atg airports ltd

Micro 200+ CCR

Microprocessor Controlled PWM Constant Current Regulator

Installation and Operational Manual
HS17-0-00-02

This manual applies to regulators using firmware v1.09 onwards.

CE

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For personnel familiar with AGL Regulators and safe working practises for this type of equipment, refer to Sections 3 and 4 for a quick guide to Connecting and Commissioning the Micro 200+ CCR.

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AMENDMENT CONTROL

Issue	Date	Author	Amendment description	Firm-ware	Technical Approval	Approved for issue by
1	23.10.24	P. Craven	First issue	v1.08	P. Craven	R. Everett
2	20.11.24	P. Craven	Default setting for Capacitive Current Detection Threshold changed from 10 to 30. Some minor text changes.	v1.09	P. Craven	R. Everett

CCR PART NUMBERING SYSTEM

Example Part Number: M200+CCR - 66 15 - 400 - PS - EF/LF/LA/D

Model:
Micro 200+ CCR

Output Current:
6.0A = 06
6.6A = 66
12.0A = 12
20.0A (non std) = 20

Output kVA:
1,0 kVA (non std) = 01
2.5 kVA = 02
4.0 kVA = 04
5.0 kVA = 05
7.5 kVA = 07
10.0 kVA = 10
12.5 kVA = 12
15.0 kVA = 15

Note – 12.5-15kVA not available in 220V series

Supply Voltage:
208V = 208
220V = 220
240V = 240

380V = 380
400V = 400
415V = 415

Remote Control:

Hard wired:	24V	= 24
	48V	= 48
Serial Comms:	ProfiBus	= PS
	J-Bus / ModBus RTU	= JS
	ModBus TCP / IP (Ethernet)	= MTS

Optional Accessories (always add to part number in order shown):

	Earth Fault Monitor	= EF
	Load Indicator	= LI
	Lamp Fault Indicator	= LF
	Output Lightning Arrestors	= LA
	Field Circuit Isolator	= FCI
	4-20mA Power Meter	= PM
	4-20mA Current Meter	= CM
	Door Safety Interlocks	= DI
Circuit Selector Switch:	Direction / Alternate	= D
	2 Way Circuit Switch	= 2W
	3 Way Circuit Switch	= 3W
	4 Way Circuit Switch	= 4W
	5 Way Circuit Switch	= 5W
	6 Way Circuit Switch	= 6W

SAFETY NOTICES

DANGER – HIGH VOLTAGE CIRCUITRY

This equipment employs high voltage circuitry within the cubicle – up to 2500V for a 15kVA regulator - that presents a hazard of fatal electric shock should personnel come into contact with or close proximity to the conductors.

Installation and servicing of the CCR should only be undertaken by suitably qualified personnel who are familiar with this type of equipment. Extreme caution should be exercised when working on the CCR.

Whilst every practicable safety precaution has been incorporated in the CCR, the following rules must be strictly observed.

KEEP AWAY FROM LIVE CIRCUITS

Do not perform any service work on the CCR, or remove the covers to the main CCR HT cubicle, HT output terminal and mains supply terminal boxes, work on the series circuit or change AGL circuit lamps, without first turning off and isolating the supply to the CCR.

STATUTORY REGULATIONS AND CODES OF PRACTICE

Regulations, codes of practice and safety precautions applicable in the locality should be strictly adhered to. Reference can also be made to the FAA Advisory Circular AC 150/5340-26 'Maintenance of Airport Visual Aid Facilities' for instructions on safety precautions.

The following are examples of statutory regulations which MUST be complied with in the UK:-

- **Electricity at Work Regulations 1989**
- **Electricity Supply Regulations 1988**
- **Health and Safety at Work Act 1974**
- **Management of Health and Safety at Work Regulations 1992**

RESUSCITATION

Maintenance personnel should familiarise themselves with the technique for resuscitation found in first aid manuals.

1 Introduction

1.1 Description

The **atg airports** Micro 200+ Constant Current Regulator provides a controlled level of current to supply airfield ground lighting primary series loop circuits. The Micro 200+ uses an advanced IGBT H-Bridge which is PWM modulated at high frequency. This is followed by a filter which smooths the output of the bridge back to mains frequency, before applying to the primary of the main CCR output transformer. This provides, for a typical AGL circuit that is largely resistive in characteristic, a sinusoidal output waveform at mains frequency.

The Micro 200+ CCR produces significant benefits in terms of the Power Quality drawn from the supply as compared to conventional thyristor regulators. When connected to a rated load, the Power Factor approaches unity at maximum output current, and typically does not drop below 0.85 at minimum current. The level of the supply current total harmonic distortion (THD) is low at all CCR output current steps. To maintain the Power Quality at reduced loads, the CCR output isolation transformer is provided with multiple secondary tappings which can be selected to match the load on the series circuit.

The Micro 200+ CCR is available in two supply voltage ranges: the 220V series is available to operate either from a single-phase or two-phase supply, and the 400V series operates from a two-phase supply. Primary voltage taps are available to provide fine adjustment to suit local conditions; for example, the 400V series can be set to operate at 380, 400 or 415V.

To ensure maximum reliability and operational security, control of the IGBT H-Bridge and all critical fault detection circuits are implemented in hardware.

The Micro 200+ is pre-programmed with default operating parameters suitable for most applications. If required, programming changes and calibration can be performed by accessing the menu driven system using the rotary encoder and pushbutton on the CCR front panel. (Note - the Set-up and Engineering menus are password protected to prevent unauthorised access). Although an external PC is not necessary for service and commissioning work, a USB port is provided.

1.2 Standard Features and available options

1.2.1 Standard Features

The Micro 200+ CCR has the following standard features:

- Accurate control of RMS output current level into all loads from short circuit to full rated load Display of output voltage, output kVA and output power
- 3, 5 or 8 pre-programmed brilliancy levels to IEC, FAA or CAP168 standards
- 8 fully adjustable brilliancy levels, between 0.1 – 100%
- Local control from front panel rotary switch; fast and easy – no need to enter menu system to select brilliancy
- Display of output current true RMS value
- Open circuit protection implemented in hardware for maximum reliability

- Over current protection
- Lamp Failure Detection – displayed as a total or as a percentage
- Capacitive Current Detection – ensures correct operation of open circuit protection on highly capacitive AGL series loop circuits
- Asymmetric Output Current Detection
- Instantaneous response to overcurrent conditions caused by load impedance changes during block switching operations
- Warning indication of “Tolerance Fault” (output current outside tolerance limits)
- Elapsed time counter records hours run at maximum brilliancy and total hours run
- Adjustable current ramp for switch on, increases lifetime of lamps
- Black heat - selectable low current output level available for remote “OFF” setting
- Operating parameters configurable from front panel with fast entry using rotary encoder and press-selector – there is no need for a computer
- Separate compartments for low voltage, mains voltage and high voltage circuitry, all with individual lockable covers
- Supplied with castors as standard for easy manoeuvrability

1.2.2 Optional Features

The Micro 200+ CCR can be supplied with the following options:-

- Serial communication using Profibus, Modbus TCP/IP or J-BUS. Permits remote control of the CCR and / or monitoring of relevant operating parameters
- External brilliancy control from 24V, 48V or volt free contact, 8-Wire, 3-Wire encoded or BCD encoded
- Earth Leakage Resistance Measurement. Continuous measurement of the series circuit resistance to earth at 500V whilst the CCR is operating, or at 1000V during manual testing when the CCR is set to ‘Local OFF’. A two-stage alarm / trip output is provided; the resistance value can also be displayed
- Internal Lightning Arrestors on the outgoing circuit
- Power analyser module – measures input and output voltage, current, power, power factor, kVA and regulator efficiency
- Series Circuit Cutout Switch with three position plug-in lid. This is an optional safety device that is used to isolate the series circuit from the high voltage output of the CCR and connect the field cables to earth for safe maintenance. It also has a connection position that provides insulation resistance measuring test points.

1.3 Specification

The Micro 200+ CCR is designed to comply with IEC 61820-3-2:2023 – Electrical installations for lighting and beaconing of aerodromes, and all applicable EMC standards.

Mains supply voltage range:	+/-10% of nominal
Mains supply frequency:	46.25 to 64.5 Hz
Control method:	PWM IGBT H-Bridge. Hysteresis waveshape inner control loop and output current level outer control loop.
Remote Brilliancy Inputs:	24 / 48V. Internal or external supply, polarity insensitive.
Number of Brilliancy steps:	8
Efficiency (standard models):	90% or better at full load 80% or better, averaged over all current steps, into a full nominal resistive load tested as per IEC 61820-3-2:2023
Power factor:	0.95 or better into a full nominal resistive load
Degree of Protection:	IP2X

2 Installation

2.1 Physical Characteristics

The Micro 200+ CCR cabinet is constructed from mild steel with an IP2X rating. Figure 2-1 below shows the outline drawing of the CCR. The same cabinet is used for all regulators from 2.5kVA to 15kVA.

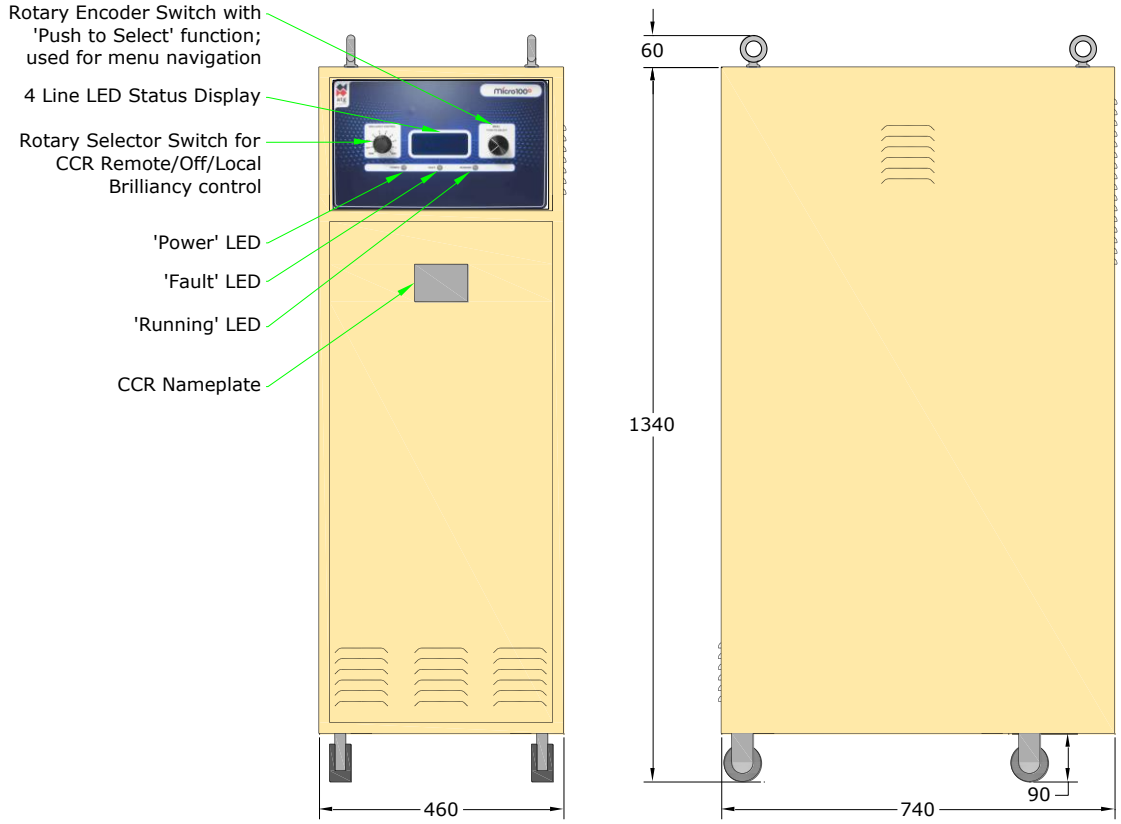


Figure 2-1 CCR Cabinet Outline Dimensions

The cubicle is divided into the following easily accessible compartments, as described below and shown overleaf in the photographs of Figure 2-4:

i) Microcontroller Compartment – accessible from the front

ii) Main Electronics Compartment. Contains the AT1030 Main Control Card and all option cards. Accessible via the lower front cover. **Note – there are mains voltages present in this section (230V AC fan supply), at the top right-hand corner of the AT1030 Card. These terminals are protected by a shroud.**

iii) Power and HT Compartment. Contains the IGBT H-Bridge and AT732 Power Card, filters, main CCR transformer, contactor, RFI filter etc. Accessible via side, rear and top covers. **Note – high voltages are present within this compartment.**

iv) Mains Supply Terminal Box - accessible from the rear

v) Low Voltage Control Terminal Box - accessible from the rear

vi) HT Output Terminal Box - accessible from the rear. **Note – high voltages are present within this compartment.**

Figure 2-2 and Figure 2-3 (below) show the cabinet covers, which can be removed to give access to the individual compartments. Note – locks secure the covers to each of these, except for the Microcontroller Compartment and top cover. Some units include electrical door interlocks, which open the main contactor if a door is opened.

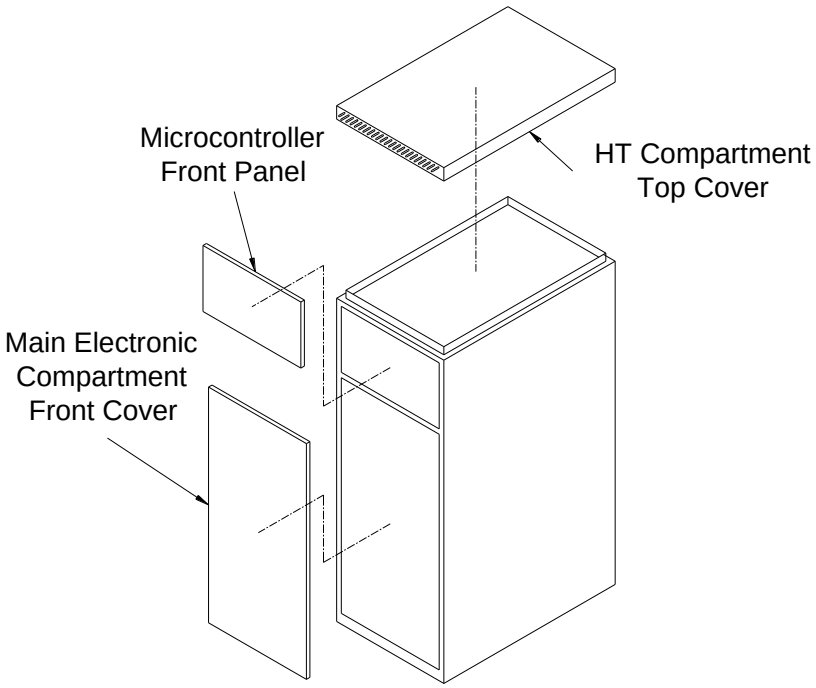


Figure 2-2 CCR Cabinet Covers (Front)

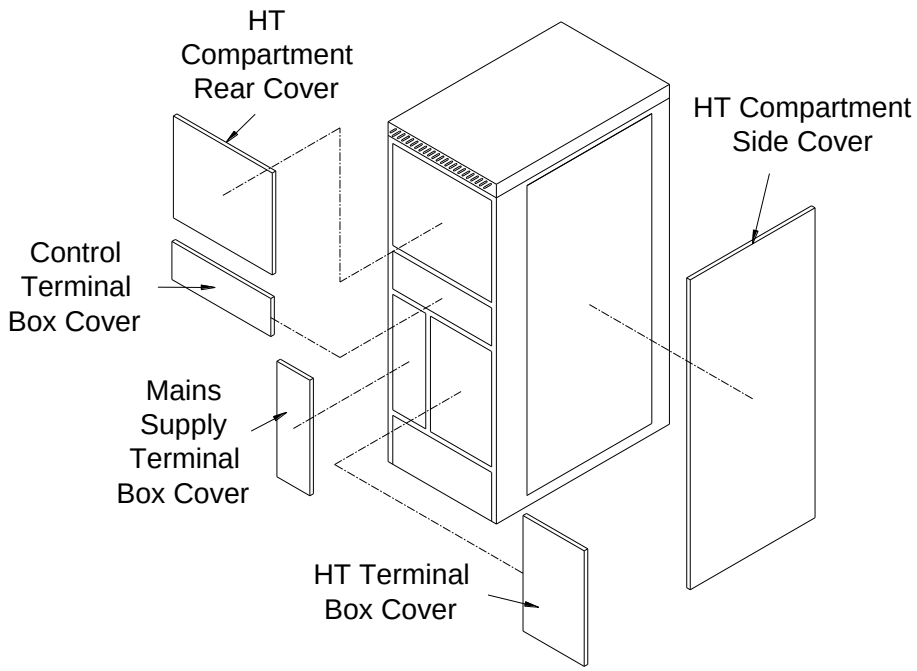


Figure 2-3 CCR Cabinet Covers (Rear)

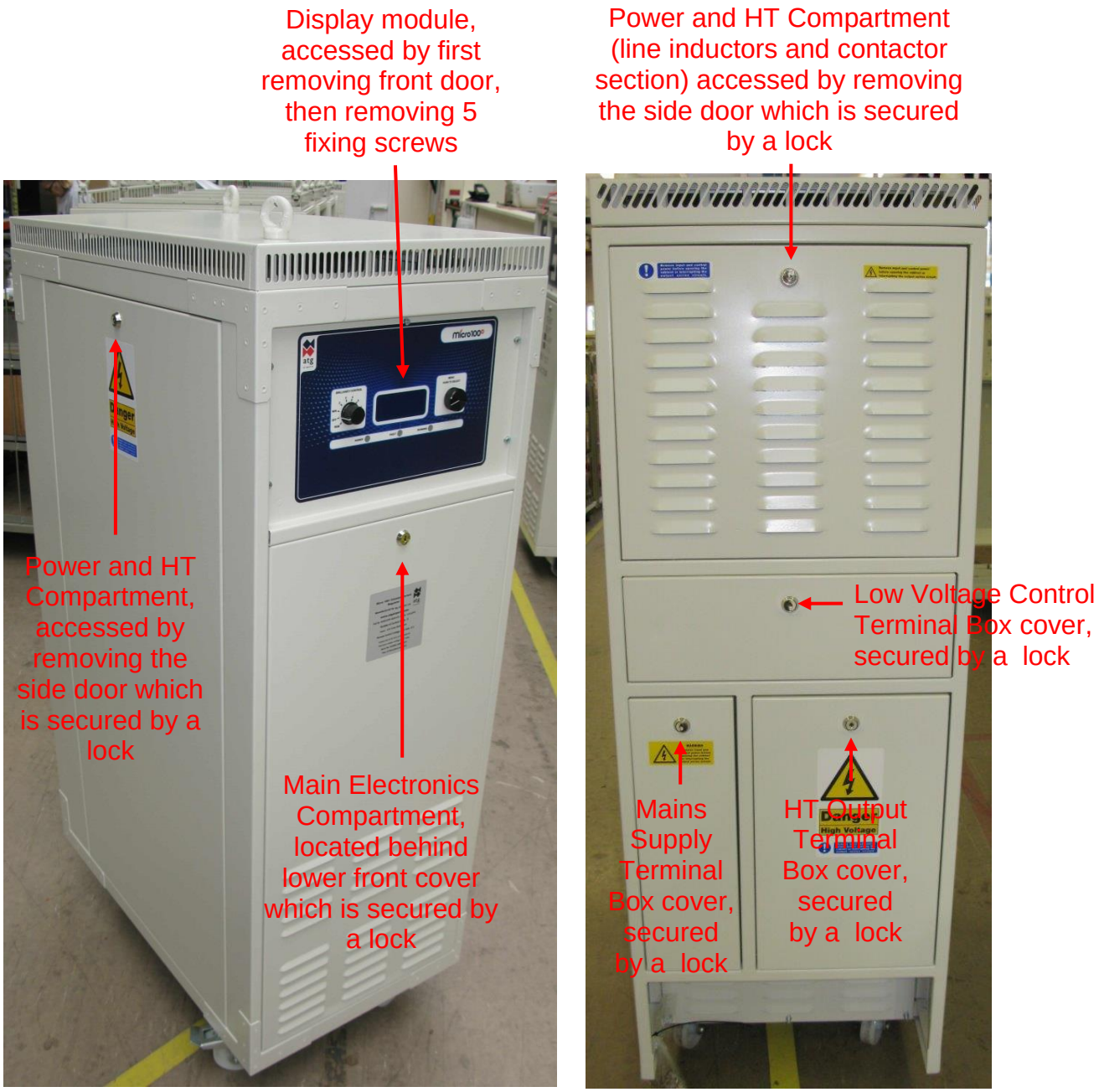


Figure 2-4 CCR front / side view, and rear view showing terminal covers

2.2 Operating environment and clearance around the cabinet

The Micro 200+ CCR is designed for indoor installations in an area that should be clean and dry, free of dust, etc. (Pollution Degree 2, as defined by EN 60439-1). There should be adequate ventilation for cooling, with the following environmental conditions:

Temperature range:	-40°C to 50°C
Relative Humidity:	10% to 95%, non-condensing
Altitude:	Sea level to 2000 metres

To facilitate safe working practices for maintenance, a clearance of 1000mm is recommended at the front and back of the regulator.

A clearance of 40mm should be left at the sides of the cabinet for ventilation of the slots in the sides of the cabinet lid.

2.3 Cabinet weights and manoeuvring of the CCR

The approximate weights of the standard sizes of regulator are listed in Table 2-1.

Regulator output size (kVA)	Approximate weight (kg)
2.5	140
4	150
5	170
7.5	190
10	245
12.5	250
15	270

Table 2-1 Approximate Regulator Weights

For general manoeuvring of the CCR cabinet around the substation, the cabinet is fitted with four castors on the underside. These are to be used over short distances, such as within the electrical substation and test facilities. The castors are designed only for smooth surfaces. Prior to manoeuvring a CCR, the person responsible for manoeuvring is to check the route to ensure it is clear of obstructions or other hazards to people or equipment. If it is planned to move the CCR outside of the electrical substation and over uneven ground, it is recommended to use a vehicle with a tail lift to transport the CCR to its final destination.

If it is required to lift the CCR cabinet off the ground then the four lifting eyes should be

used, with slings or a lifting shackle inserted through the eyebolts, and a suitable lifting device used to elevate the cabinet. A spreader bar should be used to ensure that the slings or lifting shackles are positioned vertically as the cabinet is raised, so as not to introduce a side load to the lifting eyes. The lift should be performed smoothly without jerking the cabinet as it is raised.

2.4 Supply Current and Input Circuit Breaker Rating

Table 2-2 provides a guide for typical input current requirements for the standard sizes of regulator, with full rated load connected, and the CCR operating at maximum brilliancy.

kVA Rating	Approximate input current requirement with the CCR running at full rated load.					
	220V series			400V series		
	208V	220V	240V	380V	400V	415V
2.5	14	13.3	12.2	7.7	7.3	7.1
4	22.5	21.3	19.5	12.3	11.7	11.3
5	28.1	26.6	24.4	15.4	14.7	14.1
7.5	42.2	39.9	36.6	23.1	22	21.2
10	56.2	53.2	48.8	30.8	29.5	28.2
12.5	N/A	N/A	N/A	38.5	36.6	35.3
15	N/A	N/A	N/A	46.2	43.9	42.3

Table 2-2 CCR Input Current Requirements

A guide for calculating the total load of the series circuit, including AGL cable losses and transformer losses, is included in Section 8.1. This can be used to determine the kVA rating of the regulator which should be used on any given circuit.

The regulator output is designed to remain stable with an input voltage variation of up to +/-10% of the nominal supply voltage.

Table 3-1 provides a list of the minimum recommended supply cable sizes for each rating of CCR.

It is recommended that the external distribution circuit breaker or fuses are rated for 125% of the CCR supply current (or the next size larger), unless local regulations specify a different rating requirement. Ensure that the circuit breakers or fuses used provide adequate protection for the supply cables used, and always install in accordance with the current IEE or local codes of practice.

3 Connecting the CCR

3.1 Terminal Categories

Connections to the CCR are divided into three categories: CCR Mains Supply Input; Control Terminals and HT Series Circuit Output. Each has its own terminal compartment at the rear of the CCR, each with its own lockable cover. These are shown in Figure 3-1:

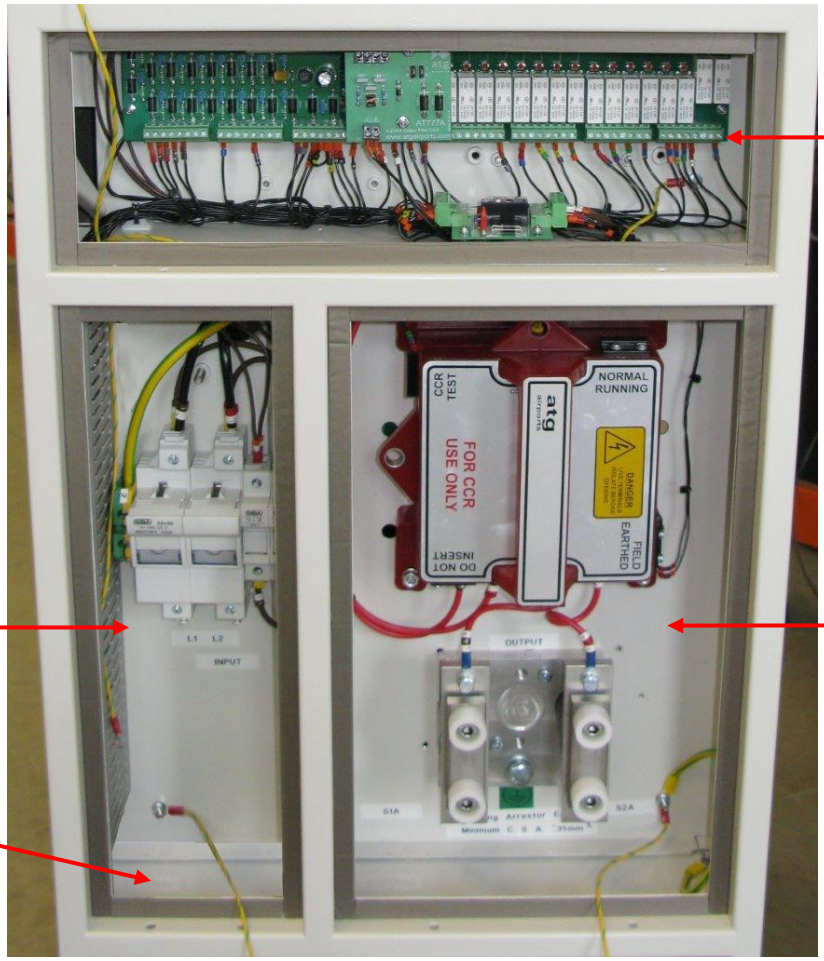


Figure 3-1 Terminal Boxes

The terminal box gland plate – fitted at the bottom – is normally supplied as a blank. Holes will need to be punched at the time of installation. The control cables should enter at the left-hand side of the gland plate, and run through the trunking in the left-hand side of the Mains Supply Terminal Compartment and through the entry hole into the Low Voltage Control Terminal Compartment. For safety, and to maintain the IP rating of the cubicle and the EMC shielding, the gland plate must always be fitted. No extra holes should be made in the plate in addition to those used for the cable glands.

Note – Micro 200+ CCRs can be supplied to order fitted with customer specific control connectors, prewired to the internal CCR control terminals; Contact **atg airports** for details.

3.2 CCR Mains Supply Input and Cabinet Earth

This terminal box contains the mains supply fuses or circuit breaker and the control supply fuses. Cable entry is via the gland plate at the bottom of the box; the incoming mains cables connect directly into the fuse carriers (or circuit breaker), to the terminals marked “L1” and “L2”. The typical supply current requirements are listed in Table 2-2 of the previous section, and the minimum recommended CCR supply cable sizes are listed in Table 3-1 below.

kVA Rating	**Minimum recommended CCR supply cable sizes**					
	220V series		**400V series**			
	CSA mm²	**AWG**	**CSA mm²**	**AWG**		
2.5	4 mm²	AWG 12	2.5 mm²	AWG 14		
4	6 mm²	AWG 10	4 mm²	AWG 12		
5	10 mm²	AWG 8	4 mm²	AWG 12		
7.5	16 mm²	AWG 6	6 mm²	AWG 10		
10	25 mm²	AWG 4	10 mm²	AWG 8		
12.5	25 mm²	AWG 3	10 mm²	AWG 8		
15	25 mm²	AWG 3	16 mm²	AWG 6		
Note - due to cables specified in mm² or AWG not always being available in exactly matching sizes, the recommended CSA in mm² may be higher or lower than the nearest AWG cable size depending on the supply current of the particular CCR.						

Table 3-1 Minimum recommended CCR supply cable sizes

The earth cable also connects to a terminal within this box. The minimum size of the earth cable, regardless of the CCR power rating, should be 10 mm² (AWG 8), but always with a CSA of at least 50% of that of the mains supply cables. Always ensure compliance with the local electrical codes of practise.

3.3 Control Connections

Except for those regulators with custom control connectors fitted to the gland plate or those using serial communication modules, all control connections are made to screw terminals on PCB(s) fitted within the control terminal box. The field cables enter through the gland plate at the bottom of the mains terminal box and pass through a duct within this box, before entering the low voltage control terminal compartment. The PCB terminal will accommodate cable with a cross sectional area from 0.25mm^2 to 2.5mm^2.

In addition to the mains supply input, earth and AGL series loop output connection, no other connections are required to permit the CCR to operate in local control.

For a standard Micro 200+ with an AT712 Relay I/O Card fitted, the CCR can operate with the following Remote-Control configurations:

i) 8-Wire Brilliancy Selection, with or without Command On input.
ii) 3-Wire Encoded Brilliancy selection, with or without Command On input (7 Brilliancy Levels)
iii) BCD Encoded Brilliancy Selection, with or without Command On input (8 Brilliancy Levels)

Figure 3-2 AT712 Relay I/O Card fitted in Control Terminal Box

Relay contacts are provided on the AT712 Card for Back Indication of CCR status. The relay contacts are rated at 4A @ 250V AC or 4A @ 30V DC with a resistive load. However, in order to maintain the ELV rating of the control terminal box it is recommended not to apply a voltage greater than 60V DC or 25V AC.

When options such as an integrated Circuit Selector Switch or Power / Current Monitor modules are fitted, additional cards will be mounted over the AT712 Card. Refer to the appropriate supplementary manuals for details.

Optional serial communications modules are available to give Remote Control using Profibus, Modbus TCP/IP or J-BUS. Contact **atg airports** for details. These modules would normally be fitted in place of the AT712 Relay I/O Card, although they can be used in addition to this to give a monitoring function only.

3.3.1 Remote Brilliancy Selection – up to 8 individual inputs

The default Remote Control Configuration for a standard Micro 200+ CCR with a Relay I/O Card fitted is 8-Wire Remote Brilliancy Selection without Command On. (In this case, the CCR operates whenever a Brilliancy Input is activated). Other modes of operation can be selected via the keypad menu; for example, 8-Wire control can be used with or without the Command On input. To program the operating mode, refer to Section 9.3.2.2 – Remote Control Configuration.

The CCR can be programmed to operate with a maximum of 8 Brilliancy Steps (using all 8 Brilliancy Inputs - normally UK CAP168 brilliancy levels), but it is also possible to configure for 5 step FAA / IEC Style 2 (using Brilliancy Inputs 1 to 5) or 3 step FAA / IEC Style 1 (using Brilliancy Inputs 1 to 3). Whichever configuration is used, the appropriate pre-programmed current levels assigned to each Brilliancy Input are selected via the keypad menu system. These are normally set during factory testing based on the CCR order specification, but can be changed if necessary – refer to Section 9.3.2.7 - Brilliancy Levels Style selection. Alternatively, up to a maximum of 8 User Defined Current / Brilliancy Levels may be selected – see Section 9.3.2.8.

Figure 3-3 and Figure 3-4 show the connections to the Relay I/O Card for 8-Wire control. The optional Command On input is also shown; the use of this is selected via the menu system – refer to Section 9.3.2.2 – Remote Control Configuration.

Figure 3-3 shows the connection using the CCR internal power supply, and Figure 3-4 shows the same scheme using an external power source. Note – when using an external supply, it should be free floating and not referenced to earth.

The CCR Remote Brilliancy inputs can be driven from an external 24V or 48/50V DC supply, of either polarity, or an internal 24V DC supply.

If more than one Brilliancy Input is selected the CCR operates using the highest input, but an alarm is flagged on the front panel.

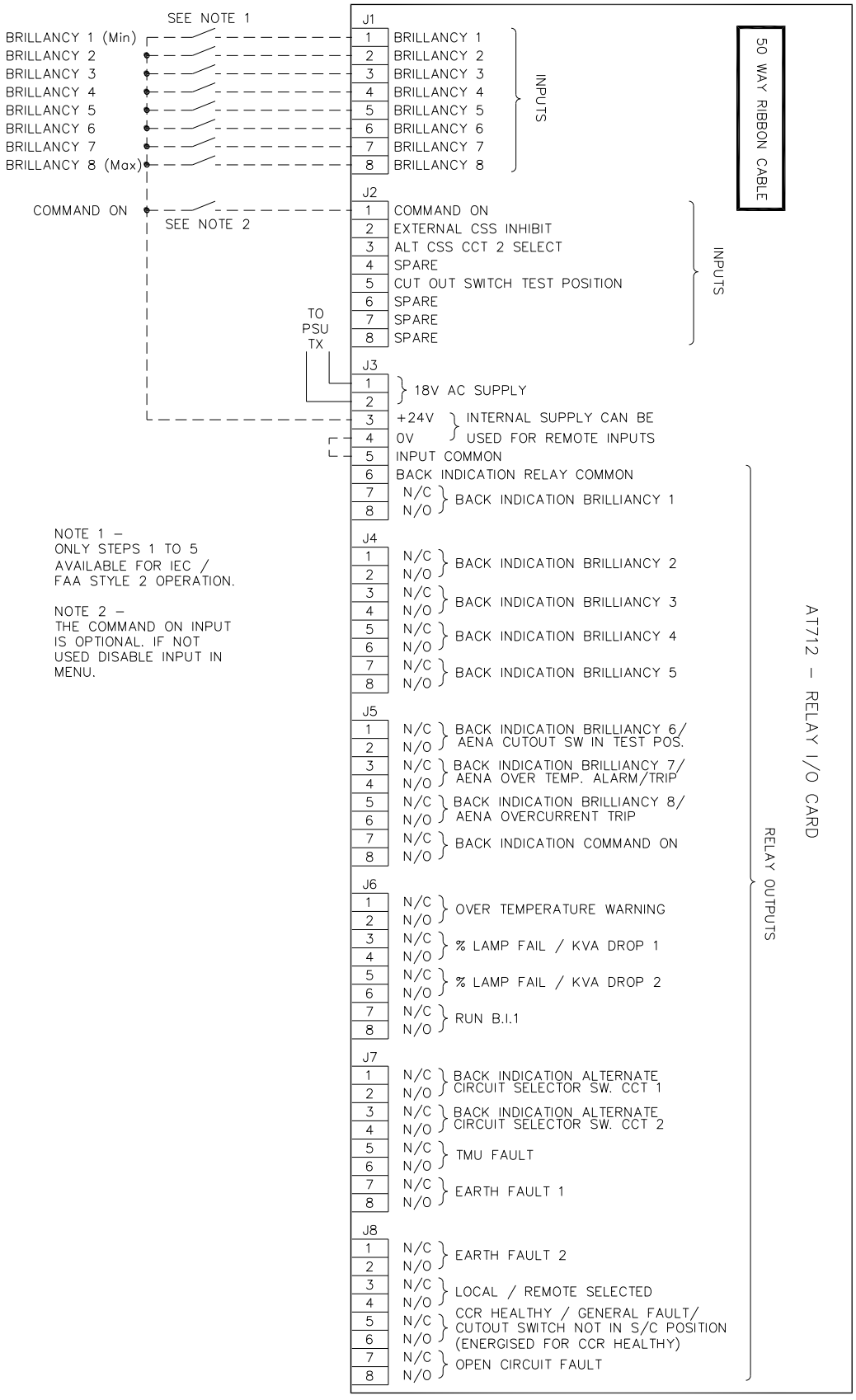


Figure 3-3 Connections for 8-Wire Remote Brilliancy using CCR internal PSU

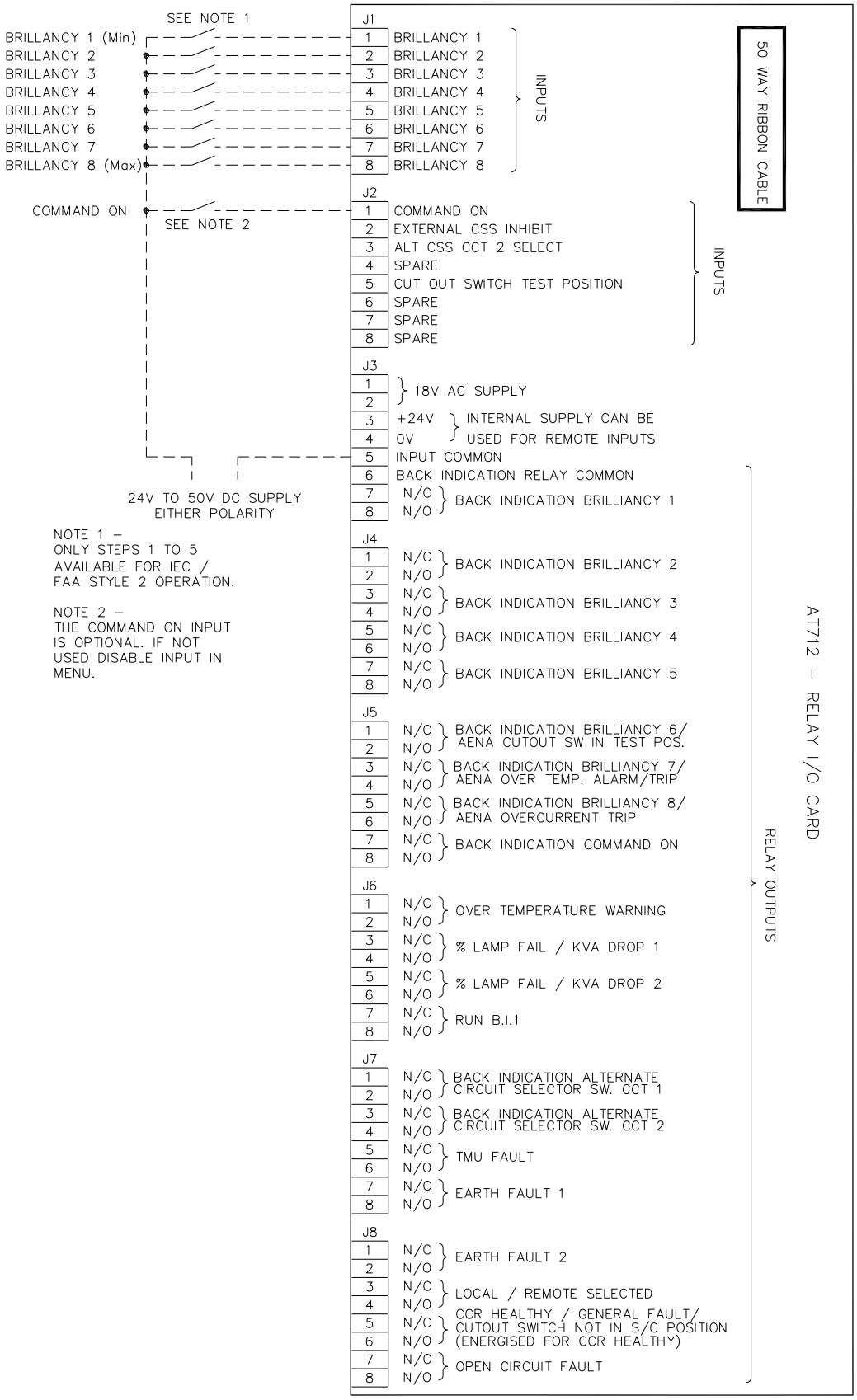


Figure 3-4 Connections for 8-Wire Remote Brilliancy using external PSU

3.3.2 3-Wire Encoded Remote Brilliancy Selection

The circuit of Figure 3-5 below shows the connections for 3-Wire Encoded Remote Brilliancy Selection using the CCR internal power supply. The use of a 'Command On' input is optional; the appropriate configuration should be selected using the keypad menu. All other information in Section 3.3.1 applies. To program the CCR for 3-Wire operation, refer to Section 9.3.2.2.

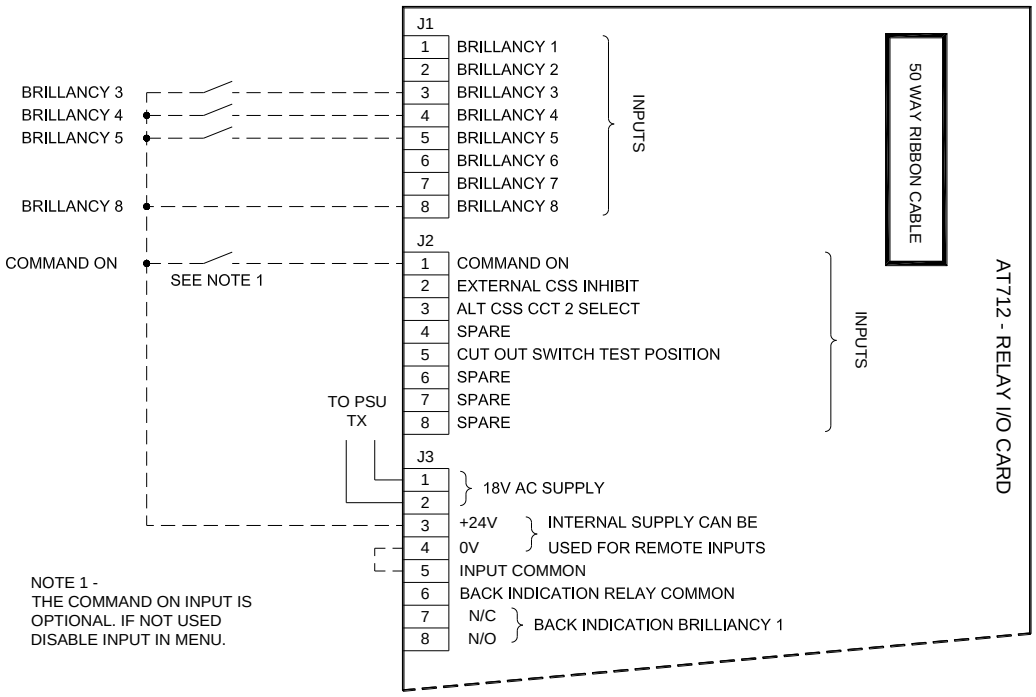


Figure 3-5 Connections for 3-Wire Encoded Remote Brilliancy Selection

Table 3-2 below, describes the encoding. Note – a '1' indicates that the input is selected; 'N/R' indicates not required.

3-Wire Encoded Remote Brilliancy Selection							
Step	**Brilliancy (default UK CAP 168 levels)**	**Remote Input**					
		Brilliancy 8	**Brilliancy 7**	**Brilliancy 6**	**Brilliancy 5**	**Brilliancy 4**	**Brilliancy 3**
Off	Off	0	N/R	N/R	X	X	X
1	0.1%	1	N/R	N/R	0	0	0
2	0.3%	1	N/R	N/R	0	0	1
3	1%	1	N/R	N/R	0	1	0
4	3%	1	N/R	N/R	0	1	1
5	10%	1	N/R	N/R	1	0	0
6	30%	1	N/R	N/R	1	0	1
7	80%	1	N/R	N/R	1	1	0
8	100%	1	N/R	N/R	1	1	1

Table 3-2 3-Wire Encoded Remote Brilliancy Selection

3.3.3 BCD Encoded Remote Brilliancy Selection

The circuit of Figure 3-6 below shows this configuration. The use of a 'Command On' input is optional. All other information described in Section 3.3.1 applies. To program the CCR for BCD encoded operation, refer to Section 9.3.2.2.

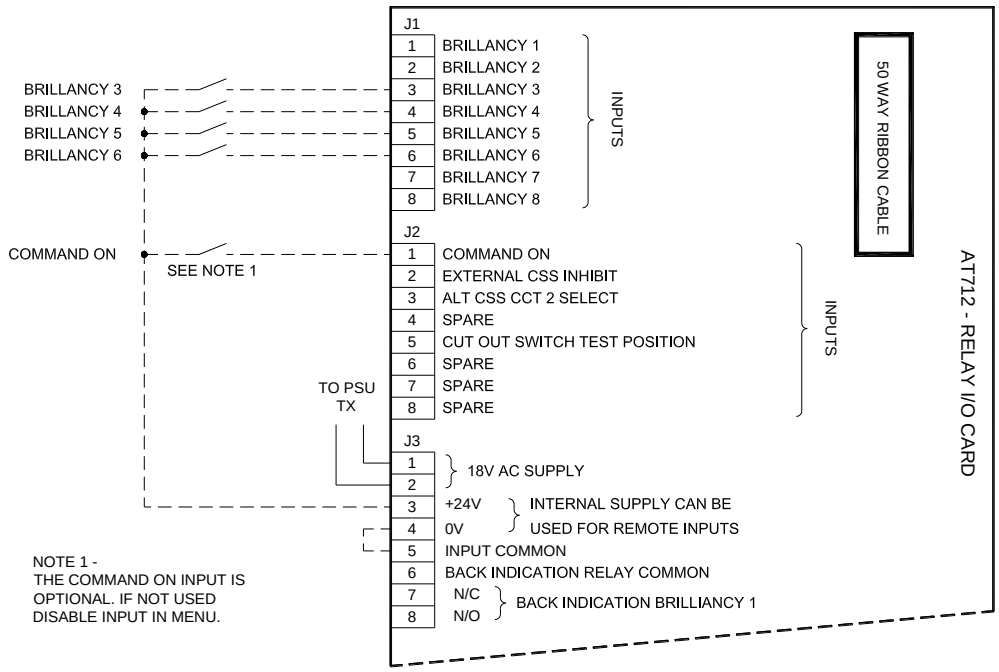


Figure 3-6 Connections for BCD Encoded Remote Brilliancy Selection

Note – it is possible to select from 2 coded tables; BCD (standard) and BCD control Option 2, as shown in Table 3-3 and Table 3-4. Note – a '1' indicates that the input is selected; 'N/R' indicates not required.

BCD (standard) Encoded Remote Brilliancy Selection							
Step	**Brilliancy (default UK CAP 168 levels)**	**Remote Input**					
		Brilliancy 8	**Brilliancy 7**	**Brilliancy 6**	**Brilliancy 5**	**Brilliancy 4**	**Brilliancy 3**
Off	Off	1	N/R	0	0	0	0
1	0.1%	1	N/R	0	0	0	1
2	0.3%	1	N/R	0	0	1	0
3	1%	1	N/R	0	0	1	1
4	3%	1	N/R	0	1	0	0
5	10%	1	N/R	0	1	0	1
6	30%	1	N/R	0	1	1	0
7	80%	1	N/R	0	1	1	1
8	100%	1	N/R	1	0	0	0

Table 3-3 BCD (standard) Encoded Remote Brilliancy Selection

BCD Option 2 Encoded Remote Brilliancy Selection							
Step	**Brilliancy (default UK CAP 168 levels)**	**Remote Input**					
		Brilliancy 8	**Brilliancy 7**	**Brilliancy 6**	**Brilliancy 5**	**Brilliancy 4**	**Brilliancy 3**
Off	Off	N/R	N/R	N/R	1	1	1
3	1%	N/R	N/R	N/R	1	1	0
4	3%	N/R	N/R	N/R	1	0	1
5	10%	N/R	N/R	N/R	1	0	0
6	30%	N/R	N/R	N/R	0	1	1
7	80%	N/R	N/R	N/R	0	1	0
8	100%	N/R	N/R	N/R	0	0	1
Off	Off	N/R	N/R	N/R	0	0	0

Table 3-4 BCD Option 2 Encoded Remote Brilliancy Selection

3.3.4 External Circuit Selector Switch Connection

The Micro 200+ CCR can be supplied with an optional Integral Circuit Selector Switch. However, if an external CSS is to be used a volt-free inhibit contact should be provided on the CSS control unit to momentarily turn off the regulator during switching of the Circuit Selector Switch.

This contact should be connected to the AT712 “EXTERNAL CSS INHIBIT” input (terminal J2/2), as shown in Figure 3-7 below.

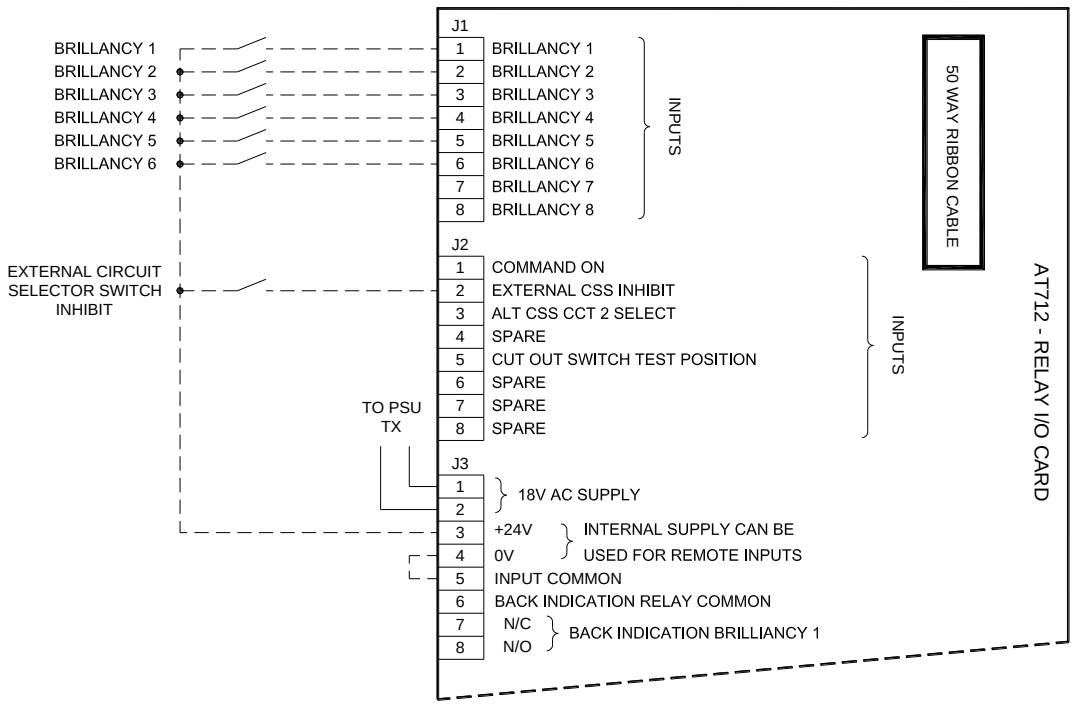


Figure 3-7 Connection for External Circuit Selector Switch inhibit line

When the CSS inhibit contact is CLOSED, the green CCR “RUN” LED on the front panel will flash to indicate that the CCR output is switched off, and the following message will be displayed:

R	E	M	O	T	E		B	R	I	L	L		5				↑	↓	
E	X	T		C	S	S		I	N	H	I	B	I	T					
O	P		C	U	R	R	E	N	T	:			X	.	X	X		A	
O	P		V	O	L	T	A	G	E	:			X	X	X	X		V	

Note – in this condition, the CCR line contactor remains energised.

3.4 HT Series Circuit Output Terminals.

WARNING – HIGH VOLTAGES – UP TO 2500V FOR A 15KVA REGULATOR – ARE PRESENT WITHIN THE HT TERMINAL BOX. THE COVER TO THIS COMPARTMENT SHOULD NEVER BE OPENED WITHOUT FIRST ISOLATING THE REGULATOR MAINS SUPPLY INPUT

FURTHERMORE, BEFORE THE AGL FIELD CABLES AND CCR OUTPUT TERMINALS ARE SAFE TO TOUCH, THEY SHOULD BE SHORTED TOGETHER AND CONNECTED TO EARTH, PREFERABLY USING A SUITABLE SWITCHING DEVICE. RESIDUAL CHARGE OR INDUCED EMF FROM OTHER AGL CIRCUITS MAY OTHERWISE PRESENT A HAZARD TO PERSONNEL.

CCRS CONTAINING INTEGRAL LIGHTNING ARRESTORS MAY BE SUPPLIED WITH TWO INSULATING COVERS FITTED OVER THE LIGHTNING ARRESTOR TERMINALS. IN THIS CASE, ENSURE THAT THE INSULATING COVERS ARE REFITTED AFTER THE AGL SERIES CIRCUIT CABLES HAVE BEEN CONNECTED.

This terminal box contains 2 HT output terminals for a standard regulator, 4 for an Integral Alternate Circuit Selector Switch, and up to 7 for a Multi-way Circuit Selector. Refer to the manual supplements for connection details for these options.

Figure 3-8 (overleaf) shows photographs of standard output terminals, and a 4-terminal lightning arrestor assembly as used for an integral alternate circuit selector switch or a 3-way simultaneous circuit selector switch. This 4-terminal assembly is fitted with insulating sheets at the sides of the terminals; these are necessary since clearance is limited between the end terminals and the sides of the compartment.

Note – the voltage rating of the AGL cable should be chosen according to the rated output voltage of the regulator used, on the output current setting used; be it 6.0 / 6.6A or 12A. Refer to Table 4-6 and Table 4-7 for the Main CCR Transformer output voltages.

Figure 3-8 Standard Output Terminals and 4 Terminal Lightning Arrestor

For those regulators fitted with Integral Lightning Arrestors, a separate earth connection must be made. This should connect to the aluminium lightning arrestor assembly base plate, using the bolt near the bottom of the plate. The earth cable used should have a cross sectional area of at least 35 mm^2. Refer to Section 6 - Output Lightning Arrestors, for more information.

4 Commissioning

4.1 Introduction

The factory test of the Micro 200+ CCRs includes accurate calibration of the CCR output current level to that specified by the customer. This is performed using a specialised, calibrated, power analyser. Re-calibration of the regulator should not therefore, be undertaken as part of the commissioning process.

If verification of the set current is required this can be done by connecting either a short circuit, or better still, a resistive load bank to the output terminals and running the regulator at maximum brilliancy.

Note – **atg airports** do not consider 'clamp' type RMS ammeters as being sufficiently accurate for the calibration of CCRs, due to the variation in measured current with clamp pressure. If a regulator is to be re-calibrated, this should be done using a suitable in-line 'true RMS' ammeter as described in Section 10.2.

For a standard Micro 200+ CCR with no Option Modules fitted, and providing that the AGL circuit is matched to the CCR rated output current (see rating label), then commissioning of the regulator requires only to:

i) Verify that the default CCR operating parameters are correct for the application, eg. 8-Wire Remote Brilliancy Selection, 5 step FAA / IEC Style 2 or 8 step UK CAP168 Brilliancy / Current Levels. (Note - if any special requirements were notified to **atg airports** at the time of ordering, these will have been programmed during factory testing). See Section 4.2

ii) Verify the correct operation of the external control connections.

iii) Set the CCR Main Transformer (T101) input voltage connection to be one tap lower than the local supply, for example connect the 380V tap for a 400V supply. (This is to ensure that the Micro 200+ can cope with a 10% dip in mains supply voltage, and still maintain the output current within the specified limits at full load). Set the Transformer output voltage taps to correctly match the series circuit load - see Section 4.3. For CCR output voltage and load kVA monitoring, program in the output voltage used on the CCR Main Transformer – see section 4.4.1 and section 9.3.2.18.

If any Option Cards or Modules are fitted, then these may require hardware set-up and / or programming of operating parameters. The set-up of the most commonly used Option Cards is included in this manual; the Earth Leakage Resistance Measurement Module is described in Section 4.5, and the Percentage Lamp Failure System is described in Section 4.6.

Refer to the supplementary manuals for any other optional components fitted, for example, a serial communications module.

When the regulator has been correctly configured, as described in the following sections, it is ready for initial power up.

First, turn the Front Panel Brilliancy Selection rotary switch to “OFF” and energise the mains supply. On power up the following screen will be displayed:

L	O	C	A	L			O	F	F								↓
O	P		C	U	R	R	E	N	T	:			0	.	0	0		A	
O	P		V	O	L	T	A	G	E	:						0		V	

If a fault screen should appear instead of the above, refer to section 9.5, Fault Screen Listings.

4.2 Default CCR Operating Parameters

Table 4-1, below, lists the most important CCR Operating Parameters, along with a brief description and the default setting. A box is provided to record any non-standard settings used. Table 12-2 (commissioning Parameter Record Sheet) has a full listing of parameters with descriptions, default settings and space for recording any parameters changed from default.

Table 4-2 through to Table 4-5 list the pre-programmed current settings available and their associated tolerance limits.

Section 9 describes navigating around the Menu System and programming the CCR using the Front Panel Keypad. Sections 9.3 and 9.4 contain comprehensive listings of all Operating Parameters, along with the default settings. The majority of the parameters can be left on the default setting for most applications.

Parameter	**Description**	**Location of parameter**	**Firmware default setting**	**CCR Serial Number:** **User Settings**
MAXIMUM OUTPUT CURRENT (See Note 1)	Maximum CCR output current, 6.0A, 6.6A, 12.0A or 20.0A (note - the output currents available are also dependent on the power transformer fitted)	Engineering Configuration Menu; see section 9.4.2.1	6.60A	
REMOTE CONTROL CONFIG.	Remote Control Brilliancy Selection: 8 Wire, 3 Wire Encoded, BCD Encoded, (all with or without Command), or Serial Comms	Set-up Menu; see section 9.3.2.2	8 WIRE	
BRILLIANCY LEVELS STYLE (See Note 1)	Current setting for each Brilliancy step; Pre-programmed table to UK Cap 168 levels, 3 Step FAA - IEC/EN Style 1, 5 Step FAA - IEC/EN Style 2 or User Defined	Set-up Menu; see sections 9.3.2.7 and 9.3.2.8	UK CAP168	

Parameter	Description	Location of parameter	Firmware default setting	CCR Serial Number: User Settings
TOLERANCE MONITORING	Tolerance Monitoring Unit (TMU), checks that measured CCR output current falls within specified limits	Set-up Menu; see sections 9.3.2.9 and 9.3.2.11	ENABLED (Tol. Mon. limits automatically set according to Brilliancy Levels table selected)	
BLACK HEAT OUTPUT CURRENT IN REM OFF	CCR produces a low current output when in 'OFF' state under remote control. Prevents condensation in tungsten halogen lamps	Set-up Menu; see sections 9.3.2.12 and 9.3.2.13	DISABLED	
EARTH LEAKAGE STAGE 2 TRIP	Two threshold levels can be set for the resistance to earth of the series loop circuit. This parameter selects whether the CCR should trip or alarm once the second threshold is reached (Stage 2). (Note – the Earth Leakage Card is optional)	Set-up Menu; see section 4.5.2.3	ENABLED. (For reasons of safety, it is recommended to leave ENABLED, to trip the CCR on Stage 2 earth leakage fault)	
PLF / POWER ANALYSER CARD TYPE FITTED (See Note 1)	Allows selection between AT1031 PLF/PA Card and AT1134 PLF/PM Card	Engineering Configuration Menu; see section 9.4.2.3	AT1134 PLF/PM Card	
% LAMP FAILURE (PLF) CONFIGURATION	Monitors the inductance of the series loop circuit to detect lamp failures and provides power measurement for control of PFCCs	Set-up Menu. The PLF Card Set-up procedure is described in Section 4.6	ENABLED	
MAIN TRANSFORMER TAPPING VOLTAGE	To correctly monitor the output voltage and to correctly control the PFC capacitors, it is necessary to program the main transformer output voltage as connected (sum of each winding section connected).	Set-up Menu; see section 4.4.1	0001V	
CCR KVA RATING (See Note 1)	To correctly monitor the load on the CCR and to correctly control the PFC capacitors, it is necessary to enter the kVA rating of the CCR.	Engineering Configuration Menu; see section 9.4.2.5	15kVA	

Table 4-1 Main CCR Operating Parameters

Note 1 - The required value or setting is programmed during factory testing and would not normally need to be changed, unless a new AT1030 Motherboard is fitted or default settings have been applied.

Brilliancy Step		UK CAP 168 Brilliancy level	Default / UK CAP 168			FAA / IEC Style 1			FAA / IEC Style 2		
			Current Level, Amps	Range, Amps		Current Level, Amps	Range, Amps		Current Level, Amps	Range, Amps	
FAA / IEC	DOE			Lower Limit	Upper Limit		Lower Limit	Upper Limit		Lower Limit	Upper Limit
8	MAX	N/A	6.00	5.82	6.09	N/A	N/A	N/A	N/A	N/A	N/A
7	2		5.73	5.64	5.78						
6	3		4.86	4.78	5.23						
5	4		4.14	3.82	4.36						
4	5		3.54	3.36	3.68						
3	MIN		3.06	2.96	3.25						
2	N/A		2.64	2.51	2.89						
1	N/A		2.34	2.17	2.41						
0	OFF		0	0	0						

Table 4-2 6.00A pre-programmed current levels.

