DC900P series

Frame 1, 2, 3, 4

Issue 1
Product Manual

DC900P DC Digital Drive

PRODUCT MANUAL

Safety Information

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

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

Safety Information

Requirements

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

Intended Users

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

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

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

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

Application Area

The equipment described is intended for industrial (non-consumer) motor speed control utilising DC motors.

Personnel

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

Safety Information

Product Warnings

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

Hazards

DANGER! - Ignoring the following may result in injury

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

Safety Information

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

SAFETY

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

- Never perform high voltage resistance checks on the wiring without first disconnecting the drive from the circuit being tested.

- Whilst ensuring ventilation is sufficient, provide guarding and /or additional safety systems to prevent injury or damage to equipment.

- When replacing a drive in an application and before returning to use, it is essential that all user defined parameters for the product's operation are correctly installed.

- All control and signal terminals are SELV, i.e. protected by double insulation. Ensure all external wiring is rated for the highest system voltage.

- Thermal sensors contained within the motor must have at least basic insulation.

- All exposed metalwork in the Drive is protected by basic insulation and bonded to a safety earth.

- RCDs are not recommended for use with this product but, where their use is mandatory, only Type B RCDs should be used.

EMC

- In a domestic environment this product may cause radio interference in which case supplementary mitigation measures may be required.

- This equipment contains electrostatic discharge (ESD) sensitive parts. Observe static control precautions when handling, installing and servicing this product.

- This is a product of the restricted sales distribution class according to IEC 61800-3.

- It is designated as "professional equipment" as defined in EN61000-3-2. Permission of the supply authority shall be obtained before connection to the low voltage supply.

Safety Information

CAUTION!

APPLICATION RISK

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

RISK ASSESSMENT

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

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

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

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

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CHAPTER 2 PRODUCT OVERVIEW

CHAPTER 3 INSTALLING THE DRIVE

CHAPTER 4 OPERATING THE DRIVE

CHAPTER 5 CONTROL LOOPS

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APPENDIX B PARAMETER SPECIFICATION TABLES

APPENDIX C PROGRAMMING

Chapter 1

Getting Started

A few things you should do when you first receive the unit.

About this Manual

This manual is intended for use by the installer, user and programmer of the DC900P Series DC Digital Drive. It assumes a reasonable level of understanding in these three disciplines.

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

Enter the “Model No” from the rating label into the "Installation Details" table at the front of this manual. It is important that you pass this manual on to any new user of this unit.

This manual is for the following models from the DC900P Series DC Digital Drive:

- Three phase, regenerative, four quadrant armature controllers: 900P
- Three phase non-regenerative, two quadrant armature controllers: 901P
- 900P Door

How the Manual is Organised

This Engineering Reference manual is organised into chapters and appendices, indicated by the numbering on the edge of each page.

The manual is more detailed than the QuickStart manual, and so is of use to the unfamiliar as well as the high-end user.

Application Block Diagram

You will find this at the rear of Appendix D: "Programming" . These will become your programming tool as you become more familiar with the software.

Initial Steps

Use the manual to help you plan the following:

Installation

Know your requirements:

- certification requirements, CE/UL/c-UL conformance
- 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:

- plan your “block diagram programming”
- enter a password to guard against illicit or accidental changes
- learn how to back-up your application data
- customise the Keypad to the application

Equipment Inspection and Storage

- 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: “Product Overview” to check the rating label/product code.
Refer to Chapter 8: “Routine Maintenance and Repair” for information on returning damaged goods.
Refer to Appendix E: “Technical Specifications” - Environmental Details for the storage temperature.

Packaging and Lifting Details

WARNING

The packaging is combustible. Igniting it 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 unit. Never lift the unit 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 unit down.

Chapter 2

Product Overview

An introduction to the 900P range of products, and a quick look at the Keypads and available plug-in Options.

Product Range

The DC900P Series DC Digital Drive is designed for use in a suitable enclosure, with associated control equipment. The unit accepts a variety of standard three-phase ac supply voltages depending upon the model, and is suitable for the powering of DC shunt field and permanent magnet motors, providing controlled dc output voltage and current for armature and field.

All units are designed for simple and economical panel mounting using keyhole slots. Plug-in control connectors simplify the fitting and removal of the unit to the panel.

Where possible, standard parts are used throughout the range thereby reducing the variety of spare parts required to maintain a multi-drive system. For example, the same basic control boards are used in all types of three-phase armature controller regardless of horsepower or bridge configuration.

The control circuit is totally isolated from the power circuit thus simplifying the interconnection of controllers within a system and improving operator safety. The coding circuitry adjusts automatically to accept supply frequencies between 45-65Hz and possesses high immunity to supply-borne interference. The armature controllers are phase rotation insensitive.

Control and Communications

The drive is controlled by a 32 bit Microcontroller providing advanced features such as:

- **Complex control algorithms** which are not achievable by simple analog techniques.
- **Software-configurable control circuitry** built around standard software blocks.
- **Serial link communications** with other drives or a PC for advanced process systems.

The Keypad gives access to parameters, diagnostic messages, trip settings and full application programming.

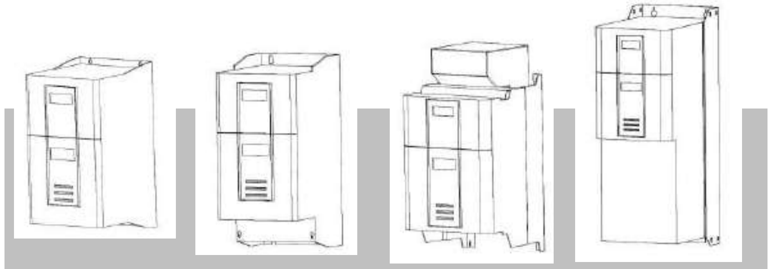
Regenerative and Non-Regenerative Models

The motor armature controllers include both regenerative and non-regenerative models:

- **Regenerative controllers** consist of two fully-controlled thyristor bridges and a field bridge with full transient and overload protection, together with sophisticated electronic control of acceleration and deceleration, speed and torque in both directions of rotation.
- **Non-regenerative controllers** consist of one fully-controlled thyristor bridge and a field bridge with full transient and overload protection, together with its associated electronic control circuitry, and provide accurate speed and/or torque control in one selected direction of rotation.

Field Regulator

A field regulator is fitted as standard. The regulator consists of a full-wave half controlled single phase thyristor bridge with transient and overload protection. It provides either a fixed voltage or fixed current source, depending upon the selected mode of operation for constant torque applications. The field current mode of operation can be further enhanced to provide field weakening for drive control motors which require extended speed or constant horsepower control.



Output Currents

Frame	Frame	Frame	Frame
20A	40A	200A	400A
35A	80A	280A	550A
	120A		750A
	160A		850A

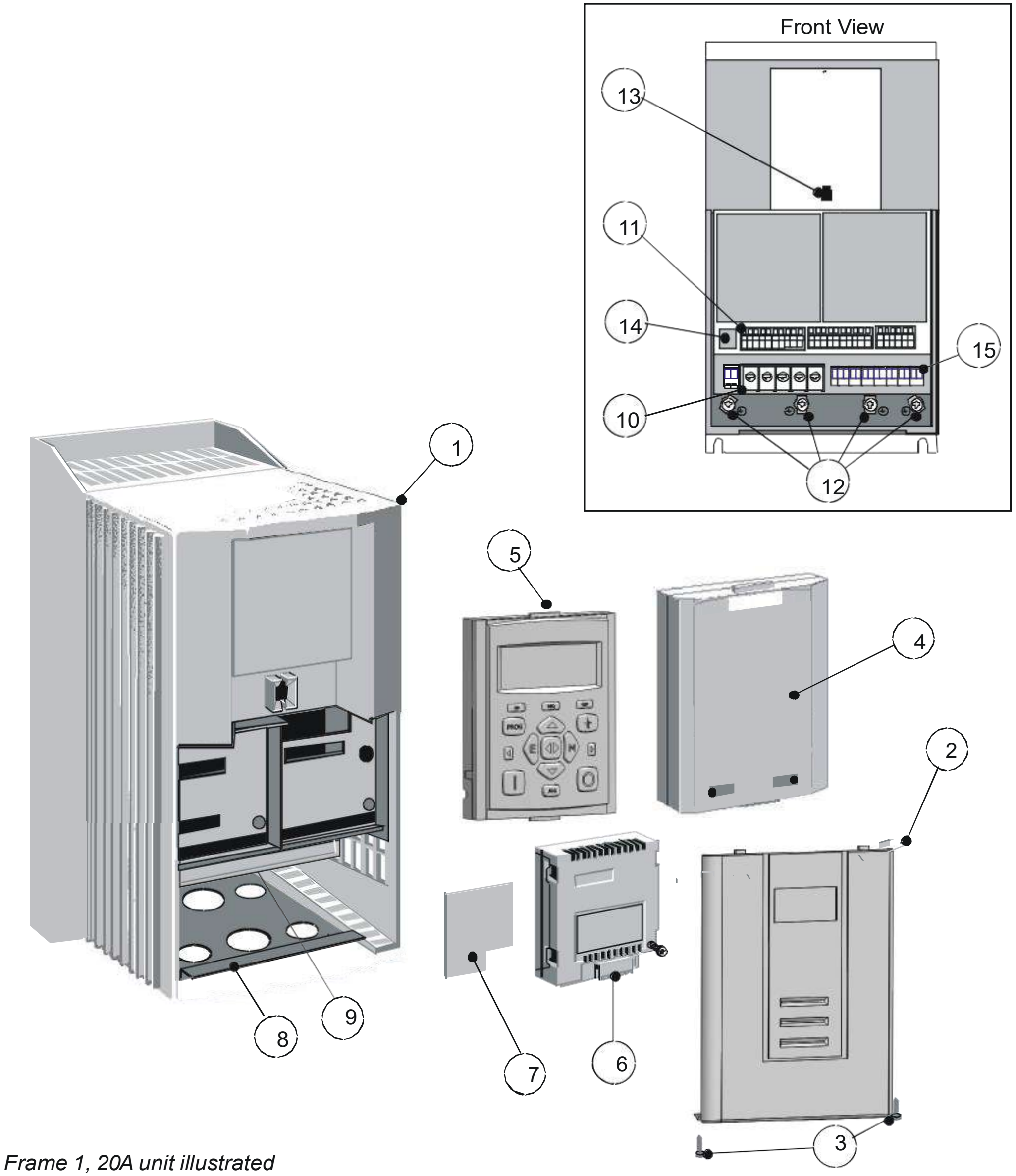
All units are available as

900P : 4Q 3-phase, fully controlled, anti-parallel thyristor bridge configuration

901P : 2Q 3-phase, fully controlled thyristor bridge configuration

900P Controller (Frames 1 & 2)

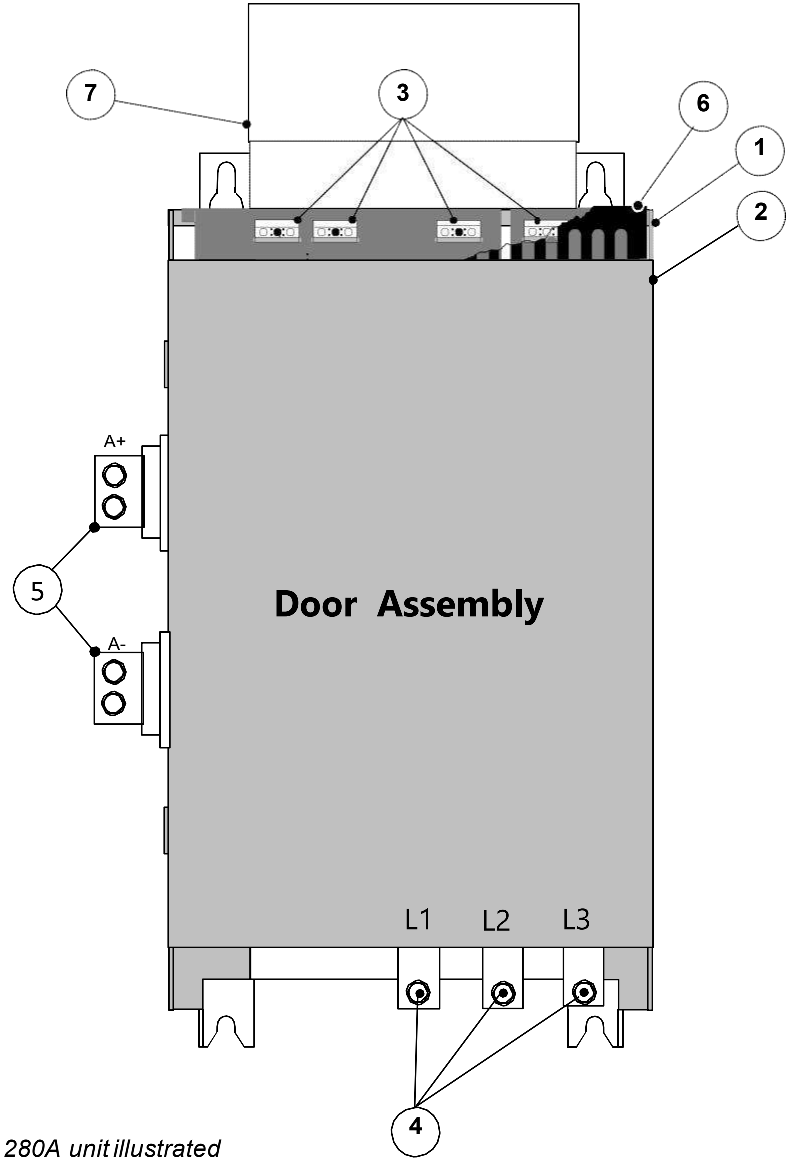
1	Main drive assembly
2	Terminal cover
3	Terminal cover retaining screw
4	Blank cover
5	DC 900P keypad (optional)
6	COMMS technology box (optional)
7	Speed feedback technology card (optional)
8	Gland plate
9	Power terminal shield
10	Power terminals
11	Control terminals
12	Earthing points
13	Keypad port
14	RS232 programming port
15	Auxiliary power, external contactor and isolated thermistor terminals



Frame 1, 20A unit illustrated

900P Controller (Frame 3)

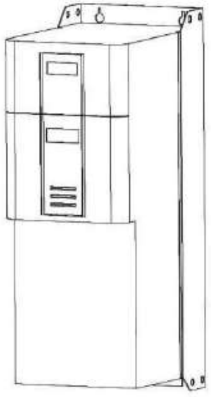
1	Main drive assembly
2	Door assembly
3	AUX POWER,External contactor,Field wiring terminals
4	Busbars - main power input
5	Busbars - main power output
6	IP20 Top Cover
7	IP20 Fan Housing (where fitted)



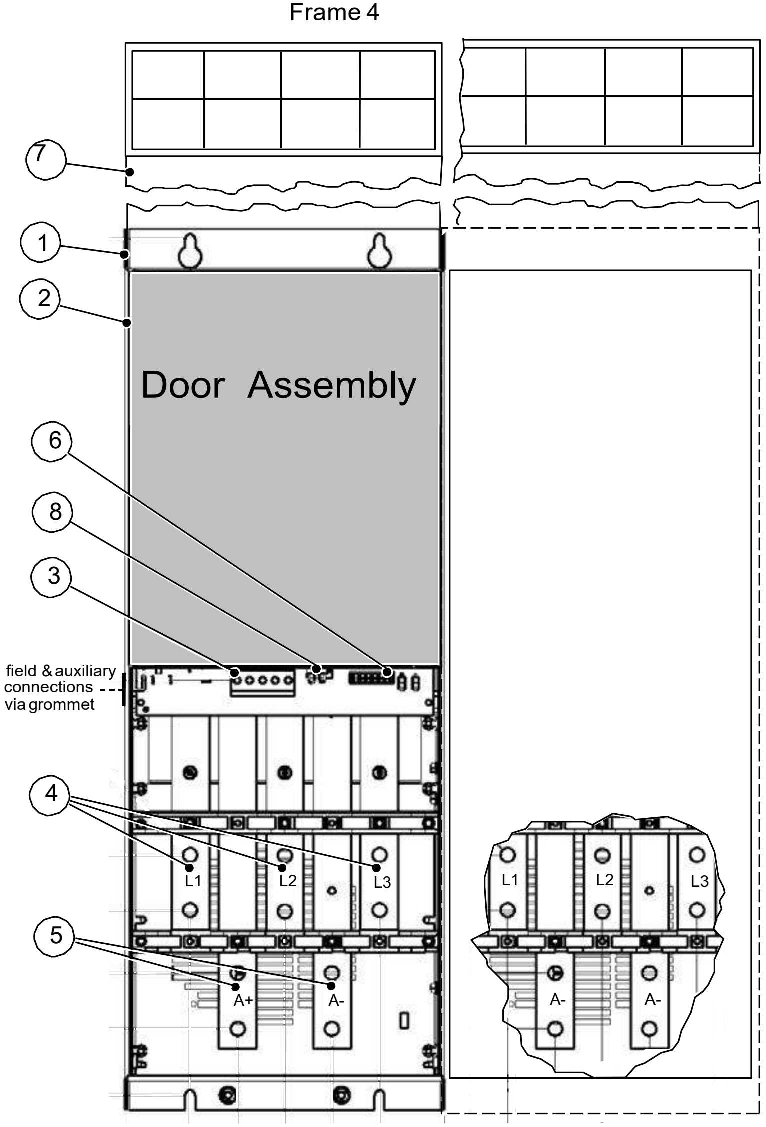
280A unit illustrated

900P Controller (Frames 4)

1	Main drive assembly
2	Standard door assembly
3	Motor field terminals
4	Busbars - main power input
5	Busbars - main power output
6	Auxiliary supply, contactor and motor thermistor terminals
7	Frame 4 External vent (where fitted)
8	Contactor Control Select

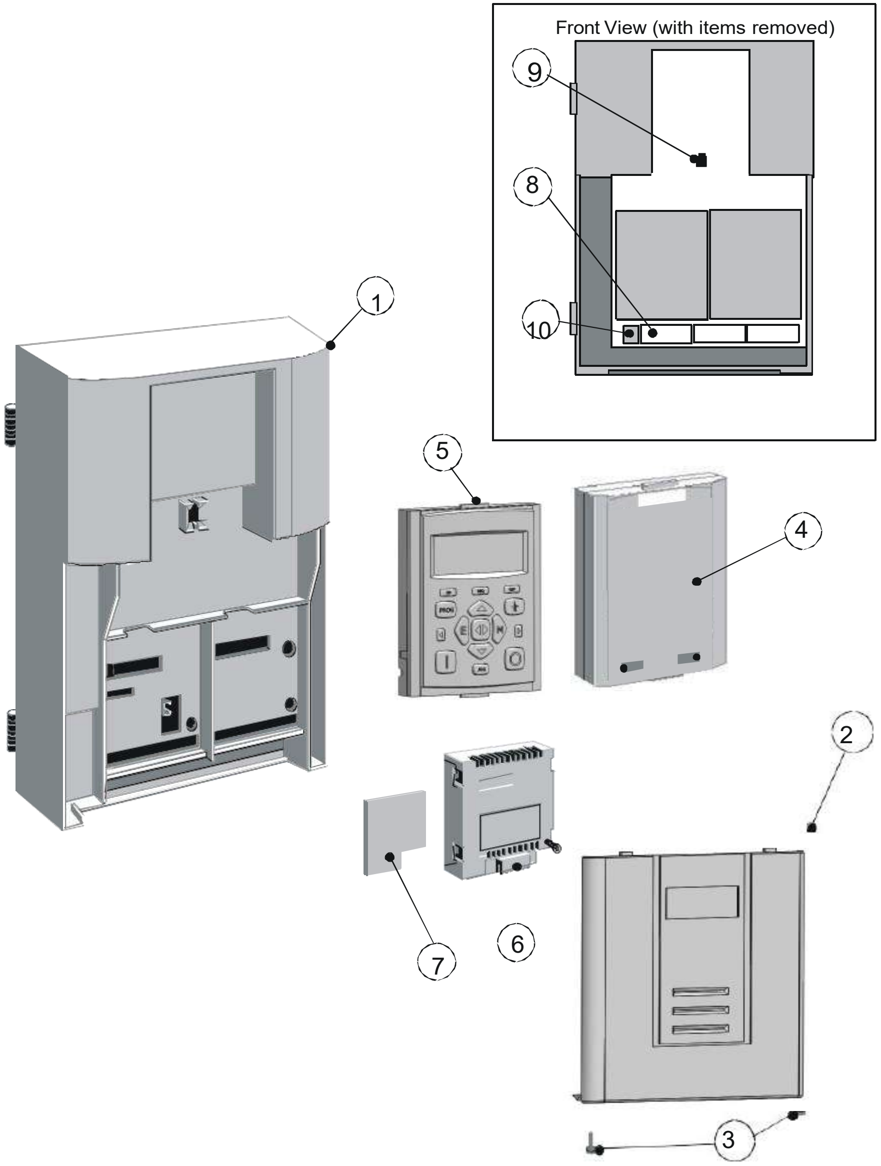


Frame 4



900P Door Assembly (Frames 3, 4)

1	Main door assembly
2	Terminal cover
3	Terminal cover retaining screw
4	Blank cover
5	6901 keypad (optional)
6	COMMS technology box (optional)
7	Speed feedback technology card (optional)
8	Control terminals
9	Keypad port
10	RS232 programming port (P3)



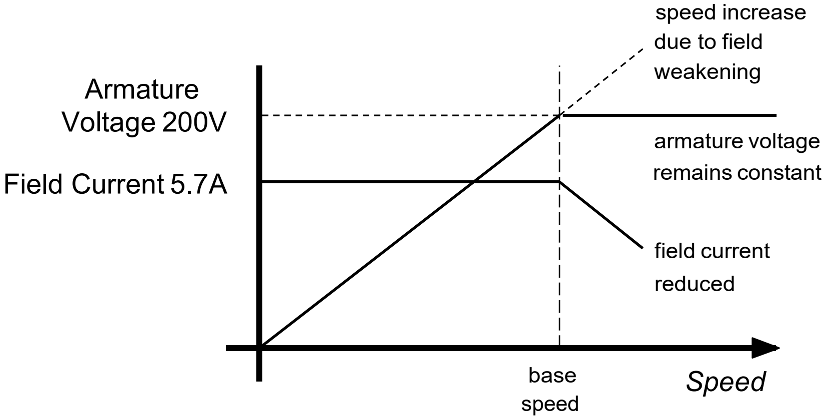
How it Works

NOTE **Refer to Chapter 5: "Control Loops" for a more detailed explanation.**

In ***very*** simple terms, the drive controls the dc motor with the use of *Control Loops* - an inner Current Loop and an outer Speed Loop. These control loops can be seen in the Application Block Diagram. The block diagram shows all the drive's software connections.

Using the Keypad, you can select the control loops to be used by the drive to provide either:

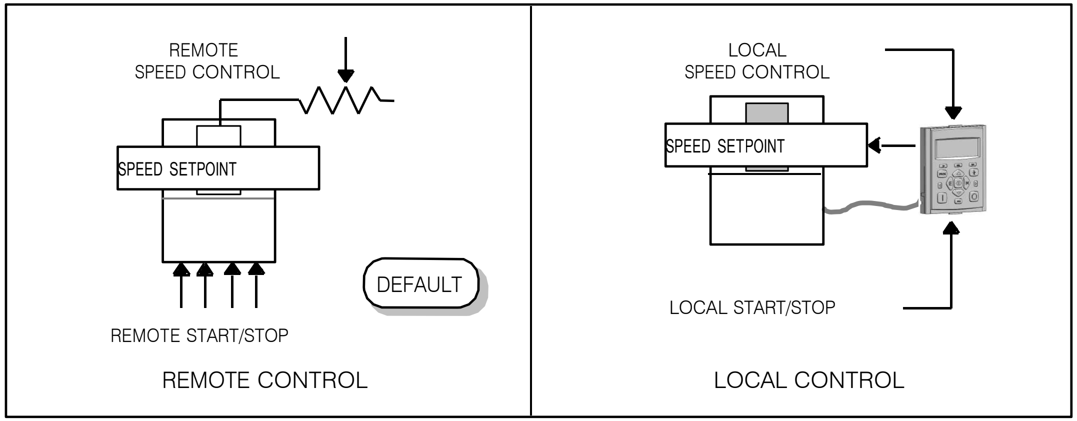
- Current Control
- Speed Control (default)



It is usual to supply a Current or Speed Feedback signal to the appropriate loop for more effective control of the drive. Current Feedback sensors are built-in, whereas Speed Feedback is provided directly from the armature sensing circuit (default), or by tachogenerator, encoder connection to the relevant option board.

When in Speed Control, you can modify the performance of the drive further by controlling the motor field, i.e. Field Control. By weakening the field current, you can obtain an increase in motor speed beyond that normally achievable for the rated Armature Voltage of the dc motor.

The drive is controlled remotely using digital/analog inputs and outputs, or locally using the Keypad. By plugging in a COMMS Option Technology Box, the drive can be linked into a network and controlled by a PLC/SCADA or other intelligent device.



Control Features

Control	Control Circuits	Fully isolated from power circuit (SELV)	
	Output Control	• Fully controlled 3-phase thyristor bridge • Microprocessor implemented phase control extended firing range • For use on 50 or 60Hz supplies with a frequency compliance range of 45 to 65Hz • Phase control circuits are phase rotation insensitive	
	Control Action	• Fully digital • Advanced PI with fully adaptive current loops for optimum dynamic performance • Self Tuning Current Loop utilising "Autotune" algorithm • Adjustable speed PI with integral defeat	
	Speed Control	• By Armature Voltage feedback with IR compensation • By Encoder feedback or analog tachogenerator	
	Speed Range	100 to 1 typical with tachogenerator feedback	
	Steady State Accuracy	• 0.01 % Encoder Feedback with Digital setpoint (serial link or P3) • 0.1 % Analog Tach Feedback • 2 % Voltage Feedback • Absolute (0.0% error) using QUADRALOC Mk II 5720 Digital Controller **NOTE** **Long term analog accuracy is subject to tachogenerator temperature stability.**	
	Adjustments	All adjustments in software can be altered by the Keypad or via serial communications. The Keypad provides monitoring and adjustment of parameters and levels, in addition to diagnostic facilities.	
Protection		• High energy MOVs • Overcurrent (instantaneous) • Overcurrent (inverse time) • Field failure • Speed feedback failure • Motor overtemperature	• Thyristor Stack overtemperature • Thyristor "Trigger" failure • Thyristor Snubber Network • Zero-speed detection • Standstill logic • Stall protection
Diagnostics		• Fully computerised with first fault latch and automatic display • Digital LCD monitoring • Full diagnostic information available on RS422/RS485 • LED circuit state indication	

Table 2-1 Control Features

Keypads

The drive is fitted with the Keypad.

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

For example, you can start and stop the motor, check on diagnostic information, and change parameters values on the drive.

The keypad fits to the front of the drive, however, you can also remote-mount the keypad up to 3 metres away.

For remote-mounting, you'll need the correct Remote Mounting Kit. Refer to Chapter 6: "The Keypad".

Keypad

Option Boards

A range of Option Boards are available for the DC900P drive. The boards provide for Speed Feedback and Communications.

Refer to Chapter 3 : "Installing the Drive" - Speed Feedback and Technology Options.

Chapter 3 Installing the Drive

This chapter describes the installation of the DC900P drive and associated equipment.

Mechanical Installation

IMPORTANT ***Read Appendix B: "Certification" before installing this unit. Refer to "Installation Drawings", page 3-75 for further information. Note the additional information for Frame 6 and Frame H at the end of this Chapter.***

Unpacking the Drive

Caution

The packaging is combustible and this action may produce lethal toxic fumes.

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

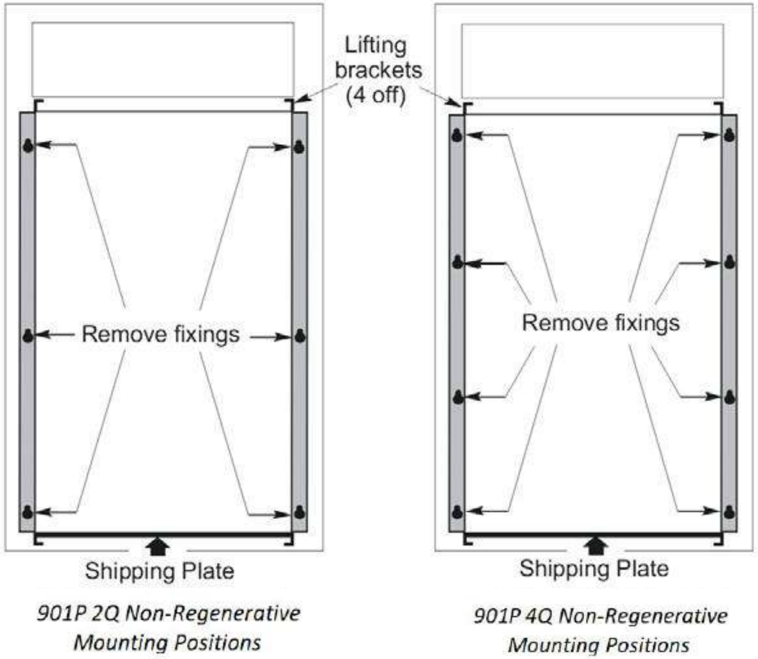
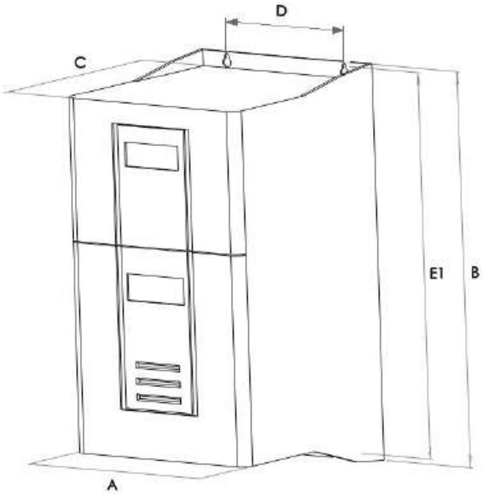


Figure 3- 1 Lifting Details

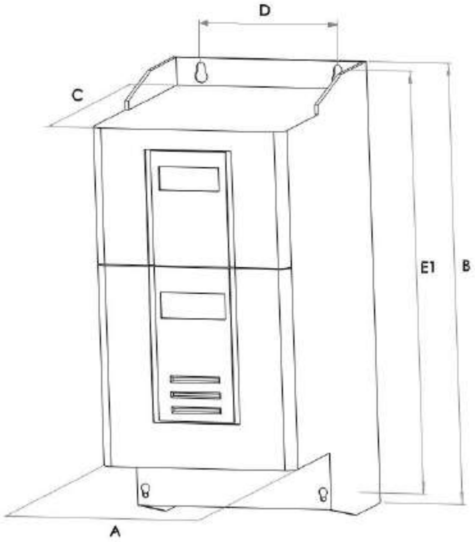
Lifting the Drive

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.

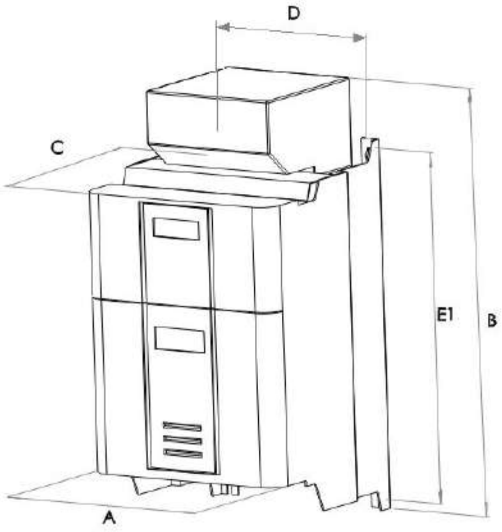
Frame 4 drives have lifting eyes and a shipping plate fitted to the base to enable the drive to be lifted into position, or to be set-on-end by a forklift. Remove the shipping plate before wiring the power terminals.



20A - 35A
Frame 1

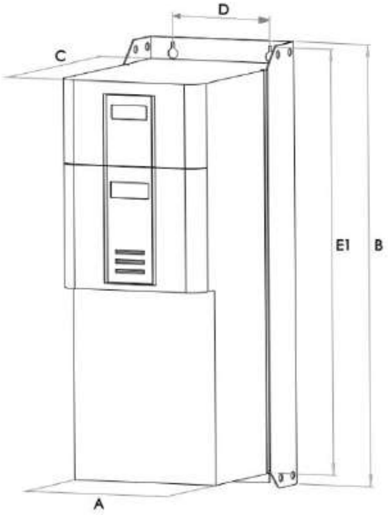


40A - 160A
Frame 2



200A - 280A
Frame 3

Current Rating (A)	Weight in Kg (lbs)	Overall Dimensions			Fixing Centres	
		A	B	C	D	E1
20 - 35	6.4	196 (7.72)	372.2(14.65)	211 (8.3)	140 (5.52)	363 (14.29)
40 - 160	11.3	196 (7.72)	430 (16.93)	255 (10.04)	140 (5.52)	412 (16.22)
200	18	250(9.8)	485(19.7)	180 (8.3)	200 (7.9)	400 (15.7)
280	20	300(11.8)	485(19.7)	180 (8.3)	200 (7.9)	400 (15.7)
Dimensions are in millimetres (inches) **Refer to "Installation Drawings", page 3-75.**						



380A - 850A
Frame 4
(vent kit assemblies not shown)

Current Rating (A)	Weight Kg (lbs)	Overall Dimensions			Fixing Centres	
		A	B	C	D	E1
400	42	253 (10.0)	700 (27.6)	358 (14.2)	150 (5.9)	680 (26.8)
550	42	253 (10.0)	700 (27.6)	358 (14.2)	150 (5.9)	680 (26.8)
750	48	253 (10.0)	700 (27.6)	358 (14.2)	150 (5.9)	680 (26.8)
850	48	253 (10.0)	700 (27.6)	358 (14.2)	150 (5.9)	680 (26.8)
*900P drive weighs 270Kg (595.4 lbs) without packaging and fan assembly 901P drive weighs 160kg (352.8 lbs) without packaging and fan assembly Fan weighs 18.5Kg (40.8 lbs) *Dimensions are in millimetres (inches)*						

Mounting the Drive

NOTE **General installation details are given below for mounting the Drive, however, if you are installing the unit with an EMC filter refer to "External AC Supply EMC Filter Installation, page 3-60.**

Mount the unit vertically on a solid, flat, vertical surface. It is mounted using bolts or screws into four fixing points (keyhole slots). The design allows the use of 100mm grid fixing.

It must be mounted inside a suitable cubicle. To comply with the European safety standards VDE 0160 (1994)/EN50178 (1998), the cubicle must require a tool for opening.

NOTE **Holes for the mounting bolts or screws must be placed accurately.**

Cover any units all ready mounted to the panel to protect them from stray metal filings while drilling mounting holes.

General Mounting Hints

Caution

Use proper lifting techniques when lifting and moving.

Drill the mounting holes into the backplate. The holes must be positioned accurately. Fit the nut inserts. Fit bolts and washers into the top inserts so that the drive can be hung using the keyhole slots.

Hang the drive on the bolts, between the panel and washers you have just fitted. Fit bolts and washers to the lower nut inserts. Finally, use the socket wrench to tighten all nuts securely.

Check the drive and its housing for packing material, mounting debris, or any other material that could damage and/or restrict the operation of the equipment.

Recommended Tools

Socket wrench	With a 6 Inch extension
Deep sockets	M6, M10, M13, M17, 7/16", 1/2"
Screwdrivers	Phillips No.2, flat blade - 0.5 x 3.0mm, 0.8 x 4.0mm
Wire cutters	Small

Ventilation and Cooling Requirements

NOTE **When fitting a drive into a sealed enclosure additional cooling MUST be provided, otherwise the internal air will overheat causing the drive to trip on "overtemperature".**

Refer to Appendix E: “Technical Specifications” - Cooling Fans.

The Drive gives off heat during normal operation and must therefore be mounted to allow the free flow of air through the air entries and exits. Maintain the minimum air clearances given on the drawings to ensure 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 DC900P’s together, these clearances are cumulative.

Ensure that the mounting surface is normally cool.

AC Line Choke

We recommend that you always use the specified ac line choke with the Drive
to provide a known supply impedance for effective operation of the thyristor transient suppression circuits. At least 1% line impedance should be provided in the supply side of the drive.

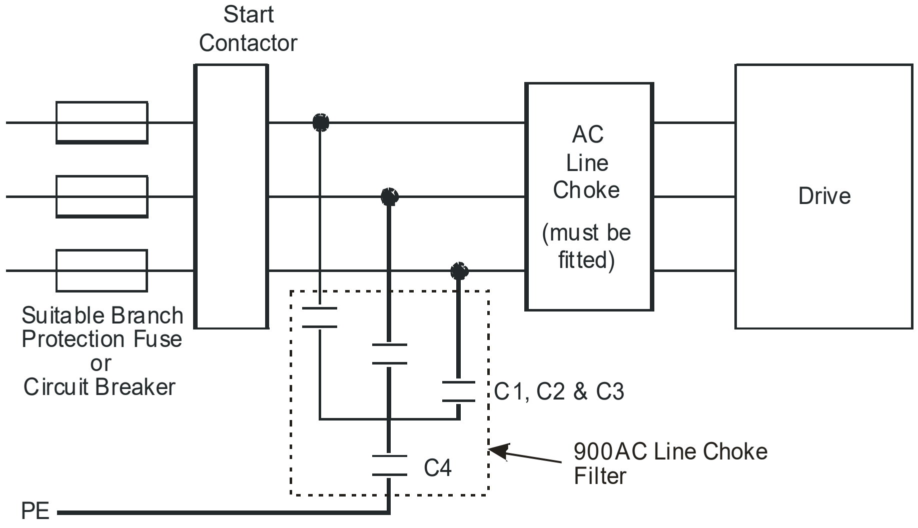
Refer to Appendix E: “Technical Specifications” - AC Line Choke for selection details.

Filtering

NOTE **Refer to Appendix B: "Certification" - EMC.**

For compliance in Europe with EN61800-3 Table 11:

- The CE marking of drives whose armature current >100A is applicable without filtering.
- The CE marking of drives whose armature current <100A is **only** applicable with filtering. The drive requires one of the following:
  1. The specified filter given in Appendix B
     (also refer to External AC Supply EMC Filter Installation, page 3-60)
  2. Compliant filtering offered by the System
  3. Capacitors fitted between phase and earth (see Figure 3- 4 below)



Capacitor Reference Number	Capacitor Value/Type
C1, C2, C3	3.0µF 400V, EMI suppressor type Class X1
C4	1.0µF 400V, EMI suppressor type Class X1

Figure 3- 4 AC Line Choke and Capacitors fitted to Frame 1 (20A & 35A) & Frame 2 (40A & 80A) Drives

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 Appendix E: "Technical Specifications" for additional *Wiring Requirements for EMC Compliance* and *Wire Sizes and Termination Tightening Torques.***

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 Appendix B: "Certification".

If the controller is to be operating in a regenerating mode for extended periods acting as a load generator for another machine, it is advisable to fit additional protection in the armature circuit. A dc fuse or high speed circuit breaker will provide this protection. If in doubt, contact DC900P Drives.

If fitted, the AC filter MUST be placed between the supply and the choke.

Failure to do so will result in unreliable operation of the drive and reduced lifetime of the filter.

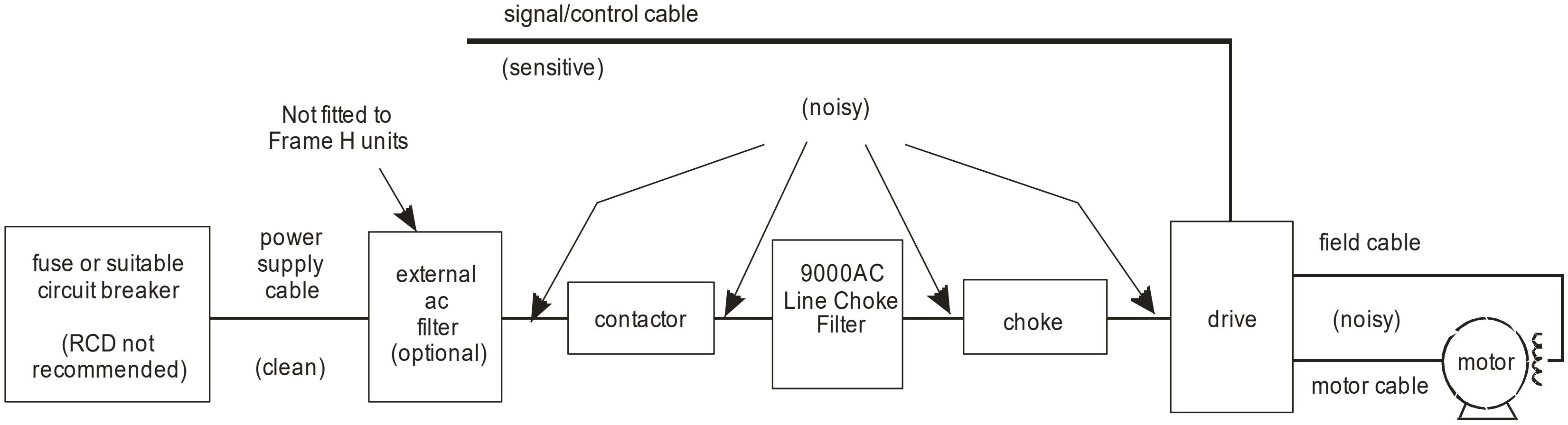


Figure 3- 5 Cabling Requirements

Cable Gland Requirements

Use a metal gland to connect to the cubicle backplate, near the VSD (variable speed drive). 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.

We suggest a rubber grommet is fitted on holes where a cable gland is not used.

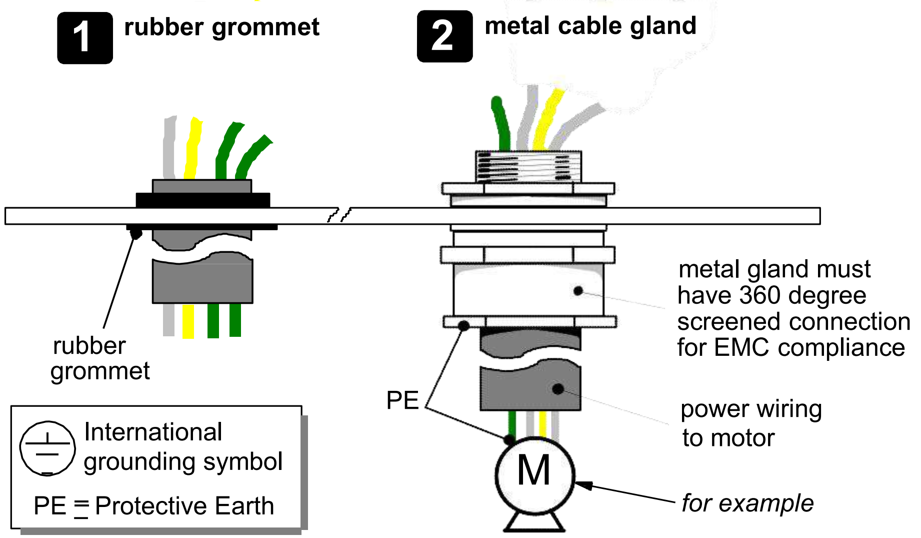


Figure 3- 6 Cable and Screen Fixings

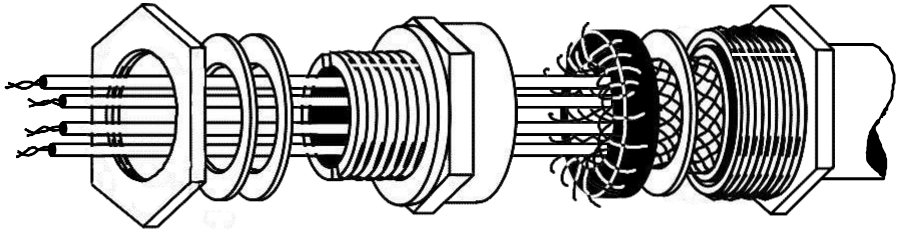


Figure 3- 7 360 Degree Screened Connection

Minimum Connection Requirements

IMPORTANT *If in doubt about the connection of the DC motor to the drive, contact DC900P Drives.*

NOTE **Because of the complexity of showing all possible configurations, this Chapter deals only with a `general purpose' operation as a basic speed controller. Special wiring options usually form part of a customer-specific system and connection details will be provided separately.**

✓ **Minimum connections to operate the drive safely are shown using bold lines in the following circuit diagrams. These connections are highlighted in text with the symbol opposite. The remaining connections are not necessary for a "quick start-up".**

The Drive is using the default Armature Voltage feedback when following the `minimum connection' instructions.

WARNING

Power terminals carry an electrical voltage which can be lethal. Never work on any control equipment or motors without first removing all power supplies from the equipment.

Caution

Make sure all wiring connections meet or exceed applicable local and National Electrical Codes. Be sure to fit branch circuit and motor overload protection.

IMPORTANT *If fitting your own "Power On" indicator lamp, annunciator, etc., this should be switched by an auxiliary contactor of the main contactor, not by the controller auxiliary relay.*

To avoid damaging the drive NEVER carry out high voltage resistance or dielectric strength tests without first completely disconnecting the drive from the circuit being tested.

Power Cables

NOTE **Refer to Appendix E: "Technical Specifications" - Wire Sizes and Termination Tightening Torques.**

- minimum rating of 1.1 x full load current (Europe)
- minimum rating of 1.25 x full load current (UL)

Control Wiring

NOTE **Refer to Appendix E: "Technical Specifications" for Control Terminal information.**

- Control wiring must have a minimum cross-section area of $0.75mm^2$ (18AWG).
- Use screened control cables to comply with EMC requirements.
- Feed the control cables into the drive and connect to the control terminals. Refer to the connection label on the inside of the terminal cover. Close the terminal cover.

IMPORTANT ***All connections made to terminal blocks A, B and C must be isolated signal voltages.***

Important Connections

The following connections must be made for the drive to run:

- Terminals TH1 and TH2 must be linked if a motor thermostat is not fitted.
- Terminals C1 and C2 must be linked if an External Trip interlock is not required.

Connection Diagrams

FRAMES 1, 2, 3 & 4
Bold lines indicate "minimum connections"

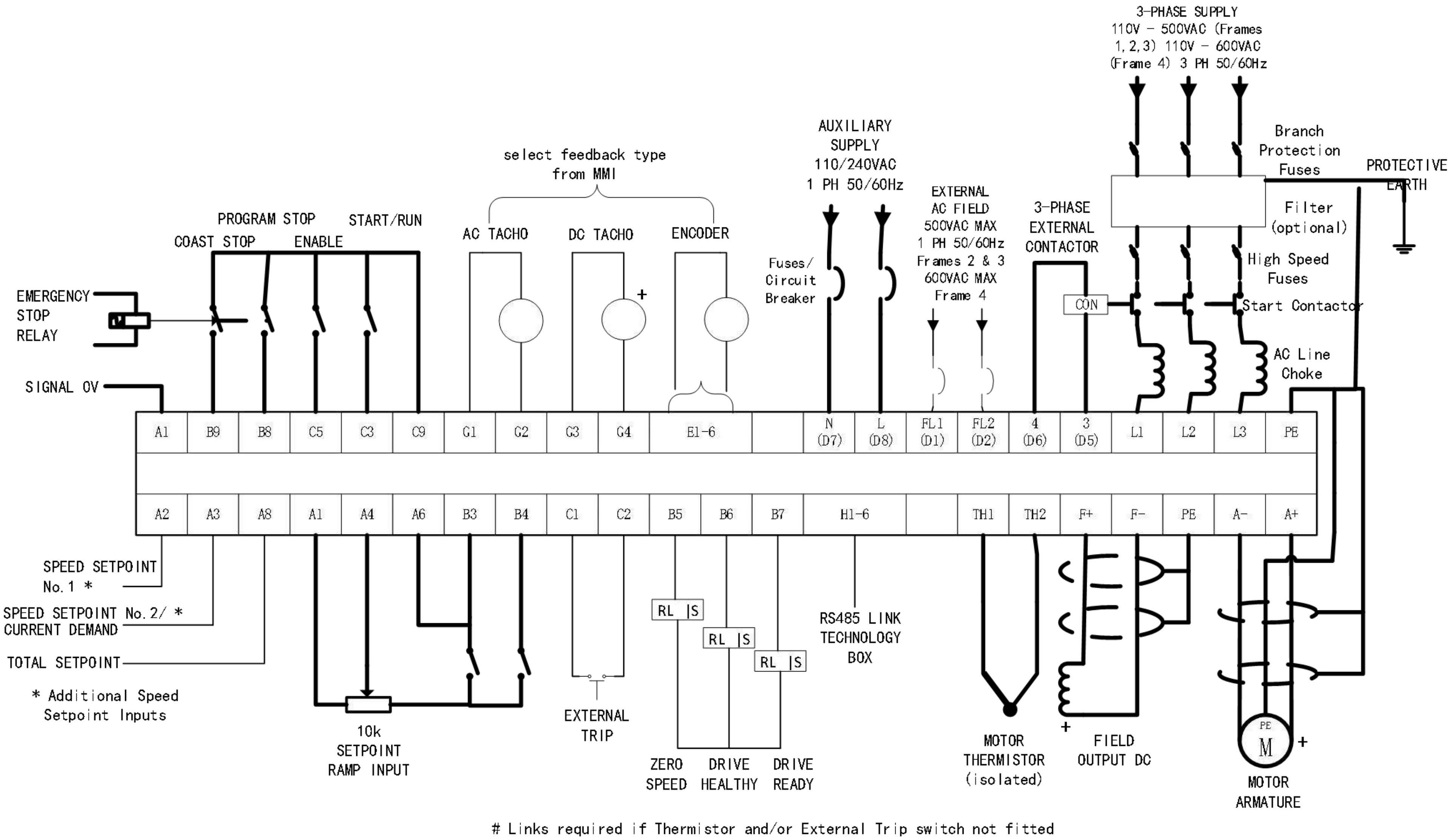


Figure 3- 8 Power Connections: Frames 1, 2, 3 & 4 (`general purpose’ configuration)

Power Connections

3-Phase Supply, 3-Phase External Contactor ☐ ✓

L1

L2

L3

3

4

Connect the main ac power to busbar terminals L1, L2 & L3 via the Branch Protection, AC Filter (optional), 3-Phase External Contactor, and AC Line Choke.

Connect the contactor coil to terminals 3 (Line) and 4 (Neutral).

Frame 3 : Terminals 3 & 4 = C & N

Main AC Power

There is no specific phase connection to terminals L1, L2 and L3 as the controller is phase rotation independent.

Branch Protection

AC current = 0.83 x DC Armature Current

You must provide branch circuit protection using a suitable fuse or Type 2 circuit breaker (RCD, ELCB, GFCI circuit breakers are not recommended, refer to “Earth Fault Monitoring Systems”, page 3-62). Also refer to Appendix B: “Certification” - Conditions for Compliance with UL508c.

IMPORTANT ***If a motor becomes completely short-circuited, the current trip (OVER I TRIP)*** *will not* ***protect the Drive.***

Refer to Appendix E: “Technical Specifications” - External Power Semiconductor Protection Fuses.

AC Filter (optional)

Refer to "External AC Supply EMC Filter Installation", page 3-60.

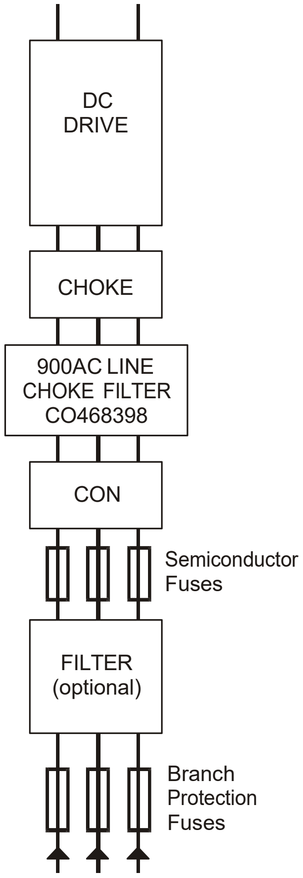


Diagram shows correct placement of units

Power Connections continued

3-Phase Supply, 3-Phase External Contactor continued

3-Phase External Contactor

The contactor does not switch current and is primarily for disconnection and sequencing of the power bridge. It must be energised directly from the controller by a coil with a rating suitable (AC1) for the controller concerned. No additional series contacts or switches are permitted since they will interfere with the sequencing of the controller and cause unreliability and possible failure.

Connect to main contactor terminals Con L and Con N only as described in Appendix E, otherwise unreliable or dangerous operation may occur - do not connect to a PLC input or sensitive relay.

Slave Relay : If the 3-phase contactor has a coil with an inrush greater than 3A, a slave relay **MUST** be used to drive the contactor coil. The contactor and slave relay (if required) **MUST** have coil voltages compatible with the controller auxiliary supply voltage.

DO NOT use a slave relay with a coil current less than 25mA as it may be energised by the contact suppression network.

Frames 4 : A relay jumper (CONN1) is provided on the power board enabling terminals 3 & 4 to be powered (auxiliary supply - default position), or to be volt-free (for customers own contactor supply).

DC Contactor : A DC contactor can be used but the sequencing must be adjusted to accommodate its use: an auxilliary normally open volt-free contact of the contactor must be connected in series with the "ENABLE" input (C5) to disable the drive until after the contactor is closed.

AC Line Choke

IMPORTANT ***Always fit the recommended choke. Refer to Appendix E: “Technical Specifications” - AC Line Choke.***

We can provide suitable chokes, designed to connect directly to the drive terminals. Refer to Appendix E: "Technical Specifications" - AC Line Choke.

Power Connections continued

PE

Protective Earth Connections ☐ ✓

Connect the drive's PE terminal to an independent earth/ground star point.

Connect this earth/ground star point to Protective Earth.

IMPORTANT ***The drive and filter (if fitted) must be*** *permanently earthed*. ***Each conductor used for permanent earthing must*** **individually** ***meet the requirements for a protective earth conductor.***

For installations to EN 60204 in Europe:

- For permanent earthing, the drive requires either two individual incoming protective earth conductors (<10mm² cross-section), or one conductor (≥10mm² cross-section) connected to an independent protective earth/ground point near the drive.
- Run the motor protective earth/ground connection in parallel with the motor supply conductors, ideally in the same conduit/screen/armour, and connect to an independent protective earth/ground point near the drive.

Refer to Appendix B: "Certification" - EMC General Installation Considerations.

Caution

On the Frame 5, both the Master and Slave drives must be individually earthed.

A+

A-

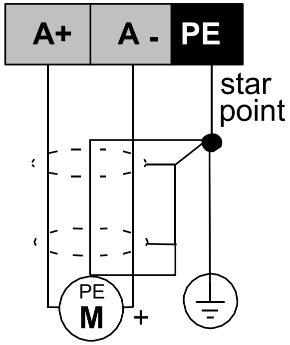
Motor Armature ☐ ✓

Connect the motor armature to terminals A+ and A-.

Connect the cable screen to the motor's PE terminal and the earth/ground star point.
Connect the motor's PE terminal to the earth/ground star point.

For cable information refer to Appendix B: "Certification" - Recommended Wire Sizes.

NOTE **If the drive is to operate in regenerating mode for long periods, it is advisable to fit a dc fuse or high speed circuit breaker in the armature circuit. If in doubt consult DC900P Drives.**



Power Connections continued

F-
F+

Motor Field

☐ ✓

Connect the motor field (-) to terminal F-, and connect field (+) to terminal F+.

Frame 3: Terminals F- & F+ = D3 & D4

Connect the cable screen to the independent earth/ground point.
If the motor has no field connections, is a permanent magnet motor, or if the field is derived externally, you must either:

MMI Menu Map

1 SETUP PARAMETERS
2 FIELD CONTROL
FIELD ENABLE

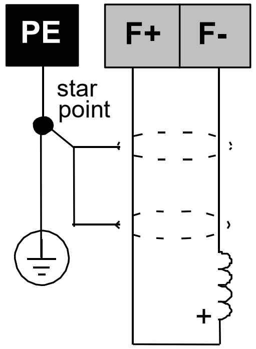
disable the FIELD ENABLE parameter (Tag No. 170) later during Set-up (disables the Field Fail alarm automatically)

or

MMI Menu Map

1 SETUP PARAMETERS
2 INHIBIT ALARMS
FIELD FAIL

disable the Field Fail alarm



Th1
Th2

Motor Thermistor

☐ ✓

Connect the motor thermistor to terminals Th1 and Th2

or

link terminals if sensors are not fitted.

Frames 3: Terminals Th1 & Th2 = THERM1 & THERM 2

Terminals Th1 and Th2 must be linked if motor sensors are not fitted.

(Thermistor terminals for Frames 3 are on the Control Door Board).

We recommend that you protect the dc motor against overtemperature by the use of temperature sensitive resistors or switches in the field and interpole windings of the machine. When the motor is fitted with over-temperature sensing devices, such as thermostats or PTC thermistors, these should be connected (in series) between terminals TH1 and TH2.

- Thermistors must have a combined working resistance of 750Ω or less, rising to 4kΩ at over-temperature. These thermistors are classified by IEC34-II as Mark A.
- Temperature switches must be normally closed, and open at rated temperature.

The over temperature alarm will activate at 3kΩ. It is latched in software and must be reset by re-starting the Drive.

NOTE **The motor temperature alarm (THERMOSTAT) cannot be inhibited in software.**

Power Connectionscontinued

FL1

FL2

External AC Field ☐ ✓

Connect the external field supply to terminals FL1 and FL2.

Frame 3: Terminals FL1 & FL2 = D1 & D2

(Not available on Frame 1 units)

Used if an external field supply is required to the controller for application reasons. The magnitude of this voltage is determined by the desired field voltage. The supply must be protected externally with suitable fuses.

IMPORTANT ***The connection of the controller and the external field supply must be consistent when using an externally supplied field regulator. Always derive the 1phase, 50/60Hz supply from the L1 (Red) and L2 (Yellow) phases of the main power supply, directly or indirectly through a single-phase transformer, with the Red phase connected to terminal FL1 and the Yellow phase to terminal FL2.***

NOTE **You must provide branch circuit and overload protection.**

To change the drive from an internal to an external field type refer to.

L

N

Auxiliary Supply ☐ ✓

Connect the control supply to terminals L (Live) and N (Neutral).

Frame 3: Terminals L & N = D8 & D7

Single phase, 110/240V ac, 50/60Hz.

Note: **The auxiliary supply chosen must equate to the contactor coil voltage used.**

IMPORTANT ***The auxiliary supply terminals must be connected directly to the incoming supply via a fuse or circuit breaker. No series sequencing switches or contacts are permitted without consultation from DC900 Division.***

Use suitable external fuse protection: the steady state current absorbed by the controller is nominal, the external fuse is determined chiefly by considering the contactor holding VA and the controller cooling fans.

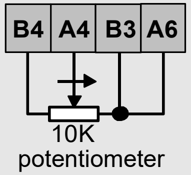
Refer to Appendix E: “Technical Specifications” - Power Supply Fuses.

Control Connections

A1
A4
B3
B4

Ramp Speed Setpoint ☐ ✓

Connect a 10k potentiometer between terminals A1 and B3. Connect the wiper to A4.



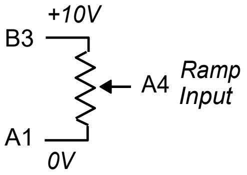
Speed Demand
Controls the speed of the motor

Uni-directional Speed Setpoint

This connection provides a Uni-Directional Speed Setpoint for non-reversing applications and the 2 Quadrant controller (901P):

Maximum forward speed setpoint (+100%) = Terminal B3, +10V input
Zero speed setpoint (0%) = Terminal B1, 0V input

Thus, zero speed is at the **left** (anti-clockwise) position on the potentiometer.

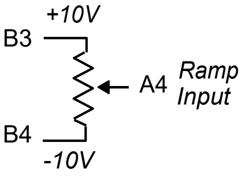


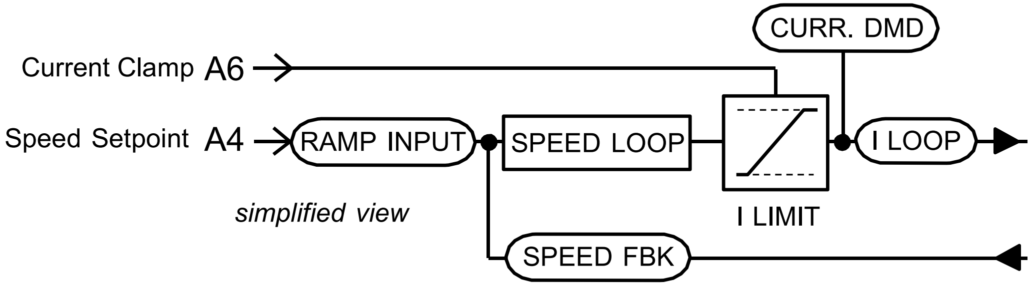
Bi-directional Speed Setpoint

Alternatively, substitute A1 for terminal B4 to scale the input such that:

Maximum forward speed setpoint (+100%) = Terminal B3, +10V input
Maximum reverse speed setpoint (-100%) = Terminal B4, -10V input

Thus, zero speed demand is at the **centre** position on the potentiometer.





In both cases, the Current Limit is controlled via terminal A6 (ANIN5).

NOTE **Terminals A1, B1 and C1 (Signal 0V) are the common reference points for all analog signals used in the drive.**

Control Connections continued

A6
B3

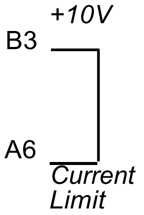
Current Limit ☐ ✓

Connect terminal A6 to B3.

Current Limit Controls the available motor torque

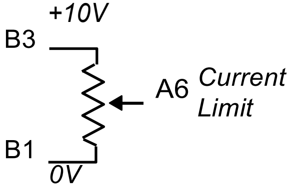
This connection provides control of the Positive and Negative Current Clamps and hence the Current Demand via terminal A6 (ANIN5). The "ANIN 5 (A6)" function block contains parameters to set up maximum/minimum values for the analog input, and a scaling ratio.

Adjust the main current limit using the MAIN CURR. LIMIT parameter [Tag No. 15]. Refer to Appendix D: "Programming" - CURRENT LOOP.



Fixed Current Limit

For normal operation of the main current limit, connect Terminal A6 (ANIN5) to Terminal B3 (+10V reference) and set the CURR.LIMIT/SCALER parameter to 200%. This allows the MAIN CURR.LIMIT parameter to adjust the current limit between 0 and 200% full load current.



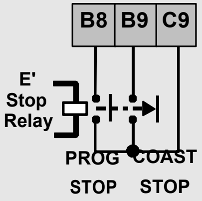
Variable Current Limit

If external control of the current demand is required, an additional 10K potentiometer connected between Terminal B3 (+10V Ref) and Terminal B1(0V), with the wiper connected to Terminal A6 (Analog I/P5) gives 0 to 200% of full load current provided that the MAIN CURR. LIMIT and CUR. LIMIT/SCALER parameters are set to 200%.

B8
B9
C9

Program Stop/Coast Stop ☐ ✓

Connect terminals B8 & B9 to C9 via an Emergency Stop relay.



These connections provide a Program Stop (B8), and a Coast Stop (B9).
Refer to Chapter 4: "Operating the Drive" - Starting and Stopping Methods.

The "Emergency Stop" relay (normally-open, delay on de-energisation) should not be part of the normal sequencing system which is implemented via the Start contacts, but is a relay which can be operated in exceptional circumstances where human safety is of paramount importance.

- Removing 24V from B9 opens the main contactor via the relay
- Removing 24V from B8 provides regenerative braking for 4 Quadrant DC900P drives

A regenerative drive can be stopped using a *Normal Stop*, a *Program Stop,* or an *Emergency Stop.* However, a non-regenerative drive can only be made to stop faster than friction and loading will allow by Dynamic Braking.

Control Connections continued

C5
C9

Enable ☐ ✓

Connect terminal C5 to C9.

Terminal C5 (Enable) must be connected to C9 (+24V) to allow the drive to run.

Connection via a switch is useful to inhibit the drive without opening the main contactor, however, it is not a safe mode of operation as the drive dc output is only reduced to zero. If the equipment controlled by the drive is to be serviced, then this method should be avoided and the drive disabled and isolated.
It is important that more than one stop input (ENABLE C5, START/RUN C3, COAST STOP B9, PROG STOP B8) is always used to ensure stopping of the drive under single fault conditions .

C3
C9

Start/Run ☐ ✓

Connect terminal C3 to C9 via a switch.

When the single contact between C3 and C9 is closed the drive will run provided that:

- B8 & B9 are TRUE (+24V) - see "Emergency Stop" above
- C5 is TRUE (+24V) - see "Enable" above

When the single contact between C3 and C9 is opened the drive will decelerate the motor to zero speed at a rate determined by the STOP TIME parameter’s value and the MAIN CURR. LIMIT value. Refer to Appendix D: “Programming” - STOP RATES for further details.

NOTE **If Enable C5 is opened during a Normal Stop sequence, the drive is disabled, the contactor opens, and the drive will Coast To Stop.**

C4
C9

Jog/Slack ☐ ✓

Connect terminal C4 to C9 via a switch or pushbutton.

- If the drive is stationary this switch provides a Jog facility.
- If the drive is running, this switch provides a Take-Up Slack facility.

For other user-definable operating modes, refer to Appendix D: "Programming" - JOG/SLACK for further details.

Control Connections continued

C1
C2

External Trip ☐ ✓

Connect terminal C1 to C2, or link terminals if not required.

Terminals C1 and C2 must be linked if an External Trip interlock is not required.

This input terminal provides an external trip facility to any normally-closed trip switch , e.g. for vent fan overload protection.

C1
B6

Drive Healthy ☐ ✓

Connect terminal C1 to B6 via a lamp (for example).

This is one of three digital output terminals that provide a +24V dc output signal under certain conditions. They allow for the connection of relays which, in conjunction with the Enable, Start/Run and Emergency Stop relay, can be used to enhance the safe starting and stopping of the controller.

The drive is "healthy" (TRUE) if there is no Start command.

These are configurable outputs and can be used as required in the control system design, i.e. cubicle door lamps, connection to a suitable PLC.

B5
B6
B7

Digital Outputs

User connection to external equipment.

There are three digital output terminals that provide a +24V dc output signal under certain conditions. They allow for the connection of relays which, in conjunction with the Enable, Start/Run and Emergency Stop relay, can be used to enhance the safe starting and stopping of the controller.

These are configurable outputs and can be used as required in the control system design, i.e. cubicle door lamps, connection to a suitable PLC.

The default actions are:

- B5 = Zero Speed Detected
- B6 = Drive Healthy
- B7 = Drive Ready

Refer to Appendix E: "Technical Specifications" - Terminal Information - Control Board, also Chapter 6: "The Keypad" - DIAGNOSTICS.

Control Connections continued

Direct Speed Setpoints

A2 **A3** **C8**

Connect your external setpoint(s) and/or A3.

Speed Setpoint No. 1 (A2)

This input is configurable Terminal A2 (Analog Input 1) is a direct speed demand by-passing the "Setpoint Ramp Generator", and should be used if direct control is required.

Speed Setpoint No. 2 / Current Demand (A3)

This input is **not** configurable. Terminal A3 (Analog Input 2) is a dual function terminal (either "Speed Setpoint No. 2" or "Current Demand") as selected by mode switch control "Current Demand Isolate", Terminal C8. As a speed setpoint, it can be used in the same way as Terminal A2.

If more than one speed setpoint is used, they are additive. Also refer back to A4, Ramp Speed Setpoint, page 3-22.

Auxiliary Current Clamp (-ve)

A5 **B4** **C6** **C9**

Connect terminal A5 to B4 to provide -10V, or supply externally.

Connect terminal C6 to C9 to enable bipolar current clamps.

Used to allow separate control of positive and negative Main Current Clamps, for example, in Winder applications.

Enable bipolar current clamps by providing 24V at terminal C6. Terminal A5 (ANIN4) is an Auxiliary Current Clamp (-ve), 0 to -10V.

NOTE **If driven positive, it will form a current demand.**

The "ANIN 4 (A5)" function block contains parameters to set up maximum/minimum values for the analog input, and a scaling ratio.

With 24V at terminal C6, Terminal A6 (ANIN 5) acts only as the Auxiliary Current Clamp (+ve), 0 to +10V.

<table>
<tr><td colspan="3">**Control Connections continued**</td></tr>
<tr><td rowspan="2">**A7**
A8</td><td colspan="2">**Analog Outputs**</td></tr>
<tr><td>**User connection to external equipment**
.</td><td>These are configurable outputs and can be used as required in the control system design, i.e. connection to a meter, for cascading to another drive.
• Terminal A7, Analog Output 1 provides a Speed Feedback value, -10V to +10V
• Terminal A8, Analog Output 2 provides a Total Speed Setpoint value, -10V to +10V
The "ANOUT1" and "ANOUT2" function blocks contain parameters to configure the values.</td></tr>
<tr><td rowspan="2">**A9**</td><td colspan="2">**Current Meter Output**</td></tr>
<tr><td>**User connection to external equipment.**</td><td>This connection is for a Current Meter.
The "ARMATURE I (A9)" parameter is used to select either unipolar or bipolar output. Refer to Appendix D: "Programming" - CALIBRATION.
This ouput is **not** configurable. It is driven directly by hardware.</td></tr>
<tr><td rowspan="2">**C6**
C7
C8</td><td colspan="2">**Digital Inputs**</td></tr>
<tr><td>**User connections to the drive.**</td><td>These configurable 24V dc digital inputs are used to control the drive.
The default configurations are:
• C6 : Current Clamp Select (see **A5** and **A6**)
• C7 : Ramp Hold
• C8 : Current Demand Isolate (see **A3**)
Refer to Appendix E: "Technical Specifications" - Terminal Information - Control Board, also Appendix D: "Programming" - DIGITAL INPUTS.</td></tr>
</table>

Control Connections continued

G1
G2
G3
G4

Analog Tachometer

User connection to external equipment.

Fit the Tacho Calibration Option Board to the Drive.

This provides terminals G1 to G4.

Refer to Optional Equipment, page 3-53, for further information.

An Analog Tachometer is connected to the Drive using a screened twisted pair cable throughout its entire length to provide speed feedback via the Tacho Calibration Option Board. This provides facility for an AC or DC tachometer. The screen is grounded or earthed only at the drive end, any other grounding arrangement may cause problems.

- Terminals G1 & G2 are for AC tacho connections.
- Terminals G3 & G4 are for DC tacho connections.

NOTE **The speed loop is set-up for an analog tacho by the SPEED FBK SELECT parameter in the SPEED LOOP function block. Select ANALOG TACH for this parameter.**

If an AC tachogenerator is used the output is rectified to produce the dc feedback to the speed loop. Consequently, the controller can only be used with a positive setpoint.

Refer to Chapter 4: “Operating the Drive” for set-up information.

Control Connections continued

Wire-Ended Encoder

E1 **E2** **E3** **E4** **E5** **E6**	**User connection to external equipment.** **Fit the Encoder Board Option Board to the Drive.** **This provides terminals E1 to E6.**	Refer to O ptional Equipment, page 3 -53, for further information. The wire-ended encoder is connected to the Drive using a screened cable throughout its entire length to provide speed feedback. Terminals E1 (0V) and E2 (+24V dc) are the return and supply respectively. NOTE **The speed loop is set-up for the Encoder by the SPEED FBK SELECT parameter in the SPEED LOOP function block. Select ENCODER for this parameter.** The maximum allowable encoder frequency is 100kHz, thus with a standard 1000 lines per revolution encoder the motor speed cannot exceed 6000 rpm. For specification and connection information refer to DC900P Drives or the appropriate Technical Manual.

Technology Box Option

H1 **H2** **H3** **H4** **H5** **H6**	**User connection to external equipment.** **Fit the Technology Box Option to the Drive.** **This provides terminals H1 to H6.**	The Technology Box Option allows drives to be linked together to form a network. We can supply Options for most protocols. Refer to Appendix D: "Programming" - TEC OPTION for information about Technology Box Option types. For detailed information, refer to the appropriate Technical Manual supplied with the Technology Box.

Motor Field Options

WARNING

Isolate the drive before converting to internal/external supply.

The FIELD CONTROL function block controls the motor field. The FLD CTRL MODE parameter allows you to select either Voltage or Current Control mode.

- In Voltage Control mode, the FLD. VOLTS RATIO parameter is used to scale the motor field output voltage as a percentage of the input supply voltage.
- In Current Control mode, the SETPOINT parameter is used to set an absolute motor field output current, expressed as a percentage of the calibrated field current (IF CAL).

Internal/External Supply (Frames 2, 3, 4)

NOTE **The Frame 1 unit allows only an internal motor field supply. For information about the following terminal/power boards refer to Appendix E: "Technical Specifications" - Terminal Information (Power Board).**

The internal motor field is more widely used, however, there is provision on the unit for an external motor field supply to be connected (perhaps for where the field voltage is greater than the input voltage and therefore not attainable, or where the motor field is switched separately for convenience).

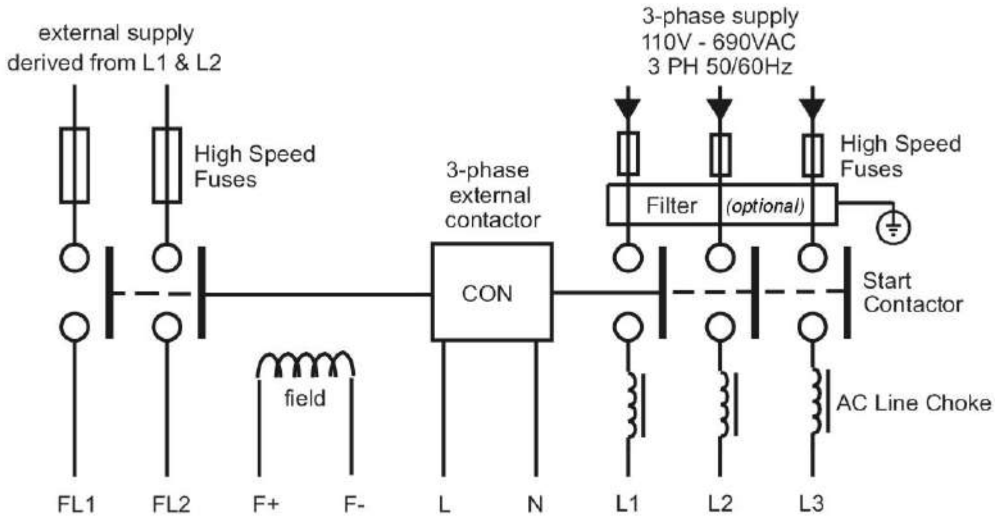
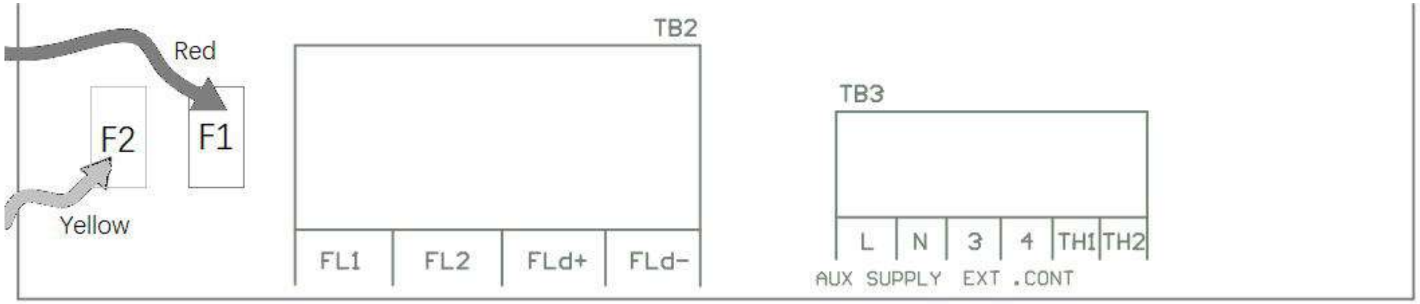


Figure 3- 12 Typical connection diagram

Reference 030101011 (Frame 2)

The position of the jumper selects the board to use either an internal or external motor field.



Internal Motor Field (default for this board)

Terminals F+ and F-, the motor field outputs, are energised when the 3-phase supply is connected to L1/L2/L3. Terminals FL1 and FL2 are not required. The internal motor field supply is fused by 10A fuses, FS5 & FS6.

External Motor Field Connections

Terminals FL1 and FL2 can be used for external ac supply connection for the Motor Field Supply. You should provide suitably rated external, fast-acting semi-conductor fusing, to a maximum of 10A.

Caution

When using an external ac input it is important to have the correct phase relationship on the terminals. The supply must be derived from L1 (Red) and L2 (Yellow) phases directly or indirectly through a single-phase transformer.
L1 must be connected to FL1 through F1 , and L2 connected to FL2 through F2.

The external field supply can now be connected and power restored to the drive.

Power Board-PCB Reference 030101008 (Frame 3)

This power board (printed with the above number) can be altered for use with either an internal or external motor field supply:

Internal Motor Field (default for this board)

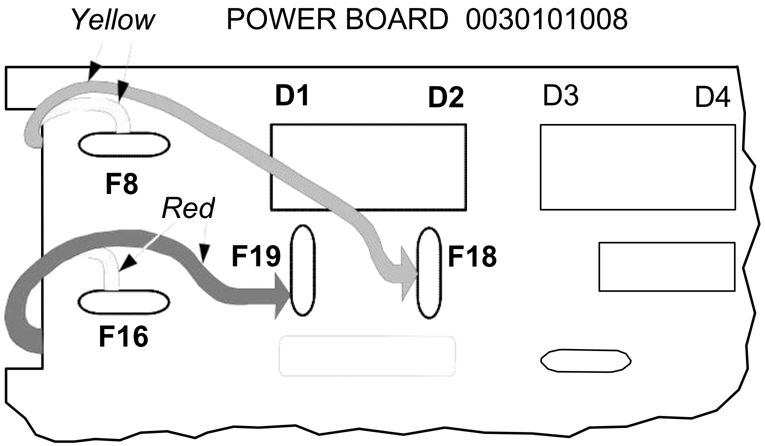
Terminals D3 and D4, the motor field outputs, are energised when the 3-phase supply to L1/L2/L3 is energised and the internal motor field is used. Terminals D1 and D2 are not energised. The internal motor field supply is fused by the 10A fuses, FS2 & FS3.

External Motor Field Connections

Terminals D1 and D2 on the Power Board can be used for an external ac supply connection for the Motor Field Supply.

A simple re-wiring procedure disconnects the internal motor field supply and prepares terminals D1 and D2 for the external ac supply connection.

You should provide suitably rated external, fast-acting semi-conductor fusing, to a maximum of 10A.



Re-Wiring Procedure

WARNING

Isolate all power to the drive.

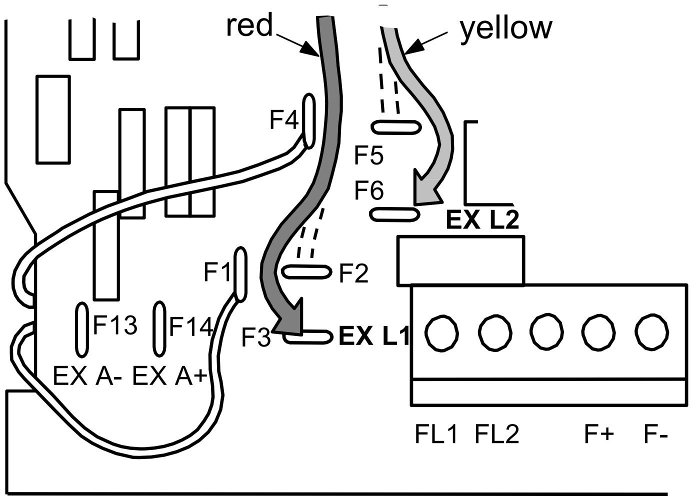
1. Loosen the control board fixing screws (2 off) and position the control board to allow access to the power board.
2. Remove the **red** link from the Faston connector “F16” on the left-hand side of the board and connect it to staging post “F19”, located below terminal D1.
3. Remove the **yellow** link wire from the Faston connector **“**F8” on the left-hand side of the board and connect it to staging post **“**F18”, located below terminal D2.

Caution

When using an external ac input it is important to have the correct phase relationship on the terminals. The supply must be derived from L1 (Red) and L2 (Yellow) phases directly or indirectly through a single phase transformer.
L1 must be connected to D1, and L2 connected to D2.

The external field supply can now be connected and power restored to the drive.

This power board (printed with the above number) can be altered for use with either an internal or external motor field supply:



Internal Motor Field (default for this board)

Terminals F+ and F-, the motor field outputs, are energised when the 3-phase supply to L1/L2/L3 is energised and the internal motor field is used. Terminals FL1 and FL2 are not energised. The internal motor field supply is fused by the 30A fuses FS1 and FS2.

External Motor Field Connections

Terminals FL1 and FL2 on the Power Board can be used for an external ac supply connection for the Motor Field Supply.

A simple re-wiring procedure disconnects the internal field supply and prepares terminals FL1 and FL2 for the external ac supply connection.

You should provide suitably rated external, fast-acting semi-conductor fusing, to a maximum of 30A.

Re-Wiring Procedure

WARNING

Isolate all power to the drive.

1. Loosen the control board fixing screws (2 off) and position the control board to allow access to the power board.
2. Remove the **red** link from the Faston connector “F2” and connect it to the staging post “F3” nearby (EX L1).
3. Remove the **yellow** link wire from the Faston connector “F5” and connect it to the staging post “F6” nearby (EX L2).

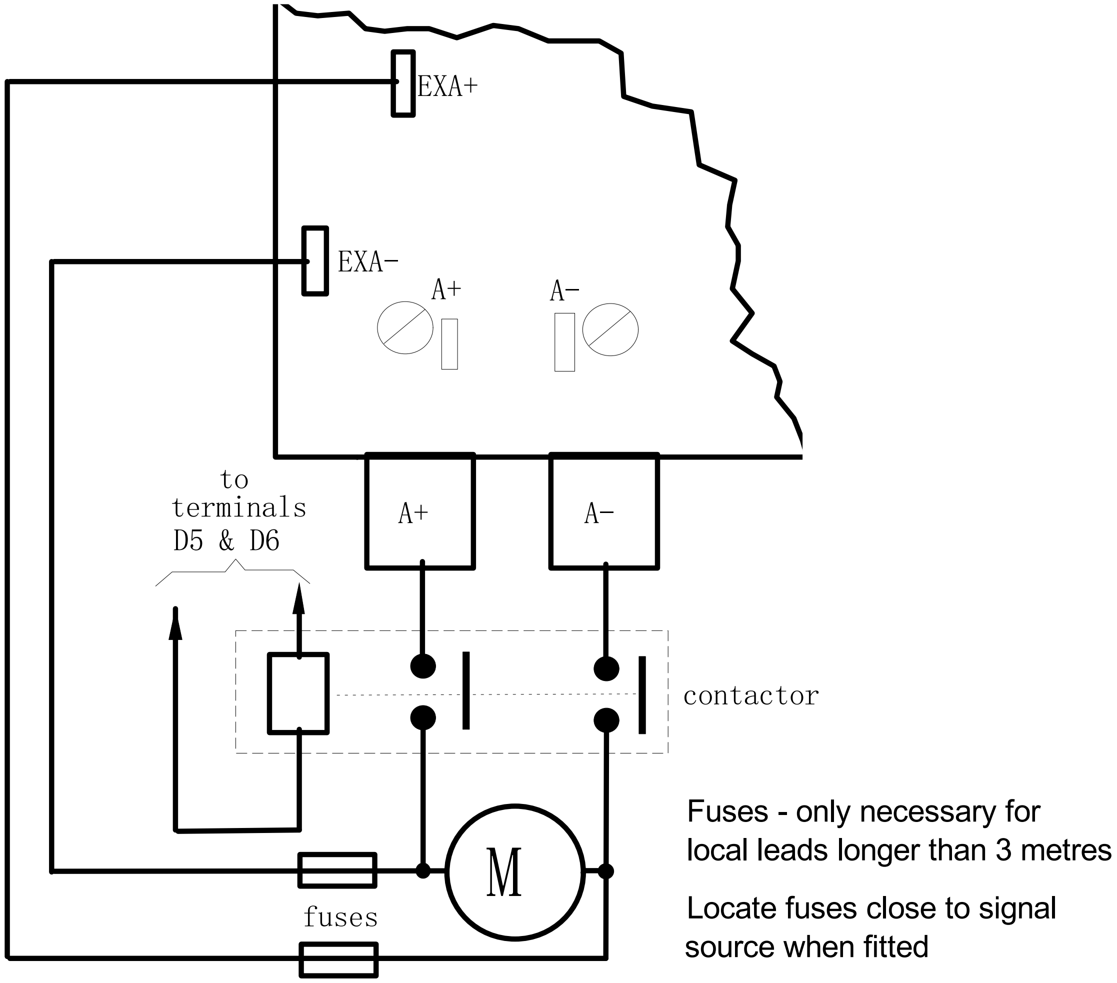
Caution

When using an external ac input it is important to have the correct phase relationship on the terminals. The supply must be derived from L1 (Red) and L2 (Yellow) phases directly or indirectly through a single phase transformer.
L1 must be in phase with FL1, and L2 must be in phase with FL2

DC Contactor - External Va Sensing

Connections are provided for external armature voltage sensing (at the motor) for when a dc contactor is used between the drive and motor.

