

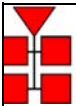
## **5 Channel, Channelised Cell Enhancer**

Maintenance Handbook

For

AFL Works Order Nō.:Q108745

|                                  |           |                    |
|----------------------------------|-----------|--------------------|
| Includes AFL product part Nō's.: | 50-060602 | Downlink Amplifier |
|                                  | 50-060603 | Uplink Amplifier   |
|                                  | 50-060604 | Power Supply       |

|                                                                                                                                                                                                                               |                                                                    |                     |                                        |
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|                                                                                                                                                                                                                               | H/book Number:- <b>50-060601HBKM</b>                               | Issue No:- <b>1</b> | Date:- <b>04/07/2003</b> Page:-1 of 54 |

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## AMENDMENT LIST RECORD SHEET

[illegible]

Document Ref:-50-060601HBKM

## INTRODUCTION

### Scope

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

### Purpose

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

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

## Limitation of Information Notice

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

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

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

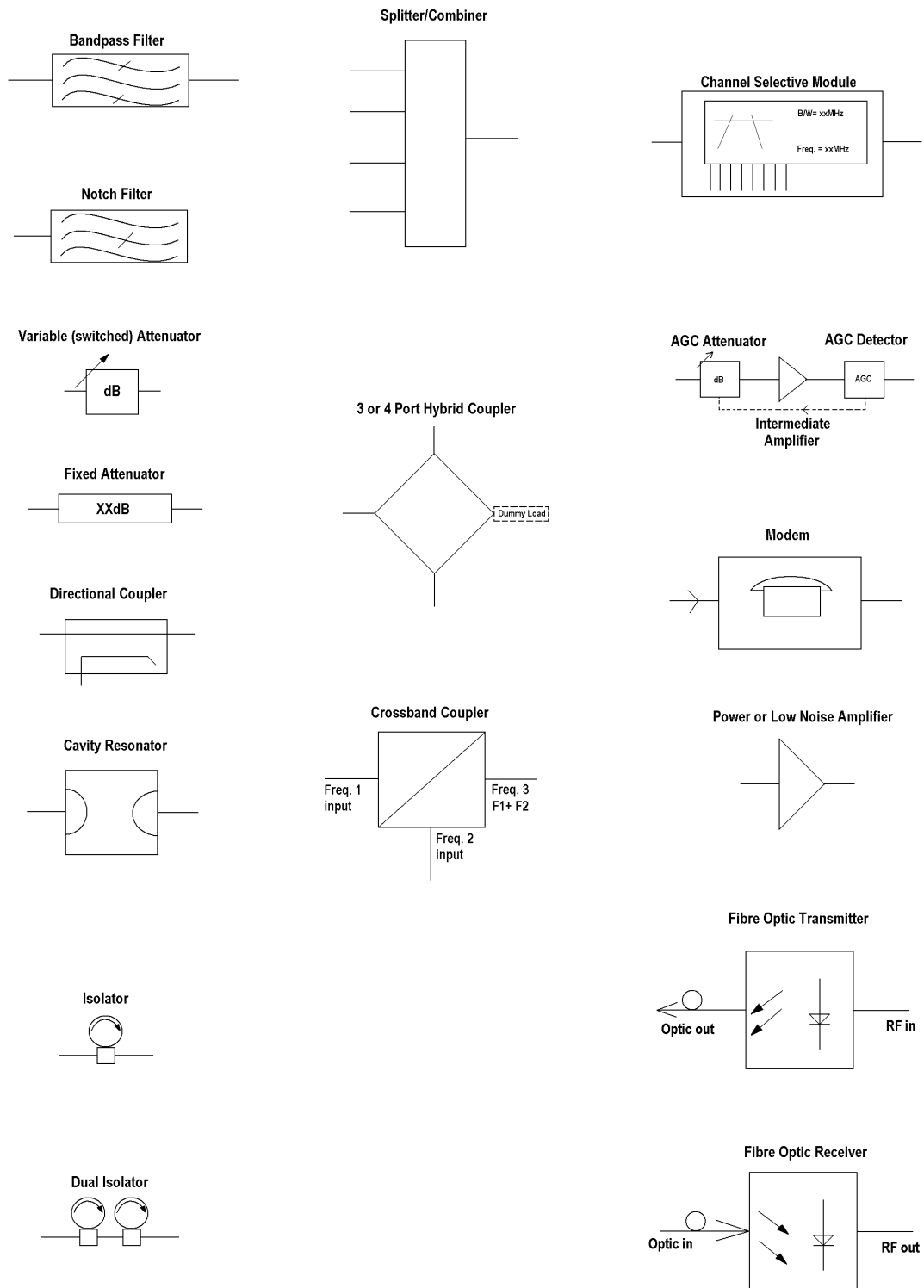
All AFL products carry a twelve month warranty from date of shipment. The warranty is expressly on a return to base repair or exchange basis and the warranty cover does not extend to on-site repair or complete unit exchange.

|                                                                                                                                                                                                                               |                                                                    |                          |                       |
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## Glossary of Terms

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

# Key to AFL RF Module Drawing Symbols



## Key to AFL RF Modules

|                                                                                                                                                                                                                                          |                                                                             |                                |                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|--------------------------------|-----------------------------|
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## 1. SAFETY CONSIDERATIONS

### 1.1 Earthing of Equipment

Cell Enhancers supplied from the mains must be connected to grounded outlets and earthed in conformity with appropriate local, national and international electricity supply and safety regulations.

### 1.2 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.

### 1.3 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  $50\Omega$ , and that of free space at  $377\Omega$ , which would severely mitigate against the efficient radiation of RF power. Radio frequency burns could also be a hazard, if any RF power carrying components were to be carelessly touched!

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

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

|                                                                                                                                                                                                                               |                                                                    |                     |                                                |
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#### 1.4 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.

#### 1.5 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

|                                                                                                                                                                                                                               |                                                                    |                          |                       |
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## 2. OVERVIEW/SYSTEM DESCRIPTION

The AFL Channel Selective Cell Enhancer is a 2-way on-band repeater. Various models are available to cover frequency bands from 50MHz to 3000MHz. Its main sphere of applications is in urban areas where the topology is such that shadows occur in the propagation pattern (for example within large buildings, conference centres and tunnels, etc.,)

The Channel Selective Cell Enhancer is a 2-port device for direct connection to two antennas, usually a highly directional Yagi or similar aligned towards the base (donor) site and an omni-directional antenna to cover the mobiles. The frequency bands that are passed by the Cell Enhancer are set as per the specific customer requirements.

AFL manufacture a wide range of Cell Enhancers, configured for each customer's specific requirements. Two basic physical variants are available, a rack mounted version to fit in a standard 19" rack and an environmentally sealed wall mounted version which requires no further enclosure.

The rack-mounted version is usually supplied in 3 units, a power supply unit and 2 RF units (one containing each path). Each shelf/tray unit containing active modules has a 'D.C. on' indicator on the front panel and the PSU also has an 'A.C. on' indicator.

The wall-mounted version is supplied in a single environmentally-protected case. Handles are provided for carrying the unit and the door is fitted with locks. A supply isolator switch is fitted inside the unit and there are 'DC. on' and 'Alarm on' indicators on the outside of the door.

|                                                                                                                                                                                                                               |                                                                    |                          |                        |
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### 3. SPECIFICATION

#### 3.1 5 Channel Channelised Cell Enhancer 50-060601 Parts Lists

| AFL Part Nō. | Description              | Qty. |
|--------------|--------------------------|------|
| 50-060602    | D/L CCE 80dB 10W Q108330 | 1    |
| 50-060603    | U/L CCE 80dB 10W Q108330 | 1    |
| 50-060604    | PSU Q108330              | 1    |

Modules described in the text are shown as highlighted in the parts list in the quantity column. All fuses used in this equipment must be replaced with identical types as proscribed in the description column of the particular unit's parts list.

##### 3.1.1 Downlink Channelised CE 50-060602 Parts List

|           |                                     |   |
|-----------|-------------------------------------|---|
| 02-010701 | 5P 380MHz(V.B/W)X CPLING SMA POSTS  | 2 |
| 05-002603 | UHF 3dB SPLITTER SMA                | 2 |
| 05-003803 | 3 WAY SPLITTER, UHF, ZINGER         | 4 |
| 10-000701 | 1/4W0-30dB SWITCHED ATTENUATOR      | 1 |
| 11-007302 | LNA. 380-500MHz 20dB (C/W RELAY) GA | 2 |
| 11-007402 | LNA. 380-500MHz 30dB (C/W RELAY) GA | 1 |
| 12-001901 | PWR AMP.450MHz 20W GEN.ASSY         | 1 |
| 12-002201 | 3 STAGE AMPLIFIER ALARM BOARD       | 2 |
| 12-002220 | 3 STAGE ALARM PCB COVER             | 2 |
| 13-001803 | DUAL DC/DC CONVERTER 24V-12V 1A     | 1 |
| 17-003012 | CHAN MOD 450MHz, 15kHz (8p) BW      | 5 |
| 19-000826 | 2U,3U,4U 19" UNIT 400 DEEP LID      | 1 |
| 20-001602 | 24V RELAY BOARD                     | 1 |
| 80-024420 | 5U CHASSIS FRONT PANEL              | 1 |
| 80-024421 | 5U CHASSIS 400mm DEEP               | 1 |
| 80-043320 | HEATSINK                            | 1 |
| 91-020004 | N JACK PANEL UT-141                 | 3 |
| 91-500001 | POWER PLG 3 PIN PNL.MOUNT NC-X      | 1 |
| 91-510003 | 3 PIN R.ANGLE FREE SOC.NC-X.        | 1 |
| 91-600001 | 'D'TYPE 9 WAY PLUG S/B TERM         | 1 |
| 91-620001 | 'D' 25 WAY SOCKET S/B TERM          | 2 |
| 91-620006 | 'D' 25 WAY CONNECTOR SHELL          | 2 |
| 91-700017 | ICD 15 WAY 0.1' CONNECTOR           | 4 |
| 92-340001 | M3 x 8mm 'D'CONNECTOR SCREW LOCK    | 0 |
| 96-110001 | FUSE HOLDER 20 x 5mm6.3A            | 1 |
| 96-110013 | T 3.15 A ANTI SURGE FUSE 20mm       | 1 |
| 96-500005 | DC INPUT FILTERS                    | 1 |
| 96-600002 | INSULATING BOOT SMALL               | 1 |
| 96-600003 | INSULATING BOOT D.C.                | 1 |
| 97-400006 | 5U HANDLE [ALLOY]                   | 2 |

