atg airports ltd

Micro 100 CCR

Microprocessor Controlled Constant Current Regulator

Installation and Operational Manual
HS12-0-00-22

This manual applies to regulators using firmware v3.15 onwards.

CE

atg airports ltd, Automation House, Lowton Business Park, Newton Road,
Lowton St. Mary's, Warrington WA3 2AP
Tel: 44 (0)1942 685555 Fax: 44 (0)1942 685518 email: airports@atgairports.com

TABLE OF CONTENTS

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 100 CCR.

INDEX OF FIGURES

INDEX OF TABLES

AMENDMENT CONTROL

Issue	Date	Author	Amendment description	Firm-ware	Technical Approval	Approved for issue by
11	05.07.06	I Crosland	Change of FAA document reference to AC No: 150/5345-10F in section 7.3.3. and change to the CCR output current tolerance to ±0.1A for 6.6A and ±0.3A for 20A. Section 4.2.	V2.30	P. Craven	K. Armstrong
	23.02.07	R.Marron I Crosland P. Craven	CCR Part Numbering System Updated. Section 2.2, Figure 3-2, Figure 3-3 and Table 3-2 updated New screens added for Analogue PLF set-up. New parts list – Section 10	V2.30	P. Craven	K. Armstrong
	01.05.07	I Crosland	Addition of 'CONT. ANALOGUE' type of Earth Leakage testing. Additional remote control Command On input options (section 8.3.2.2)	V2.30	P. Craven	K. Armstrong
12	7.7.10	P. Craven	Addition of USER DEF DOE brilliancy levels, changed User Tolerance limits, updated supply current and CCR weight tables. Added complete parts listing and CCT diagram, updated Relay I/O card drawings to include modified Command On input and FAA build part number (AT925). Added calibration procedure for replacing AT533, and procedure for reloading operating parameters. Part code change – installation supply voltage now to be specified.	V2.38	P. Craven	G. Copitch
13	14.9.12	P. Craven	Parts list update, minor text changes.	V2.38	P. Craven	C. Kenyon
14	9.9.15	P. Craven	Modbus TCP / IP communication card included as an option, inclusion of sections on Lightning Arrestors and Cutout Switch, parts list updates, CCR circuit schematic update, various text changes	V3.15	P. Craven	A. Smart
	10.9.15	I. Crosland	New display screens added for AENA I/O, Cutout Switch and Overtemp. monitor	V3.15		
15	26.11.15	I. Crosland	SET CCT SEL FLT ACTION description added to Table 8-2	V3.15	P. Craven	A. Smart
		P. Craven	Minor changes on Cutout Sw. and Earth Leakage Card descriptions	V3.15		
16	15.7.16	P. Craven	Updated 6.6A transformer windings (section 4.3.1), various text changes, parts list and CCR options list updated.	V3.15	P. Craven	D. McGuinness
17	24.4.18	P. Craven	CCR Part Numbering System Updated, added Section 9.1.1 – Location of main components of Micro 100, Parts list updated	V3.15	P. Craven	A. Sole
18	13.6.18	P. Craven	Supply voltage range updated. Table 9-1 Routine maintenance – updated. Section 9.3.4.3 capacitive current threshold measurement Test Pin added. Figure 10-1 updated.	V3.15	P. Craven	D. Watterson
19	22.2.19	P. Craven	Section 9.3.3 - Checking the Over-current Trip Point and Trip Delay Time - updated. Figure 9-6 added. Section 9.3.4.3 VR3 Capacitive Current detection sensitivity – updated. Table 11-1 CCR Fault Finding – updated.	V3.15	P. Craven	A. Sole
20	11.03.20	P. Craven	Table 3-1 added – Minimum recommended supply cable sizes. Section 4 and section 9.2 - notes on testing into a short circuit updated. Section 4.3 updated, including new section 4.3.3 - Configuring the main transformer for a short circuit load test. Section 4.3.4 – updated to include conduction times for 60Hz supply. Table 11-1 - CCR Fault Finding - updated. Section 12, contactor part numbers updated in parts list. Figure 12-1 – Micro 100 wiring diagram updated.	V3.15	P. Craven	A. Sole
21	20.09.21	P. Craven	Section 2.4 – text added.	V3.15	P. Craven	R. Everett
22	23.09.21	P. Craven	Section 2.3 – text change regarding lifting of CCR cabinet.	V3.15	P. Craven	R. Everett

CCR PART NUMBERING SYSTEM

Example Part Number: M100CCR - 66 15 - 400 - PS - EF/LF/LA/D

Model:
Micro 100 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
20.0 kVA = 20
25.0 kVA = 25
30.0 kVA = 30
Note – 20-30kVA not available in 220V series

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

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

460V = 460
480V = 480

Remote Control:

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

Optional Accessories. (Note - codes LI, LF, LA not necessary for CCRs manufactured to FAA specification). 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
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

CCRs manufactured to the FAA specification:

FAA Regulator without monitoring (includes LA)	= FAA L-828
FAA Regulator with monitoring (includes LI, LF, LA)	= FAA L-829

SAFETY NOTICES

DANGER – HIGH VOLTAGE CIRCUITRY

This equipment employs high voltage circuitry within the cubicle – up to 5000V for a 30kVA 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

All 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 100 CCR is a microprocessor supervised constant current regulator that provides a controlled level of current to airfield ground lighting series circuits.

The Micro 100 CCR is available in three supply voltage ranges: the 220V series is available to operate either from a single or two phase supply, and the 400V and 480V series operate from a two phase supply. Transformer 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. The regulator output is designed to remain stable and within the output current tolerance limits with an input voltage variation of +/-10% of the nominal supply voltage.

The Micro 100 CCR uses an anti-parallel thyristor pair with phase angle control to vary the voltage applied to the primary of the main output isolation transformer such that the CCR gives the required output current. The transformer secondary has multiple tappings so that the output voltage range can be selected (during commissioning) to match the load on the AGL series circuit; this is in order to minimise the supply current drawn and to reduce the harmonic effects.

To ensure maximum reliability, the output current control loop, thyristor triggering and all critical fault detection circuits are performed in hardware using analogue and digital electronic circuits. The supervising microcontroller provides run and current demand signals as well as status information.

The Micro 100 CCR 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 four pushbuttons on the front panel display. An external PC is not necessary. Note - the Set-up and Engineering menus are password protected to prevent unauthorised access.

The required CCR kVA rating is dependent on the total kVA rating of the lamps on the AGL circuit plus cable and transformer losses, and an allowance for open circuit lamps. Refer to section 7.1 for a guide to calculating the required CCR size.

1.2 Standard Features and available options

1.2.1 Standard Features

- Accurate control of RMS output current level into all AGL circuit loads
- 3, 5 or 8 pre-programmed brilliancy levels to IEC, FAA or CAP168 standards
- 8 fully adjustable brilliancy levels, between 0.1 – 100%
- Display of output current true RMS value
- Open circuit protection
- Over current protection
- Over current clamp activates if current exceeds 103% of rated value caused by a change of load impedance during block switching operations
- Internal/external brilliancy control; external brilliancy control from 24V, 48V or volt free contact as standard, 8-Wire, 3-Wire encoded or BCD encoded.

Provision for Remote Analogue Brilliancy Demand signal
- Warning indication of “Tolerance Fault” (output current outside tolerance limits)
- Elapsed time counter records hours run at maximum brilliancy & total hours run
- Adjustable current ramp for switch on, enhances lamp life by reducing stress on lamp filaments
- Black heat - selectable low current output level available for remote “OFF” setting to prevent condensation in lamps
- Operating parameters configurable from front panel

1.2.2 Optional Features

The Micro 100 CCR can be supplied with the following options: -

- Lamp Failure Detection – displayed as a total or as a percentage. (Included on FAA L-829 – Regulator with monitoring)
- 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. (Included on FAA regulators)
- Input surge arrestors
- Capacitive Current Detection – ensures correct operation of open circuit protection on highly capacitive AGL series loop circuits
- Asymmetric Output Current Detection
- Series Circuit Cutout Switch with three position plug-in lid. An additional safety device can be fitted that isolates the series circuit from the high voltage output of the CCR and connects the field cables to earth for safe maintenance. It also provides insulation resistance measuring test points
- Serial communication using Profibus, Modbus TCP/IP (Ethernet) or J-BUS (Modbus RTU). Permits remote control of the CCR and / or monitoring of relevant operating parameters.

1.3 Specification

The Micro 100 CCR complies with EN 61822:2009 – Electrical installations for lighting and beaconing of aerodromes – Constant current regulators, FAA AC 150/5345-10 - Specification for Constant Current Regulators and Regulator Monitors, and all applicable EMC standards.

Mains supply voltage range:	+/-10% of nominal
Mains supply frequency:	46.25 to 64.5 Hz
Control method:	Thyristor phase angle control, with control loop closed around output current.
Remote Brilliancy Inputs:	24 / 48V. Internal or external supply, polarity insensitive.
Number of Brilliancy steps:	8
Efficiency (standard models):	90% or better
Power factor:	0.90 or better at full load
Cooling:	Convection cooled
Degree of Protection:	IP2X

2 Installation

2.1 Physical Characteristics

The Micro 100 CCR cabinet is constructed from mild steel and is naturally ventilated 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 30kVA.

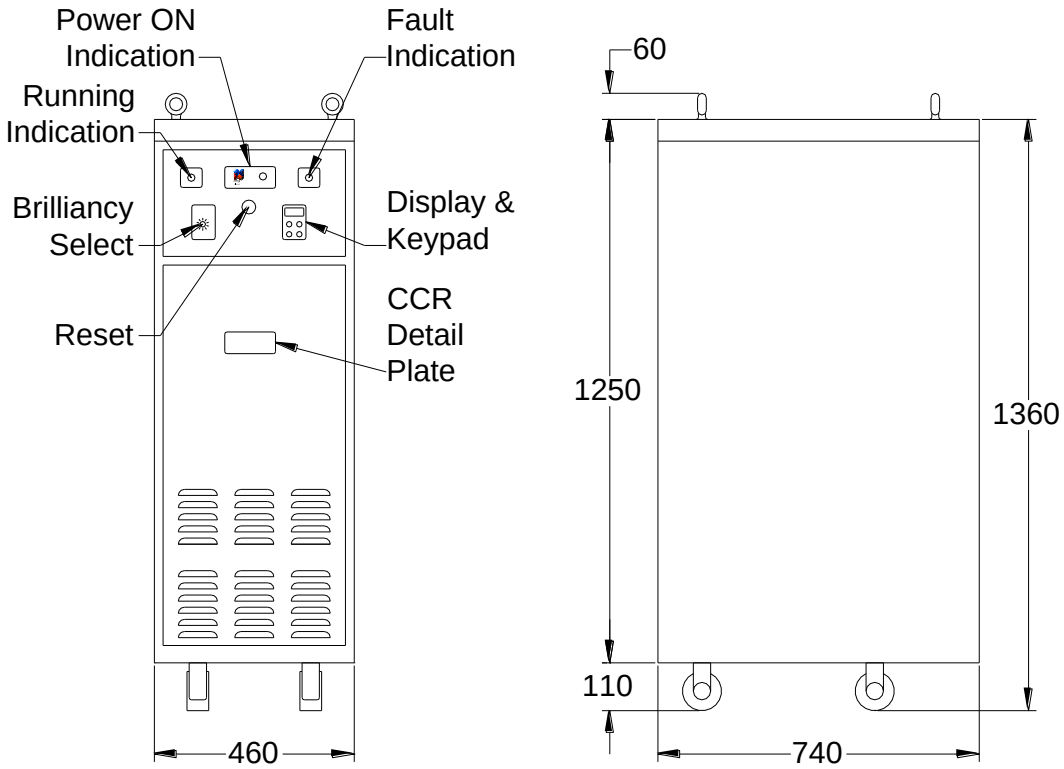


Figure 2-1 CCR Cabinet Outline Dimensions

The cubicle is divided into the following easily accessible compartments:

i) Microcontroller Compartment – accessible from the front
ii) Main Electronics Compartment. Contains the AT533 Main Power Control Card and all option cards. Accessible via the lower front cover. **Note – there are mains voltages present in this section, up to 415V. These terminals are protected by a shroud.**
iii) Power and HT Compartment. Contains the thyristor module and optional fuse, 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.

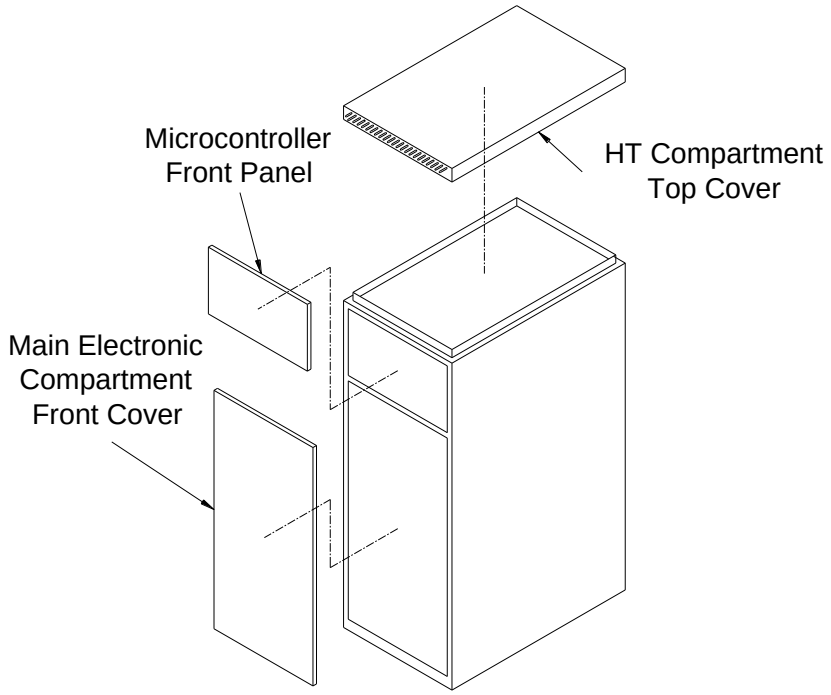


Figure 2-2 CCR Cabinet Covers (Front)

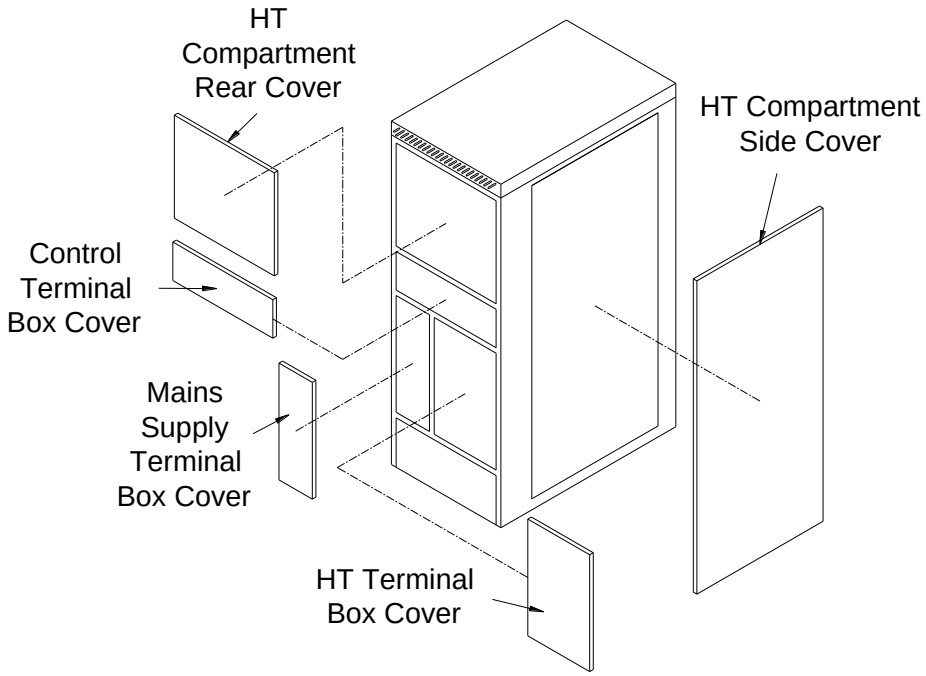


Figure 2-3 CCR Cabinet Covers (Rear)

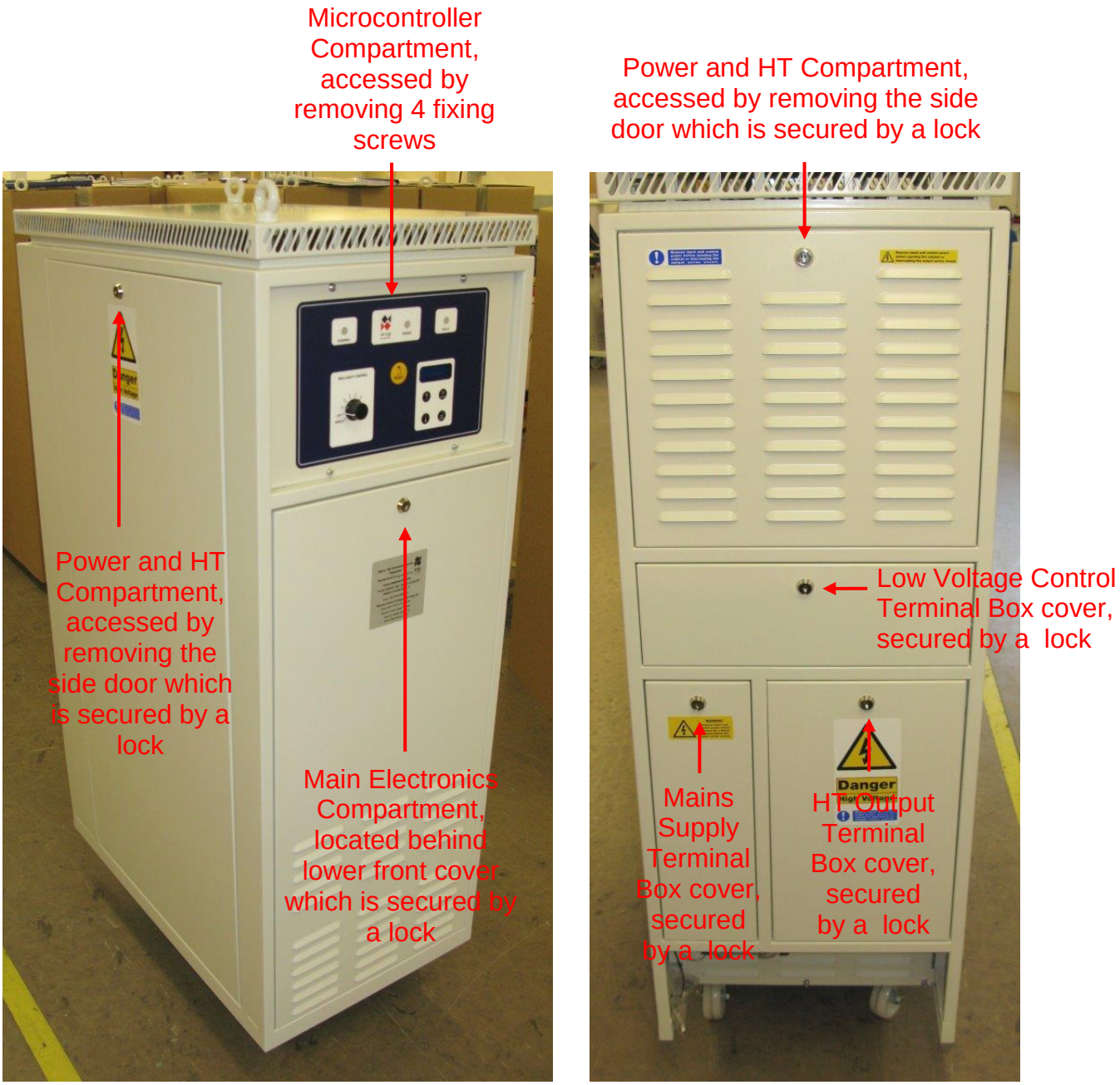


Figure 2-4 CCR front / side view, and rear view showing terminal covers

2.2 Operating environment and clearance around the cabinet

The Micro 100 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 by convection, 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.

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	110
4	120
5	130
7.5	170
10	210
12.5	230
15	245
20	300
25	320
30	350

Table 2-1 Approximate weights of regulators

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 two 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 supply current requirements for the standard sizes of regulator, with full rated load connected, and the CCR operating at maximum brilliancy. The supply current drawn is partially dependant on the primary voltage tapping used on the CCR main transformer, and this should be set to suit the supply voltage at the installation.

kVA Rating	Approximate input current requirement with the CCR running at full rated load, at specified main transformer primary tapping voltage								
	220V series			400V series			480V series		
	208V	220V	240V	380V	400V	415V	460V	480V	
2.5	14.1	13.3	12.2	7.7	7.3	7.0	6.4	6.1	
4	22.5	21.3	19.5	12.3	11.7	11.3	10.2	9.7	
5	28.1	26.6	24.4	15.4	14.6	14.1	12.7	12.2	
7.5	42.2	39.9	36.5	23.1	21.9	21.1	19.1	18.3	
10	56.2	53.2	48.7	30.8	29.2	28.2	25.4	24.4	
12.5	70.3	66.5	60.9	38.5	36.5	35.2	31.8	30.5	
15	84.3	79.7	73.1	46.2	43.9	42.3	38.1	36.5	
20	N/A	N/A	N/A	61.6	58.5	56.4	50.9	48.7	
25	N/A	N/A	N/A	76.9	73.1	70.5	63.6	60.9	
30	N/A	N/A	N/A	92.3	87.7	84.5	76.3	73.1	

Table 2-2 CCR Supply Current Requirements

A guide for calculating the total load of the series circuit, including AGL cable losses and transformer losses, is included in Section 7.1. 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 below:

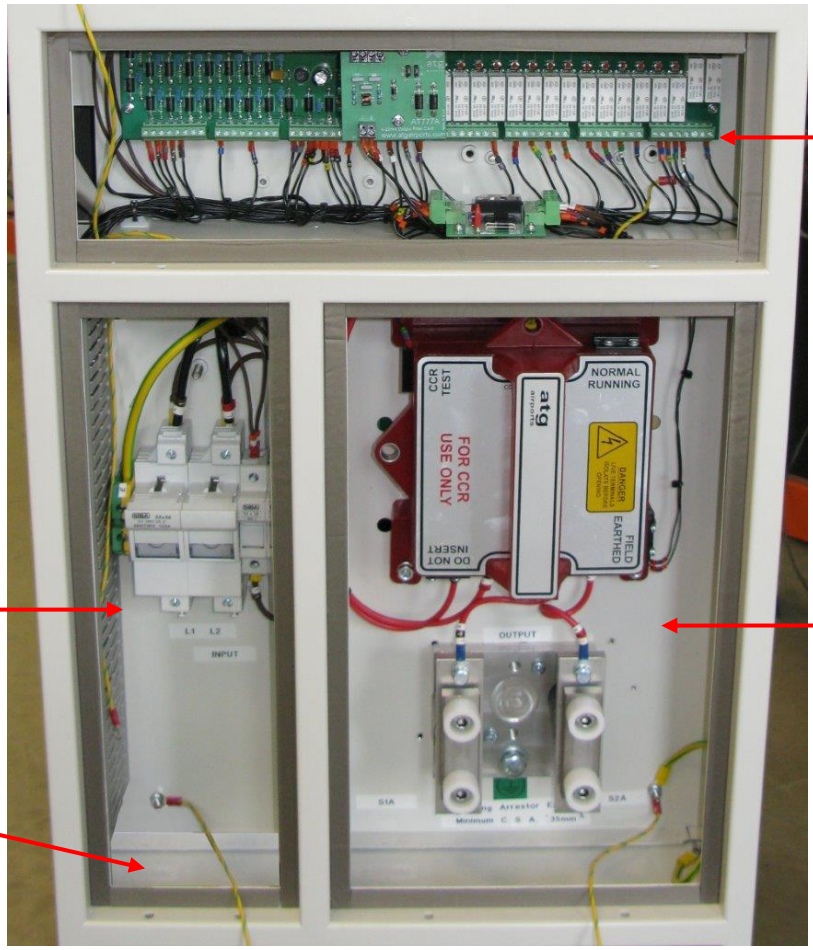


Figure 3-1 Terminal Boxes

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, 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 100 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		480V series	
	CSA mm^2	AWG	CSA mm^2	AWG	CSA mm^2	AWG
2.5	4 mm^2	AWG 12	2.5 mm^2	AWG 14	2.5 mm^2	AWG 14
4	6 mm^2	AWG 10	4 mm^2	AWG 12	2.5 mm^2	AWG 14
5	10 mm^2	AWG 8	4 mm^2	AWG 12	4 mm^2	AWG 12
7.5	16 mm^2	AWG 6	6 mm^2	AWG 10	6 mm^2	AWG 10
10	25 mm^2	AWG 4	10 mm^2	AWG 8	6 mm^2	AWG 10
12.5	25 mm^2	AWG 3	10 mm^2	AWG 8	10 mm^2	AWG 8
15	25 mm^2	AWG 3	16 mm^2	AWG 6	10 mm^2	AWG 8
20	N/A	N/A	25 mm^2	AWG 4	16 mm^2	AWG 6
25	N/A	N/A	25 mm^2	AWG 3	25 mm^2	AWG 4
30	N/A	N/A	35 mm^2	AWG 2	25 mm^2	AWG 3
Note - due to cables specified in mm^2 or AWG not always being available in exactly matching sizes, the recommended CSA in mm^2 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 mm^2 (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 100 with an AT662A/AT925 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)
iv) Remote Analogue Brilliancy Reference, with or without Command On input (8 Brilliancy Levels)

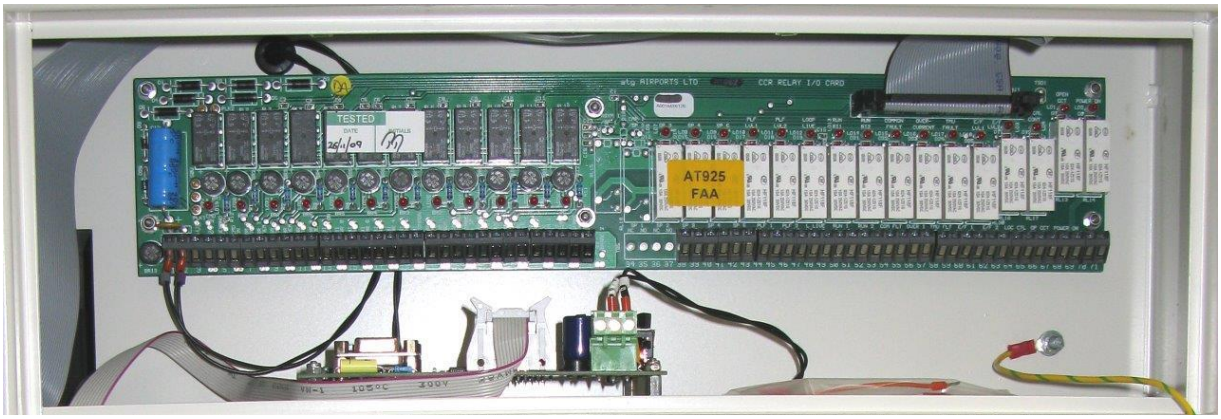


Figure 3-2 AT925 Relay I/O and Serial Comms Cards fitted in Control Terminal Box

Note – regulators built to meet the IEC specification are fitted with the AT662A Relay I/O Card, whilst those built to the FAA specification are fitted with the AT925 Card. The terminal functionality of both of these cards is identical.

Relay contacts are provided for Back Indication of CCR status, the ratings of which are listed below. 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.

Terminals	Contact Ratings
13 - 19, 29-33	2A@30V DC, 0.6A@110V DC, 0.6A@125V AC, resistive load
34 - 69	4A@30V DC, 4A@250V AC, resistive load

Table 3-2 AT662 / AT925 Back indication Relay Contact ratings.

When options such as an integrated Circuit Selector Switch or Power / Current Monitor modules are fitted, additional cards will be mounted over the AT662 / AT925 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 instead of the AT662A/AT925 Relay I/O Cards in the control

terminal box, although they can be used in addition to these 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 100 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 - refer to Section 8.3.2.2 – 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 8.3.2.7 - Brilliancy Level Selection. Alternatively, up to a maximum of 8 User Defined Current / Brilliancy Levels may be selected – see Section 8.3.2.10.

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 operation of the Command On input is enabled or disabled by the Remote Control Configuration selected in the Set-up menu – refer to Section 8.3.2.2.

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. If the Remote Brilliancy inputs are to be driven from 24V, PLK1 on the AT662A / AT925 card should be fitted in the 24V position. It is important that PLK1 is NOT fitted to the 24V position if a 48/50V supply is used. (As standard, the CCR internal supply is set at 50V DC; it is possible to change this if necessary to 24V by changing the tappings on the internal control PSU transformer T105).

Note - PLK2 should always be fitted on the AT662A / AT925 card. On previous versions of the firmware, a different terminal was used for the Command On input – terminal 6 - and PLK2 would have to be removed to enable the use of this input.

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

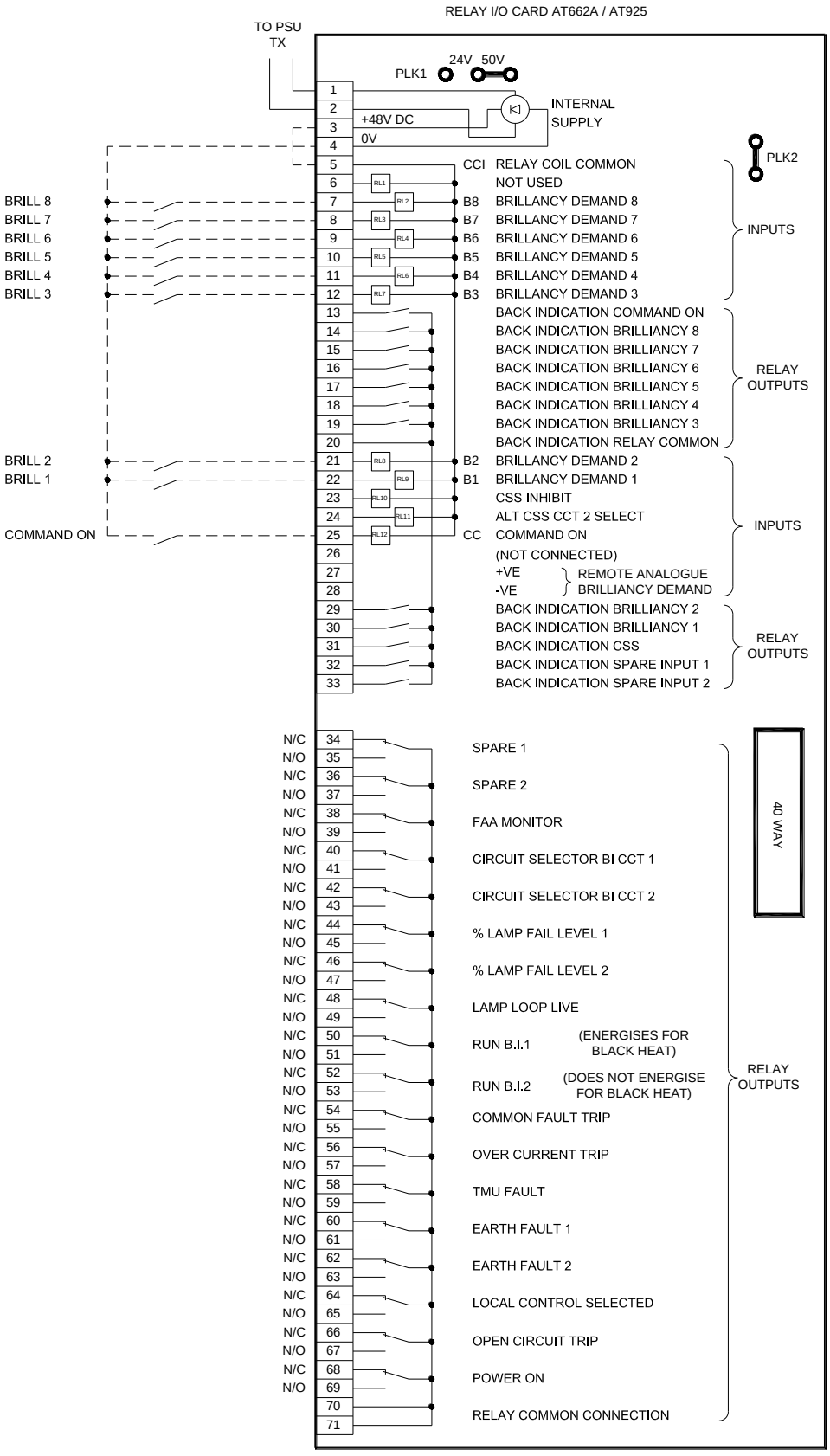


Figure 3-3 Connections for 8-Wire Remote Brilliancy using CCR internal PSU

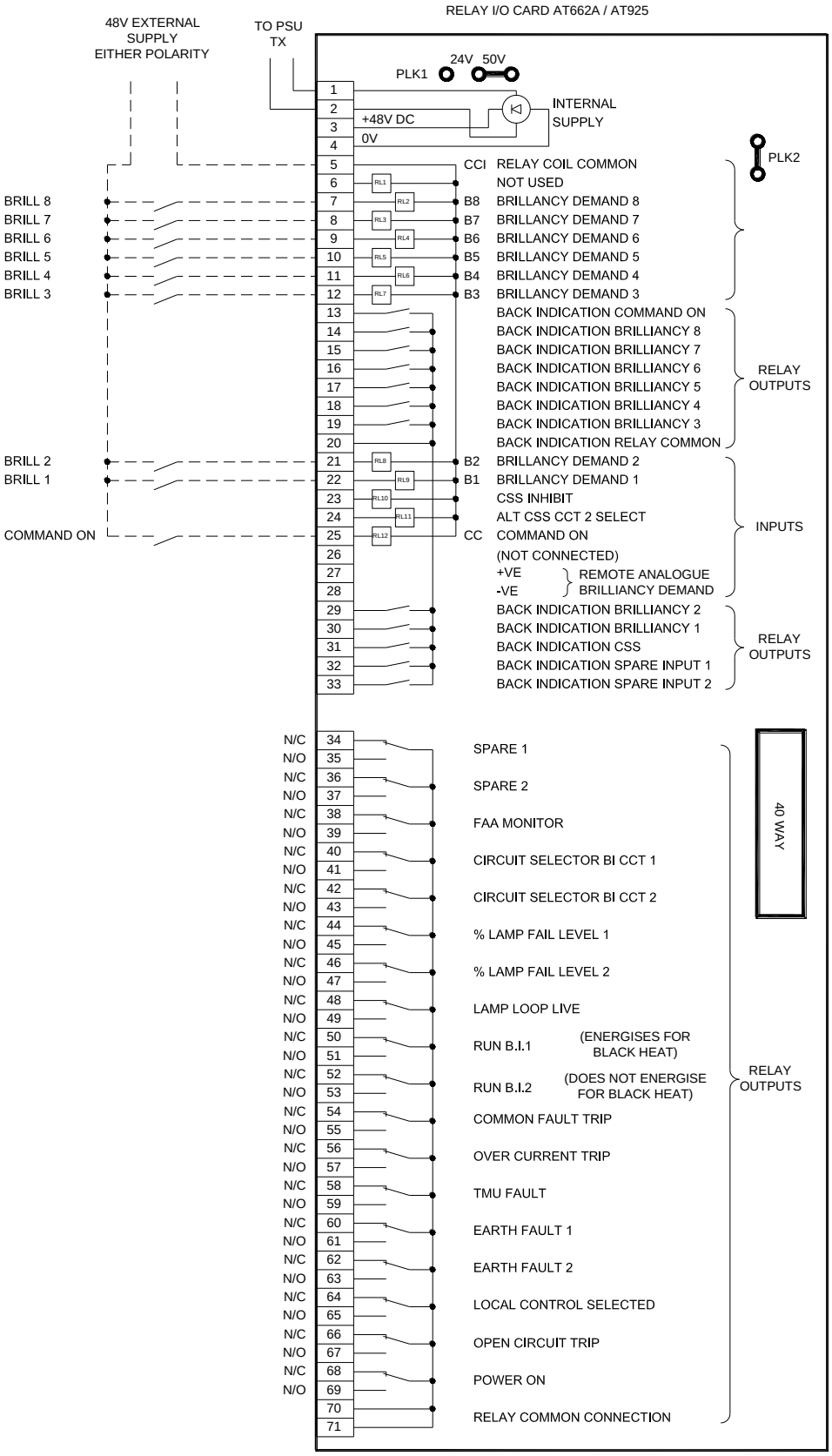


Figure 3-4 Connections for 8-Wire Remote Brilliancy using external PSU

3.3.2 3-Wire Encoded Remote Brilliancy Selection

The circuit of Figure 3-5 shows the control connections for 3-Wire Encoded Remote Brilliancy Selection using the CCR internal supply. The use of a Command On input is optional. All other information in Section 3.3.1 applies. To program the CCR for 3-Wire operation, refer to Section 8.3.2.2.

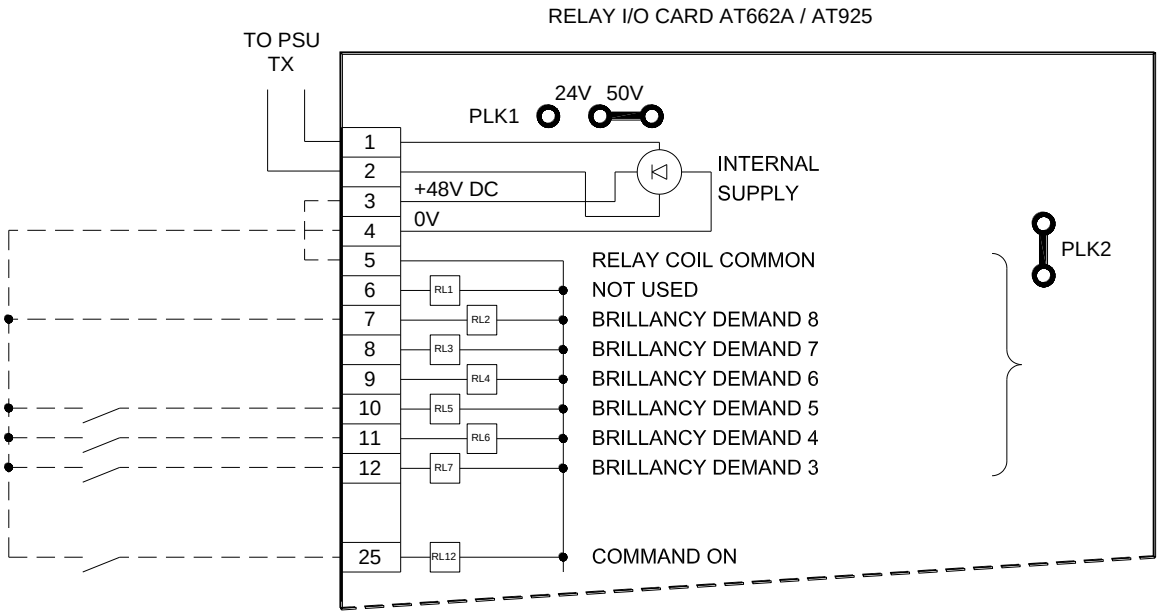


Figure 3-5 Connections for 3-Wire Encoded Remote Brilliancy Selection

Table 3-3 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 3-3 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 8.3.2.2.

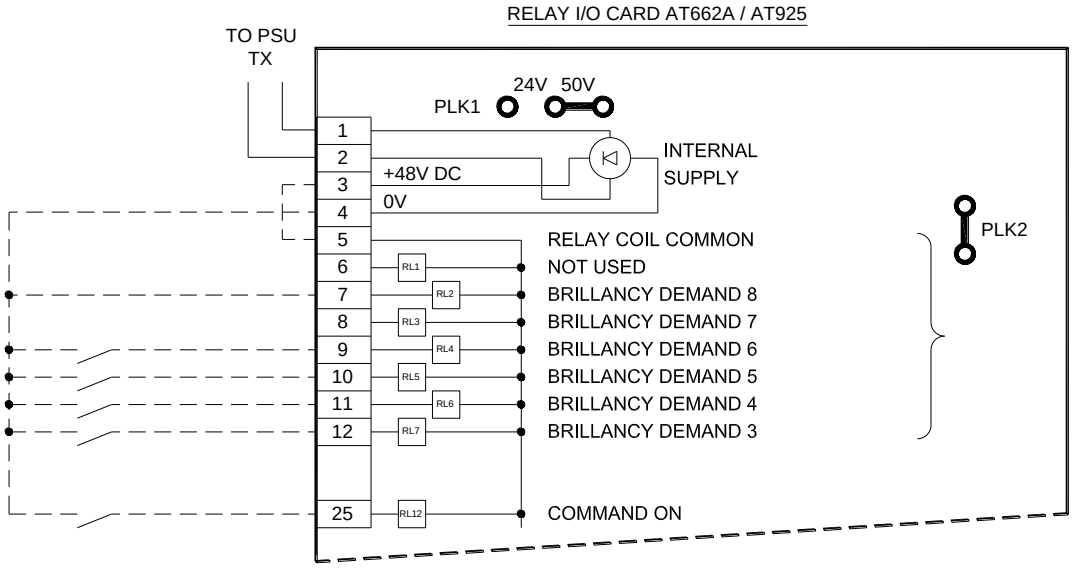


Figure 3-6 Connections for BCD Encoded Remote Brilliancy Selection

Note – it is possible to select from 2 coded tables; BCD (standard) and BCD control Option 2, as shown in Table 3-4 and Table 3-5. 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 3-4 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 3-5 BCD Option 2 Encoded Remote Brilliancy Selection

3.3.4 Remote Analogue Brilliancy Reference

The Micro 100 CCR can also be operated from a Remote Analogue Brilliancy Reference signal of up to 48V DC. In this mode of operation, the CCR Brilliancy Step will be selected according to the level of the Analogue Reference input. To program the CCR for this mode of operation, refer to Section 8.3.2.2, and to set the operating thresholds refer to section 8.4.2.3.

