Bardac drives

E-Series

AC Flux Vector Drive

Getting Started Manual

Part Number 4201-179 Revision K

IMPORTANT

This manual must be used in conjunction with the *E-Series AC Flux Vector Drive Technical Manual - Part Number 4201-180*.

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

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Phone: (410) 604-3400 Fax: (410) 604-3500
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:
May 2002	J	Update Fuse tables, cable drawings
May 2003	K	Update to software V4.1. Environmental warnings added.

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 a pollution degree of 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 fuses.

– 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**

CONTENTS

SECTION 1:

UNPACKING, INSTALLATION AND CONNECTION

1.1 UNPACKING YOUR E-SERIES

1.1.1 UNPACKING THE E-SERIES

On unpacking, check that all listed items are present and undamaged.

Item 1: E-Series motor controller

Item 2: 1 x Manual Pack containing the following:
1 x E-Series Getting Started Manual 4201-179
1 x E-Series Technical Manual 4201-180
1 x Warning Label 4101-403

Item 3: 1 x Plastic Bag containing either of the following:
Frame 1 - 2: 2 x Terminal Connectors 3 pin
6 x White Blanking Plugs
2 x Rubber Grommets
Frame 3: 2 x Terminal Connectors 3 pin
12 x White Blanking Plugs
4 x Rubber Grommets

If the E-Series motor controller appears to be damaged, file a report with your carrier.

If any documentation is not present, contact your local Bardac Drives supplier or distributor.

1.1.2 DISPOSAL OF PACKAGING

All packaging materials made from cardboard and/or wood are able to be recycled at your local recycling centre.

1.2 INSTALLATION OF THE E-SERIES

1.2.1 INSTALLATION ENVIRONMENT

Figures 1.1 to 1.3 details the dimensions and weights of the E-Series range of induction motor controllers. The ambient temperature of the installation location must not exceed 50°C (122°F). An ambient temperature below 40°C (104°F) is preferable, for longer component lifetime, and to enable extra output rating to be achieved for quadratic torque pump and fan applications.

The internal components of the E-Series IP54 models are sealed from the cooling air and therefore are protected against an environment contaminated to pollution degree 2 (damp or dusty air).

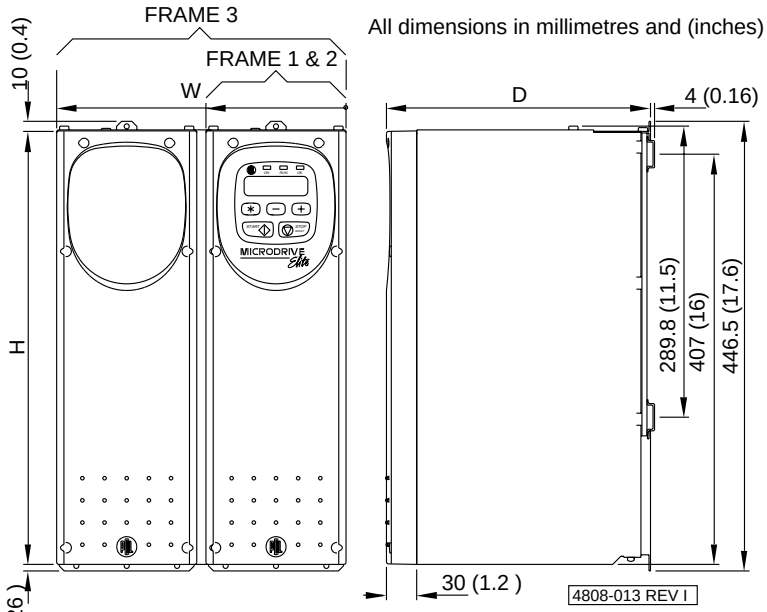
Each E-Series motor controller must have cooling air available and will contribute to heating the environment in which it is mounted. Details are given in Figure 1.4 from which the total cooling load should be calculated. Any air conditioning or ventilation system used in the plant room must be capable of handling this load, plus that caused by any other dissipative devices in the same room, while keeping the ambient air temperature below 40°C to 50°C (104°F to 122°F). The air delivery system must be able to handle the total calculated air flow, with allowance made for system back pressure.

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.

Consult Bardac if there an any doubts about the environmental conditions this equipment may be operating in or subjected to.

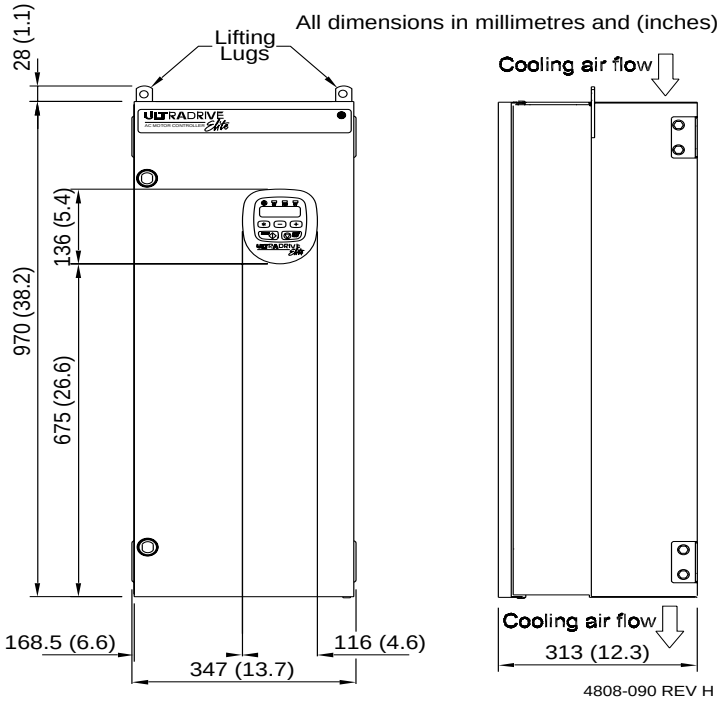
As with all electronic equipment, the cleaner, cooler and more vibration free environment, the longer and more trouble free will be the life of the E-Series.

Not adhering to the above conditions will result in the warranty being void.



MODEL	H mm (ins)	W mm (ins)	D mm (ins)	Weight kg (lbs)
FRAME 1 & 2	430 (17)	139 (5.5)	262 (10.3)	10-14 (22-31)
FRAME 3	430 (17)	279 (11)	262 (10.3)	27 (60)

Figure 1.1: Microdrive E-Series Frame 1 to 3 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 1.2: 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)

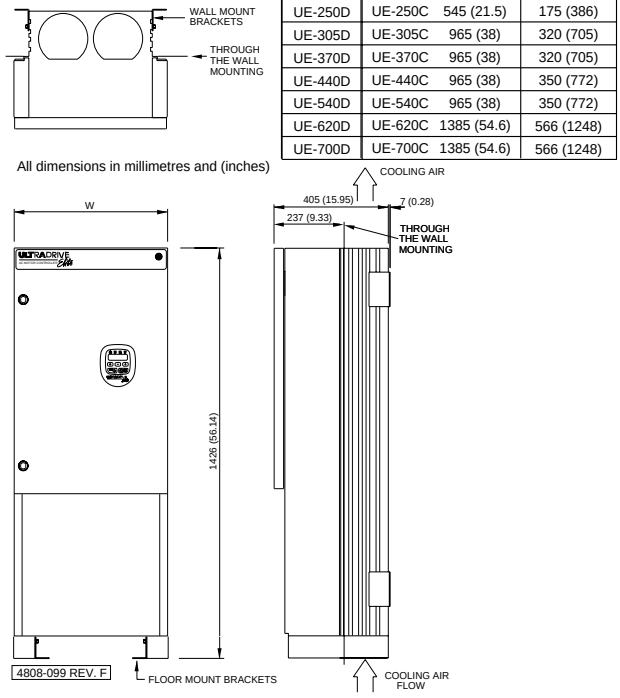


Figure 1.3: Ultradrive E-Series Frame 5 to 7 Dimensions

FRAME	MODEL 400V	MODEL 500V	DISSIPATION AT MAX CT LOAD (W)	DISSIPATION AT MAX VT LOAD (W)	COOLING AIR FLOW RATE (cubic m/hr)
F1	E002	ME-2D	55	68	100-120
	E006	ME-6D	140	165	100-120
	E010	ME-9D	220	250	100-120
	E012	ME-11D	250	290	100-120
F2	E018	ME-16D	330	385	100-120
	E022	ME-21D	465	560	100-120
F3	E031	ME-30D	640	775	200-240
	E038	ME-35D	780	925	200-240
	E046	ME-41D	950	1080	200-240
F4	UE-60C	UE-60D	1100	1375	400
	UE-75C	UE-75D	1300	1630	400
	UE-90C	UE-90D	1600	2000	400
	UE-115C	UE-115D	2000	2500	400
	UE-140C	UE-140D	2500	3125	400
F5	UE-170C	UE-170D	2600	3250	800-1000
	UE-205C	UE-205D	3150	3850	800-1000
	UE-250C	UE-250D	3700	4500	800-1000
F6	UE-305C	UE-305D	4500	5450	1800-2000
	UE-370C	UE-370D	5000	6000	1800-2000
	UE-440C	UE-440D	6500	8000	1800-2000
	UE-540C	UE-540D	7800	9000	1800-2000
F7	UE-620C	UE-620D	9000	10200	2500-2700
	UE-700C	UE-700D	10200	12400	2500-2700
2 x F6	UE-760C	UE-760D	13000	16000	3600-4000
	UE-930C	UE-930D	15600	18000	3600-4000
2 x F7	UE-1070C	UE-1070D	18000	20400	5000-5400
	UE-1200C	UE-1200D	20400	25000	5000-5400
					4201-156 Rev I

Figure 1.4: Full Load Dissipation and Cooling Air Flow Rates

1.2.2 MOUNTING METHODS - MICRODRIVE E-SERIES

The Microdrive E-Series range is designed for wall or switchboard mounting.

Allowable mounting methods are:

- (Standard) vertical, back to wall, with gland plate at bottom. Steel DIN rail mounting at top, screw fixing at bottom.
- Inverted mounting, with gland plate at top. Steel DIN rail mounting at centre, screw fixing at top.
- Vertical mounting, side to wall. Use extra mounting brackets.
- Horizontal mounting. Steel DIN rail mounting at centre, screw fixing at sides. Allow 300 mm of free air space vertically top and bottom to provide adequate ventilation.

Avoid mounting inline above other units to prevent accumulated air heating.

