MICRODRIVE Elite

ULTRADRIVE Elite

ELITE SERIES TECHNICAL MANUAL
PART NO. 4201-180 REV F

Head Office:
81 Austin Street
P.O. Box 741
Napier
New Zealand
Tel.: +64-6-843-5855
Fax.: +64-6-843-5185

4201-003 Rev C

PDL ELECTRONICS LTD

Leaders in AC Motor Control

IMPORTANT NOTES

WARNING:

– It is the installer's responsibility to ensure the configuration and installation of the Elite Series meets the requirements of the local safety regulations.

– The Elite Series operates from HIGH VOLTAGE, HIGH ENERGY ELECTRICAL SUPPLIES. Stored charge is present after switch off.

– Due to the high leakage currents inherent to AC drives, earth connection of both the motor and the Elite Series is essential before connection to the supply. The Elite Series must be permanently connected to the supply.

– Do not attempt to isolate the motor while the Elite Series is running.

– Some parameter settings may cause the Elite Series to start automatically after power failure.

– Motor overspeed operation may be limited by mechanical constraints.

– Always screen control wiring.

– Ensure that the Elite Series is not mounted in an adverse environment.

– Service only by qualified personnel.

– Always isolate and allow to discharge before servicing.

– Never replace ceramic fuses with glass types.

– Always wear safety glasses when operating with the cover removed.

– The Elite Series contains static sensitive printed circuit boards. Use static safe procedures when handling these boards.

– Never work on live equipment alone.

– Observe all recommended practices.

– This manual and the screen list contained within documents Elite Series software version 2.x. Refer to Screen Z2 for the software version of your Elite Series.

Understanding of the equipment is the key to safe and efficient use – please read this manual thoroughly.

DEDICATION TO QUALITY

AC Motor Control Products can dramatically improve your process control, productivity and energy efficiency, but only if they are working correctly.

Which is why we at PDL Electronics go to great lengths in our design and manufacturing, to ensure that our products operate correctly first time, every time.

An extensive research and development investment ensures that this product is one of the most technically advanced in the world, with built-in strength and robustness to suit your application and environment.

Our AS/NZS ISO 9001 certification gives you the confidence of our international, independently certified Quality Assurance program. All staff are actively involved in continuous improvement programs with a customer focus.

The components that go into our products are selected from the best in the world - and must pass our rigorous and demanding test program.

Finally, every new drive design is run through a rigorous test program, including full load operation at above rated temperature, under the most demanding load conditions.

Our dedication to quality makes the PDL Electronics product, regardless of price, less expensive than other controllers in the long run.

COMPREHENSIVE SUPPORT PROGRAM

The PDL Electronics customer support program demonstrates our confidence in our Quality Assurance system. We have total faith in our products and their reliability, and so provide a comprehensive warranty.

Fully trained engineers and technicians, with a wealth of experience and easy access to information, can assist in solving any of your drive application projects.

Our service staff are available for commissioning, after sales service, and repairs, 24 hours a day, seven days a week.

We select capable and highly qualified representatives to act as our distributors and service agents. Only after passing PDL Electronics' intensive training program are they accredited for repair or on-selling of our products.

To further support our products and customers, we run a series of comprehensive training programs focusing on self maintenance and application advice. These are available on-site and at our Head Office.

REVISION HISTORY

Date:	Revision:	Description:
April 1997	D	Process Control and Fibre Optic Mode added.
Nov. 1997	E	Elite Software Version 2.0
May 1998	F	Ultradrive specifications added

CONTENTS

FIGURES

1 INTRODUCTION TO THE ELITE SERIES AC MOTOR CONTROLLER

1.1 THE CONCEPT

The AC induction motor is the preferred choice of motive power for many industrial applications. With the development of electronic variable voltage variable frequency (VVVF) controllers, it became possible to control the speed of the induction motor. PDL Electronics has been at the forefront of development of VVVF controllers for the past 25 years.

However standard VVVF controllers have certain performance limitations, specifically in applications where high torque is required at standstill and very low speeds, and in applications where extremely fast dynamic response is required. To address these limitations, PDL Electronics has developed the Elite Series of controllers. Advanced flux vector control techniques enables extended performance to be obtained from the AC induction motor, including full torque at standstill, and a speed response rivalling that of servomotors.

The Elite Series further evolves the hardware and software technology of previous ranges. The same Elite Series induction motor controller can be used without motor feedback for general industry applications, or with a shaft encoder (pulse tacho) driven by the motor to give the full performance associated with flux vector orientation control.

1.2 THE ELITE SERIES RANGE

The Elite Series has been developed from PDL's previous AC motor controller series, the Microdrive and Microvector. It inherits the Microdrive's simplicity and well proven electrical design. The Elite Series improves on the already highly flexible digital controls which have become the hallmark of the Microdrive and Microvector series.

The Elite Series range currently consists of fourteen models spanning the range from 0.75 kW to 75kW, with extensions to the range presently under development. All models are constructed in IP54 enclosures, for protection against the ingress of dust and splashing water.

1.3 THE BASIC PRINCIPLE OF FLUX VECTOR CONTROL

Field orientated flux vector control (or simply vector control) is a technique for controlling the torque developed by an AC induction motor. By independently controlling the magnitude of the air gap flux and the rotor current, and maintaining their orthogonality, it becomes possible to directly control the torque output of the motor. This is achieved by controlling the torque-producing and flux-producing components of the motor stator current. This is similar to controlling the armature and field currents in a separately excited DC motor. To achieve this level of control, the shaft speed and position must be sensed using a shaft encoder on the motor.

The Elite Series employs this technique in its Closed Loop Vector control mode. However if a shaft encoder is not used on the motor, Open Loop Vector control operation is available. This uses sophisticated monitoring and modelling techniques to estimate the rotor position. Speed and torque accuracy are sacrificed, and very low speed operation is not possible.

1.4 CONFIGURATION OF CONTROLLER TYPE

When the Elite Series is set up for Closed Loop Vector control, it is set up as a torque controller. If further configured to "torque control" mode, it provides accurate output torque from the motor, in response to an external torque reference signal. This torque is available down to zero speed. This mode is most suited for use in torque control applications, e.g., power winder and rewinder systems. It can also be used in position control applications, with an external speed-position controller. A quadrature shaft encoder will be required on the motor, to provide rotor position feedback.

Closed Loop Vector control - speed control is a mode recommended for servomotor type applications, or anywhere that a speed controller with fast dynamic response or accurate speed holding is required. This mode is suitable for elevators or crane hoists, and other applications where full torque capability at zero speed are required. In this mode, the Elite Series can also be used in conjunction with an external position controller to do position control applications. A quadrature shaft encoder will be required on the motor, to provide rotor position and speed feedback.

Open Loop Vector control operating mode is for general purpose speed control applications, e.g., pumps, fans, conveyors, mixers etc. This mode gives equivalent or better performance to that of drives using previous VVVF technologies. In this mode, a quadrature shaft encoder on the motor is not necessary.

The V/Hz control operating mode is also suitable for general purpose speed control applications e.g., pumps, fans, conveyors, mixers etc. his mode gives equivalent or better performance to that of drives using previous VVVF technologies.When multiple motors are to be driven from the output of the Elite Series, the V/Hz control operating mode must be utilised.

The Elite Series will also function as an accurate sensor of torque, power and speed. The accuracy of this sensing is improved by using in Closed Loop Vector control operating mode. The outputs are available in analogue or digital format, or can be applied to internal comparators and limits.

1.5 CONTROL CONFIGURATION OPTIONS

The functions and formats of the six digital and two analogue inputs, and three digital and two analogue outputs, can be configured in a number of different ways.

Full details of the available screens and control functions are given in Section 9 of this manual.

2 ELITE SERIES SPECIFICATIONS

2.1 ELITE SERIES SPECIFICATIONS

INPUT

Input supply voltage	230 to 480Vac 3 phase earthed neutral supply
Input supply tolerance	-20% to +5%
Input frequency range	48 to 62Hz
Input current	< output current
Input displacement factor	> 0.99
Input current THD	< 40%
Power loss ride through	> 2 seconds at rated voltage

OUTPUT

Output voltage to motor	0 to V_{IN} -15V
Current overload capability	200% for 1 sec (Closed Loop Vector) 150% for 30 secs (when hot) at 50°C 150% for 60 secs (when hot) at 40°C
Frequency range	Closed Loop Vector 0 to ±100Hz Open Loop Vector 0 to ± 100Hz (or 0 to ±100%) V/Hz 0 to ± 400Hz
Efficiency (full load, 50Hz)	>97%
Suit motor rated kW	50 to 150% of Elite Series rating
Suit motor rated voltages	5 to 500Vac
Suit motor rated frequencies	10 to 400Hz
Modulation method	Space vector modulation
Modulation frequency	Up to 16kHz Whisper Wave or Narrow Band

ENVIRONMENTAL

Protection standard	IP54, dust and splashing water protected
Operating temperature	0°C to 50°C
Temperature re-rating of output current @ 40°C	125% @ >25Hz, decreasing to 100% @ 0Hz
Storage temperature	-25°C to +80°C
Relative humidity	<90%, noncondensing
Altitude	1000m
Altitude derating (>1000m)	-1% per 100m; 3000m max
Display unit protection	IP54, dust and splashing water protected

MOTOR AND DYNAMIC BRAKE PROTECTION

Motor thermal model trip	PTC thermistor trip
Overload warning	Shear pin trip (configurable)

Dynamic brake resistor thermal model trip
Torque limit and time-out (configurable)
Speed limit and time-out (configurable)

ELITE SERIES PROTECTION

Supply loss	Input phase loss
Software thermal model	Heatsink overheat
IGBT overload	Internal air overheat
Output current limit	Output current trip
DC bus voltage limiting	Software 750Vdc Hardware 800Vdc
Short circuited load	Ground fault
Low DC bus voltage	Regeneration limit
Hardware failure	

CONTROL

Control method	Closed Loop Flux Vector, Open Loop Flux Vector
Analogue inputs	2 inputs, configurable as 0–10Vdc, ±10Vdc, 4–20mA or 0–20mA
Digital inputs	6 inputs, configurable as active high/low, inch, speed or torque select, direction invert functions, front panel configurable to provide stop, start, reset
Analogue outputs	2 outputs, configurable as 0–10Vdc, ±10Vdc, 4–20mA or 0–20mA, with multiple function selections for each
Relay outputs	1 changeover, 2 normally open, rated 230Vac or 30Vdc 2A non-inductive, with multiple function selections for each
Display unit controls	2 lines x 16 characters liquid crystal display, start, stop-reset push-buttons. Increase, decrease, select push-buttons. Display unit can be removed and relocated up to 3m distance.

	NOMINAL OUTPUT @ 50°C						RE-RATED @ 40°C and GREATER THAN 25 Hz (Note 1)					
MODEL	OUTPUT CURRENT Amps	NOMINAL MOTOR POWER (Note 2)					OUTPUT CURRENT Amps	RE-RATED MOTOR POWER (Note 2)				
		230Vac kW	400Vac kW	415Vac kW	230Vac hp	460Vac hp		230Vac kW	400Vac kW	415Vac kW	230Vac hp	460Vac hp
ME-2.5	2.5	0.55	0.75	0.75	¾	1½	3.1	0.75	1.1	1.1	1	2
ME-6.5	6.5	1.5	3	3	2	3	8.1	1.5	3	4	2	5
ME-10.5	10.5	2.2	4	4	3	7½	13.1	3	5.5	5.5	3	10
ME-12	12	3	5.5	5.5	3	7½	15	3	7.5	7.5	5	10
ME-18	18	4	7.5	7.5	5	10	22.5	5.5	7.5	11	7½	15
ME-22.5	22.5	5	11	11	7½	15	28	7.5	15	15	10	20
ME-31	31	7.5	15	15	10	20	39	11	18.5	18.5	15	30
ME-38	38	11	18.5	18.5	15	30	47	11	22	22	15	30
ME-46	46	15	22	22	15	30	57	15	30	30	20	40
UE-60	60	15	30	30	20	40	75	22	37	37	30	60
UE-75	75	22	37	37	30	50	94	30	45	45	30	60
UE-90	90	22	45	45	30	60	112	30	55	55	40	75
UE-115	115	30	55	55	40	75	144	37	75	75	50	100
UE-140	140	45	75	75	50	100	175	55	90	90	60	125

Note 1: Decrease linearly to nominal at 0Hz . Note 2: Power rating applies to 4-pole machines only. Check your motor specification before selecting.

4202-167 Rev G

Specifications are subject to change without notice

3 DESCRIPTIONS

3.1 DESCRIPTION OF THE ELITE SERIES HARDWARE

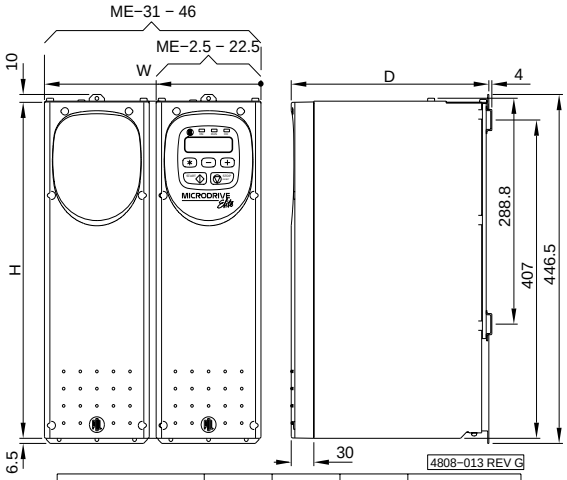
3.1.1 Overview

The Elite Series range is a family of advanced AC induction motor controllers, presented in a wall mounting enclosure. This enclosure is of IP54 ingress protection rating, suitable for installation in an environment where dust and splashing water may be present.

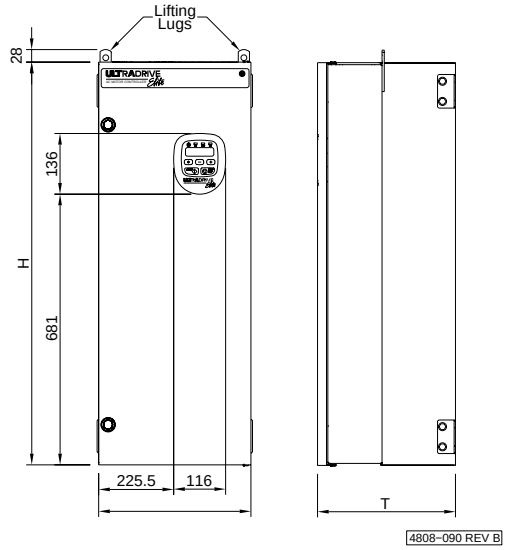
For detailed dimensional drawings, refer to Figure 3.1.

An electrical overview is shown in Figure 3.2.

Full details of mounting are provided in the Elite Series Getting Started Manual, Part No. 4201-179.



MODEL	H (mm)	W (mm)	D (mm)	Weight (kg)
ME−2.5 to ME−22.5	430	139	262	10 − 14
ME−31 to ME−46	430	279	262	27



MODEL	H (mm)	W (mm)	D (mm)	Net Weight (kg)	Packaged Weight (kg)
UE−60, UE−75	970	347	313	73.5	90
UE−90	970	347	313	77.5	94
UE−115, UE−140	970	347	313	80.5	97

Figure 3.1: Elite Series Dimensions

3.1.2 Power Conversion

Key electrical circuit elements of the Elite Series range are shown in Figure 3.3.

AC power is fed to the Elite Series input via external input fuses. Here it is rectified to DC, filtered by chokes and capacitors and reconverted ("inverted") to AC current at the appropriate frequency, phase and voltage to supply the motor.

DC bus terminals are provided for connection of dynamic braking modules or direct supply from a DC source (external softcharge needed for DC supply).

3.1.3 Control Board

The control processor (control board) is supplied from the DC bus via a DC to DC converter. In this way the control system uses the DC bus to provide brief energy storage to achieve significant immunity to small mains supply interruptions or variations. Provision is made for energisation of the control board from an external power supply.

A Display Unit (3 LEDs, 16 x 2 character alphanumeric display, 3 keys, and START and STOP-RESET push-buttons) provides the primary user interface to the Elite Series. Details follow in Section 3.1.4. The Elite Series can be configured from this Display Unit. Alternatively custom configuration can be achieved by use of the external PDL Vista® for Windows software package, launched from a PC running Microsoft Windows.

These push-buttons can be configured to be inactive, or to provide stand-alone START/STOP-RESET control.

Analogue and digital inputs and outputs are provided as detailed in Section 3.1.5. More details can be found in the Elite Series Getting Started Manual, Part No. 4201-179.

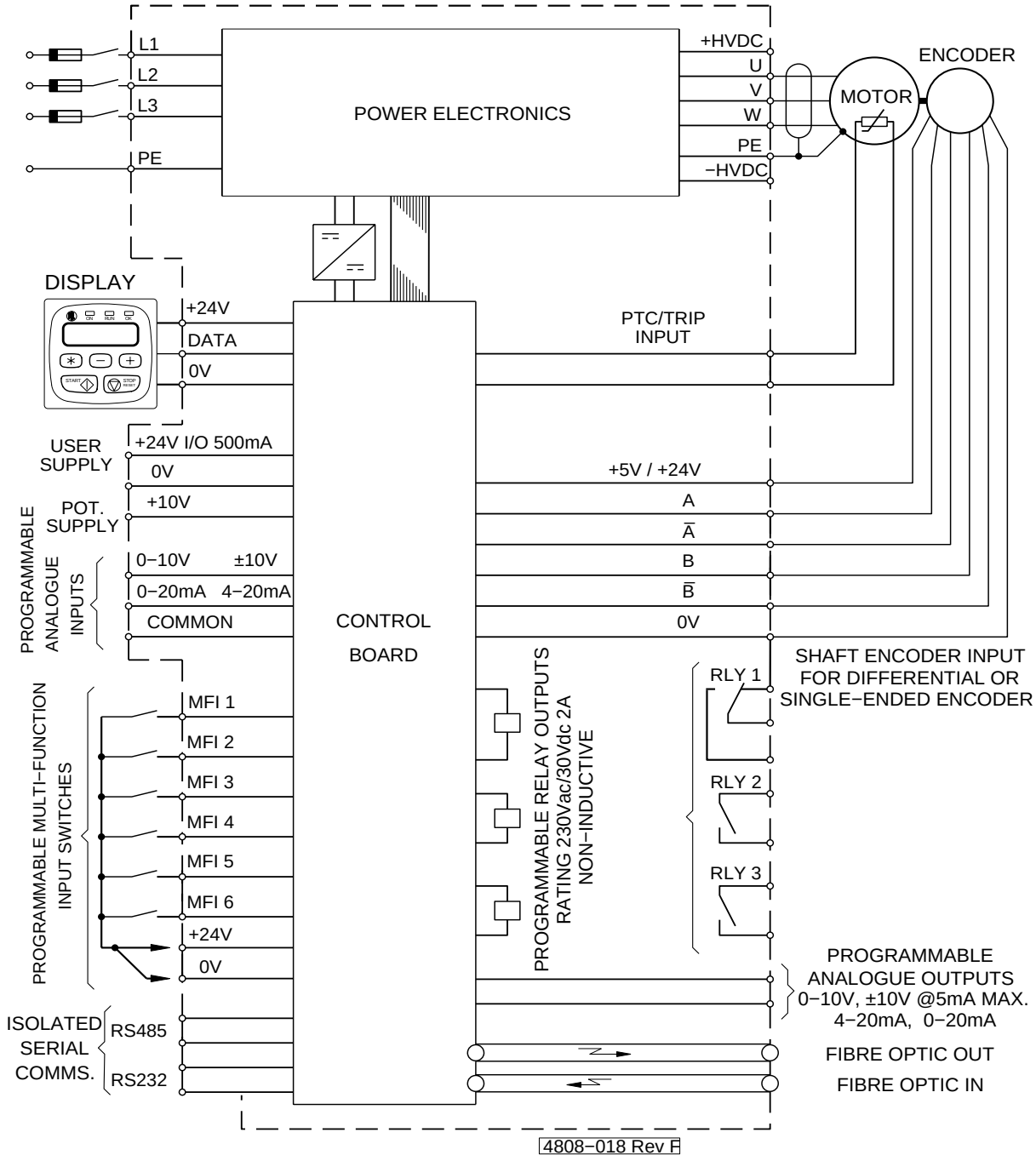


Figure 3.2: Elite Series Electrical Overview

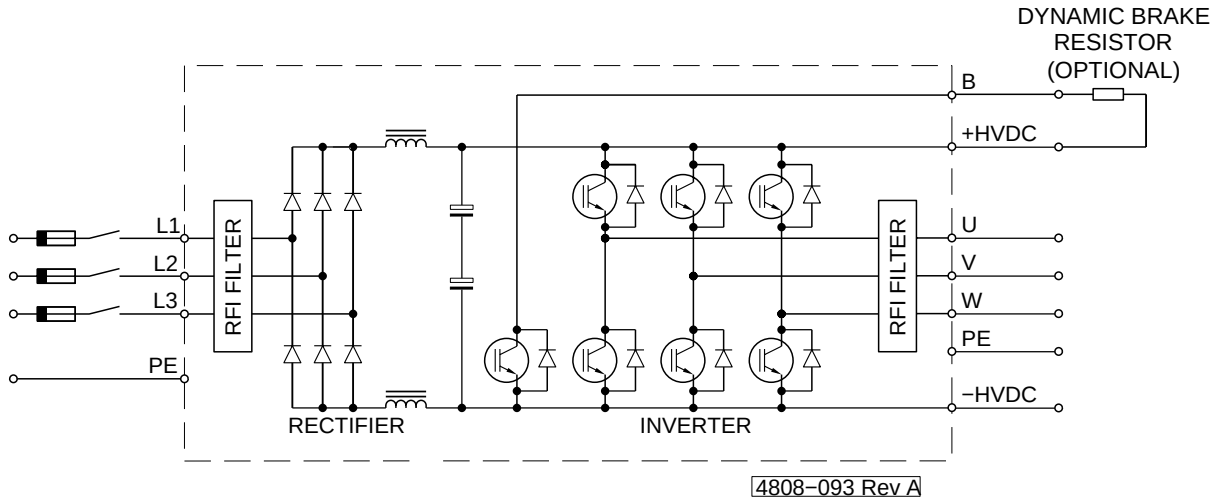


Figure 3.3a: Power Electronics - Elite Series 2.5A - 22.5A

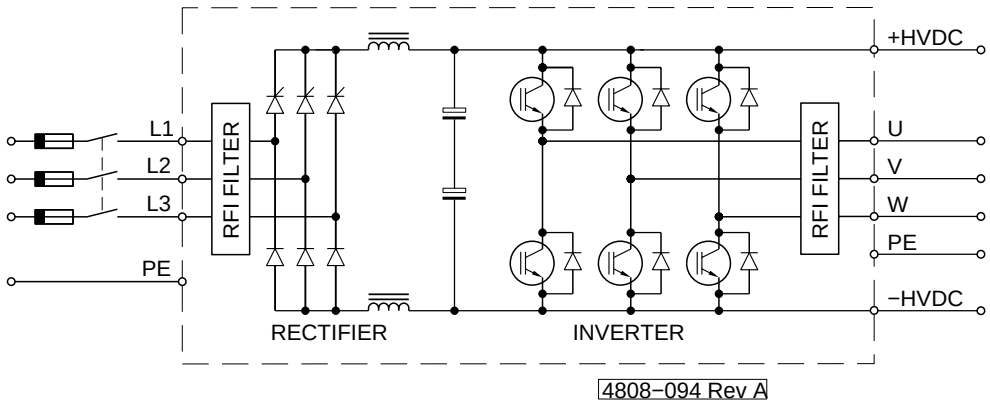


Figure 3.3b: Power Electronics - Elite Series 31A - 46A

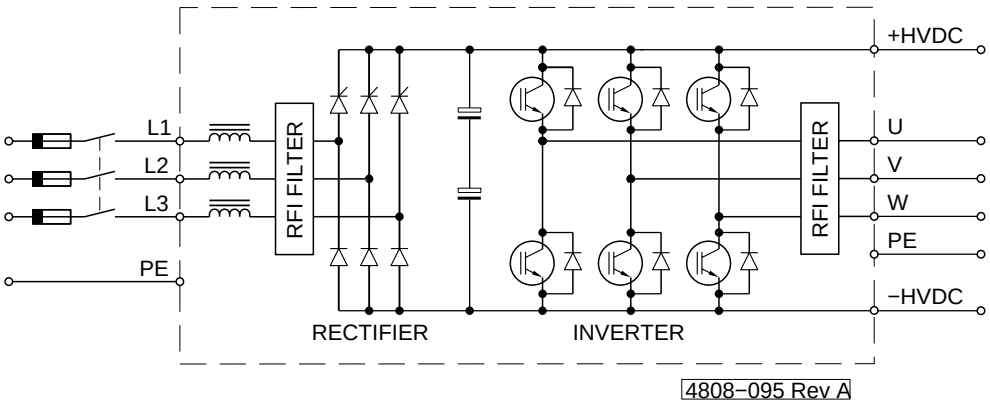


Figure 3.3c: Power Electronics - Elite Series 60A - 140A

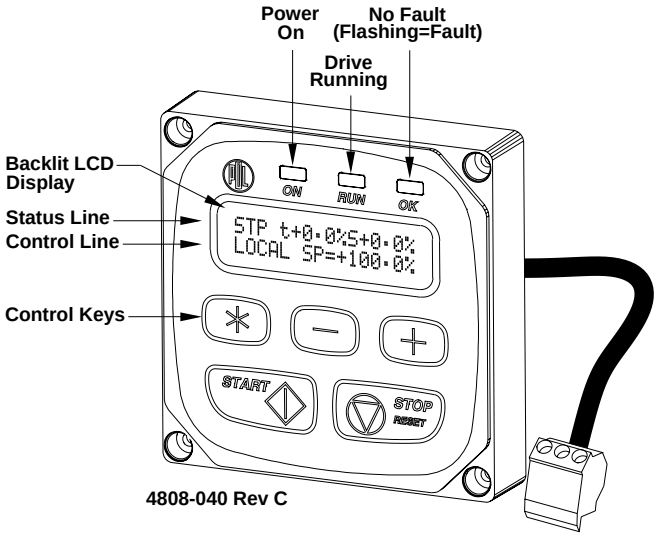


Figure 3.4: The Display Unit and Keys

3.1.4 The Display Unit and Controls

The Display Unit of the Elite Series may be removed from the front of the unit, and refitted in any orientation, or mounted remotely from the unit (up to three metres away). The display is in an IP54 enclosure, thus is protected against ingress of dust and moisture.

The following descriptions refer to Figure 3.4.

THE LED INDICATORS

ON Indicates mains power is supplied to the Elite Series Display.

RUN Indicates the Elite Series is running (driving a motor).

OK Indicates that the Elite Series is operating normally.

OK Flashing: Indicates that the Elite Series has tripped on fault protection.

THE LCD DISPLAY

The Elite Series has a sixteen character by two line (16x2) LCD display.

The lines each have different functions:

- The STATUS LINE is always present and shows the Elite Series status, the output torque and the motor speed.
- The CONTROL LINE of the display is used to view and/or adjust the many parameters of the Elite Series.

THE CONTROL KEYS

The "+" and "–" keys are used to scroll between screen groups. The "∗" key can be used to unfold a screen group, then the "∗" and "+" or "–" keys used to adjust the parameter or mode on display on the control line. Refer to Section 7 of this manual for full details of screen organisation and control.

THE START AND STOP-RESET PUSH-BUTTONS

These push-buttons may be configured to enable starting and stopping of the motor from the display unit if required, and also to reset the Elite Series in the event of a fault trip.

Alternatively, the START push-button can be configured to be in parallel with an external START switch, and the STOP-RESET push-button in series with an external STOP-RESET switch.

Details on configuring these push-buttons are given in Section 9 of this manual.

SCREEN ORGANISATION

Screens can be arranged in **folded** format. Each screen group has a main screen with the group identifying letter and description. Folded under this main Screen can be a number of subscreens, each of which has a single parameter or mode for viewing or adjustment. These subscreens cannot be viewed until unfolded using the "∗" key. The entire set of screens is known as a Screen List**.**

Once unfolded, some subscreens in a Screen List have a numerical parameter which may be adjusted. Others may have a list of options, with each option separately viewable and selectable.

Each screen or subscreen has a viewing attribute. This attribute defines if the screen is "read only", "read–write" or "hidden".

Note that the main screen or subscreen will be visible only if its attribute is configured to be "read" or "read-write". If a screen is configured as "hidden" it will only be visible when the Elite Series is in "commissioning" mode.

Details on controlling these screens and adjusting parameters and modes are given in Section 7 of this manual.

Full details of the Screen List are given in Section 9 of this manual.

CUSTOMISATION OF CONFIGURATION

The Elite Series Control Board processor has a number of logic and processing blocks integrated into the firmware. These can be configured to enhance the existing default configuration, or for configuring a completely new control system. These blocks include logic gates, counters, timers, analogue signal processors, PID controllers, inputs and outputs.

To suit any custom configuration, a custom Screen List can also be designed. This Screen List may be a modified version, or a foreign language version, of the default Screen List provided.

More details on customisation of control are given in Section 8 of this manual.

SECURITY PROTECTION

For reasons of security, the Elite Series must be in **commissioning mode** (Screen Z) before certain adjustments can be made. Some adjustments also cannot be made unless the Elite Series is in a OFF state (this is for safety reasons).

If **commissioning mode** is enabled, any user can adjust all settings and configurations. To enable this mode, scroll to Screen Z, and enter the correct password. Further details are given in Section 9 of this manual.

3.1.5 Control Inputs and Outputs

Figure 3.4 provides the complete electrical specification of all Elite Series control inputs and outputs. Each input and output is individually described below. Further information (including specific examples of connection) is presented in the detailed descriptions of the relevant control screens.

For further connection information to these terminals, refer to Elite Series Getting Started Manual, Part No. 4201-179.

Terminals T1 to T7 - Configurable Relay Outputs

These are low power relay contacts offering operation at signal or 230Vac levels. Selection of their function is made through the output (O) screens. Avoid settings which cause the relays to switch excessively as this will reduce their life expectancy. The software places a 250ms minimum pulse width to prevent relay chatter.

Terminals T8, T9 - Dynamic Brake Control

If a dynamic brake is to be installed in conjunction with the Elite Series, it can be controlled from these terminals. For drives up to and including ME-22.5, these terminals will be internally connected to the inbuilt dynamic brake transistor. Dynamic brake resistor thermal protection can be configured from Screen Group D.

Terminal T10 to T12 - Display Unit

The connections to the Display Unit are made via these terminals. The Display Unit may be removed from its position within the drive and be mounted remotely, The maximum allowable length of wiring is 3 metres.

Terminals T13 to T18 - Multi-function Inputs

The function of these inputs can be programmed from the keyboard, from Screen Group I. Alternatively they can be customised via the PDL Vista® for Windows software running on a personal computer.

Their operating format may be set for active high or active low. These inputs are factory preset for active high operation (that is, they are internally connected to bias low).

Terminal T19 - External trip/Motor PTC

This is a digital input committed to causing a protective trip should the resistance between this terminal and the selected common exceed 4kOhms. This is characterised for a set of standard motor PTC thermistors. The operating mode of the input can be changed between active high and active low.

Terminals T20, T21 - Input Switch 0V & +24Vdc Connections

These terminals provide a return point for the seven digital inputs connected to terminals T13 to T19. If active high is selected, the common points of the switches connect to Terminal T21. If active low is selected, the common points of the switches connect to Terminal T20.

Terminal T22 - Analogue Output Ground Connection

This ground is a suitable return point for the two analogue outputs connected to Terminals T23, T24.

