



E-Series

AC Flux Vector Drive

Technical Manual

Part Number 4201-180 Revision K

IMPORTANT

This manual must be used in conjunction with the *E-Series AC Flux Vector Getting Started Manual - Part Number 4201-179*.

Read and understand the procedures described in both manuals before attempting to install or commission your drive.

If in doubt, before proceeding, please contact Bardac Drives at:

410-604-3400

IMPORTANT NOTES

SAFETY WARNINGS:

- It is the installer's responsibility to ensure the configuration and installation of the E-Series meets the requirements of any site specific, local and national electrical regulations.
- The E-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 E-Series is essential before connection to the supply. The E-Series must be permanently connected to the supply.
- For safety reasons, normal operation of the E-Series requires front covers/doors to be in place and secured closed.
- Do not attempt to isolate the motor while the E-Series is running.
- Some parameter settings may cause the E-Series to start automatically after power failure.
- Motor overspeed operation may be limited by mechanical constraints.

RELIABILITY WARNINGS:

- Always screen control wiring.
- Ensure that the E-Series is not mounted in an adverse environment.

ENVIRONMENTAL WARNINGS:

- Corrosive vapours or gases may interfere with the correct operation of electronic equipment. These compounds may include fumigants such as methyl bromide, or gases such as sulphur dioxide, hydrogen sulphide or chlorine derivatives.

Please consult the manufacturer if there are any doubts about the environmental conditions this equipment may be operating in or subjected to.
- The IP rating refers to dust and water ingress and not corrosive gases. Bardac products are designed and manufactured to pollution degree 1 or 2 which do not cover corrosive vapours or gases.
- This equipment is intended for installation in a second (industrial) environment as defined by BS EN 61800-3. It is not intended to be used on a low voltage public network which supplies domestic premises. Radio frequency interference may result if used on such a network.

SERVICING WARNINGS:

- 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 E-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.

NOTES:

- This manual and the screen list contained within this document relate to E-Series software version **4.1**. Refer to Screen Z2 for the software version of your E-Series.
- It is the responsibility of the end user/purchaser to ensure that operators understand how to use this equipment safely. Please read this manual thoroughly.
- The latest revision of this manual is available from our web-site **www.bardac.com**

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 Bardac Drives 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, under the most demanding load conditions.

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

COMPREHENSIVE SUPPORT PROGRAM

The Bardac Drives 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 Bardac Drives' 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	E-Series Software version 2.0
May 1998	F	Ultradrive specifications added
March 1999	G	Add large Ultradrive specifications
Dec. 2000	H	Update to software version 3.5. UL listings added. 500V ratings & Open Loop Vector added.
Oct. 2001	I	New 500V ratings and parallel drive fault codes added
April 2002	J	UL Cables sizes added
June 2003	K	Update to software version 4.1 Environmental warning added. Screens S12 & S13 added.

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SYMBOLS USED



Caution, risk of electric shock *ISO 3864, No. B.3.6*



Caution (refer to accompanying documents) *ISO 3864, No. B.3.1*

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Three-phase alternating current *IEC 617-2, No. 02-02-06*

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Direct Current *IEC 417, No. 5031*



Protective Earth (PE) Terminal *IEC 417 No. 5019*



Earth (ground) Terminal *IEC 417 No. 5017*



Induction motor, three phase, squirrel cage *IEC 617-2, No. 06-08-01*

1 INTRODUCTION TO THE E-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. Bardac Drives 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, Bardac Drives has developed the E-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 rivaling that of servomotors.

The E-Series further evolves the hardware and software technology of previous ranges. The same E-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 E-SERIES RANGE

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

The E-Series currently spans the range from 0.75 kW to 1MW (1hp to 1200hp). All models are constructed to meet IP54, for protection against the ingress of dust and splashing water.

All E-Series models have attained UL listing in the categories of Power Conversion Equipment and Power Conversion Equipment Certified for Canada.

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 E-Series employs this technique in its Closed Loop Vector control mode. However if a shaft encoder is not used on the motor, Open Loop Mode 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 **may not be possible**.

1.4 CONFIGURATION OF CONTROLLER TYPE

When the E-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" mode is 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 E-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 Mode 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. This 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 E-Series, the V/Hz control operating mode must be utilised.

The E-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.

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2 E-SERIES SPECIFICATIONS

2.1 E-SERIES SPECIFICATIONS

INPUT

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 nominal voltage
Input voltage	(model dependant) refer figures 2.1 and 2.2 for details 3 phase earth neutral Consult with factory for floating earth and corner earth supplies

OUTPUT

Output voltage to motor	
Microdrive E-Series	0 to V _{IN} -3V @ 100% load
Ultradrive E-Series	0 to V _{IN} -15V @ 100% load
Current overload capability	150% for 30 secs (when hot) at 50°C at nominal rating 150% for 60 secs (when hot) at 40°C at nominal rating
Frequency range	
Closed Loop Mode	0 to ±100Hz
Open Loop Mode	0 to ± 100Hz
V/Hz Mode	0 to ± 400Hz
Efficiency (full load, 50Hz)	>97%
Suit motor rated kW	typically 50 to 150% of E-Series nominal 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 (model dependent)
Cable Length	Maximum cable length is typically 150m. This is dependent on E-Series rating, cable type, switching frequency and ambient temperature. For motor cable length exceeding 50m, please refer to Bardac's General Application Note "Output Choke Selection for the E-Series" Bardac Document 4216-053.

ENVIRONMENTAL

Protection standard	Refer to figures 2.1 and 2.2.
IP54/NEMA 12	Protected against dust and splashing water. Maximum pollution degree 2.
NEMA 1	Protected against accidental electrical contact. Maximum pollution degree 1.
Operating temperature	0°C to 50°C
Temperature re-rating of output current @ 40°C	
For quadratic torque applications, the E-Series may be up-rated when operated with a maximum ambient temperature of 40°C. Refer to figures 2.1 and 2.2.	
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

ELECTROMAGNETIC COMPATIBILITY

IEC 61800-3 Ed 2. / EN 61800-3:1996 +A11:2000

Adjustable speed electrical power drive systems, part 3: EMC product standard including specific test methods.

BS EN55011:1998 / CISPR 11:1997

Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment.

BS EN61000-4-2:1995. (incorporating Amendment 1: 1999 issue 2)

Testing and measurement techniques – Electrostatic discharge immunity.

BS EN61000-4-3:1998-11. Edition 1.1

Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity.

BS EN61000-4-4:1995-01

Testing and measurement techniques – Electrical fast transient/burst immunity.

BS IEC/EN61000-4-5:1995-03

Testing and measurement techniques – Surge Immunity.

IEC 61000-4-6:1993-04

Testing and measurement techniques – Immunity to conducted disturbances induced by radio-frequency fields.

Specifications are subject to change without notice

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)	

E- 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	E002 to E046 Other E-Series
Software	720Vdc 820Vdc
Hardware	750Vdc 850Vdc
Phase Fault	Ground fault
Low DC bus voltage	Regeneration limit
Hardware failure	

CONTROL

Control method	Closed Loop Mode, Open Loop Mode, V/Hz Mode
Analogue inputs	2 inputs, configurable as 0–10Vdc, ± 10 Vdc, 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, ± 10 Vdc, 4–20mA or 0–20mA, with multiple function selections for each
Relay outputs	1 changeover, 2 normally open, rated 250Vac 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.

Power Quality

The E-Series has been designed to operate in a Class 3 electromagnetic environment, as detailed by BS EN 6100-2-4:1995. This refers to an industrial environment where a large part of the electrical load is fed through converters, large motors are frequently started, loads vary rapidly, or welding machines are present.

For a 400V 50Hz or 480V 60Hz supply, this sets the following distortion limits:

Notch Depth:	40% maximum
Total Harmonic Distortion (THD):	10%
Notch Area:	250% degrees, at rated voltage and current

Failure to observe these limits may cause “soft charge” failure when power is applied to the drive.

In addition, repetitive overvoltage spikes (transients) must never exceed an instantaneous maximum voltage of 1.25 x the nominal phase peak voltage. Failure to observe this limit will apply excess stress on internal components and may cause premature failure.

For mains supplies with disturbances exceeding these limits, consult Bardac Drives Applications Engineers for advice.

Output Current Rating of the E-Series

The E-Series output rating is determined by its current. The maximum motor size that can be run from each drive in the range is a function of this current, and of the motor rated voltage, the type of load, and the ambient temperature.

Each drive in the E-Series range has two current ratings, depending on the type of load and the maximum expected ambient temperature.

Variable Torque Current Rating

This current rating, as detailed in Figures 2.1 and 2.3, may be applied to any load where torque (and therefore motor current) increases with increasing motor speed. This includes centrifugal pumps and fans. The variable torque current rating is higher than the constant torque current rating because at low speed operation, current is also low and thermal cycle does not occur.

As can be seen from the tables, the variable torque ratings are approximately 20% higher than the constant torque ratings. This generally enables the next largest motor to be used, when compared with a constant torque load. Notice however that the variable torque ratings are valid for an ambient temperature not exceeding 40°C. For ambient temperatures greater than 40°C, derate the current rating by the amount shown in the figures, up to a maximum expected temperature of 50°C.

Constant Torque Current Rating

This current rating, as detailed in figures 2.2 and 2.4, is to be applied for any “constant torque” load. A constant torque load is defined as one where the motor load (and therefore the current drawn by the motor) remains essentially constant over the full speed range of the drive, such loads may include hoists, winches, conveyors, or any highly dynamic load which has regular and widely varying speed changes while operating. Any of the E-Series range operating in closed loop vector mode must use this rating table. These types of load are the most severe on the drive, because significant thermal cycling of the drive's power components will occur when operating at high torque at low speed.

Overload Rating

In general, the maximum overload current rating for each drive is 50% above the constant torque load rating, for a time of 60 seconds, at an ambient temperature of 40°C. This is a hardware limit, and cannot be varied. For ambient temperatures exceeding 40°C, the overload time must be reduced, (to 30s at 50°C), or the overload current must be reduced. Refer to figures 2.1 to 2.4 for the required overload current derating, as a function of ambient temperature.

1	2	3	4	5	6	7	8	9
E-SERIES 400V VARIABLE TORQUE @ 40°C								
ENCLOSURE RATING	FRAME	ITEM	I[A]	MOTOR kW 400V	Overload I[A] 60 Seconds Maximum	Recommended Cable Size per Phase: (Note 6) AWG / kcmil mm ²		Fuses per Phase (A) (Note 7)
Nema 12 IEC IP54	1	E002	3.1	1.1	3.7	14 to 12	2.5 to 4	6
		E006	8.1	4	9.7	12 to 10	2.5 to 4	16
		E010	13.1	5.5	15.7	12 to 10	2.5 to 4	25
		E012	15	7.5	18.0	10 to 8	4 to 6	32
	2	E018	22.5	11	27	10 to 8	4 to 6	40
		E022	28	15	33	10 to 8	4 to 6	50
	3	E031	38	18.5	46	8 to 6	6 to 10	80
		E038	47	22	57	6 to 4	10 to 16	100
		E046	57	30	69	4 to 3	16 to 25	100
Nema 12 IEC IP54 Electronics Enclosure	4	UE60C54	75	37	90	3 to 1	16 to 36	150
		UE75C54	94	45	112	1 to 1/0	25 to 50	200
		UE90C54	112	55	135	1/0 to 3/0	25 to 50	200
		UE115C54	144	75	172	2/0 to 4/0	50 to 95	300
		UE140C54	175	90	210	4/0 to 250	70 to 120	300
Nema 12 IEC IP54 Electronics Enclosure	5	UE170C54	205	110	255	3/0 to 300	95 to 150	350
		UE205C54	250	132	307	250 to 400	120 to 240	350
		UE250C54	305	160	375	350 to 500	185 to 240	350
	6	UE305C54	370	200	457	2 by 500	2 by 240	2 by 350
		UE370C54	440	250	555	2 by 500	2 by 240	2 by 350
		UE440C54	540	315	660	2 by 500	2 by 240	2 by 350
		UE540C54	620	355	810	2 by 500	2 by 240	2 by 350
	7	UE620C54	700	400	930	3 by 500	3 by 240	3 by 350
		UE700C54	850	500	1050	3 by 500	3 by 240	3 by 350
	Parallel Ultradrive E-Series (Note 4)	UE760C54	935	560	1140	4 by 500	4 by 240	4 by 350
		UE930C54	1070	630	1395	4 by 500	4 by 240	4 by 350
		UE1070C54	1210	710	1605	6 by 500	6 by 240	6 by 350
		UE1200C54	1470	710	1800	6 by 500	6 by 240	6 by 350
Note 1:	Supply Voltage (V _{in}) - 380Vac to 440Vac (-10% to +10%). Supply type - 3 phase earthed neutral.							
Note 2:	Frame 4 is UL/cUL approved for 230 & 380 - 480Vac. 230V option must be specified at time of order. Frames 5 to 7 and Parallel drives are UL/cUL approved 380 - 500Vac. 230V options w here available as a special will not be UL certified.							
Note 3:	Motor kW ratings are based on typical 4 - pole ratings only. Check your motor specification before selecting.							
Note 4:	Parallel Ultradrive E-Series require the motor to be connected in "inside delta".							
Note 5:	To maintain a 60 second overload above 40°C use a derating factor of 2.2 % per degree Celsius for nominal and overload current to a maximum of 50°C . Refer to diagram below.							
Note 6:	Cable sizes in columns 7 & 8 are stated for copper cables. For compliance w ith UL/cUL, use copper cables only. Frame 1 minimum cable size is 10AWG (5.3mm ²) for UL/cUL compliance.							
Note 7:	With respect to fuse sizes stated in column 9: Frames 1-2 input fuses must be of type gG (distribution) or gR/UR (semiconductor). Frames 3-4 input fuses must be of type gR/UR (semiconductor). Frames 5-7 and Parallel drives have UL-recognised type gR/UR (semiconductor) fuses fitted as standard. Fuses must be selected to protect circuits w ith a maximum 200kA prospective symmetrical short circuit capacity.							
Overload Current Nominal Current 40°C 50°C 2.2 Percent 1 Degree Celsius								
4202-427 Rev A								

Figure 2.1: E-Series 400V Variable Torque Ratings

1	2	3	4	5	6	7	8	9
E-SERIES 400V CONSTANT TORQUE @ 50°C								
ENCLOSURE RATING	FRAME	ITEM	I[A]	MOTOR kW 400V	Overload I[A] 30 Seconds Maximum (60 Seconds @ 40°C)	Recommended Cable Size per Phase: (Note 7) AWG / kcmil mm ²		Fuses per Phase (A) (Note 8)
Nema 12 IEC IP54	1	E002	2.5	0.75	3.7	14 to 12	2.5 to 4	6
		E006	6.5	3	9.7	12 to 10	2.5 to 4	16
		E010	10.5	4	15.7	12 to 10	2.5 to 4	25
		E012	12	5.5	16.5	10 to 8	4 to 6	32
	2	E018	18	7.5	24	10 to 8	4 to 6	40
		E022	22.5	11	31.5	10 to 8	4 to 6	50
	3	E031	31	15	45	8 to 6	6 to 10	80
		E038	38	18.5	52.5	6 to 4	10 to 16	100
		E046	46	22	61.5	4 to 3	16 to 25	100
	Nema 12 IEC IP54 Electronics Enclosure	4	UE60C54	60	75	90	3 to 1	16 to 36
UE75C54			75	37	112.5	1 to 1/0	25 to 50	200
UE90C54			90	45	135	1/0 to 3/0	25 to 50	200
UE115C54			115	55	172.5	2/0 to 4/0	50 to 95	300
UE140C54			140	75	210	4/0 to 250	70 to 120	300
Nema 12 IEC IP54 Electronics Enclosure	5	UE170C54	170	90	255	3/0 to 300	95 to 150	350
		UE205C54	205	110	307.5	250 to 400	120 to 240	350
		UE250C54	250	132	375	350 to 500	185 to 240	350
	6	UE305C54	305	160	457.5	2 by 500	2 by 240	2 by 350
		UE370C54	370	200	55	2 by 500	2 by 240	2 by 350
		UE440C54	440	250	660	2 by 500	2 by 240	2 by 350
		UE540C54	540	315	810	2 by 500	2 by 240	2 by 350
	7	UE620C54	620	355	930	3 by 500	3 by 240	3 by 350
		UE700C54	700	400	1050	3 by 500	3 by 240	3 by 350
	Parallel Ultradrive E-Series (Note 4)	UE760C54	760	450	1140	4 by 500	4 by 240	4 by 350
		UE930C54	930	560	1395	4 by 500	4 by 240	4 by 350
		UE1070C54	1070	630	1605	6 by 500	6 by 240	6 by 350
		UE1200C54	1200	710	1800	6 by 500	6 by 240	6 by 350
Note 1:		Supply Voltage (V _{in}) - 380Vac to 440Vac (-10% to +10%). Supply type - 3 phase earthed neutral.						
Note 2:		Frame 4 is UL/cUL approved for 230 & 380 - 480Vac. 230V option must be specified at time of order. Frames 5 to 7 and Parallel drives are UL/cUL approved 380 - 500Vac. 230V options w here available as a special will not be UL certified.						
Note 3:		Motor kW ratings are based on typical 4 - pole ratings only. Check your motor specification before selecting.						
Note 4:		Parallel Ultradrive E-Series require the motor to be connected in "inside delta".						
Note 5:		By increasing the maximum overload time to 60 seconds , the table above can be used for Constant Torque current ratings at 40°C						
Note 6:		To maintain a 60 second overload above 40°C use a derating factor of 2.2 % per degree Celsius for nominal and overload current to a maximum of 50°C . Refer to diagram below .						
Note 7:		Cable sizes in columns 7 & 8 are stated for copper cables. For compliance with UL/cUL, use copper cables only. Frame 1 minimum cable size is 10AWG (5.3mm ²) for UL/cUL compliance.						
Note 8:		With respect to fuse sizes stated in column 9: Frames 1-2 input fuses must be of type gG (distribution) or gR/UR (semiconductor). Frames 3-4 input fuses must be of type gR/UR (semiconductor). Frames 5-7 and Parallel drives have UL-recognised type gR/UR (semiconductor) fuses fitted as standard. Fuses must be selected to protect circuits w ith a maximum 200kA prospective symmetrical short circuit capacity.						
Overload Current Nominal Current 40°C 50°C 2.2 Percent 1 Degree Celsius								
4202-428 Rev A								

Figure 2.2: E-Series 400V Constant Torque Ratings

1	2	3	4	5	6	7	8	9	10
E-SERIES 500V VARIABLE TORQUE @ 104°F (40°C)									
ENCLOSURE RATING	FRAME	ITEM	I[A]	3 Phase Supply		Overload I[A] 60 Seconds Maximum	Recommended Cable Size per Phase: (Note 7)		Fuses per Phase (A) (Note 8)
				MOTOR HP 460V	MOTOR HP 230V		AWG / kcmil	mm ²	
Nema 12 IEC IP54	1	ME002D54	3.1	1.5	0.5	3.7	14 to 12	2.5 to 4	6
		ME006D54	7.6	5	2	9.0	12 to 10	2.5 to 4	16
		ME009D54	12	7.5	3	13.5	12 to 10	2.5 to 4	25
		ME011D54	14	10	3	16.0	10 to 8	4 to 6	32
	2	ME016D54	21	15	7.5	24	10 to 8	4 to 6	40
		ME021D54	27	20	10	31	10 to 8	4 to 6	50
		ME030D54	37.5	25	10	45	8 to 6	6 to 10	80
	3	ME035D54	45	30	15	52	6 to 4	10 to 16	100
		ME041D54	52	40	20	61	4 to 3	16 to 25	100
Nema 12 IEC IP54 Electronics Enclosure	4	UE060D54	75	50	25	90	3 to 1	16 to 36	150
		UE075D54	94	60	30	112	1 to 1/0	25 to 50	200
		UE090D54	112	75	40	135	1/0 to 3/0	25 to 50	200
		UE0115D54	144	100	50	172	2/0 to 4/0	50 to 95	300
		UE0140D54	175	125	60	210	4/0 to 250	70 to 120	300
Nema 12 IEC IP54 Electronics Enclosure	5	UE0170D54	205	150	75	255	3/0 to 300	95 to 150	350
		UE0205D54	250	200	100	307	250 to 400	120 to 240	350
		UE0250D54	305	250	125	375	350 to 500	185 to 240	350
	6	UE0305D54	370	300	150	457	2 by 500	2 by 240	2 by 350
		UE0370D54	440	350	150	555	2 by 500	2 by 240	2 by 350
		UE0440D54	540	450	200	660	2 by 500	2 by 240	2 by 350
		UE0540D54	620	500	250	810	2 by 500	2 by 240	2 by 350
	7	UE0620D54	700	600	300	930	3 by 500	3 by 240	3 by 350
		UE0700D54	850	680	350	1020	3 by 500	3 by 240	3 by 350
	Parallel Ultradrive E-Series	UE0760D54	935	680	Not available as 230V	1140	4 by 500	4 by 240	4 by 350
		UE0930D54	1070	845		1395	4 by 500	4 by 240	4 by 350
		UE01070D54	1210	952		1605	6 by 500	6 by 240	6 by 350
		UE01200D54	1470	1207		1800	6 by 500	6 by 240	6 by 350
Note 1:		Supply Voltage (V _{in}) - 440Vac to 500Vac (-10% to +10%). Supply type - 3 phase earthed neutral.							
Note 2:		Frames 1 - 4 are UL/cUL approved for 230 & 380 - 480Vac. 230V option must be specified at time of order. Frames 5 to 7 and Parallel drives are UL/cUL approved 380 - 500Vac. 230V options where available as a special will not be UL certified.							
Note 3:		HP ratings are based on typical 4 - pole ratings only. Check your motor specification before selecting.							
Note 4:		Parallel Ultradrive E-Series require the motor to be connected in "inside delta".							
Note 5:		To maintain a 60 second overload above 104°F (40°C) use a derating factor of 2.2 % per degree Celsius for nominal and overload current to 122°F (50°C) . Refer to diagram below.							
Note 7:		Cable sizes in columns 8, 9 are stated for copper cables. For compliance with UL/cUL, use copper cables only. Frame 1 minimum cable size is 10AWG (5.3mm ²) for UL/cUL compliance.							
Note 8:		With respect to fuse sizes stated in column 10: Frames 1-2 input fuses must be of type gG (distribution) or gR/UR (semiconductor). Frames 3-4 input fuses must be of type gR/UR (semiconductor). Frames 5-7 and Parallel drives have UL-recognised type gR/UR (semiconductor) fuses fitted as standard. Fuses must be selected to protect circuits with a maximum 200kA prospective symmetrical short circuit capacity.							
Overload Current Nominal Current 40°C 50°C 2.2 Percent 1 Degree Celsius									
4202-429 Rev A									

Figure 2.3: E-Series 500V Variable Torque Ratings

1	2	3	4	5	6	7	8	9	10
E-SERIES 500V CONSTANT TORQUE @ 104°F (40°C)									
ENCLOSURE RATING	FRAME	ITEM	I[A]	3 Phase Supply		Overload I[A] 60 Seconds Maximum	Recommended Cable Size per Phase: (Note 7)		Fuses per Phase (A) (Note 8)
				MOTOR HP 460V	MOTOR HP 230V		AWG / kcmil	mm ²	
Nema 12 IEC IP54	1	ME002D54	2.5	1	0.5	3.7	14 to 12	2.5 to 4	6
		ME006D54	6	3	1.5	9	12 to 10	2.5 to 4	16
		ME009D54	9	5	2	13.5	12 to 10	2.5 to 4	25
		ME011D54	11	7.5	3	16.0	10 to 8	4 to 6	32
	2	ME016D54	16	10	5	24	10 to 8	4 to 6	40
		ME021D54	21	15	7.5	31.0	10 to 8	4 to 6	50
	3	ME030D54	30	20	10	45	8 to 6	6 to 10	80
		ME035D54	35	25	10	52	6 to 4	10 to 16	100
		ME041D54	41	30	15	61	4 to 3	16 to 25	100
Nema 12 IEC IP54 Electronics Enclosure	4	UE060D54	60	40	20	90	3 to 1	16 to 36	150
		UE075D54	75	50	25	112	1 to 1/0	25 to 50	200
		UE090D54	90	60	30	135	1/0 to 3/0	25 to 50	200
		UE115D54	115	75	40	172	2/0 to 4/0	50 to 95	300
		UE140D54	140	100	50	210	4/0 to 250	70 to 120	300
Nema 12 IEC IP54 Electronics Enclosure	5	UE170D54	170	125	60	255	3/0 to 300	95 to 150	350
		UE205D54	205	150	75	307	250 to 400	120 to 240	350
		UE250D54	250	200	100	375	350 to 500	185 to 240	350
	6	UE305D54	305	250	125	457	2 by 500	2 by 240	2 by 350
		UE370D54	370	300	150	555	2 by 500	2 by 240	2 by 350
		UE440D54	440	350	150	660	2 by 500	2 by 240	2 by 350
		UE540D54	540	450	200	810	2 by 500	2 by 240	2 by 350
	7	UE620D54	620	500	250	930	3 by 500	3 by 240	3 by 350
		UE700D54	700	600	300	1020	3 by 500	3 by 240	3 by 350
	Parallel Ultradrive E-Series	UE760D54	760	600	Not available as 230V	1140	4 by 500	4 by 240	4 by 350
		UE930D54	930	680		1395	4 by 500	4 by 240	4 by 350
		UE1070D54	1070	845		1605	6 by 500	6 by 240	6 by 350
		UE1200D54	1200	952		1800	6 by 500	6 by 240	6 by 350
Note 1:		Supply Voltage (V _{in}) - 440Vac to 500Vac (-10% to +10%). Supply type - 3 phase earthed neutral.							
Note 2:		Frames 1 - 4 are UL/cUL approved for 230 & 380 - 480Vac. 230V option must be specified at time of order. Frames 5 to 7 and Parallel drives are UL/cUL approved 380 - 500Vac. 230V options where available as a special will not be UL certified.							
Note 3:		HP ratings are based on typical 4 - pole ratings only. Check your motor specification before selecting.							
Note 4:		Parallel Ultradrive E-Series require the motor to be connected in "inside delta".							
Note 5:		By reducing the maximum overload time to 30 seconds , the table above can be used for Constant Torque current ratings at 122°F (50°C).							
Note 6:		To maintain a 60 second overload above 104°F (40°C) use a derating factor of 2.2 % per degree Celsius for nominal and overload current to a maximum of 122°F (50°C).							
Note 7:		Cable sizes in columns 8, 9 are stated for copper cables. For compliance with UL/cUL, use copper cables only. Frame 1 minimum cable size is 10AWG (5.3mm ²) for UL/cUL compliance.							
Note 8:		With respect to fuse sizes stated in column10: Frames 1-2 input fuses must be of type gG (distribution) or gR/UR (semiconductor). Frames 3-4 input fuses must be of type gR/UR (semiconductor). Frames 5-7 and Parallel drives have UL-recognised type gR/UR (semiconductor) fuses fitted as standard. Fuses must be selected to protect circuits with a maximum 200kA prospective symmetrical short circuit capacity.							
Overload Current Nominal Current 40°C 50°C 2.2 Percent 1 Degree Celsius									
4202-430 Rev A									

Figure 2.4: E-Series 500V Constant Torque Ratings

3 DESCRIPTIONS

3.1 DESCRIPTION OF THE E-SERIES HARDWARE

3.1.1 Overview

The E-Series range is a family of advanced AC induction motor controllers, presented in seven frame styles. All models are available with IP54 ingress protection rating, suitable for installation in an environment where dust and splashing water may be present.

