Lincoln/Holland Upgrade Equipment

User/Maintenance Handbook

For

Concourse Communications Group

AWL Works Order Q116786

AWL Product Part Nos.

Tri-Band Cable Signal Combiner	60-214702
Fibre Fed Remote Repeater	60-214701
Redundant PSU + Battery Backup	60-214703

Aerial Facilities Limited AVITEC

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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 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 Operations Support Director (see section 2.7.).
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 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 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 Operations Support Department can be contacted on:

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

3. Tri-Band Cable Signal Combiner 60-214702

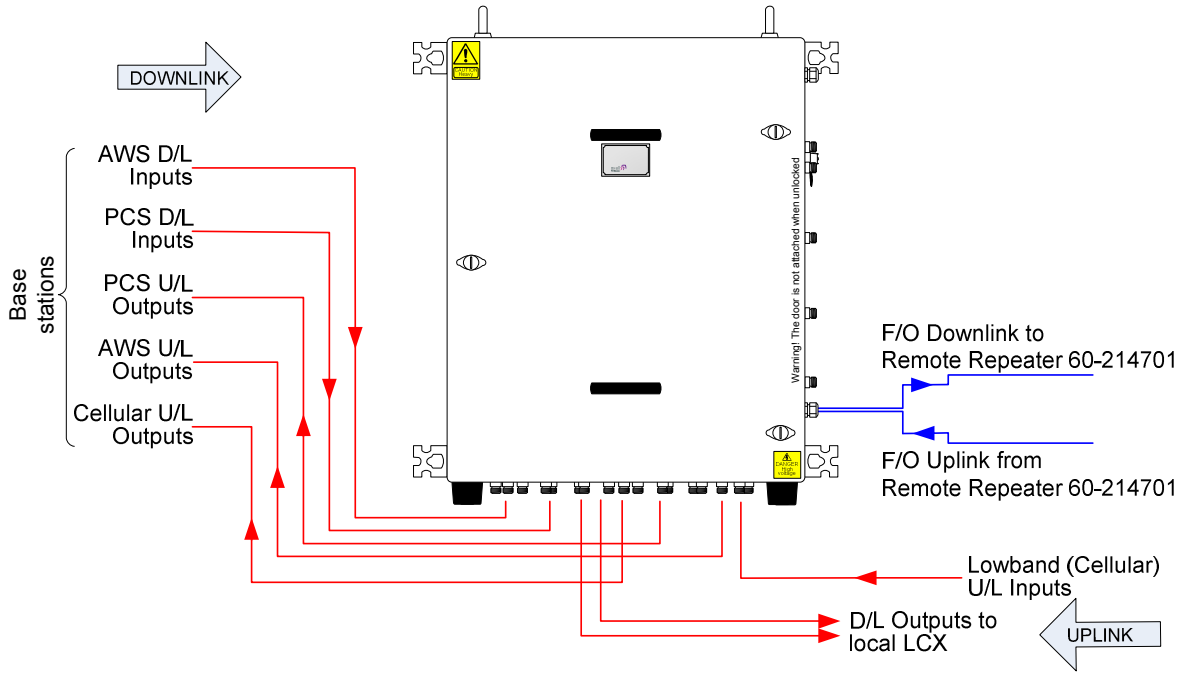
Tri-Band Combiner 60-214702 is built into a wall-mounted, environmentally protected (IP65) aluminium alloy case; RF ports and connectors are also IP65 standard making the entire enclosure and connecting ports weatherproof. The door is fitted with three locking door handles which also serve to locate the door onto the case. Caution, the door is not attached to the case when the locking door handles are opened.

The Combiner has connections for various RF inputs and outputs across three bands; AWS, PCN and Cellular.

AWS and PCN Downlink signals are received from the operators' base stations, filtered and combined into a single path and then passed to local LCX antannas, a portion of the Downlink signal is tapped off and fed to a fibre optic transmitter which modulates the RF signal onto a laser for transmission to the Remote Repeater 60-214701 as optical signals over fibre optic cable.

AWS and PCN Uplink signals are received from the local LCX antannas, filtered and amplified before being split into their respective band/frequency allocations and fed to the operators' base stations. Optical signals from the Remote Repeater 60-214701 are demodulated to RF and combined with the Uplink signal from the LCX antennas after the amplification stages.
The Cellular signal path is in the Uplink direction only, Signals are received, filtered and amplified before being fed to the operators' base stations.

3.1. Tri-Band Combiner 60-214702 Simplified Arrangement Sketch

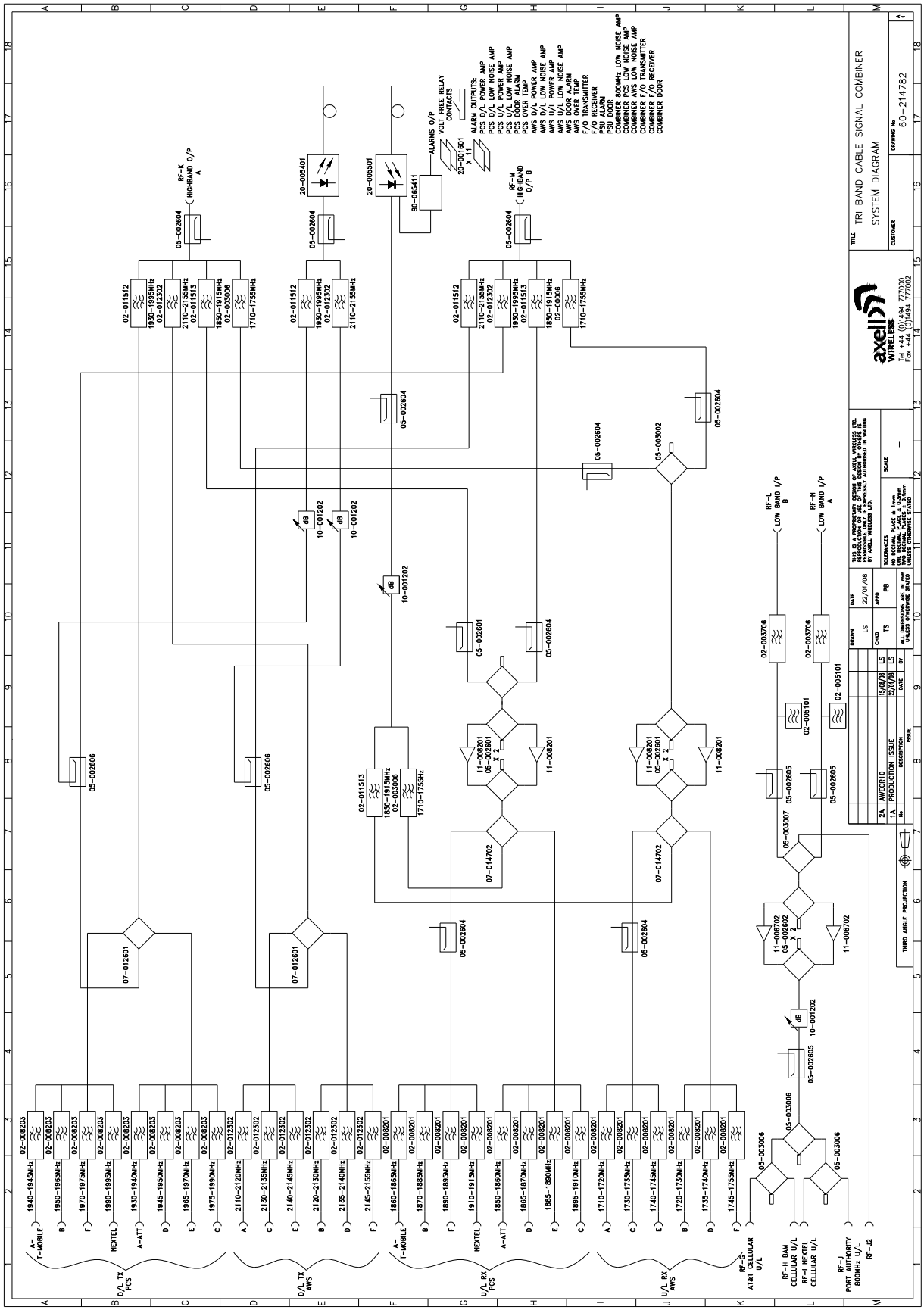


60-214702 features dual redundant amplification stages in the Uplink bands so that in case of any single amplifier failure, complete signal loss would not occur in that path, allowing continued coverage. It also has a comprehensive alarm system (each amplifier module carries its own voltage-free contact alarm relay output). 60-214702 is powered from an AC supply at 110V.

Caution must be exercised when attempting to move or lift this unit as the gross weight of the unit is in excess of 90kg (200lbs)

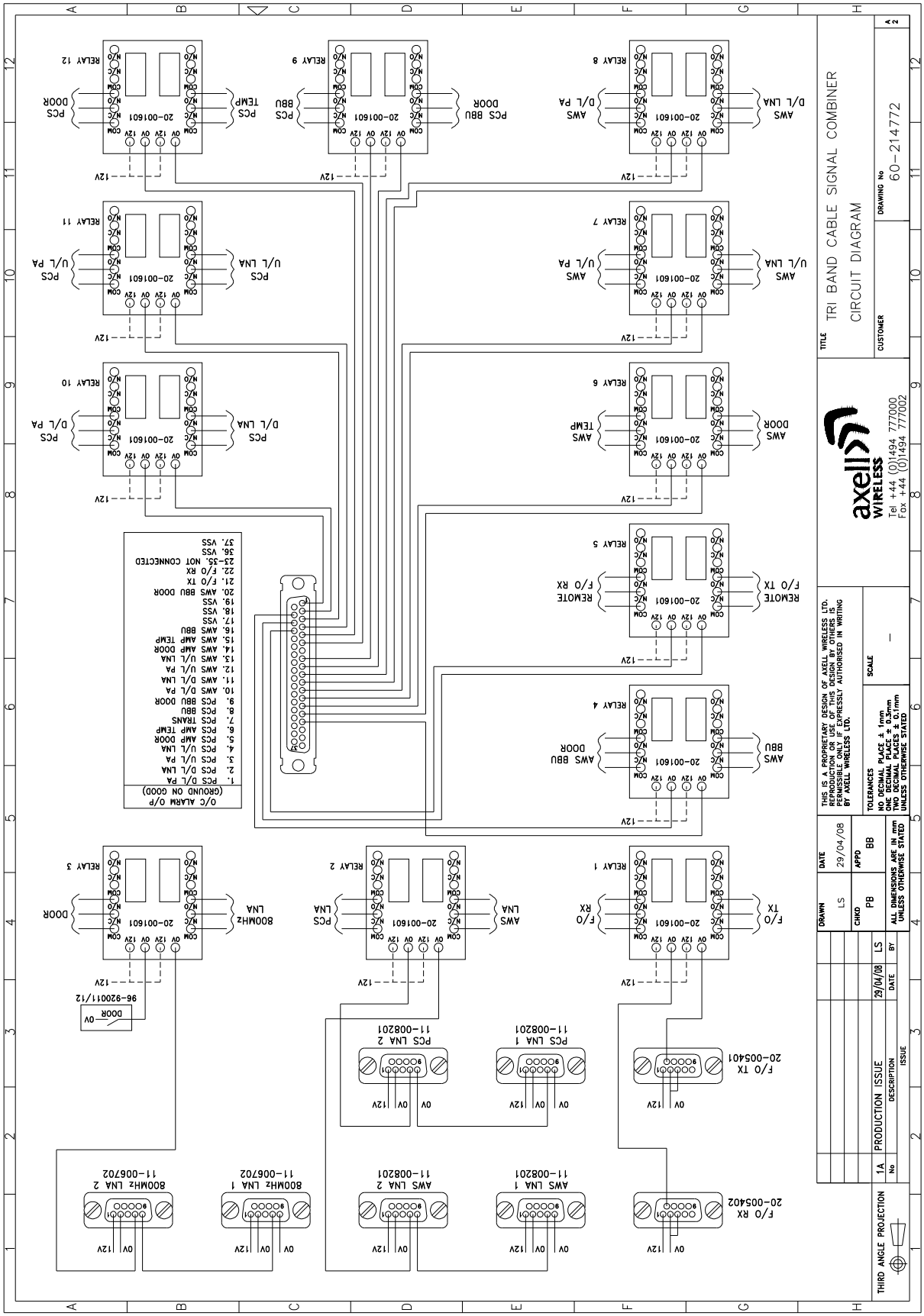
3.2. Tri-Band Combiner 60-214702 Circuit Schematic

