



Fiber Optic, Uplink, Band Selective,
VHF Booster Amplifier
User Handbook

For
GETS Global Signalling L.L.C.

AWL Works Order Q122997
AWL Product Part No. 60-274901

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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 page. 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.

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.

Unless specified otherwise, 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.

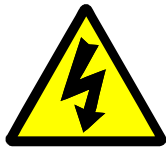
2. Safety Considerations

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 compromise 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 Equipment above ground e.g. on a mast or pole and manual handling precautions relevant to items of the weight of the equipment being worked on must be observed at all times when handling, installing or dismantling this equipment.

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 Operations Support 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 fiber ends or connector faces or point them at other people, Use only approved filtered or attenuating viewing aids.

Any single or multiple fiber 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 fibers 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 fiber jumper cable minimum bend radius is 3cm; bending to a smaller radius may result in optical cable breakage and excessive transmission losses.

Caution: The FO units are NOT weather proof.

2.7. Emergency Contact Numbers



The Axell Wireless Network Services Support Desk can be contacted on:

Telephone +44 (0)1494 777747

Fax. +44 (0)1494 777002

e-mail support@axellwireless.com

3. Equipment Overview

Fiber Optic, Uplink, Band Selective, VHF Booster Amplifier Part Number 60-274901 is built into an 8U, 19" rack mount shelf. The amplifier is used to filter and amplify the signal levels of one VHF band, 155.5MHz to 161.0MHz; in the Uplink direction only.

The Uplink Optical signal is received from Fiber Optic Transmitter Part Number 60-275101 via Fiber Optic cable at the FC/APC port labelled "F/O" (annotated "A" in 3.4.); the optical Uplink signal then enters Fiber Optic RX Module 20-005501 which demodulates the Optical signal to RF.

The RF signal then passes through a Bandpass Filter 01-001749 tuned to pass the Uplink band and to reject out-of-band noise; after leaving the Bandpass filter the Uplink signal passes through the Variable Switched Attenuator 10-000701 which can introduce up to 30dB of signal attenuation if required. The attenuator is controlled by a set of four toggle switches (annotated "E" in section 3.5.) on the front panel of the Amplifier shelf; each switch is clearly marked with the attenuation it provides, and the total attenuation in-line is the sum of the values switched in.

After leaving the switched attenuator the Uplink signal passes first through the AGC Attenuator Module 17-016401 (which is controlled by AGC Detector Module 17-019801 fitted further on in the RF path) and then through a Low Noise Amplifier 11-008901 which provides 28dB of gain.

The Low Noise Amplifier is followed by a 20W Power Amplifier 12-028501 which provides 36dB of gain and then the Uplink signal passes through the AGC Detector Module 17-019801 which regulates the gain level by adjusting AGC Attenuator Module 17-016401.

The AGC Detector Module 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 AGC Attenuator Module to limit the RF output to the (factory set) threshold. Therefore overloading of the power amplifier is avoided.

After passing through the AGC Detector Module the Uplink path passes through a second Bandpass Filter 01-001749 to further reject out-of-band noise and then through VSWR Monitor 21-003207.

Upon leaving the VSWR Monitor the Uplink signal exits the Amplifier shelf for the Uplink Antenna System via the N type port labelled "RF Base" (annotated "F" in section 3.5.).

The Amplifier is powered from mains AC at 110V which drives an internal 400W PSU module providing 24V DC for the power amplifier; a DC/DC converter provides 12V DC for the remaining active modules.

The Amplifier has an alarm system; both of the amplifier modules, the PSU, DC/DC converter, the F/O RX and the VSWR Monitor modules carry their own voltage-free, dry contact alarm relay outputs which are summed at the 15 way "D" alarm output connector on the rear of the case (annotated "L" in section 3.5.).

