PDL ELECTRONICS LTD

ELITE SERIES SERVICE MANUAL
Part No. 4201-230 Rev B

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Schneider Electric

DEDICATION TO QUALITY

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

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

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

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

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

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

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

COMPREHENSIVE SUPPORT PROGRAM

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

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

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

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

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

REVISION HISTORY

Date:	Revision:	Description:
Jan 2000	A	Created and issued 400V models 2.5 to 140A.
Jan 2003	B	Revised, 400V range extended to 660A, 500V range added.

IMPORTANT NOTES

SAFETY WARNINGS:

- It is the installer's responsibility to ensure the configuration and installation of the Elite Series meets the requirements of any site specific, local and national electrical regulations.
- The Elite Series operates from HIGH VOLTAGE, HIGH ENERGY ELECTRICAL SUPPLIES. Stored charge is present after switch off.
- Due to the high leakage currents inherent to AC drives, earth connection of both the motor and the Elite Series is essential before connection to the supply. The Elite Series must be permanently connected to the supply.
- For safety reasons, normal operation of the Elite Series requires front covers/doors to be in place and secured closed.
- Do not attempt to isolate the motor while the Elite Series is running.
- Some parameter settings may cause the Elite Series to start automatically after power failure.
- Motor overspeed operation may be limited by mechanical constraints.

RELIABILITY WARNINGS:

- Always screen control wiring.
- Ensure that the Elite 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. PDL products are designed and manufactured to a pollution degree 1 or 2. Neither of which cover corrosive vapours or gases.

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 Elite Series contains static sensitive printed circuit boards. Use static safe procedures when handling these boards.
- Never work on live equipment alone.
- Observe all recommended practices.

NOTES:

- This manual and the screen list contained within this document relate to Elite Series software version **3.8**. Refer to Screen Z2 for the software version of your Elite 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.pdl.co.nz.**

DISCLAIMER

This service manual applies to Elite Series Variable Speed Drives and is current at August 2002. While there have been minor changes in preceding Elite models and there may be minor changes in future Elite models this manual should still convey the basic service information required. If you have any concerns contact PDL Electonics or our agent.

CONTENTS

NOTES

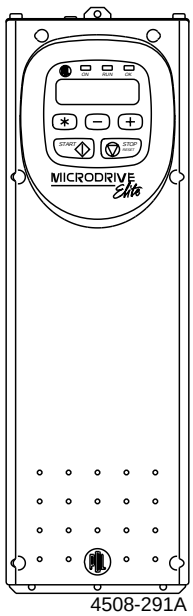
1.0 MICRODRIVE ELITE FRAMES 1 & 2

This section covers 400V models ME-2.5 to ME-22.5 and 500V models ME-2D to ME-21D.

Frame 1: ME-2.5 to ME-12 ME-2D to ME-11D

Frame 2: ME-18 to ME-22.5 ME-16D to ME21D

These are referred to within this manual as Frame 1 and 2. The 400V and 500V models are essentially identical for assembly purposes. When specific differences exist between the 400V and 500V models, these are noted.



4508-291A

CONTENTS

1.1 BEFORE STARTING TESTING OR SERVICE WORK

Site Preparation

This size of Elite is best serviced on a bench. We recommend a bench with an earthed antistatic mat to place the Elite on and an earthed wriststrap.

You will need flat surfaces for placing parts on and containers for small items like screws and bolts.

Tool Requirements

1 x No.2 Phillips screwdriver

1 x No.3 Phillips screwdriver

1 x Flat blade 3.5 mm screwdriver for terminals

1 x Flat blade 5.5 mm screwdriver

1 x No.3 Square drive screwdriver

1 x 5.5mm nut drivers

1 x 7mm nut drivers

1 x 10mm nut drivers

1 x Category 3 multimeter with ranges to 1000V AC and DC maximum

1 x PDL Soft Power Supply

1 x Single Phase Variac

1 x Isolating Transformer (Optional)

1 x 24Vdc power supply

(a current limited supply is preferred but a simple plug pack or batteries can be used with a lamp in series to limit the current flow)

4 x 230VAC 100W lamps and lamp holders

Safety & Testing Before Starting Repairs

1) Isolate and lock out the mains supply to the Elite and any low voltage supply that may be in parallel with the control power supply.
2) Allow approximately 5 minutes for the DC Bus capacitors to discharge.
3) Remove the cover by undoing 6 off Phillps head screws **Note: these screws stay in the cover**.
   Check the DC Bus live indicator on the bottom right hand side of the Control board. The red LED should not be glowing.
4) Test between input terminals L1, L2, L3 and L1, L2, L3 to earth to ensure the supply has been disconnected.
5) Test between the HVDC terminals +VE and -VE to ensure the DC Bus has fully discharged.

1.2 PRINTED CIRCUIT BOARD DESCRIPTIONS

Display Unit

The Display Unit has three buttons and a 2 by 16 character liquid crystal display. It is the user interface for all the parameter settings and is common to the Elite Series range. The Display Unit plugs into the Control Board.

Control Board

The Control Board is common to the Elite Series range. The Control Board accepts all external control inputs and generates output signals. The inputs and outputs include, digital, analogue and fibre optic. A Modbus RTU serial communications port is also included. A Shaft Encoder interface and 5V power supply is standard. The Display Unit plugs into the Control Board.

The Control Board has a bi-directional 24Vdc user power supply rated at 500mA.

Gatedrive Board

The Gatedrive Board is a general purpose board and as such performs many functions:

Gatedrive and Desaturation Circuits

- Seven gatedrive circuits accept signals from the Control Board and turn either on or off the relevant IGBT. Six of the gatedrive circuits are for the inverter and one for the Dynamic Brake.
- The desaturation circuit monitors the IGBTs for overload conditions. If overload occurs, the relevant IGBT is turned off and a desat fault is signalled to the control board.

Thermal Sense

An NTC thermal sensor circuit is connected to the heatsink via a small tab. This circuit monitors the heatsink and will cause the Elite to trip if the heatsink temperature exceeds 80°C (176°F).

Switch Mode Power Supply

The switch mode power supply provides various isolated DC supplies required by the Elite these are:

- 4 off +16.5V, 0V, -13.5V for the gatedrive circuitry.
- 28Vdc for the internal fans and Control Board.
- 24Vdc 500mA user power supply (Via the Control Board).

Bus Live Indication

- One red light emitting diode (LED) to indicate the DC Bus is live.
- One internal fan for circulating air within the Elite (IP54 only).

Power Board

The Power Board has RFI and snubber circuitry. The rectifier and IGBT blocks attach to this board.

- The IGBT block is soldered to the Power Board (Frame 1only).
- Has two DC Bus capacitors (Frame 2 only).
- Has VDRs for input voltage surge suppression (500V models).

Terminal Board

The Terminal Board contains:

- Power terminations.
- DC Current Transformers (DCCTs).
- DC Bus capacitors.
- Soft Charge relay and resistor.

1.3 FAULT FINDING GUIDE

1.3.1 SUPPLY ISSUES

Power supply problems can be misinterpreted as faults in the Elite. Some of the faults are listed below:

Fault 01 LOW Vdc

The supply to the Elite is dropping below the switch mode power supply operating level and the Elite is shutting down. This is usually caused by a weak supply or faults in the supply system. Look for motors starting direct on line or other machines drawing high current. For further details see the fault list in section 8 of this manual.

Fault 02 HIGH Vdc

The supply to the Elite is surging too high. Rapid load changes in the supply system may be faster than the automatic tap changing transformers can adjust to.

For further details see the fault list in section 8 of this manual.

Fault 04 SUPPLY FLT

Is an indication that the ripple on the DC Bus has exceeded 40Vac. This can be caused by diode(s) in the rectifier going open circuit, see section 1.4 for more information. This is more likely to be caused by;

- The loss of an input phase which increases the ripple on the DC Bus. The Elite will run on two phases up to half to two thirds of its current rating at which point the DC Bus filter will not be capable of maintaining the ripple below 40Vac and the Elite will trip.

  The Elite can be reset using the display unit.

- Excessive mains distortion (harmonics) can cause excessive ripple on the DC Bus. The cause of excessive supply distortion in an industrial situation may be SCR controlled heating equipment, DC drives, current source inverters, and other high current non linear loads. This fault can also occur where backup generators are used and they have not been sized correctly relative to the total variable speed drive load (VSD). The total loading of VSDs on a backup generator should be about 60% and the remaining 40% made up of linear loads.

1.3.2 FUSE FAILURE

Fuse failure is not a normal event, and it usually indicates a more serious fault. Therefore the reason for the fuse failure should be investigated.

Supply Fuses

Location: At point of supply to the Elite.

Possible cause: Supply surge, age or cyclic stress failure, wrong fuses, fault in supply cable to the Elite, rectifier or inverter fault, motor or motor cable fault.

Action:

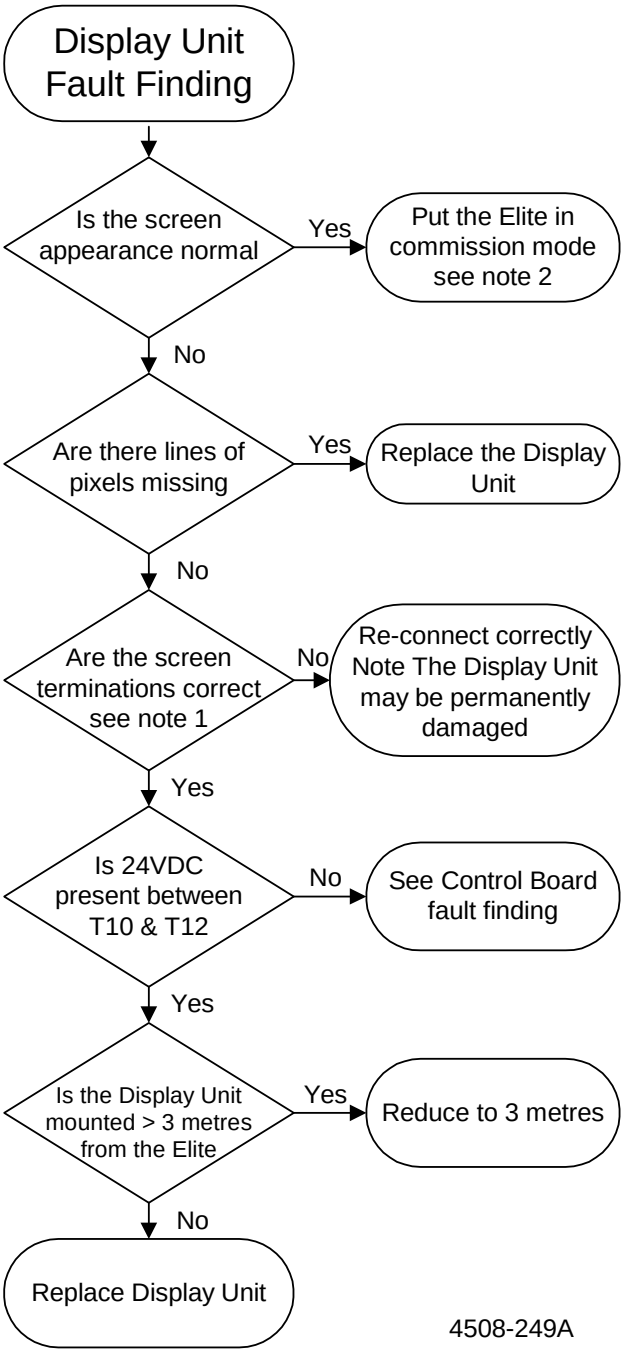
1) See section 1.1 before starting.
2) Perform a visual inspection for mechanical damage, water entry, or any other possible damage to the system.
3) For new or modified installations check the wiring is correct as per the Elite Technical Manual PDL Part No. 4201-180.
4) Check fuses for correct rating.
5) Disconnect supply cables and test for phase to phase or phase to earth fault.
6) Mark and disconnect the output cables, test the cables and motor for phase to phase and phase to earth fault.
7) Test the Elite for rectifier, inverter or DC Bus faults as per section 1.4.
8) If no faults are found, soft power the Elite as per section 1.5.
9) If you consider the fuses have failed because of an external issue such as short term overload or cyclic stress, reconnect the Elite, replace the fuses and attempt to restart the Elite.

Control Board Fuse

Location: On the Control Board.

This fuse is in series with the user 24Vdc 500mA power supply accessed via T36 and T37. The user power supply is short circuit protected and will shut down if a short is present in the field control wiring or any device connected to T36 and T37.

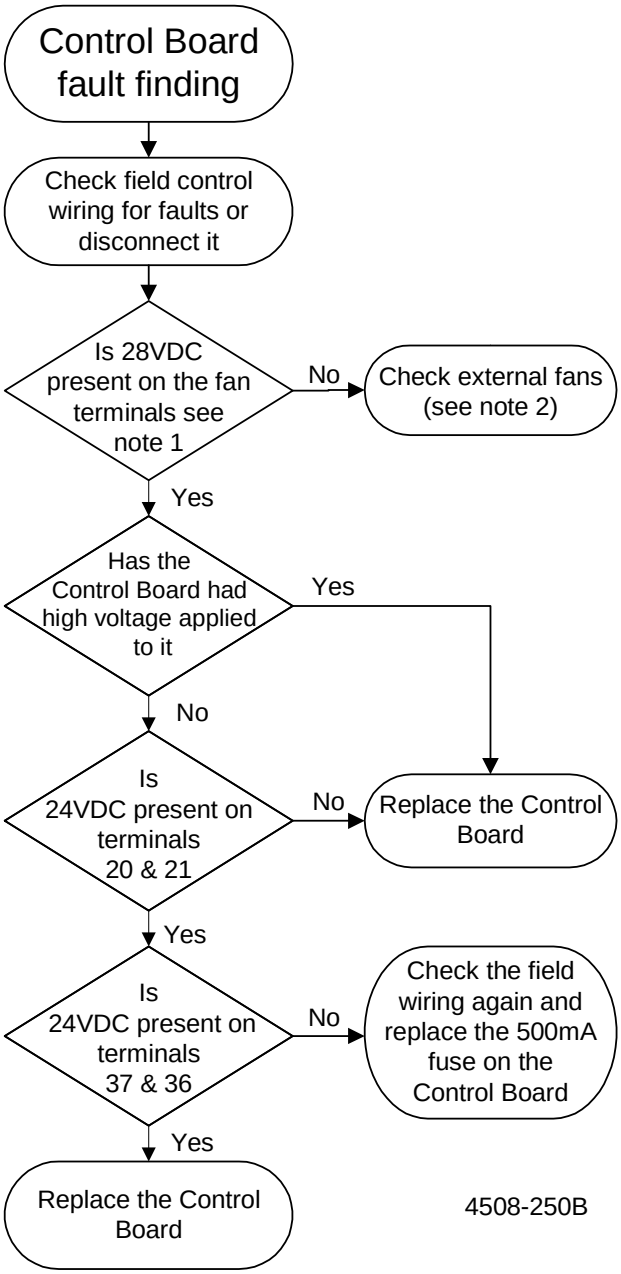
1.3.3 DISPLAY



Note 1:
Terminal 10 - red
Terminal 11 - white
Terminal 12 - black + screen
Note 2:
See Elite Series Technical Manual 4201-180 Screens Z to Z1

Figure 1.1: Display Fault Finding

1.3.4 CONTROL BOARD



Note 1:
The fan terminals are located between the fibre optic connections at the bottom of the Control Board.
Note 2:
Disconnect fan and recheck 28 volt supply. If 28Vdc is not present, the switch mode power supply on the Gatedrive Board is not functioning. If the supply returns when the fans are disconnected, the fans may be at fault.

Figure 1.2: Control Board Fault Finding

1.3.5 RECTIFIER

The rectifier is a full bridge rectifier with 6 diodes built into a single block, failure is typically indicated by two supply fuses blowing. See section 1.4. for testing of the rectifier.

Possible causes of Rectifier failure

Internal fault in Elite: i.e. DC Bus capacitors or inverter failure.

Fault in supply cable, motor cable or motor.

Soft Charge relay shorted: The Soft Charge circuit is a resistor in series with the positive DC Bus, the resistor limits the current drawn when the Elite is powered up. When the soft charge period is complete the resistor is shorted out by a relay. The Soft Charge circuit is mounted on the Terminal Board.

Supply voltage exceeding the Elite's rating: The 500V Elite has VDRs to protect against voltage transients, these will not cope with a supply that is constantly above the maximum level the Elite was designed for. The VDRs will fail and the Elite may be damaged.

1.3.6 INVERTER

The inverter consists of insulated gate bipolar transistors (IGBTs). The IGBT block has seven transistors, six are for the inverter stage and one for the Dynamic Brake. These are built into one block.

Symptoms of Inverter failure

- Input fuses blowing on power application.
- DESAT fault 08 to 13 constantly on the same phase and polarity.
- Current limit fault 07 this is a hardware trip to indicate that 220% of rated current has been reached.

For all of the above faults test the IGBTs as per section 1.4.1, and also check the motor and motor cables. If no faults are found attempt to reset the Elite, if the fault is repetitive on the same phase and polarity check the IGBTs again, if the fault is a DESAT fault and not always on the same phase the problem may be is most likely in the Gatedrive Board.

1.3.7 DC BUS FILTER

The DC Bus filter is comprised of electrolytic capacitors and chokes. The chokes are mounted in the heatsink and are in series with the rectifier output. The filter's function is to reduce the harmonic current drawn by the Elite and the ripple on the DC Bus, excess ripple >40VAC will be detected and displayed as a supply fault, see section 1.3.1 for further details.

To achieve the required voltage rating, two capacitors are connected in series, the capacitors are rated for the 400V and 500V models.

Possible causes of failure

The definition of capacitor failure is for the capacitance of the capacitor to fall outside the manufacturers tolerance or suffer a catastrophic failure which is an open or short circuit. While this section is quite detailed the capacitors seldom cause any problems.

400V capacitors rating 680 MFD +/- 20% at 20°C and 120Hz

500V capacitors rating 560 MFD +/- 20% at 20°C and 120Hz

Factors affecting the life of the DC Bus Capacitors

- **Stress related issues:** these are vibration, excessive ripple, above rated voltage and or temperature. Over heating is the most likely cause of premature failure and can be brought about by reduction in cooling air flow to the drive (check the heatsink for blockage and the fan operation), excessive ambient temperature or excess ripple due to some of the capacitors going open circuit.
- **Shelf life:** the recommended storage period without use should not exceed 3 years. If there is concern regarding the time an Elite has been stored, a DC supply can be connected to the DC Bus terminals and starting at about 50Vdc and over 8 hours the voltage is gradually increased to about 560 to 600Vdc for 400V models and 660 to 700Vdc for 500V models. Failure to do this can cause failure of the DC Bus capacitors on initial application of full voltage.

Symptoms of DC Bus Capacitor failure

Open Circuited Capacitor

If a single DC Bus capacitor goes open circuit, the symptoms may not be noticeable. However the remaining capacitors will have an increased ripple current and will run hotter. If more capacitors consequently go open circuit, the DC bus ripple will increase and may cause a **SUPPLY FLT** trip, especially when the Elite is running at or near full output current.

Short Circuited DC Bus Capacitor

A shorted capacitor should cause two input fuses to fail during or soon after the soft charge interval, because they are connected in series to share the DC bus voltage, if one capacitor has shorted it will have exposed all the capacitors opposite it to above rated voltage. This is shown in figure 1.3. In the drawing on the right the top set of capacitors have been exposed to full DC bus voltage which will be approximately twice their rating. In this event it is recommended to replace all the DC Bus capacitors or at a minimum all the opposing capacitors as well as the faulty one.

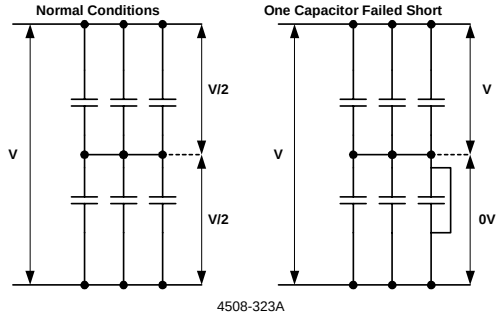


Figure 1.3: DC Bus capacitor short circuit

1.4 TESTING

1.4.1 TESTING THE RECTIFIER AND INVERTER

Refer to figure 1.4 and using a multimeter, check the rectifier as the drawing indicates.

NOTE: each test is carried out 3 times (i.e. once per phase) which is a total of twelve tests.

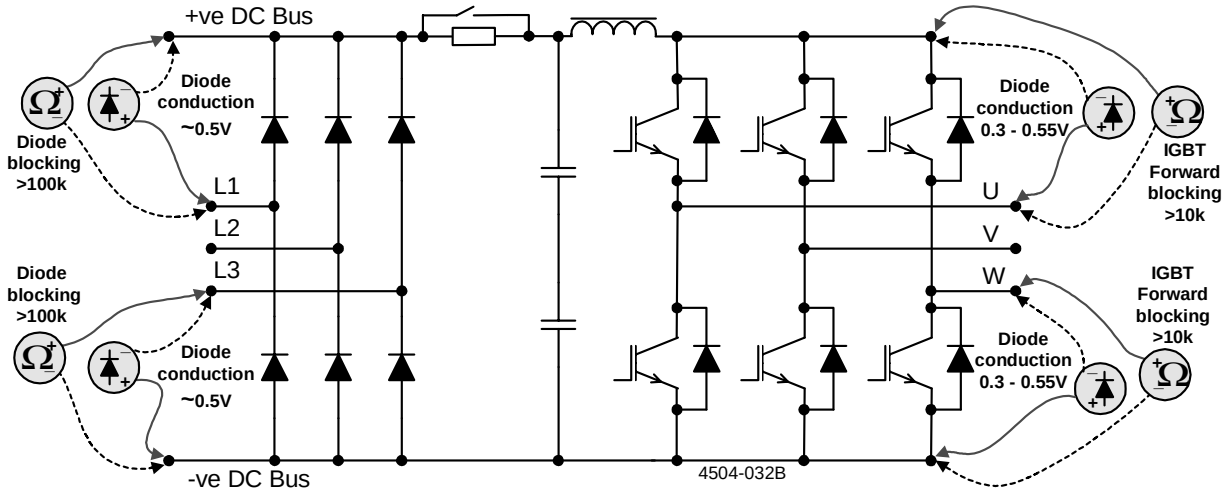


Figure 1.4: Rectifier and Inverter Testing Frames 4

1.4.2 TESTING AN INDIVIDUAL DIODE

Refer figure 1.5 when the Elite is disassembled so the diodes can be tested individually.

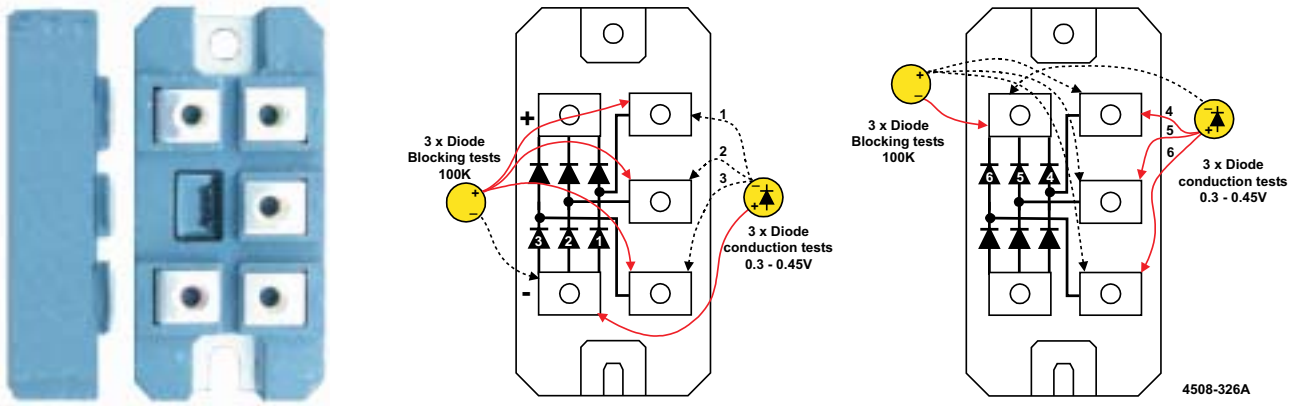


Figure 1.5: Individual Diode Test

1.4.3 TESTING AN INDIVIDUAL IGBT

Individual tests are not practical as shown on Frames 3 to 7 in sections 2 to 4 within this manual.

1.4.4 TESTING THE DCCT AND DCCT SUPPLY

The DCCTs measure motor current, and are located on the output of the Elite. DCCT failure may be indicated by, **Fault 21 (Ground fault)** or **Fault 58 (Current imbalance)**, even with the motor disconnected. If Fault 21 is apparent and the motor and motor cable have been checked, check the DCCT terminations as shown in figure 1.6 and the Inverter as shown in figure 1.4. The 6 pin connector is located at the very top of the Control board.

How to test the DCCTs

1) Power up the Elite but do not start. Test between ground -T1, then ground -T4 to confirm the DCCT has a ±14V supply. If the ±14 supply is not present the switch mode power supply on the Control or Gatedrive board may be faulty, refer to section 2.3.4 for fault finding on the Control board.
2) Test the DCCTs by measuring between ground -T3, ground -T5 and ground -T6, these should read 0V. If the three readings are not 0V, check the drive is not running, then replace the terminal board.

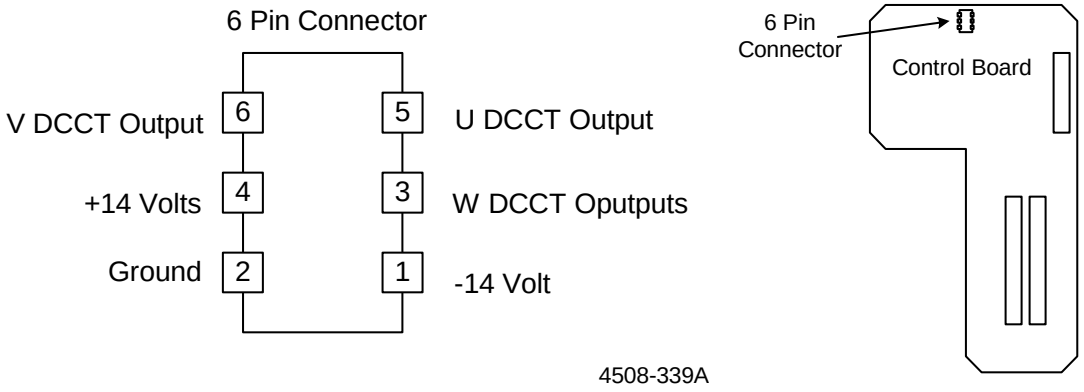


Figure 1.6: DCCT Testing

1.4.5 TESTING THE DC BUS CAPACITOR

A general test without disassembling the Elite is recommended. Follow section 1.4.1 to test the rectifier and then the inverter. Use a meter set to OHMS to test the capacitors between HVDC terminals + and -. The resistance should start low, then increase as the capacitors charge to the meter battery voltage (ensure the DC bus capacitors are fully discharged first). This charging period could take some time. It is best carried out by testing the faulty machine against a known good Elite of the same size or check the spare parts list and pick a model within the same frame size with the same number of DC Bus capacitors. Time the rate of charge, i.e. the increase in ohms on the meter, and compare this against the faulty Elite. If this test indicates reasonable variation there may be a problem with the capacitors. Further testing requires disassembly of the Elite.

To test for individual open or short circuited capacitors, the Elite must be dismantled and each capacitor individually checked with a multimeter. Ensure all capacitors are fully discharged before proceeding, then connect the meter on OHMS range across each capacitor in turn, with the meter positive to the capacitor positive. On a good capacitor, the resistance should start low, then increase as the capacitor charges to the meter battery voltage.

Visual Inspection of a capacitor

Each capacitor is a sealed canister without a vent and as such are required to have a purposely weakened area to allow the case to split if the capacitor should fail and pressure build up internally. This weakest area is found in the base or top of the capacitor and will show signs of bulging and splitting if the capacitor has overheated or suffered an internal fault.

1.5 SOFT POWERING AFTER REPAIR

Once all faulty components and assemblies are replaced, and the Elite has been carefully reassembled, it is recommended the Elite be tested as per section 1.4.1 then Soft Powered.

To Soft Power an Elite

Refer to figure 1.7 and connect a 24Vdc current limited power supply to T36 (positive) and T37 (0V). Start the Elite, the Display unit should liven up then set the Elite to local control as per the Elite technical manual part no. 4201-180. Disconnect the supply.

Connect a PDL Soft Power Supply to the DC bus as in figure 1.7. The Soft Power supply is available from PDL Electronics Ltd or refer to the circuit diagram is shown in section 8 of this manual to build one. The power supply is a 600Vdc power source, which is used to power up the DC Bus. The procedure enables any remaining DC Bus or inverter fault to be found without causing damage.

Connect the Soft Power Supply to the mains, as shown in figure 1.7. The isolating transformer is not required for galvanic isolation between supplies as only one supply is used but it is recommended to do so as a safety measure. The lamps in series reduce the current that will flow if the Elite is faulty. Set the variac to the lowest setting, switch on and increase the voltage setting to 230Vac over 5 seconds (any longer risks burning out the soft charge resistor in the Soft Power Unit).

The Display should come up when the supply reaches 280Vdc and the red DC Bus live LED should energise on Gatedrive board (visible at the bottom of the Control board). Now set the Elite to local start/stop and speed reference control, see Technical manual part number 4201-180 for details.

The Elite should respond to Display unit Start/Stop commands and Speed reference changes. Start the Elite from the Display unit and increase the output frequency or speed to 100% . Now use a multimeter set to AC VOLTS, to measure the output voltage between terminals U-V, V-W, W-U. These voltages should all be balanced at approximately 400Vac. If there is any sign of imbalance, measure between each output and earth to isolate which phase is faulty. It is likely that there is an unrepaired fault on that particular phase or loose terminations.

If the test shows no faults and a good output voltage balance, the test power supplies can be disconnected, the mains and motor reconnected, and a full test done.

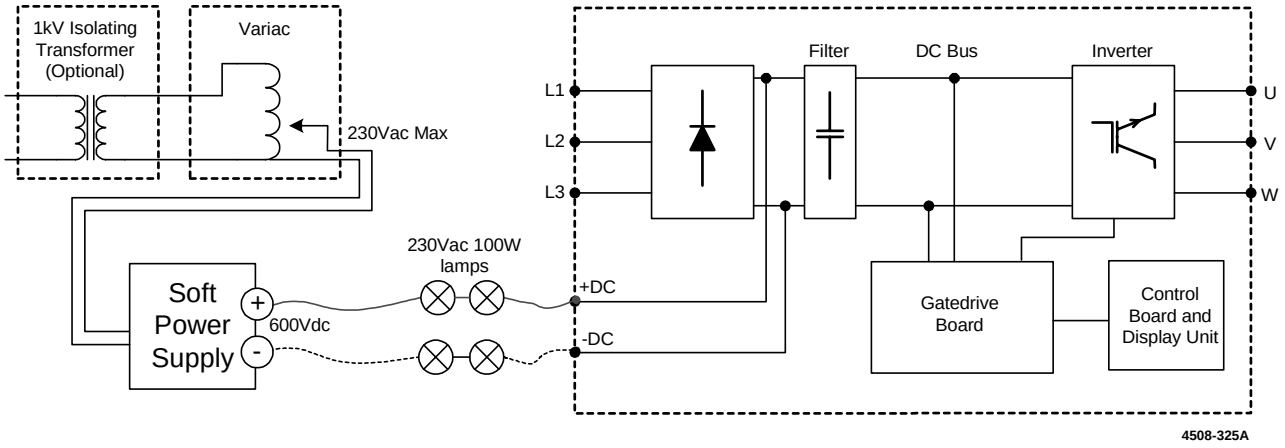


Figure 1.7: Soft Power Supply Connections

1.6 PARTS LIST AND BLOCK DIAGRAM

1.6.1 FRAMES 1 AND 2 400V MICRODRIVE ELITE PARTS LIST

400 VOLT MICRODRIVE ELITE PARTS LIST						
Frame Size	FRAME 1				FRAME 2	
Model	ME-2.5	ME-6.5	ME-10.5	ME-12.5	ME-18	ME-22.5
Display Cover Label	4101-545					
Front Cover	3903-116					
Cover Gasket	3907-021					
Display Unit	E000-620S					
Control Board	E000-610S					
Power Board	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					1757-106	
IGBT Thermstrate	1781-530		1781-530		1781-205	
Rectifier Thermstrate					1781-108	
DC Bus Capacitors	2 x 1277-547	2 x 1277-547	4 x 1277-547	4 x 1277-547	6 x 1277-547	6 x 1277-547
External Fan	2941-012					
Internal Fan	2941-010					
						4508-269A

Figure 1.8: Frames 1 & 2 400V Microdrive Elite Parts List

1.6.2 FRAMES 1 AND 2 500V MICRODRIVE ELITE PARTS LIST

500 VOLT MICRODRIVE ELITE 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	E013-611S				E023-611S	
Gatedrive Board	E013-612S				E023-612S	
Terminal Board	E003-616S	E007-616S	E013-616S		E023-616S	
Rectifier Block	1757-103		1757-104		1421-023	
IGBT Block					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					
						4508-271A

Figure 1.9: Frames 1 & 2 500V Microdrive Elite Parts List

1.6.3 FRAMES 1 AND 2 400V AND 500V MICRODRIVE ELITE BLOCK DIAGRAM

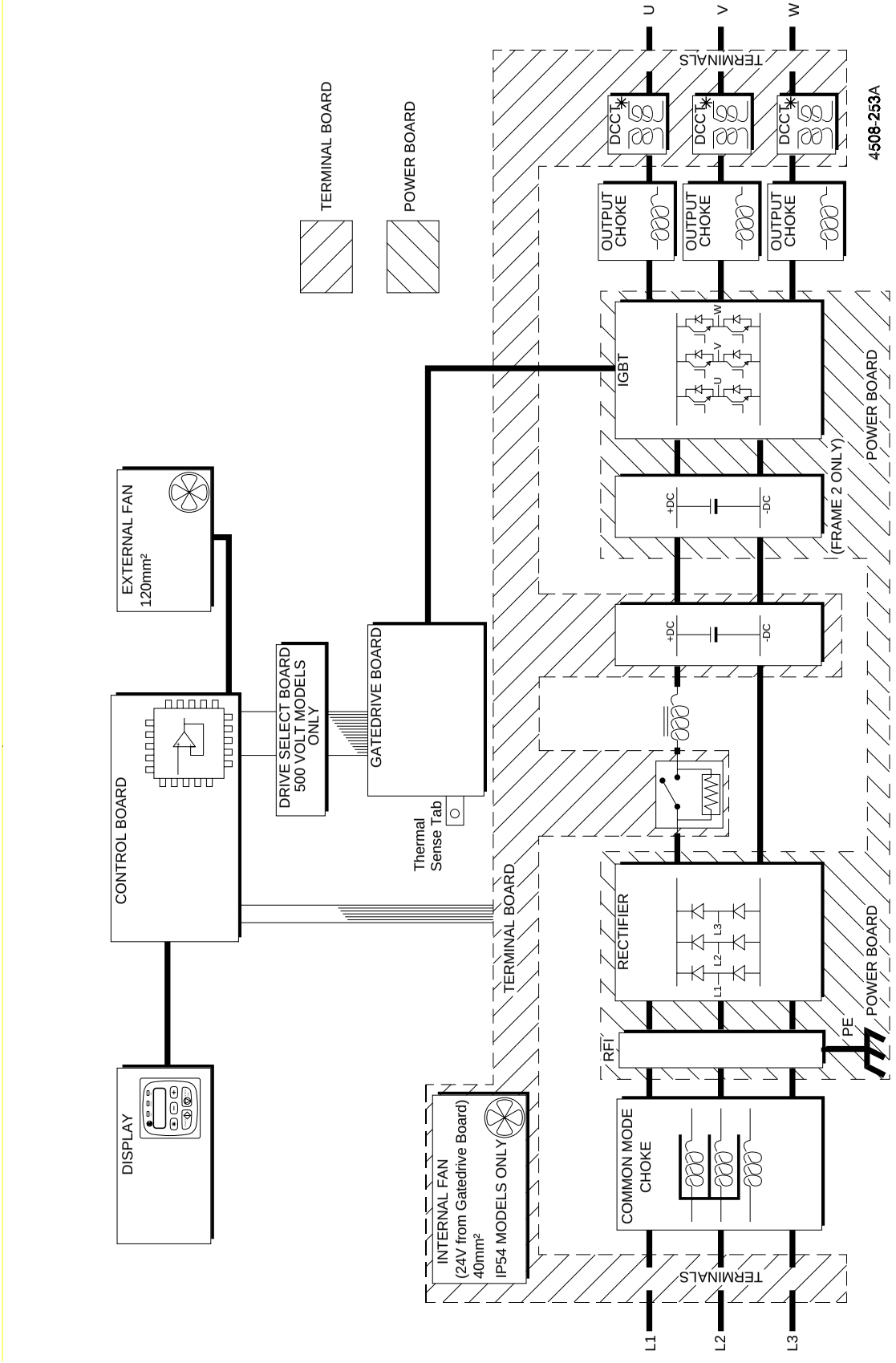


Figure 1.10: Frames 1 & 2 400V and 500V Microdrive Elite Block Diagram

1.7 SERVICE

1.7.1 REMOVING THE CONTROL BOARD

Refer to figure 1.11 while following this instructions.

Read section 1.1 for isolation and testing prior to starting work.

1) Static safe procedures must be observed i.e. a grounding strap must be worn and earthed while servicing a unit. In addition to the grounding strap, an earthed antistatic mat is required if the product is being serviced on a bench.

2) Mark the location and remove the control wiring plugs (use a felt pen and number each plug). Remove fibre optic cables if used and the Display unit.

3) Remove the Control board cover under the Display unit by unscrewing the Phillips 8G x 1/2" wafer screw.

4) Remove the Terminal plate by unscrewing 8 off Phillips 8G x 1/2" wafer screws and one Phillips head which is the 0V control earth (Note: this screw may have been already removed during installation).

5) Remove the earth connection for the Control board and terminal cover situated under the terminal plate.

6) The Control board is secured at the top by 2 off Phillips 8G x 1/2" wafer screws. Once these are removed the 40 pin (top right) and 6 pin (top left) connectors are all that is holding it down.

7) Disconnect the external fan wire from the bottom of the Control board.

8) Using the tool supplied gently lift the Control board evenly off the connecting pins by inserting it in the slots at the end of the connectors and pulling up.

9) To slide the Control board out of the Elite, lift it slightly at the fibre optic input/output end and gently slide it out of the Elite cabinet. When the Control board is removed place it in a static proof bag or on static safe foam for safekeeping.

Replacing the Control Board

1) Continue to observe static safe work procedures.

2) Avoid excessive handling of the new Control board.

3) The replacement Control board will be in biscuit format i.e. it will have to be trimmed to the same size as the existing Control board, see figure 1.12 for the biscuit shape. This is done with a fine pair of side cutters cutting as close to the Control board as possible.

4) Unsolder the Control board earth from the old Control board and solder it onto the replacement board.

5) Ensure the Terminal board and Gatedrive boards are located in the vertical slots at the top of the Elite cabinet.

6) Place the Control board on the connecting pins.

7) Move the Control board until the pins appear to be in place through the slots at each end of the connection sockets. Be very careful at this point to avoid bending the pins on the Gatedrive and Terminal boards.

8) Gently push the 6 pin connector down, repeat the process with the 40 pin connector. If locating the 6 pin connector first does not work try locating the 40 pin connector then the 6 pin. If problems are still encountered check step 5 again and ensure the bridges which held the removed part of the Control board biscuit are as short as possible. Do not apply force.

9) Replace the remaining components back into the Elite reversing the order used when removing the Control board.

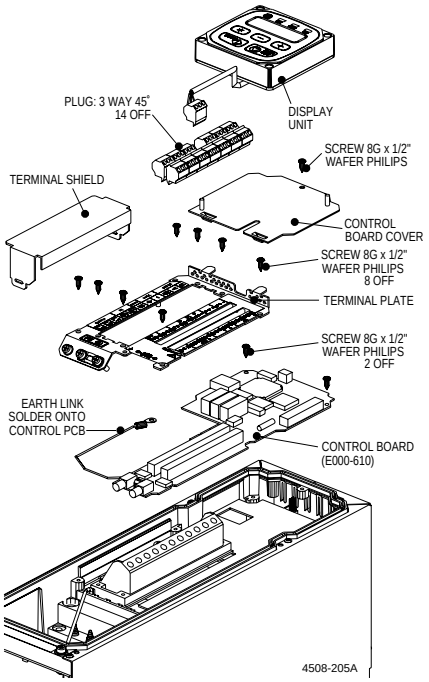


Figure 1.11: Control Board Removal

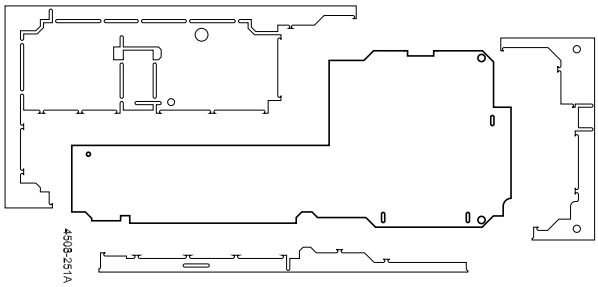


Figure 1.12: Control Board Biscuit

1.7.2 REMOVING THE SHROUD

To access any other boards, the shrouds and skirts in the Elite must be removed first.

Complete previous section first.

Refer figure 1.13 when removing the shrouds.

1) To remove the shrouds remove:

   a) 4 off wafer Phillips 8G x 1/2 inch.

   b) 2 off 3/4 pan square screws.

   c) 2 off M4x10mm Phillips screws which also secure the fan.

2) Tilt the top of the shrouds out from the Elite body slightly and lift clear of the locating lugs on the bottom of the shrouds.

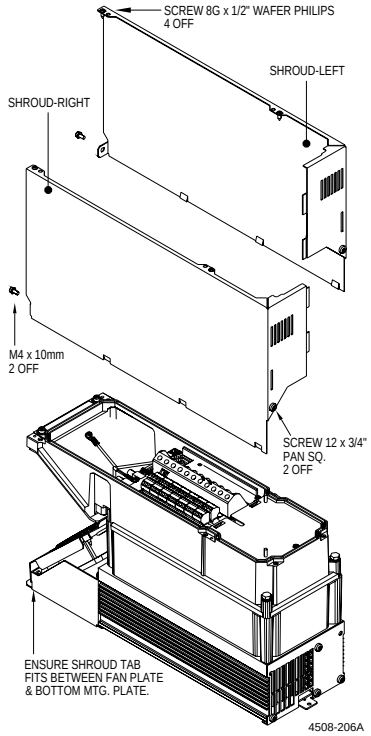


Figure 1.13: Shroud Removal Frames 1 and 2

1.7.3 REMOVING THE SKIRT

Refer figure 1.14 when removing the skirt.

1) Remove the fan and pull the wire through the rubber gasket.

2) Remove two rubber grommets from the top skirt just above the gland plate.

3) The gland plate earth link may need to be removed unless the gland plate has already been removed.

4) Remove the 4 off M6x110mm bolts that hold the skirts to the heat sink. The two skirts can now be lifted clear.

Replacing the Skirt

For IP54 models it is important to ensure correct alignment of the top and bottom skirt to the Elite to maintain the IP54 rating of the Elite.

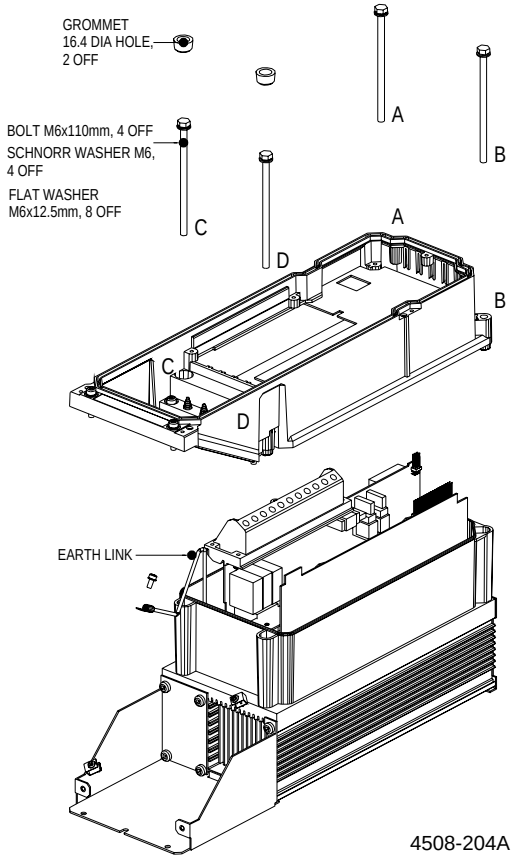


Figure 1.14: Skirt Removal Frames 1 and 2

1.7.4 SERVICING THE TERMINAL BOARD

Removing the Terminal Board for Frame 1

Refer figure 1.15 when removing the terminal board.

1) **Note:** before proceeding it is critical that all wiring be labelled to guarantee correct reassembly, especially the output phases.

To remove the Terminal board remove:

2) M4x40mm Phillips screw (H) which holds the common mode choke body to the heatsink.

3) M4x12mm Phillips screws (I, J and K) which hold the red, yellow and blue wires to the Power board. **Note:** there are extra 4mm washers.

4) 7 off M4x10mm Phillips screws (A to G) which will disconnect all the choke wiring.

5) A M4x10mm Phillips screw (not shown) attaches the earth from the Terminal board and gland plate to the heatsink.

6) The Terminal board is now held by a 4 pin socket, lift the board vertically to disconnect it from the Power board.

Replacing Terminal boards for Frames 1 & 2

The replacement Terminal board for Frame 1 will not have terminal blocks, common mode choke or the main earth. These need to be removed from the old board and placed onto the replacement board using the instructions set out below.

1) Lift the terminal insulator block from the old Terminal board and place the terminal clamps on the new board. Finger tighten the terminal clamp screws.

2) Place the terminal insulator block onto the terminal clamps and push it down until it locates against the Terminal board.

3) Unsolder the common mode choke and main earth and re-solder them to the new board. Reassemble the Elite.

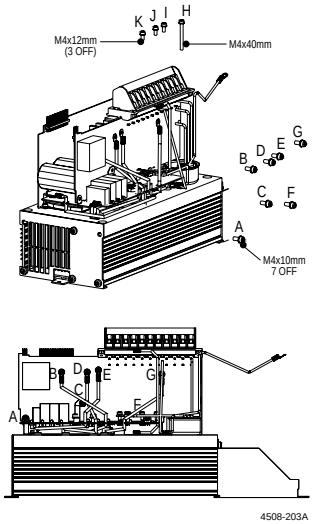


Figure 1.15: Terminal Board Removal

Removing theTerminal board for Frame 2

Refer figure 1.16 when removing the terminal board.

Note: Before proceeding, it is critical that all wiring be labelled to guarantee correct reassembly, especially the output phases.

Remove the terminal board by removing:

1) M4x400mm Phillips screw (N) which holds the common mode choke body to the heatsink.

2) M5x12mm Phillips screws (K,L and M) which holds the red, yellow and blue wires to the Gatedrive board.

3) 7 off M4x100mm Phillips screws (A to G) which will disconnect all the choke wiring.

4) A M4x10mm Phillips screw which is not shown, attaches the earth wire from the Terminal board to the heatsink and under the same screw is the gland plate earth.

The Terminal board is now held by a 4 pin socket, lift the board vertically to disconnect it from the power board.

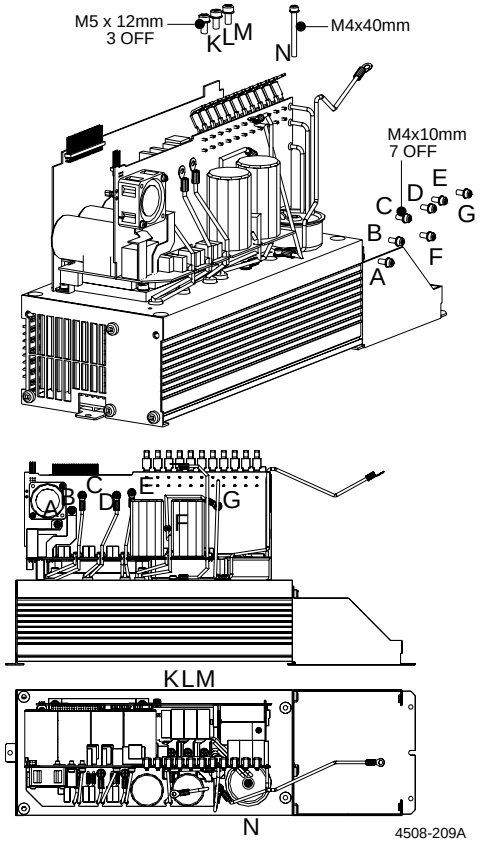


Figure 1.16: Terminal Board Removal Frame 2

1.7.5 SERVICING GATE DRIVE BOARD

Removing the Gatedrive Board Frame 1

Remove the Control board, Shrouds, Skirts and Terminal board before proceeding.

Refer figure 1.17 when removing the Gatedrive board.

Do not attempt to remove the Gatedrive board without removing the Terminal board first. This can damage the Terminal board when it is pulled to one side to allow access to the M4x10mm Phillips screws labelled A.

Remove M4 x 100mm Phillips screws (A and B) and lift the board vertically off the Power board and IGBT connecting pins.

Note: When replacing the Gatedrive board, the heatsink temperature monitoring is done through the tab secured by screw B.

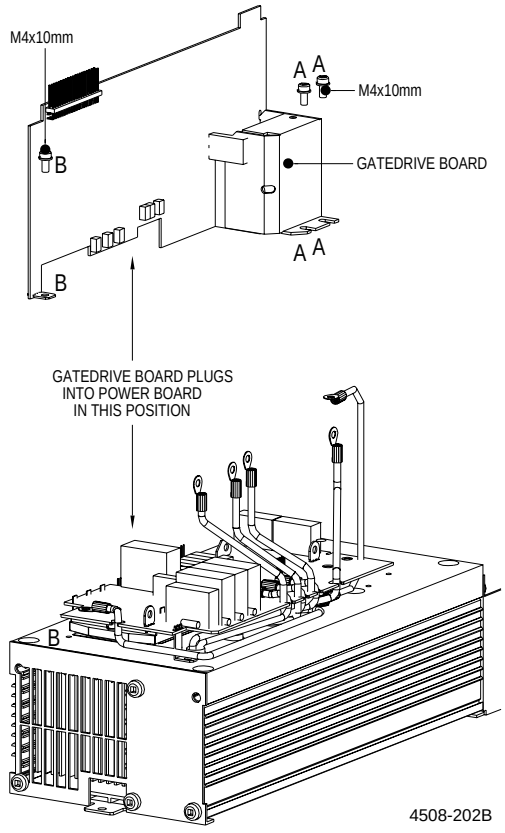


Figure 1.17: Gatedrive Removal Frame 1

Removing the Gatedrive Board Frame 2

Refer figure 1.18 when removing the Gatedrive board.