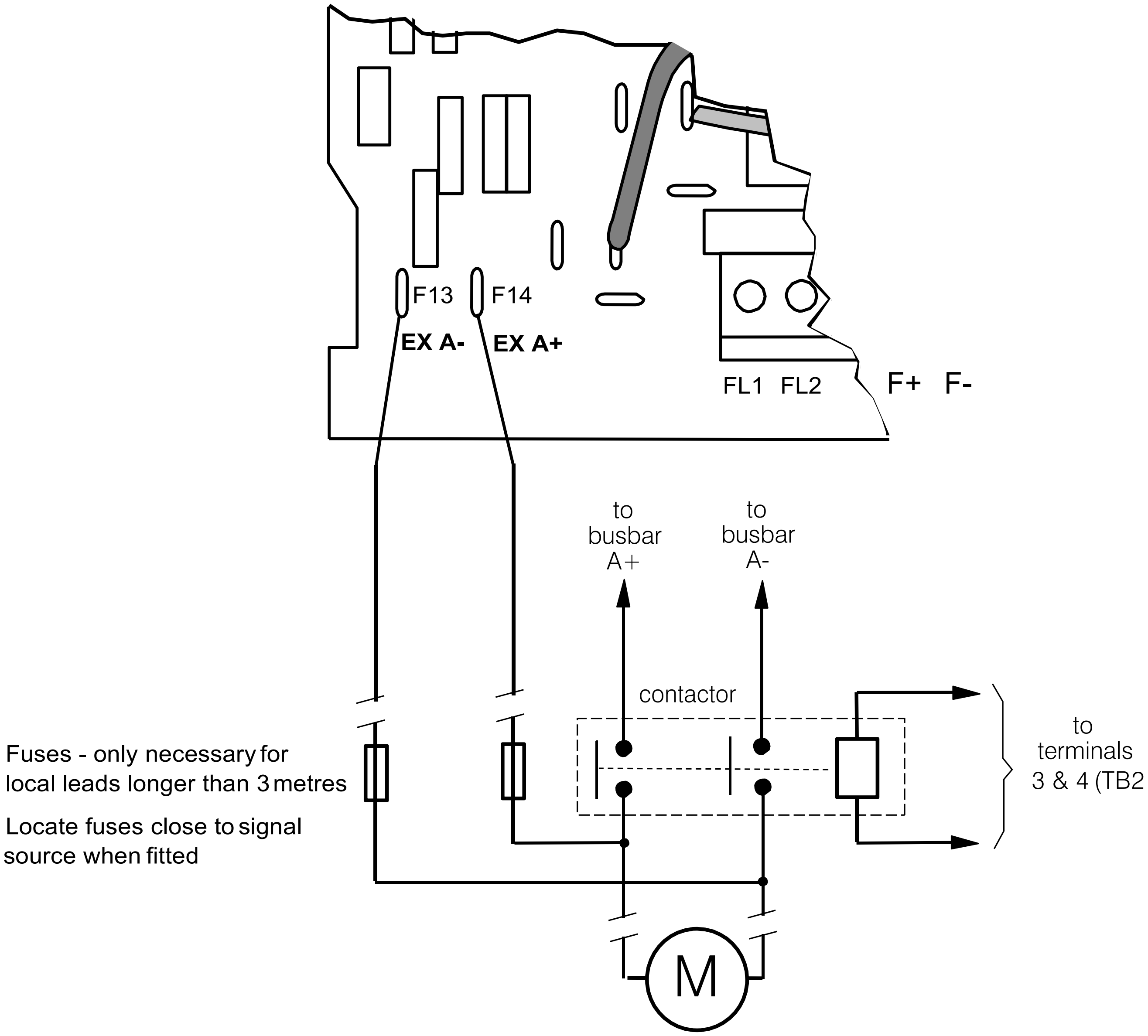
Power Board - PCB Reference 030101008 (Frame 3)



Fuses - only necessary for local leads longer than 3 metres

Locate fuses close to signal source when fitted

Power Board-PCB Reference 030101005 (Frames 4)



Fuses - only necessary for local leads longer than 3 metres

Locate fuses close to signal source when fitted

Power Board Circuit Descriptions

030101013 (Frame 1)

(2 Quad and 4 Quad)

Power supplies for the controller are generated from the single phase auxiliary supply via a Switched Mode Power Supply. The incoming supply is directly rectified to provide a high voltage dc power rail. A high voltage transistor switches this rail on to the primary of a high frequency transformer, the output of which is rectified and smoothed to provide the dc power supply rails. The +15V dc rail is monitored via a reference element and a control signal returned via an opto-isolator to the control element of the high voltage switching transistor. The other dc rails (-15V & +24V dc) are generated via separate secondary windings which are rectified and smoothed, with a separate SMPS element providing a regulated +5V dc rail. The SMPS operates over a0n input voltage range of 110V to 240V ac ±10%, 50/60Hz.

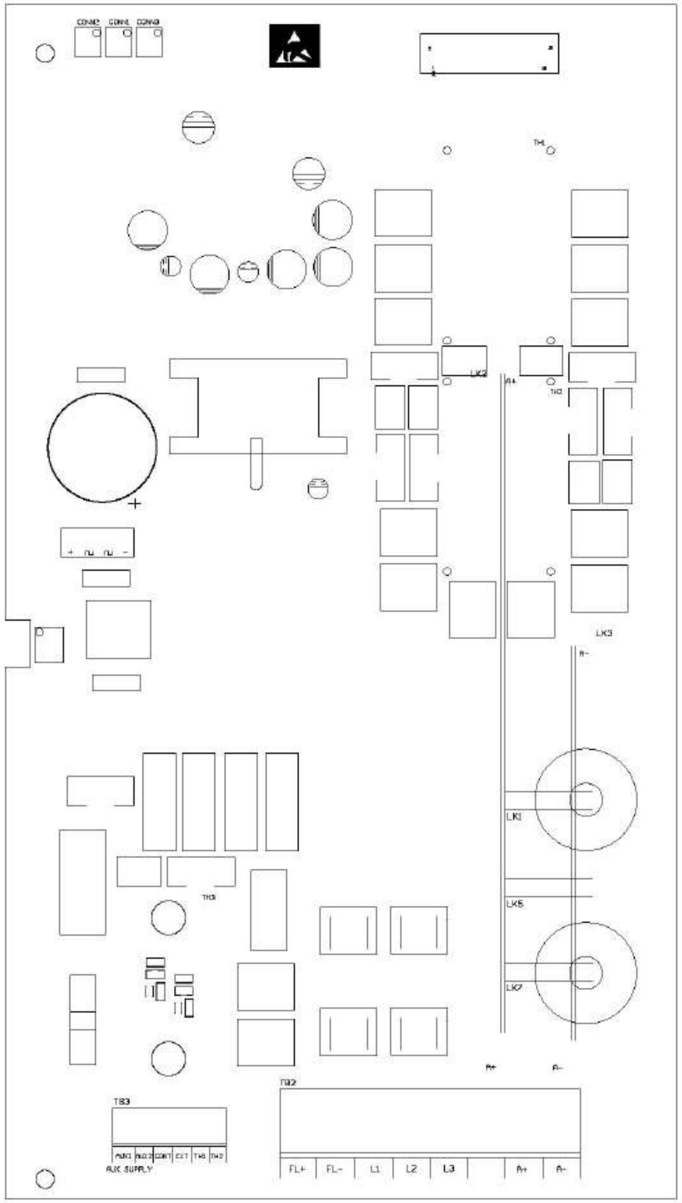


Figure 3- 13 900P Power Board 4 Quad

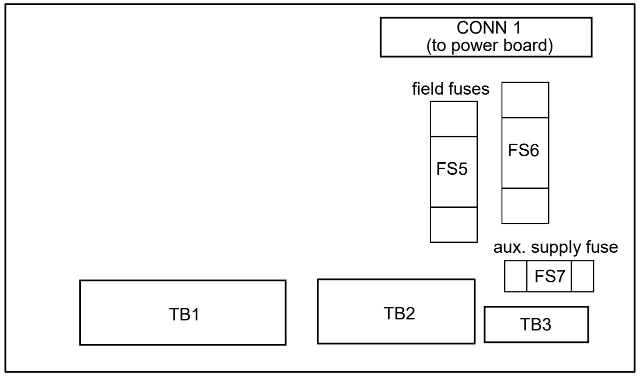


Figure 3- 14 Terminal Board

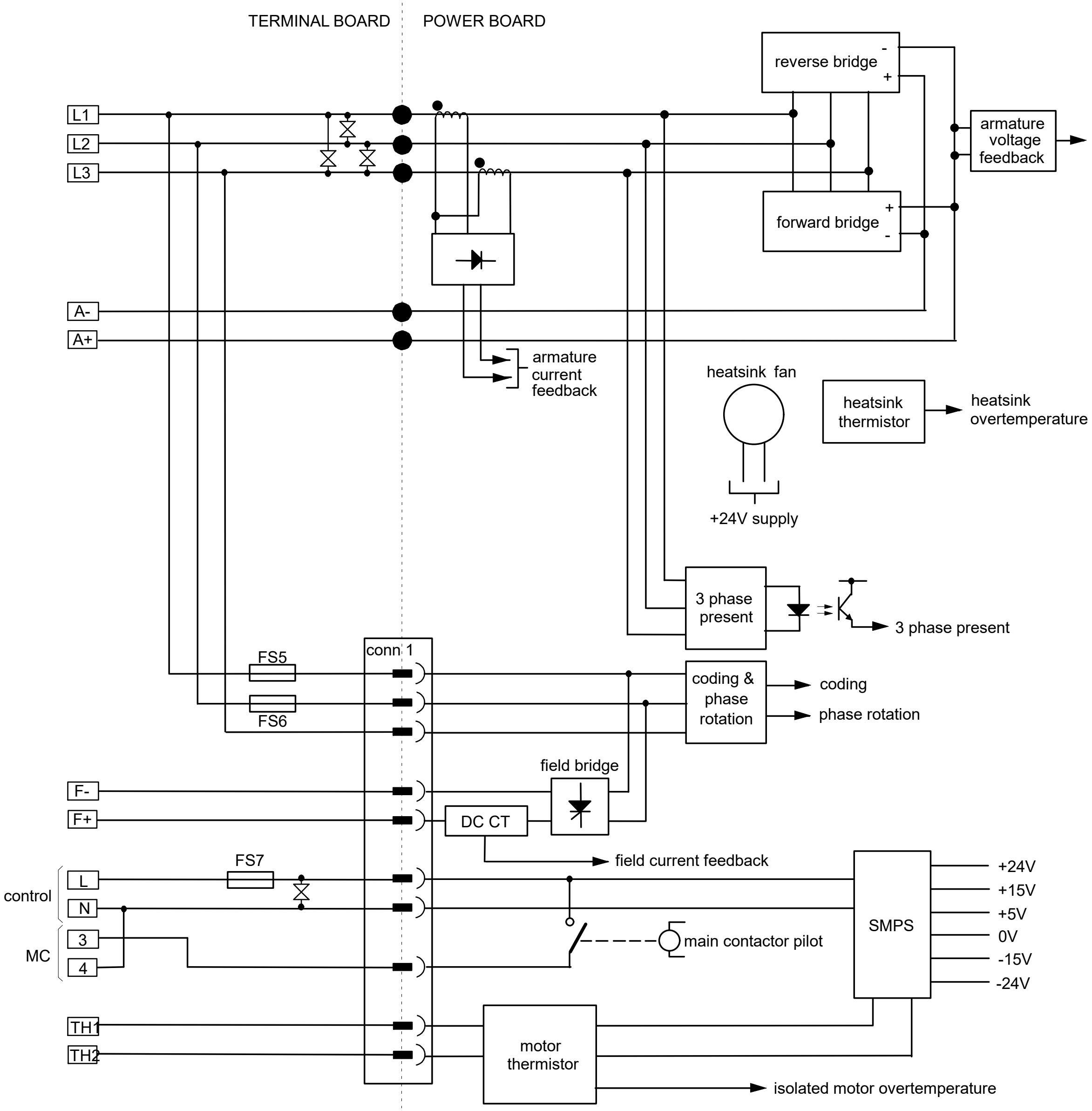


Figure 3- 15 Connection Diagram for Power Board and Terminal Board - 030101013 (Frame 1)

030101011 (Frame 2)

(2 Quad and 4 Quad)

Power supplies for the controller are generated from the single phase auxiliary supply via a Switched Mode Power Supply. The incoming supply is directly rectified to provide a high voltage dc power rail. A high voltage transistor switches this rail on to the primary of a high frequency transformer, the output of which is rectified and smoothed to provide the dc power supply rails. The +15V dc rail is monitored via a reference element and a control signal returned via an opto-isolator to the control element of the high voltage switching transistor. The other dc rails (-15V & +24V dc) are generated via separate secondary windings which are rectified and smoothed, with a separate SMPS element providing a regulated +5V dc rail. The SMPS operates over an input voltage range of 110V to 240V ac ±10%, 50/60Hz.

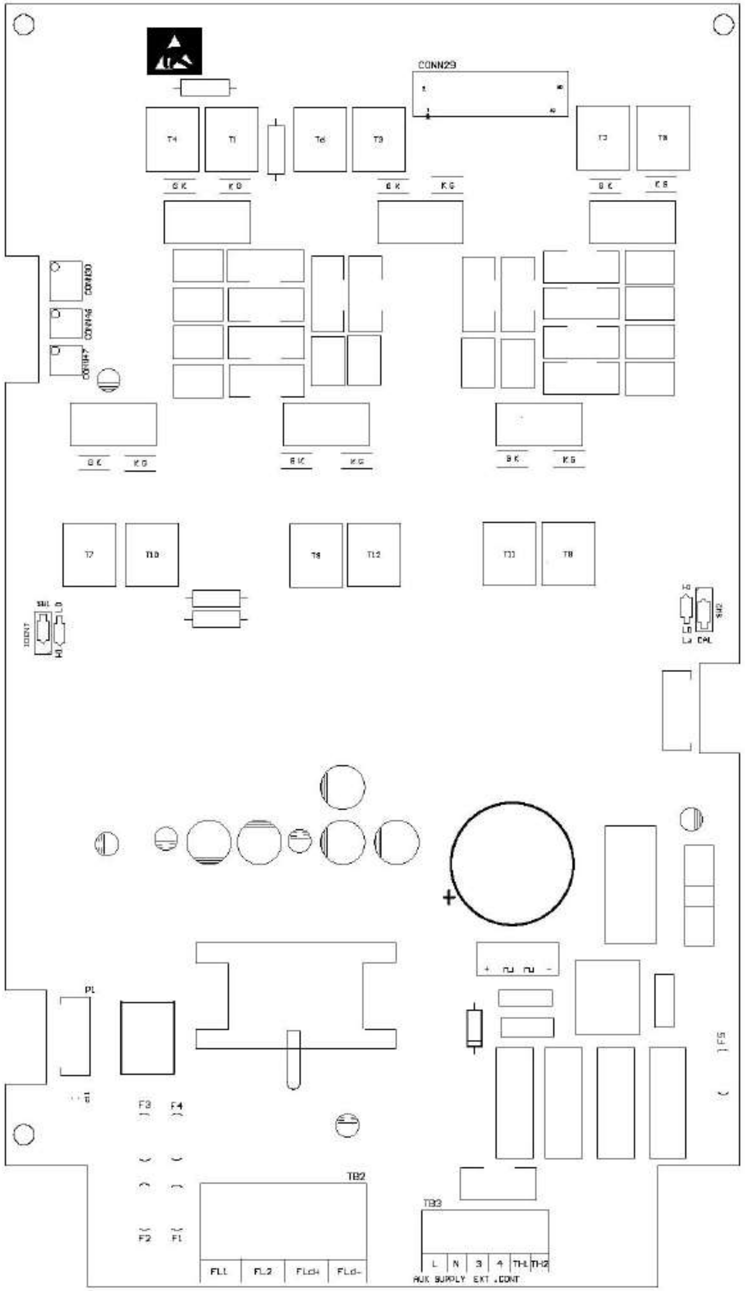


Figure 3- 16 900P Power Board

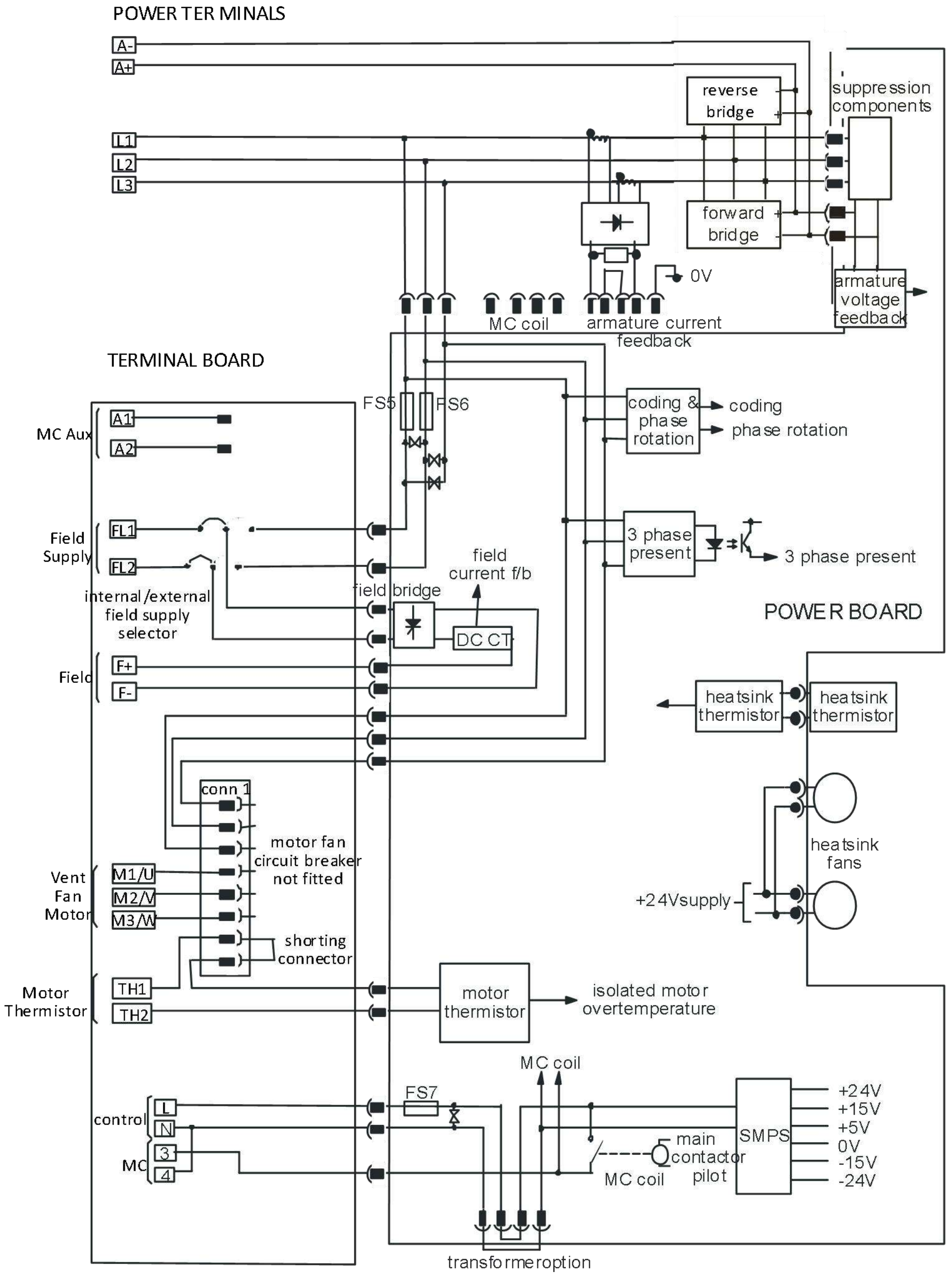


Figure 3- 17 030101011 (Frame 2)

030101008 (Frame 3)

(900P - 4 Quad, 901P - 2 Quad; Low and High Volt)

Power supplies for the controller are generated from the single phase auxiliary supply via a switched mode power supply. The incoming supply is directly rectified to provide a high voltage dc power rail. A high voltage transistor switches this rail on to the primary of a high frequency transformer, the output of which is rectified and smoothed to provide the dc power supply rails. The +5V dc rail is monitored via a reference element and a control signal returned via an opto-isolator to the control element of the high voltage switching transistor. The ±15V dc rails are generated via separate secondary windings which are rectified, smoothed and stabilised by linear regulators. The SMPS operates over an input voltage range of 110V to 240V ac ±10%, 50/60Hz. The auxiliary supply fuse FS1 provides protection of the high voltage elements.

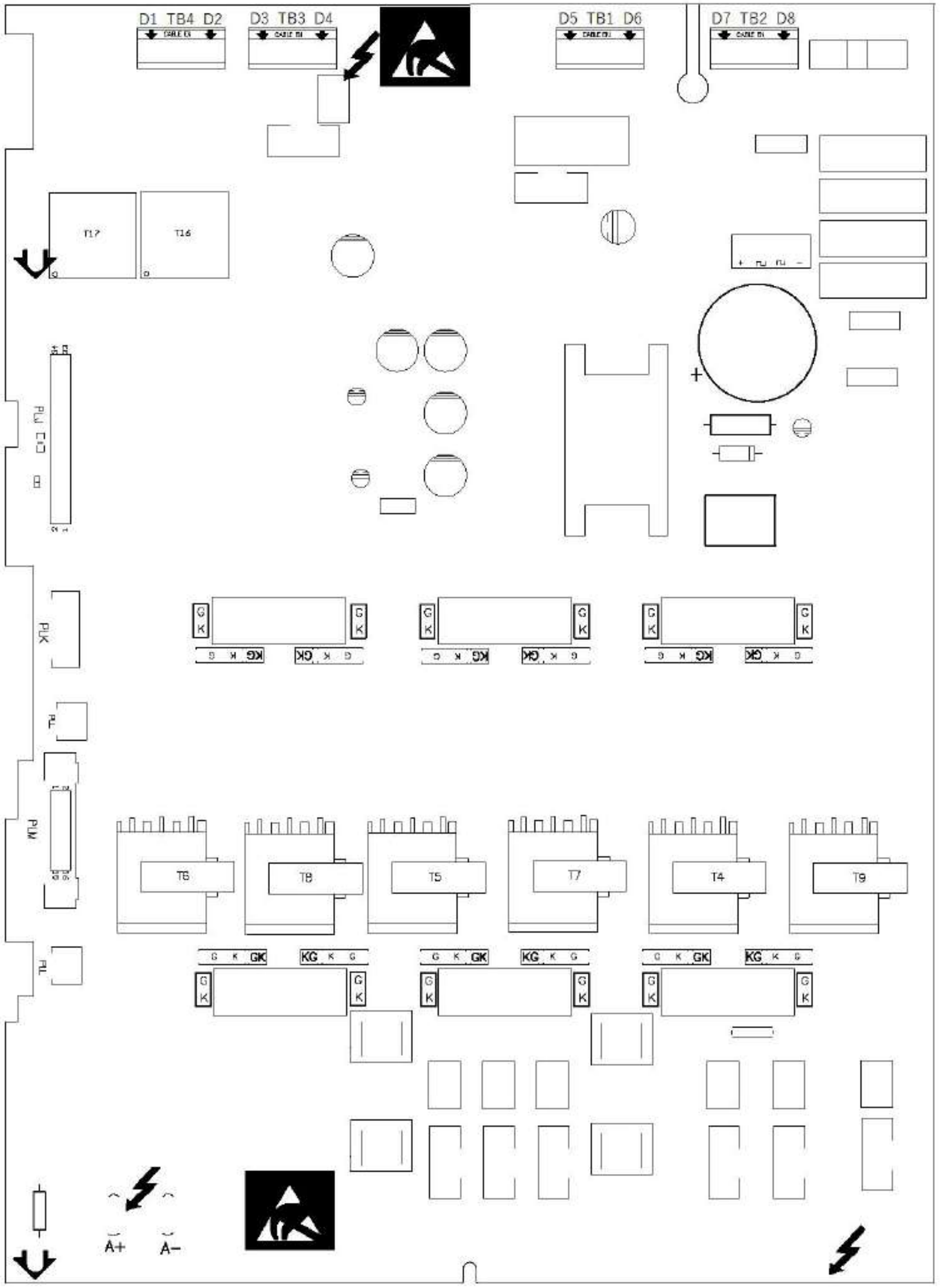


Figure 3- 18 901P Power Board 2 Quad (030101008) - (Frame 3)

Heatsink Cooling Fan Connections

When fitted, these fans are connected on the power board to FAN LIVE (F27), FAN NEUTRAL (F24) and FAN COMMON (F23) as described below:

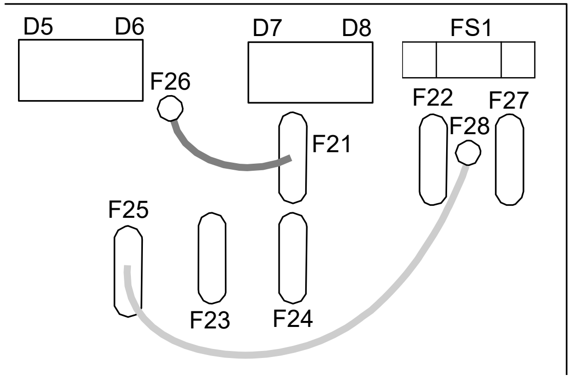
- A single fan must be matched to the auxiliary supply and connected to F27 and F24.
- Two fans using a 110/115V auxiliary supply must be connected in parallel to F27 and F24.
- Two fans using a 220/240V auxiliary supply must be connected in series to F27 and F24 using F23 as the centre point.

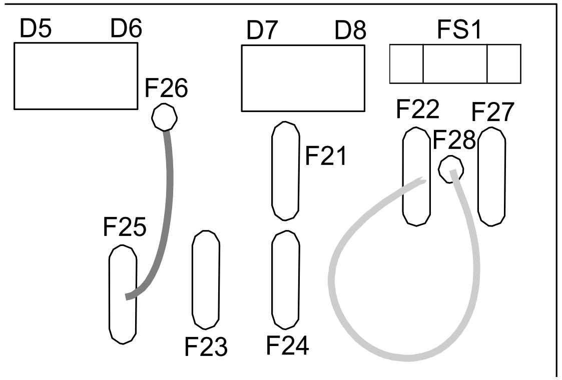
Contactor Supply

The controller requires an ac or dc power contactor in series with the main power path to ensure correct power-up sequencing. This contactor is directly initiated by the Microcontroller via an isolating relay which drives the contactor coil with the same voltage as that of the auxiliary supply.

This is achieved by the brown wire connection from COIL LIVE (F28) to RELAY (F25) and the blue wire connection from COIL NEUTRAL (F21) to CONTACTOR RETURN (F26).

However, if an alternative supply for the contactor coil is required move the brown wire from F25 to F22 , and move the blue wire from F21 to F25. The external coil supply can now be switched using a volt-free contact between terminals D5 and D6.





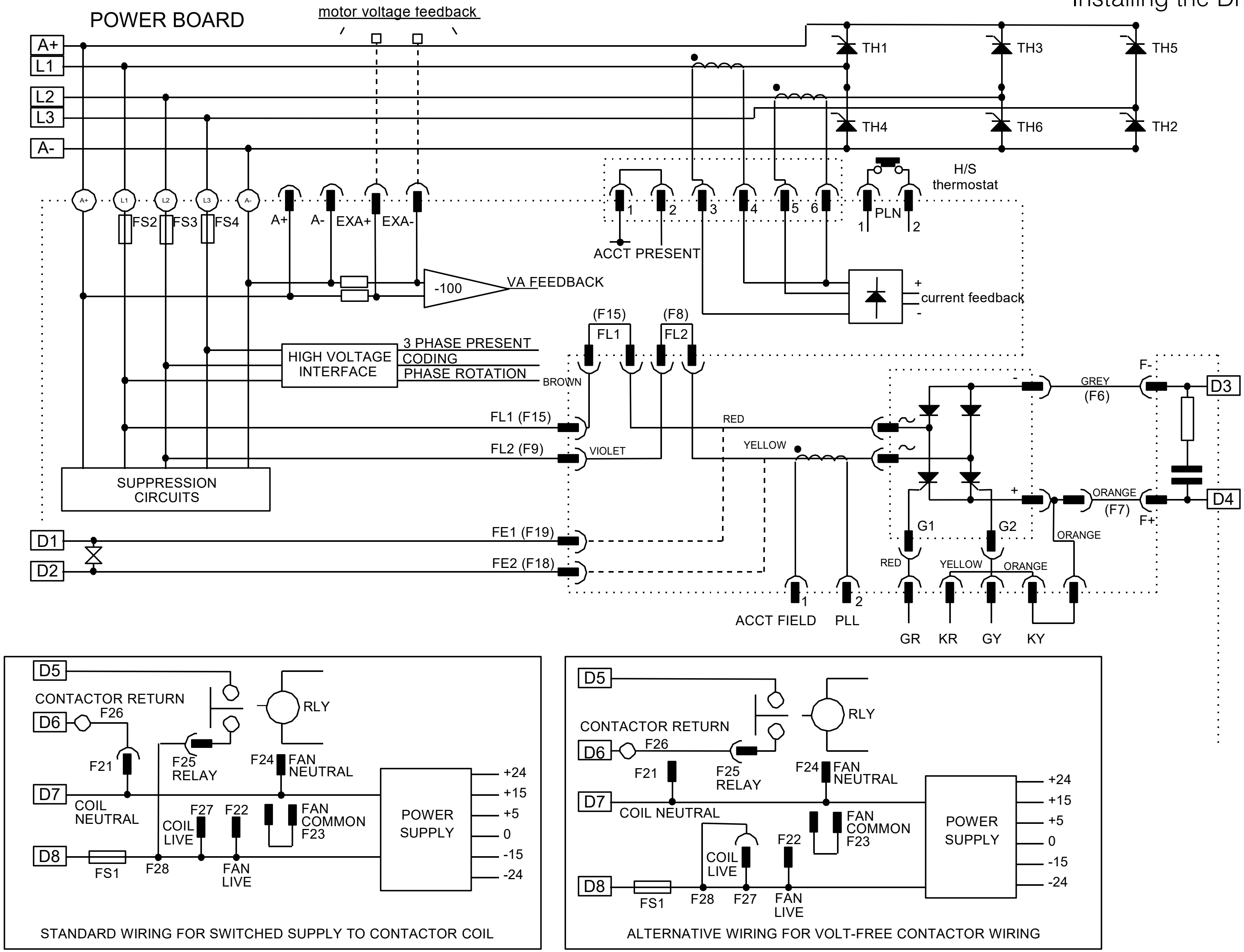


Figure 3- 19 37 Quad Power Circuit - using 030101008 (Frame

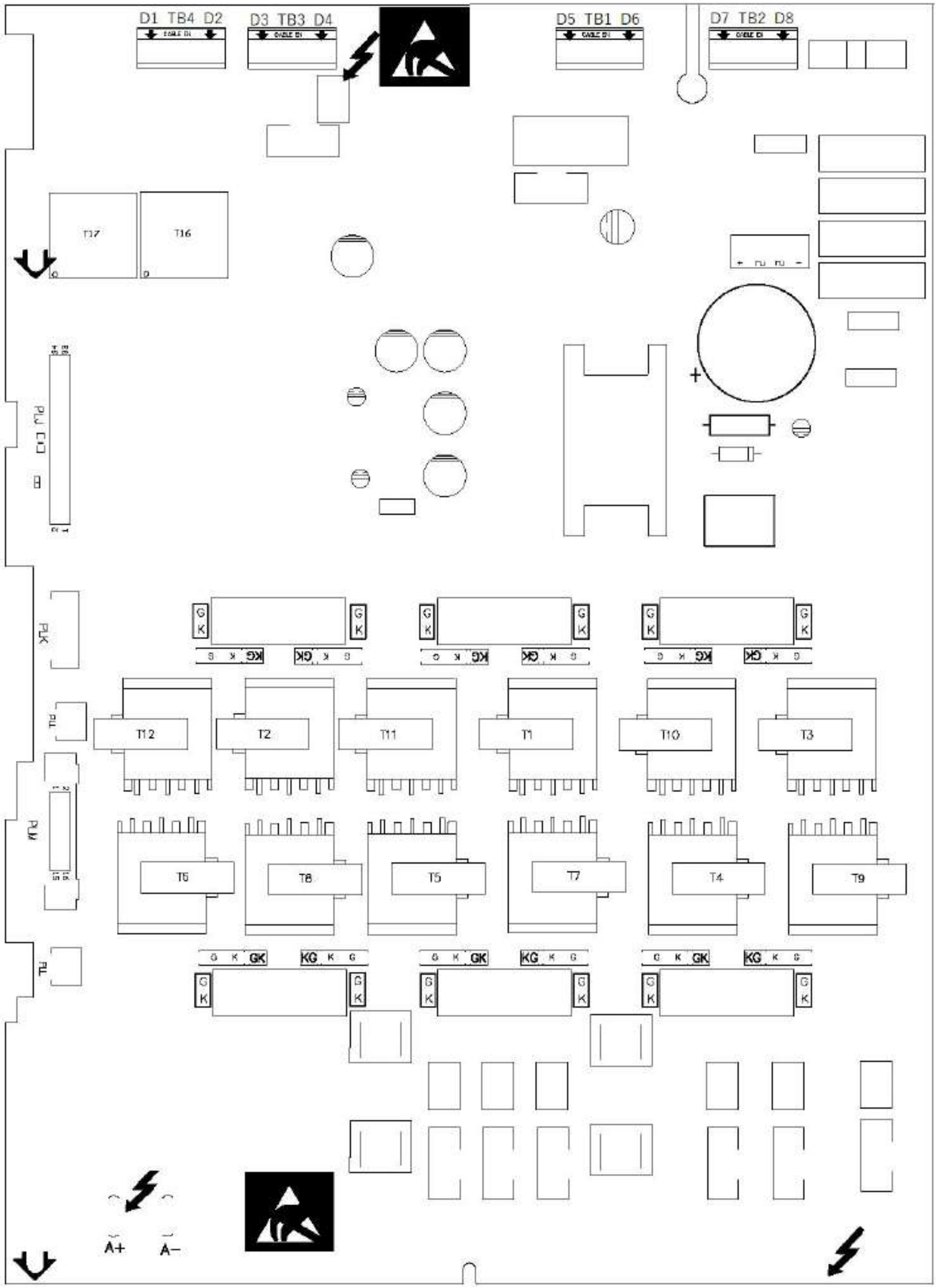


Figure 3- 20 900P Power Board 4 Quad (030101008) - (Frame 3)

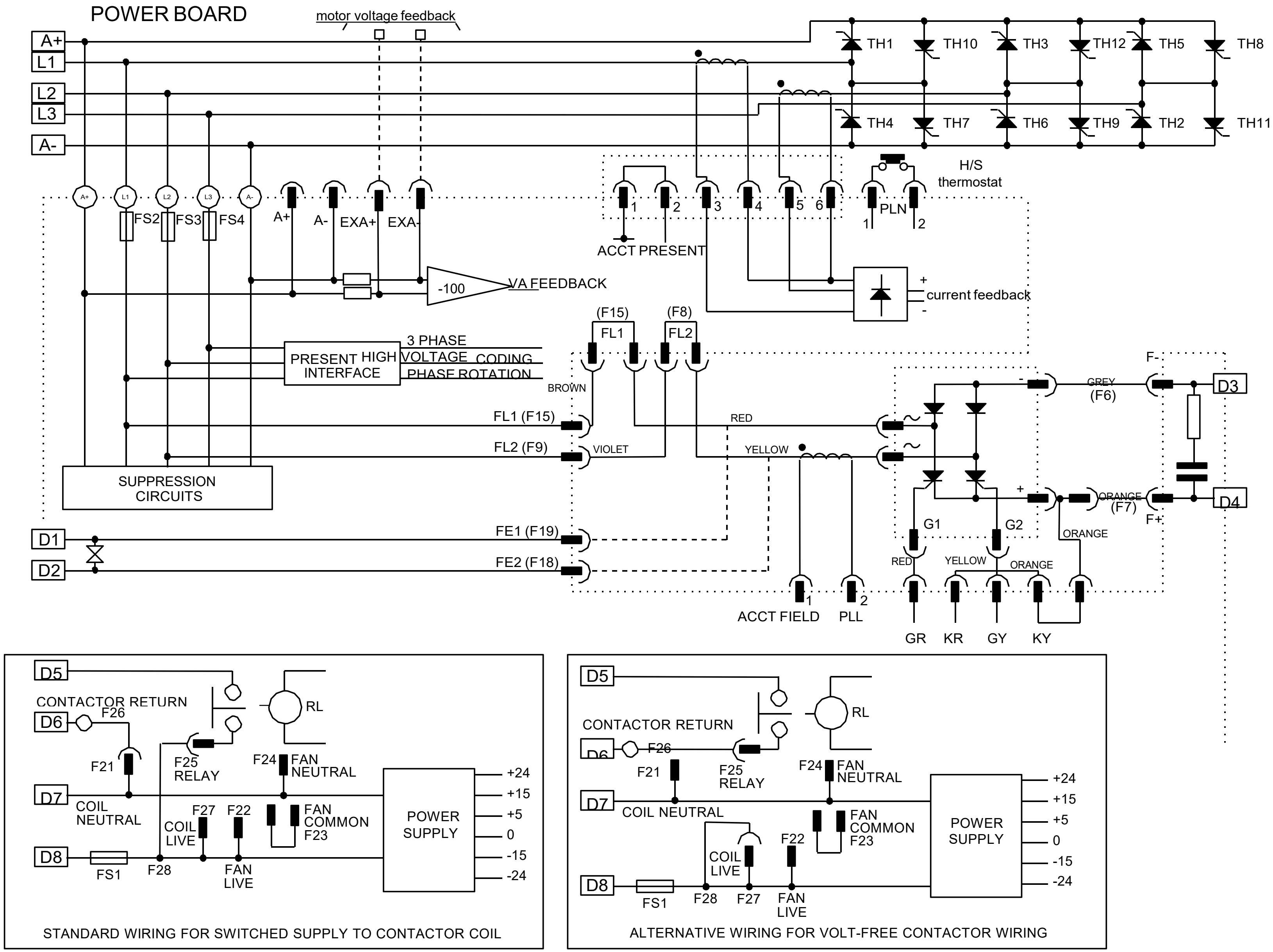


Figure 3- 21 4 Quad Power Circuit - using 030101008 (Frame 3)

030101005 (Frames 4)

900P 4 Quad and 901P 2 Quad; Low, Medium and High Volt

Power supplies for the controller are generated from the single phase auxiliary supply via a Switched Mode Power Supply. The incoming supply is directly rectified to provide a high voltage dc power rail. A high voltage transistor switches this rail on to the primary of a high frequency transformer, the output of which is rectified and smoothed to provide the dc power supply rails. The +15V dc rail is monitored via a reference element and a control signal returned via an opto-isolator to the control element of the high voltage switching transistor. The other dc rails (-15V & +24V dc) are generated via separate secondary windings which are rectified and smoothed, with a separate SMPS element providing a regulated +5V dc rail. The SMPS operates over an input voltage range of 110V to 240V ac ±10%, 50/60Hz.

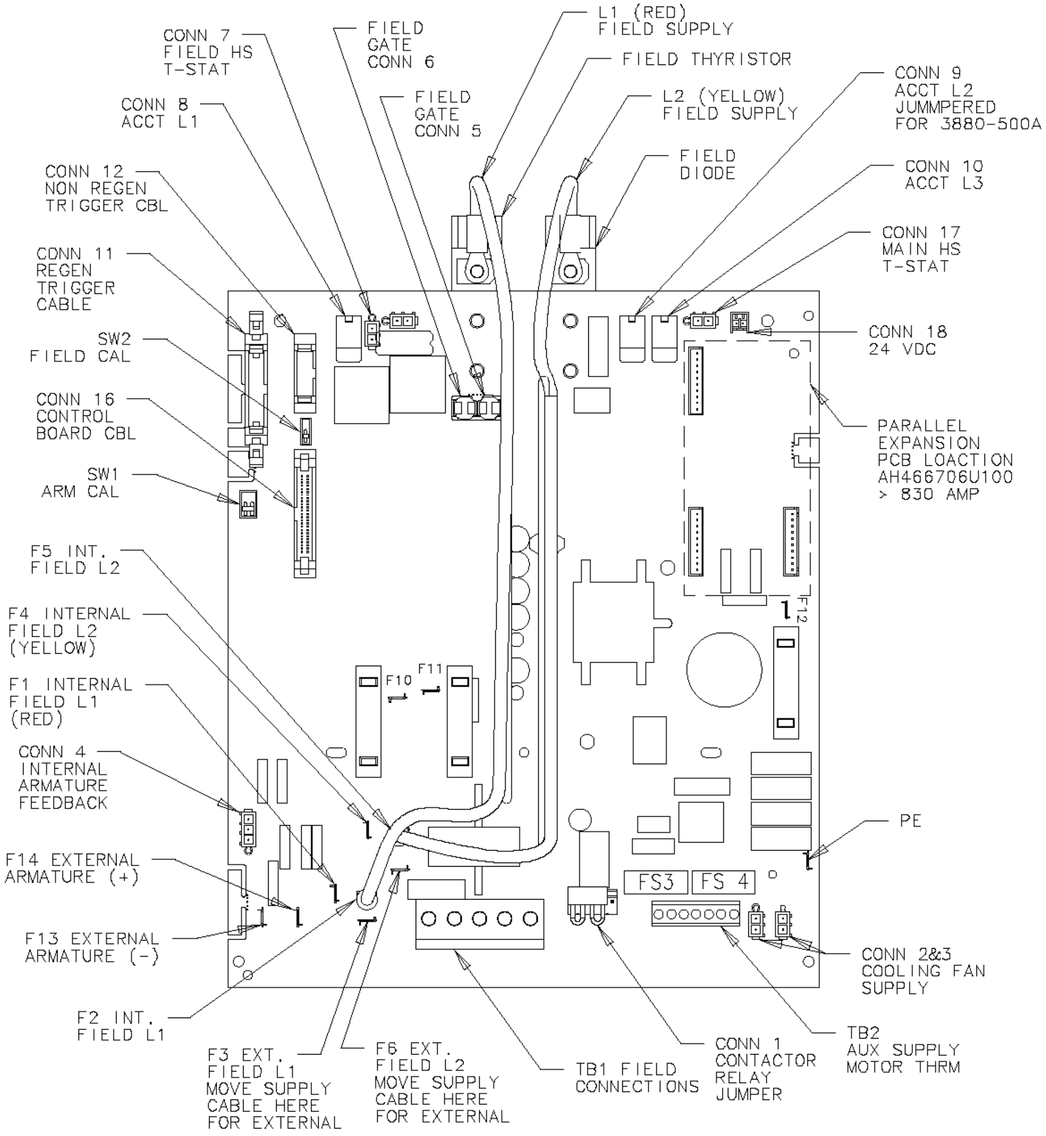


Figure 3- 22
900P/901P Power Board

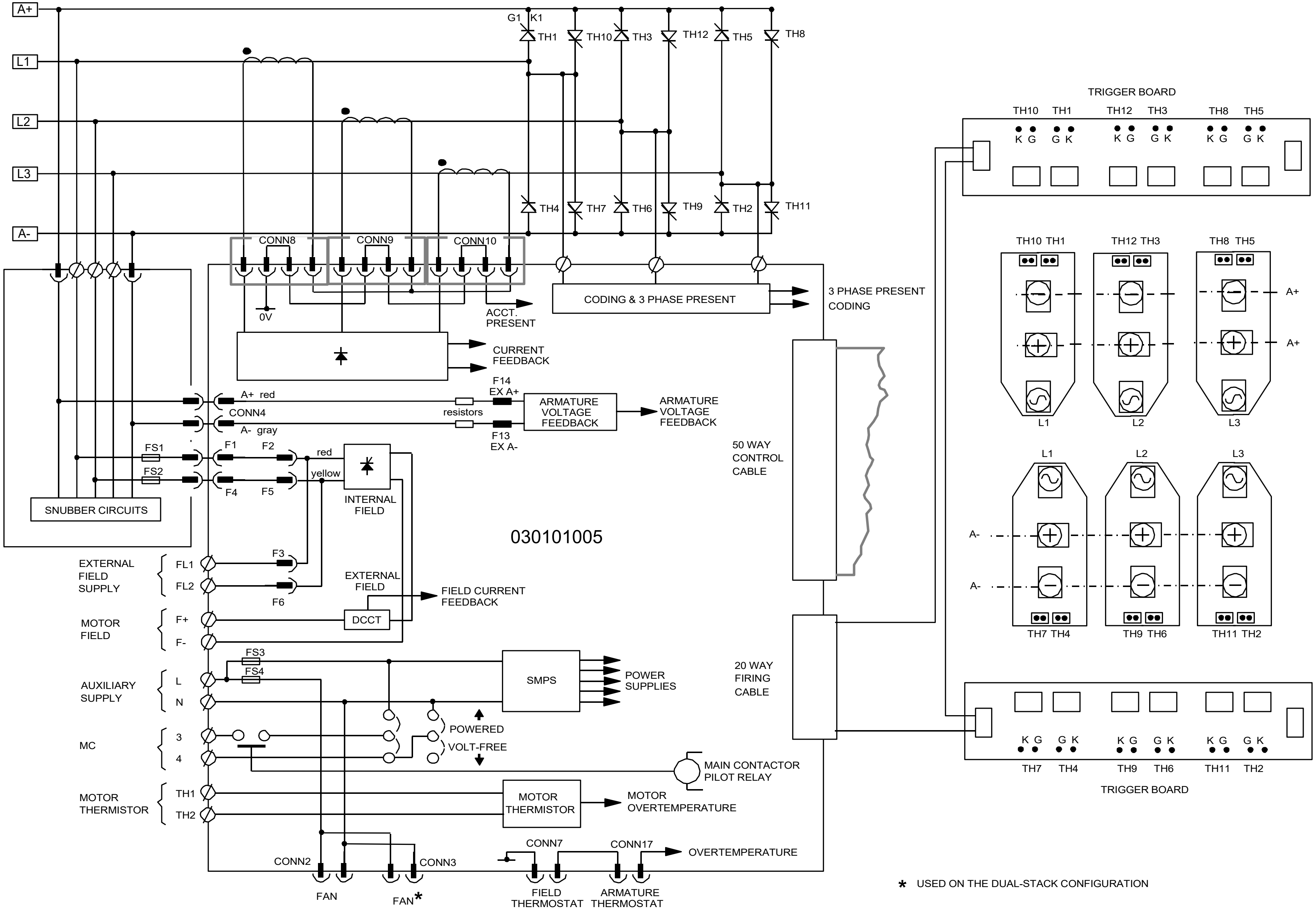


Figure 3- 23 4 Quad Power Circuit – Frame 4 Units using 030101005

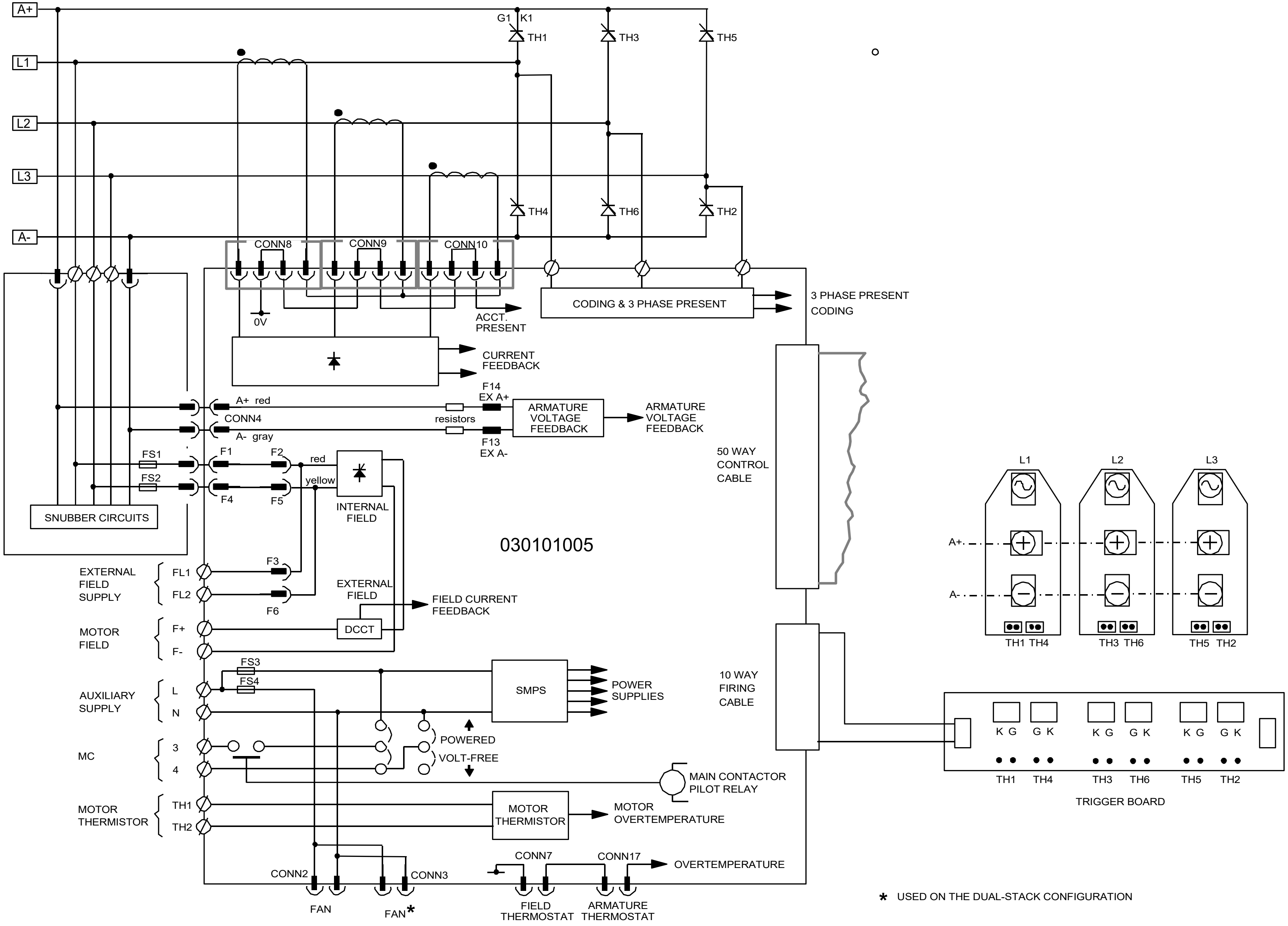


Figure 3- 24 2 Quad Power Circuit – Frame 4 Units using 030101005

Optional Equipment

Contact your local D Drives office to order optional equipment.

Item	Part Number
900 Digital Section Control *A DC900P Drives application manual detailing the use of the block diagram to implement open and closed loop control of driven web section rolls*	
CACT *DC900P Drives' Windows-based block programming software*	
Encoder Option Board *A board to interface to a wire-ended encoder*	*030101004*
Tacho Calibration Option Board *A switchable calibration board for interfacing to AC/DC analog tachogenerators*	030101007
Comms Option Board (P1) Board *Two board types for supporting EI BYSYNCH or PROFIBUS communication protocols for connection to other equipment.* • *RS485* • *PROFIBUS* • *PROFINT*	*030101018* *030101009*

Remote Mounting the Keypad

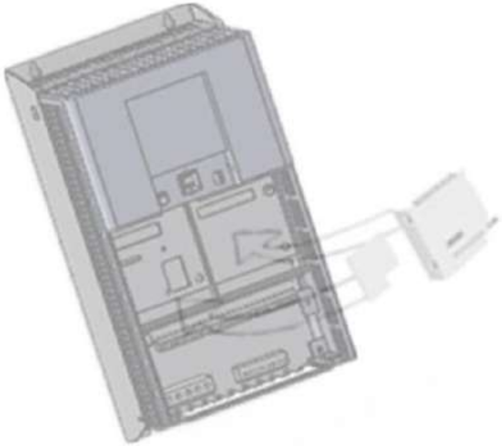
The 6052 Mounting Kit is required to remote-mount a 6901 or 6911 Keypad. An enclosure rating of IP54 is achieved for the remote Keypad when correctly mounted using the 6052 Mounting Kit

Speed Feedback and Technology Options

The Options are:

1. Speed Feedback (Analog Tacho Calibration Option Board or Encoder Feedback Option Card)
2. Communications Technology Box (Profinet, Profibus, Serial RS485)

They are inserted separately into the specified position, as illustrated.

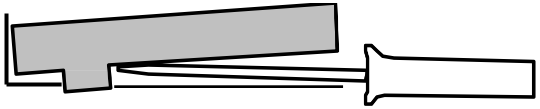


You can operate the Inverter with the Speed Feedback and/or Communications Technology Options.

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

Removal

After removing the earthing screw, remove the COMMS option by carefully pushing a long screwdriver (for instance) under the option and gently levering it out. The pins are protected by the option moulding.



WARNING

Isolate the drive before fitting or removing the options.

Speed Feedback Option Boards

Each option board below is shown with the correct selection for the SPEED FBK SELECT parameter.

The selections are ARM VOLTS FBK, ANALOG TACH, ENCODER and ENCODER/ANALOG.

(ARM VOLTS FBK is default and requires no option board).

MMI Menu Map

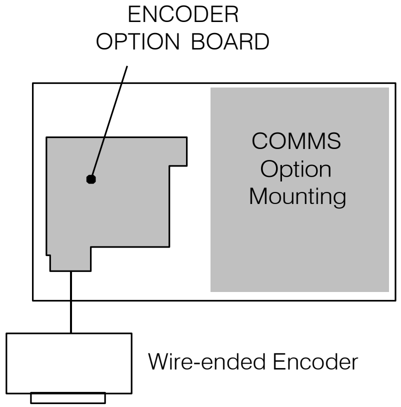
1 SETUP PARAMETERS
2 SPEED LOOP
SPEED FBK SELECT

Wire-Ended Encoder Option Board

ENCODER

The board accepts connection from a wire-ended encoder.

If fitted, refer to the Encoder Technical Manual for further information.



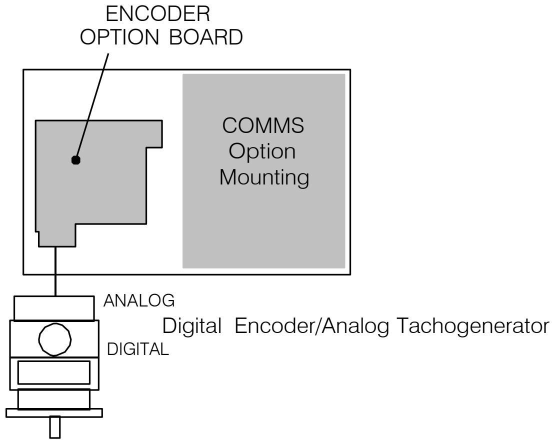
Combined Tacho and Encoder Feedback

ENCODER/ANALOG

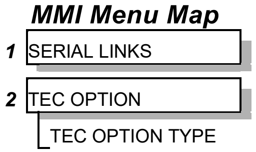
If an analog tachogenerator and digital encoder are to be used, the Encoder Option Board receives the digital signal, the analog signal is routed to Terminals B2 (Tacho) and B1 (0V).

Note: External scaling resistors are required for the Analog Tacho Feedback and a shorting link inserted in the analog plug to directly connect terminal B2 to the analog speed feedback input.

Please refer to DC900P Drives Engineering Department for assistance with this feature .



Communications Technology Options



Various protocols are supported, each requiring a different Technology Box. The type of Technology Box fitted is selected in the TYPE parameter:

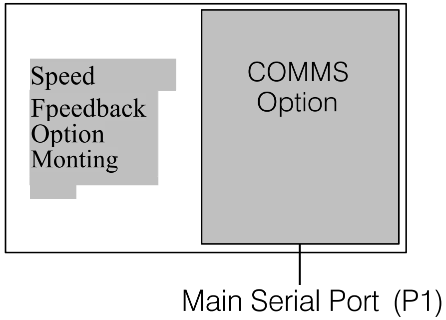
- RS485 (EI BINARY, EI ASCII or MODBUS RTU)
- PROFIBUS DP

COMMS Option Technology Box

The option allows the DC900P Drive to be controlled as part of a system.

The system can also comprise other products such as the 605 and 584SV Inverters, or any other equipment using the same protocol.

IMPORTANT : The comms option should not be fitted or removed whilst the product is powered.



Earth Fault Monitoring Systems

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 (1998) / VDE0160 (1994) / EN60204-1 (1994)

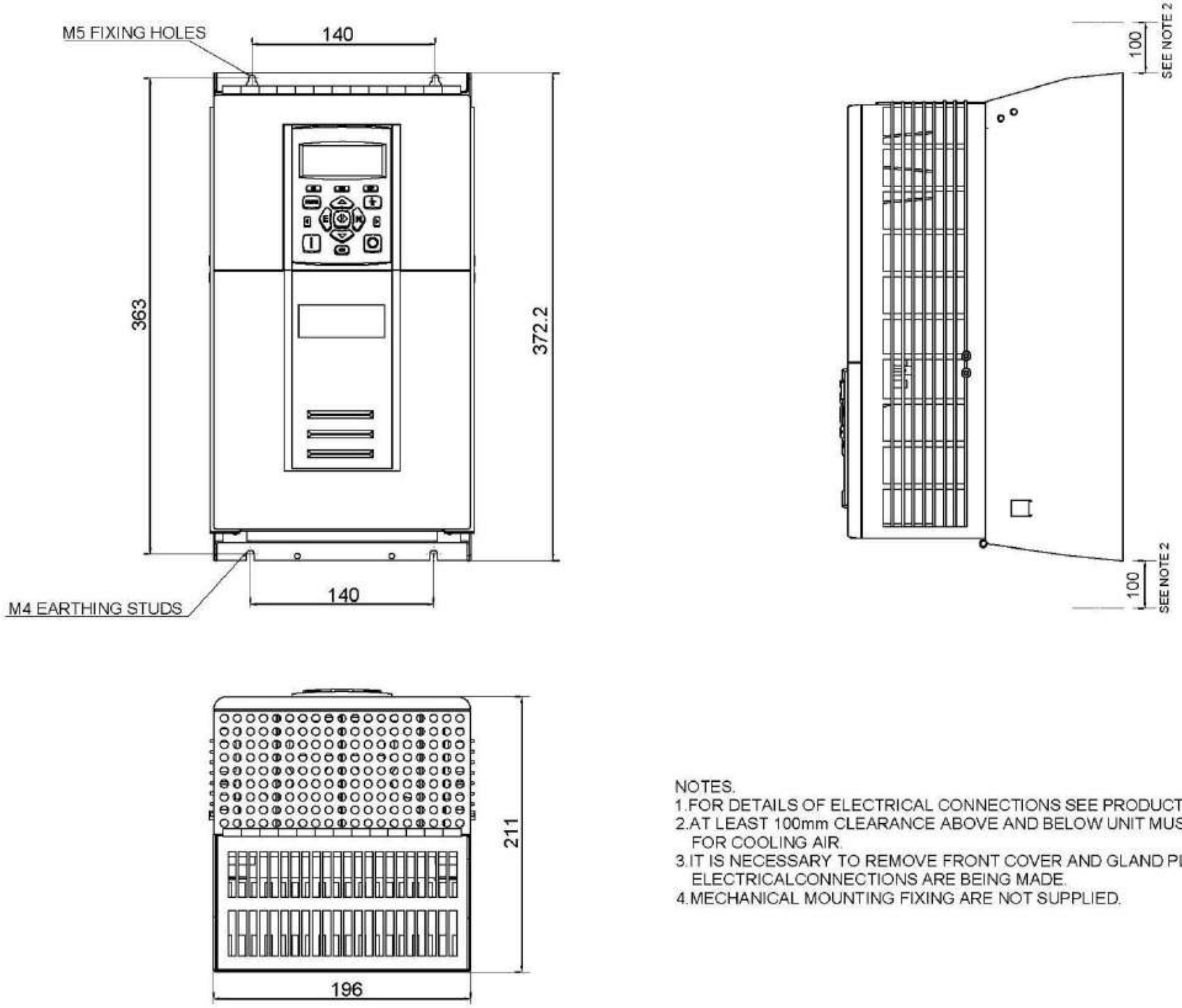
We do not recommend the use of circuit breakers (e.g. RCD, ELCB, GFCI), but where their use is mandatory, they should:

- Operate correctly with dc and ac protective earth currents (i.e. type B RCDs as in BS EN61009-1 : 2004).
- Have adjustable trip amplitude and time characteristics to prevent nuisance tripping on switch-on.

NOTE **When the ac supply is switched on, a pulse of current flows to earth to charge the EMC filter internal capacitors which are connected between phase and earth. This has been minimised in DC900P 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.**

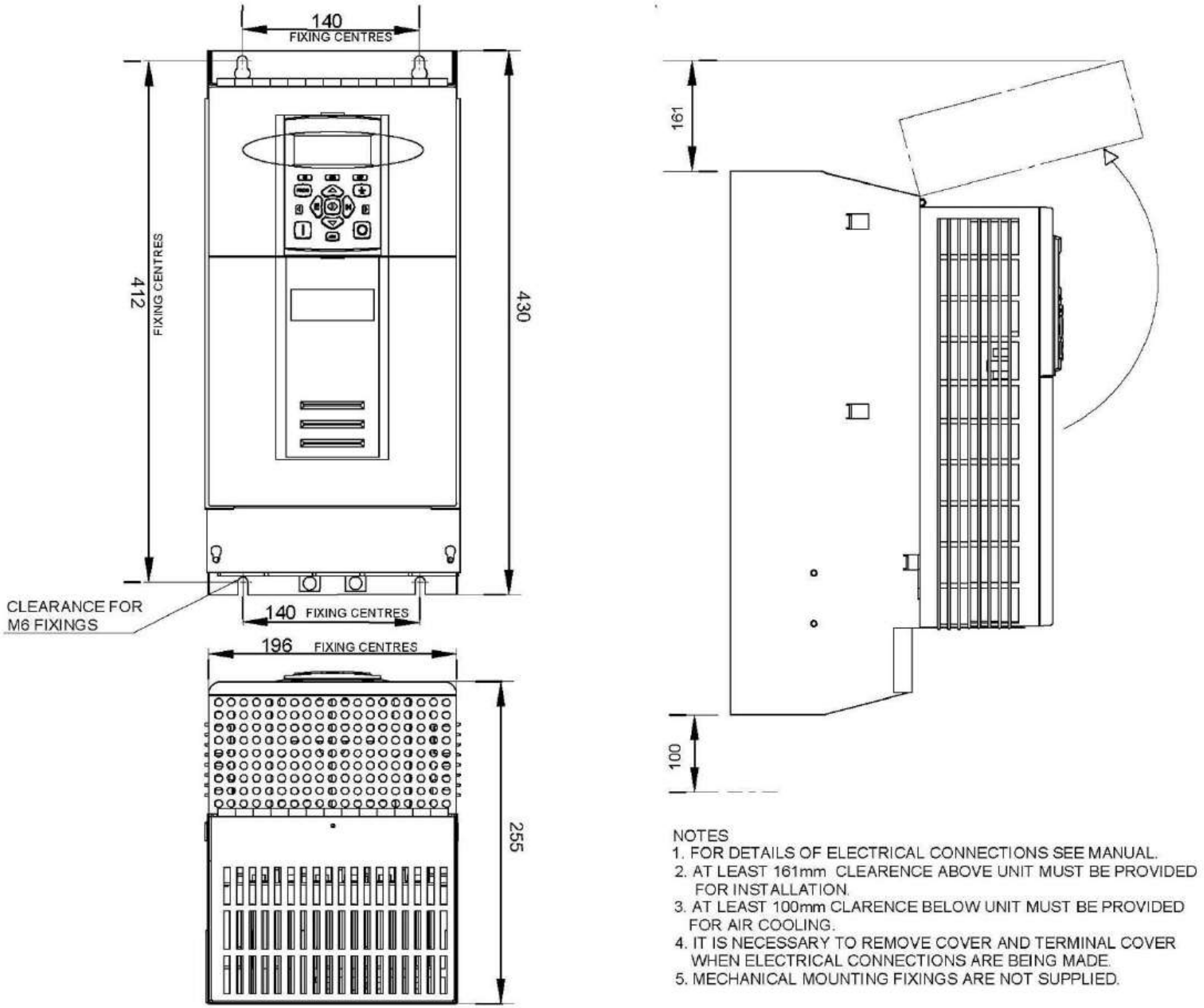
Installation Drawings

Drive Installation Drawings



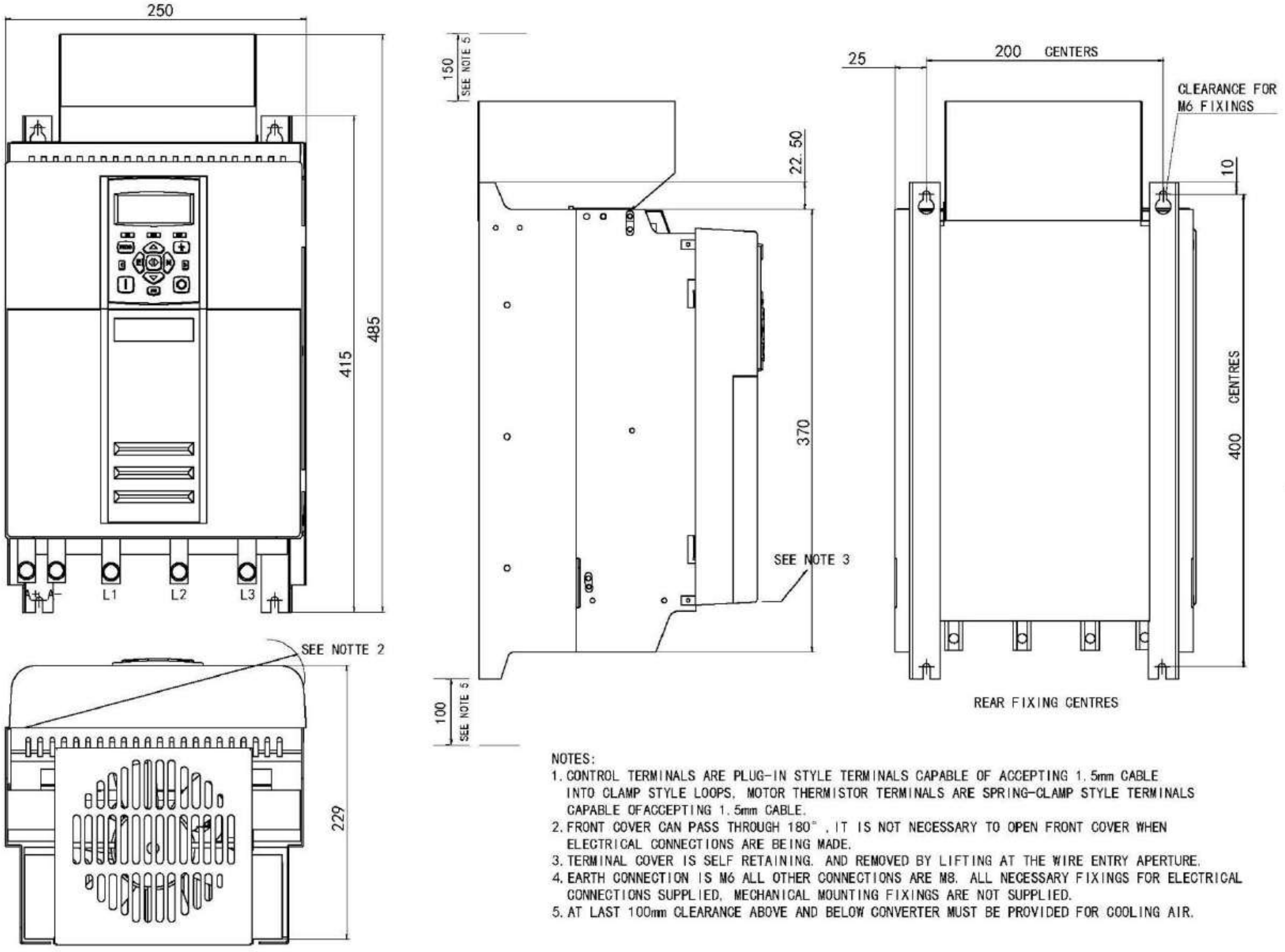
NOTES.
1.FOR DETAILS OF ELECTRICAL CONNECTIONS SEE PRODUCT MANUAL.
2.AT LEAST 100mm CLEARANCE ABOVE AND BELOW UNIT MUST BE PROVIDED FOR COOLING AIR.
3.IT IS NECESSARY TO REMOVE FRONT COVER AND GLAND PLATE WHEN ELECTRICALCONNECTIONS ARE BEING MADE.
4.MECHANICAL MOUNTING FIXING ARE NOT SUPPLIED.

Figure 3- 28 Frame 1 : 20A & 35A Stack Assembly



NOTES
1. FOR DETAILS OF ELECTRICAL CONNECTIONS SEE MANUAL.
2. AT LEAST 161mm CLEARENCE ABOVE UNIT MUST BE PROVIDED FOR INSTALLATION.
3. AT LEAST 100mm CLARENCE BELOW UNIT MUST BE PROVIDED FOR AIR COOLING.
4. IT IS NECESSARY TO REMOVE COVER AND TERMINAL COVER WHEN ELECTRICAL CONNECTIONS ARE BEING MADE.
5. MECHANICAL MOUNTING FIXINGS ARE NOT SUPPLIED.

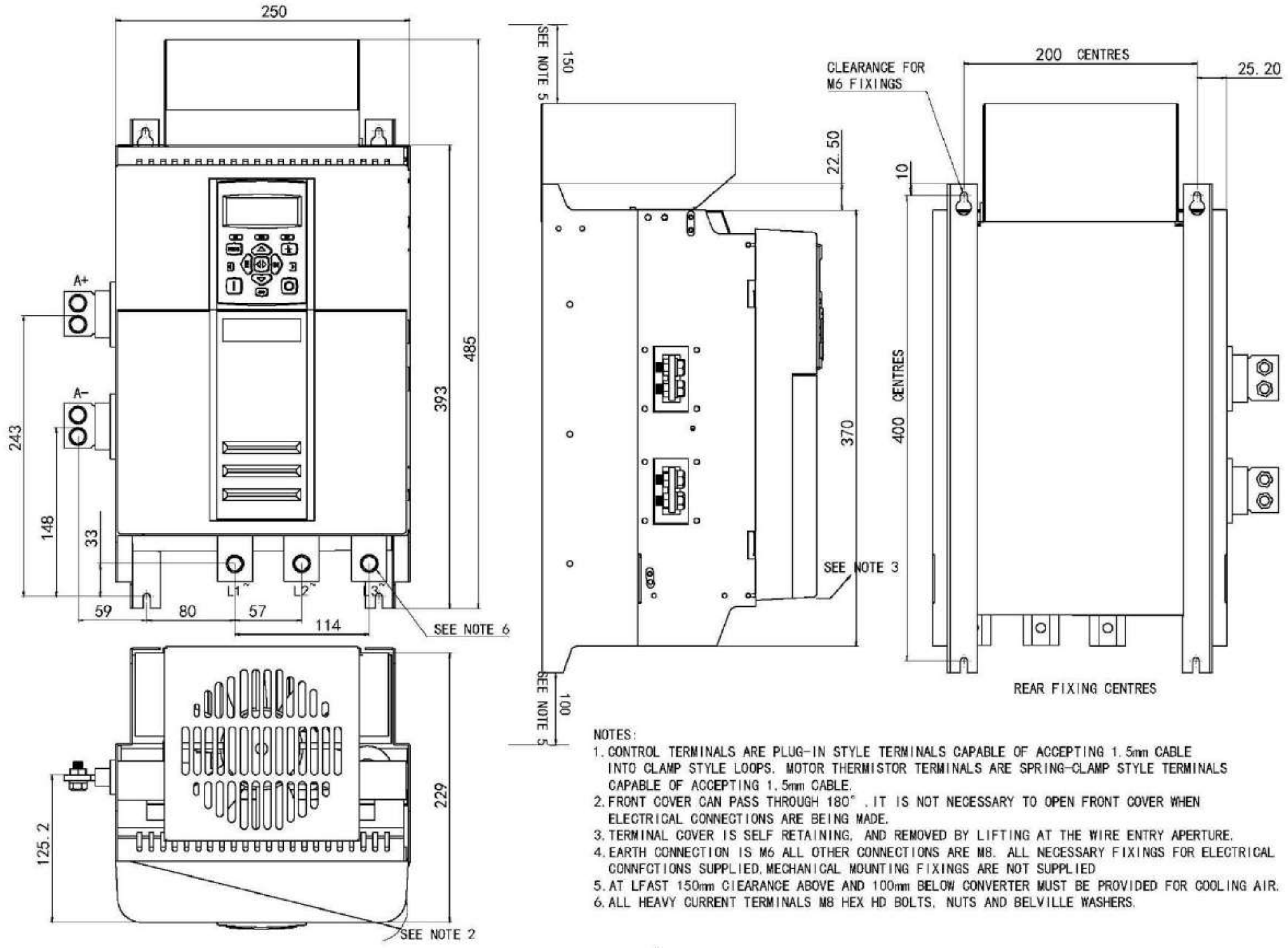
Figure 3- 29 Frame 2 : 40A-160A Stack Assembly



NOTES:

1. CONTROL TERMINALS ARE PLUG-IN STYLE TERMINALS CAPABLE OF ACCEPTING 1.5mm CABLE INTO CLAMP STYLE LOOPS. MOTOR THERMISTOR TERMINALS ARE SPRING-CLAMP STYLE TERMINALS CAPABLE OFACCEPTING 1.5mm CABLE.
2. FRONT COVER CAN PASS THROUGH 180° , IT IS NOT NECESSARY TO OPEN FRONT COVER WHEN ELECTRICAL CONNECTIONS ARE BEING MADE.
3. TERMINAL COVER IS SELF RETAINING. AND REMOVED BY LIFTING AT THE WIRE ENTRY APERTURE.
4. EARTH CONNECTION IS M6 ALL OTHER CONNECTIONS ARE M8. ALL NECESSARY FIXINGS FOR ELECTRICAL CONNECTIONS SUPPLIED. MECHANICAL MOUNTING FIXINGS ARE NOT SUPPLIED.
5. AT LAST 100mm CLEARANCE ABOVE AND BELOW CONVERTER MUST BE PROVIDED FOR COOLING AIR.

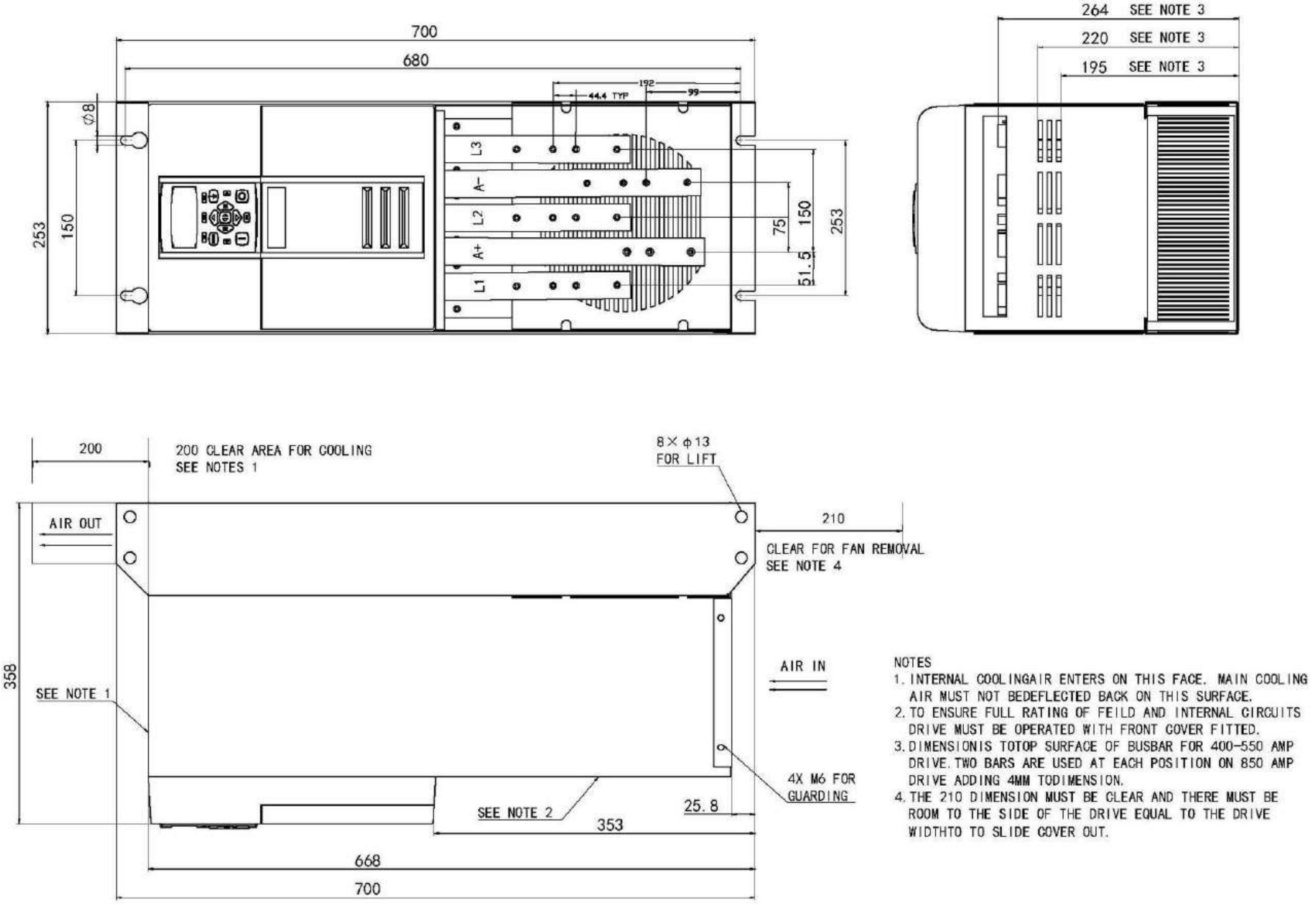
Figure 3- 30 Frame 3 : 200A Stack Assembly



NOTES:

1. CONTROL TERMINALS ARE PLUG-IN STYLE TERMINALS CAPABLE OF ACCEPTING 1.5mm CABLE INTO CLAMP STYLE LOOPS. MOTOR THERMISTOR TERMINALS ARE SPRING-CLAMP STYLE TERMINALS CAPABLE OF ACCEPTING 1.5mm CABLE.
2. FRONT COVER CAN PASS THROUGH 180° .IT IS NOT NECESSARY TO OPEN FRONT COVER WHEN ELECTRICAL CONNECTIONS ARE BEING MADE.
3. TERMINAL COVER IS SELF RETAINING, AND REMOVED BY LIFTING AT THE WIRE ENTRY APERTURE.
4. EARTH CONNECTION IS M6 ALL OTHER CONNECTIONS ARE M8. ALL NECESSARY FIXINGS FOR ELECTRICAL CONNFCTIONS SUPPLIED,MECHANICAL MOUNTING FIXINGS ARE NOT SUPPLIED
5. AT LFAST 150mm CIEARANCE ABOVE AND 100mm BELOW CONVERTER MUST BE PROVIDED FOR COOLING AIR.
6. ALL HEAVY CURRENT TERMINALS M8 HEX HD BOLTS, NUTS AND BELVILLE WASHERS.

Figure 3- 31 Frame 3 : 280A Stack Assembly



NOTES

1. INTERNAL COOLINGAIR ENTERS ON THIS FACE. MAIN COOLING AIR MUST NOT BEDEFLECTED BACK ON THIS SURFACE.
2. TO ENSURE FULL RATING OF FEILD AND INTERNAL CIRCUITS DRIVE MUST BE OPERATED WITH FRONT COVER FITTED.
3. DIMENSIONIS TOTOP SURFACE OF BUSBAR FOR 400-550 AMP DRIVE. TWO BARS ARE USED AT EACH POSITION ON 850 AMP DRIVE ADDING 4MM TODIMENSION.
4. THE 210 DIMENSION MUST BE CLEAR AND THERE MUST BE ROOM TO THE SIDE OF THE DRIVE EQUAL TO THE DRIVE WIDTHTO TO SLIDE COVER OUT.

Figure 3- 32 Frame 4 : 400-850A Stack Assembly

Chapter 4 Operating the Drive

Learn how to turn the motor for the first time, and about the various ways you can start and stop the drive. This chapter also offers some application advice.

Pre-Operation Checks

Initial checks before applying power:

- Mains power supply voltage is correct.
- Auxiliary power supply voltage is correct.
- Motor is of correct armature voltage and current rating.
- Check all external wiring circuits - power, control, motor and earth connections.

NOTE **Completely disconnect the drive before point-to-point checking with a buzzer, or when checking insulation with a 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.

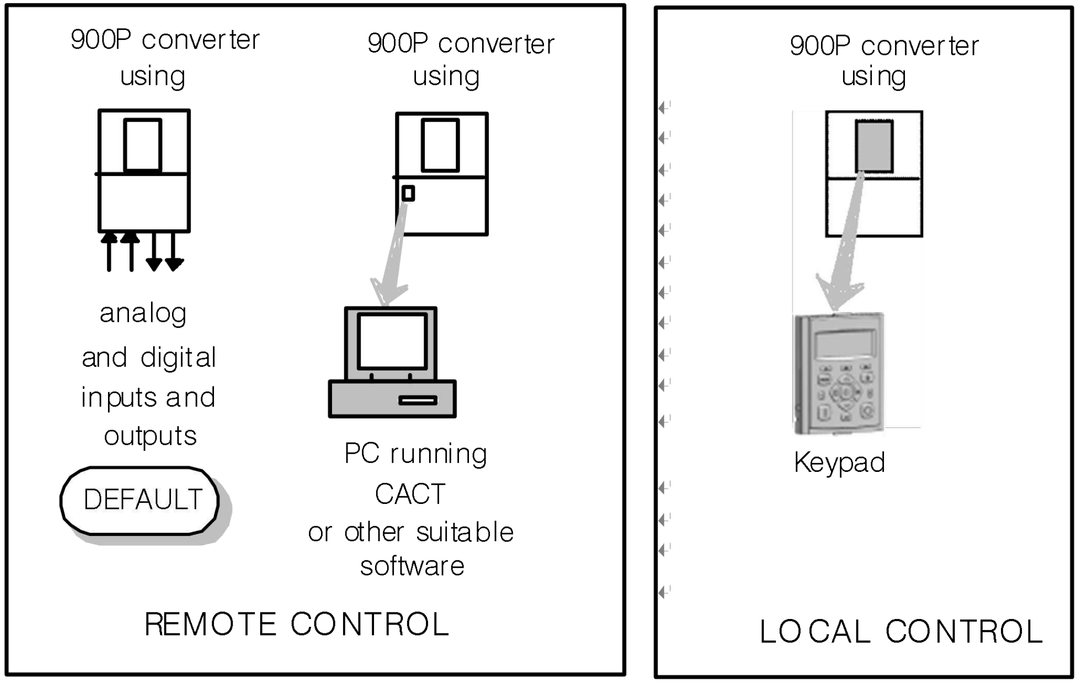
Ensure the safety of the complete system before the drive is energised:

- 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 main external HRC fuses to prevent the main 3-phase and single phase auxiliary supply from being connected.
- 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 Appendix E: "Technical Specifications"- Terminal Information - Control Board.
- If there is any doubt about the integrity of a particular installation, insert a high wattage resistor, i.e. fire elements, in series with the motor armature.
- Check external run contacts are open.
- Check external speed setpoints are all zero.

Control Philosophy



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

Figure 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, System Port P3 or the Technology Option

Thus the Drive can operate in two modes:

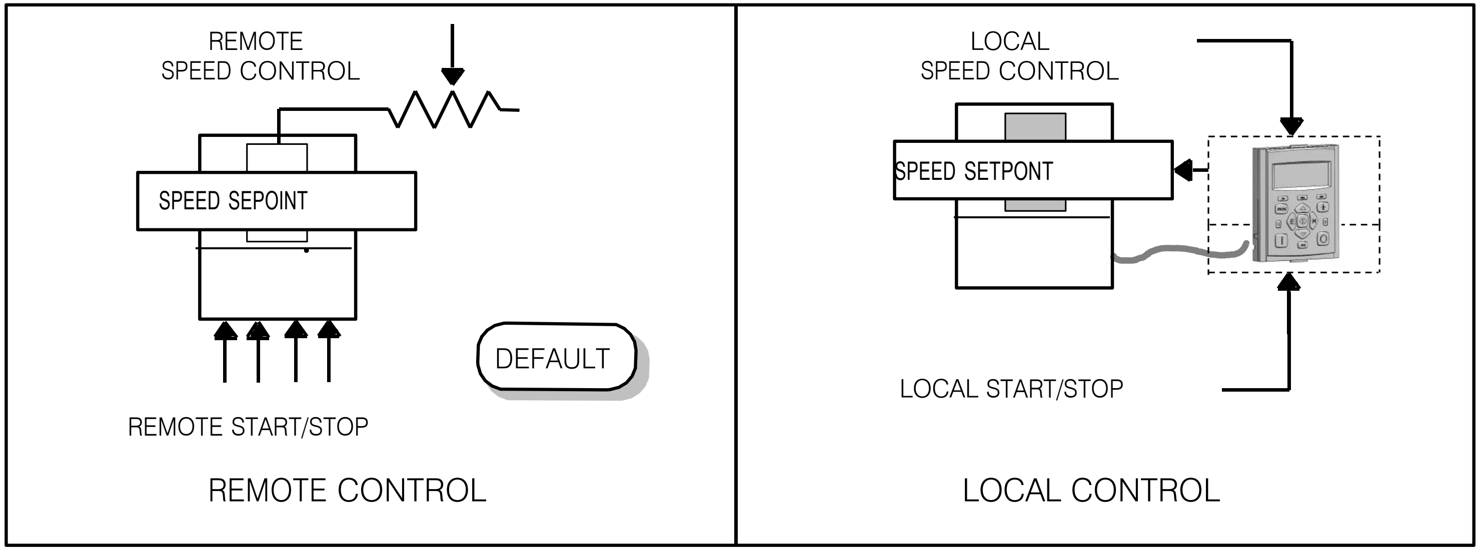


Figure 4-2 Local and Remote Control

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

Selecting Local or Remote Control

DEFAULT *The default is for the **L/R** key to be set for Remote control, i.e. both the SEQ and REF LEDs will be off.*

If the default 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 Local Start/Stop and Speed Control.

NOTE **You can only change between Local and Remote control when the Drive is "stopped".**

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.

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 (l), then LOCAL mode is in force.

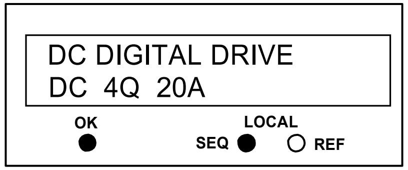


Figure 4-3 Control Mode LED Indications

Operation in Local Mode

The drive requires the following power terminals to be connected for operation in Local control.

3-phase supply via contactor
Auxiliary supply
3-phase contactor coil
Motor thermistor TH1 & TH2
Motor armature
Motor field

The drive requires the following control terminals to be active for operation in Local control.

Current Limit (jumper A6 to B3)
Program Stop - high (jumper B8 to C9)
Coast Stop - high (jumper B9 to C9)
External Trip - low (jumper C1 to C2)
External Enable - high (jumper C5 to C9)

To run in Local control:

Press the L/R key to enable Local control as detailed above
On the Keypad press the RUN key Ⓘ to start the unit
Use the UP ▲ and DOWN ▼ keys to control the speed
On the Keypad press the STOP key ◉ to stop the unit

Setting-up the Drive

IMPORTANT ***You must not exceed the maximum drive and motor ratings. Refer to the Product Code or maximum rating label, and the motor rating plate.***

The following start-up routine assumes that the Keypad is connected and is in default mode, and that the Drive's control terminals are wired as shown in the Minimum Connection diagrams in Chapter 3.

The following instructions are written in logical order. Complete each stage successfully before progressing to the next.

Calibrating the Control Board

AUXILIARY POWER ONLY IS CONNECTED AT THIS STAGE

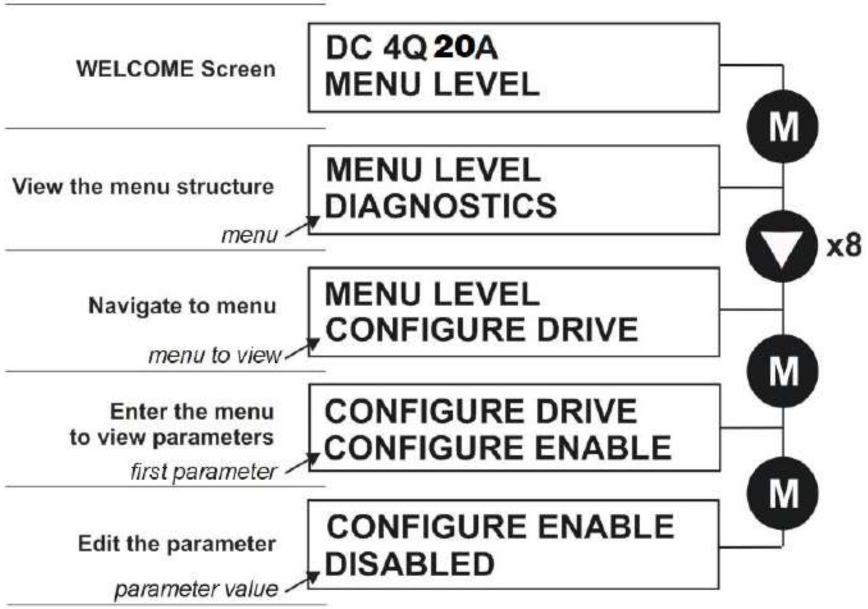
You must first calibrate the Drive for use with the motor.