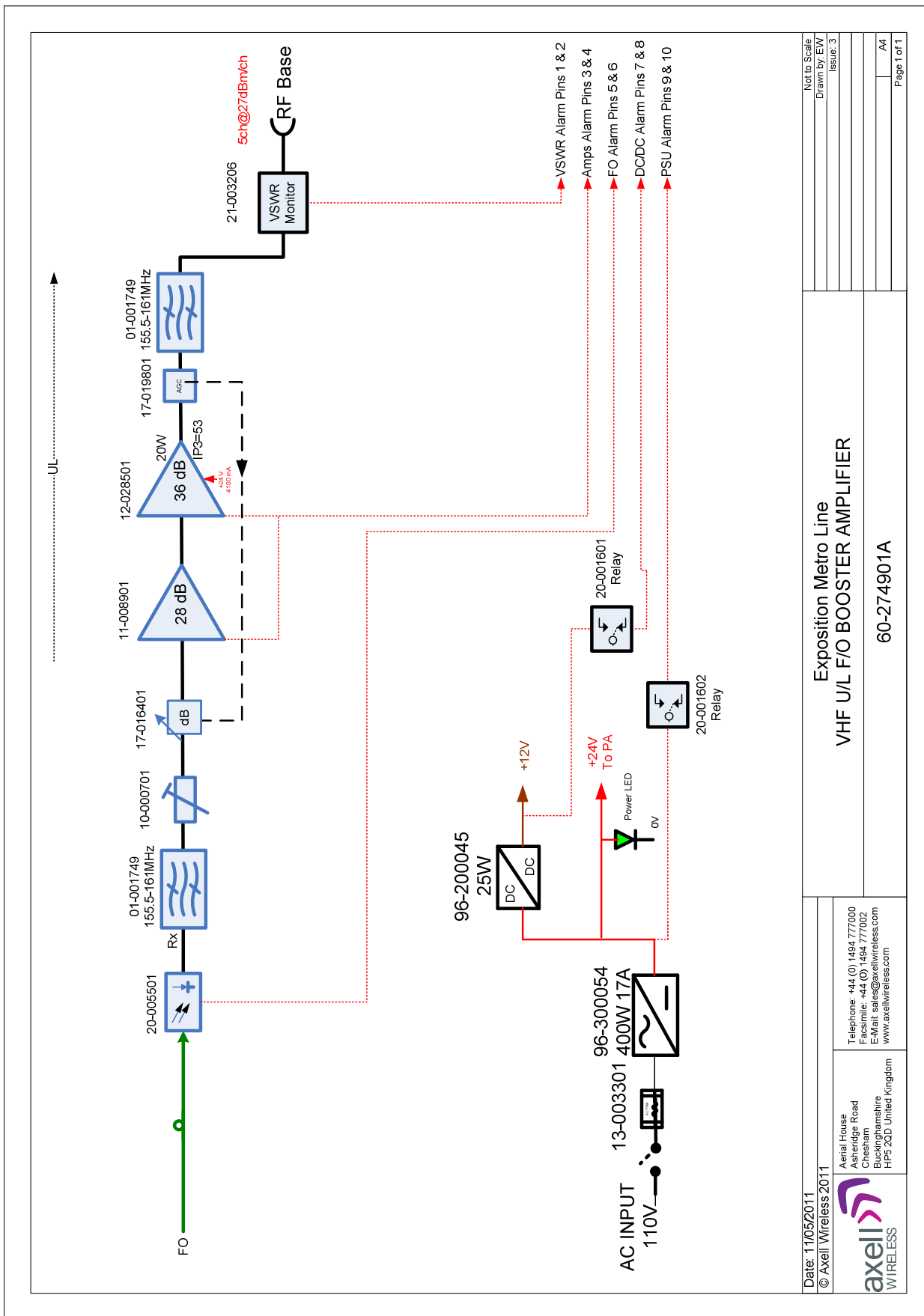
3.1. List of Major Sub-Components

Component Part	Part Description	Qty Per Assembly
01-001749	Bandpass Filter	2
10-000701	Variable Switched Attenuator 0-30dB	1
11-008901	Low Noise Amplifier 28dB	1
12-028501	20W Power Amplifier 36dB	1
13-003301	Mains Filter Assembly	1
17-016401	AGC Attenuator Module	1
17-019801	AGC Detector Module	1
20-001601	12V Dual Relay Assembly	3
20-001602	24V Dual Relay Assembly	1
20-005501	Fiber Optic RX Module	1
21-003207	VSWR Monitor	1
96-200045	DC/DC Converter 24V in/12V out	1
96-300054	400W PSU Module	1
91-520003	Switchd/Fused Mains Inlet	1