### 3.1.2...Uplink Channelised CE 50-060603 Parts List

| AFL Part Nō. | Description                         | Qty. |
|--------------|-------------------------------------|------|
| 02-010701    | 5P 380MHz(V.B/W)X CPLING SMA POSTS  | 2    |
| 05-002603    | UHF 3dB SPLITTER SMA                | 2    |
| 05-003803    | 3 WAY SPLITTER, UHF, ZINGER         | 4    |
| 10-000701    | 1/4W0-30dB SWITCHED ATTENUATOR      | 1    |
| 11-007302    | LNA. 380-500MHz 20dB (C/W RELAY) GA | 2    |
| 11-007402    | LNA. 380-500MHz 30dB (C/W RELAY) GA | 1    |
| 12-001901    | PWR AMP.450MHz 20W GEN.ASSY         | 1    |
| 12-002201    | 3 STAGE AMPLIFIER ALARM BOARD       | 2    |
| 12-002220    | 3 STAGE ALARM PCB COVER             | 2    |
| 13-001803    | DUAL DC/DC CONVERTER 24V-12V 1A     | 1    |
| 17-003012    | CHAN MOD 450MHz, 15kHz (8p) BW      | 5    |
| 19-000826    | 2U,3U,4U 19" UNIT 400 DEEP LID      | 1    |
| 20-001602    | 24V RELAY BOARD                     | 1    |
| 21-001701    | DC TAP PT FREEPORT                  | 1    |
| 80-024420    | 5U CHASSIS FRONT PANEL              | 1    |
| 80-024421    | 5U CHASSIS 400mm DEEP               | 1    |
| 80-043320    | HEATSINK                            | 1    |
| 91-020004    | N JACK PANEL UT-141                 | 3    |
| 91-500001    | POWER PLG 3 PIN PNL.MOUNT NC-X      | 2    |
| 91-510003    | 3 PIN R.ANGLE FREE SOC.NC-X.        | 1    |
| 91-600001    | 'D'TYPE 9 WAY PLUG S/B TERM         | 1    |
| 91-620001    | 'D' 25 WAY SOCKET S/B TERM          | 2    |
| 91-620006    | 'D' 25 WAY CONNECTOR SHELL          | 2    |
| 91-700017    | ICD 15 WAY 0.1' CONNECTOR           | 4    |
| 92-340001    | M3 x 8mm 'D'CONNECTOR SCREW LOCK    | 0    |
| 96-110001    | FUSE HOLDER 20 x 5mm6.3A            | 1    |
| 96-110013    | T 3.15 A ANTI SURGE FUSE 20mm       | 1    |
| 96-500005    | DC INPUT FILTERS                    | 1    |
| 96-600002    | INSULATING BOOT SMALL               | 1    |
| 96-600003    | INSULATING BOOT D.C.                | 1    |
| 97-400006    | 5U HANDLE [ALLOY]                   | 2    |

### 3.1.3 Power Supply Shelf 50-060604 Parts List

|           |                                     |   |
|-----------|-------------------------------------|---|
| 19-000826 | 2U,3U,4U 19" UNIT 400 DEEP LID      | 1 |
| 19-001021 | 4U 19" UNIT 400 DEEP CHASSIS + BKT  | 1 |
| 19-001024 | 4U 19" UNIT FRONT PANEL FAB         | 1 |
| 20-001602 | 24V RELAY BOARD                     | 1 |
| 80-064120 | HEATSINK 4U FLATPAC 16A 10W         | 1 |
| 91-500025 | 3 PIN RIGHT ANGLE FREE PLUG NC-X    | 1 |
| 91-510003 | 3 PIN R.ANGLE FREE SOC.NC-X.        | 1 |
| 91-510004 | 3 PIN PNL.MOUNT SOCKET NC-X         | 3 |
| 91-520001 | PWR MAINS INL FIXED/SOLD.TERMS      | 3 |
| 91-520004 | POWER MAINS INL.FREE R/ANGLE        | 3 |
| 91-600001 | 'D'TYPE 9 WAY PLUG S/B TERM         | 1 |
| 92-340001 | M3 x 8mm 'D'CONNECTOR SCREW LOCK    | 0 |
| 93-560001 | VARISTOR V275LA20A                  | 1 |
| 96-300054 | 24V 17A PSU 400W (XP BCC)           | 1 |
| 96-300056 | 48V 6A PSU DIN RAIL (TRACO)         | 1 |
| 96-700034 | LED RED 5mm IP67 INTEGRAL RES. 24V  | 1 |
| 96-700035 | LED GREEN 5mm IP67 INTEGRAL RES 24V | 2 |
| 96-900018 | AC TRIP SWITCH (5 AMP M.C.B.)       | 2 |
| 97-400002 | HANDLE TYPE H6803 4U.[ALLOY]        | 2 |

### 3.2 Technical Specification

| PARAMETER                      | SPECIFICATION                  |
|--------------------------------|--------------------------------|
| Downlink Frequency Range:      | 453.30-453.75MHz               |
| Uplink Frequency Range:        | 458.30-458.75MHz               |
| Channel Bandwidth selectivity: | 12.5kHz adjacent channel >20dB |
|                                | 25kHz adjacent channel >80dB   |
| Number of Channels:            | 5                              |
| Number of ports:               | 2                              |
| RF Connectors:                 | N type, female                 |
| Impedance:                     | 50Ω                            |
| VSWR:                          | Better than 1.5:1              |
| Sensitivity:                   | 0.35 microvolts @ 12dB SINAD   |
| Downlink Output Power:         | 10 Watts                       |
| Uplink Output Power:           |                                |
| Uplink TOI:                    | 50dBm                          |
| Downlink TOI:                  | 50dBm                          |
| RF level per carrier:          | >+23dBm                        |
| Passband ripple:               | <±1.5dB                        |
| Noise figure:                  | <6dB (@max gain)               |
| Gain:                          | 96dB                           |
| Gain adjustment:               | 0-30dB (in 2dB steps)          |
| In band spurious:              | Better than –36dBm             |
| Spurious up to 3GHz:           | Better than –90dBc             |
| Input AC Supply:               | 120V AC                        |
| Consumption:                   | 150 Watts                      |
| Alarms:                        | Volt-free relay contacts       |
|                                | Excessive VSWR                 |
|                                | Forward power drop             |
| MTBF:                          | 80,000 Hrs.                    |
| Housing:                       | 19” Rack mounted               |

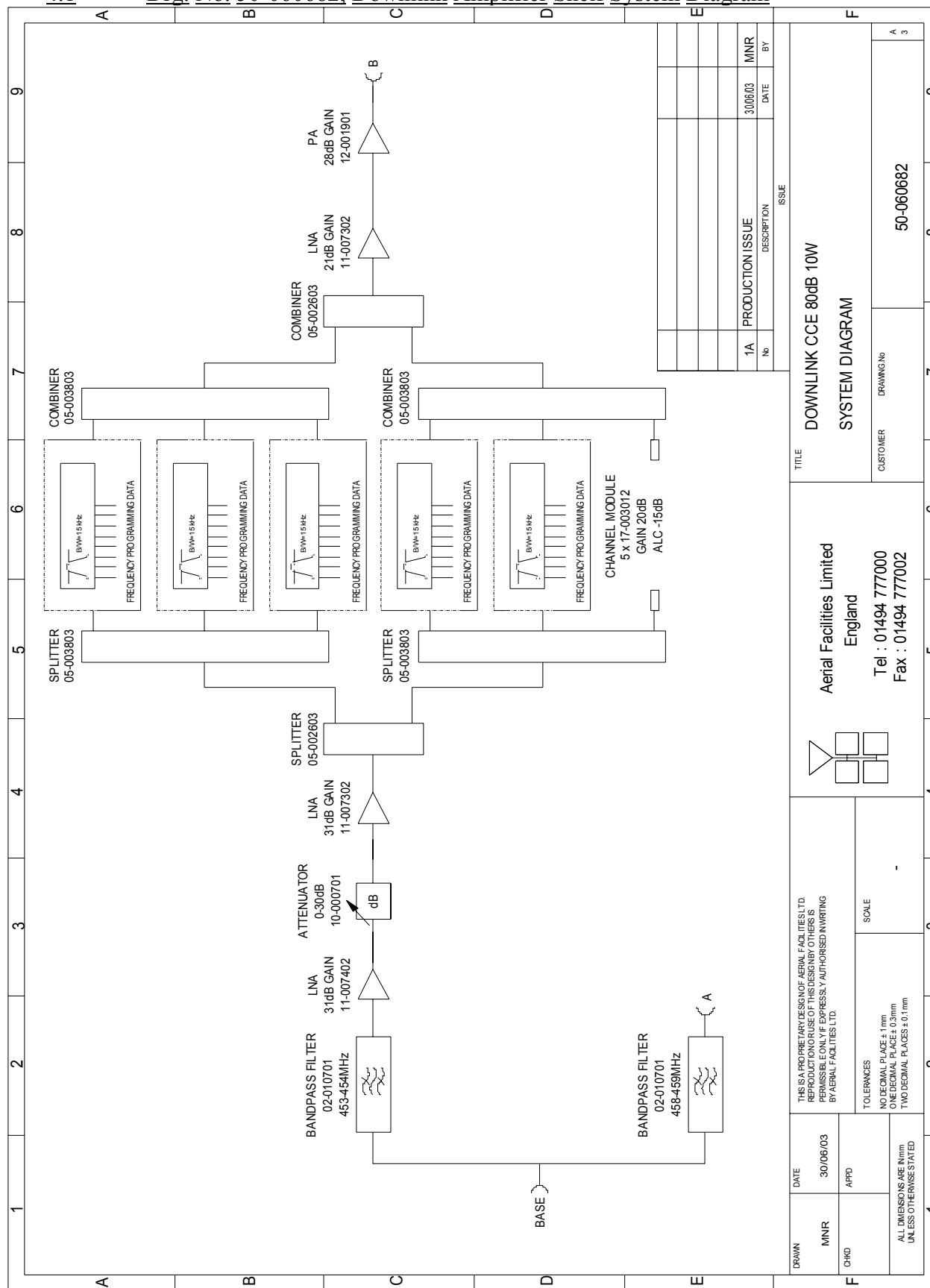
### 3.3 Mechanical Specification

|                           |              |                                                                                                                 |
|---------------------------|--------------|-----------------------------------------------------------------------------------------------------------------|
| Case Size:                | Height:      | Eurorack Shelves(1U=44.5mm)                                                                                     |
|                           | Width:       | 19"                                                                                                             |
|                           | Depth:       | <500mm                                                                                                          |
|                           |              | (excluding heatsinks, connectors, handles and feet)                                                             |
| Temperature Range:        | operational: | -10°C to +55°C                                                                                                  |
|                           | storage:     | -40°C to +70°C                                                                                                  |
| Weight:                   |              | <30kg* (approximately)                                                                                          |
| Humidity:                 |              | 5 – 95% non-condensing                                                                                          |
| RF Connectors:            |              | N type female                                                                                                   |
| Environmental Protection: |              | IP54                                                                                                            |
| Finish:                   | Case:        | Alocrom                                                                                                         |
|                           | Heatsinks:   | Matt black                                                                                                      |
|                           | Handles:     | Alocrom                                                                                                         |
| Supply Cable:             |              | Unit supplied with suitable supply input leads with connector and specified length of cable (where appropriate) |