Drawing Number 60-214782

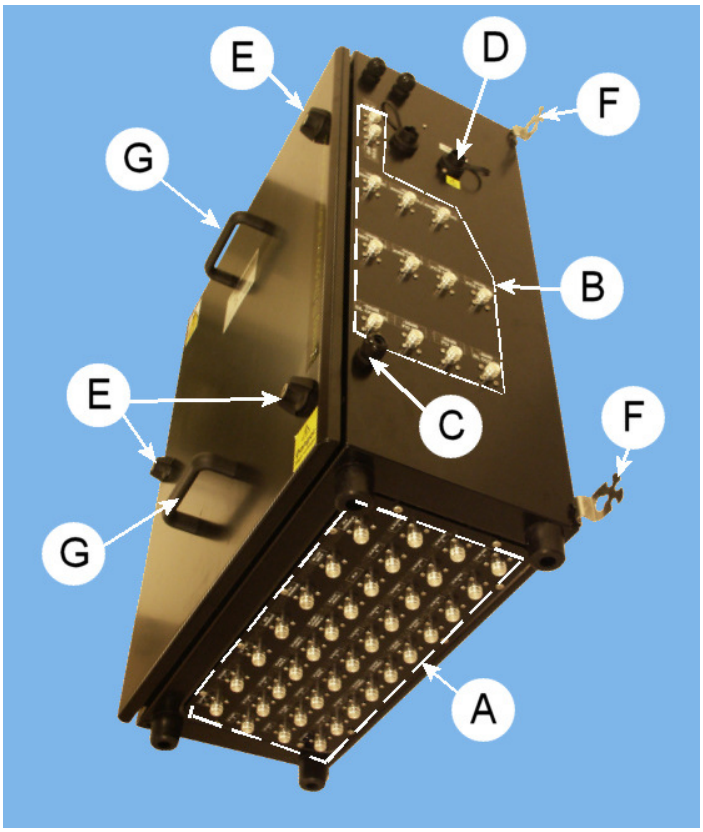


3.3. Tri-Band Combiner 60-214702 Alarm Wiring Diagram

Drawing Number 60-214772



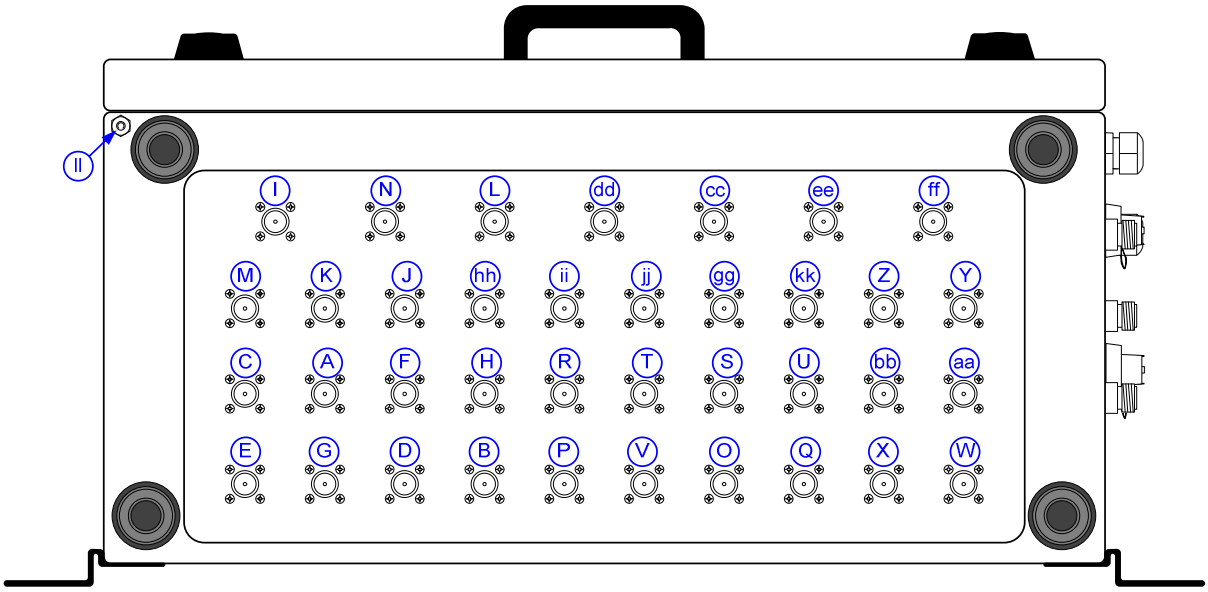
3.4. Tri-Band Combiner 60-214702 External Features



A	RF Inputs and Outputs (see section 3.5. below)
B	RF Monitor/Test ports (see section 3.6. below)
C	Cable Gland for Fibre Optic Cable Input/Output
D	AC Mains Input
E	Lockable door handles
F	Wall mounting brackets
G	Door Lifting handles

Note: Door is not fixed to body when Lockable door handles (E) are open.

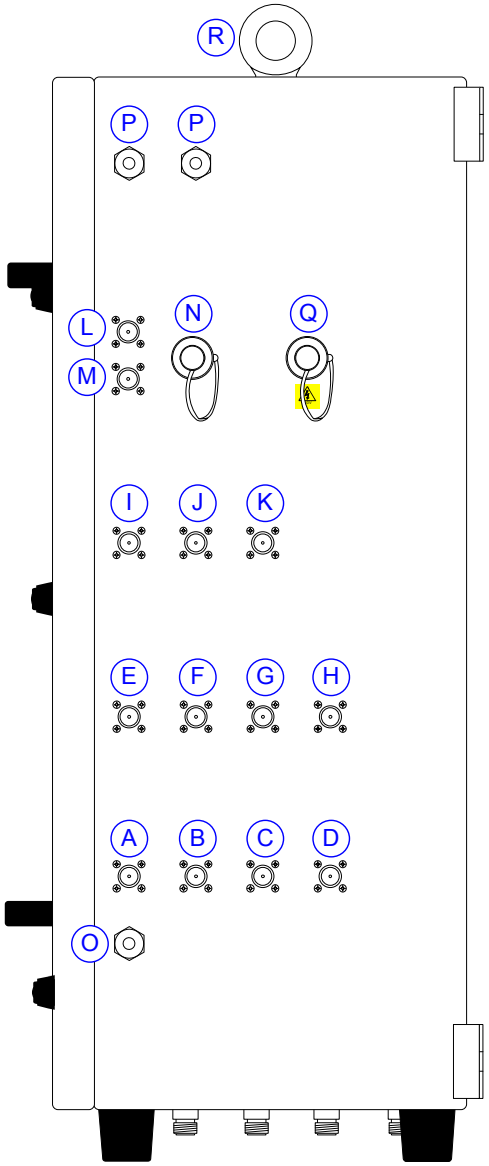
3.5. Tri-Band Combiner 60-214702 RF Connections on underside of case



A	PCS D/L I/P port “A-AT&T” 1930-1940MHz	O	PCS U/L O/P port “A-AT&T” 1850-1860MHz
B	PCS D/L I/P port “A-T Mobile” 1940-1945MHz	P	PCS U/L O/P port “A-T Mobile” 1860-1865MHz
C	PCS D/L I/P port “D” 1945-1950MHz	Q	PCS U/L O/P port “D” 1865-1870MHz
D	PCS D/L I/P port “B” 1950-1965MHz	R	PCS U/L O/P port “B” 1870-1885MHz
E	PCS D/L I/P port “E” 1965-1970MHz	S	PCS U/L O/P port “E” 1885-1890MHz
F	PCS D/L I/P port “F” 1970-1975MHz	T	PCS U/L O/P port “F” 1890-1895MHz
G	PCS D/L I/P port “C” 1975-1990MHz	U	PCS U/L O/P port “C” 1895-1910MHz
H	PCS D/L I/P port “Nextel” 1990-1995MHz	V	PCS U/L O/P port “Nextel” 1910-1915MHz
I	AWS D/L I/P port “A” 2110-2120MHz	W	AWS U/L O/P port “A” 1710-1720MHz
J	AWS D/L I/P port “B” 2120-2130MHz	X	AWS U/L O/P port “B” 1720-1730MHz
K	AWS D/L I/P port “C” 2130-2135MHz	Y	AWS U/L O/P port “C” 1730-1735MHz
L	AWS D/L I/P port “D” 2135-2140MHz	Z	AWS U/L O/P port “D” 1735-1740MHz
M	AWS D/L I/P port “E” 2140-2145MHz	aa	AWS U/L O/P port “E” 1740-1745MHz
N	AWS D/L I/P port “F” 2145-2155MHz	bb	AWS U/L O/P port “F” 1745-1755MHz

cc	Highband (PCS+AWS) Output to/Input from Local LCX port “RF-K”
dd	Highband (PCS+AWS) Output to/Input from Local LCX port “RF-M”
ee	Lowband (Cellular) U/P I/P port “RF-L”
ff	Lowband (Cellular) U/P I/P port “RF-N”
gg	Lowband (Cellular) U/P O/P port “RF-G AT&T Cellular”
hh	Lowband (Cellular) U/P O/P port “RF-H BAM Cellular”
ii	Lowband (Cellular) U/P O/P port “RF-I NEXTEL Cellular”
jj	Lowband (Cellular) U/P O/P port “RF-J Port Authority 800 MHz”
kk	Lowband (Cellular) U/P O/P port “RF-J2”
ll	Earthing Connection

3.6. Tri-Band Combiner 60-214702 Connections on R.H. Side of case



A	30dB Monitor Port coupled from D/L Output port “RF-M” (“dd” in section 3.5.).
B	30dB Monitor Port coupled from RF from F/O Uplink Input.
C	30dB Monitor Port coupled from RF from F/O Downlink Output.
D	30dB Monitor Port coupled from D/L Output port “RF-K” (“cc” in section 3.5.).
E	30dB Monitor Port for AWS U/L Input coupled from port “RF-K” (“cc” in section 3.5.).
F	30dB Monitor Port for AWS U/L Input coupled from port “RF-M” (“dd” in section 3.5.).
G	30dB Monitor Port for PCS U/L Input coupled from port “RF-K” (“cc” in section 3.5.).
H	30dB Monitor Port for PCS U/L Input coupled from port “RF-M” (“dd” in section 3.5.).
I	30dB Monitor Port coupled from Lowband (Cellular) U/L Output ports (“gg” to “kk” in section 3.5.).
J	30dB Monitor Port coupled from Lowband (Cellular) U/L Input port “RF-L” (“ee” in section 3.5.).
K	30dB Monitor Port coupled from Lowband (Cellular) U/L Input port “RF-N” (“ff” in section 3.5.).
L	30dB Monitor Port coupled from AWS Uplink Output Ports (“W”, “Y” & “aa” in section 3.5.).
M	30dB Monitor Port coupled from PCS Uplink Output Ports (“P”, “R”, “T” & “V” in section 3.5.).
N	Spare port
O	Cable Gland for Fibre Optic Cables.
P	Spare cable Glands
Q	AC Mains Input 110V
R	Lifting Eyes

