BSR757
Factory Acceptance Test
(FAT)

Arcadian Networks Broadband Wireless Access System

700 MHz UHF system, IP
A-Guard Band

1/May/08

Version 2.01

Copyright and Compliance

Copyright Information

Revision History

Date	ECO	Version	Description	Author
25/10/07	----	**2.00**	First release for rebanding – Based on Version 1.14 of the BTS-700	Baruch (Hillel)
4/5/08	----	**2.01**	Update output level, RCU delete	Hillel

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1 Overview

The purpose of this document is to provide methodology and instruction for testing the performance integrity of the Arcadian Networks Base station Rack, not including any antennae. This document will detail all required tests, the points within the Arcadian Networks BSR where test measurements will be taken, the equipment required to perform the tests and the configuration of the test equipment. Test results that show compliance are to be recorded where indicated within this document. Equipment that is found to be non-compliant is to be replaced and tested. The FAT will be deemed completed when all tests have been performed and all equipment is operating within the required ranges.

This document can be used for testing single, dual or triple sector BTS. Key differences among the different types of equipment are:

- Mechanical configuration
- RF configuration (upstream and downstream channels)
- Test points

☑ **Note:**. The BSR-757 Base Station replaces the BSR-700 station. The BSR-757 supports A-Guard Band after the 700 MHz Band Restructure. **This FAT should not be used to test the BSR-700.** The BSR-700 has its own FAT.

1.1 Test Equipment/Tools

The following equipment/tools are required:

Equipment	QTY	Remarks	Respons
Spectrum Analyzer	1	HP 4403E (or equivalent) with "Auto Channel Measurement" option	Factory
Signal Generator	1		Factory
Various RF Cables, Connectors and Attenuators	-	As needed, including two six foot RF test cables of RG-6 (or less loss cable) with male f-connectors on both ends, two Cat-5 Cross-connect Ethernet cables with RJ45 connectors on both ends, one 6 dB attenuator, several other attenuators of various values and/or an adjustable attenuator, a 100 Watt dummy load, and a 20 dB antenna coupler.	Factory
Windows PC	1	Able to run the NMS and DOS Ping. Connected to the WMTS through the CAT-5 Cross-connect Ethernet cable to port y (user data). Fully configured as described in Section 3.1Prerequisites.	Factory

Figure 1-1: Test Equipment and Tools

1.2 *System Configuration

The WMTS will be loaded with the latest software load and configured as shown in the following table:

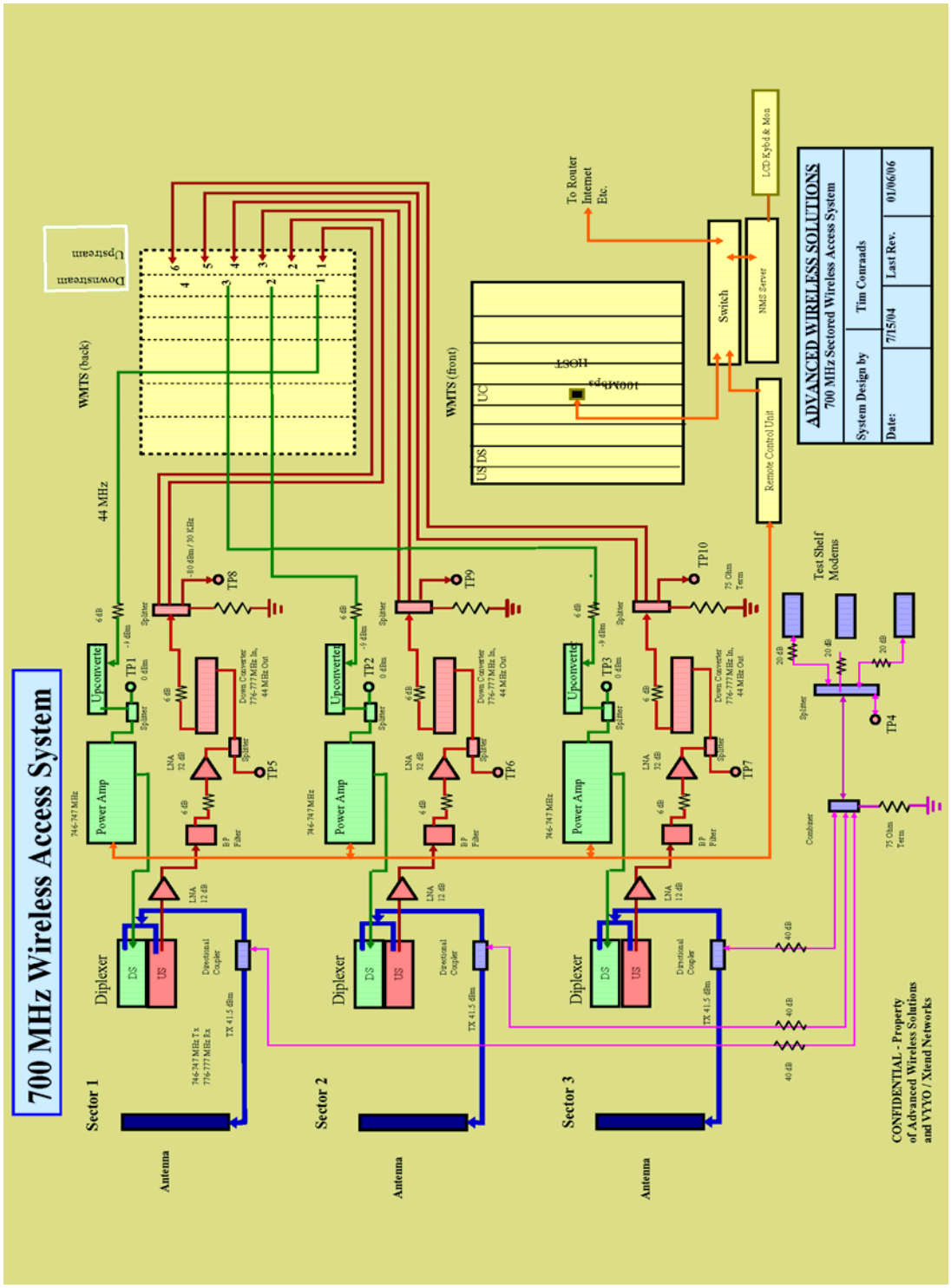
Parameter	Value
Number of Sectors	3
Number of Downstream Channels	3
Downstream Channel Width	330 KHz
Downstream Channel Modulation	64 QAM
Downstream Channel Frequency	757.170, 757.5, And 757.830 MHz
Number of Upstream Channels	3
Upstream channel 1 Port assignment	1 & 2 with antenna diversity
Upstream channel 2 Port assignment	3 & 4 with antenna diversity
Upstream channel 3 Port assignment	5 & 6 with antenna diversity
Upstream Channels Bandwidth	325 KHz
Upstream Channels Modulation	16 QAM
Upstream Channels Frequency	787.170, 787.5, 787.830 MHz

Table 1-1: System Configuration

***Note: The system can be built as 1, 2 or 3 sectors. The above table refers to a 3 sectors BTS.**
When a single sector BTS is built, only channel 1 is used.
For dual sectors only channel 1 and 2 are used.
The actual RF frequencies for 1 and 2 sectors will be determined by the customer.

➔ Pull all the WMTS cards and record the complete WMTS Configuration in Section 1 of the Test Results: Serial Numbers

1.3 Block Diagram



2 Physical Description

2.1 Visual Inspection Power Off

The assembled rack height will be no more than 6'11". Necessary connection points between the assembled BSR and the housing facility (e.g. electrical power, ground, RF transport, backhaul transport, etc.) are located at the top of the BSR.

Verify that each piece of active equipment in a section is grounded to an internal ground bus or equivalent single point, with 14 gauge terminated stranded wire. Ground bus will interconnect between sections at a single point with (2 inch ground strap – 10 gauge strand or better.) The ground point on each piece of equipment will be supplied by the manufacturer. In the event there is no manufacturer's supplied ground point then an enclosure screw will be made free of insulative coating and used as the ground point. Passive components will be mounted on metal plates or rack rails.

Verify that point clusters are clearly and correctly labeled in a permanent manner. Verify that cable management is such that a neat and secure layout is maintained Verify that all cables are labeled clearly at both ends with a secure self-locking label. Verify that all cables from one common region within the BSR to another common region within the BSR are the same length. Verify that all interconnections are labeled according to the master BSR wiring schematic. Verify that each assembled BSR is labeled with an assigned, unique serial number. Verify that the BSR serial number cross references an all-inclusive list of the serial numbers of serialized items installed in the BSR.

2.2 BSR Sections

2.2.1 Power Section

The bottom section of the BSR houses the PAs (power amplifiers) and the UPS (uninterruptible power supply). The test point cluster for the Power Section includes:

- Test Points 1, 2 and 3 which allow measurement of the output of the Downstream Upconverters pre-PA.

*Test Point	Description
TP1	Tap-off between Downstream Upconverter and PA channel 1
TP2	Tap-off between Downstream Upconverter and PA channel 2
TP3	Tap-off between Downstream Upconverter and PA channel 3

Table 2-1**: Test Point Cluster – Power Section**

***Note: For dual sector PA3 and TP3 are not used.**
For a single sector PA2 and PA3, TP2, TP3 are used, respectively.

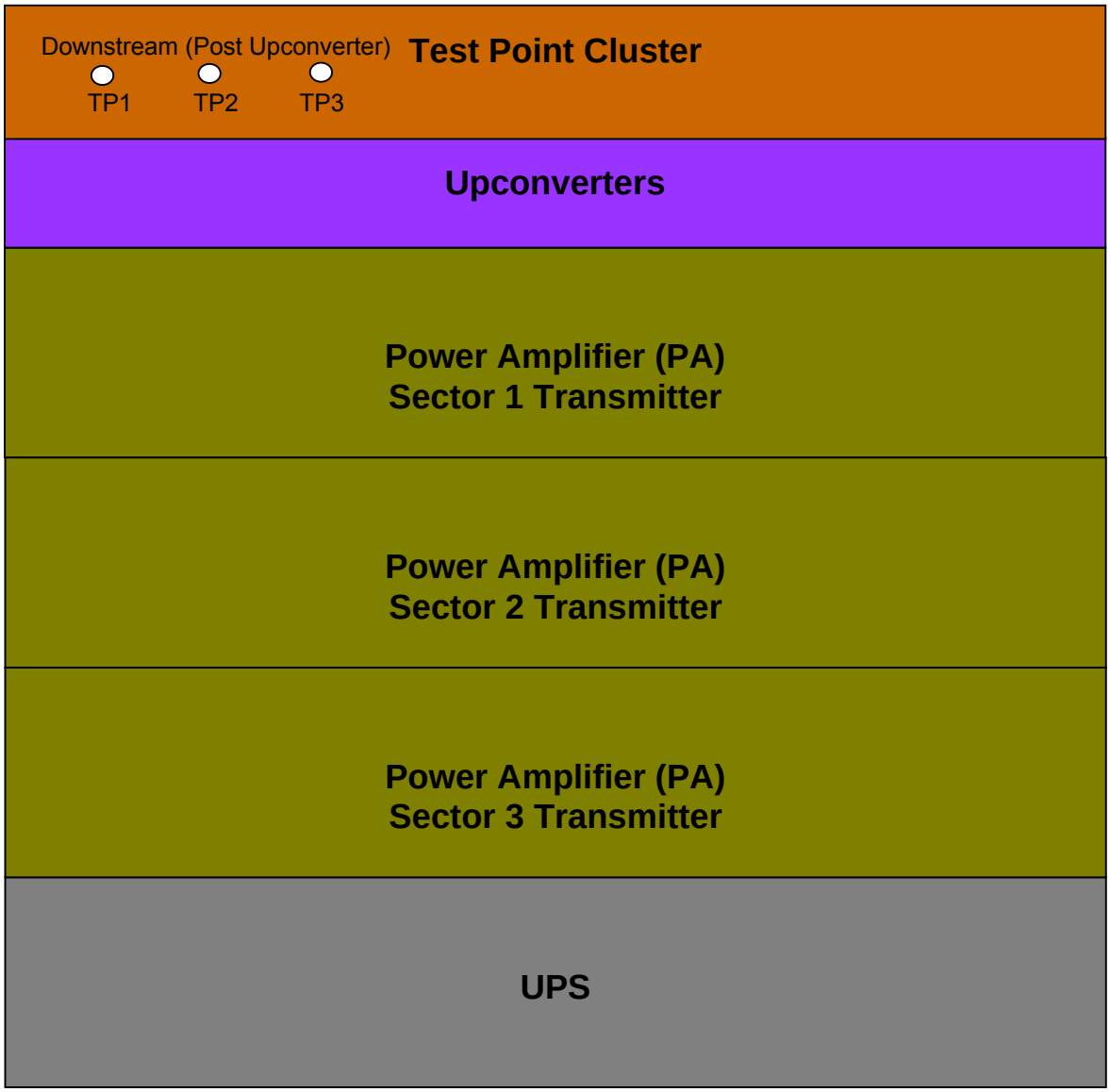


Figure 2-1: Power Section Physical Layout

2.2.2 Data Section

The middle section of the BSR houses the WMTS (V3000), Remote Control Unit, Upstream splitter tray and customer added backhaul interface. The test point cluster for the Data Section includes:

