

# Roseville Tunnel Band Selective

## PCS Repeater


User Handbook

For

AFL Inc.

AFL Works Order Nō.: Q112081

AFL product part Nō.: 55-151601

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	Handbook Nō.-55-151601HBK	Issue No:-A	Date:- <b>22/04/2005</b>   Page:-1 of 29

# Table of Contents

<b>AMENDMENT LIST RECORD SHEET .....</b>	<b>3</b>
<b>INTRODUCTION.....</b>	<b>4</b>
<b>Scope .....</b>	<b>4</b>
<b>Purpose .....</b>	<b>4</b>
<b>Glossary of Terms.....</b>	<b>5</b>
<b>Key to AFL RF Module Drawing Symbols .....</b>	<b>6</b>
<b>1. SAFETY CONSIDERATIONS.....</b>	<b>7</b>
<b>1.1 Earthing of Equipment .....</b>	<b>7</b>
<b>1.2 Electric Shock Hazard.....</b>	<b>7</b>
<b>1.3 RF Radiation Hazard.....</b>	<b>8</b>
<b>1.4 Chemical Hazard .....</b>	<b>9</b>
<b>1.5 Emergency Contact Numbers.....</b>	<b>9</b>
<b>2. SYSTEM OVERVIEW .....</b>	<b>10</b>
<b>3. PCS BAND-SELECTIVE BDA.....</b>	<b>11</b>
<b>3.P System Photographs .....</b>	<b>11</b>
<b>3.1 Description .....</b>	<b>12</b>
<b>3.2 Technical Specification.....</b>	<b>12</b>
<b>3.3 Mechanical Specification.....</b>	<b>13</b>
<b>3.4 System Drawings.....</b>	<b>14</b>
<b>3.5 Parts Lists.....</b>	<b>15</b>
<b>4. SUB-UNIT MODULES.....</b>	<b>16</b>
<b>4.1 Bandpass Filters (02-011505 &amp; 02-011506).....</b>	<b>16</b>
<i>4.1.1 Description .....</i>	<i>16</i>
<i>4.1.2 Technical Specification.....</i>	<i>16</i>
<b>5. INSTALLATION .....</b>	<b>23</b>
<b>5.1 Initial Installation Record.....</b>	<b>23</b>
<b>6. MAINTENANCE .....</b>	<b>24</b>
<b>6.1 General Procedures .....</b>	<b>24</b>
<i>6.1.1 Fault Finding.....</i>	<i>24</i>
<i>6.1.2 Downlink.....</i>	<i>25</i>
<i>6.1.3 Uplink .....</i>	<i>25</i>
<i>6.1.4 Fault repair.....</i>	<i>25</i>
<i>6.1.5 Checking service.....</i>	<i>26</i>
<i>6.1.6 Service Support.....</i>	<i>26</i>
<b>6.2 Tools &amp; Test Equipment .....</b>	<b>26</b>
<b>6.3 Care of Modules.....</b>	<b>27</b>
<i>6.3.1 General Comments .....</i>	<i>27</i>
<i>6.3.2 Module Removal (LNA's, general procedure): .....</i>	<i>27</i>
<i>6.3.3 Module Replacement (general): .....</i>	<i>27</i>
<i>6.3.4 Power Amplifiers .....</i>	<i>27</i>
<i>6.3.5 Low Power Amplifier Replacement .....</i>	<i>28</i>
<i>6.3.6 Module Transportation: .....</i>	<i>28</i>
<b>APPENDIX A INITIAL EQUIPMENT SET-UP CALCULATIONS.....</b>	<b>29</b>



## INTRODUCTION

### Scope

This handbook is for use solely with the equipment identified by the AFL Part Number shown on the front cover. It is not to be used with any other equipment unless specifically authorised by Aerial Facilities Limited.

### Purpose

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

This handbook has been prepared in accordance with BS 4884, and AFL's Quality procedures, which maintain the company's registration to 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.