3.7. Tri-Band Combiner 60-214702 Specification

PARAMETER		SPECIFICATION
Frequencies		
PCS Downlink Passbands	T-MOBILE RF-A	1940-1945 MHz
	RF-B	1950-1955 MHz
	RF-F	1970-1975 MHz
	NEXTEL	1990-1995 MHz
	A-ATT	1930-1940 MHz
	RF-D	1945-1950 MHz
	RF-E	1965-1970 MHz
	RF-C	1975-1990 MHz
AWS Downlink Passbands	RF-A	2110-2120 MHz
	RF-C	2130-2135 MHz
	RF-E	2140-2145 MHz
	RF-B	2120-2130 MHz
	RF-D	2135-2140 MHz
	RF-F	2145-2155 MHz
PCS Uplink Passbands	T-MOBILE RF-A	1860-1865 MHz
	RF-B	1870-1885 MHz
	RF-F	1890-1895 MHz
	NEXTEL	1910-1915 MHz
	A-ATT	1835-1860 MHz
	RF-D	1865-1870 MHz
	RF-E	1885-1890 MHz
	RF-C	1895-1910 MHz
AWS Uplink Passbands	RF-A	1710-1720 MHz
	RF-C	1730-1735 MHz
	RF-E	1740-1745 MHz
	RF-B	1720-1730 MHz
	RF-D	1735-1740 MHz
	RF-F	1745-1755 MHz
Cellular Uplink Passband	RF-G, H, I, J	806-849 MHz
Path Losses		
Downlink paths to Local LCX		</= 10.0 dB
Cellular Uplink to Port RF-J2		6.0 dB typical
Downlink paths to FO TX O/P		40 dB typical
(RF-A,B,C,D,E,F) Max Input Power		100 Watts at each Input port
(BTS Inputs) Reurn loss		1.5:1
Path Gains		
RF-L to RF-G, H, I, J RF-N to RF-G, H, I, J RF-K to RF-A, B, C, D, E, F RF-M to RF-A, B, C, D, E, F		14 dB typical 14 dB typical 15.0 dB typical 15.0 dB typical
Rejection		
RF-L to RF-G,H,I,J RF-N to RF-G,H,I,J (851-869 MHz)		15 dB
FO-B to RF-A, B, C, D, E, F (RX)		9.0 dB typical

continued...

General		
Impedance		50 Ohms
Alarms Fitted (summary volt-free contacts)		PCS Downlink Power Amplifier PCS Downlink LNA PCS Uplink Power Amplifier PCS Uplink LNA PCS Door Alarm PCS Over Temperature. AWS Downlink Power Amplifier AWS Downlink LNA. AWS Uplink Power Amplifier AWS Uplink LNA AWS Door Alarm AWS Over Temperature FO Transmitter FO Receiver PSU Alarm PSU Door Combiner 800 MHz Low Noise Combiner PCS LNA Combiner AWS LNA Combiner FO Receiver Combiner FO Transmitter Combiner Door
AC Supply Voltage		110V AC
Redundancy		Parallel modules in all Uplink Amplifier stages
Case Size		896mm x 735mm x 362mm
Case Material		Mild Steel (2mm)
Case Finish		Black Semi-gloss
AC Supply Voltage		110V AC
RF Connectors		N type female
Temperature	Storage	-40 to +71°C
	Operating	-10 to +55°C
Humidity		95% RHNC

3.8. Tri-Band Combiner 60-214702 List of Major Sub-Components

Component Part	Component Part Description	Qty Per Assembly
02-003006	Bandpass FIlter	3
02-003706	Bandpass FIlter	2
02-005101	Notch Reject Filter	2
02-008201	Bandpass FIlter	14
02-008216	Bandpass FIlter	8
02-011512	Bandpass FIlter	3
02-011513	Bandpass FIlter	3
02-012302	Bandpass FIlter	9
05-002601	Splitter/Combiner	4
05-002602	Splitter/Combiner	2
05-002604	20dB Coupler	10
05-002605	20dB Coupler	3
05-002606	30dB Coupler	2
05-003002	3 Port Hybrid Combiner	2
05-003006	3 Port Hybrid Combiner	3
05-003007	4 Port Hybrid Combiner	1
07-012601	4 Port 2 Way Combiner	2
07-014702	4 Port 2 Way Combiner	2
10-001202	Remote Variable Attenuator	4
11-006702	Low Noise Amplifier (800-1000MHz)	2
11-008201	Low Noise Amplifier (PCN)	4
20-001601	12V Relay Board	12
20-005401	Fibre Optic Transmitter	1
20-005501	Fibre Optic Receiver	1
80-065411	FO Alarm RX De-Modulator	1
91-800003	10 Way Krone Module	7
96-300051	PSU Module	1

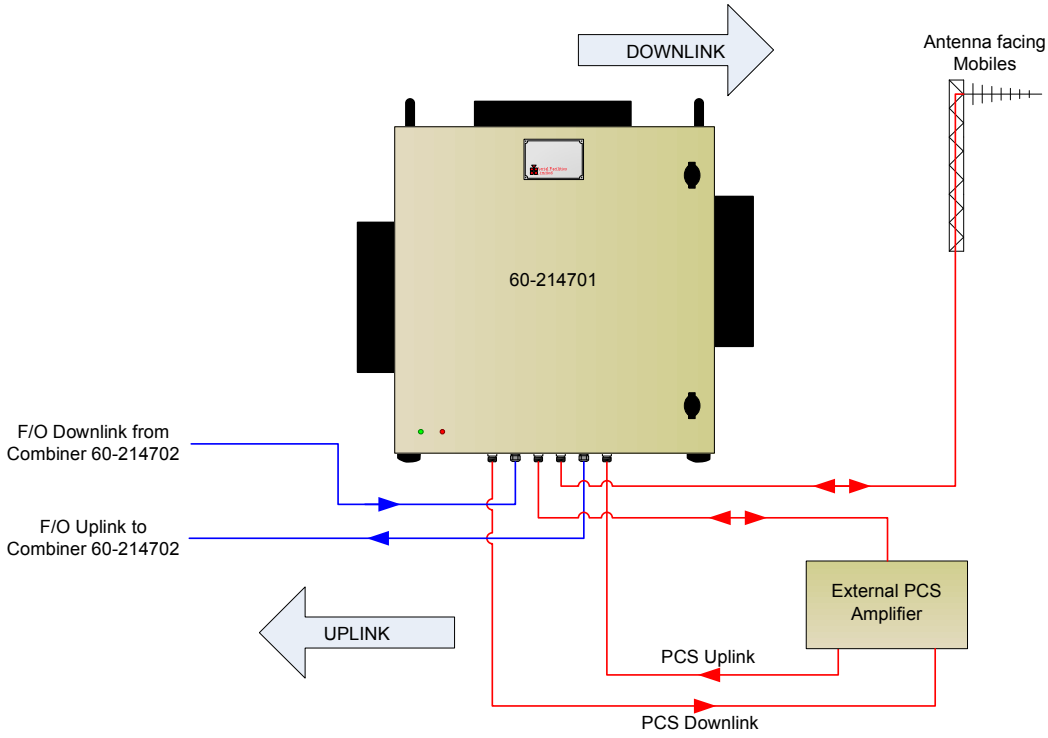
4. Fibre Fed Remote Repeater 60-214701

Remote Repeater 60-214701 is built into a wall-mounted, environmentally protected (IP65) aluminium alloy case; RF ports and connectors are also IP65 standard making the entire enclosure and connecting ports weatherproof. Handles are provided for carrying the unit and the door is fitted with locks and there are Power On and Alarm indicators on the outside of the door.

The Repeater has two fibre optic connections for two fibre optic cables, one carying Downlink signals from the Tri-Band Cable Signal Combiner 60-214702 and one carying Uplink signals to the Tri-Band Cable Signal Combiner 60-214702. The Repeater also had an RF connection carying Downlink and Uplink signals to and from the Antenna facing the mobiles

Provision is made for feeding the PCS signal path out to an existing external PCS bi-directional amplifier.

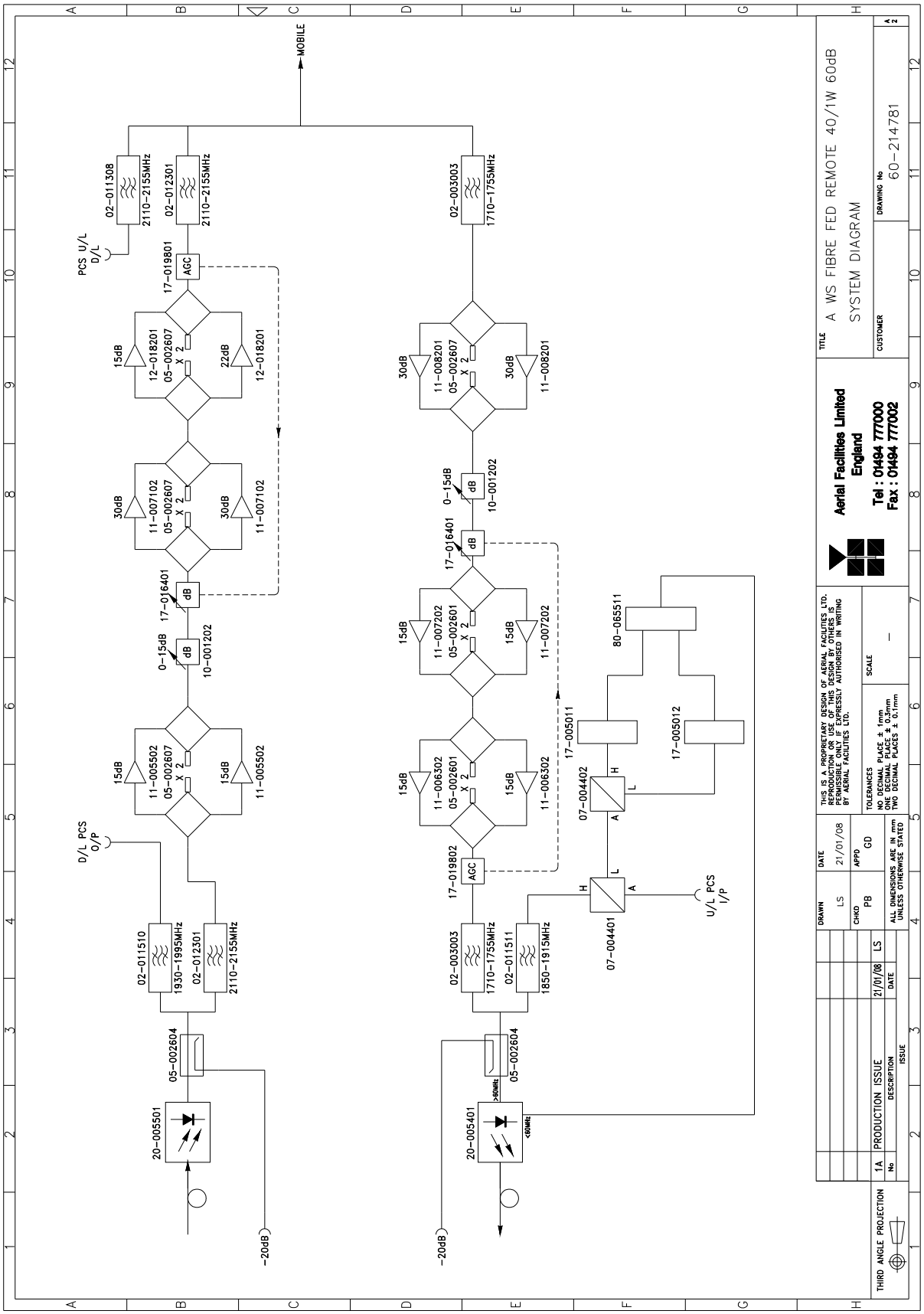
4.1. Remote Repeater 60-214701 Simplified Arrangement Sketch



60-214701 features dual redundant amplification stages in both Downlink and Uplink bands so that in case of any single amplifier failure, complete signal loss would not occur in that path, allowing continued coverage. It also has a comprehensive alarm system (each amplifier module carries its own voltage-free contact alarm relay output), with the capability of remote configuration/alteration through a multiplexed RS232 base station modem link. 60-214701 is powered from a DC supply at 24V which is provided by PSU and Battery Backup 60-214703.