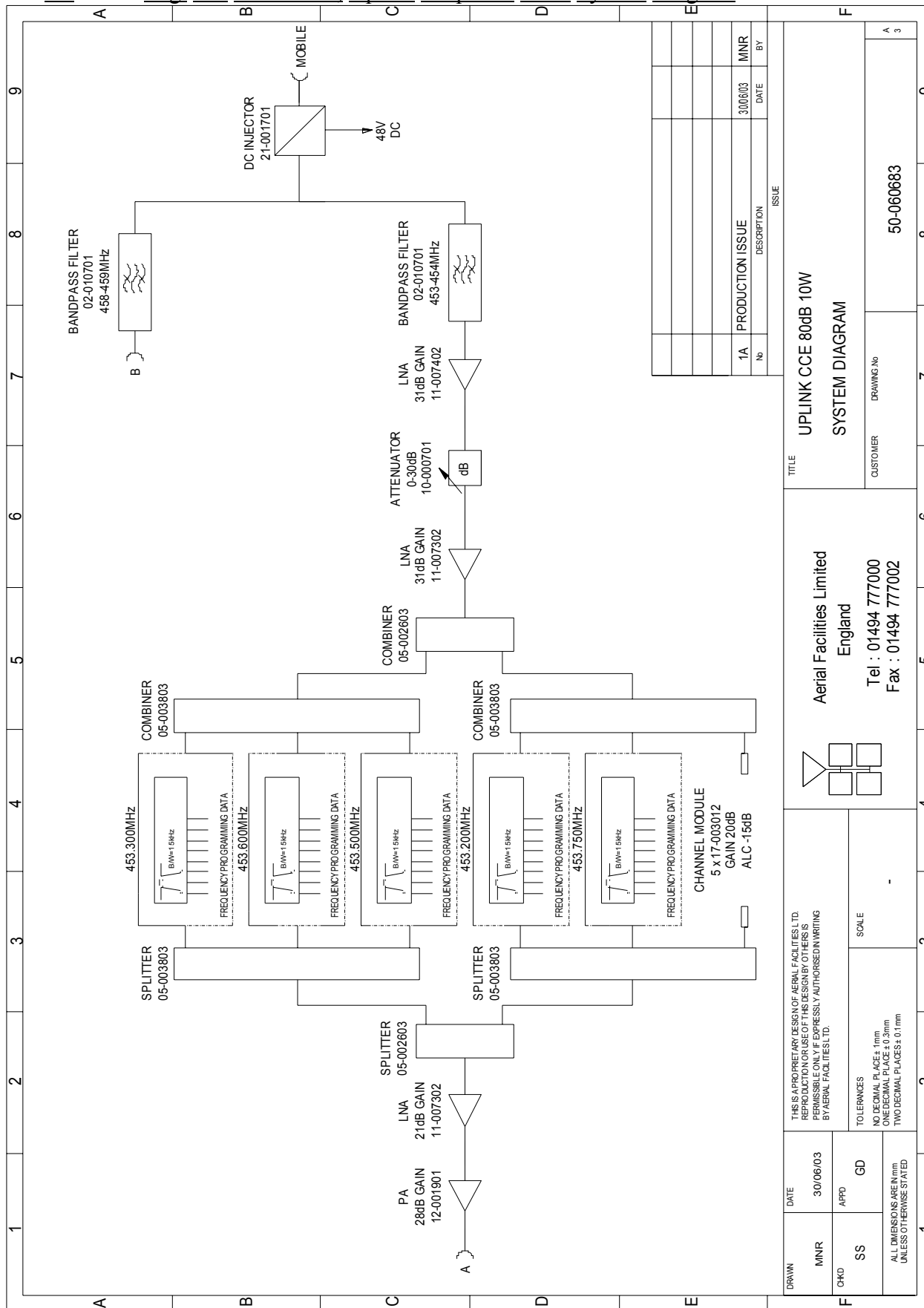
\* Note: Individual shelf weights unspecified.

#### 4. SYSTEM DRAWINGS

##### 4.1 Drg. Nō. 50-060682, Downlink Amplifier Shelf System Diagram

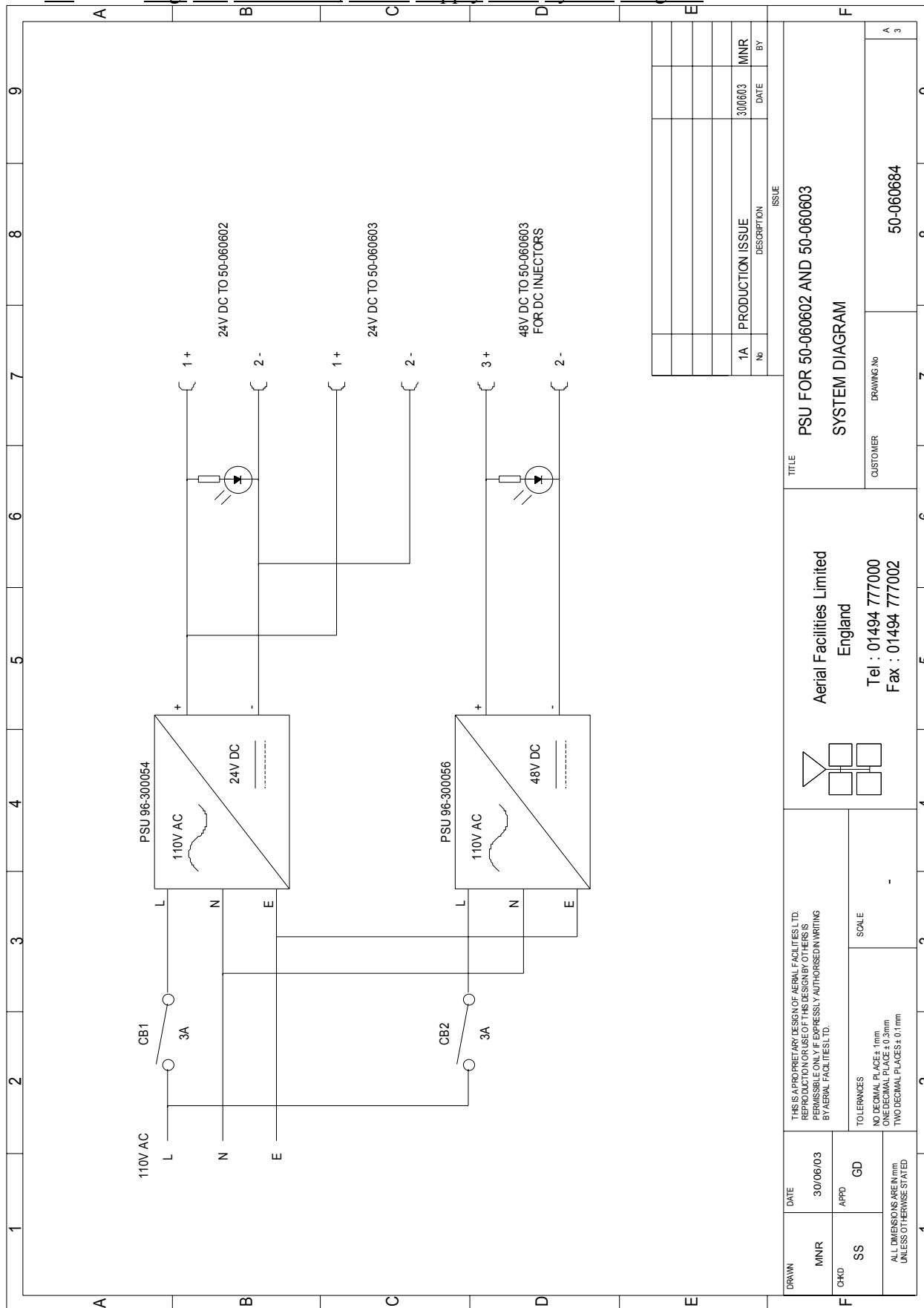


## 4.2 Drg. No. 50-060683, Uplink Amplifier Shelf System Diagram



## 4.3

## Drg. No. 50-060684, Power Supply Shelf System Diagram



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## 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 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 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.

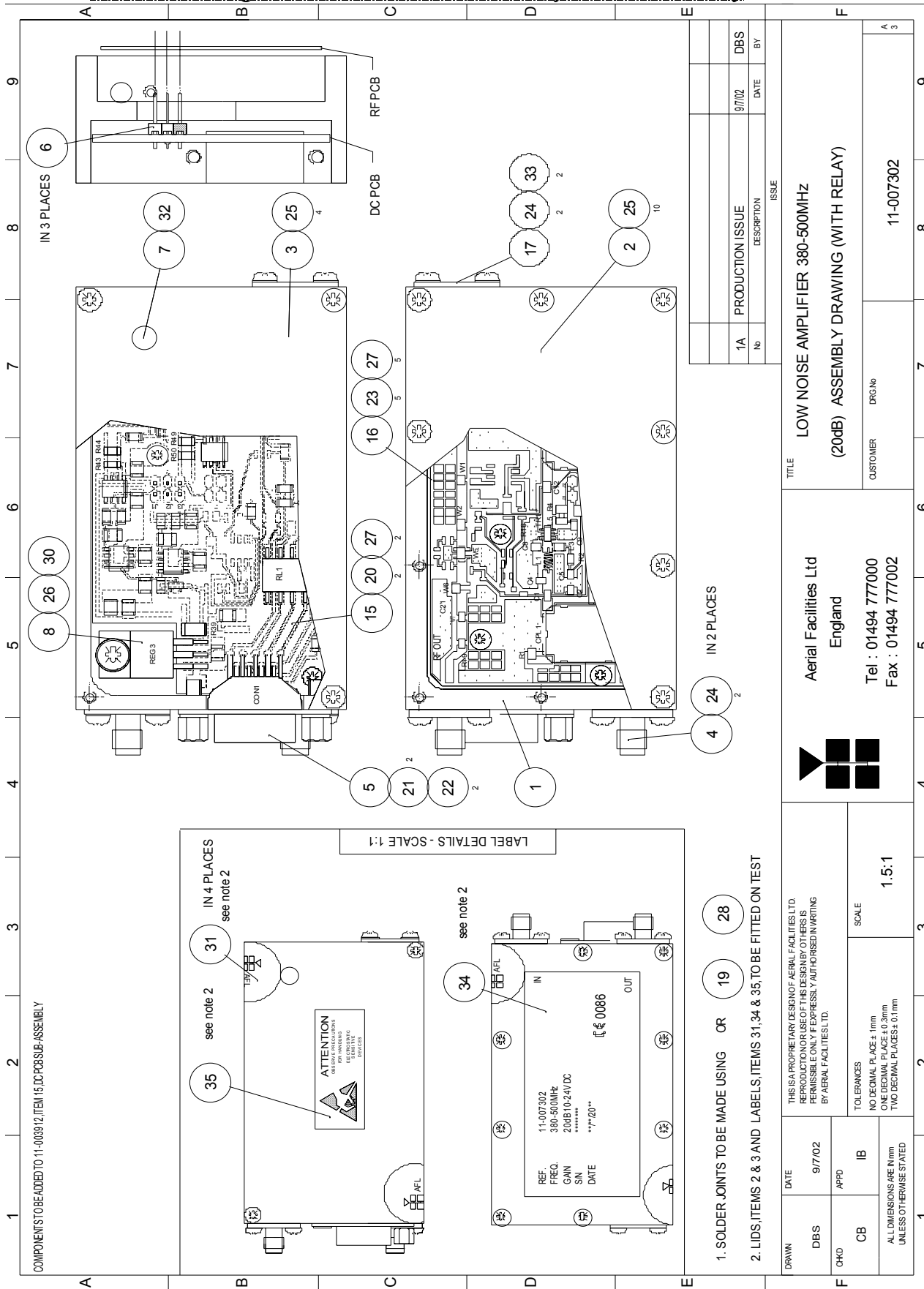
#### 5.1.5.2 Technical Specification, (11-007302)