- Test Point 4 which provides RF samples of the downstream signals as delivered to the antennae from the Power Amplifiers (PA). All three downstream signals are taken from their respective directional coupler sample ports which provide 30 dB of attenuation.
- Test Points 8,9, and 10 are located on the front of the Downconverters and provide RF samples of the Upstream signal post-Downconverter. Note that the upstream channel frequencies are inverted – see section 3.3.1.2 for an explanation.

*Test Point	Description
TP4	Tap-off from Directional couplers for channels 1,2,3 (Cluster)
TP8	TP8 Upstream post Downconverters. Splitter between Downconverter and WMTS channel 1.
TP9	TP9 Upstream post Downconverters. Splitter between Downconverter and WMTS channel 2.
TP10	TP10 Upstream post Downconverters. Splitter between Downconverter and WMTS channel 3.

Table 2-2**: Test Point Cluster – Data Section**

***Note: For a single sector TP10, TP9 are not in use.**
For a dual sector TP10 is note in use.

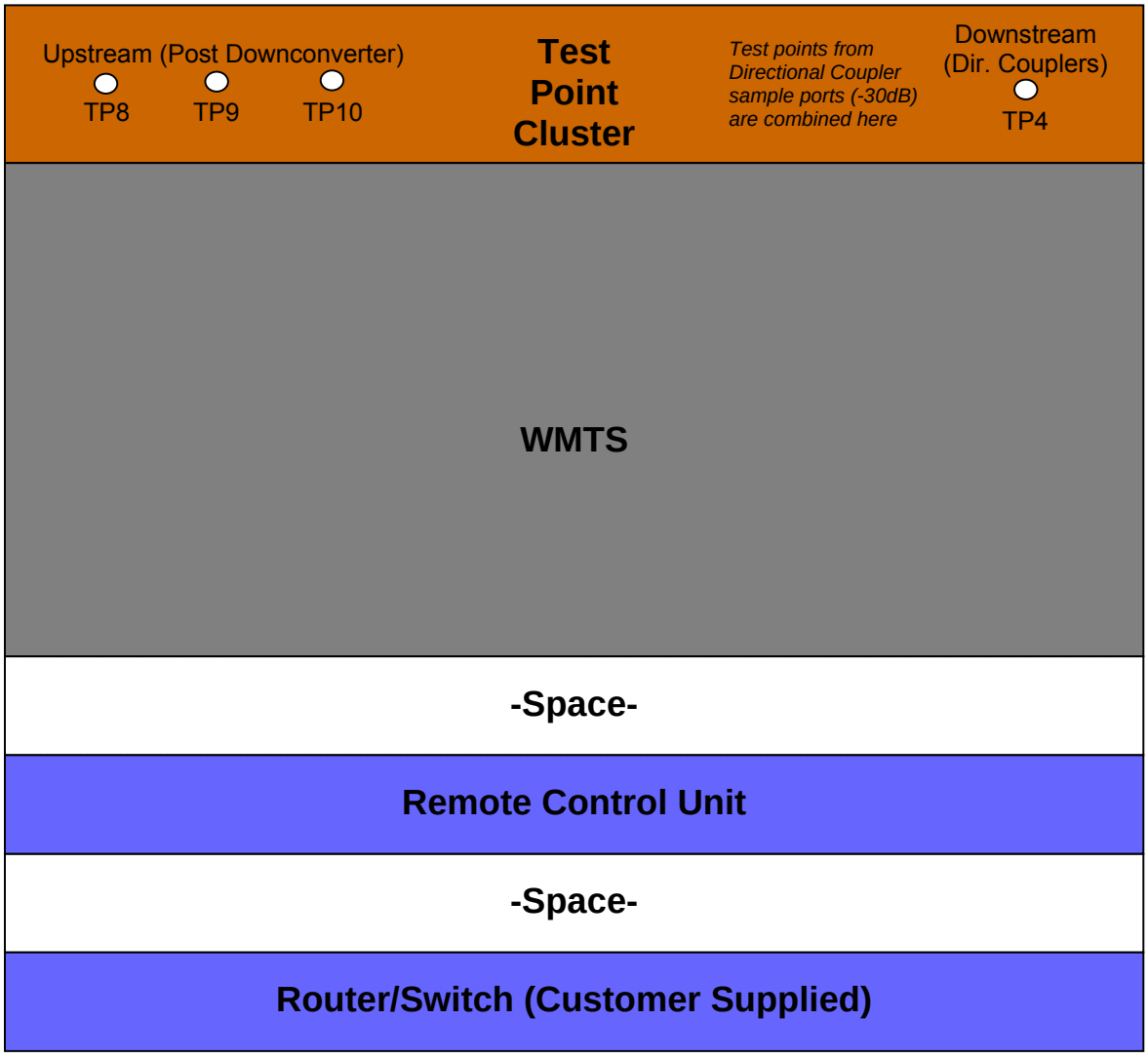


Figure 2-2: Data Section Physical Layout

2.2.3 *RF Section

The top section of the BSR houses the Diplexer module (including the TX/RX Diplexer and the directional couplers), Upstream LNA module (including upstream LNA, Band Pass Filter and spliters) upstream Downconverter modules (including downconverter and splitter), ground-bus to facility point, electric power to facility point and transmitting line to antenna connection points. See

Figure 2-3: RF Section Physical Layout.

The test point cluster for the RF Section includes:

- Test Points 5, 6 and 7 provide RF samples of the upstream signal post-LNA.

Test Point	Description
TP5	TP5 Upstream post LNAs. Tap-off between 2nd stage LNA and Downconverter channel 1.
TP6	TP6 Upstream post LNAs. Tap-off between 2nd stage LNA and Downconverter channel 2.
TP7	TP7 Upstream post LNAs. Tap-off between 2nd stage LNA and Downconverter channel 3.

Table 2-3: Test Point Cluster – RF Section

***Note: For a single sector TP6, TP7 are not in use.**
For a dual sector TP7 is not in use.

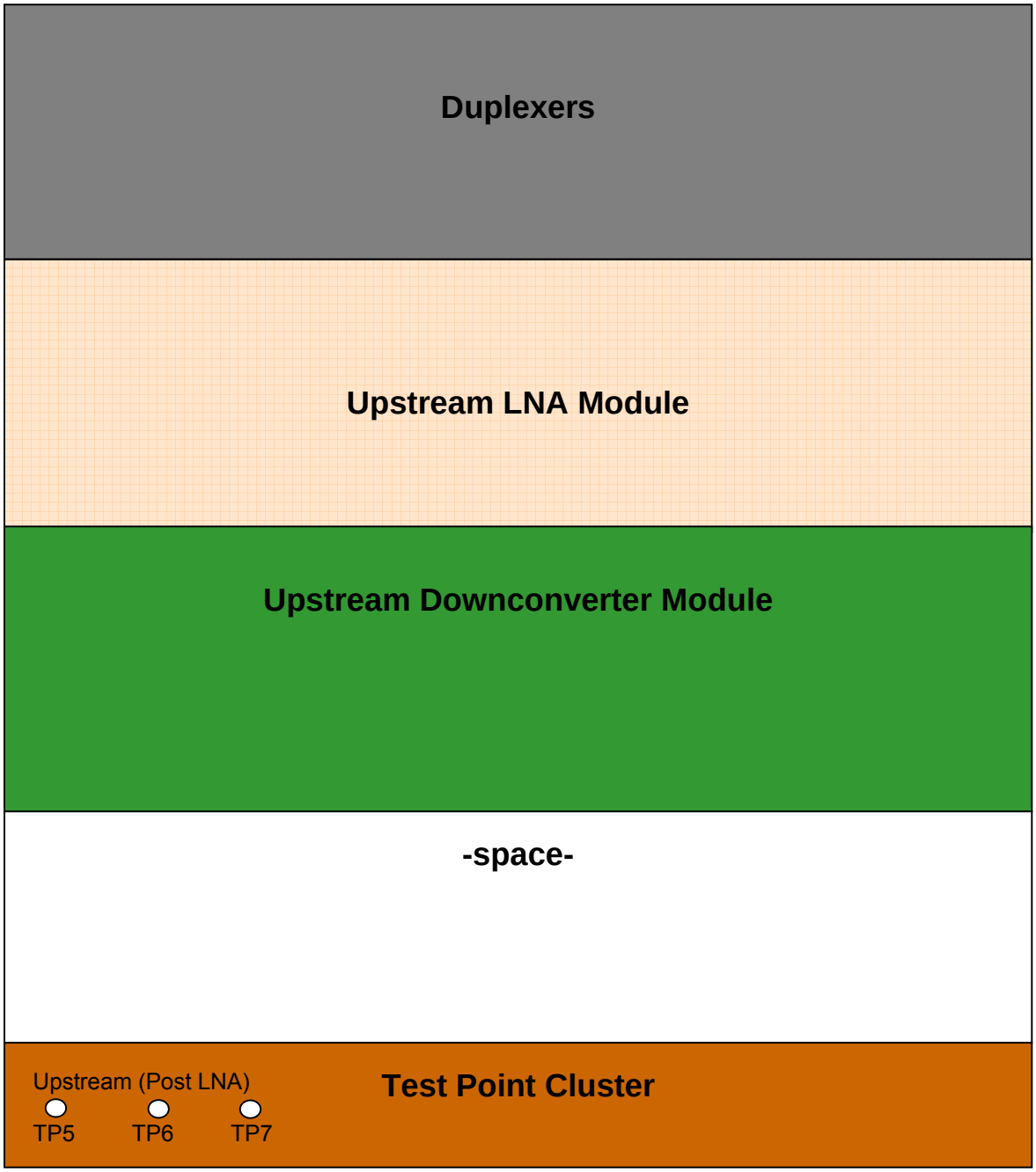


Figure 2-3: RF Section Physical Layout

3 Tests

The Arcadian Networks BSR is designed to provide broadband wireless connectivity over two 1 MHz wide bands in the 700 MHz A-Guard Band frequencies. These 1 MHz channels will be divided into three equal subchannels, one subchannel to be delivered via each one of a three sector antenna array providing a frequency diverse coverage area from each base station tower site. Each BSR will have three discrete RF paths to and from the WMTS to the sector antennae. All RF paths and channels will be active at all times in an installed and commissioned BSR. Test conditions for this FAT need to mirror a commissioned environment, therefore, all tests need to occur while all test relevant channels are active, set to proper power levels, and delivered to an antennae array or dummy load.
The RF paths within the BSR will be qualified for gain and/or loss at either IF or RF using the Spectrum Analyzer and the Signal Generator. Gain and loss values will be adjusted for compliance at each TestPoint using a combination of fixed attenuators and manual machine adjustments. The process will be delineated in detail from the WMTS to the directional coupler for both the upstream and downstream RF chains.

