5. SUB-UNIT MODULES

5.1 Bandpass Filters (02-007201 & 01-002503)

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 slot coupled, folded 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 (02-007201)

PARAMETER		SPECIFICATION
Response Type		Chebyshev
Frequency Range:		800 - 950MHz (tuned to spec.)
Bandwidth:		10-25MHz (tuned to spec.)
Number of Sections:		8
Insertion Loss:		1.0 dB
VSWR:		better than 1.2:1
Power Handling:		100W max
Temperature range:	operation:	-10°C to +60°C
	storage:	-20°C to +70°C
Weight:		3 kg (typical)

5.1.3 Technical Specification (01-002503)

SPECIFICATION		PARAMETER
Response type:		Chebyshev
Frequency range:		135 – 250MHz
Bandwidth:		3.5MHz (tuned to spec.)
Nō. of sections:		6
Insertion loss:		1.2dB
VSWR:		Better than 1.2:1
Power Handling:		100W maximum
Temperature range:	operate:	-10°C to +60°C
	store:	-20°C to +70°C
Weight:		3 kg
Size:		384 x 82.5 x 56.4mm

5.2 900MHz 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, 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.
Being passive devices, the splitters should have an extremely long operational life and require no maintenance. Should a unit be suspect, it is usually most time efficient to replace the whole module rather than attempt repair or re-tuning.

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

5.2.2 Technical Specification

PARAMETER		SPECIFICATION
Frequency Range:	Narrowband:	815 – 960MHz
	Broadband:	800 – 1200MHz
Bandwidth:	Narrowband:	145MHz
	Broadband:	400MHz
	Input ports:	1
	Output ports:	2
Insertion loss:	Narrowband:	3.3dB
	Broadband:	3.5dB
Return loss input & output:		1.3:1
	Impedance:	50Ω
Isolation:	Narrowband:	>20dB
	Broadband:	>18dB
	MTFB:	>180,000 hours
Power rating:	Splitting:	20Watts
	Combining:	0.5Watt
	Connectors:	SMA female
	Weight:	200g (approximately)
	Size:	54 x 44 x 21mm (including connectors)

5.3 1 Watt 3dB Broadband Splitter (05-002901)

5.3.1 Description

The 1 Watt, 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 and ensuring that the VSWR and insertion losses are kept to a minimum. Any unused ports will be terminated with an appropriate 50Ω load.

5.3.2 Technical Specification

PARAMETER	SPECIFICATION
Frequency Range:	100 - 520 MHz
Bandwidth:	380 MHz
Inputs:	1
Outputs:	2
Insertion Loss:	3.5 dB (typical)
Isolation:	>18 dB
Return Loss (VSWR) – Input:	Better than 1.3:1
Return Loss (VSWR) – Output:	Better than 1.3:1
Impedance:	50 Ω
Power Rating – Splitter:	20 Watts
Power Rating – Combiner:	1.0 Watt
Connectors:	SMA female
Size:	54 x 44 x 21 mm (including connectors)
Weight:	200 gm (approximately)

5.4 Four Way Splitter (05-003302)

5.4.1 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.

5.4.2 Technical Specification

PARAMETER		SPECIFICATION
Frequency range:		700-900MHz
Bandwidth:		200MHz
Rejection:		>14dB
Insertion loss:		7.5dB (in band, typical)
Connectors:		SMA
Weight:		<1.5kg
Temperature range:	operational:	-10°C to +60°C
	storage	-20°C to +70°C

5.5 Four Way Hybrid Splitter (05-003401)

5.5.1 Description

The hybrid splitter used is a device for accurately matching one 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 would be terminated with an appropriate 50Ω load.

5.5.2 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:	-10°C to +60°C
	storage	-20°C to +70°C

5.6 3 Way Splitter/Combiner (05-003801)

5.6.1 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.

5.6.2 Technical Specification

PARAMETER	SPECIFICATION
Frequency Range:	800-1000MHz
Bandwidth:	200MHz (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 Ω
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)

5.7 Wideband 3dB Splitter (07-004101)

5.7.1 Description

This wideband, 2 way hybrid splitter, is an AFL stock item with many years of reliable service. The successful construction of such a device, relies largely on a pcb developed within a rigid specification, skilled assembly and testing. Insertion loss quoted is a typical figure, any unit will be within 5% of this figure.