| 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) |

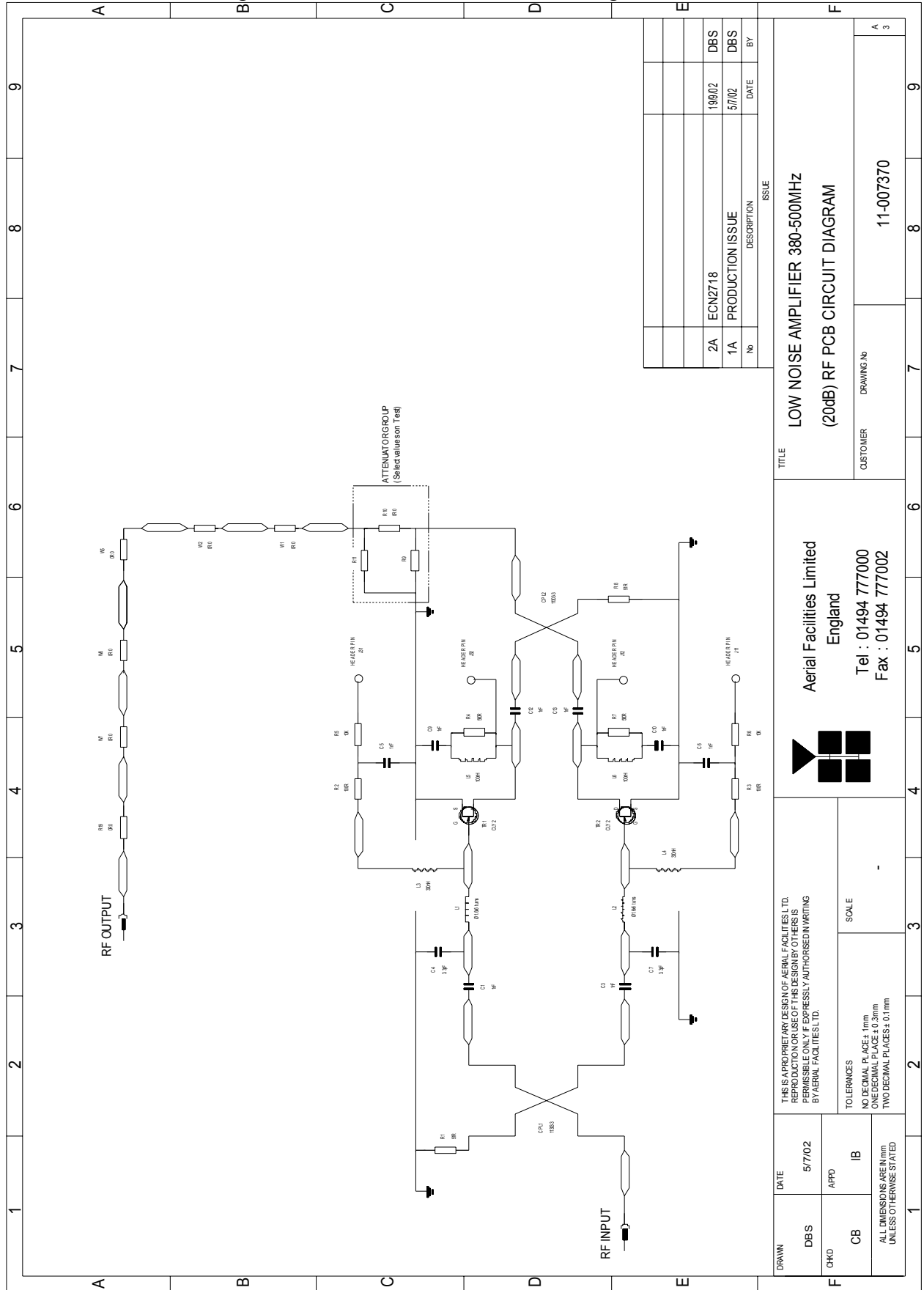
#### 5.1.5.3 Technical Specification (11-007402)

| 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) |

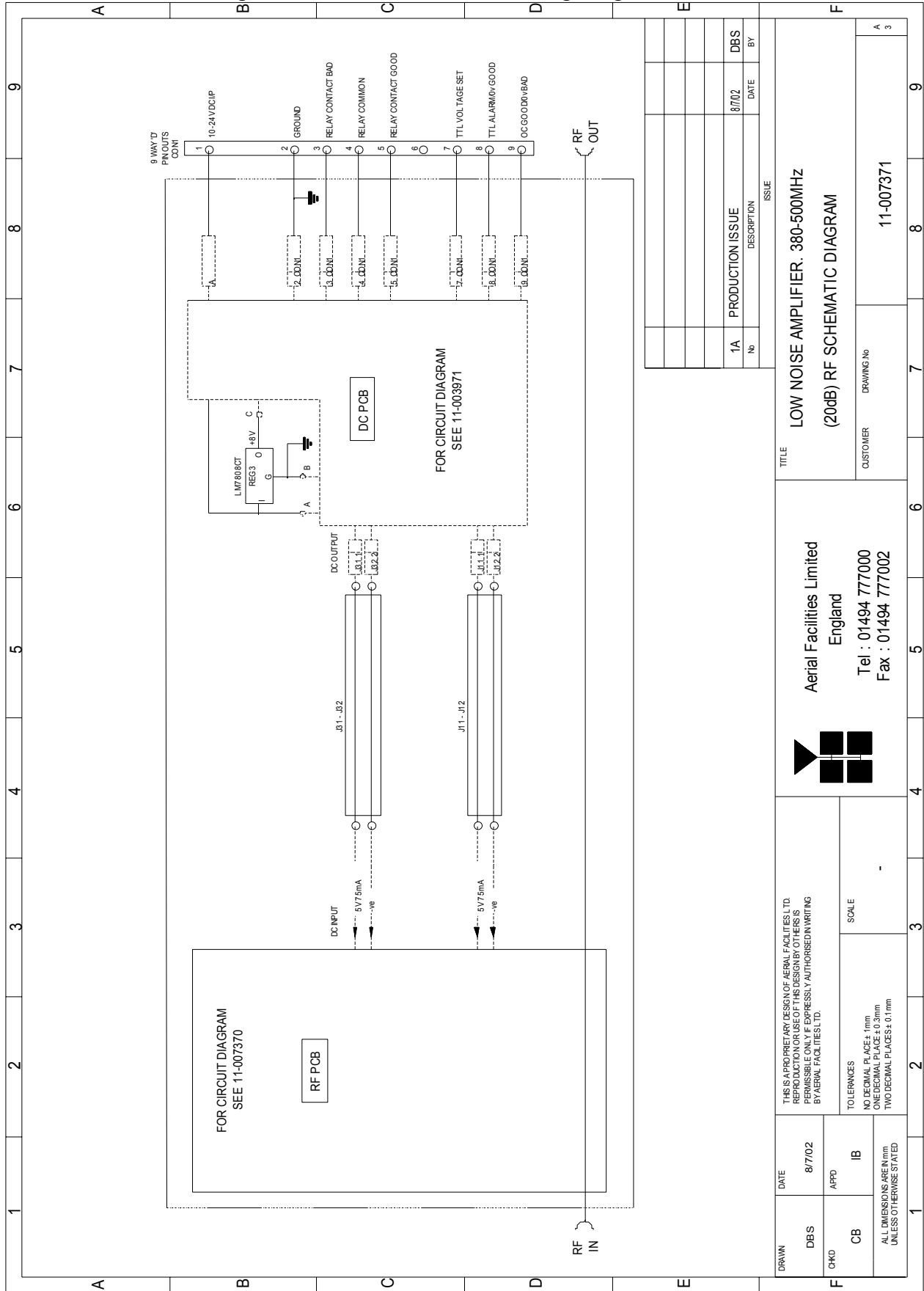
Drg. Nō. 11-007302, LNA Assembly With Alarm Relay



# 5.1.5.4 Drg. Nō. 11-007370, LNA RF Circuit Diagram



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





## 5.1.6 10Watt Power Amplifier (12-001901)

### 5.1.6.1 Description

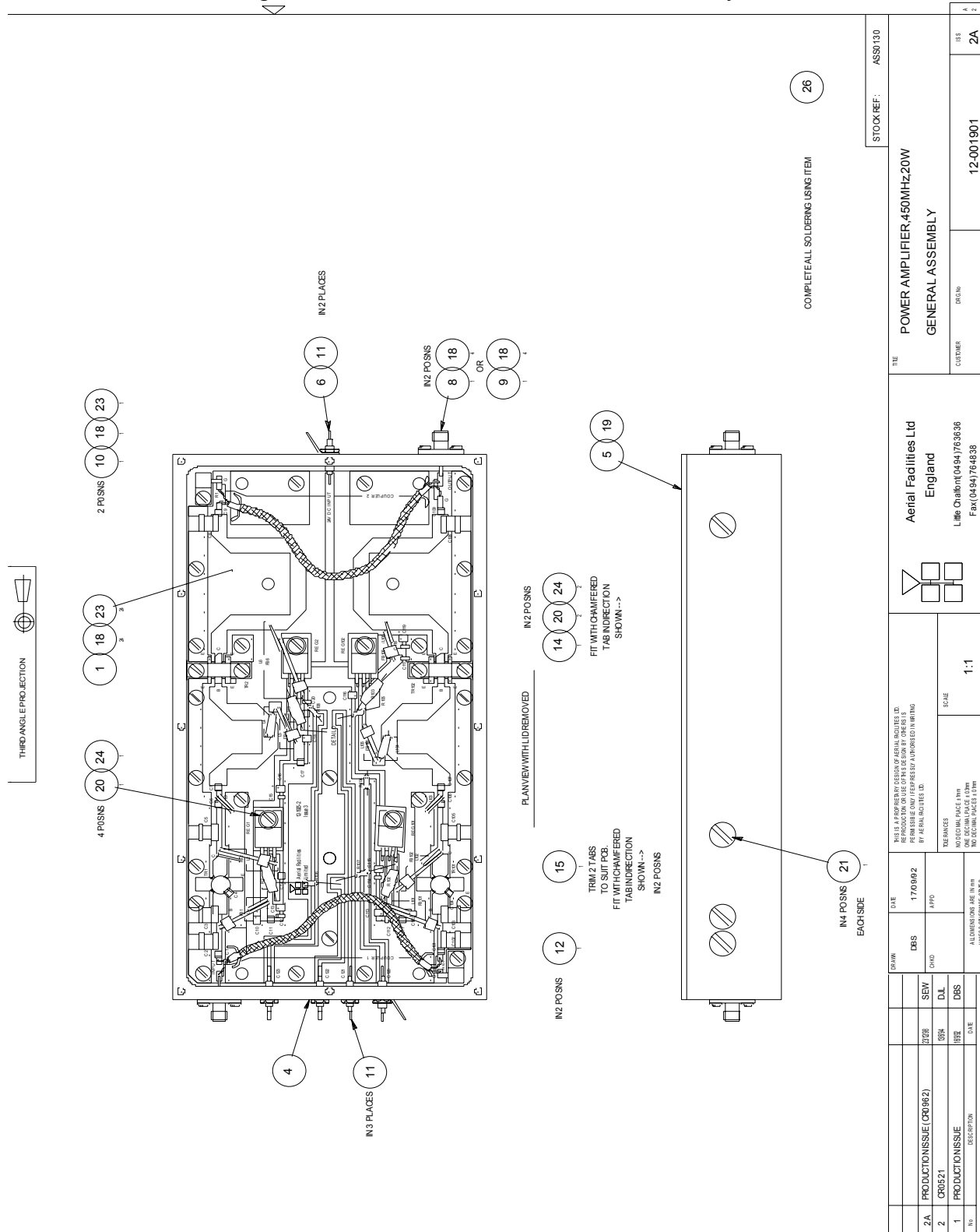
The power amplifier fitted to this unit is a multi-stage, solid state class A power amplifier. All the semi-conductor devices are very conservatively rated to ensure low device junction temperatures and a long, trouble free working lifetime. The amplifier was originally designed to have a 20W power output,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

