Pasadena Blue Line

Metro Radio System

Maintenance Handbook
For

Canam Technology Inc.
AFL Works Order Nō.: Q109394
AFL product part Nō.: **60-056104** **800MHz BDA**

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AMENDMENT LIST RECORD SHEET

Issue Nō.	Date	Incorporated by	Page No.'s Amended	Reason for new issue
1	09/04/2003	CMH		1st Issue

Document Ref:-60-056100HBKM

INTRODUCTION

Scope

This handbook is for use solely with the equipment identified by the AFL Part Number shown on the front cover. It is not to be used with any other equipment unless specifically authorised by Aerial Facilities Limited. This is a controlled release document and, as such, becomes a part of Aerial Facilities' Total Quality Management System. Alterations and modification may therefore only be performed by Aerial Facilities Ltd.

Purpose

The purpose of this handbook is to provide the user/maintainer with sufficient information to service and repair the equipment to the level agreed. Maintenance and adjustments to any deeper level must be performed by AFL, normally at the company's repair facility in Chesham, England.

This handbook has been prepared in accordance with BS 4884, and AFL's Quality procedures, which maintain the company's registration to ISO 9001: 1994 and to the R&TTE Directive of the European Parliament. Copies of the relevant certificates and the company Quality Manual can be supplied on application to the Quality Manager.
This document fulfils the relevant requirements of Article 6 of the R&TTE Directive.

Limitation of Information Notice

This manual is written for the use of technically competent operators/service persons. No liability is accepted by AFL for use or misuse of this manual, the information contained therein, or the consequences of any actions resulting from the use of the said information, including, but not limited to, descriptive, procedural, typographical, arithmetical, or listing errors.

Furthermore, AFL does not warrant the absolute accuracy of the information contained within this manual, or it's completeness, fitness for purpose, or scope.

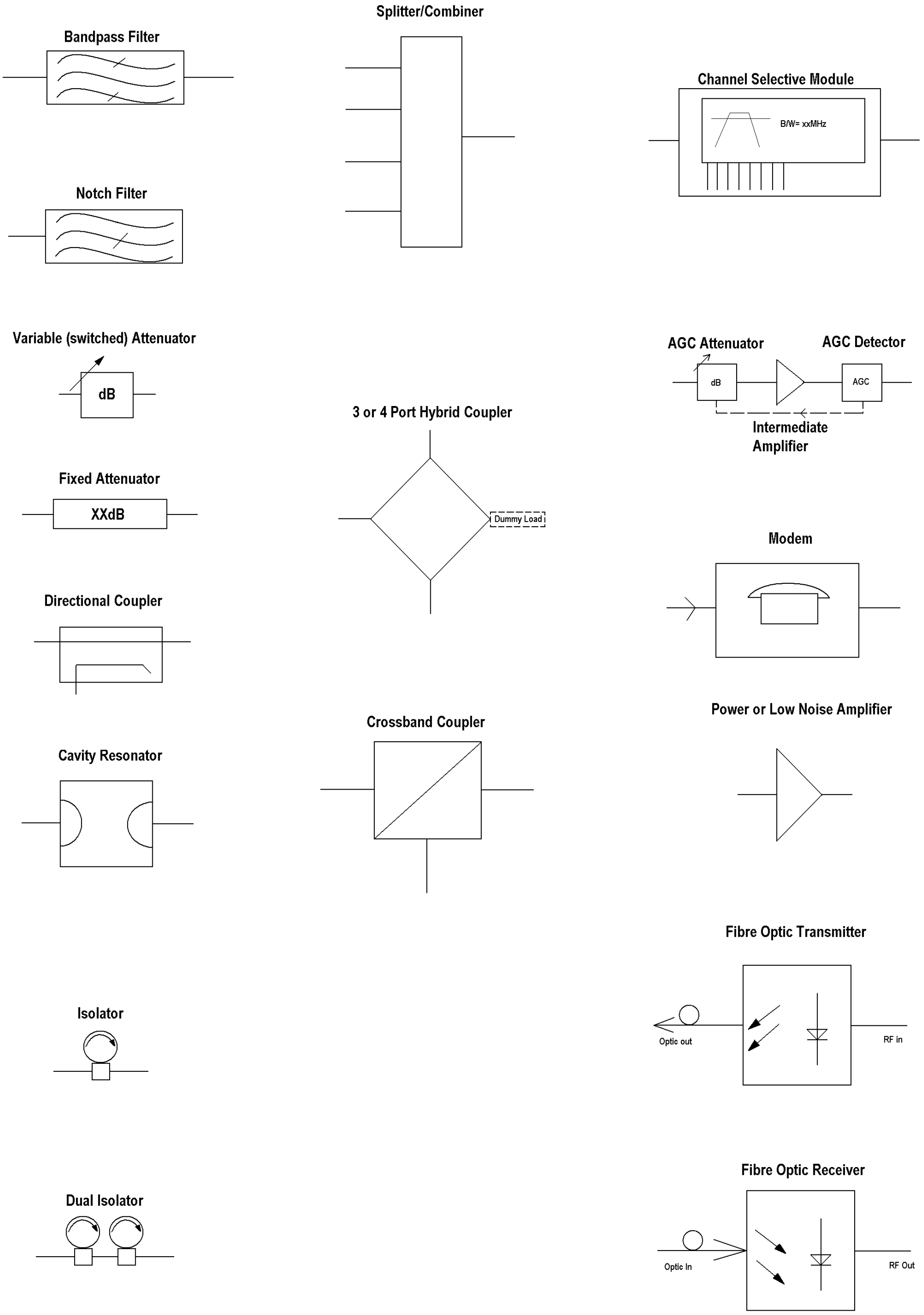
AFL has a policy of continuous product development and enhancement, and as such, reserves the right to amend, alter, update and generally change the contents, appearance and pertinence of this document without notice.

All AFL products carry a twelve month warranty from date of shipment. The warranty is expressly on a return to base repair or exchange basis and the warranty cover does not extend to on-site repair or complete unit exchange.

Glossary of Terms

Repeater or Cell Enhancer	A Radio Frequency (RF) amplifier which can simultaneously amplify and re-broadcast Mobile Station (MS) and Base Transceiver Station (BTS) signals.
Band Selective Repeater	A Cell Enhancer designed for operation on a range of channels within a specified frequency band.
Channel Selective Repeater	A Cell Enhancer, designed for operation on specified channel(s) within a specified frequency band. Channel frequencies may be factory set or on-site programmable.
BTS	Base Transceiver Station
C/NR	Carrier-to-Noise Ratio
Downlink (D.L.)	RF signals transmitted from the BTS and to the MS
Uplink (U.L.)	RF signals transmitted from the MS to the BTS
EMC	Electromagnetic Compatibility
GND	Ground
DC	Direct Current
AC	Alternating Current
ID	Identification Number
OIP3	Output Third Order Intercept Point = RF_{out} +(C/I)/2
LED	Light Emitting Diode
M.S.	Mobile Station
N/A	Not Applicable
N/C	No Connection
NF	Noise Figure
RF	Radio Frequency
Rx	Receiver
Tx	Transmitter
S/N	Serial Number

AFL Drawing Symbol Keys



Key to AFL RF Modules

1. SAFETY CONSIDERATIONS

1.1 Electric Shock Hazard

Electrical shocks due to faulty mains driven power supplies.
Whilst ever potentially present in any electrical equipment, such a condition would be minimised by quality installation practice and thorough testing at:

a) Original assembly.

b) Commissioning.

c) Regular intervals, thereafter.

All test equipment to be in good working order prior to its use. High current power supplies can be dangerous because of the possibility of substantial arcing. Always switch off during disconnection and reconnection.

1.2 RF Radiation Hazard

"CAUTION: This equipment is approved for antennas mounted on fixed outdoor permanent structures. A minimum separation distance of 2 metres must be maintained between the radiating elements and any nearby persons. A maximum antenna gain of 21 dBi may be used. Operating this equipment without regard to these restrictions will result in RF exposure levels above the limits allowed by FCC rules."

This equipment complies with part 90 of the FCC rules. Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

RF radiation, (especially at UHF frequencies) arising from transmitter outputs connected to AFL's equipment, must be considered a safety hazard.
This condition might only occur in the event of cable disconnection, or because a 'spare' output has been left unterminated. Either of these conditions would impair the system's efficiency. No investigation should be carried out until all RF power sources have been removed. This would always be a wise precaution, despite the severe mismatch between the impedance of an N type connector at 50Ω, and that of free space at 377Ω, which would severely mitigate against the efficient radiation of RF power. Radio frequency burns could also be a hazard, if any RF power carrying components were to be carelessly touched!

Antenna positions should be chosen to comply with requirements (both local & statutory) regarding exposure of personnel to RF radiation. When connected to an antenna, the unit is capable of producing RF field strengths, which may exceed guideline safe values especially if used with antennas having appreciable gain. In this regard the use of directional antennas with backscreens and a strict site rule that personnel must remain behind the screen while the RF power is on, is strongly recommended.

Where the equipment is used near power lines, or in association with temporary masts not having lightning protection, the use of a safety earth connected to the case-earthing bolt is strongly advised.

1.3 Chemical Hazard

Beryllium Oxide, also known as Beryllium Monoxide, or Thermalox™, is sometimes used in devices within equipment produced by Aerial Facilities Ltd. Beryllium oxide dust can be toxic if inhaled, leading to chronic respiratory problems. It is harmless if ingested or by contact.

Products that contain beryllium are load terminations (dummy loads) and some power amplifiers. These products can be identified by a yellow and black "skull and crossbones" danger symbol (shown above). They are marked as hazardous in line with international regulations, but pose no threat under normal circumstances. Only if a component containing beryllium oxide has suffered catastrophic failure, or exploded, will there be any danger of the formation of dust. Any dust that has been created will be contained within the equipment module as long as the module remains sealed. For this reason, any module carrying the yellow and black danger sign should not be opened. If the equipment is suspected of failure, or is at the end of its life-cycle, it must be returned to Aerial Facilities Ltd for disposal.

To return such equipment, please contact the Quality Department, who will give you a Returned Materials Authorisation (RMA) number. Please quote this number on the packing documents, and on all correspondence relating to the shipment.

PolyTetraFluoroEthylene, (P.T.F.E.) and P.T.F.E. Composite Materials

Many modules/components in AFL equipment contain P.T.F.E. as part of the RF insulation barrier.
This material should never be heated to the point where smoke or fumes are evolved. Any person feeling drowsy after coming into contact with P.T.F.E. especially dust or fumes should seek medical attention.

1.4 Emergency Contact Numbers

The AFL Quality Department can be contacted on:

Telephone	+44 (0)1494 777000
Fax	+44 (0)1494 777002
e-mail	qa@aerial.co.uk

2. OVERVIEW/SYSTEM DESCRIPTION

The AFL 800MHz Off Air Amplifier for the Pasadena Blue line project is an 8 way channelised RF amplifier. It's application is as an air interface between the donor radio site and the tunnel leaky feeder system. The unit is housed in an environmentally protected IP65 steel wall-mount case. Handles are provided for carrying the unit and the door is fitted with locks. The unit interfaces with 'N' type female connectors for RF connections and heavy duty connectors for routing of AC power supply input and alarm output wiring.

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To provide adequate selectivity in the Downlink and Uplink paths, combline design duplexers are used at the input and output ports. To provide the required gain to reach the required signal levels, low-noise amplifiers (LNA's) are used in each path, these being followed by power amplifier modules to provide the required intermodulation performance. Gain adjustment is available locally using switched attenuators.

Note that "Downlink" refers to the RF path from FO receiver to the leaky feeder port and that "Uplink" refers to the RF path from the leaky feeder port to the FO transmitter.

3. SPECIFICATIONS

3.1 800MHz Channelised BDA 60-056104 Parts Lists

02-011601	900MHz 8POLE 7.5MHz B/W SMA	4
05-002602	900MHz SPLITTER/COMBINER, 20W	4
05-003302	4 WAY SPLITTER GSM 900MHz	8
10-000701	1/4W0-30dB SWITCHED ATTENUATOR	4
11-005902	900MHz LOW NOISE AMP WITH RELAY ASS	3
11-006702	GA 800-1000MHz LNA 29dB (WITH RELAY)	2
12-002105	900MHz 10W PA 24V 2.8A (ALARMS)	2
12-002201	3 STAGE AMPLIFIER ALARM BOARD	2
12-002220	3 STAGE ALARM PCB COVER	2
12-002826	ALARM BOARD ACRYLIC LENS	2
13-003011	DC/DC CONVERTER 24-12V 8A PCB SUB-ASS	2
13-003020	DC-DC CONVTR 24-12V HEATSINK	2
17-000126	CELL ENHANCER LABEL 6 DIGIT	1
17-001522	BASE PLATE 560 x 345mm 17-001520&9020	1
17-002101	CHANNEL CONTROL MODULE	4
17-002103	26WAY RIBBON CABLE LEAD	0
17-003022	MODULE PATTERNED LEAVE	16
17-003023	SUBRACK SIDE PANEL	8
17-003024	SUBRACK REAR BRACKET	16
17-003025	BOTTOM MODULE GUIDE	16
17-003028	MODULE SQUARE LEAVE	16
17-003029	TOP MODULE GUIDE	16
17-009026	C/E 820 x 620 x 250(3 HEATSINKS)2.0 CASE	1
17-009127	CHAN MOD 810-860MHz 30KHz 8p TCXO	16
17-009723	EQUIP. MTG PLATE No.4	4
17-009725	EQUIP. MTG PLATE No.6	2
80-008902	24V RELAY PCB ASSEMBLY	1
80-032320	10W PA HEATSINK (NEEDS 17-000526)	2
80-032322	10W PSU HEATSINK (NEEDS 17-000526)	1
90-010021	RF CABLE SUPFLEX SMA R/A MALE 100mm	5
90-010022	RF CABLE SUPFLEX SMA R/A MALE 200mm	3
90-010026	RF CABLE HIFLEX SMA R/A MALE 150mm	4
90-010028	RF CABLE HIFLEX SMA R/A MALE 350mm	1
90-010029	RF CABLE HIFLEX SMA R/A MALE 450mm	1
90-010131	RF CABLE SMA R/A-N PANEL JACK 200mm	1
90-010135	RF CABLE SMA R/A-N PANEL JACK 500mm	1
91-500011	PWR 3POLE PNL PLUG SEALED IP68	2
91-500015	PWR CON CAP SEALED with INT. THREAD	2
91-500016	PWR 6POLE PNL PLUG SEALED IP68	1
91-510010	PWR 3POLE FREE SOC.SEALED IP68	1