The Remote Analogue Brilliancy Reference should connect between terminals 27 (+ve) and 28 (-ve) on the AT662A / AT925 card. It is recommended to use screened twisted pair for this input; connect the screen to terminal 26. The circuit of Figure 3-7 below shows this configuration. The use of the Command On input (to turn the CCR on or off) is optional; if this is not selected, the CCR simply switches on when the Analogue Brilliancy Reference goes above the minimum or switch-on threshold.

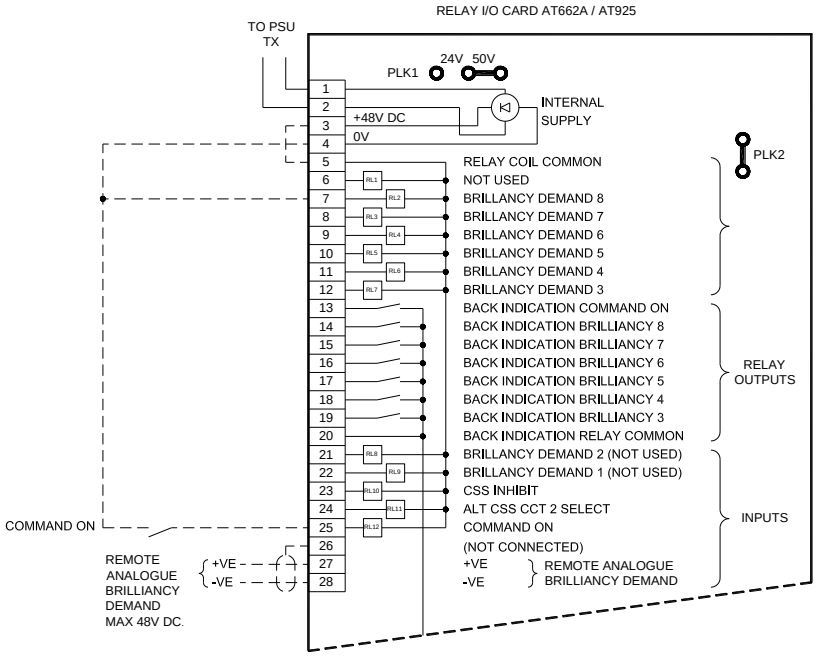


Figure 3-7 Connections for Remote Analogue Brilliancy Reference.

3.3.5 External Circuit Selector Switch Connection

The Micro 100 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 AT662A / AT925 “CSS INHIBIT” input (terminal 23), as shown in Figure 3-8 below.

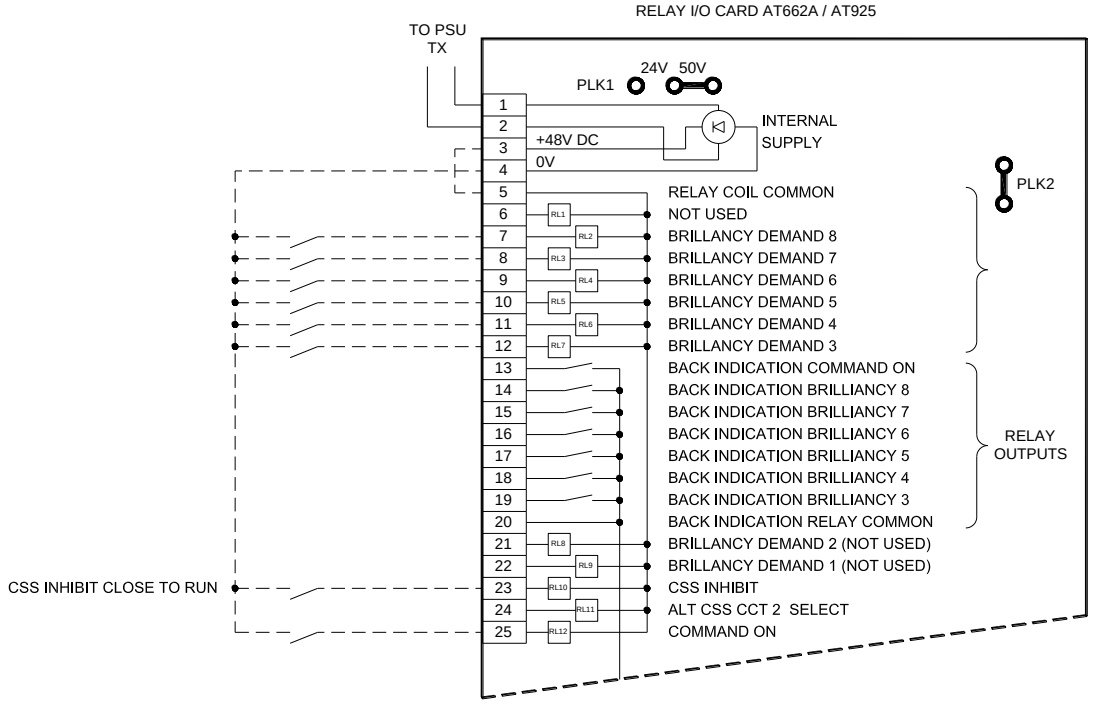


Figure 3-8 Connection for External Circuit Selector Switch inhibit line

To make use of this inhibit contact, it will be necessary to remove a wire link within the CCR – wire number 187. This connects TB17 terminal 4 to TB19 terminal 7 of the AT533 “Main Control Board”. This board is fitted behind the CCR (lower) front cover. See Figure 3-9 and Figure 3-10, overleaf.

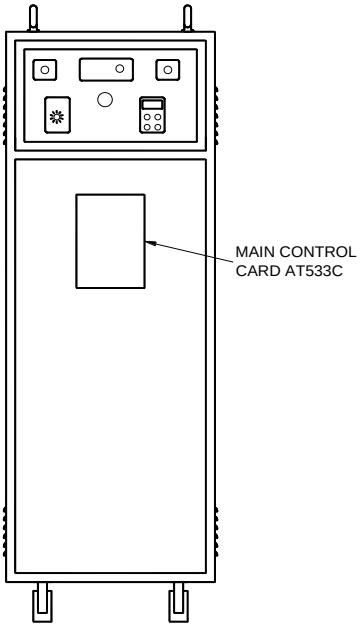


Figure 3-9 Location of Main Control Card (AT533)

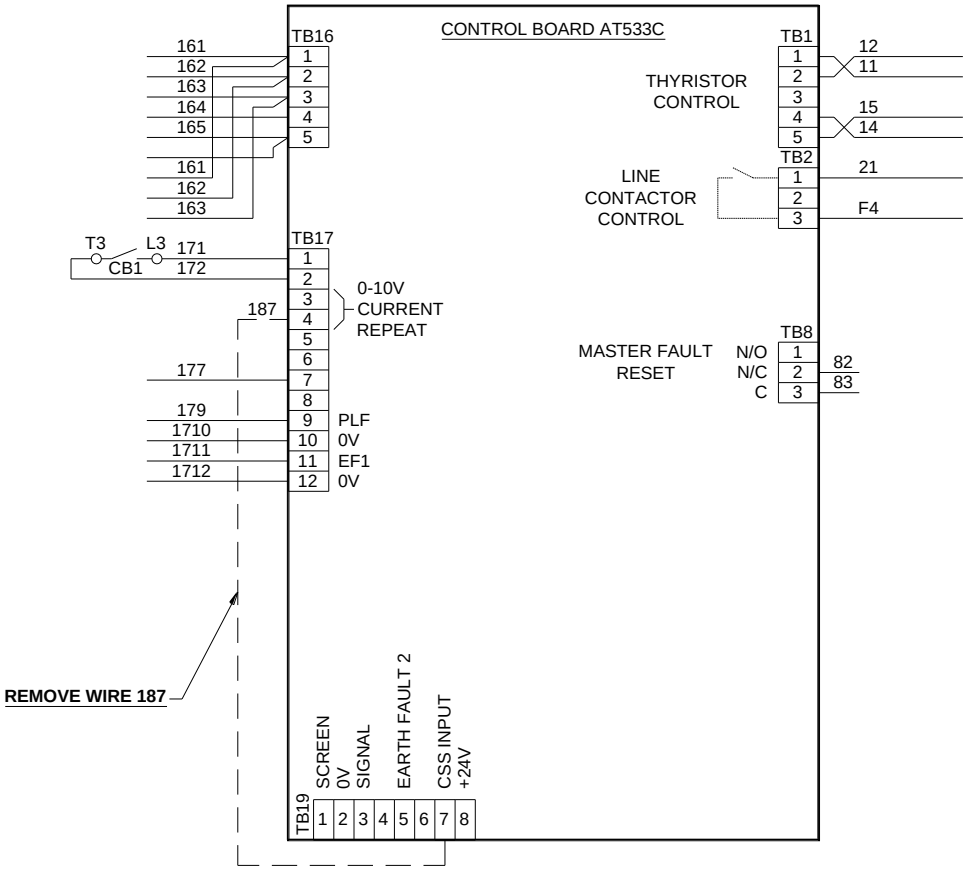


Figure 3-10 Wiring modification for external CSS inhibit line.

With this modification done, when the CSS inhibit contact is open, 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:

	C	S	S		I	N	H	I	B	I	T				
					I		=		X	X	.	X	X	A	

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

3.4 HT Series Circuit Output Terminals.

WARNING – HIGH VOLTAGES – UP TO 5000V FOR A 30KVA 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 3-11 (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 6.0A/6.6A or 12A. Refer to Table 4-6 and Table 4-8 for the Main CCR Transformer output voltages.

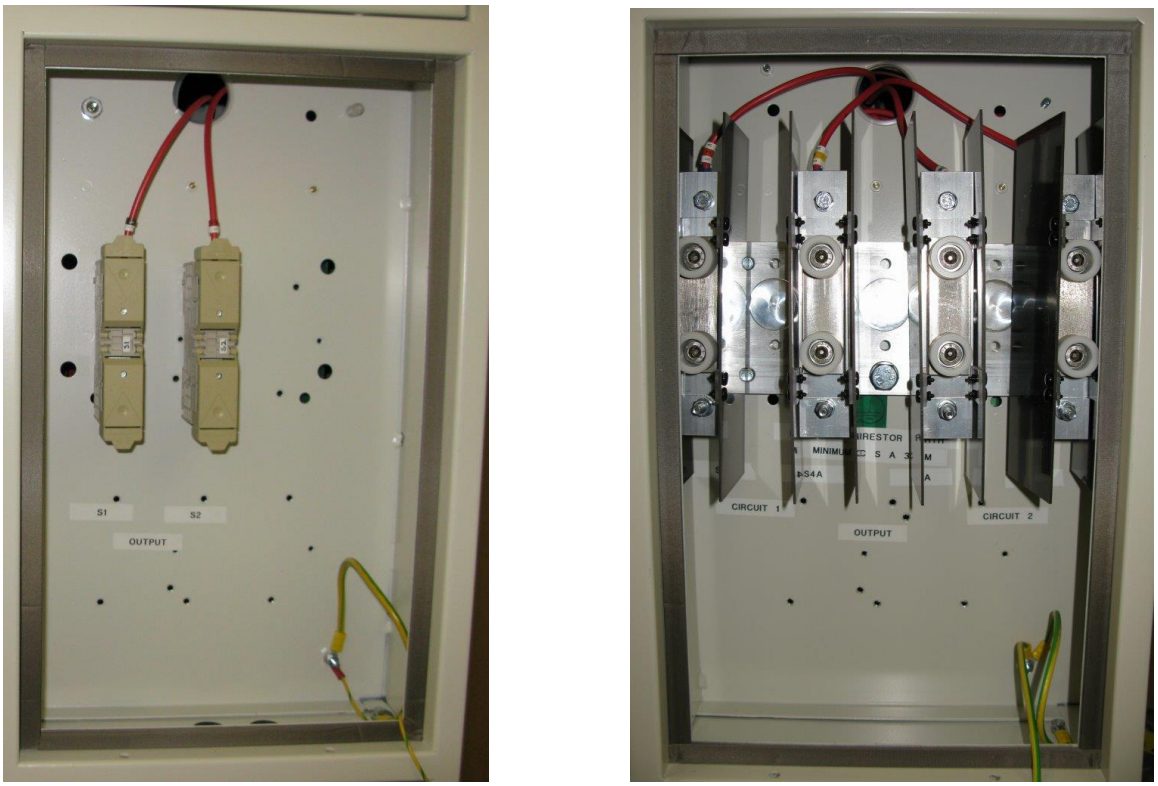


Figure 3-11 Standard Output Terminals and 4 Terminal Lightning Arrestor

For those regulators fitted with Integral Lightning Arrestors, a separate earth connection must be made to the lightning arrestor assembly aluminium base plate, using the bolt near the bottom of the plate. This should connect to the earth bars of the sub-station lightning protection earth system (not to the distribution board earth), to provide a low impedance path to earth, via a counterpoise and ground rods located around the building, to dissipate the energy from lightning discharges.

The earth cable connecting the lightning arrestor base plate to the substation lightning protection earth system should have a cross sectional area of at least 35 mm^2, and the length should be kept to a minimum. Refer to Section 5 - Output Lightning Arrestors, for more information.

If screened primary series loop cables are used, then the earthing screen should also be connected to the lightning arrestor base plate earth connection and therefore to the sub-station lightning protection earth system.

4 Commissioning

4.1 Introduction

The factory test of the Micro 100 CCRs includes accurate calibration of the CCR output current level. 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 output current is required before connecting the AGL circuit, then this can be done by connecting a resistive load bank to the output terminals and running the regulator at maximum brilliancy. If a load bank is not available, then a shorting link can be connected between the output terminals; however do not operate the CCR into a short circuit at any setting above minimum brilliancy unless the main transformer T101 secondary tapping voltage has been set to minimum; see Section 4.3.3. If this is not done, the high peak current levels may cause the mains input fuses or thyristor protection fuses to fail. Also, operating with a shorting link normally requires that the 'STAB' potentiometer on the AT533 Card is turned fully clockwise to improve the current control loop stability (see Figure 9-5).

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 9.2.

For a standard Micro 100 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 input voltage taps to suit the local supply, for example 380v, 400v or 415v. 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

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 are included in this manual; the Earth Leakage Resistance Measurement Module is described in Section 4.5, and the Percentage Lamp Failure Card 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 microprocessor reads the CCR configuration and hours run data from the EEPROM. During this operation the following screen will be briefly displayed.

						C	C	R							
		I	N	I	T	I	A	L	I	S	I	N	G		

Following a successful initialisation; the screen will change to indicate the regulator’s operational state, which in this case will be ‘OFF’.

4.2 Default CCR Operating Parameters

Table 4-5, overleaf, 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 4-1 through to Table 4-4 list the pre-programmed current settings available and their associated tolerance limits.

Section 8 describes navigating around the Menu System and programming the CCR using the Front Panel Keypad. Sections 8.3 and 8.4 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.

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	
			Lower Limit	Upper Limit		Lower Limit	Upper Limit		Lower Limit	Upper Limit
8	N/A	6.00	5.82	6.09	N/A	N/A	N/A	N/A	N/A	N/A
7		5.73	5.64	5.78						
6		4.86	4.78	5.23						
5		4.14	3.82	4.36						
4		3.54	3.36	3.68						
3		3.06	2.96	3.25						
2		2.64	2.51	2.89						
1		2.34	2.17	2.41						
0		0	0	0						

Table 4-1 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	
			Lower Limit	Upper Limit		Lower Limit	Upper Limit		Lower Limit	Upper Limit
8	100 %	6.60	6.40	6.70	6.60	6.50	6.70	6.60	6.50	6.70
7	80 %	6.30	6.20	6.36	6.60	6.50	6.70	6.60	6.50	6.70
6	30 %	5.35	5.26	5.76	6.60	6.50	6.70	6.60	6.50	6.70
5	10 %	4.55	4.20	4.80	6.60	6.50	6.70	6.60	6.50	6.70
4	3 %	3.89	3.70	4.05	6.60	6.50	6.70	5.20	5.10	5.30
3	1 %	3.37	3.26	3.58	6.60	6.50	6.70	4.10	4.00	4.20
2	0.3 %	2.90	2.76	3.18	5.50	5.40	5.60	3.40	3.30	3.50
1	0.1 %	2.57	2.39	2.65	4.80	4.70	4.90	2.80	2.70	2.90
0	0 %	0	0	0	0	0	0	0	0	0

Table 4-2 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	
			Lower Limit	Upper Limit		Lower Limit	Upper Limit		Lower Limit	Upper Limit
8	100 %	12.00	11.64	12.18						
7	80 %	11.45	11.27	11.56						
6	30 %	9.72	9.56	10.47						
5	10 %	8.28	7.64	8.73						
4	3 %	7.08	6.72	7.36	N/A	N/A	N/A	N/A	N/A	N/A
3	1 %	6.12	5.92	6.51						
2	0.3 %	5.28	5.01	5.78						
1	0.1 %	4.68	4.34	4.82						
0	0 %	0	0	0						

Table 4-3 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	
			Lower Limit	Upper Limit		Lower Limit	Upper Limit		Lower Limit	Upper Limit
8	100 %	20.00	19.62	20.40				20.00	19.70	20.30
7	80 %	19.21	18.78	19.28				20.00	19.70	20.30
6	30 %	16.21	15.90	17.45				20.00	19.70	20.30
5	10 %	13.79	12.72	14.54				20.00	19.70	20.30
4	3 %	11.79	11.21	12.27	N/A	N/A	N/A	15.80	15.50	16.10
3	1 %	10.20	9.87	10.85				12.40	12.10	12.70
2	0.3 %	8.79	8.36	9.64				10.30	10.00	10.60
1	0.1 %	7.79	7.24	8.03				8.50	8.20	8.80
0	0 %	0	0	0				0	0	0

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

Parameter	Description	Location of parameter	Firmware default setting	CCR Serial Number: User Settings
CCR FULL LOAD CURRENT	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)	CCR Hardware Configuration Menu. Section 8.4.2.1	6.60A; non-standard requirements programmed at time of factory testing.	
REMOTE CONTROL CONFIG.	Remote Control Brilliancy Selection: 8 Wire, 3 Wire Encoded, BCD Encoded, Analogue Input Reference	Set-up Menu. Section 8.3.2.2	8 WIRE	
BRILL. LEVELS	Current setting for each Brilliancy step; Pre-programmed table to UK Cap 168 levels, FAA / IEC Style 1, FAA / IEC Style 2 or User Defined	Set-up Menu. Sections 8.3.2.7 and 8.3.2.10	UK CAP168 (note - FAA / IEC Style 2 programmed during factory testing for continental European Market)	
BLACK HEAT	CCR produces a low current output when in 'OFF' state under remote control. Prevents condensation in tungsten halogen lamps	Set-up and Hardware Config. Menus. Sections 8.3.2.8 and 8.4.2.4	DISABLED	
TOLERANCE MON.	Tolerance Monitoring Unit (TMU), checks that measured CCR output current falls within specified limits	Set-up Menu. Sections 8.3.2.9 and 8.4.2.7	ENABLED (Limits set according to Brilliancy Levels table selected)	
EARTH FAULT: TRIP ON EARTH 2	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 only once the second threshold is reached (Stage 2). (Note – the Earth Leakage Card is optional)	CCR Hardware Configuration Menu. Section 8.4.2.12	ENABLED (for reasons of safety, it is recommended to leave ENABLED, to trip the CCR on Stage 2 earth leakage threshold)	
PERCENTAGE LAMP FAIL	Monitors the inductance of the series loop circuit to detect lamp failures. (Note – the PLF Card is optional)	CCR Hardware Configuration Menu. The PLF Card Set-up procedure is described in Section 4.6	2 STAGE ALARM (note – if optional AT642 PLF card not fitted, leave as default)	

Table 4-5 Main CCR Operating Parameters

4.3 Setting the Main Transformer Output Voltage

WARNING – HIGH VOLTAGES – UP TO 5000V FOR A 30KVA 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 MAINS SUPPLY TO THE REGULATOR.

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 10-1 of Section 10 shows the block diagram of the CCR with a primary series field loop connected. The CCR uses an anti-parallel thyristor pair to control the voltage applied to the primary of the main CCR transformer. The conduction period of the thyristors is then controlled so as to give the correct RMS current on the output side of the 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. This adjustment should be made during commissioning of the CCR. 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).

The supply current drawn by the CCR is largely determined by the transformer output tapping voltage selected, since the supply current is approximately equal to the secondary current multiplied by the transformer step up voltage ratio. This formula holds true irrespective of the kVA of the load connected to the CCR. By changing the CCR transformer output tapping voltage to correctly match the load, the ratio of the transformer is changed, thus keeping the supply current (and supply kVA), to a minimum.

If the output voltage is set higher than required for a particular load, then the CCR compensates for this mismatch by reducing the thyristor conduction period to maintain the correct RMS output current. However, the CCR supply current and supply kVA will be higher than necessary, and it could be much higher for a badly mismatched transformer output voltage. In this case, the power factor of the supply to the CCR is also very poor, and, due to the short thyristor conduction period, a higher level of harmonic current will be present both on the supply and the output side. The harmonic currents cause a slightly higher output current on the secondary side of the AGL transformers, thus reducing lamp life. This is discussed in more detail in Section 7.3.

Note – for testing of the CCR, a shorting link can be connected between the CCR output terminals. However, do not operate the CCR into a short circuit at any

setting above minimum brilliancy unless the main transformer T101 secondary tapping voltage has been set to minimum; see Section 4.3.3. If this is not done, the high peak current levels may cause the mains input or thyristor protection fuses to fail. Also, operating with a shorting link normally requires that the 'STAB' potentiometer on the AT533 Card is turned fully clockwise to improve the current control loop stability (see Figure 9-5).

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, with each winding split into 2 or 3 tapped sections as show in Figure 4-1 (400V series). 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 6.6A range of Transformers for each size of regulator.

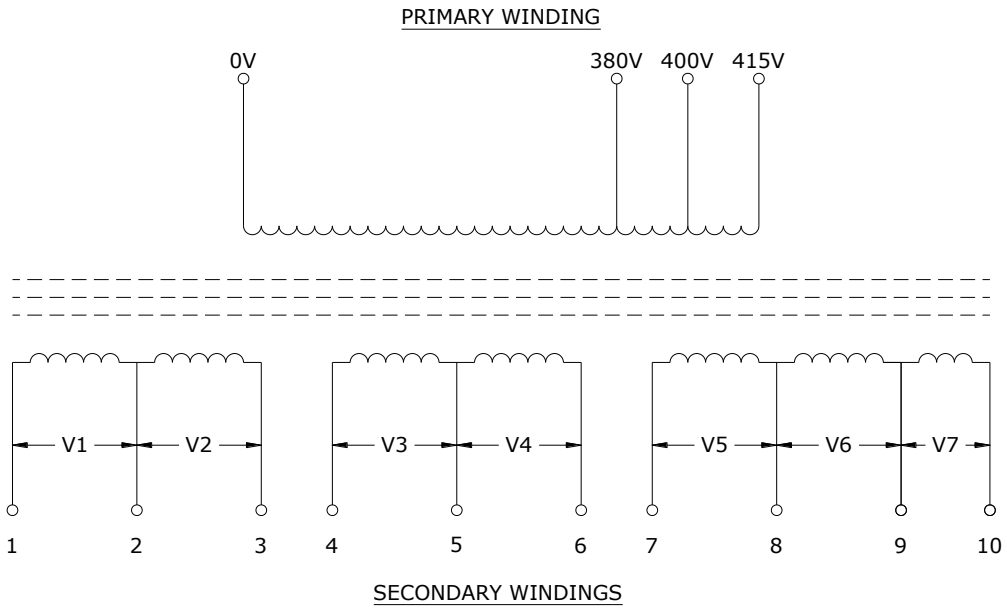


Figure 4-1 6.6A CCR Main Transformer winding arrangement - seven section secondary winding type

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
20	3055	48.5	97.00	194	388.00	776.00	1391	161
25	3798	60.6	121.3	242.5	485.00	970.00	1739	201
30	4557	72.75	145.5	291	582	1164	2087	241

Table 4-6 6.6A CCR Main Transformer Output Voltages – six or seven section secondary winding types

Note - winding V7 is only included on transformers rated at 12.5kVA or above. It should be connected for IEC applications to give 0.9PF and the ability to cope with supply voltage dips of up to 10%, and disconnected for FAA applications to give 0.95PF and 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. See Figure 4-4 and Table 4-7 for the winding arrangement and secondary winding voltages for the transformers with five secondary winding sections.

A third connection is made to the transformer output windings, which goes to the Earth Leakage Detector (wire number 5). 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 low current secondary (monitoring) winding provided on the transformer, for use by the (optional) Percentage Lamp Failure Card. This is not shown on these drawings.

To calculate the required CCR output voltage according to the AGL circuit load, refer to Section 7.1

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 below; S1 and S2 are the output cables, whilst wire number 5 is for the (optional) Earth Leakage Detector.

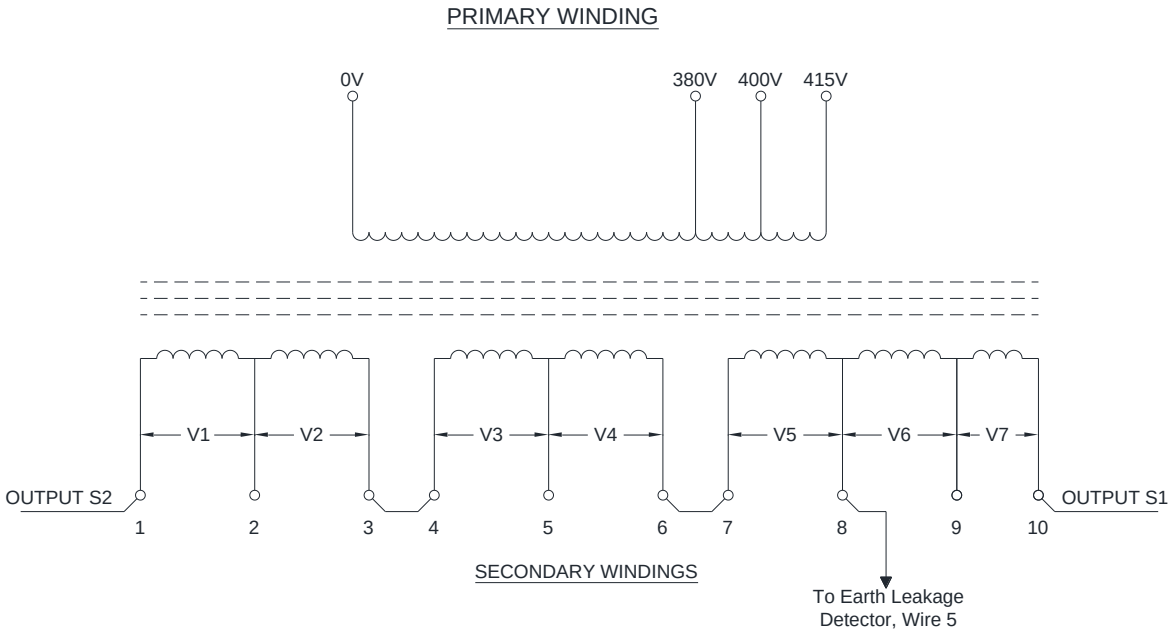


Figure 4-2 6.6A transformer configured for full voltage - seven section secondary winding type

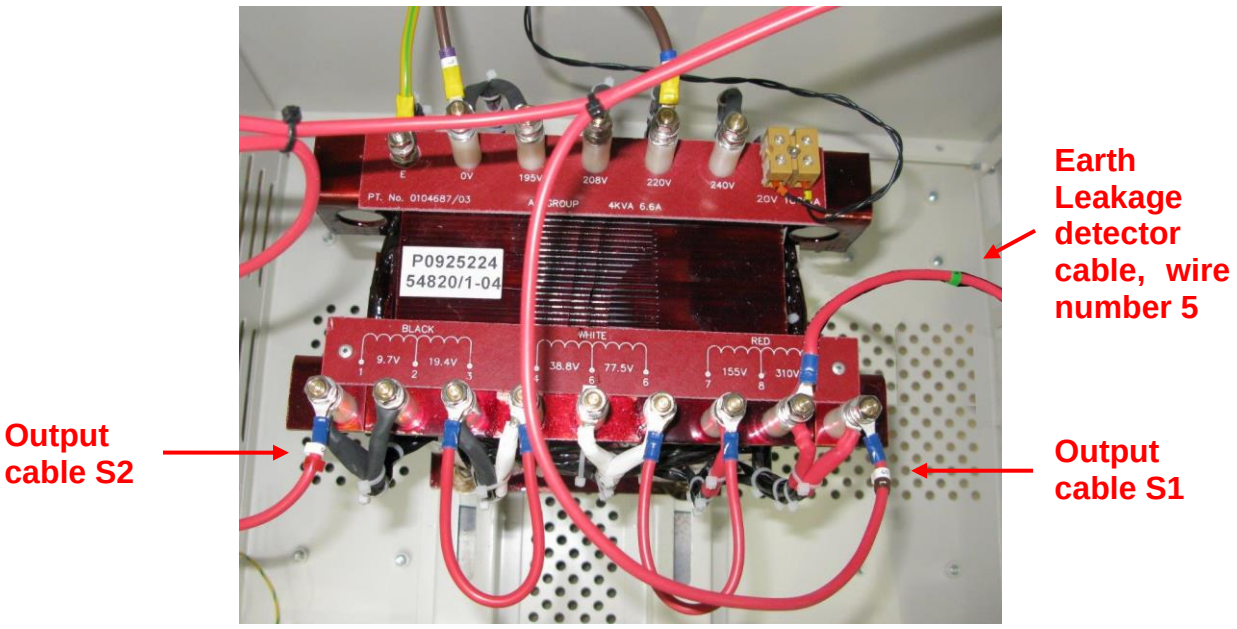


Figure 4-3 Photograph of 6.6A transformer configured for full voltage - six section secondary winding type

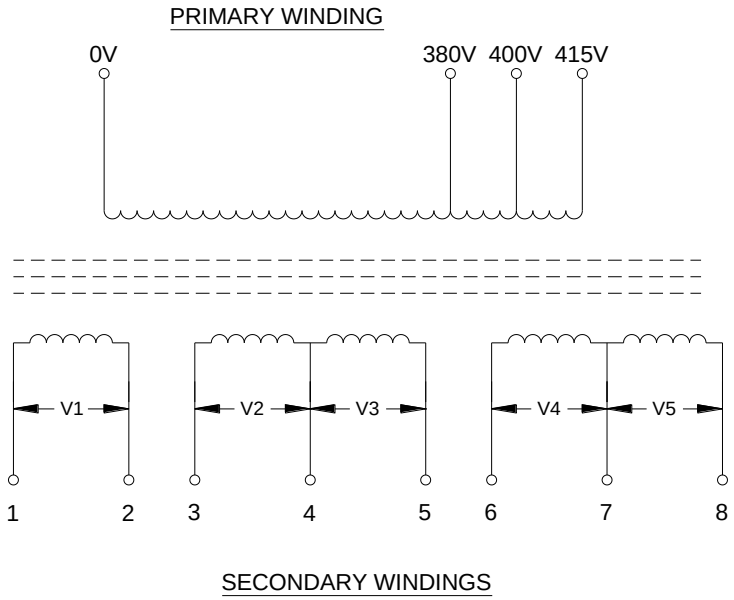


Figure 4-4 6.6A CCR Main Transformer winding arrangement - five section secondary winding type

RATED OUTPUT kVA	RATED OUTPUT VOLTAGE AT 6.6A	OUTPUT VOLTAGE WINDING V1	OUTPUT VOLTAGE WINDING V2	OUTPUT VOLTAGE WINDING V3	OUTPUT VOLTAGE WINDING V4	OUTPUT VOLTAGE WINDING V5
2.5	388	13	25	50	100	200
4	620	20	40	80	160	320
5	760	25	49	98	196	392
7.5	1147	37	74	148	296	592
10	1519	49	98	196	392	784
12.5	1900	62	123	245	490	980
15	2287	74	148	295	590	1180
20	3038	98	196	392	784	1568
25	3798	123	245	490	980	1960
30	4557	147	294	588	1176	2352

Table 4-7 6.6A CCR Main Transformer Output Voltages - five section secondary winding type

An example of an intermediate output voltage (based on a 6.6A circuit, with a CCR transformer with seven secondary winding sections) is shown below. In this case the output voltage is:

V3 + V4 + V6 +V7

Which for a 15kVA regulator is:

145.5 + 291 + 1044 +120 = 1600.5V

The connections to give this voltage are shown in Figure 4-5.

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 4-5. In this way, the voltages from each section will add and not subtract.

WARNING - DO NOT CONNECT A LINK WIRE DIRECTLY ACROSS A WINDING SECTION – THIS WILL CREATE A SHORT CIRCUIT AND WILL CAUSE IRREPARABLE DAMAGE TO THE TRANSFORMER.

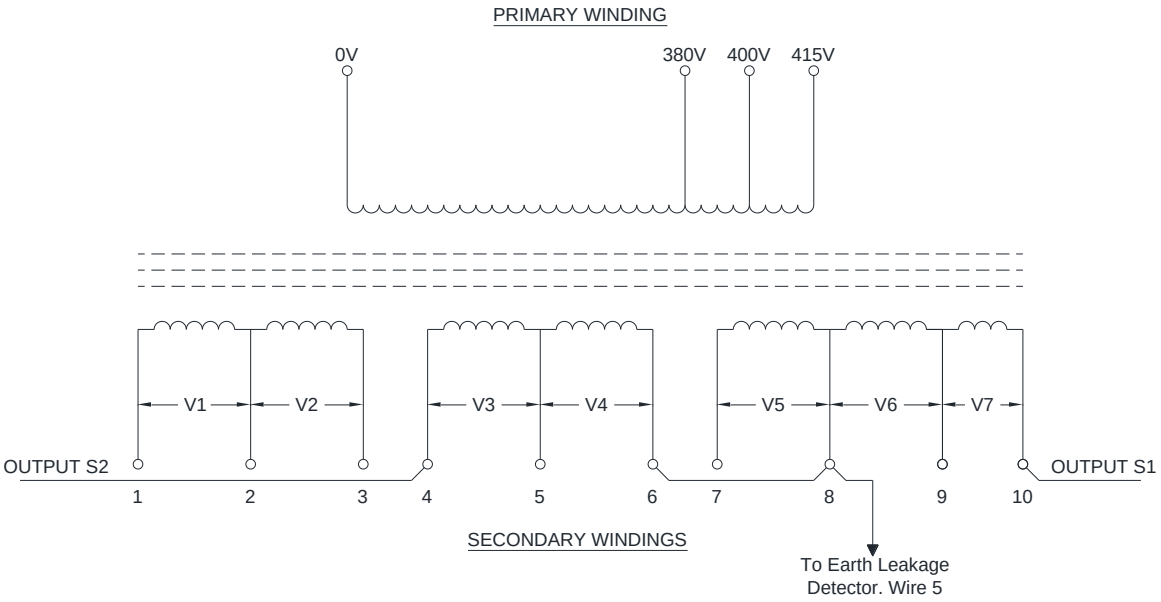


Figure 4-5 6.6A Transformer configured for intermediate voltage

It is important to verify that the transformer output voltage tappings are set to correctly match the load, so that the thyristor conduction period is near to the optimum value at maximum current. This is described in Section 4.3.4

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 4-6 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 4-8 lists the secondary winding voltages for the most common sizes of transformer of this style.

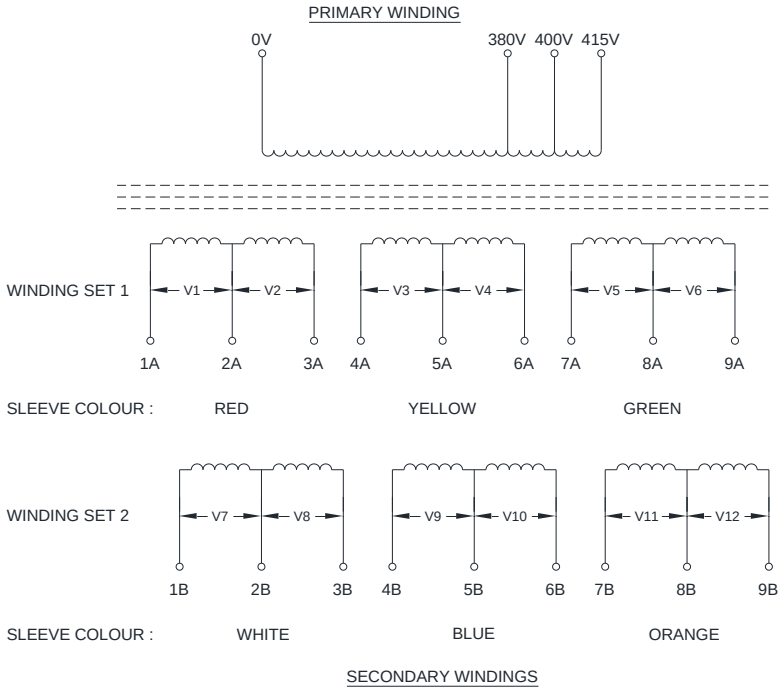


Figure 4-6 6.6A / 12.0A CCR Main Transformer, 2 sets of 3 secondary windings

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
22	1890	3780	30	60	120	240	480	960
26	2205	4410	35	70	140	280	560	1120

Table 4-8 6.6A / 12.0A Main Transformer Output Voltages, 2 sets of 3 windings

Figure 4-7 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 4-8, refer to the tapping voltages marked on the transformer itself.

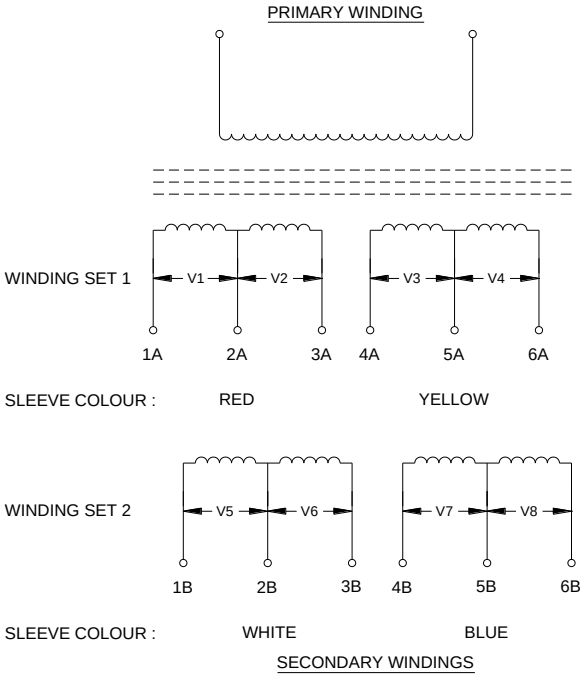


Figure 4-7 6.6A / 12.0A CCR Main Transformer, 2 sets of 2 secondary windings

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 4-8 (S1 and S2 are the output cables). 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 4-9.

Note – a third connection is made to the transformer output windings, which goes to the Earth Leakage Detector (wire number 5). 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 (optional) Percentage Lamp Failure Card. This is not shown on these drawings.