Each value at each test point will be recorded, along with the date and time the test was taken, and witnessed/signed by the tester.

3.1 Prerequisites

3.1.1 Grounding

As per visual Inspection.

3.1.2 Windows PC Configuration

- The PC used for this test will be fully configured with the correct Network Release and NMS.
- The MMU MAC addresses will be entered in the configuration file used by the DHCP server and bound to the proper modem configuration files (which specify the downstream frequency and upstream channel ID)
- The Ping test program will be loaded into an appropriate test directory
- Set all upstream channels to Antenna Diversity using the Arcadian Networks Configuration Tool

3.1.3 Verify Equipment Operation

Verify all the equipment is installed properly and all the equipment provided by Arcadian Networks is properly mounted and all interconnection wiring is completed and labeled as needed.

Verify that all active components of the BSR are plugged into the power strips and energized. This may be done by visual inspection when indicator lights and such are

visible. Some of the tests, where indicated, require that the power amplifiers and Upconverters be turned off.

3.2 Downstream Acceptance Tests

3.2.1 WMTS Modulator Output / Upconverter Output Test

Objective

This test will verify:

1. The compliant operation of each WMTS modulated channel for output power and adjacent channel interference energy.
2. The compliant operation of each Upconverter module for output power, frequency conversion and adjacent channel interference energy.

3.2.1.1 Equipment

- Spectrum Analyzer HP 4403E with auto channel measurement option
- RF Test Cable (to be connected from WMTS to Spectrum Analyzer)

3.2.1.2 Prerequisites

Downstream Channel Setup

WMTS configured for 330 kHz downstream channel at 64 QAM for each sector. All of the upconverters shall be set to the center of the downstream band (757.5 MHz). The IF frequency offset feature (Arcadian Networks Configuration Tool) will be used to obtain a downstream RF frequency which is offset from the center frequency (e.g., 757.170 MHz). The following table assumes the nominal Upconverter IF (input) frequency is 44.0 MHz and its RF (center) output frequency is 757.5 MHz. However, spectral inversion does occur with the downstream Upconverter and therefore the Downstream Center IF Frequency must be inverted to compensate. For a three sector configuration the downstream settings would be as follows:

*Downstream Channel	Downstream Center IF Freq.	Actual Downstream Freq. after Conversion
1	44.330	757.170
2	44.0	757.500
3	43.670	757.830

These channel assignments may be set using the NMS Downstream Channel Configuration Menu of the Arcadian Networks Configuration Tool.

***Note: If a single sector is used, the other 2 channels shall be shut down.**
If two sectors are used, the remaining channel shall be shut down.

3.2.1.3 Procedure

Perform the following procedure for all channels (1,2 and 3):

WMTS Output Power Level Measurement

1. Set Spectrum Analyzer to the following configuration to measure power levels. The Center Frequency must be set to the Downstream Center IF Frequency of the channel under test.

Spectrum Analyzer Setup

*Center Frequency:	Ch. 1 44.33 MHz Ch. 2 44.00 MHz Ch. 3 43.67 MHz
Span:	1 MHz
Resolution Bandwidth:	1 MHz
Video Bandwidth:	300 KHz
Sweep:	50 msec. (Auto)
Reference Level:	59 dBmV
Attenuation:	Auto

2. Verify that a 6 dB attenuator is installed at the output of the WMTS DS Card connector for the channel under test and connect it to the Spectrum Analyzer using the RF Test Cable.
3. Observe trace. ➔Record channel power value on Test Results page: WMTS DS Channel Output Power. Note: If the spectrum analyzer you are using supports 'Channel Power Measurement' capabilities, please make the power measurement using a 330 KHz channel width setting.

Required Value:	43 ± 3 dBmV

***Note: If a single sector is used, the other 2 channels shall be shut down.**
If two sectors are used, the remaining channel shall be shut down.

WMTS Adjacent Channel Interference Power Level Measurement

4. Set Spectrum Analyzer to the following configuration to measure adjacent channel power levels:

Spectrum Analyzer Setup	
*Center Frequency:	Ch. 1 44.33 MHz Ch. 2 44.00 MHz Ch. 3 43.67 MHz
Span:	1 MHz
Resolution Bandwidth:	10 KHz
Video Bandwidth:	300 Hz
Sweep:	6.7 sec. (Auto)
Reference Level:	49 dBmV
Attenuation:	Auto

***Note: If a single sector is used, the other 2 channels shall be shut down.**
If two sectors are used, the remaining channel shall be shut down.

5. Verify that a 6 dB attenuator is installed at the output of the WMTS DS Card connector for the channel under test and connect it to the Spectrum Analyzer using the RF Test Cable.
6. Measure the amplitude difference of the signal at the center frequency to the amplitude at +/- 200 kHz from the center. Use the Marker amplitude delta function.
7. ➔Record values on the Test Results page: Adjacent Channel Interference Power Level. Note any anomalies on the Test Results page (such as shoulders or spurs that deviate more than 2 dB from the screen shot.)

Required Value:	< -48 dBc

8. Reconnect the output of the 6dB attenuator (on the output of the WMTS DS Card for the channel under test) to its corresponding Upconverter module using the associated cable in the BSR rack.

Upconverter Output Power Level Measurement

9. Ensure that the Upconverter output frequency is set to 757.5 MHz (this is the same for ALL channels), then use the Arcadian Networks Configuration Tool frequency offset feature (described above in section

3.2.1.2) to set the Downstream Center IF Frequency corresponding to the channel under test (Ch 1: 44.33 MHz., Ch 2: 44 MHz., Ch 3: 43.67 MHz.).

10. Connect Spectrum Analyzer to the **Test Point** associated with the channel under test (Ch.1: TP1, Ch. 2: TP2, Ch. 3: TP3).
11. Setup the spectrum analyzer to measure the **power level** for the channel under test:

Spectrum Analyzer Setup

*Center Frequency:	Ch. 1 757.17 MHz Ch. 2 757.50 MHz Ch. 3 757.83 MHz
Span:	1 MHz
Resolution Bandwidth:	10 KHz
Video Bandwidth:	300 Hz
Sweep:	6.7 sec. (Auto)
Reference Level:	59 dBmV
Attenuation:	Auto

12. Adjust Upconverter output power using the front panel control until the channel power is the compliant value of 34 dBmV.
13. ➔Record channel power value on 'Test Results' page: Upconverter Output Power.

Required Value:	34 ± 2 dBmV

***Note: If a single or dual sector is used, the tester should configure the spectrum analyzer to the relevant frequency/ies.**

Upconverter Adjacent Channel Power Level Measurement

14. Setup the spectrum analyzer to measure the Adjacent Channel Power level as shown below. Set the Cener Frequency to that of the channel under test.

Spectrum Analyzer Setup	
*Center Frequency:	Ch. 1 757.17 MHz Ch. 2 757.50 MHz Ch. 3 757.83 MHz
Span:	1 MHz
Resolution Bandwidth:	10 KHz
Video Bandwidth:	300 Hz
Sweep:	6.7 sec. (Auto)
Reference Level:	62 dBmV
Attenuation:	Auto

***Note: If a single or dual sector is used, the tester should configure the spectrum analyzer to the relevant frequency/ies.**

15. Measure the amplitude difference of the signal at the center frequency to the amplitude at +/- 200 kHz from the center. Use the Marker amplitude delta function.

Required Value:	< -48 dBc

16. ➔Record values on the Test Results page: Adjacent Channel Power Level. Note any anomalies on the Test Results page (such as shoulders or spurs that deviate more than 2 dB.

The following diagram illustrates the relationship of Test Point 1 to the equipment under test. Test points 2 and 3 are equivalent to Test Point 1 for Channels 2 and 3.

NOTE: Yellow indicates where adjustments may be made.

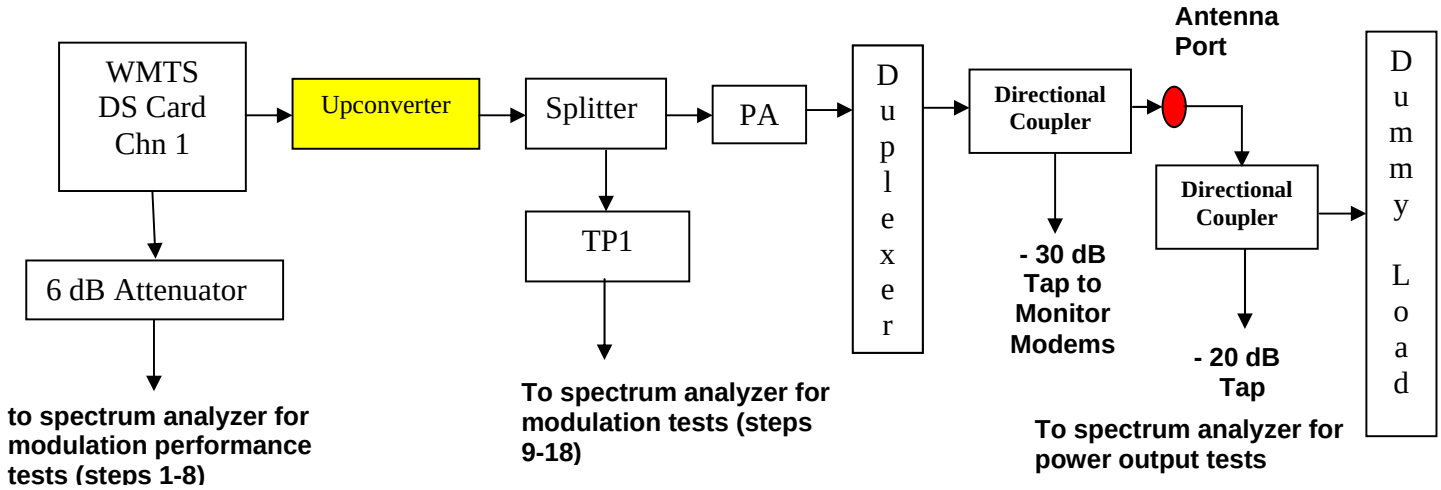


Figure 3-1: Modulated Output and Upconverter Tests

3.2.2 PA Output Power Test

Objective
This test will set and verify the correct output of each PA (Power Amplifier) at the antenna port. The output level is set to nominal10W (not exceed 11.5W).

3.2.2.1 Equipment

- Spectrum Analyzer HP 4403E with auto channel measurement option
- WMTS configured for 330khz channel at 64QAM
- Six foot RF test cable (male f-connectors and RG-6 or less loss) from directional coupler to Spectrum Analyzer
- 20 dB directional coupler for antenna port
- 20 dB attenuator to Spectrum Analyzer input connector

3.2.2.2 Prerequisites

The PA must be connected (through the Directional Coupler and the Diplexer) to the antenna port to an external antenna or to a dummy load. There shall be a coupler between the antenna port and the load/antenna.

Warning: Shut off the power for all of the PAs before disconnecting the load/antenna.

3.2.2.3 Procedure

Perform the following procedure for all channels (1, 2 and 3)*:

Setting the Rack Output Power Level.

1. Connect the spectrum analyzer to the 20 dB directional coupler port between the antenna port and a 100 Watt dummy power load (or an antenna). Connect additional 20 dB attenuator between the Spectrum analyzer and the Directional coupler.
2. Setup the spectrum analyzer to measure the Output Power level as shown below. Set the Center Frequency to that of the channel under test.