### Limitation of Information Notice

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

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

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

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

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	Handbook Nō.-55-151601HBK	Issue No:-A	Date:- <b>22/04/2005</b>

## Glossary of Terms

### **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.

**BTS**

Base Transceiver Station

**C/NR**

Carrier-to-Noise Ratio

**Downlink (D.L.)**

RF signals transmitted from the BTS and to the MS

**Uplink (U.L.)**

RF signals transmitted from the MS to the BTS

**EMC**

Electromagnetic Compatibility

**GND**

Ground

**DC**

Direct Current

**AC**

Alternating Current

**ID**

Identification Number

**OIP3**

Output Third Order Intercept Point =  $RF_{out} + (C/I)/2$

**LED**

Light Emitting Diode

**M.S.**

Mobile Station

**N/A**

Not Applicable

**N/C**

No Connection

**NF**

Noise Figure

**RF**

Radio Frequency

**Rx**

Receiver

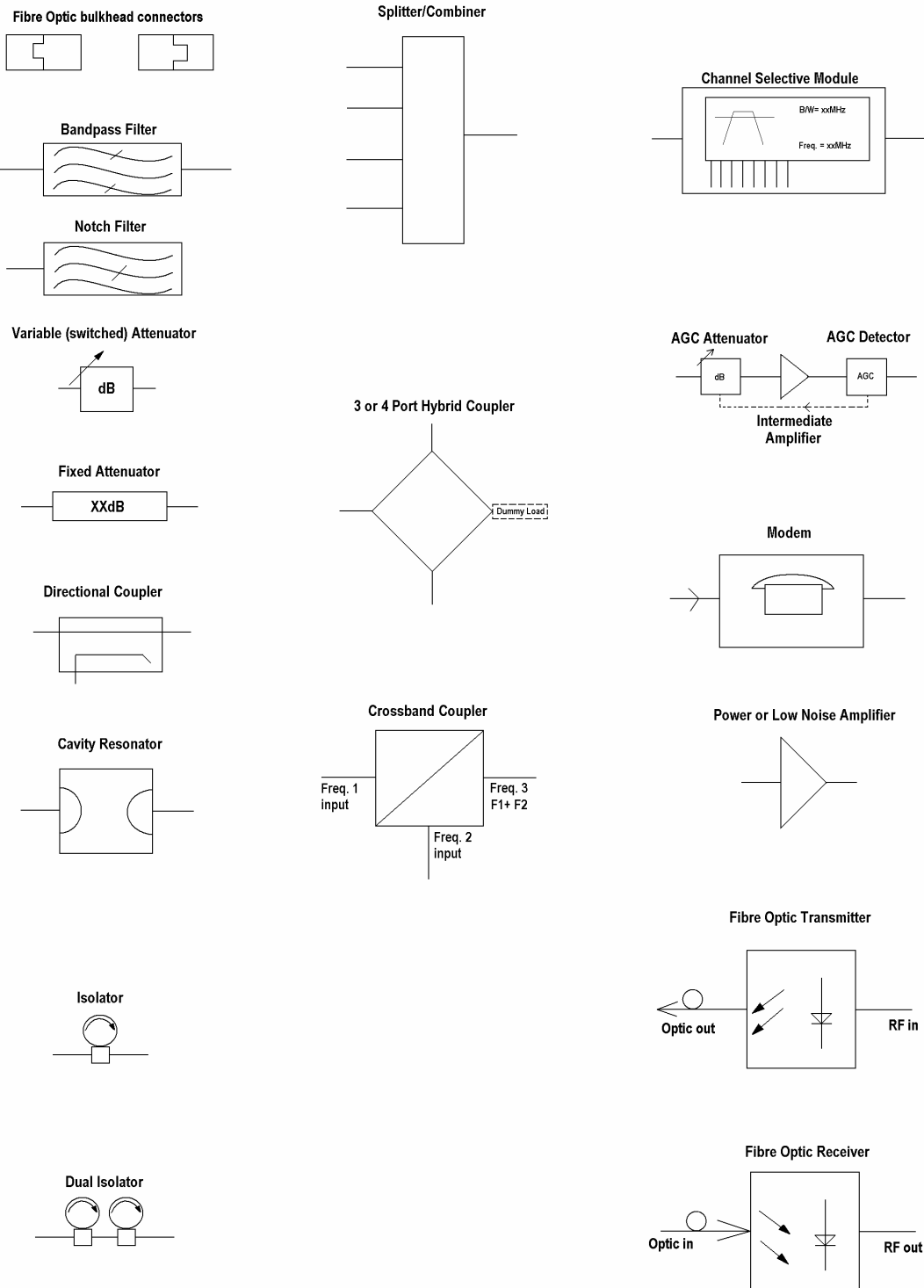
**Tx**

Transmitter


**S/N**

Serial Number

## Key to AFL RF Module Drawing Symbols



## Key to AFL RF Modules

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	Handbook No.-55-151601HBK	Issue No:-A	Date:-22/04/2005

## 1. SAFETY CONSIDERATIONS

### 1.1 Earthing of Equipment



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

### 1.2 Electric Shock Hazard




Electrical shocks due to faulty mains driven power supplies.

