BSR-757 Base Station

User Guide

Version 100
Part Number: 3BR0040

Copyright and Compliance Information

FCC Compliance Information

NOTE: This equipment is authorized under FCC ID:V72BSR757 to operate in the A block of the Upper 700 MHz Guard Band pursuant to Part 27 of the FCC's rules.

In addition, this equipment has been tested and found to comply with the limits for a Class B digital device pursuant to Part 15 of the FCC's rules.

These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. In addition, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the antenna.
- Increase the distance between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver was connected.
- Consult the dealer or an experienced radio/TV technician for assistance.

Warning!

Changes or modifications to this equipment not expressly approved by Arcadian Networks Inc. could void the user's authority to operate the equipment.

This product was tested with shielded coaxial cable (not provided by Arcadian Networks) and Category 5 Ethernet cable (optional) equipped with a shielded RJ-45 connector. These types of cables must be used with the unit to ensure compliance.

Table of Contents

About This Guide

The BSR-757 Base Station User Guide is part of the documentation package for the Arcadian Networks. The guide describes the BSR-757 Base Station, and how to install, configure and maintain it. In this guide, the term *Base Station* refers to the Base Station Rack hardware, software, and management facilities. It does not refer to the antennas, pole, and antenna cables, and they are not discussed in this guide.

☑ **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 guide does not explain how to upgrade from the BSR-700 to the BSR-757.

Intended Audience

This guide is intended for service personnel required to install, configure or maintain the Base Station. Some technical radio understanding is assumed.

Document Objectives

This guide is designed to be used as a tool in the initial installation and periodic maintenance of the Base Station. It contains information on how to perform the following tasks:

- Installing the Base Station
- Configuring the Base Station
- Maintaining the Base Station
- Troubleshooting the Base Station

Document Conventions

The following icons appear throughout this guide:

☑ **Note:** This is a note. It provides additional information on the current topic.

⚠ ***Warning:*** *This is a warning. It contains cautionary information on the current topic.*

Tip: This is a tip. It provides time saving information to the reader.

How This Guide is organized

This guide is organized into the following chapters and appendices:

Chapter 1: Overview

This chapter provides an overview of the Arcadian Networks, the Base Station, and the configuration of the system.

Chapter 2: Base Station Components

This chapter includes descriptions of the top, middle and bottom sections of the Base Station rack, and the various Base Station components.

Chapter 3: Installing the Base Station

This chapter details installation prerequisites, explains how to install the various components of the Base Station, and describes initial operation. It also explains how to set the WMTS IP address and connect the WMTS to the backbone network. In addition, it provides guidelines for provisioning the monitoring modem, and for verifying proper Base Station operation.

Chapter 4: Configuring the Base Station

This chapter describes the basic frequency setup, and explains how to configure the WMTS and the Upconverter.

Chapter 5: Maintaining the Base Station

This chapter describes the LED functions of various components, and explains how to monitor the Base Station and upgrade the WMTS software version.

Chapter 6: Troubleshooting

This chapter provides troubleshooting information to help solve common problems.

Appendix A: Technical Specifications

This chapter provides technical specifications for the Base Station and its components.

Related Documentation

For information on other Arcadian Networks topics, see the following guides:

- *NMS User Guide*
- *V390iA User Guide*

Obtaining Documentation

To obtain additional documentation, please contact info@arcadiannetworks.com.

Documentation Feedback

We welcome your comments about this guide. Please send comments to:

Email address: helpdesk@arcadiannetworks.com

Please include in the comment the name and version number of the guide.

List of Abbreviations

Following is a list of the abbreviations used in the guide.

Abbreviation	Meaning
BPI	Baseline Privacy Interface
BSR	Base Station Rack
BTS	Base Stations
BW	Bandwidth
CIR	Committed Information Rate
CLI	Command Line Interface
CPE	Customer Premises Equipment
CRC	Cyclic Redundancy Check
dB	Decibels
dBmV	Decibel-Millivolt
DES	Digital Encryption Standard
DHCP	Dynamic Host Configuration Protocol
DOCSIS	Data-Over-Cable Service Interface Specifications
DS	Downstream
DSCP	Differentiated Services Code Point
FAT	Factory Accepted Test
FDD	Frequency Division Duplexing
FEC	Forward Error Correction
FTP	File Transfer Protocol
GHz	Gigahertz
ICMP	Internet Control Message Protocol
IEEE	Institute of Electrical and Electronic Engineers
IETF	Internet Engineering Task Force
IGMP	Internet Group Management Protocol
IP	Internet Protocol
ISO	International Standards Organization
ITU	International Telecommunications Union

Abbreviation	Meaning
ITU-T	Telecommunication Standardization Sector of the International Telecommunication Union
Kbps	Kilobits per second
KHx	Kilohertz
LAN	Local Area Network
LOS	Line of Sight
LLC	Logical Link Control procedure
MAC	Media Access Control
Mbps	Megabits per second
MHz	Megahertz
MIB	Management Information Base
MMU	Monitor Modem Unit
MPEG	Moving Picture Experts Group
Ms	Millisecond
MTU	Maximum Transmission Unit
NLOS	Non Line of Sight
NMS	Network Management System
Ns	Nanosecond
PHY	Physical Layer
PPP	Point-to-Point Protocol
QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
QPSK	Quadrature Phase-Shift Keying
RCU	Remote Control Unit
RF	Radio Frequency
RFC	Request For Comments
RTU	Remote Transmission Unit
SCADA	Supervisory Control And Data Acquisition
SNAP	Subnetwork Access Protocol
SNMP	Simple Network Management Protocol
SNR	Signal-to-Noise Ratio
TCP	Transmission Control Protocol

