L.A. M.T.A. BDA Line Amplifier

User/Maintenance Handbook

For

GETS Global Signalling LLC

AWL Works Order Q115342

Product Part Nos.
In-Line BDA Wall Mount 80-301401
In-Line BDA Rack Mount 80-301406

Aerial Facilities Limited AVITEC

AFL and Avitec have merged to form Axell Wireless

AXELL WIRELESS UK
Aerial House
Asheridge Road
Chesham, Buckinghamshire
HP5 2QD, United Kingdom
Tel: + 44 (0) 1494 777000
Fax: + 44 (0) 1494 777002

info@axellwireless.com
www.axellwireless.com

AXELL WIRELESS SWEDEN
Box 7139
174 07 Sundbyberg
Sweden
Tel: + 46 (0) 8 475 4700
Fax: + 46 (0) 8 475 4799

Table of Contents

1. INTRODUCTION

1.1. Scope and Purpose of Document

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

AWL recommends that the installer of this equipment familiarise themselves with the safety and installation procedures contained within this document before installation commences.

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 AWL, normally at the company's repair facility in Chesham, England.

This handbook has been prepared in accordance with BS 4884, and AWL's Quality procedures, which maintain the company's registration to BS EN ISO 9001:2000 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.

1.2. Limitation of Liability Notice

This manual is written for the use of technically competent operators/service persons. No liability is accepted by AWL 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, AWL does not warrant the absolute accuracy of the information contained within this manual, or its completeness, fitness for purpose, or scope.

AWL 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.

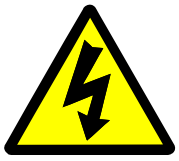
All AWL products carry a twelve month warranty from date of shipment. The warranty is expressly on a return to base repair or exchange basis and the warranty cover does not extend to on-site repair or complete unit exchange.

2. SAFETY CONSIDERATIONS

2.1. Earthing of Equipment

Equipment 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.

2.2. Electric Shock Hazard



The risk of electrical shocks due to faulty mains driven power supplies whilst potentially ever present in any electrical equipment, would be minimised by adherence to good installation practice and thorough testing at the following stages:

a) Original assembly.
b) Commissioning..
c) Regular intervals, thereafter.

All test equipment must 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.

2.3. RF Radiation Hazard

RF radiation, (especially at UHF frequencies) arising from transmitter outputs connected to AWL'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 un-terminated. Either of these conditions would impair the system's efficiency. No investigation should be carried out until all RF power sources have been removed. This would always be a wise precaution, despite the severe mismatch between the impedance of an N type connector at 50Ω, and that of free space at 377Ω, which would severely mitigate against the efficient radiation of RF power. Radio frequency burns could also be a hazard, if any RF power carrying components were to be carelessly touched!

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

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

2.4. Lifting and other Health and Safety Recommendations

Certain items of AWL equipment are heavy and care should be taken when lifting them by hand. Ensure that a suitable number of personnel, appropriate lifting apparatus and appropriate personal protective equipment is used especially when installing Cell Enhancers above ground e.g. on a mast or pole.

2.5. Chemical Hazard

Beryllium Oxide, also known as Beryllium Monoxide, or Thermalox™, is sometimes used in devices within equipment produced by Axell Wireless 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 Axell Wireless 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 AWL 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.

2.6. Laser safety

General good working practices adapted from EN60825-2: 2004/ EC 60825-2:2004

Do not stare with unprotected eyes or with any unapproved optical device at the fibre ends or connector faces or point them at other people, Use only approved filtered or attenuating viewing aids.
Any single or multiple fibre end or ends found not to be terminated (for example, matched, spliced) shall be individually or collectively covered when not being worked on. They shall not be readily visible and sharp ends shall not be exposed.
When using test cords, the optical power source shall be the last connected and the first disconnected; use only approved methods for cleaning and preparing optical fibres and optical connectors.
Always keep optical connectors covered to avoid physical damage and do not allow any dirt/foreign material ingress on the optical connector bulkheads.
The optical fibre jumper cable maximum bend radius is 3cm; any smaller radii may result in optical cable breakage or excessive transmission losses.
Caution: The FO units are *NOT* weather proof.

2.7. Emergency Contact Numbers

The AWL Quality Department can be contacted on:

Telephone	+44 (0)1494 777000
Fax.	+44 (0)1494 777002
e-mail	qa@axellwireless.com

3. In-Line BDA Wall Mount 80-301401

The wall mount In Line BDA consists of 4 wall mount enclosures:

80-301402 the Combiner unit.
80-301403 which houses the VHF and UHF Low Band amplification modules.
80-301404 which houses the Mid and High band UHF amplification modules.
80-301405 which houses the 800MHz amplification modules.

Downlink
The downlink signal is received from the leaky feeder and enters the Combiner 80-301402 where by means of crossband splitter/couplers it is split into VHF, UHF and 800MHz paths, the UHF path is further split into Low, Middle and Highband paths.

The VHF and UHF Lowband paths then leave Combiner 80-301402 and enters VHF/UHF BDA Unit 80-301403,

The UHF Mid and Highband paths leaves Combiner 80-301402 and enters UHF BDA Unit 80-301404

The 800MHz path leaves Combiner 80-301402 and enters 800MHz BDA Unit 80-301405

After being amplified the Downlink signals from the three BDA units then re-enter Splitter/Combiner 80-301402 where they are combined into a single path and fed into the leaky feeder.

Uplink
The Uplink signal signal is received from the leaky feeder and enters the Splitter/Combiner 80-301402 where by means of crossband splitter/couplers it is split into VHF, UHF and 800MHz paths, the UHF path is further split into Low, Middle and Highband paths.

The VHF and UHF Low band paths then leave Splitter/Combiner 80-301402 and enters VHF/UHF BDA Unit 80-301403,

The UHF Mid and Highband paths leaves Splitter/Combiner 80-301402 and enters UHF BDA Unit 80-301404

The 800MHz path leaves Splitter/Combiner 80-301402 and enters 800MHz BDA Unit 80-301405

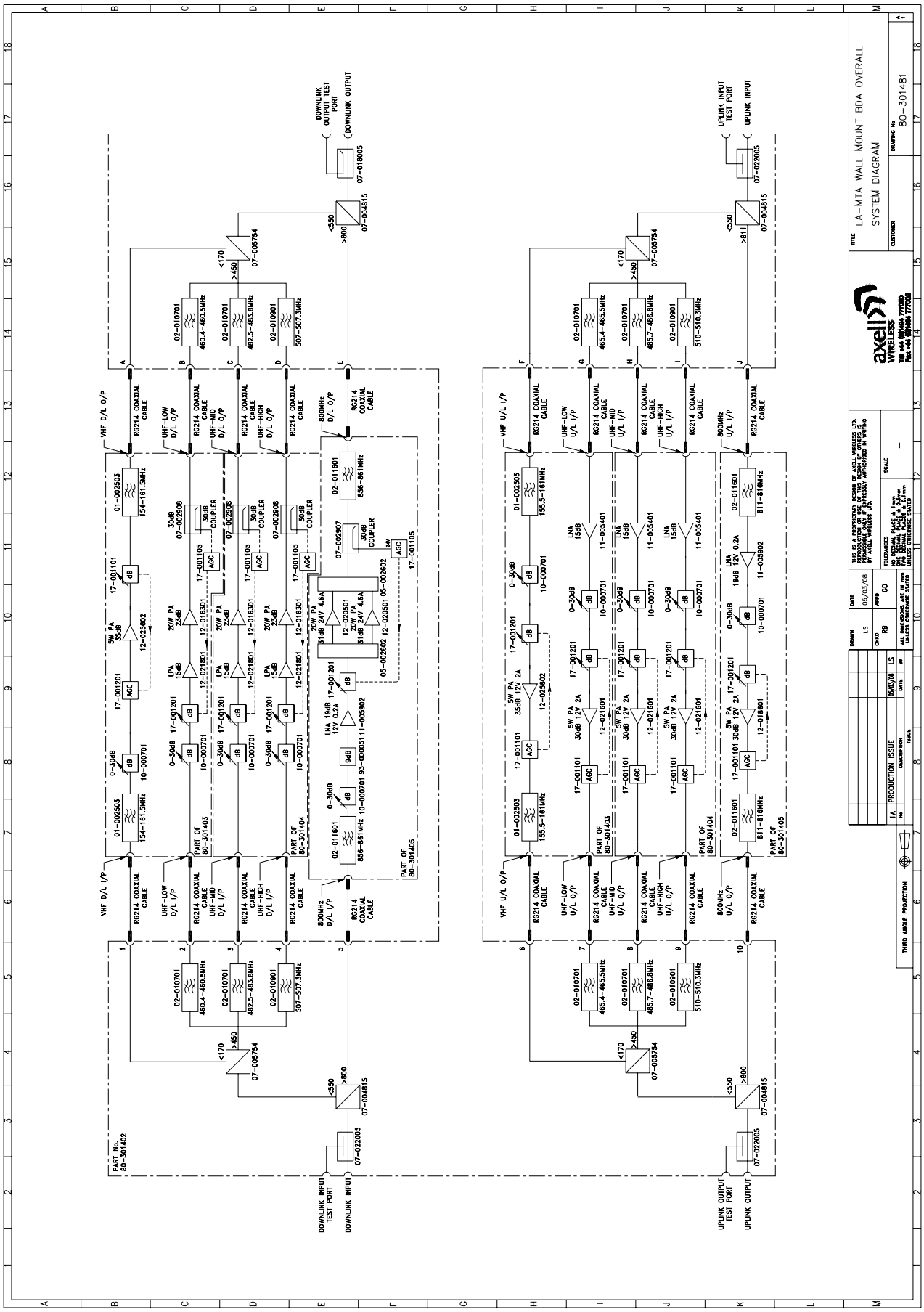
After being amplified the Uplink signals from the three BDA units then re-enter Splitter/Combiner 80-301402 where they are combined into a single path and fed into the leaky feeder.

3.1. In-Line BDA Wall Mount 80-301401 Specification

ELECTRICAL SPECIFICATION			
Frequency Range	VHF	Downlink	154.0 to 161.5 MHz
		Uplink	155.5 to 161.0 MHz
	UHF Low	Downlink	460.4 to 460.5 MHz
		Uplink	465.4 to 465.5 MHz
	UHF Mid	Downlink	482.5 to 483.8 MHz
		Uplink	485.7 to 486.8 MHz
	UHF High	Downlink	507.0 to 507.3 MHz
		Uplink	510.0 to 510.3 MHz
	800MHz	Downlink	856.0 to 861.0 MHz
		Uplink	811.0 to 816.0 MHz
Passband Ripple			± 1.5dB
Downlink Power Amplifier		VHF	5 Watts
		UHF Low	20 Watts
		UHF Mid	20 Watts
		UHF High	20 Watts
		800MHz	40 Watts
Uplink Power Amplifier		VHF	5 Watts
		UHF Low	5 Watts
		UHF Mid	5 Watts
		UHF High	5 Watts
		800MHz	5 Watts
Gain			30dB
Gain Adjust			0 - 30dB in 2dB Steps
Sampling Ports			30dB
VSWR			1.5:1
Impedance			50 Ohms
Power Supply			24V DC
Power Consumption			< 800 Watts
Environmental/Mechanical Specification			
Mechanical			IP65 Wall Mount
Dimensions (excludes handles and connectors)			Qty. 4 off, 620mm x 620mm x 250mm (24” x 24” x 10” approx)
RF Connectors			N-Type Female
Alarm Interfaces			Local Alarms to SCADA Dry Contact with LED Indication per band path

3.1.1. In-Line BDA Wall Mount 80-301401 Overall system Diagram

Drawing Number 80-301481



3.2. In-Line BDA Wall Mount 80-301401 List of Major Components

Section	Component Part	Component Part Description	Qty Per Assembly
3.3.	80-301402	Combiner	1
3.4.	80-301403	VHF/UHF BDA Unit	1
3.5.	80-301404	UHF BDA Unit	1
3.6.	80-301405	800MHz BDA Unit	1

3.3. Combiner 80-301402

Splitter/Combiner 80-301402 is the main Splitter/Combiner unit. Signals are received from the leaky feeder and are then split into their various separate paths before being amplified by external band specific amplifiers and then the signals are re-combined for onward transmission via the leaky feeder The unit is housed in a wall mount case 600x600x250mm (24” x 24” x 10” approx)

Downlink signals are received at the port labelled “DOWNLINK INPUT” (Annotated AA in the picture in section 3.3.4.2.) and there is a 30dB test port labelled “DOWNLINK INPUT TEST PORT” (Z in section 3.3.4.2.).

Ports labelled 1 to 5 (P to T in section 3.3.4.2.) are the Downlink outputs to the amplification stages and ports labelled A to E (A to E in section 3.3.4.2.) are the Downlink inputs from the amplification stages. These outputs and inputs are further described below.

The Downlink signal leaves the Splitter/Combiner for the leaky feeder via the port labelled “DOWNLINK OUTPUT” (L in section 3.3.4.2.) and there is a 30dB test port labelled “DOWNLINK OUTPUT TEST PORT” (K in section 3.3.4.2.).

Uplink signals are received at the port labelled “UPLINK INPUT” (N in section 3.3.4.2.) and there is a 30dB test port labelled “UPLINK INPUT TEST PORT” (M in section 3.3.4.2.).

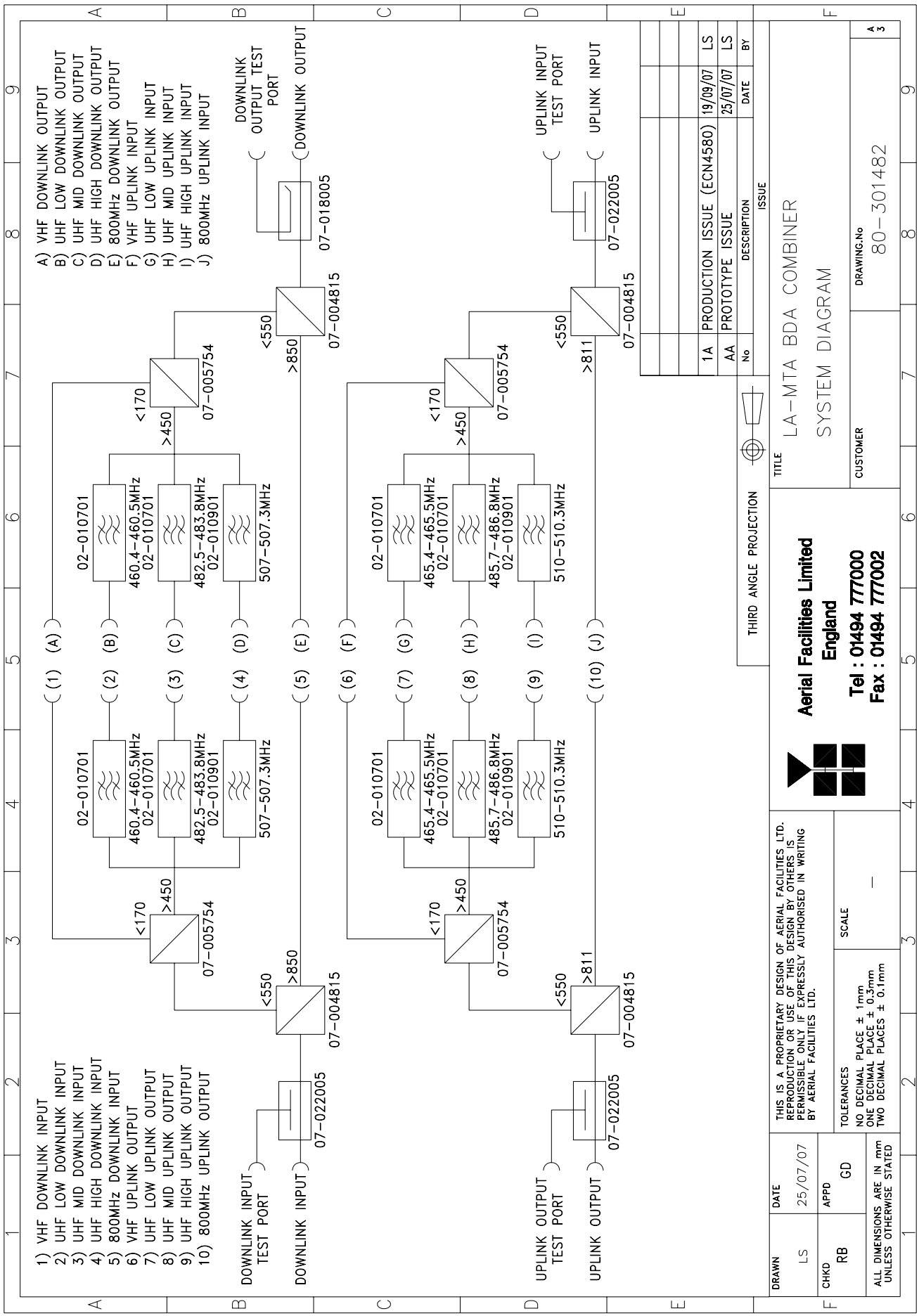
Ports labelled F to J (F to J in section 3.3.4.2.) are the Uplink outputs to the amplification stages and ports labelled 6 to 10 (U to Y in section 3.3.4.2.) are the Uplink inputs from the amplification stages. These outputs and inputs are further described below.

The Uplink signal leaves the Splitter/Combiner for the leaky feeder via the port labelled “UPLINK OUTPUT” (CC in section 3.3.4.2.) and there is a 30dB test port labelled “UPLINK OUTPUT TEST PORT” (BB in section 3.3.4.2.).