Whilst ever potentially present in any electrical equipment, such a condition would be minimised by quality installation practice and thorough testing at:

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

All test equipment to be in good working order prior to its use. High current power supplies can be dangerous because of the possibility of substantial arcing. Always switch off during disconnection and reconnection.

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	Handbook Nō.-55-151601HBK	Issue No:-A	Date:- <b>22/04/2005</b>

### 1.3 RF Radiation Hazard




RF radiation, (especially at UHF frequencies) arising from transmitter outputs connected to AFL's equipment, must be considered a safety hazard.

This condition might only occur in the event of cable disconnection, or because a 'spare' output has been left unterminated. Either of these conditions would impair the system's efficiency. No investigation should be carried out until all RF power sources have been removed. This would always be a wise precaution, despite the severe mismatch between the impedance of an N type connector at  $50\Omega$ , and that of free space at  $377\Omega$ , which would severely mitigate against the efficient radiation of RF power. Radio frequency burns could also be a hazard, if any RF power carrying components were to be carelessly touched!

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

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

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	Handbook Nō.-55-151601HBK	Issue No:-A	Date:- <b>22/04/2005</b>



## 1.4 Chemical Hazard



**Beryllium Oxide**, also known as Beryllium Monoxide, or Thermalox™, is sometimes used in devices within equipment produced by Aerial Facilities Ltd. Beryllium oxide dust can be toxic if inhaled, leading to chronic respiratory problems. It is harmless if ingested or by contact.

Products that contain beryllium are load terminations (dummy loads) and some power amplifiers. These products can be identified by a yellow and black “skull and crossbones” danger symbol (shown above). They are marked as hazardous in line with international regulations, but pose no threat under normal circumstances. Only if a component containing beryllium oxide has suffered catastrophic failure, or exploded, will there be any danger of the formation of dust. Any dust that has been created will be contained within the equipment module as long as the module remains sealed. For this reason, any module carrying the yellow and black danger sign should not be opened. If the equipment is suspected of failure, or is at the end of its life-cycle, it must be returned to Aerial Facilities Ltd for disposal.

To return such equipment, please contact the Quality Department, who will give you a Returned Materials Authorisation (RMA) number. Please quote this number on the packing documents, and on all correspondence relating to the shipment.

### **PolyTetraFluoroEthylene, (P.T.F.E.) and P.T.F.E. Composite Materials**


Many modules/components in AFL equipment contain P.T.F.E. as part of the RF insulation barrier.

This material should never be heated to the point where smoke or fumes are evolved. Any person feeling drowsy after coming into contact with P.T.F.E. especially dust or fumes should seek medical attention.

## 1.5 Emergency Contact Numbers

The AFL Quality Department can be contacted on:

Telephone +44 (0)1494 777000  
Fax +44 (0)1494 777002  
e-mail qa@aerial.co.uk

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	Handbook Nō.-55-151601HBK	Issue No:-A	Date:- <b>22/04/2005</b>

## 2. SYSTEM OVERVIEW

The AFL Band Selective Cell Enhancer is a 2-way on-band repeater. Various models are available to cover frequency bands from 50MHz to 3000MHz with power levels up to 100Watts. Its main sphere of applications is in urban areas where the topology is such that shadows occur in the propagation pattern (for example within large buildings, conference centres and tunnels, etc.)


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

Each active module carries its own volt-free, alarm relay contact interface which may be easily integrated into any such summary system. A comprehensive range of RS232/422 computer controlled alarms/monitors for band selective and channelised systems is also available.

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

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


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

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	Handbook Nō.-55-151601HBK	Issue No:-A	Date:-22/04/2005

### 3. PCS BAND-SELECTIVE BDA

#### 3.P System Photographs



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Handbook No.-55-151601HBK	Issue No:-A	Date:-22/04/2005	Page:-11 of 29	

### 3.1 Description

The band selective (no channelisation) tunnel amplifier is directly connected to an air interface antenna directed towards the base station and a leaky feeder antenna to cover the mobiles in the tunnel. The downlink power is 20Watts, provided by a pair of parallel configured 10W amplifiers, and the uplink power device is a single 1W amplifier, which is sufficient power for ample communications with the base station.

Automatic gain control is featured in both paths to prevent overloading of the input stages should a mobile be operated close to the antennas.