Brilliancy Step		UK CAP 168 Brilliancy level	Default / UK CAP 168			FAA / IEC Style 1			FAA / IEC Style 2		
			Current Level, Amps	Range, Amps		Current Level, Amps	Range, Amps		Current Level, Amps	Range, Amps	
FAA / IEC	DOE			Lower Limit	Upper Limit		Lower Limit	Upper Limit		Lower Limit	Upper Limit
8	MAX	100 %	6.60	6.40	6.70	6.60	6.50	6.70	6.60	6.50	6.70
7	2	80 %	6.30	6.20	6.36	6.60	6.50	6.70	6.60	6.50	6.70
6	3	30 %	5.35	5.26	5.76	6.60	6.50	6.70	6.60	6.50	6.70
5	4	10 %	4.55	4.20	4.80	6.60	6.50	6.70	6.60	6.50	6.70
4	5	3 %	3.89	3.70	4.05	6.60	6.50	6.70	5.20	5.10	5.30
3	MIN	1 %	3.37	3.26	3.58	6.60	6.50	6.70	4.10	4.00	4.20
2	N/A	0.3 %	2.90	2.76	3.18	5.50	5.40	5.60	3.40	3.30	3.50
1	N/A	0.1 %	2.57	2.39	2.65	4.80	4.70	4.90	2.80	2.70	2.90
0	OFF	0 %	0	0	0	0	0	0	0	0	0

Table 4-3 6.60A pre-programmed current levels.

Brilliancy Step		UK CAP 168 Brilliancy level	Default / UK CAP 168			FAA / IEC Style 1			FAA / IEC Style 2		
			Current Level, Amps	Range, Amps		Current Level, Amps	Range, Amps		Current Level, Amps	Range, Amps	
FAA / IEC	DOE			Lower Limit	Upper Limit		Lower Limit	Upper Limit		Lower Limit	Upper Limit
8	MAX	100 %	12.00	11.64	12.18	N/A	N/A	N/A	N/A	N/A	N/A
7	2	80 %	11.45	11.27	11.56						
6	3	30 %	9.72	9.56	10.47						
5	4	10 %	8.28	7.64	8.73						
4	5	3 %	7.08	6.72	7.36						
3	MIN	1 %	6.12	5.92	6.51						
2	N/A	0.3 %	5.28	5.01	5.78						
1	N/A	0.1 %	4.68	4.34	4.82						
0	OFF	0 %	0	0	0						

Table 4-4 12.00A pre-programmed current levels.

Brilliancy Step		UK CAP 168 Brilliancy level	Default / UK CAP 168			FAA / IEC Style 1			FAA / IEC Style 2		
			Current Level, Amps	Range, Amps		Current Level, Amps	Range, Amps		Current Level, Amps	Range, Amps	
FAA / IEC	DOE			Lower Limit	Upper Limit		Lower Limit	Upper Limit		Lower Limit	Upper Limit
8	MAX	100 %	20.00	19.62	20.40	N/A	N/A	N/A	20.00	19.70	20.30
7	2	80 %	19.21	18.78	19.28				20.00	19.70	20.30
6	3	30 %	16.21	15.90	17.45				20.00	19.70	20.30
5	4	10 %	13.79	12.72	14.54				20.00	19.70	20.30
4	5	3 %	11.79	11.21	12.27				15.80	15.50	16.10
3	MIN	1 %	10.20	9.87	10.85				12.40	12.10	12.70
2	N/A	0.3 %	8.79	8.36	9.64				10.30	10.00	10.60
1	N/A	0.1 %	7.79	7.24	8.03				8.50	8.20	8.80
0	OFF	0 %	0	0	0				0	0	0

Table 4-5 20.00A pre-programmed current levels.

4.3 Setting the Main Transformer Output Voltage

WARNING – HIGH VOLTAGES – UP TO 2500V FOR A 15KVA REGULATOR – ARE PRESENT ON THE CCR MAIN TRANSFORMER OUTPUT TERMINALS. THE TRANSFORMER IS MOUNTED WITHIN THE HT CUBICLE, THE COVER OF WHICH SHOULD NEVER BE OPENED WITHOUT FIRST ISOLATING THE REGULATOR MAINS SUPPLY INPUT

FURTHERMORE, THE AGL FIELD CABLES SHOULD BE SHORTED TOGETHER AND CONNECTED TO EARTH BEFORE THE HT CIRCUITRY – INCLUDING THE TRANSFORMER OUTPUT TERMINALS - IS SAFE TO TOUCH. RESIDUAL CHARGE OR INDUCED EMF FROM ADJACENT AGL CIRCUITS MAY OTHERWISE PRESENT A HAZARD TO PERSONNEL.

Figure 11-1 of Section 11.1 shows the block diagram of the CCR with a primary series field loop connected. The CCR uses a PWM IGBT H-Bridge to control the voltage applied to the primary of the main CCR transformer. The transformer secondary has multiple tappings such that the output voltage can be adjusted to give the correct operating range according to the load connected to the AGL circuit. The conduction period of the H-Bridge is then controlled so as to give the correct RMS current on the output side of the transformer.

It is important that the main transformer output voltage is correctly adjusted to match the load of the series loop circuit. Too low an output voltage will mean that the CCR will not be able to drive the rated current into the load, causing an ‘Open Circuit’ trip or an ‘Under Current’ tolerance alarm. (Depending on the output voltage set, this may only become a problem during conditions of supply voltage dips or when lamps have failed).

If the transformer output voltage is set higher than required for a particular load, then the CCR compensates for this mismatch by reducing the conduction period of the IGBT H-Bridge to maintain the correct RMS output current. However, the CCR supply current and supply kVA will be higher than necessary. For a badly mismatched transformer output voltage, the power factor of the supply to the CCR will also be slightly worse, as will the level of harmonic current on the supply.

(Note – for correct operation of the Micro 200+ control loop and to prevent instability, the transformer secondary tapping voltages should be set no lower than 20% of maximum, even for short circuit load tests).

atg airports have developed two standard ranges of transformers for use in the Constant Current Regulators; one range is designed for operation at a maximum current of 6.6A, whilst the other range can be configured for operation at 12.0A or 6.0 / 6.6A. These two ranges are described below.

4.3.1 6.6A Transformer Winding Arrangement

For CCRs designed to operate at a maximum current of 6.6A, the transformers have 3 (or more) isolated secondary windings. The type with 3 is shown in Figure 4-1; the label on the transformer itself will also show the arrangement and voltage of each section. Each section of the secondary winding produces twice the voltage of the preceding section; for example, the voltage of winding section 5 is twice that of section 4. By connecting the appropriate winding sections in series, the CCR output voltage can be set to suit the load on the AGL series circuit. Table 4-6 lists the secondary winding voltages for the most common of the 6.6A range of transformers for each size of regulator.

The primary tapping voltages shown are for the 400V series CCR.

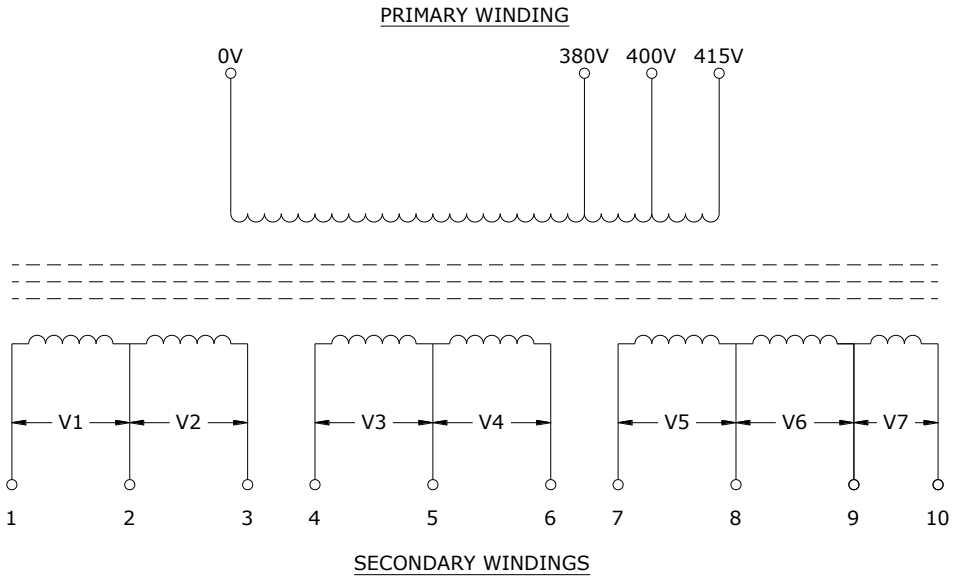


Figure 4-1 6.6A CCR Main Transformer winding arrangement

RATED OUTPUT kVA	RATED OUTPUT VOLTAGE AT 6.6A	WINDING V1 OP VOLTAGE	WINDING V2 OP VOLTAGE	WINDING V3 OP VOLTAGE	WINDING V4 OP VOLTAGE	WINDING V5 OP VOLTAGE	WINDING V6 OP VOLTAGE	WINDING V7 OP VOLTAGE. SEE NOTE
1.0	153	2.4	4.8	9.7	19.5	39	78	N/A
2.5	382	6.06	12.13	24.25	48.5	97	194	N/A
4	610	9.7	19.4	38.8	77.5	155	310	N/A
5	764	12.1	24.2	48.5	97	194	388	N/A
7.5	1146	18.2	36.4	72.8	145.5	291	582	N/A
10	1528	24.25	48.5	97	194	388	776	N/A
12.5	1909	30.3	60.6	121.3	242.5	485	869	100
15	2287	36.4	72.75	145.5	291	582	1044	120

Table 4-6 6.6A CCR Main Transformer Output Voltages

Note - winding V7 is only included on transformers rated at 12.5kVA or above. It should be connected for IEC applications to give the ability to cope with supply voltage dips of up to 10%, and disconnected for FAA applications to give the ability to cope with supply voltage dips of up to 5%, with full rated load connected.

For transformers where the secondary and/or primary tapping voltages differ from those shown above, the winding arrangement and tapping voltages are indicated on the transformer label.

A third connection is made to the transformer output windings, which goes to the Earth Leakage Detector. This should connect as closely as possible to the mid – voltage point of whichever windings are utilised – see Figure 4-2.

There is also a 20V low current secondary winding provided on the transformer, for load monitoring purposes. This is not shown on these drawings.

To set the maximum output voltage on a 6.6A regulator, all the windings will be connected in series as shown in Figure 4-2 and below.

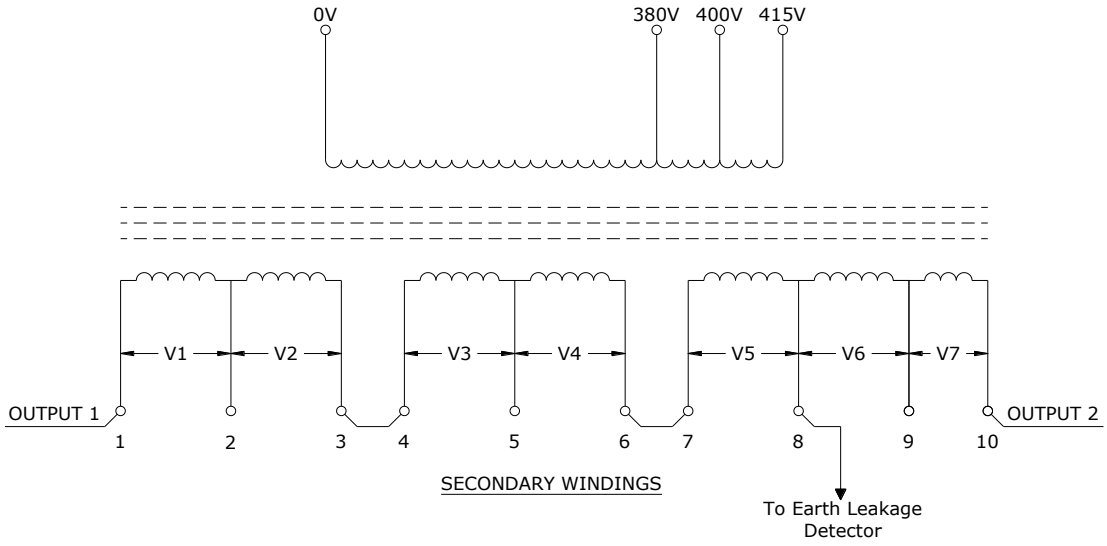


Figure 4-2 6.6A Transformer configured for full voltage

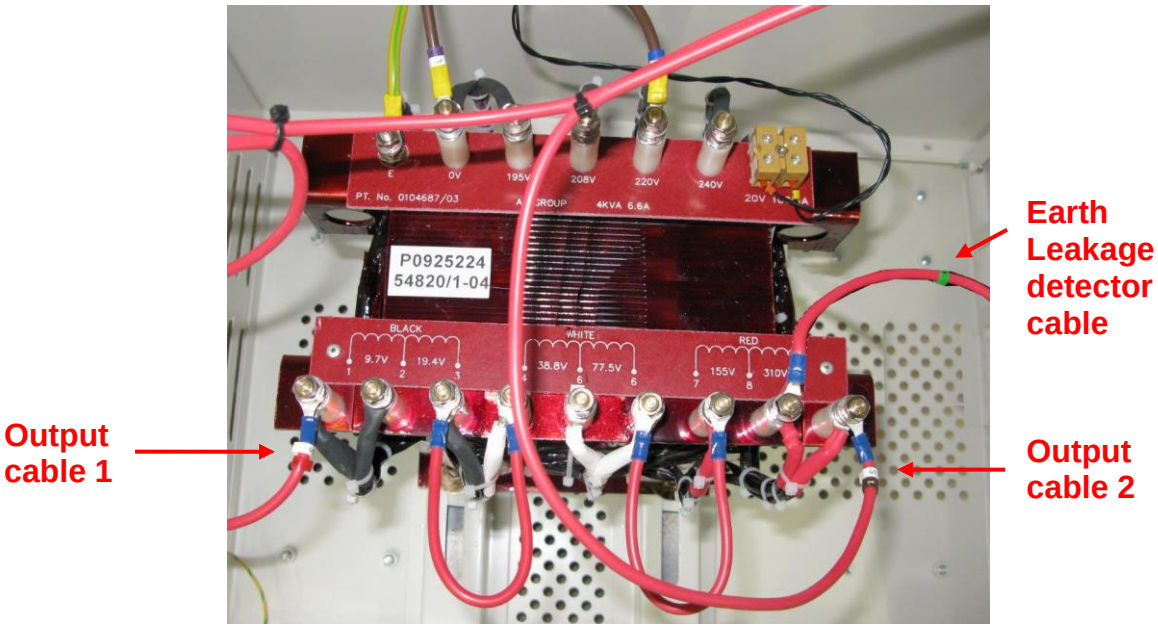


Figure 4-3 Photograph of 6.6A Transformer configured for full voltage

To calculate the required CCR output voltage according to the AGL circuit load, refer to Section 8.1

An example of an intermediate output voltage (based on a 6.6A circuit) is shown below. In this case the output voltage is:

$$V3 + V4 + V6 + V7$$

This for a 15KVA regulator is:

$$145.5 + 291 + 1044 + 120 = 1600.5V$$

The connections to give this voltage are shown in Figure 4-4.

Note – when connecting together sections of the secondary windings, ensure that the windings are connected with the correct orientation (phasing), as shown in Figure 4-2 or Figure 4-4. In this way, the voltages from each section will add and not subtract.

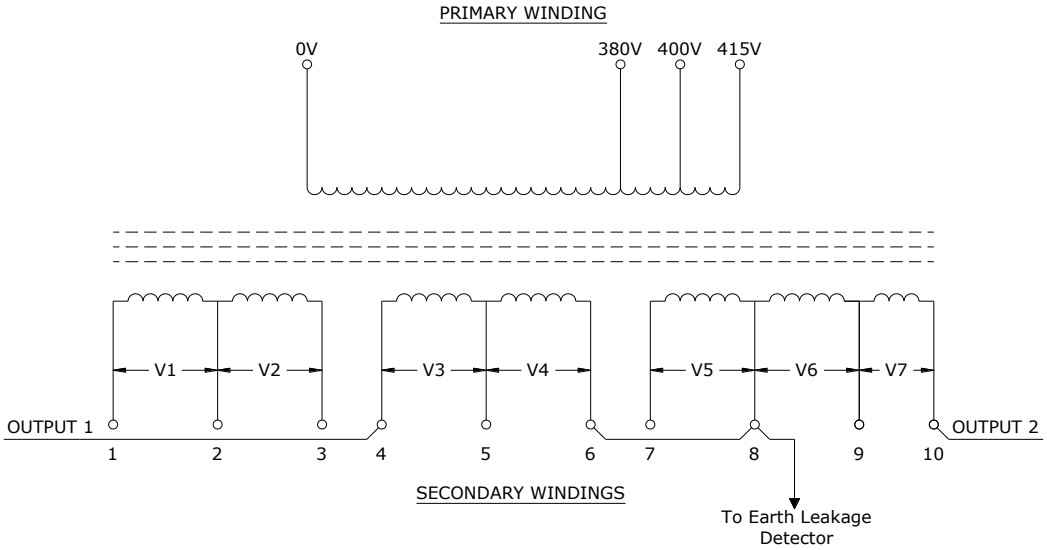


Figure 4-4 6.6A Transformer configured for intermediate voltage

It is important to verify that the transformer output voltage tappings are set to correctly match the load, as described in Section 4.3.3.

4.3.2 6.6A / 12.0A Transformer Winding Arrangement

The range of transformers fitted to CCRs which can operate at 6.6A or 12.0A either have 6 isolated secondary windings, arranged as 2 sets of 3 windings, or 4 isolated secondary windings, arranged as 2 sets of 2 windings. Each winding is rated at 6.6A; these can be connected in parallel to give a 12.0A rating, or in series for 6.0A or 6.6A operation, but at twice the output voltage. A different coloured sleeve identifies the cables from each winding. Each section of the secondary winding produces twice the voltage of the preceding section; for example, the voltage of winding section 5 is twice that of section 4.

Figure 4-5 shows the winding arrangement for the 6.6A / 12.0A range of CCR Main Transformers which have 2 sets of 3 secondary windings, whilst Table 4-7 lists the secondary winding voltages for the most common sizes of transformer of this style.

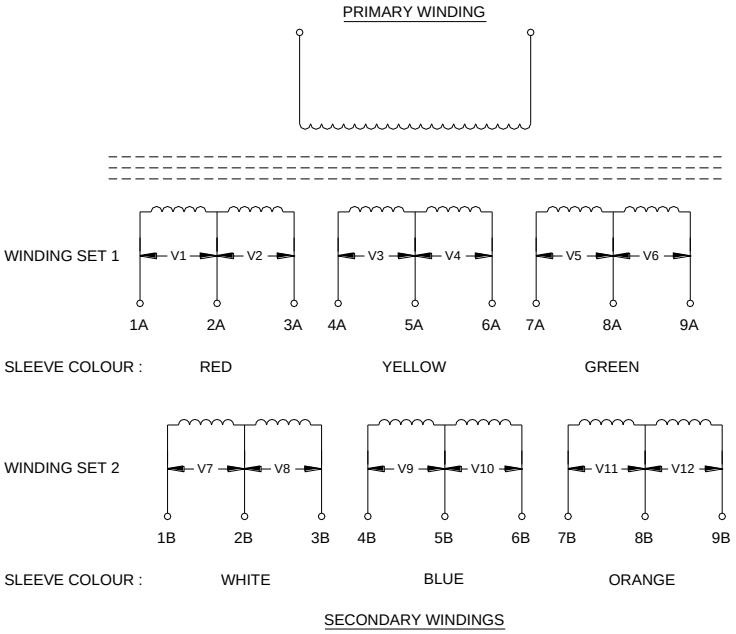


Figure 4-5 6.6A / 12.0A CCR Main Transformer, 2 sets of 3 secondary windings

RATED OUTPUT KVA	RATED OUTPUT VOLTAGE AT 12A	RATED OUTPUT VOLTAGE AT 6.6A	OUTPUT VOLTAGE WINDINGS V1 AND V7	OUTPUT VOLTAGE WINDINGS V2 AND V8	OUTPUT VOLTAGE WINDINGS V3 AND V9	OUTPUT VOLTAGE WINDINGS V4 AND V10	OUTPUT VOLTAGE WINDINGS V5 AND V11	OUTPUT VOLTAGE WINDINGS V6 AND V12
4	315	630	5	10	20	40	80	160
7.5	630	1260	10	20	40	80	160	320
15	1260	2520	20	40	80	160	320	640

Table 4-7 6.6A / 12.0A Main Transformer Output Voltages, 2 sets of 3 windings

Figure 4-6 shows the winding arrangement for those transformers which have 2 sets of 2 secondary windings.

Note – For those transformers whose winding voltages are not listed in Table 4-7, refer to the tapping voltages marked on the transformer itself.

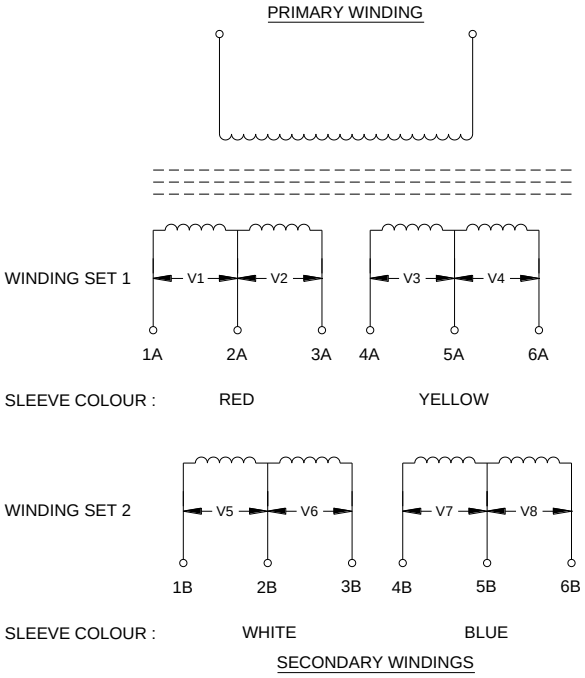


Figure 4-6 6.6A / 12.0A CCR Main Transformer, 2 sets of 2 secondary windings

By connecting the appropriate winding sections in series and / or parallel the required CCR output voltage and current can be obtained. To set the maximum output voltage on a 6.0A or 6.6A regulator, all the windings will be connected in series as shown in Figure 4-7. To set the maximum output voltage for a 12A regulator, winding set 1 will be connected in parallel with winding set 2, using the links provided. This is shown in Figure 4-8.

Note – a third connection is made to the transformer output windings, which goes to the Earth Leakage Detector. This should connect as closely as possible to the mid – voltage point of whichever windings are utilised.

There is also a low current secondary (monitoring) winding provided on the transformer, for use by the AT733 Control Card and the (optional) AT1134 Percentage Lamp Failure Card. This is not shown on these drawings.

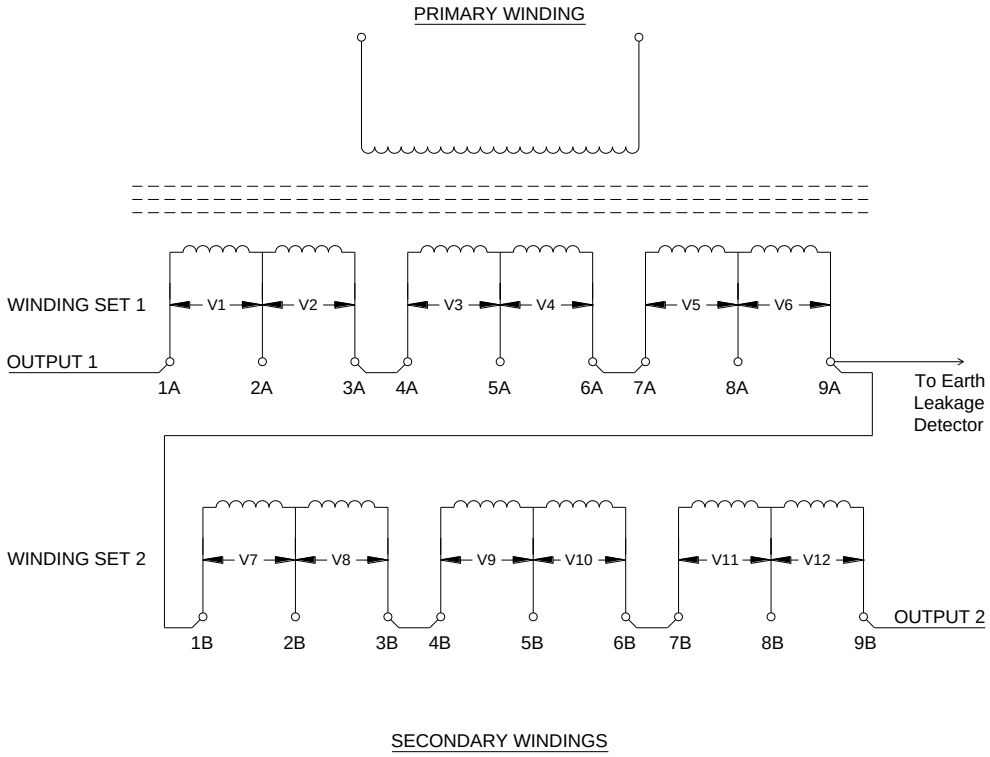


Figure 4-7 6.6A / 12.0A Transformer configured for 6.6A at full voltage

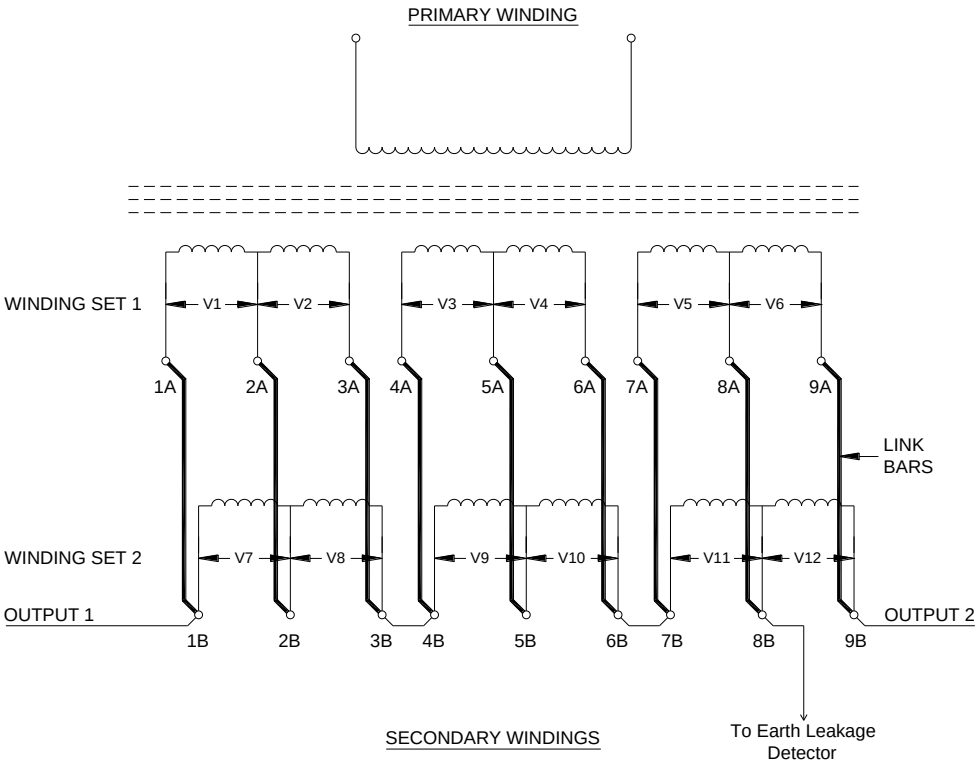


Figure 4-8 6.6A / 12.0A Transformer configured for 12.0A at full voltage

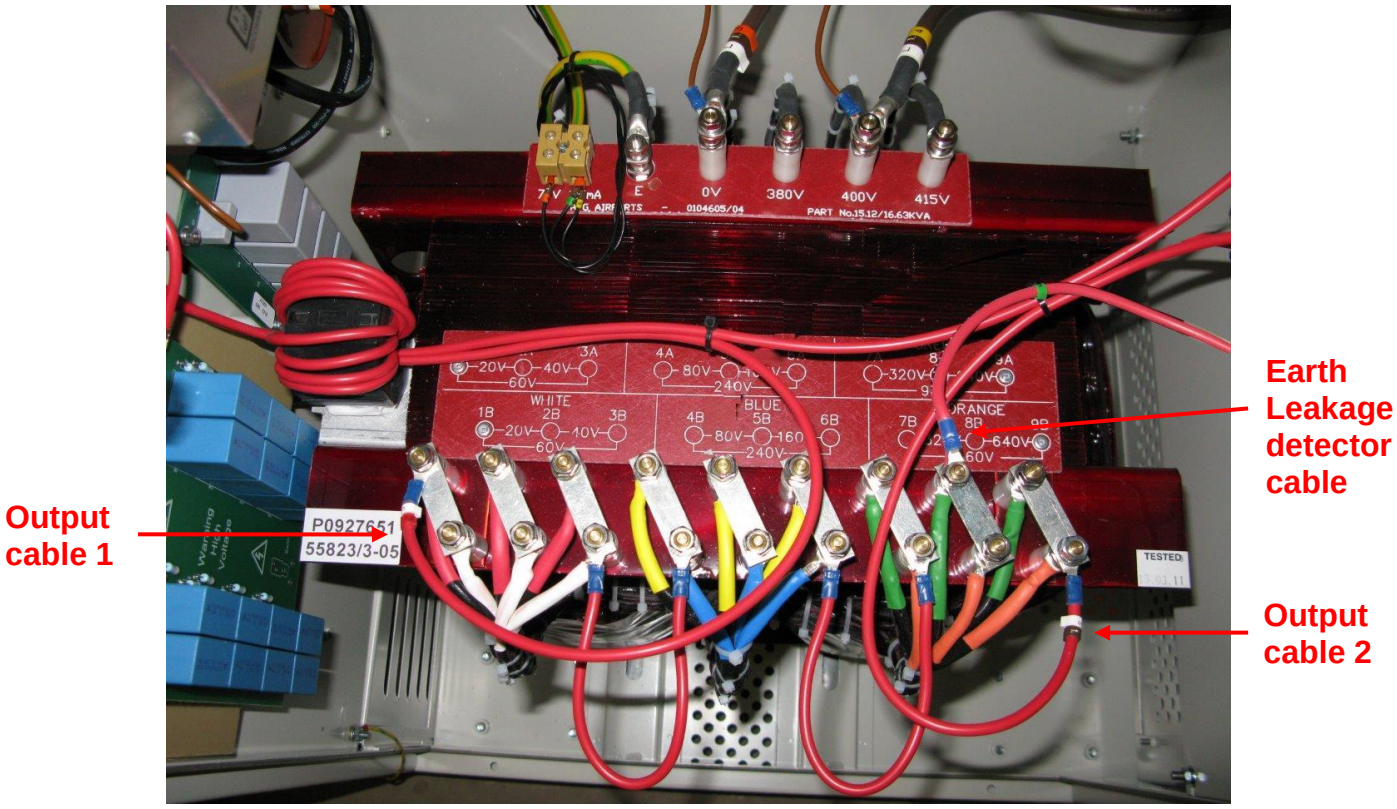


Figure 4-9 Photograph of 6.6A/12.0A Transformer configured for 12.0A, full voltage

To calculate the required CCR output voltage according to the AGL circuit load, refer to Section 8.1

An example of an intermediate output voltage (based on a 6.6A circuit) is shown below. In this case the output voltage is:

$$V4 + V5 + V6 + V10 + V11 + V12$$

Which for a 15kVA regulator is:

$$160 + 320 + 640 + 160 + 320 + 640 = 2240V$$

The transformer connections to give this voltage are shown in Figure 4-10.

Note – when connecting together sections of the secondary windings, ensure that the windings are connected with the correct orientation (phasing), as shown in Figure 4-7 or Figure 4-10. In this way, the voltages from each section will add and not subtract.

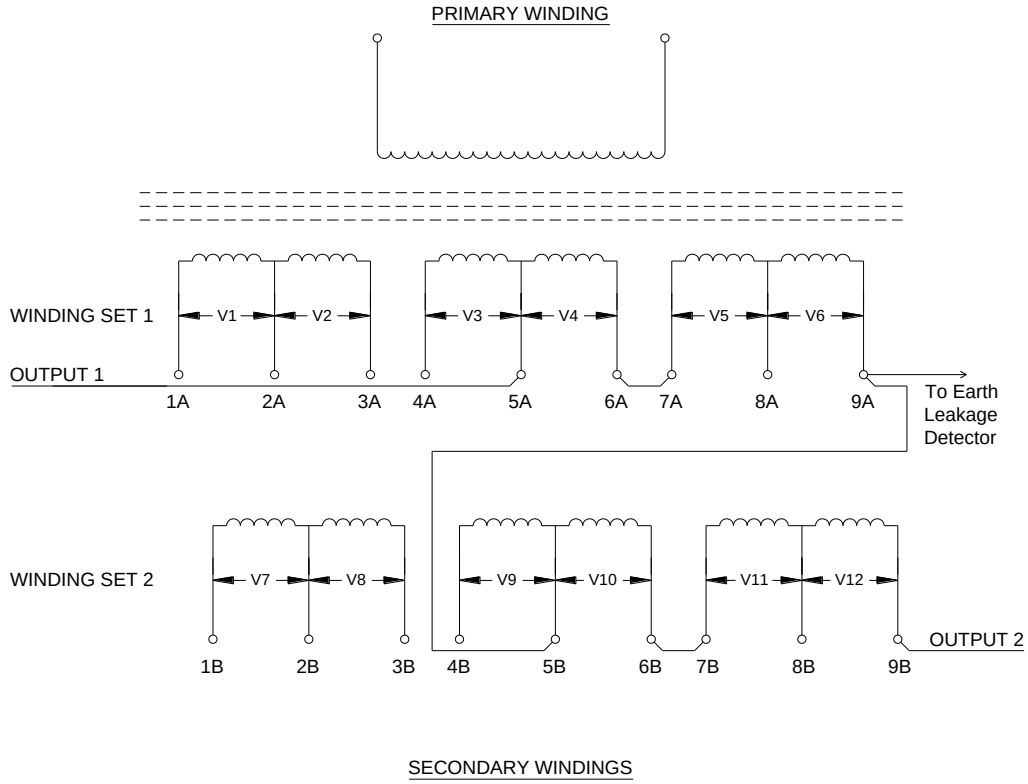


Figure 4-10 6.6A / 12.0A Transformer configured for 6.6A, intermediate voltage

It is important to verify that the transformer output voltage tappings are set to correctly match the load, as described in Section 4.3.3.

4.3.3 Verifying the Transformer Setting

The CCR output voltage should be adjusted to suit the load on the series circuit in order to optimise the supply Power Factor and supply current harmonics.

To verify that the transformer tapping is set correctly, the CCR should be operated at maximum current into the maximum load impedance which will normally be connected.

Before applying mains voltage to the CCR input terminals, open the HT cubicle door and check the main transformer output tapping voltage setting. The output tapping voltage is the sum of all the secondary windings which are connected. (This is normally set to maximum, that is, the rated CCR output voltage, during factory testing of the CCR). The output tapping voltage, as connected, should be programmed in via the keypad in order to obtain an accurate indication on the display of the actual CCR output voltage. Again, this will have been done during factory testing of the CCR. If necessary, this can be checked – refer to Section 4.4.1

Close all the doors and covers, apply power to the CCR, and switch it on at maximum current. Make a note of the displayed CCR output voltage; if it is between 90% and 100% of the selected tapping voltage, then no adjustment to the main transformer secondary tappings will be necessary. If the displayed output voltage is less than 90% of the selected tapping voltage, then the transformer tapping voltage should be reduced.

If, on the other hand, the displayed output voltage is greater than the selected tapping voltage, then the transformer output is too low. In this case the CCR may not be able to deliver maximum current, particularly in conditions of supply voltage dips. The CCR may trip on 'open circuit' or give a 'low current' tolerance alarm.

Isolate the supply to the CCR, and then open the HT cubicle door. Reconfigure the main transformer secondary connections (as described in the previous sections) in order that the total voltage of the winding sections connected in series are at, or just above, the voltage displayed on the front panel during operation at maximum current.

Apply power to the CCR, and whilst in the 'Off' state, program in the connected transformer secondary tapping voltage as described in Section 4.4.1

Switch the CCR on at maximum current, and re-check that the displayed output voltage is at, or lower (by no more than 10%) of, the selected tapping voltage.

4.4 Output Voltage and Output Load Monitoring

The CCR can display output voltage and output load (kVA and kW) by scrolling up from the Running Screen, and can also be programmed to give an alarm signal if the output load kVA drops by 10% or more at any particular brilliancy.

In order that the CCR output voltage and output load can be correctly displayed, the output voltage of the CCR Main Transformer tappings, as connected, should be programmed in via the keypad menu system. This is also important for the correct functioning of the load compensation capacitors. During factory testing, this will have been set to be the maximum output tapping voltage. If the transformer secondary taps have not been changed during commissioning, then no change is required to the programmed value. If adjustment is required, then refer to Section 4.4.1 below.

Refer to Section 4.4.2 to enable the load kVA Alarm.

4.4.1 Programming the Main Transformer Tapping Voltage

To correctly monitor the output voltage and output load kVA of the CCR, the actual tapping voltage used on the Main CCR Output Transformer must be entered. If this is not done, then the displayed output voltage and load kVA will not be correct. The actual transformer output voltage is the sum of all sections of the transformer secondary

windings that are connected in series. Using the example of Figure 4-4, this would be 2065V.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	M	A	I	N		T	R	A	N	S	F	O	R	M	E	R		↑	↓
	T	A	P	P	I	N	G		V	O	L	T	A	G	E	:			
					1	V													

Press the selector and the arrow (→) moves to the bottom line to indicate that the tapping voltage can now be entered:

	M	A	I	N		T	R	A	N	S	F	O	R	M	E	R		↑	↓
	T	A	P	P	I	N	G		V	O	L	T	A	G	E	:			
→		0	0	0	1	V													

Load the total output transformer tapping voltage that has been connected, one digit at a time, by turning the Rotary Menu Selector and then pressing to enter. (The transformer tapping voltage can be set between 1 and 5000 Volts). After the last digit has been entered the cancel / confirm change screen will be displayed:

	M	A	I	N		T	R	A	N	S	F	O	R	M	E	R		↑	↓
	T	A	P	P	I	N	G		V	O	L	T	A	G	E	:			
→		C	A	N	C	E	L		C	H	A	N	G	E					
		C	O	N	F	I	R	M		C	H	A	N	G	E				

Turn the Rotary Menu Selector anticlockwise so that the arrow (→) moves to 'CONFIRM CHANGE', and then press the menu selector.

4.4.2 KVA Alarm Enable

If 'Voltage Feedback' is activated, then 'KVA Alarm' can also be enabled. This generates an alarm if the CCR output load kVA drops below 90% of the peak measured load value for the brilliancy step in operation, for a period of 5 seconds.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	K	V	A		A	L	A	R	M	:								↑	↓
		D	I	S	A	B	L	E	D										

Press the menu selector so that the following screen is displayed:

	K	V	A		A	L	A	R	M	:						↑	↓
		E	N	A	B	L	E	D									
→		D	I	S	A	B	L	E	D								

Turn the Rotary Menu Selector clockwise so that the arrow (→) moves to ‘ENABLED’, then press the menu selector. The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits the submenu.

4.5 Commissioning the Earth Leakage Measurement System

Each AGL lamp module is isolated from the high voltage primary series loop circuit by an AGL transformer. The joints connecting the primary windings of these AGL transformers to the series loop cables tend to leak and allow water to penetrate into the transformer. This causes earth faults on the primary loop internally within the transformer, or from the cable joint itself to earth.

This causes two problems:

i) If more than one earth fault develops, then sections of the AGL circuit between the faults can be shorted out. This results in reduced brilliancy levels, or sections of the lamp circuit may switch off altogether.

ii) More importantly, having an earth leakage path presents a safety hazard. The CCR output circuit is isolated from the mains power supply and from earth by the CCR main power transformer. However, if there is leakage to earth at one or more points in the primary series field circuit there will now be a potential difference between other sections of the circuit and earth, and this could be up to several thousand volts for a high power regulator. If personnel come into contact with the high voltage cables under these conditions, this could, depending on the earth leakage resistance and hence the level of current flow through the contactee, result in a lethal electric shock.

For these reasons, it is necessary to detect earth faults before they become a problem.

This section describes commissioning of the **atg airports** Analogue Earth Leakage Resistance Measurement system which is available as an option on the Micro 200+. This system, based on the AT699 and AT709 cards, provides a measurement of the resistance to earth of the Primary Series Loop Circuit using three test modes:

i) Programmed to ‘ENABLED’ (see section 4.5.2) – insulation resistance measured when the CCR is operating using a test voltage of 500V DC.

ii) Programmed to ‘CONTINUOUS ENABLED’ (see section 4.5.2) – insulation resistance measured when the CCR is operating AND in standby using a test voltage of 500V DC.

ii) Manual test using a voltage of 1000V DC. Note - this test is only available when the CCR is set to “OFF”. (Performance of this test is described in Section 9.2.2).

Two resistance alarm thresholds are provided, the levels of which can be individually set. The Stage 1 Alarm and Stage 2 Alarm / Trip Threshold levels should be set according to the CCR kVA rating and the Primary Series Loop Circuit characteristics. For reasons of safety, it is recommended that the Stage 2 threshold is programmed to trip the CCR.

The actual resistance measurement circuit is calibrated during factory testing and does not require adjustment during commissioning of the CCR. Note – the continuous 500V DC test is for indication only; for accurate measurements the 1000V DC manual test should be used.

4.5.1 Calculation of Earth Leakage Resistance Alarm and Trip points

The first part of the commissioning procedure involves the calculation of the desired (Stage 1) Alarm and (Stage 2) Trip thresholds. These should be set according to the CCR rating, and to match the particular AGL Primary Series Loop Circuit.

For an AGL Primary Series Loop Circuit WITHOUT a breakdown of the insulation to earth, the leakage resistance is dependent on the total number of AGL transformers fitted, and the total length of the AGL cable.

4.5.1.1 Calculation of Stage 1 Alarm Threshold

Calculate the Stage 1 Alarm Threshold Resistance as follows:

Stage 1 Alarm Threshold Resistance (Ω) = (1.5 x Maximum CCR output voltage) / ((0.4µA x number of AGL transformers) + (0.01µA x total cable length in km))

The resulting resistance value should be programmed in as described in Section 4.5.2.2.

An example calculation is shown below:

An 8km long series loop circuit is fitted with 200 AGL transformers, and powered from a 7.5kVA regulator. The circuit is rated at 6.6A.

The maximum CCR output voltage is 1147V (when operating at 6.6A).

Stage 1 Alarm Threshold Resistance (Ω) = (1.5 x 1147V) / ((0.4µA x 200) + (0.01µA x 8))

Stage 1 Alarm Threshold Resistance (Ω) = 1720.5V / ((80 x 10^{-6}) + (0.08 x 10^{-6}))A

Stage 1 Alarm Threshold Resistance (Ω) = 21.5MΩ

Owing to the programming steps, the threshold should be set to 20MΩ

4.5.1.2 Calculation of Stage 2 Trip Threshold

The Stage 2 Trip Threshold should be set so as to limit the maximum current that could be conducted to anybody who may come into contact with the AGL Series Loop cables to a level below 10mA. This is the threshold of let go, and therefore the contactee should be able to disengage before a fatal electric shock is received. It is recommended, therefore, that the Stage 2 Threshold should be programmed to trip out the CCR, rather than just triggering an alarm. See Section 4.5.2.2

NOTE – THE OPERATION OF THE EARTH LEAKAGE RESISTANCE MEASUREMENT CIRCUITRY DOES NOT GUARANTEE THAT THE HIGH VOLTAGE OUTPUT FROM THE CONSTANT CURRENT REGULATOR WOULD BE CUT BEFORE A LETHAL ELECTRIC SHOCK COULD BE RECEIVED BY PERSONNEL COMING INTO CONTACT WITH THE PRIMARY SERIES LOOP CONDUCTORS. THE EARTH LEAKAGE MODULE IS DESIGNED ONLY AS AN AID TO SAFETY.

NORMAL SAFE WORKING PROCEDURES SHOULD ALWAYS BE STRICTLY ADHERED TO. BEFORE WORKING ON THE PRIMARY SERIES LOOP CABLING, OR ANY AGL TRANSFORMERS CONNECTED TO THE PRIMARY SERIES LOOP, ENSURE THAT THE CCR FEEDING THE CIRCUIT IS SWITCHED OFF, AND THAT THE MAINS POWER TO THE CCR IS ISOLATED AND LOCKED OFF. IT IS ALSO RECOMMENDED TO CONNECT THE AGL FIELD CABLES TO EARTH TO DISSIPATE ANY STORED CHARGE OR INDUCED EMF.

The Stage 2 Trip Threshold should be calculated as follows:

Stage 2 Trip Threshold Resistance (Ω) = Maximum CCR output voltage / I_B

Where I_B = maximum body current, 10mA

The resulting resistance value should be programmed in as described in Section 4.5.2.2.

An example based on a 7.5kVA regulator operating on a 6.6A circuit would give:

Stage 2 Trip Threshold Resistance (Ω) = 1147V / 10mA

Stage 2 Trip Threshold Resistance (Ω) = 115kΩ

Owing to the programming steps, the threshold should be set to 120kΩ

4.5.2 Programming the Earth Leakage System

4.5.2.1 Earth Leakage Resistance Measurement System Configuration

The setting on this screen can be selected between ‘ENABLED’, ‘CONTINUOUS ENABLED’ and ‘DISABLED’. (Note - if the optional AT699 and AT709 cards are not fitted to the CCR then this setting should be left as ‘DISABLED’).

Setting to ‘ENABLED’ provides an earth leakage resistance measurement whilst the CCR is operating using a 500V DC test voltage, and with the possibility to perform a manual test measurement using a 1000V DC test voltage when the Brilliancy Control selector is set to ‘LOCAL OFF’ (refer to section 9.2.2). The ‘ENABLED’ setting will have been selected during factory testing of the CCR if the earth leakage measurement cards are fitted.

Setting to ‘CONTINUOUS ENABLED’ provides an earth leakage resistance measurement whilst the CCR is operating AND when in the ‘OFF’ state, using a 500V

DC test voltage. This mode should be used with caution due to the continuous presence of the DC test voltage on the CCR output circuitry and output field cables even when the CCR is switched off.

To view or change the setting, first enter the Set-up Menu as described in Section 9.3, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	E	A	R	T	H		L	E	A	K	A	G	E				↑	↓
	M	E	A	S	U	R	E	M	E	N	T		C	O	N	F	I	G	:
		E	N	A	B	L	E	D											

The configuration will be set to ‘ENABLED’ during factory testing if the Earth Leakage Measurement Module is fitted to the CCR.

Press the selector and the screen will change to show the following options, with the arrow (→) moving down to indicate that the setting can now be changed:

	E	A	R	T	H		L	E	A	K	A	G	E				↑	↓
	M	E	A	S	U	R	E	M	E	N	T		C	O	N	F	I	G	:
→		E	N	A	B	L	E	D											
		C	O	N	T	I	N	U	O	U	S		E	N	A	B	L	E	D

Turning the Rotary Menu Selector anticlockwise scrolls down to the other available setting:

	E	A	R	T	H		L	E	A	K	A	G	E				↑	↓
	M	E	A	S	U	R	E	M	E	N	T		C	O	N	F	I	G	:
		C	O	N	T	I	N	U	O	U	S		E	N	A	B	L	E	D
→		D	I	S	A	B	L	E	D										

Turn the Rotary Menu Selector to scroll up or down to set the arrow (→) alongside the desired setting, then press to select that option.

The cancel / confirm change screen will now be shown. Turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits the submenu.

4.5.2.2 Programming the Earth Leakage Resistance Alarm and Trip Points

Note – the following screens are not available if the Earth Leakage Measurement is set to ‘DISABLED’.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	E	A	R	T	H		L	E	A	K	A	G	E				↑	↓
	A	L	A	R	M		T	H	R	E	S	H	O	L	D				
	S	T	A	G	E		1	:											
				1	0		M	Ω											

Press the selector and the arrow (→) will move down to the bottom line to indicate that the setting can now be changed:

	E	A	R	T	H		L	E	A	K	A	G	E					↑	↓
	A	L	A	R	M		T	H	R	E	S	H	O	L	D	:			
	S	T	A	G	E		1	:											
→				1	0		M	Ω											

The required Earth Leakage Stage 1 Alarm Threshold level can now be set; the valid range is between 5 kΩ and 40 MΩ; the default value is 10 MΩ. Turn the Rotary Menu Selector to increment or decrement the value; turning anticlockwise below 5 kΩ selects 'DISABLED' for this alarm and turning further causes the value to loop round to 40 MΩ.

After adjusting the value press the selector; the cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside 'CONFIRM CHANGE' then press the selector again – this saves the new setting and exits the submenu back to Menu 2, the Set-up menu.

Now turn the Rotary Menu Selector anticlockwise by one click to scroll down to the following screen:

→	E	A	R	T	H		L	E	A	K	A	G	E					↑	↓
	A	L	A	R	M		T	H	R	E	S	H	O	L	D	:			
	S	T	A	G	E		2	:											
			2	0	0		k	Ω											

Press the selector and the arrow (→) will move down to the bottom line to indicate that the setting can now be changed:

	E	A	R	T	H		L	E	A	K	A	G	E					↑	↓
	A	L	A	R	M		T	H	R	E	S	H	O	L	D	:			
	S	T	A	G	E		2	:											
→			2	0	0		k	Ω											

The required Earth Leakage Stage 2 Alarm / Trip Threshold level can now be set; the valid range is between 5 kΩ and 40 MΩ; the default value is 200 kΩ. Turn the Rotary Menu Selector to increment or decrement the value; turning anticlockwise below 5 kΩ selects 'DISABLED' for this alarm and turning further causes the value to loop round to 40 MΩ.

After adjusting the value press the selector; the cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside 'CONFIRM CHANGE' then press the selector again – this saves the new setting and exits the submenu back to Menu 2, the Set-up menu.

4.5.2.3 Stage 2 Earth Leakage Trip Enable

The Stage 2 Earth Leakage Resistance Threshold can be programmed either to activate an alarm or to trip out the CCR. For reasons of safety, **atg airports** recommend that the Stage 2 Earth Leakage Threshold should be set to trip out the CCR. This functionality is programmed as follows:

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	E	A	R	T	H		L	E	A	K	A	G	E					↑	↓
	S	T	A	G	E		2		T	R	I	P	:						
		E	N	A	B	L	E	D											

Press the selector and the screen will change to show the following options, with the arrow (→) moving down to indicate that the setting can now be changed:

	E	A	R	T	H		L	E	A	K	A	G	E					↑	↓
	S	T	A	G	E		2		T	R	I	P	:						
→		E	N	A	B	L	E	D											
		D	I	S	A	B	L	E	D										

Select between ‘ENABLED’ and ‘DISABLED’ by turning the Rotary Menu Selector to set the arrow (→) alongside the desired setting, then press the Rotary Menu Selector.

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits the submenu.

4.6 Commissioning the Percentage Lamp Failure System

The Percentage Lamp Failure System is usually based on the AT1134 M200+ PLF Card, which is a daughter board which is fitted to the AT1030 Motherboard. The card generates an error signal that is a function of the number of failed lamps on the AGL circuit. Note – some CCRs will use the AT1031 PLF / Power Analyser Card (also a daughter board for the AT1030). This card gives the same PLF functionality as described below for the AT1134, but the AT1031 operation is implemented in software rather than hardware.

The system is designed to be used with AGL transformers feeding tungsten lamps. LED fittings may not behave in the same way if the fitting develops a fault unless they specifically include a facility to open circuit the input of the light fitting in the event of a fault. Only in the latter case would the PLF system operate correctly with a circuit composed of LED fittings.

An AGL circuit with all the lamps working is largely resistive; however, when lamps fail the load becomes more inductive due to the open circuited ground transformer now presenting an inductive load. This change in the total AGL primary series loop circuit characteristic can be detected by the PLF card, which produces an error voltage that can be used to give an indication of the number of failed lamps on the circuit.

The PLF card is also used for capacitive current detection.

The following sections describe how to commission the PLF system.

Note – the characteristic of the series loop circuit (as regards the behaviour of the PLF system) changes dependant on the condition of the ground, particularly whether the ground is wet or dry. It is therefore recommended to recalibrate the PLF system every 6 months, especially after a change in weather conditions.

4.6.1 AT1134 PLF Card Initial Settings

The AT1134 PLF card monitors the CCR output voltage and output current waveforms for distortion caused by the load becoming inductive when lamps fail open circuit. Threshold levels on the card are set to monitor the part of the waveform most likely to be affected by this distortion in order to maximise the discrimination in error voltage between operating with all lamps intact and that with a proportion of lamps open circuited. Note – depending on the exact characteristics of the AGL circuit, some ‘tuning’ of the threshold levels may be required for best performance; see Section 4.6.4.

Jumper link J6 should be fitted between the upper and centre pins for high sensitivity (standard setting), which detects up to a maximum of around 16% lamp outage, or between the lower and centre pins for a range up to around 32%.

The initial threshold settings listed in Table 4-8 should be checked before attempting to commission the PLF system. This should be done with the regulator powered up, but in the ‘OFF’ state. A digital voltmeter will be required to check these; set it to read DC volts (up to 20 volts) and measure the voltage on the specified test point, using TP2 or TP15 on the AT1134 card as the 0v connection.

Description	Test Point	Adjusting Potentiometer	Threshold setting
Voltage waveform rising edge comparator threshold (VTH)	TP5	RV2 (VTH)	–8.3v DC +/- 0.1v
Current waveform rising edge comparator threshold (ITH)	TP1	RV1 (ITH)	–7.7v DC +/- 0.1v

Table 4-8 AT1134 Percentage Lamp Failure Card initial settings

With all lamps intact on the AGL circuit, use the CCR front panel rotary switch to operate the CCR at maximum current. Using the DVM, measure the (DC) error voltage produced at TP9. Make a record of this voltage level; it will later be compared with the error voltage levels produced with a number of lamps open circuited to match the desired alarm points – see Section 4.6.2.3. If the error discrimination between all lamps intact and the desired number of lamps open circuited is not greater than around 0.8V (normally it will be several volts), then adjustment of the comparator threshold levels will be necessary, as described in Section 4.6.4. This will require the use of an oscilloscope, preferably 4 channels, but with a minimum of 2 channels.

4.6.2 Programming for Analogue Input PLF Operation

The PLF settings need to be programmed via the menu system; enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screens. Note – on the Micro 200+, either the AT1134 M200+ PLF Card or AT1031 PLF / Power Analyser Card will be fitted to the CCR, and the PLF Detection Configuration will have been set during factory testing to either ‘ENABLED’ or ‘ENABLED FAA STYLE’. With the PLF operation enabled, all the other PLF sub-menus will now be available for setting up and calibrating the PLF system. (Refer also to section 9.3.2.17). The second sub-menu – PLF Alarm Delay Time – is set by default to 15 seconds and will not normally require adjustment.

4.6.2.1 Percentage Lamp Failure Detection Configuration

This is the first of the PLF set-up screens; on the Micro 200+ this will have been factory set to ‘ENABLED’ or ‘ENABLED FAA STYLE’.

→	%		L	A	M	P		F	A	I	L	U	R	E				↑	↓
	(	P	L	F	)		C	O	N	F	I	G	U	R	A	T	I	O	N
		E	N	A	B	L	E	D											

Press the selector and the screen will change to show the following options, with the arrow (→) moving down to indicate that the setting can now be changed:

	%		L	A	M	P		F	A	I	L	U	R	E				↑	↓
	(	P	L	F	)		C	O	N	F	I	G	U	R	A	T	I	O	N
→		E	N	A	B	L	E	D											
		E	N	A	B	L	E	D		F	A	A		S	T	Y	L	E	

Turning the Rotary Menu Selector anticlockwise scrolls down to the other available setting:

	%		L	A	M	P		F	A	I	L	U	R	E				↑	↓
	(	P	L	F	)		C	O	N	F	I	G	U	R	A	T	I	O	N
		E	N	A	B	L	E	D		F	A	A		S	T	Y	L	E	
→		D	I	S	A	B	L	E	D										

The setting on this screen can be selected between ‘ENABLED’, ‘ENABLED - FAA STYLE’ and ‘DISABLED’.

The ‘ENABLED - FAA STYLE’ means that after the pre-set number of lamps has failed, the monitor can be put into a degraded operation mode by resetting the alarm. When in the degraded operation mode, the monitor will reactivate the alarm upon the failure of an additional pre-set number of lamps (one to five).

Turn the Rotary Menu Selector to scroll up or down to set the arrow (→) alongside the desired setting, then press to select that option.

The cancel / confirm change screen will now be shown:

	%		L	A	M	P		F	A	I	L	U	R	E				↑	↓
	(	P	L	F	)		C	O	N	F	I	G	U	R	A	T	I	O	N
→		C	A	N	C	E	L		C	H	A	N	G	E					
		C	O	N	F	I	R	M		C	H	A	N	G	E				

Turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits the submenu.

4.6.2.2 Total Number of Lamps in the Circuit

In order to correctly indicate the number of open circuit (failed) lamps, it is necessary to enter the total number of lamps fitted to the circuit powered by the CCR.

Turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	%		L	A	M	P		F	A	I	L	U	R	E				↑	↓
	N	U	M	B	E	R		L	A	M	P	S		I	N		C	C	T
		1	0	0															

Press the selector and the arrow (→) moves to the bottom line to indicate that the value for the total number of lamps fitted to the circuit can now be programmed in:

	%		L	A	M	P		F	A	I	L	U	R	E				↑	↓
	N	U	M	B	E	R		L	A	M	P	S		I	N		C	C	T
→		1	0	0															

Enter the number of lamps one digit at a time (total of 3 digits) using the Rotary Menu

Selector to scroll up and down, and then press the selector button after each digit is set. The permissible setting is between 1 and 400

When all digits have been entered the cancel / confirm change screen will be displayed:

	%		L	A	M	P		F	A	I	L	U	R	E				↑	↓
	N	U	M	B	E	R		L	A	M	P	S		I	N		C	C	T
→		C	A	N	C	E	L		C	H	A	N	G	E					
		C	O	N	F	I	R	M		C	H	A	N	G	E				

Turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits this submenu and shows the new programmed value. (Note – the quantity of lamps has been left at the default value of 100 for the following example screens).

→	%		L	A	M	P		F	A	I	L	U	R	E				↑	↓
	N	U	M	B	E	R		L	A	M	P	S		I	N		C	C	T
		1	0	0															

4.6.2.3 Alarm Threshold levels

The required Stage 1 and Stage 2 Percentage Lamp Failure alarm thresholds now need to be programmed.

Turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	%		L	A	M	P		F	A	I	L	U	R	E				↑	↓
	A	L	A	R	M		T	H	R	E	S	H	O	L	D	S	:		
		S	1	:				5		L	A	M	P	S	-			5	%
		S	2	:			1	0		L	A	M	P	S	-		1	0	%

Press the selector and the following advisory screen will be displayed:

→	N	O	T	E	:														
	C	A	L	I	B	R	A	T	E		P	L	F		A	T			
	T	R	I	P		P	O	I	N	T	S		F	O	R				
	B	E	S	T		A	C	C	U	R	A	C	Y						

This means that the calibration procedure described in the next section should be performed to achieve the best accuracy of the alarm thresholds.

Press the selector and the following screen will be displayed:

	%		L	A	M	P		F	A	I	L	U	R	E				↑	↓
	A	L	A	R	M		T	H	R	E	S	H	O	L	D	S	:		
→		E	X	I	T														
		S	1	:				5		L	A	M	P	S	-			5	%

Turn the Rotary Menu Selector anticlockwise to set the arrow (→) alongside the Stage 1 PLF setting:

	%		L	A	M	P		F	A	I	L	U	R	E			↑	↓
	A	L	A	R	M		T	H	R	E	S	H	O	L	D	S	:	
		E	X	I	T													
→		S	1	:				5		L	A	M	P	S	-		5	%

With the arrow (→) alongside the Stage 1 PLF setting, press the selector to show the following screen:

	%		L	A	M	P		F	A	I	L	U	R	E			↑	↓
	A	L	A	R	M		T	H	R	E	S	H	O	L	D		S	E	T
→		S	1	:				5		L	A	M	P	S	-		5	%

Turn the Rotary Menu Selector to increment or decrement the threshold for the number of lamps out; the range is from 1 to the total number of lamps entered for that circuit. Turning the selector anticlockwise below 1 causes the value to loop round to the total number. Note - the value for the percentage of the total is automatically calculated and displayed.