5.7.2 Technical Specification

PARAMETER		SPECIFICATION
	Frequency Range:	70-1000MHz
	Split ratio:	1:2
	Insertion Loss:	3.2dB (typical)
	Isolation:	>20dB
	Power rating:	1.0 Watt
	VSWR:	Better than 1.3:1
	Available connectors:	BNC, N type, SMA
Temperature range:	operation:	-10°C to +60°C
	storage:	-20°C to +70°C
	Weight:	Circa 200gms

5.8 VHF/UHF 3-Way Splitter (07-005401)

5.8.1 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 and ensuring that the VSWR and insertion losses are kept to a minimum. Any unused ports will be terminated with an appropriate 50Ω load.

5.8.2 Technical Specification

PARAMETER	SPECIFICATION
Frequency Range:	160-470MHz
Bandwidth:	300MHz
Inputs:	1
Outputs:	3
Insertion Loss:	4.5 dB (typical)
Isolation:	>14 dB
Return Loss (VSWR) – Input:	Better than 1.3:1
Return Loss (VSWR) – Output:	Better than 1.3:1
Impedance:	50 Ω
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)

5.9 3 Port Tx Hybrid Coupler (80-024203)

5.9.1 Description

The transmitter hybrid couplers provide isolation from unwanted reflected frequencies to/from the leaky feeder antennas. They are specialist narrow-band 3 port devices, designed with rejection and power handling as the main criteria. Being passive devices, the hybrid couplers should be maintenance free over their entire lifetime and have an extremely high MTBF figure. It is not recommended that the top cover be removed or any of the internal components needlessly touched, since the original factory alignment/tuning would be extremely hard to reproduce in a 'field' environment.

5.9.2 Technical Specification

PARAMETER	SPECIFICATION
Frequency Range:	140-175 MHz
Bandwidth:	±10% of f_o
Insertion Loss:	3.5dB
Rejection:	-18dB
Impedance:	50Ω
V.S.W.R:	1.2:1
Input to input isolation:	>20dB
Connectors:	Type N Standard
Dimensions:	140 x 120 x 35mm
Power rating:	50Watts
Weight:	0.5kg

5.10 Crossband Coupler (07-005705)

5.10.1 Description

The purpose of a crossband coupler is to either combine/split transmission signals from different parts of the frequency spectrum.
The crossband coupler fitted here, is the means by which the separate VHF and UHF frequency band signals are mixed to form a composite RF signal.

It basically comprises of a 3 port device, two filters, one a low pass the other a high pass, that are then mixed and fed to a common output. The couplers are built into a machined aluminium casing having a centre screening wall between the filter sections and lid secured by screws at frequent intervals over its perimeter to obtain a tight seal and to ensure linearity and stability of response.

5.10.2 Technical Specification

PARAMETER		SPECIFICATION
Passband	250MHz:	70-250MHz
	380MHz:	380-960MHz
Power Rating:		50 Watts (CW)
Number of Input ports:		2
Number of Output ports:		1
Insertion loss:		0.5 dB
Isolation:		> 50 dB 70-250MHz > 50 dB 380-960MHz (15 dB typical return loss 500-960)
Impedance:		50 Ω
Connectors:		SMA- female

5.11 6dB Power Monitor (07-014002)

5.11.1 Description

The purpose of these couplers is to tap off known portions (usually 3-30dB) of RF signal from transmission lines, either resistively or by induction, and to combine them, for example through splitter units for different purposes (alarms/monitoring etc.), whilst maintaining an accurate 50Ω load to all ports/interfaces throughout the specified frequency range. They are formally known as *directional* couplers as they couple power from the RF mainline *in one direction only*.

Various constructional techniques are used depending on the specification required. These include microstrip, stripline, coaxial cable and capacitive types.