Spectrum Analyzer Setup

*Center Frequency:	Ch. 1 757.17 MHz Ch. 2 757.50 MHz Ch. 3 757.83 MHz
Span:	1 MHz
Resolution Bandwidth:	1 MHz
Video Bandwidth:	300 KHz
Sweep:	50 msec. (Auto)
Reference Level:	59 dBmV
Attenuation:	Auto

***Note: If a single or dual sector is used, the tester should configure the spectrum analyzer to the relevant frequency/ies.**

NOTE: For measuring output power in the following steps, take into account the Directional Coupler and the Cable losses.

3. **Turn off power to the PAs for the channels not being tested** (e.g., if Channel 1 is being tested, turn off the PAs for Channels 2 and 3) to minimize external interference.

4. Adjust Upconverter module output power level such that the Spectrum Analyzer reads **43 dBmV**. This indicates that the actual Upconverter output power is 89 dBmV (10W) since there is a 20 dB loss from the directional coupler, another 20 dB loss from the attenuator on the

Spectrum Analyzer input and a final 6 dB setup cable loss (89 – 20 – 20 – 6 = 43).

5. ➔Record this measured value on 'Test Results' page: Channel Power Post PA at the Antenna Port.

Required Value:	(43 ± .5 dBmV)

6. ➔Record the PA output level (Fwd. Power) as shown on the PA front panel display on 'Test Results' page: Channel Power Post PA at the Antenna Port.

Required Value:	8 to 20 Watts

7. ➔Disconnect the spectrum analyzer from the antenna port and connect it to TP4. Measure and record the power level for the channel under test on 'Test Results' page: Channel Power Post PA at Test Point Cluster TP4.

Required Value:	5 ± 3 dBmV

Checking for Adjacent Channel Interference

8. Setup the spectrum analyzer to measure the Adjacent Channel Interference as shown below. Set the Center Frequency to that of the channel under test.

Spectrum Analyzer Setup

Center Frequency:	Ch. 1 757.17 MHz Ch. 2 757.50 MHz Ch. 3 757.83 MHz
Span:	1 MHz
Resolution Bandwidth:	10 KHz
Video Bandwidth:	300 Hz
Sweep:	6.7 sec. (Auto)
Reference Level:	39 dBmV
Attenuation:	Auto

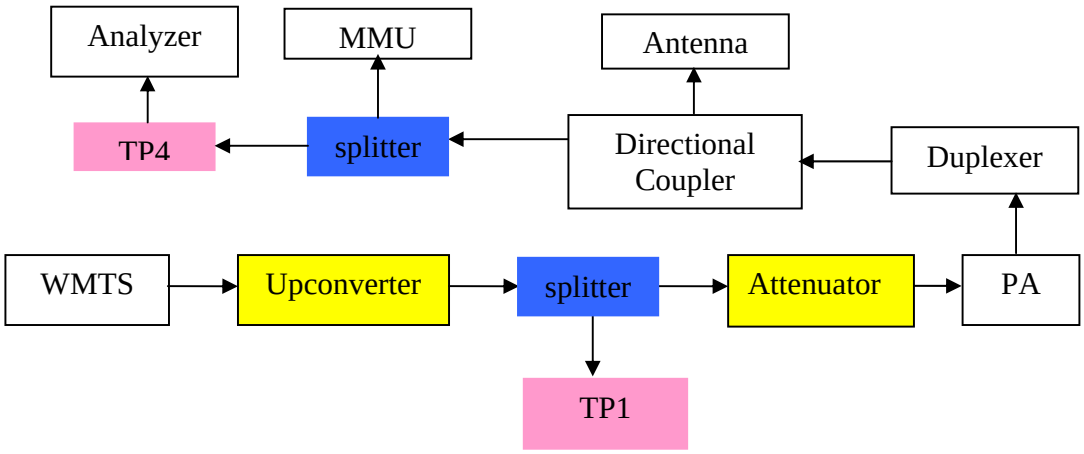
***Note: If a single or dual sector is used, the tester should configure the spectrum analyzer to the relevant frequency/ies.**

9. **Turn off power to the PAs for the channels not being tested** (e.g., if Channel 1 is being tested, turn off the PAs for Channels 2 and 3).

10. Ensure that there is no spectral regrowth at the final Upconverter setting by measuring the amplitude difference of the signal at the center frequency to the amplitude at +/- 200 kHz from the center. Use the Marker amplitude delta function. Measure the signal level relative to the carrier for the adjacent channel levels at ± 200 KHz from the center frequency.
11. ➔Record the value on 'Test Results' page: Adjacent Channel Power post PA at Directional Coupler.

Required Value:	< -43 ± 2 dBc

12. Disconnect the Spectrum Analyzer from TP4



**NOTE* Yellow indicates where adjustments may be made*

Figure 3-2: Test Points 1 and 4

3.2.3 Downstream Received Power/SNR Test – Modem Monitor Unit

Objective

This test will verify the correct operation and setting of the system for downstream received SNR and power (signal strength) using the NMS and the MMU (Modem Monitoring Unit).

3.2.3.1 Equipment

NMS and servers connected to WMTS and tester has access to NMS screens.

3.2.3.2 Prerequisites

- Provisioning servers are connected to the switch
- NMS is running, configured and successfully polling the WMTS, connected via Ethernet to the WMTS
- MMU (Modem Monitoring Unit) modems are provisioned for operation within the server suite: DHCP entry for modem MAC address and its corresponding configuration file available in the TFTP directory on the server (Windows Test PC)
- All downstream channels enabled and operational
- All upstream channels enabled and operational
- MMU's connected

3.2.3.3 Procedure for viewing MMU downstream receive signal strength

Perform the following procedure for all channels (1, 2 and 3) *

***Note: If a single sector is used the other 2 channels should be shut down.**
If dual sectors are used, the remaining channel should be shut down.

1. Confirm that the MMU modem for the channel under test is connected and shows a lit 'Status' LED.
2. Open the window for this MMU on the NMS server: double click on the MMU icon or the name of the MMU in the left window pane to bring up the MMU Display shown in Figure 3-4.

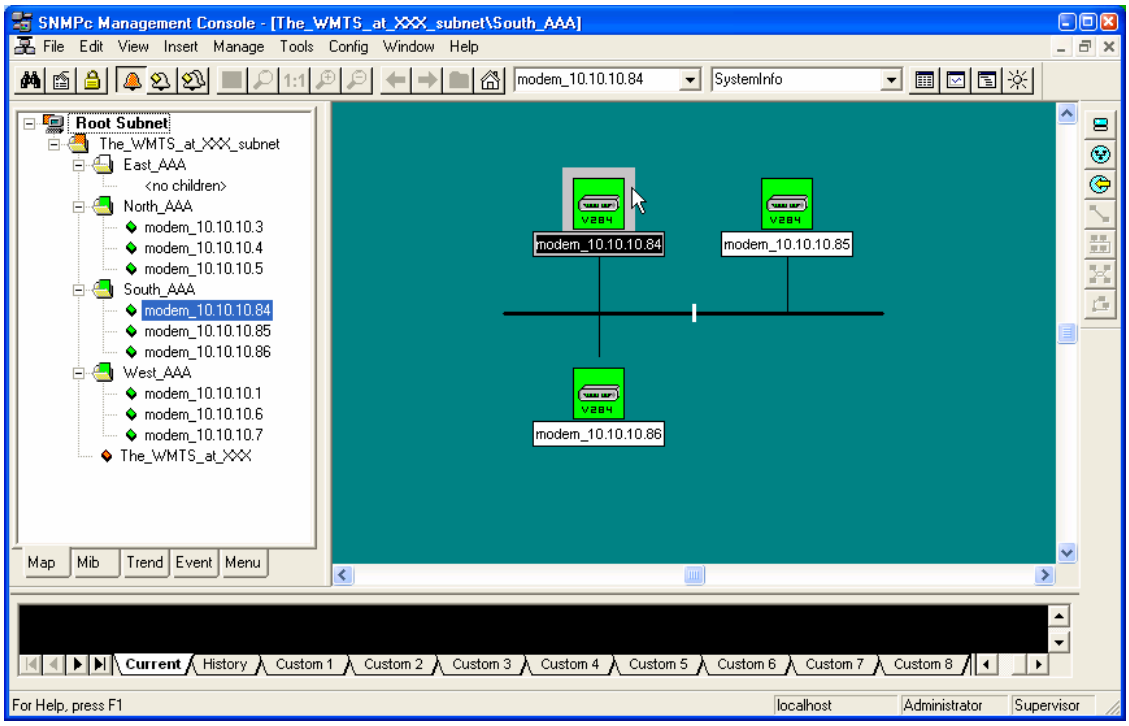


Figure 3-3: NMS MMU Selection

3. From the “Arcadian Networks Modem” menu, select “Rx Power”

Figure 3-4: Arcadian Networks Modem Menu

4. Observe the value of the Rx Power represented in 10^{ths} of dBmv (in the example below -15.6dBmv)

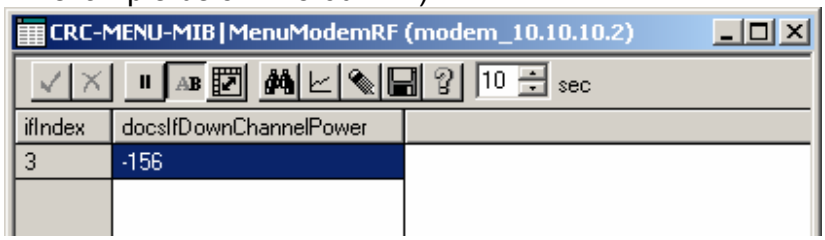


Figure 3-5: MMU Rx Power reading

5. ➔Record the value on the test results page for the channel under test: MMU Downstream Received Signal Strength.

Required Value:	- 16 ± 3 dBmV

3.2.3.4 Procedure For Viewing MMU Downstream SNR

Perform the following procedure for channels 1, 2 and 3*:

***Note: If a single sector is used the other 2 channels should be shut down. If dual sectors are used, the remaining channel should be shut down.**

1. Open the window for the MMU under test as in the previous procedure.

2. From the “Arcadian Networks Modem” menu, select “Signal Quality”

Figure 3-6

3. Observe the value of the Signal-to-Noise ratio given in 10^{ths} of dB (in the example below 34.3 dB)

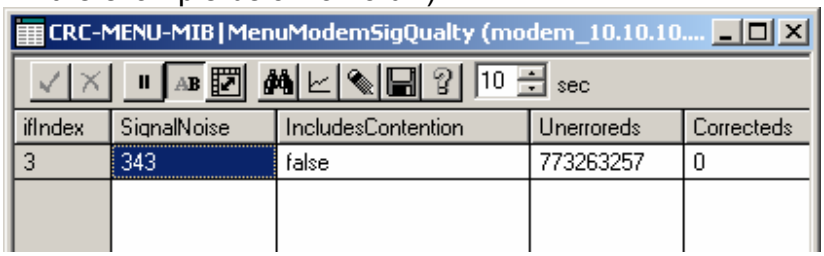


Figure 3-7

4. ➔Record the value on the test results page for sector 1: MMU Downstream SNR.

Required Value:	≥ 30 dB

3.3 Upstream Acceptance Tests

3.3.1 LNA Module Test

Objective

This test will verify the correct operation of each Upstream LNA module for correct gain settings.

3.3.1.1 Equipment

- Spectrum Analyzer HP 4403E with auto channel measurement option
- Signal generator with output frequency capability to 777 MHz
- Six foot RF Test Cable (to be connected from Test Point to Spectrum Analyzer)
- Six foot RF Test Cable (to be connected from antenna side of Directional Coupler to Signal Generator.)

3.3.1.2 Prerequisites

Upstream Channel Setup

Only the first stage of the downconverter is used in base station deployments. This results in spectral inversion of the upstream signal. For ALL upstream channels the downconverter RF Input Frequency shall be set to 787.5 MHz. The downconverter IF Output frequency is fixed at 44.0 MHz. All channel assignments shall be setup using the upstream frequency offset feature of the NMS Upstream Channel Configuration Menu of the Arcadian Networks Configuration Tool.