After adjusting the value press the selector; the cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits the submenu back to this screen:

	%		L	A	M	P		F	A	I	L	U	R	E			↑	↓
	A	L	A	R	M		T	H	R	E	S	H	O	L	D	S	:	
→		E	X	I	T													
		S	1	:				5		L	A	M	P	S	-		5	%

Turn the rotary selector anticlockwise to place the arrow (→) alongside the Stage 2 PLF setting:

	%		L	A	M	P		F	A	I	L	U	R	E			↑	↓
	A	L	A	R	M		T	H	R	E	S	H	O	L	D	S	:	
		S	1	:				5		L	A	M	P	S	-		5	%
→		S	2	:			1	0		L	A	M	P	S	-	1	0	%

With the arrow (→) alongside the Stage 2 PLF setting, press the selector to show the following screen:

	%		L	A	M	P		F	A	I	L	U	R	E			↑	↓
	A	L	A	R	M		T	H	R	E	S	H	O	L	D		S	E	T
→		S	2	:			1	0		L	A	M	P	S	-		1	0	%

Turn the Rotary Menu Selector to increment or decrement the threshold for the number of lamps out.

After adjusting the value press the selector; the cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside 'CONFIRM CHANGE' then press the selector again – this saves the new setting and exits the submenu back to this screen:

	%		L	A	M	P		F	A	I	L	U	R	E			↑	↓
	A	L	A	R	M		T	H	R	E	S	H	O	L	D	S	:		
→		E	X	I	T													
		S	1	:				5		L	A	M	P	S	-		5	%

With the arrow (→) alongside 'EXIT', press the selector to return to the original 'Alarm Threshold' screen in the setup menu.

→	%		L	A	M	P		F	A	I	L	U	R	E			↑	↓
	A	L	A	R	M		T	H	R	E	S	H	O	L	D	S	:		
		S	1	:				5		L	A	M	P	S	-		5	%
		S	2	:			1	0		L	A	M	P	S	-	1	0	%

4.6.3 PLF System Calibration

4.6.3.1 Quick PLF Auto Calibration

The Quick Auto Calibration method uses a pre-loaded lamp failure threshold detection curve, and for most requirements this will give adequate detection of the number of failed lamps.

To perform a Quick Auto Calibration of the PLF, all lamps of the circuit must be intact; the system will sample the PLF error signal in the normal circuit condition and add in threshold levels to give an indication of the number of lamps that may fail.

Turn the power to the CCR back on, but leave the Brilliancy Control Selector switch in the 'Off' position. Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen.

→	%		L	A	M	P		F	A	I	L	U	R	E			↑	↓
	C	A	L	I	B	R	A	T	I	O	N	:						

Press the menu selector; the screen will change to:

	%		L	A	M	P		F	A	I	L	U	R	E			↑	↓
	C	A	L	I	B	R	A	T	I	O	N	:						
→		E	X	I	T													
		Q	U	I	C	K		C	A	L	I	B	R	A	T	I	O	N

Turn the Rotary Menu Selector to set the arrow against 'QUICK CALIBRATION' then follow the instructions to run the calibration routine. WARNING – the CCR will operate at all levels of brilliancy in order to sample the error signal from the PLF card.

After completing the calibration, with the arrow (→) alongside 'EXIT', press the selector to return to the original screen and exit the Set-up menu as described in section 9.3.2.25.

4.6.3.2 Full PLF Calibration

To achieve the most accurate indication of the number of failed lamps on the circuit, the PLF system requires calibration by sampling the AT1134 or AT1131 Card PLF error signal with lamps removed / AGL transformers open circuited at two levels of open circuit lamps. The error signal can then be calculated for all levels in between. It is recommended, however, that for the most accurate operation, the calibration be done with the number of lamps removed / AGL transformers open circuited that correspond to the two alarm points (2 Stages) that will be used.

WARNING – always turn the CCR off and isolate the power supply, and it is recommended to earth down the AGL cables at the CCR output before connecting or disconnecting AGL transformers and / or AGL lamps. The open circuited secondary connections from an AGL transformer can generate high voltages. Ensure that these connections are well insulated during this test, and that personnel do not come into contact with them.

i/ Switch off the CCR and isolate the power supply. Remove a number of lamps from the field circuit or connect additional AGL transformers in series with the CCR output (same VA rating as those in the field circuit, with the secondary connections open circuited). The number of lamps removed (or open circuit transformers connected) should preferably correspond to the lower of the required alarm thresholds (Stage 1 PLF), programmed as described in Section 4.6.2.3, above.

Turn the power to the CCR back on, but leave the Brilliancy Control Selector switch in the 'Off' position. Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen.

→	%		L	A	M	P		F	A	I	L	U	R	E				↑	↓
	C	A	L	I	B	R	A	T	I	O	N	:							

Press the menu selector; the screen will change to:

	%		L	A	M	P		F	A	I	L	U	R	E				↑	↓
	C	A	L	I	B	R	A	T	I	O	N	:							
→		E	X	I	T														
		Q	U	I	C	K		C	A	L	I	B	R	A	T	I	O	N	

Turn the Rotary Menu Selector to reveal the following selection:

	%		L	A	M	P		F	A	I	L	U	R	E				↑	↓
	C	A	L	I	B	R	A	T	I	O	N	:							
→		C	A	P	T	U	R	E		P	L	F		E	R	R		L	1
		C	A	P	T	U	R	E		P	L	F		E	R	R		L	2

With the arrow (→) alongside the 'CAPTURE PLF ERR L1' parameter, press the menu selector; the screen will change to:

	%		L	A	M	P		F	A	I	L	U	R	E		↑	↓
	C	A	L	I	B	R	A	T	I	O	N	:					
→		E	N	T	E	R		N	U	M		O	C		L	A	M	P	S
		F	O	R		L	1		C	A	P	T	U	R	E	:			5

Turn the Rotary Menu Selector to set the number of lamps removed / AGL transformers open circuited for this calibration point, and confirm by pressing the selector switch. If the setting used is different to that programmed for the PLF Stage 1 alarm threshold set in Section 4.6.2.3 above, then the following screen will be displayed, otherwise it will go directly to the warning screen:

→	F	O	R		B	E	S	T		A	C	C	U	R	A	C	Y		
	C	A	L	I	B	R	A	T	E		W	I	T	H		N	U	M	
	O	C		L	A	M	P	S		E	Q	U	A	L		T	O		
	S	T	A	G	E		1		A	L	A	R	M		P	O	I	N	T

Press the menu selector; the screen will change to:

W	A	R	N	I	N	G		C	C	R		O	U	T	P	U	T	↑	↓
W	I	L	L		E	N	E	R	G	I	S	E							
→		C	A	N	C	E	L												
		C	O	N	T	I	N	U	E										

Turn the Rotary Menu Selector anticlockwise so that the arrow (→) moves alongside 'CONTINUE', then press the selector again to record the PLF Card error signals for level one calibration. After running and automatically recording the error signal at each Brilliancy level, the CCR will switch off, and the screen will revert back to the 'Calibrate PLF' screen.

ii/ Repeat the procedure for the second calibration point, as follows.

Switch off the CCR and isolate the power supply. Remove a number of lamps from the field circuit or connect additional AGL transformers in series with the CCR output (with the secondary connections open circuited). The number of lamps removed (or open circuit transformers connected) should preferably correspond to the higher of the required alarm thresholds (Stage 2 PLF), programmed as described in Section 4.6.2.3 above.

Turn the power to the CCR back on, but leave the Brilliancy Control Selector switch in the 'Off' position. Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen.

→	%		L	A	M	P		F	A	I	L	U	R	E				↑	↓
	C	A	L	I	B	R	A	T	I	O	N	:							

Press the menu selector; the screen will change to:

	%		L	A	M	P		F	A	I	L	U	R	E			↑	↓
	C	A	L	I	B	R	A	T	I	O	N	:						
→		E	X	I	T													
		Q	U	I	C	K		C	A	L	I	B	R	A	T	I	O	N

Turn the Rotary Menu Selector anticlockwise so that the arrow (→) moves alongside the 'CAPTURE PLF ERR L2' parameter:

	%		L	A	M	P		F	A	I	L	U	R	E			↑	↓
	C	A	L	I	B	R	A	T	I	O	N	:						
		C	A	P	T	U	R	E		P	L	F		E	R	R	L	1
→		C	A	P	T	U	R	E		P	L	F		E	R	R	L	2

Press the menu selector; the screen will change to:

	%		L	A	M	P		F	A	I	L	U	R	E			↑	↓
	C	A	L	I	B	R	A	T	I	O	N	:						
→		E	N	T	E	R		N	U	M		O	C		L	A	M	P	S
		F	O	R		L	2		C	A	P	T	U	R	E	:		1	0

Turn the Rotary Menu Selector to set the number of lamps removed / AGL transformers open circuited for this calibration point, and confirm by pressing the selector switch. If the setting used is different to that programmed for the PLF Stage 1 alarm threshold set in Section 4.6.2.3 above, then the following screen will be displayed, otherwise it will go directly to the warning screen:

→	F	O	R		B	E	S	T		A	C	C	U	R	A	C	Y		
	C	A	L	I	B	R	A	T	E		W	I	T	H		N	U	M	
	O	C		L	A	M	P	S		E	Q	U	A	L		T	O		
	S	T	A	G	E		2		A	L	A	R	M		P	O	I	N	T

Press the menu selector; the screen will change to:

W	A	R	N	I	N	G		C	C	R		O	U	T	P	U	T	↑	↓
W	I	L	L		E	N	E	R	G	I	S	E							
→		C	A	N	C	E	L												
		C	O	N	T	I	N	U	E										

Turn the Rotary Menu Selector anticlockwise so that the arrow (→) moves alongside 'CONTINUE', then press the selector again to record the PLF Card error signals for level two calibration. After running and automatically recording the error signal at each Brilliancy level, the CCR will switch off, and the screen will revert back to the 'Calibrate PLF' screen.

Turn the CCR off and isolate the supply. Remove the test AGL transformers from the circuit, if used, and replace any AGL lamps that were removed.

4.6.4 Optimising the AT1134 Card Threshold Levels to match the AGL circuit

This section describes how to adjust the comparator threshold levels on the AT1134 Card to maximise the discrimination of the error signal between all lamps intact and that with lamps open circuited. It requires the use of an oscilloscope, preferably with 4 channels, but as a minimum 2 channels. Fine tuning of the alternative AT1131 Card threshold levels is performed via in software via the menu system.

The following oscilloscope traces illustrate how to optimise these AT1134 card settings. They were captured on a 12A Micro 200+ CCR at 2 different current levels, with either all lamps intact or with 1 lamp open circuit. The traces on each waveform are as follows:

Channel 1 (yellow): AT1134 TP3 – CCR output voltage waveform after rectification and automatic gain control (AGC) applied. (Leading waveform).

Channel 2 (blue): AT1134 TP4 – CCR output current waveform after rectification and automatic gain control (AGC) applied. (Lagging waveform).

Channel 3 (violet): AT1134 TP6 – Error signal produced at comparator output (held low if no error; goes high for period dependant on number of failed lamps).

Channel 4 (green): AT1134 TP9 – Error voltage (average, after smoothing).

The 0V level for all traces is in the centre of the screen.

Referring to the oscilloscope traces below, Figure 4-11 has no error signal (held low), since all lamps are intact, whereas in Figure 4-12 the signal at TP6 goes high for a period of around 1mS, thus raising the error voltage at TP9 (to 6.9V). TP6 goes high after the (rising) voltage waveform at TP3 crosses its' comparator threshold, which is set at -6.0V (measured at TP5, adjusted by RV2 / VTH). TP6 remains high until the (rising) current waveform at TP4 crosses its' comparator threshold, which is set at -8.0V (measured at TP1, adjusted by RV1 / ITH).

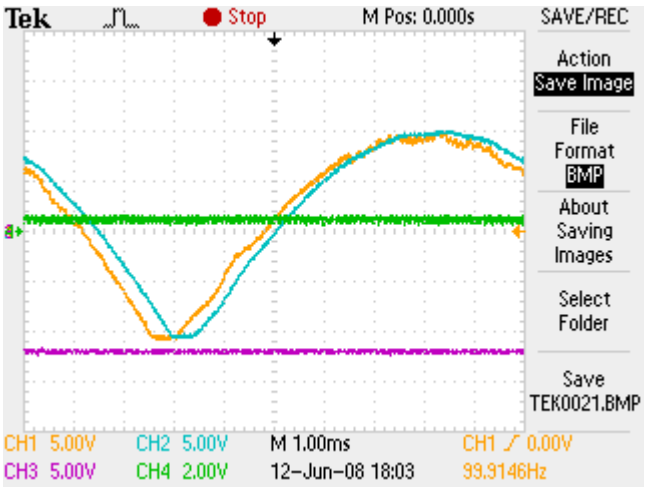


Figure 4-11 12A CCR running at 12A, all lamps intact

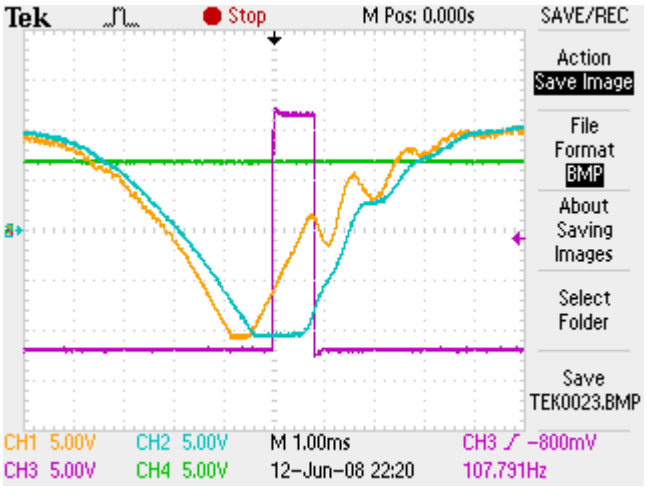


Figure 4-12 12A CCR running at 12A, 1 lamp open circuit

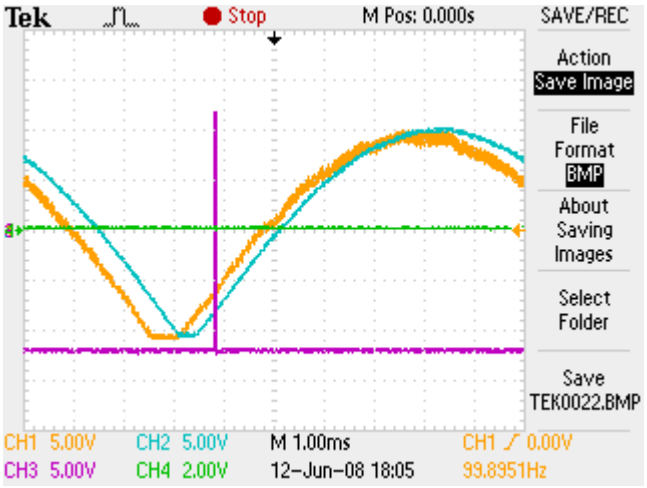


Figure 4-13 12A CCR running at 6.6A, all lamps intact

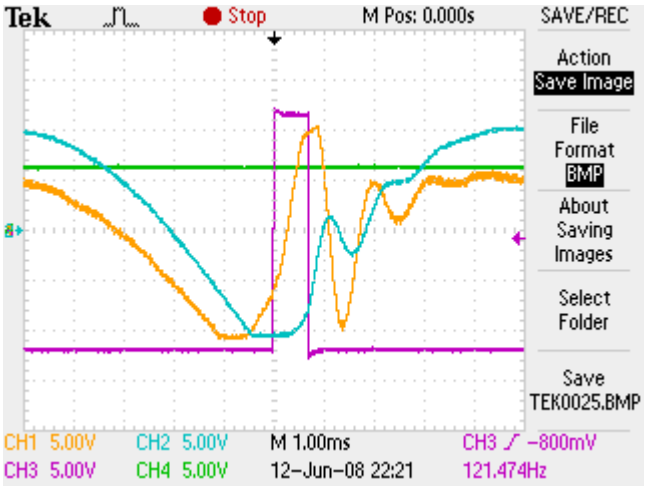


Figure 4-14 12A CCR running at 6.6A, 1 lamp open circuit

Note – all of the above traces were taken with the factory threshold levels set, as per Table 4-9 below. As can be seen, the error signal varies slightly with the CCR operating current.

Optimising the PLF system involves varying the comparator threshold levels for the waveforms of voltage and current in order to maximise the time period when TP6 goes high when the circuit becomes more inductive due to lamps failing. The system measures the period that the voltage waveform is leading that of the current waveform; TP6 goes high when the voltage waveform crosses its comparator threshold, and goes low when the current waveform crosses its comparator threshold. On the other hand, when all lamps are intact the threshold settings should be such that TP6 should either be held low, or better still, go momentarily high at certain output current levels (as per Figure 4-13). Setting the threshold levels just to the point of producing a small error signal with all lamps intact - possibly just at certain levels of current - is recommended, since any small change in circuit inductance due to lamps failing would produce a reasonable error signal.

Optimising the error signal requires adjusting the threshold levels to focus in on the area of the (rectified) waveforms for voltage and current where there is maximum distortion and divergence (the rising edge of the voltage waveform starts to lead the current waveform) as the load becomes more inductive due to failed lamps. The system should be optimised at maximum current, and at the next current step above half maximum output current. (The latter is the minimum step at which the auto-calibration routine samples the error voltage - see Section 4.6.3.2).

Depending on the AGL circuit, there may be some resonant effects, particularly when lamps have failed open circuit – this can be seen in Figure 4-14. In some cases (although not with this example circuit), this may mean that the factory threshold settings may not produce the best results, and makes tuning the system more difficult.

Table 4-9 lists the threshold level monitoring test points and adjustment potentiometers. Use TP2 or TP15 on the AT1134 card as the 0v connection.

Description	Test Point	Adjusting Potentiometer	Factory Threshold setting
Voltage waveform rising edge comparator threshold (VTH)	TP5	RV2 (VTH)	–8.3v DC +/- 0.1v
Current waveform rising edge comparator threshold (ITH)	TP1	RV1 (ITH)	–7.7v DC +/- 0.1v

Table 4-9 AT1134 Percentage Lamp Failure Card adjustments

4.6.5 Capacitive current detection threshold setting

The capacitive current detection threshold level is factory set and should not require adjustment. Any changes required would be made in software via the menu system; see section 9.4.2.13.

5 4-20mA Current Loop Meter - Current or Power Measurement

Fitting of a 4-20mA current loop meter is optional on the Micro 200+; this requires fitting of the AT1130 4-20mA Transmitter Card, the AT759 Current Transducer Card and the AT777 4-20mA Output Filter Card. This system can be configured to measure CCR rms output current (CCR option product code CM) or output power measurement (CCR option product code PM). For CCRs built to the AENA specification, these boards are always fitted and configured for power measurement. Configuration of the measurement type (current or power) is made via the engineering menu system – see section 9.4.2.4.

The output connections are taken from the AT777 4-20mA Output Filter Card mounted in the control terminal box at the back of the CCR. The 4 –20mA output can be loop powered or powered from the transducer modules internal 24V supply. For a loop powered system, links LK1 and LK2 on the AT777 Card are fitted in position ‘A’ (upper position), this configuration is shown in Figure 5-1 below.

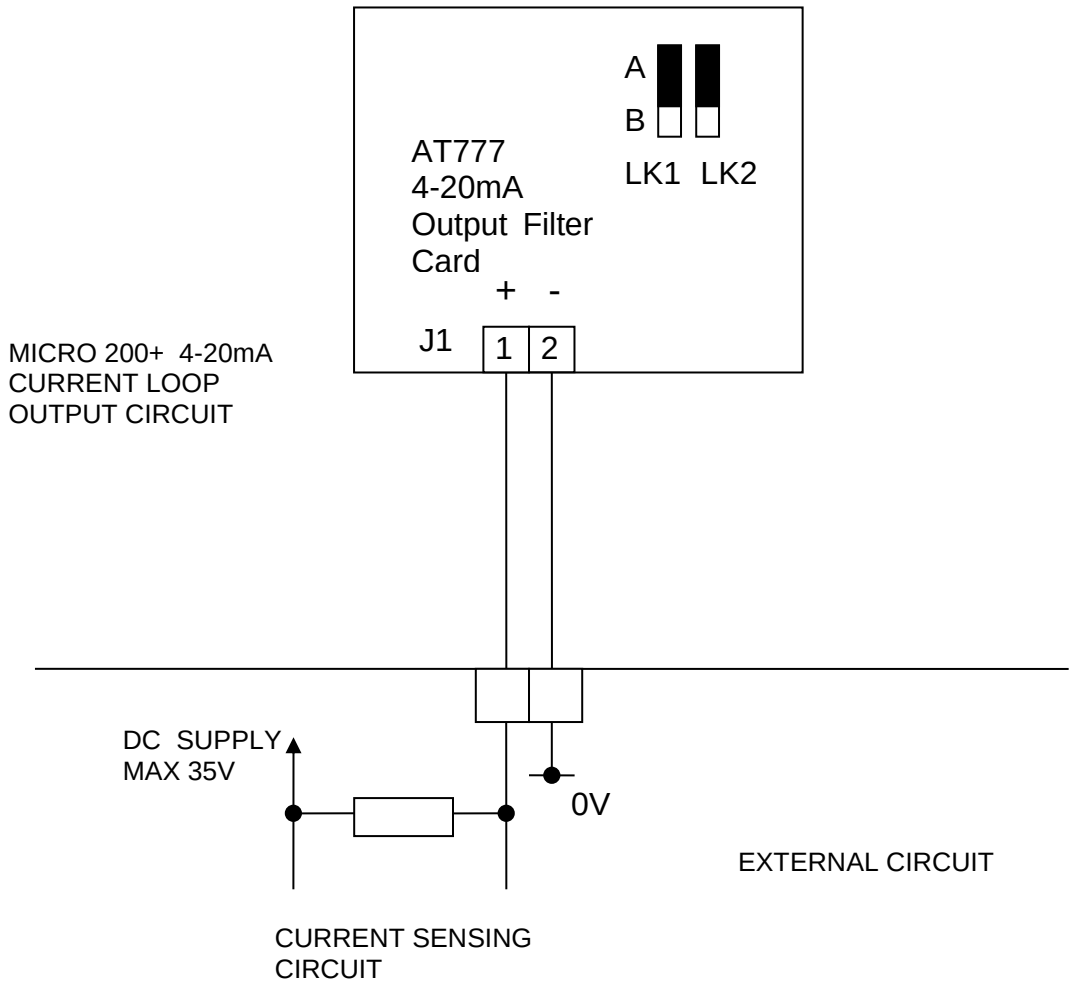


Figure 5-1 Loop powered 4 – 20mA output configuration

To use the AT777 Card's internal 24V supply, links LK1 and LK2 on the AT777 Card are fitted in position 'B' (lower position), this configuration is shown in Figure 5-2 below. (Note – this configuration is used on AENA specification regulators, built for the Spanish market).

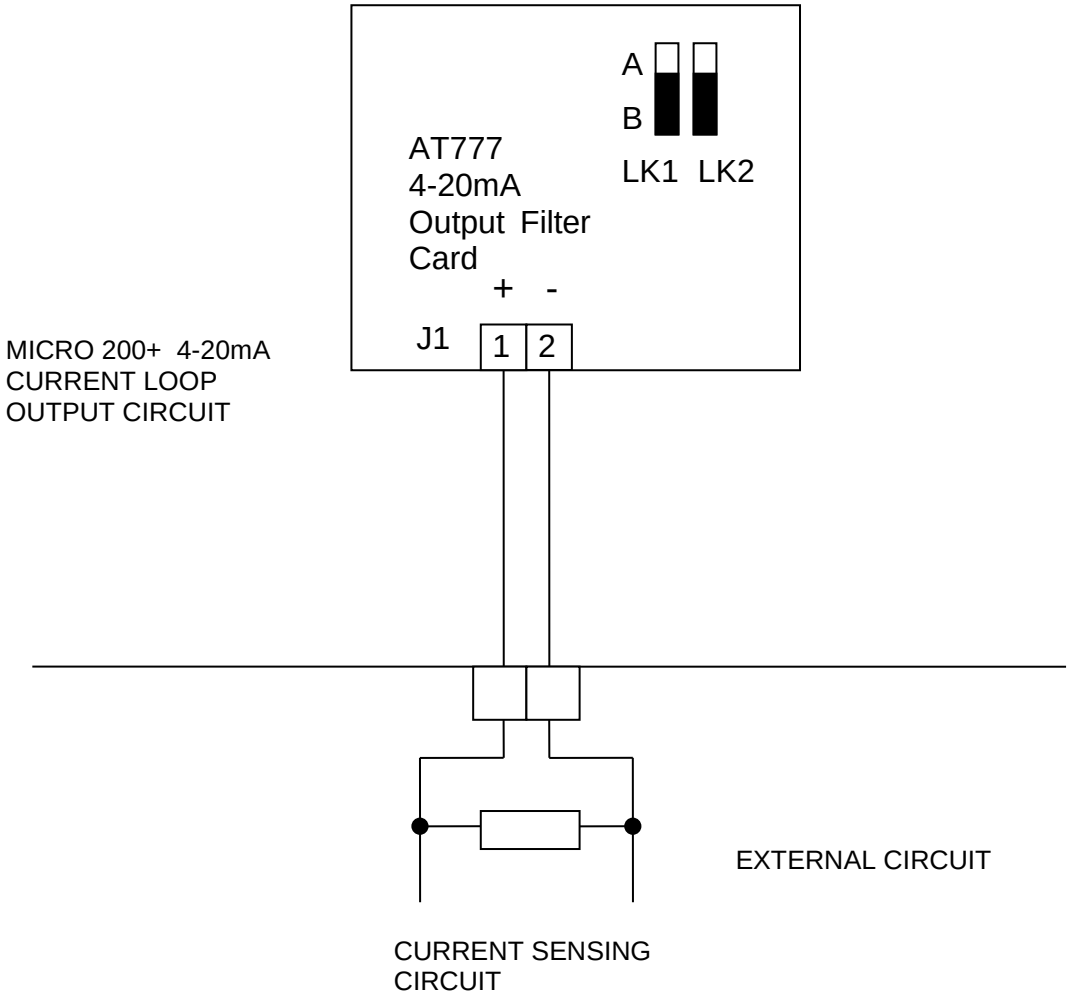


Figure 5-2 4 – 20mA output configuration using the AT777 internal supply

6 Output Lightning Arrestors

Output Lightning Arrestors are available as an option on the Micro 200+. These are fitted in place of the standard CCR HT output terminals, and function both as the CCR output terminal and the Output Surge Protective Device (SPD). Each Lightning Arrestor terminal consists of a high power MOV and a terminal bar clamp. The assembly meets the impulse surge requirements of IEC 61820-3-2:2023 and FAA Advisory Circular 150/5345-10F.

Figure 6-1 below shows a 2-pole Output Lightning Arrestor Terminal; more poles can be fitted for CCRs which include integral Circuit Selector Switches. The Lightning Arrestor base plate should be earthed with a cable having a cross sectional area of at least 35 mm^2.

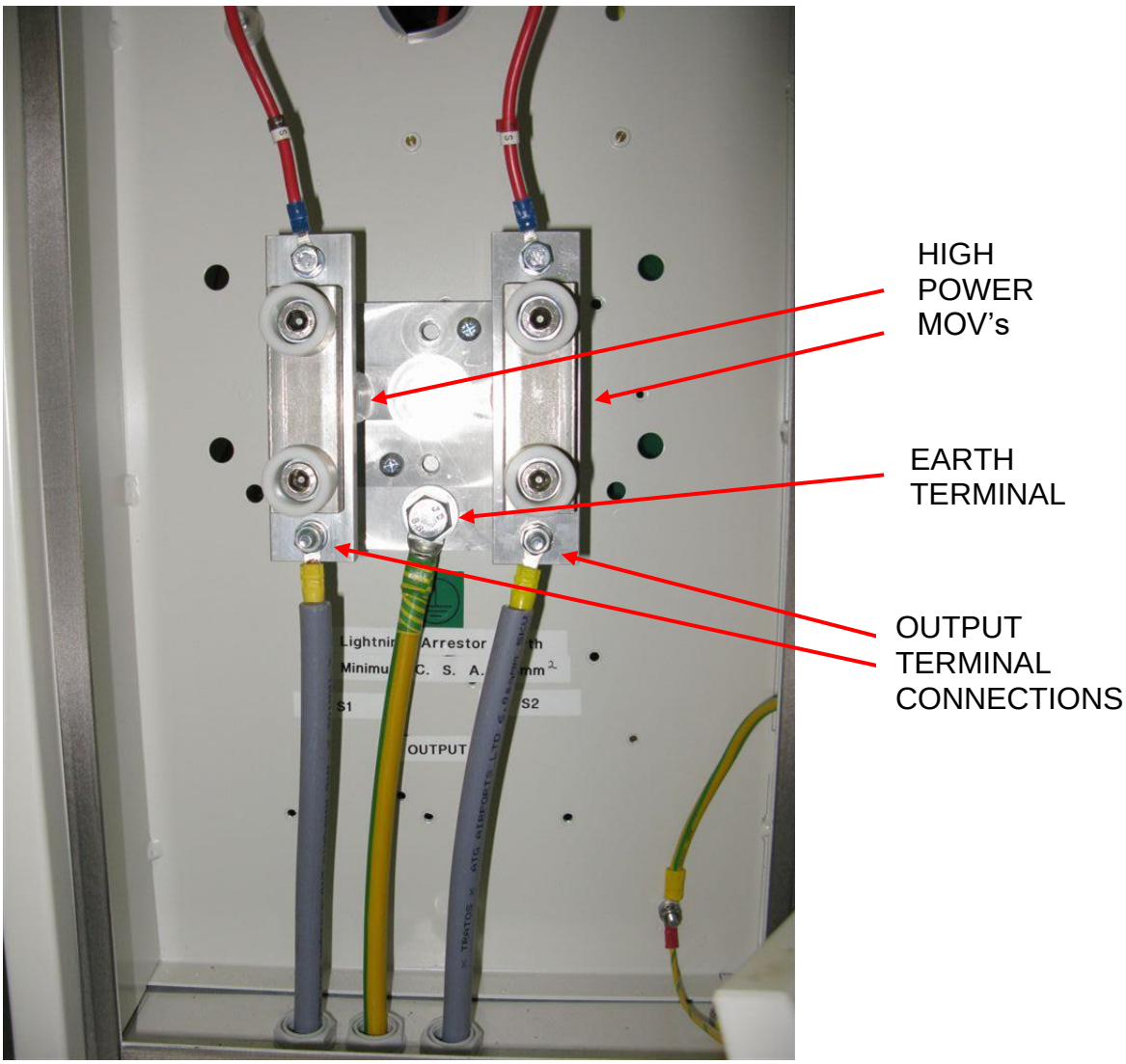


Figure 6-1 Output Lightning Arrestor Terminal

7 Cutout Switch

The Cutout Switch, which is available as an option on the Micro 200+, is a three-position plug-in switch / connector which is designed to facilitate safe working on the CCR and the AGL field circuit for maintenance purposes. By using the Cutout Switch to short together and earth down the field circuit (after first isolating the supply to the regulator), any induced voltages on the field circuit cables will be dissipated and so the conductors made safe to work on. The MKV Cutout Switch complies with IEC 61820-3-2:2023 and AENA DIN/DSEYN/PPT/002-05/13.

The Cutout Switch is usually mounted in the HT terminal box at the rear of the regulator, although on Micro 200+ CCRs fitted with Alternate or 2 Way Simultaneous Circuit Selector Switches, two Cutout Switches may be mounted in a lockable enclosure fitted on top of the CCR.

WARNING – HIGH VOLTAGES – UP TO 2500V FOR A 15kVA REGULATOR – ARE PRESENT WITHIN THE HT TERMINAL BOX AND HT COMPARTMENT. THE COVERS TO THESE COMPARTMENTS SHOULD NEVER BE OPENED WITHOUT FIRST ISOLATING THE REGULATOR MAINS SUPPLY INPUT

Figure 7-1 below shows a Cutout Switch mounted above the CCR lightning arrestor / output terminals in the HT Terminal box of a Micro 200+ CCR.

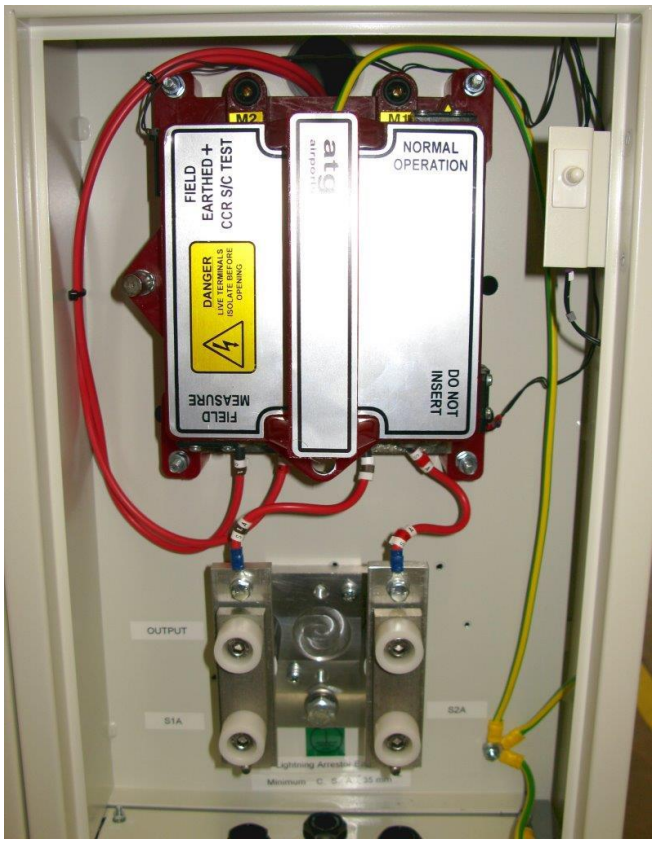


Figure 7-1 Cutout Switch mounted in CCR HT Output Terminal box

The Cutout Switch can be fitted with magnetic reed switches to give positional feedback; the reed switches work in conjunction with the optional AT726 Cutout Switch Relay Card. When these are fitted, removal of the Cutout Switch lid will prevent the CCR contactor from energising. Additionally, for units built to the AENA specification (Spanish market), Back Indication is given via the control connector that the Cutout Switch is in the test position.

Figure 7-2 below shows the outline of the Cutout Switch, and identifies the cable connections. M2 and M1 are 4mm test terminals – see Section 7.1.3

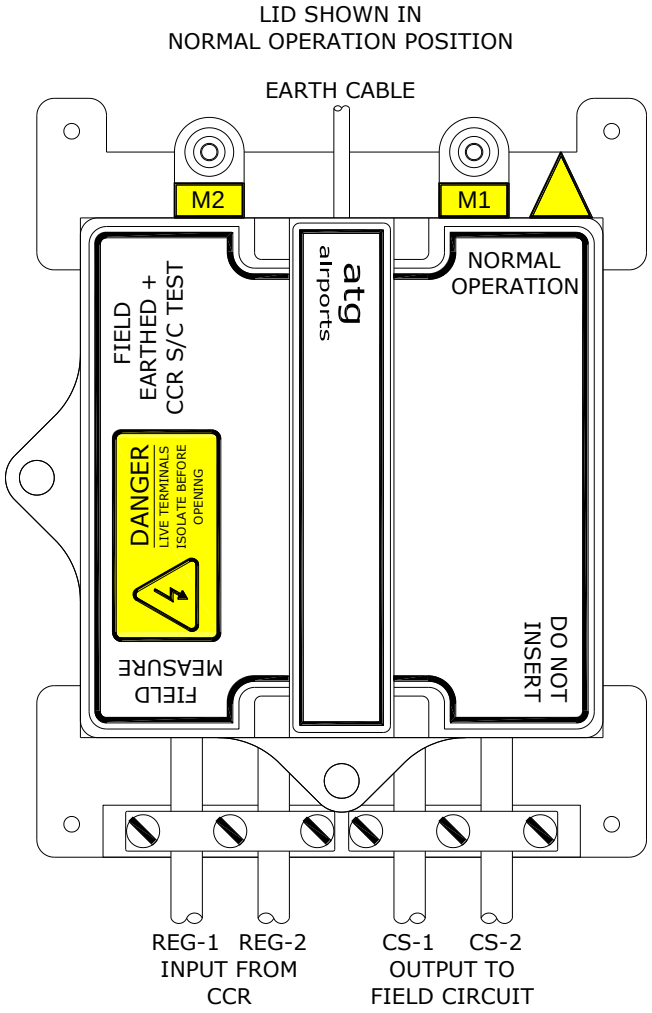


Figure 7-2 Cutout Switch outline drawing

7.1 Use of the Cutout Switch

The lid of the Cutout Switch can be removed and fitted in any of three different orientations in order to give the required connectivity. The three switch positions are described in the following sections. Note – the yellow arrow in the top right-hand corner of the base indicates the active position, alongside the text in this corner of the lid. In the case of Figure 7-2, this is Normal Operation.

WARNING: HIGH VOLTAGES – UP TO 2500V FOR A 15kVA REGULATOR – ARE PRESENT WITHIN THE HT TERMINAL BOX AND HT CUBICLES, AND ON THE TERMINALS OF THE CUTOUT SWITCH. THE COVERS TO THESE COMPARTMENTS SHOULD NEVER BE OPENED, NOR THE CUTOUT SWITCH LID REMOVED, WITHOUT FIRST ISOLATING THE REGULATOR MAINS SUPPLY INPUT.

7.1.1 Cutout Switch in 'Normal Operation' position

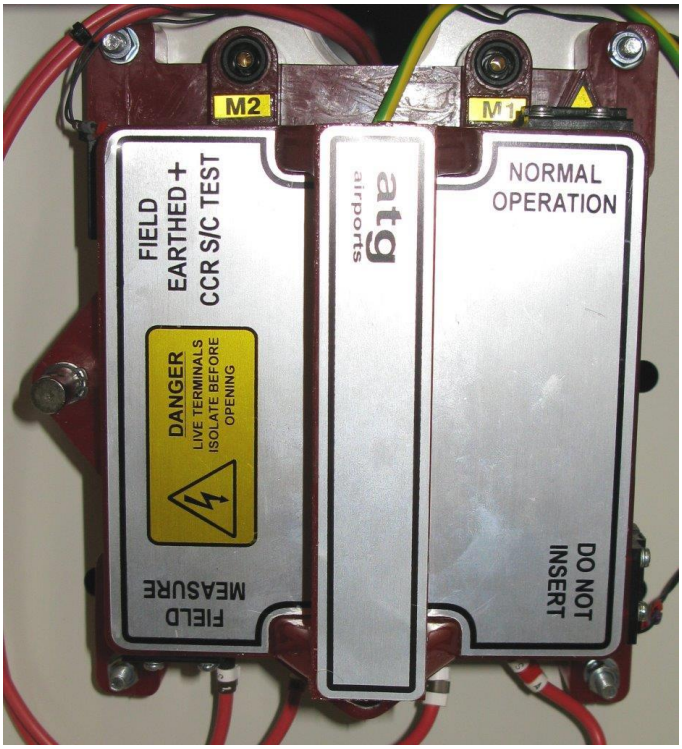


Figure 7-3 Cutout Switch in 'Normal Operation' position

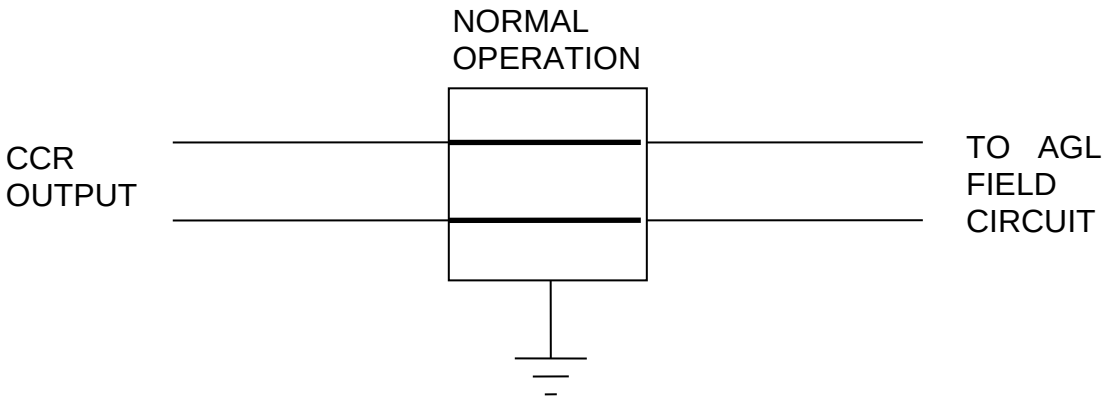


Figure 7-4 Electrical connections of Cutout Switch in 'Normal Operation' position

In the 'Normal Operation' position, the output of the CCR is connected directly to the AGL primary series loop.

7.1.2 Cutout Switch in 'Field Earthed and CCR Short Circuit Test' maintenance position

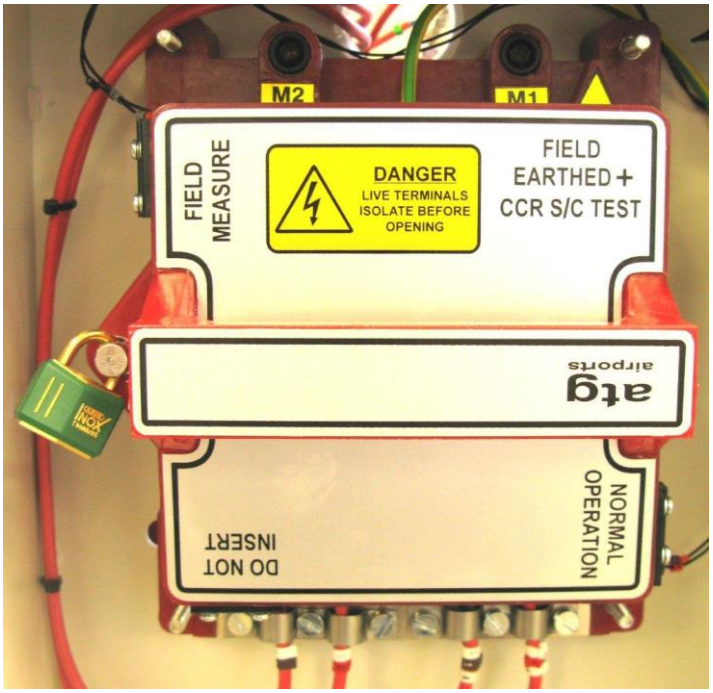


Figure 7-5 Cutout Switch in 'Field Earthed and CCR Short Circuit Test' maintenance position

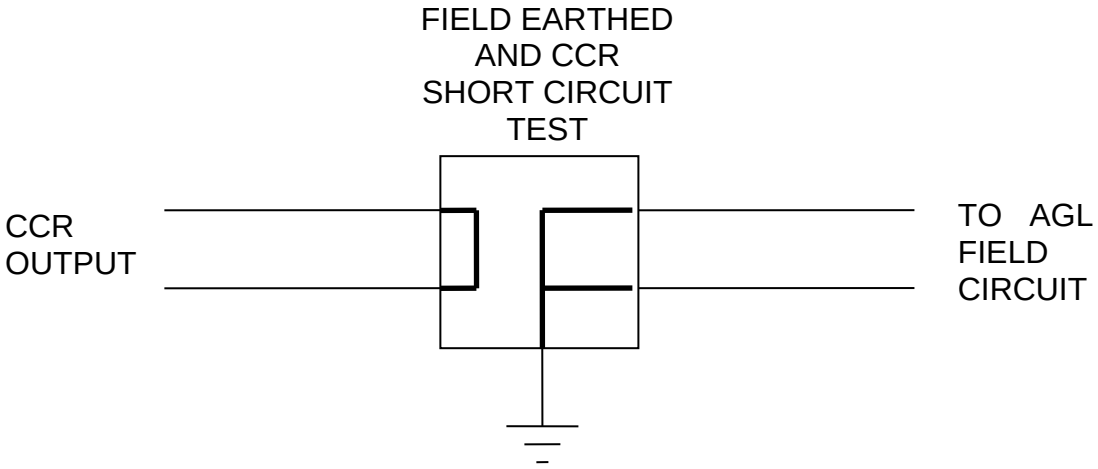


Figure 7-6 Electrical connections of Cutout in 'Field Earthed + CCR S/C Test' maintenance position

In the 'Field Earthed and CCR Short Circuit Test' position, the output of the CCR is shorted together, isolated from the AGL field circuit, and the field circuit is shorted and connected to earth.

The Cutout Switch is fitted in this position so that maintenance work can be safely carried out on the field circuit. Note – a padlock may be attached to lock the Cutout Switch in this position for additional security.

7.1.3 Cutout Switch in 'Field Measure' position

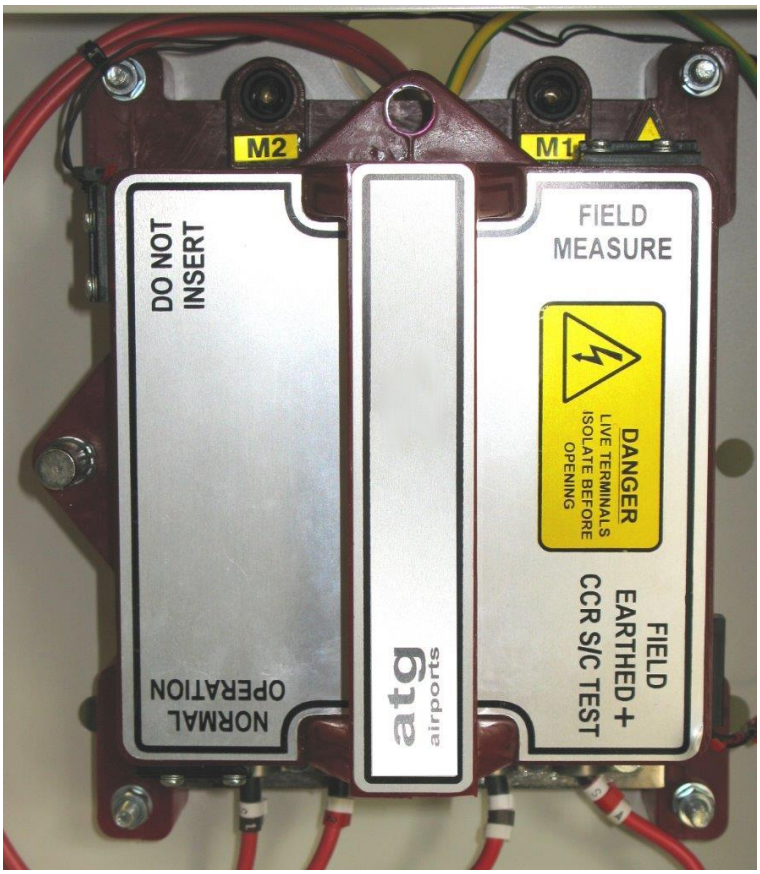


Figure 7-7 Cutout Switch in 'Field Measure' position

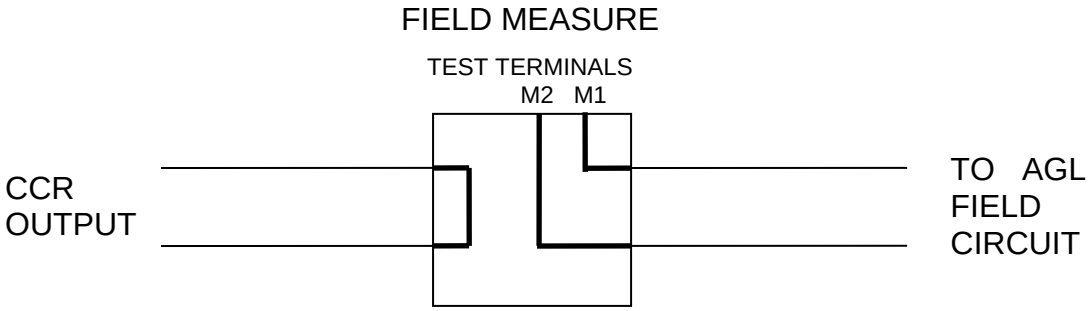


Figure 7-8 Electrical connections of Cutout Switch in 'Field Measure' position

In the 'Field Measure' position, the output of the CCR is shorted together. Access for instrument connection to both of the load side terminals is provided via 4mm test sockets M1 and M2.

The test terminals allow for insulation or 'Megger testing' to measure the resistance of the AGL field circuit to ground, and to measure continuity of the field circuit.

8 General CCR Application Information

8.1 Calculation of the AGL Circuit Load: Regulator Sizing and Required Output Voltage

The CCR kVA rating must be chosen to match the field circuit load requirements. If the CCR is too small, the maximum output voltage will be too low to drive the required current into the load circuit. If it is too big, it will work but at a cost of reduced efficiency.

This section describes how to calculate the total AGL circuit load. The CCR used should be the next size up from this calculated load.

Upon installation, the Main CCR transformer output voltage will have to be set to match the calculated circuit load. The calculated load power (kW) should be divided by the maximum series circuit current to give a value for the desired CCR output voltage:

$$V = P / I$$

The CCR output transformer voltage taps can be configured as described in Section 4.3 to give a total maximum output voltage equal to this value.

8.1.1 AGL Circuit Load

Figure 8-1 below, shows a typical AGL circuit.

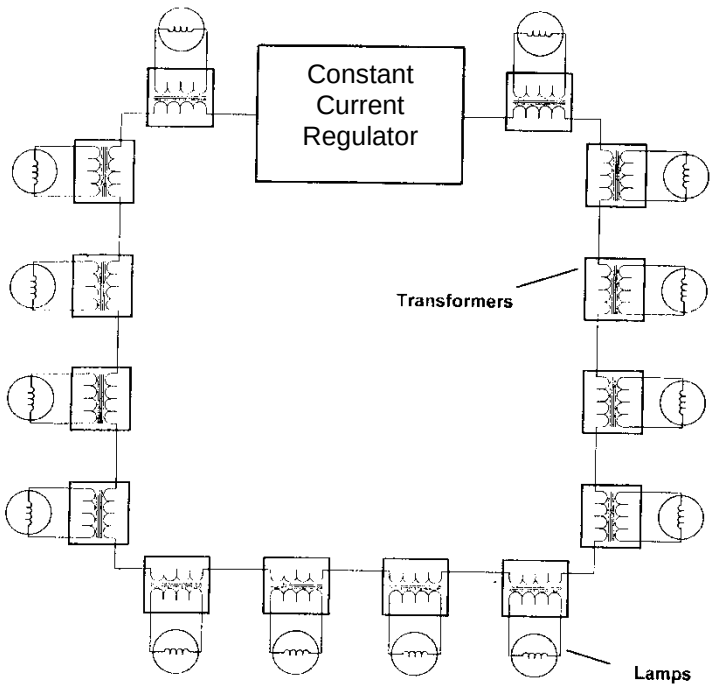


Figure 8-1 Typical Airfield Lighting Circuit

The AGL circuit load therefore consists of the following components:

- The total wattage of all the lamps on the circuit

- An allowance, if necessary, for the losses in long AGL transformer secondary extension leads. AGL transformers are supplied as standard with a secondary lead of 2 metres in length, of 4mm^2 cross sectional area. In this case, the power dissipation in the secondary lead is negligible and can be ignored. If, however, long extension leads of a small CSA were to be used, this would produce an appreciable volt-drop. In this case, the additional I^2R power loss should be calculated and taken into account. (Note – the AGL transformer secondary current can be different from the primary loop current. This should be verified before any calculations are done).

- An allowance of 10% for the inefficiency of the AGL lamp transformers, based on the transformer load being the addition of the above 2 items. Note - If only a small proportion of transformers have long extensions, then as a rough rule of thumb, simply increase the allowance for transformer losses to 15%

- Power losses in the AGL primary series loop cable. This is simply an I^2R power loss. A typical circuit would use 6mm^2 AGL cable, which has a resistance of 3 ohms per kilometre.

- An allowance for lamp failures, conditions of reduced supply voltage and other supply losses - oversize by 10%

In summary, the total CCR load will be:

((Total lamp wattage x 1.1) + (I^2R power loss in the AGL primary series loop cable)) x 1.1

Or, if long AGL transformer secondary extension leads are used:

(((Total lamp wattage + AGL tx secondary extension lead I^2R losses) x 1.1)

+ (I^2R power loss in the AGL primary series loop cable))) x 1.1

Note – the load calculations give a value in kilowatts, whilst the CCR is rated in kVA. These figures can be considered to be equivalent for the purposes of rating the CCR.

8.1.2 Example AGL Circuit Load Calculation

Consider the following worked example.

i/ Circuit 1 has 160 lamps each rated at 45w, with 6.6A filaments. The lamps are mounted adjacent to the AGL transformers; such that the secondary leads have negligible losses.

The primary series circuit is also rated at 6.6A, and the total length of the series circuit loop is 5.5 kilometres. 6mm^2 AGL cable has been used, with a resistance of 3 ohms per kilometre

Lamp load	160 x 45w = 7200 watts
Total transformer load (Lamp load plus transformer losses)	7200w x 1.1 = 7920 watts
Primary series circuit cable I^2R power losses	6.6 x 6.6 x 3 x 5.5 = 718.74 watts
Total circuit load	7920w + 718.74w = 8638.74 watts
Overrate by 10% to allow for lamp failures, conditions of reduced supply voltage and other supply losses	8638.74 x 1.1 = 9.5 kilowatts (approx.)

In this case, a 10KVA CCR should be used

The transformer output voltage taps should be configured to give a maximum output voltage of:

V = P/I = 9500/6.6 = 1440 volts

Refer to Section 4.3 to set the transformer output voltage selector taps.

8.2 Load Changing / Block Switching

During ‘Block Switching’ operations, for example, when using electronic switching of the secondary side of the airfield ground lighting transformers to short out and switch off (‘Suppress’) sections of the AGL circuit, many types of regulator produce a momentary overloading of the remainder of the circuit. This is because there is a finite time before the CCR control loop can reduce the CCR output voltage to match the reduced load impedance, and bring the current back to its set point. It can cause failures of lamps and of fuses in the CCR; it is particularly a problem with conventional thyristor regulators, where the best that can be achieved is to limit the overload to half a mains cycle.

The Micro 200+ overcomes this problem due to the fast-acting control of the IGBT H-bridge, which responds almost instantaneously to the current overload.

However, it is recommended that during block switching operations, the control system should momentarily reduce the CCR Brilliancy, or switch off the CCR altogether, during block switching operations.

8.3 Black Heat

In certain circumstances (usually on PAPIs), a "black heat" output is required. Black heat means that a small output current flows all the time even if the regulator is commanded "off" by air traffic control, in order to prevent condensation in tungsten halogen light fittings. See Section 9.3.2.12 for details of enabling Black Heat, and Section 9.3.2.13 for setting the current level.

9 Programming Menus

9.1 Overview

This section describes the Microcontroller Menu system, how to load the CCR operating parameters via the Front Panel Keypad and how to set-up some of the more specialised functions.

The Micro 200+ CCR is pre-programmed with default operating parameters suitable for most applications. Parameters such as the CCR Maximum Output Current will normally be programmed to customer specifications during factory testing, along with any other non-standard requirements if these were notified to **atg airports** at the time the equipment was ordered.

The screens are divided into three menus, as listed below

1. Main menu – displays information about the status of the regulator
2. Set-Up menu – allows programming of CCR operating parameters
3. CCR Hardware Configuration menu – gives access to calibration and engineering screens

Access to the Set-up menu is password protected with a further password to access the CCR Engineering Configuration Menu.

Additionally, there are a number of fault screens that can be activated. CCR faults are divided between those that give a ‘soft’ alarm but allow continued operation, and those that trip the regulator.

9.1.1 How to Navigate Around the Screens

The Micro 200+ uses a Rotary Encoder switch with a ‘Push to Select’ function in order to navigate through the menu system and to reset any faults (this is referred to as the ‘Rotary Menu Selector’). The Brilliancy Control Selector switch on the left-hand side is used for control of the CCR. The Front Control Panel is shown below:

Figure 9-1 Front Control Panel and Display

9.2 Main Menu and CCR Status Screens

Under normal operation, the front panel display shows the regulator's Running Mode screen, which displays the CCR Output Current and, if available, the Output Voltage. The operator can scroll down through the menu from the Running Mode screen by turning the Rotary Menu Selector anticlockwise to show the following screens: Fault List Screen, Hours Run, Earth Leakage Display (if available), PLF Display (if available), Output kVA (if available), CCR Product Information, and if the CCR is set to 'Local Off', the Set-up Menu Password Entry screen is also available. After a period of 60 seconds of inactivity the display will revert to show the Running Mode and Output Current.

The Main Menu Flowchart is shown in Figure 9-2 below, whilst Table 9-1 lists the Main Menu screens and gives a brief description of them.

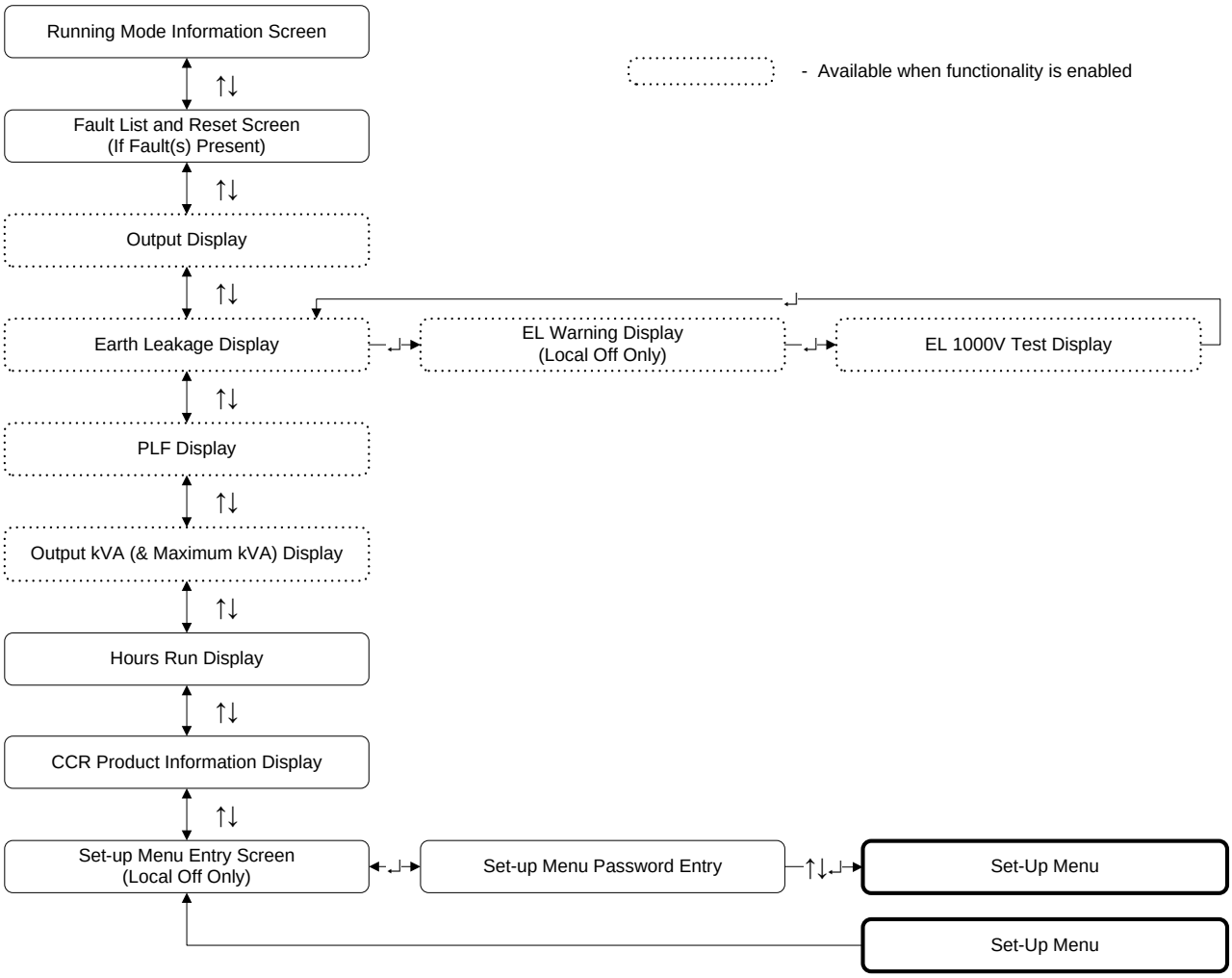


Figure 9-2 Main Menu Flowchart.