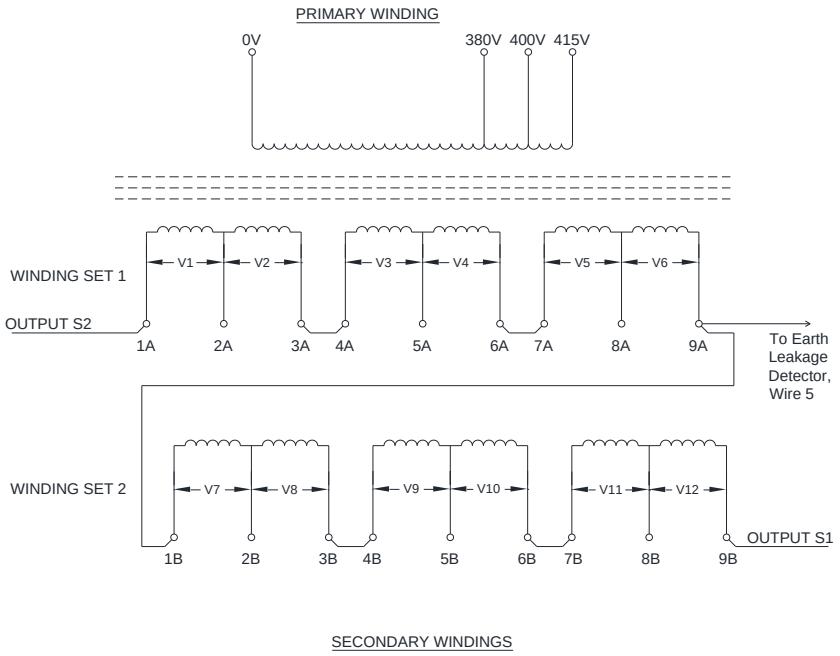


Figure 4-8 6.6A / 12.0A Transformer configured for 6.6A at full voltage

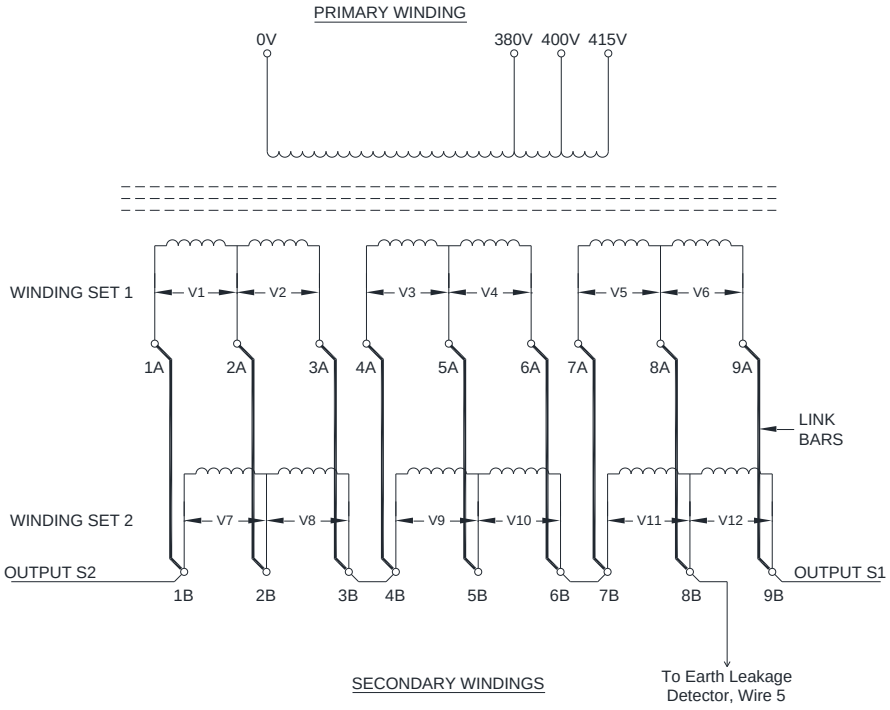


Figure 4-9 6.6A / 12.0A Transformer configured for 12A at full voltage

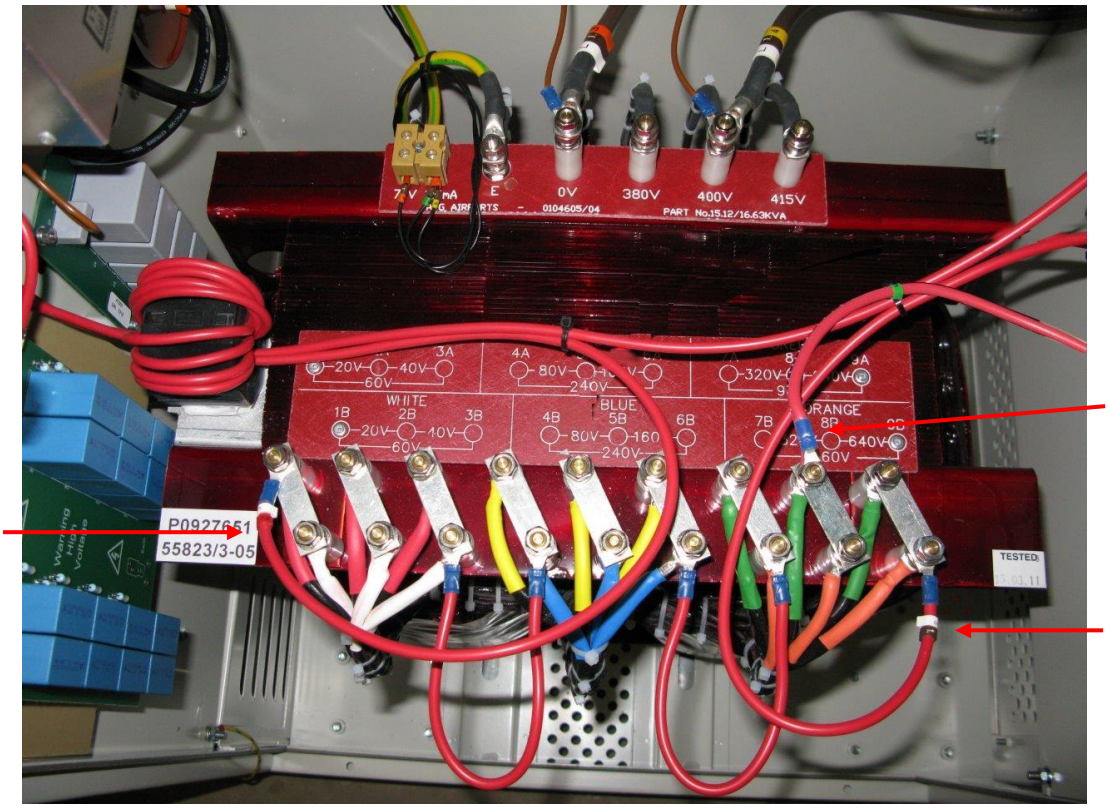


Figure 4-10 Photograph of 6.6A/12.0A Transformer configured for 12.0A, full voltage

To calculate the required CCR output voltage according to the AGL circuit load, refer to Section 7.1

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 4-11.

Note – when connecting together sections of the secondary windings, ensure that the windings are connected with the correct orientation (phasing), as shown in Figure 4-8 or Figure 4-11. In this way, the voltages from each section will add and not subtract.

WARNING - DO NOT CONNECT A LINK WIRE DIRECTLY ACROSS A WINDING SECTION – THIS WILL CREATE A SHORT CIRCUIT AND WILL CAUSE IRREPARABLE DAMAGE TO THE TRANSFORMER.

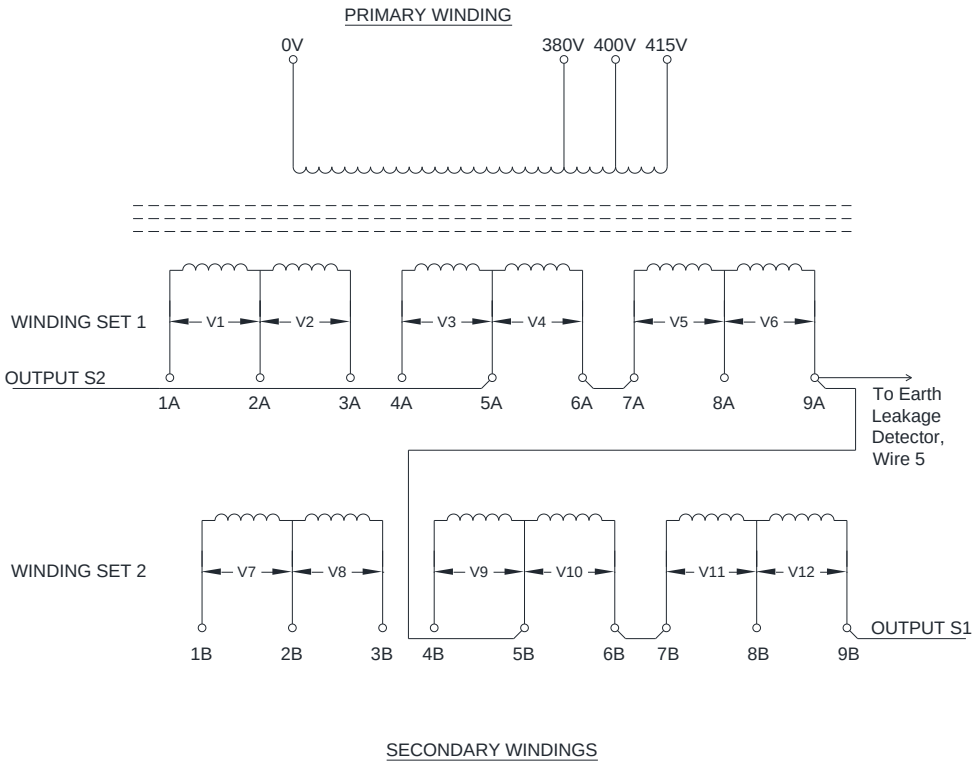


Figure 4-11 6.6A / 12.0A Transformer configured for 6.6A, intermediate voltage

It is important to verify that the transformer output voltage tappings are set to correctly match the load, so that the thyristor conduction period is near to the optimum value at maximum current. This is described in Section 4.3.4

4.3.3 Configuring the Main Transformer for a short circuit load test

When the CCR is to be tested with a shorting link connected to the output in place of the series circuit, only the lowest voltage winding should be connected to the output cables. For a 6.6A transformer this is winding section V1, or for the dual wound 6.6A/12A transformers this would be windings V1 and V7 (where there are two sets of three secondary windings), either connected in series for 6.6A output, or in parallel for 12A output.

Examples are shown in the Figures below; S1 and S2 are the output cables, whilst wire number 5 is for the (optional) earth leakage detector.

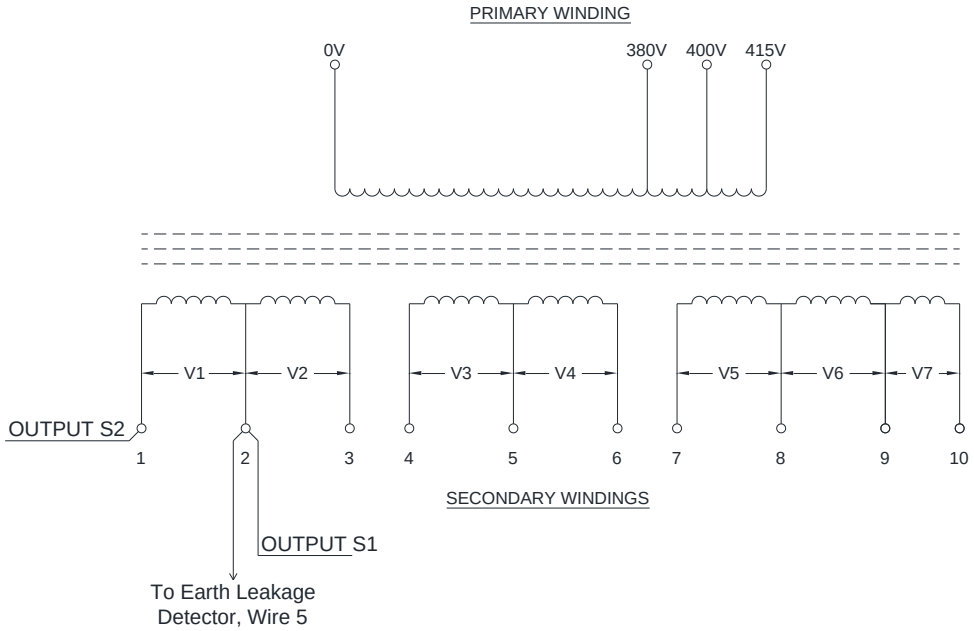


Figure 4-12 6.6A transformer configured for CCR short circuit test, minimum voltage

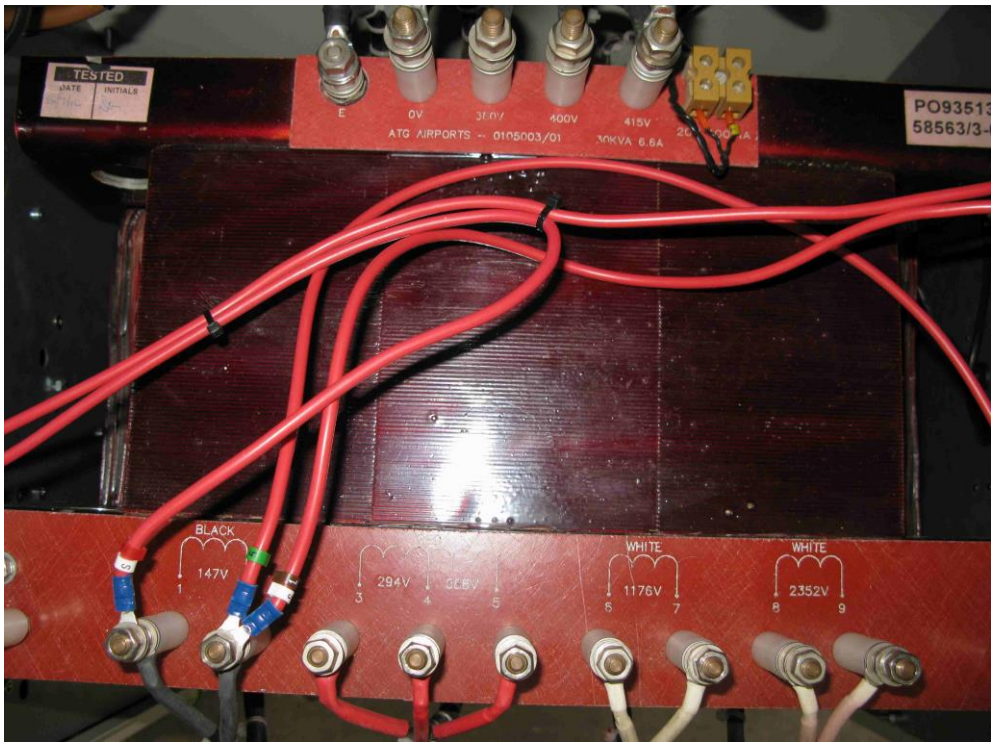


Figure 4-13 Photograph of 6.6A transformer configured for CCR short circuit test, minimum voltage

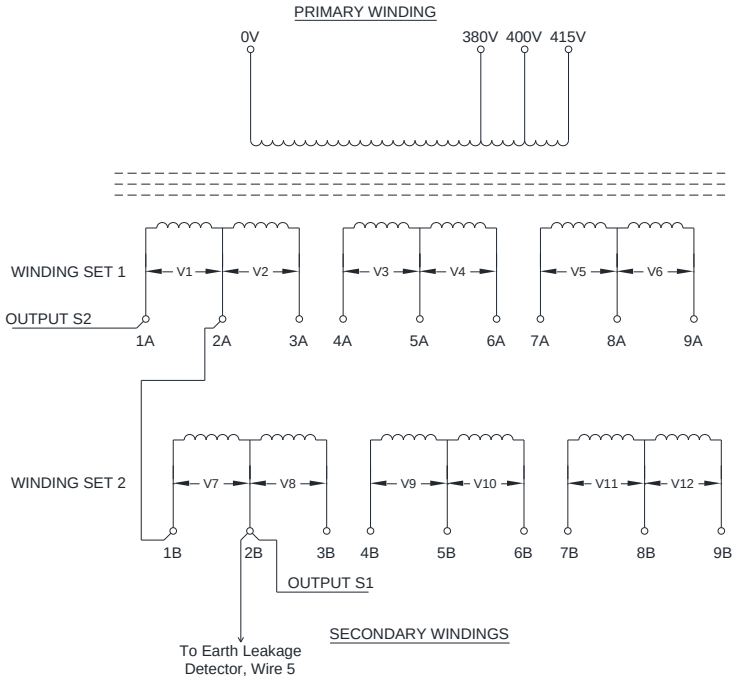


Figure 4-14 6.6A / 12.0A Transformer configured for CCR short circuit test, minimum voltage, at 6.6A output

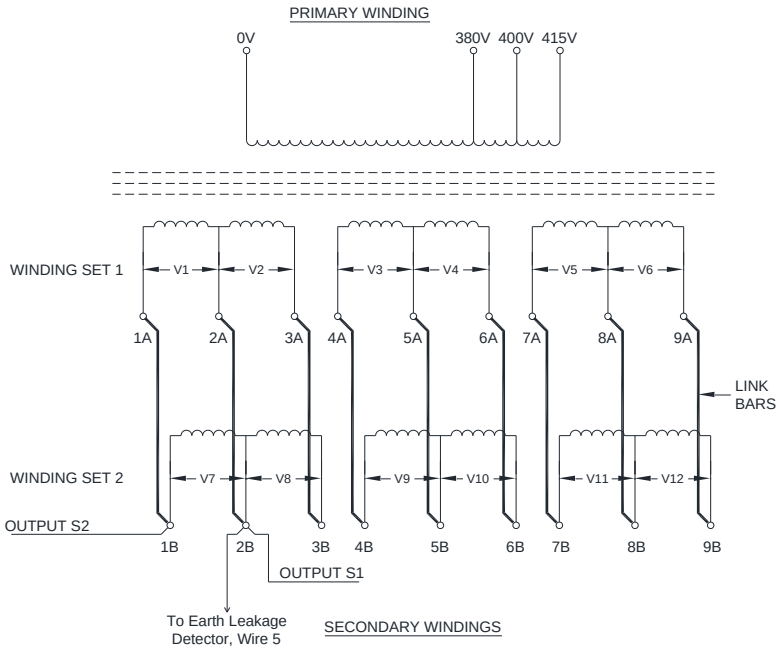


Figure 4-15 6.6A / 12.0A Transformer configured for CCR short circuit test, minimum voltage, at 12A output

4.3.4 Thyristor Conduction Period; Verifying the Transformer Setting

The CCR output voltage should be adjusted to suit the load on the series circuit such that the optimum thyristor conduction period is obtained:

For the majority of CCRs, the optimum thyristor conduction angle is around 121 degrees at maximum output current, which equates to 6.7ms conduction period per half cycle on a 50Hz supply or 5.6ms conduction period per half cycle on a 60Hz supply. This is in order to minimise the supply current harmonics and to achieve a 0.9PF, yet be able to maintain the output current within tolerance with a 10% drop in supply voltage.

For those CCRs of 12.5kVA or above which are built to comply with FAA AC 150/5345-10, the optimum thyristor conduction angle is around 133 degrees at maximum output current, which equates to 7.4ms conduction period per half cycle on a 50Hz supply or 6.16ms conduction period per half cycle on a 60Hz supply. This is in order to minimise the supply current harmonics and to achieve a 0.95PF, yet be able to maintain the output current within tolerance with a 5% drop in supply voltage.

Figure 4-16 shows the output current waveform for a 50 Hz supply when the regulator output voltage is set to correctly match the load in order to achieve 0.9PF (first case above). The conduction period is 6.7ms on, 3.3ms off for each half cycle when operating at maximum brilliancy.

If the transformer output voltage is set too high, then the control loop will give a shorter thyristor conduction period to maintain the correct output current. In this case, the CCR supply current will be higher than necessary, the power factor will be worse, and the harmonic current content of both the supply to the CCR, and the output to the AGL primary series circuit, will be worse. However, the CCR will be more tolerant to increases in the series circuit load, and to reductions in the supply voltage.

If, on the other hand, the transformer output voltage is set too low, then there is the possibility that even at full sinusoidal conduction (i.e, the ‘on’ period for each a thyristor being a half mains cycle or 180 degrees), then the CCR will not be able to deliver the required output current. In this case, the regulator may trip on ‘Open Circuit’, or give an ‘Under Current’ tolerance alarm.

This waveform can be observed using an oscilloscope, either by connecting a current clamp over one of the CCR output cables, or by connecting an oscilloscope probe between TP1 (0v) and TP11 on the AT533 Main Control Card. This card is located behind the CCR front door. (Note – 415v is present on terminal blocks TB1 and TB2 of this card, which have a cover fitted over them).

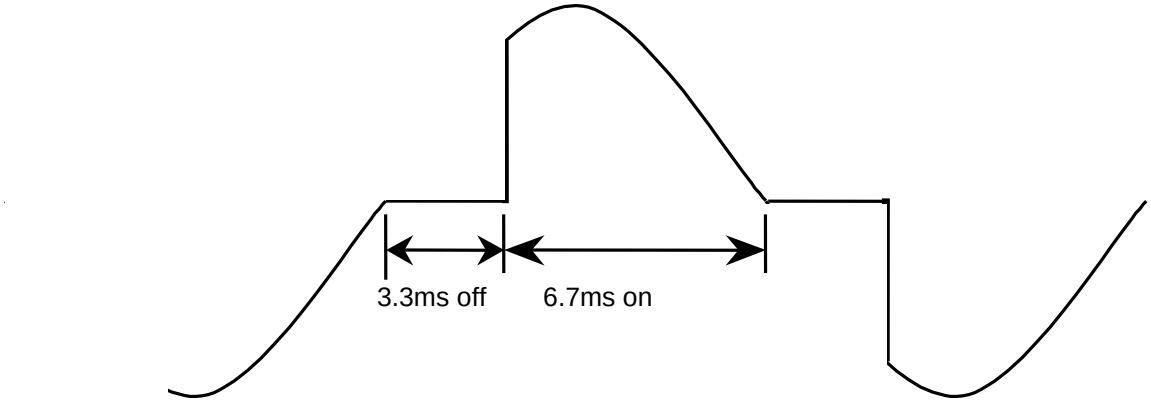


Figure 4-16 Correctly matched CCR Output Current Waveform for a 50Hz supply

If an oscilloscope is not available, an alternative (but less accurate) method of checking that the transformer tappings are set correctly is to measure the output voltage from the transformer auxiliary winding which feeds the (optional) AT642 Percentage Lamp Failure Card. A true RMS voltmeter will be required for this measurement. With the CCR running at maximum brilliancy into the desired load, the voltage measured between terminals 1 and 3 (wires 3 and 4) on the AT642 PLF Card should be between 18V and 20V AC RMS. (Note – on some earlier versions of the CCR, a nominal 70V auxiliary winding is used. In this case, wires 3 and 4 connect to terminals 2 and 3 on the PLF card. In this case, the correct measurement should be between 63 and 70 volts). If the measured voltage is too low, then the transformer output tapping voltage is set too high, and vice-versa.

4.4 Output Voltage and Output Load kVA Monitoring

In order to monitor the CCR output voltage and output load kVA, the optional AT642D Percentage Failure Card must be fitted. (Note - this card is included in CCRs built to FAA L-829 specification).

This card provides rms measurement of the CCR output voltage, which is then fed to the I^2C serial bus and through the 10 way ribbon cable connector CN1 to the AT500 Microcontroller Card. The CCR can then be programmed to display output voltage and output load kVA, and also 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 load kVA can be correctly displayed, the output voltage of the CCR Main Transformer tappings, as connected, should be programmed in via the keypad menu system. Refer to Section 4.4.2 overleaf. Potentiometer VR11 - 'VOLT CAL' on the AT642D card - is used to calibrate the voltage feedback; this is set during factory testing and should not require further adjustment. Do not adjust VR11 to correct the displayed value if the tapping voltage used has not been correctly programmed in.

The following sections describe how to use these additional features.

4.4.1 Voltage Feedback Enable

The output voltage of the CCR may be displayed on the 'Running Mode' screen, alongside the CCR output current. If this is enabled, then the CCR output load kVA can also be displayed; this is available by scrolling down from the 'Running Mode' screen.

Enter the Hardware Configuration Menu as described in Section 8.4.1, and use the (↓) button to scroll down to the following screen:

→	D	I	S	P	L	A	Y		O	P		V		↑	↓
					E	N	A	B	L	E	D				

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line. The setting can now be selected between ENABLED & DISABLED using the (↑) (↓) buttons.
Press the (↵ Enter) button to load the new setting. The arrow will return to the top left-hand corner of the screen.

Once enabled however, it is necessary to program in the actual tapping voltage used on the Main CCR Output Transformer. If this is not done, then the displayed output voltage and load kVA will not be correct. The setting can be adjusted as described below.

4.4.2 Programming the Output 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. 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 4-5, this would be 2065v

Enter the Hardware Configuration Menu as described in Section 8.4.1, and use the (↓) button to scroll down to the following screen:

	E	N	T		T	X		O	P		V	O	L	T	S
Y	=	↵		U	S	E	↑	↓		0	0	0	1	V	

It is now possible to load the Output Transformer Tapping Voltage, one digit at a time, by using the (↑) (↓) and (↵ Enter) buttons. The Output Transformer Tapping Voltage can be set between 1 and 5000 Volts. Press the (↵ Enter) button to confirm the setting.

4.4.3 KVA Alarm Enable

If 'Voltage Feedback' 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 Hardware Configuration Menu as described in Section 8.4.1 and use the (↓) button to scroll down to the following screen:

	K	V	A		A	L	A	R	M				↑	↓
					E	N	A	B	L	E	D			

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line. The setting can now be selected between ENABLED & DISABLED using the (↑) (↓) buttons.

Press the (↵ Enter) button to load the new setting. The arrow will return to the top left-hand corner of the screen.

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 based on the AT699 card. This system provides a measurement of the resistance to earth of the Primary Series Loop Circuit using two test modes:

i) Continuously when the CCR is operating (and optionally 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 8.2.2).

The Micro 100 CCR can be configured to carry out 500V DC testing both while operating and in standby by selecting the ‘CONT ANALOGUE’ type of testing (see section 8.4.2.12 Earth Leakage Detection Type).

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 / $((80 \times 10^{-6}) + (0.08 \times 10^{-6}))$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 Stage 2 Earth Leakage Trip Selection

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 Hardware Configuration Menu as described in Section 8.4.1, then use the (↑) or (↓) buttons to scroll to the following screen:

→	T	R	I	P		O	N		E	A	R	T	H	2
				E	N	A	B	L	E	D				

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line:

	T	R	I	P		O	N		E	A	R	T	H		2
→				E	N	A	B	L	E	D					

The setting can now be selected between ENABLED and DISABLED using the (↑) and (↓) buttons. Setting to 'ENABLED' will cause the CCR to trip on Stage 2 Earth Fault.

Press the (↵ Enter) button to load the new setting. The arrow will return to the top left-hand corner of the screen.

4.5.2.2 Programming the Earth Leakage Resistance Alarm and Trip Points

The following screens are only available if the optional Analogue Earth Leakage Resistance Measurement Module is fitted and the CCR is programmed for 'ANALOGUE' or 'CONT. ANALOGUE' Earth Leakage type (refer to Section 8.4.2.12).

Turn the Brilliancy Control Selector switch SW1 to 'OFF'. Enter the Set-up Menu as described in Section 8.3.1, and use the (↑) or (↓) buttons to scroll to the following screen:

→	E	A	R	T	H		L	E	A	K	A	G	E	↑	↓
	S	T	A	G	E		1				2	0		M	Ω

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line. Use the (↑) or (↓) buttons to set the Stage 1 Alarm threshold resistance anywhere between 4kΩ and 50 MΩ, or to DISABLE the alarm.

Press the (↵ Enter) button to accept the setting. The arrow will return to the top left-hand corner of the screen.

To set the Stage 2 Trip Threshold, press the (↓) buttons to scroll to the following screen:

→	E	A	R	T	H		L	E	A	K	A	G	E	↑	↓
	S	T	A	G	E		2			1	2	0		k	Ω

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line. Use the (↑) or (↓) buttons to set the Stage 2 Trip threshold resistance anywhere between 4kΩ and 50 MΩ, or to DISABLE the alarm.

Press the (↵ Enter) button to accept the setting. The arrow will return to the top left-hand corner of the screen.

4.6 Commissioning the Percentage Lamp Failure System

The Percentage Lamp Failure System is available as an option on the Micro 100 CCR. This system is based on the AT642 PLF Card, which if this option is selected, will be mounted behind the CCR lower front door. (Note – the AT642 Card is included in the CCRs built to comply with the FAA L-829 specification). The card generates an error voltage that is a function of the number of failed lamps on the AGL circuit.

The error voltage is produced by comparing the rise time of the CCR output transformer voltage waveform with that of the current waveform, at the point when the thyristors are triggered. 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), which results in the rising edge of the current waveform lagging that of the voltage waveform. The time lag between the two waveforms is used to generate an error voltage; this is compared with threshold levels which, when exceeded, trigger the PLF alarms.

Note - the system is designed to be used with AGL transformers feeding tungsten lamps; when the lamp fails open circuit the load on the transformer secondary becomes open circuit, and the primary presents an inductive load. Circuits composed of 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 to the fitting in the event of a fault. Only in the latter case would the CCR PLF system operate correctly.

On CCRs fitted with the AT642D Card (introduced in November 2004), the PLF error voltage is also fed to the I^2C serial bus and, via the 10 way ribbon cable connector CN1, to the AT500 Microcontroller Card. Using this signal, the Microcontroller is able to calculate the percentage of lamps failed, or, if the total number of lamps on the circuit is programmed in, it can display the number of lamps failed. To use the PLF card in this way, select ‘ANALOGUE IP' mode for the Percentage Lamp Failure set-up from within the Hardware Configuration menu. This is the recommended mode of PLF operation, since calibration is partially automated, and any non-linearity in the PLF error voltage over different CCR Brilliancy’s is automatically accounted for. However, to use this mode (also known as ‘software’ mode), the automated calibration routine must be run with lamps removed to record the error voltage in the conditions corresponding to the desired alarm thresholds for the 2 Stages. Refer to the following section for the Set-up procedure.

On CCRs fitted with Firmware version 2.03 or earlier (manufactured prior to November 2004) the 2 Stage Percentage Lamp Failure output alarms can only be driven from the two relays on the AT642 Card. These are set to energise when the PLF error voltage exceeds the threshold levels selected by the two rotary switches SW1 and SW2. This is known as the ‘hardware’ mode of operation.

The generated PLF error voltage under any given percentage of failed lamps will be dependent on the particular AGL circuit characteristics. For example, an error voltage of 3.5v may be produced at 1% of failed lamps on one AGL circuit, and 2% on another circuit. For this reason, it is recommended to calibrate the card by either removing lamps from the AGL circuit, or temporarily introducing additional AGL transformers into the circuit, without lamps connected. For example, if a 2% alarm setting is required on a circuit with 100 lamps, connect two additional transformers (of the same VA rating as those in the field circuit) with the secondary connections open circuit, or remove two lamps from the AGL field circuit.

Whether the PLF system is being calibrated for the ‘hardware’ mode of operation, that is, 1 Stage or 2 Stage operation, or for ‘ANALOGUE IP’ mode of operation, then the system should preferably be calibrated with the actual number of lamps removed corresponding to the required alarm points.

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.

Whichever mode of operation is selected, the AT642 PLF Card should first be set up as described below.

The initial settings listed in Table 4-9, which should already have been made during factory testing of the CCR, should be verified. This should be done with the regulator powered up, but in the ‘OFF’ state. A digital voltmeter will be required to check these; use TP11 on the AT642 card (next to VREG2) as the 0v connection.

Ensure that PLK4 and PLK5 on the AT642 Card are NOT fitted, and if the ‘ANALOGUE IP' mode is to be used, PLK1 should be fitted in position A. On AT642D cards and later, if PLK2 is fitted (denoted by MOD 1), then this should be fitted in position B for high sensitivity (standard setting), which detects up to a maximum of around 16% lamp outage, or position A, for a range up to around 32%.

Parameter:	Notes:	Measurement Point:	Adjust:	Required setting or measurement:
Stage 1 PLF alarm threshold voltage	First set rotary switch SW1 (PLF1) to position '0' (test position; this gives maximum voltage).	TP13 (located next to rotary switch SW1)	VR1	10.0v DC +/- 0.1v
Stage 2 PLF alarm threshold voltage	First set rotary switch SW2 (PLF2) to position '0' (test position; this gives maximum voltage).	TP14 (located next to rotary switch SW2)	VR2	10.0v DC +/- 0.1v
Voltage waveform rising edge comparator threshold (VTH)	Regulators rated at 7.5KVA and above	TP5	VR4 (VTH)	–1.63v DC +/- 0.02v
	Regulators rated at less than 7.5KVA	TP5	VR4 (VTH)	0.00v DC +/- 0.02v
Current waveform rising edge comparator threshold (ITH)	Regulators rated at 7.5KVA and above	TP6	VR5 (ITH)	–1.63v DC +/- 0.02v
	Regulators rated at less than 7.5KVA	TP6	VR5 (ITH)	–2.42v DC +/- 0.02v
'IMIX' average current mix linearity control		N/A	VR3 (IMIX)	Fully clockwise; zero current signal mixed with error voltage

Table 4-9 AT642 Percentage Lamp Failure Card initial settings

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 Setting and calibrating for 'ANALOGUE IP' PLF(Software) Mode

4.6.1.1 Programming the CCR for 'ANALOGUE IP' PLF operation

First, it will be necessary to program the PLF Monitoring Configuration for 'ANALOGUE IP' operation.

Enter the Hardware Configuration Menu as described in Section 8.4.1, then use the (↑) or (↓) buttons to scroll to the following screen (note – the second line may read '1 STAGE' or 'ANALOGUE IP' if the settings have already been changed from the default setting):

→	%		L	A	M	P		F	A	I	L		↑	↓
				2		S	T	A	G	E				

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line. Using the (↑) (↓) buttons, scroll through until 'ANALOGUE IP' is displayed on the bottom line. Press the (↵ Enter) button to load the new setting. The arrow will return to the top left-hand corner of the screen.

→	%		L	A	M	P		F	A	I	L		↑	↓
			A	N	A	L	O	G	U	E		I	P	

Next, program in the total number of lamps fitted to the AGL series loop circuit.

Use the (↓) button to scroll down to the following screen:

→	N	U	M		O	F		L	A	M	P	S	↑	↓
				x	x	x								

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line. Enter the total number of lamps on the circuit, one digit at a time, by using the (↑) (↓) buttons and confirm by pressing the (↵ Enter) button. The permissible setting is between 1 and 400. The arrow will return to the top left-hand corner of the screen after all 3 digits have been set.

Next, set the Stage 1 PLF Alarm threshold level.

Use the (↓) button to scroll down to the following screen:

→	P	L	F		L	I	M	I	T		1			↑	↓
		x	x	x		(	x	x	x	%	)				

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line. The number of failed lamps required to trigger a Stage 1 PLF alarm can now be set by counting up or down using the (↑) (↓) buttons. Note - the corresponding figure for the Percentage of Lamps Failed on the circuit will be calculated and displayed at the same time.

Confirm the setting by pressing the (↵ Enter) button twice, or alternatively, press the (↵ Enter) button once to move to the percentage display. The alarm threshold can now be set as a Percentage of Lamps Failed by counting up or down using the (↑) (↓) buttons. The corresponding figure for the number of lamps failed will be calculated and displayed at the same time. Confirm the setting by pressing the (↵ Enter) button once.

Next, set the Stage 2 PLF Alarm threshold level.

Use the (↓) button to scroll down to the following screen:

→	P	L	F		L	I	M	I	T		2			↑	↓
		x	x	x		(	x	x	x	%	)				

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line. The number of failed lamps required to trigger a Stage 2 PLF alarm can now be set by counting up or down using the (↑) (↓) buttons. Note - the corresponding figure for the Percentage of Lamps Failed on the circuit will be calculated and displayed at the same time.

Confirm the setting by pressing the (↵ Enter) button twice, or alternatively, press the (↵ Enter) button once to move to the percentage display. The alarm threshold can now be set as a Percentage of Lamps Failed by counting up or down using the (↑) (↓) buttons. The corresponding figure for the number of lamps failed will be calculated and displayed at the same time. Confirm the setting by pressing the (↵ Enter) button once.

If the setting selected for either of the thresholds above is different to the calibration levels used (see next section), then the following screen is displayed:

C	A	L	.		A	T		T	R	I	P		P	T	.
		F	O	R		A	C	C	U	R	A	C	Y		

Press the (↵ Enter) button once more to return to the previous screen.

4.6.1.2 Calibrating the CCR for 'ANALOGUE IP' PLF operation

In 'ANALOGUE IP' mode the PLF system requires calibrating by sampling the AT642 Card PLF error voltage at two levels of open circuit lamps. The error voltage 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 points (Stage 1 PLF), programmed as described in Section 4.6.1.1, above.

Turn the power to the CCR back on, but leave the rotary switch in the 'Off' position. Enter the Hardware Configuration Menu as described in Section 8.4.1, then use the (↑) or (↓) buttons to scroll to the following screen:

C	A	L	I	B	R	A	T	E		P	L	F		↑	↓
	I	N	P	U	T	?							Y	=	↵

Press the (↵ Enter) button; the screen will change to:

A	L	A	R	M		S	T	A	G	E		T	O		
C	A	P	T	U	R	E	:		S	1		↑	↓		↵

If necessary, use the (↑) or (↓) buttons to select level ONE; Confirm by pressing the (↵ Enter) button; the screen will change to:

E	N	T		N	U	M		O	C		L	A	M	P	S
S	1		Y	=	↵		U	S	E	↑	↓				5

Use the (↑) or (↓) buttons to set the number of lamps removed / AGL transformers open circuited for this calibration point, and confirm by pressing the (↵ Enter) button. If the setting used is different to that programmed for the

PLF Limit 1 alarm threshold set in Section 4.6.1.1 above, then the following screen will be displayed:

C	A	L	.		A	T		T	R	I	P		P	T	.
		F	O	R		A	C	C	U	R	A	C	Y		

Press the (↵ Enter) button; the screen will change to:

	C	C	R		W	I	L	L		S	T	A	R	T	
	C	O	N	T	I	N	U	E	?			Y	=	↵	

Press the (↵ Enter) button again. The CCR will switch on and the screen will change to:

	P	R	E	S	S		↵		T	O					
	C	A	P	T	U	R	E		I	/	P				

Press the (↵ Enter) button again to record the PLF Card error voltages for level one calibration. After running and automatically recording the error voltage 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 points (Stage 2 PLF), programmed as described in Section 4.6.1.1 above.

Turn the power to the CCR back on, but leave the rotary switch in the ‘Off’ position. Enter the Hardware Configuration Menu as described in Section 8.4.1, then use the (↑) or (↓) buttons to scroll to the following screen:

C	A	L	I	B	R	A	T	E		P	L	F		↑	↓
	I	N	P	U	T	?							Y	=	↵

Press the (↵ Enter) button; the screen will change to:

A	L	A	R	M		S	T	A	G	E		T	O		
C	A	P	T	U	R	E	:		S	1		↑	↓		↵

Use the (↑) or (↓) buttons to select level TWO; Confirm by pressing the (↵ Enter) button; the screen will change to:

E	N	T		N	U	M		O	C		L	A	M	P	S
S	2		Y	=	↵		U	S	E	↑	↓			1	0

Use the (↑) or (↓) buttons to set the number of lamps removed / AGL transformers open circuited for this calibration point, and confirm by pressing the (↵ Enter) button. If the setting used is different to that programmed for the PLF Limit 2 alarm threshold set in Section 4.6.1.1 above, then the following screen will be displayed:

C	A	L	.		A	T		T	R	I	P		P	T	.
		F	O	R		A	C	C	U	R	A	C	Y		

Press the (↵ Enter) button; the screen will change to:

	C	C	R		W	I	L	L		S	T	A	R	T	
	C	O	N	T	I	N	U	E	?			Y	=	↵	

Press the (↵ Enter) button again. The CCR will start and the screen will change to:

	P	R	E	S	S		↵		T	O					
	C	A	P	T	U	R	E		I	/	P				

Press the (↵ Enter) button again to record the PLF Card error voltages for level two calibration. After running and automatically recording the error voltage at each Brilliancy level, the CCR will switch off, and the screen will revert back to the ‘Calibrate PLF’ screen.

To exit from the screen, press the (X Clear) button.

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.

4.6.2 Setting and calibrating for ‘Hardware’ mode PLF operation

Setting the PLF Monitoring Configuration to ‘1 Stage’ or ‘2 Stage’, that is, ‘hardware’ mode, means that the alarm signals are generated entirely by the AT642 PLF card. For all measurements, use TP11 on the AT642 card (next to VREG2) as the 0v connection.

The final PLF error voltage, which can be measured at TP4 on the AT642 Card, is compared with the two alarm threshold voltages, which can be measured at TP13 (Stage 1) and TP14 (Stage 2) respectively. When the error voltage exceeds an alarm threshold voltage, a relay is energised which gives a signal to the Microcontroller. After a time delay, a PLF alarm is raised.

The two alarm threshold voltages are selected by the setting of rotary switches SW1 ('PLF1') and SW2 ('PLF2'), with the adjacent potentiometers, VR1 and VR2 respectively, providing fine adjustment. Switch position 1 is the most sensitive setting for the circuit, giving the lowest threshold voltage, and position 9 the highest. SW2 is normally set higher than SW1, since this will be the second stage alarm.

It is preferable that the error voltage produced is approximately equal over the full range of CCR Brilliancy levels. For smaller regulators, it may be necessary to mix in a proportion of the average CCR output current to the raw error voltage (measured at TP3) to maintain linearity, since the raw error voltage can be smaller at higher CCR output currents. The 'IMIX' potentiometer is thus turned anticlockwise to achieve a suitable setting. For the larger regulators (4.0kVA and above), non-linearity is generally not a problem and so the 'IMIX' potentiometer is set fully clockwise, with zero average current mixed in. The final PLF error voltage, after the mixer circuit, can be measured at TP4. Note – the change in error voltage when lamps fail is greater if the 'IMIX' potentiometer is set fully clockwise. The potentiometer should, therefore, only be moved from this setting when absolutely necessary.

As for the 'ANALOGUE IP' software mode, it is recommended 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. However, if it is not possible to calibrate the PLF system with lamps removed (or additional AGL transformers connected), an approximate setting can be made by measuring the TP4 error voltage with all the AGL lamps in circuit, then setting the alarm threshold levels to be just a little higher than this.

This basic set-up is described in (i) and (ii) below:

i/ Run the CCR at maximum Brilliancy with all the AGL lamps fitted and operating (check that none of the lamps have already failed), and measure the PLF error voltage at TP4 on the AT642 Card. (Use TP11 as the 0v connection for the meter).

Next, run the CCR at the lowest Brilliancy, and measure the voltage at TP4 again. If it is significantly higher, turn the 'IMIX' potentiometer slightly anticlockwise from the normal clockwise setting, say to mid-position. (Note - the change in error voltage when lamps fail is greater if the 'IMIX' potentiometer is set in the fully clockwise position. This setting should therefore be used unless there is a large discrepancy in the error voltage between minimum and maximum CCR Brilliancy).

Run the CCR over the full range of Brilliancies, and check that the TP4 error voltage does not change significantly between minimum and maximum CCR Brilliancy. Adjust the 'IMIX' potentiometer again if necessary,

Measure and take a note of the highest value that the TP4 error voltage reaches over the full range of CCR Brilliancies (it may be highest on a Brilliancy in the middle of the range).

ii/ Set the PLF Stage 1 threshold voltage at TP13 to be between 0.6v and 1.0v above the highest value measured for the TP4 error voltage, depending on the sensitivity required. (Note – the further the 'IMIX' potentiometer is turned from the normal clockwise setting, then the closer the TP13 threshold voltage should be set to the highest error voltage measured at TP4). The TP13 voltage is set by turning rotary switch SW1 ('PLF1') anticlockwise until the TP13 voltage is just a little above the desired value, and then adjusting potentiometer VR1 to get a precise setting.

Set the PLF Stage 2 threshold voltage at TP14 to be between 1.0v and 1.6v above the highest value measured for the TP4 error voltage, depending on the sensitivity required. The TP14 voltage is set by turning rotary switch SW2 ('PLF2') anticlockwise until the TP14 voltage is just a little above the desired value, and then turning potentiometer VR2 to get a precise setting.