The Gatedrive board removal for Frame 2 is similar to Frame 1 except the Gatedrive board plugs directly on to the gate connections of the IGBT as per figure 1.18.

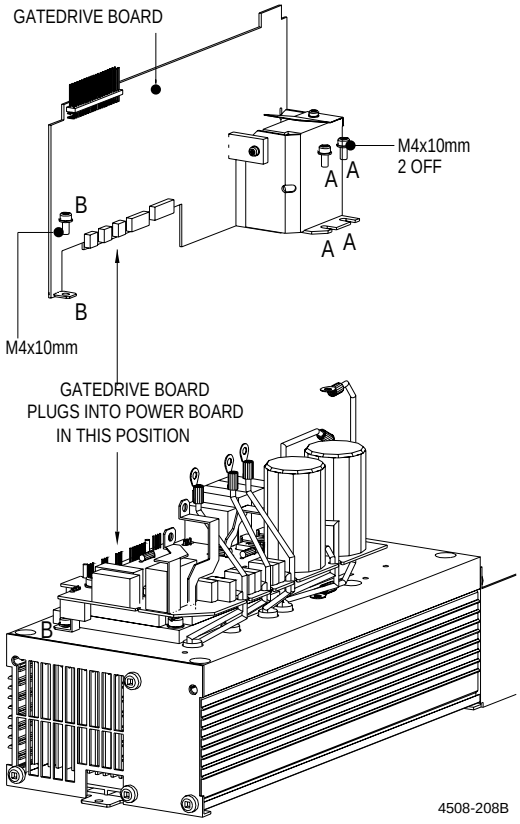


Figure 1.18: Gatedrive Removal Frame 2

Removing Gatedrive Board (500V Models)

Refer figure 1.19 when removing the Gatedrive board.

The Gatedrive board removal for 500V models is similar to the 400V Frame 1 except:

1) The Microtherm is held in place by 2 off M3x6mm CW screws.

2) Drive Select board located on the Gatedrive board.

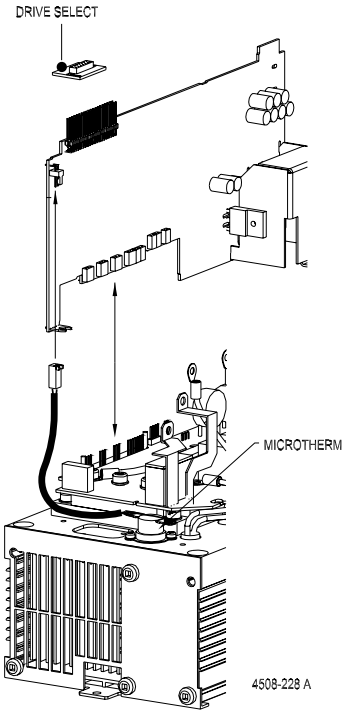


Figure 1.19: 500V Microtherm and Drive Select

1.7.6 SERVICING THE POWER BOARD AND RECTIFIER/IGBT

Removing Frame 1 Power Board and IGBT/Rectifier

Remove the Control board, Shrouds, Skirts, Terminal board and Gatedrive board before proceeding.

Refer figure 1.20 when removing the Power board.

Note: the DC Bus capacitors on the Power Board compared to figure 1.21

The Rectifier/IGBT block is soldered to the Power board and must be removed as one unit. To do this remove:

a) M4x12mm Phillips screws (B, C and D) connecting the output chokes to the Power Board.

b) M4x12mm Phillips screw (F) which connects the DC choke to the DC Bus on the Power board.

c) The wiring from the retaining holes in the Power board.

d) M4x12mm Phillips screws (G and H) anchoring the IGBT/Rectifier to the heatsink.

e) M4x6mm Phillips screws (A and E) which anchor the Power board to the heatsink. The Power board is now only held down by the thermstrate.

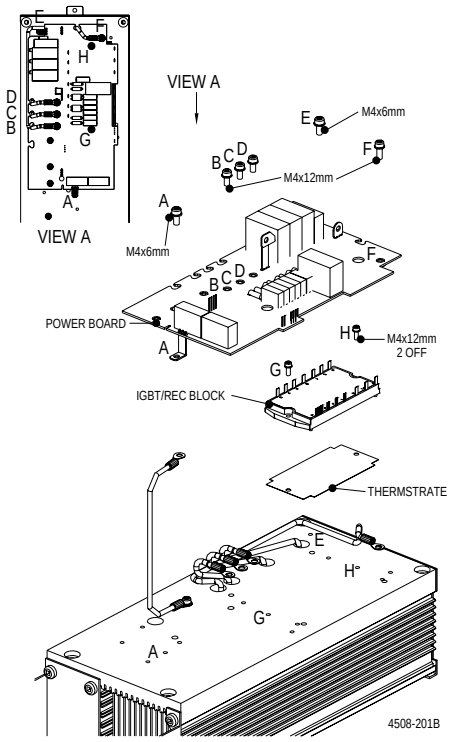


Figure 1.20: Rectifier/IGBT Block Removal Frame 1

Replacing the Rectifier/IGBT Block

The rectifier/IGBT block is soldered to the Power board in 10 places.

1) If you do not have access to desoldering equipment the IGBT block can be removed by cutting all 10 tabs which secure it to the PCB. Use a hacksaw blade between the Power board and the IGBT block, then desolder the tabs remaining in the Power board. Remove all traces of solder. Clean the underside of the board and check for damage caused by the hacksaw.

2) Clean the heatsink and place a new thermstrate on it, note avoid touching the surface of it and be sure to remove the paper packer.

3) Leave the foam on the gate terminals of the IGBT block. Place the IGBT block on the heatsink and secure with screws (G and H).

Note: the IGBT block is extremely sensitive to static damage

4) Remove the foam from the IGBT gate terminals and carefully locate the Power board on to the IGBT block. If it does not fit easily check for solder obstructing the holes in the Power board.

5) Secure the Power board with screws A and E.

6) The bottom of the Power board should be 15.5mm from the heatsink. Ensure the Power board is parallel with the heatsink and solder in the IGBT block.

Removing Power Board Frame 2

Refer Figure 1.21

The Power board is secured to the heatsink, the IGBT and rectifier blocks.

To remove the Power board remove:

1) 2 off Phillips screws (C) which secure the Power board to the heatsink.

2) Phillips screws 3 off (D) and 5 off (E) which secure the Power board connections to the rectifier and IGBT blocks.

The Power board can now be removed.

Removing the IGBT or Rectifier Block Frame 2

To remove the rectifier block remove:

1) 2 off Phillips screws (A).

2) To remove the IGBT block remove 4 off Phillips screws (B).

Note: the IGBT block is extremely sensitive to static damage.

Replacing the IGBT or Rectifier Frame 2

When replacing the IGBT Blocks use new thermstrates. Do not use the paper packers, and avoid touching the surface of the new thermstrate.

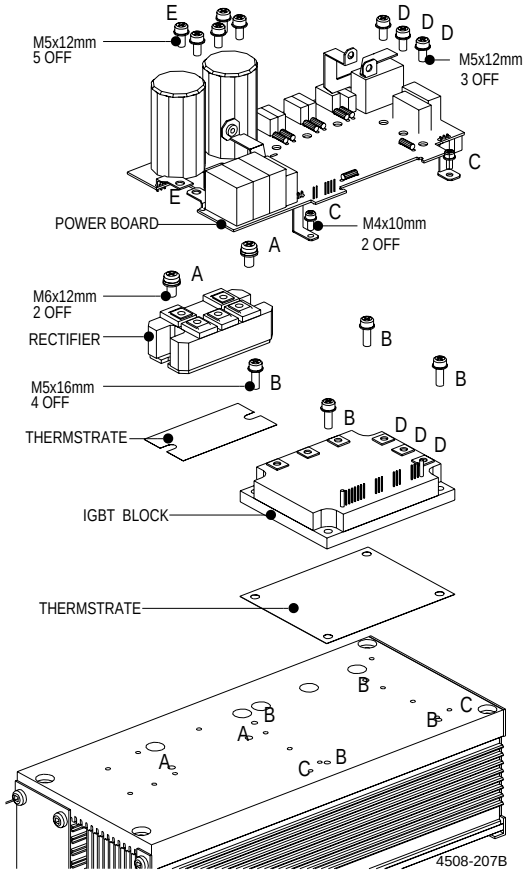
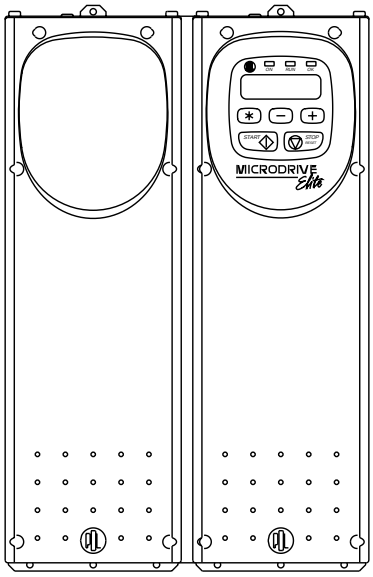


Figure 1.21: Rectifier/IGBT Removal Frame 2

2.0 MICRODRIVE ELITE SERIES FRAME 3

This section covers 400V models ME-31 to ME-46 and 500V models ME-30D to ME-41D

The 400V and 500V models are essentially identical for assembly purposes. When specific differences exist between the 400V and 500V models, these are noted.



4508-290A

CONTENTS

2.1 BEFORE STARTING TESTING OR SERVICE WORK

Site Preparation

This size of Elite is best serviced on a bench. We recommend a bench with an earthed antistatic mat for working on and an earthed wrist strap.

You will need flat surfaces for placing parts on and containers for small items like screws and bolts.

Tool Requirements

1 x No. 2 Phillips screwdriver

1 x No. 3 Phillips screwdriver

1 x Flat blade 3.5 mm screwdriver for terminals

1 x Flat blade 5.5 mm screwdriver

1 x No. 3 Square drive screwdriver

1 x 5.5mm nutdriver

1 x 7mm nutdriver

1 x 10mm nutdriver

1 x Category 3 multimeter with ranges to 1000V AC and DC maximum

1 x PDL Soft Power Supply

1 x Single Phase variac

1 x Isolating transformer (Optional)

1 x 24Vdc volt power supply.
(a current limit supply is preferred but a simple plug pack or batteries can be used with a lamp in series to limit the current flow)

4 off 230Vac 100W lamps and lamp holders

Safety & Testing Before Starting Repairs

1) Isolate and lock out the mains supply to the Elite and any low voltage supply that may be in parallel with the control power supply.

2) Allow approximately 5 minutes for the DC Bus capacitors to discharge.

3) Remove the right hand cover by undoing 6 off Phillps head screws. **Note: these screws stay in the cover**. Check the DC Bus live indicator on the bottom right of the Control board, the red LED should not be glowing.

4) Remove 6 off Phillps head screws to remove the left cover. Then remove the lexan terminal cover.

5) Test between input terminals L1, L2, L3 and L1, L2, L3 to earth to ensure the supply has been disconnected.

6) Finally, test between the HVDC terminals +VE and -VE to ensure the DC Bus has fully discharged.

2.2 PRINTED CIRCUIT BOARD DESCRIPTIONS

IP54 models are built in two enclosures, with 4 bushes connecting the enclosures.

The right enclosure contains: Display unit, IGBT's, DC Bus capacitors, Gatedrive board, Control board, internal cooling fans, DC current transformer interface & control terminations.

The left enclosure contains: Power terminations, common mode choke, rectifier and DC current transformers (DCCTs).

Display Unit

The Display unit has three buttons and a 2 by 16 character liquid crystal display. It is the user interface for all parameter settings and is common to the Elite Series range. The Display unit plugs into the Control board user terminals.

Control Board

The Control board is common to the Elite Series range and accepts all external control inputs and generates output signals. These include digital, analogue and fibre optic signals. A Modbus RTU serial communications port is also included on the Control board. A Shaft Encoder interface and 5V power supply is standard. The Control board also has a bidirectional 24Vdc user power supply rated at 500mA.

Gatedrive Board

The Gatedrive board is a general purpose board and as such performs many functions.

Gatedrive and Desaturation Circuits

- Six gatedrive circuits accept gatedrive signals from the Control board and turn on/off the respective IGBT.
- Monitoring the IGBTs for overload conditions and turns the relevant IGBTs off if this should occur and generates Desaturation (Desat) fault to the Control board.

The main switch mode power supply provides various isolated DC supplies required by the Elite. These are:

- 4 off +16.5V, 0V, -13.5V for gatedrive circuitry.
- 28Vdc for the internal fans and the Control board.
- 24Vdc 500mA user power supply (via the Control board).

Bus Live Indication

One red light emitting diode (LED) to indicate the DC Bus is live.

Circulating Fans

IP54 models only have two internal fans for circulating air within the Elite.

Thermal Sense (400V models)

An NTC thermal sensor circuit is connected to the heatsink via a small tab. This circuit monitors the heatsink and will cause the Elite to trip on a thermal fault if the heatsink temperature exceeds 80°C (176°F).

Thermal Sense (500V models)

A separate Thermal Sense Board and 2 off 90°C (194°F) microtherms are included in these models.

Capacitor Board

This board has the DC Bus capacitors on it.

Power Board

The Power Board has snubber capacitors and IGBT blocks power connections.

Rectifier Board

The Rectifier Board has a switch mode power supply, soft charge circuit, snubber circuit, RFI filtering, voltage transient protection (500V only) and SCR gatedrive.

There is no external control to this board, the soft charge is initiated on power being applied to the board (i.e. when the Elite is powered up).

SCR switch mode power supply provides various isolated DC supplies required by the Elite. These are:

- +15V, 0V, for SCR Gatedrive circuitry and DC Bus discharge control.
- +5V, 0V for switch mode regulation.

2.3 FAULT FINDING GUIDE

2.3.1 SUPPLY ISSUES

Power supply problems can be misinterpreted as faults in the Elite, some are listed below:

Fault 01 LOW Vdc

The supply to the Elite is dropping below the switch mode power supply operating level and the Elite is shutting down. This is usually caused by a weak supply or faults in the supply system. Look for motors starting direct on line or other machines drawing high current. For further details see the fault list in section 8 of this manual.

Fault 02 HIGH Vdc

The supply to the Elite is surging too high. Rapid load changes in the supply system may be faster than automatic tap changing transformers can adjust to. For further details see the fault list in section 8 of this manual.

Fault 04 SUPPLY FLT

Supply fault (Fault 04) is an indication that the ripple on the DC Bus has exceeded 40Vac. The Elite will trip if this condition is reached and will display Fault 04 ***SUPPLY FLT***. This can be caused by diode(s) in the rectifier going open circuit, see section 2.4, but is more likely to be caused by;

- The loss of an input phase which increases the ripple on the DC Bus. The Elite will run on two phases up to about half to two thirds of its current rating, at which point the DC Bus filter will not be capable of maintaining the ripple below 40Vac and the Elite will trip. The Display unit will stay live. The Elite can be reset and will run to about the same current before tripping again.
- Excessive mains distortion (harmonics) can also cause excessive ripple on the DC Bus. The cause of excessive supply distortion in an industrial situation may be; SCR controlled heating equipment, DC drives, current source inverters, and other high current non linear loads. This can also occur where backup generators are used and they have not been sized correctly relative to the total variable speed drive load (VSD). The total loading of VSDs on a backup generator should be about 60% and the remaining 40% made up of linear loads.

2.3.2 FUSE FAILURE

Fuse failure is not a normal event, and it usually indicates a more serious fault. Therefore, the reason for fuse failure should be investigated.

Supply Fuses

Location: At point of supply to the Elite.

Possible reason for failure: Supply surge, age or cyclic stress failure, wrong fuses, fault in supply cable to the Elite, rectifier, or inverter fault, motor or motor cable fault.

Action:

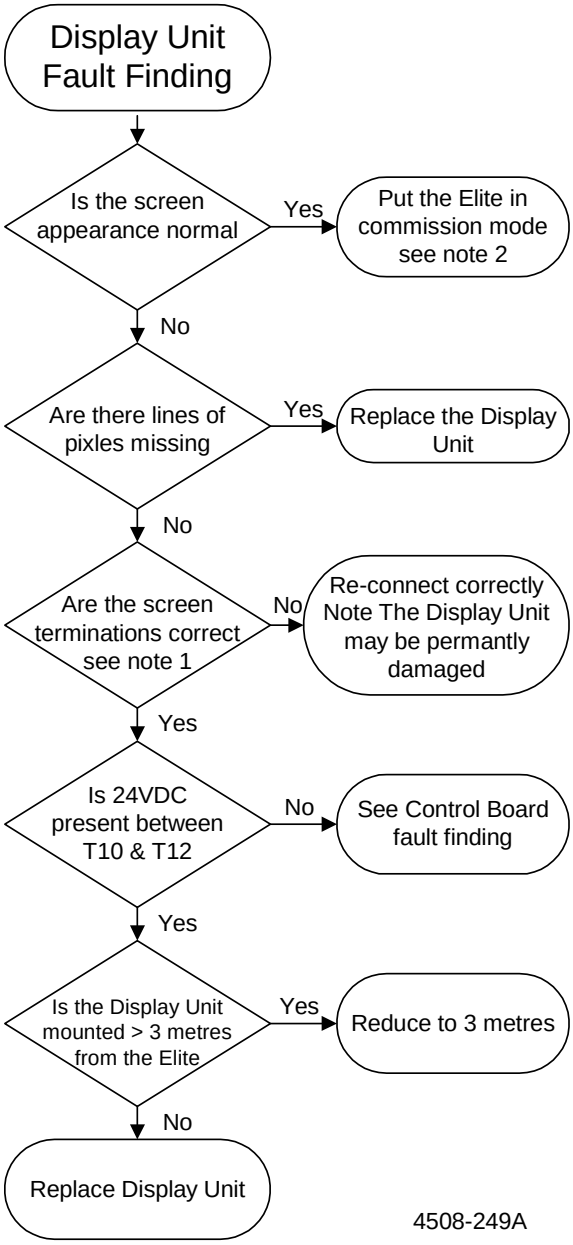
1) See section 2.1 before starting.
2) Perform a visual inspection for mechanical damage, water entry, or any other possible damage to the system.
3) For new or modified installations check the wiring is correct as per the Technical Manual 4201-180.
4) Check fuses for correct rating.
5) Disconnect supply cables and test for phase to phase or phase to earth fault.
6) Mark and disconnect the output cables, test the cables and motor for phase to phase and phase to earth fault.
7) Test the Elite for rectifier, inverter or DC Bus faults as per section 2.4.
8) If no faults are found, the best option is to softpower the Elite as per section 2.5. If the fuses failed because of an external issue such as short term overload or cyclic stress, reconnect the Elite, replace the fuses and attempt to run the Elite.

Control Board Fuse

Location: on the Control board.

This fuse is in series with the user 24Vdc 500mA power supply accessed via T36 and T37. The user power supply is short circuit protected and will close down if a short is present in the field control wiring or other device connected to T36 and T37.

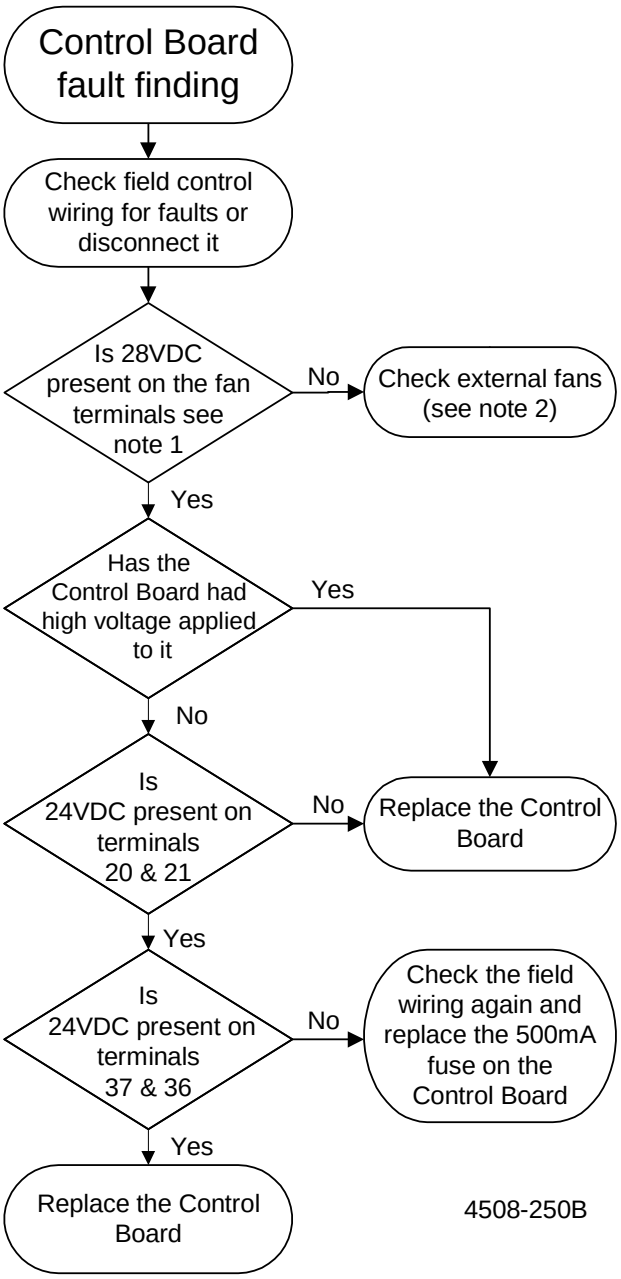
2.3.3 DISPLAY UNIT



Note 1
Terminal 10 - red
Terminal 11 - white
Terminal 12 - black + screen
Note 2
See Elite Series technical manual 4201-180 screen Z to Z1

Figure 2.1: Display Fault Finding

2.3.4 CONTROL BOARD



Note 1
The fan terminals are located between the fibre optic connections at the bottom of the Control Board.
Note 2
Disconnect fan and recheck 28 volt supply. If 28Vdc is not present the switch mode power supply on the Gatedrive Board is not functioning. If the supply returns when the fans are disconnected the fans may be at fault.

Figure 2.2: Control Board Fault Finding

2.3.5 INPUT RECTIFIER

The Rectifier is a half controlled bridge that combines DC conversion and the softcharge section of the Elite into one stage. The SCR(s) on Line 1 are phase controlled to limit the inrush current to the DC bus capacitors when the Elite is powered up. This is termed "Soft Charge". The phase control is continued until the capacitors are fully charged then all SCRs are turned on.

Rectifier/softcharge failure can be indicated by input fuses blowing on power application or display of SUPPLY FAULT, especially on application of load.

Soft Charge failure

Failure of soft charge function: Some or all of the SCR's may not respond to a gate signal or the rectifier board may not be producing a gatedrive signal. This indicates a failure in the Rectifier board or SCR/Diode block.

Diode or SCR Failure: If part of the rectifier stage has failed open circuit the Elite may not soft charge and no voltage will appear on the DC bus. **Note:** it is uncommon for semiconductors to fail open circuit.

Some causes of rectifier failure

Bus Capacitor Failure: Excess current drawn by a shorted capacitors may damage the rectifier. See section 2.3.7.

Internal fault in Elite: Failure to a short circuit will cause the two input phase fuses to blow.

Fault in supply cable, motor cable or motor.

Input supply imbalance: If Line 1 (L1) is low with respect to yellow and blue, the Elite will soft charge the capacitors to 1.414 x the L1 RMS voltage level. When the soft charge is finished, the SCRs on L2 and L3 will be turned on fully applying a higher DC level to the DC bus than is currently there. This can generate sufficient inrush current to damage the input rectifier.

Supply voltage excess: The Elite has VDR's to protect against voltage transients. These will not cope with a supply that is constantly above the maximum level the Elite was designed for. The VDRs will fail and the Elite may be damaged.

2.3.6 INVERTER

The inverter consists of insulated gate bipolar transistors (IGBTs). Each IGBT block has two transistors, one for the upper and one for the lower half phase.

Symptoms of Inverter failure

- Input fuses blowing on power application.
- DESAT fault 08 to 13 constantly on the same phase and polarity.
- Current limit fault 07 this is a hardware trip to indicate that 220% of rated current has been reached.

For all of the above faults, test the IGBTs as per section 2.4.1. Check the motor and motor cables. If no faults are found, attempt to reset the Elite. If the fault is repetitive on the same phase and polarity, check the IGBTs again. If the fault is a DESAT fault and not always on the same phase, the problem is most likely in the Gatedrive board, output cables or motor.

IGBT Replacement

Batch matching of IGBTs is not required for Frame 3 but it is required with Frames 5 to 7.

2.3.7 DC BUS FILTER

The DC Bus filter is comprised of electrolytic capacitors and chokes. The chokes are mounted in the DC Bus and are in series with the rectifier output. The filter's function is to reduce the harmonic current drawn by the Elite and the ripple on the DC Bus, excess ripple >40Vac will be detected and displayed as a supply fault.

To achieve the required voltage rating, two capacitors are connected in series. The capacitors are rated at 400V and 450V for the 400V and 500V models respectively. The capacitors are connected in parallel.

Possible Causes of Failure

The definition of capacitor failure is for the capacitance of the capacitor to fall outside manufacturers tolerance or suffer a catastrophic failure which is an open or short circuit. While this section is quite detailed the capacitors seldom cause any problems.

400V capacitors rating 680 MFD +/- 20% at 20°C and 120Hz.

500V capacitors rating 560 MFD +/- 20% at 20°C and 120Hz.

Factors Affecting The Life of The DC Bus Capacitors

- **Stress related issues:** these are vibration, excessive ripple, excessive voltage and/or temperature.
  Over heating is the most likely cause of premature failure and can be brought about by reduction in cooling air flow to the drive. Check the heatsink for blockage and the fan operation. Check for excessive ambient temperature or excess ripple due to some of the capacitors going open circuit.
- **Shelf life:** the recommended storage period without use should not exceed 3 years.

If there is concern regarding the time an Elite has been stored, a DC supply can be connected to the DC Bus terminals. Starting at about 50Vdc and over 8 hours the voltage is gradually increased to about 560-600Vdc for 400V models and 660-700Vdc for 500V models. Failure to do this can cause failure of the DC Bus capacitors on initial application of full voltage.

Symptoms of DC Bus Capacitor Failure

Open Circuited Capacitor

If a single DC Bus capacitor goes open circuit, the symptoms may not be noticeable. However, the remaining capacitors will have an increased ripple current and will run hotter. If more capacitors consequently go open circuit, the DC bus ripple will increase. Which may cause a SUPPLY FLT trip, especially when the Elite is running at or near full output current.

Short Circuited DC Bus Capacitor

A shorted capacitor should cause two input fuses to fail during or soon after the soft charge interval. Because they are connected in series to share the DC bus voltage, if one capacitor has shorted it will expose all the capacitors opposite it to above rated voltage. This is shown in figure 2.3, in the right hand drawing the top set of capacitors have been exposed to full DC bus voltage which will be approximately twice their rating. In this event, it is recommended to replace, at a minimum, all the opposing capacitors as well as the faulty one.

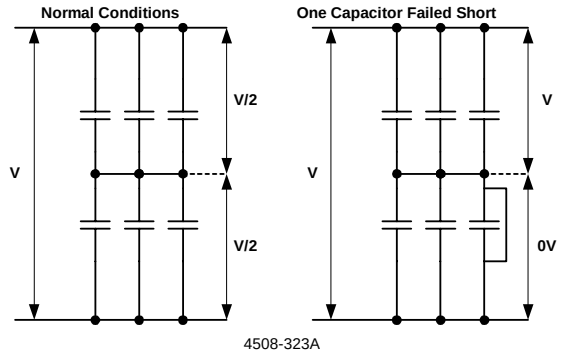


Figure 2.3: DC Bus capacitor short circuit

2.4 TESTING

2.4.1 TESTING THE RECTIFIER AND INVERTER

Refer figure 2.4 and using a multimeter, check the rectifier as the drawing indicates.

Note: each test is carried out 3 times (i.e. once per phase) which is a total of twelve tests.

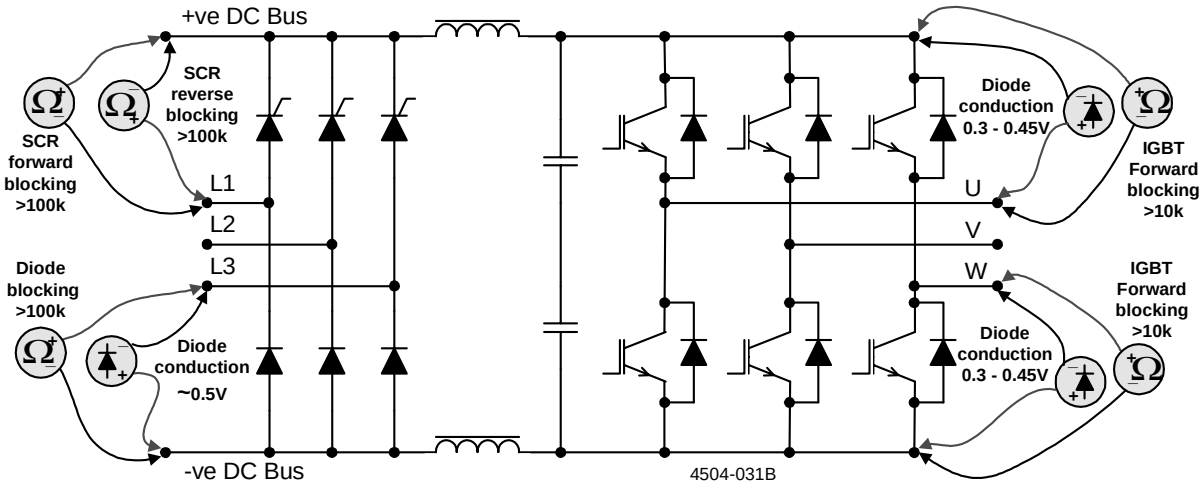


Figure 2.4: Rectifier and Inverter Testing Frame 4

2.4.2 TESTING AN INDIVIDUAL SCR

When the Elite is disassembled, the SCR's can be tested individually as shown in figure 2.5.

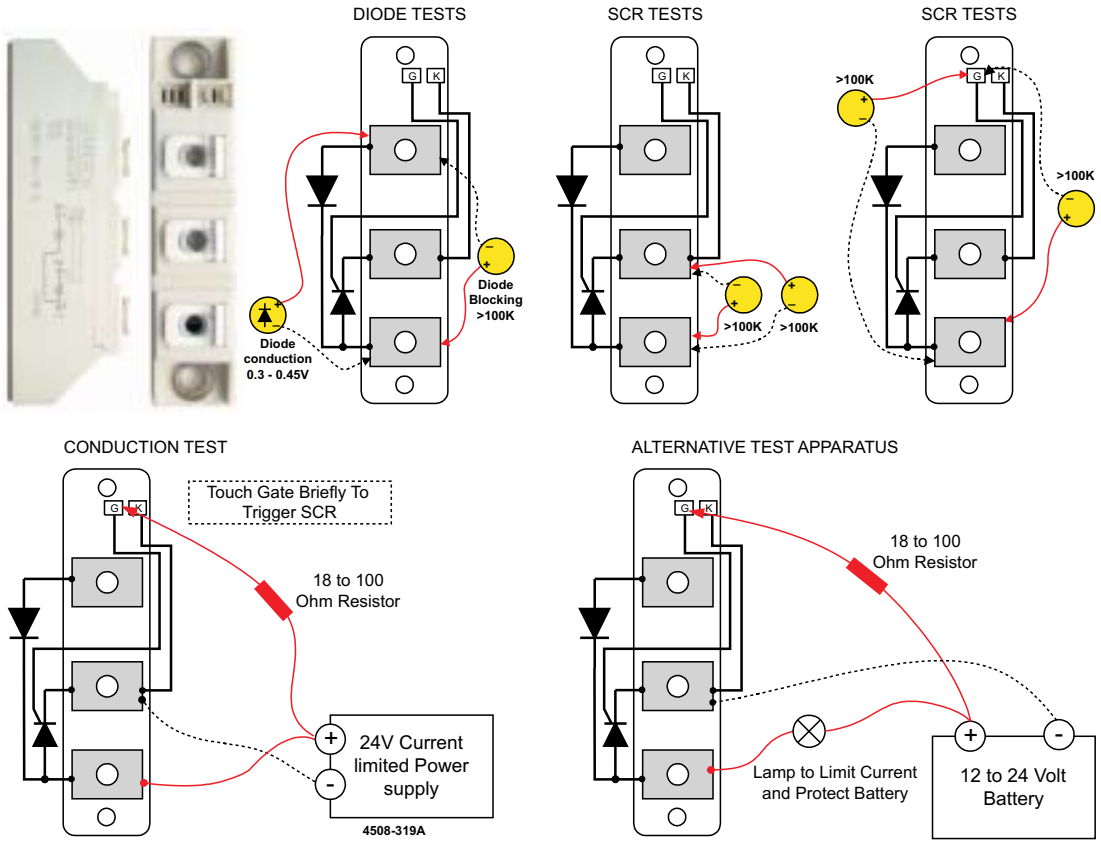


Figure 2.5: Individual SCR Conduction Test

2.4.3 TESTING AN INDIVIDUAL IGBT

You **MUST** wear a static grounding wrist strap which must be earthed. The preliminary tests are done with a multi meter. The meter readings in figure 2.6 are a guide and may vary with differing meter brands. It is best to compare the suspect IGBT with a known good IGBT. Note the gate and emitter shorted together for one test as shown in figure 2.6. The IGBTs should be stored and handled in this state.

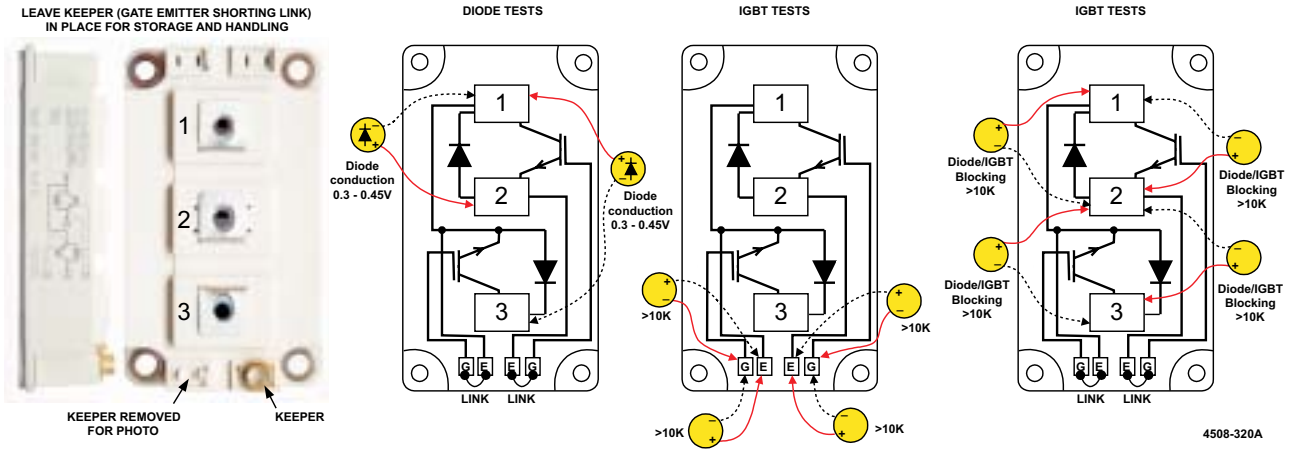


Figure 2.6: Individual IGBT Testing

The final tests are done as shown in figure 2.7. This test is very important as it is possible that the multi meter tests show the IGBTs are OK, but the IGBT may not actually work (i.e. the IGBT does not respond to a Gatedrive signal). **Important note:** the 1K ohm resistor must be between the gate and emitter at all times during the tests.

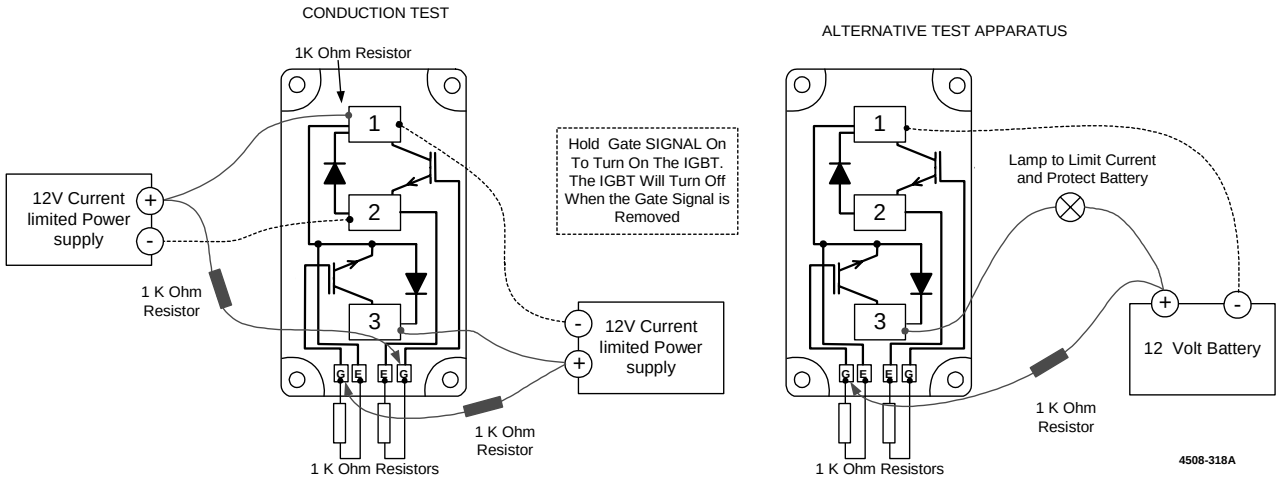


Figure 2.7: Final IGBT Testing

2.4.4 TESTING THE DCCT AND DCCT SUPPLY

The DCCTs measure motor current, and are located on the output of the Elite. DCCT failure may be indicated by **Fault 21** *Ground fault* or **Fault 58** *Current imbalance*, even with the motor disconnected. If **Fault 21** is apparent, and the motor and motor cable have been checked and are OK. Check the DCCT terminations as shown in figure 2.6 and the inverter as shown in figure 2.4. The 6 pin connector is located at the very top of the Control board.

How to test the DCCTs

1) Power up the Elite but do not start. Test between ground - T1, ground - T4 and ground - T6 to confirm the DCCT has a ±14V supply. If the ±14 supply is not present, the Control or Gatedrive boards switch mode power supply may be faulty. See section 2.3.4 to determine which board is faulty.
2) Test the DCCTs by measuring between ground - T3, ground - T5 and ground - T6. This should be 0V. If the three readings are not at 0V, check the drive is not supplying current to the motor. If no current is evident, replace the terminal board.

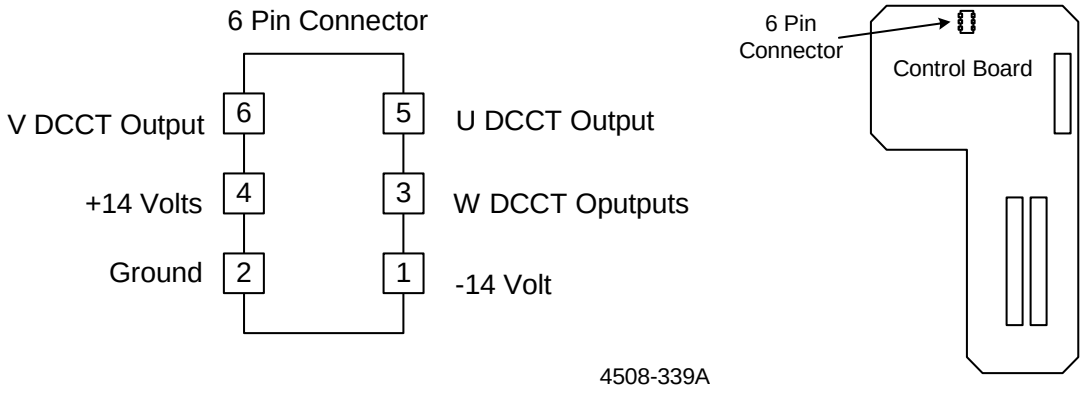


Figure 2.8: DCCT Testing

2.4.5 DC BUS CAPACITOR TESTS

Test the rectifier and inverter by following the procedure in section 2.4.1. Test the capacitors by using a meter set to OHMS between HVDC terminals + and -. The resistance should start low, then increase as the capacitors charge to the meter battery voltage (ensure the DC bus capacitors are fully discharged first). This charging period could take some time and it is best carried out by testing the suspect machine against a known good Elite of the same amperage rating or check the spare parts list and pick an Elite of the same frame size with the same number of DC Bus capacitors. Time the rate of charge (i.e. the increase in ohms on the meter) and compare this against the faulty Elite. If this test indicates reasonable variation, there may be a problem with the capacitors. Further testing requires the Elite to be disassembled.

To test for individual open or short circuited capacitors, the Elite must be dismantled and each capacitor individually checked with a multimeter. Ensure all capacitors are fully discharged. Connect the meter on OHMS range across each capacitor in turn, with the meter positive to the capacitor positive. On a good capacitor, the resistance should start low, then increase as the capacitor charges to the meter battery voltage.

Disassemble the Elite for a visual inspection of the capacitors. These capacitors are a sealed canister without a vent and have a purposely weakened area to allow the case to split if the capacitor should fail and pressure build up internally. This weakened area may show signs of bulging or be split if the capacitor has overheated or suffered an internal fault.

2.5 SOFT POWERING AFTER REPAIR

Once all the faulty components and assemblies have been replaced, and the Elite has been carefully reassembled it is recommended that the machine be tested as per section 2.4.1 then Soft Power.

Soft Powering

Refer to figure 2.9. Connect a 24Vdc current limited power supply to T36 (positive) and T37 (0 volt). Energise the supply and the Display unit should activate. Set the Elite to local control as per the technical manual PDL part no. 4201-180. Disconnect the supply.

Connect a PDL softpower supply to the DC bus as shown in figure 2.9. The softpower supply is available from PDL Electronics or the circuit diagram to build one is available in section 8 of this manual. This power supply is a 600Vdc power source, which can be used to power up the DC Bus. The procedure enables any remaining DC Bus or inverter fault to be found without causing damage.

Connect the soft power supply to the mains. The isolating transformer is not required for galvanic isolation between supplies as only one supply is used compared to Frames 4 to 7. It is recommended as a safety measure. The lamps in series reduce the current that will flow if the Elite is faulty. Set the variac to the lowest setting, switch on the variac and increase the voltage setting to 230Vac over about 5 seconds. Any longer risks burning out the soft charge resistor in the soft power unit.

The Display should activate when the supply reaches 280Vdc and the red DC Bus live LED should energise on the Gatedrive board (visible at the bottom of the Control board). Set the Elite to local start/stop and speed reference control, see technical manual part number 4201-180 for further details. The Elite should respond to the Display unit Start/Stop commands and speed reference changes.

Start the Elite from the Display unit and increase the output frequency or speed to 100% . Use a multimeter set to AC VOLTS, to measure the output voltage, between terminals U-V, V-W, and W-U. These voltages should all be balanced at approximately 400Vac. If there is any sign of imbalance, measure between each output and earth to isolate which phase is faulty. It is likely that there is an unrepaired fault on that particular phase or loose terminations.

If the test shows no faults and a good output voltage balance, the test power supplies can be disconnected. The mains and the motor can be reconnected, and a full test done.

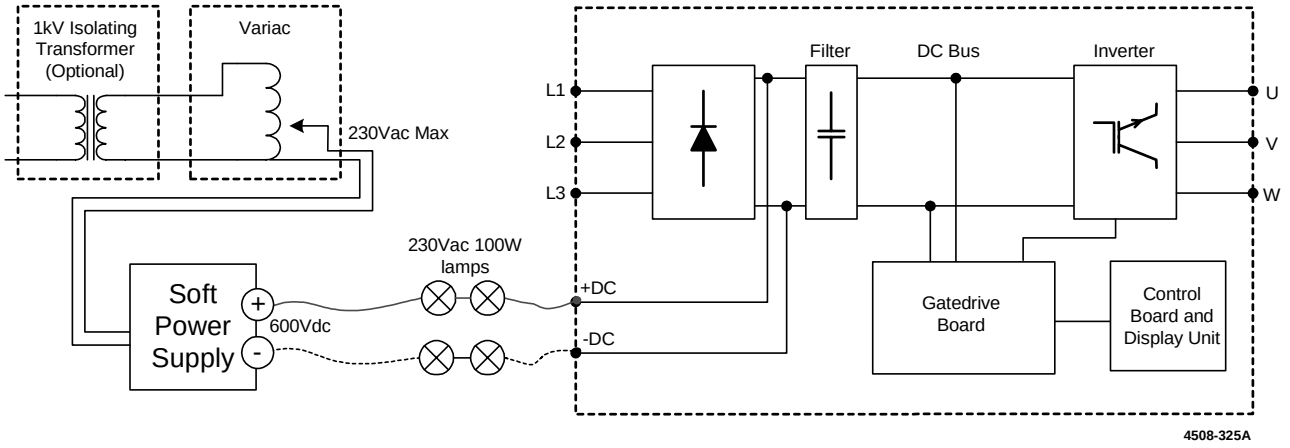


Figure 2.9: Soft Power Supply Connections

2.6 PARTS LIST AND BLOCK DIAGRAM

2.6.1 FRAME 3 400V MICRODRIVE ELITE PARTS LIST

400 VOLT MICRODRIVE ELITE PARTS LIST			
Frame Size	FRAME 3		
Model	ME-31	ME-38	ME-46
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)		
			4508-270A

Figure 2.10: Frame 3 400V Microdrive Elite Parts list

2.6.2 FRAME 3 500V MICRODRIVE ELITE PARTS LIST

500 VOLT MICRODRIVE ELITE 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	E047-612S		
Drive Select	E030-623	E035-623	E041-623
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)		
			4508-272A

Figure 2.11: Frame 3 500V Microdrive Elite Parts list

2.6.3 FRAME 3 400V AND 500V MICRODRIVE ELITE BLOCK DIAGRAM

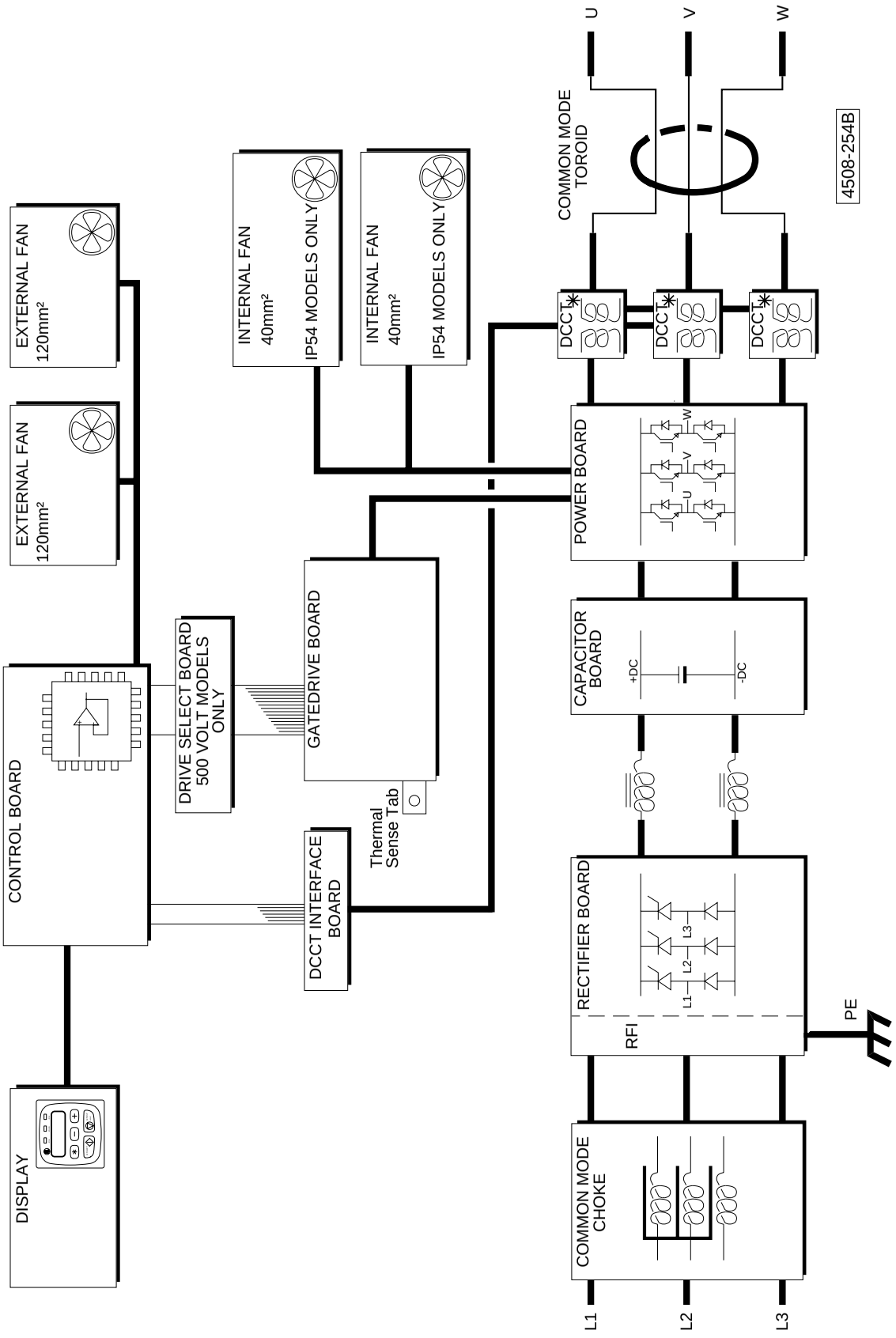


Figure 2.12: Frame 3 400V and 500V Microdrive Elite Block Diagram

2.7 SERVICE

2.7.1 REMOVING THE CONTROL BOARD

Refer to figure 2.13.

See section 2.1 before commencing service work.

1) Mark the location of the control wiring plugs and remove them (use a felt pen and number each plug). Remove the fibre optic cables if used.

2) Remove the Display unit.