Connect the auxiliary power supply to auxiliary supply terminals L & N (Frame 3: Terminals L & N = D8 & D7), but do not connect the main 3-phase power supply at this stage. Check that the correct voltage appears between these terminals.

The Keypad will now display the Welcome screen, and the Health and Forward LEDs will be illuminated (assuming that the Drive's control terminals are wired as shown in Figure 3-4, Minimum Connection Requirements).

NOTE **The CONFIGURE DRIVE menu at the top of the menu tree contains many of the important parameters used during set-up.**

Refer to Chapter 6: "The Keypad" to familiarise yourself with the keypad's LED indications, and how to use the keys and menu structure.



MMI Menu Map

1 CONFIGURE DRIVE
  - CONFIGURE ENABLE
  - NOM MOTOR VOLTS
  - ARMATURE CURRENT
  - FIELD CURRENT
  - FLD. CTRL MODE
  - FLD. VOLTS RATIO
  - MAIN CURR. LIMIT
  - AUTOTUNE
  - SPEED FBK SELECT
  - ENCODER LINES
  - ENCODER RPM
  - ENCODER SIGN
  - SPD. INT. TIME
  - SPD. PROP. GAIN

Set the following parameters:

CONFIGURE ENABLE

Set to TRUE. This allows you to change parameter values, but the drive cannot run.

NOM MOTOR VOLTS – Armature Voltage (VACAL)

If the drive is designed for use on a nominal 3-phase power supply of 500, 600 or 690V, set the Armature Voltage value in the NOM MOTOR VOLTS parameter.

OR

If the drive is designed for use on a nominal 3-phase power supply of 220V, set DOUBLE the Armature Voltage value in the NOM MOTOR VOLTS parameter.

NOTE **Refer to the Product Code on the drive's Rating Label to confirm the drive's specification. Also refer to Appendix E: "Technical Specifications" - Understanding the Product Code.**

ARMATURE CURRENT (IA CAL)

Note the maximum armature current from the motor rating plate and set this value in the ARMATURE CURRENT parameter.

FIELD CURRENT (IF CAL)

Note the nominal field current from the motor rating plate and set this value in the FIELD CURRENT parameter.

FLD.CTRL MODE

Set the field control mode to Field Voltage or Field Current control. Refer to Appendix D: “Programming” - FIELD CONTROL for further information. By default, the drive is operating in Voltage Control mode.

FLD.VOLTS RATIO

Enter the calculated ratio into the parameter given by the equation:

$$100 \times \frac{\text{FIELD VOLTS}}{\text{RMS AC INPUT VOLTS}}$$

The maximum value obtainable is 90%, i.e. field output = 0.9 x Vac. Setting this parameter higher than the default 90% will not increase the field output.

Selecting Speed Feedback

AUXILIARY POWER ONLY IS CONNECTED AT THIS STAGE

MMI Menu Map

1 CONFIGURE DRIVE

SPEED FBK SELECT

Using the Keypad, select the correct speed feedback option. The default is ARM VOLTS FBK.

The selections are ARM VOLTS FBK, ANALOG TACH, ENCODER and ENCODER/ANALOG.

NOTE **Refer to Chapter 3: "Installing the Drive" - Speed Feedback and Technology Options for further information.**

Speed Feedback Option Boards

Analog Tacho Calibration Option Board

WARNING

Do not fit this Option Board with the drive powered-up.

NOTE **This option is not required if armature voltage or encoder feedback is to be used.**

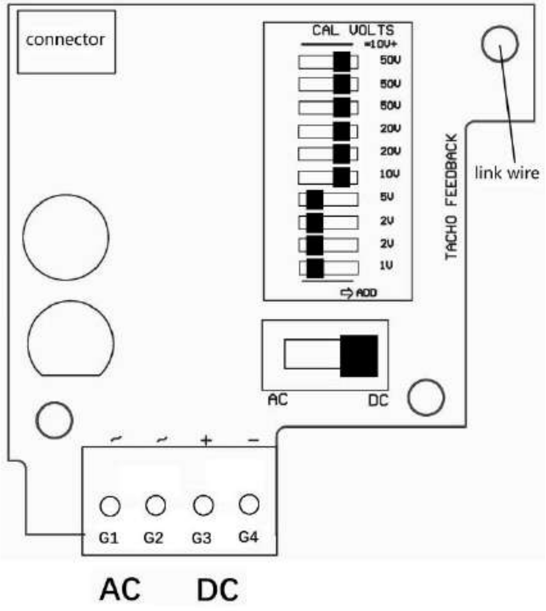
The board plugs into the front of the drive. Mount it on the 10-pin connector correctly using the 4 left-hand pins. This will allow the locating pegs to align with the mounting holes. It also requires the connecting link wire to the control board. This link is inherent but must be connected for operation.

The board supports AC and DC analog tachos with a calibration range of 10 to 200V:

- For AC tacho feedback, use terminals G1 and G2 with the selector switch in the AC position.
- For DC tacho feedback, use terminals G3 and G4 with the selector switch in the DC position

Calculate the tacho voltage by multiplying the required maximum speed by the tacho calibration factor, e.g. motor speed 1500 rpm and tacho calibration factor 60V per 1000 rpm is 90V.

This product may be fitted with a new version of the Analog Tacho Calibration Board:



ORIGINAL: The original option has part number AH30101007 and the tacho calibration volts are set using the 2 in-line switches (10-way). The switches set Volts in units and tens. The hundreds are set by the 1-way switch. The illustration shows a setting of 90V. When setting switches for AC tachos, calibrate the switches for √2 x voltage feedback required, i.e. √2 x 90V = 127V. This adjusts the rms value received from an AC tacho into the required peak value.

Initial Start-Up Routine

Complete steps 1 to 18, including steps 16 and 17 as appropriate.

NOTE **This routine assumes that the Drive's control terminals are wired as shown in the Minimum Connection Requirements drawings in Chapter 3. The field is "Enabled" and is in Voltage Control (default settings).**

IMPORTANT ***Do not change any of the previously made calibration settings once the main contactor is energised.***

Step 1: Check the Speed Setpoints operate correctly

ANIN1 (terminal A2) : an additional setpoint
ANIN2 (terminal A3) : an additional setpoint
ANIN3 (terminal A4) : this is the normal speed reference source

Use the Keypad to display the value of the ANIN 3 (A4) (and the additional setpoints if present).
Vary the setpoint potentiometer and observe the input voltage change.

The sum of all the setpoints is given by the value of the SPEED SETPOINT parameter. This is also output at terminal A8.

MMI Menu Map

- 1 DIAGNOSTICS
  - ANIN 1 (A2)
  - ANIN 2 (A3)
  - ANIN 3 (A4)
  - SPEED SETPOINT

Step 2: Check the External Current Clamps

Use the Keypad to check the operation of the external current clamp settings (refer to Appendix D: "Programming" - ANALOG INPUTS for setting details).

- *If using a single external clamp (Unipolar), terminal C6 low (0V):*

  Check that ANIN 5 (A6) is +10V or is adjustable up to +10V **Set to +10V**

- *If using dual external clamps (Bipolar), terminal C6 high (+24V):*

  Check the ANIN 5 (A6) is at +10V or is adjustable up to +10V **Set to +10V**
  Check that ANIN 4 (A5) is at -10V or is adjustable up to -10V **Set to -10V**

Setting the current clamps to 10V means that the current demand is controlled by the MAIN CURR. LIMIT parameter for the purposes of this initial Start routine.

MMI Menu Map

- 1 DIAGNOSTICS
  - ANIN 4 (A5)
  - ANIN 5 (A6)

Step 3: Check the Speed Feedback signals

If possible, check the speed feedback by rotating the shaft manually in the forward direction.

- *Analog Tachogenerator:*

  The Analog Tach Input should go positive.

MMI Menu Map

- 1 DIAGNOSTICS
  - SPEED FEEDBACK
  - TACH INPUT
  - ENCODER

Step 4: Select the Speed Feedback method

Write down the MAIN CURR. LIMIT parameter’s value here: %

Set the MAIN CURR. LIMIT parameter to **0.00%**.

MMI Menu Map

1 SETUP PARAMETERS

2 CURRENT LOOP

MAIN CURR. LIMIT

Select ARMATURE VOLTAGE initially for the speed feedback method in the SPEED FBK SELECT parameter.

MMI Menu Map

1 CONFIGURE DRIVE

SPEED FBK SELECT

MMI Menu Map

1 PARAMETER SAVE

PARAMETER SAVE

Perform a PARAMETER SAVE. Refer to Chapter 6: “The Keypad” - Saving Your Application.

Step 5: Start the Drive using Auxiliary Power only

With +24V present at terminals B8 and B9 (Program Stop and Coast Stop):

- *Apply the "Start/Run" command to C3*

  The main 3-phase contactor should pull-in and remain energised, (it may de-energise almost immediately due to the 3-phase fail alarm).

- *Remove the "Start/Run" command from C3*

  The main 3-phase contactor should drop-out and remain de-energised.

MMI Menu Map

1 DIAGNOSTICS

PROGRAM STOP

CONTACTOR CLOSED

If the above sequence does not function, remove the auxiliary power and check start/stop sequencing and contactor wiring.

If the contactor is left energised for an extended time during this check, the controller will detect that 3-phase is not connected and switch off the contactor, flagging the 3-phase alarm.

IMPORTANT ***The main contactor should never be operated by any means other than the drive internal controls, nor should any additional circuitry be placed around the contactor coil circuit.***

WARNING

Do not continue until the stop/start circuits and contactor operate correctly.

Step 6: Power-down the drive and connect the 3-phase supply; power-up the Drive

Switch off all power supplies to the equipment and, when the whole system is totally isolated and safe, re-connect the main 3-phase power supply.

- Switch on the auxiliary supply.
- Switch on the main 3-phase supply.

MAIN & AUXILIARY POWER ARE CONNECTED AT THIS STAGE

Step 7: Set the Speed Setpoint(s) to 5%

Set the Speed Setpoint(s) to 5% so that the value of the SPEED SETPOINT parameter is 5.0%.
This is also output at Terminal A8.

MMI Menu Map

1 DIAGNOSTICS
  SPEED SETPOINT

Step 8: Check the MAIN CURR LIMIT is zero

Double-check that the MAIN CURR. LIMIT is set to 0.00%.

MMI Menu Map

1 SETUP PARAMETERS
2 CURRENT LOOP
  MAIN CURR.LIMIT

Step 9: Start the Drive and check the field voltage

Apply the Start/Run command and check that 3-phase mains is applied to Power Terminals L1, L2 and L3.

Apply 24V to "Enable" (C5) and immediately check that the correct field voltage appears between the auxiliary supply terminals F+ and F-.
(Note that any external interlocks which affect the Enable input C5 will affect the operation of the drive.)

Caution

This is high voltage DC, proceed with caution. Do not continue if this is incorrect, switch off all supplies and check connections.
Refer to 9.1 or 9.2 on the next page.

If the field voltage is incorrect, make the following checks:

Step 9.1 Internally Supplied Field:

- Check that 3-phase is applied to terminals L1, L2 and L3 when the main contactor is closed.
- Check that the coding fuses on the power board or suppression board are healthy.
- The FIELD ENABLE parameter should be set to ENABLE.
- With the FIELD ENABLE parameter in view, press the ↓ (DOWN) key. The display changes to FLD CTRL MODE. Press the **M** key. Is this set to VOLTAGE CONTROL or CURRENT CONTROL?
  - ➢ If set to VOLTAGE CONTROL, check the value of the FLD. VOLTS RATIO parameter. Set this to 65% to obtain 300V fields from 460V supplies.
  - ➢ If set to CURRENT CONTROL, check the field current calibration set-up, refer back to "Calibration".

    If the field volts are at maximum, check the field continuity. (The field current may initially be lower than the rated value due to a cold field.)

MMI Menu Map

1 SETUP PARAMETERS
2 FIELD CONTROL
  FIELD ENABLE

MMI Menu Map

1 CONFIGURE DRIVE
  FLD. VOLTS RATIO

Step 9.2 Externally Supplied Field: (not available on Frame 1 units)

Refer to Chapter 3: "Installing the Drive" - Motor Field Options for conversion details.

- Check the voltage applied (externally fused) to terminals FL1 and FL2.
- Check the phasing of voltage applied to FL1 and FL2:
  - ➢ FL1 must be connected directly or indirectly to the Red phase on main power terminal L1.
  - ➢ FL2 must be connected directly or indirectly to the Yellow phase on main power terminal L2.
- The FIELD ENABLE should be set to ENABLE.

MMI Menu Map

1 SETUP PARAMETERS
2 FIELD CONTROL
FIELD ENABLE

- With the FIELD ENABLE parameter in view, press the ↓ (DOWN) key. The display changes to FLD CTRL MODE. Press the **M** key. Is this set to VOLTAGE CONTROL or CURRENT CONTROL?
  - ➢ If set to VOLTAGE CONTROL, check the value of the FLD. VOLTS RATIO parameter. Set this to 65% to obtain 300V fields from 460V supplies.
  - ➢ If set to CURRENT CONTROL, check the field current calibration set-up, refer back to "Calibration".

Check that 3-phase is applied to terminals L1, L2 and L3.

MMI Menu Map

1 SETUP PARAMETERS
2 FIELD CONTROL
3 FLD VOLTAGE VARS
FLD. VOLTS RATIO

Step 10: Check the Keypad

Check that the HEALTH and RUN Keypad LEDs are now illuminated, also either the FWD or REV LED.

Step 11: Check the STANDSTILL LOGIC parameter

If the STANDSTILL LOGIC parameter in the STANDSTILL menu at level 2 is ENABLED, temporarily set it to DISABLED.

MMI Menu Map

1 SETUP PARAMETERS
2 CURRENT LOOP
MAIN CURR.LIMIT

Caution

During the following set-up instructions, be ready to STOP the drive should the motor try to overspeed.

If 5% speed (approximately) is exceeded and the motor continues to accelerate a reversed connection is implied, decrease the MAIN CURR.LIMIT parameter to zero. Open the main contactor and disconnect all supplies. Reverse the motor connections.

Step 12: Turn the motor and check direction of rotation

Slowly increase the MAIN CURR.LIMIT parameter towards a maximum of 20%. At some point the motor will begin to rotate as the parameter value is increased. The motor speed will settle at 5% of full speed. If the motor is loaded it may require more than 20% current limit to turn the motor.

MMI Menu Map

1 SETUP PARAMETERS
2 STANDSTILL
  STANDSTILL LOGIC

- If the motor does not turn at all when the MAIN CURR.LIMIT is increased to 20%, check the CURRENT FEEDBACK parameter to verify that current is flowing into the armature. If no current is flowing, switch off and check the armature connections.
  - ➢ Is the motor connected to the drive?
  - ➢ Verify that Calibration has been carried out correctly.

MMI Menu Map

1 DIAGNOSTICS
  CURRENT FEEDBACK

Check the direction of rotation is suitable for your process:

- If the direction of rotation is correct, then the armature and field are wired correctly.
- If direction of rotation is incorrect then open the main contactor and disconnect all supplies. Reverse either the armature or field wiring .

WARNING

Do not continue until Step 12 is completed satisfactorily.

Step 13: Check the Speed Feedback sign

With the motor rotating in the correct direction, check the sign of the feedback from the Tachometer or Encoder using the appropriate Diagnostic menu: TACH INPUT or ENCODER.

MMI Menu Map

1 DIAGNOSTICS
  TACH INPUT
  ENCODER

- If the diagnostic value is positive (correct), stop the drive. Re-instate your selection for the SPEED FBK SELECT parameter (if other than ARM VOLTS FBK) and run the drive to check operation. If the test is successful go to Step 14.
- If the diagnostic value is negative:
  - ➢ Analog Tach: reverse the connections of the analog tach on terminals G3 and G4
  - ➢ Encoder: change the sign of the encoder feedback parameter.

  Re-instate your selection for the SPEED FBK SELECT parameter (if other than ARM VOLTS FBK) and run the drive to check operation.

MMI Menu Map

1 CONFIGURE DRIVE
  ENCODER SIGN

MMI Menu Map

1 CONFIGURE DRIVE
  SPEED FBK SELECT

MMI Menu Map

1 PARAMETER SAVE
  PARAMETER SAVE

When satisfactory operation has been achieved, perform a PARAMETER SAVE. Refer to Chapter 6: "The Keypad" - Saving Your Application.

Step 14: Adjusting the Speed Setpoint

With the MAIN CURR.LIMIT parameter set to 20% or to the level required to achieve rotation, set the Speed Setpoints so that the value of the SPEED SETPOINT is about 10%, 1.0V at setpoint input (Terminal A8). The motor will accelerate to this speed setting.

Step 14.1 *4 Quadrant Drives which require reverse rotation:*
Alter the Speed Setpoints so that the value of the SPEED SETPOINT parameter is about -10% and check that motor runs in the reverse direction.

MMI Menu Map

1 DIAGNOSTICS
  SPEED SETPOINT

Step 14.2 *Adjustment of ZERO SPEED OFFSET parameter (Ensure STANDSTILL is DISABLED as in Step 11):*

- 4 Quadrant, non-reversing drives

  Set the Speed Setpoint potentiometer to zero and adjust the ZERO SPEED OFFSET parameter for minimum shaft rotation.
- 2 Quadrant, non-reversing drives

  Set the Speed Setpoint potentiometer to zero and adjust the ZERO SPEED OFFSET parameter until the shaft is just rotating then reduce level until the shaft stops.
- 4 Quadrant, reversing drives
  Set the ZERO SPEED OFFSET parameter to balance maximum speed in forward and reverse directions. You can also set STANDSTILL LOGIC parameter to ENABLE if a stationary shaft is required.

MMI Menu Map

1 SETUP PARAMETERS
2 CALIBRATION
  ZERO SPD.OFFSET

MMI Menu Map

1 SETUP PARAMETERS
2 STANDSTILL
  STANDSTILL LOGIC

Step 15: Fine adjustments for Speed Feedback

Gradually increase the Speed Setpoints so that the value of the SPEED SETPOINT (DIAGNOSTIC menu) is at maximum. Check the shaft speed is correct.

If fine adjustment is required adjust the calibration as appropriate to the speed feedback selection:

- Armature Voltage feedback has a +2/-10% trim, greater changes outside this range require re-setting of the calibration switches.
- Analog Tachogenerator has a +2/-10% trim, greater changes outside this range require re-setting of the calibration switches.
- The Encoder should give an absolute rotational speed for which adjustment is unnecessary however the motor speed may not be the relevant factor thus speed of rotation can be altered by simply adjusting the calibration.

MMI Menu Map

1 SETUP PARAMETERS

2 CALIBRATION

- ARMATURE V CAL.
- ANALOG TACH CAL.
- ENCODER RPM

Step 16: Adjustment for Field Weakening

If the drive is to be run with a top speed greater than the base speed then `field weakening' is used to achieve that top speed. (Refer to Chapter 5: "Control Loops" - Field Control for a more detailed explanation).

MMI Menu Map

1 CONFIGURE DRIVE

- FLD CTRL MODE

NOTE **The drive must be operating in Field Current Control. Select CURRENT CONTROL on the FLD CTRL MODE parameter. Also, field weakening cannot be used if you have Armature Voltage feedback selected.**

IR COMPENSATION (CALIBRATION function block) is also used in field weakening applications to improve dynamic response and speed holding stability.

To set up IR COMPENSATION:

Set FIELD ENABLE to DISABLED (FIELD CONTROL function block). Start the drive with a 5% speed demand and ensure the ACTUAL POS I LIMIT is 100% (diagnostic). This should stall the drive at zero speed and cause it to pass 100% current. Monitor the BACK EMF diagnostic and note the value (typically anything up to 17% is normal). Stop the drive and enter this value into IR COMPENSATION and repeat the test to ensure that BACK EMF then reads zero.

Run the drive up to base speed and check the motor volts are correct.

In the FLD WEAK VARS menu, verify that field weakening is selected (FIELD WEAK ENABLE) and that the MIN FLD CURRENT parameter is set appropriately. Adjust the maximum BEMF volts to the required scaled level by setting the MAX VOLTS parameter.

Increase the speed above the base speed, checking that the armature volts remain constant whilst the field current reduces.

Gradually increase to maximum speed. Monitor the armature volts at maximum speed and trim the speed using the appropriate control as detailed in Step 15. *PROCEED WITH CARE - MAKE SMALL ADJUSTMENTS.*

Trim the MIN FLD CURRENT parameter to the appropriate setting (5% lower than the field current at full speed).

MMI Menu Map

1 SETUP PARAMETERS

2 FIELD CONTROL

3 FLD CURRENT VARS

4 FLD WEAK VARS

- FLD. WEAK ENABLE
- MIN FLD CURRENT
- MAX VOLTS

Step17: Adjustment for Reversing Drives

For reversing drives, check the maximum reverse speed.

Imbalance in reversing drives can only be corrected by adjusting the ZERO SPD OFFSET parameter, which may be to the detriment of operation at Zero Setpoint.

MMI Menu Map

1 SETUP PARAMETERS
2 CALIBRATION
  ZERO SPD.OFFSET

Step 18: Re-setting the MAIN CURR. LIMIT parameter

Re-set the MAIN CURR. LIMIT parameter to the original setting that you previously noted in Step 4. If in doubt, set it to 100% to correspond to 100% full load current (FLC).

NOTE **The controller cannot achieve 200% current unless the CUR. LIMIT/SCALER parameter is increased to 200% (from its default setting of 100%). Until this is done, the External Current Clamp will limit the current to 100%, refer to Appendix D: "Programming" - CURRENT LOOP.**

MMI Menu Map

1 SETUP PARAMETERS
2 CURRENT LOOP
  MAIN CURR.LIMIT

- If the current limit is set higher (maximum 200%) and the motor runs into an overload condition, the current is automatically reduced from the current limit level down to 103% FLC (continual rating).
- If the motor is overloaded, the controller will reduce the current to 103% of the current calibration. (If the motor continues to rotate it may overheat and thermal protection should be provided).
- If the motor is overloaded and the current provided by the controller is not enough to maintain rotation, i.e. it stalls, the controller will trip out showing STALL TRIP alarm, if enabled.

Performance Adjustment

Current Loop - The ARMATURE Autotune Feature

Now perform an Autotune to identify and store the following Current Loop parameters:

PROP. GAIN INT. GAIN DISCONTINUOUS

Initial Conditions

1. Main contactor open, i.e. no Start/Run signal at terminal C3.
2. Set the AUTOTUNE parameter to OFF.
3. Program Stop (terminal B8) and Coast Stop (terminal B9) should be high, i.e. 24V.
4. If the field is being supplied by a third-party controller, remove the field manually. (If the field is internally regulated, Autotune automatically quenches the field).

IMPORTANT ***The shaft may require clamping for certain motors to prevent rotation >20% during the Autotune sequence. If the motor is either a compound motor (series field), has some residual magnetism, or is a permanent magnet motor it WILL rotate and the shaft must be clamped. If in any doubt, CLAMP OR BE READY TO STOP THE MOTOR.***

Performing an Autotune

MMI Menu Map

1 CONFIGURE DRIVE
  AUTOTUNE

- Set the AUTOTUNE parameter to ARMATURE.
- Close the main contactor, i.e. Start/Run signal to terminal C3.
- Energise the Enable terminal (C5).

The Autotune sequence is initiated. The Keypad displays "AUTOTUNING" during the process (also the HEALTH led is lit and the RUN led flashes). When complete (after approximately 10 seconds), the main contactor is opened automatically signalling the end of the sequence and the AUTOTUNE parameter is reset to OFF.

- **Perform a PARAMETER SAVE now**. Refer to Chapter 6: "The Keypad - Saving Your Application.
- If necessary, restore field connections and remove the mechanical clamp.

Autotune Failed?

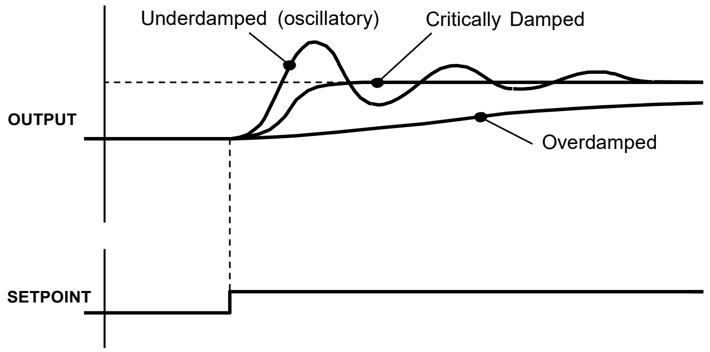
- The Keypad displays the message AUTOTUNE ABORTED
  If any one of the Initial Conditions above are removed, or the Autotune sequence times out (after 2 minutes), then the Autotune sequence is aborted causing the main contactor to drop out.
- The Keypad displays the message AUTOTUNE ERROR
  - ➢ The motor shaft was rotating, or was caused to rotate.
  - ➢ The field current was seen to exceed 6%, when a field-off Autotune had been selected, or the field current stopped during a field-on Autotune.
  - ➢ The drive to armature wiring was open-circuit.
  - ➢ The discontinuous current boundary was found to exceed 200% of either the stack rating or the nominated motor armature current rating
  - ➢ Large imbalance in the three-phase voltages of the supply.
  - ➢ A hardware fault relating to current feedback was detected on the control board.

NOTE **Refer to Chapter 5: "Control Loops" - Current Control for manual tuning instructions.**

Speed Loop Adjustment

You will need to adjust the Speed Loop for your particular application although in most cases the default settings are acceptable. The optimum Speed Loop performance is achieved by adjusting the PROP. GAIN and INT. TIME CONST. parameters.

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



Proportional Gain (PROP. GAIN)
This is used to adjust the basic response of the closed loop control system. The speed error is multiplied by the Proportional Gain to produce a motor current demand.

Integral (INT.TIME CONST.)
The Integral term is used to reduce steady state error between the setpoint and feedback values of the controller by accumulating current demand in proportion to the error input. If the integral is set to zero, then there will always be a steady state error.

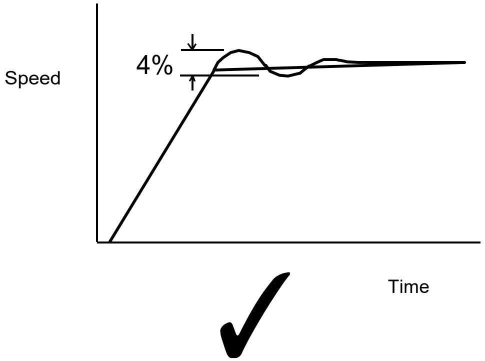
A Method for Setting-up the PI Gains

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

To set up the P gain, set the I gain to zero. Apply a step change in setpoint that is typical for the System, and observe the speed feedback response on terminal A7. Increase the gain and repeat the test until the system becomes oscillatory. At this point, reduce the P gain until the oscillations disappear. This is the maximum value of P gain achievable.

If the steady state error is significant, i.e. the feedback is not sufficiently close to the setpoint value, the I term needs to be used. As before, increase the I gain and apply the step change. Monitor the output. If the output becomes oscillatory, reduce the P gain slightly. This should reduce the steady state error. Increasing the I gain further may reduce the time to achieve zero steady state error.

Correct Response



Critically Damped Response with no more than 4% of maximum speed from first overshoot to first undershoot

Starting and Stopping Methods

Stopping Methods

- If the Drive is "non-regenerative" (2-quad - 901P) it effectively coasts to a stop once the current demand reverses.
- If the Drive is "regenerative" (4-quad - 900P) then it can stop faster because it uses energy from the load, i.e. reverse current is allowed to flow.

Normal Stop and Program Stop are only relevant for a "regenerative" controller.

The parameters STOP TIME and PROG STOP TIME have associated timers which initiate a Coast Stop after the timed period.

The Coast Stop has direct control of the Run relay with no intervening electronics.

All associated parameters can be found in the STOP RATES menu.

MMI Menu Map

1 SETUP PARAMETERS
2 STOP RATES

Terminal	Description	Function	Parameter	Priority
B9	Coast Stop	Motor coasts to rest	--	Overrides Program Stop and Normal Stop
B8	Program Stop	Motor decelerates at Program Stop rate	PROG STOP TIME	Overrides Normal Stop
C3	Start/Run (Normal Stop)	Motor decelerates at Normal Stop rate	STOP TIME	--

Normal Stop (C3)

This is achieved by removing 24V from Terminal C3.

The motor speed is brought to zero in a time defined by the STOP TIME parameter.

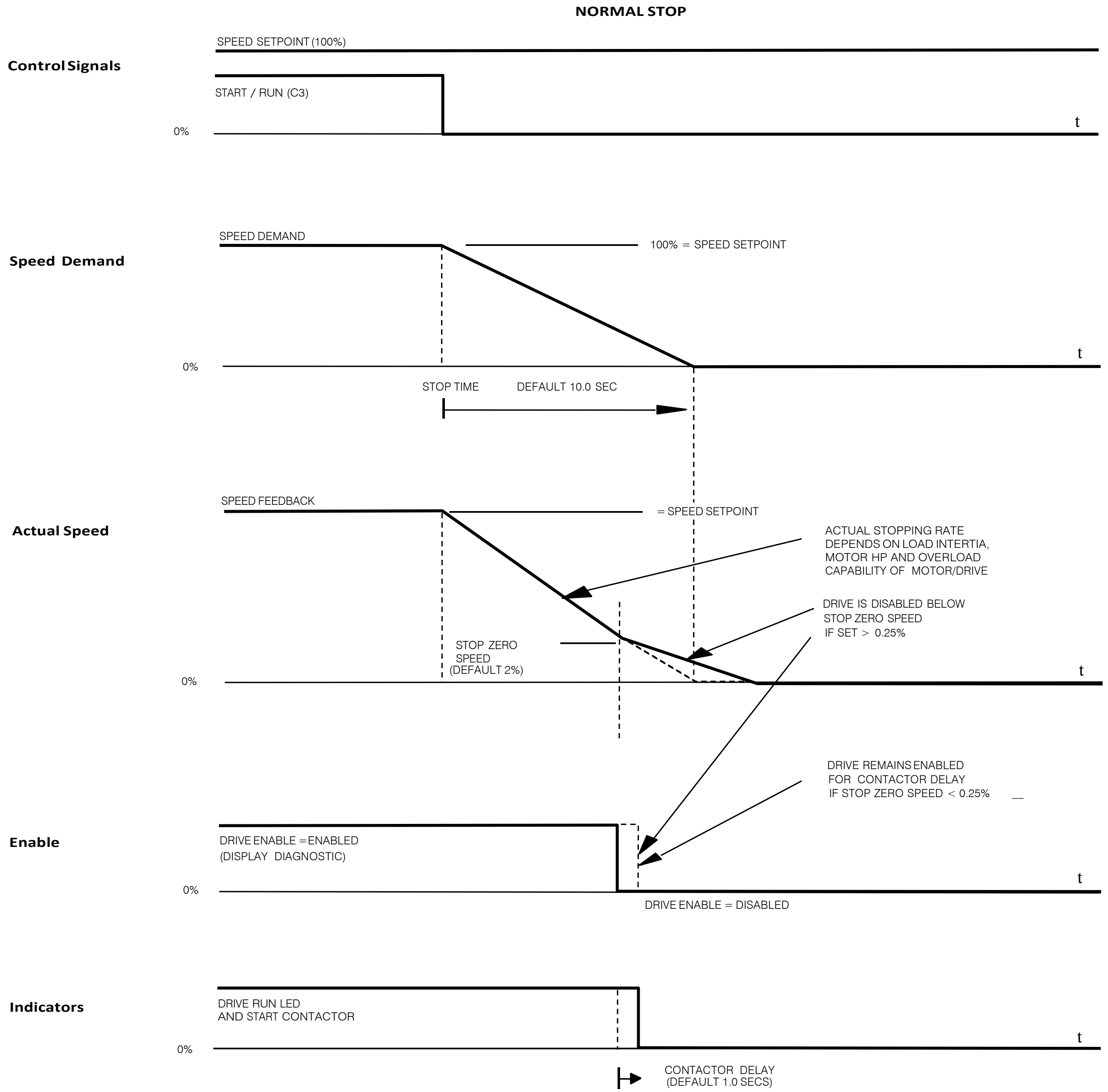
During Normal Stop, the current is limited by the MAIN CURR. LIMIT parameter

MMI Menu Map

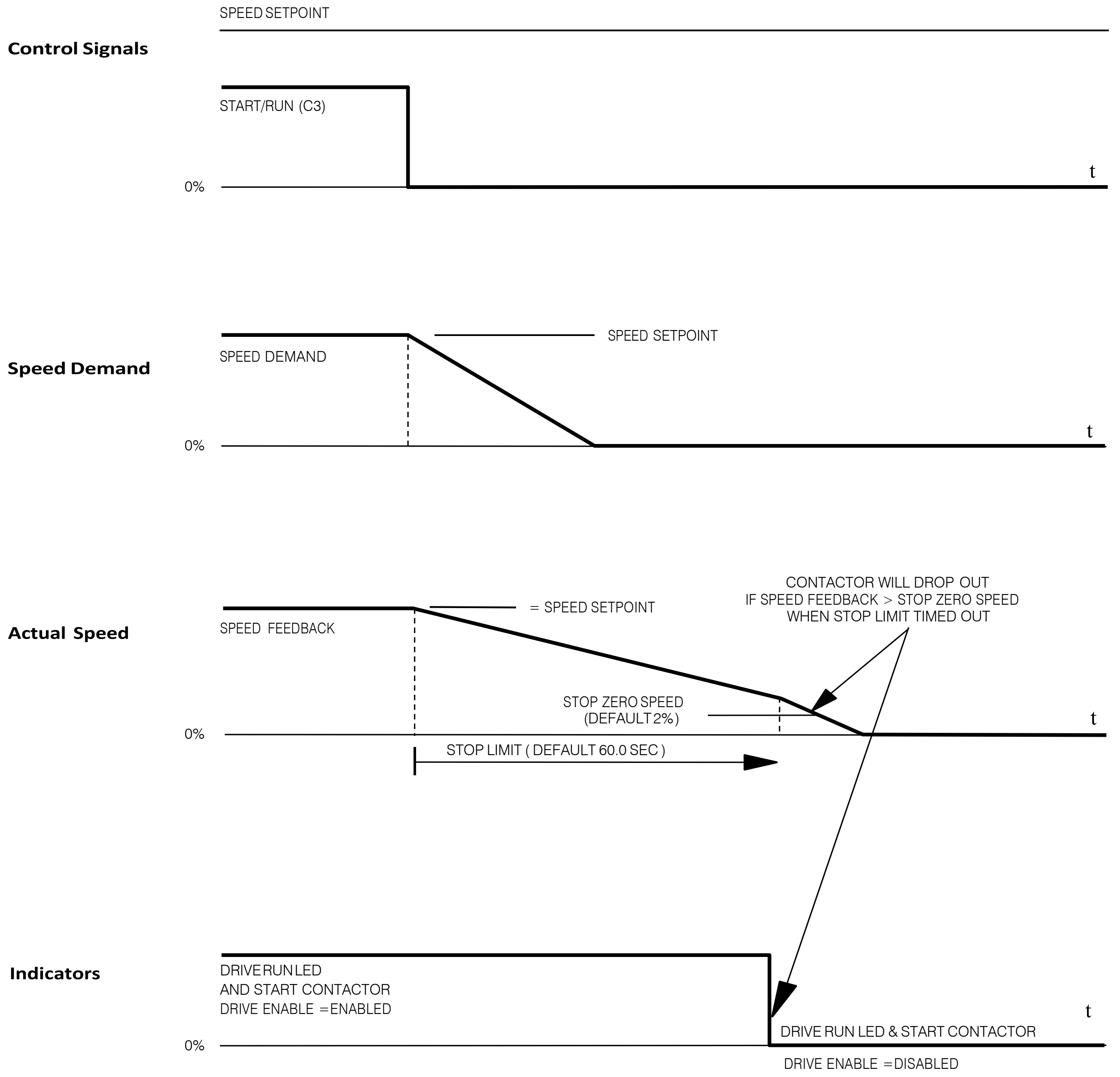
1 SETUP PARAMETERS
2 STOP RATES
STOP TIME

MMI Menu Map

1 SETUP PARAMETERS
2 CURRENT LOOP
MAIN CURR.LIMIT


NORMAL STOP
Control Signals
SPEED SETPOINT (100%)
START / RUN (C3)
0%
t
Speed Demand
SPEED DEMAND
100% = SPEED SETPOINT
0%
t
STOP TIME
DEFAULT 10.0 SEC
Actual Speed
SPEED FEEDBACK
= SPEED SETPOINT
ACTUAL STOPPING RATE
DEPENDS ON LOAD INTERTIA,
MOTOR HP AND OVERLOAD
CAPABILITY OF MOTOR/DRIVE
DRIVE IS DISABLED BELOW
STOP ZERO SPEED
IF SET > 0.25%
STOP ZERO
SPEED
(DEFAULT 2%)
0%
t
DRIVE REMAINS ENABLED
FOR CONTACTOR DELAY
IF STOP ZERO SPEED < 0.25%
Enable
DRIVE ENABLE =ENABLED
(DISPLAY DIAGNOSTIC)
0%
t
DRIVE ENABLE = DISABLED
Indicators
DRIVE RUN LED
AND START CONTACTOR
0%
t
CONTACTOR DELAY
(DEFAULT 1.0 SECS)

TIME-OUT IN NORMAL STOP



Program Stop (B8)

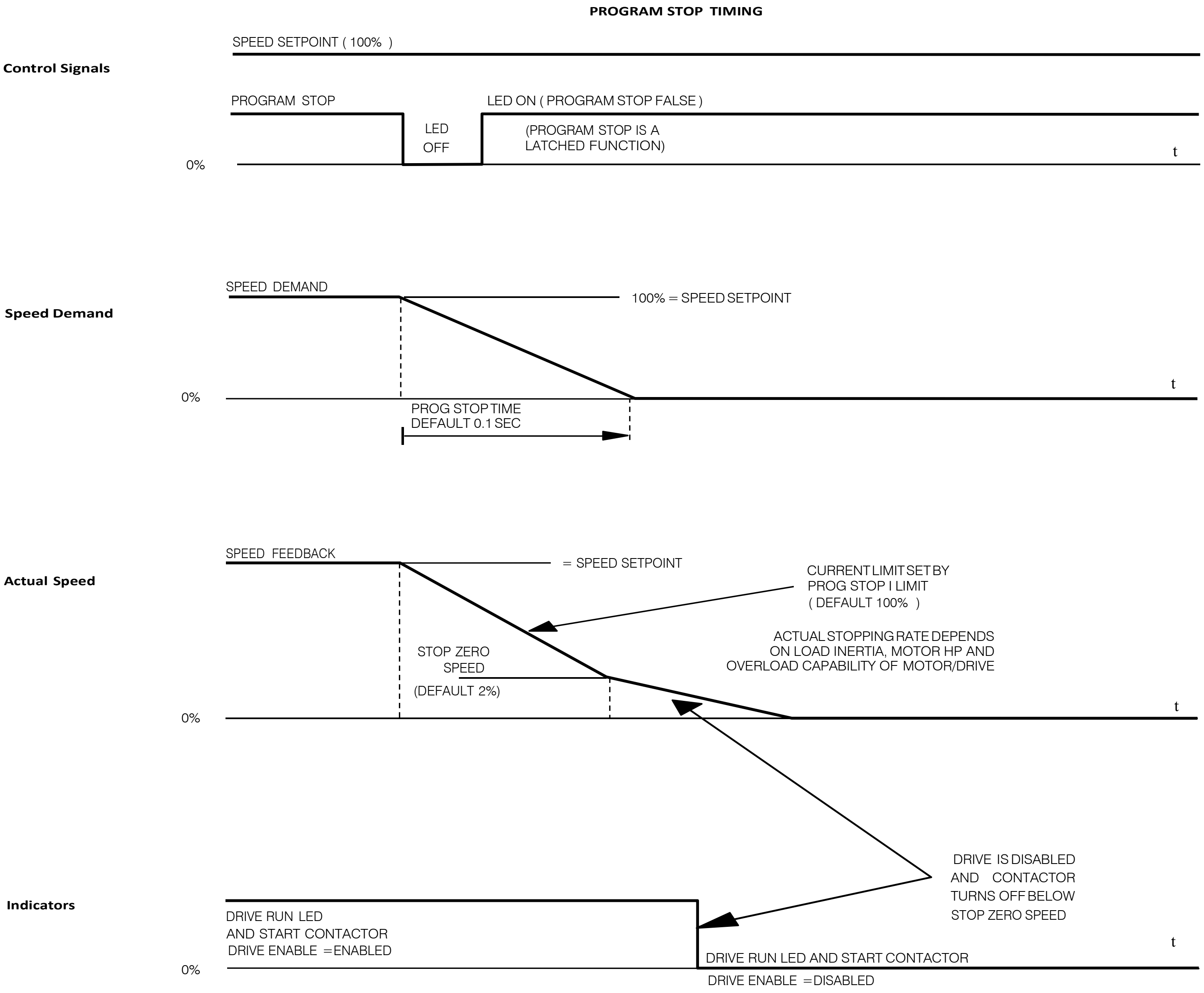
This is achieved by removing 24V from Terminal B8.

The motor speed is brought to zero under conditions defined by the PROG. STOP TIME (ramp rate) and PROG. STOP I LIMIT parameters.

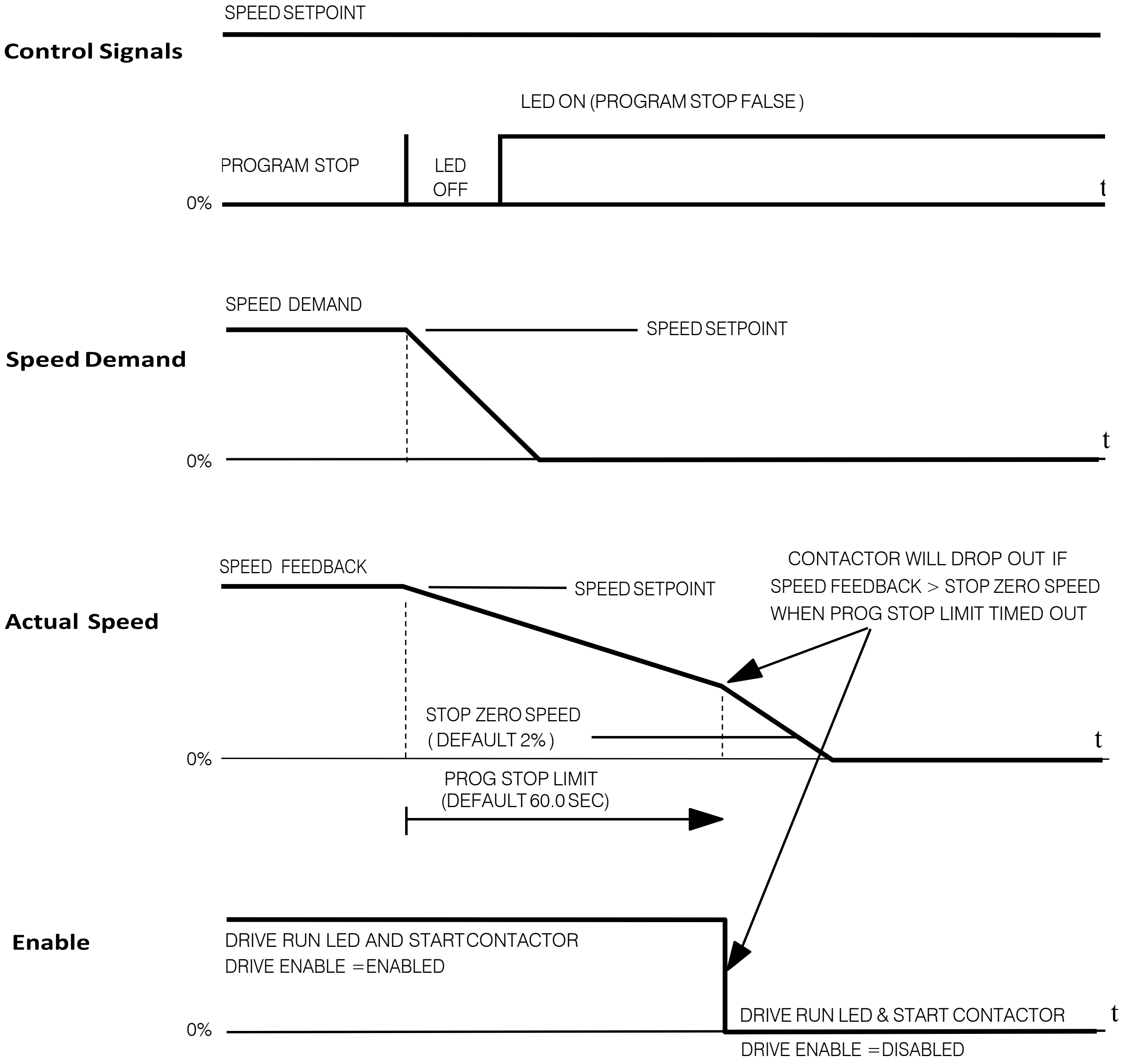
MMI Menu Map

1 SETUP PARAMETERS

2 STOP RATES
- PROG. STOP TIME
- PROG. STOP I LIMIT


PROGRAM STOP TIMING
Control Signals
SPEED SETPOINT (100%)
PROGRAM STOP
LED OFF
LED ON (PROGRAM STOP FALSE)
(PROGRAM STOP IS A LATCHED FUNCTION)
0%
t
Speed Demand
SPEED DEMAND
100% = SPEED SETPOINT
0%
t
PROG STOP TIME DEFAULT 0.1 SEC
Actual Speed
SPEED FEEDBACK
= SPEED SETPOINT
CURRENT LIMIT SET BY PROG STOP I LIMIT (DEFAULT 100%)
ACTUAL STOPPING RATE DEPENDS ON LOAD INERTIA, MOTOR HP AND OVERLOAD CAPABILITY OF MOTOR/DRIVE
STOP ZERO SPEED
(DEFAULT 2%)
0%
t
DRIVE IS DISABLED AND CONTACTOR TURNS OFF BELOW STOP ZERO SPEED
Indicators
DRIVE RUN LED AND START CONTACTOR DRIVE ENABLE =ENABLED
0%
t
DRIVE RUN LED AND START CONTACTOR
DRIVE ENABLE =DISABLED

TIME-OUT IN PROGRAM STOP



Coast Stop (B9)

This is achieved by removing 24V from Terminal B9.

The stack is automatically quenched and the contactor is opened. The motor coasts to a stop.

NOTE **The motor coast stop rate is dictated by the motor inertia - the drive does not control the motion.**

MMI Menu Map

1 SETUP PARAMETERS
2 STANDSTILL
  STANDSTILL LOGIC
  ZERO THRESHOLD

Standstill

Refer to Appendix D: "Programming" - STANDSTILL.

The Trip Condition

When a trip condition is detected, a similar stopping method to Coast Stop is used. The power stack cannot be re-enabled until the trip condition has been cleared and successfully reset.

Refer to Chapter 7: "Trips and Fault Finding" for further details.

Normal Starting Method

To achieve a normal start of the Drive:

1. Apply 24V to Terminal C5 (Enable)
2. Apply 24V to Terminal C3 (Start)

NOTE **The Drive will not start if there are alarms present, or if Terminals B8 (Program Stop) or B9 (Coast Stop) are low, 0V.**

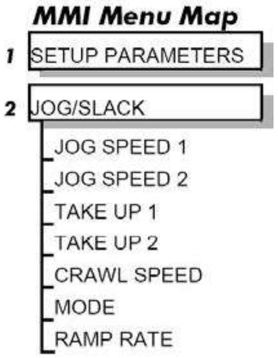
Ensure that Program Stop and Coast Stop are valid before Start/Run is applied.

Advanced Starting Methods

Starting Several Drives Simultaneously

1. Apply 24V to Terminal C3 (Start)
2. Use Terminal C5 (Enable) to synchronise the start-up of the Drives

Jog



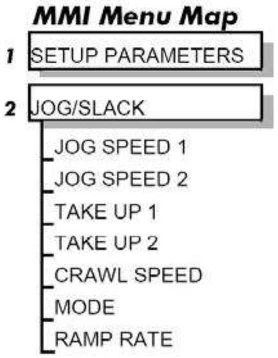
NOTE **The Drive will not start if there are alarms present.**

This facility provides two dedicated jog setpoints (or perhaps an Inch Forward/Inch Reverse). Activating Jog runs the motor at speeds set by JOG SPEED 1 or JOG SPEED 2. The JOG/SLACK::MODE parameter selects JOG SPEED 1 or 2.

1. Apply 24V to Terminal C5 (Enable)
2. Apply 24V to Terminal C4 (Jog Mode)

Refer to Appendix D: "Programming" - JOG/SLACK for further information. Also refer to the STOP RATES function block: the CONTACTOR DELAY parameter is used to prevent multiple operations of the main contactor from rapid use of the Jog switch.

Crawl



NOTE **The Drive will not start if there are alarms present.**

This facility provides a dedicated crawl setpoint. Activating Crawl runs the motor at the speed set by CRAWL SPEED.

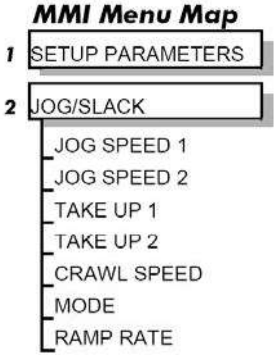
1. Apply 24V to Terminal C5 (Enable)
2. Set JOG/SLACK::MODE parameter (Tag No. 228) to **TRUE.**
3. Apply 24V to Terminal C3 (Start) and Terminal C4 (Jog Mode) simultaneously to start the Drive using the crawl speed, in Forward or Reverse.

When selecting CRAWL, apply Start (C3) and Jog (C4) simultaneously, otherwise you may experience Modes 3 or 6 momentarily. Refer to Appendix D: "Programming" - JOG/SLACK for further information (see the Setpoint Selection Table).

Take Up Slack

NOTE **The Drive will not start if there are alarms present.**

This facility provides two additional Take Up Slack setpoints. Activating Take Up Slack runs the motor at the speed set by "speed setpoint + TAKE UP1" or "speed setpoint + TAKE UP 2".



TAKE UP SLACK 1:

1. Apply 24V to Terminal C5 (Enable).
2. Apply 24V to Terminal C3 (Start) to accelerate to set speed.
3. Set JOG/SLACK::MODE parameter (Tag No. 228) to **FALSE**.
4. Apply 24V to Terminal C4 (Jog Mode) to run the motor at "speed setpoint + TAKE UP 1".
5. Remove 24V from Terminal C4 (Jog Mode) to run the motor at speed setpoint.

TAKE UP SLACK 2:

6. Apply 24V to Terminal C5 (Enable).
7. Apply 24V to Terminal C3 (Start) to accelerate to set speed.
8. Set JOG/SLACK::MODE parameter (Tag No. 228) to **TRUE** to run the motor at "speed setpoint + TAKE UP 2".
9. Set JOG/SLACK::MODE parameter (Tag No. 228) to **FALSE** to run the motor at speed setpoint .

Refer to Appendix D: “Programming” - JOG/SLACK for further information (see the Setpoint Selection Table).

External Control of the Drive

Remote Sequencing Command

REM. SEQUENCE : Tag 536, Mnemonic "ow", Default = 0x0000 ("0x" denotes a Hexadecimal value)

This is a control word that allows the device to be operated remotely over a field bus. REM. SEQ. ENABLE must be TRUE to enable this function.

NOTE **Refer to the RS485 Communications Interface Technical Manual.**

Reserved bits are undefined when read and should be set Zero when written.

Bit Number	Mask	Name	Comment
0 (lsb)	0x0001	Remote Enable	
1	0x0002	Remote Start	
2	0x0004	Remote Jog	
3	0x0008	Remote Jog Mode	Selects Jog Speed
4	0x0010	Reserved	
5	0x0020	Reserved	
6	0x0040	Reserved	
7	0x0080	Reserved	
8	0x0100	Remote Alarm Ack	Alarm Acknowledge
9	0x0200	Remote/Remote Trip	Remote Trip (High for OK)
10	0x0400	Reserved	
11	0x0800	Reserved	
12	0x1000	Reserved	
13	0x2000	Reserved	
14 (msb)	0x4000	Reserved	
15 (msb)	0x8000	Validation	This bit must be zero for the command word to be accepted

Useful Commands using EI Bisynch ASCII - REM. SEQUENCE

Tag 536, Mnemonic "ow", for example:

	/Remote Trip	Alarm Ack	Jog Mode	Jog	Start	Enable	Command
Start Drive	1	0	X	0	1	1	ow>0203
Stop Drive	1	0	X	0	0	1	ow>0201
Disable Drive	1	0	X	X	X	0	ow>0200
Jog Setpoint 1	1	0	0	1	0	1	ow>0205
Jog Setpoint 2	1	0	1	1	0	1	ow>020D
Remote Trip	0	0	X	X	X	X	ow>0000
Reset Alarm a)	1	1	0	0	0	0	ow>0300
							Healthy Output Bit 11 goes high
Reset Alarm b)	1	0	X	0	0	0	ow>0200

Sequence Status

SEQ STATUS : Tag 537, Mnemonic "ox" (Read Only)

Reserved bits are undefined when read.

Bit Number	Mask	Name	Comment
0 (lsb)	0x0001	Coast Stop	Coast Stop demanded
1	0x0002	Program Stop	Program (Fast) Stop demanded
2	0x0004	Disable	/Enable demanded
3	0x0008	Run	Drive Start demanded
4	0x0010	Jog	Drive Jog demanded
5	0x0020	Reserved	Undefined
6	0x0040	Alarm	Unacknowledged alarm (Health Store != 0)
7	0x0080	Reserved	Undefined
8	0x0100	Running	Contactor in and drive ready to be enabled
9	0x0200	Enabled	Drive is enabled
10	0x0400	Zero Speed	Zero speed Output TAG 17
11	0x0800	Healthy Output	Healthy Output TAG 12
12	0x1000	Ready	Ready Output TAG 559
13	0x2000	Reserved	Undefined
14	0x4000	Reserved	Undefined
15 (msb)	0x8000	Reserved	Undefined

Typical Bit Patterns reported via SEQ STATUS

Tag 537, Mnemonic "ox" (Read Only) - for example:

Sequence Status	Comment
0x1B0B	Running
0x044B	Tripped, Run High
0x0447	Tripped, Run Low, Enable Low
0x0C47	Trip Acknowledged, Healthy output TRUE Alarm stays high until drive is restarted.

Chapter 5

Control Loops

This chapter explains the principle of operation, and provides help on setting up the control loops correctly.

Control Loops - Principle of Operation

MMI Menu Map

1 SETUP PARAMETERS

2 CURRENT LOOP

I DMD ISOLATE

NOTE **Selection between Current Control or Speed Control (default) is made by the I DMD ISOLATE (current demand isolate) parameter using Digital I/P3 (Terminal C8). If ENABLED the Drive operates as a current controller, and if DISABLED (the default) it operates as a speed controller.**

Current Loop

The current loop accepts a demand from either the speed loop, or directly from the plant, and forms an error signal which is the difference between demand and average value of feedback. The error signal is fed into a Proportional + Integral compensator which produces the output of the current loop, i.e. the firing angle signal.

In the Drive, the error signal is created in two different forms:

1. The *average* error is computed as the difference between demand and average value of feedback and fed into the Integral part of the P + I algorithm.
2. The *instantaneous* error is computed as the difference between demand and instantaneous value of feedback and is fed into the Proportional part of the P + I algorithm. This gives higher transient performance since it does not contain any time lag, unlike the average which has a built-in lag of 1/6 of mains cycle. However, the average is the true measurement of torque which is the objective of the current control and this is not affected by the small time lag in achieving zero steady-state error.

The firing angle signal is translated into a certain time delay from the mains zero cross point (obtained via a Phase-Lock-Loop) and this results in a firing command being issued to the thyristor stack every 1/6 of a mains cycle in steady-state.

Some special features of the current controller are discussed separately below.

Adaptive Current Control

The gain of a thyristor 6-pulse converter (voltage-time area over firing angle) drops dramatically at discontinuous values of armature current. Therefore a gain boost is required in the current controller to compensate for that.

In the Drive, this is handled by an adaptive algorithm which allows the current to follow the demand in one step (firing) within the discontinuous region of operation.

Back EMF (BEMF) Estimate

With the motor at standstill, the firing angle for zero current is 120 degrees. When the motor is rotating at different speeds the firing angle for zero current follows a cosine locus.

It is of paramount importance to track this locus as close as possible throughout the speed range if the current loop bandwidth is to be maintained at its highest possible level during current reversals from master to slave bridge and visa-versa.

There are two reasons for the loss of bandwidth at current reversals:

1. The loss of converter gain needs to be compensated in an accurate way which is the objective of the adaptive algorithm.
2. The above algorithm also relies on the right start-up value of firing angle in the incoming bridge in order to minimise both the "dead-time" (time interval of zero current referred to below) as well as the rise time to the required current demand.

In order to get the right start-up value of firing angle the knowledge of the operating BEMF is necessary. In the Drive, this is achieved by a combination of a hardware peak current detector and appropriate software algorithm.

Bridge Changeover Delay

The bridge changeover "dead-time", i.e. time interval of zero current, is programmable from 1 to 1500 (via Reserved Menu) with a default value of 1.

For values from 1 to 6:

The delay can be set at multiples of 1/6 mains period, i.e. max. 6 x 3.33 = 20ms at 50Hz. This is relevant for use with large power converters where it is advisable to allow more time for snubber currents to subside before reversal is enabled. It is also relevant for motors with very large armature inductance where zero current detection is more sensitive and therefore a "factor of safety" in the bridge changeover delay is advisable.

For values from 7 to 1500:

The delay corresponds to 7 x 1.33µs up to 1500 x 1.33µs = 2ms maximum.

Manual Tuning

NOTE **This procedure is rarely used or required, if possible use Autotune.**

If the motor is permanent magnet or (very rarely) wound-field of relatively high permanent magnetism, and the drive is a 4Q drive, then clamp the shaft prior to using the 4Q Autotune process (default). This mode of Autotune produces current pulses on alternate thyristor bridges, and thus the net rotational torque is very low.

There are two circumstances where a manual tuning process would be required:

1. The motor is permanent magnet or (very rarely) wound-field of relatively high permanent magnetism, and the drive is a 2Q drive.
2. The Autotune process has failed with AUTOTUNE ERROR message. The possible causes of an Autotune error are:
   - The motor shaft was rotating, or was caused to rotate.
   - The field current was seen to exceed 6%, when a field-off Autotune had been selected, or the field current stopped during a field-on Autotune.
   - The drive to armature wiring was open-circuit.
   - The discontinuous current boundary was found to exceed 200% of either the stack rating or the nominated motor armature current rating (see **A** below).
   - Large imbalance in the three-phase voltages of the supply (see **B** below).
   - A hardware fault relating to current feedback was detected on the control board.

If the cause of the Autotune failure can be determined and rectified then do so and simply repeat the Autotune process.

MMI Menu Map

1 SETUP PARAMETERS

2 CURRENT LOOP
  - MAIN CURR.LIMIT
  - PROP. GAIN
  - INT. GAIN
  - DISCONTINUOUS
  - I DMD. ISOLATE

A. If a very high motor discontinuous current boundary was the cause of failure, then the discontinuous-region manual tuning process needs to be applied as follows:

1. Set the DISCONTINUOUS parameter to 0, which selects adaptive current control off. When operating in this mode, disable the Missing Pulse alarm, since it is normally masked in the discontinuous region, and it will otherwise give spurious trips at low currents.
2. Set PROP. GAIN to a low level (typically 1), since it is ineffectual in the discontinuous current operating region.
3. Set the INT. GAIN to a moderate level (typically 10), sufficient to give fast response throughout the discontinuous current region.

MMI Menu Map

1 SETUP PARAMETERS

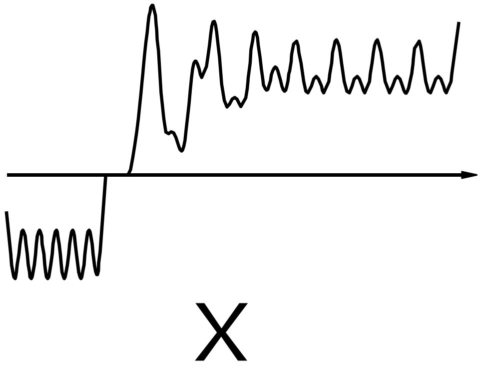
2 FIELD CONTROL
  - FIELD ENABLE

B. If imbalance in the three-phase voltages of the supply is the cause of failure then the PI-control manual tuning process needs to be applied as follows:

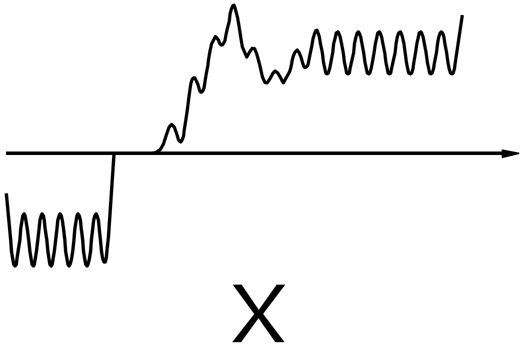
1. Set FIELD ENABLE to Disabled and clamp the motor shaft, to prevent rotation.
2. Attach an oscilloscope to the control board armature current monitor test-point (test point IA [see page 5 -5], scaled for 1.1V = 100% rated armature current, +ve = reverse bridge, -ve = forward bridge). The scaled armature current value can also be seen in the CURRENT FEEDBACK diagnostic.
3. Run the drive with a positive speed demand, gradually increasing MAIN CURR. LIMIT until the armature current pulses are seen to just join up. At this point, enter the value of CURRENT FEEDBACK into the DISCONTINUOUS parameter.
4. Enable the I DMD. ISOLATE parameter (or supply 24V to terminal C8). Use a toggling square-wave (< 20Hz) on the direct demand input (terminal A3) to generate current steps above the discontinuous region. Alternately increase PROP. GAIN and INT. GAIN, as far as possible, until the current loop response is correct (see Tuning Hints below).

MMI Menu Map

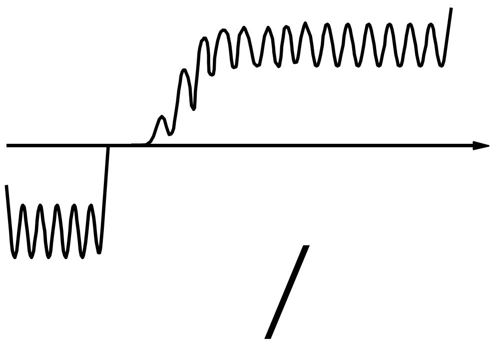
1 DIAGNOSTICS
  - CURRENT FEEDBACK



Current Loop controls incorrectly set. Rapid alternating oscillation = P gain too high



Current Loop controls incorrectly set. Slower oscillatory response = I gain too high



Current Loop controls correctly set.

Tuning Hints

If the P gain (PROP.GAIN) is too high then the response will exhibit a rapid oscillation, that alternates on consecutive current pulses.

If the I gain (INT. GAIN) is too high then the result will be a slower oscillatory response (under-damped), with a period of multiple pulses.

If the I gain (INT. GAIN) is too low then the response will exhibit a long settling tail.

Diagnostics

The diagnostic point for "real" armature current is the first (left-hand side) test point below the calibration panel. This will give 1.1V average for 100% current. It will also give the operating bridge, i.e. it will be negative for the Master bridge (positive current demand) and positive for the Slave bridge (negative current demand).

Current Demand Rate Limit (di/dt)

Access to the di/dt limit is currently reserved for Drives personnel only in the Reserved Menu.

This is a limit imposed on the rate of change of the current demand. It is to be used for motors with commutation limitations, mechanical systems that cannot absorb rapid torque transients and also as a means of limiting current overshoot for large current swings (e.g. 0 à 200%). The default value is set at 35% (i.e. maximum allowable change is 35% of FLC in 1/6 mains cycle) which has no practical effect on the current response between 0 and 100%.

Speed Loop

The speed loop accepts a demand from either an outside loop (i.e. position loop) or directly from the plant and forms the error signal which is the difference between demand and feedback. The error signal is fed into a Proportional + Integral compensator which produces the output of the speed loop, i.e. the current demand signal.

The integral gain is translated into a Time Constant (secs) in the MMI which defines more clearly the function of the compensator against a certain load time constant.

Speed Loop Synchronised with Current Loop

The proportional part of the P+I algorithm is executed immediately before each run of the current loop, thus ensuring minimum time lag and therefore maximum bandwidth.

Combined Analog Tacho/Encoder Feedback

By using the analog tacho feedback on the Proportional part of the P + I algorithm and the encoder feedback on the Integral part (using similar principle as in the current loop), the Drive combines maximum transient response with the increased steady-state accuracy of the digital feedback.

Field Control

MMI Menu Map

1 CONFIGURE DRIVE
  AUTOTUNE

Set-Up Notes

Use the field AUTOTUNE facility to tune the field current control loop.

Initial Conditions

1. Main contactor open, i.e. no Start/Run signal at terminal C3.

2. Set the AUTOTUNE parameter to OFF.

3. Program Stop (terminal B8) and Coast Stop (terminal B9) should be high, i.e. 24V.

4. The motor should be stationary.

Caution

Never perform a field autotune if the motor is turning above base speed, since this will generate armature voltages that can overvoltage the armature circuit.

Performing an Autotune

1. Set the AUTOTUNE parameter to FIELD.

2. Close the main contactor, i.e. Start/run signal to terminal C3.

3. Energise the Enable terminal (C5).

The Autotune sequence is initiated. When complete (after approximately 5 seconds), the main contactor is opened signalling the end of the sequence and the AUTOTUNE parameter is reset to OFF.

4. Perform a PARAMETER SAVE now. Refer to Chapter 6: "The Keypad - Saving Your Application".

MMI Menu Map

1 SETUP PARAMETERS
2 FIELD CONTROL
3 FLD.CURRENT VARS
  SETPOINT
  PROP. GAIN
  INT. GAIN
>> FLD.WEAK VARS

Autotune Failed?

The AUTOTUNE ERROR message may result if:

- ➢ The field terminals are open-circuit or short-circuit.
- ➢ More than 180% or less than 20% field voltage is required to drive the current configured in the FIELD CURRENT parameter.
- ➢ The natural field time-constant is greater than 5 seconds.

In these cases, a manual tuning process will be required, much like the manual tuning of the armature current loop. With manual tuning, one convenient method of producing field current demand steps is to set the field demand (SETPOINT) to 50% and then use the drive enable to move to and from the 'quench' and 'standby' modes to create transients. Monitor the field current at control board test-point IF, scaled 4V = 100% rated field current.

Current Control

The field current loop can accept a demand directly from the plant and/or an outside field weakening loop and forms the error signal which is the difference between demand and feedback. The error signal is fed into a P + I compensator which produces the output of the field loop, i.e. the field firing angle signal.

The firing angle signal is translated into a certain time delay from the mains zero cross point (obtained via the same Phase-Lock-Loop as for the armature) and this results into a firing command being issued to the field bridge every 1/2 of a mains cycle in steady-state.

Voltage Control

This offers the facility of an open-loop voltage control for motors which do not provide in the nameplate the field current rating. The field voltage is controlled by the specified FLD. VOLTS RATIO which defaults to 90.0%. This is the maximum dc Volts that can be obtained for a given ac RMS input in a single-phase rectifier, i.e. 370V dc for 415V ac supply. The specified ratio determines directly the firing angle at which the controller operates and therefore the thermal effects on the field resistance as well as mains voltage variations are not compensated for. It is also worth noting that in this mode the field overcurrent alarm is not active (since there is no current scaling) and therefore this mode is not recommended for use with supplies much greater than the field voltage rating.

Field Weakening

Motor field weakening is used to extend the speed region of the motor above its base speed (the motor speed resulting at rated armature voltage, rated armature current and rated field current), in a constant power mode of operation (motor torque reducing with increasing speed).

Note that the motor should be rated for field-weakened operation, in terms of rotational speed and reduced field current, before utilising this mode.

The drive includes a field weakening loop that, above base speed, can control the field current demand to the correct level required to maintain motor back-EMF at a pre-defined level.

MMI Menu Map

1 SETUP PARAMETERS

2 FIELD CONTROL

3 FLD.CURRENT VARS

4 FLD.WEAK VARS

- FLD. WEAK ENABLE
- EMF LEAD
- EMF LAG
- EMF GAIN
- MIN FLD.CURRENT
- MAX VOLTS
- BEMF FBK LEAD
- BEMF FBK LAG

NOTE **Field weakening is not possible when running with Armature Volts feedback. Although field weakening can be “Enabled” in this instance, a software interlock clamps the field demand at 100% and will not allow the field weakening to reduce it.**

When the back-EMF measurement is higher than the MAX VOLTS setting (default 100%) the excess voltage is presented to the field weakening gain-limited PI controller as an error, and this controller reduces the field current demand accordingly.

The gain-limited controller is tuned as follows:

1. Ensure that the armature current, speed and field current loops are correctly tuned.
2. Enable field weakening control (FLD. WEAK ENABLE = ENABLE), with analogue tachogenerator, encoder speed feedback, correctly installed and configured for extended speed operation.
3. Run the drive and slowly increase the speed demand so that the field is being weakened by the gain-limited PI controller. Change the MAX VOLTS parameter down and up by 10% to generate field current transients.
4. Alternately increase the P gain (using the dc-gain parameter EMF GAIN) and reduce the integral time-constant (parameter EMF LEAD) until the loop is correctly tuned (see the Current Loop "Tuning Hints" above).

It is the over-voltage of the back-EMF that provides the error which drives this controller to weaken the field, and the over-voltage occurring during ramp through base speed is dependent on the rate of ramp. If the over-voltage is excessive, then it can be reduced most simply by switching to the ADVANCED field weakening mode. In the STANDARD mode, provide advanced notice of the overvoltage, in order to reduce it, by employing the lag/lead filter applied to the back-emf measurement. This filter is disabled by default through its equal lag and lead time-constant settings, increase the lead time-constant to provide advance notice of weakening to the controller.

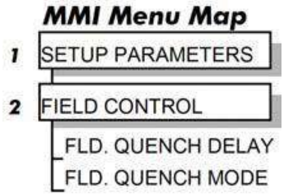
Notes on field weakening controller usage:

1. **The use of the back-EMF filter should be limited to 3:1 ratio of lag to lead time-constants, and the field current loop and field weakening controller may need to be de-tuned, in order to maintain overall loop stability.**
2. **The gain-limit of the PI controller may also be adjusted in order to optimise the balance between transient and static back-EMF over-voltage. Lower lag time-constants and lower dc-gains result in more static back-EMF over-voltage, but allow for more back-EMF filter advance during speed ramps. The ratio of lag to lead time-constants should be typically maintained above 10 to avoid significant dc over-voltage on the back-EMF.**

ADVANCED Mode

The ADVANCED mode of the field weakener offers the following advantages over the STANDARD mode.

1. **A feedforward control is applied in addition to the gain-capped PI controller.** This term, which compares the actual speed feedback to the calculated base speed, estimates the required field weakening. The use of this control term significantly reduces the overvoltage on transition through base speed, prior to the application of any lead-lag compensation. Transistions through base speed can be more rapid without overvoltage as a result. In addition, false weakening of the field is eliminated for speed transients just below base speed, if the lead-lag back-emf filter is left disabled.
2. **The back-emf control loop is gain compensated for reducing field level.** Motor back-emf is related directly to the motor speed, and to the motor flux level. As a result the transfer gain from field current to back-emf is directly related to motor speed. An adaptive gain element is included in the ADVANCED mode that increases back-emf loop gain below full speed, and this allows improved control performance at the field weakening boundary whilst maintaining stability at full speed.
3. **The speed control loop is gain compensated for reducing field level.** Motor torque is related directly to both armature current and motor flux level. An adaptive gain element is included in the ADVANCED mode that increases speed loop gain below full field, and this maintains speed control performance into the field weakened operating region. Note that the lag-lead back-emf filter can still be applied in the ADVANCED mode to further improve voltage control during rapid excursions into field weakening.



Standby Field

When the armature current gets quenched, a timer starts timing-out and after a certain delay (FLD. QUENCH DELAY) it will either quench the field totally (FLD. QUENCH MODE = QUENCH) or will reduce it to 50% of the current or voltage setpoint (FIELD QUECH MODE = STANDBY). This applies to both current and voltage modes.

Appendix A

Serial Communications

System Port (P3)

This port has several uses:

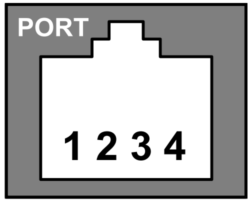
UDP Support	Upload information from a PC	Refer to page A-2
CACT	Parameters can be monitored and updated by CACT (or other suitable PC programming tool)	Refer to page A-4
EI ASCII	Communications with other control/supervisory equipment	Refer to page A-8
EI BINARY	Communications with other control/supervisory equipment	Refer to page A-13

Drive Connections

The port is an un-isolated RS232, 9600 Baud (default), supporting the standard EI BISYNCH ASCII communications protocol. Contact DC900P Drives for further information.

Use a standard P3 lead to connect to the Drive.

P3 Port Pin	Lead	Signal
1	Black	0V
2	Red	24V
3	Green	TX
4	Yellow	RX

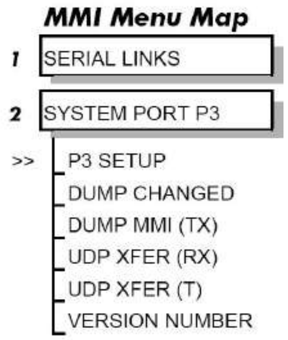


6-Way Lead to DB9/DB25 Connector

IMPORTANT ***There is 24V present on pin 2 of the P3 port. This may damage your PC or the Drive.***

P3 Port Pin	Lead	Female DB9 Pin	Female DB25 Pin
1	Black	5	7
2	Red	not connected	not connected
3	Green	2	3
4	Yellow	3	2

UDP Support



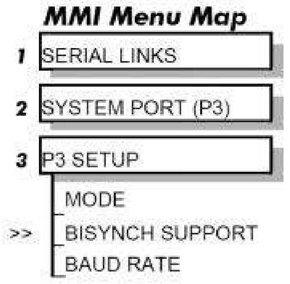
The Upload Download Protocol (UDP) can be used to transfer text files between the drive and a host computer using the P3 port. Files that can be transferred using UDP are configuration files, language files and text “dumps” of all the parameters shown on the MMI.

Configuration files and language files are formatted as Intel Hex files. The files contain a copy of the drive’s configuration and may be transferred either from the drive to the host computer, or from the host computer to the drive. **Transferring a configuration file to the drive will over-write all the drive’s settings.**

Language files contain information required to display parameters on the Display/Keypad in a language other than English. These may only be transferred from the host computer to the drive. Contact Drives for further information.

MMI dumps are human readable text files showing all the parameters in the drive in the order they are shown on the MMI. The files can only be transferred from a drive to the host computer.

System Port (P3) Set-up



When transferring data using UDP the communications settings used are:

Baud rate selected via the P3 BAUD RATE parameter, (Tag No 198).

1 Stop bit, (fixed)

No Parity, (fixed)

8 data bits, (fixed)

No flow control, (fixed)

UDP Transfer Procedure

UDP XFER (RX)

This is the transfer of either a language or a configuration file from the host computer to the Drive. The drive automatically detects whether the file is a language file or a configuration file. **Transferring a configuration file to the drive will over-write all the drive’s settings.**

1. Connect the Drive to the host using the appropriate lead.
2. Using a standard communications package prepare the host to transfer an ASCII file. Remember to set-up the host's serial port first.
3. Start the transfer on the Drive by selecting UDP XFER (RX) on the MMI and pressing the UP (↑) key, as instructed.
4. When the Drive says RECEIVING, begin the file transmission.
5. The Drive automatically terminates the UDP transfer when it detects the end of the Intel Hex end-of-file record.

UDP XFER (TX)

This is the transfer of the drive’s settings as an Intel Hex file.

1. Connect the Drive to the host using the appropriate lead.
2. Using a standard communications package prepare the host to receive an ASCII file. Remember to set up the host's serial port first.
3. On the host computer, direct data received on the serial comms port to a file.
4. Start the transfer on the Drive by selecting UDP XFER (TX) on the MMI and pressing the UP (↑) key, as instructed. The drive says SENDING.
5. When the transfer is finished, terminate the capture of serial data on the host computer.

MMI Dump Procedure

The MMI dump can be used to transfer all of the drive’s parameters or just those that have been changed from the default values. The format of the data is human readable and may be used as documentation of the drive’s configuration.

DUMP CHANGED

This parameter is used in conjunction with DUMP MMI (TX). When TRUE, only those parameters that have been modified from their default value are included in the dump.

DUMP MMI (TX)

This is the transfer of all parameters.

1. Connect the Drive to the host using the appropriate lead.
2. Using a standard communications package prepare the host to receive an ASCII file. Remember to set up the host's serial port first.
3. On the host computer, direct data received on the serial comms port to a file.
4. Start the transfer on the Drive by selecting DUMP MMI (TX) on the MMI and pressing the UP (↑) key, as instructed. The drive says REQUESTED.
5. When the transfer is finished, terminate the capture of serial data on the host computer.

CACT Support

This is Windows-based block programming software. It has a graphical user interface and drawing tools to allow you to create block programming diagrams quickly and easily.

System Port (P3) Set-up

Set MODE parameter (Tag No. 130) to EIASCII using the MMI

Set the BAUD RATE parameter to match the baud rate selected on the host computer.

1 Stop bit (fixed)

Even Parity (fixed)

7 bits (fixed)

No flow control, (fixed)

Appendix B

Parameter Specification Tables

Details for all parameters provided on the Keypad.

Parameter Tables

The headings for the Tag No. table are described below.

Tag	A numeric identification of the parameter. It is used to identify the source and destinations of internal links.
Mn	Serial Communications Mnemonic: Refer to Appendix A: "Serial Communications"
MMI Block Name	The menu page under which the parameter is stored on the MMI.
MMI Parameter Name	The parameter name as it appears on the MMI.
Minimum/Maximum/ Default/Units/Range	The Range varies with parameter type: INT The upper and lower limits of the parameter, indicating the parameter's true, internally-held, number of decimal. ***Note:*** Decimal Places **- some internally held parameters with two decimal places are only displayed with one decimal place. These parameters are indicated in the Parameter Description tables. The Range parameter highlights these with "(h)".** BOOL 0 = FALSE, 1 = TRUE WORD 0x0000 to 0xFFFF (hexadecimal)
Notes	Output parameters are not saved in non-vol memory unless noted otherwise. Input parameters are saved in non-vol memory unless noted otherwise. View levels: V0 Normal, V1 Advanced Write qualifiers: W0 Always; W1 Only when stopped; W2 Only when in configuration mode; W3 Only in thee-button reset mode; W4 Read only, (output parameters)

Parameter Types:

Parameters that look like 0x0000 are WORDS

Parameters that have text are BOOLs if they have a range of 0,1

Parameters that have text are WORDS if their range is 0 to greater than 1

All other parameters are INT (integers)

If a parameter can only be written to in Config mode, this implies that the drive is stopped.