Abbreviation	Meaning
TFTP	Trivial File-Transfer Protocol
US	Upstream
VSWR	Voltage Standing Wave Ratio
WMTS	Wireless Modem Termination System

1 Overview

Arcadian Networks's BSR-757 Base Station is a component of the Arcadian Networks access system. This system provides point to multipoint broadband wireless access over the 700 MHz A-Guard Band frequencies. The system enables utilities to operate secure wireless networks for communications and Supervisory Control And Data Acquisition (SCADA) of their remote assets.

Overview of the Arcadian Networks access System

Arcadian Networks access systems consist of a BSR-757 Base Station Rack (BSR) located in base stations, and wireless modems located at the substation site and connected to the utility's Remote Transmission Units (RTU). The system can be remotely managed from any location using Arcadian Networks's Web-based Network Management System (NMS).

The following figure illustrates the Arcadian Networks access system.

Figure 1: Arcadian Networks System

Arcadian Networks's solutions are standards-based. The Arcadian Networks system architecture is Internet Protocol (IP)-based and utilizes a version of the cable industry's DOCSIS standard, adapted to the wireless environment.

The Arcadian Networks wireless products are designed to provide broadband wireless connectivity over two 1 MHz wide bands in the 700 MHz A-Guard Band frequencies.

Arcadian Networks equipment supports flexible cellular planning, using one-, two-, or three-sector cells, with frequency reuse. Each sector provides a single sub-channel with both downstream and upstream connectivity.

As illustrated in Figure 1, the main components of the system include:

- The BSR-757 Base Stations, described in this guide.
- The wireless modems. The Base Station supports two modem types:
  - V390i – this is an industrial wireless modem located in the utility substation sites. It includes a V384 data modem with additional interfaces, such as four serial ports (typically for SCADA devices), three Fast Ethernet ports, and a WiFi access point. This modem is described in the *V390i User Guide*.
  - V384 (monitoring modems) – this is an indoor UHF band A data modem, which is part of the BSR. It is used to monitor the RF signal quality of a sector.
- The NMS, described in the *NMS User Guide*.

Overview of the Base Station

The Arcadian Networks BSR is a pre-configured rack, containing all the components necessary for operating a secure wireless network for communications.

The BSR is designed to provide broadband wireless connectivity over two 1 MHz wide bands in the 700 MHz A-Guard Band frequencies, separated 30 MHz from each other. These 1 MHz channels are divided into three equal subchannels, each subchannel being delivered via each one of a three sector antenna array providing a frequency diverse coverage area from each base station tower site. Each BSR has three discrete RF paths to and from its Wireless Modem Termination System (WMTS) to the sector antennae. The antenna is typically installed on a 100-300’ height must. The base station transmits a “Downstream” RF signal to the CPE, and receives an “Upstream” RF signal from the CPE.

This document describes the three-sector Base Station configuration. One-sector or two-sector configurations are optional, either for Omni coverage, or for support of two sectors out of three. Where a three-sector configuration includes three RF subcomponents (Upconverter, PA, LNA, Downconverter, etc.), the one- or two-sector configurations include the corresponding one or two RF subcomponents. All sections of this document are relevant also for the one- and two-sector configurations.

Base Station Basic Description

The following is a simplified block diagram of the three-sector Base Station.