Terminals T23, T24 - Configurable Analogue Outputs

These two analogue outputs may have their formats and sources configured. Formats can be 0 to 10Vdc, -10 to +10Vdc, 0 to 20mA or 4 to 20mA. Configuration is done from Screen Group O.

Terminal T25 - Analogue Input 0V Connection

This connection is a suitable return point for the two analogue outputs connected to Terminals T26, T27.

Terminals T26, T27 - Analogue Inputs

These inputs are configurable as to their function, also their formats and scaling may be set. Formats can be 0 to 10Vdc, -10 to +10Vdc, 0 to 20mA or 4 to 20mA. Configuration is done from Screen Group I.

Terminals T28, T29 - Potentiometer Supply

A 10V supply with a 10mA constant current source capability is provided for connection to a 1k Ohm potentiometer.

Terminals T30 - +5Vdc

This terminal is provided for the encoder power supply. Maximum rating 5Vdc 100mA.

Terminals T31 to T34 - Incremental Quadrature Encoder Inputs

The Elite Series is designed to accept input from a standard quadrature encoder designed to operate from +5Vdc to 24Vdc and having single ended open collector outputs, push-pull open collector outputs, or differential logic driver outputs. This encoder is only required if operating in Closed Loop Vector control mode. The encoder type and pulses per revolution may be configured from Screen Group N.

Terminal T35 - Encoder 0V

This terminal is provided for the encoder power supply 0V return.

Terminals T36, T37 - User 24Vdc In/out, 0V

These are provided for powering of user controls, encoder power supply or for back feeding a backup power supply to energise the control board in the event of mains failure. This output is fuse protected.

Maximum output current capability: 500mA
Minimum input current capacity of backup supply: 1A.
Backup supply voltage: 24Vdc ±10%

Terminals T38 to T42 - RS232 / RS485 Connections

These terminals are provided for serial communications connections, for control, monitoring or configuration from a PC or other remote host. These terminals are optically isolated from the Elite Series potential.

IMPORTANT NOTES REGARDING RELIABILITY OF CONTROL CIRCUITS

Screening

Screening - it is essential that all control inputs and analogue outputs are screened. There are no exceptions if you expect reliability!

Cable Separation

Do not run control signals together with power input or output cables to the motor - space at least 300mm away, and cross at right angles.

Relay Signals

Output relay signals do need to be screened. If power switching, do not include output relay signals in the same screened cable with control signals. Do not overload relays.

Switch Inputs

Switch Input circuits are designed for 24Vdc operation. Do not apply any other voltage.

Earthing of Control 0V

To comply with the requirement of a Class 1 earthing system, the Microdrive Elite control 0V must be linked to earth at some point. Connection of multiple earth points may cause earth loops and should be avoided. An earth link is provided, and must be removed if not required. Removal will allow the 0V point to float up to ±50Vdc (30Vac) from chassis earth.

More comprehensive connection information is given in the Elite Series Getting Started Manual (PDL Part No. 4201-179).

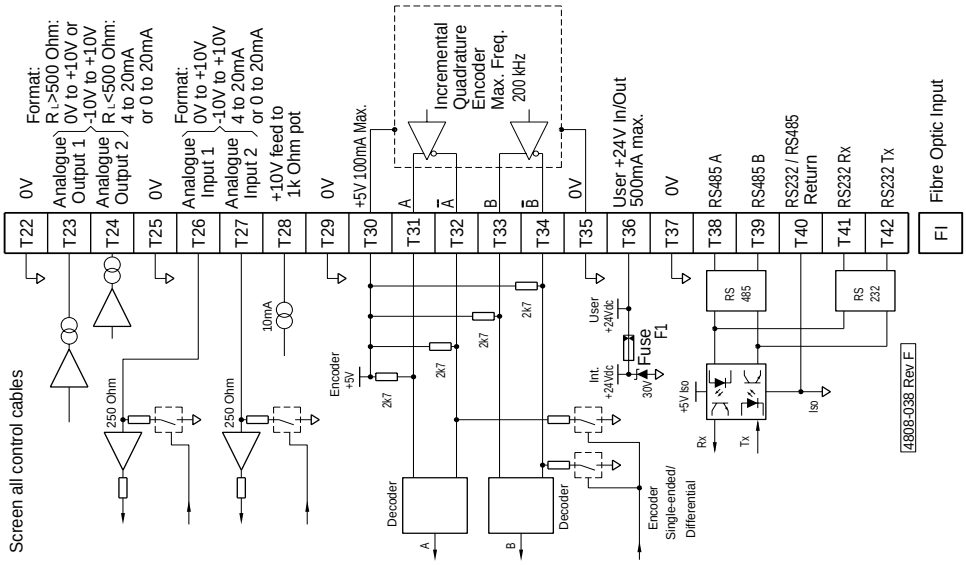


Figure 3.5a: Control Terminals T22-T42

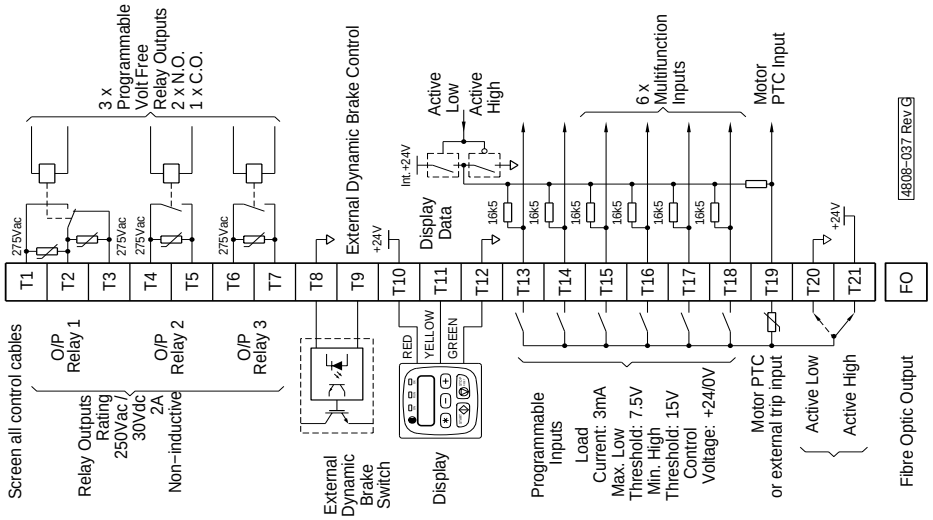


Figure 3.5b: Control Terminals T1-T21

3.2 DESCRIPTION OF THE ELITE SERIES CONTROL SYSTEM

3.2.1 Structure of the Inputs and Outputs

The following descriptions refer to Figure 3.5.

ANALOGUE INPUTS

Two analogue inputs are provided. The format and scaling of these inputs are configurable from the front panel.

The format of each is configurable by Screens I6a, I6d, without links, to be 0 to 10Vdc, –10 to +10Vdc, 0 to 20mA or 4 to 20mA.

Analogue Processing - A zero band may be introduced using Screen I6g to the analogue signals. This is used to ease setting of absolute zero values. Scaling determines the percentage (of motor speed or torque) demanded by the minimum and maximum settings. This is done by Screens I6b, I6c, I6e, I6f.

OUTPUTS

Potentiometer Supply - Provision for output to a 0-10V 1kOhm potentiometer is provided from a +10V 10mA constant current source.

Relay Outputs - Each of three relay outputs may be controlled from a large number of sources using Screens O2a, O2c, O2e. Each may be individually inverted. RLY1 is of changeover configuration, RLY2 and RLY3 have normally open contacts.

Analogue Outputs - Each of the two analogue outputs can have its source, format and scaling configured from the display unit. Each analogue output can have its format configured, with a choice of 0 to 10Vdc (unipolar), –10 to +10Vdc (bipolar), 0 to 20mA or 4 to 20mA using Screens O1a to O1h.

COMPARATOR

Comparator -Two software comparators allow relay outputs to respond to analogue levels. The comparators may be individually selected to any analogue output source. Individual ON and OFF levels may be set. A window function may also be selected. Configuration is by Screens C1 to C6.

SWITCH INPUTS - MULTI-FUNCTION INPUTS

Switch Inputs - Six switch inputs are provided. These inputs set digital levels and are collectively known as Multi-function Inputs (MFI).

The multi-function inputs are factory set from the Display Unit to bias low for active high switching, which is considered to be a "fail-safe" mode. Alternatively the inputs may be set for active low switching using Screen I7b.

The six multi-function inputs perform control functions according to the input mode selected on Screen I7a. When certain modes are selected the function of some (or all) of the inputs may be individually programmed to act as one of a wide range of possible controls, by use of Screens I7c to I7h.

The switch inputs are processed together with keyboard controls (and set point references - multi-references) to provide a number of internal digital controls as well as the control of two analogue reference signals (motorised potentiometer and multi-reference).

3.2.2 Structure of the Motor Control System

Referring to Figure 3.6, the structure of the Elite Series control system may be considered as a torque controller, (the flux vector control system), the input of which selects either a speed referencing or torque referencing processor. This torque controller may be operated with a shaft encoder mounted on the motor for the best response and low speed operation. Alternatively it may be used without an encoder (Open Loop Vector control mode) for less critical applications.

THE FLUX VECTOR (TORQUE) CONTROLLER

Unlike conventional AC motor speed controllers, the Elite Series is primarily a torque control system. The flux vector control method requires complete knowledge of motor parameters, together with feedback of the rotor shaft speed. A high resolution encoder fixed to the motor shaft directly feeds back accurate indication of motor speed. This is scaled according to the pulse per revolution rating of the encoder (typically 2000 ppr) and the motor rated speed. The encoder additionally feeds back speed to the speed control loop, and overspeed protection override.

To ensure accurate operation, all the motor and shaft encoder parameters must be entered using the N screen group. Also vector loop tuning parameters (the X screens) must also be entered. The X screens can most easily be set up by using the autotuning facilities available (Screen X2).

Open Loop Vector operation is also available, where a motor shaft encoder is not used. A reduction in performance may be expected when running in this mode.

The source of the torque demand reference is selected according to the desired (speed or torque) operating mode. The torque reference is subject to overspeed limits set on Screens L2 and L3, and minimum and maximum torque limits set on Screens L4 and L5.

Additionally a special torque limit (L8 MAX REGEN) is provided which controls the maximum level of regenerated power.

TORQUE REFERENCE PROCESSING

The torque set point may be selected from seven possible torque references. Additionally a second alternative reference selection may be made. The chosen torque set point may optionally be inverted. Minimum and maximum torque limits are provided. An optional torque filter completes the processing. The torque set point is then routed to the flux vector controller source selector.

SPEED REFERENCE PROCESSING

The speed set point may be selected from seven possible sources. Additionally a second alternative reference selection may be made. The chosen speed reference may optionally be inverted. At this point the speed set point may be overridden by fixed speed demands such as inch references.

Minimum and maximum speed limits are provided followed by Skip speeds (set by Screens L10 to L12) to allow the user to avoid mechanical resonances. The speed set point is then processed by the acceleration, deceleration and speed filter controls according to various rate (R) screen settings.

As the flux vector controller is a torque control system, the speed control signal cannot be applied directly to the vector controller. Instead it must be applied to a speed feedback loop, the output of which is a torque demand. Thus, the speed set point is finally applied to a PID speed controller. The set point is compared to the actual speed, fed back from the shaft speed encoder. The resulting torque command signal is routed to the flux vector controller source selector.

PROCESS CONTROL

The inclusion of a full three term PID regulator allows the Elite Series to perform process control (e.g., constant pressure pumping etc.). External auto/manual selection is also available to assist during startup conditions.

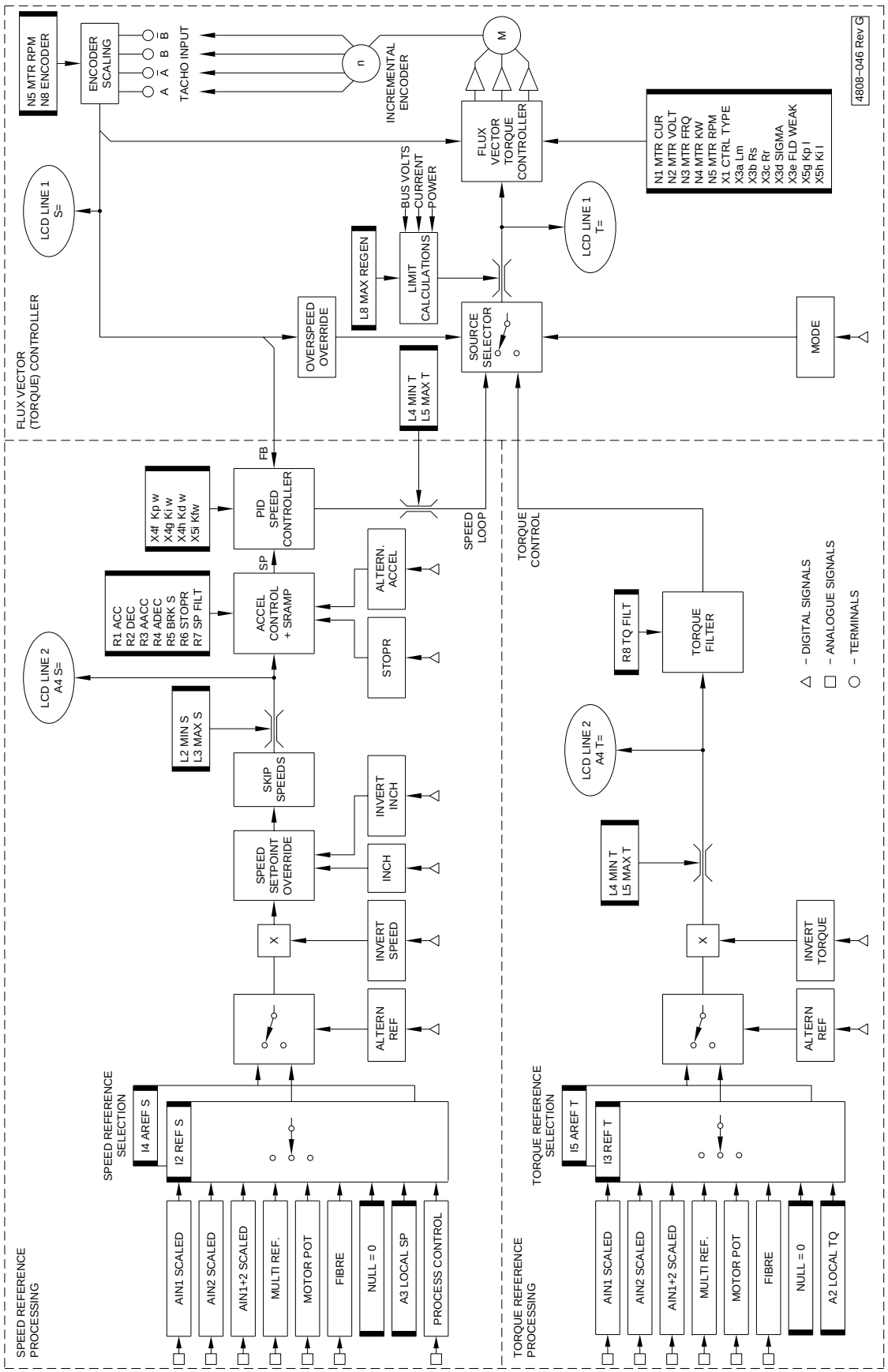


Figure 3.6: Structure of the Elite Series Motor Control System

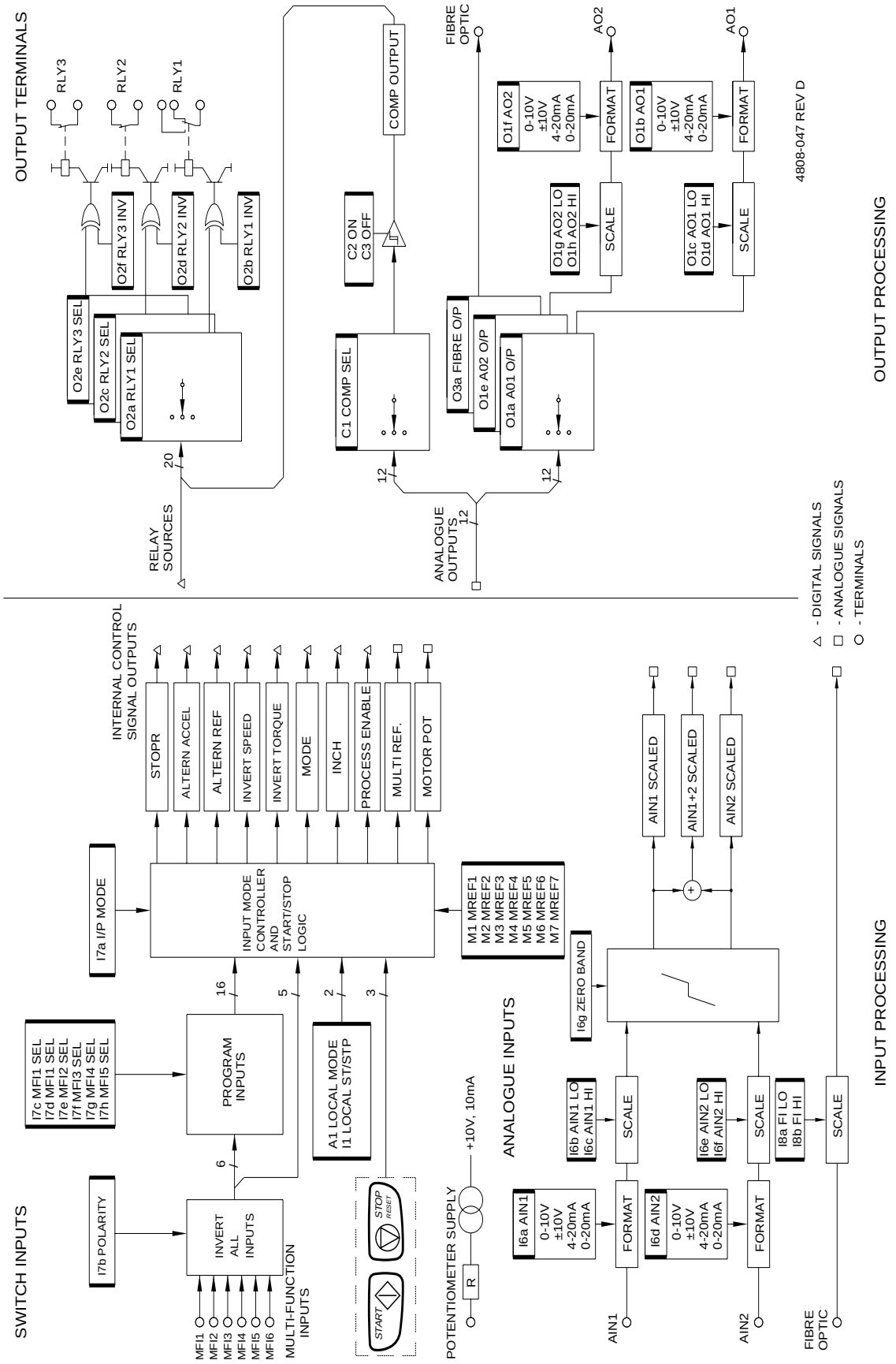


Figure 3.7: Structure of the Elite Series Input/Output Processing System

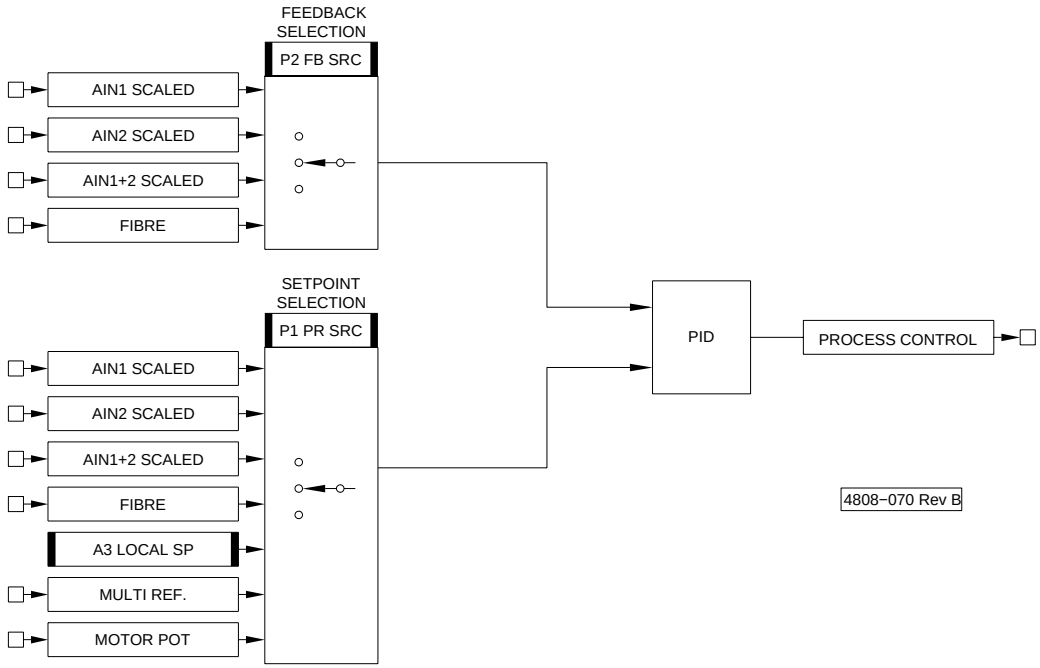


Figure 3.8: Process Control Processing

4 APPLICATION AND INSTALLATION RECOMMENDATIONS

4.1 THE MOTOR

4.1.1 Sizing the Motor and Elite Series

The Elite Series is suitable for controlling all standard three phase induction motors. In sizing the Elite Series, the torque requirements of the load must first be assessed. Under flux vector control conventional induction motors are able to provide at least 200% of rated torque (often 250%). Choose a motor capable of supplying the required torque and a Elite Series capable of supplying the motor's current requirements.

In applications requiring high peak torques, the Elite Series is required to supply current approximately in proportion to the torque. The Elite Series should be chosen according to its peak overload limit of 200% (1 second) and its short term overload limit of 150% (30 seconds).

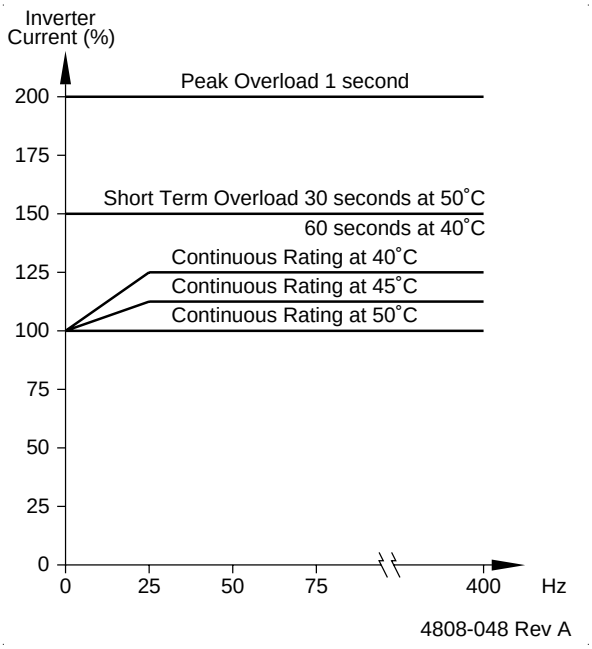


Figure 4.1: Elite Series Thermal Overload Characteristics

In application operating continuous loads or providing significant torque at low speeds, the motor must be chosen on a basis of continuous dissipation. It may be necessary to oversize, or force cool the motor for applications operating with significant torque at low speeds (Figure 4.2). In such applications the Elite Series should be chosen according to its continuous rating.

For pump and fan applications, where a high overload margin is not usually required, the Elite Series may be re-rated by +25%, if the Elite Series is to be operated in an environment of an ambient temperature not exceeding 40°C.

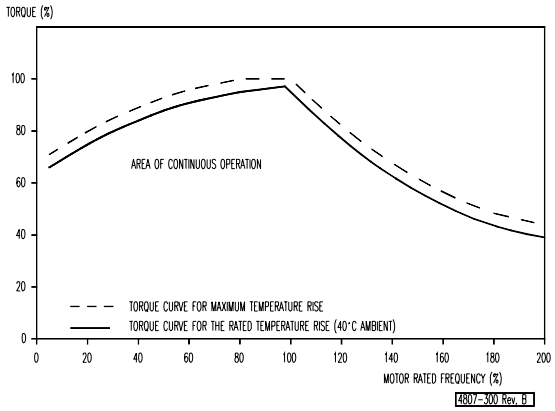


Figure 4.2: Typical Motor Thermal Derating

4.1.2 Operation Above Motor Rated Speed

The Elite Series can be operated above motor rated speed, however the torque that is able to be generated declines (1/f) as there is insufficient voltage to provide correct stator flux. The torque response also reduces significantly in this mode of operation for the same reasons.

Check that the motor is suitable for operation above rated speed. Consult the motor manufacturer.

A popular solution to achieve a wider speed range is to reconfigure the motor for lower voltage operation (e.g., 230Vac delta connect a 400Vac star motor, or specially wind the motor). Full performance is achieved at increased speeds (until the supply voltage is reached), at the penalty of increased motor current.

4.1.3 Operation of More Than One Motor

When running the Elite Series in Open or Closed Loop Vector control mode, operation of more than one motor from the Elite Series is generally impractical. In certain applications utilising identical motors with identical loads (e.g., load sharing or mechanically locked) connection of more than one motor may be possible.

When running the Elite Series in V/Hz Mode , it is possible to run more than one motor in parallel off one Elite Series. If running parallel motors, the rating of the Elite Series should exceed the sum of the individual motor currents. Each motor will require individual thermal protection. Performance will be reduced and torque control cannot be selected.

4.1.4 Thermal Protection of the Motor

The Elite Series maintains a thermal model of the motor as its primary means of detecting overload and protection. Nevertheless the use of a temperature protecting PTC embedded in the motor windings provides ultimate protection and is recommended. The thermal model will not be effective if the Elite Series is running more than one motor.

4.2 THE ENCODER

4.2.1 Choice of Encoder

If the Elite Series is to be used in Closed Loop Vector control mode, a shaft encoder will need to be connected to the motor. A specification for a suitable encoder for a 50 or 60Hz motor is:

Encoder type:

Incremental, quadrature (bi-phase), differential or single-ended output. Push-pull output preferred to maximise range.

Recommended ppr:

1000 to 2000 ppr per motor pole pair, for directly driven encoder

Minimum ppr:

500 ppr per motor pole pair (4 pole motor = 1000 ppr)

Supply requirement:

5Vdc, 100mA maximum

The shaft encoder should be fitted directly to the motor (using a flexible coupling) or indirectly via a toothed (zero slip) belt drive or similar. There must be zero slip or backlash, and high shaft loads or loose couplings must be avoided.

The encoder MUST be connected using shielded twisted cable. The shield should be earthed at the Elite Series end only, to avoid the possibility of earth loops. The maximum cable length is inversely proportional to the required maximum pulse rate. A push-pull output encoder gives a better range than a single ended open collector type, and is recommended for cable runs exceeding 30 metres. If using an open collector type of encoder, when wired with typical shielded cable with capacitance of 200pF/metre, the product of cable length (metres) x max. frequency (kHz) should not exceed 1500.

A differential output encoder has a high common-mode noise rejection capability, thus is **recommended** for electrically noisy environments. The encoder inputs to the Elite Series will also accept input pulses from an encoder operating off a supply up to 24Vdc.

4.2.2 Connection of the Encoder

The encoder orientation shown in the drawings in this manual (i.e., the connection of the A and B outputs) assumes the encoder is to be connected directly to the non-drive end (non-shaft end) of the motor and that motor wiring orientation is normal (motor terminals U1, V1 and W1 are connected to Elite Series terminals U, V, W, respectively). In this case, an increasing count (Screen Z9) should correspond to rotation in the positive direction (motor shaft rotates clockwise when the motor is viewed from the drive end), in response to a positive speed reference.

If the encoder direction is inverted (e.g., by mounting at the drive end or using an inverting belt coupling), A and B signals, or for a differential encoder, A and /A signals should be swapped.

4.3 SWITCHING

4.3.1 Power Switching

Generally it is better practice to leave electronic equipment (including the Elite Series) permanently connected to the mains supply. Switching the mains on and off to control the Elite Series is bad practice and should be avoided (use the control terminals). Mains switching must not occur more often than once every five minutes to avoid overheating the charging circuits.

4.3.2 Motor Switching

Because the Elite Series acts as a variable frequency (including DC) current source :-

WARNING: Motor isolation **MUST NOT BE OPENED** while the Elite Series is running.

Although the Elite Series will not be damaged, standard industrial switchgear is not designed to operate at or near DC conditions, and there is great danger of damage or fire due to arcing under these conditions.

4.4 TORQUE AND SPEED CONTROL MODES

4.4.1 Torque Control Mode

Unlike conventional AC motor speed controllers, the Elite Series is primarily a torque controlling device. When used in Closed Loop Vector torque mode, a reference torque demand signal sets the output torque level which the Elite Series will try to achieve from the motor. This level may be positive or negative and is quite independent of the motor speed (within speed limits). Web control systems which require constant tension applied to the web, regardless of speed, are a typical torque control application.

While in torque mode, speed limits are used to limit overspeed such as may occur from temporary loss of load (e.g., a web break in the above example). The speed reference signal is disregarded while in torque control mode.

To run in torque control mode, it is necessary to employ Closed Loop Vector control mode and use a shaft encoder on the motor.

4.4.2 Speed Control Mode

Speed control in the Elite Series is implemented through closed loop control of torque. PID settings are used to adjust the response of the speed control loop. Apart from this, speed control is implemented and settings made in a similar way to conventional AC drives.

A reference speed control signal sets the output speed which the Elite Series will try to achieve at the motor. The direction may be positive or negative, and is independent of load torque (within torque limits).

While in speed control mode, torque limits are used to limit over- torque such as may occur due to process changes or fault conditions.

For best performance in speed control mode, employ Closed Loop Vector control mode and use a shaft encoder on the motor. This gives improved speed regulation, faster dynamic response, and full torque capability at zero speed.

If such high performance is not required, Open Loop Vector control mode may be employed. In this mode a shaft encoder on the motor is not necessary.

4.4.3 Switching Between Torque and Speed Control Modes

When switched, transition from torque control mode to speed control mode and the inverse, is achieved without discontinuity (i.e., smoothly). This will only apply when the Elite Series is used in Closed Loop Vector control mode.

4.5 DYNAMIC BRAKING

Regeneration is achieved through the motor being driven by the load (e.g., lowering crane hoists or rapid deceleration of high inertia loads). While being driven, the motor acts as a generator and energy is transferred back into the DC bus capacitors of the Elite Series. In its standard form the Elite Series can only dissipate this energy as losses and so can only provide limited braking of 5-10%.

Where higher levels of braking are needed, an additional dynamic brake module must be fitted. Dynamic brakes are controlled power switches which are used to dump energy from the DC bus into resistive loads. Generally such brakes and resistors must be sized to suit the requirements of the

application according to considerations of both peak and continuous power dissipation requirements. Refer to the supplier for more information regarding specific dynamic brake modules, or to the dynamic brake manual if already supplied.

The Elite Series models up to the ME-22.5 have a dynamic brake transistor built into the unit. Simply connect the appropriately sized resistor between the positive DC bus terminal "+" and the dynamic brake resistor terminal "B".