Splitter/Combiner 80-301402 also incorporates bandpass filtering for the three UHF bands, the filters are placed in the RF path before the outputs to and after the inputs from the external amplification stages

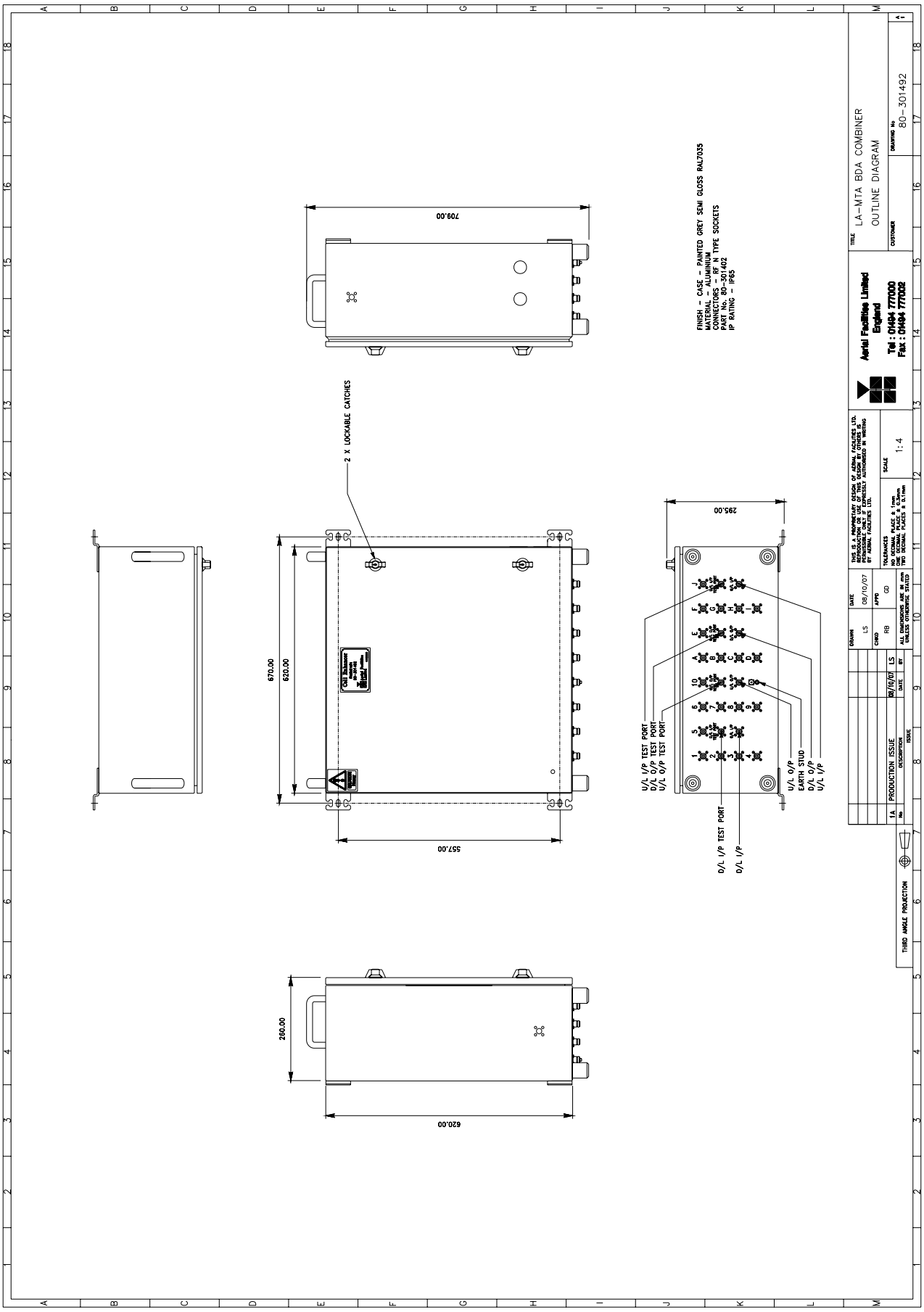
3.3.1. Combiner 80-301402 System Diagram

Drawing Number 80-301482



3.3.2. Combiner 80-301402 Outline Drawing

Drawing Number 80-301492



3.3.3. Combiner 80-301402 Specification

Downlink

PARAMETER	SPECIFICATION
Insertion Loss from Downlink Input port to port indicated	
VHF Band to port 1	< 1.0dB at 154.0 – 161.3MHz
UHF Low Band to port 2	< 3.5dB at 460.4 – 460.5MHz
UHF Mid Band to port 3	< 3.5dB at 482.5 -483.8MHz
UHF High Band to port 4	< 4.0dB at 507.0 – 507.3MHz
800MHz Band to port 5	< 1.0dB at 856.0 – 861.0MHz
Insertion Loss from port indicated to Downlink Input test port	
VHF Band	30dB at 154.0 – 161.3MHz
UHF Low Band	30dB at 460.4 – 460.5MHz
UHF Mid Band	30dB at 482.5 – 483.8MHz
UHF High Band	30dB at 507.0 – 507.3MHz
800MHz Band	30dB at 856.0 – 861.0MHz
Insertion Loss from port indicated to Downlink Output	
VHF Band from port A	< 1.0dB at 154.0 – 161.3MHz
UHF Low Band from port B	< 3.5dB at 460.4 – 460.5MHz
UHF Mid Band from port C	< 3.5dB at 482.5 -483.8MHz
UHF High Band from port D	< 4.0dB at 507.0 – 507.3MHz
800MHz Band from port E	< 1.0dB at 856.0 – 861.0MHz
Insertion Loss from port indicated to Downlink Output Test port	
VHF Band from port A	31.0dB at 154.0 – 161.3MHz
UHF Low Band from port B	33dB at 460.4 – 460.5MHz
UHF Mid Band from port C	33dB at 482.5 – 483.8MHz
UHF High Band from port D	33dB at 507.0 – 507.3MHz
800MHz Band from port E	31dB at 856.0 – 861.0MHz

Uplink

PARAMETER	SPECIFICATION
Insertion Loss from from Uplink Input port to port indicated	
VHF Band to port F	< 1.0dB at 155.7 – 160.8MHz
UHF Low Band to port G	< 3.5dB at 465.4 – 465.5MHz
UHF Mid Band to port H	< 3.5dB at 485.7 -486.8MHz
UHF High Band to port I	< 4.0dB at 510.0 – 510.3MHz
800MHz Band to port J	< 1.0dB at 811.0 – 816.0MHz
Insertion Loss from port indicated to Uplink Input test port	
VHF Band	31dB at 155.7 – 160.8MHz
UHF Low Band	33dB at 465.4 – 465.5MHz
UHF Mid Band	33dB at 485.7 – 486.8MHz
UHF High Band	33dB at 510.0 – 510.3MHz
800MHz Band	31dB at 811.0 – 816.0MHz
Insertion Loss from port indicated to Uplink Output	
VHF Band from port 6	< 1.0dB at 155.7 – 160.8MHz
UHF Low Band from port 7	< 3.5dB at 465.4 – 465.5MHz
UHF Mid Band from port 8	< 3.5dB at 485.7 -486.8MHz
UHF High Band from port 9	< 4.0dB at 510.0 – 510.3MHz
800MHz Band from port 10	< 1.0dB at 811.0 – 816.0MHz
Insertion Loss from port indicated to Uplink Output Test port	
VHF Band from port 6	31dB at 155.7 – 160.8MHz
UHF Low Band from port 7	33dB at 465.4 – 465.5MHz
UHF Mid Band from port 8	33dB at 485.7 – 486.8MHz
UHF High Band from port 9	33dB at 510.0 – 510.3MHz
800MHz Band from port 10	31dB at 811.0 – 816.0MHz

PARAMETER	SPECIFICATION
Mechanical	IP65 Wall Mount
RF connectors	N type female
Dimensions (excludes handles and connectors	620mm x 620mm x 250mm (24” x 24” x 10” approx)

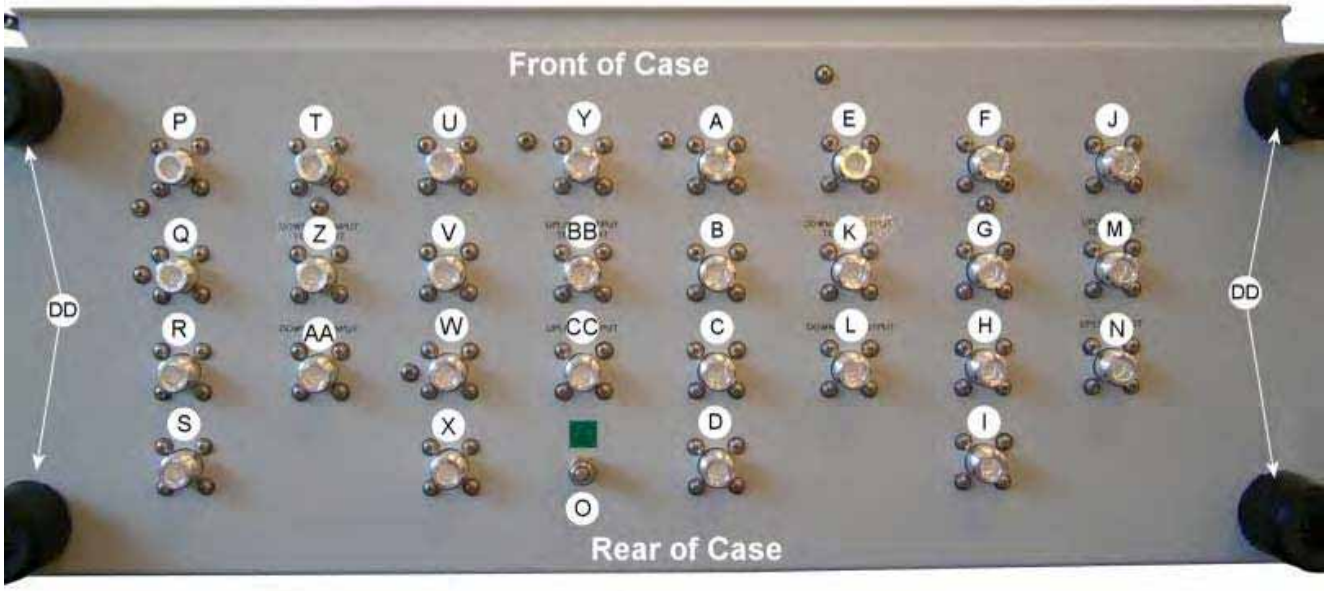
3.3.4. Combiner 80-301402 Photographs

3.3.4.1. Front View

Note: All connectors are on the underside

A	Lockable Door Handles

3.3.4.2. Underside view showing RF connectors



A	Port A. Downlink VHF Input from VHF/UHF BDA Unit 80-301403
B	Port B. Downlink UHF Lowband Input from VHF/UHF BDA Unit 80-301403
C	Port C. Downlink UHF Midband Input from UHF BDA Unit 80-301404
D	Port D. Downlink UHF Highband Input from UHF BDA Unit 80-301404
E	Port E. Downlink 800MHz Input from 800MHz BDA Unit 80-301405
F	Port F. Uplink VHF Output to VHF/UHF BDA Unit 80-301403
G	Port G. Uplink UHF Lowband Output to VHF/UHF BDA Unit 80-301403
H	Port H. Uplink UHF Midband Output to UHF BDA Unit 80-301404
I	Port I. Uplink UHF Highband Output to UHF BDA Unit 80-301404
J	Port J. Uplink 800MHz Output to 800MHz BDA Unit 80-301405
K	Downlink Output Test Port (30dB Tap)
L	Downlink Output to Radiating Cable
M	Uplink Input Test Port (30dB Tap)
N	Uplink Input from Radiating Cable
O	Earth Connection
P	Port 1. Downlink VHF Output to VHF/UHF BDA Unit 80-301403
Q	Port 2. Downlink UHF Lowband Output to VHF/UHF BDA Unit 80-301403
R	Port 3. Downlink UHF Midband Output to UHF BDA Unit 80-301404
S	Port 4. Downlink UHF Highband Output to UHF BDA Unit 80-301404
T	Port 5. Downlink 800MHz Output to 800MHz BDA Unit 80-301405
U	Port 6. Uplink VHF Input from VHF/UHF BDA Unit 80-301403
V	Port 7. Uplink UHF Lowband Input from VHF/UHF BDA Unit 80-301403
W	Port 8. Uplink UHF Midband Input from UHF BDA Unit 80-301404
X	Port 9. Uplink UHF Highband Input from UHF BDA Unit 80-301404
Y	Port 10. Uplink 800MHz Input from 800MHz BDA Unit 80-301405
Z	Downlink Input Test Port (30dB Tap)
AA	Downlink Input from Radiating Cable
BB	Uplink Output Test Port (30dB Tap)
CC	Uplink Output to Radiating Cable
DD	Case feet

3.3.4.3. Interior view

A	Downlink Input 30dB Bi-Directional Coupler 07-022005
B	Downlink Input Crossband Splitter/Coupler 07-004815
C	Downlink Input Crossband Splitter/Coupler 07-005754
D	Downlink Input UHF Lowband Bandpass Filter 02-010701
E	Downlink Input UHF Midband Bandpass Filter 02-010701
F	Downlink Input UHF Highband Bandpass Filter 02-010901
G	Downlink Output UHF Lowband Bandpass Filter 02-010701
H	Downlink Output UHF Midband Bandpass Filter 02-010701
I	Downlink Output UHF Highband Bandpass Filter 02-010901
J	Downlink Output Crossband Splitter/Coupler 07-005754
K	Downlink Output Crossband Splitter/Coupler 07-004815
L	Downlink Output 30dB Coupler 07-018005
M	Uplink Input 30dB Bi-Directional Coupler 07-022005
N	Uplink Input Crossband Splitter/Coupler 07-004815
O	Uplink Input Crossband Splitter/Coupler 07-005754
P	Uplink Input UHF Lowband Bandpass Filter 02-010701
Q	Uplink Input UHF Midband Bandpass Filter 02-010701
R	Uplink Input UHF Highband Bandpass Filter 02-010901
S	Uplink Output UHF Lowband Bandpass Filter 02-010701
T	Uplink Output UHF Midband Bandpass Filter 02-01070
U	Uplink Output UHF Highband Bandpass Filter 02-010901
V	Uplink Output Crossband Splitter/Coupler 07-005754
W	Uplink Output Crossband Splitter/Coupler 07-004815
X	Uplink Output 30dB Bi-Directional Coupler 07-022005

3.3.5. Combiner 80-301402 Major Sub-Components

Section	Component Part	Component Part Description	Qty Per Assembly
3.3.5.1.	02-010701	Bandpass Filter	8
3.3.5.2.	02-010901	Bandpass Filter	4
3.3.5.3.	07-004815	Crossband Splitter/Coupler 550/800MHz	4
3.3.5.4.	07-005754	Crossband Splitter/Coupler VHF/UHF	4
3.3.5.5.	07-018005	30dB Directional Coupler	1
3.3.5.6.	07-022005	30dB Bi-Directional Coupler	3

3.3.5.1. Bandpass Filter 02-010701

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.

02-010701 Specification

PARAMETER			SPECIFICATION
Passband Frequency	UHF Low	Downlink	460.4 to 460.5 MHz
		Uplink	465.4 to 465.5 MHz
	UHF Mid	Downlink	482.5 to 483.8 MHz
		Uplink	485.7 to 486.8 MHz
Bandwidth		UHF Low	0.1 MHz
		UHF Mid	1.3 MHz
Number of sections			5
Insertion loss			2.4 dB (typical)
VSWR			better than 1.2:1
Connectors			SMA
Power Handling			100W max
Temperature range		operation	-20°C to +60°C
		storage	-40°C to +70°C
Weight			3 kg (typical)

3.3.5.2. Bandpass Filter 02-010901

Bandpass Filter 02-010901 is a multi-section design 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 helical & combline design respectively, and are carefully aligned during manufacture in order to optimise the insertion loss, VSWR and intermodulation characteristics of the unit. The body and 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.

SPECIFICATION		PARAMETER
Passband Frequency	Downlink	507.0 to 507.3MHz
	Uplink	510.0 to 510.3MHz
Bandwidth	Uplink	0.3 MHz
	Downlink	0.3 MHz
Insertion Loss		2.9 dB (typical)
Power Rating		50W
Impedance		50Ω
VSWR		Better than 1.2:1
Connectors		SMA
Weight		3Kg (approximately)

3.3.5.3. Crossband Splitter/Coupler 550/800MHz (07-004815)

The purpose of Crossband Splitter/Coupler (07-004815) is to split or combine RF signals from different parts of the frequency spectrum.
It is a 3 port device comprising two filters, one a low pass, the other a high pass, connected to a common input/output. The couplers are housed in a machined aluminium casing having a centre screening wall between the filter sections and lid secured by screws at frequent intervals over its perimeter to obtain a tight seal and to ensure linearity and stability of response.

07-004815 Specification

Parameter		Low Pass Port	High Pass Port
Passband Frequencies		380 to 550MHz	800 to 960MHz
Insertion loss		<0.5dB	<0.5dB
Isolation between Bands		>50dB	>50dB
VSWR		1.3:1	
Impedance		50 ohm	
Power rating		50W	
Temperature range	operation	-20°C to +60°C	
	storage	-40°C to +70°C	
RF Connectors		SMA (female)	
Weight		<1kg	

3.3.5.4. Crossband Splitter/Coupler VHF/UHF (07-005754)

The purpose of Crossband Splitter/Coupler (07-005754) is to split or combine RF signals from different parts of the frequency spectrum.
It is a 3 port device comprising two filters, one a low pass, the other a high pass, connected to a common input/output. The couplers are housed in a machined aluminium casing having a centre screening wall between the filter sections and lid secured by screws at frequent intervals over its perimeter to obtain a tight seal and to ensure linearity and stability of response.

07-005754 Specification

Parameter		Low Pass Port	High Pass Port
Passband Frequencies		70 to 175 MHz	380 to 500 MHz
Insertion loss		<0.5dB	<0.5dB
Return loss		>14dB typical	>14dB typical
Isolation between Bands		>60dB	>60dB
Impedance		50 ohm	
Power rating		50W	
Temperature range	operation	-20°C to +60°C	
	storage	-40°C to +70°C	
RF Connectors		SMA (female)	
Weight		<1kg	

3.3.5.5. 30dB Directional Coupler (07-018005)

The purpose of these couplers is to tap off known portions (in this case 30dB) of RF signal from transmission lines and to combine them, for example though splitter units for different purposes (alarms/monitoring etc.), whilst maintaining an accurate 50Ω load to all ports/interfaces throughout the specified frequency range. 07-018005 is a Uni-Directional device and as such will only couple 30dB of signal in one direction.

07-018005 Specification

PARAMETER		SPECIFICATION
Frequency Range		70 MHz - 1000MHz
Mainline Insertion Loss		<0.5
Coupling Loss		30 dB
VSWR Mainline		Better than 1.3:1
Impedance		50 Ω
Power Handling (CW)		100W
Outline (W x D x H)		176mm x 104mm x 24mm (ex. connectors)
Connectors		N (female) on all ports
Case Material		Aluminium
Finish		Iridite NCP
Temperature range	operation	-20°C to +60°C
	storage	-40°C to +70°C
Ingress Protection		IP54

3.3.5.6. 30dB Bi-Directional Coupler (07-022005)

The purpose of these couplers is to tap off known portions (in this case 30dB) of RF signal from transmission lines and to combine them, for example though splitter units for different purposes (alarms/monitoring etc.), whilst maintaining an accurate 50Ω load to all ports/interfaces throughout the specified frequency range. 07-022005 is a Bi-Directional device and as such will couple 30dB of signal whichever direction the signal is traveling.

07-022005 Specification

PARAMETER	SPECIFICATION
Frequency Range	100kHz – 2.7GHz
Mainline Insertion Loss	< 1.0 dB
Coupling Loss	30 dB
Coupling Loss Tolerance	+/-2.0 dB
VSWR Mainline	Better than 1.4:1
Impedance	50 Ω
Power Handling (CW)	5W
Outline (W x D x H)	44.5mm x 41mm x 27mm (ex. connectors)
Connectors	SMA (female) on all ports
Case Material	Aluminium
Finish	Iridite NCP
Operating Temperature	-20 to +55°C
Ingress Protection	IP54

3.4. VHF/UHF BDA Unit (80-301403)

VHF/UHF BDA Unit (80-301403) provides the amplification stages for the VHF and UHF Lowband paths, The unit is housed in a wall mount case 600x600x250mm (24" x 24" x 10" approx).