A built-in current fault alarm system monitors each active device in the system and outputs a summary volt-free, relay contact pair suitable for integrating into any existing alarm loop system.

### 3.2 Technical Specification

PARAMETER		SPECIFICATION
Frequency range:		1930-1990MHz (Downlink)
		1850-1910MHz (Uplink)
Bandwidth:		60MHz
Passband ripple:		±1.5dB
Gain:		>85dB
Gain Adjustment:		0 - 30dB (in 2dB steps, both paths)
Uplink Power:		>1.0Watts
Downlink Power:		>20.0Watts
IP3:	Uplink:	+40dBm
	Downlink:	+52.5dBm
1dB compression point:		+41.5dBm (downlink)
		+29dBm (uplink)
Noise Figure:		<6dB (@max gain)
AGC:		+40dBm (downlink)
		+28dBm (uplink)
VSWR:		better than 1.5:1
RF Connectors:		N type, female
Temperature range:	operational:	-10°C to +60°C
	storage:	-40°C to +70°C
Alarms Fitted: (volt-free relay contacts/TTL)		1 Amplifiers (U/L & D/L)

### 3.3 Mechanical Specification

PARAMETER		SPECIFICATION
Case size	Height:	<b>620mm</b>
	Width:	<b>420mm</b>
	Depth:	<b>250mm</b>
(excluding heatsinks, connectors, handles and feet)		
Fixings:		4 holes on <b>470(w) x 500(h)mm</b>
Temperature Range:	operational:	<b>-10°C to +60°C</b>
	storage:	<b>-40°C to +70°C</b>
Weight:		35kg (approximately)
RF Connectors:		<b>N</b> type female
Environmental Protection:		<b>IP65</b> (with door closed and all ports terminated)
Finish:	Case:	To <b>RAL 7035</b>
	Heatsinks:	<b>Matt black</b> (where fitted)
	Handles:	Black Technopolymer
Supply Cable:		Unit supplied with suitable supply input leads with connector and appropriate length of cable



### 3.5 Parts Lists

AFL Part Nō.	Part Description	Qty.
02-011505	PCS Rx Filter (SMA)	4
02-011506	PCS Tx Filter (SMA)	4
05-002601	PCN SPLITTER/COMBINER, 20W	2
10-001204	ATTEN.REMOTE D TYPE 30dB 12V	2
10-001720	REMOTE ATTEN. SWITCH PLATE(END)	2
10-001725	REMOTE ATTEN. SWITCH PCB	2
11-006302	PCN 1W AMP. 15dB GAIN (WITH RELAY)	1
11-007202	LOW NOISE AMPLIFIER PCN WITH RELAY	1
11-008201	LOW NOISE AMPLIFIER PCN 30dB GAIN	4
12-017301	POWER AMPLIFIER PCN 10W	2
17-000126	CELL ENHANCER LABEL 6 DIGIT	1
17-000526	CE 10/20W HEATSINK THERMAL GASKET	3
17-001109	CE AGC UNIT LOG DET/AMP ASSY (12v)	2
17-001201	C/E AGC UNIT ATTENUATOR ASSY	2
17-001522	BASE PLATE 560x345mm 17-001520&9020	1
17-009020	ENCLOSURE 620x420x250 (3 H/S) ALU	1
80-008901	12V RELAY PCB ASSEMBLY	1
80-032320	10W PA HEATSINK (NEEDS 17-000526)	2
80-310420	BCC 400W POWER SUPPLY HEATSINK	1
90-100003	MAINS LEAD '6 AMP'	1
90-200004	DC I/P LEADS, FREE SOCKET	1
90-400006	ALARM LEADS	1
91-030002	N ADAPTOR PANEL FEMALE:FEMALE	2
91-130001	SMA ADAPT 'T' ALL FEMALE 3 GHz	2
91-500011	PWR 3POLE PNL PLUG SEALED IP68	1
91-500013	PWR 2POLE PNL PLUG SEALED IP68	1
91-500015	PWR CON CAP SEALED with INT. THREAD	3
91-500016	PWR 6POLE PNL PLUG SEALED IP68	1
91-510032	20A SOCKET CONTACT PIN	4
91-600007	'D' 9 WAY BLACK SHELL	8
91-600014	'D' 9 WAY SOCKET S/B (NON FILTERED)	8
91-660001	2W5 MIXED D TYPE SOCKET (7 WAY)	2
96-110047	20A ATO FUSE	1
96-500003	AC FILTER 110V 5A	1
96-700034	LED RED 5mm IP67 INTEGRAL RES. 24V	1
96-700035	LED GREEN 5mm IP67 INTEGRAL RES 24V	1
96-900018	AC TRIP SWITCH (5 AMP M.C.B.)	1
96-920002	DPDT MINI TOGGLE SWITCH	8
97-300010	C/E SUPPLY INPUT COVER	1
97-300011/2	DC BOX 12V ATO TYPE 1 ASSEMBLY	1
97-400010	BLACK PLASTIC HANDLE 50mm HIGH	2
97-900003	RUBBER FOOT 1 1:2' DIA.	4