3.2. Specification

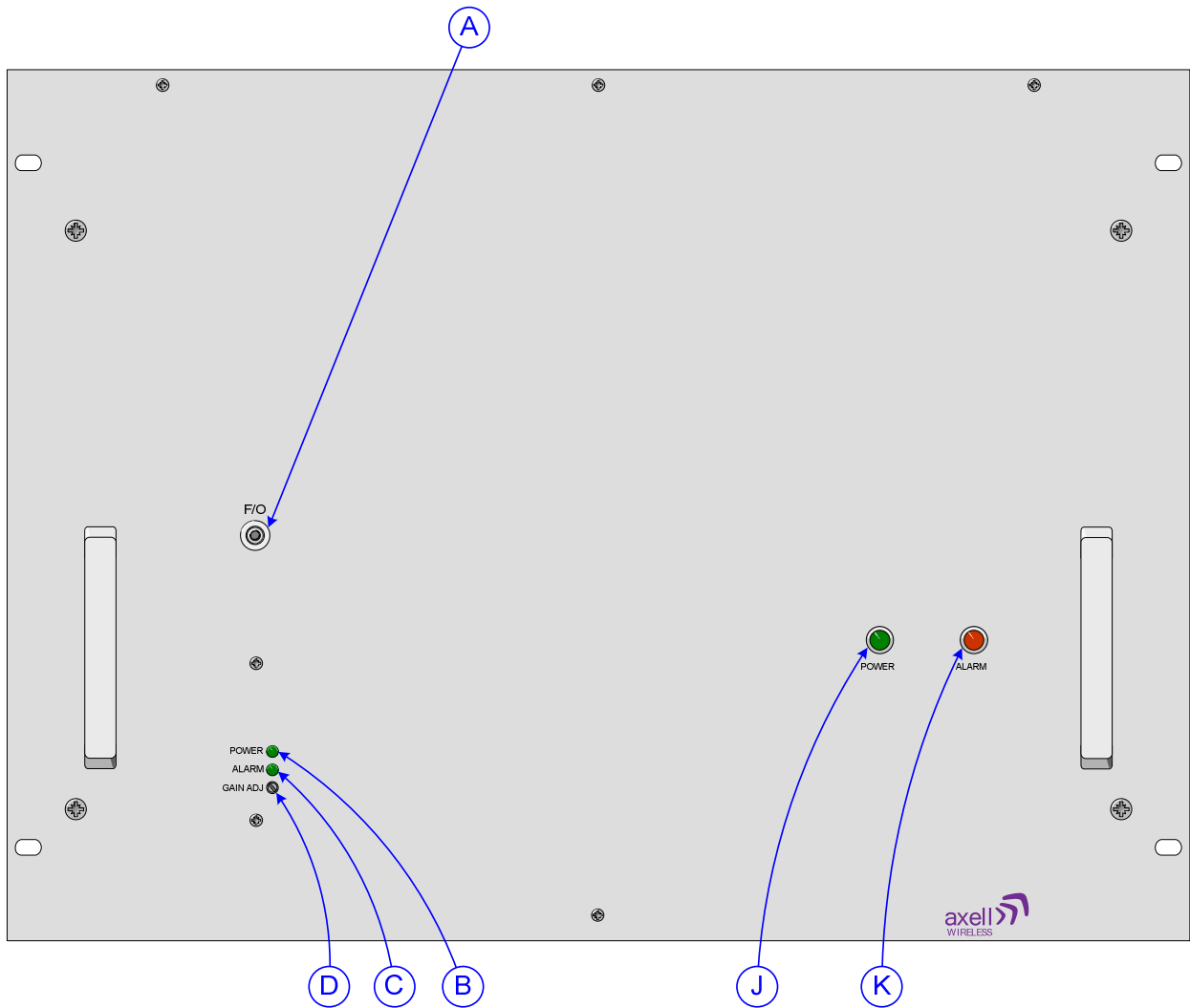
Electrical	
Uplink Frequency Range	155.5MHz to 161.0MHz
Bandwidth	5.5 MHz Typical
Passband Ripple	± 1.5dB
Uplink Power Amplifier	20W
Uplink PA IP3	+53 dBm
Uplink Output Power	+27 dBm/carrier
No. of F/O ports	1 FC/APC
Gain	30-60 dB
Gain Adjust	0-30dB in 1dB Steps
VSWR	1.5:1
Impedance	50 Ohms
Uplink Noise Figure	< 6dB (at maximum gain)
AGC	30dB Dynamic Range
Power Supply	220VAC or 110VAC
Power Consumption	< 300 Watts
Environmental/Mechanical	
Operating Temperature	-25 °C to 55 °C
Storage Temperature	-30 °C to 70 °C
Cooling	Convection
Humidity	95% RHNC
Mechanical	19" rack, 8U
Dimensions	W483mm x D400mm x H360mm
Weight	< 25kg
RF Connectors	N-Type Female
Battery Back Up	N/A
Alarm Interfaces	Local