ELITE SERIES	DB RESISTOR MINIMUM RESISTANCE	DB RESISTOR POWER RATING (MIN)
ME-2.5	500 Ohm	1.1 kW
ME-6.5	180 Ohm	3.0 kW
ME-10.5	130 Ohm	4.0 kW
ME-12	100 Ohm	5.3 kW
ME-18	50 Ohm	10.6 kW
ME-22.5	50 Ohm	10.6 kW

4202-185 Rev D

Figure 4.3: Dynamic Brake Resistor Ratings

Dynamic Brake Resistor Wiring

Due to the high voltage switching and the currents involved, special wiring practices must be observed when connecting the dynamic brake resistor.

For the dynamic brake resistor connection a multicore cable with screen is recommended. Alternatively, two separate cables securely tied together at 200 mm intervals without gaps between the cables may be used. This minimises the cable inductance. Keep the cable length to a minimum to reduce overall cable inductance.

The resistor bank MUST be of non-inductive construction.

Do observe normal wiring practices of separating control and power cables.

The dynamic brake resistor cable must have sufficient diaelectic strength to withstand 1000 Vdc (conductor to conductor rating for multicore cables).

On the Elite Series, set Screen D1 (DB Time Constant) to the time it would take to reach 64% of the resistor's final temperature if continuously energised.

Set Screen D2 (DB Duty) to the average percentage of time that the resistor may be operated for.

For application advice on resistor sizing and cabling requirements please request assistance from PDL Electronics or its agent.

5 UNPACKING, INSTALLATION AND CONNECTION

5.1 UNPACKING

Full details on the unpacking procedure are given in the Elite Series Getting Started Manual (Part No. 4201-179). Ensure that all of the listed items are supplied, and that there is no visible damage. The packaging material must be disposed of thoughtfully.

5.2 INSTALLATION

Full details on the installation of the Elite Series are given in the Elite Series Getting Started Manual (Part No. 4201-179).

The Elite Series is protected against an environment contaminated to pollution degree 3 (damp or dusty air). It can handle an ambient air temperature not exceeding 50°C. However the cleaner and cooler the environment, the longer the lifetime that can be expected from the unit. If used in an ambient temperature not exceeding 40°C, the Elite Series may have its output current re-rated by 25% for motor speeds exceeding 25Hz. This is useful for pump and fan applications.

The Elite Series range is designed for wall mounting, either vertical upright, vertical inverted, with back or side to the wall.

5.3 POWER WIRING CONNECTIONS

Full electrical connection details are given in the Elite Series Getting Started Manual (Part No. 4201-179).

Figure 5.1 provides a summary of required power connections. Note the following requirements:

1 The Elite Series is designed for operation from a three phase earthed neutral supply. The Elite Series' input supply and its cooling fans are not phase sequence sensitive. Input fuses are required. Details of the recommended fuse size are given in Fig. 5.2. In all cases, observe local wiring and safety regulations.

2 Power factor capacitors are not required on the Elite Series input, and must not be connected to the Elite Series output.

3 An off load isolation switch or contactor may be fitted to the Elite Series output. **Never** attempt to operate this switch under load. **Never** open a contactor on the output while the Elite Series is running as the Elite Series operates as a current source. Opening the output while running could cause extensive damage or fire in the switchgear.

4 The Elite Series is fitted with radio frequency interference (RFI) filtering (input and output filters) as standard. To maximise the effectiveness of these filters, screened cable (e.g., neutral screen, steel conduit) must be used on the Elite Series output. Bond the screen solidly to the Elite Series and motor chassis. Failure to use screened output cables may lead to disruption of other electronic equipment. The output cables should be run separately from the input cables, to reduce the chance of RFI cross-coupling between cables.

5 The Elite Series protects the motor with an electronic overload, so an external overload relay is not necessary. Where multiple motors are attached, separate overload protection must be applied to each motor. The Elite Series or the motor must be isolated before operating on the motor terminals.

6 The Elite Series output switching voltage waveform can give rise to high (capacitive) earth leakage currents. Permanent earth connection of the motor and the Elite Series is essential before connection to the supply. Screened cable must be used between the Elite Series output and the motor to reduce the chances of radio frequency interference problems. A suitable cable is three phase neutral screened, with the screen wired as the earth return. Steel conduit may also be suitable.

7 For applications where regeneration is likely to occur, a dynamic brake resistor may be required. The resistor must be positioned where the expected heat generated by it will not ignite or damage its surroundings.

8 The location and order of the power terminals varies from model to model. Refer to the terminals labels before connection.

To achieve full IP54 ingress protection rating, it is important to pass all external wiring through the gland plate supplied. Glands must be correctly fitted to the cables and the gland plate screws tightened to the recommended torque. Also once connections are made, ensure that the terminal cover is fitted correctly and all screws tightened to the recommended torque.

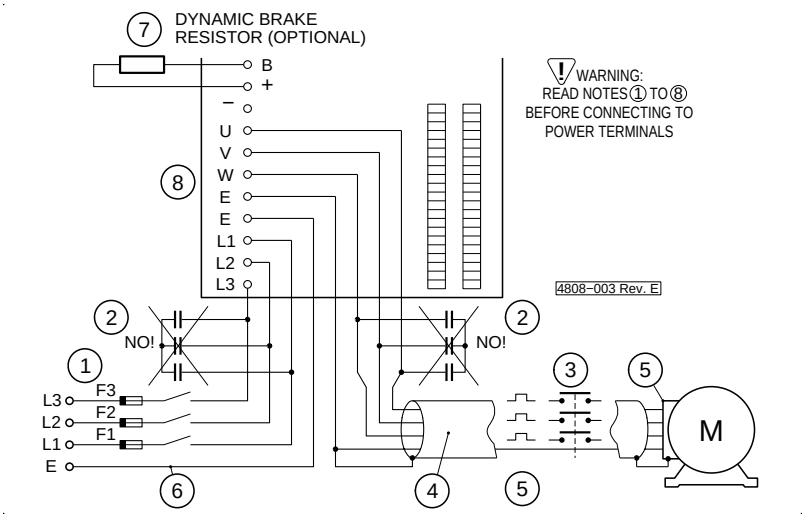


Figure 5.1: Elite Series Power Connection

MODEL	MAXIMUM RATED INPUT CURRENT (A)	RECOMMENDED FUSE RATING (A)	RECOMMENDED CABLE SIZE (mm²)
ME-2.5	3.1	6	2.5 - 4
ME-6.5	8.1	16	2.5 - 4
ME-10.5	13.1	25	2.5 - 4
ME-12	15	32	4 - 6
ME-18	22	40	4 - 6
ME-22.5	28	50	4 - 6
ME-31	39	80	6 - 10
ME-38	47	100	10 - 16
ME-46	57	100	16 - 25
UE-60	75	150	25-35
UE-75	95	200	35-50
UE-90	115	200	50-70
UE-115	145	300	70-95
UE-140	175	300	95-120

4202-157 Rev G

Figure 5.2: Recommended Fuse Rating and Cable Sizes

5.4 CONTROL WIRING CONNECTIONS

Control wiring should be done using screened cable. The screen is earthed at one end only (at the Elite Series end). For safety reasons, the Elite Series control 0V should be linked to earth at some point. Avoid connection of multiple 0V points to earth as this will cause earth loops.

Note that the control inputs and output are highly configurable, so the desired configuration should be planned and designed before attempting connections.

Communications connections can be made to the RS232 or RS485 ports.

Control wiring connections and recommendations are detailed in the Elite Series Getting Started Manual (Part No. 4201-179).

5.5 SHAFT ENCODER CONNECTIONS

If using the Elite Series in Closed Loop Vector mode, a shaft encoder is required on the motor. Shaft encoder recommendations are detailed in Section 4.2 of this manual. Figure 5.3 details encoder connections. Refer to the Elite Series Getting Started Manual (PDL Part No. 4201-179) for details on achieving correct orientation of encoder and motor wiring.

5.6 FIBRE OPTIC CONNECTION

The fibre optic cable used can be any low cost plastic fibre with 1mm core diameter. The maximum recommended cable length is 50m at 50°C ambient. Note that if the fibre optic cable is located near power cables, the local ambient temperature may exceed 50°C. Signal attentuation increases with temperature thereby decreasing the maximum cable length for reliable communication.

Connection is made by cutting a suitable length using a knife (recommended) or side cutters, inserting through a rubber control cable grommet into the fibre optic port and screwing tight the connector. There is no need to strip back the sleeving of the fibre optic cable.

5.7 DYNAMIC BRAKE DETAILS

The possible need for dynamic braking is discussed in Section 4.5 of this manual. If a dynamic brake is required, the brake resistor must be mounted in a position where the expected heat generated by it will not ignite or damage its surroundings.

5.8 COMMISSIONING DETAILS

Full information on the commissioning of the Elite Series are given in the Elite Series Getting Started Manual (Part No. 4201-179).

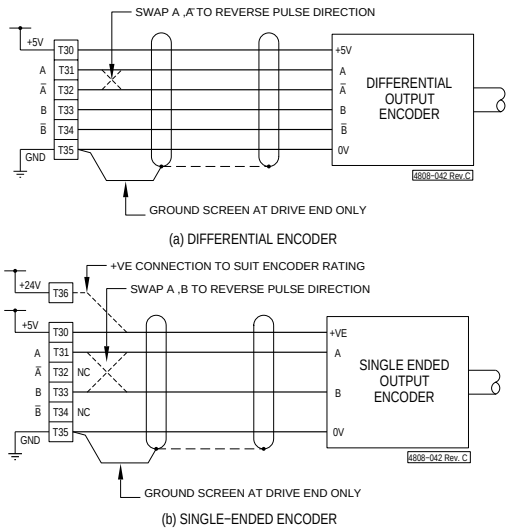


Figure 5.3: Shaft Encoder Connection Details

6 SERVICE AND MAINTENANCE

WARNING: Observe the safety precautions detailed at the beginning of this manual.

6.1 FAULT FINDING

Faults in the Elite Series will fall into one of five major categories:

- Failure of an external control device, e.g., switch or analogue input device.
- Protective fault operation with resulting display message.
- Incorrect settings, set up or adjustment resulting in unsatisfactory performance.
- Encoder failure.
- Electrical failure within the drive.

6.1.1 Electrical Failure

Electrical failure is rare but can occur in the power electronic circuits or in the control circuits. A problem with the power electronics will usually evidence itself as an input fuse failure, and subsequent loss of power to the Elite Series, or as an "Desaturation fault" or " Current Trip fault" which is persistent or can not be reset. Note that the desaturation fault indication also can be caused by wiring faults or load related problems. Often severe electrical faults will cause physical damage which must be checked for and corrected before any attempt is made to restart the Elite Series.

Electrical failure is generally not repairable by the user. Repair is achieved by returning the faulty unit to PDL Electronics or their authorised Service Agent. Before disconnection, try to record commissioning parameters either on paper or by uploading to a PC running PDL Drivecomm for Windows or PDL Vista® for Windows**.** If, due to the nature of the fault, you cannot power up the unit to do this recording, it may be possible to liven the Control Board by back-feeding with 24Vdc. Refer to the Elite Series Getting Started Manual (4201-179) for instructions.

6.1.2 Protective Fault Operation

The Elite Series is designed to trip when a fault or user programmed trip function is detected. The fault message will be displayed on the LCD display. Refer to Section 6.3 for detailed descriptions.

6.1.3 Encoder Failure

The Elite Series cannot continue to operate in **full vector control mode** if the encoder signals are missing or excessively corrupted by noise. Should the signals be lost, the unit will indicate 0% speed. If the Elite Series is operating in speed control and the encoder signal is lost then the output frequency and shaft speed will drop to only a few percent and the unit will indicate torque or current limit.

If you cannot run the Elite Series above a certain speed in spite of a high speed reference signal, and torque limit is indicated at this speed, this may indicate that the encoder signals are becoming unreadable by the Control Board. The usual cause of this is excess encoder cable capacitance. This can be overcome by using a screened cable of lower capacitance per metre, using a shorter cable run, or by selecting a complementary output or differential output type shaft encoder. These types of encoder can drive a higher capacitance than a single-ended open collector type.

To check the encoder connection and function use V/Hz control mode (by setting Screen X1).

6.1.4 Incorrect Set-up or Adjustment

Many problems will stem from an inappropriate configuration or maltuned control parameters.

Ensure the correct input mode and reference source is chosen and that the programmable input selections are appropriate. Note that some input modes are designed to operate in conjunction with other parameters and may be affected by the reference source selection.

In some instances the Elite Series may be unable to follow the prescribed control signals. This will be indicated by the various limit status indications (as seen on the Status Screen). The torque, speed, and regeneration limits (L screens) are user selectable within bounds and must be set to suit the application.

All the screens apart from those which define the motor ratings and vector control parameters (N and X screens) can be returned to the factory default settings through Screen Y2. The level of initialisation can be chosen. Refer to Section 9 of this manual for details. Use this feature if the set-up is unknown.

6.1.5 Poor Vector Control Tuning

If the parameters in the X and N screens are not correctly adjusted the Elite Series may operate erratically. Excessive current draw, vibration and motor noise, and the failure to accelerate indicate possible maladjustment. Generally if **autotuning** has been employed, this problem should not occur. Autotuning can be configured on Screen X2. Full details on tuning options are given in the Elite Series Getting Started Manual (4201-179).

If when running in Closed Loop Vector control mode**,** the Elite Series output voltage is very sensitive to load torque and/or the torque reading is in error and does not correspond to the expected current (rated current at rated torque) then parameters X3a and X3c may be incorrect. If the Elite Series operates correctly in torque control mode but is unstable in speed control mode then the speed control parameters X4f, X4g, X4h and X5i may be maltuned.

All the X and N screens can be returned to the factory default settings through Screen Y2. Use this feature if the setup is unknown. Reinitialisation will cause a "ZERO PARAM" fault indication which can be reset only after the N nameplate parameters are reprogrammed.

6.1.6 Failure of External Control Device

A problem with the signal processing circuitry may cause erratic and possibly rough operation or cause the Elite Series to fail to respond to control signals. External wiring faults or incorrect setup can also stop the Elite Series responding to control signals in the desired manner. Therefore special provision has been made to simplify the checking of the incoming signals and input circuitry. Refer to Screens Z3 to Z12 for diagnostic information.

6.1.7 Failure of the Display Unit

Should the Elite Series fail to communicate with the Display Unit, the message **COMMS ERROR** will be displayed. This indicates that the 24Vdc supply to the Display Unit is functioning but invalid (or no) communications has been received by the Display Unit. Check the connection to the Display Unit from the Elite Series unit.

6.2 THE FAULT SCREEN

(See also Status Messages, Screen AA)

6.2.1 Control of the Fault Screen

Fault messages are automatically displayed on the Fault Screen (Screen F).

There is a **fault log** folded as subscreens of the fault screen. This fault log records the previous five faults, with the first screen being the most recent fault. This fault log may be inspected at any time.

When a fault is cleared and the Elite Series is reset, the fault message will be moved to the first of the screens folded behind the fault screen. All existing messages on the fault log will be moved down one screen, with the oldest message being discarded. The fault message on the main fault screen will be replaced by **NO FAULT**.

6.2.2 Fault Messages

Fault conditions, their interpretation and suggested remedies are listed below.

Fault **NO FAULT**
Detail No fault detected
Possible cause Normal operation
Action None required

Fault **01 LOW Vdc**
Detail Mains voltage has dropped too low (=LOW V TRIP - Screen S5).
Sense level 180Vac (250Vdc on DC bus)
Possible cause Mains interruption, dip.
Action Check supply conditions. Disable Low Volts Trip (refer detailed description of Screen S7).

Fault **02 HIGH Vdc**
Detail DC bus voltage has risen to a dangerous level
Sense level 800Vdc
Possible cause Very high mains surge. Excessive regeneration from regenerative load or excessive deceleration rate (refer detailed description of Screen R2). Earth fault on motor.
Action Reduce deceleration rate. Check motor circuit for earth fault. Apply Speed Filter via Screen R7.

Fault **03 HI Vdc T/O**
Detail DC bus voltage has risen to a dangerous level
Sense level 750Vdc for greater than 5 seconds
Possible cause Mains too high for too long. Earth fault on motor.
Action Check mains supply voltage. Check motor circuit for earth fault.

Fault **04 SUPPLY FLT**
Detail Input supply phase voltage imbalance
Sense level 40Vac ripple voltage in Elite Series DC bus. Phase imbalance is most sensitive under heavy load conditions. Under light load conditions, the Elite Series will run satisfactorily with only two phases connected.
Possible cause Loss of phase, fuse, motor phase loss, motor winding fault.
Action Check supply conditions, check wiring to motor, check motor.

Fault **05 S/W DL FLT**
Detail Incorrect software down loaded.
Possible cause Data transmission error; incompatible software and hardware revisions.
Action Down load correct software.

Fault **06 EEPROM FLT**
Detail Nonvolatile memory (EEPROM) is faulty
Possible cause IC failure
Action Seek service.

Fault **07 I TRIP FLT**
Detail Output current has reached a dangerous level.
Sense level 210% of Elite Series rated current.
Possible cause Short circuit; wiring fault; circuit fault; motor fault.
Action Check entire output circuit and motor for wiring or winding faults. Check output circuit contactors or isolators for correct operation.

Fault **08 U+ DESAT**
09 V+ DESAT
10 W+ DESAT
11 U– DESAT
12 V– DESAT
13 W– DESAT
14 NEG DESAT
Detail Automatic protection of the internal power switching semiconductor device has operated.
Possible cause Short circuit; extreme overcurrent; wiring fault; circuit fault; motor fault; IGBT desaturation; IGBT failure.
Action Check entire output circuit and motor for wiring or winding faults. If fault persists when output leads are disconnected, replace or service the Elite Series.

Fault **15 ELITE O/L**
Detail The temperature calculated by the Elite Series inverter thermal model has reached a dangerous level.
Sense level 150% of rated Elite Series rated current for 30 seconds at 50° C. Maximum continuous operation possible without trip is 105% of Elite Series rating.
Possible cause Continuous overload of Elite Series.
Action Check load requirements.

Fault **16 MOTOR O/L**
Detail The temperature calculated by the thermal model of the motor has reached a dangerous level.
Sense level 110%
Possible cause Excessive load on motor (current draw too high); motor load exceeds cooling capacity at the operating speed; motor phase loss; motor winding fault; motor thermal model parameters incorrectly set. Refer also to the detailed descriptions of Screens N1 and N6.
Action Check load and thermal model settings in Screens N1 and N6.

Fault **17 BRAKE O/L**
Detail The temperature calculated by the thermal model of the dynamic brake resistor has reached a dangerous level.
Sense level Set by dynamic brake thermal model in Screens D1 and D2.
Possible cause Excessive regeneration for the resistor specified in Screens D1 and D2. Incorrect values entered.

Action Check values (refer detailed descriptions of Screens D1 and D2). Reduce regeneration via Screen L8. Select a bigger braking resistor. Reduce deceleration rate (Screen R2).
Note: Active whether a dynamic brake is connected or not.

Fault **18 DATA FLT**
Detail Nonvolatile memory (EEPROM) reading error. This fault can only be cleared using Screen Y2 to initialise user and motor settings. Be sure motor is isolated before resetting fault and entering correct data.
Sense level Check sum in memory
Possible cause Spurious fault; faulty memory.
Action If fault recurs, replace Elite Series.

Fault **19 ZERO PARAM**
Detail Zero parameters (N screens) have been detected.
Possible cause Elite Series has been reinitialised; ex-factory state; error in set up.
Action Enter all N values correctly.

Fault **20 PARAM FLT**
Detail Inconsistent set of parameters (N screens, L9 screen) selected.
Possible cause Error in set up; wrong values chosen.
Action Enter consistent set of N values.

Fault **21 GROUND FLT**
Detail Excessive current flow to ground.
Sense level Internally set.
Possible cause Motor or cable insulation fault.
Action Check motor and cables (isolate from Elite Series first).

Fault **22 EXT/PTC**
Detail External trip device has operated. External motor winding temperature sensor (PTC, thermostat etc.) circuit (Terminal T19) has operated.
Sense level Circuit resistance exceeds 4kOhms.
Possible cause Operation of external trip device; Motor has become too hot (motor load exceeds cooling capacity at the operating speed); Fault in sensor wiring.
Action Check motor temperature and sensor wiring. Check external trip switch (if fitted).

Fault **23 H/S TEMP**
Detail Elite Series heatsink too hot.
Sense level 80°C.
Possible cause Poor ventilation; obstructed ventilation path, Elite Series cooling fan failure; local ambient temperature exceeds 50°C.
Action Check fan is operating; Check ventilation and thermal conditions. Improve cooling. Clean fins with compressed air. Seek service.

Fault **24 INT TEMP**
Detail Elite Series internal temperature too hot.
Sense level 70°C.
Possible cause Poor ventilation; obstructed ventilation path, Elite Series heatsink and internal cooling fan failure; local ambient temperature exceeds 50°C.
Action Check heatsink and internal cooling fans are operating; Check ventilation and thermal conditions. Improve cooling. Seek service.

Fault **25 COMMS TRIP**
Detail Host computer generated trip.
Sense level –
Possible cause Trip generated by the host computer via serial communications.
Action No action required.

Fault **26 COMMS T/O**
Detail Time since last valid serial communication has exceeded timeout period on Screen H3.
Sense level Set by communications timeout value on Screen H3.
Possible cause Serial communications wiring faults; host computer fault; incorrect settings on Screens H1 to H4.
Action Check complete serial communications system; Check screen settings, Seek Service.

Fault **27 FIBRE T/O**
Detail Time since last valid fibre optic input has exceeded timeout period.
Sense level 1 second.
Possible cause Speed or torque reference (Screens I2 to I5) selected from fibre optic port with no fibre optic cable connected; fibre optic cable connected to fibre optic output port instead of input port; fibre optic cable fault.
Action Check fibre optic cable; Check screen settings; Seek Service.

Fault **28 OVERSPEED**
Detail Maximum output speed has been exceeded.
Sense level 300% of motor rated frequency; absolute maximum 450Hz; or 50% above speed limits.
Possible cause Loss of control of the motor while being driven by load; excessive load.
Action Check actual operating conditions to determine cause. Adjust load or set up to eliminate problem.

Fault **29 TQ LIM T/O**
Detail At torque limit for longer than specified.
Sense level Set by Screen L7.
Possible cause Load condition or inappropriate setting of Screen L7; encoder failure.
Action Check load condition or alter Screen L7.

Fault **30 SP LIM T/O**
Detail At speed limit for longer than specified.
Sense level Set by Screen L6.
Possible cause Load condition or inappropriate setting of Screen L6.
Action Check load condition or alter Screen L6.

Fault **31 CAL FLT**
Detail Internal reference voltage levels are incorrect.
Possible cause Elite Series fault. Seek service.

Fault **32 S/W T/O**
Detail Internal timing requirements exceeded.
Possible cause PDL Vista® for Windows configuration too complex.
Action Simplify configuration.

Fault **33 LVDC FLT**
Detail Failure of the low voltage dc power supplies.
Possible cause Heatsink cooling fan failure, control PCB failure.
Action Seek service.

Fault **34 VISTA TRIP**
Detail Custom configuration developed using PDL Vista® for Windows has deliberately tripped the Elite Series.
Possible cause Refer to custom configuration schematic.
Action Refer to custom configuration schematic.

Fault **35 NO DISPLAY**
Detail The Elite Series has detected that the display unit is disconnected or faulty. The Elite Series will trip on this fault only if the display unit is enabled via Screen I1 (I1 LOCAL S/STP= 1,2,3).
Possible cause Display removed by personnel; display mounted more than 3m distance from the Elite Series unit; faulty display unit.
Action Connect display unit and disable keyboard mode using Screen I1 (I1 LOCAL S/STP=0); reduce distance, replace display unit.

Fault **36 EPLD FLT**
Detail An unrecognised fault has been detected by the control board EPLD.
Possible cause Power supply fault.
Action Reset fault; if fault persists, seek service or replace the Elite Series.

Fault **37 WATCHDOG**
Detail An unknown fault has reset the Control Board microcontroller.
Possible cause Power supply fault., PDL Vista® for Windows configuration too complex.
Action Reset fault; if fault persists, seek service or replace the Elite Series; simplify PDL Vista® for Windows configuration.

Fault **38 NO VISTA PRG**
Detail User Program not set
Action Reload Program via Drivelink software

Fault **39 FIBRE TRIP**
Detail The Elite Series has tripped due to a fault being reported via the Fibre Optic Network
Cause See other Elite Series connected to the network
Action Reset fault on the other Elites

6.3 USE OF LED INDICATORS

The LED indicators on the Display Unit provide visual indication of the unit's status as follows:

LED **ON**
Functional indication Mains power is supplied and stored charge is present.
Actual indication +24V functioning on the Display Unit.
Implication Primary and secondary switchmodes functioning.

LED **RUN**
Functional indication Elite Series is running.
Actual indication Output devices enabled.
Implication Elite Series is functional.

LED **OK**
Functional indication Elite Series is operating normally.
Actual indication Elite Series ready to operate.
Implication No fault is present.

LED **OK (Flashing)**
Functional indication Fault trip.
Actual indication Output disable.
Implication A fault (Screen F) has tripped the Elite Series.

6.4 FUSE FAILURE

The Elite Series incorporates electronic protection. The few fuses included are for SAFETY back up.

Supply fuses Fitted by customer at point of supply

Possible reason for failure
Wrong fuses; Supply surge; Age or cyclic stress failure; Fault in supply cable to inverter; Inverter failure.

Action Check supply cable; check Elite Series unit . Isolate inverter and replace fuses. If OK reconnect inverter and re-test. If failure persists replace Elite Series or request service.

+24Vdc User supply fuse (F1)
Fitted beneath the expansion board cover beneath the normal Display Unit position.

Possible reason for failure
Overload of the +24Vdc supply or low voltage supplies derived from +24Vdc. Faulty external equipment connected to the User +24Vdc supply. Faulty heatsink or internal cooling fans. 230Vac accidentally connected to the +24Vdc input supply.

Action Check external equipment connected to the +24Vdc supply; check Elite Series cooling fans. Replace fuse. If failure persists request service.

7 THE ELITE SERIES DISPLAY UNIT

7.1 DISPLAY UNIT CONTROLLABILITY

The Display Unit, as described in Section 3.1.4, is shown in Figure 7.1. The degree of control and monitoring available from this display will be as set up at the time of commissioning.

The status (top) line of the display will display the drive status, overload status, output torque and speed magnitude and direction, and operation mode (speed or torque control).

Each screen will have a pre-configured attribute, controlling whether it is hidden, read only, or read-write. The attribute will apply only when the Elite Series is in Operation Mode (refer Section 7.3 following). When in Commissioning Mode, all screens will be read-write. Before control adjustment is available from the Display Unit when in Operation Mode, the respective screen must have its attribute set to read-write.

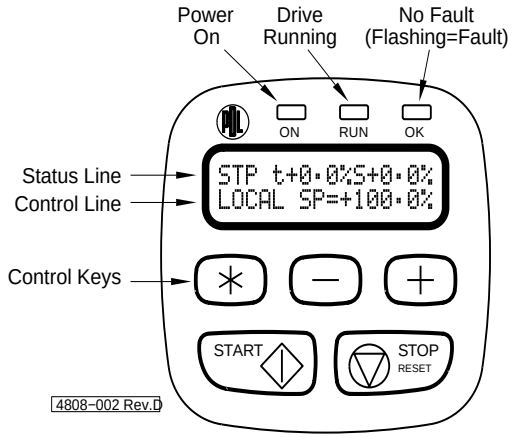


Figure 7.1: The Display Unit

The Display Unit is considered to be the LOCAL controller. Therefore for local control, the START and STOP-RESET are usually enabled via Screen I1 (I1 LOCAL S/STP=3) and the speed reference is usually set to come from the Display Unit Screen A3 (I2 REF S=LOCAL).
The digital inputs are usually disabled by setting to local mode (I7a I/P MODE=00 DISABLED). This is the factory default mode.

7.2 MENU STRUCTURES AND SCREENS

7.2.1 Screen Lists

The Elite Series screen list is comprised of multiple screens. Each individual screen, its function and options are discussed in detail in Section 9 of this manual.

A Screen List may also be a foreign language translation of the default screen list as discussed above. When operating in a specific configuration, the required Screen List may be selected (when in Commissioning Mode) from Screen Y1.

7.2.2 Scrolling, Unfolding and Folding

Each screen list is organised in a hierarchical structure, as shown in Figure 7.2.

Scrolling between main screens is by use of “+” or “–” keys. When the main screen of interest is reached, press then release “∗” key. This will unfold any subscreens under the main screen, and scroll to the first subscreen. Only subscreens that do not have attributes set to “hidden” will be visible.

Scroll down the subscreens by using “+” key. Scroll up using “–” key. When the top subscreen is reached, press “–” key to fold up the subscreens and return to the main screen.

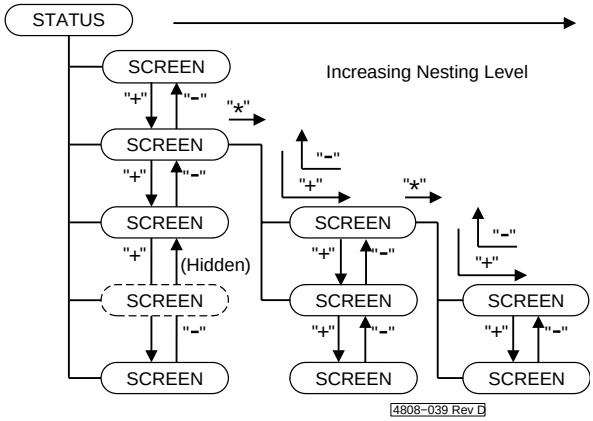


Figure 7.2: Screen Unfolding and Folding

7.2.3 Parameter Conventions

USE OF %

Where possible, all adjustments are normalized to the motor parameters - i.e., they are given as a percentage of a motor rating.

The motor ratings themselves are entered in engineering units (volts, amps, etc.).

USE OF “+” AND “–”

“+” Is used to describe speed or torque in the forward direction of the motor.

“–” Is used to describe speed or torque in the reverse direction of the motor.

According to IEC34-7, the motor rotates forward (clockwise) when:

- viewed from the drive (shaft) end
- and terminals U1, V1, and W1 or U2, V2 and W2 are connected to Elite Series phases U, V, W respectively
- and the Elite Series is operating with “+” speed.

7.2.4 Adjusting a Screen Value

Before a screen value can be changed, the screen on view must have its attribute set to “read-write”.

To adjust a numeric parameter, press “∗” and “+” to make it more positive. Press “∗” and “–” to make it more negative. The new value is stored to nonvolatile memory (EEPROM) on release of “∗” key.

To adjust a two-state parameter (e.g., HI/LO, Y/N) use “∗” and “+” or “–” to toggle the state of the parameter.

To select from a list, use “∗” and “+” or “–” keys to scroll through the choices. Release of “∗” key will store the displayed choice to EEPROM.

7.2.5 Stop to Change

For maximum flexibility, most screens can be adjusted while the Elite Series is running.

For reasons of safety, however, certain settings may not be adjusted while running. Attempts to do so will cause the display of the message OFF TO MODIFY.

7.3 OPERATING MODES

7.3.1 Summary of Operating Modes

Operation Mode

This is the normal operating mode of the drive. Each screen will have a pre-configured attribute, controlling whether it is hidden, read only, or read-write. Thus operator access to screens can be controlled.

Commissioning Mode

In this mode, each screen is visible and commissioning parameters may be adjusted, irrespective of the screen's attribute. Some parameters are not adjustable while the drive is started or running.

Access to Commissioning Mode may be controlled by a password.

