Channelised Bi-Directional RF Amplifier

Operation & Maintenance Manual
For

Dicarlo Associates, Inc.

AFL product part Nō.: **50-063701**

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AMENDMENT LIST RECORD SHEET

Issue Nō.	Date	Incorporated by	Page No.'s Amended	Reason for new issue
1	29/09/2003	CMH		1st Issue
2	03/11/03	PLB	8	Add FCC RF exposure Note

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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.

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.

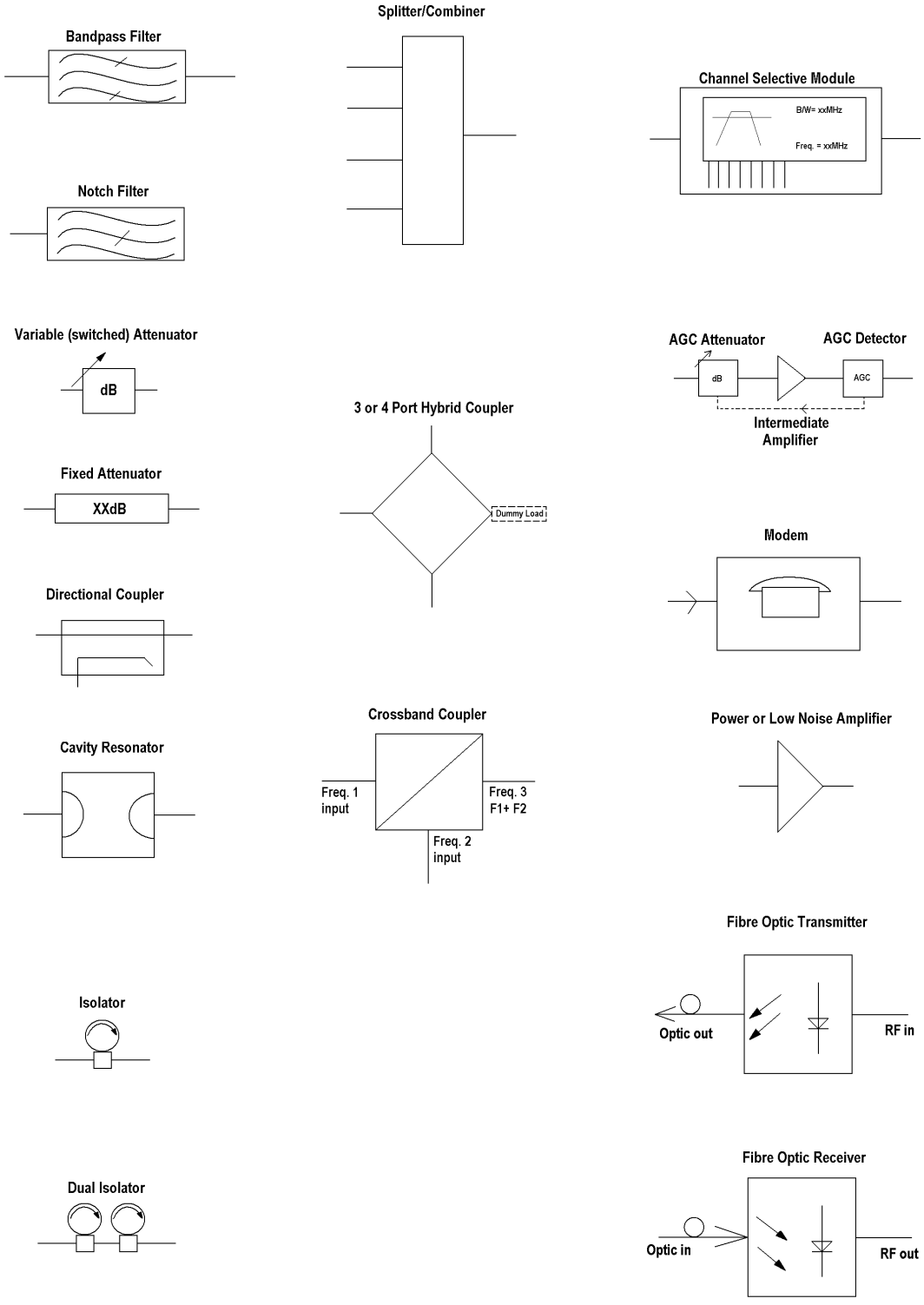
AFL has a policy of continuous product development and enhancement, and as such, reserves the right to amend, alter, update and generally change the contents, appearance and pertinence of this document without notice.

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
RSA	Receiver/Splitter Amplifier
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

Key to AFL RF Module Drawing Symbols



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

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.
IMPORTANT NOTE: To comply with FCC RF exposure compliance requirements, a separation distance of at least 20cm must be maintained between the leaky feeder attached to this device and all persons. Furthermore the gain of antennas attached must be chosen and located so as to satisfy the MPE categorical exclusion and co-location requirements.

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 equipment covered in this manual is a UHF Bi-directional Amplifier (also known as a Repeater). Its main sphere of application is in urban areas where the topography is such that shadows occur in the propagation pattern (for example within large buildings, conference centres and tunnels, etc.)

The Amplifier is a 4-port device for direct connection to two Base facing antennas, usually a highly directional Yagi or similar aligned towards the base (donor) site, and two radiating cable feeders to cover the mobiles. The channel frequencies passed by the Amplifier are set as per the specific customer requirements. In this instance, the channel module frequencies have been 'hard-wired' and so it is not possible to change frequencies without some re-configuration of the channel programming.

The system for which the Amplifier is to be used with is mainly duplex channel UHF radio system but with a single simplex channel. The duplex channels operate constantly in each direction using the Base Antenna port 2 and Radiating Cable port 2. There are five Downlink (Base Transmit) duplex channels and four Uplink (Base Receive) duplex channels. In addition there is the Uplink simplex (talkaround) channel operating via these ports.

The Downlink simplex channel operates through the Base Antenna port 1 and Radiating Cable port 1 ports. This is to avoid any interaction between the common frequency channel high gain paths. Using separate antennas adds the isolation required for the simplex part of the Amplifier to work.

The simplex channels are not constantly operating in their entirety. Instead, each simplex path has the output amplification disabled and when an input is detected in one path that amplifier will be switched on and the other path will be held off until that input signal has stopped. In this way, the simplex part of the system is constantly ready to pass the channel in either path.

The Bi-directional Amplifier consists of six different 19" rack mount 4U chassis. These are a Base side Duplex/PA chassis (AFL part: **50-063702**) to provide the link with Antenna 2 and the remainder of the system. In addition there is a Tunnel side Duplex/PA chassis (AFL part: **50-063705**) to connect the Radiating cable 2 to the remainder of the system. The channel selectivity is made in the Downlink by a Downlink Channel chassis (AFL part: **50-063703**) and in the Uplink by the Uplink Channel chassis (AFL part: **50-063704**). The Downlink simplex channel and part of the Uplink simplex channel circuit is housed in the Simplex chassis (AFL part: **50-063706**) and there is a Power Supply chassis (AFL part: **50-063707**) to provide the DC supply to each of the five RF units.

The Bi-directional Amplifier is housed in a single 38U 19" rack. All external connections are made towards the bottom of the rear of the rack suitable for cable entry via cable ducts through the open underside of the rack. External connections are for the 110V AC input, four 'N' type female RF connectors and a Krone block for the alarm output.

For better understanding of the system, the system diagram on page 23 should be consulted.

Downlink path

Duplex system signals in the Downlink path arriving at Base Antenna port 2 are first passed to the Base side chassis and so through a duplexed bandpass filter to ensure good input selectivity. This is then followed by a 31dB gain LNA to provide some amplification and a switchable attenuator then allows up to 30dB of gain adjustment in 2dB steps.
From here signals are routed to the Downlink Channel chassis where a 2 way splitter is followed by two three way splitters to provide six equal paths. One of these is terminated with a 50ohm load and the remaining five each connect to a channel selectivity module. The Downlink channel modules offer 15dB gain and have ALC circuitry to limit the module output to -25dBm. This is ensure that the total output power may not become higher than the specified level. The channel module outputs are taken to two three way combiners for connection to a two way combiner which then routes signals out of the Downlink Channel chassis and to the Tunnel side chassis.
The Downlink duplex channel frequencies factory set are:
457.050MHz
458.225MHz
457.850MHz
457.300MHz
457.775MHz
In the Tunnel side chassis a 21dB gain LNA is then followed by a 15dB gain LPA to drive a 23dB gain 20Watt Power Amplifier which provides the final stage of amplification. The Power Amplifier is followed by a duplexed bandpass filter connecting to the Radiating cable port 2.

The Downlink simplex channel, 452.850MHz, is received at Base Antenna port 1 and is passed through a bandpass filter to provide selectivity. A 31dB gain LNA then provides initial amplification and this is followed by a switchable attenuator giving up to 30dB of gain adjustment in 2dB steps. An ALC attenuator is then fitted for muting the input of the channel module when an Uplink path signal has been detected and is being amplified in that direction. The channel module following the attenuator has 15dB of gain and has ALC circuitry to limit the module output to -20dBm to limit the total output power to that specified in case of an increase in off-air signal input. The channel module is followed by a 31dB gain LNA and then a 15dB gain 1Watt LPA. A bandpass filter after the LPA connects to the Radiating cable port 1.