Ensure the correct model was specified for the intended environment. For detailed dimensional drawings, refer to figures 3.1 to 3.3.

An electrical overview is shown in figure 3.4.

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

3.1.2 Power Conversion

Key electrical circuit elements of the E-Series range are shown in figure 3.5.

AC power is fed to the E-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 soft charge 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 energising 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 E-Series. Detail follows in Section 3.1.4. The E-Series can be configured from this Display Unit. Alternatively custom configuration can be achieved by use of the external Vysta® for Windows software package, on a PC running Microsoft Windows.

The 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 E-Series Getting Started Manual, Part No. 4201-179.

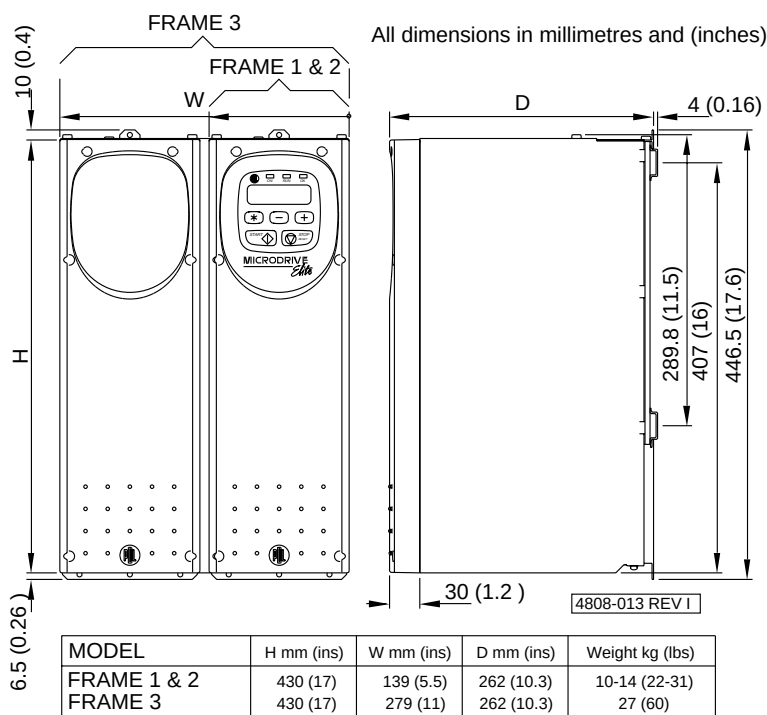
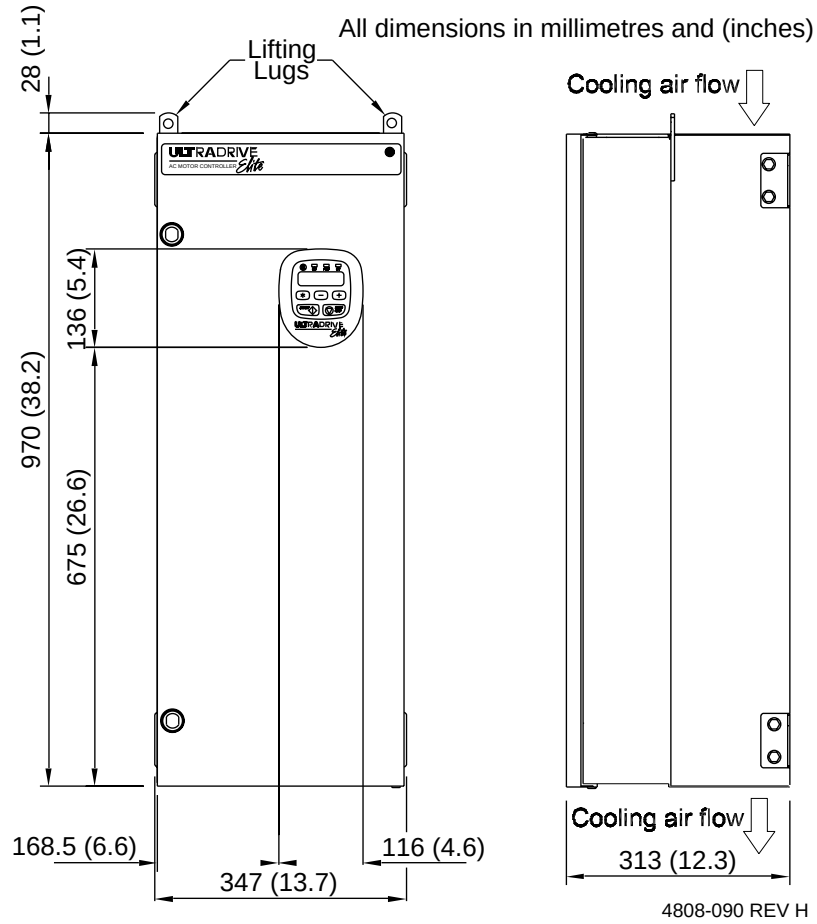


Figure 3.1: Microdrive E-Series Dimensions

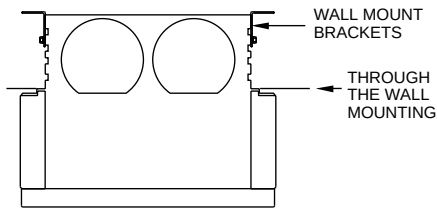


MODELS 400V and 500V	Net Weight kg (lbs)
UE-60C, UE-60D,	73.5 (162.04)
UE-75C, UE-75D	73.5 (162.04)
UE-90C, UE-90D	77.5 (170.86)
UE-115C, UE-115D	80.5 (177.47)
UE-140C, UE-140D	80.5 (177.47)

Figure 3.2: Ultradrive E-Series Frame 4 Dimensions

DIMENSIONS

500V MODELS	400V MODELS	W mm (inches)	Net Weight kg (lbs)
UE-170D	UE-170C	545 (21.5)	160 (353)
UE-205D	UE-205C	545 (21.5)	160 (353)
UE-250D	UE-250C	545 (21.5)	175 (386)
UE-305D	UE-305C	965 (38)	320 (705)
UE-370D	UE-370C	965 (38)	320 (705)
UE-440D	UE-440C	965 (38)	350 (772)
UE-540D	UE-540C	965 (38)	350 (772)
UE-620D	UE-620C	1385 (54.6)	566 (1248)
UE-700D	UE-700C	1385 (54.6)	566 (1248)



All dimensions in millimetres and (inches)

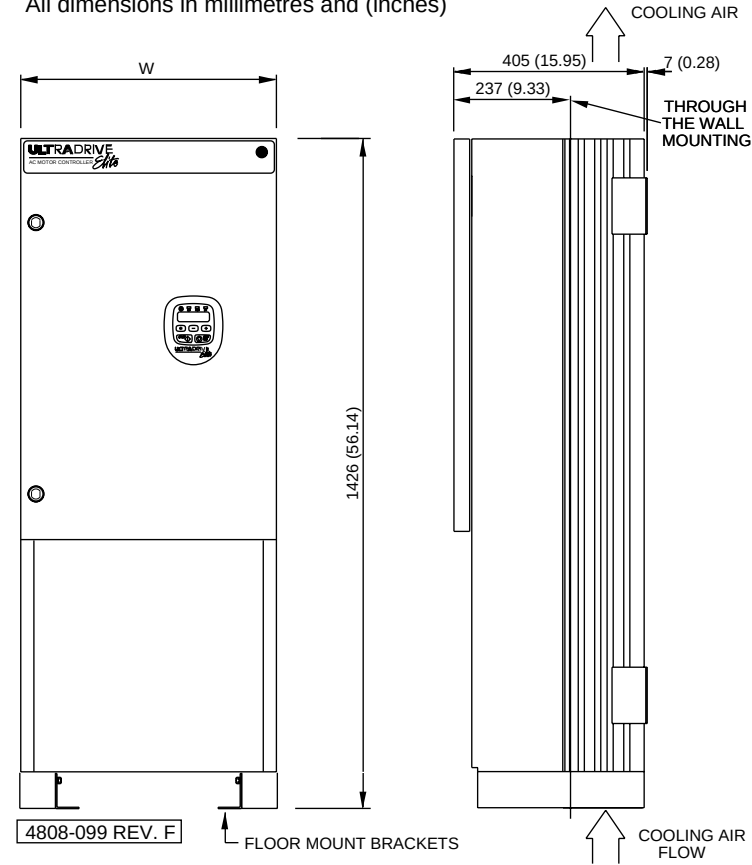


Figure 3.3: Ultradrive E-Series Frames 5 to 7 Dimensions

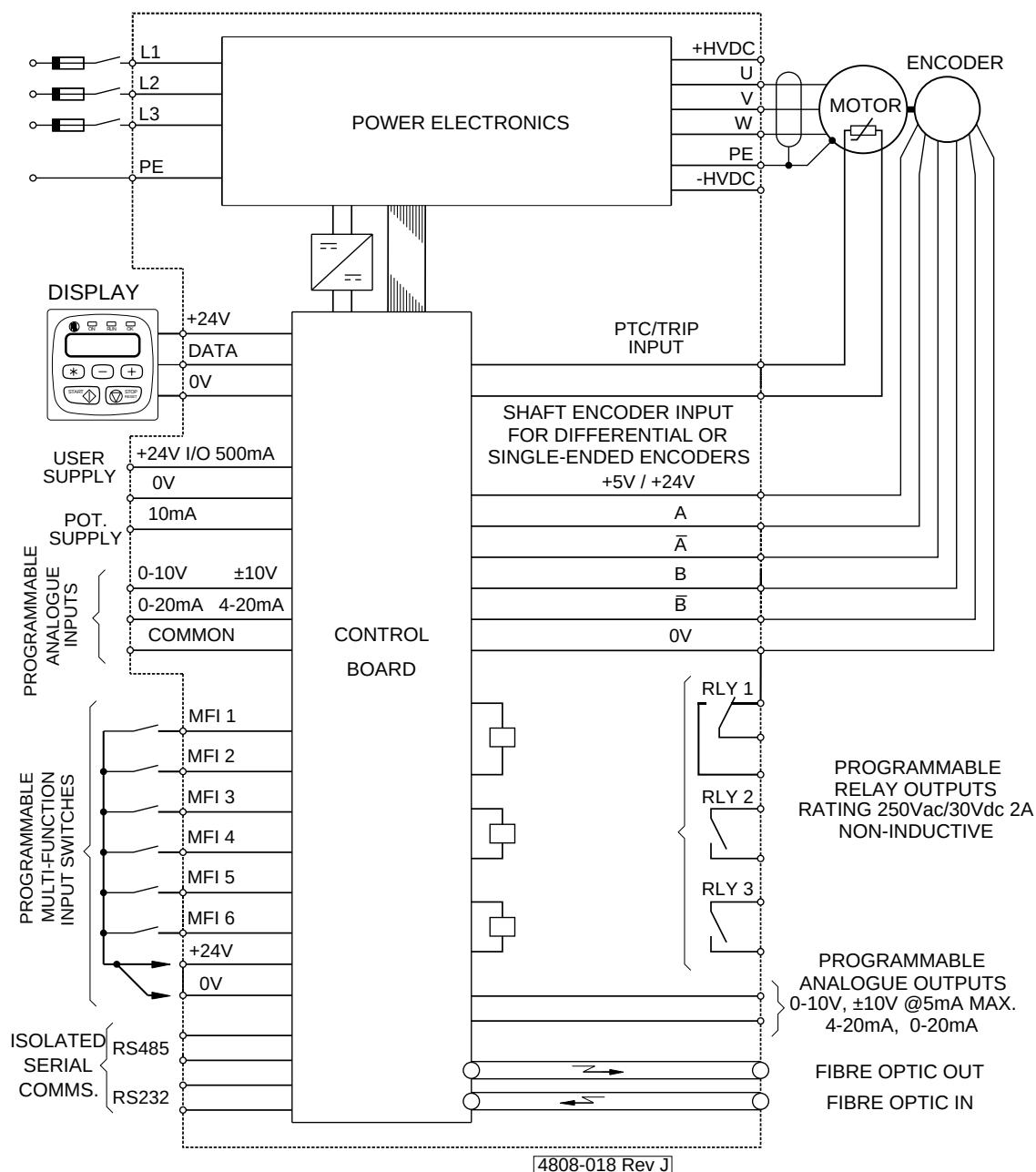
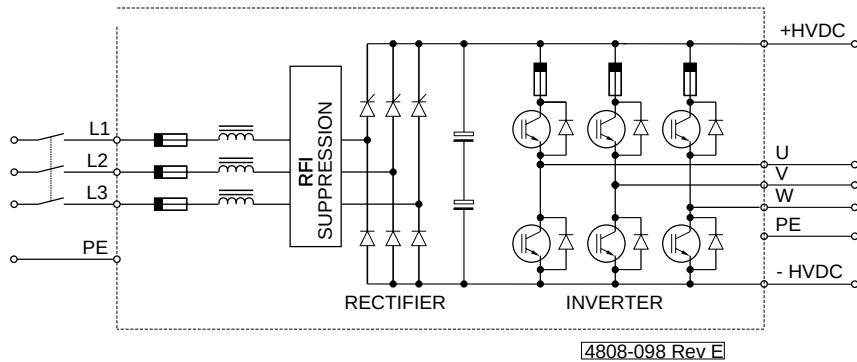
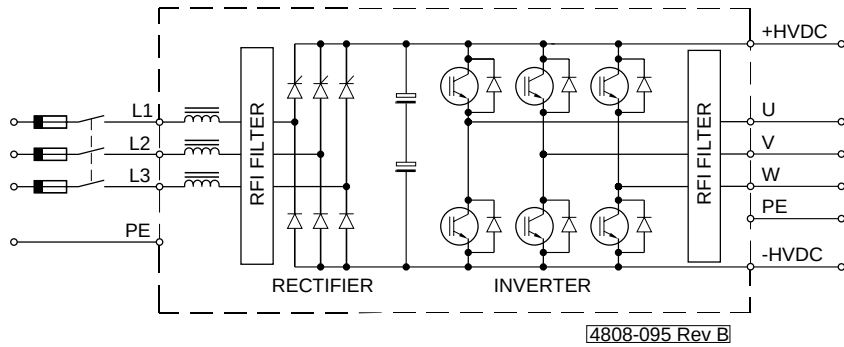
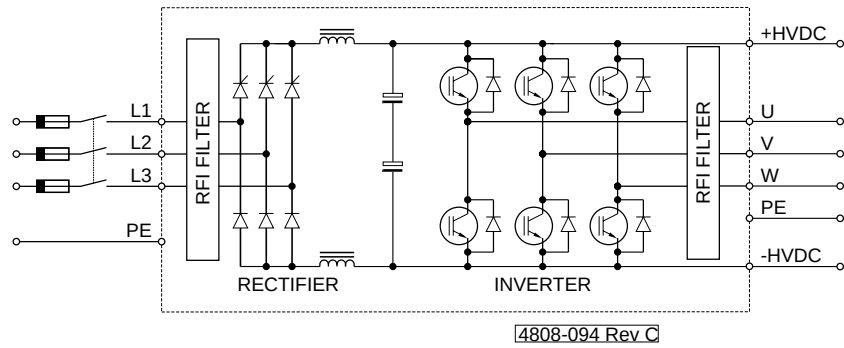
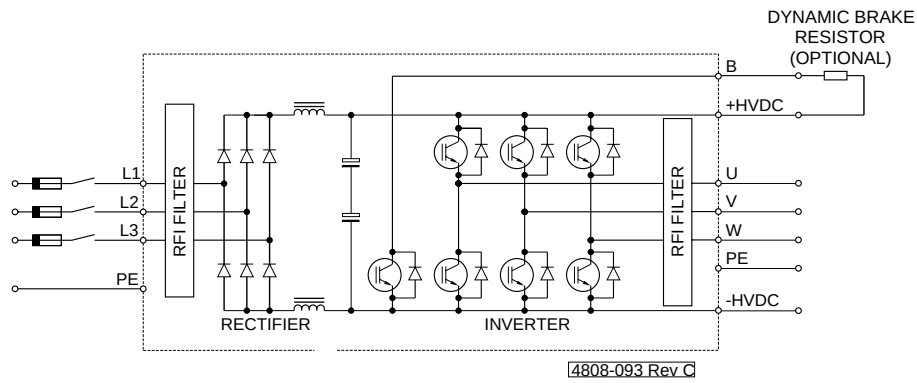


Figure 3.4: E-Series Electrical Overview



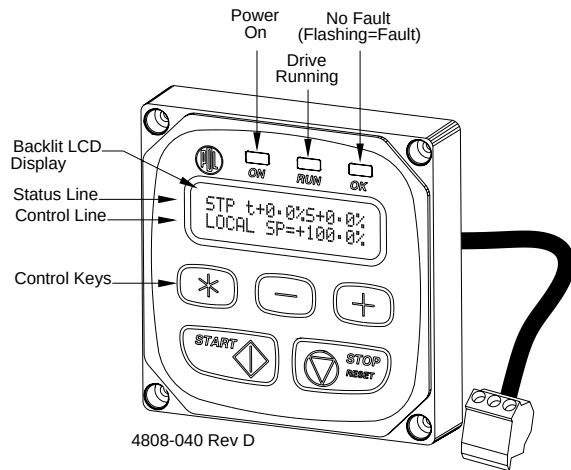


Figure 3.6: The Display Unit and Keys

3.1.4 The Display Unit and Controls

The Display Unit of the E-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 3.6.

THE LED INDICATORS

- | | |
|-----|--|
| ON | Indicates mains power is supplied to the E-Series Display. |
| RUN | Indicates the E-Series is running (driving a motor). |
| OK | Steady: Indicates that the E-Series is operating normally. |
| OK | Flashing: Indicates that the E-Series has tripped on fault protection. |

THE LCD DISPLAY

The E-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 E-Series status, the output current or torque and the motor speed.
- The CONTROL LINE of the display is used to view and/or adjust the many parameters of the E-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 E-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 E-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 E-Series Control Board processor has a number of logic and processing blocks integrated into the firmware. These can be configured using **VYSTA® for Windows** 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 E-Series must be in **commissioning mode** (Screen Z) before certain adjustments can be made. Some adjustments also cannot be made unless the E-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

Figures 3.7a & 3.7b provides the complete electrical specification of all E-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 E-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 250Vac levels (referenced to the protective earth - PE). Selection of their function is made through Screen Group O. 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 E-Series, it can be controlled from these terminals. For drives up to and including Frame 3, 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 Vysta® 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). Sampling rate: 4ms

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 2.1kOhms. 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. Opening this circuit will always trip the E-Series, removing power from the motor. Open this circuit in the event of a "loss of control" situation. Sampling rate: 4ms

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.

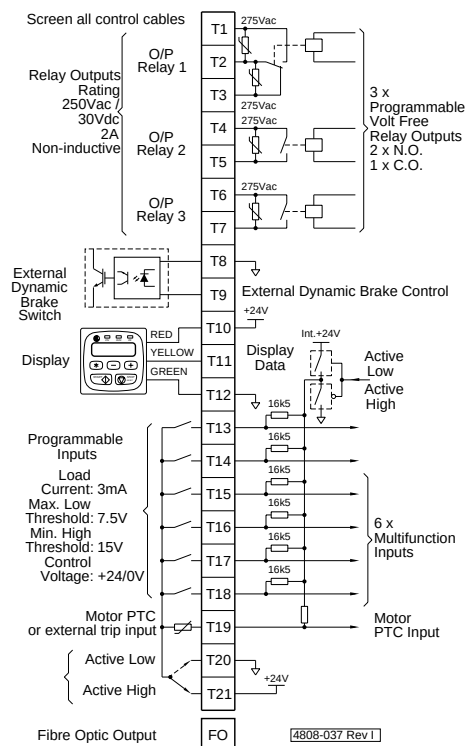


Figure 3.7a: Control Terminals T1-T21

Terminal T22 - Analogue Output 0V Connection

This 0V is a suitable return point for the two analogue outputs connected to Terminals T23, T24. This ground is internally linked to the other control grounds with the exception of T40.

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; 5mA max or 0 to 20mA or 4 to 20mA. Configuration is done from Screen Group O. Accuracy: $\pm 2\%$; Resolution: 8 bits.

Terminal T25 - Analogue Input 0V Connection

This 0V connection is a suitable return point for the two analogue outputs connected to Terminals T26, T27. This ground is internally linked to the other control grounds with the exception of T40.

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. Accuracy: $\pm 2\%$; Resolution: 10 bits.

Terminals T28, T29 - Potentiometer Supply

A 10mA constant current source provides up to 10Vdc for a 1k Ohm potentiometer.

Terminals T30 - +5Vdc

This terminal is provided for the encoder power supply. Maximum load is 100mA.

Terminals T31 to T34 - Incremental Quadrature Encoder Inputs

The E-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. This ground is internally linked to the other control grounds with the exception of T40.

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 $\pm 10\%$

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 E-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 (multifunction) 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 E-Series 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 $\pm 50\text{Vdc}$ (30Vac) from chassis earth.

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

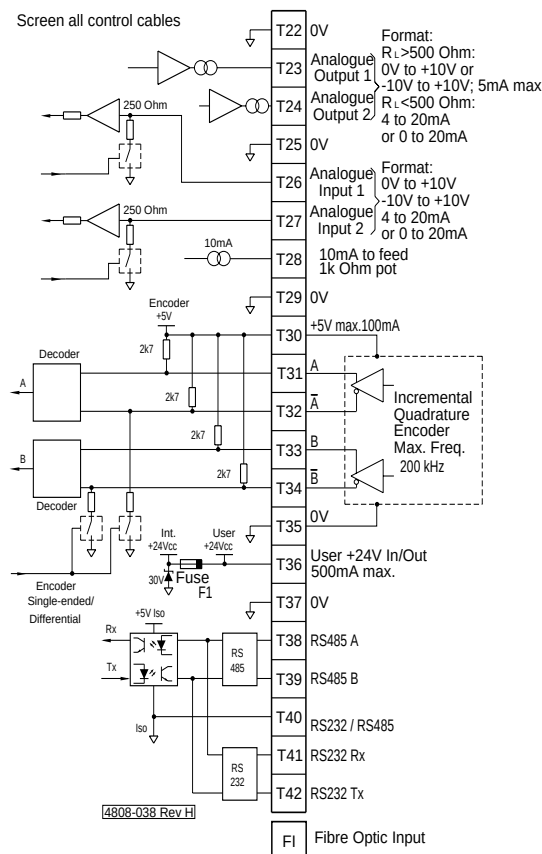


Figure 3.7b: Control Terminals T22-T42

3.2 DESCRIPTION OF THE E-SERIES CONTROL SYSTEM

3.2.1 Structure of the Inputs and Outputs

The following descriptions refer to figure 3.8.

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 -Screen I6g may be used to introduce a zero baud to the analogue signal. 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, and I6f.

OUTPUTS

Potentiometer Supply - A 11mA constant current source provides 10V to a 1kOhm potentiometer.

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 3.9, **unless the E-Series is operating in V/Hz mode**, the structure of the E-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 Mode control mode) for less critical applications.