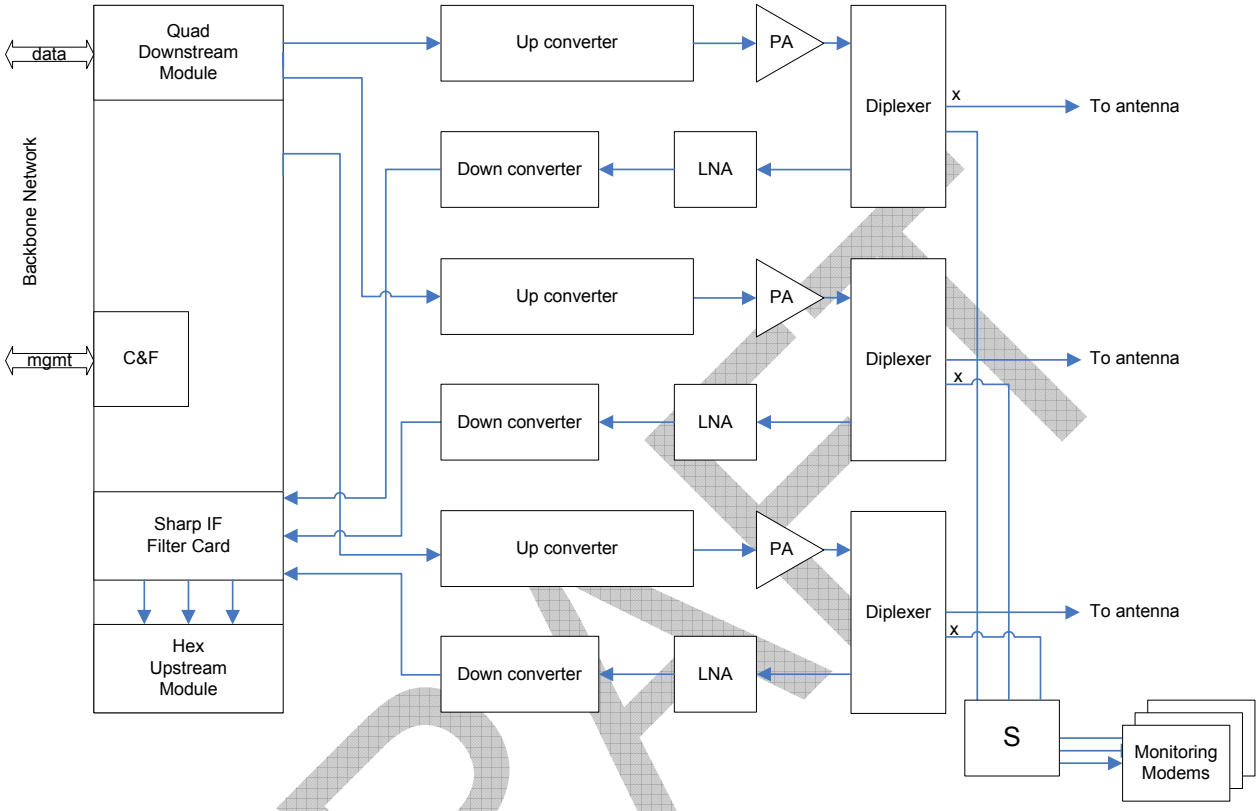


Figure 2: Three-Sector Base Station – Simplified Block Diagram

☑ Note: The Sharp IF Filter card is an optional card that filters out extraneous signals. Without the Sharp IF Filter card, the connection between the Down converter and the Hex Upstream Module is a straight wire.

The Base Station supports three separate Transmit (TX) and Receive (RX) RF-paths for the three sectors. Each RF path includes a transmitter and a receiver. The actual RF frequencies for one- and two-sectors will be determined by the customer.

The basic components and process of the Base Station include:

- **Downstream (transmit) path description:** Digital signals arrive at the WMTS from the customer's backbone network. The WMTS Quad Downstream card include a digital modulator, with output TX IF signal at 44 MHz. This signal is up-converted to the RF signal, amplified by the Power Amplifier unit, and then delivered through the Diplexer to the antenna port. A 50-300' cable is typically connected between the BSR to the antenna. From the antenna the signal is transmitted to the modems.
- **Upstream (receive) path description:** RF Signals arrive at the antenna from the remote equipment. The RX RF signal from the antenna is delivered through the Diplexer to the Low Noise Amplifier (LNA) and Down-converter module, and then delivered as an IF signal to the WMTS Hex Upstream receiver card. From there it is transmitted to the customer's backbone network.
- **WMTS:** The Wireless Modem Termination System (WMTS) is the system's heart. The WMTS is a mediator between the wireless access system and the customer's backbone. The WMTS exchanges the digital signal to/from the customer's backbone with the RF signals to/from the CPE modems. Multiple RF paths terminate in a single WMTS device.
- **Monitoring:** The Base Station includes several RF test points to enable local RF signals measurements, and three monitoring modems to enable remote monitoring of the base station functionality for each sector. The Base Station also includes a Remote Control Unit (RCU). It is intended to provide extended BTS monitoring in future versions.
- **UPS**: The Uninterruptible Power Supply (UPS) serves as a battery backup for the whole base station in case of a power down event. The battery backup assures uninterrupted operation until the external AC Generator goes into operation.

Note: When a one-sector BTS is built, only channel 1 is used. For two-sectors, channels 1 and 2 are used. For three-sectors, channels 1, 2, and 3 are used.

System Configuration Description

The following table describes the system configuration.

Parameter	One-Sector	Two-Sector	Three-Sector
Number of Sectors	1	2	3
Number of Downstream Channels	1	2	3
Downstream Channel Width	330 KHz (245 KHz optional)	330 KHz (245 KHz optional)	330 KHz (245 KHz optional)
Downstream Channel Modulation	64QAM typ. (QPSK, 16QAM, 256QAM optional)	64QAM typ. (QPSK, 16QAM, 256QAM optional)	64QAM typ. (QPSK, 16QAM, 256QAM optional)
Downstream Channel Frequencies	757.170, 757.5, 757.830 MHz	757.170, 757.5, 757.830 MHz	757.170, 757.5, 757.830 MHz
Number of Upstream Channels	1	2	3
Upstream Channel 1 Port Assignment	1 & 2 with diversity	1 & 2 with diversity	1 & 2 with diversity
Upstream Channel 2 Port Assignment	NA	3 & 4 with diversity	3 & 4 with diversity
Upstream Channel 3 Port Assignment	NA	NA	5 & 6 with diversity
Upstream Channels Bandwidth	325 KHz	325 KHz	325 KHz
Upstream Channels Modulation	16 QAM	16 QAM	16 QAM
Upstream Channels Frequencies	787.170, 787.5, 787.830 MHz	787.170, 787.5, 787.830 MHz	787.170, 787.5, 787.830 MHz

Downstream 4 frequencies configuration:

The Downstream can be configured also for 4 separated narrower channels of 245 KHz. Each sector can be configured to each of the following frequencies:

Downstream Channel Bandidth	245 KHz
Downstream Channel Frequencies	757.1325, 757.3775, 757.6225, 757.8675 MHz

2 Base Station Components

The Base Station is housed in a rack, composed of three main sections. The following sections describe the main sections and their components.