3.3. Circuit Schematic



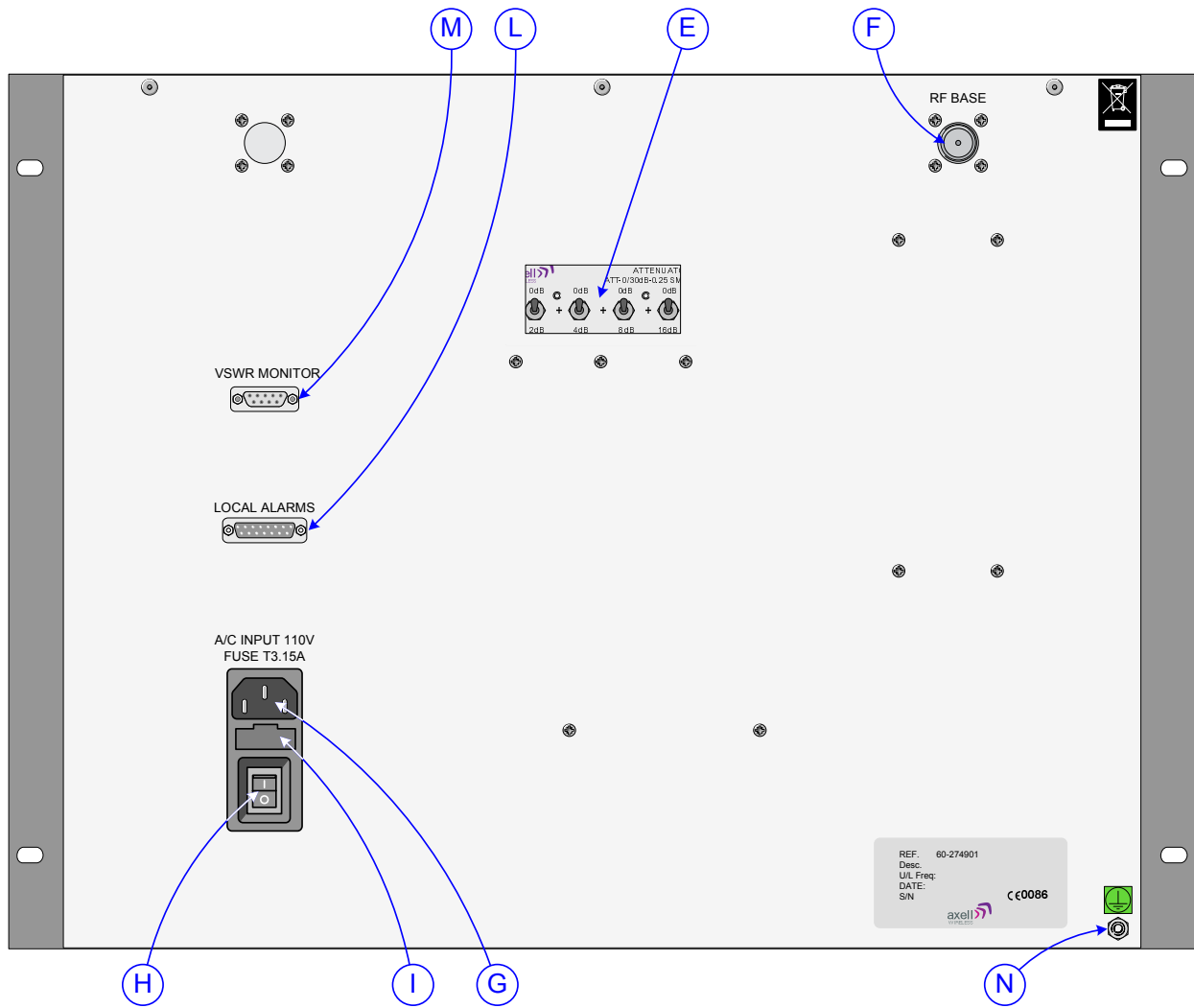
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© Axell Wireless 2011		Drawn by: EW	
		Issue: 3	
Aerial House Asheridge Road Chesham Buckinghamshire HP5 2AD United Kingdom		Exposition Metro Line VHF U/L F/O BOOSTER AMPLIFIER	
Telephone: +44 (0) 1494 777000 Facsimile: +44 (0) 1494 777002 E-Mail: sales@axellwireless.com www.axellwireless.com		60-274901A	
axell WIRELESS		Page 1 of 1	