The Downlink VHF signal is received at the port labelled "VHF D/L INPUT" (Annotated A in the picture in section 3.4.4.2.). The Downlink VHF path passes through a bandpass filter to remove out of band noise and then a switched attenuator providing 0 to 30 dB of RF signal attenuation.
After leaving the attenuator the VHF Downlink signal passes through a 5W amplification stage, this amplification stage is straddled by an Automatic Gain Control assembly providing limiting to the output signals in the case of high input signals.
After leaving the Amplification/AGC stage the VHF Downlink signal passes through a second bandpass filter and exits the BDA via the port labelled "VHF D/L OUTPUT" (B in section 3.4.4.2.).

The Uplink VHF Signal is received at the port labelled "VHF U/L INPUT" (C in section 3.4.4.2.). The VHF Uplink path passes through a bandpass filter to remove out of band noise and then a switched attenuator providing 0 to 30 dB of RF signal attenuation.
After leaving the attenuator the VHF Uplink signal passes through a 5W amplification stage, this amplification stage is straddled by an Automatic Gain Control assembly providing limiting to the output signals in the case of high input signals.
After leaving the Amplification/AGC stage the VHF Uplink signal passes through a second bandpass filter and exits the BDA via the port labelled "VHF U/L OUTPUT" (D in section 3.4.4.2.).

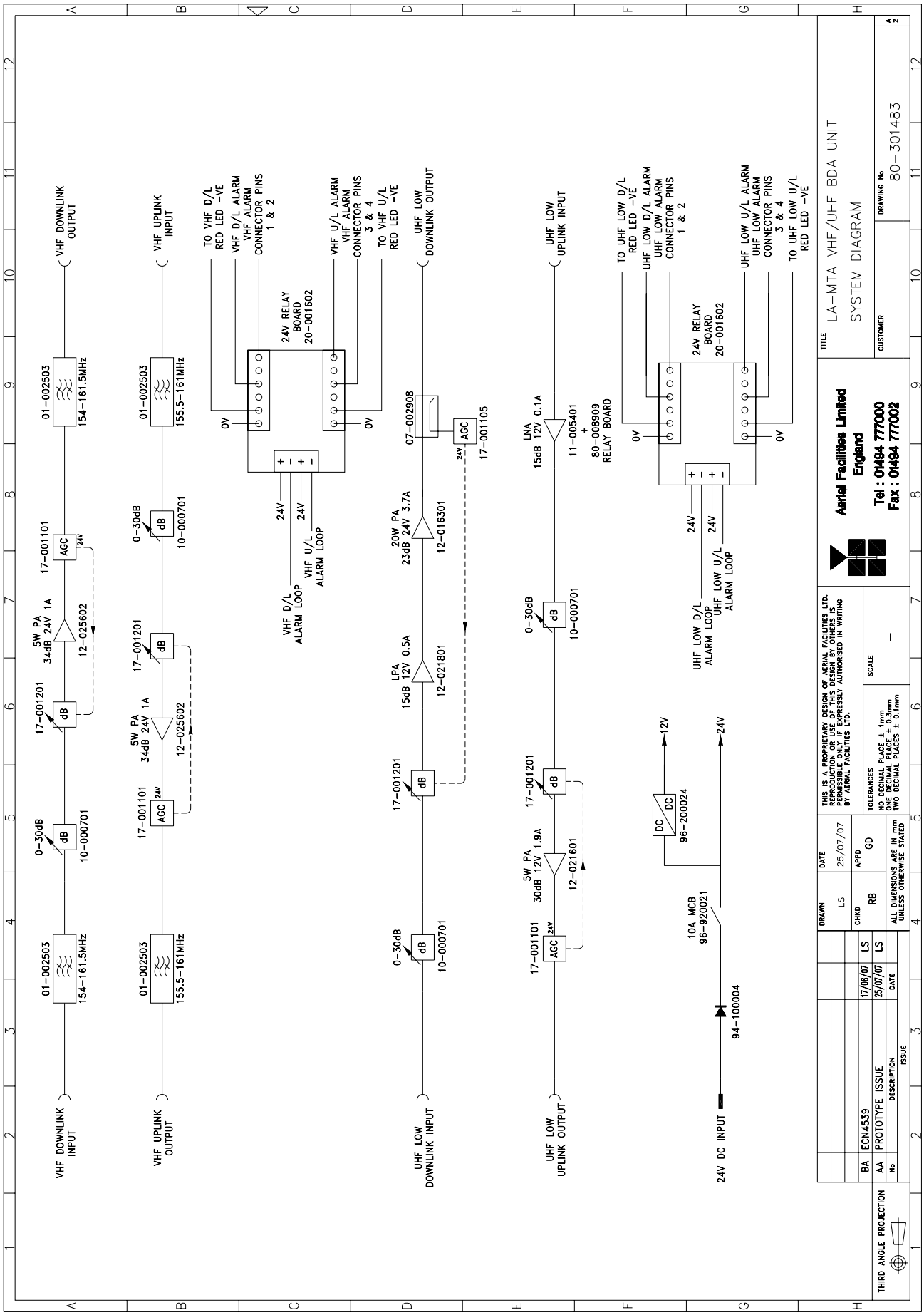
The Downlink UHF Lowband signal is received at the port labelled "UHF LOW D/L INPUT" (E in section 3.4.4.2.). The signal passes through a switched attenuator providing 0 to 30 dB of RF signal attenuation and then into the amplification stage. The Downlink UHF Lowband amplification stage is provided by tow amplifier modules, the first is a 15dB gain Low Power Amplifier and the second is a 20W, 23dB gain power amplifier. Both amplification stages are straddled by an Automatic Gain Control assembly providing limiting to the output signals in the case of high input signals.
The input to the AGC detector is provided by the output of a 30dB tap. After leaving the Amplification/AGC stage the Downlink UHF Lowband signal exits the BDA via the port labelled "UHF LOW D/L OUTPUT" (F in section 3.4.4.2.).

The Uplink UHF Lowband signal is received at the port labelled "UHF LOW U/L INPUT" (G in section 3.4.4.2.). The signal passes into a Low Noise Amplifier providing 15dB of gain and then into a switched attenuator providing 0 to 30 dB of RF signal attenuation. After the attenuator the Uplink UHF Lowband signal passes into a second stage of amplification provided by a 5W, 30dB gain Power Amplifier, this amplification stage is straddled by an Automatic Gain Control assembly providing limiting to the output signals in the case of high input signals.
The Uplink UHF Lowband signal exits the BDA via the port labelled "UHF LOW U/L OUTPUT" (H in section 3.4.4.2.).

VHF/UHF BDA Unit (80-301403) is provided with a 24V DC input to power the amplifier modules within and those amplifier modules are configured to provide alarm status reports. Separate alarm contact outputs are provided for the VHF and the UHF Lowband paths.

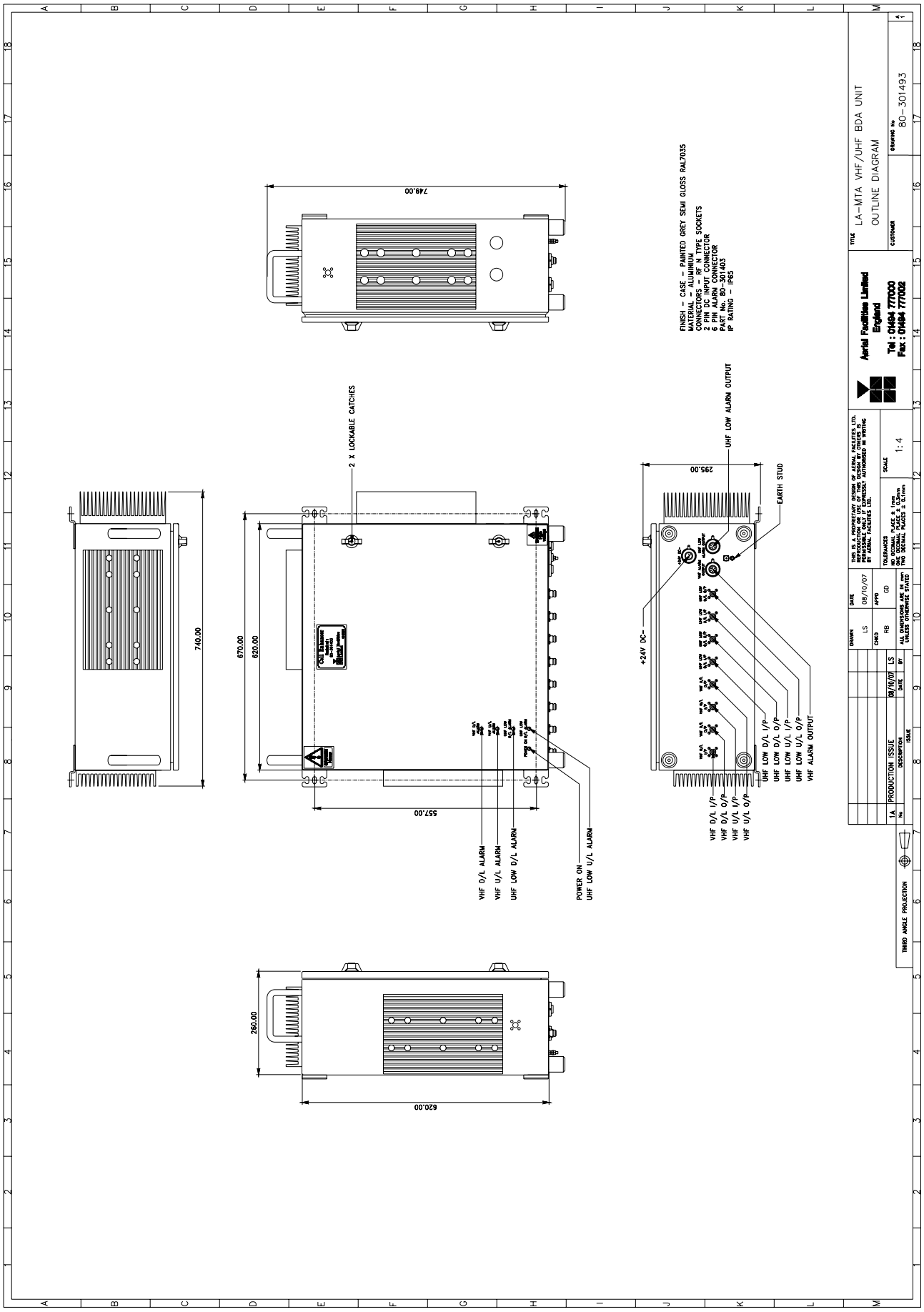
3.4.1. VHF/UHF BDA Unit (80-301403) System Diagram

Drawing Number 80-301483



3.4.2. VHF/UHF BDA Unit (80-301403) Outline Drawing

Drawing Number 80-301493



3.4.3. VHF/UHF BDA Unit(80-301403) Specification

Parameter		Specification
Downlink		
Downlink Passband	VHF	154.0 to 161.5MHz
	UHF Lowband	460.4 to 460.5MHz
Maximun gain	VHF	30dB
	UHF Lowband	30dB
Gain Adjustment	VHF	0 to 30dB in 2dB steps
	UHF Lowband	0 to 30dB in 2dB steps
1dB Compression Point (P1dB)	VHF	> +34.0dBm
	UHF Lowband	> +42.5dBm
ALC setting	VHF	1dB below P1dB
	UHF Lowband	1dB below P1dB
3rd Order Intercept point	VHF	> +45.0dBm
	UHF Lowband	> +53.5dBm
Uplink		
Uplink Passband	VHF	155.5 – 161.0MHz
	UHF Lowband	465.4 – 465.5MHz
Maximun gain	VHF	30dB
	UHF Lowband	30dB
Gain Adjustment	VHF	0 to 30dB in 2dB steps
	UHF Lowband	0 to 30dB in 2dB steps
1dB Compression Point (P1dB)	VHF	> +34.0dBm
	UHF Lowband	> +36.5dBm
ALC setting	VHF	+27dBm
	UHF Lowband	+27dBm
3rd Order Intercept point	VHF	> +45.0dBm
	UHF Lowband	> +48.0dBm
Noise Figure	VHF	< 10dB
	UHF Lowband	< 3.0dB
Environmental/Mechanical Specification		
Mechanical		IP65 Wall Mount
Dimensions (excludes handles and connectors)		620mm x 620mm x 250mm (24” x 24” x 10” approx)
RF Connectors		N-Type Female
Alarm Interfaces		Local Alarms to SCADA Dry Contact with LED Indication per band path
Power Supply		24V DC

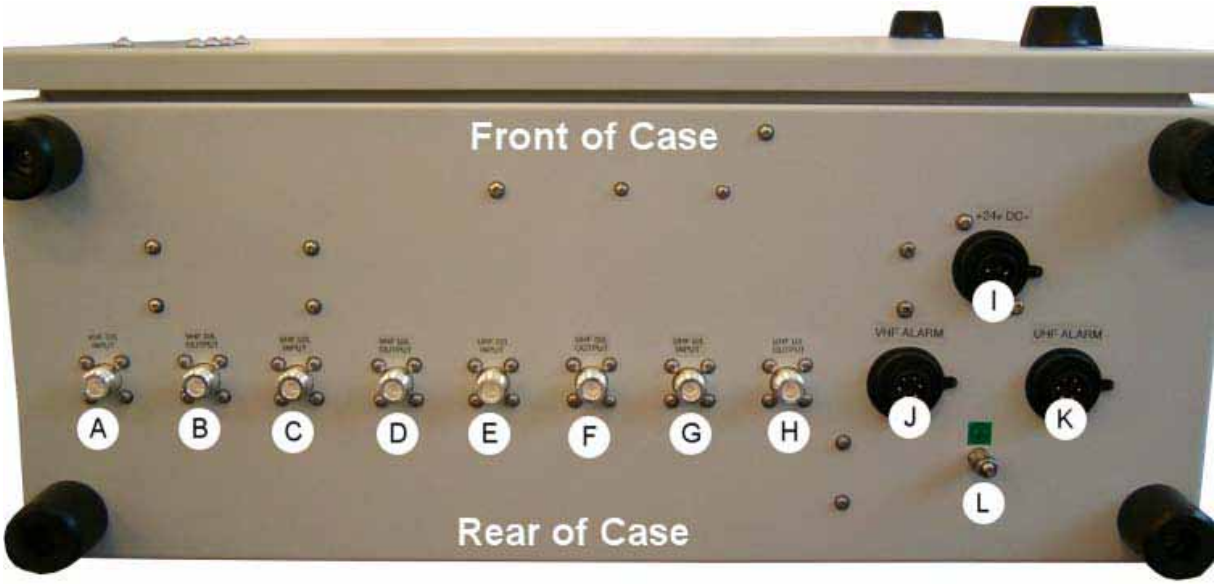
3.4.4. VHF/UHF BDA Unit(80-301403) Photographs

3.4.4.1. Front View

Note: All connectors (RF, DC and Alarms) are on the underside

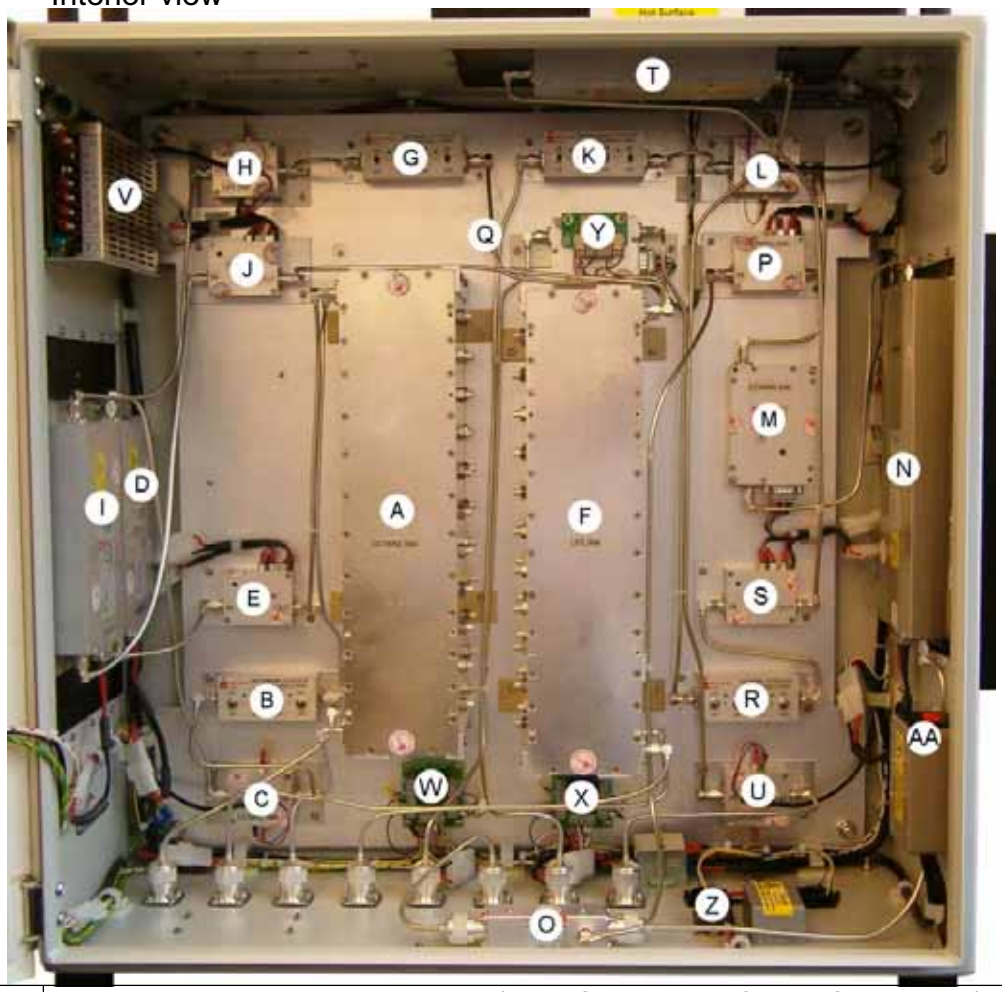
A	Green LED “Power On”
B	Red LED VHF Downlink Alarm
C	Red LED VHF Uplink Alarm
D	Red LED UHF Lowband Downlink Alarm
E	Red LED UHF Lowband Uplink Alarm
F	Lockable Door Handles

3.4.4.2. Underside view showing connectors



A	VHF Downlink Input from port 1 on Combiner 80-301402
B	VHF Downlink Output to port A on Combiner 80-301402
C	VHF Uplink Input from port F on Combiner 80-301402
D	VHF Uplink Output to port 6 on Combiner 80-301402
E	UHF Lowband Downlink Input from port 2 on Combiner 80-301402
F	UHF Lowband Downlink Output to port B on Combiner 80-301402
G	UHF Lowband Uplink Input from port G on Combiner 80-301402
H	UHF Lowband Uplink Output to port 7 on Combiner 80-301402
I	24V DC Input
J	VHF Band Alarm Output
K	UHF Lowband Alarm Output
L	Earth Connection

