5. SUB-UNIT MODULES

5.1 Downlink Channelised Cell Enhancer 60-060602 (5U chassis)

5.1.1 Bandpass Filters (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.

No adjustments should be attempted without full network sweep analysis facilities to monitor both insertion loss and VSWR simultaneously.

5.1.1.2 Technical Specification

PARAMETER	SPECIFICATION
Passband	453-454 MHz
Insertion Loss	1.9 dB typical
Rejection	> 456 MHz > 55 dB
	> 458-459 MHz > 60 dB
Power Rating	50 Watt
Impedance	50 ohm
VSWR	Better than 1.2:1

5.1.2 UHF 3dB 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 and ensuring that the VSWR and insertion losses are kept to a minimum. Any unused ports will be terminated with an appropriate 50Ω load.

5.1.2.2 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
Return Loss (VSWR) – Output:	Better than 1.3:1
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 g

5.1.3 3dB UHF Splitter (05-002603)

5.1.3.1 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.

5.1.3.2 Technical Specification

PARAMETER	SPECIFICATION
Frequency Range:	400-500 MHz
Power Rating:	5 Watts
Insertion Loss:	5.2dB Typical
VSWR:	1.2:1
Impedance:	50 Ohms
Connectors:	SMA
Weight:	<0.5Kgs
Mechanical:	Drawing No. 07-003890

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 (11-007302 & 11-007402)

5.1.5.1 Description

The low noise amplifiers used are double stage solid-state low-noise amplifiers. Class A circuitry is used in the units to ensure excellent linearity 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 failure then the entire amplifier should be replaced. The two amplifiers are very similar in construction, the only difference is the biasing, which changes the gain figure, see tables below.

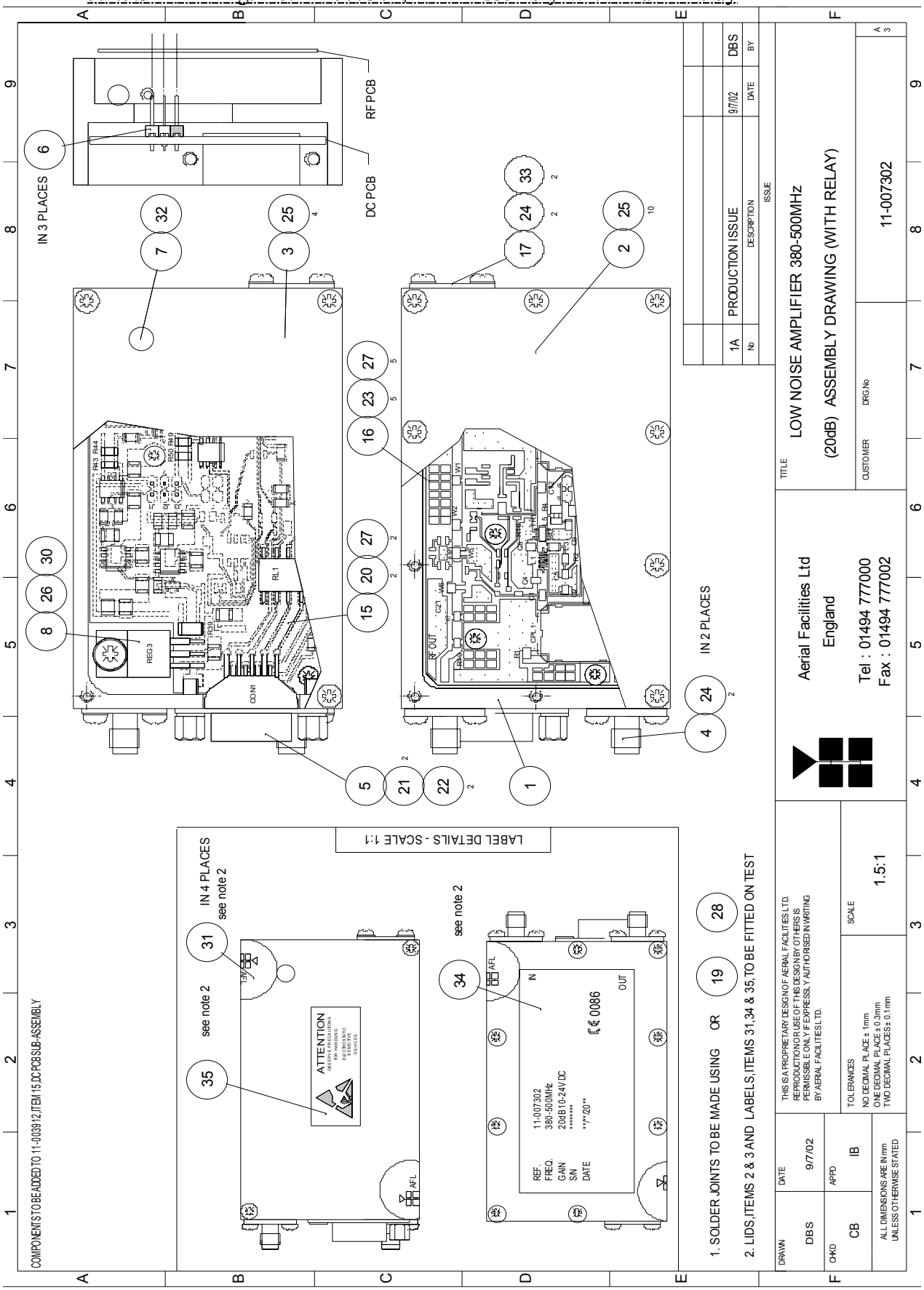
5.1.5.2 Technical Specification, (11-007302)

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:	-10°C to +55°C
	storage:	-30°C to +70°C
Weight:		<300gms
Size:		90 x 55 x 30.2 (case only)

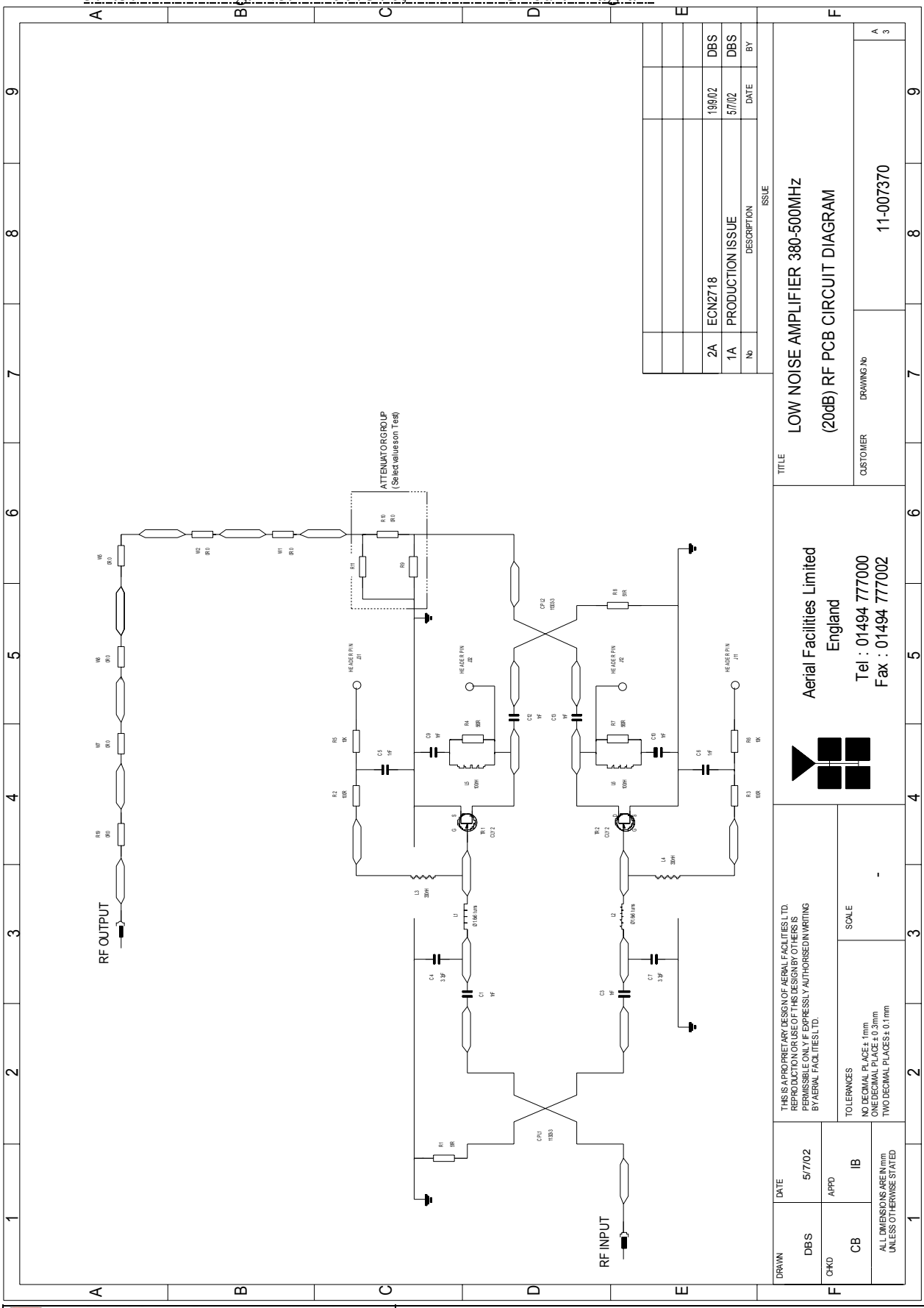
5.1.5.3 Technical Specification (11-007402)