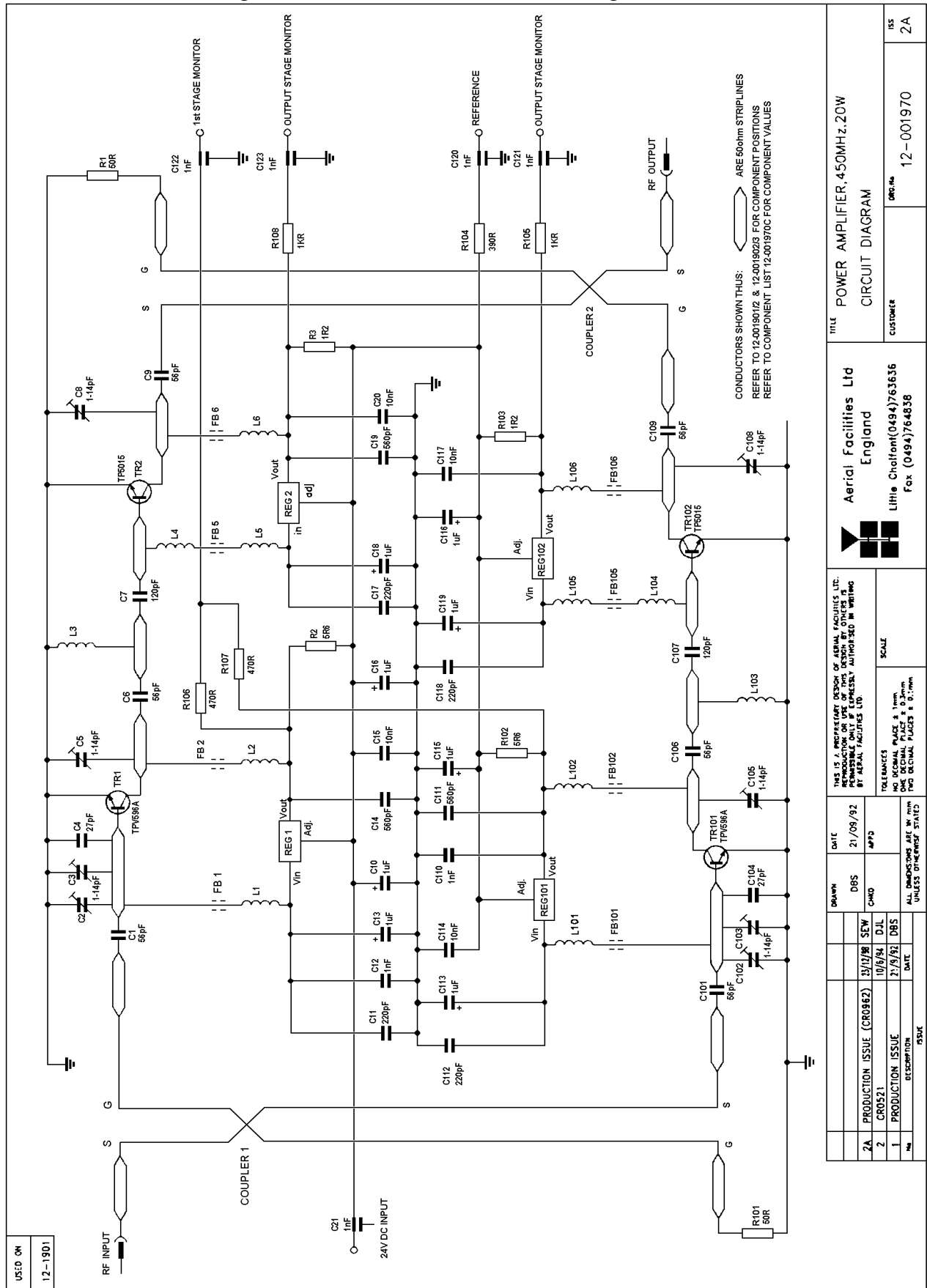
### 5.1.6.2 Technical Specification

| 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



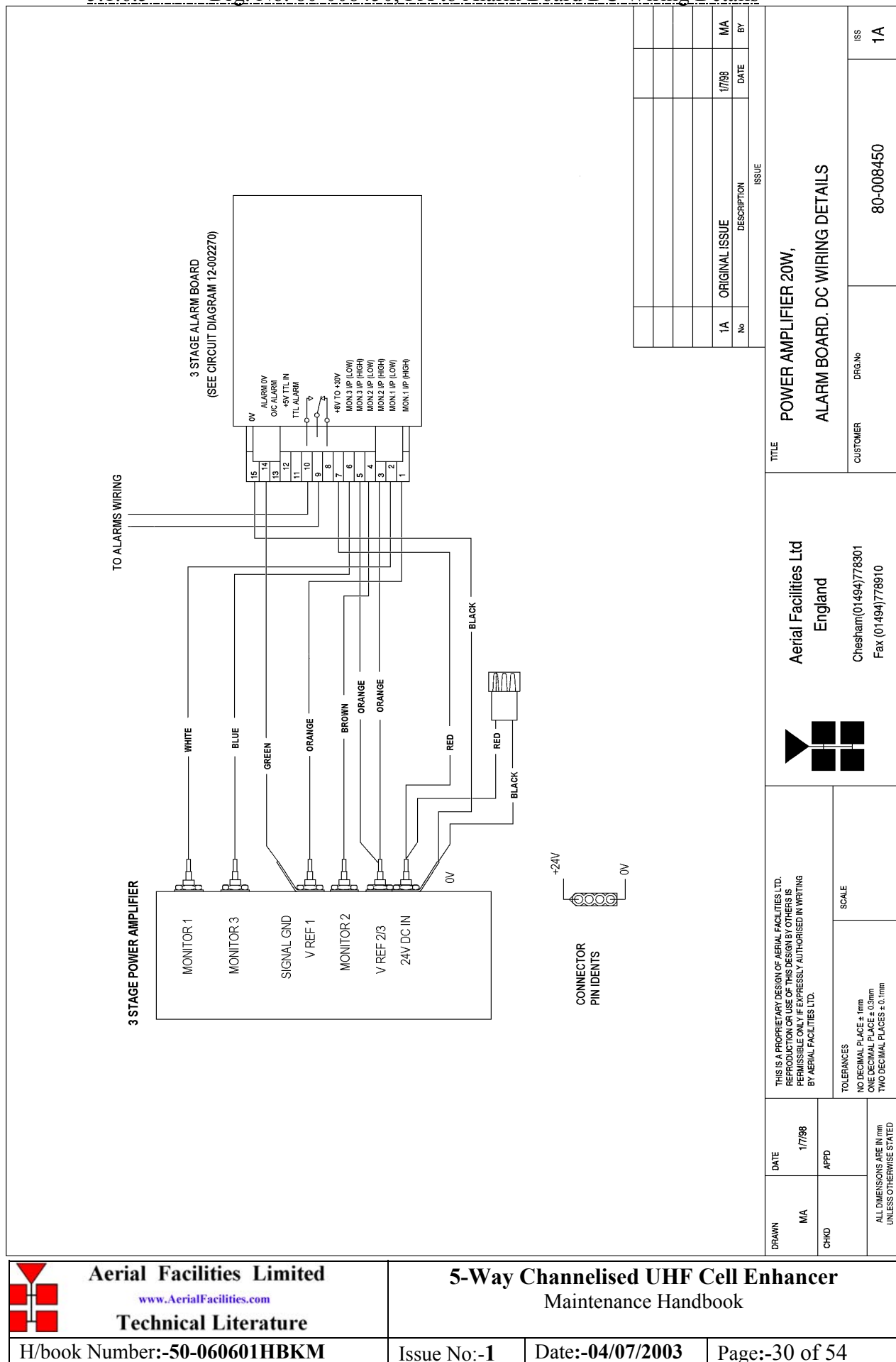
# 5.1.6.4 Drg. No. 12-001970, 10W PA Circuit Diagram



|                              |                                                                                                                                           |                                                                    |                  |                |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|------------------|----------------|
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|                                                                                                                                                                                                                    |  |                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------------------------------|
| <b>POWER AMPLIFIER, 450MHz, 20W</b><br><b>CIRCUIT DIAGRAM</b>                                                                                                                                                      |  | ISS<br>2A                            |
| <b>Aerial Facilities Ltd</b><br><b>England</b><br>                                                                                                                                                                 |  | CUSTOMER<br>12-001970<br>DRC: Hs<br> |
| <b>Little Chalfont (0494) 763636</b><br><b>Fax (0494) 764838</b>                                                                                                                                                   |  | SCALE<br>                            |
| THIS IS A PROPRIETARY DESIGN OF AERIAL FACILITIES LTD.<br>IT IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, WITHOUT PERMISSION IN WRITING BY AERIAL FACILITIES LTD. |  | DATE<br>21/08/92<br>APPD<br>         |
| 2A PRODUCTION ISSUE (CRO362) 11/12/98 SEW<br>2 CRO521 10/8/94 DJL<br>1 PRODUCTION ISSUE 21/8/92 DBS<br>DESCRIPTION DATE                                                                                            |  | ISSUE                                |

# 5.1.6.5 Drg. Nō. 80-008450, PA to Alarm Board DC Wiring Details



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### 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.

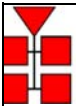
The use of precision voltage sources and resistors has eliminated the need for initial adjustment or calibration, and the board will function correctly with a wide variation in power supply voltage (8 to 30 volts, nominal supply is 12 or 24Volts).

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.

|                                                                                                                                                                                                                               |                                                                    |                     |                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|---------------------|-------------------------------------------------|
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### 5.1.7.2 Technical Specification

| PARAMETER                           |              | SPECIFICATION                 |
|-------------------------------------|--------------|-------------------------------|
| Operating voltage:                  |              | 8 to 30V (floating earth)     |
| Alarm Threshold:                    |              | Vcc - 1.20 volt $\pm$ 15%     |
| <b>Alarm output relay contacts:</b> |              |                               |
| Max. switch current:                |              | 1.0Amp                        |
| Max. switch volts:                  |              | 120Vdc/60VA                   |
| Max. switch power:                  |              | 24W/60VA                      |
| Min. switch load:                   |              | 10.0 $\mu$ A/10.0mV           |
| Relay isolation:                    |              | 1.5kV                         |
| Mechanical life:                    |              | >2x10 <sup>7</sup> 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