5.11.2 Technical Specification

PARAMETER		SPECIFICATION
	Frequency range:	170 – 2200MHz
	Insertion Loss:	<0.3dB
	Coupling level:	-6dB
	Rejection:	N/A
	Weight:	<200gms
	Connectors:	N type, female
Temperature range:	operation:	-10°C to +60°C
	storage:	-20°C to +70°C

5.12 2-Port RF Isolator (08-930002)

5.12.1 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.

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.

5.12.2 Technical Specification

PARAMETER	SPECIFICATION
Frequency range:	150-300MHz
Bandwidth (% of centre frequency):	2
Isolation:	35dB (typical)
Insertion loss:	0.25dB (typical
V.S.W.R:	1.15:1 (typical)
Maximum power:	200Watts (per carrier)
Connector:	SMA
Weight:	200gm (approximately)

5.13 ¼Watt 0- -30dB & 0-15dB Variable Attenuators (10-000701 & 10-000901)

5.13.1 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.

5.13.2 Switched Attenuators

The AFL switched attenuators are available in two different types; 0 – 30dB in 2 dB steps, 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.

5.14 LNA's (11-001202, 11-005802, 11-005902 11-006002, 11-006702 & 11-004802)

5.14.1 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.

5.14.2 Technical Specification (11-001202)

PARAMETER	SPECIFICATION
Frequency range:	10 - 600MHz
Bandwidth:	200MHz (as required, tuneable)
1dB Compression point:	>+15 dBm
3rd order intercept:	>+25dBm
Gain:	20dB (typical)
VSWR:	better than 1.5:1
Noise figure:	3.5dB (typical)
Connectors:	SMA female
Supply:	108mA @ 24V DC
Temp. range: operational:	-10°C to +60°C
storage:	-20°C to +70°C
Weight:	0.4kg
Size:	88.9 x 50.8 x 31.75 mm (case only)

5.14.3 Technical Specification (11-004802)

PARAMETER		SPECIFICATION
	Frequency Range:	350 - 550MHz
	Bandwidth:	<100MHz (as required, tuneable)
	1dB Compression Point:	>+29dBm
	3rd Order Intercept:	>+44dBm
	Gain:	>10dB (typical)
	VSWR:	better than 1.5:1
	Input return loss:	>14dB
	Noise Figure:	<4.0dB (typical)
	Connectors:	SMA female
	Supply:	300mA at 24V DC
Temperature range:	operational:	-10°C to +60°C
	storage:	-20°C to +70°C
	Size:	88 x 50 x 34mm (ex. connectors)
	Weight:	0.26kg

5.14.4 Technical Specification (11-005802)

PARAMETER		SPECIFICATION
Frequency Range:		800 – 960MHz
Bandwidth:		<170MHz
Gain:		14.5±0.5dB (typical)
1dB Compression Point:		30dBm
OIP3:		46dBm
Input/Output Return Loss:		>18dB
Noise Figure:		<2.7dB
Power Consumption:		510-540mA @ 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:		280gm (approximately)

5.14.5 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

5.14.6 Technical Specification (11-006002)

PARAMETER		SPECIFICATION
Frequency range:		70 – 500MHz
Bandwidth:		<430MHz
Gain:		21dB (typical)
1dB Compression Point:		+20dB (typical)
3rd order intercept:		+33dB (typical)
Input return loss:		>14dB
Output return loss:		>20dB
VSWR:		Better than 1.5:1
Noise figure:		<2.7dB
Connectors:		SMA female
Supply:		230 - 260mA @ 10 to 24V DC
Size:		88 x 50 x 34mm (ex. connectors)
Temperature range:	operational:	-10°C to +60°C
	storage:	-20°C to +70°C
Weight:		0.26kg

5.14.7 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)

5.15 5, 10 & 20W 900MHz Power Amplifiers (12-018601, 12-018001 & 12-018002)

5.15.1 Description

These Gallium-Arsenide power amplifiers are Class A 10 & 20W power amplifier from 800-960MHz in a 1 stage balanced configuration. It demonstrates a very high linearity and a very good input/output return loss. It has built in a Current Fault Alarm Function with a volt-free relay contact pair as its output.
Its housing is an 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. These amplifiers have no user adjustments and in case of failure should only be replaced.