Described below are the additional procedures for calibrating the PLF system with the number of lamps removed / AGL transformers open circuited that correspond to the desired two alarm points. This is the recommended method of setting the system, and will provide more accurate results.

The first part of the set-up procedure is to follow that described in (i) above, then proceed as described in (iii) and (iv) below.

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.

iii/ 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 which should correspond to the lower of the required alarm points (Stage 1 PLF).

Switch the power back on, then run the CCR over the full range of Brilliancies, and check that the TP4 error voltage does not change significantly between minimum and maximum CCR Brilliancy. Adjust the 'IMIX' potentiometer again if necessary.

Run the CCR at maximum brilliancy. Turn rotary switch SW1 ('PLF1')

anticlockwise (to reduce the alarm threshold) until LED L1 switches on, then turn it back one step so that the LED goes out. Now turn VR1 anticlockwise until the LED comes back on, and then turn it a further half turn anticlockwise past this point. This sets the alarm threshold for PLF Level 1.

Switch off the CCR and isolate the power supply. Replace the AGL lamp(s) or remove the test AGL transformer(s). Switch the power back on, then run the CCR at all Brilliancies to ensure that the alarm threshold is not now reached, that is, LED L1 does not light.

iv/ Turn the CCR off and isolate the supply. Set the number of lamps removed / transformers open circuited corresponding to the higher of the required alarm points (Stage 2 PLF).

Run the CCR at maximum Brilliancy. Turn rotary switch SW2 ('PLF2') anticlockwise until LED L2 switches on, then turn it back one step so that the LED goes out. Now turn VR2 anticlockwise until the LED comes back on, and then turn it a further half turn anticlockwise past this point. This sets the alarm threshold for PLF Level 2.

Switch off the CCR and isolate the power supply. Replace some of the AGL lamps or remove some of the test AGL transformers to give the conditions corresponding to the Stage 1 alarm level. Switch the power back on, and then run the CCR at all Brilliancies to ensure that the alarm threshold is not now reached, that is, LED L2 does not light.

Turn the CCR off and isolate the supply. Replace the AGL lamps or remove the test AGL transformers.

5 Output Lightning Arrestors

Output Lightning Arrestors are available as an option on the Micro 100. 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 61822:2009 and FAA Advisory Circular 150/5345-10.

Figure 5-1 below shows a 2-pole Output Lightning Arrestor Terminal; more poles can be fitted for CCRs which include integral Circuit Selector Switches.

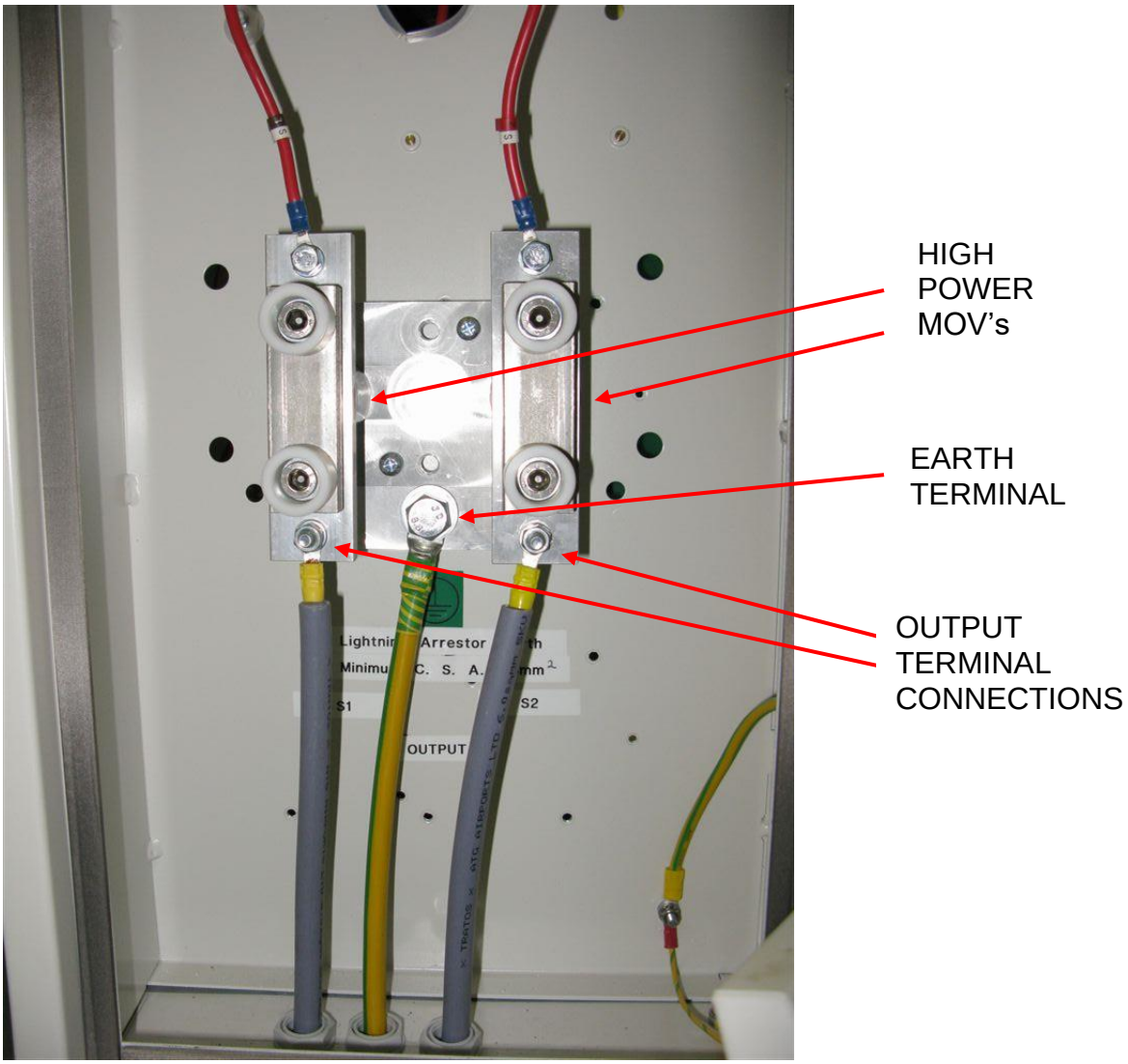


Figure 5-1 Output Lightning Arrestor Terminal

A separate earth connection must be made to the lightning arrestor assembly aluminium base plate, using the bolt near the bottom of the plate. This should connect to the earth bars of the sub-station counterpoise earth system (not to the

distribution board earth), to provide a low impedance path to earth, via ground rods located around the building, for the energy from lightning discharges.

The earth cable connecting the lightning arrestor base plate to the substation earth system should have a cross sectional area of at least 35 mm^2, and the length should be kept to a minimum.

If screened primary series loop cables are used, then the earthing screen should also be connected to the lightning arrestor base plate earth connection (and therefore to the sub-station counterpoise earth), in order to provide a low impedance path for lightning discharges.

6 Cutout Switch

The Cutout Switch, which is available as an option on the Micro 100, 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 61822:2009 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, but on Micro 100 CCRs fitted with Alternate or 2 Way Simultaneous Circuit Selector Switches, two Cutout Switches will be mounted behind the HT compartment rear (top) cover.

WARNING – HIGH VOLTAGES – UP TO 5000V FOR A 30KVA 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 6-1 below shows a Cutout Switch mounted above the CCR lightning arrestor / output terminals in the HT Terminal box of a Micro 100 CCR.

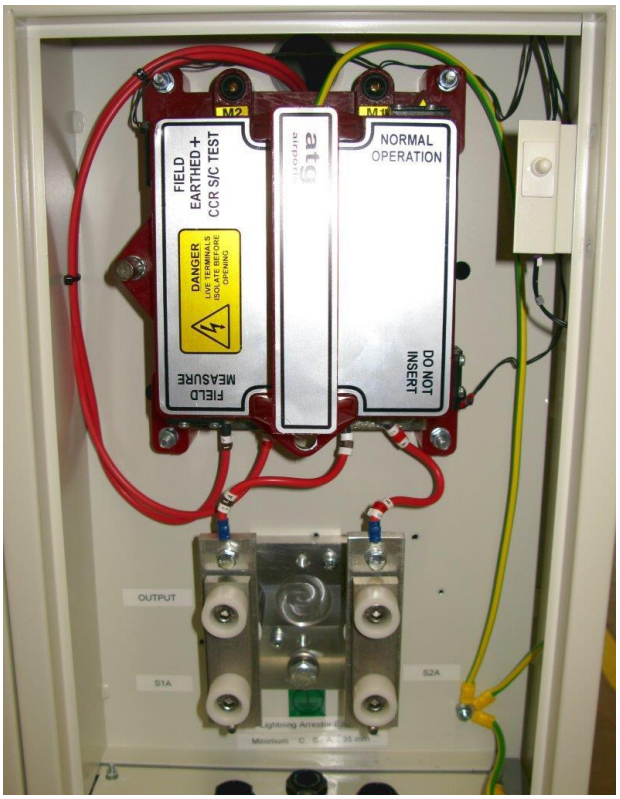


Figure 6-1 Cutout Switch mounted in CCR HT Output Terminal box

The Cutout Switch can be fitted with magnetic reed switches to give positional feedback; the reed switches work in conjunction with the 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 6-2 below shows the outline of the Cutout Switch, and identifies the cable connections. M1 and M2 are 4mm test terminals – see Section 6.1.3

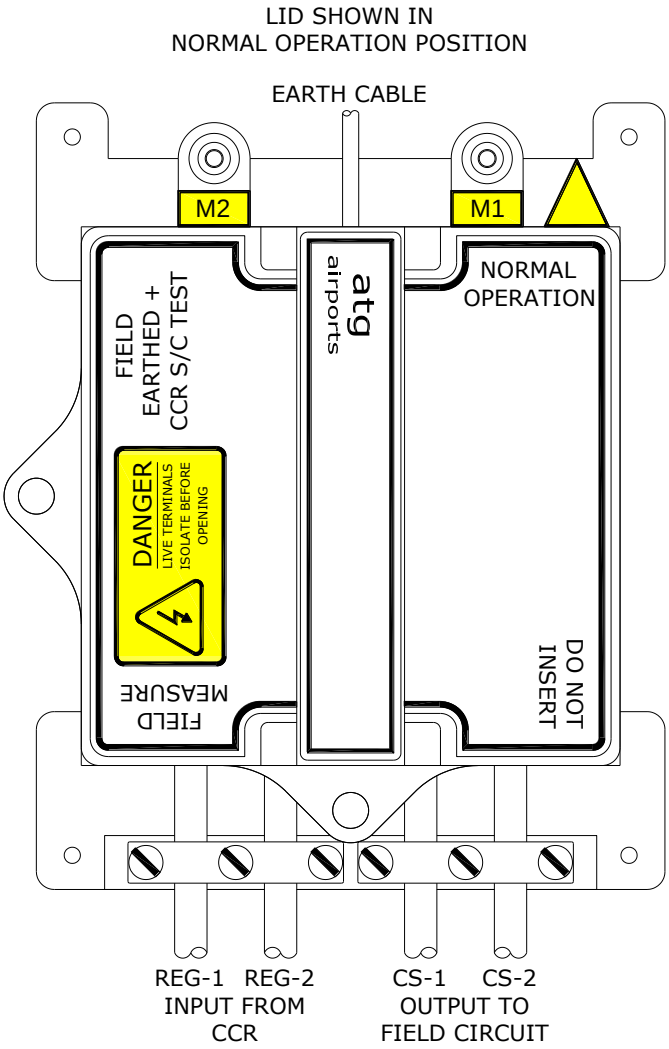


Figure 6-2 Cutout Switch outline drawing

6.1 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 6-2, this is Normal Operation.

WARNING: HIGH VOLTAGES – UP TO 6500V FOR A 30kVA 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.

6.1.1 Cutout Switch in 'Normal Operation' position

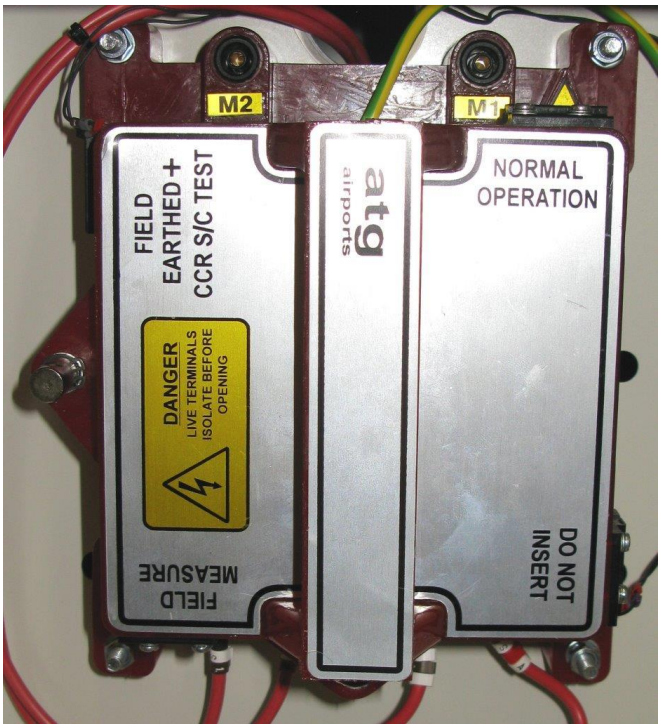


Figure 6-3 Cutout Switch in 'Normal Operation' position

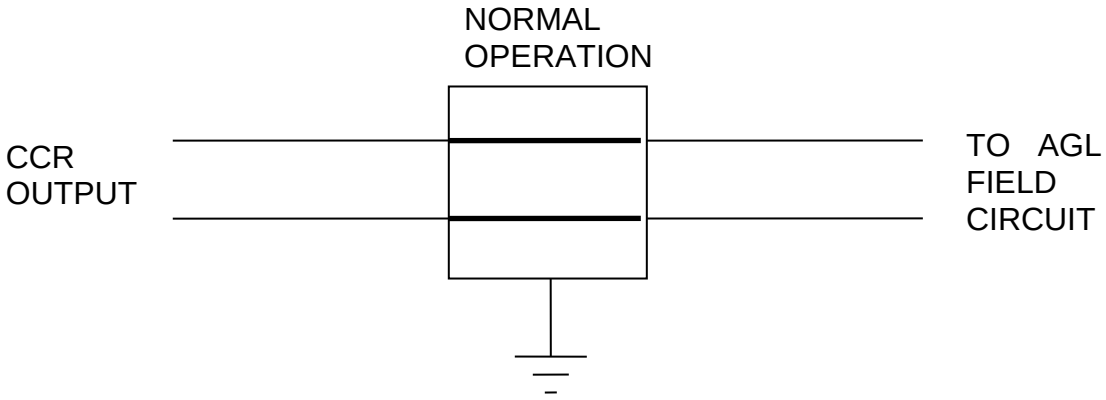


Figure 6-4 Electrical connections of Cutout Switch in 'Normal Operation' position

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

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

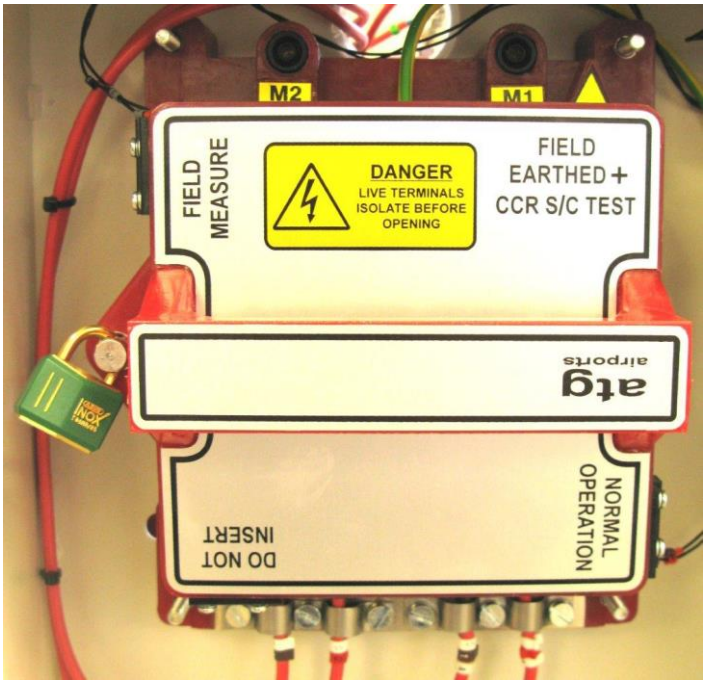


Figure 6-5 Cutout Switch in 'Field Earthed and CCR Short Circuit Test' maintenance position

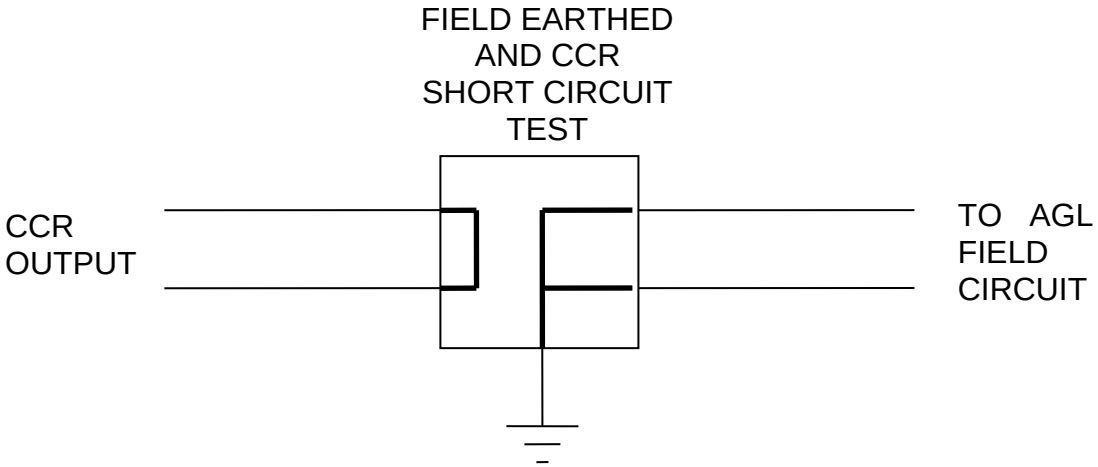


Figure 6-6 Electrical connections of Cutout in 'Field Earthed + CCR S/C Test' maintenance position

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. (Note – do not operate the CCR into a short circuit at any setting above minimum brilliancy unless the main transformer T101 secondary tapping voltage has been set to minimum; see Section 4.3. If this is not done, the high peak current levels may cause the mains input or thyristor protection fuses to fail).

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.

6.1.3 Cutout Switch in 'Field Measure' position

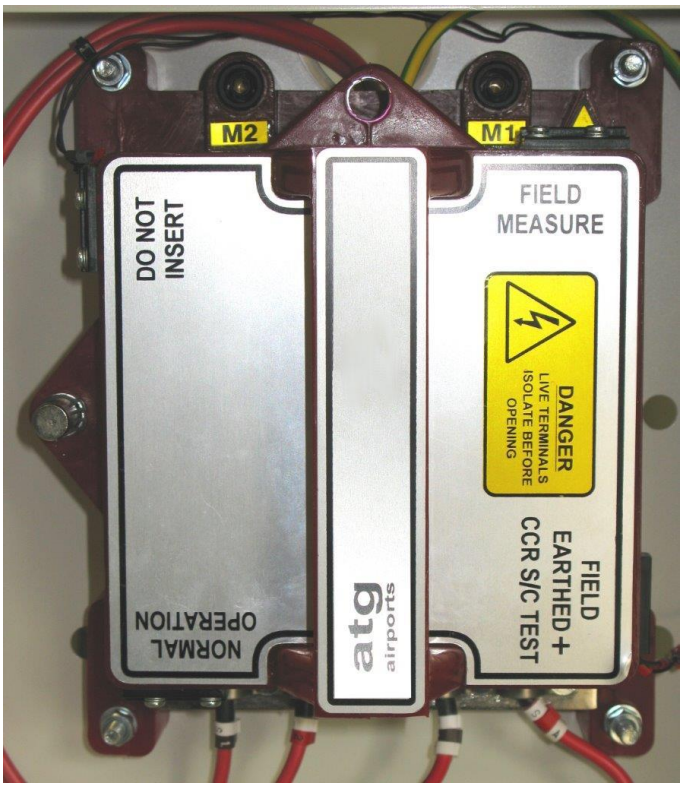


Figure 6-7 Cutout Switch in 'Field Measure' position

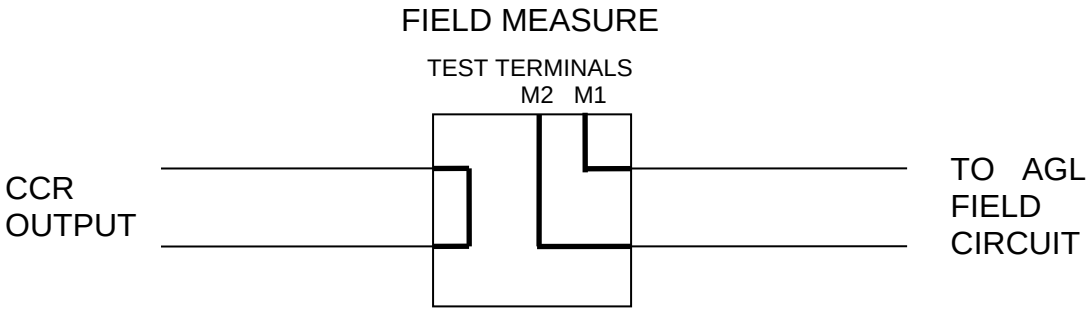


Figure 6-8 Electrical connections of Cutout Switch in 'Field Measure' position

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.

7 General CCR Application Information

7.1 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.

7.1.1 AGL Circuit Load

Figure 7-1 below, shows a typical AGL circuit.

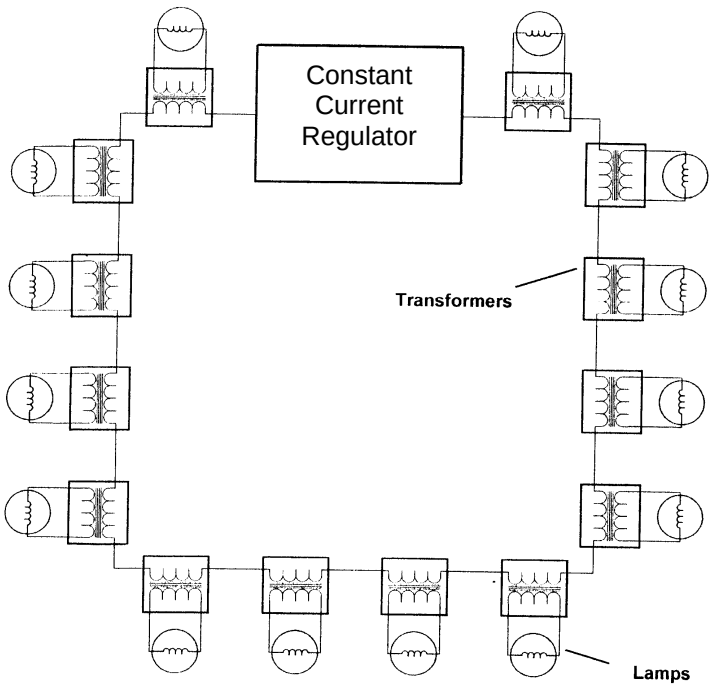


Figure 7-1 Typical Airfield Lighting Circuit

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.

7.1.2 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.

7.2 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 sections of the AGL circuit, there is 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.

The Micro 100 CCR contains a current clamp, which cuts in if the threshold of 103% of full load current is exceeded. In this case, the CCR permits a maximum of half a mains cycle of overload before backing the current off and ramping back up to its set point. This gives a much faster response to overload conditions than would be possible with conventional control circuitry, and therefore reduces the stress on the lamp filaments.

However, it is recommended that during block switching operations, the control system should momentarily reduce the CCR Brilliancy, or switch off the CCR altogether, in order not to stress the AGL lamps.

7.3 Lamp Life

Many lamp transformers today are supplied to ICA, or similar specifications, where performance is defined based on a sinusoidal supply current.

The Micro 100 regulators manufactured by **atg airports** ltd, in keeping with other regulators of a similar design, use thyristor phase angle control circuitry coupled with a closed loop controller to provide a constant current output. The output waveform is consequently a chopped sine wave, as shown below.

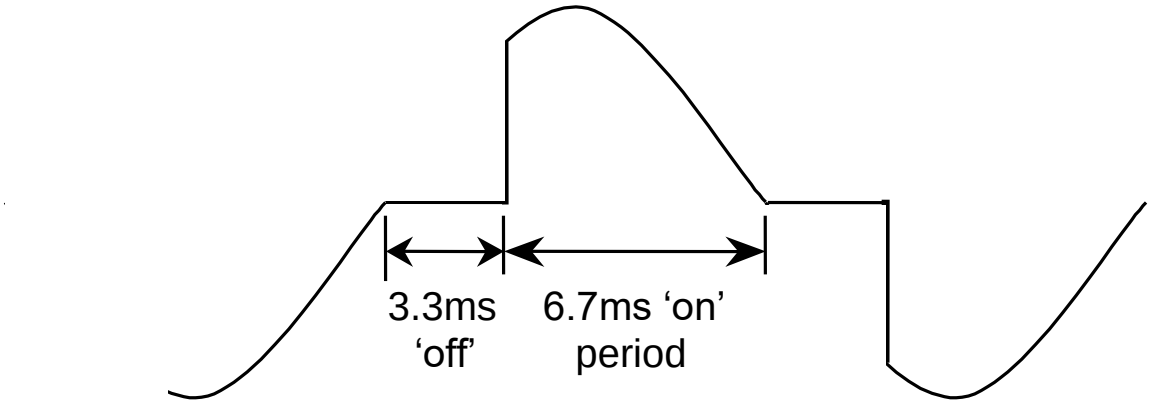


Figure 7-2 Typical output waveform and conduction period for a 50Hz supply

The conduction periods indicated are for a correctly matched main transformer output voltage, with the CCR operating at full Brilliancy.

Chopping the waveform produces harmonics, particularly the 3rd, (150Hz) 5th (250Hz) and the 7th (350Hz). The shorter the conduction period then the greater the harmonic content. At these frequencies, the lamp transformers actually become more efficient and produce extra power, resulting in higher lamp currents, sometimes up to 5% higher, depending on the conditions.

The higher currents cause reduced lamp life, and so to overcome this it is necessary to match the CCR main transformer output voltage as closely as possible to the load by making good use of the transformer output tappings. This will result in a waveform closer to that shown on the previous page, and consequently a lower harmonic content.

The importance of matching the secondary voltage of the output transformer with the required circuit voltage is something that is often overlooked, as the regulator control system is quite capable of accommodating any mismatch. If, however, the mismatch is not corrected it results in reduced lamp life, higher harmonic currents (as explained above), high instantaneous peak currents, reduced power factor of the supply and high supply kVA.

The Micro 100 CCRs have multiple tappings on the output transformers that permit close matching to the circuit load.

7.4 Black Heat

In certain circumstances, usually on PAPI’s, 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 8.3.2.8 for details of enabling Black Heat, and Section 8.4.2.4 for setting the current level.

8 Programming Menus

8.1 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 100 CCR is pre-programmed with default operating parameters suitable for most applications. Parameters such as the CCR Full Load 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 Hardware 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.

8.1.1 How to Navigate Around the Screens

There are four buttons on the Front Panel Keypad that are used to navigate through the menus and select screens as required. These are the (↑), (↓), (↵ Enter) and (X Clear) buttons, as shown below:

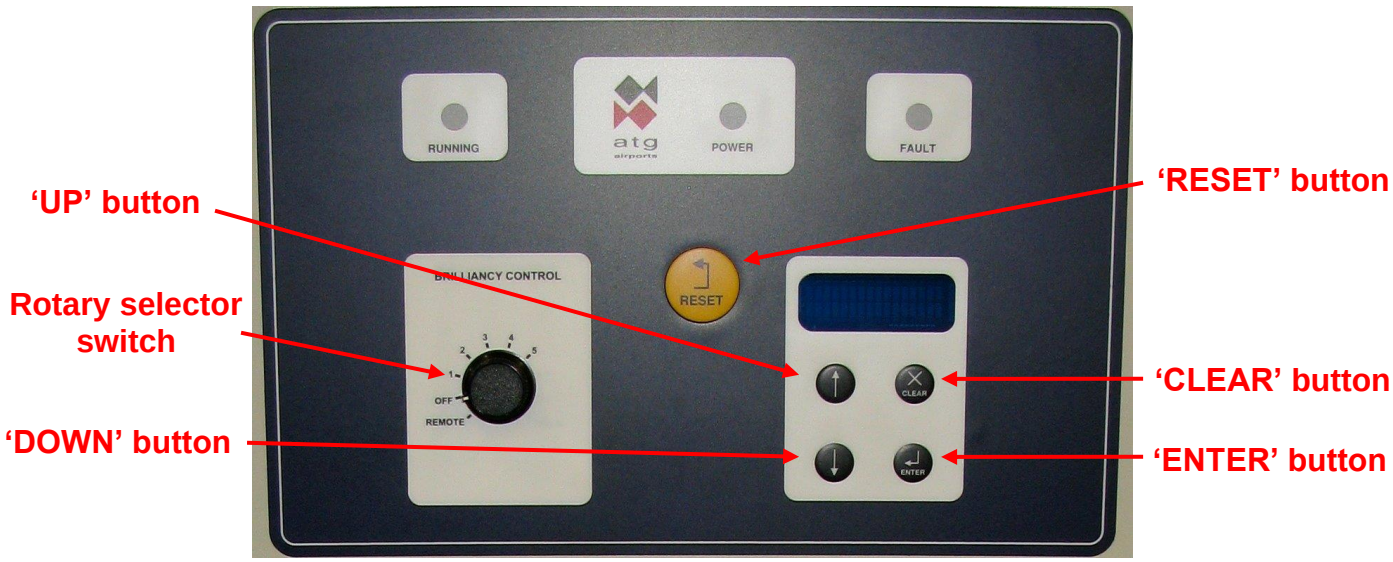


Figure 8-1 Front Panel Keypad

The (↑) and (↓) buttons are used to scroll up and down through the menu or to increment or decrement any parameters being changed, whilst the (↵ Enter) is pressed to input and accept any changes. The (X Clear) button is used to cancel selections and leave screens.

The other button on the Front Panel is the Reset button, which is used to reset any faults that may occur with the operation of the CCR.

8.2 Main Menu and CCR Status Screens

If the CCR is powered up and set to 'Local Off' (that is, by turning the brilliancy control selector switch SW1 to 'OFF') the display will show 'LOCAL OFF'. The operator can then scroll up or down using the (↑) (↓) buttons to display the Hours Run screen and the Set-up Menu Password Entry screen. If the optional Earth Leakage Resistance Measurement module is fitted, the Earth Leakage screen can also be displayed.

When the CCR output is energised, the display shows the regulator's Running Mode and Output Current. The operator can scroll up or down using the (↑) (↓) buttons to display the following screens: Output kVA (if programmed), Hours Run, PLF Display (if available), Earth Leakage Display (if available), and the screens for any faults which may be present. If no buttons are pressed, after a predetermined time the display will revert to show the Running Mode and Output Current.

The Main Menu Flowchart is shown in Figure 8-2 below, whilst Table 8-1 lists the Main Menu screens and gives a brief description of them.

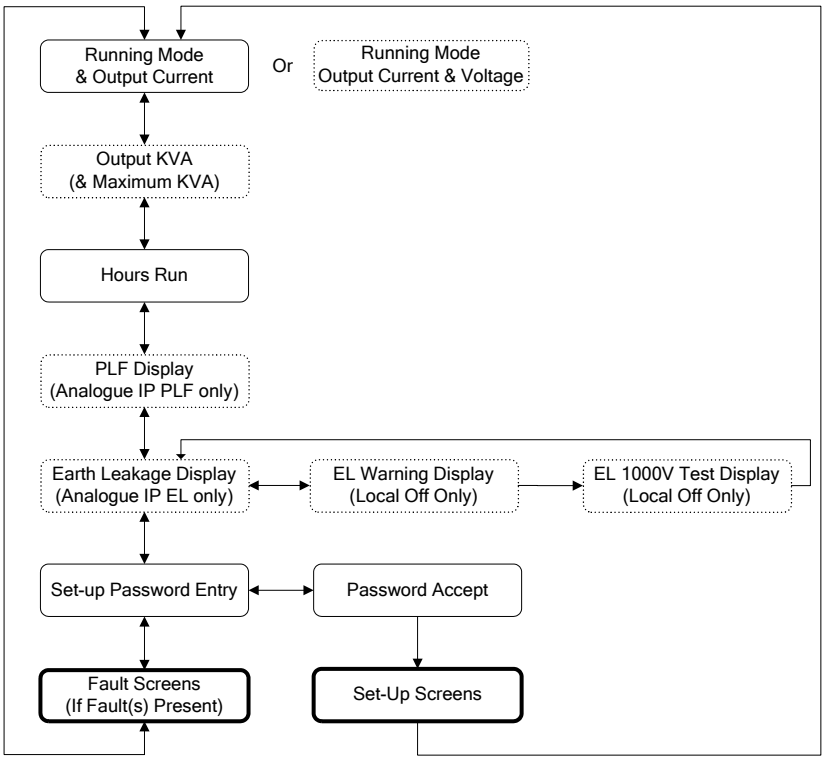


Figure 8-2 Main Menu Flowchart.

Parameter	Description
Running Mode & Output Current (& Voltage) Display	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
Hours Run	Displays overall Hours Run and the Hours Run at Maximum Brilliancy
Output kVA (& Maximum kVA) Display	Displays output kVA (screen only available if 'Voltage Feedback' is enabled). If 'kVA Alarm' also enabled, displays Maximum recorded kVA for the selected brilliancy level
PLF Display	Displays the number of lamps failed (screen only available if 'Analogue IP' PLF mode selected)
Earth Leakage Display	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 'Analogue' type Earth Leakage Detection is selected, applicable when the optional Earth Leakage Measurement module is fitted)
Press to Test Circuit at 1000V	Confirm 1000V Earth Leakage test to be carried out.
Testing Circuit at 1000 Volts	1000V Earth Leakage test in progress.
Set-up Password Entry	Allows entry of password to access Set-up menu
Fault screens (shown during fault conditions only)	See Section 8.5

Table 8-1 Main Menu screens

If a fault occurs, then the display alternates between the fault(s) and the Running Mode and Output Current display. The fault screens are described in Section 8.5, and listed in Table 8-6. Any faults must be reset before the display returns to normal, even if the fault is no longer present. To reset a fault, then the reset button must be pressed during the time when the fault is displayed on the screen.

8.2.1 Screens Displayed During Normal CCR Operation

Examples of screens displayed during normal operation are shown below:

The 'Running Mode' screen appears like this when the CCR has been programmed for UK CAP 168 current levels, 6.60A, with Voltage Feedback (CCR output voltage display) enabled, is set to 'Remote' and has been commanded on at 100% Brilliancy:

	R	E	M	O	T	E			1	0	0	%			
I	=		6	.	6	0	A		V	=	1	9	0	0	V

The screen appears as shown below when the CCR has been set to ‘Remote’ but the ‘Commanded On’ input has not been activated. In this example, ‘Black Heat’ has been enabled:

	R	E	M	O	T	E		B	L	_	H	E	A	T
					I		=			1	.	5	0	A

If the CCR has been configured to perform continuous Earth Leakage resistance measurements (‘Continuous Analogue’ under the ‘Earth Leakage Detection Type’ menu), and if the CCR is in the ‘Off’ state, then the display will show a warning to that effect. A warning may also be displayed if a Cutout switch is fitted (optional), and it has been set to the test position.

The ‘Output kVA’ screen (available if Voltage Feedback is enabled) is reached by scrolling down from the ‘Running Mode’ screen. If the kVA alarm is also enabled, the second line will show the measured peak kVA value for the selected brilliancy step. (If the output kVA drops by more than 10% from the peak recorded value for that Brilliancy step, for example, due to an earth fault on the AGL series circuit, then an alarm is raised).

			k	V	A				=		1	2	.	5
S	T	E	P		P	E	A	K	=		1	2	.	5

The ‘Earth Leakage Display’ screen is available if the optional Earth Leakage Measurement module is fitted and correctly programmed. Scroll down from the ‘Running Mode’ screen; the Earth Leakage Resistance measurement is displayed. When the CCR is running, the display will show the value as currently measured using a test voltage of 500V DC. When the CCR is in the ‘Off’ state, the display shows the last measured value and the test voltage used.

E	A	R	T	H		L	E	A	K	A	G	E	:	
@		5	0	0	V			>		5	0		M	Ω

The ‘PLF Display’ screen is available when the PLF system is programmed for ‘Analogue IP’. With the CCR running, scroll down from the ‘Running Mode’ screen. The (approximate) number of lamps failed is displayed; this is also expressed as a percentage of the total number of lamps on the field circuit:

N	U	M		L	A	M	P	S		F	A	I	L	E	D
			5			(		1	0	%	)				

If the Stage 1 Percentage lamp failure threshold has been exceeded, then the following fault screen will be shown. The display will alternate between the ‘Running Mode’ screen and the fault screen every 2 seconds:

1	F	A	U	L	T		-		S	T	A	G	E	1
		%		L	A	M	P		F	A	I	L	U	R	E

The screen appears like this if the CCR is being used with an external Circuit Selector Switch, and the CSS inhibit contact is open circuit:

	C	S	S		I	N	H	I	B	I	T				
					I		=		X	X	.	X	X	A	

The screen appears like this if the CCR is fitted with the optional Cutout Switch with position monitoring, and the Switch is in either of the test positions (‘Field Earthed + CCR S/C Test’ or ‘Field Measure’ position) :

	L	O	C	A	L				1	0	0	%			
	C	C	R		O	P		S	/	C		T	E	S	T

8.2.2 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 CCR is set to ‘LOCAL OFF’. Turn the CCR brilliancy control selector switch SW1 to 'OFF'; the display will show ‘LOCAL OFF’. Scroll up or down using the (↑) (↓) buttons to display the Earth Leakage screen:

E	A	R	T	H		L	E	A	K	A	G	E	:		
@		5	0	0	V			>		5	0		M	Ω	

The screen will display the last measured value of the leakage resistance. Normally, this will have been measured at 500V when the CCR was last running, however if the CCR has not been run since the last 1000V manual test, it will display the results of this test. Press the (↵ Enter) button, the screen will change to:

P	R	E	S	S		↵		T	O		T	E	S	T	
C	I	R	C	U	I	T		A	T		1	0	0	0	V

Pressing the (↵ Enter) button will initiate the leakage resistance test at 1000V DC. The screen will change to:

T	E	S	T	I	N	G		C	I	R	C	U	I	T	
	A	T		1	0	0	0		V	O	L	T	S		

The screen will flash to indicate that the test is in progress. After the test is finished, the screen will display the measured resistance:

E	A	R	T	H		L	E	A	K	A	G	E	:		
@		1	0	0	0	V		>		5	0		M	Ω	

To exit from any of the above screens, press the (X Clear) button.

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.

8.3 Set-up Menu Screens

The Set-up Menu allows access to many of the Set-up and Operating Parameters to allow configuration of the CCR. The Set-up Menu flowchart is shown in Figure 8-3 below, whilst Table 8-2 gives a listing of the screens and the default settings for the operating parameters.