Uplink path

All Uplink channels enter the Bi-Directional Amplifier at Radiating Cable port 2 and pass to the Tunnel side chassis where a duplexed bandpass filter routes the signals to the Uplink input amplifier, a 31dB gain LNA. A switchable attenuator then gives up to 30dB of gain adjustment in 2dB steps before signals connect to the Uplink Channel chassis.
In the Uplink Channel chassis, a 2 way splitter connects to two three way splitters to provide six equal paths. One of these is unused and so is terminated with a 50ohm load. Four of the remaining paths each connect to a channel selectivity module giving 15dB gain with an ALC limited maximum output of -23dBm. The four module outputs then connect to a four way combiner for routing to the Base side chassis. The last of the six paths is routed to the Simplex chassis which will be described later in this section.

The Uplink duplex channel frequencies are factory set:
452.050MHz
453.225MHz
452.300MHz
452.775MHz
The four Uplink duplex channels arrive in the Base side chassis and pass through a 21dB gain then a 15dB gain LPA driver before a 23dB gain 20Watt Power Amplifier. There is an isolator fitted at the PA output to provide protection from the Uplink simplex channel path. A 2 way combiner then combines the four duplex channels with the simplex channel and a bandpass filter then connects to the Base Antenna port 2.

In the Simplex chassis, the Uplink path from the Uplink Channel chassis is first routed through two ALC attenuators to mute the input to the Uplink channel selectivity module when a Downlink simplex signal is being passed in the other path. A channel selectivity module, set for 452.850MHz, then gives 25dB of gain and has an ALC level of -17dBm. The module is followed by a 31dB gain LNA and then a 15dB gain LPA with an isolator at the output to provide protection from the duplex path PA. The Uplink simplex signal then connects to the Mobile side chassis for routing to the 2 way combiner.

The Power Supply Unit operates from an AC supply of 110V and has a 7.5Ampere circuit breaker to switch the chassis On or Off. A 15A filter then provides some protection against instabilities in the AC supply. There are two 400Watt PSU modules fitted and the outputs of these are distributed to six 24V DC output sockets at the rear of the Power Supply chassis.

The RF connectors used for user interface are ‘N’ type female and interconnecting RF chassis connectors are SMA female. Each of the five RF chassis has a DC input fuse and the front panels have a green ‘Power ON’ LED and a red ‘ Alarm’ LED. The Power Supply chassis has a single green ‘Power ON’ front panel LED.

Each chassis has a summary alarm output connecting to the Krone block at the lower rear of the rack for user interface. In addition, the 19” rack has intruder alarms fitted to the front and rear doors of the rack. The alarm outputs may be connected to singly or in parallel as a rack summary. The alarm outputs are voltage free dry contacts being Closed in normal operation and Open in an Alarm state.

3. SPECIFICATION

3.1 50-063701 Parts Lists

50-063702	BASE ANT SIDE UHF DUPLEX/PA CHASSIS	1
50-063703	DOWNLINK UHF 5 CHANNEL CHASSIS	1
50-063704	UPLINK UHF 4 CHANNEL CHASSIS	1
50-063705	LCX SIDE UHF DUPLEX/PA CHASSIS	1
50-063706	UHF SIMPLEX CHANNEL CHASSIS	1
50-063707	POWER SUPPLY CHASSIS, 110V AC INPUT	1
97-500033	38U RACK 38U 600 x 600mm RAL7035	1
97-500065	EURORACK GND/EARTHING KIT	1

3.1.1 Base Antenna Side UHF Duplex/PA Shelf 50-063702 Parts List

02-010701	5POLE UHF COMBLINE BANDPASS FILTER	2
05-002603	UHF 3dB SPLITTER SMA	1
08-004905	25Watt 2 PORT ISOLATOR N 330-470MHz	1
10-000701	1/4Watt 0-30dB SWITCHED ATTENUATOR	1
11-006102	LPA 380-500MHz 1Watt	1
11-007302	LNA. 380-500MHz 20dB	1
11-007402	LNA. 380-500MHz 30dB	1
12-016301	POWER AMPLIFIER 380-470MHz 20Watt CLASS A	1
17-004327	ATTENUATOR COVER	1
17-004730	ATTENUATOR MOUNTING	1
19-000826	19" CHASSIS 400mm DEEP LID	1
19-001021	4U 19" RACKMOUNT 400mm DEEP CHASSIS	1
19-001024	4U 19" CHASSIS FRONT PANEL	1
80-063820	HEATSINK 20Watt PA	1
91-030002	N ADAPTOR PANEL FEMALE/FEMALE	1
91-130005	SMA BULKHEAD ADAPTOR FEMALE/FEMALE	2
91-500001	POWER PLUG 3 PIN PANEL MOUNT NC-X	1
91-600014	'D' 9 WAY SOCKET (NON FILTERED)	3
91-600015	'D' 9 WAY PLUG (NON FILTERED)	1
91-600019	'D'15 WAY SHELL (2W7)	1
91-640004	LARGE PIN FOR 91-660001 D SOCKET	2
91-660001	2W5 MIXED D TYPE SOCKET (7 WAY)	1
96-110021	T10A 0.25 x 1.25' FUSE CERAMIC	2
96-110034	FUSE HOLDER 16-30A, 32mm	1
96-700034	LED RED 5mm IP67	1
96-700035	LED GREEN 5mm IP67	1
97-400002	4U HANDLE [ALLOY]	2

3.1.2 Downlink UHF 5 Channel Shelf 50-063703 Parts List

05-002603	UHF 3dB SPLITTER SMA	2
05-003803	3 WAY SPLITTER, UHF	4
13-001803	DUAL DC/DC CONVERTER 24V-12V 1A	2
17-003012	CHANNEL MODULE 450MHz, 15kHz (8p)	5
19-000826	19" CHASSIS 400mm DEEP LID	1
19-001021	4U 19" RACK MOUNT 400mm DEEP CHASSIS	1
19-001024	4U 19" CHASSIS FRONT PANEL	1
20-001601	12V RELAY BOARD	3
91-130005	SMA BULKHEAD ADAPTOR FEMALE/FEMALE	2
91-500001	POWER PLUG 3 PIN PANEL MOUNT NC-X	1
91-600015	'D' 9 WAY PLUG (NON FILTERED)	1
91-620001	'D' 25 WAY SOCKET	5
93-930003	SMA 50ohm TERMINATION	2
96-110001	FUSE HOLDER 20 x 5mm6.3A	1
96-110011	T 4A A.SURGE FUSE 20mm	2
96-600002	INSULATING BOOT SMALL	1
96-600003	INSULATING BOOT D.C.	1
96-700034	LED RED 5mm IP67	1
96-700035	LED GREEN 5mm IP67	1
97-400002	4U HANDLE [ALLOY]	2

3.1.3 Uplink UHF 4 Channel Shelf 50-063704 Parts List

05-002603	UHF 3dB SPLITTER SMA	1
05-003401	4 WAY SPLITTER LOW POWER	1
05-003803	3 WAY SPLITTER, UHF	2
13-001803	DUAL DC/DC CONVERTER 24V-12V 1A	2
17-003012	CHANNEL MODULE 450MHz, 15kHz (8p)	4
19-000826	19" CHASSIS 400mm DEEP LID	1
19-001021	4U 19" CHASSIS 400mm DEEP CHASSIS	1
19-001024	4U 19" CHASSIS FRONT PANEL	1
20-001601	12V RELAY BOARD	2
91-130005	SMA BULKHEAD ADAPTOR FEMALE/FEMALE	3
91-500001	POWER PLUG 3 PIN PANEL MOUNT NC-X	1
91-600015	'D' 9 WAY PLUG	1
91-620001	'D' 25 WAY SOCKET	4
93-930003	SMA 50ohm TERMINATION	1
96-110001	FUSE HOLDER 20 x 5mm6.3A	1
96-110011	T 4A A.SURGE FUSE 20mm	2
96-600002	INSULATING BOOT SMALL	1
96-600003	INSULATING BOOT D.C.	1
96-700034	LED RED 5mm IP67	1
96-700035	LED GREEN 5mm IP67	1
97-400002	4U HANDLE [ALLOY]	2

3.1.4 Tunnel side UHF Duplex/PA Shelf 50-063705 Parts List

02-010701	5POLE COMBLINE BANDPASS FILTER	2
10-000701	1/4Watt 0-30dB SWITCHED ATTENUATOR	1
11-006102	LPA 380-500MHz 1Watt	1
11-007302	LNA. 380-500MHz 20dB	1
11-007402	LNA. 380-500MHz 30dB	1
12-016301	POWER AMPLIFIER 380-470MHz 20Watt CLASS A	1
13-001803	DUAL DC/DC CONVERTER 24V-12V 1A	1
17-004327	ATTENUATOR COVER	1
17-004730	ATTENUATOR MOUNTING	1
19-000826	19" CHASSIS 400mm DEEP LID	1
19-001021	4U 19" RACK MOUNT 400mm DEEP CHASSIS	1
19-001024	4U 19" CHASSIS FRONT PANEL	1
80-063820	HEATSINK 20Watt PA	1
91-030002	N ADAPTOR PANEL FEMALE/FEMALE	1
91-130005	SMA BULKHEAD ADAPTOR FEMALE/FEMALE	2
91-500001	POWER PLUG 3 PIN PANEL MOUNT NC-X	1
91-600014	'D' 9 WAY SOCKET (NON FILTERED)	3
91-600015	'D' 9 WAY PLUG (NON FILTERED)	1
91-600019	'D'15 WAY SHELL (2W7)	1
91-640004	LARGE PIN FOR 91-660001 D SOCKET	2
91-660001	2W5 MIXED D TYPE SOCKET (7 WAY)	1
96-110021	T10A 0.25 x 1.25' FUSE CERAMIC	2
96-110034	FUSE HOLDER 16-30A, 32mm	1
96-700034	LED RED 5mm IP67	1
96-700035	LED GREEN 5mm IP67	1
97-400002	4U HANDLE [ALLOY]	2