> ***NOTE: Make sure to check the Spectral Inversion box on the Arcadian Networks Configuration Tool Upstream menu (since only one stage of the downconverter will be used).***

The settings for the upstream channels, assuming they are exactly 30 MHz above their corresponding downstream channels are:

*Upstream Channel	Rx Frequency	Tx Frequency	Actual Upstream Freq. Before Conversion
1	44.330	43.670	787.170
2	44.0	44.0	787.5
3	43.670	44.330	787.830

Warning: Shut off the power for all of the PAs.

***Note: If a single sector is used, the other two channels should be shut down.**
If a dual sector BTS is used, the remaining channel should be shut down.

3.3.1.3 Procedure

Perform the following procedure for all channels (1,2 and 3):

LNA Module Test

1. **Power off Upconverters and make sure PAs are off**
2. Connect output of signal generator to 'antenna' side of directional coupler using one of the 6 foot RF Test Cables.
3. Connect Spectrum Analyzer to the Test Point associated with the channel under test using the other six foot RF Test Cable.
4. Configure the Signal Generator to CW (Continuous Wave) output with a power level of -31 dBmV and the frequency associated with the channel under test.
5. Setup the spectrum analyzer to measure the LNA Module output level given the known input level from the Signal Generator above. Set the Center Frequency to that of the channel under test:

Spectrum Analyzer Setup

*Center Frequency:	Ch. 1 787.17 MHz Ch. 2 787.50 MHz Ch. 3 787.83 MHz
Span:	4 MHz
Resolution Bandwidth:	10 KHz
Video Bandwidth:	1 KHz
Sweep:	100 msec. (Auto)
Reference Level:	49 dBmV
Attenuation:	Auto

***Note: If a single sector is used, the other two channels should be shut down.**
If a dual sector BTS is used, the remaining channel should be shut down.

6. ➔Press 'Marker Peak' and record value on Test Results page: Gain Test Signal Strength.

Required Value:	4 ± 2 dBmV

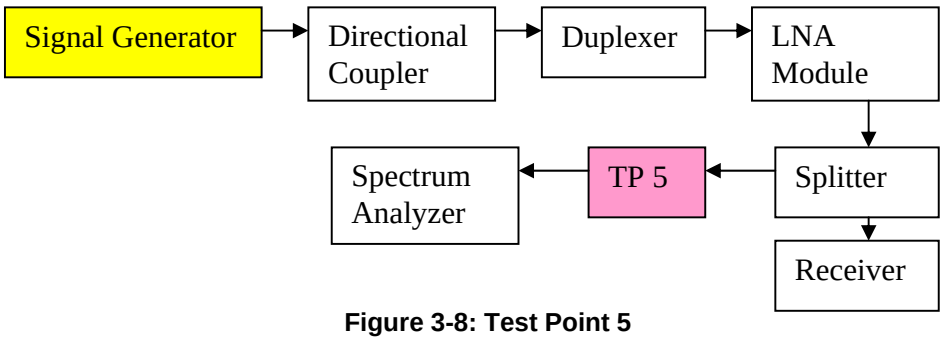


Figure 3-8: Test Point 5

3.3.2 Upstream Downconverters – Freq. Conversion and Gain Setting

Objective

This test will verify the correct operation and conversion/gain setting of each Upstream Downconverter, and for the whole upstream chain. The gain setting is used to adjust the RF SNR.

3.3.2.1 Equipment

- Spectrum Analyzer HP 4403E with auto channel measurement option
- Six foot RF Test Cable

3.3.2.2 Prerequisites

- All Downstream channels powered off

> **Warning:** Shut off the power for all of the PAs.

3.3.2.3 Procedure

Perform the following procedure for all channels (1, 2 and 3*):

The procedure for setting the RF SNR is summarized as follows:

i. Measure the channel gain
ii. Integrate a modem, and RX level fine tuning for required SNR

1. Connect the analyzer to the Test Point associated with the channel under test (Ch 1: TP8, Ch 2: TP9, Ch 3: TP10).

2. Setup the spectrum analyzer to measure the LNA Module output level (given a known input level from the Signal Generator). Set the Center Frequency to that of the channel under test. See section 3.3.1.2 for additional details and the table of Rx Frequencies.

Spectrum Analyzer Setup

*Center Frequency:	Ch. 1 44.33 MHz Ch. 2 44.00 MHz Ch. 3 43.67 MHz
Span:	1 MHz
Resolution Bandwidth:	30 KHz
Video Bandwidth:	300 Hz
Sweep:	50 msec. (Auto)
Reference Level:	19 dBmV
Attenuation:	Auto

***Note: If a single sector is used, the other two channels should be shut down. If a dual sector BTS is used, the remaining channel should be shut down.**

3. Set the Signal Generator to the frequency of the channel being tested (Ch. 1: 787.17 MHz., Ch. 2:787.5 MHz., Ch 3.: 787.83 MHz.), adjust it to output a –31dBmV signal and connect it to the antenna port for the channel under test. See section 3.3.1.2 for the table of Actual Upstream Frequencies Before Conversion.
4. ➔Measure and record the output signal level "Po" at the Test Point associated with the channel under test (Ch 1.: TP8, Ch 2.: TP9, Ch 3.: TP10) on the Test Results page: Downconverter Output Signal Level. Obtaining the required output signal level given the known input signal level (from the Signal Generator) verifies that the upstream gain and frequency conversion are correct.

Required Value (Po):	14 ± 3 dBmV

5. ➔Use the value of Po from the previous step to calculate and record the system gain (System Gain = Po + 31) on the Test Results page: Calculated System Gain.

Required Value:	45 ± 3 dB

6. Disconnect the signal generator from the antenna port

7. Connect the antenna port to the antenna or to dummy load. Power ON the PAs and Upconverters

Modem Integration Procedure

3.3.2.4 Prerequisites

- Directional couplers connected to 100 Watt dummy load or to broadcast antenna
- All Downstream channels enabled, and PA's turned on
- MMUs (Modem Monitoring Units) connected

8. Make sure the MMU's are connected to the system. Verify that modems are locked onto the upstream and downstream channels, and that the modem status LED is lit.
9. Send a continuous ping to a modem IP address on the channel under test. The ping length "-l" (lowercase "L") option should be set to 850 bytes ("ping 10.10.10.xx –t –l 850"). Verify the ping response.
10. Observe the signal level for the ping message to the modem using the spectrum analyzer (You could use the Max Hold function to capture the ping signal level). The spectrum analyzer should still be connected to the test point for the channel under test at this time (e.g., Channel 1 uses TP 8).
11. Set spectrum analyzer to the following parameters:

Spectrum Analyzer Setup

*Center Frequency:	Ch. 1 44.33 MHz Ch. 2 44.00 MHz Ch. 3 43.67 MHz
Span:	1 MHz
Resolution Bandwidth:	10 KHz
Video Bandwidth:	100 Hz
Sweep:	50 msec. (Auto)
Reference Level:	19 dBmV
Attenuation:	Auto

***Note: If a single sector is used, the other two channels should be shut down. If a dual sector BTS is used, the remaining channel should be shut down.**

12. Using the Spectrum analyzer, observe the RF SNR (the ratio between the signal level and the noise floor level).
13. RF SNR should be 24 ± 1 dB. IF the SNR is deviating from 24 ± 1 dB, set the WMTS Hex Card RX level, through the NMS, to get 24 dB SNR (increasing the input level by 1 dB will raise the SNR by 1 dB).
14. ➔Measure and record the Noise Floor level and SNR on the Test Results page: Noise floor level to WMTS (on RBW of 10KHz).

Required Noise Floor:	-31 ± 3 dBmv

15. ➔Measure and record the final SNR on the Test Results page: SNR Measurement.

Required Noise Floor SNR:	24 ± 1 dB

16. Stop the ping

3.3.3 Upstream SNR Verification Test - MMU

Verify all the equipment is installed properly and all the equipment provided by Arcadian Networks is properly mounted and all interconnection wiring is completed and labeled as needed. Verify the BSR is properly grounded to the operator's requirements. Verify that all the equipment is powered and shows a "ready" status indicator where applicable. These steps are visual inspections.

Objective
This test will verify the correct operation of the WMTS for the desired Upstream SNR using the NMS.

3.3.3.1 Equipment

- Windows Test PC with NMS and servers operational
- Cat-5 Cross-connect cable (to connect Linux PC to WMTS)

3.3.3.2 Prerequisites

- Configure the upstream channel to a bandwidth of 325 KHz, and 16 QAM modulation.
- Directional couplers connected to the Broadcast antennae or dummy load
- Provisioning servers are connected to the switch
- NMS is running, configured and successfully polling the WMTS, connected via Ethernet to the WMTS
- MMU (Modem Monitoring Unit) modems are provisioned for operation within the server suite: DHCP entry for modem MAC address and its corresponding configuration file available in the TFTP directory on the server (Windows Test PC)
- All downstream channels enabled and operational
- All upstream channels enabled and operational
- MMU's connected

3.3.3.3 Procedure

Perform the following procedure for all channels (1, 2 and 3*):

***Note: If a single sector is used, the other two channels should be shut down. If a dual sector BTS is used, the remaining channel should be shut down.**

1. Confirm that the MMU modem for the channel under test is connected and shows a lit 'Status' LED. To provide some activity for the spectrum analyzer to measure, send a continuous ping to the MMU modem on the channel under test. The ping length "-l" (lowercase "L") option should be set to 850 bytes ("ping 10.10.10.xx –t –l 850"). Verify the ping response.
2. Open the GUI for the WMTS on the NMS server: Double click on the WMTS icon or the name of the WMTS in the left window pane to bring up the WMTS Display shown in Figure 3-10.