91-510013	PWR CON CAP SEALED with Ext. THREAD	2
91-510014	PWR 6POLE FREE SOC.SEALED IP68	1
91-600014	'D' 9 WAY SOCKET S/B (NON FILTERED)	6
91-620002	'D' 25 WAY SOCKET/IDC TERMS	4
91-640003	MISC 26 WAY RIBBON CABLE SOCK.	4
91-700017	ICD 15 WAY 0.1' CONNECTOR	3
92-280033	Captive Screw	8
92-400017	GASKET FOR N TYPE CONNECTOR	3
93-540035	1K3 0.25W 1% RES MRS25 M:F	2
96-300011	24 V 400 W FLATPACK PWR SUPPLY	1
96-500003	AC FILTER 110V 5A	1
96-500005	DC INPUT FILTERS	1
96-700002	LED.GREEN 5mm SEALED IP66	1
96-700005	LED.RED 5mm SEALED IP66	1
96-900018	AC TRIP SWITCH (5 AMP M.C.B.)	1
96-920011	PROXIMITY SWITCH	1
96-920012	PROXIMITY SWITCH MAGNET	1
97-000002	BLACK MODULE CAGE RUNNER	8
97-300010	SUPPLY I/P COVERS	1
97-400010	BLACK PLASTIC HANDLE 37311	2
97-600001	SUBRACK FRONT HORIZ	2
97-600002	SUBRACK M2.5 STD TAP	8
97-900004	RUBBER FOOT FOR CELL ENHANCERS	4

3.2 Technical Specifications

3.2.5 800MHz 8 Channel Channelised BDA Technical Specification

Frequency Range:	Downlink 857.0-861.0MHz	Uplink 812.0-816.0MHz
Band Width:	Downlink: 25kHz Uplink: 25kHz	
No. of Paths:	2	
No. of RF Ports:	2	
No. of Fibre Connections:	N/A	
RF Connector:	N type female	
RF Impedance:	50Ω	
VSWR:	Better than 1.5:1	
Downlink Gain:	95 dB min	
Uplink Gain:	95 dB min	
Gain Adjustment:	0 to 30 in 2dB steps	
Downlink PA:	10W Class A Linear	
Downlink Power:	8 Carriers at +17dBm	
Uplink PA:	10W Class A Linear	
Uplink Power:	8 Carriers at +17dBm	
Duplexer UP/DN Isolation:	>80 dB	
Passband Ripple:	<±1.5 dB	
Noise Figure:	Uplink <6 dB at maximum gain Downlink <5 dB at maximum gain	
In-Band Spurious:	Better than –36dBm downlink Better than –36dBm uplink (measure with 30KHz BW with max gain setting)	
MTBF:	>50,000 hours	
Supply Input Voltage:	110V AC	
Alarms Fitted:	Alarm: Volts free contacts (Amps, PSU,door) Alarm indicator- Red LED Power Indicator-Green LED	

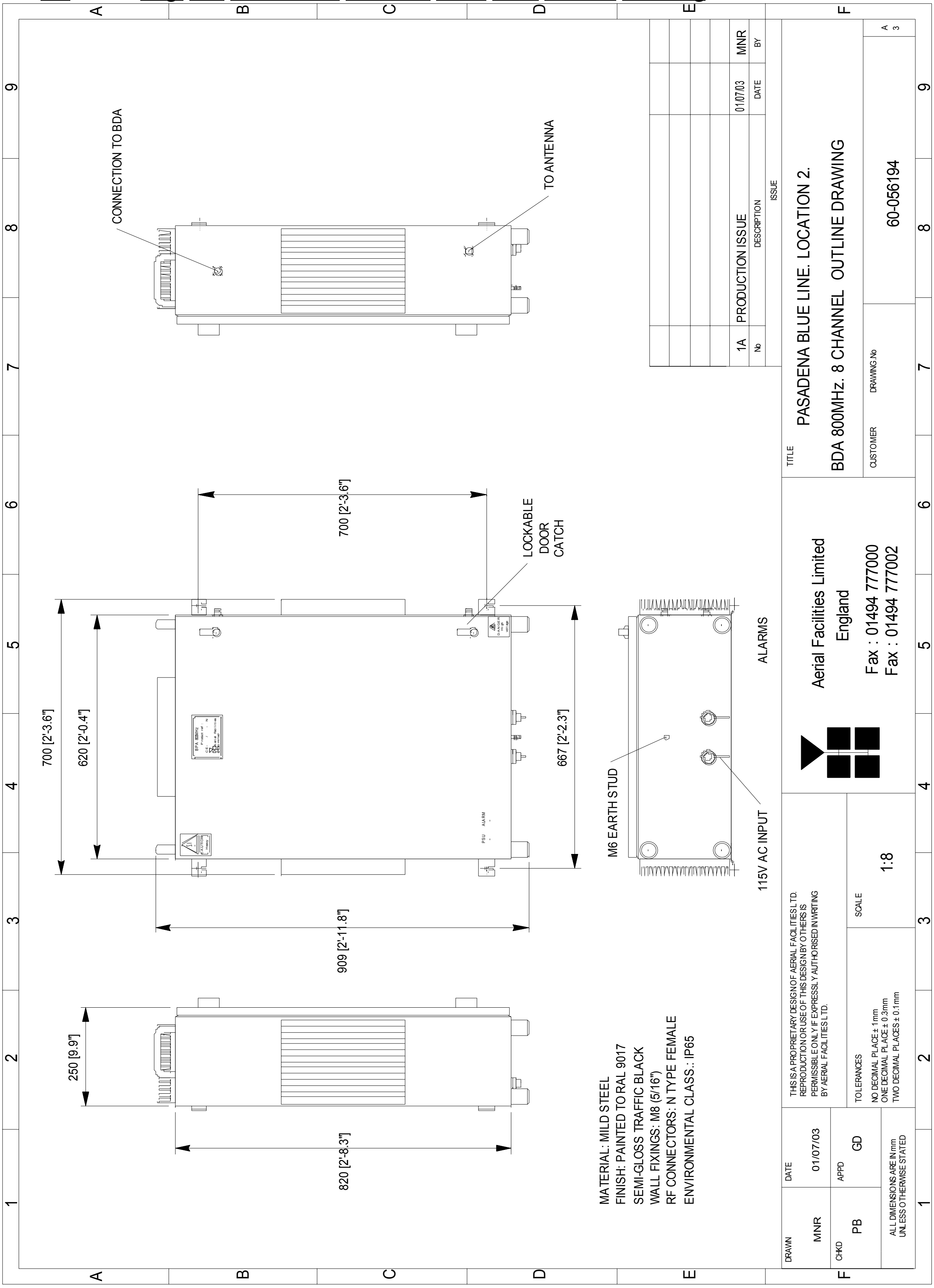
3.3 Mechanical Specification

3.3.1 800MHz BDA Wall Mount Case

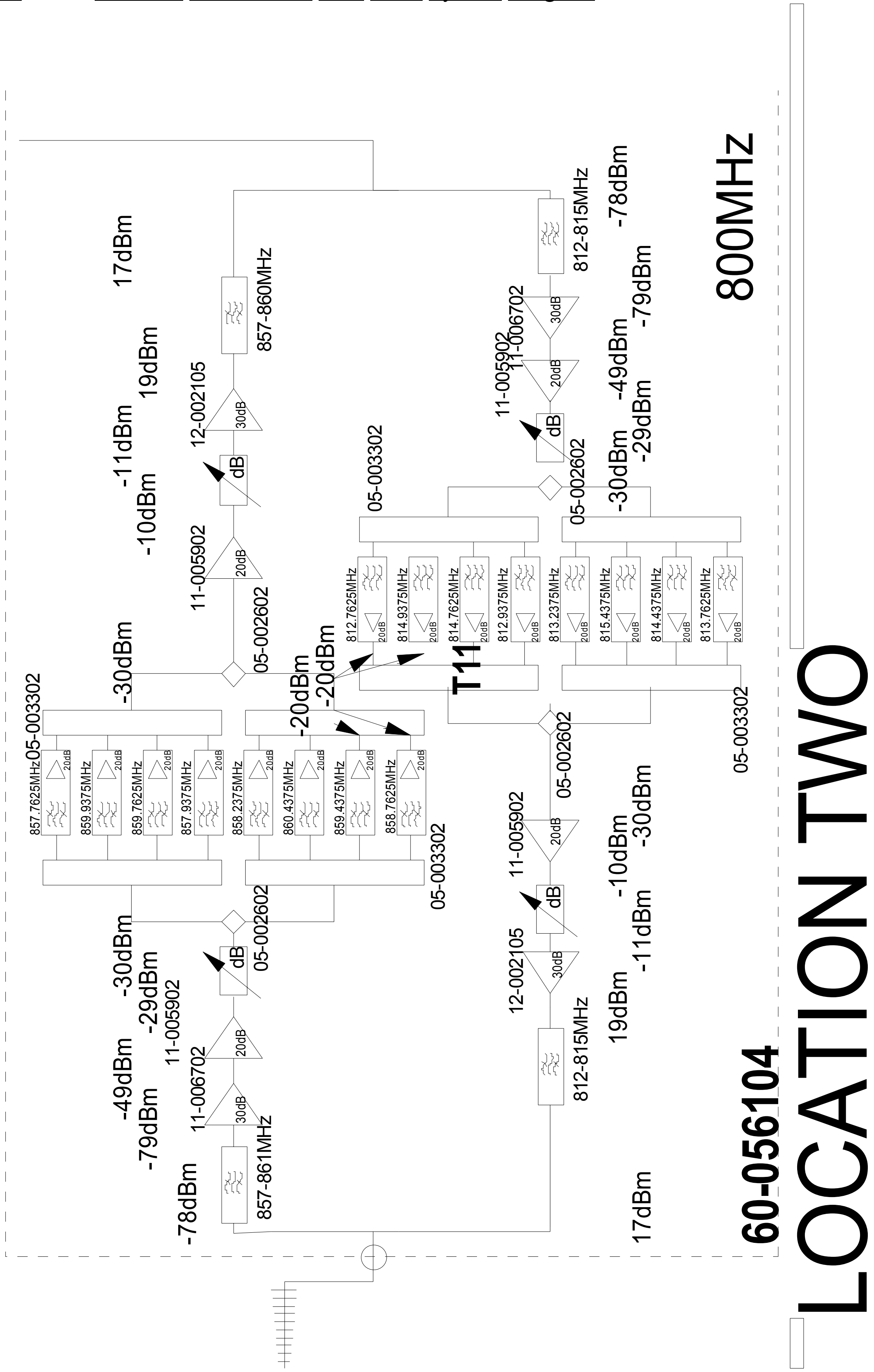
Size:	height:	**820** mm
	width:	**620** mm
	depth:	**250** mm
(excluding connectors, heatsinks, handles and feet)		
Fixings:		4 holes on **700** mm (h) x **667** mm (w)
Weight:		**50** kg (approx.)
Temperature Range:	operational:	**-20**°C to +**50**°C
	storage:	**-40**°C to +**70**°C
Humidity:		**10%** to **95%** non-condensing
Environmental Protection:		**IP65** (with door closed and all ports terminated)
Finish:	Case:	**RAL 7032**
	Heatsinks:	**Black anodised**
	Handles:	**Black** (where fitted)
Supply Cable:		Unit supplied with 3-pin IP68 connector for customer interface with AC input.

4. SYSTEM DRAWINGS

4.1 Drg. Nō. 60-056194, 800MHz BDA Case Outline Drawing



4.2 800MHz Channelised PBL BDA System Diagram



5. SUB-UNIT MODULES

5.1 Bandpass Filter (02-011601)

5.1.1 Description

The bandpass filters are multi-section designs with a bandwidth dependent upon the passband frequencies, (both tuned to customer requirements). The response shape is basically Chebyshev with a passband design ripple of 0.1dB. The filters are of combline design, and are carefully aligned during manufacture in order to optimise the insertion loss, VSWR and intermodulation characteristics of the unit. The tuned elements are silver-plated to reduce surface ohmic losses and maintain a good VSWR figure and 50Ω load at the input and output ports.

Being passive devices, the bandpass filters should have an extremely long operational life and require no maintenance. Should a filter be suspect, it is usually most time efficient to replace the module rather than attempt repair or re-tuning.

5.1.2 Technical Specification

PARAMETER		SPECIFICATION
Response Type:		Chebyshev
Frequency Range:		857-861MHz (Dlink)
		812-816MHz (Ulink)
Bandwidth:		<7.5 MHz (tuned to requirements)
Number of Sections:		8
Insertion Loss:		1.2 dB
VSWR:		better than 1.2:1
Connectors:		SMA
Power Handling:		100W max
Temperature range	operation:	-10°C to +55°C
	storage:	-40°C to +70°C
Weight:		3 kg (typical)

5.2 2-Way Splitter/Combiner (05-002602)

5.2.1 Description

The Splitter/Combiner used is a device for accurately matching two or more RF signals to single or multiple ports; most usually within a specified frequency band, whilst maintaining an accurate 50Ω load to all inputs/outputs and ensuring that the VSWR and insertion losses are kept to a minimum. Any unused ports will be terminated with an appropriate 50Ω load.

5.2.2 Technical Specification

PARAMETER		SPECIFICATION
Frequency Range:	Narrowband:	800-1000MHz
	Broadband:	600-1300MHz
Bandwidth:	Narrowband:	300 MHz
	Broadband:	700 MHz
	Inputs:	1
	Outputs:	2
Isolation:	Narrowband:	>20 dB
	Broadband:	>18 dB
Insertion Loss:	Narrowband:	3.3 dB
	Broadband:	3.5 dB
	VSWR Input & Output:	Better than 1.3:1
	Impedance:	50 ς
	Connectors:	SMA female
	Weight:	200gms
	Size:	54 x 44 x 21mm (including connectors)
Power Rating:	Splitter:	20 Watts
	Combiner:	0.5Watts

5.3 4-Way Splitter/Combiner (05-003302)

5.3.1 Description

The Splitter/Combiner used is a device for accurately matching two or more RF signals to single or multiple ports, whilst maintaining an accurate 50Ω load to all inputs/outputs and ensuring that the VSWR and insertion losses are kept to a minimum. Any unused ports will be terminated with an appropriate 50Ω load. This splitter is used in conjunction with the previously mentioned 05-002602 to split & combine the signal before and after the channel selective modules (in both up & downlink paths).

5.3.2 Technical Specification

PARAMETER		SPECIFICATION
Frequency range:		700-1000MHz
Bandwidth:		>200MHz
Rejection:		>14dB
Insertion loss:		6.5dB (typical)
Connectors:		SMA
Weight:		<1.5kg
Temperature range:	operational:	-10BC to +55BC
	storage	-40BC to +70BC

5.4 ¼Watt 0- -30dB Switched Attenuator (10-000701)

5.4.1 General Application

In many practical applications for Cell Enhancers etc., the gain in each path is found to be excessive. Therefore, provision is made within the unit for the setting of attenuation in each path, to reduce the gain.