Base Station Front and Back Views

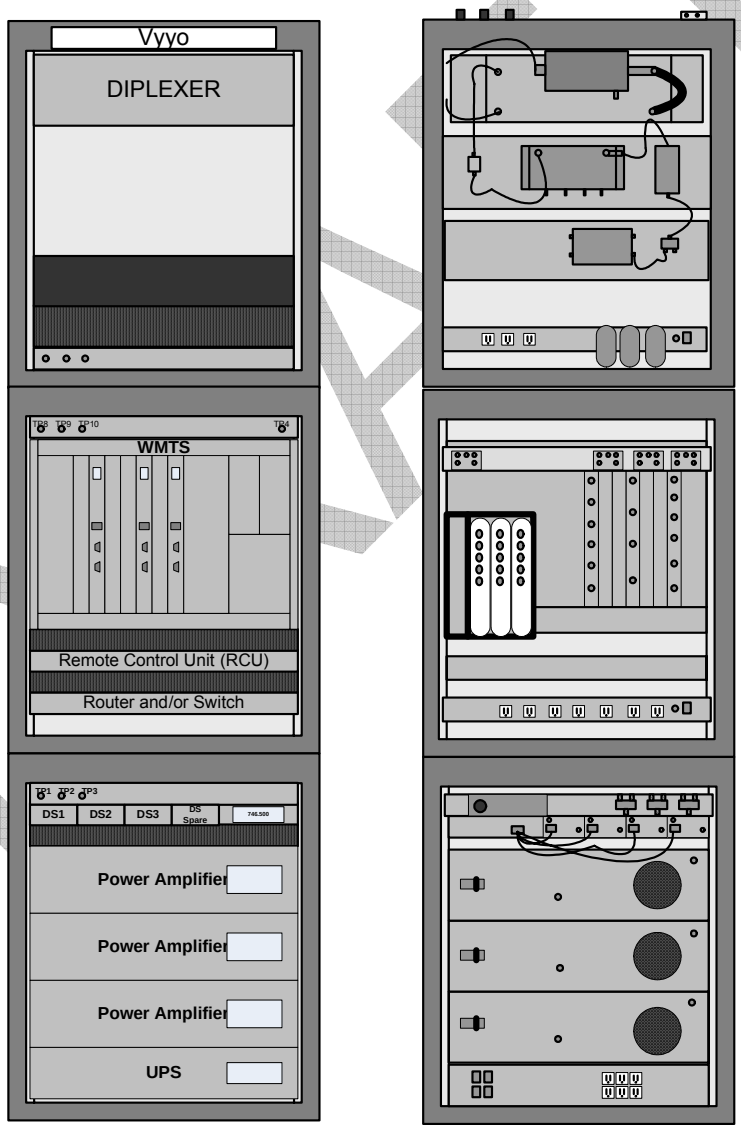


Figure 3: Base Station – Front View and Back View

BSR Physical Sections

The BSR (Base Station Rack) is a complete unit, assembled of three sections: a bottom section, a middle section, and a top section. The three sections are detailed below.

Base Station Bottom Section

The bottom section of the BSR houses the PAs (power amplifiers), the UPS (Uninterruptible Power Supply), and the Upconverters.

For a one-sector installation, install the single PA in the PA 3 slot. For a two-sector installation, install the two PAs in the PA 3 and PA 2 slots.

The test point cluster for the bottom section includes Test Points 1, 2, and 3, which enable measurement of the output of the Downstream Upconverters pre-PA. A one-sector installation uses only Test Point 1. A two-sector installation uses Test Points 1 and 2. A three-sector installation uses Test Points 1, 2, and 3.