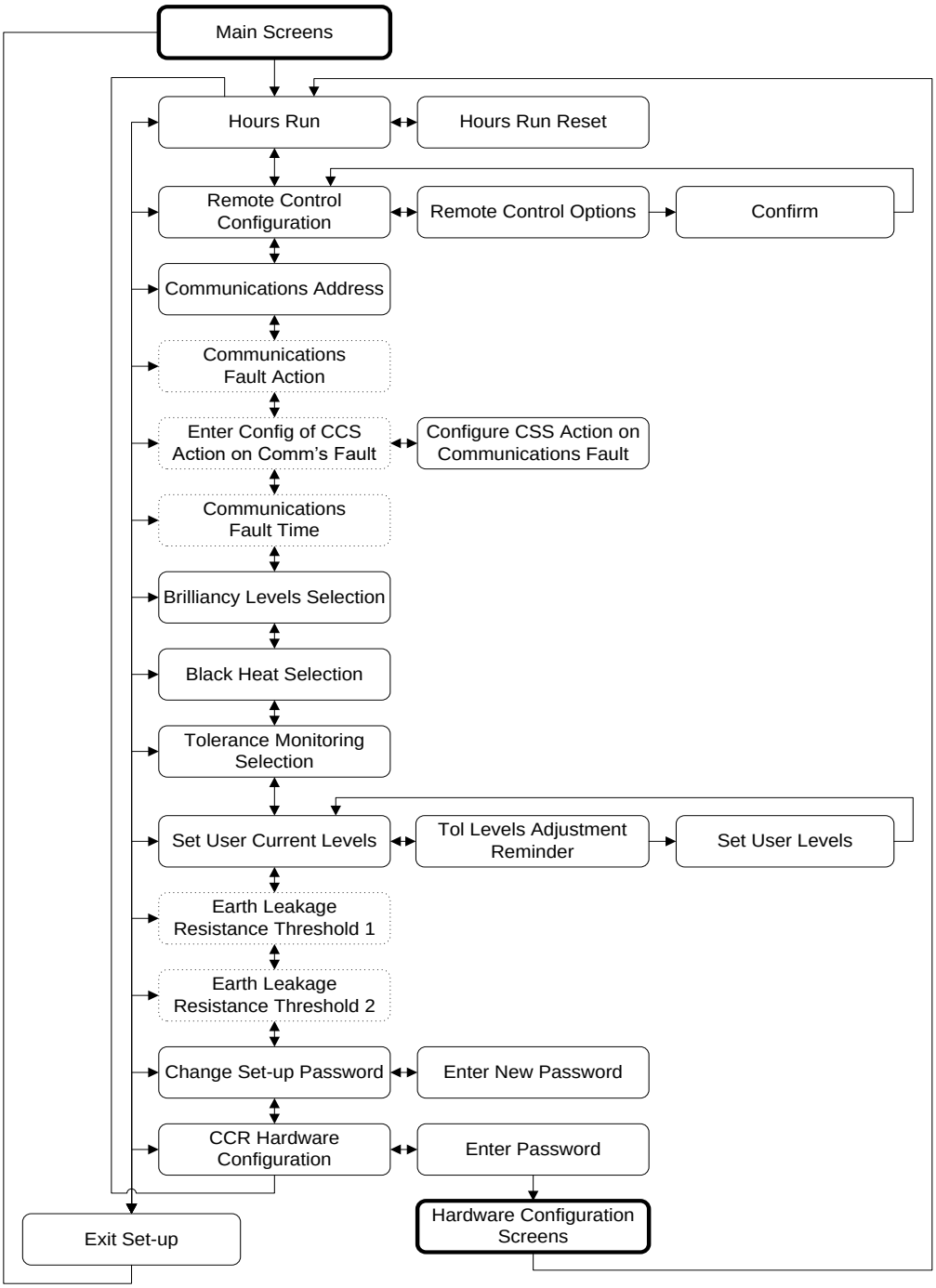


Figure 8-3 Set-up Menu Flowchart

Parameter	Description	Default Setting
HOURS RUN RESET?	Reset the hours run data	
Confirm Reset	Confirm hours run reset	
REMOTE CONTROL CONFIG?	Configure the remote control method	
Remote Control Options	Select method of remote control (3 Wire, 3 Wire & Command, BCD, BCD & Command, BCD (Option 2), BCD (Option 2) & Command, 8 Wire, 8 Wire & Command, Serial Communications.)	8 WIRE
Confirm Remote	Confirm choice of remote control method	
COMMS ADDRESS	Select Address of unit for serial communications (Only available if 'Communication' selected as method for remote control)	255 (not selected)
COMMS FAULT ACTION	Select the action to be taken in the case of a communications fault. (Only available if 'Communication' selected as method for remote control)	CCR OFF
SET CCT SEL FLT ACTION?	Configure CCS action on communications fault	
Circuit Selector action on Communications Fault Options	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.)	Individual circuits revert to fail-safe condition; alternate CSS circuits revert to CCT1
COMMS FAULT TIME	Select the delay time (in seconds) before the Communications fault is raised	2 S
BRILL LEVELS	Select (UK) CAP168, FAA / IEC Style 1, FAA / IEC Style 2 User Defined or User Def. DOE. brilliancy levels	(UK) CAP 168
BLACK HEAT	Enable/ Disable Black Heat operation	DISABLED
TOLERANCE MON	Enable/ Disable internal Tolerance Monitoring Unit	ENABLED
SET USER CURRENT LEVELS?	When User Defined Brilliancy Levels are selected, allows adjustment of the current levels. (Note - the default levels are those of UK CAP 168).	(UK) CAP 168
User Levels reminder	Reminds the user that the Tolerance Monitoring levels may need to be changed if current levels are changed	
Set User Levels	Allows selection of User Defined current levels	(UK) CAP 168
EARTH LEAKAGE STAGE 1	Select the threshold of resistance for the 1st stage Earth Leakage Alarm.	10 MΩ
EARTH LEAKAGE STAGE 2	Select the threshold of resistance for the 2nd stage Earth Leakage Alarm / Trip.	200 kΩ
CHANGE SET-UP PASSWORD?	Go to Change the Set-up password Screen	
Enter Set-up Password	Enter new Set-up password	atg
CCR HARDWARE CONFIG?	Access CCR Hardware Configuration menu	
CCR Hardware Configuration Password	To access the CCR Hardware Configuration menu, enter the password one letter at a time.	eng
Press Clear to display:		
EXIT SETUP?	Confirmation of exiting setup menu	

Table 8-2 Set-up Menu screens

8.3.1 Accessing the 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 brilliancy control selector switch SW1 to 'OFF'. Press the (↑) button to display the password entry screen:

E	N	T		S	E	T	-	U	P		P	W	O	R	D
Y	=	↵		U	S	E	↑	↓		*	*	*			

Press (↵ Enter), the screen will change to:

E	N	T		S	E	T	-	U	P		P	W	O	R	D
Y	=	↵		U	S	E	↑	↓		a	a	a			

Enter the correct password one letter at a time using the (↑) (↓) buttons to scroll up and down the alphabet, and then pressing the (↵ Enter) button. **The default password is 'atg'.** If you enter the password incorrectly the screen will display:

E	N	T		S	E	T	-	U	P		P	W	O	R	D
Y	=	↵		U	S	E	↑	↓		N	N	N			

You can re-try the password by first pressing (↵ Enter) and then loading the correct password. There is no limit to the number of retries. If you enter the correct password the screen will display:

E	N	T		S	E	T	-	U	P		P	W	O	R	D
Y	=	↵		U	S	E	↑	↓		Y	Y	Y			

Press (↵ Enter) and the screen will change to the first of the set-up screens.
It is now possible to scroll through the Menu using the (↑) (↓) buttons.

Pressing the (↵ Enter) button will permit modifications to the parameters for the selected screen. The left-hand arrow will move to the second line, and then pressing the (↑) or (↓) buttons will scroll through the available parameter settings. For example, if you have entered the Brilliancy Levels screen and changed the selection from UK CAP 168 to User Defined using the (↑) (↓) buttons

		B	R	I	L	L		L	E	V	E	L	S	↑	↓
→		U	S	E	R		D	E	F	I	N	E	D		

Pressing (↵ Enter) will load the new parameter, or pressing the (X Clear) button will quit without loading the changes, maintaining the CAP 168 setting as shown below:

→		B	R	I	L	L		L	E	V	E	L	S	↑	↓
				C	A	P		1	6	8					

To exit from the Set-up Menu and return to the Main Menu, press the (X Clear) button. The screen will change to:

		E	X	I	T		S	E	T	U	P		?		
		Y	=	↵		C	A	N	C	E	L	=	X		

Press the (↵ Enter) button to confirm exit from the Menu.

8.3.2 Set-up Menu Screens

8.3.2.1 Hours Run Reset

The CCR records the total number of Hours Run and the number of Hours Run at Maximum Brilliancy. It is possible to reset the Hours Run Counter values to zero from this menu.

Turn the Brilliancy Control Selector switch SW1 to 'OFF'. Enter the Set-up Menu as described in Section 8.3.1 above. The first screen displayed will be:

													↑	↓
H	O	U	R	S		R	U	N					↑	↓
R	E	S	E	T	?							Y	=	↵

To reset the ‘Hours Run’ press the (↵ Enter) button and the screen will change to:

H	O	U	R	S		R	U	N		R	E	S	E	T	
S	U	R	E	?			Y	=	↵		N	=	X		

Press the (↵ Enter) button again, the Hours Run Counters will be reset to zero. Note – if the (X Clear) button is pressed instead, the screen will be exited without resetting the hours Run Counter. In both cases, the screen will change back to:

													↑	↓
H	O	U	R	S		R	U	N					↑	↓
R	E	S	E	T	?							Y	=	↵

To return to the Main Menu, press the (X Clear) button followed by the (↵ Enter) button to confirm exit from the Set-up Menu.

8.3.2.2 Remote Control Configuration

The Remote Control of the CCR may be performed using 8-Wire Brilliancy Selection (this is normally used for 3 step, 5 step as well as 8 step applications), 3-Wire Encoded, BCD Encoded, BCD Option 2 or Remote Analogue Brilliancy Reference, all with or without Command On. This section describes how to program the CCR for the required configuration.

Turn the Brilliancy Control Selector switch SW1 to 'OFF'. Enter the Set-up Menu as described in Section 8.3.1, and use the (↓) button 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	?				Y	=	↵

Press the (↵ Enter) button and the screen will change to show the following control option:

			3		W	I	R	E					↑	↓
	L	I	N	E		C	O	N	T	R	O	L	↵	X

Pressing the (↑) or (↓) button will allow scrolling through the other possible control options as detailed below:

	3	W	I	R	E		&		C	M	M	D		↑	↓
	L	I	N	E		C	O	N	T	R	O	L		↵	X

					B	C	D						↑	↓
	L	I	N	E		C	O	N	T	R	O	L		↵	X

		B	C	D		&		C	M	M	D			↑	↓
	L	I	N	E		C	O	N	T	R	O	L		↵	X

		B	C	D		C	O	N	T	R	O	L		↑	↓
			O	P	T	I	O	N		2				↵	X

		B	C	D		&		C	M	M	D			↑	↓
			O	P	T	I	O	N		2				↵	X

*				8		W	I	R	E					↑	↓
			C	O	N	T	R	O	L					↵	X

	8	W	I	R	E		&		C	M	M	D		↑	↓
			C	O	N	T	R	O	L					↵	X

	C	O	M	M	S		M	O	D	U	L	E		↑	↓
				C	O	N	T	R	O	L				↵	X

Press the (↵ Enter) button when the required option is displayed and the screen will change to:

	C	H	A	N	G	E		R	E	M	O	T	E	
	C	O	N	T	R	O	L	?			Y	=	↵	

Press the (↵ Enter) button to accept the new setting. The screen will return to the selected setting and a star in the top left-hand corner of the screen will indicate the selection:

*		3	W	I	R	E		B	R	I	L	L	↑	↓
		&		C	M	M	D		L	I	N	E	↵	X

8.3.2.3 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).

Turn the Brilliancy Control Selector switch SW1 to 'OFF'. Enter the Set-up Menu as described in Section 8.3.1, and use the (↓) button to scroll down to the following screen:

→	C	O	M	M	S		A	D	D	R	E	S	S	↑	↓
		0	0	5										

Pressing the (↵ Enter) button will cause the arrow in the top left-hand corner of the screen to move to the bottom line. The required address can now be set; the valid range is between 001 and 254. Use the (↑) (↓) buttons to increment or decrement the value; press the (↵ Enter) button to load the value for each digit in turn.

When all 3 digits are programmed, press the (↵ Enter) button again to accept the new address. The arrow will return to the top left-hand corner of the screen.

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).

8.3.2.4 Communications Fault Action

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: ‘CCR OFF’, ‘LATCH’, and ‘CCR ON’. Selecting the first option will cause the CCR, if set for remote control, to turn off in the event of a communications fault. Selecting the second means the CCR will continue operating with the last instruction received. Selecting the third option will, if the

CCR was commanded to ‘OFF’ by the last instruction received, but with a brilliancy level selected, turn the CCR on at the brilliancy level of the last instruction. If the CCR was commanded to ‘ON’ by the last instruction received, it will continue operating with the previously selected brilliancy.

Turn the Brilliancy Control Selector switch SW1 to 'OFF'. Enter the Set-up Menu as described in Section 8.3.1, and use the (↓) button to scroll down to the following screen:

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

Pressing the (↵ Enter) button will cause the arrow in the top left-hand corner of the screen to move to the bottom line. The required fault action can be selected using the (↑) (↓) buttons.

Press the (↵ Enter) button to accept the selection. The arrow will return to the top left-hand corner of the screen.

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

8.3.2.5 Circuit Selector action on Communications Fault.

If the CCR is fitted with an Internal Circuit Selector Switch and it is configured to use ‘Communication’ for the remote control method, then reference should be made to the Internal Circuit Selector Manual for details on how to program the action for each individual circuit in the event of a serial communications fault.

8.3.2.6 Communications Fault 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.

Turn the Brilliancy Control Selector switch SW1 to 'OFF'. Enter the Set-up Menu as described in Section 8.3.1, and use the (↓) button to scroll down to the following screen:

→	C	O	M	M	S		F	A	U	L	T			↑	↓
	T	I	M	E			2		S						

Pressing the (↵ Enter) button will cause the arrow in the top left-hand corner of the screen to move to the bottom line. The required time can now be set; the valid range is between 2 and 15 seconds. Use the (↑) (↓) buttons to increment or decrement the value.

Press the (↵ Enter) button to accept the fault time selected. The arrow will return to the top left-hand corner of the screen.

8.3.2.7 Brilliancy Level Selection

The CCR may operate using output current levels specified by UK CAP 168, FAA or IEC standards (see Table 4-1 through to Table 4-4 of Section 4.2), or levels defined by the user.

Turn the Brilliancy Control Selector switch SW1 to 'OFF'. Enter the Set-up Menu as described in Section 8.3.1, and use the (↓) button to scroll down to the following screen:

→		B	R	I	L	L		L	E	V	E	L	S	↑	↓
					C	A	P	1	6	8					

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line. The required brilliancies can now be selected between CAP 168, FAA / IEC STYLE 1, FAA / IEC STYLE 2, USER DEFINED and USER DEF. DOE. using the (↑) (↓) buttons.

Press the (↵ Enter) button to accept the setting. The arrow will return to the top left-hand corner of the screen.

Refer to Section 8.3.2.10 to set the User Current levels.

8.3.2.8 Black Heat Selection

The CCR may be configured to give a 'Black Heat' low level output current when the CCR is set to ‘Remote Off’. This section describes how to select the Black Heat mode of operation.

Turn the Brilliancy Control Selector switch SW1 to 'OFF'. Enter the Set-up Menu as described in Section 8.3.1, and use the (↓) button to scroll down to the following screen:

→		B	L	A	C	K		H	E	A	T		↑	↓
			D	I	S	A	B	L	E	D				

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line. The setting can now be selected between ENABLED and DISABLED using the (↑) (↓) buttons.

Press the (↵ Enter) button to accept the setting. The arrow will return to the top left-hand corner of the screen.

Refer to Section 8.4.2.4 to set the Black Heat current level.

8.3.2.9 Tolerance Monitoring Selection

This section describes how to enable or disable the operation of the Tolerance Monitoring function.

Turn the Brilliancy Control Selector switch SW1 to 'OFF'. Enter the Set-up Menu as described in Section 8.3.1, and use the (↑) or (↓) buttons to scroll to the following screen:

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

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line. The setting can now be selected between ENABLED and DISABLED using the (↑) (↓) buttons.

Press the (↵ Enter) button to accept the setting. The arrow will return to the top left-hand corner of the screen.

8.3.2.10 User Current Levels

For each of the eight Brilliancy Levels, the CCR output current can be programmed – in amps, to 2 decimal places - to any value between 5% and 100% of Full Load Current. However, the default settings are exactly the same as the UK CAP 168 levels.

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:

	L	O	C	A	L			B	R	I	L	L		X	
	U	S	E	R		B	R	I	L	L		O	F	F	

	R	E	M	O	T	E		B	R	I	L	L		X	
	U	S	E	R		B	R	I	L	L		O	F	F	

This section describes how to set the User Current Levels.

Turn the Brilliancy Control Selector switch SW1 to 'OFF'. Enter the Set-up Menu as described in Section 8.3.1, and use the (↑) or (↓) buttons to scroll to the following screen:

S	E	T		U	S	E	R		C	U	R	R		↑	↓
L	E	V	E	L	S	?								↵	X

Press the (↵ Enter) button and the screen will change to:

T	O	L		L	E	V	S		M	A	Y		R	Q	R
A	D	J	U	S	T	I	N	G						↵	X

The screen warns the user that following a change of User Current Levels, the Tolerance Monitoring threshold levels may require adjustment. If this is not done, Tolerance Monitoring Alarms may occur.

Press the (↵ Enter) button and the screen will change to:

→		B	R	I	L	L		L	E	V	E	L		8	
						6	.	2	0		A				

Use the (↑) and (↓) buttons to scroll to whichever Brilliancy Level requires adjustment.

Press the (↵ Enter) button and the arrow in the top left-hand corner of the screen will move to the bottom line. The current setting can now be adjusted one digit at a time by using the (↑) (↓) and (↵ Enter) buttons.

After setting each digit, the arrow at the left of the screen will move to the top line.

8.3.2.11 Earth Leakage Resistance – Alarm and Trip Thresholds

These screens are only available if the CCR is programmed for ‘ANALOGUE’ Earth Leakage type. If for any reason the screens are not available, refer to Section 8.4.2.12.

Turn the Brilliancy Control Selector switch SW1 to 'OFF'. Enter the Set-up Menu as described in Section 8.3.1, and use the (↑) or (↓) buttons to scroll to the following screen:

→	E	A	R	T	H		L	E	A	K	A	G	E	↑	↓
	S	T	A	G	E		1				2	0		M	Ω

Refer to Section 4.5 for a complete description of how to commission the Analogue Earth Leakage Measurement system.

8.3.2.12 Changing the Set-up Menu Password

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

Turn the Brilliancy Control Selector switch SW1 to 'OFF'. Enter the Set-up Menu as described in Section 8.3.1, and use the (↑) button to scroll to the following screen:

C	H	A	N	G	E		S	E	T	-	U	P		↑	↓
P	A	S	S	W	O	R	D	?					Y	=	↵

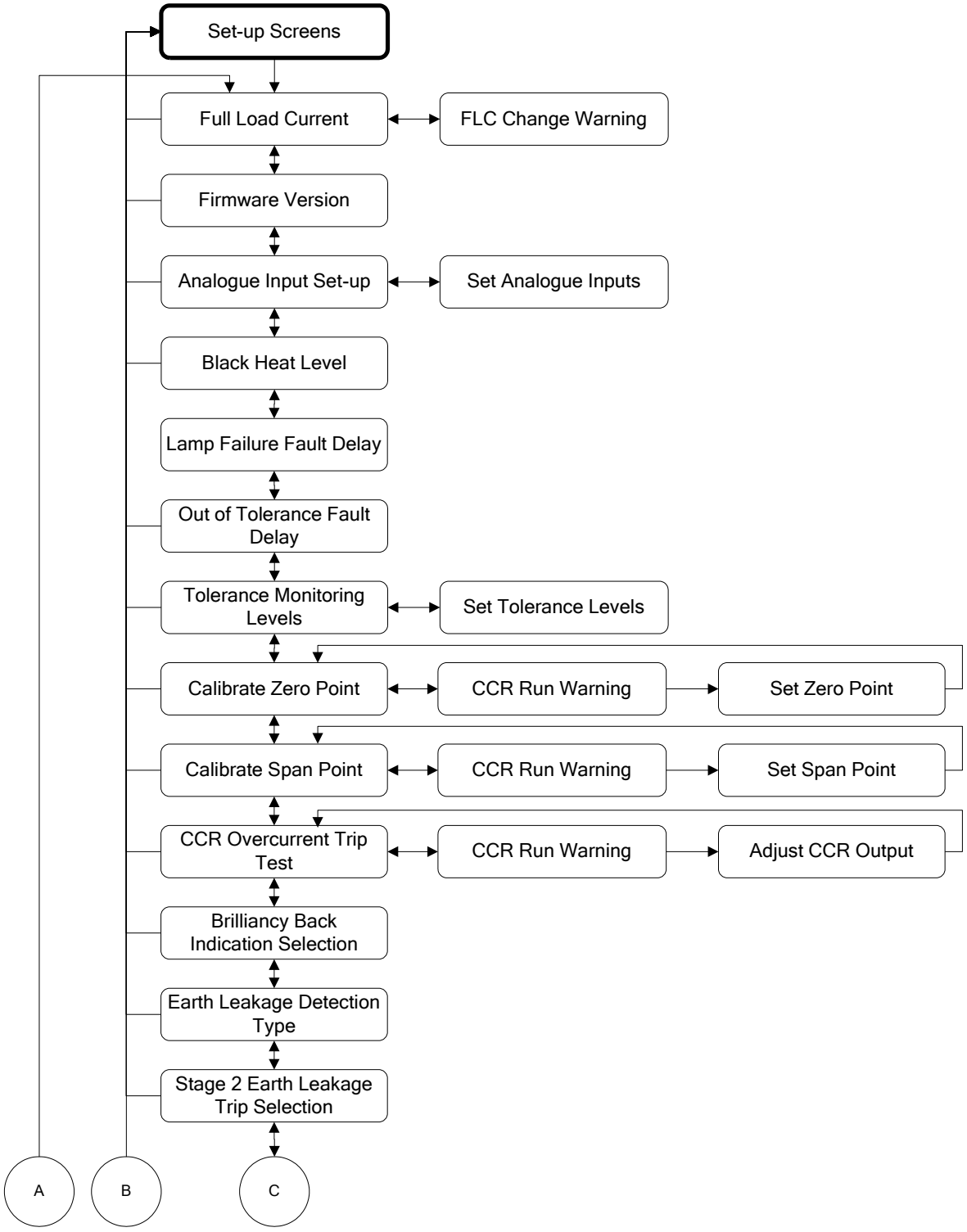
Press the (↵ Enter) button and the screen will change to:

S	E	T		S	E	T	-	U	P		P	W	O	R	D
Y	=	↵		U	S	E	↑	↓		a	t	g			

Enter the new password one letter at a time using the (↑) (↓) buttons to scroll up and down the alphabet, and then pressing the (↵ Enter) button.

8.4 CCR Hardware Configuration Menu

The Hardware Configuration Menu allows access to the engineering parameters of the CCR. The flowchart of the Menu is shown in Figure 8-4 below, whilst Table 8-3 gives a listing of the screens and the default settings for the parameters.



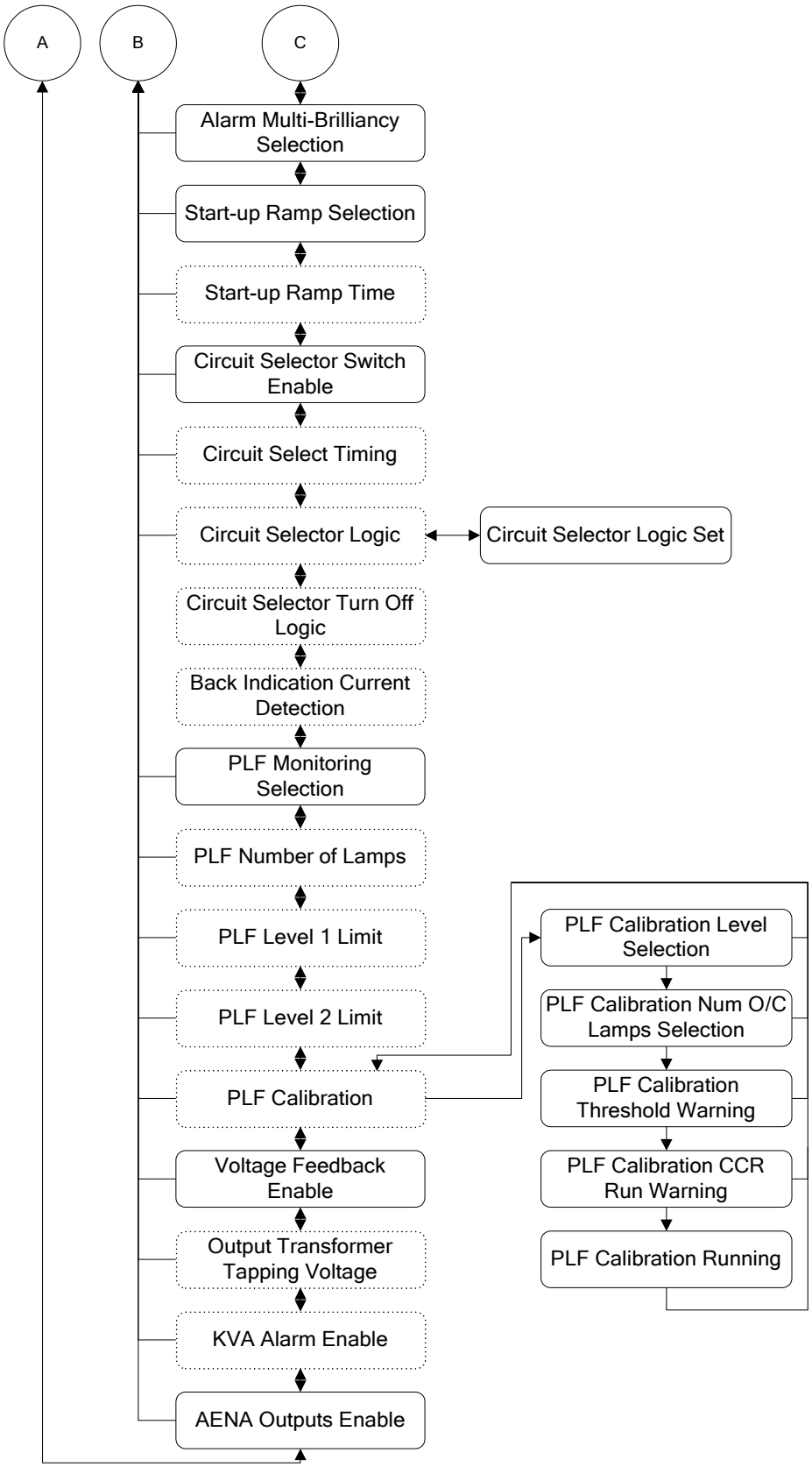


Figure 8-4 Hardware Configuration Menu Flowchart

Parameter	Description	Default Settings
FULL LOAD I	Select CCR nominal output current. Available settings are 6.00, 6.60, 12.0 and 20.0A.	6.60A
FLC Change Warning	Displays a warning that changing the FLC setting will require re-calibration of the CCR	
FIRMWARE VERSION	Displays the version of the CPU firmware	
ANALOGUE I/P SETUP	Configure operation of Remote Analogue Brilliancy control; only available when Analogue IP selected for Remote Control (Note - this function is rarely used).	
Set Analogue Input thresholds	Set the threshold levels at which the CCR will switch between each brilliancy level under Remote Analogue Brilliancy control.	
BLACK HEAT	Set the Black Heat current level	6.0A FLC = 1.5A 6.6A FLC = 1.5A 12A FLC = 2.5A 20A FLC= 5.75A
% LAMP FAIL TIME	Set the delay time (seconds) before the Percentage Lamp Failure alarm is raised	15 S
TOL MON FAIL TIME	Set the delay time (seconds) before an out of tolerance alarm is raised	15 S
SET USER TOL LEVELS	Program the Tolerance Monitoring alarm levels	(UK) CAP 168
Enter out of tolerance levels	Set the under and over current Tolerance Monitoring alarm threshold levels	
CALIBRATE ZERO POINT	Calibrate the zero point for the control loop	
CCR run warning	Warning that the CCR will start during this operation	
Set Zero Point	Sets the zero point control reference	
CALIBRATE SPAN POINT	Calibrate the span point for the control loop	
CCR run warning	Warning that the CCR will start during this operation	
Set Span Point	Sets the span point control reference, calibrates the CCR ammeter and CCR maximum output current	
TEST OVERCURRENT TRIP POINT	Test use only - not to be used on live circuit. Allows manual control of output current in order to test the Over-current Trip Point	
CCR run warning	User warning that the CCR will start during this operation	
Set current output	Allows direct control of current output. Displays current demand level and peak measured current for over-current test	
BRILL BI ON FLT ENABLED	Configure the brilliancy back indication to be active or inactive when a fatal alarm is present (only applicable if non-standard I^2C Back Indication option card fitted)	DISABLED
EARTH LEAK DET	Configure the earth leakage detection type to be Digital, Analogue, Continuous Analogue or Disabled. Note - optional AT699 Earth Leakage Detection card rqd for this function to operate	DISABLED
TRIP ON EARTH 2	Configure the stage 2 Earth Leakage detector to give an alarm and continue to run (disabled), or to shutdown (trip) the CCR (enabled)	ENABLED
ALARM MULT BRIL	Enable/ Disable the alarm which alerts if an illegal combination of remote control inputs is detected	ENABLED

Parameter	Description	Default Settings
OP START 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
ST RAMP TIME	Set the Current Ramp time for CCR start-up. (Only available if Start Up Ramp is enabled)	600ms
CCT SELECTOR	Disables (internal) CSS operation or allows selection of Alternate or Multiway (2 - 6 way) CSS	DISABLED
CCT SEL TIME	Set the changeover switching time before re-energisation of the internal circuit selector. Allows selection of Slow Contactor (500ms), 300ms, 250ms, 200ms, 150ms, 100ms or Vacuum Relay (15ms). (Screen only available when circuit selector is enabled)	SLOW CONTACTOR
SET CCT SEL LOGIC?	Select normally open or normally closed logic for correct fail safe modes for each circuit of Multiway Circuit Selector	N/O
Circuit Selector Logic	Program Multiway Circuit Selector operating logic	
C/S TURN OFF CCR	Allows the Circuit Selector control logic to turn off the CCR when all circuits are selected to off. (Available when Multiway (2 to 6 way) Circuit Selector is enabled)	ENABLED
C/S PCB TYPE	Allows selection of the Multi-Way Circuit Selector Back Indication Current Detection philosophy, depending on the version of PCB fitted.	AT661C ONWARD
% LAMP FAIL	Enable Percentage Lamp Failure monitoring; Analogue (with auto calibration) is recommended. Note - requires the optional AT642 PLF card to be fitted for this function to operate.	DISABLED
NUM OF LAMPS	Enter the total number of lamps on the AGL circuit (Only available if 'Analogue IP' PLF monitoring is enabled)	100
PLF LIMIT 1	Enter the number of lamps failed to trigger a Stage-1 alarm. (Only available if 'Analogue IP' PLF monitoring is enabled)	5 (5%)
PLF Threshold warning	Warning that the PLF alarm threshold does not match the calibration level used.	
PLF LIMIT 2	Enter the number of lamps failed to trigger a Stage-2 alarm. (Only available if 'Analogue IP' PLF monitoring is enabled)	10 (10%)
PLF Threshold warning	Warning that the PLF alarm threshold does not match the calibration level used.	
CALIBRATE PLF INPUT	Calibration screens for PLF. (Only available if 'Analogue IP' PLF monitoring is enabled)	
SELECT LEVEL	Allows selection of which PLF alarm threshold points are to be calibrated - high or low level	
NUM OF OPEN CCT LAMPS	Enter the number of open circuit lamp fittings in the test circuit used for calibration of this level.	
PLF Threshold warning	Warning that the PLF alarm threshold does not match the calibration level used.	
CCR run warning	Warning that the CCR will start during this operation	
PLF threshold	Records the PLF error voltage for the lamps out threshold being calibrated, at each brilliancy level	

Parameter	Description	Default Settings
DISPLAY OP V	Allows the display of CCR output voltage and output load kVA. (Requires fitting of AT642 PLF Card in order to function)	DISABLED
ENT TX OP VOLTS	Program the main transformer output voltage as connected (sum of each winding section connected). (Only available if 'Voltage Feedback' is enabled)	0001V
KVA ALARM	Alarm screen displayed if there is a 10% or greater drop in the volt-amperes being delivered to the series loop circuit. (Only available if 'Voltage Feedback' is enabled)	Disabled
AENA OUTPUTS	Enables AENA I/O configuration (for Spanish market)	Disabled

Table 8-3 CCR Hardware Configuration Screens

8.4.1 Accessing the CCR Hardware Configuration Menu

The CCR Hardware Configuration Menu is accessed from the Set-up Menu by the use of a password, as described below.

Turn the Brilliancy Control Selector switch SW1 to 'OFF'. Enter the Set-up Menu as described in Section 8.3.1, and use the (↑) button to scroll to the following screen:

	C	C	R		H	A	R	D	W	A	R	E	↑	↓
			C	O	N	F	I	G	?			Y	=	↵

Press (↵ Enter) and the screen will change to the CCR Hardware Configuration Password screen:

E	N	T		C	O	N	F	I	G		P	W	O	R	D
Y	=	↵		U	S	E	↑	↓		a	a	a			

Enter the password 'e n g' using the (↑), (↓) and (↵ Enter) buttons. (Note – this password cannot be changed).

If you enter the password incorrectly the screen will display:

E	N	T		C	O	N	F	I	G		P	W	O	R	D
Y	=	↵		U	S	E	↑	↓		N	N	N			

You can re-try the password by first pressing (↵ Enter) and then loading the correct password. There is no limit to the number of retries.

If you enter the correct password the screen will display:

E	N	T		C	O	N	F	I	G		P	W	O	R	D
Y	=	↵		U	S	E	↑	↓		Y	Y	Y			

Press (↵ Enter) and the screen will change to the first of the CCR Hardware Configuration screens. It is now possible to scroll through the Menu using the (↑) (↓) buttons.

Pressing the (↵ Enter) button will permit modifications to the parameters for the selected screen. The left-hand arrow will move to the second line, and then pressing the (↑) or (↓) buttons will scroll through the available parameter settings. Pressing the (↵ Enter) button will load the new parameter.

To exit from the CCR Hardware Configuration Menu and return to the Set-up Menu, press the (X Clear) button. (Note – if you are within one of the Hardware Configuration screens, you will need to press the (X Clear) button twice). The screen will change to:

	C	C	R		H	A	R	D	W	A	R	E		↑	↓
			C	O	N	F	I	G	?				Y	=	↵

To exit from the Set-up Menu and return to the Main Menu, press the (X Clear) button. The screen will change to:

		E	X	I	T		S	E	T	U	P		?		
		Y	=	↵		C	A	N	C	E	L	=	X		

Press the (↵ Enter) button to confirm the exit.

8.4.2 Hardware Configuration Screens

8.4.2.1 Setting the Full Load Current

This screen allows the Full Load Current (nominal output current) of the regulator to be programmed. The value would normally be set to customer specifications during factory testing – as indicated on the regulator identification plate - and would only need to be reset if the conditions described Section 9.2.2 occurred.

Enter the Hardware Configuration Menu as described in Section 8.4.1, and use the (↓) button to scroll down to the following screen:

→		F	U	L	L		L	O	A	D		I		↑	↓
					6	.	6	0		A					

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line. (NOTE - IF THE SCREEN IS ACCESSED BY MISTAKE, PRESS THE X (CLEAR) BUTTON TO EXIT). The required Full Load Current can now be selected between 6.00, 6.60; 12.0 using the (↑) (↓) buttons.

If the (↵ Enter) button is pressed the screen will change to

	W	I	L	L		R	Q	R		S	E	T	U	P	
	A	C	C	E	P	T	?					Y	=	↵	

The screen warns the user that following a change of the FLC setting, the CCR will require recalibration. IF IT IS NOT REQUIRED TO CHANGE THE FLC, PRESS THE X (CLEAR) BUTTON TO EXIT; PRESSING THE (↵ ENTER) BUTTON WILL REQUIRE A RECALIBRATION OF THE REGULATOR. Changing the FLC resets the Microcontroller 'Span' Current Demand register output value to the default value of 50 from a normal calibrated level of between 182 and 198. The 'Zero' register is also put back to the default value, and the User Current Levels revert to the default UK CAP 168 values for the selected FLC rating.

Pressing the (↵ Enter) button will load the new Full Load Current. The CCR should now be recalibrated as described in Section 9.2.

8.4.2.2 Firmware Version

This screen displays the version number of the Microprocessor Firmware; no changes can be made to the screen. Enter the Hardware Configuration Menu as described in Section 8.4.1, and use the (↓) button to scroll down to display:

F	I	R	M	W	A	R	E						↑	↓
V	E	R	S	I	O	N			X	.	X			↵

8.4.2.3 Remote Analogue Brilliancy Reference Operating Bands

The principle of operation of Remote Analogue Brilliancy Control is as follows. The signal level of the Remote Analogue Input Reference is measured by the Microcontroller using an 8 bit ADC, and converted to a digital level, 0 to 255. There are 8 bands corresponding to the 8 Brilliancy Levels available. Depending which 'band' the signal falls into, a corresponding CCR operating Brilliancy is selected.

Boundary, or threshold levels, set the upper and lower limits of these bands. There are 8 of these, B1 to B8, and these set the point at which the CCR changes from one Brilliancy to the next. These boundary levels are pre-programmed with default settings, but they can be adjusted if required. The default values are proportional to the current levels for each Brilliancy Step, based on UK CAP 168 settings. This is to maintain compatibility with some older systems where the Remote Analogue Brilliancy Reference is used as a demand signal for the current control loop.

The principle is illustrated in
Table 8-4 below. With a Remote Analogue Brilliancy Reference measured at 143 on the ADC, this would select Brilliancy Level 4.

Example Remote Analogue Brilliancy Reference, digitised value	Default boundary levels	Band	Limits of band	Brilliancy Level Selected
	B8 = 232	8	≥ 232	8
	B7 = 220	7	220 to 231	7
	B6 = 179	6	179 to 219	6
	B5 = 154	5	154 to 178	5
143	B4 = 132	4	132 to 153	4
	B3 = 116	3	116 to 131	3
	B2 = 102	2	102 to 115	2
	B1 = 47	1	47 to 101	1
		0	< 47	0FF

Table 8-4 Remote Analogue Brilliancy Reference Operating Bands

This section describes how to set the boundary levels.

Enter the Hardware Configuration Menu as described in Section 8.4.1, and use the (↓) button to scroll down to the following screen:

→	A	N	A	L	O	G	U	E		I	/	P	↑	↓
	S	E	T	U	P							Y	=	↵

Press the (↵ Enter) button and the screen will change to:

→		B	R	I	L	L		L	E	V	E	L	8	
		B	=	(	2	3	5	)		A	=	8	4	

This enables the (digitised) Remote Analogue Brilliancy Reference Signal to be viewed e.g. A = 84.

Potentiometer VR9 on the AT533 Main Control Card should first be calibrated to give the correct range of operation. Ensure that the Remote Analogue Brilliancy Reference Signal is at the maximum level, then adjust potentiometer VR9 (labelled 'Ext Analogue Ref Trim') on the AT533 board to achieve a reading of A = 244 on the display.

Next, set the Remote Analogue Brilliancy Reference to each of the levels used for selecting brilliancy. For each input level in turn, make a note of the 'A =' value displayed on the screen.

The desired Boundary (changeover) points between each Brilliancy Level can now be calculated according to the formula:

$$B_N = ((A_N - A_{N-1}) / 2) + A_{N-1}$$

Where:

B = Boundary level
A = Measured (digitised) Remote Analogue Brilliancy Reference at each Brilliancy Input level
N = Brilliancy / Boundary level number, 1 to 8

Note – the Boundary Level value is always lower than the digitised Analogue Brilliancy Reference.

The object is to set the Boundary (Changeover) Levels at the midpoint between consecutive Brilliancy Levels of the Remote Analogue Brilliancy Reference Signal. Table 8-5 below, provides an example of Boundary Level settings, based on the digitised Remote Analogue Brilliancy Reference 'A' values listed.

Brilliancy Level	Measured 'A' value - Remote Analogue Brilliancy Reference, digitised value	Desired Boundary Level	Calculation of Boundary Level: $B_N = ((A_N - A_{N-1}) / 2) + A_{N-1}$
1	20	B1 = 10	((20 – 0) / 2) + 0
2	60	B2 = 40	((60 – 20) / 2) + 20
3	90	B3 = 75	((90 – 60) / 2) + 60
4	120	B4 = 105	((120 – 90) / 2) + 90
5	150	B5 = 135	((150 – 120) / 2) + 120
6	180	B6 = 165	((180 – 150) / 2) + 150
7	210	B7 = 195	((210 – 180) / 2) + 180
8	240	B8 = 225	((240 – 210) / 2) + 210

Table 8-5 Example Remote Analogue Brilliancy Boundary settings

The Boundary Levels ('B' values) are programmed from within the Analogue Input Set-up screens, accessed as described earlier.

For each Brilliancy Level in turn, change the screen to display the required Brilliancy Level and then press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line. The 'B' setting can now be adjusted one digit at a time by using the (↑) (↓) and (↵ Enter) buttons.

		B	R	I	L	L		L	E	V	E	L		1	
→		B	=	(	0	1	0	)		A	=		2	0	

Note – it is not possible to set a value greater than that of the Boundary Level immediately above, nor less than that of the Boundary Level below. It may therefore be necessary to adjust the levels of the adjacent Boundary Levels in order to obtain the desired value.

8.4.2.4 Black Heat Current Level

The Black Heat current may be set as required to any value between 12% of the Full Load Current, and Full Load Current. This section describes how to set the Black Heat current level.

Enter the Hardware Configuration Menu as described in Section 8.4.1, and use the (↓) button to scroll down to the following screen:

→			B	L	A	C	K		H	E	A	T		↑	↓
					2	.	5	0		A					

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line. The setting can now be adjusted a digit at a time by using the (↑) (↓) and (↵ Enter) buttons.

8.4.2.5 Percentage Lamp Fail Alarm Delay

This screen allows adjustment of the time delay between the Percentage Lamp Failure threshold being crossed, and the alarm being activated.

Enter the Hardware Configuration Menu as described in Section 8.4.1, and use the (↓) button to scroll down to the following screen:

→	%		L	A	M	P			F	A	I	L		↑	↓
	T	I	M	E			5	.	0	0	S				

Press (↵ Enter) button and the arrow in the top left-hand corner of the screen will move to the bottom line.

	%		L	A	M	P			F	A	I	L		↑	↓
→	T	I	M	E		1	0	.	0	0		S			

Set the Lamp Fail Alarm Delay time, one digit at a time, by using the (↑) (↓) and (↵ Enter) buttons. The delay time can be set between 5 and 60 seconds, with a resolution of 1 second.

8.4.2.6 Tolerance Monitoring Alarm Delay

This screen allows adjustment of the time delay between the Tolerance Monitoring threshold being crossed, and the alarm being activated.

Enter the Hardware Configuration Menu as described in Section 8.4.1, and use the (↑) or (↓) buttons to scroll to the following screen

→	T	O	L		M	O	N		F	A	I	L	↑	↓
	T	I	M	E		1	5	.	0	0		S		

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line.

	T	O	L		M	O	N		F	A	I	L	↑	↓
→	T	I	M	E		1	5	.	0	0		S		

Set the Tolerance Monitoring Alarm delay time, one digit at a time, by using the (↑) (↓) and (↵ Enter) buttons. The delay time can be set between 5 and 60 seconds, with a resolution of 1 second.