3.4.4.3. Interior view



A	VHF Downlink Filters 01-002503 (Input filter below, Output filter above)
B	VHF Downlink Switched Attenuator 10-000701
C	VHF Downlink AGC Attenuator 17-001201
D	VHF Downlink 5W Power Amplifier 12-025602
E	VHF Downlink AGC Detector 17-001101
F	VHF Uplink Filters 01-002503 (Input filter below, Output filter above)
G	VHF Uplink Switched Attenuator 10-000701
H	VHF Uplink AGC Attenuator 17-001201
I	VHF Uplink 5W Power Amplifier 12-025602
J	VHF Uplink AGC Detector 17-001101
K	UHF Lowband Downlink Switched Attenuator 10-000701
L	UHF Lowband Downlink AGC Attenuator 17-001201
M	UHF Lowband Downlink Low Power Amplifier 12-021801
N	UHF Lowband Downlink 20W Power Amplifier 12-016301
O	UHF Lowband Downlink 30dB Directional Coupler 07-002908
P	UHF Lowband Downlink AGC Detector 17-001105
Q	UHF Lowband Uplink Low Noise Amplifier 11-005401
R	UHF Lowband Uplink Switched Attenuator 10-000701
S	UHF Lowband Uplink AGC Attenuator 17-001201
T	UHF Lowband Uplink 5W Power Amplifier 12-021601
U	UHF Lowband Uplink AGC Detector 17-001101
V	DC/DC Converter 96-200024
W	24V Dual Relay Assembly (VHF Alarm output) 20-001602
X	24V Dual Relay Assembly (UHF Lowband output) 20-001602
Y	24V Relay Assembly 80-008902
Z	Dual Diode Assembly 94-100004
AA	Main DC 10A Circuit Breaker 96-920021

3.4.5. VHF/UHF BDA Unit(80-301403) Major Sub-components

Section	Component Part	Component Part Description	Qty Per Assembly
3.4.5.1.	01-002503	Bandpass Filter	4
3.4.5.2.	07-002908	30dB Directional Coupler	1
3.4.5.3.	10-000701	Switched Attenuator 0.25Watt, 0 - 30dB	4
3.4.5.4.	11-005401	Low Noise Amplifier	1
3.4.5.5.	12-016301	TETRA Power Amplifier 20W	1
3.4.5.6.	12-021601	TETRA Power Amplifier 5W	1
3.4.5.7.	12-021801	Low Power Amplifier	1
3.4.5.8.	12-025602	VHF Power Amplifier 5W	2
3.4.5.9.	17-001101	AGC Detector Assembly	3
	17-001105	AGC Detector Assembly (Logarithmic)	1
	17-001201	AGC Attenuator Assembly	4
3.4.5.10.	20-001602	24V Dual Relay Assembly	2
3.4.5.11.	80-008902	24V Relay Assembly	1
3.4.5.12.	94-100004	Dual Diode Assembly	1
3.4.5.13.	96-200024	DC/DC Converter	1

3.4.5.1. Bandpass Filter (01-002503)

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 helical 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 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.

01-002503 Specification

SPECIFICATION		PARAMETER
Bandpass Frequency	Downlink	154.0 MHz to 161.5 MHz
	Uplink	155.5 MHz to 161.0 MHz
Bandwidth	Downlink	7.5MHz
	Uplink	5.5MHz
No. of sections		6
Insertion loss		1.5dB
VSWR		Better than 1.2:1
Connectors		SMA
Power handling		100W maximum
Temperature range	operational	-20°C to +60°C
	store	-40°C to +70°C
Weight		3 kg
Size		384 x 82.5 x 56.4mm

3.4.5.2. 30dB Directional Coupler (07-002908)

The purpose of these couplers is to tap off known portions of RF signal from transmission lines and to combine them, for example through splitter units for different purposes (alarms/monitoring etc.), whilst maintaining an accurate 50Ω load to all ports/interfaces throughout the specified frequency range. They are known as directional couplers as they couple power from the RF mainline in one direction only.
Directional Coupler 07-002908 is configured to tap off 30dB.

07-002908 Specification

PARAMETER		SPECIFICATION
Frequency range		50 - 1000MHz
Insertion loss		<0.3dB
Coupling level		30dB
Rejection		N/A
Weight		<200gms
Connectors		N type, female
Temperature range	operation	-20°C to +60°C
	storage	-40°C to +70°C

3.4.5.3. Switched Attenuator 0.25Watt, 0 - 30dB (10-000701)

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.

10-000701 provides attenuation from 0 to 30dB in 2 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.

10-000701 Specification

PARAMETER		SPECIFICATION
Attenuation Values		0-30dB
Attenuation Steps		2, 4, 8 and 16dB
Power Handling		0.25 Watt
Attenuation Accuracy		± 1.0 dB
Frequency Range		DC to 1GHz
Impedance		50Ω
Connectors		SMA
VSWR		1.3:1
Weight		0.2kg
Temperature range	operation	-20°C to +60°C
	storage	-40°C to +70°C

3.4.5.4. Low Noise Amplifier (11-005401)

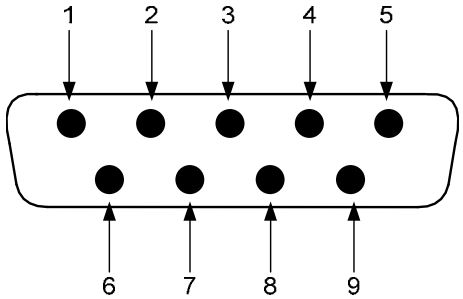
The 15dB gain low noise amplifier used in the unit is a double stage solid-state low noise amplifier. Class A circuitry is used throughout the units to ensure excellent linearity over a very wide dynamic range. The active devices are very moderately rated to provide a long trouble-free working life. There are no adjustments on these amplifiers, and in the unlikely event of a failure, the complete amplifier should be replaced. The amplifier is housed in an aluminium case (Iridite NCP finish) with SMA connectors for the RF input/output and a 9way D-type for DC and alarm outputs.

11-005401 Specification

PARAMETER		SPECIFICATION
Frequency range		380 - 500MHz
Bandwidth		<100MHz (as required, tuneable)
1dB compression point		>+20dBm
3rd order intercept		>+33dBm
Gain		>15.5dB (typical)
VSWR		better than 1.5:1
Input return loss		>14dB
Noise figure		<2.0dB (typical)
Connectors		SMA female
Supply		115mA at 12V DC
Temperature range	operational	-10°C to +60°C
	storage	-40°C to +70°C
Size		88 x 50 x 34mm (ex. connectors)
Weight		0.26kg

LNA 'D' Connector Pin-out details	
Connector pin	**Signal**
1	+ve input (10-24V)
2	GND
3	Alarm relay O/P bad
4	Alarm relay common
5	Alarm relay good
6	No connection
7	TTL voltage set
8	TTL alarm/0V (good)
9	O/C good/0V bad

9-Way Pin-Out Graphical Representation



3.4.5.5. TETRA Power Amplifier 20W (12-016301)

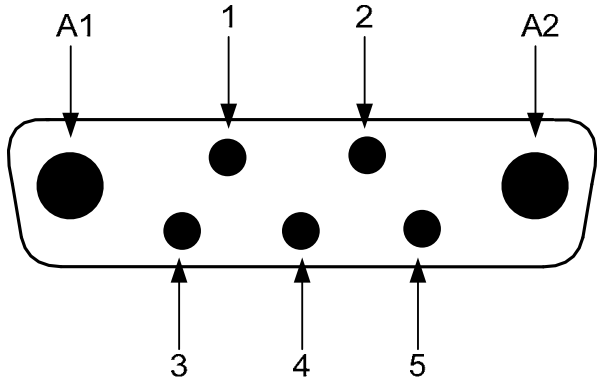
This amplifier is a Class A 20W power amplifier from 380MHz to 470MHz in a 1 stage balanced configuration. It demonstrates a very high linearity and a very good input/output return loss (RL). It has built in a Current Fault Alarm Function.
It is housed is an aluminium case (Iridite NCP finish) with SMA connectors for the RF input/output and a D-Type connector for the power supply and the Current Fault Alarm Function. Note the large diameter DC power input pins (1 & 2) fitted to reduce volt-drop/arcing.

12-016301 Specification

PARAMETER		SPECIFICATION
Frequency range		380-470MHz
Small signal gain		23dB
Gain flatness		±1.7dB
I/O Return loss		>18dB
1dB compression point		+43dBm
OIP3		+55dBm
Supply voltage		24V DC
Supply current		3.8Amps (Typical)
Temperature range	operational	-10°C to +60°C
	storage	-20°C to +70°C
Weight		<2kg (no heatsink)

7-Way Connector Pin-out details	
Connector Pin	**Signal**
A1 (large pin)	+24V DC
A2 (large pin)	GND
1	Alarm relay common
2	TTL alarm/0V good
3	Alarm relay contact (bad)
4	Alarm relay contact (good)
5	O/C good/0V bad (TTL)

7-Way Connector Graphical Representation



3.4.5.6. TETRA Power Amplifier 5W (12-021601)

Power amplifier 12-021601 is a multi-stage, solid state power amplifier. Class A circuitry is employed throughout the device to ensure excellent linearity over a wide dynamic frequency range. All the semi-conductor devices are very conservatively rated to ensure low device junction temperatures and a long, trouble free working lifetime.

The power 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.

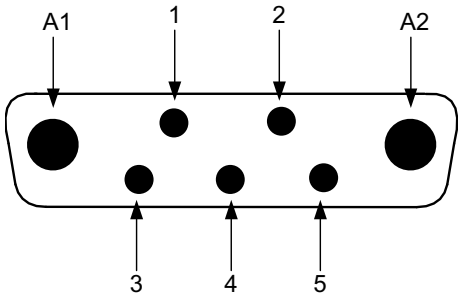
The unit housing is an aluminium case (Iridite NCP finish) with SMA connectors for the RF input/output and a D-Type connector for the power supply and the Current Fault Alarm Function.

12-021601 Specification

PARAMETER		SPECIFICATION
Frequency range:		380-470MHz (as required)
Bandwidth:		10-40MHz (typical, tuned to spec.)
Maximum RF output:		>5Watts
Gain:		>30dB
1dB compression point:		+37.5dBm
3rd order intercept point:		+50dBm
VSWR:		better than 1.5:1
Connectors:		SMA female
Supply:		1.9Amps @ 12V DC
Weight:		1kg (excluding heatsink)
Temperature range:	operational:	-10°C to +60°C
	storage:	-20°C to +70°C

7-Way Connector Pin-out details	
Connector Pin	**Signal**
A1 (large pin)	+12V DC
A2 (large pin)	GND
1	Alarm relay common
2	TTL alarm/0V good
3	Alarm relay contact (bad)
4	Alarm relay contact (good)
5	O/C good/0V bad (TTL)

7-Way Pin-Out Graphical Representation



3.4.5.7. Low Power Amplifier (1Watt) (12-021801)

The low power amplifier used is a 1 stage balanced configuration, solid-state amplifier. Class A circuitry is used in the unit to ensure excellent linearity over a very wide dynamic range. The three active devices are very moderately rated to provide a long trouble-free working life.
Its housing is an aluminium case (Iridite NCP finish) with SMA connectors for the RF input/output and a D-Type connector for the power supply and the Current Fault Alarm Function.
There are no adjustments on this amplifier, and in the unlikely event of failure then the entire amplifier should be replaced.

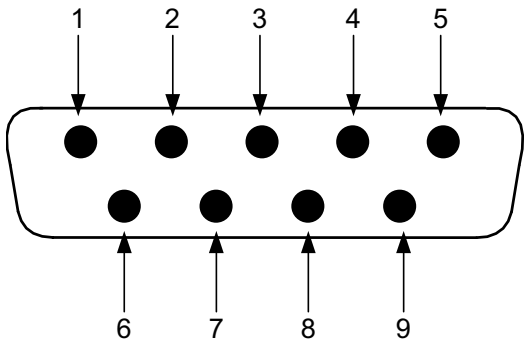
12-021801 Specification

PARAMETER		SPECIFICATION
Temperature		-20 to +70 °C
Frequency Range		380 - 500 MHz
Small Signal Gain		15.5 +/- 0.5 dB
Gain Flatness		0.7 dB p-p
ΔGain vs. Temperature		0.7 dB
In RL		20 dB
Out RL		20 dB
Output Power @ 1dB Compression Point		+30.5 dBm
Output 3rd Order IP		+41.5 dBm
Noise Figure		6 dB
DC Supply Voltage		10-15 Vdc
DC Supply Current		540 mA
Temperature range	operational:	-10°C to +60°C
	storage:	-40°C to +100°C
Weight:		<0.5 kg
Size:		110.5 x 66mm x 24.6mm

Low Power Amplifier (12-021801) 9-Way Connector Pin-outs

Connector pin	Signal
1	+ve input (10-15V)
2	GND
3	Alarm relay O/P bad
4	Alarm relay common
5	Alarm relay good
6	No connection
7	TTL voltage set
8	TTL alarm/0V (good)
9	O/C good/0V bad

9-Way Pin-Out Graphical Representation



3.4.5.8. VHF Power Amplifier 5W (12-025602)

Power amplifier 12-025602 is a multi-stage, solid state power amplifier. Class A circuitry is employed throughout the device to ensure excellent linearity over a wide dynamic frequency range. All the semi-conductor devices are very conservatively rated to ensure low device junction temperatures and a long, trouble free working lifetime. There is a Current Fault Alarm Function, which indicates failure of each RF transistor with an open collector of a NPN transistor. A relay is fitted to indicate the failure by voltage free change over the relay contacts.

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.

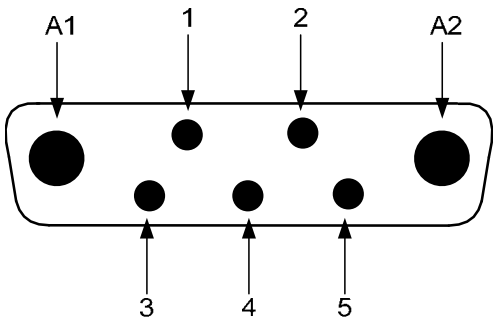
The unit housing is an aluminium case (Iridite NCP finish) with SMA connectors for the RF input/output and a D-Type connector for the power supply and the Current Fault Alarm Function.

12-025602 Specification

PARAMETER		SPECIFICATION
Frequency range		108 to 174 MHz (as required)
Maximum RF output		>5Watts
Gain		≥ 34 dB
1dB compression point		≥ +37 dBm
3rd order intercept point		≥ +48 dBm
In / RL		16 dB
Out / RL		15 dB
Noise Figure		≤ 9.5 dB
Connectors		SMA female
Supply		24 +/- 0.5 Vdc @ 1040 mA Max
Temperature range	operational	-10°C to +60°C
	storage	-20°C to +70°C

7-Way Connector Pin-out details	
Connector Pin	**Signal**
A1 (large pin)	+24V DC
A2 (large pin)	GND
1	Alarm relay common
2	TTL alarm/0V good
3	Alarm relay contact (bad)
4	Alarm relay contact (good)
5	O/C good/0V bad (TTL)

7-Way Connector Graphical Representation



3.4.5.9. Automatic Gain Control

17-001101 AGC Detector Assembly
17-001105 AGC Detector Assembly (Logarithmic)
17-001201 AGC Attenuator Assembly

VHF/UHF BDA UNIT(80-301403) is fitted with two differing types of Automatic Gain Control (AGC) system, one linear, and one logarithmic. The Downlink UHF Lowband path is fitted with logarithmic detector (17-001105), and attenuator (17-001201) the Uplink UHF Lowband path and the two VHF paths are each fitted with linear detector (17-001101) and attenuator (17-001201)

The Automatic Gain Control system consists of two units, a detector/amplifier and an attenuator. The detector/amplifier unit is inserted in the RF path on the output of the power amplifier, and the attenuator is situated in the RF path before the amplification stage(s)

The attenuator comprises a 50Ω P.I.N diode, voltage-variable attenuator with a range of 3 to 30dB. The attenuation is controlled by a DC voltage which is derived from the associated detector controller board.

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

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

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

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

For small signals, below AGC onset, the output control line will be close to 12V and the AGC attenuator will have minimum attenuation. As the signal level increases the control line voltage will fall, increasing the attenuator value and keeping the system output level at a constant value.

3.4.5.10. 24V Relay Dual Assembly (20-001602)

The General Purpose 24V Dual Relay Board (20-001602) 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. Its common use is to amalgamate all the alarm signals into one, volts-free relay contact pair for the main alarm system.

20-001602 Specification

PARAMETER		SPECIFICATION
Operating voltage		8 to 30V (floating earth)
Alarm Threshold		Vcc - 1.20 volt +15%
Alarm output relay contacts:		
Max. switch current		1.0Amp
Max. switch volts		120Vdc/60VA
Max. switch power		24W/60VA
Min. switch load		10.0µA/10.0mV
Relay isolation		1.5kV
Mechanical life		>2x10^7 operations
Relay approval		BT type 56
Connector details		Screw terminals
Temperature range	operational	-10°C to +60°C
	storage	-20°C to +70°C

3.4.5.11. 24V Relay Assembly (80-008902)

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

The relay is provided with a polarity protection diode 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.

80-008902 Specification

Parameter		Specification
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

3.4.5.12. Dual Diode Assembly (94-100004)

The purpose of these dual diode assemblies is to allow two DC voltage sources to be combined, so that the main DC rail within the equipment can be sourced from either a mains driven PSU, or externally through an XLR connector or from dual mains driven PSUs . They are very heavy-duty diodes and they prevent any reverse current from flowing back to their source or the alternative supply rail. Combining diodes such as these will also be used if the equipment is to be powered from external back-up batteries.

3.4.5.13. DC/DC Converter, 24V in, 12V 5A out (96-200024)

This unit it is an O.E.M high power device with a 5 amp @ 12V (60Watts) output capability used to derive a 12V fixed voltage power supply rail from a 24V supply. In the event of failure this unit should not be repaired, only replaced.

96-200024 Specification

PARAMETER		SPECIFICATION
Input Voltage range		18-28V DC
Output voltage		12V±0.5V
Max output current load		5.0 Amps
Temperature range	operation	-10°C to +60°C
	storage	-20°C to +70°C

3.5. UHF BDA Unit (80-301404)

UHF BDA Unit (80-301404) provides the amplification stages for the UHF Midband and UHF Highband paths, The unit is housed in a wall mount case 600x600x250mm (24" x 24" x 10" approx).

The Downlink UHF Midband signal is received at the port labelled "UHF MID D/L INPUT" (Annotated A in the picture in section 3.5.4.2.). The signal passes through a switched attenuator providing 0 to 30 dB of RF signal attenuation and then into the amplification stage. The Downlink UHF Midband amplification stage is provided by two amplifier modules, the first is a 15dB gain Low Power Amplifier and the second is a 20W, 23dB gain power amplifier. Both amplification stages are straddled by an Automatic Gain Control assembly providing limiting to the output signals in the case of high input signals.
The input to the AGC detector is provided by the output of a 30dB tap. After leaving the Amplification/AGC stage the Downlink UHF Midband signal exits the BDA via the port labelled "UHF MID D/L OUTPUT" (B in section 3.5.4.2.).