5.15.2 Technical Specification (12-018601, 5W)

PARAMETER		SPECIFICATION
Frequency range:		800-960MHz
Small signal gain:		30dB
Gain flatness:		±1.2dB
I/O Return loss:		>20dB
1dB compression point:		37dBm
OIP3:		52dBm
Supply voltage:		12V DC
Supply current:		2.0Amps (Typical)
Temperature range	operational:	-10°C to +55°C
	storage:	-30°C to +70°C
Weight:		<2kg (no heatsink)

5.15.3 Technical Specification (12-018001, 10W)

PARAMETER		SPECIFICATION
Frequency range:		800-960MHz
Small signal gain:		30dB
Gain flatness:		±1.2dB
I/O Return loss:		>18dB
1dB compression point:		42.8dBm
OIP3:		56dBm
Supply voltage:		24V DC
Supply current:		5.0Amps (Typical)
Temperature range	operational:	-10°C to +55°C
	storage:	-30°C to +70°C
Weight:		<2kg (no heatsink)

5.15.4 Technical Specification (12-018002, 20W)

PARAMETER		SPECIFICATION
Frequency range:		800-960MHz
Small signal gain:		30dB
Gain flatness:		±1.2dB
I/O Return loss:		>18dB
1dB compression point:		42.8dBm
OIP3:		56dBm
Supply voltage:		12V DC
Supply current:		5.0Amps (Typical)
Temperature range	operational:	-10°C to +55°C
	storage:	-30°C to +70°C
Weight:		<2kg (no heatsink)

5.16 VHF 5Watt Power Amplifier (12-004902)

5.16.1 Description

The power amplifier used is a triple stage solid-state low-noise amplifier. Class AB circuitry is used in the unit to ensure good linearity over a wide dynamic range. The three active devices are very moderately rated to provide a long trouble-free working life. There are no adjustments on this amplifier, and in the unlikely event of failure then the entire amplifier should be replaced.

5.16.2 Technical Specification

PARAMETER		SPECIFICATION
Frequency range:		80-260MHz
Bandwidth:		20MHz (tuned to specificati
Maximum RF output:		>5.0 Watt
Gain:		40dB
1dB compression point:		+30dBm
3rd order intercept point:		+40dBm
VSWR:		better than 1.5:1
Connectors:		SMA female
Supply:		2000mA @ 24V DC
Temperature range:	operational:	-10°C to +60°C
	storage:	-20°C to +70°C
Weight:		0.5 kg
Size:		167x52x25mm

5.17 3 Stage Alarm PCB & 3 Stage Simplex Alarm PCB(12-002201 & 12-002203)

5.17.1 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.

In systems using simplex channel switching, it is necessary to be able to distinguish between a ‘normal’ switching operation and erroneous modes where faults in the detector circuitry may cause data errors but not necessarily fire the alarms. The simplex alarm board is designed to differentiate between normal and spurious switching signals