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
Temperature range:	operational:	-10°C to +55°C
	storage:	-30°C to +70°C
Weight:		<300gms
Size:		90 x 55 x 30.2 (case only)

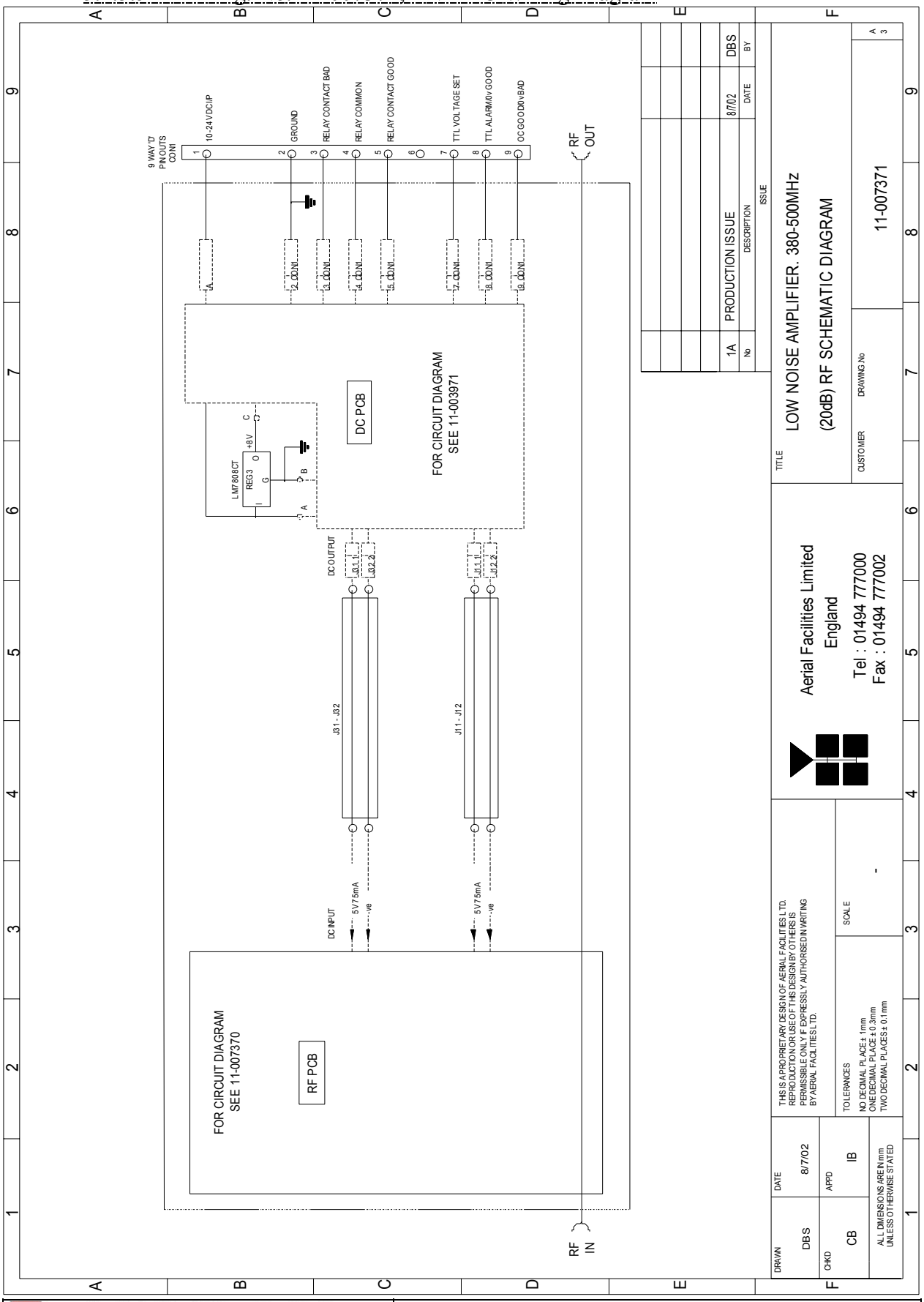
5.1.5.3 Drg. Nō. 11-007302, LNA Assembly With Alarm Relay



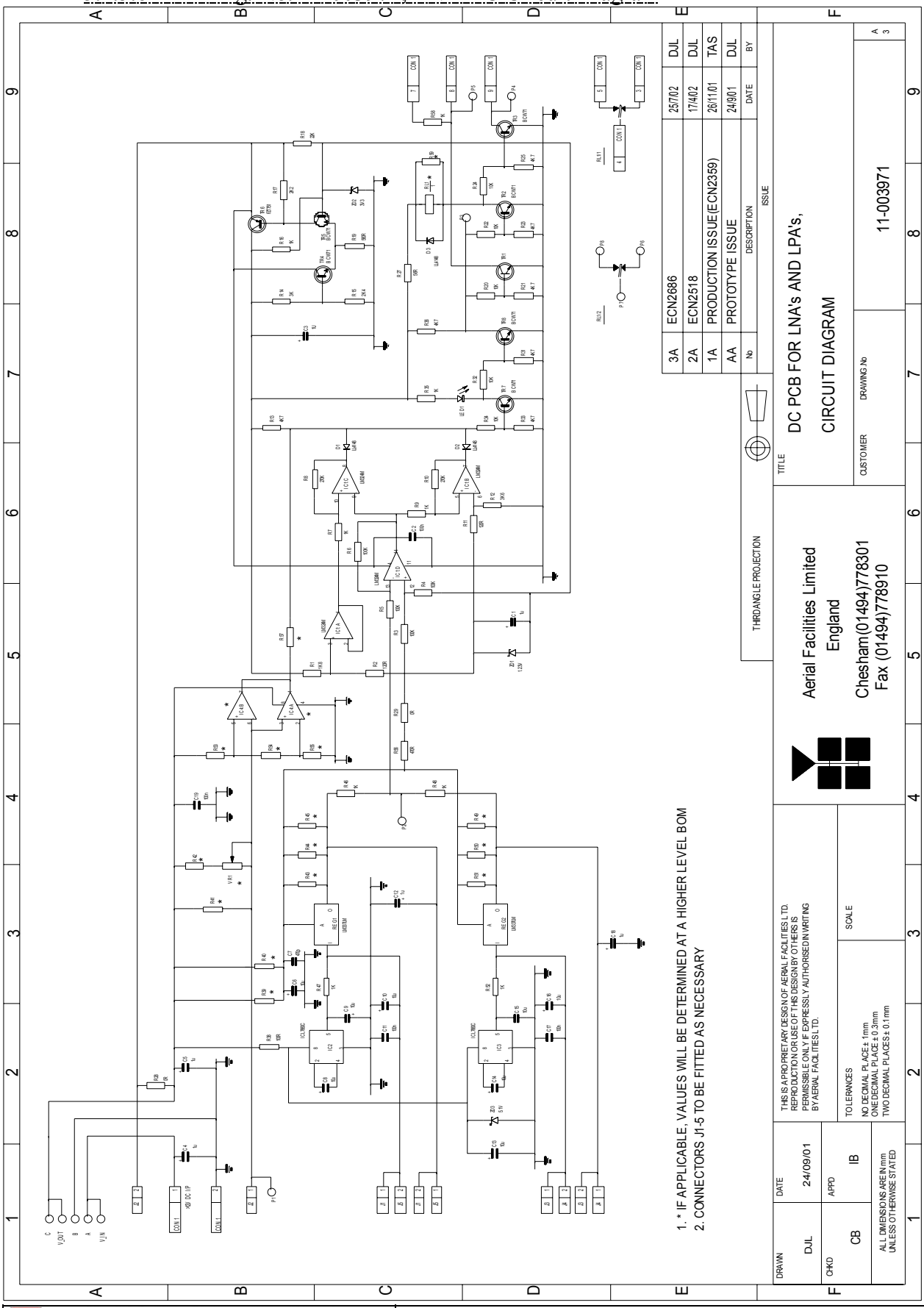
5.1.5.4 Drg. No. 11-007370, LNA RF Circuit Diagram