THE FLUX VECTOR (TORQUE) CONTROLLER

Unlike conventional AC motor speed controllers, the E-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 mode operation is also available, where a motor shaft encoder is not used. A reduction in performance may be expected when running in this mode. Torque control is not available when operating in Open loop 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 eight 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 eight 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 E-Series to perform process control (e.g., constant pressure pumping etc.). External auto/manual selection is also available to assist during start-up conditions. Refer to figure 3.10

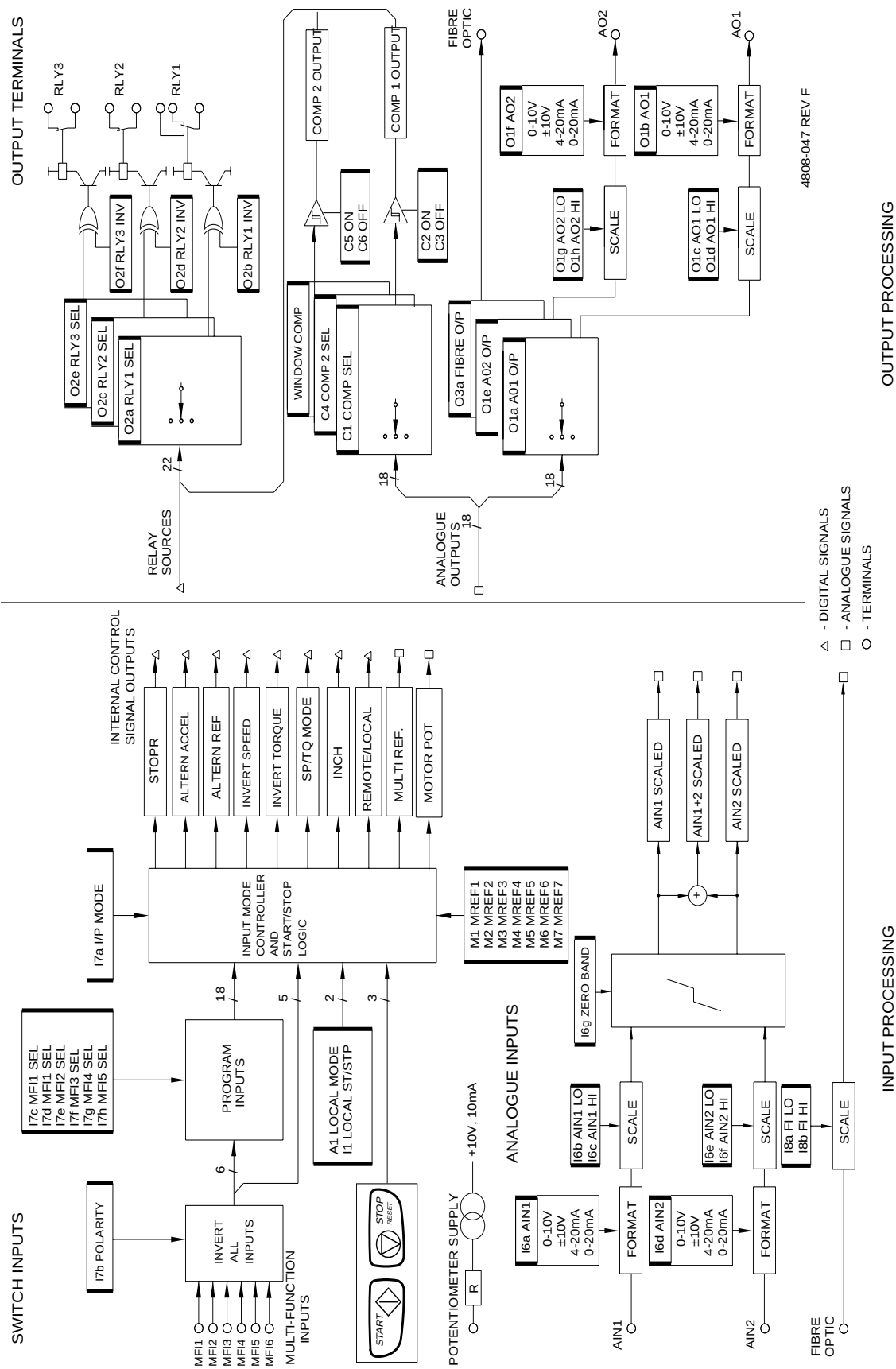


Figure 3.8: Structure of the E-Series Input/Output Processing System

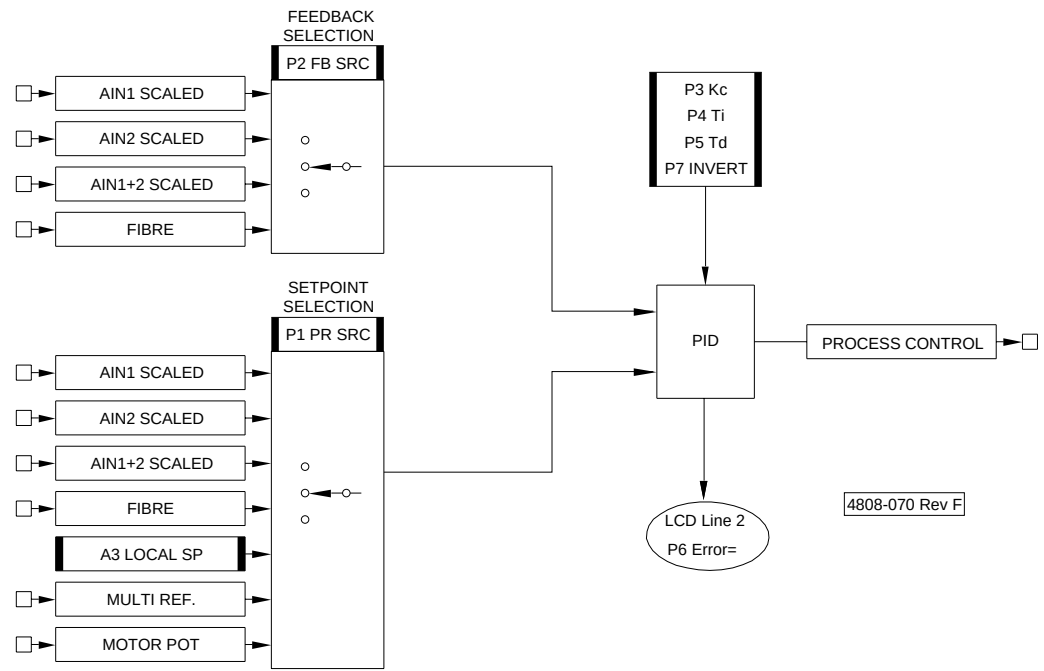


Figure 3.10: Process Control

4 APPLICATION RECOMMENDATIONS

4.1 THE MOTOR

4.1.1 Sizing the Motor and E-Series

The E-Series is suitable for controlling all standard three phase induction motors. In sizing the E-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 E-Series capable of supplying the motor's current requirements.

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

Note: Figure 4.1 is presented as a guide only. Refer to figures 2.1 and 2.2 for the 400V ratings and figures 2.3 and 2.4 for the exact ratings of the 500V models.

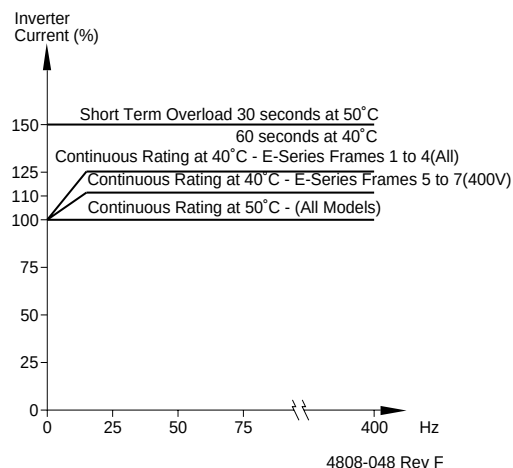


Figure 4.1: E-Series Thermal Overload Characteristics

In applications 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 E-Series should be chosen according to its continuous rating.

For pump and fan applications having a quadratic torque requirement where a high overload margin is not usually required, the E-Series may be re-rated according to figures 2.1 and 2.3, if the E-Series is to be operated in an environment of an ambient temperature not exceeding 40°C.

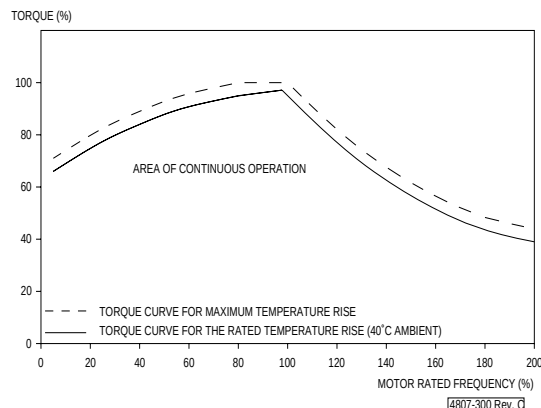


Figure 4.2: Typical Motor Thermal Derating

4.1.2 Operation Above Motor Rated Speed

The E-Series can be operated above motor rated speed in V/Hz and closed loop mode only, 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., connect a 400Vac star motor as a 230Vac delta, 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 E-Series in Open or Closed Loop mode, operation of more than one motor from the E-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 E-Series in V/Hz Mode, it is possible to run more than one motor in parallel off one E-Series. If running parallel motors, the rating of the E-Series should exceed the sum of the individual motor currents. Each motor will require individual thermal protection. Performance will be reduced.

4.1.4 Thermal Protection of the Motor

The E-Series maintains a thermal model of the motor as its primary means of detecting overload and providing 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 E-Series is running more than one motor.

4.1.5 Large Frame-size Motor Considerations

Large frame-size motors (typically greater than 315 frame) have additional installation requirements when used with AC motor controllers. These motors may exhibit rotor voltage build-up due to parasitic capacitance. Unless protective measures are taken, this voltage may discharge through the anti-friction bearings possibly leading to degradation of the bearing via electrical discharge machining (EDM).

The preferred solution is to fit insulated bearings (or an insulated bearing housing) with a rotor earthing brush. Careful selection of the rotor earthing brush is required, as this brush must provide a low impedance earth for high frequency pulses. Rotor shaft earthing brushes are now commercially available to suit this low voltage, low current application. These brush systems are designed for long life with minimal maintenance. Contact Bardac Drives or its agent for further information on suitable earthing brushes. An alternative solution is available from Bardac Drives in the form of Bardac's EDM Filter. The EDM filters out the common mode voltage applied to the motor. Contact Bardac Drives or its agent for further information on the EDM Filter.

4.2 THE ENCODER

4.2.1 Choice of Encoder

If the E-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 E-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 E-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 E-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, or for a differential encoder, A and $\bar{A}$ signals should be swapped. Refer figure 5.3.

4.3 SWITCHING

4.3.1 Power Switching

Generally it is better practice to leave electronic equipment (including the E-Series) permanently connected to the mains supply. Switching the mains on and off to control the E-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 E-Series acts as a variable frequency (including DC) current source :-

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

Although the E-Series will not be damaged, standard industrial switchgear (AC1 or AC3) 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 E-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 E-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

In Open Loop or Closed Loop vector mode 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 E-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 Mode or V/Hz control mode may be employed. In these modes 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). **Torque Control mode may only be selected** when the E-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 E-Series. In its standard form the E-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 E-Series frame 1 to 2 models 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".

E-SERIES	DB RESISTOR MINIMUM (Ohms)	DB RESISTOR POWER RATING (MIN-kW)
E002	500	1.1
ME-2D	500	1.4
E006	180	3
ME-6D	180	3.8
E010	130	4
ME-9D	130	5.3
E012	100	5.3
ME-11D	100	6.7
E018	50	10.6
ME-16D	50	13.5
E022	50	10.6
ME-21D	50	13.5

Figure 4.3: Dynamic Brake Resistor Ratings
(Typical)

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

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 200mm 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 dielectric strength to withstand 1000 Vdc (conductor to conductor rating for multicore cables).

On the E-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.

5 UNPACKING, INSTALLATION AND CONNECTION

5.1 UNPACKING

Full details on the unpacking procedure are given in the E-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 E-Series are given in the E-Series Getting Started Manual (Part No. 4201-179).

The E-Series IP54 models are protected against an environment contaminated to pollution degree 2 (damp or dusty air). The E-Series 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 E-Series may have its output current re-rated according to figures 2.1 and 2.3 for motor speeds exceeding 25Hz. This is useful for pump and fan applications with quadratic torque requirements.

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

The Ultradrive E-Series frame 4 is designed for wall mounting (vertical upright). Do not invert.

The Ultradrive E-Series frames 5 to 7 are designed for floor mounting only (vertical upright). Secure using the wall supports for earthquake protection.

As with all electronic equipment, the cleaner, cooler and more vibration free environment, the longer and more trouble free will be the life of the E-Series AC Motor Controller.

Frame	380-440V Models (note 1)	440-500V Models (note 2)
1	E002 to E012	ME-2D to ME-11D
2	E018 to E022	ME-16D to ME-21D
3	E031 to E046	ME-30D to ME-41D
4	UE-60C to UE-140C	UE-60D to UE-140D
5	UE-170C to UE-250C	UE-170D to UE-250D
6	UE-305C to UE-540C	UE-305D to UE-540D
7	UE-620C to UE-700C	UE-620D to UE-700D

Note 1: Frames 1-4 are also available to suit a 230Vac (-20+10%) supply
 Note 2: Frames 1-4 are UL/cUL approved to 480Vac

5.3 MANUFACTURER'S RECOMMENDATIONS

Failure to adhere to the manufacturer's recommendations for installation, environmental conditions and electrical specifications may result in damage to the E-Series (and/or external equipment) and may void the warranty.

5.4 POWER WIRING CONNECTIONS

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

Figure 5.2 provides a summary of required power connections. Note the following requirements:

- 1 The E-Series is designed for operation from a three phase earthed neutral supply. Input fuses are required. Details of the recommended fuse size are given in figures 2.1 to 2.4. In all cases, observe all site, local and national wiring and safety regulations. Harmonic and EMC suppression techniques used means that the E-Series is designed only for connection to an industrial power supply, supplied by a dedicated distribution transformer. The E-Series is not suitable for direct connection to a low-voltage public mains network which is shared with other premises.
- 2 Due to the high leakage currents inherent to AC drives, earth connection of both the motor and the E-Series is essential before connecting to the supply. The E-Series must be permanently connected to the supply.
- 3 Power factor capacitors are not required on the E-Series input, and must not be connected to the E-Series output.
- 4 An off load isolation switch or contactor may be fitted to the E-Series output. **Never** attempt to operate this switch under load. **Never** open a contactor on the output while the E-Series is running as the E-Series operates as a current source. Opening the output while running could cause extensive damage or fire in the switchgear.
- 5 The Microdrive E-Series and Ultradrive E-Series frame 4 are fitted with electromagnetic interference (EMI) filtering as standard. External supply side filters are **not required** for the Ultradrive E-Series frames 5 to 7. Shielded mains supply cables are not required to meet EMC requirements, however these may be used to reduce the possibility of interference to very sensitive equipment. As an alternative, 3 phases and an earth lead can be run together in a tight loom to reduce any magnetic and electric fields. Enclosing the cable loom in metallic trunking can also reduce interference problems. Do not run mains wiring in close proximity to motor output cables or control cables. Further information is available from Bardac Drives Applications Department.
- 6 The E-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 E-Series or the motor must be isolated before operating on the motor terminals.
- 7 The E-Series output switching waveform can give rise to high (capacitive) earth leakage currents. A direct, permanent earth connection between the motor and the E-series drive is essential before connection to the supply. Screened EMC cable should be used between the E-series output and the motor and the E-series output and the motor to reduce the chances of radio frequency interference (RFI) problems. Suitable EMC cables are SIEMENS PROTOLEX - EMV, OLEX VAROLEX- flex, and TRIANGLE AM cables. A 360° EMC clamp should be used to secure the cable screen to the cable gland plate. Parallel connection of EMC cables for higher operating currents is possible provided the cables are equal length and each cable uses all of the three output phases.

Where screened EMC cable is impractical individual cables for each phase can be used but these must be run parallel and close proximity to each other. Binding these cables together with tape and/or cable ties will minimize stray magnetic and electric fields as well as RFI. Enclosing these cables inside steel conduit or ducting can further reduce the possibility of interference. Do not run motor output cables in close proximity to mains wiring or control cabling. Further information is available from Bardac Drives Applications Engineers.

- 8 For applications where regeneration is likely to occur, a dynamic brake resistor or module may be required. The resistor must be positioned where the expected heat generated by it will not ignite or damage its surroundings.
- 9 The location and order of the power terminals varies from model to model. Refer to the terminals labels before connection. Figure 5.1 provides recommended tightening torques for the power terminals.

The E-Series, frame sizes 5 to 7, are fitted with UL approved DC cooling fans. These fans are powered from a DC power supply. The AC supply to the fan transformer must be matched to the incoming supply voltage.

Mismatching the fan power supply and line voltage can lead to inefficient cooling, or fan damage.

To achieve full IP54 and UL Type 12 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 refer to the E-Series Getting Started Manual (Bardac Part No. 4201-179). Also once connections are made, ensure that the terminal cover is fitted correctly and all screws and locks tightened to the recommended torque.

Model	Torque N.m (lbs.ins)
ME frames 1 to 2	1.7 - 2.3 (15-20)
ME frame 3	10.2 - 12.4 (90-110)
UE frame 4	M8 22 - 29 (195-257) M10 43 - 56 (381-496)
UE frames 5 to 7	43 - 56 (381-496)

Figure 5.1: E-Series Power Terminal tightening Torque

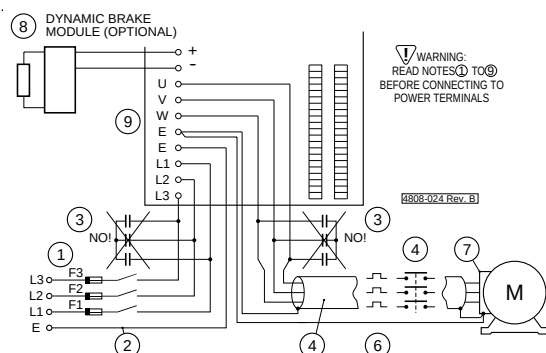


Figure 5.2: E-Series Power Connection

5.5 CONTROL WIRING CONNECTIONS

Control wiring should be done using screened cable. The screen is earthed at one end only (at the E-Series end). For safety reasons, the E-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 E-Series Getting Started Manual (Part No. 4201-179).

5.6 SHAFT ENCODER CONNECTIONS

If using the E-Series in Closed Loop 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 E-Series Getting Started Manual (Bardac Part No. 4201-179) for details on achieving correct orientation of encoder and motor wiring.

5.7 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 attenuation 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.

5.8 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.

5.9 ANCILLARY EQUIPMENT

The Ultradrive E-Series frames 5 to 7 has mounting points for small items of ancillary equipment. Do not drill additional holes in the E-Series metalwork as swarf (metal filings etc) may short internal components leading to irreparable damage and danger to personnel.

5.10 COMMISSIONING DETAILS

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

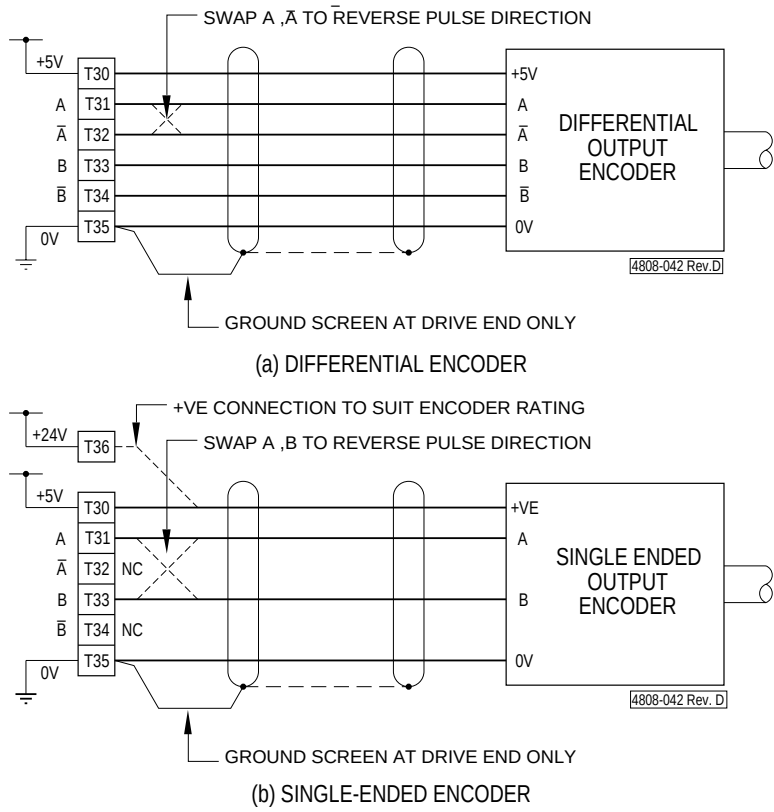


Figure 5.3: Shaft Encoder Connection Details

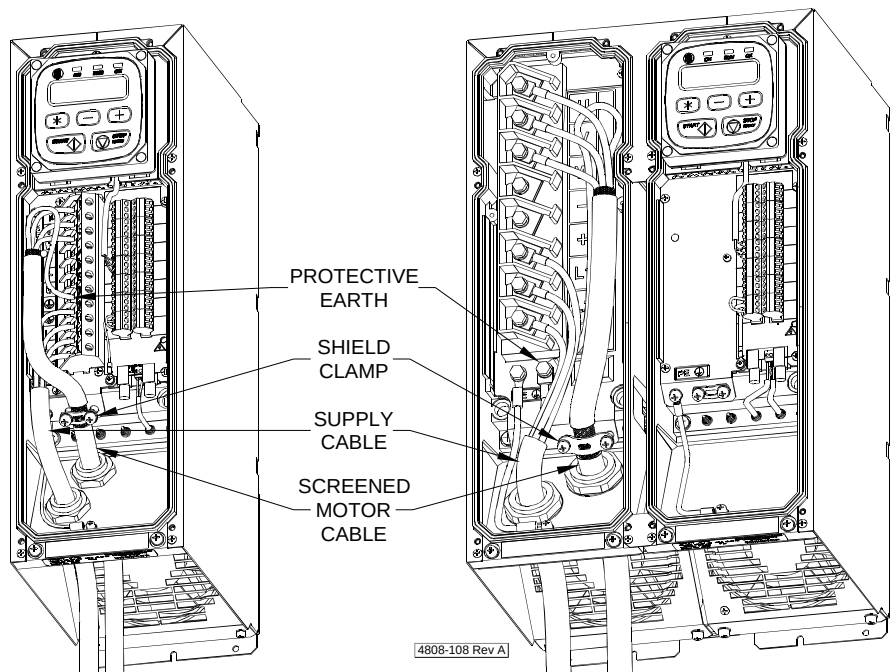


Figure 5.4: Microdrive E-Series Cable Configuration

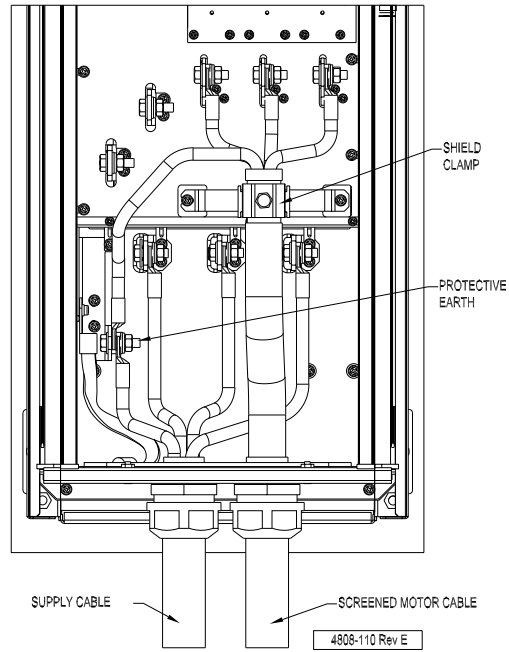


Figure 5.5: Ultradrive E-Series Frame 4 Cable Configuration

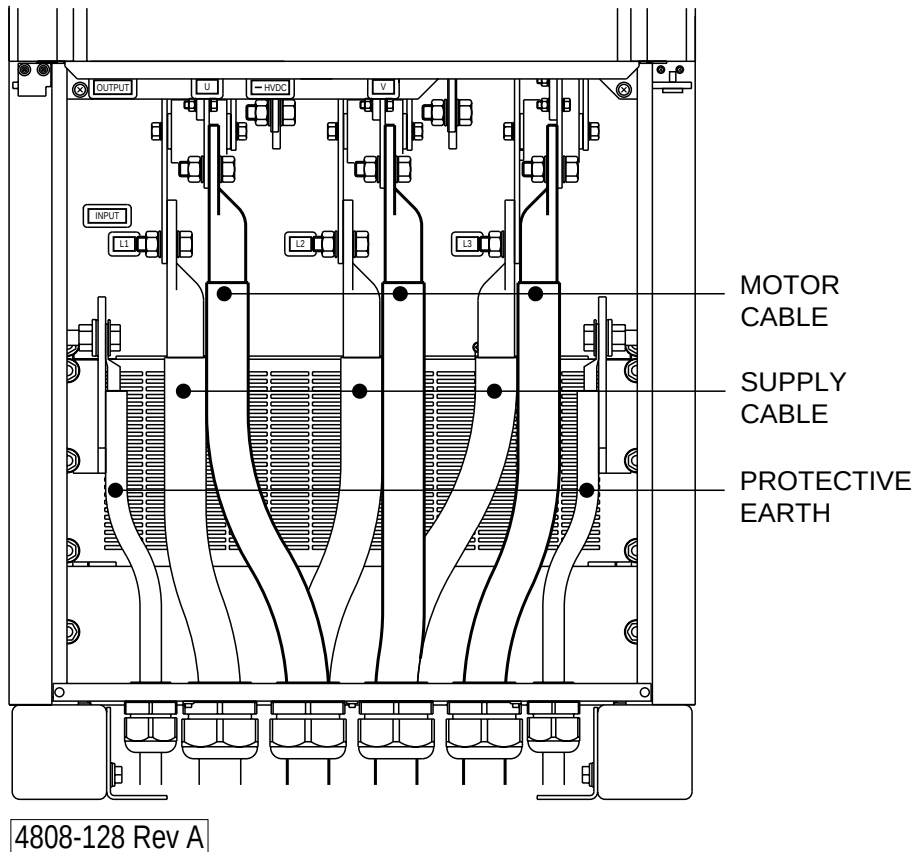
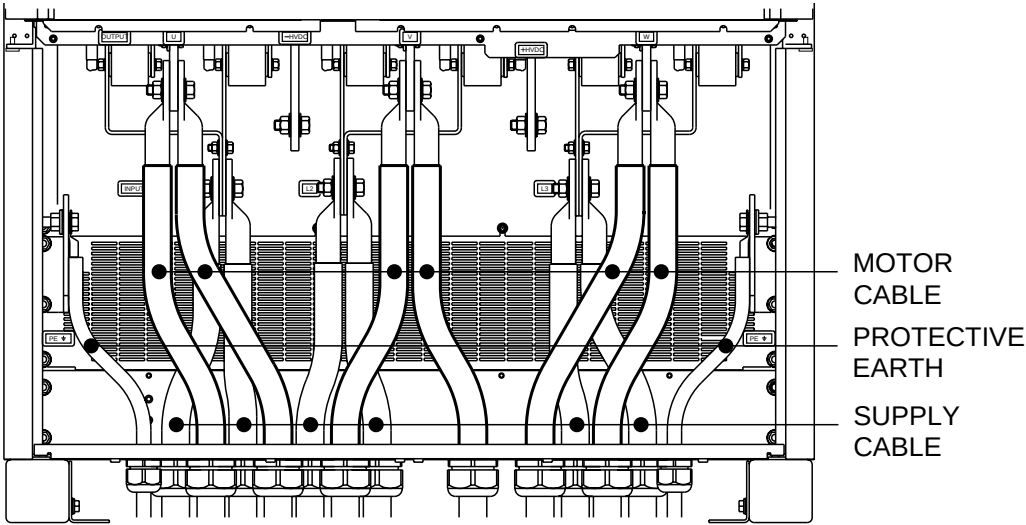
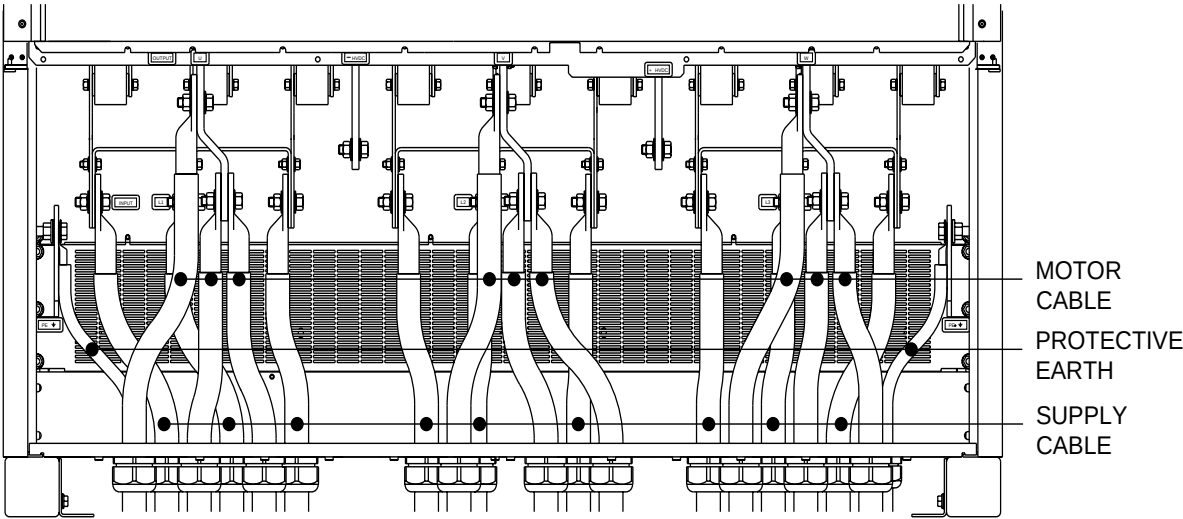


Figure 5.6: Ultradrive E-Series Frame 5 Cable Configuration



4808-129 Rev A

Figure 5.7: Ultradrive E-Series Frame 6 Cable Configuration



4808-130 Rev A

Figure 5.8: Ultradrive E-Series Frame 7 Cable Configuration

6 SERVICE AND MAINTENANCE

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

6.1 FAULT FINDING

Faults in the E-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 E-Series, or as a "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 E-Series.