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

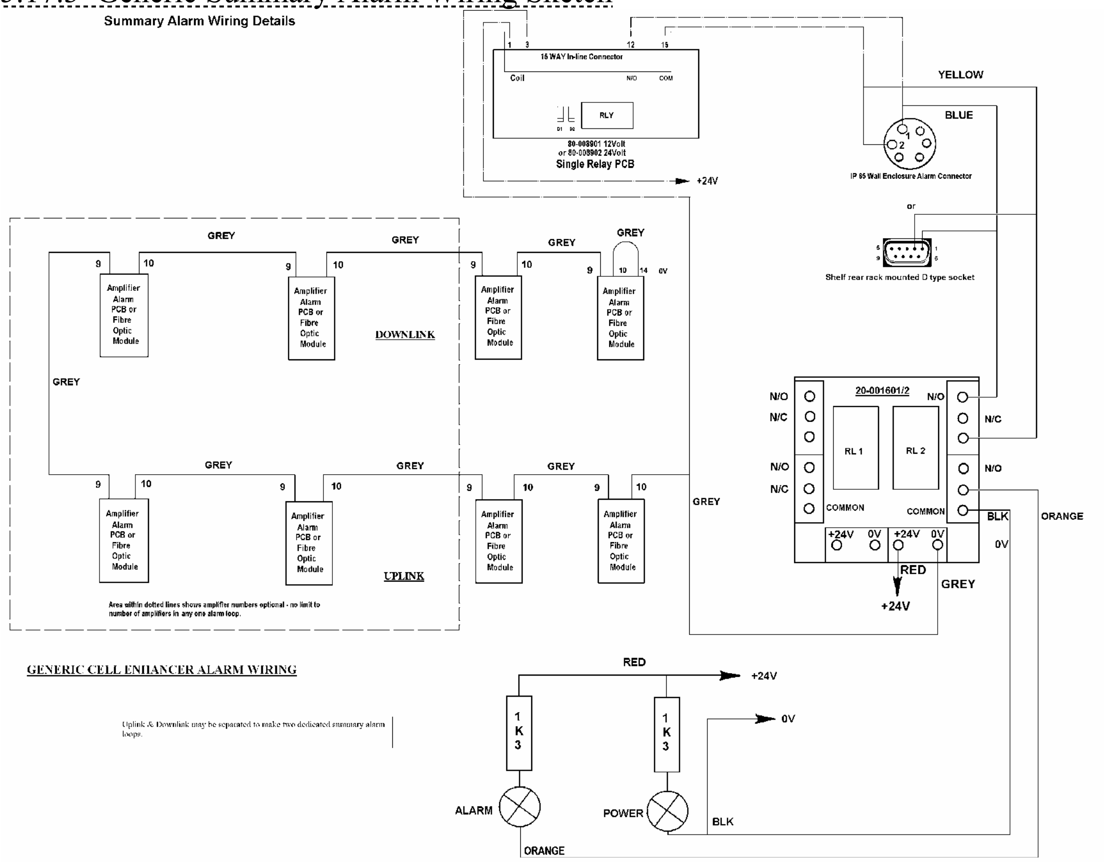
LINK1 - Removed to convert to two-way alarm board.
LINK2 - Removed to isolate 0V from chassis earth.

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

5.17.2 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:		15-way 0.1" pitch
Temperature range:	operational:	-10°C to +60°C
	storage:	-20°C to +70°C
PCB Size:		74 x 56mm (3 stage)
		54 x 56mm (1 stage)

5.17.3 Generic Summary Alarm Wiring Sketch



5.18 1 & 3 Stage Alarm/Simplex/Mute PCB (12-002804 & 12-002213)

5.18.1 Description

In systems using simplex channel switching, it is necessary to be able to distinguish between a 'normal' switching operation and erroneous modes where faults in the detector circuitry may cause data errors but not necessarily fire the alarms. The simplex alarm/mute board is designed to differentiate between normal and spurious switching signals for single or multiple stage amplifiers.

5.19 Simplex Controller PCB (12-002811)

5.19.1 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, and 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.

5.20 Dual DC/DC Converter (13-001803)

5.20.1 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.

5.20.1 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:	-10°C to +60°C
	storage	-20°C to +70°C
PCB Size:		85 x 63mm

5.21 Simplex Squelch & AF Module (17-002802)

5.21.1 Description

The difference in signal levels between the 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 de-sense module, (which is controlled by the Simplex Rx squelch unit), apply maximum attenuation (via an AGC attenuator unit) to the downlink path, when the uplink is active.

5.21.2 Technical Specification

PARAMETER		SPECIFICATION
Frequency range:		80-260MHz
Bandwidth:		20MHz (tuned to spec.)
Maximum RF output:		>5.0 Watt
Gain:		40dB
1dB compression point:		+30dBm
3rd order intercept point:		+40dBm
Noise Figure:		2.4dB
VSWR:		better than 1.5:1
Connectors:		SMA female
Supply:		1.8A @ 24V DC
Temperature range:	operational:	-10°C to +60°C
	storage:	-20°C to +70°C
Weight:		0.5 kg
Size:		167x52x25mm

5.22 Wide Dynamic Range (Log.) 12V AGC (17-001109, det. & 17-001201, atten.)

5.22.1 Description

The equipment is fitted with a wide dynamic range (logarithmic detector) Automatic Gain Control (AGC) system. This is generally fitted in the Uplink path (not usually needed in the downlink path, as the signal here is at an almost constant level), to avoid overloading the input amplifiers should a mobile be operated very close to the unit.