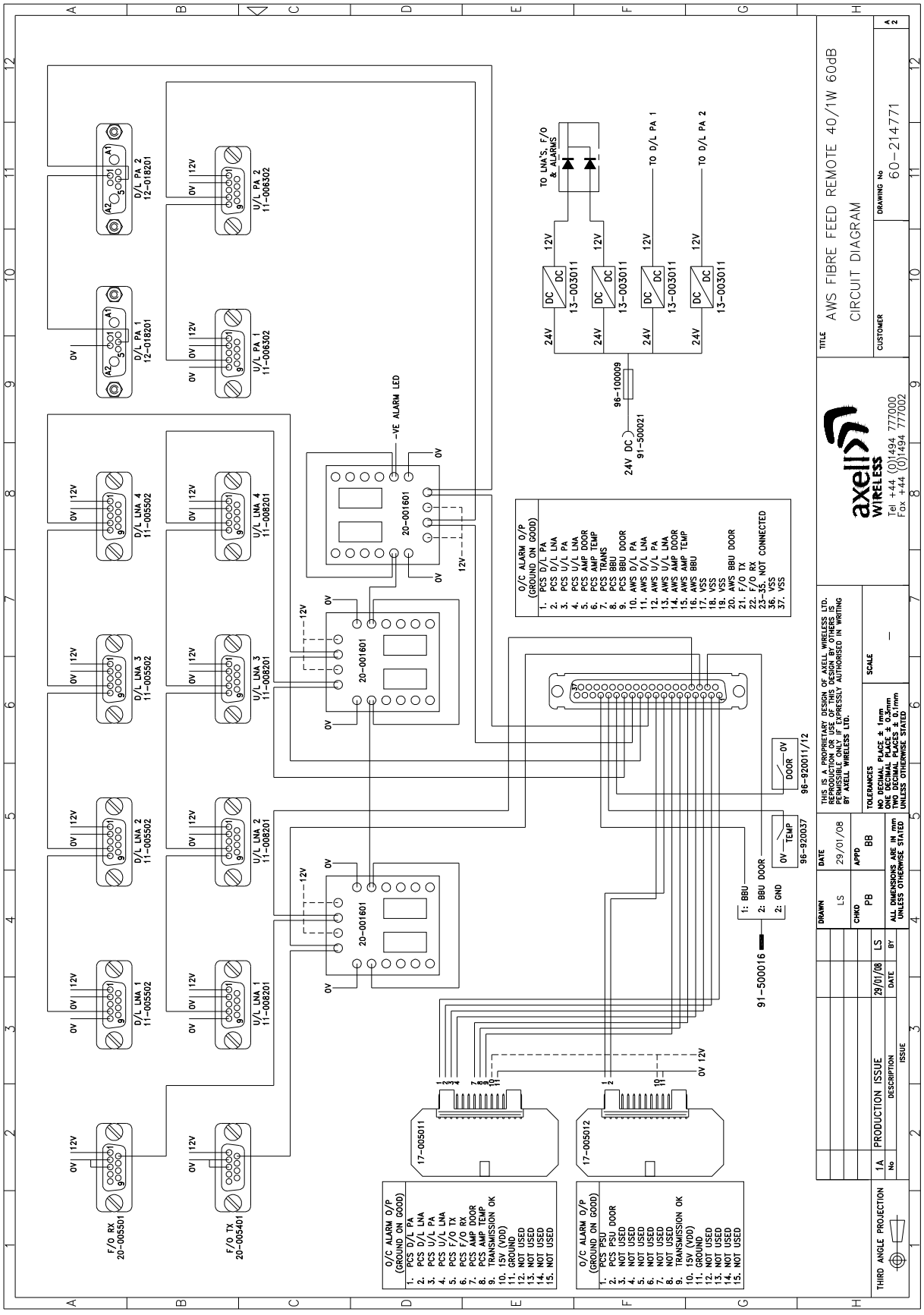
4.2. Remote Repeater 60-214701 Circuit Schematic

Drawing Number 60-214781

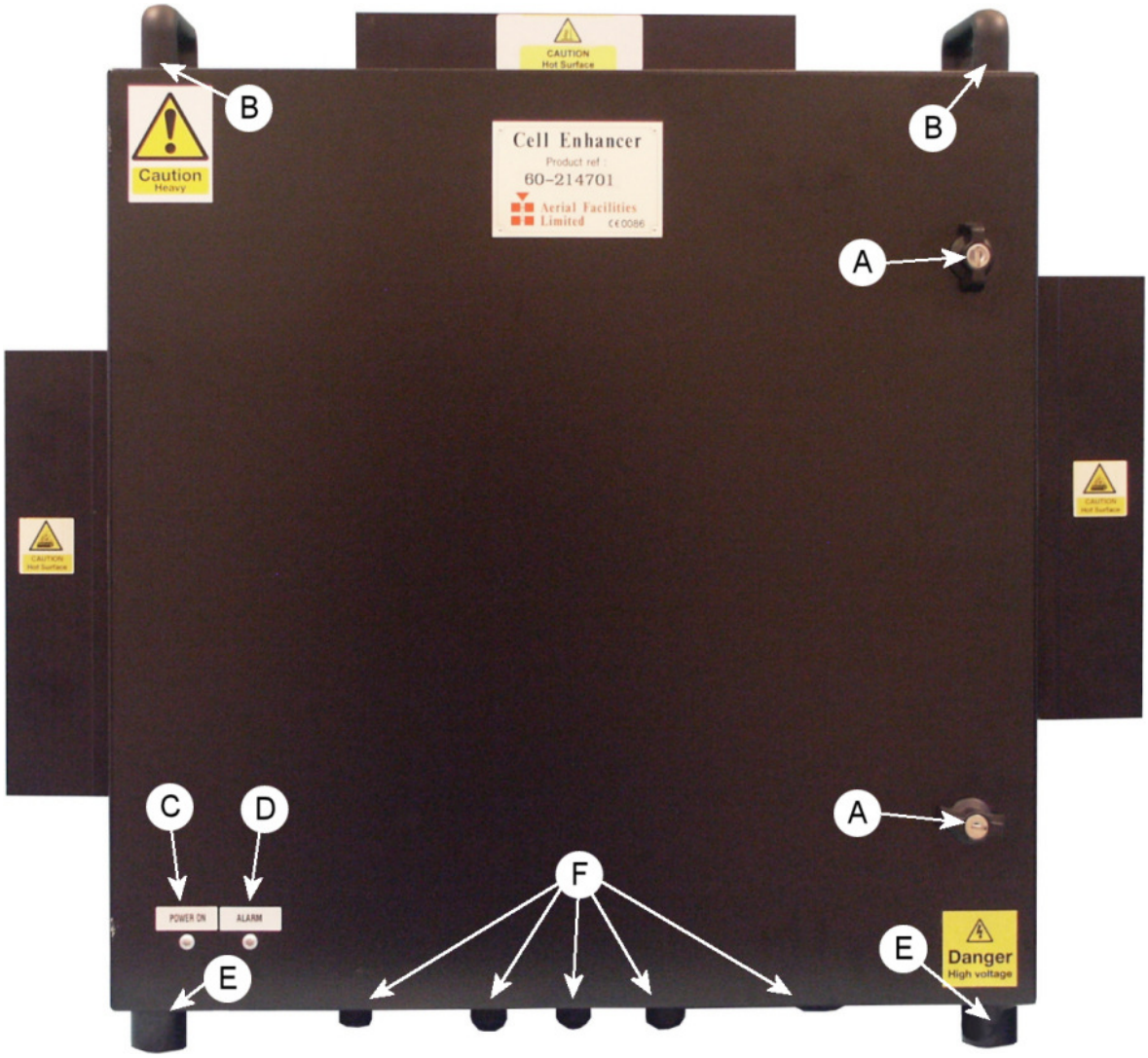


4.3. Remote Repeater 60-214701 Alarm Wiring Diagram

Drawing Number 60-214771

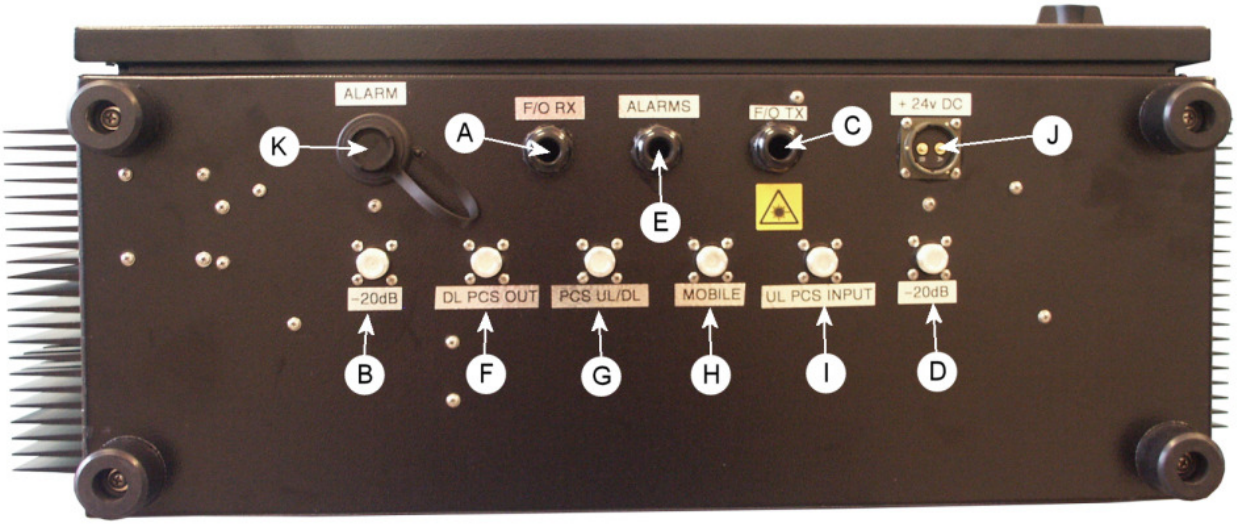


4.4. Remote Repeater 60-214701 Front View



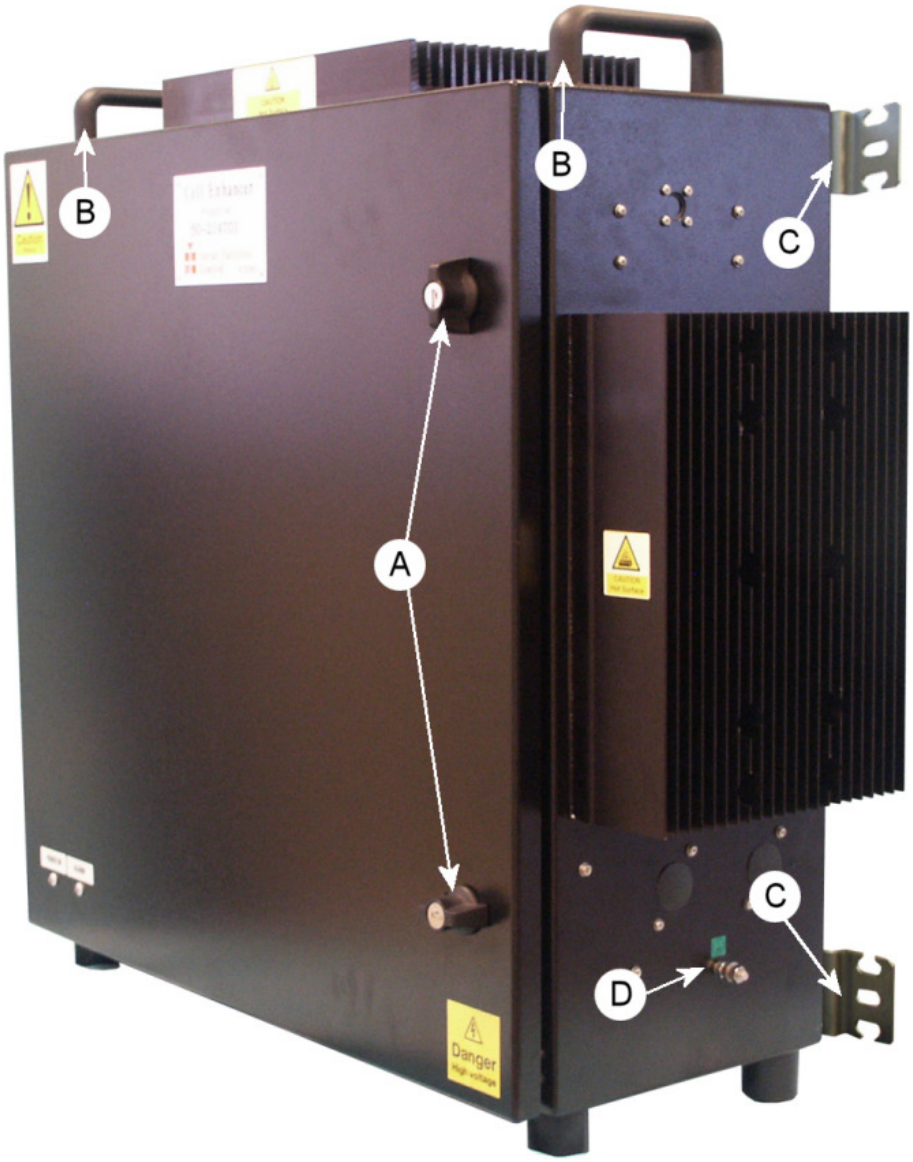
A	Lockable Door Handles
B	Lifting handles
C	Green LED “POWER ON”
D	Red LED “ALARM”
E	Rubber Feet
F	Connectors on Underside – see section 4.5.