5.1.5.5 Drg. No. 11-007371, LNA DC Wiring Diagram



5.1.5.6 Drg. Nō. 11-003971, LNA DC Circuit Diagram



5.1.6 10Watt Power Amplifier (12-001901)

5.1.6.1 Description

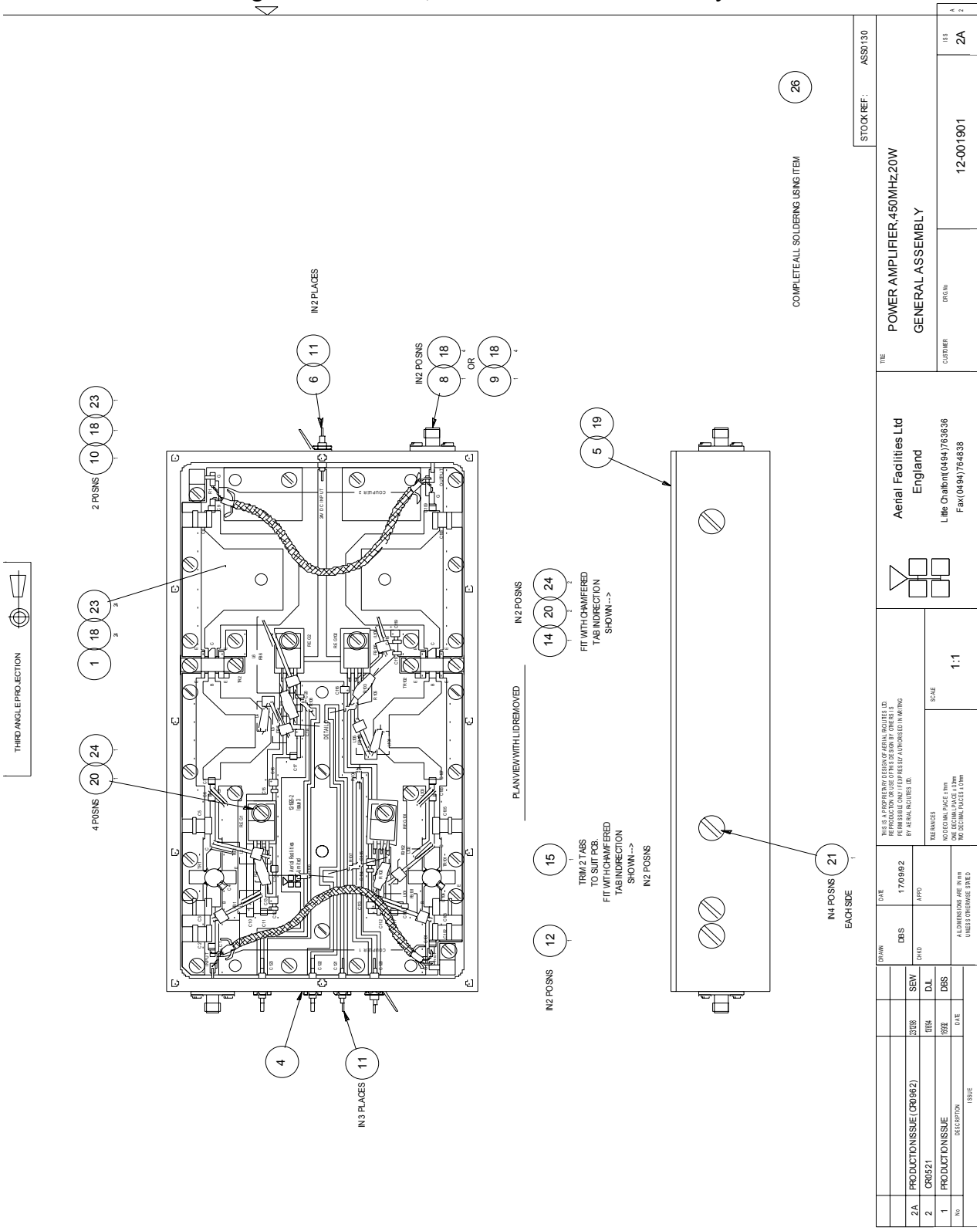
The power amplifier fitted to this unit is a multi-stage, solid state class A power amplifier. All the semi-conductor devices are very conservatively rated to ensure low device junction temperatures and a long, trouble free working lifetime. The amplifier was originally designed to have a 20W power output, but in this instance, the biasing is changed to give the device a 10W rating.