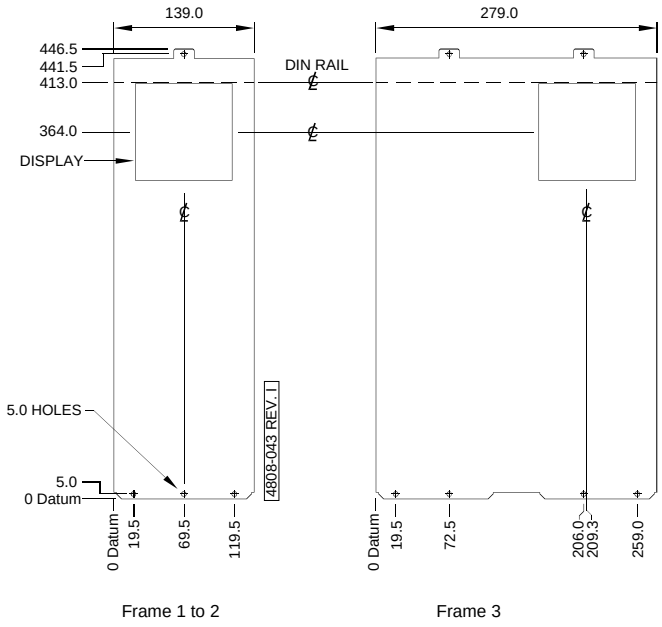


Figure 1.4a: Standard Mounting Details for Microdrive E-Series

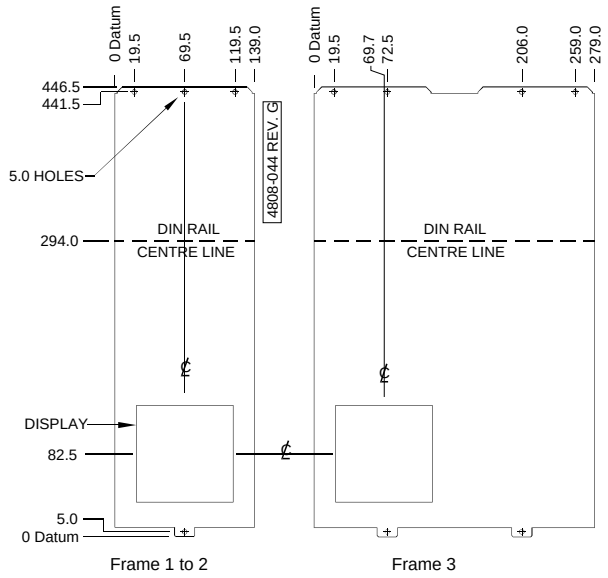


Figure 1.4b: Inverted Mounting Details for Microdrive E-Series

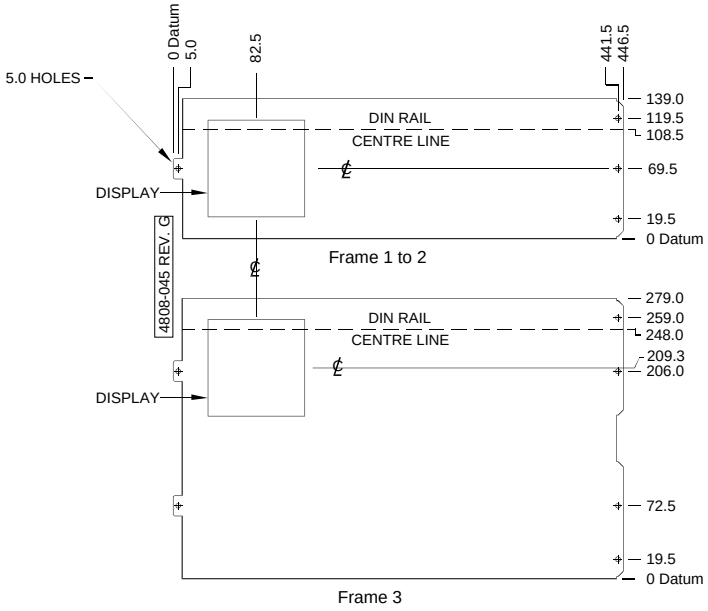


Figure 1.4c: Horizontal Mounting Details for Microdrive E-Series Frame 1 to 3

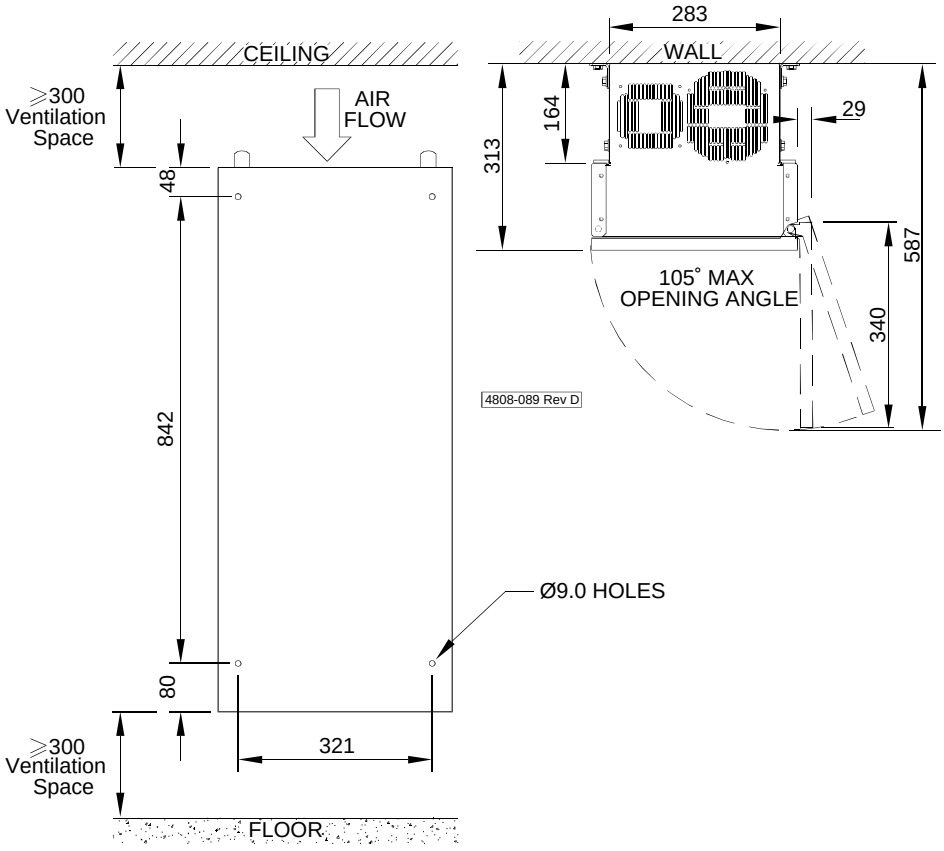


Figure 1.4d: Ultradrive E-Series Frame 4 Mounting Details

1.2.3 MOUNTING METHODS - ULTRADRIVE E-SERIES FRAME 4

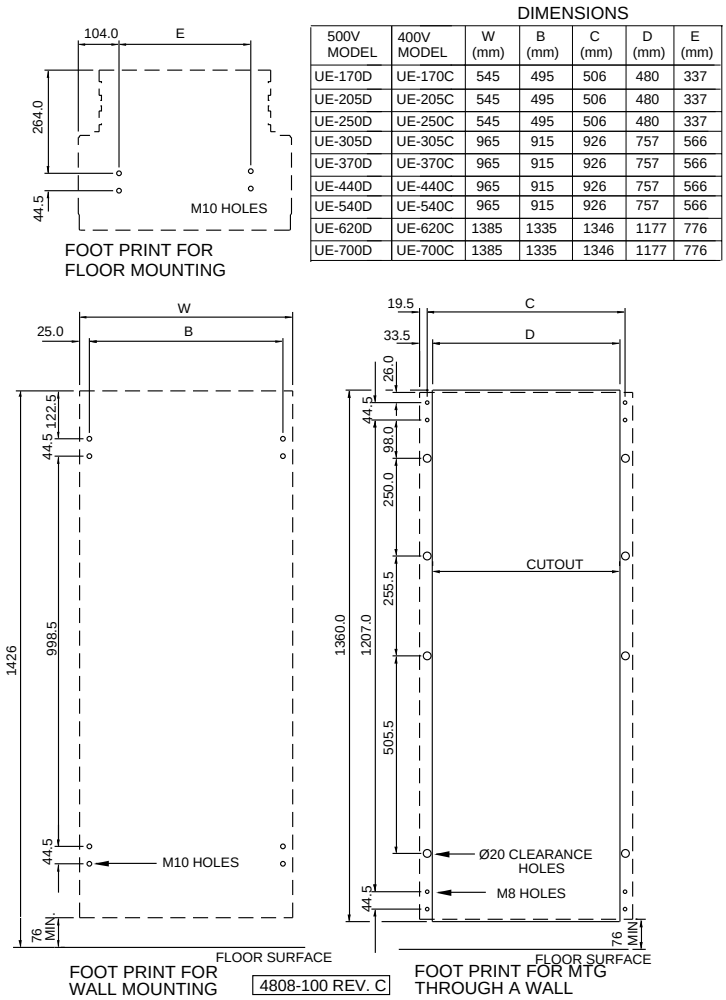
The Ultradrive E-Series frame 4 range is designed for wall or switchboard mounting.

The mounting must be:

- Vertical back to wall, with gland plate at bottom.
- 4 x M8 high tensile bolts must be used for fixing to wall.
  Note that eyelets are provided to allow prefixing of the mounting bolts before fitting of the E-Series.
- Wall/switchboard gear plate must be designed for the weight of the E-Series and power cables.

1.2.4 MOUNTING METHODS - ULTRADRIVE E-SERIES FRAME 5 TO 7

The Ultradrive E-Series frame 5 to 7 is designed for floor mounting only (vertical upright). Secure using the wall supports for eqrthquake protection. Allow 300mm of free air space above for adequate ventilation.



DIMENSIONS

500V MODEL	400V MODEL	W (mm)	B (mm)	C (mm)	D (mm)	E (mm)
UE-170D	UE-170C	545	495	506	480	337
UE-205D	UE-205C	545	495	506	480	337
UE-250D	UE-250C	545	495	506	480	337
UE-305D	UE-305C	965	915	926	757	566
UE-370D	UE-370C	965	915	926	757	566
UE-440D	UE-440C	965	915	926	757	566
UE-540D	UE-540C	965	915	926	757	566
UE-620D	UE-620C	1385	1335	1346	1177	776
UE-700D	UE-700C	1385	1335	1346	1177	776

Figure 1.5: Ultradrive E-Series Frames 5 to 7 Mounting Details

1.3 CONNECTING THE E-SERIES

Remove the terminal cover for access to the gland plate and terminals. All external wiring should be passed through the gland plate supplied. Glands must be correctly fitted to the cables and the gland plate screws tightened to the recommended torque of 3.5Nm to preserve the IP54 and UL Type 12 rating of the E-Series.

1.3.1 POWER WIRING CONNECTIONS

WARNING:

ENSURE SUPPLY IS ISOLATED BEFORE WIRING UP

Figure 1.7 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 Figure 1.8. In all cases, observe all site, local and national wiring and safety regulations. Harmonic and EMC rsuppression 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 power supply which is shared with other premises.

2 Due to the high leakage currents inherent to AC drives, earth connection of both the motor and E-Series is essential before connecting to the mains 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 series frames 5 to 7.
Shielded mains supply cables are not required to meet EMC requirements, however these may be used to reduce interference to very sensitive equipment. As an alternative, three phases and an earth lead may be run together in a tight loom to reduce any magnetic and electric fields. Enclosing the cable in metallic trunking can also reduce interference problems. Do not run mains cables in close proximity to motor output cables or control cables.

