brake resistor selection information.

High Starting Torque

Applications requiring high motor starting torque (greater than 100% of rated torque) need careful setup of the drive voltage boost feature. For most motors, a FIXED BOOST parameter (FLUXING function block) setting of 6.0% is usually adequate. Setting the FIXED BOOST parameter level too high can cause the drive current limit feature to operate. If this occurs, the drive will be unable to ramp up in frequency. The IT LIMITING diagnostic (INVERSE TIME function block) will indicate TRUE when the inverse time current limit feature is operating. Simply reducing the level of the FIXED BOOST parameter will remove this problem. It is important to use the minimum level of FIXED BOOST necessary to accelerate the load. Using a level of FIXED BOOST higher than necessary will lead to increased motor heating and increased risk of drive overload.

Note: *Motor torques greater than 100% require high currents to be drawn from the drive. Thus, the CURRENT LIMIT parameter (CURRENT LIMIT function block) will have to be set accordingly such that the drive current limit feature will not activate when accelerating the load.*

The best motor starting performance can be achieved by setting up the SLIP COMP function block, refer to the Software Product Manual: "Programming Your Application" - SLIP COMP. Also setting the BASE VOLTS parameter (VOLTAGE CONTROL function block) to 115.4% and the FREQ SELECT parameter (PATTERN GEN function block) to 3kHz, can help to start difficult loads in the most extreme cases.

Winder Applications

The drive contains function blocks for winder applications, refer to the Software Product Manual, Chapter 5: "Application Macros".

Roll Diameter Calculation Accuracy

With any centre winding system it is most important, under all conditions, that the roll diameter is set within the winder block to accurately match the winding roll.

At Zero Speed

The diameter calculation division will not calculate accurately below a certain minimum line speed, and will not calculate at all at zero speed.

If the diameter is not accurately set at zero speed the winder may not start without large changes in web tension. It is therefore most important for good winder performance that the diameter is reset to the correct value before the machine is started. The following diagrams show typical ways to preset the roll diameter.

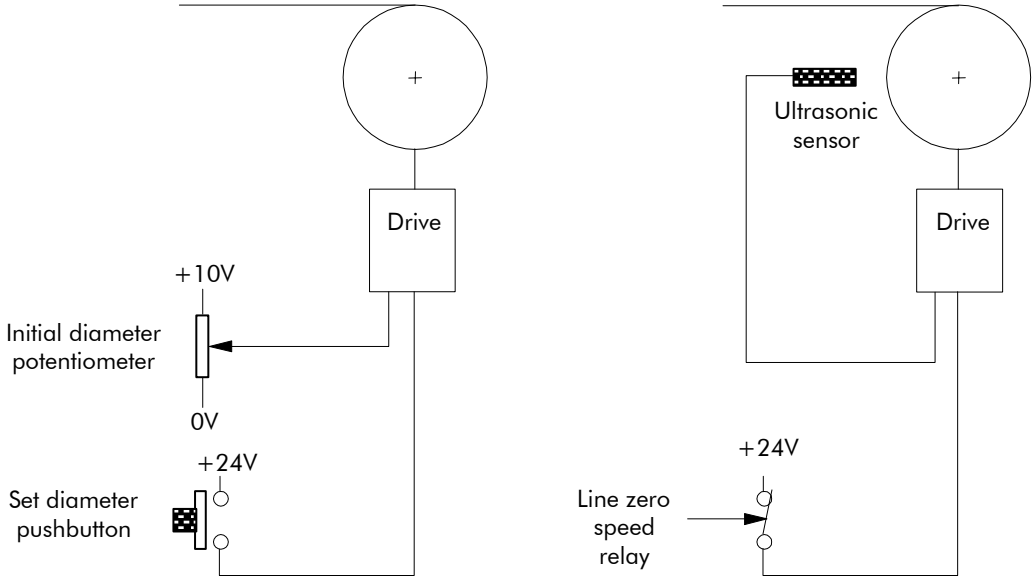


Figure Chapter 10 -3 Roll Diameter

The left hand diagram above shows a simple, low accuracy way of pre-setting the roll diameter. Here, a potentiometer is used by the machine operator to set the roll diameter. The potentiometer is scaled such that 10V is 100% diameter. When the push button is pressed, the diameter calculator is preset to the potentiometer value. The push button should be suitably interlocked with the line drive so that the diameter cannot be preset when the machine is running.

The right hand diagram shows a more accurate method where the diameter is measured using an ultrasonic sensor. This measurement technique is especially useful for unwind applications where the diameter of the incoming roll is not known.

Other methods such as mechanical diameter followers, or lay on arms can be useful to provide the diameter signal. The requirements here are correct scaling and linearity over the diameter range.

It is also important to preset the diameter accurately in the case of twin turret winders. Here, the diameter should be accurately preset using either diameter measurement in the case of unwinds, or fixed potentiometers corresponding to the core diameters in the case of rewinds. The setting of the diameter will determine the speed match of the new roll in relation to the line speed.

The winder block diameter calculator is frozen below a Line Reference threshold, set by the MINIMUM SPEED parameter (DIAMETER CALC function block). The default value for this parameter in the Winder macro is set at 5%. This is satisfactory for most line speeds and diameter build-up ratios. The MINIMUM SPEED parameter must not be reduced significantly as diameter errors may result at low line speeds.

When Running

Since the winder block calculates the roll diameter using a division of the Line Reference and Winder Speed feedback signals, it is important that these signals are accurate.

Ideally, in order to improve accuracy, the diameter calculation signals need to be the actual speeds of the line and winder. The reel speed reference however, needs to be driven from the Line Reference in order to give good acceleration performance for the winder.

The following diagram shows the Line Reference and Line Speed signals used to give an improved accuracy winder.

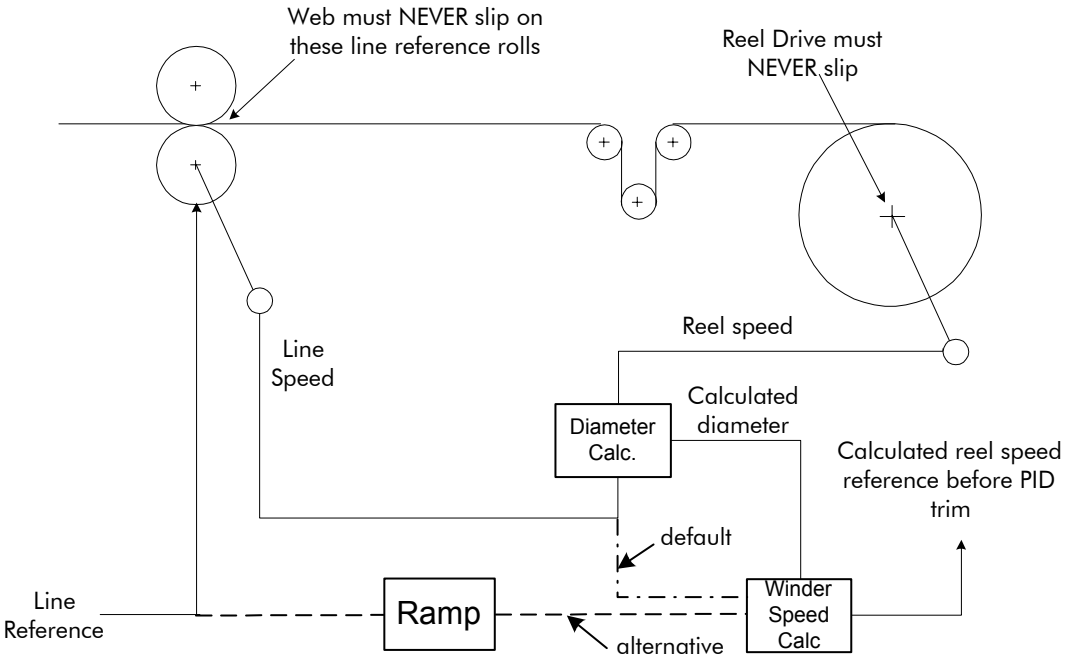


Figure Chapter 10 -4 Line Reference and Line Speed

By default, Line Speed is connected to ANIN 1 and is used both as Line Reference and Line Speed.