3.4. Case Front View



A	FC/APC Optical connector "F/O", VHF Optical Uplink input from F/O Transmitter, 60-275101
B	Green LED "POWER", Fiber Optic RX Power On indicator, illuminated during normal operation
C	Green LED "ALARM", Fiber Optic RX Alarm indicator, extinguished during alarm state
D	Fiber Optic RX RF gain adjustment
J	Green LED "POWER", illuminated during normal operation
K	Red LED "ALARM", illuminated during alarm condition

3.5. Case Rear View

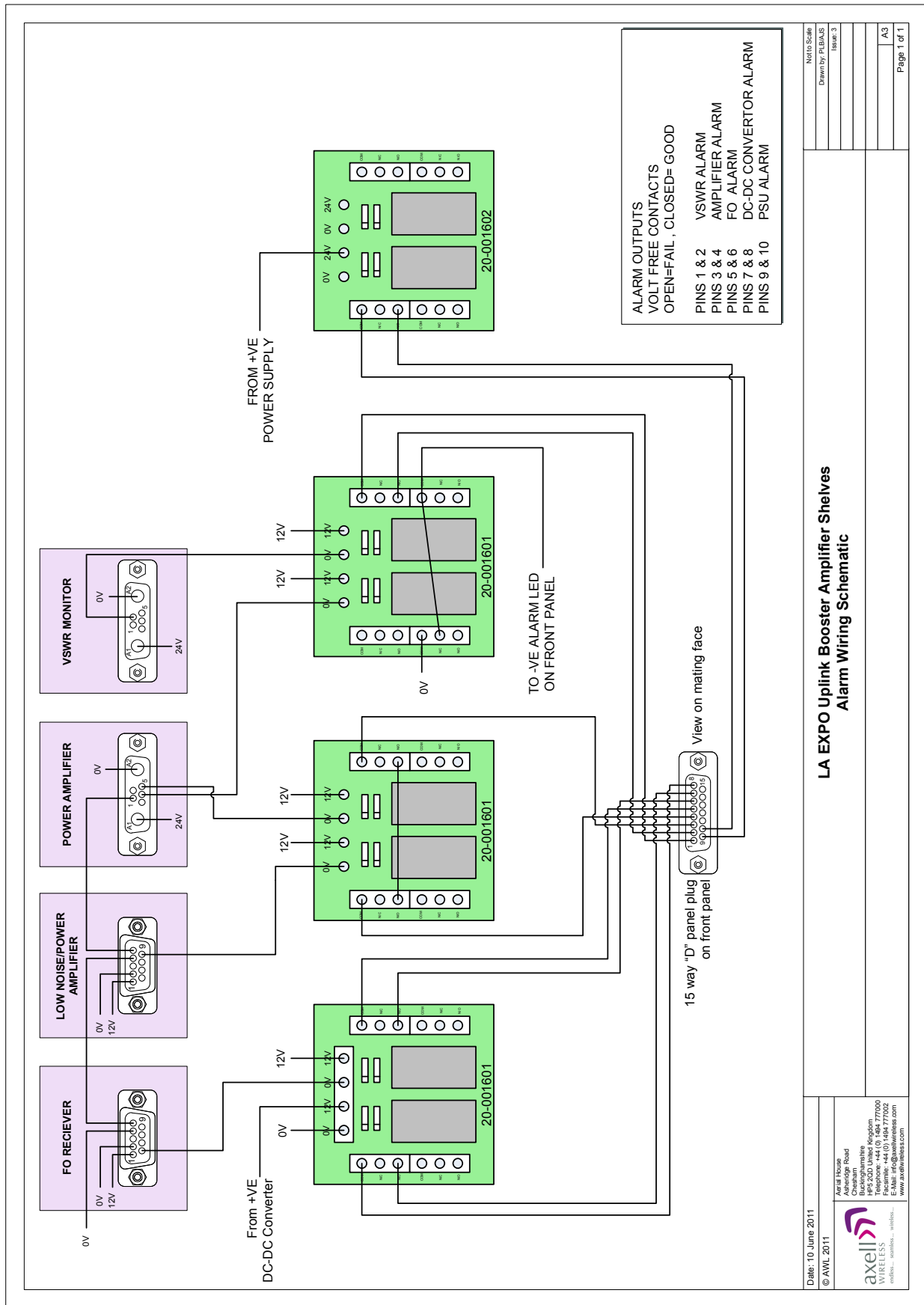


E	Variable Switched Attenuator 0-30dB, 10-000701
F	N type port "RF BASE", VHF RF U/L O/P to U/L antenna system
G	AC Input, 110V
H	AC Input on/off switch
I	Location of fuse for AC input
L	15 Way "D" panel plug "LOCAL ALARMS", volt free, dry contact alarm output. ⁽¹⁾
M	9 Way "D" panel socket "VSWR MONITOR", RS232 port for VSWR Monitor configuration ⁽²⁾
N	Earthing connection