Electrical failure is generally not repairable by the user. Repair is achieved by returning the faulty unit to Bardac Drives or their authorised Service Agent. Before disconnection, try to record commissioning parameters either on paper or by uploading to a PC running Drivecomm 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 E-Series Getting Started Manual (4201-179) for instructions.

6.1.2 Protective Fault Operation

The E-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 6.2 for detailed descriptions.

6.1.3 Encoder Failure

The E-Series cannot continue to operate in **Closed Loop 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 E-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 typically indicate torque or current limit.

If you cannot run the E-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) and monitor the encoder Screen Z9.

If the motor speed or torque is erratic; check that the encoder is mounted correctly to the rotor and is not slipping.

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 E-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 using the Initialise User Parameters function in 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 E-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 invoked from Screen X2. Full details on tuning options are given in the E-Series Getting Started Manual (4201-179).

If when running in Closed Loop Vector control mode, the E-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 E-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 using the Initialise Motor Parameters function (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 E-Series to fail to respond to control signals. External wiring faults or incorrect setup can also stop the E-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 E-Series fail to communicate with the Display Unit, the message **NO COMMS** 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 E-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 E-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 S7).
Sense level	Model dependant
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	820Vdc (E002 to E046) 900Vdc (Other E-Series)
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. Dynamic Brake failure or undersized.
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 (E002 to E046) 850Vdc for greater than 5 seconds (Other E-Series)
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 E-Series DC bus. Phase imbalance is most sensitive under heavy load conditions. Under light load conditions, the E-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 LIM FLT
Detail	Output current has reached a dangerous level.
Sense level	220% of E-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 E-Series.
Fault	15 ELITE O/L
Detail	The temperature calculated by the E-Series Series inverter thermal model has reached a dangerous level.
Sense level	150% of rated E-Series rated current for 30 seconds at 50° C. Maximum continuous operation possible without trip is 105% of E-Series rating.
Possible cause	Continuous overload of E-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.	Sense level	80°C.
Fault Detail	17 BRAKE O/L The temperature calculated by the thermal model of the dynamic brake resistor has reached a dangerous level.	Possible cause	Poor ventilation; obstructed ventilation path, E-Series heatsink and internal cooling fan failure; local ambient temperature exceeds 50°C.
Sense level	Set by dynamic brake thermal model in Screens D1 and D2.	Action	Check heatsink and internal cooling fans are operating; Check ventilation and thermal conditions. Improve cooling. Seek service.
Possible cause	Excessive regeneration for the resistor specified in Screens D1 and D2. Incorrect values entered.	Fault Detail	25 COMMS TRIP Host computer generated trip.
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).	Sense level	–
Note:	Active whether a dynamic brake is connected or not.	Possible cause	Trip generated by the host computer via serial communications.
Fault Detail	18 DATA FLT 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.	Action	No action required.
Sense level	Check sum in memory	Fault Detail	26 COMMS T/O Time since last valid serial communication has exceeded timeout period on Screen H2.
Possible cause	Spurious fault; faulty memory.	Sense level	Set by communications timeout value on Screen H2.
Action	If fault recurs, replace E-Series.	Possible cause	Serial communications wiring faults; host computer fault; incorrect settings on Screens H1 to H4.
Fault Detail	19 ZERO PARAM Zero parameters (N screens) have been detected.	Action	Check complete serial communications system; Check screen settings, Seek service.
Possible cause	E-Series has been reinitialised; ex-factory state; error in set up.	Fault Detail	27 FIBRE T/O Time since last valid fibre optic input has exceeded timeout period on Screen I8d.
Action	Enter all N values correctly.	Sense level	Set by Fibre T/O value on Screen I8d.
Fault Detail	20 PARAM FLT Inconsistent set of parameters (N screens, L9 screen) selected.	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.
Possible cause	Error in set up; wrong values chosen.	Action	Check fibre optic cable; Check screen settings; Seek service.
Action	Enter consistent set of N values.	Fault Detail	28 OVERSPEED Maximum output speed has been exceeded.
Fault Detail	21 GROUND FLT Excessive current flow to ground.	Sense level	300% of motor rated frequency; absolute maximum 450Hz.
Sense level	Internally set.	Possible cause	Loss of control of the motor while being driven by load; excessive load.
Possible cause	Motor or cable insulation fault.	Action	Check actual operating conditions to determine cause. Adjust load or set up to eliminate problem.
Action	Check motor and cables (isolate from E-Series first). Refer to Screen L13.	Fault Detail	29 TQ LIM T/O At torque limit for longer than specified.
Fault Detail	22 EXT/PTC External trip device has operated. External motor winding temperature sensor (PTC, thermostat etc.) circuit (Terminal T19) has operated.	Sense level	Set by Screen L7.
Sense level	Circuit resistance exceeds 4kOhms.	Possible cause	Load condition or inappropriate setting of Screen L7; encoder failure.
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.		Additional causes for this fault occurring during Open Loop mode starting are: Insufficient start torque (Screen X4c) Too high an acceleration rate (Screen R1, & R3), and Insufficient start delay (Screen S5).
Action	Check motor temperature and sensor wiring. Check external trip switch (if fitted).		Another possible cause is the motor is overloaded while in Open Loop mode.
Fault Detail	23 H/S TEMP E-Series heatsink too hot.	Action	Check load condition or alter Screen L7. For Open Loop mode starting fault adjust any of the three screens mentioned above as follows: Increase start torque (Screen X4c), Decrease acceleration rate (Screen R1), Increase the torque limit (Screen L4 & L5).
Sense level	90°C.		
Possible cause	Poor ventilation; obstructed ventilation path, E-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 Detail	24 INT TEMP E-Series internal temperature too hot.		

	Increase Rs(Screen X3b)	Action	Check cables and motor for possible short circuit.
Fault	30 SP LIM T/O	Fault	41 STOP T/O
Detail	At speed limit for longer than specified.	Detail	The system has not stopped within the time-out set by Screen S11
Sense level	Set by Screen L6.	Possible Cause	Parameters set incorrectly: Stop Timeout (Screen S11), Decel rates (Screen R2, R4, R6), Speed filter (R7). Mal-tuned speed pid in vector systems.
Possible cause	Load condition or inappropriate setting of Screen L6.	Action	Check all parameters. Check Dynamic brake.
Action	Check load condition or alter Screen L6.	Fault	43 MAS U+ DES 44 MAS U- DES 45 MAS V+ DES 46 MAS V- DES 47 MAS W+ DES 48 MAS W- DES 49 SLV U+ DES 50 SLV U- DES 51 SLV V+ DES 52 SLV V- DES 53 SLV W+ DES 54 SLV W- DES
Fault	31 CAL FLT	Detail	Internal protection of a semiconductor switching device has occurred. MAS = Master Ultradrive E-Series. SLV = Slave Ultradrive E-Series. DES = DESAT.
Detail	Internal reference voltage levels are incorrect.	Possible Cause	Output short circuit, extreme output over current, wiring fault, IGBT Desaturation, IGBT failure.
Possible cause	E-Series fault. Seek service.	Action	Check entire output circuit and motor for wiring or winding faults. If fault persists when output leads are disconnected, replace or service the Ultradrive E-Series.
Fault	32 S/W T/O	Fault	55 MAS I FLT
Detail	Internal timing requirements exceeded.	Detail	The MASTER Ultradrive E-Series output current has reached a dangerous level.
Possible cause	Vysta® for Windows configuration too complex.	Possible Cause	Short circuit, wiring fault, circuit fault, motor fault.
Action	Simplify configuration.	Action	Check entire output circuit and motor for wiring or winding faults. Check output circuit contactors and or isolators for correct operation.
Fault	33 LVDC FLT	Fault	56 SLV I FLT
Detail	Failure of the low voltage dc power supplies.	Detail	The SLAVE Ultradrive E-Series output current has reached a dangerous level.
Possible cause	Heatsink cooling fan failure, control PCB failure.	Possible Cause	Short circuit, wiring fault, circuit fault, motor fault.
Action	Seek service.	Action	Check entire output circuit and motor for wiring or winding faults. Check output circuit contactors and or isolators for correct operation.
Fault	34 VYSTA TRIP	Fault	57 DESAT/OCT
Detail	Custom configuration developed using Vysta® for Windows has deliberately tripped the E-Series.	Detail	The SLAVE drive indicates a common desat or over current fault.
Possible cause	Refer to custom configuration schematic.	Possible Cause	Short circuit, wiring fault, circuit fault, motor fault.
Action	Refer to custom configuration schematic.	Action	Check entire output circuit and motor for wiring or winding faults. Check output circuit contactors and or isolators for correct operation.
Fault	35 NO DISPLAY	Fault	58 CURR IMB
Detail	The E-Series has detected that the display unit is disconnected or faulty. The E-Series will trip on this fault only if the display unit is enabled via Screen I1 (I1 LOCAL S/STP= 1,2,3).	Detail	The MASTER and SLAVE Ultradrive E-Series output current is out of balance.
Possible cause	Display removed by personnel; display mounted more than 3m distance from the E-Series unit; faulty display unit.	Sense Level	10% of actual individual Drive output current.
Action	Connect display unit and disable keyboard mode using Screen I1 (I1 LOCAL S/STP=0); reduce distance, replace display unit.	Possible Cause	Mismatch of IGBTs, output impedances or input rectifier.
Fault	36 EPLD TRIP		
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 E-Series.		
Fault	37 WATCHDOG		
Detail	An unknown fault has reset the Control Board microcontroller.		
Possible cause	Power supply fault, Vysta® for Windows configuration too complex.		
Action	Reset fault; if fault persists, seek service or replace the E-Series; simplify Vysta® for Windows configuration.		
Fault	38 NO VYSTA PRG		
Detail	User Program not set		
Action	Reload Program via Drivelink software		
Fault	39 FIBRE TRIP		
Detail	The E-Series has tripped due to a fault being reported via the Fibre Optic Network		
Cause	See other E-Series connected to the network		
Action	Reset fault on the other E-Series		
Fault	40 ILIMIT T/O		
Detail	The hardware current limit has been active for longer than 30 seconds.		
Possible Cause	A partial short circuit in the cabling or motor.		

Action	Check entire output circuit including IGBTs output bus work, DC bus fuses and input rectifier.	Fault Detail	68 SLV SW VER SLAVE Ultradrive E-Series has incorrect software loaded.
Fault Detail	59 SLV HS FLT The SLAVE Drive has detected either MASTER or SLAVE drive heatsink is TOO HOT.	Possible Cause	The SLAVE drive control board data transmission error; incompatible software and hardware revisions.
Sense Level	80°C.	Action	Download correct software to SLAVE drive Control Board.
Possible Cause	Poor ventilation; obstructed ventilation path, E-Series cooling fan failure; local ambient temperature exceeds 50°C.	Fault Detail	69 SLV PCBTEM The SLAVE Ultradrive E-Series internal temperature is too hot.
Action	Check fan is operating; check ventilation and thermal conditions. Improve cooling. Clean fins with compressed air. Seek service.	Sense level	70°C
Fault Detail	60 SLV DC HI The SLAVE Ultradrive E-Series dc bus voltage has risen to a dangerous level.	Possible Cause	Poor ventilation; obstructed ventilation path; fan failure; local ambient temperature exceeds 50°C.
Sense Level	820Vdc	Action	Check fan is operating; Check ventilation and thermal conditions; Seek service.
Possible Cause	DC bus inter-link cable fault.	Fault Detail	70 DC FUSE FLT Fuse monitoring device has operated. External fuse monitoring circuit on SLAVE Ultradrive E-Series Parallel Board T30 has operated.
Action	Check dc bus inter-link.	Possible Cause	One of the monitored fuses has failed and the monitoring switch has opened.
Fault Detail	61 SLV EPLD The SLAVE Ultradrive E-Series internal processing units have faulted.	Action	Check for continuity on fuse monitoring circuit, look for open circuit in wiring.
Possible Cause	Faulty or unprogramed SLAVE drive control board.	Fault Detail	71 DWM1 TRIP Drive web interface watchdog timer trip
Action	Reset all Drive parameters using the INILITILISE ALL VAR at Screen Y2; replace SLAVE drive Control Board.	Sense level	Time out set by Driveweb server during configuration
Fault Detail	62 CONNECT FLT The MASTER and/or SLAVE Ultradrive E-Series looming connections are incorrect.	Possible Cause	Ethernet interface link to drive has been lost. Driveweb interface has not been polled within the watchdog time specified.
Possible Cause	The fibre optic connections are plugged in incorrectly or not working.	Action	Check Ethernet interface wiring.
Action	Check all the wiring connections.	Fault Detail	72 DWTI BLOCKS Driveweb interface is fitted and drive has detected Vysta program blocks are loaded.
Fault Detail	63 SLV WDT An unknown fault has reset the SLAVE drive Control Board.	Possible Cause	No Vysta blocks are allowed in a drive fitted with a Driveweb interface.
Possible Cause	Power supply fault, Software fault.	Action	Remove Vysta program from drive (download standard screen list) or remove Driveweb interface.
Action	Reset fault; seek service or replace the SLAVE drive Control Board.		
Fault Detail	64 SLV EEPROM The SLAVE drive Control Board's nonvolatile memory (EEPROM) is faulty.		
Possible Cause	IC failure.		
Action	Seek service.		
Fault Detail	65 SLV PSU The SLAVE Ultradrive E-Series Control Board power supply failure.		
Possible Cause	Fault IC.		
Action	Seek service.		
Fault Detail	66 SLV DATA The SLAVE Ultradrive E-Series Control Board's nonvolatile memory (EEPROM) reading error. This fault can only be cleared using Screen Y2 to initialise settings. Isolate motor before resetting fault.		
Sense level	Check sum in memory.		
Possible Cause	Spurious fault; faulty memory.		
Action	If fault recurs, replace SLAVE paralleling card.		
Fault Detail	67 SLV CAL The SLAVE Ultradrive E-Series drive select modules are incorrect.		
Possible Cause	Incorrect combination of drive select modules are plugged into the SLAVE drive select card.		
Action	Check both drive select modules are identical on the SLAVE drive Control Board.		

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	E-Series is running.
Actual indication	Output devices enabled.
Implication	E-Series is functional.

LED OK (Steady)

Functional indication	E-Series is operating normally.
Actual indication	E-Series ready to operate.
Implication	No fault is present.

LED OK (Flashing)

Functional indication	Fault trip.
Actual indication	Output disabled.
Implication	A fault (Screen F) has tripped the E-Series.

6.4 FUSE FAILURE

The E-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 E-Series; E-Series failure.

Action Check supply cable; check E-Series unit. Isolate E-Series and replace fuses. If OK reconnect E-Series and re-test. If failure persists replace E-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. 230Vac accidentally connected to the +24Vdc input supply.

Action Check external equipment connected to the +24Vdc supply. Replace fuse. If failure persists request service.

Microdrive E-Series Supply fuses

These fuses must be fitted at the point of input termination to the E-Series. Refer to figures 2.1 to 2.4 for recommended fuses. These fuses are fitted to limit fault energy let-through to protect cables and upstream switchgear.

Possible reason for failure

Wrong fuses; supply surge; age or cyclic stress failure; fault in supply cable to E-Series; E-Series failure.

Action Check input cables and E-Series for any signs of a fault. Isolate E-Series and replace with correct fuses. Test. If OK, reconnect E-Series and re-test. If failure persists replace E-Series, or request service.

Ultradrive E-Series frames 5 to 7

DC bus fuses

These fuses are fitted to limit fault energy and prevent damage to the Power PCB.

Possible reason for failure

Supply surge; age or cyclic stress failure; wrong fuses; fault in output cable to motor; Ultradrive E-Series failure.

Action Isolate Ultradrive E-Series. Check output cables; check Ultradrive E-Series; Unless confident fault found and cured, contact service agent. Replace fuses. Reconnect Ultradrive E-Series and test. If failure persists replace Ultradrive E-Series, or request service.

Ultradrive E-Series frames 5 to 7

F1/F2 2A 440Vac SMPS DC Bus Fuses

Fitted on Ultradrive E-Series frames 5 to 7 DC Fuse PCB to protect the Power PCB and DC bus cable loom to the Power PCB.

Possible reason for failure

Fault in switch mode power supply or loom to Power PCB.

Action Replace fuses. If failure persists, replace Ultradrive E-Series Power PCB assembly, or request service.

WARNING: These fuses must not be replaced with glass fuses (glass fuses will rupture and cause catastrophic damage). Use only the specified 440Vac 2A ceramic fuse.

Ultradrive E-Series frames 5 to 7

10A 440Vac heatsink fan supply fuses

Fitted on the Ultradrive E-Series frames 5 to 7 SCR PCB to protect against transient suppression overload; and to protect against heatsink fan failure.

Possible reason for failure

Supply surge; faulty heatsink cooling fan.

Action Replace fuse, check fan operation. If failure persists, replace heatsink cooling fan(s), or request service. Use only the specified 440Vac ceramic fuses.

WARNING: These fuses must not be replaced with glass fuses (glass fuses will rupture and cause catastrophic damage). Use only the specified 440Vac 2A ceramic fuse.

7 THE E-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 current or 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 E-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.

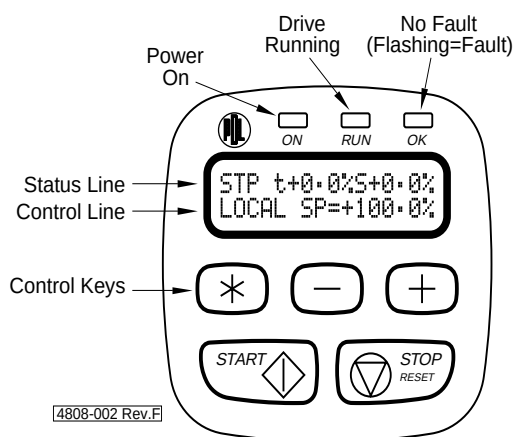


Figure 7.1: The Display Unit

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 E-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 pressing the "+" key will 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.

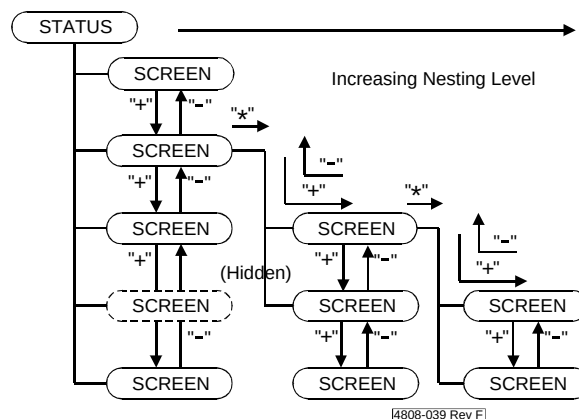


Figure 7.2: Screen Unfolding and Folding

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 E-Series phases U, V, W respectively
- and the E-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 Off to Modify

For maximum flexibility, most screens can be adjusted while the E-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.

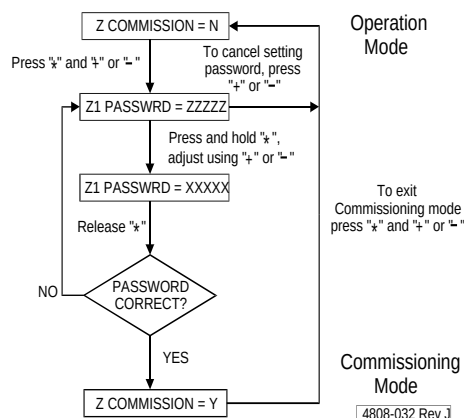


Figure 7.3: Setting Commission Mode after a Password has been set

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 PASSWRD= OFF.

Press "*" and "+" or "-" to set the required password.

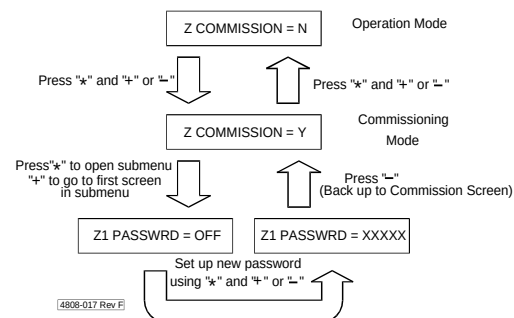


Figure 7.4: Setting a Password for the First Time

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 Bardac Drives 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

Entering 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 entering to and exiting MENU SET-UP mode.

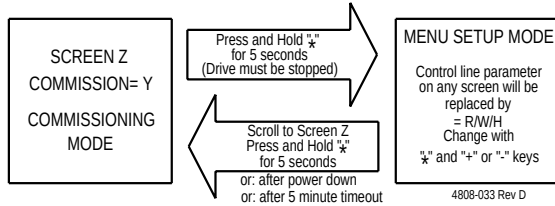


Figure 7.5: Entering and Exiting Menu Set-up Mode

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	=		?			

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.

Initialising user parameters in Screen Y2 will return the menu setup to the default configuration.

8 CUSTOMISATION OF CONTROL

8.1 VYSTA® FOR WINDOWS CONFIGURATION SOFTWARE

Customisation of Control

The E-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.

Vysta® for Windows Editor

Configuration of these processing blocks is done by Vysta® for Windows. Vysta® 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 E-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 Vysta® for Windows Schematics

A configuration schematic designed using the Vysta® 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 Vysta® for Windows editor, it is saved in Netlist format.

When a saved file is opened, the Netlist is decompiled and icons will be regenerated for display on the screen.

The Vysta® for Windows is available for Microsoft Windows 95/98 and Windows NT. Bardac Part No. VYSTA

8.2 CUSTOM SCREEN CONFIGURATION

Screen Editor

The Vysta® for Windows configuration software has a screen editing utility included. This enables a new Screen List to be created and down loaded to the E-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 E-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 E-Series. These variables can be defined as the variable names assigned when configuring processing blocks, or system names.

8.3 DRIVELINK FOR WINDOWS SOFTWARE PACKAGE

The DRIVELINK software package allows Vysta for Windows configuration to be downloaded to the E-Series drives. It also allows the system code within the E-Series to be updated with later revision software as it is developed.

This package is available for Microsoft Windows 95, and Windows NT. Bardac Part No. 0407.

8.4 MODBUS COMMUNICATIONS CONNECTIONS BETWEEN PC AND DRIVE

8.4.1 The E-Series to PC Connection

The Modbus serial communications format is used for data transfer between the E-Series and a personal computer. The E-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 and **downloading system code**, 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 E-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 E-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 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 E-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 E-Series. On transfer, the Netlist files stored in the E-Series 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 E-Series provides as a default a very flexible set of formats and functions for control inputs and outputs.

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

The Screen List available in the default configuration are shown in figures 9.1a to 9.1d.