Alternatively, a separate analog input for Line Reference may be used for the winder speed calculation.

If an analog tach is used for Line Speed, it must be scaled ±10V full scale.

Note: *It is most important for centre wind systems that the web does not slip on the line reference rolls. Also the reel drive must never slip.*

If slipping does occur, the diameter calculator will not be accurate, and very poor winder performance will result.

Basic Set-up Instruction

This section describes the operations required to set up drives containing the closed loop winder blocks.

Two different types of closed loop winders are described above, but the basic steps required to set up the drive are very similar in both cases.

If the drive is configured using the display and keys, it is important to ensure that the parameters of the drive are saved to the application on a regular basis. If this is not done, parameters adjusted during the following set-up may be lost if the auxiliary supply to the drive fails.

Information Required

The following information is required from the winding machine manufacturer in order to set up the winder blocks:

- Absolute minimum roll diameter.
- Absolute maximum roll diameter.
- Absolute maximum line speed.
- Motor maximum speed, at smallest roll diameter and maximum line speed.

Set-up with no Web connected to the Winder

The majority of the drive set-up should be performed without web connected to the centre winder. This allows the winding spindle to rotate freely, without being restrained by the web.

Before configuring the Closed Loop centre winder load the Winder macro, refer to the Software Product Manual, Chapter 5: “Application Macros”.

DIAMETER CALC Function Block

Set the MINIMUM DIAMETER parameter with the drive stopped.

This value can be calculated, knowing the absolute maximum and minimum roll diameters and applying the equation:

$$\text{Min Diameter} = \frac{\text{Smallest core diameter}}{\text{Maximum roll diameter}} \times 100\%$$

It is important that the absolute maximum range of diameter is used when calculating the minimum diameter parameter.

Commission the Drive Control Loops

Since the winder blocks are equally applicable for Unwind and Rewind applications the following convention for the sign of the various set points and the direction of rotation, is useful:

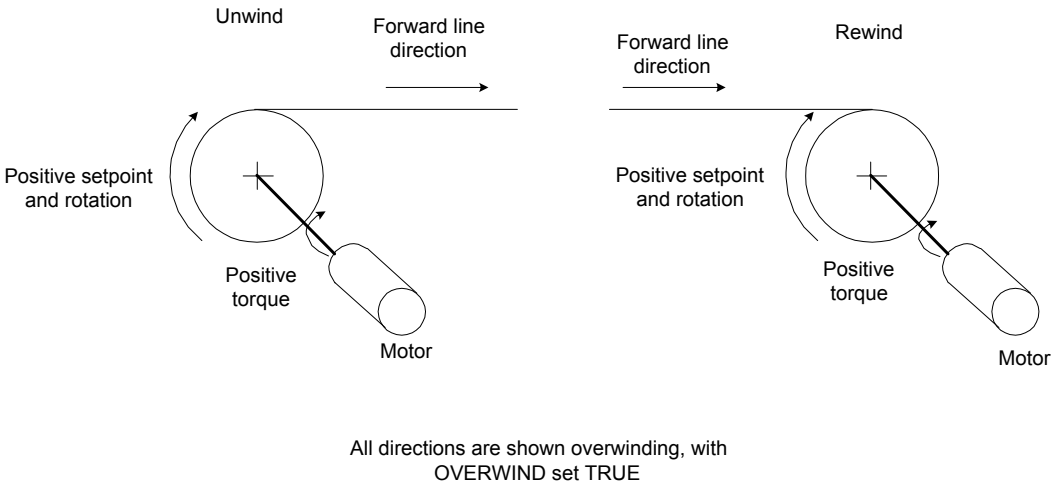


Figure Chapter 10 -5 Conventions

Equations

The following equations are used to determine motor torque and power requirements.

Simple Centre Winder Equations

It is assumed that the winders operate in constant tension mode.

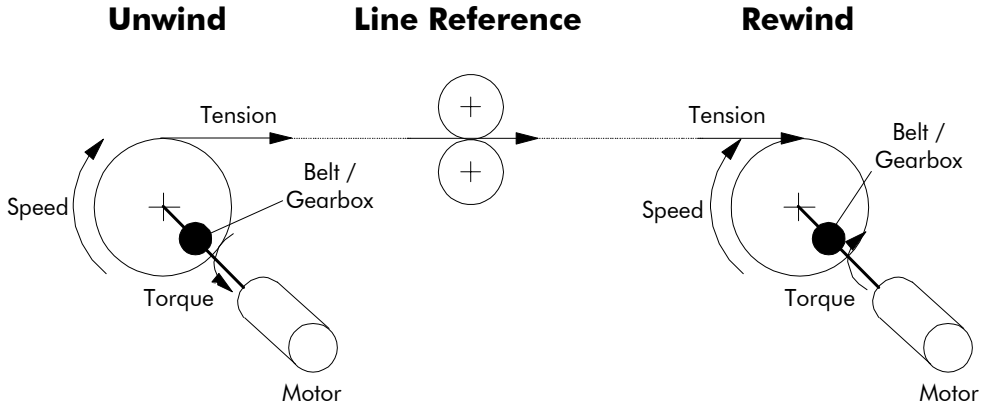


Figure Chapter 10 -6 Constant Tension Winder

Metric Units

The following SI units are used to produce the equations shown below.

Tension - Kilograms force (kgf)

Torque - Newton Metres (Nm)

Line Speed - Metres/Sec (MS-1)

Line accel - Metres/Sec2 (MS-2)

Rotation speed - RPM (RPM)

Roll Diameter - Metres (M)

Power - KWatt (kW)

Mass - kg (kg)

Motor Power

The following diagram shows the motor and roll powers at maximum line speed compared to roll speed.

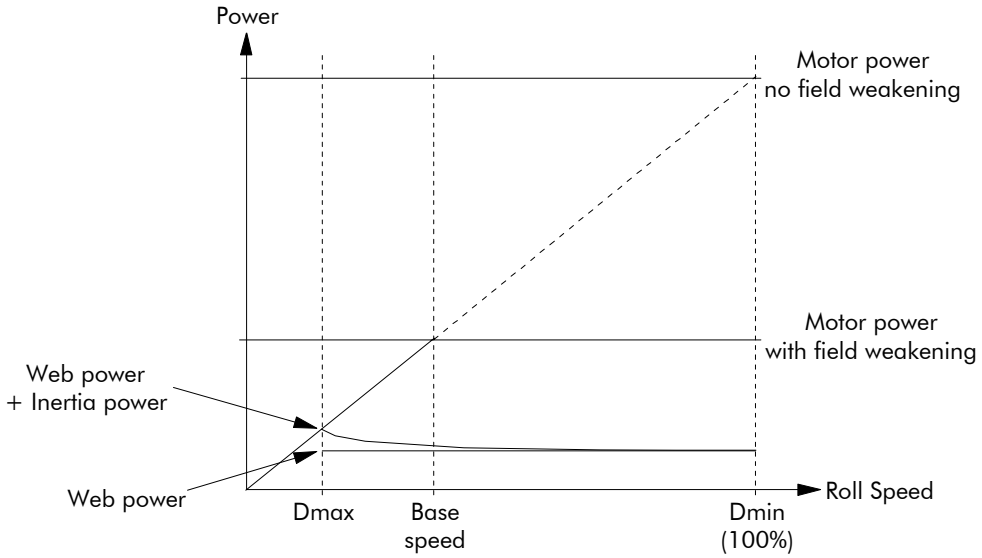


Figure Chapter 10 -7 Motor Power

The above graph is for the case of constant tension. Friction is ignored.

$$Power_{Web} = \frac{Tension \times Max\,Line\,Speed}{101.94}\,kW$$

$$Power_{Inertia} = \frac{Roll\,Mass \times Max\,Line\,Accel \times Max\,Line\,Speed}{2000}\,kW$$

$$Power_{Friction} = \frac{Motor\,Max\,Speed}{9549} \times Motor\,Torque_{Friction}\,kW$$

Using the above individual roll powers

$$Power_{Roll} = Power_{Web} + Power_{Inertia} + Power_{Friction}\,kW$$

Referring to a motor with field weakening

$$\therefore Power_{Motor} = \left\{ \left(Power_{Web} + Power_{Inertia} \right) \times \frac{Diameter\,Build\,Up}{Cons\tan t\,Power\,Range} \right\} + Power_{Friction}\,kW$$

Here, the Constant Power Range is the motor field weakening range.