Specification Table: Tag Number Order

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
2	a2	RAMPS	RAMP ACCEL TIME	0.1	600.0	10.0	s		V0	W0
3	a3	RAMPS	RAMP DECEL TIME	0.1	600.0	10.0	s		V0	W0
5	a5	MIN SPEED	RAMP INPUT	-105.00	105.00	0.00	%		V1	W0
6	a6	SETPOINT SUM 1	RATIO 1	-3.0000	3.0000	1.0000			V0	W0
7	a7	SPEED LOOP	RATIO 2 (A3)	-3.0000	3.0000	1.0000			V0	W0
8	a8	SETPOINT SUM 1	SIGN 1	0	1	1		0: NEGATIVE 1: POSITIVE	V1	W0
9	a9	SPEED LOOP	SIGN 2 (A3)	0	1	1		0: NEGATIVE 1: POSITIVE	V0	W0
10	aa	CALIBRATION	ZERO SPD. OFFSET	-5.00	5.00	0.00	%		V0	W0
11	ab	STANDSTILL	STANDSTILL LOGIC	0	1	0		0: DISABLED 1: ENABLED	V0	W0
12	ac	STANDSTILL	ZERO THRESHOLD	0.00	100.00	2.00	%		V0	W0
13	ad	SPEED LOOP	SPD.INT.TIME	0.001	30.000	0.500	s		V0	W0
14	ae	SPEED LOOP	SPD.PROP.GAIN	0.00	200.00	10.00			V0	W0
15	af	CURRENT LOOP	CUR.LIMIT/SCALER	0.00	200.00	100.00	%		V0	W0
16	ag	CURRENT LOOP	PROP. GAIN	0.00	200.00	45.00			V0	W0
17	ah	CURRENT LOOP	INT. GAIN	0.00	200.00	3.50			V0	W0
18	ai	AUTOTUNE	AUTOTUNE	0	2	0		0: OFF 1: ARMATURE 2: FIELD	V0	W0
19	aj	ALARMS	FIELD FAIL	0	1	0		0: ENABLED 1: INHIBITED	V0	W0
20	ak	CALIBRATION	ARMATURE V CAL.	0.9800	1.1000	1.0000			V0	W0
21	al	CALIBRATION	IR COMPENSATION	0.00	100.00	0.00	%		V0	W0
22	am	ENCODER 1	ENCODER RPM	0	6000	1000	RPM		V0	W1
23	an	CALIBRATION	ANALOG TACH CAL	0.9800	1.1000	1.0000			V0	W0
24	ao	ENCODER 1	ENCODER LINES	10	5000	1000			V0	W1
25	ap	CALIBRATION	ARMATURE I (A9)	0	1	1		0: UNIPOLAR 1: BIPOLAR	V0	W0
26	aq	STOP RATES	PROG STOP TIME	0.1	600.0	0.1	s		V0	W0
27	ar	STOP RATES	STOP TIME	0.1	600.0	10.0	s		V0	W0

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
28	as	ALARMS	STALL TRIP	0	1	0		0: ENABLED 1: INHIBITED	V1	W0
29	at	STOP RATES	STOP ZERO SPEED	0.00	100.00	2.00	%		V0	W0
30	au	CURRENT LOOP	ADDITIONAL DEM	-200.00	200.00	0.00	%		V1	W0
31	av	CURRENT PROFILE	SPD BRK2 (HIGH)	0.0	100.0	100.0	%		V0	W1
32	aw	CURRENT PROFILE	SPD BRK1 (LOW)	0.0	100.0	100.0	%		V0	W1
33	ax	CURRENT PROFILE	IMAX BRK2(SPD2)	0.0	200.0	200.0	%		V0	W1
37	b1	MENUS	VIEW LEVEL	0	2	1		0: BASIC 1: STANDARD 2: ADVANCED	V0	W0
39	b3	CONFIGURE DRIVE	CONFIGURE ENABLE	0	1	0		0: DISABLED 1: ENABLED	V0	W1
41	b5	SPEED LOOP	SETPOINT 4	-105.00	105.00	0.00	%		V0	W0
42	b6	CURRENT LOOP	AT CURRENT LIMIT	0	1	0			V1	W4
43	b7	DIGITAL OUTPUT 1	MODULUS	0	1	1			V0	W0
44	b8	DIGITAL OUTPUT 2	MODULUS	0	1	1			V0	W0
45	b9	DIGITAL OUTPUT 3	MODULUS	0	1	1			V0	W0
47	bb	SPEED LOOP	SPEED FBK SELECT	0	4	0		0: ARM VOLTS FBK 1: ANALOG TACH 2: ENCODER 3: ENCODER/ANALOG 4: ENCODER 2	V0	W1
48	bc	CURRENT LOOP	NEG. I CLAMP IN	-200.00	200.00	-200.00	%		V1	W0
49	bd	ENCODER 1	ENCODER SIGN	0	1	1		0: NEGATIVE 1: POSITIVE	V0	W1
50	be	ANALOG INPUT 1	ANIN 1 (A2)	0.00	0.00	0.00	V		V1	W4
51	bf	ANALOG INPUT 2	ANIN 2 (A3)	0.00	0.00	0.00	V		V1	W4
52	bg	ANALOG INPUT 3	ANIN 3 (A4)	0.00	0.00	0.00	V		V1	W4
53	bh	ANALOG INPUT 4	ANIN 4 (A5)	0.00	0.00	0.00	V		V1	W4
54	bi	ANALOG INPUT 5	ANIN 5 (A6)	0.00	0.00	0.00	V		V1	W4
55	bj	ANALOG OUTPUT 1	ANOUT 1 (A7)	0.0	0.0	0.0	V		V1	W4
56	bk	ANALOG OUTPUT 2	ANOUT 2 (A8)	0.0	0.0	0.0	V		V1	W4
57	bl	CALIBRATION	TERMINAL VOLTS	0.0	0.0	0.0	%		V1	W4
58	bm	CALIBRATION	UNFIL.TACH INPUT	0.0	0.0	0.0	%		V0	W4
59	bn	ENCODER 1	UNFIL.ENCODER	0	0	0	RPM		V0	W4

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
60	bo	CALIBRATION	BACK EMF	0.0	0.0	0.0	%		V0	W4
61	bp	CURRENT LOOP	ACTUAL NEG I LIM	0.0	0.0	0.0	%		V0	W4
62	bq	SPEED LOOP	UNFIL.SPD.FBK	0.00	0.00	0.00	%		V0	W4
63	br	SPEED LOOP	SPEED SETPOINT	0.00	0.00	0.00	%		V0	W4
64	bs	SPEED LOOP	UNFIL.SPD.ERROR	0.00	0.00	0.00	%		V0	W4
65	bt	CURRENT LOOP	IaFbk UNFILTERED	0.0	0.0	0.0	%		V0	W4
66	bu	CURRENT LOOP	IaDmd UNFILTERED	0.0	0.0	0.0	%		V0	W4
67	bv	CURRENT LOOP	ACTUAL POS I LIM	0.0	0.0	0.0	%		V0	W4
68	bw	SEQUENCING	START (C3)	0	1	0		0: OFF 1: ON	V1	W4
69	bx	DIGITAL INPUT 4	DIGITAL INPUT C4	0	1	0		0: OFF 1: ON	V1	W4
70	by	DIGITAL INPUT 5	DIGITAL INPUT C5	0	1	0		0: OFF 1: ON	V1	W4
71	bz	DIGITAL INPUT 1	DIGIN 1 (C6)	0	1	0		0: OFF 1: ON	V1	W4
72	c0	DIGITAL INPUT 2	DIGIN 2 (C7)	0	1	0		0: OFF 1: ON	V1	W4
73	c1	DIGITAL INPUT 3	DIGIN 3 (C8)	0	1	0		0: OFF 1: ON	V1	W4
74	c2	DIGITAL OUTPUT 1	DIGOUT 1 (B5)	0	1	0		0: OFF 1: ON	V1	W4
75	c3	DIGITAL OUTPUT 2	DIGOUT 2 (B6)	0	1	0		0: OFF 1: ON	V1	W4
76	c4	DIGITAL OUTPUT 3	DIGOUT 3 (B7)	0	1	0		0: OFF 1: ON	V1	W4
77	c5	STANDSTILL	AT ZERO SPEED	0	1	0			V0	W4
78	c6	STANDSTILL	AT ZERO SETPOINT	0	1	0			V1	W4
79	c7	STANDSTILL	AT STANDSTILL	0	1	0			V1	W4
80	c8	SEQUENCING	PROGRAM STOP	0	1	0			V1	W4
81	c9	ALARMS	SPEED FBK ALARM	0	1	0		0: ENABLED 1: INHIBITED	V0	W0
82	ca	SEQUENCING	DRIVE START	0	1	0		0: OFF 1: ON	V0	W4
83	cb	SEQUENCING	CONTACTOR CLOSED	0	1	0			V0	W4

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
84	cc	SEQUENCING	DRIVE ENABLE	0	1	0			V0	W4
85	cd	RAMPS	RAMP OUTPUT	0.00	0.00	0.00	%		V1	W4
86	ce	SETPOINT SUM 1	SPT SUM OUTPUT	0.00	0.00	0.00	%		V1	W4
87	cf	CURRENT LOOP	POS. I CLAMP	0.0	0.0	0.0	%		V1	W4
88	cg	CURRENT LOOP	NEG. I CLAMP	0.0	0.0	0.0	%		V1	W4
89	ch	SPEED LOOP	SPEED DEMAND	0.00	0.00	0.00	%		V0	W4
90	ci	CURRENT LOOP	BIPOLAR CLAMPS	0	1	0		0: DISABLED 1: ENABLED	V1	W0
91	cj	STOP RATES	PROG STOP I LIM	0.00	200.00	100.00	%		V0	W0
92	ck	ALARMS	ENCODER ALARM	0	1	0		0: ENABLED 1: INHIBITED	V0	W0
93	cl	CURRENT PROFILE	IMAX BRK1(SPD1)	0.0	200.0	200.0	%		V0	W1
94	cm	AUX I/O	AUX DIGOUT 1	0	1	0		0: OFF 1: ON	V0	W0
95	cn	AUX I/O	AUX DIGOUT 2	0	1	0		0: OFF 1: ON	V0	W0
96	co	AUX I/O	AUX DIGOUT 3	0	1	0		0: OFF 1: ON	V0	W0
97	cp	LINK 13	SOURCE TAG	-1276	1276	77			V0	W2
98	cq	LINK 14	SOURCE TAG	-1276	1276	122			V0	W2
99	cr	LINK 15	SOURCE TAG	-1276	1276	125			V0	W2
100	cs	DEADBAND	INPUT 1	-200.00	200.00	0.00	%		V1	W0
102	cu	LINK 20	DESTINATION TAG	0	1276	90			V0	W2
103	cv	DIGITAL INPUT 1	VALUE FOR TRUE	-300.00	300.00	0.01	%		V0	W0
104	cw	DIGITAL INPUT 1	VALUE FOR FALSE	-300.00	300.00	0.00	%		V0	W0
105	cx	LINK 21	DESTINATION TAG	0	1276	118			V0	W2
106	cy	DIGITAL INPUT 2	VALUE FOR TRUE	-300.00	300.00	0.01	%		V0	W0
107	cz	DIGITAL INPUT 2	VALUE FOR FALSE	-300.00	300.00	0.00	%		V0	W0
108	d0	LINK 22	DESTINATION TAG	0	1276	119			V0	W2
109	d1	DIGITAL INPUT 3	VALUE FOR TRUE	-300.00	300.00	0.01	%		V0	W0
110	d2	DIGITAL INPUT 3	VALUE FOR FALSE	-300.00	300.00	0.00	%		V0	W0
111	d3	ALARMS	RCV ERROR	0	1	0		0: ENABLED 1: INHIBITED	V0	W0
112	d4	ALARMS	STALL TRIP	0	1	0		0: OK 1: FAILED	V1	W4

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
113	d5	RAMPS	RAMPING	0	1	0			V1	W4
114	d6	SEQUENCING	SEQ STATE	0	15	0		0: SEQ INIT 1: SEQ INIT 2: SEQ HOLD 3: SEQ STANDBY 4: SEQ PRE READY 5: SEQ READY 6: SEQ AUTOTUNING 7: SEQ RUN 8: SEQ AT ZERO SPD. 9: SEQ QUENCH 10: SEQ PROGRAM STOP 11: SEQ STOP 12: SEQ DELAY STOP 13: SEQ COAST STOP 14: SEQ ERROR 15: CURRENT DECAY	V0	W4
115	d7	ALARMS	HEALTH WORD	0x0000	0xFFFF	0x0000			V1	W4
116	d8	ALARMS	HEALTH STORE	0x0000	0xFFFF	0x0000			V1	W4
118	da	RAMPS	RAMP HOLD	0	1	0		0: OFF 1: ON	V1	W0
119	db	CURRENT LOOP	I DMD. ISOLATE	0	1	0		0: DISABLED 1: ENABLED	V1	W0
120	dc	MENUS	ENTER PASSWORD	0x0000	0xFFFF	0x04D2			V0	W0
121	dd	MENUS	CHANGE PASSWORD	0x0000	0xFFFF	0x0000			V1	W0
122	de	ALARMS	HEALTH LED	0	1	0			V0	W4
125	dh	SEQUENCING	READY	0	1	0			V0	W4
126	di	MIN SPEED	MIN SPEED	0.00	100.00	0.00	%		V1	W0
128	dk	AUX I/O	ANOUT 1	-100.00	100.00	0.00	%		V0	W0
129	dl	AUX I/O	ANOUT 2	-100.00	100.00	0.00	%		V0	W0
130	dm	COMMS PORT 3	MODE	0	4	3		0: DISABLED 1: MASTER 2: SLAVE 3: EIASCII 4: EIBINARY	V0	W0
131	dn	DEADBAND	DEADBAND WIDTH	0.0	100.0	0.0	%		V0	W0
132	do	IN	SETPT. RATIO	-3.0000	3.0000	0.0000			V0	W0

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
133	dp	IN	SETPT. SIGN	0	1	1		0: NEGATIVE 1: POSITIVE	V0	W0
134	dq	LINK 16	SOURCE TAG	-1276	1276	89			V0	W2
135	dr	LINK 45	DESTINATION TAG	0	1276	41			V0	W2
137	dt	CURRENT LOOP	DISCONTINUOUS	0.00	200.00	12.00	%		V0	W0
155	eb	DRIVE INFO	VERSION NUMBER	0x0000	0xFFFF	0x0000			V0	W4
158	ee	COMMS PORT 2	ERROR REPORT	0x0000	0xFFFF	0x00C0			V0	W0
161	eh	SEQUENCING	AUX START	0	1	1		0: OFF 1: ON	V0	W0
162	ei	CONFIGURE DRIVE	EMULATE 900P	0x0000	0xFFFF	0x0001			V1	W2
168	eo	SEQUENCING	AUX ENABLE	0	1	1		0: OFF 1: ON	V0	W0
169	ep	FIELD CONTROL	FIELD ENABLED	0	1	0		0: DISABLED 1: ENABLED	V0	W4
170	eq	FIELD CONTROL	FIELD ENABLE	0	1	1		0: DISABLED 1: ENABLED	V0	W1
171	er	FIELD CONTROL	SETPOINT	0.00	100.00	100.00	%		V1	W0
172	es	FIELD CONTROL	INT. GAIN	0.00	100.00	1.28			V0	W0
173	et	FIELD CONTROL	PROP. GAIN	0.00	100.00	0.10			V0	W0
174	eu	FIELD CONTROL	FLD. WEAK ENABLE	0	2	0		0: DISABLED 1: STANDARD 2: ADVANCED	V0	W1
175	ev	FIELD CONTROL	EMF LEAD	0.10	50.00	2.00			V0	W0
176	ew	FIELD CONTROL	EMF LAG	0.00	200.00	40.00			V0	W0
177	ex	FIELD CONTROL	EMF GAIN	0.00	100.00	0.30			V0	W0
178	ey	FIELD CONTROL	MAX VOLTS	0.00	100.00	100.00	%		V0	W0
179	ez	FIELD CONTROL	MIN FLD.CURRENT	0.00	100.00	90.00	%		V0	W1
180	f0	ALARMS	SPDFBK ALM LEVEL	0.0	100.0	50.0	%		V1	W0
181	f1	FEEDBACKS	UNFIL.FIELD FBK	0.00	0.00	0.00	%		V0	W4
182	f2	CALIBRATION	FIELD I CAL.	0.9800	1.1000	1.0000			V0	W0
183	f3	FIELD CONTROL	FIELD DEMAND	0.00	0.00	0.00	%		V1	W4
184	f4	FIELD CONTROL	FLD.FIRING ANGLE	0.00	0.00	0.00	DEG		V1	W4
185	f5	FIELD CONTROL	FLD.QUENCH DELAY	0.0	600.0	0.0	s		V1	W0
186	f6	FIELD CONTROL	FLD. QUENCH MODE	0	1	0		0: QUENCH 1: STANDBY	V1	W0

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
187	f7	IN	RAW INPUT	0.00	0.00	0.00	%		V0	W4
189	f9	IN	SCALED INPUT	0.00	0.00	0.00	%		V0	W4
191	fb	FIELD CONTROL	BEMF FBK LEAD	20	5000	100			V0	W0
192	fc	FIELD CONTROL	BEMF FBK LAG	20	5000	100			V0	W0
195	ff	DIGITAL OUTPUT 1	THRESHOLD (>)	-300.00	300.00	0.00	%		V0	W0
196	fg	DIGITAL OUTPUT 2	THRESHOLD (>)	-300.00	300.00	0.00	%		V0	W0
197	fh	DIGITAL OUTPUT 3	THRESHOLD (>)	-300.00	300.00	0.00	%		V0	W0
198	fi	COMMS PORT 3	BAUD RATE	0	9	5		0: 300 1: 600 2: 1200 3: 2400 4: 4800 5: 9600 6: 19200 7: 38400 8: 57600 9: 115200	V0	W0
201	fl	CURRENT LOOP	REGEN ENABLE	0	1	1		0: 2Q (NON-REGEN) 1: 4Q (REGEN)	V0	W1
202	fm	SPEED LOOP	INT. DEFEAT	0	1	0		0: OFF 1: ON	V1	W0
203	fn	INVERSE TIME	INVERSE TIME O/P	0.00	0.00	0.00	%		V1	W4
206	fq	ENCODER 1	ENCODER	0	0	0	RPM		V0	W4
207	fr	FEEDBACKS	SPEED FEEDBACK	0.00	0.00	0.00	%		V0	W4
208	fs	SETPOINT SUM 1	RATIO 0	-3.0000	3.0000	1.0000			V0	W0
209	ft	FIELD CONTROL	FLD.CTRL MODE	0	1	0		0: VOLTAGE CONTROL 1: CURRENT CONTROL	V0	W1
210	fu	FIELD CONTROL	FLD.VOLTS RATIO	0.0	100.0	90.0	%		V0	W0
212	fw	JOG/SLACK	OPERATING MODE	0	7	0		0: STOP 1: STOP 2: JOG SP. 1 3: JOG SP. 2 4: RUN 5: TAKE UP SP. 1 6: TAKE UP SP. 2 7: CRAWL	V1	W4
216	g0	STOP RATES	PROG STOP LIMIT	0.0	600.0	60.0	s		V1	W0

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
217	g1	STOP RATES	STOP LIMIT	0.0	600.0	60.0	s		V1	W0
218	g2	JOG/SLACK	JOG SPEED 1	-100.00	100.00	5.00	%		V0	W0
219	g3	JOG/SLACK	JOG SPEED 2	-100.00	100.00	-5.00	%		V0	W0
224	g8	ALARMS	STALL TRIP DELAY	0.1	600.0	30.0	s		V1	W0
225	g9	JOG/SLACK	CRAWL SPEED	-100.00	100.00	10.00	%		V0	W0
227	gb	SEQUENCING	AUX JOG	0	1	1		0: OFF 1: ON	V0	W0
228	gc	JOG/SLACK	MODE	0	1	0			V0	W0
230	ge	ANALOG INPUT 1	CALIBRATION	-3.0000	3.0000	1.0000			V0	W0
231	gf	ANALOG INPUT 1	MAX VALUE	-300.00	300.00	100.00	%		V0	W0
232	gg	ANALOG INPUT 1	MIN VALUE	-300.00	300.00	-100.00	%		V0	W0
233	gh	ANALOG INPUT 2	CALIBRATION	-3.0000	3.0000	1.0000			V0	W0
234	gi	ANALOG INPUT 2	MAX VALUE	-300.00	300.00	100.00	%		V0	W0
235	gj	ANALOG INPUT 2	MIN VALUE	-300.00	300.00	-100.00	%		V0	W0
236	gk	ANALOG INPUT 3	CALIBRATION	-3.0000	3.0000	1.0000			V0	W0
237	gl	ANALOG INPUT 3	MAX VALUE	-300.00	300.00	100.00	%		V0	W0
238	gm	ANALOG INPUT 3	MIN VALUE	-300.00	300.00	-100.00	%		V0	W0
239	gn	ANALOG INPUT 4	CALIBRATION	-3.0000	3.0000	1.0000			V0	W0
240	go	ANALOG INPUT 4	MAX VALUE	-300.00	300.00	200.00	%		V0	W0
241	gp	ANALOG INPUT 4	MIN VALUE	-300.00	300.00	-200.00	%		V0	W0
242	gq	ANALOG INPUT 5	CALIBRATION	-3.0000	3.0000	1.0000			V0	W0
243	gr	ANALOG INPUT 5	MAX VALUE	-300.00	300.00	200.00	%		V0	W0
244	gs	ANALOG INPUT 5	MIN VALUE	-300.00	300.00	-200.00	%		V0	W0
245	gt	ANALOG OUTPUT 1	% TO GET 10V	-300.00	300.00	100.00	%		V0	W0
246	gu	LINK 23	DESTINATION TAG	0	1276	100			V0	W2
247	gv	LINK 26	DESTINATION TAG	0	1276	301			V0	W2
248	gw	ANALOG OUTPUT 2	% TO GET 10V	-300.00	300.00	100.00	%		V0	W0
249	gx	LINK 24	DESTINATION TAG	0	1276	5			V0	W2
250	gy	LINK 25	DESTINATION TAG	0	1276	48			V0	W2
251	gz	LINK 17	SOURCE TAG	-1276	1276	62			V0	W2
252	h0	LINK 18	SOURCE TAG	-1276	1276	63			V0	W2
253	h1	JOG/SLACK	TAKE UP 1	-100.00	100.00	5.00	%		V0	W0
254	h2	JOG/SLACK	TAKE UP 2	-100.00	100.00	-5.00	%		V0	W0
255	h3	RAISE/LOWER	RESET VALUE	-300.00	300.00	0.00	%		V0	W0

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
256	h4	RAISE/LOWER	INCREASE RATE	0.1	600.0	10.0	s		V0	W0
257	h5	RAISE/LOWER	DECREASE RATE	0.1	600.0	10.0	s		V0	W0
258	h6	RAISE/LOWER	MIN VALUE	-300.00	300.00	-100.00	%		V0	W0
259	h7	RAISE/LOWER	MAX VALUE	-300.00	300.00	100.00	%		V0	W0
260	h8	LINK 27	RAISE/LOWER DEST	0	1276	0			V0	W2
261	h9	RAISE/LOWER	RAISE INPUT	0	1	0			V0	W0
262	ha	RAISE/LOWER	LOWER INPUT	0	1	0			V0	W0
263	hb	ALARMS	STALL THRESHOLD	0.00	200.00	95.00	%		V1	W0
264	hc	RAISE/LOWER	RAISE/LOWER O/P	0.00	0.00	0.00	%		V0	W4
266	he	RAMPS	% S-RAMP	0.00	100.00	2.50	%		V1	W0
268	hg	SPEED LOOP	MODE	0	3	0		0: DISABLED 1: SPD FBK DEP 2: SPD ERR DEP 3: CUR DMD DEP	V0	W0
269	hh	SPEED LOOP	SPD BRK1 (LOW)	0.00	100.00	1.00	%		V0	W0
270	hi	SPEED LOOP	SPD BRK2 (HIGH)	0.00	100.00	5.00	%		V0	W0
271	hj	SPEED LOOP	PROP. GAIN	0.00	200.00	5.00			V0	W0
272	hk	SPEED LOOP	INT.TIME.CONST	0.001	30.000	0.500	s		V0	W0
274	hm	SPEED LOOP	I GAIN IN RAMP	0.0000	2.0000	1.0000			V0	W0
284	hw	SPEED LOOP	ZERO SPD. LEVEL	0.00	200.00	0.50	%		V0	W0
285	hx	SPEED LOOP	ZERO IAD LEVEL	0.00	200.00	1.50	%		V0	W0
286	hy	RAMPS	RAMPING THRESH.	0.00	100.00	0.50	%		V1	W0
287	hz	RAMPS	AUTO RESET	0	1	1		0: DISABLED 1: ENABLED	V1	W0
288	i0	RAMPS	EXTERNAL RESET	0	1	0		0: DISABLED 1: ENABLED	V1	W0
289	i1	SPEED LOOP	SETPOINT 1	-105.00	105.00	0.00	%		V0	W0
290	i2	SPEED LOOP	SETPOINT 2 (A3)	0.00	0.00	0.00	%		V0	W4
291	i3	SPEED LOOP	SETPOINT 3	-105.00	105.00	0.00	%		V0	W0
292	i4	SETPOINT SUM 1	SIGN 0	0	1	1		0: NEGATIVE 1: POSITIVE	V1	W0
293	i5	LINK 28	RAMP O/P DEST	0	1276	291			V0	W2
294	i6	LINK 29	SPT SUM 1 DEST	0	1276	289			V0	W2
297	i9	SPEED LOOP	SPEED ERROR	0.00	0.00	0.00	%		V0	W4
298	ia	FEEDBACKS	CURRENT FEEDBACK	0.00	0.00	0.00	%		V0	W4

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
299	ib	CURRENT LOOP	CURRENT DEMAND	0.00	0.00	0.00	%		V0	W4
300	ic	FIELD CONTROL	FIELD I FBK.	0.00	0.00	0.00	%		V0	W4
301	id	CURRENT LOOP	POS. I CLAMP IN	-200.00	200.00	200.00	%		V0	W0
302	ie	STOP RATES	CONTACTOR DELAY	0.1	600.0	1.0	s		V1	W0
304	ig	MENUS	LANGUAGE	0	1	0		0: ENGLISH 1: ENGLISH	V1	W1
305	ih	ALARMS	TRIP RESET	0	1	1			V1	W0
306	ii	LINK 19	SOURCE TAG	-1276	1276	89			V0	W2
307	ij	RAISE/LOWER	EXTERNAL RESET	0	1	0			V1	W0
308	ik	FEEDBACKS	TACH INPUT	0.0	0.0	0.0	%		V0	W4
309	il	SETPOINT SUM 1	INPUT 0	-300.00	300.00	0.00	%		V1	W0
312	io	PNO CONFIG	PNO 112	-1276	1276	0			V0	W0
313	ip	PNO CONFIG	PNO 113	-1276	1276	0			V0	W0
314	iq	PNO CONFIG	PNO 114	-1276	1276	0			V0	W0
315	ir	PNO CONFIG	PNO 115	-1276	1276	0			V0	W0
316	is	PNO CONFIG	PNO 116	-1276	1276	0			V0	W0
317	it	PNO CONFIG	PNO 117	-1276	1276	0			V0	W0
318	iu	PNO CONFIG	PNO 118	-1276	1276	0			V0	W0
319	iv	PNO CONFIG	PNO 119	-1276	1276	0			V0	W0
320	iw	PNO CONFIG	PNO 120	-1276	1276	379			V0	W0
321	ix	PNO CONFIG	PNO 121	-1276	1276	380			V0	W0
322	iy	PNO CONFIG	PNO 122	-1276	1276	381			V0	W0
323	iz	PNO CONFIG	PNO 123	-1276	1276	382			V0	W0
324	j0	PNO CONFIG	PNO 124	-1276	1276	383			V0	W0
325	j1	PNO CONFIG	PNO 125	-1276	1276	384			V0	W0
326	j2	PNO CONFIG	PNO 126	-1276	1276	385			V0	W0
327	j3	PNO CONFIG	PNO 127	-1276	1276	0			V0	W0
328	j4	COMMS PORT 3	ESP SUP.(ASCII)	0	1	1			V0	W0
329	j5	COMMS PORT 3	GROUP ID (GID)	0	7	0			V0	W0
330	j6	COMMS PORT 3	UNIT ID (UID)	0	255	0			V0	W0
337	jd	ALARMS	THERMISTOR STATE	0	1	0			V0	W4

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
339	jf	miniLINK	VALUE 1	-300.00	300.00	0.00	%		V1	W0
340	jg	miniLINK	VALUE 2	-300.00	300.00	0.00	%		V1	W0
341	jh	miniLINK	VALUE 3	-300.00	300.00	0.00	%		V1	W0
342	ji	miniLINK	VALUE 4	-300.00	300.00	0.00	%		V1	W0
343	jj	miniLINK	VALUE 5	-300.00	300.00	0.00	%		V1	W0
344	jk	miniLINK	VALUE 6	-300.00	300.00	0.00	%		V1	W0
345	jl	miniLINK	VALUE 7	-300.00	300.00	0.00	%		V1	W0
346	jm	miniLINK	LOGIC 1	0	1	0		0: OFF 1: ON	V1	W0
347	jn	miniLINK	LOGIC 2	0	1	0		0: OFF 1: ON	V1	W0
348	jo	miniLINK	LOGIC 3	0	1	0		0: OFF 1: ON	V1	W0
349	jp	miniLINK	LOGIC 4	0	1	0		0: OFF 1: ON	V1	W0
350	jq	miniLINK	LOGIC 5	0	1	0		0: OFF 1: ON	V1	W0
351	jr	miniLINK	LOGIC 6	0	1	0		0: OFF 1: ON	V1	W0
352	js	miniLINK	LOGIC 7	0	1	0		0: OFF 1: ON	V1	W0
353	jt	miniLINK	LOGIC 8	0	1	0		0: OFF 1: ON	V1	W0
355	jv	JOG/SLACK	RAMP RATE	0.1	600.0	1.0	s		V0	W0
357	jx	SPEED LOOP	MAX DEMAND	0.00	105.00	105.00	%		V0	W0
358	jy	SPEED LOOP	MIN DEMAND	-105.00	105.00	-105.00	%		V0	W0
359	jz	DIGITAL OUTPUT 1	INVERTED	0	1	0			V0	W0
360	k0	DIGITAL OUTPUT 2	INVERTED	0	1	0			V0	W0
361	k1	DIGITAL OUTPUT 3	INVERTED	0	1	0			V0	W0
362	k2	ANALOG OUTPUT 1	MODULUS	0	1	0			V0	W0
363	k3	ANALOG OUTPUT 2	MODULUS	0	1	0			V0	W0
364	k4	LINK 1	SOURCE TAG	-1276	1276	0			V0	W2
365	k5	LINK 1	DESTINATION TAG	0	1276	0			V0	W2
366	k6	LINK 2	SOURCE TAG	-1276	1276	0			V0	W2
367	k7	LINK 2	DESTINATION TAG	0	1276	0			V0	W2

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
368	k8	LINK 3	SOURCE TAG	-1276	1276	0			V0	W2
369	k9	LINK 3	DESTINATION TAG	0	1276	0			V0	W2
370	ka	LINK 4	SOURCE TAG	-1276	1276	0			V0	W2
371	kb	LINK 4	DESTINATION TAG	0	1276	0			V0	W2
374	ke	SEQUENCING	SYSTEM RESET	0	1	0			V0	W4
375	kf	SETPOINT SUM 1	LIMIT	0.00	200.00	105.00	%		V0	W0
376	kg	SEQUENCING	DRIVE RUNNING	0	1	0			V0	W4
379	kj	miniLINK	VALUE 8	-300.00	300.00	0.00	%		V1	W0
380	kk	miniLINK	VALUE 9	-300.00	300.00	0.00	%		V1	W0
381	kl	miniLINK	VALUE 10	-300.00	300.00	0.00	%		V1	W0
382	km	miniLINK	VALUE 11	-300.00	300.00	0.00	%		V1	W0
383	kn	miniLINK	VALUE 12	-300.00	300.00	0.00	%		V1	W0
384	ko	miniLINK	VALUE 13	-300.00	300.00	0.00	%		V1	W0
385	kp	miniLINK	VALUE 14	-300.00	300.00	0.00	%		V1	W0
390	ku	LINK 11	SOURCE TAG	-1276	1276	0			V0	W2
391	kv	LINK 43	DESTINATION TAG	0	1276	0			V0	W2
392	kw	ADVANCED 1	ADVANCED	0	1	0		0: OFF 1: ON	V0	W0
393	kx	ADVANCED 1	MODE	0	6	0		0: SWITCH 1: INVERT 2: AND 3: OR 4: SIGN CHANGER 5: MODULUS 6: COMPARATOR	V0	W0
394	ky	LINK 41	AUX.SOURCE	-1276	1276	0			V0	W2
395	kz	LINK 12	SOURCE TAG	-1276	1276	0			V0	W2
396	l0	LINK 44	DESTINATION TAG	0	1276	0			V0	W2
397	l1	ADVANCED 2	ADVANCED	0	1	0		0: OFF 1: ON	V0	W0
398	l2	ADVANCED 2	MODE	0	6	0		See Tag 393	V0	W0
399	l3	LINK 42	AUX.SOURCE	-1276	1276	0			V0	W2
400	l4	LINK 30	PID O/P DEST	0	1276	0			V0	W2
401	l5	PID	DERIVATIVE TC	0.000	10.000	0.000	s		V1	W0
402	l6	PID	INT.TIME.CONST	0.01	100.00	5.00	s		V1	W0

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
403	l7	PID	FILTER T.C.	0.000	10.000	0.100	s		V1	W0
404	l8	PROFILED GAIN	PROP. GAIN	0.0	100.0	1.0			V1	W0
405	l9	PID	POSITIVE LIMIT	0.00	105.00	100.00	%		V1	W0
406	la	PID	NEGATIVE LIMIT	-105.00	0.00	-100.00	%		V1	W0
407	lb	PID	O/P SCALER(TRIM)	-3.0000	3.0000	0.2000			V1	W0
408	lc	PID	ENABLE	0	1	1		0: DISABLED 1: ENABLED	V1	W0
409	ld	PID	INT. DEFEAT	0	1	0		0: OFF 1: ON	V1	W0
410	le	PID	INPUT 1	-300.00	300.00	0.00	%		V1	W0
411	lf	PID	INPUT 2	-300.00	300.00	0.00	%		V1	W0
412	lg	PID	RATIO 1	-3.0000	3.0000	1.0000			V1	W0
413	lh	PID	RATIO 2	-3.0000	3.0000	1.0000			V1	W0
414	li	PID	DIVIDER 2	-3.0000	3.0000	1.0000			V1	W0
415	lj	PID	PID ERROR	0.00	0.00	0.00	%		V1	W4
416	lk	PID	PID CLAMPED	0	1	0			V1	W4
417	ll	PID	PID OUTPUT	0.00	0.00	0.00	%		V1	W4
418	lm	PID	DIVIDER 1	-3.0000	3.0000	1.0000			V1	W0
419	ln	SETPOINT SUM 1	DIVIDER 1	-3.0000	3.0000	1.0000			V1	W0
420	lo	SETPOINT SUM 1	DIVIDER 0	-3.0000	3.0000	1.0000			V0	W0
421	lp	CURRENT LOOP	MAIN CURR. LIMIT	0.00	200.00	110.00	%		V0	W0
422	lq	RAMPS	RESET VALUE	-300.00	300.00	0.00	%		V1	W0
423	lr	SETPOINT SUM 1	INPUT 2	-300.00	300.00	0.00	%		V1	W0
424	ls	DIAMETER CALC.	LINE SPEED	-105.00	105.00	0.00	%		V1	W0
425	lt	DIAMETER CALC.	MIN DIAMETER	0.00	100.00	10.00	%		V1	W0
426	lu	DIAMETER CALC.	MIN SPEED	0.00	100.00	5.00	%		V1	W0
427	lv	DIAMETER CALC.	DIAMETER	0.00	0.00	0.00	%		V1	W4
428	lw	DIAMETER CALC.	MOD OF LINE SPD	0.00	0.00	0.00	%		V0	W4
429	lx	DIAMETER CALC.	MOD OF REEL SPD	0.00	0.00	0.00	%		V0	W4
430	ly	DIAMETER CALC.	UNFILT DIAMETER	0.00	0.00	0.00	%		V0	W4
431	lz	LINK 31	DIAMETER	0	1276	0			V0	W2
432	m0	TORQUE CALC.	TORQUE DEMAND	-200.00	200.00	0.00	%		V1	W0
433	m1	TORQUE CALC.	TENSION ENABLE	0	1	1		0: DISABLED 1: ENABLED	V1	W0

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
434	m2	TORQUE CALC.	OVER WIND	0	1	1		0: DISABLED 1: ENABLED	V1	W0
435	m3	LINK 32	POS. I CLAMP	0	1276	0			V0	W2
436	m4	LINK 33	NEG. I CLAMP	0	1276	0			V0	W2
437	m5	DIAMETER CALC.	REEL SPEED	-105.00	105.00	0.00	%		V1	W0
438	m6	DIAMETER CALC.	TAPER	-100.00	100.00	0.00	%		V1	W0
439	m7	DIAMETER CALC.	TENSION SPT.	0.00	100.00	0.00	%		V1	W0
440	m8	DIAMETER CALC.	TENSION TRIM	-100.00	100.00	0.00	%		V1	W0
441	m9	DIAMETER CALC.	TOT.TENS.DEMAND	0.00	0.00	0.00	%		V1	W4
442	ma	LINK 34	TAPER	0	1276	0			V0	W2
443	mb	SETPOINT SUM 2	INPUT 1	-300.00	300.00	0.00	%		V1	W0
444	mc	SETPOINT SUM 2	INPUT 0	-300.00	300.00	0.00	%		V1	W0
445	md	SETPOINT SUM 2	INPUT 2	-300.00	300.00	0.00	%		V1	W0
446	me	SETPOINT SUM 2	RATIO 1	-3.0000	3.0000	1.0000			V0	W0
447	mf	SETPOINT SUM 2	RATIO 0	-3.0000	3.0000	1.0000			V0	W0
448	mg	SETPOINT SUM 2	DIVIDER 0	-3.0000	3.0000	1.0000			V0	W0
449	mh	SETPOINT SUM 2	LIMIT	0.00	200.00	105.00	%		V0	W0
450	mi	LINK 35	SETPOINT SUM 2	0	1276	0			V0	W2
451	mj	SETPOINT SUM 2	SPT SUM OUTPUT	0.00	0.00	0.00	%		V1	W4
452	mk	DIAMETER CALC.	TAPERED DEMAND	0.00	0.00	0.00	%		V1	W4
453	ml	DIAMETER CALC.	RAMP RATE	0.1	600.0	5.0	s		V1	W0
454	mm	LINK 5	SOURCE TAG	-1276	1276	0			V0	W2
455	mn	LINK 5	DESTINATION TAG	0	1276	0			V0	W2
456	mo	LINK 6	SOURCE TAG	-1276	1276	0			V0	W2
457	mp	LINK 6	DESTINATION TAG	0	1276	0			V0	W2
458	mq	LINK 7	SOURCE TAG	-1276	1276	0			V0	W2
459	mr	LINK 7	DESTINATION TAG	0	1276	0			V0	W2
460	ms	LINK 8	SOURCE TAG	-1276	1276	0			V0	W2
461	mt	LINK 8	DESTINATION TAG	0	1276	0			V0	W2
462	mu	DIAMETER CALC.	RESET VALUE	0.00	100.00	10.00	%		V1	W0
463	mv	DIAMETER CALC.	EXTERNAL RESET	0	1	0		0: DISABLED 1: ENABLED	V1	W0
464	mw	ANALOG OUTPUT 1	OFFSET	-100.00	100.00	0.00	%		V0	W0
465	mx	ANALOG OUTPUT 2	OFFSET	-100.00	100.00	0.00	%		V0	W0

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
466	my	SETPOINT SUM 2	DIVIDER 1	-3.0000	3.0000	1.0000			V1	W0
467	mz	LINK 9	SOURCE TAG	-1276	1276	0			V0	W2
468	n0	LINK 9	DESTINATION TAG	0	1276	0			V0	W2
469	n1	LINK 10	SOURCE TAG	-1276	1276	0			V0	W2
470	n2	LINK 10	DESTINATION TAG	0	1276	0			V0	W2
472	n4	ALARMS	SPEED FBK STATE	0	1	0			V0	W4
473	n5	PROFILED GAIN	MODE	0	4	0			V1	W0
474	n6	PROFILED GAIN	MIN PROFILE GAIN	0.00	100.00	20.00	%		V1	W0
475	n7	PROFILED GAIN	PROFILED GAIN	0.0	0.0	0.0			V1	W4
478	na	LINK 36	TENS+COMP CALC.	0	1276	0			V0	W2
479	nb	DIAMETER CALC.	FIX.INERTIA COMP	-300.00	300.00	0.00	%		V1	W0
480	nc	DIAMETER CALC.	VAR.INERTIA COMP	-300.00	300.00	0.00	%		V1	W0
481	nd	DIAMETER CALC.	ROLL WIDTH/MASS	0.00	100.00	100.00	%		V1	W0
482	ne	DIAMETER CALC.	FILTER T.C.	0	20000	10			V1	W0
483	nf	DIAMETER CALC.	RATE CAL	-100.00	100.00	10.00			V1	W0
484	ng	DIAMETER CALC.	NORMALISED dv/dt	-300.00	300.00	0.00	%		V1	W0
485	nh	DIAMETER CALC.	INERTIA COMP O/P	0.00	0.00	0.00	%		V1	W4
486	ni	DIAMETER CALC.	TENSION SCALER	-3.0000	3.0000	1.0000			V1	W0
487	nj	DIAMETER CALC.	STATIC COMP	-300.00	300.00	0.00	%		V0	W0
488	nk	DIAMETER CALC.	DYNAMIC COMP	-300.00	300.00	0.00	%		V0	W0
489	nl	DIAMETER CALC.	REWIND	0	1	1		0: DISABLED 1: ENABLED	V0	W0
491	nn	SETPOINT SUM 2	STPT SUM 2 OUT 0	0.00	0.00	0.00	%		V0	W4
492	no	SETPOINT SUM 2	STPT SUM 2 OUT 1	0.00	0.00	0.00	%		V0	W4
493	np	ANALOG INPUT 2	OUTPUT	0.00	0.00	0.00	%		V0	W4
494	nq	LINK 37	DESTINATION TAG	0	1276	496			V0	W2
495	nr	LINK 38	DESTINATION TAG	0	1276	497			V0	W2
496	ns	SEQUENCING	JOG/SLACK	0	1	0		0: OFF 1: ON	V0	W0
497	nt	SEQUENCING	ENABLE	0	1	0		0: OFF 1: ON	V0	W0
498	nu	DIAMETER CALC.	LINE SPEED SPT	-105.00	105.00	0.00	%		V0	W0

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
500	nw	TEC OPTION	TEC OPTION TYPE	0	15	0		0: NONE 1: RS485 2: PROFIBUS DP	V0	W0
501	nx	TEC OPTION	TEC OPTION IN 1	-32768	32767	0			V0	W0
502	ny	TEC OPTION	TEC OPTION IN 2	-32768	32767	0			V0	W0
503	nz	TEC OPTION	TEC OPTION IN 3	-32768	32767	0			V0	W0
504	o0	TEC OPTION	TEC OPTION IN 4	-32768	32767	0			V0	W0
505	o1	TEC OPTION	TEC OPTION IN 5	-32768	32767	0			V0	W0
506	o2	TEC OPTION	TEC OPTION FAULT	0	5	0		0: NONE 1: PARAMETER 2: TYPE MISMATCH 3: SELF TEST 4: HARDWARE 5: MISSING	V0	W4
507	o3	TEC OPTION	TEC OPTION VER	0x0000	0xFFFF	0x0000			V0	W4
508	o4	TEC OPTION	TEC OPTION OUT 1	0	0	0			V0	W4
509	o5	TEC OPTION	TEC OPTION OUT 2	0	0	0			V0	W4
510	o6	DRIVE INFO	PRODUCT CODE	0	104	3		0: INVALID 1: DC 4Q 20A 2: DC 2Q 20A 3: DC 4Q 35A 4: DC 2Q 35A 5: DC 4Q 40A 6: DC 2Q 40A 7: DC 4Q 60A 8: DC 2Q 60A	V0	W3

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes
								9: DC 4Q 80A 10: DC 2Q 80A 11: DC 4Q 90A 12: DC 2Q 90A 13: DC 4Q 120A 14: DC 2Q 120A 15: DC 4Q 125A 16: DC 2Q 125A 17: DC 4Q 162A 18: DC 2Q 162A 19: DC 4Q 160A 20: DC 2Q 160A 21: DC 4Q 35A D 22: DC 2Q 35A D 23: DC 4Q 80A D 24: DC 2Q 80A D 25: DC 4Q 120A D 26: DC 2Q 120A D 27: DC 4Q 160A D 28: DC 2Q 160A D 29: DC 4Q 200A D 30: DC 2Q 200A D 31: DC 4Q 280A D 32: DC 2Q 280A D 33: DC 4Q 128* 20* D 34: DC 2Q 128* 20* D 35: DC 4Q 1024* 20*D 36: DC 2Q 1024* 20*D 37: DC 4Q 1024* 26*D 38: DC 2Q 1024* 26*D 39: DC 4Q 360A D 40: DC 2Q 360A D 41: DC 4Q 450A D 42: DC 2Q 450A D 43: DC 4Q 750A D 44: DC 2Q 750A D 45: DC 4Q 850A D 46: DC 2Q 850A D 47: DC 4Q 1024* 30*D 48: DC 2Q 1024* 30*D 49: DC 4Q 1200A 20 D	

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
								50: DC 2Q 1200A 20 D 51: DC 4Q 1700A 20 D 52: DC 2Q 1700A 20 D 53: DC 4Q 2200A 20 D 54: DC 2Q 2200A 20 D 55: DC 4Q 2700A 20 D 56: DC 2Q 2700A 20 D 57: DC 4Q 1200A 40 D 58: DC 2Q 1200A 40 D 59: DC 4Q 1700A 40 D 60: DC 2Q 1700A 40 D 61: DC 4Q 2200A 40 D 62: DC 2Q 2200A 40 D 63: DC 4Q 2700A 40 D 64: DC 2Q 2700A 40 D 65: DC 4Q 1200A 60 D 66: DC 2Q 1200A 60 D 67: DC 4Q 1700A 60 D 68: DC 2Q 1700A 60 D 69: DC 4Q 2200A 60 D 70: DC 2Q 2200A 60 D 71: DC 4Q 2700A 60 D 72: DC 2Q 2700A 60 D 73: DC 4Q 1200A 80 D 74: DC 2Q 1200A 80 D 75: DC 4Q 1700A 80 D 76: DC 2Q 1700A 80 D 77: DC 4Q 2200A 80 D 78: DC 2Q 2200A 80 D 79: DC 4Q 2700A 80 D 80: DC 2Q 2700A 80 D 81: DC RETRO 4Q 128A 82: DC RETRO 2Q 128A 83: DC 2Q 40A 84: DC 4Q 40A 85: DC 4Q 750A 86: DC 2Q 750A 87: DC 4Q 850A 88: DC 2Q 850A 89: DC 4Q 1580A 90: DC 2Q 1580A		

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
								91: DC 4Q 400A 92: DC 2Q 400A 93: DC 4Q 550A 94: DC 2Q 550A 95: DC 4Q 750A 40*D 96: DC 2Q 750A 40*D 97: DC 4Q 850A 40*D 98: DC 2Q 850A 40*D 99: DC 4Q 1580A 40*D 100: DC 2Q 1580A 40*D 101: DC 4Q 400A 40*D 102: DC 2Q 400A 40*D 103: DC 4Q 550A 40*D 104: DC 2Q 550A 40*D		
511	o7	OP-STATION	LOCAL KEY ENABLE	0	1	1			V0	W0
512	o8	OP-STATION	SETPOINT	0.00	100.00	0.00	%		V0	W0
513	o9	OP-STATION	JOG SETPOINT	0.00	100.00	5.00	%		V0	W0
514	oa	OP-STATION	RAMP ACCEL TIME	0.1	600.0	10.0	s		V0	W0
515	ob	OP-STATION	RAMP DECEL TIME	0.1	600.0	10.0	s		V0	W0
516	oc	OP-STATION	INITIAL DIR	0	1	1		0: REVERSE 1: FORWARD	V0	W0
517	od	OP-STATION	INITIAL MODE	0	1	0		0: REMOTE 1: LOCAL	V0	W0
518	oe	OP-STATION	INITIAL VIEW	0	1	0		0: LOCAL 1: PROGRAM	V0	W0
519	of	OP-STATION	INITIAL SETPOINT	0.00	100.00	0.00	%		V0	W0
520	og	OP-STATION	INITIAL JOG	0.00	100.00	5.00	%		V0	W0
521	oh	CONFIGURE DRIVE	NOM MOTOR VOLTS	100	875	100	V		V0	W2
523	oj	CONFIGURE DRIVE	ARMATURE CURRENT	1.0	35.0	1.0	A		V0	W2
524	ok	CONFIGURE DRIVE	FIELD CURRENT	0.2	4.0	0.2	A		V0	W2
525	ol	SEQUENCING	COAST STOP	0	1	0			V0	W4
527	on	CURRENT LOOP	MASTER BRIDGE	0	1	0			V0	W4
528	oo	ALARMS	LAST ALARM	0x0000	0xFFFF	0x0000			V0	W4
535	ov	SEQUENCING	REM.SEQ.ENABLE	0	1	0			V0	W1
536	ow	SEQUENCING	REM.SEQUENCE	0x0000	0xFFFF	0x8000			V1	W0
537	ox	SEQUENCING	SEQ STATUS	0x0000	0xFFFF	0x0000			V0	W4

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
538	oy	CURRENT LOOP	CURRENT FBK.AMPS	0.0	0.0	0.0	A		V0	W4
539	oz	FIELD CONTROL	FIELD I FBK.AMPS	0.0	0.0	0.0	A		V0	W4
540	p0	ALARMS	REM TRIP INHIBIT	0	1	0		0: ENABLED 1: INHIBITED	V0	W0
541	p1	ALARMS	REM TRIP DELAY	0.1	600.0	10.0	s		V0	W0
542	p2	ALARMS	REMOTE TRIP	0	1	0			V0	W4
545	p5	DRIVE INFO	PCODE ID	0	255	3			V0	W2
547	p7	SPEED LOOP	SPD.FBK.FILTER	0.000	1.000	0.000			V0	W0
549	p9	SPEED LOOP	SPEED LOOP O/P	0.00	0.00	0.00	%		V0	W4
556	pg	INERTIA COMP	INERTIA	0.00	200.00	0.00			V0	W0
557	ph	INERTIA COMP	FILTER	0	20000	0			V0	W0
558	pi	INERTIA COMP	RATE CAL	0.00	200.00	100.00			V0	W0
559	pj	PRESET SPEEDS	MAX SPEED	0.1	3000.0	100.0	%		V0	W0
560	pk	PRESET SPEEDS	SELECT 1	0	1	0			V0	W0
561	pl	PRESET SPEEDS	SELECT 2	0	1	0			V0	W0
562	pm	PRESET SPEEDS	SELECT 3	0	1	0			V0	W0
563	pn	PRESET SPEEDS	INVERT O/P	0	1	0			V0	W0
564	po	PRESET SPEEDS	INPUT 0	-3000.0	3000.0	0.0			V0	W0
565	pp	PRESET SPEEDS	INPUT 1	-3000.0	3000.0	0.0			V0	W0
566	pq	PRESET SPEEDS	INPUT 2	-3000.0	3000.0	0.0			V0	W0
567	pr	PRESET SPEEDS	INPUT 3	-3000.0	3000.0	0.0			V0	W0
568	ps	PRESET SPEEDS	INPUT 4	-3000.0	3000.0	0.0			V0	W0
569	pt	PRESET SPEEDS	INPUT 5	-3000.0	3000.0	0.0			V0	W0
570	pu	PRESET SPEEDS	INPUT 6	-3000.0	3000.0	0.0			V0	W0
571	pv	PRESET SPEEDS	INPUT 7	-3000.0	3000.0	0.0			V0	W0
572	pw	PRESET SPEEDS	PRESET O/P	0.00	0.00	0.00	%		V0	W4
573	px	LINK 39	PRESET DEST	0	1276	0			V0	W2
574	py	SRAMP	INPUT	-100.00	100.00	0.00	%		V0	W0
575	pz	SRAMP	RATE SELECT	0	1	0			V0	W0
576	q0	SRAMP	ACCEL 0	0.00	100.00	60.00	%		V0	W0
577	q1	SRAMP	DECEL 0	0.00	100.00	60.00	%		V0	W0
578	q2	SRAMP	ACCEL 0 JERK 1	0.00	100.00	20.00	%		V0	W0
579	q3	SRAMP	ACCEL 1	0.00	100.00	30.00	%		V0	W0
580	q4	SRAMP	DECEL 1	0.00	100.00	30.00	%		V0	W0

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
581	q5	SRAMP	ACCEL 1 JERK 1	0.00	100.00	20.00	%		V0	W0
582	q6	SRAMP	AUTO RESET	0	1	1			V0	W0
583	q7	SRAMP	EXTERNAL RESET	0	1	0			V0	W0
584	q8	SRAMP	RESET VALUE	-100.00	100.00	0.00	%		V0	W0
585	q9	SRAMP	QUENCH	0	1	0			V0	W0
586	qa	SRAMP	AT SPEED LEVEL	0.00	100.00	1.00	%		V0	W0
587	qb	SRAMP	AT SPEED	0	1	0			V0	W4
588	qc	SRAMP	ACCEL OUTPUT	0.00	0.00	0.00	%		V0	W4
589	qd	SRAMP	SRAMP OUTPUT	0.00	0.00	0.00	%		V0	W4
900	qe	LINK 40	SRAMP DEST	0	1276	0			V0	W2
593	qh	PRESET SPEEDS	OUTPUT FPM	0.0	0.0	0.0			V0	W4
594	qi	STOP RATES	CURR DECAY RATE	0.00	200.00	0.00			V0	W0
595	qj	SPEED LOOP	PRESET TORQUE	-250.00	250.00	0.00	%		V0	W0
596	qk	SRAMP	DECEL 0 JERK 1	0.00	100.00	20.00	%		V0	W0
597	ql	SRAMP	DECEL 1 JERK 1	0.00	100.00	20.00	%		V0	W0
600	qo	PRESET SPEEDS	LIMIT	0	1	0			V0	W0
601	qp	INERTIA COMP	DELTA	0.00	0.00	0.00	%		V0	W4
602	qq	INERTIA COMP	INERTIA COMP O/P	0.00	0.00	0.00	%		V0	W4
603	qr	INERTIA COMP	UNSCALED OUTPUT	0.00	0.00	0.00	%		V0	W4
604	qs	SPEED LOOP	PRESET T SCALE	-200.00	200.00	100.00	%		V0	W0
605	qt	FEEDBACKS	ARM VOLTS FBK	0	0	0	V		V0	W4
609	qx	AUTOTUNE	METHOD	0	1	0		0: 4Q MULTI 1: 2Q MULTI	V1	W1
610	qy	PRESET SPEEDS	GRAY SCALE	0	1	0			V0	W0
611	qz	SRAMP	ACCEL 0 JERK 2	0.00	100.00	20.00	%		V0	W0
612	r0	SRAMP	ACCEL 1 JERK 2	0.00	100.00	20.00	%		V0	W0
613	r1	SRAMP	DECEL 0 JERK 2	0.00	100.00	20.00	%		V0	W0
614	r2	SRAMP	DECEL 1 JERK 2	0.00	100.00	20.00	%		V0	W0
617	r5	FIELD CONTROL	FIELD I THRESH	0.00	100.00	80.00	%		V0	W0
618	r6	FIELD CONTROL	UP TO FIELD	0	1	0			V0	W4
620	r8	RAMPS	INVERT	0	1	0			V0	W0
626	re	DRIVE INFO	FRAME ID	0	0	0			V0	W4
628	rg	CONFIGURE DRIVE	UDP USE OP PORT	0	1	0			V0	W0
629	rh	LINK 13	DESTINATION TAG	0	1276	683			V0	W2

Tag	Mn	MMI Block Na	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
630	ri	LINK 14	DESTINATION TAG	0	1276	684			V0	W2
631	rj	LINK 15	DESTINATION TAG	0	1276	685			V0	W2
632	rk	LINK 17	DESTINATION TAG	0	1276	678			V0	W2
633	rl	LINK 18	DESTINATION TAG	0	1276	679			V0	W2
634	rm	LINK 19	DESTINATION TAG	0	1276	699			V0	W2
635	rn	LINK 20	SOURCE TAG	-1276	1276	680			V0	W2
636	ro	LINK 21	SOURCE TAG	-1276	1276	681			V0	W2
637	rp	LINK 22	SOURCE TAG	-1276	1276	682			V0	W2
638	rq	LINK 23	SOURCE TAG	-1276	1276	674			V0	W2
639	rr	LINK 24	SOURCE TAG	-1276	1276	675			V0	W2
640	rs	LINK 25	SOURCE TAG	-1276	1276	676			V0	W2
641	rt	LINK 26	SOURCE TAG	-1276	1276	677			V0	W2
642	ru	LINK 27	SOURCE TAG	-1276	1276	264			V0	W2
643	rv	LINK 28	SOURCE TAG	-1276	1276	85			V0	W2
644	rw	LINK 29	SOURCE TAG	-1276	1276	86			V0	W2
645	rx	LINK 30	SOURCE TAG	-1276	1276	417			V0	W2
646	ry	LINK 31	SOURCE TAG	-1276	1276	427			V0	W2
647	rz	LINK 32	SOURCE TAG	-1276	1276	707			V0	W2
648	s0	LINK 33	SOURCE TAG	-1276	1276	708			V0	W2
649	s1	LINK 34	SOURCE TAG	-1276	1276	441			V0	W2
650	s2	LINK 35	SOURCE TAG	-1276	1276	451			V0	W2
651	s3	LINK 36	SOURCE TAG	-1276	1276	706			V0	W2
652	s4	LINK 37	SOURCE TAG	-1276	1276	69			V0	W2
653	s5	LINK 38	SOURCE TAG	-1276	1276	70			V0	W2
654	s6	LINK 39	SOURCE TAG	-1276	1276	572			V0	W2
655	s7	LINK 40	SOURCE TAG	-1276	1276	589			V0	W2
656	s8	LINK 41	DESTINATION TAG	0	1276	687			V0	W2
657	s9	LINK 42	DESTINATION TAG	0	1276	689			V0	W2
658	sa	LINK 43	SOURCE TAG	-1276	1276	712			V0	W2
660	sc	LINK 44	SOURCE TAG	-1276	1276	713			V0	W2
662	se	LINK 45	SOURCE TAG	-1276	1276	189			V0	W2
664	sg	LINK 46	SOURCE TAG	-1276	1276	700			V0	W2
665	sh	LINK 46	DESTINATION TAG	0	1276	701			V0	W2

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
666	si	LINK 47	SOURCE TAG	-1276	1276	427			V0	W2
667	sj	LINK 47	DESTINATION TAG	0	1276	709			V0	W2
668	sk	LINK 48	SOURCE TAG	-1276	1276	425			V0	W2
669	sl	LINK 48	DESTINATION TAG	0	1276	710			V0	W2
670	sm	LINK 49	SOURCE TAG	-1276	1276	691			V0	W2
671	sn	LINK 49	DESTINATION TAG	0	1276	697			V0	W2
672	so	LINK 50	SOURCE TAG	-1276	1276	475			V0	W2
673	sp	LINK 50	DESTINATION TAG	0	1276	711			V0	W2
674	sq	ANALOG INPUT 1	OUTPUT	0.00	0.00	0.00	%		V0	W4
675	sr	ANALOG INPUT 3	OUTPUT	0.00	0.00	0.00	%		V0	W4
676	ss	ANALOG INPUT 4	OUTPUT	0.00	0.00	0.00	%		V0	W4
677	st	ANALOG INPUT 5	OUTPUT	0.00	0.00	0.00	%		V0	W4
678	su	ANALOG OUTPUT 1	INPUT	-300.00	300.00	0.00	%		V0	W0
679	sv	ANALOG OUTPUT 2	INPUT	-300.00	300.00	0.00	%		V0	W0
680	sw	DIGITAL INPUT 1	OUTPUT	0.00	0.00	0.00	%		V0	W4
681	sx	DIGITAL INPUT 2	OUTPUT	0.00	0.00	0.00	%		V0	W4
682	sy	DIGITAL INPUT 3	OUTPUT	0.00	0.00	0.00	%		V0	W4
683	sz	DIGITAL OUTPUT 1	INPUT	-300.00	300.00	0.00	%		V0	W0
684	t0	DIGITAL OUTPUT 2	INPUT	-300.00	300.00	0.00	%		V0	W0
685	t1	DIGITAL OUTPUT 3	INPUT	-300.00	300.00	0.00	%		V0	W0
686	t2	ADVANCED 1	INPUT 1	-32768.00	32768.00	0.00	%		V0	W0
687	t3	ADVANCED 1	INPUT 2	-32768.00	32768.00	0.00	%		V0	W0
688	t4	ADVANCED 2	INPUT 1	-32768.00	32768.00	0.00	%		V0	W0
689	t5	ADVANCED 2	INPUT 2	-32768.00	32768.00	0.00	%		V0	W0
691	t7	MIN SPEED	OUTPUT	0.00	0.00	0.00	%		V1	W4
693	t9	COMMS PORT 1	ERROR REPORT	0x0000	0xFFFF	0x00C0			V0	W0
697	td	RAMPS	RAMP INPUT	-105.00	105.00	0.00	%		V1	W0
698	te	JOG/SLACK	JOG/SLACK	0.00	0.00	0.00	%		V1	W4
699	tf	STANDSTILL	INPUT	-300.00	300.00	0.00	%		V0	W0
700	tg	DEADBAND	OUTPUT	0.00	0.00	0.00	%		V1	W4
701	th	SETPOINT SUM 1	INPUT 1	-300.00	300.00	0.00	%		V1	W0
702	ti	SETPOINT SUM 1	OUTPUT 1	0.00	0.00	0.00	%		V0	W4
703	tj	SETPOINT SUM 1	OUTPUT 0	0.00	0.00	0.00	%		V0	W4

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
704	tk	SETPOINT SUM 2	SIGN 1	0	1	1		0: NEGATIVE 1: POSITIVE	V1	W0
705	tl	SETPOINT SUM 2	SIGN 0	0	1	1		0: NEGATIVE 1: POSITIVE	V1	W0
706	tm	DIAMETER CALC.	OUTPUT	0.00	0.00	0.00	%		V1	W4
707	tn	TORQUE CALC.	POS. I CLAMP	0.00	0.00	0.00	V		V0	W4
708	to	TORQUE CALC.	NEG. I CLAMP	0.00	0.00	0.00	V		V0	W4
709	tp	PROFILED GAIN	DIAMETER	0.00	100.00	10.00	%		V1	W0
710	tq	PROFILED GAIN	MIN DIAMETER	0.00	100.00	10.00	%		V1	W0
711	tr	PID	PROP. GAIN	0.0	100.0	1.0			V1	W0
712	ts	ADVANCED 1	OUTPUT	0.00	0.00	0.00	V		V0	W4
713	tt	ADVANCED 2	OUTPUT	0.00	0.00	0.00	V		V0	W4
714	tu	OUT	INPUT	-300.00	300.00	0.00	%		V0	W0
720	u0	LINK 51	SOURCE TAG	-1276	1276	0			V0	W2
721	u1	LINK 51	DESTINATION TAG	0	1276	0			V0	W2
722	u2	LINK 52	SOURCE TAG	-1276	1276	0			V0	W2
723	u3	LINK 52	DESTINATION TAG	0	1276	0			V0	W2
724	u4	LINK 53	SOURCE TAG	-1276	1276	0			V0	W2
725	u5	LINK 53	DESTINATION TAG	0	1276	0			V0	W2
726	u6	LINK 54	SOURCE TAG	-1276	1276	0			V0	W2
727	u7	LINK 54	DESTINATION TAG	0	1276	0			V0	W2
728	u8	LINK 55	SOURCE TAG	-1276	1276	0			V0	W2
729	u9	LINK 55	DESTINATION TAG	0	1276	0			V0	W2
730	ua	LINK 56	SOURCE TAG	-1276	1276	0			V0	W2
731	ub	LINK 56	DESTINATION TAG	0	1276	0			V0	W2
732	uc	LINK 57	SOURCE TAG	-1276	1276	0			V0	W2
733	ud	LINK 57	DESTINATION TAG	0	1276	0			V0	W2
734	ue	LINK 58	SOURCE TAG	-1276	1276	0			V0	W2
735	uf	LINK 58	DESTINATION TAG	0	1276	0			V0	W2
736	ug	LINK 59	SOURCE TAG	-1276	1276	0			V0	W2
737	uh	LINK 59	DESTINATION TAG	0	1276	0			V0	W2
738	ui	LINK 60	SOURCE TAG	-1276	1276	0			V0	W2
739	uj	LINK 60	DESTINATION TAG	0	1276	0			V0	W2
740	uk	LINK 61	SOURCE TAG	-1276	1276	0			V0	W2

Tag	Mn	MMI Block Na	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
741	ul	LINK 61	DESTINATION TAG	0	1276	0			V0	W2
742	um	LINK 62	SOURCE TAG	-1276	1276	0			V0	W2
743	un	LINK 62	DESTINATION TAG	0	1276	0			V0	W2
744	uo	LINK 63	SOURCE TAG	-1276	1276	0			V0	W2
745	up	LINK 63	DESTINATION TAG	0	1276	0			V0	W2
746	uq	LINK 64	SOURCE TAG	-1276	1276	0			V0	W2
747	ur	LINK 64	DESTINATION TAG	0	1276	0			V0	W2
748	us	LINK 65	SOURCE TAG	-1276	1276	0			V0	W2
749	ut	LINK 65	DESTINATION TAG	0	1276	0			V0	W2
750	uu	LINK 66	SOURCE TAG	-1276	1276	0			V0	W2
751	uv	LINK 66	DESTINATION TAG	0	1276	0			V0	W2
752	uw	LINK 67	SOURCE TAG	-1276	1276	0			V0	W2
753	ux	LINK 67	DESTINATION TAG	0	1276	0			V0	W2
754	uy	LINK 68	SOURCE TAG	-1276	1276	0			V0	W2
755	uz	LINK 68	DESTINATION TAG	0	1276	0			V0	W2
756	v0	LINK 69	SOURCE TAG	-1276	1276	0			V0	W2
757	v1	LINK 69	DESTINATION TAG	0	1276	0			V0	W2
758	v2	LINK 70	SOURCE TAG	-1276	1276	0			V0	W2
759	v3	LINK 70	DESTINATION TAG	0	1276	0			V0	W2
760	v4	LINK 71	SOURCE TAG	-1276	1276	0			V0	W2
761	v5	LINK 71	DESTINATION TAG	0	1276	0			V0	W2
762	v6	LINK 72	SOURCE TAG	-1276	1276	0			V0	W2
763	v7	LINK 72	DESTINATION TAG	0	1276	0			V0	W2
764	v8	LINK 73	SOURCE TAG	-1276	1276	0			V0	W2
765	v9	LINK 73	DESTINATION TAG	0	1276	0			V0	W2
766	va	LINK 74	SOURCE TAG	-1276	1276	0			V0	W2
767	vb	LINK 74	DESTINATION TAG	0	1276	0			V0	W2
768	vc	LINK 75	SOURCE TAG	-1276	1276	0			V0	W2
769	vd	LINK 75	DESTINATION TAG	0	1276	0			V0	W2
770	ve	LINK 76	SOURCE TAG	-1276	1276	0			V0	W2
771	vf	LINK 76	DESTINATION TAG	0	1276	0			V0	W2
772	vg	LINK 77	SOURCE TAG	-1276	1276	0			V0	W2
773	vh	LINK 77	DESTINATION TAG	0	1276	0			V0	W2

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
774	vi	LINK 78	SOURCE TAG	-1276	1276	0			V0	W2
775	vj	LINK 78	DESTINATION TAG	0	1276	0			V0	W2
776	vk	LINK 79	SOURCE TAG	-1276	1276	0			V0	W2
777	vl	LINK 79	DESTINATION TAG	0	1276	0			V0	W2
778	vm	LINK 80	SOURCE TAG	-1276	1276	0			V0	W2
779	vn	LINK 80	DESTINATION TAG	0	1276	0			V0	W2
780	vo	LOGIC FUNC 1	INPUT A	0	1	0			V0	W0
781	vp	LOGIC FUNC 1	INPUT B	0	1	0			V0	W0
782	vq	LOGIC FUNC 1	INPUT C	0	1	0			V0	W0
783	vr	LOGIC FUNC 1	TYPE	0	15	0		0: NOT(A) 1: AND(A,B,C) 2: NAND(A,B,C) 3: OR(A,B,C) 4: NOR(A,B,C) 5: XOR(A,B) 6: 0-1 EDGE(A) 7: 1-0 EDGE(A) 8: AND(A,B,!C) 9: OR(A,B,!C) 10: S FLIP-FLOP 11: R FLIP-FLOP 12: LATCH 13: SWITCH 14: (A AND B) OR C 15: (A OR B) AND C	V0	W0
784	vs	LOGIC FUNC 1	OUTPUT	0	1	0			V0	W4
785	vt	LOGIC FUNC 2	INPUT A	0	1	0			V0	W0
786	vu	LOGIC FUNC 2	INPUT B	0	1	0			V0	W0
787	vv	LOGIC FUNC 2	INPUT C	0	1	0			V0	W0
788	vw	LOGIC FUNC 2	TYPE	0	15	0		See Tag 783	V0	W0
789	vx	LOGIC FUNC 2	OUTPUT	0	1	0			V0	W4
790	vy	LOGIC FUNC 3	INPUT A	0	1	0			V0	W0
791	vz	LOGIC FUNC 3	INPUT B	0	1	0			V0	W0
792	w0	LOGIC FUNC 3	INPUT C	0	1	0			V0	W0
793	w1	LOGIC FUNC 3	TYPE	0	15	0		See Tag 783	V0	W0
794	w2	LOGIC FUNC 3	OUTPUT	0	1	0			V0	W4

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
795	w3	LOGIC FUNC 4	INPUT A	0	1	0			V0	W0
796	w4	LOGIC FUNC 4	INPUT B	0	1	0			V0	W0
797	w5	LOGIC FUNC 4	INPUT C	0	1	0			V0	W0
798	w6	LOGIC FUNC 4	TYPE	0	15	0		See Tag 783	V0	W0
799	w7	LOGIC FUNC 4	OUTPUT	0	1	0			V0	W4
800	w8	LOGIC FUNC 5	INPUT A	0	1	0			V0	W0
801	w9	LOGIC FUNC 5	INPUT B	0	1	0			V0	W0
802	wa	LOGIC FUNC 5	INPUT C	0	1	0			V0	W0
803	wb	LOGIC FUNC 5	TYPE	0	15	0		See Tag 783	V0	W0
804	wc	LOGIC FUNC 5	OUTPUT	0	1	0			V0	W4
805	wd	LOGIC FUNC 6	INPUT A	0	1	0			V0	W0
806	we	LOGIC FUNC 6	INPUT B	0	1	0			V0	W0
807	wf	LOGIC FUNC 6	INPUT C	0	1	0			V0	W0
808	wg	LOGIC FUNC 6	TYPE	0	15	0		See Tag 783	V0	W0
809	wh	LOGIC FUNC 6	OUTPUT	0	1	0			V0	W4
810	wi	LOGIC FUNC 7	INPUT A	0	1	0			V0	W0
811	wj	LOGIC FUNC 7	INPUT B	0	1	0			V0	W0
812	wk	LOGIC FUNC 7	INPUT C	0	1	0			V0	W0
813	wl	LOGIC FUNC 7	TYPE	0	15	0		See Tag 783	V0	W0
814	wm	LOGIC FUNC 7	OUTPUT	0	1	0			V0	W4
815	wn	LOGIC FUNC 8	INPUT A	0	1	0			V0	W0
816	wo	LOGIC FUNC 8	INPUT B	0	1	0			V0	W0
817	wp	LOGIC FUNC 8	INPUT C	0	1	0			V0	W0
818	wq	LOGIC FUNC 8	TYPE	0	15	0		See Tag 783	V0	W0
819	wr	LOGIC FUNC 8	OUTPUT	0	1	0			V0	W4
820	ws	LOGIC FUNC 9	INPUT A	0	1	0			V0	W0
821	wt	LOGIC FUNC 9	INPUT B	0	1	0			V0	W0
822	wu	LOGIC FUNC 9	INPUT C	0	1	0			V0	W0
823	wv	LOGIC FUNC 9	TYPE	0	15	0		See Tag 783	V0	W0
824	ww	LOGIC FUNC 9	OUTPUT	0	1	0			V0	W4
825	wx	LOGIC FUNC 10	INPUT A	0	1	0			V0	W0
826	wy	LOGIC FUNC 10	INPUT B	0	1	0			V0	W0
827	wz	LOGIC FUNC 10	INPUT C	0	1	0			V0	W0

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
828	x0	LOGIC FUNC 10	TYPE	0	15	0		See Tag 783	V0	W0
829	x1	LOGIC FUNC 10	OUTPUT	0	1	0			V0	W4
830	x2	VALUE FUNC 1	INPUT A	-32768.00	32768.00	0.00			V0	W0
831	x3	VALUE FUNC 1	INPUT B	-32768.00	32768.00	0.00			V0	W0
832	x4	VALUE FUNC 1	INPUT C	-32768.00	32768.00	0.00			V0	W0
833	x5	VALUE FUNC 1	TYPE	0	46	0		0: IF(C) -A 1: ABS(A+B+C) 2: SWITCH(A,B) 3: (A*B)/C 4: A+B+C 5: A-B-C 6: B<=A<=C 7: A>B+/-C 8: A>=B 9: ABS(A)>B+/-C 10: ABS(A)>=B 11: A(1+B) 12: IF(C) HOLD(A) 13: BINARY DECODE 14: ON DELAY 15: OFF DELAY 16: TIMER 17: MINIMUM PULSE 18: PULSE TRAIN 19: WINDOW 20: UP/DWN COUNTER 21: (A*B)/C ROUND 22: WINDOW NO HYST 23: WIND A>=B,A<=C 24: A<=B 25: ((A*B)/100)+C 26: MIN(A,B,C) 27: MAX(A,B,C) 28: PROFILE SQRT 29: PROFILE LINEAR 30: PROFILE x^2 31: PROFILE x^3 32: PROFILE x^4 33: ON A>B, OFF A<C 34: (A+B) CLAMPED C	V0	W0

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
								35: (A-B) CLAMPED C 36: (A*B) CLAMPED C 37: (A/B) CLAMPED C 38: A>=B:A, A<=C:0 39: (A * B) + C 40: A * (B + C) 41: A * (B - C) 42: A * (1+B/C) 43: A * (1+(B * C)) 44: MONOSTABLE HIGH 45: MONOSTABLE LOW 46: FILTER		
834	x6	VALUE FUNC 1	OUTPUT	0.00	0.00	0.00			V0	W4
835	x7	VALUE FUNC 2	INPUT A	-32768.00	32768.00	0.00			V0	W0
836	x8	VALUE FUNC 2	INPUT B	-32768.00	32768.00	0.00			V0	W0
837	x9	VALUE FUNC 2	INPUT C	-32768.00	32768.00	0.00			V0	W0
838	xa	VALUE FUNC 2	TYPE	0	46	0		See Tag 833	V0	W0
839	xb	VALUE FUNC 2	OUTPUT	0.00	0.00	0.00			V0	W4
840	xc	VALUE FUNC 3	INPUT A	-32768.00	32768.00	0.00			V0	W0
841	xd	VALUE FUNC 3	INPUT B	-32768.00	32768.00	0.00			V0	W0
842	xe	VALUE FUNC 3	INPUT C	-32768.00	32768.00	0.00			V0	W0
843	xf	VALUE FUNC 3	TYPE	0	46	0		See Tag 833	V0	W0
844	xg	VALUE FUNC 3	OUTPUT	0.00	0.00	0.00			V0	W4
845	xh	VALUE FUNC 4	INPUT A	-32768.00	32768.00	0.00			V0	W0
846	xi	VALUE FUNC 4	INPUT B	-32768.00	32768.00	0.00			V0	W0
847	xj	VALUE FUNC 4	INPUT C	-32768.00	32768.00	0.00			V0	W0
848	xk	VALUE FUNC 4	TYPE	0	46	0		See Tag 833	V0	W0
849	xl	VALUE FUNC 4	OUTPUT	0.00	0.00	0.00			V0	W4
850	xm	VALUE FUNC 5	INPUT A	-32768.00	32768.00	0.00			V0	W0
851	xn	VALUE FUNC 5	INPUT B	-32768.00	32768.00	0.00			V0	W0
852	xo	VALUE FUNC 5	INPUT C	-32768.00	32768.00	0.00			V0	W0
853	xp	VALUE FUNC 5	TYPE	0	46	0		See Tag 833	V0	W0
854	xq	VALUE FUNC 5	OUTPUT	0.00	0.00	0.00			V0	W4
855	xr	VALUE FUNC 6	INPUT A	-32768.00	32768.00	0.00			V0	W0
856	xs	VALUE FUNC 6	INPUT B	-32768.00	32768.00	0.00			V0	W0

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
857	xt	VALUE FUNC 6	INPUT C	-32768.00	32768.00	0.00			V0	W0
858	xu	VALUE FUNC 6	TYPE	0	46	0		See Tag 833	V0	W0
859	xv	VALUE FUNC 6	OUTPUT	0.00	0.00	0.00			V0	W4
860	xw	VALUE FUNC 7	INPUT A	-32768.00	32768.00	0.00			V0	W0
861	xx	VALUE FUNC 7	INPUT B	-32768.00	32768.00	0.00			V0	W0
862	xy	VALUE FUNC 7	INPUT C	-32768.00	32768.00	0.00			V0	W0
863	xz	VALUE FUNC 7	TYPE	0	46	0		See Tag 833	V0	W0
864	y0	VALUE FUNC 7	OUTPUT	0.00	0.00	0.00			V0	W4
865	y1	VALUE FUNC 8	INPUT A	-32768.00	32768.00	0.00			V0	W0
866	y2	VALUE FUNC 8	INPUT B	-32768.00	32768.00	0.00			V0	W0
867	y3	VALUE FUNC 8	INPUT C	-32768.00	32768.00	0.00			V0	W0
868	y4	VALUE FUNC 8	TYPE	0	46	0		See Tag 833	V0	W0
869	y5	VALUE FUNC 8	OUTPUT	0.00	0.00	0.00			V0	W4
870	y6	VALUE FUNC 9	INPUT A	-32768.00	32768.00	0.00			V0	W0
871	y7	VALUE FUNC 9	INPUT B	-32768.00	32768.00	0.00			V0	W0
872	y8	VALUE FUNC 9	INPUT C	-32768.00	32768.00	0.00			V0	W0
873	y9	VALUE FUNC 9	TYPE	0	46	0		See Tag 833	V0	W0
874	ya	VALUE FUNC 9	OUTPUT	0.00	0.00	0.00			V0	W4
875	yb	VALUE FUNC 10	INPUT A	-32768.00	32768.00	0.00			V0	W0
876	yc	VALUE FUNC 10	INPUT B	-32768.00	32768.00	0.00			V0	W0
877	yd	VALUE FUNC 10	INPUT C	-32768.00	32768.00	0.00			V0	W0
878	ye	VALUE FUNC 10	TYPE	0	46	0		See Tag 833	V0	W0
879	yf	VALUE FUNC 10	OUTPUT	0.00	0.00	0.00			V0	W4
880	yg	DEMULTIPLEXER	OUTPUT 0	0	1	0			V0	W4
881	yh	DEMULTIPLEXER	OUTPUT 1	0	1	0			V0	W4
882	yi	DEMULTIPLEXER	OUTPUT 2	0	1	0			V0	W4
883	yj	DEMULTIPLEXER	OUTPUT 3	0	1	0			V0	W4
884	yk	DEMULTIPLEXER	OUTPUT 4	0	1	0			V0	W4
885	yl	DEMULTIPLEXER	OUTPUT 5	0	1	0			V0	W4
886	ym	DEMULTIPLEXER	OUTPUT 6	0	1	0			V0	W4
887	yn	DEMULTIPLEXER	OUTPUT 7	0	1	0			V0	W4
888	yo	DEMULTIPLEXER	OUTPUT 8	0	1	0			V0	W4
889	yp	DEMULTIPLEXER	OUTPUT 9	0	1	0			V0	W4

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
890	yq	DEMULTIPLEXER	OUTPUT 10	0	1	0			V0	W4
891	yr	DEMULTIPLEXER	OUTPUT 11	0	1	0			V0	W4
892	ys	DEMULTIPLEXER	OUTPUT 12	0	1	0			V0	W4
893	yt	DEMULTIPLEXER	OUTPUT 13	0	1	0			V0	W4
894	yu	DEMULTIPLEXER	OUTPUT 14	0	1	0			V0	W4
895	yv	DEMULTIPLEXER	OUTPUT 15	0	1	0			V0	W4
896	yw	DEMULTIPLEXER	INPUT	0x0000	0xFFFF	0x0000			V0	W0
897	yx	OUT	DELAY	0	1000	0	ms		V0	W0
1128	hK	MULTIPLEXER	OUTPUT	0x0000	0xFFFF	0x0000			V0	W4
1129	hL	MULTIPLEXER	INPUT 0	0	1	0			V0	W0
1130	hM	MULTIPLEXER	INPUT 1	0	1	0			V0	W0
1131	hN	MULTIPLEXER	INPUT 2	0	1	0			V0	W0
1132	hO	MULTIPLEXER	INPUT 3	0	1	0			V0	W0
1133	hP	MULTIPLEXER	INPUT 4	0	1	0			V0	W0
1134	hQ	MULTIPLEXER	INPUT 5	0	1	0			V0	W0
1135	hR	MULTIPLEXER	INPUT 6	0	1	0			V0	W0
1136	hS	MULTIPLEXER	INPUT 7	0	1	0			V0	W0
1137	hT	MULTIPLEXER	INPUT 8	0	1	0			V0	W0
1138	hU	MULTIPLEXER	INPUT 9	0	1	0			V0	W0
1139	hV	MULTIPLEXER	INPUT 10	0	1	0			V0	W0
1140	hW	MULTIPLEXER	INPUT 11	0	1	0			V0	W0
1141	hX	MULTIPLEXER	INPUT 12	0	1	0			V0	W0
1142	hY	MULTIPLEXER	INPUT 13	0	1	0			V0	W0
1143	hZ	MULTIPLEXER	INPUT 14	0	1	0			V0	W0
1144	iA	MULTIPLEXER	INPUT 15	0	1	0			V0	W0
1145	iB	SELECT 1	INPUT 0	-32768.00	32768.00	0.00			V0	W0
1146	iC	SELECT 1	INPUT 1	-32768.00	32768.00	0.00			V0	W0
1147	iD	SELECT 1	INPUT 2	-32768.00	32768.00	0.00			V0	W0
1148	iE	SELECT 1	INPUT 3	-32768.00	32768.00	0.00			V0	W0
1149	iF	SELECT 1	INPUT 4	-32768.00	32768.00	0.00			V0	W0
1150	iG	SELECT 1	INPUT 5	-32768.00	32768.00	0.00			V0	W0
1151	iH	SELECT 1	INPUT 6	-32768.00	32768.00	0.00			V0	W0
1152	iI	SELECT 1	INPUT 7	-32768.00	32768.00	0.00			V0	W0

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
1153	iJ	SELECT 1	SELECT	0	7	0			V0	W0
1154	iK	SELECT 1	OUTPUT 0	0.00	0.00	0.00			V0	W4
1155	iL	SELECT 1	OUTPUT 1	0.00	0.00	0.00			V0	W4
1156	iM	SELECT 2	INPUT 0	-32768.00	32768.00	0.00			V0	W0
1157	iN	SELECT 2	INPUT 1	-32768.00	32768.00	0.00			V0	W0
1158	iO	SELECT 2	INPUT 2	-32768.00	32768.00	0.00			V0	W0
1159	iP	SELECT 2	INPUT 3	-32768.00	32768.00	0.00			V0	W0
1160	iQ	SELECT 2	INPUT 4	-32768.00	32768.00	0.00			V0	W0
1161	iR	SELECT 2	INPUT 5	-32768.00	32768.00	0.00			V0	W0
1162	iS	SELECT 2	INPUT 6	-32768.00	32768.00	0.00			V0	W0
1163	iT	SELECT 2	INPUT 7	-32768.00	32768.00	0.00			V0	W0
1164	iU	SELECT 2	SELECT	0	7	0			V0	W0
1165	iV	SELECT 2	OUTPUT 0	0.00	0.00	0.00			V0	W4
1166	iW	SELECT 2	OUTPUT 1	0.00	0.00	0.00			V0	W4
1169	iZ	CONFIGURE DRIVE	DUMP CHANGED	0	1	0			V1	W1
1172	jC	CONFIGURE DRIVE	DEBOUNCE DIGIN	0	1	1			V0	W0
1174	jE	CURRENT LOOP	PHASE ANGLE @ E	0.00	0.00	0.00	DEG		V0	W4
1175	jF	COMMS PORT 3	REPLY DELAY	0	255	2	ms		V0	W0
1185	jP	FIELD CONTROL	WEAK PID ERROR	0.00	0.00	0.00	%		V1	W4
1186	jQ	FIELD CONTROL	WEAK PID OUT	0.00	0.00	0.00	%		V1	W4
1187	jR	FIELD CONTROL	FIELD STATE	0	6	0		0: FIELD INIT 1: FIELD QUENCH 2: FIELD STANDBY 3: FIELD FULL FLD 4: FIELD TIMER 5: FIELD ERROR 6: LOCAL BEMF	V0	W4
1188	jS	LINK 11	DESTINATION TAG	0	1276	686			V0	W2
1189	jT	LINK 12	DESTINATION TAG	0	1276	688			V0	W2
1190	jU	LINK 16	DESTINATION TAG	0	1276	714			V0	W2

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
1198	kC	PLL	PLL STATE	0	6	0		0: STOPPED 1: 1ST CODING EDGE 2: READ EDGES 3: MAINS PERIOD 4: LOCKED 5: UNLOCKED 6: FAIL	V0	W4
1199	kD	PLL	PHASE ERROR	0.00	0.00	0.00			V0	W4
1201	kF	PLL	PLL MAINS FREQ	0.00	0.00	0.00			V0	W4
1204	kI	SEQUENCING	COMMS TIMEOUT	0.0	60.0	0.0	s		V0	W0
1220	kY	CONFIGURE DRIVE	AUTOMATIC SAVE	0	1	0			V0	W0
1226	lE	AUTOTUNE	STATE	0	3	0		0: IDLE 1: RUNNING 2: SUCCESS 3: FAILED	V1	W4
1227	lF	ENCODER 1	SPEED FEEDBACK	0.0	0.0	0.0	%		V0	W4
1230	lI	ENCODER 2	ENCODER LINES	10	5000	1000			V0	W1
1231	lJ	ENCODER 2	ENCODER SIGN	0	1	1		0: NEGATIVE 1: POSITIVE	V0	W1
1232	lK	ENCODER 2	ENCODER RPM	0	6000	1000	RPM		V0	W1
1235	lN	ENCODER 2	UNFIL.ENCODER	0	0	0	RPM		V0	W4
1236	lO	ENCODER 2	ENCODER	0	0	0	RPM		V0	W4
1237	lP	ENCODER 2	SPEED FEEDBACK	0.0	0.0	0.0	%		V0	W4
1238	lQ	DIGITAL INPUT 4	OUTPUT	0.00	0.00	0.00	%		V0	W4
1239	lR	DIGITAL INPUT 4	VALUE FOR TRUE	-300.00	300.00	0.01	%		V0	W0
1240	lS	DIGITAL INPUT 4	VALUE FOR FALSE	-300.00	300.00	0.00	%		V0	W0
1241	lT	DIGITAL INPUT 5	OUTPUT	0.00	0.00	0.00	%		V0	W4
1242	lU	DIGITAL INPUT 5	VALUE FOR TRUE	-300.00	300.00	0.01	%		V0	W0
1243	lV	DIGITAL INPUT 5	VALUE FOR FALSE	-300.00	300.00	0.00	%		V0	W0
1246	lY	ALARM HISTORY	ALARM 1 NEWEST	0x0000	0xFFFF	0x0000			V0	W4
1247	lZ	ALARM HISTORY	ALARM 2	0x0000	0xFFFF	0x0000			V0	W4
1248	mA	ALARM HISTORY	ALARM 3	0x0000	0xFFFF	0x0000			V0	W4
1249	mB	ALARM HISTORY	ALARM 4	0x0000	0xFFFF	0x0000			V0	W4
1250	mC	ALARM HISTORY	ALARM 5	0x0000	0xFFFF	0x0000			V0	W4
1251	mD	ALARM HISTORY	ALARM 6	0x0000	0xFFFF	0x0000			V0	W4

Tag	Mn	MMI Block Name	MMI Parameter Name	Minimum	Maximum	Default	Units	Range	Notes	
1252	mE	ALARM HISTORY	ALARM 7	0x0000	0xFFFF	0x0000			V0	W4
1253	mF	ALARM HISTORY	ALARM 8	0x0000	0xFFFF	0x0000			V0	W4
1254	mG	ALARM HISTORY	ALARM 9	0x0000	0xFFFF	0x0000			V0	W4
1255	mH	ALARM HISTORY	ALARM 10 OLDEST	0x0000	0xFFFF	0x0000			V0	W4
1259	mL	PID	HI RES PROP GAIN	0.000	100.000	0.000			V1	W0
1265	mR	?	POSITIVE LIMIT	0.00	250.00	250.00			?	?
1266	mS	?	NEGATIVE LIMIT	-250.00	0.00	-250.00			?	?
1267	mT	ENCODER 1	ENCODER TYPE	0	1	1		0: CLOCK/DIRECTION 1: QUADRATURE	V0	W1
1268	mU	ENCODER 2	ENCODER TYPE	0	1	1		0: CLOCK/DIRECTION 1: QUADRATURE	V0	W1
1273	mZ	FIELD CONTROL	BEMF SOURCE	0	1	0		0: LOCAL BEMF 1: BEMF INPUT	V1	W1
1274	nA	FIELD CONTROL	BEMF INPUT	-200.00	200.00	0.00	%		V1	W0
1275	nB	CURRENT LOOP	ISOL DMD SOURCE	0	1	0		0: ANIN 2 (A3) 1: FIELD I DEMAND	V1	W1
1276	nC	AUTOTUNE	ERROR TYPE	0	11	0		0: NO ERROR 1: OVER SPEED 2: FIELD ERROR 3: PULSE WIDTH 4: OVER CURRENT 5: TIMEOUT 6: AUTOTUNE ABORTED 7: FIRING ANGLE 8: PEAK/AVER. RATIO 9: UNBALANCED BRID. 10: NULL AVERAGE CUR 11: THYRISTOR OFF	V1	W4

Appendix C Programming

This Appendix provides an introduction to programming the drive. It describes the function blocks and parameters available in CACT. The FUNCTION BLOCKS menu on the MMI provides access to these programming tool menu structures.

Programming Your Application

Programming with Block Diagrams

We recommend that you use a suitable programming tool (such as “CACT” which is ‘DC900P Drives’ block programming software) to program the Drive for specific applications. It is however possible to use the Keypad.

NOTE **The Menus on the MMI contain parameters that don't necessarily reside in similarly-named function blocks in our Configuration Tool. To locate the function block for a parameter when using the MMI, hold the "M" key down when editing the parameter. This will display the Tag number. You can find the details for every Tag in this Appendix: Parameter Specification Tables. Alternatively, the Parameter Table in Appendix C: "Parameter Specifications" provides a quick reference from the MMI list to the associated function block.**

The Drive is supplied with a basic set-up which can be used as a starting point for application-specific programming. This programming could simply involve the inputting of parameter values, or it may require the making or breaking of programmable links, which is a feature of this unit.

Block diagram programming provides a visual method of planning the software to suit your application. The basic block diagram is provided at the end of this Appendix and shows the software connections consisting of *function blocks* and *links:*

- Each function block contains the parameters required for setting-up a particular processing feature. Sometimes more than one function block is provided for a feature, i.e. for multiple digital inputs.
- Software links are used to connect the function blocks. Each link transfers the value of an output parameter to an input parameter of another (or the same) function block.

Each individual block is a processing feature: it takes the input parameter, processes the information, and makes the result available as one or more output parameters.

Modifying a Block Diagram

Operating and Configuration Modes

MMI Menu Map

1 SYSTEM

2 CONFIGURE I/O

CONFIGURE ENABLE

There are two modes of operation used while modifying a block diagram: *Operating* and *Configuration* modes.

The CONFIGURE ENABLE command is used to toggle between these two modes of operation.

DEFAULT

Operating Mode (CONFIGURE ENABLE = DISABLED)

In Operating mode you can change parameter values. The Drive can be running or stopped. Note that some parameters can only be changed when the Drive is stopped. It is not possible to modify the internal links when the Drive is in Operating mode.

Configuration Mode (CONFIGURE ENABLE = ENABLED)

In the configuration mode you can modify connections between the function blocks in the drive. You can also change parameter values, as above. The Drive cannot run in this mode. Output values are not updated.

Making and Breaking Function Block Connections

Links can be changed, added or deleted from a block diagram whilst in the Configuration mode. There are 80 general-purpose links available, each has its own identification number ("link" number). You make a link by setting the link's "source" and "destination" tags to be the two parameter tag numbers to be linked. The outputs of function blocks are not updated whilst in this mode.

NOTE **Links 1 to 50 are pre-connected between certain blocks and form the connections shown in the Default Block Diagram. Any of these links can be re-used elsewhere in the block diagram.**

The functions of the special links in previous software versions, (LINK 11 and LINK 12), are replaced by the ADVANCED 1 AND ADVANCED 2 function blocks.

In previous software versions, certain links were single-ended "special links". This is no longer the case. All links can now be re-used anywhere in the block diagram.

Programming Rules

The following rules apply when programming:

Operating Mode (CONFIGURE ENABLE = DISABLED)

- Function block output parameter values cannot be changed (because they are a result of the function block's processing)
- Function block input parameter values that receive their values from a link cannot be changed (as the link will overwrite the value when the Drive is running).

Configuration Mode (CONFIGURE ENABLE = ENABLED)

- A link's destination tag must be set to an input parameter (only one link per input parameter).
- A link's source tag may be set to any parameter. Both input and output parameters can be used as a source.
- Disable a link/function block by setting the "destination" and "source" tag to zero.
- To mark a link as a feedback link, set the source to the negative value of the tag to be connected. Feedback links are ignored when the function block execution order is determined.

Execution Rules

The complete block diagram is executed every 5ms, with individual control blocks executing within 1ms. Just before a function block is executed, all the links that have that block as their destination are executed, thereby copying new values in to the block's parameter inputs. The input parameters are then processed to produce a new set of output parameters. The execution order of the blocks is automatically arranged for minimal delay.