3) Remove the Phillips head screw in the Display unit mounting plate and ease the mounting plate off the locating tabs on the control terminal plate.

4) To remove the Terminal plate remove:

   a) 4 off Phillips 8Gx1/2 head screws.

   b) 1 off M3x10mm Phillips head screws which is the Control board earth.

   c) 1 off M5X16mm which is the Gland Plate earth connection.

   d) 1 off M3X6mm which is the 0V control earth, if it has not been removed on installation.

5) Remove the earth connection.

6) Remove the external fan wires from the bottom of the Control board.

7) Remove the 2 off 8Gx1/2 Phillips head screws securing the Control board. Remove the 40 pin connector (top right) that is holding it in place.

8) Using the tool provided with the Control board gently lift the Control board evenly off the 40 way socket connecting pins.

9) Unplug the DC current transformer (DCCT) Interface board from under the 6 way socket on the top left of the Control board.

10) Place the Control board in a static proof bag or on antistatic foam.

<u>Replacing the Control Board</u>

1) Continue to observe static safe work procedures.

2) Avoid excessive handling of the new Control board.

3) The replacement Control board will be in biscuit format and will have to be trimmed to size. This is done with a fine pair of side cutters, cutting as close to the Control board as possible. If the stubs of the joining bridges are too large they will need to be filed down or inserting the Control board will be more difficult. See figure 2.14.

4) Plug the DCCT interface into the Control board and place the Control board on the 40 pin connector. The lexan mounting sheet for the internal cooling fans is fixed through some slots in the Control board. The lexan may have to be moved to allow the Control board to fix correctly on the pins.

5) Gently push the 40 pin connector onto the pins once step 4 is completed and check through the slots to ensure no pins are showing.

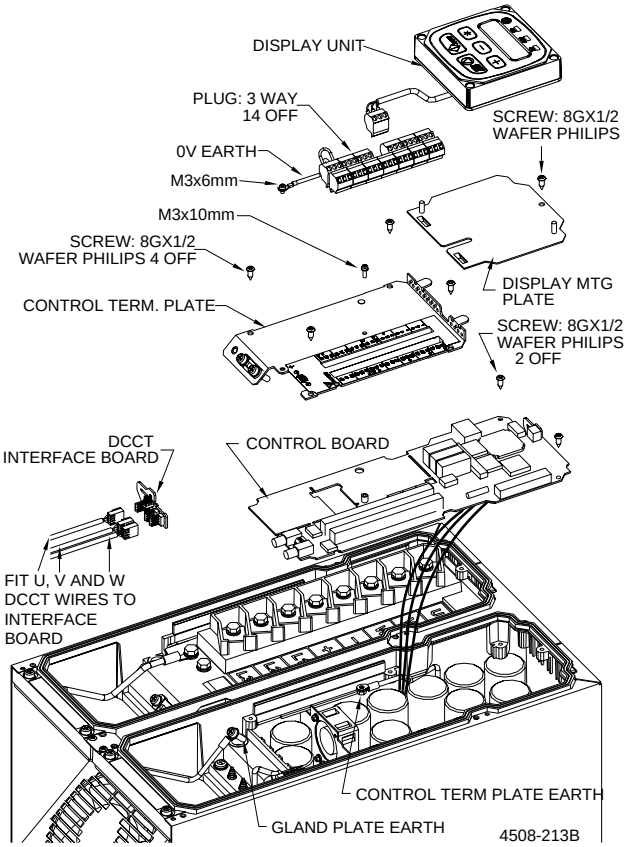


Figure 2.13 : Frame 3 Control Board Removal

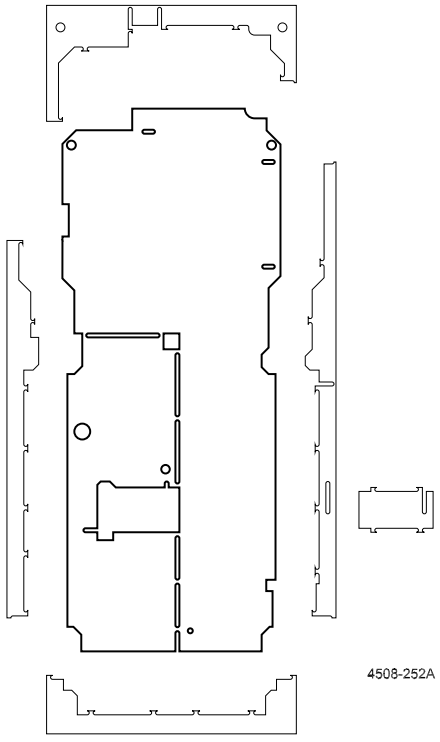


Figure 2.12: Frame 3 Control Board Biscuit

2.7.2 REMOVING THE SHROUD

Further service of the Elite requires better access. This will require the removal of the shrouds and top skirts.

Refer figure 2.13.(*Shroud removal*)

To remove the shrouds remove:

1) 6 off 8Gx1/2 wafer screws.

2) 3 off 12x3/4 pan square screws.

3) 2 off M4x10 phillips screws.

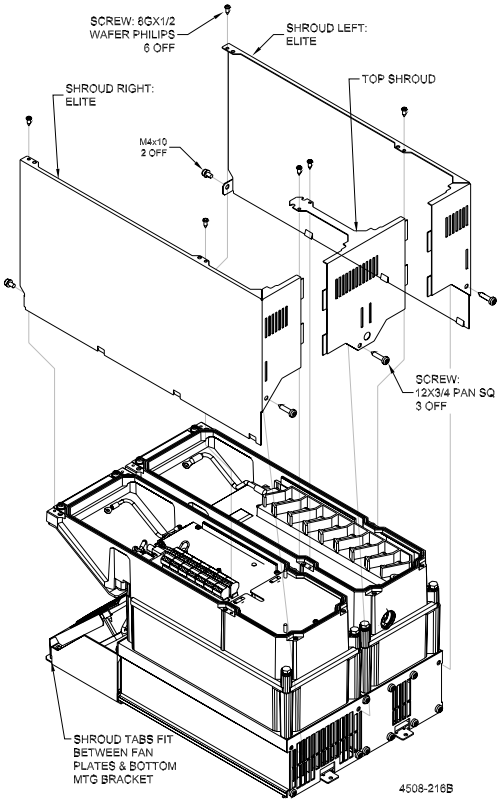


Figure 2.13: Shroud Removal

2.7.3 REMOVING THE SKIRT

Refer figure 2.16.

To remove the top half of the skirts remove:

1) 2 off 8Gx1/2 Screws holding the body link to the lower end of the skirts.

2) 4 off rubber grommets.

3) 8 off M6x110 bolts.

4) 2 off M6x16 Phillips head screws.

The top half of the skirts can now be lifted clear.

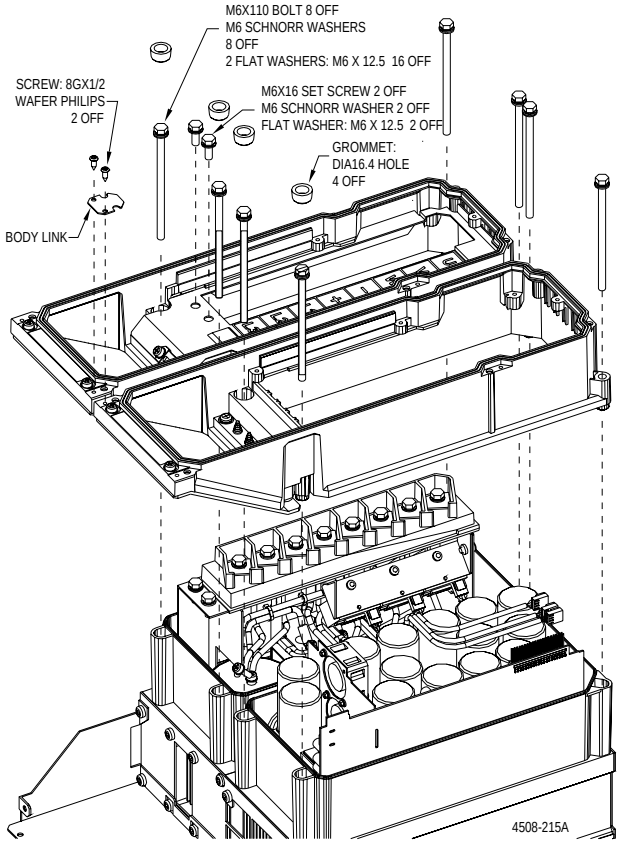


Figure 2.16: Skirt Removal

2.7.4 REMOVING THE INTERNAL FAN

Refer figure 2.17.

The fan mounting lexan sheet is clipped in place between the gatedrive board and the Capacitor board. The fans are powered from the DC bus Board.

1) The upper fan barrier is a small lexan sheet that must be bowed sufficiently to remove the locating tab from the gatedrive or the Capacitor board.

2) Unplugging the fans from the DC bus Board requires removing the Capacitor board.

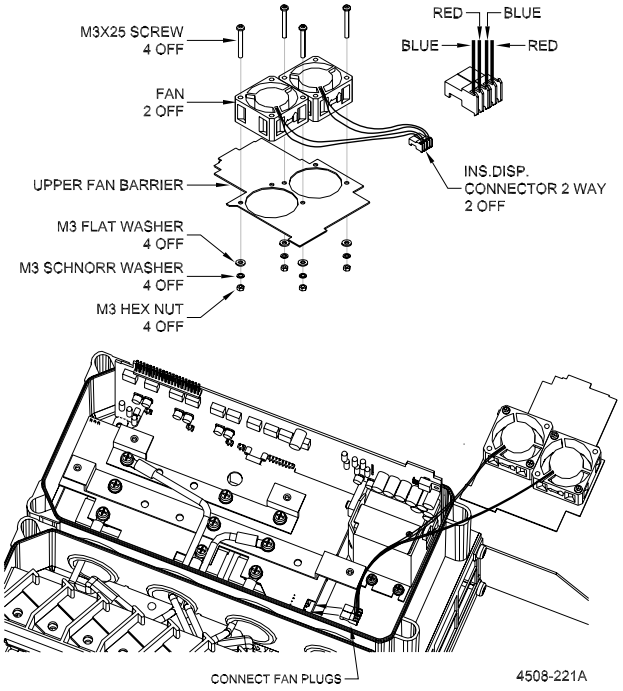


Figure 2.17: Internal Fan Removal

2.7.5 SERVICING THE CAPACITOR BOARD

Refer figure 2.16.(*Capacitor Board removal*)

The Capacitor board is directly connected to the DC Bus with 4 off M4x10 Phillips screws. Remove these and lift the Capacitor board from the enclosure.

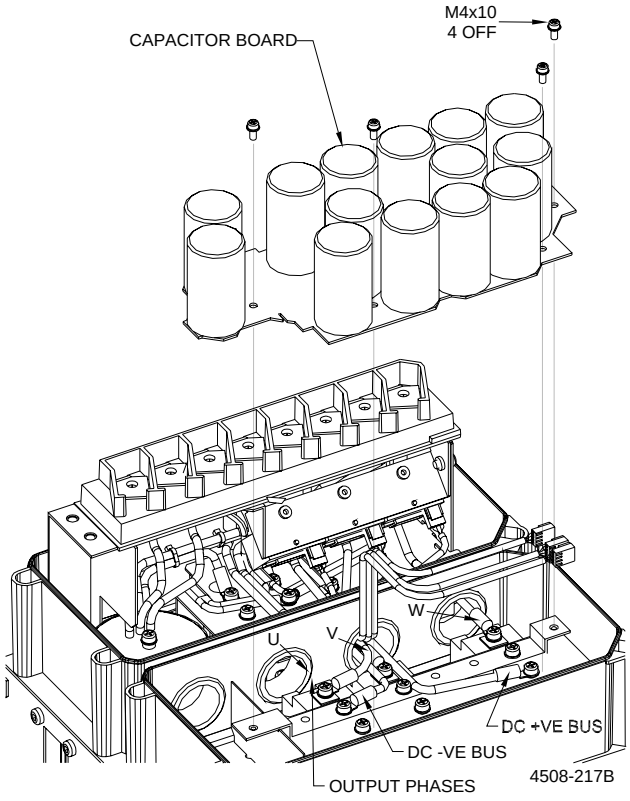


Figure 2.16: Capacitor Board Removal

2.7.6 REMOVING THE GATEDRIVE

Refer figure 2.17.(*Gatedrive removal*)

Remove Phillips screws A and B and lift the board off the gatedrive connections to the IGBT's **evenly**.

400V models note: the heatsink temperature is monitored by a NTC resistor via the tab held down by screw B.

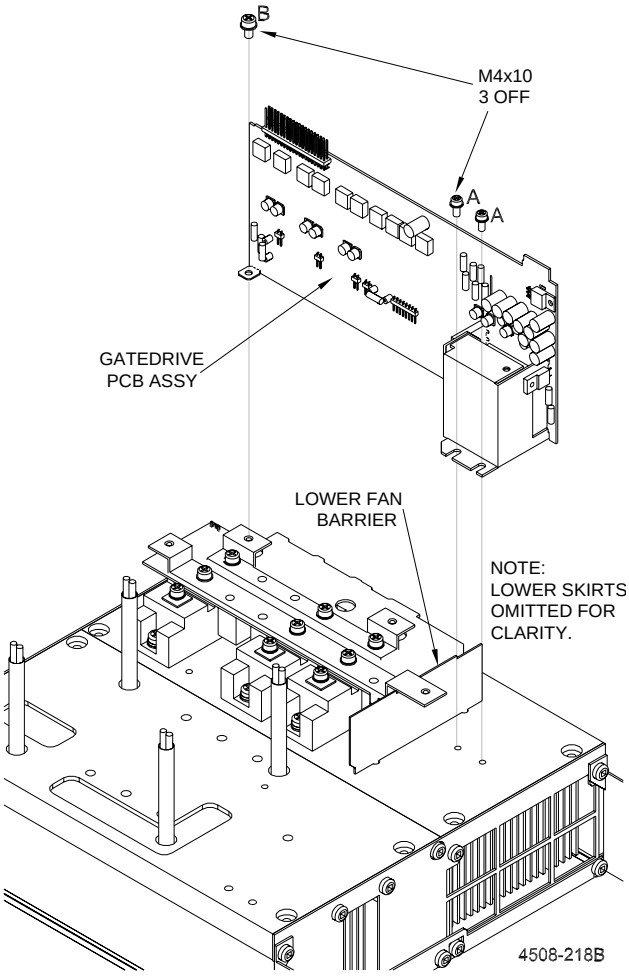


Figure 2.17: Gatedrive Removal

2.7.7 500V MICROTHERMS AND THERMAL SENSE BOARD

Refer figure 2.20 and 2.21.

The 500V models have two Thermal sense boards and a microtherm for heatsink temperature monitoring. The Loom to the Thermal sense board plugs in to the Gatedrive board. **Note:** the Drive Select board is shown as well, this is unique to the 500V models.

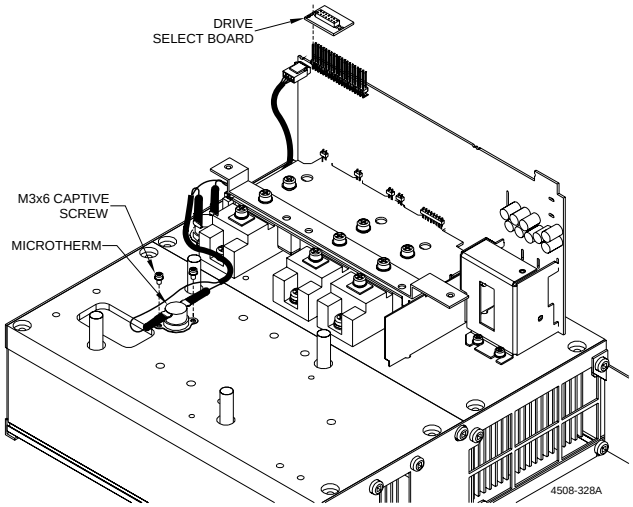


Figure 2.20: 500V Microtherm And Thermal Sense Board Locations

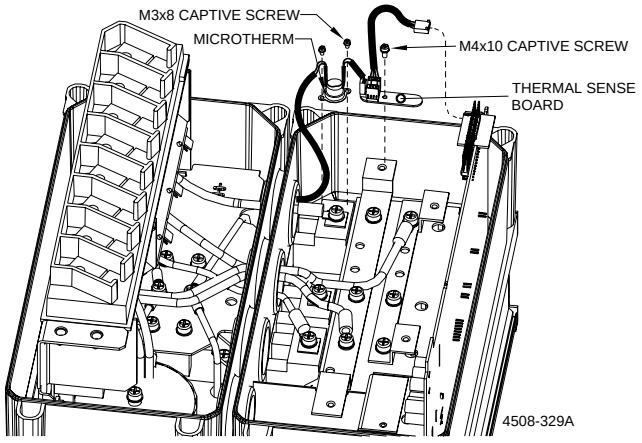


Figure 2.21: 500V Microtherm And Thermal Sense Board Removal

2.7.8 POWER BOARD SERVICE

Refer figure 2.22.

The Power board assembly is supplied complete with the DC bus components, Power board and IGBTs.

To remove it remove:

1) 3 off M5x12 Phillips screws and the positive DC bus bar.

2) 6 off M6x16 Phillips screws and washers.

The lexan shield under the lower end of the -ve DC bus can be left in place. It is important to replace it, if it is removed as it ensures the correct internal air flow.

Replacing the Power board.

1) Clean the Heatsink.

2) Place the new thermstrates on the heatsink. Avoid touching the surface of the thermstrate and remove the paper packing strips.

3) Remove the shorting pins from the Power board assembly prior to replacing the gatedrive.

4) When replacing the Power board ensure the terminals are located correctly.

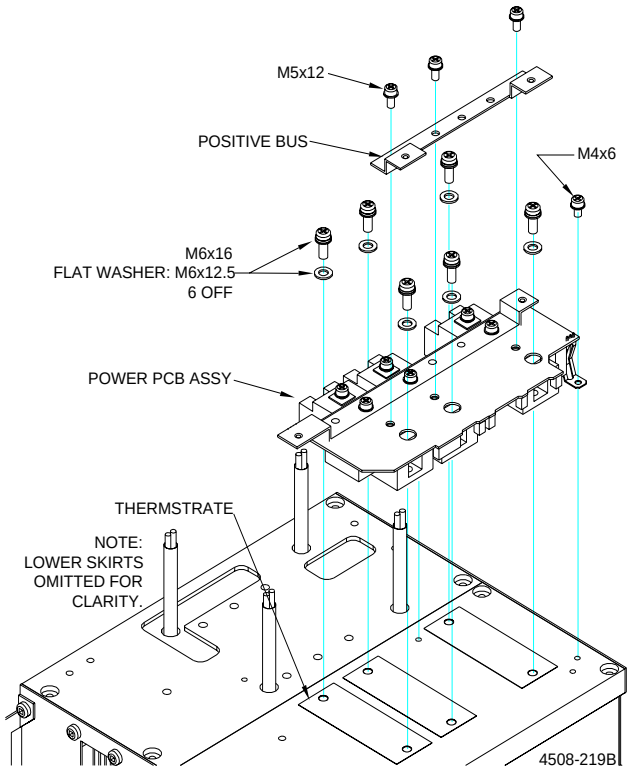


Figure 2.22: Power Board Assembly

2.7.9 REPLACING THE IGBTS

Refer figure 2.21.(*IGBT removal*)

There are 3 blocks and each contain 2 IGBT's. **Note:** the IGBT Gatedrive inputs are extremely sensitive to static damage.

The Power board/DC Bus consists of three parts:

1) The -ve DC bus link.

2) The +ve DC bus link

3) The Power Board .

To replace the IGBT's, the above assembly must be removed by removing:

1) 9 off M5x12 screws, visible in figure 2.21 in the right cabinet.

2) Lift the +ve and -ve DC bus clear.

3) The Power board is held to the IGBT's by the gatedrive connections, which are two plugs per IGBT. Lift the Power board off the IGBT's.

The IGBT's can now be removed one at a time as required.

Replacing the Power board

Ensure the Power board terminals are plugged in to the gate drive connections when locating the board on the IGBTs.

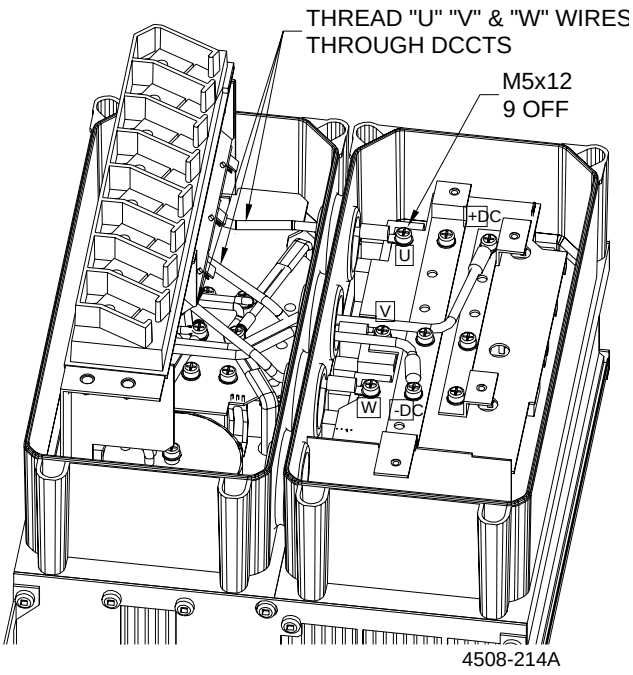


Figure 2.21: IGBT Removal

2.7.10 SERVICING THE RECTIFIER

Power Termination Removal

Refer figure 2.22.(*Power Termination removal*)

1) Remove the left side cover.
2) Figure 2.22 indicates the position of all wiring. If you do not consider this adequate, label all wiring.
3) Remove the top half of the left side skirt, see section 2.7.2.
4) Ensure the internal wiring from the terminal connections are labelled adequately for correct reassembly later.
5) Remove all internal wiring from the terminal board.
6) The DCCT's are mounted under the terminal assembly and are connected to the Control board by three 4 pin plugs. Ensure the plugs at the DCCT's are labelled then unplug them.
7) The terminal/DCCT assembly is attached to the upper terminal mounting bracket by 1 off M5x10 screw and it is a push fit on to the lower mounting bracket.
8) The terminal assembly is held by the output wires labelled U, V & W. These come from the IGBT's through their respective DCCT's, then a torroid which all three wires pass through. The wiring must be pulled through these when the terminal assembly is lifted clear.

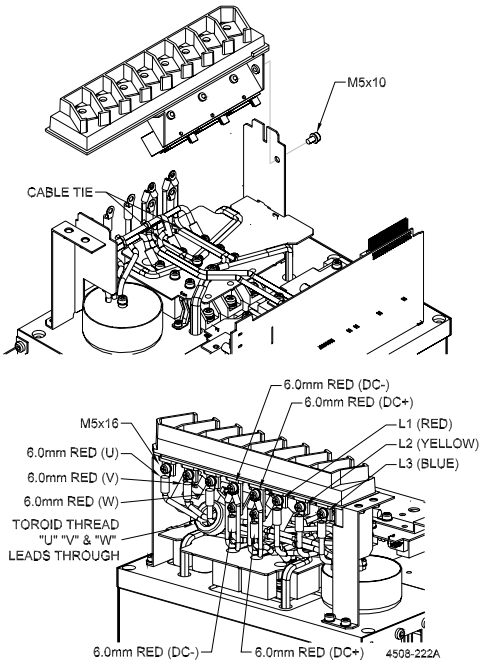


Figure 2.22: Power Termination Removal

Common Mode Input Choke Wiring

Refer figure 2.25.

Remove 3 off M6x12 screws (A) to remove the assembly.

When the wiring has been removed, replace the screws. This is to support the SCR's when the assembly is removed.

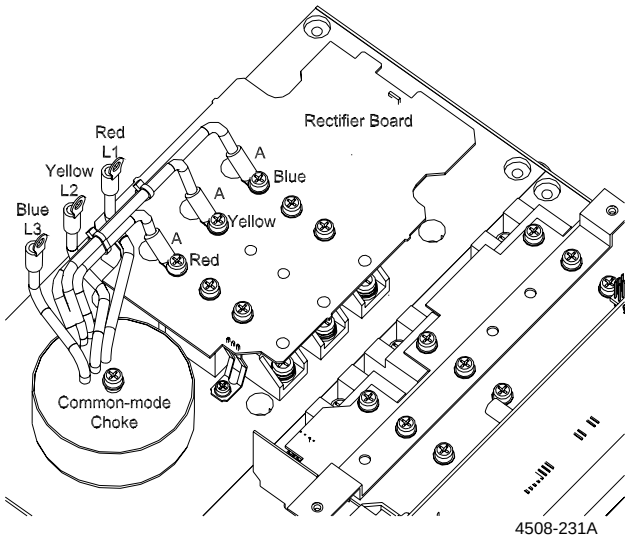


Figure 2.23: Common Mode Choke

DC Choke Wiring

Refer figure 2.26.

Remove the DC bus and Choke wiring by removing the 2 off M6x12 screws (B).

When the wiring has been removed, replace the screws.

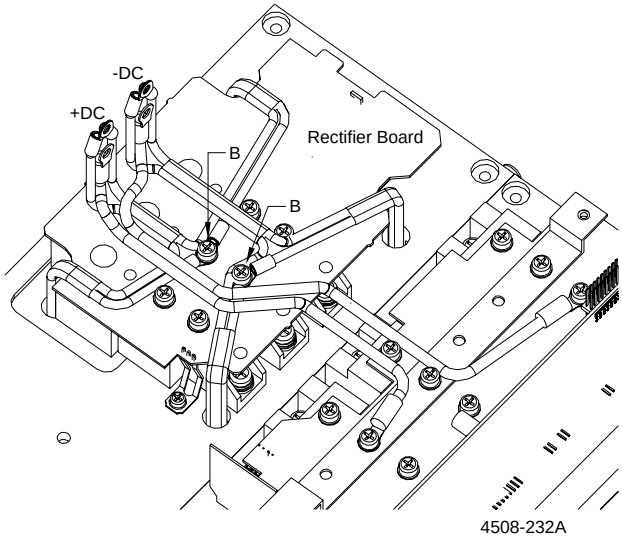


Figure 2.26: DC Bus/Choke Wiring

2.7.11 REMOVING THE RECTIFIER

Refer figure 2.27.

To remove the Rectifier assembly remove.

1) 1 off M4x6 screw which earths the rectifier board to the heatsink.

2) 6 off M6x16 screws.

3) Lift the board off the heatsink, the thermstrates are the only thing holding it down.

To replace rectifier blocks

1) Remove the remaining screws that hold the block to the PCB. Be careful to support the weight of the block, as it is only held by the Gatedrive connections.

2) Unplug the block from the Power board.

3) Plug in the new SCR and replace the screws.

4) Place the new thermstrates on the heatsink. Avoid touching the surface of the thermstrate and remove the paper packing strips.

5) Reassemble the Elite.

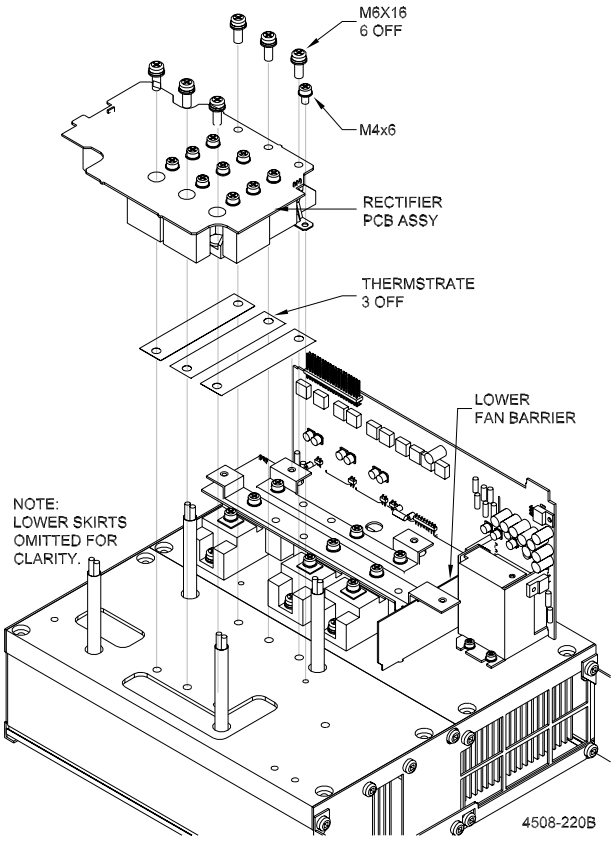
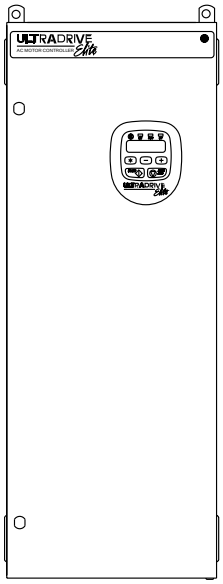


Figure 2.27: Rectifier Assembly

3.0 ULTRADRIVE ELITE FRAME 4

This section covers 400V models from UE-60 to UE-140 and 500V models UE-60D to UE-140D.

The 400V and 500V models are essentially identical for assembly purposes. When specific differences exist between the 400V and 500V models, these are noted.



4508-324A

CONTENTS

3.1 BEFORE STARTING TESTING OR SERVICE WORK

Site Preparation

Many locations where the Elite is mounted will not be ideal for servicing and it is recommended that:

The work area in front of the Elite be cleaned.

Some flat surfaces are arranged for placing of parts.

Containers provided for small items like screws and bolts.

Tool Requirements

1 x No. 2 Phillips screwdriver

1 x No. 3 Phillips screwdriver

1 x Flat blade 3.5 mm screwdriver for terminals

2 x 10 mm Ring spanner

2 x 12mm Ring spanner

2 x 13mm Ring spanner

1 x 3/8 inch ratchet driver

1 x 3/8 inch small extension

1 x 10mm socket

1 x 13mm socket

1 x Category 3 multimeter with ranges to 1000V AC and DC maximum

1 off PDL Soft Power Supply

1 off Isolating Transformer 1kVA

1 off 24Vdc volt power supply.
(a current limit supply is preferred but a simple plug pack or batteries can be used with a lamp in series to limit the current flow to about 2 amps)

Safety & Testing Before Starting Repairs.

1) Static safe procedures must be observed (i.e. a grounding strap must be worn and earthed). If the product is being serviced on a bench, an earthed antistatic mat should be used to work on in addition to the grounding strap.
2) Isolate and lockout the mains supply to the Elite and any low voltage supply that may be in parallel with the control power supply.
3) Allow approximately 5 minutes for the DC bus capacitors to discharge.
4) Open the cabinet door and check the red LED DC bus live indicator is not showing this is located on the lower righthand side of the Control board. This indicates the DC bus is discharged. **Note:** this is only an indicator.
5) Remove the lexan terminal cover.
6) Test between input terminals L1, L2, L3 and L1, L2, L3 to earth, to ensure the supply has been disconnected.
7) Finally, test between the +VE and -VE DC bus terminals to ensure the DC bus has fully discharged.

3.2 PRINTED CIRCUIT BOARD DESCRIPTIONS

Display Unit

The Display unit has three buttons and a 2 by 16 character liquid crystal display. It is the user interface for all parameter settings and is common to the Elite Series range. The Display unit plugs into the Control board user terminals. For a fault finding guide. See section 3.3.3.

Control Board

The Control board is common to the Elite Series range and accepts all external control inputs and generates output signals. These include digital, analogue and fibre optic signals. A Modbus RTU serial communications port is also included on the Control board. A Shaft Encoder interface and 5V power supply is standard. The Control board also has a bidirectional 24Vdc user power supply rated at 500mA.

Bus Assembly Board

Provides power to the Power tray, voltage transient protection on the RFI board for the Elite and snubbering for the SCRs. This board also has the connections to the IGBTs and SCRs.

Power Board

The Power tray is made up of a metal support tray, Control board mounting tray and Power board. The Power Tray receives power from the DC bus.

The main switchmode power supply provides various isolated DC supplies required by the Elite. These are:

- 6 off +16.5V, 0V, -13.5V for Gatedrive circuitry.
- 28V for the internal fans and Control board.
- 24V 500mA user power supply (accessed via the Control board)

SCR switchmode power supply provides various isolated DC supplies required by the Elite: These are

- +22V, 0V, for SCR Gatedrive circuitry and DC Bus discharge control.
- +15, 0V for switchmode regulation circuitry.

The gatedrive control for the SCRs and DC Bus discharge circuit .

The drive select module plugs into the Power board. **Note:** the locations are different for the 400V and 500V models.

6 off Gatedrive circuits to control the inverter IGBTs.

6 off Desat circuits to monitor the voltage across the IGBTs and turn off the IGBTs in a controlled manner if they become overloaded. On this condition, the Desat circuitry also sends a trip signal to the Control board. This signal will trip the Elite and the display will then indicate which half phase was overloaded.

LED (RED) DC Bus Indication.

Actual indication DC Bus Live.

Implication The Elite has power connected.

A replacement Power tray will come complete with the metal support tray and Control board mounting plate.

3.3 FAULT FINDING GUIDE

3.3.1 SUPPLY ISSUES

Power supply problems can be misinterpreted as faults in the Elite, some are listed below.

Fault 01 LOW Vdc

The supply to the Elite is dropping below the switchmode power supply operating level and it is shutting down. This is usually caused by a weak supply or faults in the supply system. Look for motors starting direct on line or other machines drawing high current. For further details see the fault list in the section 8 of this manual.

Fault 02 HIGH Vdc

The supply to the Elite is surging too high. Rapid load changes in the supply system may be faster than the automatic tap changing transformers can adjust to. For further details see the fault list in the section 8 of this manual.

Fault 04 SUPPLY FLT

Supply fault (Fault 04) is an indication that the ripple on the DC Bus has exceeded 40Vac. The Elite will trip if this condition is reached and display fault 04 SUPPLY FLT. This fault can be caused by diode(s) in the rectifier going open circuit, see section 3.4, but is more likely to be caused by either;

- The loss of an input phase which increases the ripple on the DC Bus.
  The Elite will run on two phases up to about half to two thirds of its current rating, at which point the DC Bus filter will not be capable of maintaining the ripple below 40Vac and the Elite will trip. The Display unit will stay live, the Elite can be reset and will run to about the same current before tripping again.
- Excessive mains distortion (harmonics) can also cause excessive ripple on the DC Bus. The cause of excessive supply distortion in an industrial situation may be SCR controlled heating equipment, DC drives, current source inverters, and other high current non linear loads. This can also occur where backup generators are used and they have not been sized correctly relative to the total variable speed drive load (VSD). The total loading of VSDs on a backup generator should be about 60% and the remaining 40% made up of linear loads.

3.3.2 FUSE FAILURE

Fuse failure is not a normal event, and it usually indicates a more serious fault. Thus the reason for fuse failure should be investigated.

Supply Fuses

Location: At point of supply to the Elite.

Possible reason for failure: Supply surge, age or cyclic stress failure, wrong fuses, fault in supply cable to the Elite, rectifier or inverter fault, motor or motor cable fault.

Action:

1) See section 3.1 before starting.
2) Perform a visual inspection for mechanical damage, water entry, or any other possible damage to the system.
3) For new or modified installations check the wiring is correct as per the technical manual 4201-180.
4) Check fuses for correct rating.
5) Disconnect supply cables and test for phase to phase or phase to earth fault.
6) Mark and disconnect the output cables. Test the cables and motor for phase to phase and phase to earth fault.
7) Test the Elite for rectifier, inverter or DC Bus faults as per section 3.4.
8) If no faults are found, the best option is to Soft power the Elite as per section 3.5. If you consider the fuses failed because of an external issue such as short term overload or cyclic stress, reconnect the Elite replace the fuses and attempt to run the Elite.

Power Tray Fuses

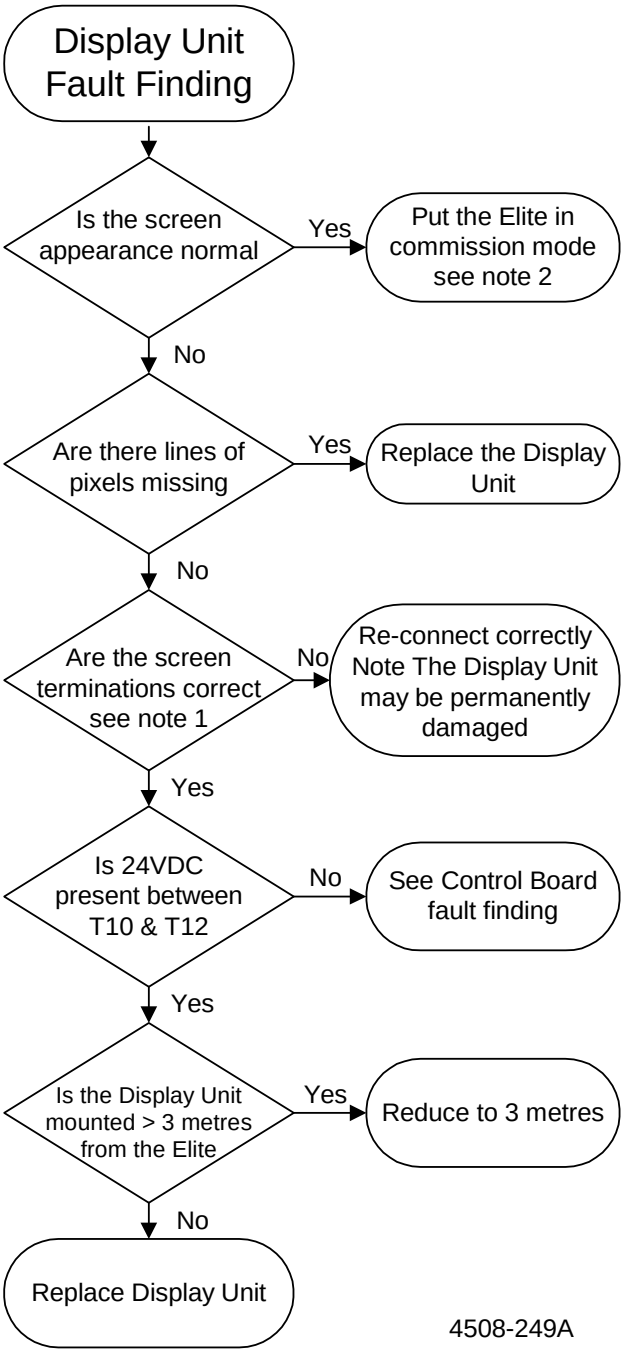
Fuse two is in the positive DC Bus feed to the Main switchmode power supply. It must be replaced with a ceramic fuse of the same rating. If the fuse has failed look for burnt components around the main switchmode transformer. If none are found, replace the fuse and repower the Elite. If it fails again, replace the Power tray.

Fuse three is in the Line 1 feed to the SCR switchmode power supply. It must be replaced with a ceramic fuse of the same rating. If the fuse has failed, look for burnt components around the SCR switchmode transformer. If nothing is found, test the SCR gate drives and SCRs as per section 3.4.2. If these test OK, replace the fuse and repower the Elite. If it fails again, replace the Power tray.

Control Board Fuse

Located on the Control board, this fuse is in series with the user 24Vdc 500mA power supply accessed via T36 and T37. The user power supply is short circuit protected, and will close down if a short is present in the field control wiring or other device connected to T36 and T37.

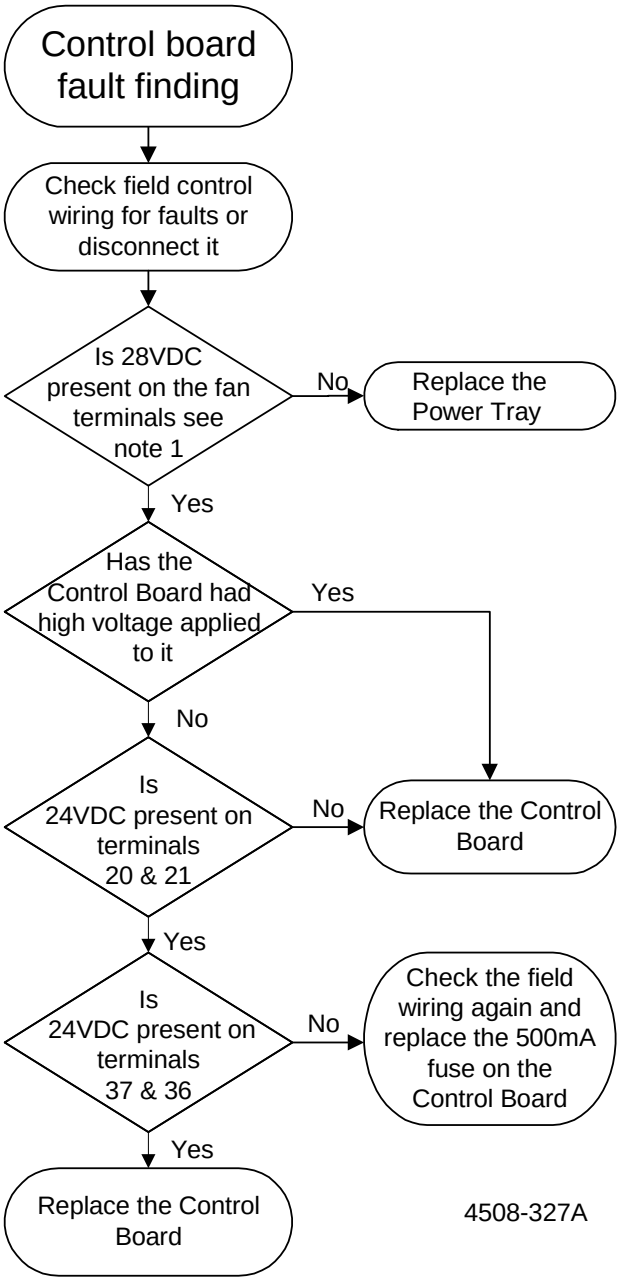
3.3.3 DISPLAY



Note 1:
Terminal 10 - red
Terminal 11 - white
Terminal 12 - black + screen
Note 2:
See Elite Series Technical Manual 4201-180 Screens Z to Z1

Figure 3.1: Display Fault Finding

3.3.4 CONTROL BOARD



Note 1
The fan terminals are located between the fibre optic connections at the bottom of the Control Board. These are not used in these frame sizes, but still indicate that the Power Tray switch mode power supply is producing the 28Vdc required by the Control Board.

Figure 3.2: Control Board Fault Finding

3.3.5 INPUT RECTIFIER

The Rectifier is a half controlled bridge that combines DC conversion and the Soft Charge section of the Elite into one stage. The SCR(s) on Line 1 are phase controlled to limit the inrush current due to the DC Bus capacitors when the Elite is powered up, this is termed "Soft Charge". The phase control is continued until the capacitors are fully charged then all SCRs are turned on.

Rectifier/Soft Charge failure can be indicated by Input fuses blowing on power application or Display of SUPPLY FAULT, especially on application of load. See section 3.3.1 for supply problems.

Some Causes of Rectifier Failure

1) **Bus Capacitor Failure:** Excess current drawn by a shorted capacitors may damage the rectifier. See section 3.3.6.
2) **Internal fault in Elite:** Failure to a short circuit will cause two input phase fuses to blow. See section 3.4.
3) Fault in supply cable, motor cable or motor.
4) **Input supply imbalance:** If Line 1 (L1) is low with respect to yellow and blue, the Elite will soft charge the capacitors to 1.414 x the L1 RMS voltage level. When the soft charge is finished the SCR's on L2 and L3 will be turned on fully applying a higher DC level to the DC bus than is currently there. This can generate sufficient inrush current to damage the input rectifier.
5) **Supply voltage exceeding the Elite's rating:** The Elite has VDR's to protect against voltage transients. These will not cope with a supply that is constantly above the maximum level the Elite was designed for. The VDR's will fail and the Elite also may be damaged.

Soft Charge Failure

1) **Failure of the Soft Charge function:** Some or all of the SCR's may not respond to a gate signal or the Power tray may not be producing a gatedrive signal. Look for a dislodged cable and test the SCR's as per section 3.4.2.
2) **Diode or SCR failure:** If part of the rectifier stage has failed open circuit, the Elite may not soft charge and no voltage will appear on the DC bus. **Note:** it is uncommon for semiconductors to fail open circuit.

Replacement SCR'S

Replacement SCRs do not require batch matching.

3.3.6 INVERTER DESCRIPTION

The inverter consists of insulated gate bipolar transistors (IGBTs). Each IGBT block has two IGBTs in it, one for the upper and one for the lower half phase (i.e. U+ and U-).

Symptoms of Inverter failure

1) Input fuses blowing on power application.
2) DC bus fuses blowing on power application frames.
3) DESAT fault 08 to 13 constantly on the same phase and polarity.
4) Current limit fault 07 this is a hardware trip to indicate that 220% of rated output current has been reached.

For all of the above faults test the IGBTs as per section 3.4.1, check the motor and motor cables. If no faults are found, attempt to reset the Elite. If the fault is repetitive on the same half phase, check the IGBTs again. If the fault is a DESAT fault, and not always on the same phase, the problem may most likely be in the Power tray, output cables or motor.

IGBT replacement

The IGBTs have two IGBTs per block, one block does a positive and negative half phase for ONE output phase (i.e. one block does U+ and U-). Batch matching of IGBT's is not required for Frame 4.

3.3.7 DC BUS FILTER

The DC Bus filter is comprised of electrolytic capacitors and chokes. The chokes are mounted in series with L1, L2 and L3 and are called line chokes. The filter's function is to reduce the harmonic current drawn by the Elite and the ripple on the DC Bus. Excess ripple >40Vac will be detected and displayed as a supply fault, see section 3.3.1 for further details.

To achieve the required voltage rating, two capacitors are connected in series. The capacitors are rated at 400V and 450V for the 400V and 500V models respectively.

Possible causes of failure

The definition of capacitor failure is the capacitance of the capacitor to drop and exceed the manufacturers tolerance or suffer a catastrophic failure which is an open or short circuit. While this section is quite detailed the capacitors seldom cause any problems.

400V capacitors rating 2200 MFD +/- 20% at 20°C and 120Hz.

500V capacitors rating 1800 MFD +/- 20% at 20°C and 120Hz.

Factors affecting the life of the DC Bus Capacitors

1) Stress related issues include vibration, excessive ripple, above rated voltage and/or temperature.

   Over heating, is the most likely cause of premature failure and can be brought about by reduction in cooling air flow to the drive, excessive ambient temperature or excess ripple due to some of the capacitors going open circuit.Check the heatsink for blockage and fans for operation.

2) The recommended storage period without use should not to exceed 3 years.

   If there is concern regarding the time an Elite has been stored, a DC supply can be connected to the DC Bus terminals. Starting at about 50Vdc and over 8 hours the voltage is gradually increased to about 560V to 600Vdc for 400V models and 660V to 700Vdc for 500V models. Failure to do this can cause failure of the DC Bus capacitors on initial application of full voltage.

Symptoms of DC bus capacitor failure

Open Circuited Capacitor

If a single DC Bus capacitor goes open circuit, the symptoms may not be noticeable. However, the remaining capacitors will have an increased ripple current and will run hotter. If more capacitors consequently go open circuit, the DC bus ripple will increase and may cause a SUPPLY FLT trip, especially when the Elite is running at or near full output current.

Short Circuited DC Bus Capacitor

A shorted capacitor should cause two input fuses to fail during or soon after the soft charge interval. Because they are connected in series to share the DC bus voltage, if one capacitor has shorted it will expose all the capacitors opposite it to above rated voltage. This is shown in figure 3.3. In the righthand drawing, the top set of capacitors have been exposed to full DC bus voltage which will be approximately twice their rating. In this event it is recommended to replace all the DC Bus capacitors or at a minimum all the opposing capacitors as well as the faulty one.

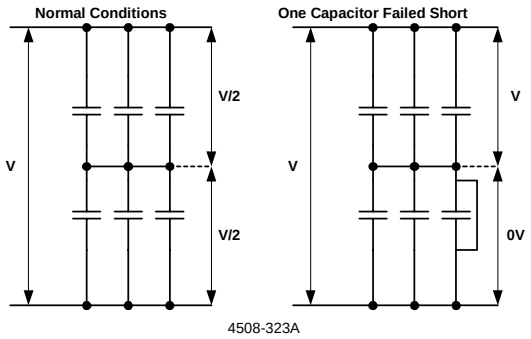


Figure 3.3: DC Bus Capacitor Short Circuit

3.4 TESTING

3.4.1 TESTING THE RECTIFIER AND THE INVERTER

Refer Figure 3.4 and using a multimeter check the rectifier as the drawing indicates.

Note: each test is carried out 3 times (i.e. once per phase, a total of twelve tests).

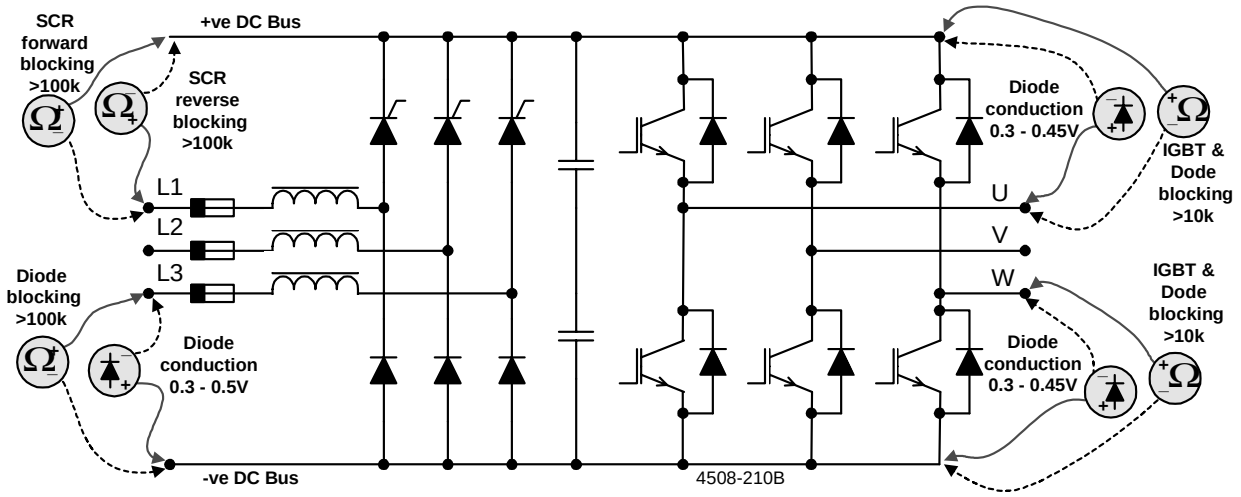


Figure 3.4: Rectifier and Inverter Testing Frame 4

3.4.2 TESTING FOR CORRECT SCR CONDUCTION

Using a 24Vdc current limit power supply or battery arrangement as shown in figure 3.5. Connect the supply positive to the respective input fuse/choke terminal, and the supply negative to the positive DC BUS terminal.