This parameter is 1 if no field weakening.

Motor Torque

The worst case motor torque will exist for the following conditions:

Maximum roll diameter

Maximum acceleration rate

Maximum roll width

Maximum material tension

Maximum roll mass

$$\text{Torque}_{\text{Tension}} = \text{Tension} \times \text{Roll Diameter} \times 4.905$$

Assuming the roll is a solid cylinder

$$\text{Torque}_{\text{Inertia}} = \frac{\text{Roll Mass} \times \text{Line Accel} \times \text{Roll Diameter}}{4}$$

$$\text{Torque}_{\text{Roll}} = \text{Torque}_{\text{Tension}} + \text{Torque}_{\text{Inertia}}$$

$$\therefore \text{Torque}_{\text{Motor}} = \frac{\text{Torque}_{\text{Roll}}}{\text{Ratio}_{\text{Gearbox}}} + \text{Torque}_{\text{Friction}}$$

Motor Speed

The maximum motor speed will exist under the following conditions:

Maximum line speed

Smallest core diameter

Maximum gearbox ratio

$$\text{Speed}_{\text{Roll}} = \frac{\text{Speed}_{\text{Line}}}{\text{Diameter}} \times 19.1 \text{ RPM}$$

$$\therefore \text{Speed}_{\text{Motor}} = \text{Speed}_{\text{Roll}} \times \text{Ratio}_{\text{Gearbox}} \text{ RPM}$$

2-Q Common DC Bus Applications

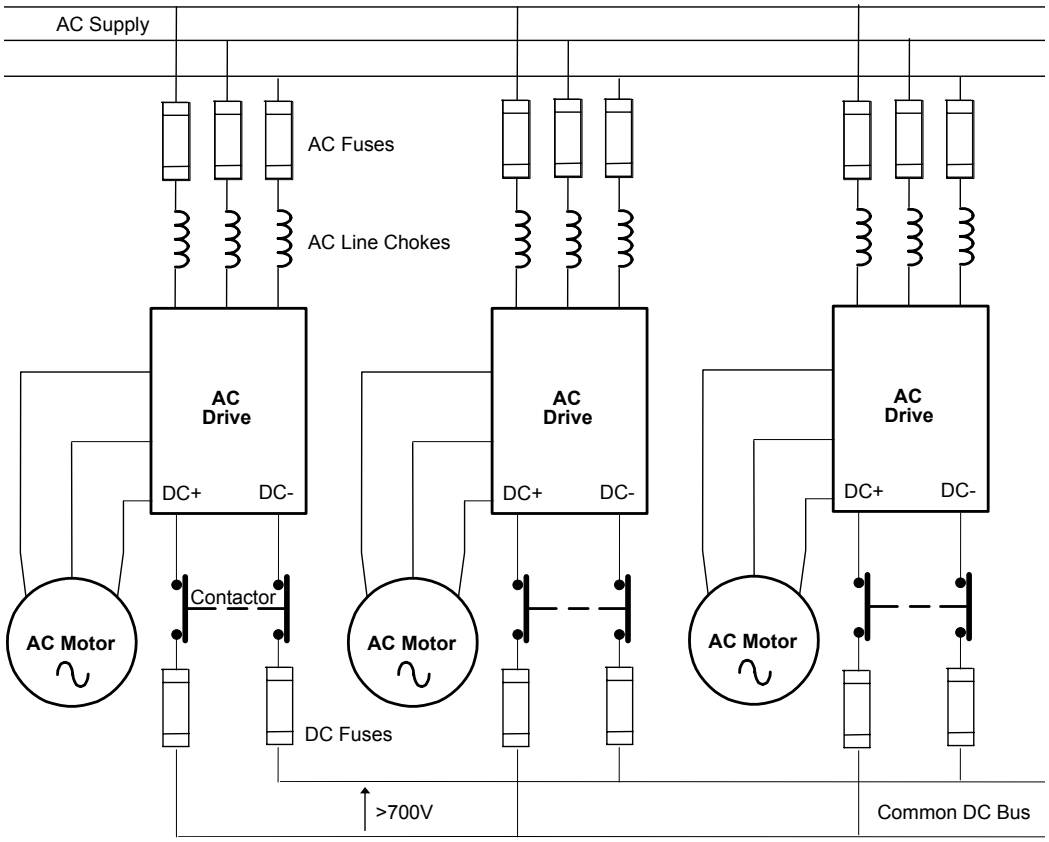
Using a common DC bus allows regenerative energy to be shared between the drives on the system, improving efficiency.

Two Options are shown below. Both options are single-ended, i.e. no power is returned from the control system to the mains. It is redistributed throughout the system, resulting in less drain from the supply.

Note: *The choice of option will depend upon the application and different quantities/powers of inverters, to provide the greatest efficiency.*

OPTION 1

Small numbers of drives can be coupled together on both the AC supply side and DC bus side.



Considerations

- AC fuses should be fast-acting. Ideally, add fuse monitoring to shut down the total system in the event of any AC fuse failure.
- AC line chokes must be fitted (minimum 3% per unit impedance). Use the following formula to derive the value of inductance required to satisfy the per unit impedance requirement:

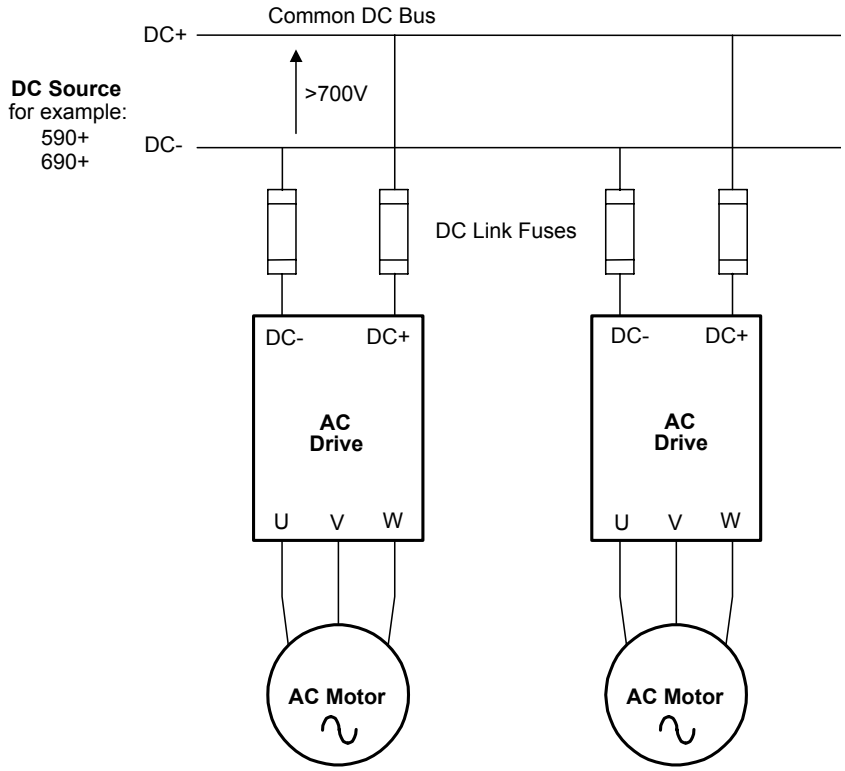
$$\frac{\text{LINE VOLTS}}{\text{363 x INPUT CURRENT (A) x FREQUENCY (Hz)}} = \text{INDUCTANCE (H)}$$

where $363 = (2 \times \pi \times \sqrt{3} \times 100) / 3$

- Sequence contactors so that the AND of all the DRIVE READY signals starts a short timer which in turn closes all the contactors together. The contactors should not be opened until line stop, not even under fault conditions.
- Because the drives are fed from the AC side, clearing of the DC fuses may not present a run-threatening situation. The drives will remain functional unless the isolated drive regenerates power. Consider using indicating fuses, especially if a drive is permanently regenerating.