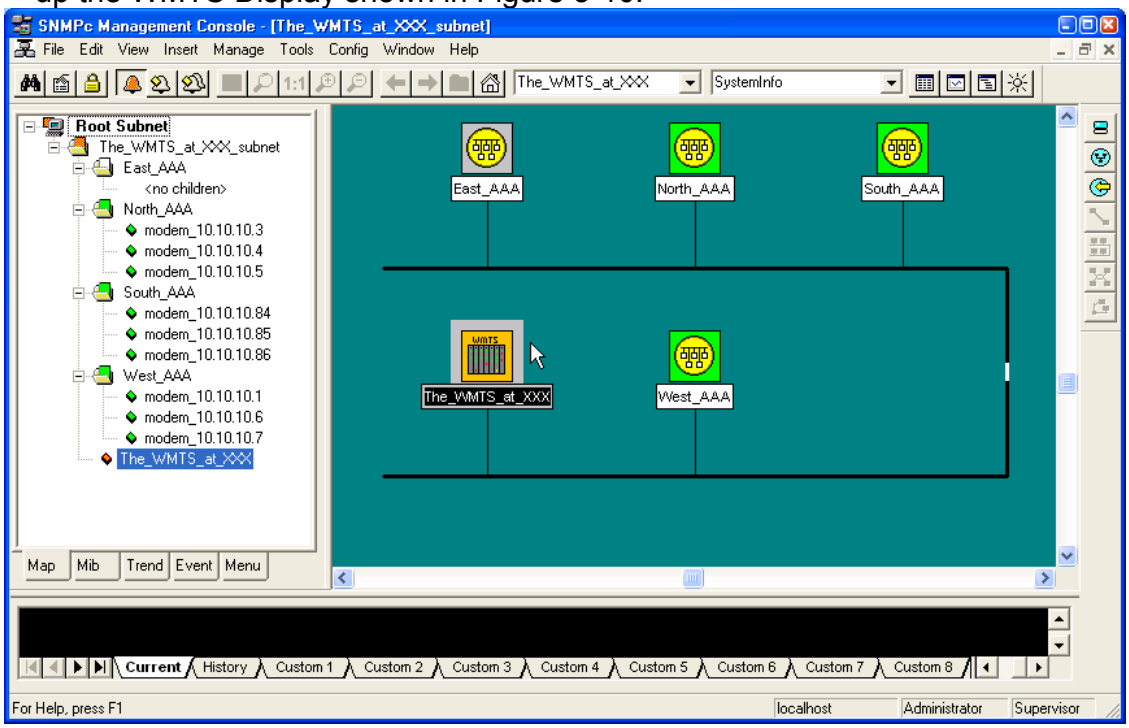


Figure 3-9: WMTS Selection

3. Select "Channels" and "Upstream" from the top 'pull-down' menu.
4. Select Upstream
5. Select Port Signal Statistics

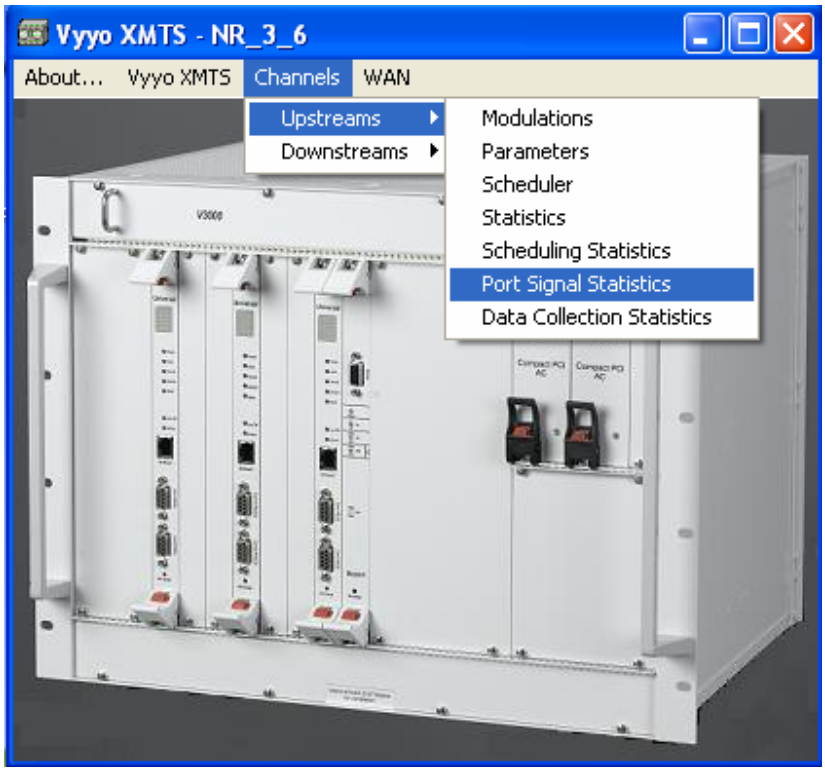


Figure 3-10: WMTS Display

6. Locate the entry line for the channel under test (e.g., line 5 = channel 1).Scroll right to the end of the line until you see the field "SignalStatusSNR". (*The value is in 10th of dBs.)*
7. Bring up the SNR Graph by selecting the graphical display function.
8. Obtain the average SNR by using the graphical display window. Use a 4-minute average to provide a conservative value.

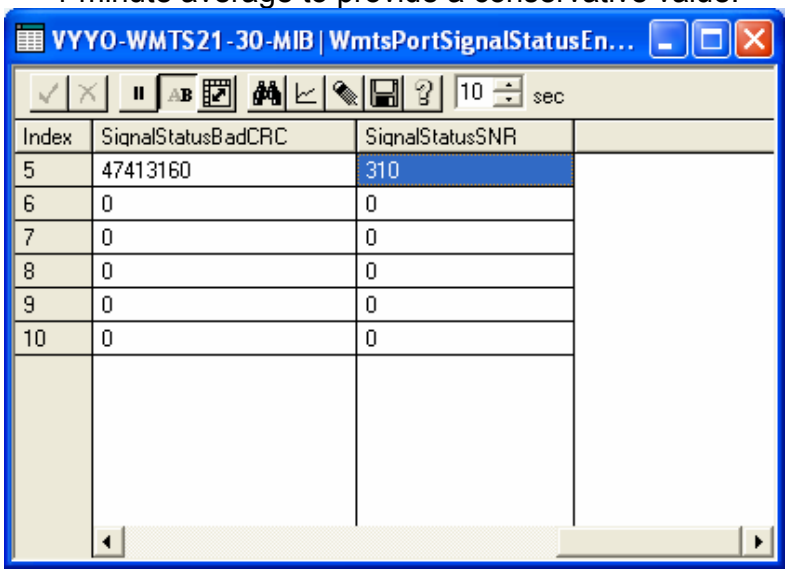


Figure 3-11

9. ➔Record value on Test Results page: SNR Value For Upstream Channels.

Required Value:	> 22 dB

3.4 UPS Acceptance Tests

The UPS (Un-interruptible Power Supply) will carry the full power requirement of the chassis for two minutes. All powered equipment within the BSR will be connected to the UPS. The UPS will be tested under full power load to verify compliance in:

- Power Delivery
- Power Integrity
- Non-service Affecting Switch-over
- Battery-pack Charging Compliance.

3.4.1 Power Delivery/Power Integrity Test

3.4.1.1 Equipment

- Fluke 43 or 43B Power Test Meter
- Fully loaded Base Station Rack
- One MMU for each upstream channel
- NMS PC

3.4.1.2 Prerequisites

- Charging: Connect the UPS to a compliant power source. Power on and observe that the UPS status indicators show that the UPS is operational and charging the batteries.

  NOTE: The UPS requires 24 hours to fully charge the battery pack. Care should be taken to follow the manufactures recommendation on 'first-time-charge'.
- BSR powered up, all racked equipment plugged in and fully operational
- Upstream MMUs provisioned, connected and operational
- NMS PC is connected and polling the WMTS and MMUs

3.4.1.3 Procedure

Perform the following procedure for all channels (1, 2 and 3*):

***Note: If a single sector is used, the other two channels should be shut down. If a dual sector BTS is used, the remaining channel should be shut down.**

Power Delivery/Power Integrity

1. Select Volts/Amps/Hertz from the menu of the power test meter
2. ➔Record load voltage(Volts) and current (Amps) value on Test Results page: Initial Power Delivery
3. Select Harmonics from the menu of the power test meter

4. ➔Record THD (Total Harmonic Distortion) value on Test Results page: Initial Power Conditioning

Non-service affecting switchover

5. Now run a continuous ping to the WMTS from the NMS PC ("ping –t 10.10.10.xx")
6. Disconnect UPS from facility power
7. ➔ Verify that pings continue uninterrupted and record result on Test Results page: UPS Disconnected Ping Operation
8. Select Volts/Amps/Hertz from the menu of the power test meter
9. ➔Record load voltage(Volts) and current (Amps) value on Test Results page: UPS Disconnect Power Delivery
10. ➔ Verify that indicators on UPS show correct state and record result on Test Results page: UPS Disconnect Indicators
11. Select Harmonics from the menu of the power test meter
12. ➔Record THD (Total Harmonic Distortion) value on Test Results page: UPS Power Conditioning
13. Reconnect UPS to compliant power source
14. ➔ Verify that pings continue uninterrupted and record result on Test Results page: UPS Reconnected Ping Operation

Battery pack charging compliance

15. Select Volts/Amps/Hertz from the menu of the power test meter
16. ➔ Record value on Test Results page: UPS Reconnect Power Delivery
17. ➔ Verify that indicators on UPS show correct state and record result on Test Results page: UPS Reconnect Indicators

3.5 Networking Tests

The networking tests section is designed to verify step by step the networking connectivity of the different networking elements in the system including Ethernet Switch, WMTS and the modems. This test assumes a stable RF link between the WMTS and the modems.

3.5.1 Management Link Test - WMTS

This section verifies the management network connection to the WMTS.

3.5.1.1 Equipment

- PC with Windows 2000 OS or later (See section 1.1 item 4).
- Cross-connect Cat-5 Ethernet Cables (used to connect the PC to the WMTS)

3.5.1.2 Prerequisites

- Obtain the IP address of the WMTS.
- Make sure the above IP addresses are on the same network.
- Configure the PC with an IP address that is on the same network as the WMTS and the Switch (usually this is 10.10.10.xxx with a mask of 255.255.255.0).

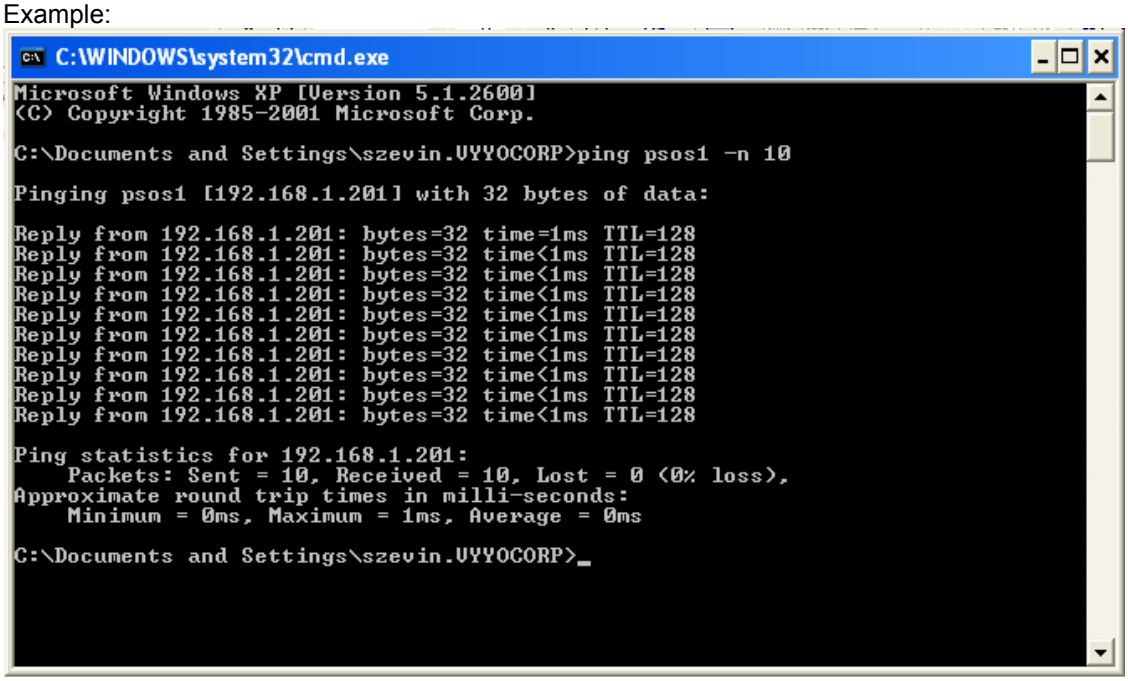
3.5.1.3 Procedure

1. Connect the PC to the WMTS Management port (CF Card) using the standard Cat-5 cable.
2. Verify that the WMTS Management port LED is illuminated.
3. Ping the WMTS using the standard DOS ping command and wait for response:

   "ping <WMTS IP address> -n 10"

   This command will send ten successive ping messages to the WMTS IP address.

Example:



4. ➔Record number of packets sent / received on Test Results page: Management Link Test – WMTS: WMTS.

3.5.2 Management Link Test - Modem

This test verifies the network connection to the modems. This will ensure the management path is operating correctly.

3.5.2.1 Equipment

- PC with Windows 2000 OS or later (See section 1.1. item 4).
- Cross-connect Cat-5 Ethernet Cables (be used to connect the PC to the WMTS)
- Three modems: one connected to each upstream-downstream pair.

3.5.2.2 Prerequisites

- Make sure the PC IP address is on the same network as the WMTS (usually this is 10.10.10.xxx with a mask of 255.255.255.0).
- Obtain the IP address of the three test modems.
- Configure the WMTS such that downstream channel 1 is associated with upstream channels 1 and 2, downstream channel 2 is associated with upstream channels 3 and 4 and downstream channel 3 is

associated with upstream channels 5 and 6. These will be referred to as sector 1, sector 2 and sector 3 respectively.