3.1.5 UHF Simplex Shelf 50-063706 Parts List

02-010701	5POLE COMBLINE BANDPASS FILTER	2
08-930003	2 PORT ISOLATOR 360-470MHz SMA	1
10-000701	1/4Watt 0-30dB SWITCHED ATTENUATOR	1
11-006102	LNA 380-500MHz 1Watt	2
11-007402	LNA. 380-500MHz 30dB	3
13-001803	DUAL DC/DC CONVERTER 24V-12V 1A	2
13-002811	SIMPLEX CONTROLLER	1
17-001201	ALC ATTENUATOR	2
17-002802	SIMPLEX RX/SQUELCH & AF	2
17-004327	ATTENUATOR COVER	1
17-004730	ATTENUATOR MOUNTING	1
17-010802	CHANNEL MODULE 450MHz 8p 15kHz BW + IF OUT	2
19-000826	19" CHASSIS 400mm DEEP LID	1
19-001021	4U 19" RACK MOUNT 400mm DEEP CHASSIS	1
19-001024	4U 19" CHASSIS FRONT PANEL	1
20-001601	12V RELAY BOARD	1
91-030002	N ADAPTOR PANEL FEMALE/FEMALE	2
91-130005	SMA BULKHEAD ADAPTOR FEMALE/FEMALE	2
91-500001	POWER PLUG 3 PIN PANEL MOUNT NC-X	1
91-600014	'D' 9 WAY SOCKET (NON FILTERED)	5
91-600015	'D' 9 WAY PLUG (NON FILTERED)	1
91-620001	'D' 25 WAY SOCKET	1
96-110034	FUSE HOLDER 16-30A, 32mm	1
96-700034	LED RED 5mm IP67	1
96-700035	LED GREEN 5mm IP67	1
97-400002	4U HANDLE [ALLOY]	2

3.1.6 Power Supply Shelf 50-063707 Parts List

80-008902	24V RELAY PCB ASSEMBLY	1
80-008920	DUAL PSU HEATSINK	2
80-008921	DUAL PSU CASE	1
80-008922	DUAL PSU LID	1
80-008925	DUAL PSU FRONT PANEL	1
91-510004	3 PIN PANEL MOUNT SOCKET NC-X	6
91-510035	3 WAY MATE N LOK PLUG HOUSING	2
91-520001	POWER MAINS INLET FIXED	1
91-520005	MAINS LEAD (IEC)	1
91-520010	MAINS RETAINING CLIP	1
91-520032	MATE N LOK SOCKET CONTACT 20/14 AWG	6
91-600015	'D' 9 WAY PLUG (NON FILTERED)	1
91-700017	ICD 15 WAY 0.1' CONNECTOR	1
91-700062	6 WAY 0.1' CONNECTOR	2
91-800015	TRIPLE DECK TERMINAL BLOCK	6
91-800016	TRIPLE DECK TERMINAL JUMPER	2
91-800017	TRIPLE DECK TERMINAL END	1
91-800031	SYMETRIC 35 x 7.5mm DIN RAIL	1
92-900014	DIN RAIL (TOP HAT) EARTH CLAMP M5	1
96-300054	24V 17A PSU 400W (XP BCC)	2
96-500005	DC INPUT FILTERS	6
96-500009	SURGE FILTER, 15A, 110V, DIN RAIL	1
96-600001	INSULATING BOOT LARGE	1
96-700034	LED RED 5mm IP67	1
96-700035	LED GREEN 5mm IP67	1

3.2 Technical Specification

PARAMETER		SPECIFICATION
Frequency range:		457.0-458.5MHz (Downlink) + 452.850MHz
		452.0-453.5MHz (Uplink)
Bandwidth:		1.5MHz
Gain:		80dB (70dB +/- 10dB)
Gain Adjustment:		0 - 30dB (in 2dB steps)
Channel Bandwidth:		15kHz
Channel Selectivity:		> 20dBc at +/-12.5kHz
Uplink Power output:		+23dBm per channel
Downlink Power output:		+23dBm per channel
OIP3: Uplink		+50dBm
Downlink		+54dBm
In-band Spurious Noise Figure:		<-36dBm (30kHz B/W)
ALC:		Fitted in each channel module
VSWR:		better than 1.5:1
RF Connectors:		N type, female
Temperature range:	operational:	-30°C to +60°C
	storage:	-40°C to +70°C
Summary alarm: (volt-free contacts at Krone block)		1 PSU Chassis
		2 Tunnel side Chassis
		3 Base side Chassis
		4 Simplex Chassis
		5 Downlink Channels Chassis
		6 Uplink Channels Chassis
		7 Rack Doors Open

3.2.1 Channel Module Frequencies

17-003012 Duplex Channel Modules				
Frequency (MHz)	**Bandwidth**	**Gain**	**ALC**	**Qty.**
457.050 (Downlink)	15kHz	15dB	-25dBm	1
457.300 (Downlink)	15kHz	15dB	-25dBm	1
457.775 (Downlink)	15kHz	15dB	-25dBm	1
457.850 (Downlink)	15kHz	15dB	-25dBm	1
458.225 (Downlink)	15kHz	15dB	-25dBm	1
452.050 (Uplink)	15kHz	15dB	-23dBm	1
452.300 (Uplink)	15kHz	15dB	-23dBm	1
457.775 (Uplink)	15kHz	15dB	-23dBm	1
453.225 (Uplink)	15kHz	15dB	-23dBm	1

17-010802 Simplex Channel Modules				
Frequency (MHz)	**Bandwidth**	**Gain**	**ALC**	**Qty.**
452.850(Uplink)	15kHz	25dB	-17dBm	1
452.850(Downlink)	15kHz	15dB	-20dBm	1

All with hardwired frequency selection

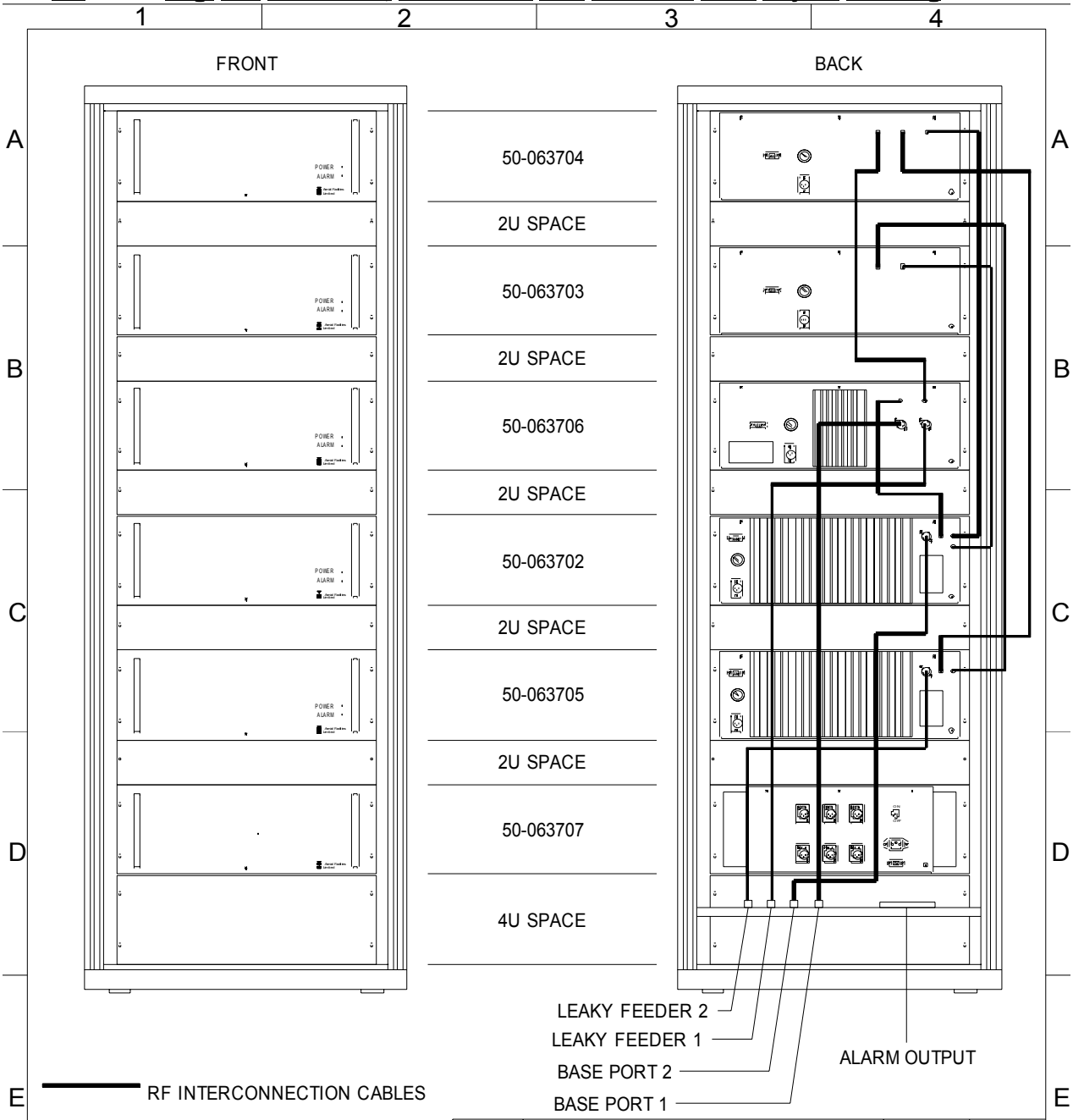
3.3 Mechanical Specification

PARAMETER		SPECIFICATION
Case (rack) size:	Height:	38U Eurorack (1U=44.5mm)
	Width:	600mm
	Depth:	600mm
Temperature Range:	operational:	-30°C to +60°C
	storage:	-40°C to +70°C
Weight:		>100kg*
Humidity:		10 – 90% non-condensing
RF Connectors:		N type female
Environmental Protection:		IP40
Finish:	Shelves:	Alocrom
	Heatsinks:	Black anodised
	Handles:	Alloy
Supply Cable:		Unit supplied with suitable supply input leads with connector and specified length of cable.