|                                                                                                                                                                                                                               |                                                                    |                          |                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------|------------------------|
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| CIRC. REF. | APL STOCK REF. | DESCRIPTION                           | CIRC. REF. | APL STOCK REF. | DESCRIPTION                    |
|------------|----------------|---------------------------------------|------------|----------------|--------------------------------|
| R1         | 95-630040      | 1.8K $\Omega$ 0.125W 2% CHIP RESISTOR | T64        | 94-020007      | BCW71 NPN TRANSISTOR SMD       |
| R2         | 95-630024      | 120 $\Omega$ 0.125W 2% CHIP RESISTOR  | T65        | 94-020007      | BCW71 NPN TRANSISTOR SMD       |
| R3         | 95-630024      | 120 $\Omega$ 0.125W 2% CHIP RESISTOR  | T66        | 94-020010      | FZ751/753 PNP TRIN SMD         |
| R4         | 95-630024      | 3.6K $\Omega$ 0.125W 2% CHIP RESISTOR | IC1        | 94-210001      | LM432M SMD QUAD OP AMP         |
| R5         | 95-640003      | 100K PRECISION RESISTOR 0.1%          | IC2        | 94-210001      | LM432M SMD QUAD OP AMP         |
| R6         | 95-640003      | 100K PRECISION RESISTOR 0.1%          | IC3        | 94-210001      | LM432M SMD QUAD OP AMP         |
| R7         | 95-640003      | 100K PRECISION RESISTOR 0.1%          | RL1        | 95-900004      | BY DPCO NON LATCHING RELAY     |
| R8         | 95-630037      | 1K $\Omega$ 0.125W 2% CHIP RESISTOR   | H1         | 91-700016      | 15 WAY 0.1" LOCKING HEADER PCB |
| R9         | 95-630037      | 270K $\Omega$ 0.125W 2% CHIP RESISTOR |            |                |                                |
| R10        | 95-630037      | 1K $\Omega$ 0.125W 2% CHIP RESISTOR   |            |                |                                |
| R11        | 95-630037      | 1K $\Omega$ 0.125W 2% CHIP RESISTOR   |            |                |                                |
| R12        | 95-630037      | 1K $\Omega$ 0.125W 2% CHIP RESISTOR   |            |                |                                |
| R13        | 95-640003      | 100K PRECISION RESISTOR 0.1%          |            |                |                                |
| R14        | 95-640003      | 100K PRECISION RESISTOR 0.1%          |            |                |                                |
| R15        | 95-640003      | 100K PRECISION RESISTOR 0.1%          |            |                |                                |
| R16        | 95-640003      | 100K PRECISION RESISTOR 0.1%          |            |                |                                |
| R17        | 95-630037      | 1K $\Omega$ 0.125W 2% CHIP RESISTOR   |            |                |                                |
| R18        | 95-630037      | 270K $\Omega$ 0.125W 2% CHIP RESISTOR |            |                |                                |
| R19        | 95-630037      | 1K $\Omega$ 0.125W 2% CHIP RESISTOR   |            |                |                                |
| R20        | 95-630037      | 270K $\Omega$ 0.125W 2% CHIP RESISTOR |            |                |                                |
| R21        | 95-640003      | 100K PRECISION RESISTOR 0.1%          |            |                |                                |
| R22        | 95-640003      | 100K PRECISION RESISTOR 0.1%          |            |                |                                |
| R23        | 95-640003      | 100K PRECISION RESISTOR 0.1%          |            |                |                                |
| R24        | 95-640003      | 100K PRECISION RESISTOR 0.1%          |            |                |                                |
| R25        | 95-630037      | 1K $\Omega$ 0.125W 2% CHIP RESISTOR   |            |                |                                |
| R26        | 95-630037      | 270K $\Omega$ 0.125W 2% CHIP RESISTOR |            |                |                                |
| R27        | 95-630037      | 1K $\Omega$ 0.125W 2% CHIP RESISTOR   |            |                |                                |
| R28        | 95-630037      | 270K $\Omega$ 0.125W 2% CHIP RESISTOR |            |                |                                |
| R29        | 95-630049      | 4.7K $\Omega$ 0.125W 2% CHIP RESISTOR |            |                |                                |
| R30        | 95-630042      | 2.2K $\Omega$ 0.125W 2% CHIP RESISTOR |            |                |                                |
| R31        | 95-630053      | 10K $\Omega$ 0.125W 2% CHIP RESISTOR  |            |                |                                |
| R32        | 95-630049      | 4.7K $\Omega$ 0.125W 2% CHIP RESISTOR |            |                |                                |
| R33        | 95-630053      | 10K $\Omega$ 0.125W 2% CHIP RESISTOR  |            |                |                                |
| R34        | 95-630049      | 4.7K $\Omega$ 0.125W 2% CHIP RESISTOR |            |                |                                |
| R35        | 95-630037      | 1K $\Omega$ 0.125W 2% CHIP RESISTOR   |            |                |                                |
| R36        | 95-630049      | 4.7K $\Omega$ 0.125W 2% CHIP RESISTOR |            |                |                                |
| R37        | 95-630037      | 1K $\Omega$ 0.125W 2% CHIP RESISTOR   |            |                |                                |
| R38        | 95-630037      | 2.2K $\Omega$ 0.125W 2% CHIP RESISTOR |            |                |                                |
| R39        | 95-630053      | 10K $\Omega$ 0.125W 2% CHIP RESISTOR  |            |                |                                |
| R40        | 95-630042      | 2.2K $\Omega$ 0.125W 2% CHIP RESISTOR |            |                |                                |
| R41        | 95-630057      | 20K $\Omega$ 0.125W 2% CHIP RESISTOR  |            |                |                                |
| R42        | 95-630049      | 4.7K $\Omega$ 0.125W 2% CHIP RESISTOR |            |                |                                |
| C1         | 95-240004      | 1 $\mu$ F TANTALUM CHIP CAP 35V SMD   |            |                |                                |
| C2         | 95-200021      | 100nF 63V 10X CHIP CAPACITOR          |            |                |                                |
| C3         | 95-200021      | 100nF 63V 10X CHIP CAPACITOR          |            |                |                                |
| C4         | 95-200021      | 100nF 63V 10X CHIP CAPACITOR          |            |                |                                |
| C5         |                |                                       |            |                |                                |
| C6         | 95-200021      | 100nF 63V 10X CHIP CAPACITOR          |            |                |                                |
| C7         | 95-240004      | 1 $\mu$ F TANTALUM CHIP CAP 35V SMD   |            |                |                                |
| C8         | 95-240004      | 1 $\mu$ F TANTALUM CHIP CAP 35V SMD   |            |                |                                |
| D1         | 94-130003      | 1.23V VOLTAGE REFERENCE DIODE         |            |                |                                |
| D2         | 94-130003      | 1.23V VOLTAGE REFERENCE DIODE         |            |                |                                |
| D3         | 94-150001      | LL4148 GP MINIMELF DIODE SMD          |            |                |                                |
| D4         | 94-150001      | LL4148 GP MINIMELF DIODE SMD          |            |                |                                |
| D5         | 94-150001      | LL4148 GP MINIMELF DIODE SMD          |            |                |                                |
| D6         | 94-150001      | LL4148 GP MINIMELF DIODE SMD          |            |                |                                |
| D7         | 94-150001      | LL4148 GP MINIMELF DIODE SMD          |            |                |                                |
| D8         | 94-150001      | LL4148 GP MINIMELF DIODE SMD          |            |                |                                |
| D9         | 94-150001      | LL4148 GP MINIMELF DIODE SMD          |            |                |                                |
| LED1       | 96-700008      | GREEN LED SMD                         |            |                |                                |
| TR1        | 94-020007      | BCW71 NPN TRANSISTOR SMD              |            |                |                                |
| TR2        | 94-020007      | BCW71 NPN TRANSISTOR SMD              |            |                |                                |
| TR3        | 94-020007      | BCW71 NPN TRANSISTOR SMD              |            |                |                                |
| TR4        | 94-020007      | BCW71 NPN TRANSISTOR SMD              |            |                |                                |



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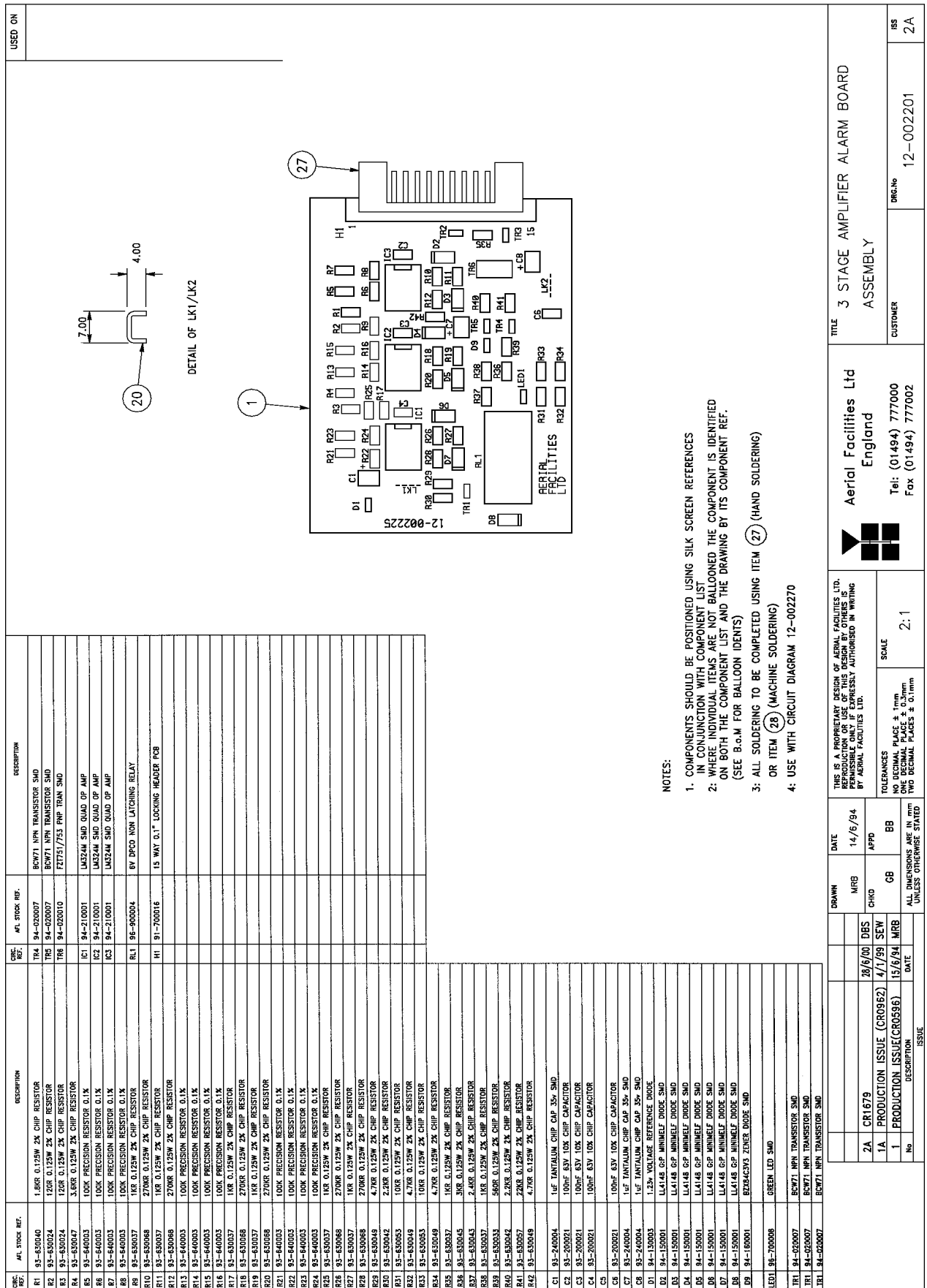
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Maintenance Handbook