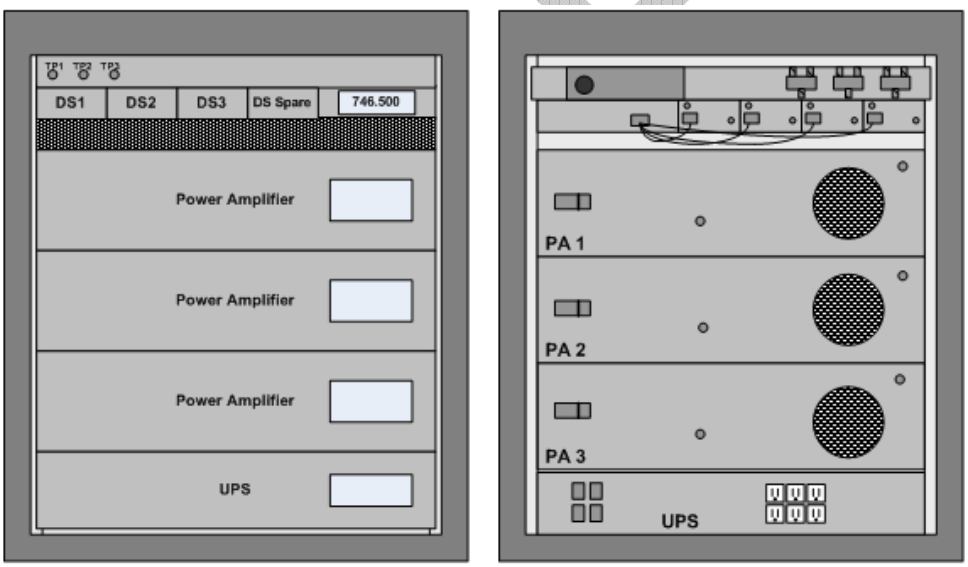


Figure 4: Bottom Section Physical Layout – Front and Back Views

Base Station Middle Section

The middle section of the BSR houses the WMTS (V3000), Remote Control Unit, Upstream splitter tray and customer added backhaul interface. The three Monitoring Modem Units (MMU) are located on the back side of the middle section, behind the WMTS.

For a one-sector installation, install the MMU in the left-most slot. For a two-sector installation, install the MMUs in the two left-most slots.

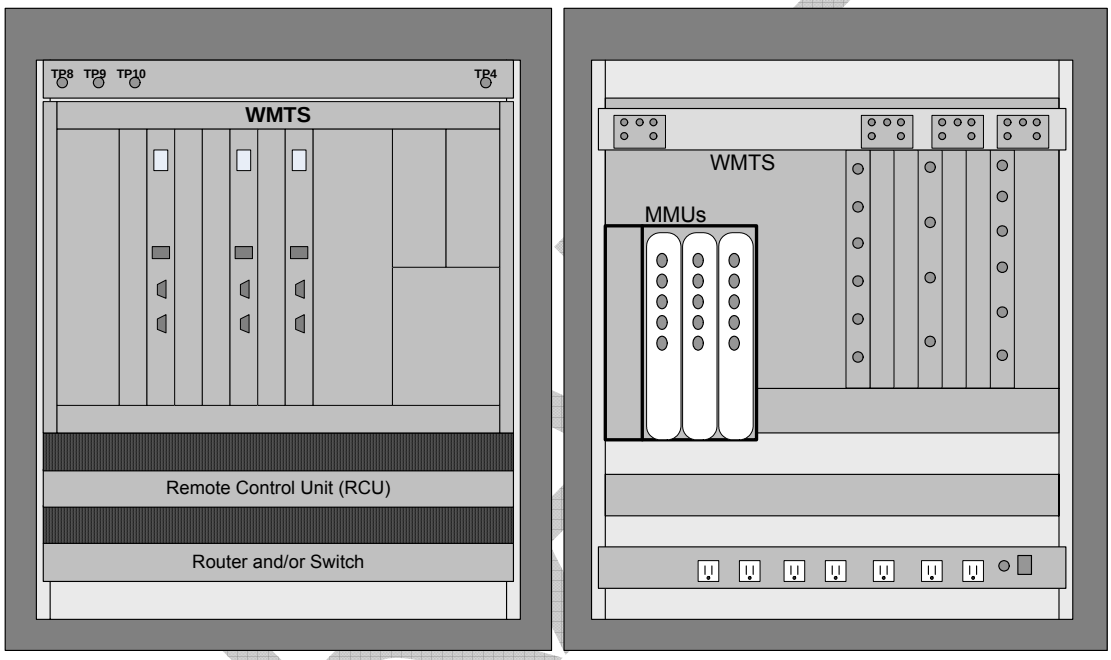


Figure 5: Middle Section Physical Layout – Front and Back Views

The test point cluster for the middle section includes:

- Test Point 4, which provides RF samples of the three 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, and are combined together after signal attenuation, to be tested on Test Point 4.
  Test Point 4 normally serves as a downstream signal level test point. It can also be used as a common Upstream/Downstream point for connecting test modems.
- Test Points 8, 9, and 10 are located on the front of the Downconverters and provide RF samples of the Upstream signal post-Downconverter.

Base Station Top Section

The top section of the BSR houses the Diplexer module (including the TX/RX Diplexer and the directional couplers), the upstream LNA module (including upstream LNA, Band Pass Filter and splitters), the upstream Downconverter modules (including Downconverter and splitter), ground-bus to facility point, and electric power to facility point. The antenna connection ports are located on the top of the rack.

The Diplexer, LNA, and Downconverter each consist of three units. Each unit serves a single sector. The units serving sector 1 are located towards the front of the rack, the units serving sector 2 are located towards the rear of the rack, and the units serving sector 3 are located in the middle.

The test point cluster for the top section includes test Points 5, 6 and 7, which provide RF samples of the upstream signal post-LNA (prior to Downconverter).