The AFL wide dynamic range Automatic Gain Control system consists of two units, a detector/amplifier and an attenuator. The logarithmic 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.

Normally the attenuator is at minimum attenuation. The detector/amplifier unit monitors the RF level being delivered by the power amplifier, and when a certain threshold is reached it begins to increase the value of the attenuator to limit the RF output to the (factory set) threshold. Therefore overloading of the power amplifier is avoided.

The factory set threshold is 1dB below the Enhancer 1dB compression point. Some adjustment of this AGC threshold level is possible, a 10dB range is mostly achieved. It is not recommended under any circumstances to adjust the AGC threshold to a level greater than the 1dB compression point as system degradation will occur.

The detector comprises of a 50Ω transmission line with a logarithmic amplifier which samples a small portion of the mainline power. The sampled signal is amplified and fed to a conventional half wave diode rectifier, the output of which is a DC voltage logarithmically proportional to the RF input signal.

This DC voltage is passed via an inverting DC amplifier with integrating characteristics, to the output, which drives the attenuation control line of the corresponding AGC attenuator. This unit is fitted at some earlier point in the RF circuit.

For small signals, below AGC onset, the output control line will be close to 12V and the AGC attenuator will have minimum attenuation. As the signal level increases the control line voltage will fall, increasing the attenuator value and keeping the system output level at a constant value.
The AGC onset level is adjusted by the choice of sampler resistor R1 and by the setting of potentiometer VR1, (factory set @ time of system test) do not adjust unless able to monitor subsequent RF levels.
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 from the associated AGC detector unit. Note that the log detector module is used with an associated controller board, in the duplex shelves for detecting the presence of signals to be muted/amplified.

5.22.2 Technical Specification

PARAMETER		SPECIFICATION
Frequency Range:		up to 1000MHz
Attenuation Range:		3 to 30dB
Attenuation Steps:		continuously variable
VSWR:		better than 1.2:1
RF Connectors:		SMA female
Power Handling:	attenuator:	1W
	detector/amp:	>30W (or as required)
Temperature Range:	operation:	-10°C to +60°C
	storage:	-20°C to +70°C
Size:	attenuator pcb	50 x 42 x 21mm
	detector/amp pcb	54 x 42 x 21mm
Weight:	attenuator:	90gm
	detector/amp:	100gm

5.23 Channel Control Module (17-002101)

5.23.1 Description

The purpose of the channel control modules is to change the channel selective module frequencies by means of a series of D.I.P switch banks, each switch corresponding to a different 'frequency bit'.

5.23.2 Technical Specification

Below shows the pin assignments for each switch on a channel control module.

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	N/C
19	4	
20	16	
21	3	
22	15	+5V
23	2	0V
24	14	Switched 12V
25	1	0V
26	---	---

5.23.3 900MHz Programming Procedure

Check that the required downlink and uplink frequencies fall within the operational band limits of the Cell Enhancer.

For each Downlink and Uplink channel frequency, subtract the appropriate synthesiser offset frequency from the required operational frequency and record the resulting local oscillator frequencies.

Divide each Downlink and Uplink local oscillator frequency by the synthesiser channel spacing and check that the result is an integer (ie: no remainder).

If the synthesiser division ratio is not an integer value, check the required operational frequency and repeat the calculation checking for mistakes.

Convert the required local oscillator frequency to synthesiser programming switch state patterns according to the following table.

NOTE: Ensure that the correct column is used from the table below according to the synthesiser channel spacing of the particular channel modules fitted to the Cell Enhancer.