8.4.2.7 Setting of User Defined Tolerance Levels

When the Brilliancy Level selection is set to operate from UK CAP 168, FAA / IEC Style 1 or FAA / IEC Style 2 levels, the relevant tolerance Levels will automatically be used (see Section 4.2 above). When the Brilliancy Level selection is set to User Defined, then Tolerance Monitoring Levels set by the user will be applied. By default, these are set to UK CAP168 Levels, but they should be adjusted to values appropriate to the User Defined Current Levels.

Enter the Hardware Configuration Menu as described in Section 8.4.1, and use the (↑) or (↓) buttons to scroll to the following screen:

S	E	T		U	S	E	R			T	O	L	↑	↓
L	E	V	E	L	S	?							↵	X

Press the (↵ Enter) button and the screen will change to:

→		O	V	E	R			T	O	L		8		
						6	.	7	0		A			

This is the screen for the Upper Tolerance Limit on Brilliancy Level 8.

Press the (↓) button and the screen will change to:

→		U	N	D	E	R		T	O	L		8		
						6	.	4	0		A			

This is the screen for the Lower Tolerance Limit on Brilliancy Level 8
Use the (↑) (↓) buttons to scroll to whichever Tolerance Limit is to be adjusted.

To modify the Tolerance Limit press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line. Change the Tolerance Limit, one digit at a time, by using the (↑) (↓) and (↵ Enter) buttons. The digit flashing on and off indicates the digit being set. The 'tens' digit is only displayed if it has been set to a value other than zero. Press the (↵ Enter) button to accept the new setting.

		O	V	E	R			T	O	L		8		
→						6	.	7	0		A			

When all four digits have been entered, the arrow returns to the top line and the operator can now select another Tolerance Limit to define.

The lower limits, the 'UNDER TOL' values, cannot be set to a value greater than the operating current level for that particular User Defined Brilliancy, or to a value less than the operating current level minus 10%.

Over tolerance values cannot be set to a value greater than the operating current level for that particular User Defined Brilliancy plus 10%, or to a value less than the operating current level.

8.4.2.8 Zero Point Calibration

This screen allows entry to the CCR Zero Point Calibration routine. Enter the Hardware Configuration Menu as described in Section 8.4.1, then use the (↑) or (↓) buttons to scroll to the following screen:

C	A	L	I	B	R	A	T	E		Z	E	R	O	↑	↓
P	O	I	N	T									Y	=	↵

Refer to Section 9.2.2.2 for a full description of the calibration method.

Note – if accessing this menu just in order to make a record of the calibration factor, pressing the (X Clear) button will exit without altering the calibration.

8.4.2.9 Span Point Calibration

This screen allows entry to the CCR Span Point Calibration routine. Enter the Hardware Configuration Menu as described in Section 8.4.1, then use the (↑) or (↓) buttons to scroll to the following screen:

C	A	L	I	B	R	A	T	E		S	P	A	N	↑	↓
P	O	I	N	T									Y	=	↵

Refer to Section 9.2.2.3, Setting the Span Point, for a full description of the calibration method.

Note – if accessing this menu just in order to make a record of the calibration factor, pressing the (X Clear) button will exit without altering the calibration.

8.4.2.10 Test Over-current Trip Point

This screen allows the operator to directly control the CCR output current level. The current can be increased above the normal Full Load Current value in order to test the Over-current Trip Point and Trip Time.

The testing of the Over-current Detection Circuit is, however, part of the factory tests, and would not normally be performed by the user. IT SHOULD NOT TO BE DONE ON A LIVE AGL CIRCUIT.

Enter the Hardware Configuration Menu as described in Section 8.4.1, then use the (↑) or (↓) buttons to scroll to the following screen:

T	E	S	T		O	V	E	R	C	U	R	E	N	T
T	R	I	P		P	O	I	N	T			Y	=	↵

Refer to Section 9.3.3, Checking the Over-current Trip Point and Trip Delay Time, for a full description of the test method.

8.4.2.11 Brilliancy Back Indication Selection

This section applies only to those CCRs fitted with an optional Brilliancy Back Indication Relay Card that provides outputs controlled by the Microcontroller via the I^2C bus.

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 Hardware Configuration Menu as described in Section 8.4.1, then use the (↑) or (↓) buttons to scroll to the following screen:

→	B	R	I	L	L		B	I		O	N		F	L	T
				E	N	A	B	L	E	D					

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line.

	B	R	I	L	L		B	I		O	N		F	L	T
→				E	N	A	B	L	E	D					

The setting can now be selected between ENABLED & DISABLED using the (↑) and (↓) buttons. Press the (↵ Enter) button to accept the setting; the arrow will return to the top left-hand corner of the screen.

8.4.2.12 Earth Leakage Detection Type

There are 2 types of Earth Leakage Modules which can be fitted to the CCR; the Analogue Module (based on the AT699 pcb) gives an actual measurement of the earth leakage resistance, whilst an earlier design – the 2 Stage Earth Leakage system (based on the B101981 rev3 card) - gives 2 fixed alarm threshold levels.

This screen allows programming the CCR to match the type of Earth Leakage Module fitted.

Note – this setting will be made during factory testing of the CCR, and will not normally require any modification.

Enter the Hardware Configuration Menu as described in Section 8.4.1, then use the (↑) or (↓) buttons to scroll to the following screen:

→	E	A	R	T	H		L	E	A	K		D	E	T	
			A	N	A	L	O	G	U	E					

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line:

	E	A	R	T	H		L	E	A	K		D	E	T	
→			A	N	A	L	O	G	U	E					

The setting can now be selected between ANALOGUE, CONT. ANALOGUE, DIGITAL and DISABLED, using the (↑) and (↓) buttons. Select ‘ANALOGUE’ or ‘CONT. ANALOGUE’ if the AT699 Earth Leakage Measurement Module is fitted, select ‘DIGITAL’ if the earlier 2 Stage Earth Leakage pcb is fitted, and select ‘DISABLED’ if no earth fault unit is fitted.

Press the (↵ Enter) button to load the new setting. The arrow will return to the top left-hand corner of the screen.

8.4.2.13 Stage 2 Earth Leakage Trip Selection

Enter the Hardware Configuration Menu as described in Section 8.4.1, then use the (↑) or (↓) buttons to scroll to the following screen:

→	T	R	I	P		O	N		E	A	R	T	H	2
				E	N	A	B	L	E	D				

Refer to Section 4.5.2.1 to program this menu.

8.4.2.14 Alarm on Multiple Remote Brilliancy Selection

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 Hardware Configuration Menu as described in Section 8.4.1, then use the (↑) or (↓) buttons to scroll to the following screen:

→	A	L	A	R	M		M	U	L	T		B	R	I	L
				E	N	A	B	L	E	D					

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line:

	A	L	A	R	M		M	U	L	T		B	R	I	L
→				E	N	A	B	L	E	D					

Select between ENABLED and DISABLED using the (↑) and (↓) buttons, and press the (↵ Enter) button to load the new setting. The arrow will return to the top left-hand corner of the screen.

8.4.2.15 Start Up Ramp Selection

This screen allows the selection of a CCR Output Current Start-up Ramp.

Enter the Hardware Configuration Menu as described in Section 8.4.1, then use the (↑) or (↓) buttons to scroll to the following screen:

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

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line. The setting can now be selected between ENABLED & DISABLED using the (↑) (↓) buttons.

Press the (↵ Enter) button to load the new setting; the arrow will return to the top left-hand corner of the screen.

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

8.4.2.16 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 8.4.2.15 above, use the (↓) button to change the screen to

→	S	T		R	A	M	P		T	I	M	E	↑	↓
				X	X	X	X		m	S				

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line.

	S	T		R	A	M	P		T	I	M	E	↑	↓
→				X	X	X	X		m	S				

It is now possible to set the Ramp Time, one digit at a time, by using the (↑) (↓) and (↵ Enter) buttons. The Ramp Time can be set between 10 and 1600 milliseconds.

Press the (↵ Enter) button to confirm the setting.

8.4.2.17 Internal Circuit Selector Configuration

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

Enter the Hardware Configuration Menu as described in Section 8.4.1, then use the (↑) or (↓) buttons to scroll to the following screen:

→	C	C	T		S	E	L	E	C	T	O	R	↑	↓
				D	I	S	A	B	L	E	D			

Refer to the supplementary manual for the Internal Circuit Selector Switch for instructions on CSS configuration.

8.4.2.18 Percentage Lamp Failure Monitoring Selection.

The PLF Monitoring inputs are configured via this screen.

Enter the Hardware Configuration Menu as described in Section 8.4.1, then use the (↑) or (↓) buttons to scroll to the following screen:

→	%		L	A	M	P		F	A	I	L		↑	↓
				1		S	T	A	G	E				

Refer to Section 4.6, for a complete description of the calibration method.

8.4.2.19 Voltage Feedback Enable

The output voltage of the CCR may be displayed on the ‘Running Mode’ screen, alongside the CCR output current. If this is enabled, then the CCR output load kVA can also be displayed; this is available by scrolling down from the ‘Running Mode’ screen.

Enter the Hardware Configuration Menu as described in Section 8.4.1, and use the (↓) button to scroll down to the following screen:

→	D	I	S	P	L	A	Y		O	P		V	↑	↓
					E	N	A	B	L	E	D			

Refer to Section 4.4, Output Voltage and Output Load kVA Monitoring, for a complete description of the set-up procedure.

8.4.2.20 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 whichever brilliancy step is in operation, for a period of 5 seconds.

Enter the Hardware Configuration Menu as described in Section 8.4.1 and use the (↓) button to scroll down to the following screen:

	K	V	A		A	L	A	R	M				↑	↓
					E	N	A	B	L	E	D			

Press the (↵ Enter) button; the arrow in the top left-hand corner of the screen will move to the bottom line. The setting can now be selected between ENABLED & DISABLED using the (↑) (↓) buttons.

Press the (↵ Enter) button to load the new setting. The arrow will return to the top left-hand corner of the screen.

8.4.2.21 AENA Outputs Enable

The CCR can be configured to use the AENA I/O configuration.

Enter the Hardware Configuration Menu as described in Section 8.4.1, and use the (↓) button 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			

8.5 Fault Screens

All faults are logged by the Microcontroller and will result in an appropriate fault screen being displayed. The display will alternate between the Running Display and the fault screen every 2 seconds. Example screens are shown below:

1	F	A	U	L	T		-		%		L	A	M	P
									F	A	I	L	U	R	E

If more than one fault has been registered, the fault screen with the highest priority only will be the one normally shown. However, it is possible to scroll down through the fault screens, starting from the priority fault screen, by using the (↓) button. The total number of faults logged is also indicated.

4	F	A	U	L	T	S	-		O	P	E	N		
									C	I	R	C	U	I	T

The fault screen will continue to be displayed even if the fault is no longer present. (Except for external communications fault, which is self re-setting.) To clear a fault screen, press the Reset button at the moment that the fault screen is being displayed. The screen will not reset if the button is pressed while the Running Display is present, nor if the fault is still present on the system.

Figure 8-5 overleaf shows the Fault Screen hierarchy, whilst Table 8-6 gives a listing of the Fault Screens and a description of each.

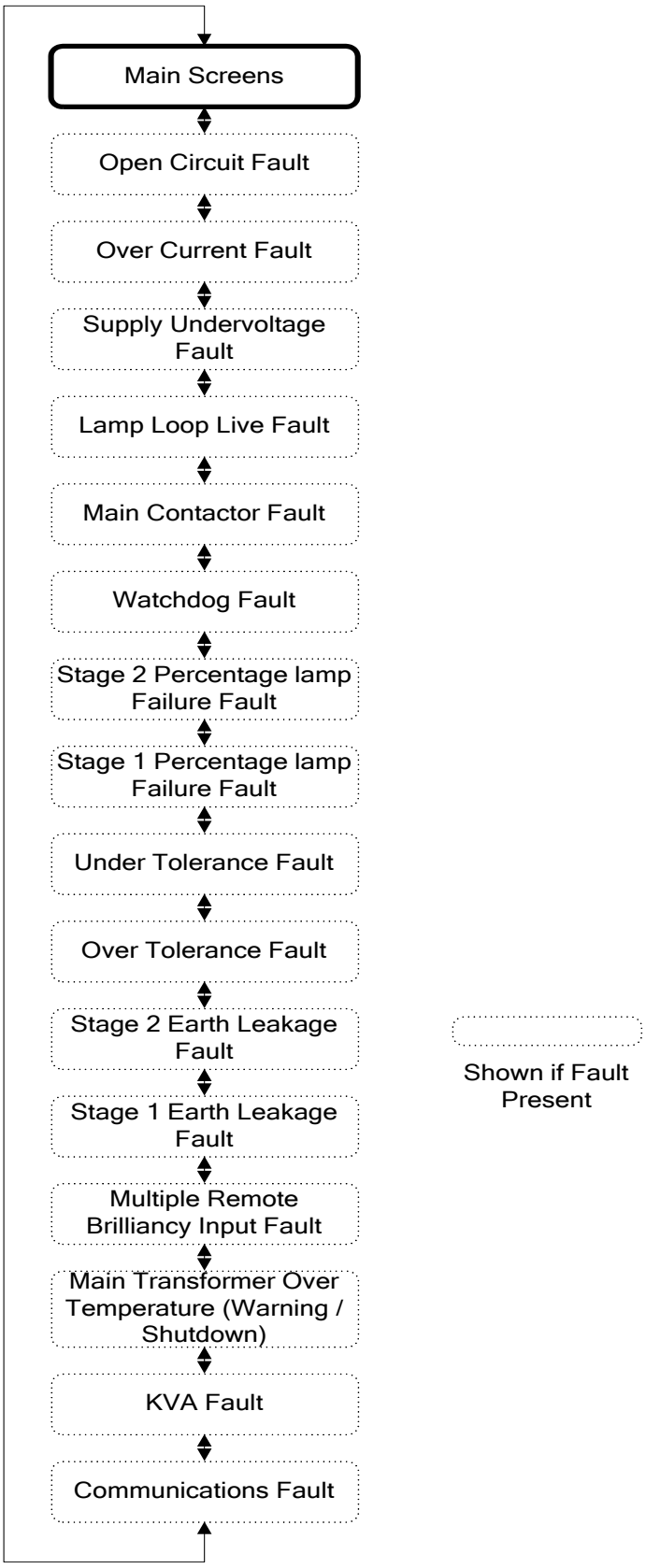


Figure 8-5 Fault Screen Hierarchy

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, or CCR reverted to default operating parameters after 'Verify Failure' on power up, and recalibration required
Over Current	CCR output current overload fault
Supply Under Voltage	CCR supply voltage drops below 75% of nominal for more than 1 second
Output Current Low	Lamp Loop Live fault. Little or no CCR output current; likely to occur if CCR reverted to default operating parameters after 'Verify Failure' on power up, and recalibration required
Main Contactor Fail	Main contactor not energising / door interlock open (if these are fitted) or contactor auxiliary fault
Watchdog Fail	CCR Microcontroller (Watchdog) fault or Main Control Card Common fault
Stage 2 Percentage Lamp Failure	The number of failed lamps on the field circuit exceeds the Stage 2 Percentage Lamp Failure threshold
Stage 1 Percentage Lamp Failure	The number of failed lamps on the field circuit exceeds the Stage 1 Percentage Lamp Failure threshold
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
Transformer Over Temperature Warning	Main Transformer Over Temperature warning
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.

Table 8-6 Fault Screens

9 Maintenance, Hardware Configuration and Calibration

9.1 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 9-1 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 11 of this manual for a fault-finding guide.

9.1.1 Location of main components of the Micro 100

The following photographs show the main components of the Micro 100 CCR:

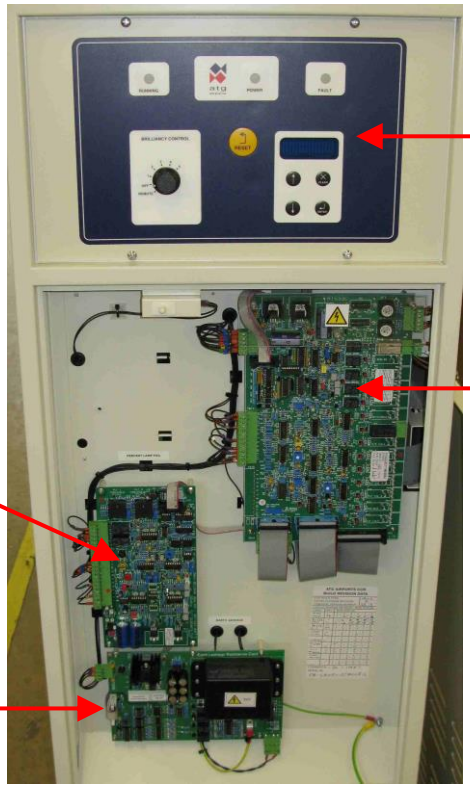


Figure 9-1 Control cards behind front door

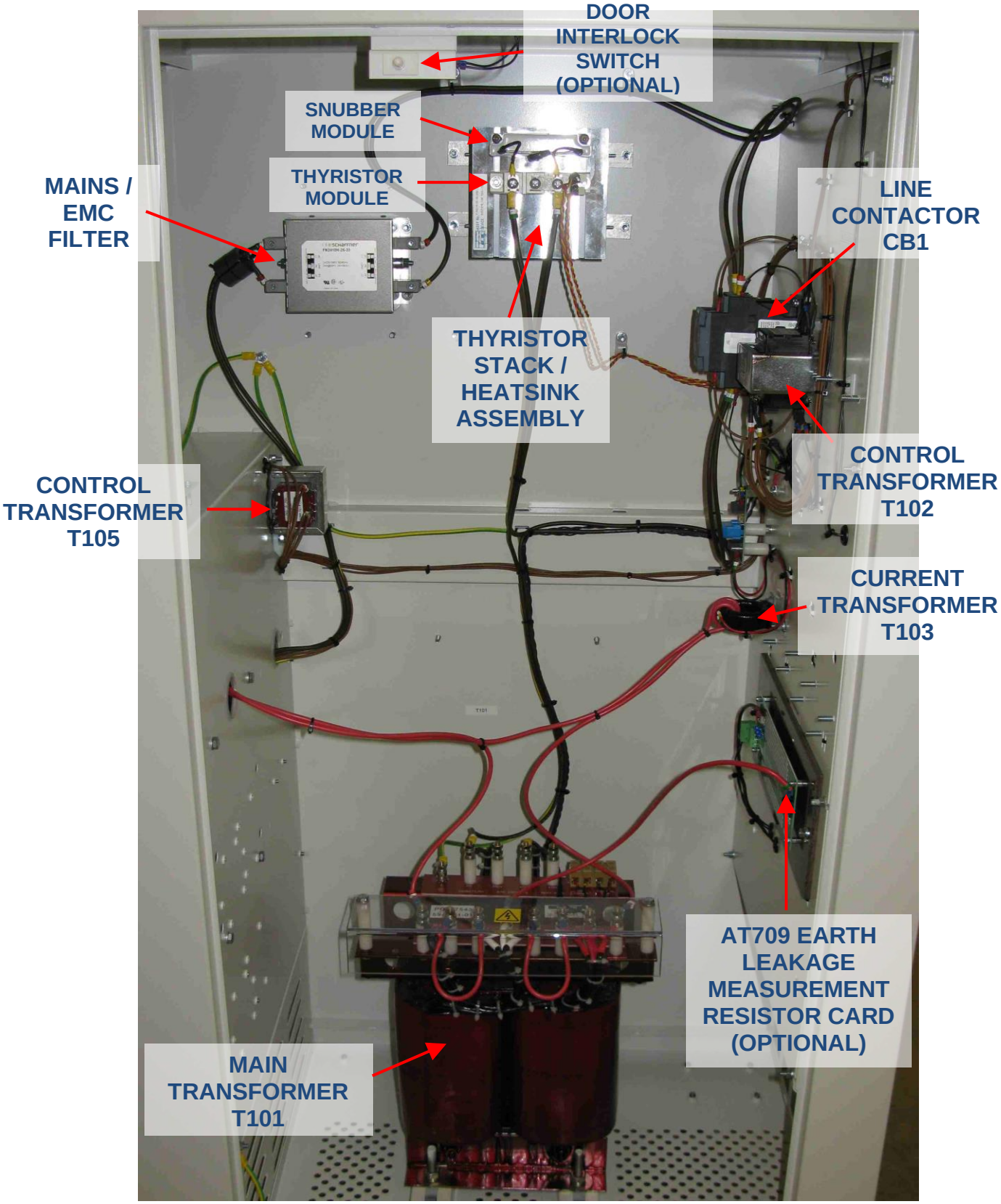


Figure 9-2 Components fitted in HT cubicle – CCRs up to 20A supply current

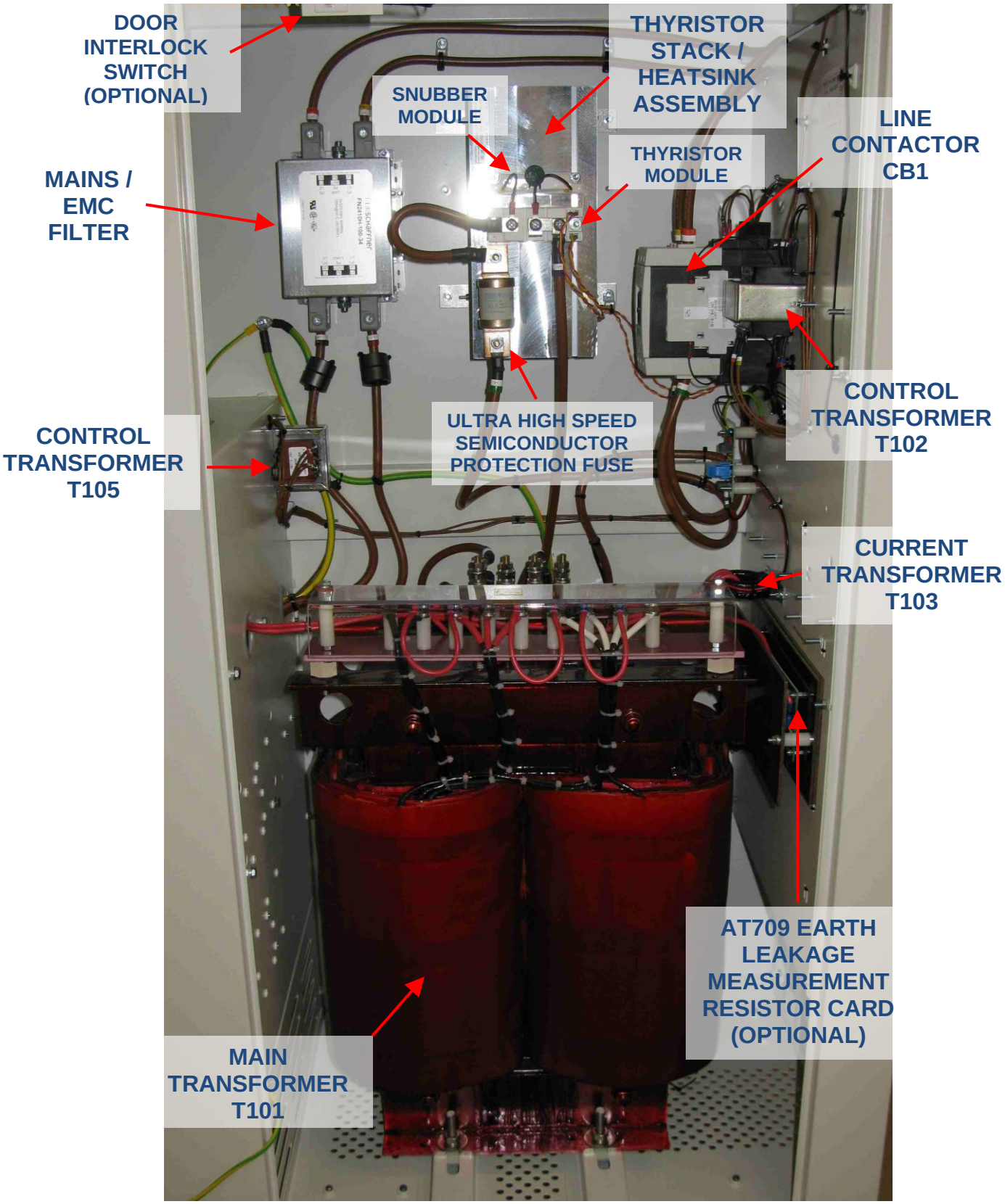


Figure 9-3 Components fitted in HT cubicle – CCRs up to 93A supply current

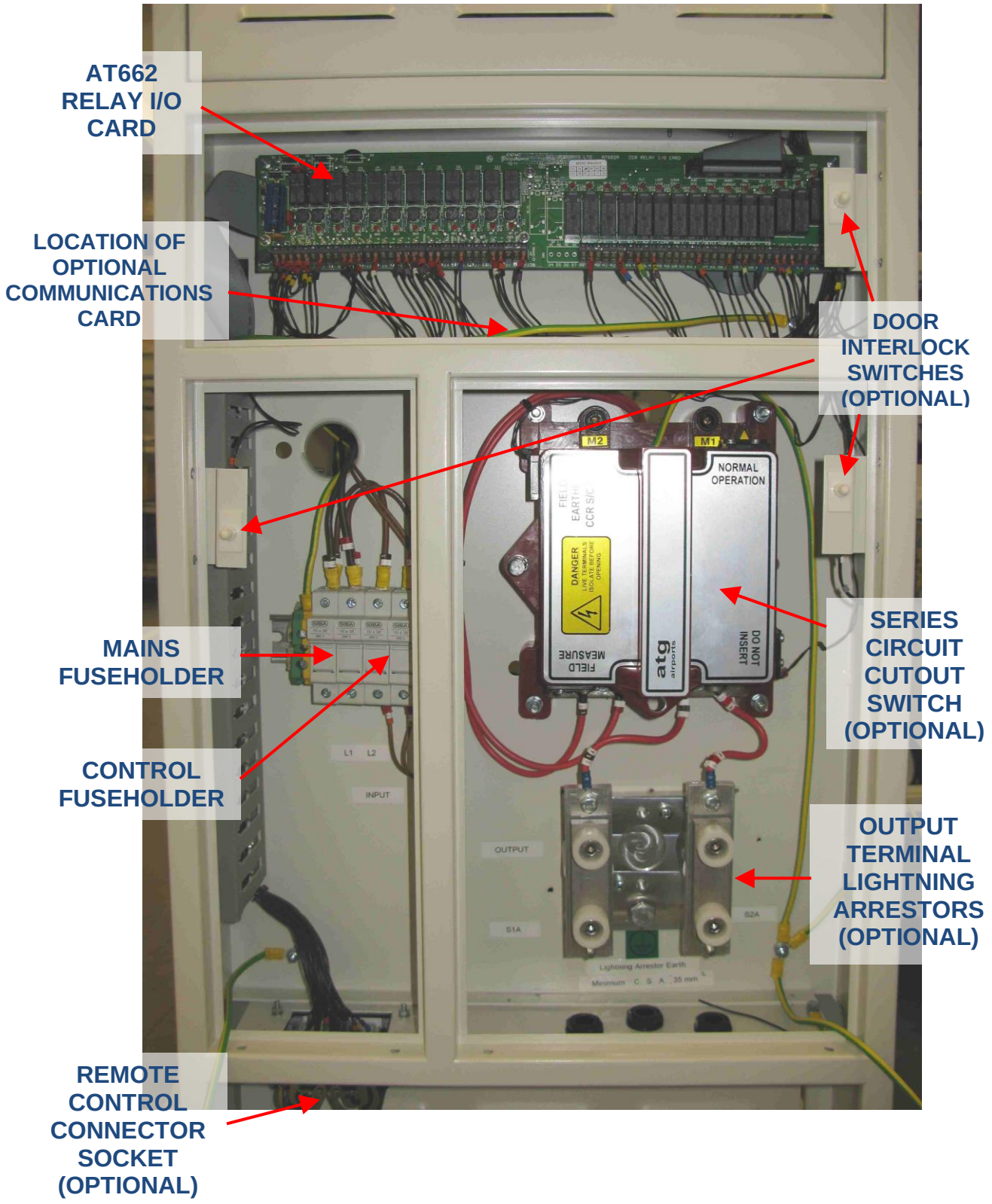


Figure 9-4 Components at rear of CCR

9.2 Calibrating the CCR

9.2.1 Overview

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 4-1 to Table 4-4.

ii/ If the Microcontroller Front Display Panel (containing the AT500 Card) has been replaced.

iii/ If the AT533 Control Card has been replaced (note – a partial recalibration may be sufficient in this case – see Section 9.2.3)

To avoid any possible damage to the AGL lamps should the output current go too high, or should the CCR control loop become unstable for any reason, it is recommended that calibration should not be performed with the regulator connected to the AGL circuit. Ideally, a resistive load bank should be connected in place of the AGL circuit, or, if a load bank is not available, then the CCR output terminals can be short circuited.

Note - using a shorting link or a low impedance load will produce an output current waveform with a short conduction period and a high Crest Factor. If the CCR output is shorted it is very important that only the lowest voltage main transformer secondary winding should be connected to the output (see section 4.3.3), otherwise the high peak current levels on the primary side may cause the mains input or thyristor protection fuses to fail.

A high Crest Factor waveform also has the effect of slightly reducing the accuracy of the RMS converter IC and hence the accuracy of the calibration. The main transformer T101 secondary tapping voltage should therefore be set to match the load used; with a shorting link, only the lowest voltage secondary winding should be connected.

WARNING – HIGH VOLTAGES, UP TO 5000V FOR A 30kVA CCR - ARE PRESENT AT THE CCR OUTPUT TERMINALS AND WITHIN THE HT SECTIONS OF THE CABINET. ISOLATE THE POWER TO THE CCR AND CONNECT THE OUTPUT TERMINALS TO EARTH BEFORE WORKING ON THIS CIRCUITRY.

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.

Configuration and setting up of the regulator is largely achieved via menu selections using the keypad. However, calibration of the regulator also requires that certain voltage measurements are made on the main power board (AT533) whilst in the 'Calibrate Span' menu, and adjustment of the 'CCR CAL' pot VR5. Refer to the pcb layout below.

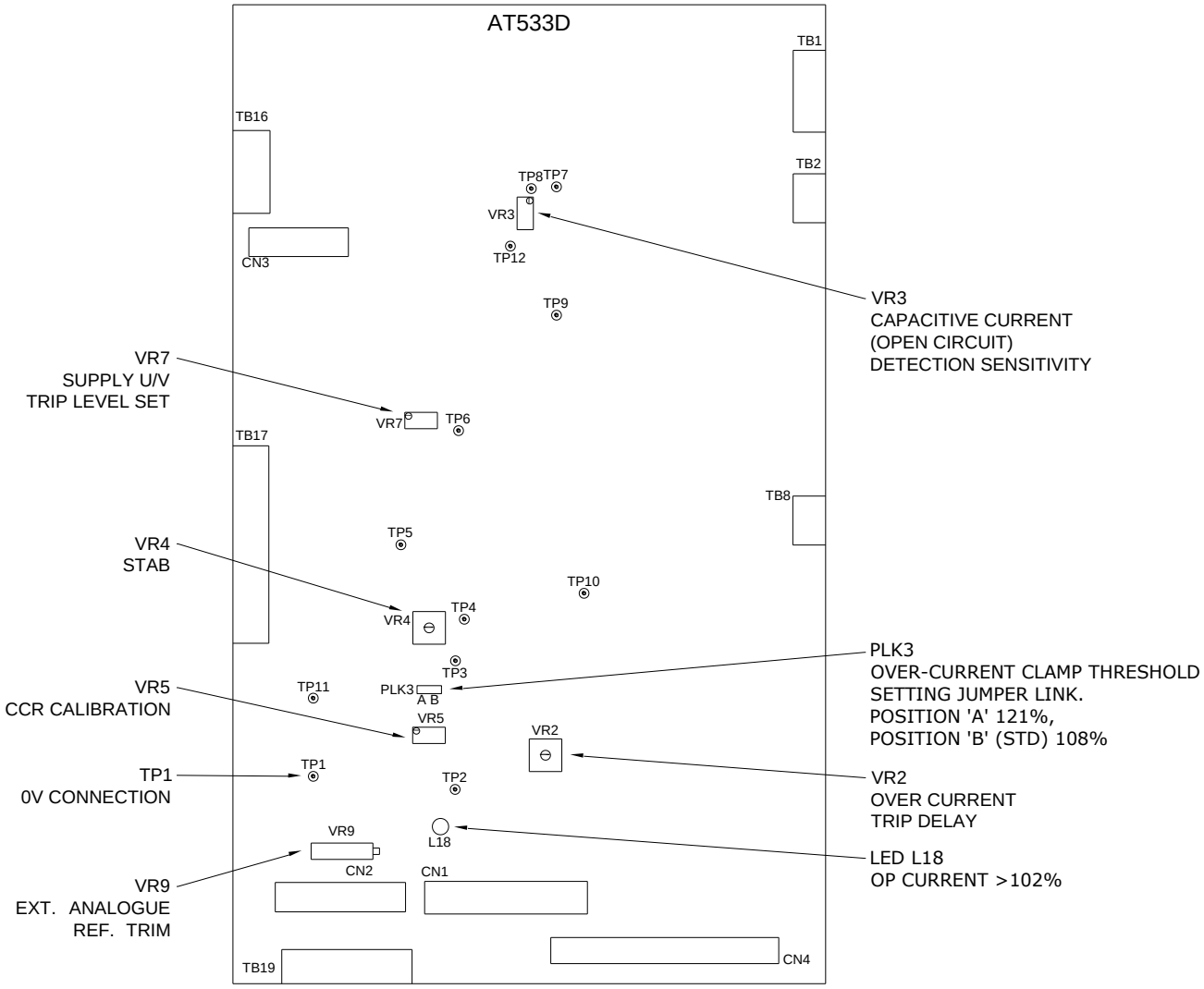


Figure 9-5 AT533 - Main Control Board Potentiometer & Test Point Locations

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 TB1 and TB2 respectively, located at the top right-hand corner of the AT533 card. Due to the voltages present, a cover is fitted over these terminals.

9.2.2 Calibrating the CCR Output Current

Calibration of the regulator requires setting the Zero and Span points, as described in the following sections. The Full Load Current setting of the regulator is programmed during factory testing, and should not require adjustment unless:

i/ The CCR output current rating is to be changed, for example, if the regulator is to be used on a different AGL circuit.

ii/ The Microcontroller Front Panel (containing the AT500 Card) has been replaced.

iii/ 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

If this occurs and default operating parameters are applied without recalibrating the regulator, the CCR will operate but with an extremely low output current, causing an 'Open Circuit' fault trip. The Full Load Current will also return to its default setting, (6.60A), and so may require changing. If a record has been kept of all CCR operating and calibration parameters, then these can be reloaded as described in Section 11.1.

If any of the above three conditions apply, then the Full Load Current should be programmed first, since any changes to the Full Load Current always require that the Zero and Span points are then recalibrated.

9.2.2.1 Setting the Full Load Current

If it is necessary to change the CCR Full Load Current from the Firmware default value of 6.60A, then this should be done before calibrating the Zero and Span points.

Turn the Brilliancy Control Selector Switch SW1 to 'OFF', then programme the Full Load Current by entering the Hardware Configuration Menu. This is described in Sections 8.4.1 and 8.4.2.1.

The CCR may be programmed to operate at 6.00, 6.60 or 12.0 Amps. However, the transformers fitted in the majority of the CCRs are limited to 6.6A maximum output. Transformers wound with dual sets of secondary windings can operate at 6.6A or 12A. 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 have to be changed, (see Sections 4.3 and 9.3.1), followed by reprogramming the Full Load Current and recalibration of the regulator to the new output current level.

9.2.2.2 Setting the Zero Point

Ensure there are no alarms present; turn the Brilliancy Control Selector Switch SW1 to 'OFF'. Connect a DVM, set on the 200mV DC range, between TP1 (0 volts) and TP5 on the AT533 Main Control Board (refer to the card layout in Section 9.2.1); this card is located behind the front cover of the regulator, below the keypad.

Enter the Hardware Configuration Menu as described in Section 8.4.1; use the (↑) or (↓) buttons to scroll to the following screen:

C	A	L	I	B	R	A	T	E		Z	E	R	O	↑	↓
P	O	I	N	T									Y	=	↵

Press the (↵ Enter) button and the screen will change to

→	C	C	R		W	I	L	L		S	T	A	R	T	
	C	O	N	T	I	N	U	E	?			Y	=	↵	

Press (↵ Enter) button again, the CCR will start and the screen will change to

	P	R	E	S	S		↑	↓		U	N	T	I	L	
T	P	5	=	0	.	0	0	V		(		2	0	)	

The figure in brackets on the second line is the Microcontroller Zero Point output register value. This will change during calibration; the default value is 20.

Press the (↑) (↓) buttons to adjust the voltage measured at TP5 as close as possible to 0 volts; the residual voltage can be of either polarity. It should be possible to reduce the voltage to a magnitude of less than 50mV. When this has been correctly adjusted, press the (↵ Enter) button.

Note – if accessing this menu just in order to make a record of the calibration factor, pressing the (X Clear) button will exit without altering the calibration.

9.2.2.3 Setting the Span Point

To avoid any possible damage to the AGL lamps should the output current go too high, or should the CCR control loop become unstable for any reason, it is recommended that calibration should not be performed with the regulator connected to the AGL circuit. Ideally, a resistive load bank should be connected in place of the AGL circuit, or, if a load bank is not available, then the CCR output terminals can be short circuited.

Note - using a shorting link or a low impedance load will produce an output current waveform with a short conduction period and a high Crest Factor. If the CCR output is shorted it is very important that only the lowest voltage main transformer secondary winding should be connected to the output (see section 4.3.3); otherwise the high peak current levels on the primary side may cause the mains input or thyristor protection fuses to fail. Also, operating with a shorting link normally requires that the 'STAB' potentiometer on the AT533 Card is turned fully clockwise to improve the current control loop stability (see Figure 9-5).

A high Crest Factor waveform also has the effect of slightly reducing the accuracy of the RMS converter IC and hence the accuracy of the calibration. The main transformer T101 secondary tapping voltage should therefore be set to match the load used; with a shorting link, only the lowest voltage secondary winding should be connected. Section 4.3 describes how to adjust the transformer secondary taps, and section 3.4 shows the high voltage output terminals.

WARNING – HIGH VOLTAGES, UP TO 5000V FOR A 30kVA CCR - ARE PRESENT AT THE CCR OUTPUT TERMINALS AND WITHIN THE HT SECTIONS OF THE CABINET. ISOLATE THE POWER TO THE CCR AND CONNECT THE OUTPUT TERMINALS TO EARTH BEFORE GAINING ACCESS TO THESE COMPARTMENTS.

Connect a calibrated in-line 'true RMS' ammeter in the regulator output circuit.

Ensure there are no alarms present; turn the Brilliancy Control Selector Switch SW1 to 'OFF'.

Connect a DVM, set on 2V DC range, between TP1 (0 volts) and TP2 on the AT533 Main Control Board (refer to the AT533 card layout in Section 9.2.1). Measure the voltage at TP2 with the CCR in the off state – it should be close to 1.50V. Make a record of the exact voltage.

Reconnect the DVM between TP1 (0 volts) and TP4 on the AT533 Main Control Board. Turn the 'CURR CALIB' pot VR5 on the AT533 fully anti-clockwise.

Enter the Hardware Configuration Menu as described in Section 8.4.1, then use the (↑) or (↓) buttons to scroll to the following screen:

C	A	L	I	B	R	A	T	E		S	P	A	N	↑	↓
P	O	I	N	T									Y	=	↵

Press (↵ Enter) button and screen will change to

	C	C	R		W	I	L	L		S	T	A	R	T	
	C	O	N	T	I	N	U	E	?			Y	=	↵	

Press (↵ Enter) button again, the CCR will start and the screen will change to

	P	R	E	S	S		↑	↓		U	N	T	I	L	
T	P	4	=	1	.	5	V		(	1	9	8	)		

The internal demand voltage can now be adjusted using the (↑) (↓) buttons until the voltage measured at TP4 on the DVM is exactly equal to that measured at TP2 in the off state - approximately 1.50V. This is critical because it sets the correct operating voltage level for the Current Control Loop, the Over-current Clamp and the Over-current Protection.

The second line of the display should read somewhere between 182 and 198 when correctly adjusted.

Once this is achieved the ‘CURR CALIB’ pot VR5 on the main control board can be adjusted until exactly the required CCR Full Load Current – be it 6.00, 6.60 or 12.00A - is measured on the true RMS ammeter. When, and only when the current is correct, press the (↵ Enter) button.

Pressing (↵ Enter) loads the Microcontroller’s internal scaling factor, such that the actual measured current is set to the selected CCR Full Load Current.

Note – if accessing this menu just in order to make a record of the calibration factor, pressing the (X Clear) button will exit without altering the calibration.

9.2.3 AT533 Control Card replacement – partial recalibration

This procedure can be used to put the CCR back into service after replacing ONLY the AT533 Control Card; it assumes that the CCR output current display meter calibration is correct. An independent ‘True RMS’ ammeter – not necessarily of the accuracy normally used for calibration purposes - can be used as a backup if necessary, but it will be the CCR current display that will be used to calibrate the AT533 Card.

The procedure is as follows:

i/ Prior to switching on the CCR, turn VR5 - the 'CCR CAL' potentiometer - fully anticlockwise. Refer to the AT533 card layout in Section 9.2.1 for the location of the potentiometer.

ii/ To avoid any possible damage to the AGL lamps should the output current go too high, or should the CCR control loop become unstable for any reason, it is recommended that calibration should not be performed with the regulator connected to the AGL circuit. Ideally, a resistive load bank should be connected in place of the AGL circuit, or, if a load bank is not available, then the CCR output terminals can be short circuited.