* Note: Individual shelf weights not specified.

4. SYSTEM DRAWINGS

4.1 Drg. Nō. 50-063751, Channelised Cell Enhancer Rack Layout Drawing



No	DESCRIPTION	DATE	BY
1A	PRODUCTION ISSUE	23/09/03	MNR

ISSUE

THIRD ANGLE PROJECTION

Aerial Facilities Limited
Tel : 01494 777000 Fax : 01494 777002

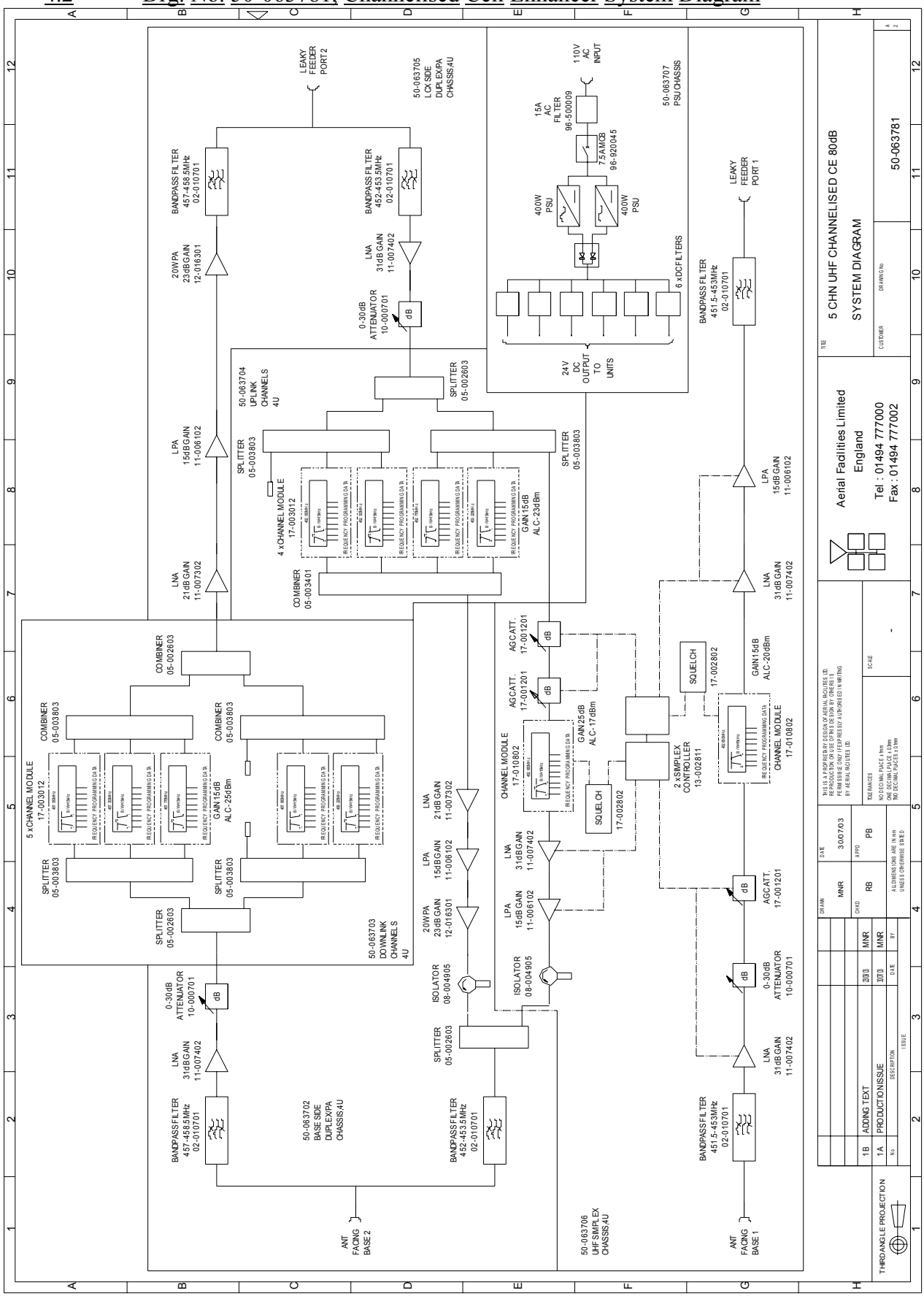
TOLERANCES
NO DECIMAL PLACE ± 1mm
ONE DECIMAL PLACE ± 0.3mm
TWO DECIMAL PLACES ± 0.1mm

ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED

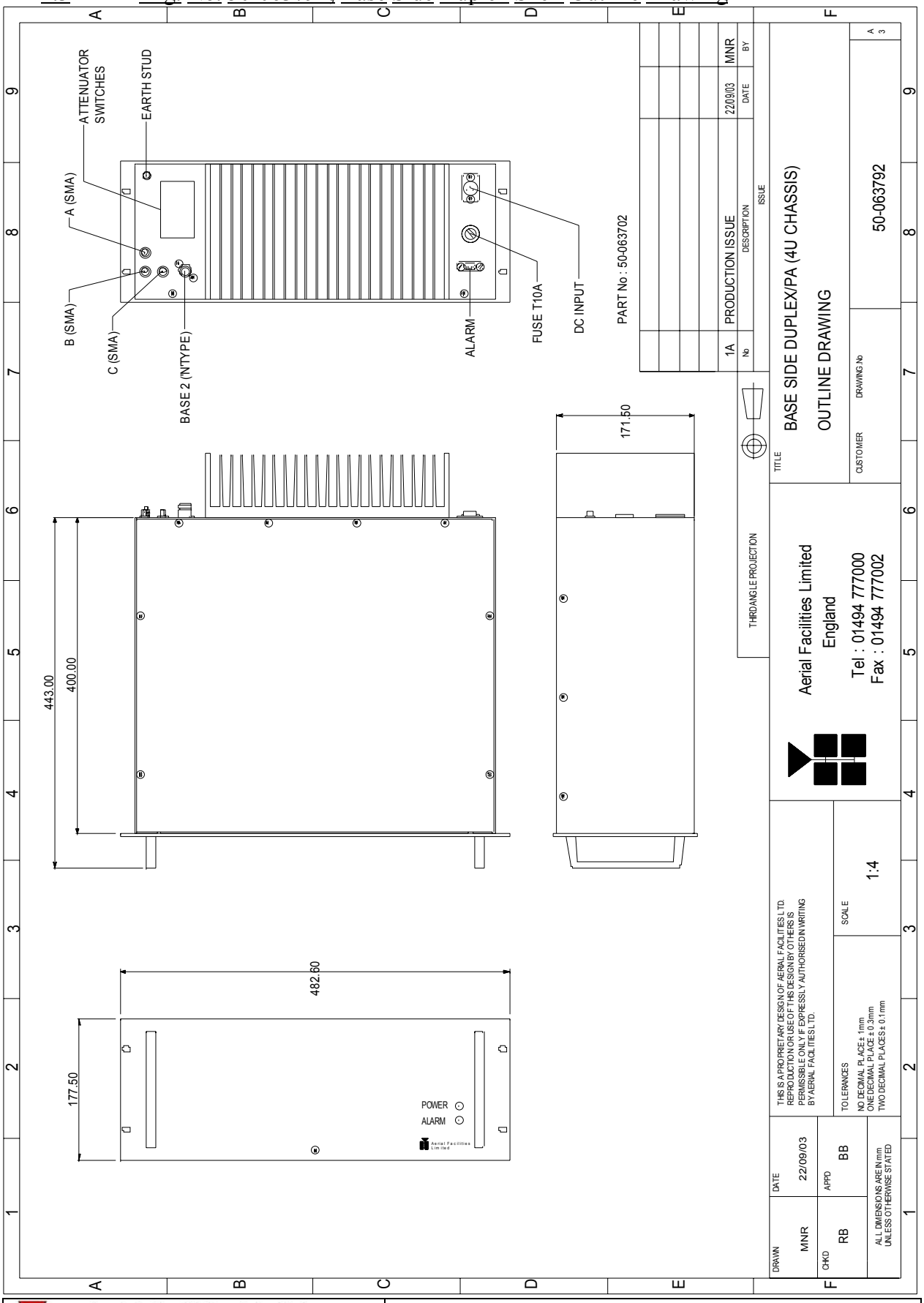
TITLE: RACK INTERCONNECTION AND LAYOUT FOR 5 CHN UHF CHANNELISED CE 80dB

DRAWN	DATE	CHKD	APPD	SCALE	CUSTOMER	DRAWING No	A4
MNR	23/09/03	RB	BB	1:10		50-063751	

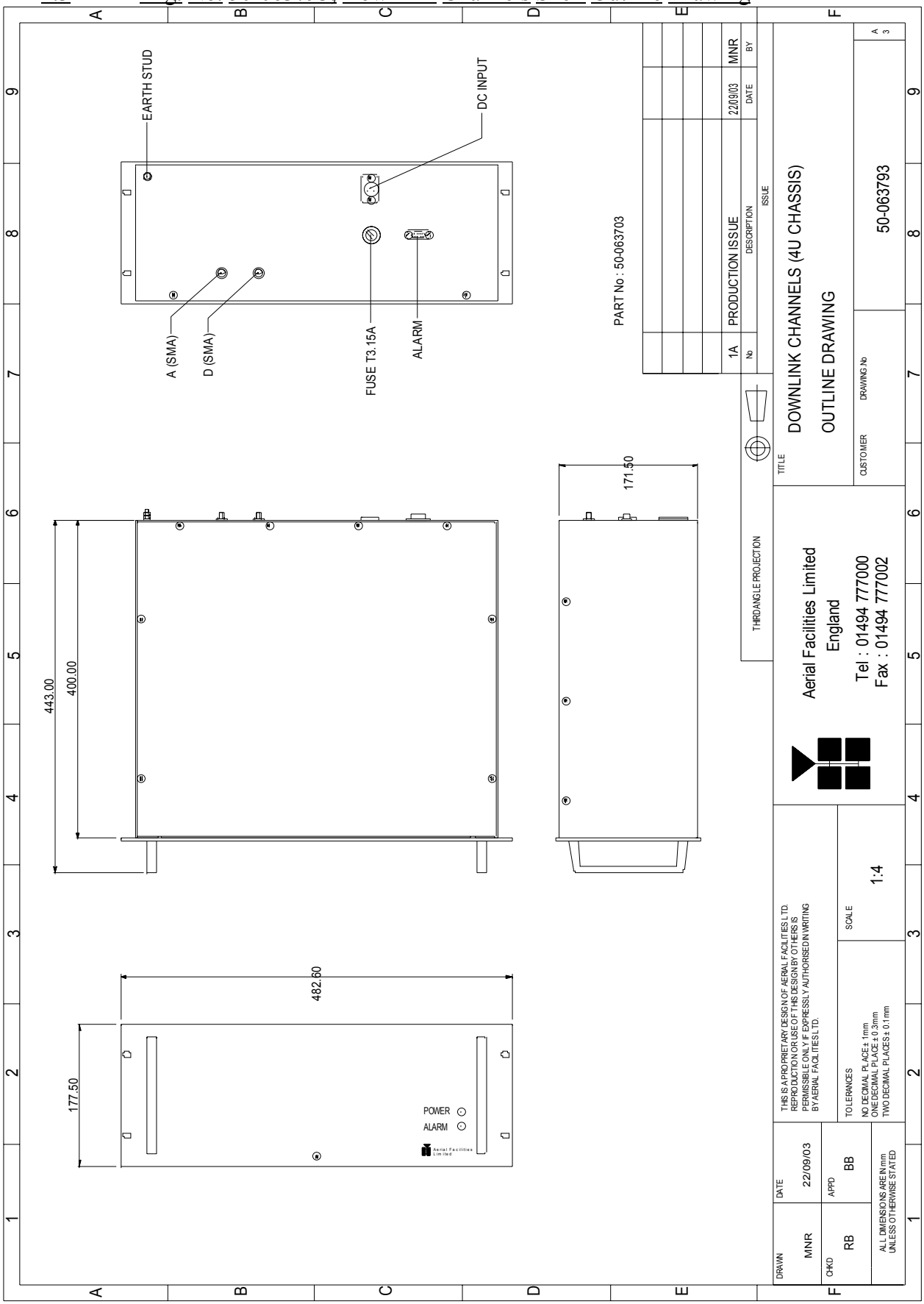
4.2 Drg. Nō. 50-063781, Channelised Cell Enhancer System Diagram



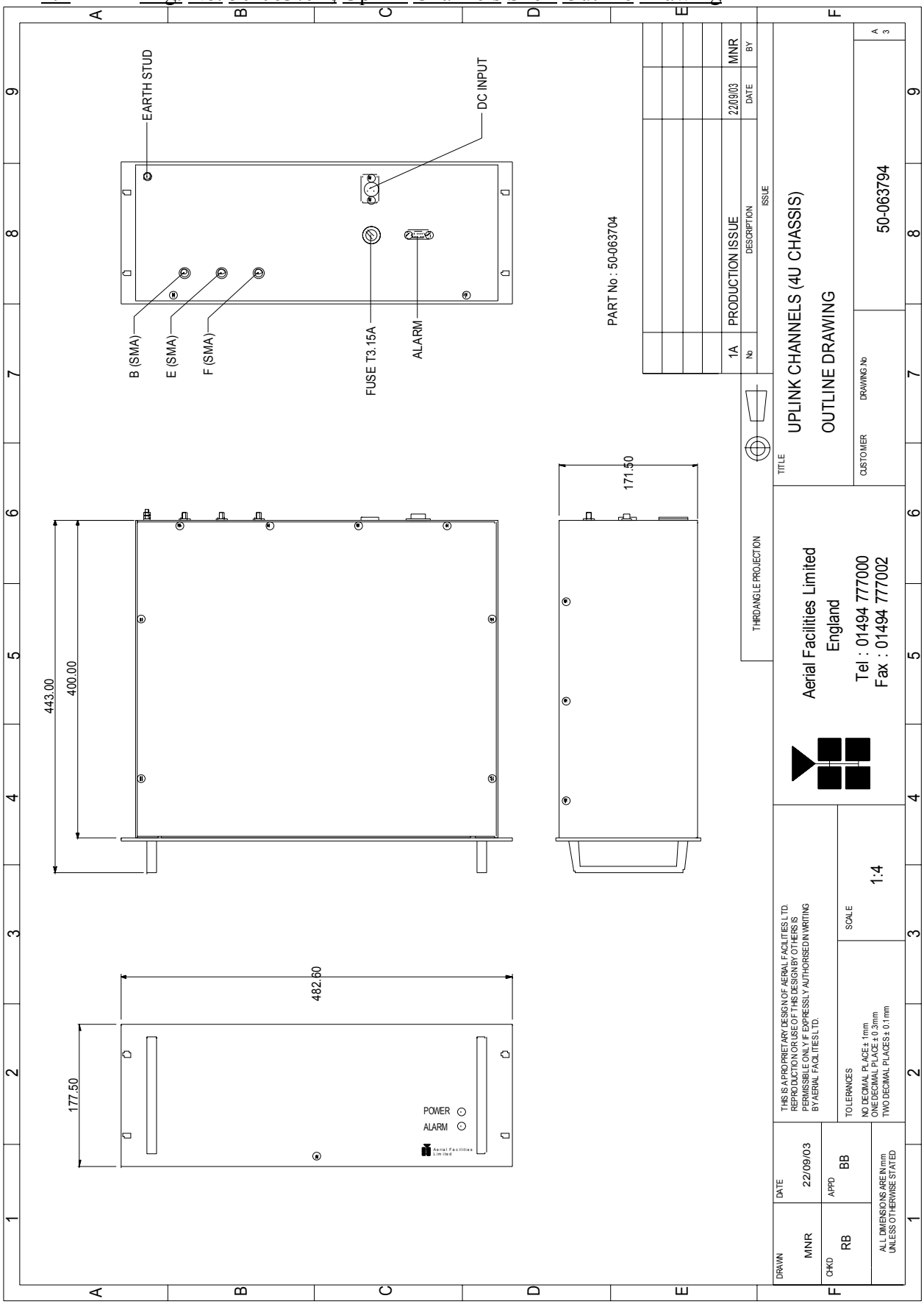
4.3 Drg. Nō. 50-063792, Base Side Duplex Shelf Outline Drawing