4.5 Remote Repeater 60-214701 Underside View



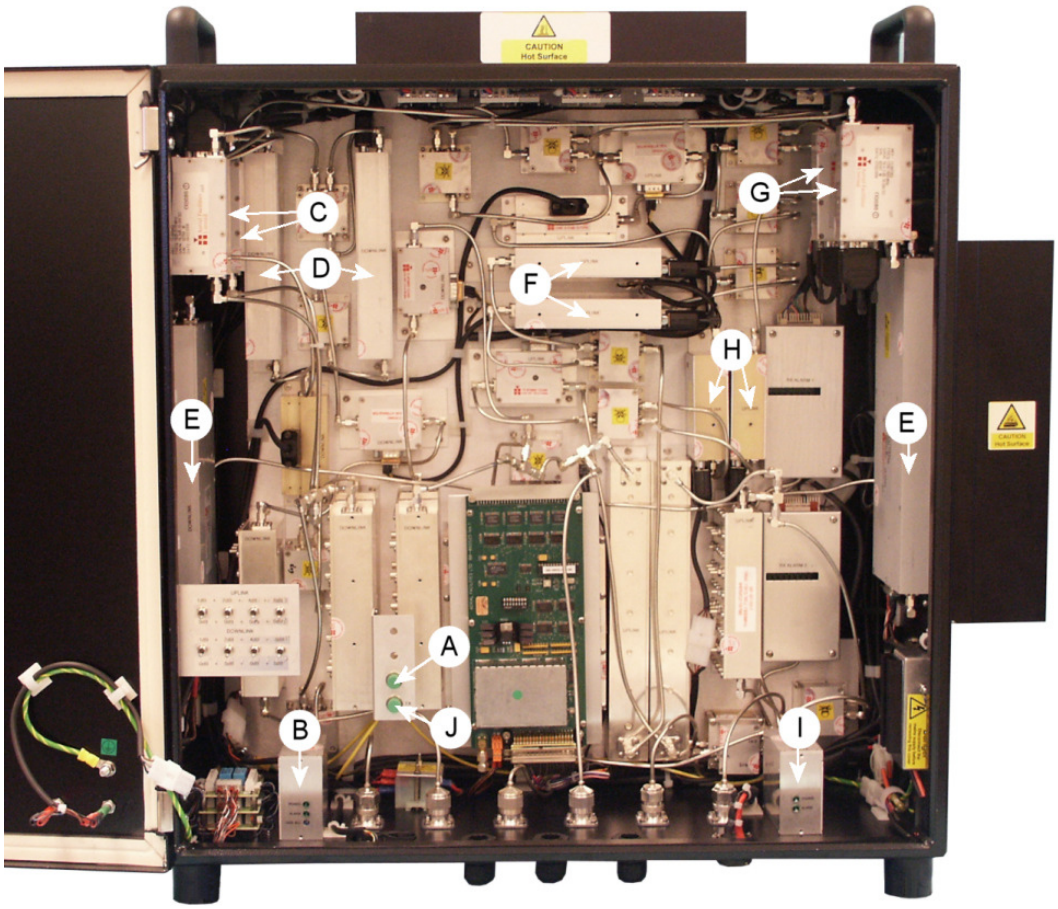
A	Fibre Optic Cable Gland for Downlink from Combiner 60-214702
B	20dB Monitor port for Fibre Optic Downlink Input
C	Fibre Optic Cable Gland for Uplink to Combiner 60-214702
D	20dB Monitor port for Fibre Optic Uplink Output
E	Cable Gland for Auxillary Alarms
F	Downlink RF PCS Output to External Amplifier
G	Combined RF PCS Downlink from and Uplink to External Amplifier
H	Combined RF Output to/Input from Mobile Antenna
I	Uplink RF PCS Input from External Amplifier
J	24V C D Input from PSU and Battery Backup 60-214703
K	Alarm Input from PSU and Battery Backup 60-214703

4.6. Remote Repeater 60-214701 Three-quarter View



A	Lockable Door Handles
B	Lifting handles
C	Wall Mounting Brackets
D	Earthing connection

4.7. Remote Repeater 60-214701 Interior View



A	Downlink Fibre Optic Input port
B	Fibre Optic Receiver 20-005501
C	Downlink 1st stage amplifiers - Low Nolise Amplifiers 11-005502
D	Downlink 2nd stage amplifiers - Low Power Amplifiers 11-007102
E	Downlink 3rd stage amplifiers - Power Amplifiers 12-018201
F	Uplink 1st stage amplifiers - Low Nolise Amplifiers 11-008201
G	Uplink 2nd stage amplifiers - Low Noise Amplifiers 11-007202
H	Upink 3rd stage amplifiers - Low Power Amplifiers 11-006302
I	Fibre Optic Transmitter 20-005401
J	Uplink Fibre Optic Output port

4.8. Remote Repeater 60-214701 Specification

PARAMETER		SPECIFICATION
DOWNLINK		
Passband Frequency		2110-2155MHz
Passband Gain		60 dB
Passband Ripple		<±1.5 dB
Variable Attenuator		2-30 dB (± 1dB)
1dB Compression		+44dB
OIP3		+60dBm
In Band Spurious Noise (30kHz Bandwidth)		< -13dm @ (60dB gain)
PCS Input 1850-1995MHz Insertion Loss		<2dB
UPLINK		
Passband Frequency		1710-1755 MHz
Passband Gain		>60 dB
Passband Ripple		<±1.5 dB
Variable Attenuator		2-30 dB (± 1dB)
1dB Compression		+30dB
ALC Setting		0 dBm
OIP3		+40dBm
Noise Figure		<4dB (max.gain)
In Band Spurious Noise (30kHz Bandwidth)		< -13dBm @ (60dB gain)
PCS Input 1850-1915MHz Insertion Loss		<2dB
OPTICAL		
Optical Input Alarm Threshold		< -9dBm at 1310nm
F/O TX Output Power		> 1dBm at 1310nm
GENERAL		
Case Size (ex. handles and heatsinks)		620mm x 620mm x 250mm
Case Material		Aluminium Alloy (2mm)
Case Finish		Black Semi-gloss
DC Supply Voltage		24V
RF Connectors		N type female
Optical Connectors		FC/APC
Redundancy		Parallel modules in all Amplifier stages
Alarms Fitted (summary volt-free contacts)		Over Temperature Uplink Low Noise Amplifiers Fail Uplink Power Amplifiers Fail Downlink Low Noise Amplifiers Fail Downlink Power Amplifiers Fail Door Open FO TX Fail FO RX Fail
Temperature Range	operation	-20°C to +60°C
	storage	-40°C to +70°
Humidity		95% RHNC

4.9. Remote Repeater 60-214701 List of Major Sub-Components

Component Part	Component Part Description	Note	Qty Per Assembly
02-003003	Bandpass Filter		2
02-011308	Bandpass Filter		1
02-011510	Notch Reject Filter		1
02-011511	Notch Reject Filter		1
02-012301	Bandpass Filter		2
05-002601	2 Way Splitter/Combiner		6
05-002604	20dB Coupler		2
05-002607	2 Way Splitter/Combiner		6
07-004401	Crossband Coupler		1
07-004402	Crossband Coupler		1
10-001202	Remote Variable Attenuator		2
11-005502	Low Noise Amplifier	D/L Stage 1	2
11-006302	1Watt PCN Low Power Amplifier	U/L Stage 3	2
11-007102	1Watt UMTS Low Power Amplifier	D/L Stage 2	2
11-007202	Low Noise Amplifier	U/L Stage 2	2
11-008201	Low Noise Amplifier	U/L Stage 1	2
12-018201	20W Power Amplifier	D/L Stage 3	2
13-003011	DC/DC Converter		4
17-005011	FO Alarm RX Module 21.4MHz		1
17-005012	FO Alarm RX Module 10.7MHz		1
17-016401	AGC Attenuator		2
17-019801	AGC Detector/Amplifier		1
17-019802	AGC Detector/Amplifier		1
20-005401	Fibre Optic Transmitter		1
20-005501	Fibre Optic Receiver		1
80-065311	Front Panel Display Sub-Assembly		1
80-065511	FO Alarm TX Modulator		1
96-100009	DC Dual Diode Box		1

5. PSU and Battery Backup 60-214703

PSU and Battery Backup 60-214703 is built into a wall-mounted, environmentally protected (IP65) aluminium alloy case; ports and connectors are also IP65 standard making the entire enclosure and connecting ports weatherproof. The door is fitted with locking door handles and handles are provided for carrying the unit. There are Power On and Alarm indicators on the outside of the door.

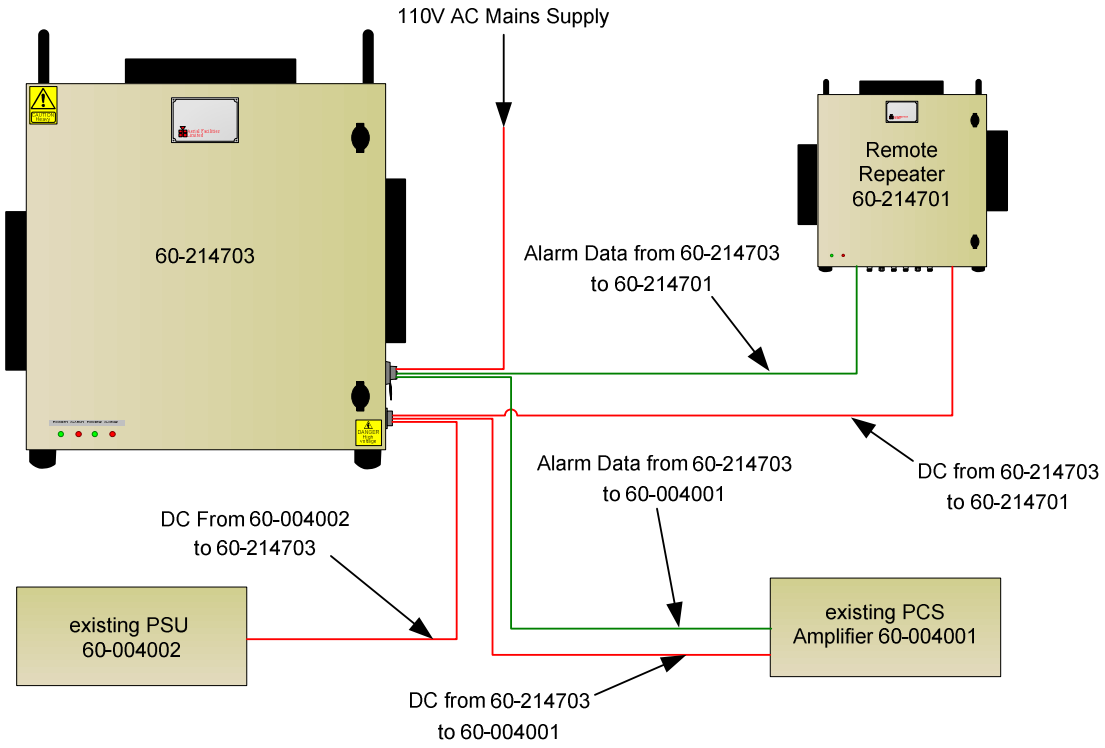
The power supply uses two identical 400Watt mains driven PSU modules connected via power combining diodes to supply 24V DC power to the Remote site equipment. This wiring arrangement allows either of the modules to supply power continuously should one of the PSUs fail. Both the PSU modules are alarmed through a 12V relay PCB and will activate the main alarm should either module fail. Mains trip switches isolate the AC supply to either PSU module should either need to be switched off.