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

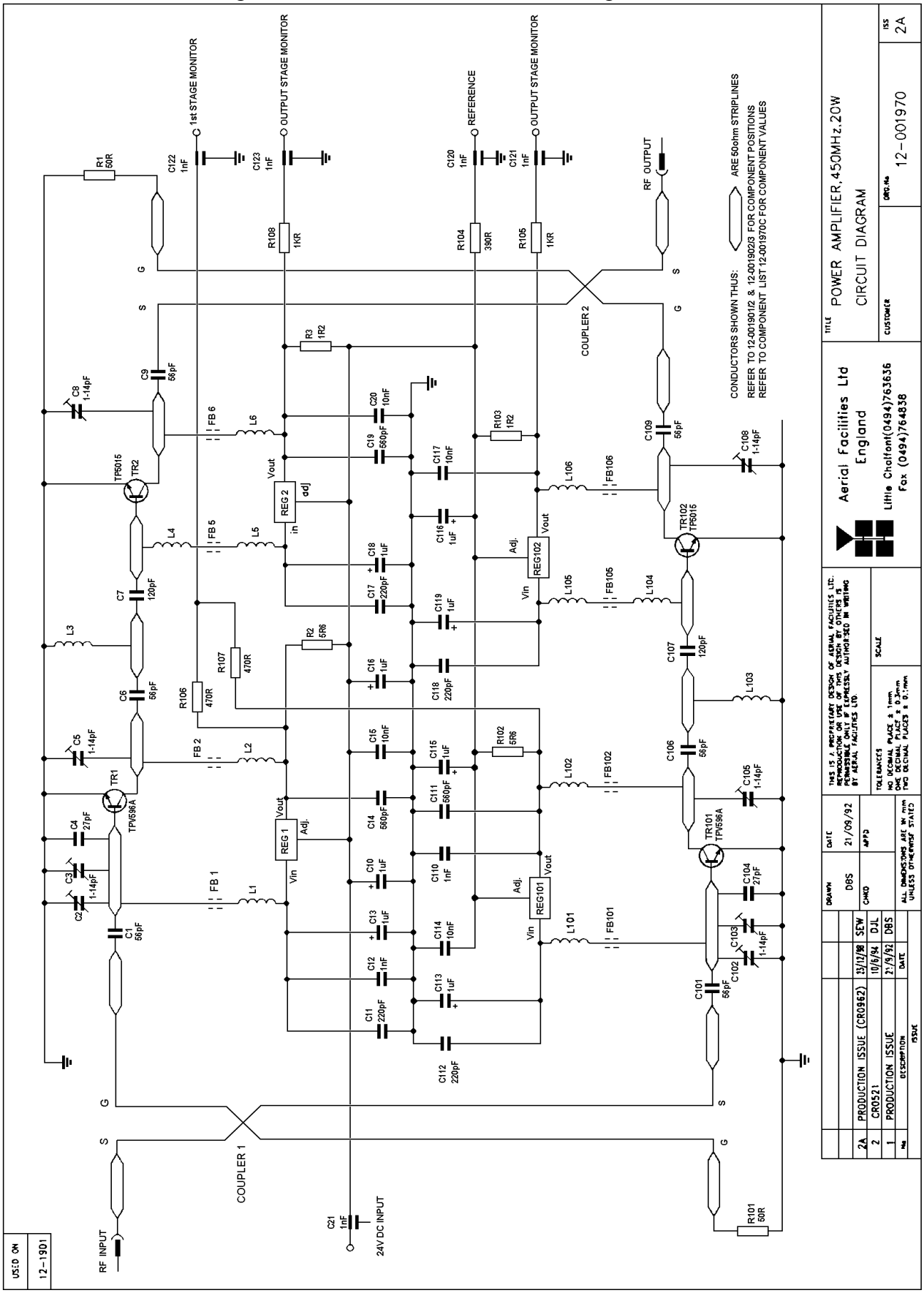
5.1.6.2 Technical Specification

PARAMETER		SPECIFICATION
Frequency Range:		400 - 500MHz (tuned to spec.)
Bandwidth:		20MHz (typical, tuneable)
Maximum Output Power:		>10W
Gain:		28dB
3rd Order Intercept Point:		<+51dBm
1dB Compression Point:		<+40dBm
VSWR:		better than 1.45:1
Connectors:		SMA female
Supply:		2.5A @ 24V DC
Temperature range:	operational:	-10°C to +55°C
	storage:	-40°C to +70°C
Size:		276 x 78 x 40mm (case only)
Weight:		1.5 kg (excluding heatsink)

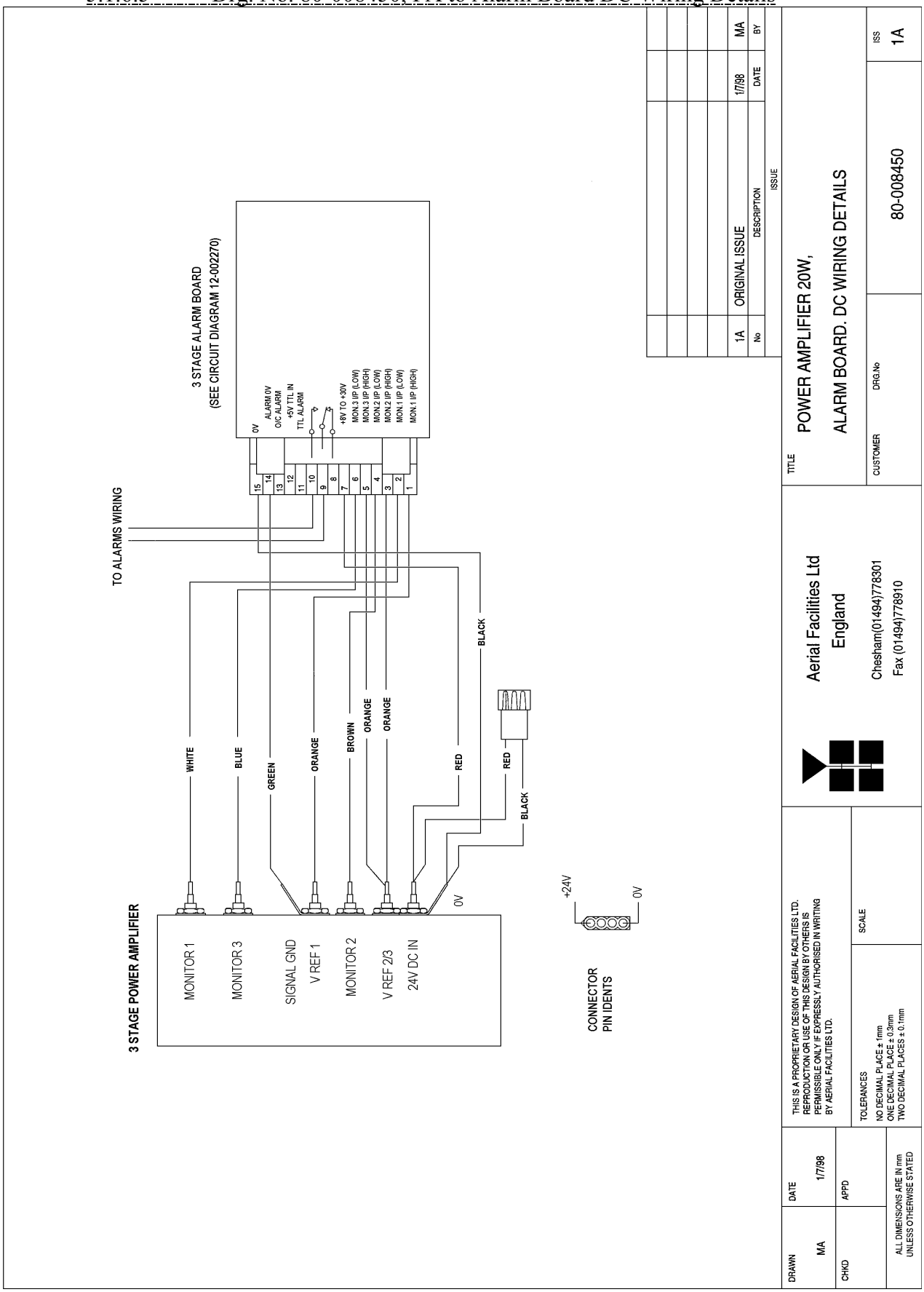
5.1.6.3 Drg. Nō. 12-001901, 10W PA PCB Sub-Assembly



5.1.6.4 Drg. No. 12-001970, 10W PA Circuit Diagram



5.1.6.5 Drg. No. 80-008450, PA to Alarm Board DC Wiring Details



5.1.7 3 Stage Amplifier Alarm Boards (12-002201)

5.1.7.1 Description

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

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

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

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

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

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

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

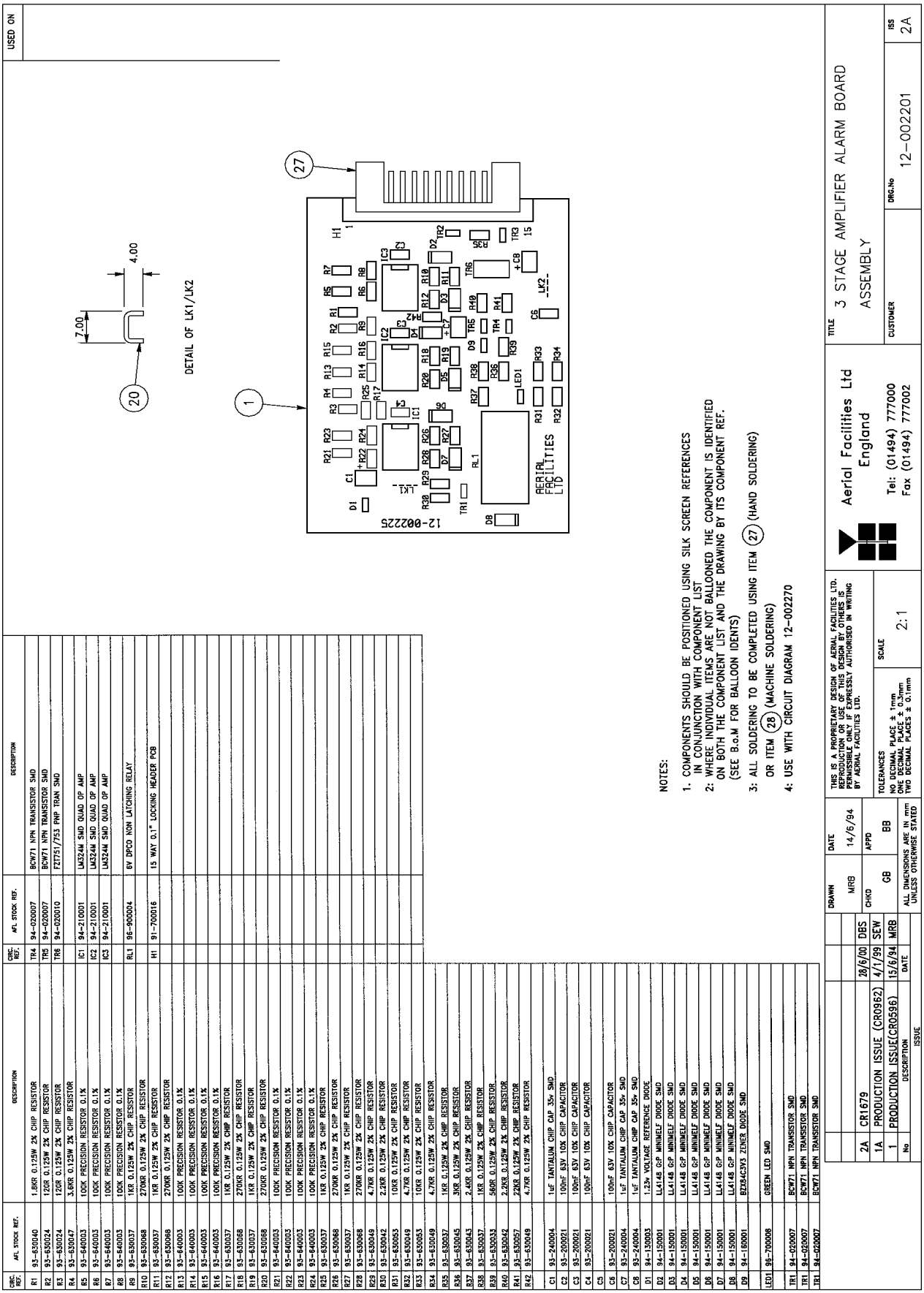
LINK1 - Removed to convert to two-way alarm board.
LINK2 - Removed to isolate 0V from chassis earth.