## 4. SUB-UNIT MODULES

### 4.1 Bandpass Filters (02-011505 & 02-011506)

#### 4.1.1 Description

The bandpass filters are multi-section designs with a bandwidth dependent upon the passband frequencies, (both tuned to customer requirements). The response shape is basically Chebyshev with a passband design ripple of 0.1dB. The filters are of slot coupled, folded combline design, and are carefully aligned during manufacture in order to optimise the insertion loss, VSWR and intermodulation characteristics of the unit. The tuned elements are silver-plated to reduce surface ohmic losses and maintain a good VSWR figure and 50Ω load at the input and output ports.

Being passive devices, the bandpass filters should have an extremely long operational life and require no maintenance. Should a filter be suspect, it is usually most time efficient to replace the module rather than attempt repair or re-tuning.

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

#### 4.1.2 Technical Specification

PARAMETER		SPECIFICATION
Response Type		Chebyshev
Frequency Range:		1850-1910MHz (02-011505) 1930-1990MHz (02-011506)
Bandwidth:		60MHz (tuned to spec.)
Number of Sections:		6
Insertion Loss:		1.2 dB
VSWR:		better than 1.2:1
Connectors:		SMA female
Power Handling:		100W max
Temperature range:	operation:	-10°C to +60°C
	storage:	-20°C to +70°C
Weight:		3 kg (typical)



## 4.2 PCN Splitter/Combiner (05-002601)

### 4.2.1 Description

The Splitter/Combiner used is a device for accurately matching two or more RF signals to single or multiple ports; most usually within a specified frequency band, whilst maintaining an accurate 50Ω load to all inputs/outputs and ensuring that the VSWR and insertion losses are kept to a minimum. Any unused ports will be terminated with an appropriate 50Ω load.

### 4.2.2 Technical Specification

PARAMETER		SPECIFICATION
Frequency Range:	Narrowband:	1700–2000 MHz
	Broadband:	1500–2200 MHz
Bandwidth:	Narrowband:	300 MHz
	Broadband:	700 MHz
Inputs:		1
Outputs:		2
Isolation:	Narrowband:	>20 dB
	Broadband:	>18 dB
Insertion Loss:	Narrowband:	3.3 dB
	Broadband:	3.5 dB
VSWR Input & Output:		Better than 1.3:1
Connectors:		SMA female
Weight:		200gms
Size:		54 x 44 x 21mm
Power Rating:	Splitter:	20 Watts
	Combiner:	0.5Watts


## 4.3 ¼Watt 0- -30dB Switched Attenuator (10-001204)

### 4.3.1 General Application

In many practical applications for Cell Enhancers etc., the gain in each path is found to be excessive. Therefore, provision is made within the unit for the setting of attenuation in each path, to reduce the gain.

### 4.3.2 Switched Attenuators

The AFL switched attenuators are available in two different types; 0 – 30dB in 2 dB steps (as in this case), or 0 – 15dB in 1 dB steps. The attenuation is simply set using the four miniature toggle switches on the top of each unit. Each switch is clearly marked with the attenuation it provides, and the total attenuation in line is the sum of the values switched in. They are designed to maintain an accurate 50Ω impedance over their operating frequency at both input and output.

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	Handbook Nō.-55-151601HBK	Issue No:-A	Date:-22/04/2005

#### 4.4 Low Noise Amplifier (11-006302)

##### 4.4.1 Description


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, then the complete amplifier should be replaced.