The battery backup system operates in parallel with the main AC derived DC supply from the PSU Modules; thus if the primary AC fails the backup system provides a seamless “no-break” transition from mains to battery. Four 12V, 38Ah Sealed Lead-Acid batteries are employed, arranged in two pairs wired in series each pair providing a 24V Output. Pair 1 provides backup for Remote Repeater 60-214701 and Pair 2 provides backup for existing PCS Amplifier 60-004001. During normal operation the AC mains float charge the batteries via a third mains driven PSU Module.

A Low Voltage Disconnect circuit exists which cuts the battery power to the equipment when the battery voltage falls below a pre-set threshold. A series regulator circuit ensures that the DC voltage from the fully charged batteries does not exceed 12V per battery.

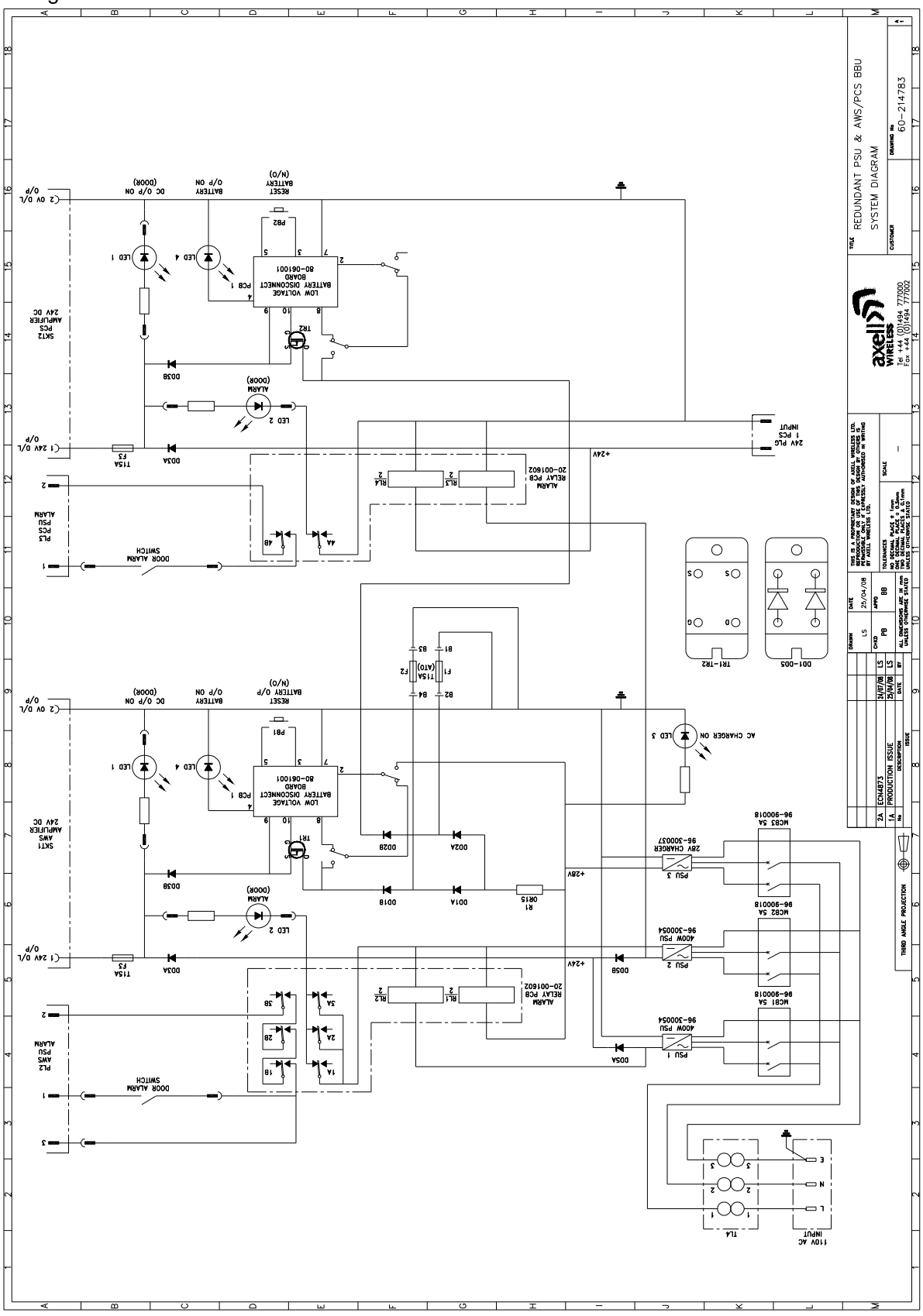
All PSU modules are separately alarmed and the summed alarm data is presented at the connector labelled “N” in section 5.3.2. from where it is fed to Remote Repeater 60-214701 for onward transmission to the Master Site

5.1. PSU and Battery Backup 60-214703 Simplified Arrangement Sketch



5.2. PSU and Battery Backup 60-214703 Circuit Diagram

Drawing Number 60-214783

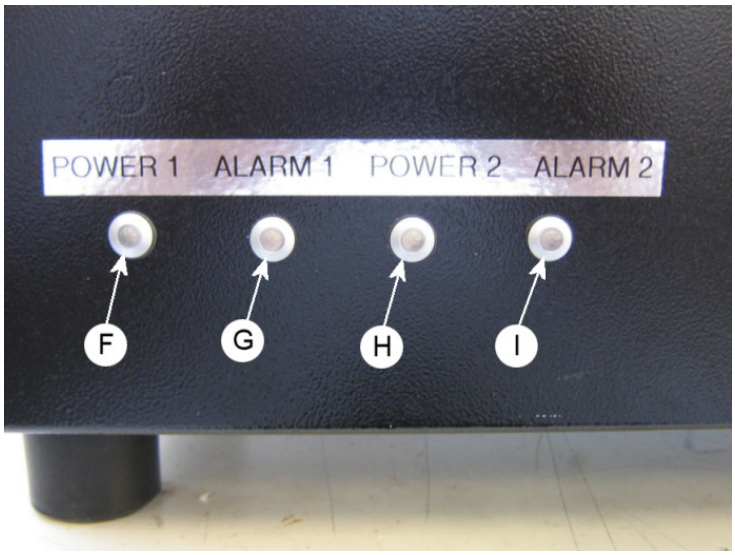


5.3. PSU and Battery Backup 60-214703 External Features

A	Lifting Handles **
B	Lockable Door Handles
C	Power and Alarm Indicators
D	Wall Mounting Brackets
E	Power and Alarm Ports see section 5.3.2. below

**Caution must be exercised when attempting to move or lift this unit when the batteries are installed, the gross weight of the unit will be in excess of 70kg (155lbs)

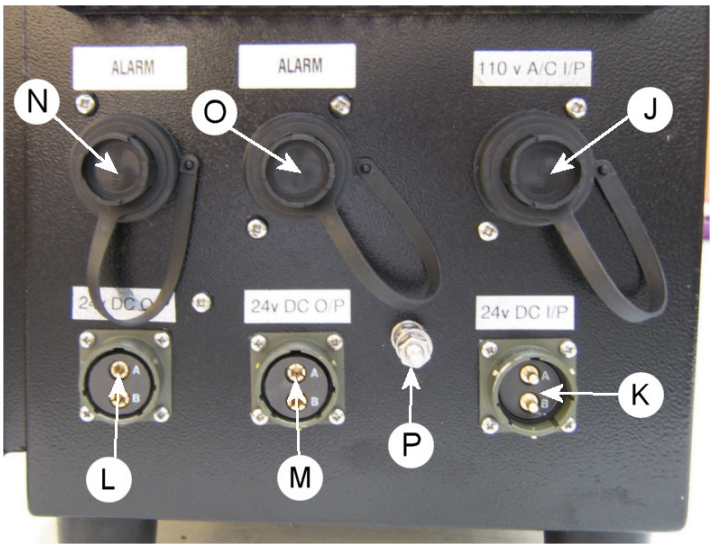
5.3.1. External LEDs



F	Green LED “POWER 1” PSU 1*
G	Red LED “ALARM” PSU 1
H	Green LED “POWER 2” PSU 3*
I	Red LED “ALARM” PSU 3

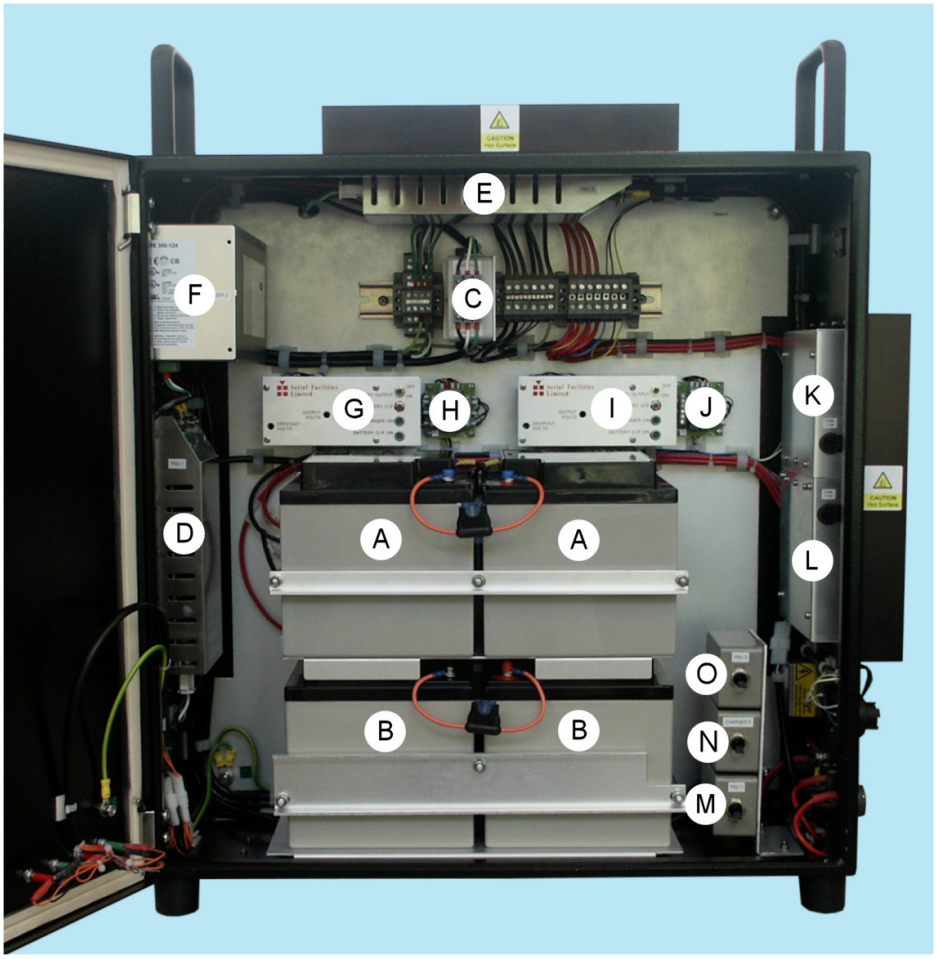
* See section 5.4. below

5.3.2. Power and Alarm Ports



J	AC Mains Input 110V
K	24V DC Input from Existing PSU 60-004002
L	24V DC Output to Remote Repeater 60-214701
M	24V DC Output to existing PCS Amplifier 60-004001
N	“PSU 1” Alarm output to Remote Repeater 60-214701
O	“PSU 3” Alarm output to existing PCS Amplifier 60-004001
P	Earth Connection