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

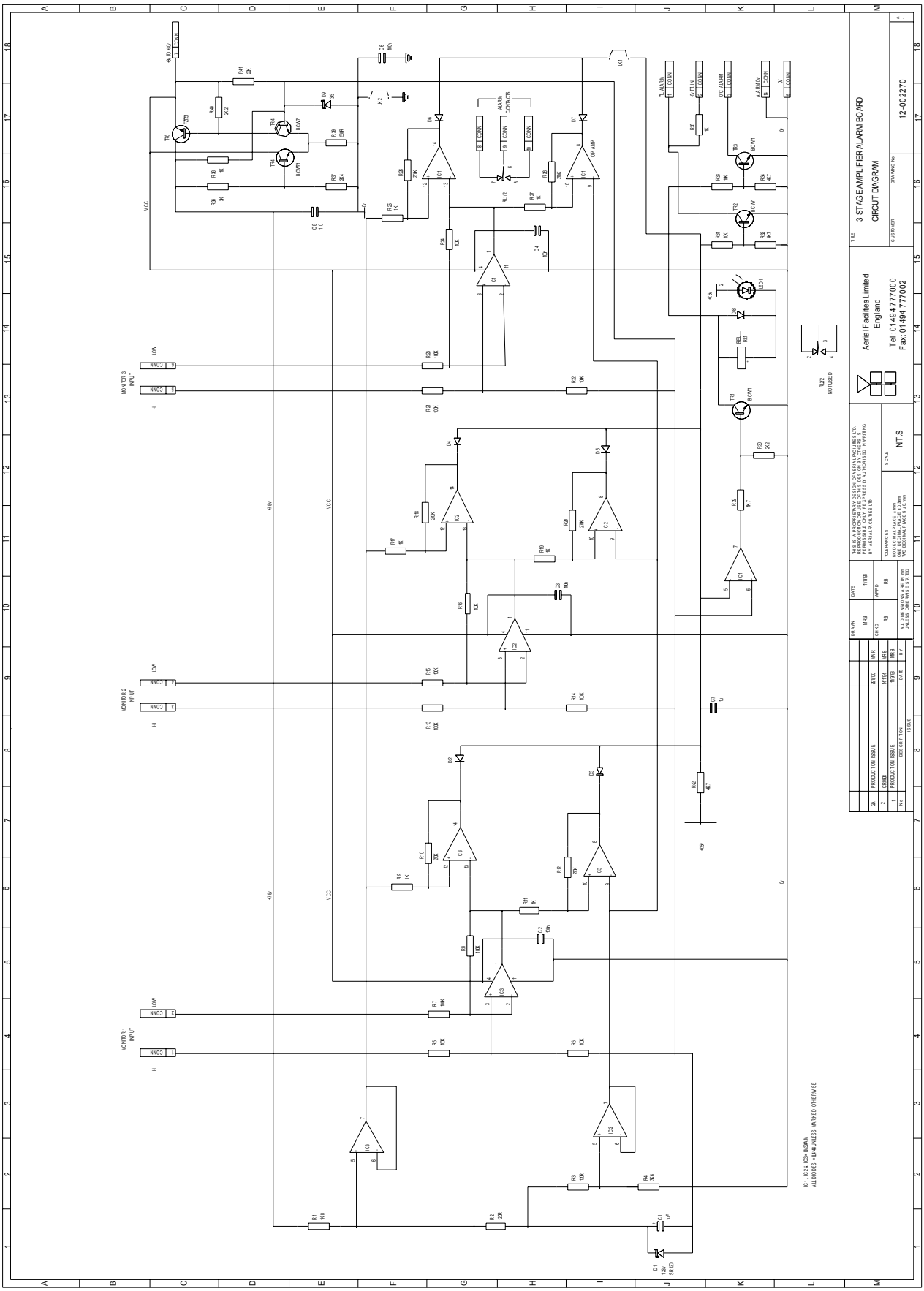
5.1.7.2 Technical Specification

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 +55°C
	storage:	-40°C to +70°C
PCB Size:		74 x 56mm (3 stage)
		54 x 56mm (1 stage)

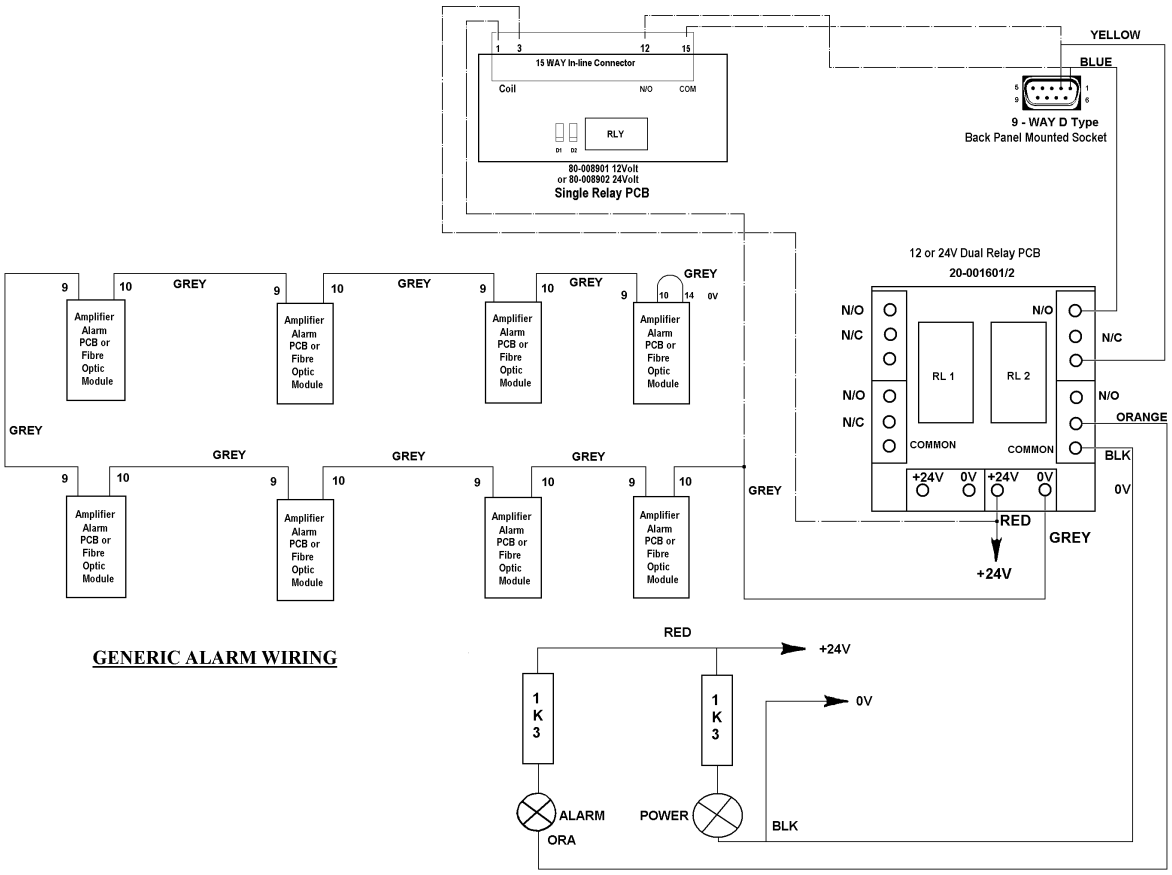
5.1.7.3 Drg. Nō. 12-002201, 3 Stage Alarm Board Assembly Drawing & Parts List