- Make sure that the upstream bandwidth for each channel is set to 325 kHz QAM16 and the downstream bandwidth is set to 330 kHz QAM64.
- Configure the modems such that each modem is operating on its pair of upstream-downstream channels, i.e., first modem is operating on downstream channel 1 and upstream channel 1, and so forth. Use the DHCP server to bind the modems to an upstream-downstream pair via downloading an appropriate modem configuration file.
- Make sure that all modems are operational prior to commencing the tests.

3.5.2.3 Procedure

Perform the following procedure for all channels (1, 2 and 3*):

***Note: If a single sector is used, the other two channels should be shut down.**
If a dual sector BTS is used, the remaining channel should be shut down.

1. Connect the PC to the WMTS Management port (CF Card) using the standard Cat-5 cable.
2. Verify the WMTS Management port LED is illuminated.
3. Ping the test modem connected to the channel under test using the standard DOS ping command and wait for response:
   "ping <Modem IP address> -n 10"
4. ➔Record number of packets sent / received on Test Results page: Management Link Test – Modems

3.5.3 Data Link Test

This test verifies the user data path in the system. This will be done by testing the connection to a simple data CPE station. An external PC connected to one of the modems will be used for this purpose.

3.5.3.1 Equipment

- Two PCs with Windows 2000 OS or later (See section 1.1. item 4).
- Two Cross-connect Cat-5 Ethernet Cables (used to connect the PC to the WMTS)
- Single modem connected to sector 1.
  Note: There is no added value from running this test on other sectors.

3.5.3.2 Prerequisites

- Make sure the two PC IP addresses are on the same network as the WMTS (usually this is 10.10.10.xxx with a mask of 255.255.255.0).
- Configure the WMTS such that downstream channel 1 is associated with upstream channel 1 (Sector 1).
- Make sure that the upstream bandwidth is set to 325 kHz QAM16 and the downstream bandwidth is set to 330 kHz QAM64.
- Make sure that modem number 1 is operational prior to commencing the tests.

3.5.3.3 Procedure

1. Connect the first PC to the WMTS Data User Port (DS Card) using the standard Cat-5 cable.
2. Verify that the WMTS Data port LED is illuminated.
3. Connect the second PC to the Ethernet port of the sector 1 modem using standard Cat-5 cable.
4. Verify the modem port link LED is illuminated.
5. Use the first PC (connected to switch) to ping the second one:
   "ping <PC2 IP address>"
6. ➔Record number of packets sent /received on Test Results page: Data Link Test – Modem.

3.6 Performance Tests

Verify roundtrip connectivity from the CPE to the network by sending Ping packets to the test modems connected to each of the three channels. Note that multiple modems are used for this test.

3.6.1 Ping Test

3.6.1.1 Equipment

- A PC (laptop or otherwise) running Windows 2000 or later and capable of executing the "ping" command.
- Cross-connect Cat-5 Ethernet Cable (to be used to connect the PC to the WMTS management port)
- Special Ping Test software which allows up to nine modems to be pinged simultaneously.
    - PTrun.bat - the Windows "batch" file which executes the Ping Test
    - PT1.bat - the Windows "batch" file used to ping the first modem
    - PT2.bat - the Windows "batch" file used to ping the second modem
    - PT3.bat - the Windows "batch" file used to ping the third modem
    - PT4.bat … PT9.bat are additional "batch" files (scripts) which allow additional modems to be pinged
    - Tping.exe - special version of the ping software modified for this test
- Nine modems

3.6.1.2 Prerequisites

- Connect the PC to the WMTS Management LAN port (the one on the Universal card….) using a standard Cat-5 cable with RJ-45 connectors on each end.
- Obtain the IP address of WMTS
- Obtain the MAC addresses of the nine modems to be used in testing
- Configure the PC with an IP address that is on the same network as the WMTS (usually this is 10.10.10.xxx with a mask of 255.255.255.0).
- Copy the Ping Test software into a convenient directory (the "Ping Test Directory") on the PC being used to perform the test
- Configure the WMTS such that downstream channel 1 is associated with upstream channel 1, downstream channel 2 is associated with upstream channel 2 and downstream channel 3 is associated with upstream channel 3. These will be referred to as sector 1, sector 2 and sector 3 respectively.
- Make sure that the upstream bandwidth for each channel is set to 325 kHz and the downstream bandwidth is set to 330 kHz.

- Configure the nine modems into three groups such that three modems are operating on each pair of upstream-downstream channels, i.e., three modems are operating on downstream channel 1 and upstream channel 1, and so forth. Use the DHCP server to bind the modems to an upstream-downstream pair via downloading an appropriate modem configuration file.
- Make sure that all modems are operational prior to commencing the tests

3.6.1.3 Procedure

Perform the following procedure for all channels (1, 2 and 3*):

***Note: In case that, only one sector is used the other 2 channels shall be shut down. In case that, only two sectors are used the Remaining channel shall be shut down.**

1. Bring up a DOS window and use the "cd" command to change to the Ping Test Directory (see Prerequisites above). An easy way to do this is to click the Windows "Start" button (lower left corner) then select "Run" from the menu and type in "cmd" (abbreviation for "command") when the text input box is displayed. Hit the "Enter" key and a DOS command window will be displayed. Now use the "cd" (Change Directory) command to move to the Ping Test Directory.

2. To verify connectivity three modems are required: use the three modem IP addresses bound to the upstream-downstream pair corresponding to the channel under test. Type this command and wait for the response:

   "ptrun <IP address of Modem 1> <IP address of Modem 2> <IP address of Modem 3>"

NOTE: If there is a significant (> 200 milliseconds) discrepancy between the System Timer and System Tick Counter elapsed times you should rerun the test to ensure accurate results.

Example:

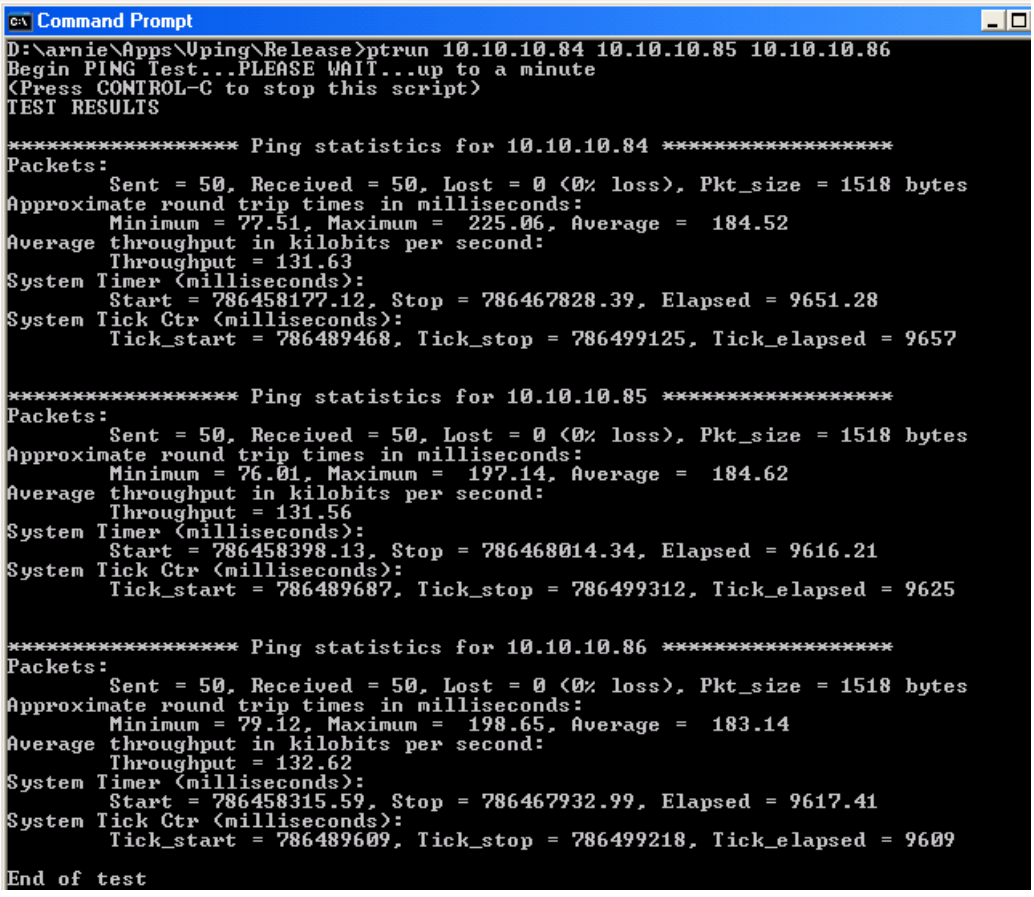
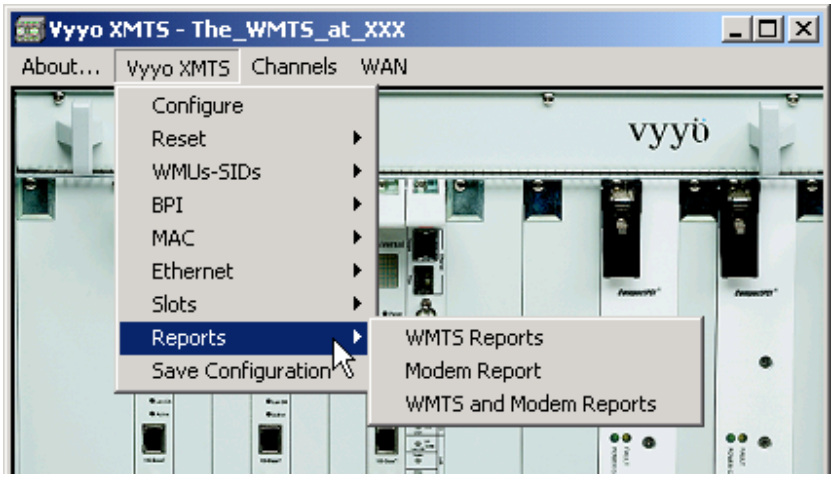


Figure 3-12: Ping Test

3. ➔ Record the Throughput and System Timer (last 6 digits) results on the Test Results page: Ping Test – Connectivity

3.7 Configuration Summary

Capture the state of the WMTS by using the WMTS Reports function of the NMS. Details on the operation and use of the NMS are contained in the NMS Reference Guide. This is the screen that you will use by selecting the WMTS Reports menu item:



The various reports in the newly created Reports folder are stored in ".csv" (comma separated variables) format and contain all the configuration information necessary for the WMTS. This Reports folder should be archived in a known location for future use as needed.

Note the completion of the Reports creation and capture on the Test Results page: Configuration Summary.

The Factory Acceptance Test is now complete.

Factory Acceptance Test
RESULTS
(FAR)

ARCADIAN Networks

BSR-757
Arcadian Networks Broadband Wireless Access System
700 MHz UHF system, IP
A-Guard Band

BSR-757 S/N:

Date:

Great River Energy
17845 E. Hwy. 10
Elk River, MN 55330

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4 Test Results: Serial Numbers

BSR Serial Number	

*Equipment Description	Serial Number
Upconverter – Sector 1	
Upconverter – Sector 2	
Upconverter – Sector 3	
Power Amp – Sector 1	
Power Amp – Sector 2	
Power Amp – Sector 3	
MMU - Sector 1 (MAC address)	
MMU - Sector 2 (MAC address)	
MMU - Sector 3 (MAC address)	
RCU	
UPS	

***Note: In case that, only one sector is used; the other 2 sectors on the table above shall be disregarded.**

In case that, only two sectors are used; the remaining sector shall be disregarded.