The Uplink UHF Midband signal is received at the port labelled "UHF MID U/L INPUT" (D in section 3.5.4.2.). The signal passes into a Low Noise Amplifier providing 15dB of gain and then into a switched attenuator providing 0 to 30 dB of RF signal attenuation. After the attenuator the Uplink UHF Midband signal passes into a second stage of amplification provided by a 5W, 30dB gain Power Amplifier, this amplification stage is straddled by an Automatic Gain Control assembly providing limiting to the output signals in the case of high input signals.
The Uplink UHF Midband signal exits the BDA via the port labelled "UHF MID U/L OUTPUT" (C in section 3.5.4.2.).

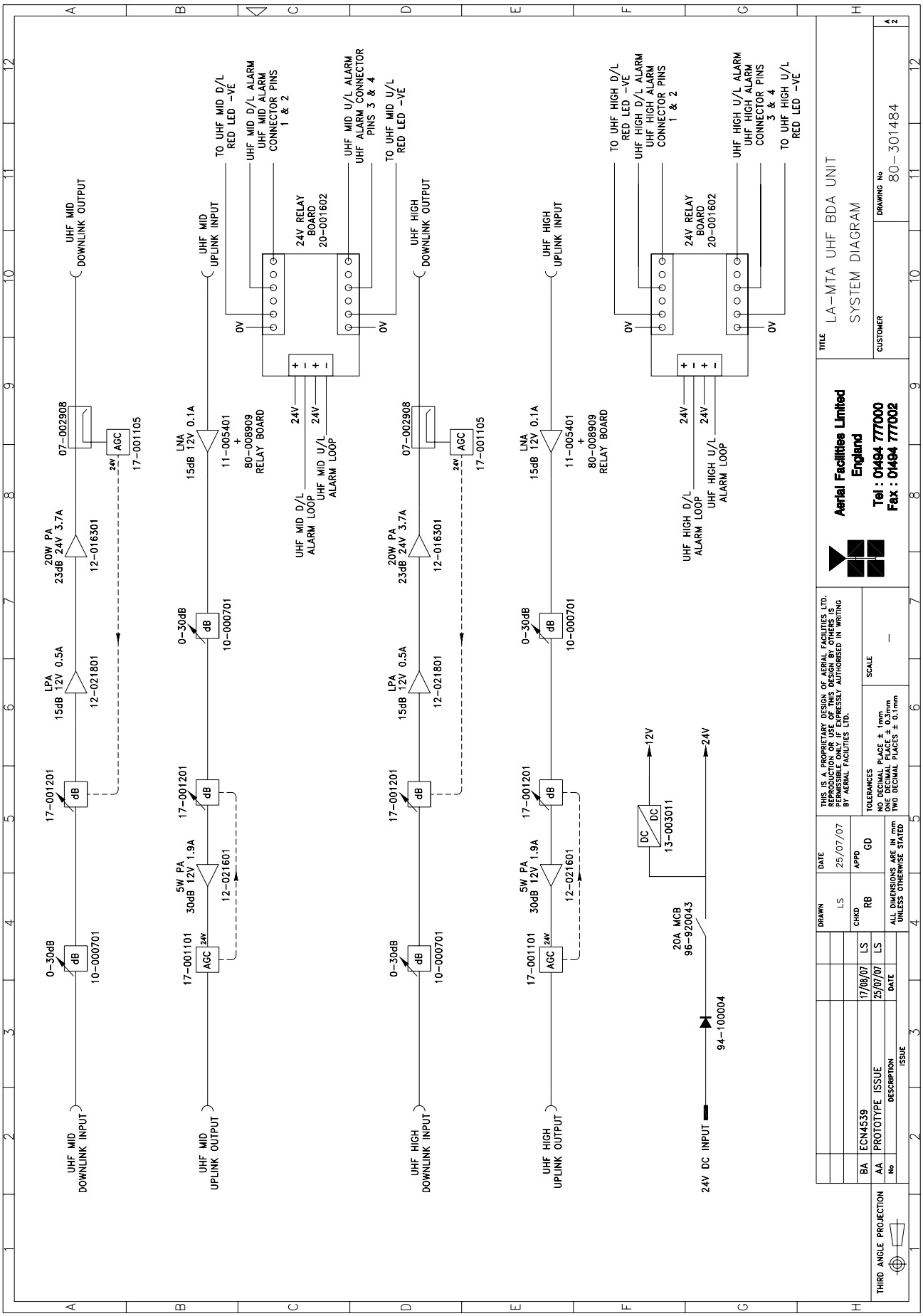
The Downlink UHF Highband signal is received at the port labelled "UHF HIGH D/L INPUT" (Annotated G in the picture in section 3.5.4.2.). The signal passes through a switched attenuator providing 0 to 30 dB of RF signal attenuation and then into the amplification stage. The Downlink UHF Highband amplification stage is provided by two amplifier modules, the first is a 15dB gain Low Power Amplifier and the second is a 20W, 23dB gain power amplifier. Both amplification stages are straddled by an Automatic Gain Control assembly providing limiting to the output signals in the case of high input signals.
The input to the AGC detector is provided by the output of a 30dB tap. After leaving the Amplification/AGC stage the Downlink UHF Highband signal exits the BDA via the port labelled "UHF HIGH D/L OUTPUT" (H in section 3.5.4.2.).

The Uplink UHF Highband signal is received at the port labelled "UHF HIGH U/L INPUT" (E in section 3.5.4.2.). The signal passes into a Low Noise Amplifier providing 15dB of gain and then into a switched attenuator providing 0 to 30 dB of RF signal attenuation. After the attenuator the Uplink UHF Highband signal passes into a second stage of amplification provided by a 5W, 30dB gain Power Amplifier, this amplification stage is straddled by an Automatic Gain Control assembly providing limiting to the output signals in the case of high input signals.
The Uplink UHF Highband signal exits the BDA via the port labelled "UHF HIGH U/L OUTPUT" (F in section 3.5.4.2.).

UHF BDA Unit (80-301404) is provided with a 24V DC input to power the amplifier modules within and those amplifier modules are configured to provide alarm status reports. Separate alarm contact outputs are provided for the UHF Midband and the UHF Highband paths.

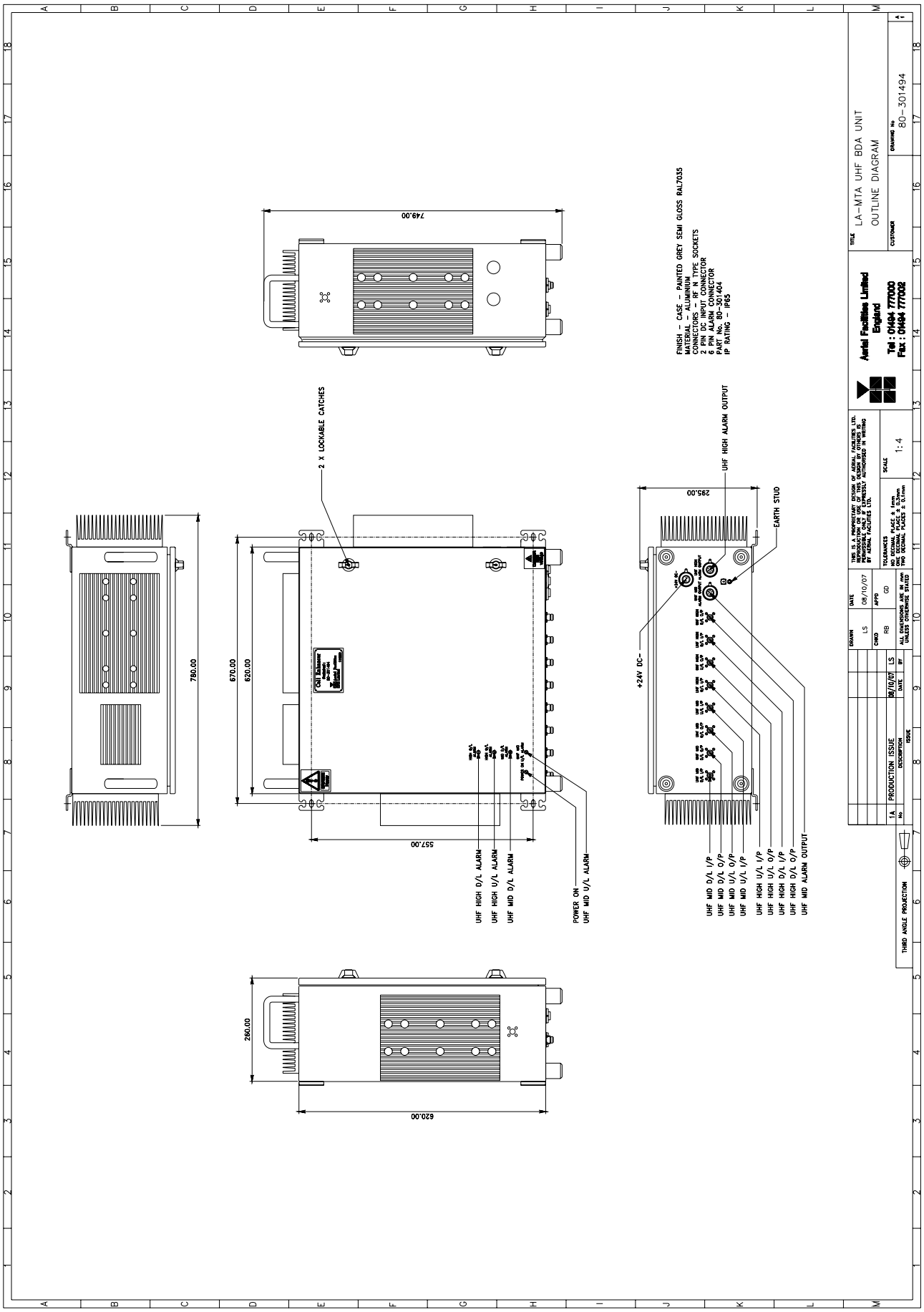
3.5.1. UHF BDA Unit (80-301404) System Diagram

Drawing Number 80-301484



3.5.2. UHF BDA Unit (80-301404) Outline Drawing

Drawing Number 80-301494



3.5.3. UHF BDA Unit (80-301404) Specification

Parameter		Specification
Downlink		
Downlink Passband	UHF Midband	482.5 to 483.8MHz
	UHF Highband	507.0 to 507.3MHz
Maximun gain	UHF Midband	30dB
	UHF Highband	30dB
Gain Adjustment	UHF Midband	0 to 30dB in 2dB steps
	UHF Highband	0 to 30dB in 2dB steps
1dB Compression Point (P1dB)	UHF Midband	> +42.5dBm
	UHF Highband	> +42.5dBm
ALC setting	UHF Midband	1dB below P1dB
	UHF Highband	1dB below P1dB
3rd Order Intercept point	UHF Midband	> +53.5dBm
	UHF Highband	> +53.5dBm
Uplink		
Uplink Passband	UHF Midband	485.7 to 486.8MHz
	UHF Highband	510.0 to 510.3MHz
Maximun gain	UHF Midband	30dB
	UHF Highband	30dB
Gain Adjustment	UHF Midband	0 to 30dB in 2dB steps
	UHF Highband	0 to 30dB in 2dB steps
1dB Compression Point (P1dB)	UHF Midband	> +36.5dBm
	UHF Highband	> +36.5dBm
ALC setting	UHF Midband	+27dBm
	UHF Highband	+27dBm
3rd Order Intercept point	UHF Midband	> +48.0dBm
	UHF Highband	> +48.0dBm
Noise Figure	UHF Midband	< 3.0dB
	UHF Highband	< 3.0dB
Environmental/Mechanical Specification		
Mechanical		IP65 Wall Mount
Dimensions (excludes handles and connectors)		620mm x 620mm x 250mm (24” x 24” x 10” approx)
RF Connectors		N-Type Female
Alarm Interfaces		Local Alarms to SCADA Dry Contact with LED Indication per band path
Power Supply		24V DC

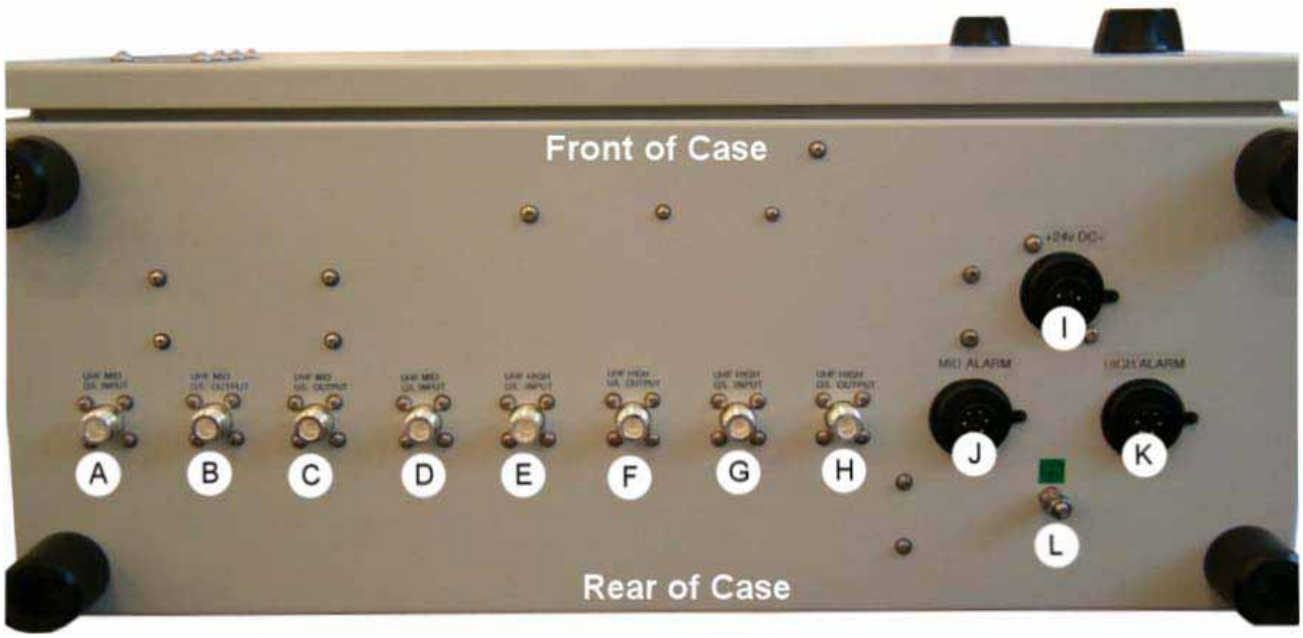
3.5.4. UHF BDA Unit (80-301404) Photographs

3.5.4.1. Front View

Note: All connectors (RF, DC and Alarms) are on the underside

A	Red LED UHF Highband Downlink Alarm
B	Red LED UHF Highband Uplink Alarm
C	Red LED UHF Midband Downlink Alarm
D	Red LED UHF Midband Uplink Alarm
E	Green LED “Power On”
F	Lockable Door Handles

3.5.4.2. Underside view showing connectors



A	UHF Midband Downlink Input from port 3 on Combiner 80-301402
B	UHF Midband Downlink Output to port C on Combiner 80-301402
C	UHF Midband Uplink Output to port 8 on Combiner 80-301402
D	UHF Midband Uplink Input from port H on Combiner 80-301402
E	UHF Highband Uplink Input from port I on Combiner 80-301402
F	UHF Highband Uplink Output to port 9 on Combiner 80-301402
G	UHF Highband Downlink Input from port 4 on Combiner 80-301402
H	UHF Highband Downlink Output to port D on Combiner 80-301402
I	24V DC Input
J	UHF Midband Band Alarm Output
K	UHF Highband Alarm Output
L	Earth Connection

3.5.4.3. Interior view

A	UHF Midband Downlink Switched Attenuator 10-000701
B	UHF Midband Downlink AGC Attenuator 17-001201
C	UHF Midband Downlink Low Power Amplifier 12-021801
D	UHF Midband Downlink 20W Power Amplifier 12-016301
E	UHF Midband Downlink 30dB Directional Coupler 07-002908
F	UHF Midband Downlink AGC Detector Assembly 17-001105
G	UHF Midband Uplink Low Noise Amplifier 11-005401
H	UHF Midband Uplink Switched Attenuator 10-000701
I	UHF Midband Uplink AGC Attenuator 17-001201
J	UHF Midband Uplink 5W Power Amplifier 12-021601
K	UHF Midband Uplink AGC Detector Assembly 17-001101
L	UHF Highband Downlink Switched Attenuator 10-000701
M	UHF Highband Downlink AGC Attenuator 17-001201
N	UHF Highband Downlink Low Power Amplifier 12-021801
O	UHF Highband Downlink 20W Power Amplifier 12-016301
P	UHF Highband Downlink 30dB Directional Coupler 07-002908
Q	UHF Highband Downlink AGC Detector Assembly 17-001105
R	UHF Highband Uplink Low Noise Amplifier 11-005401
S	UHF Highband Uplink Switched Attenuator 10-000701
T	UHF Highband Uplink AGC Attenuator 17-001201
U	UHF Highband Uplink 5W Power Amplifier 12-021601
V	UHF Highband Uplink AGC Detector Assembly 17-001101
W	DC/DC Converter 13-003011
X	24V Dual Relay Assembly 20-001602 UHF Highband Alarms
Y	24V Dual Relay Assembly 20-001602 UHF Midband Alarms
Z	24V Relay Assembly 80-008909 UHF Midband Alarms
AA	24V Relay Assembly 80-008909 UHF Highband Alarms
BB	Dual Diode Assembly 94-100004
CC	DC Circuit Breaker

3.5.5. UHF BDA Unit (80-301404) Major Sub-components

Section	Component Part	Component Part Description	Qty Per Assembly
3.5.5.1.	07-002908	30dB Directional Coupler	2
3.5.5.2.	10-000701	Switched Attenuator 0.25Watt, 0 - 30dB	4
3.5.5.3.	11-005401	Low Noise Amplifier	2
3.5.5.4.	12-016301	TETRA Power Amplifier 20W	2
3.5.5.5.	12-021601	TETRA Power Amplifier 5W	2
3.5.5.6.	12-021801	Low Power Amplifier	2
3.5.5.7.	13-003011	DC/DC Converter	1
3.5.5.8.	17-001101	AGC Detector Assembly	2
	17-001105	AGC Detector Assembly (Logarithmic)	2
	17-001201	AGC Attenuator Assembly	4
3.5.5.9.	20-001602	24V Dual Relay Assembly	2
3.5.5.10.	80-008909	24V Relay Assembly	2
3.5.5.11.	94-100004	Dual Diode Assembly	1

3.5.5.1. 30dB Directional Coupler (07-002908)

The purpose of these couplers is to tap off known portions of RF signal from transmission lines and to combine them, for example through splitter units for different purposes (alarms/monitoring etc.), whilst maintaining an accurate 50Ω load to all ports/interfaces throughout the specified frequency range. They are known as directional couplers as they couple power from the RF mainline in one direction only.
Directional Coupler 07-002908 is configured to tap off 30dB.