Parameter	Description
Running Mode Screen: Output Current (& Output Voltage) Display Screen	Indicates whether the CCR is operating under Local or Remote control, and displays the Brilliancy Level selected and the CCR output current. If 'Voltage Feedback' is enabled, also displays CCR output voltage. The second line shows fault indications, warnings or other information.
Fault list and Reset Screen	If there are any faults registered then these are listed on this screen. Faults can be reset from this screen providing that the faults are no longer present on the CCR.
Output Display Screen - kVA, voltage and power	Displays the measured output kVA, voltage and power.
Earth Leakage Display Screen	Displays the last measured value of the Resistance to Earth of the Primary Series Loop Circuit. The measurement is either made continuously (at 500V) whilst the CCR is operating, or, when the CCR is set to 'Local Off', a manual test can be made at 1000V. (Note – this screen is only available if the optional Earth Leakage Measurement module has been fitted and its' operation enabled).
PLF Display Screen	Displays the number of lamps failed. (Note – this screen is only available if the Percentage Lamp Failure Card is fitted and its' operation has been enabled).
Output kVA (& Maximum kVA) Display Screen	Displays the measured output kVA. If 'kVA Alarm' is also enabled, displays Maximum recorded kVA for the selected brilliancy level.
Hours Run Display Screen	Displays overall Hours Run and the Hours Run at Maximum Brilliancy
CCR Product Information Screen	This screen displays product information and the software version number.
Set-up Menu Entry Screen	This screen allows access to Menu 2 – the Set-up Menu. Note – this screen is only available if the Brilliancy Control Selector switch is set to 'OFF'.

Table 9-1 Main Menu screens

If a fault occurs, then this is indicated on the second line of the Running Mode screen. The faults are listed on the next screen down, available by turning the Rotary Menu Selector anticlockwise. The fault screens are described in Section 9.5, and listed in Table 9-4.

9.2.1 Screens Displayed During Normal CCR Operation

The screens displayed during normal operation are described below, and are accessed in the order shown, starting from the 'Running Mode' screen, by turning the Rotary Menu Selector anticlockwise to scroll down through the menu. The display automatically reverts back to the 'Running Mode' screen from any of the other screens within this menu after a period of 60 seconds of inactivity. Note – not all of the screens described below are available depending on the configuration of the CCR.

9.2.1.1 Running Mode Display Screen

The ‘Running Mode’ screen shows the operating status of the CCR. In the following example the CCR has been programmed for IEC Style 2 (5 Step) Brilliancy levels (see section 9.3.2.7), is set to ‘Remote’ control and has been commanded on at Brilliancy 5 (maximum), with a measured output current of 6.60A. The fourth line displays the measured output voltage.

Since this screen is the first one in this menu, there is only one arrow on the top right-hand side, pointing down to indicate that you can only scroll down from here in the menu, by turning the Rotary Menu Selector anti-clockwise.

R	E	M	O	T	E		B	R	I	L	L		5						↓
O	P		C	U	R	R	E	N	T	:			6	.	6	0		A	
O	P		V	O	L	T	A	G	E	:			2	2	8	6		V	

The second line is used for fault indications, warnings or other information. The second line will cycle from one item to the next if there is more than one message to display. If any faults have been registered, then the number of faults will be indicated. If a fault is of the type which trips the CCR, then a message ‘CCR DISABLED’ will also be shown.

The screen appears as shown below when the CCR is under ‘Remote’ control and has been set to ‘Off’. In this example, ‘Black Heat’ has been enabled, and so a low level residual output current is produced to prevent condensation forming in the light fittings.

R	E	M	O	T	E		O	F	F									↓
E	N	E	R	G	I	S	E	D		B	L	A	C	K		H	E	A	T
O	P		C	U	R	R	E	N	T	:			1	.	5	0		A	
O	P		V	O	L	T	A	G	E	:				8	1	3		V	

Other warnings or indications which may be shown (or cycled through) on the second line of the display include:

- If the CCR has been configured to perform continuous Earth Leakage resistance measurements (‘Continuous Analogue’ under the ‘Earth Leakage Detection Type’ menu – see section 9.3.2.16), then a warning message to that effect will be shown on the second line.
- If a Cutout switch is fitted (optional) and it has been set to the test position, this will be indicated on the second line.
- CSS Inhibit may be displayed if the CCR is being used with an external Circuit Selector Switch, and the CSS inhibit contact is open circuit.

9.2.1.2 Fault List and Reset Display Screen

If there are any faults registered then this is indicated on the second line of the Running Mode Display screen. For example, an 'Open Circuit' fault, which trips (disables) the CCR, indicates the following, with the second line toggling between the messages shown on the screens below:

R	E	M	O	T	E		O	F	F								↓
1		F	A	U	L	T											
O	P		C	U	R	R	E	N	T	:			0	.	0	0		A	
O	P		V	O	L	T	A	G	E	:						0		V	

R	E	M	O	T	E		O	F	F									↓
C	C	R		D	I	S	A	B	L	E	D							
O	P		C	U	R	R	E	N	T	:			0	.	0	0		A	
O	P		V	O	L	T	A	G	E	:						0		V	

A list of the fault(s) registered is shown on the next screen down, which is displayed by turning the Rotary Menu Selector anticlockwise:

1		F	A	U	L	T											↑	↓
	S	E	L	E	C	T		T	O		R	E	S	E	T			
→	O	P	E	N		C	I	R	C	U	I	T		F	A	U	L	T	

Faults can be reset from this screen providing that the faults are no longer present on the CCR; position the arrow (→) against the fault description and press the menu selector. Note – not all faults will trip the CCR – many will show as a 'soft' alarm with the CCR continuing to operate as indicated on the 'Running Mode' screen. Refer to section 9.5 for more information.

9.2.1.1 Output Display Screen

This screen, which displays the measured CCR output kVA, output voltage and output power.

	O	U	T	P	U	T	:										↑	↓	
		6	.	6	0	A		2	2	8	6	V			1	5	K	W	

9.2.1.2 Hours Run Display Screen

This screen displays the hours run at maximum brilliancy (or effective maximum brilliancy), and the total hours run:

																	↑	↓
H	O	U	R	S		R	U	N										
M	A	X		B	R	I	L	L	:				1	2	4		H	R	S
				T	O	T	A	L	:				6	6	2		H	R	S

9.2.1.3 Earth Leakage Display Screen

This screen is only available if the optional Earth Leakage Measurement module has been fitted and its' operation enabled; refer to section 4.5.2.

When enabled and when the CCR is running, the earth leakage resistance value is measured using a test voltage of 500V DC; the resulting measurement is displayed on the second line of the display. When the CCR is in the 'Off' state, the display shows the last measured value and the test voltage used. (Note – if no earth leakage test has yet been run, or if 'Earth Leakage' has been enabled but there is no Earth Leakage Measurement module fitted to the CCR, then the second line will read 'NO RESULT AVAILABLE').

If the Rotary Brilliancy Selector Switch is set to 'Off' then lines three and four are also displayed on this screen, showing the possibility to run an earth leakage test at 1000V:

E	A	R	T	H		L	E	A	K	A	G	E				↑	↓
		@		5	0	0	V		>		5	0		M	Ω			
→		P	R	E	S	S		S	E	L	E	C	T		T	O			
		R	U	N		1	0	0	0	V		T	E	S	T				

Refer to section 9.2.2 for more information on this test.

9.2.1.4 Percentage Lamp Failure Display Screen

This screen, which displays the (approximate) number of failed lamps and the (approximate) percentage of failed lamps, is only available if the Percentage Lamp Failure Card functionality has been enabled; refer to section 4.6.

P	E	R	C	E	N	T	A	G	E								↑	↓
L	A	M	P		F	A	I	L	U	R	E							
F	A	I	L	E	D		L	A	M	P	S	:			2			
													(		2	%	)	

9.2.1.5 Output kVA Display Screen

This screen displays the measured CCR output kVA.

If the kVA alarm is also enabled, the fourth line will show the measured peak kVA value for the selected brilliancy step. Note - if the output kVA drops by more than 10% from the peak recorded value for that Brilliancy step, due to earth faults on the AGL series circuit for example, then an alarm is raised.

O	U	T	P	U	T		k	V	A							↑	↓	
		2	5	.	6	9		k	V	A								
C	U	R	R	E	N	T		S	T	E	P		P	E	A	K	:	
		2	6	.	4	8		k	V	A								

9.2.1.6 CCR Product Information Screen

This screen displays product information and the software version number:

A	T	G		A	I	R	P	O	R	T	S		L	T	D			↓
M	I	C	R	O		2	0	0	+		C	C	R					
S	W		V	E	R	S	I	O	N	:								
			v	1	0	.	0	6	.	0	0	0	3	t				

9.2.1.7 Set-up Menu Entry Screen

The final screen in this menu enables access to Menu 2 – the Set-up Menu. Note – this screen is only available if the Brilliancy Control Selector switch is set to 'OFF'.

→	E	N	T	E	R		M	E	N	U		2						↑	
	S	E	T	-	U	P		M	E	N	U								

Refer to section 9.3.1 for further information.

9.2.2 Earth Leakage Resistance – Manual Test at 1000V DC

This test is only available if the optional Earth Leakage Measurement module is fitted and correctly programmed.

The measurement of the Primary Series Loop Earth Leakage Resistance using a test voltage of 1000V DC can only be made when the Brilliancy Control Selector Switch is set to ‘OFF’. From the ‘Running Mode’ screen, scroll down to the ‘Earth Leakage’ screen; with the CCR set to ‘LOCAL OFF’, lines three and four are also displayed showing the possibility to run an earth leakage test at 1000V:

E	A	R	T	H		L	E	A	K	A	G	E						↑	↓
		@		5	0	0	V		>		5	0		M	Ω				
→		P	R	E	S	S		S	E	L	E	C	T		T	O			
		R	U	N		1	0	0	0	V		T	E	S	T				

Press the Rotary Menu Selector, a test confirmation screen will be shown:

E	A	R	T	H		L	E	A	K	A	G	E						↑	↓
R	U	N		1	0	0	0	V		T	E	S	T						
→		C	A	N	C	E	L												
		C	O	N	F	I	R	M											

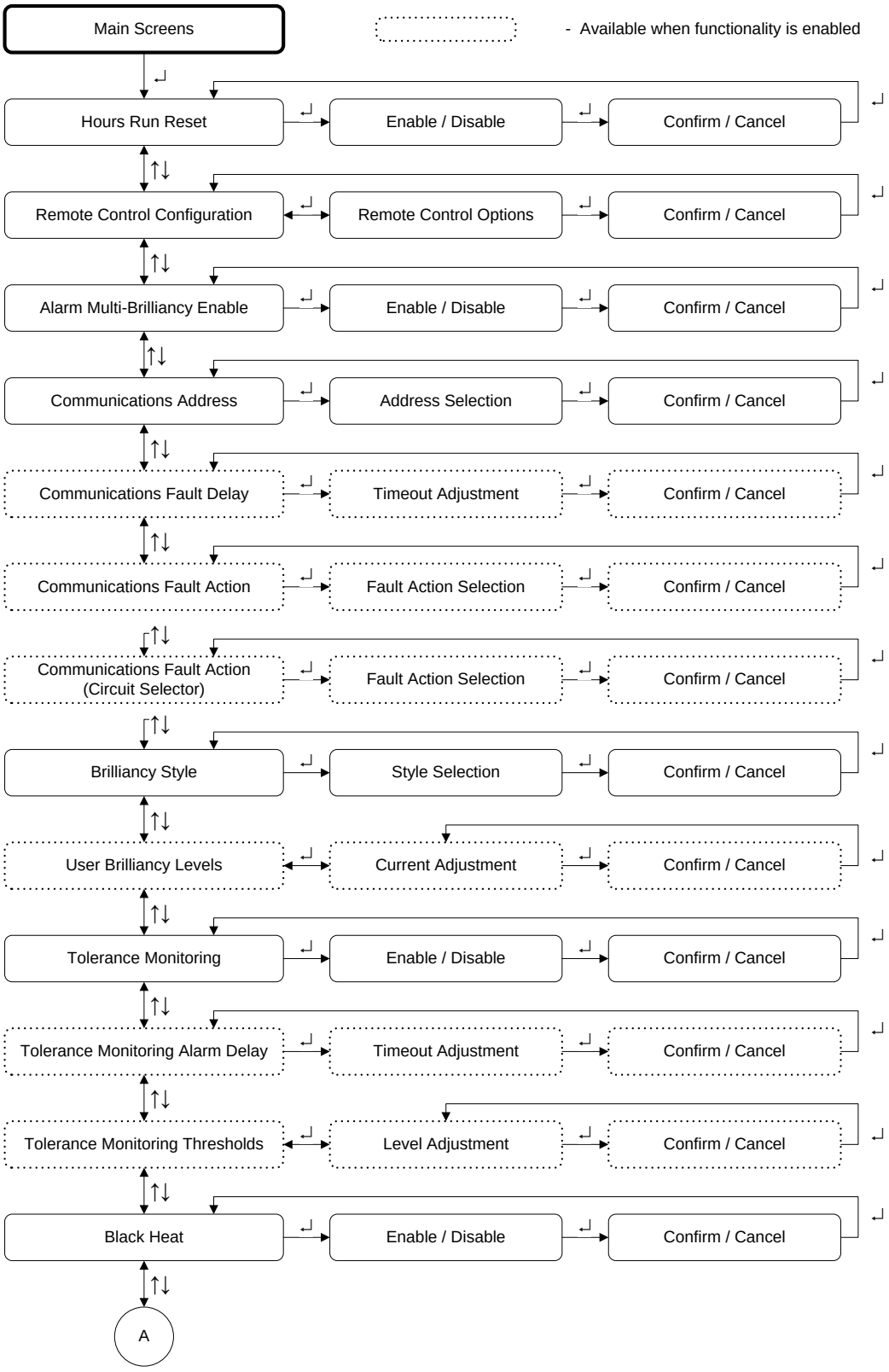
Turn the Rotary Menu Selector anticlockwise so that the arrow (→) moves to the bottom line (alongside ‘CONFIRM’), then press the selector again to confirm running of the test.

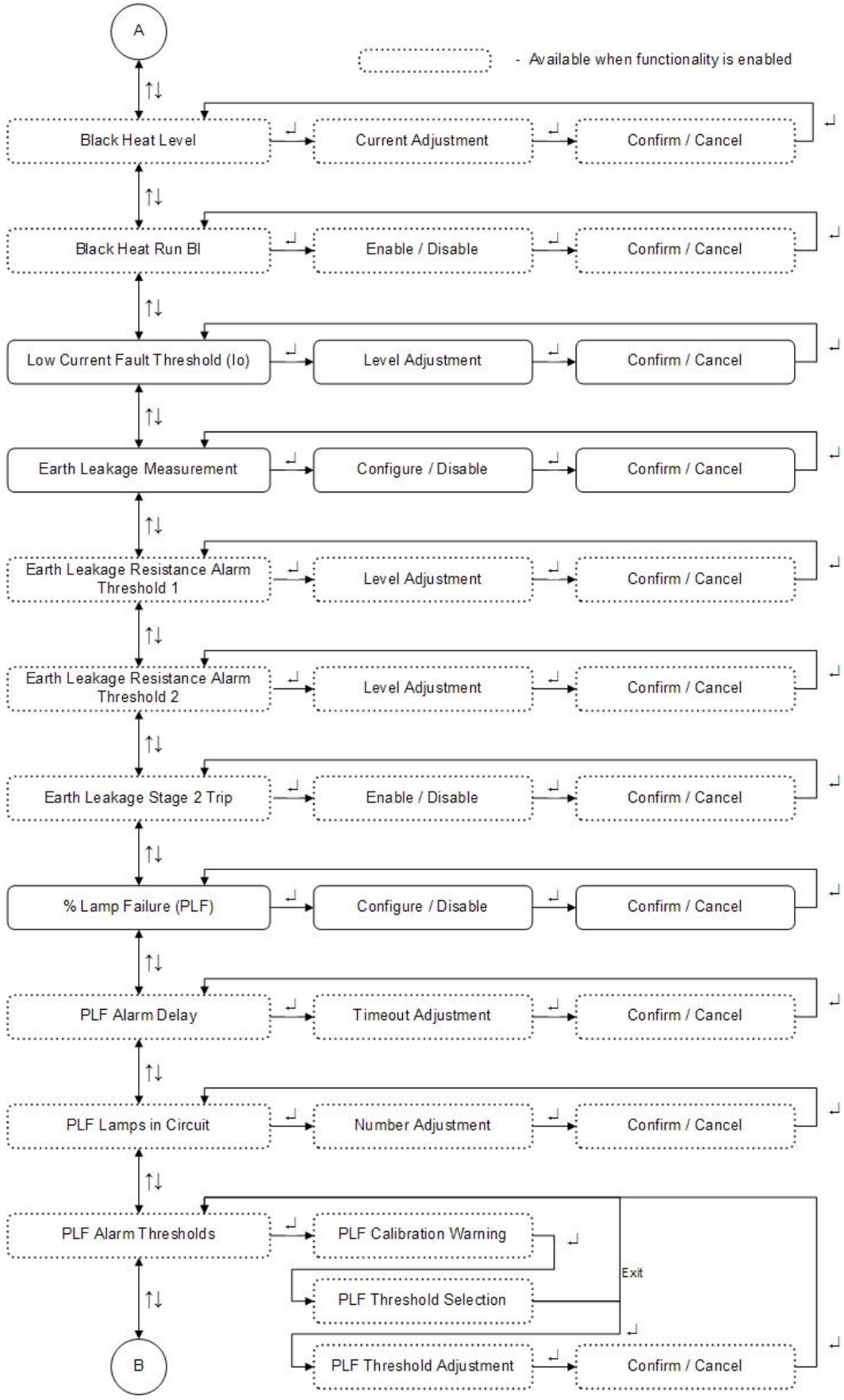
After the test is completed the new earth leakage resistance measurement will be displayed, and the test voltage used to obtain the measurement.

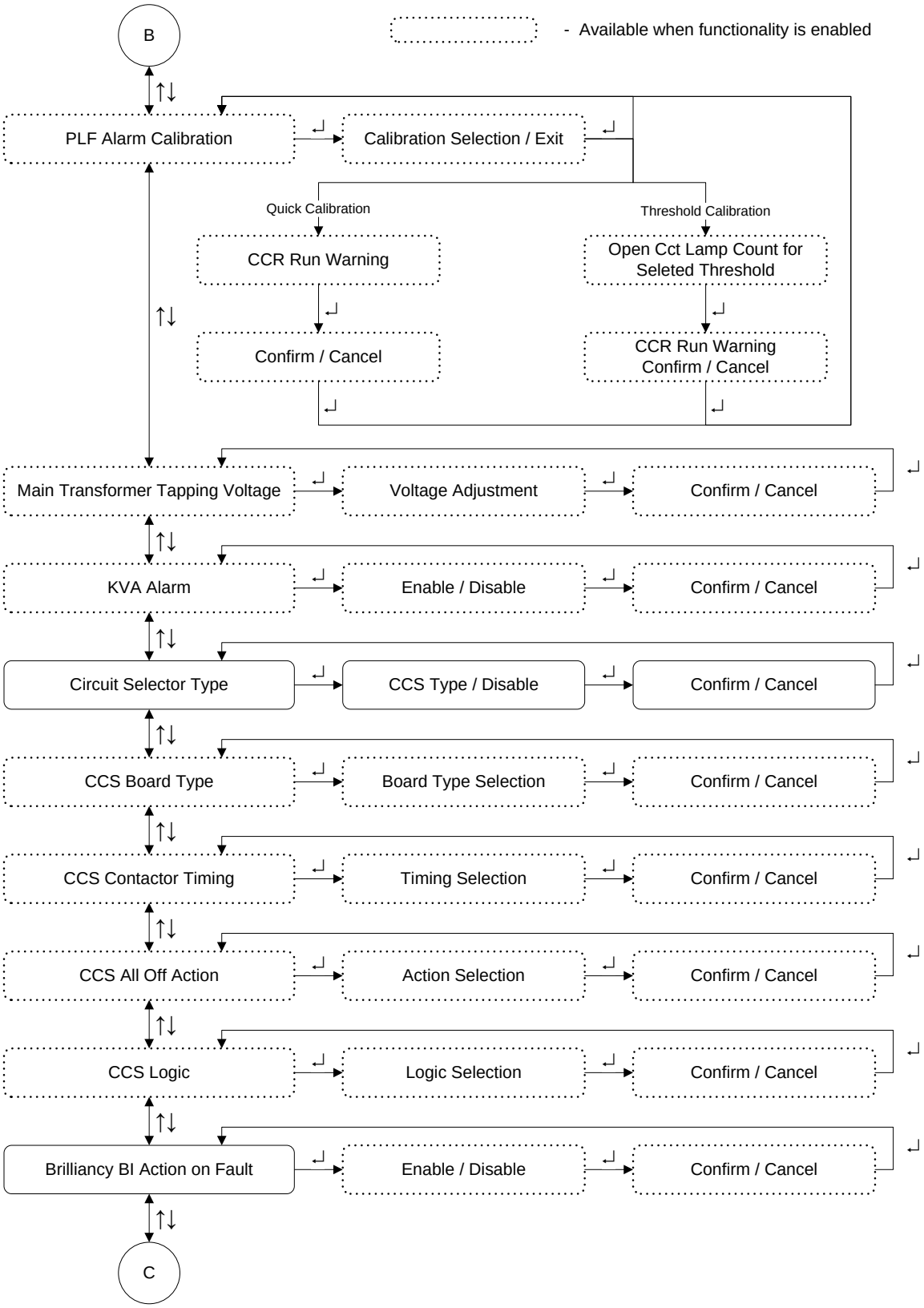
If the CCR is set to run, or if the Earth Leakage test type is set to ‘Continuous Analogue, the display will revert to showing the result of the 500V Earth Leakage resistance testing.

9.3 Menu 2 - Set-up Menu Screens

Menu 2 contains the Set-up and Operating Parameters to allow the user to configure the CCR. The Set-up Menu flowchart is shown in Figure 9-3 below:




A
- Available when functionality is enabled
Black Heat Level
Current Adjustment
Confirm / Cancel
Black Heat Run BI
Enable / Disable
Confirm / Cancel
Low Current Fault Threshold (Io)
Level Adjustment
Confirm / Cancel
Earth Leakage Measurement
Configure / Disable
Confirm / Cancel
Earth Leakage Resistance Alarm Threshold 1
Level Adjustment
Confirm / Cancel
Earth Leakage Resistance Alarm Threshold 2
Level Adjustment
Confirm / Cancel
Earth Leakage Stage 2 Trip
Enable / Disable
Confirm / Cancel
% Lamp Failure (PLF)
Configure / Disable
Confirm / Cancel
PLF Alarm Delay
Timeout Adjustment
Confirm / Cancel
PLF Lamps in Circuit
Number Adjustment
Confirm / Cancel
PLF Alarm Thresholds
PLF Calibration Warning
PLF Threshold Selection
Exit
PLF Threshold Adjustment
Confirm / Cancel
B


B
- Available when functionality is enabled
PLF Alarm Calibration
Calibration Selection / Exit
Quick Calibration
Threshold Calibration
CCR Run Warning
Open Cct Lamp Count for Seleted Threshold
Confirm / Cancel
CCR Run Warning Confirm / Cancel
Main Transformer Tapping Voltage
Voltage Adjustment
Confirm / Cancel
KVA Alarm
Enable / Disable
Confirm / Cancel
Circuit Selector Type
CCS Type / Disable
Confirm / Cancel
CCS Board Type
Board Type Selection
Confirm / Cancel
CCS Contactor Timing
Timing Selection
Confirm / Cancel
CCS All Off Action
Action Selection
Confirm / Cancel
CCS Logic
Logic Selection
Confirm / Cancel
Brilliancy BI Action on Fault
Enable / Disable
Confirm / Cancel
C

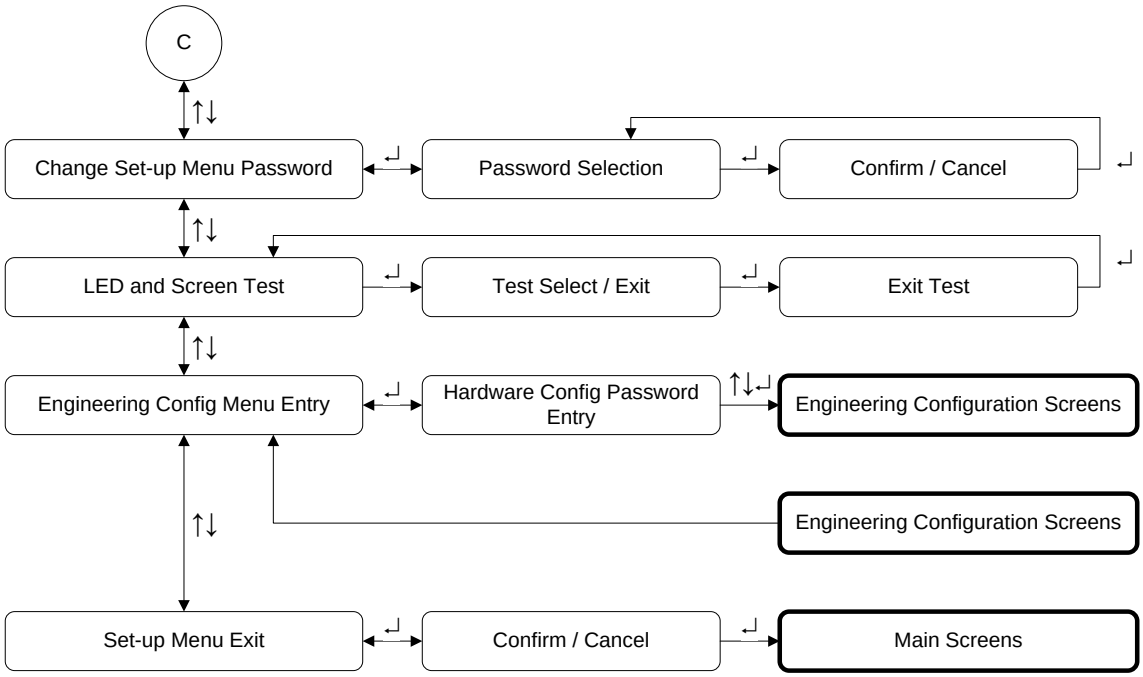


Figure 9-3 Set-up Menu Flowchart

Table 9-2 (below) gives a listing of the screens and the default settings for the operating parameters.

Parameter (Set-up Menu)	**Description**	**Default Setting**
RESET HOURS RUN AT MAX BRILL	Reset the hours run at maximum brilliancy.	
REMOTE CONTROL CONFIG?	Select between 3 Wire, 3 Wire & Command, BCD, BCD & Command, BCD Option 2, BCD Option 2 & Command, 8 Wire, 8 Wire & Command and Serial Communications. Note - selecting Serial Communications opens further screens (see below).	8 WIRE
ALARM ON MULTIPLE REMOTE INPUTS	Enable/ Disable the alarm which alerts if an illegal combination of remote control inputs is detected.	ENABLED
SERIAL COMMS ADDRESS	Select Address of unit for serial communications. (Only available if 'Communication' selected for remote control)	255 (ie, not selected)
SERIAL COMMS FAULT DELAY TIME	Select the delay time (in seconds) before the Communications fault is raised. (Only available if 'Communication' selected for remote control)	5 S
SERIAL COMMS FAULT ACTION	Select the action to be taken in the case of a communications fault. Select between 'CCR LATCH', 'CCR ON' and 'CCR OFF'. (Only available if 'Communication' selected as method for remote control).	CCR LATCH

Parameter (Set-up Menu)	Description	Default Setting
SERIAL COMMS FAULT CIRCUIT SELECTOR ACTION	Select the action to be taken by the circuit selector in the case of a communications fault. (Only available if 'Communication' selected as method for remote control and the CCR is configured to use an internal circuit selector)	Each individual circuit reverts to fail-safe condition; alternate CSS reverts to CCT1
BRILLIANCY LEVELS STYLE	Select between 5 Step Style 2, 3 Step Style 1, 8 Step UK CAP168, User Defined or User Defined DIO.	8 STEP UK CAP 168
USER BRILLIANCY LEVELS	When User Defined Brilliancy Levels are selected, allows adjustment of the current levels. (Note - the default levels are those of UK CAP 168).	Levels as per 8 STEP UK CAP 168
TOLERANCE MONITORING	Enable/ Disable internal Tolerance Monitoring Unit	ENABLED
TOLERANCE MONITOR ALARM DELAY TIME	Set the delay time (seconds) before an out of tolerance alarm is raised	15 S
TOLERANCE MONITOR ALARM THRESHOLDS	Program the Tolerance Monitoring alarm threshold levels. Note – the initial thresholds are taken from either the CAP 168 or 5 / 3 Step tolerance limits. Note - if the User Defined brilliancy (current levels) are changed from the default values, then the Tolerance Levels are automatically moved to be +/- 0.1A from the new operating current value.	
BLACK HEAT OUTPUT CURRENT IN REMOTE OFF	Enable/ Disable Black Heat operation.	DISABLED
BLACK HEAT OUTPUT CURRENT LEVEL	Set the Black Heat current level. (Available if Black Heat operation is enabled)	6.0A CCR = 1.5A 6.6A CCR = 1.5A 12A CCR = 2.5A 20A CCR = 5.75A
BLACK HEAT RUN BI RELAY ACTION	Enable the run back indication output when the CCR is running in 'black heat' (Available if Black Heat operation is enabled)	DISABLED
LOW CURRENT FAULT THRESHOLD (Io)	Sets the threshold for the minimum CCR output current below which the CCR will trip out. This is in addition to the hardware controlled open circuit detection.	1.5A
EARTH LEAKAGE MEASUREMENT CONFIG	Select between 'ENABLED', 'CONTINUOUS ENABLED' and 'DISABLED'. Note - optional AT699 Earth Leakage Detection Card required for this function to operate.	DISABLED
EARTH LEAKAGE ALARM THRESHOLD STAGE 1	Select the threshold of resistance for the 1st stage Earth Leakage Alarm.	10 MΩ
EARTH LEAKAGE ALARM THRESHOLD STAGE 2	Select the threshold of resistance for the 2nd stage Earth Leakage Alarm / Trip.	200 kΩ
EARTH LEAKAGE STAGE 2 TRIP	Configure the stage 2 Earth Leakage detector to give an alarm and continue to run (disabled), or to shutdown (trip) the CCR (enabled). For reasons of safety, trip should be enabled.	ENABLED

Parameter (Set-up Menu)	Description	Default Setting
% LAMP FAILURE (PLF) CONFIGURATION	Enable Percentage Lamp Failure monitoring; select between 'ENABLED', 'ENABLED FAA STYLE' or 'DISABLED'. Note - requires the optional AT1134 PLF / Power Measurement Card or AT1031 PLF / Power Analyser Card to be fitted for this feature to operate.	DISABLED
% LAMP FAILURE ALARM DELAY TIME	Set the delay time (seconds) before the Percentage Lamp Failure alarm is raised.	15 S
% LAMP FAILURE NUMBER OF LAMPS IN CCT	Enter the total number of lamps on the AGL circuit.	100
% LAMP FAILURE ALARM THRESHOLDS		
PLF S1 THRESHOLD	Enter the number of failed lamps to trigger a Stage 1 alarm.	5 (5%)
PLF S2 THRESHOLD	Enter the number of failed lamps to trigger a Stage 2 alarm.	10 (10%)
% LAMP FAILURE CALIBRATION		
PLF QUICK CALIBRATION	The 'QUICK' calibration should be only be performed with all lamps on the circuit in good condition (not open circuited); the system will then record the PLF error signal at all brilliancies with the lighting series loop circuit in this state. A pre-set margin (based on typical alarm measurements) will be added to give alarm threshold levels for failed lamps.	N/A
CAPTURE PLF ERR L1	Full Calibration routine - records the PLF error signal for the lamps out threshold level 1, at each brilliancy step.	N/A
CAPTURE PLF ERR L2	Full Calibration routine - records the PLF error signal for the lamps out threshold level 2, at each brilliancy step.	N/A
MAIN TRANSFORMER TAPPING VOLTAGE	To correctly monitor the output voltage, it is necessary to program the main transformer output voltage as connected (sum of each winding section connected).	0001V
KVA ALARM	When enabled generates an alarm if the CCR output load kVA drops below 90% of the peak measured load value for the brilliancy step in operation, for a period of 5 seconds. Note – requires that the AT1134 PLF / Power Measurement Card or AT1031 PLF / Power Analyser Card is fitted for this feature to operate.	DISABLED
CIRCUIT SELECTOR TYPE	Disables CSS operation or allows selection of Alternate or Multiway (2 - 6 way) CSS or of External CCS.	DISABLED
CIRCUIT SELECTOR MULTIWAY CARD TYPE	Allows selection of the Multi-Way Circuit Selector Back Indication Current Detection philosophy, depending on the version of PCB fitted.	AT661 REV C ONWARD

Parameter (Set-up Menu)	Description	Default Setting
CIRCUIT SELECTOR CONTACTOR TIMING	Set the time delay before re-energisation of the CCR after changeover of the internal circuit selector. Timings available: 15 mS – Vacuum Relay, 100mS, 150mS, 200mS, 250mS, 300mS, 500mS - Contactors. Set a delay time longer than the actual contactor / relay operating times. (Screen only available when circuit selector is enabled).	500mS CONTACTOR
CIRCUIT SELECTORS ALL OFF ACTION	Set to 'CCR OFF' to turn off the CCR when all circuits are selected to off, even though the CCR itself is selected to on. Alternatively, set to 'CCR ON' – the CCR will continue to operate with all outputs shorted. (Available when Multiway (2 to 6 way) Circuit Selector is enabled).	CCR OFF
CIRCUIT SELECTORS LOGIC	Select normally open or normally closed logic for correct fail-safe modes for each circuit of Multiway Circuit Selector. Note – the relays / contactors should first be wired to use normally open or normally closed contacts according to the fail-safe requirements of each field circuit (eg. stopbar – fail to on – normally open contact required), then the type of contact used for each circuit programmed via this screen.	N/O
BRILL BI RELAYS ACTIVE ON FAULT	Set to enabled to allow Brilliancy Level Back Indication Relays to remain energised under fault trip conditions.	DISABLED
CHANGE PASSWORD FOR MENU 2 SET-UP	Allows the password for entry to the Set-up menu to be changed.	atg
LED & SCREEN TESTS	Allows test of front panel LEDs and OLED screen.	N/A
ENTER MENU 3 ENGINEERING CONFIG	Allows entry to the Engineering Configuration Menu via the password entry screen.	eng
EXIT MENU 2 SET-UP MENU	Allows exit from the set-up menu.	

Table 9-2 Set-up Menu screens

9.3.1 Accessing Menu 2 - Set-up Menu

The Set-up Menu is accessed from the Main Menu by the use of a password. The CCR must first be set to 'Local Off' (by turning the left-hand side Brilliancy Control Selector switch SW1 to 'OFF'), then turn the right-hand side Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	E	N	T	E	R		M	E	N	U		2						↑	
	S	E	T	-	U	P		M	E	N	U								

Press the menu selector; the screen will change to:

	E	N	T	E	R		P	A	S	S	W	O	R	D				↑	↓
	F	O	R		M	E	N	U		2		-		S	E	T	-	U	P
→		a	a	a															

The left-hand arrow (→) moves down from the top line to be alongside the line for the password (this indicates that a parameter can be changed or selected). Enter the correct password one letter at a time using the Rotary Menu Selector to scroll up and down the alphabet, and then pressing selector button. **The default password is 'atg'.** If you enter the password incorrectly the screen will display:

	P	A	S	S	W	O	R	D		E	R	R	O	R				↑	↓
	F	O	R		M	E	N	U		2		E	N	T	R	Y			
→		R	E	T	R	Y													
		C	A	N	C	E	L												

You can re-try the password by first pressing the menu selector and then loading the correct password. There is no limit to the number of retries. If the correct password has been entered, the first screen of the Set-up Menu will be displayed:

→	R	E	S	E	T		H	O	U	R	S		R	U	N			↑	↓
	A	T		M	A	X		B	R	I	L	L							

Turn the Rotary Menu Selector anticlockwise to scroll down to the through the Set-up Menu screens. Pressing the selector will enter the sub-menu and allow the Set-up parameters to be changed as required.

For example, to set the Remote Control Configuration, scroll down to this screen:

→	R	E	M	O	T	E		C	O	N	T	R	O	L			↑	↓
	C	O	N	F	I	G	:											
		8		W	I	R	E											

Press the Rotary Menu Selector and then turn the selector anticlockwise to scroll down through the available settings to the desired Remote Control Input Configuration. The left-hand arrow (→) moves down from the top line alongside the available settings when in the selection mode.

	R	E	M	O	T	E		C	O	N	T	R	O	L				↑	↓
	C	O	N	F	I	G	:												
		8		W	I	R	E		&		C	M	D						
→		S	E	R	I	A	L		C	O	M	M	S						

With the arrow (→) against the desired configuration press the Rotary Menu Selector; the following screen will then be displayed:

	R	E	M	O	T	E		C	O	N	T	R	O	L				↑	↓
	C	O	N	F	I	G	:												
→		C	A	N	C	E	L		C	H	A	N	G	E					
		C	O	N	F	I	R	M		C	H	A	N	G	E				

Turn the Rotary Menu Selector anticlockwise so that the arrow (→) moves to the bottom line (alongside 'CONFIRM CHANGE'), then press the selector again to confirm the selection. Alternatively, if you do not wish to change the setting, press the selector when the arrow (→) is alongside 'CANCEL'.

	R	E	M	O	T	E		C	O	N	T	R	O	L				↑	↓
	C	O	N	F	I	G	:							:					
		C	A	N	C	E	L		C	H	A	N	G	E					
→		C	O	N	F	I	R	M		C	H	A	N	G	E				

The display will exit from the sub-menu and change to the following Menu 2 screen, confirming the new Remote Control Configuration:

→	R	E	M	O	T	E		C	O	N	T	R	O	L				↑	↓
	C	O	N	F	I	G	:												
		S	E	R	I	A	L		C	O	M	M	S						

All of the Set-up and Engineering Configuration screens and sub-menus operate in a similar manner.

To enter Menu 3 – Engineering Configuration, scroll down to the last but one screen within Menu 2:

→	E	N	T	E	R		M	E	N	U		3	-				↑	↓
	E	N	G	I	N	E	E	R	I	N	G		C	O	N	F	I	G	:

By pressing the selector, the password entry screen will then be shown. Refer to 9.4.1 for instructions on accessing the Engineering Configuration menu.

To exit Menu 2 and return to the Main Menu / Run screens, scroll down to the last screen within Menu 2 to display this:

→	E	X	I	T		M	E	N	U		2		-					↑	
	S	E	T	-	U	P		M	E	N	U								

Press the selector to show the cancel / confirm screen:

	E	X	I	T		M	E	N	U		2		-					↑	↓
	S	E	T	-	U	P		M	E	N	U								
→		C	A	N	C	E	L												
		C	O	N	F	I	R	M											

Turn the Rotary Menu Selector anticlockwise so that the arrow (→) moves to the bottom line (alongside ‘CONFIRM’), then press the selector again to confirm the exit from the menu.

9.3.2 Menu 2 - Set-up Menu Screens

To access the following screens, first turn the Brilliancy Control Selector switch SW1 to 'OFF', then enter Menu 2 - Set-up Menu, as described above in Section 9.3.1.

To exit Menu 2, scroll down to the last screen ‘EXIT MENU 2 SET-UP CONFIGURATION’, press the Rotary Menu Selector, then confirm exit. This is described at the end of section 9.3.1 above.

9.3.2.1 Reset Hours Run at Maximum Brilliancy

The CCR records the total number of Hours Run and the number of Hours Run at Maximum Brilliancy. It is possible from this sub-menu to reset to zero the counter for the Hours Run at Maximum Brilliancy; this may be desired after replacing the lamps in a circuit.

Enter the Set-up Menu as described in Section 9.3.1; the first screen within Menu 2 is:

→	R	E	S	E	T		H	O	U	R	S		R	U	N			↑	↓
	A	T		M	A	X		B	R	I	L	L							

To reset the ‘Hours Run at Max Brill’ press the Rotary Menu Selector and the screen will change to:

	R	E	S	E	T		H	O	U	R	S		R	U	N			↑	↓
	A	T		M	A	X		B	R	I	L	L							
→		C	A	N	C	E	L												
		C	O	N	F	I	R	M											

Turn the Rotary Menu Selector anticlockwise so that the arrow (→) moves to the bottom line (alongside 'CONFIRM'), then press the menu selector again to confirm the selection.

	R	E	S	E	T		H	O	U	R	S		R	U	N			↑	↓
	A	T		M	A	X		B	R	I	L	L							
		C	A	N	C	E	L												
→		C	O	N	F	I	R	M											

The Hours Run at Maximum Brilliancy counter will now be reset to zero.

9.3.2.2 Remote Control Configuration

The Remote Control of the CCR may be performed using 3-Wire Encoded, BCD Encoded, BCD Option 2, 8-Wire Brilliancy Selection or Serial Communications, all with or without Command On. (Note – 8-Wire control is normally used for 3 Step, 5 Step and 8 step applications). Refer to section 3.3 for more information on the different remote control wiring configurations. This section describes how to program the CCR for the required configuration.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	R	E	M	O	T	E		C	O	N	T	R	O	L				↑	↓
	C	O	N	F	I	G	:												
		8		W	I	R	E												

Press the selector; the cursor will move to the bottom line alongside the default or the previously selected option:

	R	E	M	O	T	E		C	O	N	T	R	O	L				↑	↓
	C	O	N	F	I	G	:												
		B	C	D		O	P	T	I	O	N		2		&		C	M	D
→		8		W	I	R	E												

Turn the Rotary Menu Selector clockwise to show the available options starting at the top of the list:

	R	E	M	O	T	E		C	O	N	T	R	O	L				↑	↓
	C	O	N	F	I	G	:												
→		E	X	I	T														
		3		W	I	R	E												

Turning the Rotary Menu Selector anticlockwise scrolls down through the other available settings:

	R	E	M	O	T	E		C	O	N	T	R	O	L		↑	↓
	C	O	N	F	I	G	:										
		3		W	I	R	E										
→		3		W	I	R	E		&		C	M	D				

	R	E	M	O	T	E		C	O	N	T	R	O	L		↑	↓
	C	O	N	F	I	G	:										
		B	C	D													
→		B	C	D		&		C	M	D							

	R	E	M	O	T	E		C	O	N	T	R	O	L		↑	↓
	C	O	N	F	I	G	:										
		B	C	D		O	P	T	I	O	N		2				
→		B	C	D		O	P	T	I	O	N		2		&	C	M	D

	R	E	M	O	T	E		C	O	N	T	R	O	L		↑	↓
	C	O	N	F	I	G	:										
		8		W	I	R	E										
→		8		W	I	R	E		&		C	M	D				

	R	E	M	O	T	E		C	O	N	T	R	O	L		↑	↓
	C	O	N	F	I	G	:										
		8		W	I	R	E		&		C	M	D				
→		S	E	R	I	A	L		C	O	M	M	S				

Refer to section 3.3 for more information on the different remote control wiring configurations.

Scroll up or down to set the arrow (→) alongside the desired setting, then press the Rotary Menu Selector to select that option.

The following screen will then be displayed:

	R	E	M	O	T	E		C	O	N	T	R	O	L		↑	↓
	C	O	N	F	I	G	:										
→		C	A	N	C	E	L		C	H	A	N	G	E			
		C	O	N	F	I	R	M		C	H	A	N	G	E		

Turn the Rotary Menu Selector anticlockwise so that the arrow (→) moves to the bottom line (alongside ‘CONFIRM CHANGE’), then press the selector again to confirm the selection.

The display will exit from the sub-menu and change to the following Menu 2 screen, confirming the new Remote Control Configuration:

→	R	E	M	O	T	E		C	O	N	T	R	O	L			↑	↓
	C	O	N	F	I	G	:											
		S	E	R	I	A	L		C	O	M	M	S					

9.3.2.3 Alarm enable for Multiple Remote Brilliancy

The CCR will give an alarm if more than one Remote Brilliancy Input is selected when using 8-Wire control. This screen allows the alarm to be disabled.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	A	L	A	R	M		O	N		M	U	L	T	I	P	L	E	↑	↓
	R	E	M	O	T	E		I	N	P	U	T	S	:					
		E	N	A	B	L	E	D											

Press the selector and the screen will change to show the following options:

	A	L	A	R	M		O	N		M	U	L	T	I	P	L	E	↑	↓
	R	E	M	O	T	E		I	N	P	U	T	S	:					
→		E	N	A	B	L	E	D											
		D	I	S	A	B	L	E	D										

Select between ‘ENABLED’ and ‘DISABLED’ by turning the Rotary Menu Selector to set the arrow (→) alongside the desired setting, then press the Rotary Menu Selector.

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits the submenu.

9.3.2.4 Communications Address

If the CCR is configured to use ‘Communication’ for remote control, the serial communications address must be set. (This must also be set if ‘read only’ communications are to be used for monitoring purposes).

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	S	E	R	I	A	L		C	O	M	M	S					↑	↓
	A	D	D	R	E	S	S	:										
		2	5	5														

Press the selector and the arrow (→) moves to the bottom line to indicate that the address can now be changed:

	S	E	R	I	A	L		C	O	M	M	S				↑	↓
	A	D	D	R	E	S	S	:									
→			1	6													

The required address can now be set; the valid range is between 001 and 254; the default value of 255 is outside of range and means that the address has not been set. Turn the Rotary Menu Selector to increment or decrement the value; turning anticlockwise past zero causes the value to loop round to 255.

Press the menu selector when the desired value is shown, the cancel / confirm change screen will now be shown. Turn the selector anticlockwise to set the arrow (→) alongside 'CONFIRM CHANGE' then press the selector again – this saves the new setting and exits the submenu.

Note: The communications protocol used is dependent upon which communications module is fitted to the CCR. These are described in the corresponding supplementary documentation: Micro 100/200 CCR Communications Card (Profibus), document number HS12-0-03-0*, Micro 100/200 CCR Communications Card (Modbus TCP / IP), document number HS12-0-09-0*, or Micro 100/200 CCR Communications Card (J-Bus), document number HS12-0-04-0*. (Note – the last digit indicates the document issue number).

9.3.2.5 Serial Communication Fault Delay Time

This screen allows adjustment of the time delay between a communications fault being detected and the alarm being activated. Note – this alarm can only be activated if the CCR is configured to use 'Communication' for remote control.

The default alarm delay time is 5 seconds.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	S	E	R	I	A	L		C	O	M	M	S					↑	↓
	F	A	U	L	T		D	E	L	A	Y		T	I	M	E	:	
		5		S														

Press the selector and the arrow (→) moves to the bottom line to indicate that the alarm delay time can now be changed:

	S	E	R	I	A	L		C	O	M	M	S					↑	↓
	F	A	U	L	T		D	E	L	A	Y		T	I	M	E	:	
→		5		S														

Turn the Rotary Menu Selector to increment or decrement the delay time. The valid range is between 2 and 15 seconds; turning anticlockwise below 2 causes the value to loop round to 15 seconds.

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside 'CONFIRM CHANGE' then press the selector again – this saves the new setting and exits the submenu.

9.3.2.6 CCR Action in the event of a Communications Fault

If the CCR is configured to use 'Communication' for remote control, the action to be taken in the event of a serial communications fault can be set using this screen.

The three possible fault actions are:

1) 'CCR - LATCH' (default setting). Selecting this means that the CCR will continue operating with the last instruction received before communication was lost.

2) 'CCR - ON'. This setting will, if the CCR was commanded to 'OFF' by the last instruction received but with a brilliancy level still selected, cause the CCR to turn back on at the brilliancy level of the last instruction. Note – it is always recommended to maintain selection of a brilliancy level from the control system even when the CCR is commanded to 'OFF'. If this is not done, then the CCR will not have a brilliancy level to return to, and will not switch back on in the event of communications failure.

   If the CCR was commanded to 'ON' by the last instruction received, it will continue operating with the previously selected brilliancy.

3) 'CCR - OFF'. Selecting this will turn the CCR off in the event of a communications fault.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the third screen:

→	S	E	R	I	A	L		C	O	M	M	S					↑	↓
	F	A	U	L	T		A	C	T	I	O	N	:					
		C	C	R		-		L	A	T	C	H						

Press the selector and the screen will change to show the following options:

	S	E	R	I	A	L		C	O	M	M	S					↑	↓
	F	A	U	L	T		A	C	T	I	O	N	:					
→		C	C	R		-		L	A	T	C	H						
		C	C	R		-		O	N									

Turning the Rotary Menu Selector anticlockwise scrolls down through the other available settings:

	S	E	R	I	A	L		C	O	M	M	S					↑	↓
	F	A	U	L	T		A	C	T	I	O	N	:					
		C	C	R		-		O	N									
→		C	C	R		-		O	F	F								

Scroll up or down to set the arrow (→) alongside the desired setting, then press the Rotary Menu Selector to select that option.

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside 'CONFIRM CHANGE' then press the selector again – this saves the new setting and exits the submenu.

Note: The fault actions described above apply only when the CCR Brilliancy Selector Switch is set to 'REM'.

9.3.2.7 Brilliancy Levels Style selection

The CCR may operate using output current levels specified by UK CAP 168, FAA or IEC/EN standards (see Table 4-2 through to Table 4-5 of Section 4.2), or levels defined by the user.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	B	R	I	L	L	I	A	N	C	Y		L	E	V	E	L	S	↑	↓
	S	T	Y	L	E	:												
		5		S	T	E	P		S	T	Y	L	E		2			

Press the selector; the arrow (→) will move down to be alongside the default or the previously selected option. Turn the Rotary Menu Selector clockwise to show the available options starting at the top of the list:

	B	R	I	L	L	I	A	N	C	Y		L	E	V	E	L	S	↑	↓
	S	T	Y	L	E	:												
→		5		S	T	E	P		S	T	Y	L	E		2			
		3		S	T	E	P		S	T	Y	L	E		1			

Turning the Rotary Menu Selector anticlockwise scrolls down through the other available settings:

	B	R	I	L	L	I	A	N	C	Y		L	E	V	E	L	S	↑	↓
	S	T	Y	L	E	:												
		8		S	T	E	P		U	K		C	A	P		1	6	8	
→		U	S	E	R		D	E	F	I	N	E	D						

	B	R	I	L	L	I	A	N	C	Y		L	E	V	E	L	S	↑	↓
	S	T	Y	L	E	:													
		U	S	E	R		D	E	F	I	N	E	D						
→		U	S	E	R		D	E	F	I	N	E	D		D	I	O		

Note - section 4.2 contains tables showing the pre-programmed current levels for each of the settings listed above, except for the 'USER DEFINED' levels. The setting of the customised User Defined Current levels is described in Section 9.3.2.8 below.

Turn the Rotary Menu Selector to scroll up or down to set the arrow (→) alongside the desired setting, then press to select that option.

The cancel / confirm change screen will now be shown. Turn the selector anticlockwise to set the arrow (→) alongside 'CONFIRM CHANGE' then press the selector again – this saves the new setting and exits the submenu.

9.3.2.8 Set User Defined Brilliancy Levels

This menu is available only if 'USER DEFINED' or 'USER DEFINED DIO' Brilliancy Levels Style have been selected from the previous menu.

For each of the eight User Defined Brilliancy Levels, the CCR output current can be programmed – in amps, to 2 decimal places - to any value between 5% and 100% of Maximum Output Current.

The default or initial current settings for User Defined Brilliancy Levels are those of the Brilliancy Levels Style that were previously selected, be it 5 Step Style 2, 3 Step Style 1 or 8 Step UK CAP 168.

The CCR can also be programmed to turn off on when a particular Brilliancy Level is selected. This is particularly useful when a number of CCRs are controlled in parallel by the same remote Brilliancy control lines, and it is required to turn off one or more CCRs on certain Brilliancy Levels. This is done by setting the User Current Level to '0.00A'. When this Brilliancy Level is selected in operation, the CCR will switch off and display one of the following, depending if the CCR is operating in Local or Remote, with the second line flashing:

L	O	C	A	L			B	R	I	L	L		1					↑	↓
U	S	E	R		B	R	I	L	L	I	A	N	C	Y		O	F	F	
O	P		C	U	R	R	E	N	T	:			0	.	0	0		A	
O	P		V	O	L	T	A	G	E	:						0		V	

R	E	M	O	T	E		B	R	I	L	L		1					↑	↓
U	S	E	R		B	R	I	L	L	I	A	N	C	Y		O	F	F	
O	P		C	U	R	R	E	N	T	:			0	.	0	0		A	
O	P		V	O	L	T	A	G	E	:						0		V	

This section describes how to set the User Current Levels.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	U	S	E	R		B	R	I	L	L	I	A	N	C	Y			↑	↓
	L	E	V	E	L	S	:												

Press the selector to show the following screen:

	U	S	E	R		B	R	I	L	L	I	A	N	C	Y			↑	↓
	L	E	V	E	L	S	:												
→		E	X	I	T														
		B	R	I	L	L		1	:			2	.	8	0		A		

To quit without making any changes, press the selector with the arrow (→) alongside ‘EXIT’, otherwise turn the Rotary Menu Selector anticlockwise by one click to show the following screen

	U	S	E	R		B	R	I	L	L	I	A	N	C	Y			↑	↓
	L	E	V	E	L	S	:												
		B	R	I	L	L		1	:			2	.	8	0		A		
→		B	R	I	L	L		2	:			3	.	4	0		A		

Turn the selector to set the arrow (→) alongside whichever Brilliancy Level it is necessary to adjust, then press the selector to enter the set screen:

	U	S	E	R		B	R	I	L	L	I	A	N	C	Y			↑	↓
	L	E	V	E	L	S													
		B	R	I	L	L	I	N	A	C	Y		1	:					
→		S	E	T		T	O	:			2	.	8	0		A			

Enter the desired Brilliancy (Current) Level one digit at a time using the Rotary Menu Selector to increase or decrease the value (the active digit will flash on and off), and then press the selector button to move to the next digit. Note – it is possible to set the current to 0.00A, which means the CCR turns off on this Brilliancy setting. Attempting to set a current a level above 0.00A but less than 5% of nominal output current causes the second and third decimal places to go to the minimal value of 5% as a starting point.

When all digits have been entered the cancel / confirm change screen will be displayed:

	U	S	E	R		B	R	I	L	L		L	V	L		1		↑	↓
	S	E	T		T	O	:			2	.	8	0		A				
→		C	A	N	C	E	L		C	H	A	N	G	E					
		C	O	N	F	I	R	M		C	H	A	N	G	E				

Turn the selector anticlockwise to set the arrow (→) alongside 'CONFIRM CHANGE' then press the selector again – this saves the new setting and exits this submenu to once again display the following screen:

	U	S	E	R		B	R	I	L	L	I	A	N	C	Y	↑	↓
	L	E	V	E	L	S	:										
		B	R	I	L	L		1	:			2	.	8	0	A	
→		B	R	I	L	L		2	:			3	.	4	0	A	

Turn the Rotary Menu Selector anticlockwise to move the arrow (→) alongside the next Brilliancy (Current) Level which is to be adjusted; the procedure is as described above.

Once all Brilliancy Levels have been set as required, from the first submenu turn the Rotary Menu Selector clockwise to move the arrow (→) alongside 'EXIT' then press the selector:

	U	S	E	R		B	R	I	L	L	I	A	N	C	Y	↑	↓
	L	E	V	E	L	S	:										
→		E	X	I	T												
		B	R	I	L	L		1	:			2	.	8	0	A	

This exits back to Menu 2, the Set-up menu.

9.3.2.9 Tolerance Monitoring Enable

Tolerance Monitoring checks that the CCR output current falls within the specified tolerance limits; this function is enabled or disabled as described below.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	T	O	L	E	R	A	N	C	E							↑	↓
	M	O	N	I	T	O	R	I	N	G	:						
		E	N	A	B	L	E	D									

Press the selector and the screen will change to show the following options, the arrow (→) will have moved down to be alongside the default or the previously selected option:

	T	O	L	E	R	A	N	C	E							↑	↓
	M	O	N	I	T	O	R	I	N	G	:						
→		E	N	A	B	L	E	D									
		D	I	S	A	B	L	E	D								

Select between 'ENABLED' and 'DISABLED' by turning the Rotary Menu Selector to set the arrow (→) alongside the desired setting, then press the Rotary Menu Selector.

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside 'CONFIRM CHANGE' then press the selector again – this saves the new setting and exits the submenu.

9.3.2.10 Tolerance Monitor Alarm Delay Time

This sub-menu is only available if Tolerance Monitoring has been enabled.

This screen allows adjustment of the time delay between the Tolerance Monitoring threshold being crossed, and the alarm being activated. The default delay time is 15 seconds.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	T	O	L	E	R	A	N	C	E		M	O	N	I	T	O	R	↑	↓
	A	L	A	R	M		D	E	L	A	Y		T	I	M	E	:		
		1	5		S														

Press the selector and the arrow (→) moves to the bottom line to indicate that the alarm delay time can now be changed:

	T	O	L	E	R	A	N	C	E		M	O	N	I	T	O	R	↑	↓
	A	L	A	R	M		D	E	L	A	Y		T	I	M	E	:		
→		1	5		S														

Turn the Rotary Menu Selector to increment or decrement the delay time. The valid range is between 5 and 60 seconds; turning anticlockwise below 5 causes the value to loop round to 60 seconds.

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside 'CONFIRM CHANGE' then press the selector again – this saves the new setting and exits the submenu.

9.3.2.11 Tolerance Monitor Alarm Threshold Levels

This sub-menu is only available if Tolerance Monitoring has been enabled.

The Tolerance Monitor Alarm Threshold levels are set by default according to the Brilliancy Levels Style selected (see Section 9.3.2.7 above), be it 5 Step FAA / IEC Style 2, 3 Step FAA / IEC Style 1 or 8 Step UK CAP 168. The Upper (MAX) and Lower (MIN) Limits are listed in the tables of Section 4.2.

The Tolerance Monitor Alarm Thresholds can be adjusted from the pre-set values, although it is not generally recommended to adjust these levels when the standard 5 Step FAA / IEC Style 2, 3 Step FAA / IEC Style 1 or 8 Step UK CAP 168 Brilliancy settings are used.

The default or initial Tolerance Monitor Alarm Threshold levels for 'User Defined' brilliancies are taken from one of the standard tables of Section 4.2; if the User Defined brilliancy (current levels) are changed from the default values, then the Tolerance Levels are automatically moved to be +/- 0.1A from the new operating current value. Further adjustments can be made via this sub-menu if necessary.

Adjustment of the Tolerance Monitor Alarm Thresholds is described below.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	T	O	L	E	R	A	N	C	E		M	O	N	I	T	O	R	↑	↓
	A	L	A	R	M		T	H	R	E	S	H	O	L	D	S			

Press the menu selector and the screen will change to:

	T	O	L	E	R	A	N	C	E		M	O	N	I	T	O	R	↑	↓
	A	L	A	R	M		T	H	R	E	S	H	O	L	D	S			
→		E	X	I	T														
		B	R	I	L	L		1		M	I	N			2	.	7	0	A

To quit without making any changes, press the selector with the arrow (→) alongside 'EXIT', otherwise turn the Rotary Menu Selector anticlockwise so that the arrow (→) moves alongside the threshold level that is to be adjusted:

	T	O	L	E	R	A	N	C	E		M	O	N	I	T	O	R	↑	↓
	A	L	A	R	M		T	H	R	E	S	H	O	L	D	S			
		E	X	I	T														
→		B	R	I	L	L		1		M	I	N			2	.	7	0	A

Press the selector to enter the set screen:

	T	O	L	E	R	A	N	C	E		M	O	N	I	T	O	R	↑	↓
	A	L	A	R	M		T	H	R	E	S	H	O	L	D	S			
		B	R	I	L	L		1		M	I	N		T	H	L	D		
→		S	E	T		T	O	:				2	.	7	0		A		

Enter the desired tolerance alarm threshold one digit at a time using the Rotary Menu Selector to increase or decrease the value (the active digit will flash on and off), and then press the selector button to move to the next digit. When all digits have been entered the cancel / confirm change screen will be displayed:

	B	R	I	L	L		1		M	I	N		T	H	L	D			
	S	E	T		T	O	:				2	.	7	0		A			
→		C	A	N	C	E	L		C	H	A	N	G	E					
		C	O	N	F	I	R	M		C	H	A	N	G	E				

Turn the selector anticlockwise to set the arrow (→) alongside 'CONFIRM CHANGE' then press the selector again – this saves the new setting and exits this submenu to once again display the following screen:

	T	O	L	E	R	A	N	C	E		M	O	N	I	T	O	R	↑	↓
	A	L	A	R	M		T	H	R	E	S	H	O	L	D	S			
		E	X	I	T														
→		B	R	I	L	L		1		M	I	N			2	.	7	0	A

Turn the Rotary Menu Selector anticlockwise to move the arrow (→) alongside the next tolerance threshold limit which is to be adjusted; the procedure is as described above.

Once all tolerance limits have been set as required, from the first submenu turn the Rotary Menu Selector clockwise to move the arrow (→) alongside 'EXIT' then press the selector:

	T	O	L	E	R	A	N	C	E		M	O	N	I	T	O	R	↑	↓
	A	L	A	R	M		T	H	R	E	S	H	O	L	D	S			
→		E	X	I	T														
		B	R	I	L	L		1		M	I	N			2	.	7	0	A

This exits back to Menu 2, the Set-up menu.