OPTION 2

The drives are coupled together on the DC bus side only. The drives AC inputs are unused.



Considerations

- The DC Source must be correctly rated to match the maximum power to be imported into the system. Use the following formula which takes into account form factor and efficiency:

$$\text{DC CURRENT (DC A)} >= \frac{2000 \times SP}{V_L}$$

where: SP = Supply Power (kW)
V_L = Supply Line Volts (V)

- Fit DC link fusing to protect cabling to each drive.

Check the voltage rating of any DC link components. Voltages >700V are common.

4-Q Regen Control/Common DC Bus Applications

Introduction

A **4-Q REGEN** (4 Quadrant Regenerative) control mode is available on all 690+ Series AC Drives that :

- use Software Version 5.1 or greater

  AND

- display "/007" in Block 12 of the (Europe) Product Code, indicating that Special Option 7 is applied ("Y" cap disconnection)

IMPORTANT: All drives in a common DC link scheme using a 4-Q Regen front-end must have their internal "Y" caps to earth (PE) removed.

The **4-Q REGEN** control mode allows a single 690+ to act as a 4-Q power supply unit that is capable of drawing (motoring) and supplying (regenerating) sinusoidal, near-unity power factor current from the supply.

The output from the 4-Q Regen drive acts as a DC supply which is used to power other drives on a common DC Bus system.

Advantages

Using the 690+ as a 4-Q power supply in common DC Bus schemes provides the following advantages:

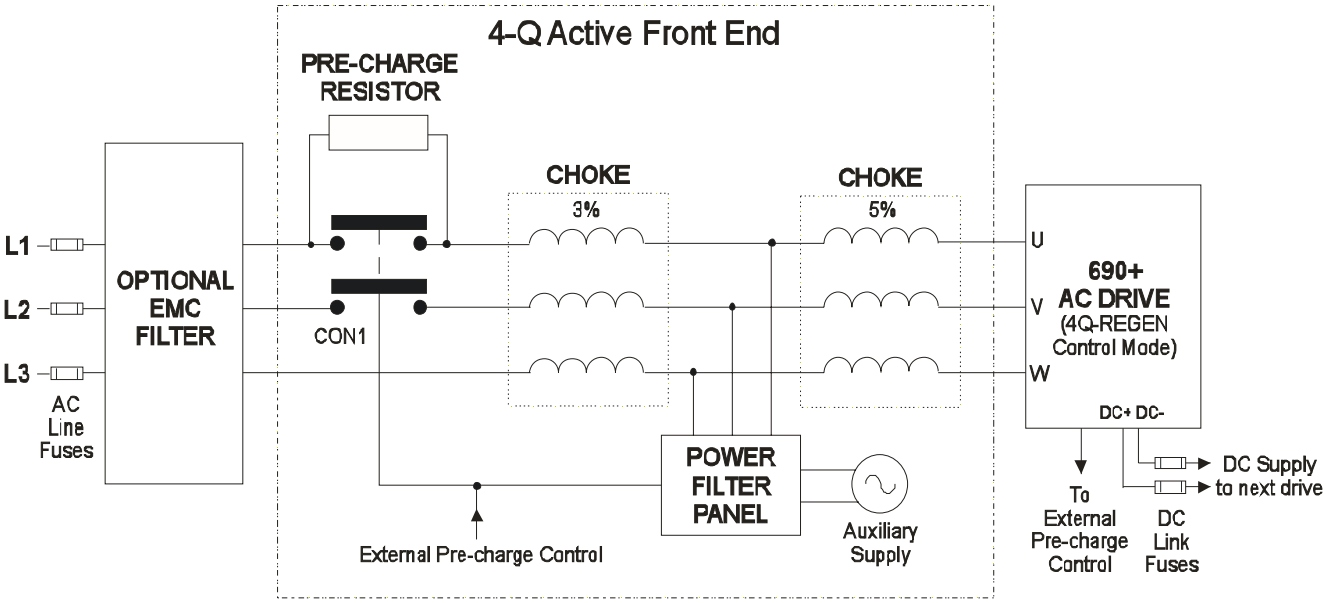
- Simplified approach to Common DC Link systems
- Allows standard 690+ drive to act as 4-Q DC Link power supply unit
- Near-sinusoidal supply currents (Motoring and Regenerating)
- Near-unity power factor operation (0.99 or better)
- Low supply harmonics currents (helps to meet G5/4 and IEEE519)

WARNING!

690+ AC Drives operating in **4-Q REGEN** control mode are **NOT** suitable for use on systems where the mains supply (L1, L2, L3) is provided by a generator (where the supply cannot absorb the regenerated current).

4-Q Active Front End

The 4-Q Regen drive requires the following 4-Q Active Front End:



Notes:

Contactor CON1 is rated to match the 4-Q power supply drive current (AC1 rating)
The 3% and 5% line chokes are custom designed for this application. Refer to page 10-22
The 4-Q Active Front End connects to the U, V, W terminals on the 4Q-Regen Drive

Power Filter Panel				
Frame	**kW**	**Volts**	**Part Number 110V fans + control**	**Part Number 230V fans + control**
B	4	230	LA482467U004	LA482470U004
C	7.5	230	LA482467U011	LA482470U011
D	18.5	230	LA482467U018	LA482470U018
E	22	230	LA482467U030	LA482470U030
F	45	230	LA482467U055	LA482470U055
B	6	400	LA482468U006	LA482471U006
C	15	400	LA482468U018	LA482471U018
D	30	400	LA482468U037	LA482471U037
E	45	400	LA482468U055	LA482471U055
F	90	400	LA482468U110	LA482471U110
G	180	400	LA482468U220	LA482471U220
H	280	400	LA482468U315	LA482471U315
J	315	400	LA482468U355	LA482471U355
B	6	500	LA482469U006	LA482472U006
C	15	500	LA482469U018	LA482472U018
D	30	500	LA482469U037	LA482472U037
E	45	500	LA482469U055	LA482472U055
F	90	500	LA482469U110	LA482472U110
G	180	500	LA482469U220	LA482472U220
H	280	500	LA482469U315	LA482472U315
J	315	500	LA482469U355	LA482472U355

EMC Filtering

We recommend all 690+ Regen systems meet the EMC product specific standard EN61800-3. To achieve this, an EMC filter is required. Refer to Chapter 8 for details of suitable filters.

Contactor and Fusing

- Use AC Line Fuses to protect the 4-Q Regen drive. These fast, semiconductor protection fuses must be capable of withstanding the system AC supply voltage. Refer to "Input Fuse Ratings" in Chapter 8.

- The AC contactor, CON1, used in the external pre-charge circuit must have an AC1 or thermal rating of the constant torque current rating of the 4-Q Regen drive. Refer to page 10-21.

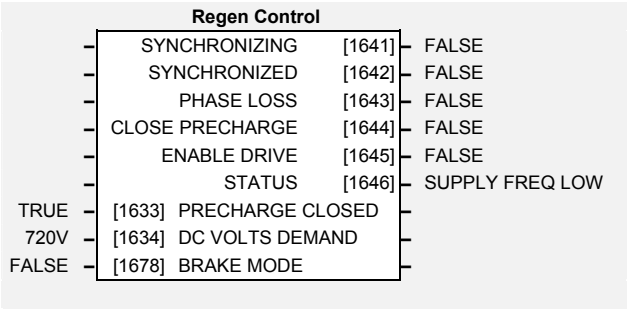
- Use DC Link fuses in both the DC+ and DC- lines to protect each drive connected to the common DC bus. The fuses must be of suitable current rating and capable of withstanding 1000Vdc . Although HRC fuses would be adequate, the high DC voltage requirement (1000Vdc) may limit the choice to semiconductor fuses. Refer to page 10-20.

- The DC contactor used in the Brake Mode system (described on page 10-19) must have an adequate thermal rating for the regen current required. Typically the regen rating of the system, and hence the rating of the DC contactor and fuses, will be less than motoring requirement as the contactor should not open under load.

Drive Set-up

The 690+ drive must be set-up correctly to work in a 4-Q Regen Control/Common DC Bus Application.