Menu Set-Up Mode

This mode is accessible when in commissioning mode, and enables the attributes of each screen to be set, The attribute controls access to the screen when in Operation Mode, as follows:

Hidden: The screen cannot be viewed or changed.

Read Only: The screen can be viewed, but not changed.

Read-Write: The screen can be viewed and the parameter changed when in Operation Mode.

7.3.2 Swapping Between OPERATION and COMMISSIONING Modes

Setting to COMMISSIONING mode before a Password has been set:

Scroll to Main Screen Z.
Z COMMISSION= N

Press "∗" and "+" or "–". The status line should change to:
Z COMMISSION= Y

All screens will now be visible, and all parameters adjustable.

Selecting COMMISSIONING mode after a Password has been set:

Figure 7.3 illustrates the procedure for swapping between OPERATION and COMMISSIONING modes using a password.

Scroll to Main Screen Z. The display's control (bottom) line will read:
Z COMMISSION= N

Press "∗" and "+" or "–". The screen will automatically display:
PASSWORD= ZZZZZ

Now press "∗" and "+" or "–" until the correct password is reached. Then release the keys.

All screens will now be visible, and all parameters adjustable.

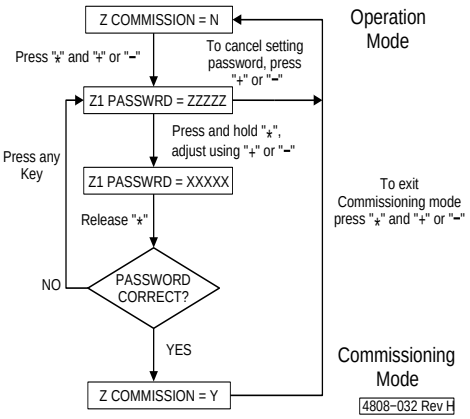


Figure 7.3: Setting Commission Mode after a Password has been set

Selecting OPERATION Mode:
To change from COMMISSIONING Mode to OPERATION Mode, scroll to Screen Group Z.

The display's control line will read:
Z COMMISSION= Y

Use "∗" and "+" or "–" to toggle to :
Z COMMISSION = N

Setting a Password for the First Time

Refer to Figure 7.4.
Once set to COMMISSIONING mode as described above, a password may be set up. Unfold Screen Group Z and scroll to Screen Z1. The display will read:
Z1 PASSWORD= OFF.

Press "∗" and "+" or "–" to set the required password.

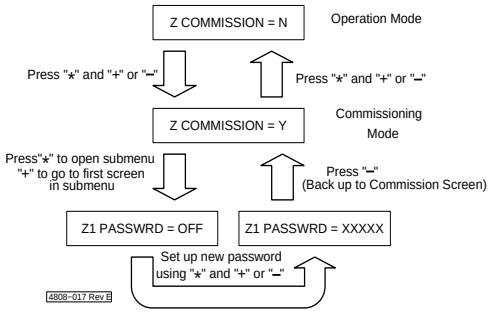


Figure 7.4: Setting a Password for the First Time

What happens if a password is unknown or forgotten?

Once a password has been entered, a special hashing number is displayed on Screen Z when trying to enter COMMISSIONING mode.

The display will read:
Z PASSWORD= ZZZZZ

Take a note of this number and contact a PDL Electronics Applications Engineer, who with suitable authority will be able to pass this code through an algorithm to reconstruct the original password.

7.3.3 MENU SET-UP Mode

Setting to MENU SET-UP mode

The drive must be stopped before entering MENU SET-UP Mode.

While in COMMISSIONING mode and displaying the commissioning screen (Screen Z), press "∗" for five seconds. The status (top) line of the display will be replaced with the message: MENU SET-UP MODE

Figure 7.5 illustrates the procedure for setting to and exiting from MENU SET-UP mode.

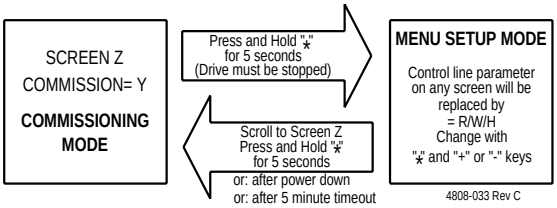


Figure 7.5: Setting to and Exiting From MENU SET-UP MODE

Figure 7.6 shows a typical screen display when in MENU SET-UP mode.

M	E	N	U		S	E	T	-	U	P		M	O	D	E
N	1		M	T	R		C	U	R	=		?			

4202-170 Rev C

Where ? = R (read only) or W (read-write) or H (hidden or invisible)

Figure 7.6: Typical Screen Display in MENU SET-UP Mode

All screens will be unhidden, but the parameter value on each control line will be replaced by R or W or H (for read only/read-write/Hidden). The attribute can be altered by "∗" and "+" or "–".

Exiting MENU SET-UP Mode

This is achieved by pressing "∗" for more than five seconds.

Exit also occurs after more than five minutes of inactivity, or on start-up after power-down.

8 CUSTOMISATION OF CONTROL

8.1 PDL VISTA® FOR WINDOWS CONFIGURATION SOFTWARE

Customisation of Control

The Elite Series Control Board processor has a number of logic and processing blocks integrated into the firmware. These can be configured to enhance one of the existing default configuration, or for configuring a completely new control system. These blocks include logic gates, counters, timers, analogue signal processors, PID controllers, inputs and outputs.

PDL Vista® for Windows Editor

Configuration of these processing blocks is done by PDL Vista® for Windows. PDL Vista® for Windows is an editing software package which can be installed on a personal computer running Microsoft Windows. Each processing block is represented by an icon.

The icons can be placed on the screen and interconnected as required. Each icon has an associated dialogue box for naming and defining parameters. Each type of icon can be used as many times as required, within the limits of user memory within the Elite Series. The resultant schematic diagram can have comments and text attached, and a title block attached. The schematic can be printed.

Compilation and Decompilation of PDL Vista® for Windows Schematics

A configuration schematic designed using the PDL Vista® for Windows editor is compiled into a text-based Netlist**.** This list stores sufficient information to identify the blocks, their associated names, inputs, outputs, variables, interconnection information, and associated screens. When a file is saved inside the PDL Vista® for Windows editor, it is saved in Netlis**t** format.

When a saved file is opened, the Netlist is decompiled and icons will be regenerated for display on the screen. If a file existing in the Elite Series firmware is uploaded to a PC, the icons will be regenerated but any comments, title block, etc. will not be displayed.

8.2 CUSTOM SCREEN CONFIGURATION

Screen Editor

The PDL Vista® for Windows configuration software has a screen editing utility included. This enables a new Screen List to be created and down loaded to the Elite Series.

Creating or Modifying a Screen List

When creating a new Screen List, a dialogue box is presented to name and number the list. Then a Screen Window is presented enabling the hierarchical structure of the Screen List to be designed. Screen groups and subscreens can be inserted, deleted, or edited.

Editing a Screen

When a screen is selected for editing, a dialogue box appears. The screen title, attributes and text may be inserted. When down loaded to the Elite Series, this text will appear in the control line (second line) of the display.

The text can include variables, which can be set up as read only, or modifiable from the front panel of the Elite Series. These variables can be defined as the variable names assigned when configuring processing blocks, or system names.

8.3 PDL DRIVELINK FOR WINDOWS SOFTWARE PACKAGE

The DRIVELINK software package allows Vista for Windows configuration to be downloaded to the Elite Series drives. It also allows the system code within the Elite to be updated with later revision software as it is developed. The status of the drive can be monitored including information within the Vista configurations.

This package is available for Microsoft Windows 3.1, Windows 95, and Windows NT. PDL Part Number 0407.

8.4 MODBUS COMMUNICATIONS CONNECTIONS BETWEEN PC AND DRIVE

8.4.1 The Elite Series to PC Connection

The Modbus serial communications format is used for data transfer between the Elite Series and a personal computer. The Elite Series is equipped with RS485 and RS232 ports, either of which (but not both) can be used.

For long range communication (more than five metres), or where connection to more than one drive is required, RS485 is the recommended connection. An RS485/RS232 protocol converter will be required, located near to the PC.

For one-to-one communication over a short range, the RS232 connection should be satisfactory. It is more noise sensitive than RS485, and can only be connected to a single drive. However direct connection is possible, without the need for a protocol converter.

8.4.2 Configuring the Connection

Each Elite Series unit connected to the serial communications link will require a Modbus Address. Program this address on Screen H3a. This address must be unique to each drive on the same link.

The baud rate must be set on Screen H3b of the Elite Series. This should be set to the maximum (9600 baud). However if regular communications failures are noted, the baud rate may require reducing.

Configure the PDL Drivelink baud rate to match that of the connected drive(s). Configure the serial port to COM 1 if the 9-pin serial connector is available on the PC. If this port is used (e.g., by the mouse), configure the serial port to COM 2 (usually a 25-pin connector on the PC).

8.4.3 Down-loading from a PC to the Elite Series

Once the serial connection is established and configured, a custom control configuration and custom Screen List can be down loaded from the PC to the Elite Series**.** Note that drawing titles and any loose text are not transferred to the Elite Series, and thus will not be recovered on up-loading.

8.4.4 Up-loading from the Elite Series to a PC

Once the serial connection is established and configured, the custom control configuration and custom Screen List can be up loaded from the Elite Series to the PC. On transfer, the Netlist files stored in the Elite are converted to Modbus code and transmitted via the configured RS232 port. The Netlist file can then be stored for future reference.

9 THE DEFAULT SCREEN LIST

The Elite Series provides as a default a very flexible set of formats and functions for control inputs and outputs.

The Elite Series can be operated in Open Loop Vector mode as a speed controller, or in Closed Loop Vector mode as a torque or speed controller.

The Screen List available in the default configuration is shown in Figure 9.1.

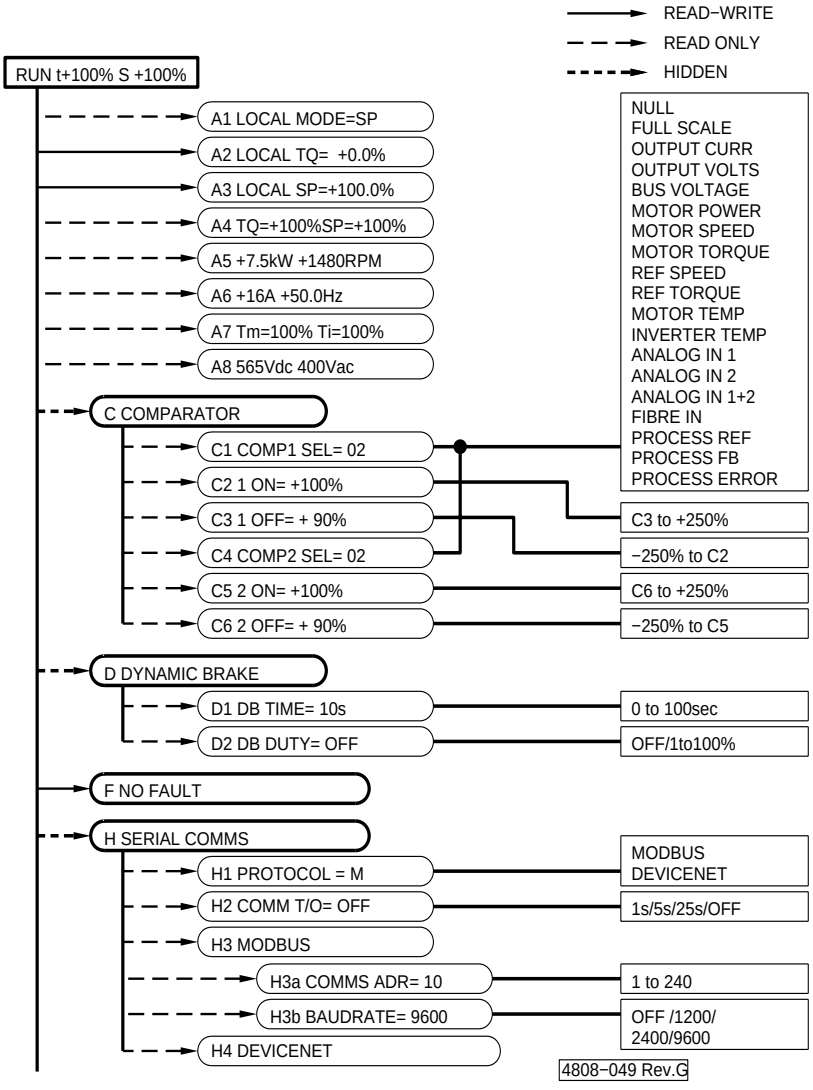


Figure 9.1: Screen List A-H

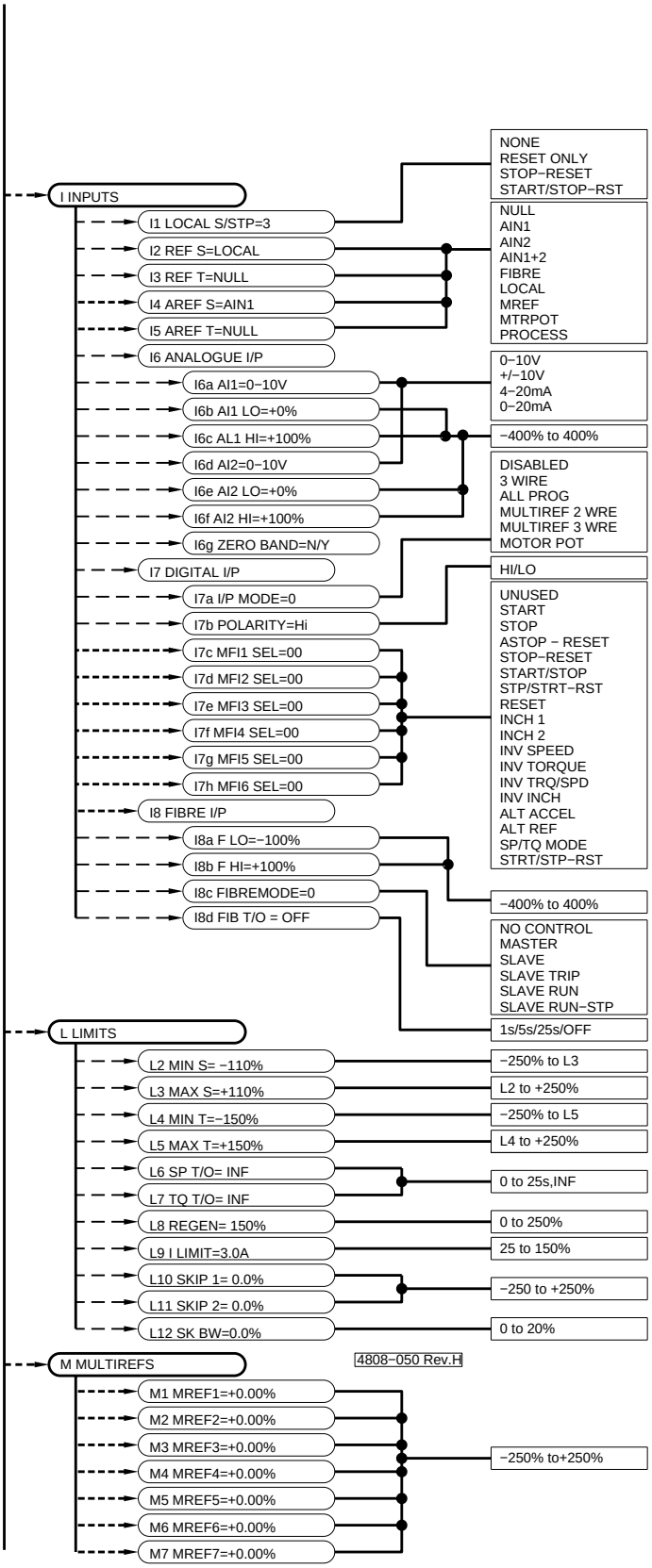


Figure 9.1b: Screen List I-M

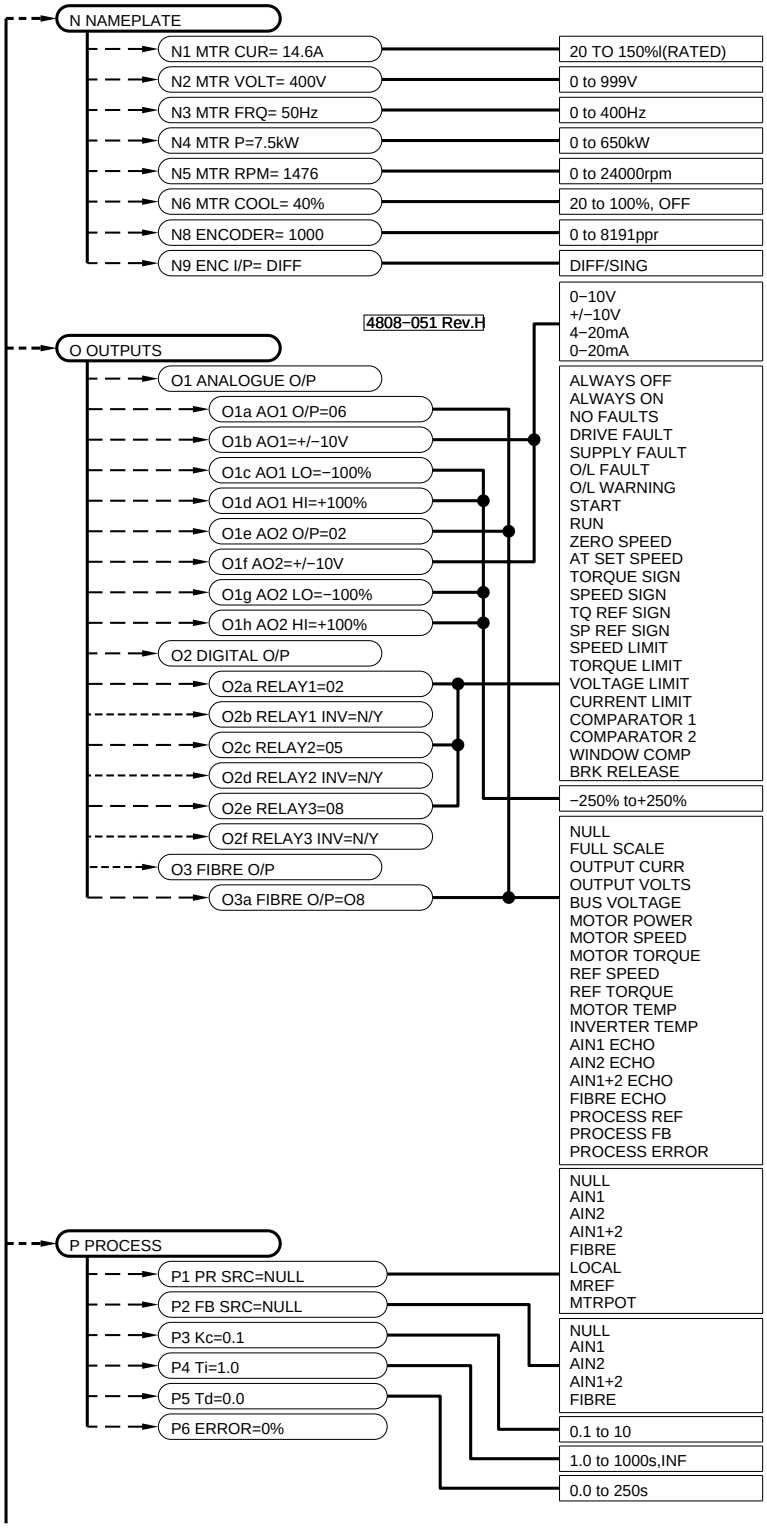


Figure 9.1c: Screen List N-P

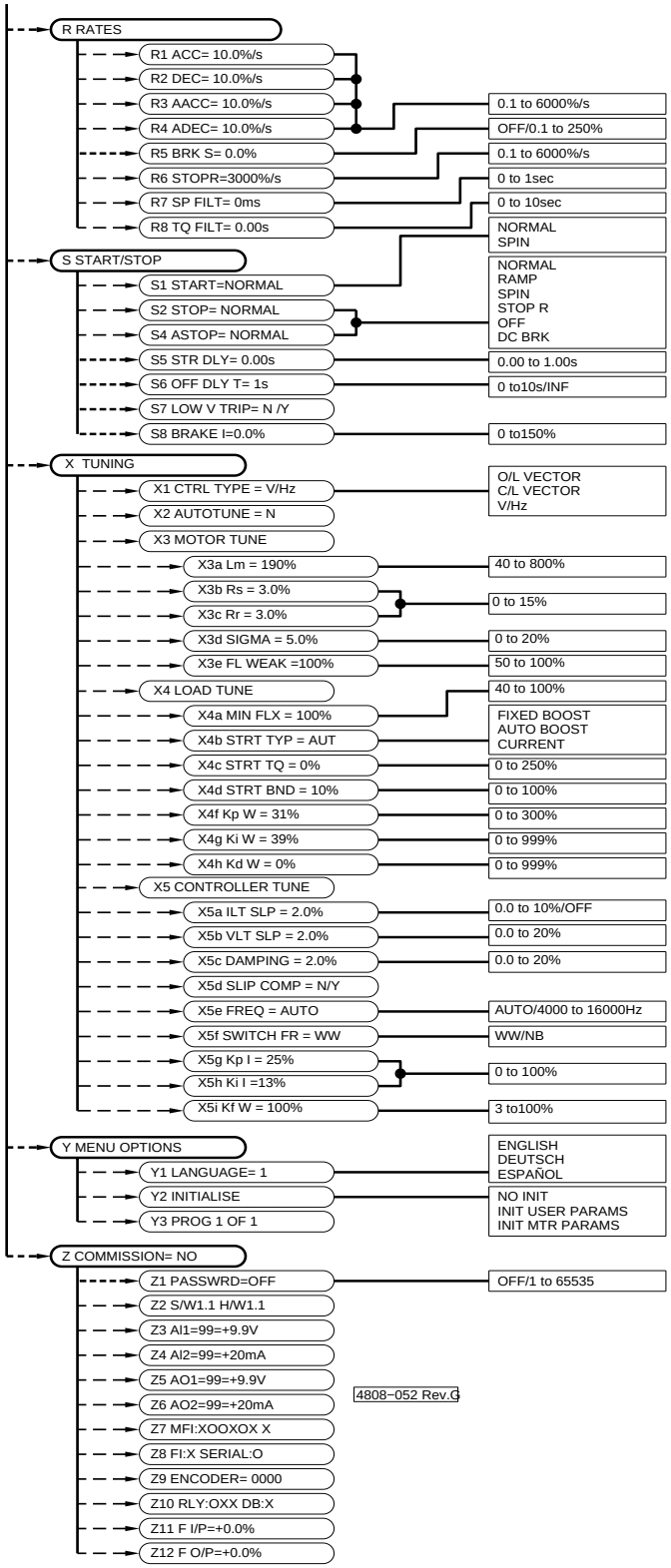


Figure 9.1d: Screen List R-Z

STATUS LINE

AA

AA **STATUS LINE**

Screen AA **STP t+000% S+000%**

Description STATUS, OVERLOAD, TORQUE/ CURRENT, SPEED,INDICATION

Units –, % OF RATED MOTOR TORQUE/AMPS, % OF RATED MOTOR SPEED

Notes ALWAYS DISPLAYED

FUNCTION This is the top line of the display and is permanently present. The status line shows Elite Series status, overload condition, output torque or current and output speed. Indication of operational mode is also provided.

SCREEN	**STP**	**()**	**t**	**+000%**	**S**	**+000%**
	1	**2**	**3**	**4**	**5**	**6**

Table Reference 1 2 3 4 5 6

REF.	**FUNCTION**
1	Elite Series Status Indication Refer to list opposite
2	Overload Status Indicated by a lower case letter while overload is present i - current exceeds Elite Series rating. The Elite Series will shut down to protect itself if the overload persists. m - current exceeds motor capability. The thermal model of the motor indicates the motor will become too hot if this condition persists. The Elite Series will eventually trip if the overload is not eliminated. o - Elite Series and motor overload exists.
3	Torque Mode Indicator T- Elite Series is in vector torque mode t- Elite Series is in vector speed mode A- Elite Series is in VHz speed mode
4	Motor Torque or Current Indication In vector mode this shows the actual motor torque as a percentage of rated motor torque. In V/Hz the motor current is displayed in amps.
5	Speed Mode Indicator S - Elite Series is in speed mode s - Elite Series is in torque mode
6	Motor Speed Indication Shows actual motor speed as a percentage of rated motor speed

Status Messages

Indication **STP**
Message STOPPED
Notes Motor stopped.

Indication **SPG**
Message STOPPING
Notes Motor is stopping.

Indication **RDY**
Message READY
Notes Elite Series is ready to run. A start command has been received but the bus voltage is too low to run.

Indication **RUN**
Message RUNNING
Notes Motor is running.

Indication **INC**
Message INCHING
Notes Elite Series is responding to an inch command.

Indication **ILT**
Message CURRENT LIMITING
Notes Elite Series has altered the motor speed to maintain the motor current at or below the current limit setting.

Indication **VLT**
Message VOLTAGE LIMITING
Notes Elite Series is limiting the deceleration rate to avoid excessive regeneration (Vdc > 720V).

Indication **Fnn**
Message FAULT TRIP
Notes Elite Series has tripped on a fault. Where “nn” indicates the fault number (refer to Screen F for detail).

Indication **OFF**
Message OUTPUT OFF
Notes Elite Series has switched off all output power.

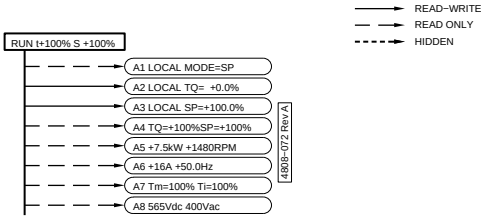
Indication **SLT**
Message SPEED LIMITING
Notes Speed is being limited to value set by Screens L1 or L2.

Indication **TLT**
Message TORQUE LIMITING
Notes Torque is being limited to value set by Screens L3 or L4.

Indication **ATU**
Message AUTOTUNING
Notes Autotune in progress.

Indication **SPN**
Message SPIN STARTING
Notes Elite Series is searching for the speed of the motor.

SCREEN GROUP A: STATUS DISPLAYS



A1 LOCAL CONTROL MODE

Screen **A1 LOCAL MODE=SP**
Description LOCAL KEYBOARD MODE SELECT
Range SPEED/TORQUE
Default Value SPEED
Stop to Change NO
Attribute Read Only
FUNCTION Sets the operating mode of the Elite Series if not otherwise selected (i.e., as a Multi-function input. Refer Screen I7a).
SETTING UP Select the desired operating (speed or torque) mode.
Note: The selected mode is indicated on the Status Screen by means of a uppercase “S” (speed mode) or uppercase “T” (torque mode).

A2 LOCAL TORQUE REFERENCE

Screen **A2 LOCAL TQ= +0.0%**
Description LOCAL TORQUE REFERENCE
Range -250% to +250%
Units % OF MOTOR RATED TORQUE
Default Value 0%
Stop to Change NO
Attribute Read-Write
FUNCTION Local keyboard control of reference torque.
SETTING UP The reference torque source (Screen I3 or I5) must be set to LOCAL before this screen has an effect. Although it can be adjusted to ±250% of motor rated torque, the reference torque is constrained between the minimum and maximum torque (set by Screens L4 and L5).

A3 LOCAL SPEED REFERENCE

Screen **A3 LOCAL SP=+100.0%**
Description LOCAL SPEED REFERENCE
Range -250% to +250%
Units % OF MOTOR RATED SYNCHRONOUS SPEED
Default Value 100%
Stop to Change NO
Attribute Read-Write
FUNCTION Local keyboard control of reference speed.
SETTING UP The reference speed source (Screen I2 or I4) must be set to LOCAL before this screen has an effect. Although it can be adjusted to ±250% of motor rated synchronous speed, the reference speed is constrained between the minimum and maximum speeds (set by Screens L2 and L3).

A4 REFERENCE TORQUE, REFERENCE SPEED

Screen **A4 TQ=+0.0%SP=+100%**
Description TORQUE REFERENCE, SPEED REFERENCE
Range -250% TO +250%; -250 TO +250%
Units % OF MOTOR RATED TORQUE; % OF MOTOR RATED SYNCHRONOUS SPEED
Attribute READ ONLY
FUNCTION Shows reference torque and speed. This screen is displayed after power up or external reset.

A5 MOTOR POWER, MOTOR RPM

Screen **A5 +7.5kW +1480RPM**
Description MOTOR POWER, MOTOR RPM
Range -999kW TO +999kW; -12000RPM TO +12000RPM
Units kW - KILOWATTS; RPM - REVOLUTIONS PER MINUTE
Attribute READ ONLY
FUNCTION Shows estimated motor power and motor speed in revolutions per minute (RPM). In Open Loop Vector and V/Hz control modes, the speed will be estimated.
SETTING UP The motor rated kW (Screen N4) and rated RPM (Screen N5) must be entered for correct calibration of this screen.

A6 MOTOR CURRENT, STATOR FREQUENCY

Screen **A6 +16A +50.0Hz**
Description MOTOR CURRENT, FREQUENCY OF AC APPLIED TO STATOR
Units Amps; HERTZ
Attribute READ ONLY

A7 MOTOR, INVERTER TEMPERATURES

Screen **A7 Tm=100% Ti=100%**
Description ESTIMATED MOTOR TEMPERATURE; ESTIMATED INVERTER TEMPERATURE
Range 0 TO 150%; 65 TO 150%
Units % OF RATED MOTOR TEMPERATURE; % RATED INVERTER TEMPERATURE
Attribute READ ONLY
FUNCTION Shows motor temperature as estimated by the motor thermal model, and Elite (inverter) temperature as estimated by the inverter thermal model.
Note: The inverter thermal model is non-linear, starting at 66%, determined by the 30 second overload rating at 150% of rated inverter current in a 50°C ambient. Refer Section 4.1.1.

A8

C1

C2

C3

C4

C5

C6

A8 BUS AND OUTPUT VOLTAGES

Screen **A8 565Vdc 400Vac**
Description DC BUS VOLTAGE ; OUTPUT VOLTAGE
Units Vdc;Vac
Attribute READ ONLY

FUNCTION Shows the internal DC voltage of the Elite Series, and the AC voltage applied to the motor.

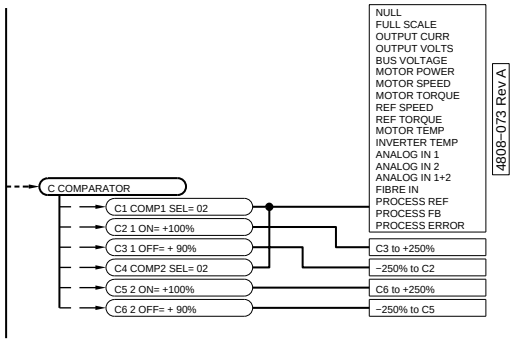
Note: The control system of the Elite Series will attempt to apply whatever voltage is necessary to achieve the calculated current requirement - therefore output voltages displayed with the motor disconnected or isolated may not relate to the voltage applied once the motor is connected.