9.3.2.12 Black Heat Output Current in Remote Off

The CCR can be configured to give a 'Black Heat' low level output current when the CCR is set to 'Remote Off', in order to prevent condensation in tungsten halogen light fittings such as PAPI's.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	B	L	A	C	K		H	E	A	T		O	U	T	P	U	T	↑	↓
	C	U	R	R	E	N	T		I	N		R	E	M		O	F	F	:

Press the selector and the screen will change to show the following options, the arrow (→) will have moved down to be alongside the default or the previously selected option:

	B	L	A	C	K		H	E	A	T		O	U	T	P	U	T	↑	↓
	C	U	R	R	E	N	T		I	N		R	E	M		O	F	F	:
		E	N	A	B	L	E	D											
→		D	I	S	A	B	L	E	D										

Select between ‘ENABLED’ and ‘DISABLED’ by turning the Rotary Menu Selector to set the arrow (→) alongside the desired setting, then press the Rotary Menu Selector.

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits the submenu.

9.3.2.13 Black Heat Current Level

This sub-menu is only available if ‘Black Heat’ has been enabled. This section describes how to set the Black Heat current level.

The Black Heat current may be set as required to any value between 12% of the Maximum Output Current, and Maximum Output Current; the default value is 1.5A for a 6.0A or 6.6A regulator, or 2.5A for a 12A regulator.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	B	L	A	C	K		H	E	A	T		O	U	T	P	U	T	↑	↓
	C	U	R	R	E	N	T		L	E	V	E	L	:					
			1	.	5	0		A											

Press the selector and the arrow (→) moves to the bottom line to indicate that the current level can now be changed:

	B	L	A	C	K		H	E	A	T		O	U	T	P	U	T	↑	↓
	C	U	R	R	E	N	T		L	E	V	E	L	:					
→			1	.	5	0		A											

Enter the desired Brilliancy (Current) Level one digit at a time using the Rotary Menu Selector to scroll up and down, and then press the selector button. Note – it is not possible to load a value of less than 12% of the CCR maximum rated current, ie, 0.79A on a 6.60A regulator, or greater than the rated current.

When all digits have been entered the cancel / confirm change screen will be displayed:

	B	L	A	C	K		H	E	A	T		O	U	T	P	U	T	↑	↓
	C	U	R	R	E	N	T		L	E	V	E	L	:					
→		C	A	N	C	E	L		C	H	A	N	G	E					
		C	O	N	F	I	R	M		C	H	A	N	G	E				

Turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits this submenu.

9.3.2.14 Black Heat - Run Back Indication Relay Action

This sub-menu is only available if 'Black Heat' has been enabled.

The Run Back Indication Relay can be programmed to 'ENERGISED WITH BH' when the CCR is producing a 'Black Heat' output current in 'Remote Off', or not energised in this condition. The default setting is 'NOT ENERGISED', since the control system would normally interpret a 'Run' Back Indication signal as a fault when the CCR has been commanded to off via the remote control.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	B	L	A	C	K		H	E	A	T							↑	↓
	R	U	N		B	I		R	E	L	A	Y		A	C	T	I	O	N
		N	O	T		E	N	E	R	G	I	S	E	D				

Press the selector and the screen will change to show the following options; the arrow (→) will have moved down to be alongside the default or the previously selected option:

	B	L	A	C	K		H	E	A	T							↑	↓
	R	U	N		B	I		R	E	L	A	Y		A	C	T	I	O	N
		E	N	E	R	G	I	S	E	D		W	I	T	H		B	H	
→		N	O	T		E	N	E	R	G	I	S	E	D				

Select between 'ENERGISED WITH BH' and 'NOT ENERGISED' by turning the Rotary Menu Selector to set the arrow (→) alongside the desired setting, then press the Rotary Menu Selector.

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside 'CONFIRM CHANGE' then press the selector again – this saves the new setting and exits the submenu.

9.3.2.15 Low Current Fault Threshold Io

This screen is used to set the threshold for the minimum CCR output current below which the CCR will trip out. This provides a second type of open circuit protection, and is in addition to the hardware controlled open circuit detection.

Note – this trip threshold is not active for 'Black Heat' operation when the CCR is selected to 'Remote Off; only the hardware open circuit protection operates in this case.

For most conventional lighting circuits the default setting of 1.5A will give a suitable trip level in order to comply with the requirements of IEC 61820-3-2:2023; only if low current LED circuits are to be driven at currents below 1.5A (using 'User Defined Current' settings) will this trip level need to be reduced.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	L	O	W		C	U	R	R	E	N	T		F	A	U	L	T	↑	↓
	T	H	R	E	S	H	O	L	D		(	I	o	)	:				
	1	.	5	0	A														

Press the selector and the arrow (→) moves to the bottom line to indicate that the current level can now be changed:

	L	O	W		C	U	R	R	E	N	T		F	A	U	L	T	↑	↓
	T	H	R	E	S	H	O	L	D		(	I	o	)	:				
→	1	.	5	0	A														

Enter the desired Brilliancy (Current) Level one digit at a time using the Rotary Menu Selector to scroll up and down, and then press the selector button. Note – it is not possible to enter a value of less than 2.5% of the CCR maximum rated current, ie, 0.16A on a 6.60A regulator, or greater than 33% of the rated current.

When all digits have been entered the cancel / confirm change screen will be displayed:

	L	O	W		C	U	R	R	E	N	T		F	A	U	L	T	↑	↓
	T	H	R	E	S	H	O	L	D		(	I	o	)	:				
→		C	A	N	C	E	L		C	H	A	N	G	E					
		C	O	N	F	I	R	M		C	H	A	N	G	E				

Turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits this submenu.

9.3.2.16 Earth Leakage Resistance Measurement Configuration

The optional AT699 and AT709 Earth Leakage Measurement Cards provide an analogue measurement of the earth leakage resistance, ie, the resistance from the primary series loop to ground.

To view or change the first of the Earth Leakage System settings, enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	E	A	R	T	H		L	E	A	K	A	G	E					↑	↓
	M	E	A	S	U	R	E	M	E	N	T		C	O	N	F	I	G	:
		D	I	S	A	B	L	E	D										

The setting on this screen can be selected between ‘ENABLED’, ‘CONTINUOUS

ENABLED' and 'DISABLED'. However, if the optional AT699 and AT709 cards are not fitted to the CCR then this setting should be left as 'DISABLED'. If set to 'DISABLED', then the other Earth Leakage System set-up screens are not available.

Refer to Section 4.5 for a complete description of how to commission the Earth Leakage Resistance Measurement system, and Section 4.5.2 on programming the operating parameters.

9.3.2.17 Percentage Lamp Failure Detection Configuration

The AT1134 PLF & Power Measurement Card and AT1031 PLF & Power Analyser Card (one or the other will be fitted) generate an error signal that is a function of the Percentage of Lamps Failed on the AGL circuit. This error signal is fed to the microcontroller on the AT1030 Motherboard thus enabling a measurement of the number of open circuit lamps on the AGL circuit. (Note - the type of card fitted - AT1134 or AT1031 is selected in 'Menu 3 – Engineering Configuration Menu'.

To view or change the setting, first enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	%		L	A	M	P		F	A	I	L	U	R	E				↑	↓
	(	P	L	F	)		C	O	N	F	I	G	U	R	A	T	I	O	N
		E	N	A	B	L	E	D											

The PLF functionality will normally be set to 'ENABLED', but can also be set to 'ENABLED FAA STYLE' or to 'DISABLED'. Refer to Section 4.6 for a full description of how to configure the PLF system, and Figure 9-3 and Table 9-2 give a listing of the sub-menus associated with setting up the PLF system.

9.3.2.18 Main Transformer Tapping Voltage

To correctly monitor the output voltage and output load kVA of the CCR, the actual tapping voltage used on the Main CCR Output Transformer must be entered.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	M	A	I	N		T	R	A	N	S	F	O	R	M	E	R		↑	↓
	T	A	P	P	I	N	G		V	O	L	T	A	G	E	:			
					1	V													

Refer to Section 4.4.1 for more information.

9.3.2.19 KVA Alarm Enable

If 'Output Voltage Monitoring' is activated, then 'KVA Alarm' can also be enabled (this function is always enabled on FAA L-829 regulators). This generates an alarm if the CCR output load kVA drops below 90% of the peak measured load value for the brilliancy step in operation, for a period of 5 seconds.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	K	V	A		A	L	A	R	M	:								↑	↓
		D	I	S	A	B	L	E	D										

Refer to Section 4.4.2 for more information on this feature.

9.3.2.20 Internal Circuit Selector Switch Configuration (optional)

The optional Internal Circuit Selector Switch (CSS) is available in two formats:

i. Alternate Circuit Selector. This version switches the CCR output between two available AGL circuits, using changeover contacts from a contactor or vacuum relay.

ii. Multiway Circuit Selector. The number of circuits that can be controlled can be anywhere between 2 and 6 circuits. The Circuit Selector contactors or vacuum relays are arranged so that when the contact is closed, it shorts out the requisite section of the AGL circuit, thus switching off that section of lights.

If the CCR has been built with an Internal Circuit Selector fitted, then most of the settings for this will have been configured via the menu system during factory testing of the CCR. However, for Multiway Circuit Selectors the correct failsafe settings should be made by wiring to normally open or normally closed switch contacts, and programming this information in via the menu system. Refer to the supplementary Internal Circuit Selector Manual for a full description of how to configure the Circuit Selector, and a listing of the sub-menus available if the screen shown below has been configured for CSS operation.

To view the first Circuit Selector screen, enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following sub-menu:

→	C	I	R	C	U	I	T		S	E	L	E	C	T	O	R		↑	↓
	T	Y	P	E	:														
		D	I	S	A	B	L	E	D										

This screen allows configuration of the Internal Circuit Selector Switch type, and allows entry to the other CSS set-up screens.

9.3.2.21 Brilliancy Back Indication Relays Active On Fault

The control of the relays can be configured to either switch all relays off when a fatal alarm trips the regulator, or to continue to provide back indication of the demanded Brilliancy Level even during trip conditions.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	B	R	I	L	L		B	I		R	E	L	A	Y	S			↑	↓
	A	C	T	I	V	E		O	N		F	A	U	L	T	:			
		D	I	S	A	B	L	E	D										

Press the selector and the screen will change to show the following options; the arrow (→) will have moved down to be alongside the default or the previously selected option:

	B	R	I	L	L		B	I		R	E	L	A	Y	S			↑	↓
	A	C	T	I	V	E		O	N		F	A	U	L	T	:			
		E	N	A	B	L	E	D											
→		D	I	S	A	B	L	E	D										

Select between ‘ENABLED’ and ‘DISABLED’ by turning the Rotary Menu Selector to set the arrow (→) alongside the desired setting, then press the Rotary Menu Selector.

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits the submenu.

9.3.2.22 Change Password For Menu 2 Set-up

This section describes how to change the Menu 2, Set-up Menu entry password. Ensure that a record is kept of the new password.

Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to display the following screen:

→	C	H	A	N	G	E		P	A	S	S	W	O	R	D			↑	↓
	F	O	R		M	E	N	U		2		S	E	T	-	U	P	:	
		a	t	g															

Press the menu selector and the arrow (→) will move down to the bottom line, alongside the password, to indicate that this can now be changed:

	C	H	A	N	G	E		P	A	S	S	W	O	R	D			↑	↓
	F	O	R		M	E	N	U		2		S	E	T	-	U	P	:	
→		a	t	g															

Enter the new password one letter at a time using the Rotary Menu Selector to scroll up and down, and then press the selector button. After entering the final letter, the screen will change to:

	C	H	A	N	G	E		P	A	S	S	W	O	R	D			↑	↓
	F	O	R		M	E	N	U		2		S	E	T	-	U	P	:	
→		C	A	N	C	E	L		C	H	A	N	G	E					
		C	O	N	F	I	R	M		C	H	A	N	G	E				

Turn the selector anticlockwise to set the arrow (→) alongside 'CONFIRM CHANGE' then press the selector again – this saves the new password and exits the submenu.

9.3.2.23 LED and Screen Tests

The LEDs and the entire screen can be illuminated via this sub-menu for test purposes. Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to display the following screen:

→	L	E	D		&		S	C	R	E	E	N						↑	↓
	T	E	S	T	S														

Press the Rotary Menu Selector to show:

	L	E	D		&		S	C	R	E	E	N						↑	↓
	T	E	S	T	S														
→		E	X	I	T														
		L	E	D		T	E	S	T										

Turn the Rotary Menu Selector anticlockwise so that the arrow (→) moves alongside 'LED TEST'; pressing the selector turns on all three front panel LEDs. Pressing again turns them off.

Turn the Rotary Menu Selector anticlockwise so that the arrow (→) moves to the bottom line alongside 'SCREEN TEST'. Pressing the selector turns on all segments of the front panel OLED screen; pressing again turns them off and returns to the screen shown below.

	L	E	D		&		S	C	R	E	E	N						↑	↓
	T	E	S	T	S														
		L	E	D		T	E	S	T										
→		S	C	R	E	E	N		T	E	S	T							

Turn the Rotary Menu Selector anticlockwise so that the arrow (→) moves down alongside 'EXIT', then press the selector to exit this submenu.

	L	E	D		&		S	C	R	E	E	N						↑	↓
	T	E	S	T	S														
→		E	X	I	T														
		L	E	D		T	E	S	T										

9.3.2.24 Enter Menu 3 – Engineering Configuration Menu

Menu 3, the Engineering Configuration Menu, contains parameters that are set during factory testing of the CCR and would not normally require further changes.

The Engineering Configuration Menu is accessed from the Set-up Menu by the use of a password. Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to display the last but one screen:

→	E	N	T	E	R		M	E	N	U		3	-					↑	↓
	E	N	G	I	N	E	E	R	I	N	G		C	O	N	F	I	G	

Accessing the Engineering Configuration menu is described in Section 9.4.1.

9.3.2.25 Exit Menu 2 – Set-up Menu

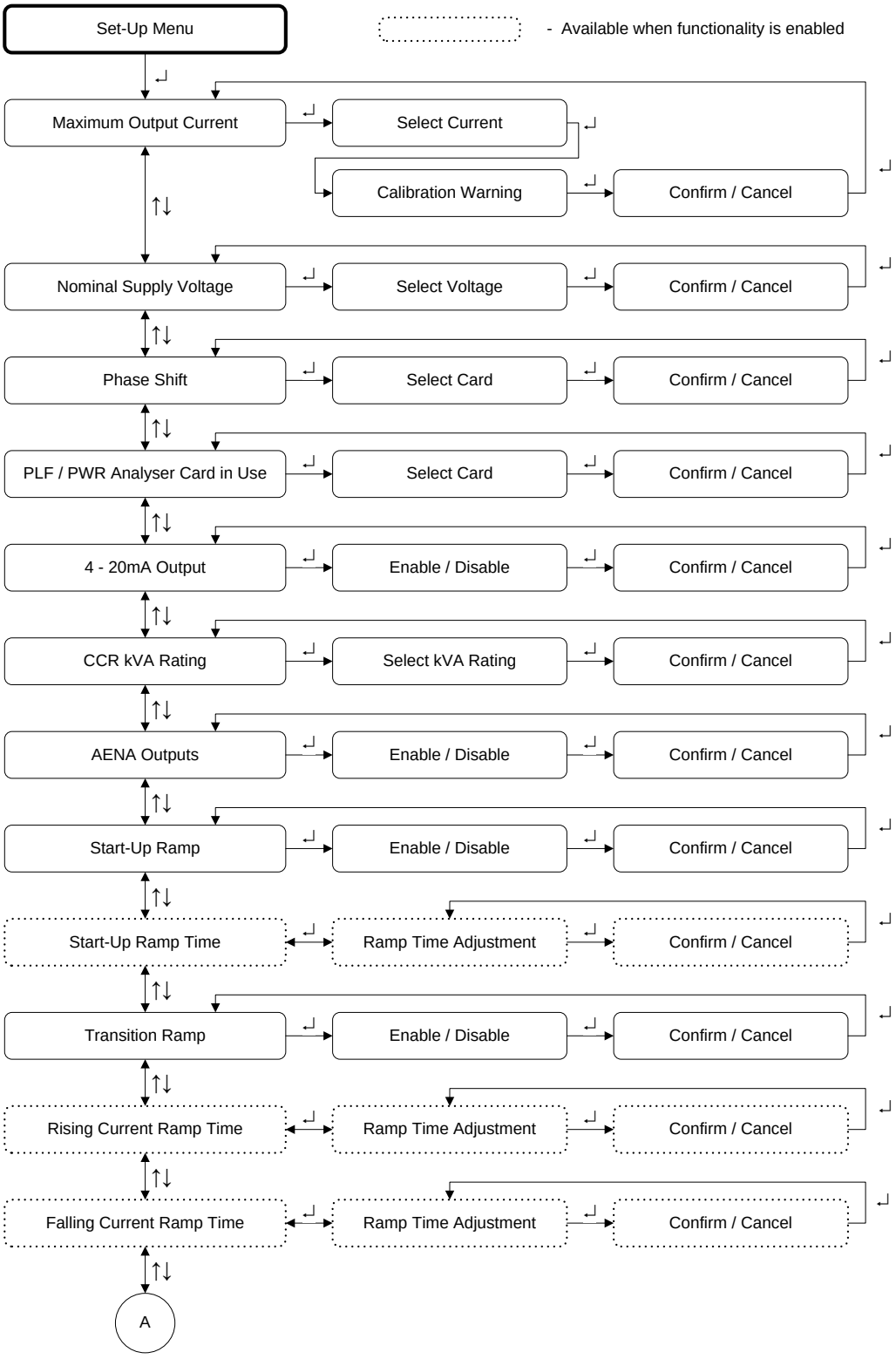
From within the Set-up Menu, turn the Rotary Menu Selector anticlockwise to display the final screen:

→	E	X	I	T		M	E	N	U		2		-					↑	
	S	E	T	-	U	P		M	E	N	U								

Press the menu selector; the cancel / confirm screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM’ then press the selector again – this will exit from the Set-up Menu.

9.4 Menu 3 - Engineering Configuration Menu

The Engineering Configuration Menu contains parameters that are set during factory testing of the CCR and would not normally require further changes. Enter this menu as described below. The flowchart of the Menu is shown in Figure 9-4 below:



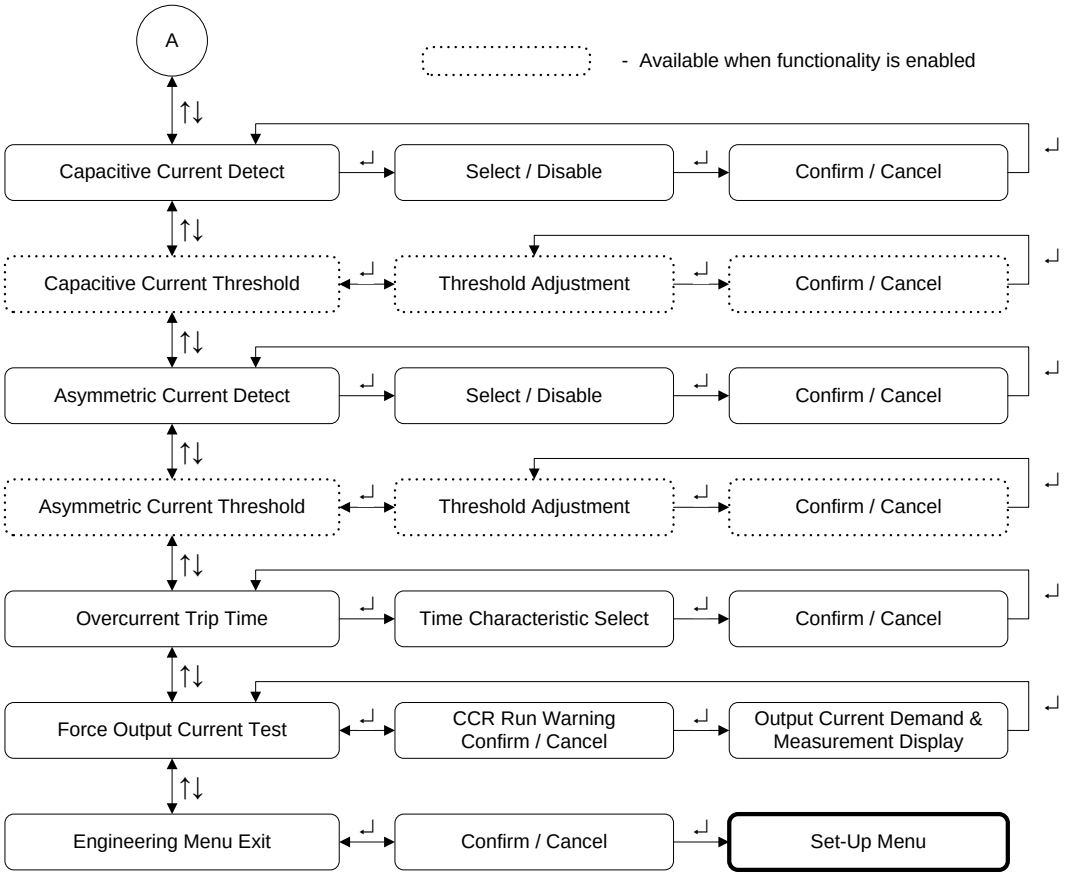


Figure 9-4 Engineering Configuration Menu Flowchart

Table 9-3 (below) gives a listing of the screens and the default settings for the operating parameters.

Parameter	**Description**	**Default Settings**
MAXIMUM OUTPUT CURRENT	Select CCR maximum output current. Available settings are 6.00, 6.60, 12.0 and 20.0A.	6.60A
NOMINAL SUPPLY VOLTAGE	Select the nominal supply voltage for which the CCR has been manufactured. Note - this will be indicated on the CCR nameplate.	415V
SINE WAVE DEMAND PHASE SHIFT	Allows for fine tuning of the phase shift between the supply voltage and CCR output current waveshape to minimise harmonic distortion of the supply current.	0 DEGREES
PLF & POWER MEASUREMENT / ANALYSER CARD TYPE FITTED	Allows selection between AT1031 PLF-PA Card, AT1134 PLF-PM Card or disabled	AT1134
AT1130 4-20mA MEASUREMENT TYPE	Set the measurement type for the optional AT1130 4-20mA Card to be either CCR output current or output power, and set the scaling of the measured parameter. Set to 'Disabled' if the card is not fitted.	DISABLED
CCR KVA RATING	Enter the kVA rating of the CCR.	15kVA
AENA OUTPUTS	Enables AENA I/O configuration (for Spanish market)	DISABLED

Parameter	Description	Default Settings
START-UP RAMP	The CCR can be programmed to gradually ramp up the output current to the selected level on start-up, in a set time period, rather than switch on directly at the selected level. Enable/ Disable Start Ramp.	DISABLED
START-UP RAMP TIME	Set the Current Ramp time for CCR start-up. (Only available if Start Up Ramp is enabled)	600ms
TRANSITION RAMP	The CCR can be programmed to gradually ramp up and ramp down the output current on switching transitions, with separate time periods selectable for ramp up and ramp down. (Note – this has no effect on the initial Start-up ramp time). Enable/ Disable Transition Ramp.	DISABLED
RISING CURRENT RAMP TIME	Set the Current Ramp time for rising output current transitions. (Note – this has no effect on the initial Start-up ramp time. This is only available if Transition Ramp is enabled)	600ms
FALLING CURRENT RAMP TIME	Set the Current Ramp time for falling output current transitions. (This is only available if Transition Ramp is enabled).	600ms
CAPACITIVE CURRENT DETECTION	Detection of capacitive current flow can be set to trip the CCR, cause a soft alarm but continue operating, or detection can be disabled. For reasons of safety, it should be set to trip the CCR since for circuits using primary series loop cable with an earth screen, an open circuit fault may not otherwise be detected due to current continuing to flow through the capacitance of the earth sheath.	TRIP
CAPACITIVE CURRENT THRESHOLD	Sets the threshold level for detection of capacitive current. The valid range is from 1 to 100; the lower the value the more sensitive is the detector. It can be desensitised if nuisance tripping is encountered.	30
ASYMMETRIC CURRENT DETECTION	This feature monitors for asymmetric conduction periods for each half cycle of the CCR output current. It can be programmed to give an alarm but continue operating in the event of detection of asymmetric current, or to trip the CCR, or it can be disabled altogether.	DISABLED
ASYMMETRIC CURRENT THRESHOLD	Sets the threshold level for detection of asymmetric current. The valid range is from 1 to 100; the lower the value the more sensitive is the detector. It can be desensitised if nuisance alarms / tripping is encountered, or made more sensitive if necessary.	10
OVERCURRENT TRIP TIME	Set the Overcurrent Trip Time characteristic: IEC/EN setting trips in less than 5 seconds for an overcurrent of 102.3%, FAA setting trips in less than 5 seconds for an overcurrent of 105%	IEC (102.3% < 5s)
FORCE OUTPUT CURRENT TEST MENU	Test use only - not to be used on live circuit. Allows manual control of output current in order to test the Overcurrent and Undercurrent trip points	CCR maximum output current
EXIT MENU 3 ENGINEERING CONFIG	Allows exit from the Engineering Configuration Menu.	

Table 9-3 CCR Engineering Configuration Screens

9.4.1 Accessing the Engineering Configuration Menu

Menu 3, the Engineering Configuration Menu, contains parameters that are set during factory testing of the CCR and would not normally require further changes.

The Engineering Configuration Menu is accessed from the Set-up Menu by the use of a password. Enter the Set-up Menu as described in Section 9.3.1, and turn the Rotary Menu Selector anticlockwise to display the last but one screen:

→	E	N	T	E	R		M	E	N	U		3					↑	↓
	E	N	G	I	N	E	E	R	I	N	G		C	O	N	F	I	G

Press the menu selector; the screen will change to:

	E	N	T	E	R		M	E	N	U		3					↑	↓
	E	N	G	I	N	E	E	R	I	N	G		C	O	N	F	I	G
→		a	a	a														

Enter the correct password one letter at a time using the Rotary Menu Selector to scroll up and down the alphabet, and then pressing selector button. **The default password is 'e n g'.** If you enter the password incorrectly the screen will display:

																	↑	↓
	P	A	S	S	W	O	R	D		E	R	R	O	R				
	F	O	R		M	E	N	U		3		E	N	T	R	Y		
→		R	E	T	R	Y												
		C	A	N	C	E	L											

You can re-try the password by first pressing the menu selector and then loading the correct password. There is no limit to the number of retries. If the correct password has been entered, the first screen of the Engineering Configuration Menu will be displayed:

→	M	A	X	I	M	U	M		O	U	T	P	U	T				↓
	C	U	R	R	E	N	T	:										
			6	.	6		A	M	P	S								

This sub-menu is described in Section 9.4.2 below.

Turn the Rotary Menu Selector anticlockwise to scroll down to the through the Engineering Configuration Menu screens. Pressing the selector will enter the sub-menu and allow the settings to be changed as required.

To exit from the Engineering Configuration Menu (Menu 3) and return to the Set-up Menu (Menu 2), scroll down to the last screen within Menu 3 to display this:

																	↑	
→	E	X	I	T		M	E	N	U		3							
	E	N	G	I	N	E	E	R	I	N	G		C	O	N	F	I	G

Press the selector to show the cancel / confirm screen:

	E	X	I	T		M	E	N	U		3						↑	
	E	N	G	I	N	E	E	R	I	N	G		C	O	N	F	I	G
→		C	A	N	C	E	L		E	X	I	T						
		C	O	N	F	I	R	M		E	X	I	T					

Turn the Rotary Menu Selector anticlockwise so that the arrow (→) moves to the bottom line (alongside 'CONFIRM'), then press the selector again to confirm the exit from the menu.

To exit Menu 2 and return to the Main Menu / Run screens, scroll down to the last screen within Menu 2 to display this:

→	E	X	I	T		M	E	N	U		2		-					↑	
	S	E	T	-	U	P		M	E	N	U								

Press the selector to show the cancel / confirm screen:

	E	X	I	T		M	E	N	U		2		-					↑	
	S	E	T	-	U	P		M	E	N	U								
→		C	A	N	C	E	L		E	X	I	T							
		C	O	N	F	I	R	M		E	X	I	T						

Turn the Rotary Menu Selector anticlockwise so that the arrow (→) moves to the bottom line (alongside 'CONFIRM'), then press the selector again to confirm the exit from the menu.

9.4.2 Engineering Configuration Menu Screens

9.4.2.1 Setting the CCR Maximum Output Current

This screen allows the Maximum Output Current (nominal output current) of the regulator to be programmed. This value is indicated on the CCR name plate - and would only need to be re-programmed for the reasons described in Section 10.2.2.

Enter the Engineering Configuration Menu as described in Section 9.4.1; the first screen shown will be:

→	M	A	X	I	M	U	M		O	U	T	P	U	T				↓
	C	U	R	R	E	N	T	:										
			6	.	6		A	M	P	S								

Press the selector and the screen will change to show the following current settings, with the arrow (→) shown alongside the default or the previously selected option:

S	E	T		M	A	X		O	P		C	U	R	R	:			↑	↓
		6	.	0	0		A	M	P	S									
→		6	.	6	0		A	M	P	S									
	1	2	.	0	0		A	M	P	S									

Turning the Rotary Menu Selector anticlockwise scrolls down to show the last available current setting:

S	E	T		M	A	X		O	P		C	U	R	R	:			↑	↓
		6	.	6	0		A	M	P	S									
→	1	2	.	0	0		A	M	P	S									
	2	0	.	0	0		A	M	P	S									

Turn the Rotary Menu Selector so that the arrow (→) moves alongside the required Maximum Output Current setting, then press the menu selector.

A warning screen will now be displayed:

→	W	A	R	N	I	N	G		-		C	H	A	N	G	I	N	G	
M	A	X		O	P		C	U	R	R		M	A	Y					
R	E	Q	U	I	R	E		S	T	Y	L	E		A	N	D			
T	R	A	N	S	F	O	R	M	E	R		R	E	C	O	N	F	I	G

The actual CCR output current rating cannot normally be changed (except between 6.00 and 6.60A) since this is fixed by the type of main transformer fitted. The other exception to this rule is for CCRs fitted with the range of dual wound 6.0 / 12.0A transformers, which can operate at 6.00 / 6.60A or 12.0A depending on the configuration of the secondary connections. (Refer to Section 4.3.2 for a description of how to configure the dual wound power transformers, Section 10.3.1 to configure the current measurement CT, and Section 10.2 for re-calibrating the CCR). Therefore, the Maximum Output Current programmed value should not be changed to a different range except where a 12A dual wound transformer is to be re-configured, OR if there has been corruption of the EEPROM memory and a loss of the previously programmed value.

Press the menu selector and the cancel / confirm change screen will be displayed:

	M	A	X	I	M	U	M		O	U	T	P	U	T				↑	↓
	C	U	R	R	E	N	T		S	E	T	T	I	N	G	:			
→		C	A	N	C	E	L		C	H	A	N	G	E					
		C	O	N	F	I	R	M		C	H	A	N	G	E				

Turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits this submenu.

9.4.2.2 Programming the CCR Nominal Supply Voltage

This screen allows the nominal supply voltage for which the CCR has been manufactured to be registered. Note - this voltage will be indicated on the CCR nameplate. Programming in this value is necessary for metering purposes on some models of CCR.

Enter the Engineering Configuration Menu as described in Section 9.4.1; the first screen shown will be:

→	M	A	X	I	M	U	M		O	U	T	P	U	T				↓
	C	U	R	R	E	N	T	:										
			6	.	6		A	M	P	S								

Press the selector and the screen will change to show the following current settings, with the arrow (→) shown alongside the default or the previously selected option:

S	E	T		M	A	X		O	P		C	U	R	R	:			↑	↓
		6	.	0	0		A	M	P	S									
→		6	.	6	0		A	M	P	S									
	1	2	.	0	0		A	M	P	S									

Turning the Rotary Menu Selector anticlockwise scrolls down to show the last available current setting:

S	E	T		M	A	X		O	P		C	U	R	R	:			↑	↓
		6	.	6	0		A	M	P	S									
→	1	2	.	0	0		A	M	P	S									
	2	0	.	0	0		A	M	P	S									

9.4.2.3 Selecting the type of PLF & Power Measurement / Analyser Card

Select the type of PLF and Power Measurement / Analyser Card fitted from the AT1031 PLF/PA Card or the AT1134 PLF/PM Card (default setting for the Micro 200+). Enter the Engineering Configuration Menu as described in Section 9.4.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

	P	L	F	/	P	W	R		A	N	A	L	Y	S	E	R		↑	↓
	C	A	R	D		T	Y	P	E		F	I	T	T	E	D	:		
		A	T	1	0	3	1		P	L	F	/	P	A		C	A	R	D
→		A	T	1	1	3	4		P	L	F	/	P	M		C	A	R	D

Turn the Rotary Menu Selector so that the arrow (→) moves alongside the required PLF Card type, then press the menu selector.

The cancel / confirm change screen will now be displayed:

	P	L	F	/	P	W	R		A	N	A	L	Y	S	E	R		↑	↓
	C	A	R	D		T	Y	P	E		F	I	T	T	E	D	:		
→		C	A	N	C	E	L		C	H	A	N	G	E					
		C	O	N	F	I	R	M		C	H	A	N	G	E				

Turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits this submenu.

9.4.2.4 Optional AT1130 4-20mA Measurement Type

Set the measurement type for the optional AT1130 4-20mA Card to be either CCR output current or output power, and set the scaling of the measured parameter. Set to 'Disabled' if the card is not fitted. Enter the Engineering Configuration Menu as described in Section 9.4.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	A	T	1	1	3	0			4	-	2	0	m	A				↑	↓
	M	E	A	S	U	R	E	M	E	N	T		T	Y	P	E	:		
		O	P		I	:		1	9	.	0	m	A	=	M	A	X		I

Press the selector and the screen will change to show the following, with the arrow (→) shown alongside the default or the previously selected option:

	A	T	1	1	3	0			4	-	2	0	m	A				↑	↓
	M	E	A	S	U	R	E	M	E	N	T		T	Y	P	E	:		
→		O	P		I	:		1	9	.	0	m	A	=	M	A	X		I
		O	P		I	:		1	9	.	3	6	m	A	=	1	2	A	

or scroll down further:

	A	T	1	1	3	0			4	-	2	0	m	A				↑	↓
	M	E	A	S	U	R	E	M	E	N	T		T	Y	P	E	:		
		O	P		P	:		1	9	m	A	=	R	A	T	E	D	K	W
→		D	I	S	A	B	L	E	D										

Turn the Rotary Menu Selector so that the arrow (→) moves alongside the required 4-20mA measurement type, then press the menu selector.

	A	T	1	1	3	0			4	-	2	0	m	A				↑	↓
	M	E	A	S	U	R	E	M	E	N	T		T	Y	P	E	:		
→		O	P		I	:		1	9	.	0	m	A	=	M	A	X		I
		O	P		I	:		1	9	.	3	6	m	A	=	1	2	A	

The cancel / confirm change screen will now be displayed:

	A	T	1	1	3	0			4	-	2	0	m	A				↑	↓
	M	E	A	S	U	R	E	M	E	N	T		T	Y	P	E	:		
→		C	A	N	C	E	L		C	H	A	N	G	E					
		C	O	N	F	I	R	M		C	H	A	N	G	E				

Turn the selector anticlockwise to set the arrow (→) alongside 'CONFIRM CHANGE' then press the selector again – this saves the new setting and exits this submenu.

9.4.2.5 Entering the CCR kVA Rating

The kVA rating of the CCR is entered via this screen. Enter the Engineering Configuration Menu as described in Section 9.4.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	C	C	R		k	V	A		R	A	T	I	N	G	:			↑	↓
		1	5		k	V	A												

Press the selector and the screen will change to show the following kVA settings, with the arrow (→) shown alongside the default or the previously selected option:

	C	C	R		k	V	A		R	A	T	I	N	G	:			↑	↓
		1	2	.	5		k	V	A										
→		1	5		k	V	A												

Turn the Rotary Menu Selector clockwise to show the first three of the available settings:

	C	C	R		k	V	A		R	A	T	I	N	G	:			↑	↓
→		1		k	V	A													
		2	.	5		k	V	A											
		4		k	V	A													

The available kVA settings are: 1.0, 2.5, 4.0, 5.0, 7.5, 10, 12.5 and 15.

Turn the Rotary Menu Selector so that the arrow (→) moves alongside the required kVA Rating, then press the menu selector. The cancel / confirm change screen will now be displayed:

	C	C	R		k	V	A		R	A	T	I	N	G	:			↑	↓
→		C	A	N	C	E	L		C	H	A	N	G	E					
		C	O	N	F	I	R	M		C	H	A	N	G	E				

Turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits this submenu.

9.4.2.6 AENA Outputs Enable

This screen allows selection of the Back Indication Relay configuration for CCRs built to meet the Spanish AENA standard.

Enter the Engineering Configuration Menu as described in Section 9.4.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	A	E	N	A		O	U	T	P	U	T	S	:					↑	↓
		D	I	S	A	B	L	E	D										

Press the selector and the screen will change to show the following options:

	A	E	N	A		O	U	T	P	U	T	S	:					↑	↓
→		E	N	A	B	L	E	D											
		D	I	S	A	B	L	E	D										

Select between ‘ENABLED’ and ‘DISABLED’ by turning the Rotary Menu Selector to set the arrow (→) alongside the desired setting, then press the Rotary Menu Selector.

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits the submenu.

9.4.2.7 Start-up Ramp Selection

This screen allows the selection of a CCR output current Start-up Ramp.

Enter the Engineering Configuration Menu as described in Section 9.4.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	S	T	A	R	T	-	U	P		R	A	M	P	:				↑	↓
		D	I	S	A	B	L	E	D										

Press the selector and the screen will change to show the following options:

	S	T	A	R	T	-	U	P		R	A	M	P	:				↑	↓
→		E	N	A	B	L	E	D											
		D	I	S	A	B	L	E	D										

Select between ‘ENABLED’ and ‘DISABLED’ by turning the Rotary Menu Selector to set the arrow (→) alongside the desired setting, then press the Rotary Menu Selector.

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside 'CONFIRM CHANGE' then press the selector again – this saves the new setting and exits the submenu.

When enabled, the default Start-up Ramp Time is 600ms. The time can be adjusted as described below.

9.4.2.8 Start-up Ramp Time

This screen, only available if the CCR output current Start-up Ramp is enabled, allows the Ramp Time to be set.

Note – the Ramp Time relates to the approximate time taken to go from zero to 100% current on start-up. If a lower Brilliancy is selected at Start-up, then the Ramp Time will be proportionally smaller.

After enabling the Start-up Ramp as described in Section 9.4.2.7 above, turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	S	T	A	R	T	-	U	P		R	A	M	P					↑	↓
	T	I	M	E	:														
	(	0		→		6	.	6	A	)									
			6	0	0		m	s											

Press the menu selector; the arrow in the top left-hand corner of the screen will move to the bottom line.

	S	T	A	R	T	-	U	P		R	A	M	P					↑	↓
	T	I	M	E	:														
	(	0		→		6	.	6	A	)									
→			6	0	0		m	s											

It is now possible to set the Ramp Time between 10 and 1600 milliseconds by turning the Rotary Menu Selector; when the desired value is shown press the menu selector.

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside 'CONFIRM CHANGE' then press the selector again – this saves the new setting and exits the submenu.

9.4.2.9 Transition Ramp

This screen allows the selection of a CCR output current 'Transition Ramp' on changes between output levels.

Enter the Engineering Configuration Menu as described in Section 9.4.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	T	R	A	N	S	I	T	I	O	N		R	A	M	P	:		↑	↓
		D	I	S	A	B	L	E	D										

Press the selector and the screen will change to show the following options:

	T	R	A	N	S	I	T	I	O	N		R	A	M	P	:		↑	↓
		E	N	A	B	L	E	D											
→		D	I	S	A	B	L	E	D										

Select between 'ENABLED' and 'DISABLED' by turning the Rotary Menu Selector to set the arrow (→) alongside the desired setting, then press the Rotary Menu Selector.

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside 'CONFIRM CHANGE' then press the selector again – this saves the new setting and exits the submenu.

When enabled, the default Transition Ramp Time is 600ms. The time can be adjusted as described below.

9.4.2.10 Transition Ramp – Rising Current Ramp Time

This screen, only available if the CCR output current Transition Ramp is enabled, allows the Rising Current Ramp Time to be set.

Note – the Rising Current Ramp Time relates to the approximate time taken to go from zero to 100% current. If a smaller current step is initiated, then the Ramp Time will be proportionally smaller.

After enabling the Transition Ramp as described in the section above, turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	R	I	S	I	N	G		C	U	R	R	E	N	T				↑	↓
	R	A	M	P		T	I	M	E	:									
	(	0		→		6	.	6	A	)									
			6	0	0		m	s											

Press the menu selector; the arrow in the top left-hand corner of the screen will move to the bottom line.

	R	I	S	I	N	G		C	U	R	R	E	N	T			↑	↓
	R	A	M	P		T	I	M	E	:								
	(	0		→		6	.	6	A	)								
→			6	0	0		m	s										

It is now possible to set the Rising Current Ramp Time between 10 and 1600 milliseconds by turning the Rotary Menu Selector; when the desired value is shown press the menu selector.

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside 'CONFIRM CHANGE' then press the selector again – this saves the new setting and exits the submenu.

9.4.2.11 Transition Ramp – Falling Current Ramp Time

This screen, only available if the CCR output current Transition Ramp is enabled, allows the Falling Current Ramp Time to be set.

Note – the Falling Current Ramp Time relates to the approximate time taken to go from 100% to zero current. If a smaller current step is initiated, then the Ramp Time will be proportionally smaller.

After enabling the Transition Ramp as described in the section above, turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	F	A	L	L	I	N	G		C	U	R	R	E	N	T		↑	↓
	R	A	M	P		T	I	M	E	:								
	(	6	.	6		→		0	A	)								
			6	0	0		m	s										

Press the menu selector; the arrow in the top left-hand corner of the screen will move to the bottom line.

	F	A	L	L	I	N	G		C	U	R	R	E	N	T		↑	↓
	R	A	M	P		T	I	M	E	:								
	(	6	.	6		→		0	A	)								
→			6	0	0		m	s										

It is now possible to set the Falling Current Ramp Time between 10 and 1600 milliseconds by turning the Rotary Menu Selector; when the desired value is shown press the menu selector.

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside 'CONFIRM CHANGE' then press the selector again – this saves the new setting and exits the submenu.

9.4.2.12 Capacitive Current Detection (Open Circuit)

For circuits using primary series loop cable with an earth screen, the standard open circuit detection circuitry may not be effective in detecting an open circuit fault due to current continuing to flow through the capacitance of the earth sheath of the cable. For this reason, an additional capacitive current detection monitor is included.

This menu allows setting of the operation of the capacitive current detection monitor. For reasons of safety the default setting is to trip the CCR in the event of capacitive current flow being detected, but the unit can also be programmed to give an alarm but continue operating, or the function can be disabled altogether.

Enter the Engineering Configuration Menu as described in Section 9.4.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	C	A	P	A	C	I	T	I	V	E							↑	↓
	C	U	R	R	E	N	T		D	E	T	E	C	T	I	O	N	:
		T	R	I	P													

Press the selector and the screen will change to show the following options; the arrow (→) will have moved down to be alongside the default or the previously selected option:

	C	A	P	A	C	I	T	I	V	E							↑	↓
	C	U	R	R	E	N	T		D	E	T	E	C	T	I	O	N	:
→		T	R	I	P													
		A	L	A	R	M												

Turn the Rotary Menu Selector anticlockwise to scroll down to show the other option:

	C	A	P	A	C	I	T	I	V	E							↑	↓
	C	U	R	R	E	N	T		D	E	T	E	C	T	I	O	N	:
		A	L	A	R	M												
→		D	I	S	A	B	L	E	D									

Select between ‘TRIP’, ‘ALARM’ and ‘DISABLED’ by turning the Rotary Menu Selector to set the arrow (→) alongside the desired setting, then press the Rotary Menu Selector. (The default setting is ‘TRIP’, and for reasons of safety and to maintain compliance with IEC/EN 61820-3-2:2023 this setting should be used).

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits the submenu.

9.4.2.13 Capacitive Current Detection Threshold

If nuisance tripping is encountered when the AGL circuit is not in fact open circuited, then it might be that the setting for the capacitive current detection circuit is too sensitive for the installation, in which case it can be adjusted as described below.

Note – this screen is not available if the capacitive current detection has been disabled.

Enter the Engineering Configuration Menu as described in Section 9.4.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	C	A	P	A	C	I	T	I	V	E							↑	↓
	C	U	R	R	E	N	T		T	H	R	E	S	H	O	L	D	:
			3	0														

Press the menu selector; the arrow in the top left-hand corner of the screen will move to the bottom line.

	C	A	P	A	C	I	T	I	V	E							↑	↓
	C	U	R	R	E	N	T		T	H	R	E	S	H	O	L	D	:
→			3	0														

Turn the Rotary Menu Selector to increment or decrement the value for the detection threshold. The valid range is from 1 to 100; the lower the value the more sensitive is the detector. Press the selector to enter the desired setting.

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits the submenu.

9.4.2.14 Asymmetric Current Detection

This feature monitors for asymmetric / unequal conduction periods for the positive and negative half cycles of the CCR output current.

This menu allows setting of the operation of the asymmetric current detection monitor. The default setting is ‘DISABLED’, but the unit can also be programmed to give an alarm but continue operating in the event of detection of asymmetric current, or to trip the CCR.

Enter the Engineering Configuration Menu as described in Section 9.4.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	A	S	Y	M	M	E	T	R	I	C							↑	↓
	C	U	R	R	E	N	T		D	E	T	E	C	T	I	O	N	:
		D	I	S	A	B	L	E	D									

Press the selector and the screen will change to show the following options; the arrow (→) will have moved down to be alongside the default or the previously selected option:

	A	S	Y	M	M	E	T	R	I	C							↑	↓
	C	U	R	R	E	N	T		D	E	T	E	C	T	I	O	N	:
		A	L	A	R	M												
→		D	I	S	A	B	L	E	D									

Turn the Rotary Menu Selector clockwise to scroll up to show the other option:

	A	S	Y	M	M	E	T	R	I	C						↑	↓
	C	U	R	R	E	N	T		D	E	T	E	C	T	I	O	N	:	
→		T	R	I	P														
		A	L	A	R	M													

Select between ‘TRIP’, ‘ALARM’ and ‘DISABLED’ by turning the Rotary Menu Selector to set the arrow (→) alongside the desired setting, then press the Rotary Menu Selector. (The default setting is ‘DISABLED’).

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits the submenu.

9.4.2.15 Asymmetric Current Detection Threshold

This screen is only available if the Asymmetric Current Detection is enabled, ie, the previous setting is for ‘ALARM’ or ‘TRIP’.

If nuisance alarms or trips are encountered, or the setting is not sensitive enough, then the threshold for detection can be adjusted as described below.

Enter the Engineering Configuration Menu as described in Section 9.4.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

	A	S	Y	M	M	E	T	R	I	C							↑	↓
	C	U	R	R	E	N	T		T	H	R	E	S	H	O	L	D	:	
			1	0															

Press the menu selector; the arrow in the top left-hand corner of the screen will move to the bottom line.

	A	S	Y	M	M	E	T	R	I	C							↑	↓
	C	U	R	R	E	N	T		T	H	R	E	S	H	O	L	D	:	
→			1	0															

Turn the Rotary Menu Selector to increment or decrement the value for the detection threshold. The valid range is from 1 to 100; the lower the value the more sensitive is the detector. Press the selector to enter the desired setting.

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits the submenu.

9.4.2.16 Overcurrent Trip Time

This screen is used to set the Overcurrent Trip Time characteristic, and is set during factory testing to give the correct trip delay to meet the requirements of either IEC 61820-3-2:2023 or the FAA Advisory Circular 150/5345-10. For the European

market, the IEC/EN settings are used, with the following trip times for a 6.6A regulator: 3 to 5 seconds for a current of 6.75A or more (102.3% of nominal), and less than 300ms for a current of 8.30A or more. Where the FAA standard is called up, the trip times are set to: 5 seconds for a 5% Over-current condition, and 1 second for 25% Over-current.

Enter the Engineering Configuration Menu as described in Section 9.4.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	O	V	E	R	C	U	R	R	E	N	T					↑	↓
	T	R	I	P		T	I	M	E	:							
		I	E	C		(	1	0	2	.	3	%		<		5	s	)	

Press the selector and the screen will change to show the following options; the arrow (→) will have moved down to be alongside the default or the previously selected option:

	O	V	E	R	C	U	R	R	E	N	T					↑	↓	
	T	R	I	P		T	I	M	E	:								
→		I	E	C		(	1	0	2	.	3	%		<		5	s	)	
		F	A	A		(	1	0	5	.	0	%		<		5	s	)	

Turn the Rotary Menu Selector to set the arrow (→) alongside the desired setting, then press the Rotary Menu Selector.

The cancel / confirm change screen will now be shown; turn the selector anticlockwise to set the arrow (→) alongside ‘CONFIRM CHANGE’ then press the selector again – this saves the new setting and exits the submenu.

9.4.2.17 Force Output Current Test Menu

This screen allows the operator to directly control the CCR output current level. The current can be increased above the normal Maximum Output Current value in order to test the over-current Trip Point and Trip Time, or reduced below normal running current levels.

The testing of the over-current detection circuit is, however, part of the factory tests, and would not normally be done by the user. IT SHOULD NOT TO BE PERFORMED ON A LIVE AGL CIRCUIT.

Refer to Section 10.3.2, Checking the Over-current Trip Point and Trip Delay Time, for a full description of the test method.

Enter the Engineering Configuration Menu as described in Section 9.4.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	F	O	R	C	E		O	U	T	P	U	T					↑	↓
	C	U	R	R	E	N	T		T	E	S	T		M	E	N	U	:	

Press the menu selector and the following warning screen will be displayed:

C	C	R		O	U	T	P	U	T		W	I	L	L				↑	↓
E	N	E	R	G	I	S	E												
→		C	A	N	C	E	L												
		C	O	N	T	I	N	U	E										

Turn the selector anticlockwise to set the arrow (→) alongside ‘CONTINUE’ then press the selector again to enter the test screen:

F	O	R	C	E		O	U	T	P	U	T		C	U	R	R	E	N	T
→	S	T	O	P															
	I		D	E	M	A	N	D	:						6	.	6	0	A
	I		M	E	A	S	U	R	E	D	:				6	.	6	0	A

The CCR will turn on at the nominal maximum output current level. Turn the Rotary Menu Selector to increase or decrease the ‘I DEMAND’ to set the CCR output current to the desired level for the test that is being run.

Press the menu selector to stop the test, ie, to turn the CCR off.

If during the test a fault occurs, for example an overcurrent trip during the overcurrent test, then the following screen will be shown:

F	O	R	C	E		O	U	T	P	U	T		C	U	R	R	E	N	T
→	R	E	S	E	T		F	A	U	L	T		&		E	X	I	T	
	I		D	E	M	A	N	D	:						6	.	8	0	A
	I		M	E	A	S	U	R	E	D	:				0	.	0	0	A

Pressing the menu selector will reset the fault(s) and exit this screen and revert to the entry screen:

→	F	O	R	C	E		O	U	T	P	U	T						↑	↓
	C	U	R	R	E	N	T		T	E	S	T		M	E	N	U	:	

If the test screen is then re-entered the ‘I DEMAND’ will start from the last value used; 6.80A in this example. The overcurrent test can therefore be conducted with the CCR output starting immediately at the correct test level, and so the time taken to trip at this current level can be accurately recorded without a delay to adjust the current level.

9.5 Fault Screen Listings

All faults are logged by the Microcontroller on the AT1030 Motherboard and will result in an appropriate fault screen being displayed. The run screen will indicate that a fault is present, whilst scrolling down (by turning the Rotary Menu Selector).to the second screen will indicate what the fault actually is. The fault screens are listed in Table 9-4.

If more than one fault has been registered, the fault screen with the highest priority will be the one normally shown. However, it is possible to scroll down to view the other faults by turning the Rotary Menu Selector.

The fault screen will continue to be displayed even if the fault is no longer present, all except for an External Communications fault which auto-resets. To clear a fault screen, press the Rotary Menu Selector at the moment that the fault screen is displayed and follow the instructions on the screen. If the fault is still present, the fault screen cannot be reset.

Note - if the screen indicates ‘Verify Failure’ on power up, refer to Section 12.1

Table 9-4 below gives a listing of the Fault Screens and a description of each fault. Refer also to Table 12-1 - CCR Fault Finding.

Fault Screen	**Description**
Open Circuit	Series loop open circuit, possibly with capacitive load current detected, or main CCR transformer output voltage taps set too low. Door interlock (optional) preventing CCR from operating, or thyristor stack fuse failed (if fitted – depends on CCR specification)
GAL / Open Circuit Fault	IGBT Control fault or series loop open circuit.
Under Current	Lamp Loop Live fault. Little or no CCR output current.
Over Current	CCR output current overload fault
Supply Under Voltage	CCR supply voltage drops below 75% of nominal for more than 1 second
Supply Over Voltage	Supply above 115% of nominal
Stage 2 Percentage Lamp Failure	The number of failed lamps on the field circuit exceeds the Stage 2 Percentage Lamp Failure threshold
Stage 1 / FAA Degraded Mode Percentage Lamp Failure	The number of failed lamps on the field circuit exceeds the Stage 1 Percentage Lamp Failure threshold. (FAA Type Selected: Running in Degraded Mode)
Tolerance Monitoring Under Current	CCR output current less than lower tolerance limit for the selected brilliancy
Tolerance Monitoring Over Current	CCR output current greater than upper tolerance limit for the selected brilliancy
Stage 2 Earth Leakage	The resistance to earth of the series loop circuit is less than the threshold level for the Stage 2 Earth Leakage Fault Detector. (Note Stage 2 Earth Leakage indicates a higher leakage current flow than Stage 1)
Stage 1 Earth Leakage	The resistance to earth of the series loop circuit is less than the threshold level for the Stage 1 Earth Leakage Fault Detector.
Transformer Over Temperature Shutdown	CCR Shutdown due to Main Transformer over temperature (only available for certain CCR build types)

Fault Screen	Description
Transformer Over Temperature Warning	Main Transformer Over Temperature warning (only available for certain CCR build types)
Heatsink Over Temperature Shutdown	CCR Shutdown due to IGBT heatsink over temperature
Heatsink Over Temperature Warning	IGBT heatsink Over Temperature warning
Run into Short Circuit	The CCR has been running with the output load in a short circuit condition for 30 seconds
Multiple Remote Brilliancy Inputs	More than one Remote Brilliancy Input activated. Only applicable for 8-Wire Remote Brilliancy Control
KVA	CCR output kVA drops below 90% of the peak measured load value for whichever brilliancy step is in operation, for a period of 5 seconds.
Communications	The Internal and/or External Communications have failed. Notes: • The fault reported will be internal if the communications between the microprocessor board and the communications adaptor have failed, or external if the failure is with the external bus (e.g. Profibus, Modbus TCP/IP). • Priority is given to reporting internal communications faults. External faults are automatically reset.
Capacitive Current Fault / Alarm	• Series loop open circuit, with capacitive load current detected. Series loop cables with an earthing sheaf can be prone to capacitive current flow, providing a current path even with a break in the series loop circuit.
Asymmetric Current Fault / Alarm	Detection of asymmetric conduction periods for the positive and negative half cycles of the CCR output current.
Main Contactor Fail	Main contactor not energising or contactor auxiliary fault
Door Interlock Fault	Door interlock open (if these are fitted).
Memory Fault	AT1030 Motherboard FRAM memory fault.
PLF/PA Error	Fault reported from the optional AT1031 power analyser card
General Fault	CCR Microcontroller (Watchdog) fault or Main Control Card Common fault

Table 9-4 Fault Screens

10 Maintenance, Hardware Configuration and Calibration

10.1 Introduction

Routine maintenance is generally confined to those items listed in the table below, however the period between maintenance work may need to be reduced according to the installation conditions.

Maintenance	Period
• Visual examination for damage, discolouration / heating of cable connections • Check all connections for tightness, including cabinet earth connection • Check continuity of CCR cabinet earth studs to substation earth	6 Monthly
• Visual examination for damage, discolouration / heating of cable connections • Check all connections for tightness, including cabinet earth connection • Check continuity of CCR cabinet earth studs to substation earth • Clean out any dust which may have built up • Verify CCR output current level using high quality in-line true RMS ammeter	Annually

Table 10-1 Routine maintenance

If a fault should develop it will first be necessary to determine if a fault lies in the regulator or with its associated field circuit. See Section 12 of this manual for a fault-finding guide.