Typically a 690+ system will contain a 4-Q Regen drive providing the 4-Q power supply, and one or more 690+ drives on the common DC bus.



Settings

All 690+ Drives

ALL 690+ drives in the system **MUST** have their "Y" caps disconnected (see "Introduction" on page 10-12).

Set the demanded boosted DC link voltage (DC VOLTS DEMAND) appropriately for the drive voltage rating. This is given in the separate table below.

Refer to the Software Product Manual, Chapter 1 for a full description of the REGEN CONTROL function block parameters.

MMI Menu Map
1 SETUP
2 MOTOR CONTROL
3 REGEN CNTROL
DC VOLTS DEMAND

690+ 4-Q Regen Drive:

Load "Macro 8" via the RESTORE CONFIG menu.

Refer to page 10-16 for wiring details.

MMI Menu Map
1 SYSTEM
2 RESTORE CONFIG
RESTORE CONFIG

Set the CONTROL MODE parameter to "4-Q REGEN".

Set the LEAKAGE INDUC parameter to the value of the total line choke inductance. Refer to page 10-23.

MMI Menu Map
1 SETUP
2 MOTOR CONTROL
3 MOTOR DATA
CONTROL MODE
LEAKAGE INDUC

Other 690+ Drives on the Bus

Set the ENABLE parameter in the SLEW RATE LIMIT function block to FALSE. This disables ramp-hold during deceleration on high link volts feature.

MMI Menu Map
1 SETUP
2 MOTOR CONTROL
3 SLEW RATE LIMIT
ENABLE

If in Volts/Hz motor control mode, the VOLTAGE MODE parameter in the VOLTAGE CONTROL function block **MUST** be set to FIXED. This will ensure the motor is not overfluxed by the boosted 720V DC Bus. Failure to do this may lead to motor overheating and possible burn out.

MMI Menu Map
1 SETUP
2 MOTOR CONTROL
3 VOLTAGE CONTROL
VOLTAGE MODE

Setting for DC VOLTS DEMAND Parameter

Drive Voltage Rating (V)	Under Volts Trip Level (V)	Over Volts Trip Level (V)	Recommended DC VOLTS DEMAND
380V – 460V	410V	820V	720V
220V – 240V	205V	410V	370V

Macro 8 : 4Q Regen

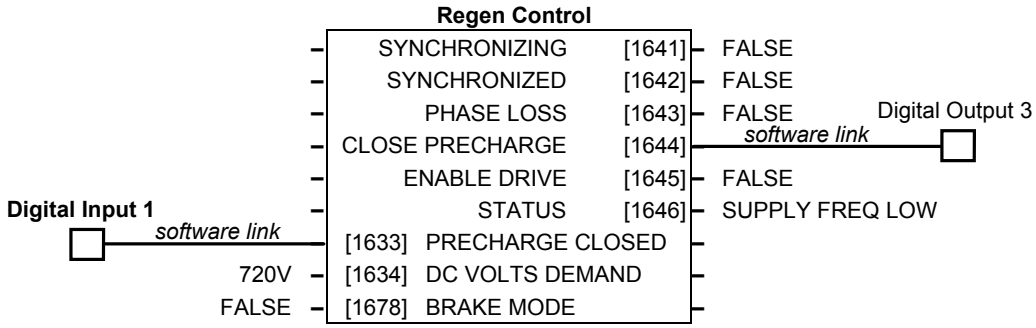
Macro 8 is provided to simplify the set-up of 4-Q Regen systems. A full description of Macro 8 can be found in the Software Product Manual, Chapter 5.

Note: *To use Macro 8, set the CONTROL MODE parameter to "4-Q REGEN", and set the LEAKAGE INDUC parameter to the value of the total line choke inductance (refer to page 10-23), as discussed in "Drive Set-up" page 10-15.*

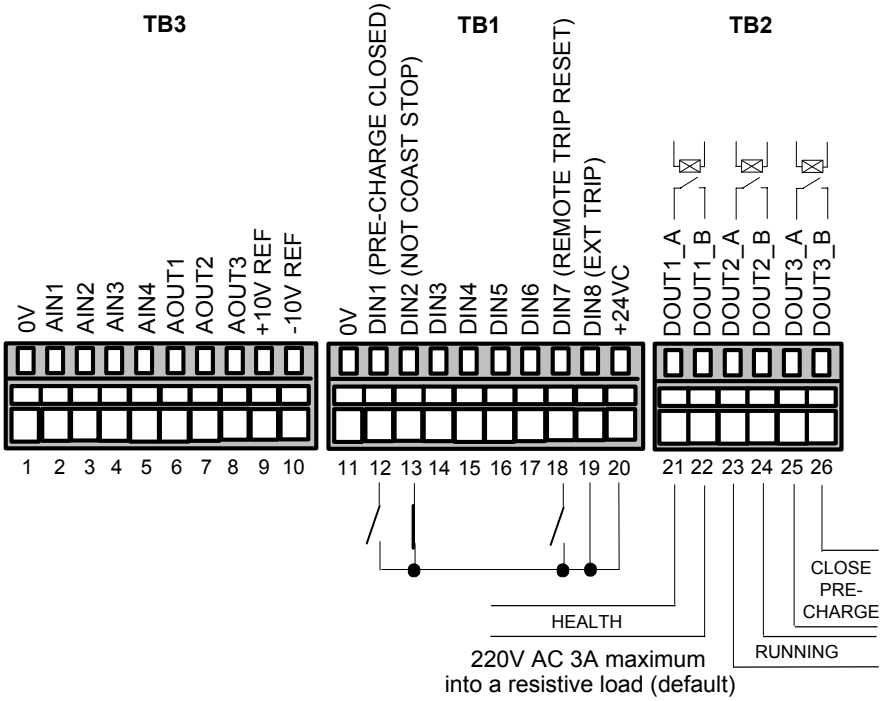
Macro 8 provides the following connections:

- **Digital Input 1** (terminal 12, PRECHARGE CLOSED, Tag 1633) is used to confirm the status of the pre-charge circuit (open or closed). The 4-Q Regen drive is not allowed to synchronise to the mains unless the pre-charge relay is closed and the NOT COAST STOP parameter is True.
- **Digital Input 2** (terminal 13, NOT COAST STOP, Tag 278) is used to run the 4-Q Regen drive.
- **Digital Output 3** (terminals 25 & 26, CLOSE PRECHARGE, Tag 1644) controls the external pre-charge circuit and goes True to close the contactor when DC link volts are established.

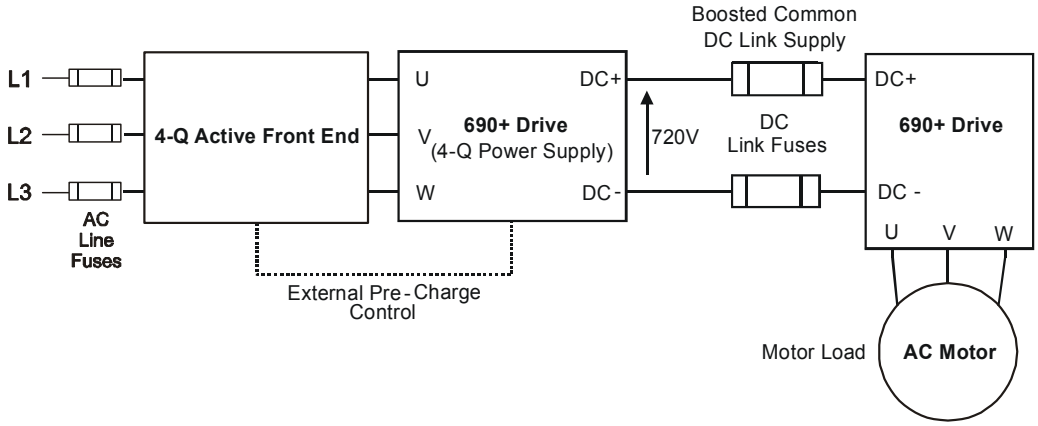
In Macro 8, the Run command is default True. Thus the drive automatically synchronises to the mains when the pre-charge relay closes. Digital Input 2 is used to cause a coast stop in case of emergencies.