5.4.2 Switched Attenuators

The AFL switched attenuators are available in two different types; 0 – 30dB in 2 dB steps (as in this case), or 0 – 15dB in 1 dB steps. The attenuation is simply set using the four miniature toggle switches on the top of each unit. Each switch is clearly marked with the attenuation it provides, and the total attenuation in line is the sum of the values switched in. They are designed to maintain an accurate 50Ω impedance over their operating frequency at both input and output.

5.5 Low Noise Amplifiers (11-005902 & 11-006702)

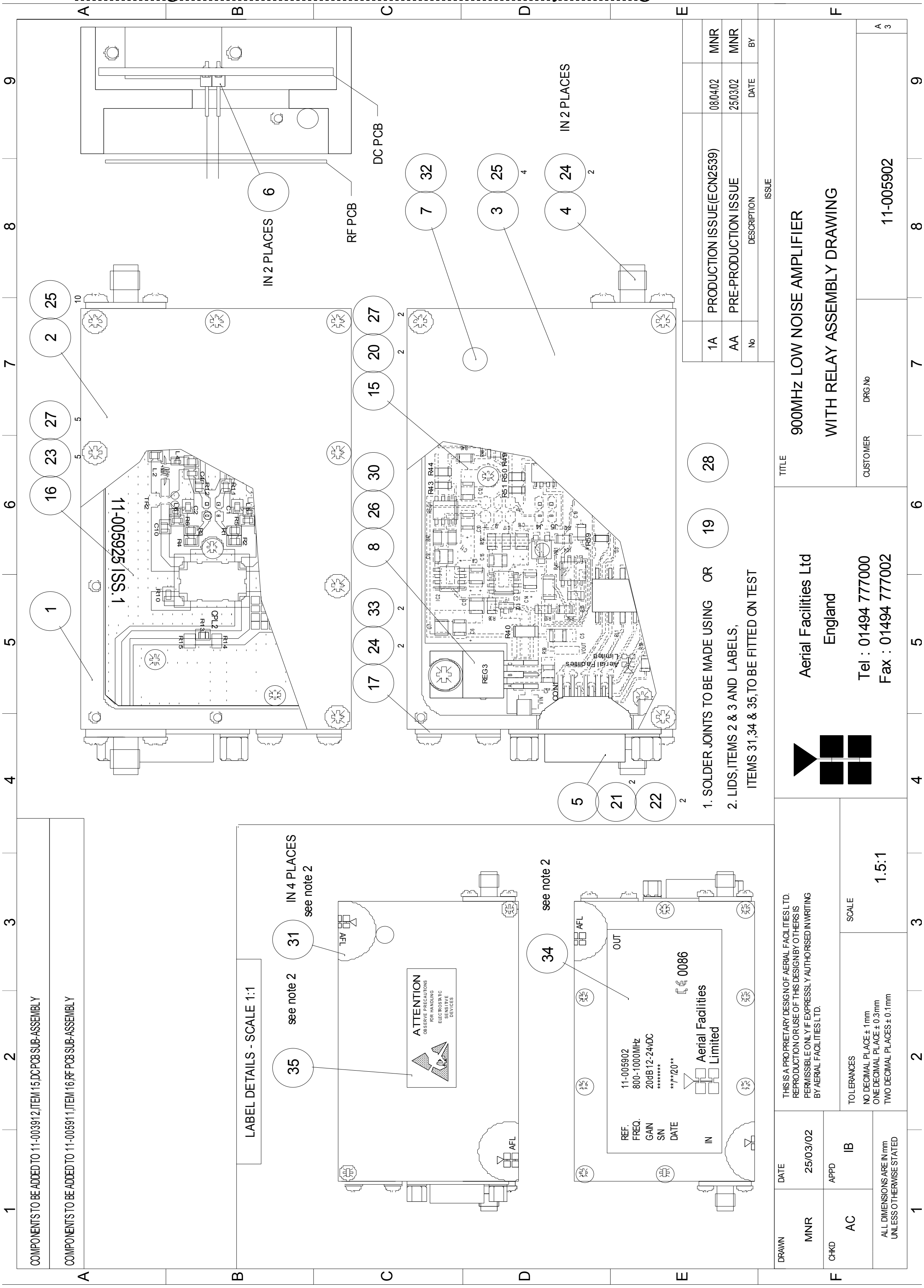
5.5.1 Description

The Gallium-Arsenide low noise amplifiers used in the unit are double stage, solid-state low noise amplifiers. Class A circuitry is used throughout the units to ensure excellent linearity and extremely low noise over a very wide dynamic range. The active devices are very moderately rated to provide a long trouble-free working life. There are no adjustments on these amplifiers, and in the unlikely event of a failure, then the complete amplifier should be replaced. This amplifier features its own in-built alarm system which gives a volt-free relay contact type alarm that is easily integrated into the main alarm system.

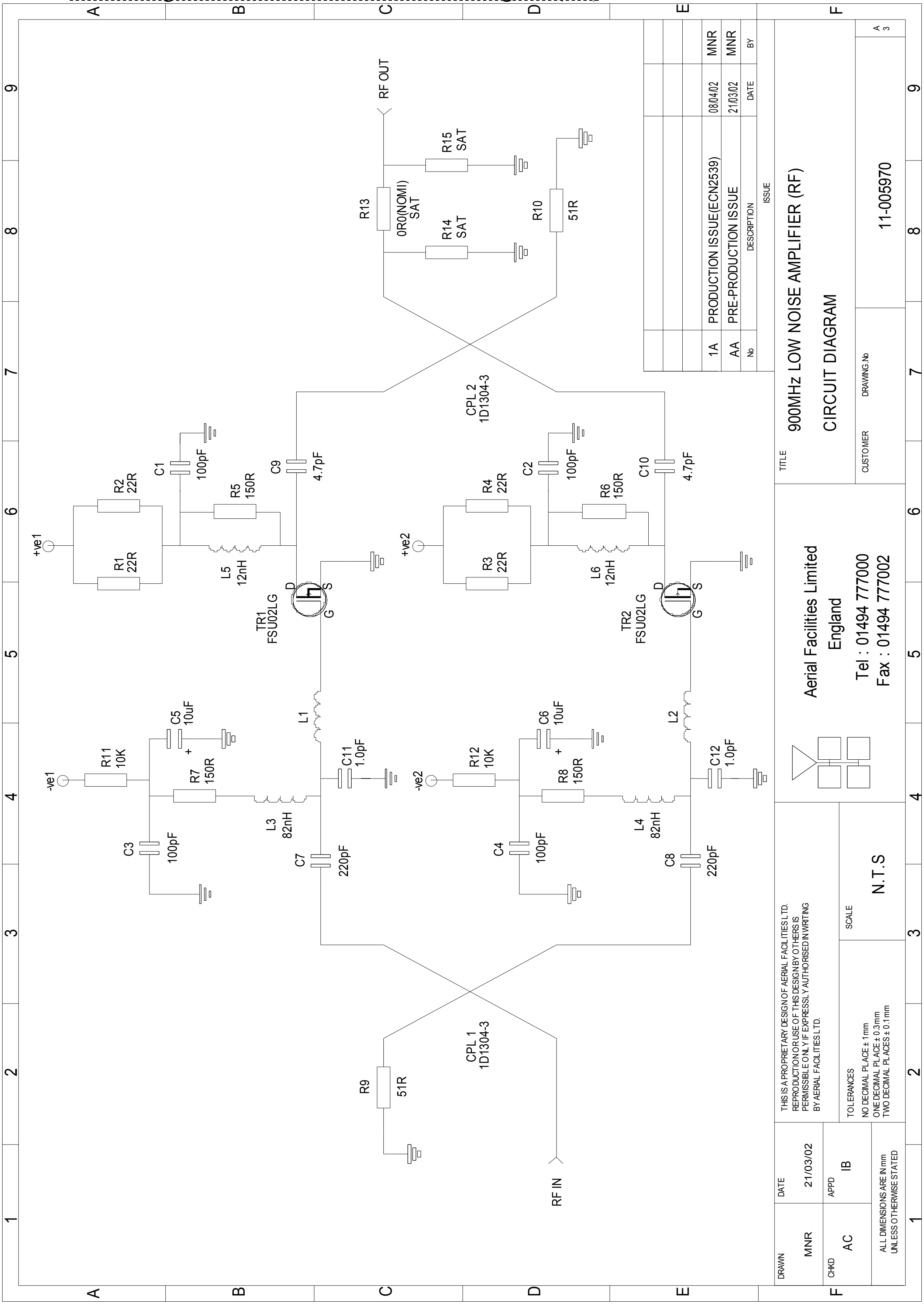
5.5.2 Technical Specification (11-005902)

PARAMETER		SPECIFICATION
Frequency Range:		800 – 960MHz
Bandwidth:		<170MHz
Gain:		19.5dB (typical)
1dB Compression Point:		21dBm
OIP3:		33dBm
Input/Output Return Loss:		>20dB
Noise Figure:		1dB (typical)
Power Consumption:		190mA @ 24V DC
Supply Voltage:		10-24V DC
Connectors:		SMA female
Temperature Range:	operational:	-10°C to +55°C
	storage:	-40°C to +70°C
Size:		90 x 55 x 30.2mm
Weight:		280gms (approximately)

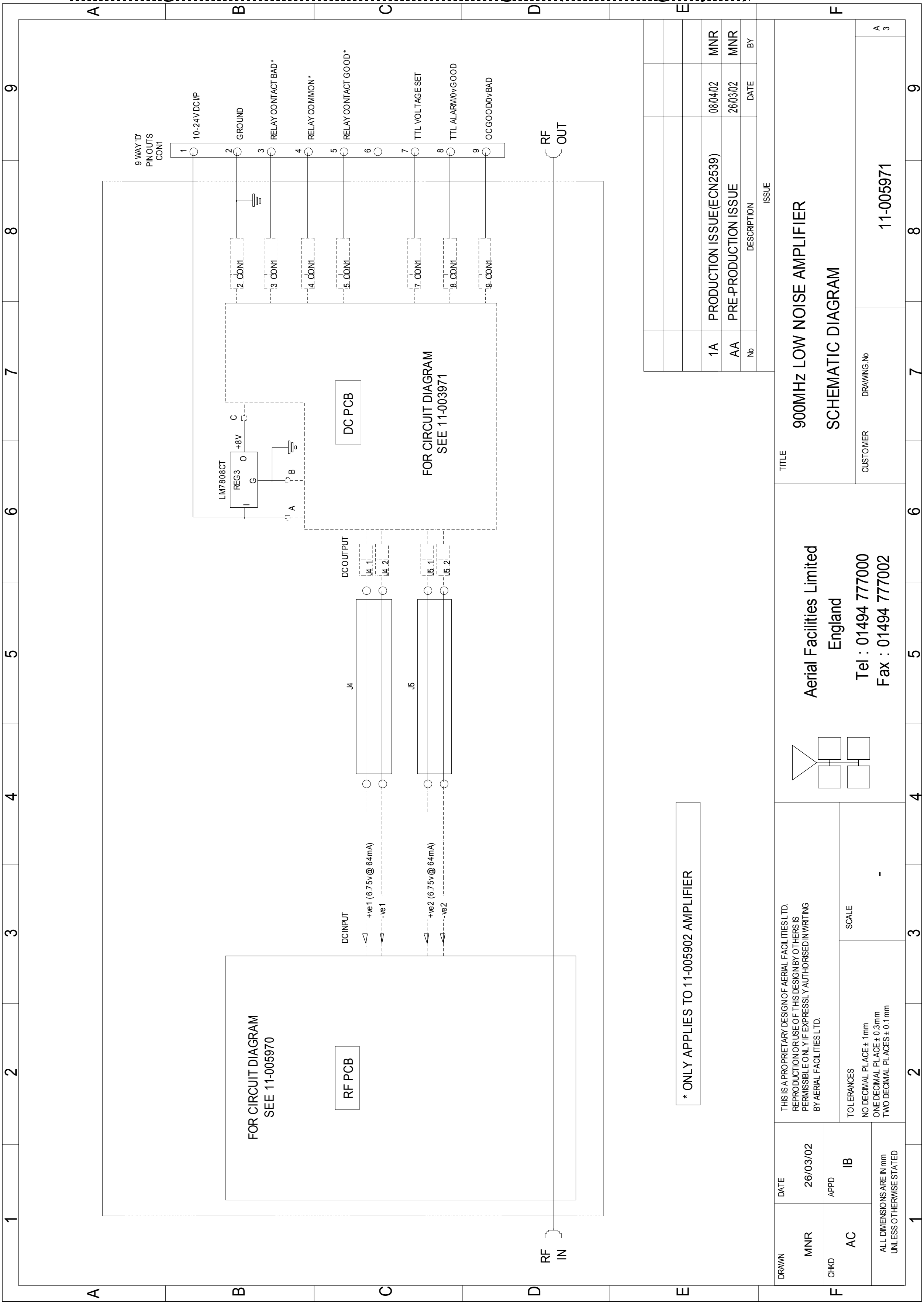
5.5.3 Drg. Nō. 11-005902 LNA General Assembly Drawing