NO.	SOURCE	UNITS
00	NULL	-
01	FULL SCALE	100% of full scale
02	OUTPUT CURR	% of motor current
03	OUTPUT VOLTS	% of motor voltage
04	BUS VOLTAGE	% of motor voltage x 1.414
05	MOTOR POWER	% of motor power
06	MOTOR SPEED	% of motor speed
07	MOTOR TORQUE	% of motor torque
08	REF SPEED	% of motor speed
09	REF TORQUE	% of motor torque
10	MOTOR TEMP	% of motor temperature
11	INVERTER TEMP	% of inverter temperature
12	AIN1 ECHO	%
13	AIN2 ECHO	%
14	AIN1+2 ECHO	%
15	FIBRE ECHO	%
16	PROCESS REF	%
17	PROCESS FEEDBACK	%
18	PROCESS ERROR	%

4202-160 Rev E

Figure 9.2 : Comparator Source Selection

SCREEN GROUP C: LEVEL COMPARATOR



Group Attribute Hidden

Screen **C1 COMP1 SEL =02**
C4 COMP2 SEL =02
Description COMPARATOR SOURCE SELECTION
Range 00-18, REFER FIGURE 9.2
Default Value 02 (OUTPUT CURRENT)
Stop to Change NO

Screen **C2 1 ON =+100%**
C5 2 ON =+100%
Description COMPARATOR ON SETPOINT
Units % OF FUNCTION SELECTED
Range C3, C6 TO +250%
Default Value 100
Stop to Change NO

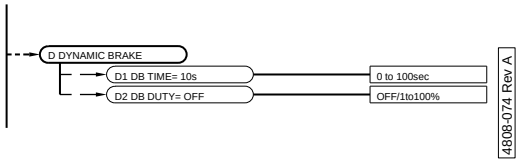
Screen **C3 1 OFF =+90%**
C6 2 OFF =+90%
Description COMPARATOR OFF SETPOINT
Range -250% TO C2, C5
Units % OF FUNCTION SELECTED
Default Value 90
Stop to Change NO

FUNCTION Provides two highly programmable relay output comparator functions. Each comparator may select one of a number of analogue levels. Screens C1 & C4, select from the table figure 9.2. The level at which the relay should turn ON and turn OFF is programmable (Screens C2, C5 and C3,C6 respectively).

SETTING UP If not required, leave set to default values. Where required, select the appropriate function for the Comparator (Screens C1,C4) and set the desired ON and OFF levels (C2,C5 and C3,C6).
The output of Comparator is only available to the relay outputs. The desired relay must be configured to connect to the comparator (see Screens O2).
The output of Comparator 1 and Comparator 2 may be connected to the relay outputs to form a window comparator. Comparator 1 sets the lower switching level and Comparator 2 sets the upper switching level.

Note: If ON/OFF levels are adjusted very closely together any noise in the signal may cause the relays to chatter, significantly reducing their life. Avoid this condition by ensuring a reasonable margin between the ON and OFF levels.

SCREEN GROUP D: DYNAMIC BRAKE CONTROLS



Group Attribute Hidden

Screen	**D1 DB TIME= 10s**
Description	TIME CONSTANT OF DYNAMIC BRAKE RESISTOR
Range	0 TO 250 SEC
Units	SEC
Default Value	10
Stop to Change	NO

Screen	**D2 DB DUTY= OFF**
Description	% DUTY RATING OF DYNAMIC BRAKE RESISTOR
Range	OFF, 0 TO 100%,
Units	% OF TIME ON
Default Value	OFF
Stop to Change	NO

FUNCTION The Elite Series includes thermal model protection for a dynamic brake. To protect the brake resistor the Elite Series will stop (indicating BRAKE O/L) when the calculated use of the resistor exceeds its rating.

The time constant of the brake resistor is the time it would take to reach 64% of its final temperature if continuously energised.

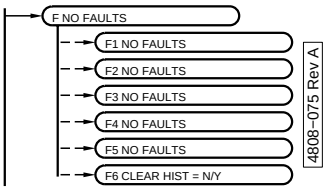
The percentage duty rating represents the average percentage of time the resistor may be operated for (when averaged over periods long in comparison to the time constant).

SETTING UP Leave these screens set at 10s and OFF respectively unless a Elite Series dynamic brake option is fitted (the model is active whether a dynamic brake is fitted or not).

If a dynamic brake option is fitted, these screens MUST BE CORRECTLY SET according to the manufacturer's resistor specifications. The dynamic brake thermal model can only protect the resistor if it is correctly set - never consider using larger than specified figures.

Refer to Section 4.5 for dynamic brake resistor selection,

SCREEN GROUP F: FAULT HISTORY SCREENS



Group Attribute Read-Write

Screen	**F NO FAULTS**
Description	FAULT DISPLAY SCREEN

FUNCTION Automatic display of fault information.

The Elite Series automatically shows this screen in the event of a fault tripping of the drive (unless a key has been pressed in the last 2 seconds).

A list of possible faults and suggested causes are given in Section 6 of this manual.

In the event of a fault, the Elite Series may be reset by pressing the STOP-RESET button on the display unit, or using an externally configured RESET input.

Screens **F1 NO FAULTS**
F2 NO FAULTS
F3 NO FAULTS
F4 NO FAULTS
F5 NO FAULTS
F6 NO FAULTS

Description FAULT HISTORY LOG

FUNCTION Display of fault history log.

Nested under Screen F is a list of the five most recent faults, in order of their occurrence, with the most recent fault first. This is the fault history log. It is used to retain information for maintenance personnel.

After the clearing of the current fault and resetting the Elite Series, the fault just cleared will move to the first position on the fault log. All other logged faults will move down one position. The oldest logged fault message will be lost.

The fault history log is retained when the power is removed from the Elite Series.

Screen	**F6 CLEAR HIST=N**
Description	CLEAR FAULT HISTORY LOG
Range	YES OR NO
Default Value	NO
Stop to Change	NO

FUNCTION Clears the fault history log.

SETTING UP Select Yes to clear the fault history log. The screen will automatically be set back to the default NO once the fault history log is cleared.

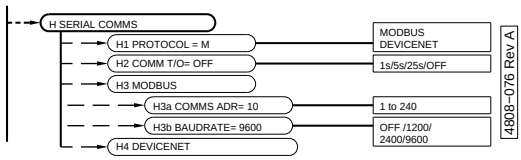
SCREEN GROUP H: SERIAL COMMUNICATION CONTROLS

H1

H2

H3

H4



Group Attribute Hidden

Screen **H1 PROTOCOL = M**
Description SELECT SERIAL PROTOCOL TO USE
Range MODBUS/DEVICENET
Default Value MODBUS
Stop to Change NO

NOTE DeviceNet operation requires an additional product (EDNI) to be used with the Elite Series. The DeviceNet Screens are described in the manual for the EDNI (PDL part number 4201-212).

Screen **H2 COMMS T/O= OFF**
Description SERIAL COMMUNICATIONS TIMEOUT PERIOD
Range 1/5/25/OFF
Units SEC
Default Value OFF
Stop to Change NO

FUNCTION The communications timeout period provides the option of tripping the Elite Series (indicating COMMS T/O) if the time since the last valid serial communications data transfer has exceeded the communications timeout period. Serial communications with the Elite Series is available via the RS232 serial communications terminals, RS485 serial communications terminals or serial communication interface. This allows the Elite Series to be controlled by a host computer such as a PLC or computer from a remote location, and enables the down loading of customised application configurations generated by the PDL Vista® for Windows PC software package. All the controls, parameters and modes available on the Elite Series can be monitored or adjusted by using the serial communications option. For example, the host controller can start and stop the motor, control its speed, monitor the estimated motor temperature, and the status of the drive. In addition, the host controller can monitor a process by accessing unused digital and analogue I/O on the Elite Series.

SETTING UP When there is no host controller connected, the communications address and baudrate parameters have no effect. However, the communications timeout feature remains active, and, as such, should be set to “OFF”. If the Elite Series serial communications feature is required, select the required address baudrate and timeout period.

SUBGROUP H3: MODBUS COMMUNICATION PARAMETERS

Screen **H3a COMMS ADR= 10**
Description MODBUS SERIAL COMMUNICATIONS ADDRESS
Range 1–240
Units -
Default Value 10
Stop to Change NO

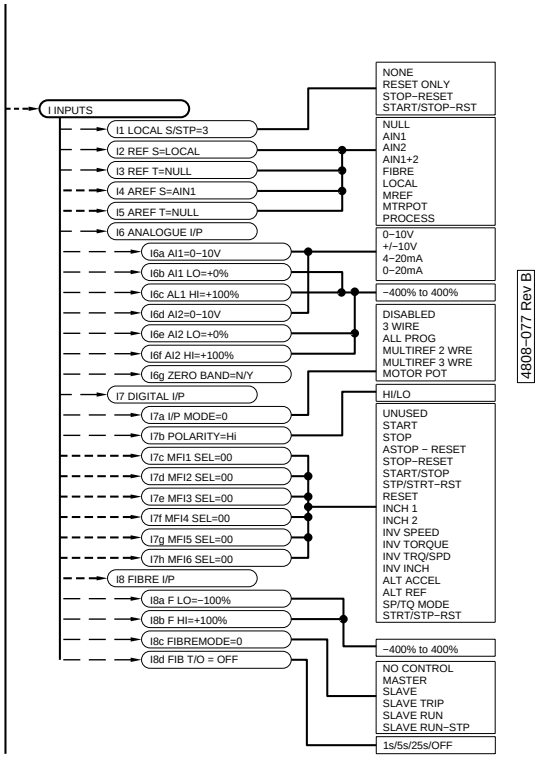
Screen **H3b BAUDRATE= 9600**
Description MODBUS SERIAL COMMUNICATIONS BAUDRATE
Range 1200/4800/9600/OFF
Units -
Default Value 9600
Stop to Change NO

SUBGROUP H4: DEVICENET COMMUNICATIONS PARAMETERS

These option will be valid if an Elite DeviceNet Interface (EDNI) module has been installed.

SCREEN GROUP I: INPUTS

Group Attribute Read Only



I1 LOCAL START/STOP-RESET CONTROL

Screen **I1 LOCAL S/STP=3**

Description LOCAL START/STOP AND RESET CONTROL

Range 0-3 See Table below

Default Value 3 START/STOP-RST

Stop to Change NO

Attribute READ ONLY

FUNCTION Enables the display units START, STOP and RESET functions.

SETTING UP

	Code	Notes
0	NONE	START and STOP/RESET inactive. Allows operation without display.
1	RESET ONLY	START and STOP inactive. STOP/RESET key resets faults only
2	STOP-RESET	START inactive. STOP and RESET functions active.
3	START/STOP-RST	START, STOP and RESET functions active

4202-210 Rev B

Figure 9.3: Local Start/Stop-Reset Control

I2, I4 SPEED REFERENCE SOURCES

Screen **I2 REF S= LOCAL**

Description SPEED REFERENCE SOURCE

Range REFER TABLE BELOW

Default Value LOCAL

Stop to Change YES

Attribute READ ONLY

Screen **I4 AREF S= AIN1**

Description ALTERNATIVE SPEED REFERENCE SOURCE

Range REFER TABLE BELOW

Default Value AIN1 (ANALOGUE INPUT 1)

Stop to Change YES

Attribute HIDDEN

FUNCTION Defines which input source is used as the speed reference (I2) or alternative speed reference source (I4):

CODE	SPEED REFERENCE SOURCE
NULL	NO SOURCE SELECTED
AIN1	ANALOGUE INPUT 1
AIN2	ANALOGUE INPUT 2
AIN1+2	ADDITION OF SCALED ANALOGUE INPUTS 1 + 2
FIBRE	FIBRE OPTIC INPUT
LOCAL	LOCAL SPEED CONTROL (SCREEN A3)
MREF	MULTI-REFERENCE (SCREENS I7a, M1 TO M7)
MTRPOT	MOTORISED POTENTIOMETER (SCREEN I7a)
PROCESS	PROCESS CONTROL OUTPUT

4202-161 Rev D

Figure 9.4: Speed Reference Source Selection

Note: The alternative speed reference is a switchable second source option. This function is enabled by selecting alternative reference as a multi-function input, by appropriate selection of Screens I7a and I7c to I7h.

SETTING UP Select the desired (and alternative, if required) speed reference source to suit your requirements.

Note: If the alternative speed reference is to be used, the Digital Input controlling this also selects the alternative torque reference source, so Screen I5 must also be set appropriately.

I3, I5 TORQUE REFERENCE SOURCES

Screen **I3 REF T= NULL**

Description TORQUE REFERENCE SOURCE

Range REFER TABLE BELOW

Default Value NULL (NO SOURCE SELECTED)

Stop to Change YES

Attribute READ ONLY

Screen **I5 AREF T= NULL**

Description ALTERNATIVE TORQUE REFERENCE SOURCE

Range REFER TABLE BELOW

Default Value NULL (NO SOURCE SELECTED)

Stop to Change YES

Attribute HIDDEN

FUNCTION Defines which input source is used as the torque reference (I3) or alternative torque reference source (I5):

CODE	TORQUE REFERENCE SOURCE
NULL	NO SOURCE SELECTED
AIN1	INPUT 1
AIN2	INPUT 2
AIN1+2	ADDITION OF SCALED ANALOGUE INPUTS 1 + 2
FIBRE	FIBRE OPTIC INPUT
LOCAL	LOCAL SPEED CONTROL (SCREEN A2)
MREF	MULTI-REFERENCE (SCREENS I7a, M1 TO M7)
MTRPOT	MOTORISED POTENTIOMETER (SCREEN I7a)
PROCESS	PROCESS CONTROL OUTPUT

4202-162 Rev E

Figure 9.5: Torque Reference Source Selection

I6a

I6b

I6c

I6d

I6e

I6f

Note: The alternative torque reference is a switchable second source option. This function is enabled by selecting alternative reference as a multi-function input, by appropriate selection of Screens I7a and I7c to I7h.

SETTING UP Select the desired (and alternative, if required) torque reference source to suit your requirements.

Note: If the alternative torque reference is to be used, the Digital Input controlling this also selects the alternative speed reference source, so Screen I4 must also be set appropriately.

SUBGROUP I6: ANALOG INPUTS

I6a - I6g ANALOGUE INPUT FORMATTING AND SCALING CONTROLS

Screen **I6a AI1= 0-10V**
Description ANALOGUE INPUT 1 FORMAT
Range REFER TABLE BELOW
Default Value 0-10V
Stop to Change YES
Attribute READ ONLY

Screen **I6b AI1 LO = 0%**
Description ANALOGUE INPUT 1 LOW SETPOINT
Range -400% TO +400%
Units %
Default Value 0%
Stop to Change NO
Attribute HIDDEN

Screen **I6c AI1 HI = +100%**
Description ANALOGUE INPUT 1 HIGH SETPOINT
Range -400% TO +400%
Units %
Default Value +100%
Stop to Change NO
Attribute HIDDEN

Screen **I6d AI2= 0-10V**
Description ANALOGUE INPUT 2 FORMAT
Range REFER TABLE BELOW
Default Value 0-10V
Stop to Change YES
Attribute READ ONLY

Screen **I6e AI2 LO = 0%**
Description ANALOGUE INPUT 2 LOW SETPOINT
Range -400% TO +400%
Units %
Default Value 0%
Stop to Change NO
Attribute HIDDEN

Screen **I6f AI2 HI =+100%**
Description ANALOGUE INPUT 2 HIGH SETPOINT
Range -400% TO +400%
Units %
Default Value +100%
Stop to Change NO
Attribute HIDDEN

CODE	ANALOGUE INPUT FORMAT
0-10V	0 to 10Vdc input
+/-10V	-10 to +10Vdc input
4-20mA	4 to 20 mA input
0-20mA	0 to 20 mA input

4202-191 Rev B

Figure 9.6: Analogue Input Format Selection

SCALING AI1 LO / AI2 LO
Set the reference level when minimum analogue level applied to respective input.

AI1 HI / AI2 HI
Set the reference level when maximum analogue level applied to respective input. The Elite Series input is interpolated linearly between the selected LO and HI settings.

LO settings may be greater than HI settings,

thus providing inverse control (i.e., increasing the reference input decreases the reference speed, torque or process setpoint).

SETTING UP If it has been determined that one or both analogue inputs are needed as torque or speed reference sources, they must first be selected (Screens I2 to I5).

Determine the required format of these analogue inputs, and set up on Screens I6a, I6d.

Determine the range over which analogue control is desired. Adjust the LO setting (Screens I6b, I6e) to the speed/torque desired at minimum analogue input. Adjust the HI setting (Screens I6c, I6f) to the speed/ torque desired at maximum analogue input (+10V/20mA).

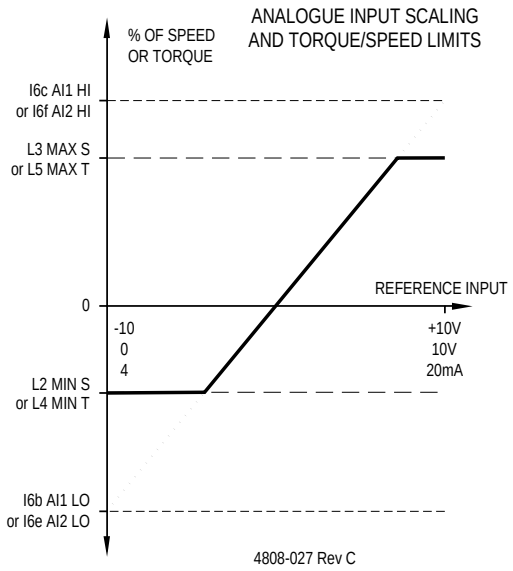


Figure 9.7: Analogue Input Scaling and Torque/ Speed Limits

I6g ANALOGUE ZERO BAND

Screen	**I6g ZERO BAND=N**
Description	ZERO BAND OF ±2% FOR ANALOGUE INPUT SOURCES
Range	YES/NO
Default Value	NO
Stop to Change	NO
Attribute	HIDDEN

FUNCTION To provide a definite zero region for analogue controls, especially for speed control.

This is important in applications where absolute zero speed (or torque) is required in conjunction with analogue control. It overcomes small errors in reference voltage about the zero reference point.

SETTING UP Not required if analogue reference inputs are not used.

If analogue references are to be used to command exactly zero speed (or torque) or the motor shaft is to be locked (i.e., mechanical brake) at zero speed, the zero band must be set to YES.

If absolute zero speed (or torque) is not critical, the shaft is not mechanically locked at zero speed or the analogue reference forms part of a feedback loop, set the zero band to NO.

Note: Zero band is provided since the digital tacho feedback employed in the Elite Series in Closed Loop Vector control mode is absolute - i.e., it cannot lose counts. Therefore any error in zero speed reference setting, however small, will be integrated over time causing the shaft to rotate.

The zero band function does not apply to the digital speed references (e.g., Local keyboard, fibre optic, or multi-reference select) since such zero settings are absolute.

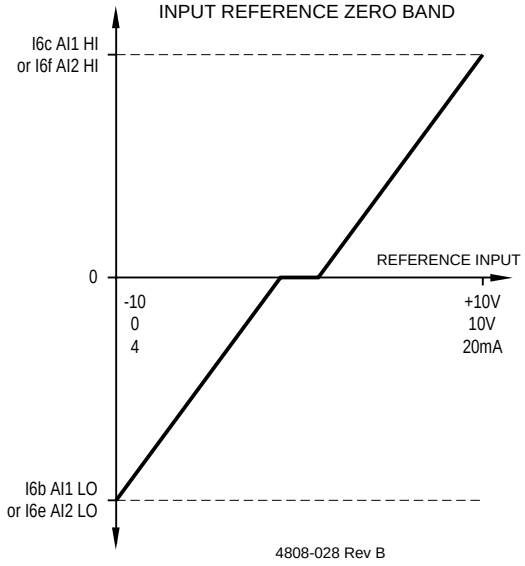


Figure 9.8: Input Reference Zero Band

SUBGROUP I7: DIGITAL INPUT

I7a - I7h DIGITAL INPUT CONTROLS

I7a

I7a MULTI-FUNCTION INPUT MODE SELECTION

Screen **I7a I/P MODE= 00**
Description MULTI-FUNCTION INPUT MODE SELECTION
Range 0 TO 5, REFER FIGURE 9.9
Default Value 00 - DISABLED
Stop to Change YES
Attribute READ ONLY

DESCRIPTIONS OF MULTI-FUNCTION INPUT MODES

0 **Disabled -** Disables all multifunction digital inputs. If the Display Unit Start/Stop-Reset is enabled from Screen I1, then the motor may be started and stopped using the Display Unit. Useful for commissioning by keyboard control without interference from external inputs.

1 **Remote (3 Wire) Control -** Enables Start/ Stop-Reset control from external inputs.

MFI 1	ASTOP-RESET
MFI 2	START
MFI 3	STOP-RESET
MFI 4	INVERT SPEED
MFI 5	INVERT TORQUE
MFI 6	SPEED/TORQUE

If the Display Unit Start/Stop-Reset are enabled from Screen I1, then the motor may also be started and stopped using the Display Unit.

2 **All Programmable** - Each of the six inputs (MFI 1 to MFI 6) can individually be programmed to one of many functions, using Screens I7c to I7h respectively.

3 **Multi-reference, 2 Wire** - Two of the six inputs (MFI 5, MFI 6) may be used to select from the multi-reference settings (Y, Z; refer to Screens M4 to M7), allowing a selection of four preset references.

The remaining four inputs (MFI 1 to MFI 4) may be individually programmed using Screens I7c to I7f respectively.

4 **Multi-reference, 3 Wire** - Three of the six inputs (MFI 4 to MFI 6) may be used to select from the multi-reference settings (X, Y, Z; refer to Screens M1 to M7), allowing a selection of zero plus seven preset references.

The remaining three inputs (MFI 1 to MFI 3) may be individually programmed using Screens I7c to I7e respectively.

5 **Motorised Potentiometer** - Offers reference control by UP (increase reference) or DOWN (decrease reference) push buttons.

UP (increase reference) (MFI 5) is defined as normally open and may be parallel connected to provide distributed control points. DOWN (decrease reference) (MFI 6) is defined as normally closed and may be series connected to provide distributed control points.

MFI 4 selects which reference is to be adjusted (Speed = Open & Torque = Closed).

The speed reference source (Screen I2 or I4) and/or the torque reference source (Screen I3 or I5) must be set to the motorised potentiometer ("MTRPOT") selection.

MFI 1 to MFI 3 may be individually programmed using Screens I7a to I7e respectively.

Adjustment is possible from minimum to maximum as follows (refer to Screens M4 to M7):

MREF4	-	Minimum Speed
MREF5	-	Maximum Speed
MREF6	-	Minimum Torque
MREF7	-	Maximum Torque

By setting the minimum speed or torque to be greater than the maximum setting, reverse control may be implemented.

The adjustment rate is scaled to allow full scale adjustment in ten seconds. On power up, the motorised potentiometer speed reference is set to MREF4 and the motorised potentiometer torque reference is set to MREF6 unless the minimum and maximum values span zero in which case the reference is set to zero.

MULTI-FUNCTION SETTING UP WARNING

Altering the multi-function input mode of the Elite Series completely reconfigures the logic of operation of the input control terminals. Be very sure that you understand the operating mode that you require, and that any inputs already connected will not cause the unit to automatically start once your mode is selected.

Hints: Mode 0 is a special "safe" multi-function mode in which all inputs are disabled. In this mode the Elite Series will not respond to external terminal inputs, but it will show the state and operation of the analogue and multifunction inputs on the control status display screens (Screens Z3 to Z12). Before finally selecting your desired operating multifunction mode, use this mode to safely inspect the status and operation of all of your inputs. If the previous setup of the Elite Series is not known - remove the link from the External Trip input (Terminal T19). This will trip the Elite Series and prevent possible instantaneous starting of the motor upon applying power.

The status of the six inputs can be observed on Screen Z7.

Notes: The multifunction Speed/Torque reference modes can be selected using Screens I2-I5.

INPUT MODES		CONTROL INPUT TERMINAL FUNCTIONS					
NO.	NAME	INPUT 1 T13	INPUT 2 T14	INPUT 3 T15	INPUT 4 T16	INPUT 5 T17	INPUT 6 T18
0	DISABLED	DISABLED	DISABLED	DISABLED	DISABLED	DISABLED	DISABLED
1	3 WIRE	ASTOP-RST	START	STP-RST	INV SP	INV TQ	SP/TQ
2	ALL PROG	MFI 1	MFI 2	MFI 3	MFI 4	MFI 5	MFI 6
3	MULTIREF 2 WIRE	MFI 1	MFI 2	MFI 3	MFI 4	Y	Z
4	MULTIREF 3 WIRE	MFI 1	MFI 2	MFI 3	X	Y	Z
5	MOTORISED POT	MFI 1	MFI 2	MFI 3	SP/TQ	UP	DOWN

4202-163 Rev C

Figure 9.9: Input Mode Selection

I7b MULTI-FUNCTION INPUT INVERSION

Screen **I7b POLARITY= HI**

Description MULTI-FUNCTION INPUT LOGICAL INVERSION

Range HI (active high) or LO (active low)

Default Value HI (active high)

Stop to Change YES

Attribute HIDDEN

FUNCTION The Elite Series has the ability to have its input circuits operated in two modes:

ACTIVE HIGH (I7b POLARITY= HI)

Pull input high to activate

ACTIVE LOW (I7b POLARITY= LO)

Pull input low to activate

This screen changes the biasing of the digital input circuits, to bias low when active high is selected, or bias high when active low is selected. It also changes the polarity of the input logic running in the processor.

Note 1: Changing the input polarity allows the user to select the voltage level required to close the input circuits — either 24Vdc (when configured as active high) or 0Vdc (when confirgured in active low).

Note 2: The setting of this screen is not modified when the Elite Series is initialised from Screen Y2. The default (factory set) mode for this screen is:

ACTIVE HIGH(I7b POLARITY= HI)

Pull input high to activate.

Note 3: The setting of this screen can not be modified unless Screen I7a is set to DISABLED. This is to prevent possible starting upon changing the digital input polarity.

WARNING It is strongly recommended that all Elite Series drives on any one site should be configured for either ACTIVE HIGH or ACTIVE LOW to minimise the risk of non-fail-safe operation if drives are exchanged. The mode would probably be set up to correspond to that used by other models of drive used on site.

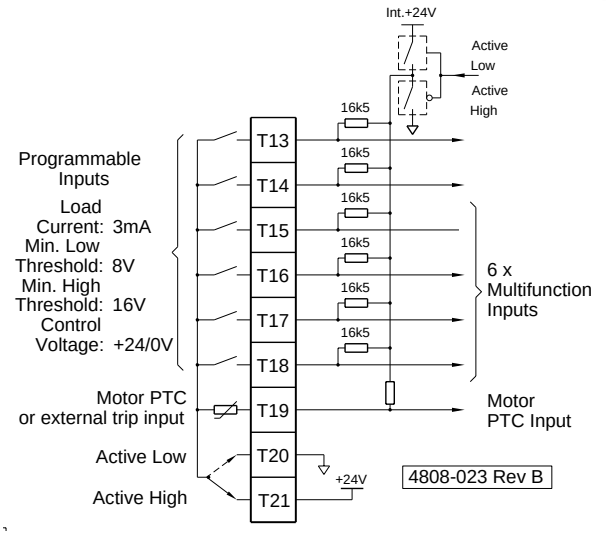


Figure 9.10: Active High/Active Low Selection

I7c - I7h MULTI-FUNCTION INPUT SELECTIONS

I7c

Attributes HIDDEN

Screen **I7c MFI 1 SEL= 00**

Description MULTI-FUNCTION 1 INPUT SELECTIONS; TERMINAL T13

I7d

Range 00 TO 18, REFER FIGURE 9.11
Default Value 00 (UNUSED)
Stop to Change YES

Screen **I7d MFI 2 SEL= 00**

I7e

Description MULTI-FUNCTION 2 INPUT SELECTIONS; TERMINAL T14
Range 00 TO 18, REFER FIGURE 9.11
Default Value 00 (UNUSED)

I7f

Stop to Change YES

Screen **I7e MFI 3 SEL= 00**

Description MULTI-FUNCTION 3 INPUT SELECTIONS; TERMINAL T15

I7g

Range 00 TO 18, REFER FIGURE 9.11
Default Value 00 (UNUSED)
Stop to Change YES

I7h

Screen **I7f MFI 4 SEL= 00**

Description MULTI-FUNCTION 4 INPUT SELECTIONS; TERMINAL T16
Range 00 TO 18, REFER FIGURE 9.11
Default Value 00 (UNUSED)
Stop to Change YES

Screen **I7g MFI 5 SEL= 00**

Description MULTI-FUNCTION 5 INPUT SELECTIONS; TERMINAL T17
Range 00 TO 18, REFER FIGURE 9.11
Default Value 00 (UNUSED)
Stop to Change YES

Screen **I7h MFI 6 SEL= 00**

Description MULTI-FUNCTION 6 INPUT SELECTIONS; TERMINAL T18
Range 00 TO 18, REFER FIGURE 9.11
Default Value 00 (UNUSED)
Stop to Change YES

FUNCTION Certain input modes are able to be selected from Screen I7a which offer programmable input functions. There are a maximum of six inputs and each may be programmed individually using Screens I7c to I7h. The selection of functions available is shown in table opposite.

SETTING UP Determine which input mode is required (Screen I7a). Program each input, MFI 1 to 6, Screens I7c to I7h, as required.

Be very careful that you have selected the correct functions.

Always check operation under safe conditions before entering the system into service.

NO	INPUT	INACTIVE STATE	ACTION FUNCTION/ NOTES
00	Unused	N/A	Input has no effect
01	Start	Open	Commands start, latching
02	Stop	Closed	Commands stop (Screen S2), latching
03	Alternative Stop-Reset	Closed	Commands alternative stop (Screen S4) while active; latches stop (Screen S2); reset on opening edge
04	Stop-Reset	Closed	Commands stop (Screen S2); latching; reset on opening edge
05	Start/Stop	Open	Commands start when closed; stop when open
06	Stop/ Start-Reset	Open	As 05, but provides reset on closing edge
07	Reset	Closed	Reset upon opening edge
08	Inch 1	Open	Inches (jumps to speed mode) at setting of MREF1 (Screen M1); Inch is dominant; Closing Inch 1 and Inch 2 gives Inch 3 (MREF 3)
09	Inch 2	Open	Inches (jumps to speed mode) at setting of MREF2 (Screen M2); Inch is dominant; Closing Inch 1 and Inch 2 gives Inch 3 (MREF3)
10	Invert Speed	Open	Inverts sign of speed reference
11	Invert Torque	Open	Inverts sign of torque reference
12	Invert Torque-Speed	Open	Inverts sign of both torque and speed references
13	Invert Inch	Open	Inverts sign of inch reference
14	Alternative Acceleration	Open	Toggles selected acceleration and deceleration rates in conjunction with Screen R5 (Accel/Decel break speed)
15	Alternative Reference	Open	Selects alternative reference (Screens I4, I5)
16	Speed/Torque Mode	Open	Switches to torque control mode
17	Unused	N/A	Input has no effect
18	Start/Stop-Reset	Open	As 05, but provides reset on opening edge

4202-115 Rev F

Figure 9.11: Multi-function Input Functions (Selectable Functions)

SUBGROUP I8: FIBRE OPTIC INPUT

I8a - I8d FIBRE OPTIC INPUT SCALING CONTROLS

Screen **I8a F LO = –100.0%**
Description FIBRE INPUT LOW SETPOINT
Range -400% TO +400%
Units % OF MOTOR RATED SYNCHRONOUS SPEED OR TORQUE
Default Value –100%
Stop to Change NO
Attribute HIDDEN

Screen **I8b F HI =+100.0%**
Description FIBRE INPUT HIGH SETPOINT
Range -400% TO +400%
Units % OF MOTOR RATED SYNCHRONOUS SPEED OR TORQUE
Default Value +100%
Stop to Change NO
Attribute HIDDEN
FUNCTION Defines the format and scaling of the Fibre Optic input.

Screen **I8c FIBRE MODE = 0**
Description FIBRE OPTIC CONTROL MODE SELECTION
Range 0-5, REFER TABLE BELOW
Default Value 0 (No Control)
Stop to Change YES
Attribute HIDDEN
FUNCTION A master/slave fibre optic network enabling synchronised starting/stopping and fault response of drives connected via a fibre optic loop. Refer General Application Note 4216-045 for more detail.