The output value transferred by a link on execution is clamped to be between the maximum and minimum value for its destination input parameter.

MMI Menu Map

1 FUNCTION BLOCKS

2 MISCELLANEOUS

3 CONFIGURE DRIVE
  - AUTOMATIC SAVE
  - DUMP BLOCKS
  - DUMP TRACE
  - UDP USE OP PORT
  - EMULATE 590P
  - DEBOUNCE DIGIN

The setting of the EMULATE 900P parameter (tag 162) in the CONFIGURE DRIVE function block affects the time constants of the PID block and the linking of parameters in the function block diagram:

- ➢ **When non-zero** the drive emulates the functionality of links in earlier firmware versions of the 900P, (firmware Versions 5.x and 7.x)
- ➢ **When zero (0x0000)** the behaviour changes so that the value is transferred, preserving the decimal place, (firmware Version 8.x and onwards).

Refer to "Compatibility with Earlier Versions of Firmware", page D-7, for more information.

To maintain compatibility, the new firmware emulates the functionality and behavior of links in earlier firmware versions by defaulting the EMULATE 900P parameter to 0x0001 (non-zero).

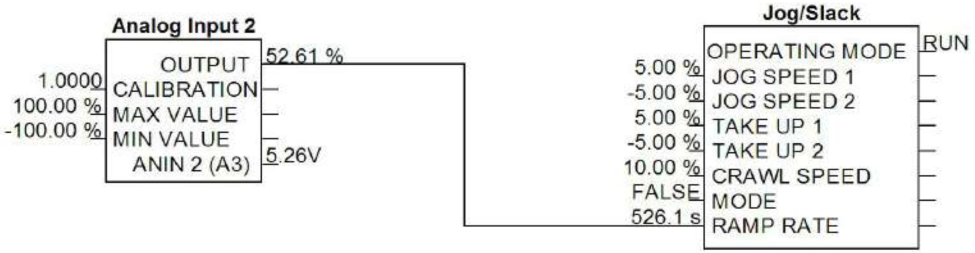


Figure 1 Operation of links (EMULATE 900P = non-zero : firmware Versions 5.x, 7.x, 8.x and onwards)

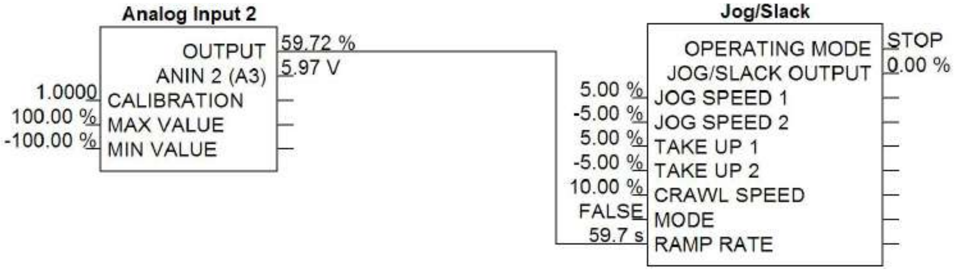


Figure 2 Operation of links (EMULATE 900P = zero : firmware Version 8.x and onwards)

The operation of a link is determined by the number of decimal places of each parameter. Previous firmware versions ignored the decimal place when linking two parameters. For example, linking Analog Input 2 to the Jog Ramp rate gave a Ramp Rate of 526.1s for an input value of 52.61%. Compare the Figure above.

An additional enhancement is that all values are now held to over 4 decimal places of precision. This is also true of values transferred via links. In the above example, although the Jog Ramp Rate is shown as 59.7s, internally the value will match that of the output of Analog Input 2, to over 4 decimal places.

Saving Your Modifications

Ensure that CONFIGURE ENABLE = DISABLED before performing a PARAMETER SAVE.

If AUTOMATIC SAVE is set TRUE then changes made via the Operator Station are automatically saved.

If parameter values or links have been modified, the new settings must be saved. The Drive will then retain the new settings during power-down. Refer to Chapter 6: “The Keypad” - Saving Your Application.

Understanding the Function Block Description

The following function blocks show the parameter information necessary for programming the Drive. Input parameters are shown on the left hand side, and output parameters are shown on the right hand side of the block.

Default Value	The default value of the unmodified factory set-up
Input/Output Parameter Name	The name shown on CACT
Tag Number	Unique identification used for linking and communications

Decimal Places - some parameters are held in memory with two decimal places but are displayed with one decimal place. These parameters are indicated in the Parameter Description tables. The Range parameter highlights these with a " **(h)** " suffix.

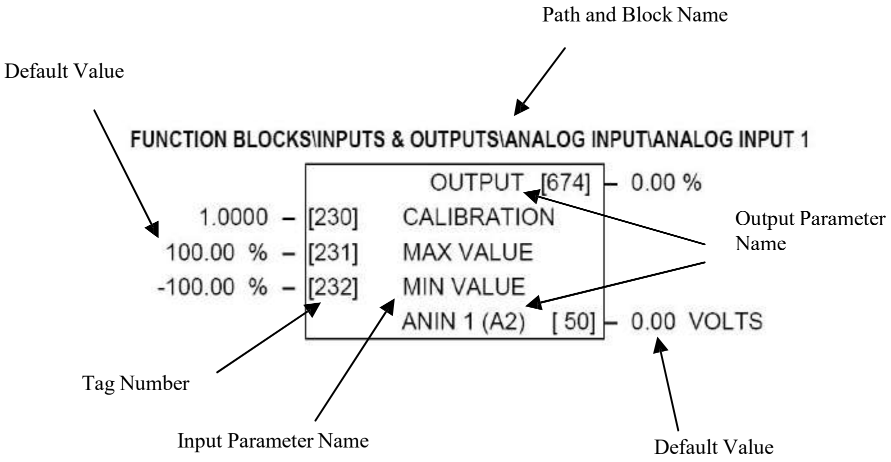


Figure D-3 Function Block Parameter Information

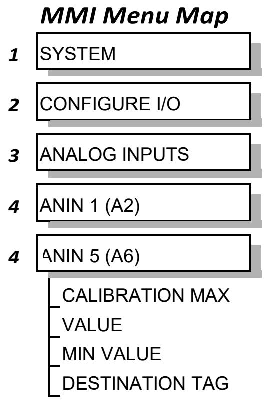
MMI Menu Maps

The function block descriptions include an easy-find menu showing the menu levels and titles encountered to find the appropriate menu title, and the parameters contained in the menu(s).

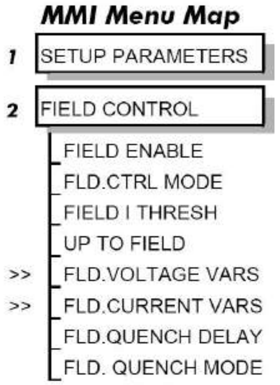
The Menu Maps are shown as if the view level is STANDARD.

Where there is more than one sub-menu, i.e. ANALOG INPUTS as illustrated, the parameters shown will be for the last sub-menu. In many cases, these parameters will reflect the name and number of the last sub-menu.

MMI parameters are named intuitively to make the keypad easier to use, however, they may vary slightly from function block names.

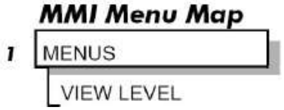


A function block may contain parameters that are contained within more than one MMI menu, for example FIELD CONTROL. In this case, the extra menus are indicated by >> in the MMI Menu Map.



Function Blocks By Category

The function blocks described in this Appendix are arranged in alphabetical order, however, they are listed below by Category. They each appear as a Menu in the FUNCTION BLOCKS menu. To view the FUNCTION BLOCKS Menu, ADVANCED view level must be selected



Alarms					
ALARM HISTORY	D-17	ALARMS	D-18		
Communications					
IN	D-12	COMMS PORT	D-32	TEC OPTION	D-133
OUT	D-13	miniLINK	D-85		
Inputs & Outputs					
ANALOG INPUTS	D-22	AUX I/O	D-28	DIGITAL OUTPUTS	D-54
ANALOG OUTPUTS	D-24	DIGITAL INPUTS	D-51		
Menus					
MENUS	D-83	OP STATION	D-87		
Miscellaneous					
ADVANCED	D-14	DRIVE INFO	D-57	MULTIPLEXER	D-86
CONFIGURE DRIVE	D-34	LINKS	D-72	VALUE FUNC	D-136
DEMULITPLEXER	D-42	LOGIC FUNC	D-77		
Motor Control					
AUTOTUNE	D-25	ENCODER	D-59	INVERSE TIME	D-73
CALIBRATION	D-29	FEEDBACKS	D-62	PLL	D-94
CURRENT LOOP	D-35	FIELD CONTROL	D-64	SPEED LOOP	D-117
CURRENT PROFILE	D-40	INERTIA COMP	D-71		
Seq & Ref					
JOG/SLACK	D-74	SEQUENCING	D-111	STOP RATES	D-130
RAMPS	D-104	STANDSTILL	D-127		
Setpoint Funcs					
DEADBAND	D-41	PRESET SPEEDS	D-96	SETPOINT SUM	D-114
MIN SPEED	D-84	RAISE/LOWER	D-101	SRAMP	D-124
PID	D-89	SELECT	D-110		
Winder					
DIAMETER CALC	D-43	PROFILED GAIN	D-99	TORQUE CALC	D-135

Function Block Descriptions

NOTE **Remember to select the correct mode, Setup or Configuration, whilst editing. Refer to “Modifying a Block Diagram”, page D-1. To view the FUNCTION BLOCKS Menu, ADVANCED view level must be selected.**

MMI Menu Map

1 MENUS
  VIEW LEVEL

ADVANCED

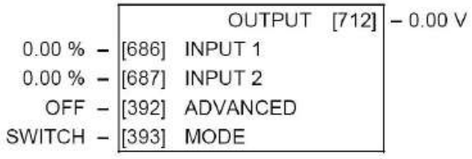
MMI Menu Map

1 SYSTEM
2 CONFIGURE I/O
3 INTERNAL LINKS
4 LINK 11
4 LINK 12
  SOURCE TAG
  DESTINATION TAG
  ADVANCED
  MODE
  AUX. SOURCE

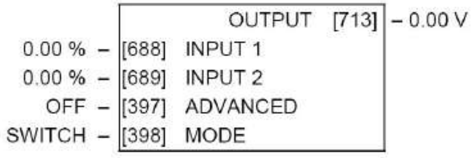
These two blocks perform some simple functions. They are compatible with the special Link 11 and Link12 used in earlier versions of this product.

For new configurations, consider using the new VALUE and LOGIC function blocks.

FUNCTION BLOCKS\MISCELLANEOUS\ADVANCED\ADVANCED 1



FUNCTION BLOCKS\MISCELLANEOUS\ADVANCED\ADVANCED 2



ADVANCED

Parameter	Tag	Range
INPUT 1	**686, 688**	**-32768.00 to 32768.00 %**
General purpose input.		
INPUT 2	**687, 689**	**-32768.00 to 32768.00 %**
General purpose input.		
ADVANCED	**392, 397**	**OFF/ON**
Controls the OUTPUT parameter. When OFF, OUTPUT is the same as INPUT 1. When ON, OUTPUT is the result of the function selected by MODE.		
MODE	**393, 398**	**See below**
This determines which operation is performed on the INPUT 1 and INPUT 2. It can be combined with ADVANCED to dynamically switch the		

OUTPUT between INPUT 1 and the result of the selected function. The functionality of the various MODE selections are shown in the table.

0 : SWITCH	
1 : INVERTER	
2 : AND	(logic)
3 : OR	(boolean)
4 : SIGN CHANGER	
5 : MODULUS	
6 : COMPARATOR	

OUTPUT	**712, 713**	**— .xx V**

Result of the selected function on the inputs.

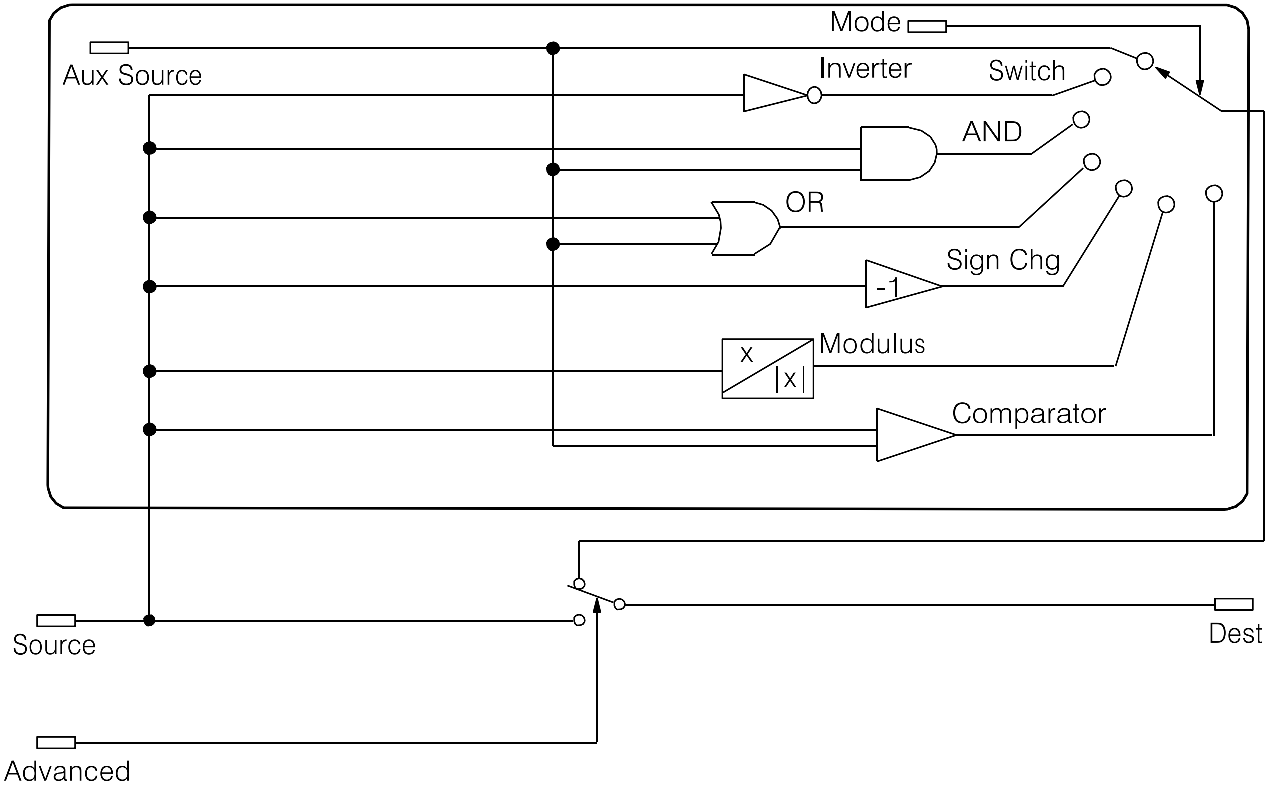
Functional Description

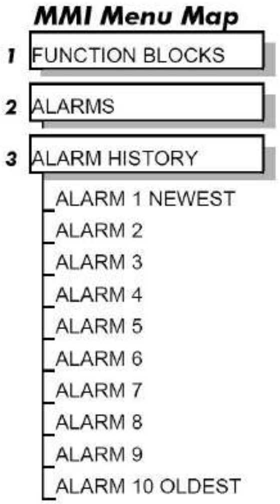
MODE	Description
SWITCH - switches the signal source between auxilliary and source analog or logic tags	If ADVANCED = OFF OUTPUT = SOURCE If ADVANCED = ON OUTPUT = INPUT 2
INVERTER - inverts the source logic signal	If ADVANCED = OFF OUTPUT = INPUT 1 If ADVANCED = ON OUTPUT = Logic Inversion of INPUT 1
AND - gives AND-ed result of source logic signal and an auxilliary source logic signal	If ADVANCED = OFF OUTPUT = INPUT 1 If ADVANCED = ON OUTPUT = INPUT 1 AND INPUT 2
OR - gives OR-ed result of source logic signal and an auxilliary source logic signal	If ADVANCED = OFF OUTPUT = INPUT 1 If ADVANCED = ON OUTPUT = INPUT 1 OR INPUT 2
SIGN CHANGER - reverses the sign of the source logic signal	If ADVANCED = OFF OUTPUT = INPUT 1 If ADVANCED = ON OUTPUT = Value sign change of INPUT 1
MODULUS - produces the modulus of the source logic signal	If ADVANCED = OFF OUTPUT = INPUT 1 If ADVANCED = ON OUTPUT = Modulus of INPUT 1
COMPARATOR - changes destination logic signal to TRUE when source analog signal is greater than auxilliary analog signal	If ADVANCED = OFF OUTPUT = INPUT 1 If ADVANCED = ON If INPUT 1 ≤ INPUT 2 OUTPUT = 0 If INPUT 1 > INPUT 2 OUTPUT = 1

Functional Description

The following diagram shows the internal schematic for a special link.

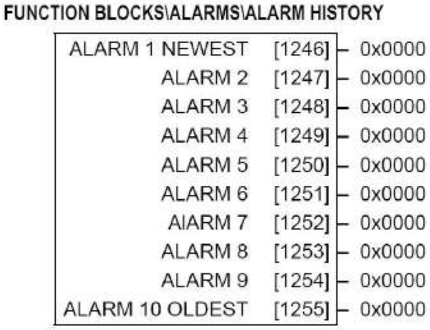
ADVANCED 1 & ADVANCED 2 (Link 11 & Link 12)





ALARM HISTORY

This function block records the last ten alarms. ALARM 1 NEWEST is the most recent alarm and will be the same as the ALARMS::LAST ALARM parameter when an alarm is active.



ALARM HISTORY

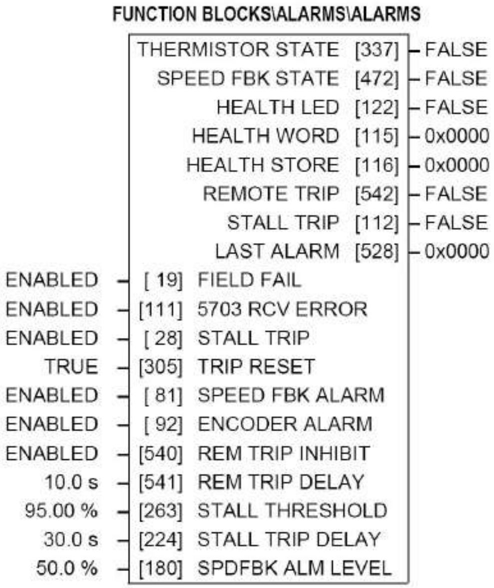
Parameter	Tag	Range
ALARM 1 NEWEST	**1246**	**0x0000 to 0xFFFF**
The hexadecimal value of the most recent alarm. Refer to Chapter 7: "Trips and Fault Finding" - Alarm Messages.		
ALARM 2 - ALARM 9	**1247, 1248, 1249, 1250, 1251, 1252, 1253, 1254**	**0x0000 to 0xFFFF**
The second to ninth most recent alarms.		
ALARM 10 OLDEST	**1255**	**0x0000 to 0xFFFF**
The tenth most recent alarm.		

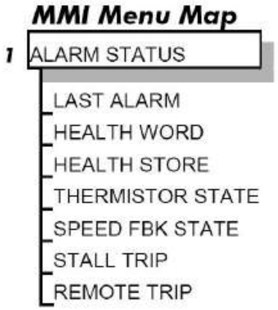
ALARMS

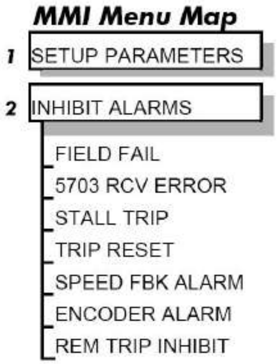
This block allows you to disable certain alarms and leave drive operation un-interrupted if the related fault occurs.

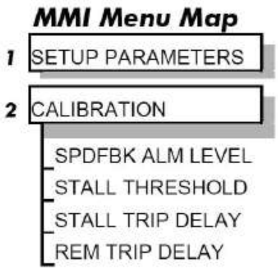
Caution

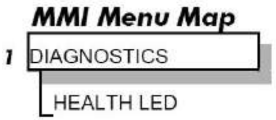
Do NOT inhibit any alarms if this might result in danger to personnel or equipment.









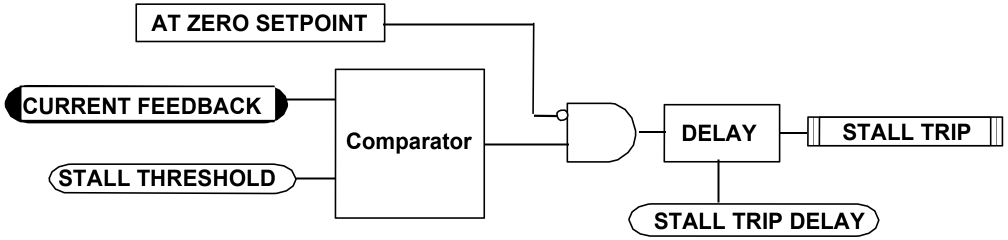


ALARMS

Parameter	Tag	Range
FIELD FAIL Inhibits the field fail alarm.	**19**	**ENABLED / INHIBITED**
RCV ERROR	**111**	**ENABLED / INHIBITED**
STALL TRIP Inhibits the stall trip alarm from tripping out the contactor. This is useful in applications requiring extended operation at zero speed.	**28**	**ENABLED / INHIBITED**
TRIP RESET When FALSE: faults are latched permanently and the HEALTHY output remains inactive, even when toggling the Start/Run input (C3) off/on. Once the drive is stopped the sequencing state remains in the SEQ HOLD state if any fault has been stored. Changing from FALSE to TRUE clears any stored faults. Also, when TRUE: stored faults are cleared whenever a Run signal is given to terminal C3. This feature can be used in applications where you want to reset the faults under your own control, rather than automatically with the Start/Run command.	**305**	**FALSE / TRUE**
SPEED FBK ALARM Inhibits the speed feedback alarm.	**81**	**ENABLED / INHIBITED**

ALARMS

Parameter	Tag	Range
ENCODER ALARM Inhibits the encoder option board alarm.	**92**	**ENABLED / INHIBITED**
REM TRIP INHIBIT Inhibits the remote trip.	**540**	**ENABLED / INHIBITED**
REM TRIP DELAY The delay between the remote trip alarm being activated and the drive tripping.	**541**	**0.1 to 600.0 s**
STALL THRESHOLD Stall comparator current feedback threshold level.	**263**	**0.00 to 200.00 %**
STALL TRIP DELAY Stall comparator time-out delay before stall output becomes true.	**224**	**0.1 to 600.0 s**

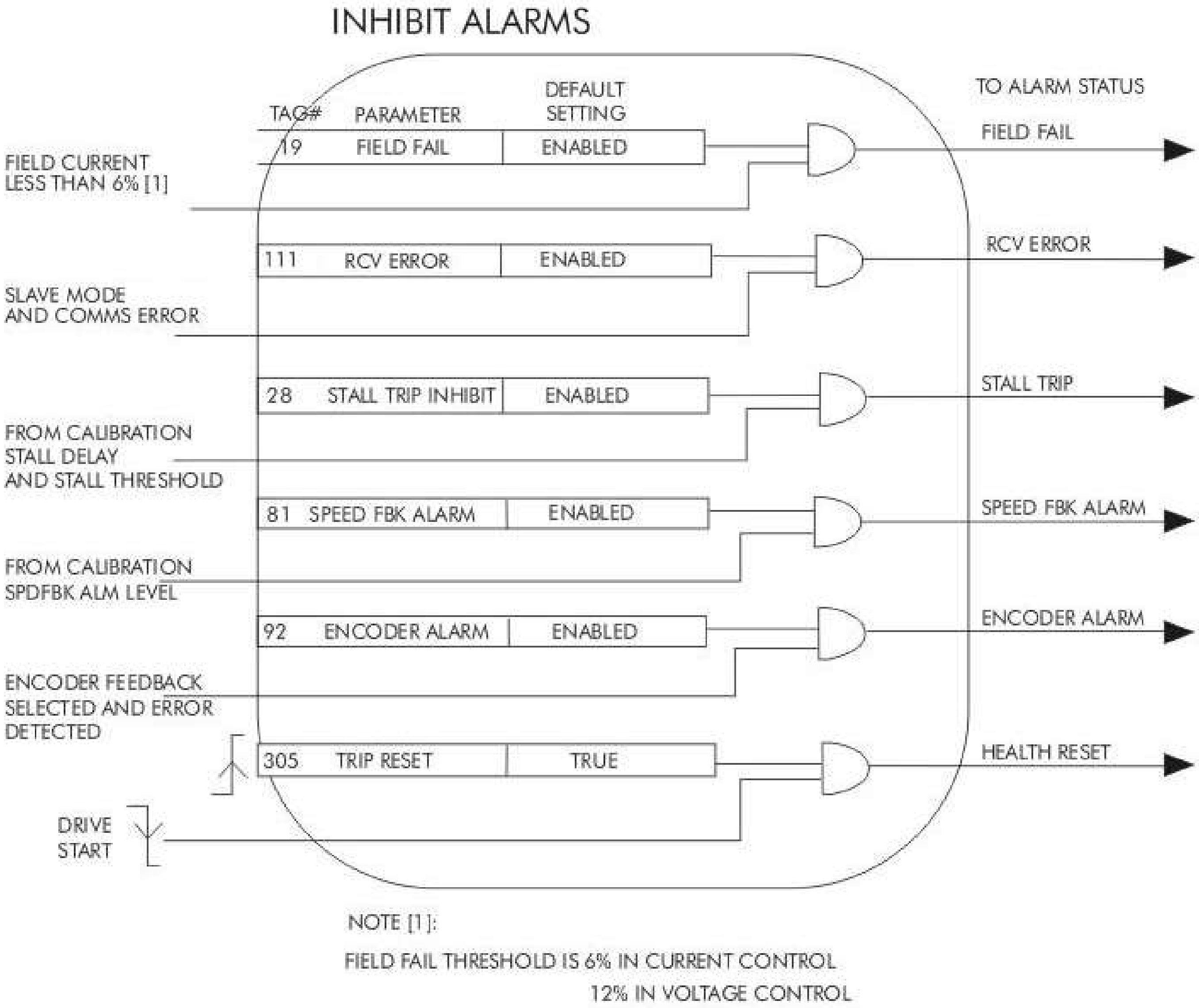


Parameter	Tag	Range
SPDFBK ALM LEVEL The speed feedback alarm compares speed feedback to armature voltage. The alarm level is the threshold which the difference between the two signals should exceed for the alarm to activate.	**180**	**0.0 to 100.0 % (h)**
THERMISTOR STATE TRUE if the thermistor input is active, FALSE otherwise.	**337**	**FALSE / TRUE**
SPEED FBK STATE A Boolean output that shows the state of the speed feedback alarm. This output is updated even when the alarm is disabled.	**472**	**FALSE / TRUE**
HEALTH LED State of Health LED on Keypad.	**122**	**FALSE / TRUE**
HEALTH WORD The hexadecimal sum of any alarms present. Refer to Chapter 7: “Trips and Fault Finding” - Alarm Messages.	**115**	**0x0000 to 0xFFFF**
HEALTH STORE The hexadecimal value of the first (or only) alarm. Refer to Chapter 7: “Trips and Fault Finding” - Alarm Messages.	**116**	**0x0000 to 0xFFFF**
REMOTE TRIP The state of Remote Trip.	**542**	**FALSE / TRUE**

ALARMS

<table>
<tr><th>Parameter</th><th>Tag</th><th>Range</th></tr>
<tr><td>STALL TRIP</td><td>112</td><td>FALSE / TRUE</td></tr>
<tr><td colspan="3">Armature current is above STALL THRESHOLD and AT ZERO SPEED but not AT ZERO SETPOINT.</td></tr>
<tr><td>LAST ALARM</td><td>528</td><td>0x0000 to 0xFFFF</td></tr>
<tr><td colspan="3">The hexadecimal value of the last (or only) alarm. Refer to Chapter 7: “Trips and Fault Finding” - Alarm Messages.
0x0000 : NO ACTIVE ALARMS
0x0001 : OVER SPEED
0x0002 : MISSING PULSE
0x0004 : FIELD OVER I
0x0008 : HEATSINK TRIP
0x0010 : THERMISTOR
0x0020 : OVER VOLTS (VA)
0x0040 : SPD FEEDBACK
0x0080 : ENCODER FAILED
0x0100 : FIELD FAILED
0x0200 : 3 PHASE FAILED
0x0400 : PHASE LOCK
0x0800 : RCV ERROR
0x1000 : STALL TRIP
0x2000 : OVER I TRIP
0x8000 : ACCTS FAILED
0xF001 : AUTOTUNE ERROR
0xF002 : AUTOTUNE ABORTED
0xF003 : SEQ PRE READY
0xF004 : CONTACTOR DELAY
0xF005 : EXTERNAL TRIP
0xF006 : REMOTE TRIP
0xF007 : ENABLE LOW
0xF009 : SEQUENCING
0xF010 : COMMS TIMEOUT
0xF200 : CONFIG ENABLED
0xF300 : CALIBRATION
0xF400 : NO OP-STATION
0xFF03 : AUX SUPPLY
0xFF05 : PCB VERSION
0xFF06 : PRODUCT CODE</td></tr>
</table>

Functional Description



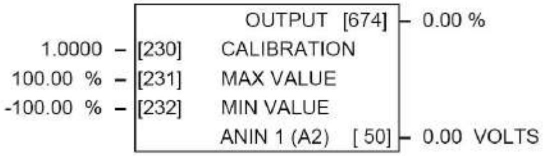
MMI Menu Map

1 SYSTEM
2 CONFIGURE I/O
3 ANALOG INPUTS
4 ANIN 1 (A2)
4 ANIN 2 (A3)
4 ANIN 3 (A4)
4 ANIN 4 (A5)
4 ANIN 5 (A6)
- CALIBRATION
- MAX VALUE
- MIN VALUE
- DESTINATION

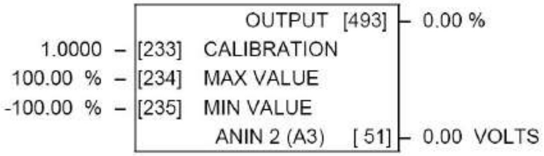
ANALOG INPUTS

The analog input block is used to scale and clamp the inputs for terminals A2 to A6.

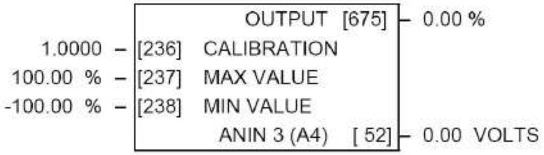
FUNCTION BLOCKS\INPUTS & OUTPUTS\ANALOG INPUT\ANALOG INPUT 1



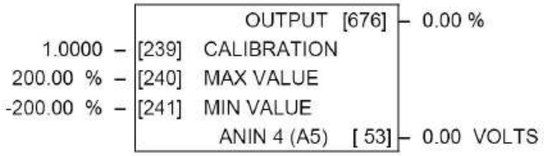
FUNCTION BLOCKS\INPUTS & OUTPUTS\ANALOG INPUT\ANALOG INPUT 2



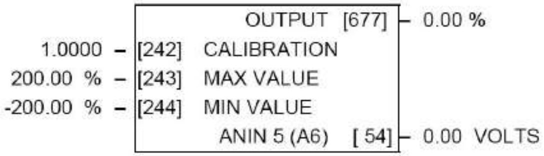
FUNCTION BLOCKS\INPUTS & OUTPUTS\ANALOG INPUT\ANALOG INPUT 3



FUNCTION BLOCKS\INPUTS & OUTPUTS\ANALOG INPUT\ANALOG INPUT 4



FUNCTION BLOCKS\INPUTS & OUTPUTS\ANALOG INPUT\ANALOG INPUT 5

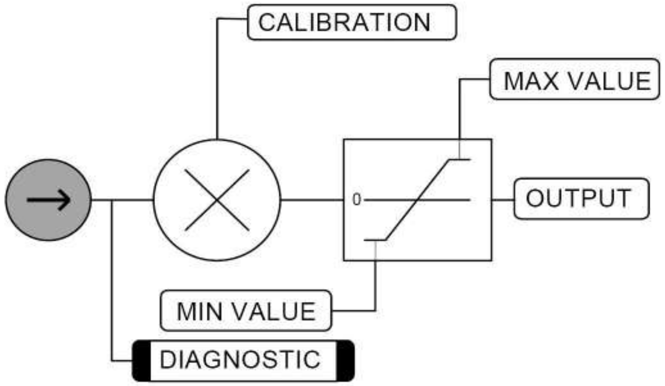


NOTE **Terminal ANIN 2 (A3) is permanently connected to SETPOINT 2 (A3) in the SPEED LOOP function block and to the Current Demand via I DEMAND ISOLATE (the current demand isolate switch) in the CURRENT LOOP function block.**

To avoid interference with other drive functions when not required: the parameter RATIO 2 (A3) (Tag 7 in the SPEED LOOP function block) must be set to zero; and the I DMD. ISOLATE parameter (Tag 119 in the CURRENT LOOP function block) must be set to DISABLED, i.e. selecting the Speed Loop as shown in the Main Block Diagram.

Because ANIN 2 (A3) is scanned synchronously with the current loop (typically every 3.3/2.6ms, 50/60Hz), it should be used for any signal whose response is critical e.g. a trim input from an external positioning system or load share.

Configurable Analog Inputs

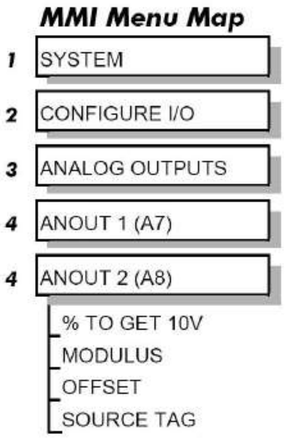


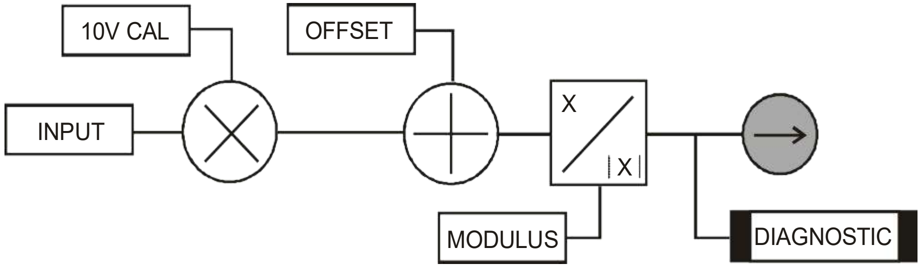
ANALOG INPUTS

Parameter	Tag	Range
CALIBRATION	**230, 233, 236, 239, 242**	**-3.0000 to 3.0000**
The analog input scaling ratio. For a value of 1.0, 10V =100%.		
MAX VALUE	**231, 234, 237, 240, 243**	**-300.00 to 300.00 %**
The maximum value of the scaled analog input.		
MIN VALUE	**232, 235, 238, 241, 244**	**-300.00 to 300.00 %**
The minimum value of the scaled analog input.		
OUTPUT	**674, 493, 675, 676, 677**	**— .xx %**
These parameters is the output diagnostic ANALOG INPUT 1 to ANALOG INPUT 5. Note by default 10V = 100%. To obtain a different range, adjust the CALIBRATION, MAX VALUE and MIN VALUE parameters.		
ANIN 1 (A2) to ANIN 5 (A6)	**50, 51, 52, 53, 54**	**—.xx VOLTS**
Actual volts measured on the analog input.		

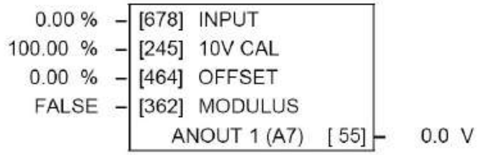
ANALOG OUTPUTS

This function block converts the demand percentage into 1-10V, suitable for driving the analog output electronics of the drive.

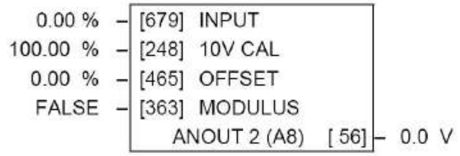




FUNCTION BLOCKS\INPUTS & OUTPUTS\ANALOG OUTPUT\ANALOG OUTPUT 1

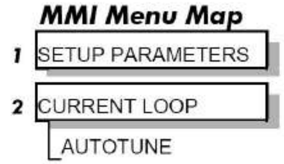


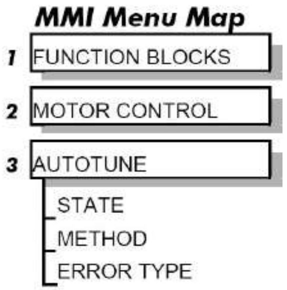
FUNCTION BLOCKS\INPUTS & OUTPUTS\ANALOG OUTPUT\ANALOG OUTPUT 2



ANALOG OUTPUTS

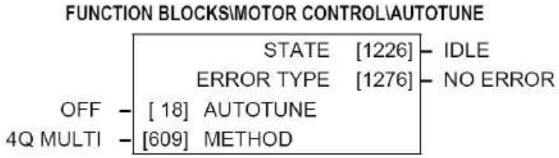
Parameter	Tag	Range
INPUT	**678, 679**	**-300.00 to 300.00 %**
Analog output value as a percentage of range.		
10V CAL	**245, 248**	**-300.00 to 300.00 %**
(% TO GET 10V) Scaler value which produces 10V output. Set 10V CAL to be 50% to get ±10V out for ±50% in.		
OFFSET	**464, 465**	**-100.00 to 100.00 %**
Offset value added to the normal output value after the scaler and before the modulus.		
MODULUS	**362, 363**	**FALSE / TRUE**
Unipolar analog output enable. If TRUE, then -10% gives +1V out.		
ANOUT 1 (A7) to ANOUT 2 (A8)	**55, 56**	**—.xx V (h)**
Actual voltage output to the terminal.		





AUTOTUNE

The Autotune feature is used to correctly set up the current loop controller parameters for the motor load.



The process consists of the drive generating a series of current pulses in the armature in order to determine:

1. The optimal proportional term and integral terms gains in the current controller, and storing these values as PROP. GAIN and INT. GAIN.
2. The average value at which the normal running pulses would just join up (stop being discontinuous), and storing this value as the DISCONTINUOUS parameter.

The Autotune is by default performed with the motor field off, and so the final proportional term gain is reduced by 30% to allow for some armature inductance fall-off when the field is re-applied.

Refer to Chapter 4: Performance Adjustment for details of how to perform an Autotune.

AUTOTUNE

<table>
<tr><th>Parameter</th><th>Tag</th><th>Range</th></tr>
<tr><td>AUTOTUNE</td><td>18</td><td>OFF / ARMATURE / FIELD</td></tr>
<tr><td colspan="3">Turns the AUTOTUNE procedure on, and selects if field or armature tuning is required. Refer to Chapter 4: Performance Adjustment.</td></tr>
<tr><td>STATE</td><td>1226</td><td>See below</td></tr>
<tr><td colspan="3">Indicates the current operating state of the Autotune function block. The FAILED state indicates failure or abort of the Autotune process (for causes refer to Chapter 4: Performance Adjustment).
0 : IDLE
1 : RUNNING
2 : SUCCESS
3 : FAILED</td></tr>
<tr><td>METHOD</td><td>609</td><td>See below</td></tr>
<tr><td colspan="3">Controls the method of operation of the Autotune process.
• The default method 4QMULTI uses both thyristor bridges to generate balanced forward and reverse armature current pulses.
• The 2QMULTI method only uses the forward thyristor bridge.
Note that the 2Q MULTI method is always used on a 2Q drive (591) irrespective of the setting of this parameter.
0 : 4Q MULTI
1 : 2Q MULTI</td></tr>
</table>

AUTOTUNE

Parameter	Tag	Range
ERROR TYPE	**1276**	**See below**

Indicates the cause of an autotune error condition.

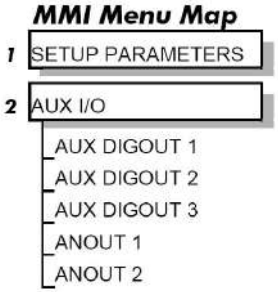
0 : NO ERROR
1 : OVER SPEED
2 : FIELD ERROR
3 : PULSE WIDTH
4 : OVER CURRENT
5 : TIMEOUT
6 : AUTOTUNE ABORTED
7 : FIRING ANGLE
8 : PEAK/AVER. RATIO
9 : UNBALANCED BRID.
10 : NULL AVERAGE CUR
11 : THYRISTOR OFF (missing pulse)

Functional Description

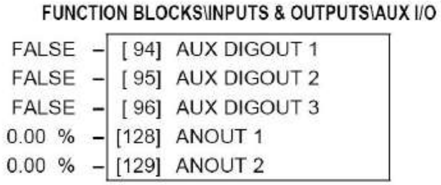
OVER SPEED	Motor speed detected at greater than 20% during autotune.
FIELD ERROR	Armature Autotune: For a field-off armature autotune, it means that the field current was measured at greater than 6% of the calibration value (which, if the field is calibrated to a low current, can be a very low threshold). For a field-on armature autotune, it means that the field was not up to current when expected during the autotune process. Field Autotune: Field volts found to be less than 10% for 50% of rated field current flowing, or Field current measured at > 105% of rated during autotune.
PULSE WIDTH	Less than 12 pulses have been measured during the autotune that meeting the pulse width angle tolerance requirements – likely unstable/unbalanced supply or motor shaft moving.
OVER CURRENT	Equivalent discontinuous armature current level measured at greater than 200% of either the stack rating or ARMATURE CURRENT setting;
TIMEOUT	Various timeouts.

AUTOTUNE ABORTED	User abort of the process.
FIRING ANGLE	Firing angle has reached 60deg. before zero voltage crossing, in an attempt to derive a 60deg. wide pulse – likely absent armature or severely resistive load.
PEAK/AVER.RATIO	Badly shaped current pulse, where the pk/average current ratio is more than 30% away from expected 1.5.
UNBALANCED BRID.	Pulse size imbalance greater than that from a motor BEMF equivalent to 5deg. from zero voltage crossing – likely poorly balanced supply phases or motor shaft turning.
NULL AVERAGE CUR	No current pulses detected.
THYRISTOR OFF	Missing pulse detected – likely missing firing pulses from one or more thyristors.

AUX I/O



The auxiliary I/O parameters are primarily intended to extend the functionality of the serial links by allowing them access to the drive analog and digital terminals.



AUX I/O

Parameter	Tag	Range
AUX DIGOUT 1	**94**	**FALSE / TRUE**
Software digital output 1. For example, to directly drive the configurable digital output DIGOUT1, connect the Source of DIGOUT1 to this parameter, Tag 94.		
AUX DIGOUT 2	**95**	**FALSE / TRUE**
Software digital output 2. For example, to directly drive the configurable digital output DIGOUT2, connect the Source of DIGOUT2 to this parameter, Tag 95.		
AUX DIGOUT 3	**96**	**FALSE / TRUE**
Software digital output 3. For example, to directly drive the configurable digital output DIGOUT3, connect the Source of DIGOUT3 to this parameter, Tag 96.		
ANOUT 1	**128**	**-100.00 to 100.00 %**
Software analog output 1. For example, to directly drive the configurable analog output ANOUT1, connect the Source of ANOUT1 to this parameter, Tag 128. ANOUT 1 can also be used as a general "staging post" for connecting inputs to outputs. For example, connect Analog Input 1 (A2) directly to Analog Output 1 (A7)		
ANOUT 2	**129**	**-100.00 to 100.00 %**
Software analog output 2. For example, to directly drive the configurable analog output ANOUT2, connect the Source of ANOUT2 to this parameter, Tag 129. ANOUT 2 can also be used as a general "staging post" for connecting inputs to outputs. For example, connect Analog Input 1 (A2) directly to Analog Output 2 (A8)		

MMI Menu Map

1 SETUP PARAMETERS

2 CALIBRATION

- ARMATURE V CAL.
- IR COMPENSATION
- ANALOG TACH CAL
- ZERO SPD. OFFSET
- ARMATURE I (A9)
- FIELD I CAL.

MMI Menu Map

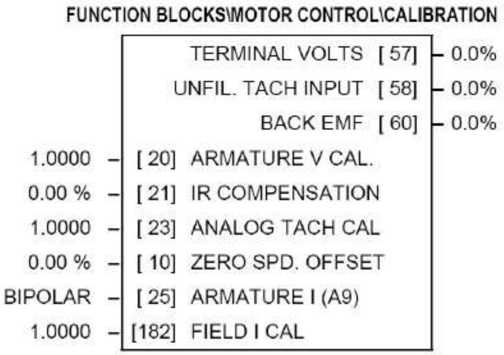
1 DIAGNOSTICS

- TERMINAL VOLTS
- BACK EMF
- UNFIL. TACH INPUT

CALIBRATION

This function block contains motor-specific parameters.

When CONFIGURE ENABLE = TRUE, the operation of the Block Diagram is suspended and all Keypad LEDs will flash.



CALIBRATION

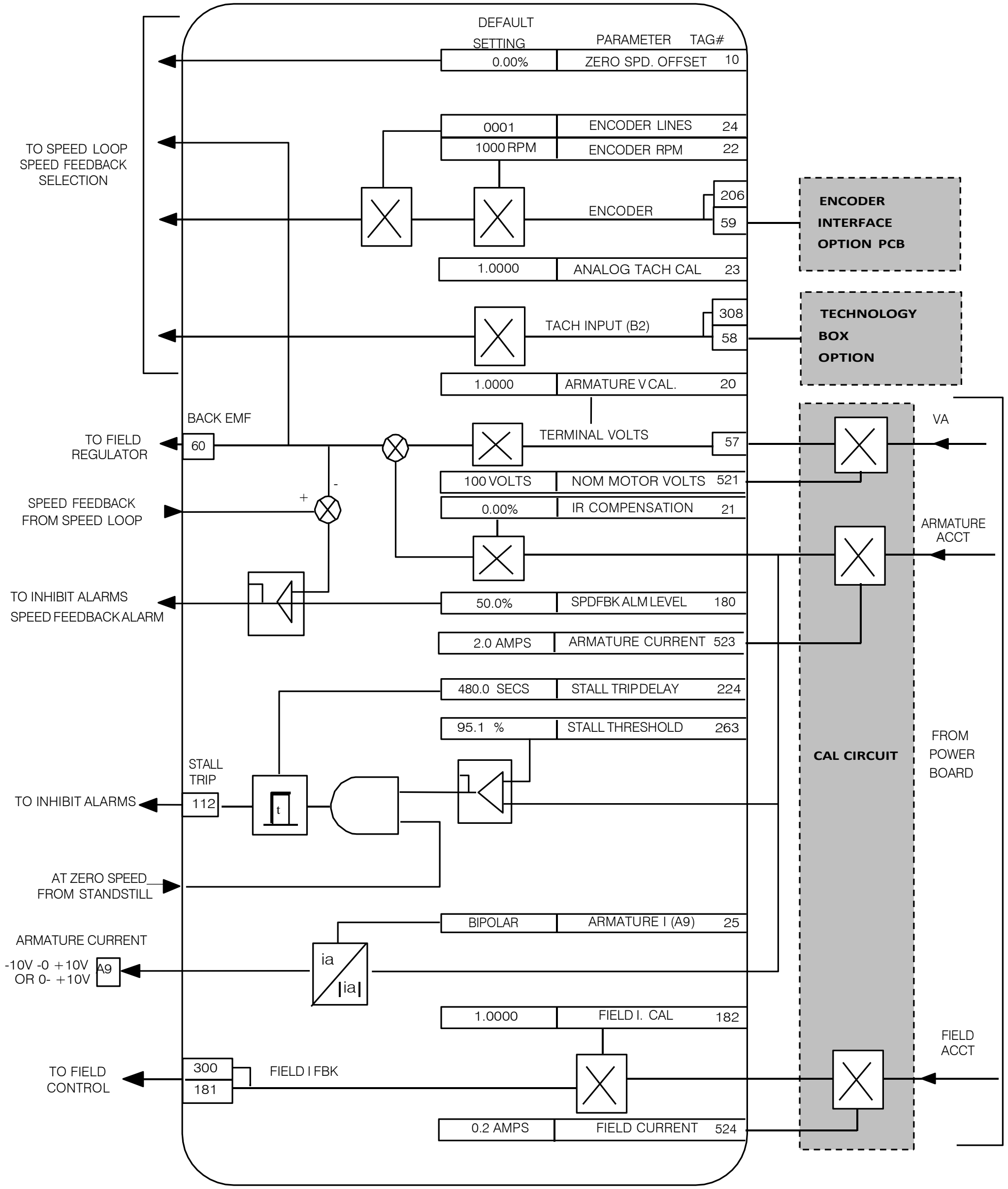
<table>
<tr><th>Parameter</th><th>Tag</th><th>Range</th></tr>
<tr><td>ARMATURE V CAL.</td><td>20</td><td>0.9800 to 1.1000</td></tr>
<tr><td colspan="3">Trim adjustment of the motor armature volts to give exactly 100% at the required actual voltage value (e.g. 460V etc.).
Note: - Primary voltage calibration is achieved by adjusting the NOM MOTOR VOLTS parameter (CONFIGURE DRIVE function block).</td></tr>
<tr><td>IR COMPENSATION</td><td>21</td><td>0.00 to 100.00 %</td></tr>
<tr><td colspan="3">Compensation for motor IR drop to improve regulation when using armature voltage feedback as the speed feedback. This is also used in field weakening applications to improve dynamic response and speed holding stability, refer to “Initial Start-up Routine” in Chapter 4, Item 16.</td></tr>
<tr><td>ANALOG TACH CAL</td><td>23</td><td>0.9800 to 1.1000</td></tr>
<tr><td colspan="3">Trim adjustment of the motor speed to give exactly 100% at the required actual speed value (e.g. 1500 RPM etc). <i>Note: Primary tacho calibration is achieved by adjusting SW1 - 3 on the tacho calibration board.</i></td></tr>
<tr><td>ZERO SPD. OFFSET</td><td>10</td><td>-5.00 to 5.00 %</td></tr>
<tr><td colspan="3">If the speed feedback is not zero when the motor is stationary (possibly due to hardware offsets etc.) the setting of this parameter to the value of the offset will result in a zero reading from the speed feedback.</td></tr>
<tr><td>ARMATURE I (A9)</td><td>25</td><td>UNIPOLAR / BIPOLAR</td></tr>
<tr><td colspan="3">Selects operation of the current meter output (terminal A9), either bipolar or unipolar.
Bipolar mode : +10V = 200% output current forward, -10V = 200% output current reverse
Unipolar mode : +10V = 200% output current</td></tr>
<tr><td>FIELD I CAL.</td><td>182</td><td>0.9800 to 1.1000</td></tr>
<tr><td colspan="3">Trim adjustment of the motor field current to give exactly 100% at the required actual current value (e.g. 1.5A etc.). Note:- Primary field calibration is achieved by adjusting the FIELD CURRENT parameter (CONFIGURE DRIVE function block).</td></tr>
</table>

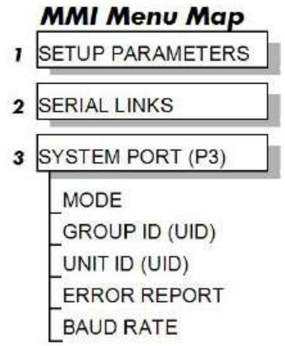
CALIBRATION

Parameter	Tag	Range
TERMINAL VOLTS	**57**	**—.x % (h)**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
UNFIL. TACH INPUT	**58**	**—.x % (h)**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
BACK EMF	**60**	**—.x % (h)**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		

Functional Description

CALIBRATION





COMMS PORT

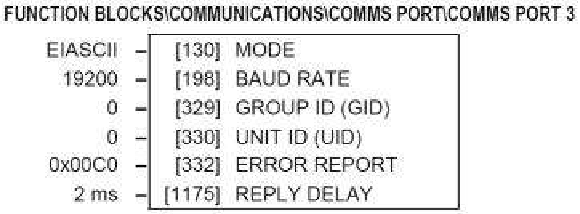
Use this block to configure the drive's P3 port.

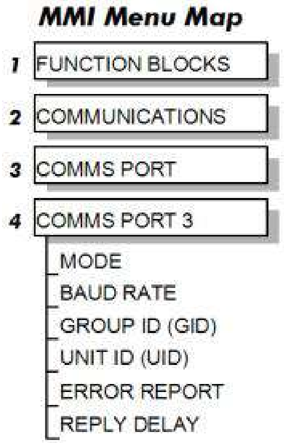
Refer to Appendix A: "Serial Communications" - System Port P3 for further information.

The P3 port is a non-isolated serial communications port built in to the drive's Control Board.

It is used off-line (while the drive is stopped) for transferring and saving drive configuration files using a personal computer (PC) running a serial communications program.

You can also use the P3 port to transfer configuration files by connecting to a PC running the Windows ™ compatible software package "CACT". Refer to the CACT manual.



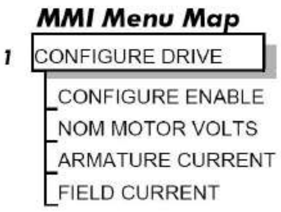


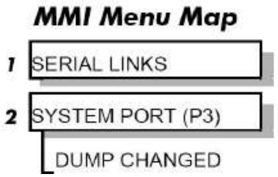
COMMS PORT

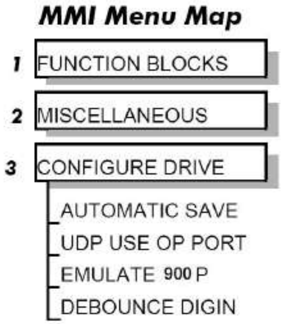
Parameter	Tag	Range
MODE Used the set the protocol on this port. 0 : DISABLED 1 : MASTER 2 :SLAVE 3 : EIASCII 4 : EIBINARY	**130**	**See below**
BAUD RATE Transmission rate. Options available are: 0 : 300 1 : 600 2 : 1200 3 : 2400 4 : 4800 5 : 9600 (default) 6 : 19200 7 : 38400 8 : 57600 9 : 115200	**198**	**See below**
GROUP ID (GID) The DC900P Drives protocol group identity address.	**329**	**0 to 7**

COMMS PORT

Parameter	Tag	Range
UNIT ID (UID)	**330**	**0 to 255**
The DC900P Drives protocol unit identity address.		
ERROR REPORT	**332**	**0x0000 to 0xFFFF**
Displays the last error as a hexadecimal code. Writing any value to this parameter will set the value to >00C0 (No Error). Refer to Appendix A: "Serial Communications" - Reference for a list of codes.		
DELAY	**1175**	**0 to 255 ms**
A programmable delay inserted by the drive before replying to a request.		







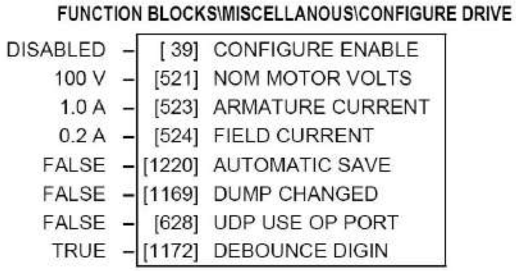
CONFIGURE DRIVE

This block contains many of the parameters required for configuring the drive.

NOTE **The CONFIGURE DRIVE menu on the MMI contains a different set of parameters, for set-up using the keypad.**

CONFIGURE ENABLE: The operation of the Block Diagram is suspended and all Keypad LEDs will flash whilst CONFIGURE ENABLE = TRUE.

NOTE **The CONFIGURE ENABLE parameter is also available in the following MMI menus for ease of use: CALIBRATION, CONFIGURE I/O**



CONFIGURE DRIVE

Parameter	Tag	Range
CONFIGURE ENABLE	**39**	**FALSE / TRUE**
Selects Operating Mode (FALSE) or Configuration Mode (TRUE). Refer to "Modifying a Block Diagram", page D-1.		
NOM MOTOR VOLTS	**521**	**100 to 875 VOLTS**
Sets the 100% value for Armature Volts VA. Set this value to match the motor in use. (Refer to ARMATURE V CAL in the CALIBRATION function block).		
ARMATURE CURRENT	**523**	**Product code dependent AMPS**
Sets the 100% value for Armature Current IA. Set this value to match the motor in use.		
FIELD CURRENT	**524**	**Product code dependent AMPS**
Sets the 100% value for Field Current IF. Set this value to match the motor in use. Note: this should be set to a minimum value if in Field Voltage control - see FLD. CTRL MODE in the FIELD CONTROL function block.		
AUTOMATIC SAVE	**1220**	**FALSE/TRUE**
When TRUE, changes made to parameters using the operator station are automatically saved to the drive's non-volatile memory.		
DUMP CHANGED	**1169**	**FALSE /TRUE**
This parameter is used in conjunction with DUMP MMI (TX) and DUMP BLOCKS. When TRUE, only those parameters that have been modified from their default value are included in the dump.		
UDP USE OP PORT	**628**	**FALSE/TRUE**
When TRUE the UDP transfer will be re-directed to the operator station port.		
DEBOUNCE DIGIN	**1172**	**FALSE/TRUE**
When TRUE the drive adds a 3ms debounce filter to the digital inputs. This affects terminals C3 to C8, B8 and B9. The hardware connection between terminal B9, (COAST STOP) and the control of the external contactor is not affected.		

MMI Menu Map

1 SETUP PARAMETERS
2 CURRENT LOOP
  - MAIN CURR. LIMIT
  - PROP. GAIN
  - INT. GAIN
  - DISCONTINUOUS
  - ADDITIONAL DEM
  - BIPOLAR CLAMPS
  - REGEN ENABLE
  - MASTER BRIDGE
  - POS. I CLAMP IN
  - NEG. I CLAMP IN
  - I DMD. ISOLATE
  - CUR. LIMIT/SCALER

MMI Menu Map

1 DIAGNOSTICS
  - CURRENT DEMAND
  - CURRENT FBK. AMPS
  - IaFbk UNFILTERED
  - IaDmd UNFILTERED
  - POS. I CLAMP
  - NEG. I CLAMP
  - ACTUAL POS I LIM
  - ACTUAL NEG I LIM
  - AT CURRENT LIMIT
  - BACK EMF

MMI Menu Map

1 FUNCTION BLOCKS
2 MOTOR CONTROL
3 CURRENT LOOP
  - PHASE ANGLE @ E
  - ISOL DMD SOURCE

CURRENT LOOP

Use this to setup the drive's conventional current/torque loop.

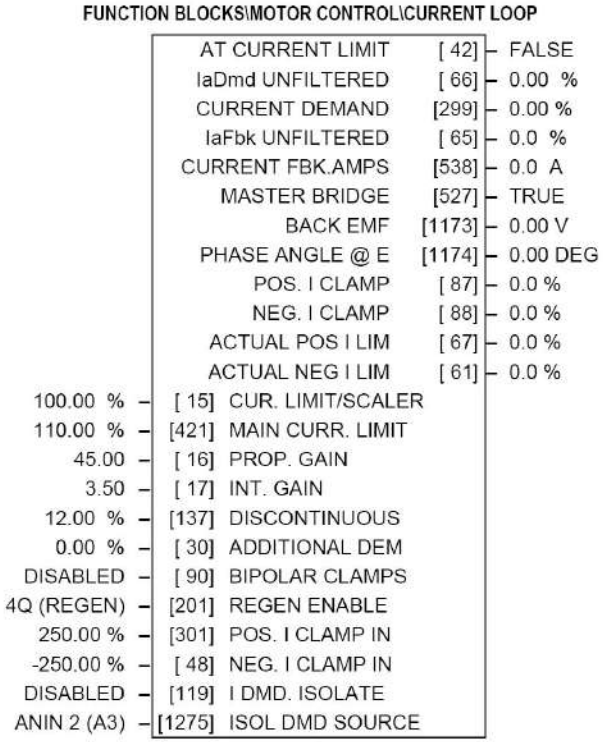
It takes the current demand, imposes limits through four clamps, and then uses a PI loop to control the output.

The four separate clamps - current profile, inverse time overload, bipolar clamps and main current clamp - the clamps are in series and lowest clamp takes effect. The resultant clamp value can be seen in the diagnostics ACTUAL POS I LIM and ACTUAL NEG I LIM.

The internal inputs to this block are:

- the current demand from the speed loop or terminal A3 (selected via I DMD. ISOLATE)
- the current limit clamps from CURRENT PROFILE and INVERSE TIME (note that the bipolar clamps and main current clamp are resident in the CURRENT LOOP block)
- current feedback from CALIBRATION.

The default configuration uses DIGIN 1 and DIGIN 3 for switching modes (BIPOLAR CLAMPS and I DMD. ISOLATE respectively), ANIN 5 for setting the symmetrical positive and negative current clamps.



FUNCTION BLOCKS\MOTOR CONTROL\CURRENT LOOP

AT CURRENT LIMIT	[42]	FALSE
IaDmd UNFILTERED	[66]	0.00 %
CURRENT DEMAND	[299]	0.00 %
IaFbk UNFILTERED	[65]	0.0 %
CURRENT FBK.AMPS	[538]	0.0 A
MASTER BRIDGE	[527]	TRUE
BACK EMF	[1173]	0.00 V
PHASE ANGLE @ E	[1174]	0.00 DEG
POS. I CLAMP	[87]	0.0 %
NEG. I CLAMP	[88]	0.0 %
ACTUAL POS I LIM	[67]	0.0 %
ACTUAL NEG I LIM	[61]	0.0 %

100.00 %	[15]	CUR. LIMIT/SCALER
110.00 %	[421]	MAIN CURR. LIMIT
45.00	[16]	PROP. GAIN
3.50	[17]	INT. GAIN
12.00 %	[137]	DISCONTINUOUS
0.00 %	[30]	ADDITIONAL DEM
DISABLED	[90]	BIPOLAR CLAMPS
4Q (REGEN)	[201]	REGEN ENABLE
250.00 %	[301]	POS. I CLAMP IN
-250.00 %	[48]	NEG. I CLAMP IN
DISABLED	[119]	I DMD. ISOLATE
ANIN 2 (A3)	[1275]	ISOL DMD SOURCE

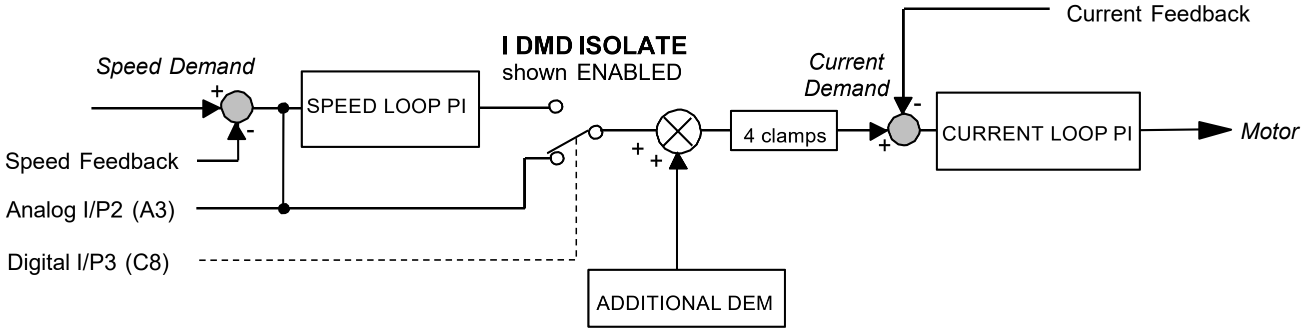
CURRENT LOOP

Parameter	Tag	Range
CUR. LIMIT/SCALER	**15**	**0.00 to 200.00 %**
Current limit scaler. It scales bipolar/unipolar clamps. To achieve 200% current limit, the current limit scaler should be set to 200%.		
MAIN CURR. LIMIT	**421**	**0.00 to 200.00 %**
Independent symmetric current clamp. Sets symmetric clamps outside scaling from the CUR. LIMIT/SCALER parameter.		
PROP GAIN	**16**	**0.00 to 200.00**
Proportional gain control for armature current PI loop. This parameter is set during the autotune function.		
INT. GAIN	**17**	**0.00 to 200.00**
Integral gain control for armature current PI loop, set during the autotune function.		

<table>
<tr><th></th><th>Tag</th><th>Range</th></tr>
<tr><td>DISCONTINUOUS</td><td>137</td><td>0.00 to 200.00 %</td></tr>
<tr><td colspan="3">Sets the boundary current between the discontinuous and continuous regions of operation. This is set during the autotune function and affects the performance of the adaptive algorithm.</td></tr>
<tr><td>ADDITIONAL DEM</td><td>30</td><td>-200.00 to 200.00 %</td></tr>
<tr><td colspan="3">Additional current demand input.</td></tr>
<tr><td>BIPOLAR CLAMPS</td><td>90</td><td>DISABLED / ENABLED</td></tr>
<tr><td colspan="3">Selects between bipolar (asymmetric) or unipolar (symmetric) current clamps for the 4 quadrants of operation. Default setting of DISABLED means UNIPOLAR clamps selected.
DISABLED - unipolar (symmetric)
ENABLED - bipolar (asymmetric)
With BIPOLAR CLAMPS disabled, the clamps are symmetrical and are set by POS. I CLAMP IN. With BIPOLAR CLAMPS enabled, the clamps are assymmetrical, bipolar. In bipolar mode, POS. I CLAMP IN sets the maximum positive current and NEG. I CLAMP IN sets the maximum negative current. Both clamps can be positive or negative, however, the POS I CLAMP IN value is internally prevented from going numerically below the NEG I CLAMP IN. CUR. LIMIT/SCALER scales both POS. I CLAMP IN and NEG. I CLAMP IN.</td></tr>
<tr><td>REGEN ENABLE</td><td>201</td><td>See below</td></tr>
<tr><td colspan="3">When REGEN ENABLE is 2Q (NON-REGEN), negative current demands are clamped to zero. Current feedback is subtracted from the current demand and the result is controlled by the PI loop. The result provides SCR phase angle control.
2Q (NON-REGEN) - non-regenerative (2-quadrant)
4Q (REGEN) - regenerative (4-quadrant)</td></tr>
<tr><td>POS. I CLAMP IN</td><td>301</td><td>-200.00 to 200.00 %</td></tr>
<tr><td colspan="3">Positive current clamp when BIPOLAR CLAMPS is ENABLED.</td></tr>
<tr><td>NEG. I CLAMP IN</td><td>48</td><td>-200.00 to 200.00 %</td></tr>
<tr><td colspan="3">Negative current clamp when BIPOLAR CLAMPS is ENABLED.
<i>Note on bipolar current clamps: these clamps in bipolar mode can cross-over onto the same quadrant. The POS. I CLAMP IN value is internally prevented from going numerically below the NEG. I CLAMP IN.</i></td></tr>
</table>

CURRENT LOOP

Parameter	Tag	Range
I DMD. ISOLATE	**119**	**DISABLED / ENABLED**
Speed loop bypass; the current demand is taken from ANIN 2 (A3). With I DMD. ISOLATE disabled, the current loop uses the current demand from the speed loop. With I DMD. ISOLATE enabled, ANALOG I/P 2, terminal A3, supplies the current demand. With default scaling, 10V dc on terminal A3 is 100% current demand. An additional current input, ADDITIONAL DEM, can be added to the current demand. The simplified diagram below, with reference to the default Block Diagram, shows how the I DMD ISOLATE parameter selects the controlling loop.		



Parameter	Tag	Range
AT CURRENT LIMIT	**42**	**FALSE / TRUE**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
IaDmd UNFILTERED	**66**	**—.x % (h)**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
CURRENT DEMAND	**299**	**—.xx %**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
IaFbk UNFILTERED	**65**	**—.x % (h)**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
CURRENT FBK. AMPS	**538**	**—.x AMPS**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
MASTER BRIDGE	**527**	**FALSE/TRUE**
A diagnostic indicating currently active bridge; master = TRUE, slave = FALSE.		
BACK EMF	**1173**	**—.x V**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
PHASE ANGLE @ E	**1174**	**—.x DEG**
The motor back EMF, presented as the angle at which the supply volts matches it. This is the instantaneous angle above which firing the thyristor would just start to make armature current.		

CURRENT LOOP

Parameter	Tag	Range
POS. I CLAMP	**87**	**—.x %**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
NEG. I CLAMP	**88**	**—.x %**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
ACTUAL POS I LIM	**67**	**—.x %**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
ACTUAL NEG I LIM	**61**	**—.x %**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
ISOL DMD SOURCE	**1275**	**ANIN 2 (A3) / FIELD I DEMAND**

Selects the source of the isolated current demand.

- Setting ANIN 2 (A3) makes use of the A3 analogue input terminal as the current demand.
- Setting FIELD I DEMAND makes use of the current demand (%) at the field current controller, as the percentage armature current demand.

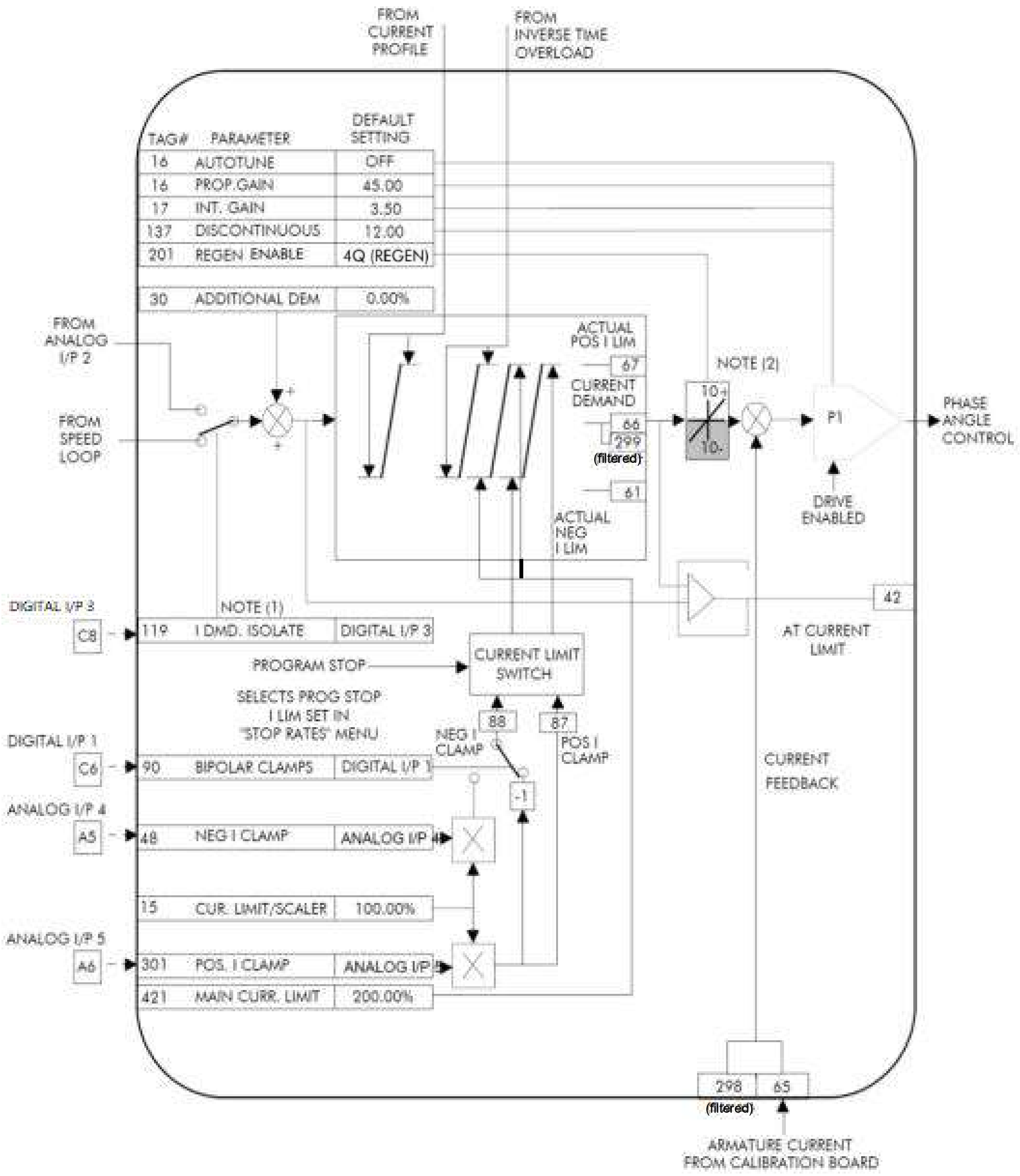
The use of this parameter is typically combined with parameters BEMF SOURCE, BEMF INPUT and 3-PHASE FIELD to apply the drive to field weakening control of a motor field.

Functional Description

Note 1: I DMD. ISOLATE removes speed loop demand and selects analog I/P 2 as current regulator demand.
I DMD. ISOLATE is overridden by program stop and stop to return drive to speed regulation.

Note 2: REGEN ENABLE = 2Q (NON-REGEN) prevents negative current demand. Non-regenerative drives use non-regen mode irrespective of the REGEN ENABLE parameter setting.

CURRENT LOOP



MMI Menu Map

1 SETUP PARAMETERS

2 CURRENT PROFILE
  - SPD BRK1 (LOW)
  - SPD BRK2 (HIGH)
  - IMAX BRK1(SPD1)
  - IMAX BRK2(SPD2)

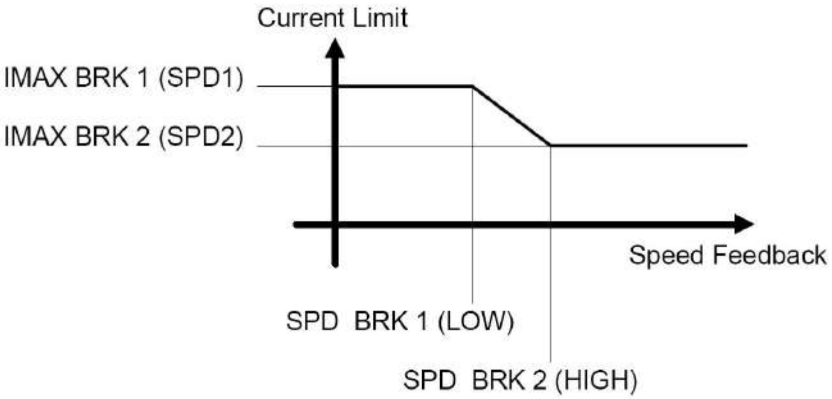
CURRENT PROFILE

Use this to clamp the current limit for applications where motors have a reduced ability to commutate armature current at low field currents.

Normally this is required when using Field Weakening, although some motors exhibit commutation limitations at higher speeds even with rated field current.

The input to the block is SPEED FEEDBACK from the SPEED LOOP function block. The output of the block changes the current limit clamp in the current loop.

- When SPEED FEEDBACK exceeds SPD BRK 1 (LOW), the current profile begins scaling the current limit as set by IMAX BRK 1 (SPD1).
- As the SPEED FEEDBACK increases toward SPD BRK2 (HIGH), the current limit is reduced linearly toward IMAX BRK2 (SPD2).
- When the speed exceeds SPD BRK2 (HIGH), the current limit remains at the IMAX BRK2 (SPD2) setting.



CURRENT PROFILE

Parameter	Tag	Range
SPD BRK 1 (LOW)	**32**	**0.0 to 100.0 % (h)**
This is the motor speed at which current limit profiling begins.		
SPD BRK 2 (HIGH)	**31**	**0.0 to 100.0 % (h)**
This is the upper speed limit at which current limit profiling ends.		
IMAX BRK 1 (SPD1)	**93**	**0.0 to 200.0 % (h)**
This sets the current limit value at or below speed break-point 1, provided the other current limit clamps (inverse time overload, bipolar clamps and main current clamps) are greater than this setting.		
IMAX BRK 2 (SPD2)	**33**	**0.0 to 200.0 % (h)**
This sets the current limit value at or above speed break-point 2, provided the other current limit clamps setting (inverse time overload, bipolar clamps and main current clamps) are greater than this.		

DEADBAND

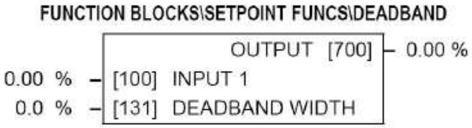
When the input is within the deadband, the output is clamped to zero to ignore any noise. The limits are symmetrical around zero. The limits are set by the DEADBAND parameter.

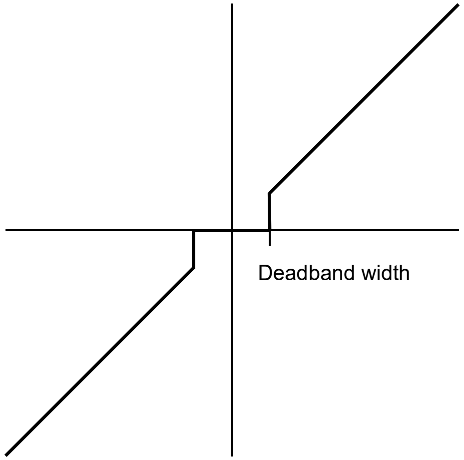
MMI Menu Map

- 1 SETUP PARAMETERS
  - 2 SETPOINT SUM 1
    - DEADBAND WIDTH
    - INPUT 1

MMI Menu Map

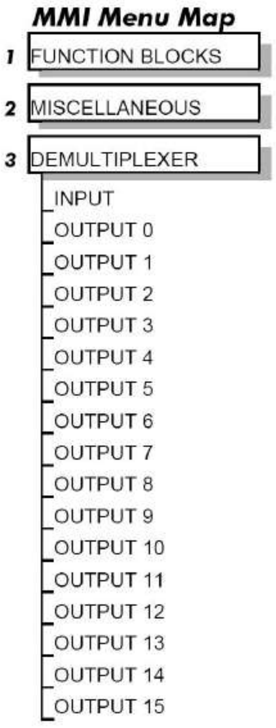
- 1 FUNCTION BLOCKS
  - 2 SETPOINT FUNCS
    - 3 DEADBAND
      - OUTPUT





DEADBAND

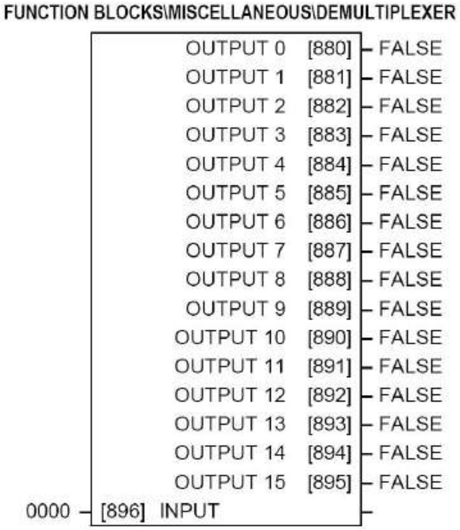
Parameter	Tag	Range
INPUT 1	**100**	**-200.00 to 200.00 %**
Input 1 value. By default this is connected to Analog Input 1 (terminal A2).		
DEADBAND	**131**	**0.0 to 100.0 %**
Range within which the output is clamped at zero.		
OUTPUT	**700**	**—.xx %**
Modified value of input.		



DEMULTIPLEXER

The demultiplexer function block splits the input word into 16 individual bits.

This may be used to extract the individual trip bits from the ACTIVE TRIPS parameter, for example.



DEMULTIPLEXER

Parameter	Tag	Range
INPUT	**896**	**0x0000 to 0xFFFF**
The input to be split into its component bits.		
OUTPUT 0 to OUTPUT 15	**880 to 895**	**FALSE / TRUE**
Each output returns the corresponding bit of the 16 bit input word.		

MMI Menu Map

1 SETUP PARAMETERS

2 SPECIAL BLOCKS

3 DIAMETER CALC.
  - LINE SPEED
  - REEL SPEED
  - MIN DIAMETER
  - MIN SPEED
  - RESET VALUE
  - EXTERNAL RESET
  - RAMP RATE
  - DIAMETER
  - MOD OF LINE SPD
  - MOD OF REEL SPD
  - UNFILT DIAMETER

MMI Menu Map

1 SETUP PARAMETERS

2 SPECIAL BLOCKS

3 TAPER CALC.
  - TAPER
  - TENSION SPT
  - TAPERED DEMAND
  - TENSION TRIM
  - TOT. TENS. DEMAND

DIAMETER CALC.

This block performs three functions.

DIAMETER CALC:	Used to calculate roll diameters in winder applications.
TAPER CALC:	Used to profile the tension demand with diameter.
TENS+COMP CALC:	Used to provide additional torque to compensate for static and dynamic friction, as well as load inertia.

These three functions are combined into one function block as they are functionally closely coupled.

DIAMETER CALC calculates the diameter of a reel as a function of the reel speed and the line speed. The resulting diameter is a percentage of the maximum full roll diameter. A lead section, adjacent line section, or surface driven speed sensing device is required to supply the line speed signal. The winder or unwind drive's motor speed feedback provides the reel speed input.

The ratio of the minimum core diameter to the maximum roll diameter determines the operating range of the diameter calculator. Set MIN DIAMETER to that ratio using the expression:

Minimum Core Outside Diameter ÷ Maximum Full Roll Diameter x 100%

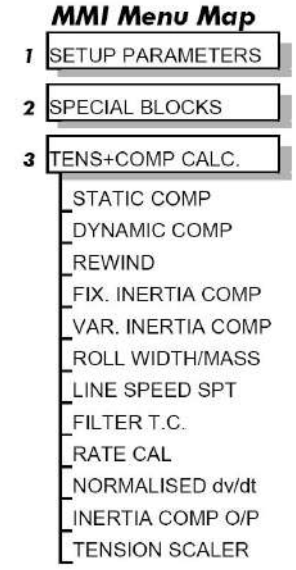
The magnitude of LINE SPEED is compared with MIN SPEED to determine when the diameter calculator will operate:

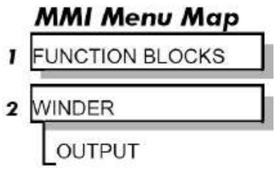
- When LINE SPEED is above MIN SPEED the calculator is on
- When LINE SPEED is below MIN SPEED, DIAMETER is held at the last calculated diameter

When EXTERNAL RESET is ENABLED, RESET VALUE is used as the diameter output.

NOTE **In turret winder applications, LINE SPEED will usually be above MIN SPEED. During roll changes, EXTERNAL RESET must be held ENABLED for the new spindle until the web has been transferred and the diameter is calculated properly. RESET VALUE must be set to the appropriate new core value for a rewind, or new roll diameter for an unwind.**

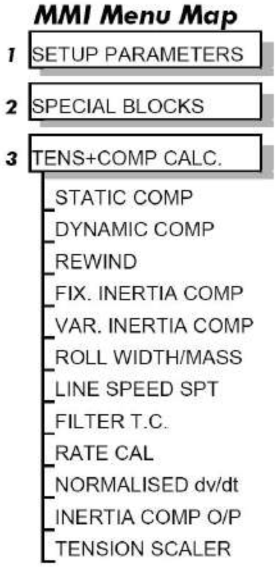
RAMP RATE adjusts the filtering of the diameter output. Its setting is the time it takes for a 100% change in DIAMETER. For example, at the default setting of 5.0 seconds, a 50% step change in diameter would take 2.5 seconds for the output diameter output to display the change.





DIAMETER CALC.

Parameter	Tag	Range
LINE SPEED	**424**	**-105.00 to 105.00 %**
This will usually be configured to be the analog tacho input and scaled appropriately during calibration.		
REEL SPEED	**437**	**-105.00 to 105.00 %**
This will usually be configured to be the drive's own speed feedback, i.e. encoder or armature volts feedback.		
MIN DIAMETER	**425**	**0.00 to 100.00 %**
Set to the minimum core diameter (normally the empty core diameter) as a percentage of the maximum roll diameter.		
MIN SPEED	**426**	**0.00 to 100.00 %**
This is the minimum LINE SPEED level below which the diameter calculation is frozen.		
RESET VALUE	**462**	**0.00 to 100.00 %**
Normally for winders this will be set to the MIN DIAMETER value. It is the diameter preset used when changing rolls. This value will be preloaded into the ramp (filter) output when EXTERNAL RESET is enabled.		
EXTERNAL RESET	**463**	**DISABLED / ENABLED**
Sets and holds the diameter to the RESET VALUE when ENABLED.		
RAMP RATE	**453**	**0.1 to 600.0 s**
This is used to smooth the output of the diameter calculator.		
TAPER	**438**	**-100.00 to 100.00 %**
This defines the amount of tapering in the tension demand with diameter variation. When TAPER is positive, the tension demand is hyperbolically decreased as diameter increases.		
TENSION SPT.	**439**	**0.00 to 100.00 %**
This is the required tension setpoint.		
TENSION TRIM	**440**	**-100.00 to 100.00 %**
This is the additional tension demand in the form of a trim.		
STATIC COMP	**487**	**-300.00 to 300.00 %**
Static friction compensation set-up parameter.		
DYNAMIC COMP	**488**	**-300.00 to 300.00 %**
Dynamic friction compensation set-up parameter.		
REWIND	**489**	**DISABLED / ENABLED**
Switches the sign of the friction compensations when the motor changes direction. Set to DISABLED only when the winder reverses.		



DIAMETER CALC.

Parameter	Tag	Range
FIX. INERTIA COMP	**479**	**-300.00 to 300.00 %**
Fixed inertia compensation set-up parameter.		
VAR. INERTIA COMP	**480**	**-300.00 to 300.00 %**
Variable inertia compensation set-up parameter.		
ROLL WIDTH/MASS	**481**	**0.00 to 100.00 %**
Scales the inertia fixed and variable compensations based on roll width. 100% = maximum roll width.		
LINE SPEED SPT	**498**	**-105.00 to 105.00 %**
Used to calculate the line speed acceleration rate value for the fixed and variable inertia compensations.		
FILTER T.C.	**482**	**0 to 20000**
The line speed acceleration rate value is calculated from the line speed input. The calculated rate value may have a large ripple content that can disturb the motor torque. The rate signal is therefore filtered, and this filter has a time constant set by this parameter.		
RATE CAL	**483**	**-100.00 to 100.00**
Scales the inertia compensation acceleration/deceleration rate value to 100% of the maximum line ramp rate. This parameter should be set to the maximum time required to ramp from zero to full speed in seconds. If RATE CAL = 0.00, then this parameter is set externally through NORMALISED dv/dt, otherwise, RATE CAL sets the inertia compensation acceleration/deceleration rate. *Note - Inertia compensation does not work well for line ramp rates above 100 seconds and therefore this parameter is limited to 100.00.*		
NORMALISED dv/dt	**484**	**-300.00 to 300.00 %**
Useful for large line ramp rates (>100 Secs). Tag an external signal to NORMALISED dv/dt to set the inertia compensation acceleration/deceleration rate externally from the drive. Useful for ramp rates exceeding 100 seconds. The external signal must be normalised to 100% = the maximum line ramp rate. Active *only* when RATE CAL = 0.00.		
TENSION SCALER	**486**	**-3.0000 to 3.0000**
Scales the TENSION DEMAND which is directly connected from the TAPER CALC. function block.		
DIAMETER	**427**	**—.xx %**
This is the output of the block.		
MOD OF LINE SPEED	**428**	**—.xx %**
Modulus of line speed.		
MOD OF REEL SPEED	**429**	**—.xx %**
Modulus of reel speed.		
UNFILTERED DIAMETER	**430**	**—.xx %**
Unfiltered value of "diameter" (before RAMP RATE filter).		
TAPERED DEMAND	**452**	**—.xx %**
This is the output of the TAPER calculation on the TENSION SPT (before adding TENSION TRIM).		