Remove plug P11 from the Power Tray and apply a gate signal. Apply a trigger pulse to pins 12 (L1), 13 (L2), 14 (L3), with 24Vdc via a resistor of between 18 and 100 ohms, via the plug on the unplugged end of the gate drive cable. Trigger the SCR as per the figure 3.5.

When the gate has been triggered, the SCR should latch into conduction and the supply. Go to current limit or the lamp glow for the alternative testing arrangement. The supply is DC, therefore the SCR will not turn off until the supply is removed. If the SCR will not stay latched on, check the current limit is not set too low, or the lamp is too low a wattage to allow sufficient current for the SCR to maintain a latched state.

If the SCR fails to conduct, suspect the SCR, Gate Trigger PCB or interconnecting loom.

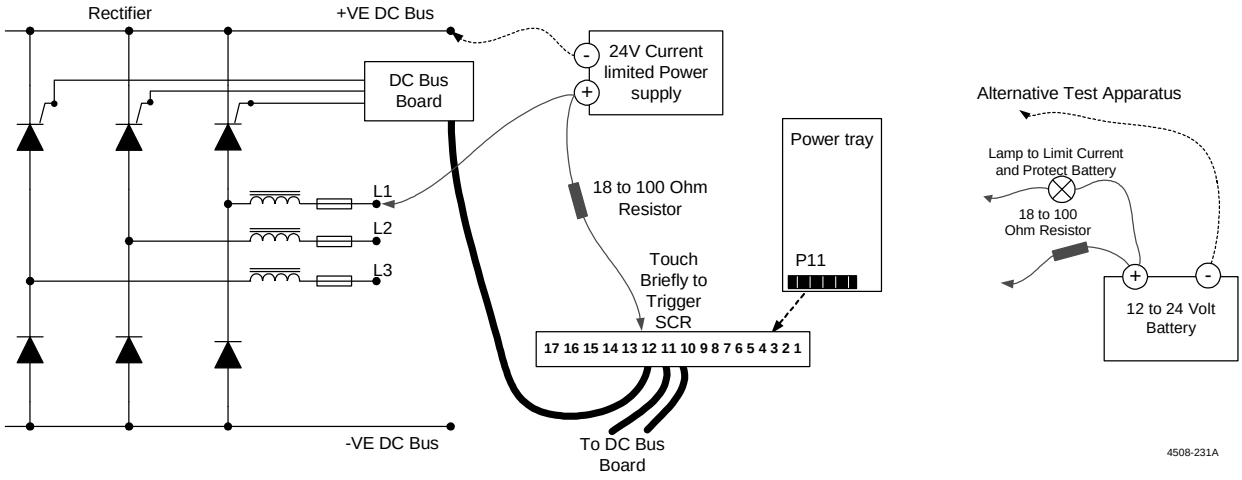


Figure 3.5: SCR Conduction Test

3.4.3 TESTING AN INDIVIDUAL SCR

When the Elite is disassembled, the SCR's can be tested individually as in figure 3.6.

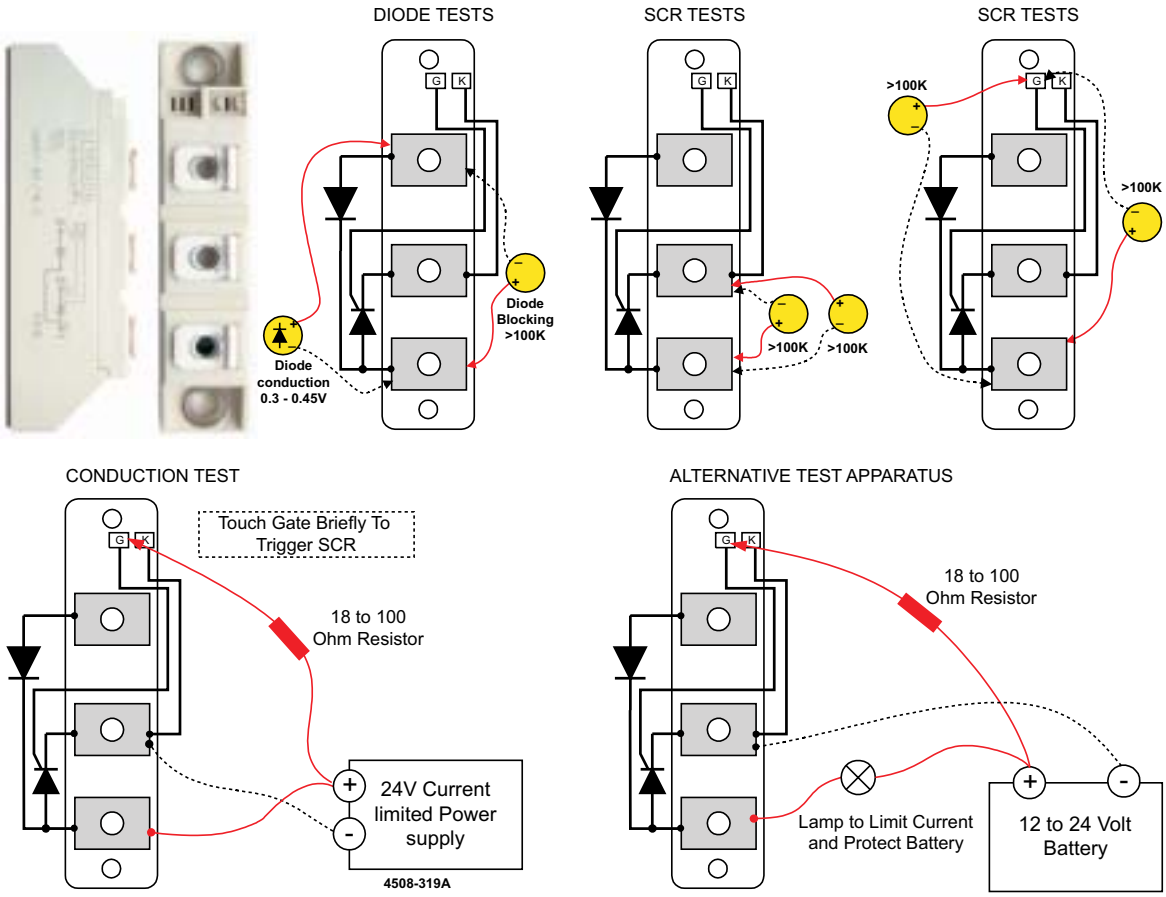


Figure 3.6: Individual SCR Conduction Test

3.4.4 INDIVIDUAL IGBT TESTS

You must wear a static grounding wrist strap and it must be earthed when doing these tests. The preliminary tests are done with a multimeter. The meter readings in figure 3.7 are a guide and may vary with differing meter brands. It is best to compare the suspect IGBTs with a known good IGBT. **Note:** When the gate and emitter are shorted together for one test as shown in figure 3.7, the IGBTs should be stored and handled in this state.

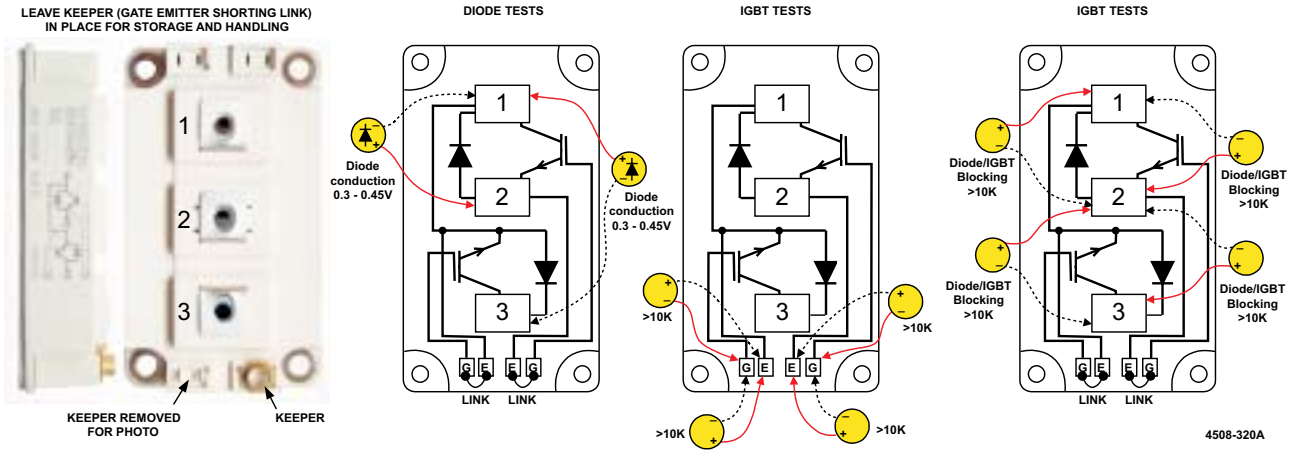


Figure 3.7: Individual IGBT Testing

The final tests are done as shown in figure 3.8. This test is very important as it is possible that the multi meter tests show the IGBTs are OK, but the IGBT may not actually work (i.e. the IGBT may not respond to a gatedrive signal).

Important Note: the 1 K ohm resistor must be between the gate and emitter at all times during the tests.

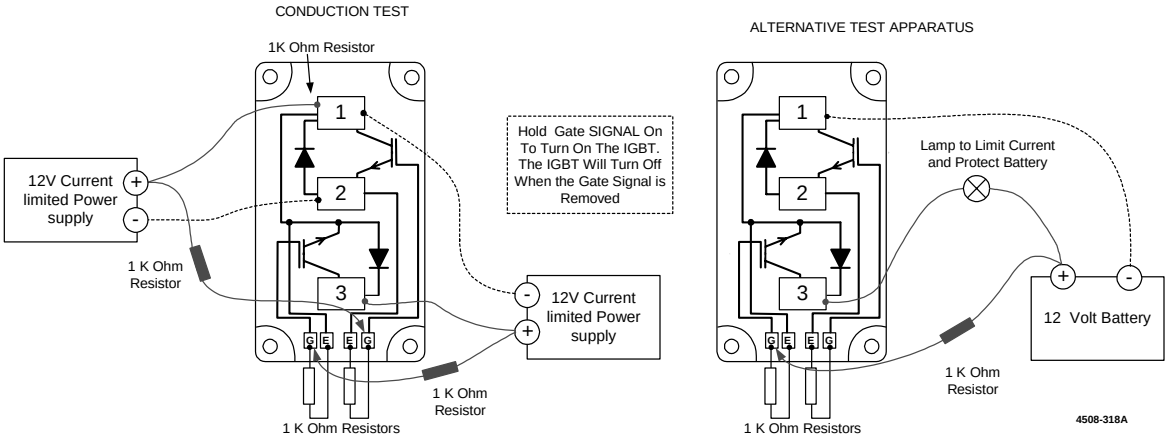


Figure 3.8: Individual IGBT Conduction Testing

3.4.5 TESTING THE DCCT AND DCCT SUPPLY

The DCCTs measure motor current, and are located on the output of the Elite. DCCT failure may be indicated by **Fault 21 (Ground fault)** or **Fault 58 (Current imbalance)**, even with the motor disconnected. If fault 21 is apparent and the motor and motor cable have been checked, check the DCCT terminations as shown in figure 3.9 and the Inverter as shown in figure 3.4. The 6 pin connector is located at the very top of the Control board.

Check plugs P301, P302 and P303 connecting the DCCTs to the Power tray. Ensure they are correctly inserted.

How to test the DCCTs

1) Power up the Elite but do not start, refer to figure 3.9. This drawing shows two options for testing the DCCTs. Test between ground and terminal 1 then ground and terminal 4 to confirm the DCCT has a ±14V supply or test at the plug. If the ±14 supply is not present unplug the DCCT's and recheck the ±14 supply. If the supply has returned one or more of the DCCTs are faulty. If the supply has not returned the Control board or Power tray's switchmode power supply may be faulty, see section 3.3.4 to determine which.

2) Test the DCCTs by measuring between ground and T3, ground and T5 and ground and T6. This should measure 0V. If the 3 readings are not at 0V, then replace the faulty DCCT(s).

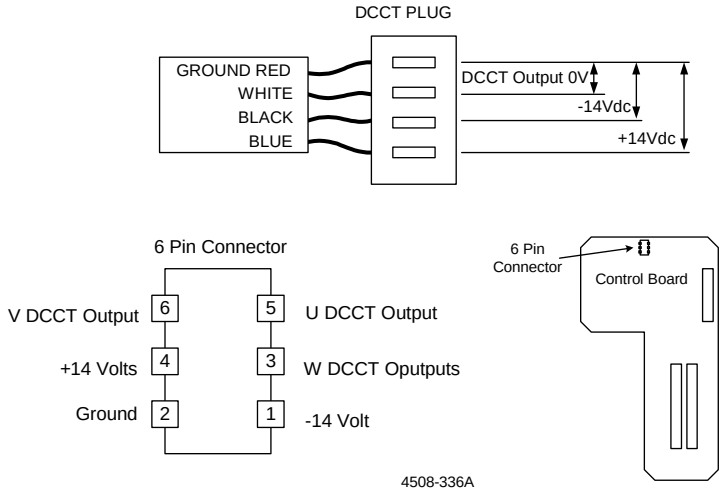


Figure 3.9: DCCT and Supply Testing

3.4.6 TESTING THE DC BUS CAPACITOR

Test the rectifier and inverter by following the procedure in section 3.4.1.

Test the capacitors by using a meter set to OHMS between HVDC terminals + and -. The resistance should start low, then increase as the capacitors charge to the meter battery voltage (ensure the DC bus capacitors are fully discharged first). This charging period could take some time and it is best carried out by testing the suspect machine against a known good Elite of the same amperage rating or check the spare parts list and pick an Elite of the same frame size with the same number of DC Bus capacitors. Time the rate of charge (i.e. the increase in ohms on the meter) and compare this against the suspect Elite. If this test indicates reasonable variation, there may be a problem with the capacitors. Further testing requires disassembly of the Elite.

To test for individual open or short circuited capacitors, the Elite must be dismantled and each capacitor individually checked with a multimeter. Ensure all capacitors are fully discharged. Then connect the meter on OHMS range across each capacitor in turn. Make sure the meter positive is to the capacitor positive. On a good capacitor the resistance should start low, then increase as the capacitor charges to the meter battery voltage.

The capacitors are a sealed canister with a vent beside the terminal posts. If the capacitor has overheated or suffered an internal fault and pressure has build up internally, the bung in the vent hole should be displaced.

3.5 SOFT POWERING AFTER REPAIR

Once all faulty components and assemblies have been replaced, and the Elite has been carefully reassembled, it is recommended that the machine be tested as per section 3.4.1 then Soft Power.

To Soft Power the Elite

Refer to figure 3.10.

Connect a 24Vdc current limited power supply to T36 (positive) and T37 (0V). Energise the supply and the Display unit should liven up. Set the Elite to local control as per Technical manual part no. 4201-180. Disconnect the supply.

Now connect a PDL Soft Power Supply to the DC bus as shown in figure 3.10. The Soft Power supply is available from PDL Electronics or the circuit diagram to build one can be found in the section 8 of this manual. This power supply is a 600Vdc power source, which can be used to power up the DC Bus. The procedure enables any remaining DC Bus or inverter fault to be found without causing damage.

Connect the Soft Power Supply to the mains, as shown in figure 3.10. The isolating transformer is not required for galvanic isolation between supplies as only one supply is used as compared to Frames 4 to 7 but it is recommended as a safety measure. The lamps in series reduce the current that will flow if the Elite is faulty. Set the variac to the lowest setting, switch on the variac and increase the voltage setting to 230Vac over about 5 seconds (any longer risks burning out the soft charge resistor in the Soft Power Unit).

The Display should power up when the supply reaches 280Vdc and the red DC Bus live LED should energise on Gatedrive board (visible at the bottom of the Control board). Set the Elite to local Start/Stop and Local speed reference control, see Technical manual part number 4201-180 for details. The Elite should respond to the Display unit's Start/Stop commands and speed reference changes. Start the Elite from the Display unit and increase the output frequency or speed to 100% . Now use a multimeter set to AC VOLTS, to measure the output voltage, between terminals U-V, V-W, W-U. These voltages should all be balanced at approximately 400Vac. If there is any sign of imbalance, measure between each output and earth to isolate which phase is faulty. It is likely that there is an unrepaired fault on that particular phase or loose terminations.

If the test shows no faults and a good output voltage balance, the test power supplies can be disconnected, the mains and motor reconnected, and a full test done.

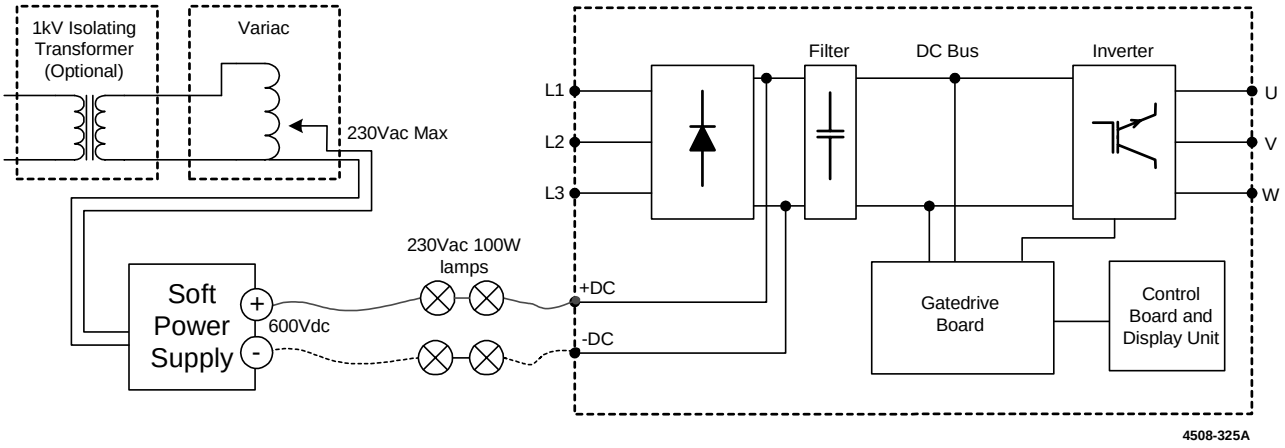


Figure 3.10: Soft Power Supply Connections

3.6 PARTS LIST AND BLOCK DIAGRAM

3.6.1 FRAME 4 400V ULTRADRIVE ELITE PARTS LIST

400 VOLT ULTRADRIVE ELITE PARTS LIST							
Frame Size	FRAME 4					Spares Guide	
Model	UE-60	UE-75	UE-90	UE-115	UE-140	*Level 1	**Level 2
Display Unit	E141-620S						
Control Board	E000-610S					1	1
Power Tray	E060-611S	E075-611S	E090-611S	E115-611S	E140-611S	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 E660-619S						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 1352-453	6 x 1352-453		8 x 1352-453			
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 Fan	2941-013					1	1
* Level 1: Minimum spares stock							
**Level 2: Typical spares stock							
4508-273A							

Figure 3.11: 400V Frame 4 Parts list

3.6.2 FRAME 4 500V ULTRADRIVE ELITE PARTS LIST

500 VOLT ULTRADRIVE ELITE PARTS LIST							
Frame Size	FRAME 4					Spares Guide	
Model	UE-60D	UE-75D	UE-90D	UE-115D	UE-140D	*Level 1	**Level 2
Display Unit	E141-620S						
Control Board	E000-610S					1	1
Power Tray	E141-627S					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	E140-621						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							
4508-274A							

Figure 3.12: 500V Frame 4 Parts list

3.6.2 FRAME 4 400V AND 500V ULTRADRIVE ELITE BLOCK DIAGRAM

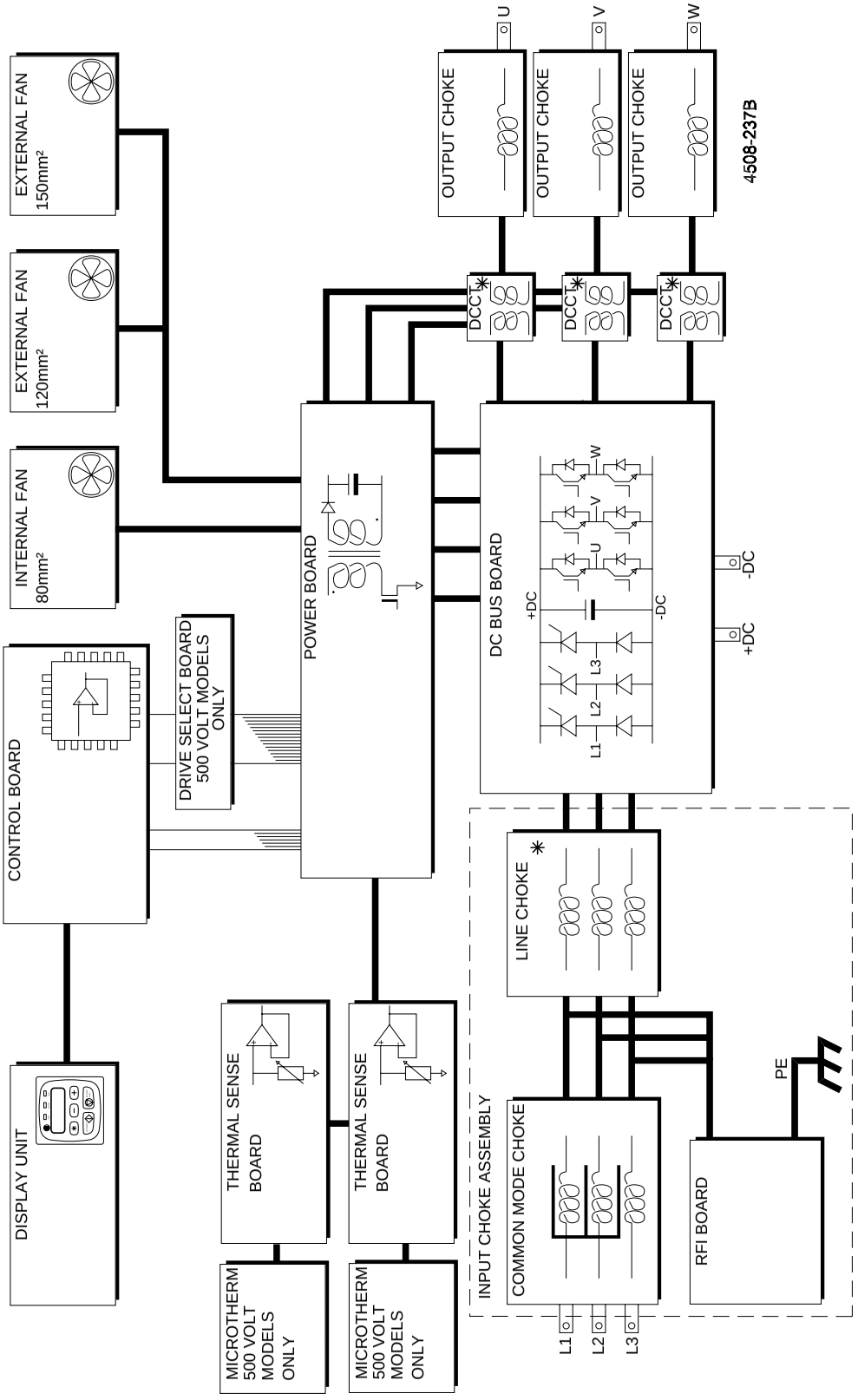


Figure 3.13: 400V and 500V Block Diagram

3.7 SERVICE

3.7.1 REMOVING THE CONTROL BOARD

See section 3.1, before commencing service work for isolation and testing prior, to starting work.

1) Mark the location of the control wiring plugs (use a felt pen and number each plug) then remove them. Remove the fibre optic cables and serial communications interface if used.

2) Remove the top cover plate by undoing six Phillips head M4x10 screws as per figure 3.14.

3) Lift the cover slightly at the end retained by the four screws, then slide it towards the bottom of the drive to clear the fibre optic input/outputs.

4) The following instructions refer to figure 3.15, **Note** the figure shows the Power tray removed from the Elite for clarity. There are two variations in Control board earthing which affects the location of one screw.

5) The Control board is now only held by the 6 pin and 40pin connecting sockets, see figure 3.15. **Lift the board gently and evenly at the connecting socket areas** . When the board is removed place it in a static proof bag or on static safe foam.

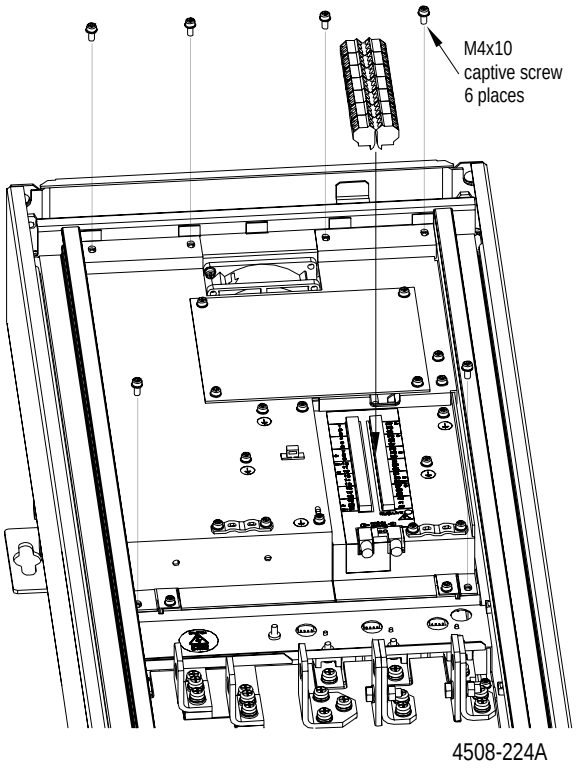


Figure 3.14: Cover Plate

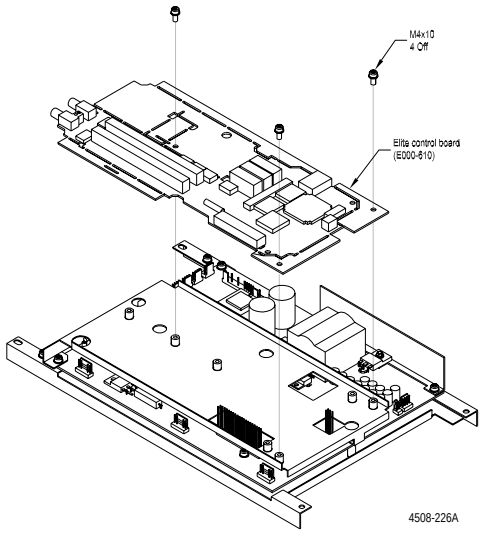


Figure 3.15: Control Board Removal

REPLACING THE CONTROL BOARD

1) Continue to observe static safe work procedures and avoid excessive handling of the new Control board

2) The replacement Control board will be in biscuit format (i.e. it will have to be trimmed to the same size as the existing board size as per figure 3.16). This is done with a fine pair of side cutters cutting as close to the Control board as possible.

3) Place the Control board on the connecting pins.

4) Gently push the 6 pin connector down slightly, and repeat the process with the 40 pin connector. When this is completed, check through the slots to ensure no connecting pins are showing or damaged. Push the Control board completely home and replace the 3 off M4x10 Phillips screws as per figure 3.15.

5) Replace the remaining components of the Ultradrive in the opposite order as detailed in removing the Control board.

Note: if you encounter problems locating the cover plate check the Control board bridges. These were cut to remove the lower part of the control biscuit, if they are too long they obstruct the top cover plate.

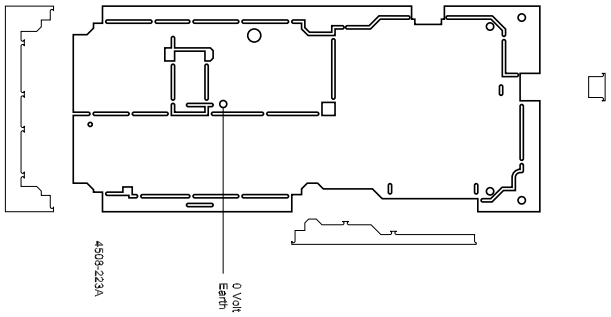


Figure 3.16: Control Board Biscuit

3.7.2 SERVICING THE POWER TRAY

Removing the Power Tray

The Power tray is sold as an assembly and includes the steel work.

See section 3.7.1 and remove the Control board from the old Power tray and install on the new Power tray.

A tool is required for this procedure to protect the IGBT's when the gate connection plug is removed from the Power tray. A typical shorting link is shown in figure 3.17.

Figure 3.17: Shorting Link

1) Continue to observe static safe procedures and remove the plugs as detailed:

   a) U,V,W Gate drive plugs and fit the shorting links.

   b) The fan supply plugs.

   c) The DCCT Plugs (it is best to label them if they are the white series)

   d) The Thermal Sensor loom plug.

   e) The DC Bus Board loom plug.

2) 500V models have a Drive Select Board on the 40 pin connector, transfer this to the new Power tray.

3) Remove the 2 off M4x16 and 3 off M4x10 Phillips head screws

4) The Control board can now be lifted off the Power tray. Place it in a static proof bag.

Replacing the Power Board

The Power tray is sold as a complete assembly and excludes the Control board. Replacing the Power tray is done in the opposite order to removing it.

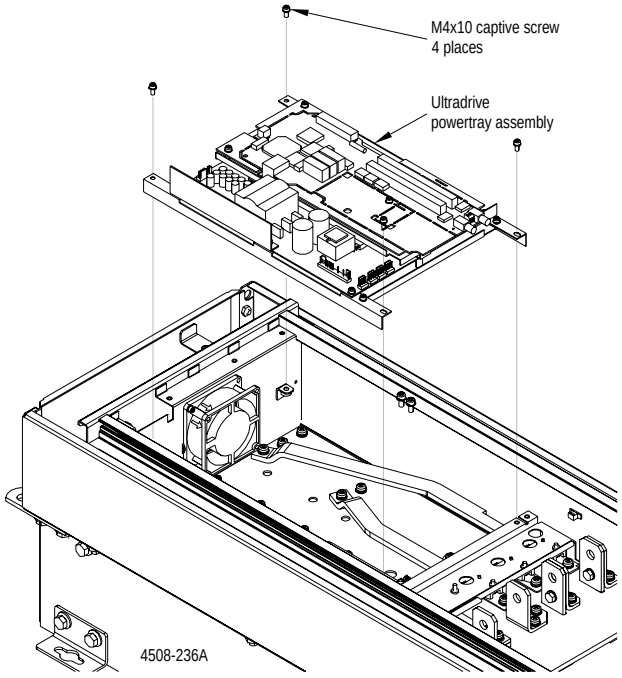


Figure 3.18: Power Tray

3.7.3 REMOVING THE HEAT EXCHANGER

If further disassembly is required, it is expedient to remove the heat exchanger from the Elite.

1) Remove the Door by removing the M6 Bolt that holds the RFI/Earth strap to the door and the two pins which retain the door hinge pivots.

2) Cut the cable ties securing the fan wiring and unplug the fans.

3) Refer to figure 3.19, remove the side panels by removing:

   a) 4 off M5x12 Phillips head screw from the top of the Elite.

   b) 4 off M8x20 Bolt from the lifting lugs.

   c) 2 off M8x16 bolts from the lower end of the side panel.

4) Loosen the 8 off M8 nuts (the side panel is slotted).

5) The side panels can now be lifted clear.

6) Remove the 8 off M5x12 Phillips head screws from the top and bottom of the heat exchanger frame as shown in figure 3.20.

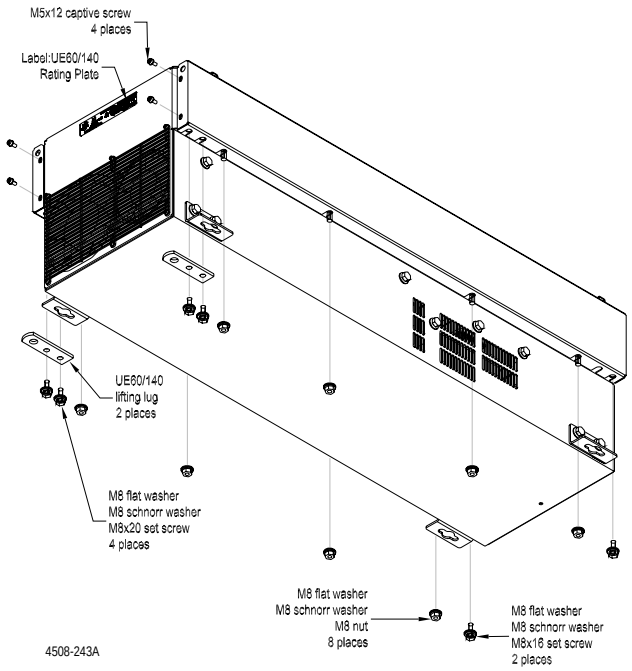


Figure 3.19: Side Panel Disassembly

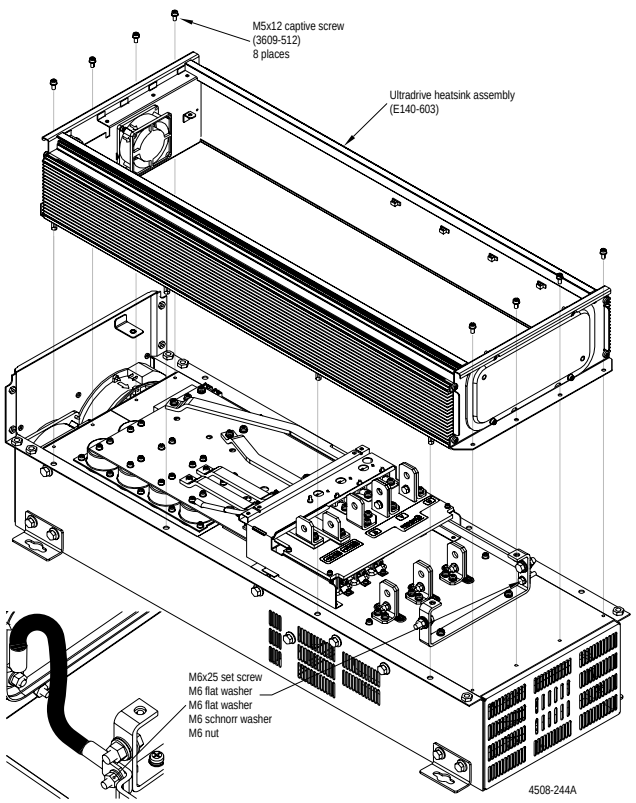


Figure 3.20: Heat Exchanger Removal

3.7.4 REMOVING THE DCCT BRACKET

The DCCT bracket can be removed in one piece.

Refer to figure 3.21

The DCCT removal requires the removal of:

1) The output busbars are secured by
   a) 3 off M6x16 Phillips screws.
   b) 3 off M6x20 Phillips screws.

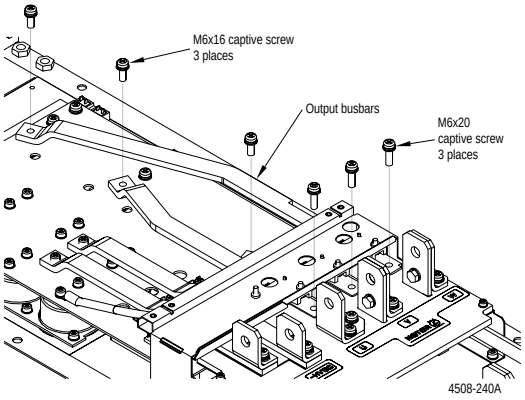


Figure 3.21: Output Busbars

Refer to figure 3.22.

2) The heatsink earth link is removed because it obscures one of the screws which secures the DCCT mounting bracket. This earth link is held by
   a) 1 off M6x12 Phillips screw.
   b) 1 off M6x25 bolt screw.

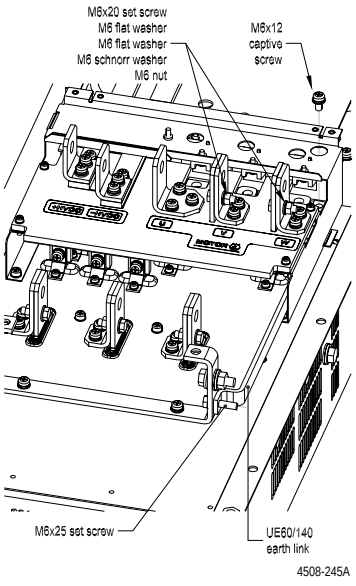


Figure 3.22: Earth Link

Refer to figure 3.23.

3) The DCCT assembly is held by:
   a) 2 off M5x16 Phillips screws which secure the input/output DC busbars to the DC bus PCB.
   b) 1 off M6x20 Phillips screw which connects the output terminal U to the output out the RFI choke.
   c) 4 off M5x10 Phillips screws which secure the steel bracket to the formica board.

   When these are removed, the DCCT assembly can be lifted clear.

4) Remove 2 off M6x20 bolts (these have no immediate effect).

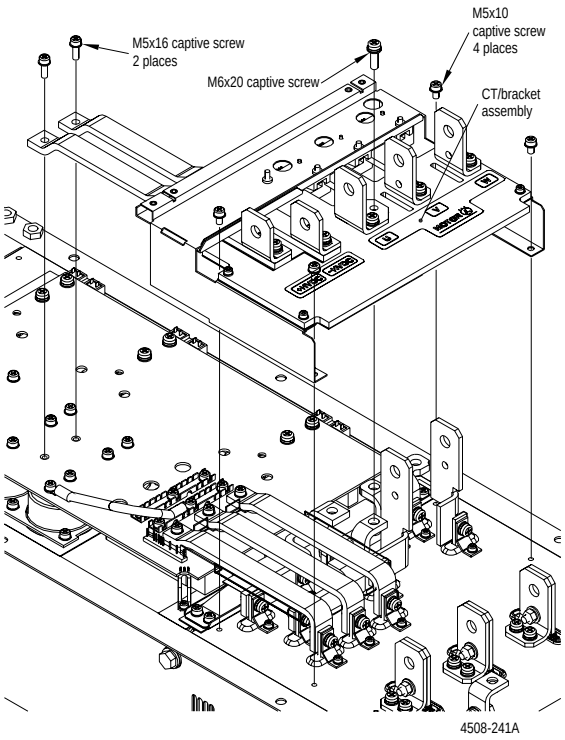


Figure 3.23: DCCT assembly

3.7.5 SERVICING THE DC BUS BOARD

The DC Bus Board is the same for all models, but there are some variations regarding extra components for the larger sizes:

1) 400V and 500V models UE-115(D) and UE-140(D) have two busbars to increase the current carrying capacity or the PCB.

2) 400V and 500V models UE-140(D) have an extra bus bar for the same reason.

Removing the Input busbar

The input busbars supply the rectifier via the DC bus board, see figure 3.24.

1) The bars are held by

a) 3 off M6x20 Phillips screws.

b) 3 off M6x16 Phillips screws.

Note: When reinstalling the W Input busbar, push it towards the U Busbar when tightening the M6x20 screw. This allows clearance for the current transformer.

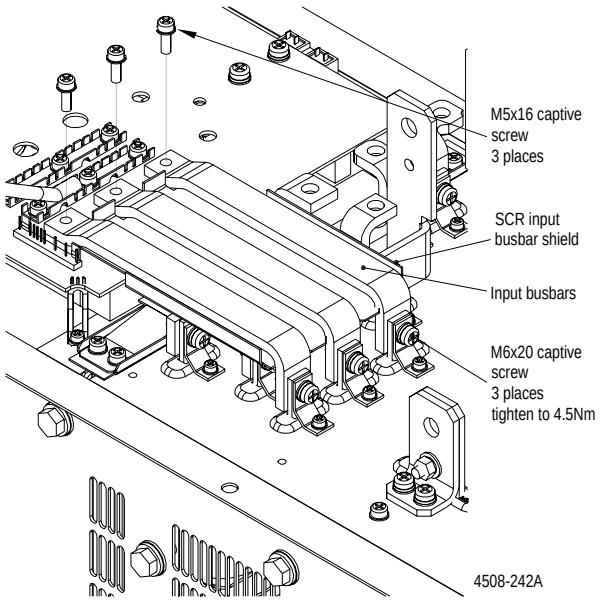


Figure 3.24: Input Busbars

Removing the DC Bus Board

Remove the DC bus board by removing:

1) 1 off M4x10 Phillips head screw, this earths the PCB.

2) The board is secured to the capacitors and the SCR/Diode blocks by 22 off M5x12 Phillips screws.

Note: This is for the UE-140(D). The models below UE-140(D) have less capacitors (see the parts list for the exact numbers).

3) 6 off M16x12 Phillips screws which secure the board to the IGBT's

4) The board is now held by the SCR/Diode block connections, lift it carefully off these.

Replacing the DC Bus board

The most important part, is to ensure the female spade terminals on the underside of the board are aligned on to the SCR/Diode block terminals.

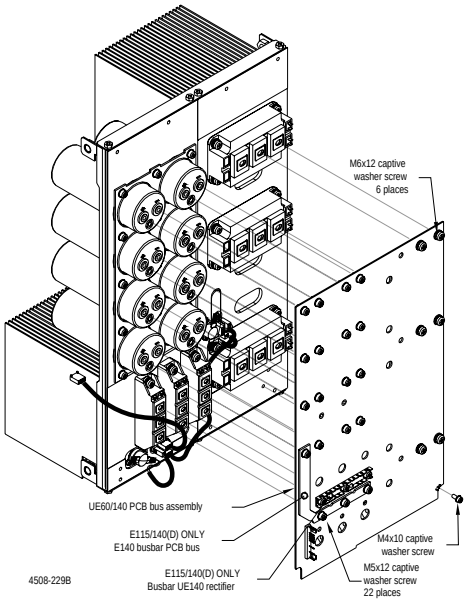


Figure 3.25: DC Bus Board

3.7.6 SERVICING THE CAPACITOR

The capacitors are mounted through the heatsink, with the bulk of the capacitor in the main cooling air flow at the back of the Elite. Sealing rings are used to prevent air leakage through to the inside of the Elite.

To remove the capacitors undo 15 off M5x12 Phillips screws see figure 3.26.

Replacing the capacitors

1) The capacitors should be installed with a jig (part number 5101-190) that ensures the height and rotational position are exact.

2) The sealing rings must be fitted to the capacitors at 23.5mm below the top of the terminal post.

3) Place the capacitors in the heatsink and loosely screw down the clamping plate.

4) Fit the jig to the capacitors then tighten the clamping plate screws. If a jig is not be available precise fitting of the individual capacitors is required see figure 3.27.

5) Fit the capacitor sealing ring as above, this should help to align the capacitor terminal post at 29.5 mm above the heatsink, when the clamping plate is secured. The rotational alignment of the post is also critical to prevent cross threaded screws when the DC bus board is attached.

6) Slight adjustments will need to be made as the clamping plate is clamped down.

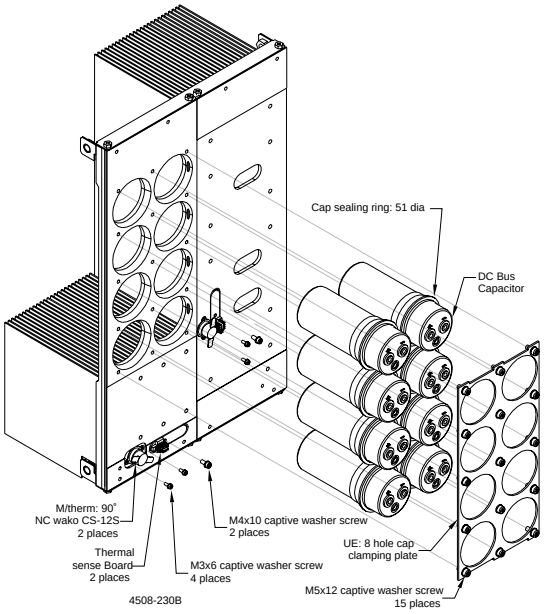


Figure 3.26: Bus Capacitors

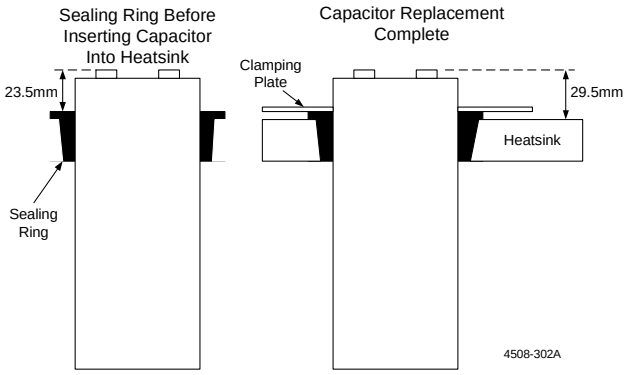


Figure 3.27: Bus Capacitors Replacement

3.7.7 REPLACING THE IGBT AND SCR/DIODE BLOCK

The IGBT's and SCR/Diode blocks can be tested individually as per section 3.4.2.

Replacing the blocks will require new thermstrates, do not use the paper packing and avoid touching the surface of the new thermstrate.

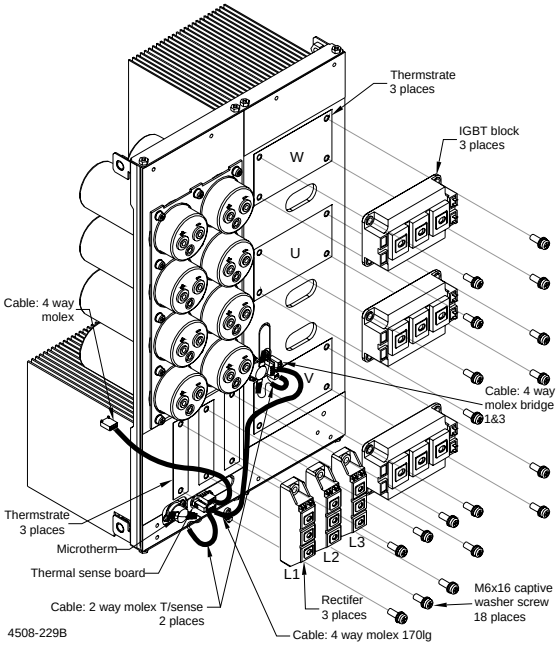


Figure 3.28: Rectifier/IGBT blocks

3.7.8 REMOVING THE EXTERNAL FAN

The fans have DC brushless motors and hence are not phase sensitive. Polarity is still important wen reassembling the Elite. The air flow is from the top of the Ultradrive Elite and out the bottom.

1) To remove the fans, cut the cable ties and unplug the inline connector and the spade terminals off the larger fan, see figure 3.29.

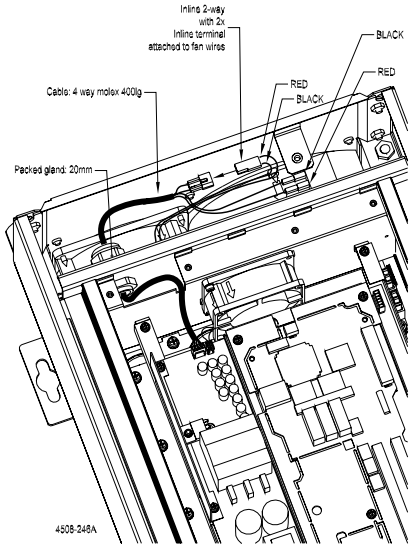


Figure 3.29: Fan Connections

2) Remove the fan grill which is secured by 6 off M4x10 Phillips screws see figure 3.30.

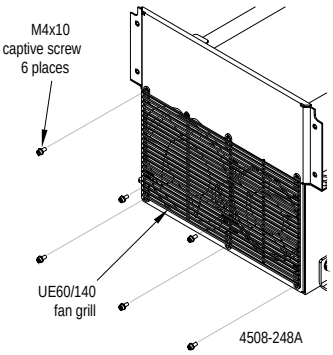


Figure 3.30: Fan Connections

3) Remove the Wafer screws from the fan to be replaced.

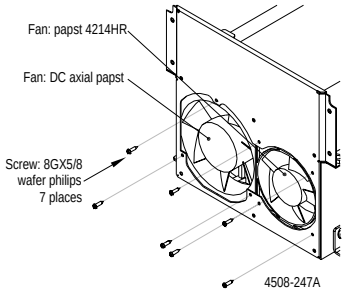


Figure 3.31: Fan Connections

NOTES

4.0 ULTRADRIVE ELITE FRAMES 5, 6 AND 7 FAULT FINDING AND TESTING

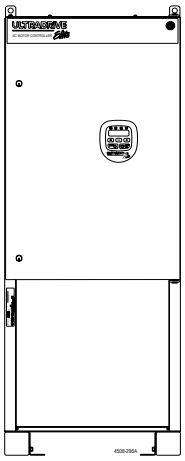
This section covers 400V models UE-170 to UE-660 and 500V models UE-170D to UE-700D

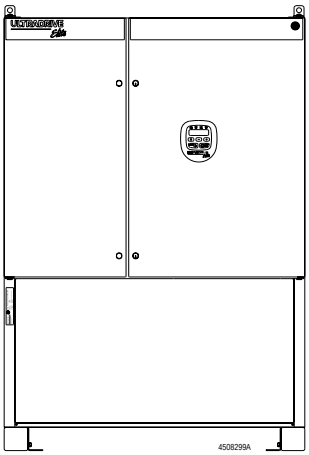
Frame 5: UE-170 to UE-250 UE-170D to UE-250D

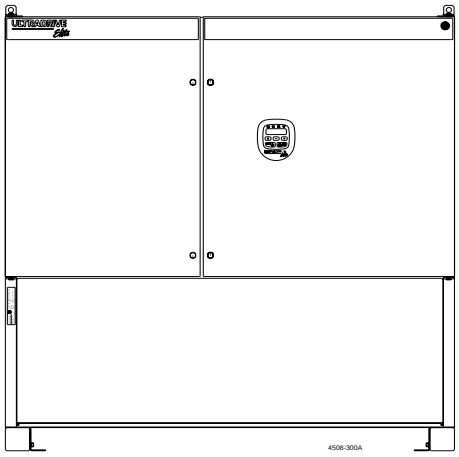
Frame 6: UE-305 to UE-480 UE-305D to UE-540D

Frame 7: UE-575 to UE-660 UE-620D to UE-700D

These will be referred to Frames 5, 6 or 7. The voltage range will not be mentioned unless there are specific differences between the 400V and 500V models.