07-002908 Specification

PARAMETER		SPECIFICATION
Frequency range		50 - 1000MHz
Insertion loss		<0.3dB
Coupling level		-30dB
Rejection		N/A
Weight		<200g
Connectors		N type, female
Temperature range	operation	-20°C to +60°C
	storage	-40°C to +70°C

3.5.5.2. Switched Attenuator 0.25Watt, 0 - 30dB (10-000701)

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.

10-000701 provides attenuation from 0 to 30dB in 2 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.

10-000701 Specification

PARAMETER		SPECIFICATION
Attenuation Values		0-30dB
Attenuation Steps		2, 4, 8 and 16dB
Power Handling		0.25 Watt
Attenuation Accuracy		± 1.0 dB
Frequency Range		DC to 1GHz
Impedance		50Ω
Connectors		SMA
VSWR		1.3:1
Weight		0.2kg
Temperature range	operation	-20°C to +60°C
	storage	-40°C to +70°C

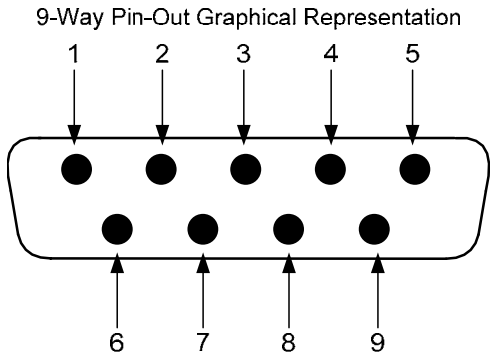
3.5.5.3. Low Noise Amplifier (11-005401)

The 15dB gain low noise amplifier used in the unit is a double stage solid-state low noise amplifier. Class A circuitry is used throughout 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 a failure, the complete amplifier should be replaced. The amplifier is housed in an aluminium case (Iridite NCP finish) with SMA connectors for the RF input/output and a 9way D-type for DC and alarm outputs.

11-005401 Specification

PARAMETER		SPECIFICATION
Frequency range		380 - 500MHz
Bandwidth		<100MHz (as required, tuneable)
1dB compression point		>+20dBm
3rd order intercept		>+33dBm
Gain		>15.5dB (typical)
VSWR		better than 1.5:1
Input return loss		>14dB
Noise figure		<2.0dB (typical)
Connectors		SMA female
Supply		115mA at 12V DC
Temperature range	operational	-10°C to +60°C
	storage	-40°C to +70°C
Size		88 x 50 x 34mm (ex. connectors)
Weight		0.26kg

LNA 'D' Connector Pin-out details	
Connector pin	**Signal**
1	+ve input (10-24V)
2	GND
3	Alarm relay O/P bad
4	Alarm relay common
5	Alarm relay good
6	No connection
7	TTL voltage set
8	TTL alarm/0V (good)
9	O/C good/0V bad



3.5.5.4. TETRA Power Amplifier 20W (12-016301)

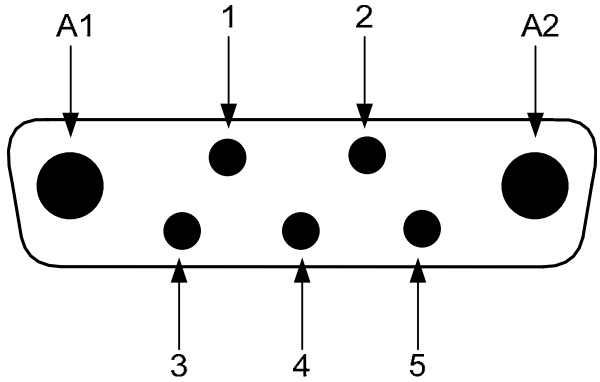
This amplifier is a Class A 20W power amplifier from 380MHz to 470MHz in a 1 stage balanced configuration. It demonstrates a very high linearity and a very good input/output return loss (RL). It has built in a Current Fault Alarm Function.
It is housed is an aluminium case (Iridite NCP finish) with SMA connectors for the RF input/output and a D-Type connector for the power supply and the Current Fault Alarm Function. Note the large diameter DC power input pins (1 & 2) fitted to reduce volt-drop/arcing.

12-016301 Specification

PARAMETER		SPECIFICATION
Frequency range		380-470MHz
Small signal gain		23dB
Gain flatness		±1.7dB
I/O Return loss		>18dB
1dB compression point		+43dBm
OIP3		+55dBm
Supply voltage		24V DC
Supply current		3.8Amps (Typical)
Temperature range	operational	-10°C to +60°C
	storage	-20°C to +70°C
Weight		<2kg (no heatsink)

7-Way Connector Pin-out details	
Connector Pin	**Signal**
A1 (large pin)	+24V DC
A2 (large pin)	GND
1	Alarm relay common
2	TTL alarm/0V good
3	Alarm relay contact (bad)
4	Alarm relay contact (good)
5	O/C good/0V bad (TTL)

7-Way Connector Graphical Representation



3.5.5.5. TETRA Power Amplifier 5W (12-021601)

Power amplifier 12-021601 is a multi-stage, solid state power amplifier. Class A circuitry is employed throughout the device to ensure excellent linearity over a wide dynamic frequency range. All the semi-conductor devices are very conservatively rated to ensure low device junction temperatures and a long, trouble free working lifetime.

The power 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.

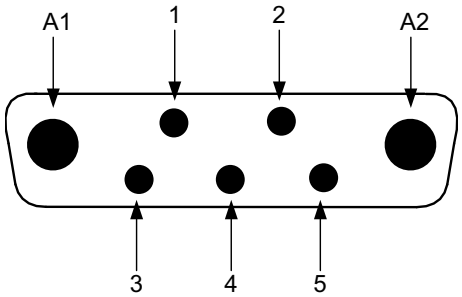
The unit housing is an aluminium case (Iridite NCP finish) with SMA connectors for the RF input/output and a D-Type connector for the power supply and the Current Fault Alarm Function.

12-021601 Specification

PARAMETER		SPECIFICATION
Frequency range:		380-470MHz (as required)
Bandwidth:		10-40MHz (typical, tuned to spec.)
Maximum RF output:		>5Watts
Gain:		>30dB
1dB compression point:		+37.5dBm
3rd order intercept point:		+50dBm
VSWR:		better than 1.5:1
Connectors:		SMA female
Supply:		1.9Amps @ 12V DC
Weight:		1kg (excluding heatsink)
Temperature range:	operational:	-10°C to +60°C
	storage:	-20°C to +70°C

7-Way Connector Pin-out details	
Connector Pin	**Signal**
A1 (large pin)	+10-24V DC
A2 (large pin)	GND
1	Alarm relay common
2	TTL alarm/0V good
3	Alarm relay contact (bad)
4	Alarm relay contact (good)
5	O/C good/0V bad (TTL)

7-Way Pin-Out Graphical Representation



3.5.5.6. Low Power Amplifier (12-021801)

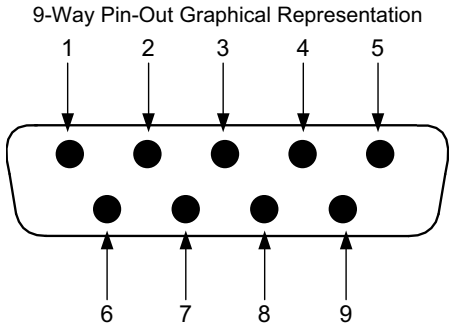
The low power amplifier used is a 1 stage balanced configuration, solid-state amplifier. Class A circuitry is used in the unit to ensure excellent linearity over a very wide dynamic range. The three active devices are very moderately rated to provide a long trouble-free working life.
Its housing is an aluminium case (Iridite NCP finish) with SMA connectors for the RF input/output and a D-Type connector for the power supply and the Current Fault Alarm Function.
There are no adjustments on this amplifier, and in the unlikely event of failure then the entire amplifier should be replaced.

12-021801 Specification

PARAMETER		SPECIFICATION
Temperature		-20 to +70 °C
Frequency Range		380 - 500 MHz
Small Signal Gain		15.5 +/- 0.5 dB
Gain Flatness		0.7 dB p-p
ΔGain vs. Temperature		0.7 dB
In RL		20 dB
Out RL		20 dB
Output Power @ 1dB Compression Point		+30.5dBm
Output 3rd Order IP		+41.5dBm
Noise Figure		6 dB
DC Supply Voltage		10-15 Vdc
DC Supply Current		540 mA Max
Temperature range	operational	-10°C to +60°C
	storage	-40°C to +100°C
Weight		<0.5 kg
Size		110.5 x 66mm x 24.6mm

Low Power Amplifier (12-021801) 9-Way Connector Pin-outs

Connector pin	Signal
1	+ve input (10-15V)
2	GND
3	Alarm relay O/P bad
4	Alarm relay common
5	Alarm relay good
6	No connection
7	TTL voltage set
8	TTL alarm/0V (good)
9	O/C good/0V bad



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

The DC/DC converter fitted is a high power PCB unit with an 8 amp at 12V output capability. The circuit is basically an O.E.M semiconductor regulator (one side of which has a heatsink mounting plate, usually bolted to the casing of the unit) and smoothing components built onto a printed circuit board with screw block terminations.
In event of failure this unit should not be repaired, only replaced.

13-003011 Specification

PARAMETER		SPECIFICATION
Input Voltage range		18-28V DC
Output voltage		12V±0.5V
Max. current load		8.0Amps
Temperature range	operation	-10°C to +60°C
	storage	-20°C to +70°C
Size(PCB)		190 x 63mm
Weight (Loaded PCB)		291g

3.5.5.8. Automatic Gain Control

17-001101 AGC Detector Assembly
17-001105 AGC Detector Assembly (Logarithmic)
17-001201 AGC Attenuator Assembly

UHF BDA UNIT(80-301404) is fitted with two differing types of Automatic Gain Control (AGC) system, one linear, and one logarithmic. The Downlink UHF Midband and Highband paths are each fitted with logarithmic detector (17-001105), and attenuator (17-001201) the Uplink UHF Midband and Highband paths are each fitted with linear detector (17-001101) and attenuator (17-001201) The Automatic Gain Control system consists of two units, a detector/amplifier and an attenuator. The detector/amplifier unit is inserted in the RF path on the output of the power amplifier, and the attenuator is situated in the RF path before the amplification stage(s)

The attenuator comprises a 50Ω P.I.N diode, voltage-variable attenuator with a range of 3 to 30dB. The attenuation is controlled by a DC voltage which is derived from the associated detector controller board. Normally the attenuator is at minimum attenuation. The detector/amplifier unit monitors the RF level being delivered by the power amplifier, and when a certain threshold is reached it begins to increase the value of the attenuator to limit the RF output to the (factory set) threshold. Therefore overloading of the power amplifier is avoided.

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

The detector comprises of a 50Ω transmission line with a resistive tap which samples a small portion of the mainline power. The sampled signal is amplified and fed to a conventional half wave diode rectifier, the output of which is a DC voltage proportional to the RF input signal. This DC voltage is passed via an inverting DC amplifier with integrating characteristics, to the output, which drives the attenuation control line of the corresponding AGC attenuator. This unit is fitted at some earlier point in the RF circuit. For small signals, below AGC onset, the output control line will be close to 12V and the AGC attenuator will have minimum attenuation. As the signal level increases the control line voltage will fall, increasing the attenuator value and keeping the system output level at a constant value.

3.5.5.9. 24V Relay Dual Assembly (20-001602)

The General Purpose 24V Dual Relay Board (20-001602) 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. Its common use is to amalgamate all the alarm signals into one, volts-free relay contact pair for the main alarm system.

20-001602 Specification

PARAMETER		SPECIFICATION
Operating voltage		8 to 30V (floating earth)
Alarm Threshold		Vcc - 1.20 volt +15%
Alarm output relay contacts:		
Max. switch current		1.0Amp
Max. switch volts		120Vdc/60VA
Max. switch power		24W/60VA
Min. switch load		10.0µA/10.0mV
Relay isolation		1.5kV
Mechanical life		>2x10^7 operations
Relay approval		BT type 56
Connector details		Screw terminals
Temperature range	operational	-10°C to +60°C
	storage	-20°C to +70°C

3.5.5.10. 24V Relay Assembly (80-008909)

Relay Board (80-008909) allows the inversion of signals and the isolation of circuits. It is equipped with a single dual pole change-over relay RL1, with completely isolated wiring, accessed via a 15 way in-line connector. The relay is provided with polarity protection diodes and diodes for suppressing the transients caused by "flywheel effect" which can destroy switching transistors or induce spikes on neighbouring circuits. It's common use is to amalgamate all the alarm signals into one, volts-free relay contact pair for the main alarm system. This relay board also carries an LED to serve as a "Status OK" indicator which is illuminated during normal operation.

80-008909 Specification

PARAMETER		**SPECIFICATION**
Operating voltage		8 to 30V (floating earth)
Alarm threshold		Vcc - 1.20 volt +15%
Alarm output relay contacts		
Max. switch current		1.0Amp
Max. switch volts		120Vdc/60VA
Max. switch power		24W/60VA
Min. switch load		10.0µA/10.0mV
Relay isolation		1.5kV
Mechanical life		>2x10^7 operations
Relay approval		BT type 56
Connector details		Screw terminals
Temperature range	operational	-10°C to +60°C
	storage	-20°C to +70°C

3.5.5.11. Dual Diode Assembly (94-100004)

The purpose of these dual diode assemblies is to provide polarity protection for the DC supply input. They are very heavy-duty diodes and they prevent any reverse current from flowing back to their source.

3.6. 800MHz BDA UNIT (80-301405)

800MHz BDA UNIT (80-301405) provides the amplification stages for the 800MHz paths, The unit is housed in a wall mount case 600x600x250mm (24” x 24” x 10” approx).

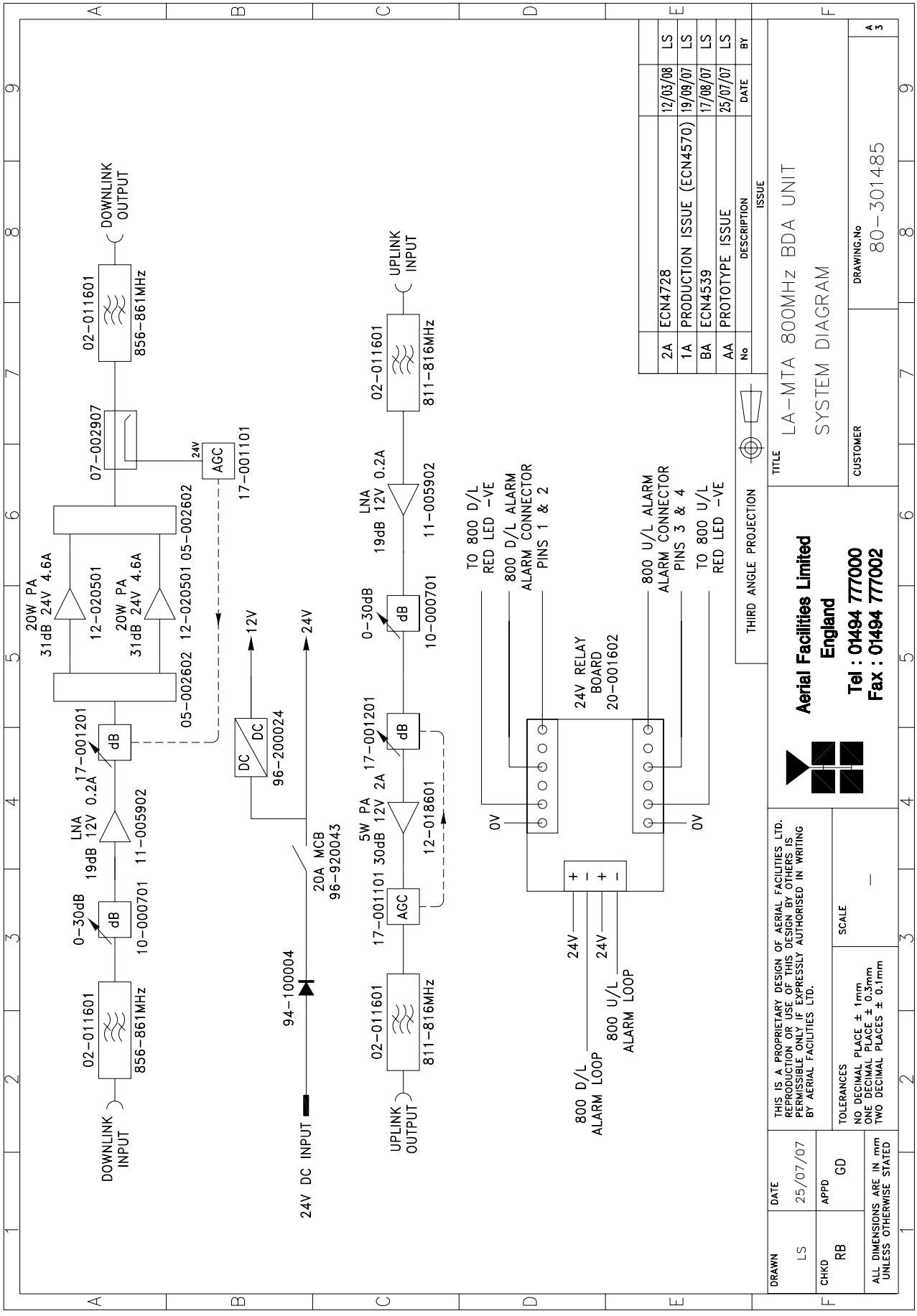
The Downlink 800MHz signal is received at the port labelled “D/L INPUT” (Annotated A in the picture in section 3.6.4.2.). The Downlink 800MHz path passes through a bandpass filter to remove out of band noise and then a switched attenuator providing 0 to 30 dB of RF signal attenuation, after the Attenuator the signal passes through the first of two amplification stages. This first stage is provided by a low noise amplifier which gives approx. 19dB of gain.
After the Low Noise Amplifier the Downlink 800MHz signal passes through the second amplification stage; the signal is first split into two equal paths and then each path is passed through a 20W power amplifier and then the two signal paths are re-combined. The second stage amplifiers are straddled by an Automatic Gain Control assembly providing limiting to the output signals in the case of high input signals.
After leaving the second stage amplifiers the Downlink 800MHz signal path passes through a second bandpass filter before exiting the BDA via the port labelled “D/L OUTPUT” (B in section 3.6.4.2.).