MMI Menu Map

1 SETUP PARAMETERS

2 SPECIAL BLOCKS

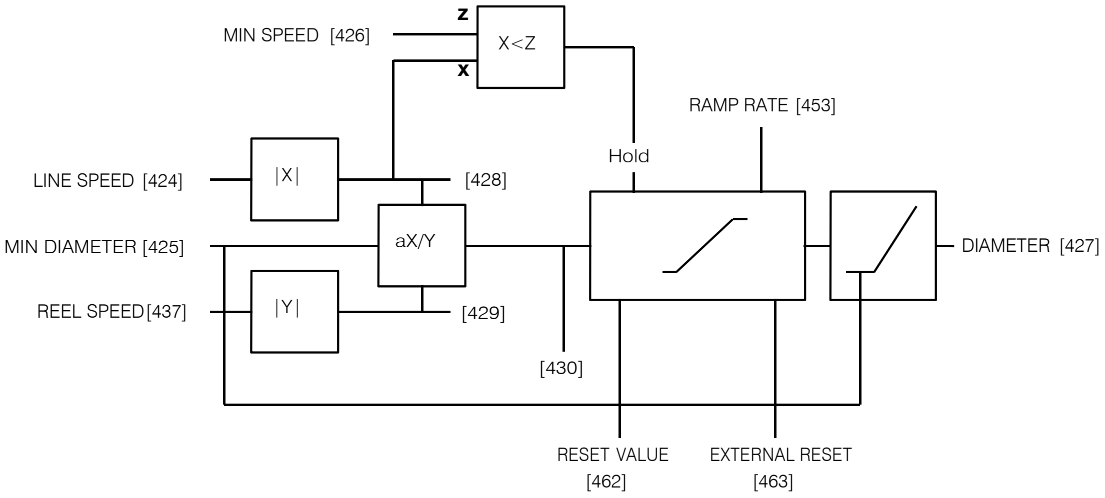
3 TENS+COMP CALC.
  - STATIC COMP
  - DYNAMIC COMP
  - REWIND
  - FIX. INERTIA COMP
  - VAR. INERTIA COMP
  - ROLL WIDTH/MASS
  - LINE SPEED SPT
  - FILTER T.C.
  - RATE CAL
  - NORMALISED dv/dt
  - INERTIA COMP O/P
  - TENSION SCALER

DIAMETER CALC.

Parameter	Tag	Range
TOT. TENS. DEMAND	**441**	**—.xx %**
This is the final output of this block (total tension demand) which can be connected to the appropriate points in the block diagram.		
INERTIA COMP O/P	**485**	**—.xx %**
Monitors the sum of all inertia compensations.		
OUTPUT	**706**	**—.xx %**
The sum of the diameter-scaled TENSION DEMAND after the TENSION SCALER scaling and the compensation losses. For open loop winder applications, connect this output to the TORQUE DEMAND (Tag 432) in the TORQUE CALC. function block. (This output is located in the SYSTEM::CONFIGURE I/O::BLOCK DIAGRAM menu).		

Functional Description

DIAMETER CALC.

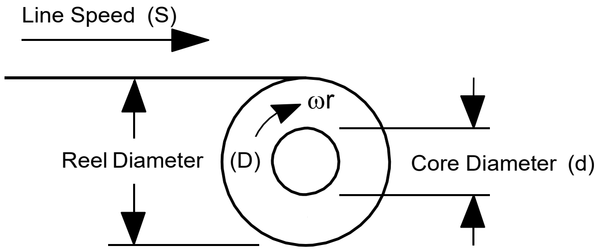


Circumference = πD or Line Speed (S) = Reel Speed (ωr) x D

Thus D = $\frac{S}{\omega r}$

i.e. $D \propto \frac{\text{Line Speed (S)}}{\text{Reel Speed } (\omega r)}$

Therefore with the web intact we can calculate the diameter from the two speeds.



TAPER CALC

Use this to profile the tension demand with diameter.

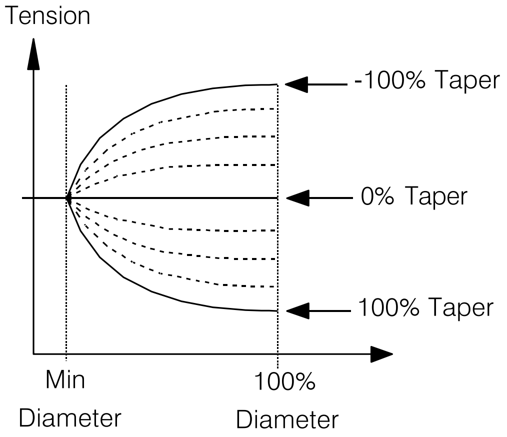
The function uses two inputs, tension setpoint and taper setpoint, to create the tension demand. The operator usually controls these setpoints.

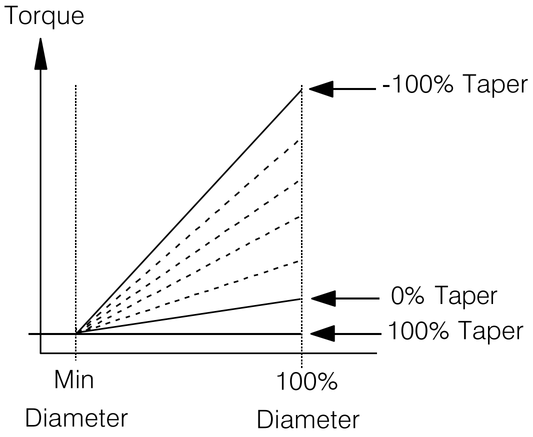
Taper is a common requirement for winders. It reduces the tension as the roll diameter increases.

A profiler adjusts the tension using the equation:

$$\text{Tapered Demand} = \text{Tension Spt} \times \left\{ 100\% - \frac{\text{Taper}}{\text{Diameter}} \times \left(\text{Diameter} - \text{Min Diameter} \right) \right\}$$

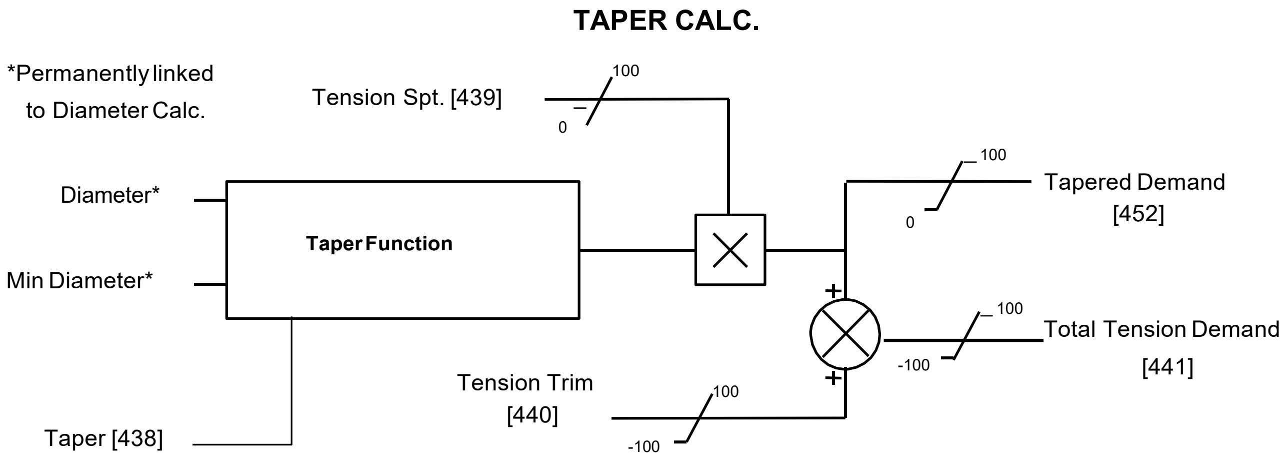
to yield a hyperbolic taper output. The taper tension characteristics are shown below:





The result is multiplied by TENSION SPT. to get TAPER DEMAND. When the taper setpoint is at 100%, the motor produces constant torque. That is, a constant torque from core to full roll, and the tension falls off as the roll builds.

TENSION TRIM allows the tension demand to be adjusted, for example, when using closed loop trim. The result is TOT. TENS DEMAND.



TENS+COMP CALC

This provides additional torque to compensate for static and dynamic friction, as well as the load inertia.

Add these losses to the diameter-scaled tension demand to produce a compensated torque demand for open loop winder applications.

The inputs to this function are DIAMETER, TOT. TENS. DEMAND, and SPEED FEEDBACK from the SPEED LOOP function block.

For open loop winder applications, connect OUTPUT to TORQUE DEMAND (Tag 432) in the TORQUE CALC. function block.

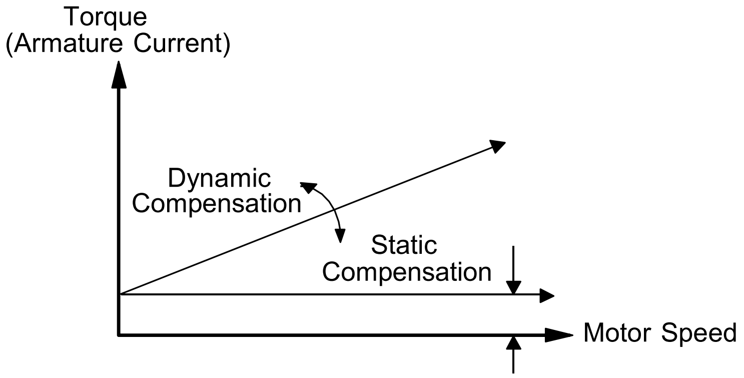
Static and Dynamic Frictional Losses

Static and dynamic friction are due to gearbox resistance and mechanical binding in the winder spindle and motor bearings. Both absorb motor output torque and require compensation to maintain accurate winder tension.

Static friction, or "stiction", is a constant offset most noticeable at or near zero speed. The compensation torque required to overcome static friction is fixed over an entire operating speed range. You can ignore "stiction" for winders which do not normally operate at zero speeds.

Dynamic friction results from friction losses within the drive train, which includes gearboxes and chain belting linkages. The oil viscosity in gearboxes and windage losses in the motor armature fans also contribute to dynamic frictional losses.

The effects of static and dynamic friction are shown opposite.



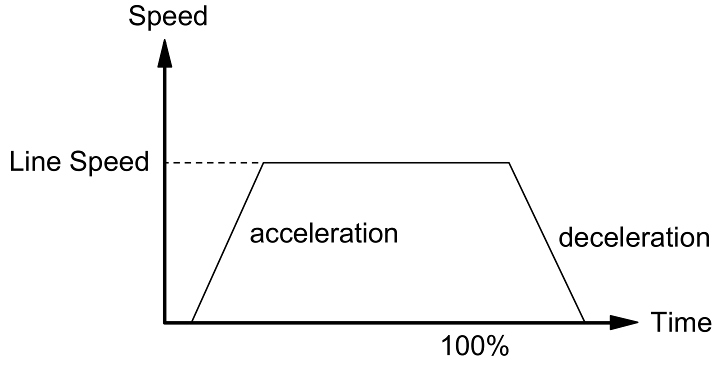
Inertia Compensation

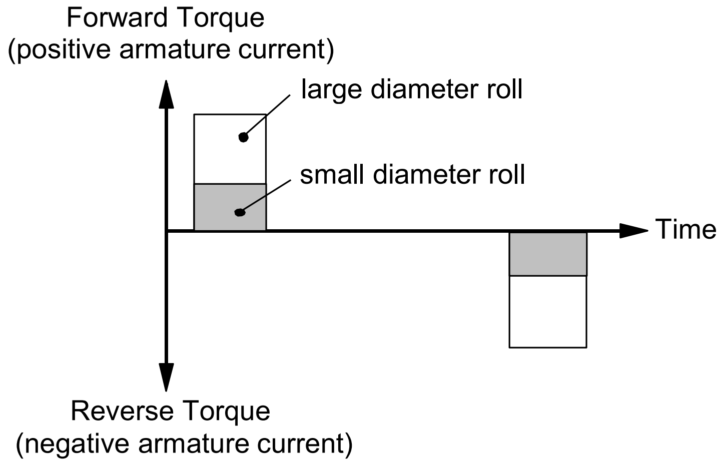
Many winders need inertia compensation to add or subtract torque during acceleration and deceleration to maintain constant tension, especially at large roll diameters. Without compensation, the tension holding capability of open loop winders diminishes during speed changes causing tension sag.

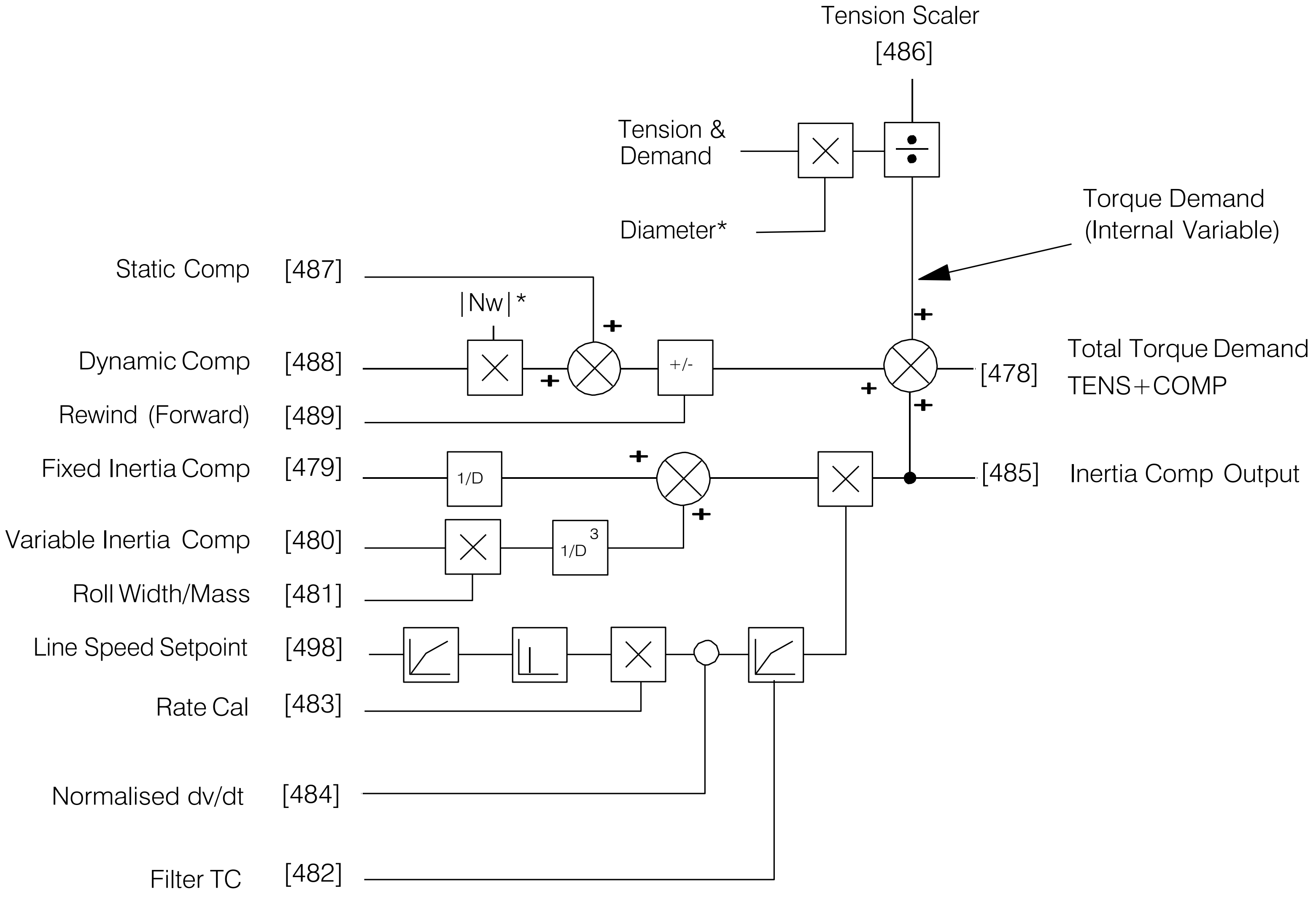
The inertia compensation characteristics is shown opposite.

For winder applications, inertia compensation is split into two components:

1. Fixed inertia compensation for the fixed motor, transmission and load components.
2. Variable inertia compensation for the changing roll inertia. This is especially necessary for high diameter build unwinds and winders.



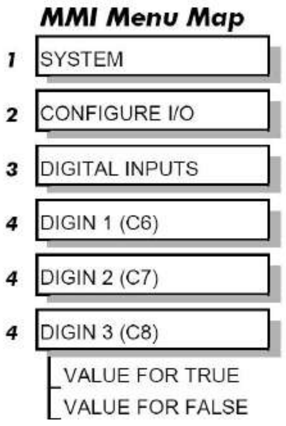




& - Internally connected to Taper Calculator

* - Internally connected to Diameter Calculator

TENS + COMP Block Diagram

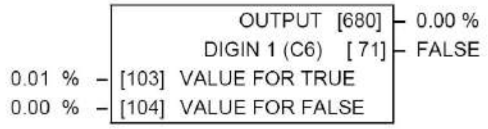


DIGITAL INPUTS

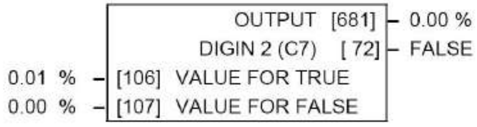
Use this block to control the digital operating parameters of the software.

The digital input can be configured to point to a destination location, and to set that destination TRUE or FALSE depending upon programmable values.

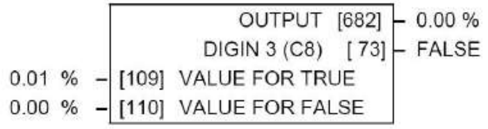
FUNCTION BLOCKS\INPUTS & OUTPUTS\DIGITAL INPUT\DIGITAL INPUT 1



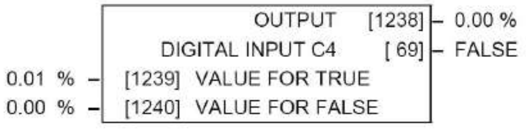
FUNCTION BLOCKS\INPUTS & OUTPUTS\DIGITAL INPUT\DIGITAL INPUT 2



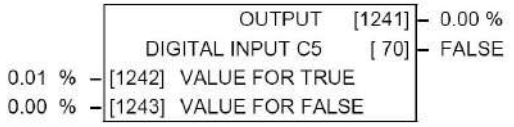
FUNCTION BLOCKS\INPUTS & OUTPUTS\DIGITAL INPUT\DIGITAL INPUT 3



FUNCTION BLOCKS\INPUTS & OUTPUTS\DIGITAL INPUT\DIGITAL INPUT 4



FUNCTION BLOCKS\INPUTS & OUTPUTS\DIGITAL INPUT\DIGITAL INPUT 5



DIGITAL INPUTS

Parameter	Tag	Range
VALUE FOR TRUE	**103, 106, 109, 1239**	**-300.00 to 300.00 %**
The output value when input is TRUE, that is: Digital Input 1, terminal C6 = 24V (True) Digital Input 2, terminal C7 = 24V (True) Digital Input 3, terminal C8 = 24V (True)		
VALUE FOR FALSE	**104, 107, 110, 1240**	**-300.00 to 300.00 %**
The output value when input is FALSE, that is: Digital Input 1, terminal C6 = 0V (False) Digital Input 2, terminal C7 = 0V (False) Digital Input 3, terminal C8 = 0V (False)		
OUTPUT	**680, 681, 682, 1238**	**— .xx %**
The output value, this is either VALUE FOR TRUE or VALUE FOR FALSE.		
DIGIN 1 (C6) to DIGITAL INPUT C5	**71, 72, 73, 69**	**OFF / ON**
The Boolean representation of the actual voltage applied to the terminal.		

Digital Input Examples

Using Digital Inputs with LOGIC Parameters

Logic parameters have values of 1/0: TRUE/FALSE, ON/OFF, ENABLED/DISABLED etc.

For example, the default connections in the drive allow the Digital Inputs to switch LOGIC parameters. These are the connections from:

- Terminal C6 to Tag 90 (BIPOLAR CLAMPS)
- Terminal C7 to Tag 118 (RAMP HOLD)
- Terminal C8 to Tag 119 (I DMD. ISOLATE)

In each case, the state of the terminal (24V or 0V) switches the destination parameter by sending a 1 or 0.

The format for the VALUE FOR TRUE and VALUE FOR FALSE parameters is in percent, thus 0.00% = 0 and 0.01% (or any other non-zero positive number) = 1.

Inverting the Input Signal

The default setting is for VALUE FOR TRUE to be 0.01% and VALUE FOR FALSE to be 0.00%. Inverting the digital input is therefore simple; set VALUE FOR TRUE to 0.00% and VALUE FOR FALSE to 0.01% (or any other non-zero number).

To do this:

1. Set CONFIGURE I/O::CONFIGURE ENABLE to TRUE
2. Set DIGIN 1 (C6)::VALUE FOR TRUE to 0.00%
3. Set VALUE FOR FALSE to 0.01%
4. Reset CONFIGURE I/O::CONFIGURE ENABLE to FALSE

Digital Input 1 now sends a 0 when the input signal is TRUE, and 1 when it is FALSE.

Using Digital Inputs with VALUE Parameters

Value parameters have values such as 100.00, or with units like 50.00%, 10.0 SECS etc.

You can use a Digital Input to send two fixed values to a VALUE parameter depending upon the state of the input terminal, 24V or 0V. You set the two fixed values you require in the VALUE FOR TRUE and VALUE FOR FALSE parameters.

For example, to connect Digital Input 1 to SPEED LOOP::SPD.PROP.GAIN:

1. Set CONFIGURE I/O::CONFIGURE ENABLE to TRUE
2. Find the tag number for SPD.PROP.GAIN either from the function block detail in this chapter, or from the Parameter Table: MMI Order - refer to Appendix C. (It is 14).
3. Set DIGIN 1 (C6)::DESTINATION TAG to 14
4. Set VALUE FOR TRUE to 10.00%
5. Set VALUE FOR FALSE to 30.00%
6. Reset CONFIGURE I/O::CONFIGURE ENABLE to FALSE

Digital Input 1 will now set SPD.PROP.GAIN to two values depending upon the state of the input signal:

- When the input terminal is at 24V, SPD.PROP.GAIN is set to 10.00
- When the input terminal is at 0V, SPD.PROP.GAIN is set to 30.00

DIGITAL INPUT C5

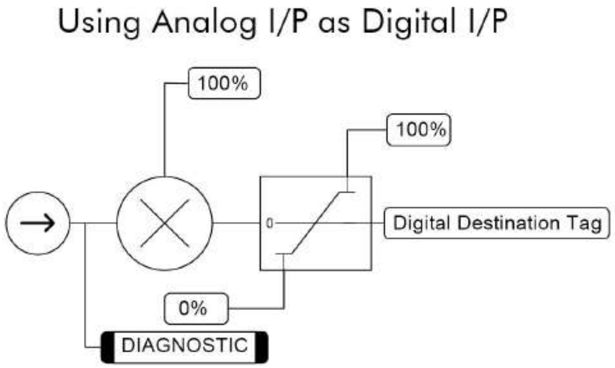
Caution

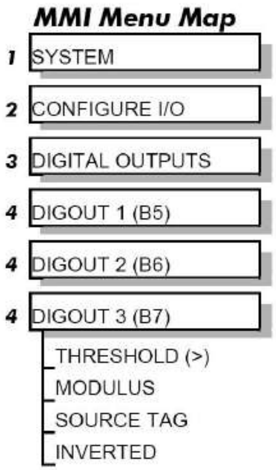
If you are isolating power on the drive output using a DC contactor, you must use an auxiliary, normally-open contact connected to terminal C5 to immediately disable the drive's current loop when the contactor coil de-energises. Free-up terminal C5 for other uses **only** when isolating main power on the input side of the drive using an AC contactor.

NOTE **Some 900 DRV models isolate power on the 900 drive output using a DC contactor, so you cannot use terminal C5 as an additional digital input.**

Additional Digital Inputs

It is possible to use an Analog Input as a Digital Input to extend the number of Digital Inputs available. Again, 0.00% is regarded as Logic 0 and 0.01% (or any other non-zero positive value) is regarded as Logic 1.

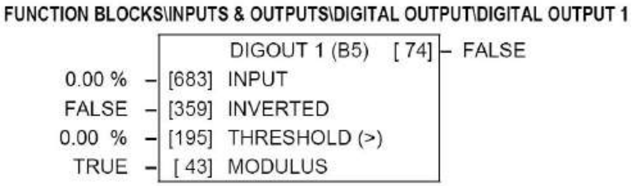


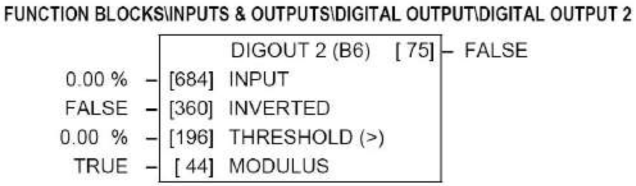


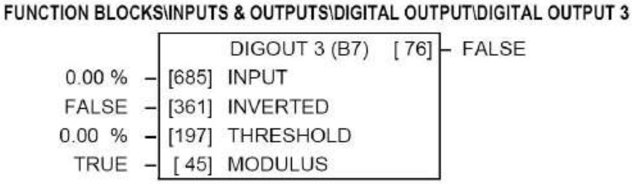
DIGITAL OUTPUTS

These function block allows you to output digital parameters within the software to other equipment.

A digital output can be configured to point to any digital value within the software system and to output information depending upon the status of that value.



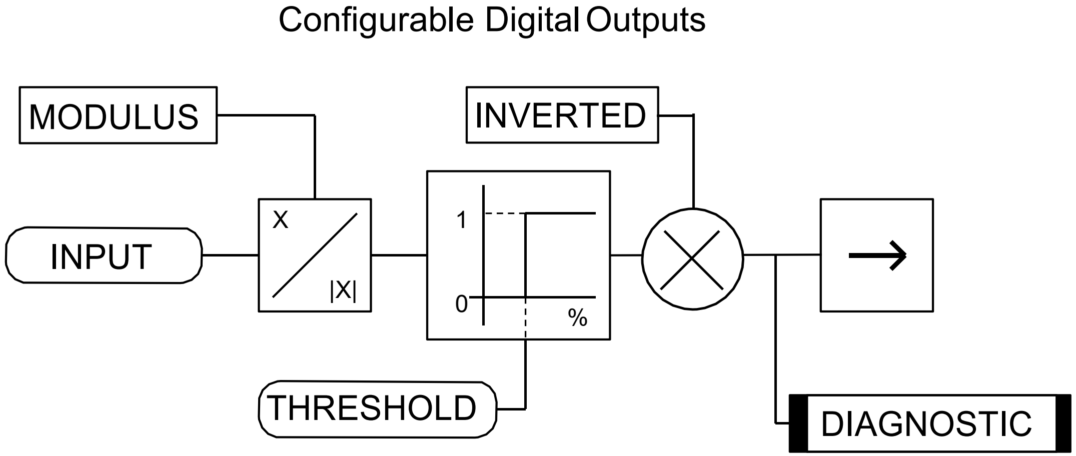




DIGITAL OUTPUTS

Parameter	Tag	Range
INPUT The unprocessed value to output.	**683, 684, 685**	**— .xx %**
INVERTED Selects to invert the output when TRUE.	**359, 360, 361**	**FALSE / TRUE**
THRESHOLD (THRESHOLD (>)) The threshold which the input value must exceed to set the output to TRUE.	**195, 196, 197**	**-300.00 to 300.00 %**
MODULUS When TRUE, the absolute value of INPUT is used for the threshold test.	**43, 44, 45**	**FALSE / TRUE**
DIGOUT 1 (B5) to DIGOUT 3 (B7) The actual Boolean value sent to the output terminal.	**74, 75, 76**	**OFF / ON**

Functional Description



Digital Output Examples

Using Digital Outputs with LOGIC Parameters

Logic parameters have values of 1/0: TRUE/FALSE, ON/OFF, ENABLED/DISABLED etc.

For example, the (logic) default connections in the drive allow the Digital Outputs to provide (source) 24V or 0V dc depending upon the state of following tag connections:

- Terminal B5, Digital Output 1 is linked to Tag Number 77 (AT ZERO SPEED)
- Terminal B6, Digital Output 2 is linked to Tag Number 122 (HEALTH LED)
- Terminal B7, Digital Output 3 is linked to Tag Number 125 (READY)

In each case, the state of the source parameter defines the voltage available at the terminal (TRUE = 24V, FALSE = 0V when INVERTED = FALSE). Inverting the digital output is simple; set INVERTED to TRUE.

Using Digital Outputs with VALUE Parameters (Up-to-speed Detector)

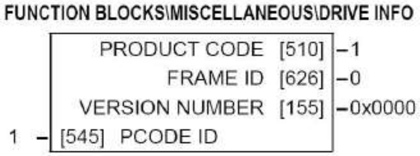
Value parameters have values such as 100.00, or with units like 50.00%, 10.0 SECS etc.

For example, to connect Digital Output 1 to read UNFIL.SPD.FBK:

1. Set CONFIGURE I/O::CONFIGURE ENABLE to TRUE
2. Find the tag number for UNFIL.SPD.FBK either from the function block detail in this chapter, or from the Parameter Table: MMI Order - refer to Appendix C. (It is 62).
3. Set DIGITAL OUTPUTS::DIGOUT 1 (B5)::SOURCE TAG to 62
4. Set DIGITAL OUTPUTS::DIGOUT 1 (B5)::THRESHOLD(>) to 50.00%
5. Set DIGITAL OUTPUTS::DIGOUT 1 (B5)::MODULUS to TRUE
6. Set DIGITAL OUTPUTS::DIGOUT 1 (B5)::INVERTED to FALSE
7. Set CONFIGURE I/O::CONFIGURE ENABLE to FALSE

This option is useful for generating an "up-to-speed" output. The MODULUS removes the sign from the value (so -100 becomes 100). The THRESHOLD(>) parameter determines when the output is 24V or 0V dc (the input signal must exceed this setting for the output to go high). Set INVERTED to TRUE to invert the result of the output.

DRIVE INFO



MMI Menu Map

1 SERIAL LINKS

This block provides information to identify the drive hardware and firmwareversion.

MMI Menu Map

1 FUNCTION BLOCKS
2 MISCELLANEOUS
3 DRIVE INFO
PCODE ID
PRODUCT CODE
FRAME ID

DRIVE INFO

Parameter	Tag	Range
PCODE ID	**545**	**0 to 100**

The product code. This representation is guaranteed to be unchanged between different software versions.

0: INVALID
1: DC 4Q 20A
2: DC 2Q 20A
3: DC 4Q 35A
4: DC 2Q 35A
5: DC 4Q 40A
6: DC 2Q 40A
7: DC 4Q 60A
8: DC 2Q 60A
9: DC 4Q 80A
10: DC 2Q 80A
11: DC 4Q 90A
12: DC 2Q 90A
13: DC 4Q 120A
14: DC 2Q 120A
15: DC 4Q 125A
16: DC 2Q 125A
17: DC 4Q 162A
18: DC 2Q 162A
19: DC 4Q 160A
20: DC 2Q 160A
21: DC 4Q 35A D
22: DC 2Q 35A D
23: DC 4Q 80A D
24: DC 2Q 80A D
25: DC 4Q 120A D
26: DC 2Q 120A D
27: DC 4Q 160A D
28: DC 2Q 160A D
29: DC 4Q 200A D
30: DC 2Q 200A D
31: DC 4Q 280A D
32: DC 2Q 280A D
33: DC 4Q 128* 20* D
34: DC 2Q 128* 20* D
35: DC 4Q 1024* 20*D
36: DC 2Q 1024* 20*D
37: DC 4Q 1024* 30*D
38: DC 2Q 1024* 30*D
39: DC 4Q 360A D
40: DC 2Q 360A D
41: DC 4Q 450A D
42: DC 2Q 450A D
43: DC 4Q 750A D
44: DC 2Q 750A D
45: DC 4Q 850A D
46: DC 2Q 850A D
47: DC 4Q 1024* 30*D
48: DC 2Q 1024* 30*D
49: DC 4Q 1200A 20 D
50: DC 2Q 1200A 20 D
51: DC 4Q 1700A 20 D
52: DC 2Q 1700A 20 D
53: DC 4Q 2200A 20 D
54: DC 2Q 2200A 20 D
55: DC 4Q 2700A 20 D
56: DC 2Q 2700A 20 D
57: DC 4Q 1200A 40 D
58: DC 2Q 1200A 40 D
59: DC 4Q 1700A 40 D
60: DC 2Q 1700A 40 D
61: DC 4Q 2200A 40 D
62: DC 2Q 2200A 40 D
63: DC 4Q 2700A 40 D
64: DC 2Q 2700A 40 D
65: DC 4Q 1200A 60 D
66: DC 2Q 1200A 60 D
67: DC 4Q 1700A 60 D
68: DC 2Q 1700A 60 D
69: DC 4Q 2200A 60 D
70: DC 2Q 2200A 60 D
71: DC 4Q 2700A 60 D
72: DC 2Q 2700A 60 D
73: DC 4Q 1200A 80 D
74: DC 2Q 1200A 80 D
75: DC 4Q 1700A 80 D
76: DC 2Q 1700A 80 D
77: DC 4Q 2200A 80 D
78: DC 2Q 2200A 80 D
79: DC 4Q 2700A 80 D
80: DC 2Q 2700A 80 D
81: DC RETRO 4Q 128A
82: DC RETRO 2Q 128A
83: DC 2Q 40A
84: DC 4Q 40A
85: DC 4Q 750A
86: DC 2Q 750A
87: DC 4Q 850A
88: DC 2Q 850A
89: DC 4Q 1580A
90: DC 2Q 1580A
91: DC 4Q 400A
92: DC 2Q 400A
93: DC 4Q 550A
94: DC 2Q 550A
95: DC 4Q 750A 40D
96: DC 2Q 750A 40D

DRIVE INFO

Parameter	Tag	Range
PRODUCT CODE	**510**	**0 to 96**

An internal representation of the product code. This representation may change between software versions.

0: INVALID
1: DC 4Q 20A
2: DC 2Q 20A
3: DC 4Q 35A
4: DC 2Q 35A
5: DC 4Q 40A
6: DC 2Q 40A
7: DC 4Q 60A
8: DC 2Q 60A
9: DC 4Q 80A
10: DC 2Q 80A
11: DC 4Q 90A
12: DC 2Q 90A
13: DC 4Q 120A
14: DC 2Q 120A
15: DC 4Q 125A
16: DC 2Q 125A
17: DC 4Q 162A
18: DC 2Q 162A
19: DC 4Q 160A
20: DC 2Q 160A
21: DC 4Q 35A D
22: DC 2Q 35A D
23: DC 4Q 80A D
24: DC 2Q 80A D
25: DC 4Q 120A D
26: DC 2Q 120A D
27: DC 4Q 160A D
28: DC 2Q 160A D
29: DC 4Q 200A D
30: DC 2Q 200A D
31: DC 4Q 280A D
32: DC 2Q 280A D
33: DC 4Q 128* 20* D
34: DC 2Q 128* 20* D
35: DC 4Q 1024* 20*D
36: DC 2Q 1024* 20*D
37: DC 4Q 1024* 30*D
38: DC 2Q 1024* 30*D
39: DC 4Q 360A D
40: DC 2Q 360A D
41: DC 4Q 450A D
42: DC 2Q 450A D
43: DC 4Q 750A D
44: DC 2Q 750A D
45: DC 4Q 850A D
46: DC 2Q 850A D
47: DC 4Q 1024* 30*D
48: DC 2Q 1024* 30*D
49: DC 4Q 1200A 20 D
50: DC 2Q 1200A 20 D
51: DC 4Q 1700A 20 D
52: DC 2Q 1700A 20 D
53: DC 4Q 2200A 20 D
54: DC 2Q 2200A 20 D
55: DC 4Q 2700A 20 D
56: DC 2Q 2700A 20 D
57: DC 4Q 1200A 40 D
58: DC 2Q 1200A 40 D
59: DC 4Q 1700A 40 D
60: DC 2Q 1700A 40 D
61: DC 4Q 2200A 40 D
62: DC 2Q 2200A 40 D
63: DC 4Q 2700A 40 D
64: DC 2Q 2700A 40 D
65: DC 4Q 1200A 60 D
66: DC 2Q 1200A 60 D
67: DC 4Q 1700A 60 D
68: DC 2Q 1700A 60 D
69: DC 4Q 2200A 60 D
70: DC 2Q 2200A 60 D
71: DC 4Q 2700A 60 D
72: DC 2Q 2700A 60 D
73: DC 4Q 1200A 80 D
74: DC 2Q 1200A 80 D
75: DC 4Q 1700A 80 D
76: DC 2Q 1700A 80 D
77: DC 4Q 2200A 80 D
78: DC 2Q 2200A 80 D
79: DC 4Q 2700A 80 D
80: DC 2Q 2700A 80 D
81: DC RETRO 4Q 128A
82: DC RETRO 2Q 128A
83: DC 2Q 40A
84: DC 4Q 40A
85: DC 4Q 750A
86: DC 2Q 750A
87: DC 4Q 850A
88: DC 2Q 850A
89: DC 4Q 1580A
90: DC 2Q 1580A
91: DC 4Q 400A
92: DC 2Q 400A
93: DC 4Q 550A
94: DC 2Q 550A
95: DC 4Q 750A 40D
96: DC 2Q 750A 40D

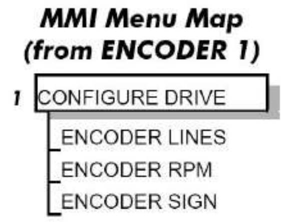
FRAME ID	**626**	**–.**

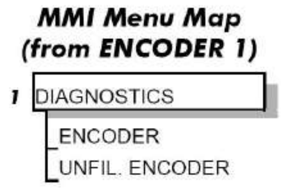
An internal representation of the frame size.

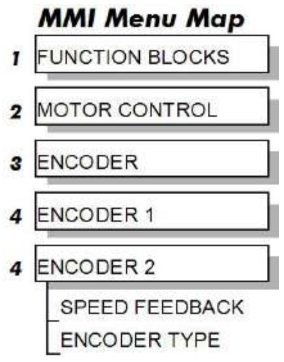
VERSION NUMBER	**155**	**0x0801**

The drive's version number as seen via communications. Version 8.01 is represented as 0x0801.

Serial communications mnemonic = V0. The version number cannot be changed, and is software version dependent.

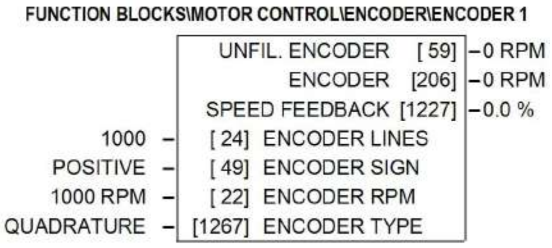


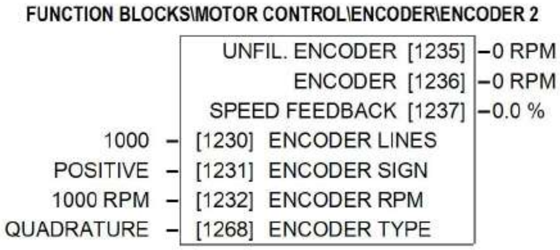




ENCODER

This block allows the Speed Feedback to be measured using a quadrature encoder when a Speed Feedback Option is fitted - refer to Chapter 3: Speed Feedback and Technology Options.





The ENCODER 1 function block is associated with the speed feedback option.

The ENCODER 2 function block is associated with Digital Input 2 (terminal C7) and Digital Input 3 (terminal C8) where:

- Digital Input 2 provides the clock.
- Digital Input 3 is used as a direction input.

ENCODER

Parameter	Tag	Range
ENCODER LINES	**24, 1230**	**10 to 5000**
The number of lines must be set to match the type of encoder being used. Incorrect setting of this parameter will result in an erroneous speed measurement. Proprietary encoders of specifications can be normalised by setting this parameter as appropriate.		
ENCODER SIGN	**49, 1231**	**NEGATIVE / POSITIVE**
Since the encoder feedback cannot be reversed electrically, the signal polarity can be reversed by the control software. *It is necessary to set up this parameter when in CLOSED-LOOP VEC mode, as the encoder direction must be correct for this mode to operate.*		
ENCODER RPM	**22, 1232**	**0 to 6000**
Motor top speed setting (100%) when using encoder feedback.		
UNFIL. ENCODER	**59, 1235**	**—. RPM**
Unfiltered encoder speed in RPM		
ENCODER	**206, 1236**	**—. RPM**
Encoder speed in RPM		
SPEED FEEDBACK	**1227, 1237**	**—.x %**
Encoder speed in %. A speed of 100% indicates that the encoder is rotating at the value set in the ENCODER RPM parameter.		

ENCODER

Parameter	Tag	Range
ENCODER TYPE	**1267, 1268**	**See below**

Selects the operating mode of the encoder input. Both of these encoder function blocks can be used in either QUADRATURE or CLOCK/DIRECTION modes of operation. When in CLOCK/DIRECTION mode, the CLOCK input is applied to terminal A on the speed feedback option (for ENCODER 1) or to Digital Input 2 (for ENCODER 2), and every rising edge of the CLOCK is counted.

0 : CLOCK/DIRECTION
1 : QUADRATURE

Functional Description

You must configure Digital Input 2 and 3 which, by default, provide "Ramp Hold" and "Current Demand Isolate" functionality. In the default configuration they are linked using LINK 21 and LINK 22 respectively. The Encoder blocks are connected to terminals C7 and C8 internally and thus don't require these links. Use the Configurator Tool to delete the links.

Alternatively when the default configuration is loaded, this can be done using the Keypad as shown below:

> Navigate to the SYSTEM::CONFIGURE I/O menu. Select the CONFIGURE ENABLE parameter and set to ENABLED. All LEDS on the Keypad will flash. Press the E key. Use the ▼ key to navigate to the DIGITAL INPUTS menu.
>
> In this menu, select the DIGIN 2 (C7) menu. Navigate to the DESTINATION TAG parameter and set this value to 0 (zero). Repeat this operation for the DIGIN 3 (C8) parameter.

Remember to perform a Parameter Save.

ENCODER TYPE = CLOCK/DIRECTION

This (pulse-counting mode) Encoder Type can be set in the ENCODER 2 function block only.

> Digital Input 2 (terminal C7) is used to provide the clock - the pulses are applied on C7
>
> Digital Input 3 (terminal C8) is used as a direction input:
>
> - When C8 is high, (24V), the count is incremented
> - When C8 is low, (0V), the count is decremented

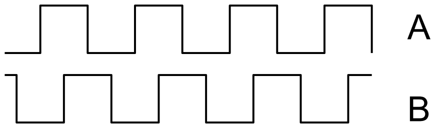
Each full pulse received increments the encoder count.

A full pulse is the pulse input going from low to high, and then back to low.
Speed is calculated using the following function:

$$\text{SPEED HZ} = \text{filter}\left[\frac{\text{CountsPerSecond}}{\text{Lines}}, \text{FilterTime}\right]$$

ENCODER TYPE = QUADRATURE

A quadrature encoder uses 2 input signals (A and B), phase shifted by a quarter of a cycle (90°).



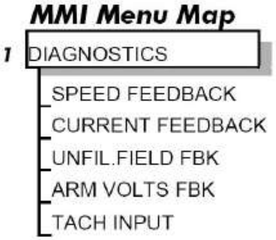
Digital input 2, (C7) = Encoder A phase
Digital input 3, (C8) = Encoder B phase

Direction is obtained by looking at the combined state of A and B.

Each edge received from the encoder increments the encoder count. There are 4 counts per line.

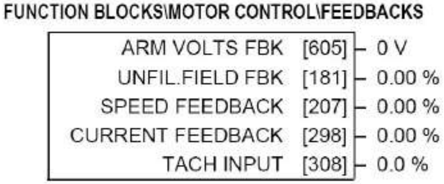
Speed is calculated using the following function:

$$\text{SPEED HZ} = \text{filter}\left[\frac{\text{CountsPerSecond}}{\text{Lines x 4}}, \text{FilterTime}\right]$$



FEEDBACKS

Diagnostics for the motor feedbacks.



FEEDBACKS

Parameter	Tag	Range
ARM VOLTS FBK Back EMF scaled by NOM MOTOR VOLTS.	**605**	**— .x V**
UNFIL.FIELD FBK Scaled field current feedback	**181**	**— .xx %**
SPEED FEEDBACK Speed feedback.	**207**	**— .xx %**
CURRENT FEEDBACK Scaled and filtered armature current feedback.	**298**	**— .xx %**
TACH INPUT Scaled analog tachogenerator feedback.	**308**	**— .x %**

FIELD CONTROL

MMI Menu Map

1 SETUP PARAMETERS

2 FIELD CONTROL
- FIELD ENABLE
- FLD.CTRL MODE
- FIELD I THRESH
- UP TO FIELD
- >> FLD.VOLTAGE VARS
- >> FLD.CURRENT VARS
- FLD.QUENCH DELAY
- FLD. QUENCH MODE

This function block contains all the parameters for the field operating mode.

It controls the drive's full wave, single phase, motor field thyristor bridge circuit.

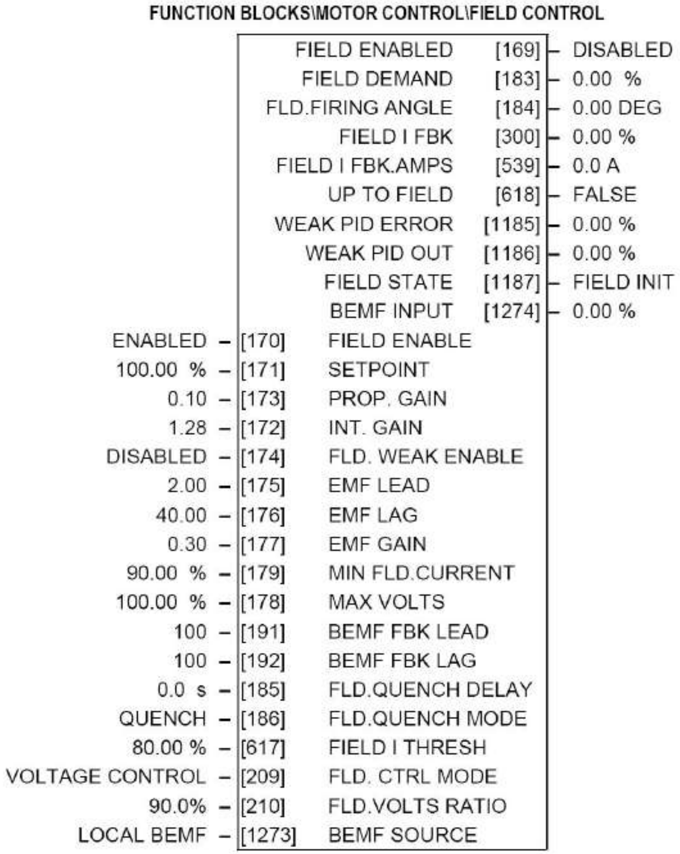
The FIELD CONTROL function block is viewed in three sub-menus on the MMI: FLD VOLTAGE VARS, FLD CURRENT VARS and FLD WEAK VARS.

In the FIELD CONTROL menu, you select the field operating mode: open loop voltage control or closed loop current control.

The inputs to the FIELD CONTROL block come from FLD VOLTAGE VARS and FLD CURRENT VARS.

FIELD ENABLE controls the field thyristor bridge and is set to DISABLED in permanent field motor applications. Disabling the field automatically overrides the field fail alarm. If FIELD ENABLE is enabled, you can select between voltage and current control using the FLD CTRL MODE parameter. The default is VOLTAGE CONTROL.

The diagnostic DRIVE ENABLE (Tag 84) is also used by the FLD. QUENCH DELAY to delay disabling the field when Run is removed.



MMI Menu Map

1 SETUP PARAMETERS

2 FIELD CONTROL

3 FLD.VOLTAGE VARS
- FLD.VOLTS RATIO

FLD VOLTAGE VARS : MMI Sub-Menu

Contains the parameter for the open loop VOLTAGE CONTROL mode.

In VOLTAGE CONTROL mode, set the value of FLD.VOLTS RATIO to provide the correct field voltage. This control mode provides open-loop phase angle control of the thyristor bridge. To calculate FLD.VOLTS RATIO, divide the desired DC field voltage by the line-to-line RMS AC input voltage and multiply by 100. Note that supply voltage variations are not compensated for in the field supply when in this mode of operation.

MMI Menu Map

1 SETUP PARAMETERS

2 FIELD CONTROL

3 FLD.CURRENT VARS
- SETPOINT
- PROP. GAIN
- INT. GAIN
- >> FLD.WEAK VARS

FLD CURRENT VARS : MMI Sub-Menu

Contains the parameters for the closed loop current control mode.

CURRENT CONTROL mode uses actual field current feedback for closed-loop control giving accurate motor field control independent of motor temperature. This mode makes use of a simple PI controller and is a pre-requisite for field weakening.

FLD WEAK VARS : MMI Sub-Menu

In certain applications of a DC motor controller, high speeds can only be achieved by reducing the field current and therefore the resultant torque. This is termed as the Constant-Horsepower region or Field-Weakening region, and the speed at which it begins is known as the Base Speed.

FIELD CONTROL

Parameter	Tag	Range
FIELD ENABLE	**170**	**DISABLED / ENABLED**
Enables and disables the drive motor Field Control.		
SETPOINT	**171**	**0.00 to 100.00 %**
Field current setpoint as percentage of calibrated value.		
PROP. GAIN	**173**	**0.00 to 100.00**
This is the proportional gain adjustment of the field current PI loop. The default of 0.10 is equivalent to a real gain of 10.		
INT. GAIN	**172**	**0.00 to 100.00**
This is the integral gain adjustment of the field current PI loop.		
FLD. WEAK ENABLE	**174**	**DISABLED/STANDARD/ADVANCED**
Activates the additional motor back-emf, gain-limited PI loop for field weakening (field spillover) control. STANDARD mode uses the control loop to convert the back-emf in excess of the MAX VOLTS setting, into a reduction of the demanded field current. ADVANCED mode also adds in a feedforward control term, based on a comparison of the speed feedback to the calculated base speed, and uses adaptive gain, in both the back-emf and speed control loops, to compensate for the gain effects of reduced field operation.		
EMF LEAD	**175**	**0.10 to 50.00**
With field weakening control enabled, a gain-limited PI loop is brought into operation. This is the lead time constant adjustment of the field weakening PI loop. With a default of 2.00, real time constant = 200ms. Refer to Chapter 5: "Control Loops" for details of Tuning.		
EMF LAG	**176**	**0.00 to 200.00**
This is the lag time constant adjustment of the field weakening PI loop With a default of 40.00, real time constant = 4000ms. Refer to Chapter 5: "Control Loops" for details of Tuning.		
EMF GAIN	**177**	**0.00 to 100.00**
This is the steady-state gain adjustment of the field weakening PI loop. With a default of 0.30, real gain = 30. Refer to Chapter 5: "Control Loops" for details of Tuning.		

MMI Menu Map

1 SETUP PARAMETERS
2 FIELD CONTROL
3 FLD.CURRENT VARS
4 FLD.WEAK VARS
- FLD. WEAK ENABLE
- EMF LEAD
- EMF LAG
- EMF GAIN
- MIN FLD.CURRENT
- MAX VOLTS
- BEMF FBK LEAD
- BEMF FBK LAG

MMI Menu Map

1 DIAGNOSTICS
- FIELD ENABLED
- FIELD DEMAND
- FIELD I FBK
- FIELD I FBK.AMPS
- FLD.FIRING ANGLE

MMI Menu Map

1 FUNCTION BLOCKS
2 MOTOR CONTROL
3 FIELD CONTROL
- WEAK PID ERROR
- WEAK PID OUT
- FIELD STATE
- BEMF SOURCE
- BEMF INPUT

FIELD CONTROL

Parameter	Tag	Range
MIN FLD. CURRENT	**179**	**0.00 to 100.00 %**
Protects against motor overspeeding due to unintended excessive field weakening. The field weakening loop reduces the field current to achieve speed control above base speed. At top speed the field reaches a minimum value. MIN FIELD CURRENT should be set below this minimum value to allow reasonable margin for transient control near the top speed but not lower than 6% as this could then cause the "Field Fail" alarm to operate.		
MAX VOLTS	**178**	**0.00 to 100.00 %**
Maximum volts is the back-emf voltage level at which field weakening begins. It is also known as "Spillover Bias". The default value is 100% of the nominal value as set by the armature voltage calibration value. This value might be reduced due to the known IR drop included in the armature voltage calibration value. Additionally for commissioning purposes, this value may be set to another (lower) desirable level, and subsequently returned to the original value.		
BEMF FBK LEAD	**191**	**20 to 5000**
This is the lead time constant of the back emf feedback filter which is used for reducing armature voltage overshoots when accelerating fast through base speed with a default of 100 (ms). Refer to Chapter 5: "Control Loops" for details of Tuning.		
BEMF FBK LAG	**192**	**20 to 5000**
This is the lag time constant of the above feedback filter. If the filter is active, the ratio of lead / lag should always be greater than 1 to give an overall lead action which reduces the voltage overshoot and less than, typically, 3 for stable control. The default values cancel each other and make the filter inactive with a default of 100 (ms). Refer to Chapter 5: "Control Loops" for details of Tuning.		
FLD. QUENCH DELAY	**185**	**0.0 to 600.0 s**
If dynamic breaking is used the field must be maintained for a period after the drive is disabled until the motor reaches zero speed. The field quench delay is the period of time that the field is maintained for when the drive is disabled.		
FLD. QUENCH MODE	**186**	**QUENCH / STANDBY**
After the field quench delay has expired, the field can be entirely quenched or put into a standby mode at 50% of rated current or volts depending whether in current or voltage control mode respectively. (The default standby value of 50% can be modified through the "SYSTEM / Reserved" Menu which is primarily for factory use only and requires the “super” password.)		
FIELD I THRESH	**617**	**0.00 to 100.00 %**
Threshold for UP TO FIELD diagnostic as a percentage of calibrated field current (see below).		
FLD. CTRL MODE	**209**	**See below**
Selects between open-loop VOLTAGE CONTROL or closed-loop CURRENT CONTROL.		
FLD. VOLTS RATIO	**210**	**0.0 to 100.0 %**
Sets the output dc field voltage as a percentage of the RMS FIELD supply voltage (line-to-line) when FLD CTRL MODE is set to VOLTAGE CONTROL.		
FIELD ENABLED	**169**	**DISABLED / ENABLED**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		

FIELD CONTROL

Parameter	Tag	Range
FIELD DEMAND	**183**	**—.xx %**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
FLD. FIRING ANGLE	**184**	**—.xx DEG**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
FIELD I FBK.	**300**	**—.xx %**
Field current feedback, as a percentage of the calibrated level.		
FIELD I FBK.AMPS	**539**	**—.x A**
FIELD I FBK calibrated in Amps.		
UP TO FIELD	**618**	**FALSE / TRUE**
Field current feedback is above FIELD I THRESHOLD when TRUE. This may be used as part of a mechanical brake release strategy.		
WEAK PID ERROR	**1185**	**—.xx %**
Input error, as a percentage of calibrated Volts, to the field weakening controller. This is formed from the spill-over of filtered BEMF above the MAX VOLTS setting.		
WEAK PID OUT	**1186**	**—.xx %**
Output field reduction demand, as a percentage of calibrated field current, from the field weakening controller.		
FIELD STATE	**1187**	**See below**
State of the field controller. 0 : FIELD INIT 1 : FIELD QUENCH 2 : FIELD STANDBY 3 : FIELD FULL FLD 4 : FIELD TIMER indicates that the FLD.QUENCH DELAY timer is counting down 5 : FIELD ERROR 6 : LOCAL BEMF		
BEMF SOURCE	**1273**	**LOCAL BEMF / BEMF INPUT**
Selects the source of the back-emf feedback into the field weakening control loop. Setting LOCAL BEMF makes use of the back-emf measured at the armature terminals. Setting BEMF INPUT uses the value in the parameter BEMF INPUT as the feedback for the field weakening control.		

FIELD CONTROL

Parameter	Tag	Range
BEMF INPUT	**1274**	**— .xx %**

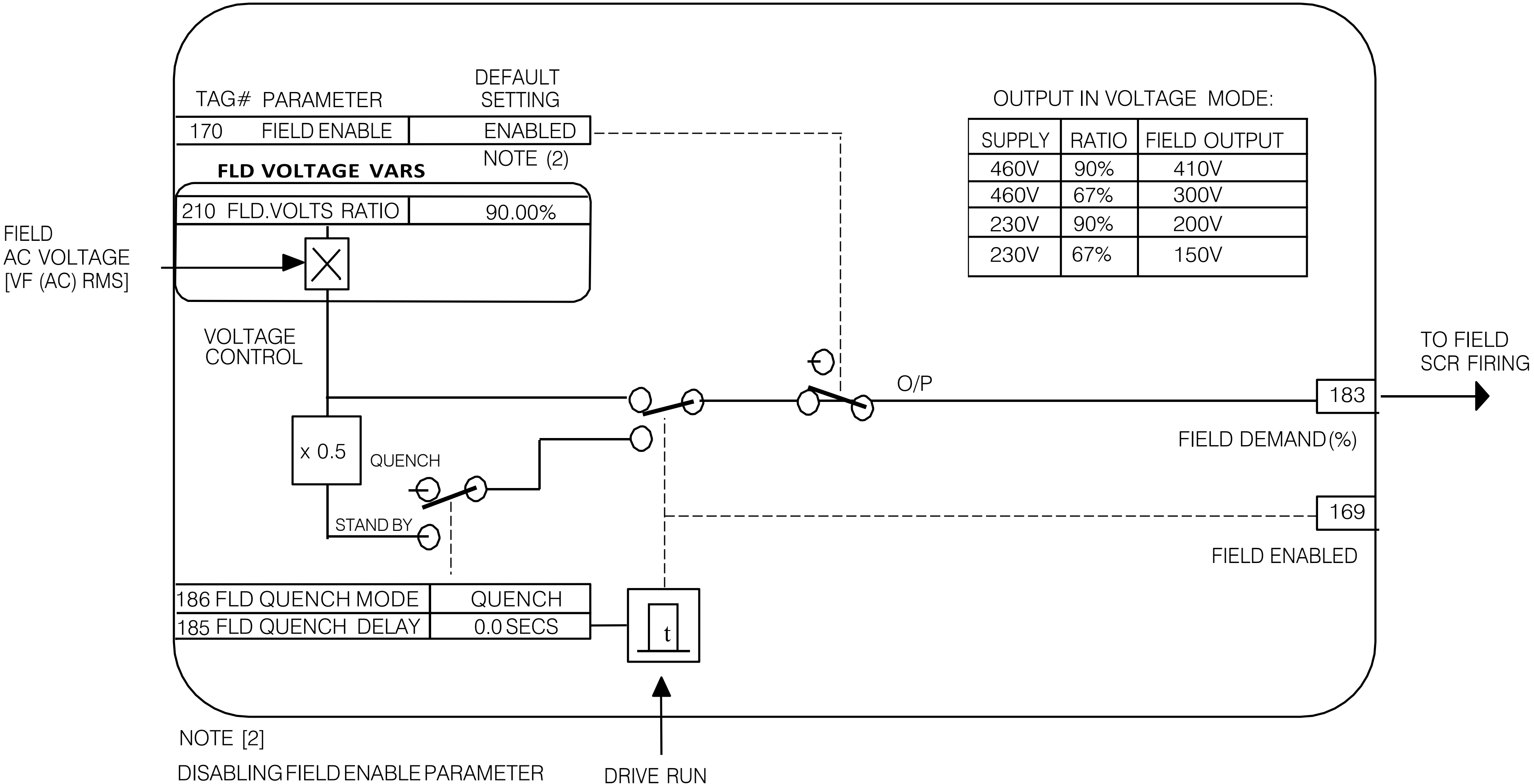
The feedback value of back-emf used for the field weakening control, when BEMF SOURCE is set to BEMF INPUT. It allows for the use of the field weakening control structure on motors not directly connected to the armature terminals. It can be wired within the block diagram to an analogue input or a communications path.

The use of this parameter is typically combined with parameters ISOL DMD SOURCE and 3-PHASE FIELD (CURRENT LOOP function block) to apply the drive to field weakening control of a motor field.

Note: If the ADVANCED field weakening mode is being used with an external back-emf feedback, ensure to apply the speed feedback so that the base speed calculator can function correctly.

Functional Description

FIELD CONTROL MODE : VOLTAGE



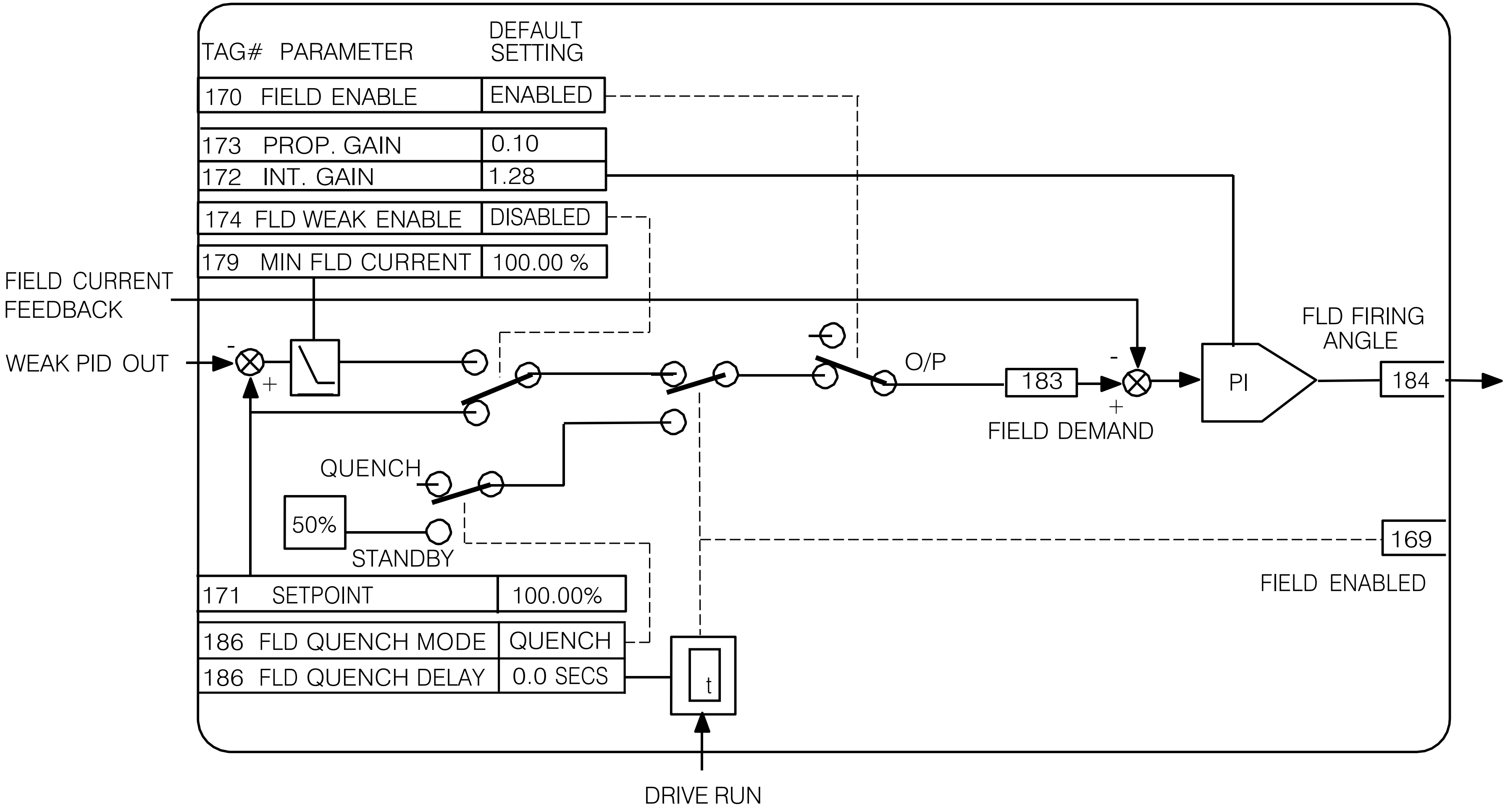
OUTPUT IN VOLTAGE MODE:

SUPPLY	RATIO	FIELD OUTPUT
460V	90%	410V
460V	67%	300V
230V	90%	200V
230V	67%	150V

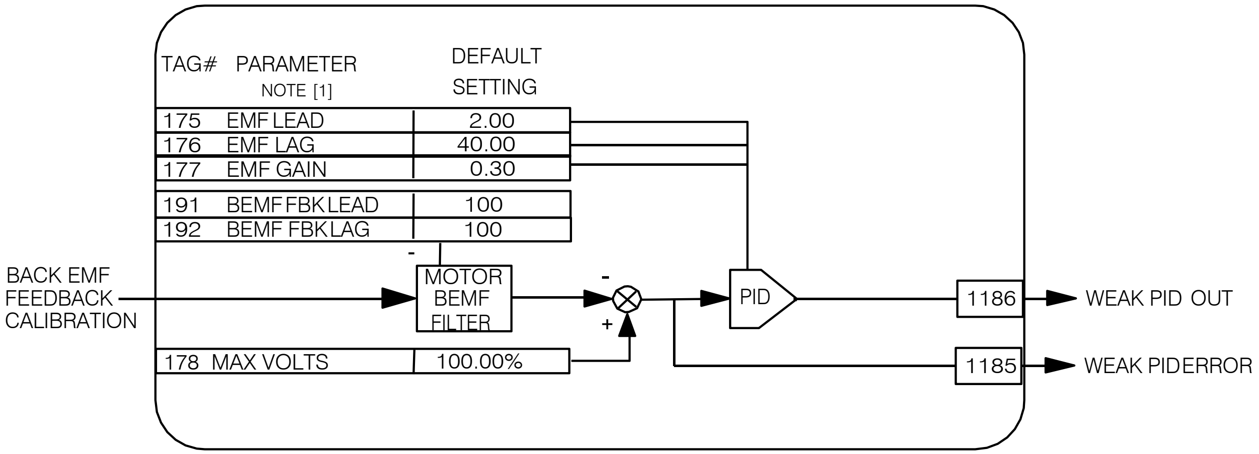
NOTE [2]

DISABLING FIELD ENABLE PARAMETER WILL AUTOMATICALLY OVERRIDE FIELD FAILURE ALARM.

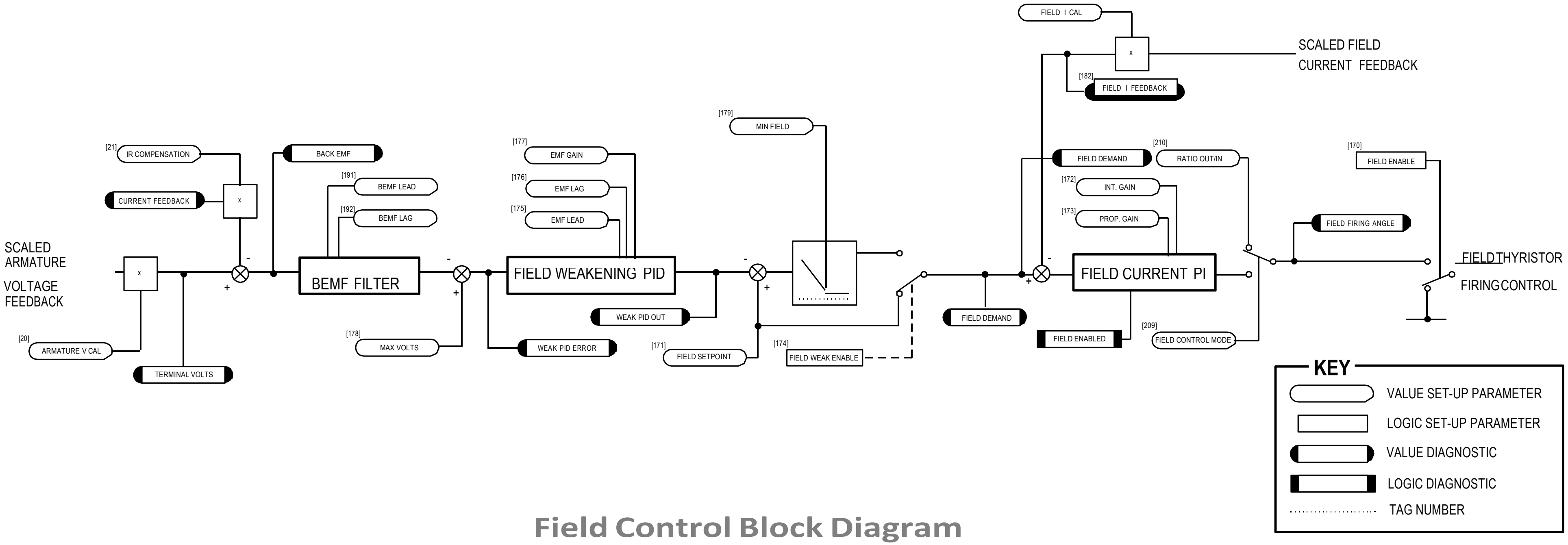
FIELD CONTROL MODE : CURRENT



FLD WEAKVARS



NOTE [1]
FIELD WEAKENING OPERATION REQUIRES ENCODER OR ANALOG TACH FEEDBACK



Field Control Block Diagram

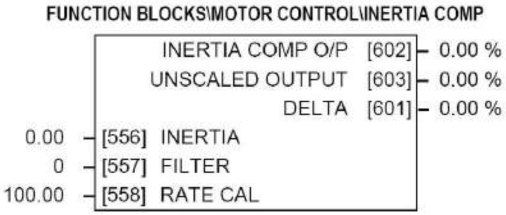
MMI Menu Map

1 SETUP PARAMETERS
2 SPEED LOOP
3 ADVANCED
4 INERTIA COMP
  - INERTIA
  - FILTER
  - RATE CAL
  - DELTA
  - UNSCALED OUTPUT
  - INERTIA COMP O/P

INERTIA COMP

This function block directly compensates for load inertia during acceleration.

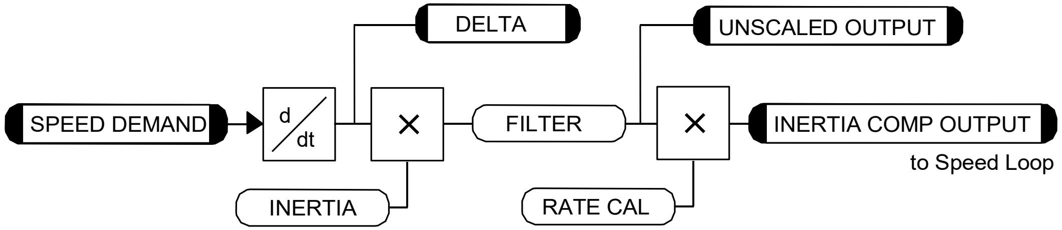
This is particularly useful in high accuracy applications such as positioning systems and elevators. The block calculates its output at the same rate as the current loop for maximum performance.



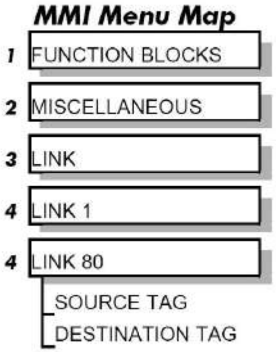
INERTIA COMP

Parameter	Tag	Range
INERTIA	**556**	**0.00 to 200.00**
The value of current necessary to accelerate load to 100% speed in 1 second.		
FILTER	**557**	**0 to 20000**
Low pass filter acting on the DELTA parameter.		
RATE CAL	**558**	**0.00 to 200.00**
Inertia compensation scaling factor.		
INERTIA COMP O/P	**602**	**—.xx %**
Inertia compensation directly added to the speed loop output.		
UNSCALED OUTPUT	**603**	**—.xx %**
Unscaled inertia compensation.		
DELTA	**601**	**—.xx %**
Rate of change of speed demand in %/s^2.		

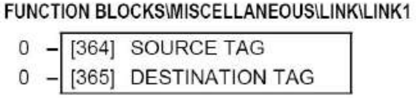
Functional Description



LINK

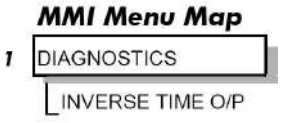


Use internal links to connect between function block parameters.



LINK

Parameter	Tag	Range
LINK 1 - 80		
SOURCE TAG	**Refer to Parameter Table**	**-1276 to 1276**
Enter the tag number of the source input value. Refer to "Making and Breaking Function Block Connections", page D-2.		
DESTINATION TAG	**Refer to Parameter Table**	**0 to 1276**
Enter the tag number for the destination output value. Refer to "Making and Breaking Function Block Connections", page D-2.		



INVERSE TIME

The purpose of the inverse time is to automatically reduce the current limit in response to prolonged overload conditions.

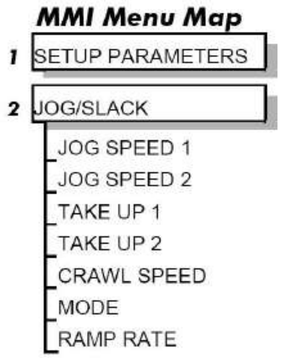
As the motor current exceeds an internal threshold of 103%, the excess current is integrated. The inverse time output remains unchanged until the integrated value is equivalent to an overload of 200% current for 60s. Once this limit is reached the integral value is clamped, and the inverse time output is decreased towards 103% at 10% per second.

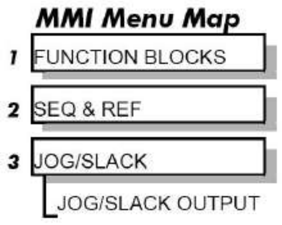
Should the current drop below the 103% threshold the integrator value starts to discharge. As soon as the integrated value is less than the maximum overload level the inverse time output is allowed to ramp back up to 200% at a rate of 10% per second.

The inverse time output parameter is internally used by the current loop.

INVERSE TIME

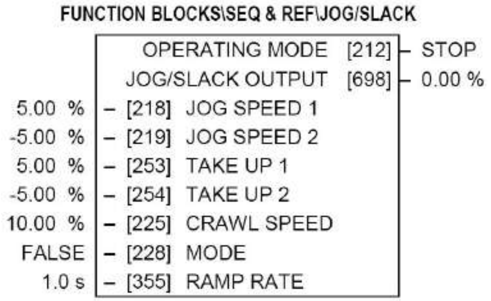
Parameter	Tag	Range
INVERSE TIME	**203**	**— .xx %**
Inverse time clamp output level.		





JOG/SLACK

This block can be used to provide jog, take up slack and crawl speed functions.



The inputs to this block are the Start and Jog signals via the SEQUENCING function block, and the speed demand from the RAMPS function block. The output of this block is connected to the RAMPS function block.

The JOG/SLACK parameters modify or replace the ramp input speed demand. You should use a spare digital input to switch between modes to achieve full functionality.

The JOG/SLACK OUTPUT parameter is internally connected to the RAMPS function block. This output is the modified value of the speed demand as required by MODE, Start, and Jog. These settings are shown in the Setpoint Selection table.

- ***Jog:*** With the Start signal OFF, the jog speed demand replaces the ramp input speed demand. MODE selects between jog setpoints 1 and 2. The jog RAMP RATE replaces the RAMP ACCEL TIME and RAMP DECEL TIME in the RAMPS function block. % S-RAMP is also set to 0.00%.

- ***Take Up Slack:*** With the Start signal ON, the jog signal performs a "take up slack" function. When a jog signal is received, the take up slack setpoint is added to the ramp input speed demand. MODE and Jog settings, from the table, select between the two take-up slack setpoints.

- ***Crawl:*** CRAWL SPEED replaces the ramp input speed demand as the output signal when both Start and Jog signals are ON, and MODE is TRUE.

JOG/SLACK

Parameter	Tag	Range
JOG SPEED 1 Jog speed setpoint 1.	**218**	**-100.00 to 100.00 %**
JOG SPEED 2 Jog speed setpoint 2.	**219**	**-100.00 to 100.00 %**
TAKE UP 1 Take-up slack speed setpoint 1.	**253**	**-100.00 to 100.00 %**
TAKE UP 2 Take-up slack speed setpoint 2.	**254**	**-100.00 to 100.00 %**
CRAWL SPEED Crawl speed setpoint.	**225**	**-100.00 to 100.00 %**
MODE Selects jog speed setpoints, take up setpoints, and the crawl setpoint. To achieve full functionality, connect MODE to a spare digital input.	**228**	**FALSE / TRUE**

JOG/SLACK

Parameter	Tag	Range
RAMP RATE	**355**	**0.1 to 600.0 s**

The ramp rate used while jogging. This is independent of the main ramp rate during normal running. The acceleration and deceleration times in jog are always equal.

Parameter	Tag	Range
OPERATING MODE	**212**	**See below**

Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).

0 : STOP
1 : STOP
2 : JOG SP. 1
3 : JOG SP. 2
4 : RUN
5 : TAKE UP SP. 1
6 : TAKE UP SP. 2
7 : CRAWL

Parameter	Tag	Range
JOG/SLACK OUTPUT	**698**	**___.00 %**

The setpoint combined with the JOG / SLACK function.

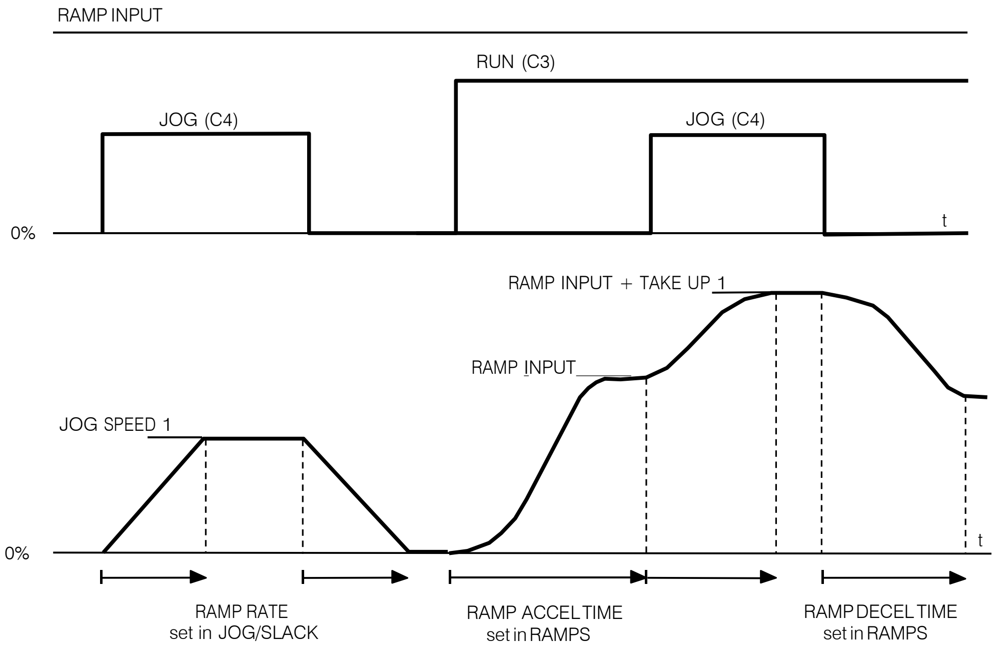
Functional Description

NOTE **The setpoint column in the table below refers to the Ramp Input ONLY, as indicated in the table. Any "direct" setpoints present will also add to this setpoint to make the total speed setpoint. If you don't want this to happen, for example during jogging, then disconnect the direct setpoint(s) during the appropriate conditions.**

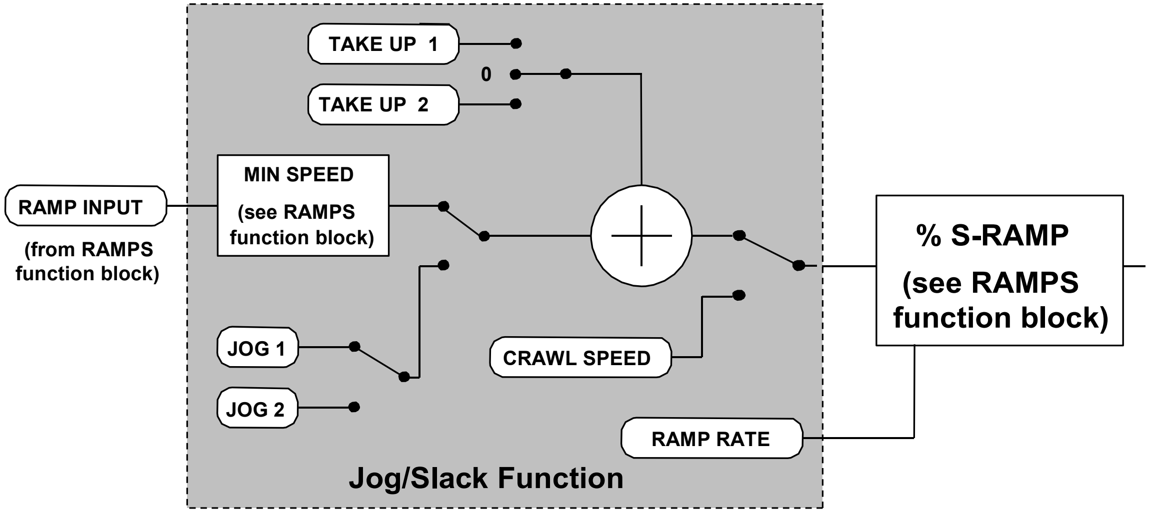
Setpoint Selection Table

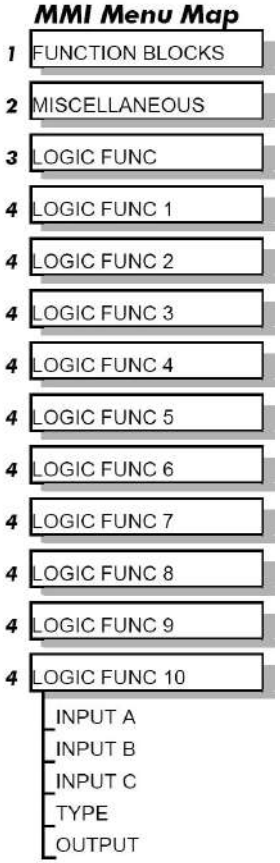
OPERATING MODE [212] - diagnostic		Start C3	Jog C4	MODE [228]	Ramp Input	Ramp Time	Contactor
0 : STOP		OFF	OFF	False	Setpoint	Default	OFF
1 : STOP		OFF	OFF	True	Setpoint	Default	OFF
2 : JOG SP. 1	(inch/jog 1)	OFF	ON	False	JOG SPEED 1	RAMP RATE	ON
3 : JOG SP. 2	(inch/jog 2)	OFF	ON	True	JOG SPEED 2	RAMP RATE	ON
4 : RUN		ON	OFF	False	Setpoint	Default	ON
5 : TAKE UP SP. 1	(take-up slack 1)	ON *	ON *	False	Setpoint + TAKE UP 1	Default	ON
6 : TAKE UP SP. 2	(take-up slack 2)	ON	OFF	True	Setpoint + TAKE UP 2	Default	ON
7 : CRAWL		ON *	ON *	True	CRAWL SPEED	Default	ON

* Start (C3) and Jog (C4) must be applied (ON) simultaneously in the cases of TAKE UP SP.1 and CRAWL.



Block Diagram

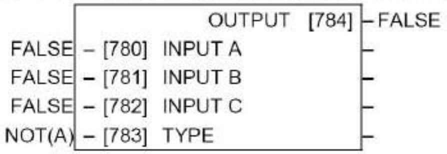




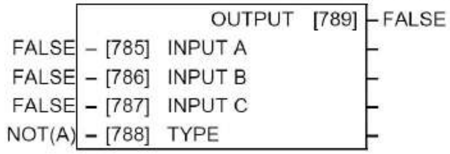
LOGIC FUNC

These generic function blocks can be configured to perform one of a number of simple functions upon a fixed number of inputs.