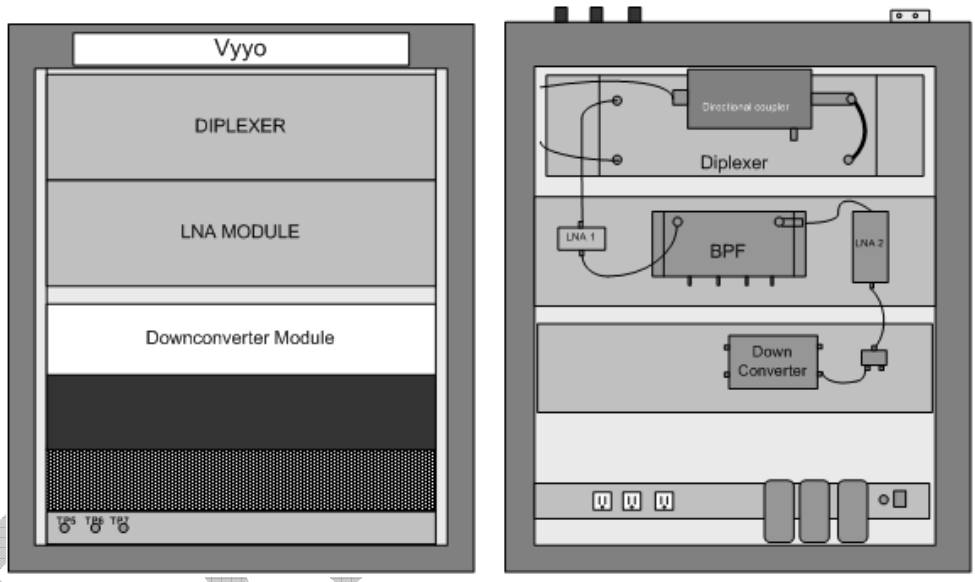


Figure 6: Top Section Physical Layout – Front and Back Views

The various components of the Base Station are described below.

Base Station Main Components

The Base Station includes the following main components:

- *WMTS*, described on page 3.
- *Upconverter*, described on page 3.
- *Power Amplifier*, described on page 3.
- *Diplexer*, described on page 3.

- *LNA Module*, described on page 3.
- *Downconverter*, described on page 3.
- *Test Points*, described on page 3.
- *Monitoring Modems*, described on page 3.

The following sections describe each component in detail. For the technical specifications of the Base Station rack and of each of the components, refer to *Appendix A: Technical Specifications*, on page 3.

WMTS

The WMTS chassis includes the following cards (see Figure 8):

- **Host card** – The host card serves as a PCI bus arbiter and provides system clock and timing.
- **Quad Downstream module** – The quad downstream module consists of a universal card inserted in the front portion of the chassis matched with a modulator card inserted in the rear of the chassis. This downstream module generates IF of four downstream channels. It also serves as the interface to backbone data traffic.
- **Hex Upstream module** – The hex upstream module consists of a universal card inserted in the front portion of the chassis matched with a demodulator card. It demodulates the data from the six US channels and extracts the Ethernet packets.
- **C&F card** – The C&F card runs the WMTS control application. It also serves as the interface to backbone management data traffic.
- **Sharp IF Filter card** – The filter card is inserted in the rear of the chassis. It rejects unwanted signals, ensuring that the signals received by the base station are free of interference. This is an optional card.

The system cards communicate and handle traffic over a standard internal Compact PCI bus.

- To extend the system, more upstream and downstream modules can be inserted into the WMTS. Each module consists of a universal card, a rear card (Upstream or Downstream), and an appropriate software application. Two slots are reserved, one for the host card and one for the C&F card. The system can be extended to any combination of 6 communication modules.

WMTS Physical Description

The WMTS is mounted in a standard 19” by 6U high rack-mounted chassis, as illustrated in Figure 8. The chassis has a fan tray above the unit, bringing the total height required in the rack, to 8U. The eight bay chassis contains 8 slots in the front, 6 slots in the rear, and a mid-plane card in between, used to interface the cards. Blank panels cover unused slots.

A standard Compaq PCI bus is used to transfer traffic and data between the system cards. The power supplies, host card and the universal cards are inserted in the front of

the chassis. The modulator and hex demodulator cards are inserted in the rear of the chassis.

The ON/OFF power switch and the fuse are located in the rear of the power supply.

The rear panel of the chassis is illustrated in Figure 7, and the front panel in Figure 8.