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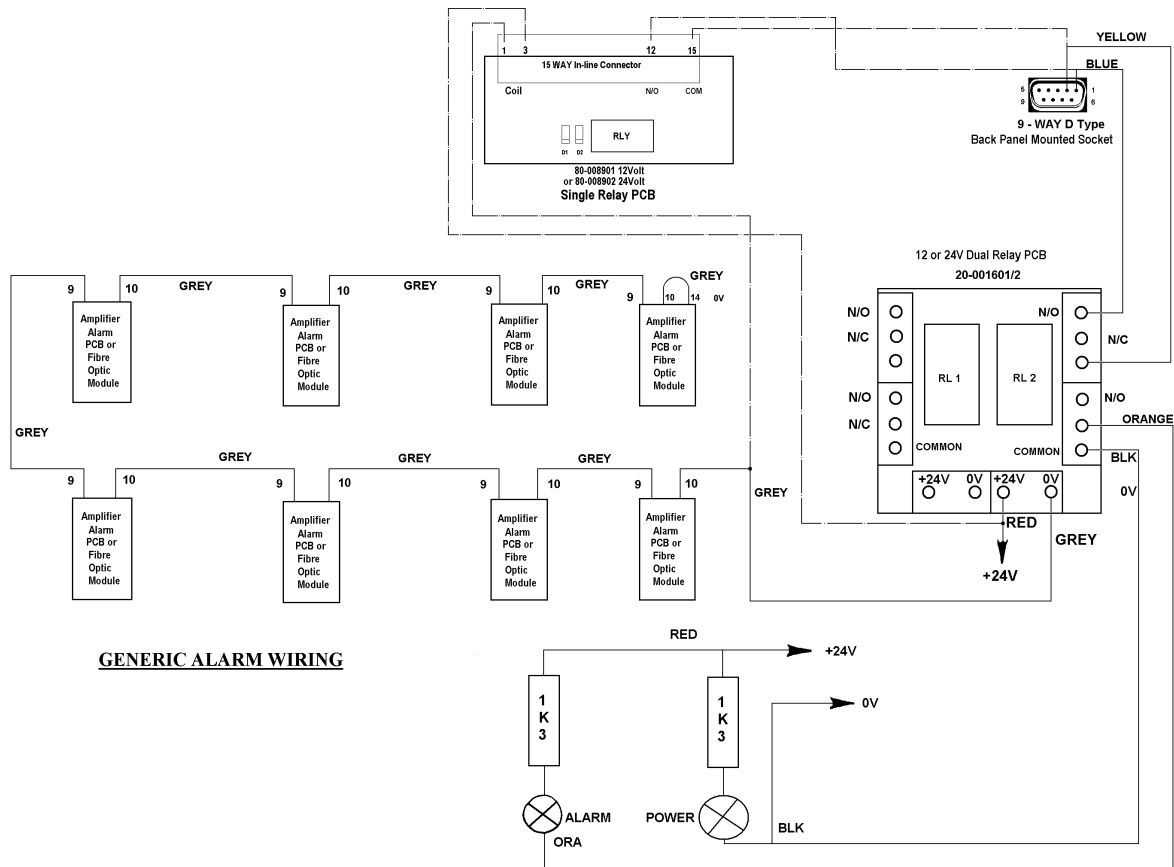
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## 5.1.8 Dual DC/DC Converter (13-001803)

### 5.1.8.1 Description

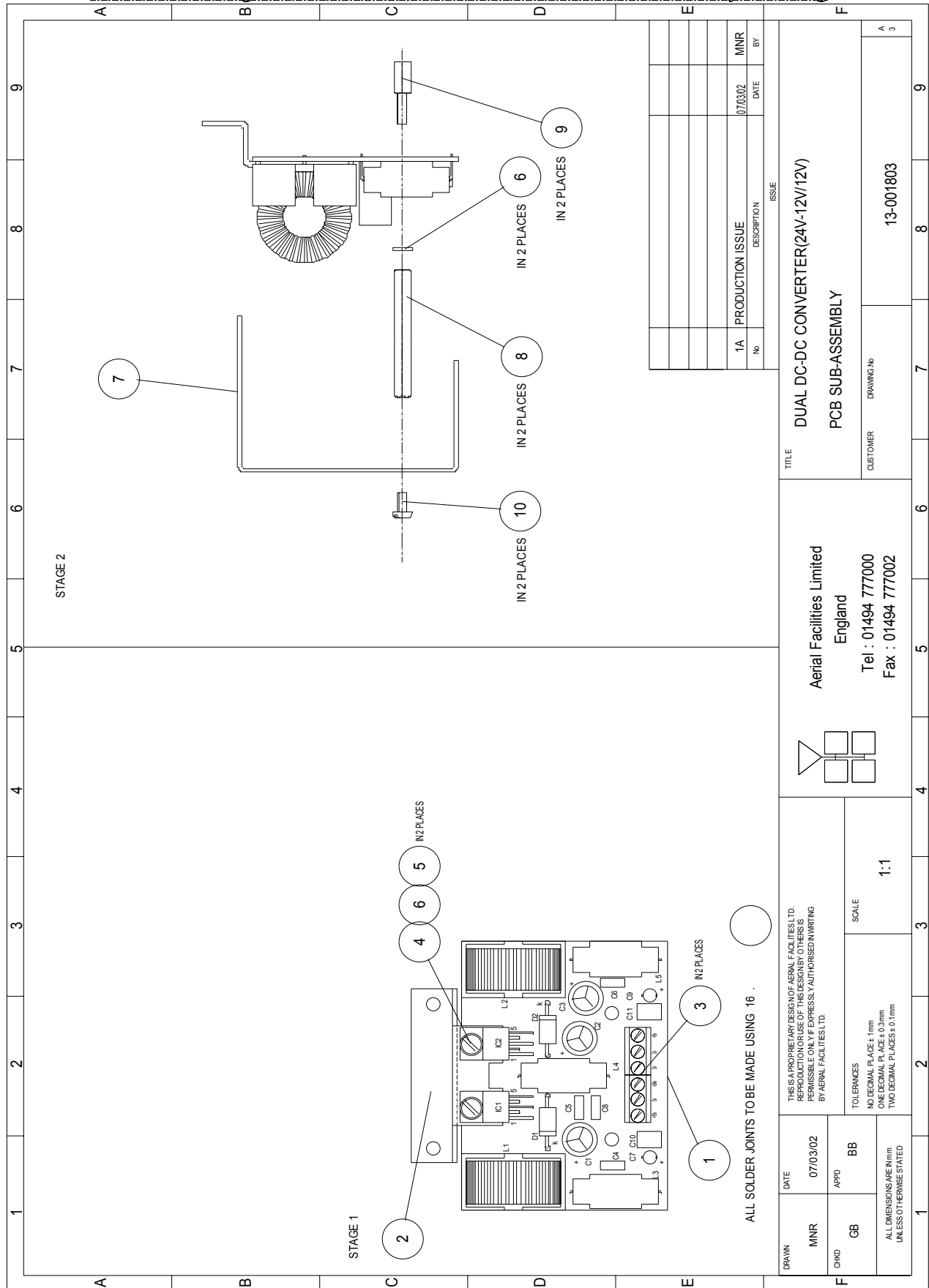
This unit is employed where it is necessary to derive two fixed voltage power supply rails from some higher voltage. Typically it is used to derive 5, 8, 12 or 15V from a 24V input.

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.

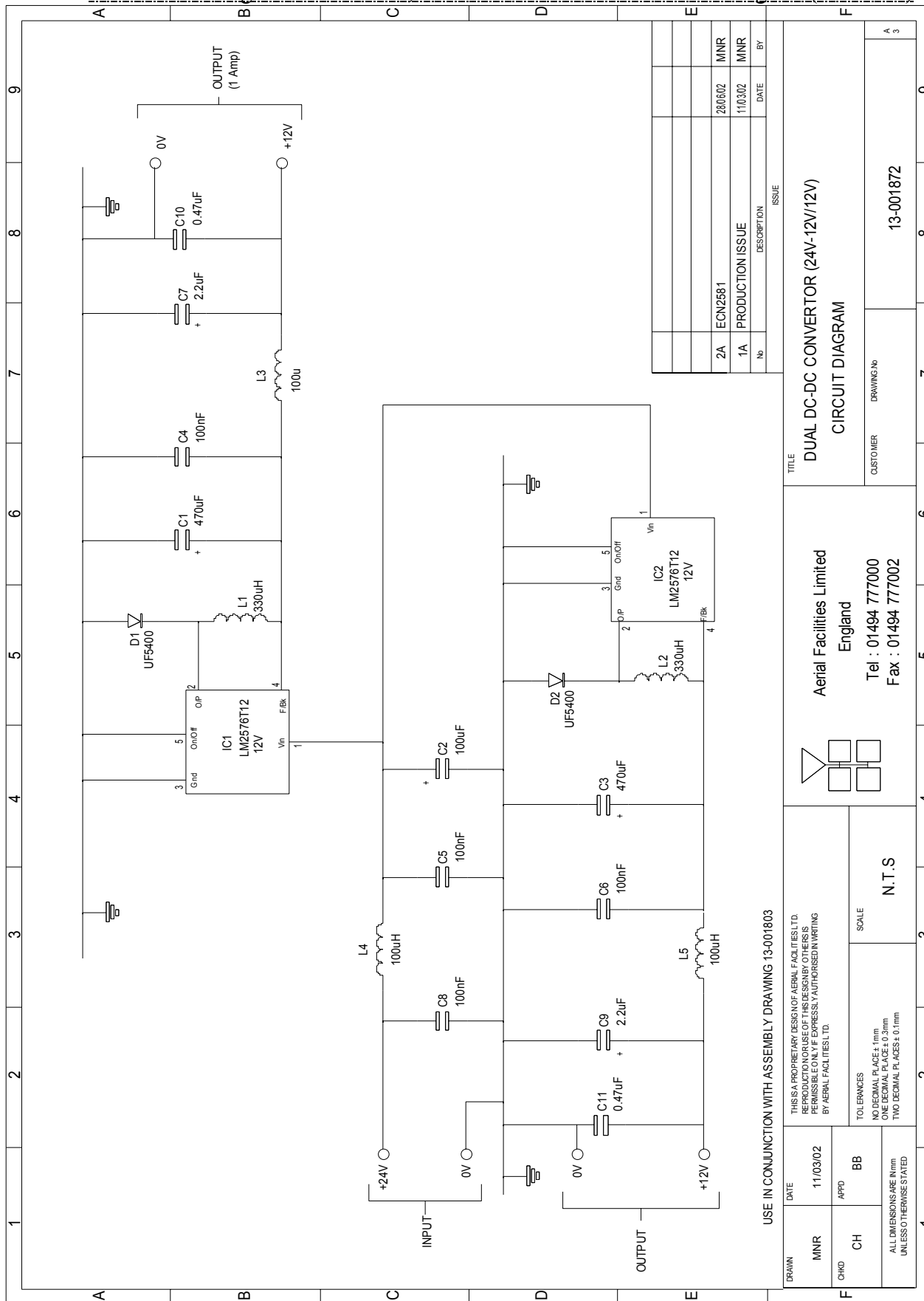
### 5.1.8.2 Technical Specification

| 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<br>: | -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. Nō. 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.

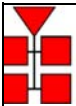
Selectivity is obtained from a fixed bandwidth block filter operating at an intermediate frequency (IF) in the low VHF range. This filter may be internal to the channel selectivity module (Crystal or SAW filter) or an externally mounted bandpass filter, (LC or Helical Resonator). Various IF bandwidths 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.