5.4. PSU and Battery Backup 60-214703 Internal Features



A	Batteries 96-000004 “Pair 1”
B	Batteries 96-000004 “Pair 2”
C	Mains Filter 13-003302
D	400W PSU 96-300054 “PSU 1”
E	400W PSU 96-300054 “PSU 3”
F	Charger PSU 96-300037 “PSU 2”
G	Charger Alarm Indicator Assembly 50-046937 for Batteries Pair 1
H	24V Relay Assembly 20-001602 for Batteries Pair 1
I	Charger Alarm Indicator Assembly 50-046937 for Batteries Pair 2
J	24V Relay Assembly 20-001602 for Batteries Pair 2
K	Power Combining Diodes and Fuse Assembly for DC Output from “PSU 1”
L	Power Combining Diodes and Fuse Assembly for DC Output from “PSU 3”
M	Trip Switch for “PSU 1”
N	Trip Switch for “PSU 2”
O	Trip Switch for “PSU 3”

5.5. PSU and Battery Backup 60-214703 Specification

PARAMETER		SPECIFICATION
AC Supply Voltage		110V
DC Outputs		2 x 24V DC
DC Input (from 60-004002)		24V
Charging Current		< 6.0 Amps
Battery Output Voltage Set Level		23.5V ± 0.2V
Low Voltage Disconnect level		21.5V ± 0.5V
Alarms Fitted (summary volt-free contacts)		PSU 1 Fail PSU 2 Fail Charger PSU Fail Door Open DC Input from 60-004002 Fail
Case Size (ex. handles and heatsinks)		620mm x 620mm x 250mm
Case Material		Aluminium Alloy (2mm)
Case Finish		Black Semi-gloss
Temperature Range	operation	-20°C to +60°C
	storage	-40°C to +70°
Humidity		95% RHNC

5.6. PSU and Battery Backup 60-214703 Major Sub Components

Component Part	Component Part Description	Qty Per Assembly
13-003302	Mains Filter	1
20-001602	24V Relay Assembly	2
50-046937	Charger Alarm Indicator Assembly	2
80-061001	Low Voltage Battery Disconnect Circuit	2
96-000004	38AH 12V Sealed Lead Acid Battery	4
96-300037	Charger PSU	1
96-300054	400W PSU	2

5.6.1. Batteries 96-000004

The batteries used in this arrangement are 38Ah 12V Sealed Lead Acid units and require no maintenance.

General Specifications		
Capacity		38 Ah
Chemical System		Lead-Acid
Dimensions (L x W x H)		197 mm x 165 mm x 170 mm
Internal Resistance		7.5 Milliohms
Maximum Operating Temperature		+50 ℃ (Charge) +60 ℃ (Discharge)
Minimum Operating Temperature		-15 ℃ (Charge) -20 ℃ (Discharge)
Nominal Voltage		12 V
Weight		14.2 kg
Life Expectancy	Standby Use	3 to 5 years
	Cycle Use (approx)	100% depth of discharge 250 cycles 50% depth of discharge 550 cycles 30% depth of discharge 1200 cycles

6. Installation – General Notes

6.1 General Remarks

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

The procedure for installing and commissioning an Axell Wall Mount Repeater is generally as follows:

1 Secure the Repeater in the chosen wall position.

2 Fix the antenna and connect its cables to the Repeater antenna ports.

3 Connect a suitable mains or battery power supply to the Repeater

4 Calculate the attenuation settings required for the uplink and the downlink paths, and set the attenuators as described elsewhere in this document.

5 Switch the equipment mains on with the small switch located inside the Repeater on the lower right hand side of the case.

6 If Base Station signals are available, make test calls via the Amplifier to ensure correct operation, if possible monitoring the signal levels during these calls to ensure that the uplink and downlink RF levels are as anticipated.

6.2 Electrical Connections

It is recommended that the electrical mains connection is made by a qualified electrician, who must be satisfied that the supply will be the correct voltage and of sufficient capacity.

All electrical and RF connections should be completed and checked prior to power being applied for the first time.

Ensure that connections are kept clean and are fully tightened.

6.3 RF Connections

Care must be taken to ensure that the correct connections are made with particular attention made to the base station TX/RX ports. In the event that the base transmitter is connected to the RX output of the equipment, damage to the equipment will be done if the base station transmitter is then keyed.

6.3.1. Termination of Unused Ports

In the event that any RF ports are unused (available for future expansion) these ports must be kept terminated with the load terminations supplied by Axell for that purpose
Ensure that connections are kept clean and are fully tightened.

6.4 Optical Connections

The optical input and output ports will be shown in the system drawings. The ports are supplied with a green plastic cover, which must be removed prior to the connection of the fibre cable. Ensure that transmitter and receiver fibre cable are identified to prevent misconnection. At the master site, the fibre transmitters are in the downlink path with the receivers in the uplink. At the remote sites the fibre transmitters are in the uplink with the receivers in the downlink.
Always ensure that connections are kept clean and are fully tightened.

6.5 Commissioning

Once all connections are made the equipment is ready for commissioning.

To commission the system the test equipment detailed in Section 7.2. will be required.
Using the system diagrams and the end-to-end test specification (supplied with the equipment), the equipment should be tested to ensure correct operation. Typical RF levels that are not listed in the end-to-end specification, such as input levels to the fibre transmitters are detailed in the maintenance section of this manual.

On initial power up the system alarm indicators on the front doors of the equipment should be checked. A green LED on each unit with a power supply to it illuminates to indicate that the power supply is connected to the unit. A red LED illuminated indicates a fault in that particular unit that must be investigated before proceeding with the commissioning.

In the event that any part of the system does not function correctly as expected, check all connections to ensure that they are to the correct port, that the interconnecting cables are not faulty and that they are tightened. The majority of commissioning difficulties arise from problems with the interconnecting cables and connectors.

6.6 Antenna Installation & Gain Calculations

A The equipment typically requires two (or as appropriate) antennas, one a highly directional Yagi or similar directed towards the donor cell base station, and one a leaky feeder, omni-directional antenna or Yagi to cover the area in which the mobiles are to be served.

B The maximum gain at which the equipment can be set is limited by the isolation that can be achieved between these two antennas. Therefore when the antennas have been installed, inject a signal (at a known power level) into one of them and measure the signal level received by the other antenna on a spectrum analyser. The isolation can then be calculated as the difference between these two figures. The gain in each path of the equipment should be set at least 10 dB below this figure, using attenuators as described below in paragraph E.

C Also measure the received signal from the donor cell at the input to the equipment (base port). The gain of the equipment downlink path should be set such the donor site will not overload the equipment amplifiers. It is recommended that the input level should be less than -50dBm at the input of the equipment (Base Port). (This figure is assuming maximum gain, and may be increased by the value of the attenuator fitted in the downlink path.)

D Ensure that the mobile facing antenna has at least 70dB isolation from the nearest mobile. (This is usually easily achieved when using a leaky feeder.)

E The equipment gain is set by setting the variable switched attenuators in each path (uplink and downlink) refer to the photographs and layout drawings for the exact attenuator locations). Note that the uplink (mobile to base) and downlink (base to mobile) path gains are set independently. This allows the paths to have different gains if required to set the correct output power levels.

F It is recommended that the gains are set such that the Downlink channel output levels from the equipment are typically +30dBm per channel
(Input level + Gain = Output level).

7. Maintenance – General Notes

7.1. Fault Finding

7.1.1. Quick Fault Checklist

All tunnel equipment is individually tested to specification prior to despatch. Failure of this type of equipment is not common. Experience has shown that a large number of fault conditions relating to tunnel installations result from simple causes often occurring as result of transportation, unpacking and installation. Below are listed some common problems which have resulted in poor performance or an indicated non-functioning of the equipment.

- Mains power not connected or not switched on.
- External connectors not fitted or incorrectly fitted.
- Internal connectors becoming loose due to transport vibration.
- Wiring becoming detached as a result of heavy handling.
- Input signals not present due to faults in the antenna and feeder system.
- Base transmissions not present due to fault at the base station.
- Modems fitted with incorrect software configuration.
- Changes to channel frequencies and inhibiting channels.
- Hand held radio equipment not set to repeater channels.
- Hand held radio equipment not set to correct base station.

7.1.2 Fault Isolation

In the event that the performance of the system is suspect, a methodical and logical approach to the problem will reveal the cause of the difficulty. The System consists of modules fitted in enclosed shelves within a rack mounted, environmentally protected enclosure.

Transmissions from the main base stations are passed though the system to the mobile radio equipment; this could be a handheld radio or a transceiver in a vehicle. This path is referred to as the downlink. The return signal path from the mobile radio equipment to the base station is referred to as the uplink.

The first operation is to check the alarms of each of the active units and determine that the power supplies to the equipment are connected and active.
This can be achieved remotely (via CEMS, the RS232 Coverage Enhancement Management System, if fitted), or locally with the front panel LED's. The green LED on the front panel should be illuminated, while the red alarm indicator should be off. If an Alarm is on, then that individual shelf must be isolated and individually tested against the original test specification.

The individual amplifier units within the shelf have a green LED showing through a hole in their piggy-back alarm board, which is illuminated if the unit is working correctly. If an amplifier is suspect, check the DC power supply to the unit. If no other fault is apparent use a spectrum analyser to measure the incoming signal level at the input and then after reconnecting the amplifier input, measure the output level. Consult with the system diagram to determine the expected gain and compare result.

In the event that there are no alarms on and all units appear to be functioning it will be necessary to test the system in a systematic manner to confirm correct operation.

7.1.3 Downlink

Confirm that there is a signal at the expected frequency and strength from the base station. If this is not present then the fault may lay outside the system. To confirm this, inject a downlink frequency signal from a known source at the master site BTS input and check for output at the remote site feeder output.

If a signal is not received at the output it will be necessary to follow the downlink path through the system to find a point at which the signal is lost. The expected downlink output for the given input can be found in the end-to-end test specification.

7.1.4 Uplink

Testing the uplink involves a similar procedure to the downlink except that the frequencies used are those transmitted by the mobile equipment.

7.1.5 Fibre Optics

The Fibre Optic transmitters and receivers both have two LED status indicators, one on each module showing DC power and the other indicating 'Laser On' for the transmitter, and 'Carrier Being Received' for the receiver. Assuming that all of the indicators are illuminated, it will be necessary to check the RF inputs and outputs to the fibre optic units.

Typically the input to transmitter units will be at a level of between -30 and -15 dBm. The RF gain of a pair (TX to RX) units is factory set to give a 0dB gain, but this is with a short, low loss fibre. In determining the performance of the link, the insertion loss of the fibre and any power splitters fitted must be considered. A general rule of thumb figure would be around 0.5 - 1.5dB loss per Kilometre.

7.1.7 Checking service

Following the repair of any part of the system it is recommended that a full end-to-end test is carried out in accordance with the test specification and that the coverage is checked by survey.
It is important to bear in mind that the system includes a radiating cable network and base stations that may be faulty or may have been damaged.

7.1.8 Fault repair

Once a faulty component has been identified, a decision must be made on the appropriate course to carry out a repair. A competent engineer can quickly remedy typical faults such as faulty connections or cables. The exceptions to this are cable assemblies connecting bandpass filter assemblies that are manufactured to critical lengths to maintain a 50-ohm system.

Care should be taken when replacing cables or connectors to ensure that items are of the correct specification. The repair of component modules such as amplifiers and bandpass filters will not usually be possible in the field, as they frequently require specialist knowledge and test equipment to ensure correct operation. It is recommended that items of this type are replaced with a spare unit and the faulty unit returned to Axell Wireless for repair.