⁽¹⁾ See section 3.6. below

⁽²⁾ Not user configurable

3.6. Local Alarm Output Schematic



Appendix A

A.1. Glossary of Terms used in this document

Repeater or Cell Enhancer	A Radio Frequency (RF) amplifier which can simultaneously amplify and re-broadcast Mobile Station (MS) and Base Transceiver Station (BTS) signals.
Band Selective Repeater	A Repeater designed for operation on a range of channels within a specified frequency band.
Channel Selective Repeater	A Repeater, designed for operation on specified channel(s) within a specified frequency band. Channel frequencies may be factory set or on-site programmable.
AC	Alternating Current
AGC	Automatic Gain Control
BBU	Battery Backup Unit
BDA	Bi-directional Amplifier
BTS	Base Transceiver Station (Base Station)
B/W	Bandwidth
CEMS	Coverage Enhancement Management System
C/NR	Carrier-to-Noise Ratio
Critical Harness	A coaxial cable harness with components of a critical length used to minimise phase discrepancies when joining signal paths of differing frequencies.
DAS	Distributed Antenna System
DC	Direct Current
Downlink (D/L)	Signals transmitted from the BTS to the Mobiles
DSP	Digital Signal Processing
F/O	Fiber Optic
GND	Ground
ID	Identification (Number)
I/P	Input
LCX	Leaky Coaxial Cable (Leaky Feeder).
LED	Light Emitting Diode
LNA	Low Noise Amplifier
LPA	Low Power Amplifier
Mobile(s)	Hand-portable or other "Mobile" RF Transceiver equipment
MOU	Master Optical Unit
MTBF	Mean Time Between Failures
N/A	Not Applicable
N/C (of Relays)	Normally Closed
N/O (of Relays)	Normally Open
OFR	On Frequency Repeater
OIP3	Output Third Order Intercept Point
O/P	Output
P1dB	1dB Compression Point
PA	Power Amplifier
RF	Radio Frequency
RHNC	Relative Humidity, Non Condensing
RSA	Receiver/Splitter Amplifier
RX	Receiver (Received)
SDR	Software-Defined Radio
S/N	Serial Number
TX	Transmitter (Transmitted)
Uplink (U/L)	Signals transmitted from the Mobiles to the BTS
UPS	Uninterruptible Power Supply
VSWR	Voltage Standing Wave Ratio
WDM	Wave division multiplex
Date Format	Date Format used in this document is dd/mm/yyyy