5.5.4 Drg. Nō. 11-005970, LNA Circuit Diagram (RF)



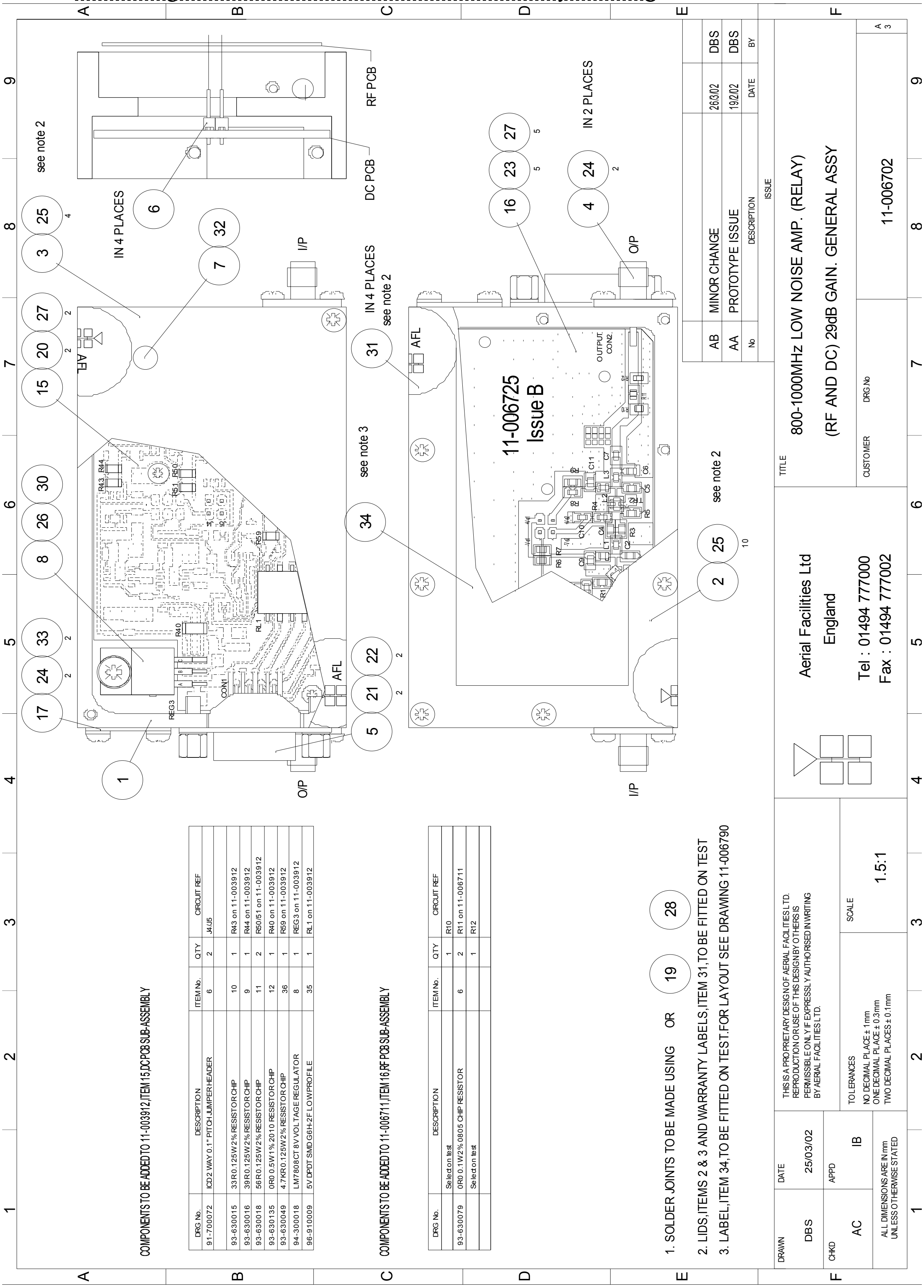
5.5.5 Drg. Nō. 11-005971, LNA Circuit Diagram (DC Wiring Layout)



5.5.6 Technical Specification (11-006702)

PARAMETER		SPECIFICATION
Frequency Range:		800 – 1000MHz
Bandwidth:		<200MHz
Gain:		29dB (typical)
1dB Compression Point:		20dBm
OIP3:		33dBm
Input/Output Return Loss:		>18dB
Noise Figure:		1.3dB (typical)
Power Consumption:		180mA @ 24V DC
Supply Voltage:		10-24V DC
Connectors:		SMA female
Temperature Range:	operational:	-10°C to +55°C
	storage:	-40°C to +70°C
Size:		90 x 55 x 30.2mm
Weight:		290gms (approximately)

5.5.7 Drg. Nō. 11-006702, LNA General Assembly Drawing



COMPONENTS TO BE ADDED TO 11-003912,ITEM 15,DC PCB SUB-ASSEMBLY

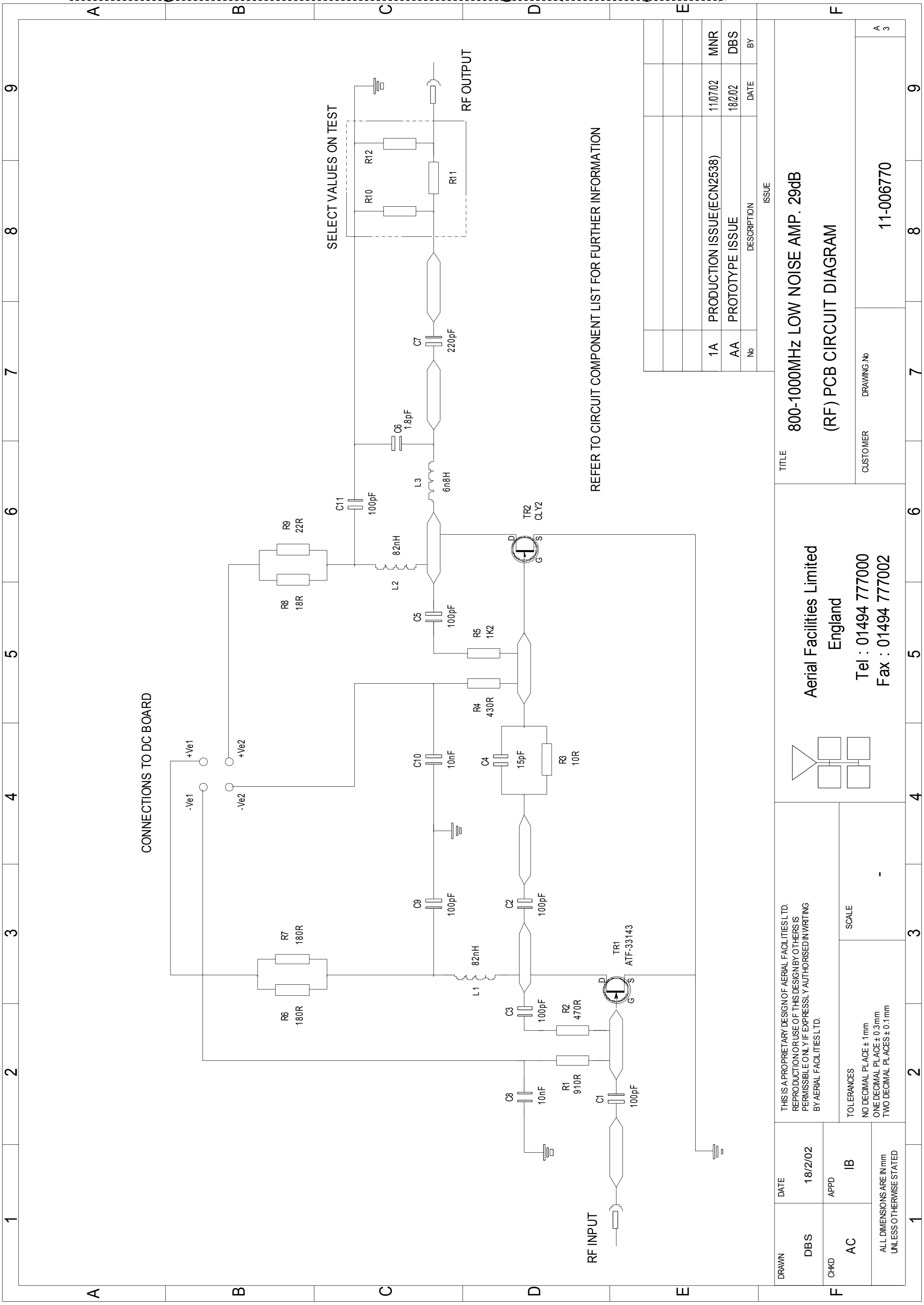
DRG No.	DESCRIPTION	ITEM No.	QTY	CIRCUIT REF
91-700072	ICD 2 WAY 0.1" PITCH JUMPER HEADER	6	2	J4/J5
93-630015	33R 0.125W 2% RESISTOR CHIP	10	1	R43 on 11-003912
93-630016	39R 0.125W 2% RESISTOR CHIP	9	1	R44 on 11-003912
93-630018	56R 0.125W 2% RESISTOR CHIP	11	2	R50/51 on 11-003912
93-630135	0R0 0.5W 1% 2010 RESISTOR CHIP	12	1	R40 on 11-003912
93-630049	4.7KR 0.125W 2% RESISTOR CHIP	36	1	R59 on 11-003912
94-300018	LM7808CT 8V VOLTAGE REGULATOR	8	1	REG3 on 11-003912
96-910009	5V DPDT SMD G6H-2F LOWPROFILE	35	1	RL1 on 11-003912

COMPONENTS TO BE ADDED TO 11-006711,ITEM 16,RF PCB SUB-ASSEMBLY

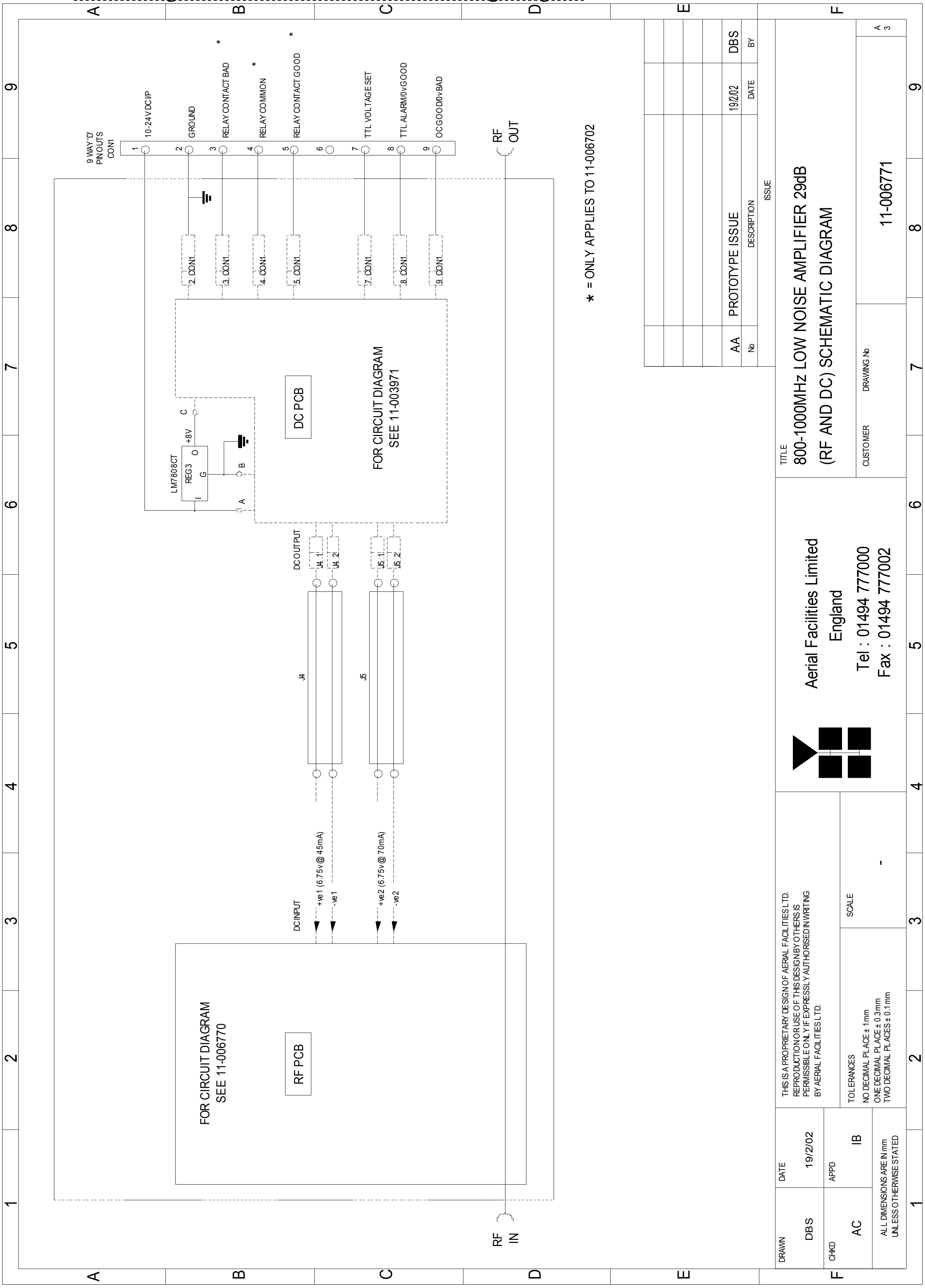
DRG No.	DESCRIPTION	ITEM No.	QTY	CIRCUIT REF
	Select on test		1	R10
93-630079	0R0 0.1W 2% 0805 CHIP RESISTOR	6	2	R11 on 11-006711
	Select on test		1	R12

1. SOLDER JOINTS TO BE MADE USING 19 OR 28
2. LIDS,ITEMS 2 & 3 AND WARRANTY LABELS,ITEM 31,TO BE FITTED ON TEST
3. LABEL,ITEM 34,TO BE FITTED ON TEST.FOR LAYOUT SEE DRAWING 11-006790

5.5.8 Drg. Nō. 11-006770, LNA Circuit Diagram (RF Components)



5.5.9 Drg. Nō. 11-006771, LNA DC Wiring Diagram



5.6 10Watt Power Amplifier (12-002105)