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 voltage waveform can give rise to high (capacitive) earth leakage currents. Permanent earth connection of the motor and the E-Series is essential before connection to the supply. Screened EMC cable should be used between 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 and Triangle AM cables. A 360^{O} EMC clamp should be used to secure the cable screen to the cable gland plate or earthing bar. Parallel connection of EMC cables for higher operating currents is possible, provided that the cables are of the same length and each cable uses all of the three output phases. Where screened output cable is impractical, individual cables for each phase may be used but these must be run parallel and in close proximity to each other. Binding these cables together with tape and/or cable ties will minimise stray magnetic and electric fields as well as RFI. Enclosing these cables inside steel ducting or conduit can further reduce the possibility of interference. Do not run motor cables in close proximity to mains wiring or control cabling.

8 For applications where regeneration is likely to occur, a dynamic brake resistor may be required. The resistor must be positioned where the expected heat generated by it will not ignite or damage its surroundings. Refer to the E-Series Technical Manual (Bardac Part No. 4201-180) for dynamic brake setup information.

9 The location and order of the power terminals varies from model to model. Refer to the terminals labels before connection. Figure 1.6 provides recommended tightening torques for the power terminals.

The E-Series, frames 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 power supply transformer must be matched to the incoming supply voltage. Ensure that the phase to phase voltage of the incoming supply goes into the correct position on the Fan Supply terminal block. The factory wiring of this is indicated by the model number suffix on the rating label. UE***C indicates 400V wiring and UE***D indicates 500V wiring.

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. 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)

Figure1.6: E-Series Power Terminal tightening Torque

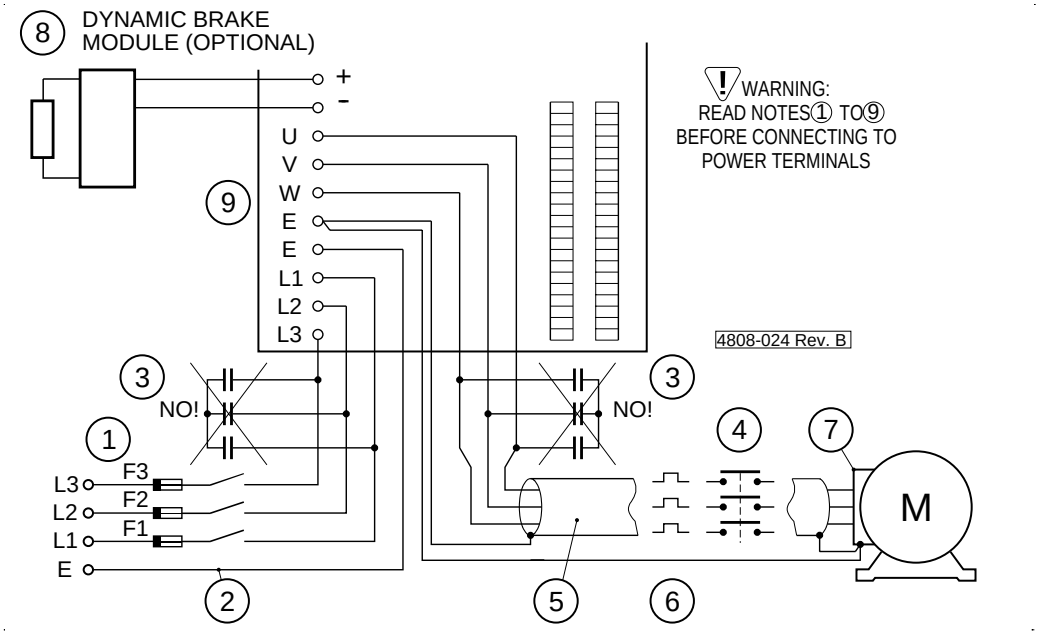


Figure 1.7: Power Wiring and Dynamic Brake Connections

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**	**mm²**	**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 where 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 with UL/cUL, use copper cables only. Frame 1 minimum cable size is 10AWG (5.3mm2) 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 with a maximum 200kA prospective symmetrical short circuit capacity.

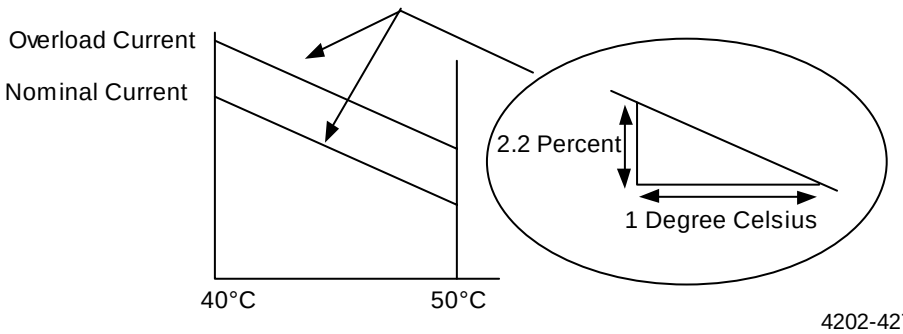


Figure 1.8: E-Series 400V Variable Torque Ratings and Cable Sizes

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: AWG / kcmil** (Note 7)	**mm²**	**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	150
		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 where 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 (5.3mm2) 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 with a maximum 200kA prospective symmetrical short circuit capacity.

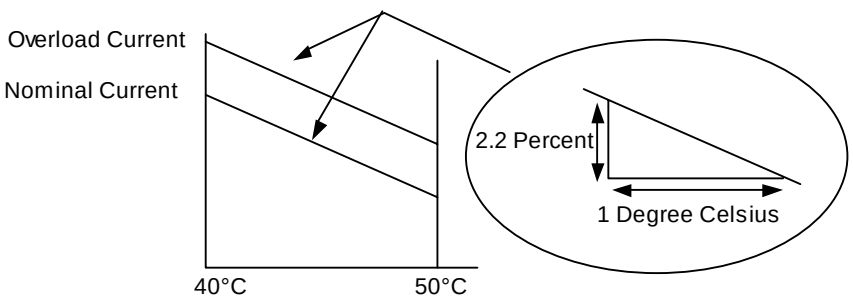


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Figure 1.9: E-Series 400V Constant Torque Ratings and Cable Sizes

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**	**mm²**	
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
	3	ME030D54	37.5	25	10	45	8 to 6	6 to 10	80
		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 (5.3mm²) 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.

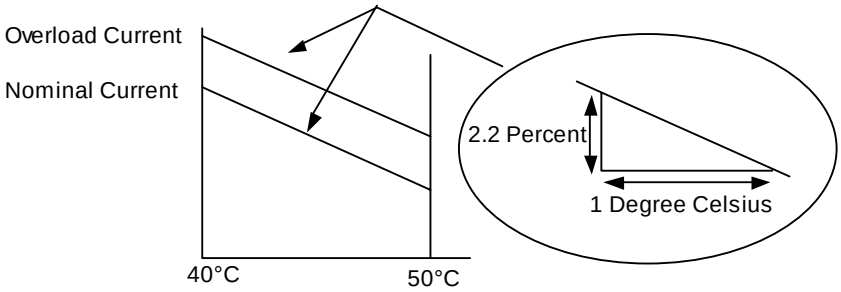

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Figure 1.10: E-Series 500V Variable Torque Ratings and Cable Sizes

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**	**mm²**	
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, t**he 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 (5.3mm²) 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.

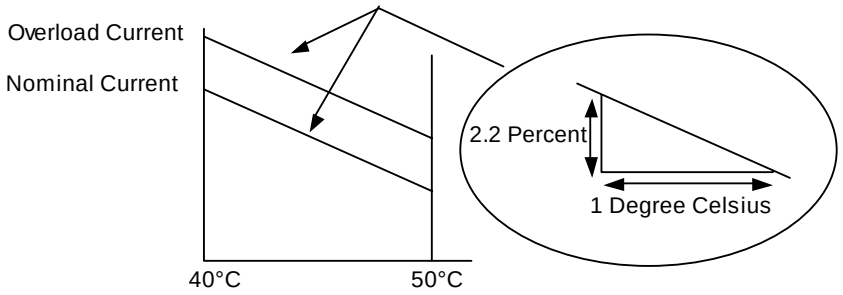

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Figure 1.11: E-Series 500V Constant Torque Ratings and Cable Sizes