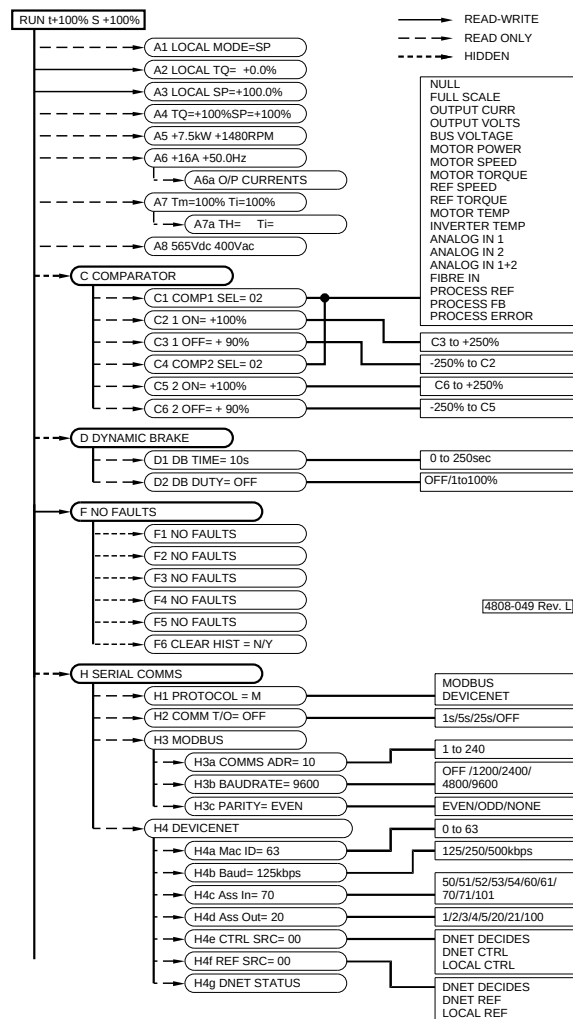


Figure 9.1a: Screen List A-H

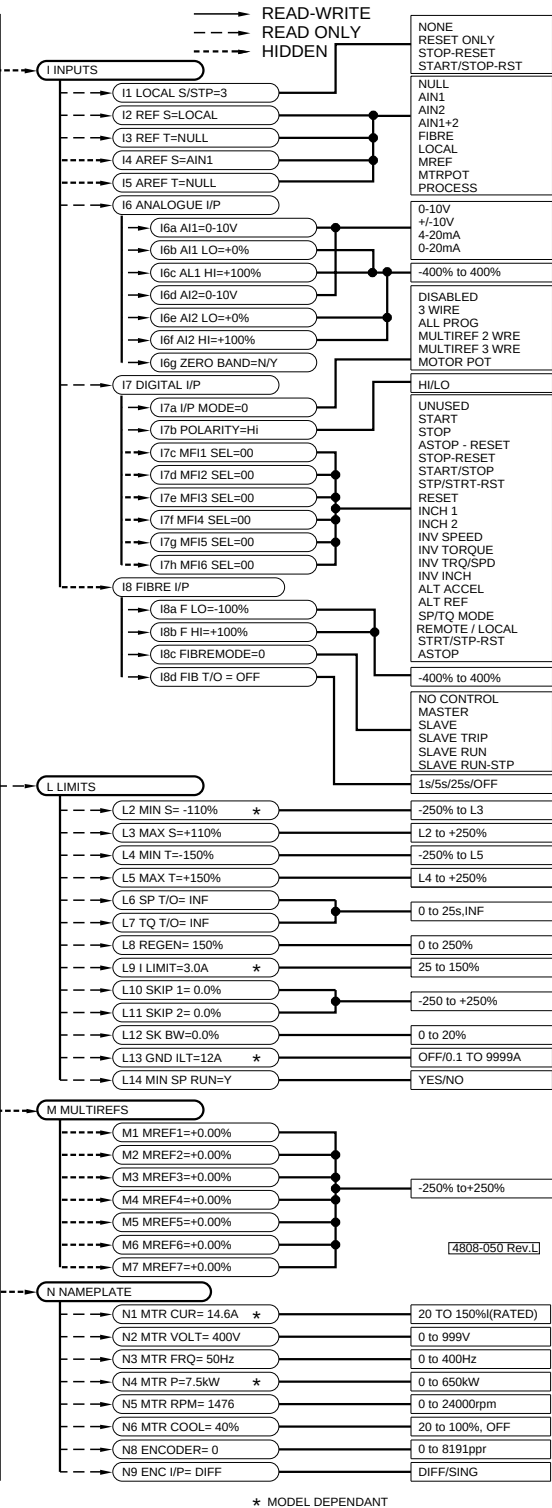


Figure 9.1b: Screen List I-N

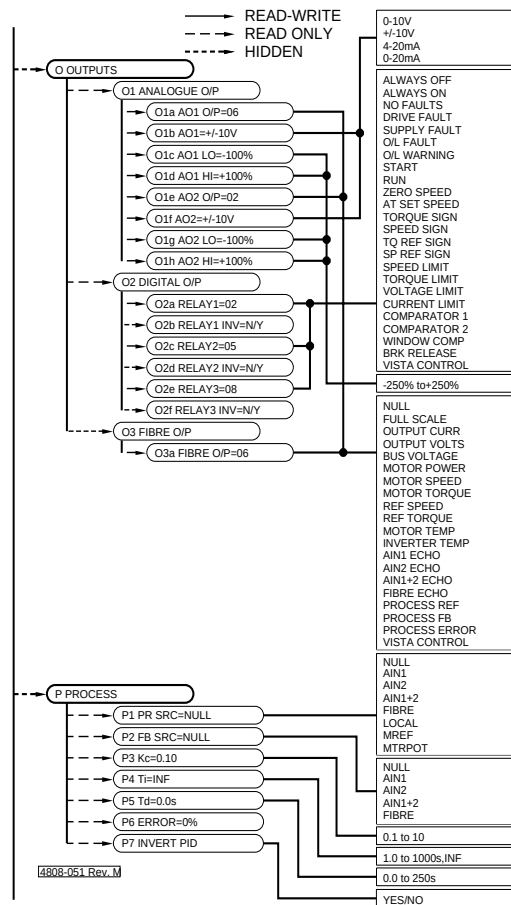


Figure 9.1c: Screen List O-P

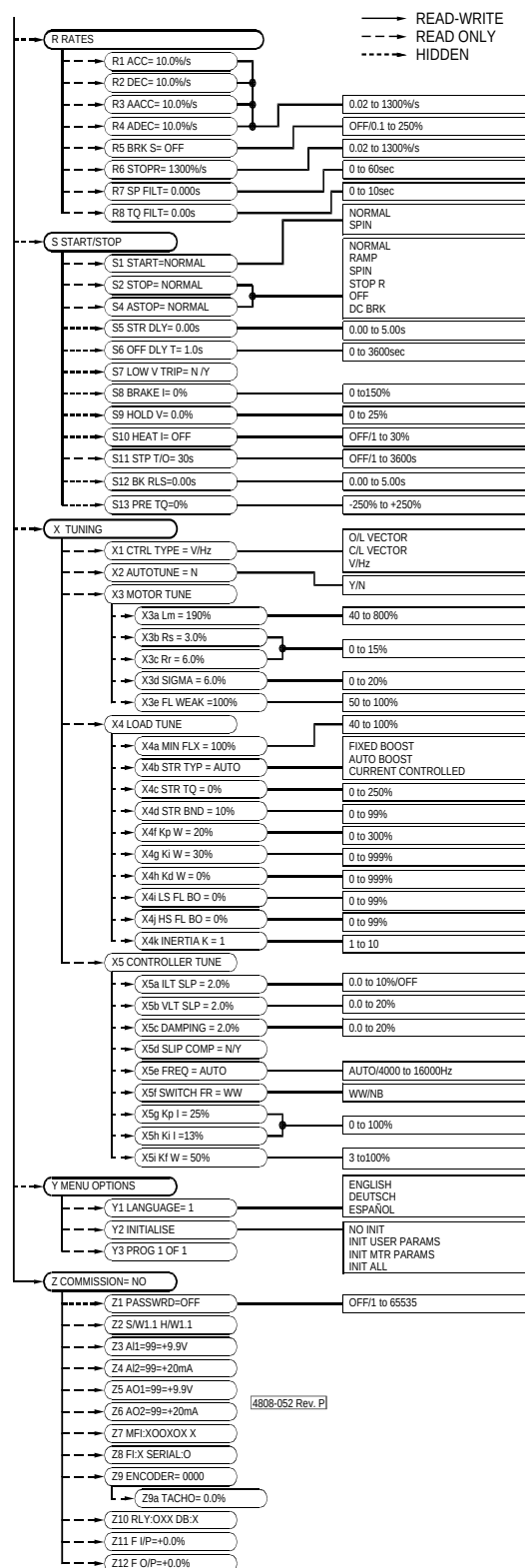


Figure 9.1d: Screen List R-Z

STATUS LINE**AA STATUS LINE**

Screen AA **OFF 0.0% 0.0%**
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
E-Series status, overload condition,
output torque or current and output speed.
Indication of operational mode is also
provided.

SCREEN **OFF 0.0% 0.0%**
STP () t +000% S +000%
1 2 3 4 5 6

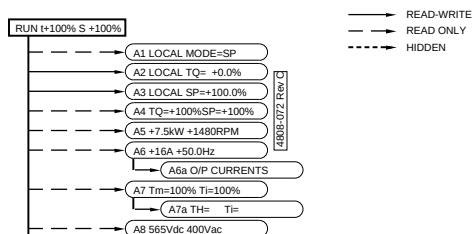
Table Reference 1 2 3 4 5 6

REF.	FUNCTION
1	E-Series Status Indication Refer to list opposite
2	Overload Status Indicated by a lower case letter while overload is present i - current exceeds E-Series rating. The E-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 E-Series will eventually trip if the overload is not eliminated. o - E-Series and motor overload exists.
3	Torque Mode Indicator T- E-Series is in C/L vector torque mode t- E-Series is in C/L vector speed mode l E-Series is in V/Hz speed mode or O/L mode
4	Motor Torque or Current Indication In C/L vector mode this shows the actual motor torque as a percentage of rated motor torque. In V/Hz or O/L mode the motor current is displayed in amps.
5	Speed Mode Indicator S - E-Series is in speed mode s - E-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	E-Series is ready to run. A start command has been received but the bus voltage is too low to run or L14 run at minimum speed is set to NO and setpoint is below minimum speed (L2).
Indication	RUN
Message	RUNNING
Notes	Motor is running.
Indication	INC
Message	INCHING
Notes	E-Series is responding to an inch command.
Indication	ILT
Message	CURRENT LIMITING
Notes	E-Series has altered the motor speed to maintain the motor current at or below the current limit setting.
Indication	VLT
Message	VOLTAGE LIMITING
Notes	E-Series is limiting the deceleration rate to avoid excessive regeneration (Vdc > 740V for 400V, Vdc>825V for 500V).
Indication	Fnn
Message	FAULT TRIP
Notes	E-Series has tripped on a fault. Where "nn" indicates the fault number (refer to Screen F for detail).
Indication	OFF
Message	OUTPUT OFF
Notes	E-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 or L8.
Indication	ATU
Message	AUTOTUNING
Notes	Autotune in progress.
Indication	SPN
Message	SPIN STARTING
Notes	E-Series is searching for the speed of the motor.
Indication	HGT
Message	HEATING
Notes	DC Heat is being applied to the motor.
Indication	LFX
Message	LOW FLUX STATUS
Notes	Open loop vector controller has detected that the motor is close to stalling and has taken compensatory action.

A1

SCREEN GROUP A: STATUS DISPLAYS

A2

A3

A4

A1 LOCAL CONTROL MODE

Screen **LOCAL MODE=SP**

Description LOCAL KEYBOARD MODE SELECT

Range SPEED/TORQUE

Default Value SPEED

OFF to Modify NO

Attribute Read Only

FUNCTION Sets the operating mode of the E-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 **LOCAL TQ=+0.0%**

Description LOCAL TORQUE REFERENCE

Range -250% to +250%

Units % OF MOTOR RATED TORQUE

Default Value 0%

OFF to Modify 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 $\pm 250\%$ 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 **LOCAL SP=+100.0%**

Description LOCAL SPEED REFERENCE

Range -250% to +250%

Units % OF MOTOR RATED SYNCHRONOUS SPEED

Default Value 100%

OFF to Modify 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 $\pm 250\%$ 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 **TQ=+100.0% 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 **+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 Mode 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 **+16A +50.0Hz**
 Description MOTOR CURRENT, FREQUENCY OF AC APPLIED TO STATOR
 Units Amps; HERTZ
 Attribute Read Only

A6a PHASE OUTPUT CURRENTS

Screen **1.2A 1.2A 1.2A**
 Description PHASE OUTPUT CURRENTS
 Range 0 to 1999A
 Units Amps
 Attribute Read Only
 FUNCTION This screen displays the individual phase currents of the E-Series.

A7 MOTOR, INVERTER TEMPERATURES

Screen **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 E-Series (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.

A7a ACTUAL HEATSINK & INTERNAL TEMPS

Screen **Th=23° Ti=26°**
 Description HEATSINK TEMPERATURE;
 INTERNAL TEMPERATURE
 Units °C
 Attribute Read only
 FUNCTION This screen displays the actual measured heatsink and internal temperatures of the E-Series.

A8 BUS AND OUTPUT VOLTAGES

Screen **565Vdc 400Vac**
 Description DC BUS VOLTAGE ; OUTPUT VOLTAGE
 Units Vdc;Vac
 Attribute Read only
 FUNCTION Shows the internal DC voltage of the E-Series, and the AC voltage applied to the motor.

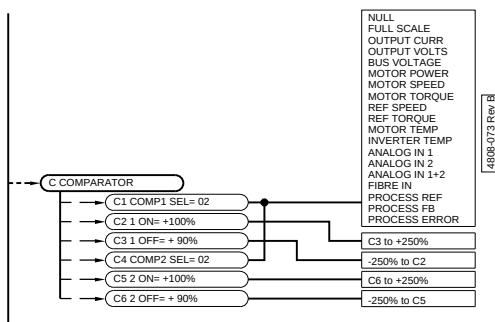
Note: The control system of the E-Series will attempt to apply whatever voltage is necessary to achieve the calculated current requirement - therefore output voltages displayed with the motor disconnected or isolated may not relate to the voltage applied once the motor is connected.

NO.	SOURCE	UNITS
00	NULL	minimum signal output
01	FULL SCALE	maximum signal output
02	OUTPUT CURR	% of motor rated current
03	OUTPUT VOLTS	% of motor rated voltage
04	BUS VOLTAGE	% of motor rated voltage x 1.414
05	MOTOR POWER	% of motor rated power
06	MOTOR SPEED	% of motor rated speed
07	MOTOR TORQUE	% of motor rated torque
08	REF SPEED	% of motor rated speed
09	REF TORQUE	% of motor rated torque
10	MOTOR TEMP	% of motor rated temperature
11	INVERTER TEMP	% of inverter rated temperature
12	ANALOG IN 1	%
13	ANALOG IN 2	%
14	ANALOG IN 1+2	%
15	FIBRE IN	%
16	PROCESS REF	%
17	PROCESS FEEDBACK	%
18	PROCESS CONTROL	%

Figure 9.2: Comparator Source Selection

SCREEN GROUP C: LEVEL COMPARATOR

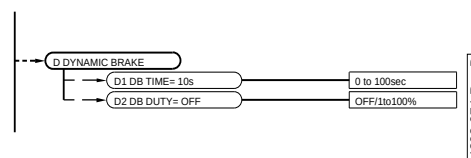
Group Attribute Hidden



C1	Screen	C1 COMP1 SEL =02
C2	Description	COMPARATOR SOURCE SELECTION
C3	Range	00-18, Refer figure 9.2
C4	Default Value	02 (OUTPUT CURRENT)
C5	OFF to Modify	NO
C6	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
	OFF to Modify	NO
D1	Screen	C3 1 OFF =+90%
		C6 2 OFF =+90%
D2	Description	COMPARATOR OFF SETPOINT
	Range	-250% TO C2, C5
	Units	% OF FUNCTION SELECTED
	Default Value	90
	OFF to Modify	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 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

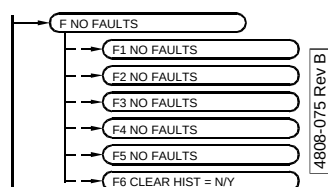
Group Attribute Hidden



Screen	D1 DB TIME= 10s
Description	TIME CONSTANT OF DYNAMIC BRAKE RESISTOR
Range	0 TO 250 SEC
Units	SEC
Default Value	10
OFF to Modify	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
OFF to Modify	NO
FUNCTION	The E-Series includes thermal model protection for a dynamic brake. To protect the brake resistor the E-Series will stop (indicating BRAKE O/L) when the calculated use of the resistor exceeds its rating. 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 E-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

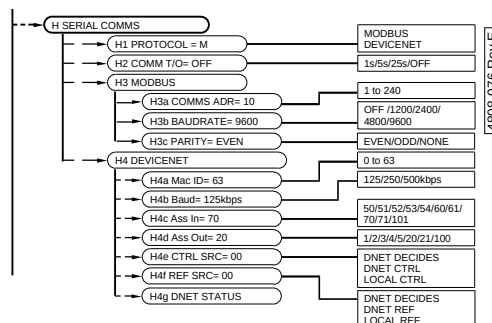


Screen	F NO FAULTS
Description	FAULT DISPLAY SCREEN
FUNCTION	Automatic display of fault information. The E-Series automatically shows this screen in the event of a fault tripping of the drive (unless a key has been pressed in the last 2 seconds). A list of possible faults and suggested causes are given in Section 6 of this manual. In the event of a fault, the E-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
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 E-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 E-Series.
Screen	F6 CLEAR HIST=N
Description	CLEAR FAULT HISTORY LOG
Range	YES OR NO
Default Value	NO
OFF to Modify	NO
Attribute	Read-Write
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

F

Group Attribute Hidden



Screen	H1 H1 PROTOCOL = M
Description	SELECT SERIAL PROTOCOL TO USE
Range	MODBUS/DEVICENET
Default Value	MODBUS
OFF to Modify	NO
NOTE	DeviceNet operation requires an additional product (EDNI) to be used with the E-Series.
Screen	H2 H2 COMMS T/O=OFF
Description	SERIAL COMMUNICATIONS TIMEOUT PERIOD
Range	1/5/25/OFF
Units	SEC
Default Value	OFF
OFF to Modify	NO
FUNCTION	The communications timeout period provides the option of tripping the E-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 E-Series is available via the RS232 serial communications terminals, RS485 serial communications terminals or serial communication interface. This allows the E-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 Vysta® for Windows PC software package. All the controls, parameters and modes available on the E-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 inputs on the E-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 E-Series serial communications feature is required, select the required address, baudrate, parity and timeout period.

H1

H2

H3a**SUBGROUP H3: MODBUS COMMUNICATION PARAMETERS****H3b**

Screen **H3a COMM ADR=10**
 Description MODBUS SERIAL COMMUNICATIONS ADDRESS

Range 1–240
 Units -

H3c

Default Value 10
 OFF to Modify NO

Screen **H3b BAUD=9600**

H4a

Description MODBUS SERIAL COMMUNICATIONS BAUDRATE

Range 1200/2400/4800/9600/OFF
 Units -

H4b

Default Value 9600
 OFF to Modify NO

FUNCTION Sets the Modbus serial communication baudrate.

H4c

SETTING UP The baudrate selection must match that of the Modbus master who is communicating with the E-Series.

H4d

Screen **H3c PARITY=EVEN**
 Description MODBUS PARITY SELECTION
 Range EVEN/ODD/NONE
 Units -

Default Value EVEN
 OFF to Modify NO

H4e

FUNCTION Sets the Modbus serial communication parity.

H4f

SETTING UP The parity selection must match that of the Modbus master which is communicating with the E-Series.

SUBGROUP H4: DEVICENET COMMUNICATIONS PARAMETERS

These option will be valid if an E-Series DeviceNet Interface (EDNi) module has been installed.

Screen **H4a Mac ID=63**

Description MAC IDENTIFICATION NUMBER

Range 0 to 63

Default Value 63

OFF to Modify NO

FUNCTION Defines the Mac ID for the E-Series unit.

SETTING UP Each unit must have a unique Mac ID.

Notes Changes to MAC ID have no effect until EDNi is reset via DeviceNet or the power is cycled.

Screen **H4b BAUD=125kbps**

Description DEVICENET COMMUNICATION BAUD RATE

Range 125/250/500

Units kbps

Default Value 125kbps

OFF to Modify NO

Notes Changes to MAC ID have no effect until baud rate EDNi is reset via DeviceNet or the power is cycled.

Screen

H4c Ass In=70

Description

ASSEMBLY INPUT INSTANCE

Range

50 Basic Overload/Contactor Input (1 byte)
 51 Extended Overload/Contactor Input (1 byte)
 52 Basic Motor Starter Input (1 byte)
 53 Extended Motor Starter 1 Input (1 byte)
 54 Extended Motor Starter 2 Input (1 byte)
 60 Basic Softstarter Input (1 byte)
 61 Extended softstarter Input (1 byte)
 70 Basic Speed Control Input (4 bytes)
 71 Extended Speed Control Input (4 bytes)
 101 Control Input (8 bytes)

Default Value

70

OFF to Modify

NO

SETTING UP

Select the Input Instance that gives the required functionality. Refer to the EDNi Technical Manual (Bardac part no. 4201-212) for further detail.

Screen

H4d Ass Out=20

Description

Assembly Output Instance

Range

1 Basic Contactor Output (1 byte)
 2 Basic Overload Output (1 byte)
 3 Basic Motor Starter Output (1 byte)
 4 Extended Contactor Output (1 byte)
 5 Extended Motor Starter Output (1 byte)
 20 Basic Speed Control Output (4 bytes)
 21 Extended Speed Control Output (4 bytes)
 100 Control Output (8 bytes)

Default Value

20

OFF to Modify

NO

SETTING UP

Select the Input Instance that gives the required functionality. Refer to the EDNi Technical Manual (Bardac part no. 4201-212) for further detail.

Screen

H4e CTRL SRC=00

Description

DEVICENET CONTROL SOURCE

Range

00 DNET DECIDES
 01 DNET REF
 02 LOCAL REF

Default Value

00

OFF to Modify

NO

FUNCTION

Controls where the Run & Reset commands for the E-Series came from. Local control selects the normal E-Series controls (keyboard and multifunction inputs). DNET Ctrl selects the commands to come from the source selected by the "Control from Net" bit in the input instance.

Screen

H4f REF SRC=00

Description

DEVICENET REFERENCE SOURCE

Range

00 DNET DECIDES
 01 DNET CTRL
 02 LOCAL CONTROL

Default Value

00

OFF to Modify

NO

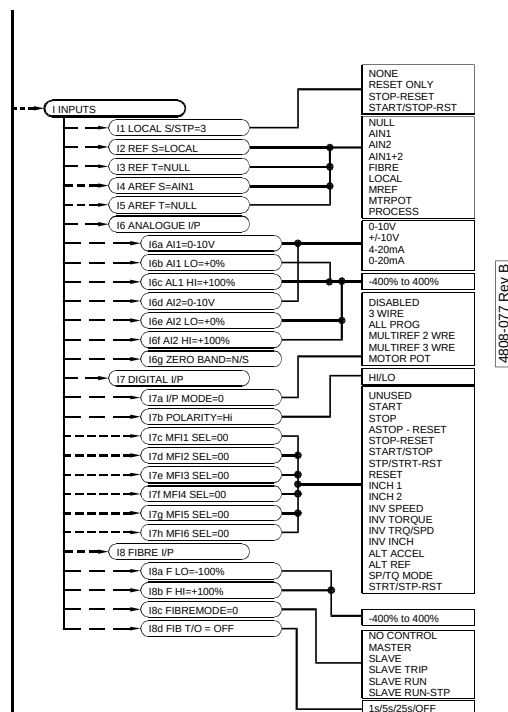
FUNCTION

Controls where the speed reference for the E-Series comes from. Local Control selects the normal E-Series reference. DNET CTRL selects the drives reference to come from DeviceNet and DNET DECIDES allows the E-Series speed reference to come from the source selected by the "Reference from Net" bit in the input instance.

Screen	H4g	Interface Status
Description	DEVICENET INTERFACE STATUS	
Range	Off Line	Interface board not responding or network not powered up.
	No Net Power	24Volts missing on DeviceNet network
	Self-Testing	Powering up.
	Standby	Network power OK but no communications established.
	Operational	Network is OK and communication is established.
	R Fault	Recoverable network fault has occurred.
	NR Fault	Non-recoverable network fault has occurred.

SCREEN GROUP I: INPUTS

Group Attribute Hidden



I1

LOCAL START/STOP-RESET CONTROL

Screen	I1 LOCAL S/STP=3
Description	LOCAL START/STOP AND RESET CONTROL
Range	0-3 (Refer figure 9.3)
Default Value	3 START/STOP-RST
OFF to Modify	NO
Attribute	READ ONLY
FUNCTION	Enables the display unit's START, STOP and RESET functions.

SETTING UP

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

Figure 9.3: Local Start/Stop-Reset Control

12**I2, I4 SPEED REFERENCE SOURCES**

Screen **I2 REF S=LOCAL**
 Description SPEED REFERENCE SOURCE
 Range Refer figure 9.4
 Default Value LOCAL
 OFF to Modify YES

13Screen **I4 AREF S=AIN1****14**

Description ALTERNATIVE SPEED REFERENCE SOURCE
 Range Refer figure 9.4
 Default Value AIN1 (ANALOGUE INPUT 1)
 OFF to Modify YES

15

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)
PROCESSS	PROCESS CONTROL OUTPUT

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 figure 9.5
 Default Value NULL (NO SOURCE SELECTED)
 OFF to Modify YES

Screen **I5 AREF T=NULL**

Description ALTERNATIVE TORQUE REFERENCE SOURCE
 Range Refer figure 9.5
 Default Value NULL (NO SOURCE SELECTED)
 OFF to Modify YES

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	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 A2)
MREF	MULTI-REFERENCE (SCREENS I7a, M1 TO M7)
MTRPOT	MOTORISED POTENTIOMETER (SCREEN I7a)
PROCESSS	PROCESS CONTROL OUTPUT

Figure 9.5: Torque Reference Source Selection

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 - I6f ANALOGUE INPUT FORMATTING AND SCALING CONTROLS

- Screen **I6a AI1=0-10V**
 Description ANALOGUE INPUT 1 FORMAT
 Range Refer figure 9.6
 Default Value 0-10V
 OFF to Modify YES
- Screen **I6b AI1 LO= 0%**
 Description ANALOGUE INPUT 1 LOW SETPOINT
 Range -400% TO +400%
 Units %
 Default Value 0%
 OFF to Modify NO
- Screen **I6c AI1 HI= +100%**
 Description ANALOGUE INPUT 1 HIGH SETPOINT
 Range -400% TO +400%
 Units %
 Default Value +100%
 OFF to Modify NO
- Screen **I6d AI2=0-10V**
 Description ANALOGUE INPUT 2 FORMAT
 Range Refer figure 9.6
 Default Value 0-10V
 OFF to Modify YES
- Screen **I6e AI2 LO=0%**
 Description ANALOGUE INPUT 2 LOW SETPOINT
 Range -400% TO +400%
 Units %
 Default Value 0%
 OFF to Modify NO
- Screen **I6f AI2 HI=+100%**
 Description ANALOGUE INPUT 2 HIGH SETPOINT
 Range -400% TO +400%
 Units %
 Default Value +100%
 OFF to Modify NO

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

Figure 9.6: Analogue Input Format Selection

- SCALING** AI1 LO / AI2 LO
 Refer to figure 9.7.
 Sets the reference level when the minimum analogue level is applied to the respective input.
- AI1 HI / AI2 HI
 Sets the reference level when the maximum analogue level is applied to the respective input. The E-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).

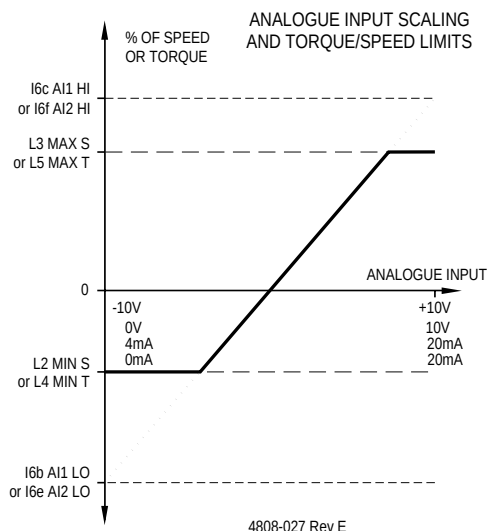


Figure 9.7: Analogue Input Scaling and Torque/Speed Limits

I6g ANALOGUE ZERO BAND

- Screen **I6g ZERO BAND=N**
 Description ZERO BAND OF $\pm 2\%$ FOR ANALOGUE INPUT SOURCES
 Range YES/NO
 Default Value NO
 OFF to Modify NO
- 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 the reference voltage about the zero reference point.
- SETTING UP** Refer to figure 9.8.
 Not required if analogue reference inputs are not used.
- If analogue input 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

17a

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 tachometer feedback employed in the E-Series in Closed Loop Mode 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.

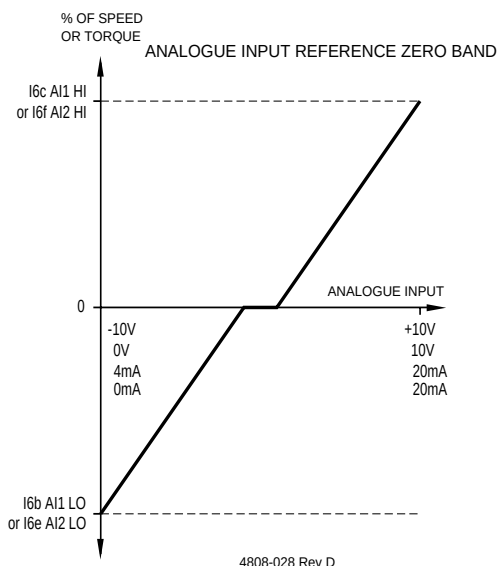


Figure 9.8: Analogue Input Reference Zero Band

SUBGROUP I7: DIGITAL INPUT

I7a - I7h DIGITAL INPUT CONTROLS

I7a MULTI-FUNCTION INPUT MODE SELECTION

Screen	I/P MODE=0
Description	MULTI-FUNCTION INPUT MODE SELECTION
Range	0 TO 5, refer figure 9.9
Default Value	0 - DISABLED
OFF to Modify	YES

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. **The PTC/Ext Trip input is still active in this mode.**

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.