Note - using a shorting link or a low impedance load will produce an output current waveform with a short conduction period and a high Crest Factor. If the CCR output is shorted it is very important that only the lowest voltage main transformer secondary winding should be connected to the output (see section 4.3.3); otherwise the high peak current levels on the primary side may cause the mains input or thyristor protection fuses to fail. Also, operating with a shorting link normally requires that the 'STAB' potentiometer on the AT533 Card is turned fully clockwise to improve the current control loop stability (see Figure 9-5).

A high Crest Factor waveform also has the effect of slightly reducing the accuracy of the RMS converter IC and hence the accuracy of the calibration. The main transformer T101 secondary tapping voltage should therefore be set to match the load used; with a shorting link, only the lowest voltage secondary winding should be connected. Section 4.3 describes how to adjust the transformer secondary taps, and section 3.4 shows the high voltage output terminals. Always follow the normal safety procedures for working on high voltage airfield lighting circuitry.

WARNING – HIGH VOLTAGES, UP TO 5000V FOR A 30kVA CCR - ARE PRESENT AT THE CCR OUTPUT TERMINALS AND WITHIN THE HT SECTIONS OF THE CABINET. ISOLATE THE POWER TO THE CCR AND CONNECT THE OUTPUT TERMINALS TO EARTH BEFORE GAINING ACCESS TO THESE COMPARTMENTS.

iii/ Switch the CCR on at maximum brilliancy using the front panel rotary switch. Turn the 'CCR CAL' potentiometer on the AT533 Card slowly clockwise until the CCR front panel displays a current of exactly 6.60A, 12.0A, or whichever is the rated output current.

iv/ Switch the CCR off and isolate the mains supply. Disconnect the load bank or the shorting link from the CCR output and reconnect the AGL field circuit. Re-connect the main transformer secondary tappings to match the load on the AGL circuit.

v/ Switch the CCR on at minimum current using the front panel rotary switch, and slowly increase the brilliancy level one step at a time. Verify that the current displayed on the CCR front panel is at the correct level for each brilliancy step.

vi/ Increase to maximum brilliancy and verify that the output current shown on the CCR display is at precisely the correct value when operating into the field circuit. Adjust the 'CCR CAL' potentiometer if necessary, taking care not to go above the rated output current.

9.3 Additional CCR Hardware configuration

9.3.1 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 4 primary turns through the CT, and for 12.00A operation there should be 2 primary turns.

Note – this is always set during factory testing to match the nominal CCR Full Load Current. It will therefore not require changing unless the regulator operating current range is to be changed from 6.00 / 6.60A to 12.00A or vice-versa. (Note – only transformers with dual sets of secondary windings can operate at 6.00 / 6.60A or 12.00A). In this case, it will be necessary to change the Main Transformer secondary connections (see Section 4.3) and the programmed CCR Full Load Current (see section 8.4.2.1) to suit the new operating current, followed by recalibrating the CCR (see section 9.2.2).

9.3.2 Remote Analogue Input Reference Calibration

This input reference only requires calibration on those regulators where Remote Brilliancy selection is to be controlled from a Remote Analogue Brilliancy Reference signal.

Potentiometer VR9 on the AT533 Main Control Board calibrates the Remote Analogue Reference Signal in order to maximise the resolution of the Analogue to Digital converter input on the AT500 Microcontroller Card.

Enter the Hardware Configuration Menu as described in Section 8.4.1, and use the (↓) button to scroll down to the following screen:

→	A	N	A	L	O	G	U	E		I	/	P		↑	↓
	S	E	T	U	P								Y	=	↵

Press the (↵ Enter) button and the screen will change to:

→		B	R	I	L	L		L	E	V	E	L		8	
		B	=	(	2	3	5	)		A	=		8	4	

This enables the (digitised) Remote Analogue Brilliancy Reference Signal to be viewed e.g. A = 84.

Ensure that the Remote Analogue Reference Signal is at the maximum level.

Adjust potentiometer VR9 (labelled ‘Ext Analogue Ref Trim’) on the AT533 board to achieve a reading of A = 244 on the display.

Once calibration of VR9 is complete, however, the boundary levels may have to be set in order for the regulator to correctly switch between Brilliancy Levels in response to changes in the Analogue Brilliancy Reference Input. This is done using the Analogue Input Set-up screens shown above, and is described in Section 8.4.2.3.

9.3.3 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 not be tested on a live AGL circuit due to the risk of damaging the lights due to the excess currents applied.**

The Over-current 'TRIP DELAY' potentiometer VR2 on the AT533 Card is set during factory testing to give the correct trip times to meet the requirements of either the International and European Standard IEC/EN61822:2009, or alternatively, 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 (6.93A and 8.25A respectively for a 6.6A regulator). For the IEC/EN61822 settings, VR2 is set fully anti-clockwise; turning clockwise increases the trip delay time.

The AT533 Card is located behind the CCR front door – refer to Figure 9-1; the position of the AT533 potentiometers, test points and jumper link are shown in Figure 9-5 and Figure 9-6.

If for any reason the trip time needs to be tested, then a resistive load bank or a shorting link should be connected in place of the AGL circuit at the output of the CCR so as not to risk damaging the airfield lights. The CCR main transformer T101 secondary tapping voltage should be adjusted according to the impedance of the test load so as to minimise the CCR output current waveform crest factor (refer to section 4.3). This enables the control card RMS convertor IC's to operate more accurately.

Note - using a shorting link or a low impedance load will produce an output current waveform with a short conduction period and a high Crest Factor. If the CCR output is shorted it is very important that only the lowest voltage main transformer secondary winding should be connected to the output (see section 4.3.3); otherwise the high peak current levels on the primary side may cause the mains input or thyristor protection fuses to fail. Also, operating with a shorting link normally requires that the 'STAB' potentiometer on the AT533 Card is turned fully clockwise to improve the current control loop stability.

WARNING – HIGH VOLTAGES, UP TO 5000V FOR A 30kVA CCR - ARE PRESENT AT THE CCR OUTPUT TERMINALS AND WITHIN THE HT SECTIONS OF THE CABINET. ISOLATE THE POWER TO THE CCR AND CONNECT THE OUTPUT TERMINALS TO EARTH BEFORE GAINING ACCESS TO THESE COMPARTMENTS.

On CCRs fitted with the AT533C version of the Main Control Card, the Over-current Trip time can only be tested up to 108% of nominal RMS current, (7.18A on a 6.6A regulator), which is the threshold level for operation of the overcurrent clamp circuit. The overcurrent clamp, which is separate from the Over-current Trip circuit, is designed to protect the lamps if 'block switching' is employed, ie, if large sections of the lamp circuit are switched off simultaneously using electronic switches, thus causing a sudden reduction in the load impedance and consequently an overcurrent spike at the CCR

output. The current surge is detected by the overcurrent clamp circuit which, within a half mains cycle, reduces the output current of the CCR before allowing it to ramp back up again to the desired value.

On CCRs fitted with the later AT533D version of the Main Control Card, the overcurrent clamp threshold can be raised from 108% to 121% of nominal RMS current (8.05A on a 6.6A regulator), by moving jumper link PLK3 to position 'A' (between the centre and left-hand pins – see Figure 9-6 overleaf). This allows a higher level of test current to be used to check the Over-current trip time. Note – the jumper link should be moved back to position 'B' (between the centre and right-hand pins) after the test is finished.

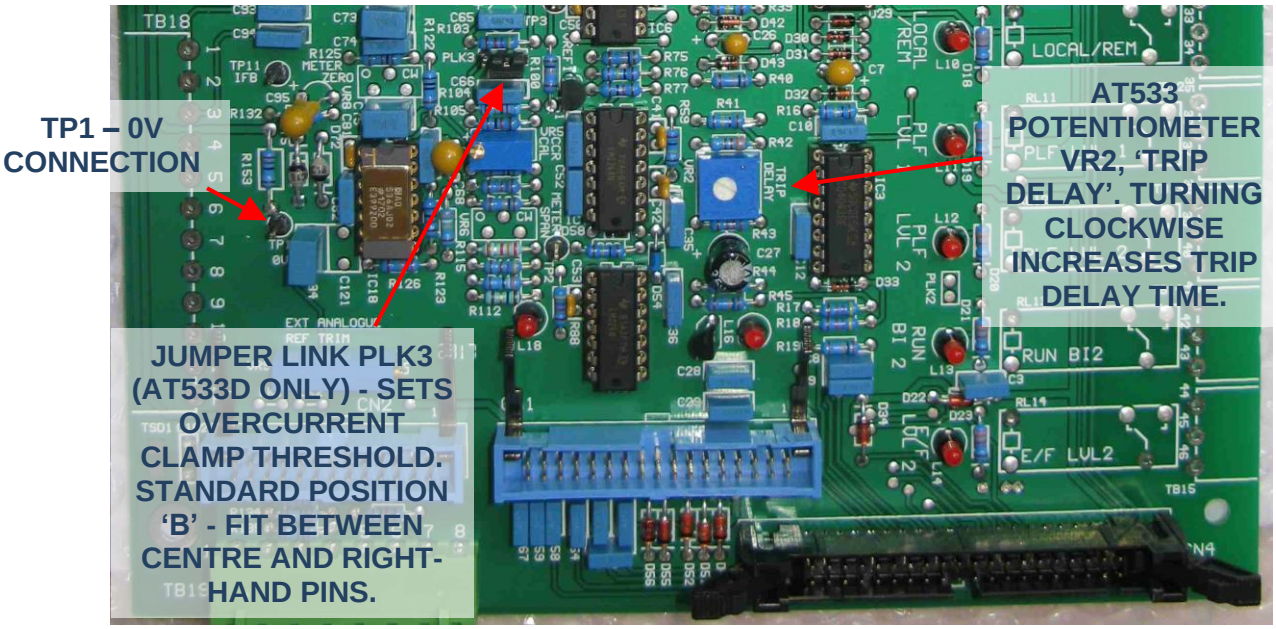


Figure 9-6 AT533 - Location of 'TRIP DELAY' potentiometer VR2 and jumper link PLK3

Enter the Hardware Configuration Menu as described in Section 8.4.1, then use the (↑) or (↓) buttons to scroll to the following screen:

T	E	S	T		O	V	E	R	C	U	R	R	E	N	T
T	R	I	P		P	O	I	N	T				Y	=	↵

This screen allows the operator to directly control the CCR output current level. The current can be increased above the normal Full Load Current value in order to test the Over-current Trip Point and Trip Time.

Press the (↵ Enter) button and the screen will change to:

	C	C	R		W	I	L	L		S	T	A	R	T	
	C	O	N	T	I	N	U	E	?			Y	=	↵	

Press the (↵ Enter) button again, the CCR will start and the screen will display:

	A	D	J	U	S	T		W	I	T	H		↑	↓	
D	=		6	.	6	0		M	=		6	.	6	0	

The 'D' value represents the current demand, and starts at the programmed Full Load Current. The 'M' value represents the measured current, but will also record peak levels after a trip condition.

Press and hold the UP button (↑) to increase the current level. LED L18 (next to IC8) on the AT533 card will change from glowing dimly or flickering at 100% of nominal current, to glowing brightly once the current exceeds approximately 101.5% of nominal, ie, 6.70A on a 6.60A regulator. This enables the Over-current protection circuit to start charging.

Press and hold the (↑) button until the 'D' value is either:

6.80A to check the IEC Over-current setting, or
6.93A to check the FAA Over-current setting.

The Over-current circuit should soon trip. (Note – for CCRs with an output current rating other than 6.60A, the test current levels are changed proportionally).

Press the 'RESET' pushbutton; measure the time taken before the unit trips again; it should be 4.0 seconds +/- 0.5 seconds for the IEC setting, or 5.0 seconds +/- 0.5 seconds for the FAA setting.

If necessary, adjust the position of the 'TRIP DELAY' potentiometer to achieve the required time; turning it clockwise increases the delay. Press the 'RESET' pushbutton to repeat the test if necessary, to verify the trip time.

Note – the Over-current Trip circuit will only operate correctly if the CCR has been correctly calibrated, since calibration also sets the level of the overcurrent trip threshold. If the trip delay time cannot be set correctly, or if the regulator does not trip, then the calibration of the CCR should be checked, specifically the DC voltage measured at TP4 on the AT533 Card when the CCR is running at maximum rated output current. To ensure the correct Over-current threshold level, the voltage measured at TP4 at maximum CCR output current should be exactly equal to that measured at TP2 when the CCR is switched off, which should be approximately 1.5V DC. (Note - use TP1 as the 0V return; see Figure 9-6). Refer to section 9.2.2 for a full description of CCR calibration.

9.3.4 AT533 Main Control Board – other Potentiometers and link settings

The remaining potentiometers on the AT533 Main Control Board are factory set and should not require adjustment. The following sections give a description of their functions, and how the settings are made. The board is mounted behind the front door of the Micro 100 CCR, as shown in Figure 9-1. Refer to the card layout of Figure 9-5 for the location of the potentiometers, test points, jumper link and LED L18.

9.3.4.1 VR4 'STAB'

The 'STAB' potentiometer on the AT533 adjusts the stability of the CCR current control loop. The normal setting for the potentiometer is fully clockwise, which should work satisfactorily for most circuit loads. This will provide a fast response to changes in current level or circuit load, with no overshoot.

It is not recommended to adjust the 'STAB' potentiometer when an Airfield Ground Lighting circuit is connected, since any instability could damage the lamps. The safest way to do this is to connect a resistive load bank in place of the AGL circuit. If a shorting link is connected on the CCR output, then the CCR Power Transformer should be set to minimum output voltage (see Section 4.3.3), otherwise the high current peaks may cause the mains input or thyristor protection fuses to fail. Operating with a shorting link normally requires that the 'STAB' potentiometer is turned fully clockwise to improve the current control loop stability.

The sound of the CCR will often give a good indication if the control loop is stable, particularly on the larger CCRs. A 'growling' sound may be heard from the Power Transformer if the control loop is not stable, which will get louder as the CCR output current is increased. Do not, however, attempt to set the control loop stability without the use of other monitoring instrumentation

Correct control loop stability is best checked using an oscilloscope, or failing that, an analogue clip-on ammeter clamped over one of the CCR output cables. Note - it is not possible to monitor or set the stability of the regulator using the CCRs own digital ammeter, since the response time is not fast enough.

To check with an oscilloscope, connect the probe between TP1 (0v) and TP11 - this allows monitoring of the CCR output current by looking at the voltage across the CT burden resistor. Set the oscilloscope time base to 20 ms per division, and the scale to 1v per division.

Switch the regulator on at the lowest brilliancy setting and examine the oscilloscope trace. There should be no overshoot as the current reaches its set-point, and no instability or oscillation in the current waveform. If using an analogue clip-on ammeter, the needle should move directly to the measured value, with no overshoot and no oscillation. Increase the CCR current one step at a time; if there is any instability in the control of the current, then adjust the 'STAB' potentiometer. The control loop must be stable at all current steps, including maximum output.

9.3.4.2 VR7 'SUPPLY U/V TRIP LEVEL SET'

This adjustment sets the undervoltage level at which the CCR will switch off.

With the mains power to the regulator switched off, the resistance between test points TP1 and TP6 on the AT533 Main Control Board should be measured. VR7 should be adjusted until a value of 4.38K ohms +/- 0.02K is obtained, which corresponds to a voltage trip level of 311 volts, i.e. 75% of 415 volts.

9.3.4.3 VR3 'CAPACITIVE CURRENT (OPEN CIRCUIT) DETECTION SENSITIVITY'

The fault message 'CAP/ASYM CURRENT/WATCHDOG' can indicate a trip of the CCR due to 'capacitive current' detection. This may be due to an open circuit fault but with current continuing to flow through the capacitance formed by the earth sheath of a screened airfield primary series loop cable. If the AGL circuit is not in fact open circuited and nuisance tripping is encountered, 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 capacitive current detection is only included as standard on the 'D' version or later of the Main Control Board, AT533D.

Potentiometer VR3 on the AT533D board can be adjusted in order to de-sensitize the capacitive current detection circuit. This potentiometer sets the trip threshold level for the capacitive load current detection circuitry, which is one of two circuits which can cause an Open Circuit trip. The factory setting is -6.5V, as measured at TP12 on the AT533D card. (Refer to Figure 9-7, below, for the locations of VR3 and TP12). Use TP1 as the 0V return – this is located near the bottom left-hand of the pcb (see Figure 9-6).

If nuisance tripping is encountered, then this circuit can be de-sensitised by turning potentiometer VR3 clockwise to increase the threshold voltage measured at TP12, to around -5.0V or a little higher.

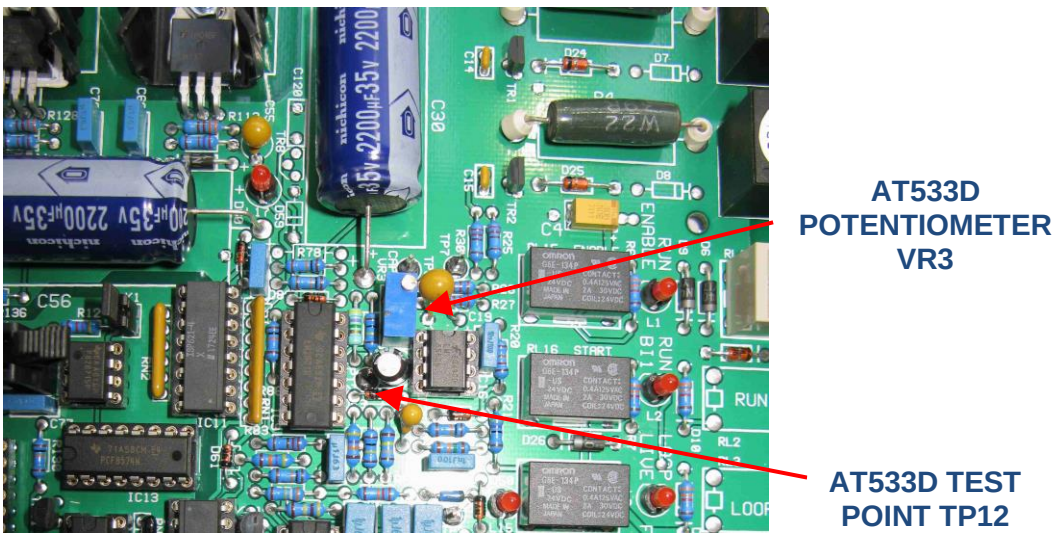


Figure 9-7 AT533D – locations of potentiometer VR3 and test pin TP12

9.3.4.4 Link PLK3 – Over-current Clamp threshold setting (AT533D or later)

The overcurrent clamp, which is separate from the Over-current Trip circuit, is designed to protect the lamps if 'block switching' is employed, ie, if large sections of the lamp circuit are switched off simultaneously using electronic switches, thus causing a sudden reduction in the load impedance and consequently an overcurrent spike at the CCR output. The current surge is detected by the overcurrent clamp circuit which, within a

half mains cycle, reduces the output current of the CCR before allowing it to ramp back up again to the desired value.

Some electronic loads can cause current surging on power up due to the load impedance fluctuating, which can cause nuisance operation of the over-current clamp. Evidence of this happening is shown by LED L18 on the AT533 card flickering. (Note – L18 lights if the output current is greater than 102% of nominal, but can also light if the CCR 'Span' has not been correctly calibrated – see Section 9.2.2.3).

On CCRs fitted with the later AT533D version of the Main Control Card, this can be prevented from occurring by raising the overcurrent clamp threshold from 108% to 121% of nominal RMS current (8.05A on a 6.6A regulator), by moving jumper link PLK3 from the standard position 'B' (fitted between the centre and right-hand pins) to position 'A' (between the centre and left-hand pins). Refer to Figure 9-5 or Figure 9-6 for the location of PLK3 on the AT533D card.

10 CCR Theory of Operation

10.1 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. See Figure 7-1, page 7-6. 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 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 10-1 (overleaf) shows the block diagram of the CCR with a primary series field loop connected. The CCR uses an anti-parallel thyristor pair with phase angle control to vary the voltage applied to the primary of the main CCR output isolation transformer. The transformer secondary has multiple tappings such that the output voltage can be adjusted during commissioning to give the correct range according to the load connected to the AGL circuit; this is in order to minimise the supply current drawn and to reduce the harmonic effects. The conduction period of the thyristors is then controlled to give the correct RMS current on the output side of the transformer; the brilliancy of the AGL lamps is a function of the RMS current level flowing through them.

10.2 Control Cards

10.2.1 AT500 Microcontroller Card

The AT500 card, which is mounted behind the Front Display Panel, contains a Microcontroller IC which provides run control and supervisory functions, along with the brilliancy / current demand signal. It also has an independent RMS current measurement circuit that provides a running value to the display module. Additionally, this signal is used for Tolerance Monitoring, to ensure that the CCR output current is within acceptable limits.

All input signals are routed to the Microcontroller and the majority of output relays are also controlled by it. Additionally, all fault conditions are logged by the Microcontroller.

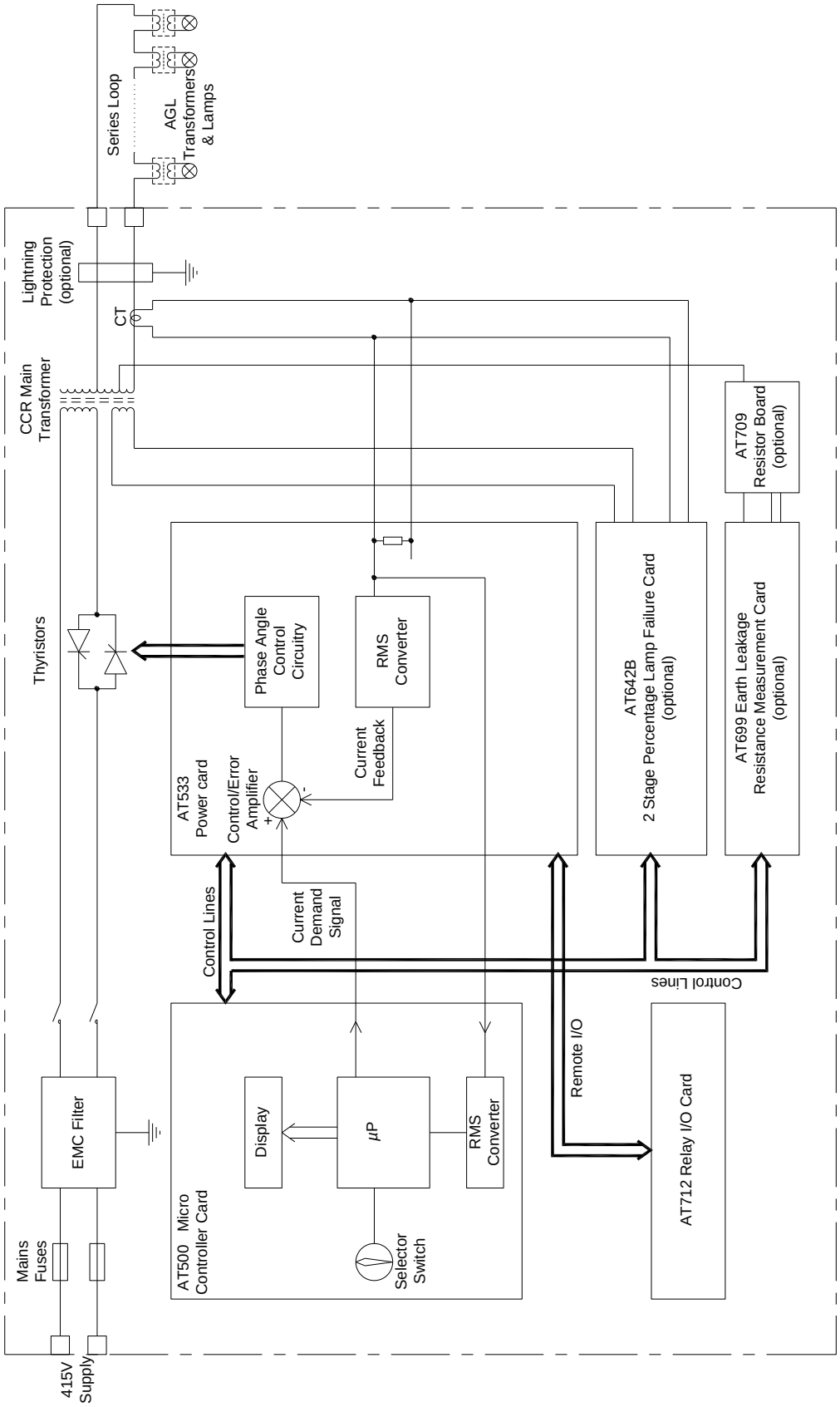


Figure 10-1 Block diagram of CCR

10.2.2 AT533 Main Control and Power Card

Warning – the voltage on the thyristor gate / cathode connections, and the main contactor coil connections may be as high as 415V. These connect to terminal blocks TB1 and TB2 respectively, located at the top right-hand corner of the board (see Figure 9-1). Due to the voltages present, a cover is fitted over these terminals.

This card, mounted behind the CCR lower front cover (see Figure 3-9), contains the control / error amplifier, current feedback, RMS to DC converter and the thyristor control and firing circuitry. It varies the thyristor conduction period to maintain the RMS level of CCR output current demanded by the AT500 Microcontroller card.

The AT533 also contains circuitry for the detection of Open Circuit and Over-Current fault conditions.

10.2.3 2 Stage Percentage Lamp Failure Card AT642

This card is also mounted behind the CCR lower front cover. The function of the AT642 PLF Card is to give an indication of the Percentage of Lamps Failed on an AGL circuit. The output signals can be taken directly from the 2 relay outputs – one for each failure threshold level, preset by switches on the card – or the Microcontroller can interpret the AT642 error voltage to give a display of the actual number of failed lamps.

The principle of operation of the AT642 PLF Card is that the time delay between the rising edges of the CCR output voltage and current waveforms – at the thyristor switching point - 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.

A more detailed description of this card is given in Section 4.6.

Revision ‘D’ versions of this card (AT642D) and later provide CCR output voltage and output load kVA monitoring. Potentiometer VR11 ‘VOLT CAL’ is used to calibrate the voltage feedback; this is set during factory testing and should not require further adjustment. Note – the actual CCR Mains transformer output tapping voltage used should be programmed in via the keypad menu system, in order that the CCR output voltage and load kVA can be correctly displayed. Do not adjust VR11 to correct the display if the tapping voltage has not been correctly programmed in.

Note - some versions of the regulator use a 70v output from the auxiliary PLF winding on the main CCR transformer (connecting to terminals 2 and 3 on the PLF card). For this reason, a cover is fitted over these terminals.

10.2.4 Earth Leakage Resistance Measurement

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 Fault Finding

PROBLEM	POSSIBLE CAUSE	CORRECTIVE MAINTENANCE
Regulator does not operate and Power light is not illuminated.	Main power source 'OFF'.	Check main 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 gG fuse on the input, which are less susceptible to failure due to short term surges, however these CCRs are fitted with an ultra-rapid thyristor protection fuse, F7, which can fail under these conditions. See Table 12-6 for a complete fuse listing.
	Blown control fuses F3, F4.	Check transformers T102 and T105 for faults before replacing.
	Blown fuse F1 (AT500 Microcontroller Board).	Check for transformer or other fault on AT500 board before replacing.
	Faulty control transformer T102.	Check that 230V AC appears between terminals L & N on the AT500 Micro Controller Board
Regulator does not operate, Power and Fault lights are illuminated but Vacuum Fluorescent display is blank	Incorrect supply voltage.	Check supply voltage against regulator rating plate.
	Faulty control transformer T102.	Check that 40V AC appears between TB16 terminals 1 and 3 on the AT533 Main Control Board.
	Supply to Control Board AT533 disconnected	Re-connect supply to Control Board AT533 TB16.
Regulator does not operate, Power and Fault lights are illuminated and Supply Under-voltage fault is displayed	Incorrect supply voltage.	Check supply voltage against regulator rating plate.
	Faulty or disconnected 10 way ribbon cable between AT500 and AT533 Cards	Replace or re-connect ribbon cable.
	Incorrectly adjusted supply under voltage detector on AT533 Control Board	Adjust as described in Section 9.3.4.2
	Faulty control board AT533	Replace Control Board AT533 and re-calibrate the regulator.
Regulator does not operate, Power and Fault lights are illuminated and Output Current Low fault is displayed	Incorrect Zero and Span calibration ('Verify Failure' message may be observed after power up)	Check and if necessary re-calibrate the regulator. See Sections 11.1 and 9.2.
	Main CCR Transformer (T101) secondary tapping voltage set too low.	Adjust as described in Section 4.3.
	Faulty or disconnected ribbon cable RIBB 1	Replace or re-connect ribbon cable.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE MAINTENANCE
Regulator does not operate, Power and Fault lights are illuminated and Open Circuit Fault displayed.	Ascertain if fault lies within the regulator or the AGL series circuit	Switch off the power to the CCR. Connect a shorting link between the CCR output terminals. (Note – do not operate the CCR into a short circuit at any setting above minimum brilliancy unless transformer T101 sec tapping voltage has been set to minimum (see Section 4.3.3), otherwise the high peak current levels may cause the supply / thyristor fuses to fail). Operate the CCR, and if possible, measure the CCR supply current using a true RMS ammeter. If the CCR runs at all brilliancies without taking excessive input current then the problem is with the AGL circuit.
Regulator does not operate, Power and Fault lights are illuminated and Watchdog Fail fault is displayed	Faulty or disconnected 34 way ribbon cable between the AT500 and AT533	Replace or re-connect ribbon cable.
	Faulty control board AT533	Replace Control Board AT533 and re-calibrate the regulator.
Regulator does not operate, Power and Fault lights are illuminated and Main Contactor fault is displayed	Door open (if door interlocks fitted)	Close door
	Faulty Contactor CB 1	Check the coil voltage of CB1. If supply voltage is present, but the contactor fails to operate, CB1 is defective. Replace contactor.
	Faulty or open circuit contactor auxiliary circuit	With CB1 energised check continuity through wires 171 and 172. Replace contactor or re-connect circuit.
Regulator does not respond to the remote brilliancy signals	Keypad rotary switch SW1 not in Remote position	Turn switch to Remote position
	Incorrect remote control configuration selected	Check operating mode selected for Remote Control, see Section 8.3.2.2.
	Fault on external brilliancy control signals	Check switching of all appropriate brilliancy control signals, including Command On input (if programmed for separate ‘Command On’)
	Faulty or disconnected 40 way ribbon cable between the AT533 and AT662A / AT925 Cards	Replace or re-connect ribbon cable
Regulator does not respond to Remote Analogue Brilliancy Input signal	Keypad rotary switch SW1 not in Remote position	Turn switch to Remote position
	Incorrect remote control configuration selected	Check operating mode selected for Remote Control, see Section 8.3.2.2.
	Fault on external Command signal	Check wiring. See Section 3.3
	Incorrect calibration and threshold set-up for Remote Analogue Brilliancy Input	Refer to Section 9.3.2 to calibrate the input, and Section 8.4.2.3 to set the threshold points.
	Fault on external analogue signal	Check analogue control signal is present on terminals 27 and 28 of the AT662A / AT925 RIO Card
	Faulty or disconnected 40 way ribbon cable between the AT533 and AT662A / AT925 Cards	Replace or re-connect ribbon cable

PROBLEM	POSSIBLE CAUSE	CORRECTIVE MAINTENANCE
Regulator switches to fewer than expected brilliancy levels in response to remote brilliancy signals	Incorrect Remote Control configuration	Check operating mode selected for Remote Control, see Section 8.3.2.2
	Fault on external brilliancy control signals	Check switching of all appropriate remote brilliancy control signals. Refer to Section 3.3
	Faulty or disconnected 40 way ribbon cable between the AT533 and AT662A / AT925	Replace or re-connect ribbon cable
When a brilliancy level is selected the regulator operates briefly before tripping and then displays the 'Open Circuit' fault.	Blown semiconductor protection ultra-rapid fuse F7 (located next to thyristor, on heatsink). Note – this fuse is not included on most IEC spec regulators.	Check for earth fault before replacing.
	Circuit characteristics (causing resonance for example) causes capacitive current detection circuitry to trip CCR even with AGL circuit conducting normally	Capacitive current detection circuitry should be de-sensitised by adjusting VR3 on AT533 card. See Section 9.3.4.3. After adjusting VR3 to allow the circuit to stay on, check if all lamps on the circuit are operating normally. If a portion of the lamps are not operating, this would indicate that there is in fact a break in the AGL circuit which should be repaired. VR3 on the AT533 should then put back to its original setting.
	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.
	Open Circuit / discontinuity on AGL series loop circuit.	Switch off the power to the regulator. Connect a shorting link between the regulator output terminals S1 and S2, in place of the AGL circuit. Switch back on; If the regulator operates correctly with the output shorted, the problem is with the AGL series circuit which should be repaired.
	Loose or broken connections.	Shut off power to regulator and check all wiring connections for tightness.
	Faulty thyristor.	Shut off power to regulator and check thyristor. Replace if faulty.
	Incorrect voltage selector tappings on Main CCR Output Transformer T101	Adjust as described in Section 4.3 .
The CCR trips out and the fault message 'CAP/ASYM CURRENT/WATCHDOG' is displayed. This can indicate a trip of the CCR due to 'capacitive current' detection.	Could be an open circuit series loop fault but with current continuing to flow through the capacitance of the earth sheath of a screened airfield primary series loop cable. If the AGL circuit is not open circuited, then the capacitive current detection circuit is too sensitive for the installation.	De-sensitize the capacitive current detection circuit as described in Section 9.3.4.3

PROBLEM	POSSIBLE CAUSE	CORRECTIVE MAINTENANCE
When a brilliancy level is selected the regulator operates briefly then displays 'Over Current' fault.	Incorrect Zero and Span calibration	Switch off the power to the regulator. Connect an in-line true RMS ammeter in place of the AGL circuit between the regulator output terminals S1 and S2. Check the regulator output current. If necessary, recalibrate the regulator as described in Section 9.2
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 screens.	Program this as described in Section 4.4.2

Table 11-1 CCR Fault Finding

11.1 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

This indicates that there has been corruption of data stored in the eeprom on the AT500 Microcontroller Card. Pressing the (↵ Enter) button – which is the only means to go past this screen - will load default operating parameters, thus requiring a full reprogramming and recalibration of the regulator. (Note – if default operating parameters are applied without recalibrating the regulator, the CCR will operate but with an extremely low output current, causing an 'Open Circuit' fault trip).

Providing that a record has been kept of the operating parameters and calibration factors 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). However, if the original Zero and Span calibration values for the particular regulator were not recorded, then a full recalibration will be required using a high quality true RMS ammeter, preferably of the in-line type. Refer to Section 9.2.2

Note – if the Microcontroller front panel assembly (including the AT500 Card) has been replaced, a full calibration will also be required. This is because of tolerances in the AT500 circuitry, which means that the calibration factors are matched to the particular circuit board.

Providing that the original circuit boards remain in place – the AT500 Microcontroller Card, and the AT533 Main Control Card - and that the 'CCR CAL' potentiometer on the AT533 has not been adjusted, then reloading the original Span Calibration factor should bring the CCR output current precisely back to the correct value without the need to perform a full recalibration.

Since the following process involves a partial recalibration of the regulator, then to prevent the possibility of damaging the AGL lamps in case of a current overload, it is advisable to disconnect the CCR from the AGL circuit. It is recommended either to connect a shorting link, or for a more accurate calibration, a resistive load bank to the output of the regulator, in place of the AGL circuit. (Follow the normal safety procedures for working on high voltage airfield lighting circuitry - 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 adjusted to suit. This will reduce the crest factor of the output waveform thus enabling the RMS converter IC's to operate more accurately, improving the accuracy of the calibration. (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.

However, if reprogramming has to be carried out with the AGL circuit connected (for example, if an Approved Person is not available to issue HT permits), then extreme caution must be exercised when calibrating the Span Point not to overshoot the original calibration factor value and cause a current overload. It is advisable to monitor the CCR output current on a true RMS ammeter to ensure that it does not exceed the rated level.

The following is a list of the main CCR operating parameters, which should be reprogrammed in the sequence described below.

Hardware Configuration Menu:
FULL LOAD I - (Note – the default value is 6.6A)
CALIBRATE ZERO POINT - (Press the (↵ Enter) button after loading the correct value)
CALIBRATE SPAN POINT - (Load the correct value and wait for a few seconds for the current to stabilise then press the (↵ Enter) button)
EARTH LEAK DET - (Requires optional earth leakage measurement card set to be fitted)
DISPLAY OP V - (If optional AT642D PLF card fitted)
ENT TX OP VOLTS - (If optional AT642D PLF card fitted. Load the original transformer tapping voltage, not the temporary setting which may be used for the reprogramming procedure)

Set-up Menu:
REMOTE CONTROL CONFIG?
BRILL LEVELS
BLACK HEAT - (If required)
SET USER CURRENT LEVELS? - (If User Defined ‘BRILL LEVELS’ selected)
EARTH LEAKAGE STAGE 1 - (If ‘EARTH LEAK DET’ used, and default threshold level not suitable)
EARTH LEAKAGE STAGE 2 - (If ‘EARTH LEAK DET’ used, and default threshold level not suitable)

If the following functions are used, it will be necessary to return to the Hardware Configuration Menu.

Hardware Configuration Menu:
BLACK HEAT - (If ‘BLACK HEAT’ selected, and the default current setting is not suitable, set the current level)
SET USER TOL LEVELS - (If User Defined ‘BRILL LEVELS’ selected)
% LAMP FAIL - (If optional AT642D PLF card fitted. Note - if ‘ANALOGUE’ type selected, the sub-menus will also require programming, and PLF calibration will be necessary)

After completing this procedure, ensure that the CCR power transformer secondary taps – if they were altered - are put back to the original settings.

11.2 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 REPROGRAMMED AFTER A LOSS OF PARAMETERS, IT IS NECESSARY FIRST OF ALL TO PROGRAMME THE FOLLOWING PARAMETERS FROM THE HARDWARE CONFIGURATION MENU:

1. FULL LOAD I - PROGRAMME THE NOMINAL CCR OUTPUT CURRENT, IF DIFFERENT FROM THE DEFAULT VALUE OF 6.60A
2. CALIBRATE ZERO POINT
3. CALIBRATE SPAN POINT

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'. Press the (↑) button to display the password entry screen '* * *', press (Enter) to show 'a a a'.

Enter the correct password one letter at a time using the (↑) (↓) buttons to scroll up and down the alphabet, and then press the (Enter) button. The default password is 'atg'. If the password is loaded correctly, the display will show 'YYY'.

Press (Enter) and the screen will change to the first of the set-up screens. It is now possible to scroll through the menu using the (↑) (↓) buttons; scroll down (↓) to reach the following screens.

Pressing the (Enter) button will permit modifications to the parameters for the selected screen. The left-hand arrow will move to the second line, and then pressing the (↑) or (↓) buttons will scroll through the available parameter settings.

Pressing (Enter) will load the new parameter, or pressing the (X Clear) button will quit without loading the changes.

To exit the Set-up menu press the (X Clear) button, and at the exit confirmation screen, press the (Enter) button.

Refer to Section 8.3 for more detailed information on the menu structure.

NOTE - THE PARAMETERS / ROWS WITH THE SHADED BACKGROUND ARE THOSE MOST COMMONLY CHANGED FROM DEFAULT. THOSE SCREENS MARKED * ARE ONLY AVAILABLE WHEN THAT FUNCTION IS SELECTED IN THE HARDWARE CONFIGURATION MENU.

PARAMETER	DESCRIPTION	DEFAULT SETTING	SETTING USED (IF CHANGED FROM DEFAULT)
HOURS RUN RESET?	Reset the hours run data	N/A	
REMOTE CONTROL CONFIG?	Select method of remote control (3 Wire, 3 Wire & Command, BCD, BCD & Command, BCD (Option 2), BCD (Option 2) & Command, 8 Wire, 8 Wire & Command, Analogue IP, Analogue IP & Command, Serial Communications)	8 WIRE	
COMMS ADDRESS	Select Address of unit for serial communications (Only required if 'Communication' selected for remote control)	255 (not selected)	

COMMS FAULT ACTION		Select the action to be taken in the case of a communications fault. (Only available if 'Communication' selected for remote control)	CCR OFF			
SET CCT SEL FLT 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			
COMMS FAULT TIME		Select the delay time (in seconds) before the Communications fault is raised. (Only available if 'Communication' selected for remote control)	5 S			
BRILL LEVELS		Select (UK) CAP168, FAA / IEC Style 1, FAA / IEC Style 2 User Defined or User Def. DOE. brilliancy levels	(UK) CAP 168			
BLACK HEAT		Enable/ Disable Black Heat operation	DISABLED			
TOLERANCE MON		Enable/ Disable internal Tolerance Monitoring Unit	ENABLED			
SET USER CURRENT LEVELS?		When User Defined Brilliancy Levels are selected, allows adjustment of the current levels. (Note - the default levels are those of UK CAP 168).	N/A			N/A
	Set User Levels	CCR OUTPUT CURRENT RATING	6.0A	6.6A	12A	
		MAX	6.00	6.60	12.00	
		STEP 7 / DOE STEP 2	5.73	6.30	11.45	
		STEP 6 / DOE STEP 3	4.86	5.35	9.72	
		STEP 5 / DOE STEP 4	4.14	4.55	8.28	
		STEP 4 / DOE STEP 5	3.54	3.89	7.08	
		STEP 3 / DOE MIN	3.06	3.37	6.12	
		STEP 2 / DOE N/A	2.64	2.90	5.28	
		MIN / DOE N/A	2.34	2.57	4.68	
EARTH LEAKAGE STAGE 1		Select the threshold of resistance for the 1st stage Earth Leakage Alarm.	10 MΩ			
EARTH LEAKAGE STAGE 2		Select the threshold of resistance for the 2nd stage Earth Leakage Alarm / Trip.	200 kΩ			
CHANGE SET-UP PASSWORD?		Enter new Set-up password	atg			
CCR HARDWARE CONFIG?		To access the CCR Hardware Configuration menu, enter the password one letter at a time	eng			

HARDWARE CONFIGURATION MENU

The CCR Hardware Configuration Menu is accessed from the Set-up Menu by the use of a password, as described below.