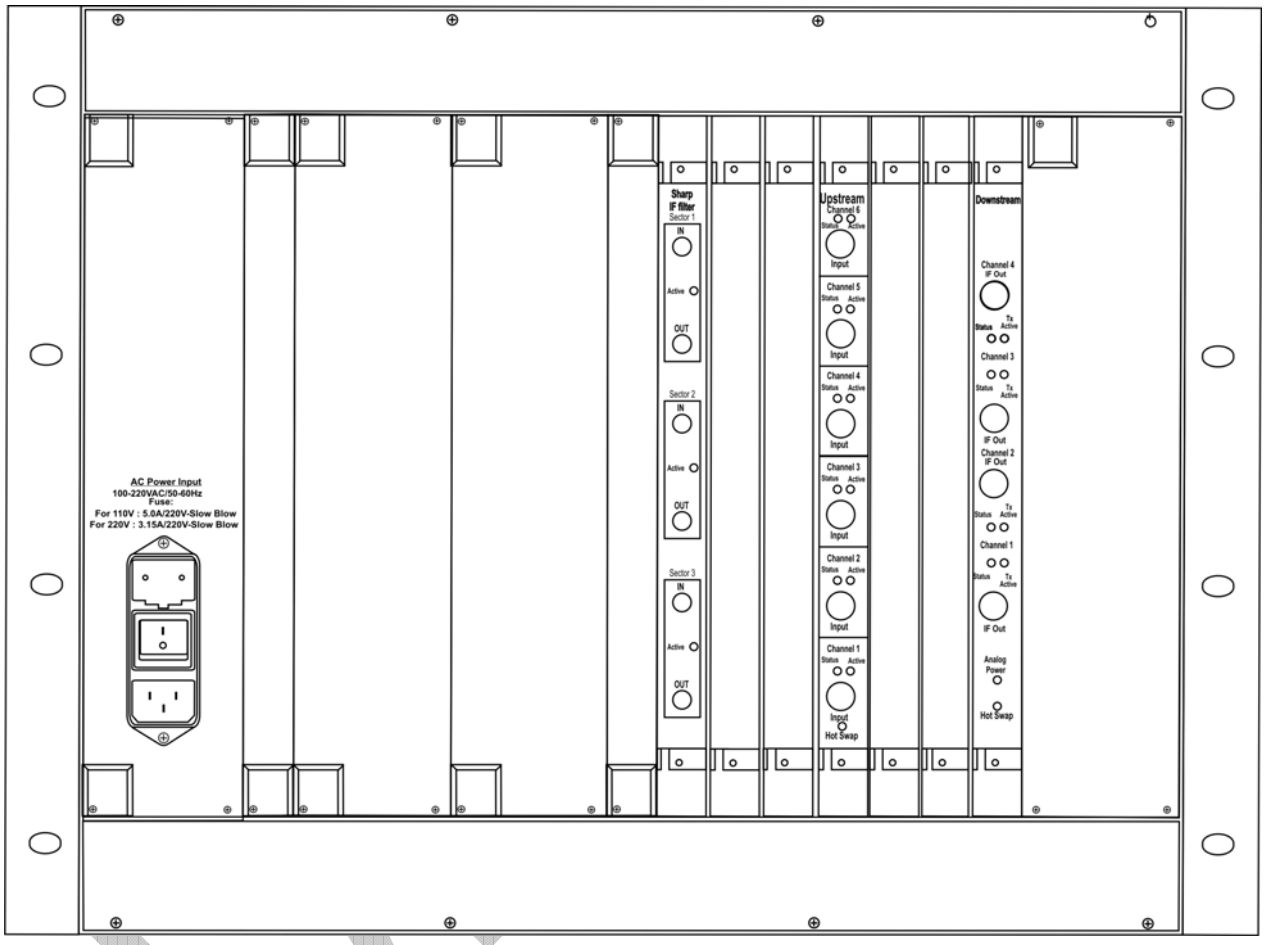


Figure 7: WMTS Chassis – Rear Panel

Figure 8 shows the WMTS chassis with (from left to right) Upstream module, Downstream module, Control and Forward card, Host card, and Power Supplies.

Figure 8: WMTS Chassis – Front Panel

Upconverter

The digital QAM Upconverter includes four independent single IF upconverter modules. Three of the upconverter modules are used, each for a sector. The fourth upconverter serves as a spare. The unit uses a common power supply and control module to manage all the upconverters. An easy to read back-lit LCD is used to display all the module information. The unit features an advanced menu system, which provides for easy programming using the push-button navigation switches on the unit's front panel. The Upconverter uses a fix input frequency of 44 MHz, and a fix input level (from the WMTS). The Upconverter output frequency and output level are controlled by the front panel push-button switch. The Upconverter output level is set through the Tune Procedure to limit the BSR output level below the maximum aloud level.

Power Amplifier

The Power amplifier model TAUD-40 supplies up to 20 watts of 64QAM digitally modulated signal. The amplifier includes an extensive built-in remote control and monitoring systems. The front panel LCD enables monitoring the forward and reflected RF power, and DC voltage.
The back panel AC Circuit breaker eliminates replacement of fuses.

Figure 9: Power Amplifier – Front and Rear

Diplexer

The Diplexer separates the TX/RX signal being transmitted to/from the antenna. The Diplexer supports a very high TX to RX signal separation.

LNA Module

The LNA module receives the upstream received signal from the Diplexer, amplifies it, and delivers it to the Downconverter. The LNA module includes two Low Noise Amplifiers in series. A narrow band BPF (band pass filter) is placed between the amplifiers to improve receive signal filtering. The LNA module has a fixed gain.

Downconverter

The V3300-A band A ownconverter is preset to receive a signal at 787.5 MHz, and to convert it to a signal at 44 MHz. Its output signal is spectrum inverted and the unit has a fix gain of 18 dB. The unit is powered by 6.5V 900 mA supply received from an external wall mount power supply.