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



5.1.7.5 Generic Rack Shelf Enclosure Alarm Wiring Sketch


15 WAY In-line Connector
Coil
N/O
COM
RLY
80-008901 12Volt
or 80-008902 24Volt
Single Relay PCB
YELLOW
BLUE
9 - WAY D Type
Back Panel Mounted Socket
12 or 24V Dual Relay PCB
20-001601/2
RL 1
RL 2
COMMON
+24V
0V
ORANGE
BLK
RED
GREY
Amplifier Alarm PCB or Fibre Optic Module
GENERIC ALARM WIRING
1K3
ALARM
ORA
POWER
BLK

5.1.8 Dual DC/DC Converter (13-001803)

5.1.8.1 Description

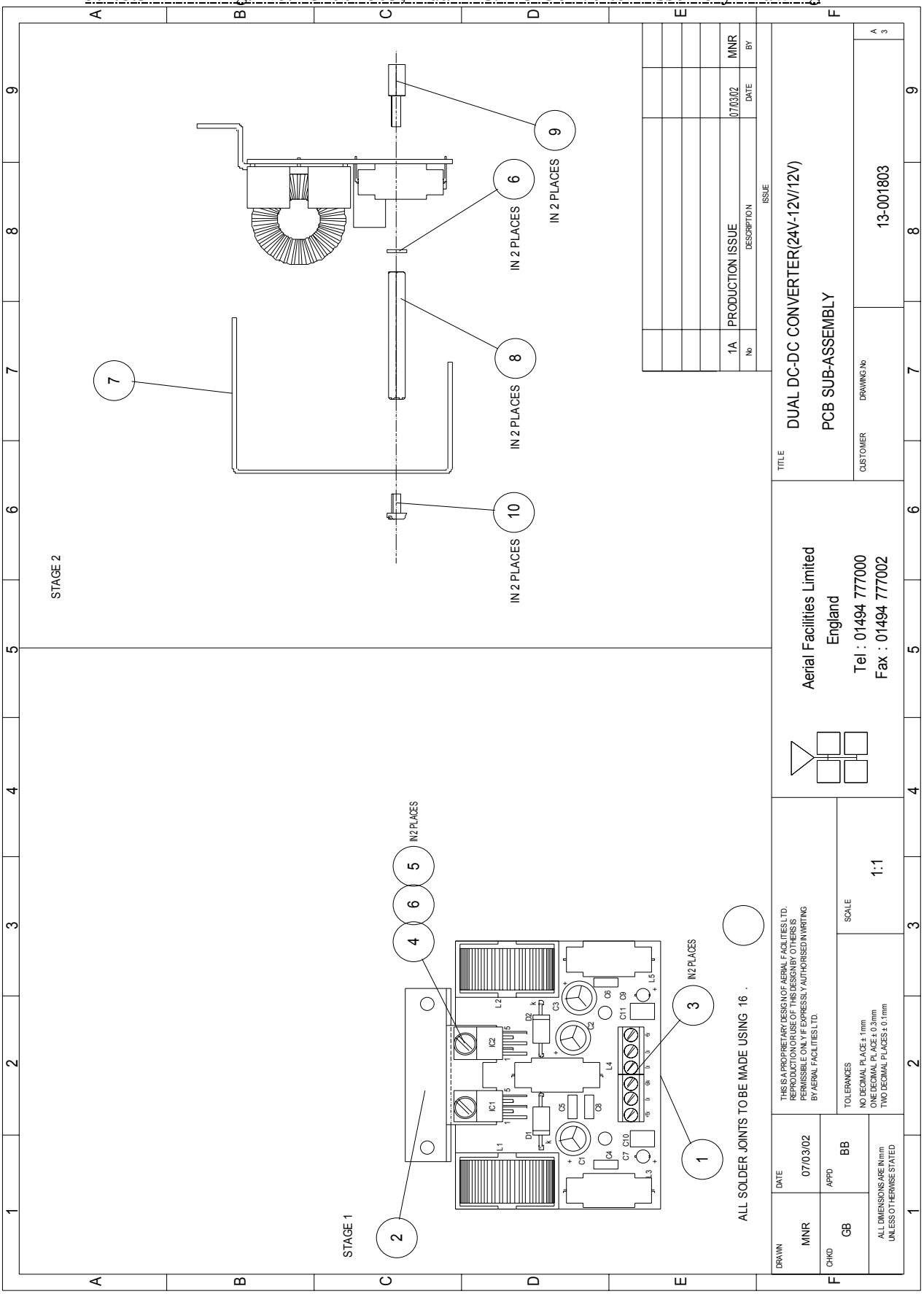
This unit is employed where it is necessary to derive two fixed voltage power supply rails from some higher voltage. Typically it is used to derive 5, 8, 12 or 15V from a 24V input.

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.