##### 4.4.2 Technical Specification

PARAMETER		SPECIFICATION
Frequency range:		1700-1930MHz
Bandwidth:		200MHz
Gain:		15dB
1dB compression point:		31dBm
IP3:		44dBm
I/O return loss:		>18dB
Noise figure:		<1.3dB
Supply requirement:		10 – 24V, DC
Consumption:		560-590mA @ (10 – 24V)
Temperature range	operation:	-10°C to +60°C
	storage:	-20°C to +70°

##### 4.4.3 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

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Handbook Nō.-55-151601HBK	Issue No:-A	Date:- <b>22/04/2005</b>	Page:-19 of 29

 <p><b>Aerial Facilities Limited</b> <a href="http://www.AerialFacilities.com">www.AerialFacilities.com</a> <b>Technical Literature</b></p>	<p><b>Roseville Tunnel PCS Band Selective Repeater</b> User Handbook</p>		
Handbook No.-55-151601HBK	Issue No:-A	Date:- <b>22/04/2005</b>	Page:-20 of 29



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**Technical Literature**


**Roseville Tunnel PCS Band Selective Repeater**  
User Handbook

Handbook Nō.-55-151601HBK

Issue No:-A

Date:-**22/04/2005**


Page:-21 of 29

 <p><b>Aerial Facilities Limited</b> <a href="http://www.AerialFacilities.com">www.AerialFacilities.com</a> <b>Technical Literature</b></p>	<p><b>Roseville Tunnel PCS Band Selective Repeater</b> User Handbook</p>		
Handbook No.-55-151601HBK	Issue No:-A	Date:- <b>22/04/2005</b>	Page:-22 of 29

## 5. INSTALLATION

### 5.1 Initial Installation Record

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

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	Handbook Nō.-55-151601HBK	Issue No:-A	Date:- <b>22/04/2005</b>

## 6. MAINTENANCE

### 6.1 General Procedures

#### 6.1.1 Fault Finding

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

Transmissions from the main base stations are passed through 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 removed 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.

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	Handbook Nō.-55-151601HBK	Issue No:-A	Date:- <b>22/04/2005</b>



### 6.1.2 Downlink

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


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

### 6.1.3 Uplink

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

### 6.1.4 Fault repair

Once a faulty component has been identified, a decision must be made on the appropriate course to carry out a repair. A competent engineer can quickly remedy typical faults such as faulty connections or cables. The exceptions to this are cable assemblies connecting bandpass filter assemblies that are manufactured to critical lengths to maintain a 50-ohm system. Care should be taken when replacing cables or connectors to ensure that items are of the correct specification. The repair of component modules such as amplifiers and bandpass filters will not usually be possible in the field, as they frequently require specialist knowledge and test equipment to ensure correct operation. It is recommended that items of this type are replaced with a spare unit and the faulty unit returned to AFL for repair.

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	Handbook Nō.-55-151601HBK	Issue No:-A	Date:- <b>22/04/2005</b>

### 6.1.5 Checking service

Following the repair of any part of the system it is recommended that a full end-to-end test is carried out in accordance with the test specification and that the coverage is checked by survey.

It is important to bear in mind that the system includes a radiating cable network and base stations that may be faulty or may have been damaged.


### 6.1.6 Service Support

Advice and assistance with maintaining and servicing this system are available by contacting Aerial Facilities Ltd.

## 6.2 Tools & Test Equipment

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

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

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	Handbook Nō.-55-151601HBK	Issue No:-A	Date:-22/04/2005

## 6.3 Care of Modules

### 6.3.1 General Comments

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

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

### 6.3.2 Module Removal (LNA's, 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).

### 6.3.3 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.

### 6.3.4 Power Amplifiers

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

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

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

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	Handbook Nō.-55-151601HBK	Issue No:-A	Date:- <b>22/04/2005</b>

- 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.**

#### 6.3.5 Low Power Amplifier Replacement


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

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

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

#### 6.3.6 Module Transportation:

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

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	Handbook Nō.-55-151601HBK	Issue No:-A	Date:-22/04/2005

## APPENDIX A INITIAL EQUIPMENT SET-UP CALCULATIONS

GENERAL INFORMATION			
Site Name:		Client Name:	
Date:		AFL Equip. Model Nō.	

ANTENNA SYSTEMS				
	<b>Model</b>	<b>Gain</b>	<b>Azimuth</b>	<b>Comments</b>
A - Service Antenna				
B – Donor Antenna				
	<b>Type</b>	<b>Loss</b>	<b>Length</b>	<b>Comments</b>
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	<b>E - G</b>	dB
Isolation required	(Gain + 10dB)	dB
Service antenna gain (A)		dB
Service antenna feeder loss (C)		dB
Effective radiated power (ERP)	<b>E+A-C</b>	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)	<b>E+B-D</b>	dBm
Attenuator setting	(CE gain-gain setting)	dB