10.1.1 Location of main components of the Micro 200+

The following photographs show the main components of the Micro 200+ CCR:

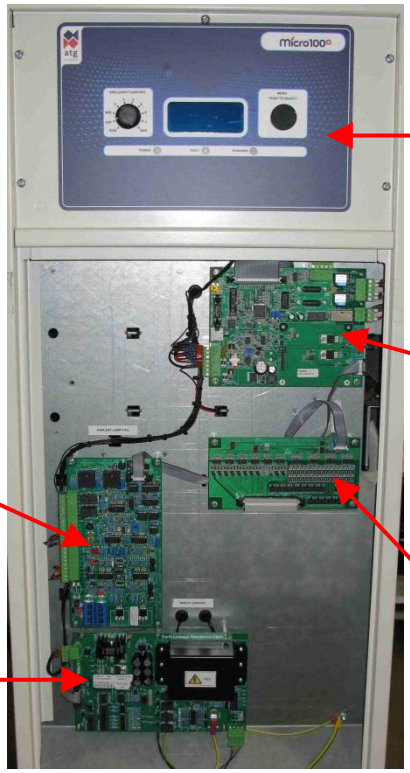


Figure 10-1 Control cards behind front door

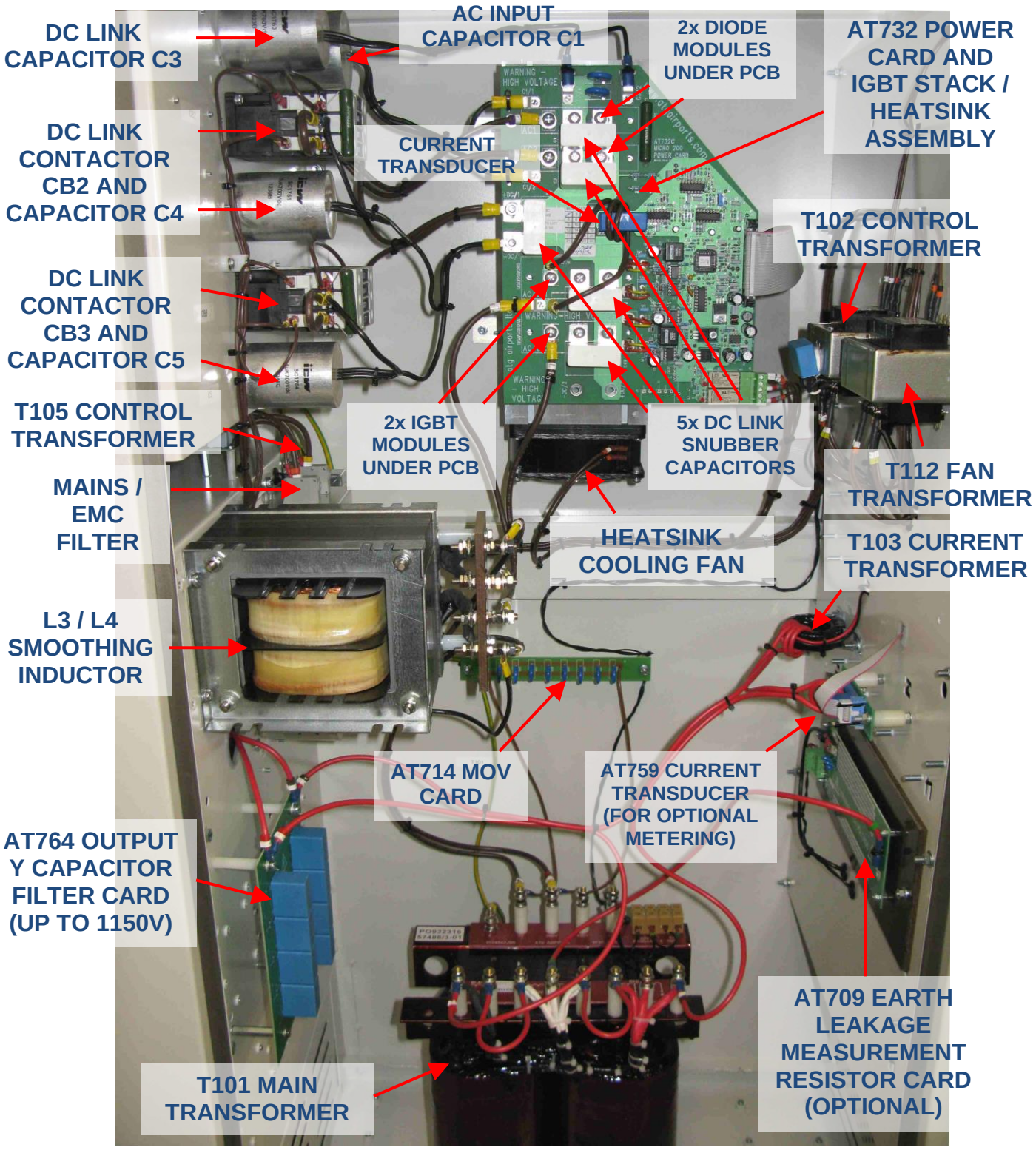


Figure 10-2 Components fitted in HT cubicle – CCRs up to 25A supply current

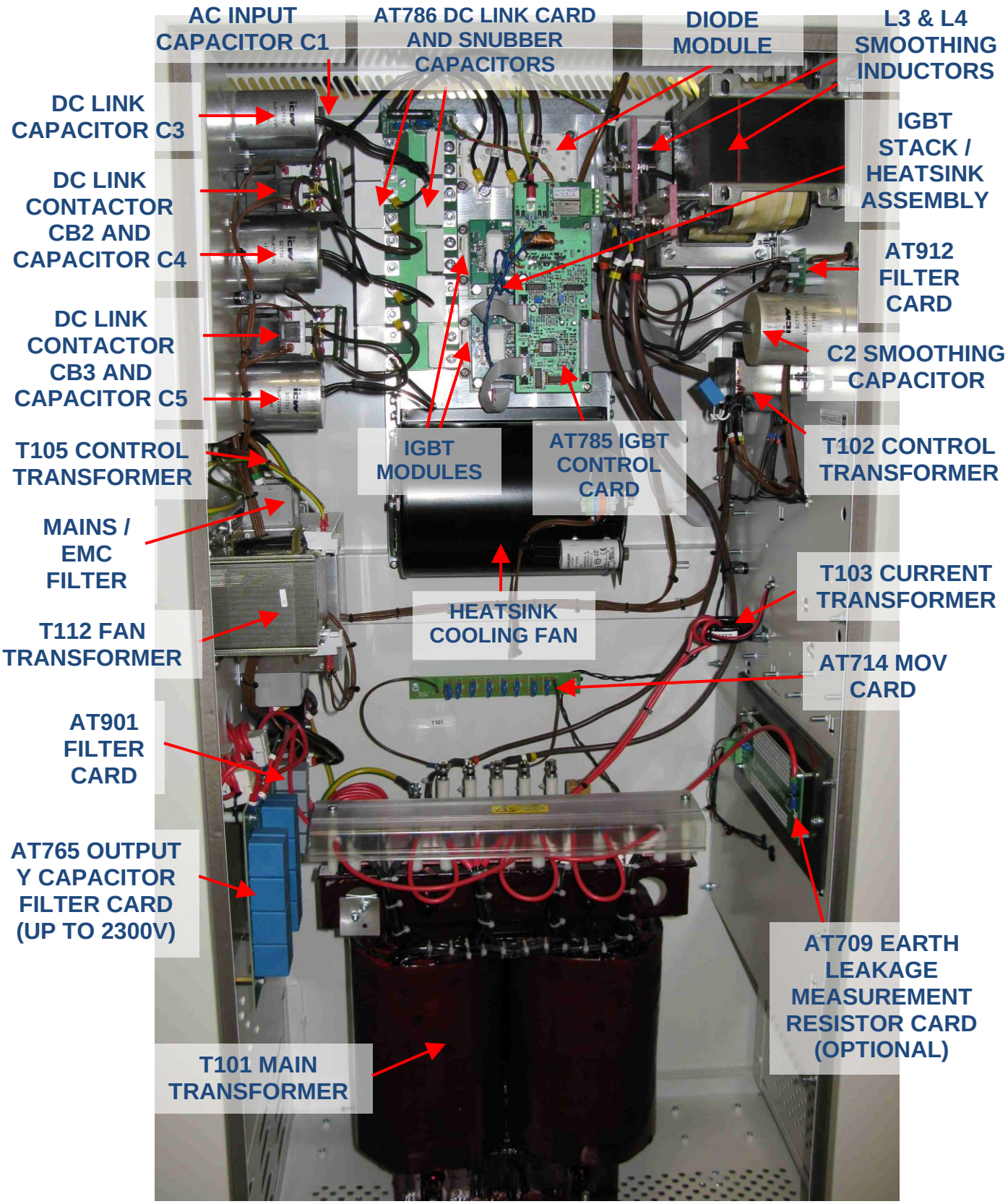


Figure 10-3 Components fitted in HT cubicle – CCRs up to 55A supply current

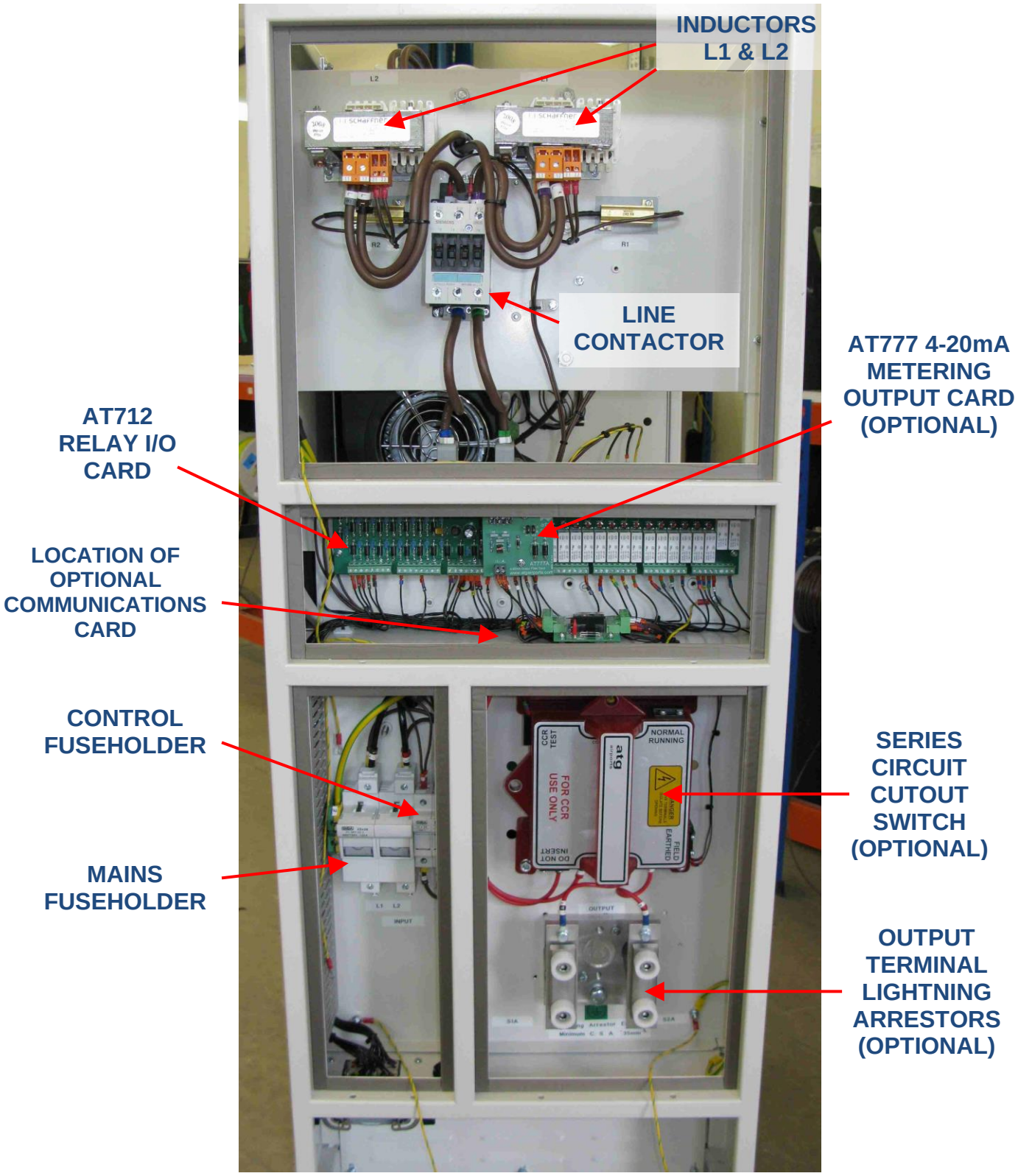


Figure 10-4 Components at rear of CCR

10.2 Calibrating the CCR

Calibration of the regulator output current may be required for the following reasons:

i/ After measuring the maximum output current level of the CCR using a high quality in-line 'true RMS' ammeter (recommended annual test), the current is found to be outside the tolerance limits specified in Table 4-2 to Table 4-5.

ii/ If the AT1030 Control Card has been replaced

atg airports do not recommend the use of 'clamp' type RMS ammeters for calibrating the CCR since the measurement can change substantially with clamping pressure. A high quality, 'true RMS' in-line meter should instead be used, and the meter itself should have a valid certificate of calibration. It should be connected in the CCR output loop in order to measure the actual regulator output current during re-calibration.

10.2.1 Programming the CCR Maximum Output Current

For a normal recalibration of the CCR it is not necessary to check or change the programmed Maximum Output Current value, so this section can be bypassed. However, if it is necessary to change the CCR Maximum Output Current value due to reconfiguration of the CCR, or if the pre-programmed value has been lost due to corruption of the EEPROM memory, then this should be done before calibrating the output current. (Note - the Firmware default value is 6.60A).

The CCR may be programmed to operate at 6.00, 6.60, 12.0 or 20.0 Amps; the value set at manufacture is indicated on the CCR nameplate affixed to the front door. Note - the transformers fitted in the majority of the CCRs are limited to 6.60A maximum output. 12.0A transformers wound with dual sets of secondary windings can operate at 6.00 / 6.60A or 12.0A. If it is required to change the nominal output current of the CCR from 6.00 / 6.60 to 12.0 Amps or vice-versa, then the number of turns through the control loop CT and the configuration of the main CCR transformer output connections will also have to be changed, (see Sections 4.3 and 10.3.1), followed by reprogramming the Maximum Output Current and recalibration of the regulator to the new current rating.

In order to programme the Maximum Output Current value, first turn the Brilliancy Control Selector Switch SW1 to 'OFF', then enter the Engineering Configuration Menu as described in Sections 9.4.1 and set the value as described in Section 9.4.2.1.

10.2.2 Calibrating the CCR Output Current

Do not attempt to calibrate the regulator output current with an AGL circuit connected in case an excess current is applied which could damage the AGL lamps - connect a resistive load or a shorting link to the output of the regulator instead. (Refer to Section 3.4 – HT Series Circuit Output Terminals). If a low value resistive load or a shorting link is used, the CCR Main Transformer output voltage should be reduced to suit the load. This will reduce the crest factor of the output waveform, thus improving the accuracy of the RMS current measurement and ensuring accurate calibration of the regulator. (Refer to Section 4.3 for setting the transformer taps). Connect only the lowest voltage transformer output winding section if a shorting link is connected on the CCR output.

Connect a calibrated in-line 'true RMS' ammeter in the regulator output circuit; the CCR output current will be calibrated to this meter reading.

Ensure there are no alarms present, then turn the Brilliancy Control Rotary Selector Switch fully clockwise to give the maximum output current.

The potentiometers which are adjusted during calibration of the CCR output current and the CCR (front panel) ammeter are shown in the layout of the AT1030 Motherboard in Figure 10-5 below. This card is mounted behind the CCR front door – refer to Figure 10-1.

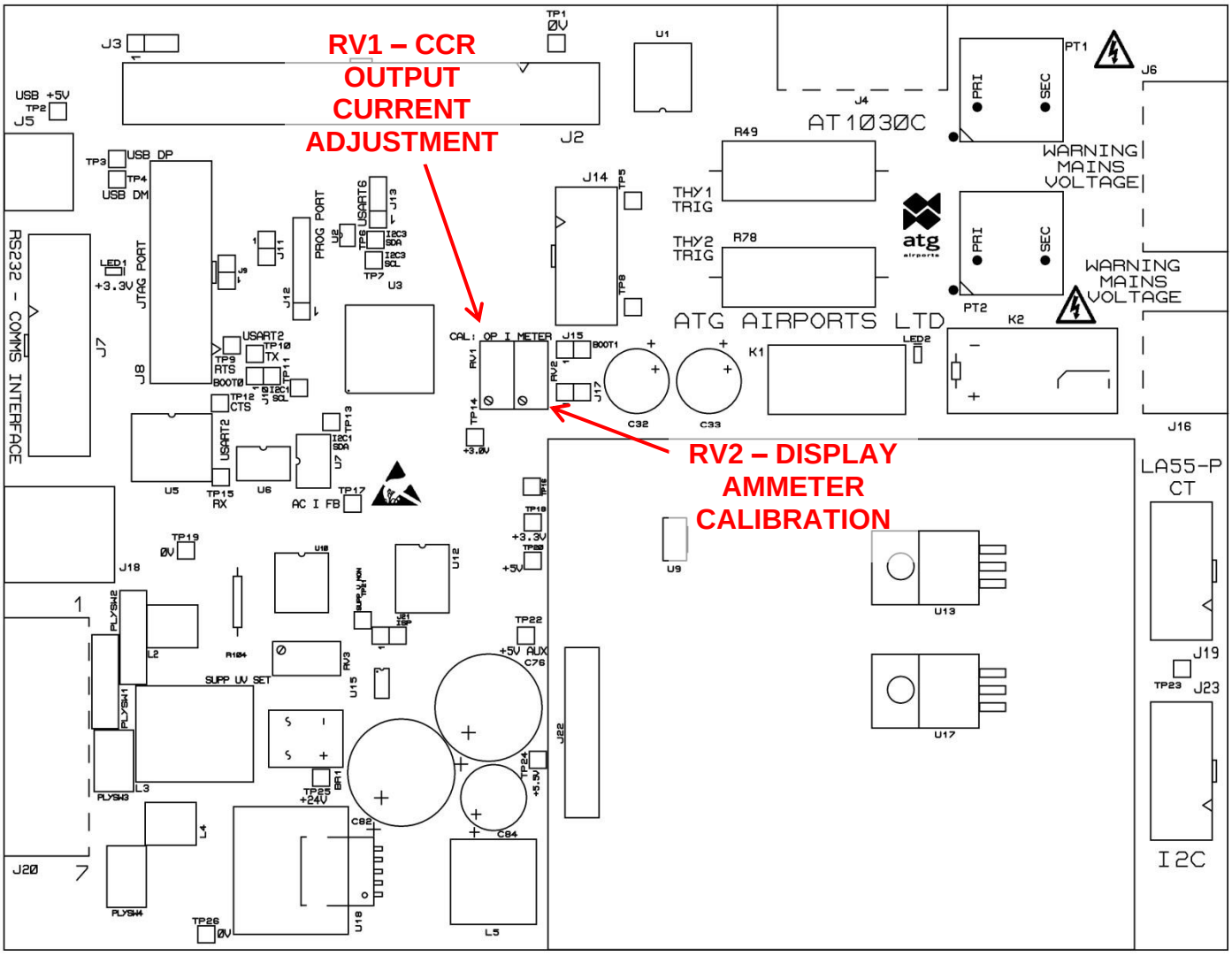


Figure 10-5 AT1030 Motherboard Potentiometer & Test Point Locations

Warning – the thyristor gate / cathode connections and the contactor coil connections are at mains potential – this could be as high as 415V. These connect to terminal blocks J6 and J16 respectively, located at the top right-hand corner of the AT1030 card. Due to the voltages present, a cover is fitted over these terminals.

Turn potentiometer RV1 on the AT1030 Motherboard (labelled 'CAL: OP I') until exactly the required Maximum Output Current – be it 6.00, 6.60, 12.00 or 20.0A - is produced by the CCR and measured on the external true RMS ammeter.

10.2.3 Calibrating the CCR Display Ammeter

After calibrating the CCR output as described above, and with the inline 'true RMS' ammeter still connected to the CCR output and the Brilliancy Control Rotary Selector Switch still set to maximum output current, turn potentiometer RV2 on the AT1030 Motherboard (labelled 'CAL: METER') until the CCR front panel display current reading matches that of the external true RMS ammeter.

10.2.4 Calibrating the front panel Real Power Meter

The Real Power Meter is calibrated during factory testing of the CCR, and does not require adjustment when the regulator is commissioned.

If it is required to recalibrate the meter, then this can be performed with the AGL circuit connected, or with a resistive load bank. It is recommended that the CCR Main Transformer output tapping voltage should already have been adjusted to match the load used (see Section 4.3), and the tapping voltage that has been set is programmed in as described in Section 4.4.1. (The latter is very important to achieve the correct output power measurement).

For a reference measurement, connect an independent, calibrated, Real Power meter to the regulator output circuit. (Note – ensure that the input of the meter is rated for the output voltage of the CCR. If it is not, it will be necessary to use an interposing step-down voltage transformer of instrumentation class).

Turn the Rotary Menu Selector until the output kW is displayed. Check that the value displayed on the CCR front panel matches that of the independent Power Meter. If it does not, then adjust potentiometer RV5 ('POWER METER CAL') on the AT1134 PLF Card.

10.2.5 Calibrating the front panel Output Voltage and kVA Meters

The Output Voltage and kVA metering is calibrated during factory testing of the CCR, and does not require adjustment when the regulator is commissioned.

If it is required to recalibrate (both meters are calibrated from the same potentiometer), then this can be performed with the AGL circuit connected, or with a resistive load bank. It is recommended that the CCR Main Transformer output tapping voltage should already have been adjusted to match the load used (see Section 4.3), and the sum total voltage of the secondary windings connected is programmed in as described in Section 4.4.1. (The latter is very important to achieve the correct meter readings).

For a reference measurement, connect an independent, calibrated, voltmeter and kVA meter to the regulator output circuit. (Note – ensure that the meter input voltage

measurement circuit is rated for the output voltage of the CCR. If it is not, an interposing voltage instrumentation transformer will be necessary).

Run the regulator at maximum output. Check that the value of the Output Voltage displayed on the CCR front panel matches that of the independent Voltmeter. If it does not, then adjust RV4 ('VFB CAL') on the AT1134 Card.

Turn the Rotary Menu Selector until the output kVA is displayed. Check that the value displayed on the CCR front panel matches that of the independent kVA Meter. If there is a large discrepancy, even though the voltage metering was correct, then check the calibration of the CCR output current meter as described in section 10.2.3.

10.3 Additional CCR Hardware configuration

10.3.1 Control Loop Current Transformer Primary Turns

The main CT, reference T103, which is used to measure the CCR output current, is set as follows: for 6.00A or 6.60A operation, there should be four primary turns through the CT, for 12.00A operation there should be two primary turns, and for 20.00A one primary turn.

Note – this is always set during factory testing to match the nominal CCR Maximum Output Current. The number of CT primary turns will therefore not require changing unless a transformer with dual sets of secondary windings is fitted - designed for 6.00 / 6.60A or 12.00A operation - and the regulator operating current range is to be changed from 6.00 / 6.60A to 12.00A or vice-versa. In this case, it will be necessary to change the Main Transformer secondary connections (see Section 4.3) and re-program the CCR Maximum Output Current (see section 9.4.2.1) to suit the new operating current, followed by recalibrating the CCR (see section 10.2). All other transformer designs are fixed in terms of the maximum output current.

10.3.2 Checking the Over-current Trip Point and Trip Delay Time

The testing of the over-current detection circuit is part of the factory tests, and would not normally be performed by the user. **It is not part of the CCR commissioning procedure, and should under no circumstances be tested on a live AGL circuit.**

The 'FORCE OUTPUT CURRENT TEST MENU' menu screen is used to set the Overcurrent Trip Time characteristic (Menu 3 - Engineering Config. - see section 9.4.2.16), and is set during factory testing to give the correct trip delay to meet the requirements of either IEC 61820-3-2:2023 or the FAA Advisory Circular 150/5345-10. For the European market, the IEC/EN settings are used, with the following trip times for a 6.6A regulator: 3 to 5 seconds for a current of 6.75A or more, and less than 300ms for a current of 8.30A or more. Where the FAA standard is called up, the trip times are set to: 5 seconds for a 5% Over-current condition, and 1 second for 25% Over-current.

If for any reason this test needs to be performed, then a resistive load bank or a shorting link should be connected in place of the AGL circuit. DO NOT PERFORM THIS TEST WITH AN AGL CIRCUIT CONNECTED SINCE EXCESS CURRENTS WILL BE APPLIED.

The CCR Main Transformer output voltage should be adjusted according to the load used (set to minimum if a shorting link is connected), to reduce the current waveshape Crest Factor thus enabling the RMS current measurement to be made more accurately.

Enter the Engineering Configuration Menu as described in Section 9.4.1, and turn the Rotary Menu Selector anticlockwise to scroll down to the following screen:

→	F	O	R	C	E		O	U	T	P	U	T						↑	↓
	C	U	R	R	E	N	T		T	E	S	T		M	E	N	U	:	

Press the menu selector and the following warning screen will be displayed:

C	C	R		O	U	T	P	U	T		W	I	L	L				↑	↓
E	N	E	R	G	I	S	E												
→		C	A	N	C	E	L												
		C	O	N	T	I	N	U	E										

Turn the selector anticlockwise to set the arrow (→) alongside ‘CONTINUE’ then press the selector again to enter the test screen:

F	O	R	C	E		O	U	T	P	U	T		C	U	R	R	E	N	T
→	S	T	O	P															
	I		D	E	M	A	N	D	:						6	.	6	0	A
	I		M	E	A	S	U	R	E	D	:				6	.	6	0	A

The CCR will turn on at the nominal maximum output current level. Turn the Rotary Menu Selector clockwise to increase the ‘I DEMAND’ to set the CCR output current to the desired level for the over-current test that is being run:

6.80A to check the IEC over-current setting,
or
6.93A to check the FAA over-current setting.

The over-current circuit will soon trip and the following screen will be shown:

F	O	R	C	E		O	U	T	P	U	T		C	U	R	R	E	N	T
→	R	E	S	E	T		F	A	U	L	T		&		E	X	I	T	
	I		D	E	M	A	N	D	:						6	.	8	0	A
	I		M	E	A	S	U	R	E	D	:				6	.	8	0	A

Note - the ‘I MEASURED’ value represents the measured current during a test, but also records the peak level reached before a trip condition occurs.

Pressing the menu selector will reset the fault(s) and exit this screen and revert to the entry screen:

→	F	O	R	C	E		O	U	T	P	U	T					↑	↓
	C	U	R	R	E	N	T		T	E	S	T		M	E	N	U	:	

If the test screen is then re-entered the ‘I DEMAND’ will start from the last value used – 6.80A in this example. The overcurrent test can therefore be conducted with the CCR output starting immediately at the correct test level, and so the time taken to trip at this current level can be accurately recorded without a delay to adjust the test current.

10.3.3 Supply Under-voltage Trip Setting

RV3 on the AT1030 Motherboard (labelled ‘SUPPLY UV SET’ - see Figure 10-5) sets the mains supply under-voltage level at which the CCR will trip / switch off.

This is factory set to trip the CCR if the supply voltage falls below 85% of nominal, and would not normally need to be adjusted.

10.4 Testing and replacement of IGBTs, diodes and driver cards

The IGBT stack assemblies are mounted inside the high-tension cubicle above the power transformer, and are accessed by opening the large side door of the CCR.

WARNING - HIGH VOLTAGES – UP TO 2500V FOR A 15KVA REGULATOR – ARE PRESENT ON THE CCR MAIN TRANSFORMER OUTPUT TERMINALS. THE TRANSFORMER IS MOUNTED WITHIN THE HT CUBICLE, THE DOOR TO WHICH SHOULD NEVER BE OPENED WITHOUT FIRST ISOLATING THE REGULATOR MAINS SUPPLY INPUT.

MAINS VOLTAGES OF UP TO 415V AC AND 590V DC ARE PRESENT ON THE IGBT STACK AND DC LINK CAPACITOR CONNECTIONS DURING NORMAL OPERATION.

10.4.1 25A IGBT stack assembly

The 25A IGBT heatsink / stack assembly (stock code 7500-1800K) is used in CCRs up to 7.5kVA in the 400V series, and up to 4kVA in the 220V series. This assembly includes two SKM75GB IGBT modules (each containing two IGBTs), two SKKD 81/14 diode modules (each containing two power diodes), heatsink, fan and the AT732 Power Card. It is shown in the photograph of Figure 10-8.

Whilst individual components can be replaced, in the case of faults it is recommended to replace the complete 25A IGBT heatsink and AT732 Card assembly, since a fault on the card can be one cause of IGBT failures, and conversely, an IGBT failure can damage the driver Card.

10.4.1.1 Testing of 25A stack IGBT and diode modules

Before gaining access to the high voltage cubicle, isolate and lock off the mains supply.

The usual mode of failure for an IGBT is to fail short circuit; this can be verified by measuring the resistance across the IGBT power terminals as described below and as indicated in Figure 10-6 and Figure 10-7 overleaf. Note - the IGBTs are mounted underneath the AT732 Card, near the bottom of the stack assembly.

Since the IGBT modules are effectively connected in parallel – the input connections for both modules are connected together via the DC Link (on the AT732 Card), and the output connections are connected together via the smoothing inductors and the power transformer primary windings - in order to determine which of the two IGBT modules may have a fault, cable L10 should be temporarily disconnected from the AC/OP2 screw terminal before performing the following tests. Refit the screw after disconnecting the cable, and ensure that the cable end does not touch any other conductors.

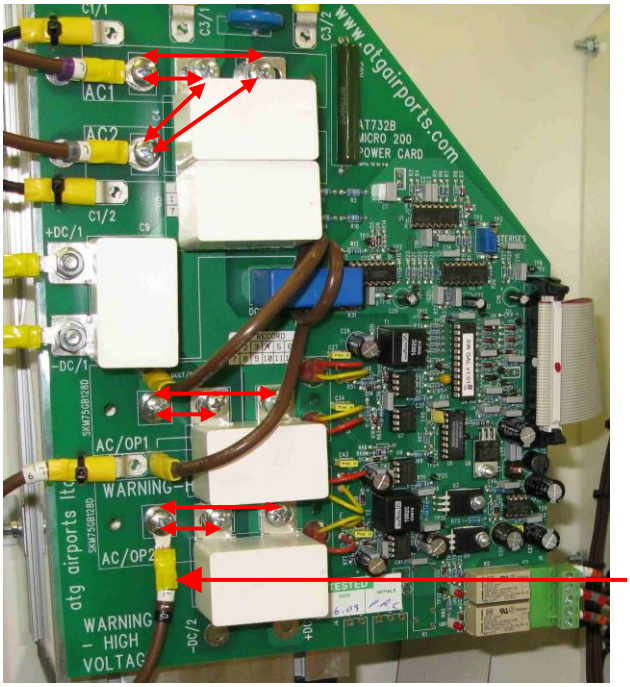
1/ Measure between the AC/OP1 left-hand IGBT screw connections and the adjacent centre and right-hand IGBT screw connections, each in turn. Note – the AC/OP1 connection has a cable looped through the current transducer, so measure from the left-hand IGBT screw power connection to the centre and right-hand screws. Healthy readings should be over 100k ohms; a faulty IGBT usually goes short circuit.

2/ Measure between the AC/OP2 left-hand IGBT screw connection and the adjacent centre and right-hand IGBT screw connections (if there is access, depending on the type of capacitors fitted), or upper centre and right-hand IGBT screw connections, each in turn.

(Note - the upper and lower IGBT module centre and right-hand terminals are connected together on the DC link). Measurements should be as above.

DIODE MODULES – USE DVM IN DIODE TEST MODE TO MEASURE BETWEEN POINTS INDICATED BY ARROWS; A SHORT CIRCUIT INDICATES A FAULTY DIODE.

IGBTS - MEASURE RESISTANCE BETWEEN POINTS INDICATED BY ARROWS; A SHORT CIRCUIT INDICATES A FAULTY IGBT.

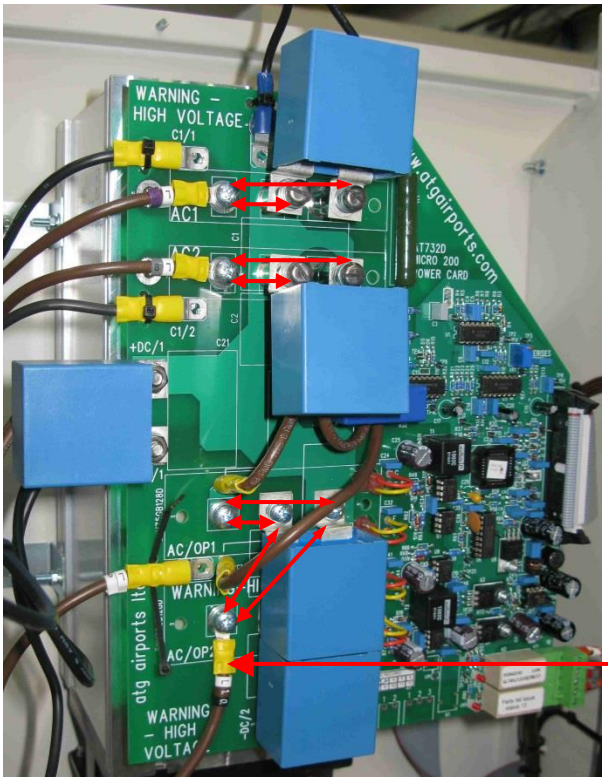


TEMPORARILY DISCONNECT CABLE L10 BEFORE MAKING IGBT RESISTANCE MEASURMENTS

Figure 10-6 25A IGBT stack test measurement points – early type snubber capacitor

DIODE MODULES – USE DVM IN DIODE TEST MODE TO MEASURE BETWEEN POINTS INDICATED BY ARROWS; A SHORT CIRCUIT INDICATES A FAULTY DIODE.

IGBTS - MEASURE RESISTANCE BETWEEN POINTS INDICATED BY ARROWS; A SHORT CIRCUIT INDICATES A FAULTY IGBT.



TEMPORARILY DISCONNECT CABLE L10 BEFORE MAKING IGBT RESISTANCE MEASURMENTS

Figure 10-7 25A IGBT stack test measurement points – Epcos snubber capacitor

It is also possible to check the condition of the diode modules using a DVM, but this time set to ‘diode test’, which measures the diode volt drop. Measure between each of the stack AC input cable connections (near the top of the stack assembly) and the adjacent

centre and right-hand screws of the diode module power connections each in turn, as follows and as shown in Figure 10-6 and Figure 10-7:

1/ Measure from the AC1 left-hand diode screw connection to the centre and right-hand diode screw connections, each in turn. Two measurements will be required each time, with the meter leads reversed in order to measure in both polarities. In one direction, the forward volt drop of the diode should be measured – around 0.42V, and in the other direction an 'OL' reading should be obtained. A faulty diode is usually short circuit – measuring 0V.

2/ Measure from the AC2 left-hand diode screw connection to the adjacent centre and right-hand diode screw connections (if there is access – depending on the type of capacitors fitted) or upper centre and right-hand diode screw connections, each in turn. (Note - the centre and right-hand connections for the upper and lower diode modules are connected together on the DC link). Again, two measurements will be required, with the meter leads reversed in order to measure in both polarities. Measurements should be as above.

10.4.1.2 Replacement of complete 25A IGBT stack assembly

Before gaining access to the high voltage cubicle, isolate and lock off the mains supply. Referring to the photograph of Figure 10-8, make a note of the position of the power and capacitor cables before disconnecting them from the AT732 Card. Next, disconnect the ribbon control cable, the plug next to the relays (J6 at the bottom right-hand side of the AT732), and the fan cables.

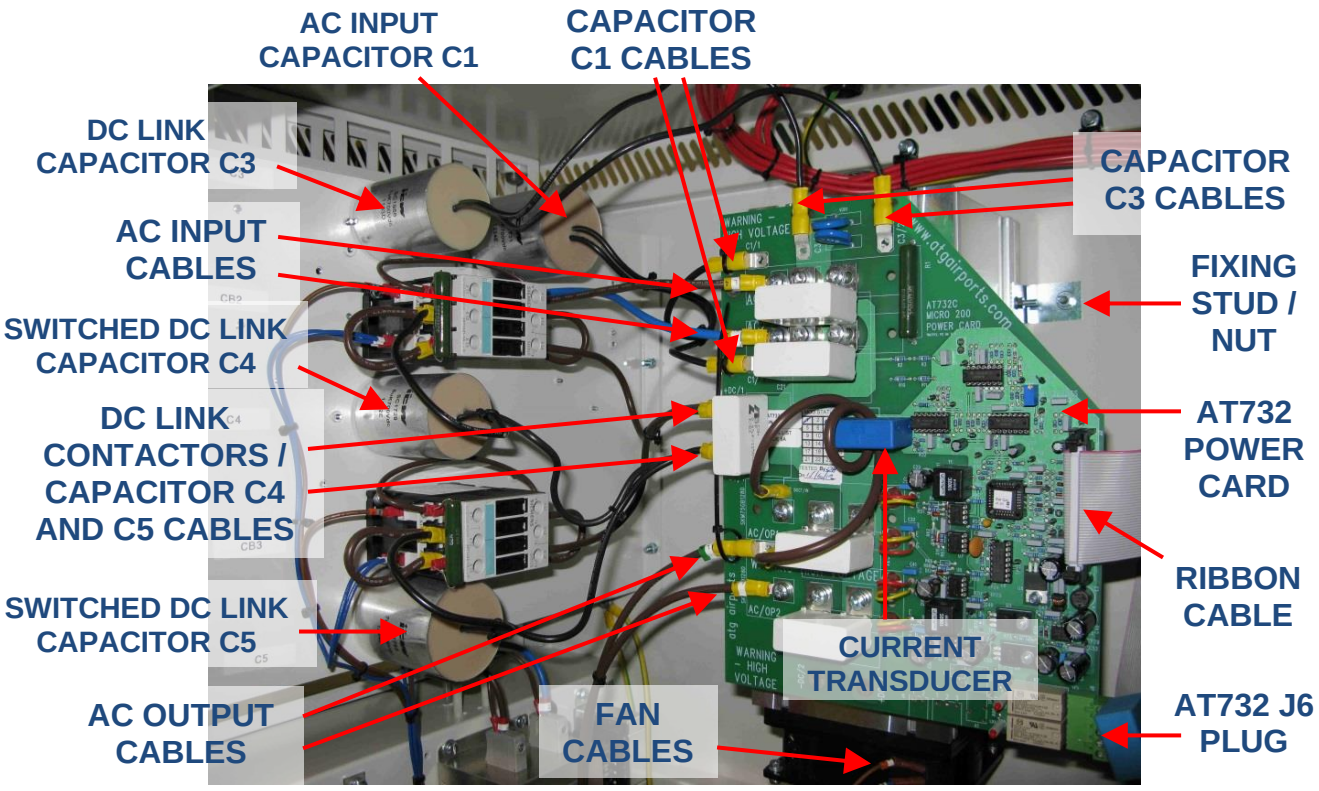


Figure 10-8 25A IGBT stack assembly with connections marked

The assembly is held in place by a total of four mounting brackets, two on either side of the heatsink. Remove the nuts which go over the studs fixed to the side of the cubicle (undo the bottom ones first), so that the assembly can be withdrawn with the fixing brackets still attached.

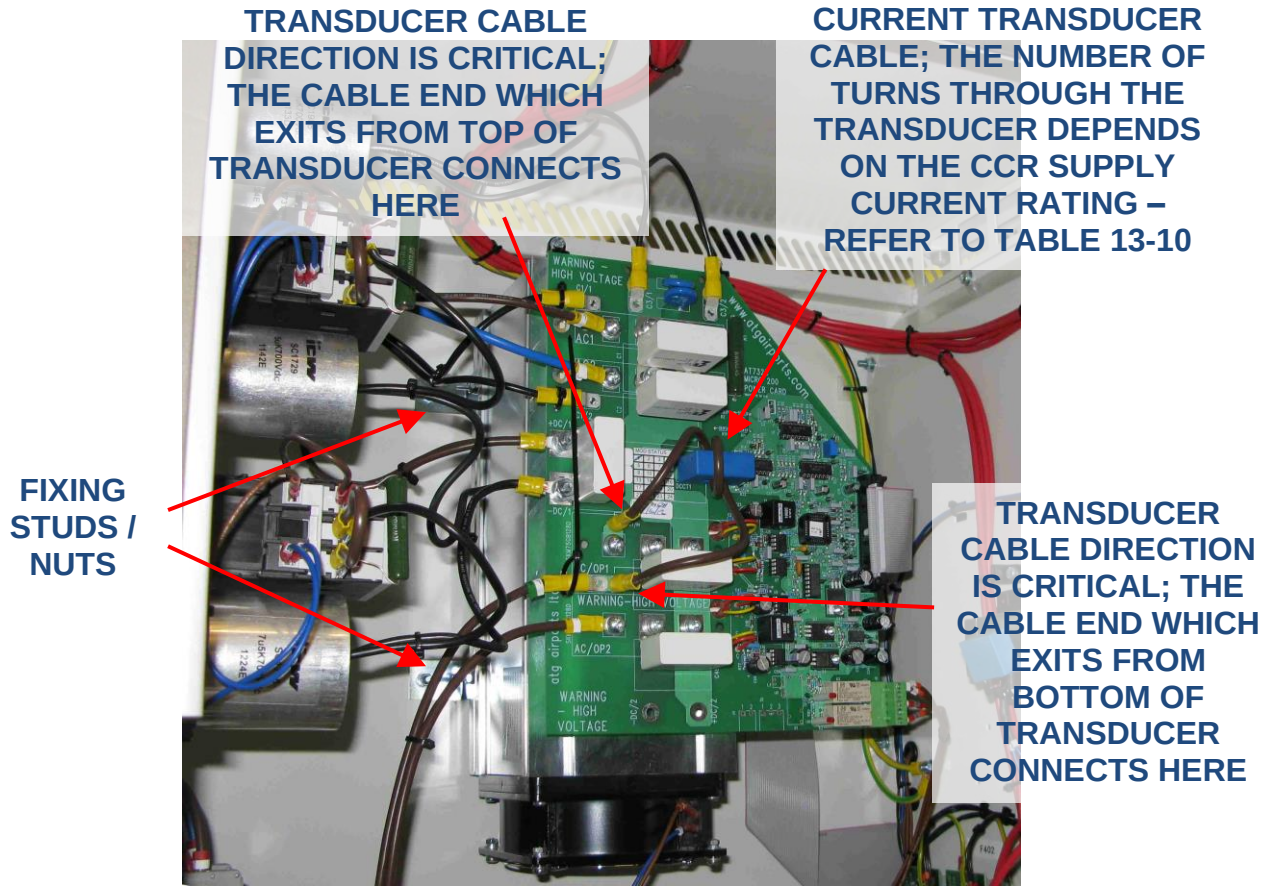


Figure 10-9 25A IGBT stack assembly - fixings and current transducer cable marked

It will be necessary to swop the mounting brackets from the old to the new stack assembly; carefully fit them in the same position so that they line up with the fixing studs in the cabinet. The new stack assembly is then be fitted over the studs in the cabinet, the washers and nuts fitted (top ones first), then all cables reconnected as before. Tighten the M5 screws connecting the cables to the diodes (terminals AC1 and AC2) and IGBT (terminal AC/OP2) to a torque of 3 Nm. Some power cables use push-on connectors; in this case use a small tie-wrap to secure the cable in place. The two fan cables use small push on connectors.

It is very important that the cable through the current transducer has the correct number of turns and is of the correct cable CSA to suit the CCR primary current. This is specified in Table 13-10, but it is easier just to copy the original assembly or re-use the cable from the original. To remove the cable from the old stack assembly it will be necessary to cut off one of the crimp connectors in order to pull the cable out from the transducer. The cables are connected using 6.3mm push on crimps, so after passing the cable through the transducer on the replacement unit, the new cable crimp can then be fitted.

Note – the orientation of the cable through the current transducer / direction of current

flow is critical. If it is reversed, it will destroy the IGBTs – refer to the photographs above and the markings on the AT732 pcb for the correct connection of the cable.

10.4.1.3 Replacement of 25A stack IGBT and diode modules

The SKM75GB IGBTs (stock code 2323-0207) and SKKD 81/14 diodes (stock code 2270-0005) used on the 25A stack can be replaced individually if necessary, as described below.

Caution - IGBTs are extremely sensitive to damage from static electricity, as are parts of the driver boards, so a wrist earthing strap should be worn when working with these devices. Avoid touching the gate and emitter connections if the driver boards are not fitted to the IGBT modules, and if the boards are fitted, avoid touching the sensitive electronic circuitry on the board. Always handle these components by the edges.

1. Although this procedure can be undertaken with the stack fitted inside the CCR, for ease of work it is recommended that the complete stack assembly should be removed from the CCR as described in section 10.4.1.2 above.
2. Disconnect the gate and emitter drive cables from the IGBTs as shown below, using a pair of long nosed pliers.

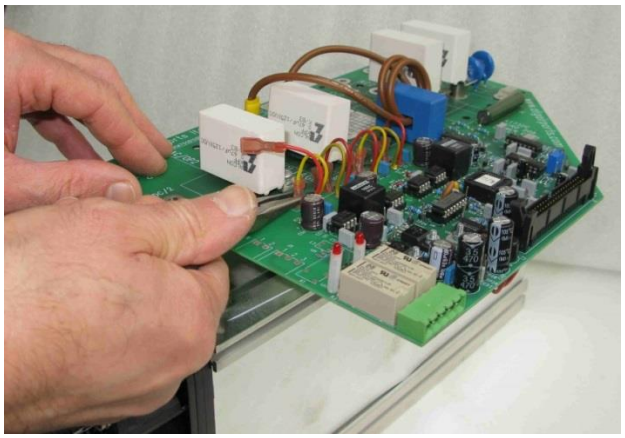


Figure 10-10 25A IGBT stack – disconnection of gate drive cables

3. Remove all of the snubber capacitor mounting screws and other screws fixing the AT732 board to the IGBT and diode modules as shown in the photographs below. Note – once the screws are removed, hold the board in position so as not to strain the thermistor cable underneath the board.

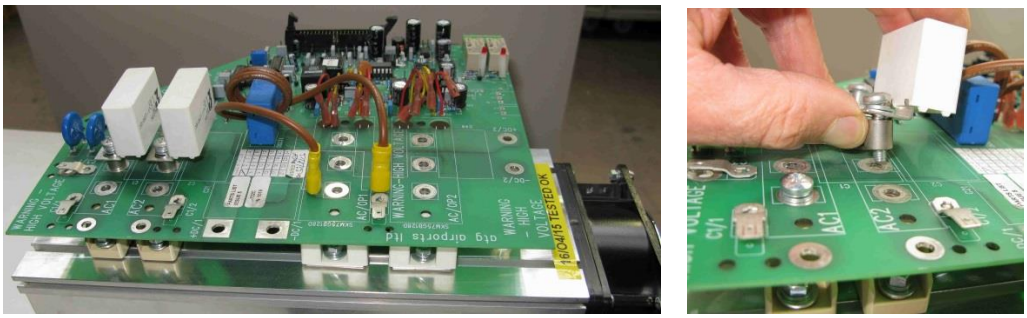


Figure 10-11 25A IGBT stack removal of snubber capacitors and AT732 fixing screws

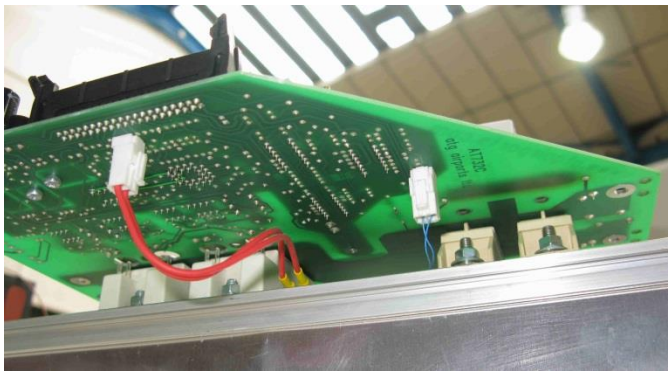


Figure 10-12 25A IGBT stack – thermal switch and thermistor cables

4. Carefully tilt the board to reveal the thermistor and thermal switch connections on the underside of the AT732 card, and unplug the connectors as shown in the photographs below. Note – it will be necessary to squeeze the tag on the cable end to release the connector.

Caution – avoid touching the IGBT gate and emitter connections - these are extremely sensitive to damage from static electricity. A wrist earthing strap should be worn during this procedure.

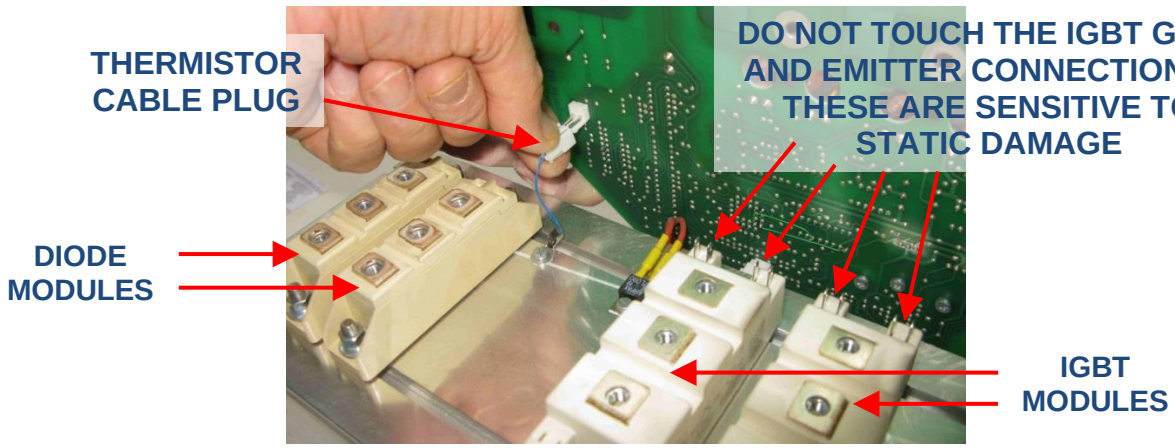


Figure 10-13 25A IGBT stack – disconnection of thermistor cable plug

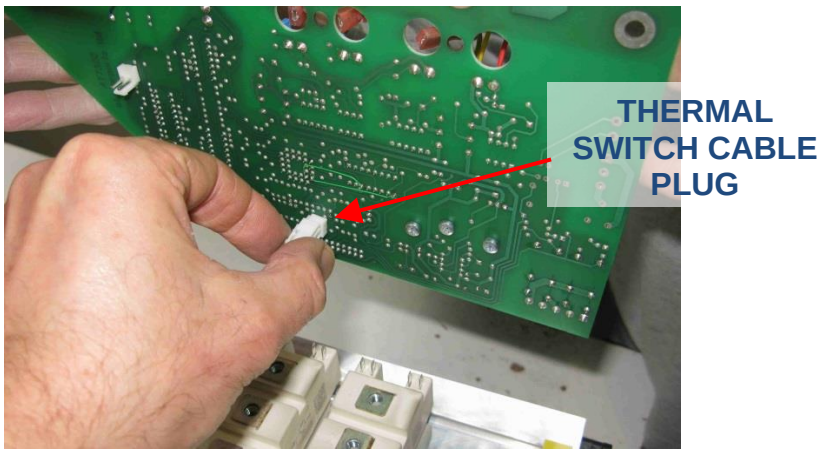


Figure 10-14 25A IGBT stack – disconnection of thermal switch cable plug

5. Using a fine marker pen, mark the position of the edge of the IGBT (or diode module) that is to be removed on the heatsink in order to correctly position the new module.

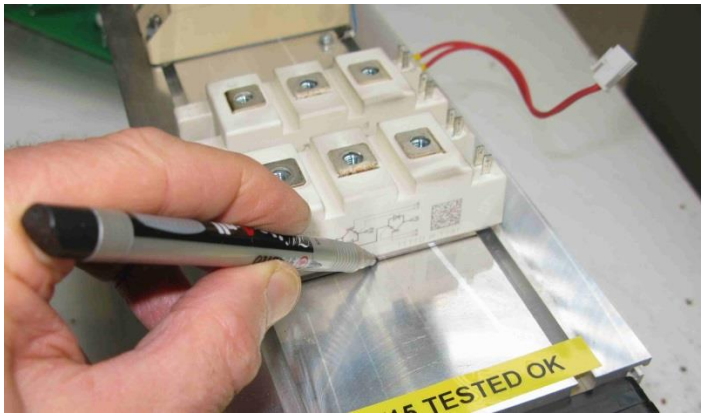


Figure 10-15 25A IGBT stack – mark position of module that is to be removed

6. Using an 8mm 'Nut Driver' type spanner unbolt and remove the faulty IGBT or diode module:

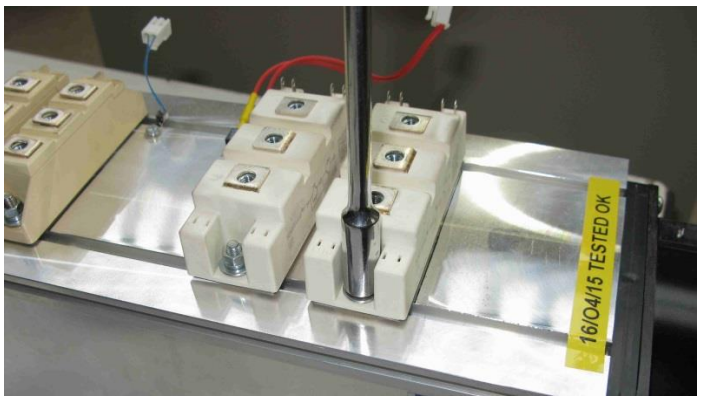


Figure 10-16 25A IGBT stack – unbolt the faulty IGBT or diode module

7. Smear a thin coating of heatsink compound onto the back surface of the new IGBT or diode module. Use Dow Corning 340 heatsink compound or similar; spread uniformly to a thickness of around 50 µm. Ensure no dust or dirt contaminates this surface before it is fitted to the heatsink. Note – the IGBT gate / emitter connections are sensitive to static damage; handle by the device body and at this stage leave the protective gate / emitter shorting rings in place.

Figure 10-17 25A IGBT stack – smear the back of the module with heatsink compound

8. Position the new device over the fixing bolts on the heatsink, fit the plain washer, spring washer then nut and tighten evenly on each side to a torque of 3 Nm.

9. For a replacement IGBT module, and whilst wearing the wrist earthing strap, remove the gate / emitter shorting rings with a pair of long nosed pliers.

Figure 10-18 25A IGBT stack – remove the gate / emitter shorting rings from new IGBT

10. Reconnect the thermal switch cable plug to the underside of the AT732 card, followed by the thermistor cable plug.

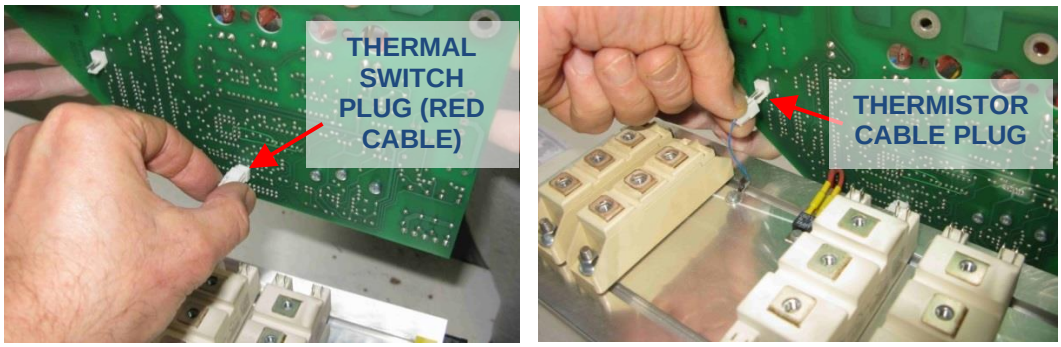


Figure 10-19 25A IGBT stack – re-connection of thermal switch and thermistor plugs

11. Position the AT732 card over the diode and IGBT modules, and loosely fit two screws in the AC1 and AC/OP2 terminals to hold in place, as shown below:

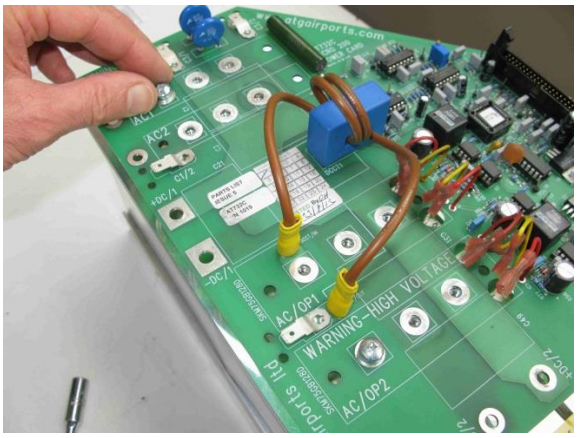


Figure 10-20 25A IGBT stack – re-fit AT732 card, loosely fitting two screws to hold

12. Refit the snubber capacitors in the same sequence as they were removed, using the metal spacers for the capacitors fitted over the diode modules. Tighten the M5 fixing screws to a torque of 3 Nm.

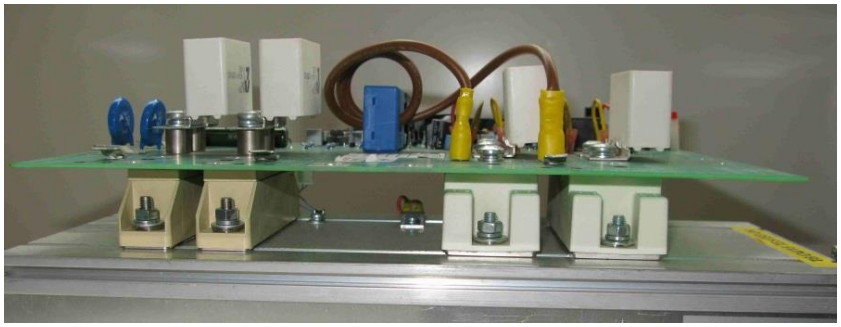


Figure 10-21 25A IGBT stack – re-fit the snubber capacitors

Note – for CCRs manufactured from 2018 onwards using the Epcos snubber capacitors (blue), ensure that three plain washers (plus the spring washer) are fitted under the heads of the screws securing the snubber capacitors above the diode modules, since otherwise these screws are too long. Note also that two spacers are used for each of these screws. See Figure 10-22 below.

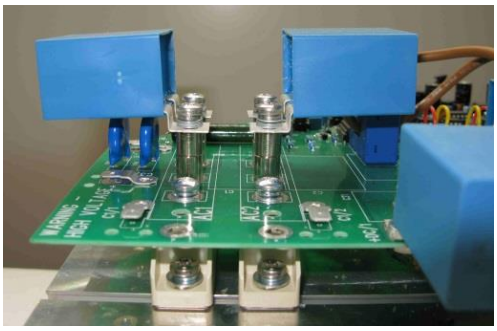


Figure 10-22 25A IGBT stack – Epcos capacitors fitted over diodes

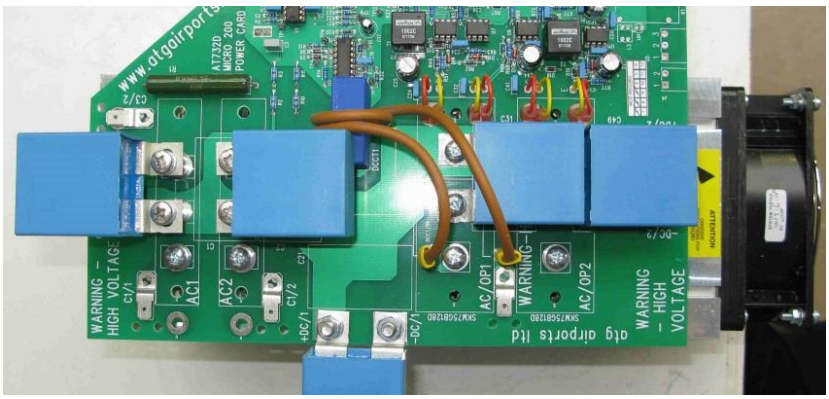


Figure 10-23 25A IGBT stack – Epcos snubber capacitors

Note – the fifth snubber capacitor, fitted at the side of the AT732 card (at the bottom in the above photograph - terminals marked +DC/1 and –DC/1), only needs to be fitted when the stack is installed into the CCR since there are two cables which connect under the capacitor fixing bolts.

13. Using a pair of long nosed pliers, re-connect all the gate and emitter driver cables from the AT732 Card to the IGBTs. Ensure that the crimp is correctly pushed down over the IGBT connector blade pin, and that the connector pin of the IGBT does not go between the cable crimp and the plastic outer insulator, resulting in an unreliable connection.

Caution – avoid touching the IGBT gate and emitter connections - these are extremely sensitive to damage from static electricity. A wrist earthing strap should be worn during this procedure.

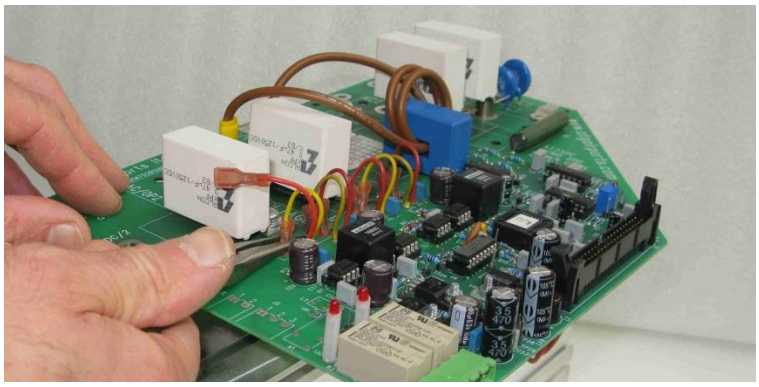


Figure 10-24 25A IGBT stack – re-connection of IGBT gate and emitter driver cables

14. Refit the stack assembly to the CCR, referring to Figure 10-8 and Figure 10-9 from section 10.4.1.2. Ensure that all cables are reconnected exactly as before. Some power cables use push-on connectors; in this case use a small tie-wrap to secure the cable in place. The two fan cables use small push on connectors.

10.4.2 55A IGBT stack assembly

The 55A IGBT heatsink / stack assembly (stock code 7500-1761A) is used in CCRs up to 15kVA in the 400V series, and up to 10kVA in the 220V series. This assembly includes two Semix 202 IGBT modules (each containing two IGBTs), two sets of 2S Adapter Boards and Skyper 32 Driver Cards, one Semix 341 diode module (containing six power diodes), heatsink, fan, AT785 IGBT Control Card and AT786 DC Link Card. The stack assembly is shown in the photograph below:

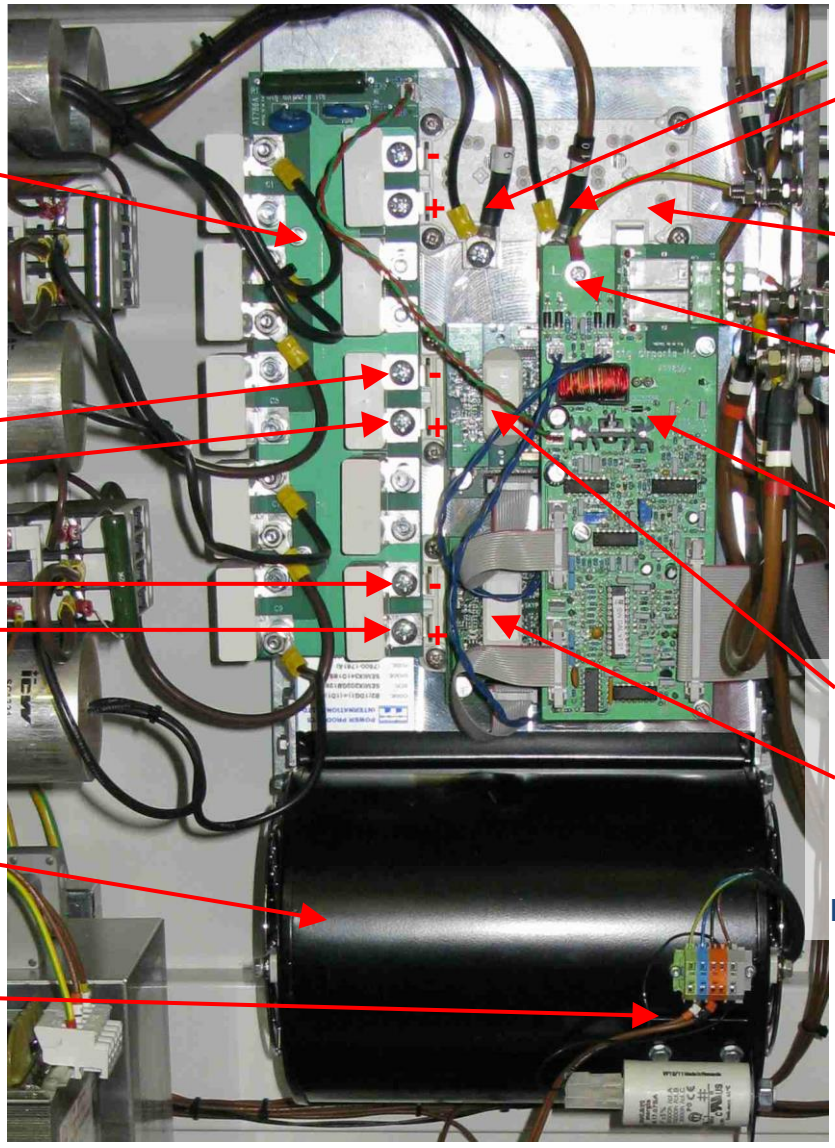


Figure 10-25 55A IGBT stack assembly components

In case of faults, it is usually simpler to replace individual components or sub-assemblies, as described overleaf.