Connection Diagram for Macro 8



A Single Motor System



The simplest configuration for 4-Q Regen control is a single 690+ Regen drive acting as the unity power factor supply, connected via the DC link to another 690+ driving the application.

Applications of single motor 4-Q Regen systems include :

- Hoist and Elevators
- Dynamometer test rigs
- Unwind Stands
- Installations that would otherwise require a Harmonic Power Filter

In this system, the two 690+ drives are matched in power. The 4-Q Regen drive supplies the full motoring and regenerating requirement of the load.

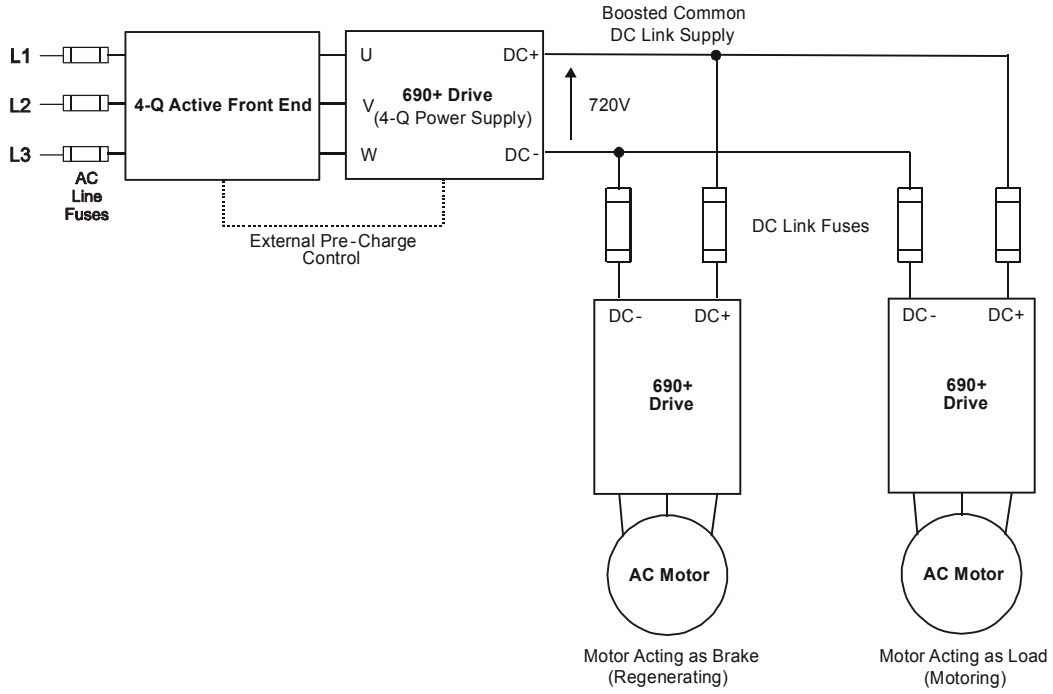
Additional external equipment required by the 4-Q Regen drive includes :

- EMC Filter
- AC Line Fuses
- DC Link Fuses

No extra hardware is required to detect the rotation, frequency and phase of the mains supply. Also, no dynamic braking resistor is required.

When mains power is applied to the 4-Q Regen drive, the DC link slowly charges through the external pre-charge circuit and the drive's internal power supply will start in the normal way. If the 4-Q Regen drive is healthy and the Run signal is applied, it will synchronise to the mains supply (phase, rotation and frequency). This process takes approximately 100ms. After synchronisation, the DC link on the common bus is boosted to approximately 720V (on a 400V product). This high value of DC link volts is required for successful regen operation.

A Multi-Motor System



In many applications, the total power consumed by the system is less than the installed power of the drives. This is because some drives are motoring (eg. winders) and some are regenerating (eg. unwinders). In these situations it is convenient to connect the drives on a common DC link.

In this system, the 4-Q Regen drive supplies the motoring and regenerating requirement of the load.

Additional external equipment required by the 4-Q Regen drive includes :

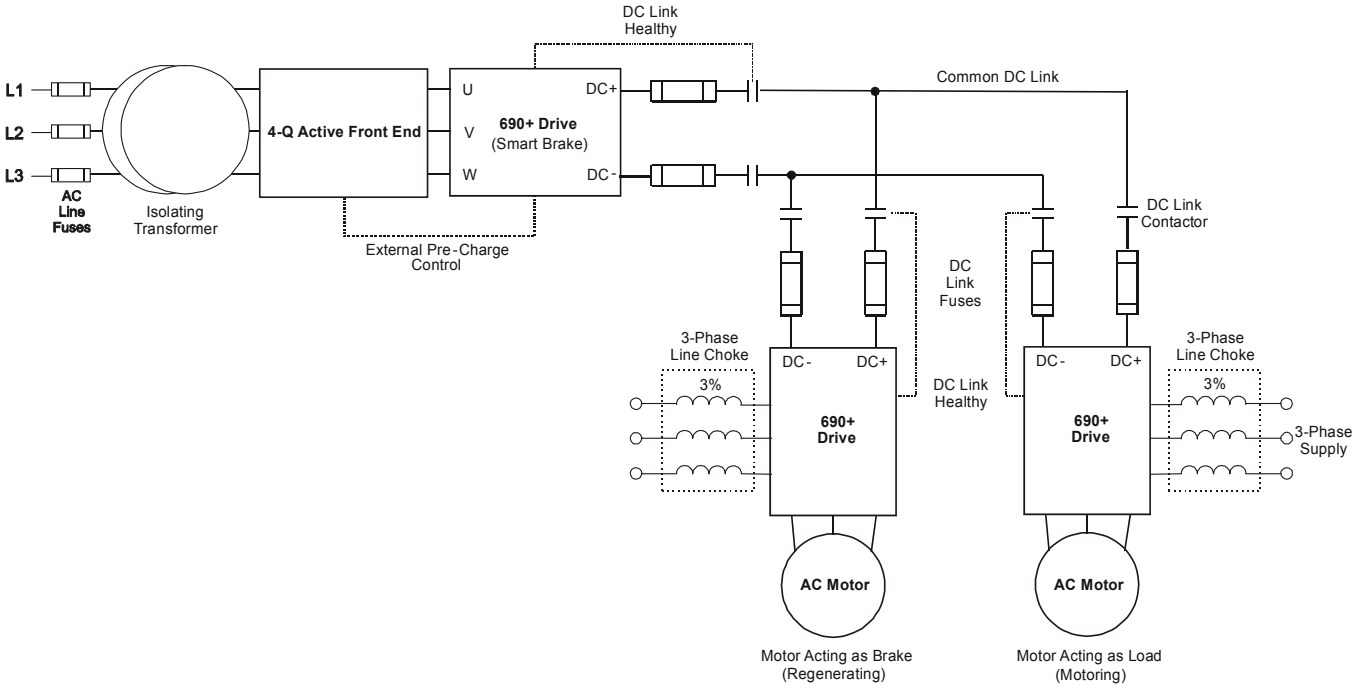
- EMC Filter
- AC Line Fuses
- DC Link Fuses

No extra hardware is required to detect the rotation, frequency and phase of the mains supply. Also, no dynamic braking resistor is required.

The 4-Q Regen drive draws sinusoidal, unity power factor current from the supply and only has to be rated for either the power consumed or supplied by the system, or by the system braking requirements, whichever is the larger.

Dynamic Braking (eg. for Emergency Stopping purposes) can still be used in this control mode if required.

A Smart Brake System



IMPORTANT: It is essential to use an isolation transformer on the supply to the Smart Brake drive, as shown above.

The 4-Q Regen drive can act as a Smart Brake:

MMI Menu Map

1 SETUP
2 MOTOR CONTROL
3 REGEN CNTROL
BRAKE MODE

4-Q Regen Drive:

- In addition to the settings given in "Drive Set-up", page 110-15, set the BRAKE MODE parameter in the REGEN CONTROL function block to TRUE.

In this system, the 4-Q Regen drive supplies the regenerating requirement of the load.