7.1.9 Service Support

Advice and assistance with maintaining and servicing this system are available by contacting Axell Wireless Ltd., see section 2.7.

NOTE

Individual modules are not intended to be repaired on site and attempts at repair will invalidate active warranties. Company policy is that individual modules should be repaired by replacement. Axell Wireless Ltd. maintains a level of stock of most modules which can usually be despatched at short notice to support this policy.

7.2 Tools & Test Equipment

The minimum tools and test equipment needed to successfully service this Axell Wireless product are as follows:-

Spectrum analyser	100kHz to 2GHz (Dynamic range = 90dB).
Signal Generator	30MHz to 2GHz (-120dBm to 0dBm o/p level).
Attenuator	20dB, 10W, DC-2GHz, (N male – N female).
Test Antenna	Yagi or dipole for operating frequency.
Optical Power Meter	1300 – 1560nM (-40 - +10dB)
Digital multi-meter	Universal Volt-Ohm-Amp meter.
Test cable x 2	N male – N male, 2M long RG214.
Test cable x 2	SMA male – N male, 1m long RG223.
Hand tools	Philips #1&2 tip screwdriver.
	3mm flat bladed screwdriver.
	SMA spanner and torque setter.

7.3 Care of Modules

7.3.1 General Comments

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

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

7.3.2 Module Removal (LNAs, general procedure):

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

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

7.3.3 Module Replacement (general):

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

7.3.4 Power Amplifiers

1) Remove power to the unit. (Switch off at mains/battery, or remove DC in connector)

2) Remove alarm wires from alarm screw terminal block or disconnect multi-way alarm connector.

3) Carefully disconnect the RF input and output coaxial connectors (usually SMA)

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

4) There is (usually) a plate attached to the alarm board which fixes it to the amplifier, remove its retaining screws and the alarm board can be withdrawn from the amplifier in its entirety. On certain types of amplifier the alarm board is not mounted on a dedicated mounting plate; in this case it will have to firstly be removed by unscrewing it from the mounting pillars, in most cases, the pillars will not have to be removed before lifting the amplifier.

5) If the amplifier to be removed has a heatsink attached, there may be several different ways it can have been assembled. The most commonly used method, is screws through the front of the heatsink to threaded screw holes (or nuts and bolts), into the amplifier within the main case. If the heatsink is mounted on the rear of the main case (e.g., against a wall in the case of wall mounted enclosures), then the fixing method for the heatsink will be from within the case, (otherwise the enclosure would have to be removed from the wall in order to remove the heatsink).

When the heatsink has been removed, the amplifier may be unscrewed from the main casing by its four corner fixings and gently withdrawn.

Fitting a new power amplifier module will be the exact reverse of the above.

Note: Do not forget to apply fresh heatsink compound to the heatsink/main case joint and also between the amplifier and the main case.

7.3.5 Low Power Amplifier Replacement

- Disconnect the mains power supply and disconnect the 24V dc supply connector for the LPA.
- Disconnect the RF input and output cables from the LPA.
- Disconnect the alarm connector.
- Remove the alarm monitoring wires from (D type connector) pins 9 and 10.
- Remove the LPA module by removing the four retaining screws, replace with a new LPA module and secure it with the screws.
- Connect the RF cables to the LPA input and output connectors. Reconnect the wires to the alarm board connector pins 9 and 10.
- Reconnect the DC supply connector and turn the mains switch on.

Note: Tighten SMA connectors using only a dedicated SMA torque spanner. If SMA connectors are over-tightened, irreparable damage will occur. Do not use adjustable pliers to loosen/tighten SMA connectors.

Also take care not to drop or knock the module as this can damage (or misalign in the case of tuned passive modules) sensitive internal components. Always store the modules in an environmentally friendly location

7.3.6 Module Transportation:

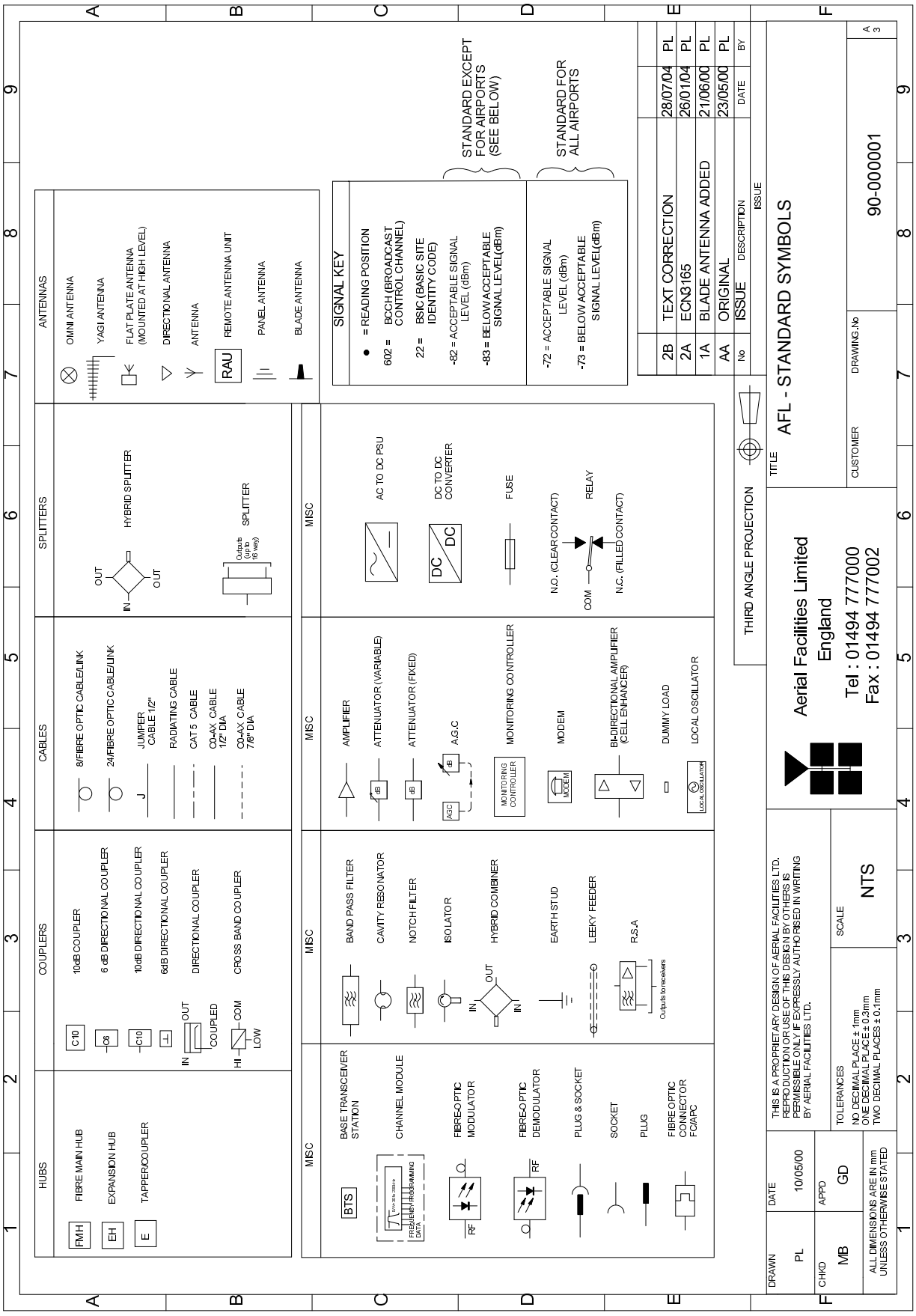
To maintain the operation, performance and reliability of any module it must be stored and transported correctly. Any module not installed in a whole system must be kept in an anti-static bag or container. These bags or containers are normally identified by being pink or black, and are often marked with an ESD label. Any module sent back to Axell Wireless for investigation/repair must be so protected. Please contact the Axell Wireless quality department before returning a module, see section 2.7.

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 Cell Enhancer designed for operation on a range of channels within a specified frequency band.
Channel Selective Repeater	A Cell Enhancer, 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
BTS	Base Transceiver Station
CEMS	Coverage Enhanced Management System
C/NR	Carrier-to-Noise Ratio
DC	Direct Current
Downlink (D/L)	RF signals TX from the BTS to the Master Site
FO	Fibre Optic
GND	Ground
ID	Identification Number
LED	Light Emitting Diode
LNA	Low Noise Amplifier
LPA	Low Power Amplifier
MOU	Master Optical Unit
M.S.	Mobile Station
MTBF	Mean Time Between Failures
N/A	Not Applicable
N/C	No Connection
OFR	On Frequency Repeater
OIP3	Output Third Order Intercept Point
P1dB	1dB Compression Point
PA	Power Amplifier
RF	Radio Frequency
RSA	Receiver/Splitter Amplifier
RX	Receiver
S/N	Serial Number
TX	Transmitter
Uplink (U/L)	RF signals transmitted from the MS to the BTS
VSWR	Voltage Standing Wave Ratio
WDM	Wave division multiplex

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



A.3. EC Declaration of Conformity

In accordance with BS EN ISO/IEC 17050-1&-2:2004

Axell Wireless Limited
Aerial House
Asheridge Road
Chesham
Buckinghamshire HP5 2QD
United Kingdom

CE 0086

DECLARES, UNDER OUR SOLE RESPONSIBILITY THAT THE FOLLOWING PRODUCT:
PRODUCT PART No. AND DESCRIPTION

60-214702 Tri-Band Cable Signal Combiner
60-214701 Fibre Fed Remote Repeater
60-214703 Redundant PSU + Battery Backup

IN ACCORDANCE WITH THE FOLLOWING DIRECTIVES:

1999/5/EC The Radio & Telecommunications Terminal Equipment Directive Annex V and its amending directives

HAS BEEN DESIGNED AND MANUFACTURED TO THE FOLLOWING STANDARD[S] OR OTHER NORMATIVE DOCUMENT[S]:

BS EN 60950 Information technology equipment.
Safety. General requirements

ETS EN 301 489-1 EMC standard for radio equipment and services.
Part 1. Common technical requirements

I hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications. The unit complies with all essential requirements of the Directives.
SIGNED

B. S. Barton
Operations Director

DATE: 24/06/2008

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
A	11 June 2008	AJS		Draft
B	29 July 2008	AJS	3.2.	Preliminary Issue
1	29 August 2008	AJS	3.2.	Issue

Appendix B

B.1 Initial Equipment Set-Up Calculations

General Information			
Site Name:		Client Name:	
Date:		AWL Equip. Model No.	

Antenna Systems				
	Model	Gain	Azimuth	Comments
A - Service Antenna				
B – Donor Antenna				
	Type	Loss	Length	Comments
C – Service Feeder				
D – Donor Feeder				

Initial Parameters	
E – CE Output Power	dBm
F – Antenna Isolation	dB
G – Input signal level from donor BTS	dBm
Operating Voltage	V

Downlink Calculations		
Parameter	Comments	Value
Input signal level (G)		dBm
CE max. o/p power (E)		dBm
Gain setting	E - G	dB
Isolation required	(Gain + 10dB)	dB
Service antenna gain (A)		dB
Service antenna feeder loss (C)		dB
Effective radiated power (ERP)	E+A-C	dBm
Attenuator setting	CE gain-gain setting	dB

If the input signal level in the uplink path is known and steady, use the following calculation table to determine the gain setting. If the CE features Automatic Gain Control the attenuator should be set to zero and if not, then the attenuation setting for both uplink and downlink should be similar.

Uplink Calculations		
Parameter	Comments	Value
Input signal level		dBm
CE max. o/p power (E)		dBm
Gain setting		dB
Required isolation		dB
Donor antenna gain (B)		dB
Donor antenna feeder loss (D)		dB
Effective radiated power (ERP)	E+B-D	dBm
Attenuator setting	(CE gain-gain setting)	dB