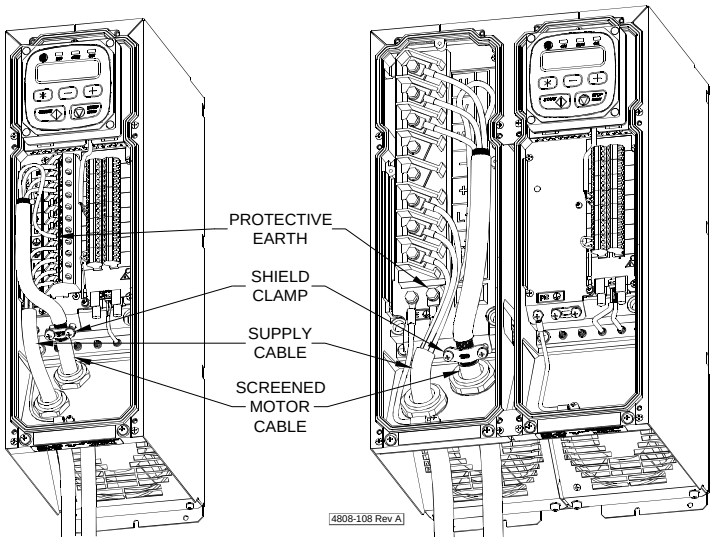

Figure 1.12: Microdrive E-Series Frame 1 to 3 Screened Motor Cable Configuration

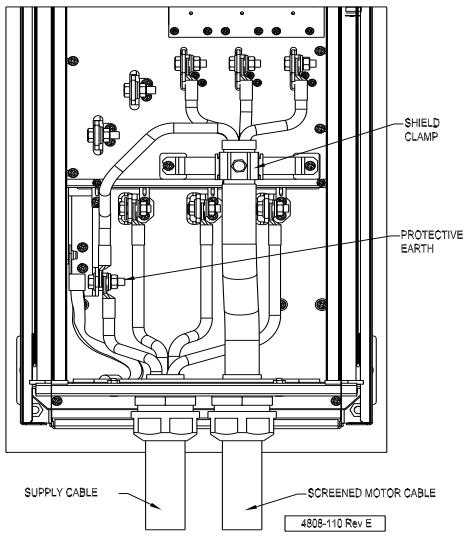

Figure 1.13: Ultradrive E-Series Frame 4 Screened Motor Cable Configuration

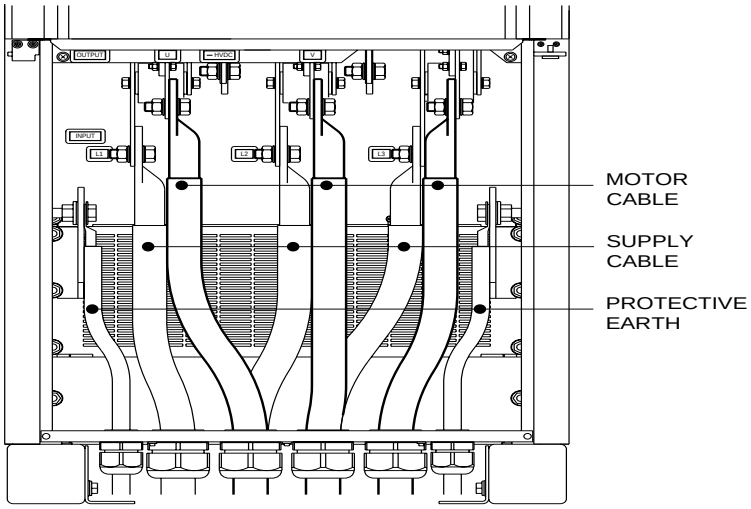

Figure 1.14: Ultradrive E-Series Frame 5 Screened Motor Cable Configuration

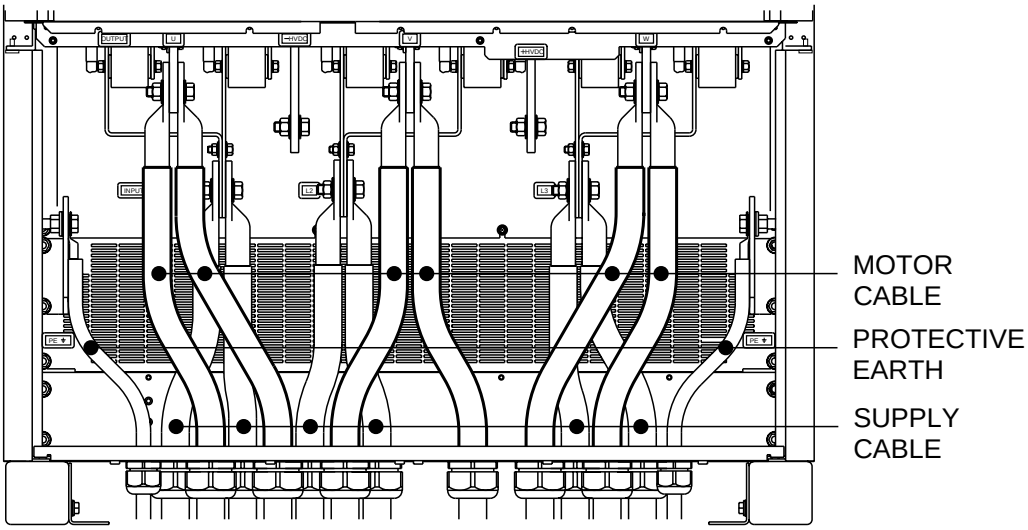

Figure 1.15: Ultradrive E-Series Frame 6 Screened Motor Cable Configuration

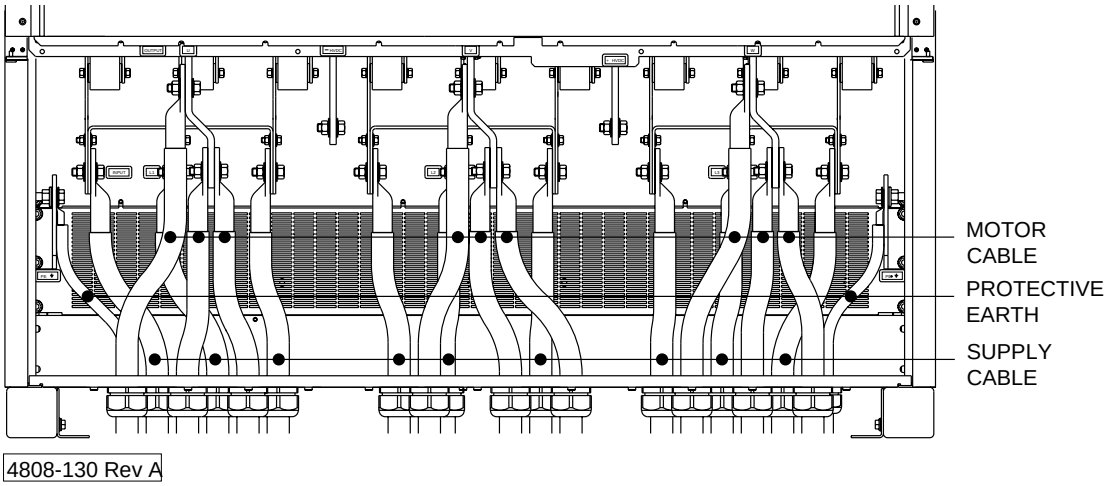

Figure 1.16: Ultradrive E-Series Frame 7 Screened Motor Cable Configuration

1.3.2 MOTOR ROTATION

USE OF "+" AND "–"

"+" Speed is used to describe speed in the forward direction.

According to IEC34-7, the motor rotates clockwise when:
– viewed from the shaft end
– terminals U1, V1 and W1 or U2, V2 and W2 are connected to the E-Series output phases U, V, W respectively
– the E-Series is operating with "+" speed.

"–" is used to describe speed in the reverse direction of the motor.

1.3.3 DISPLAY MOUNTING

The display unit may be rotated in 90° increments, to suit the mounting orientation of the Microdrive E-Series. The display unit may also be mounted remotely from the drive, to a maximum of 3 metres.

1.3.4 CONTROL WIRING

Control Wiring Recommendations
Bring the control wiring into the enclosure through the gland plate, and install glands to maintain IP54 integrity. Loom control wiring and power wiring separately, at least 300 mm apart and crossing only at right angles. Control cables must be screened to ensure correct operation. Connect the screen only to the ground at the E-Series to prevent ground loops.

Connection recommendations are:
Maximum tightening torque: 0.5 Nm (4.5 lb-in)

Maximum cable size:	1.5 mm^2 appliance wire (26 - 14 AWG Cu)
Maximum number of cables per terminal:	Two
Cable stripping length:	7 mm (0.28 in)

The default configuration of the digital inputs is active high. i.e., the common of all multi-function input switches should be connected to +24Vdc (Terminal T21).

The External Trip/PTC input must be connected to +24Vdc (Terminal T21) (when set for active high) for the E-Series to start and run a motor.

1.3.5 EARTHING OF CONTROL 0V

To comply with the requirements 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 between Terminal T20 and the terminal surround plate and must be removed if not required. Removal will allow the 0V point to float up to ±50Vdc (30Vac) from chassis earth.

1.3.6 SHAFT ENCODER SELECTION AND MOUNTING

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 A signals should be swapped. Refer Figure 5.4.

A shaft encoder will be needed if operating the E-Series in closed loop vector control mode.

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

Alternative Specification:
Type:
Single ended push-pull - will cause a reduction in noise immunity.
Or:
Single ended open collector - pulses will be distorted by long cables. For this type of encoder the product of cable length (metres) x maximum frequency (kHz) should not exceed 1500. Absolute maximum cable length is 30 m.

Fitting of Encoder:
Fit directly to the motor (using a flexible coupling) or indirectly via a toothed drive belt or similar. Avoid slip, backlash, loose couplings and high shaft loadings. Wiring must be done using shielded twisted cable. Earth the shield at the drive end only. Figure 1.15 supplies connection details.

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.

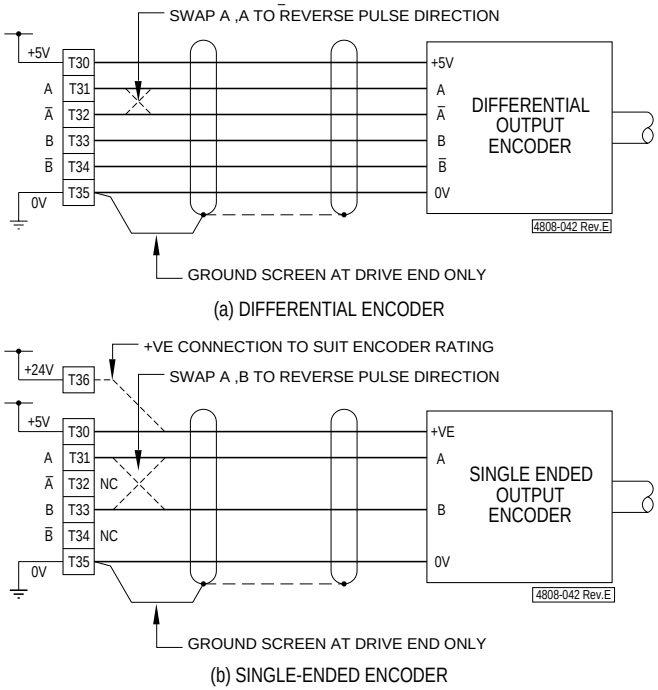

Figure 1.15: Shaft Encoder Connection Details

1.3.7 FIBRE OPTIC CONNECTIONS

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

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

1.3.8 RUBBER CONTROL CABLE GROMMETS

Several rubber control cable grommets are provided within the gland plate area of the Microdrive E-Series 2.5A to 46A for glanding control cables, fibre optic cables and encoder cables. Cut the tip to the desired diameter for proper sealing around the cable.

1.3.9 EXTERNAL POWERING OF THE CONTROL BOARD

The E-Series Control Board can be externally energised, by connection of an external +24Vdc (nominal) 1A supply to control terminals T36, T37.

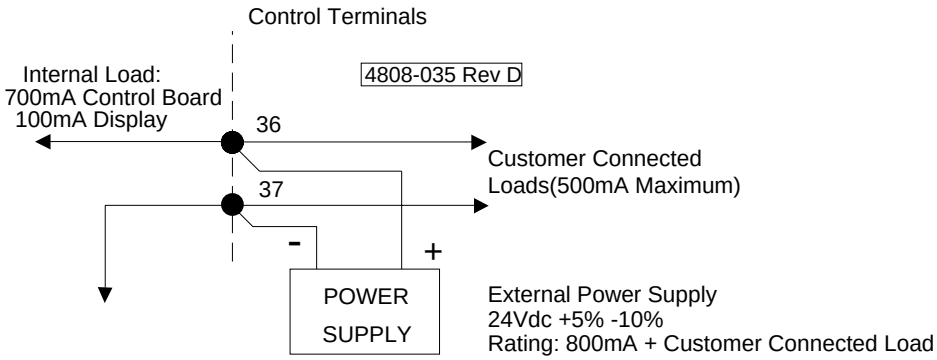

Figure 1.18: External Powering of Control Board

1.3.10 GLAND PLATE AND FRONT COVER RECOMMENDED SCREW TORQUES

To ensure that the E-Series is protected against ingress of dust and splashing water, cable glands must be used and the gland plate and front cover must be tightened to the recommended torque.