A.2. Key to Drawing Symbols used in this document

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<p>HUBS</p> <p>FIBRE MAIN HUB FMH</p> <p>EXPANSION HUB EH</p> <p>TAPPER/COUPLER E</p>		<p>COUPLERS</p> <p>10dB COUPLER C10</p> <p>6 dB DIRECTIONAL COUPLER C6</p> <p>10dB DIRECTIONAL COUPLER C10</p> <p>6dB DIRECTIONAL COUPLER C6</p> <p>DIRECTIONAL COUPLER C10</p> <p>CROSS BAND COUPLER C10</p>		<p>CABLES</p> <p>8/FIBRE OPTIC CABLE/LINK</p> <p>24/FIBRE OPTIC CABLE/LINK</p> <p>JUMPER CABLE 1/2"</p> <p>RADIATING CABLE</p> <p>CAT 5 CABLE</p> <p>CO-AX. CABLE 1/2" DIA</p> <p>CO-AX. CABLE 7/8" DIA</p>		<p>SPLITTERS</p> <p>HYBRID SPLITTER</p> <p>SPPLITTER</p>		<p>ANTENNAS</p> <p>OMNI ANTENNA</p> <p>YAGI ANTENNA</p> <p>FLAT PLATE ANTENNA (MOUNTED AT HIGH LEVEL)</p> <p>DIRECTIONAL ANTENNA</p> <p>ANTENNA</p> <p>REMOTE ANTENNA UNIT</p> <p>PANEL ANTENNA</p> <p>BLADE ANTENNA</p>		<p>MISC</p> <p>BASE TRANSCIVER STATION</p> <p>CHANNEL MODULE</p> <p>FIBRE-OPTIC MODULATOR</p> <p>FIBRE-OPTIC DEMODULATOR</p> <p>PLUG & SOCKET</p> <p>SOCKET</p> <p>PLUG</p> <p>FIBRE OPTIC CONNECTOR FC/APC</p>		<p>MISC</p> <p>BAND PASS FILTER</p> <p>CAVITY RESONATOR</p> <p>NOTCH FILTER</p> <p>ISOLATOR</p> <p>HYBRID COMBINER</p> <p>EARTH STUD</p> <p>LEEKEY FEEDER</p> <p>R.S.A</p> <p>Outputs to receivers</p>		<p>MISC</p> <p>AMPLIFIER</p> <p>ATTENUATOR (VARIABLE)</p> <p>ATTENUATOR (FIXED)</p> <p>A.G.C</p> <p>MONITORING CONTROLLER</p> <p>MODEM</p> <p>BI-DIRECTIONAL AMPLIFIER (CELL ENHANCER)</p> <p>DUMMY LOAD</p> <p>LOCAL OSCILLATOR</p>		<p>MISC</p> <p>AC TO DC PSU</p> <p>DC TO DC CONVERTER</p> <p>FUSE</p> <p>N.O. (CLEAR CONTACT)</p> <p>RELAY</p> <p>N.C. (FILLED CONTACT)</p>		<p>SIGNAL KEY</p> <p>• = READING POSITION</p> <p>602 = BCCH (BROADCAST CONTROL CHANNEL)</p> <p>22 = BASIC (BASIC SITE IDENTITY CODE)</p> <p>-82 = ACCEPTABLE SIGNAL LEVEL (dBm)</p> <p>-83 = BELOW ACCEPTABLE SIGNAL LEVEL (dBm)</p> <p>-72 = ACCEPTABLE SIGNAL LEVEL (dBm)</p> <p>-73 = BELOW ACCEPTABLE SIGNAL LEVEL (dBm)</p>		<p>REVISIONS</p> <table border="1"> <tr> <th>No</th> <th>DESCRIPTION</th> <th>DATE</th> <th>BY</th> </tr> <tr> <td>2C</td> <td>BORDER & TITLE UPDATED</td> <td>30/08/04</td> <td>LS</td> </tr> <tr> <td>2B</td> <td>TEXT