5.6.1 Description

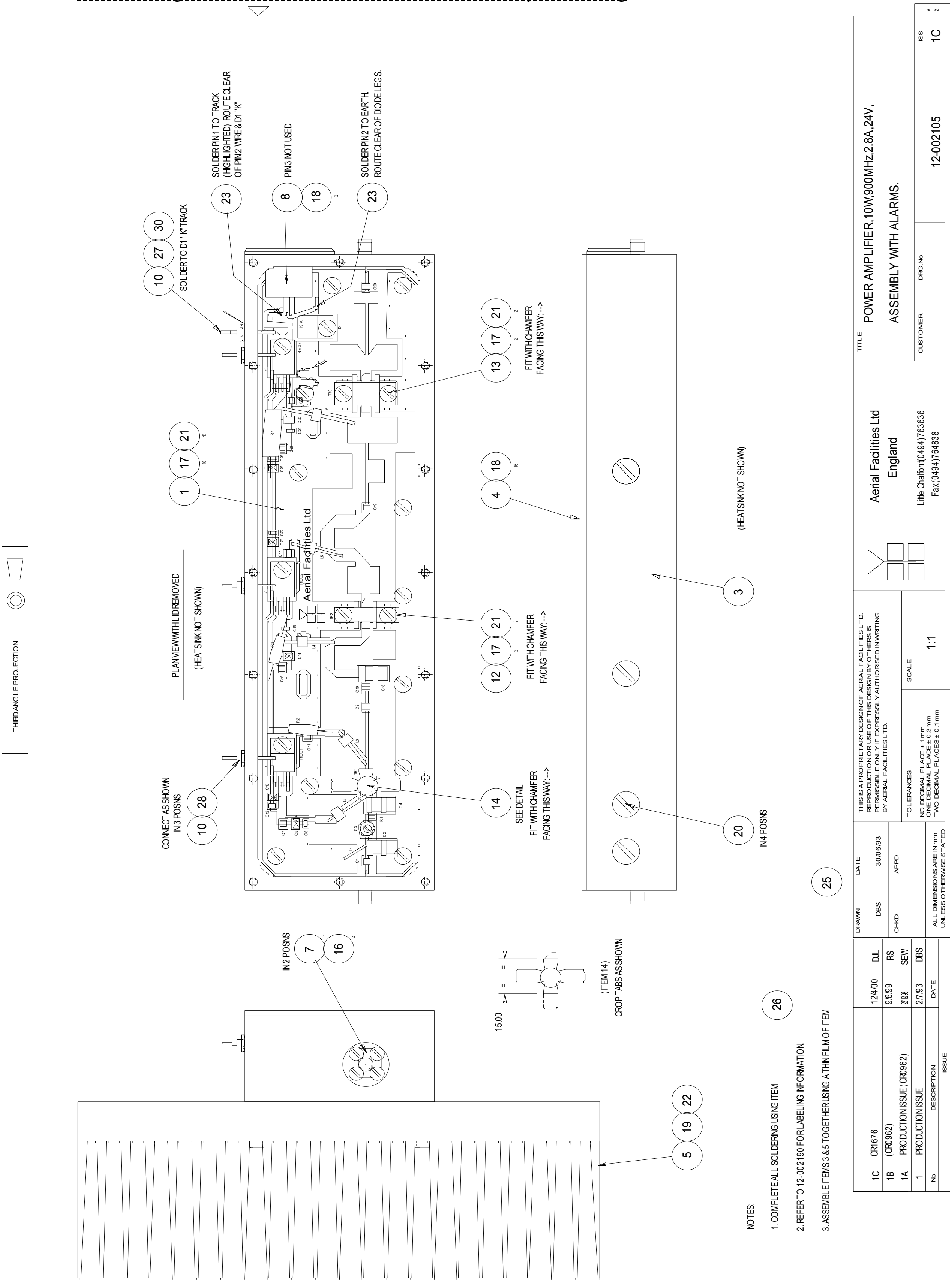
The power amplifiers fitted to this unit (up & downlink paths) are multi-stage, solid state power amplifiers. Class A circuitry is employed throughout the device to ensure excellent linearity over a wide dynamic frequency range. All the semi-conductor devices are very conservatively rated to ensure low device junction temperatures and a long, trouble free working lifetime.

The power amplifiers should require no maintenance over their operating life. Under no circumstances should the cover be removed or the side adjustments disturbed unless it is certain that the amplifier has failed; since it is critically aligned during manufacture and any re-alignment will require extensive test equipment.

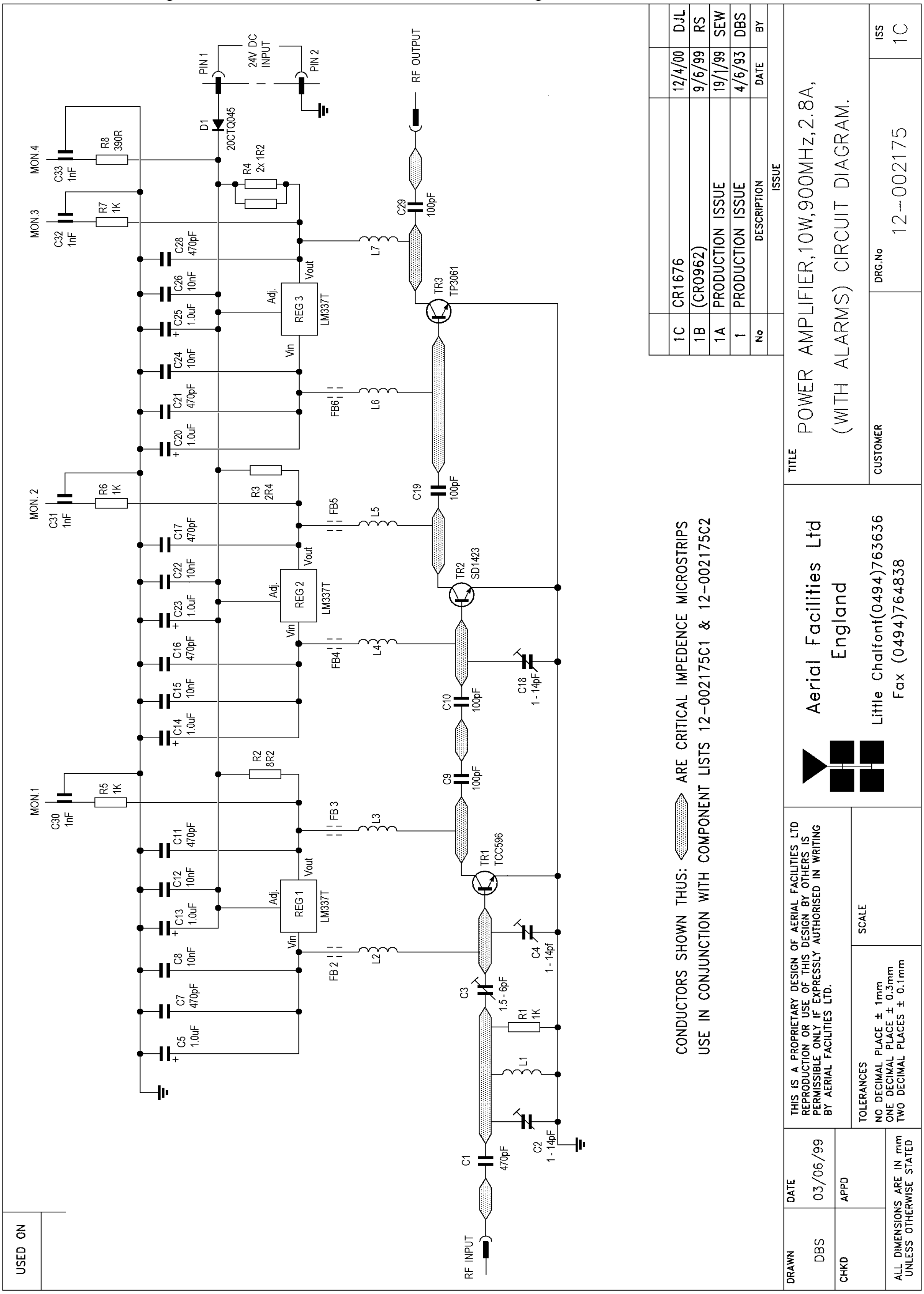
5.6.2 Technical Specification

PARAMETER		SPECIFICATION
	Frequency range:	800 - 970MHz (tuned to spec.)
	Bandwidth:	10 - 100MHz (typical, tuned to spec.)
	Maximum RF output:	>10.0 Watt
	Gain:	30dB
	1dB compression point:	+40dBm
	3rd order intercept point:	+50dBm
	VSWR:	better than 1.5:1
	Connectors:	SMA female
	Supply:	2.8A @ 24V DC
Temperature range:	operational:	-10°C to +55°C
	storage:	-40°C to +70°C
	Weight:	1.5 Kg (case only)

5.6.3 Drg. Nō. 12-002105, 10W PA Assembly Drawing



5.6.4 Drg. Nō. 12-001275, 10W PA Circuit Diagram



5.6.5 Drg. Nō. 12-002175C12, PA Parts List(1)

USED ON	CIRC. REF.	AFL STOCK REF.	DESCRIPTION
	C1	93-200017	470pF CERAMIC CAP 10
	C2	93-130023	1-14pF AIR TRIM CAP
	C3	93-130014	1.5-6.0pF CERAMIC CAP
	C4	93-130023	1-14pF AIR TRIM CAP
	C5	93-240004	1uF 35V TANTALUM CHI
	C6		
	C7	93-200017	470pF CERAMIC CAP 10
	C8	93-200019	10nF 50V CERAMIC CA
	C9	93-200007	100pF CERAMIC CAP 10
	C10	93-200007	100pF CERAMIC CAP 10
	C11	93-200017	470pF CERAMIC CAP 10
	C12	93-200019	10nF 50V CERAMIC CA
	C13	93-240004	1uF 35V TANTALUM CHI
	C14	93-240004	1uF 35V TANTALUM CHI
	C15	93-200019	10nF 50V CERAMIC CA
	C16	93-200017	470pF CERAMIC CAP 10
	C17	93-200017	470pF CERAMIC CAP 10
	C18	93-130023	1-14pF AIR TRIM CAP
	C19	93-200007	100pF CERAMIC CAP 10
	C20	93-240004	1uF 35V TANTALUM CHI
	C21	93-200017	470pF CERAMIC CAP 10
	C22	93-200019	10nF 50V CERAMIC CA
	C23	93-240004	1uF 35V TANTALUM CHI
	C24	93-200019	10nF 50V CERAMIC CA
	C25	93-240004	1uF 35V TANTALUM CHI
	C26	93-200019	10nF 50V CERAMIC CA
	C27		
	C28	93-200017	470pF CERAMIC CAP 10
	C29	93-200007	100pF CERAMIC CAP 10
	C30	93-150001	1nF FEED THROUGH CAP
	C31	93-150001	1nF FEED THROUGH CAP
	C32	93-150001	1nF FEED THROUGH CAP
	C33	93-150001	1nF FEED THROUGH CAP

ISSUE	DATE	CHANGE No	ISSUE	DATE	CHANGE No	ISSUE	DATE	CHANGE No	ISSUE	DATE	CHANGE No
2A	12/4/00	CR1676									
1A	3/6/99	(CR0962)									
1	30/6/93	Prod. Iss.									

Aerial Facilities Limited

TITLE
POWER AMPLIFIER,10W,900MHz,2.8A,(WITH ALARMS)
COMPONENT LIST - SHEET 1 OF 2

DRAWN	DATE	CHKD	APPD	CUSTOMER	COMPONENT LIST FOR	ISS
DBS	30/06/93				12-002175C1	2A

5.6.6 Drg. Nō. 12-002175C2, PA Parts List(2)

USED ON	CIRC. REF.	AFL STOCK REF.	DESCRIPTION
	D1	94-120006	20CTQ45 10A 45V DUA
	FB2	93-910001	FERROX BEAD 3S1 5x2x
	FB3	93-910001	FERROX BEAD 3S1 5x2x
	FB4	93-910001	FERROX BEAD 3S1 5x2x
	FB5	93-910001	FERROX BEAD 3S1 5x2x
	FB6	93-910001	FERROX BEAD 3S1 5x2x
	FB7	93-910001	FERROX BEAD 3S1 5x2x
	R1	93-630037	1KR 0.125W 2% CHIP RESIST
	R2	93-540080	8R2 2.5W % RESWELWYN
	R3	93-540077	2R4 2.5W % RESWELWYN
	R4	93-540075	1R2 2.5W % RES WELW x 2 IN PARALLEL
	R5	93-540033	1K 0.25W 1% RES MRS2
	R6	93-540033	1K 0.25W 1% RES MRS2
	R7	93-540033	1K 0.25W 1% RES MRS2
	R8	93-540027	390R 0.25W 1% RES MR
	REG1	94-300002	LM337T. VOLTAGE REGU
	REG2	94-300002	LM337T. VOLTAGE REGU
	REG3	94-300002	LM337T. VOLTAGE REGU
	TR1	94-010018	TPV596A/SD1439/TCC59 *
	TR2	94-010016	TP 3022A/SD1423 POWE *
	TR3	94-010017	TP 3061.SD4701.R. *
	L1	90-500008	22 S.W.G. TINNED COP
	L2	90-500012	1.25 ENAMELLED COP
	L3	90-500012	1.25 ENAMELLED COP
	L4	90-500012	1.25 ENAMELLED COP
	L5	90-500012	1.25 ENAMELLED COP
	L6	90-500012	1.25 ENAMELLED COP
	L7	90-500012	1.25 ENAMELLED COP

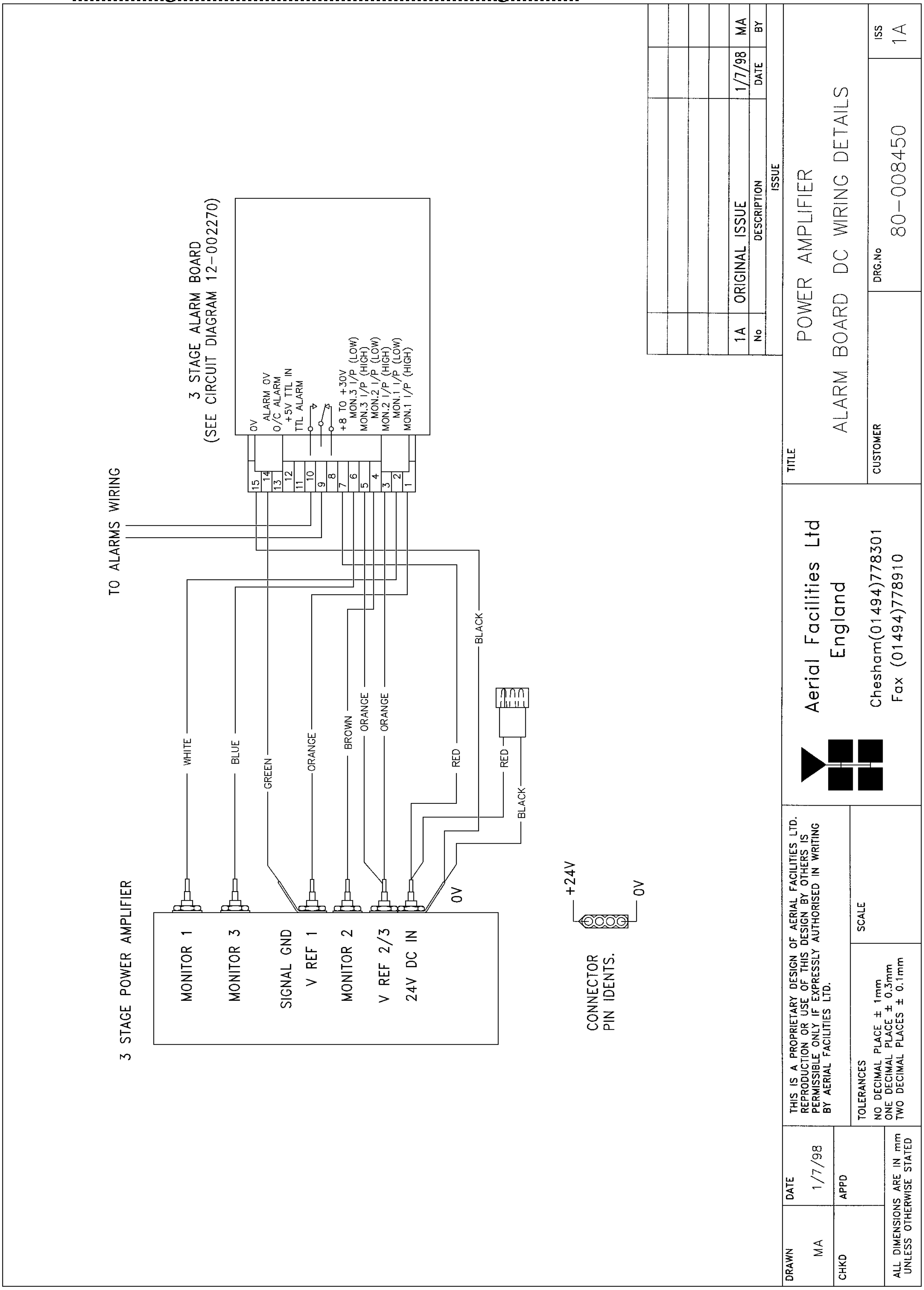
ISSUE	DATE	CHANGE No	ISSUE	DATE	CHANGE No	ISSUE	DATE	CHANGE No	ISSUE	DATE	CHANGE No
2A	11/4/00	CR1676									
1A	3/6/99	(CR0962)									
1	30/6/93	Prod. Iss.	2B	26/4/00	TITLE ERROR						

Aerial Facilities Limited

TITLE
POWER AMPLIFIER,10W,900MHz,2.8A,(WITH ALARMS)
COMPONENT LIST - SHEET 2 OF 2

DRAWN	DATE	CHKD	APPD	CUSTOMER	COMPONENT LIST FOR	ISS
DBS	30/06/93				12-002175C2	2B

5.6.7 Drg. Nō. 80-008450, PA Alarm Wiring Details



5.7 3 Stage Alarm Board (12-002201)

5.7.1 Description

Amplifier Alarm Boards are fitted to monitor the bias conditions of AFL Class A amplifiers which remain constant in normal operation. Any departure from normal bias conditions is a result of device failure, excess temperature, over-driving or oscillation (excessive power).