Recommended tightening torques are:

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)

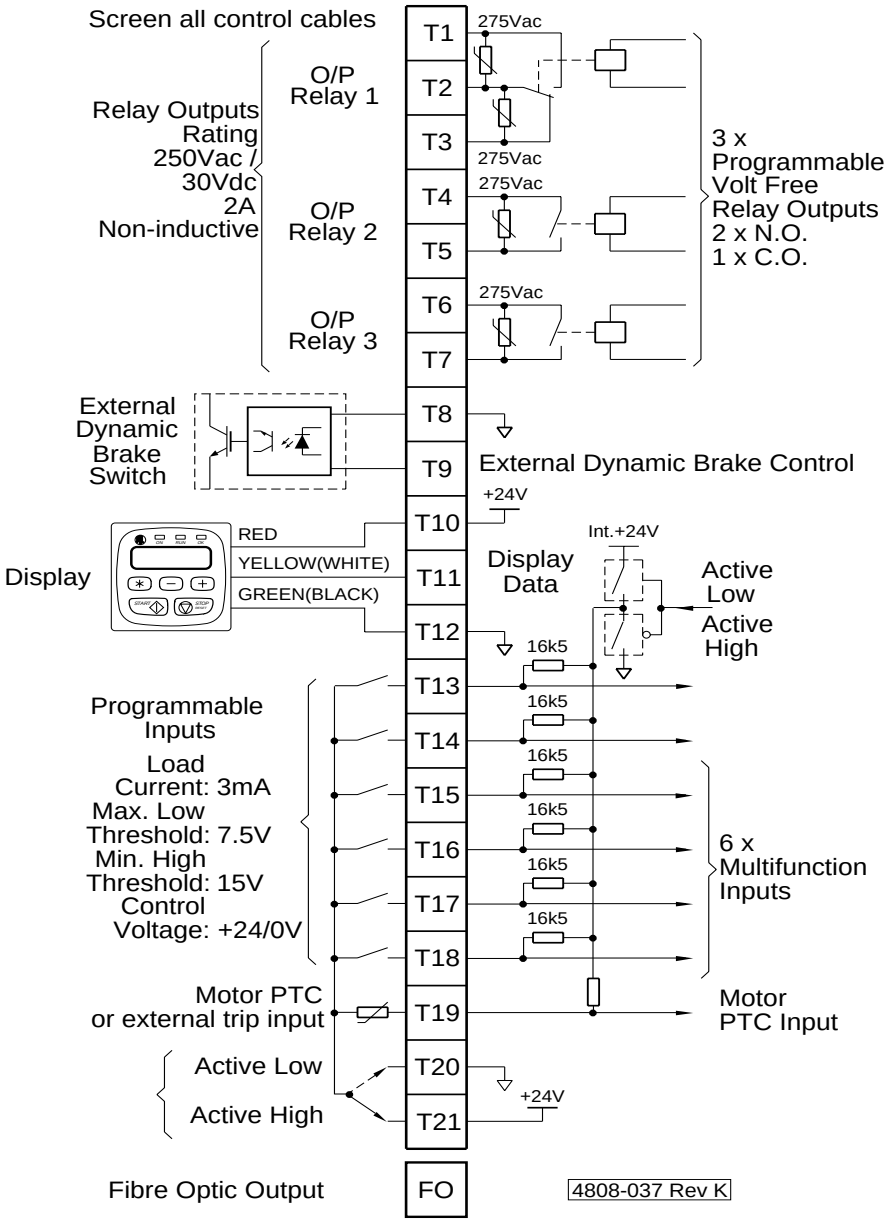

Figure 1.19: Control Inputs and Outputs

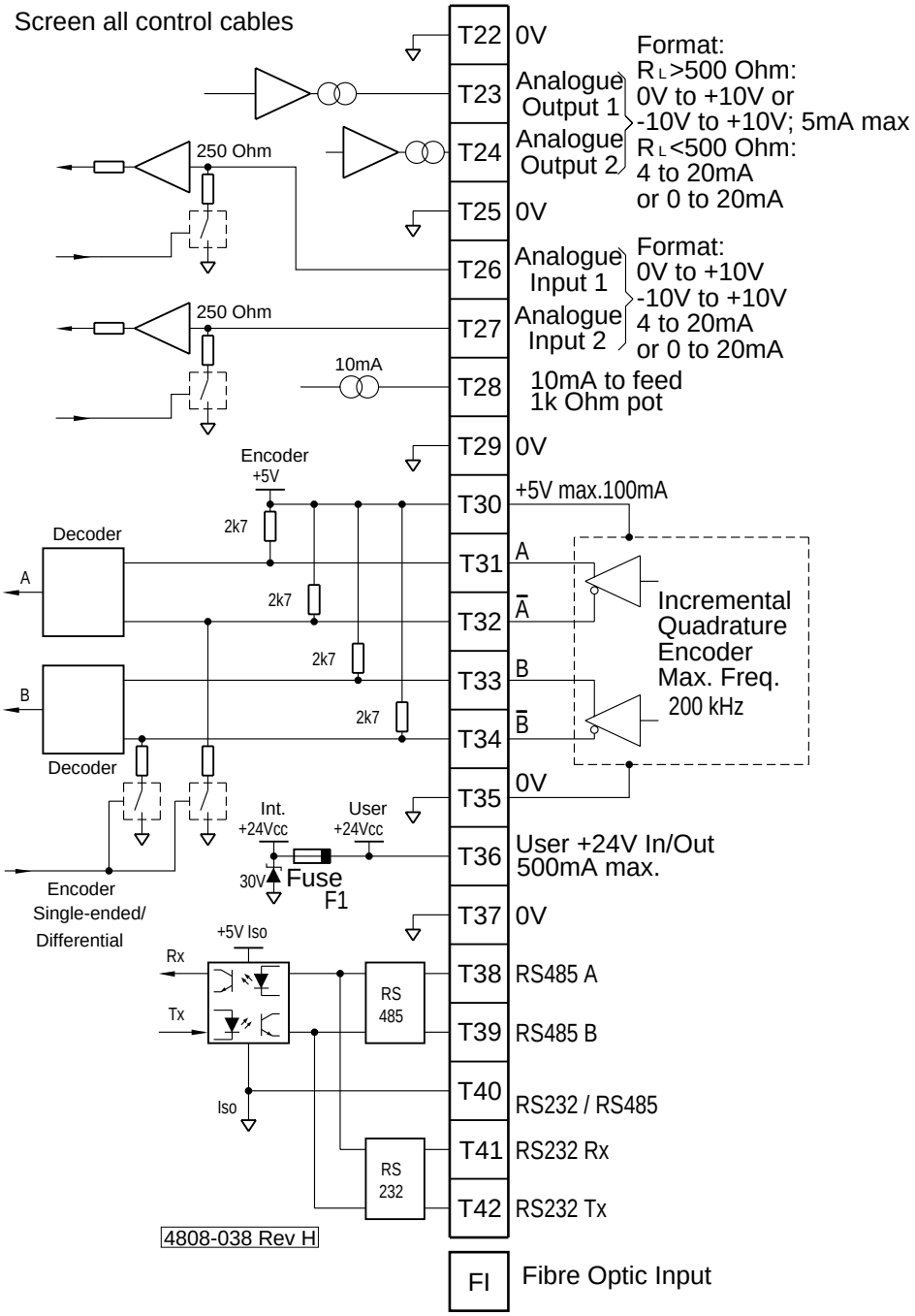

Figure 1.20: Control Inputs and Outputs

SECTION 2:

OPERATION OF THE DISPLAY UNIT

2.1 DISPLAY UNIT DESCRIPTION

2.1.1 THE DISPLAY UNIT AND KEYS

Refer to Figure 2.1 for Display Unit Details

STATUS LINE: Indicates drive status, overload status, output torque, output speed.

CONTROL LINE: Indicates screen number, screen description, parameter for adjustment.

SCREEN CONTROL KEYS
"+" and "–" keys enable scrolling between screen groups and subscreens.
"∗" allows unfolding of screens if required.
By holding down the "∗" key and using the "+" or "–" keys, individual modes or parameters can be adjusted, if allowed.

START / STOP-RESET PUSH-BUTTON
If keyboard control is enabled, these push-button allow starting or stopping/resetting of the E-Series. This may be in conjunction with external START and STOP push-button.

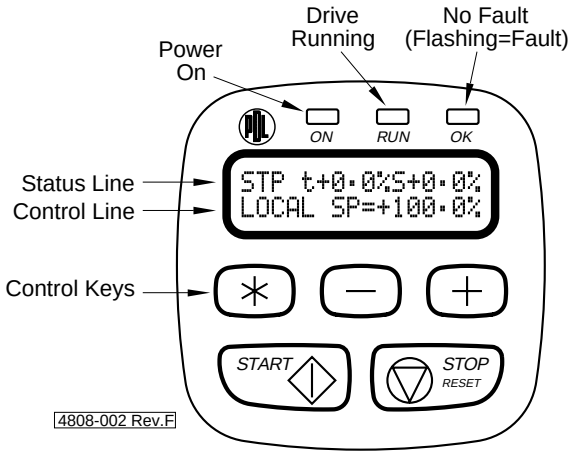

Figure 2.1: E-Series Display Unit

2.1.2 SELECTION OF SCREENS

Screens are 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. Once unfolded, some subscreens have a numerical parameter which may be adjusted. Others may have a list of options with each option separately viewable and selectable. Extra screens or subscreens may become available when the E-Series is in "Commissioning" mode.

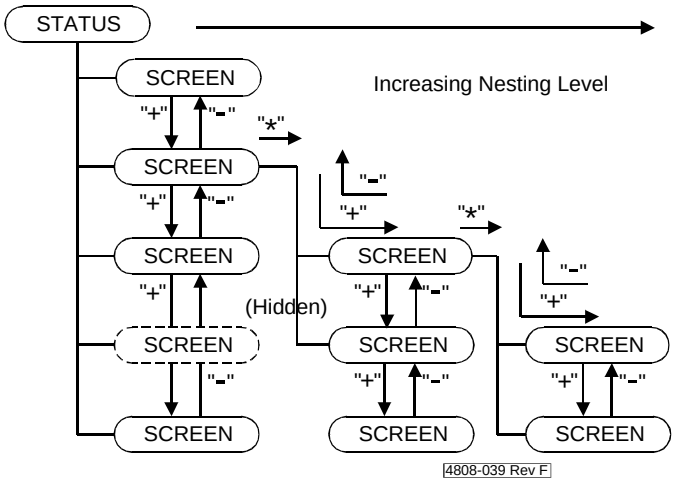

Figure 2.2: Control of Screen Folding

Referring to Figure 2.2, when "+" or "–" are used to scroll through the screens, no subscreens are shown. If a particular subscreen is required, scroll to the associated group, then press and release "∗". This will unfold all of the screens associated with that group. "+" will move down through the subscreens, stopping on the last subscreen in a group. "–" will move up through the subscreens, until the group title is reached. This will cause the screens to automatically refold.

2.1.3 PARAMETER AND MODE ADJUSTMENT

Once a screen group has been unfolded and a screen selected, the parameter or mode displayed on the control line may be adjusted. For a screen with access rights configured as “hidden” or “read only”, this adjustment may only be made if the E-Series is in COMMISSIONING mode.

Adjustment is done by depressing the “∗” key and using “+” or “-” keys, to increase or decrease the parameter respectively.

2.2 CONFIGURING OF OPERATING MODE

Before livening the E-Series motor controller, it is important that you know the intended operating mode and control configuration of the drive. These may have been preset into the E-Series before dispatch. Alternatively this may have been predetermined by an Applications Engineer but still need to be programmed into the E-Series. If this is the case, you as the installer may have to temporarily set up a mode and configuration, to allow livening and testing.

2.2.1 OPERATING MODES

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

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.
Hidden: The screen cannot be viewed or changed.

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

Access to COMMISSIONING Mode may be controlled by a password.

2.2.2 SWAPPING BETWEEN OPERATION AND COMMISSIONING MODES

Selecting COMMISSIONING mode before a Password has been set:

Scroll to Main Screen Z.
Z COMMISSION=N

Hold down “∗” key and use “+” or “–” keys and the status line should change to:
Z COMMISSION=Y

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

Selecting COMMISSIONING mode after a Password has been set:

Figure 2.3 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

Hold down “∗” and use “+” or “–” keys and the screen will automatically display:
PASSWORD= ZZZZZ

Hold down “∗” key and use “+” or “–” keys until the correct password is reached. Then release the keys.