Contents

4.1 BEFORE STARTING TESTING OR SERVICE WORK

4.1.1 SITE PREPARATION

These frame sizes are the most likely to be serviced in place due to their physical size and weight. Many locations where they are mounted will not be ideal for servicing and therefore it is recommended that:

1) The work area in front of the Elite be cleaned.
2) Some flat surfaces are arranged for placement of parts.
3) Provide containers for small items like screws and bolts.

Tool Requirements

1 x No.2 Phillips Screw Drivers

1 x No.3 Phillips Screw Drivers

1 x Flat blade 3.5 mm for terminals

2 x 10 mm Ring spanners

2 x 13mm Ring spanners

1 x 3/8 inch ratchet driver

1 x 3/8 inch small extension

1 x 10mm socket

1 x 13mm socket

1 x Category 3 multimeter with ranges to 1000V AC and DC maximum

1 x PDL Soft Power Supply

1 x Isolating Transformer 1kVA

1 x 24Vdc volt power supply, a current limited supply is preferred but a simple plug pack or batteries can be used if it is not available with a lamp in series to limit the current flow to about 2 amps.

SAFETY

1) Static safe procedures must be observed. A grounding strap must be worn and earthed.
2) Isolate and lock out the mains supply to the Elite and any low voltage supply that may be in parallel with the control power supply.
3) Allow approximately 5 minutes for the DC bus capacitors to discharge.
4) Open the cabinet door and check the red LED DC bus live indicator is not showing. This is located on the lower right hand side of the control board. This indicates the DC bus is discharged.

Note this is only an indicator.

TESTING BEFORE STARTING REPAIRS USING FRAME 5 AS AN EXAMPLE

1) Remove the 2 off M5x12 CW screws and remove the bottom front panel.
2) Test between input terminals L1, L2, L3 and L1, L2, L3 to earth, to ensure the supply has been disconnected.
3) Finally test between the +VE and -VE DC bus terminals to ensure the DC bus has fully discharged.

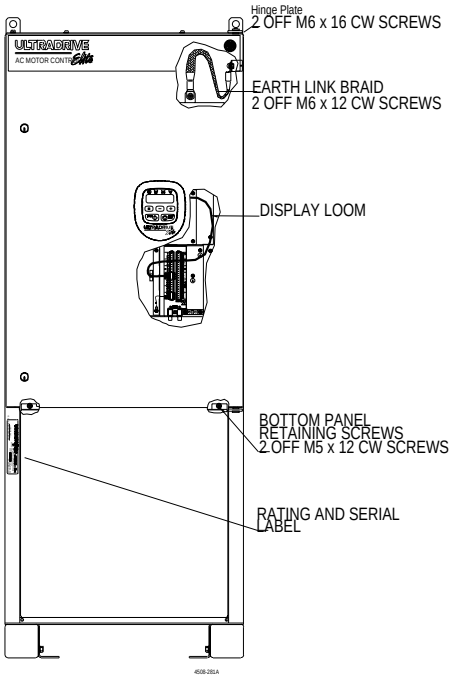
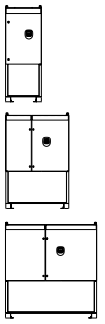


Figure 4.1: Frame 5 Cabinet View

4.2 PRINTED CIRCUIT BOARD DESCRIPTION



Display

The Display has three buttons and a 2 by16 character display. It is the user interface for all parameter settings and is common to the Elite Series, for a fault finding guide see section 4.3.3.

Control Board

The Control board is common to the Elite Series. For a description and a fault finding guide, see section 4.3.4. The Control board accepts all external control inputs and generates output signals. The inputs and outputs include; digital, analogue, fibre optic and Modbus serial communications. A shaft encoder interface and 5V power supply is standard. The Display plugs into the control board.

The Control board also has a bidirectional 24Vdc user power supply rated at 500mA.

Power Tray

The Power tray (Power Electronics Assembly) is made up of a metal support tray, Control board mounting tray and Power board. The Power tray receives power from the DC bus via the DC Supply board.

Circuitry included on the Power Tray

The main switch mode power supply provides various isolated DC supplies required by the Elite these are:

1) 6 off +17V, 0V, -14V to the Gatedrive board.

2) 28V for the internal fans and Control board.

3) 24V 500mA user power supply (via the Control board).

SCR switch mode power supply provides various isolated DC supplies required by the Elite, these are:

1) +8V, 0V, for SCR Gatedrive circuitry and DC Bus discharge control.

2) +15, 0V for switch mode regulation circuitry.

The Gatedrive control for the SCR's and DC Bus discharge circuit are also located here.

The drive select module plugs into this board.

Note the locations are different for the 400V and 500V models.

The Power tray is also used as an interface board for the DCCT's and Gatedrive Board to the Control Board.

Light emitting diodes (LEDS) located on the Power tray.

LED (Green) One for each half phase (6)

Actual indication IGBT Gatedrive circuit active.

Implication The Elite is running.

LED (RED) One for DC Bus indication.

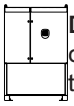
Actual indication DC BUS is LIVE.

Implication The Elite has power connected.

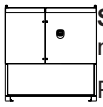
When ordering a replacement Power Tray it will come with the metal support tray and Control Board mounting plate.

Gatedrive Board

Gatedrive Circuits: responds to a fibre-optic signal from the control board via the Power tray and controls the inverter IGBTs.



Desat Circuits: monitors the voltage across the IGBTs and turn off the IGBTs in a controlled manner if they become overloaded. On this condition the Desat circuitry also sends a trip signal to the Control board via the fibre-optic link to the Power tray. This signal will trip the Elite and the display will indicate which half phase was overloaded.



Snubber Circuits 2 off: protects the IGBTs from damage due to voltage spikes, caused by inductance in the Elite, the motor circuit and the IGBTS rapid switching.

Power tray LED indicators are located by the fibre-optic connections.

LED (red) One for each half phase

Actual indication Transmit fibre OK.

Implication The Desat fibre optic driver has power (this is not an indication of a fault it is a normal condition).

LED (Green) One for each half phase

Actual indication IGBT Gatedrive circuit active.

Implication The Elite is running.

Power Supply Board

Provides power to the power tray and has two LED's to indicate DC bus voltage is present.

Bus Sharing Boards

This boards ensures that the DC bus voltage is divided evenly across the DC Bus capacitors.

SCR Boards

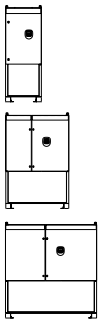
These boards have voltage transient. RFI protection for the Elite and snubbering for the SCR's. They also have a connection to the SCR gate for the Gatedrive signal from the Power tray, and a 10 Amp fuse for the external fans or fan power supply on the 500V models.

500V External Fan Power Supply

A 400Vac to 500Vac to 24Vdc linear power supply for the 500V model external fans.

Note there are connection points for voltage ranges from 400V to and including 500V.

4.3 FAULT FINDING GUIDE



4.3.1 SUPPLY ISSUES

Power supply problems can be misinterpreted as faults in the Elite, some are listed below.

Fault 01 LOW Vdc

The supply to the Elite is dropping below the switch mode power supply operating level and it is shutting down. This is usually caused by a weak supply or faults in the supply system. Look for motors starting direct on line or other machines drawing high current. For further details see the fault list in section 8 of this manual.

Fault 02 HIGH Vdc

The supply to the Elite is surging too high. Rapid load changes in the supply system may be at fault. For further details see the fault list in section 8 of this manual.

Fault 04 SUPPLY FLT

Supply fault (Fault 04) is an indication that the ripple on the DC Bus has exceeded 40Vac. The Elite will trip if this condition is reached and display fault 04 SUPPLY FLT. This can be caused by diode(s) in the rectifier going open circuit, see section 1.4. But is more likely to be caused by

1) The loss of an input phase will increase the ripple on the DC Bus. The Elite can run on two phases up to about half to two thirds of its current rating. At which point the DC Bus filter will not be capable of maintaining the ripple below 40Vac and the Elite will trip. The Display will stay live and the Elite can be reset and will run to about the same current before tripping again.

2) Excessive mains distortion (harmonics) can also cause excessive ripple on the DC Bus. The cause of excessive supply distortion in an industrial situation may be SCR controlled heating equipment, DC drives, current source inverters, and other high current non linear loads. This can occur where backup generators are used which have not been sized correctly relative to the total variable speed drive load (VSD). The total loading of VSDs on a backup generator should be about 60% and the remaining 40% made up of linear loads.

4.3.2 FUSE FAILURE

Frames 5 to 7 Elite have a number of fuses for SAFETY backup. Fuse failure is not a normal event, and it usually indicates a more serious fault. Thus the reason for fuse failure should be investigated.

A list of fuses, with their locations, possible reasons for failure and suggested corrective actions, follows:

Input and DC Bus Fuses

The input fuses are located in the lower cabinet and the DC bus fuses are located in the electronics cabinet.

Possible reason for failure: Supply surge, age or cyclic stress failure, wrong fuses, fault in supply cable to the Elite, rectifier or inverter fault, motor or motor cable fault.

Action:

1) See section 4.1 before starting.

2) Perform a visual inspection for mechanical damage, water entry, or any other possible damage to the system.

3) For new or modified installations, check the wiring is correct as per the Technical Manual 4201-180.

4) Check fuses for correct rating.

5) Disconnect supply cables and test for phase to phase or phase to earth fault.

6) Mark and disconnect the output cables, test the cables and motor for phase to phase and phase to earth fault.

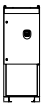
7) Test the Elite for rectifier, inverter or DC Bus faults as per section 4.5.1.

8) If no faults are found the best option is to Soft Power the Elite as per section 4.5. If you consider the fuses failed because of an external issue such as short term overload or cyclic stress, reconnect the Elite, replace the fuses and attempt to run the Elite.

Control Board Fuse

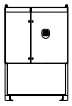
Located on the Control board.

This fuse is in series with the user 24Vdc 500mA power supply accessed via T36 and T37. The user power supply is short circuit protected and will shut down if a short is present in the field control wiring or other device connected to T36 and T37.

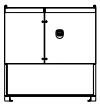


2A 440V Power Tray DC Supply Fuses
Fitted on Elite Power Supply Board.

Possible reason for failure: Fault in main switch mode power supply on Power tray. Inspect the Power tray for visibly damaged or blackened components. If damaged components exist, replace the Power tray. If there is no visible damage, replace the fuse and repower the Elite. If the fuse blows again, replace the Power tray.



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



Action: Replace fuses. If failure persists, replace Power tray.

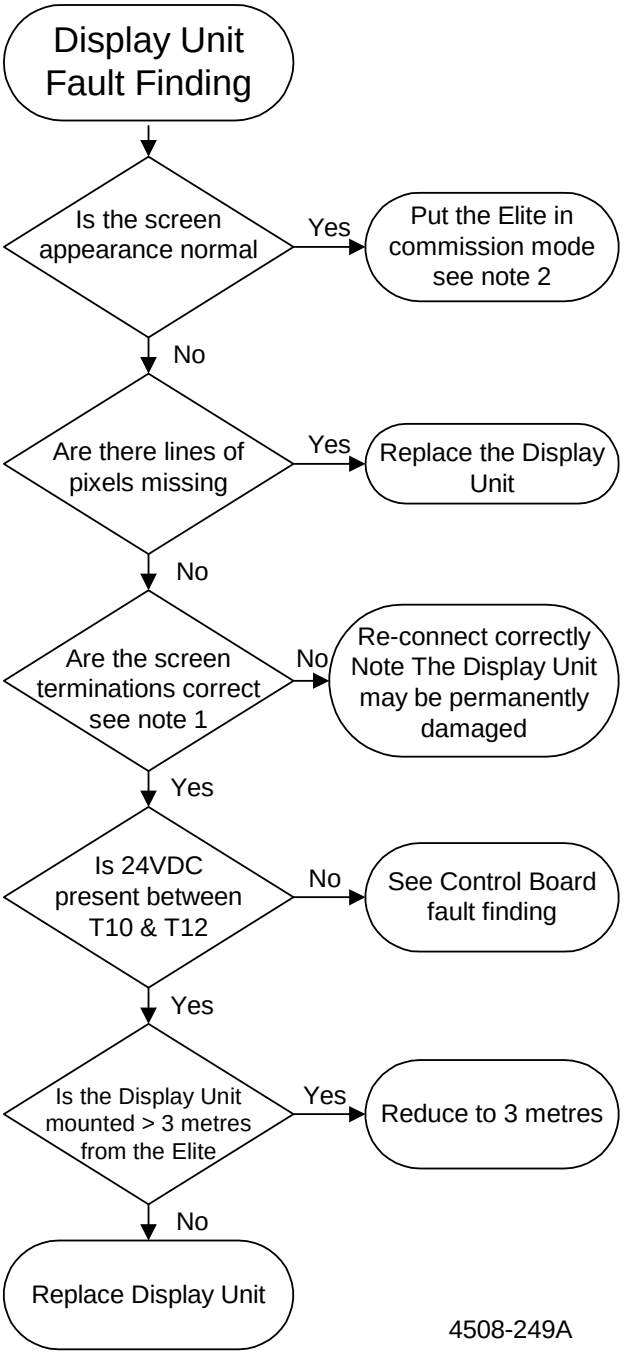
10A 440V heatsink fan supply fuses

Fitted on SCR boards.

Possible reason for failure: Supply surge; 400V models external cooling fan fault or for 500V models a fault in the external cooling fan power supply.

Action: Check cooling fans or cooling fan power supply. Check varistor on SCR boards for signs of damage, a small dentist's style mirror is suitable for this.

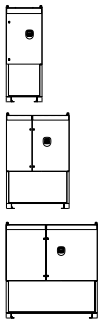
4.3.3 DISPLAY

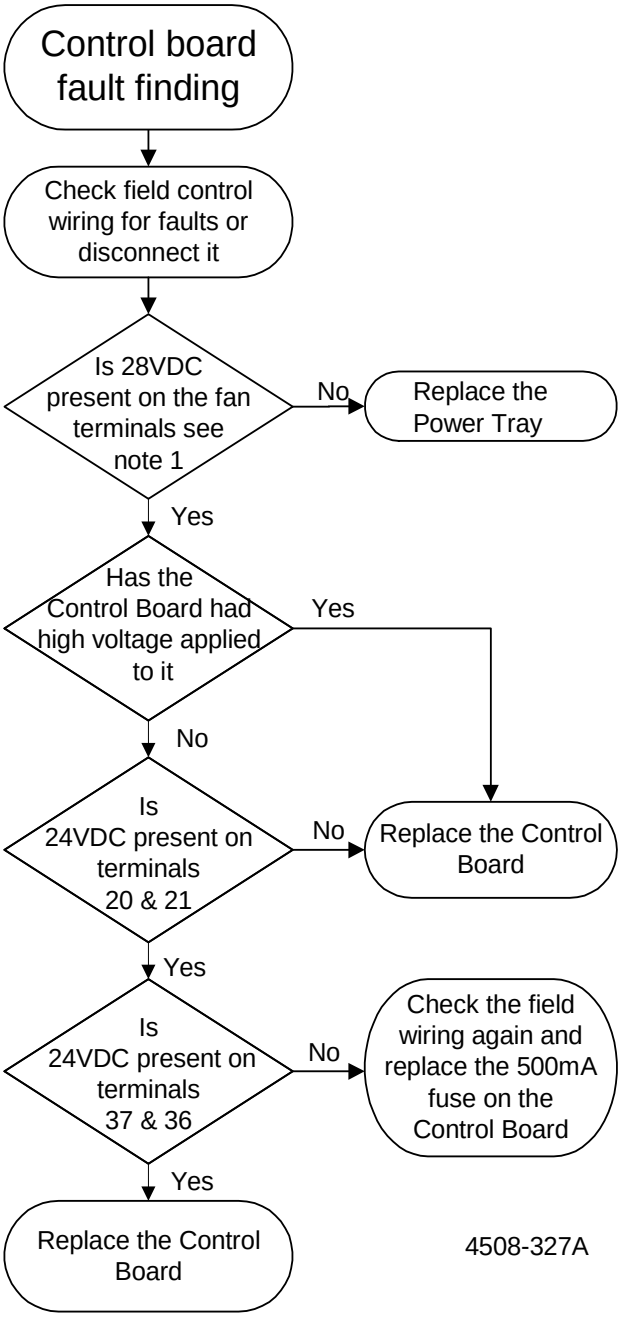


Note 1:
Terminal 10 - red
Terminal 11 - white
Terminal 12 - black + screen
Note 2:
See Elite Series Technical Manual 4201-180 Screens Z to Z1

Figure 4.2: Display Fault Finding

4.3.4 CONTROL BOARD





Note 1
The fan terminals are located between the fibre optic connections at the bottom of the Control Board. These are not used in these frame sizes, but still indicate that the Power Tray switch mode power supply is producing the 28Vdc required by the Control Board.

Figure 4.3: Control Board Fault Finding

4.3.5 INPUT RECTIFIER

The Rectifier is a half controlled bridge that combines DC conversion and the Soft Charge section of the Elite into one stage. The SCR(s) on Line 1 are phase controlled to limit the inrush current due to the DC Bus capacitors when the Elite is powered up, this is termed "Soft Charge". The phase control is continued until the capacitors are fully charged then all SCRs are turned on.

Rectifier/Soft Charge failure can be indicated by:

Input fuses blowing on power application or display of SUPPLY FAULT, especially on application of load. See section 4.4.1 for supply problems

Some Causes of Rectifier Failure

Bus Capacitor Failure: Excess current drawn by a shorted capacitors may damage the rectifier. See section 4.3.3.

Internal fault in Elite: Failure to a short circuit will cause two input phase fuses to blow. See section 4.3.

Fault in supply cable, motor cable or motor.

Input supply imbalance: If Line 1 (L1) is low with respect to yellow and blue, the Elite will soft charge the capacitors to 1.414 x the L1 RMS voltage level. When the soft charge is finished, the SCRs on L2 and L3 will be turned on fully applying a higher DC level to the DC bus than is currently there. This can generate sufficient inrush current to damage the input rectifier.

Supply voltage exceeding the Elite's rating: The Elite has VDR's to protect against voltage transients, these will not cope with a supply that is constantly above the maximum level the Elite was designed for. The VDR's will fail and the Elite may be damaged also.

Soft Charge Failure

Failure of the Soft Charge function: Some or all of the SCR's may not respond to a gate signal or the Power tray may not be producing an SCR gatedrive signal. Look for a dislodged cable and test the SCR's as per section 4.4.2.

Diode or SCR Failure: If part of the rectifier stage has failed open circuit the Elite may not soft charge and no voltage will appear on the DC bus. Note it is uncommon for semiconductors to fail open circuit.

REPLACEMENT SCR'S

Replacement SCRs do not require batch matching.

4.3.6 INVERTER DESCRIPTION

The inverter consists of insulated gate bipolar transistors (IGBTs) in parallel to achieve the required current rating. Frame size 5 has two IGBTs per half phase, Frame 6 has four and Frame 7 has six. These are in parallel and share evenly the current supplied to the motor.

SYMPTOMS OF INVERTER FAILURE

1) Input fuses blowing on power application.

2) DC bus fuses blowing on power application.

3) DESAT fault 08 to 13 constantly on the same phase and polarity.

4) Current limit fault 07, this is a hardware trip to indicate that 220% of rated output current has been reached.

For all of the above faults, test the IGBTs as per section 4.4.1. Check the motor and motor cables. If no faults are found, attempt to reset the Elite. If the fault is repetitive on the same phase and polarity check the IGBTs again. If the fault is a DESAT fault and not always on the same phase, the problem is most likely in the Gatedrive board. There is a small possibility that the Power tray may be at fault and since it is the easiest, it is worth replacing it first.

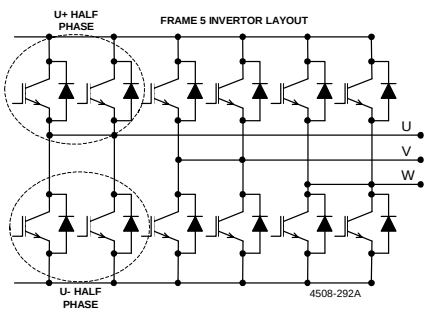
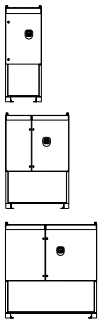


Figure 4.5 : IGBT Half Phase Layout



Replacing the IGBT

The IGBTs are manufactured in batches, and each batch has a unique batch number. The IGBTs from a specific batch are made from the same silicon, therefore their operating characteristics will be the same. Therefore we require that IGBTs in each half phase, be from the same batch. When an Elite is repaired under warranty, the complete half phase must be replaced with the same batch or the warranty will be void.

Note: the batch in a half phase does not have to match the batch in another half phase. For example in a Frame 7 it may have transpired that 2 IGBTs are damaged and the other 4 in the half phase test OK with a multimeter. In this situation, PDL or its agent would replace all six IGBTs. Apart from the batch issue, we have found, that while the remaining IGBTs in the half phase may test OK they will have been stressed. The effect on their life span due to the stress cannot be gauged. For these reasons, a repair without full half phase IGBT replacement can not be guaranteed.

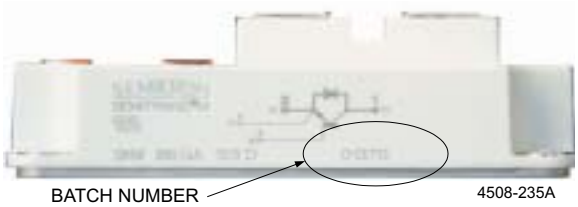


Figure 4.5: Batch Number

4.3.7 DC BUS FILTER

The DC Bus filter is comprised of electrolytic capacitors and chokes. The chokes are mounted in series with L1, L2 and L3 and are called line chokes. The filter's function is to reduce the harmonic current drawn by the Elite and the ripple on the DC Bus. Excess ripple >40Vac will be detected and displayed as a supply fault, see section 4.3.1 for further details.

To achieve the required voltage rating, two capacitors are connected in series. The capacitors are rated at 400V and 450V for the 400V and 500V models respectively.

Possible Causes of Failure

The definition of capacitor failure is for the capacitance of the capacitor to drop or exceed the manufacturers tolerance or to suffer a catastrophic failure which is an open or short circuit. While this section is quite detailed the capacitors seldom cause any problems.

400V capacitors rating 2200 MFD +/- 20% at 20°C and 120Hz.

500V capacitors rating 1800 MFD +/- 20% at 20°C and 120Hz.

Factors Affecting The Life of The DC Bus Capacitors

Stress related issues, these are vibration, excessive ripple, above rated voltage and or temperature.

Over heating is the most likely cause of premature failure and can be brought about by reduction in cooling air flow to the drive (Check the heatsink for blockage and fans), excessive ambient temperature or excess ripple due to some of the capacitors going open circuit.

Shelf life, the recommended storage period without use should not exceed 3 years.

If there is concern regarding the time an Elite has been stored, a DC supply can be connected to the DC Bus terminals and starting at about 50Vdc and over 8 hours the voltage is gradually increased to about 560 to 600Vdc for 400V models and 660 to 700Vdc for 500V models. Failure to do this can cause failure of the DC Bus capacitors on initial application of full voltage.

Symptoms of DC Bus Capacitor Failure

Open Circuited Capacitor

If a single DC Bus capacitor goes open circuit, the symptoms may not be noticeable. However the remaining capacitors will have an increased ripple current and will run hotter. If more capacitors consequently go open circuit, the DC bus ripple will increase and may cause a SUPPLY FLT trip, especially when the Elite is running at or near full output current.

Short Circuited DC Bus Capacitor

A shorted capacitor should cause two input fuses to fail during or soon after the soft charge interval. Because they are connected in series to share the DC bus voltage, if one capacitor has shorted it will have exposed all the capacitors opposite it to above rated voltage. This is shown in figure 4.6. In the right hand drawing, the top set of capacitors have been exposed to full DC bus voltage which will be approximately twice their rating. In this event, it is recommended to replace all the DC Bus capacitors or at a minimum, all the opposing capacitors as well as the faulty one.

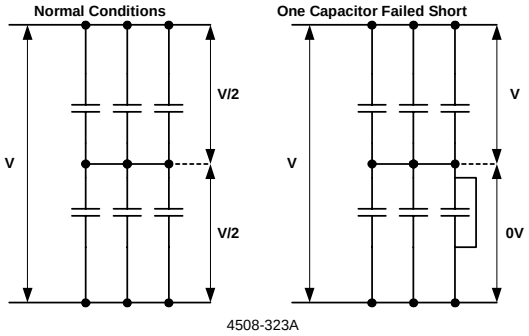


Figure 4.6: DC Bus Capacitor Short Circuit

4.4 TESTING

4.4.1 TESTING FRAMES 5 TO 7 RECTIFIER AND INVERTER

Refer figure 4.7 and using a Fluke 75 or similar check the rectifier as the drawing indicates.

Note each test is carried out 3 times, once per phase which is a total of twelve tests.

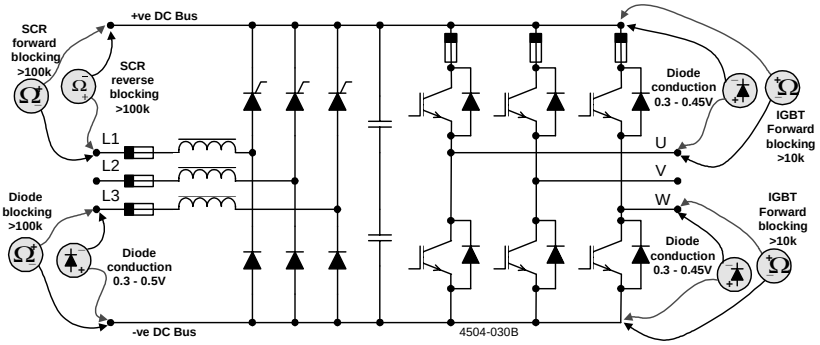


Figure 4.7: Rectifier and Inverter Testing Frames 5 to 7

4.4.2 FURTHER TESTING DETAILS

The components and the numbers per half phase are shown below to assist in understanding what you are testing.

1) To test the rectifier components individually, remove the input fuses and test on the load side of the fuses.

2) To test the IGBTs individually requires disassembly of the Elite.

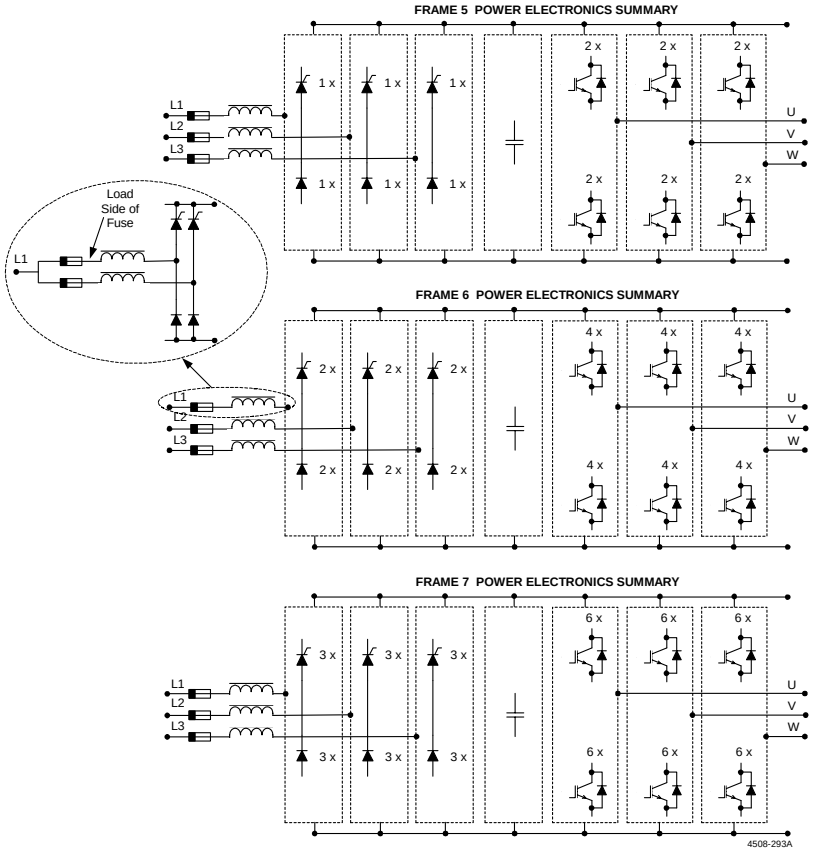


Figure 4.8: Rectifier and Inverter Power Electronics Summary

4.4.3 TESTING FOR CORRECT SCR CONDUCTION

Using a 24Vdc current limited power supply or battery arrangement as shown in figure 4.9. Connect the supply positive to the respective input fuse/choke terminal, and the supply negative to the positive DC Bus terminal.

Unplug the other end of the corresponding gatedrive cable from the Power tray. Turn on the power supply and set the output voltage to 24Vdc (approx.) Apply a trigger pulse to the SCR under test with 24Vdc via a resistor of between 18 and 100 ohms, via the plug on the unplugged end of the gate drive cable. Trigger the SCR as per figure 4.9 below.

Note: the SCR will not be damaged if the red lead makes contact with the trigger lead from the power supply.

When the gate has been triggered, the SCR should latch into conduction and the supply go to current limit or the lamp glow for the alternative testing arrangement. Since the supply is DC, the SCR will not turn off until the supply is removed. If the SCR will not stay latched on, check the current limit is not set too low, or the lamp is too low a wattage to allow sufficient current for the SCR to maintain a latched state.

If the SCR fails to conduct, suspect a failed input fuse, SCR, Gate Trigger PCB or interconnecting loom.

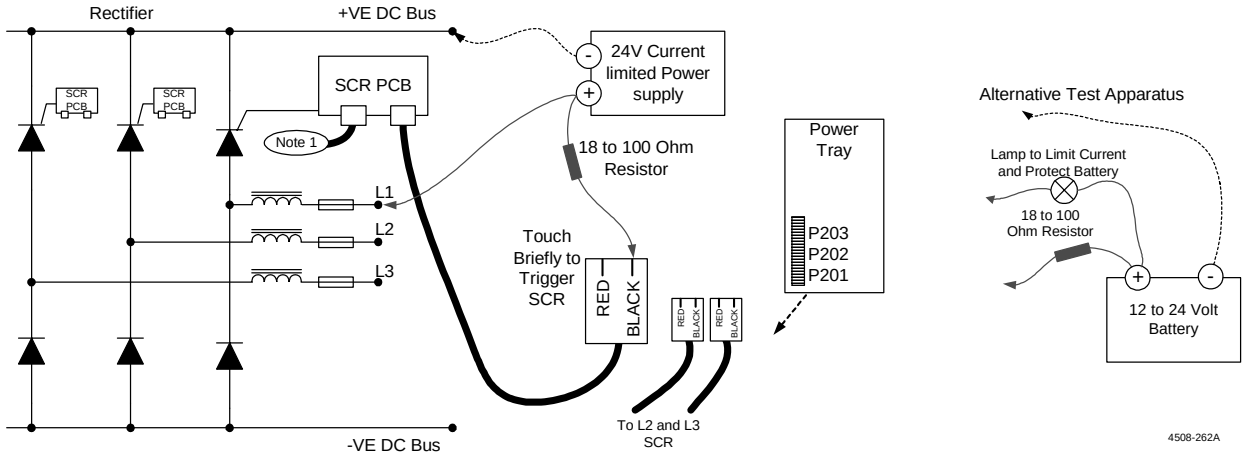


Figure 4.9: SCR Conduction Test

4.4.4 INDIVIDUAL SCR TESTING

When the Elite is disassembled, the SCR's can be tested individually as shown in figure 4.10.

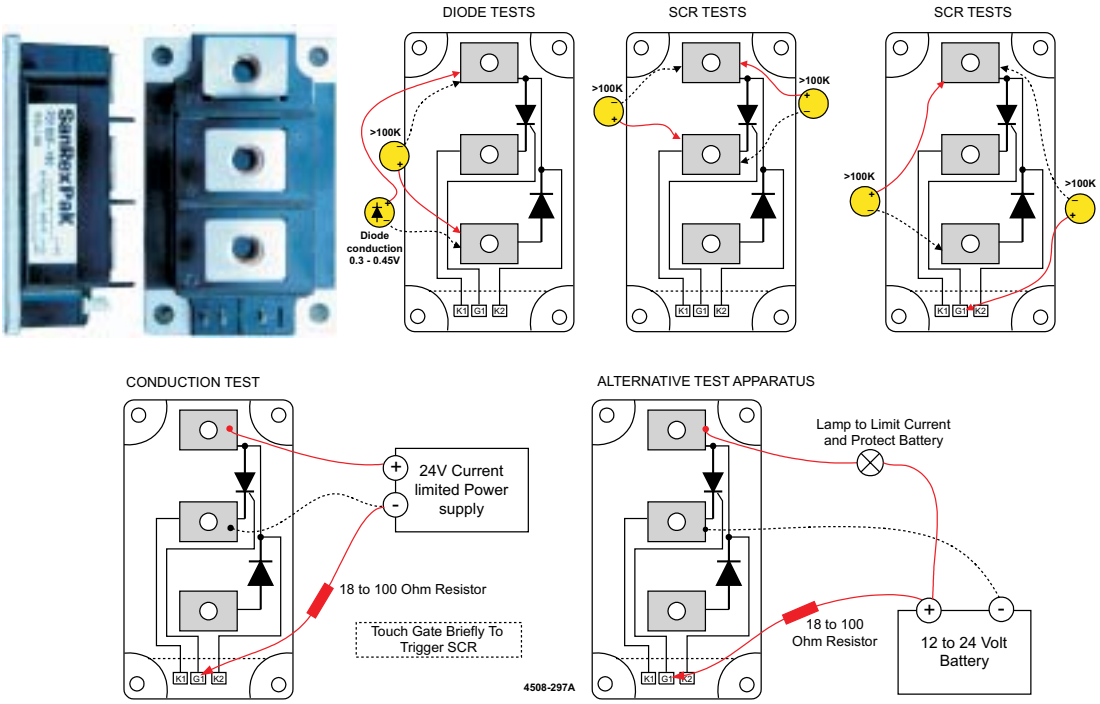


Figure 4.10: Individual SCR Conduction Test

4.4.5 TESTING INDIVIDUAL IGBT

You must wear a static grounding wrist strap and it must be earthed. The IGBTs should be tested individually, this can be done with or with out the Gatedrive board in place. The preliminary tests are done with a multi meter. The meter readings below are a guide and may vary with differing meter brands. It is best to compare the suspect IGBT's with a known good IGBT.

Note: the gate and emitter are shorted together for one test as shown below. The IGBTs should be stored and handled in this state.

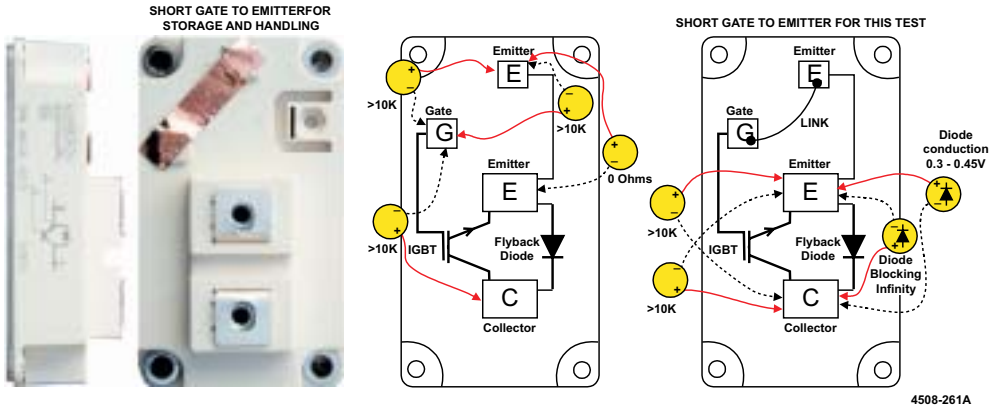


Figure 4.11: Individual IGBT Testing

The final tests are done as shown in figure 4.12. This test is very important as it is possiblefor the multi meter tests to show the IGBTs are OK, but the IGBT may not actually work (the IGBT does not respond to a Gatedrive signal) If this is not detected and the Elite is reassembled with a non functioning IGBT in parallel with good IGBTs, the current will be shared between the good IGBT's. When the Elite is supplying full load current the IGBT's in the half phase with the faulty one will be overloaded and will fail prematurely.

Important note, the 1K resistor must be between the gate and emitter at all times during the tests.

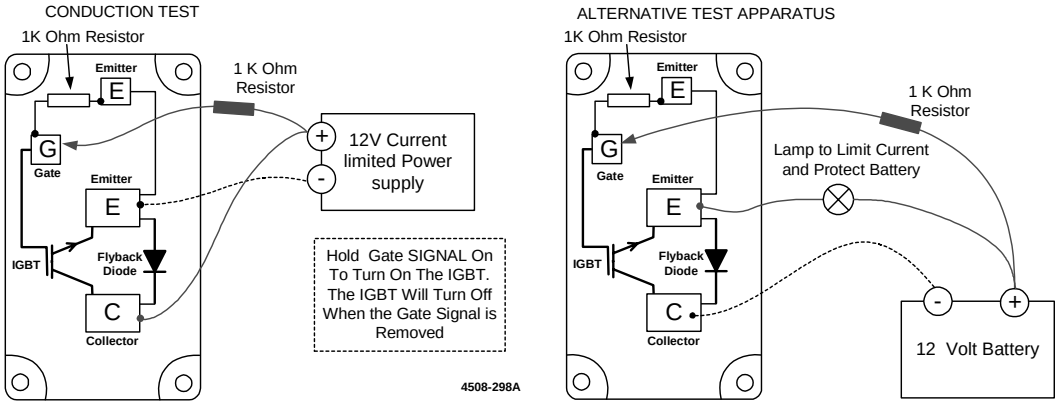


Figure 4.12: Individual IGBT Testing

4.4.6 TESTING THE DCCT AND DCCT SUPPLY

The DCCTs measure motor current, and are located on the output of the Elite. DCCT failure may be indicated by: **Fault 21 (Ground fault)** or **Fault 58 (Current imbalance)**, even with the motor disconnected. If fault 21 is apparent and the motor and motor cable have been checked and are OK, check the DCCT terminations as shown in figure 3.9 and the Inverter as shown in figure 4.7. The 6 pin connector is located at the very top of the Control Board.

Check plugs P1, P2 and P3 connecting the DCCTs to the Power tray. Ensure they are correctly inserted.

How to test the DCCTs

1) Power up the Elite but do not start, refer to figure 4.13. This drawing shows two options for testing the DCCTs, either test between ground and terminal 1, then between ground and terminal 4 and 6 to confirm the DCCT has a ±14V supply or test at the plug. If the ±14 supply is not present, unplug the DCCT's and recheck the ±14 supply. If the supply has returned, one or more of the DCCTs are faulty. If the supply has not returned, the Control board or Power tray's switch mode power supply may be faulty, see section 3.3.4 to determine which is faulty.

2) Test the DCCTs by measuring between ground and terminals 3, 5 and 6 this should be 0V, if the three readings are not at 0 volts, replace the faulty DCCT(s).

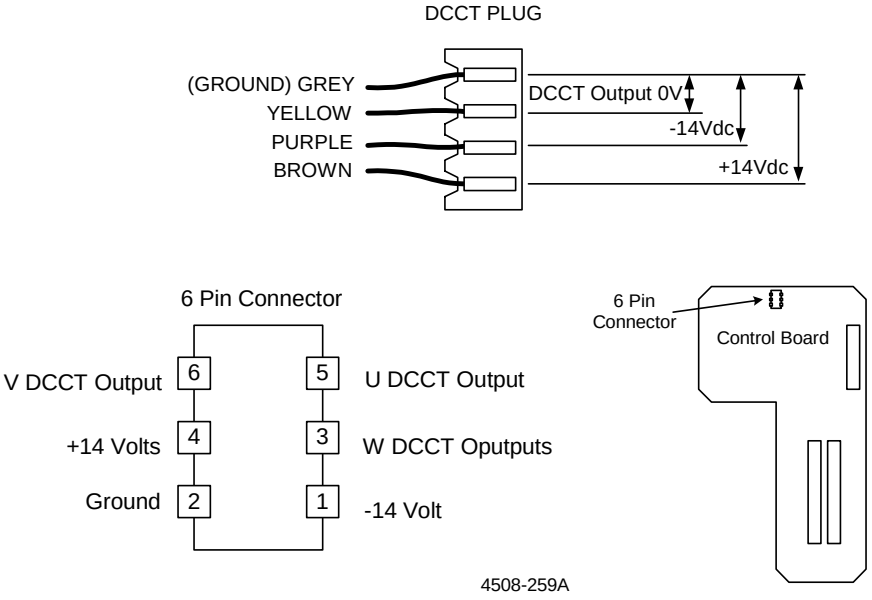


Figure 4.13: DCCT and Supply Testing

4.4.7 DC BUS CAPACITOR TESTS

First test the rectifier and inverter by following the procedure in section 4.4.1

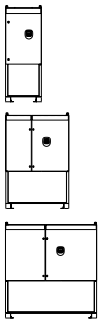
Test the capacitors by using a meter set to OHMS between HVDC terminals + and -. The resistance should start low, then increase as the capacitors charge to the meter battery voltage (ensure the DC bus capacitors are fully discharged first). This charging period could take some time and it is best carried out by testing the suspect machine against a known good Elite of the same amperage rating or check the spare parts list and pick an Elite of the same frame size with the same number of DC Bus capacitors. Time the rate of charge i.e. the increase in ohms on the meter and comparing this against the suspect Elite. If this test indicates reasonable variation there may be a problem with the capacitors. Further testing requires disassembly of the Elite.

To test for individual open or short circuited capacitors Elite must also be dismantled and each capacitor individually checked with a multimeter. Ensure all capacitors are fully discharged, then connect the meter on OHMS range across each capacitor in turn, with the meter positive to the capacitor positive. On a good capacitor, the resistance should start low, then increase as the capacitor charges to the meter battery voltage.

Visual Inspection

These capacitors are a sealed canister with a vent beside the terminal posts. If the capacitor has overheated or suffered an internal fault and pressure build up internally the bung in the vent hole should be displaced.

4.5 SOFT POWERING AFTER REPAIR



Once all faulty components and assemblies have been replaced, and the Elite has been carefully reassembled, it is recommended that the machine be tested as per section 4.4.1 then Soft Power.

4.5.1 SOFT POWERING

This procedure uses a special Soft Power supply, available from PDL Electronics or the circuit diagram to build one is in section 8 of this manual . This power supply generates a 600Vdc power source, which can be used to power up the power electronics PCB without powering up the DC bus. Then the DC bus is energised with a separate DC power supply (around 24Vdc) with current limiting. The procedure enables any remaining inverter fault to be found without causing further damage.

Energising of Power Electronics Sub Assembly

Connect the Soft Power supply to the mains, preferably via an isolating transformer. Do not switch on. Remove the Power tray DC supply plug P204 and connect the output plug from the soft power supply to plug P204. P204 is on the lower left-hand side of the Power tray.

Energise the Soft Power supply. The Display should come up as per normal and the red BUS LIVE LED should energise on the Power tray. Set the Elite to local start/stop and speed reference control, see Technical manual part number 4201-180 for details. The Elite should respond to Display key pad start/stop commands and speed reference changes. Bring the output to zero speed and stop. Power down the Soft Power supply.

Energising the DC Bus

Now connect a 24Vdc Power Supply (current limited) to the +DC Bus and -DC Bus terminals, observing correct polarity. Turn on this power supply and slowly bring up the output voltage to 24Vdc. The supply should not draw noticeable current except the bus capacitor charging current when increasing the output voltage.

Once the DC bus voltage is at 24Vdc, energise the Soft Power Supply again. Start the Elite from the keyboard and increase the output frequency or speed to100% . Now use a multimeter set to AC VOLTS, to measure the output voltage, between terminals U-V, V-W, W-U. These voltages should all be balanced at approximately 17.5Vac. If there is any sign of imbalance, measure between each output and earth. If any output voltage is **significantly** different, suspect that there is still an unrepaired fault on that particular phase or a loose termination.

If the test shows no faults and a good output voltage balance, the test power supplies can be disconnected, mains and motor reconnected, and a full test done.

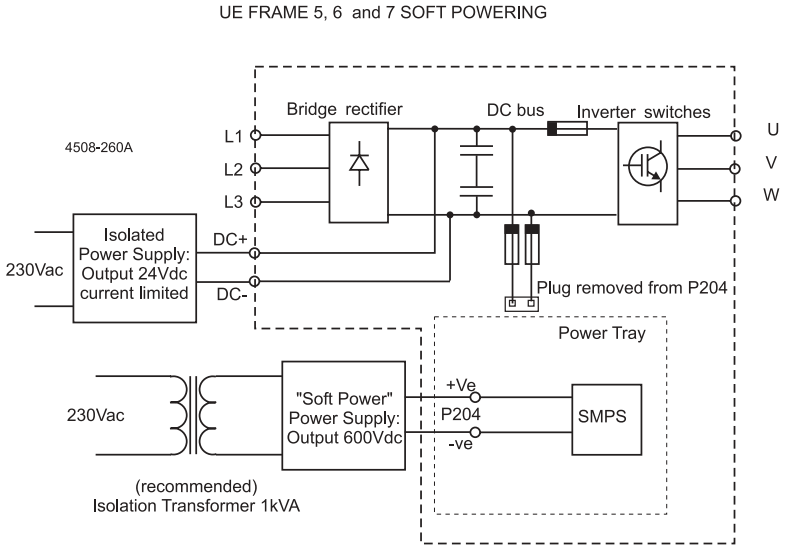
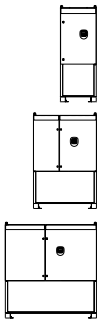


Figure 4.14: Soft Power Supply Connections



NOTES

5.0 FRAME 5 ULTRADRIVE ELITE SERVICE

This section covers 400V models from UE-170 to UE-250 and 500V models from UE-170D to UE-250D

The 400V and 500V models are essentially identical for disassembly and reassembly purposes. When specific differences exist between the 400V and 500V models, these are noted.