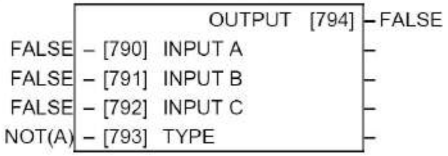
FUNCTION BLOCKS\MISCELLANEOUS\LOGIC FUNC\LOGIC FUNC 1



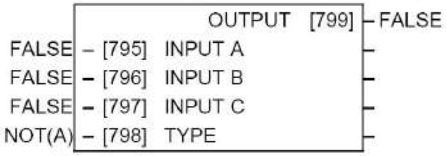
FUNCTION BLOCKS\MISCELLANEOUS\LOGIC FUNC\LOGIC FUNC 2



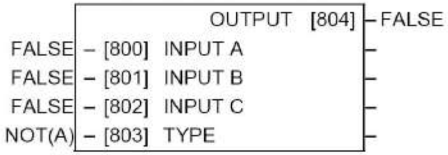
FUNCTION BLOCKS\MISCELLANEOUS\LOGIC FUNC\LOGIC FUNC 3



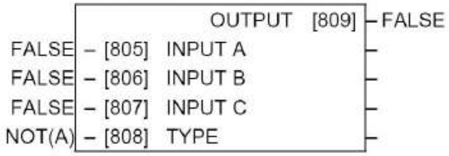
FUNCTION BLOCKS\MISCELLANEOUS\LOGIC FUNC\LOGIC FUNC 4



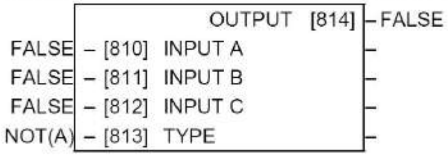
FUNCTION BLOCKS\MISCELLANEOUS\LOGIC FUNC\LOGIC FUNC 5



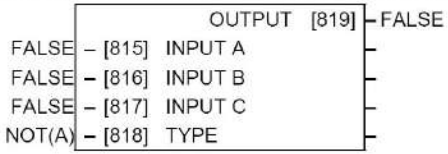
FUNCTION BLOCKS\MISCELLANEOUS\LOGIC FUNC\LOGIC FUNC 6



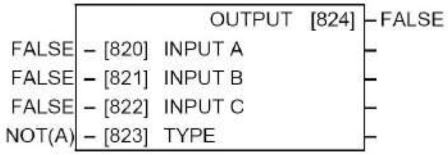
FUNCTION BLOCKS\MISCELLANEOUS\LOGIC FUNC\LOGIC FUNC 7



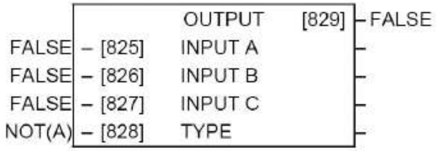
FUNCTION BLOCKS\MISCELLANEOUS\LOGIC FUNC\LOGIC FUNC 8



FUNCTION BLOCKS\MISCELLANEOUS\LOGIC FUNC\LOGIC FUNC 9



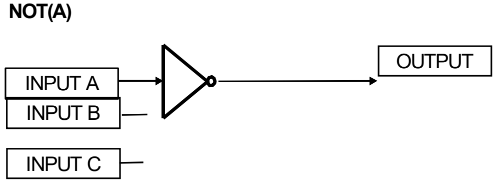
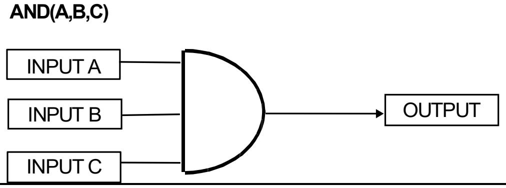
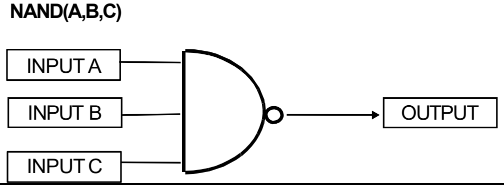
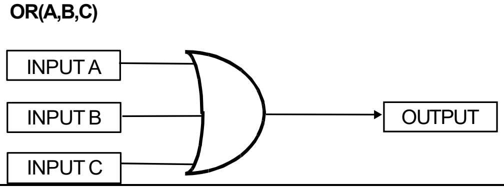
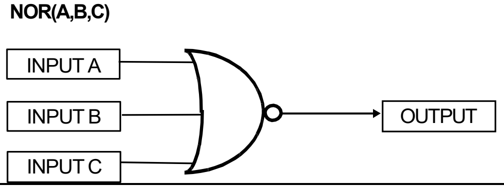
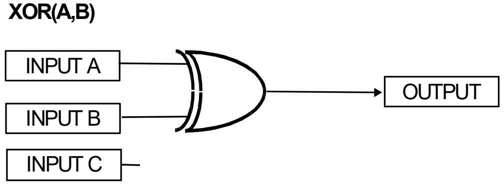
FUNCTION BLOCKS\MISCELLANEOUS\LOGIC FUNC\LOGIC FUNC 10

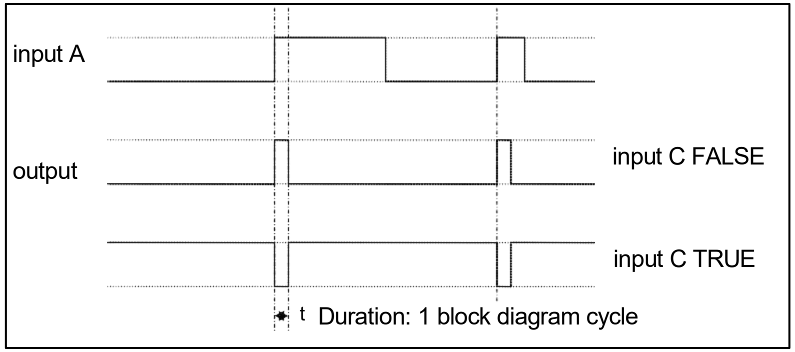
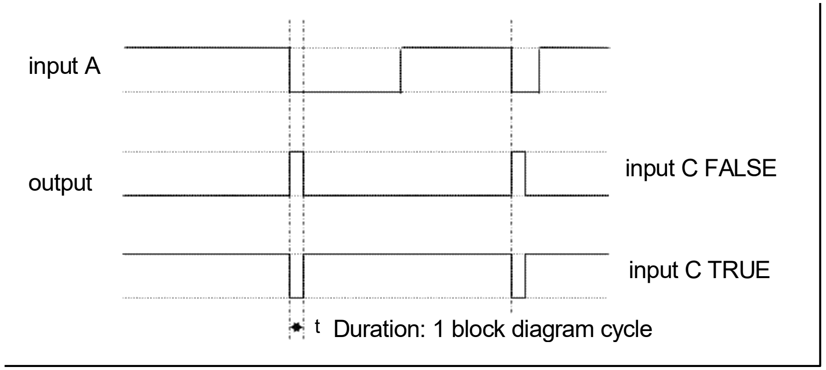


LOGIC FUNC

Parameter	Tag	Range
INPUT A	**780, 785, 790, 795, 800, 805, 810, 815, 820, 825**	**FALSE / TRUE**
General purpose logic input.		
INPUT B	**781, 786, 791, 796, 801, 806, 811, 816, 821, 826**	**FALSE / TRUE**
General purpose logic input.		
INPUT C	**782, 787, 792, 797, 802, 807, 812, 817, 822, 827**	**FALSE / TRUE**
General purpose logic input.		
TYPE	**783, 788, 793, 798, 803, 808, 813, 818, 823, 828**	**See below**
The operation to be performed on the three inputs to produce the output value. The operations that can be selected are: 0: NOT(A) 1: AND(A,B,C) 2: NAND(A,B,C) 3: OR(A,B,C) 4: NOR(A,B,C) 5: XOR(A,B) 6: 0-1 EDGE(A) 7: 1-0 EDGE(A) 8: AND(A,B,!C) 9: OR(A,B,!C) 10: S FLIP-FLOP 11: R FLIP-FLOP 12: LATCH 13: SWITCH 14: (A AND B) OR C 15: (A OR B) AND C		
OUTPUT	**784, 789, 794, 799, 804, 809, 814, 819, 824, 829**	**FALSE / TRUE**
The result of performing the selected operation on the inputs.		

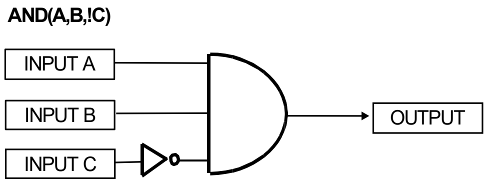
Functional Description

Operation	Description	
NOT(A)		If INPUT A is TRUE the OUTPUT is FALSE, otherwise the OUTPUT is TRUE.
AND(A,B,C)		If A and B and C are all TRUE then the OUTPUT is TRUE, otherwise the OUTPUT is FALSE.
NAND(A,B,C)		If A and B and C are all TRUE then the OUTPUT is FALSE, otherwise the OUTPUT is TRUE.
OR(A,B,C)		If at least one of A or B or C is TRUE then the OUTPUT is TRUE, otherwise the OUTPUT is FALSE.
NOR(A,B,C)		If at least one of A or B or C is TRUE then the OUTPUT is FALSE, otherwise the OUTPUT is TRUE.
XOR(A,B)		If A and B are the same, (both TRUE or both FALSE), then the output is FALSE, otherwise the output is TRUE.

Operation	Description
1-1 EDGE(A)	 **Rising Edge Trigger** Input B is not used. This function outputs a pulse of 5ms duration when INPUT A to the block becomes TRUE. When INPUT C is TRUE, the output is inverted. The output is held TRUE for one execution of the function block diagram.
1-0 EDGE(A)	 **Falling Edge Trigger** Input B is not used. This function outputs a pulse of 20ms duration when INPUT A to the block becomes FALSE. When INPUT C is TRUE, the output is inverted. The output is held TRUE for one execution of the function block diagram.

Operation	Description

AND(A,B,!C)

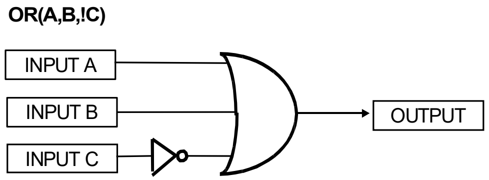


Refer to the Truth Table.

FALSE = 0, TRUE = 1.

Input State			
A	**B**	**C**	**Output State**
0	0	0	**0**
0	0	1	**0**
0	1	0	**0**
0	1	1	**0**
1	0	0	**0**
1	0	1	**0**
1	1	0	**1**
1	1	1	**0**

OR(A,B,!C)

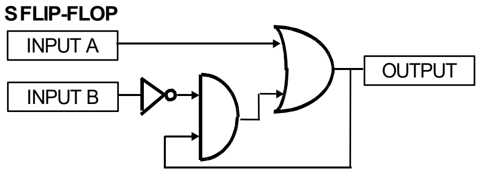


Refer to the Truth Table.

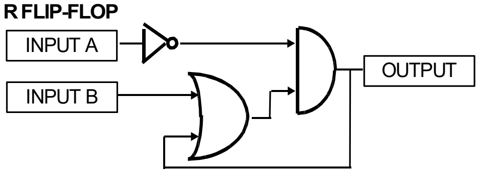
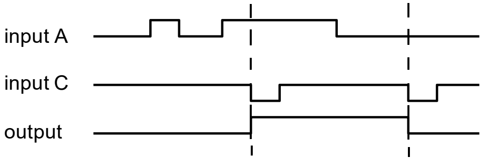
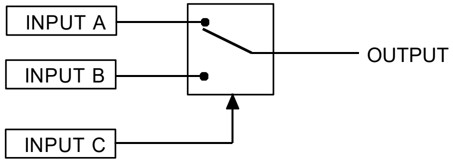
FALSE = 0, TRUE = 1.

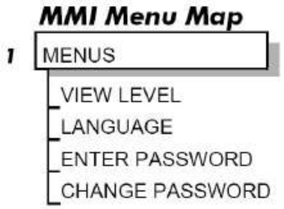
Input State			
A	**B**	**C**	**Output State**
0	0	0	**1**
0	0	1	**0**
0	1	0	**1**
0	1	1	**1**
1	0	0	**1**
1	0	1	**1**
1	1	0	**1**
1	1	1	**1**

S FLIP-FLOP



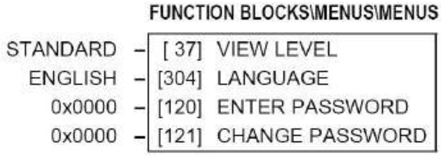
This is a set dominant flip-flop. INPUT A functions as *set,* and INPUT B as *reset* .

Operation	Description
R FLIP-FLOP	 This is a reset dominant flip-flop. INPUT A functions as *reset,* and INPUT B as *set* .
LATCH	 When INPUT C is low, the output is the value of INPUT A. This output value is then latched until INPUT C is low again. INPUT B is not used.
SWITCH	 When INPUT C is FALSE, the output is equal to INPUT A. When INPUT C is TRUE, the output is equal to INPUT B.



MENUS

Use this block to select one of three MMI menu structures, to set a display language, and to protect the Keypad with a password.



MENUS

Parameter	Tag	Range
VIEW LEVEL	**37**	**BASIC / STANDARD / ADVANCED**
This parameter controls which parameters and menus are visible on the MMI. Refer to Chapter 6: "The Keypad" -The Menu System Map to see the effects of these selections.		
LANGUAGE	**304**	**ENGLISH / OTHER**
Selects the MMI display language. Other languages are available, please contact DC900P Drives. Refer also to Chapter 6: “The Keypad” - Selecting the Display Language.		
ENTER PASSWORD	**120**	**0x0000 to 0xFFFF**
Refer to Chapter 6: “The Keypad” - Password Protection for further instruction.		
CHANGE PASSWORD	**121**	**0x0000 to 0xFFFF**
Refer to Chapter 6: “The Keypad” - Password Protection for further instruction.		

MMI Menu Map

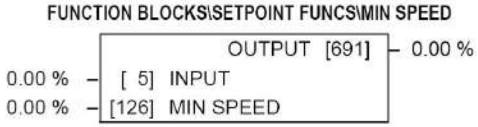
1 FUNCTION BLOCKS
2 SETPOINT FUNCTIONS
3 MIN SPEED
OUTPUT

MMI Menu Map

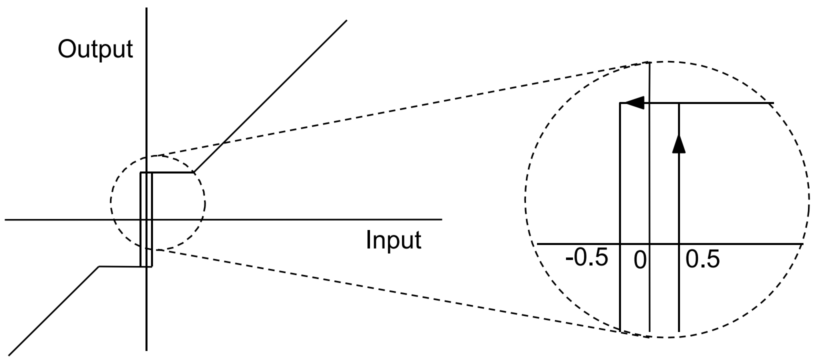
1 SETUP PARAMETERS
2 RAMPS
INPUT
MIN SPEED

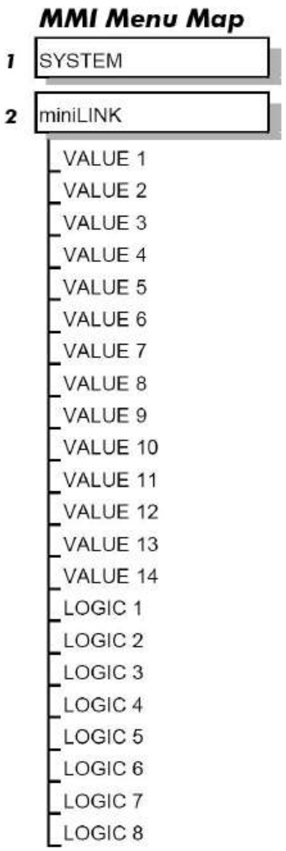
MIN SPEED

The Min Speed function block may be used to prevent the drive running with a zero setpoint.



MIN SPEED

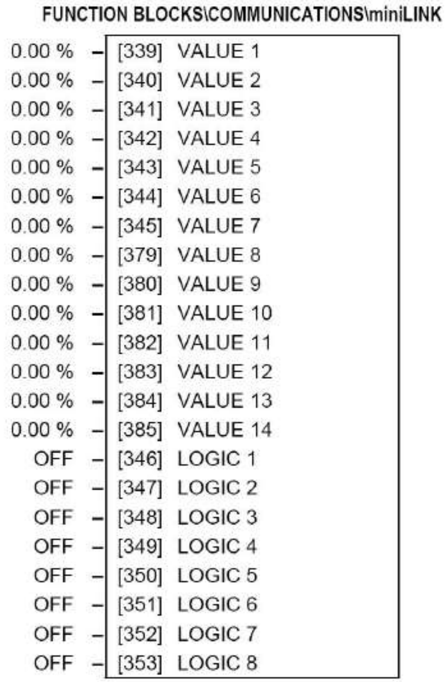
Parameter	Tag	Range
INPUT	**5**	**-105.00 to 105.00 %**
Input value.		
MIN SPEED	**126**	**0.00 to 100.00 %**
The minimum speed clamp is fully bi-directional and operates with a 0.5% hysterisis. If this parameter is less than 0.5% it is ignored and OUTPUT = INPUT. **Minimum Speed**  		
OUTPUT	**691**	**— .xx %**
Clamped value of input.		



miniLINK

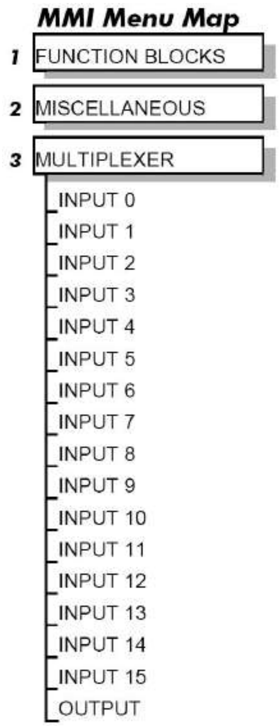
These parameters are general purpose tags.

These parameters are used extensively in conjunction with communications masters in order to map the field bus parameters into the drive. Refer to the appropriate Tech Box manual.



miniLINK

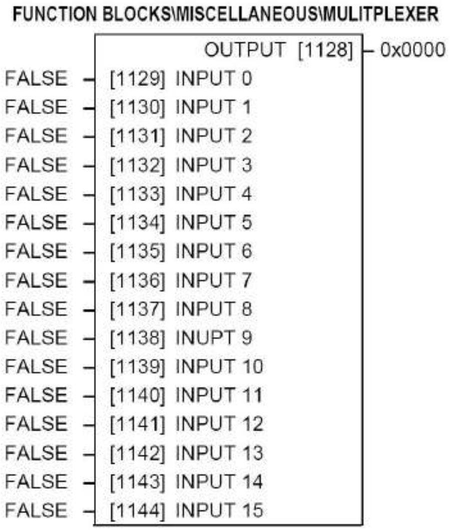
Parameter	Tag	Range
VALUE 1 to VALUE 14	**339 to 385**	**-300.00 to 300.00 %**
General purpose inputs.		
LOGIC 1 to LOGIC 8	**346 to 353**	**OFF / ON**
General purpose logic inputs.		



MULTIPLEXER

Each block collects together 16 Boolean input values into a single word.

For example, one may be used to collect individual bits within a word for efficient access from a communications master.

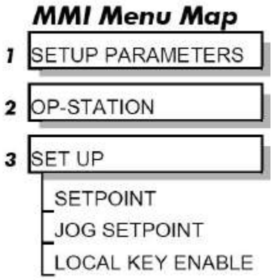


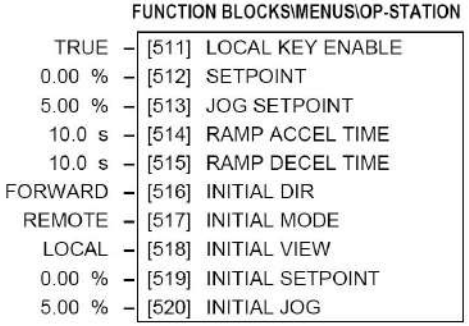
MULTIPLEXER

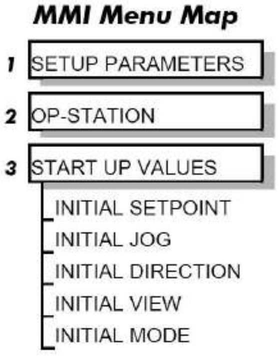
Parameter	Tag	Range
INPUT 0 to INPUT 15	**1129 to 1144**	**FALSE / TRUE**
The Boolean inputs to be assembled into a single word.		
OUTPUT	**1128**	**0x0000 to 0xFFFF**
The resulting word.		

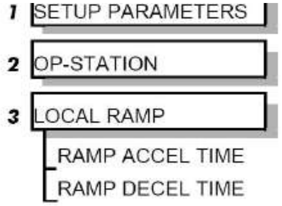
OP STATION

MMI Set-up options and Local setpoint information.









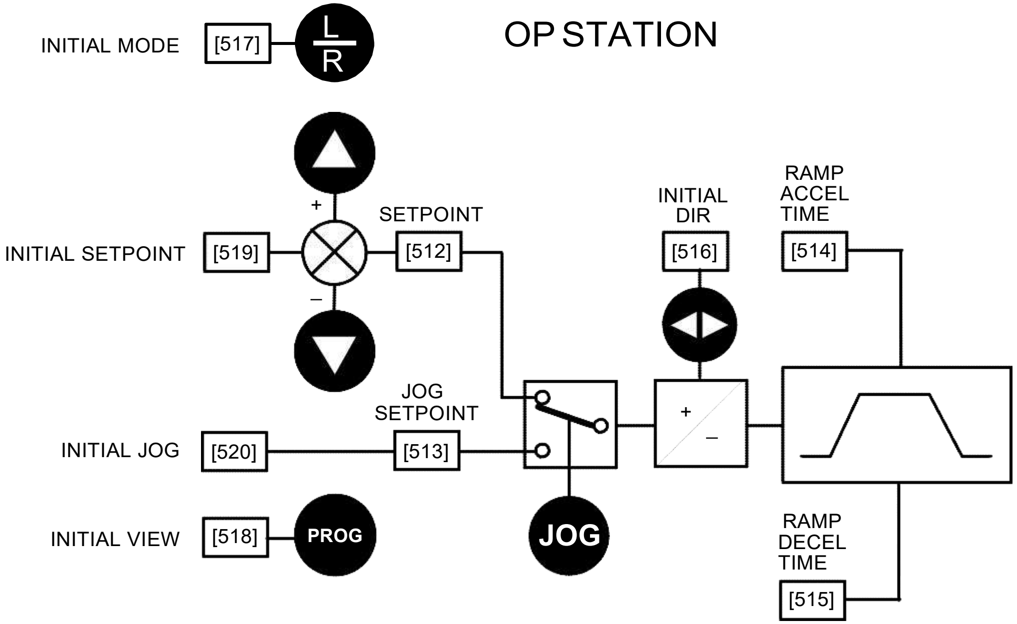
OP STATION

Parameter	Tag	Range
LOCAL KEY ENABLE	**511**	**FALSE / TRUE**
Enables the LOCAL/REMOTE control key on the op-station. Set to TRUE to allow the operator to toggle between local and remote modes.		
SETPOINT	**512**	**0.00 to 100.00 %**
SET UP menu - Actual value of local setpoint. This value is not persistent.		
JOG SETPOINT	**513**	**0.00 to 100.00 %**
SET UP menu - Actual value of local jog setpoint. This value is not persistent.		
RAMP ACCEL TIME	**514**	**0.1 to 600.0 s**
Acceleration time used while in Local mode.		
RAMP DECEL TIME	**515**	**0.1 to 600.0 s**
Deceleration time used while in Local mode.		
INITIAL DIR	**516**	**REVERSE / FORWARD**
START UP VALUES menu - Start-up mode of local direction on power-up. Set to TRUE for Forward.		
INITIAL MODE	**517**	**REMOTE / LOCAL**
START UP VALUES menu - Start-up mode of Keypad LOCAL/REMOTE control key on power-up. Set to TRUE for Local mode.		
INITIAL VIEW	**518**	**LOCAL / PROGRAM**
START UP VALUES menu - Start-up mode of Keypad PROG key on power-up. Set to TRUE for Program mode to see the local setpoint.		

OP STATION

Parameter	Tag	Range	
INITIAL SETPOINT	**519**	**0.00 to 100.00 %**	
START UP VALUES menu - Default value of local setpoint on power-up.			
INITIAL JOG	**520**	**0.00 to 100.00 %**	
START UP VALUES menu - Default Value of local jog setpoint on power up.			

Functional Description



Local Setpoint (only active when the drive is in Local mode)

PID

MMI Menu Map

1 SETUP PARAMETERS

2 SPECIAL BLOCKS

3 PID
- PROP. GAIN
- INT.TIME.CONST
- DERIVATIVE TC
- POSITIVE LIMIT
- NEGATIVE LIMIT
- O/P SCALER(TRIM)
- INPUT 1
- INPUT 2
- RATIO 1
- RATIO 2
- DIVIDER 1
- DIVIDER 2
- ENABLE
- INT. DEFEAT
- FILTER T.C.

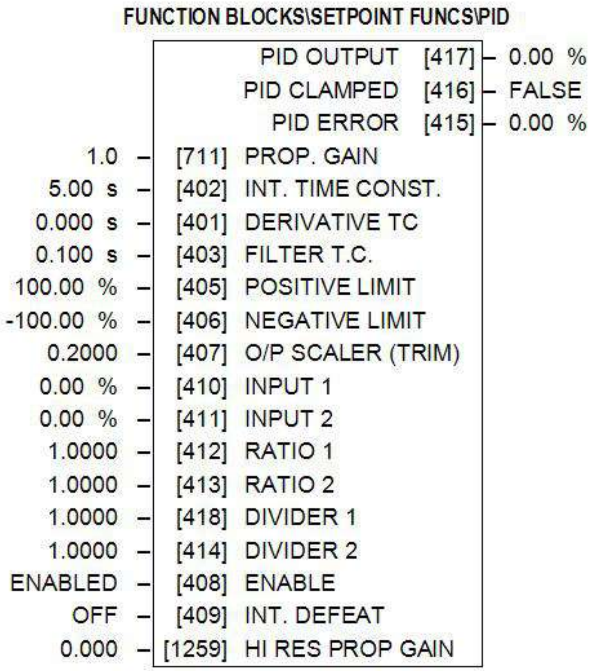
This is a general purpose PID block which can be used for many different closed loop control applications.

The PID feedback can be loadcell tension, dancer position or any other transducer feedback such as pressure, flow etc.

This block is ignored by the drive unless SYSTEM::CONFIGURE I/O::BLOCK DIAGRAM::PID O/P DEST is connected to a non-zero tag.

Features:

- Independent adjustment of gain and time constants.
- Additional first-order filter (F).
- Functions P, PI, PD, PID with/without F individually selected.
- Ratio and divider for scaling each input.
- Independent positive and negative limits.
- Output scaler (Trim).
- Gain profiled by diameter for centre-driven winder control.



PID

MMI Menu Map

1 DIAGNOSTICS
- PID OUTPUT
- PID CLAMPED
- PID ERROR

MMI Menu Map

1 FUNCTION BLOCKS
- HI RES PROP GAIN

Parameter	Tag	Range
PROP. GAIN	**711**	**0.0 to 100.0**
The maximum limit of the proportional gain. This is a pure gain factor which shifts up or down the whole Bode PID transfer function leaving the time constants unaffected. A value of P = 10.0 means that, for an error of 5%, the proportional part (initial step) of the PID output will be: 10 x [1 + (Td/Ti)] x 5 %, i.e. approx. 50% for Td << Ti. Also refer to HI RES PROP GAIN below.		
INT. TIME CONST.	**402**	**0.01 to 100.00 s**
The integral time constant (Ti)		
DERIVATIVE TC	**401**	**0.000 to 10.000 s**
The derivative time constant (Td). Set this value to 0.000 to remove the derivative term.		
FILTER T.C.	**403**	**0.000 to 10.000 s**
A first-order filter for removing high frequency noise from the PID output. When set to 0.000 the filter is removed. The high frequency lift of the transfer function is determined by the ratio k of the Derivative Time Const (Td) over the Filter Time Constant (Tf) - typically 4 of 5.		

PID

Parameter	Tag	Range
POSITIVE LIMIT	**405**	**0.00 to 105.00 %**
The upper limit of the PID algorithm.		
NEGATIVE LIMIT	**406**	**-105.00 to 0.00 %**
The lower limit of the PID algorithm.		
O/P SCALER (TRIM)	**407**	**-3.0000 to 3.0000**
The ratio that the limited PID output is multiplied by in order to give the final PID Output. Normally this ratio would be between 0 and 1.		
INPUT 1	**410**	**-300.00 to 300.00 %**
PID setpoint input. This can be either a position/tension feedback or a reference/offset.		
INPUT 2	**411**	**-300.00 to 300.00 %**
PID feedback input. This can be either a position/tension feedback or a reference/offset		
RATIO 1	**412**	**-3.0000 to 3.0000**
This multiplies Input 1 by a factor (Ratio 1).		
RATIO 2	**413**	**-3.0000 to 3.0000**
This multiplies Input 2 by a factor (Ratio 2).		
DIVIDER 1	**418**	**-3.0000 to 3.0000**
This divides Input 1 by a factor (Divider 1).		
DIVIDER 2	**414**	**-3.0000 to 3.0000**
This divides Input 2 by a factor (Divider 2).		
ENABLE	**408**	**DISABLED / ENABLED**
Enables or disables the PID output.		
INT. DEFEAT	**409**	**OFF / ON**
When ON, the Integral term is disabled. The block transfer function then becomes P+D only.		
HI RES PROP GAIN	**1259**	**0.000 to 100.000**
Additive, high resolution, proportional term gain. This value is added to PROP GAIN to form the total proportional term gain. Its default value is 1.1 (unused).		
PID OUTPUT	**417**	**—.xx %**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
PID CLAMPED	**416**	**FALSE / TRUE**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
PID ERROR	**415**	**—.xx %**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		

Functional Description

The following block diagram shows the internal structure of the PID block.

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

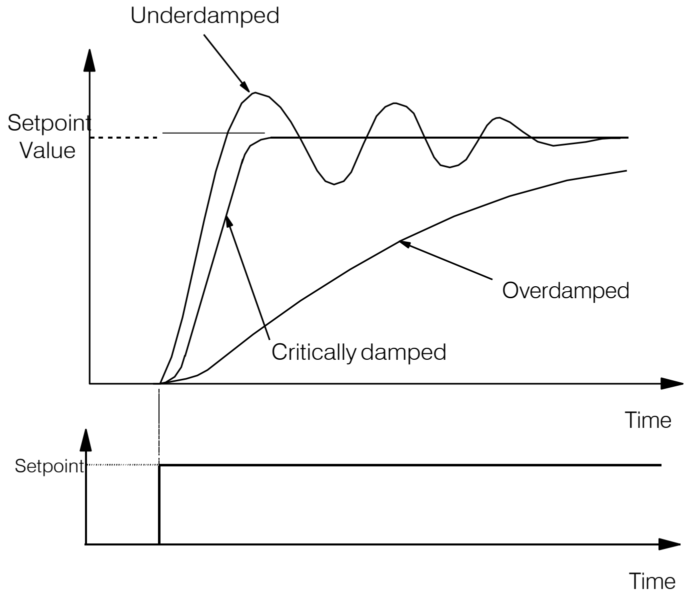
The block executes a Proportional Gain + Integral + Derivative control algorithm, with an added filter to attenuate high-frequency noise. You can select P, PD, PI or PID as required.

Proportional Gain (PROP. GAIN)
This is used to adjust the basic response of the closed loop control system. It is defined as the portion of the loop gain fed back to make the complete control loop stable. The PID error is multiplied by the Proportional Gain to produce an output.

Integral (INT. TIME CONST.)
The Integral term is used to give zero steady state error between the setpoint and feedback values of the PID. If the integral is set to a small value, this will cause an underdamped or unstable control system.

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

Critically Damped Response



The algorithm modifies the error between the setpoint and the feedback with the proportional, integral, and derivative terms. The error is clamped internally to ±105% maximum.

The proportional, integral, and derivative terms are scaled by PROP. GAIN, INT. TIME CONST., and DERIVATIVE TC respectively. An additional gain profiler can modify the proportional gain as the roll diameter changes. The block diagram shows how the proportional gain changes when using the profiler.

Proportional Gain

Proportional gain scales the output based upon the input error. Increasing PROP. GAIN will improve the response time while increasing overshoot. MODE selects the proportional gain profile. When set to 0, the proportional gain remains constant over the entire roll. Changing the value of MODE increases the profile as shown opposite.

You should try to achieve a critically damped response which allows the mechanics to track as precisely as possible a step change on the setpoint.

Integral Gain

Integral eliminates steady-state error. Reducing INT. TIME CONST. improves the response, however, if it is set too short it will cause instability. The integral value is clamped internally by the settings of POSITIVE LIMIT and NEGATIVE LIMIT. It is also held at the last value when the PID CLAMPED output is TRUE. Setting INT. DEFEAT to ON will disable the integral gain term.

Derivative Gain

Derivative gain instantaneously boosts the PID output signal. Increasing DERIVATIVE TC decreases the damping, which in most cases causes overshoot and oscillations resulting in an unacceptable system response.

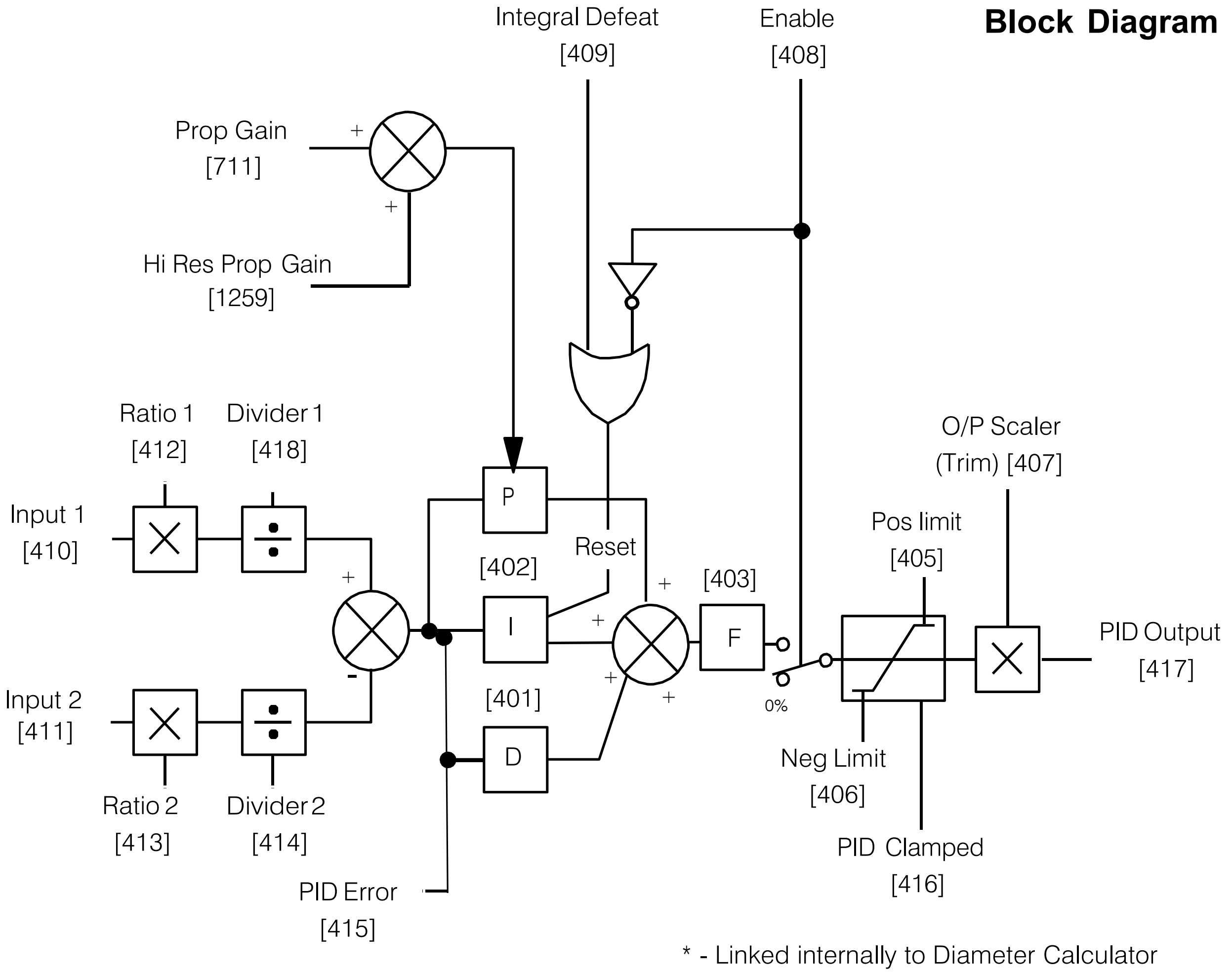
NOTE **For most applications, derivative gain is never used and is usually left at its default value of 0.000 seconds.**

Derivative gain can improve response in some dancer tension controlled systems, particularly those systems with high inertia dancers which need an instantaneous response to overcome the weight of the dancer roll. For loadcell controlled tension systems, derivative gain is almost *never* used.

- In underdamped systems, the output oscillates and the settling time increases.
- Critically damped systems have no overshoot or oscillations. They reach the setpoint within the desired response time.
- Overdamped systems do not oscillate but do not reach the setpoint within the desired response time.

NOTE **The EMULATE 900P parameter in the CONFIGURE DRIVE function block affects the time constants used in the PID. If this parameter is non-zero, the filter, integral and derivative time constants used within the PID are four times greater than those shown on the input parameters. This emulates the behaviour of earlier versions of the 900P. Refer to "Execution Rules", D-2.**

Block Diagram



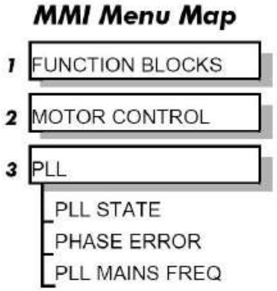
* - Linked internally to Diameter Calculator

Operators can read the PID error, PID output, setpoint and feedback on the drive's MMI by monitoring the following values:

- PID ERROR : displayed in the DIAGNOSTICS menu
- PID OUTPUT : displayed in the DIAGNOSTICS menu
- SETPOINT : monitored at SETUP PARAMETERS::SPECIAL BLOCKS::PID::INPUT 1
- FEEDBACK : monitored at SETUP PARAMETERS::SPECIAL BLOCKS::PID::INPUT 2

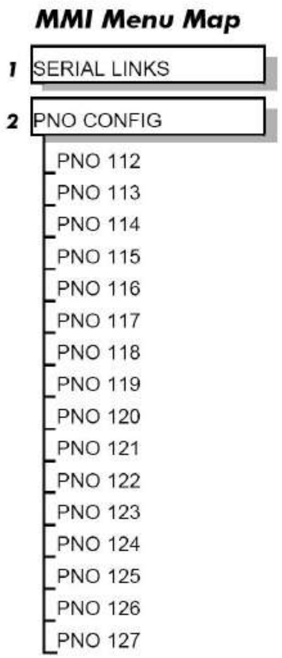
PLL (PHASE LOCKED LOOP)

The phase locked loop function block allows the drive to ride through short disturbances to the supply voltage, frequency or phase and provides immunity to waveform distortion.



PLL (PHASE LOCKED LOOP)

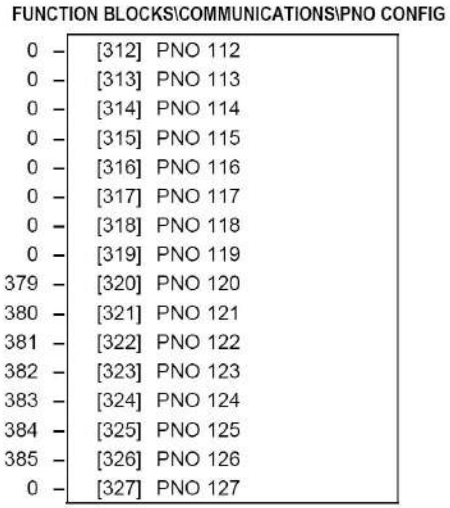
<table>
<tr><th>Parameter</th><th>Tag</th><th>Range</th></tr>
<tr><td>PLL STATE</td><td>1198</td><td>See below</td></tr>
<tr><td colspan="3">Indicates the current operating state of the phase locked loop function block. Normally the PLL will reside in the LOCKED state after close of the 3-phase line contactor. The FAIL state results if the supply frequency moves beyond the acceptable operating range.
0 : STOPPED
1 : 1ST CODING EDGE
2 : READ EDGES
3 : MAINS PERIOD
4 : LOCKED
5 : UNLOCKED
6 : FAIL</td></tr>
<tr><td>PHASE ERROR</td><td>1199</td><td>— .xx</td></tr>
<tr><td colspan="3">The instantaneous angle error between the zero-crossing detection of the line supply and the reference output from the PLL function block.</td></tr>
<tr><td>PLL MAINS FREQ</td><td>1201</td><td>— .xx</td></tr>
<tr><td colspan="3">The measured 3-phase line supply frequency at the output of the PLL function block.</td></tr>
</table>



PNO CONFIG

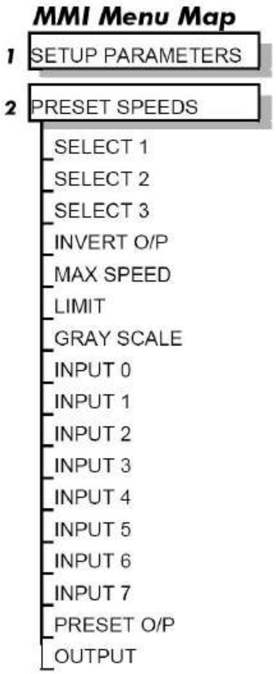
The PNO parameters are used in conjunction with the EI ASCII and EI BINARY communications protocols.

Refer to Appendix A: "Serial Communications".



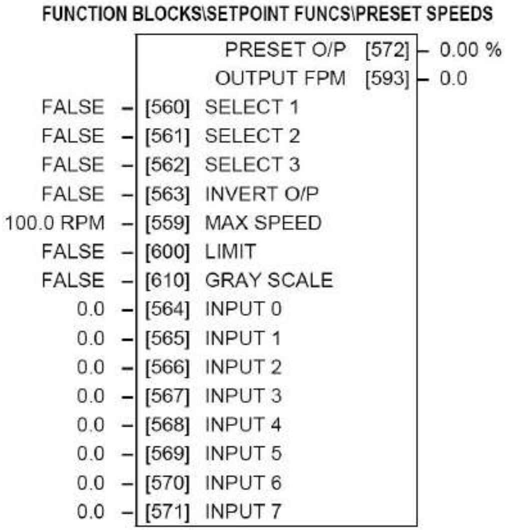
PNO CONFIG

Parameter	Tag	Range
PNO 112 - 127	**312 to 327**	**-1276 to 1276**
Indirect access parameters.		



PRESET SPEEDS

The Preset Speeds block allows you to select one of eight preset inputs, which in turn may be connected to other blocks of inputs.



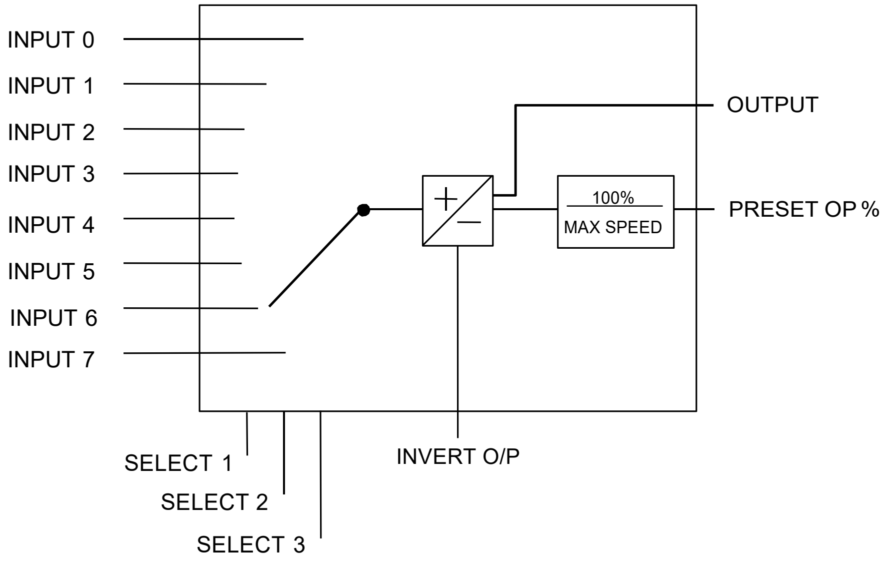
PRESET SPEEDS

Parameter	Tag	Range
SELECT 1	**560**	**FALSE / TRUE**
Select inputs 1.		
SELECT 2	**561**	**FALSE / TRUE**
Select inputs 2.		
SELECT 3	**562**	**FALSE / TRUE**
Select inputs 3.		
INVERT O/P	**563**	**FALSE / TRUE**
Changes the sign of the output. If TRUE, the output is of the opposite sign to the selected input.		
MAX SPEED	**559**	**0.1 to 3000.0 RPM**
Scaler for PRESET OP (%).		

PRESET SPEEDS

Parameter	Tag	Range
LIMIT	**600**	**FALSE / TRUE**
Clamp output to MAX SPEED if TRUE.		
GRAY SCALE	**610**	**FALSE / TRUE**
Selects Gray Scale encoding when TRUE, Binary encoding when FALSE. When gray scale is selected, only one input changes between state preventing the mis-selection of intermediate states.		
INPUT 0 to INPUT 7	**564, 565, 566, 567, 568, 569, 570, 571**	**-3000.0 to 3000.0**
Pre-set input variables.		
PRESET O/P	**572**	**— .xx %**
Scales the selected preset input by MAX SPEED.		
OUTPUT FPM	**593**	**— .x**
Outputs the selected INPUT value.		

Functional Description



Selection Table

Three Boolean variables used to select between one of the 8 preset values.

BINARY ENCODING			
Select 3	Select 2	Select 1	Input
FALSE	FALSE	FALSE	0
FALSE	FALSE	TRUE	1
FALSE	TRUE	FALSE	2
FALSE	TRUE	TRUE	3
TRUE	FALSE	FALSE	4
TRUE	FALSE	TRUE	5
TRUE	TRUE	FALSE	6
TRUE	TRUE	TRUE	7

GRAY SCALE ENCODING			
Select 3	Select 2	Select 1	Input
FALSE	FALSE	FALSE	0
FALSE	FALSE	TRUE	1
FALSE	TRUE	TRUE	2
FALSE	TRUE	FALSE	3
TRUE	TRUE	FALSE	4
TRUE	TRUE	TRUE	5
TRUE	FALSE	TRUE	6
TRUE	FALSE	FALSE	7

MMI Menu Map

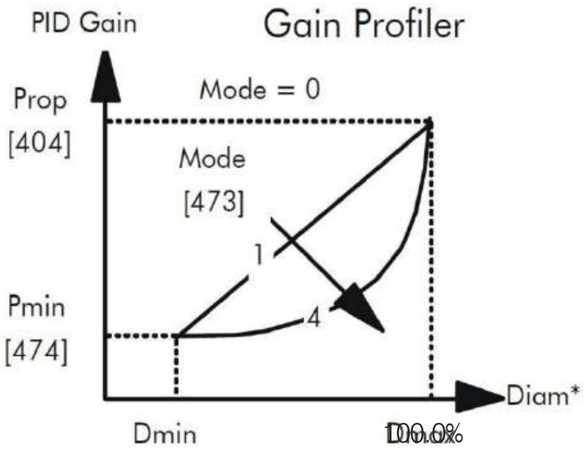
1 SETUP PARAMETERS
2 SPECIAL BLOCKS
3 PID
   - PROP. GAIN
   - MODE
   - MIN PROFILE GAIN
   - PROFILED GAIN

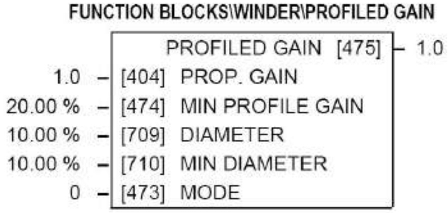
MMI Menu Map

1 FUNCTION BLOCKS
2 WINDER
3 PROFILED GAIN
   - DIAMETER
   - MIN DIAMETER

PROFILED GAIN

This function block may be used to profile the proportional gain input to the PID block.





PROFILED GAIN

Parameter	Tag	Range
PROP. GAIN	**404**	**0.0 to 100.0**
The nominal gain prior to profiling.		
MIN PROFILE GAIN	**474**	**0.00 to 100.00 %**
This expresses the minimum gain required at minimum diameter (core) as a percentage of the (maximum) P gain at full diameter (100%), when MODE > 0.		
DIAMETER	**709**	**0.00 to 100.00 %**
The actual measured diameter. If appropriate, this may be connected to the DIAMETER output parameter in the DIAMETER CALC function block.		
MIN DIAMETER	**710**	**0.00 to 100.00 %**
Set to the minimum core diameter (normally the empty core diameter) as a percentage of the maximum roll diameter. If appropriate, this may be connected to the MIN DIAMETER parameter in the DIAMETER CALC function block.		

PROFILED GAIN

Parameter	Tag	Range
MODE	**473**	**0 to 4**

This determines the shape of the proportional gain profile. The higher the setting, the steeper the curve of the profiled gain.

For Mode = 0, Profiled Gain = constant = P.

For Mode = 1, Profiled Gain = A * (diameter - min diameter) + B.

For Mode = 2, Profiled Gain = A * (diameter - min diameter)^2 + B.

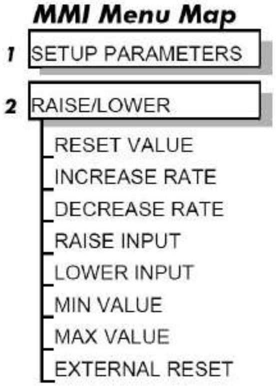
For Mode = 3, Profiled Gain = A * (diameter - min diameter)^3 + B.

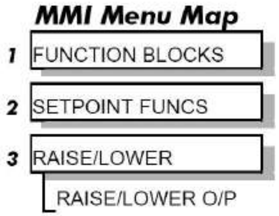
For Mode = 4, Profiled Gain = A * (diameter - min diameter)^4 + B.

Parameter	Tag	Range
PROFILED GAIN	**475**	**– .x**

The proportional gain after profiling by a profiler block which varies the gain versus diameter. This is primarily to be used with Speed Profiled Winders for compensation against varying diameter and therefore inertia.

- When MODE is not ZERO (see above) this overrides the P gain above.
- When MODE = 0, then PROFILED GAIN = PROP. GAIN.

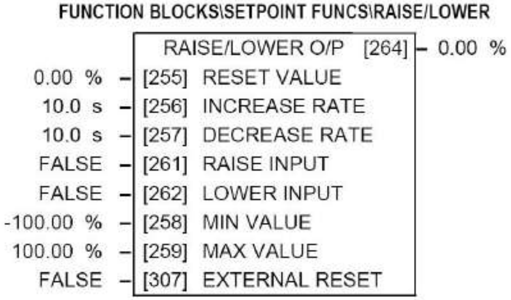




RAISE/LOWER

This function block acts as an internal motorised potentiometer (MOP).

The OUTPUT is not preserved when the drive is powered-down.



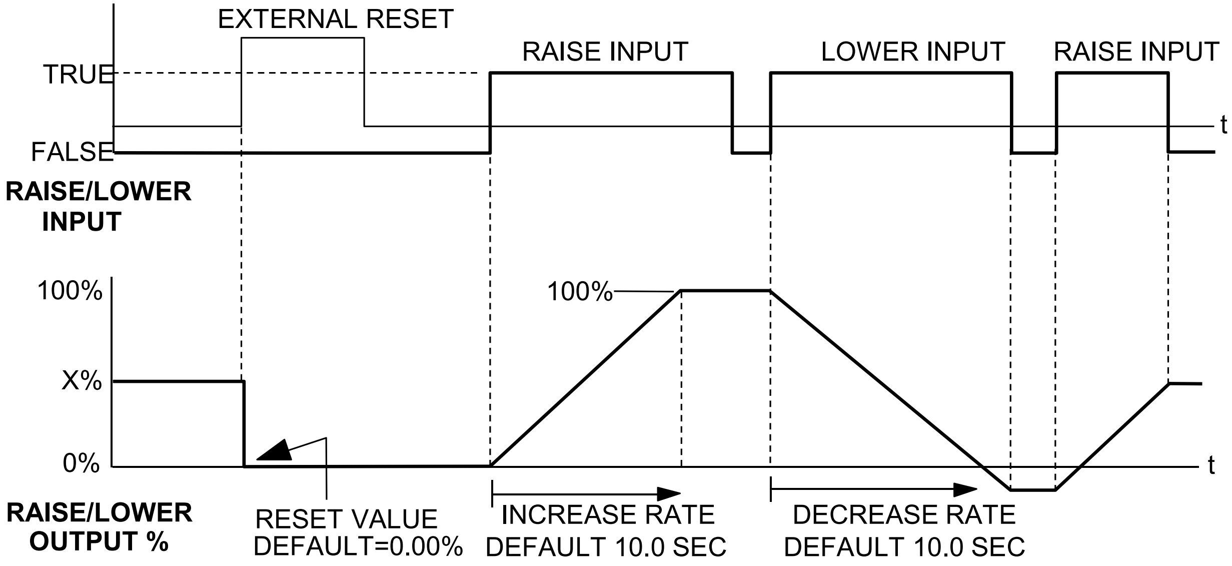
RAISE/LOWER

Parameter	Tag	Range
RAISE/LOWER O/P	**264**	**— .xx %**
The output value.		
RESET VALUE	**255**	**-300.00 to 300.00 %**
This reset value is pre-loaded directly into the output when EXTERNAL RESET is TRUE, or at power-up. It is clamped by MIN VALUE and MAX VALUE.		
INCREASE RATE	**256**	**0.1 to 600.0 s**
Rate of change of an increasing output value. An increasing value is defined as the output ramping away from zero.		
DECREASE RATE	**257**	**0.1 to 600.0 s**
Rate of change of a decreasing output value. A decreasing value is defined as the output ramping towards zero.		
RAISE INPUT	**261**	**FALSE / TRUE**
Command to raise the output value. When TRUE, increases the output at the rate determined by INCREASE RATE.		
LOWER INPUT	**262**	**FALSE / TRUE**
Command to lower the output value. When TRUE, decreases the output at the rate determined by DECREASE RATE.		

RAISE/LOWER

Parameter	Tag	Range
MIN VALUE	**258**	**-300.00 to 300.00 %**
Minimum ramp output clamp. This is a plain clamp, not a ramped "min speed" setting.		
MAX VALUE	**259**	**-300.00 to 300.00 %**
Maximum ramp output clamp.		
EXTERNAL RESET	**307**	**FALSE / TRUE**
When TRUE, sets the output of the Raise/Lower block to the RESET VALUE.		

Functional Description



The diagram above illustrates the raise/lower functionality.

When EXTERNAL RESET is set TRUE, the raise/lower output resets to RESET VALUE (default = 0.00%).

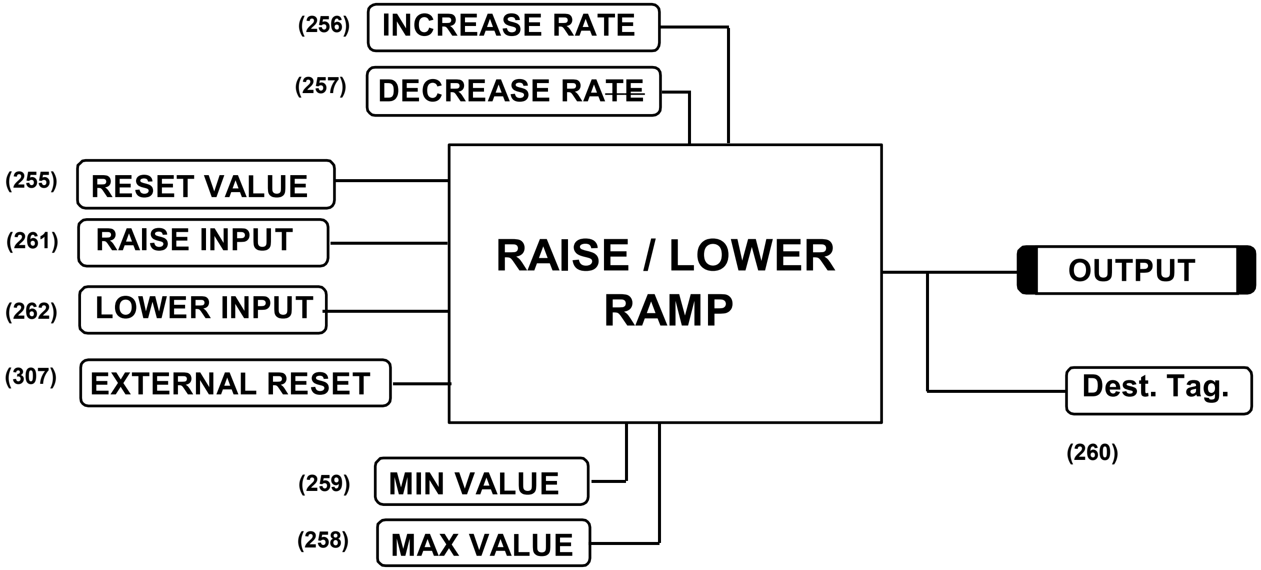
When RAISE INPUT is TRUE, the output increases at INCREASE RATE. The output cannot exceed MAX VALUE.

The reverse is true when LOWER INPUT is TRUE: LOWER INPUT reduces the output at DECREASE RATE. The output cannot drop below MIN VALUE.

The ramp is held at its last value when the RAISE and LOWER INPUT are removed.

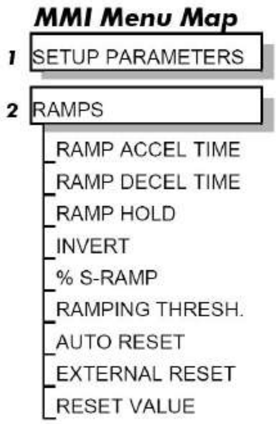
Setting both RAISE INPUT and LOWER INPUT to TRUE at the same time creates a ramp hold condition.

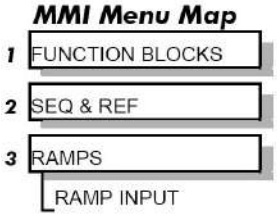
If MIN VALUE is greater than MAX VALUE the output is forced to zero.

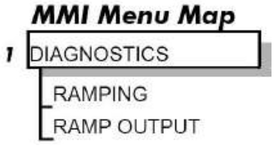


If Reset, Output = Reset Value (Clamped)

RAMPS

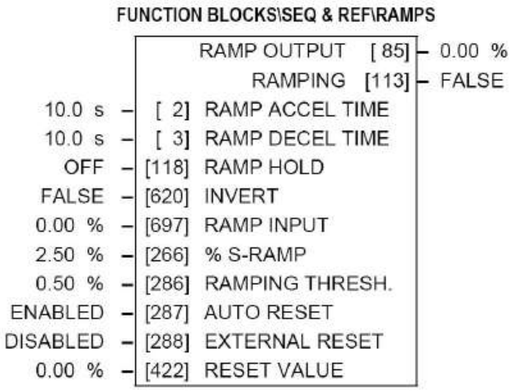






The RAMPS parameters set the shape and duration of the ramp used for starting and changing speeds.

NOTE **The STOP RATES function block contains a separate deceleration rate for controlled stopping of the drive.**



By default the inputs are ANIN 3 (A4) for a ramped speed input, and DIGIN 2 (C7) to switch RAMP HOLD. The input signal to the block is clamped by MIN SPEED, which sets the minimum ramp input speed when the drive is enabled. The default output connection is to SPEED LOOP:: SETPOINT 3.

RAMP INPUT is internally routed to the JOG/SLACK function block to be modified as determined by the JOG inputs. The RAMPS block then shapes the signal to produce the RAMP OUTPUT signal.

The RAMPING output becomes TRUE when the absolute value of the difference between RAMP OUTPUT and the JOG/SLACK function block output exceeds RAMPING THRESH.

RAMP ACCEL TIME and RAMP DECEL TIME set the acceleration and deceleration times taken for input changes. % S-RAMP adds a "S" shaped section to the linear ramp. When set to 0.00%, the ramp will be linear. As the percentage is increased, 350% of the S-RAMP time is added to the linear ramp creating more gradual starting and stopping. The formula for the actual ramp time is shown below. Ramp time is the value of parameters RAMP ACCEL TIME or RAMP DECEL TIME.

Actual Ramp Time = RAMP TIME x (3.5 x % S-RAMP/100 + 1)

RAMP HOLD stops the ramp from changing. When DIGIN 2 (C7) is ON, the ramp stays at the last ramp value.

The reset signal can have two sources, a RUN signal or an external reset signal. When AUTO RESET is ENABLED, the ramp resets whenever a Run signal is given at terminal C3. Connecting a digital input to EXTERNAL RESET allows an external source to reset the ramp.

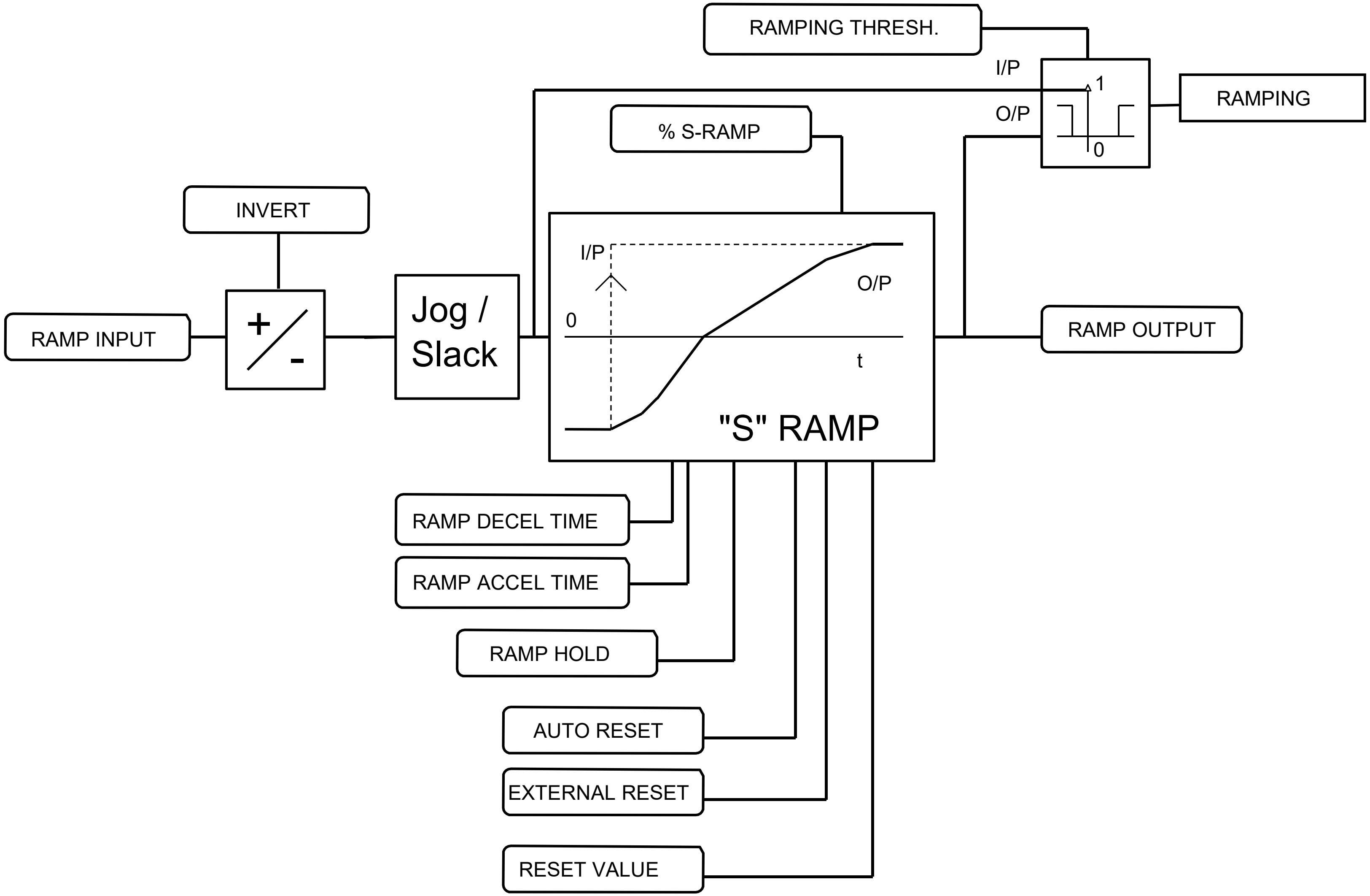
RAMPS

Parameter	Tag	Range
RAMP ACCEL TIME	**2**	**0.1 to 600.0 s**
The acceleration time for 100% change.		
RAMP DECEL TIME	**3**	**0.1 to 600.0 s**
The deceleration time for 100% change.		

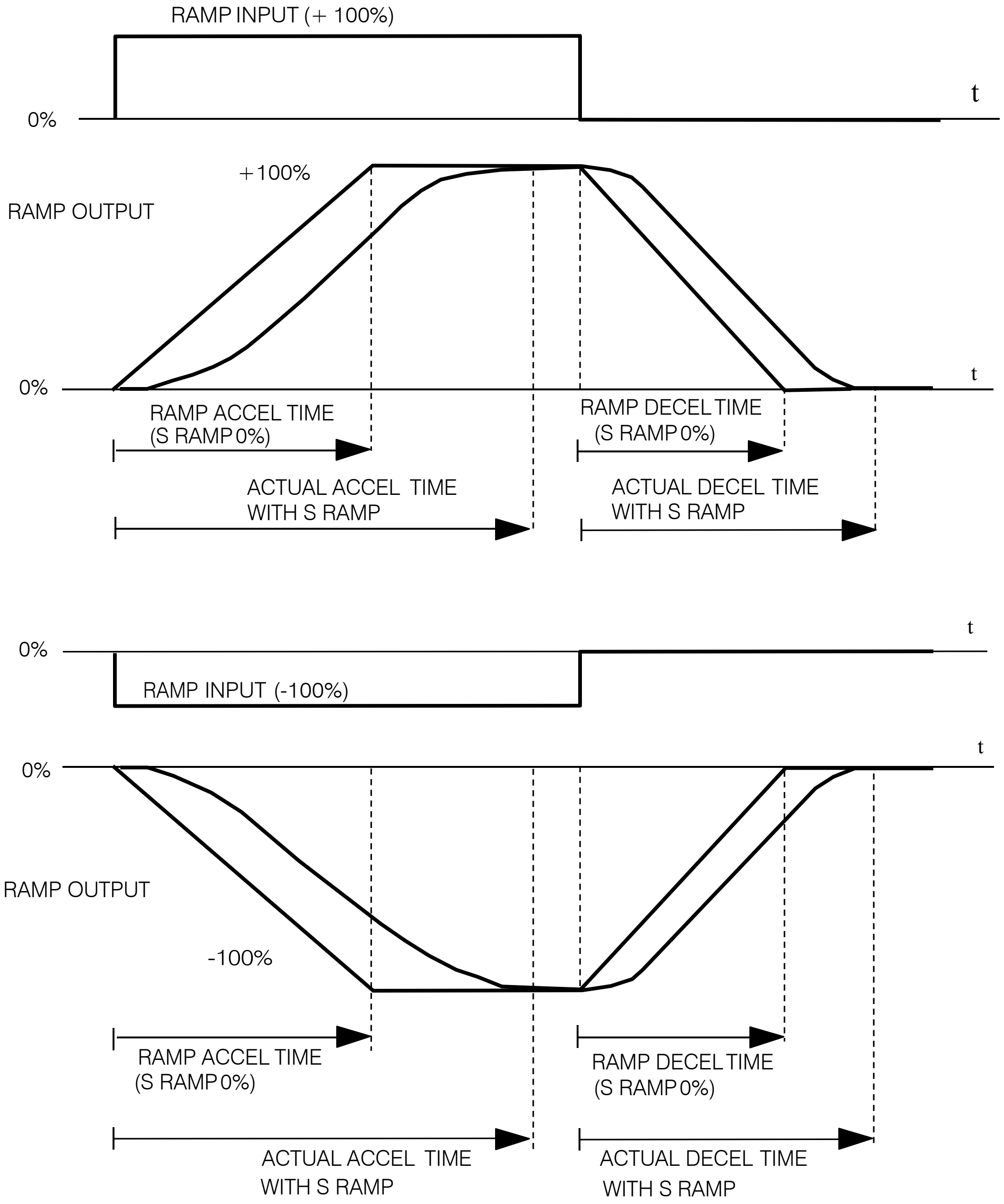
RAMPS

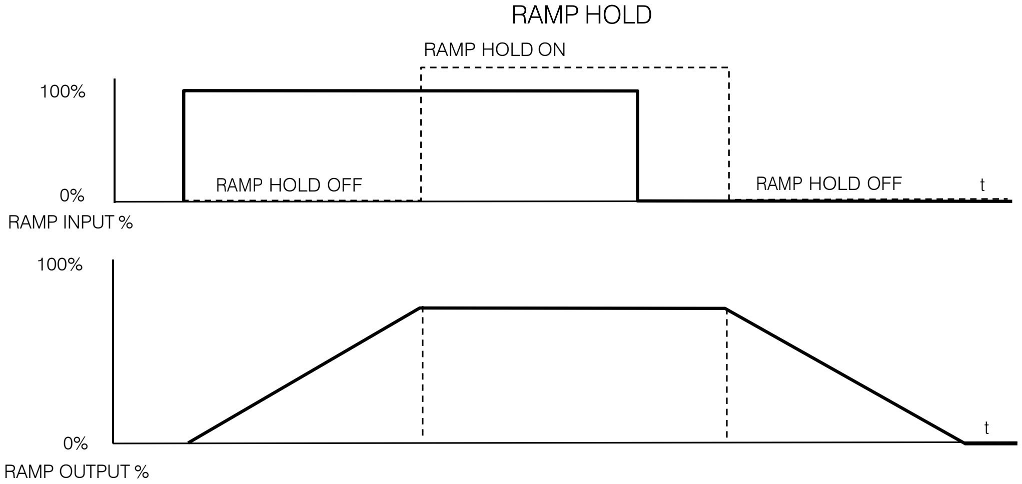
Parameter	Tag	Range
RAMP HOLD	**118**	**OFF / ON**
When ON, the ramp output is held at its last value. This is overridden by a ramp reset.		
INVERT	**620**	**FALSE / TRUE**
Inverts the RAMP INPUT signal.		
RAMP INPUT	**5**	**-105.00 to 105.00 %**
Input value.		
% S-RAMP	**266**	**0.00 to 100.00 %**
Percentage of ramp with S-shaped rate of change. A value of zero is equivalent to a linear ramp. Changing this value affects the ramp times.		
RAMPING THRESH.	**286**	**0.00 to 100.00 %**
Ramping flag threshold level. The threshold is used to detect whether the ramp is active.		
AUTO RESET	**287**	**DISABLED / ENABLED**
When ENABLED, the ramp is reset whenever SYSTEM RESET is TRUE. (SYSTEM RESET Tag 374 is an internal flag that is set TRUE for one cycle after the Speed/Current loop is enabled, i.e. every time the drive is started).		
EXTERNAL RESET	**288**	**DISABLED / ENABLED**
When ENABLED, the ramp is reset to RESET VALUE. EXTERNAL RESET does not depend on AUTO RESET for its operation.		
RESET VALUE	**422**	**-300.00 to 300.00 %**
The ramp output value at power-up, or when the ramp is reset. In order to catch a spinning load smoothly (`bumpless transfer') connect SPEED FEEDBACK Tag No. 62 (source) to RESET VALUE Tag No. 422 (destination).		
RAMP OUTPUT	**85**	**— .xx %**
Setpoint ramp output.		
RAMPING	**113**	**FALSE / TRUE**
The SETPOINT ramp function block is limiting the rate of change of Speed Setpoint.		

Functional Description

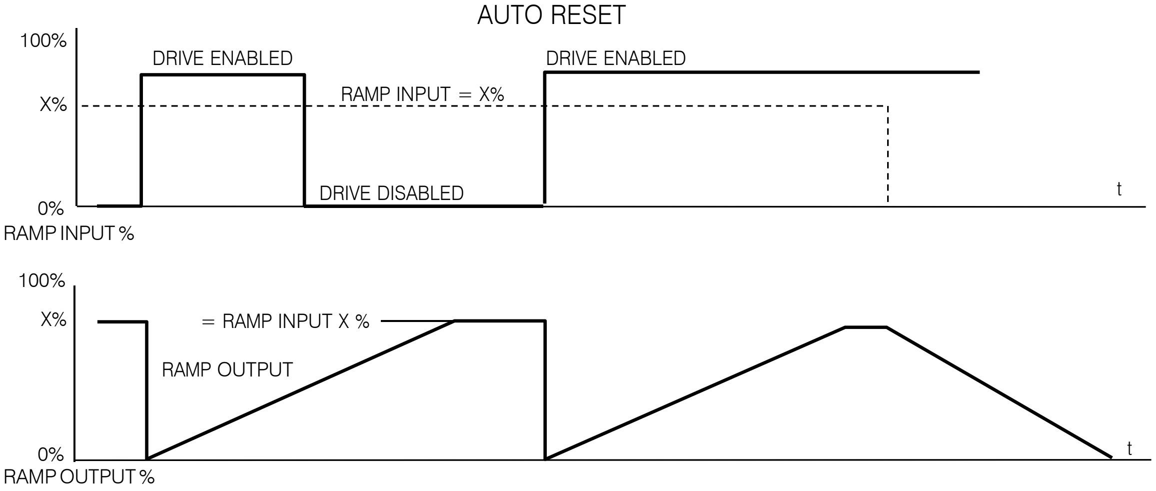


ACCELERATION/DECELERATION RATES

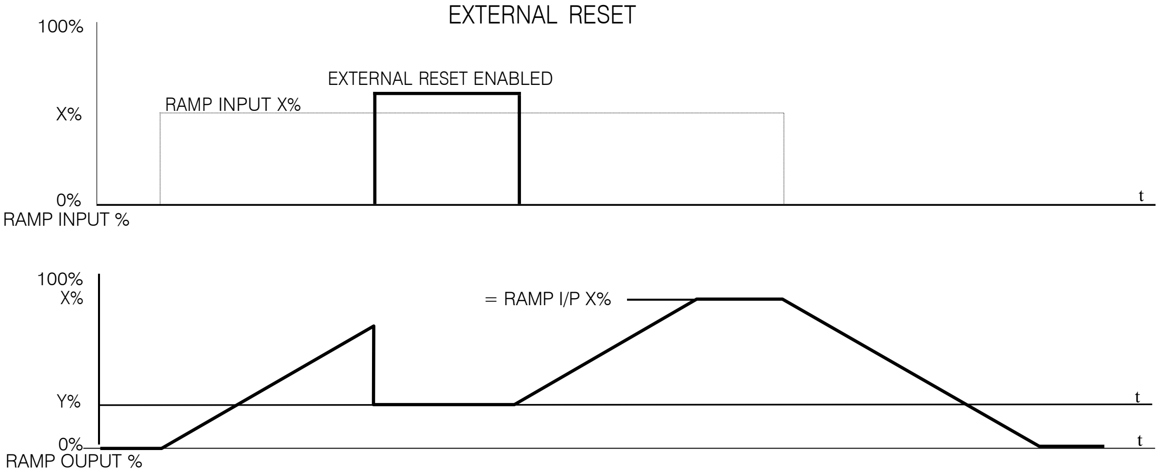




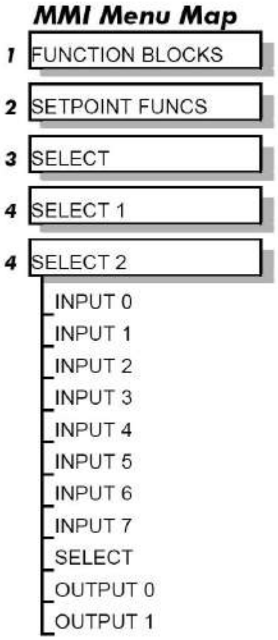
The ramp will function when a ramp input is present. When DIGIN 2 (C7) is ON, RAMP HOLD stops the ramp from changing. Even when the ramp input signal is removed, RAMP HOLD keeps the ramp output from changing. Once RAMP HOLD is OFF, the ramp resumes.



When AUTO RESET is ENABLED, ramp output resets to RESET VALUE each time the drive is enabled. In this example RESET VALUE is 0.00%. It does not reset if the drive is disabled.

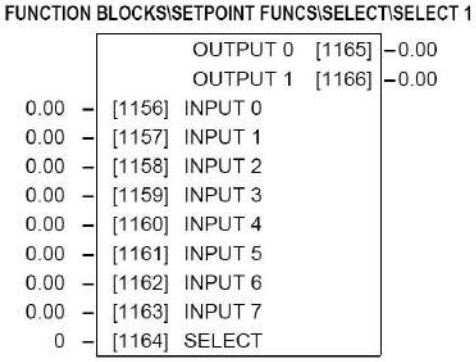


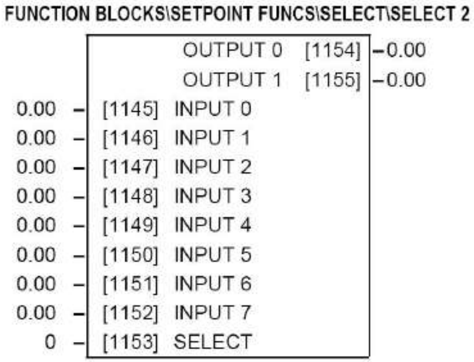
The ramp input is set to X% at time t_0. The ramp output will increase at the ramp rate.
While EXTERNAL RESET is ENABLED, the ramp output resets to RESET VALUE (Y%). When EXTERNAL RESET is DISABLED, the ramp output continues to follow the input signal.



SELECT

Used to select a value from one of eight inputs, depending on the value of the select input. A second output is provided to allow the block to be used as two banks of four inputs.





SELECT

Parameter	Tag	Range
INPUT 0 to INPUT 7	**1156 to 1163**	**-32768.00 to 32768.00**
Inputs to the select block		
SELECT	**1164**	**0 to 7**
Determines which of the inputs is routed to OUTPUT 1 . In addition, if SELECT INPUT is in the range 0 to 3, INPUT 4 to INPUT 7 respectively is routed to OUTPUT 2, otherwise OUTPUT 2 is unchanged.		
OUTPUT 0	**1165**	**—.xx**
Selected output		
OUTPUT 1	**1166**	**—.xx**
Alternative selected output from INPUT 4 to INPUT 7 if SELECT is less than 4.		

SEQUENCING

This function block contains all the parameters relating to the sequencing (start and stop) of the drive.

MMI Menu Map

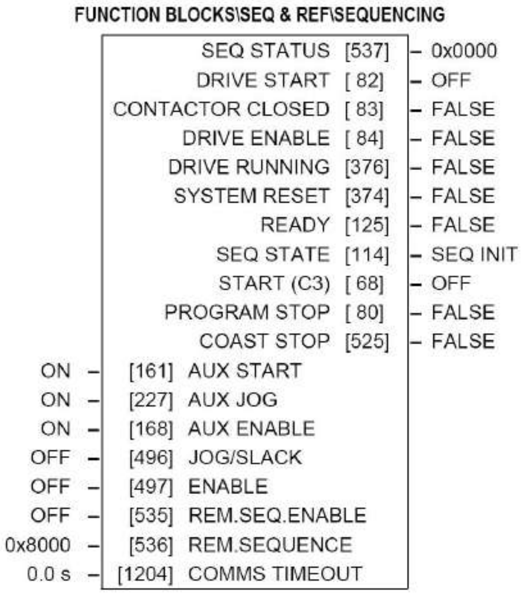
1 SETUP PARAMETERS
2 AUX I/O
  AUX START
  AUX JOG
  AUX ENABLE
  JOG SLACK
  ENABLE
  REM.SEQ.ENABLE
  REM. SEQUENCE
  SEQ STATUS

MMI Menu Map

1 DIAGNOSTICS
  PROGRAM STOP
  COAST STOP
  DRIVE START
  DRIVE ENABLE
  START (C3)
  CONTACTOR CLOSED
  READY
  DRIVE RUNNING
  SYSTEM RESET

MMI Menu Map

1 FUNCTION BLOCKS
2 SEQ & REF
3 SEQUENCING
  COMMS TIMEOUT
  SEQ STATE



SEQUENCING

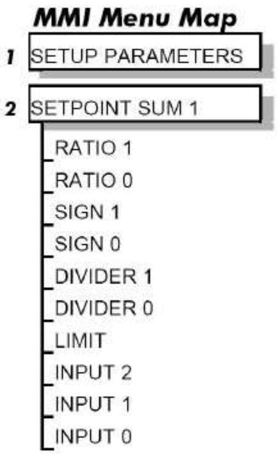
Parameter	Tag	Range
AUX START	**161**	**OFF / ON**
Software Start/Run command. Auxiliary Start is ANDed with the Start input, C3, to generate Drive Start. This should normally be left ON.		
AUX JOG	**227**	**OFF / ON**
Software Jog command. Auxiliary Jog is ANDed with the Jog input, Tag 496 (by default C4), to generate Drive Jog. This should normally be left ON.		
AUX ENABLE	**168**	**OFF / ON**
Software Enable command. Auxiliary Enable is ANDed with the Enable input, Tag 497 (by default C5), to generate Drive Enable. This should normally be left ON.		

SEQUENCING

Parameter	Tag	Range
JOG/SLACK	**496**	**OFF / ON**
Main jog input which is connected to DIGITAL INPUT C4 by default. The Jog input is ANDed with Auxiliary Jog input, Tag 227, to generate Drive Jog.		
ENABLE	**497**	**OFF / ON**
Enable input which is connected to DIGITAL INPUT C5 by default. The Enable input is ANDed with Auxiliary Enable input, Tag 168, to generate Drive Enable.		
REM.SEQ.ENABLE	**535**	**FALSE / TRUE**
(Refer to Chapter 4: "External Control of the Drive"). When enabled, the drive will accept Sequencing commands exclusively from the REM. SEQUENCE parameter, Tag 536. FALSE - disables REM. SEQUENCE TRUE - enables REM. SEQUENCE		
REM.SEQUENCE	**536**	**0x0000 to 0xFFFF**
A control word that allows the device to be operated remotely over a field bus. REM. SEQ. ENABLE must be TRUE to enable this function. (Refer to Chapter 4: "External Control of the Drive")		
COMMS TIMEOUT	**1204**	**0.0 to 60.0 s**
A watchdog timeout that may be used when the drive is in remote sequencing mode. The watchdog feature is enabled by selecting a non-zero time in this parameter. The watchdog is reset every time the REM.SEQUENCE word, (Tag 536), is written.		
SEQ STATUS	**537**	**0x0000 to 0xFFFF**
An data word that reports the status of the important system flags that can be read over a field bus. (Refer to Chapter 4: "External Control of the Drive")		
DRIVE START	**82**	**OFF / ON**
Logical OR of the START and JOG inputs.		
CONTACTOR CLOSED	**83**	**FALSE / TRUE**
When ON, the main contactor coil is energised. Refer to Terminal Information for D5 & D6 in Appendix E: "Technical Specifications" - Terminal Information.		
DRIVE ENABLE	**84**	**FALSE / TRUE**
Drive speed and current loop are enabled/quenched.		
DRIVE RUNNING	**376**	**FALSE / TRUE**
When TRUE, the stack is switched on and enabled.		

SEQUENCING

Parameter	Tag	Range
SYSTEM RESET	**374**	**FALSE / TRUE**
Set for one cycle as the drive is enabled.		
READY	**125**	**FALSE / TRUE**
The drive is ready to accept an enable signal.		
SEQ STATE	**114**	**See below**
0: SEQ INIT 1: SEQ INIT 2: SEQ HOLD 3: SEQ STANDBY 4: SEQ PRE READY 5: SEQ READY 6: SEQ AUTOTUNING 7: SEQ RUN 8: SEQ AT ZERO SPD. 9: SEQ QUENCH 10: SEQ PROGRAM STOP 11: SEQ STOP 12: SEQ DELAY STOP 13: CURRENT DECAY 14: SEQ COAST STOP 15: SEQ ERROR		
START (C3)	**68**	**OFF / ON**
State of the Start/Run terminal.		
PROGRAM STOP	**80**	**FALSE / TRUE**
State of program stop (Terminal B8). When B8 is at 24V, then PROGRAM STOP is FALSE.		
COAST STOP	**525**	**FALSE / TRUE**
State of coast stop (Terminal B9). When B9 is at 24V, then COAST STOP is FALSE.		

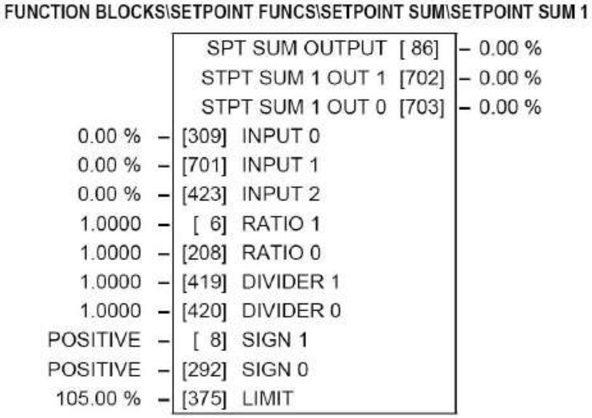


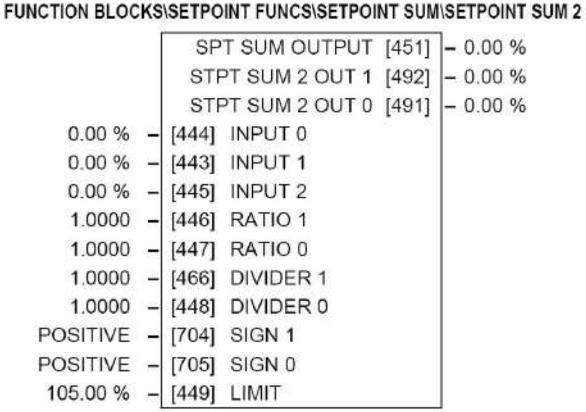
SETPOINT SUM

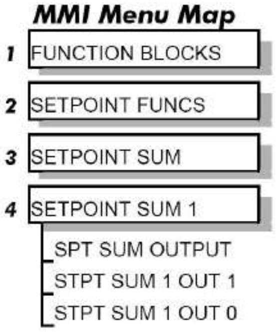
Use this menu to sum and scale up to three analog inputs to produce the SPT. SUM output.

INPUT 0 and INPUT 1 have individual ratio and divider scalers, and signs. The inputs have symmetrical limits set by LIMIT. INPUT 2 has no scaling or limits.

The output, after INPUT 0, INPUT 1 and INPUT 2 are summed, is also clamped by LIMIT before producing the SPT. SUM output.







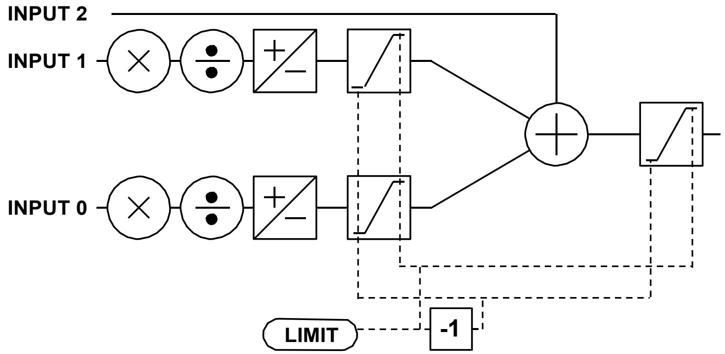
SETPOINT SUM

Parameter	Tag	Range
INPUT 0 Input 0 value.	**309**	**-300.00 to 300.00 %**
INPUT 1 Input 1 value.	**701**	**-300.00 to 300.00 %**
INPUT 2 Input 2 value.	**423**	**-300.00 to 300.00 %**
RATIO 1 Multiplier term for INPUT 1.	**6**	**-3.0000 to 3.0000**
RATIO 0 Multiplier term for INPUT 0.	**208**	**-3.0000 to 3.0000**
DIVIDER 1 Divider scaling for INPUT 1. Dividing by 0 (zero) results in a zero output.	**419**	**-3.0000 to 3.0000**
DIVIDER 0 Divider scaling for INPUT 0. Dividing by 0 (zero) results in a zero output.	**420**	**-3.0000 to 3.0000**
SIGN 1 Polarity for INPUT 1.	**8**	**NEGATIVE / POSITIVE**
SIGN 0 Polarity for INPUT 0.	**292**	**NEGATIVE / POSITIVE**

SETPOINT SUM

Parameter	Tag	Range
LIMIT	**375**	**0.00 to 200.00 %**

The Setpoint Sum programmable limit is symmetrical and has the range 0.00% to 200.00%. The limit is applied both to the intermediate results of the RATIO calculation and the total output.



Parameter	Tag	Range
SPT SUM OUTPUT	**86**	**–.xx %**
The sum of input 0, 1 and 2 after the limit clamp.		
STPT SUM 1 OUT 1	**702**	**–.xx %**
An additional output provided to gain access to Input 1 channel sub-calculations. The result of (INPUT 1 x RATIO 1) / DIVIDER 1 clamped to within ± LIMIT.		
STPT SUM 1 OUT 0	**703**	**–.xx %**
An additional output provided to gain access to Input 0 channel sub-calculations. The result of (INPUT 0 x RATIO 0) / DIVIDER 0 clamped to within ± LIMIT.		