In normal operation, the Class A bias circuit of the amplifier develops a constant voltage of 1.20V across the collector current setting resistor. The Amplifier Alarm Board is a window comparator device, which is adjusted to sense a departure from this condition. Several different alarm outputs are provided to simplify interfacing, (Relay Contact, Open Collector, and TTL Logic Levels)

The basic version of the Alarm Board (12-002801) monitors a single amplifier stage. A three-stage version (12-002201) is used on complex amplifiers where three separate comparators have their outputs logically combined to a common output stage. Failure of any one stage will activate the alarms.

Note that the alarm board has a green Light Emitting Diode located near to the centre of the printed circuit board, which is illuminated on ‘Good’, and extinguished on ‘Alarm’. It is therefore a simple matter to identify an active module failure, by searching for an Alarm Board which has its green LED extinguished. A simple test of the alarm board is possible by shorting across the monitor inputs, pins 1 and 2, 3 and 4 or across pins 5 and 6. This last monitor input is inactive if the board has been converted to a two way alarm board. (Refer to relevant amplifier alarm wiring diagram.)

1) Volt-free change over relay contacts.
2) Open collector NPN transistor pulls low on alarm.
3) TTL driver.

The use of precision voltage sources and resistors has eliminated the need for initial adjustment or calibration, and the board will function correctly with a wide variation in power supply voltage (8 to 30 volts, nominal supply is 12 or 24Volts).

There are two selectable link options on the three-way board:

LINK1 - Removed to convert to two-way alarm board.
LINK2 - Removed to isolate 0V from chassis earth.

The one way alarm board only has the 0V isolation link (LINK2) fitted.

5.7.2 Technical Specification

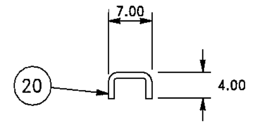
PARAMETER		SPECIFICATION
Operating voltage:		8 to 30V (floating earth)
Alarm Threshold:		Vcc - 1.20 volt $\pm$15%
Alarm output relay contacts:		
Max. switch current:		1.0Amp
Max. switch volts:		120Vdc/60VA
Max. switch power:		24W/60VA
Min. switch load:		10.0µA/10.0mV
Relay isolation:		1.5kV
Mechanical life:		>2x10^7 operations
Relay approval:		BT type 56
Connector details:		15-way 0.1" pitch
Temperature range:	operational:	-10°C to +55°C
	storage:	-30°C to +70°C
PCB Size:		74 x 56mm (3 stage)
		54 x 56mm (1 stage)

5.7.3 Drg. Nō. 12-002201, 3 Stage Alarm Board Assembly Drawing & Parts List

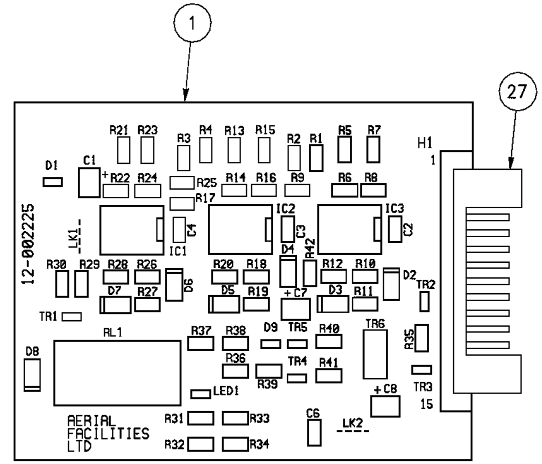
CIRC. REF.	AFL STOCK REF.	DESCRIPTION
R1	93-630040	1.8KR 0.125W 2% CHIP RESISTOR
R2	93-630024	120R 0.125W 2% CHIP RESISTOR
R3	93-630024	120R 0.125W 2% CHIP RESISTOR
R4	93-630047	3.6KR 0.125W 2% CHIP RESISTOR
R5	93-640003	100K PRECISION RESISTOR 0.1%
R6	93-640003	100K PRECISION RESISTOR 0.1%
R7	93-640003	100K PRECISION RESISTOR 0.1%
R8	93-640003	100K PRECISION RESISTOR 0.1%
R9	93-630037	1KR 0.125W 2% CHIP RESISTOR
R10	93-630068	270KR 0.125W 2% CHIP RESISTOR
R11	93-630037	1KR 0.125W 2% CHIP RESISTOR
R12	93-630068	270KR 0.125W 2% CHIP RESISTOR
R13	93-640003	100K PRECISION RESISTOR 0.1%
R14	93-640003	100K PRECISION RESISTOR 0.1%
R15	93-640003	100K PRECISION RESISTOR 0.1%
R16	93-640003	100K PRECISION RESISTOR 0.1%
R17	93-630037	1KR 0.125W 2% CHIP RESISTOR
R18	93-630068	270KR 0.125W 2% CHIP RESISTOR
R19	93-630037	1KR 0.125W 2% CHIP RESISTOR
R20	93-630068	270KR 0.125W 2% CHIP RESISTOR
R21	93-640003	100K PRECISION RESISTOR 0.1%
R22	93-640003	100K PRECISION RESISTOR 0.1%
R23	93-640003	100K PRECISION RESISTOR 0.1%
R24	93-640003	100K PRECISION RESISTOR 0.1%
R25	93-630037	1KR 0.125W 2% CHIP RESISTOR
R26	93-630068	270KR 0.125W 2% CHIP RESISTOR
R27	93-630037	1KR 0.125W 2% CHIP RESISTOR
R28	93-630068	270KR 0.125W 2% CHIP RESISTOR
R29	93-630049	4.7KR 0.125W 2% CHIP RESISTOR
R30	93-630042	2.2KR 0.125W 2% CHIP RESISTOR
R31	93-630053	10KR 0.125W 2% CHIP RESISTOR
R32	93-630049	4.7KR 0.125W 2% CHIP RESISTOR
R33	93-630053	10KR 0.125W 2% CHIP RESISTOR
R34	93-630049	4.7KR 0.125W 2% CHIP RESISTOR
R35	93-630037	1KR 0.125W 2% CHIP RESISTOR
R36	93-630045	3KR 0.125W 2% CHIP RESISTOR
R37	93-630043	2.4KR 0.125W 2% CHIP RESISTOR
R38	93-630037	1KR 0.125W 2% CHIP RESISTOR
R39	93-630033	560R 0.125W 2% CHIP RESISTOR
R40	93-630042	2.2KR 0.125W 2% CHIP RESISTOR
R41	93-630057	22KR 0.125W 2% CHIP RESISTOR
R42	93-630049	4.7KR 0.125W 2% CHIP RESISTOR
C1	93-240004	1uF TANTALUM CHIP CAP 35v SMD
C2	93-200021	100nF 63V 10% CHIP CAPACITOR
C3	93-200021	100nF 63V 10% CHIP CAPACITOR
C4	93-200021	100nF 63V 10% CHIP CAPACITOR
C5		
C6	93-200021	100nF 63V 10% CHIP CAPACITOR
C7	93-240004	1uF TANTALUM CHIP CAP 35v SMD
C8	93-240004	1uF TANTALUM CHIP CAP 35v SMD
D1	94-130003	1.23v VOLTAGE REFERENCE DIODE
D2	94-150001	LL4148 G:P MINIMELF DIODE SMD
D3	94-150001	LL4148 G:P MINIMELF DIODE SMD
D4	94-150001	LL4148 G:P MINIMELF DIODE SMD
D5	94-150001	LL4148 G:P MINIMELF DIODE SMD
D6	94-150001	LL4148 G:P MINIMELF DIODE SMD
D7	94-150001	LL4148 G:P MINIMELF DIODE SMD
D8	94-150001	LL4148 G:P MINIMELF DIODE SMD
D9	94-160001	BZX84C3V3 ZENER DIODE SMD
LED1	96-700008	GREEN LED SMD
TR1	94-020007	BCW71 NPN TRANSISTOR SMD
TR1	94-020007	BCW71 NPN TRANSISTOR SMD
TR1	94-020007	BCW71 NPN TRANSISTOR SMD

CIRC. REF.	AFL STOCK REF.	DESCRIPTION
TR4	94-020007	BCW71 NPN TRANSISTOR SMD
TR5	94-020007	BCW71 NPN TRANSISTOR SMD
TR6	94-020010	FZT751/753 PNP TRAN SMD
IC1	94-210001	LM324M SMD QUAD OP AMP
IC2	94-210001	LM324M SMD QUAD OP AMP
IC3	94-210001	LM324M SMD QUAD OP AMP
RL1	96-900004	6V DPCO NON LATCHING RELAY
H1	91-700016	15 WAY 0.1" LOCKING HEADER PCB

USED ON



DETAIL OF LK1/LK2



NOTES:

1. COMPONENTS SHOULD BE POSITIONED USING SILK SCREEN REFERENCES IN CONJUNCTION WITH COMPONENT LIST
2: WHERE INDIVIDUAL ITEMS ARE NOT BALLOONED THE COMPONENT IS IDENTIFIED ON BOTH THE COMPONENT LIST AND THE DRAWING BY ITS COMPONENT REF. (SEE B.o.M FOR BALLOON IDENTS)
3: ALL SOLDERING TO BE COMPLETED USING ITEM 27 (HAND SOLDERING) OR ITEM 28 (MACHINE SOLDERING)
4: USE WITH CIRCUIT DIAGRAM 12-002270

No	DESCRIPTION	DATE	
2A	CR1679	28/6/00	DBS
1A	PRODUCTION ISSUE (CR0962)	4/1/99	SEW
1	PRODUCTION ISSUE(CR0596)	15/6/94	MRB
ISSUE			

DRAWN	DATE
MRB	14/6/94
CHKD	APPD
GB	BB

ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED

TOLERANCES
NO DECIMAL PLACE ± 1mm
ONE DECIMAL PLACE ± 0.3mm
TWO DECIMAL PLACES ± 0.1mm

SCALE 2:1

Aerial Facilities Ltd
England
Tel: (01494) 777000
Fax (01494) 777002

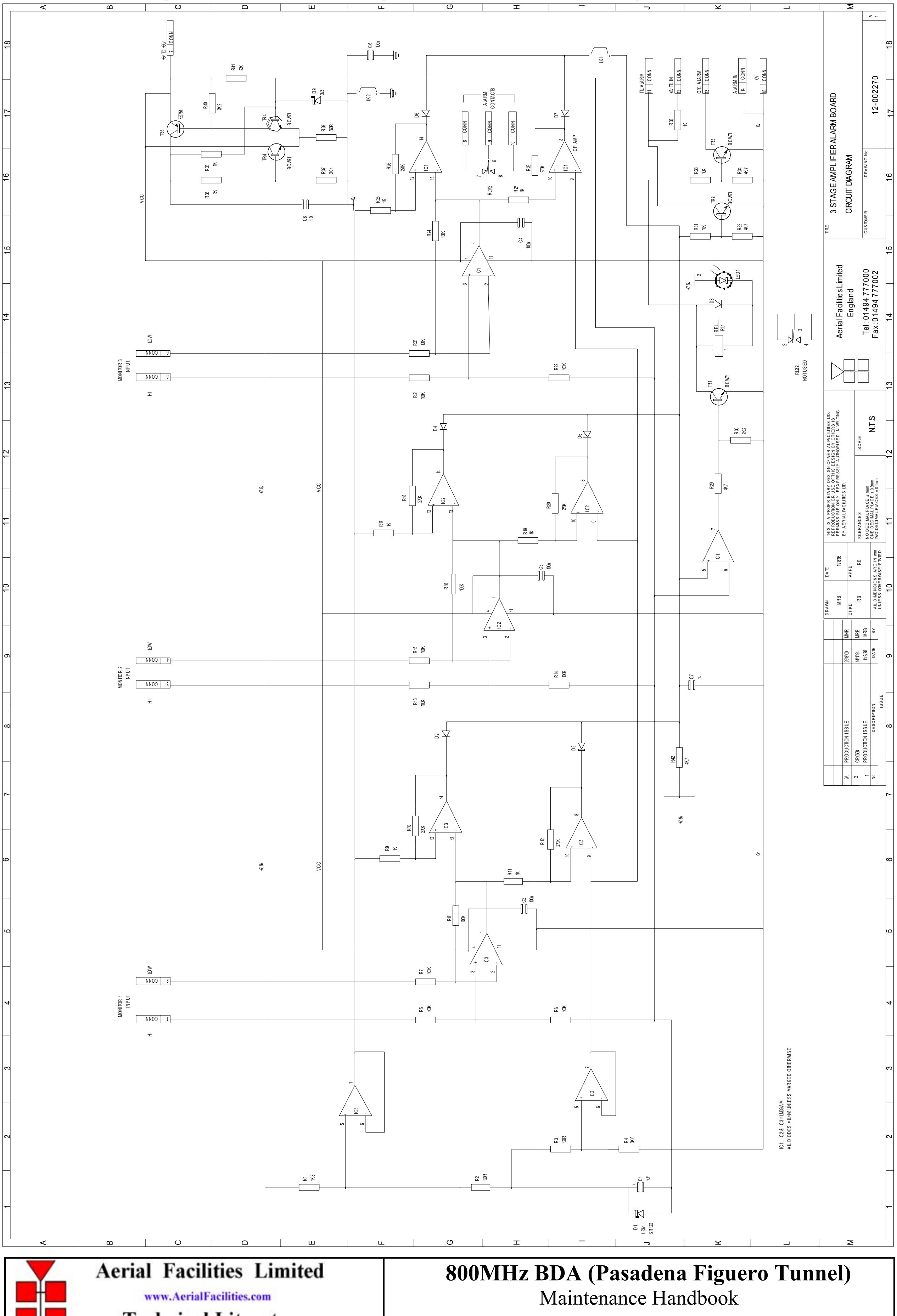
TITLE 3 STAGE AMPLIFIER ALARM BOARD ASSEMBLY