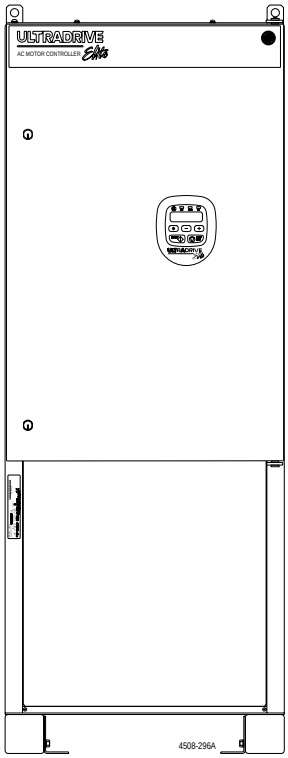


Figure 5.1: Frame 5 Ultradrive Elite

Contents

5.1 PARTS LISTS AND BLOCK DIAGRAMS

5.1.1 FRAME 5 400V ULTRADRIVE ELITE PARTS LIST

400 VOLT ULTRADRIVE ELITE PARTS LIST					
Frame Size	FRAME 5			Spares Guide	
Model	UE-170	UE-210	UE-250	*Level 1	**Level 2
Display Unit	E250-620S				
Control Board	E000-610S			1	1
Power Tray	E660-611S			1	1
SCR Board	3 x E660-615S			1	2
SCR Loom	2721-091				
AC Power to Power Tray Loom	2721-119				
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 E250-612S				2
DC Bus Capacitors	12 x 1352-453	18 x 1352-453			
Capacitor Sealing Rings	12 x 3907-004	18 x 3907-004			
External Fans	2 x 2941-011				1
Main Internal Fan	2941-006				1
DC Bus Fuse	3 x 3302-615	3 x 3302-616			3
Input Fuses	3 x 3302-615			3	3
SCR Board Fuse	3 x 2401-025				3
Power Supply Board Fuses	2 x 2404-063			2	2
DC Power Supply Board	E660-621S (Includes Fuses)				
Thermal Sensor Boards	6 x E000-619S				2
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)				
* Level 1: Minimum spares stock					
**Level 2: Typical spares stock					
4508-275A					

Figure 5.1 : Frame 5 400V Parts List

5.1.2 FRAME 5 400V ULTRADRIVE ELITE BLOCK DIAGRAM

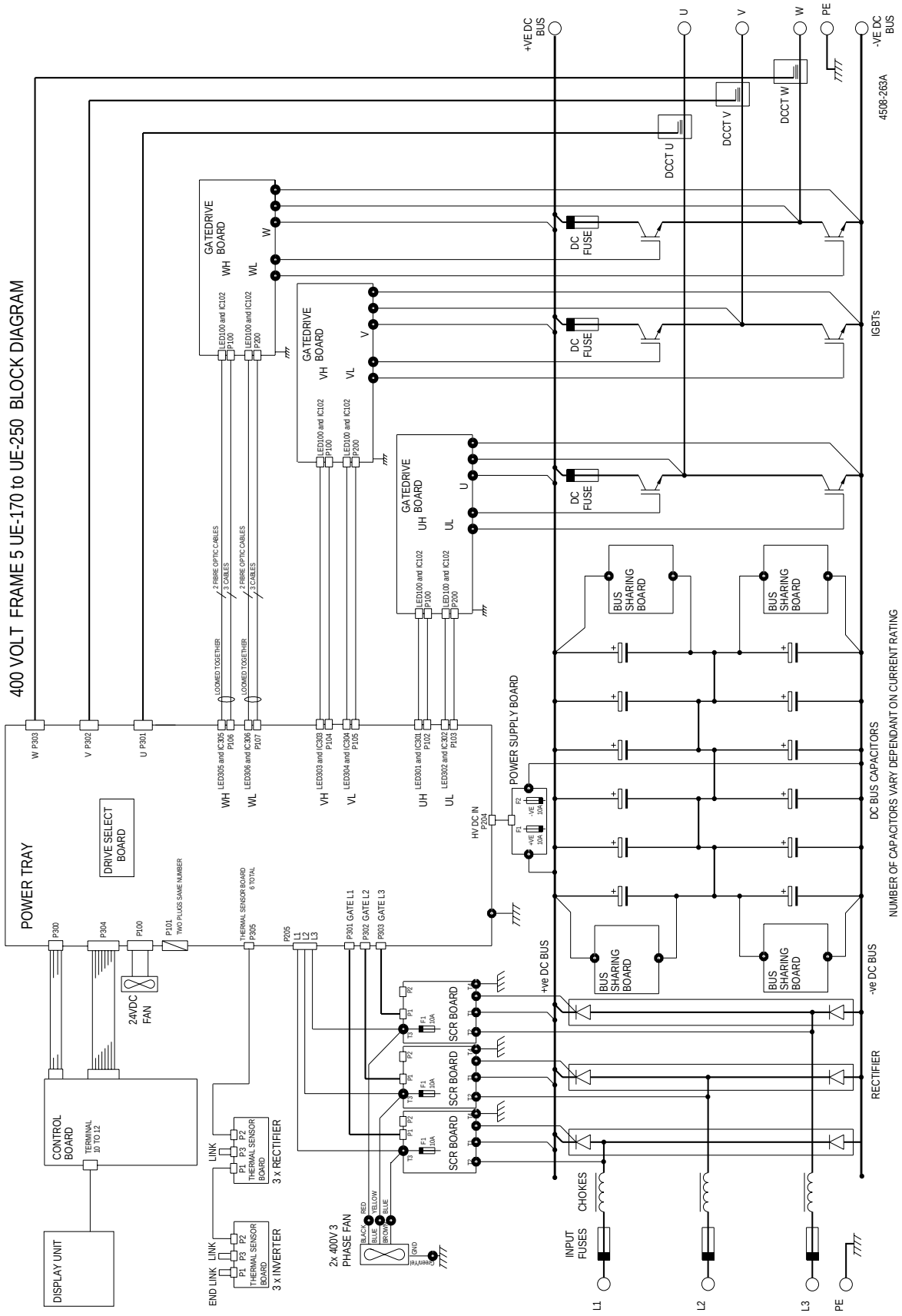


Figure 5.2 : Frame 5 400V Block Diagram

5.1.3 FRAME 5 500V ULTRADRIVE ELITE PARTS LIST

500 VOLT ULTRADRIVE ELITE PARTS LIST					
Frame Size	FRAME 5			Spares Guide	
Model	UE-170D	UE-210D	UE-250D	* Level 1	** Level 2
Display Unit	E250-620S				
Control Board	E000-610S			1	1
Power Tray	E661-611S			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 1721-040				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)				
External Fan P/S Transformer	2571-066				1
External Fan P/S Board	E000-648				1
* Level 1: Minimum spares stock					
**Level 2: Typical spares stock					
				4508-276A	

Figure 5.3: Frame 5 500V Parts List

5.1.4 FRAME 5 500V ULTRADRIVE ELITE BLOCK DIAGRAM

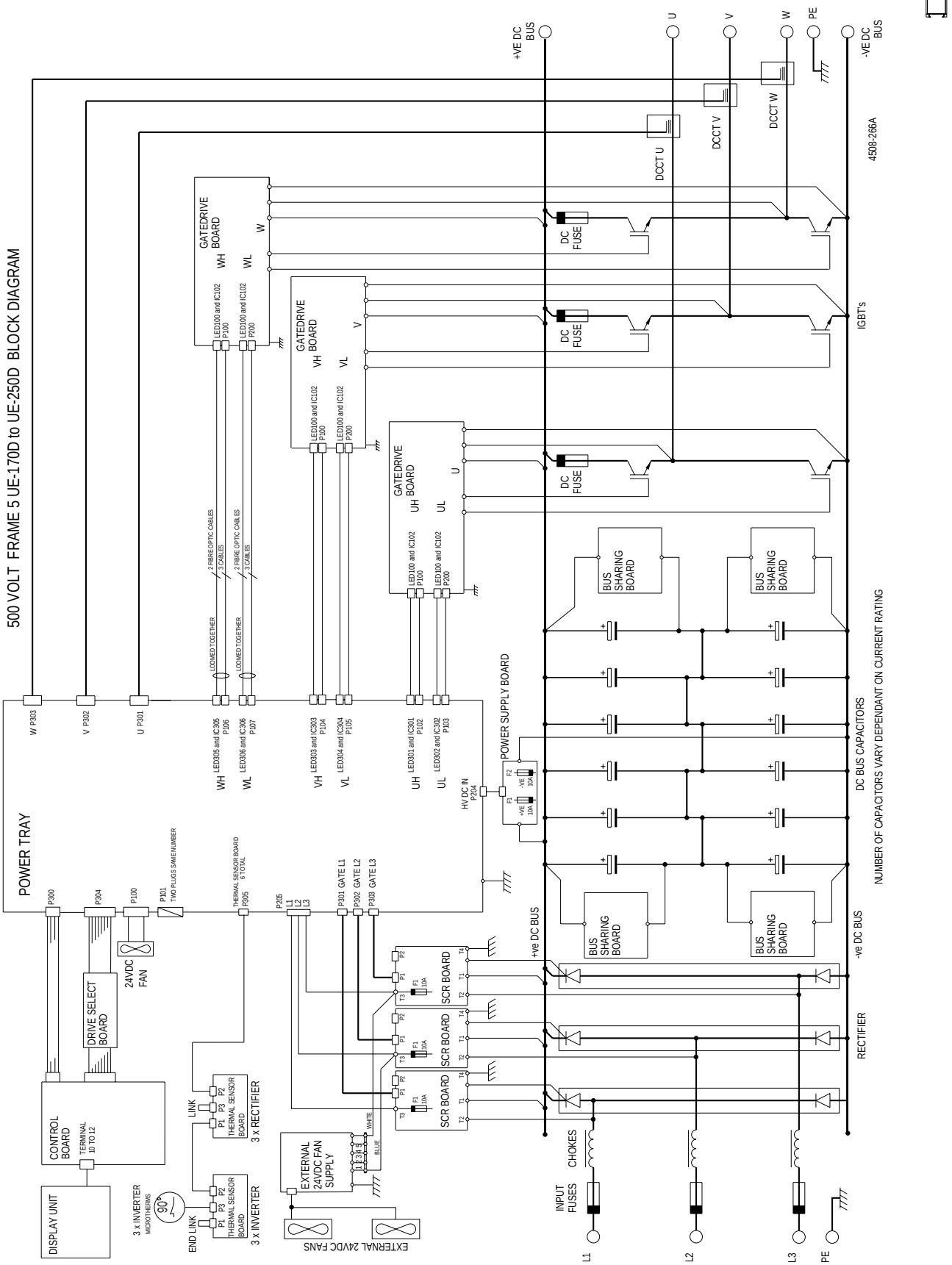


Figure 5.4: Frame 5 500V Block Diagram

5.2 SERVICE

5.2.1 SERVICING THE CONTROL BOARD

1) Ensure the Elite is safe to work, see section 4.2 before proceeding.
2) Number the three way controls to enable easy replacement then unplug them and remove the control cable clamps if used.
3) Referring to figure 5.5 access to the wiring looms on the lower left hand side by removing screws (A) 3 off CW M4x10 retaining this plate.
4) Unplug the 7 wiring looms under the plate.
5) Remove the remaining cover plates in one assembly by removing screws (B), 3 off M4x10. Slide the cover plate assembly down slightly to clear the fibre-optic connections before lifting it clear.
6) Referring to figure 5.6, the Control board is held by the Phillips screws (C), 3 off M4X10 screws. Remove these and lift the control board vertically off the connecting pins.
   Note: lift beside the plugs and keep the board level to avoid bending the connecting pins.
7) 500V models have a drive select board between the Control board and the Power tray, leave this in place.
8) The replacement Control board will be in biscuit format. It will have to be trimmed to the same size as the existing board size as per figure 5.8. This is done with a fine pair of side cutters.
9) Place the Control board on the connecting pins
10) Gently push the 6 pin connector down slightly and repeat the process with the 40 pin connector. When this is completed, check through the slots to ensure no connecting pins are showing or damaged then push the control board completely home. Replace the 3 off M4x10 Phillips screws as per figure 5.6.
11) Replace the remaining components of the Elite in the opposite order as detailed in removing the Control board.

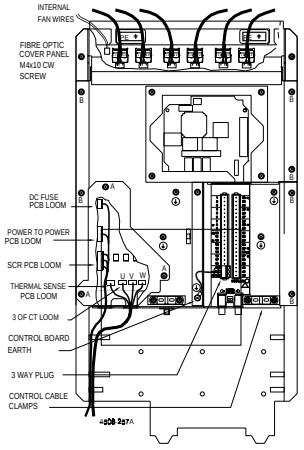


Figure 5.5: Frame 5 to 7 Power Tray

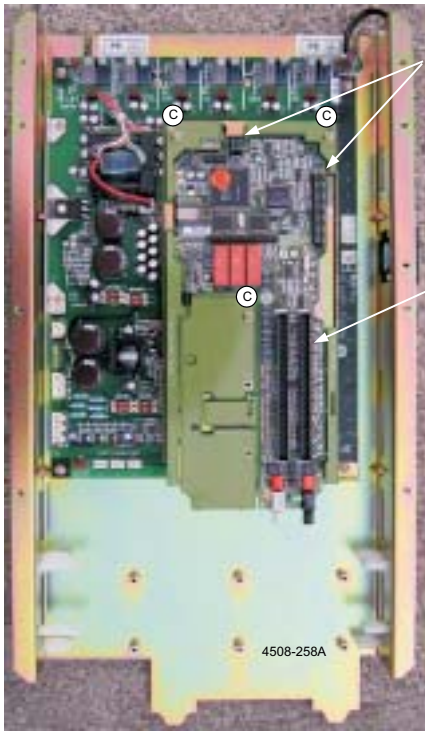


Figure 5.6: Frame 5 to 7 Power Tray and Control Board

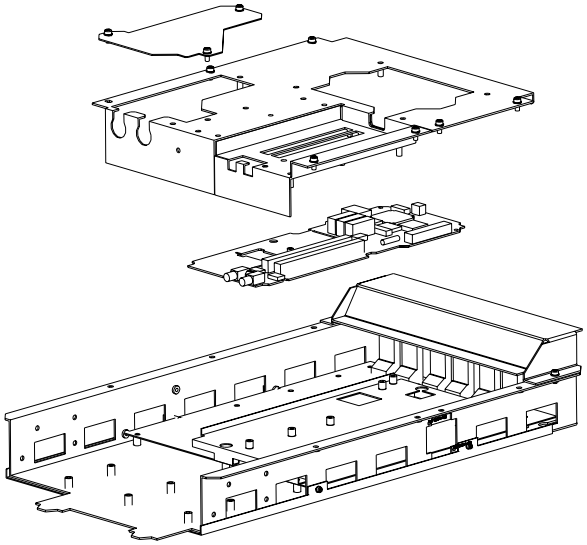


Figure 5.7: Frame 5 to 7 Power Tray Exploded View

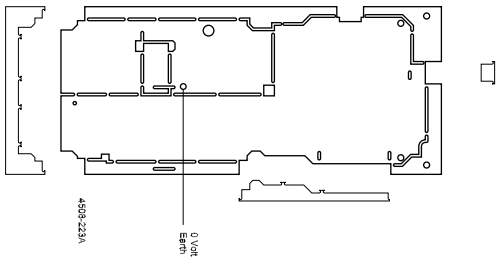


Figure 5.8: Frame 4 to 7 Control Board Biscuit

5.2.2 SERVICING THE POWER TRAY

The Power Electronics board is replaced as an entire assembly, inclusive of the mounting tray. This assembly is referred to as the Power tray .

1) See section 5.2.1 on removing Control board.
2) When the Control board has been removed, put it onto the new Power tray. For 500V models, move the Drive Select board to the new Power tray, see figure 5.10. For 400V models, this can be done after the Control Board is in place see figure 5.9.

Refer to figure 5.11 Frame 6 Power tray Removal.

3) Remove any customising items that may have been fitted in the space provided on the mounting tray.
4) Remove the lexan shield over the fibre optic looms.
5) At the top of the Power tray remove the wired connectors UL to WH (do not pull on the cables) then remove the fibre optic plugs UL to WH.
6) Unplug the internal fan plug from the top left of the Power tray.
7) Loosen the two Power tray retaining screws and lift the Power tray clear.
8) Place the new Power tray in the Elite and replace the wiring looms etc. In the opposite order that they were removed. Take care that the connectors are replaced without crossing phases, and without inadvertently off setting pins. The fibre optic looms and the circuit board are marked to ensure the connections are made correctly. Particular care must be taken with the fibre optic looms to avoid a bending radius of less than 35mm.
9) Replace the lexan shield over the fibre optic looms.

Before mains powering the Elite, it is recommended to Soft Power the Elite to test the new parts are functioning correctly without risk of damage should something else be faulty or an error made during reassembly. See section 4.6.

Figure 5.9: 400V Power tray

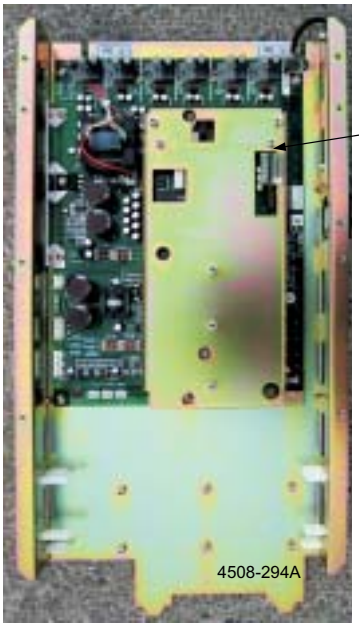


Figure 5.10: 500V Power tray

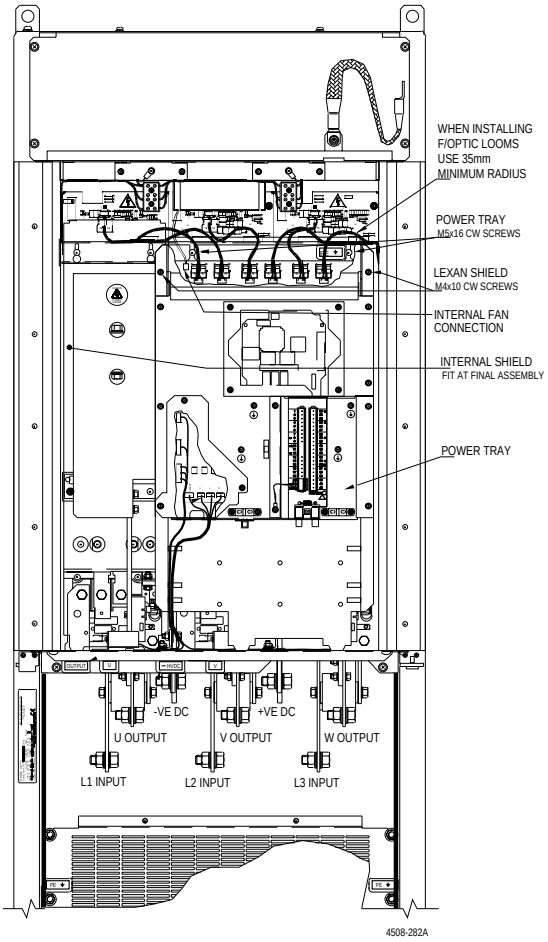


Figure 5.11: Frame 6 Power Tray Removal

5.2.3 SERVICING THE OUTPUT SHEET BUS

Ensure you have adequate small containers to place the Bus Sharing board, DC Supply board, Positive Sheet Bus and Negative sheet bus fixings in there own container. This will help speed up reassembly.

1) Remove the Power tray as in the previous section.

2) Referring to figure 5.12, remove the Lexan shield held at the top by 2 off M x16 CW Screws.

Note: All three output phases will have to be removed, the details below indicates how to remove one.

3) Remove the top Power tray support rail if you are replacing IGBTs. If you are replacing DC Bus capacitors or the SCR/diode blocks, it can be left in place. Unclip the fibre optic loom at each end of the rail, then remove the 4 off M4x10 CW screws at each end.

4) Remove screws 2 off screws (A), and 2 off bolts (B and C).

5) The output Sheet Bus can be lifted clear and the output busbar can be pulled through the grommet. If the bus bar is sticking to the grommet, some soapy water will help it slide out.

6) Unplug the lower fibre optic looms from the Gatedrive board. Leave the looms in the nylon cable clamps.

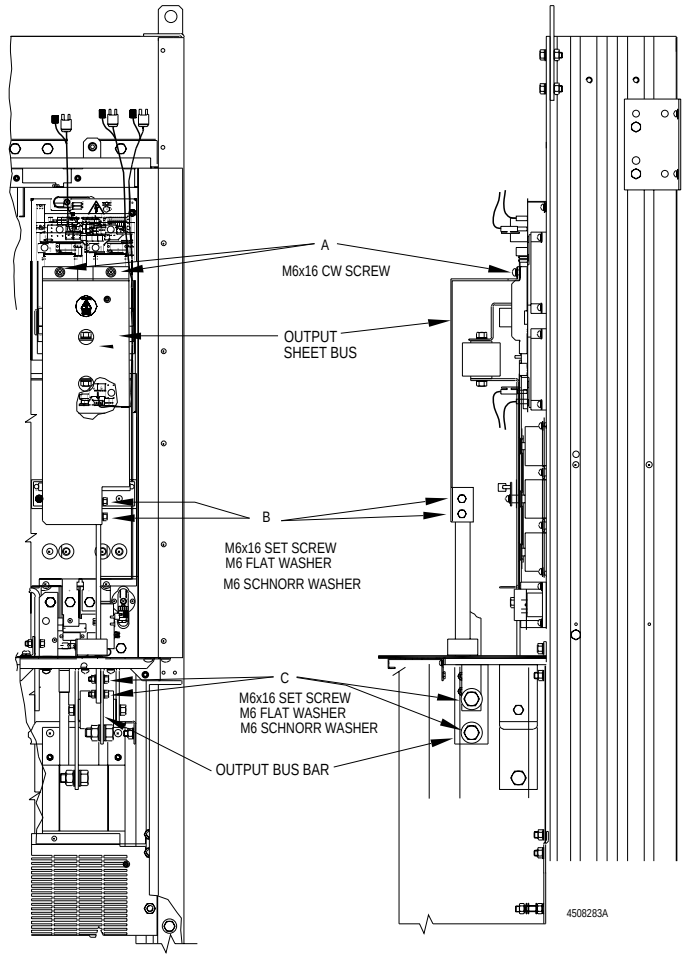


Figure 5.11: Frame 5 Output Sheet Bus Removal

5.2.4 SERVICING THE POSITIVE AND NEGATIVE SHEET BUS

Removing the Bus Sharing and Power Supply Board

Refer to figure 5.13 and figure 5.14.

1) Remove the Bus Sharing boards and Bus Sharing cable. These two assemblies are secured by screws (A, B) and use 6 off 16mm long brass spacers. It is best to remove them as a full assembly, keeping the screws and spacers together. This makes it easier to reassemble.

2) Remove the Power Supply board. This is secured by screws (C) and have 4 brass spacers. The outer two spacers are 16mm long and the inner pair are 16.8 mm long. It is best to remove them as a one assembly, keeping the screws and spacers together. This makes it easier to reassemble.

3) It is not necessary to unbolt the DC Bus fuses as the positive Sheet Bus can be removed as one piece.

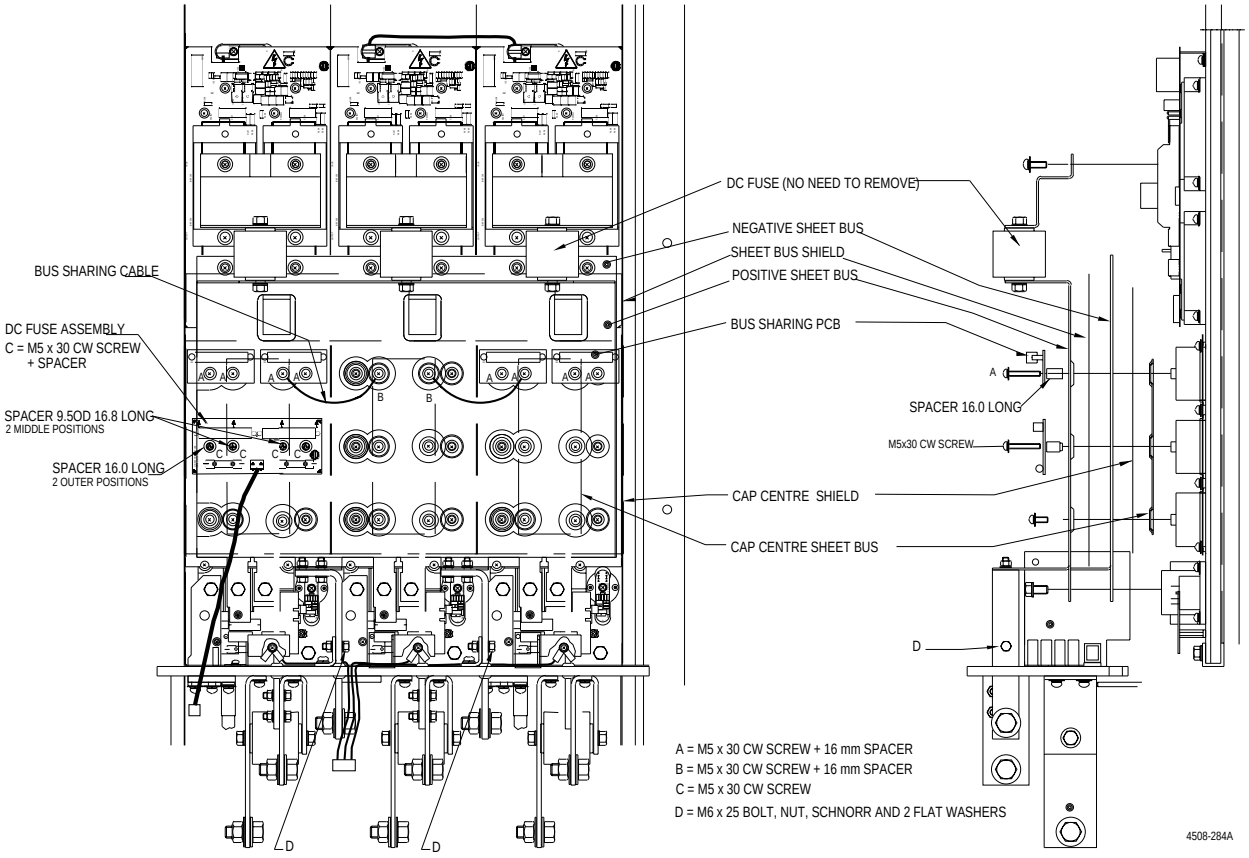


Figure 5.13: Frame 5 Positive and Negative Sheet Bus

Removing the Positive and Negative Sheet Bus

Note: This drawing has been labelled to assist more with reassembling than the disassembling.

1) Refer to figure 5.13 and remove bolts D.

Refer to figure 5.14.

2) Remove bolts (E and J). Slide the busbar into the termination area, do not slide it completely through the grommet . Use soapy water if the bus bar is sticking.

3) Remove the Positive Sheet Bus starting from F to J.

3) Remove the Negative Sheet Bus starting from B to E.

4) If you are not going to change the capacitors do not remove the cap centre Sheet Bus screws (A).

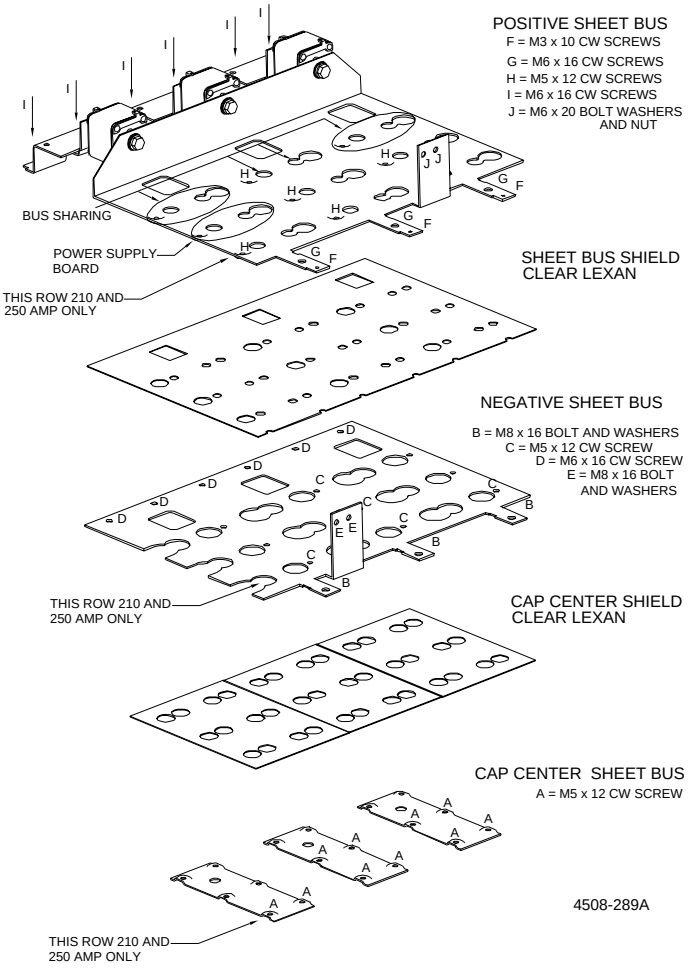


Figure 5.14: Frame 5 Positive and Negative Sheet Bus 3D View

5.2.5 SERVICING THE IGBT GATEDRIVE BOARD

Ensure you have a means of shorting out the gate and emitter of the IGBTs before you remove the Gatedrive board.

Refer to the upper section of figure 5.12.

1) Remove screws (A) 2 off, (B) 8 off and (C) 1 off on the phase you require access to and lift off the Gatedrive board.

2) Short out the gate and emitter on the IGBTs.

5.2.6 SERVICING THE SCR BOARD

Refer to the lower section of figure 5.12.

1) To get access to the SCR Board, remove the DCCT and DCCT mounting bracket as one assembly The bracket is held by 2 off M4x12 CW screws. Lay the DCCT and bracket carefully to one side.

2) Remove the choke rectifier busbar fixings (D, E and F) then slide the Bar through the grommet just enough to allow access to the SCR Board. It is best to avoid pulling out the Bus Bars if possible as they can be difficult to put back in, use soapy water if necessary.

3) Remove the screws (G and H) and unplug P1 (**Note:** P1 and P2 are common connections to the SCR gate).

4) The SCR Board is now only held to the SCR by male spade terminals. The SCR Board can now be lifted vertically off the SCR.

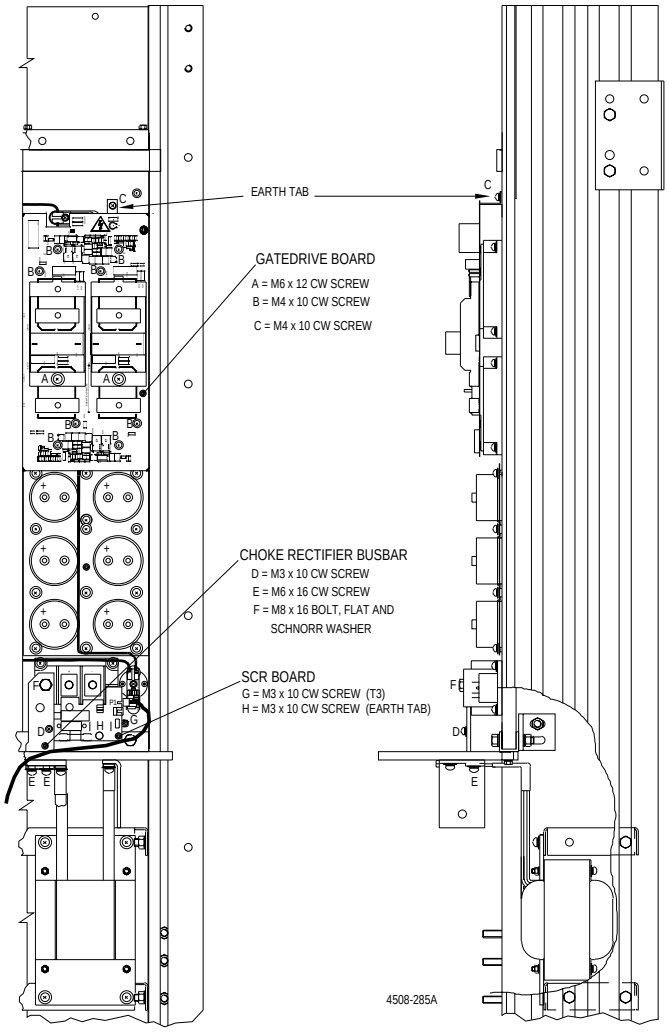


Figure 5.15: Frame 5 Snubber and SCR Board

5.2.7 SERVICING THE IGBT

Refer to the upper section of figure 5.16.

Each IGBT is held by 4 off M6x16 CW screws. A thermstrate is used between the IGBT and heatsink to ensure good thermal contact. Remove the old IGBTs and clean the heatsink surface.

1) Leave the the gate emitter shorting link on the new IGBTs.

2) Use a new thermstrate. **Avoid touching the surface of it**, **do not use the paper packer**.

3) Replace the 4 off M6x16 CW screws **do not tighten yet** and push the IGBT block towards the base of the Elite, then tighten the screws. This will align the replacement blocks in the same manner as the remaining half phases.

4) Remove the gate emitter shorting ribbon from the IGBTs and replace the Gatedrive Board.

5.2.8 SERVICING THE SCR/DIODE BLOCK

Refer to the lower section of figure 5.15.

Each SCR/diode block is held by 4 off M5x16 CW screws, and a thermstrate is used between the SCR/diode block and heatsink to ensure a good thermal contact. Remove the old SCR/Diode Block and clean the heatsink surface.

1) Use a new thermstrate, avoid touching the surface of it, do not use the paper packer.

2) Replace the 4 off M5 x 16 CW screws, **do not tighten yet,** and push the SCR/Diode block towards the bottom of the Elite. Tighten the screws. This will align the replacement blocks in the same manner as the remaining half phases.

500V MICROTHERMS

The 500V models have three microtherms connected to and located above the top set of Thermal Sense boards.

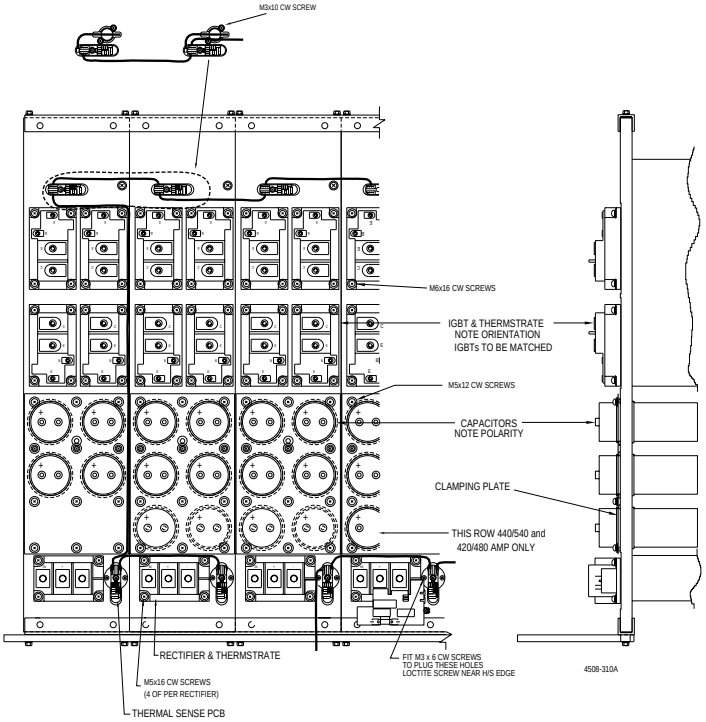


Figure 5.16: Frame 5 IGBT, Capacitors and SCR Level

5.2.9 SERVICING THE CAPACITOR

The capacitors are mounted through the heatsink with the bulk of the capacitor in the main cooling airflow at the back of the machine. Sealing rings are used to prevent air leakage through to the inside of the machine.

To remove the capacitors, undo 15 off M5x12 Phillips screws. See figure 5.16.

5.2.10 REPLACING THE CAPACITORS

The capacitors should be installed using a jig, PDL part number 5101-190, this ensures the height and rotational position are exact.

The sealing rings must be fitted to the capacitors at 23.5mm below the top of the terminal post. Place the capacitors in the heatsink and loosely screw down the clamping plate. Fit the jig to the capacitors then tighten the clamping plate screws. If a jig is not available precise fitting of the individual capacitors is required. Refer to figure 5.17. Fit the capacitor sealing rings exactly as shown. This should help to align the capacitor terminal post at 29.5 mm above the heatsink, when the clamping plate is secured. The rotational alignment of the post is also critical to prevent cross threading of the screws into the capacitor terminal post when the Sheet Bus is attached. Slight adjustments may need to be made as the clamping plate is clamped down.

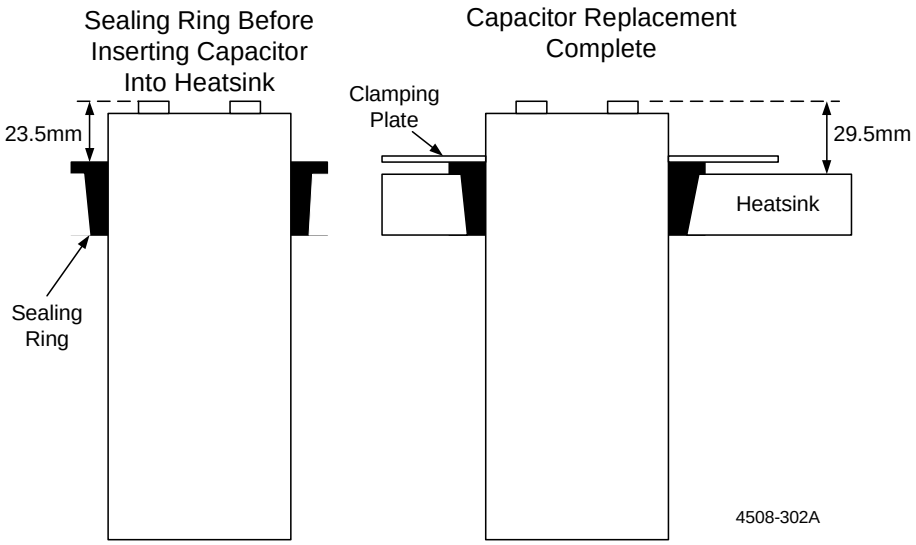


Figure 5.17: Frame Capacitor Replacement

5.2.11 500V MODELS EXTERNAL FAN POWER SUPPLY

The 500V models have a linear AC to 24Vdc power supply for the external fans. This is located directly above the internal cooling fan and is accessible by removing the gold coloured panel above the electronics cabinet. The panel is held by 6 off M5x10 CW screws.

An exploded assembly view is shown in figures 5.18 and 5.19.

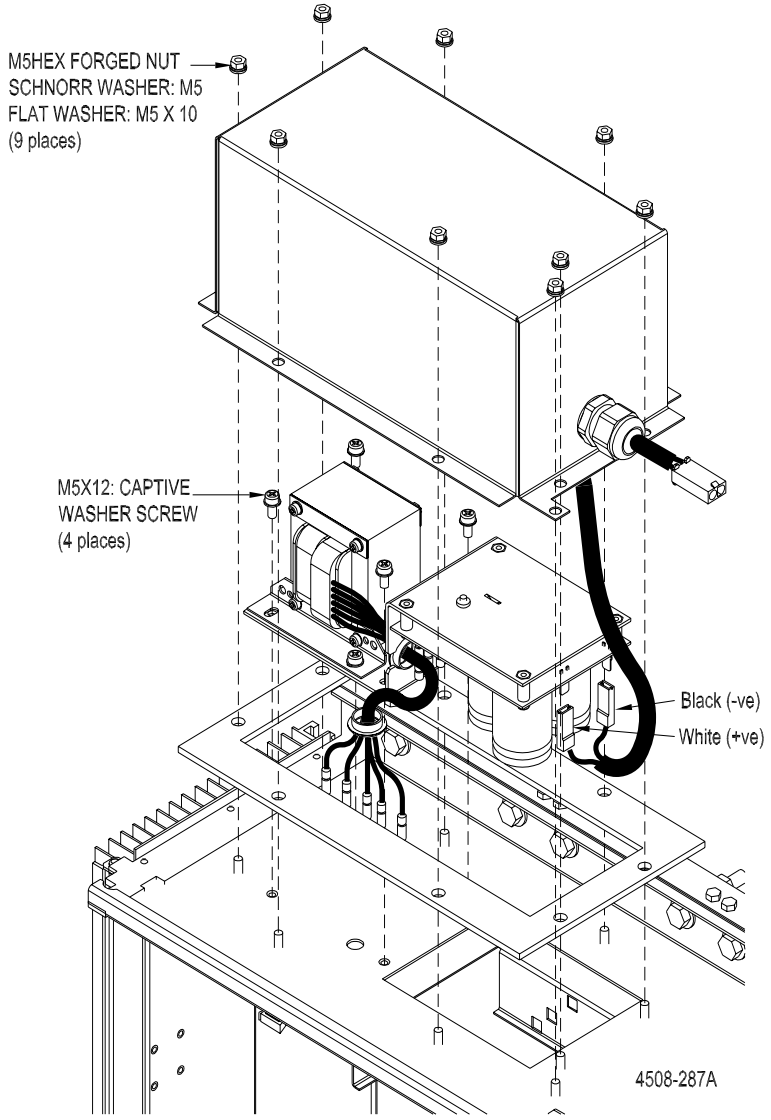


Figure 5.18: Frame 5 to 7 500V External Fan Supply

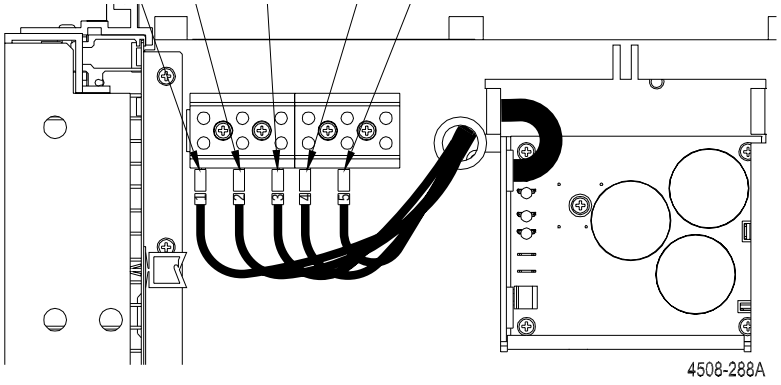


Figure 5.19: Frame 5 to 7 500V External Fan Supply Connections

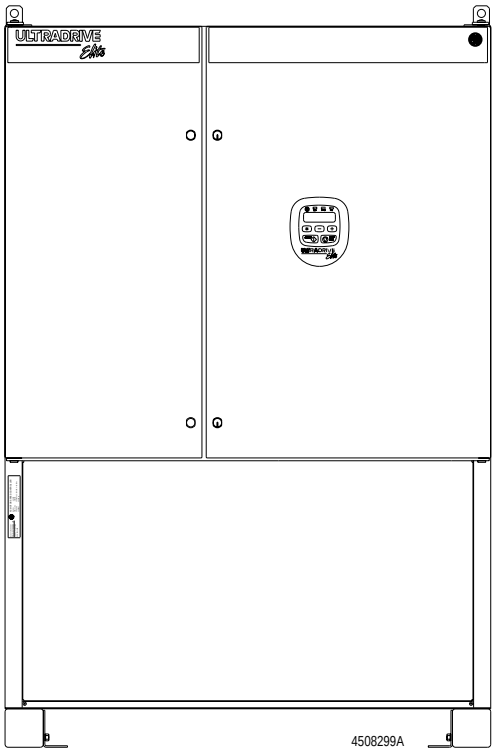
NOTES

Notes

6.0 FRAME 6 ULTRADRIVE ELITE SERVICE

This section covers 400V models from UE-305 to UE-480 and 500V models from UE-305D to UE-540D.

The 400V and 500V models are essentially identical for disassembly and reassembly purposes. When specific differences exist between the 400V and 500V models these are noted.



CONTENTS

6.1 PARTS LISTS AND BLOCK DIAGRAMS

6.1.1 FRAME 6 400V ULTRADRIVE ELITE PARTS LIST

400 VOLT ULTRADRIVE ELITE PARTS LIST						
Frame Size	FRAME 6				Spares Guide	
Model	UE-305	UE-340	UE-420	UE-480	*Level 1	**Level 2
Display Unit	E480-620S					
Control Board	E000-610S				1	1
Power Tray	E660-611S				1	1
SCR Board	6 x E660-615S					4
SCR Loom	2721-091					
AC Power to Power Tray Loom	2721-124					
Rectifier Block	6 x 1421-027					4
Rectifier Thermstrate	6 x 1781-103					4
IGBT Block	24 x 1757-136		24 x 1757-135			8
IGBT Thermstrate	24 x 1781-104					8
Gate Drive Board	3 x E480-612S					2
DC Bus Capacitors	24 x 1352-453		36 x 1352-453			
Capacitor Sealing Rings	24 x 3907-004		36 x 3907-004			
External Fans	4 x 2941-011				1	1
Main Internal Fans	2 x2941-006				1	1
Power Tray Fan	2941-014				1	1
DC Bus Fuse	6 x 3302-615		6 x 3302-616			6
Input Fuses	6 x 3302-615				6	6
SCR Board Fuse	6 x 2401-025				6	6
DC Power Supply Board Fuses	2 x 2404-063				2	2
Power Supply Board	E660-621S (Includes Fuses)					
Thermal Sensor Boards	12 x E660-619S					4
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			
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)					
* Level 1: Minimum spares stock						
**Level 2: Typical spares stock						
4508277A						

Figure 6.1 : Frame 6 400V Parts List

6.1.2 FRAME 6 400V ULTRADRIVE ELITE BLOCK DIAGRAM

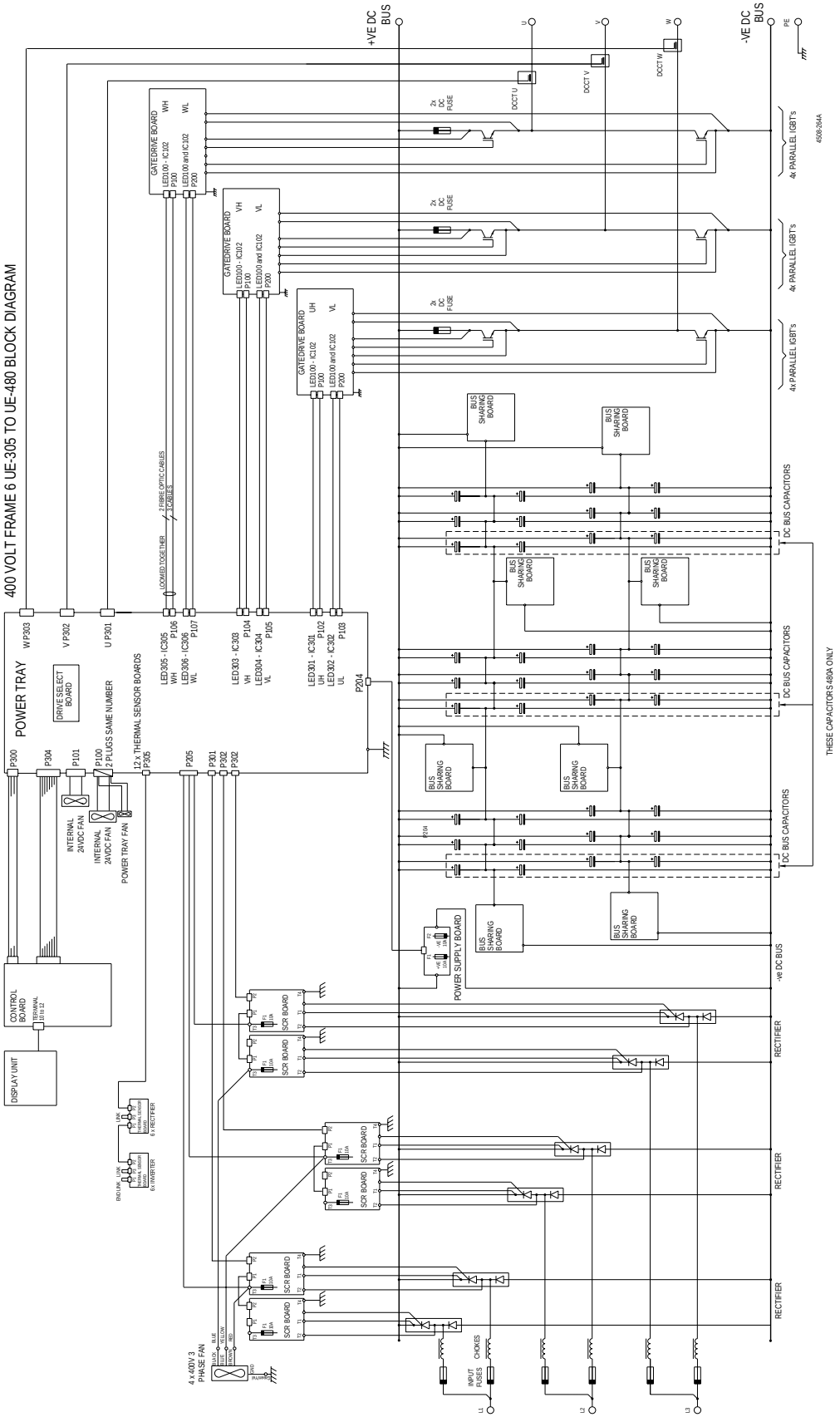


Figure 6.2 : Frame 6 400V Block Diagram

6.1.3 FRAME 6 500V ULTRADRIVE ELITE PARTS LIST

500 VOLT ULTRADRIVE ELITE PARTS LIST						
Frame Size	FRAME 6				Spares Guide	
Model	UE-305D	UE-370D	UE-440D	UE-540D	*Level 1	**Level 2
Display Unit	E480-620S					
Control Board	E000-610S					1
Power Tray	E661-611S				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 E481-612				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
Power Supply Board	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)					
External Fan P/S Transformer	2571-067					1
External Fan P/S Board	E000-648					1
* Level 1: Minimum spares stock						
**Level 2: Typical spares stock						
4508-278A						

Figure 6.3: Frame 6 500V Parts List

6.1.4 FRAME 6 500V ULTRADRIVE ELITE BLOCK DIAGRAM

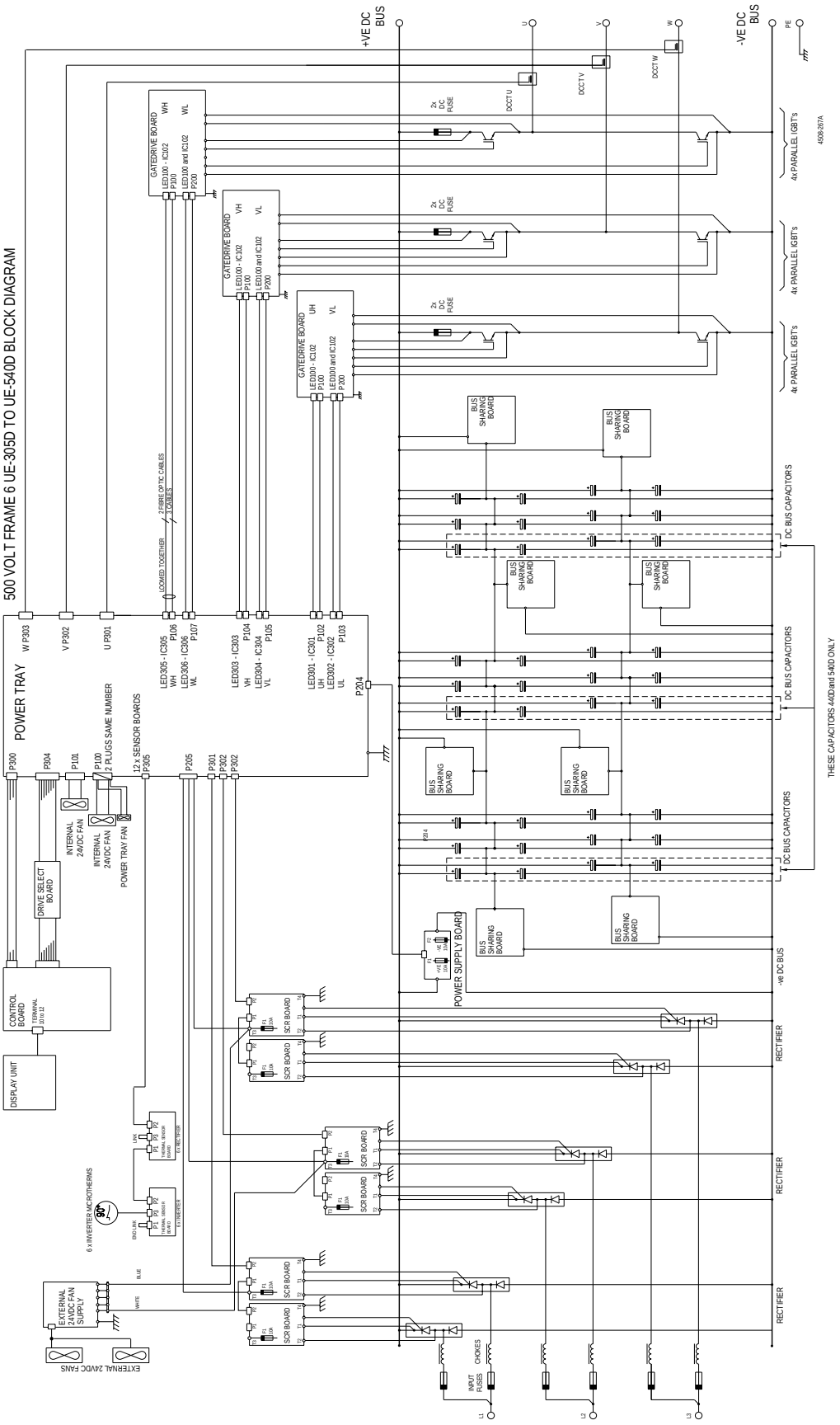


Figure 6.4: Frame 6 500V Block Diagram

6.2 SERVICE

6.2.1 SERVICING THE CONTROL BOARD

1) Ensure the Elite is safe to work, see section 4.2 before proceeding.

2) Number the three way controls to enable easy replacement then unplug them and remove the control cable clamps if used.

3) Referring to figure 6.5 access to the wiring looms on the lower left hand side by removing screws A (3 off CW M4x10) retaining this plate.

4) Unplug the 7 wiring looms under the plate.

5) Remove the remaining cover plates in one assembly by removing screws B, 3 off M4x10. Slide the cover plate assembly down to clear the fibre-optic connections before lifting it clear.

6) Referring to Figure 6.6, the Control board is held by the Phillips screws C, 3 off M4x10 screws. Remove these and lift the control board vertically off the connecting pins.
Note: lift beside the plugs and keep the board level to avoid bending the connecting pins.

7) 500V models have a drive select board between the Control board and the Power tray, leave this in place.