Additional external equipment required by the 4-Q Regen drive includes :

- EMC Filter
- AC Line Fuses
- DC Link Fuses

During motoring operation, the drives on the common link are supplied via their own internal 3-phase diode bridge. The 4-Q Regen drive tracks the mains supply but does not supply motoring power to the common DC Link.

During regeneration, the DC link voltage will rise and trigger the 4-Q Regen drive to return the excess power to the mains (sinusoidal current, unity power factor).

Thus, the 4-Q Regen drive acts as a smart, no loss, Dynamic Brake.

The BRAKE MODE allows the level of regeneration (braking) capacity in the system to be rated differently from the required motoring capacity.

When using the Brake Mode, each drive is responsible for pre-charging its own DC Link. When an individual drive is pre-charged and healthy, it connects itself on to the common DC Bus via a DC contactor.

The drives disconnect from the common bus if a trip occurs.

DC Link Fuses

Below is a list of parts for the DC Link Fuses. Refer to the Electrical Ratings tables for Quadratic Duty motor powers. Select the correct part for the drive's Motor Power.

Motor Power (Constant Duty @ 400V) (kW/Hp)	Frame Size	DC Fuse Rating (A)	DC Fuse Type	Fuse	Fuse Switch	Fuse Holder
0.75/1	B	15	CO89495J	CS481079	CS481099	CS481039
1.5/2	B	15	CO89495J	CS481079	CS481099	CS481039
2.2/3	B	15	CO89495J	CS481079	CS481099	CS481039
4/5	B	15	CO89495J	CS481079	CS481099	CS481039
5.5/7.5	C	40	SO86795J	CS481080	CS481099	CS481039
7.5/10	C	40	SO86795J	CS481080	CS481099	CS481039
11/15	C	40	SO86795J	CS481080	CS481099	CS481039
15/20	D	80	FWP 80BI	CS481081	CS481088	
18.5/25	D	80	FWP 80BI	CS481081	CS481088	
22/30	D	80	FWP 80BI	CS481081	CS481088	
30/40	E	150	IXL70F150	CS481082	CS481088	
37/50	E	150	IXL70F150	CS481082	CS481088	
45/60	E	150	IXL70F150	CS481082	CS481088	
55/75	F	300	IXL70F300	CS481083	CS481088	
75/100	F	300	IXL70F300	CS481083	CS481088	
90/125	F	300	IXL70F300	CS481083	CS481088	
90/150	F	300	IXL70F300	CS481083	CS481088	
110/150	G	350	IXL70F350	CS481084	CS481088	
132/200	G	600	IXL70F600	CS481085	CS481088	
160/250	G	600	IXL70F600	CS481085	CS481088	
200/300	H	600	IXL70F600	CS481085	CS481088	
220/350	H	800	FWP 800AI	CS481086	CS481088	
250/400	H	800	FWP 800AI	CS481086	CS481088	
280/450	H	800	FWP 800AI	CS481086	CS481088	
315/500	J	900	FWP 900AI	CS481087	CS481088	

Pre-Charge Sizing

The external pre-charge contactor is required to carry the full load current rating (including overload) of the 4-Q Regen drive. Thus, it must have an AC1 rating of the Constant Duty current rating of the drive. Refer to the Electrical Ratings tables for Constant Duty motor powers.

We recommend that standard Parker SSD Dynamic Braking resistors are used for the external pre-charge circuit. The continuous and peak power capabilities of these resistors are given below:

Parker SSD Part Nº	Resistance (Ω)	Continuous Power Rating (W)	Peak Power Rating (kW)
CZ389853	100	100	2.5
CZ463068	56	200	5
CZ388396	36	500	12.5

The recommended pre-charge resistor networks are shown in the table below. The table indicates the amount of total DC Link capacitance the network can charge for a given supply voltage.

External Pre-Charge Network	Continuous Power Rating (W)	Impulse Joule Rating (J)	Pre-Charge Capability (µF) @ $240V_{rms}$ +10%	Pre-Charge Capability (µF) @ $460V_{rms}$ +10%
100 Ohm 100W	100	2,500	35,000	9,700
56 Ohm 200W	200	5,000	71,000	19,500
36 Ohm 500W	500	12,500	179,000	48,800

The internal DC Link Capacitance for each drive in the 690+ range is given in the table below:

Drive Power (kW/Hp)	400V Units		230V Units	
	Frame	µF	Frame	µF
0.75/1	B	190	B	380
1.5/2	B	190	B	760
2.2/3	B	380	B	1140
4/5	B	380	B	1520
5.5/7.5	C	500	C	2000
7.5/10	C	1000	C	3000
11/15	C	1000	D	3000
15/20	D	1500	D	4000
18.5/25	D	2000	D	4000
22/30	D	2000	E	6000
30/40	E	2500	F	11200
37/50	E	3000	F	11200
45/60	E	3500	F	11200

Drive Power (kW/Hp)	400V Units		230V Units	
	Frame	µF	Frame	µF
55/75	F	5600		
75/100	F	5600		
90/125	F	5600		
90/150	F	5600		
110/150	G	6600		
132/200	G	9900		
160/250	G	13500		
180/300	G	13500		
200/300	H	14850		
220/350	H	14850		
250/400	H	20250		
280/450	H	20250		
315/500	J	19800		

Simply sum the DC Link capacitance for all the drives on the common DC Link and select the appropriate pre-charge network.

For example a system comprising 5, 30kW, 400V Frame E drives would have a total DC Link capacitance of:

$$C_{Total} = 5 \times 2500\mu F = 12{,}500\mu F$$

This is less than 19,500µF and thus a 56Ω, 200W (CZ463068) resistor will be adequate.

3-Phase Choke Sizing

One of the benefits of the 690+ 4-Q Regen drive is the reduction in the levels of harmonic currents drawn from the supply. The total harmonic distortion (THD) of the mains current is related to the PWM switching frequency, the supply voltage, the supply frequency and the inductance of the 3-phase line choke. The maximum allowed PWM carrier frequency in non-overload conditions, for each frame size is given below:

690+ Frame Size	PWM Carrier Frequency
B to F	3kHz
G and H	2.5kHz
J	2kHz

The IEEE 519 standard (IEEE Standard Practices and Requirements for Harmonic Control in Electrical Power Systems) requires a THD of current of 5%. The tables below show the recommended 3-phase line chokes (5% and 3% in series) and expected THD of current for 400V and 230V drives.

The PWM switching produces high levels of harmonic current in the 3% chokes. It is essential to have these properly rated to avoid significant overheating. Suitable chokes have been developed for Parker SSD Drives and their Part Numbers are provided below.

3% Choke

Drive Frame Size	Motor Power (kW/Hp)	Input Voltage (V)	Active Front End	Choke	Inductance (µH)	Currents			
						50Hz	1kHz	2.5kHz	Sum
B	4/5	230	LA468346U004	CO468341U004	854	14.95	0.39	0.00	15
C	7.5/10	230	LA468346U008	CO468341U011	503	25.38	0.66	0.00	26
D	18.5/25	230	LA468346U018	CO468341U018	208	61.63	1.59	0.00	62
E	22/30	230	LA468346U022	CO468341U030	177	72.50	1.87	0.00	73
F	45/60	230	LA468346U045	CO468341U055	92	139.57	3.60	0.00	140
B	6/10	400	LA468345U006	CO468325U006	1750	12.69	0.33	0.00	13
C	15/20	400	LA468345U015	CO468325U018	817	27.19	0.70	0.00	28
D	30/40	400	LA468345U030	CO468325U037	416	53.47	1.38	0.00	54
E	45/60	400	LA468345U045	CO468325U055	282	78.85	2.04	0.00	79
F	90/150	400	LA468345U090	CO468325U110	137	163.13	4.21	0.00	164
G	180/300	400	LA468345U180	CO468325U220	68	327.17	8.45	0.00	328
H	280/450	400	LA468345U280	CO468325U315	48	471.28	12.17	0.00	472
J	315/500	400	LA468345U315	CO468325U355	42	534.72	13.81	0.00	535