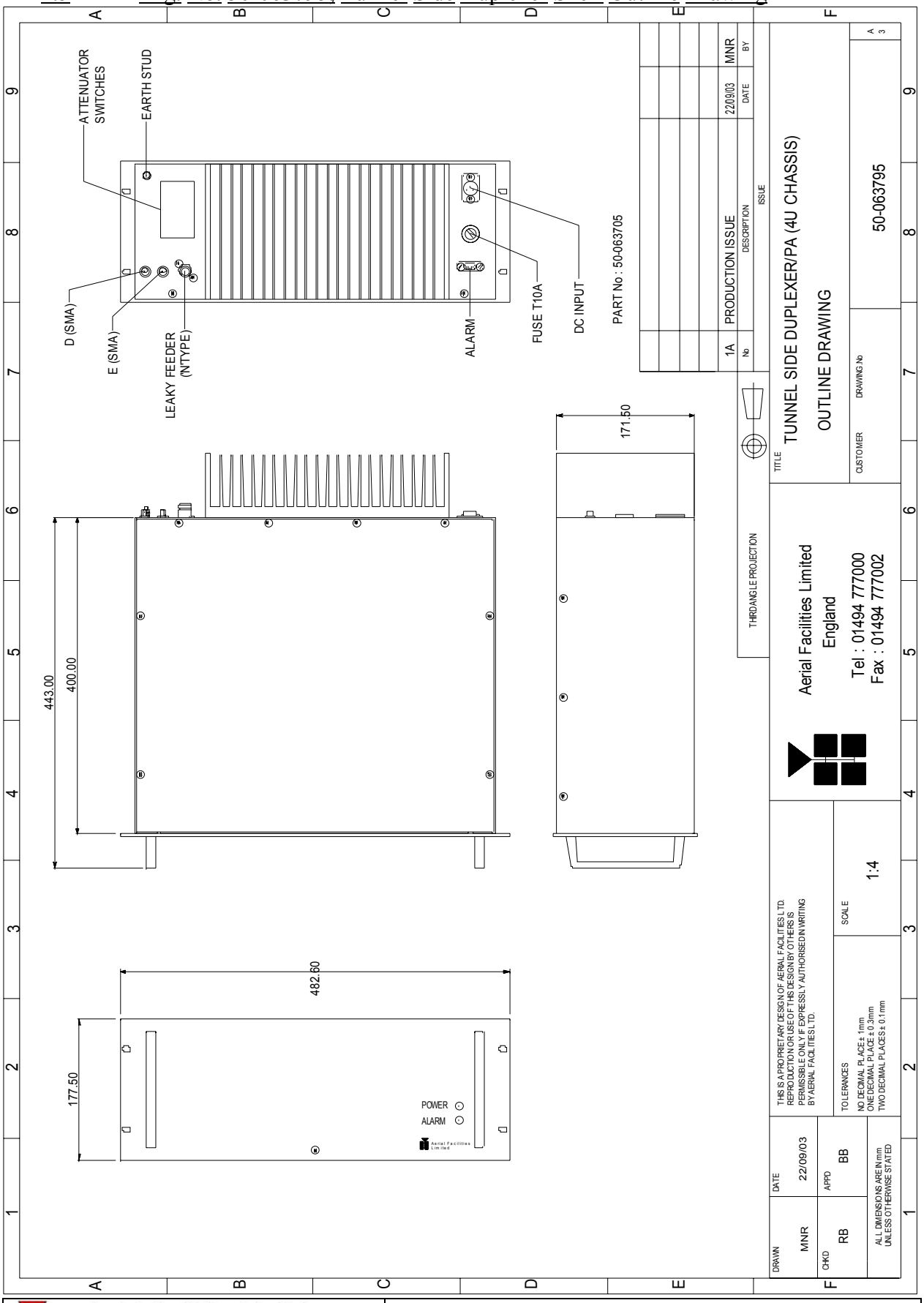
4.3 Drg. Nō. 50-063793, Downlink Channels Shelf Outline Drawing



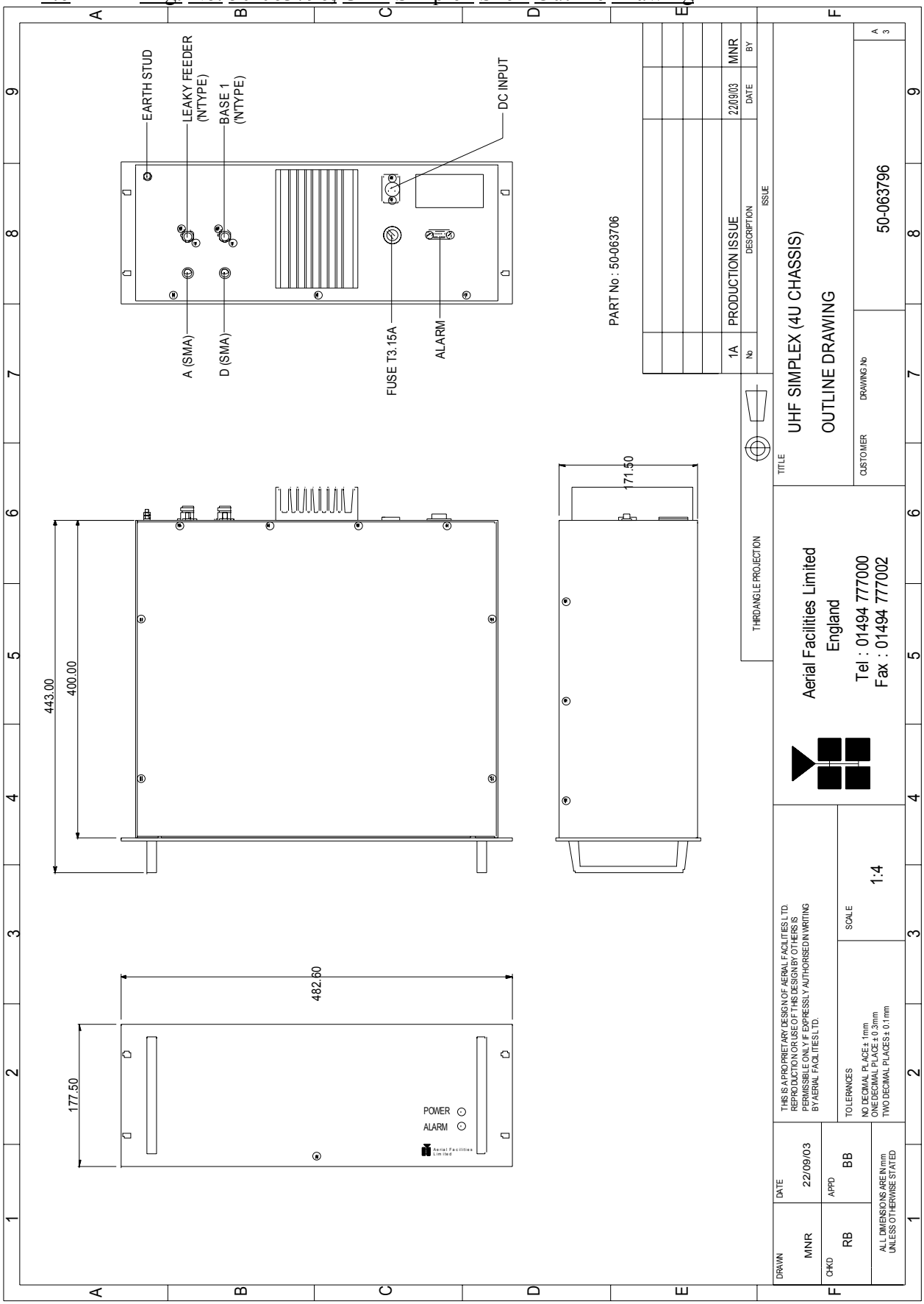
4.4 Drg. Nō. 50-063794, Uplink Channels Shelf Outline Drawing



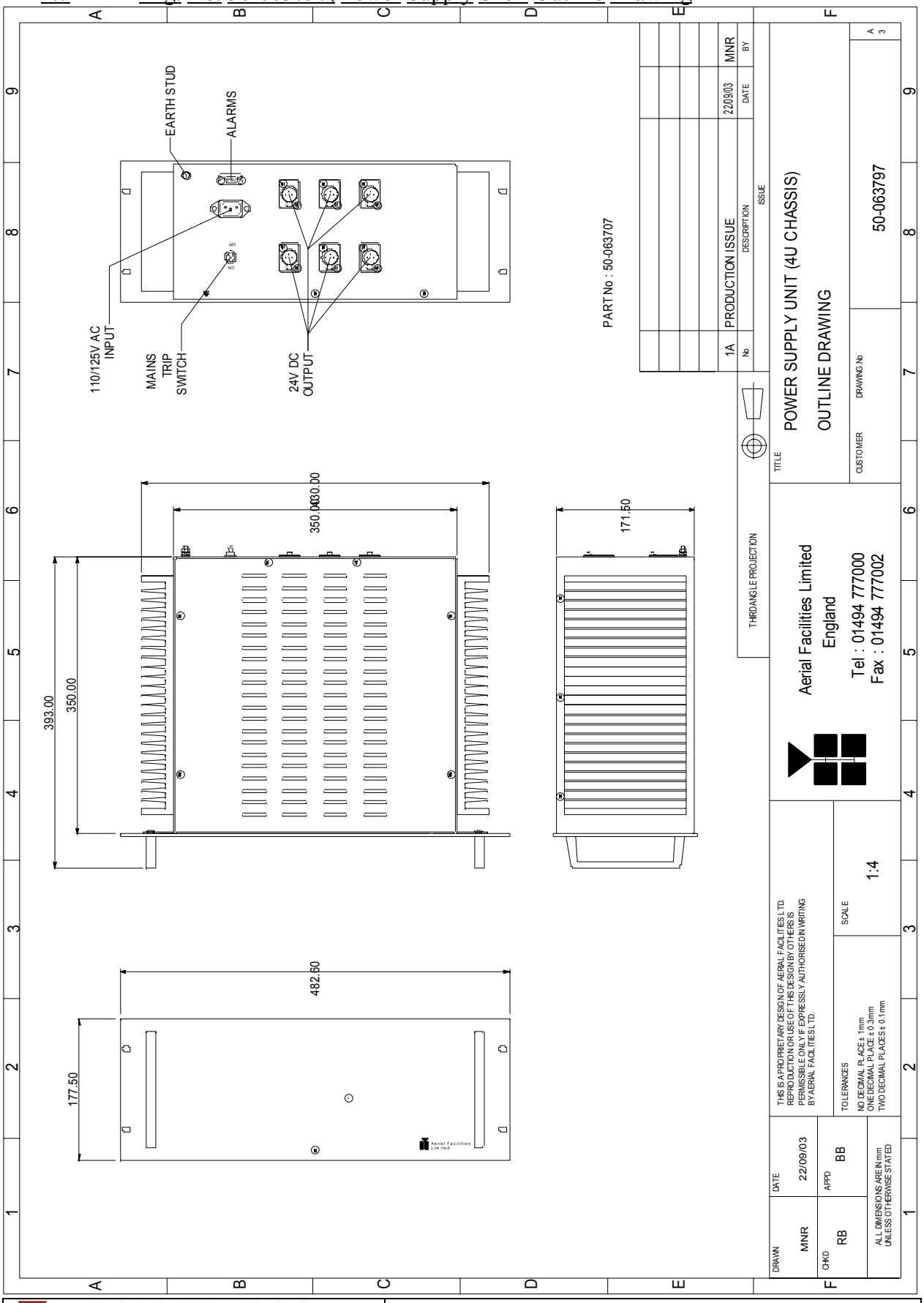
4.5 Drg. Nō. 50-063795, Tunnel Side Duplexer Shelf Outline Drawing