SETTING UP Only one drive in the loop should be set to master.

NO	FIBRE MODE	FUNCTION
0	NO CONTROL	No response to the fibre optic control
1	MASTER	Overall control of the network
2	SLAVE	Full slave control
3	SLAVE TRIP	Slave control with Trip/Reset related control only
4	SLAVE RUN	Slave control with run control only
5	SLAVE RUN/STP	Slave control with run control and stop on trip

4202-233 Rev B

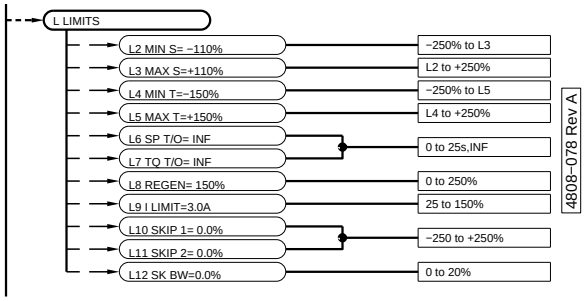
Figure 9.12: Fibre Optic Control Mode Selection

NOTE: The setting on this screen does not affect the transmission or reception of reference information which is controlled by screens I8a, I8b, and O3a.

Screen **I8d FIBRE T/O = OFF**
Description FIBRE OPTIC INPUT TIMEOUT PERIOD
Range 1s/5s/25s/OFF
Units Sec
Default Value OFF
Stop to Change YES
FUNCTION Provides the option of tripping the Elite Series (indicates “F27 FIBRE T/O”) if the time since the last valid fibre optic input signal has exceeded the timeout period.

SCREEN GROUP L: LIMITS

Group Attribute READ–WRITE



Screen **L2 MIN S= -110%**
Description MINIMUM SPEED
Range -250% TO MAXIMUM SPEED SETTING
Units % OF MOTOR RATED SYNCHRONOUS SPEED
Default Value -110%
Stop to Change NO

Screen **L3 MAX S= +110%**
Description MAXIMUM SPEED
Range MINIMUM SPEED SETTING TO +250%
Units % OF MOTOR RATED SYNCHRONOUS SPEED
Default Value +110%
Stop to Change NO
FUNCTION Set the speed limits within which the Elite Series can be commanded to operate the motor. Commands to operate beyond these limits will be limited to these limits.

Note that a negative reference speed implies motor operation in reverse.

SETTING UP Adjust minimum and maximum speeds according to your application requirements.

L4, L5 TORQUE LIMITS

Screen **L4 MIN T=-150%**
Description MINIMUM TORQUE
Range -250% TO MAXIMUM TORQUE SETTING
Units % OF RATED MOTOR TORQUE
Default Value -150%
Stop to Change NO

Screen **L5 MAX T=+150%**
Description MAXIMUM TORQUE
Range MINIMUM TORQUE SETTING TO +250%
Units % OF RATED MOTOR TORQUE
Default Value +150%
Stop to Change NO
FUNCTION Sets the torque limits within which the Elite Series can be commanded to operate the motor. Commands to operate beyond these limits (e.g., from torque reference input, or as a result of speed control demands) will be limited to these limits.

SETTING UP Adjust minimum and maximum torque according to your application limits.

L6

L7

L8

L9

Note: The motor will draw current in approximate proportion to the torque demanded. Therefore be sure that the Elite Series connected is able to supply the current necessary to supply the torque required. Do not select minimum or maximum torque which will require the Elite Series to produce more than 150% of its rated output current.

When running in Closed Loop Vector control mode, torque limiting will be indicated if the shaft encoder signals are lost.

L6, L7 TIMEOUT CONTROLS

Screen **L6 SP T/O =INF**

Description SPEED LIMIT TIMEOUT
Range 0 TO 25 SEC AND INFINITE
Units SECONDS
Default Value INFINITE
Stop to Change NO

Screen **L7 TQ T/O =INF**

Dscription TORQUE LIMIT TIMEOUT
Range 0 TO 25 SEC AND INFINITE
Units SECONDS
Default Value INFINITE
Stop to Change NO

FUNCTION To provide the option of automatically tripping the Elite Series if the speed or torque limits are encountered for a period of time between 0 and 25 seconds.

SETTING UP The Elite Series will automatically limit speed or torque (Screens L2 - L5) if required. In some processes this is normal and may occur continuously, in which case these screens should be set to never timeout - i.e., to infinite.

In other processes, such activity indicates loss of process control which may be tolerated for a brief period of time, or may call for immediate tripping of the process. In such cases these screens may be set to the appropriate time.

Torque limit timeout control also protects against shaft encoder signal loss when running in closed loop vector mode.

Zero settings equate in action to instantaneous speed or torque shear-pin functions.

Note: The Torque limit timeout is also used for Current limit timeout.

L8 REGENERATION LIMIT

Screen **L8 REGEN= 150%**

Description REGENERATION LIMIT
Range 0 TO 250%
Units % OF MOTOR POWER
Default Value 150
Stop to Change NO

FUNCTION When the sign of the load torque and motor speed are different the motor acts as generator (e.g., when decelerating high inertia loads).

This function automatically limits the torque applied (by controlling motor speed) to control the amount of regenerated power. The object of this is to keep the regenerated power within the system's capabilities (whether relying on natural losses or using a dynamic brake).

In utilising this function the optimum braking performances can be achieved without danger of loss of control due to regeneration beyond the system's ability to dispose of it.

SETTING UP If the application does not involve regeneration, this screen need not be adjusted. When relying on natural losses to dissipate regenerated power adjust this level to the estimated loss level (typically 5 to 10 percent) and confirm correct (i.e., trip free) operation by experiment.

When utilising a dynamic brake, set this screen to the appropriate (short or long term) power limit level according to the application requirement and brake dissipation capability.

L9 CURRENT LIMIT CONTROLS

Screen **L9 I LIMIT = 16A**

Description CURRENT LIMIT
Range 0.25/1.50 of I (Inverter)
Default 1.2 times Inverter rating

FUNCTION To maintain load current within controllable bounds (status = ILT). Torque limit timeout (L7) provides a setable maximum time of active current limit, beyond which the Elite will automatically trip (Fault status = TQ LIM T/O)

If the current limit timeout period is set at, or near zero, the current limit function effectively acts as a “SHEARPIN”, providing rapid over-torque protection.

SETTING UP Current limit: Where not strictly part of the required setup for the particular application leave this set at 1.2 x Elite rated current. If there is a particular requirement for this function (e.g., for torque limiting or to ensure the motor cannot approach the overload setting and thus will not trip out) set the current limit to the desired value.

Hints: For normal operation, avoid choosing values much below the motor’s rated current as various effects (starting torque settings, rapid acceleration or deceleration) can lead to confusing results.

In a well set up application current limit should never be required. Current limit acts to override incorrect Elite set or load problems. If current limit action is observed during normal operation of the Elite or process, check that the setup is correct - particularly check acceleration, deceleration, motor parameters and boost settings.

L10, L11, L12 SKIP SPEEDS

Screen	**L10 SKIP 1 = +0.0%**
Description	SKIP SPEED 1
Range	-250% to +250%
Default	Default 0%
Screen	**L11 SKIP 2 = +0.0%**
Description	SKIP SPEED 2
Range	-250% to +250%
Default	Default 0%
Screen	**L12 SKIP BW= 10.0%**
Description	SKIP BANDWIDTH
Range	0% TO 20%
Default	Default 0%
FUNCTION	To provide two zones of reference speeds that cannot be set. The object is to provide "keep out" area of operation which may be selected so that natural mechanical system resonances can be avoided. Skip speeds 1 and 2 define the middle of each skip zone. The skip bandwidth defines the width of the zones.
SETTING UP	Complete other commissioning first. Determine points, and breadths of any (two) mechanical resonances in your system. Enter skip speeds and desired bandwidth.
	To turn off skip speeds set SK BW to 0.0%.
	Check operation and readjust as necessary.

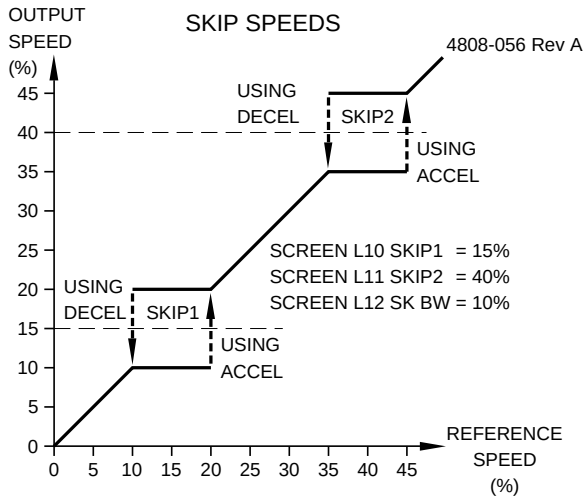
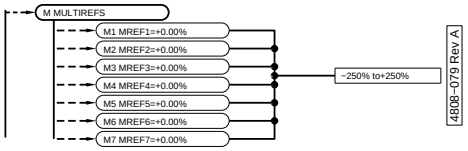


Figure 9.13: Skip Speeds

SCREEN GROUP M:MULTI-REFERENCE SETPOINTS

Group Attribute HIDDEN



Screens	**M1 MREF1= +0.00%** **M2 MREF2= +0.00%** **M3 MREF3= +0.00%** **M4 MREF4= +0.00%** **M5 MREF5= +0.00%** **M6 MREF6= +0.00%** **M7 MREF7= +0.00%**
Description	MULTI-REFERENCE SETPOINTS
Range	-250% TO +250%
Units	% OF RATED MOTOR SPEED OR TORQUE
Default Value	0.0
Stop to Change	NO
Attributes	HIDDEN
FUNCTION	These are reference setpoints into which user values can be loaded. The multi-reference setpoints are used in combination with the following modes (Screens I7a, I7c to I7h):

- INCH 1
- INCH 2
- INCH 3
- MULTI-REFERENCE*
- MOTORISED POTENTIOMETER

The following table relates inputs T16, T17, T18 (X, Y, Z) to the selected multi-reference:

SCREEN	TITLE	SPECIAL FUNCTIONS	MULTI-REFERENCE INPUTS		
			MFI4 (T16) X	MFI5 (T17) Y	MFI6 (T18) Z
	ZERO		O	O	O
M1	MREF1	INCH1	O	O	X
M2	MREF2	INCH2	O	X	O
M3	MREF3	INCH3	O	X	X
M4	MREF4	MOTORPOT MIN SPEED	X	O	O
M5	MREF5	MOTORPOT MAX SPEED	X	O	X
M6	MREF6	MOTORPOT MIN TORQUE	X	X	O
M7	MREF7	MOTORPOT MAX TORQUE	X	X	X

4202-165 Rev c

O= Open X = Closed

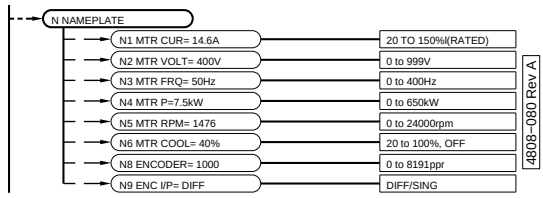
Figure 9.14: Function of Multi - Reference Set points

**Note:*	In multi-reference two wire MFI4 mode (Terminal T16) is assumed closed. Multi-reference two wire uses Screens M4, M5, M6 and M7.
SETTING UP	Adjustment is only necessary when a function requiring multi-references is selected.
	Determine the speed or torque reference level needed for each state and enter this value.

SCREEN GROUP N: MOTOR NAMEPLATE DATA

N1

Attribute HIDDEN



N2

N3

N4

N5

N6

N8

N9

Screen **N1 MTR CUR=0.0A**
Description RATED (NAMEPLATE) MOTOR CURRENT
Valid Range 20% TO 150% OF DRIVE SIZE
Units AMPS
Default Value 100%
Stop to Change NO

Screen **N2 MTR VOLT=0V**
Description RATED (NAMEPLATE) MOTOR VOLTAGE
Valid Range 0 TO 999V
Units VOLTS
Default Value 400
Stop to Change NO

Screen **N3 MTR FRQ=0Hz**
Description RATED (NAMEPLATE) MOTOR FREQUENCY
Valid Range 25 TO 400Hz
Units HERTZ
Default Value 50
Stop to Change NO

Screen **N4 MTR kW= 0.0kW**
Description RATED (NAMEPLATE) MOTOR POWER
Valid Range 0 TO 650kW, 50% TO 150% OF ELITE RATED kW
Units KILOWATTS
Default Value 0
Stop to Change NO

Screen **N5 MTR RPM= 0**
Desciption RATED (NAMEPLATE) MOTOR SPEED
Valid Range 200 TO 24000 RPM
Units REVOLUTIONS PER MINUTE
Default Value 0
Stop to Change NO

Screen **N6 MTR COOL= 40%**
Description MOTOR COOLING AT ZERO SPEED
Range 20 to 100%, OFF
Units PERCENTAGE OF COOLING AT RATED SPEED
Default Value 40%
Stop to Change NO

FUNCTION Calibrates the Elite Series for the motor being driven. Provides information for the thermal model motor protection.

The Elite Series must be correctly sized to control the motor being driven. The motor should be between 50% and 150% of the Elite Series rated power (kVA) and the motor must have between two and twelve poles.

The thermal model includes correction for the reduced efficiency of standard motor cooling at reduced speed by interpolating between the zero speed cooling term (Screen N6) and rated cooling at rated speed (refer Figure 4.2). The thermal model is reset when power is removed from the Elite Series.

SETTING UP These parameters must be set before operating the Elite Series. Invalid combinations of values will be detected as "Parameter Fault" error, tripping the Elite Series.
Enter motor rated (nameplate) parameters - current, voltage, frequency, power and speed (rpm). Where the nameplate includes multiple options or the configuration (star/ delta) of the windings has been altered, be sure to enter the correct data for your configuration.
Estimate the efficiency of cooling of your motor at zero speed and enter this figure. (This is very application dependent - as a guide, 40% is typical. Where open frame, force cooled or water cooled motors are used, higher zero speed cooling efficiency will be achieved.) If extended operation at low speed leads to tripping due to the motor thermal model, check the motor. If it is clearly not very hot, the zero speed cooling figure may be safely increased. The motor thermal model may be disabled by setting the motor cooling parameter to OFF.
Independent external thermal protection should then be applied to the motor.

N8 ENCODER SENSOR CALIBRATION

Screen **N8 ENCODER = 0000**
Description PULSES PER REVOLUTION OF TACHO ENCODER
Range 0 TO 8191 PPR
Default Value 0
Stop to Change NO

FUNCTION To operate the Microdrive Elite in Closed Loop Vector control mode, feedback of motor shaft position is required. The Elite Series is designed to accept input from an incremental shaft encoder. This parameter calibrates the Elite Series to the number of pulses per revolution generated by the encoder.

SETTING UP Enter the encoder's number of pulses per motor shaft revolution. Any gearing between the motor and encoder must be taken into account.

Notes: See also Section 4.2.

Full details on selection, mounting and checking of the shaft encoder are detailed in the Elite Series Getting Started Manual (PDL Part No. 4201-179).

N9 ENCODER INPUT TYPE SELECTION

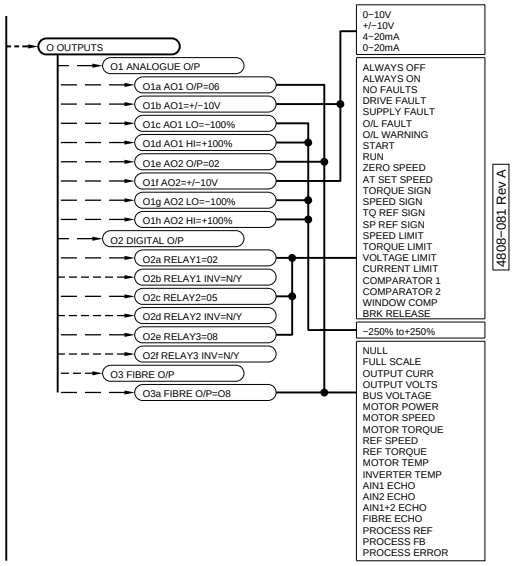
Screen **N9 ENC I/P=DIFF**
Description SELECTION OF TYPE OF ENCODER
Range SING (single ended) or DIFF (differential)
Default Value DIFF
Stop to Change YES

FUNCTION The input circuit on the Control Board can be configured to accept either style of shaft encoder. Differential type is recommended for its superior noise-rejection capabilities.

Full details on selection, mounting and checking of the shaft encoder are detailed in the Elite Series Getting Started Manual (PDL Part No. 4201-179).

SCREEN GROUP O: OUTPUTS

Group Attribute READ–WRITE



SUBGROUP O1: ANALOGUE OUTPUTS

O1a, O1e ANALOGUE OUTPUTS SOURCE SELECT

Screens **O1a AO1 O/P= 06**
O1e AO2 O/P= 02

Description ANALOGUE OUTPUT SOURCE SELECTION
Range 00 TO 18 - REFER TO TABLE BELOW
Default Value AO1 O/P= 06 (MOTOR SPEED)
AO2 O/P= 02 (OUTPUT CURRENT)
Stop to Change YES
Attribute READ ONLY

FUNCTION Provides the ability to select the driving source for each of the two analogue outputs, from the following list:

NO.	SOURCE	UNITS
00	NULL	-
01	FULL SCALE	100% of full scale
02	OUTPUT CURR	% of motor current
03	OUTPUT VOLTS	% of motor voltage
04	BUS VOLTAGE	% of motor voltage x 1.414
05	MOTOR POWER	% of motor power
06	MOTOR SPEED	% of motor speed
07	MOTOR TORQUE	% of motor torque
08	REF SPEED	% of motor speed
09	REF TORQUE	% of motor torque
10	MOTOR TEMP	% of motor temperature
11	INVERTER TEMP	% of inverter temperature
12	AIN1 ECHO	%
13	AIN2 ECHO	%
14	AIN1+2 ECHO	%
15	FIBRE ECHO	%
16	PROCESS REF	%
17	PROCESS FEEDBACK	%
18	PROCESS ERROR	%

4202-160 Rev E

Figure 9.15: Analogue & Fibre Outputs Source Selection

SETTING UP Select the desired analogue signal source for each of the two analogue outputs.

Select the format of each output using Screens O1b, O1f. Adjust the scaling using Screens O1c and O1d for AO1, and O1g and O1h for AO2.

O1b-O1d, O1f-O1h ANALOGUE OUTPUT FORMATTING AND SCALING CONTROLS

Screen **O1b AO1=+/-10V**
Description ANALOGUE OUTPUT 1 FORMAT
Range REFER TABLE BELOW
Default Value +/-10V
Stop to Change YES
Attribute READ ONLY

Screen **O1c AO1 LO = –100%**
Description ANALOGUE OUTPUT 1 LOW SETPOINT
Range -250% TO +250%
Units %
Default Value –100%
Stop to Change NO
Attribute HIDDEN

Screen **O1d AO1 HI =+100%**
Description ANALOGUE OUTPUT 1 HIGH SETPOINT
Range -250% TO +250%
Units %
Default Value +100%
Stop to Change NO
Attribute HIDDEN

Screen **O1f AO 2= +/-10V**
Description ANALOGUE OUTPUT 2 FORMAT
Range REFER TABLE BELOW
Default Value +/-10V
Stop to Change YES
Attribute READ ONLY

Screen **O1g AO2 LO = –100%**
Description ANALOGUE OUTPUT 2 LOW SETPOINT
Range -250% TO +250%
Units %
Default Value –100%
Stop to Change NO
Attribute HIDDEN

Screen **O1h AO2 HI =+100%**
Description ANALOGUE OUTPUT 2 HIGH SETPOINT
Range -250% TO +250%
Units %
Default Value +100%
Stop to Change NO
Attribute HIDDEN

CODE	ANALOGUE OUTPUT FORMAT
0-10V	0 to 10Vdc, input> 1 kohms
+/-10V	-10 to +10Vdc, input>1 kohms
4-20mA	4 to 20 mA, input<500 ohms
0-20mA	0 to 20 mA, input< 500 ohms

4202-164 Rev D

Figure 9.16: Analogue Output Format Selection

FUNCTION Provides the ability to change each of the two analogue outputs to one of the four formats listed in Figure 9.16.

SCALING AO1 LO / AO2 LO
Maps the AO1 LO / AO2 LO level to the minimum output level for the selected output format.

O2a

AO1 HI / AO2 HI
Maps the AO1 HI / AO2 HI level to the maximum output level for the selected output format. The Elite Series analogue outputs are interpolated linearly between the selected LO and HI settings.

O2c

LO settings may be greater than HI settings, thus providing inverse control (i.e., increasing the analogue output source level decreases the analogue output level).

O2e

SETTING UP No action is required if no devices are connected to these terminals.

O2b

Determine the required format of these analogue outputs to suit the external devices being driven by their respective output terminals, and set up on Screens O1b, O1f.

O2d

Determine the range over which analogue control is desired.

O2f

Adjust the LO setting (Screens O1c, O1g) to the desired minimum analogue output (-10V/0V/4mA/0mA).

Adjust the HI setting (Screens O1d, O1h) to the desired maximum analogue output (+10V/20mA).

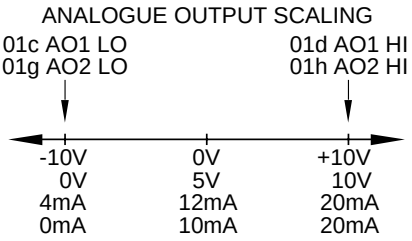


Figure 9.17: Analogue Output Scaling

Each analogue output may be tested by selecting its source to be FULL SCALE (Screens O1a, O1e to Selection 01). The gain of each may then be adjusted by setting Screens O1c and O1d for Analogue Output 1 (AO1), and Screen O1g and O1h for Analogue Output 2 (AO2).

EXAMPLE 1 Analogue Output 1 (AO1) is formatted as a ±10V output and is used to drive an analogue meter to represent motor speed for a 1440 rpm motor across the range –3000 rpm to +3000 rpm;

Set the source via Screen O1a to:
O1a AO1 O/P=06 (actual motor speed)

Set the format via Screen O1b to:
O1b AO1=+/-10V (–10Vdc to +10Vdc)

Set the scaling via Screens O1c and O1d to:
O1c AO1 LO= –200%
O1d AO1 HI=+200%
of rated synchronous speed of 1500 rpm.

With this setup, Analogue Output 1 (AO1) would output –4.8Vdc when the motor was rotating in the reverse direction at 1440 rpm.

$$\left(\frac{\text{actual motor speed}}{\text{rated synchronous speed}}\right) \bullet \frac{10\text{V}}{200\%/100\%} = -4.8\text{V}$$

where actual motor speed = –1440rpm
and rated synchronous speed = 1500rpm

EXAMPLE 2 Analogue Output 2 (AO2) is formatted as a 4-20mA output and is used to drive into a 4-20mA PLC analogue input to represent motor current for a 20A motor across the range 0A to 50A;

Set the source via Screen O1e to:
O1e AO2 O/P=02 (actual motor current)

Set the format via Screen O1f to:
O1f AO2=4-20mA

Set the scaling via Screens O1g and O1h to:
O1g AO2 LO=0.0%
O1h AO2 HI=+250%

With this setup, Analogue Output 2 (AO2) would source 10.4mA when the motor was drawing 20A.

SUBGROUP O2: DIGITAL O/P RELAYS

O2a,O2c,O2e RELAY SELECTIONS

Screens	**O2a**	**RELAY1 SEL= 02**
	O2c	**RELAY2 SEL= 05**
	O2e	**RELAY3 SEL= 08**
Description	RELAY CONTROL SOURCE SELECTION	
Range	00 TO 22, REFER FIGURE 9.18	
Default Value	RLY1 = 02 (No faults)	
	RLY2 = 05 (Overload fault)	
	RLY3 = 08 (Run)	
Stop to Change	NO	

FUNCTION Provides the ability to link each relay to one of the outputs shown in table opposite.

All relays have a 250ms minimum pulse width.

SETTING UP No action required if relays are not to be used.

Select the desired source for each relay. If necessary, set up associated level setting screens (i.e., comparators C1 to C6).

O2b, O2d, O2f RELAY INVERSION

Screens	**O2b**	**RELAY1 INV = N**
	O2d	**RELAY2 INV = N**
	O2f	**RELAY3 INV = N**
Description	INVERT THE LOGIC OF THE OUTPUT RELAY	
Range	Y/N	
Default Value	N	
Stop to Change	NO	

FUNCTION Provides the ability to invert the function of each output relay if desired.

SETTING UP No action required unless relays are used and an inverted output is necessary.

Determine desired logic inversion and select as necessary.

Note: RLY1 has both normally open contacts (T1/T2) and normally closed contacts (T2/T3).

RLY2 has normally open contacts (T4/T5).

RLY3 has normally open contacts (T6/T7).

NO.	DISPLAY	ENERGISED STATE	DESCRIPTION
OO	ALWAYS OFF	N/A	Can be used to manually force this state.
O1	ALWAYS ON	Drive Powered	Indicates supply present at drive
O2	NO FAULTS	No Fault	No faults present: failsafe
O3	DRIVE FAULT	No Fault	Drive related fault or low supply; failsafe
O4	SUPPLY FAULT	No Fault	Supply phase fault or low supply; failsafe
O5	O/L FAULT	No Fault	Motor or Drive Overload Trip; failsafe
O6	O/L WARNING	No Warning	Motor or Drive predictive overload; failsafe warning
O7	START	Started	Drive has responded to a START command
O8	RUN	Running	Drive inverter is active (running)
O9	ZERO SPEED	Standstill	Motor at standstill (+/-1% of its rated speed)
10	AT SET SPEED	At Set Speed	Motor at set speed (+/-1% of set speed)
11	TORQUE SIGN	Negative (-)	Sign of direction of motor torque
12	SPEED SIGN	Reverse (-)	Sign of direction of motor speed
13	TQ REF SIGN	Negative (-)	Sign of direction of reference torque
14	SP REF SIGN	Reverse (-)	Sign of direction of reference speed
15	SPEED LIMIT	At Limit	Drive is operating at speed limit (Screens L2, L3)
16	TORQUE LIMIT	At Limit	Drive is operating at torque limit (Screens L4, L5)
17	VOLTAGE LIMIT	Voltage Limiting	Drive is operating at voltage limit
18	CURRENT LIMIT	Current Limiting	Drive is operating at current limit
19	COMPARATOR 1	Above ON Level	De-energises below OFF level (Screens C2, C3)
20	COMPARATOR 2	Above ON Level	De-energises below OFF level (Screens C5, C6)
21	WINDOW COMP	Inside Window	Comparator 1 ON and Comparator 2 OFF
22	BRAKE RELEASE	Release	

4202-166 Rev E

Figure 9.18: Relay Table Selection

SUBGROUP O3: FIBRE OUTPUT

O3a

O3a FIBRE OUTPUT SOURCE SELECT

Screen **FIBRE O/P= 06**

Description FIBRE OUTPUT SOURCE SELECTION
Range 00 TO 18 - REFER TO FIGURE 9.15.
Default Value 06 (MOTOR SPEED)
Stop to Change NO
Attribute READ ONLY

FUNCTION Provides the ability to select the driving source for Fibre Optic output.

SETTING UP Select the desired Fibre signal source.

SCREEN GROUP P: PROCESS CONTROL

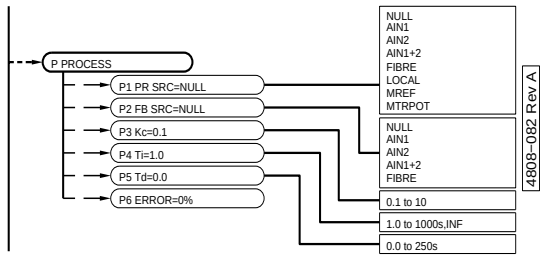
Group Attribute Read Only

P1

P2

P3

P4



Introduction The Elite Series process controller is a fully featured PID regulator. The setpoint and feedback sources may be selected from a wide choice of options. If selected the output is routed to the speed controller to provide a speed reference source (Refer Screens I2,I4).

Tuning The process controller may be tuned using manual Ziegler-Nichols techniques or by starting with the default values:

Increase the Controller Gain (Screen P3) until oscillation first occurs; then set to approximately 40% this setting.

Decrease the Integration Time (Screen P4) until oscillation occurs; then set back to approximately 150% this setting.

Increase the Differential Time (Screen P5) until minimal overshoot has been achieved but oscillation has not occurred. Typically the Differential Time would not exceed 25% of the Integration Time.

P1 PROCESS CONTROL SETPOINT SOURCE

Screen **P1 PR SRC=NULL**
Description PROCESS CONTROL SETPOINT SOURCE
Range REFER FIGURE 9.19
Default Value NULL
Stop to Change YES
Attribute READ ONLY
FUNCTION Defines which input source is used as the setpoint source for process control:

CODE	PROCESS CONTROL SETPOINT SOURCE
NULL	NO SOURCE SELECTED
AIN1	ANALOGUE INPUT 1
AIN2	ANALOGUE INPUT 2
AIN 1+2	ADDITION OF SCALED ANALOGUE INPUTS 1 + 2
FIBRE	FIBRE OPTIC INPUT
LOCAL	LOCAL SETPOINT CONTROL (SCREEN A3)
MREF	MULTI-REFERENCE (SCREENS I7a, M1 TO M7)
MTRPOT	MOTORISED POTENTIOMETER (SCREEN I7a)

4202-221 Rev B

Figure 9.19: Process Control Setpoint Source

SETTING UP Select the desired process control setpoint source to suit your requirements. Refer Figure 3.7.

P2 PROCESS CONTROL FEEDBACK SOURCE

Screen **P2 FB SRC=NULL**
Description PROCESS CONTROL FEEDBACK SOURCE
Range REFER FIGURE 9.20
Default Value NULL
Stop to Change YES
Attribute READ ONLY
FUNCTION Defines which input source is used as the feedback source for process control:

CODE	PROCESS CONTROL FEEDBACK SOURCE
NULL	NO SOURCE SELECTED
AIN1	ANALOGUE INPUT 1
AIN2	ANALOGUE INPUT 2
AIN 1+2	ADDITION OF SCALED ANALOGUE INPUTS 1 + 2
FIBRE	FIBRE OPTIC INPUT

4202-222 Rev B

Figure 9.20: Process Control Feedback Source

SETTING UP Select the desired process control feedback source to suit your requirements. Refer Figure 3.7.

P3, P4, P5 PROCESS CONTROL PID SETTINGS

Screen **P3 Kc= 0.1**
Description CONTROLLER GAIN (Kc)
Range 0.1 TO 10.0
Default Value 0.1
Stop to Change NO
Attribute READ ONLY
FUNCTION Defines the controller gain (Kc) of the process controller.

SETTING UP Select the desired controller gain to suit your requirements.

Screen **P4 Ti= INF**
Description INTEGRATION TIME (Ti)
Range 1s TO 1000s, INF
Default Value INF
Stop to Change NO
Attribute READ ONLY
FUNCTION Defines the integration time of the process controller.

SETTING UP Select the desired integration time to suit your requirements.

Anti-windup protection limits the process controller integrator.

Setting the integration time too small leads to faster error correction but the possibility of overshoot or instability.

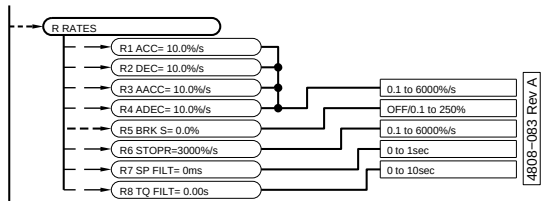
Note: The process controller has a sampling period (Ts) of 100ms.