5% Choke

Drive Frame Size	Motor Power (kW/Hp)	Input Voltage (V)	Active Front End	Choke	Inductance (µH)	Currents			
						50Hz	1kHz	2.5kHz	Sum
B	4/5	230	LA468346U004	CO468342U004	1424	14.85	0.30	2.72	16
C	7.5/10	230	LA468346U008	CO468342U011	839	25.20	0.50	4.61	26
D	18.5/25	230	LA468346U018	CO468342U018	346	61.20	1.22	11.20	63
E	22/30	230	LA468346U022	CO468342U030	294	72.00	1.44	13.18	74
F	45/60	230	LA468346U045	CO468342U055	153	138.60	2.77	25.36	141
B	6/10	400	LA468345U006	CO468326U006	2918	12.60	0.25	2.31	13
C	15/20	400	LA468345U015	CO468326U018	1362	27.00	0.54	4.94	28
D	30/40	400	LA468345U030	CO468326U037	693	53.10	1.06	9.72	54
E	45/60	400	LA468345U045	CO468326U055	470	78.30	1.57	14.33	80
F	90/150	400	LA468345U090	CO468326U110	227	162.00	3.24	29.65	165
G	180/300	400	LA468345U180	CO468326U220	114	324.90	6.50	59.46	331
H	280/450	400	LA468345U280	CO468326U315	79	468.00	9.36	85.64	476
J	315/500	400	LA468345U315	CO468326U355	70	531.00	10.62	97.17	540

Note: *Lower values for THD of current can be achieved by adding extra line impedance.*

Chapter 11 APPLICATION MACROS

The Default Application

The drive is supplied with various macros. Each macro recalls a pre-programmed set of parameters when it is loaded.

- Macro 1 is the factory default macro, providing for basic speed control

Note: *Refer to the Software Product Manual for details of other macros.*

Macro Descriptions

Note: *Parameters whose default values are product-related are indicated in the block diagrams with * or **. Refer to Chapter 2: "An Overview of the Drive" - Product-Related Default Values.*

Macro 0

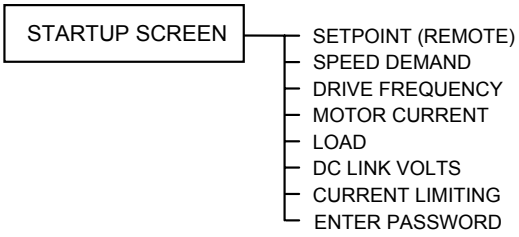
This macro will not control a motor.

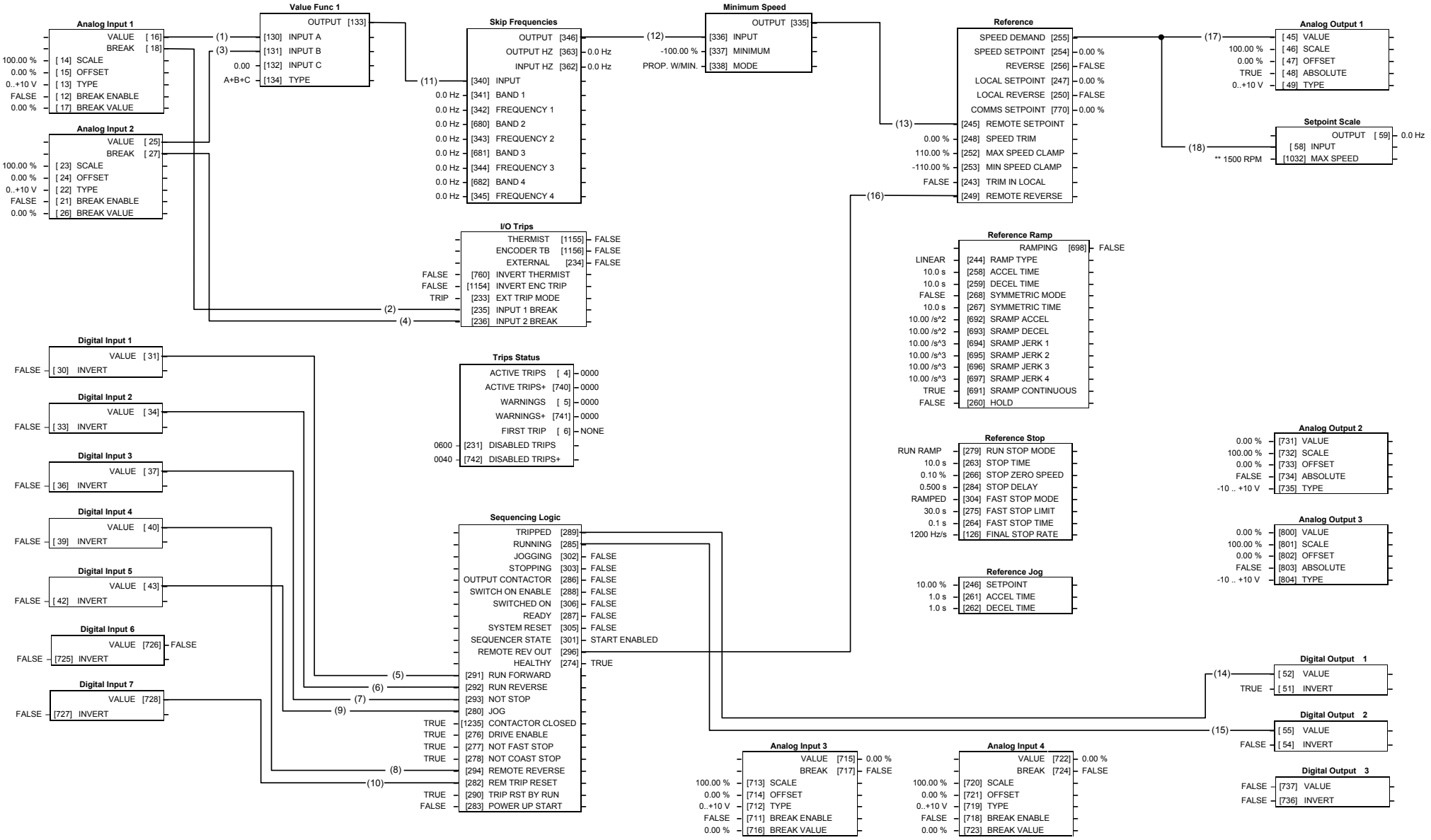
It is included to document the differences between all the configurations, using this as the base-line.

Loading Macro 0 removes all internal links, and sets all parameter values to the values defined for each function block in the Software Product Manual - Chapter 1: Programming Your Application.

The OPERATOR Menu for Macro 0

The default OPERATOR menu is shown below.





Macro 1: Basic Speed Control (default)

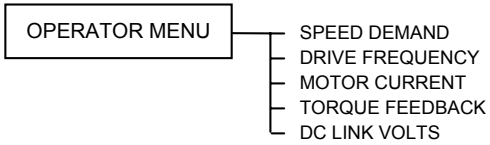
Macro 1: Basic Speed Control (default)

This macro provides standard control of the inverter.

Control Wiring I/O			
Terminal	**Name**	**Purpose**	**Comment**
2	ANALOG INPUT 1	Speed Setpoint	0V = 0%, 10V = 100%
3	ANALOG INPUT 2	Speed Trim	0V = 0%, 10V = 100%
6	ANALOG OUTPUT 1	Ramp Output	absolute speed demand 0V = 0%, 10V = 100%
12	DIGITAL INPUT 1	Run Forward	24V = run forward
13	DIGITAL INPUT 2	Run Reverse	24V = run reverse
14	DIGITAL INPUT 3	Not Stop	24V = RUN FWD and RUN REV signals latched 0V = RUN FWD and RUN REV signals not latched
15	DIGITAL INPUT 4	Remote Reverse	0V = remote forward 24V = remote reverse
16	DIGITAL INPUT 5	Jog	24V = jog
18	DIGITAL INPUT 7	Remote Trip Reset	24V = reset trips
19	DIGITAL INPUT 8	External Trip	*Non-configurable* 0V = Trip (connect to terminal 20)
21, 22	DIGITAL OUTPUT 1	Health	0V = tripped, i.e. not healthy
23, 24	DIGITAL OUTPUT 2	Running	0V = stopped, 24V = running

The Operator Menu for Macro 1

The default Operator Menu is shown below.



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