CUSTOMER

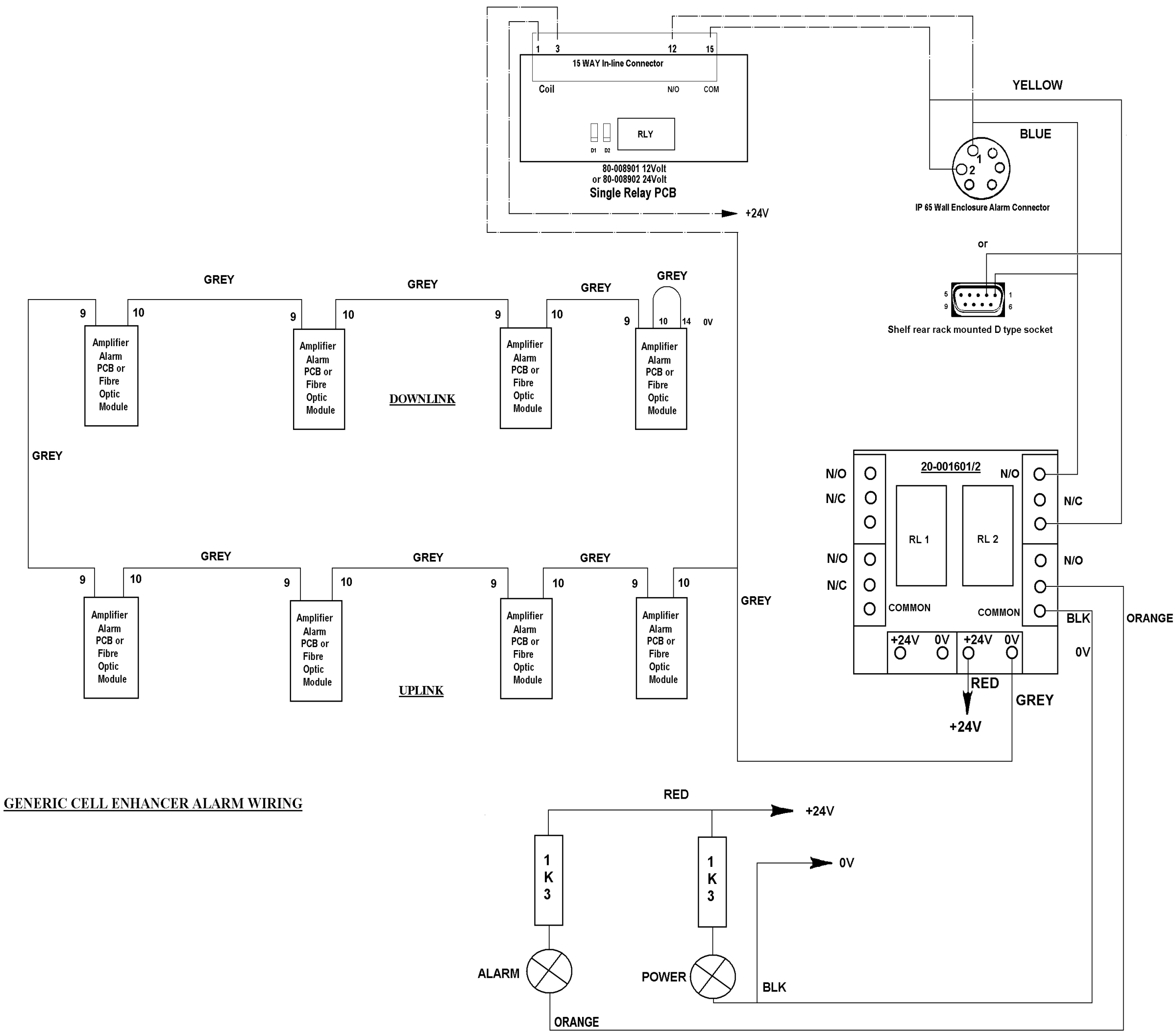
DRG.No 12-002201

ISS 2A

5.7.4 Drg. Nō. 12-002270, 3 Stage Alarm Board Circuit Diagram



5.7.5 Generic Wall Enclosure Alarm Wiring Sketch



5.8 DC/DC Converter, 24V in, 12V 8A out (13-003011)

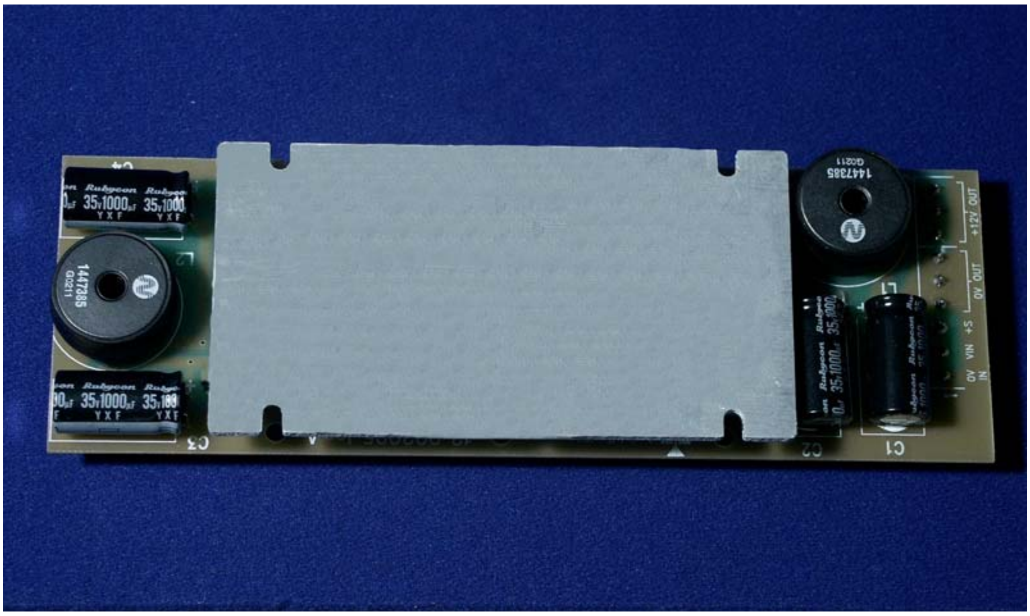
5.8.1 Description

The DC/DC converter fitted is an AFL assembled, high power PCB unit with an 8 amp @ 12V output capability. The circuit is basically an O.E.M semiconductor regulator (one side of which has a heatsink mounting plate, that is usually bolted to the casing/back panel of a Cell Enhancer) and smoothing components built onto a printed circuit board with screw block terminations.
Note: no circuit diagram of the O.E.M. regulator is available. This unit should not be repaired, only replaced.

5.8.2 Technical Specification

PARAMETER		SPECIFICATION
Input Voltage Range:		18-28V DC
Output Voltage:		12V±0.5V
Max. Current Load:		8.0Amps
Temperature Range:	operation:	-10°C to +55°C
	storage:	-30°C to +70°C
Size(PCB):		190 x 63mm
Weight (Loaded PCB):		291gm

5.8.3 Photo of Regulator PCB (regulator heatsink side)



5.9 Channel Control & Channel Selective Modules (17-002101 & 17-009127)

5.9.1 Channel Selective Module Description

The channel selectivity module is employed when the Cell Enhancer requirement dictates that very narrow bandwidths (single operating channels), must be selected from within the operating passband. One channel selectivity module is required for each channel.

The Channel Selectivity Module is an Up/Down frequency converter that mixes the incoming channel frequency with a synthesised local oscillator, so that it is down-converted to an Intermediate Frequency (IF) in the upper HF range. An eight pole crystal filter in the IF amplifier provides the required selectivity to define the operating passband of the Cell Enhancer to a single PMR channel. The same local oscillator then converts the selected IF signal back to the channel frequency.

Selectivity is obtained from a fixed bandwidth block filter operating at an intermediate frequency (IF) in the low VHF range. This filter may be internal to the channel selectivity module (Crystal or SAW filter) or an externally mounted bandpass filter, (LC or Helical Resonator). Various IF bandwidths can therefore be accommodated. A synthesized Local Oscillator is employed in conjunction with high performance frequency mixers, to translate between the signal frequency and IF.

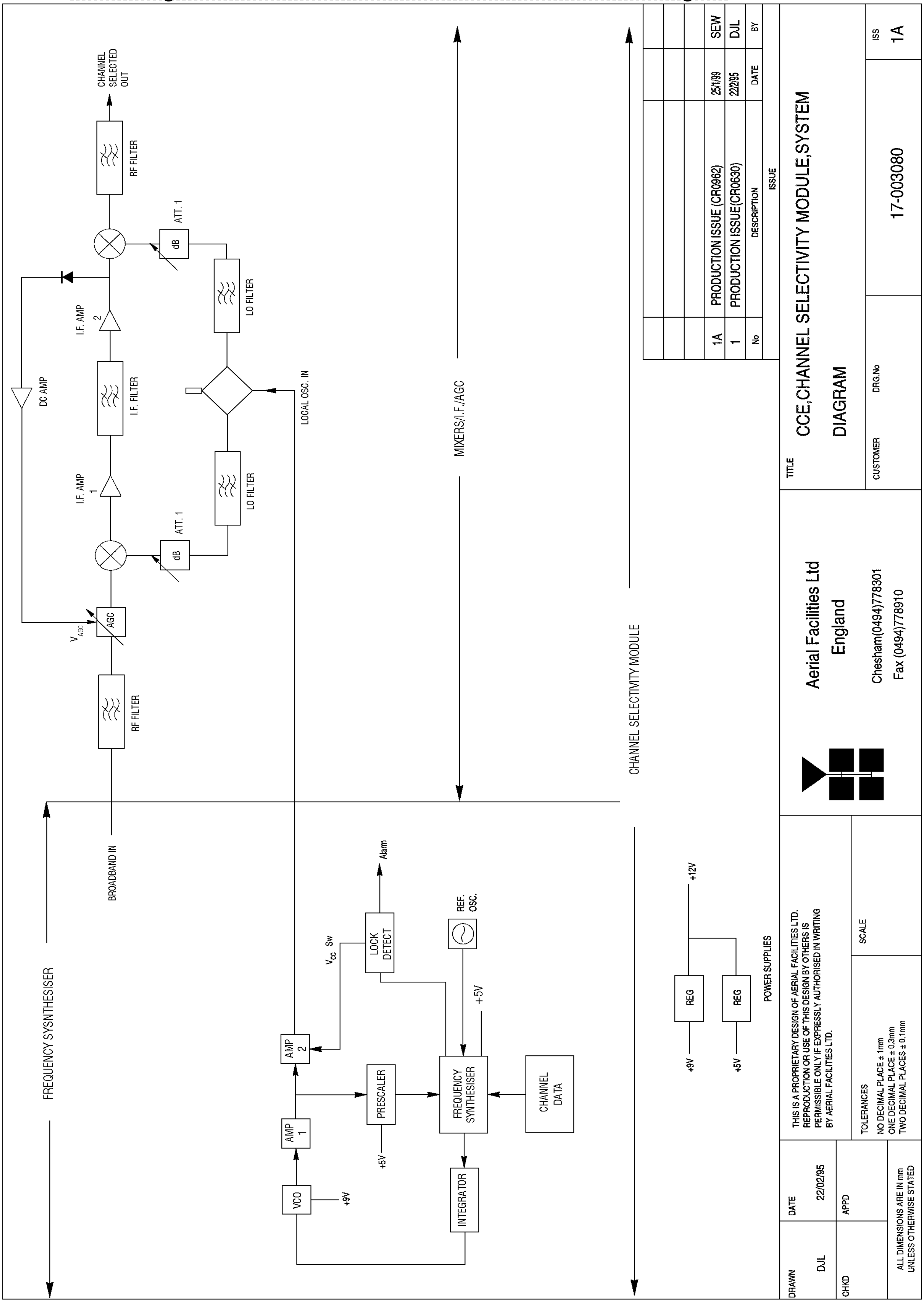
The operating frequency of each channel selectivity module is set by the programming of channel selectivity module frequencies and is achieved digitally, via hard wired links, banks of DIP switches, or via an onboard RS232 control module, providing the ability to remotely set channel frequencies.

Automatic Level Control (ALC) is provided within each channel selectivity module such that the output level is held constant for high level input signals. This feature prevents saturation of the output mixer and of the associated amplifiers.

Alarms within the module inhibit the channel if the synthesised frequency is not locked. The synthesiser will not usually go out of lock unless a frequency far out of band is programmed.

The channel selectivity module is extremely complex and, with the exception of channel frequency programming within the design bandwidth, it cannot be adjusted or repaired without extensive laboratory facilities and the necessary specialised personnel. If a fault is suspected with any channel selectivity module it should be tested by substitution and the complete, suspect module should then be returned to AFL for investigation.

5.9.2 Drg. Nō. 17-003080, Generic Channel Module Block Diagram



5.9.3 Channel Control Module Description

The control module consists of a bank of four, in-line data switches each of which control one channel module frequency setting. One controller unit can therefore control four channel modules. The following list shows the frequencies available for each switch setting.