4.6 Drg. Nō. 50-063796, UHF Simplex Shelf Outline Drawing



4.7 Drg. Nō. 50-063797, Power Supply Shelf Outline Drawing



5. SUB-UNIT MODULES

5.1 UHF Duplex Shelf 50-063702

5.1.1 Bandpass Filter (02-010701)

5.1.1.1 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.

5.1.1.2 Technical Specification

PARAMETER		SPECIFICATION
Response Type:		Chebyshev
Frequency Range:		457.0-458.5MHz (Downlink)
		452.0-453.5MHz (Uplink)
Bandwidth:		1.5 MHz
Number of Sections:		5
Insertion Loss:		1.7 dB (typical)
VSWR:		better than 1.2:1
Connectors:		SMA
Power Handling:		100W max
Temperature range	operation:	-30°C to +60°C
	storage:	-40°C to +70°C
Weight:		3 kg (typical)

5.1.2 3dB UHF Splitter (05-002603)

5.1.2.1 Description

The 3dB 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 over the specified frequency range and ensuring that the VSWR and insertion losses are kept to a minimum.

5.1.2.2 Technical Specification

PARAMETER	SPECIFICATION
Frequency Range:	380 - 520 MHz
Bandwidth:	140 MHz
Inputs:	1
Outputs:	2
Insertion Loss:	3.5 dB (typical)
Isolation:	>18 dB
Return Loss (VSWR) – Input:	Better than 1.3:1
Impedance:	50 ς
Power Rating – Splitter:	20 Watts
Power Rating – Combiner:	0.5 Watt
Connectors:	SMA female
Weight:	200 gm (approximately)

5.1.3 Ferrite Isolator (08-930003)

5.1.3.1 Description

The purpose of fitting an isolator to the output of a transmitter in a multi-transmitter environment is such that each output is afforded a degree of isolation from every other. Were this not to be the case, two simultaneous transmissions could interfere to create intermodulation products, especially in the non-linear power amplifier output stages of the transmitters. Whilst this effect would not affect the intelligibility of the two original transmissions, a further two new transmissions would be created which could themselves cause interference to third party users. In this case it is to isolate the duplex and simplex uplink power amplifiers from inter-modulating each other.

A ferrite-isolator, (or junction circulator, as it is sometimes known) generally consists of several major components; for example a ferrite region, a magnetic circuit and matching circuitry which can form a three port isolator.
The ferrite isolator is a ferro-magnetic device, which has directional properties. In the forward direction, RF arriving at the input is passed to the output with minimal attenuation. In the reverse direction, RF arriving at the output due to reflected power from a badly matched load, or due to coupling with another transmitter, is routed into an RF load where it is absorbed. The isolator therefore functions to prevent reflected RF energy reaching the power amplifier where it could cause intermodulation products or premature device failure.

Ferrite materials form the active part of the junction in which the actual circulation signal flow occurs. When a signal encounters a ferrite disk (e.g. port l) biased with a magnetic field, it divides and part of the signal flows in a clockwise direction, while a portion of the signal travels in the counter-clockwise direction, each with a different velocity. The combined effects of the two rotating signals, create a standing wave around the perimeter of the ferrite disk. By choosing the proper value of the ferrite's magnetisation and the magnetic field, the standing wave can be made to create a voltage null at port 3, such that no power is transferred to it and a peak voltage at port 2, transferring maximum power to it from port l. If a termination is placed on port 3 to absorb the signal flow in the reverse direction the device functions as an isolator.

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

5.1.4.1 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.

5.1.4.2 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.

5.1.5 Low Noise Amplifiers (11-006102, 11-007302 & 11-007402)

5.1.5.1 Description

The low noise amplifiers used are double stage solid-state low-noise amplifiers. 11-006102 is a low noise amplifier with a 1Watt power device in its final stage, enabling it to be used as a driver for the 20W power amplifier. Class A circuitry is used in the units to ensure excellent linearity over a very wide dynamic range. The two 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 failure the entire amplifier should be replaced.

5.1.5.2 Technical Specification, 11-007302

PARAMETER		SPECIFICATION
Frequency range:		380-500MHz
Bandwidth:		<140MHz
Gain:		20-22dB
1dB Compression Point:		+23.5dB (typical)
3rd order intercept:		+36dB (typical)
Input/Output return loss:		>20dB
Noise figure:		<1.3dB
Connectors:		SMA female
Supply:		200-230mA @ 24V DC
Temperature range:	operational:	-30°C to +60°C
	storage:	-30°C to +70°C
Weight:		<300gm
Size:		90 x 55 x 30.2mm (case only)

5.1.5.3 Technical Specification, 11-007402

PARAMETER		SPECIFICATION
Frequency range:		380-500MHz
Bandwidth:		<140MHz
Gain:		30-32dB
1dB Compression Point:		+22dBm (typical)
3rd order intercept:		+34-35dBm (typical)
Input/Output return loss:		>20dB
Noise figure:		<1.3dB
Connectors:		SMA female
Supply:		300-330mA @ 24V DC
Weight:		<300gm
Size:		90 x 55 x 30.2mm (case only)
Temperature range	operation:	-30°C to +60°C
	storage:	-40°C to +70°

5.1.5.4 Technical Specification, 11-006102

Frequency range:		380-500MHz
Bandwidth:		<150MHz
Gain:		15dB (typical)
1dB compression point:		+31dBm
IP3:		+46dBm
I/O return loss:		>18dB
Noise figure:		<1.3dB
Supply requirement:		10 – 24V, DC
Consumption:		510-540mA @ (10 – 24V)
Temperature range	operation:	-30°C to +60°C
	storage:	-40°C to +70°

5.1.6 20W Power Amplifier (12-016301)

5.1.6.1 Description

This amplifier is a Class A 20W power amplifier from 380MHz to 470MHz in a 1 stage balanced configuration. It demonstrates a very high linearity and a very good input/output return loss. A built in a Current Fault Alarm Function monitors DC conditions to both transistor collectors and gives an alarm upon bias change.
Its housing is a machined aluminium case (Alocrom 1200 finish) with SMA connectors for the RF input/output and a D-Type connector for the power supply and the Current Fault Alarm Function.

5.1.6.2 Technical Specification

PARAMETER		SPECIFICATION
Frequency range:		380-470MHz
Small signal gain:		23dB
Gain flatness:		±1.7dB
I/O Return loss:		>18dB
1dB compression point:		+43dBm
OIP3:		+55dBm
Supply voltage:		24V DC
Supply current:		3.8Amps (typical)
Temperature range	operational:	-30°C to +60°C
	storage:	-40°C to +70°C
Weight:		<2kg (no heatsink)

5.2 5 Channel UHF Downlink Shelf 50-063703

5.2.1 3dB Splitter 905-002603) See section 5.1.2

5.2.2 3 Way Splitter/Combiner (05-003803)

5.2.2.1 Description

The 3 way Splitter/Combiner used is a 'Zinger' type design for accurately matching three RF signals to a single port, whilst maintaining an accurate balance between ports, and ensuring that the VSWR and insertion losses attain the best possible specification. They are specialist passive devices and must be replaced in the unlikely event of failure.

5.2.2.2 Technical Specification

PARAMETER	SPECIFICATION
Frequency Range:	380 - 520 MHz
Bandwidth:	140 MHz (typical)
Inputs:	3
Outputs:	1
Insertion Loss:	5.2 dB (typical)
Isolation:	>18 dB
Return Loss (VSWR) – Input:	Better than 1.35:1
Return Loss (VSWR) – Output:	Better than 1.35:1
Impedance:	50 ς
Power Rating – Splitter:	20 Watts
Power Rating – Combiner:	0.5 Watt
Connectors:	SMA female
Size:	54 x 44 x 21 mm (including connectors)
Weight:	200 gm (approximately)

5.2.3 Dual DC/DC Converter (13-001803)

5.2.3.1 Description

This unit is employed where it is necessary to derive two fixed voltage power supply rails from some higher voltage. Typically it is used to derive 5, 8, 12 or 15V from a 24V input.