8) The replacement Control board will be in biscuit format i.e. it will have to be trimmed to the same size as the existing board size as per figure 6.8. This is done with a fine pair of side cutters.

9) Place the Control board on the connecting pins

10) Gently push the 6 pin connector down slightly and repeat the process with the 40 pin connector. When this is completed, check through the slots to ensure no connecting pins are showing or damaged then push the Control board completely home. Replace the 3 off M4x10 Phillips screws as per figure 6.6.

11) Replace the remaining components of the Elite in the opposite order as detailed in removing the Control board.

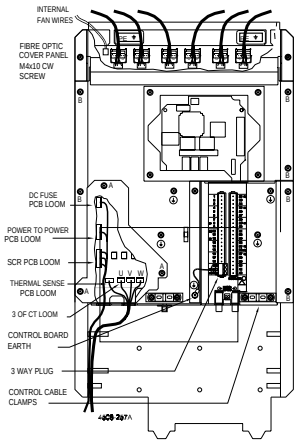


Figure 6.5: Frame 5 to 7 Power Tray

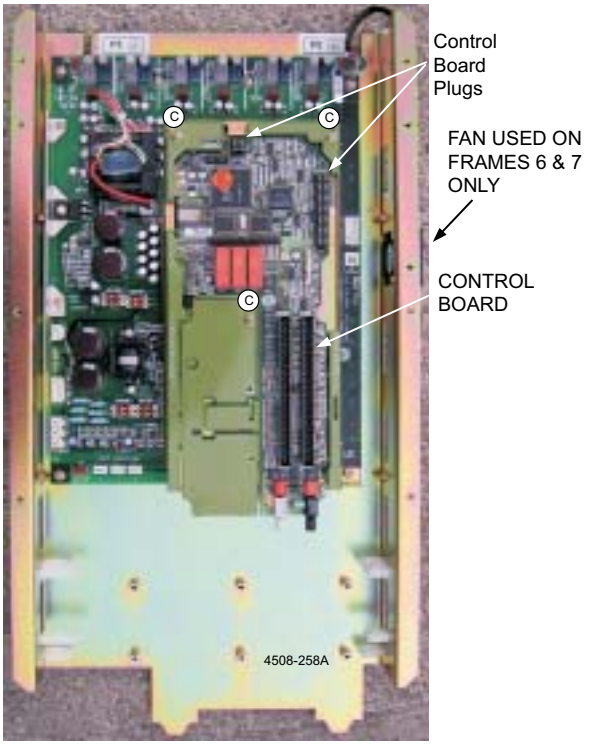


Figure 6.6: Frame 5 to 7 Power Tray and Control Board

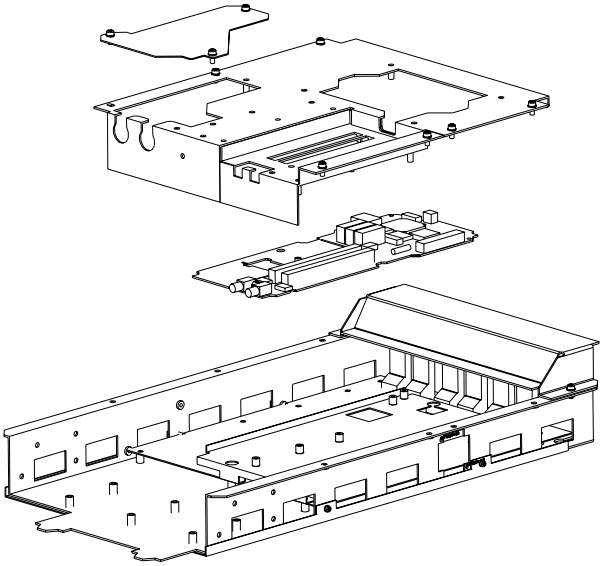


Figure 6.7: Frame 5 to 7 Power Tray Exploded View

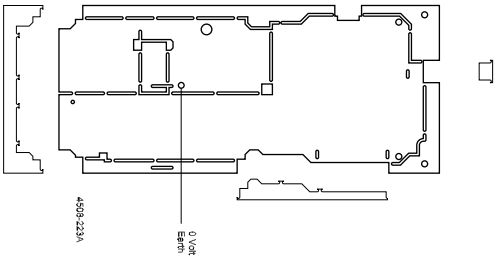


Figure 6.8: Frame 4 to 7 Control Board Biscuit

6.2.2 SERVICING THE POWER TRAY

The Power Electronics board is replaced as an entire assembly, that is, inclusive of the mounting tray. This assembly is referred to as the Power tray .

1) See section 6.2.1 on removing Control board.
2) When the Control board has been removed, put it onto the new Power tray. For 500V models, move the Drive Select board to the new Power Tray, see figure 6.10. For 400V models, this can be done after the Control board is in place, see figure 6.9.

Referring to figure 6.11.

3) Remove any customising items that may have been fitted in the space provided on the mounting tray.
4) Remove the lexan shield over the fibre optic looms.
5) At the top of the Power tray remove the wired connectors UL to WH (do not pull on the cables) then remove the fibre optic plugs UL to WH.
6) Unplug the internal fan plug from the top left of the Power tray.
7) Loosen the two off Power Tray retaining screws and lift the Power tray clear.
8) Place the new Power tray in the Elite and replace the wiring looms etc. in the opposite order that they were removed. Take care that the connectors are replaced without crossing phases, and without inadvertently off setting pins. The fibre optic looms and circuit board are marked to ensure the connections are made correctly. Particular care must be taken with the fibre optic looms to avoid a bending radius of less than 35mm.
9) Replace the lexan shield over the fibre optic looms.

Before mains powering the Elite, it is recommended to Soft Power the Elite to test the new parts are functioning correctly without risk of damage should something else be faulty or an error made during reassembly. See section 4.6.

Figure 6.9: 400V Power tray

Figure 6.10: 500V Power tray

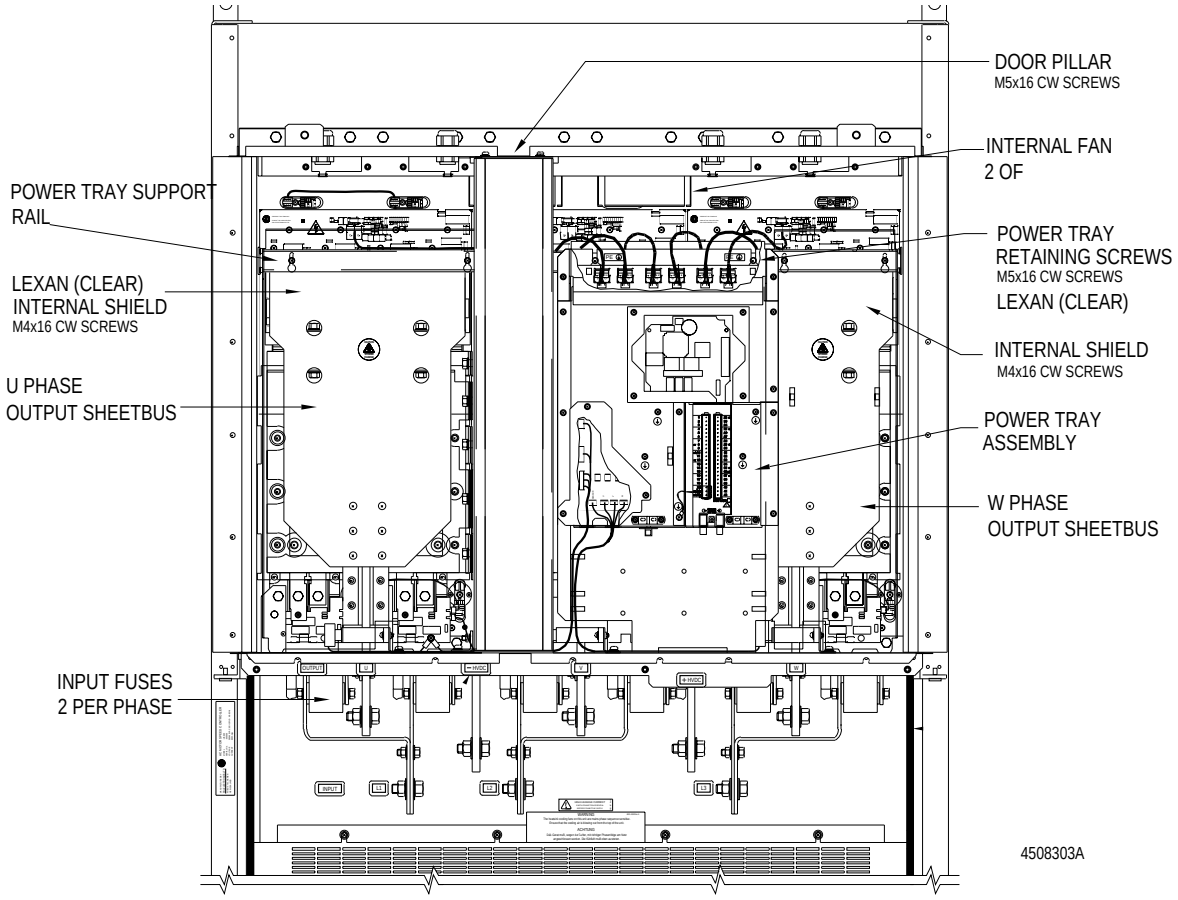


Figure 6.11: Frame 6 Power Tray Removal

6.2.3 SERVICING THE OUTPUT SHEET BUS

Frame 6 construction allows one phase to be disassembled without affecting the other two. This section and the following describe how to disassemble U Phase. The other two phases are similar in construction.

Ensure you have adequate small containers to place the Bus Sharing Board, DC Supply Board, positive Sheet Bus and negative Sheet Bus fixings in their own container. This will help to speed up reassembly.

To remove the U Phase output Sheet Bus remove:

1) The door pillar which is held by 8 off M5x16 CW screws. See figure 6.12.

2) The Lexan shield 2 off M5x 6 CW screws. See figure 6.12.

3) Screws A and B.

4) Bolts C and D.

Thread the fibre optic loom through the output Sheet Bus.

Slide the output busbar towards the bottom of the Elite (do not slide it completely through the grommet). If it is sticking use some soapy water.

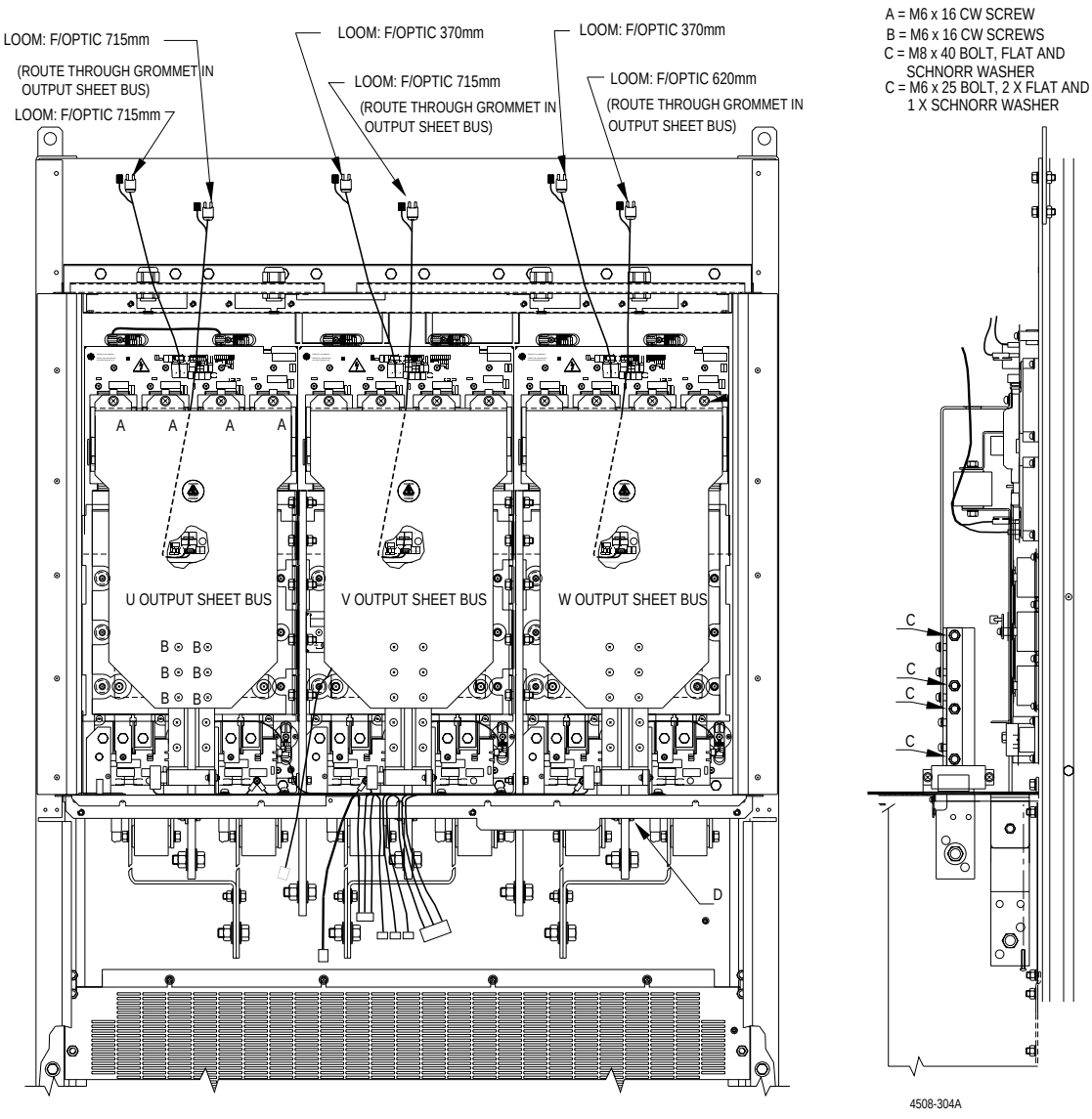


Figure 6.12: Frame 6 Output Sheet Bus Removal

6.2.4 SERVICING THE POSITIVE AND NEGATIVE SHEET BUS

Bus Sharing and Power Supply Board Removal

Refer to figure 6.13 and 6.14.

1) Remove the Bus Sharing boards and Bus Sharing cable. These two assemblies are secured with 6 off M5x30 CW screws and use 6 off 16mm long brass spacers. It is best to remove them as a full assembly keeping the screws and spacers together, this makes for easier reassembly.

2) Remove the Power Supply board, this is secured by 4 off M5x30 CW screws and has four brass spacers. The outer two spacers are 16mm long and the inner pair are 16.8 mm long. It is best to remove them as a one assembly keeping the screws and spacers together, this makes for easier reassembly.

3) It is not necessary to unbolt the DC Bus fuses as the positive Sheet Bus can be removed as one piece.

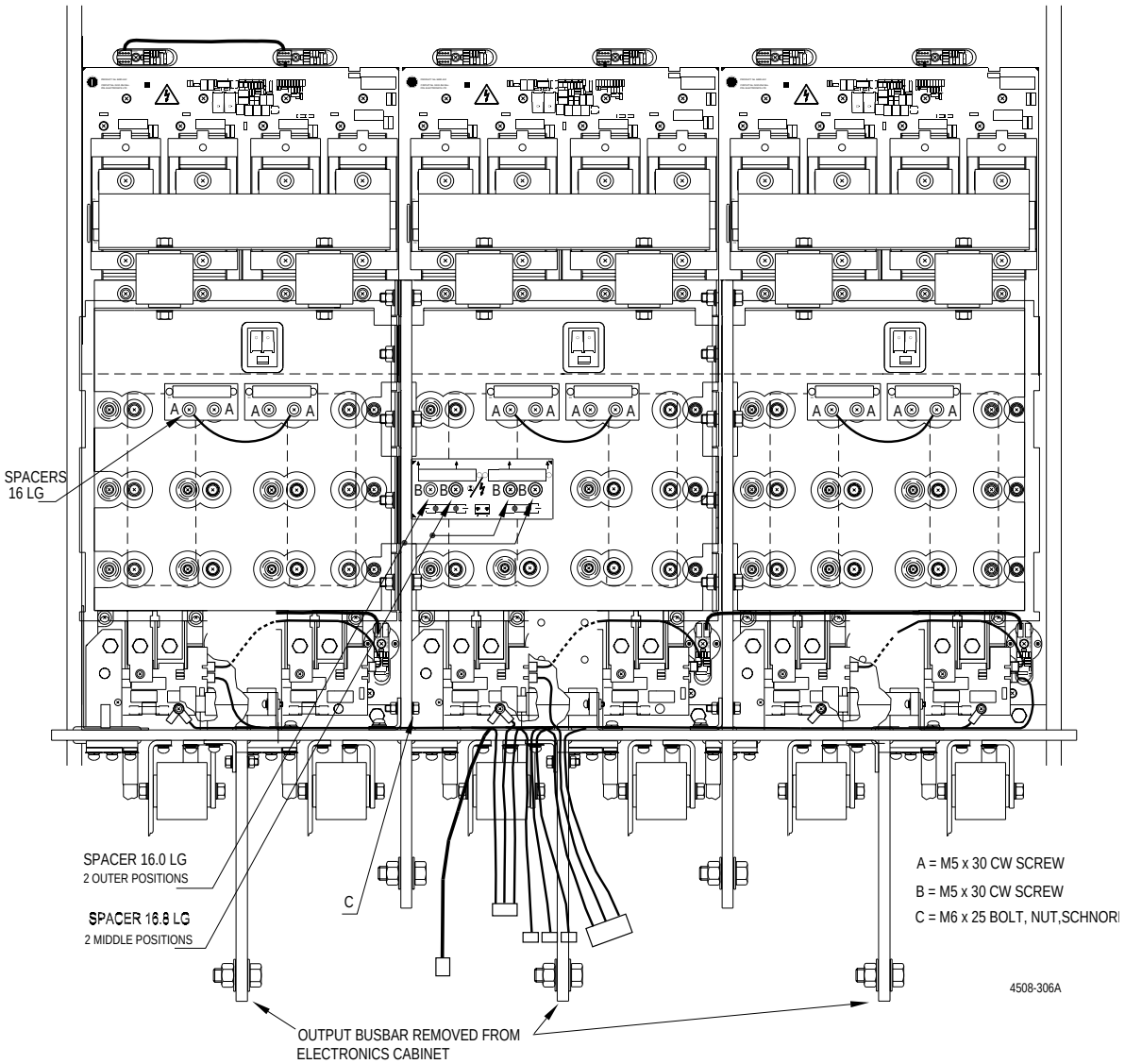


Figure 6.13: Frame 5 Positive and Negative Sheet Bus

Positive and Negative Sheet Bus Removal

Note: This drawing has been labelled to assist more with reassembly than disassembly.

1) Remove the DC output busbar by removing:

   See figure 6.14. and remove bolts J, these bolts connect the positive output busbar to the positive Sheet Bus.

   See figure 6.13. and remove bolts C where the busbar exits the electronics cabinet.

   Slide the busbar into the termination area, do not slide it completely through the grommet (use soapy water if it is sticking)

Refer to figure 6.14.

2) Remove the positive Sheet Bus starting from screws F to J and the positive Sheet Bus joining bolts.

3) Remove the negative Sheet Bus Starting from screws B to E and the negative Sheet Bus joining bolts.

4) If you are not going to change the capacitors do not remove the cap centre Sheet Bus (screws A)

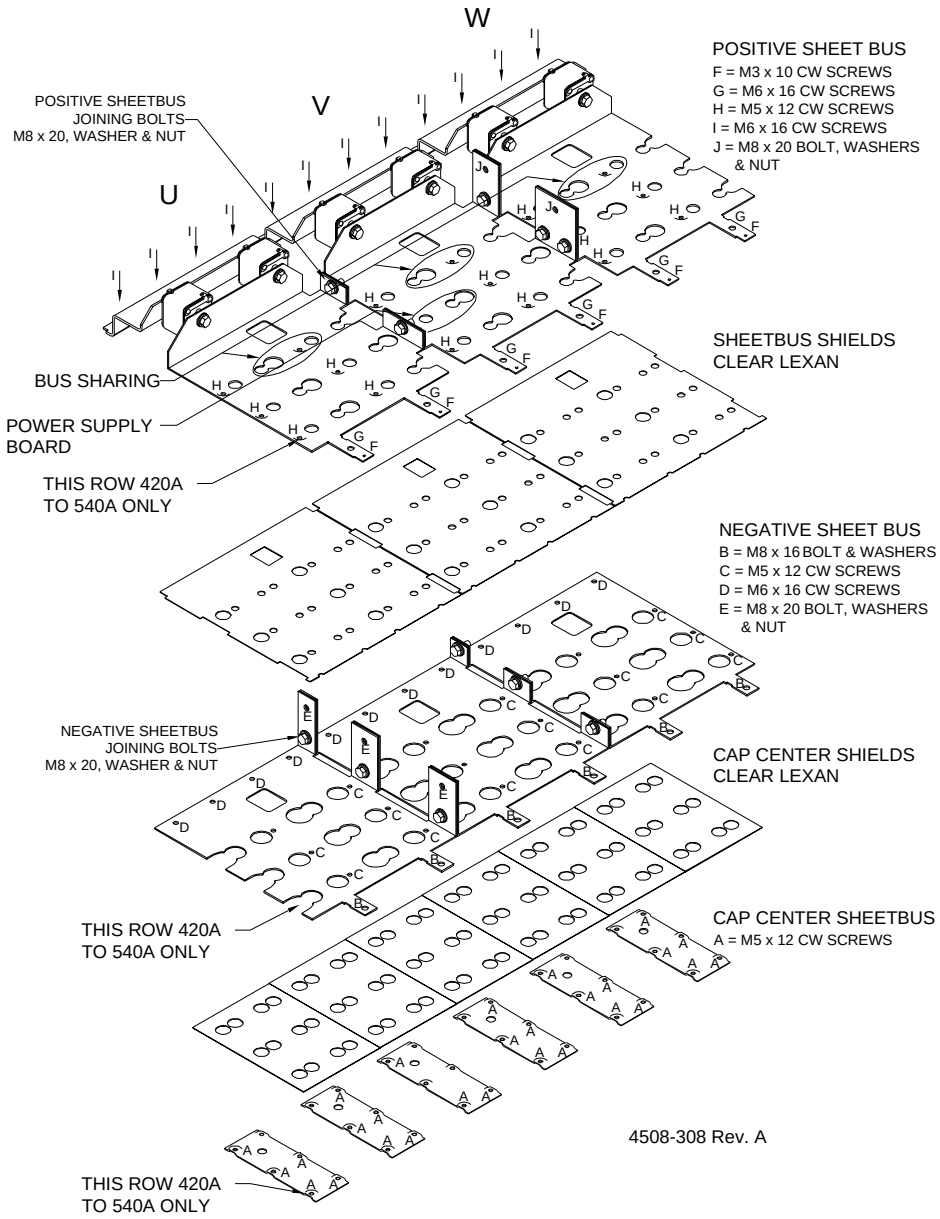


Figure 6.14: Frame 5 Positive and Negative Sheet Bus 3D View

6.2.5 SERVICING THE IGBT GATEDRIVE BOARD

Ensure you have a means of shorting out the gate and emitter of the IGBTs before you remove the Gatedrive board.

Refer to the upper section of figure 6.14.

1) Remove screws (A) 2 off, (B) 8 off and (C) 1 off on the phase you require access to and lift off the Gatedrive board.

2) Short out the gate and emitter on the IGBTs.

6.2.6 SERVICING THE SCR BOARD

Refer to the lower section of figure 6.14.

1) To get access to the SCR Board, first remove the DCCT and DCCT mounting bracket as one assembly. The bracket is held by 2 off M4x12 CW screws. Lay the DCCT and bracket carefully to one side.

2) Remove the choke rectifier busbar fixings D, E and F then slide the Bar through the grommet just enough to allow access to the SCR Board. It is best to avoid pulling out the Bus Bars if possible, as they can be difficult to put back in (use soapy water if necessary).

3) Remove the screws G and H unplug P1 (**Note:** P1 and P2 are common connections to the SCR gate).

4) The SCR Board is now only held to the SCR by male spade terminals. The SCR Board can now be lifted vertically off the SCR/diode block.

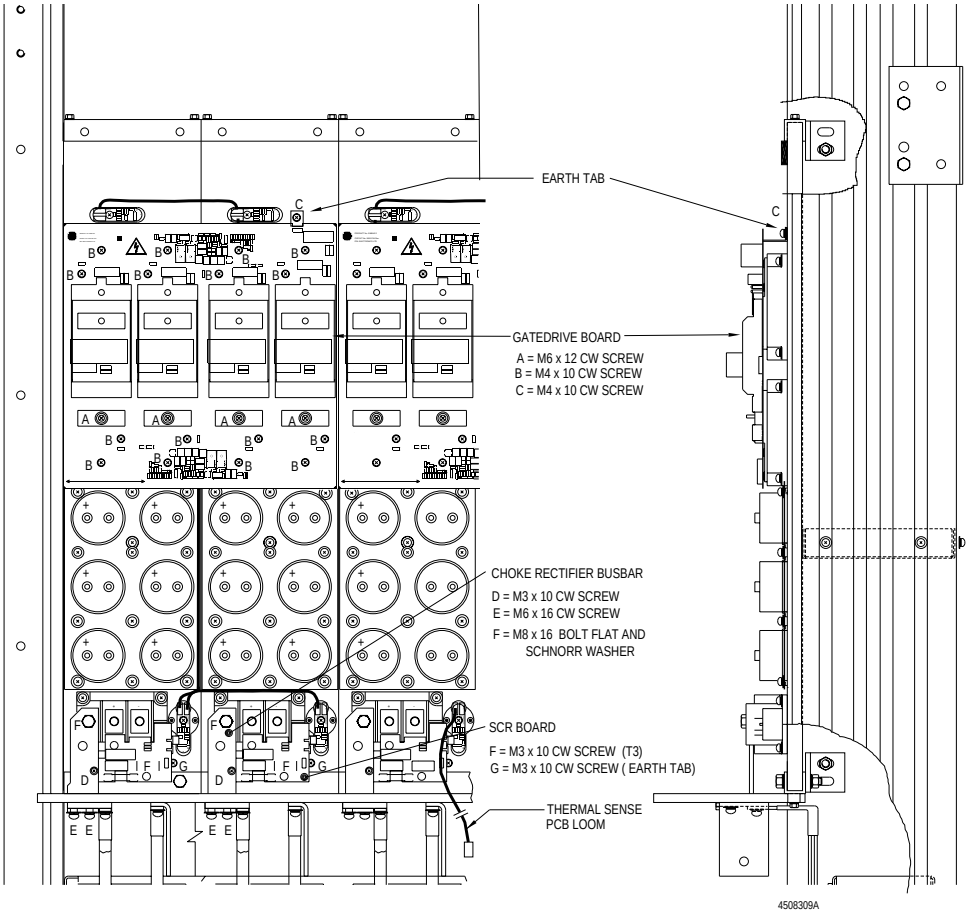


Figure 6.14: Frame 6 Snubber and SCR Board

6.2.7 SERVICING THE IGBT

Refer to the upper section of figure 6.13.

Each IGBT is held by 4 off M6x16 CW screws, a thermstrate is used between the IGBT and heatsink to ensure good thermal contact. Remove the old IGBTs and clean the heatsink surface.

1) Do not remove the gate emitter shorting link on the new IGBTs.

2) Use a new thermstrate, avoid touching the surface of it , do not use the paper packer.

3) Replace the 4 off M6x16 CW screws (do not tighten yet) and push the IGBT block towards the base of the Elite, then tighten the screws. This will align the replacement blocks in the same manner as the remaining half phases.

4) Remove the gate emitter shorting ribbon from the IGBTs and replace the Gatedrive board.

6.2.8 SCR/DIODE BLOCK SERVICE

Refer to the lower section of figure 6.12.

Each SCR/diode block is held by 4 off M5x16 CW screws, and a thermstrate is used between the SCR/diode block and heatsink to ensure a good thermal contact. Remove the old SCR/diode block and clean the heatsink surface.

1) Use a new thermstrate, avoid touching the surface of it, do not use the paper packer.

2) Replace the 4 off M5x16 CW screws (do not tighten yet) and push the SCR/diode block towards the bottom of the Elite, then tighten the screws. This will align the replacement blocks in the same manner as the remaining half phases.

500V MICROTHERMS

The 500V models have three microtherms connected to and located above the top set of Thermal Sense boards.

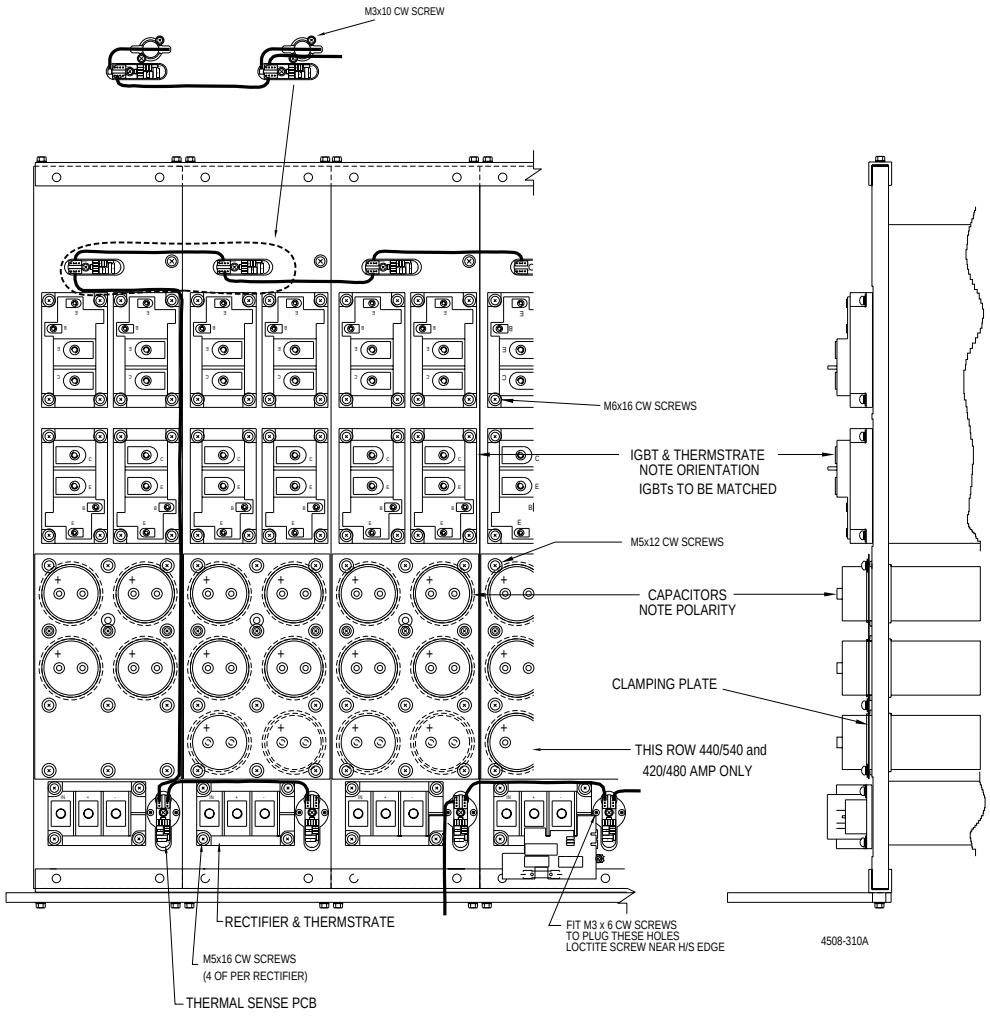


Figure 6.15: Frame 6 IGBT, Capacitors and SCR Level

6.2.9 SERVICING THE CAPACITOR

The capacitors are mounted through the heatsink with the bulk of the capacitor in the main cooling airflow at the back of the machine. Sealing rings are used to prevent air leakage through to the inside of the machine.

1) To remove the capacitors, undo 15 off M5 x 12 Phillips screws. See figure 6.15.

Replacing the Capacitors

1) The capacitors should be installed using a jig, PDL part number 5101-190, this ensures the height and rotational position are exact.

The sealing rings must be fitted to the capacitors at 23.5mm below the top of the terminal post. Place the capacitors in the heatsink and loosely screw down the clamping plate. Fit the jig to the capacitors then tighten the clamping plate screws. If a jig is not available precise fitting of the individual capacitors is required. Refer to figure 6.16. Fit the capacitor sealing rings exactly as shown, this should help to align the capacitor terminal post at 29.5 mm above the heatsink, when the clamping plate is secured. The rotational alignment of the post is also critical to prevent cross threading of the screws into the capacitor terminal post when the Sheet Bus is attached. Slight adjustments may need to be made as the clamping plate is clamped down.

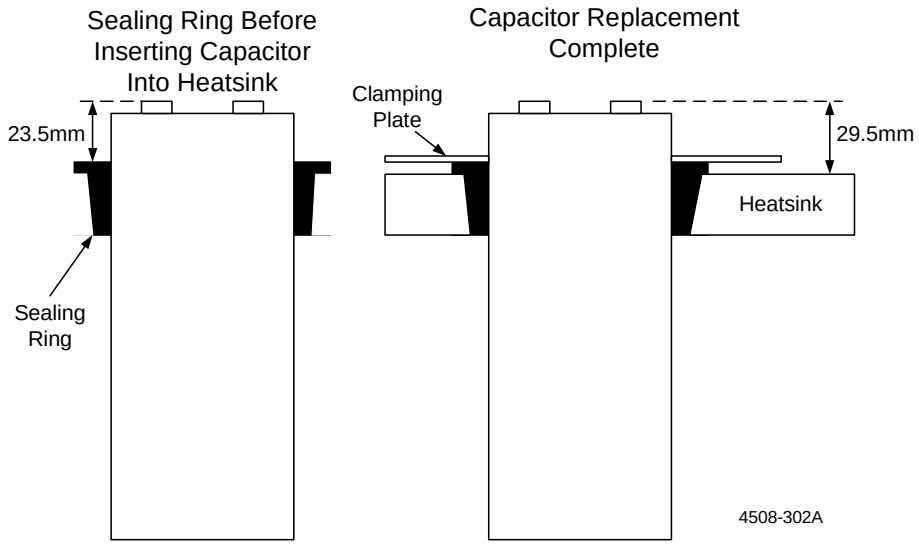


Figure 6.16: Capacitor Replacement

6.2.10 500V MODELS EXTERNAL FAN POWER SUPPLY

The 500V models have a linear AC to 24Vdc power supply for the external fans. This is located directly above the internal cooling fan and is accessed by removing the gold coloured panel above the electronics cabinet. The panel is held by 6 off M5 x 10 CW screws.

An exploded assembly view is shown in figures 6.17 and 6.18.

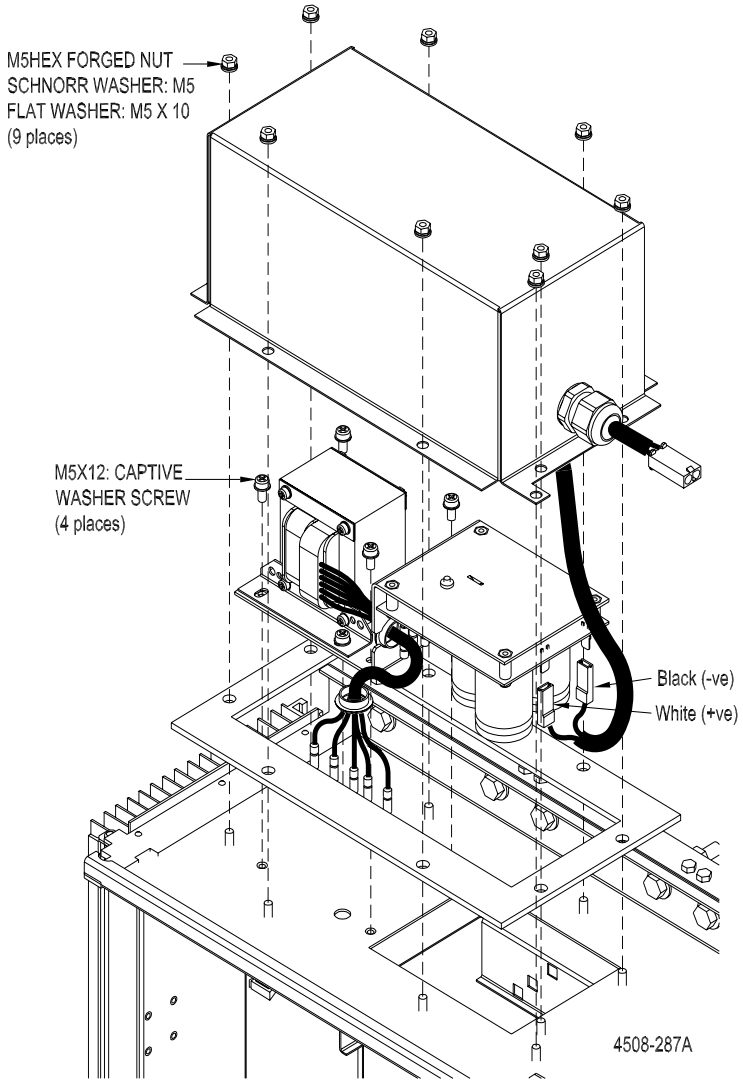


Figure 6.17: Frame 5 to 7 500V External Fan Supply

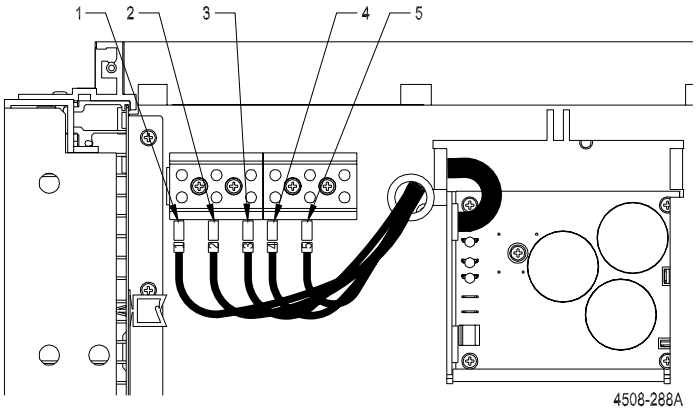


Figure 6.18: Frame 5 to 7 500V External Fan Supply Connections

Notes

7.0 FRAME 7 ULTRADRIVE ELITE SERVICE

This section covers 400V models from UE-575 to UE-660 and 500V models from UE620D to UE700D.

The 400V and 500V models are essentially identical for disassembly and reassembly purposes. When specific differences exist between the 400V and 500V models these are noted.

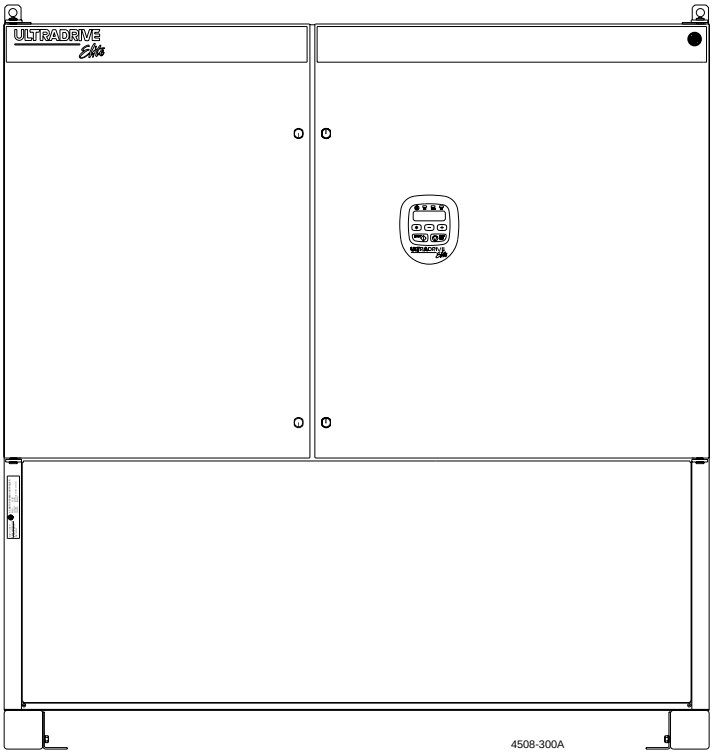


Figure 7.1: Frame 7 Ultradrive Elite

CONTENTS

7.1 PARTS LISTS AND BLOCK DIAGRAMS

7.1.1 FRAME 7 400V ULTRADRIVE ELITE PARTS LIST

400 VOLT ULTRADRIVE ELITE PARTS LIST				
Frame Size	FRAME 7		Spares Guide	
Model	UE-575	UE-660	*Level 1	**Level 2
Display Unit	E660-620S			
Control Board	E000-610S		1	1
Power Tray	E660-611S		1	1
SCR Board	9 x E660-615S			6
SCR Loom	2721-088			
AC Power to Power Tray Loom	2721-124			
Rectifier Block	9 x 1421-027			6
Rectifier Thermstrate	9 x 1781-103			6
IGBT Block	36 x 1757-136			12
IGBT Thermstrate	36 x 1781-104			12
Gate Drive Board	3 x E660-612S			2
DC Bus Capacitors	54 x 1352-453			6
Capacitor Sealing Rings	54 x 3907-004			6
External Fans	5 x 2941-011		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
Power Supply Board Fuses	2 x 2404-063		2	2
Power Supply Board	E660-621S (Includes Fuses)			
Thermal Sensor Boards	18 x E660-619S			6
Thermal Sensor Looms	Loom To Power Board 1 x 2726-105			1
	Short Linking Loom 4 x 2721-114			4
	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)			
* Level 1: Minimum spare stock				
**Level 2: Typical spare stock				
			4508-279A	

Figure 7.2: Frame 7 400V Parts List

7.1.2 FRAME 7 400V ULTRADRIVE ELITE BLOCK DIAGRAM

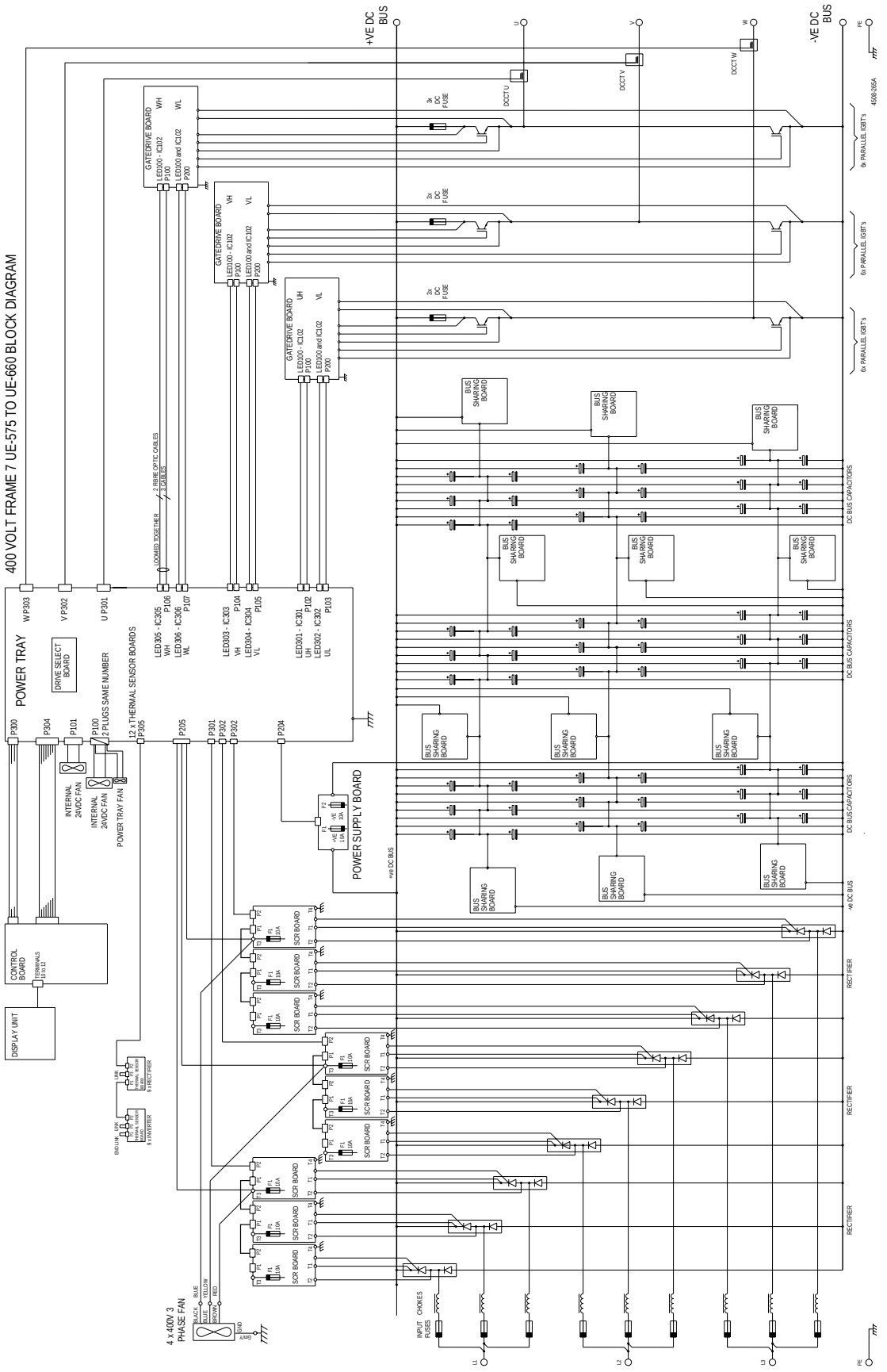


Figure 7.3 : Frame 7 400V Block Diagram

7.1.3 FRAME 7 500V ULTRADRIVE ELITE PARTS LIST

500 VOLT ULTRADRIVE ELITE PARTS LIST				
Frame Size	FRAME 7		Spares Guide	
Model	UE-620D	UE-700D	*Level 1	**Level 2
Display Unit	E660-620S			
Control Board	E000-610S		1	1
Power Tray	E661-611S		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
Power Supply Board	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)			
External Fan P/S Transformer	2571-068			1
External Fan P/S Board	E000-648			1
* Level 1: Minimum spares stock				
**Level 2: Typical spares stock				
			4508-280A	

Figure 7.4: Frame 7 500V Parts List

7.1.4 FRAME 7 500V ULTRADRIVE ELITE BLOCK DIAGRAM

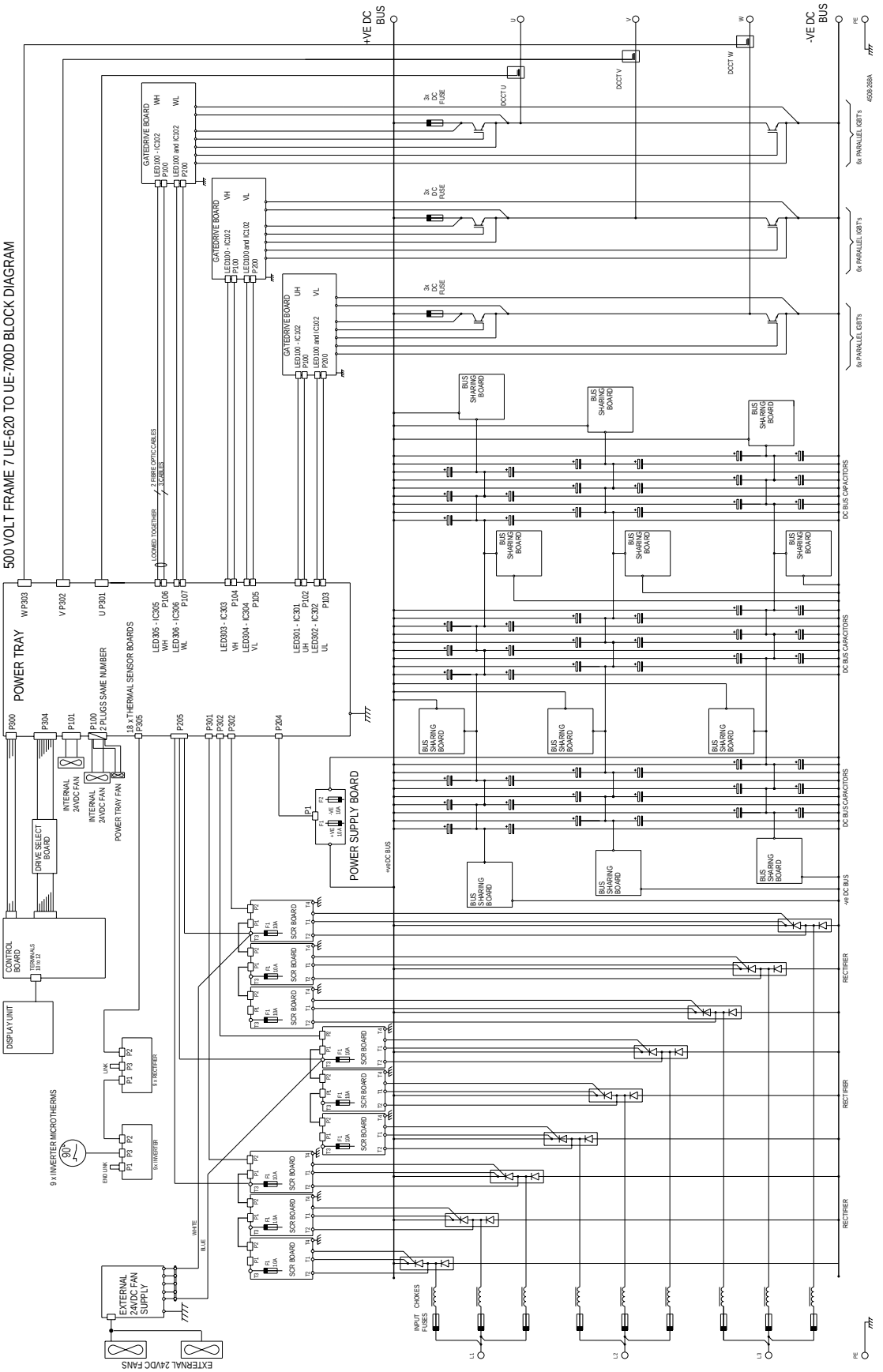


Figure 7.5: Frame 7 500V Block Diagram

7.2 SERVICE

7.2.1 SERVICING THE CONTROL BOARD

1) Ensure the Elite is safe to work, see section 4.2 before proceeding.

2) Number the three way controls to enable easy replacement then unplug them and remove the control cable clamps if used.

3) Referring to figure 7.6 access to the wiring looms on the lower left hand side by removing screws (A) 3 off CW M4x10 retaining this plate.