Screen	**P5 Td= 0.0s**
Description	DIFFERENTIATION TIME (Td)
Range	0.0s TO 250s
Default Value	0.0s
Stop to Change	NO
Attribute	READ ONLY
FUNCTION	Defines the differentation time of the process controller.
SETTING UP	Select the desired differentation time to suit your requirements. Typically left at the default value of 0.0s for pump and HEVAC applications.

Screen	**P6 ERROR = +0.0%**
Description	PROCESS ERROR
Units	%
Attribute	READ ONLY
FUNCTION	Displays the difference between the process reference (screen P1) and the process feedback (screen P2).

SCREEN GROUP R: ACCEL/DECEL RATES

Group Attribute READ ONLY



P5

P6

R1

R2

R1, R2 ACCELERATION AND DECELERATION RATES

Screen	**R1 ACC=10.0%/s**
Description	ACCELERATION RATE
Screen	**R2 DEC= 10.0%/s**
Description	DECELERATION RATE
Range	0.1 TO 6000%/SEC
Units	% OF MOTOR RATED SYNCHRONOUS SPEED PER SECOND
Default Value	10.0%
Stop to Change	NO
FUNCTION	Controls the rates of change of speed (acceleration or deceleration) of the Elite Series.
SETTING UP	These rates will be set according to suitability to a process. In high performance applications it may be desirable to calculate the maximum rates with respect to torque capability of the drive system and motor/load inertia. In some cases it may be desirable to adjust the rate to a very high level and rely on the automatic torque limit function - this will give the fastest response. Generally, use the slowest settings acceptable for your application. An acceleration rate which is too fast may cause the drive to overload (status ILT) and automatically override your setting with a slower one. A deceleration rate which is too fast can cause the motor to regenerate (status VLT) into the drive and automatically override your setting with a slower one. Being realistic with these settings generally leads to a more successful commissioning. Where fast accelerations/decelerations are called for, it is often best to use slower settings initially, until all other operations are proven. Freewheel to stop (instead of controlled deceleration) can be achieved by setting the Stop mode (Screens S2, S4) to spin. Regeneration limit may be used to automatically provide maximum deceleration rate for the given losses of a system as an alternative to fixed deceleration. See Screen L8.
EXAMPLE	For a 4 pole 50Hz motor with rated synchronous speed of 1500rpm; setting 5%/s acceleration rate would accelerate the motor from 0% speed (standstill) to 100% speed (1500rpm) in 20s.

R3, R4, R5 ALTERNATIVE ACCELERATION RATES

R3

Screen **R3 AACC= 10%/s**
Description ALTERNATIVE ACCELERATION RATE

R4

Screen **R4 ADEC= 10%/s**
Description ALTERNATIVE DECELERATION RATE
Range 0.1 TO 6000%/s
Units % OF MOTOR RATED SYNCHRONOUS SPEED PER SECOND
Default Value 10.0
Stop to Change NO

R5

Attribute HIDDEN

Screen **R5 BRK SP= OFF**

R6

Description BREAK SPEED FOR ALTERNATIVE ACCEL/DECEL
Range OFF, 0.1 TO 250%
Units % OF MOTOR RATED SYNCHRONOUS SPEED

R7

Default Value OFF
Stop to Change NO
Attribute HIDDEN

R8

FUNCTION These acceleration and deceleration settings are provided to offer the ability to achieve alternative rates. They may be accessed in two ways:

i) Access by break point -

Screen R5 is used to select a break speed **below** which the alternative rates are active.

ii) Access by utilising alternative acceleration rate multi-function control -

A multi-function input (Option 14, Screens I7c to I7h) via Screen I7a. The acceleration/ deceleration rates which are not currently in use (as controlled by Screen R5) are chosen when the input is active (closed).

SETTING UP Program the desired control (multi-function input selection or break point) as desired. Set the alternative rates to the desired levels.

The break speed for alternative accel/decel (Screen R5) defaults to zero, effectively disabling the alternative rates for normal use.

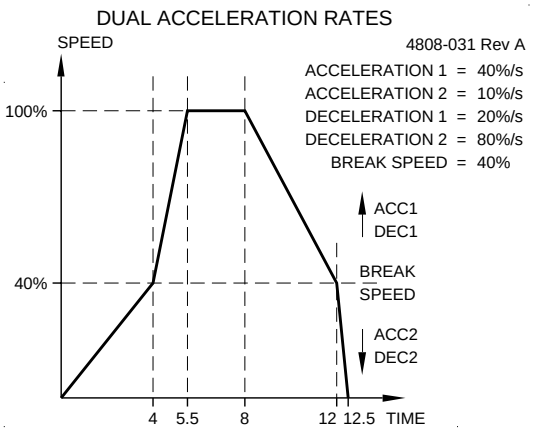


Figure 9.21: Dual Acceleration/Deceleration Rates

R6 STOP DECELERATION RATE

Screen **R6 STOPR= 3000%/s**
Description DECELERATION (STOPPING) RATE USED WHEN STOPPING
Range 0.1 TO 6000%/SEC
Units % OF RATED MOTOR SYCNCHRONOUS SPEED PER SECOND
Default Value 3000
Stop to Change NO

FUNCTION When the Elite Series receives a "stop-rate" command (see Screens S2, S4) this deceleration rate is used.

This provides the ability to separately program running accel/decel rates (e.g., to suit a control system) and a different stop-rate (e.g., to provide a very fast stop for safety reasons).

This function overrides normal and alternative deceleration rates.

SETTING UP If this function is desired, set to the appropriate deceleration rate. Set desired stop mode screen (Screen S2, S4) to STOPR.

R7 SPEED FILTER TIME CONSTANT

Screen **R7 SP FILT=0.0s**
Description SPEED S-CURVE FILTER TIME CONSTANT (used to “soften” acceleration and deceleration)
Range 0 TO 100s
Units second for 100%/s change in acceleration and deceleration
Default Value 0.0s/100%/s
Stop to Change NO

FUNCTION Provide “S-CURVE” filtering to changes in speed reference, including STOP and START commands. The S Curve filter limits the changes of acceleration and deceleration. It is often used to “soften” acceleration and deceleration, especially in hoists and elevators.

Active only in speed control mode. Not active during Stop Rate stop.

SETTING UP Leave set at 0 if not required. Setting at a value other than 0 will affect the unit’s ability to follow a speed profile.

R8 TORQUE FILTER TIME CONSTANT

Screen **R8 TQ FILT=0.00s**
Description TORQUE FILTER TIME CONSTANT
Range 0 TO 10.0 SEC
Units SECONDS
Default Value 0.0 SEC
Stop to Change NO

FUNCTION Provides low-pass filtering to changes in torque reference, including STOP and START commands. This controls the rate of change of output torque.

It is often used to "soften" changes in torque. It is especially useful when changing the sign of the torque. If there is any backlash in the mechanical system it can soften the taking up of the backlash.

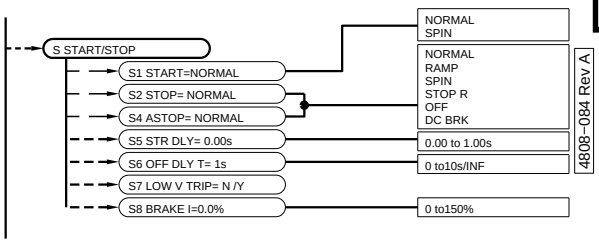
Active only in torque control modes.

SETTING UP Adjust if the shock due to sudden changes in commanded torque exhibit undesirable effects in the mechanical system.
If set for a one second time constant, in response to a 100% torque reference step, 63% of the reference torque will be achieved after a period of one second.

SCREEN GROUP S: START AND STOP MODES

Group Attribute HIDDEN

S1



S1 START MODE

Screen **S1 START= NORMAL**
Range NORMAL/SPIN
Default NORMAL
Stop to change NO

FUNCTION In V/Hz operation this screen provides the option of a special starting mode for motor loads which may be spinning when started (e.g., freewheeling fans).

Problems can occur if a spinning load is started conventionally (i.e., Elite turns on at zero hertz, before accelerating to the set speed) as the load must first be stalled to near zero speed, before being accelerated.

When spin start is selected, the Elite starts at the maximum frequency, instead of zero hertz. If the set speed does not match the spinning speed of the load, an over current situation arises, causing the Microdrive to operate in current limit and reduce its output frequency until the frequency matches the speed of the the load. Once the frequencies match, the current will be reduced and the load will be accelerated normally toward the set point.

Note: When spin starting from the maximum frequency, the direction is set to the same as the reference speed. When the reference speed is 0.0, the spin start will be in the positive direction.

SETTING UP If the Elite will not normally be require to start spinning loads or is operating in Closed Loop vector, set the starting mode to (normal) ramp acceleration.

If starting into spinning loads is a specific requirement of your application, set the starting mode to SPIN. During a spin start, while the Elite is trying to match the output frquency with the motor speed, the output current will be controlled independently of the motor current limit (Screen L9) and the Torque limit timeout (Screen L7). For most reliable starting, set the torque limit timeout to above 0.0s to prevent “Shearpin” tripping once the Elite matches the motor speed.

S2

S4

S5

S6

S2 STOP MODE

Screen **S2 STOP= NORMAL**
Description USUAL STOPPING MODE

S4 ALTERNATIVE STOP MODE

Screen **S4 ASTOP= NORMAL**
Description ALTERNATIVE STOPPING MODE
Range NORMAL/RAMP/SPIN/STOP-RATE/OFF/ DC-BRAKE
Default Value NORMAL
Stop to Change NO

FUNCTION Select the stopping mode to use (see figure 9.22).
The alternative stop mode is used if the MFI input function Alternative Stop-Reset is activated.

SETTING UP Be sure to understand the function which the process needs. Usually the default [Normal] setting will be appropriate. Select other modes to suit the application.

S5 START DELAY TIME

Screen **S5 STR DLY=0.00s**
Description START DELAY TIME
Range 0 TO 1.00 SEC
Units SECONDS
Default Value 0
Stop to Change NO

FUNCTION Sets a period of time following the receipt of a START command before accelerating the motor.

Operates in speed control only. It is intended to provide time for slow release functions to operate (particularly hoist brakes in cranes) before accelerating the motor.

SETTING UP Leave set to zero (default) unless the application specifically requires such a delay.

If required, set the appropriate delay.

S6 OFF DELAY TIME

Screen **S6 OFF DLY T= 1s**
Description OFF DELAY TIME
Range 0 TO 25 SEC AND INFINITE
Units SECONDS
Default Value 1s
Stop to Change NO

FUNCTION Sets the period of time that the Elite Series maintains the magnetising flux in the motor after coming to zero speed when stopping.

It is desirable to maintain the flux if the motor is expected to restart without a delay (the reason for this is that when starting from the "OFF" state flux must first be built up before attempting to accelerate the motor or provide torque. This may take several hundred milliseconds, and such a delay may be undesirable in some situations).

There is a small power loss in maintaining the flux of the motor; thus this function, set to infinite, doubles as an anti-condensation motor heating function.

The delay may also be used in applications to maintain control of the motor at zero speed, until the brake is applied, before turning the motor off.

SETTING UP Leave set to the default setting unless the application requires a special value.

Set to the appropriate time according to your process.

Mode	In Speed Control	In Torque Control
NORMAL	Applies a zero speed reference and decelerate to zero speed	Applies a zero torque reference and coasts to zero speed
RAMP	Same as NORMAL	Transitions to speed control and performs a normal speed controlled stop - i.e., decelerates to zero speed
SPIN	Transitions to torque control and performs a normal torque controlled stop - i.e., coasts to zero speed	Same as NORMAL
STOP-RATE	Same as NORMAL except the special stop deceleration rate (Screen R6) is used	Transistions to speed control and performs a speed controlled stop using the special stop deceleration rate (Screen R6)
OFF	Immediately disables the output - i.e., coasts to zero speed	Immediately disables the output - i.e., coasts to zero speed
DC BRAKE	Applies a DC current as set by screen S8 until the end of the OFF delay time	Applies a DC current as set by screen S8 until the end of the OFF delay time.

4202-171 Rev C

Figure 9.22: Stopping Modes

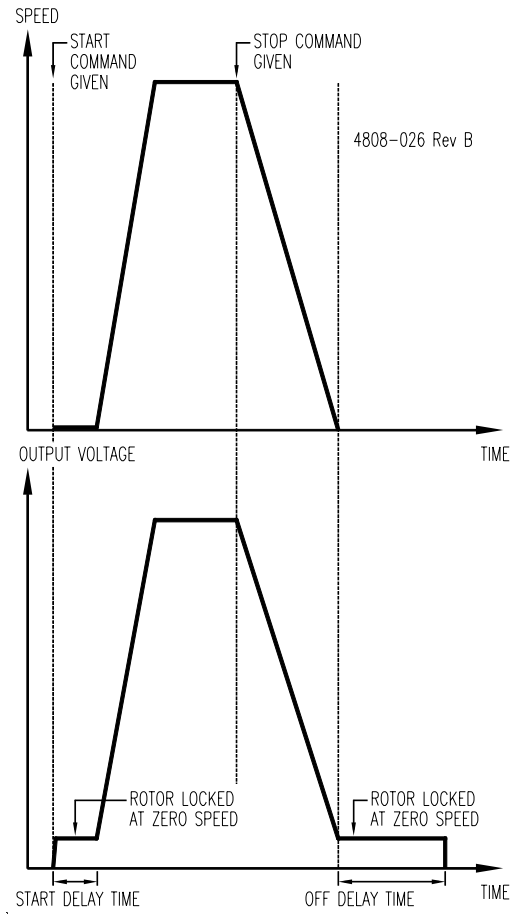


Figure 9.23: Start and Off Delay Times

S7 MAINS POWER LOSS RESPONSE

Screen **S7 LOW V TRIP= N**
Description MAINS POWER LOSS RESPONSE
Options [Y]ES / [N]O
Default Value [N]O
Stop to Change NO

FUNCTION The high voltage (mains supply) power loss function provides an optional response to a power loss situation.

Upon power loss or brown out conditions, the Elite Series continues to operate normally until the energy supplied to the motor load discharges the inverter high voltage DC bus to 250Vdc. At this stage the output power from the inverter is disabled to prevent further energy consumption by the load, but otherwise the Elite Series continues to operate from the remaining energy in the DC bus. Depending on the size of the Elite Series (and hence the energy in its DC bus), the control board can stay active for several seconds during such an event. While in this state (before the DC bus discharges below the switch mode power supply minimum operating voltage and depending upon the setting mode of this screen) the Elite Series is able to restart and continue normal operation when the mains supply returns to normal.

If the high voltage (mains supply) power loss function is set to trip (Y), the Elite Series will trip and register a mains low fault after a two second power loss and require resetting. If the mains returns to normal within two seconds, the Elite Series will restart automatically.

If the high voltage (mains supply) power loss function is set to not trip (N), the Elite Series will stay active as long as there is sufficient DC supply (perhaps several seconds). If the mains returns to normal while the control

board is still active, the Elite Series will restart automatically.

S8

SETTING UP The decision of whether to trip or not is usually based upon questions of the safety of automatically restarting equipment after brief power outages, the ability of associated equipment to continue normal operation and the reliability required of a process.

X1

If required, the Elite Series control board may be powered with a 24Vdc supply. Connection information is given in the Elite Series Getting Started Manual (PDL Part No. 4201-179)

S8 DC BRAKE CURRENT LEVEL

Screen BRAKE I=0%
Range 0 to 150%
Units PERCENT OF MOTOR RATED CURRENT
Default 0
Stop to Change NO

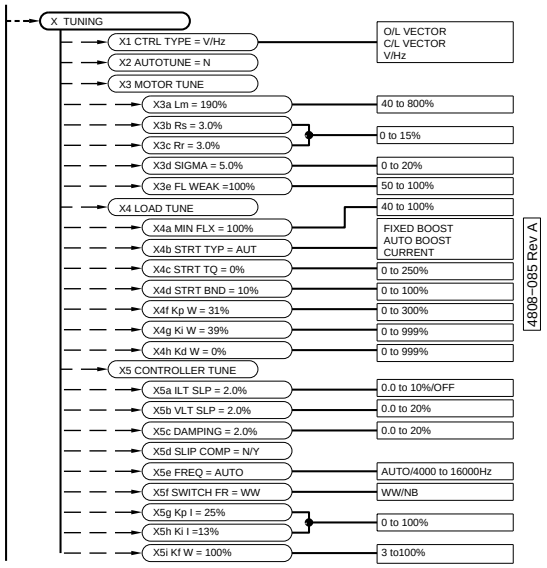
FUNCTION Sets the current level to apply to the motor while DC Braking. This level of current is applied for the OFF DELAY TIME (Screen S6). In closed loop vector mode this current is applied while stopping and during the off delay time.

SETTING UP DC braking is used to stop the motor without regenerating power into the Elite. In some circumstances this allows for faster stopping than regenerative braking. It should be noted that during DC braking the energy of the load is dissipated within the motor and the Elite's motor thermal model does not take this into account.

Adjust current level until the desired braking is achieved.

SCREEN GROUP X: TUNING

Group Attribute HIDDEN



X1 CONTROL TYPE SELECTION

Screen **X1 CTRL TYPE =V/Hz**
Description SELECTION OF OPERATING MODE
Range O/L = OPEN LOOP VECTOR
C/L = CLOSED LOOP VECTOR
V/Hz = V/Hz
Default Value V/Hz
Stop to Change YES

FUNCTION This selection determines the type of operating mode for the Elite Series.

Open Loop Vector:
No external feedback is required to operate in the mode. Commissioning and auto-tuning must be completed before selecting this control type. Selection of the control type Open Loop Vector forces the control mode to Speed Control.

Closed Loop Vector:
This control type requires an incremental encoder to be mounted on the motor to provide direct feedback on actual rotor speed. Commissioning and auto-tuning must be completed before selecting this control type. Closed Loop Vector is used where there are high requirements for speed accuracy or torque control is required.

V/Hz:
No external feedback is required to operate in the mode. Selection the of control type V/Hz forces the control mode to Speed Control.

SETTING UP V/Hz mode is provided for initial commissioning to check the operation of any shaft encoder fitted to the motor and to check motor rotation direction.

Once initial commissioning is complete,select Closed Loop Vector, Open Loop Vector or V/Hz as required.

V/Hz mode **must** also be employed when

multiple motors are connected to the Elite Series output.

X2 AUTOTUNE MODE SELECTION

Screen **X2 AUTOTUNE= N**
Description AUTOTUNES MOTOR
Range NO/YES
Default Value None
Stop to Change YES

FUNCTION The motor must be correctly characterised for good dynamic performance. This can be done automatically by the Elite Series.

Autotuning will automatically set optimum values for the following parameters (without turning the motor):

X3a Lm	Motor Main Inductance
X3b Rs	Stator Resistance
X3c Rr	Rotor Resistance

The motor must be stopped for Autotuning to function correctly.

WARNING: Autotuning applies voltage to the terminals of the motor. Check that all personnel are clear of the motor and attached machinery, and that it is safe to operate the motor.

SETTING UP Ensure that LOCAL control is enabled (Screen I7a = 00 DISABLED) before autotuning the motor.

Screen X2 selects AUTOTUNE options, as follows:

X2 AUTOTUNE = NO
Autotuning not active

AUTOTUNE = YES
This tunes the motor without moving the motor.

Autotuning may take several seconds to complete.

Refer to Section 3 of the Elite Series Getting Started Manual, Part No. 4201-179 for details on preliminary commissioning.

SUBGROUP X3: MOTOR TUNING

X3a-X3d MOTOR IMPEDANCES

Screen **X3a Lm= 190%**
Description MAIN INDUCTANCE
Range 40 TO 800%
Units PERCENTAGE OF RATED IMPEDANCE
Default Value 190
Stop to Change NO

FUNCTION The main inductance of the motor which defines the magnetising current. This is a key parameter directly affecting motor fluxing.

SETTING UP This parameter is self-adjusting and should set itself up under autotuning (Screen X2). Typical values range from 75% (for small motors) to 800% for large motors.

The correctness of the setting may be gauged by first ensuring that the Elite Series is operating in full vector control (speed control) mode. Now operate the motor at no load at some defined speed (e.g., 50%) and check that the output voltage (Screen A8) matches the percentage speed (i.e., approximately 50% of rated voltage in this case).

If the voltage does not match, adjust the main inductance value up (will decrease voltage) or down (will increase voltage).

Screen **X3b Rs= 3.0%**
Description STATOR RESISTANCE
Range 0 TO 15.0%
Units PERCENTAGE OF RATED IMPEDANCE
Default Value 3%
Stop to Change NO

FUNCTION The stator resistance represented as a percentage of rated impedance.

SETTING UP This parameter is self-adjusting and should set itself up under the autotuning feature (Screen X2).

Usually the stator resistance varies approximately between half to twice the rotor resistance (see Screen X3c Rr).

Screen **X3c Rr= 6.0%**
Description ROTOR RESISTANCE
Range 0 TO 15.0%
Units PERCENTAGE OF RATED IMPEDANCE
Default Value 6.0
Stop to Change NO

FUNCTION Sets rotor resistance of the motor. This is a key parameter directly affecting output torque.

SETTING UP This parameter is self-adjusting and should set itself up under autotuning (Screen X2). The parameter should set itself to approximately the rated slip of the motor - i.e.,

$$\text{Slip} = 100 \times \frac{\text{Syncspeed} - \text{Ratedspeed}}{\text{Syncspeed \%}}$$

The setting should change dynamically with changing motor temperature. The accuracy of this setting may be checked by observing output voltage variation during a step load change. If the voltage dips upon a small increase in load, Rr is set too high. If the voltage overshoots, Rr is set too low. If set correctly, the voltage should not change significantly. This setting should be checked when the motor is at its normal operating temperature.

Screen **X3d SIGMA = 6.0%**
Description TOTAL LEAKAGE
Range 0 to 20%
Units PERCENTAGE OF RATED IMPEDANCE
Default Value 6.0
Stop to Change NO

FUNCTION The total leakage inductance represented as a percentage of main inductance.

SETTING UP This parameter is not usually adjusted by the user.

X3e

X4a

X4b

X3e FIELD WEAKENING POINT

Screen **X3e FLD WEAK=100%**
Description FIELD WEAKENING POINT
Range 50 TO 100%
Units PERCENT OF AVAILABLE VOLTAGE
Default Value 100
Stop to Change NO

FUNCTION May be used to force the Elite Series to enter the field weakening region at less than the maximum potential voltage. The advantages of this is that it then leaves some voltage available to maintain full vector control - i.e., response in the field weakening region is improved.

The disadvantage is that since full voltage is not available, rated power cannot be achieved. If left at 100%, full voltage is applied to the motor and in the field weakening region vector control transitions to slip control. Torque response is slower in, and during exit of, this region.

SETTING UP If highly dynamic performance is not required (near maximum output voltage of the Elite Series), leave set to 100%. Otherwise set to approximately 90%. Note that the achievable motor power will be reduced in proportion.

SUBGROUP X4: LOAD TUNING

Screen **X4a MIN. FLX=100%**
Description DYNAFLUX MINIMUM FLUX LEVEL
Range 40% TO 100%
Default 100%

FUNCTION Sets the minimum flux level that the motor will be operated at under reduced load conditions.

The Elite incorporates the Dynaflux (dynamic flux) automatic motor flux optimising system. This system, is particularly useful for reducing noise and power loss by automatically reducing motor flux levels (and so losses and noise), in reduced load situations.

SETTING UP If the flux reducing feature is not required, leave set at 100% (factory set value). Dynaflux only operates in V/Hz control mode.

Dynaflux is best suited for slowly varying loads (e.g., pump and fan). This is due to the possibility of motor stall, upon a rapid load increase at a time when there is insufficient fluxing.

For fan and pump (or similar) loads, set to the lowest value, consistent with reliable operation. Usually 40% will be suitable.

Using a value which is too low can lead to instability or surging. If this occurs, increase the minimum flux level.

Selecting intermediate levels of minimum fluxing caters for more dynamic loads with reduced amounts of Dynaflux action.

Set the minimum flux level to 100% for highly dynamic loads (e.g., servos and cranes).

Screen **X4b STR TYPE=AUTO**
Description STARTING BOOST TYPE
Options FIX/AUTO/CUR
Stop to Change YES

FUNCTION Provides compensation to start difficult loads. Under V/Hz control a compensating boost may be applied to the motor in order to obtain full torque at low frequency. This screen permits configuration for Automatic Voltage Boost [AUTO], Fixed Voltage Boost [FIX], or Current Controlled Boost [CUR].

SETTING UP The Start Boost Type provides three different starting torque profiles – the most suitable of which depends on the application.

Automatic Voltage Boost
For normal single motor operation, the automatic voltage boost [AUTO] provides the best performance. In this mode the boost level is automatically adjusted according to the load conditions. Automatic voltage boost does not operate at zero frequency, therefore applications which are required to produce torque at zero frequency (e.g., hoists) must have the Start Boost Type set to [FIX] or [CUR].

Fixed Voltage Boost
This starting boost type may be used with simple non-varying loads. However, for multiple motor operation, fixed voltage boost [FIX] must be selected to provide reliable starting.

Current Controlled Boost
Current controlled boost [CUR] should be used for high stiction loads that are unable to be started using the voltage boost modes [AUTO], [FIX]. This mode allows the starting profile to be tuned using Screens X4c and X4d, where the boost level and the region it operates over are defined.

NOTES Screen X4c defines the level of boost that will be applied and must be set to a level appropriate to the motor being used.

Screen **X4c STR TQ =0%**
Description STARTING TORQUE (BOOST) ADJUSTMENT
Range 0 TO 250%
Default Value 0%
Stop to Change NO

FUNCTION Provides improved low speed torque performance when an encoder is not used, i.e., in Open Loop Vector or V/Hz modes (refer to Screen X1).

SETTING UP This screen has different setting up procedures depending on the control mode (Screen X1) and the starting boost type (Screen X4b) selected.

V/Hz – Automatic and Fixed Voltage Boost
When the control mode is set to V/Hz (refer Screen X1) and a form of voltage boost type is being used (refer Screen X4b), adjustment should be made until sufficient starting torque is developed to start the load. If the load is such that the adjustment levels required starting the load causes the Elite Series to enter a current limiting protection state, then selecting Screen X4b [CUR] is recommended.

V/Hz – Current Controlled Boost
When the control mode is set to V/Hz (refer

Screen X1) and current controlled boost is being used (refer Screen X4b), adjust the Starting Torque level so that the load starts and smoothly accelerates. High levels of adjustment may require the Torque Limit screens (Screens L4 and L5) and Current Limit screen (Screen L9) to be adjusted. The Starting Torque Screen (Screen X4c) should be used in conjunction with the Starting Band adjustment screen (Screen X4d) to provide the desired starting torque profile. Levels far in excess of that required by the load should be avoided, as this will cause increased heating of the motor.

Open Loop Vector
When the control mode is set to Open Loop Vector mode (refer Screen X1), set this screen to the desired starting torque level.

Closed Loop Vector
The starting torque adjustment is not used in closed loop vector mode (refer Screen X1).

Screen **X4d STR BAND=0%**
Description STARTING (BOOST) BAND ADJUSTMENT
Range 0 TO 99% OF RATED (NAMEPLATE) MOTOR FREQUENCY
Default Value 0%
Stop to Change NO

FUNCTION Provides speed related profiling of the starting torque for the current controlled starting type (Screen X4b STR TYPE=CUR).

SETTING UP Adjust the Starting Band to define the region (from zero speed) where the current controlled starting torque is required. When the output speed exceeds this band the boost level will be automatically adjusted to a reduced level to minimise the heating effects of possible high levels set by Screen X4c.

Loads that are characterised by high stiction but relatively low inertia will usually only require a small starting band. High inertia loads may require prolonged Current Controlled Boost to ensure smooth acceleration of the load.

It is recommended that the minimum band adjustment necessary to start and accelerate the load be used to avoid undue heating of the motor

NOTES If this band is set to the default 0% then the starting torque level set by Screen X4c will not have its full effect.

X4f, X4g, X4h ROTOR SPEED PID LOOP GAINS

Screen **X4f Kp w= 20%**
Description ROTOR SPEED PID LOOP PROPORTIONAL GAIN
Range 0 to 300%
Default Value 20%
Stop to Change NO

FUNCTION The proportional gain of the rotor speed PID controller.

Affects the response, stiffness and damping of the speed loop.

SETTING UP The default value is a low, conservative setting. While this may not give the fastest speed response, it will generally be stable. Only adjust this value if setting up for a high performance application.

When the system inertia is low, typical maximum values range from 30% (small motors) to 35% (large motors).

Where significantly higher inertia are present, the gain may be increased.

Gain settings which are too high may cause rapid oscillation of the motor shaft.

Screen **X4g Ki w= 30%**
Description ROTOR SPEED PID LOOP INTEGRAL GAIN
Range 0 TO 999%
Default Value 30%
Stop to Change NO

FUNCTION The integral gain of the rotor speed holding PID controller. Affects the long term speed hold accuracy of the speed control loop.

SETTING UP The default value is a fairly conservative (over damped) gain, generally assuring stability, but at the penalty of slowed response.

A typical maximum value is 50% when the motor has a low attached inertia. With higher inertia, the integral gain may need to be reduced, although increasing the proportional term may retain stability.

Gain Settings which are too high may cause rapid oscillation of the motor shaft.

Screen **X4h Kd w= 0%**
Description ROTOR SPEED PID LOOP DERIVATIVE GAIN
Range 0 TO 999%
Default Value 0%
Stop to Change NO

FUNCTION The derivative gain of the rotor PID controller. May improve damping of the PID loop in some cases.

SETTING UP Rarely used. Usually left set to default (zero).

SUBGROUP X5: CONTROLLER TUNING

Screen **X5a ILT SLIP=2.0%**
Description CURRENT LIMIT SLIP VALUE
Range 0.0% TO 10%, OFF
Default Value 2%(dependant on Elite Series model)

FUNCTION To actively reduce the Elite frequency or acceleration to maintain load current within controllable bounds (status=ILT).

SETTING UP Do not adjust this unless current limit action is unstable. Nominally this value should be set to the rated percent slip of the motor. To improve stability of current limit use a lower figure (the penalty against this is that predictive current limit action will occur at an earlier stage, more severely limiting acceleration rates and possibly intruding more into the normal area of operation).

Screen **X5b VLT SLIP=2.0%**
Description VOLTAGE LIMIT SLIP
Range 0.0% TO 20%

Default Value 2%(dependant on Elite Series model)

FUNCTION If a motor is overdriven (e.g., by decelerating its attached load too fast) it will regenerate

into the Elite. Too much regeneration will cause the Elite to take evasive action ("voltage limiting") by reducing the deceleration rate as regeneration occurs.

X5b

The voltage limit slip setting is an adjustment which is used to enhance the stability of voltage limiting control.

X5c

SETTING UP Do not adjust this setting unless voltage limiting is unstable. Nominally this value should be set to the rated percent slop of the motor. To improve stability of voltage limit use a lower value. The penalty against this is that voltage limiting will occur at an earlier stage, thus affecting deceleration more.

X5d

The speed filter setting (Screen R7) may also be used to improve satiability during voltage limiting.

X5e

Screen **X5c DAMPING=2.0%**

X5f

Description NO LOAD DAMPING
Range 0% TO 20%
Default Value 2%(dependant on Elite Series model)

X5g

FUNCTION Some motors may become unstable and appear to surge when operated at light load and at certain speeds. The damping term may be introduced to eliminate this tendency.

X5h

SETTING UP Do not adjust this value unless light load stability problems exist.