MMI Menu Map

1 FUNCTION BLOCKS

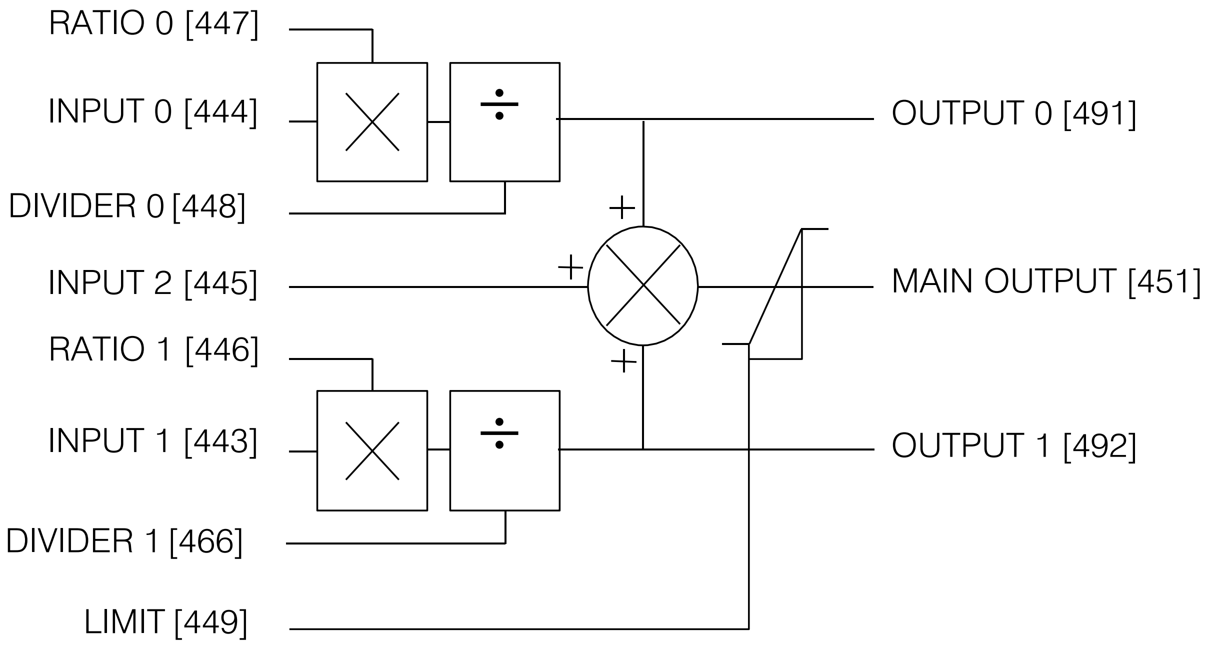
2 SETPOINT FUNCS

3 SETPOINT SUM

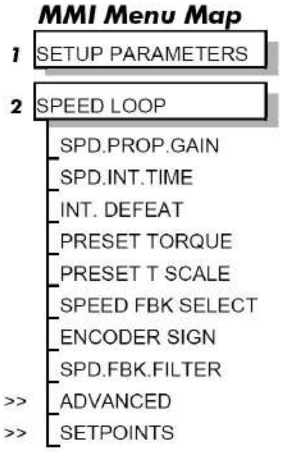
4 SETPOINT SUM 2

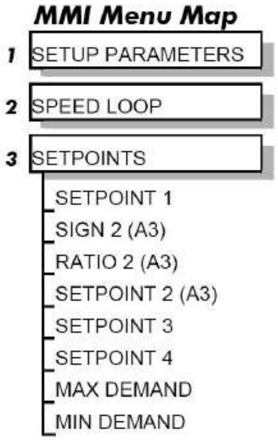
- INPUT 0
- INPUT 1
- INPUT 2
- RATIO 1
- RATIO 0
- DIVIDER 1
- DIVIDER 0
- SIGN 1
- SIGN 0
- LIMIT
- SPT SUM OUTPUT
- STPT SUM 2 OUT 1
- STPT SUM 2 OUT 0

Functional Description



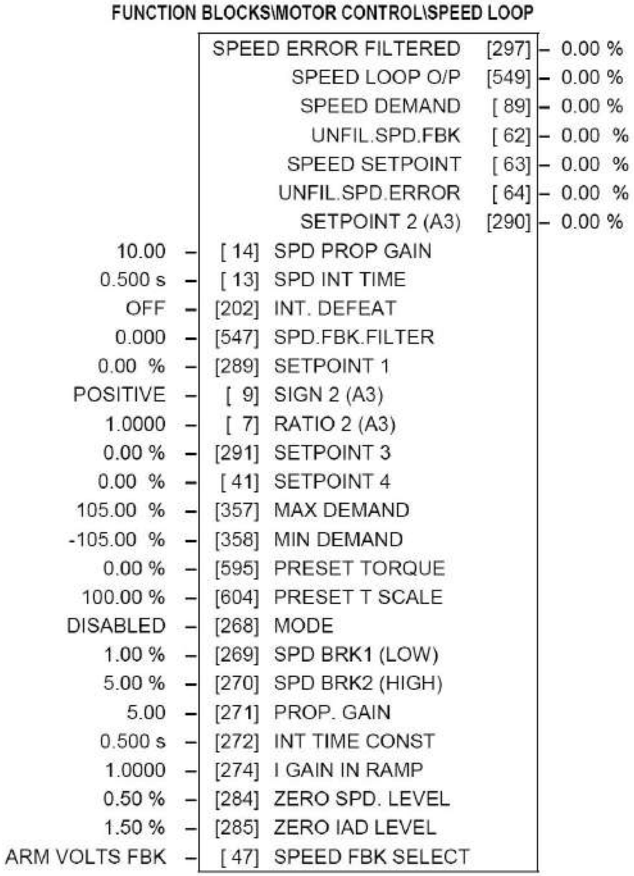
SPEED LOOP





Use this block to tune the speed loop PI to produce a current demand.

This function block has five main functions:



1. **Combining the 4 speed setpoints into a single speed setpoint.**

   Note that the speed demand is created from the combined speed setpoints and modified by any prevailing stop condition according to the STOP RATES function block settings.

2. **Selection of the speed feedback method.**

   ZERO SPD OFFSET from the CALIBRATION function block is applied to the selected speed feedback to null out any remaining feedback at zero actual speed.

3. **Implementation of the PI speed controller.**

   SPEED DEMAND is summed algebraically with SPEED FEEDBACK to produce SPEED ERROR. When the drive is enabled, SPEED ERROR is controlled by the PI loop. The resulting current demand signal is routed to the CURRENT LOOP function block and to the ADVANCED::ZERO SPD. QUENCH sub-menu.

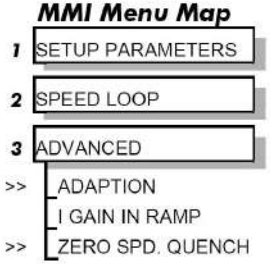
   The PI output is accessible via Tag No. 356, TOTAL I DMD. This point is before the I Limit clamps and the summing of the additional current demand. (This tag is not visible on the MMI).

4. **Speed controller gain and integral time constant profiling with speed.**

The gains change when the motor speed feedback reaches the thresholds set by SPD BRK 1 (LOW) and SPD BRK 2 (HIGH).

- At or below SPD BRK 1 (LOW), the speed loop uses the PROP. GAIN and INT. TIME CONST. values as its PI loop gains.
- Between SPD BRK 1 (LOW) and SPD BRK 2 (HIGH), profiling occurs and the speed loop gains are determined by another parameter value (according to the selection of the MODE parameter).
- Above SPD BRK 2 (HIGH), the SPD. PROP. GAIN and SPD. INT. TIME settings are used.

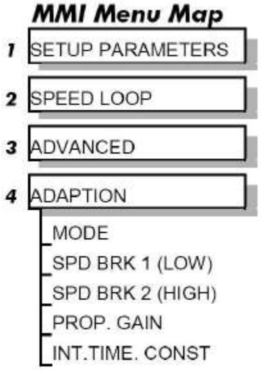
MODE selects the parameter for profiling the speed loop PI gains when the motor speed is between the two speed breakpoints.

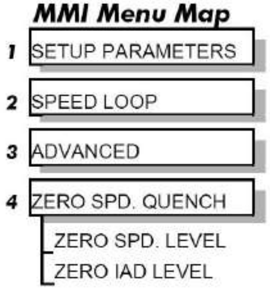


5. **Zero speed/current disabling of thyristor firing**

The current loop is disabled when SPEED DEMAND, SPEED FEEDBACK and CURRENT DEMAND have all dropped to the threshold levels set by ZERO SPD. LEVEL and ZERO IAD LEVEL.

This is similar to Standstill logic (it stops making current but the contactor stays energised) except that the speed loop remains enabled and this will cause the current loop to unquench very quickly.





SPEED LOOP

Parameter	Tag	Range
SPD PROP GAIN Speed loop PI proportional gain adjustment.	**14**	**0.00 to 200.00**
SPD INT TIME Speed loop PI integral gain adjustment.	**13**	**0.001 to 30.000 s**
INT. DEFEAT When ON it inhibits the integral part of the speed loop PI control to give proportional only control.	**202**	**OFF / ON**
SPEED FBK FILTER (SPD.FBK.FILTER) A simple filter function that is applied to speed feedback to reduce ripple caused by low line count encoders and noisy tachos. A value of 0 disables the filter action ,and 1.00 is the maximum value. A typical value would be between 0.5 and 0.75. INCREASING THE FILTER VALUE MAY MAKE THE SPEED LOOP UNSTABLE. The filter time constant τ in milliseconds can be calculated from the following equation: $\tau = \frac{3.3}{Log_e\left(\frac{1}{\alpha}\right)}$ Where α is the value of SPD FBK FILTER. A value of 0.5 equates to a filter time of 4.8ms, 0.8 to 14.7ms, and 0.9 to 31.2ms.	**547**	**0.000 to 1.000**
SETPOINT 1 Speed Setpoint 1 (Default Setpoint Sum 1 O/P).	**289**	**-105.00 to 105.00 %**
SIGN 2 (A3) Speed Setpoint 2 Sign.	**9**	**NEGATIVE / POSITIVE**

SPEED LOOP

Parameter	Tag	Range
RATIO 2 (A3) Speed Setpoint 2 Ratio.	**7**	**-3.0000 to 3.0000**
SETPOINT 3 Speed Setpoint 3 (Default Ramp O/P).	**291**	**-105.00 to 105.00 %**
SETPOINT 4 Speed Setpoint 4 .	**41**	**-105.00 to 105.00 %**
MAX DEMAND Sets the maximum input to the speed loop. It is clamped at 105% to allow for overshoot in the external loops.	**357**	**0.00 to 105.00 %**
MIN DEMAND Sets the minimum input to the speed loop.	**358**	**-105.00 to 105.00 %**
PRESET TORQUE The PRESET TORQUE is pre-loaded into the speed loop integral store as the speed loop in enabled. This is scaled by PRESET T SCALE. This may be used to pre-load the output of the speed loop in elevator/hoist applications to prevent the load from falling back when the brake is released. PRESET T SCALE may be used in situations where the load may vary.	**595**	**-200.00 to 200.00 %**
PRESET T SCALE Scaler for PRESET TORQUE.	**604**	**-200.00 to 200.00 %**
MODE Selects the speed breakpoint input signal. 0 : DISABLED 1 : SPD FBK DEP Speed Feedback Dependent 2 : SPD ERR DEP Speed Error Dependent 3 : CUR DMD DEP Current Demand Dependent	**268**	**See below**
SPD BRK 1 (LOW) Speed breakpoint 1 to start gain profiling.	**269**	**0.00 to 100.00 %**
SPD BRK 2 (HIGH) Speed breakpoint 2 to stop gain profiling.	**270**	**0.00 to 100.00 %**

SPEED LOOP

Parameter	Tag	Range
PROP. GAIN	**271**	**0.00 to 200.00**
Proportional gain used below SPD BRK 1 (LOW)		
INT. TIME CONST.	**272**	**0.001 to 30.000 s**
Integral time constant used below SPD BRK 1 (LOW)		
I GAIN IN RAMP	**274**	**0.0000 to 2.0000**
This scales the integral gain when the drive is ramping. When RAMPING (Tag No. 113) is TRUE, the integral gain from ADAPTION is switched through the I GAIN IN RAMP scaler. This can be used to help prevent integral wind-up while the drive is ramping (particularly high inertia loads).		
ZERO SPD. LEVEL	**284**	**0.00 to 200.00 %**
Sets the threshold of SPEED DEMAND and SPEED FEEDBACK for suspending the current output.		
ZERO IAD LEVEL	**285**	**0.00 to 200.00 %**
Sets the current demand threshold for suspending the current output.		
SPEED ERROR FILTERED	**297**	**— .xx %**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
SPEED LOOP O/P	**549**	**— .xx %**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
SPEED DEMAND	**89**	**— .xx %**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
UNFIL.SPD.FBK	**62**	**— .xx %**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
SPEED SETPOINT	**63**	**— .xx %**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
UNFIL.SPD.ERROR	**64**	**— .xx %**
Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).		
SETPOINT 2 (A3)	**290**	**— .xx %**
Speed Setpoint 2 - Fixed (non-configurable) setpoint scanned synchronously with the current loop		

SPEED LOOP

Parameter	Tag	Range
SPEED FBK SELECT	**47**	**See below**

Determines the source of the speed feedback signal. The default, ARM VOLTS FBK, uses internal circuitry to derive the speed feedback. The other selections require the appropriate external device to provide the feedback signal.

0 : ARM VOLTS FBK
1 : ANALOG TACH
2 : ENCODER
3 : ENCODER/ANALOG - for DC900P Drives use

Functional Description

Speed Loop PI with Current Demand Isolate

The speed loop output is still valid (active) with the I DMD. ISOLATE parameter enabled.

NOTE

1 The speed loop is reset by unquenching the speed loop/current loop.

2 I DMD. ISOLATE is overridden by Program Stop (B8) or Normal Stop (C3).

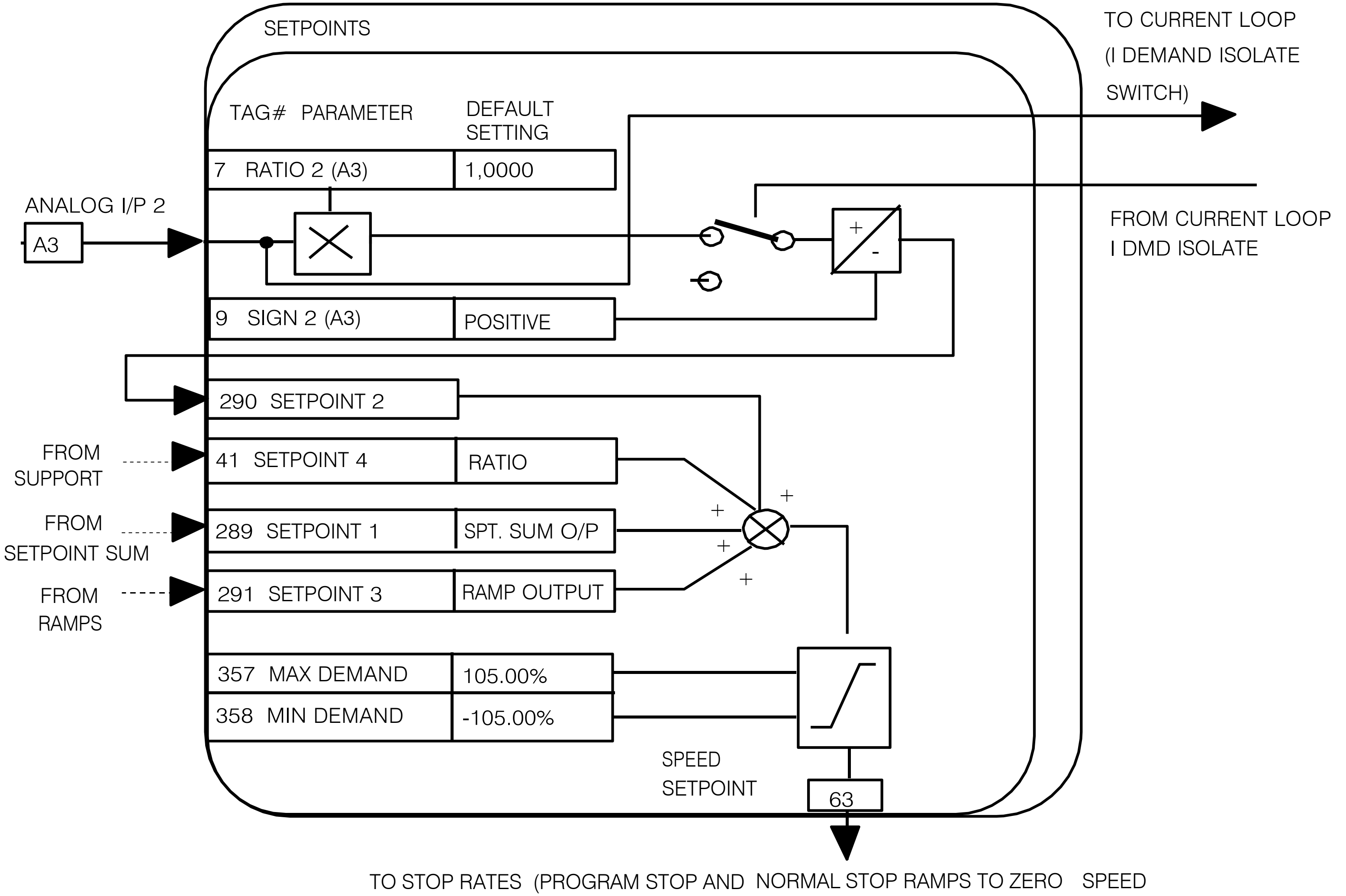
3 The speed loop PI holds the integral term as soon as the PI output reaches current limit. This is true even in Current Demand Isolate mode where it may interfere depending on the way the speed PI is used. This feature is currently not suppressible.

SPEED LOOP

Parameter	Tag	Range

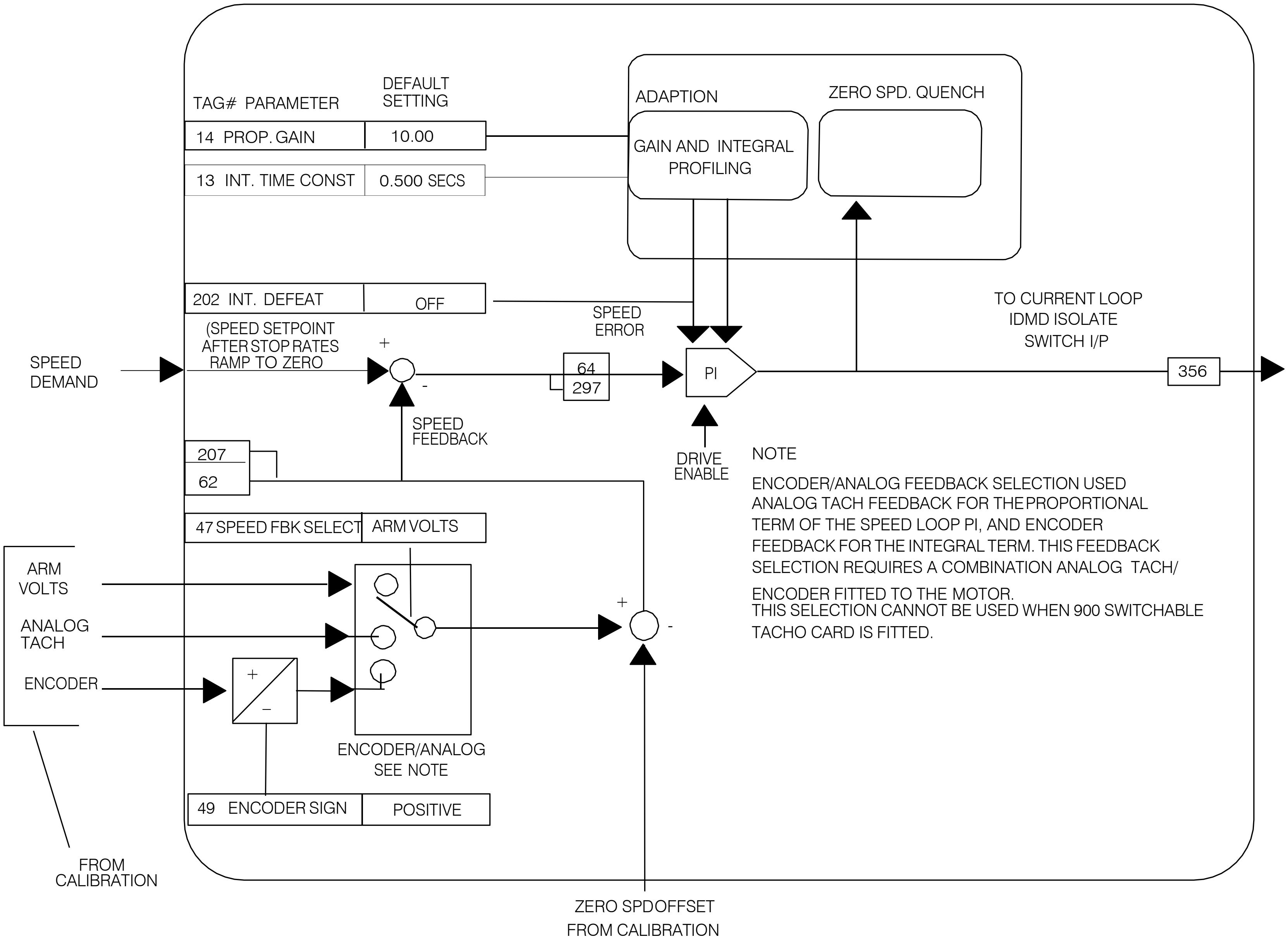
105% Speed Demands

The speed demand clamping allows the speed setpoint to reach 105%. This applies only to the final summing junction immediately before the speed loop and also to the Setpoint Sum 1 output. Individual speed setpoints are still clamped to 100%.



TO STOP RATES (PROGRAM STOP AND NORMAL STOP RAMPS TO ZERO SPEED

SPEED LOOP

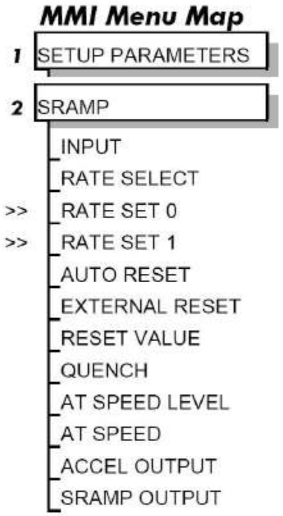


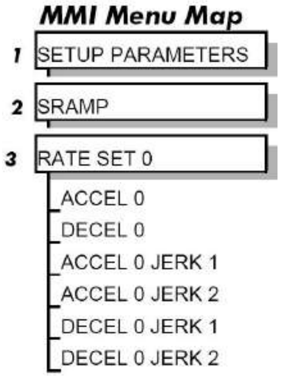
NOTE

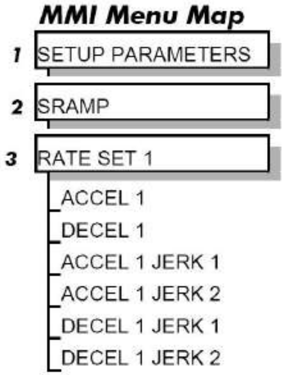
ENCODER/ANALOG FEEDBACK SELECTION USED ANALOG TACH FEEDBACK FOR THE PROPORTIONAL TERM OF THE SPEED LOOP PI, AND ENCODER FEEDBACK FOR THE INTEGRAL TERM. THIS FEEDBACK SELECTION REQUIRES A COMBINATION ANALOG TACH/ ENCODER FITTED TO THE MOTOR.
THIS SELECTION CANNOT BE USED WHEN 900 SWITCHABLE TACHO CARD IS FITTED.

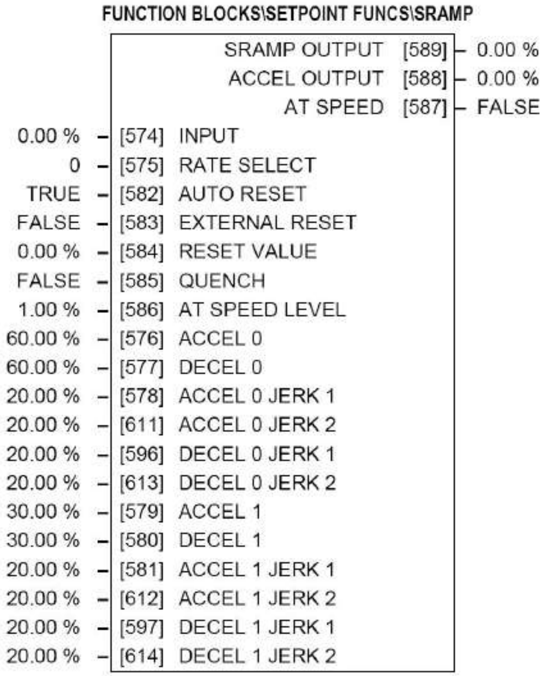
SRAMP

This function block limits the rate of change of an input by limiting the acceleration and the jerk (rate of change of acceleration).









SRAMP

Parameter	Tag	Range
INPUT	**574**	**-100.00 to 100.00 %**
Input value.		
RATE SELECT	**575**	**0 to 1**
Selects between one of two parameter sets. This allows you to have two operating modes (RATE SET 0 or RATE SET 1) with independent ramp parameters.		
AUTO RESET	**582**	**FALSE / TRUE**
The ramp is reset automatically when the drive is enabled if set to TRUE.		
EXTERNAL RESET	**583**	**FALSE / TRUE**
Resets the ramp output.		

SRAMP

<table>
<tr><th>Parameter</th><th>Tag</th><th>Range</th></tr>
<tr><td>RESET VALUE</td><td>584</td><td>-100.00 to 100.00 %</td></tr>
<tr><td colspan="3">The output value while RESET is TRUE also used as initial value on start up. If this is linked to speed feedback, the initial ramp output will be set to the current value of speed feedback.</td></tr>
<tr><td>QUENCH</td><td>585</td><td>FALSE / TRUE</td></tr>
<tr><td colspan="3">If TRUE forces the ramp input to zero.</td></tr>
<tr><td>AT SPEED LEVEL</td><td>586</td><td>0.00 to 100.00 %</td></tr>
<tr><td colspan="3">Threshold for AT SPEED diagnostic output.</td></tr>
<tr><td>ACCEL 0</td><td>576</td><td>0.00 to 100.00 %</td></tr>
<tr><td colspan="3">Acceleration rate, in units of percent per second^2. i.e. 75.00 % means that the maximum acceleration will be 75.00% per second^2 if the full speed of the machine is 1.25ms then the acceleration will be 1.25 * 75.0% = 0.9375ms^2 .</td></tr>
<tr><td>DECEL 0</td><td>577</td><td>0.00 to 100.00 %</td></tr>
<tr><td colspan="3">Deceleration rate, only active if SYMMETRIC = TRUE.</td></tr>
<tr><td>ACCEL 0 JERK 1</td><td>578</td><td>0.00 to 100.00 %</td></tr>
<tr><td colspan="3">Rate of change of acceleration, in units of percent per second^3.
For example: 75.00 % means that the maximum acceleration will be 50.00% per second^3 if the full speed of the machine is 1.25ms then the acceleration will be 1.25 * 50.0% = 0.625ms3.
If SYMMETRIC = TRUE then this value will be used for each of the four segments of the profile.
If SYMMETRIC = TRUE then this value will be used only for the first acceleration segment.</td></tr>
<tr><td>ACCEL 0 JERK 2</td><td>611</td><td>0.00 to 100.00 %</td></tr>
<tr><td colspan="3">Rate of change of acceleration in units of percent per second^3 for segment 2. Only applicable if SYMMETRIC = FALSE.</td></tr>
<tr><td>DECEL 0 JERK 1</td><td>596</td><td>0.00 to 100.00 %</td></tr>
<tr><td colspan="3">Rate of change of acceleration in units of percent per second^3 for segment 3. Only applicable if SYMMETRIC = FALSE.</td></tr>
<tr><td>DECEL 0 JERK 2</td><td>613</td><td>0.00 to 100.00 %</td></tr>
<tr><td colspan="3">Rate of change of acceleration in units of percent per second^3 for segment 4. Only applicable if SYMMETRIC = FALSE.</td></tr>
<tr><td>ACCEL 1</td><td>579</td><td>0.00 to 100.00 %</td></tr>
<tr><td colspan="3">Refer to ACCEL 0.</td></tr>
<tr><td>DECEL 1</td><td>580</td><td>0.00 to 100.00 %</td></tr>
<tr><td colspan="3">Refer to DECEL 0.</td></tr>
<tr><td>ACCEL 1 JERK 1</td><td>581</td><td>0.00 to 100.00 %</td></tr>
<tr><td colspan="3">Refer to ACCEL 0 JERK 1.</td></tr>
</table>

SRAMP

Parameter	Tag	Range
ACCEL 1 JERK 2 Refer to ACCEL 0 JERK 2.	**612**	**0.00 to 100.00 %**
DECEL 1 JERK 1 Refer to DECEL 0 JERK 1.	**597**	**0.00 to 100.00 %**
DECEL 1 JERK 2 Refer to DECEL 0 JERK 2.	**614**	**0.00 to 100.00 %**
SRAMP OUTPUT Diagnostic, ramp output.	**589**	**— .xx %**
ACCEL OUTPUT Acceleration diagnostic.	**588**	**— .xx %**
AT SPEED Diagnostic output indicating the Abs (input - output) is less than AT SPEED LEVEL.	**587**	**FALSE / TRUE**

Useful Equations

NOTE **These only hold true if Jerk = Jerk2 for acceleration or Jerk 3 = Jerk 4 for deceleration.**

V is the maximum speed the drive must reach.
In % / sec

A is the maximum allowable acceleration in %/sec^2

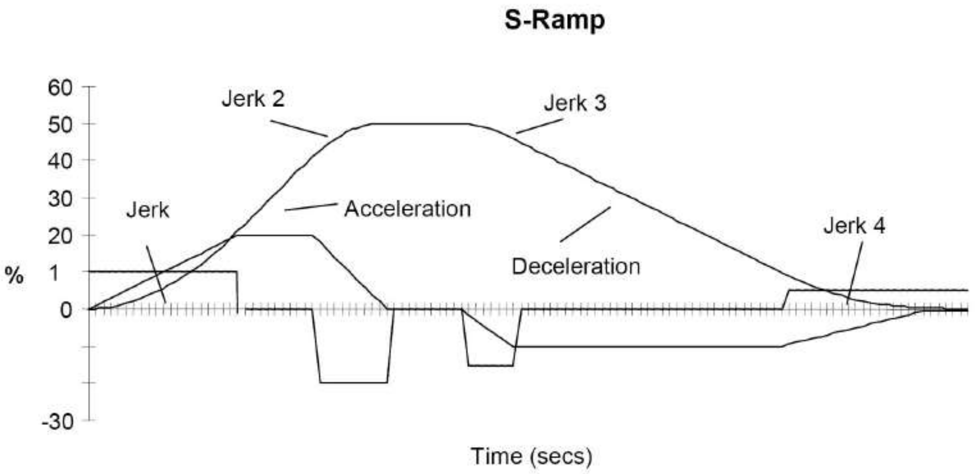
J is the maximum allowable value for jerk, in %/sec^3

The time needed to stop or accelerate is:

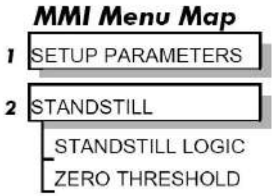
$$t = \frac{V}{A} + \frac{A}{J} \text{[Seconds]}$$

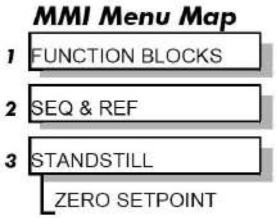
as the speed is symmetrical the average speed is V/2, therefore the stopping / acceleration distance can be calculated.

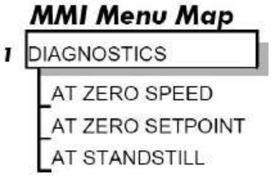
$$s = \frac{V}{2}\left(\frac{V}{A} + \frac{A}{J}\right) \quad \text{[Meters]}$$



Example acceleration graph for a velocity 60 %/s maximum Acceleration of 20 %/s^2 and a jerk of 10 %/s^3





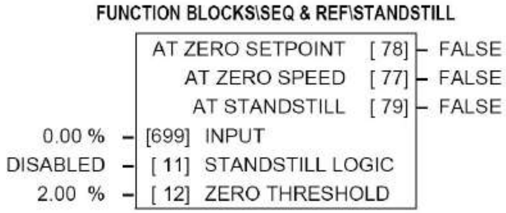


STANDSTILL

Set a ZERO THRESHOLD defining when the speed setpoint is at zero to inhibit motor rotation.

The inputs to this block are SPEED FEEDBACK from the SPEED LOOP function block and SPEED SETPOINT from setpoints.

The outputs are AT ZERO SPEED, AT STANDSTILL, and AT ZERO SETPOINT. AT ZERO SPEED is connected to DIGOUT 1 (B5) in the default configuration. A "not at standstill" signal is sent to the drive enable logic.



When SPEED FEEDBACK is less than ZERO THRESHOLD, AT ZERO SPEED is TRUE.
When SPEED SETPOINT is less than ZERO THRESHOLD, AT ZERO SETPOINT is TRUE.
When both AT ZERO SPEED and AT ZERO SETPOINT are TRUE, AT STANDSTILL is TRUE signalling the motor has stopped.

If AT STANDSTILL is TRUE and STANDSTILL LOGIC is ENABLED, then the speed and current loops are quenched. The SCR (Silicon Controlled Rectifier)/thyristor firing circuits are disabled, the main contactor remains energised and the RUN LED stays on when the drive is at standstill. The drive remains in this state until standstill drops out. That is, when the speed setpoint or speed feedback rise above the zero threshold.

STANDSTILL LOGIC is useful in maintaining absolute zero speed and aids in preventing gearbox wear due to “chattering”.

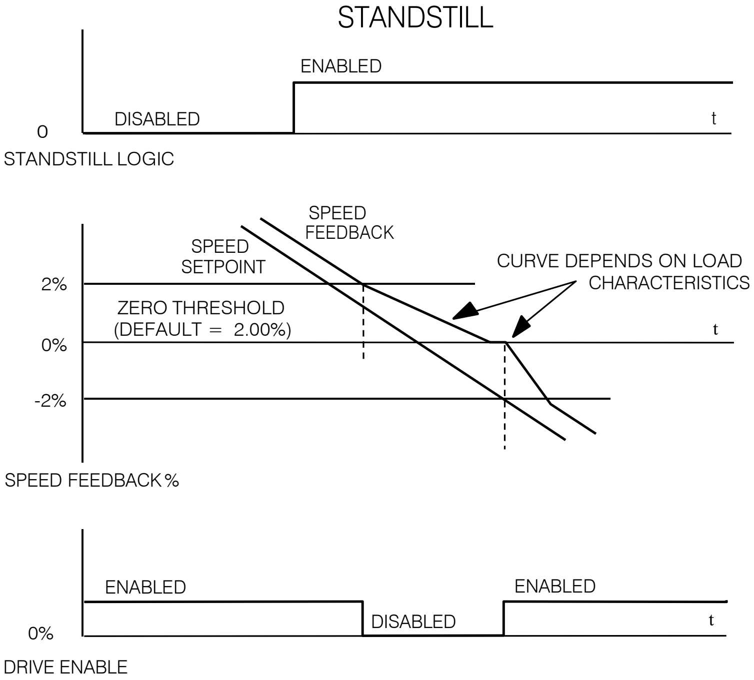
However, it can cause problems in web handling applications using tension feedback: at zero speed, the SCR/thyristors turn off allowing the web tension to pull the driven roll in reverse. When the drive no longer senses it is at zero speed, the SCR/thyristors turn back on causing the motor to move forward and regulate tension. An oscillation condition can result as the drives SCR/thyristors turn on and off trying to maintain a fixed position.

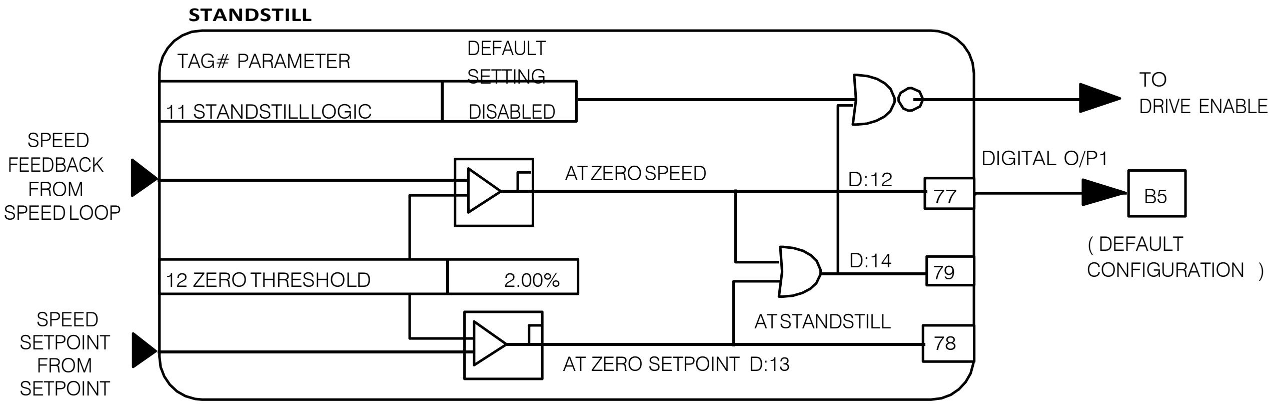
STANDSTILL

Parameter	Tag	Range
ZERO SETPOINT	**699**	**-300.00 to 300.00 %**
The input to the standstill function. By default this is connected to the speed demand parameter from the speed loop function block.		
STANDSTILL LOGIC	**11**	**DISABLED / ENABLED**
If ENABLED, the Drive is quenched (although the contactor remains in) when the Speed Feedback and Speed Setpoint values are less than ZERO THRESHOLD.		
ZERO THRESHOLD	**12**	**0.00 to 100.00 %**
Threshold level which defines zero setpoint and zero speed diagnostic outputs and also controls the zero speed relay output.		
AT ZERO SETPOINT	**78**	**FALSE / TRUE**
Logic output, TRUE when INPUT is below ZERO THRESHOLD. There is hysteresis of 0.5% on this test.		
AT ZERO SPEED	**77**	**FALSE / TRUE**

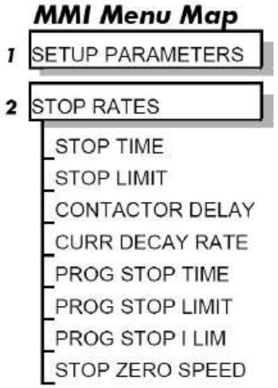
STANDSTILL

Parameter	Tag	Range
Logic output, TRUE when speed feedback is below ZERO THRESHOLD. There is hysteresis of 0.5% on this test. The speed feedback parameter is internally connected to the PERCENT RPM parameter in the FEEDBACKS block.		
AT STANDSTILL	**79**	**FALSE / TRUE**
Logic output that is TRUE when standstill is detected.		




STANDSTILL
TAG# PARAMETER
DEFAULT SETTING
11 STANDSTILL LOGIC
DISABLED
12 ZERO THRESHOLD
2.00%
SPEED FEEDBACK FROM SPEED LOOP
SPEED SETPOINT FROM SETPOINT
AT ZERO SPEED
D:12
77
D:14
79
AT STANDSTILL
78
AT ZERO SETPOINT D:13
TO DRIVE ENABLE
DIGITAL O/P1
B5
(DEFAULT CONFIGURATION)

STOP RATES

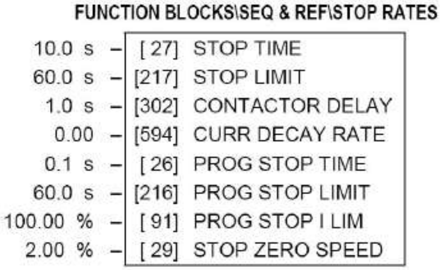


These parameters are used by a regenerative drive when stopping with Normal Stop or Program Stop.

The stopping methods of the drive are described in more detail in Chapter 4: “Operating the Drive”- Starting and Stopping Methods.

The internal inputs to this block are SPEED SETPOINT and SPEED FEEDBACK from the SPEED LOOP function block, the Run signal from terminal C3, and PROGRAM STOP from terminal B8.

The internal outputs are SPEED DEMAND to the speed loop, PROG STOP I LIM to the current loop, and signals to the coast stop and drive enable logic.



FUNCTION BLOCKS\SEQ & REF\STOP RATES

10.0 s	[27]	STOP TIME
60.0 s	[217]	STOP LIMIT
1.0 s	[302]	CONTACTOR DELAY
0.00	[594]	CURR DECAY RATE
0.1 s	[26]	PROG STOP TIME
60.0 s	[216]	PROG STOP LIMIT
100.00 %	[91]	PROG STOP I LIM
2.00 %	[29]	STOP ZERO SPEED

Normal Stop

A Normal Stop occurs when the Run signal is removed from terminal C3. It ramps the speed demand to zero at a rate set by STOP TIME.

- Non-regenerative drives can stop no faster than the coast stop rate.
- Regenerative drives use STOP TIME to set the duration of the stop.

After the stop, the contactor de-energises and the drive disables.

The STOP LIMIT timer starts when C3 goes to 0V (the Run signal is removed). If the drive speed has not reached STOP ZERO SPEED within the STOP LIMIT time, the contactor de-energises and the drive disables.

During Normal Stops, after the motor reaches zero speed, CONTACTOR DELAY delays the de-energising of the contactor. When STOP ZERO SPEED is set above 0.25% and the CURRENT DECAY RATE is not zero, the drive disables during the contactor delay. Otherwise the drive disables after the contactor delay. This is useful when using the Jog function to prevent multiple operations of the contactor. CONTACTOR DELAY is overridden when terminal C5 (Enable Input) is at 0V.

Program Stop

PROGRAM STOP provides a controlled fast stop for regenerative drives. The stop time is set by PROG STOP TIME. This timer starts once terminal B8 (Program Stop) goes to 0V. When the drive reaches STOP ZERO SPEED, the contactor de-energises and the drive disables. PROG STOP LIMIT sets the maximum time the Program Stop can take before the contactor de-energises and the drive disables.

PROG STOP I LIM sets the current limit in the current loop during a Program Stop. Other current limits can override it.

STOP RATES

<table>
<tr><th>Parameter</th><th>Tag</th><th>Range</th></tr>
<tr><td>STOP TIME</td><td>27</td><td>0.1 to 600.0 s</td></tr>
<tr><td colspan="3">Time to reach zero speed from 100% set speed in normal stop mode (terminal C3 =0V).</td></tr>
<tr><td>STOP LIMIT</td><td>217</td><td>0.0 to 600.0 s</td></tr>
<tr><td colspan="3">The maximum time a controlled stop can take in a Normal Stop (regenerative breaking) before the drive will coast to stop. The timer is triggered when terminal C3 = 0V.</td></tr>
<tr><td>CONTACTOR DELAY</td><td>302</td><td>0.1 to 600.0 s</td></tr>
<tr><td colspan="3">This defines the time the contactor stays energised for after the STOP ZERO SPEED limit is reached. Maintain zero speed during contactor delay.</td></tr>
<tr><td>CURR DECAY RATE</td><td>594</td><td>0.00 to 200.00 %/s</td></tr>
<tr><td colspan="3">This is the rate at which the current is quenched when the current loop is disabled.
A value of 100% will ramp the current from 100% to 0% in 1s.
A value of 50% will ramp the current from 100% to 0% is 2s.</td></tr>
<tr><td>PROG STOP TIME</td><td>26</td><td>0.1 to 600.0 s</td></tr>
<tr><td colspan="3">Time to reach zero speed from 100% set speed in Program Stop mode (B8 = 0V).</td></tr>
<tr><td>PROG STOP LIMIT</td><td>216</td><td>0.0 to 600.0 s</td></tr>
<tr><td colspan="3">The maximum time a Program Stop (regenerative breaking) can take before the contactor is de-energised and the drive is disabled. The timer is triggered when terminal B8 = 0V.</td></tr>
<tr><td>PROG STOP I LIM</td><td>91</td><td>0.00 to 200.00 %</td></tr>
<tr><td colspan="3">Main current limit level (assuming current limit not overridden by I Profile or Inverse Time limits) when performing a Program Stop.</td></tr>
<tr><td>STOP ZERO SPEED</td><td>29</td><td>0.00 to 100.00 %</td></tr>
<tr><td colspan="3">The threshold at which the CONTACTOR DELAY timer starts in Program Stop and Normal Stop modes. See also CONTACTOR DELAY above.</td></tr>
</table>

Functional Description

Stop Hierarchy

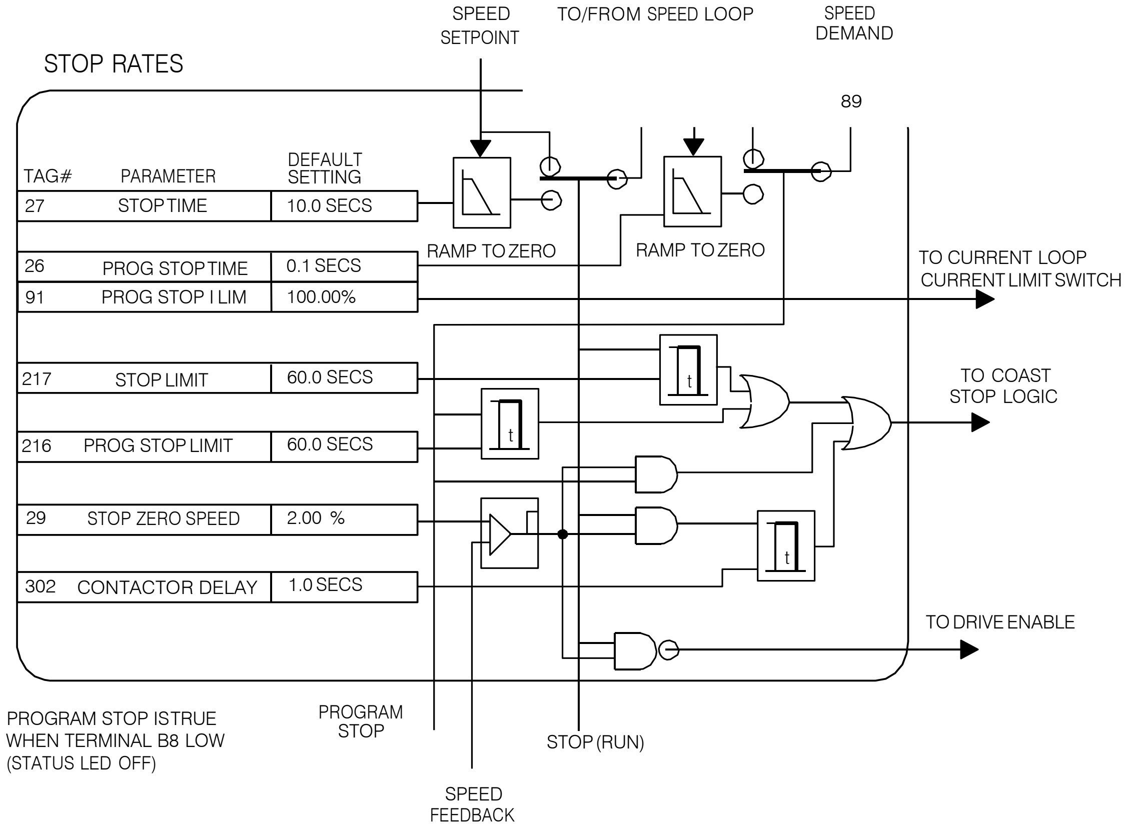
Coast Stop - Terminal B9
- Disables the drive and opens the contactor via the pilot output

Enable - Terminal C5
- Suspends and resets the Control Loops

Program Stop - Terminal B8
- Independent ramp time
- Stop Timer
- Independent Current Limit that may be higher than normal Current Limit
- Independent zero speed

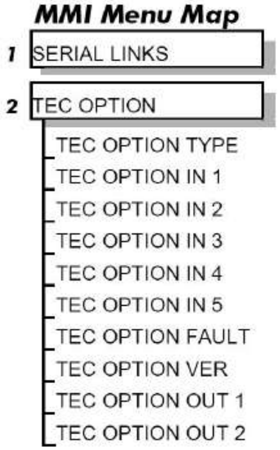
Normal Run/Stop - Terminal C3
- Independent ramp time
- Contactor Delay

The Drive's reaction to commands is defined by a state machine. This determines which commands provide the demanded action, and in which sequence. Consequently, COAST STOP and PROGRAM STOP must be FALSE, i.e. the drive is not in Coast or Program mode, before a Run signal is applied otherwise the controller assumes a Stop mode and remains disabled. Refer to Chapter 4: "Operating the Drive" - Stopping Methods for descriptions of Coast Stop and Program Stop.



TAG#	PARAMETER	DEFAULT SETTING
27	STOP TIME	10.0 SECS
26	PROG STOP TIME	0.1 SECS
91	PROG STOP I LIM	100.00%
217	STOP LIMIT	60.0 SECS
216	PROG STOP LIMIT	60.0 SECS
29	STOP ZERO SPEED	2.00 %
302	CONTACTOR DELAY	1.0 SECS

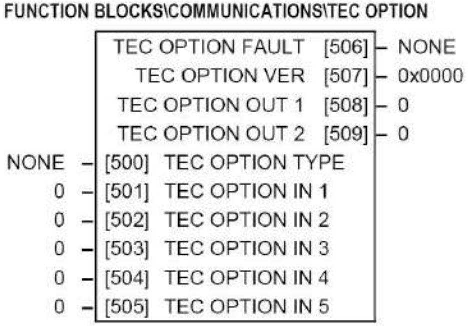
TEC OPTION



This function block is used to configure the inputs and outputs of the various Technology Options that can be fitted.

The Technology Option provides a communications interface for external control of the Drive.

Refer to the appropriate Technology Option Technical Manual supplied with the option for further details.



TEC OPTION

Parameter	Tag	Range
TEC OPTION TYPE	**500**	**See below**
Selects the type of Technology Option. 0 : NONE 1 : RS485 2 : PROFIBUS 3 : LINK 4 : DEVICE NET 5 : CAN OPEN 6 : LONWORKS 7 : CONTROLNET 8 : MODBUS PLUS 9 : ETHERNET 10 : TYPE 10 11 : TYPE 11 12 : TYPE 12 13 : TYPE 13 14 : TYPE 14 15 : TYPE 15		
TEC OPTION IN 1 to TEC OPTION IN 5	**501, 502, 503, 504, 505**	**-32768 to 32767**
The use of these input parameters depends upon the type of Technology Option fitted. Refer to the Technology Option Technical Manual.		

TEC OPTION

Parameter	Tag	Range
TEC OPTION FAULT	**506**	**See below**

The fault state of the Technology Option.

0 : NONE	no faults
1 : PARAMETER	parameter out-of-range
2 : TYPE MISMATCH	TYPE parameter mismatch
3 : SELF TEST	hardware fault - internal
4 : HARDWARE	hardware fault - external
5 : MISSING	no option fitted

If the VERSION NUMBER error message is displayed, the Technology Option is using software that doesn’t fully support the drive; refer to DC900P Drives.

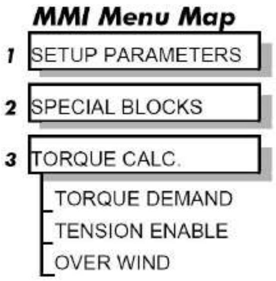
Parameter	Tag	Range
TEC OPTION VER	**507**	**0x0000 to 0xFFFF**

The version of the Technology Option. If no option is fitted then the version is reset to zero.

Parameter	Tag	Range
TEC OPTION OUT 1 to TEC OPTION OUT 2	**508, 509**	**— .**

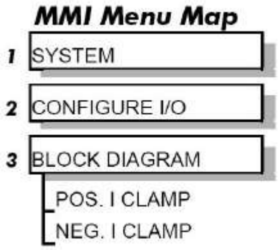
The use of these output parameters depends upon the type of Technology Option fitted. Refer to the Technology Option Technical Manual.

TORQUE CALC.

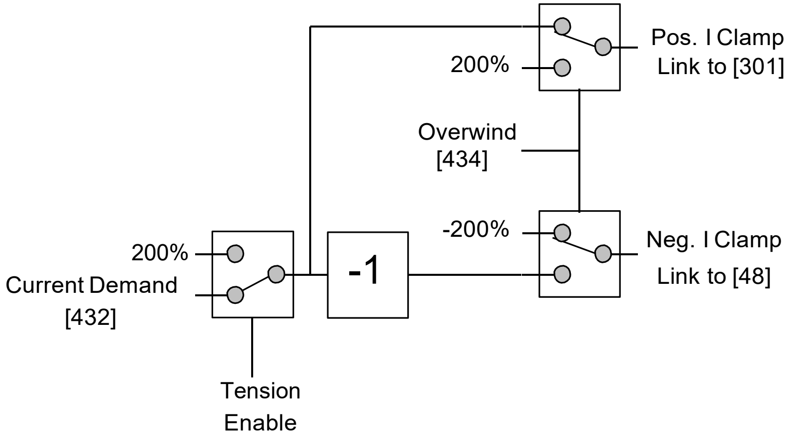


This block switches the drive between Speed and Tension mode. It also switches the current limits as required for over and under winding.

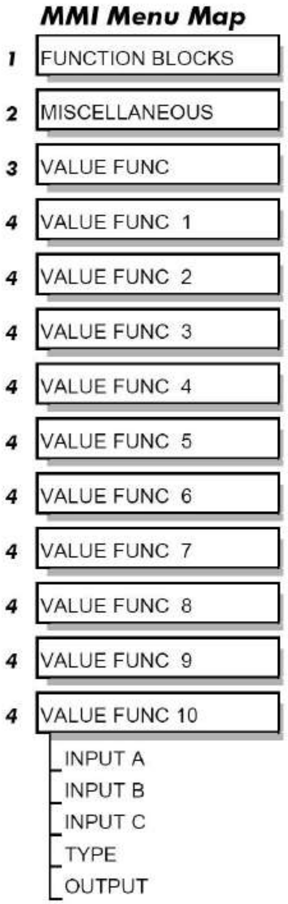
TORQUE CALC.



Parameter	Tag	Range
TORQUE DEMAND	**432**	**-200.00 to 200.00 %**
This is the TORQUE CALC function block input.		
TENSION ENABLE	**433**	**DISABLED / ENABLED**
When TENSION ENABLE is ENABLED , the tension demand is set by the TORQUE DEMAND signal , tag 432. When DISABLED, it is set by the default current limit. Switch using a free digital input.		
OVER WIND	**434**	**DISABLED / ENABLED**
Reverses the sign of the output clamps for over/under winding. Switch using a free digital input.		
POS. I CLAMP	**707**	**— .xx V**
Positive current clamp.		
NEG. I CLAMP	**708**	**— .xx V**
Negative current clamp		



VALUE FUNC



The value function blocks can be configured to perform one of a number of functions upon a fixed number of inputs.

Boolean inputs and outputs are

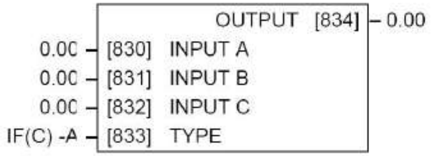
Outputs:

FALSE = 0.00
TRUE = 0.01

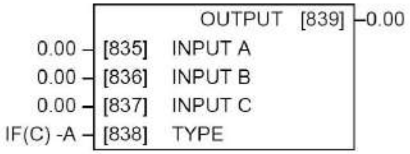
Inputs:

-0.005 < x < 0.005 = FALSE,
Else TRUE

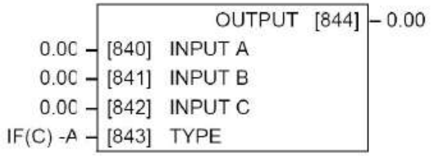
FUNCTION BLOCKS\MISCELLANEOUS\VALUE FUNC\VALUE FUNC 1



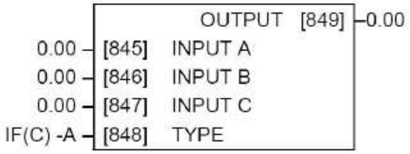
FUNCTION BLOCKS\MISCELLANEOUS\VALUE FUNC\VALUE FUNC 2



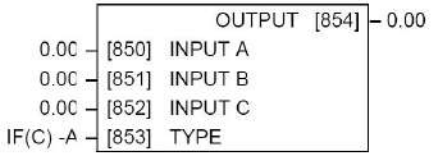
FUNCTION BLOCKS\MISCELLANEOUS\VALUE FUNC\VALUE FUNC 3



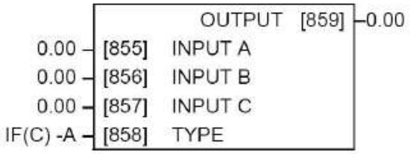
FUNCTION BLOCKS\MISCELLANEOUS\VALUE FUNC\VALUE FUNC 4



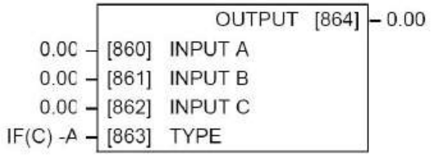
FUNCTION BLOCKS\MISCELLANEOUS\VALUE FUNC\VALUE FUNC 5



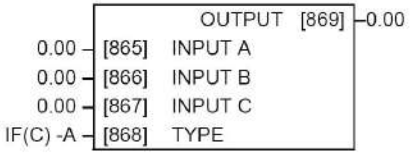
FUNCTION BLOCKS\MISCELLANEOUS\VALUE FUNC\VALUE FUNC 6



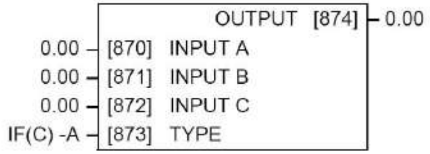
FUNCTION BLOCKS\MISCELLANEOUS\VALUE FUNC\VALUE FUNC 7



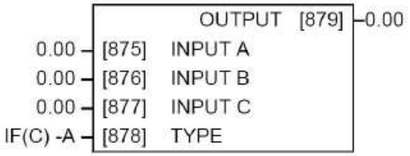
FUNCTION BLOCKS\MISCELLANEOUS\VALUE FUNC\VALUE FUNC 8



FUNCTION BLOCKS\MISCELLANEOUS\VALUE FUNC\VALUE FUNC 9



FUNCTION BLOCKS\MISCELLANEOUS\VALUE FUNC\VALUE FUNC 10

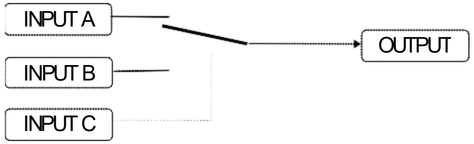
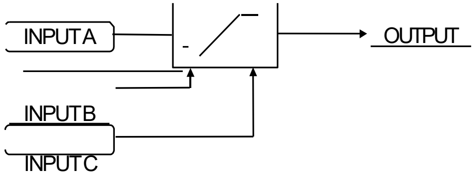
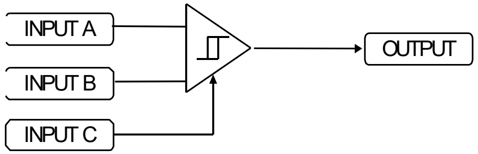
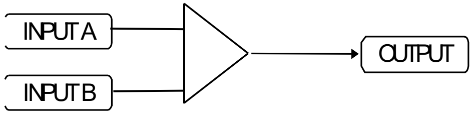


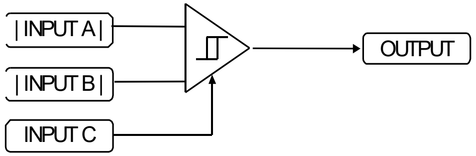
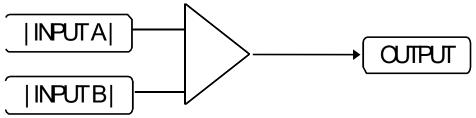
VALUE FUNCTION

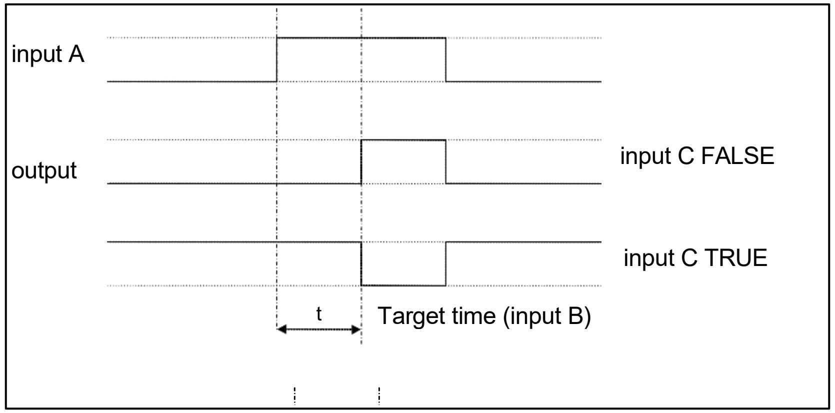
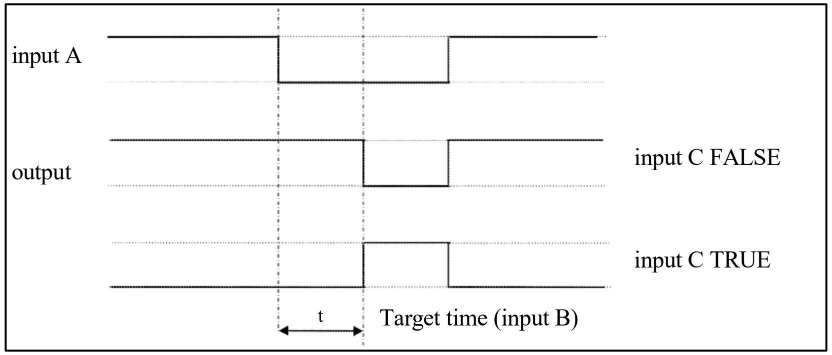
Parameter	Tag	Range
INPUT A	**830, 835, 840, 845, 850, 855, 860, 865, 870, 875**	**-32768 to 32768**
General purpose input.		
INPUT B	**831, 836, 841, 846, 851, 856, 861, 866, 871, 876**	**-32768 to 32768**
General purpose input.		
INPUT C	**832, 837, 842, 847, 852, 857, 862, 867, 872, 877**	**-32768 to 32768**
General purpose input.		
TYPE	**833, 838, 843, 848, 853, 858, 863, 868, 873, 878**	**See below**
The operation to be performed on the three inputs to produce the output value.		
0: IF(C) -A 1: ABS(A+B+C) 2: SWITCH(A,B) 3: (A*B)/C 4: A+B+C 5: A-B-C 6: B<=A<=C 7: A>B+/-C 8: A>=B 9: ABS(A)>B+/-C 10: ABS(A)>=B 11: A(1+B) 12: IF(C) HOLD(A) 13: BINARY DECODE 14: ON DELAY 15: OFF DELAY	16: TIMER 17: MINIMUM PULSE 18: PULSE TRAIN 19: WINDOW 20: UP/DWN COUNTER 21: (A*B)/C ROUND 22: WINDOW NO HYST 23: WIND A>=B,A<=C 24: A<=B 25: ((A*B)/100)+C 26: MIN(A,B,C) 27: MAX(A,B,C) 28: PROFILE SQRT 29: PROFILE LINEAR 30: PROFILE x^2	31: PROFILE x^3 32: PROFILE x^4 33: ON A>B, OFF A<C 34: (A+B) CLAMPED C 35: (A-B) CLAMPED C 36: (A*B) CLAMPED C 37: (A/B) CLAMPED C 38: A>=B:A, A<=C:0 39: (A * B) + C 40: A * (B + C) 41: A * (B - C) 42: A * (1+B/C) 43: A * (1+(B * C)) 44: MONOSTABLE HIGH 45: MONOSTABLE LOW 46: FILTER
OUTPUT	**834, 839, 844, 849, 854, 859, 864, 869, 874, 879**	**— .xx**
The result of performing the selected operation on the inputs.		

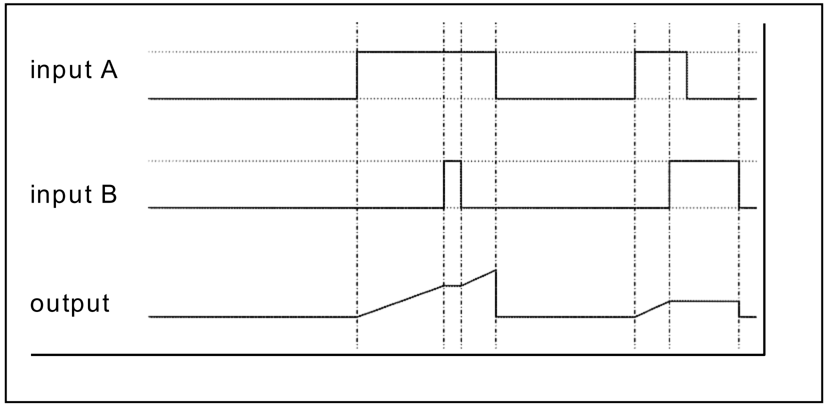
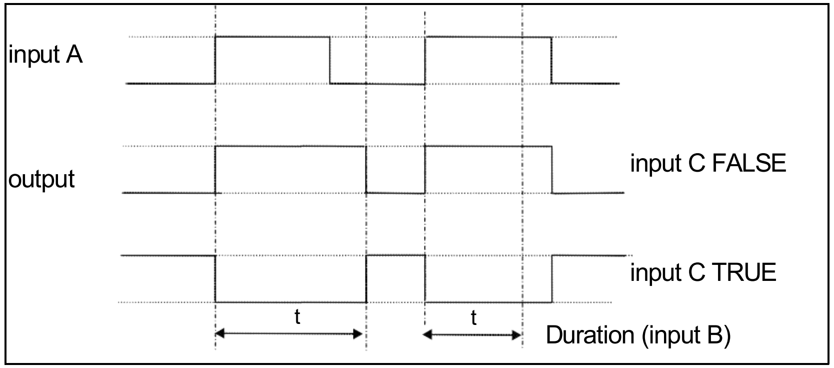
Functional Description

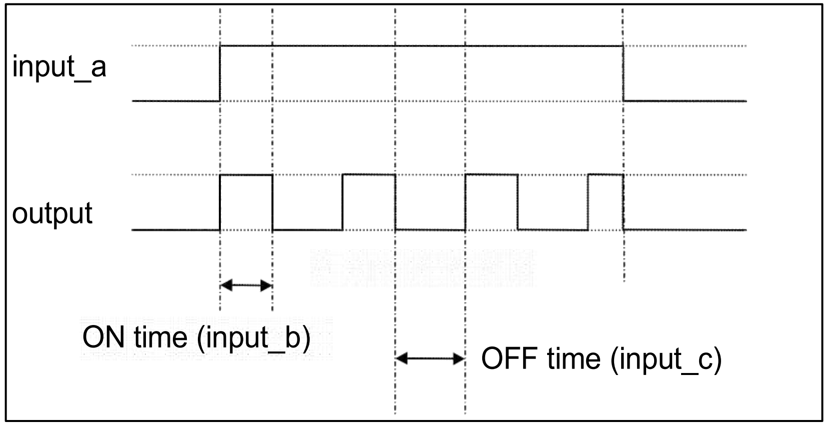
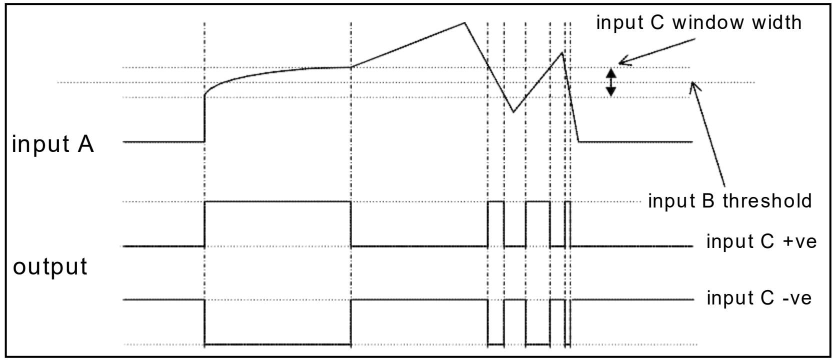
OUTPUT is generated from the inputs according to the operation type selected. The output is always limited to be within the range -32768.00 to +32767.00.

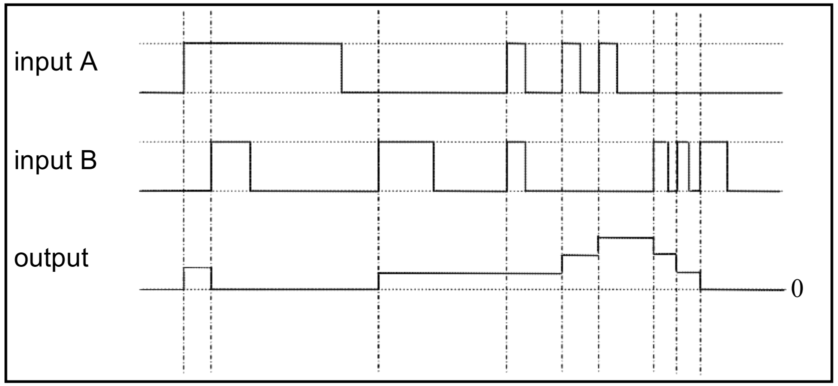
Operation	Description
IF(C) -A	If INPUT C is not zero the OUTPUT is minus INPUT A, otherwise the OUTPUT is the same as INPUT A.
ABS(A+B+C)	The OUTPUT is set to the absolute value of INPUT A + INPUT B + INPUT C.
SWITCH(A,B)	 If INPUT C is zero the OUTPUT is set to INPUT A, otherwise the output is set to INPUT B
(A*B)/C	The OUTPUT is set to (INPUT A * INPUT B) / (INPUT C). The algorithm compensates for the remainder term.
A+B+C	The OUTPUT is set to (INPUT A + INPUT B + INPUT C).
A-B-C	The OUTPUT is set to (INPUT A - INPUT B - INPUT C).
B <= A <= C	 The OUTPUT is set to the value of INPUT A, limited to between a maximum value of INPUT C and a minimum value of INPUT B. If INPUT B is greater than INPUT C the output is undefined.
A>B+/-C	 The OUTPUT is TRUE if INPUT A is greater than INPUT B + INPUT C. The OUTPUT is FALSE if INPUT A is less than INPUT B - INPUT C. Otherwise the OUTPUT is unchanged. In this way the block acts as a simple comparator with a comparison level of INPUT B and a hysteresis band equal to +/- INPUT C.
A>=B	 The OUTPUT is TRUE if INPUT A is greater than or equal to INPUT B, otherwise the OUTPUT is FALSE.

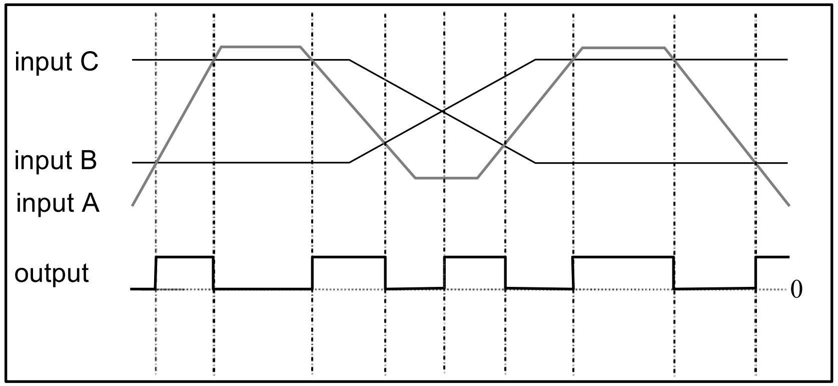
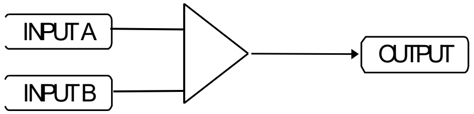
<table>
<tr><th>Operation</th><th>Description</th></tr>
<tr><td>ABS(A)>
ABS(B)+/-C</td><td>
The OUTPUT is TRUE if the magnitude of INPUT A is greater than or equal to the magnitude of INPUT B - INPUT C.
The OUTPUT is FALSE if the magnitude of INPUT A is less than the magnitude of INPUT B - INPUT C. Otherwise the OUTPUT is unchanged. In this way the block acts as a magnitude comparator with a comparison level of INPUT B and a hysteresis band equal to +/- INPUT C.</td></tr>
<tr><td>ABS(A)>
=ABS(B)</td><td>
The OUTPUT is TRUE if the magnitude of INPUT A is greater than or equal to the magnitude of INPUT B, otherwise the OUTPUT is FALSE.</td></tr>
<tr><td>A(1+B)</td><td>The OUTPUT is set to INPUT A + (INPUT A * INPUT B / 100.00).</td></tr>
<tr><td>IF(C) HOLD A</td><td>If INPUT C is zero, the OUTPUT is set to INPUT A, otherwise the OUTPUT is unchanged.
On powering up the drive, the output will be pre-loaded with the last saved value of input B.</td></tr>
<tr><td>BINARY DECODE</td><td>The OUTPUT is set according to which of the INPUTs are non-zero.
<table>
<tr><th>INPUT C</th><th>INPUT B</th><th>INPUT A</th><th>OUTPUT</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0.00</td></tr>
<tr><td>0</td><td>0</td><td>≠0</td><td>1.00</td></tr>
<tr><td>0</td><td>≠0</td><td>0</td><td>2.00</td></tr>
<tr><td>0</td><td>≠0</td><td>≠0</td><td>3.00</td></tr>
<tr><td>≠0</td><td>0</td><td>0</td><td>4.00</td></tr>
<tr><td>≠0</td><td>0</td><td>≠0</td><td>5.00</td></tr>
<tr><td>≠0</td><td>≠0</td><td>0</td><td>6.00</td></tr>
<tr><td>≠0</td><td>≠0</td><td>≠0</td><td>7.00</td></tr>
</table>
In the above table, ≠0 indicates that the corresponding input is not zero.</td></tr>
</table>

Operation	Description
ON DELAY	 A programmable delay between receiving and outputting a Boolean TRUE signal. INPUT A becoming TRUE starts the delay timer. INPUT B sets the duration of the delay in seconds (1 = 1 second). At the end of the duration, OUTPUT becomes TRUE unless INPUT A has reverted to FALSE. Setting INPUT C to TRUE (≠0) inverts the output.
OFF DELAY	 A programmable delay between receiving and outputting a Boolean FALSE signal. INPUT A becoming FALSE starts the delay timer. INPUT B sets the duration of the delay in seconds (1 = 1 second). Setting INPUT C to TRUE (≠0) inverts the output. At the end of the duration, OUTPUT becomes FALSE unless INPUT A has reverted to TRUE.

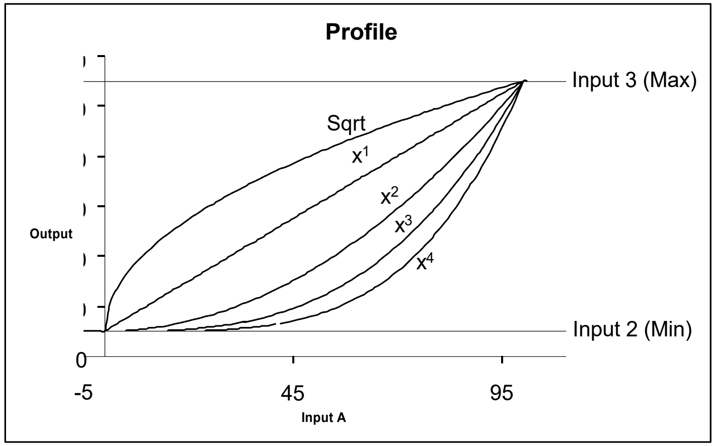
Operation	Description
TIMER	 Times the period elapsed from when INPUT A is set TRUE and held TRUE, to when INPUT B becomes TRUE. OUTPUT is the duration of the timer in seconds (1 = 1 second), starting from zero. If INPUT B is TRUE, the value for OUTPUT is held until INPUT B is released. If on release INPUT A is still TRUE, the timer will continue from the held value. Setting INPUT A and INPUT B to FALSE resets the timer. INPUT C is not used.
MINIMUM PULSE	 Creates an output of adjustable minimum time when INPUT A is TRUE. (INPUT A is assumed to be a sequence of TRUE pulses and FALSE off periods.) INPUT B sets the length of the minimum pulse required in seconds (1 = 1 second). INPUT C inverts the output when TRUE. The duration of the pulse is *at least* the period set by INPUT B.

Operation	Description
PULSE TRAIN	 Creates a pulsed FALSE / TRUE output of programmable frequency. INPUT A enables the pulse train when TRUE, disables when FALSE. INPUT B sets the length of the *on* part of the pulse in seconds (1 = 1 second). INPUT C sets the length of the *off* part of the pulse in seconds (1 = 1 second).
WINDOW	 This function outputs TRUE when INPUT A is within a programmable range, and FALSE otherwise. INPUT B sets the threshold of the window to be monitored. INPUT C defines the range of the window around the threshold. When the value of INPUT A is inside the window, the window expands by 0.01 to avoid flutter on output if noisy, i.e. if INPUT B = 5 and INPUT C = 4 then the range is 3 to 7, expanded to 2.5 to 7.5 when the value if INPUT A is inside the window. If INPUT C is set to zero, the output will only be TRUE if INPUT A is exactly equal to INPUT B (this is fulfilled in the default condition when inputs A, B & C are all zero) If INPUT C is set to a negative value, its absolute value defines the window range, and the output is inverted.

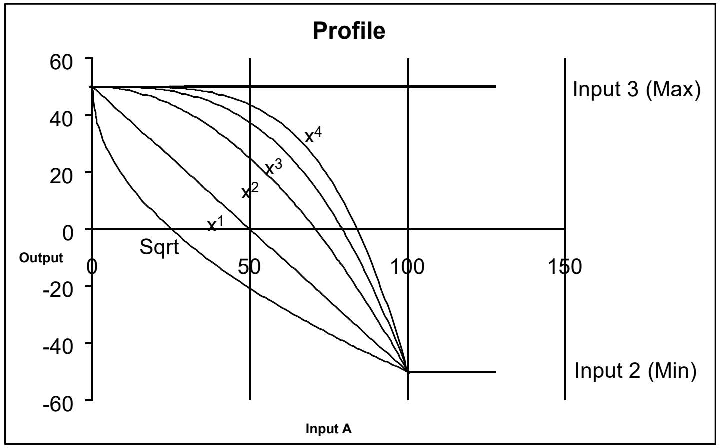
Operation	Description
UP/DOWN COUNTER	 INPUT A provides a rising edge trigger to increment the output count by one. INPUT B provides a rising edge trigger to decrement the output count by one. INPUT C holds the output at zero. The output starts at zero. The output is limited at ±300.00.
(A*B)/C ROUND	The OUTPUT is set to (INPUT A * INPUT B) / (INPUT C). This is the same as (A*B)/C (enumerated value 3) except that the result is rounded.
WINDOW NO HYST	This is the same as WINDOW (enumerated value 19) except that there is no hysteresis when inside the `window’. Thus, from the diagram given in WINDOW, if INPUT B = 5 and INPUT C = 4 then the range is 3 to 7.

Operation	Description
WINDOW B<=A<=C	 INPUT B and INPUT C are the upper and lower levels of the band. If B<= C and A is in the band then the OUTPUT is TRUE, else OUTPUT is FALSE If C<B and A is in the band then the OUTPUT is FALSE, else OUTPUT is TRUE (i.e. output is inverted) ***Note:*** **OUTPUT is set to FALSE if the TYPE is changed or is in initialisation.**
A<=B	 The OUTPUT is TRUE if INPUT A is less than or equal to INPUT B, otherwise the OUTPUT is FALSE.
((A*B)/100)+C	The OUPUT is set to ((INPUT A * INPUT B)/100)+C.
MIN (A,B,C)	The OUTPUT is set to the smallest of INPUT A, INPUT B and INPUT C.
MAX (A,B,C)	The OUTPUT is set to the largest of INPUT A, INPUT B and INPUT C.

Operation	Description
PROFILE SQRT PROFILE X^1 PROFILE X^2 PROFILE X^3 PROFILE X^4	



Example : Profile Min = 10, Max = 110



Example : Profile Min = 50, Max = -50

Profile functions convert an input (0-1) to an output with (min) +((max-min) * fn(input)) where fn() is Sqrt (square root), Linear (X^1), X^2, X^3 or X^4. The output is clamped between Min and Max. The input is clamped 0-100.

The profiles are calculated from 100 point tables and linearly interpreted between the points.

PROFILE SQRT $y = \min + (\max - \min) x^{0.5}$

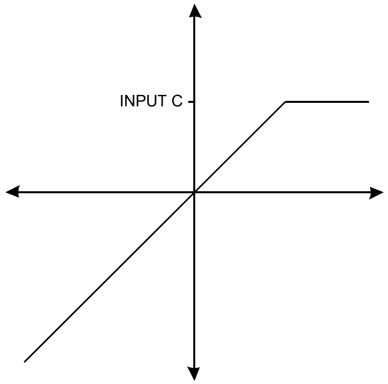
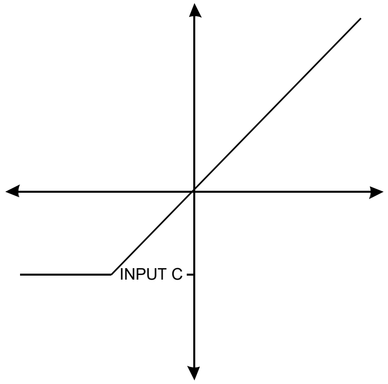
PROFILE X^1 $y = \min + (\max - \min) x$

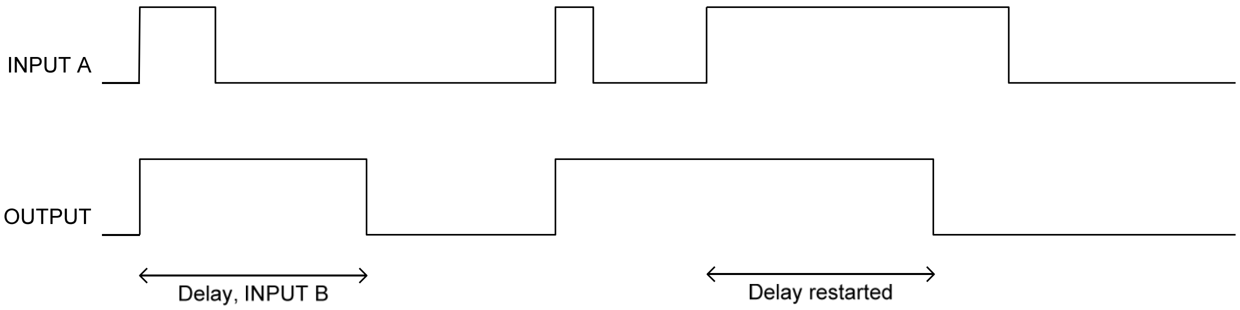
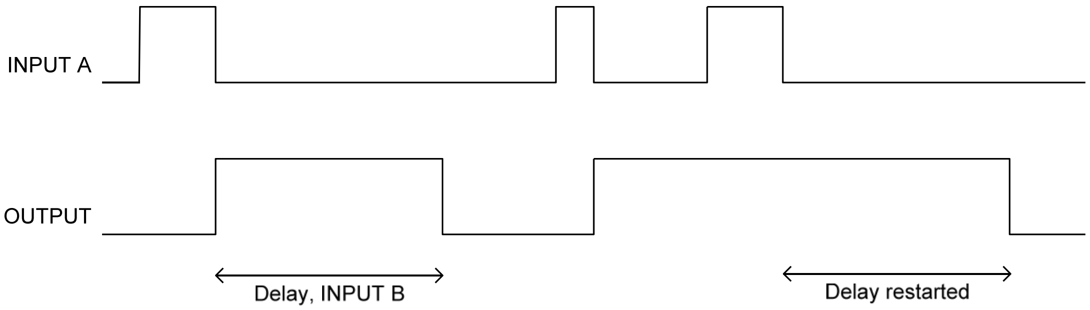
PROFILE X^2 $y = \min + (\max - \min) x^2$

PROFILE X^3 $y = \min + (\max - \min) x^3$

PROFILE X^4 $y = \min + (\max - \min) x^4$

where INPUT A : Input x INPUT B : Min INPUT C : Max

Operation	Description
ON A>B, OFF A<C	If INPUT A is greater than INPUT B then the OUTPUT is ON, (0.01). Otherwise if INPUT A is less than INPUT C then the OUTPUT is OFF, (0.00). If neither of these conditions is met then the OUTPUT is unchanged.
(A+B) CLAMPED C (A-B) CLAMPED C (A*B) CLAMPED C (A/B) CLAMPED C	The OUTPUT is the result of INPUT A +, -, * or / INPUT B, clamped by INPUT C.  **Action of clamp for when INPUT C is greater than zero** If INPUT C is greater than 0 then the OUTPUT is clamped to INPUT C if it is greater than INPUT C.  **Action of clamp when INPUT C is negative or zero** If INPUT C is negative or zero then the OUTPUT is clamped to INPUT C if it is less than INPUT C.
A>=B:A, A<=C:0	If INPUT A is greater than or equal to INPUT B then the OUTPUT is set to INPUT A. Otherwise if INPUT A is less than or equal to INPUT C then the OUTPUT is set to 0. If neither of these conditions is met then the OUTPUT is unchanged.

Operation	Description
(A * B) + C	The OUTPUT is set to the result of (INPUT A * INPUT B) + INPUT C.
A * (B + C)	The OUTPUT is set to the result of INPUT A * (INPUT B + INPUT C).
A * (B - C)	The OUTPUT is set to the result of INPUT A * (INPUT B - INPUT C).
A * (1+B/C)	The OUTPUT is set to the result of INPUT A * (1.0 + (INPUT B / INPUT C)). If INPUT C is zero then the result if (INPUT B/INPUT C) will be 32768.0 for positive values of INPUT B, and -32768.0 for negative values of INPUT B.
A * (1+(B * C))	The OUTPUT is set to the result of INPUT A * (1.0 + (INPUT B * INPUT C)).
MONOSTABLE HIGH	The OUTPUT is set HIGH, (0.01), on the rising edge of INPUT A. The OUTPUT remains high for a delay set by INPUT B, (in seconds). If a second rising edge reaches INPUT A while OUTPUT is high, the delay is restarted.  The OUTPUT is inverted if INPUT C is not zero.
MONOSTABLE LOW	The OUTPUT is set HIGH, (0.01), on the falling edge of INPUT A. The OUTPUT remains high for a delay set by INPUT B, (in seconds). If a second falling edge reaches INPUT A while OUTPUT is high, the delay is restarted.  The OUTPUT is inverted if INPUT C is not zero.

Operation	Description
FILTER	The OUTPUT is the result of INPUT A passed through a first order low pass infinite impulse response filter with time constant set by INPUT B, (in seconds). If INPUT C is not zero then the OUTPUT is set to INPUT A.