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 4 may be individually programmed using Screens I7c to I7f respectively.

In Mode 5 (motorised potentiometer) adjustment is possible from minimum to maximum as follows (refer to Screens M4 and M5):

MREF4 - Minimum Reference
MREF5 - Maximum Reference

By setting the minimum reference to be greater than the maximum reference, reverse control may be implemented.

The adjustment rate is scaled to allow full scale adjustment in ten seconds. On power up, the motorised potentiometer reference is set to MREF4 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 E-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 except for the PTC/Ext Trip Input. In this mode the E-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 E-Series is not known - remove the link from the External Trip input (Terminal T19). This will trip the E-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	MFI 4	UP	DOWN

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)

OFF to Modify YES

FUNCTION The E-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 configured in active low). Refer to figure 9.10 for details.

Note 2: The setting of this screen is not modified when the E-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 the E-Series on any one site should be configured for either ACTIVE HIGH or ACTIVE LOW to minimise the risk of non-fail-safe operation if the E-Series are exchanged. The mode would probably be set up to correspond to that used by other models of drive used on site.

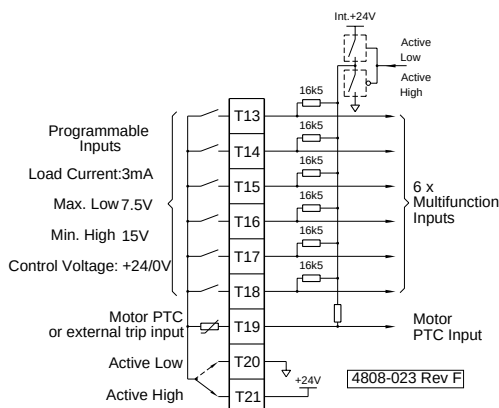


Figure 9.10: Active High/Active Low Selection

I7c - I7h MULTI-FUNCTION INPUT SELECTIONS

Screen I7c **MFI 1 SEL=00**

Description MULTI-FUNCTION 1 INPUT SELECTIONS; TERMINAL T13

Range 00 TO 19, refer figure 9.11

Default Value 00 (UNUSED)

OFF to Modify YES

Screen I7d **MFI 2 SEL=00**

Description MULTI-FUNCTION 2 INPUT SELECTIONS; TERMINAL T14

Range 00 TO 19, refer figure 9.11

Default Value 00 (UNUSED)

OFF to Modify YES

Screen I7e **MFI 3 SEL=00**

Description MULTI-FUNCTION 3 INPUT SELECTIONS; TERMINAL T15

Range 00 TO 19, refer figure 9.11

Default Value 00 (UNUSED)

OFF to Modify YES

Screen I7f **MFI 4 SEL=00**

Description MULTI-FUNCTION 4 INPUT SELECTIONS; TERMINAL T16

Range 00 TO 19, refer figure 9.11

Default Value 00 (UNUSED)

OFF to Modify YES

Screen I7g **MFI 5 SEL=00**

Description MULTI-FUNCTION 5 INPUT SELECTIONS; TERMINAL T17

Range 00 TO 19, refer figure 9.11

Default Value 00 (UNUSED)

OFF to Modify YES

Screen I7h **MFI 6 SEL=00**

Description MULTI-FUNCTION 6 INPUT SELECTIONS; TERMINAL T18

Range 00 TO 19, refer figure 9.11

Default Value 00 (UNUSED)

OFF to Modify 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 O5, but provides reset on closing edge
07	Reset	Open	Reset upon closing edge
08	Inch 1	Open	Inches (jumps to speed mode) at setting of MREF1 (Screen M1); Inch is dominant only if "STOP" is closed; Closing Inch 1 and Inch 2 give Inch 3 (MREF3)
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	Remote/Local	Open	Disables writes by Serial Comms and Comms timeout fault
18	Start/Stop-Reset	Open	As O5, but provides rest on opening edge
19	Astop	Closed	As O2, but without reset

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%
 OFF to Modify 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%
 OFF to Modify NO
 Attribute HIDDEN

FUNCTION Defines the scaling of the Fibre Optic input.

Screen **I8c FIBRE MODE=0**
 Description FIBRE OPTIC CONTROL MODE SELECTION

Range 0-5, refer figure 9.12
 Default Value 0 (No Control)
 OFF to Modify YES
 Attribute HIDDEN

FUNCTION A master/slave fibre optic network enabling synchronised starting/stopping and fault response of the E-Series connected via a fibre optic loop. Refer General Application Note 4216-045 for more detail.

SETTING UP Only one E-Series 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

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. Setting the Control Mode to a Fibre Mode other than 0 (NO CONTROL) may reset in any of the E-Series on the fibre Network starting automatically. An MFI configured as a STOP function will override a RUN command received over the Fibre Network.

I8a

I8b

I8c

I8d

Screen **I8d FIB T/O=OFF**
 Description FIBRE OPTIC INPUT TIMEOUT PERIOD
 Range 1s/5s/25s/OFF
 Units Sec
 Default Value OFF
 OFF to Modify YES

FUNCTION Provides the option of tripping the E-Series (indicates "F27 FIBRE T/O") if the time since the last valid fibre optic input signal has exceeded the timeout period.

L2

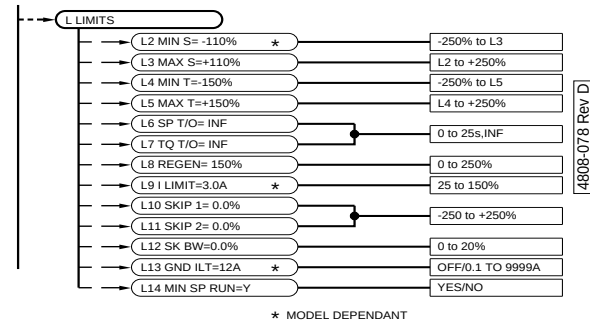
L3

L4

L5

SCREEN GROUP L: LIMITS

Group Attribute READ



Screen **L2 MIN S=-110%**
 Description MINIMUM SPEED
 Range -250% TO MAXIMUM SPEED SETTING
 Units % OF MOTOR RATED SYNCHRONOUS SPEED

Default Value -110% Frames 1 to 4
 0% Frames 5 to 7

OFF to Modify NO

Screen **L3 MAX S=+110%**
 Description MAXIMUM SPEED
 Range MINIMUM SPEED SETTING TO +250%
 Units % OF MOTOR RATED SYNCHRONOUS SPEED

Default Value +110%

OFF to Modify NO

FUNCTION Sets the speed limits within which the E-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 speed limits 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%

OFF to Modify NO

Screen **L5 MAX T=+150%**
 Description MAXIMUM TORQUE
 Range MINIMUM TORQUE SETTING TO +250%
 Units % OF RATED MOTOR TORQUE

Default Value +150%

OFF to Modify NO

FUNCTION Sets the torque limits within which the E-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 limits according to your application limits.

Note: The motor will draw current in approximate proportion to the torque demanded. Therefore be sure that the E-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 E-Series to produce more than 150% of its rated output current.

When running in Closed Loop Mode 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
OFF to Modify NO

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

Description TORQUE LIMIT TIMEOUT
Range 0 TO 25 SEC AND INFINITE
Units SECONDS
Default Value INFINITE
OFF to Modify NO

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

SETTING UP The E-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., Set 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 Mode 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
OFF to Modify NO

Note: Regeneration Limit only applies to E-Series operated in open loop or closed loop vector mode.

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 times E-Series nominal rating
Default 1.2 times E-Series nominal rating
OFF to Modify NO

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 E-Series will automatically trip (Fault status = TQ LIM T/O)

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

In Open Loop mode, the current limit is restricted to 125% of the drive current rating even if the value entered is higher. This is to preserve the integrity of the current waveshape, which is important for Open Loop mode control.

SETTING UP Current limit: Where not strictly part of the required setup for the particular application leave this set at 1.2 x E-Series nominal rated current (refer figures 2.1 & 2.2). 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 E-Series setup or load problems. If current limit action is observed during normal operation of the E-Series or process, check that the setup is correct - particularly check acceleration, deceleration, motor parameters and boost settings.

L10**L10, L11, L12 SKIP SPEEDS**Screen **L10 SKIP 1 =+0.0%**

Description SKIP SPEED 1

Range -250% to +250%

Default 0%

OFF to Modify No

L11Screen **L11 SKIP 2 =+0.0%**

Description SKIP SPEED 2

Range -250% to +250%

Default 0%

OFF to Modify No

L12Screen **L12 SKIP BW=0.0%**

Description SKIP BANDWIDTH

Range 0% TO 20%

Default 0%

OFF to Modify NO

L13

FUNCTION

Refer to figure 9.13.

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.

L13**GROUND CURRENT LIMIT**

Screen

L13 GND ILT=12A

Description

GROUND CURRENT LIMIT

Range

OFF/0.1 to 9999A

Units

Amps/Phase

Default

30% of Inverter rated current per phase

FUNCTION

To set the limit of ground current that is acceptable.

L14**RUN AT MINIMUM SPEED**

Screen

L14 MIN SP RUN=Y

Description

RUN MINIMUM SPEED

Range

YES/NO

Default

YES

FUNCTION

If set to NO then the E-Series will change to the READY state if the reference speed is reduced to below the minimum speed while running.

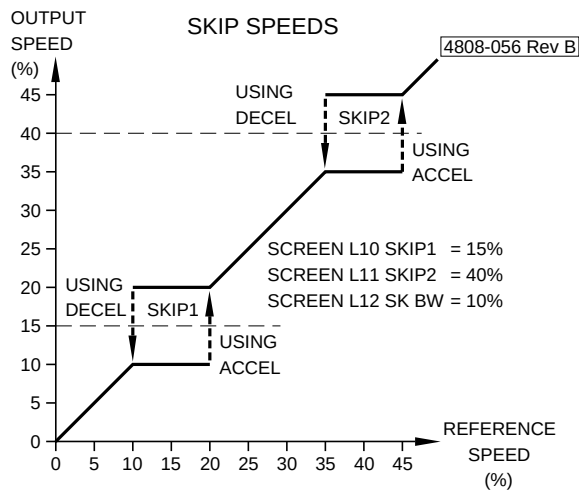
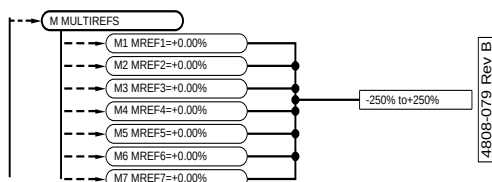


Figure 9.13: Skip Speeds

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 0.00%
 OFF to Modify NO

FUNCTION These are reference setpoints into which user values can be loaded.

SCREEN	TITLE	SPECIAL FUNCTIONS
M1	MREF1	INCH1
M2	MREF2	INCH2
M3	MREF3	INCH3
M4	MREF4	MOTORPOT MIN
M5	MREF5	MOTORPOT MAX

Figure 9.14: Special Functions using Multi-Reference Setpoints

Note: Figure 9.14 shows special functions that can be assigned to the multi-reference setpoints using either the motorised Pot input mode or all programmable input mode with multi-function input selection in Screens I7c to I7h.

SCREEN	TITLE	MULTI-REFERENCE FUNCTIONS	
		MF15 (T17) Y	MF16 (T18) Z
M4	MREF4	O	O
M5	MREF5	O	X
M6	MREF6	X	O
M7	MREF7	X	X

Figure 9.15: Multi-Reference 2 Wire Functions

Note: Figure 9.15 shows special functions assigned to Multi-reference setpoints M4-M7 when using Input Mode 03 (MREF 2W). Multireference setpoints M1-M3 are available as in figure 9.14.

SCREEN	TITLE	MULTI-REFERENCE FUNCTIONS		
		MF14 (T16) X	MF15 (T17) Y	MF16 (T18) Z
	ZERO	O	O	O
M1	MREF1	O	O	X
M2	MREF2	O	X	O
M3	MREF3	O	X	X
M4	MREF4	X	O	O
M5	MREF5	X	O	X
M6	MREF6	X	X	O
M7	MREF7	X	X	X

O= Open X = Closed

Figure 9.16: Function of Multi - Reference 3 Wire

Note: Figure 9.16 shows special functions assigned to multi-reference setpoints M1-M7 when using Input Mode 04 (MREF 3W).

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

Attribute HIDDEN

N NAMEPLATE

N1 MTR CUR= 14.6A *	20 TO 150%(RATED)
N2 MTR VOLT= 400V	0 to 999V
N3 MTR FRQ= 50Hz	0 to 400Hz
N4 MTR P=7.5kW *	0 to 650kW
N5 MTR RPM= 1476	0 to 24000rpm
N6 MTR COOL= 40%	20 to 100%, OFF
N8 ENCODER= 0	0 to 8191ppr
N9 ENC I/P= DIFF	DIFF/SING

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* MODEL DEPENDANT

N1 Screen **N1 MTR CUR=0.0A**

Description RATED (NAMEPLATE) MOTOR CURRENT

Valid Range 20% TO 150% OF E-SERIES SIZE

Units AMPS

Default Value 75%(Dependent on E-Series model)

OFF to Modify NO

Screen **N2 MTR VOLT=0V**

Description RATED (NAMEPLATE) MOTOR VOLTAGE

Valid Range 0 TO 999V

Units VOLTS

Default Value 400

OFF to Modify NO

Screen **N3 MTR FRQ=0Hz**

Description RATED (NAMEPLATE) MOTOR FREQUENCY

Valid Range 25 TO 400Hz

Units HERTZ

Default Value 50

OFF to Modify NO

Screen **N4 MTR P=0.0kW**

Description RATED (NAMEPLATE) MOTOR POWER

Valid Range 0 TO 650kW,
50% TO 150% OF E-SERIES RATED kW

Units KILOWATTS

Default Value Dependent on E-Series model

OFF to Modify NO

Screen **N5 MTR RPM=0**

Description RATED (NAMEPLATE) MOTOR SPEED

Valid Range 200 TO 24000 RPM

Units REVOLUTIONS PER MINUTE

Default Value Dependent on E-Series model

OFF to Modify 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%

OFF to Modify NO

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

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

If the motor nameplate power is listed in horsepower(hp) then convert to kilowatts(kw) by using the following formula:

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 E-Series.

SETTING UP These parameters must be set before operating the E-Series. Invalid combinations of values will be detected as "Parameter Fault" error, tripping the E-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=0**

Description PULSES PER REVOLUTION OF TACHO ENCODER

Range 0 TO 8191 PPR

Default Value 0

OFF to Modify NO

FUNCTION To operate the E-Series in Closed Loop vector mode, feedback of motor shaft position is required. The E-Series is designed to accept input from an incremental shaft encoder. This parameter calibrates the E-Series to the number of pulses per motorshaft 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 E-Series Getting Started Manual (Bardac Part No. 4201-179).

N9 ENCODER INPUT TYPE SELECTIONScreen **N9 ENC I/P=DIFF**

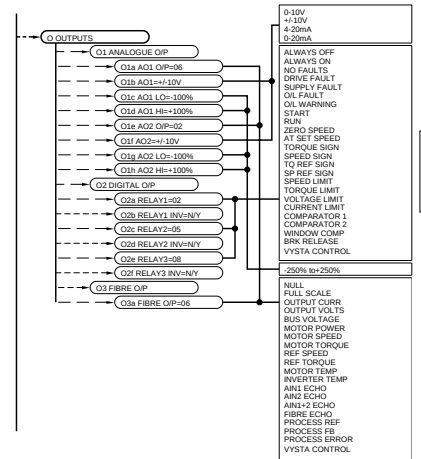
Description SELECTION OF TYPE OF ENCODER
 Range SING (single ended) or DIFF (differential)
 Default Value DIFF
 OFF to Modify YES

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 E-Series Getting Started Manual (Bardac Part No. 4201-179).

SCREEN GROUP O: OUTPUTS

Group Attribute HIDDEN

**SUBGROUP O1: ANALOGUE OUTPUTS****O1a, O1e ANALOGUE OUTPUTS SOURCE SELECTION**

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

Description ANALOGUE OUTPUT SOURCE SELECTION

Range 00 TO 19 - refer figure 9.17

Default Value AO1 O/P= 06 (MOTOR SPEED)
 AO2 O/P= 02 (OUTPUT CURRENT)

OFF to Modify YES

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	minimum signal output
01	FULL SCALE	maximum signal output
02	OUTPUT CURR	% of motor rated current
03	OUTPUT VOLTS	% of motor rated voltage
04	BUS VOLTAGE	% of motor rated voltage x 1.414
05	MOTOR POWER	% of motor rated power
06	MOTOR SPEED	% of motor rated speed
07	MOTOR TORQUE	% of motor rated torque
08	REF SPEED	% of motor rated speed
09	REF TORQUE	% of motor rated torque
10	MOTOR TEMP	% of motor rated temperature
11	INVERTER TEMP	% of inverter rated temperature
12	ANALOG IN 1	%
13	ANALOG IN 2	%
14	ANALOG IN 1+2	%
15	FIBRE IN	%
16	PROCESS REF	%
17	PROCESS FEEDBACK	%
18	PROCESS ERROR	%
19	VYSTA CONTROL	%

Figure 9.17: Analogue & Fibre Outputs Source Selection

O1b

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

O1c

Select the format of each output using Screens O1b, O1f. Adjust the scaling using Screens O1c and O1d for Analogue Output 1, and O1g and O1h for Analogue Output 2.

O1d

O1b-O1d, O1f-O1h

ANALOGUE OUTPUT FORMATTING AND SCALING CONTROLS

O1e

Screen **O1b AO1=+/-10V**
 Description ANALOGUE OUTPUT 1 FORMAT
 Range Refer figure 9.18
 Default Value +/-10V
 OFF to Modify YES

O1f

Screen **O1c AO1 LO=-100%**
 Description ANALOGUE OUTPUT 1 LOW SETPOINT
 Range -250% TO +250%
 Units %
 Default Value -100%
 OFF to Modify NO

O1g

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

O1h

Screen **O1f AO 2=+/-10V**
 Description ANALOGUE OUTPUT 2 FORMAT
 Range Refer figure 9.18
 Default Value +/-10V
 OFF to Modify YES

Screen **O1g AO2 LO= -100%**
 Description ANALOGUE OUTPUT 2 LOW SETPOINT
 Range -250% TO +250%
 Units %
 Default Value -100%
 OFF to Modify NO

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

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

Figure 9.18: 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 9.18.

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

Maps the AO1 HI / AO2 HI level to the maximum output signal level for the selected output format. The E-Series analogue outputs are 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 analogue output source level decreases the analogue output signal level).

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

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.

Determine the range over which analogue control is desired.

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

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

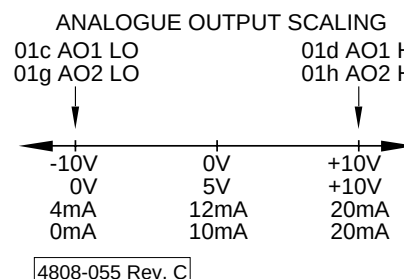


Figure 9.19: Analogue Output Scaling

Each analogue output may be tested by selecting its source to be FULL SCALE (Screens O1a, O1e to Selection 01).

EXAMPLE 1 Analogue Output 1 (AO1) is formatted as a $\pm 10V$ 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.

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

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=02
	O2c	RELAY2=05
	O2e	RELAY3=08
Description	RELAY CONTROL SOURCE SELECTION	
Range	00 TO 23, refer figure 9.20	
Default Value	RLY1 = 02 (No faults) RLY2 = 05 (Overload fault) RLY3 = 08 (Run)	
OFF to Modify	NO	
FUNCTION	Provides the ability to link each relay to one of the outputs shown in figure 9.20.	
	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	
OFF to Modify	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
O0	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	Fault	Drive related fault or low supply
O4	SUPPLY FAULT	Fault	Supply phase fault or low supply
O5	O/L FAULT	Fault	Motor or Drive Overload Trip
O6	O/L WARNING	Warning	Motor or Drive predictive overload; 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 either speed limit (Screens L2, L3)
16	TORQUE LIMIT	At Limit	Drive is operating at either 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	See Brake Release
23	VYSTA CONTROL		Controlled by Vysta program

Figure 9.20: Relay Table Selection

Brake Release:

This function can be used to release a mechanical brake on the motor. The output is activated after the start delay period and deactivated one second before the end of the off delay period (refer Screens S6, S12 and S13). For further detail on the operation of the brake release function refer General Application Note 4216-058.

O3a

SUBGROUP O3: FIBRE OUTPUT**O3a FIBRE OUTPUT SOURCE SELECT**

Screen **FIBRE O/P=06**

Description **FIBRE OUTPUT SOURCE SELECTION**

Range 00 to 19 - refer figure 9.17

Default Value 06 (MOTOR SPEED)

OFF to Modify NO

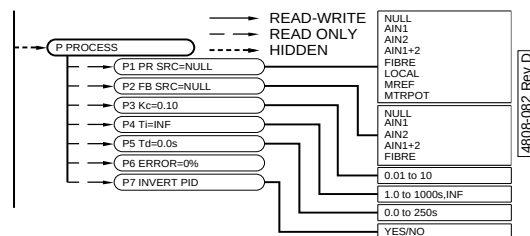
FUNCTION Provides the ability to select the driving source for Fibre Optic output.

P1

SETTING UP Select the desired Fibre signal source.

SCREEN GROUP P: PROCESS CONTROL

Group Attribute Hidden



Introduction The E-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 PID output is routed at the reference source to provide a speed or torque reference source (Refer Screens I2,I4, I3, I5). Refer to Technical Application Note 4216-048 for more detail about using the process controller.

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 9.21

Default Value NULL

OFF to Modify YES

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, M1 TO M7)

Figure 9.21: Process Control Setpoint Source

SETTING UP Select the desired process control setpoint source to suit your requirements. Refer figure 3.10.

P2 PROCESS CONTROL FEEDBACK SOURCE

Screen **P2 FB SRC=NULL**
 Description PROCESS CONTROL FEEDBACK SOURCE
 Range Refer figure 9.22
 Default Value NULL
 OFF to Modify YES
 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

Figure 9.22: Process Control Feedback Source

SETTING UP Select the desired process control feedback source to suit your requirements. Refer figure 3.10.

P3, P4, P5 PROCESS CONTROL PID SETTINGS

Screen **P3 Kc=0.10**
 Description CONTROLLER GAIN (Kc)
 Range 0.01 TO 10.0
 Default Value 0.10
 OFF to Modify NO
 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
 OFF to Modify NO
 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
 OFF to Modify NO
 FUNCTION Defines the differentiation time of the process controller.

SETTING UP Select the desired differentiation 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

Default Value 0.0%

FUNCTION Displays the difference between the process setpoint (Screen P1) and the process feedback (Screen P2).

Screen **P7 INVERT PID=N**

Description INVERT PID

Default Value N

Range YES/NO

FUNCTION Setting this screen to Y inverts the output of the PID.

When set to N, the PID response to a drop in the feedback signal is to increase the output speed. This is typically the response required when using the PID for constant pressure control. A drop in pressure (feedback) due to a higher demand will require the pump speed to increase to maintain the pressure.

When set to Y, the PID response to a drop in the feedback signal is to decrease the output speed. This is typically the response required when using the PID for temperature control. A decrease in temperature (feedback) due to a lower demand will require the cooling fan speed to decrease to maintain the temperature.

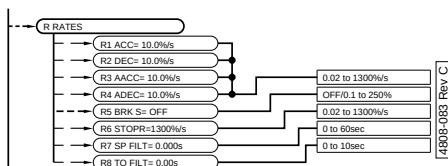
SCREEN GROUP R: ACCEL/DECEL RATES

R1

Group Attribute HIDDEN

R2

R3



R4

R1, R2

ACCELERATION AND DECELERATION RATES

Screen

R1 ACC=10.0%/s

Description

ACCELERATION RATE

R5

Screen

R2 DEC=10.0%/s

Description

DECELERATION RATE

Range

0.02 to 1300%/SEC

Units

% OF MOTOR RATED SYNCHRONOUS SPEED PER SECOND

Default Value

10%/s

OFF to Modify

NO

FUNCTION

Controls the rates of change of speed (acceleration or deceleration) of the E-Series.

SETTING UP

These rates should 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 or OFF.

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.

Note:

Remember when using extended (long) deceleration rates, adjust the Stop Timeout (Screen S11) appropriately.

R3, R4, R5

ALTERNATIVE ACCELERATION RATES

Screen

R3 AACC=10%/s

Description

ALTERNATIVE ACCELERATION RATE

Range

0.02 to 1300%/SEC

Units

% OF MOTOR RATED SYNCHRONOUS SPEED PER SECOND

Default Value

10.0%/s Frames 1 to 3

5%/s Frame 4

2%/s Frames 5 to 7

OFF to Modify

NO

Screen

R4 ADEC=10%/s

Description

ALTERNATIVE DECELERATION RATE

Range

0.02 to 1300%/SEC

Units

% OF MOTOR RATED SYNCHRONOUS SPEED PER SECOND

Default Value

10.0%/s Frames 1 to 3

5%/s Frame 4

2%/s Frames 5 to 7

OFF to Modify

NO

Screen

R5 BRK SP=OFF

Description

BREAK SPEED FOR ALTERNATIVE ACCEL/DECEL

Range

OFF, 0.1 TO 250%

Units

% OF MOTOR RATED SYNCHRONOUS SPEED

Default Value

OFF

OFF to Modify

NO

FUNCTION

These alternative 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.

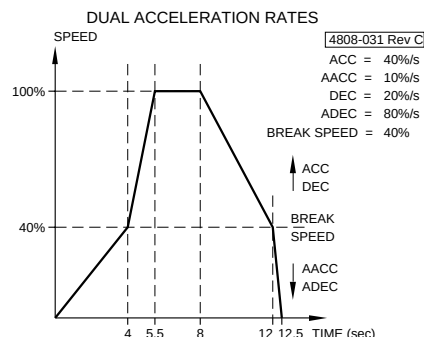


Figure 9.23: Dual Acceleration/Deceleration Rates

Note: Remember when using extended (long) deceleration rates, adjust the Stop Timeout (Screen S11) appropriately.

R6 STOP DECELERATION RATE

Screen **R6 STOPR=1300%/s**
 Description DECELERATION (STOPPING) RATE USED WHEN STOPPING
 Range 0.02 to 1300%/SEC
 Units % OF RATED MOTOR SYNCHRONOUS SPEED PER SECOND
 Default Value 1300
 OFF to Modify NO
 Attribute HIDDEN

FUNCTION When the E-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 60s
 Units seconds for 100%/s change in acceleration and deceleration
 Default Value 0.0s/100%/s Frames 1 to 3
 1.0s/100%/s Frame 4
 2.0s/100%/s Frames 5 to 7
 OFF to Modify NO
 Attribute HIDDEN
 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.