4) Unplug the 7 wiring looms under the plate.

5) Remove the remaining cover plates in one assembly by removing screws (B) 3 off M4x10. Slide the cover plate assembly down slight to clear the fibre-optic connections before lifting it clear.

6) Referring to Figure 7.7, the Control board is held by the Phillips screws (C), 3 off M4X10 screws. Remove these and lift the control board vertically off the connecting pins.
Note: lift beside the plugs and keep the board level to avoid bending the connecting pins.

7) 500V models have a Drive Select board between the Control board and the Power tray, leave this in place.

8) The replacement Control board will be in biscuit format. It will have to be trimmed to the same size as the existing board size as per figure 7.9. This is done with a fine pair of side cutters.

9) Place the Control board on the connecting pins.

10) Gently push the 6 pin connector down slightly and repeat the process with the 40 pin connector. When this is completed, check through the slots to ensure no connecting pins are showing or damaged then push the control board completely home. Replace the 3 off M4x10 Phillips screws as per figure 7.7.

11) Replace the remaining components of the Elite in the opposite order as detailed in removing the Control board.

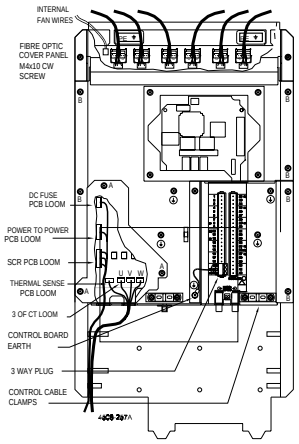


Figure 7.6: Frame 5 to 7 Power Tray

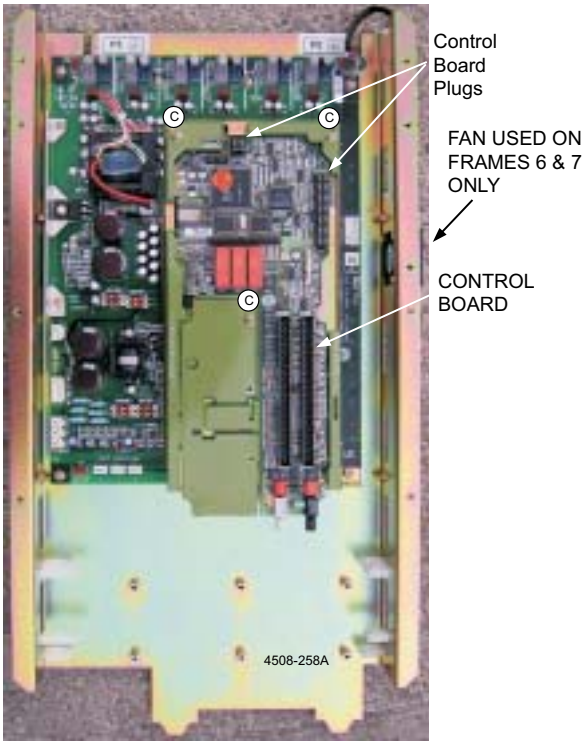


Figure 7.7: Frame 5 to 7 Power Tray and Control Board

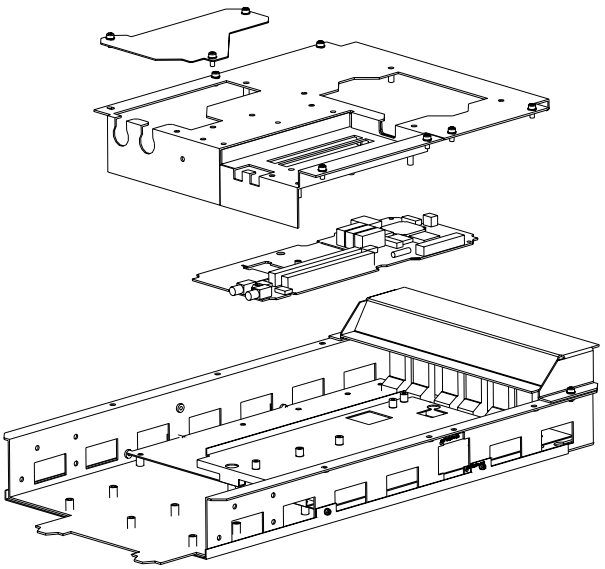


Figure 7.8: Frame 5 to 7 Power Tray Exploded View

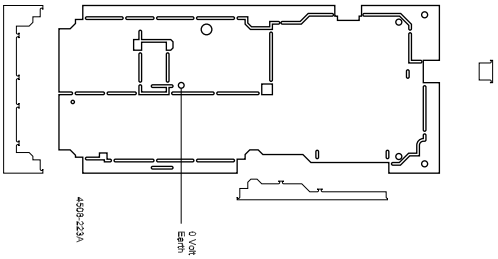


Figure 7.9: Frame 4 to 7 Control Board Biscuit

7.2.2 SERVICING THE POWER TRAY

The Power Electronics board is replaced as an entire assembly inclusive of the mounting tray. This assembly is referred to as the Power tray .

1) See section 7.2.1 on removing Control board.
2) When the Control board has been removed put it onto the new Power tray. For 500V models, move the Drive Select board to the new Power tray, see figure 7.11. For 400V models, this can be done after the Control board is in place see figure 7.10.

Refer to figure 7.12.

3) Remove any customising items that may have been fitted in the space provided on the mounting tray.
4) Remove the lexan shield over the fibre optic looms.
5) At the top of the Power tray, remove the wired connectors UL to WH (do not pull on the cables) then remove the fibre optic plugs UL to WH.
6) Unplug the internal fan plug from the top left of the Power tray.
7) Loosen the two Power tray retaining screws and lift the Power tray clear.
8) Place the new Power Tray in the Elite and replace the wiring looms etc. in the opposite order that they were removed. Take care that the connectors are replaced without crossing phases, and without inadvertently off setting pins. The fibre optic looms and the circuit board are marked to ensure the connections are made correctly. Particular care must be taken with the fibre optic looms to avoid a bending radius of less than 35mm.
9) Replace the lexan shield over the fibre optic looms.

Before mains powering the Elite, it is recommended to Soft Power the Elite to test the new parts are functioning correctly without risk of damage should something else be faulty or an error made during reassembly. See section 4.6

Figure 7.10: 400V Power tray

Figure 7.11: 500V Power tray

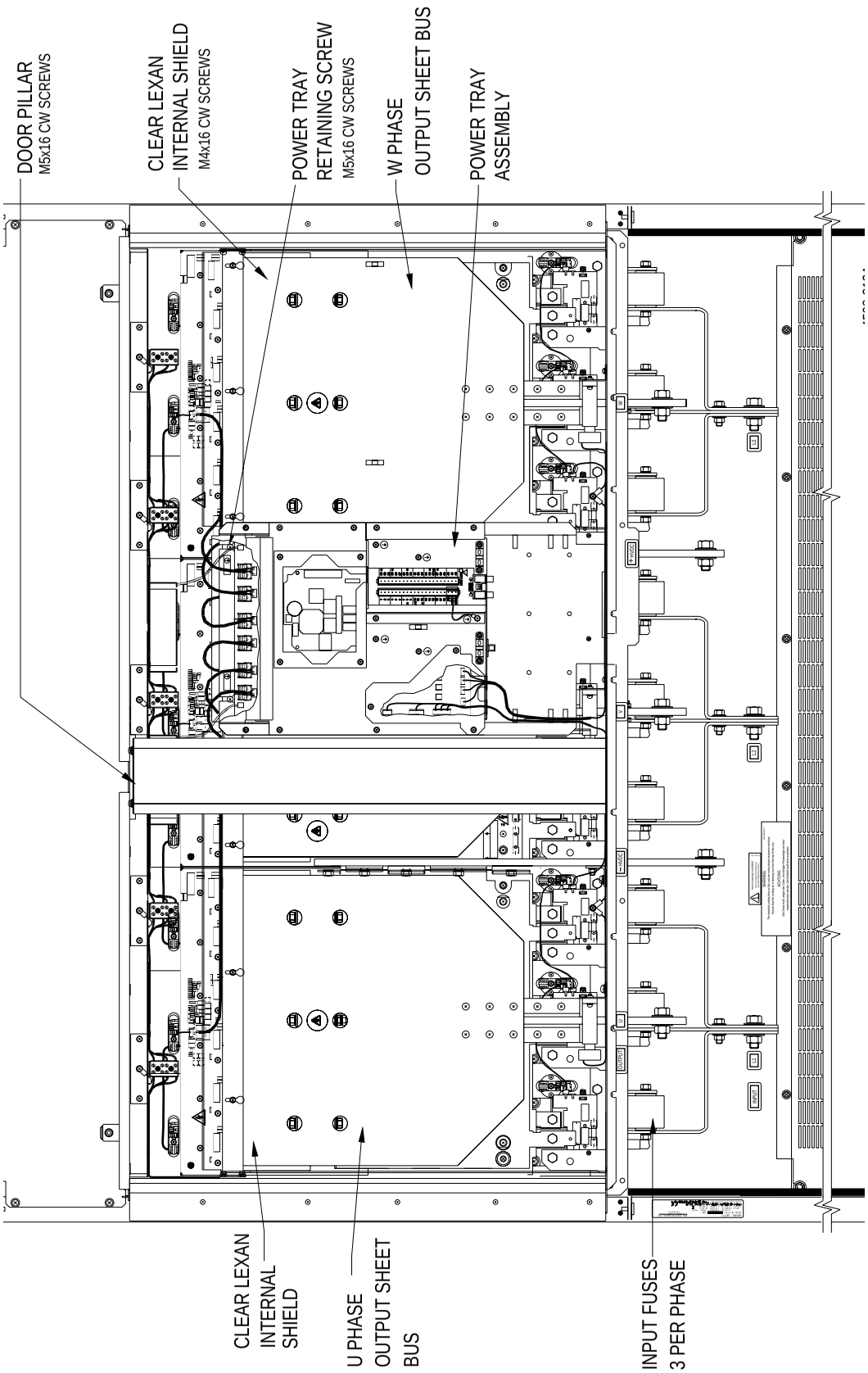


Figure 7.12: Frame 7 Power Tray Removal

7.2.3 SERVICING THE OUTPUT SHEET BUS

Frame 7 construction allows one phase to be disassembled without affecting the other two. This section and the following describe how to disassemble U Phase. The other two phases are similar in construction.

Ensure you have adequate small containers to place the Bus Sharing board, DC Supply board, positive Sheet Bus and negative Sheet Bus fixings in their own container. This will help speed up reassembly.

To remove the U Phase output Sheet Bus remove:

1) The door pillar which is held by 8 off M5x16 CW screws. See figure 7.12.

2) The Lexan shield 2 off M5x16 CW screws. See figure 7.12.

3) Screws A and B.

4) Bolts C and D.

Thread the fibre optic loom through the output Sheet Bus.

Slide the output busbar towards the bottom of the Elite (do not slide it completely through the grommet). If it is sticking use some soapy water.

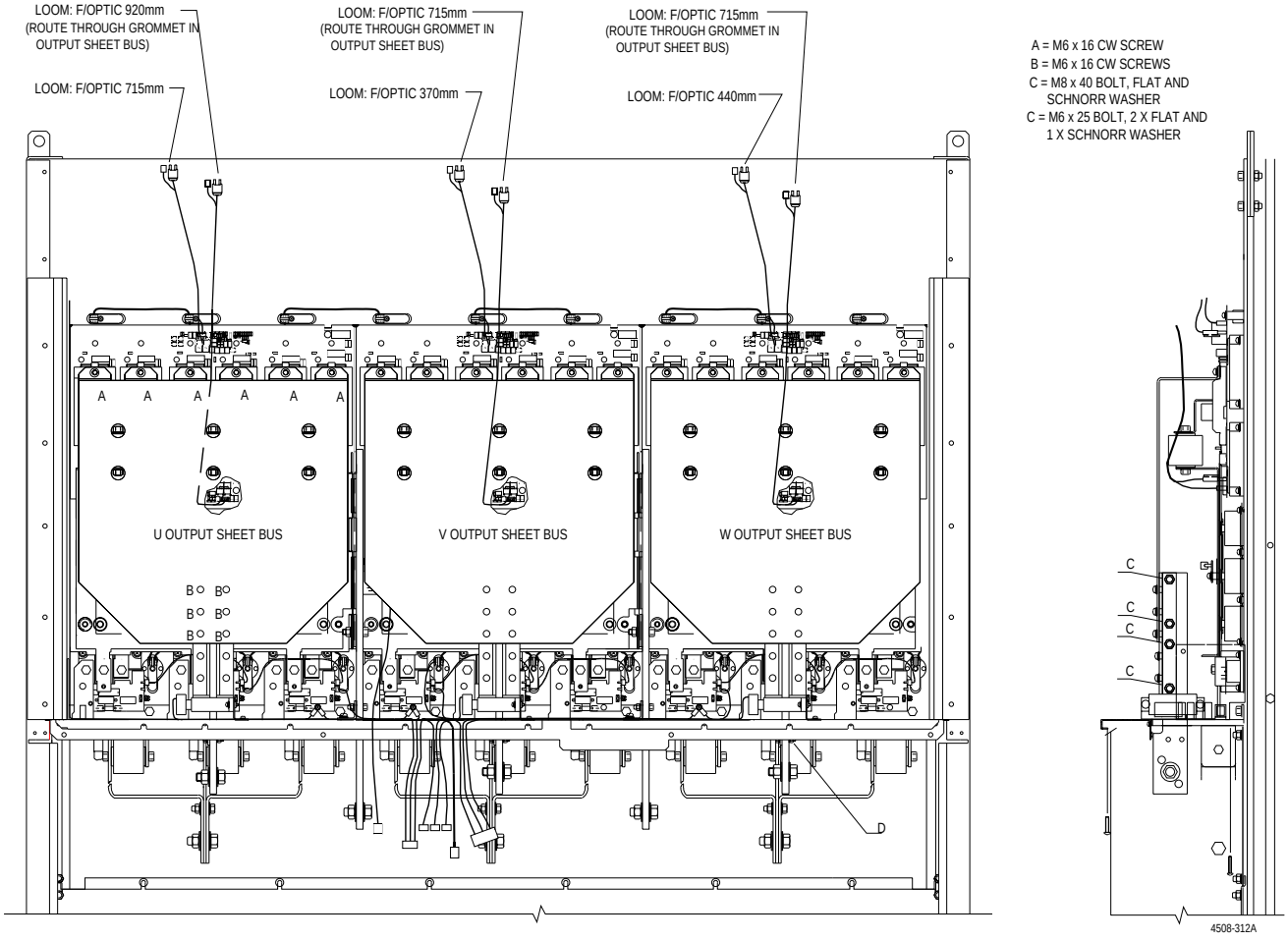


Figure 7.13: Frame 7 Output Sheet Bus Removal

7.2.4 SERVICING THE POSITIVE AND NEGATIVE SHEET BUS

Removing the Bus Sharing and Power Supply Board Removal

Refer to figure 7.14 and 7.15.

1) Remove the Bus Sharing Boards and Bus Sharing cable. These two assemblies are secured with 6 off M5x30 CW screws and use 6 off 16mm long brass spacers. It is best to remove them as a full assembly, keeping the screws and spacers together. This makes it easier to reassemble.

2) Remove the Power Supply Board. This is secured by 4 off M5 x 30 CW screws and has 4 brass spacers. The outer two spacers are 16mm long and the inner pair are 16.8 mm long. It is best to remove them as a one assembly, keeping the screws and spacers together. This makes it easier to reassemble.

3) It is not necessary to unbolt the DC Bus fuses as the positive Sheet Bus can be removed as one piece.

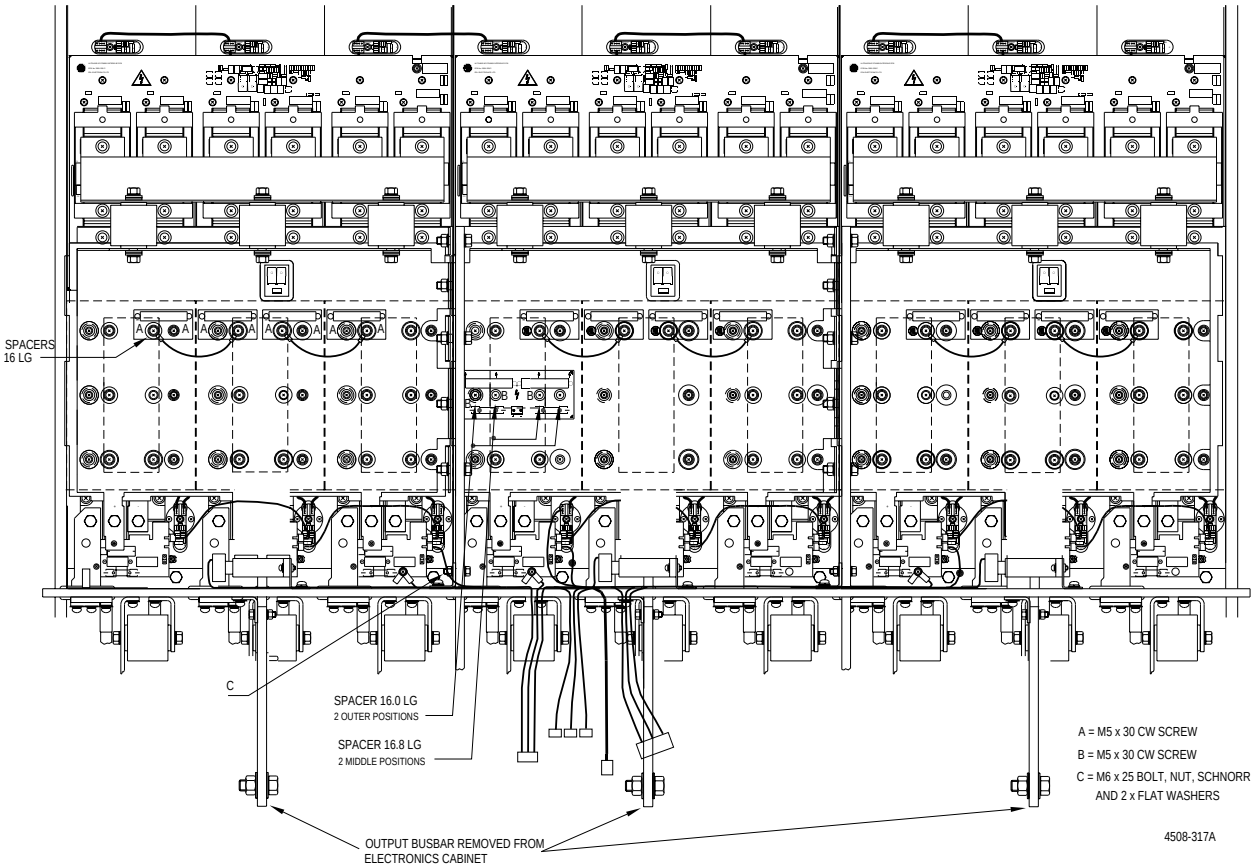


Figure 7.14: Frame 7 Positive and Negative Sheet Bus

Removing the Positive and Negative Sheet Bus

Note: This drawing has been labelled to assist more with reassembling than disassembling.

1) Remove the DC output busbar by removing:

   See figure 7.15 and figure 7.14.

   Slide the busbar to the into the termination area, do not slide it completely through the grommet. Use soapy water if it is sticking.

Refer to figure 7.15.

2) Remove the positive Sheet Bus starting from screws (F to J) and the positive Sheet Bus joining bolts.

3) Remove the negative Sheet Bus starting from screws (B to E) and the negative Sheet Bus joining bolts.

4) If you are not going to change the capacitors do not remove the cap centre Sheet Bus screws (A).

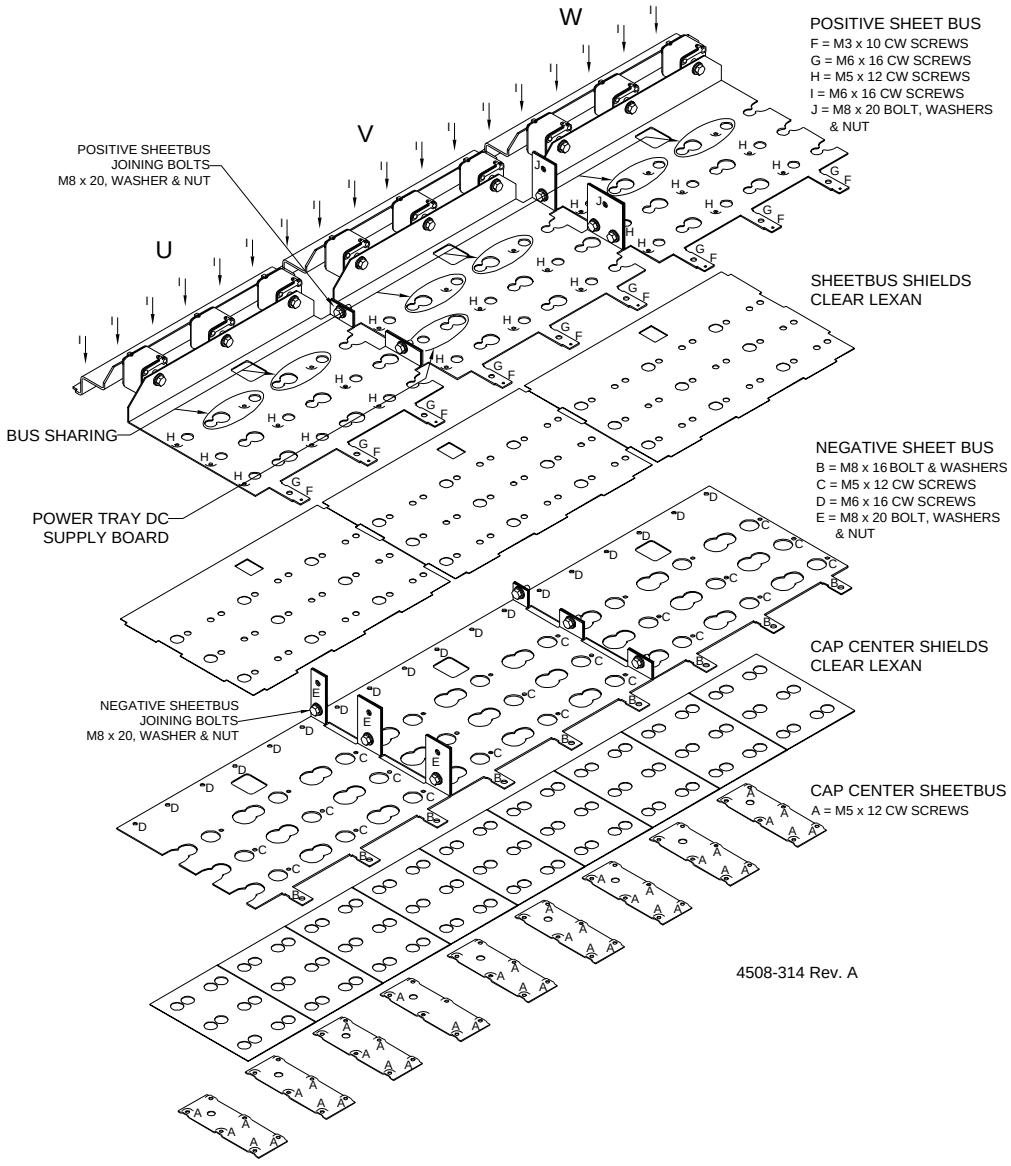


Figure 7.15: Frame 7 Positive and Negative Sheet Bus 3D View

7.2.5 SERVICING THE IGBT GATE DRIVE BOARD

Ensure you have a means of shorting out the gate and emitter of the IGBTs before you remove the Gatedrive board.

Refer to the upper section of figure 7.16.

1) Remove screws (A) 2 off, (B) 8 off and (C) 1 off on the phase you require access to and lift off the Gatedrive Board.

2) Short out the gate and emitter on the IGBTs.

7.2.6 SCR BOARD SERVICE

Refer to the lower section of figure 7.16.

1) To get access to the SCR Board, first remove the DCCT and DCCT mounting bracket as one assembly. The bracket is held by 2 off M4 x 12 CW screws. Lay the DCCT and bracket carefully to one side.

2) Remove the choke rectifier busbar fixings (D, E and F) then slide the busbar through the grommet just enough to allow access to the SCR Board. It is best to avoid pulling out the Bus Bars if possible as they can be difficult to put back in, use soapy water if necessary.

3) Remove the screws G and unplug P1. (**Note:** P1 and P2 are common connections to the SCR gate).

4) The SCR Board is now only held to the SCR by male spade terminals. The SCR Board can now be lifted vertically off the SCR/diode block.

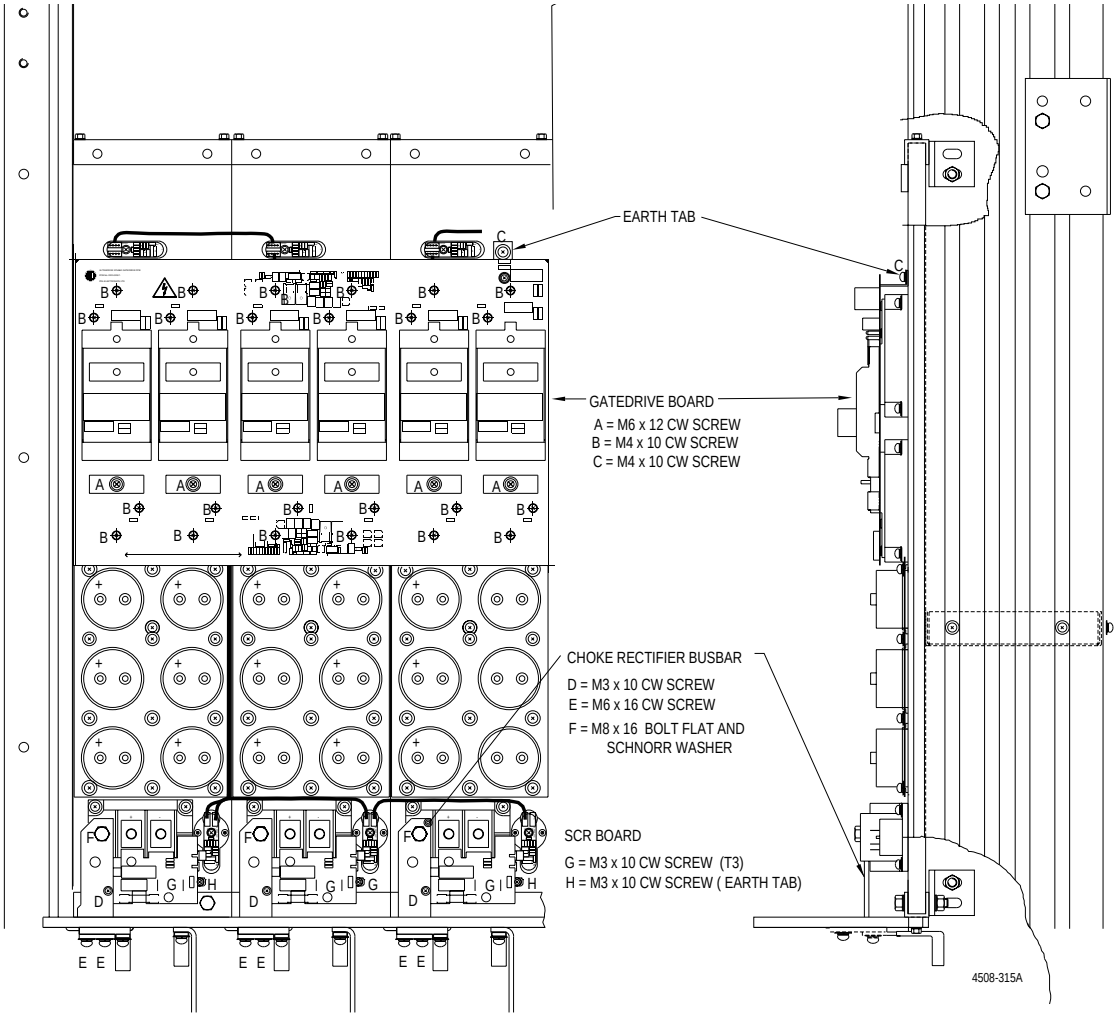


Figure 7.16: Frame 7 Gatedrive and SCR Board

7.2.7 SERVICING AN IGBT

Refer to the upper section of figure 7.16.

Each IGBT is held by 4 off M6x16 CW screws. A thermstrate is used between the IGBT and heatsink to ensure good thermal contact. Remove the old IGBTs and clean the heatsink surface.

1) Do not remove the gate emitter shorting link on the new IGBTs.

2) Use a new thermstrate, **avoid touching the surface of it** , do not use the paper packer.

3) Replace the 4 off M6 x 16 CW screws **do not tighten yet** and push the IGBT block towards the base of the Elite, then tighten the screws. This will align the replacement blocks in the same manner as the remaining half phases.

4) Remove the gate emitter shorting ribbon from the IGBTs and replace the Gatedrive Board.

7.2.8 SERVICING THE SCR/DIODE BLOCK

Refer to the lower section of figure 7.15.

Each SCR/diode block is held by 4 off M5x16 CW screws, and a thermstrate is used between the SCR/diode block and heatsink to ensure a good thermal contact. Remove the old SCR/diode block and clean the heatsink surface.

1) Use a new thermstrate, **avoid touching the surface of it**, do not use the paper packer.

2) Replace the 4 off M5x16 CW screws **do not tighten yet** and push the SCR/Diode block towards the bottom of the Elite, then tighten the screws. This will align the replacement blocks in the same manner as the remaining half phases.

500V MICROTHERMS

The 500V models have three microtherms connected to and located above the top set of Thermal Sense boards.

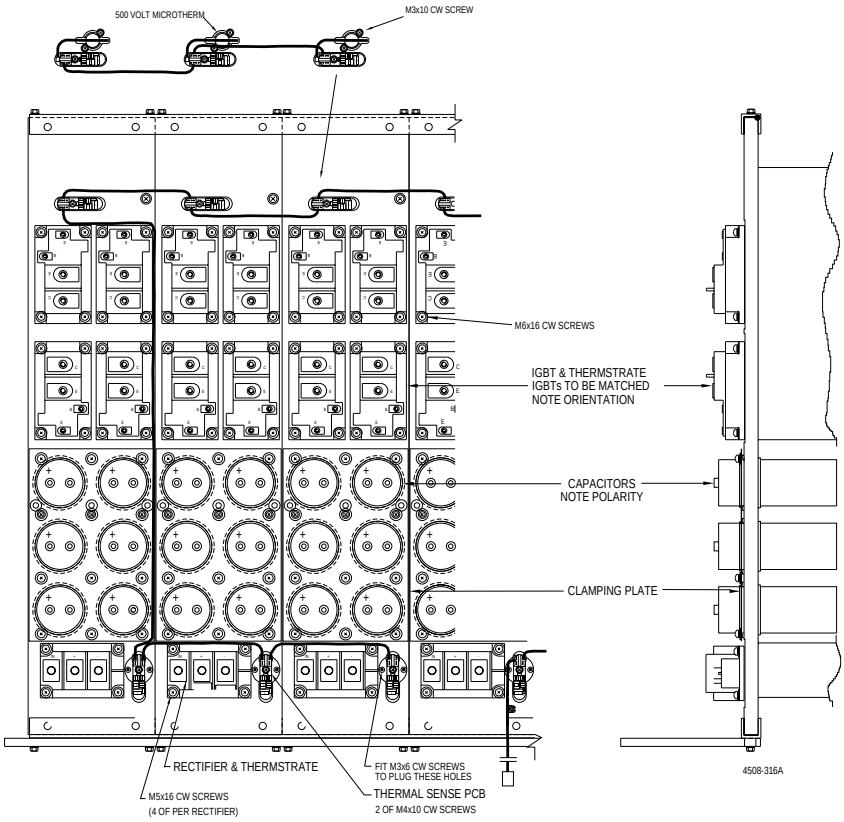


Figure 7.16: Frame 7 IGBT, Capacitors and SCR Level

7.2.9 SERVICING THE CAPACITOR

The capacitors are mounted through the heatsink with the bulk of the capacitor in the main cooling airflow at the back of the machine. Sealing rings are used to prevent air leakage through to the inside of the machine.

To remove the capacitors undo 15 off M5x12 Phillips screws. See figure 7.17.

7.2.10 REPLACING THE CAPACITORS

The capacitors should be installed using a jig, PDL part number 5101-190, this ensures the height and rotational position are exact.

The sealing rings must be fitted to the capacitors at 23.5mm below the top of the terminal post. Place the capacitors in the heatsink and loosely screw down the clamping plate. Fit the jig to the capacitors then tighten the clamping plate screws. If a jig is not available precise fitting of the individual capacitors is required. Refer to figure 7.17. Fit the capacitor sealing rings exactly as shown. This should help to align the capacitor terminal post at 29.5 mm above the heatsink, when the clamping plate is secured. The rotational alignment of the post is also critical to prevent cross threading of the screws into the capacitor terminal post when the Sheet Bus is attached. Slight adjustments may need to be made as the clamping plate is clamped down.

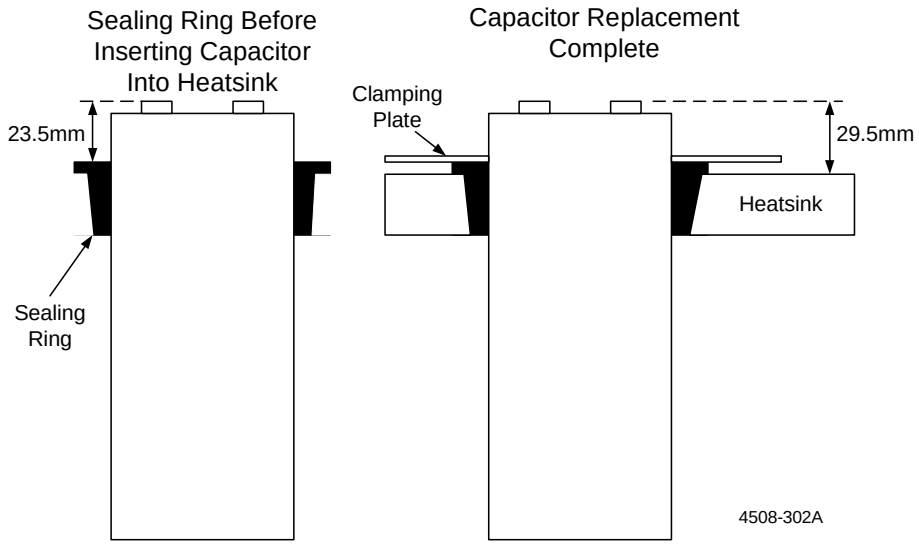


Figure 7.17: Frame Capacitor Replacement

7.2.11 500V MODELS EXTERNAL FAN POWER SUPPLY

The 500V models have a linear AC to 24Vdc power supply for the external fans. This is located directly above the internal cooling fan and is accessed by removing the gold coloured panel above the electronics cabinet. The panel is held by 6 off M5x10 CW screws.

An exploded assembly view is shown in figure 7.18 and figure 7.19.

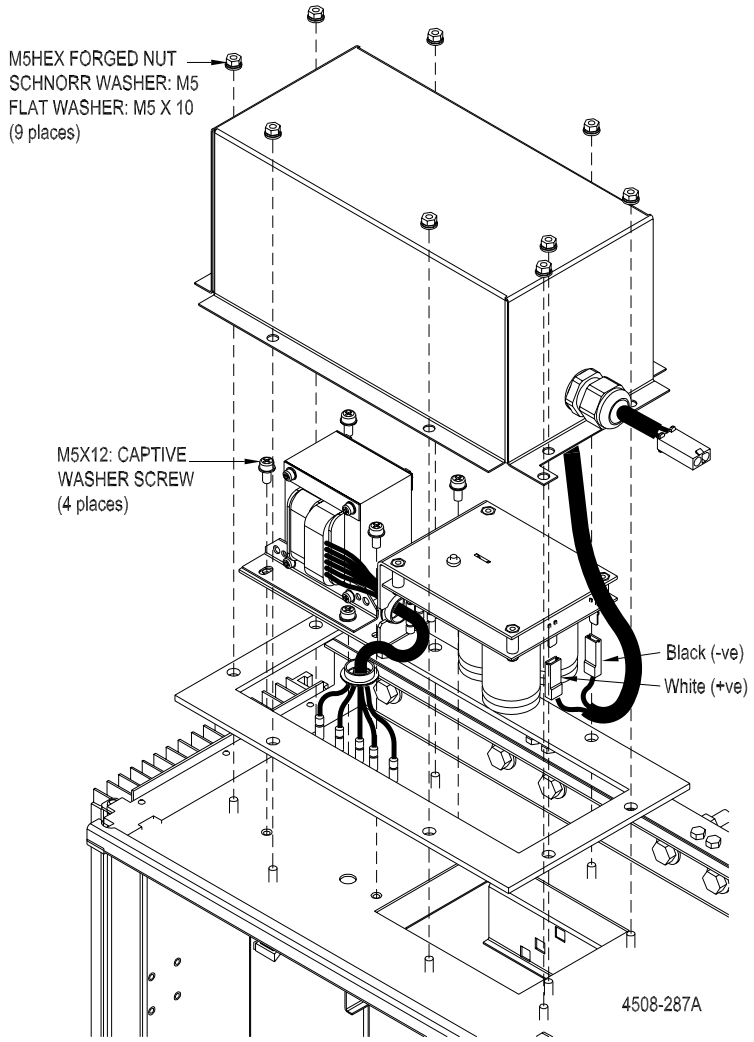


Figure 7.18: Frame 5 to 7 500V External Fan Supply

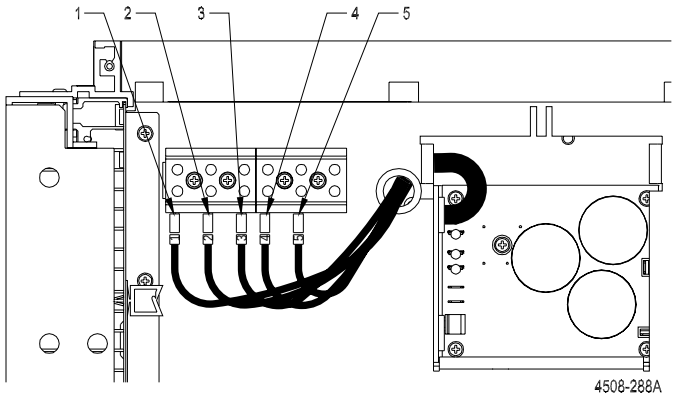


Figure 7.19: Frame 5 to 7 500V External Fan Supply Connections

Notes

8.0 APPENDIX

8.1 FAULT SCREENS

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 (400V)
900Vdc (500V)
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 (400V)
850Vdc for greater than 5 seconds (500V)
Possible cause Mains too high for too long. Earth fault on motor.
Action Check mains supply voltage. Check motor circuit for earth fault.

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

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

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

Fault **07 I LIM FLT**
Detail Output current has reached a dangerous level.
Sense level 220% of Elite Series rated current.
Possible cause Short circuit; wiring fault; circuit fault; motor fault.
Action Check entire output circuit and motor for wiring or winding faults. Check output circuit contactors or isolators for correct operation.

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

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

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

Fault **17 BRAKE O/L**
Detail The temperature calculated by the thermal model of the dynamic brake resistor has reached a dangerous level.
Sense level Set by dynamic brake thermal model in Screens D1 and D2.
Possible cause Excessive regeneration for the resistor specified in Screens D1 and D2. Incorrect values entered.
Action Check values (refer detailed descriptions of Screens D1 and D2). Reduce regeneration via Screen L8. Select a bigger braking resistor. Reduce deceleration rate (Screen R2).
Note: Active whether a dynamic brake is connected or not.

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

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

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

Fault **21 GROUND FLT**
Detail Excessive current flow to ground.
Sense level Internally set.
Possible cause Motor or cable insulation fault.
Action Check motor and cables (isolate from Elite Series first). Refer to Screen L13.

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

Fault **23 H/S TEMP**
Detail Elite Series heatsink too hot.
Sense level 90°C.
Possible cause Poor ventilation; obstructed ventilation path, Elite Series cooling fan failure; local ambient temperature exceeds 50°C.
Action Check fan is operating; Check ventilation and thermal conditions. Improve cooling. Clean fins with compressed air. Seek service.

Fault **24 INT TEMP**
Detail Elite Series internal temperature too hot.
Sense level 80°C.
Possible cause Poor ventilation; obstructed ventilation path, Elite Series heatsink and internal cooling fan failure; local ambient temperature exceeds 50°C.
Action Check heatsink and internal cooling fans are operating; Check ventilation and thermal conditions. Improve cooling. Seek service.

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

Fault **26 COMMS T/O**
Detail Time since last valid serial communication has exceeded timeout period on Screen H2.
Sense level Set by communications timeout value on Screen H2.
Possible cause Serial communications wiring faults; host computer fault; incorrect settings on Screens H1 to H4.
Action Check complete serial communications system; Check screen settings, Seek Service.

Fault **27 FIBRE T/O**
Detail Time since last valid fibre optic input has exceeded timeout period on Screen I8d.
Sense level Set by Fibre T/O value on Screen I8d.
Possible cause Speed or torque reference (Screens I2 to I5) selected from fibre optic port with no fibre optic cable connected; fibre optic cable connected to fibre optic output port instead of input port; fibre optic cable fault.
Action Check fibre optic cable; Check screen settings; Seek service.

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

Fault **29 TQ LIM T/O**
Detail At torque limit for longer than specified.
Sense level Set by Screen L7.
Possible cause Load condition or inappropriate setting of Screen L7; encoder failure. 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). Another possible cause is the motor is overloaded while in Open Loop normal mode.
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). Increase Rs(Screen X3b)

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

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

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

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

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

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

Fault **36 EPLD 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 Elite Series.

Fault **37 WATCHDOG**
Detail An unknown fault has reset the Control Board microcontroller.
Possible cause Power supply fault., PDL Vysta® for Windows configuration too complex.
Action Reset fault; if fault persists, seek service or replace the Elite Series; simplify PDL 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 Elite Series has tripped due to a fault being reported via the Fibre Optic Network
Cause See other Elite Series connected to the network
Action Reset fault on the other Elites

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 cables and motor for possible short circuit.

Fault **41 STOP T/O**
Detail The system has not stopped within the time-out set by Screen S11
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.
Action Check all parameters. Check Dynamic brake.

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
Detail Internal protection of a semiconductor switching device has occurred.
MAS = Master Ultradrive Elite.
SLV = Slave Ultradrive Elite.
DES = DESAT.
Possible Cause Output short circuit, extreme output over current, wiring 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 Ultradrive Elite.

Fault **55 MAS I FLT**
Detail The MASTER Ultradrive Elite output current has reached a dangerous level.
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 and or isolators for correct operation.

Fault **56 SLV I FLT**
Detail The SLAVE Ultradrive Elite output current has reached a dangerous level.
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 and or isolators for correct operation.

Fault **57 DESAT/OCT**
Detail The SLAVE drive indicates a common desat or over current fault.
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 and or isolators for correct operation.

Fault **58 CURR IMB**
Detail The MASTER and SLAVE Ultradrive Elite output current is out of balance.
Sense Level 10% of actual individual Drive output current.
Possible Cause Mismatch of IGBTs, output impedances or input rectifier.
Action Check entire output circuit including IGBTs output bus work, DC bus fuses and input rectifier.

Fault **59 SLV HS FLT**
Detail The SLAVE Drive has detected either MASTER or SLAVE drive heatsink is TOO HOT.
Sense Level 80°C.
Possible Cause Poor ventilation; obstructed ventilation path, Elite Series cooling fan failure; local ambient temperature exceeds 50°C.
Action Check fan is operating; check ventilation and thermal conditions. Improve cooling. Clean fins with compressed air. Seek service.

Fault **60 SLV DC HI**
Detail The SLAVE Ultradrive Elite dc bus voltage has risen to a dangerous level.
Sense Level 820Vdc
Possible Cause DC bus inter-link cable fault.
Action Check dc bus inter-link.

Fault **61 SLV EPLD**
Detail The SLAVE Ultradrive Elite internal processing units have faulted.
Possible Cause Faulty or unprogramed SLAVE drive control board.
Action Reset all Drive parameters using the INILTILISE ALL VAR at screen Y2; replace SLAVE drive control board.

Fault **62 CONNECT FLT**
Detail The MASTER and/or SLAVE Ultradrive Elite looming connections are incorrect.
Possible Cause The fibre optic connections are plugged in incorrectly or not working.
Action Check all the wiring connections.

Fault **63 SLV WDT**
Detail An unknown fault has reset the SLAVE drive control board.
Possible Cause Power supply fault., Software fault.
Action Reset fault; seek service or replace the SLAVE drive control board.

Fault **64 SLV EEPROM**
Detail The SLAVE drive control board's nonvolatile memory (EEPROM) is faulty.
Possible Cause IC failure.
Action Seek service.

Fault **65 SLV PSU**
Detail The SLAVE Ultradrive Elite Control board power supply failure.
Possible Cause Fault IC.
Action Seek service.

Fault **66 SLV DATA**
Detail The SLAVE Ultradrive Elite control board's nonvolatile memory (EEPROM) reading error. This fault can only be cleared using Screen Y2 to initialise settings. Isolated 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 **67 SLV CAL**
Detail The SLAVE Ultradrive Elite 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.

Fault **68 SLV SW VER**
Detail SLAVE Ultradrive Elite has incorrect software loaded.
Possible Cause The SLAVE drive control board data transmission error; incompatible software and hardware revisions.
Action Download correct software to SLAVE drive control board.

Fault **69 SLV PCBTEM**
Detail The SLAVE Ultradrive Elite internal temperature is too hot.
Sense level 70°C
Possible Cause Poor ventilation; obstructed ventilation path; fan failure; local ambient temperature exceeds 50°C.
Action Check fan is operating; Check ventilation and thermal conditions; Seek service.

Fault **70 DC FUSE FLT**
Detail Fuse monitoring device has operated. External fuse monitoring circuit on SLAVE Ultradrive Elite Parallel Board T30 has operated.
Sense level
Possible Cause One of the monitored fuses has failed and the monitoring switch has opened.
Action Check for continuity on fuse monitoring circuit, look for open circuit in wiring.

Fault **71 DWM1 TRIP**
Detail Drive web interface watchdog timer trip
Sense level Time out set by Driveweb server during configuration
Possible Cause Ethernet interface link to drive has been lost. Driveweb interface has not been polled within the watchdog time specified.
Action Check Ethernet interface wiring.

Fault **72 DWMI BLOCKS**
Detail Driveweb interface is fitted and drive has detected Vysta program blocks are loaded.
Possible Cause No Vysta blocks are allowed in a drive fitted with a Driveweb interface.
Action Remove Vysta program from drive (download standard screen list) or remove Driveweb interface.

8.2 SOFT POWER SUPPLY

This Soft Power Supply is designed to be used with older products as well as the Elite Series. It uses a 230 Volt single phase input and converts it to 600Vdc. Output terminals 5 and 7 are not used to Soft Powering an Elite and the components associated with these can left out. It is wise to retain a power on indication as LED 1 is used for. A modification that can be made to this circuit, is to add a switch to short out R1(the soft charge resistor) when a variac is used for Soft Powering Frames 1 to 3. This allows the voltage to be increased slowly on the Elite without burning out the resistor.

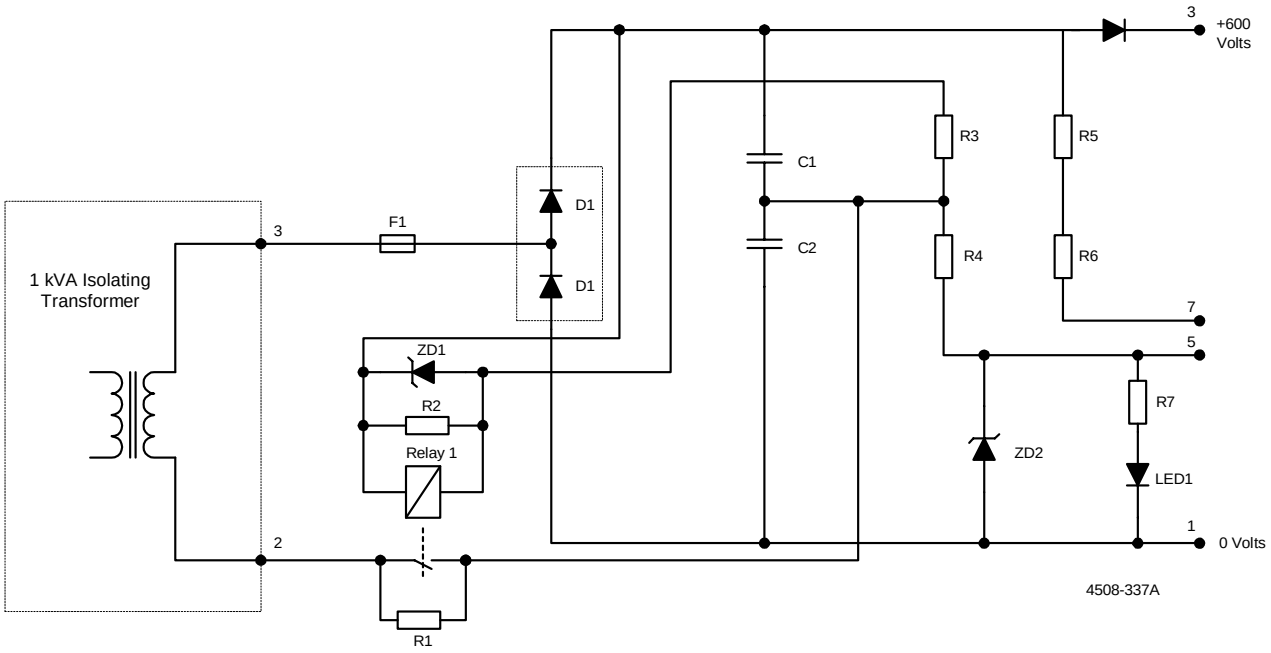


Figure 8.1: Soft Power Supply Circuit Diagram

Component list for the Soft Power Supply.

Component Number	Value	PDL Part number
R1	47R 50W	1059-117
R2	1K 0.25W	1001-145
R2, R3, R4, R5	6K8 25W	1057-165
F1	10A Fuse	2401-025
F1 Holder	Fuse Holder	
Relay 1	12V 16A	2903-011
C1, C2	680uf 400V	1277-447
ZD1, ZD2	15V 1W	1411-129
D1	2 Pack 30A 1600v	1421-012
D2	6A	1401-016
LED1	5mm	1911-001
Circuit Board		
Heatsink		
		1401-016

Figure 8.2: Soft Power Supply Circuit Components.