The Uplink 800MHz signal is received at the port labelled “U/L INPUT” (C in section 3.6.4.2.). The Uplink 800MHz path passes through a bandpass filter to remove out of band noise and then into the first of two amplification stages, the first stage is provided by a low noise amplifier which gives approx. 19dB of gain; after leaving the Low Noise Amplifier the signal passes through a switched attenuator providing 0 to 30 dB of RF signal attenuation,
After leaving the switched attenuator the Uplink 800MHz path passes through the second stage of amplification which is provided by a 5W power amplifier giving approx. 30db of gain; this second amplification stage is straddled by an Automatic Gain Control assembly providing limiting to the output signals in the case of high input signals.
After leaving the second amplification stage the Uplink 800MHz path passes through a second bandpass filter before exiting the BDA via the port labelled “U/L OUTPUT” (D in section 3.6.4.2.).

800MHz BDA UNIT (80-301405) is provided with a 24V DC input to power the amplifier modules within and those amplifier modules are configured to provide alarm status reports.

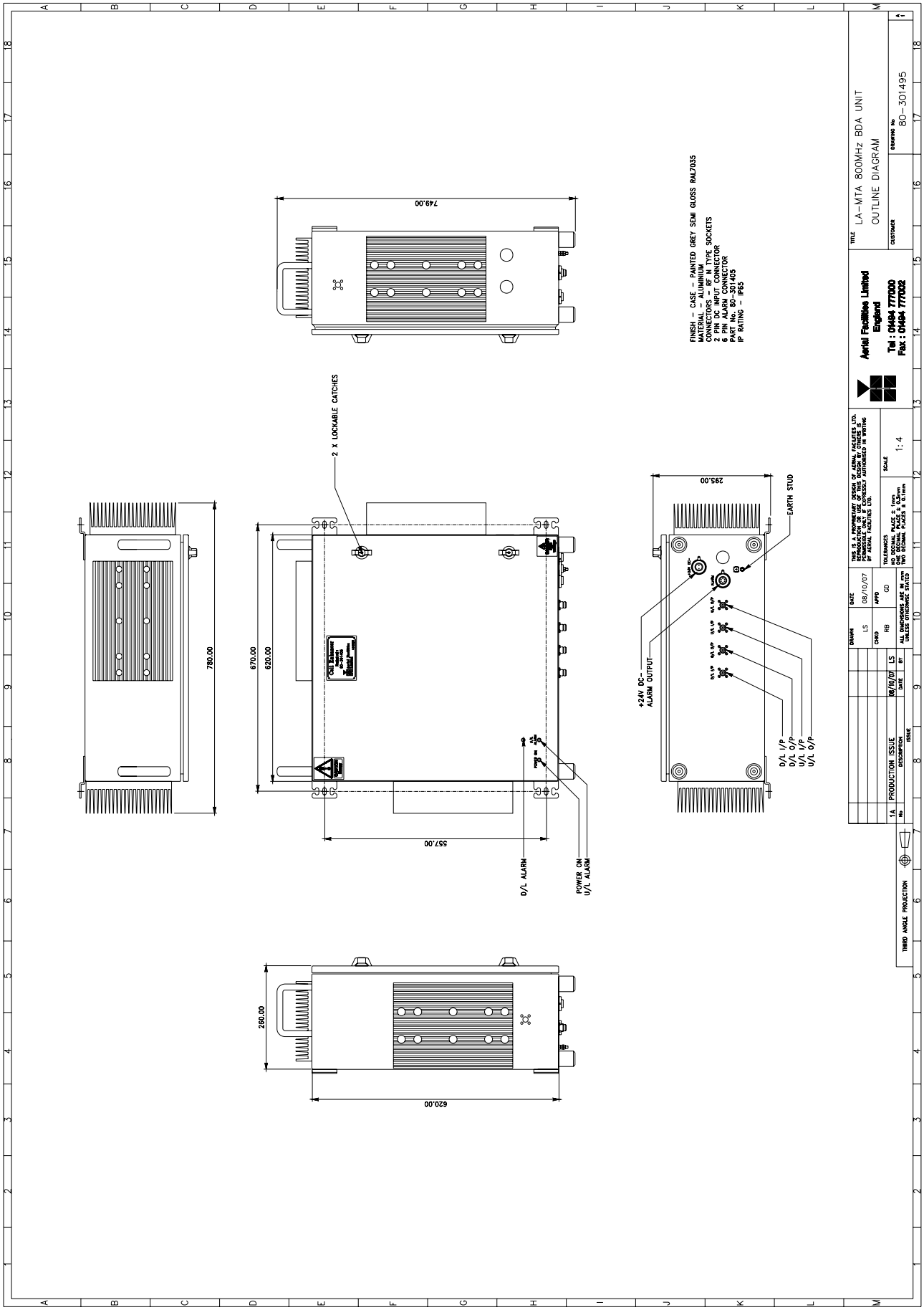
3.6.1. 800MHz BDA UNIT (80-301405) System Diagram

Drawing Number 80-301485



3.6.2. 800MHz BDA UNIT (80-301405) Outline Drawing

Drawing Number 80-301495



3.6.3. 800MHz BDA UNIT (80-301405) Specification

Parameter	Specification
Downlink	
Downlink Passband	856.0 to 861.0MHz
Maximun gain	30dB
Gain Adjustment	0 to 30dB in 2dB steps
1dB Compression Point (P1dB)	> +45.0dBm
ALC setting	1dB below P1dB
3rd Order Intercept point	> +55.0dBm
Uplink	
Uplink Passband	811.0 to 816.0MHz
Maximun gain	30dB
Gain Adjustment	0 to 30dB in 2dB steps
1dB Compression Point (P1dB)	> +36.0dBm
ALC setting	+27dBm
3rd Order Intercept point	> +46.0dBm
Noise Figure	< 5.0 dB
Environmental/Mechanical Specification	
Mechanical	IP65 Wall Mount
Dimensions (excludes handles and connectors)	620mm x 620mm x 250mm (24” x 24” x 10” approx)
RF Connectors	N-Type Female
Alarm Interfaces	Local Alarms to SCADA Dry Contact with LED Indication per band path
Power Supply	24V DC

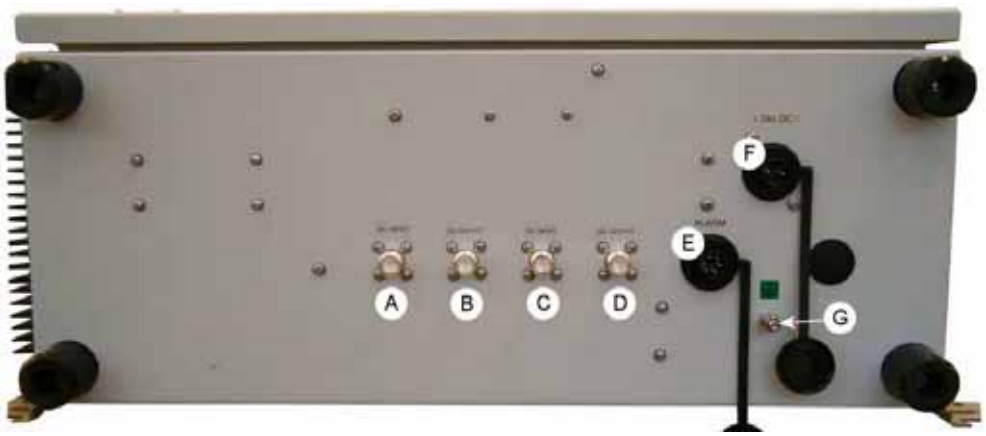
3.6.4. 800MHz BDA UNIT (80-301405) Photographs

3.6.4.1. Front View

Note: All connectors (RF, DC and Alarms) are on the underside

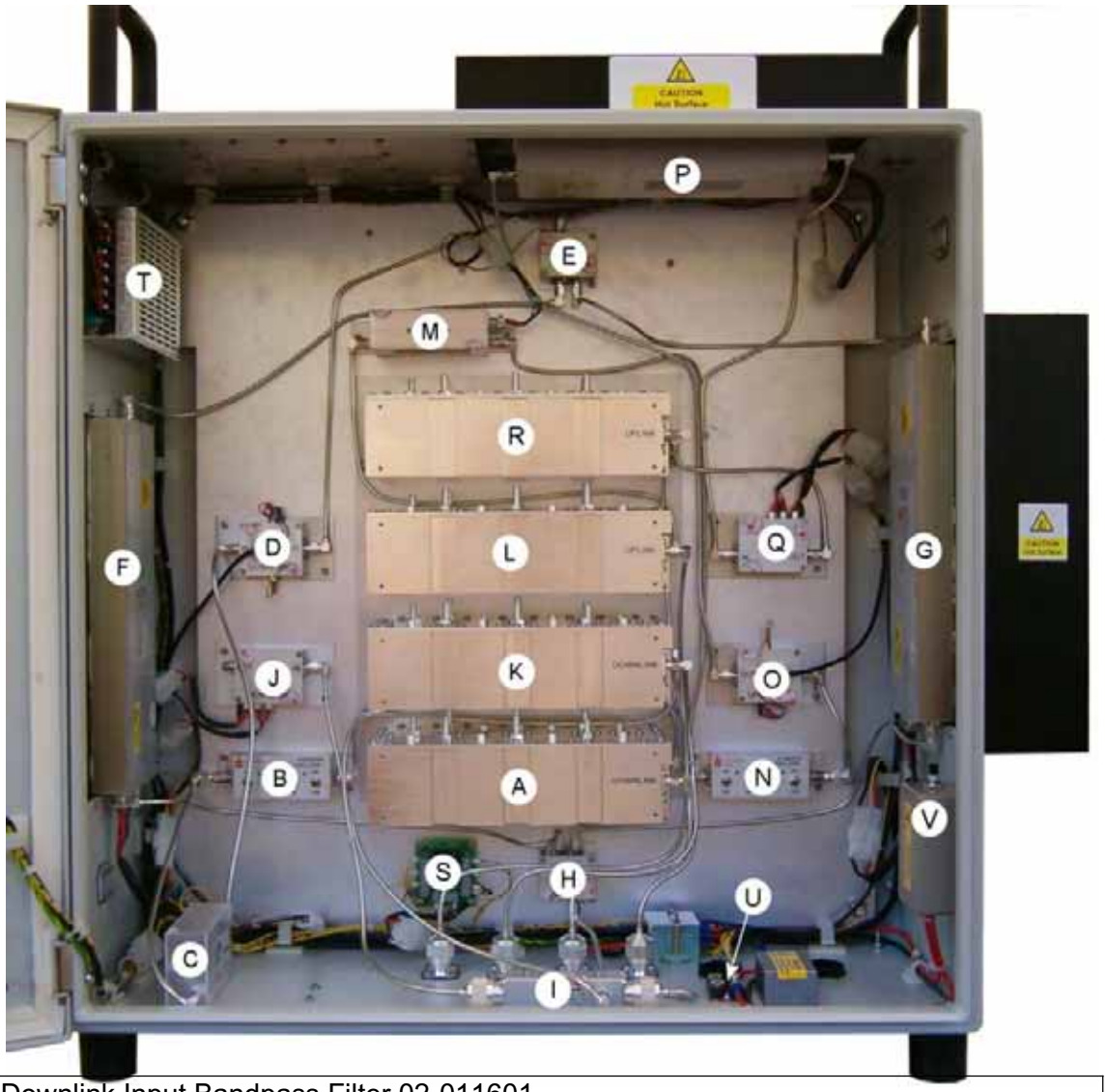
A	Green LED “Power On”
B	Red LED Uplink Alarm
C	Red LED Downlink Alarm
D	Lockable Door Handles

3.6.4.2. Underside view showing connectors



A	800MHz Downlink Input from port 5 on Combiner 80-301402
B	800MHz Downlink output to port E on Combiner 80-301402
C	800MHz Downlink Input from port J on Combiner 80-301402
D	800MHz Downlink output to port 10 on Combiner 80-301402
E	Alarm Output
F	24V DC Input
G	Earth Connection

3.6.4.3. Interior view



A	Downlink Input Bandpass Filter 02-011601
B	Downlink Switched Attenuator 10-000701
C	Downlink Low Noise Amplifier 11-005902
D	Downlink AGC Attenuator Assembly17-001201
E	Downlink Splitter/Combiner 05-002602 (splits signal to feed Power Amplifiers)
F	Downlink 20W Power Amplifier 12-020501 (1)
G	Downlink 20W Power Amplifier 12-020501 (2)
H	Downlink Splitter/Combiner 05-002602 (combines signals from Power Amplifiers)
I	Downlink 30dB Directional Coupler 07-002907
J	Downlink AGC Detector Assembly17-001105
K	Downlink Output Bandpass Filter 02-011601
L	Uplink Input Bandpass Filter 02-011601
M	Uplink Low Noise Amplifier 11-005902
N	Uplink Switched Attenuator 10-000701
O	Uplink AGC Attenuator Assembly17-001201
P	Uplink 5W Power Amplifier 12-018601
Q	Uplink AGC Detector Assembly17-001101
R	Uplink Output Bandpass Filter 02-011601
S	24V Relay Dual Assembly 20-001602
T	DC/DC Converter 96-200024
U	Dual Diode Assembly 94-100004
V	Main DC Circuit Breaker

3.6.5. 800MHz BDA UNIT (80-301405) Major Sub-components

section	Component Part	Component Part Description	Qty Per Assembly
3.6.5.1.	02-011601	Bandpass FIlter	4
3.6.5.2.	05-002602	Splitter/Combiner	2
3.6.5.3.	07-002907	30dB Directional Coupler	1
3.6.5.4.	10-000701	Switched Attenuator 0.25Watt, 0 - 30dB	2
3.6.5.5.	11-005902	Low Noise Amplifier	2
3.6.5.6.	12-018601	5W Power Amplifier	1
3.6.5.7.	12-020501	20W Power Amplifier	2
3.6.5.8.	17-001101	AGC Detector Assembly	1
	17-001105	AGC Detector Assembly (Logarithmic)	1
	17-001201	AGC Attenuator Assembly	2
3.6.5.9.	20-001602	24V Relay Dual Assembly	1
3.6.5.10.	94-100004	Dual Diode Assembly	1
3.6.5.11.	96-200024	DC/DC Converter, 24V in, 12V 5A out	1

3.6.5.1. Bandpass Filter (02-011601)

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.

02-011601 Specification

PARAMETER		SPECIFICATION
Frequency Range	Downlink	856 to 861MHz
	Uplink	811 to 816MHz
Bandwidth	Downlink	5 MHz
	Uplink	5 MHz
Number of Sections		8
Insertion Loss		1.2 dB
VSWR		better than 1.2:1
Connectors		SMA
Power Handling		100W max
Temperature range	operation	-10°C to +55°C
	storage	-40°C to +70°C
Weight		3 kg (typical)

3.6.5.2. Splitter/Combiner (05-002602)

The Splitter/Combiner used is a device for accurately matching two or more RF signals to single or multiple ports, whilst maintaining an accurate 50Ω load to all inputs/outputs and ensuring that the VSWR and insertion losses are kept to a minimum. Any unused ports should be terminated with an appropriate 50Ω load.
Being passive devices, the splitters should have an extremely long operational life and require no maintenance. Should a unit be suspect, it is usually most time efficient to replace the whole module rather than attempt repair or re-tuning.

05-002602 Specification

PARAMETER		SPECIFICATION
Frequency Range		800 – 1000MHz
Bandwidth		200MHz
Ports		3
Insertion loss		3.3dB typical
Return loss input & output		1.3:1
Impedance		50Ω
Isolation		>20dB
MTFB		>180,000 hours
Power rating	Splitting	20Watts
	Combining	0.5Watt
Connectors		SMA female
Weight		200g (approximately)
Size		54 x 44 x 21mm

3.6.5.3. 30dB Directional Coupler (07-002907)

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

07-002907 Specification

PARAMETER		SPECIFICATION
Frequency range		800 - 1000MHz
Insertion loss		<0.3dB
Coupling level		-30dB ±0.5dB
Rejection		N/A
Weight		<200g
Connectors		SMA, female
Temperature range	operation	-20°C to +60°C
	storage	-40°C to +70°C

3.6.5.4. Switched Attenuator 0.25Watt, 0 - 30dB (10-000701)

10-000701 provides attenuation from 0 to 30dB in 2 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.

10-000701 Specification

PARAMETER		SPECIFICATION
Attenuation Values		0-30dB
Attenuation Steps		2, 4, 8 and 16dB
Power Handling		0.25 Watt
Attenuation Accuracy		± 1.0 dB
Frequency Range		DC to 1GHz
Impedance		50Ω
Connectors		SMA
VSWR		1.3:1
Weight		0.2kg
Temperature range	operation	-20°C to +60°C
	storage	-40°C to +70°C

3.6.5.5. Low Noise Amplifier (11-005902)

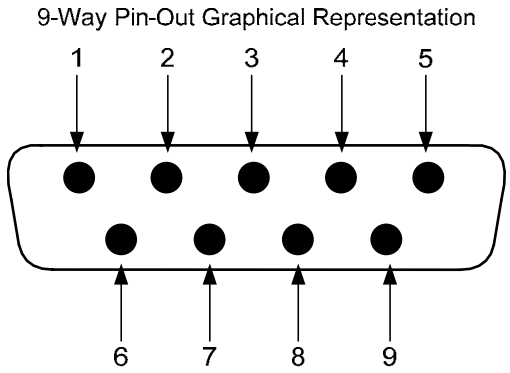
The Gallium-Arsenide low noise amplifier used in the unit is a double stage, solid-state low noise amplifier. Class A circuitry is used throughout the units to ensure excellent linearity and extremely low noise over a very wide dynamic range. The active devices are very moderately rated to provide a long trouble-free working life. There are no adjustments on these amplifiers, and in the unlikely event of a failure, then the complete amplifier should be replaced.
This amplifier features its own in-built alarm system which gives a volt-free relay contact type alarm that is easily integrated into any alarm system. There is a Current Fault Alarm Function, which indicates failure of each one or both RF transistors by a various alarm output options. The amplifier is housed in an aluminium case (Iridite NCP finish) with SMA connectors for the RF input/output and a 9way D-type for DC and alarm outputs.

11-005902 Specification

PARAMETER		**SPECIFICATION**
Frequency range		800 – 960MHz
Bandwidth		<170MHz
Gain		19.5dB (typical)
1dB compression point		+21dBm
OIP3		+33dBm
Input/output return loss		>20dB
Noise figure		1dB (typical)
Power consumption		190mA @ 24V DC
Supply voltage		10-24V DC
Connectors		SMA female
Temperature range	operational	-10°C to +60°C
	storage	-40°C to +70°C
Size		90 x 55 x 30.2mm
Weight		0.28kg

LNA ‘D’ Connector Pin-out details

Connector pin	Signal
1	+Ve input (10-24V)
2	GND
3	Alarm relay O/P bad
4	Alarm relay common
5	Alarm relay good
6	No connection
7	TTL voltage set
8	TTL alarm/0V (good)
9	O/C good/0V bad



3.6.5.6. 5W Power Amplifier (12-018601)

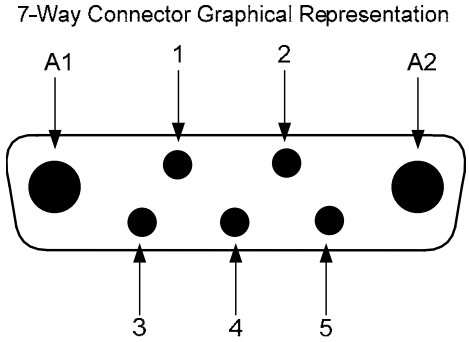
This amplifier is a Class A 5W power amplifier from 800MHz to 960MHz in a 1 stage balanced configuration. It demonstrates a very high linearity and a very good input/output return loss (RL). It has built in a Current Fault Alarm Function.
Its housing is an aluminium case (Iridite NCP finish) with SMA connectors for the RF input/output and a D-Type connector for the power supply and the Current Fault Alarm Function.