10.4.2.1 Testing of 55A stack IGBT and diode modules

The usual mode of failure for an IGBT is to fail short circuit; this can be verified by measuring the resistance between each of the DC input connections (on the left-hand side of the IGBT modules) to the output connection to the smoothing inductors. Test as follows:

1/ To determine if one of the modules is faulty without disconnecting any cables, measure the resistance (using a DVM) from the IGBT module 2 '+' and '-' terminals, each in turn, to wire L12 at the connection to inductor L4 – refer to Figure 10-26 below. The resistance measured should be at least 100k ohms; a short circuit indicates a faulty device.

2/ Since the IGBT modules are effectively connected in parallel – the input connections for both modules are connected together via the AT786 DC Link Card and the output connections are connected together via the smoothing inductors and the power transformer primary windings - if there is a fault, in order to determine which device is faulty, disconnect wire L11 from inductor L3 and test again. Measure between each of the IGBT module 1 input connections in turn to the disconnected end of wire L11; repeat for each of the IGBT module 2 input connections in turn to wire L12 at the connection to inductor L4, whilst wire L11 is still disconnected from inductor L3.

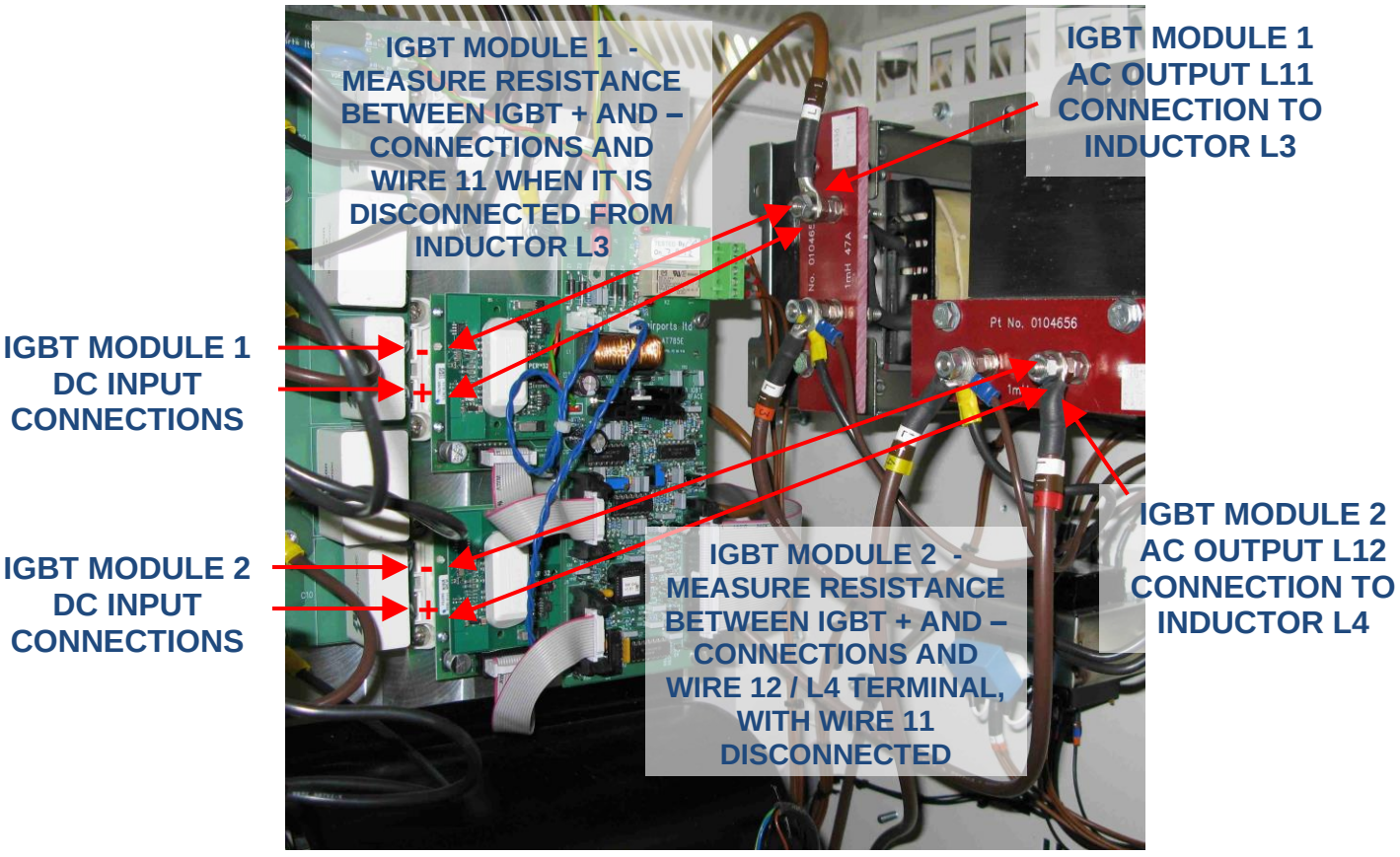


Figure 10-26 55A IGBT stack assembly IGBT test measurement points

The resistance measurement test points are shown in Figure 10-27 with the AT785 Card moved out of the way. If one or both of the IGBT modules is faulty, or if it is suspected that one of the Skyper 32 driver boards or 2S Adapter Cards are faulty ('Output Current Low' fault trip, with all other possible causes ruled out) then they should be replaced as

described in the next section.

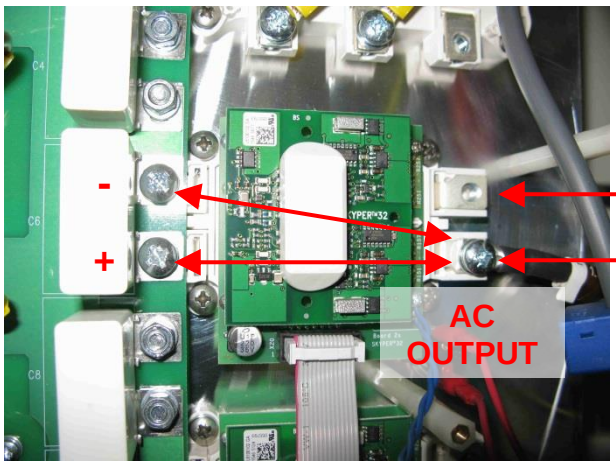


Figure 10-27 55A IGBT stack assembly IGBT terminal test measurement points

It is also possible to check the condition of the diode modules using a DVM, but this time set to 'diode test', which measures the diode volt drop. Measure between each of the stack AC input cable connections to the diode bridge (near the top of the stack assembly) and the DC power output connecting screws on the left-hand side of the diode module each, in turn, as follows and as shown in Figure 10-28 below.

1/ Measure between the L9 cable screw connection (bottom left diode terminal) and the DC output screw connections (on the left), each in turn. Two measurements will be required each time, with the meter leads reversed in order to measure in both polarities. In one direction, the forward volt drop of the diode should be measured – around 0.45V, and in the other direction an 'OL' reading should be obtained. A faulty diode will be short circuit – ie 0V.

2/ Measure between the L10 cable screw connection (bottom centre diode terminal) and the DC output screw connections (on the left), each in turn. Again, two measurements will be required, with the meter leads reversed in order to measure in both polarities. Measurements should be as above.

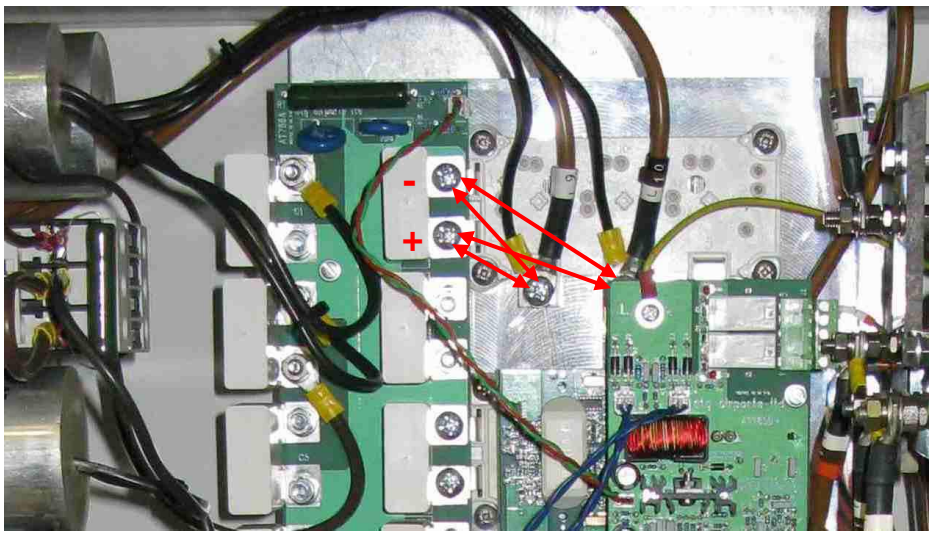


Figure 10-28 55A IGBT stack assembly diode test measurement points

10.4.2.2 Replacement of 55A stack IGBT and driver boards

The Semix 202 IGBT module, 2S Adapter Board and Skyper 32 Driver Card are supplied as a complete sub-assembly (stock code 2323-0216), and are replaced as described below. First it will be necessary to move the AT785 card to one side to gain access to the IGBT sub-assembly:

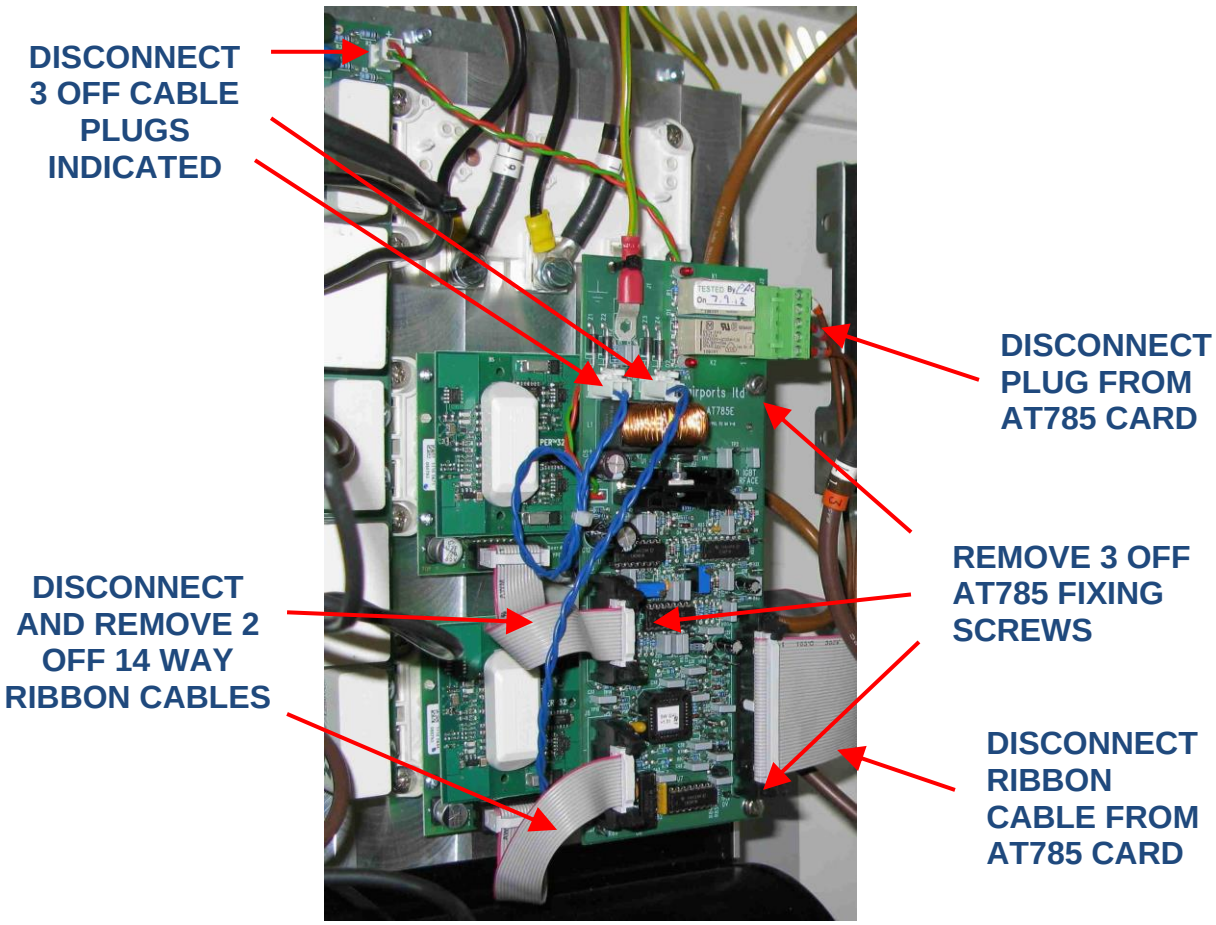


Figure 10-29 Disconnecting and moving the AT785 IGBT Control Card

Undo the thermal switch plug and power connections indicated below; the following photographs show the disconnection and removal of both IGBT modules; in some cases it will only be necessary to remove and replace one module depending on the faults found.

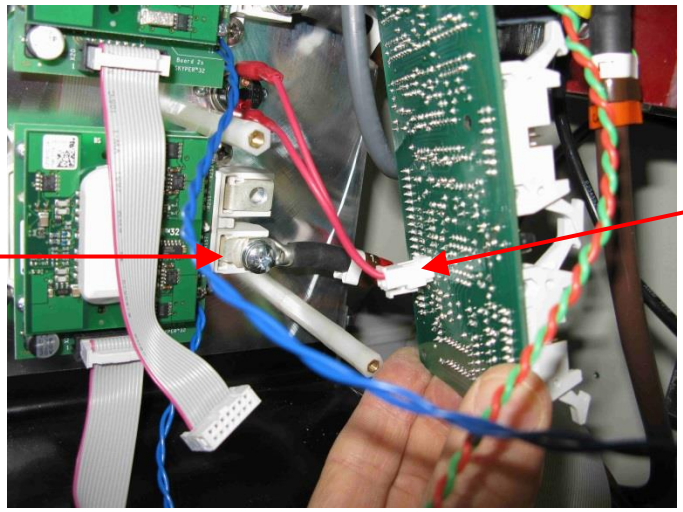


Figure 10-30 Disconnecting thermal switch

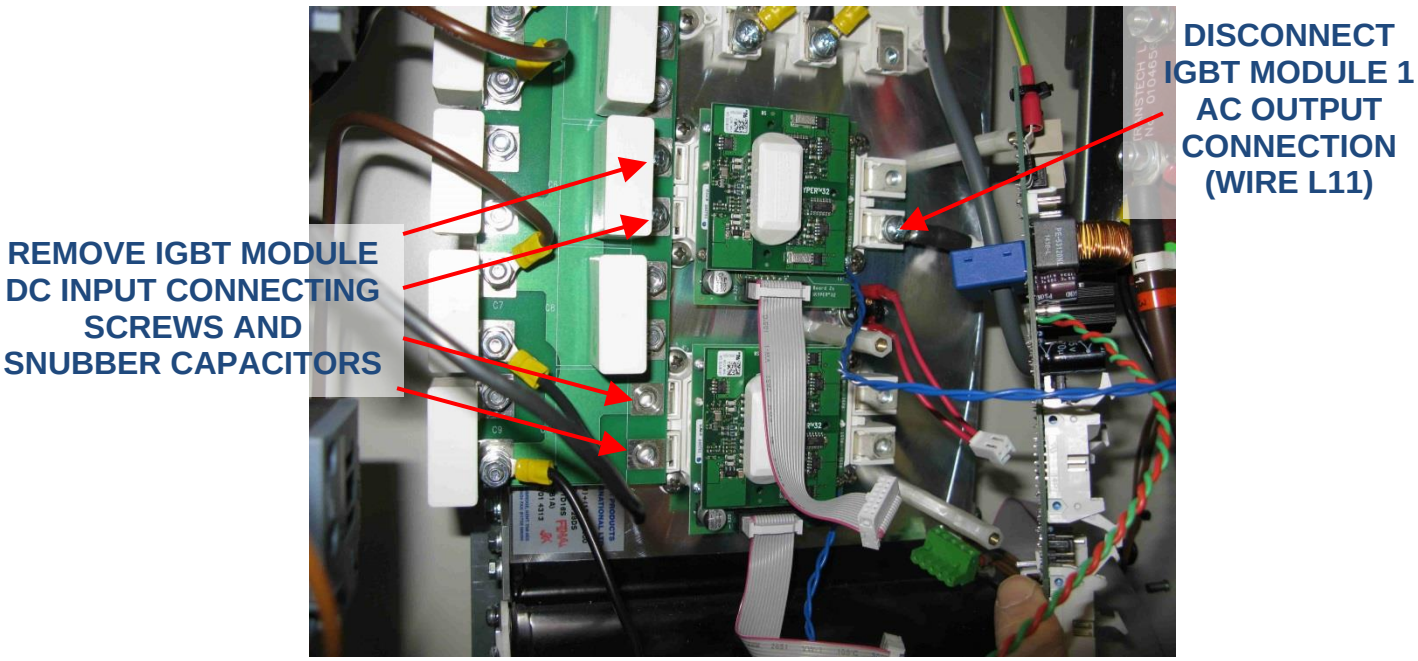


Figure 10-31 Disconnection of 55A stack IGBT module power connections

Caution - IGBTs are extremely sensitive to damage from static electricity, as are parts of the driver boards, so a wrist earthing strap should be worn when working with these devices. Avoid touching the gate connections if the driver boards are not fitted to the IGBT modules, and if the boards are fitted, avoid touching the sensitive electronic circuitry. Always handle these components by the edges.

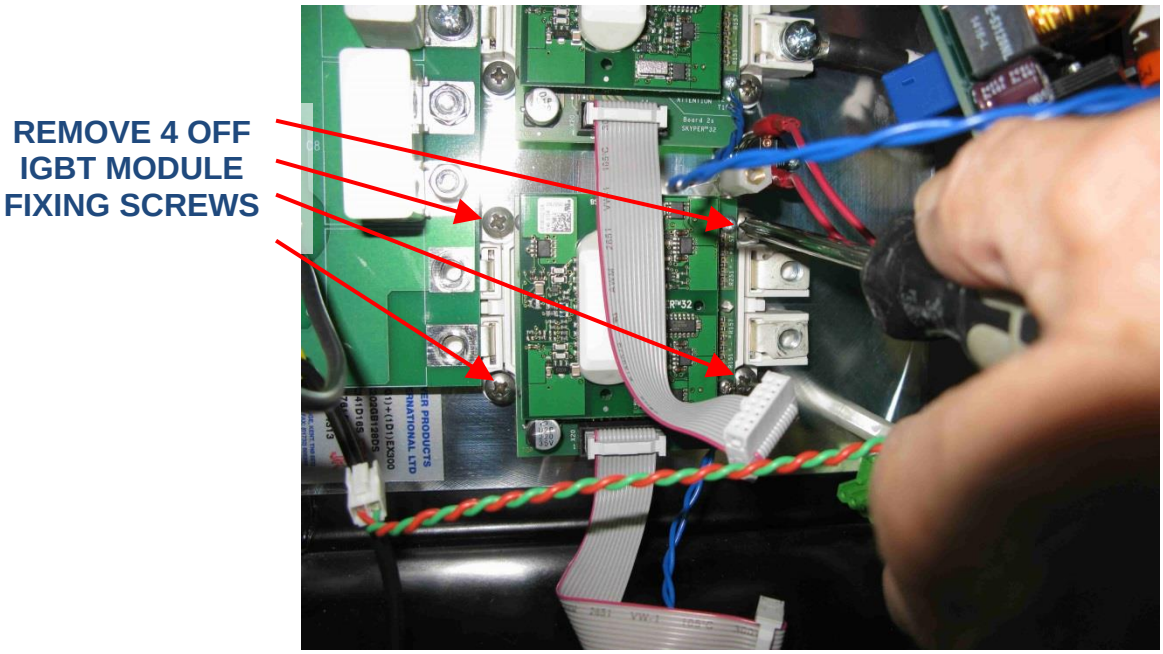


Figure 10-32 Removal of Semix 202 IGBT module fixing screws

Slide the module to the right slightly and withdraw it from the heatsink assembly with the driver card and Adapter Card still attached. Remove the other module in the same manner if it is also faulty.

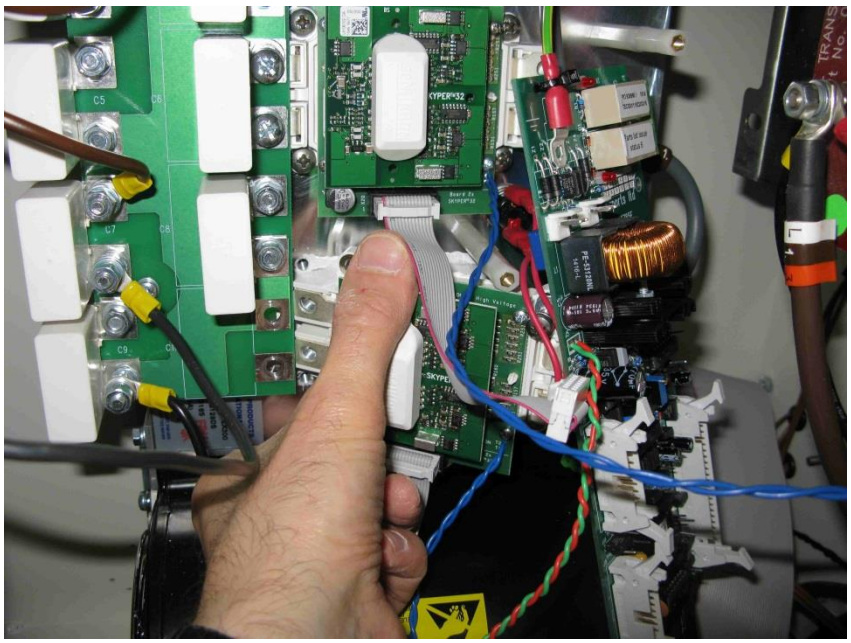


Figure 10-33 Removal of Semix 202 IGBT module

Ensure that the mounting face on the heatsink, which will have a covering of heatsink compound, does not become contaminated with dust or grit. If any dirt sticks to this surface, then the new IGBT module will not fit flush onto the surface and the flow of heat to the heatsink will be impeded.

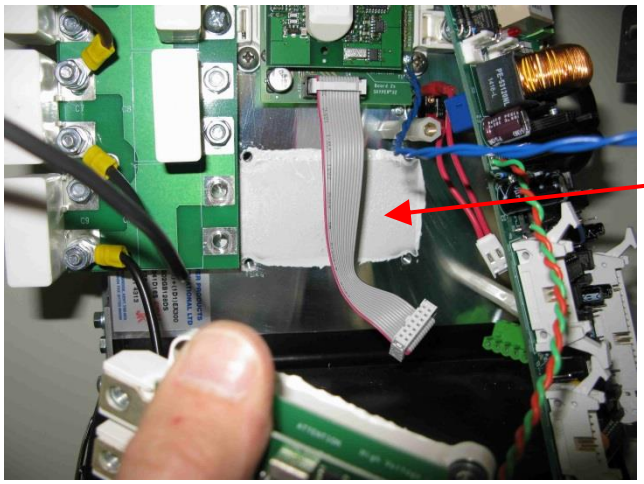


Figure 10-34 IGBT / heatsink contact area

Fitting of the new Semix 202 IGBT and Driver Card assembly is a reversal of the process described above, but before fitting it will be necessary to smear a thin coating of heatsink compound onto the back surface of the IGBT. Use Dow Corning 340 heatsink compound or similar; spread to a thickness of around 100 µm, uniformly applied with a maximum unevenness of 50 µm. Ensure no dust or dirt contaminates this surface before it is fitted to the heatsink.

Tighten the M5 fixing screws and the M6 connecting screws to a torque of 4 Nm.

It is very important to re-connect the output cables to the correct IGBT module, so that the direction of current flow through the transducer on the back of the AT785 Card goes in the right direction; refer to Figure 10-35 below:

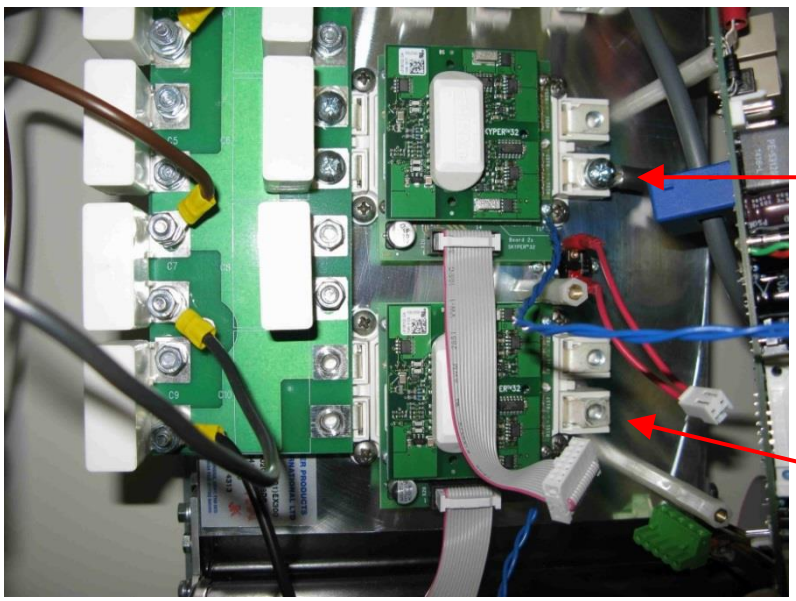


Figure 10-35 55A stack output connections

10.4.2.3 Replacement of 55A stack diode module

The diode module fitted is a Semix 341D16S, stock code 2270-0007. Referring to Figure 10-36 below, replacement of the diode module follows a similar procedure to that for the Semix 202 IGBT module described above. Disconnect the supply cables L9 and L10 and the capacitor cables from the input to the module, remove the DC output terminal screws and snubber capacitor from the left-hand side of the module, then unscrew the four fixing screws and slide the module to the right and withdraw it from the assembly.

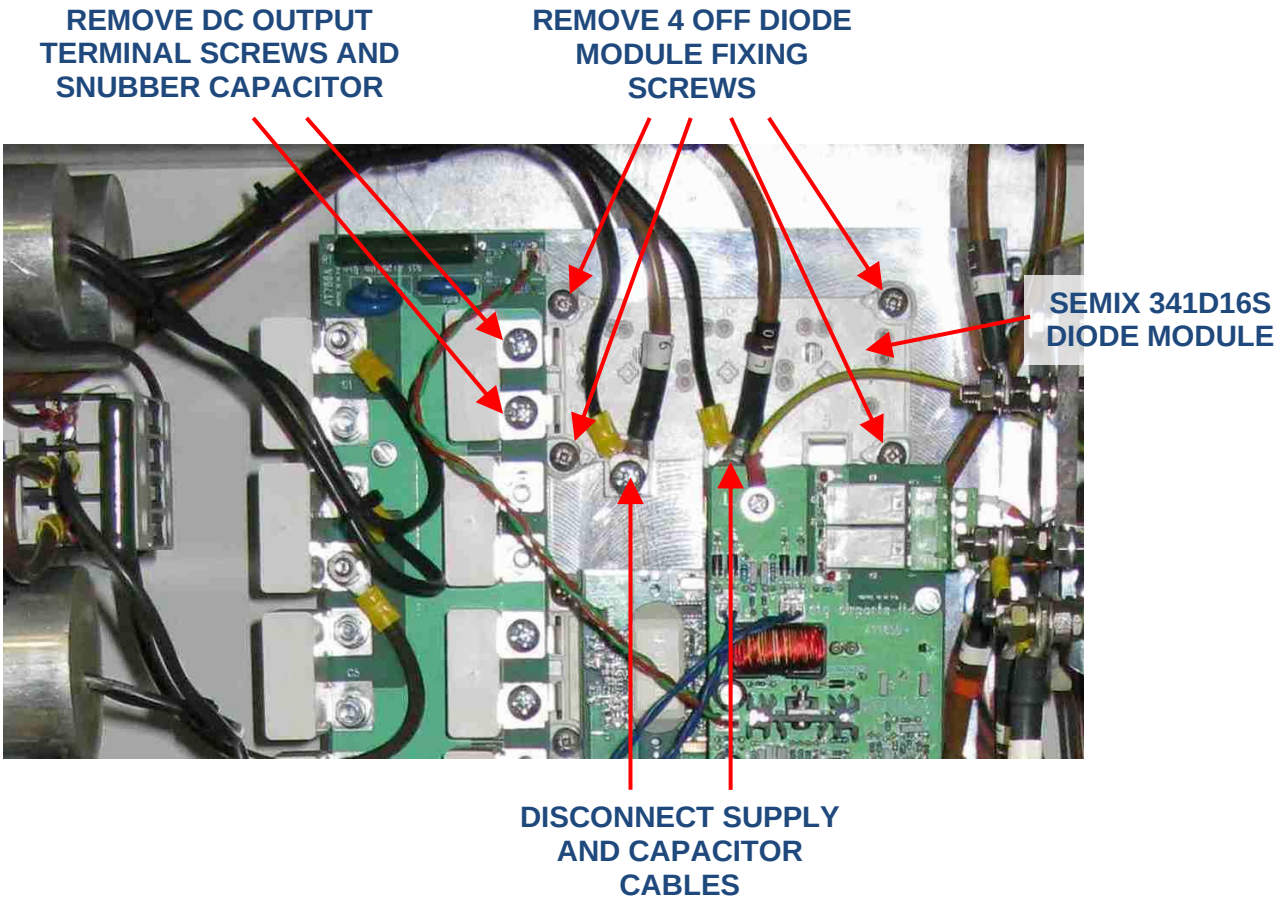


Figure 10-36 55A stack - removal of Semix 341D16S diode module

Fitting of the new Semix 341D16S diode module is a reversal of the process described above, but before fitting it will be necessary to smear a thin coating of heatsink compound onto the back surface of the diode module. Use Dow Corning 340 heatsink compound or similar; spread to a thickness of around 100 µm, uniformly applied with a maximum unevenness of 50 µm. Ensure no dust or dirt contaminates this surface before it is fitted to the heatsink.

Tighten the M5 fixing screws and the M6 connecting screws to a torque of 4 Nm.

11 CCR Theory of Operation

11.1 Introduction

A constant current regulator provides a controlled source of power for an airfield ground lighting circuit. An AGL circuit consists of a number of lights, each of which is connected to the secondary side of an AGL transformer, the primaries of which are connected together in series. Refer to Figure 8-1. The number of lamps on a circuit can range from just a few to a hundred or more, depending on the application.

The regulator supplies a constant level of current to the primary series loop, and thus to each lamp via the AGL transformer secondary connection. This means that all the lamps operate at the same brilliancy.

The AGL transformer is basically a primary wound current transformer which matches the primary series loop current, be it 6.0, 6.6 or 12.0 amps, to that required by the AGL lamp, which is typically 6.6 amps for a modern lamp. Since the AGL series loop current passes through all of these transformers connected in series, then if a lamp filament fails open circuit, the series loop current is not interrupted. In this case, the AGL transformer merely adds inductance to the series circuit load. Note – high voltages can be present on the secondary connections of AGL transformers in open circuit conditions.

Figure 11-1 (overleaf) shows the block diagram of the Micro 200+ CCR with a primary series field loop connected. The AC supply to the CCR is first passed through an EMC filter then through inductors L1 and L2 to the bridge rectifier, which provides a DC supply to the IGBT (Insulated-Gate Bipolar Transistor) H-bridge. To generate an AC output from the H-bridge, the transistors which are diametrically opposed to each other are switched on and off together at high frequency; one pair conducts current in one direction, and the other pair in the other direction. The H-bridge output current is then fed to a low pass filter consisting of the output chokes L3 / L4 and capacitor C2.

The conduction times of the transistors are Pulse Width Modulated such that the current flowing through the low pass filter (and fed to the primary of the CCR main transformer) is smoothed back to a sinewave at mains frequency. The transistor switching is also modulated so as to give the correct RMS current at the output side of the transformer, ie, at the CCR output. (The brilliancy of the AGL lamps is a function of the RMS current level flowing through them).

The CCR main transformer secondary has multiple tappings such that the output voltage can be adjusted to give the correct range according to the load connected to the AGL circuit.

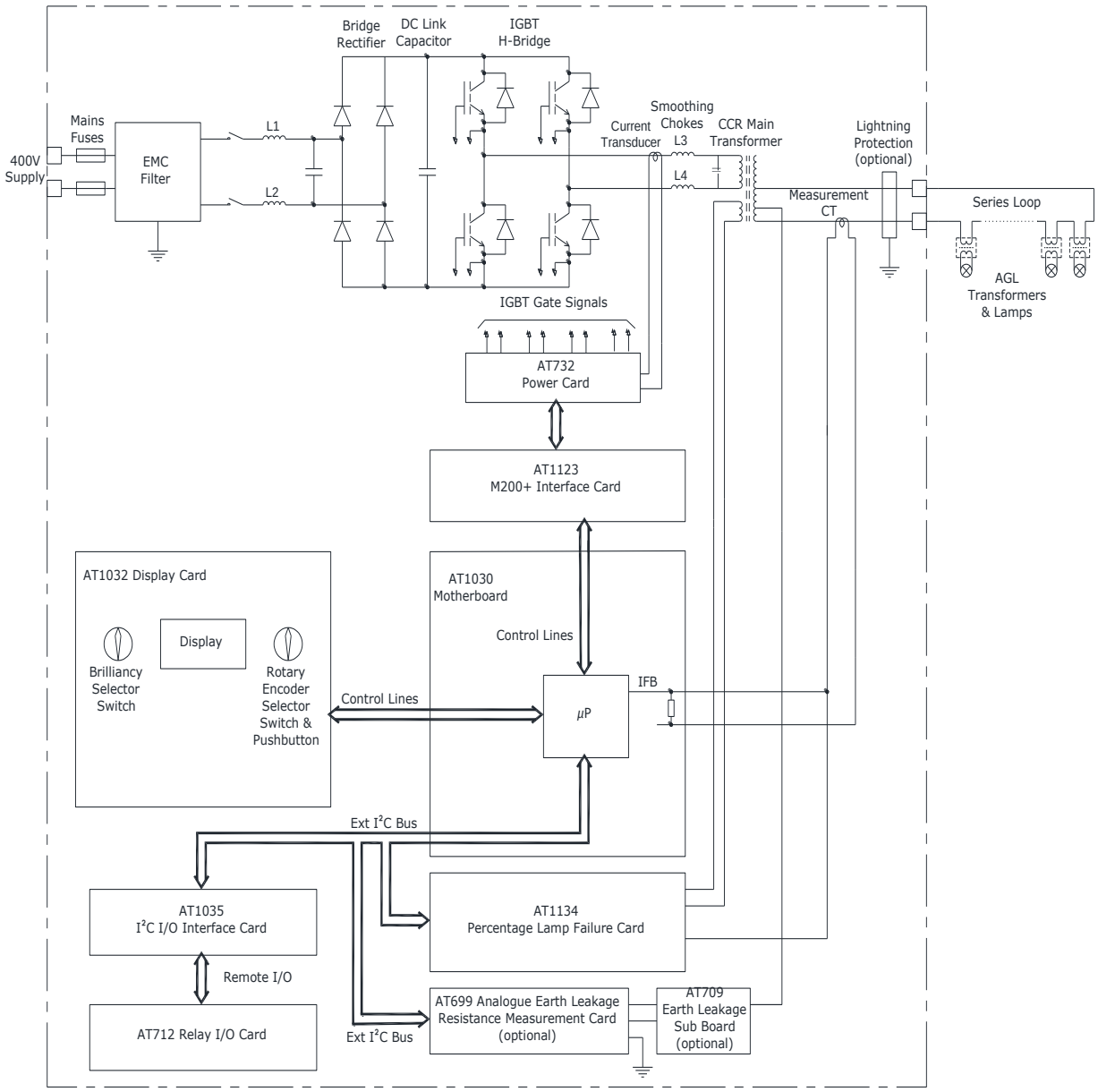


Figure 11-1 Block diagram of Micro 200+ CCR

Two control loops are employed. The outer control loop maintains the desired CCR output current level by comparing the current demand reference signal with the measured CCR RMS output current level, and varying the output of the control amplifier accordingly. The control amplifier output is then fed to a gain control circuit which varies the magnitude of an internally generated sinusoidal signal. This signal, which is synchronized to the mains supply, is the instantaneous current demand (I_{ref}) for the inner control loop, which sets the CCR output current waveshape.

11.2 Control Cards

11.2.1 AT1030 Microcontroller Motherboard

The AT1030 Microcontroller Motherboard, which is mounted behind the CCR lower front cover (see Figure 10-1) performs all of the control and current measurement functions (including the thyristor gate control) and fault detection. Whilst most of the control and measurement is performed by the microcontroller, the Open Circuit fault detection – which is a critical safety function - is implemented in hardware. The Motherboard also contains ancillary hardware such as the synchronisation input used for the thyristor gate control timing (fed from the control transformer), the thyristor firing circuitry, under and overvoltage monitoring circuitry, current feedback circuitry and Run Relay.

The Motherboard has two I^2C serial busses (internal and external), an RS232 port for connection to serial communication (remote) control modules, a USB port and a micro SD card slot. The Motherboard has a parallel connection to the AT1032 Display Card (J2 - 40-way ribbon cable connector), which in turn connects to the Brilliancy Control Rotary Selector Switch and to the Rotary Encoder / Menu Selector Switch.

All input control signals are routed to the Microcontroller via the external I2C bus, as are the control signals for the back indication relays.

11.2.2 AT1032 OLED Display Card

The AT1032 Display card, which is mounted behind the Front Display Panel, contains the 4-line OLED Display and connects to the Brilliancy Control Rotary Selector Switch and the Rotary Encoder / Menu Selector Switch.

There is a 40-way ribbon cable connection to the AT1030 Microcontroller Motherboard.

11.2.3 AT1134 Percentage Lamp Failure Card

The AT1134 Percentage Lamp Failure and Power Measurement Card is a daughter board which is fitted to the AT1030 Motherboard. The function of the AT1134 PLF Card is to give an indication of the Percentage of Lamps Failed on an AGL circuit. The Microcontroller interprets the AT1134 error voltage to give a display of the actual number of failed lamps.

The principle of operation of the AT1134 PLF Card is that the time delay between the CCR output voltage and current waveforms is measured and used to generate an error voltage.

When all lamps are intact, the time delay, or phase lag, can be very small – dependent on the particular AGL circuit characteristics. When lamp filaments on the AGL circuit fail open circuit, the load seen by the CCR becomes more inductive, meaning that the rising edge of the current waveform lags that of the voltage waveform. This lag increases as the load becomes more inductive. The error voltage generated is proportional to this phase lag, and hence is a function of the percentage of failed lamps.

The AT1134 also provides a measurement of the CCR output voltage, kVA and output power.

A more detailed description of this card is given in Section 4.6.

11.2.4 AT1123 M200+ Interface Card

The AT1123 Card, which is mounted behind the CCR lower front cover (see Figure 10-1) provides a control interface between the AT1030 Microcontroller Motherboard and the power cards (AT732 or AT785) mounted on the IGBT stack within the HT cubicle.

11.2.5 Optional Cards

11.2.5.1 Earth Leakage Resistance Measurement - AT699 & AT709

Each AGL lamp module is isolated from the high voltage primary series loop circuit by an AGL transformer. The joints connecting the primary windings of these AGL transformers to the series loop cables tend to leak and allow water to penetrate into the transformer. This causes earth faults on the primary loop internally within the transformer, or from the cable joint itself to earth.

This causes two problems:

i) If more than one earth fault develops, then sections of the AGL circuit between the faults can be shorted out. This results in reduced brilliancy levels, or sections of the lamp circuit may switch off altogether.

ii) More importantly, having an earth leakage path presents a safety hazard. If there is leakage to earth at one or more points in the primary series field circuit there will now be a potential difference between other sections of the circuit and earth. If personnel come into contact with the high voltage cables under these conditions, this could, depending on the earth leakage resistance and hence the level of current flow through the contactee, result in a lethal electric shock.

For these reasons, it is necessary to detect earth faults before they become a problem.

The Analogue Earth Leakage Resistance Measurement Module, which is optional, is based on the AT699 pcb, which mounts behind the CCR front door, and the AT709 sub Card, which mounts in the HT cubicle. The module operates by superimposing a DC test voltage onto the CCR Main Transformer output; the test voltage is 500V while the CCR is operating, or 1000V for a manual test when the CCR is in the 'OFF' state. If there is an earth fault, this causes a DC leakage current which can be measured, and a calculation is performed to give a leakage resistance value. This value can then be displayed on the CCR front panel.

The Earth Leakage Resistance Measurement Module is calibrated using specialised test equipment, and should not require adjustment. However, the alarm and trip thresholds can be programmed via the keypad.

11.2.5.2 AT1035 I2C I/O Interface Card

If the AT712 Relay I/O Card is fitted, then the AT1035 Card must also be fitted. This card, which is mounted behind the CCR lower front cover (see Figure 10-1)provides serial to parallel conversion of the remote control I/O signals from the AT1030 Microcontroller Motherboard.

It connects to the AT1030 Motherboard I^2C serial bus via a 10-way ribbon cable, and to the AT712 Relay I/O Card via a 50-way ribbon cable.

11.2.5.3 AT1130 4-20mA Transmitter Card

The AT1130 4-20mA Transmitter Card is a daughter board which is fitted to the AT1030 Motherboard. It is used to provide a 4-20mA measurement signal, which can be a measurement of CCR output current or output power, and is selectable via the menu system.

11.2.6 Power Card for 25A IGBT stack

11.2.6.1 AT732 Power Card

Note – the AT732 card is fitted over the IGBT stack in the HT cubicle, and it is not recommended to gain access to this card whilst the CCR is powered up except under special circumstances.

The AT732 card is fitted to the 25A IGBT stack assembly (see Figure 10-2), for regulators up to 4kVA from a 220V supply, or up to 7.5kVA from a 400V supply. This card contains control circuitry for the inner control loop, over temperature monitoring, DC link monitoring, and drive circuitry for the IGBT H-bridge.

Two connectors are provided on the rear of the card to plug in cables from the heat sink thermistor (J1) and thermal switch (J3).

11.2.7 Power Cards for 55A IGBT stack

The following cards are fitted to the 55A IGBT stack assembly (see Figure 10-3), for regulators up to 10kVA from a 220V supply, or up to 15kVA from a 400V supply.

Warning – the AT785 and the other power cards listed below are fitted over the IGBT stack in the high voltage cubicle, and it is not recommended to gain access to these cards whilst the CCR is powered up except under special circumstances.

11.2.7.1 AT785 IGBT Control Card

The AT785 contains control circuitry for the inner control loop, over temperature monitoring, DC link monitoring, and the interface circuitry for the Skyper 32 IGBT H-bridge driver cards.

A flying lead from the AT785 IGBT Control Card connects to the AT786 DC Link Card to provide supply voltage monitoring.

11.2.7.2 Adapter Cards 2S

Two of these cards are fitted – one for each of the Semix 202 IGBT modules. They are mounted directly on top of the IGBT module (on the IGBT stack heat sink assembly in the high voltage cubicle) and provide contact points for the electrical connections on the IGBT. The Skyper 32R Driver Cards are then plugged into the Adapter Cards. Ribbon cables connect the Adapter Cards to the AT785 IGBT Control Card to provide the drive signals.

These cards also provide connections to the thermistors built into the IGBT modules. Flying leads from the Adapter Cards plug into the AT785 IGBT Control Card to provide over-temperature protection.

11.2.7.3 Skyper 32R IGBT Driver Cards

Two of these cards are fitted – one for each of the Semix 202 IGBT modules - on the IGBT stack heat sink assembly in the high voltage cubicle. They provide the IGBT gate drive signals and also some fault monitoring.

They plug into the Adapter Cards (described above) which mount on top of the IGBT’s on the heat sink assembly in the high voltage cubicle.

11.2.7.4 AT786 DC Link Card

This card is fitted on the IGBT stack heat sink in the high voltage cubicle, and connects between the bridge rectifier output terminals and the IGBT DC input terminals. It is fitted with ten 470nF, 1250V DC rated snubber capacitors. It also provides terminals to connect the large DC link capacitors (C3, C4 and C5) with the load compensation contactors.

12 Fault Finding

PROBLEM	POSSIBLE CAUSE	CORRECTIVE MAINTENANCE
Regulator does not operate and Power light is not illuminated.	Mains power source 'OFF'.	Check mains power supply.
	Incorrect supply voltage.	Check supply voltage against regulator rating plate.
	Blown mains fuses F1, F2.	Check for earth faults in the field circuit before replacing. Most regulators built to IEC specification have gRL fuses fitted, which have a combined general line and ultra rapid protection characteristic, thus giving thyristor protection. Failure of a gRL fuse could be caused by current surges on the output circuit due to block switching or earth faults. (Some regulators built to IEC specification and all of those built to FAA specification use a gL fuse on the input, which has a slower failure time under high overload conditions. See Table 13-6 for a complete fuse listing).
	Blown fuses F3, F4.	Check control transformers T102 and T105 for faults before replacing.
	Supply plug J20 of AT1030 Motherboard disconnected.	Re-connect plug J20.
	Faulty control transformer T102.	Check that the (nominally) 18/0/18 V AC supply appears at the AT1030 Motherboard connector J20, terminals 1, 2 and 3 respectively. (Measuring from terminal 2 (0V) to terminal 1 and terminal 3 should actually give around 20V AC).
	Faulty AT1030 Motherboard.	Replace AT1030 Motherboard. After changing this board it will be necessary to re-calibrate the regulator as described in section 10.2
Regulator does not operate, Power and Fault lights are illuminated but Supply Under-voltage fault is displayed or OLED display is blank.	Incorrect supply voltage.	Check supply voltage against regulator rating plate.
	Faulty control transformer T102.	Check that the (nominally) 18/0/18 V AC supply appears at the AT1030 Motherboard connector J20, terminals 1, 2 and 3 respectively. (Measuring from terminal 2 (0V) to terminal 1 and terminal 3 should actually give around 20V AC).
	Incorrectly adjusted supply under voltage detector on AT1030 Motherboard.	Refer to ATG Airports
	Faulty AT1030 Motherboard.	Replace AT1030 Motherboard. After changing this board it will be necessary to re-calibrate the CCR as described in section 10.2
Regulator does not operate, Power and Fault lights are illuminated and Output Current Low fault is registered. (Note - turn the Rotary Menu Selector anticlockwise to view any faults present).	Main CCR Transformer (T101) secondary tapping voltage set too low for load.	Adjust as described in Section 4.3
Regulator does not operate, Power and Fault lights are illuminated and Main Contactor fault is registered. (Note - turn the Rotary Menu Selector anticlockwise to view any faults present).	Faulty Contactor CB1 or faulty AT1030 Motherboard.	Check the coil voltage of CB1. If supply voltage is present, but the contactor fails to operate, CB1 is defective. Replace contactor or replace AT1030 Motherboard and re-calibrate the regulator.
	Faulty or open circuit contactor auxiliary circuit.	With contactor CB1 energised check continuity through auxiliary contact (wires 171 and 172). Replace contactor if faulty.
	Door or cover open (if door interlocks fitted).	Close door / replace cover.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE MAINTENANCE
Regulator does not operate; Power and Fault lights are illuminated and Open Circuit fault is registered. (Note - turn the Rotary Menu Selector anticlockwise to view any faults present).	Open Circuit / discontinuity on AGL series loop circuit.	Operate the CCR with a shorting link in place of the AGL circuit. Switch off and isolate the power to the regulator then connect a shorting link between the regulator output terminals S1 and S2, in place of the AGL circuit. If the regulator operates correctly with a short circuit load, the problem is the AGL circuit.
	Incorrect output voltage selector tappings on Main CCR Output Transformer T101	There may be insufficient voltage produced by transformer T101 to deliver rated current into the load impedance, or the transformer tapping voltage is below 20% of maximum and the control loop is unstable. Adjust as described in Section 4.3
	Loose or broken connections.	Shut off power to regulator and check all wiring connections for tightness.
	Faulty IGBT H-Bridge (other than short circuit fault), or faulty IGBT driver card or power control card.	Connect a DVM (set to read AC voltage, up to 20V), or better still an oscilloscope, to TP3 on the AT1123 Interface Card (use TP2 as the 0V return). When the CCR is energised, the AC voltage should ramp up, indicating that the current demand signal is present on the Interface Card. If this signal is present, but the AC voltage is not present on wires 53 and 54 (output from the auxiliary winding of the main transformer, connects to AT1134/AT1131 PLF board), then this is likely to be caused by a faulty IGBT H-Bridge or faulty driver / power control card.
	Faulty IGBT Stack Adapter Board 2S (10 to 15kVA 400V series, or 5 to 10kVA 220V series – not used on smaller sizes)	Test as above. The Adapter Board 2S is the most common cause of failure on the larger IGBT stack assemblies; if the exact cause of failure cannot be ascertained, replace both adapter boards or the complete IGBT stack assembly
When a brilliancy level is selected the regulator operates briefly before tripping and registering an 'Open Circuit' or 'Capacitive Current' fault. (Note - turn the Rotary Menu Selector anticlockwise to view any faults present).	Open circuit / discontinuity on AGL series loop. If the AGL cable has an earth sheath this could then cause capacitive load current to flow.	Repair break in AGL series circuit.
	If the AGL circuit is not in fact open circuited (and all lamps are lighting), then the capacitive current detection circuit may be set too sensitive for the installation.	Capacitive current detection system should be de-sensitised via the menu system.
Regulator does not respond to the remote brilliancy signals	Rotary Brilliancy Selector switch not in Remote position.	Turn switch to Remote position.
	Incorrect Remote Control configuration selected.	Check operating mode selected for Remote Control, see Section 9.3.2.2.
	Fault on external brilliancy control signals	Check switching of Brilliancy control signals, including Command On input (if programmed for separate 'Command On')
	Faulty AT1035 I2C IO Interface Card or AT712 Relay I/O Card	Replace as necessary.
	Faulty / disconnected 10-way ribbon cable (I2C serial comms) between the AT1030 & AT1035 Cards	Replace or re-connect ribbon cable
	Faulty / disconnected 50-way ribbon cable between the AT1035 & AT712 Cards	Replace or re-connect ribbon cable

PROBLEM	POSSIBLE CAUSE	CORRECTIVE MAINTENANCE
Distorted input and output current waveforms, which may become worse at higher output current levels. 'Clicking' sound heard from stack output smoothing inductor L3 / L4.	Insulation breakdown within inductor L3 / L4	Replace faulty inductor.
Maximum displayed output current outside of tolerance limits; 'Tolerance' Fault registered.	AT1030 card out of calibration or new card fitted and has not been calibrated.	Calibrate the CCR as described in section 10.2
CCR output voltage (if enabled) and output load kVA incorrectly displayed	Actual CCR Main Transformer output tapping voltage used not correctly loaded via set-up menu.	Program this as described in Sections 4.4.1
Regulator does not operate, Power and Fault lights are illuminated, GAL fault is displayed	H-Bridge instantaneous over current fault, or IGBT trigger error	Press reset button when the fault message is displayed, or disconnect the CCR mains supply momentarily then turn back on again

Table 12-1 CCR Fault Finding

12.1 Cooling Fan and Heatsink Temperature Monitor

The Micro 200+ utilises a cooling fan which switches on once the IGBT stack heatsink reaches a temperature of approximately 70 ^{o}C. Should the heatsink temperature continue to rise and reach a temperature of 90 ^{o}C, a 'Heatsink Over Temperature Warning' message will be displayed. If the heatsink remains above 90 ^{o}C for a period of time then the CCR will shut down.

12.2 Transformer Over Temperature Monitor

Some versions of the Micro 200+ have thermal switches fitted within both bobbins of the T101 power transformer in order to protect the transformer against over temperature conditions. In the event of the transformer running too hot, a warning message will first be displayed and the 'Transformer Over Temperature Warning' back indication relay will energise. Should the over temperature condition persist, then after 1 minute the CCR will shut down.

In the event of a T101 power transformer over temperature condition first check that the circuit load is not greater than the CCR power rating.

12.3 Verify Failure and Reloading Operating Parameters

In the event that the Microcontroller has displayed the following message on power up:

V	E	R	I	F	Y		F	A	I	L	U	R	E				↑	↓	
→		A	P	P	L	Y		D	E	F	A	U	L	T	S				
		V	I	E	W		F	R	A	M		M	E	M	O	R	Y		

This indicates either that the AT1030 Motherboard has been powered up for the first time (and has never been commissioned on a CCR), or that there has been corruption of data stored in the FRAM memory IC on the AT1030, or a read failure. Pressing the Rotary Menu Selector – which is the only means to go past this screen - will load default operating parameters, thus requiring a reprogramming of the operating parameters for the regulator. If it is not a new regulator (or a new AT1030 Motherboard), it is therefore worth turning off the power to the CCR then back on again to check that it was not just a random read failure of the FRAM IC on power-up.

If the Rotary Brilliancy Control Switch is set to 'Off' and the Rotary Menu Selector is pressed after the 'Verify Failure' message was observed, the following screen will be displayed:

L	O	C	A	L			O	F	F									↓
O	P		C	U	R	R	E	N	T	:			0	.	0	0		A	
O	P		V	O	L	T	A	G	E	:						0		V	

Providing that a record has been kept of the operating parameters for the regulator in question, it is a straightforward process of reloading these into the two menus. (Note - a Micro CCR Parameter Record sheet is included in the following section for the purposes of recording this data).

The following is a list of the main CCR operating parameters, which should be reprogrammed in the sequence described below; refer also to Section 4.2, and for more detailed information, Section 9.3 and Section 9.4.

Menu 3 - Engineering Configuration Menu:

MAXIMUM OUTPUT CURRENT - (Note – the default value is 6.6A)
PLF/PWR ANALYSER CARD TYPE FITTED

Menu 2 - Set-up Menu:

REMOTE CONTROL CONFIG
BRILL LEVELS STYLE
EARTH LEAKAGE MEASUREMENT CONFIG
% LAMP FAILURE (PLF) CONFIGURATION
MAIN TRANSFORMER TAPPING VOLTAGE

12.4 Micro CCR Parameter Record Sheet

CIRCUIT:		**SUBSTATION:**	
CCR SERIAL NUMBER:		**FIRMWARE VERS:**	
CCR KVA RATING:		**OP CURRENT:**	
DATE COMMISSIONED:			

NOTE - IF A CCR IS BEING PROGRAMMED FOR THE FIRST TIME OR IF IT IS BEING RE-PROGRAMMED AFTER A LOSS OF OPERATING PARAMETERS FROM THE FRAM MEMORY, FIRST SET PARAMETERS IN THE ENGINEERING CONFIGURATION MENU SUCH AS THE 'MAXIMUM OUTPUT CURRENT' (IF IT IS DIFFERENT FROM THE DEFAULT VALUE OF 6.60A) AND OTHER PARAMETERS SUCH AS 'PLF/PWR ANALYSER CARD IN USE' BEFORE PROGRAMMING PARAMETERS IN THE SET-UP MENU.

NOTE - THE PARAMETERS / ROWS WITH THE BLUE BACKGROUND ARE THOSE MOST COMMONLY CHANGED FROM DEFAULT. THOSE SCREENS WHICH ARE INDENTED ARE ONLY AVAILABLE WHEN THE PARENT FUNCTION IS SELECTED FROM THE SCREEN ABOVE.

SET-UP MENU

The Set-up Menu is accessed from the Running / Main Menu by the use of a password. The CCR must first be set to ‘Local Off’, by turning the Brilliancy Control Selector switch SW1 to 'OFF'. Turn the right-hand side Rotary Menu Selector anti-clockwise until it displays 'Enter Menu 2 Set-up Menu', then press the Rotary Menu Selector to show 'a a a'.

The default password is 'atg'. Enter the password one letter at a time using the Rotary Menu Selector to scroll up and down the alphabet, and then press the Rotary Menu Selector to enter each letter in turn. If the password is loaded correctly, the display will show the first screen within the Set-up menu: 'Reset Hours Run'.

It is now possible to scroll through the menu using the Rotary Menu Selector; turn anti-clockwise to reach the following screens. Pressing the Rotary Menu Selector will permit modifications to the parameters for the selected screen. The left hand arrow will move to the second line, then turning the Rotary Menu Selector will scroll through the available parameter settings. Press the Rotary Menu Selector to load the new parameter, then turn to select 'Confirm' then press again', or alternatively on 'Cancel' to quit without loading the changes.

To exit the Set-up menu turn the Rotary Menu Selector anti-clockwise until 'Exit Menu 2' is displayed (the last screen), then press the Rotary Menu Selector, then turn to select 'Confirm' then press again.

Refer to the Micro 200+ CCR Installation and Operational Manual for more detailed information on the menu structure.