Also useful for improving deceleration under high inertia.

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

SETTING UP Leave set at the default value if not required. Setting at a value other than 0 will affect the unit’s ability to follow a speed profile. Increase this value to improve deceleration under voltage limits.

R8 TORQUE FILTER TIME CONSTANT

Screen **R8 TQ FLT=0.00s**
 Description TORQUE FILTER TIME CONSTANT
 Range 0 to 10.0 SEC
 Units SECONDS
 Default Value 0.0 SEC
 OFF to Modify NO
 Attribute HIDDEN

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

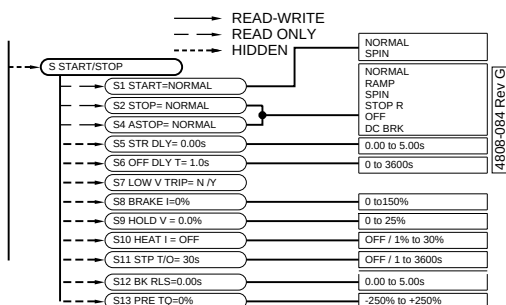
It is often used to “soften” changes in torque. It is especially useful when changing the sign of the torque. If there is any backlash in the mechanical system it can soften the taking up of the backlash.

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 the time constant is set to one second, the response to a 100% torque reference step change will be a 63% change in the reference torque after one second.

SCREEN GROUP S: START AND STOP MODES

Group Attribute HIDDEN



S1 START MODE

Screen **S1 START=NORMAL**

Range NORMAL/SPIN

Default NORMAL

OFF to Modify 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., E-Series 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 E-Series 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 E-Series 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 E-Series will not normally be require to start spinning loads or is operating in Closed Loop Vector Mode, 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 E-Series is trying to match the output frequency 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 E-Series matches the motor speed.

For reliable low speed spin starting, the Start Torque (Screen X4c) must be set correctly. Set the screen using Normal start.

S2 STOP MODE

Screen **S2 STOP=NORMAL**

Description USUAL STOPPING MODE
Range NORMAL/RAMP/SPIN/STOP-RATE/OFF/DC-BRAKE

Default Value NORMAL

OFF to Modify NO

FUNCTION Select the stopping mode to use (Refer figure 9.24).

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.

S4 ALTERNATIVE STOP MODE

Screen **S4 ASTOP=NORMAL**

Description ALTERNATIVE STOPPING MODE
Range NORMAL/RAMP/SPIN/STOP-RATE/OFF/DC-BRAKE

Default Value NORMAL

OFF to Modify NO

FUNCTION Select the stopping mode to use (refer figure 9.24).

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 5 SEC

Units SECONDS

Default Value 0.00s

OFF to Modify 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 TIMEScreen **S6 OFF DLY T=1.0s**

Description OFF DELAY TIME

Range 0 to 3600 SEC

Units SECONDS

Default Value 1s

OFF to Modify NO

FUNCTION Sets the period of time that the E-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). 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	V/Hz and Open Loop	Closed Loop Vector Speed Mode	Closed Loop Vector Torque Mode
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	Turns outputs off for the off delay time then changes to OFF state	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		Transitions 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

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Figure 9.24: Stopping Modes

For further information on Start and Stop modes refer General Application Note 4216-058.

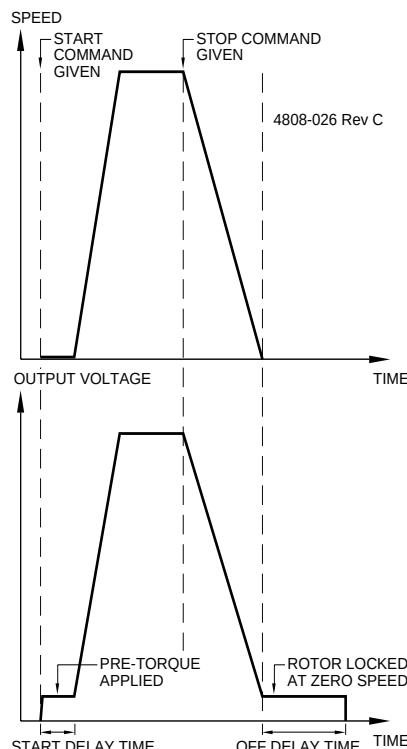


Figure 9.25: Start and Off Delay Times

S7 MAINS POWER LOSS RESPONSEScreen **LOW V TRIP=N**

Description MAINS POWER LOSS RESPONSE

Options [Y]ES / [N]O

Default Value [N]O

OFF to Modify 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 E-Series continues to operate normally until the energy supplied to the motor load discharges the inverter high voltage DC bus to its minimum working voltage. At this stage the output power from the inverter is disabled to prevent further energy consumption by the load, but otherwise the E-Series continues to operate from the remaining energy in the DC bus. The minimum voltage for the E-Series is 250Vdc, for the frames 5 to 7 the minimum is 385Vdc. Depending on the size of the E-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) the E-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 not trip (N), the E-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 E-Series will restart automatically.

S8	If the high voltage (mains supply) power loss function is set to trip (Y), the E-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 E-Series will restart automatically.
S9	
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. If required, the E-Series control board may be powered with a 24Vdc supply. Connection information is given in the E-Series Getting Started Manual (Bardac Part No. 4201-179)
S10	
S11	

S8 DC BRAKE CURRENT LEVEL

Screen	BRAKE I=0%
Range	0 to 150%
Units	PERCENT OF MOTOR RATED CURRENT
Default	0.00%
OFF to Modify	NO
FUNCTION	Sets the level of current to be applied 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 E-Series. 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 E-Series's motor thermal model does not take this into account. Adjust the current level until the desired braking is achieved.

S9 DC HOLDING VOLTAGE IN V/Hz

Screen	HOLD V=0.0%
Range	0 to 25%
Units	PERCENT OF MOTOR RATED VOLTAGE
Default	0.00%
OFF to Modify	NO
FUNCTION	Sets the amount of DC voltage applied to the motor during the off delay period in V/Hz mode. When applied, the DC current causes the motor to resist movement and is used to brake the motor.
SETTING UP	If motor braking after stopping is not required leave set to 0. First set the off delay time to a suitable value (say 2 seconds) and adjust the hold voltage to give the required amount of hold when the motor is stopped (but not off).
Notes	DC hold is only used in V/Hz mode and is not used if the DC-BRAKE stopping mode is selected.

S10 DC HEATING CURRENT

Screen	S10 HEAT I=OFF
Range	OFF/1 to 30%
Units	PERCENT OF MOTOR RATED CURRENT
Default	OFF
OFF to Modify	NO
FUNCTION	Sets the amount of DC current applied to the motor after the off delay period or before a start command is received. This provides standby (anti-condensation) heating to the motor.
SETTING UP	If motor heating is not required leave set to OFF. To set, with the motor stopped, increase the DC heating level until the current level indicated by the screen top line is approximately 10 to 25% of motor rated current.
WARNING:	High voltage will be present on the motor terminals while DC heating is employed. DO NOT USE to dry out an already wet motor.

S11 STOP TIMEOUT

Screen	STP T/O=30s
Range	OFF, 1 TO 3600 SEC
Units	SECONDS
Default Value	30s Frames 1 to 3 60s Frame 4 120s Frames 5 to 7
OFF to Modify	NO
FUNCTION	To provide the safety function of automatically tripping the E-Series if the motor has not stopped within the selected Stop Timeout period once a stop signal has been received.
SETTING UP	This function is typically used to protect against incorrectly set parameters maltuning the E-Series and preventing a controlled stop. The controlled stop time is the time to stop under normal conditions and is determined from the maximum speed (Screen L3), deceleration rates (Screens R2, R4, and R6), speed filter time constant (Screen R7), and Off Delay (Screen S6). The Stop Timeout period should be set to a value greater than the controlled stopping time. Alternatively, the controlled stopping time may be measured experimentally and the Stop Timeout set appropriately.
Note:	With a high input supply voltage, the E-Series has limited headroom in the DC bus to absorb regenerated power from a high inertia motor/load combination. This may prevent the E-Series from being able to follow the requested speed reference profile. The Stop Timeout may be used to provide protection against loss of control from excessive regeneration. The Stop Timeout is also useful for protecting against incorrectly set speed PID settings in closed loop vector mode.

S12 BRAKE RELEASE TIMEScreen **S12 BK RLS=0.00s**

Range 0.00 to 5.00s

Units SECONDS

Default 0.00s

OFF to Modify NO

FUNCTION Sets a period of time from the activation of the brake release relay until accelerating the motor. The brake release relay is activated after the start delay (Screen S5).

SETTING UP Leave set to zero unless using a mechanical brake. Set to the time it takes for the mechanical brake to free and adjust in conjunction with the pre-torque (Screen S13) to produce a smooth torque as the brake releases.

S13 PRE TORQUEScreen **S13 PRE TQ=+0%**

Range -250% to +250%

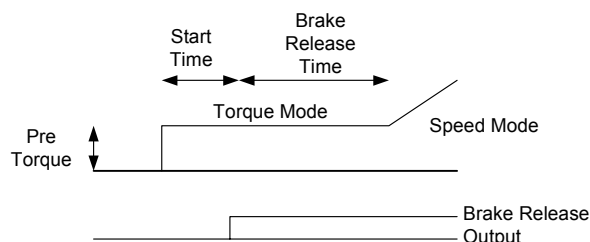
Units PERCENT OF MOTOR RATED TORQUE

Default 0%

OFF to Modify NO

FUNCTION Sets the amount of torque to apply during the start delay and brake release time.

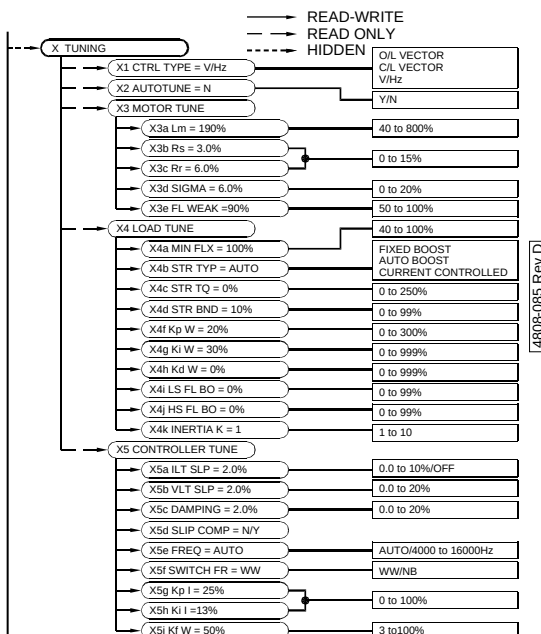
SETTING UP Leave set to zero unless using a mechanical brake. Set to produce a smooth torque as the brake releases.



For further information on Start and Stop modes refer General Application Note 4216-058.

SCREEN GROUP X: TUNING

Group Attribute HIDDEN

**S12****S13****X1****X1****CONTROL TYPE SELECTION**

Screen

X1 CTRL TYP=V/Hz

Description

SELECTION OF OPERATING MODE

Range

O/L = OPEN LOOP MODE
C/L = CLOSED LOOP VECTOR MODE
V/Hz = V/Hz

Default Value

V/Hz

OFF to Modify

YES

FUNCTION

This selection determines the type of operating mode for the E-Series.

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.

Closed Loop Mode:

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 Mode is used where there are high requirements for speed accuracy or torque control is required.

Open Loop Mode:

The Open Loop mode is a speed control mode active only for frames 1 to 4. This mode of operation can provide improved starting torque and speed accuracy compared to V/Hz mode. No external feedback is required to operate in this mode, which can offer features of the Closed Loop Vector Mode. Commissioning and autotuning must be completed before selecting this control type.

SETTING UP

V/Hz mode should be used for initial commissioning to check the operation of any shaft encoder fitted to the motor and to check motor rotation direction.

X2	Once initial commissioning is complete, select Closed Loop Vector Mode, Open Loop Mode or V/Hz as required.						
X3a	V/Hz mode must also be employed when multiple motors are connected to the E-Series output.						
X3b	V/Hz or Closed Loop Vector Mode must be used if a Vysta program is loaded into the E-Series.						
X2	AUTOTUNE MODE SELECTION						
X3c	Note: Autotune only applies to E-Series operated in open loop or closed loop vector mode.						
X3d	Screen AUTOTUNE=N Description AUTOTUNES MOTOR Range NO/YES Default Value None OFF to Modify YES FUNCTION The motor must be correctly characterised for good dynamic performance. This can be done automatically by the E-Series. Autotuning will automatically set optimum values for the following parameters (without turning the motor): <table> <tr> <td>X3a Lm</td><td>Motor Main Inductance</td></tr> <tr> <td>X3b Rs</td><td>Stator Resistance</td></tr> <tr> <td>X3c Rr</td><td>Rotor Resistance</td></tr> </table> The motor must be stopped for Autotuning to function correctly. WARNING: Autotuning may apply 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. Note: Manual tuning of the Motor/Drive is required for optimum performance in dynamic applications. 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 from several seconds to several minutes to complete. Refer to Section 3 of the E-Series Getting Started Manual, Part No. 4201-179 for details on preliminary commissioning.	X3a Lm	Motor Main Inductance	X3b Rs	Stator Resistance	X3c Rr	Rotor Resistance
X3a Lm	Motor Main Inductance						
X3b Rs	Stator Resistance						
X3c Rr	Rotor Resistance						

SUBGROUP X3: MOTOR TUNING**X3a-X3d MOTOR IMPEDANCES**

Note:	Only applies to E-Series operated in open loop or closed loop vector mode.
Screen	X3a Lm=190%
Description	MAIN INDUCTANCE
Range	40 to 800%
Units	PERCENTAGE OF RATED IMPEDANCE
Default Value	190% (Dependant on E-Series model)
OFF to Modify	NO
FUNCTION	The main inductance of the motor 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 E-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 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	3.0% (Dependant on E-Series model)
OFF to Modify	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). In Open Loop mode, care should be taken to set this correctly. The value can be set using Autotune. Alternatively, the per cent rated slip value can be used (See X3c below).
Screen	X3c Rr=6.00%
Description	ROTOR RESISTANCE
Range	0 to 15.0%
Units	PERCENTAGE OF RATED IMPEDANCE
Default Value	6.0% (Dependant on E-Series model)
OFF to Modify	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.,

$$\text{Slip (\%)} = 100 \times \frac{\text{SyncSpeed} - \text{rated speed}}{\text{SyncSpeed}}$$

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.

For Open Loop mode, set up as per Closed Loop Vector Mode.

This value will also influence the accuracy of slip compensation (X5d).

Screen	X3d SIGMA=6.0%
Description	TOTAL LEAKAGE
Range	0 to 20%
Units	PERCENTAGE OF RATED IMPEDANCE
Default Value	6.0%
OFF to Modify	NO
FUNCTION	The total leakage inductance represented as a percentage of main inductance.
SETTING UP	This parameter is not usually adjusted by the user. In Open Loop mode, sigma should be set to 6% for motors below 7.5kW and for motors above this, 6% should suffice for most cases.

X3e FIELD WEAKENING POINT

Screen	FLD WEAK=90%
Description	FIELD WEAKENING POINT
Range	50 to 100%
Units	PERCENT OF AVAILABLE VOLTAGE
Default Value	90%
OFF to Modify	NO
FUNCTION	May be used to force the E-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 E-Series), set to 100%. Otherwise leave set to approximately 90%. Note that the achievable motor power will be reduced in proportion. For Open Loop mode, this value is also the point at which the system transitions between Open Loop normal mode and Open Loop overspeed mode.

SUBGROUP X4: LOAD TUNING

Screen	X4a MIN. FLX=100%
Description	DYNAFLUX MINIMUM FLUX LEVEL
Range	40% to 100%
Default	100%
Note	Dynaflux only operates in V/Hz control mode.

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

The E-Series 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 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 TYP=AUTO
Description	STARTING BOOST TYPE
Range	FIX/AUTO/CUR
Default Value	AUTO
OFF to Modify	YES
Note	Starting Boost selection is only available in V/Hz control mode.

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]. Open Loop mode can use any setting of this variable.

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].

X4d	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.
X4f	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.
X4g	
X4h	
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.
X4i	Screen X4c STR TQ=0%
Description	STARTING TORQUE (BOOST) ADJUSTMENT
Range	0 to 250%
Default Value	0%
OFF to Modify	NO
FUNCTION	Provides improved low speed torque performance when an encoder is not used, i.e., in Open Loop Mode 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. When using V/Hz with Automatic or Fixed Voltage Boost, adjustment should be made until sufficient starting torque is developed to start the load. If the load is such that the adjustment levels required to start the load causes the E-Series to enter a current limiting protection state, then Current controlled Boost (rather than Automatic or with fixed voltage Boost) is recommended. When using V/Hz Current Controlled Boost, 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 adjustment should be used in conjunction with the Starting Band adjustment (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. When using Open Loop Mode, adjust the starting Torque to the desired starting Torque level. When using Closed Loop Vector Mode the starting torque adjustment has no affect.
Screen	X4d STR BAND=10%
Description	STARTING (BOOST) BAND ADJUSTMENT
Range	0 TO 99% OF RATED (NAMEPLATE) MOTOR FREQUENCY
Default Value	10%
OFF to Modify	NO
Note	Start Band only operates in V/Hz mode if current controlled boost is selected.

FUNCTION	Provides speed related profiling of the starting torque for the current controlled boost (Screen X4b STR TYPE=CUR). For Open Loop, this parameter determines the transition from Open Loop start mode to Open Loop normal mode. When stopping, the drive will re-enter the Open Loop start mode from Open Loop normal mode. This will occur when the speed drops to 4.5% below the STR BAND value. In Open loop mode this cannot be increased above 50% as the overspeed band can be reduced to 50% speed.
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

Note	Only operates in Open Loop or Closed Loop Vector mode.
Screen	X4f Kp w=20%
Description	ROTOR SPEED PID LOOP PROPORTIONAL GAIN
Range	0 to 300%
Default Value	20%
OFF to Modify	NO
FUNCTION	The proportional gain of the rotor speed PID controller. Affects the response, stiffness and damping of the speed loop. In Open Loop mode, set up as per Closed Loop Vector mode.
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%
OFF to Modify	NO
FUNCTION	The integral gain of the rotor speed holding PID controller. Affects the long term speed hold accuracy of the speed control loop. In Open Loop mode, set up as per Closed Loop Vector mode.
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%
OFF to Modify	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).
Screen	X4i LS FL BO=0%
Description	FLUX BOOST A
Range	X4j setting to 99%
Default Value	0%
OFF to Modify	NO
FUNCTION	Boost flux to cope with large or unstable loads when operating in Open Loop mode. Increased flux means less torque current is needed to generate a given torque.
SETTING UP	Leave at default unless a large or unstable load is present, a conservative setting of up to 15% is recommended for these loads.
Screen	X4j HS FL BO=0%
Description	FLUX BOOST B
Range	0% to X4i setting
Default Value	0%
OFF to Modify	NO
FUNCTION	Used in conjunction with FLUX BOOST A in order to phase out the adjustment linearly at higher speeds in order to prevent early onset of Open Loop Mode overspeed mode.
SETTING UP	Leave set to zero if phasing out of FLUX BOOST A is required. For a constant flux boost set to the X4i setting.

X4k	INERTIA COMPENSATION	X4k
Screen	X4k INERTIA k=1	
Description	INERTIA COMPENSATION	
Range	1 to 10	X5a
Units	none	
Default	1	
FUNCTION	The compensation factor for inertia is required for large inertia loads if slip compensation or open loop mode is used. Used for enhancing stability and not for tuning of the speed controller.	X5b
SUBGROUP X5: CONTROLLER TUNING		X5c
Note	V/Hz and Open Loop mode only	
Screen	X5a ILT SLIP=2.0%	X5d
Description	CURRENT LIMIT SLIP VALUE	
Range	0.0% to 10%, OFF	
Default Value	2.0%(dependent on E-Series model)	
FUNCTION	To actively reduce the E-Series frequency or acceleration to maintain load current within controllable bounds (status=ILT).	X5e
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). For optimal operation in Open Loop mode set value to motor slip in per cent.	X5f
Screen	X5b VLT SLIP=2.0%	
Note	V/Hz only	
Description	VOLTAGE LIMIT SLIP	
Range	0.0% to 20%	
Default Value	2.0%(dependent on E-Series model)	
FUNCTION	If a motor is overdriven (e.g., by decelerating its attached load too fast) it will regenerate into the E-Series. Too much regeneration will cause the E-Series to take evasive action ("voltage limiting") by reducing the deceleration rate as regeneration occurs. The voltage limit slip setting is an adjustment which is used to enhance the stability of voltage limiting control.	
SETTING UP	Do not adjust this setting unless voltage limiting is unstable. Nominally this value should be set to the rated percent slip 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. The speed filter setting (Screen R7) may also be used to improve stability during voltage limiting. For optimal operation in Open Loop mode, set value to motor slip in per cent.	

X5g	Screen	X5c DAMPING=2.0%
	Description	NO LOAD DAMPING
	Range	0% to 20%
	Default Value	2.0% (dependent on E-Series model)
X5h	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.
X5i	SETTING UP	Do not adjust this value unless light load stability problems exist. Increase setting to improve stability. Increasing the setting too far may induce instability.
Y1		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%
Y2	Screen	X5d SLIP COMP=N
	Note	V/Hz only
	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 or open Loop control modes - turn on. May be enabled when using Open loop mode, this will assist with speed regulation when in operating in the Open Loop mode overspeed region.
X5e, X5f MODULATION		
	Screen	X5e FREQ = AUTO
	Description	MODULATION FREQUENCY
	Options	AUTO/4000-16000 (Refer Note)
	Units	HERTZ
	Default Value	AUTO
	OFF to Modify	NO
	FUNCTION	Alters the output frequency to the motor. May be used to avoid mechanical noise within the motor. AUTO allows the E-Series' thermal management system to optimise the switching frequency to maintain reliable operation.
	Note:	Maximum frequency is frame size dependant. F1-2 16,000Hz F3-4 10,000Hz F5-7 8,000Hz

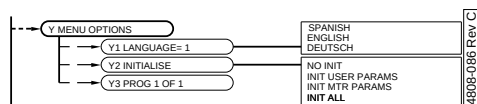
Screen	X5f SWITCH FR=WW
Description	MODULATION TYPE
Options	[WW] WHISPER WAVE [NB] NARROW BAND
Units	HERTZ
Default Value	WW
OFF to Modify	NO
FUNCTION	Alters the type of noise produced by the motor. Narrow band produces a conventional fixed frequency noise spectrum. Whisper Wave is a special mode which 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 E-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%
OFF to Modify	NO
Note	Not V/Hz
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%
OFF to Modify	NO
Note	Not V/Hz
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%
OFF to Modify	NO
Note	Closed Loop Vector mode only
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 Kfw 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
 3 = SPANISH
 Default ENGLISH
 OFF to Modify NO
 Attribute READ-WRITE
 FUNCTION Determines the language displayed by the E-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 9.26
 Attribute HIDDEN

DISPLAY	DESCRIPTION
NO	Not initialising
INIT USER SETTINGS	Initialises all user settings including menu setup mode 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)
INIT ALL	Initialises all parameters. Available after F18 fault

Figure 9.26: 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).

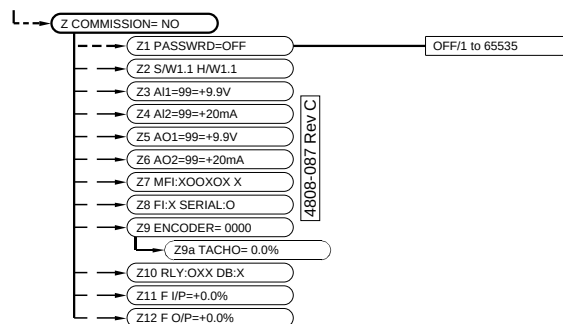
SETTING UP Select the required level and release the keys. The display will show INITIALISING... while doing so, and returns to NO when completed.

Screen **Y3 PROG 1 of 1**
 Description SELECTS PROGRAM TO USE
 Default 1
 OFF to Modify YES
 Attribute READ ONLY
 FUNCTION Determines the Control program that is running. See Section 8.

SCREEN GROUP Z: COMMISSIONING SCREENS

Y3

Group Attribute READ ONLY



Z

Z Commissioning Mode

SCREEN **Z COMMISSION=NO**
 Description COMMISSIONING MODE
 Range YES or NO
 Default Value NO
 OFF to Modify 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.

Z1	The display's control (bottom) line will now read: Z COMMISSION=Y
Z2	All screens will now be visible, and all parameters adjustable.
Z3	Selecting OPERATION Mode: To change from COMMISSIONING Mode to OPERATION Mode, scroll to Screen Group Z.
Z4	The display's control line will read: Z COMMISSION=N
Z5	Commissioning Mode Password
Screen	Z1 PASSWORD=OFF
Description	COMMISSIONING MODE PASSWORD
Range	OFF, 1 to 65535
OFF to Modify	NO
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 Bardac Drives 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
FUNCTION	Shows the revision number (X.X) of the software and hardware currently fitted to the E-Series.

Z3	ANALOGUE INPUT 1 STATUS
Screen	Z3 AI1=99=+9.9V or Z3 AI1=99=+20mA
Description	STATUS OF ANALOGUE INPUT 1
Range	00 to 99; -10V to +10V or 0 to 20mA
Screen	Z3 AI1=99=+9.9V or 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 $\pm 10V$ 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
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 $\pm 10V$ 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 $\pm 10V$ 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
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 $\pm 10V$ 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 $\pm 10V$ 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 or
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 or
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 1 2 3 4 5 6 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 an 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 (INACTIVE) or X (ACTIVE);
O (INACTIVE) or X (ACTIVE);

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 (Inactive)
X (Active)

Reference 2: Status of Serial Input
O (Inactive)
X (Active)

Note 1 An Active (X) status indicates that a valid fibre optic data packet has been received since the last screen update. An Inactive (O) status indicates that no valid data packet has been received since the last screen update.

Note 2 An Active (X) status indicates that a valid serial communication data packet has been received since the last screen update. An Inactive (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, in the forward direction.

Z9a ENCODER SPEED

Screen **Z9a TACHO=0.0%**

Description ENCODER SPEED

FUNCTION Displays the speed of the encoder as a % of motor synchronous speed.

This screen is useful for checking for faults in the encoder and encoder wiring.