CORRECTION</td> <td>26/07/04</td> <td>PL</td> </tr> <tr> <td>2A</td> <td>ECN3165</td> <td>26/01/04</td> <td>PL</td> </tr> <tr> <td>1A</td> <td>BLADE ANTENNA ADDED</td> <td>21/06/00</td> <td>PL</td> </tr> <tr> <td>AA</td> <td>ORIGINAL ISSUE</td> <td>23/05/00</td> <td>PL</td> </tr> </table>		No	DESCRIPTION	DATE	BY	2C	BORDER & TITLE UPDATED	30/08/04	LS	2B	TEXT CORRECTION	26/07/04	PL	2A	ECN3165	26/01/04	PL	1A	BLADE ANTENNA ADDED	21/06/00	PL	AA	ORIGINAL ISSUE	23/05/00	PL	<p>ISSUE</p> <table border="1"> <tr> <th>No</th> <th>DESCRIPTION</th> <th>DATE</th> <th>BY</th> </tr> <tr> <td>2C</td> <td>BORDER & TITLE UPDATED</td> <td>30/08/04</td> <td>LS</td> </tr> <tr> <td>2B</td> <td>TEXT CORRECTION</td> <td>26/07/04</td> <td>PL</td> </tr> <tr> <td>2A</td> <td>ECN3165</td> <td>26/01/04</td> <td>PL</td> </tr> <tr> <td>1A</td> <td>BLADE ANTENNA ADDED</td> <td>21/06/00</td> <td>PL</td> </tr> <tr> <td>AA</td> <td>ORIGINAL ISSUE</td> <td>23/05/00</td> <td>PL</td> </tr> </table>		No	DESCRIPTION	DATE	BY	2C	BORDER & TITLE UPDATED	30/08/04	LS	2B	TEXT CORRECTION	26/07/04	PL	2A	ECN3165	26/01/04	PL	1A	BLADE ANTENNA ADDED	21/06/00	PL	AA	ORIGINAL ISSUE	23/05/00	PL
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A.4. Waste Electrical and Electronic Equipment (WEEE) Notice



The Waste Electrical and Electronic Equipment (WEEE) Directive became law in most EU countries during 2005. The directive applies to the disposal of waste electrical and electronic equipment within the member states of the European Union.

As part of the legislation, electrical and electronic equipment will feature the crossed out wheeled bin symbol (see image at left) on the product or in the documentation to show that these products must be disposed of in accordance with the WEEE Directive.

In the European Union, this label indicates that this product should not be disposed of with domestic or "ordinary" waste. It should be deposited at an appropriate facility to enable recovery and recycling.

A.5. Document Amendment Record

Issue No.	Date	Incorporated by	Section Amended	Reason for new issue
1	07/06/2011	AJS		Draft
2	13/06/2011	AJS		Issue