PARAMETER (SET-UP MENU)	DESCRIPTION	DEFAULT SETTING			SETTING (IF CHANGED)
RESET HOURS RUN AT MAX BRILL	Reset the hours run at maximum brilliancy.	N/A			
REMOTE CONTROL CONFIG	Select between 3 Wire, 3 Wire & Command, BCD, BCD & Command, BCD Option 2, BCD Option 2 & Command, 8 Wire, 8 Wire & Command and Serial Communications. Note - selecting Serial Communications opens further screens (see below).	8 WIRE			
ALARM ON MULTIPLE REMOTE INPUTS	Enable/ Disable the alarm which alerts if an illegal combination of remote control inputs is detected.	ENABLED			
SERIAL COMMS ADDRESS	Select Address of unit for serial communications. (Only available if 'Communication' selected for remote control).	255 (not selected)			
SERIAL COMMS FAULT DELAY TIME	Select the delay time (in seconds) before the Communications fault is raised. (Only available if 'Communication' selected for remote control).	5 S			
SERIAL COMMS FAULT ACTION	Select the action to be taken in the case of a communications fault. Select between 'CCR LATCH', 'CCR ON' and 'CCR OFF'. (Only available if 'Communication' selected as method for remote control).	CCR - LATCH			
SERIAL COMMS FAULT CIRCUIT SELECTOR ACTION	Select the action to be taken by the circuit selector in the case of a communications fault. (Only available if 'Communication' selected as method for remote control and the CCR is configured to use an internal circuit selector).	Each individual circuit reverts to fail-safe condition; alternate CSS reverts to CCT1			
BRILLIANCY LEVELS STYLE	Select between 5 Step Style 2, 3 Step Style 1, 8 Step UK CAP168, User Defined or User Defined DIO.	8 Step (UK) CAP 168			
USER BRILLIANCY LEVELS	When User Defined Brilliancy Levels are selected, allows adjustment of the current levels. (Note - the default levels are those of UK CAP 168).	Levels as per 8 STEP UK CAP 168			
Set User Levels	**CCR OUTPUT CURRENT RATING**	**6.00A**	**6.60A**	**12.0A**	
	BRILL 1	2.34	2.57	4.68	
	BRILL 2	2.64	2.90	5.28	
	BRILL 3	3.06	3.37	6.12	
	BRILL 4	3.54	3.89	7.08	
	BRILL 5	4.14	4.55	8.28	
	BRILL 6	4.86	5.35	9.72	
	BRILL 7	5.73	6.30	11.45	
	BRILL 8	6.00	6.60	12.00	
TOLERANCE MONITORING	Enable/ Disable internal Tolerance Monitoring Unit.	ENABLED			
TOLERANCE MONITORING ALARM DELAY TIME	Set the delay time (seconds) before an Out of Tolerance alarm is raised.	15 S			

PARAMETER (SET-UP MENU)	DESCRIPTION	DEFAULT SETTING			SETTING (IF CHANGED)
TOLERANCE MONITORING ALARM THRESHOLDS	Allows adjustment of the Tolerance Monitoring alarm threshold levels. The tolerance levels for 8 Step brilliancy are listed here. Note - if the User Defined brilliancy (current levels) are changed from the default values, then the Tolerance Levels are automatically moved to be +/- 0.1A from the new operating current value. For 5 and 3 Step brilliancy levels these are always +/- 0.1A from the desired output current.	N/A			
	CCR OUTPUT CURRENT RATING	**6.00A**	**6.60A**	**12.0A**	
	BRILL 1 MIN	2.17	2.39	4.34	
	BRILL 1 MAX	2.41	2.65	4.82	
	BRILL 2 MIN	2.51	2.76	5.01	
	BRILL 2 MAX	2.89	3.18	5.78	
	BRILL 3 MIN	2.96	3.26	5.92	
	BRILL 3 MAX	3.25	3.58	6.51	
	BRILL 4 MIN	3.36	3.70	6.72	
	BRILL 4 MAX	3.68	4.05	7.36	
	BRILL 5 MIN	3.82	4.20	7.64	
	BRILL 5 MAX	4.36	4.80	8.73	
	BRILL 6 MIN	4.78	5.26	9.56	
	BRILL 6 MAX	5.23	5.76	10.47	
	BRILL 7 MIN	5.64	6.20	11.27	
	BRILL 7 MAX	5.78	6.36	11.56	
	BRILL 8 MIN	5.82	6.40	11.64	
	BRILL 8 MAX	6.09	6.70	12.18	
BLACK HEAT OUTPUT CURRENT IN REMOTE OFF	Enable/ Disable Black Heat operation.	DISABLED			
BLACK HEAT OUTPUT CURRENT LEVEL	Set the Black Heat output current level.	6.0A FLC = 1.5A 6.6A FLC = 1.5A 12A FLC = 2.5A 20A FLC = 5.75A			
BLACK HEAT RUN BI RELAY ACTION	Energise or de-energise the Run Relay when Black Heat output current is operating in Remote OFF.	NOT ENERGISED			
LOW CURRENT FAULT THRESHOLD (Io)	Sets the threshold for the minimum CCR output current below which the CCR will trip out. This is in addition to the hardware controlled open circuit detection.	1.5A			
EARTH LEAKAGE MEASUREMENT CONFIG	Select from Enabled, Continuous Enabled (500V test voltage also applied when CCR in 'Off' state) or Disabled. Note - requires the optional AT699 Earth Leakage Detection card must be fitted for this function to operate.	DISABLED			
EARTH LEAKAGE ALARM THRESHOLD STAGE 1	Select the threshold of resistance for the 1st stage Earth Leakage Alarm.	10 MΩ			
EARTH LEAKAGE ALARM THRESHOLD STAGE 2	Select the threshold of resistance for the 2nd stage Earth Leakage Alarm / Trip.	200 kΩ			
EARTH LEAKAGE STAGE 2 TRIP	Configure the stage 2 Earth Leakage detector to give an alarm and continue to run (disabled), or to shutdown (trip) the CCR (enabled).	ENABLED			

PARAMETER (SET-UP MENU)	DESCRIPTION	DEFAULT SETTING	SETTING (IF CHANGED)
% LAMP FAILURE (PLF) CONFIGURATION	Select from Enabled, Enabled FAA Style or Disabled. Note - only available if either of the optional AT1134 PLF / Power Measurement or AT1031 PLF / Power Analyser Cards are fitted.	DISABLED	
% LAMP FAILURE ALARM DELAY TIME	Set the delay time (seconds) before the Percentage Lamp Failure alarm is raised.	15 S	
% LAMP FAILURE NUMBER OF LAMPS IN CCT	Enter the total number of lamps on the AGL circuit.	100	
% LAMP FAILURE ALARM THRESHOLDS	Set the alarm threshold points.		
S1	Enter the threshold for the number of lamp fittings or % lamps failed to trigger a Stage 1 alarm.	5	
S2	Enter the threshold for the number of lamp fittings or % lamps failed to trigger a Stage 2 alarm.	10	
% LAMP FAILURE CALIBRATION	Calibration screens for PLF. (Only available if PLF monitoring is enabled). Select from Quick Calibration, Capture PLF err. L1 and Capture PLF err. L2. For the latter two options, lamps need to be removed corresponding to the two alarm levels to be sampled.	N/A	
QUICK CALIBRATION	Performs a quick auto calibration; all lamps must be intact.	N/A	
CAPTURE PLF ERR L1	Full Calibration routine - select PLF alarm threshold level 1 error sample / capture.	N/A	
ENTER NUM OC LAMPS FOR L1 CAPTURE	Turn the Rotary Menu Selector to show the number of lamp fittings which will be open circuited for calibration of this threshold level (ideally the same as the Stage 1 (S1) alarm threshold above), then press the Rotary Menu Selector. The CCR will then switch on and sample the error signal.	5	
CAPTURE PLF ERR L2	Full Calibration routine - select PLF alarm threshold level 2 error sample / capture.	N/A	
ENTER NUM OC LAMPS FOR L2 CAPTURE	Turn the Rotary Menu Selector to show the number of lamp fittings which will be open circuited for calibration of this threshold level (ideally the same as the Stage 1 (S2) alarm threshold above), then press the Rotary Menu Selector. The CCR will then switch on and sample the error signal.	10	
MAIN TRANSFORMER TAPPING VOLTAGE	Enter the total main transformer output voltage as connected (sum of each winding section connected). Note - only available if either of the optional AT1127 PLF or AT1031 PLF / Power Analyser Cards are fitted and enabled in the 'PLF/PWR Analyser card in use' screen in the Engineering Configuration Menu.	0001V	
KVA ALARM	When enabled generates an alarm if the CCR output load kVA drops below 90% of the peak measured load value for the brilliancy step in operation, for a period of 5 seconds. Note - only available if either of the optional AT1127 PLF or AT1031 PLF / Power Analyser Cards are fitted and enabled in the 'PLF/PWR Analyser card in use' screen in the Engineering Configuration Menu.	DISABLED	
CIRCUIT SELECTOR TYPE	Disables (internal) CSS operation or allows selection of Alternate or Multiway (2 to 6 way) CSS.	DISABLED	
CIRCUIT SELECTOR MULTIWAY CARD TYPE	Select AT661 rev C & onwards or AT661 rev A/B. Defines the Multi-Way Circuit Selector Back Indication Current Detection philosophy, depending on the PCB type fitted.	AT661C ONWARD	

PARAMETER (SET-UP MENU)	DESCRIPTION	DEFAULT SETTING		SETTING (IF CHANGED)
CIRCUIT SELECTOR CONTACTOR TIMING	Allows selection of vacuum relay (15ms) or contactor (100ms up to 500ms) to set the changeover switching time of the internal circuit selector. Set a delay time longer than the actual contactor / relay operating times. (Screen only available when circuit selector is enabled).	500MS		
CIRCUIT SELECTOR ALL OFF ACTION	Set to 'CCR OFF' to turn off the CCR when all circuits are selected to off, even though the CCR itself is selected to on. Alternatively, set to 'CCR ON' – the CCR will continue to operate with all outputs shorted. (Available when Multiway (2 to 6 way) Circuit Selector is enabled).	CCR OFF		
CIRCUIT SELECTOR LOGIC	Select normally open or normally closed logic for correct fail-safe modes for each circuit of Multiway Circuit Selector. Note – the relays / contactors should first be wired to use normally open or normally closed contacts according to the fail-safe requirements of each field circuit (eg. stopbar – fail to on – normally open contact required), then the type of contact used for each circuit programmed via this screen.	N/Op	1, 2, 3, 4, 5, 6	
		N/Cl		
BRILL BI RELAYS ACTIVE ON FAULT	Set to enabled to allow Brilliancy Level Back Indication Relays to remain energised under fault trip conditions.	DISABLED		
CHANGE PASSWORD FOR MENU 2 SET-UP	Allows the password for entry to the Set-up menu to be changed.	atg		
LED & SCREEN TESTS	Allows test of front panel LEDs and OLED screen.	N/A		
CCR MENU 3 ENGINEERING CONFIG	Allows entry to the Engineering Configuration Menu via the password entry screen.	eng		
EXIT MENU 2 SET-UP MENU	Allows exit from the Set-up menu.			

ENGINEERING CONFIGURATION MENU

The Engineering Configuration Menu is accessed from the Set-up Menu by the use of a password. From the Set-up Menu, turn the right-hand side Rotary Menu Selector anti-clockwise until it displays 'Enter Menu 3 Engineering Config', then press the Rotary Menu Selector to show 'a a a'.

The default password is 'eng'. Enter the password one letter at a time using the Rotary Menu Selector to scroll up and down the alphabet, and then press the Rotary Menu Selector to enter each letter in turn. If the password is loaded correctly, the display will show the first screen within the Engineering Configuration Menu: 'Maximum Output Current'.

It is now possible to scroll through the menu using the Rotary Menu Selector; turn anti-clockwise to reach the following screens. Pressing the Rotary Menu Selector will permit modifications to the parameters for the selected screen. The left hand arrow will move to the second line, then turning the Rotary Menu Selector will scroll through the available parameter settings. Press the Rotary Menu Selector to load the new parameter, then turn to select 'Confirm' then press again', or alternatively on 'Cancel' to quit without loading the changes.

To exit the Engineering Configuration Menu turn the Rotary Menu Selector anti-clockwise until 'Exit Menu 3' is displayed (the last screen), then press the Rotary Menu Selector, then turn to select 'Confirm' then press again.

Refer to the Micro 200+ CCR Installation and Operational Manual for more detailed information on the menu structure.

PARAMETER (ENGINEERING CONFIGURATION MENU)	DESCRIPTION	DEFAULT SETTINGS	SETTING (IF CHANGED)
MAXIMUM OUTPUT CURRENT	Select CCR maximum output current. Available settings are 6.00, 6.60, 12.0 and 20.0A.	6.6A	
NOMINAL SUPPLY VOLTAGE	Select the nominal supply voltage for which the CCR has been manufactured. Note - this will be indicated on the CCR nameplate and will have been programmed during factory testing of the CCR	415V	
PLF/PWR ANALYSER CARD IN USE	Select from AT1031 PLF-PA Card, AT1127 PLF Card or disabled	DISABLED	
CCR KVA RATING	Enter the kVA rating of the CCR. Note - screen not available on all CCRs	30KVA	
AENA OUTPUTS	Enables AENA I/O configuration (for Spanish market)	DISABLED	
START-UP RAMP	The CCR can be programmed to gradually ramp up the O/P current to selected level on start-up, in a set time period, rather than switch on directly at the selected level. Enable/ Disable Start Ramp	DISABLED	
START-UP RAMP TIME	Set the Start Up Current Ramp time. (Only available if Start Up Ramp is enabled)	600ms	
TRANSITION RAMP	The CCR can be programmed to gradually ramp up and ramp down the output current on switching transitions, with separate time periods selectable for ramp up and ramp down. (Note – this has no effect on the initial Start-up ramp time). Enable/ Disable Transition Ramp	DISABLED	
RISING CURRENT RAMP TIME	Set the Current Ramp time for rising output current transitions. (Note – this has no effect on the initial Start-up ramp time. This is only available if Transition Ramp is enabled)	600ms	
FALLING CURRENT RAMP TIME	Set the Current Ramp time for falling output current transitions. (This is only available if Transition Ramp is enabled).	600ms	
CAPACITIVE CURRENT DETECTION	Detection of capacitive current flow can be set to trip the CCR, cause a soft alarm but continue operating, or detection can be disabled. For reasons of safety, it should be set to trip the CCR since for circuits using primary series loop cable with an earth screen, an open circuit fault may not otherwise be detected due to current continuing to flow through the capacitance of the earth sheath	TRIP	
CAPACITIVE CURRENT THRESHOLD	Sets the threshold level for detection of capacitive current. The valid range is from 1 to 100; the lower the value the more sensitive is the detector. It can be desensitised if nuisance tripping is encountered.	30	
ASYMMETRIC CURRENT DETECTION	This feature detects an imbalance (asymmetry) in the current between the positive and negative half cycles of the CCR output waveshape, which can sometimes be caused by an imbalance in an active (electronic) load on the series loop circuit. Detection of asymmetric current can be set to trip the CCR, cause a soft alarm but continue operating, or detection can be disabled	ALARM	
ASYMMETRIC CURRENT THRESHOLD	Set the Overcurrent Trip Time characteristic: IEC/EN setting trips in less than 5 seconds for an overcurrent of 102.3%, FAA setting trips in less than 5 seconds for an overcurrent of 105%	10	
OVERCURRENT TRIP TIME	Configure the stage 2 Earth Leakage detector to give an alarm and continue to run (disabled), or to shutdown (trip) the CCR (enabled)	IEC (102.3% < 5s)	
FORCE OUTPUT CURRENT TEST MENU	Test use only - not to be used on live circuit. Allows manual control of output current in order to test the Overcurrent and Undercurrent trip points	CCR maximum output current	
EXIT MENU 3 ENGINEERING CONFIG	Allows exit from the Engineering Configuration Menu.	N/A	

Table 12-2 CCR Parameter Record Sheet

13 Parts Listings and Circuit Schematics

Table 13-1 to Table 13-10 provide a list of all major components fitted to a standard CCR, with the exception of the cabinet, covers and fixings. The list includes the parts for all voltage and power ratings, plus the optional components available for the Micro 200+ series. When choosing spare parts, check carefully the specification of the regulator for which the parts are to be purchased.

The recommended spares quantity varies depending on the quantity of CCRs for the project, and on how many of these CCRs use any given part.

Items which are recommended to purchase as spares include a letter in the listing denoting the spare parts category; a typical spares kit would include those parts denoted category ‘A’ and ‘B’.

The categories are defined as follows:

Category A – fuses only in this category. Refer to Table 13-6 for the quantities of each fitted; normally keep 2 spares of each type (2A control and power fuse) for every CCR on site which would use these components.

Category B – keep 1 spare part from this category where there are 5 or more CCRs on site which would use these components. Eg, 7410-1030 Control Card

Category C – keep 1 spare part from this category where there are 15 or more CCRs on site which would use these components.

For example, all Micro 200+ CCRs use the AT733 Control Card (stock number 7410-1030) and so a mixture of different CCRs, which could be in terms of voltage or kVA rating, or optional parts fitted, will make up the total quantity of CCRs using this part to determine whether it should be included in the list of recommended spares.

On the other hand, the Micro 200+ CCRs with built-in Circuit Selector Switches use a different Microcontroller Front Panel than that for a standard CCR, and the Front Panel is specific to the exact type of Circuit Selector fitted. In this case, the quantities of each particular variant of Circuit Selector Switch are used to determine the type and quantity of recommended spare Microcontroller Front panels.

T101 CCR POWER TRANSFORMERS						
220V SERIES, 6.6A OUTPUT				400V SERIES, DUAL 6.6 / 12A OUTPUT		
CCR RATING, kVA	MANUFACTURER	ATG AIRPORTS STOCK CODE		CCR RATING, kVA	MANUFACTURER	ATG AIRPORTS STOCK CODE
1	ATG AIRPORTS	2690-0689		3.78	ATG AIRPORTS	2690-0610
2.5	ATG AIRPORTS	2690-0690		7.5	ATG AIRPORTS	2690-0611
4	ATG AIRPORTS	2690-0691		11.34	ATG AIRPORTS	2690-0615
5	ATG AIRPORTS	2690-0692		15	ATG AIRPORTS	2690-0612
7.5	ATG AIRPORTS	2690-0693		18.9	ATG AIRPORTS	2690-0616
10	ATG AIRPORTS	2690-0694		22.68	ATG AIRPORTS	2690-0613
12.5	ATG AIRPORTS	2690-0695		26.46	ATG AIRPORTS	2690-0614
15	ATG AIRPORTS	2690-0696				
400V SERIES, 6.6A OUTPUT						
CCR RATING, kVA	MANUFACTURER	ATG AIRPORTS STOCK CODE				
1	ATG AIRPORTS	2690-0674				
2.5	ATG AIRPORTS	2690-0675				
4	ATG AIRPORTS	2690-0676				
5	ATG AIRPORTS	2690-0677				
7.5	ATG AIRPORTS	2690-0678				
10	ATG AIRPORTS	2690-0679				
12.5	ATG AIRPORTS	2690-0680				
15	ATG AIRPORTS	2690-0681				
20	ATG AIRPORTS	2690-0682				
25	ATG AIRPORTS	2690-0683				
30	ATG AIRPORTS	2690-0684				

Table 13-1 Parts List: T101 Power Transformers

Note – other transformer types from those listed above may be fitted depending on the exact specification of the CCR. Check the part number for the transformer actually fitted if a replacement is to be ordered.

REF	OPTION CODES WHERE FITTED	QTY	COMPONENT TYPE	DESCRIPTION	MANUFACTURER	MFTR P/N	ATG AIRPORTS STOCK CODE	SPARE PART CATEGORY / COMMENT
FP		1	FRONT PANEL	STANDARD MICRO 200+ MICROCONTROLLER FRONT PANEL	ATG AIRPORTS	8500-2010K	8500-2010K	B
FP	D	1	FRONT PANEL	ALTERNATE CIRCUIT SELECTOR MICRO 200+ MICROCONTROLLER FRONT PANEL	ATG AIRPORTS	8500-2011K	8500-2011K	B
FP	2W	1	FRONT PANEL	2W SIMULTANEOUS CIRCUIT SELECTOR MICRO 200+ MICROCONTROLLER FRONT PANEL	ATG AIRPORTS	8500-2012K	8500-2012K	B
FP	3W	1	FRONT PANEL	3W SIMULTANEOUS CIRCUIT SELECTOR MICRO 200+ MICROCONTROLLER FRONT PANEL	ATG AIRPORTS	8500-2013K	8500-2013K	B
FP	4W	1	FRONT PANEL	4W SIMULTANEOUS CIRCUIT SELECTOR MICRO 200+ MICROCONTROLLER FRONT PANEL	ATG AIRPORTS	8500-2014K	8500-2014K	B
FP	5W	1	FRONT PANEL	5W SIMULTANEOUS CIRCUIT SELECTOR MICRO 200+ MICROCONTROLLER FRONT PANEL	ATG AIRPORTS	8500-2015K	8500-2015K	B
FP	6W	1	FRONT PANEL	6W SIMULTANEOUS CIRCUIT SELECTOR MICRO 200+ MICROCONTROLLER FRONT PANEL	ATG AIRPORTS	8500-2016K	8500-2016K	B
AT637	2W/3W/4W /5W/6W	1	PCB	SIMULTANEOUS SELECTOR SWITCH CARD (PART OF 8500-2012K TO 8500-2016K)	ATG AIRPORTS	AT637	7400-1637A	B
AT657	D	1	PCB	DIRECTION / ALTERNATE CIRCUIT SELECTOR CARD (PART OF 8500-2011K)	ATG AIRPORTS	AT657	7400-1657A	B
AT661	2W/3W/4W /5W/6W	1	PCB	SIMULTANEOUS / MULTIWAY CIRCUIT SELECTOR CONTROL CARD	ATG AIRPORTS	AT661	7400-1661A	B
AT663	2W/3W/4W /5W/6W	1	PCB	SIMULTANEOUS / MULTIWAY CIRCUIT SELECTOR RELAY I/O CARD	ATG AIRPORTS	AT663	7400-1663A	B
AT683	JS	1	PCB	J-BUS / MODBUS COMMUNICATION ADAPTOR CARD	ATG AIRPORTS	AT683	7400-1683A	B
AT699	EF	1	PCB	EARTH LEAKAGE DETECTION CARD	ATG AIRPORTS	AT699	7400-1699A	C
AT709	EF	1	PCB	EARTH LEAKAGE SUB - CARD	ATG AIRPORTS	AT709	7400-1709A	C
AT712	24/48	1	PCB	RELAY I/O CARD	ATG AIRPORTS	AT712	7400-1712A	B
AT714		1	PCB	MOV TRANSIENT SUPPRESSION CARD	ATG AIRPORTS	AT714	7400-1714	B
AT728	PS	1	PCB	DUAL PROFIBUS COMMUNICATION ADAPTOR CARD	ATG AIRPORTS	AT728	7400-1728A	B
AT742		1	PCB	INPUT Y CAPACITOR FILTER CARD (UP TO 25A INPUT CURRENT)	ATG AIRPORTS	AT742	7400-1742A	

REF	OPTION CODES WHERE FITTED		COMPONENT TYPE	DESCRIPTION	MANUFACTURER	MFTR P/N	ATG AIRPORTS STOCK CODE	SPARE PART CATEGORY
AT759	PM/CM	1	PCB	CURRENT TRANSDUCER PCB	ATG AIRPORTS	AT759	7400-1759A	
AT764		1	PCB	OUTPUT Y CAPACITOR FILTER CARD (UP TO 1150V)	ATG AIRPORTS	AT764	7400-1764A	
AT765		1	PCB	OUTPUT Y CAPACITOR FILTER CARD (UP TO 2300V)	ATG AIRPORTS	AT765	7400-1765A	
AT777		1	PCB	4-20mA OP FILTER CARD	ATG AIRPORTS	AT777	7400-1777A	
AT901		1	PCB	INPUT X AND Y CAPACITOR FILTER CARD (UP TO 55A INPUT CURRENT)	ATG AIRPORTS	AT901	7400-1901A	
AT912		1	PCB	STACK OUTPUT Y CAPACITOR FILTER CARD (UP TO 55A INPUT CURRENT)	ATG AIRPORTS	AT912	7400-1912A	
AT1026	FCI	1	PCB	CUTOUT SWITCH RELAY CARD	ATG AIRPORTS	AT1026	7410-1026	B
AT1030		1	PCB	MICROCONTROLLER MOTHERBOARD	ATG AIRPORTS	AT1030	7410-1030	B
AT1032		1	PCB	OLED DISPLAY BOARD (PART OF 8500-20xxK)	ATG AIRPORTS	AT1032	7410-1032	B
AT1035	24/48	1	PCB	I2C I/O INTERFACE CARD	ATG AIRPORTS	AT1035	7410-1035	B
AT1056	MTS	1	PCB	MODBUS TCP / IP COMMUNICATION CARD	ATG AIRPORTS	AT1056	7400-1056	B
AT1123		1	PCB	M200+ INTERFACE CARD	ATG AIRPORTS	AT1123	7410-1123	B
AT1130	PM/CM	1	PCB	M100+ 4-20mA TRANSMITTER CARD	ATG AIRPORTS	AT1130	7410-1130	C
AT1134	LF	1	PCB	M200+ PERCENTAGE LAMP FAILURE CARD	ATG AIRPORTS	AT1134	7410-1134	C
BOARDS WHICH ARE A PART OF THE STACK ASSEMBLIES (ALREADY INCLUDED WITH THOSE PARTS KITS):								
AT732D		1	PCB	POWER CARD	ATG AIRPORTS	AT732D	7400-1732A	B
AT785F		1	PCB	IGBT CONTROL CARD	ATG AIRPORTS	AT785F	7400-1785A	B
AT786A		1	PCB	DC LINK CARD	ATG AIRPORTS	AT786A	7400-1786A	

Table 13-2 Parts List: Circuit Boards, including optional

CONTROL TRANSFORMERS - ALL BUILD STANDARDS							220V SERIES - QUANTITY						400V SERIES - QUANTITY							
REF	PRI. VOLTS	SEC VOLTS AND VA	MFTR	MFTR P/N	ATG AIRPORTS STOCK CODE	SPARE PART CATEGORY	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA
T102	0-208-220-240V	18/0/18v (22VA) TO AT533, 0-220v (22VA) TO AT500, 15/0/15v (12VA) TO AT699 E/F CARD, 0-20v (3VA) SPARE	DOUGLAS TRANSFORMERS	M5978	2690-0020	C	1	1	1	1	1	1								
T105	0-208-220-240V	18/0/18 (22VA) TO AT712A RIO CARD, 0-9v (6VA) TO PROFIBUS / MODBUS / J-BUS CARD	DOUGLAS TRANSFORMERS	M5979	2690-0021	C	1	1	1	1	1	1								
T102	0-380-415-440V	18/0/18v (22VA) TO AT533, 0-220v (22VA) TO AT500, 15/0/15v (12VA) TO AT699 E/F CARD, 0-20v (3VA) SPARE	DOUGLAS TRANSFORMERS	M5866	2690-0013	C							1	1	1	1	1	1	1	1
T105	0-380-415-440V	18/0/18 (22VA) TO AT712A RIO CARD, 0-9v (6VA) TO PROFIBUS / MODBUS / J-BUS CARD	DOUGLAS TRANSFORMERS	M5700	2690-0014	C							1	1	1	1	1	1	1	1
T112	0-380-415-440V	18/0/18v (22VA) TO AT533, 0-220v (22VA) TO AT500, 15/0/15v (12VA) TO AT699 E/F CARD, 0-20v (3VA) SPARE	DOUGLAS TRANSFORMERS	M5866	2690-0013	C							1	1	1	1	1			
T112	15-0-230-400V	0-230v, 200VA, 1A	RS	504-139 (ST53334)	2690-0024	C												1	1	1

Table 13-3 Parts List: standard Control Transformers

CONTROL TRANSFORMERS FOR CCR OPTIONS									
REF	OPTION CODES WHERE FITTED	QTY	DESCRIPTION	PRIMARY VOLTAGE	SECONDARY VOLTAGE(S) AND RATINGS	MFTR	MFTR P/N	ATG AIRPORTS STOCK CODE	SPARE PART CATEGORY
220V SERIES									
T106	2W/3W/4W/ 5W/6W	1	CONTROL SUPPLY FOR AT661 MULTIWAY CIRCUIT SELECTOR CARD	0-208-220-240V	0-18v (24VA), 0-18v (12VA), 0-9v (6VA)	DOUGLAS TRANSFORMERS	M6293	2690-0012A	C
T107	D	1	CONTROL SUPPLY FOR AT657 DIRECTION / ALTERNATE CIRCUIT SELECTOR CARD	0-208-220-240V	0-18v (12VA)	DOUGLAS TRANSFORMERS	M6292	2690-0017A	C
400V SERIES									
T106	2W/3W/4W/ 5W/6W	1	CONTROL SUPPLY FOR AT661 MULTIWAY CIRCUIT SELECTOR CARD	0-380-400-415V	0-18v (24VA), 0-18v (12VA), 0-9v (6VA)	DOUGLAS TRANSFORMERS	M5586	2690-0012	C
T107	D	1	CONTROL SUPPLY FOR AT657 DIRECTION / ALTERNATE CIRCUIT SELECTOR CARD	0-380-400-415V	0-18v (12VA)	DOUGLAS TRANSFORMERS	M5536	2690-0017	C
CURRENT TRANSFORMERS					RATING				
T103	STD CCR AND 2W/3W/4W/ 5W/6W	1 - 7	CURRENT TRANSFORMER	N/A	150:0.5 AMPS, 1VA CL0.5	NORATEL	TI-077554 ISS 3	2690-0009	

Table 13-4 Parts List: Control Transformers for optional circuitry and CT's

REF	CCR OPTION CODES	QTY	COMPONENT TYPE	DESCRIPTION	RATING	MANUFACTURER	MFTR P/N	ATG AIRPORTS STOCK CODE	SPARE PART CATEGORY
OUTPUT TERMINALS AND LIGHTNING ARRESTORS									
OUTPUT TERMINAL	ALL EXCEPT LA	2 - 7	TERMINAL	STANDARD CCR OUTPUT TERMINAL	125A	WEIDMULLER	WFF 35	2720-0071	
COVER	ALL EXCEPT LA	4 - 14		OUTPUT TERMINAL COVER		WEIDMULLER	WAH 35	2720-0075	
LIGHTNING ARRESTOR	LA	1	MOV / TERMINAL	2 OUTPUTS - METAL OXIDE VARISTOR AND TERMINAL ASSEMBLY	MOV IMPULSE RATING - 15kA, 10 x 20µS	ATG AIRPORTS	7200-0210	7200-0210	C
LIGHTNING ARRESTOR	LA - 2W	1	MOV / TERMINAL	3 OUTPUTS - METAL OXIDE VARISTOR AND TERMINAL ASSEMBLY	MOV IMPULSE RATING - 15kA, 10 x 20µS	ATG AIRPORTS	7200-0212	7200-0212	C
LIGHTNING ARRESTOR	LA - 3W	1	MOV / TERMINAL	4 OUTPUTS - METAL OXIDE VARISTOR AND TERMINAL ASSEMBLY	MOV IMPULSE RATING - 15kA, 10 x 20µS	ATG AIRPORTS	7200-0213	7200-0213	C
LIGHTNING ARRESTOR	LA - 4W	1	MOV / TERMINAL	5 OUTPUTS - METAL OXIDE VARISTOR AND TERMINAL ASSEMBLY	MOV IMPULSE RATING - 15kA, 10 x 20µS	ATG AIRPORTS	7200-0214	7200-0214	C
LIGHTNING ARRESTOR	LA - 5W	1	MOV / TERMINAL	6 OUTPUTS - METAL OXIDE VARISTOR AND TERMINAL ASSEMBLY	MOV IMPULSE RATING - 15kA, 10 x 20µS	ATG AIRPORTS	7200-0215	7200-0215	C
LIGHTNING ARRESTOR	LA - 6W	1	MOV / TERMINAL	7 OUTPUTS - METAL OXIDE VARISTOR AND TERMINAL ASSEMBLY	MOV IMPULSE RATING - 15kA, 10 x 20µS	ATG AIRPORTS	7200-0216	7200-0216	C
LIGHTNING ARRESTOR	LA - D	1	MOV / TERMINAL	4 OUTPUTS - METAL OXIDE VARISTOR AND TERMINAL ASSEMBLY	MOV IMPULSE RATING - 15kA, 10 x 20µS	ATG AIRPORTS	7200-0211	7200-0211	C
CUTOUT SWITCH ASSEMBLIES									
CUTOUT SWITCH	FCI	1 OR 2	ISOLATING SWITCH	SAFETY ISOLATING SWITCH	12A	ATG AIRPORTS	2610-0022A	2610-0022A	
CUTOUT SWITCH + INTERLOCK	FCI (EG, AIR. NZ)	1 OR 2	ISOLATING SWITCH	SAFETY ISOLATING SWITCH WITH REED RELAY INTERLOCK TO DISCONNECT CCR OUTPUT	12A	ATG AIRPORTS	2610-0024A	2610-0024A	
CUTOUT SW + INTLK + BACK IND	FCI (EG, AENA SPEC, SP)	1	ISOLATING SWITCH	SAFETY ISOLATING SWITCH WITH REED RELAY INTERLOCK TO DISCONNECT CCR OUTPUT, AND POSITION BACK INDICATION	12A	ATG AIRPORTS	2610-0023A	2610-0023A	
CIRCUIT SELECTOR RELAYS, MAX. 6.6A, UP TO 10kVA									
C1 - C6	2W/3W/4W /5W/6W/D	1 - 6	CONTROL RELAY	24V LOW CONSUMPTION DC COIL, INC. SUPPRESSOR. 3 NO AND 2 NC CONTACTS	CONTACT RATING: 10A	TELEMECANIQUE	CAD-32BL	2610-0140	B
CIRCUIT SELECTOR RELAYS, 12.5kVA TO 30kVA AT 6.6A, ALL KVA RATINGS AT 12A									
C1 - C6	2W/3W/4W /5W/6W/D	1 - 6	VACUUM RELAY	CIRCUIT SELECTOR RELAY, 6.6A, 12.5kVA TO 30kVA, AND 12A AT ALL KVA RATINGS	CONTACT RATING: 50A @ 12kV AC	JENNINGS	RJ2B-26S	2515-0055	B

Table 13-5 Parts List: Output Terminals, Cutout, Lightning Arrestors and CSS Relays

FUSES FOR IEC BUILD STANDARD								220V SERIES - QUANTITY. F2/F4=NUETRAL LINK ON SINGLE PHASE (L-N) MODELS. 2 PHASE MODEL QTY IN (-)						400V SERIES - QUANTITY							
REF	COMPONENT TYPE	VOLT. RAT.	CURR. RAT.	MFTR	MFTR P/N	ATG AIRPORTS STOCK CODE	SPARES CATEGORY	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA
F1, F2	FUSEHOLDER (DUAL), 10 x 38mm	N/A	N/A	SIBA	5106304.2	2720-0090		1	1	1				1	1	1	1	1			
F1, F2	gRL FUSE, 10 x 38mm	500V	10A	SIBA	6003434.10A	2550-0311	A	1 (2)						2	2						
F1, F2	gRL FUSE, 10 x 38mm	500V	20A	SIBA	6003434.20A	2550-0320	A		1 (2)							2	2				
F1, F2	gRL FUSE, 10 x 38mm	500V	30A	SIBA	6003434.30A	2550-0330	A			1 (2)								2			
F1, F2	FUSEHOLDER (DUAL), 22 x 58mm	N/A	N/A	SIBA	5106004.2	2720-0092					1	1	1						1	1	1
F1, F2	gRL FUSE, 22 x 58mm	690V	40A	SIBA	5014034.40A	2550-0440	A				1 (2)								2		
F1, F2	gRL FUSE, 22 x 58mm	690V	50A	SIBA	5014034.50A	2550-0350	A													2	
F1, F2	gRL FUSE, 22 x 58mm	690V	63A	SIBA	5014034.63A	2550-0363	A					1 (2)									2
F1, F2	gRL FUSE, 22 x 58mm	690V	80A	SIBA	5014034.80A	2550-0380	A						1 (2)								
F3, F4	FUSEHOLDER (DUAL), 10 x 38mm	N/A	N/A	SIBA	5106304.2	2720-0090		1	1	1	1	1	1	1	1	1	1	1	1	1	1
F3, F4	gG FUSE, 10 x 38mm	500V	2A	SIBA	5006308.2A	2550-0302	A	1 (2)	1 (2)	1 (2)				2	2	2	2	2			
F3, F4	gG FUSE, 10 x 38mm	500V	4A	SIBA	5006308.4A	2550-0304	A				1 (2)	1 (2)	1 (2)						2	2	2
F2, F4	NUETRAL LINK, 10 x 38mm	N/A			5006308.N	2550-0402		2 (0)	2 (0)	2 (0)	1 (0)	1 (0)	1 (0)								
F2	NUETRAL LINK, 22 x 58mm	N/A			5006008.N	2550-0404		0 (0)	0 (0)	0 (0)	1 (0)	1 (0)	1 (0)								
NOTE - 220V SERIES SINGLE PHASE (L-N) MODELS USE 1 OF EACH FUSE, WITH F2 AND F4 REPLACED BY A NUETRAL LINK. 220V 2 PHASE MODELS USE 2 OF EACH FUSE																					
FUSE TYPES:																					
gG - GENERAL LINE FUSE																					
gRL - COMBINED LINE AND SEMICONDUCTOR PROTECTION FUSE																					

Table 13-6 Parts List: Fuses

CIRCUIT BREAKERS / MCB'S - OPTIONAL, IN PLACE OF LINE FUSES.							SPARES CATEGORY	220V SERIES - QUANTITY. F2/F4=NEUTRAL LINK ON SINGLE PHASE (L-N) MODELS. 2 PHASE MODEL QTY IN (-)						400V SERIES - QUANTITY							
REF	COMP. TYPE	VOLT. RAT.	CURR . RAT.	MFTR	MFTR P/N	ATG AIRPORTS STOCK CODE		1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA
F1	MCB, SINGLE POLE 10A TYPE C	440V	10A	ABB	S201MC10	2550-1810	C	1													
F1	MCB, SINGLE POLE 20A TYPE C	440V	20A	ABB	S201MC20	2550-1820	C		1												
F1	MCB, SINGLE POLE 32A TYPE C	440V	32A	ABB	S201MC32	2550-1832	C			1											
F1	MCB, SINGLE POLE 40A TYPE C	440V	40A	ABB	S201MC40	2550-1840	C				1										
F1	MCB, SINGLE POLE 63A TYPE C	440V	63A	ABB	S201MC63	2550-1863	C					1									
F1	MCB, SINGLE POLE 80A TYPE C	440V	80A	ABB	S801N-C80	2550-1880	C						1								
F2	HOLDER, SINGLE 10x38mm	N/A	N/A	SIBA	5106304	2720-0097		1	1												
F2	HOLDER, SINGLE 22x58mm	N/A	N/A	SIBA	5106005.1	2720-0098				1	1	1									
F1, F2	MCB, 2 POLE 6A TYPE C	440V	6A	ABB	S202MC6	2550-2006	C							1							
F1, F2	MCB, 2 POLE 10A TYPE C	440V	10A	ABB	S202MC10	2550-2010	C	(1)							1						
F1, F2	MCB, 2 POLE 20A TYPE C	440V	20A	ABB	S202MC20	2550-2020	C		(1)							1	1				
F1, F2	MCB, 2 POLE 32A TYPE C	440V	32A	ABB	S202MC32	2550-2032	C			(1)								1			
F1, F2	MCB, 2 POLE 40A TYPE C	440V	40A	ABB	S202MC40	2550-2040	C				(1)								1		

CIRCUIT BREAKERS / MCB'S - OPTIONAL, IN PLACE OF LINE FUSES.							SPARES CATEGORY	220V SERIES - QUANTITY. F2/F4=NEUTRAL LINK ON SINGLE PHASE (L-N) MODELS. 2 PHASE MODEL QTY IN (-)						400V SERIES - QUANTITY							
REF	COMP. TYPE	VOLT. RAT.	CURR . RAT.	MFTR	MFTR P/N	ATG AIRPORTS STOCK CODE		1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA
F1, F2	MCB, 2 POLE 50A TYPE C	440V	50A	ABB	S202MC50	2550-2050	C													1	
F1, F2	MCB, 2 POLE 63A TYPE C	440V	63A	ABB	S202MC63	2550-2063	C					(1)									1
F1, F2	MCB, 2 POLE 80A TYPE C	440V	80A	ABB	S802N-C80	2550-2080	C						(1)								
F3, F4	HOLDER, 10x38mm	N/A	N/A	SIBA	5106304.2	2720-0090		1	1	1	1	1	1	1	1	1	1	1	1	1	1
F3, F4	gG FUSE, 10x38mm	500V	2A	SIBA	5006308.2A	2550-0302	A	1 (2)	1 (2)	1 (2)				2	2	2	2	2			
F3, F4	gG FUSE, 10x38mm	500V	4A	SIBA	5006308.4A	2550-0304	A				1 (2)	1 (2)	1 (2)						2	2	2
F2, F4	NEUTRAL LINK, 10x38mm	N/A	N/A	SIBA	5006308.N	2550-0402		2 (0)	2 (0)	1 (0)	1 (0)	1 (0)	1 (0)								
F2	NEUTRAL LINK, 22x58mm	N/A	N/A	SIBA	5006008.N	2550-0404		0 (0)	0 (0)	1 (0)	1 (0)	1 (0)	1 (0)								

NOTE - 220V SERIES SINGLE PHASE (L-N) MODELS USE SINGLE POLE MCB'S FOR F1 AND F3, WITH F2 AND F4 REPLACED BY A NEUTRAL LINK. 220V 2 PHASE MODELS USE 2 POLE MCB.	SPARES CATEGORY	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA
FUSE TYPES:		220V SERIES - QUANTITY. F2/F4=NEUTRAL LINK ON SINGLE PHASE (L-N) MODELS. 2 PHASE MODEL QTY IN (-)						400V SERIES - QUANTITY							
gG - GENERAL LINE FUSE															

Table 13-7 Parts List: Circuit Breakers (optional, in place of line fuses)

POWER CAPACITORS							220V SERIES - REF / QUANTITY						400V SERIES - REF / QUANTITY							
	COMP. TYPE	VOLT. RAT. (AC)	CAPACITANCE	MFTR	MFTR P/N	ATG AIRPORTS STOCK CODE	SPARES KIT QTY	1kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA
	NOT FITTED													C3							
	CAPACITOR	700V DC	1uF	ICW	SC1988	2190-0019	C	C3	C3					C4, 5							
	CAPACITOR	700V DC	2uF	ICW	SC1763	2190-0020	C								C3	C3	C3				
	CAPACITOR	700V DC	3uF	ICW	SC1751	2190-0021	C			C3	C3			C1, 2	C4	C4	C4	C3			
	CAPACITOR	700V DC	4uF	ICW	SC1764	2190-0022	C								C2, 5	C2, 5	C2, 5				
	CAPACITOR	700V DC	5uF	ICW	SC1729	2190-0023	C	C4	C4	C2		C3						C2, 4	C3	C3	C3
	CAPACITOR	700V DC	7.5uF	ICW	SC1765	2190-0024	C	C5	C5	C4			C3					C1, 5	C4		
	CAPACITOR	700V DC	10uF	ICW	SC1730	2190-0025	C			C1A, 1B,5	C4	C2A,2B, 5A,5B	C4A, 4B		C1	C1	C1		C1, 5	C4	C4
	CAPACITOR	700V DC	15uF	ICW	SC1731	2190-0026	C	C1, 2	C1, 2		C1A, 1B,2, 5	C1A,1B, 1C,2C,4	C2A,2B, 2C, 5A, 5B						C2	C1,2, 5	C1,2, 5
	CAPACITOR	700V DC	20uF	ICW	SC2348	2190-0031	C						C1A,1B, 1C								

INDUCTORS								220V SERIES - QUANTITY						400V SERIES - QUANTITY							
	COMP. TYPE	INDUCTANCE / DESCRIPTION	CURR. RAT.	MFTR	MFTR P/N	ATG AIRPORTS STOCK CODE		1kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA
	INDUCTOR	0.2mH DAMPER	16A	IST POWER PRODUCTS	0104637	2630-0037		2	2					2	2	2					
	INDUCTOR	0.2mH DAMPER	25A	SCHAFFNER	RU2300 4-25-99	2630-0066											2	2			
	INDUCTOR	0.15mH DAMPER	34A	IST POWER PRODUCTS	0104655	2630-0068				2	2								2		
	INDUCTOR	0.125mH DAMPER	47A	SCHAFFNER	RU2300 4-47-99	2630-0067														2	2
	INDUCTOR	0.05mH DAMPER	60A	IST POWER PRODUCTS	0104682	2630-0064						2	2								

INDUCTORS							SPARES CATEGORY	220V SERIES - QUANTITY						400V SERIES - QUANTITY							
	COMP. TYPE	INDUCTANCE / DESCRIPTION	CURR. RAT.	MFTR	MFTR P/N	ATG AIRPORTS STOCK CODE		1kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA
	INDUCTOR	1.7 + 1.7mH DIFFERENTIAL	16A	IST POWER PRODUCTS	0104636	2630-0072								1	1	1					
	INDUCTOR	1.7 + 1.7mH DIFFERENTIAL	25A	IST POWER PRODUCTS	0104599	2630-0073											1	1			
	INDUCTOR	1.5mH	34A	IST POWER PRODUCTS	0104654	2630-0038													2		
	INDUCTOR	0.8mH	43A	IST POWER PRODUCTS	0104222	2630-0043		2	2												
	INDUCTOR	1.0mH	47A	IST POWER PRODUCTS	0104656	2630-0039														2	2
	INDUCTOR	0.8mH	50A	IST POWER PRODUCTS	0104250	2630-0042				2	2	2									
	INDUCTOR	0.71mH	60A	IST POWER PRODUCTS	0104665	2630-0051							2								
	INDUCTOR	1.0mH COMMON MODE	50A	SCHAFFNER	RD8127-50-1M0	2630-0040					1	1							1	1	1
	INDUCTOR	0.8mH COMMON MODE	64A	SCHAFFNER	RD8127-64-0M8	2630-0044							1								
	INDUCTOR	FERRITE BEAD		WURTH ELECTRONICS	74270115	2680-0020		2	2	2				2	2	2	2	2			
	INDUCTOR	FERRITE BEAD (CLAMP ON)		WURTH ELECTRONICS	74271622	2680-0021					2	2	2						2	2	2
	INDUCTOR	FERRITE BEAD (CLAMP ON)		FAIR-RITE VO	431177081	2680-0022					1	1	1						1	1	1

Table 13-8 Parts List: Capacitors and Inductors

EMC FILTERS								220V SERIES - QUANTITY						400V SERIES - QUANTITY							
REF	COMPONENT TYPE	VOLT. RATING (AC)	CURR. RATING	MFTR	MFTR P/N	ATG AIRPORTS STOCK CODE	SPARE PART CATEGORY	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA
F101	EMC FILTER	520V	25A	SCHAFFNER	FN2410H-25-33	2620-0011		1	1					1	1	1	1				
F101	EMC FILTER	520V	32A	SCHAFFNER	FN2410H-32-33	2620-0013				1								1			
F101	EMC FILTER	520V	60A	SCHAFFNER	FN2410H-60-34	2620-0021					1	1							1	1	1
F101	EMC FILTER	520V	100A	SCHAFFNER	FN2410H-100-34	2620-0026							1								
CONTACTORS AND COIL SUPPRESSORS								220V SERIES - QUANTITY						400V SERIES - QUANTITY							
REF	COMPONENT TYPE	VOLT. RATING (AC)	CURR. RATING	MFTR	MFTR P/N	ATG AIRPORTS STOCK CODE	SPARE PART CATEGORY	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA
CB1	CONTACTOR, 230V AC COIL, SIZE S0	690V	35A	SIEMENS	3RT2025-1AL20	2610-0220K	C	1	1	1											
CB1	CONTACTOR, 230V AC COIL, SIZE S2	690V	55A	SIEMENS	3RT2035-1AL20	2610-0221K	C				1	1									
CB1	CONTACTOR, 230V AC COIL, SIZE S2	690V	90A	SIEMENS	3RT2038-1AL20	2610-0222K	C						1								
CB1	CONTACTOR, 400V AC COIL, SIZE S0	690V	35A	SIEMENS	3RT2025-1AR60	2610-0091K	C							1	1	1	1				
CB1	CONTACTOR, 400V AC COIL, SIZE S2	690V	55A	SIEMENS	3RT2035-1AR60	2610-0102K	C											1	1	1	1
CB1	COIL SUPPRESSOR, SIZE S0	240 TO 400V	N/A	SIEMENS	3RT29 26-1CE00	2610-0109	C	1	1	1				1	1	1	1				
CB1	COIL SUPPRESSOR, SIZE S2	240 TO 400V	N/A	SIEMENS	3RT29 36-1CE00	2610-0103	C				1	1	1					1	1	1	1
CB2, 3	CONTACTOR, 230V AC COIL, SIZE S0	690V	35A	SIEMENS	3RT2025-1AL20	2610-0220K	C	2	2	2	2	2	2								
CB2, 3	CONTACTOR, 400V AC COIL, SIZE S0	690V	35A	SIEMENS	3RT2025-1AR60	2610-0091K	C							2	2	2	2	2	2	2	2
CB2, 3	COIL SUPPRESSOR, SIZE S0	240 TO 400V	N/A	SIEMENS	3RT29 26-1CE00	2610-0109	C	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Table 13-9 Parts List: EMC Filters and Contactors

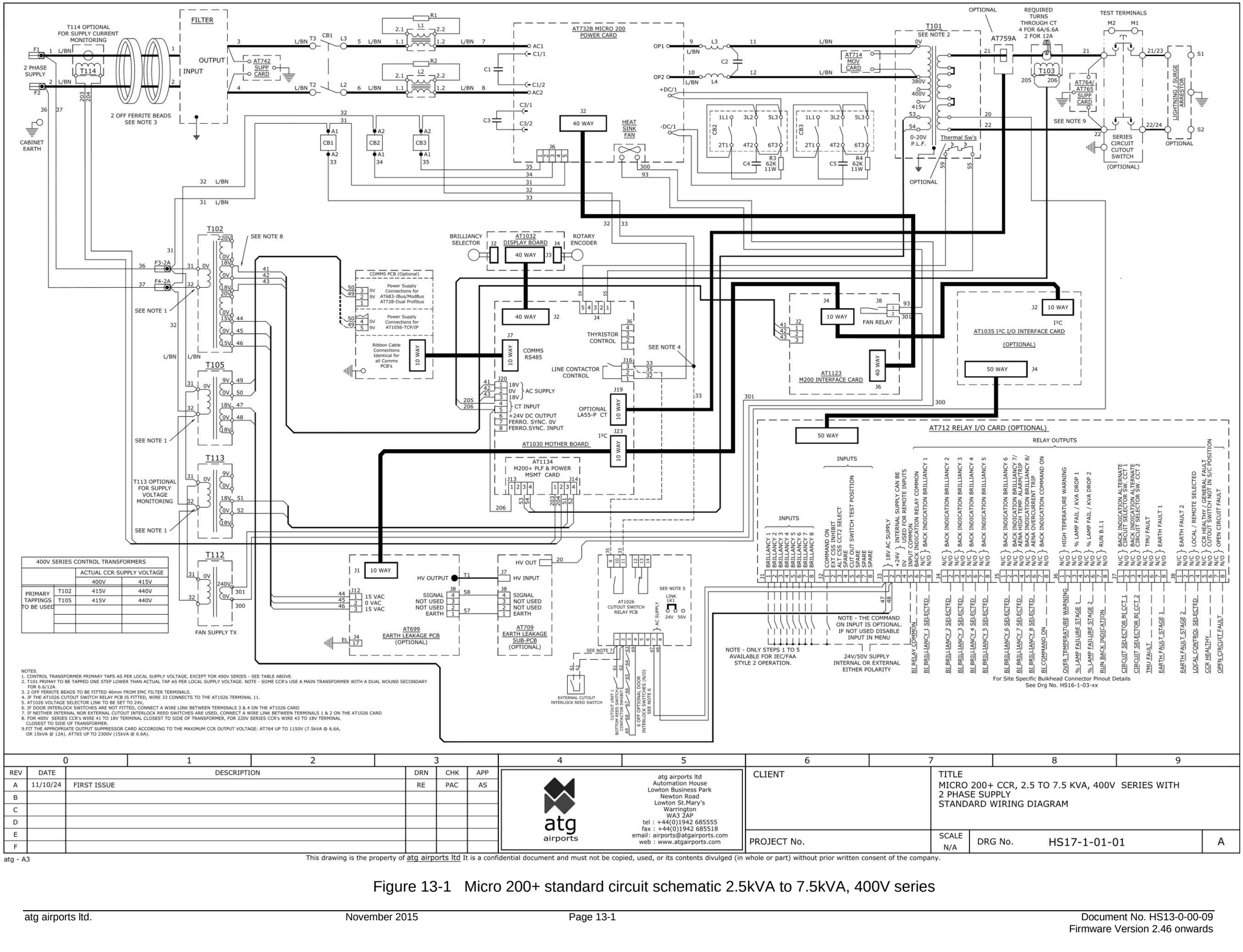
IGBT STACK ASSEMBLIES							SPARES CATEGORY	220V SERIES - QUANTITY						400V SERIES - QUANTITY							
	COMPONENT TYPE	VOLTAGE AND CURRENT RATINGS (AC)	NUMBER OF TURNS AND CABLE CSA THROUGH AT732 / AT785 CURRENT TRANSDUCER FOR THE CORRECT RANGE OF PRIMARY CURRENT	AT732 OR AT785 HYSTERESIS POTENTIOMETER SETTING	MFTR	ATG AIRPORTS STOCK CODE		1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA
	SKM75GB12T4 IGBT STACK ASSEMBLY AND AT732 CARD	415V / 25A	7 TURNS OF 1 MM	AT732 TP5 = 3.5V (ADJUST VR1; TP32 IS 0V RETURN)	ATG AIRPORTS	7500-1800K	B							1							
	SKM75GB12T4 IGBT STACK ASSEMBLY AND AT732 CARD	415V / 25A	3 TURNS OF 4 MM	AT732 TP5 = 3.5V (ADJUST VR1; TP32 IS 0V RETURN)	ATG AIRPORTS	7500-1800K	B	1							1	1					
	SKM75GB12T4 IGBT STACK ASSEMBLY AND AT732 CARD	415V / 25A	2 TURNS OF 6 MM	AT732 TP5 = 3.5V (ADJUST VR1; TP32 IS 0V RETURN)	ATG AIRPORTS	7500-1800K	B		1								1				
	SKM75GB12T4 IGBT STACK ASSEMBLY AND AT732 POWER CARD	415V / 25A	2 TURNS OF 6 MM	AT732 TP5 = 2.5V (ADJUST VR1; TP32 IS 0V RETURN)	ATG AIRPORTS	7500-1800K	B			1								1			
	SEMiX 202GB12E4S IGBT STACK ASSEMBLY	415V / 55A	1 TURN (USE 10 MM HIGH TEMP POLYRAD FXT IF MAINS CABLE IS 16MM OR 25MM)	AT785 TP6 = 7mV (ADJUST VR2; TP2 IS 0V RETURN. TP6 IS LOCATED NEXT TO VR1, 'HYST')	ATG AIRPORTS	7500-1761A					1								1		
	SEMiX 202GB12E4S IGBT STACK ASSEMBLY	415V / 55A	1 TURN (USE 10 MM HIGH TEMP POLYRAD FXT IF MAINS CABLE IS 16MM OR 25MM)	AT785 TP6 = 10mV (ADJUST VR2; TP2 IS 0V RETURN. TP6 IS LOCATED NEXT TO VR1, 'HYST')	ATG AIRPORTS	7500-1761A						1									
	SEMiX 202GB12E4S IGBT STACK ASSEMBLY	415V / 55A	1 TURN (USE 10 MM HIGH TEMP POLYRAD FXT (HIGH TEMP CABLE) WHERE MAINS CABLE IS 16MM OR 25MM)	AT785 TP6 = 20mV (ADJUST VR2; TP2 IS 0V RETURN. TP6 IS LOCATED NEXT TO VR1, 'HYST')	ATG AIRPORTS	7500-1761A							1							1	1

REPLACEMENT IGBTS, DIODE MODULES, SNUBBER CAPACITORS AND FANS (NOTE - THESE ARE SUPPLIED AS PART OF THE COMPLETE STACK ASSEMBLIES LISTED ABOVE)							SPARES CATEGORY	220V SERIES - QUANTITY						400V SERIES - QUANTITY							
	COMPONENT TYPE	MFTR	MFTR P/N	VOLTAGE RATING	CURRENT RATING	ATG AIRPORTS STOCK CODE		1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA
	IGBT	SEMIKRON	SKM75GB12T4	1200V	75A	2323-0207		2	2	2				2	2	2	2	2			
	IGBT	SEMIKRON	SEMiX 202GB12E4S	1200V	200A	2323-0215					2	2	2						2	2	2
	IGBT, DRIVER AND ADAPTER BOARD 2S COMPLETE SET	SEMIKRON	SEMiX 202GB12E4S, L6100102, L6100141	1200V	200A	2323-0216	B				2	2	2						2	2	2
	RECTIFIER DIODE MODULE	SEMIKRON	SKKD 81/14	1400V	80A	2270-0005		2	2	2				2	2	2	2	2			
	RECTIFIER DIODE MODULE	SEMIKRON	SEMIX 341D16S	1600V	340A	2270-0007	B				1	1	1						1	1	1
	CAPACITOR	ALCON	KPF 0.47uF/1250VDC	1250V DC		2195-0150		5	5	5	10	10	10	5	5	5	5	5	10	10	10
	COOLING FAN, 25A STACK	PPI	69-0036	220V AC		2570-0016	C	1	1	1				1	1	1	1	1			
	COOLING FAN, 60A STACK	PPI	69-0045	220V AC		2570-0017	C				1	1	1						1	1	1

Table 13-10 Parts List: IGBT stack and power card assemblies

DOOR SAFETY INTERLOCKS (OPTIONAL)									
REF	CCR OPTION CODES	QTY	COMPONENT TYPE	DESCRIPTION	RATING	MANUFACTURER	MFTR P/N	ATG AIRPORTS STOCK CODE	SPARE PART CATEGORY
ISOLATING SWITCH	DI (EG, AENA SPEC, SP)	6	ISOLATING SWITCH	LIMIT SWITCH	1A / 125V AC	OMRON	D3D-131	021020	
ISOLATING SWITCH	DI (EG, AENA SPEC, SP)	6	ISOLATING SWITCH	CONNECTOR HOUSING		JST	HLP-03V	021021	
ISOLATING SWITCH	DI (EG, AENA SPEC, SP)	12	ISOLATING SWITCH	CONNECTOR INSERT	18-22AWG	JST	SSF-21T-P1.4	021023	

Table 13-11 Parts List: Door interlocks



REV	DATE	DESCRIPTION	DRN	CHK	APP
A	11/10/24	FIRST ISSUE	RE	PAC	AS
B					
C					
D					
E					
F					

atg airports ltd
Automation House
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email : airports@atgairports.com
web : www.atgairports.com

CLIENT

TITLE
MICRO 200+ CCR, 2.5 TO 7.5 KVA, 400V SERIES WITH 2 PHASE SUPPLY
STANDARD WIRING DIAGRAM

PROJECT No.

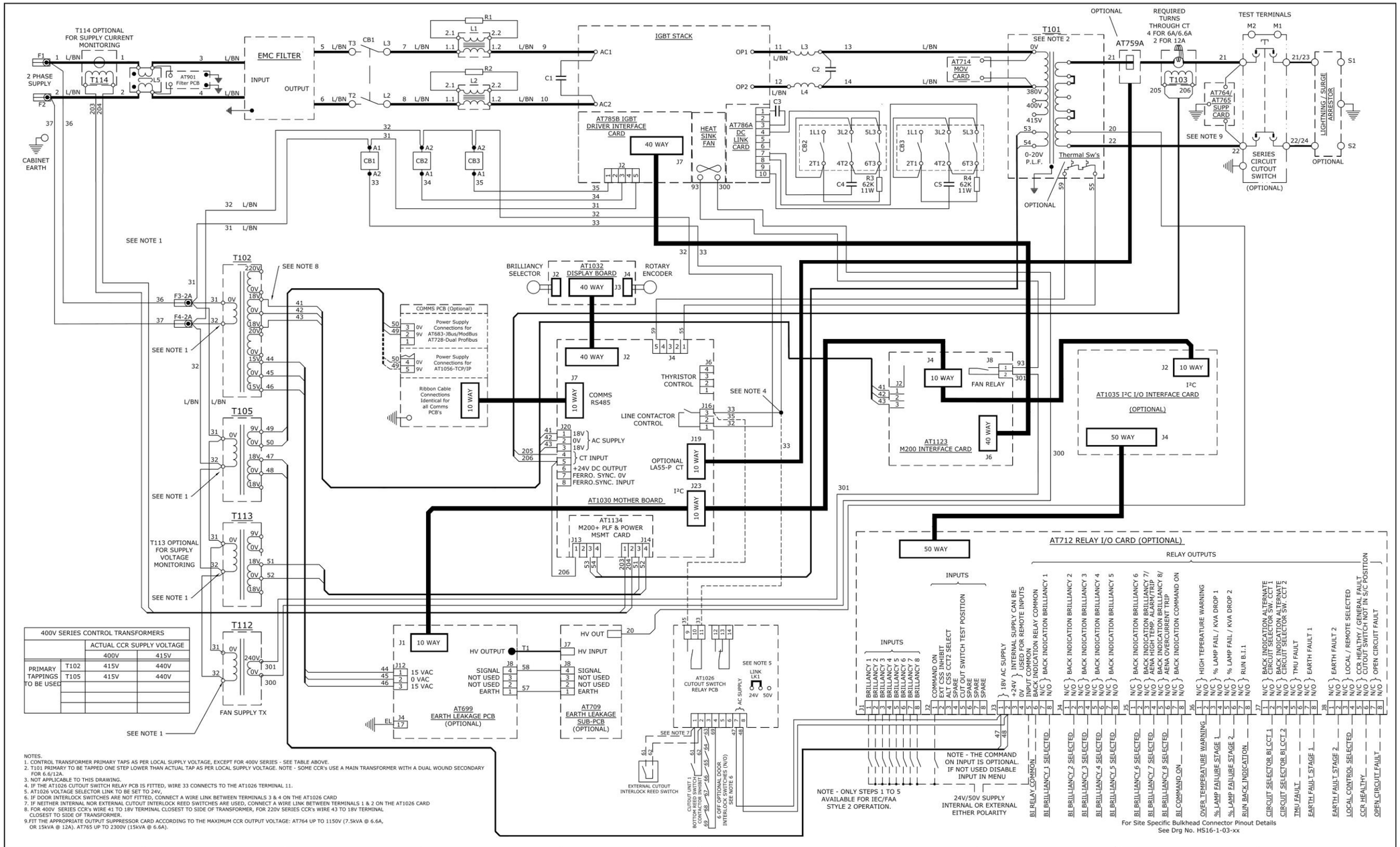
SCALE N/A

DRG No. HS17-1-01-01

A

atg - A3

Figure 13-1 Micro 200+ standard circuit schematic 2.5kVA to 7.5kVA, 400V series



REV	DATE	DESCRIPTION	DRN	CHK	APP
A	15/10/24	FIRST ISSUE	RE	PAC	AS
B					
C					
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E					
F					

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CLIENT

TITLE
MICRO 200+ CCR, 10 TO 15 KVA, 400V SERIES WITH 2 PHASE SUPPLY
STANDARD WIRING DIAGRAM

PROJECT No. | SCALE N/A | DRG No. HS17-1-01-02 | A

atg - A3

Figure 13-2 Micro 200+ standard circuit schematic 10kVA to 15kVA, 400V series