The circuit is based upon a pair of LM257 series variable voltage regulators (LM2576, 12 & 15V & LM2575, 5V), which are each capable of supplying an absolute maximum of 1.5A output current. Note that at full output current, the dissipation of the device must remain within design limits, bearing in mind the voltage which is being dropped across it. The maximum allowable dissipation will also depend on the efficiency of the heatsink on which the device is mounted.

5.2.3.2 Technical Specification

PARAMETER		SPECIFICATION
Operating Voltage:		21 – 27V DC
Output Voltage:		12V & 12V (typical)
Output Current:		1.0A (maximum per o/p)
Connections:		Screw Terminal Block
Temperature Range	operational:	-30BC to +60BC
	storage	-40BC to +70BC
PCB Size:		85 x 63mm

5.2.4 Channel Selective Module (17-003006)

5.2.4.1 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.

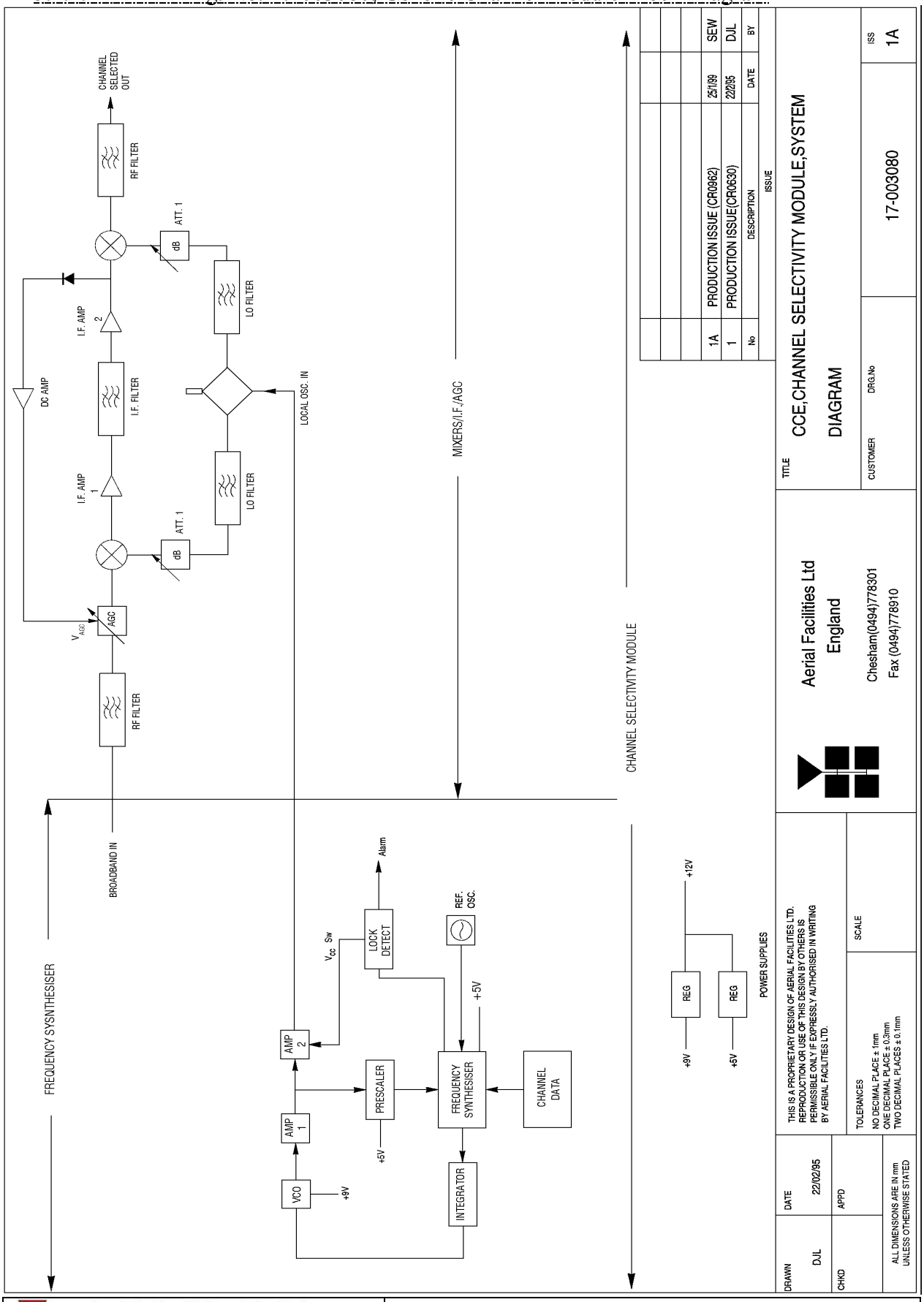
The operating frequency of each channel selectivity module is set by the programming of channel selectivity module frequencies and is achieved digitally, via hard wired links, banks of DIP switches, or via an onboard RS232 control module, providing the ability to remotely set channel frequencies.

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.

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



5.2.5 12V Relay Board (20-001601)

5.2.5.1 Description

The General Purpose Relay Board allows the inversion of signals and the isolation of circuits. It is equipped with two dual pole change-over relays RL1 and RL2, with completely isolated wiring, accessed via screw terminals.

Both relays are 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 relays fitted at RL1 and RL2.

5.2.5.2 Technical Specification

PARAMETER		SPECIFICATION
Operating voltage:		8 to 30V (floating earth)
Alarm Threshold:		Vcc - 1.20 volt ±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:		Screw terminals
Temperature range	operational:	:-30°C to +60°C
	storage:	:-40°C to +70°C

5.3 UHF Uplink 4 Channel Shelf 50-063704

5.3.1 Four Way Splitter (05-003401)

5.3.1.1 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.

5.3.1.2 Technical Specification 05-003401

PARAMETER		SPECIFICATION
Frequency range:		70 – 250MHz
Bandwidth:		180MHz
Rejection:		>14dB
Insertion loss:		6.5dB (in band, typical)
Connectors:		SMA
Weight:		<1.5kg
Temperature range:	operational:	-30BC to +60BC
	storage	-40BC to +70BC

All other modules in this shelf are described elsewhere in this document.

5.4 UHF Duplex/PA Shelf 50-063705

All modules in this shelf are described elsewhere in this document.

5.5 UHF Simplex Channel Shelf 60-063706

5.5.1 Simplex Controller PCB (13-002811)

5.5.1.1 Description

The Simplex controller logic PCB monitors the receiver squelch output for a signal change and activates the supply switching for either the uplink or down link path accordingly. In normal operation, the low level Rx path is activated, any the associated Tx path is switched off. When a signal is detected by the Rx Squelch module, the Rx squelch output goes low (0v), which triggers the controller logic PCB. The PCB mutes the power supply to the opposite path Rx LNA's and switches on the power to the output power stage. In order to prevent the power stage noise blocking the opposite path's low level receiver, the power amplifier is normally muted.

5.5.2 ALC Attenuator Module (17-001201)

5.5.2.1 Description

The AFL Automatic Gain Control system consists of two units, a detector/amplifier and an attenuator. The detector/amplifier unit is inserted in the RF path on the output of the power amplifier, and the attenuator is situated in the RF path between the 1st and 2nd stages of amplification. However, in this case only the attenuator is employed as part of the simplex control system
The attenuator comprises a 50Ω P.I.N diode, voltage-variable attenuator with a range of 3 to 30dB. The attenuation is controlled by a DC voltage which is derived in this instance from the simplex controller board.

5.5.3 Simplex Squelch Controller PCB (17-002802)

5.5.3.1 Description

The difference in signal levels between the up and downlink paths means that the channel modules would latch onto any signal in the band rather than a signal at the desired channel frequency. This is achieved, in part, to having the simplex controller apply maximum attenuation (via the AGC attenuator unit) to the downlink path, when the uplink is active.

All other modules in this shelf are described elsewhere in this document.

5.6 Power Supply Shelf 50-063707

5.6.1 24V, 400W Power Supply Pack (96-300054)

5.6.1.1 Description

The power supply unit is a switched-mode type capable of supplying 24V DC at 17.0Amps 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 using the multi-turn potentiometer mounted close to the DC output studs on the PSU PCB.

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.

5.6.1.1 Technical Specification

AC Input Supply	
Voltages:	110 or 220V nominal
	90 to 132 or 180 to 264V (absolute limits)
Frequency:	47 to 63Hz
DC Output Supply:	
Voltage:	24V DC (nominal)
	20 to 28V (absolute limits)
Maximum current:	17A

All other modules in this shelf are described elsewhere in this document.

6. INSTALLATION

6.1 Initial Installation Record

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

Installation will be a matter of securing each shelf into its appropriate place in the rack cabinet, connecting all the cables (RF, AC, DC and alarm) to their correct ports/connectors and system testing (at the customer's discretion) to prove the original specification. Power should not be applied until all connections have been double-checked and verified.

Refer to the system/layout drawing(s) in section 4.0 for cabling details.

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 radio 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 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 RS232 Cell Enhancer Management System, if fitted), or locally with the front panel LED's. The green LED on the front panel should be illuminated, while the red alarm indicator should be off.

If an Alarm is on, then that individual shelf must be removed and individually tested against the original test specification.
The individual amplifier units within the shelf have a green LED showing through a hole in their piggy-back alarm board, 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 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 systematic 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 and 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.

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* instructions 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 not 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