System Initial Configuration

WMTS S/N:_____

WMTS SW Version: _____

WMTS HW Version: _____

_

Universal Card Slot	Serial Number	Board Revision	Boot Eprom	Flash Version	Function U / D / CF
	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A

Host Card Slot	Serial Number	Board Rev.	EPC Version	Host version

IF Card Slot	IF Cards	Serial Number	Board Rev.
	__ DS __ UP		
	__ DS __ UP		
	__ DS __ UP		

Power Supply	Manufacturer	Model	Serial
Left			
Right			

5 Test Results: Measurements

5.1 Downstream Acceptance Test Results

5.1.1 WMTS Modulated Output / Upconverter Output Test

5.1.1.1 Measurement: WMTS DS Channel Output Power

Reference: Paragraph 3.2.1.3 Step 3 *WMTS DS Channel Output Power*

WMTS*1	Required	Actual	By	Date
Channel 1	43 ± 3 dBmV			
Channel 2	43 ± 3 dBmV			
Channel 3	43 ± 3 dBmV			

1* Note: For a single sector use only one channel; for two sectors use only two channels from the above.

5.1.1.2 Measurement: Adjacent Channel Interference Power Level

Reference: Paragraph 3.2.1.3 Step 7 *Adjacent Channel Interference Power Level*

Test Point Cluster*2	Required	Actual	By	Date
TP 1 **44.33 MHz**	< -48 dBc			
TP 2 **44 MHz**	< -48 dBc			
TP 3 **43.67 MHz**	< -48 dBc			

2* Note: For a single sector use only TP1 1; for two sectors use only TP1 and TP2.

Observations:

5.1.1.3 Measurement: Upconverter Output Power

Reference: Paragraph 3.2.1.3 Step 13 *Upconverter Output Power Level (RBW 10 KHz).*

WMTS*1	Required	Actual	By	Date
Channel 1	34 ± 2 dBmV			
Channel 2	34 ± 2 dBmV			
Channel 3	34 ± 2 dBmV			

1* Note: For a single sector use only one channel; for two sectors use only two channels from the above.

5.1.1.4 Measurement: Upconverter Adjacent Channel Power Level

Reference: Paragraph 3.2.1.3 Step 16 *Adjacent Channel Power Level.*

WMTS*1	Required	Actual	By	Date
Channel 1	< -48 dBc			
Channel 2	< -48 dBc			
Channel 3	< -48 dBc			

1* Note: For a single sector use only one channel; for two sectors use only two channels from the above.

5.1.2 PA Output Power Test

5.1.2.1 Measurement: Channel Power Post PA at Antenna Port (Using external Directional Coupler)

Reference: paragraph 3.2.2.3 *steps 5,6 Channel Power Post PA at Antenna Port*

Directional Coupler*1	Required	Actual	Required Front Panel Display	Actual PA Front Panel Display	By	Date
Channel 1 **757.17MHz**	43 ± .5 dBmV		8 to 20 Watts			
Channel 2 **757.5 MHz**	43 ± .5 dBmV		8 to 20 Watts			
Channel 3 **757.83 MHz**	43 ± .5 dBmV		8 to 20 Watts			

1* Note: For a single sector use only one channel; for two sectors use only two channels from the above.

5.1.2.2 Measurement: Channel Power Post PA at Test Point Cluster TP4 (measurements should be about 84 dB Below PA Level)

Reference: paragraph 3.2.2.3 *step 7 Channel Power Post PA at Test Point Cluster TP4*

Test Point Cluster*1	Required	Actual	PA Front Panel Display		By	Date
TP 4 (Chn 1) **757.17MHz**	5 ± 3 dBmV					
TP 4 (Chn 2) **757.500 MHz**	5 ± 3 dBmV					
TP 4 (Chn 3) **757.83 MHz**	5 ± 3 dBmV					

1* Note: For a single sector use only one channel; for two sectors use only two channels from the above.

5.1.2.3 Measurement: Adjacent Channel Interference Post PA at Directional Coupler

Reference: paragraph 3.2.2.3 *step 11 Adjacent Channel Interference Post PA at Directional Coupler*

Directional Coupler*1	Required	Actual	By	Date
Channel 1 **757.17MHz**	< -43 ± 2dBc			
Channel 2 **757.500 MHz**	< -43 ± 2dBc			
Channel 3 **757.83 MHz**	< -43 ± 2dBc			

1* Note: For a single sector use only one channel; for two sectors use only two channels from the above.

5.1.3 Downstream Received Power and SNR Test - MMU

5.1.3.1 Measurement: MMU Downstream Received Signal Strength

Reference: paragraph 3.2.3.3 step 5 *Downstream Received Signal Strength*

MMU Channel*3	Required	Actual	By	Date
MMU 1	-16 ± 3 dBmV			
MMU 2	-15 ± 3 dBmV			
MMU 3	-15 ± 3 dBmV			

5.1.3.2 Measurement: MMU Downstream SNR

Reference: paragraph 3.2.3.4 step 4 MMU *Downstream SNR*

MMU Channel*3	Required	Actual	By	Date
MMU 1	≥ 30 dB			
MMU 2	≥ 30 dB			
MMU 3	≥ 30 dB			

3* Note: For a single sector, use only one MMU.
For two sectors, use only 2 MMUs.

5.2 Upstream Acceptance Test Results

5.2.1 LNA Module Test

5.2.1.1 Measurement: Gain Test Signal Strength

Reference: Paragraph 3.3.1.3 step 6 *Gain Test Signal Strength*

Test Point Cluster*[4]	Required	Actual	By	Date
TP 5 (Chn 1) **787.170MHz**	4 ± 2 dBmV			
TP 6 (Chn 2) **787.5 MHz**	4 ± 2 dBmV			
TP 7 (Chn 3) **787.830MHz**	4 ± 2 dBmV			

***[4] Note: For a single sector use only one TP while the rest should be terminated by 75 ohm termination. For two sectors, use only 2 TPs while the remaining channel should be terminated by 75 ohm. (Refer to mechanical assembly for information on termination.)**

5.2.2 Upstream Downconverters: Freq. Conversion and Gain Setting

5.2.2.1 Measurement: Downconverter Output Signal Level

Reference: Paragraph 3.3.2.3 step 9 *Downconverter Output Signal Level*

Test Point Cluster*[5]	Required	Actual	By	Date
TP 8 (Chn 1) **44.330 MHz**	14 ± 3 dBmV			
TP 9 (Chn 2) **44 MHz**	14 ± 3 dBmV			
TP 10 (Chn 3) **43.670 MHz**	14 ± 3 dBmV			

***[5] Note: For a single sector use only one TP, while the rest should be terminated by 75 ohm termination. For two sectors use only 2 TPs, while the remaining channel should be terminated by 75 ohm. . (Refer to mechanical assembly for information on termination.)**

5.2.2.2 Measurement: Calculated System Gain

Reference: Paragraph 3.3.2.3 step 10 *Calculated System Gain*

Test Point Cluster*[5]	Required	Actual	By	Date

TP 8 (Chn 1) **44.330 MHz**	45 ± 3 dB			
TP 9 (Chn 2) **44 MHz**	45 ± 3 dB			
TP 10 (Chn 3) **43.670 MHz**	45 ± 3 dB			

***[5] Note: For a single sector use only one TP, while the rest should be terminated by 75 ohm termination. For two sectors use only 2 TPs, while the remaining channel should be terminated by 75 ohm. . (Refer to mechanical assembly for information on termination.)**

5.2.2.3 Measurement: Noise Floor level to WMTS

Reference: Paragraph 3.3.2.4 step 18 *Noise Floor Level To WMTS (using 10 kHz resolution BW)*

Test Point Cluster*[5]	Required	Actual	By	Date
TP 8 (Chn 1) **44.330 MHz**	-31 ± 3 dBmv			
TP 9 (Chn 2) **44 MHz**	-31 ± 3 dBmv			
TP 10 (Chn 3) **43.670 MHz**	-31 ± 3 dBmv			

5.2.2.4 Measurement: SNR to WMTS

Reference: : Paragraph 3.3.2.4 step 19 *SNR Measurement*

Test Point Cluster*[5]	Required	Actual	By	Date
TP 8 (Chn 1) **44.330 MHz**	24 ± 1 dB			
TP 9 (Chn 2) **44 MHz**	24 ± 1 dB			
TP 10 (Chn 3) **43.670 MHz**	24 ± 1 dB			

***[5] Note: For a single sector use only one TP, while the rest should be terminated by 75 ohm termination. For two sectors use only 2 TPs, while the remaining channel should be terminated by 75 ohm. . (Refer to mechanical assembly for information on termination.)**

5.2.3 Upstream Verification Test - MMU

5.2.3.1 Measurement: SNR Value for Upstream Channels

Reference: Paragraph 3.3.3.3 step 9 *SNR Value For Upstream Channels*

WMTS Channel*[6]	Required	Actual	By	Date
Upstream 1	>22 dB SNR			
Upstream 2	>22 dB SNR			
Upstream 3	>22 dB SNR			

***[5] Note: For a single sector use only one TP, while the rest should be terminated by 75 ohm termination. For two sectors use only 2 TPs, while the remaining channel should be terminated by 75 ohm. . (Refer to mechanical assembly for information on termination.)**

5.3 UPS Tests

5.3.1 Power Delivery/Power Integrity

Reference: paragraph 3.4.1.3 step 2, 4

Measurement	Required	Actual	By	Date
Initial Power Delivery	120 VAC 11.8 Amps			
Initial Power Conditioning	<5% THD All Harmonics <4v			

5.3.2 Non-service Affecting Switchover

Reference: paragraph 3.4.1.3 steps 7, 9, 10, 12, 14

Measurement	Required	Actual	By	Date
UPS Disconnected Ping Operation	0% Loss			
UPS Disconnected Power Delivery	120 VAC 11.5 Amps			
UPS Disconnected Pwr. Cond.	<5% THD All Harmonics <4v			
UPS Disconnect	Load 75%			

Indicators	AC/Bat. Red			
UPS Reconnected Ping Operation	0% Loss			

5.3.3 Battery Pack Charging Compliance

Reference: paragraph 3.4.1.3 steps 16,17

Measurement	Required	Actual	By	Date
UPS Reconnect Power Delivery	120 VAC 11.8 Amps			

5.4 Networking Tests

5.4.1 Measurement: Management Link Test – WMTS

Reference: paragraph 3.5.1.3 step 4 *Networking* test results

Device	Packets Sent	Packets Received	By	Date
Switch				
WMTS				

5.4.2 Measurement: Management Link Test – Modems

Reference: paragraph 3.5.2.3 step 4 *Networking* test results

Device*[3]	Sector #	Packets Sent	Packets Received	By	Date
Modem 1					
Modem 2					
Modem 3					

***[3]Note: For a single sector use only one MMU.**
For two sectors use only 2 MMUs.

5.4.3 Measurement: Data Link Test – Modem

Reference: paragraph 3.5.3.3 step 6 *Networking* test results

Device	Modem #	Packets Sent	Packets Received	By	Date
CPE - PC					

5.5 Performance Tests

5.5.1 Measurement: Ping Test –Connectivity

Reference: paragraph 3.6.1.3 step 3 *Ping* test results

Channel 1	Required Throughput	Actual Throughput	Start System Timer	Stop System Timer	Elapsed System Timer	By	Date
Modem 1	240 kbps						
Modem 2	240 kbps						
Modem 3	240 kbps						

Channel 2	Required Throughput	Actual Throughput	Start System Timer	Stop System Timer	Elapsed System Timer	By	Date
Modem 1	240 kbps						
Modem 2	240 kbps						
Modem 3	240 kbps						

Channel 3	Required Throughput	Actual Throughput	Start System Timer	Stop System Timer	Elapsed System Timer	By	Date
Modem 1	240 kbps						
Modem 2	240 kbps						
Modem 3	240 kbps						

5.6 Configuration Summary

Reference: paragraph 3.8 *Configuration Summary*

Reports Created and Archived	By	Date

6 Final Signoff

I hereby certify that the above BSR has passed this Factory Acceptance Test based on the above test results.

Company:	
Name:	
Title:	
Signature:	
Date:	

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