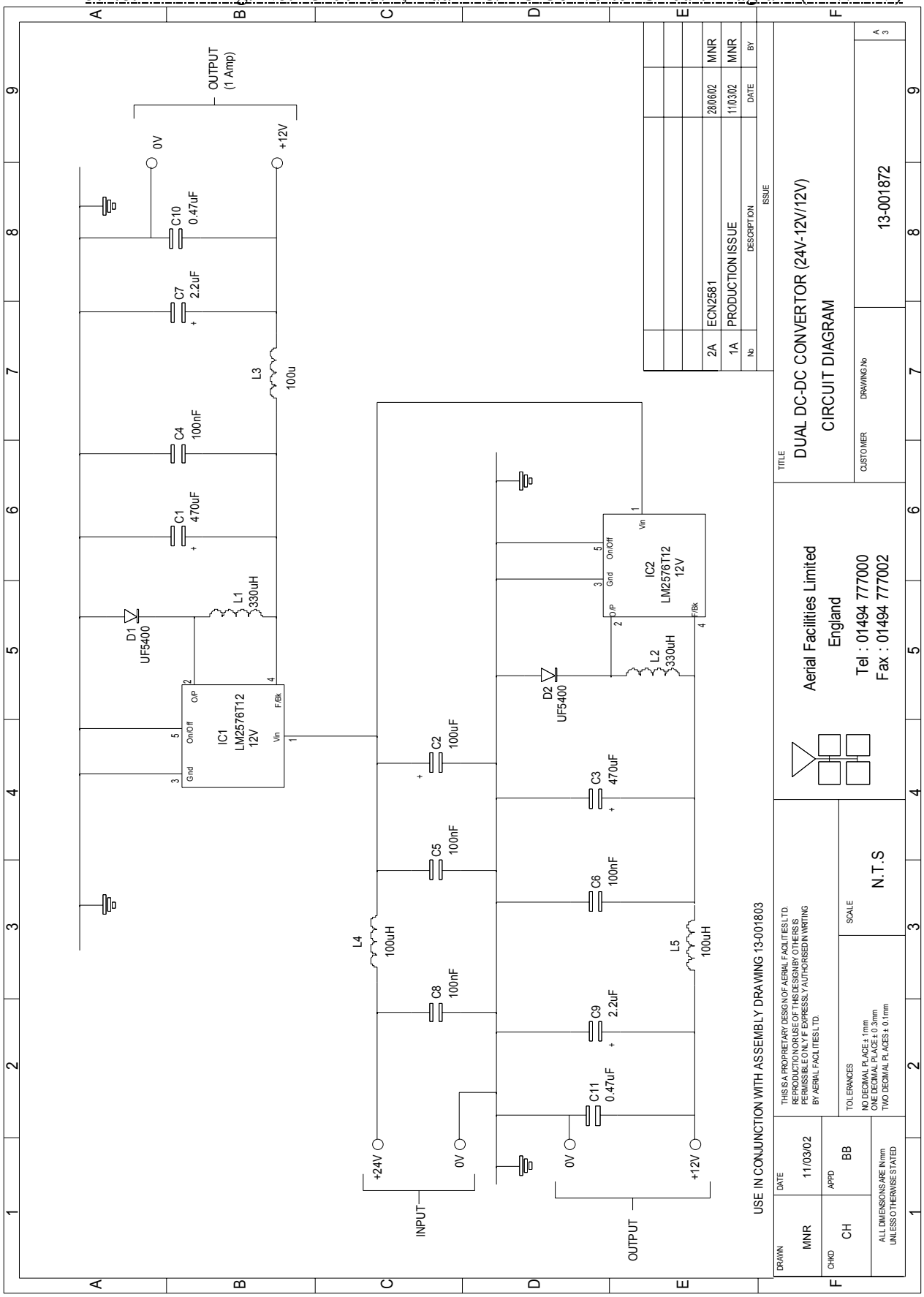
5.1.8.2 Technical Specification

PARAMETER		SPECIFICATION
Operating Voltage:		21 – 27V DC
Output Voltages:		12.0V & 12.0V (typical)
Output Current:		1.0A (maximum per o/p)
Connections:		Screw Terminal Block
Temperature range:	operational :	-10BC to +55BC
	storage:	-40BC to +70BC
PCB Size:		85 x 63mm

5.1.8.3 Drg. Nō. 13-001803, Dual DC/DC Converter Assembly Drawing



5.1.8.4 Drg. No. 13-001872, Dual DC/DC Converter Circuit Diagram (12V/12V)



5.1.9 Channel Selective Module (17-003012)

5.1.9.1 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.

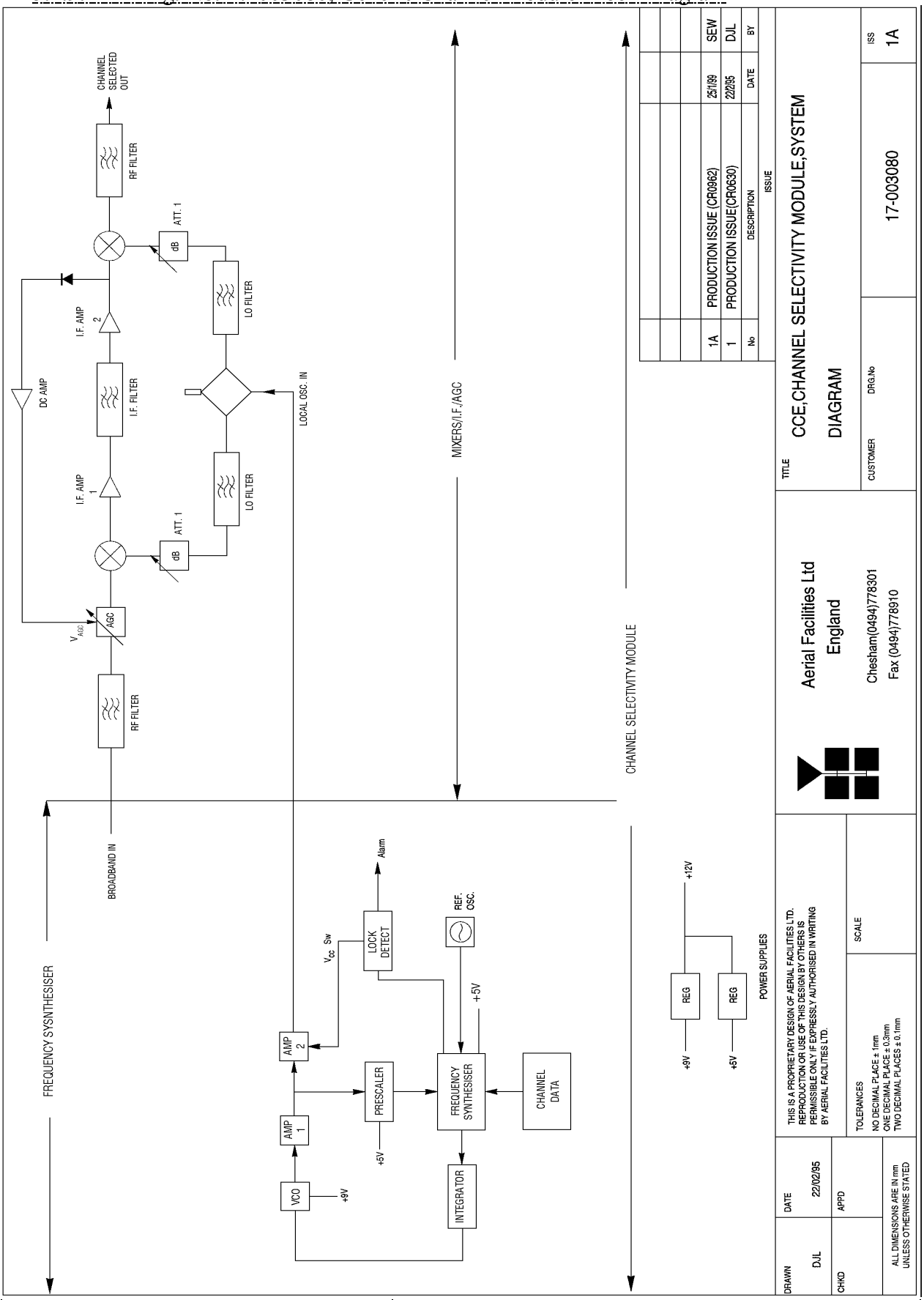
The operating frequency of each channel selectivity module is set by the programming of channel selectivity module frequencies and is achieved digitally, via hard wired links, banks of DIP switches, or via an onboard RS232 control module, providing the ability to remotely set channel frequencies.

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.

5.1.9.2 Drg. No. 17-003080, Generic Channel Module Block Diagram



5.1.10 24V Relay Board (20-001602)