From the Set-up menu, scroll through the menu using the (↑) (↓) buttons to reach the CCR Hardware Config password entry screen (it is in fact the first screen up after entering the Hardware Config menu).

Enter the password 'eng' one letter at a time using the (↑) (↓) buttons to scroll up and down the alphabet, and then press the (Enter) button.
If the password is loaded correctly, the display will show 'YYY'. Press (Enter) and the screen will change to the first of the Hardware Configuration screens. It is now possible to scroll through the menu using the (↑) (↓) buttons.

Pressing the (Enter) button will permit modifications to the parameters for the selected screen. The left-hand arrow will move to the second line, and then pressing the (↑) or (↓) buttons will scroll through the available parameter settings.

Pressing (Enter) will load the new parameter, or pressing the (X Clear) button will quit without loading the changes.

To exit the Hardware Config menu and go back to the Set-up menu press the (X Clear) button. To exit the Set-up menu press the (X Clear) button again, and at the exit confirmation screen, press the (Enter) button.

Refer to Section 8.4 for more detailed information on the menu structure.

PARAMETER	DESCRIPTION	DEFAULT SETTINGS	SETTING USED
FULL LOAD I	Select nominal CCR output current. Available settings are 6.0, 6.6, 12 and 20A. NOTE - IF THE (ENTER) BUTTON IS PRESSED BY MISTAKE TO ACCESS THE SCREEN (MOVING THE CURSOR TO THE BOTTOM LINE) PRESS THE X (CLEAR) BUTTON TO EXIT. PRESSING (ENTER) AGAIN, EVEN WITHOUT CHANGING THE CURRENT SETTING, WOULD DELETE THE CALIBRATION FACTORS THUS REQUIRING RECALIBRATION OF THE CCR	6.6A	
FIRMWARE VERSION	Displays the version of the CPU firmware	N/A	
ANALOGUE I/P SETUP	Configure operation of Remote Analogue Brilliancy control. (Note - this function is rarely used).		
BLACK HEAT	Set the Black Heat current level	6.0A FLC = 1.5A 6.6A FLC = 1.5A 12A FLC = 2.5A 20A FLC = 5.75A	
% LAMP FAIL TIME	Set the delay time (seconds) before the Percentage Lamp Failure alarm is raised	15 S	
TOL MON FAIL TIME	Set the delay time (seconds) before an Out Of Tolerance alarm is raised	15 S	

SET USER TOL LEVELS	When User Defined Brilliancy Levels are selected, allows adjustment of the Tolerance Monitoring alarm threshold levels	N/A			N/A
	CCR OUTPUT CURRENT RATING	6.0A	6.6A	12A	
	OVER TOL 8 / DOE - OVER TOL MAX	6.09	6.70	12.18	
	UNDER TOL 8 / DOE - UNDER TOL MAX	5.82	6.40	11.64	
	OVER TOL 7 / DOE - OVER TOL 2	5.78	6.36	11.56	
	UNDER TOL 7 / DOE - UNDER TOL 2	5.64	6.20	11.27	
	OVER TOL 6 / DOE - OVER TOL 3	5.23	5.76	10.47	
	UNDER TOL 6 / DOE - UNDER TOL 3	4.78	5.26	9.56	
	OVER TOL 5 / DOE - OVER TOL 4	4.36	4.80	8.73	
	UNDER TOL 5 / DOE - UNDER TOL 4	3.82	4.20	7.64	
	OVER TOL 4 / DOE - OVER TOL 5	3.68	4.05	7.36	
	UNDER TOL 4 / DOE - UNDER TOL 5	3.36	3.70	6.72	
	OVER TOL 3 / DOE - OVER TOL MIN	3.25	3.58	6.51	
	UNDER TOL 3 / DOE - UNDER TOL MIN	2.96	3.26	5.92	
	OVER TOL 2 / DOE - N/A	2.89	3.18	5.78	
	UNDER TOL 2 / DOE - N/A	2.51	2.76	5.01	
	OVER TOL 1 / DOE - N/A	2.41	2.65	4.82	
	UNDER TOL 1 / DOE - N/A	2.17	2.39	4.34	
CALIBRATE ZERO POINT	Calibrate the zero point for the control loop. IMPORTANT - IF ACCESSING THIS MENU JUST IN ORDER TO MAKE A RECORD OF THE CALIBRATION FACTOR, EXIT BY PRESSING THE 'X CLEAR' BUTTON. THIS WILL EXIT WITHOUT ALTERING THE CALIBRATION.				
CALIBRATE SPAN POINT	Calibrate the span point for the current control loop. (Note - the CCR will run at full output current during this procedure). IMPORTANT - IF ACCESSING THIS MENU JUST IN ORDER TO MAKE A RECORD OF THE CALIBRATION FACTOR, EXIT BY PRESSING THE 'X CLEAR' BUTTON. THIS WILL EXIT WITHOUT ALTERING THE CALIBRATION.				
TEST OVERCURRENT TRIP POINT	Test use only - not to be used on live circuit	N/A			N/A
BRILL BI ON FLT ENABLED	Configure the brilliancy back indication to be active or inactive when a fatal alarm is present (only applicable if non-standard I^2C Back Indication option card fitted).	DISABLED			
EARTH LEAK DET	Configure the earth leakage detection type to be Digital, Analogue, Continuous Analogue or Disabled. Note - requires the optional AT699 Earth Leakage Detection card to be fitted for this function to operate	DISABLED			

TRIP ON EARTH 2	Configure the stage 2 Earth Leakage detector to give an alarm and continue to run (disabled), or to shutdown (trip) the CCR (enabled)	ENABLED		
ALARM MULT BRIL	Enable/ Disable the alarm which alerts if an illegal combination of remote control inputs is detected	ENABLED		
OP START 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		
ST RAMP TIME	Set the Start Up Current Ramp time. (Only available if Start Up Ramp is enabled)	600ms		
CCT SELECTOR	Disables (internal) CSS operation or allows selection of Alternate or Multiway (2 to 6 way) CSS	DISABLED		
CCT SEL TIME	Set the changeover switching time before re-energisation of the internal circuit selector. Allows selection of Slow Contactor (500ms), 300ms, 250ms, 200ms, 150ms, 100ms or Vacuum Relay (15ms). (Screen only available when circuit selector is enabled)	SLOW CONTACTOR		
SET CCT SEL LOGIC?	Select normally open or normally closed logic for correct fail safe modes for each circuit of Multiway Circuit Selector	N/Op	1, 2, 3, 4, 5, 6	
		N/Cl		
C/S TURN OFF CCR	Allows the Circuit Selector control logic to turn off the CCR when all circuits are selected to off. (Available when Multiway (2 to 6 way) Circuit Selector is enabled)	ENABLED		
C/S PCB TYPE	Allows selection of the Multi-Way Circuit Selector Back Indication Current Detection philosophy, depending on the PCB type fitted.	AT661C ONWARD		
% LAMP FAIL	Enable Percentage Lamp Failure monitoring; Analogue (with auto calibration) is recommended, or for the early Micro 100 regulators, 1 Stage or 2 Stages. Note - requires the optional PLF card to be fitted for this function to operate	DISABLED		
NUM OF LAMPS	If 'Analogue IP' PLF monitoring is selected, this screen becomes available and is used to enter the total number of lamps on the AGL circuit	100		
PLF LIMIT 1	Enter the threshold for the number of failed lamps to trigger a Stage-1 alarm. (Only available if 'Analogue IP' PLF monitoring is selected). There will be a warning screen regarding calibration	5 (5%)		
PLF LIMIT 2	Enter the threshold for the number of failed lamps to trigger a Stage-2 alarm. (Only available if 'Analogue IP' PLF monitoring is selected). There will be a warning screen regarding calibration	10 (10%)		

CALIBRATE PLF INPUT		Calibration screens for PLF. (Only available if 'Analogue IP' PLF monitoring is enabled)	N/A	N/A
	SELECT LEVEL	Select which PLF alarm threshold points are to be calibrated - level ONE (low) or TWO (high)	ONE	
	NUM OPEN CCT LAMPS	Enter the number of lamp fittings which will be open circuited for calibration of this threshold level. After pressing enter, a 'CCR will start' warning will be displayed, followed by 'Press (enter) to capture' ie, calibrate	5	
	SELECT LEVEL	Select which PLF alarm threshold points are to be calibrated - level ONE (low) or TWO (high)	TWO	
	NUM OPEN CCT LAMPS	Enter the number of lamp fittings which will be open circuited for calibration of this threshold level. After pressing enter, a 'CCR will start' warning will be displayed, followed by 'Press (enter) to capture' ie, calibrate	10	
DISPLAY OP V		If the optional AT642D PLF Card is fitted, enables display of the CCR output voltage.	DISABLED	
ENT TX OP VOLTS		Enter the total main transformer output voltage as connected (sum of each winding section connected). (Only available if 'Display OP V' is enabled)	0001V	V
KVA ALARM		If enabled, an alarm screen is displayed if there is a 10% or greater drop in the volt-amperes being delivered to the series loop circuit. (Only available if 'Voltage Feedback' is enabled)	DISABLED	
AENA OUTPUTS		Enables AENA I/O configuration (for Spanish market)	DISABLED	

Table 11-2 CCR Parameter Record Sheet

12 Parts Listings and Circuit Schematic

Table 12-1 to Table 12-10 provide a list of all major components fitted the 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 100 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 12-6 for the quantities of each fitted; it is recommended to 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, 7400-1533A 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 100 CCRs use the AT533 Control Card (stock number 7400-1533A), 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 in order to determine whether it should be included in the list of recommended spares.

On the other hand, the Micro 100 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				480V SERIES, 6.6A OUTPUT		
CCR RATING, kVA	MANUFACTURER	ATG AIRPORTS STOCK CODE		CCR RATING, kVA	MANUFACTURER	ATG AIRPORTS STOCK CODE
1	ATG AIRPORTS	2690-0674		1	ATG AIRPORTS	2690-0699
2.5	ATG AIRPORTS	2690-0675		2.5	ATG AIRPORTS	2690-0700
4	ATG AIRPORTS	2690-0676		4	ATG AIRPORTS	2690-0701
5	ATG AIRPORTS	2690-0677		5	ATG AIRPORTS	2690-0702
7.5	ATG AIRPORTS	2690-0678		7.5	ATG AIRPORTS	2690-0703
10	ATG AIRPORTS	2690-0679		10	ATG AIRPORTS	2690-0704
12.5	ATG AIRPORTS	2690-0680		12.5	ATG AIRPORTS	2690-0705
15	ATG AIRPORTS	2690-0681		15	ATG AIRPORTS	2690-0706
20	ATG AIRPORTS	2690-0682		20	ATG AIRPORTS	2690-0707
25	ATG AIRPORTS	2690-0683		25	ATG AIRPORTS	2690-0708
30	ATG AIRPORTS	2690-0684		30	ATG AIRPORTS	2690-0709

Table 12-1 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 100 MICROCONTROLLER FRONT PANEL	ATG AIRPORTS	7500-2020K	7500-2020K	B
FP	D	1	FRONT PANEL	ALTERNATE CIRCUIT SELECTOR MICRO 100 MICROCONTROLLER FRONT PANEL	ATG AIRPORTS	7500-2021K	7500-2021K	B
FP	2W	1	FRONT PANEL	2W SIMULTANEOUS CIRCUIT SELECTOR MICRO 100 MICROCONTROLLER FRONT PANEL	ATG AIRPORTS	7500-2022K	7500-2022K	B
FP	3W	1	FRONT PANEL	3W SIMULTANEOUS CIRCUIT SELECTOR MICRO 100 MICROCONTROLLER FRONT PANEL	ATG AIRPORTS	7500-2023K	7500-2023K	B
FP	4W	1	FRONT PANEL	4W SIMULTANEOUS CIRCUIT SELECTOR MICRO 100 MICROCONTROLLER FRONT PANEL	ATG AIRPORTS	7500-2024K	7500-2024K	B
FP	5W	1	FRONT PANEL	5W SIMULTANEOUS CIRCUIT SELECTOR MICRO 100 MICROCONTROLLER FRONT PANEL	ATG AIRPORTS	7500-2025K	7500-2025K	B
FP	6W	1	FRONT PANEL	6W SIMULTANEOUS CIRCUIT SELECTOR MICRO 100 MICROCONTROLLER FRONT PANEL	ATG AIRPORTS	7500-2026K	7500-2026K	B
AT533D		1	PCB	MAIN CONTROL CARD	ATG AIRPORTS	AT533D	7400-1533A	B
AT558C		1	PCB	CT FILTER CARD	ATG AIRPORTS	AT558C	7400-1558A	C
AT637	2W/3W/4W/5W/6W	1	PCB	SIMULTANEOUS / MULTIWAY CIRCUIT SELECTOR SWITCH CARD	ATG AIRPORTS	AT637	7400-1637A	
AT642D	LF, FAA L-829	1	PCB	PERCENTAGE LAMP FAILURE CARD	ATG AIRPORTS	AT642D	7400-1642A	C
AT657	D	1	PCB	DIRECTION / ALTERNATE CIRCUIT SELECTOR CARD	ATG AIRPORTS	AT657A	7400-1657A	PART OF 7500-2021K
AT661C	2W/3W/4W/5W/6W	1	PCB	SIMULTANEOUS / MULTIWAY CIRCUIT SELECTOR CONTROL CARD	ATG AIRPORTS	AT661C	7400-1661A	B
AT662	24/48	1	PCB	RELAY I/O CARD (STANDARD IEC SPECIFICATION)	ATG AIRPORTS	AT662A	7400-1662A	B
AT663A	2W/3W/4W/5W/6W	1	PCB	SIMULTANEOUS / MULTIWAY CIRCUIT SELECTOR RELAY I/O CARD	ATG AIRPORTS	AT663A	7400-1663A	B
AT683	JS	1	PCB	J-BUS / MODBUS RTU COMMUNICATION 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
AT728	PS	1	PCB	DUAL PROFIBUS COMMUNICATION CARD	ATG AIRPORTS	AT728	7400-1728A	B
AT753	FAA, IPSA	1	PCB	INPUT SURGE ARRESTOR (415V)	ATG AIRPORTS	AT753	7400-1753A	B
AT754	FAA, IPSA	1	PCB	INPUT SURGE ARRESTOR (240V)	ATG AIRPORTS	AT754	7400-1754A	B
AT820	FAA, IPSA	1	PCB	INPUT SURGE ARRESTOR (500V)	ATG AIRPORTS	AT820	7400-1820A	B
AT925	FAA 24/48	1	PCB	RELAY I/O CARD (FAA SPECIFICATION)	ATG AIRPORTS	AT925	7400-1925A	B
AT1026	FCI	1	PCB	CUTOUT SWITCH RELAY CARD	ATG AIRPORTS	AT1026	7410-1026	B
AT1056	MTS	1	PCB	MODBUS TCP / IP COMMUNICATION CARD	ATG AIRPORTS	AT1056	7400-1056	B

Table 12-2 Parts List: Circuit Boards, including optional

CONTROL TRANSFORMERS - ALL BUILD STANDARDS						SPARES CATEGORY	220V SERIES - QUANTITY								400V SERIES - QUANTITY										480V SERIES - QUANTITY										
REF	PRI. VOLTS	SEC VOLTS AND VA	MFTR	MFTR P/N	ATG AIRPORTS STOCK CODE		1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA
T102	0-208-220-240V	18/0/18v (22VA) TO AT533, 0-220v (22VA) TO AT500, 15/0/15v (12VA) TO AT699, 0-20v (3VA) SPARE	DOUGLAS TRANSFORMERS	M5978	2690-0020	C	1	1	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	1	1																					
T102	0-380-415-440V	18/0/18v (22VA) TO AT533, 0-220v (22VA) TO AT500, 15/0/15v (12VA) TO AT699, 0-20v (3VA) SPARE	DOUGLAS TRANSFORMERS	M5866	2690-0013	C									1	1	1	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	1	1	1										
T102	0-460-480-500V	18/0/18v (22VA) TO AT533, 0-220v (22VA) TO AT500, 15/0/15v (12VA) TO AT699, 0-20v (3VA) SPARE	DOUGLAS TRANSFORMERS	M5986	2690-0072	C																				1	1	1	1	1	1	1	1	1	1
T105	0-460-480-500V	18/0/18 (22VA) TO AT712A RIO CARD, 0-9v (6VA) TO PROFIBUS / MODBUS / J-BUS CARD	DOUGLAS TRANSFORMERS	M5987	2690-0075	C																				1	1	1	1	1	1	1	1	1	1

Table 12-3 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	M6545	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	M6546	2690-0017	C
480V SERIES									
T106	2W/3W/4W/ 5W/6W	1	CONTROL SUPPLY FOR AT661 MULTIWAY CIRCUIT SELECTOR CARD	0-460-480-500V	0-18v (24VA), 0-18v (12VA), 0-9v (6VA)	DOUGLAS TRANSFORMERS	M6300	2690-0016	C
T107	D	1	CONTROL SUPPLY FOR AT657 DIRECTION / ALTERNATE CIRCUIT SELECTOR CARD	0-460-480-500V	0-18v (12VA)	DOUGLAS TRANSFORMERS	M6299	2690-0018	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 12-4 Parts List: Control Transformers for options; 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 EXC. LA, FAA	2 - 7	TERMINAL	STANDARD CCR OUTPUT TERMINAL	125A	WEIDMULLER	WFF 35	2720-0071	
COVER	ALL EX. LA, FAA	4 - 14		TERMINAL COVER		WEIDMULLER	WAH 35	2720-0075	
LIGHTNING ARRESTOR	LA, FAA	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 12-5 Parts List: Output Terminals, Cutout Switch, Lightning Arrestors and CSS Relays

FUSES							SPARES CATEGORY	220V SERIES - QUANTITY. F2/F4=NUETRAL LINK ON SINGLE PHASE (L-N) MODELS. 2 PHASE MODEL QTY IN (-)								400V SERIES - QUANTITY											480V 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	12.5kVA	15kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA
FUSES FOR IEC BUILD STANDARD																																				
F1, F2	HOLDER (10x38mm	N/A	N/A	SIBA	5106304.2	2720-0090		1	1	1						1	1	1	1	1							1	1	1	1	1						
F1, F2	gG FUSE, 10x38mm	500V	6A	SIBA	5006308.6A	2550-0406	A									2											2										
F1, F2	gG FUSE, 10x38mm	500V	10A	SIBA	5006308.10A	2550-0407	A	1 (2)									2											2									
F1, F2	gRL FUSE, 10x38mm	500V	20A	SIBA	6003434.20A	2550-0320	A		1 (2)									2	2										2	2							
F1, F2	gRL FUSE, 10x38mm	500V	30A	SIBA	6003434.30A	2550-0330	A			1 (2)										2											2						
F1, F2	HOLDER, 22x58mm	N/A	N/A	SIBA	5106004.2	2720-0092					1	1	1	1	1						1	1	1	1	1	1						1	1	1	1	1	1
F1, F2	gRL FUSE, 22x58mm	690V	40A	SIBA	5014034.40A	2550-0440	A				1 (2)										2											2					
F1, F2	gRL FUSE, 22x58mm	690V	50A	SIBA	5014034.50A	2550-0350	A															2											2				
F1, F2	gRL FUSE, 22x58mm	690V	63A	SIBA	5014034.63A	2550-0363	A					1 (2)											2											2			
F1, F2	gRL FUSE, 22x58mm	690V	80A	SIBA	5014034.80A	2550-0380	A						1 (2)											2											2		
F1, F2	gG FUSE, 22x58mm	500V	100A	SIBA	5006008.100A	2550-0416	A							1 (2)											2										2	2
F1, F2	gG FUSE, 22x58mm	400V	125A	SIBA	5006008.125A	2550-0417	A								1 (2)											2										

FUSES							SPARES CATEGORY	220V SERIES - QUANTITY. F2/F4=NUETRAL LINK ON SINGLE PHASE (L-N) MODELS. 2 PHASE MODEL QTY IN (-)								400V SERIES - QUANTITY										480V 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	12.5kVA	15kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA
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	1	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)	1 (2)	1 (2)	1 (2)	1 (2)	1 (2)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
F7	aR FUSE, 35 x 85mm	690V	180A	SIBA	5007406.180A	2550-0180	A							1	1										1	1									1	1
F2, F4	NUETRAL LINK, 10x38mm	N/A	N/A	SIBA	5006308.N	2550-0402		2 (0)	2 (0)	2 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)																					
F2	NUETRAL LINK, 22x58mm	N/A	N/A	SIBA	5006008.N	2550-0404		0 (0)	0 (0)	0 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)																					
FUSES FOR FAA BUILD STANDARD																																				
F1, F2	HOLDER, 10x38mm	N/A	N/A	SIBA	5106304.2	2720-0090		1	1							1	1	1	1								1	1	1	1	1						
F1, F2	gG FUSE, 10x38mm	500V	6A	SIBA	5006308.6A	2550-0406	A									2											2										
F1, F2	gG FUSE, 10x38mm	500V	10A	SIBA	5006308.10A	2550-0407	A	1 (2)									2											2									
F1, F2	gG FUSE, 10x38mm	500V	16A	SIBA	5006308.16A	2550-0408	A											2											2	2							
F1, F2	gG FUSE, 10x38mm	500V	20A	SIBA	5006308.20A	2550-0409	A		1 (2)										2																		
F1, F2	gG FUSE, 10x38mm	500V	25A	SIBA	5006308.25A	2550-0410	A																							2							
F1, F2	HOLDER, 22x58mm	N/A	N/A	SIBA	5106004.2	2720-0092				1	1	1	1	1	1					1	1	1	1	1	1	1					1	1	1	1	1	1
F1, F2	gG FUSE, 22x58mm	690V	32A	SIBA	5006008.32A	2550-0411	A			1 (2)										2											2						

FUSES							SPARES CATEGORY	220V SERIES - QUANTITY. F2/F4=NUETRAL LINK ON SINGLE PHASE (L-N) MODELS. 2 PHASE MODEL QTY IN (-)								400V SERIES - QUANTITY											480V 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	12.5kVA	15kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA
F1, F2	gG FUSE, 22x58mm	690V	40A	SIBA	5006008.40A	2550-0412	A				1 (2)										2												2				
F1, F2	gG FUSE, 22x58mm	690V	50A	SIBA	5006008.50A	2550-0413	A															2												2			
F1, F2	gG FUSE, 22x58mm	690V	63A	SIBA	5006008.63A	2550-0414	A					1 (2)											2														
F1, F2	gG FUSE, 22x58mm	690V	80A	SIBA	5006008.80A	2550-0415	A						1 (2)											2											2		
F1, F2	gG FUSE, 22x58mm	500V	100A	SIBA	5006008.100A	2550-0416	A							1 (2)											2										2	2
F1, F2	gG FUSE, 22x58mm	400V	125A	SIBA	5006008.125A	2550-0417	A								1 (2)											2										
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	1	1	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)	1 (2)	1 (2)	1 (2)	1 (2)	1 (2)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
F7	aR FUSE, 17.5 x 63.5 mm	690V	40A	SIBA	5007306.40A	2550-0040	A	1	1	1						1	1	1	1	1							1	1	1	1	1						
F7	aR FUSE, 17.5 x 63.5 mm	690V	80A	SIBA	5007306.80A	2550-0053	A				1	1									1	1	1									1	1	1			
F7	aR FUSE, 17.5 x 63.5 mm	690V	100A	SIBA	5007306.100A	2550-0100	A						1											1											1		
F7	aR FUSE, 35 x 85mm	690V	180A	SIBA	5007406.180A	2550-0180	A							1	1										1	1									1	1
F2, F4	NUETRAL LINK, 10x38mm	N/A	N/A	SIBA	5006308.N	2550-0402		2 (0)	2 (0)	2 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)																						

FUSES							SPARES CATEGORY	220V SERIES - QUANTITY. F2/F4=NUETRAL LINK ON SINGLE PHASE (L-N) MODELS. 2 PHASE MODEL QTY IN (-)							400V SERIES - QUANTITY									480V 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	12.5kVA	15kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA
F2	NUETRAL LINK, 22x58mm	N/A	N/A	SIBA	5006008.N	2550-0404		0 (0)	0 (0)	0 (0)	1 (0)	1 (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. ALL FUSEHOLDERS DUAL TYPE.

FUSE TYPES:

gG	GENERAL LINE FUSE
gRL	COMBINED LINE AND SEMICONDUCTOR PROTECTION FUSE
aR	ULTRA HIGH SPEED SEMICONDUCTOR PROTECTION FUSE (FITTED TO THYRISTOR STACK ASSEMBLY; ABOVE PART NUMBERS FOR REPLACEMENT FUSES ONLY)

Table 12-6 Parts List: Fuses

CIRCUIT BREAKERS / MCB'S - OPTIONAL, IN PLACE OF LINE FUSES. COMBINED WITH ULTRA HIGH SPEED SEMICONDUCTOR PROTECTION FUSE. (NOTE - MCB'S NOT AVAILABLE ABOVE 10KVA ON 220V SERIES, OR ABOVE 20KVA ON 400V SERIES, AND NOT AVAILABLE ON 480V SERIES)							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	12.5kVA	15kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA
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					
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)											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			
F3, F4	gG FUSE, 10x38mm	500V	2A	SIBA	5006308.2A	2550-0302	A	1 (2)	1 (2)	1 (2)	1 (2)	1 (2)				2	2	2	2	2	2	2	2			

CIRCUIT BREAKERS / MCB'S - OPTIONAL, IN PLACE OF LINE FUSES. COMBINED WITH ULTRA HIGH SPEED SEMICONDUCTOR PROTECTION FUSE. (NOTE - MCB'S NOT AVAILABLE ABOVE 10KVA ON 220V SERIES, OR ABOVE 20KVA ON 400V SERIES, AND NOT AVAILABLE ON 480V SERIES)							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	12.5kVA	15kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA
F7	aR FUSE, 17.5x63.5mm	690V	40A	SIBA	5007306.40A	2550-0040	A	1	1	1						1	1	1	1	1						
F7	aR FUSE, 17.5x63.5mm	690V	80A	SIBA	5007306.80A	2550-0053	A				1	1									1	1	1			
F7	aR FUSE, 17.5x63.5mm	690V	100A	SIBA	5007306.100A	2550-0100	A																			
F7	aR FUSE, 35 x 85mm	690V	180A	SIBA	5007406.180A	2550-0180	A																			
F2, F4	NEUTRAL LINK, 10x38mm	N/A	N/A	SIBA	5006308.N	2550-0402		2 (0)	2 (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)														
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	12.5kVA	15kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA
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																										
aR - ULTRA HIGH SPEED SEMICONDUCTOR PROTECTION FUSE (FITTED TO THYRISTOR STACK ASSEMBLY; ABOVE PART NUMBERS FOR REPLACEMENT FUSES ONLY)																										

Table 12-7 Parts List: Circuit Breakers (optional, in place of line fuses)

EMC FILTERS - ALL BUILD STANDARDS							SPARES CATEGORY	220V SERIES - QUANTITY								400V SERIES - QUANTITY										480V SERIES - QUANTITY									
REF	COMP. TYPE	VOLT. RAT. (AC)	CURR . RAT.	MFTR	MFTR P/N	ATG AIRPORTS STOCK CODE		1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA
F101	EMC FILTER	520V	25A	SCHAFFNER	FN2410H-25-33	2620-0011		1	1							1	1	1	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									1	1	1			
F101	EMC FILTER	520V	100A	SCHAFFNER	FN2410H-100-34	2620-0026							1	1	1									1	1	1								1	1	1

Table 12-8 Parts List: EMC Filters

CONTACTORS AND COIL SUPPRESSORS - ALL BUILD STANDARDS. (NOTE - STOCK CODES 2610-xxxK INCLUDES THE CONTACTOR AND THE APPROPRIATE COIL SUPPRESSOR)							SPARES CATEGORY	220V SERIES - QUANTITY								400V SERIES - QUANTITY										480V 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	12.5kVA	15kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA
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, 230V AC COIL, SIZE S3	690V	100A	SIEMENS	3RT2045-1AL20	2610-0236K	C							1	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	CONTACTOR, 400V AC COIL, SIZE S2	690V	90A	SIEMENS	3RT2038-1AR60	2610-0104K	C																	1												
CB1	CONTACTOR, 400V AC COIL, SIZE S3	690V	100A	SIEMENS	3RT2045-1AR60	2610-0111K	C																		1	1										
CB1	COIL SUPPRESSOR, SIZE S0	240 - 400V	N/A	SIEMENS	3RT29 26-1CE00	2610-0109	C	1	1	1						1	1	1	1																	
CB1	COIL SUPPRESSOR, SIZE S2	240 - 400V	N/A	SIEMENS	3RT29 36-1CE00	2610-0103	C				1	1	1							1	1	1	1	1												
CB1	COIL SUPPRESSOR, SIZE S3	240 - 400V	N/A	SIEMENS	3RT2946-1CE00	2610-0112	C							1	1										1	1										
CB1	CONTACTOR, 500V AC COIL, SIZE S2	690V	55A	SIEMENS	3RT2035-1AQ20	2610-0249K	C																				1	1	1	1	1	1	1	1		
CB1	CONTACTOR, 500V AC COIL, SIZE S2	690V	90A	SIEMENS	3RT2038-1AQ20	2610-0223K	C																											1		
CB1	CONTACTOR, 500V AC COIL, SIZE S3	690V	100A	SIEMENS	3RT2045-1AQ20	2610-0251K	C																												1	1
CB1	COIL SUPPRESSOR, SIZE S2	400 - 600V	N/A	SIEMENS	3RT29 36-1CF00	2610-0245	C																				1	1	1	1	1	1	1	1		
CB1	COIL SUPPRESSOR, SIZE S3	400 - 600V	N/A	SIEMENS	3RT2946-1CF00	2610-0252	C																												1	1

Table 12-9 Parts List: Contactors

THYRISTOR STACK ASSEMBLIES - IEC BUILD STANDARD (NOTE - SEE BELOW FOR REPLACEMENT THYRISTORS)						SPARES CATEGORY	220V SERIES - QUANTITY								400V SERIES - QUANTITY										480V SERIES - QUANTITY									
COMP. TYPE	VOLT. RAT. (AC)	VA RATING	MFTR	MFTR P/N	ATG AIRPORTS STOCK CODE		1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA
THYRISTOR, HEATSINK AND SNUBBER	480V	7.5kVA	POWER PRODUCTS INT.	05-0361/10	7500-1750A		1	1	1						1	1	1	1	1							1	1	1	1	1						
THYRISTOR, HEATSINK AND SNUBBER	480V	15kVA	POWER PRODUCTS INT.	05-0362/10	7500-1751A					1	1									1	1	1									1	1	1			
THYRISTOR, HEATSINK AND SNUBBER	480V	20kVA	POWER PRODUCTS INT.	05-0362/20	7500-1752A							1											1											1		
THYRISTOR, HEATSINK, SNUBBER AND SEMICONDUCTOR FUSE	480V	30kVA	POWER PRODUCTS INT.	05-0330/10F	7500-1758A								1	1										1	1									1	1

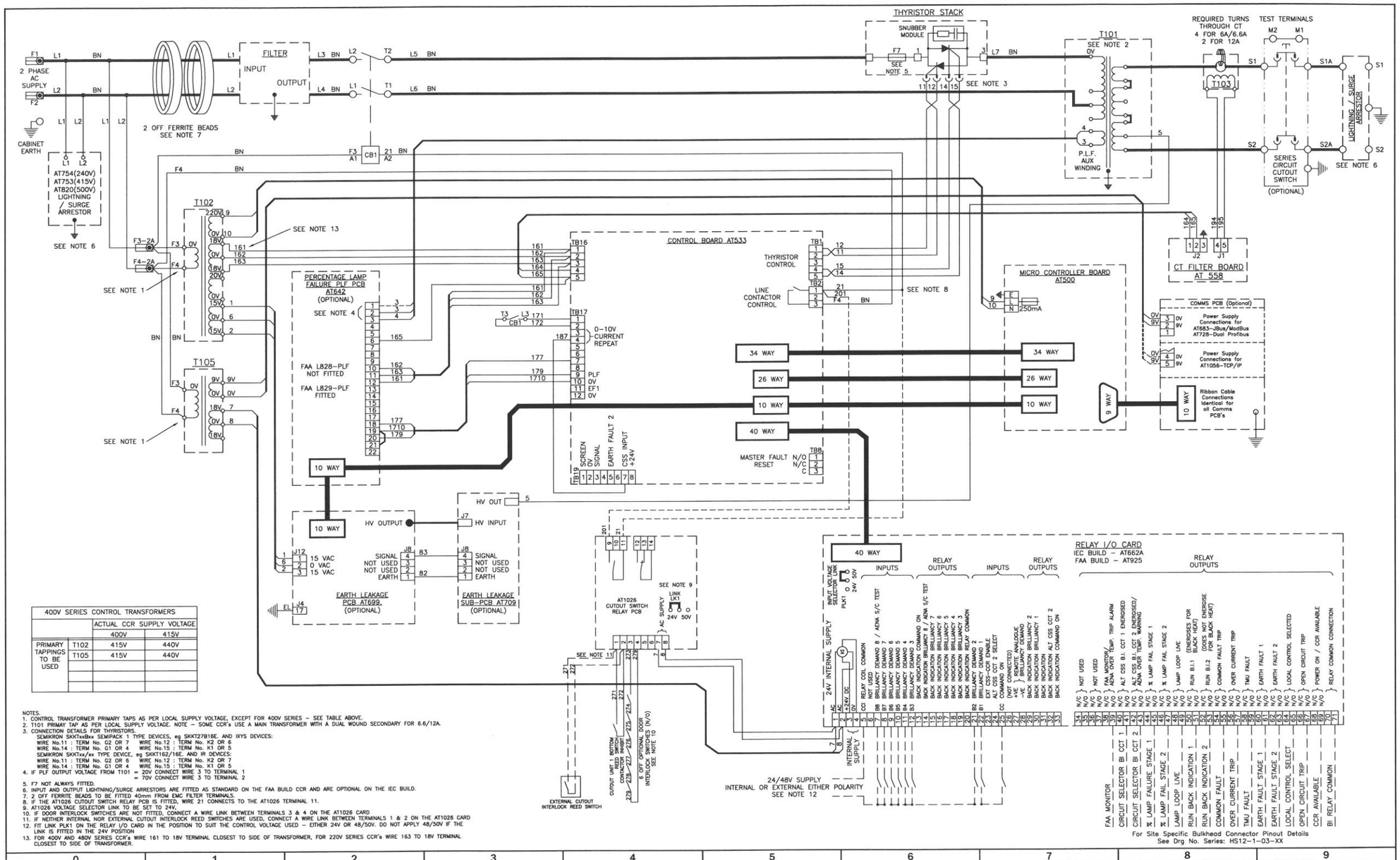
THYRISTOR STACK ASSEMBLIES - FAA BUILD STANDARDS (NOTE - SEE BELOW FOR REPLACEMENT THYRISTORS)							220V SERIES - QUANTITY								400V SERIES - QUANTITY										480V SERIES - QUANTITY									
COMP. TYPE	VOLT. RAT. (AC)	VA RATING	MFTR	MFTR P/N	ATG AIRPORTS STOCK CODE		1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA
THYRISTOR, HEATSINK, SNUBBER AND SEMICONDUCTOR FUSE	480V	7,5kVA	POWER PRODUCTS INT.	05-0328/10F	7500-1754A		1	1	1						1	1	1	1	1							1	1	1	1	1						
THYRISTOR, HEATSINK, SNUBBER AND SEMICONDUCTOR FUSE	480V	15kVA	POWER PRODUCTS INT.	05-0329/10F	7500-1755A					1	1									1	1	1									1	1	1			
THYRISTOR, HEATSINK, SNUBBER AND SEMICONDUCTOR FUSE	480V	20kVA	POWER PRODUCTS INT.	05-0329/20F	7500-1756A							1											1											1		
THYRISTOR, HEATSINK, SNUBBER AND SEMICONDUCTOR FUSE	480V	30kVA	POWER PRODUCTS INT.	05-0330/10F	7500-1758A								1	1										1	1									1	1

REPLACEMENT THYRISTORS - ALL BUILD STANDARDS						SPARES CATEGORY	220V SERIES - QUANTITY								400V SERIES - QUANTITY										480V SERIES - QUANTITY									
COMP. TYPE	VRRM, VDRM	CURR. RATING	MFTR	MFTR P/N	ATG AIRPORTS STOCK CODE		1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA	1.0kVA	2.5kVA	4.0kVA	5.0kVA	7.5kVA	10kVA	12.5kVA	15kVA	20kVA	25kVA	30kVA
THYRISTOR	1600V	27A	SEMIKRON	SKKT27B16E	2323-0176	B	1	1	1						1	1	1	1	1							1	1	1	1	1						
THYRISTOR	1600V	55A	SEMIKRON	SKKT57B16E	2323-0181	B				1	1									1	1	1									1	1	1			
THYRISTOR	1600V	95A	SEMIKRON	SKKT92B16E	2323-0184	B						1											1											1		
THYRISTOR	1600V	160A	SEMIKRON	SKKT162B16E	2323-0191	B							1	1										1	1									1	1
SNUBBER MODULE	440V		SEMIKRON	SKRC 440	2323-0230	B	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										
SNUBBER MODULE	660V		SEMIKRON	SKRC 660	2323-0231	B																				1	1	1	1	1	1	1	1	1	1

Table 12-10 Parts List: Stack Assemblies and Thyristors

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 12-11 Parts List: Door Interlocks



400V SERIES CONTROL TRANSFORMERS			
		ACTUAL CCR SUPPLY VOLTAGE	
		400V	415V
PRIMARY TAPPINGS TO BE USED	T102	415V	440V
	T105	415V	440V

NOTES.
1. CONTROL TRANSFORMER PRIMARY TAPS AS PER LOCAL SUPPLY VOLTAGE, EXCEPT FOR 400V SERIES – SEE TABLE ABOVE.
2. T101 PRIMAY TAP AS PER LOCAL SUPPLY VOLTAGE. NOTE – SOME CCR's USE A MAIN TRANSFORMER WITH A DUAL WOUND SECONDARY FOR 6.6/12A.
3. CONNECTION DETAILS FOR THYRISTORS.
   SEMIKRON SKKTxxBxx SEMIPACK 1 TYPE DEVICES, eg SKKT27B16E, AND IXYS DEVICES:
   WIRE No.11 : TERM No. G2 OR 7 WIRE No.12 : TERM No. K2 OR 6
   WIRE No.14 : TERM No. G1 OR 4 WIRE No.15 : TERM No. K1 OR 5
   SEMIKRON SKKTxx/xx TYPE DEVICE, eg SKKT162/16E. AND IR DEVICES:
   WIRE No.11 : TERM No. G2 OR 6 WIRE No.12 : TERM No. K2 OR 7
   WIRE No.14 : TERM No. G1 OR 4 WIRE No.15 : TERM No. K1 OR 5
4. IF PLF OUTPUT VOLTAGE FROM T101 = 20V CONNECT WIRE 3 TO TERMINAL 1
   = 70V CONNECT WIRE 3 TO TERMINAL 2
5. F7 NOT ALWAYS FITTED.
6. INPUT AND OUTPUT LIGHTNING/SURGE ARRESTORS ARE FITTED AS STANDARD ON THE FAA BUILD CCR AND ARE OPTIONAL ON THE IEC BUILD.
7. 2 OFF FERRITE BEADS TO BE FITTED 40mm FROM EMC FILTER TERMINALS.
8. IF THE AT1026 CUTOUT SWITCH RELAY PCB IS FITTED, WIRE 21 CONNECTS TO THE AT1026 TERMINAL 11.
9. AT1026 VOLTAGE SELECTOR LINK TO BE SET TO 24V.
10. IF DOOR INTERLOCK SWITCHES ARE NOT FITTED, CONNECT A WIRE LINK BETWEEN TERMINALS 3 & 4 ON THE AT1026 CARD
11. IF NEITHER INTERNAL NOR EXTERNAL CUTOUT INTERLOCK REED SWITCHES ARE USED, CONNECT A WIRE LINK BETWEEN TERMINALS 1 & 2 ON THE AT1026 CARD
12. FIT LINK PLK1 ON THE RELAY I/O CARD IN THE POSITION TO SUIT THE CONTROL VOLTAGE USED – EITHER 24V OR 48/50V. DO NOT APPLY 48/50V IF THE LINK IS FITTED IN THE 24V POSITION
13. FOR 400V AND 480V SERIES CCR's WIRE 161 TO 18V TERMINAL CLOSEST TO SIDE OF TRANSFORMER, FOR 220V SERIES CCR's WIRE 163 TO 18V TERMINAL CLOSEST TO SIDE OF TRANSFORMER.

REV	DATE	DESCRIPTION	DRN	CHK	APP
V	21-10-19	DRAWING MADE GENERIC FOR ALL 2 PHASE CCRS.	AB	PAC	DJ
W	23-01-20	PLK1 NOTE ADDED	AB	PAC	DJ
X	11-03-20	NOTE 13 MODIFIED	AB	PAC	AS
S	23-03-12	NOTE 3 MODIFIED	AJT	PAC	KA
T	12-08-15	CUTOUT SWITCH AT662A/AT925 TEXT & COMMS BOARD MODIFIED	AJT	PAC	APS
U	20-09-19	AT1026 CUTOUT SWITCH RELAY PCB ADDED.	AB	PAC	DJ

atg airports
atg airports ltd
Automation House
Lowton Business Park
Newton Road
Lowton St.Mary's
Warrington
WA3 2AP
tel : +44(0)1942 685555
fax : +44(0)1942 685518
email : airports@atgairports.com
web : www.atgairports.com

CLIENT

TITLE
MICRO 100 CCR - 220V, 400V AND 480V SERIES WITH 2 PHASE SUPPLY
- STANDARD WIRING DIAGRAM

PROJECT No.

SCALE N/A

DRG No. HS12-1-01-01

X

atg - A3

Figure 12-1 Micro 100 CCR Standard Wiring Diagram, HS12-1-01-01-X