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

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

Hold down “∗” key and use “+” or ” -” keys to toggle to :
Z COMMISSION=N

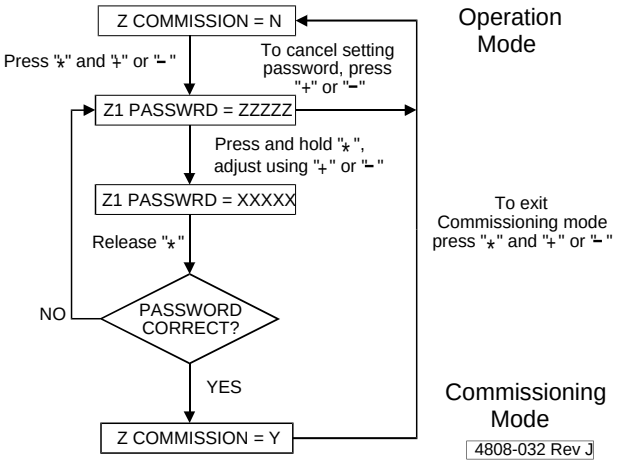

Figure 2.3: Setting Commission Mode after a Password has been set

2.2.3 SETTING A PASSWORD FOR THE FIRST TIME

Refer to Figure 2.4.
Once set to COMMISSIONING mode as described above, a password may be set up. Unfold Screen Group Z and scroll to Screen Z1. The display will read:
Z1 PASSWORD=OFF

Hold down "∗" key and use "+" or "–" keys to set the required password.

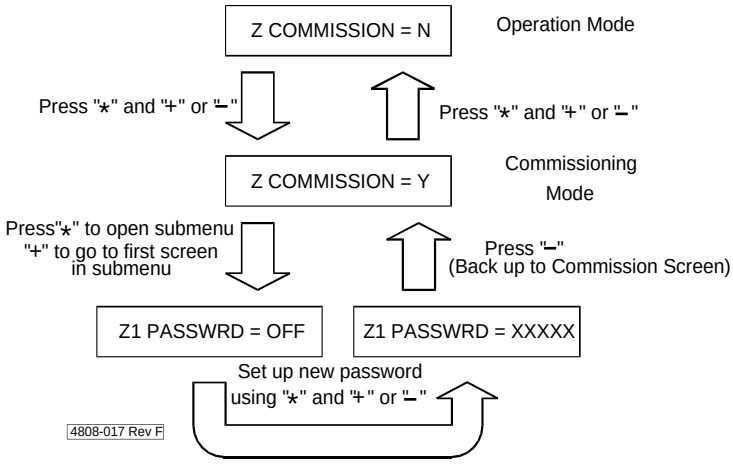

Figure 2.4: Setting a Password for the First Time

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:
PASSWORD= ZZZZZ

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

SECTION 3:

PRELIMINARY COMMISSIONING OF THE E-SERIES

3.1 COMMISSIONING WITHOUT MOTOR

3.1.1 FOREWORD

This commissioning guide is not intended to fully commission the E-Series to its final application. It is intended to prepare the drive to have its final configuration installed (possibly by others).

This commissioning should only be undertaken after all wiring has been completed and verified as detailed in Section 1 of this manual.

3.1.2 CHECKS BEFORE POWERING UP

CHECK INSTALLATION
Check that the E-Series will not be subject to an unacceptable environment. Check that adequate cooling airflow is available. Check that no tools, swarf, or hardware have been left in the drive.

CHECK POWER WIRING
Check that all supply and motor cabling is correctly dimensioned for the application, the E-Series is bonded to earth, and electrical connections are secure. The cable between the E-Series and motor should be of screened construction, with the screen (forming the earth connection) solidly bonded to the motor and the E-Series chassis. Ensure that the motor and power wiring are not transposed. Check that the correct fuses (Figure 1.8 & Figure 1.9) are fitted at the supply.

CHECK CONTROL WIRING
Control wiring must be screened and run separately from power cables.
Check that there are no loose strands, and that all terminal screws or bolts have been tightened. Check that the control wiring conforms to the required configuration – active high or active low. Note that the default configuration is active high.

WARNING: 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 unit and prevent possible instantaneous starting of the motor upon applying power to the E-Series. This circuit should also be opened in the event of the “loss of control” situation.

3.1.3 APPLYING POWER TO THE E-SERIES

BEFORE PROCEEDING, ISOLATE THE MOTOR. Switch on the mains supply to the E-Series.

CHECK DRIVE OPERATION
Check that the cooling fan is blowing air through the heatsink. Check that the display lights up. Check that the DC “Bus Live” LED is glowing red. Screen A4 will be initially displayed (unless the E-Series has tripped on a protective function).

3.2 PRELIMINARY CONTROL SETUP

3.2.1 FOREWORD

The E-Series has an advanced and adaptable set of motor control features.

A very flexible set of options for configuration of the digital, analogue and fibre optic inputs and outputs; coupled with multiple ramp rates and start/stop modes allows the user to modify the E-Series motor controller to suit their process control system.

The adaptability of the E-Series permits the user to tailor the performance requirements through selecting V/Hz or Open Loop control mode (Speed control) and the Closed Loop control modes (Speed and Torque control).

The screen list is shown in Section 4 of this manual.

Before proceeding, ensure that the E-Series is in COMMISSIONING mode. Refer to Section 2.2.2 for details.

3.2.2 CHECKING OF ANALOGUE INPUTS

If analogue inputs are being used to control the E-Series, they must have their format correctly configured. By default, Analogue Input 1 is 0 to 10Vdc, and Analogue Input 2 is 0 to 10V. These may be re-configured if necessary by using Screens I6a (Analogue Input 1) and I6d (Analogue Input 2).

Once correctly configured, the Analogue Input 1 (Terminal T26) and Analogue Input 2 (Terminal T27) can be checked by observing Screen Z3 (refer Figure 3.1) and Screen Z4 respectivily.

Reference 1: Indicates the relative level of the Analogue Input in percent
For ±10V input, -10V = 0%; +10V = 99%
For 0-10V input, 0V = 0%; +10V = 99%
For 0-20mA input, 0mA = 0%; 20mA = 99%
For 4-20mA input, 4mA = 0%; 20mA = 99%

Reference 2: Indicates the actual input level either in Volts or mA
For voltage input, -10V to +10V
For current input, 0mA to 20mA

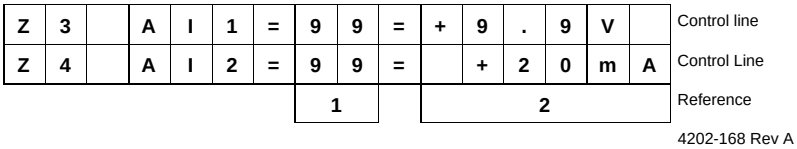

Figure 3.1: Screens Z3, Z4 – Analogue Input Status

3.2.3 CHECKING OF ANALOGUE OUTPUTS

If analogue outputs are being used, their formats must be correctly configured on the E-Series Control Board to suit the devices they are driving. Both outputs may be configured for 0-10Vdc, -10 to +10Vdc, 4 to 20mA or 0 to 20mA. These format configurations can be done from Screens O1b (Analogue Output 1), and O1f (Analogue Output 2).

Once their respective formats are configured, the operation of the outputs can be confirmed as follows. For Analogue Output 1, scroll to Screen O1a, and select Mode 1 (Full Scale). For Analogue Output 2, scroll to Screen O1e and select Mode 1 (Full Scale). This should cause the respective analogue outputs to be driven to their maximum. Check that the driven devices are driven to their full scale. When these tests are complete, restore Screens O1a, O1e to the required modes (if known).

Once correctly configured, the Analogue Output 1 (Terminal T23) and Analogue Output 2 (Terminal T24) can be checked by observing Screen Z5 (refer Figure 3.2) and Screen Z6 respectively.

Reference 1: Indicates the relative level of the Analogue Output in percent
For ± 10V output, -10V = 0%; +10V = 99%
For 0-10V output, 0V = 0%; +10V = 99%
For 0-20mA output, 0mA = 0%; 20mA = 99%
For 4-20mA output, 4mA = 0%; 20mA = 99%

Reference 2: Indicates the actual output level either in Volts or mA
For voltage output, -10V to +10V
For current output, 0mA to 20mA

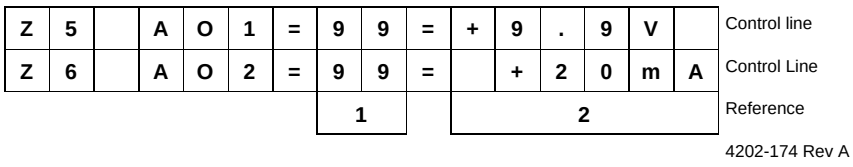

Figure 3.2: Screens Z5, Z6 – Analogue Output Status

3.2.4 CHECKING OF DIGITAL INPUTS

Scroll to Screen Z7. The six characters on the left of the bottom row of characters show the states of the six digital inputs. Refer to Figure 3.3, references 1 to 6.

Reference 7 in Figure 3.3 shows the state of the motor PTC thermistor. If no thermistor or other external trip device is fitted, the corresponding control terminal (T19 on the Control Board) should be CLOSED: i.e.,
linked to +24Vdc (Terminal T21) when configured for ACTIVE HIGH, or
linked to 0V (Terminal T20) when configured for ACTIVE LOW.

A "X" represents CLOSED and indicates that the digital input is connected to the circuit common (+24Vdc for ACTIVE HIGH or 0V for ACTIVE LOW).

A "O" represents OPEN and indicates that the digital input is NOT connected to the circuit common (+24Vdc for ACTIVE HIGH or 0V for ACTIVE LOW).

Check that each switch in turn, when operated, closes the correct circuit, and check that the multi-function input switch wiring configuration corresponds to what has been set on Screen I7b POLARITY=H/L.

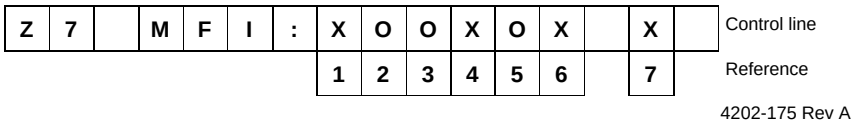

Figure 3.3: Screen Z7 – Digital Input Status

3.2.5 CHECKING OF DIGITAL OUTPUTS

If any of the three output relays are being used for remote status indication, they will need checking for correct operation. For Relay 1, scroll to Screen O2a, and select Mode 1 (ALWAYS ON) and relay not inverted on Screen O2b. This should force the relay ON, and the external connected device should reflect this. Set up Relays 2, 3 in the same way, using Screens O2c to O2f respectively. When these tests are complete, restore Screens O2a to O2f to the required modes (if known).

Screen Z10 reflects the status of the output relays. References 1, 2, 3 of Figure 3.4 refer to Relays 1, 2, 3 respectively.