Z10**Z10 OUTPUT RELAY STATUS;
DYNAMIC BRAKE OUTPUT STATUS**Screen **Z10 RLY:XXX DB:X****Z11**Description STATUS OF OUTPUT RELAYS;
STATUS OF DYNAMIC BRAKE OUTPUT
Range O (OPEN) or X (CLOSED);
O (OPEN) or X (CLOSED);

Attribute Read Only

Z12Screen **Z10 RLY:XXX DB:X**Reference **0 1 2 3 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=+0.0%**

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 E-
Series fibre optic input port.Screen **Z12 F O/P=+0.0%**

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 E-
Series fibre optic output port.Refer to Screen Z8 for an indication of fibre
optic input errors.

10 APPLICATION EXAMPLE - SIMPLE FAN SPEED CONTROL

A typical application example is for simple fan speed control using a potentiometer to set 0-10V speed reference, and pushbuttons for start and remote stop-reset control. External speed monitoring is achieved using a simple 0-10V meter representing 0-100% speed. This section shows the configuration, wiring and adjustment of a typical example.

The example given is of a system of the following specification:

Control signal 0-10V (potentiometer)

Motor 5.5kW, 11.4A, 400V 1450rpm

E-Series Model E012

Stop/start control 3 wire

Direction control None required

The configuration table (not including irrelevant and/or settings that have not been altered from factory set values) and wiring configurations follow:

SIMPLE FAN SPEED CONTROL EXAMPLE CONFIGURATION TABLE

DRIVE NO:	MODEL:	E012
LOCATION:	FAN SPEED CONTROL	
MOTOR:	kW:	5.5
	A:	11.4
	V:	400
POLES:	4	
	RPM:	1450

SETUP:

Using the procedure as set up in Section 2.1:

Set up the motor information of Screen Group N:

N1 MTR CUR=11.4A
 N2 MTR VOLT=400V
 N3 MTR FR=50Hz
 N3 MTR RPM=1450
 N6 MTR COOL=40%

Set the limits of operation using Screen Group L:

L2 MIN S=0.0%
 L3 MAX S=+100%
 L9 I LIMIT=17.1A (this represents 150%)

Set up the control sources via Screen Group I:

I1 LOCAL S/STP=0 (Local control disabled)
 I2 REF S=AIN1
 I6a AI1=0-10V
 I6b AI1 LO=0%
 I6c AI1 HI=+100%
 I7a I/P MODE=1 (Remote 3 wire control)

External monitoring of speed is achieved via Screen Group O:

O1a AO1 O/P=06 (%of motor speed)
 O1b AO1=0-10V
 O1c AO1 LO=0%
 O1d AO1 HI=+100%

The ramp rates are then set via Screen Group R:

R1 ACC=5.0%/s

R2 DEC=5.0%/s

R6 STOPR=10.0%/s

START is activated by momentarily closing the normally open pushbutton connected at Terminal T14. This starts the E-Series accelerating the motor to the reference speed defined by the potentiometer connected at Terminal T26.

STOP is activated by momentarily opening the normally closed pushbutton connected at Terminal T15. This stops the E-Series decelerating the motor to zero speed.

The acceleration and deceleration rates are defined by Screens R1 and R2.

By momentarily opening the normally closed EXT TRIP pushbutton connected at Terminal T19 the E-Series will trip, displaying the fault condition "22 EXT/PTC".

By opening the normally closed switch connected at Terminal T13, the E-Series will stop, decelerating the motor using the stop rate defined by Screen R6 (This overrides the deceleration rate defined by Screen R2). If any internal or external fault should occur, then the E-Series may be reset (once the fault condition has been removed) upon the opening edge of the ASTOP-RESET switch.

COMMISSIONING CONFIGURATION RECORD — SCREENS

DRIVE NO: _____ MODEL: _____

LOCATION: _____

MOTOR kW: _____ A: _____ V: _____

POLES: _____ RPM: _____

RECORD 1 RECORD 2

DATE: _/_/_ _/_/_

BY: _____

SCREEN UNIT

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=10s	SEC	_____	_____
D2	DB DUTY=OFF	%	_____	_____

SERIAL COMMUNICATIONS CONTROLS

H1	PROTOCOL=M	_____	_____	
H2	COMS T/O=OFF	SEC	_____	_____
H3a	COMMS ADR=10	_____	_____	
H3b	BAUDRATE=9600	_____	_____	
H3c	PARITY=EVEN	_____	_____	
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=	_____	_____
	STR/STP RESET	_____	_____
I2	REF S=LOCAL	_____	_____
I3	REF T=NULL	_____	_____
I4	AREF S=AIN1	_____	_____
I5	AREF T=NULL	_____	_____

SCREEN

UNIT

I6a	AI1=0-10V	_____	_____
I6b	AI1 LO=0%	%	_____
I6c	AI1 HI=+100%	%	_____
I6d	AI2=0-10V	_____	_____
I6e	AI2 LO= 0%	%	_____
I6f	AI2 HI=+100%	%	_____
I6g	ZERO BAND=N	_____	_____
I7a	I/P MODE=0	_____	_____
I7b	POLARITY=Hi	_____	_____
I7c	MF1 SEL=00	_____	_____
I7d	MF2 SEL=00	_____	_____
I7e	MF3 SEL=00	_____	_____
I7f	MF4 SEL=00	_____	_____
I7g	MF5 SEL=00	_____	_____
I7h	MF6 SEL=00	_____	_____
I8a	F LO =-100%	%	_____
I8b	F HI = +100%	%	_____
I8c	FIBRE MODE=0	_____	_____
I8d	FIB T/O=OFF	SEC	_____

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=*	AMP	_____	_____
L10	SKIP1=+0.0%	%	_____	_____
L11	SKIP2=+0.0%	%	_____	_____
L12	SK BW=0.0%	%	_____	_____
L13	GND ILT=12A	AMP	_____	_____
L14	MIN SP RUN=Y	_____	_____	

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	_____	_____
N3	MTR FRQ=50Hz	Hz	_____	_____
N4	MTR PWR*	kW	_____	_____
N5	MTR RPM*	RPM	_____	_____
N6	MTR COOL=40%	%	_____	_____
N8	ENCODER=0		_____	_____
N9	ENC I/P=DIFF		_____	_____

OUTPUT SIGNALS

O1a	AO1 O/P=06		_____	_____
O1b	AO1=+/-10V		_____	_____
O1c	AO1 LO= -100%	%	_____	_____
O1d	AO1 HI=+100%	%	_____	_____
O1e	AO2 O/P=02		_____	_____
O1f	AO2=+/-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=NULL		_____	_____
P2	FB SRC=NULL		_____	_____
P3	Kc = 0.1		_____	_____
P4	Ti = INF	SEC	_____	_____
P5	Td = 0.0s	SEC	_____	_____
P6	ERROR=+0.0%	%	_____	_____
P7	INVERT PID=N		_____	_____

ACCELERATION RATES

R1	ACC=10.0%/s	%/SEC	_____	_____
R2	DEC=10.0%/s	%/SEC	_____	_____
R3	AACC=*	%/SEC	_____	_____
R4	ADEC=*	%/SEC	_____	_____
R5	BRK SP=OFF	%	_____	_____
R6	STOPR=1300%/s	%/SEC	_____	_____
R7	SP FILT=*	SEC	_____	_____
R8	TQ FILT=0.00s	SEC	_____	_____

START/STOP MODES

S1	START=NORMAL		_____	_____
S2	STOP=NORMAL		_____	_____
S4	ASTOP=NORMAL		_____	_____
S5	STR DLY=0.00s	SEC	_____	_____
S6	OFF DLY=1s	SEC	_____	_____

S7	LOW V TRIP=N		_____	_____
S8	BRAKE I=0%	%	_____	_____
S9	HOLD V=0%	%	_____	_____
S10	HEAT=OFF	%	_____	_____
S11	STP T/O=*	SEC	_____	_____
S12	BK RLS=0.00s	SEC	_____	_____
S13	PRE TQ=+0%	%	_____	_____

IMPEDANCES AND GAINS

X1	CTRL TYPE=V/Hz		_____	_____
X3a	Lm=*	%	_____	_____
X3b	Rs=*	%	_____	_____
X3c	Rr=*	%	_____	_____
X3d	SIGMA=6.0%	%	_____	_____
X3e	FL WEAK=100%	%	_____	_____
X4a	MIN FLX=100%	%	_____	_____
X4b	STR TYPE=AUTO		_____	_____
X4c	STR TQ=0%	%	_____	_____
X4d	STR BAND=10%	%	_____	_____
X4f	Kp w=20%	%	_____	_____
X4g	Ki w=30%	%	_____	_____
X4h	Kd w=0%	%	_____	_____
X4i	LS FL BO=0%	%	_____	_____
X4j	HS FL BO=0%	%	_____	_____
X4k	INERTIA k=1		_____	_____
X5a	ILT SLP*	%	_____	_____
X5b	VLT SLP*	%	_____	_____
X5c	DAMPING*	%	_____	_____
X5d	SLIP COMP=N		_____	_____
X5e	FREQ=AUTO		_____	_____
X5f	SWITCH FR=WW	Hz	_____	_____
X5g	Kp I=25%	%	_____	_____
X5h	Ki I=13%	%	_____	_____
X5i	Kf w=50%	%	_____	_____

MENU OPTIONS

Y1	LANGUAGE=1		_____	_____
Y3	PROGRAM=1		_____	_____

COMMISSION = Y/N

Z1	PASSWRD=OFF		_____	_____
Z2	S/W REVISION		_____	_____
Z2	H/W REVISION		_____	_____

*Model dependent default

COMMISSIONING CONFIGURATION CONTROL — TERMINALS

				Wire Designation		Wire Colour	
Relay 1	N.O.	T1	O2a	O2b	T1		
	N.C.	T2	Relay Selection =	Inverted=Y/N	T2		
		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		
+24V Display DATA 0V		T10	I1		T10		
		T11	Local Start/Stop-Reset=		T11		
		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	O1c Lo = %	T22	
Analogue Output 1		T23	O1a Output =	4-20mA 0-20mA	O1d Hi = %	T23	
Analogue Output 2		T24	O1e Output =	O1f 0-10V ±10V	O1g Lo = %	T24	
0V		T25		4-20mA 0-20mA	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	N9		T31	
	$\bar{A}$	T32	Encoder PPR =	Encoder Type =		T32	
	B	T33				T33	
	$\bar{B}$	T34				T34	
0V		T35				T35	
User Supply +24V @ 500mA		T36				T36	
0V		T37				T37	
Isolated RS485	A	T38	H3a	H3b	H2	T38	
Isolated 0V	B	T39	Communications Address=	Baudrate = 1200 2400 4800 9600 OFF	Comms Timeout = 1s/5s 25s/OFF	T39	
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 G

E-SERIES SPARES LIST

MICRODRIVE E-SERIES FRAME1 & 2 400V SPARES LIST

400 VOLT MICRODRIVE E-SERIES SPARE PARTS LIST						
Frame Size	FRAME 1				FRAME 2	
Model	E002	E006	E010	E012	E018	E022
Display Cover Label	4101-545					
Front Cover	3903-116					
Cover Gasket	3907-021					
Display Unit	E000-620S					
Control Board	E000-610S					
Power Board	E006-611S		E012-611S		E022-611S	
Gatedrive Board	E002-612S	E006-612S	E010-612S	E012-612S	E018-612S	E022-612S
Terminal Board	E002-616S	E006-616S	E012-616S		E022-616S	
Rectifier Block	1757-103		1757-104		1421-023	
IGBT Block	(supplied w ith Pow er Board)		(supplied w ith Pow er Board)		1757-106	
IGBT Thermstrate	1781-530		1781-530		1781-205	
Rectifier Thermstrate					1781-108	
DC Bus Capacitors	2 x 1277-547		4 x 1277-547		6 x 1277-547	
External Fan	2941-012					
Internal Fan	2941-010					
To order conformally coated spare boards, add "C" suffix to the Part Number shown above.						
Example: Conformally coated Power Board for ME-2.5 = E012-611SC					4508-269A	

MICRODRIVE E-SERIES FRAME1 & 2 500V SPARES LIST

500 VOLT MICRODRIVE E-SERIES SPARE PARTS LIST						
Frame Size	FRAME 1				FRAME 2	
Model	ME-2D	ME-6D	ME-9D	ME-11D	ME-16D	ME-21D
Display Cover Label	4101-545					
Front Cover	3903-116					
Cover Gasket	3907-021					
Display Unit	E000-620S					
Control Board	E000-610S					
Power Board	E007-611S		E013-611S		E023-611S	
Gatedrive Board	E003-612S	E007-612S	E011-612S	E013-612S	E019-612S	E023-612S
Terminal Board	E003-616S	E007-616S	E013-616S		E023-616S	
Rectifier Block	1757-103		1757-104		1421-023	
IGBT Block	(supplied with Pow er Board)		(supplied with Pow er Board)		1757-106	
IGBT Thermstrate	1781-530				1781-205	
Rectifier Thermstrate					1781-108	
DC Bus Capacitors	2 x 1277-546	2 x 1277-546	4 x 1277-546	4 x 1277-546	6 x 1277-546	6 x 1277-546
Microtherm	2721-102 (Includes Wiring Loom and Plug)					
External Fan	2941-012					
Internal Fan	2941-010					
To order conformally coated spare boards, add "C" suffix to the Part Number shown above.						
Example: Conformally coated Terminal Board for ME-6D = E007-616SC						4508-271A

MICRODRIVE E-SERIES FRAME 3 400V SPARES LIST

400 VOLT MICRODRIVE E-SERIES SPARE PARTS LIST			
Frame Size	FRAME 3		
Model	E031	E038	E046
Display Cover Label	LHS 4101-582		RHS 4101-545
Front Cover	3903-116		
Cover Gasket	3907-021		
Display Unit	E000-620S		
Control Board	E000-610S		
DCCT Interface Board	E046-618S		
DCCT	3 x 2521-085		3 x 2521-086
DCCT Loom	3 x 2721-113		
Power Board	E046-611S		
Rectifier Board	E046-615S		
Gatedrive Board	E031-612S	E038-612S	E046-612S
Rectifier Block	3 x 1421-037		
IGBT Block	3 x 1757-127	3 x 1757-128	3 x 1757-128
IGBT Thermstrate	3 x 1781-006		
Rectifier Thermstrate	3 x 1781-002		
Capacitor Board	E031-617S	E038-617S	E046-617S
DC Bus Capacitors	10 x 1277-547	12 x 1277-547	14 x 1277-547
External Fans	2 x 2941-012		
Internal Fans	2 x 2941-010 (IP54 only)		
To order conformally coated spare boards, add "C" suffix to the Part Number shown above.			
Example: Conformally coated Rectifier Board for ME-31C = E046-615SC			4508-270A

MICRODRIVE E-SERIES FRAME 3 500V SPARES LIST

500 VOLT MICRODRIVE E-SERIES SPARE PARTS LIST			
Frame Size	FRAME 3		
Model	ME-30D	ME-35D	ME-41D
Display Cover Label	LHS 4101-582		RHS 4101-545
Front Cover	3903-116		
Cover Gasket	3907-021		
Display Unit	E000-620S		
Control Board	E000-610S		
DCCT Interface	E046-618S		
DCCT	3 x 2521-085		3 x 2521-086
DCCT Loom	3 x 2721-113		
Power Board	E047-611S		
Rectifier Board	E047-615S		
Gatedrive Board	E030-612S	E035-612S	E041-612S
Rectifier Block	3 x 1421-037		
IGBT Block	3 x 1757-127	3 x 1757-128	3 x 1757-128
IGBT Thermstrate	3 x 1781-006		
Rectifier Thermstrate	3 x 1781-002		
Capacitor Board	E032-617S	E039-617S	E047-617S
DC Bus Capacitors	10 x 1277-546	12 x 1277-546	14 x 1277-546
Thermal Sense Board	1 x E000-619S		
Microtherm	2721-102 (Includes Wiring Loom and Plug)		
External Fans	2 x 2941-012		
Internal Fans	2 x 2941-010 (IP54 only)		
To order conformally coated spare boards, add "C" suffix to the Part Number shown above.			
Example: Conformally coated Rectifier Board for ME-30D = E047-615SC			4508272A

ULTRADRIE E-SERIES FRAME 4 SPARES LIST

400 and 500 VOLT ULTRADRIE E-SERIES SPARE PARTS LIST							
Frame Size	FRAME 4					Spares Guide	
Model	UE-60C/D	UE-75C/D	UE-90C/D	UE-115C/D	UE-140C/D	*Level 1	**Level 2
Display Unit	E000-622S						
Control Board	E000-610S					1	1
Power Tray	E061-611S	E076-611S	E141-611S			1	1
Drive Select Module	E062-623S	E077-623S	E092-623	E117-623S	E142-623S	1	1
DC Bus Board Loom	2721-116						1
F 1 , F 2 (Power Tray)	2401-025					2	2
Thermal Sensor Loom	Loom to Power Tray 2721-113						1
	Linking Loom 2721-114						1
Thermal Sensor	2 x E000-619S						1
Microtherm	2 x 2721-101 (Includes Wiring Loom and Plug)						1
DC Bus Board	E140-621S						1
DCCT	3 x 2521-086			3 x 2521-087			
DCCT Loom	2726-102 (3 looms supplied)						
Rectifier Block	3 x 1421-030	3 x 1421-032		3 x 1421-038			2
Rectifier Thermstrate	3 x 1781-006						2
IGBT Block	3 x 1757-131	3 x 1757-124	3 x 1757-126	3 x 1757-134			2
IGBT Thermstrate	3 x 1781-104						2
IGBT Gatedrive Loom	3 x 2721-117						3
DC Bus Capacitors	4 x 1352-552	6 x 1352-552		8 x 1352-552			
Capaitor Sealing Ring	4 x 3907-004	6 x 3907-004		8 x 3907-004			
External Fans	150mm Fan 2941-015					1	1
	120mm Fan 2941-012					1	1
Internal Fans	2941-013					1	1
* Level 1: Minimum spares stock. **Level 2: Typical spares stock							
To order conformally coated spare boards, add "C" suffix to the Part Number shown above.							
Example: Conformally coated DC Bus Board for UE-90D = E140-621SC							4508-274A

ULTRADRIE E-SERIES FRAME 5 SPARES LIST

400 and 500 VOLT ULTRADRIE E-SERIES SPARE PARTS LIST					
Frame Size	FRAME 5			Spares Guide	
Model	UE-170C/D	UE-205C/D	UE-250C/D	* Level 1	** Level 2
Display Unit	E250-620S				
Control Board	E000-610S			1	1
Power Tray	E661-611S			1	1
Drive Select Module	E171-623S	E211-623S	E251-623S	1	1
SCR Board	3 x E661-615S				2
SCR Loom	2721-091				
AC Power to Power Tray Loom	2721-125				
Rectifier Block	3 x 1421-040				2
Rectifier Thermstrate	3 x 1781-103				2
IGBT Block	12 x 1757-136	12 x 1757-135			4
IGBT Thermstrate	12 x 1781-104				4
Gate Drive Board	3 x E251-612S				2
DC Bus Capacitors	12 x 1352-552	18 x 1352-552			
Capacitor Sealing Rings	12 x 3907-004	18 x 3907-004			
External Fans	2 x 2941-024	2 x 2941-025		1	1
Main Internal Fan	2941-006			1	1
DC Bus Fuse	3 x 3302-615	3 x 3302-500			3
Input Fuses	3 x 3302-615			3	3
SCR Board Fuse	3 x 2401-025			3	3
DC Power Supply Board Fuses	2 x 2404-063			2	2
Power Supply Board	E660-621S (Includes Fuses)				
Thermal Sensor Boards	6 x E000-619S				2
Microtherm Including Loom	6 x 2721-101				
Thermal Sensor Looms	Loom To Power Board 1 x 2726-104				1
	Short Linking Loom 4 x 2721-114				2
	Long Linking Loom 1 x 2726-103				1
DC Power to Power tray Loom	2721-119				
DCCT	3 x 2521-071				
Bus Sharing PCB	4 x 0371-609				
Fibre Optic Loom UH, VH & WH	3 x 2727-016 (370mm)				
Fibre Optic Loom UL & WL	2 x 2727-017 (620mm)				
Fibre Optic Loom VL	1 x 2727-018 (715mm)				
UE F5 Fan PSU	E251-648S				1
* Level 1: Minimum spares stock. **Level 2: Typical spares stock					
To order conformally coated spare boards, add "C" suffix to the Part Number shown above.					
Example: Conformally coated DC Fuse Assembly for UE-170D = E660-621SC				4508-276A	

ULTRADRIVE E-SERIES FRAME 6 SPARES LIST

400 and 500 VOLT ULTRADRIVE E-SERIES SPARE PARTS LIST						
Frame Size	FRAME 6				Spares Guide	
Model	UE-305C/D	UE-370C/D	UE-440C/D	UE-540C/D	*Level 1	**Level 2
Display Unit	E480-620S					
Control Board	E000-610S					1
Power Tray	E661-611S				1	1
Drive Select Module	E306-623S	E371-623S	E441-623S	E541-623S	1	1
SCR Board	6 x E661-615S				2	4
SCR Loom	2721-088					
AC Power to Power Tray Loom	2721-124					
Rectifier Block	6 x 1421-040				2	4
Rectifier Thermstrate	6 x 1781-103				2	4
IGBT Block	24 x 1757-136		24 x 1757-135		4	8
IGBT Thermstrate	24 x 1781-104				4	8
Gate Drive Board	3 x E481-612S				1	2
DC Bus Capacitors	24 x 1352-552		36 x 1352-552			
Capacitor Sealing Rings	24 x 3907-004		36 x 3907-004			
External Fans	5 x 2941-024		5 x 2941-022			1
Main Internal Fans	2 x 2941-012					1
Power Tray Fan	2941-014					1
DC Bus Fuse	6 x 3302-615		6 x 3302-500			6
Input Fuses	9 x 3302-615				6	6
SCR Board Fuse	6 x 2401-025				6	6
Power Supply Board Fuses	2 x 2404-063				2	2
DC Fuse Assembly	E660-621S (Includes Fuses)					
Thermal Sensor Boards	12 x E000-619S					4
Microtherm Including Loom	6 x 2721-101					
Thermal Sensor Looms	Loom To Power Board 1 x 2726-105					1
	Short Linking Loom 4 x 2721-114					3
	Long Linking Loom 2 x 2726-103					1
DC Power to Power tray Loom	2721-094					
DCCT	3 x 2521-073	3 x 2521-088	3 x 2521-072			
Bus Sharing PCB	6 x 0371-609					
Fibre Optic Loom UH, UL & VL	3 x 2727-018 (715mm)					
Fibre Optic Loom UL & WL	2 x 2727-016 (370mm)					
Fibre Optic Loom WL	1 x 2727-017 (620mm)					
UE F6 Fan PSU	E541-648S					1
* Level 1: Minimum spares stock. **Level 2: Typical spares stock						
To order conformally coated spare boards, add "C" suffix to the Part Number shown above.						
Example: Conformally coated Gate Drive Board for UE-440D = E481-612SC					4508-278A	

ULTRADrive E-SERIES FRAME 7 SPARES LIST

400 and 500 VOLT ULTRADRIVE E-SERIES SPARE PARTS LIST				
Frame Size	FRAME 7		Spares Guide	
Model	UE-620C/D	UE-700C/D	*Level 1	**Level 2
Display Unit	E660-620S			
Control Board	E000-610S		1	1
Power Tray	E661-611S		1	1
Drive Select Module	E621-623S	E701-623S	1	1
SCR Board	9 x E661-615S			6
SCR Loom	2721-088			
AC Power to Power Tray Loom	2721-124			
Rectifier Block	9 x 1421-040			6
Rectifier Thermstrate	9 x 1781-103			6
IGBT Block	36 x 1757-135			12
IGBT Thermstrate	36 x 1781-104			12
Gate Drive Board	3 x E661-612S			2
DC Bus Capacitors	54 x 1352-552			
Capacitor Sealing Rings	54 x 3907-004			
External Fans	8 x 2941-022		2	2
Main Internal Fans	2 x 2941-012		1	1
Power Tray Fan	2941-014		1	1
DC Bus Fuse	9 x 3302-500			9
Input Fuses	9 x 3302-615		9	9
SCR Board Fuse	9 x 2401-025		9	9
DC Power Supply Board Fuses	2 x 2404-063		2	2
DC Fuse Assembly	E660-621S (Includes Fuses)			
Microtherm Including Loom	6 x 2721-101			
Thermal Sensor Boards	18 x E000-619S			3
Thermal Sensor Looms	Loom To Power Board 1 x 2726-105			1
	Short Linking Loom 4 x 2721-114			2
	Long Linking Loom 2 x 2726-103			1
DC Power to Power tray Loom	2721-094			
DCCT	3 x 2521-072			
Bus Sharing PCB	12 x 0371-609			
Fibre Optic Loom UL	2727-020 (920mm)			
Fibre Optic Loom UH, VL & WL	3 x 2727-018 (715mm)			
Fibre Optic Loom WH	1 x 2727-019 (440mm)			
Fibre Optic Loom VH	1 x 2727-016 (370mm)			
UE F7 Fan PSU	E701-648S			1
* Level 1: Minimum spares stock. **Level 2: Typical spares stock				
To order conformally coated spare boards, add "C" suffix to the Part Number shown above.				
Example: Conformally coated Gate Drive Board for UE-700D = E661-612SC				4508-280A

ULTRADRIVE E-SERIES PARALLEL DRIVES SPARES LIST

400 and 500 VOLT PARALLEL ULTRADRIVE E-SERIES SPARE PARTS LIST						
Frame Size	2 off FRAME 6		2 off FRAME 7		Spares Guide	
Model	UE-760C/D	UE-930C/D	UE-1070C/D	UE-1200C/D	*Level 1	**Level 2
For Individual Drive Spares, refer to:	UE-440C/D	UE-540C/D	UE-620C/D	UE-700C/D		
Drive Select Module	E917-623	E918-623	E919-623	E920-623	1	1
UE Parallel Drive Kit (Spare)	E001-640S				1	1
* Level 1: Minimum spares stock. **Level 2: Typical spares stock						
To order conformally coated spare boards, add "C" suffix to the Part Number shown above.						
Example: Conformally coated UE Parallel Drive Kit = E001-640SC					4508-341A	

OPTIONS LIST

E-SERIES OPTIONS LIST	
Description of Option	Part No.
E-Series Display Unit (c/w 3m cable)	E000-621S
E-Series DeviceNet Interface Unit	EDNI
Profibus DP Interface Unit	PBUS
Interbus Interface Unit	IBUS
Serial bus Interface Unit	ESBI
Fibre optic cable, 10m	2727-010
Fibre optic cable, 50m	2727-050
IP54 Remote Control Unit (c/w graduated potentiometer & on/off switch)	302
Dynamic Brake 15A (includes brake resistor)	B015
Dynamic Brake 140A (external brake resistor required)	B140
UE Frame 5 extension plinth	398
UE Frame 6 extension plinth	399
UE Frame 7 extension plinth	400
Shaft encoder 1000ppr c/w plug	0322-EN
Shaft encoder mounting bracket	0300-BR
Shaft encoder coupling	0300-CP

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