Switch Number	Synthesiser offset added when switch in UP position	
	25kHz channel spacing	100kHz channel spacing
1	+25kHz	+100kHz
2	+50kHz	+200kHz
3	+100kHz	+400kHz
4	+200kHz	+800kHz
5	+400kHz	+1.6MHz
6	+800kHz	+3.2MHz
7	+1.6MHz	+6.4MHz
8	+3.2MHz	+12.8MHz
9	+6.4MHz	+25.6MHz
10	+12.8MHz	+51.2MHz
11	+25.6MHz	+102.4MHz
12	+51.2MHz	+204.8MHz
13	+102.4MHz	+409.6MHz
14	+204.8MHz	+819.2MHz
15	+409.6MHz	-
16	+819.2MHz	-

5.23.4 900MHz Programming Example

Frequency required: 958.0 MHz

Channel spacing: 25 kHz

Synthesiser offset: 70 MHz

The Local Oscillator frequency is therefore:

958.0 – 70 = 888 MHz

Dividing the LO frequency by the channel spacing of 0.025 MHz:

$$\frac{888.0}{0.025} = 35520$$

This is an integer value, therefore it is OK to proceed.

Local Oscillator Frequency	Switch settings															
	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
888.0 MHz	1	0	0	0	1	0	1	0	1	1	0	0	0	0	0	0

Switch setting: 0 = switch DOWN (on, frequency ignored)
1 = switch UP (off, frequency added)

5.24 Channel Selective Modules (17-009127 UHF, & 17-009135 VHF)

5.24.1 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.

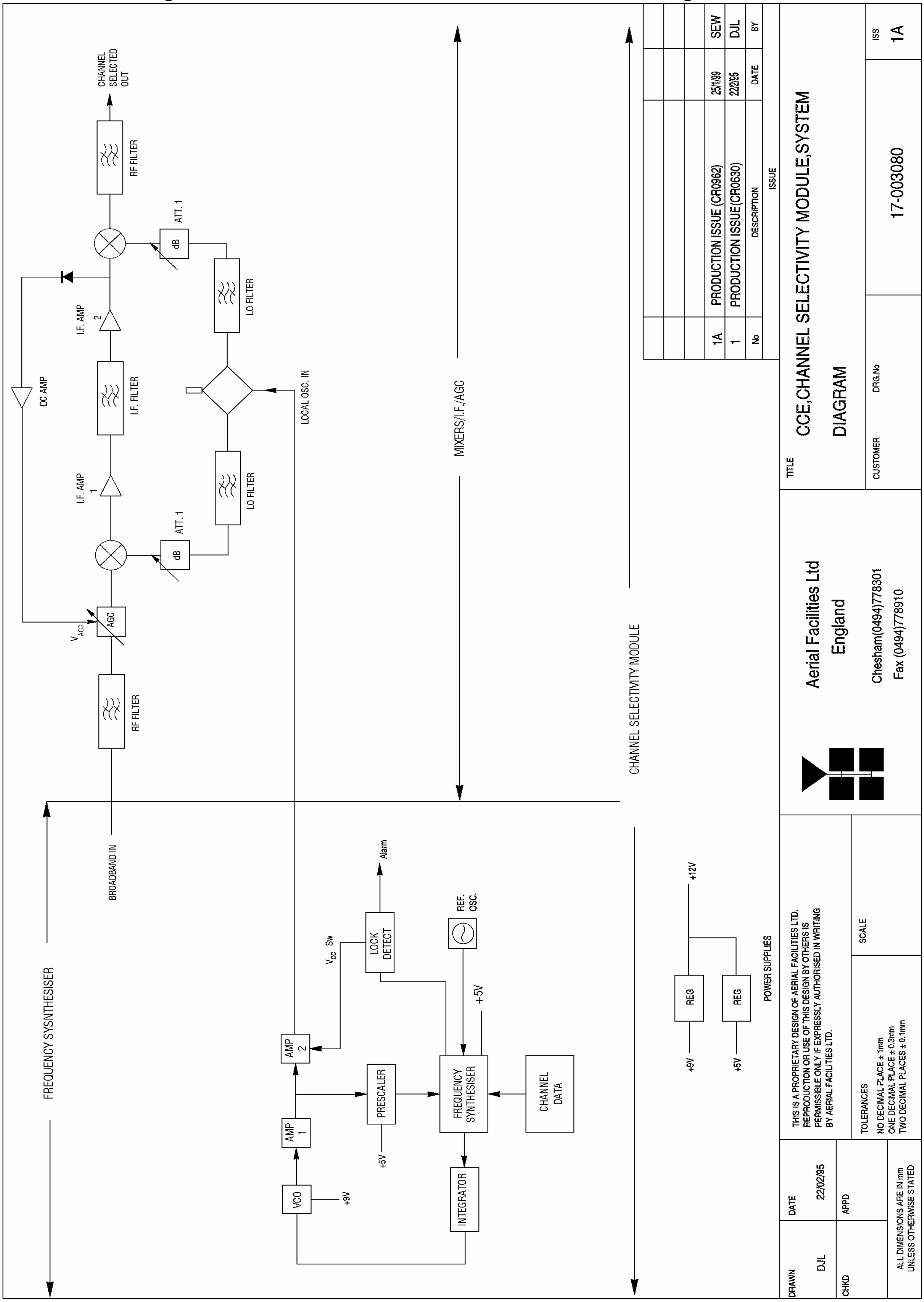
The operating frequency of each channel selectivity module is set by the programming of channel selectivity module frequencies and is achieved digitally, via hard wired links, banks of DIP switches, or via an onboard RS232 control module, providing the ability to remotely set channel frequencies.