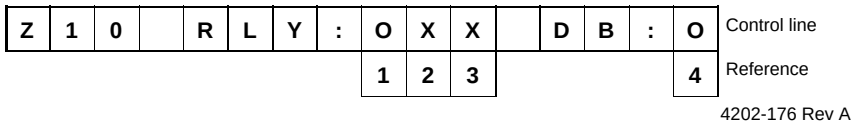

Figure 3.4: Screen Z10 – Digital Output Status

3.2.6 PRELIMINARY SETUP

Initially, the motor should be energized and controlled without using any external input devices. Thus it is recommended to set up for operation under front panel control. This is achieved by setting up the following screens:

N1 to N5	Motor Current, Volts, Frequency, kW, RPM.	Copy from the motor's rating plate.
I1	LOCAL S/STP=3	(enables local keyboard Start/Stop-Reset)
I2	REF S = LOCAL	(reference speed source = local keyboard)
I7a	I/P MODE= 0	(Local control only) (disables all multi-function inputs)
A3	LOCAL SP = 0%	(sets local speed to zero)
A1	LOCAL MODE = SP	(sets to speed control mode)
X1	CONTROL TYPE= V/Hz	(sets for V/Hz speed control mode)

This configures the operation mode to V/Hz speed control mode. If open or closed loop operation mode is required, this parameter should be set correctly later.

3.2.7 SHAFT ENCODER CONFIGURATION

If a shaft encoder is to be used to operate the E-Series in closed loop control mode, appropriate configurations must be programmed as follows:

Type of Encoder:
The type of encoder (single ended output or differential output) must be identified, and programmed into Screen N9.

Encoder Pulses per Revolution:
This parameter must be programmed into Screen N8, as the encoder pulses per revolution of the motor shaft. If the

encoder is driven directly from the motor shaft, then this figure will be the shaft encoder pulses per revolution. If the encoder is indirectly driven, for example by a toothed belt and pulley arrangement, then any ratio change must be accounted for. If it is impossible to determine the drive ratio between the motor shaft and the encoder shaft, then the ratio may be calculated by carefully turning the motor shaft through an exact number of revolutions, and observing the change in count on Screen Z9. Divide the count change by the number of revolutions of the motor shaft, and enter the result into Screen N8.

3.2.8 DYNAMIC BRAKE CONFIGURATION (IF FITTED)

If a dynamic brake has been installed in conjunction with the E-Series, configure by setting Screens D1, D2.

D1 DB Time Constant Time that the brake resistor will take to reach 64% of its final temperature if continuously energized.

D2 DB Duty Average percentage of time that the resistor may be energized for, without damage (when averaged over periods long in comparison to the time constant).

If the dynamic brake resistor has been supplied by Bardac Drives, the suggested settings will have been supplied. If a dynamic brake has not been fitted, leave at the default values.

If the dynamic brake is being used check the status on Screen Z10 (Z10 RLY:OXX DB:X) during normal operation. A Closed (X) status indicates that the dynamic brake has operated since the last screen update. An Open (O) status indicates that the dynamic brake has not operated since the last screen update.

3.2.9 CHECKING OF FIBRE OPTIC INPUT

Screen Z8 displays the status of the Fibre Optic Input (and the Serial input).

If the fibre optic input port is being used as a speed or torque reference then check that an X is displayed on Screen Z8 (Z8 FI:X SERIAL:O). A Closed (X) status indicates that a valid fibre optic data packet has been received since the last screen update. An Open (O) status indicates that no valid data packet has been received since the last screen update. An X (Closed) should be displayed at all times when the fibre optic input is receiving valid data.

3.2.10 CHECKING OF SERIAL INPUT

Screen Z8 displays the status of the Serial Input (and the Fibre Optic input).

If the serial port is being used check that an X is displayed on Screen Z8 (Z8 FI:O SERIAL:X). A Closed (X) status indicates that a valid serial data packet has been received since the last screen update. An Open (O) status indicates that no valid data packet has been received since the last screen update.

3.3 ENERGISING THE MOTOR

3.3.1 CONNECTING THE MOTOR

WARNING:Check that all personnel are clear of the motor and attached machinery, and that it is safe to operate the motor. If the motor is out of sight of the E-Series motor controller, it may be necessary to have someone in radio or telephone contact with yourself standing by the motor, to ensure safety and to report any unusual occurrences.

Remove the isolation from the motor. If the motor has been disconnected, power down the E-Series, allow to discharge, and reconnect the motor terminals. Power up the drive and proceed.

START the E-Series by using the front panel START push-button.
Scroll to Screen A3 and increase the set speed by pressing "∗" then "+".
Check that the motor is turning in the expected (forward) direction. If not, STOP the drive, power it down, wait for discharge, and swap any two motor terminations over. Power up the drive and proceed.

3.3.2 CHECKING THE SHAFT ENCODER (IF FITTED)

If a shaft encoder is fitted to the motor (i.e., for operation in closed loop mode) check that the encoder is correctly connected.

Check Screen Z9. It should be indicating a changing encoder pulse count. If this screen does not register any change in count, even though the motor is turning, check the encoder mechanical coupling and electrical connections.

If the motor is running in a forward direction (indicated by REF SPD, displayed by Screen A4, being +ve) the encoder count (Screen Z9) should be counting UP. Also the status (top) line of the display should indicate a +ve actual speed. If the encoder is indicating that the motor is running in a reverse direction, but in fact the motor is running in the preferred forward direction, swap two encoder outputs. For a differential output type shaft encoder, either swap wires into control terminals T31, T32 (A, /A) or swap wires into terminals T33, T34 (B, /B). For a single-ended output type encoder, that does not have /A, /B outputs, swap wires into terminals T31, T33 (A, B).

Stop the motor by using the Display Unit STOP-RESET push-button.

3.3.3 AUTOTUNING

The motor must be correctly characterised for good dynamic performance. This can be done automatically by the E-Series. Autotuning is controlled from Screen X2.

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

X3a	Lm	Motor Main Inductance
X3b	Rs	Stator Resistance
X3c	Rr	Rotor Resistance
X3d	SIGMA	Total Leakage Inductance

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.

Screen X2 selects AUTOTUNE options, as follows:

X2	AUTOTUNE = NO	Autotuning not active
	AUTOTUNE = YES	This tunes the motor without moving the motor.

Autotuning may take several seconds to complete.

3.3.4 PRELIMINARY COMMISSIONING COMPLETE

The E-Series motor controller has now been completely installed and checked. The unit is now ready for final commissioning.

SECTION 4:

FINAL COMMISSIONING OF THE E-SERIES

4.1 OPERATION MODE AND CONFIGURATION

Figure 4.2 summarises the Screen List available by default. Full descriptions of all screens are given in the E-Series Technical Manual, Bardac Part No. 4201-180.

4.1.1 OPERATION MODES

The E-Series may be set up to run in one of four operation modes. These are shown in Figure 4.1.

V/Hz Operating Mode:
For general-purpose speed control applications, e.g. pumps, fans, conveyors etc. A shaft encoder is not needed.This open loop speed control mode generates an output with a fixed voltage vs frequency profile. Suitable for running multiple parallel motors from one E-Series. Select by setting Screen X1 Control Type = V/Hz.

Also use V/Hz mode when autotuning an E-Series motor controller.

Closed Loop Vector Mode - Torque Control:
For use in torque control applications, e.g. winder systems, position control applications with an external speed-position controller. A quadrature shaft encoder will be required on the motor, to provide rotor position feedback.

To set up this mode of operation, set the encoder pulses per motor shaft revolution on Screen N8 and program Screen X1 to Closed Loop Vector. Then select torque control mode, either by appropriately configuring one of the multi-function inputs (Screen I7c to I7h, Selection 16 Speed/Torque Mode) and activating the switch, or by setting for torque control mode (Screen A1 LOCAL MODE=TQ).

Closed Loop Vector Mode - Speed Control:
Recommended for servomotor type applications, where fast dynamic response is required, and for crane hoists and other applications where full torque capability at zero speed is required. A quadrature shaft encoder is required on the motor, to provide rotor position and speed feedback.

To set up this mode of operation, set the encoder pulses per motor shaft revolution on Screen N8 and program Screen X1 to Closed Loop Vector. Then select speed mode, either by appropriately configuring one of the multi-function inputs (Screen I7c to I7h, Selection 16 Speed/Torque Mode) and deactivating the switch, or by setting for speed control mode (Screen A1 LOCAL MODE=SP).

When operating in closed loop vector mode, switching between speed control and torque control modes can be done without stopping the E-Series.

Open Loop Operating Mode:
For general-purpose speed control applications, e.g. pumps, fans, conveyors etc. A shaft encoder is not needed. Configuration to this mode is set by programming Screen X1 to Open Loop Vector.

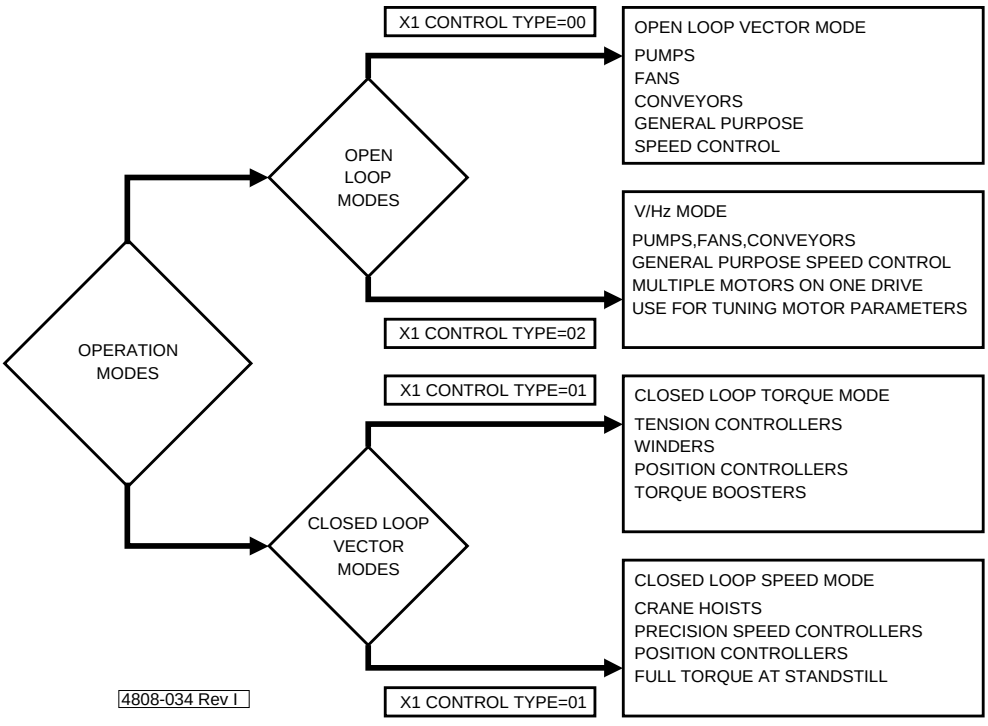

Figure 4.1: E-Series Operation Modes

4.1.2 INPUT CONFIGURATION

If Start–Stop/Reset is not required from the display unit, set Screen I1. (Refer to E-Series Technical manual 4201-180).

Select the required speed or torque reference source from Screen I2, I3. If an alternative source is required, e.g. for local/remote or auto/manual control, select from Screens I4, I5.

If Analogue Input 1 is to be used as a reference source, set format and scaling from Screens I6a, I6b, I6c. Similarly, Screens I6d, I6e, I6f set up Analogue Input 2.