12-018601 Specification

PARAMETER		SPECIFICATION
Frequency range		800-960MHz
Small signal gain		30dB
Gain flatness		±0.5dB
I/O Return loss		>20dB
1dB compression point		+37dBm
OIP3		+52dBm
Supply voltage		12V DC
Supply current		2.0Amps (typical)
Temperature range	operational	-10°C to +60°C
	storage	-20°C to +70°C
Weight		<2kg (no heatsink)

PA 7-Way Connector Pin-outs

Connector Pin	Signal
A1 (large pin)	+12V DC
A2 (large pin)	GND
1	Alarm relay common
2	TTL alarm/0V good
3	Alarm relay contact (bad)
4	Alarm relay contact (good)
5	O/C good/0V bad (TTL)



3.6.5.7. 20W Power Amplifier (12-020501)

This amplifier is a Class A 20W power amplifier from 800-960MHz in a 1 stage balanced configuration. It demonstrates a very high linearity and a very good input/output return loss (RL). It has built in a Current Fault Alarm Function.
Its housing is an aluminium case (Iridite NCP finish) with SMA connectors for the RF input/output and a D-Type connector for the power supply and the Current Fault Alarm Function.

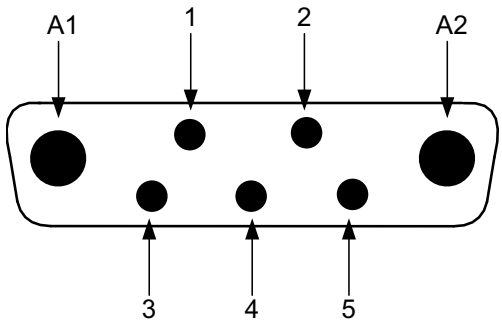
12-020501 Specification

PARAMETER		SPECIFICATION
Frequency range		800-960MHz
Small signal gain		31.5dB
Gain flatness		±0.6dB
I/O Return loss		>18dB
1dB compression point		+43.5dBm
OIP3		+54dBm
Supply voltage		24V DC
Supply current		4.6Amps @12V(typical)
Temperature range	operational	-10°C to +60°C
	storage	-20°C to +70°C
Weight		<2kg (no heatsink)

PA 7-Way Connector Pin-outs

Connector Pin	Signal
A1 (large pin)	+24V DC
A2 (large pin)	GND
1	Alarm relay common
2	TTL alarm/0V good
3	Alarm relay contact (bad)
4	Alarm relay contact (good)
5	O/C good/0V bad (TTL)

7-Way Connector Graphical Representation



3.6.5.8. Automatic Gain Control

17-001101 AGC Detector Assembly
17-001105 AGC Detector Assembly (Logarithmic)
17-001201 AGC Attenuator Assembly

800MHz BDA UNIT (80-301405) is fitted with two differing types of Automatic Gain Control (AGC) system, one linear, and one logarithmic. The Downlink path is fitted with logarithmic detector (17-001105), and attenuator (17-001201) the Uplink path is fitted with linear detector (17-001101) and attenuator (17-001201)

The Automatic Gain Control system consists of two units, a detector/amplifier and an attenuator. The detector/amplifier unit is inserted in the RF path on the output of the power amplifier, and the attenuator is situated in the RF path before the amplification stage(s)

The attenuator comprises a 50Ω P.I.N diode, voltage-variable attenuator with a range of 3 to 30dB. The attenuation is controlled by a DC voltage which is derived from the associated detector controller board.

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

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

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

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

For small signals, below AGC onset, the output control line will be close to 12V and the AGC attenuator will have minimum attenuation. As the signal level increases the control line voltage will fall, increasing the attenuator value and keeping the system output level at a constant value.

3.6.5.9. 24V Relay Dual Assembly (20-001602)

The General Purpose 24V Dual Relay Board (20-001602) 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. Its common use is to amalgamate all the alarm signals into one, volts-free relay contact pair for the main alarm system.

20-001602 Specification

PARAMETER		SPECIFICATION
Operating voltage		8 to 30V (floating earth)
Alarm Threshold		Vcc - 1.20 volt +15%
Alarm output relay contacts:		
Max. switch current		1.0Amp
Max. switch volts		120Vdc/60VA
Max. switch power		24W/60VA
Min. switch load		10.0µA/10.0mV
Relay isolation		1.5kV
Mechanical life		>2x10^7 operations
Relay approval		BT type 56
Connector details		Screw terminals
Temperature range	operational	-10°C to +60°C
	storage	-20°C to +70°C

3.6.5.10. Dual Diode Assembly (94-100004)

The purpose of these dual diode assemblies is to provide polarity protection for the DC voltage input. They are very heavy-duty diodes and they prevent any reverse current from flowing back to their source.

3.6.5.11. DC/DC Converter, 24V in, 12V 5A out (96-200024)

This unit it is an O.E.M high power device with a 5 amp @ 12V (60Watts) output capability used to derive a 12V fixed voltage power supply rail from a 24V supply. In the event of failure this unit should not be repaired, only replaced.

96-200024 Specification

PARAMETER		SPECIFICATION
Input Voltage range		18-28V DC
Output voltage		12V±0.5V
Max. current load		5.0 Amps
Temperature range	operation	-10°C to +60°C
	storage	-20°C to +70°C

4. In-Line BDA Rack Mount 80-301406

The Rack Mount In Line BDA consists of ten, 19” equipment rack mount shelves
The function is exactly the same as the Wall Mount unit in section 3 but the construction is different.

The Rack Mount BDA is divided into four main components equivalent to the four Wall Mount cases described in section 3, these are:

- The Splitter Combiner which is comprised of four, 4U 19” rack mount shelves:
  Downlink Input Shelf 80-301407
  Downlink Output Shelf 80-301408
  Uplink Input Shelf 80-301407
  Uplink Output Shelf 80-301407

- The VHF and UHF Low Band Amplifier which is comprised of two, 4U 19” rack mount shelves:
  VHF Amplifier Shelf 80-301409
  UHF Lowband Amplifier Shelf 80-301410

- The Mid and High Band UHF Amplifier which is comprised of two, 4U 19” rack mount shelves:
  UHF Midband Amplifier Shelf 80-301410
  UHF Highband Amplifier Shelf 80-301410

- The 800MHz Amplifier which is comprised of one, 8U 19” rack mount shelf:
  800MHz Amplifier Shelf 80-301411

A 2U 19” rack mount shelf houses the power supply unit that provides 24V DC feeds to the amplifier shelves

The entire arrangement is housed in two, 40U Swing-fame 19” Equipment Mountings Racks,

Rack 1 houses:
Downlink Input Shelf 80-301407
Uplink Input Shelf 80-301407
Uplink Output Shelf 80-301407
UHF Highband Amplifier Shelf 80-301410
UHF Midband Amplifier Shelf 80-301410
UHF Lowband Amplifier Shelf 80-301410
VHF Amplifier Shelf 80-301409
PSU Shelf

Rack 2 houses:
Downlink Output Shelf 80-301408
800MHz Amplifier Shelf 80-301411

Rack interconnections, test ports and connections to the Leaky Feeders are via patch panels in the tops of each rack

Downlink
The downlink signal is received from the radiating cable and enters the Downlink Input Shelf 80-301407 where by means of crossband splitter/couplers it is split into VHF, UHF and 800MHz paths, the UHF path is further split into Low, Middle and Highband paths.

The VHF and UHF LowBand paths leave Downlink Input Shelf 80-301407. The VHF path goes to the Downlink Input of VHF Amplifier Shelf 80-301409 and the UHF Lowband path goes to the Downlink Input of UHF Lowband Amplifier Shelf 80-301410.

The UHF Mid and Highband paths leave Downlink Input Shelf 80-301407 the UHF Midband path goes to the Downlink Input of UHF Midband Amplifier Shelf 80-301410; the UHF Highband path goes to the Downlink Input of UHF Highband Amplifier Shelf 80-301410

The 800MHz path leaves Downlink Input Shelf 80-301407 and goes to the Downlink Input of 800MHz Amplifier Shelf 80-301411

After their respective amplification stages the signal paths enter Downlink Output Shelf 80-301408 where they are combined into a single path and fed into the radiating cable.

Uplink
The Uplink signal signal is received from the radiating cable and enters Uplink Input Shelf 80-301407 where by means of crossband splitter/couplers it is split into VHF, UHF and 800MHz paths, the UHF path is further split into Low, Middle and High band paths.

The VHF and UHF LowBand paths leave Uplink Input Shelf 80-301407. The VHF path goes to the Uplink Input of VHF Amplifier Shelf 80-301409 and the UHF Lowband path goes to the Uplink Input of UHF Lowband Amplifier Shelf 80-301410.

The UHF Mid and Highband paths leave Uplink Input Shelf 80-301407 the UHF Midband path goes to the Uplink Input of UHF Midband Amplifier Shelf 80-301410; the UHF Highband path goes to the Uplink Input of UHF Highband Amplifier Shelf 80-301410

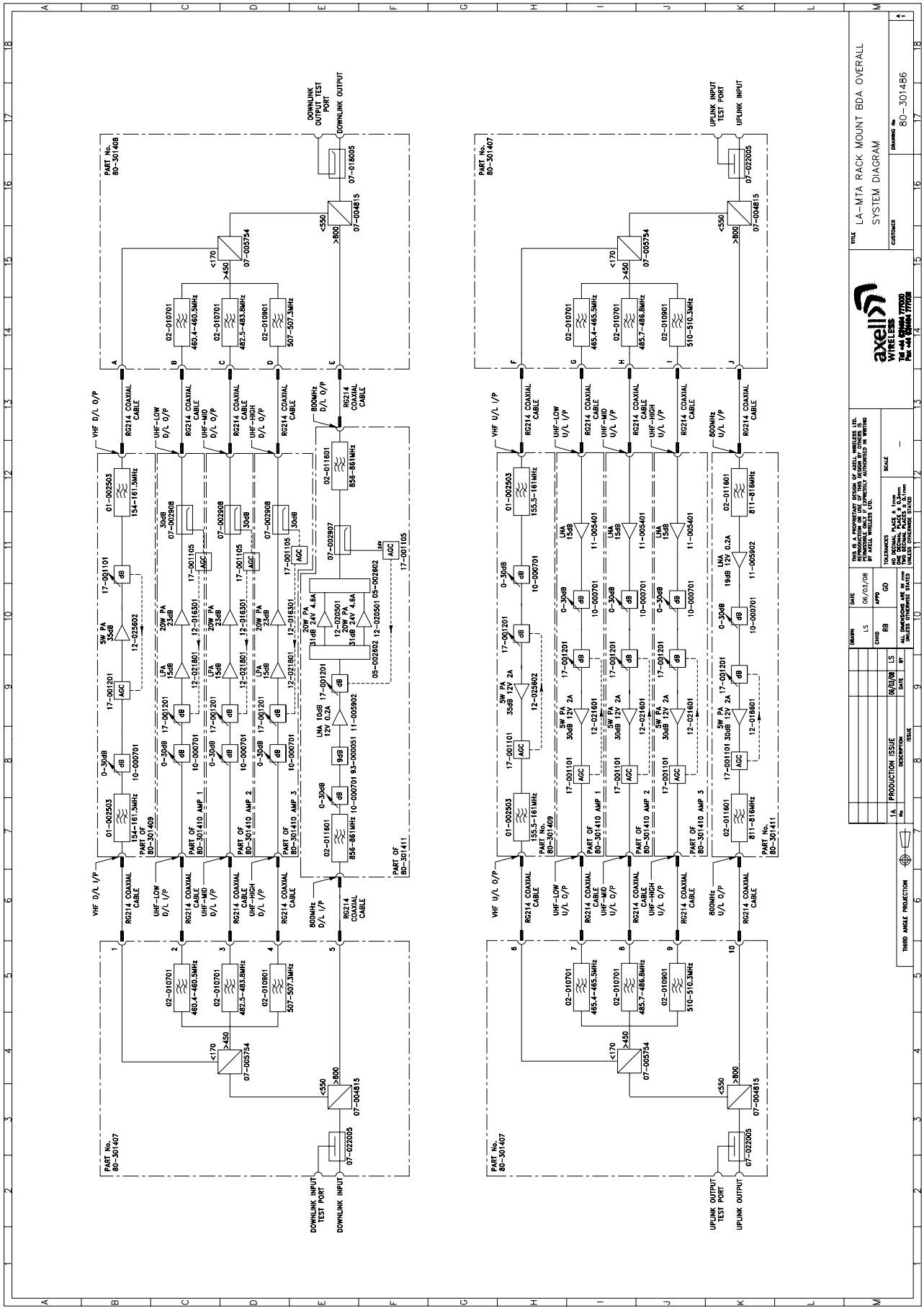
The 800MHz path leaves Uplink Input Shelf 80-301407 and goes to the Uplinklink Input of 800MHz Amplifier Shelf 80-301411

After their respective amplification stages the signal paths enter Uplink Output Shelf 80-301407 where they are combined into a single path and fed into the radiating cable.

4.1. In-Line BDA Rack Mount System Diagrams

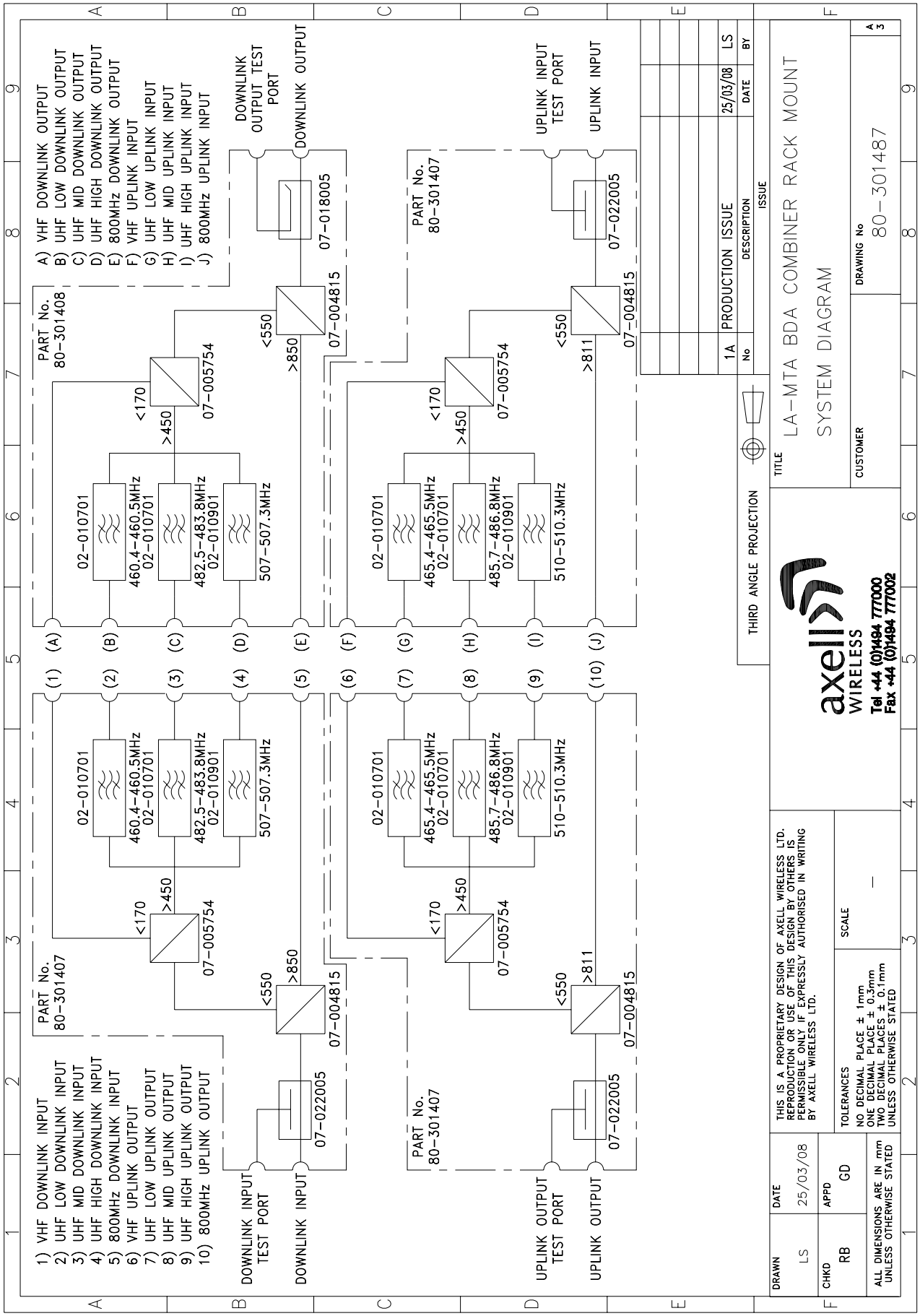
4.1.1. Overall System Diagram

Drawing Number 80-301486



4.1.2. Combiners System Diagram

Drawing Number 80-301487



4.2. In-Line BDA Rack Mount 80-301406 Specification

ELECTRICAL SPECIFICATION			
Frequency Range	VHF	Downlink	154.0 to 161.5 MHz
		Uplink	155.5 to 161.0 MHz
	UHF Low	Downlink	460.4 to 460.5 MHz
		Uplink	465.4 to 465.5 MHz
	UHF Mid	Downlink	482.5 to 483.8 MHz
		Uplink	485.7 to 486.8 MHz
	UHF High	Downlink	507.0 to 507.3 MHz
		Uplink	510.0 to 510.3 MHz
	800MHz	Downlink	856.0 to 861.0 MHz
		Uplink	811.0 to 816.0 MHz
Passband Ripple			± 1.5dB
Downlink Power Amplifier		VHF	5 Watts
		UHF Low	20 Watts
		UHF Mid	20 Watts
		UHF High	20 Watts
		800MHz	40 Watts
Uplink Power Amplifier		VHF	5 Watts
		UHF Low	5 Watts
		UHF Mid	5 Watts
		UHF High	5 Watts
		800MHz	5 Watts
Gain			30dB
Gain Adjust			0 - 30dB in 2dB Steps
Sampling Ports			30dB
VSWR			1.5:1
Impedance			50 Ohms
Power Supply			24V DC
Power Consumption			< 800 Watts
Mechanical Specification			
Mechanical			Two 40U, 19” Swingframe, 600mm x 600mm Equipment Mounting racks
RF Connectors			N-Type Female
Alarm Interfaces			Local Alarms to SCADA Dry Contact with LED Indication per band path