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.

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



5.25 12 & 24V Relay Boards (20-001601 & 20-001602)

5.25.1 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.

5.25.2 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:	Screw terminals
Temperature range	operational:	-10°C to +55°C
	storage:	-40°C to +70°C

5.26 12V Low Voltage Battery Disconnect Module (80-061003)

5.26.1 Description

The low voltage disconnect module's main function is to monitor the battery voltage as the batteries discharge. When a pre-set value has been reached (usually 21.5V DC) the unit will disconnect the batteries to prevent a 'deep discharge' state which, if allowed to continue, could irreparably damage the batteries, necessitating replacement. The unit's other function is to regulate the battery voltage to the cell enhancer equipment to 23.5V when in back-up mode (the terminal voltage of fully charged batteries is likely to be higher than 27V, and therefore potentially damaging to electronics in the system).

5.26.2 Technical Specification

PARAMETER		SPECIFICATION
Operating voltage:		9-16V
Low voltage cut-off point:		10.5V (factory set)
Temperature range	operation:	-10°C to +55°C
	storage:	-20°C to +70°C
Weight:		<1kg
Size:		109.98 x 55.88mm

5.27 Crystal Filters (93-980109)

5.27.1 Description

Crystal filters are fitted at the inputs and outputs of the simplex/duplex shelves (instead of bandpass filters) in order to maximise the excellent isolation and rejection characteristics of these narrow-band devices. It is easier to achieve close channel spacing using crystal filters, however, due to the increased insertion losses, higher gain amplification is needed when they are utilised.

5.28 IXFN170N10 Power Mos-Fet Module (94-030015)

5.28.1 Description

This power module is simply a power MOS-FET transistor which is the series regulator for the main 24V DC battery output voltage rail. It is enabled/disabled from the discriminator module, (see section 5.2) has fast switch-off characteristics and a low forward volt drop. It is attached to a heatsink assembly mounted on the side of the case.

5.29 STPS12045TV 60A Dual Diode Assembly (94-100004)

5.29.1 Description

The purpose of these dual diode assemblies is to allow two (or more) DC voltage sources to be combined, so that the main 12 or 24 volt DC rail within the equipment is sourced from either the mains driven flat-pack, or externally through an XLR connector on the rear panel. The heavy-duty diodes prevent any reverse current from flowing back to their source or the alternative supply rail. Combining diodes such as these will also be used if the equipment is to be powered from external back-up batteries.

5.30 15V Switch-Mode PSU (96-300054)

5.30.1 Description

The power supply unit is a switched-mode type capable of supplying 15V DC at 27Amps continuously. The amplifiers in this unit will draw approximately 20-22Amps 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 15.2V. The adjustment potentiometer will be found close to the DC output terminals.

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.

5.30.2 Technical Specification

AC Input Supply:	
Voltage:	110 or 220V nominal
	90 to 132 or 180 to 264V (absolute limits)
Frequency:	47 to 63Hz
DC Output Supply:	
Voltage:	15V DC (nominal)
	12.5-17V (absolute limits)
Current:	27.0A