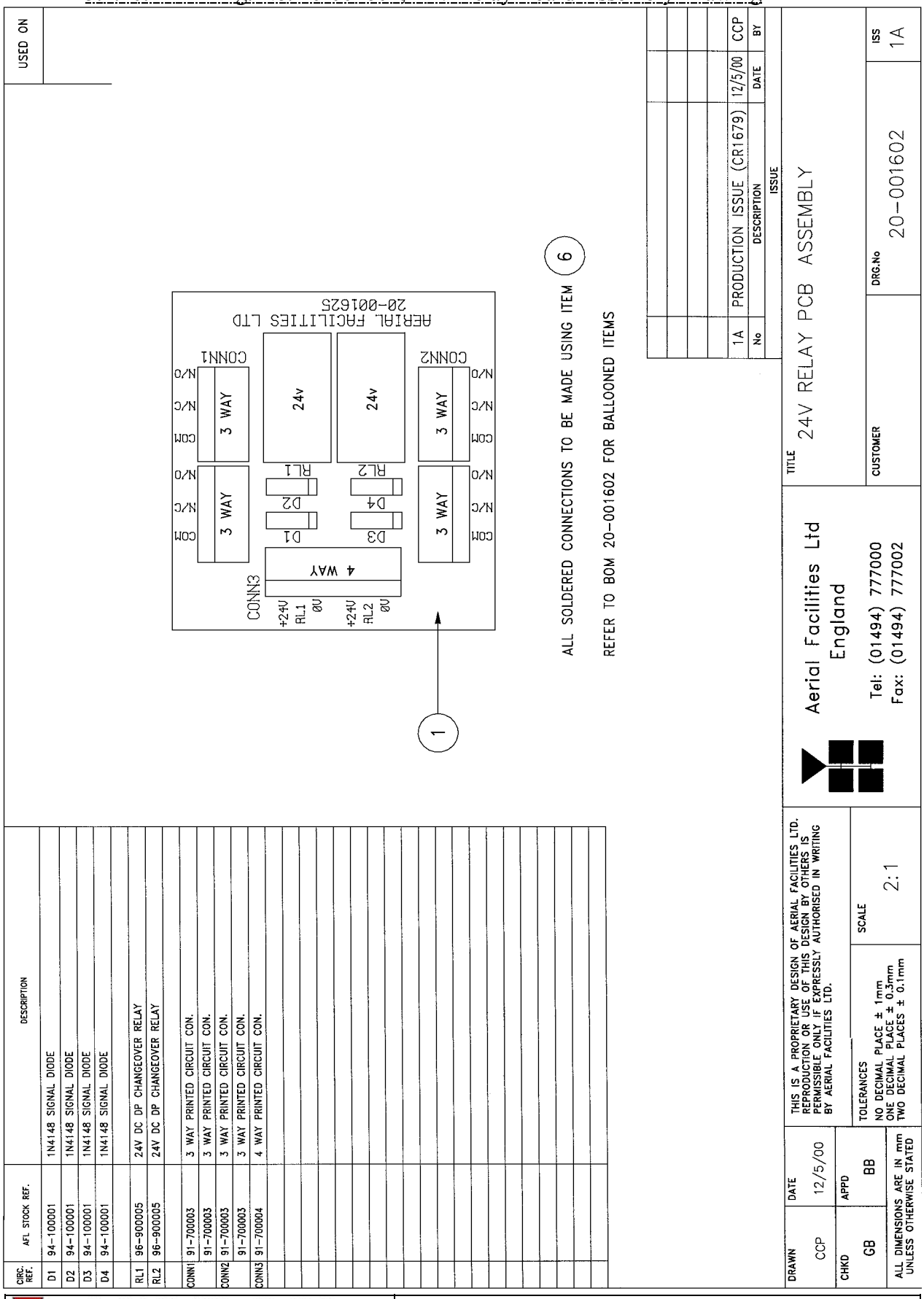
5.1.10.1 Description

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.

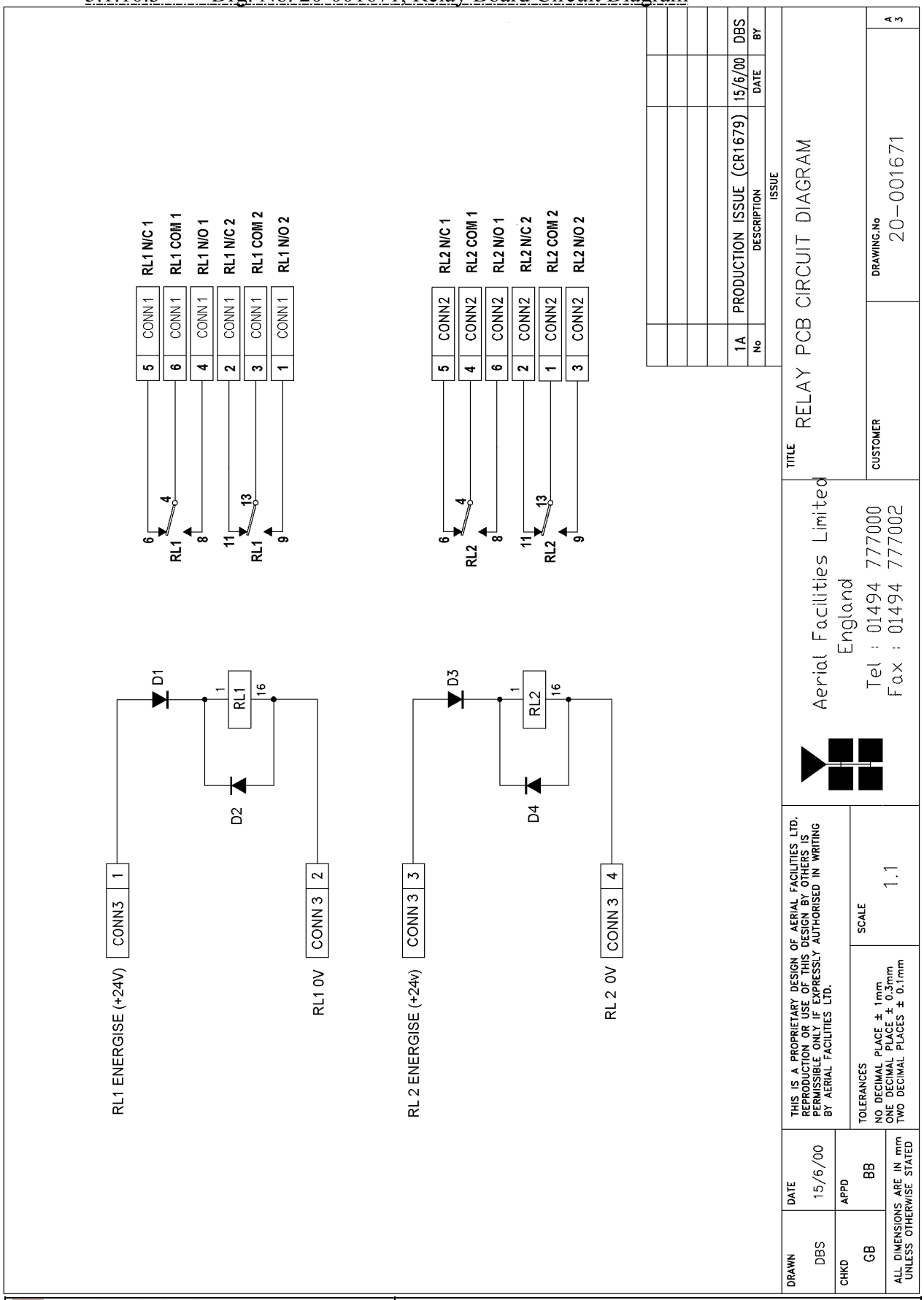
Both relays are provided with polarity protection diodes and diodes for suppressing the transients caused by "flywheel effect" which can destroy switching transistors or induce spikes on neighbouring circuits. It's common use is to amalgamate all the alarm signals into one, volts-free relay contact pair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

5.1.10.2 Drg. No. 20-001602, 24V Relay Board Assembly Drawing



5.1.10.3 Drg. No. 20-001671, Relay Board Circuit Diagram



5.2 Uplink Channelised Cell Enhancer 50-060603 (5U chassis)

5.2.1 DC Tap Module (21-001701)

5.7.1 Description

DC taps are used where it is necessary to inject a DC source 'through' an RF signal path so that equipment in a remote location may be sourced with DC power (where it may be impractical to have mains power). Where used, it will always be that one DC tap module is used at each 'end' of the DC source, one to supply the DC onto the RF signal, and one to remove it at its ultimate destination. The modules are designed for minimum insertion loss (and minimum DC volt-drop) at the operating frequency. They are purely passive devices, and should need no maintenance over their operating lifetime.

All other modules in this shelf have been described in the downlink Cell Enhancer section 5.1.

5.3 Power Supply Shelf 50-060604 (4U chassis)

5.3.1 24V 410W Flat-Pack Power Supply (96-300054)

5.3.1.1 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 5-7.0 Amps at 24V DC, so the PSU will be used conservatively ensuring a long operational lifetime.

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

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

5.3.1.2 Technical Specification

AC Input Supply:		
Voltage:		110 or 220V nominal - 90 to 132 or 180 to 264V (single phase, absolute limits)
Frequency:		47 to 63Hz
DC Output Supply:		
Voltage:		24V DC (nominal), 22 to 26V (absolute limits)
Current:		17.0A
Temperature range:	operational:	-10BC to +55BC
	storage:	-40BC to +70BC

5.3.2 48V/8A DC Power Supply Module (96-300056)

5.3.2.1 Description

This PSU module is similar in size and type to the 24V module, being a multi-mains-voltage switch mode unit but having a 48V DC output. The unit is used to power the remote amplifier unit via the DC Tap Module (see section 5.2.1). A small volt drop from the 48V PSU to the remote cell enhancer is expected so that the DC voltage may be easily converted to 24V to power the remote enhancers's electronics.

5.3.2.2 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:		48V DC (nominal)
		45-50V (absolute limits)
Maximum Output Current:		6A
Temperature range	operation:	-10BC to +55BC
	storage:	-40BC to +70BC

All other modules in this shelf have been described elsewhere in this document.