5.9.4 Channel Controller Frequencies

IDC PIN	25-way Connector	Function
1	13	Freq. bit 1 (12.5kHz)
2	25	Freq. bit 2 (25kHz)
3	12	Freq. bit 3 (50kHz)
4	24	Freq. bit 4 (100kHz)
5	11	Freq. bit 5 (200kHz)
6	23	Freq. bit 6 (400kHz)
7	10	Freq. bit 7 (800kHz)
8	22	Freq. bit 8 (1.6MHz)
9	9	Freq. bit 9 (3.2MHz)
10	21	Freq. bit 10 (6.4MHz)
11	8	Freq. bit 11 (12.8MHz)
12	20	Freq. bit 12 (25.6MHz)
13	7	Freq. bit 13 (51.2MHz)
14	19	Freq. bit 14 (102.4MHz)
15	6	Freq. bit 15 (204.8MHz)
16	18	Freq. bit 16 (409.6MHz)
17	5	Module alarm
18	17	Gain bit 1
19	4	Gain bit 2
20	16	Gain bit 3
21	3	Gain bit 4
22	15	+5V
23	2	0V
24	14	Switched 12V
25	1	0V
26	---	---

5.9.5 Channel Frequency Control Switch Table

Downlink Frequencies (MHz)	DIP Switch Setting	Uplink Frequencies (MHz)	DIP Switch Setting
857.7625	1,2,3,4,6,8,10,16	812.7625	2,3,5,7,10,16
859.9375	2,3,9,10,16	814.9375	1,3,4,6,8,10,16
859.7625	1,2,3,4,5,6,7,810,16	814.7625	2,3,6,8,10,16
857.9375	2,3,5,6,8,10,16	812.9375	1,3,4,5,7,10,16
858.2375	2,7,8,10,16	8132375	1,4,6,7,10,16
860.4375	2,4,5,9,10,16	815.4375	1,7,8,10,16
859.4375	2,5,6,7,8,10,16	814.4375	1,4,5,8,10,16
858.7625	1,2,3,5,78,10,16	813.7625	2,3,4,5,6,7,10,16

5.10 24V Single Relay Board (80-008902)

5.10.1 Description

The General Purpose Relay Board allows the inversion of signals and the isolation of circuits. It is equipped with a single dual pole change-over relay RL1, with completely isolated wiring, accessed via a 15 way in-line connector.

The relay is provided with polarity protection diodes and diodes for suppressing the transients caused by "flywheel effect" which can destroy switching transistors or induce spikes on neighbouring circuits. It’s common use is to amalgamate all the alarm signals into one, volts-free relay contact pair for the main alarm system.

Note that the board is available for different voltages (12 or 24V) depending on the type of relay fitted at RL1.

5.11 24V 400W Flat-Pack Power Supply (96-300011)

5.11.1 Description

The power supply unit is a switched-mode type capable of supplying 24V DC at 16.0Amps continuously. Equipment of this type typically requires approximately 10.0 Amps at 24V DC, so the PSU will be used conservatively ensuring a long operational lifetime.

No routine maintenance of the PSU is required. If a fault is suspected, then the output voltage from the power supply may be measured on its output terminals. This is typically set to 24.5V.

All the PSU's used in AFL Cell Enhancers are capable of operation from either 110 or 220V nominal AC supplies. The line voltage is sensed automatically, so no adjustment or link setting is needed by the operator. No drawings of the PSU are available.

5.11.2 Technical Specification

AC Input Supply:		
Voltage:		110 or 220V nominal - 90 to 132 or 180 to 264V (single phase, absolute limits)
Frequency:		47 to 63Hz
DC Output Supply:		
Voltage:		24V DC (nominal), 22 to 26V (absolute limits)
Current:		16.0A
Temperature range:	operational:	-10BC to +55BC
	storage:	-40BC to +70BC

6. INSTALLATION

6.1 Initial Installation Record

When this equipment is initially commissioned, please use the equipment set-up record sheet in Appendix A. This will help both the installation personnel and AFL should these figures be needed for future reference or diagnosis.

6.2 General

The size and weight of the wall unit means that it represent a significant health hazard unless it is mechanically installed in the correct manner. In the interests of safety this should be done before any electrical or RF connections are made.

It is important in determining the location of the wall units that space is allowed for access to the front and underneath of the equipment. To enable maintenance to be carried out, the door must be able to fully open. The location must be served with a duct to allow the entry of cables into the unit.

6.3 Electrical Connections

The mains power supply and the alarms are connected through an IP65 connector which should need no further attention once connected. It is recommended that the AC power connection is approved by a qualified electrician, who must satisfy himself that the supply will be the correct voltage and of sufficient capacity.

All electrical and RF connection should be completed and checked prior to power being applied for the first time.

6.4 RF Connections

All RF connections are made to the cable termination, located on the right-hand side of the wall enclosure. Care must be taken to ensure that the correct connections are made with particular attention made to the base station TX/RX ports. In the event that the base transmitter is connected to the RX output of the unit, damage to the equipment may be done if the base station transmitter is then keyed. If the environment where the equipment is installed is deemed to be 'wet' i.e. water seepage through roofs or walls, then suitable methods to seal the RF N type connectors should be used, for example self amalgamating sealant tape.

Ensure that connections are kept clean and are fully tightened.

6.5 Commissioning

Once all connections are made the equipment is ready for commissioning.

To commission the system the test equipment detailed in section 7.2 will be required.
Using the system diagrams and the end-to-end test specification, the equipment should be tested to ensure correct operation. Typical RF levels that are not listed in the end-to-end specification, such as input levels are detailed in the whole system diagram in section 4.

On initial power up the system alarm indicators on the door of the equipment should be checked. A red LED illuminated indicates a fault and that particular module must be investigated before proceeding with the commissioning. A green LED illuminates, to indicate that the power supply is connected and valid.

In the event that any part of the system does not function correctly as expected, check all connections to ensure that they are to the correct port, that the interconnecting cables are not faulty and that they are tightened. The majority of commissioning difficulties arise from problems with the interconnecting cables and connectors.

7. MAINTENANCE

7.1 General Procedures

7.1.1 Fault Finding

In the event that the performance of the system is suspect, a methodical and logical approach to the problem will reveal the cause of the difficulty. The System consists of modules within a wall mounted, environmentally protected enclosure.
Transmissions from the main base stations are passed though the system to the mobile radio equipment; this could be a handheld walkie-talkie, mobile telephone or a transceiver in a vehicle. This path is referred to as the downlink. The return signal path from the mobile radio equipment to the base station is referred to as the uplink.

The first operation is to check the (optional) alarms of each of the active units and determine that the power supplies to the equipment are connected and active.
This can be achieved remotely (via CEMS, the digital RS232 Coverage Enhancement Management System, if fitted), or locally with the front door LED's. The green LED on the front door should be illuminated, while the red alarm indicator should be off.

If an Alarm is on, then that individual module must be removed and tested against the original test specification.
The individual amplifier units have a green LED showing through a hole in their piggy-back alarm board (or directly through a hole in the amplifier lid), which is illuminated if the unit is working correctly.

If an amplifier is suspect, check the DC power supply to the unit. If no other fault is apparent use a spectrum analyser to measure the incoming signal level at the input and then after reconnecting the amplifier input, measure the output level. Consult with the system diagram and amplifier specification to determine the expected gain and compare result.

In the event that there are no alarms on and all units appear to be functioning it will be necessary to test the system in a logical manner to confirm correct operation.

7.1.2 Downlink

Confirm that there is a signal at the expected frequency and strength from the base station. If this is not present then the fault may lay outside the system. To confirm this, inject a downlink frequency signal from a known source at the master site BTS input and check for output at the remote site feeder output.

If a signal is not received at the output it will be necessary to follow the downlink path through the system to find a point at which the signal is lost. The expected downlink output for the given input can be found in the end-to-end test specification.

7.1.3 Uplink

Testing the uplink involves a similar procedure to the downlink except that the frequencies used are those transmitted by the mobile equipment.

7.1.4 Fault repair

Once a faulty component has been identified, a decision must be made on the appropriate course to carry out a repair. A competent engineer can quickly remedy typical faults such as faulty connections or cables. The exceptions to this are cable assemblies connecting bandpass filter assemblies that are manufactured to critical lengths to maintain a 50-ohm system. Care should be taken when replacing cables or connectors to ensure that items are of the correct specification. The repair of component modules such as amplifiers, tuned cavities or bandpass filters will not usually be possible in the field, as they frequently require specialist knowledge and test equipment to ensure correct operation. It is recommended that items of this type are replaced with a spare unit and the faulty unit returned to AFL for repair. If spare parts need to be ordered from AFL, be sure to quote the serial number of the Cell Enhancer/Repeater and the serial number [and frequencies] of the module(s) to be replaced.

7.1.5 Checking service

Following the repair of any part of the system it is recommended that a full end-to-end test is carried out in accordance with the test specification and that the coverage is checked by survey.
It is important to bear in mind that the system includes a radiating cable network and base stations that may be faulty or may have been damaged.

7.1.6 Service Support

Advice and assistance with maintaining and servicing this system are available by contacting Aerial Facilities Ltd.

7.2 Tools & Test Equipment

The minimum tools and test equipment needed to successfully service this AFL product are as follows:-

Spectrum analyser:	100kHz to 2GHz (Dynamic range = 90dB).
Signal Generator:	30MHz to 2GHz (-120dBm to 0dBm o/p level).
Attenuator:	20dB, 10W, DC-2GHz, (N male – N female).
Test Antenna:	Yagi or dipole for operating frequency.
Digital multi-meter:	Universal Volt-Ohm-Amp meter.
Test cable x 2:	N male – N male, 2M long RG214.
Test cable x 2:	SMA male – N male, 1m long RG223.
Hand tools:	Philips #1&2 tip screwdriver.
	3mm flat bladed screwdriver.
	SMA spanner and torque setter.

7.3 Care of Modules

7.3.1 General Comments

Many of the active modules contain semiconductor devices utilising MOS technology, which can be damaged by electrostatic discharge. Correct handling of such modules is mandatory to ensure their long-term reliability.

To prevent damage to a module, it must be withdrawn/inserted with care. The module may have connectors on its underside, which might not be visible to the service operative.

7.3.2 Module Removal (LNA's, general procedure):

The following *general* rules should be followed to remove a module:

1 Remove power to the unit
2 Remove all visible connectors (RF, DC & alarm)
3 Release module retaining screws.
4 Slowly but firmly, pull the module straight out of its position. Take care not to twist/turn the module during withdrawal. (When the module is loose, care may be needed, as there may be concealed connections underneath).

7.3.3 Module Replacement (general):

1 Carefully align the module into its location then slowly push the module directly straight into its position, taking care not to twist/turn it during insertion.
2 Reconnect all connectors, RF, alarm, power etc.,(concealed connectors may have to be connected first).
3 Replace retaining screws (if any).
4 Double-check all connections before applying power.

7.3.4 Power Amplifiers

1) Remove power to the unit. (Switch off @ mains/battery, or remove DC in connector)

2) Remove alarm wires from alarm screw terminal block or disconnect multi-way alarm connector.

3) Carefully disconnect the RF input and output coaxial connectors (usually SMA)

   If alarm board removal is not required, go to step 5.

4) There is (usually) a plate attached to the alarm board which fixes it to the amplifier, remove its retaining screws and the alarm board can be withdrawn from the amplifier in its entirety. On certain types of amplifier the alarm board is <u>not</u> mounted on a dedicated mounting plate; in this case it will have to firstly be removed by unscrewing it from the mounting pillars, in most cases, the pillars will not have not have to be removed before lifting the amplifier.

5) If the amplifier to be removed has a heatsink attached, there may be several different ways it can have been assembled. The most commonly used method, is screws through the front of the heatsink to threaded screw holes (or nuts and bolts), into the amplifier within the main case. If the heatsink is mounted on the rear of the main case (e.g., against a wall in the case of wall mounted enclosures), then the fixing method for the heatsink will be from within the case, (otherwise the enclosure would have to be removed from the wall in order to remove the heatsink).

   When the heatsink has been removed, the amplifier may be unscrewed from the main casing by its four corner fixings and gently withdrawn.

   Fitting a new power amplifier module will be the exact reverse of the above.

   Note: Do not forget to apply fresh heatsink compound to the heatsink/main case joint and also between the amplifier and the main case.

7.3.5 Low Power Amplifier Replacement

1 Disconnect the mains power supply and disconnect the 24V dc supply connector for the LPA.
2 Disconnect the RF input and output cables from the LPA.
3 Disconnect the alarm connector.
4 Remove the alarm monitoring wires from (D type connector) pins 9 and 10.
5 Remove the LPA module by removing the four retaining screws, replace with a new LPA module and secure it with the screws.
6 Connect the RF cables to the LPA input and output connectors. Reconnect the wires to the alarm board connector pins 9 and 10.
7 Reconnect the DC supply connector and turn the mains switch on.

Note: Tighten SMA connectors using only a dedicated SMA torque spanner. If SMA connectors are over-tightened, irreparable damage will occur. . *Do not use adjustable pliers to loosen/tighten SMA connectors*.

Also take care not to drop or knock the module as this can damage (or misalign in the case of tuned passive modules) sensitive internal components. Always store the modules in an environmentally friendly location

7.3.6 Module Transportation:

To maintain the operation, performance and reliability of any module it must be stored and transported correctly. Any module not installed in a whole system must be kept in an anti-static bag or container. These bags or containers are normally identified by being pink or black, and are often marked with an ESD label. Any module sent back to AFL for investigation/repair must be so protected. Please contact AFL's quality department before returning a module.

APPENDIX A INITIAL EQUIPMENT SET-UP CALCULATIONS

GENERAL INFORMATION			
Site Name:		Client Name:	
Date:		AFL Equip. Model Nō.	

ANTENNA SYSTEMS				
	Model	**Gain**	**Azimuth**	**Comments**
A - Service Antenna				
B – Donor Antenna				
	Type	**Loss**	**Length**	**Comments**
C – Service Feeder				
D – Donor Feeder				

INITIAL PARAMETERS	
E – CE Output Power	dBm
F – Antenna Isolation	dB
G – Input signal level from donor BTS	dBm
Operating Voltage	V

DOWNLINK CALCULATIONS		
Parameter	**Comments**	**Value**
Input signal level (**G**)		dBm
CE max. o/p power (**E**)		dBm
Gain setting	**E - G**	dB
Isolation required	(Gain + 10dB)	dB
Service antenna gain (**A**)		dB
Service antenna feeder loss (**C**)		dB
Effective radiated power (ERP)	**E+A-C**	dBm
Attenuator setting	CE gain-gain setting	dB

If the input signal level in the uplink path is known and steady, use the following calculation table to determine the gain setting. If the CE features Automatic Gain Control the attenuator should be set to zero and if not, then the attenuation setting for both uplink and downlink should be similar.

UPLINK CALCULATIONS		
Parameter	**Comments**	**Value**
Input signal level		dBm
CE max. o/p power (**E**)		dBm
Gain setting		dB
Required isolation		dB
Donor antenna gain (**B**)		dB
Donor antenna feeder loss (**D**)		dB
Effective radiated power (**ERP**)	E+B-D	dBm
Attenuator setting	(CE gain-gain setting)	dB