X5i

Increase setting to improve stability. Increasing the setting too far may induce instability.

No load damping introduces very small output frequency variations (typically <0.1 Hz). If absolute fixed output frequency is a specific requirement of your application, set to 0.0%

Screen **X5d SLIP COMP = N/Y**

Description ENABLE SLIP COMPENSATION
Default Value NO COMPENSATION

FUNCTION Changes the output frequency based on the load current to compensate for the slip of the motor.

SETTING UP If Speed regulation under varying load is required in V/Hz control mode - turn on.

X5e, X5f MODULATION

Screen **X5e FREQ = AUTO**

Description MODULATION FREQUENCY
Options AUTO/4000-16000
Units HERTZ
Default Value AUTO
Stop to Change NO

FUNCTION Alters the output frequency to the motor. May be used to avoid mechanical noise within the motor. AUTO allows the Elite's thermal management system to optimise the switching frequency to maintain reliable operation.

Note: Maximum frequency on the Elite Series greater than 22.5 Amps is limited to 10000Hz.

Screen **X5f SWITCH FR =WW**

Description MODULATION TYPE
Options [WW] WHISPER WAVE
[NB] NARROW BAND
Units HERTZ
Default Value WW
Stop to Change NO

FUNCTION Alters the type of noise produced by the motor. Narrow band produces a conventional fixed frequency noise spectrum. Whisper Wave is a special mode which distributes the noise over a wider frequency range. The noise produced in Whisper Wave mode is usually found to be less annoying and easier to mask.

SETTING UP To allow for direct comparison of the motor acoustic noise level, this mode may be switched while the Elite Series is running. Choose the option that you find most suitable.

Whisper Wave or Narrow Band should be selected to minimise the audible noise.

X5g, X5h CURRENT CONTROL LOOP GAIN

Screen **X5g Kp I= 25%**

Description CURRENT PI LOOP PROPORTIONAL GAIN
Range 0 TO 100%
Default Value 25%
Stop to Change NO

FUNCTION Proportional gain of the current control loop internal to the flux vector controller.

SETTING UP This parameter is not usually adjusted by the user.

Screen **X5h Ki I= 13%**

Description CURRENT PI LOOP INTEGRAL GAIN
Range 0 TO 100%
Default Value 13%
Stop to Change NO

FUNCTION Integral gain of the current control loop internal to the flux vector controller.

SETTING UP This parameter is not usually adjusted by the user.

Screen **X5i Kf w= 50%**

Description ROTOR SPEED FILTER CONSTANT
Range 3 to 100%
Default Value 50%
Stop to Change NO

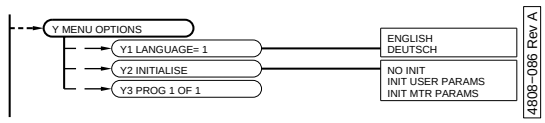
FUNCTION A filter gain in the rotor speed feedback. Can improve stability if the encoder coupling to the motor is not completely direct, or not perfect (e.g., due to any degree of backlash or elasticity in the coupling).

Note: The filter time constant in msec is 100/Kfw

SETTING UP Usually left set to 50%. Decrease Kf w to increase effect of filter.

SCREEN GROUP Y: MENU OPTIONS

Group Attribute HIDDEN



Screen **Y1 LANGUAGE= 1**

Description SELECTS LANGUAGE OF SCREEN LIST
Range 1 = ENGLISH
2 = DEUTSCH
Default ENGLISH
Stop to Change NO
Attribute READ-WRITE

FUNCTION Determines the language displayed by the Elite Series

SETTING UP Choose the required language. Further languages will be available on an "as required" basis.

Screen **Y2 INITIALISE**

Description SELECTS LEVEL OF INITIALISATION OF PARAMETERS AND MODES
Range REFER FIGURE 9.24
Attribute HIDDEN

DISPLAY	DESCRIPTION
NO	Not initialising
INIT USER SETTINGS	Initialises all user settings with the exception of the motor parameters (Screens N1 to N6, X3 to X5)
INIT MOTOR PARAMS	Initialises all motor parameters (Screens N1 to N6, X3 to X5)

4202-158 Rev F

Figure 9.24: Initialisation Levels

FUNCTION This screen allows for the initialisation of parameters (setting to default values) to the desired level.

If you want to retain settings for re-entry after initialisation, record these settings first, (e.g., on the appropriate Commissioning Configuration Record at the end of this manual).

Initialisation of motor parameters enters zero values on the N screens. The Elite Series will trip on a PARAMETER NOT SET fault. New values must be entered before the Elite Series can be operated.

SETTING UP Select the required level and release the keys. The display will show INITIALISING... while doing so, and returns to NO when completed.

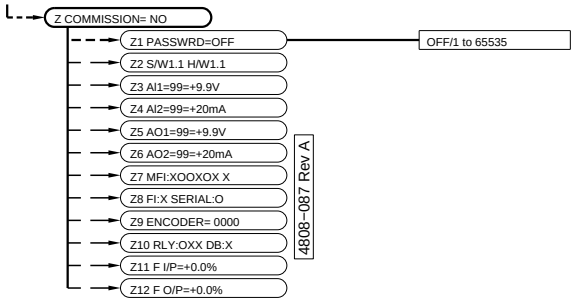
Screen **Y3 VISTA PROGRAM**

Description SELECTS PROGRAM TO USE
Default 1
Stop to Change YES
Attribute READ ONLY

FUNCTION Determines the Control program that is running. See Section 8.

SCREEN GROUP Z: COMMISSIONING SCREENS

Group Attribute READ–WRITE



Z Commissioning Mode

SCREEN **Z COMMISSION=NO**

Description COMMISSIONING MODE
Range YES or NO
Default Value NO
Stop to Change NO
Attribute Read only (if password is set)
Read-Write (if password is not set).

FUNCTION Commissioning mode is a special mode that allows the commissioning engineer to modify commissioning data.

SETTING UP Set to YES to enter commissioning mode.

The commissioning mode is normally protected with a password set from Screen Z1. This prevents unauthorised modification to commissioning data.

Once the commissioning data has been entered (and a password set if required), this screen should be set to NO.

Setting to COMMISSIONING mode before a Password has been set:

Scroll to Main Screen Z.
Z COMMISSION=N

Press "∗" and "+" or "–". The control line should change to:
Z COMMISSION=Y

All screens will now be visible, and all parameters are adjustable.

Selecting COMMISSIONING mode after a Password has been set:

Scroll to Main Screen Z. The display's control (bottom) line will read:
Z COMMISSION=N

Press "∗" and "+" or "–". The screen will automatically display:
PASSWORD=ZZZZZ

Where the number shown as "ZZZZZ" is a special hashing number and is required for lost passwords. Refer to the description of Screen Z1.

Now press "∗" and "+" or "–" until the correct password is reached. Then release the keys.

The display's control (bottom) line will now read:
Z COMMISSION=Y

All screens will now be visible, and all parameters be adjustable.

Selecting OPERATION Mode:
To change back from COMMISSIONING Mode to OPERATION Mode, scroll to Screen Group Z.

Z1

The display's control line will read:
Z COMMISSION=Y

Z2

Use "∗" and "+" or "–" to toggle to :
Z COMMISSION=N

Z3

Z1 Commissioning Mode Password

Z4

Screen **Z1 PASSWORD=OFF**
Description COMMISSIONING MODE PASSWORD
Range OFF, 1 to 65535
Stop to Change NO
Attribute HIDDEN

Z5

FUNCTION Allows the commissioning engineer to set a password to protect against unauthorised modification of commissioning parameters.

SETTING UP Once set to COMMISSIONING mode as described above, a password may be set up. Unfold Screen Group Z and scroll to Screen Z1. The display will read:

Z1 PASSWORD= OFF.

Press "∗" and "+" or "–" to set the required password.

What happens if a password is unknown or forgotten?

Once a password has been entered, a special hashing number is displayed on Screen Z when trying to enter COMMISSIONING mode.

The display will read:

Z PASSWORD= ZZZZZ

Take a note of this number and contact a PDL Electronics Applications Engineer, who with suitable authority will be able to pass this code through an algorithm to reconstruct the original password.

Z2 SOFTWARE AND HARDWARE REVISIONS

Screen **Z2 S/W1.1 H/W1.1**
Description SOFTWARE AND HARDWARE REVISION NUMBERS
Attribute READ ONLY
FUNCTION Shows the revision number (X.X) of the software and hardware currently fitted to the Elite Series.

Z3 ANALOGUE INPUT 1 STATUS

Screen **Z3 AI1=99=+9.9V**
Z3 AI1=99=+20mA
Description STATUS OF ANALOGUE INPUT 1
Range 00 TO 99;
–10V TO +10V or 0 TO 20mA
Attribute Read Only

Screen **Z3 AI1=99=+9.9V**
Z3 AI1=99=+20mA

Reference **0 1 2**
Reference 0: Screen number Z3
Reference 1: Status of Analogue Input 1 (Terminal T26)
00 to 99% of the input range

For ±10V input, -10V = 00, +10V = 99
For 0-10V input, 0V = 00, +10V = 99
For 4-20mA input, 4mA = 00, 20mA = 99
For 0-20mA input, 0mA = 00; 20mA = 99

Reference 2: Status of Analogue Input 1 (Terminal T26)

For Voltage inputs, -10V to +10V
For Current inputs, 0mA to 20mA

Z4 ANALOGUE INPUT 2 STATUS

Screen **Z4 AI2=99=+9.9V**
Z4 AI2=99=+20mA
Description STATUS OF ANALOGUE INPUT 2
Range 00 TO 99;
–10V TO +10V or 0 TO 20mA
Attribute Read Only

Screen **Z4 AI2=99=+9.9V**
Z4 AI2=99=+20mA

Reference **0 1 2**
Reference 0: Screen number Z4
Reference 1: Status of Analogue Input 2 (Terminal T27)
00 to 99% of the input range

For ±10V input, -10V = 00, +10V = 99
For 0-10V input, 0V = 00, +10V = 99
For 4-20mA input, 4mA = 00, 20mA = 99
For 0-20mA input, 0mA = 00; 20mA = 99

Reference 2: Status of Analogue Input 2 (Terminal T27)

For ±10V input, -10V to +10V
For 0-10V input, 0V to +10V
For 4-20mA input, 4mA to 20mA
For 0-20mA input, 0mA to 20mA

Z5 ANALOGUE OUTPUT 1 STATUS

Screen **Z5 AO1=99=+9.9V**
Z5 AO1=99=+20mA
Description STATUS OF ANALOGUE OUTPUT 1
Range 00 TO 99;
–10V TO +10V or 0 TO 20mA
Attribute Read Only

Screen **Z5 AO1=99=+9.9V**
Z5 AO1=99=+20mA

Reference **0 1 2**
Reference 0: Screen number Z5
Reference 1: Status of Analogue Output 1 (Terminal T23)
00 to 99% of the input range

For ±10V output, -10V = 00, +10V = 99
For 0-10V output, 0V = 00, +10V = 99
For 4-20mA output, 4mA = 00, 20mA = 99
For 0-20mA output, 0mA = 00; 20mA = 99

Reference 2: Status of Analogue Output 1 (Terminal T23)

For ±10V output,	-10V	to	+10V
For 0-10V output,	0V	to	+10V
For 4-20mA output,	4mA	to	20mA
For 0-20mA output,	0mA	to	20mA

Z6 ANALOGUE OUTPUT 2 STATUS

Screen **Z6 AO2=99=+9.9V**
Z6 AO2=99=+20mA

Description STATUS OF ANALOGUE OUTPUT 2
Range 00 TO 99;
–10V TO +10V or 0 TO 20mA
Attribute Read Only

Screen **Z6 AO2=99=+9.9V**
Z6 AO2=99=+20mA

Reference **0 1 2**
Reference 0: Screen number Z6
Reference 1: Status of Analogue Output 2 (Terminal T24)
00 to 99% of the input range

For ±10V output,	-10V = 00,		+10V = 99
For 0-10V output,	0V = 00,		+10V = 99
For 4-20mA output,	4mA = 00,		20mA = 99
For 0-20mA output,	0mA = 00;		20mA = 99

Reference 2: Status of Analogue Output 2 (Terminal T24)

For ±10V output,	-10V	to	+10V
For 0-10V output,	0V	to	+10V
For 4-20mA output,	4mA	to	20mA
For 0-20mA output,	0mA	to	20mA

Z7 MULTIFUNCTION INPUT STATUS

Screen **Z7 MFI:000000 X**
Description STATUS OF MULTI-FUNCTION INPUTS
Range O (OPEN) or X (CLOSED)
Attribute Read Only
Screen **Z7 MFI:000000 X**
Reference **0 123456 7**
Reference 0: Screen number Z7
Reference 1: Status of Digital Input 1 (Terminal T13)
O - Open
X - Closed
Reference 2: Status of Digital Input 2 (Terminal T14)
O - Open
X - Closed
Reference 3: Status of Digital Input 3 (Terminal T15)
O - Open
X - Closed
Reference 4: Status of Digital Input 4 (Terminal T16)
O - Open
X - Closed
Reference 5: Status of Digital Input 5 (Terminal T17)
O - Open
X - Closed
Reference 6: Status of Digital Input 6 (Terminal T18)
O - Open
X - Closed
Reference 7: Status of External Trip Input (Terminal T19)
O - Open
X - Closed

Note 1: Multi-function inputs - O or X represent only a Open (circuit not connected to the common) or a Closed (circuit connected to the common) respectively.

Z8 FIBRE OPTIC INPUT STATUS; SERIAL INPUT STATUS

Screen **Z8 FI:O SERIAL:O**
Description STATUS OF FIBRE OPTIC INPUT;
STATUS OF SERIAL INPUT
Range O (OPEN) or X (CLOSED);
O (OPEN) or X (CLOSED);
Attribute Read Only

Screen **Z8 FI:O SERIAL:O**
Reference **0 1 2**
Reference 0: Screen number Z8
Reference 1: Status of Fibre Optic Input
O (Open)
X (Closed)
Reference 2: Status of Serial Input
O (Open)
X (Closed)

Note 1 A Closed (X) status indicates that a valid fibre optic data packet has been received since the last screen update. An Open (O) status indicates that no valid data packet has been received since the last screen update.

Note 2 A Closed (X) status indicates that a valid serial communication data packet has been received since the last screen update. An Open (O) status indicates that no valid data packet has been received since the last screen update.

Z9 ENCODER COUNT

Screen **Z9 ENCODER=0000**
Description ENCODER COUNT
Range 0 to 16383

FUNCTION Encoder counter; displays the number of edges counted by the incremental encoder input terminals (Terminals T31 to T34). Increasing count should correspond with forward rotation (see Section 4.2 and Screen N8 for more information).

EXAMPLE For a 2000 ppr encoder, this status screen should increase by 2000 counts for a 360° rotation of the motor shaft.

Z10 OUTPUT RELAY STATUS; DYNAMIC BRAKE OUTPUT STATUS

Z10

Z11

Z12

Screen **Z10 RLY:XXX DB:X**

Description STATUS OF OUTPUT RELAYS;
STATUS OF DYNAMIC BRAKE OUTPUT

Range O (OPEN) or X (CLOSED);
O (OPEN) or X (CLOSED);

Attribute Read Only

Screen **Z10 RLY:XXX DB:X**

Reference **0 123 4**

Reference 0: Screen number Z10

Reference 1: Status of Output Relay 1 (Terminals T1/T2)
O (Open)
X (Closed)

Reference 2: Status of Output Relay 2 (Terminals T4/T5)
O (Open)
X (Closed)

Reference 3: Status of Output Relay 3 (Terminals T6/T7)
O (Open)
X (Closed)

Reference 4: Status of Dynamic Brake (DB) Output
O (Open)
X (Closed)

Note 1 RLY1 is normally open on Terminals (T1/T2)
RLY1 is normally closed on Terminals (T2/T3)
RLY2 is normally open on Terminals (T4/T5)
RLY3 is normally open on Terminals (T6/T7)

The status of the change-over relay (RLY1) on the normally closed terminals (Terminals T2/T3) is the inverse of reference 1.

Note 2 A Closed (X) status indicates that the Dynamic Brake (DB) output has been closed in the interval since the last screen update. An Open (O) status indicates that the Dynamic Brake (DB) output has not been closed in the interval since the last screen update.

Z11, Z12 FIBRE OPTIC INPUT AND OUTPUT STATUS

Screen **Z11 F I/P=+100%**

Description FIBRE OPTIC INPUT STATUS

Range -250% to +250%

Attribute Read Only

FUNCTION Indicates the level of the data on the fibre optic input port.

The status indicates the magnitude and sign of the data packet being received by the Elite Series fibre optic input port.

Screen **Z12 F O/P=+100%**

Description FIBRE OPTIC OUTPUT STATUS

Range -250% to +250%

Attribute Read Only

FUNCTION Indicates the level of the data on the fibre optic output port.

The status indicates the magnitude and sign of the data packet being sent by the Elite Series fibre optic output port.

Refer to Screen Z8 for an indication of fibre optic input errors.

COMMISSIONING CONFIGURATION RECORD — SCREENS

DRIVE NO: _____ MODEL: _____

LOCATION: _____

MOTOR kW: _____ A: _____ V: _____

POLES: _____ RPM: _____

	RECORD 1	RECORD 2
DATE:	__/__/__	__/__/__
BY:	_____	_____

SCREEN		UNIT	DATE	DATE
KEYBOARD CONTROLS				
A1	LOCAL MODE=SP		———	———
A2	LOCAL TQ=+0.0%	%	———	———
A3	LOCAL SP=+100.0%	%	———	———
COMPARATOR CONTROLS				
C1	COMP1 SEL=02		———	———
C2	COMP1 ON =+100%	%	———	———
C3	COMP1 OFF=+90%	%	———	———
C4	COMP2 SEL=02		———	———
C5	COMP2 ON =+100%	%	———	———
C6	COMP2 OFF=+90%	%	———	———
DYNAMIC BRAKE CONTROLS				
D1	DB TIME=0s	SEC	———	———
D2	DB DUTY=OFF	%	———	———
SERIAL COMMUNICATIONS CONTROLS				
H1	PROTOCOL		———	———
H2	COMS T/O=OFF	SEC	———	———
H3a	COMMS ADR=10		———	———
H3b	BAUDRATE=9600		———	———
H4a	MAC ID=63		———	———
H4b	BAUDRATE=125kps		———	———
H4c	ASM IN=70		———	———
H4d	ASM OUT=20		———	———
H4e	CTRL SRC=00		———	———
H4f	REF SRC=00		———	———
INPUT CONTROLS				
I1	LOCAL S/STP=NONE		———	———
I2	REF S=LOCAL		———	———
I3	REF T=NULL		———	———
I4	AREF S=LOCAL		———	———
I5	AREF T=NULL		———	———
I6a	AI1=0-10V		———	———

SCREEN		UNIT	DATE	DATE
I6b	AI1 LO=-100%	%	———	———
I6c	AI1 HI=+100%	%	———	———
I6d	AI2=0-10V		———	———
I6e	AI2 LO= –100%	%	———	———
I6f	AI2 HI=+100%	%	———	———
I6g	ZERO BAND=Y/N		———	———
I7a	I/P MODE=0		———	———
I7b	POLARITY=Hi		———	———
I7c	MFI1 SEL=00		———	———
I7d	MFI2 SEL=00		———	———
I7e	MFI3 SEL=00		———	———
I7f	MFI4 SEL=00		———	———
I7g	MFI5 SEL=00		———	———
I7h	MFI6 SEL=00		———	———
I8a	F LO =-100%	%	———	———
I8b	F HI = +100%	%	———	———
I8c	FIBRE MODE		———	———
L LIMITS				
L2	MIN S=-110%	%	———	———
L3	MAX S=+110%	%	———	———
L4	MIN T=-150%	%	———	———
L5	MAX T=+150%	%	———	———
L6	SP T/O=INF		———	———
L7	TQ T/O=INF		———	———
L8	REGEN=150%	%	———	———
L9	I LIMIT=AMPS		———	———
L10	SKIP1=+0.0%	%	———	———
L11	SKIP2=+0.0%	%	———	———
L12	SK BW=0.0%	%	———	———
MULTI-REFERENCE				
M1	MREF1=+0.00%	%	———	———
M2	MREF2=+0.00%	%	———	———
M3	MREF3=+0.00%	%	———	———
M4	MREF4=+0.00%	%	———	———
M5	MREF5=+0.00%	%	———	———
M6	MREF6=+0.00%	%	———	———
M7	MREF7=+0.00%	%	———	———
MOTOR NAMEPLATE PARAMETERS				
N1	MTR CUR	AMP	———	———
N2	MTR VOLT=400V	VOLT	———	———

COMMISSIONING CONFIGURATION RECORD — SCREENS

SCREEN		UNIT	DATE	DATE
N3	MTR FRQ=50Hz	Hz	———	———
N4	MTR PWR	kW	———	———
N5	MTR RPM	RPM	———	———
N6	MTR COOL=40%	%	———	———
N8	ENCODER=1000		———	———
N9	ENC I/P=DIFF		———	———
OUTPUT SIGNALS				
O1a	AO1 O/P=06		———	———
O1b	AO1=0-10V		———	———
O1c	AO1 LO= –100%	%	———	———
O1d	AO1 HI=+100%	%	———	———
O1e	AO2 O/P=02		———	———
O1f	AO2=0-10V		———	———
O1g	AO2 LO= –100%		———	———
O1h	AO2 HI=+100%	%	———	———
O2a	RELAY1=02		———	———
O2b	RELAY1 INV=N		———	———
O2c	RELAY2=05		———	———
O2d	RELAY2 INV=N		———	———
O2e	RELAY3=08		———	———
O2f	RELAY3 INV=N		———	———
O3a	FIBRE O/P=06		———	———
PROCESS				
P1	PR SRC		———	———
P2	FB SRC		———	———
P3	Kc = 0.1		———	———
P4	Ti = INF	SEC	———	———
P5	Td = 0.0s	SEC	———	———
ACCELERATION RATES				
R1	ACC=10.0%/s	%/SEC	———	———
R2	DEC=10.0%/s	%/SEC	———	———
R3	AACC=10.0%/s	%/SEC	———	———
R4	ADEC=10.0%/s	%/SEC	———	———
R5	BRK SP=OFF	%	———	———
R6	STOPR=3000%/s	%/SEC	———	———
R7	SP FILT=0.0s	SEC	———	———
R8	TQ FILT=0.0%	%	———	———

SCREEN		UNIT	DATE	DATE
START/STOP MODES				
S1	START=NORMAL		———	———
S2	STOP=NORMAL		———	———
S4	ASTOP=NORMAL		———	———
S5	STR DLY=0.05s	SEC	———	———
S6	OFF DLY=1.05s	SEC	———	———
S7	LOW V TRIP=N/Y		———	———
S8	BRAKE I=0%	%	———	———
IMPEDANCES AND GAINS				
X1	CTRL TYPE=V/Hz		———	———
X3a	Lm=190%	%	———	———
X3b	Rs=3.0%	%	———	———
X3c	Rr=3.0%	%	———	———
X3d	SIGMA=5.0%	%	———	———
X3e	FL WEAK=100%	%	———	———
X4a	MIN FLX=100%	%	———	———
X4b	STR TYPE=AUTO		———	———
X4c	STR TQ=0%	%	———	———
X4d	STR BAND=0%	%	———	———
X4f	Kp w=20%	%	———	———
X4g	Ki w=30%	%	———	———
X4h	Kd w=0%	%	———	———
X5a	ILT SLP	%	———	———
X5b	VLT SLP	%	———	———
X5c	DAMPING	%	———	———
X5d	SLIP COMP=N/Y		———	———
X5e	FREQ=AUTO		———	———
X5f	SWITCH FR=WW	Hz	———	———
X5g	Kp I=25%	%	———	———
X5h	Ki I=13%	%	———	———
X5i	Kf w=100%	%	———	———
MENU OPTIONS				
Y1	LANGUAGE=1		———	———
Y3	PROGRAM		———	———
COMMISSION = Y/N			———	———
Z1	PASSWRD=OFF		———	———
Z2	S/W REVISION		———	———
Z2	H/W REVISION		———	———

COMMISSIONING CONFIGURATION CONTROL — TERMINALS

													Wire Designation	Wire Colour
Relay 1	N.O.	T1	O2a				O2b					T1		
		T2	Relay Selection =				Inverted=Y/N					T2		
	N.C.	T3										T3		
Relay 2	N.O.	T4	O2c				O2d					T4		
		T5	Relay Selection =				Inverted=Y/N					T5		
Relay 3	N.O.	T6	O2e				O2f					T6		
		T7	Relay Selection =				Inverted=Y/N					T7		
External D.B. Switch		T8	D1				D2					T8		
		T9	D.B. Time =				D.B. Duty =					T9		
Display	+24V	T10	I1									T10		
	DATA	T11	Local Start/Stop-Reset=Y/N									T11		
	0V	T12										T12		
Multi-function Inputs	MFI 1	T13	I7a				I7c	MFI 1=				T13		
	MFI 2	T14	Multi-function Input Mode =				I7d	MFI 2=				T14		
	MFI 3	T15					I7e	MFI 3=				T15		
	MFI 4	T16					I7f	MFI 4=				T16		
	MFI 5	T17					I7g	MFI 5=				T17		
	MFI 6	T18					I7h	MFI 6=				T18		
Ext Trip/PTC		T19	External Trip /PTC Input									T19		
0V		T20	I7b	Digital Input Polarity = High/Low								T20		
+24V		T21										T21		
0V		T22					O1b	0-10V ±10V 4-20mA 0-20mA	O1d	Lo = %		T22		
Analogue Ouput 1		T23	O1a	Output =					O1c	Hi = %		T23		
Analogue Ouput 2		T24	O1e	Output =			O1f	0-10V ±10V 4-20mA 0-20mA	O1g	Lo = %		T24		
0V		T25							O1h	Hi = %		T25		
Analogue Input 1		T26	I6a	0-10V/ +/- 10V 4-20mA/0-20mA			I6b	Lo = %	I6c	Hi = %		T26		
Analogue Input 2		T27	I6d	0-10V/ +/- 10V 4-20mA/0-20mA			I6e	Lo = %	I6f	Hi = %		T27		
Potentiometer Supply 10V		T28										T28		
0V		T29										T29		
Encoder Supply +5V @ 100mA		T30										T30		
Encoder Input	A	T31	N8	Encoder PPR =			N9	Encoder Type =				T31		
	$\overline{A}$	T32										T32		
	B	T33										T33		
	$\overline{B}$	T34										T34		
0V		T35										T35		
User Supply +24V @500mA		T36										T36		
0V		T37										T37		
Isolated RS485	A	T38	H3a	Comunications Address=			H3b	Baudrate = 1200 4800 9600 OFF	H2	Comms Timeout = 1s/5s 25s/OFF		T38		
	B	T39										T39		
Isolated 0V		T40										T40		
Isolated RS232	Rx	T41										T41		
	Tx	T42										T42		
Fibre Optic In		FI	I8a	Lo = %			I8b	Hi = %	I8c	Mode		FI		
Fibre Optic Out		FO	O3a	Output =								FO		

4808-053 Rev E

MICRODRIVE ELITE SPARES LIST

Model	Part No	Quantity
ME 2.5A, 400V	E002	1
ME 6.5A, 400V	E006	1
ME 10.5A, 400V	E010	1
ME 12A, 400V	E012	1
ME 16A, 400V	E016	1
ME 22.5A, 400V	E022	1
ME 31A, 400V	E031	1
ME 38A, 400V	E038	1
ME 46A, 400V	E046	1
UE 60A, 400V	E060	1
UE 75A, 400V	E075	1
UE 90A, 400V	E090	1
UE 115A, 400V	E115	1
UE 140A, 400V	E140	1
Common Spares		
Control Board Fuse Link Set		1
1A Ceramic, 20x5mm	2401-037	10
Control Wiring Plug Set		1
3 way plug, 45°	2203-222	14
Microdrive Elite 2.5A to 22.5A Spares		
Microdrive Elite series display unit	E000-620S	1
IP54 seal		1
Screw caps		4
Screws		4
Heatsink Cooling Fan	2941-012	1
Gland Plate Set		1
3mm Aluminium Gland Plate	3811-864	1
Gland Plate gasket	3907-018	1
Gland Plate Screws	3609-525	2
Gland Plate Screws	3609-530	2
Earth Screw	3609-410	1
Control Wiring grommets	3907-022	6
Terminal Cover Kit		1
Terminal Cover	3903-116	
Terminal Cover gasket	3907-021	1.2m
Terminal Cover screws	3611-121	6
Terminal Cover Screw Caps	3903-123	6
Power Terminal Guard	3903-124	1
Microdrive Elite 31A to 46A Spares		
Microdrive Elite series display unit	E000-620S	1
IP54 seal		1
Screw caps		4
Screws		4
Heatsink Cooling Fans	2941-012	2
Gland Plate Set		2
3mm Aluminium Gland Plate	3811-864	1
Gland Plate gasket	3907-018	1
Gland Plate Screws	3609-525	2
Gland Plate Screws	3609-530	2
Earth Screw	3609-410	1
Control Wiring grommets	3907-022	6

Terminal Cover Kit (Control Terminals)		1
Terminal Cover	3903-116	
Terminal Cover gasket	3907-021	1.2m
Terminal Cover screws	3611-121	6
Terminal Cover Screw Caps	3903-123	6
Terminal Cover Kit (Power Terminals)		1
Terminal Cover	3903-116	
Terminal Cover gasket	3907-021	1.2m
Terminal Cover screws	3611-121	6
Terminal Cover Screw Caps	3903-123	6

Ultradrive Elite 60A to 140A Spares

Ultradrive Elite series display unit	E000-621S	1
IP54 seal		1
Screw caps		4
Screws		4
Heatsink Cooling Fan, Dia. 172mm	2941-015	1
Heatsink Cooling Fan, 120x120mm	2941-012	1
Internal Cooling Fan	2941-007	1
Gland Plate Set		1
3mm Aluminium Gland Plate	3892-407	1
Gland Plate gasket	3907-027	1
Gland Plate Screws	3609-517	4

ELITE SERIES OPTIONS LIST

OPTION	Part No
Elite Series display unit (3m cable)	E000-622S
DeviceNet Interface	EDNI
Interbus Interface	IBUS
Serial Bus Interface	ESBI
Fibre Optic Cable, 10m	2727-010
Fibre Optic Cable, 50m	2727-050
IP54 Remote Control (graduated potentiometer and on/off switch)	0302
Steel DIN Rail, 135mm (Microdrive Elite mounting rails)	3811-869
Steel DIN Rail, 270mm (Microdrive Elite mounting rails)	3811-871
Dynamic Brake 140A (external resistor required)	B140
Dynamic Brake 15A (includes resistor)	B015
PDL 56 Series single gang enclosure, 102x102x63mm	56E1
PDL 56 Series double gang enclosure,198x102x63mm	56E2
PDL 56 Series triple gang enclosure, 296x102x63mm	56E3
PDL 56 Series quad gang enclosure, 198x198x63mm	56E4

INDEX

PDL Electronics Ltd

Head Office: 81 Austin Street, Napier, New Zealand.
Tel: +64-6-843-5855 Fax: +64-6-843-5185
Sales branch offices in Auckland, Christchurch and Wellington.
Freephone: 0800-737-356 (New Zealand only)
Internet: www.pdl-elec.co.nz

Australia: Sales branch offices in Adelaide, Melbourne, Perth and Sydney.
Brisbane Head Office: Tel: +61-7-868-2311 Fax: +61-7-868-2366
Customer Service Hotline: 1800-644-677 (Australia only)

Germany: Nuremberg Tel: +49-9128-91990 Fax: +49-9128-919980

Specifications are subject to change without notice.