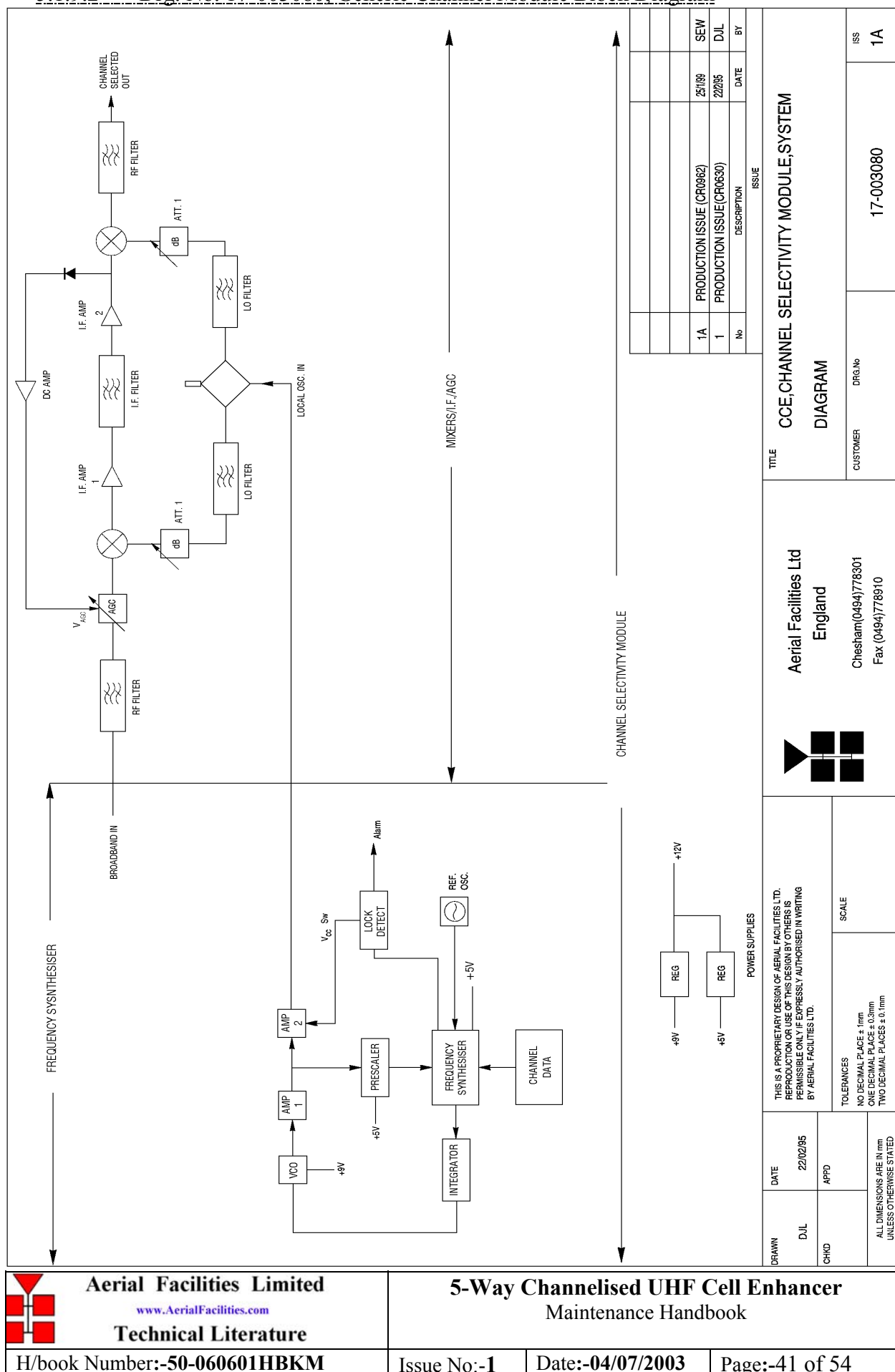
Automatic Level Control (ALC) is provided within each channel selectivity module such that the output level is held constant for high level input signals. This feature prevents saturation of the output mixer and of the associated amplifiers.

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.

|                                                                                                                                                                                                                               |                                                                    |                     |                                                 |
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#### 5.1.9.2 Drg. Nō. 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.

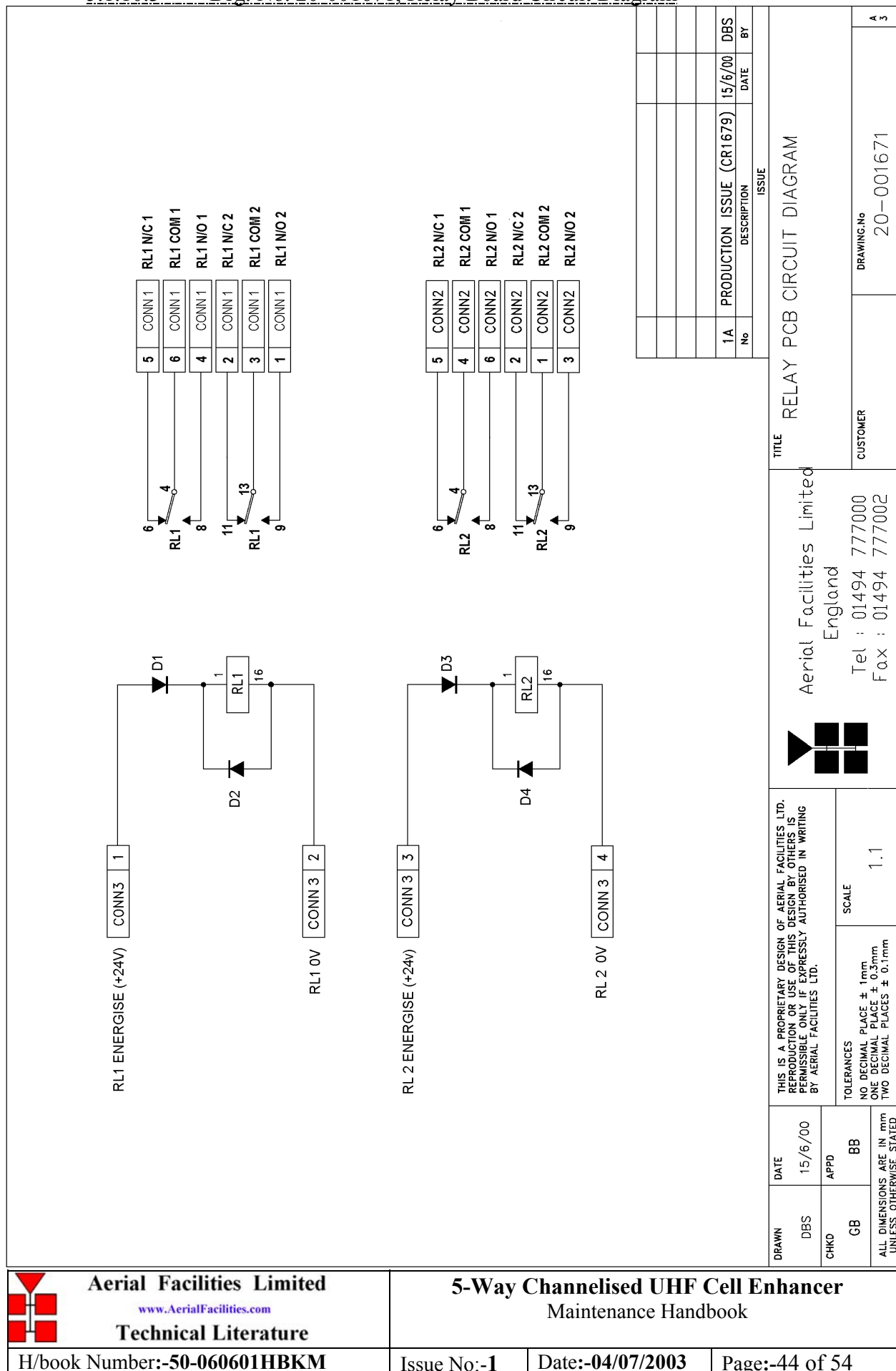
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5.1.10.2 Drg. Nō. 20-001602, 24V Relay Board Assembly Drawing

|                                                                                                                              |  |  |  |                                                                                |  |                  |  |                |  |
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| CIRC. REF. |           | AFL STOCK REF.             |  | DESCRIPTION |  |
| D1         | 94-100001 | 1N4148 SIGNAL DIODE        |  |             |  |
| D2         | 94-100001 | 1N4148 SIGNAL DIODE        |  |             |  |
| D3         | 94-100001 | 1N4148 SIGNAL DIODE        |  |             |  |
| D4         | 94-100001 | 1N4148 SIGNAL DIODE        |  |             |  |
| RL1        | 96-900005 | 24V DC DP CHANGEOVER RELAY |  |             |  |
| RL2        | 96-900005 | 24V DC DP CHANGEOVER RELAY |  |             |  |
| CONN1      | 91-700003 | 3 WAY PRINTED CIRCUIT CON. |  |             |  |
|            | 91-700003 | 3 WAY PRINTED CIRCUIT CON. |  |             |  |
| CONN2      | 91-700003 | 3 WAY PRINTED CIRCUIT CON. |  |             |  |
|            | 91-700003 | 3 WAY PRINTED CIRCUIT CON. |  |             |  |
| CONN3      | 91-700004 | 4 WAY PRINTED CIRCUIT CON. |  |             |  |
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### 5.1.10.3 Drg. No. 20-001671, Relay Board Circuit Diagram



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## 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.**

|                                                                                                                                                                                                                               |                                                                    |                          |                        |
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### 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.**

## 6. INSTALLATION

### 6.1 Initial Installation Record

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

Installation will be a matter of securing each shelf into its appropriate place in the rack cabinet, connecting all the cables (RF, 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 drawing(s) in section 4. for cabling details.

|                                                                                                                                                                                                                               |                                                                    |                          |                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------|------------------------|
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## 7. MAINTENANCE

### 7.1 General Procedures

#### 7.1.1 Basic 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 fitted within shelves or trays and all housed within a standard 19" rack type cabinet.

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 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.

|                                                                                                                                                                                                                               |                                                                    |                          |                        |
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### 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. One item that may need individual testing on site is the DC Tap system which supplies 48V DC to the remote cell enhancer. When this unit is 'on' (but not necessarily with RF signals) a DC voltage of over 40V should be available at the remote site at the input RF port. Be careful not to 'short out' the enhancer output RF cable when DC is present – it will blow the 48V PSU fuse!

|                                                                                                                                                                                                                               |                                                                    |                          |                        |
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### 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.<br>3mm flat bladed screwdriver.<br>SMA spanner and torque setter. |

## 7.3 Care of Modules

### 7.3.1 General Comments

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

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

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

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

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

### 7.3.3 Module Replacement (general):

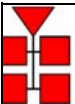
- 1 Carefully align the module into its location then slowly push the module directly straight into its position, taking care not to twist/turn it during insertion.
- 2 Reconnect all connectors, RF, alarm, power etc., (concealed connectors may have to be connected first).
- 3 Replace retaining screws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

### 7.3.4 Power Amplifiers

- 1) Remove power to the unit. (Switch off @ mains/battery, or remove DC in connector)
- 2) Remove alarm wires from alarm screw terminal block or disconnect multi-way alarm connector.
- 3) Carefully disconnect the RF input and output coaxial connectors (usually SMA)

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

- 4) There is (usually) a plate attached to the alarm board which fixes it to the amplifier, remove its retaining screws and the alarm board can be withdrawn from the amplifier in its entirety. On certain types of amplifier the alarm board is 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 to be removed before lifting the amplifier.

|                                                                                                                                                                                                                               |                                                                    |                     |                                                 |
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- 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.

|                                                                                                                                                                                                                               |                                                                    |                     |                                                 |
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## 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    |