If a zero band is required, set on Screen I6g. This sets a definite zero speed or zero torque region when using either analogue input.

If the fibre optic input is to be used as a reference source, set scaling from Screens I8a, I8b.

Configure the multi-function inputs (MFIs) from Screens I7. Screen I7a programs the MFIs in groups, while I7c to I7h programs each individually.

Configure the MFIs for active high or active low from Screen I7b.

4.1.3 OUTPUT CONFIGURATION

Select the function, format and scaling of Analogue Output 1 from Screens O1a, O1b, O1c, O1d. Similarly, Screens O1e, O1f, O1g, O1h set up Analogue Output 2.

Select the required output relay functions from Screens O2a, O2c, O2e, and their sense from Screens O2b, O2d, O2f.

If using the fibre optic output, set function and scaling from Screens O3a, O3b, and O3c.

4.1.4 ACCELERATION AND DECELERATION RATES

If operating the E-Series as a speed controller, set required acceleration and deceleration rates from Screens R1, R2. Generally, set for the required response without torque limiting when accelerating (indicated by TLT on status line of display) and without excess regeneration on deceleration (indicated by VLT on status line). These rates active only when speed controlling.

If two rates are required, set alternative rates and break speed on Screens R3, R4, R5.

Set required deceleration rate when emergency stopping on Screen R6.

Set an appropriate Stop Timeout on Screen S11.

4.1.5 SPEED AND TORQUE LIMITS

Set speed limits by Screens L2, L3. Normally set outside the range of the reference speed input. Should be active only when in torque control mode on light load. Indicated by SLT on status line of display.

Set torque limits by Screens L4, L5. Normally set outside the range of the torque reference input. Should only be active when in speed control modes, on overloads (indicated by TLT on status line of display). Also torque limiting becomes active on loss of shaft encoder pulses when running in closed loop vector mode.

Set speed limit timeout on Screen L6. Drive will trip if speed limiting exceeds this time.

Set torque limit timeout on Screen L7. Drive will trip if torque limiting exceeds this time. Provides protection against loss of shaft encoder pulses.

4.1.6 MULTI-REFERENCES

Set Screens M1 to M7 in conjunction with certain input modes (Screens I7) as preset torque or speed references.

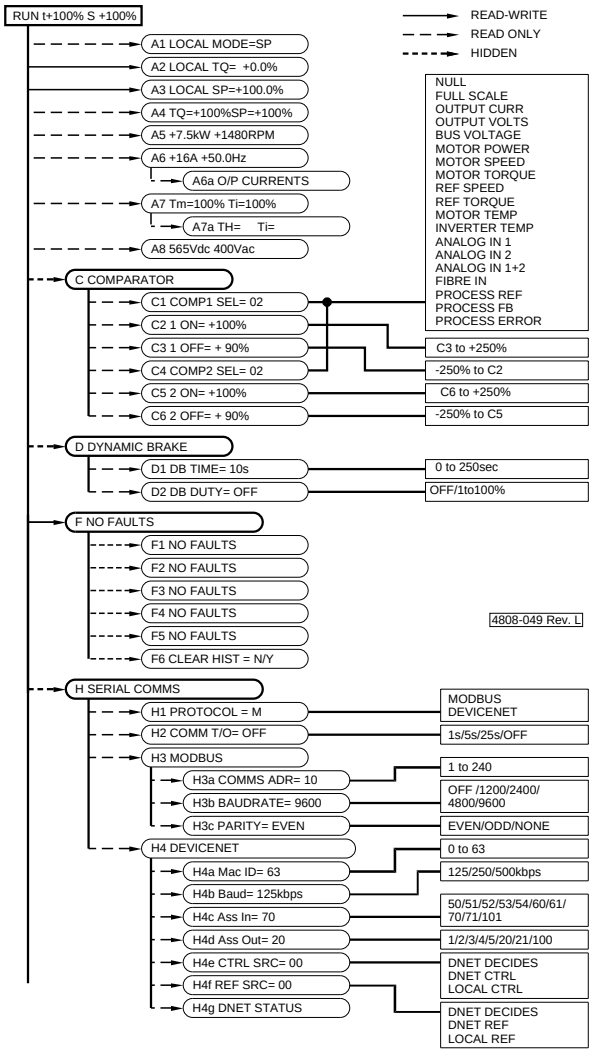

Figure 4.2: Screen List A-H

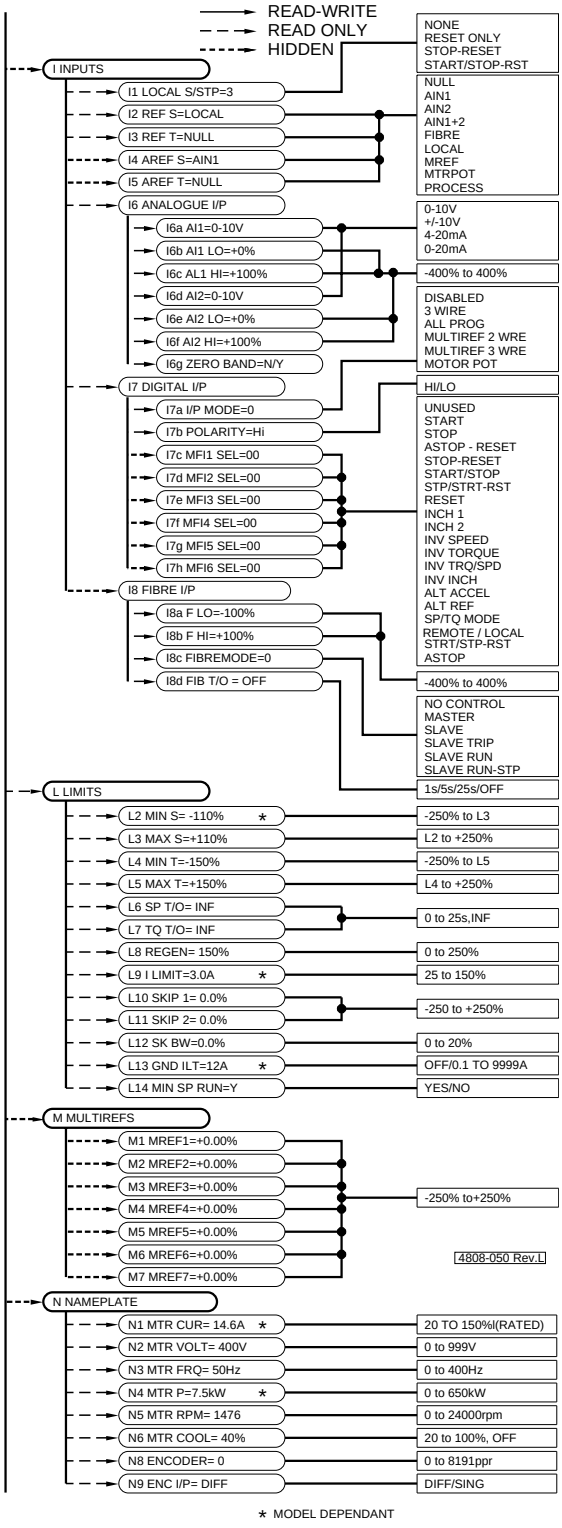

Figure 4.3: Screen List I-N

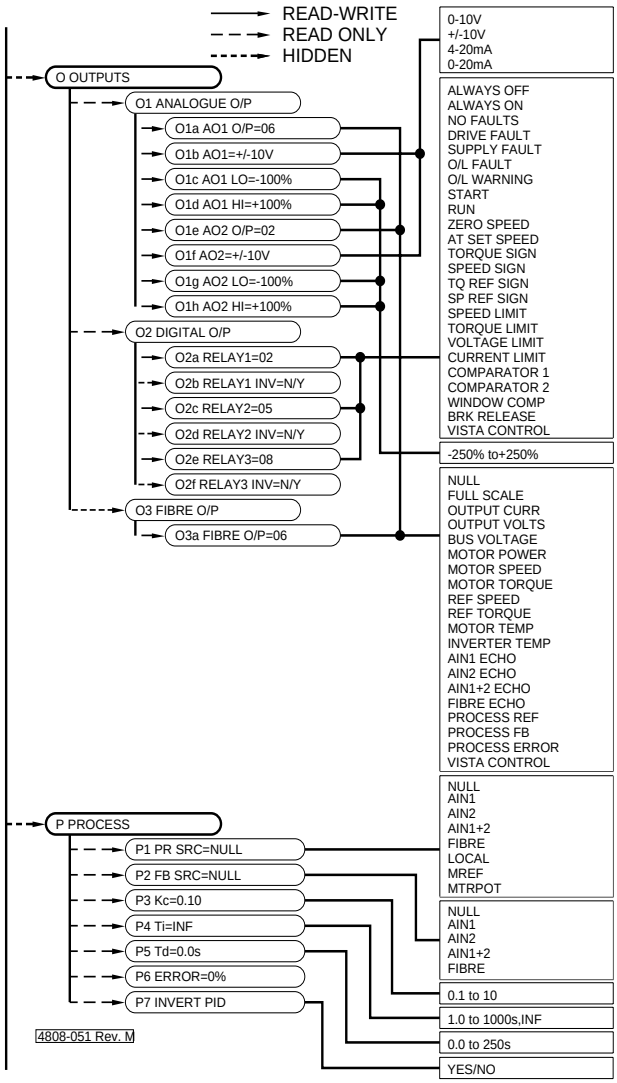

Figure 4.4: Screen Lists O-P

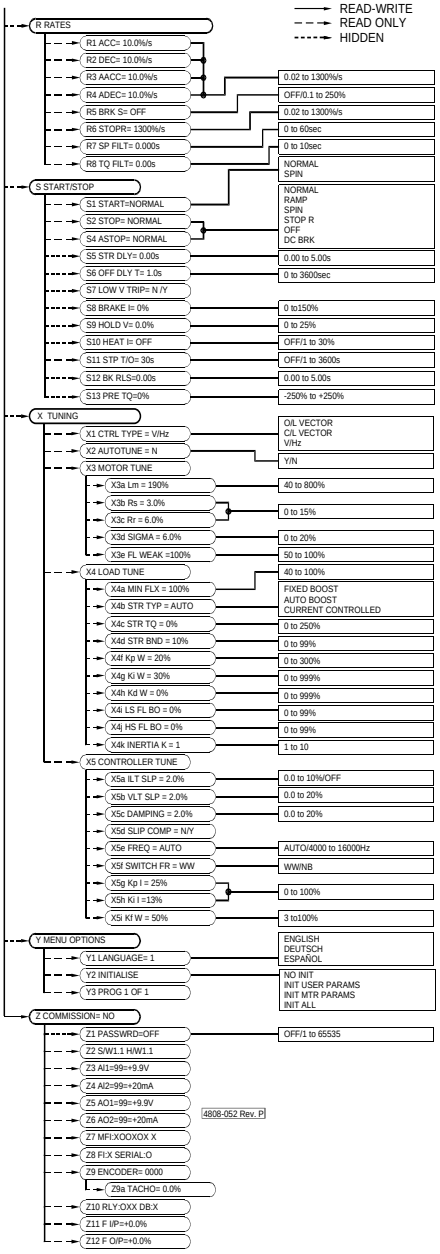

Figure 4.5: Screen List R-Z

Commissioning Notes:

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