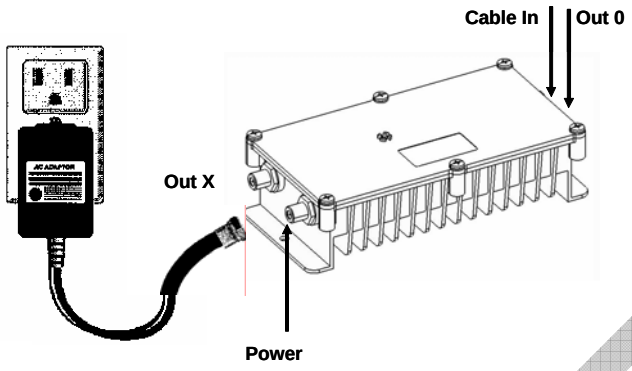


Figure 10: V3300-A band A Downconverter

Test Points

The BSR includes test points that enable measuring output of the Downstream Upconverters pre-PA, and provide RF samples of various upstream and downstream signals. The following table lists the test points.

Table 1: BSR Test Points

Location in BSR	One-Sector Test Points	Two-Sector Test Points	Three-Sector Test Points	Description
Bottom Section	TP1	TP1	TP1	Tap-off between Downstream Upconverter and PA channel 1.
		TP2	TP2	Tap-off between Downstream Upconverter and PA channel 2.
			TP3	Tap-off between Downstream Upconverter and PA channel 3.
Middle Section				
			TP4	Tap-off from output signal through a Directional coupler for channels 1, 2, and 3 (Cluster).
	TP8	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	Upstream post Downconverters. Splitter between Downconverter and WMTS channel 3.
Top Section				
	TP5	TP5	TP5	Upstream channel 1 post LNAs. Tap-off between 2nd stage LNA and Downconverter.
		TP6	TP6	Upstream channel 2 post LNAs. Tap-off between 2nd stage LNA and Downconverter.
			TP7	Upstream channel 3 post LNAs. Tap-off between 2nd stage LNA and Downconverter.

☑ **Note:** When a one-sector BTS is built, only channel 1 is used. For two-sectors, channels 1 and 2 are used. For three-sectors, channels 1, 2, and 3 are used.

Monitoring Modems

Each Monitoring Modem (V384) is a modem integrated with a built-in UHF radio that provides an upstream RF output in the 787-788 MHz range and downstream frequency input which ranges from 757-758MHz. Each monitoring modem serves a single sector, enabling monitoring of downstream and upstream paths. The modems can be monitored locally via the rear panel Ethernet connector, or via the NMS.

The following figures show the V384 front and rear panels:

Figure 11: V384 Monitoring Modem – Front Panel

Figure 12: V384 Monitoring Modem – Rear Panel

3 Installing the Base Station

The Base Station Rack is delivered as a complete unit. All the sub-components were installed, wired and pre-tested in the rack. The installation you need to perform consists of the following steps:

- *Installation Prerequisites*, described on page 3.
- *Unpacking and Inspection*, described on page 3.
- *Physical Installation*, described on page 3.
- *Initial Operation Procedure*, described on page 3.
- *Setting the WMTS Network Properties*, described on page 3.
- *Connecting the WMTS to the Backbone Network*, described on page 3.
- *Adding the WMTS to the NMS*, described on page 3.
- *Provisioning the Monitoring Modems*, described on page 3.
- *Verifying Proper BSR Operation*, described on page 3.

Installation Prerequisites

Prior to installation, make sure you meet the following prerequisites:

- **Building recommendations** – The quality of the building is of great importance if you are to expect long life and continued performance from the Base Station. The building must be clean, dry, temperature controlled and secure. Don't forget to allow space in the building for any additional racks to house test equipment, a workbench area, line regulating transformers, ladders, equipment and parts storage, first aid kit, emergency generator if uses, as well as heating and cooling devices that may be unique to your installation. A sloping roof will tend to develop leaks less rapidly. The building should be well roofed with good material. The cooling load will be lowered with reflective or light colored roofing material. These requirements are not a complete list, but are merely provided for your information.
- **Physical rack space** – Leave rack space of 30" depth x 90" height x 23.5" width. Reserve door space of 30" in the front and in the back of the rack.
- **Environmental conditions** – The rack environment temperature should be kept between 10 to 40 ºC. Humidity should be kept below 80%, non-condensed.
- **Vibration** – The BSR should be placed on a stable pedestal, to prevent vibration from nearby equipment, such as generators.

- **Power delivery** – The power should be capable of delivering 110V 3KVA. In addition, place an appropriate AC power line protector, conditioner, and/or surge suppressor across the AC supply line.
- **Grounding** – Good 8AWG wire grounding should be connected from an external GND source to the BSR.
- **BSR Cable connection** – For proper base station operation, a low loss cable should be used between the BSR antenna ports and the antennas. The cable's desired loss should be below 2.5 dB. The typical cables are LMR900 or 7/8 Heliax.
- **Antenna installation** – The base station antennas should be installed and correctly directed, before full Base Station operation.
- **Technician's laptop and cables** – The installing technician should come with a laptop that has a 10/100 BaseT connection. It is also strongly recommended that the laptop have a serial port. Use of USB to serial converters is not recommended. The laptop LAN connection Internet Protocol (TCP/IP) properties should be set to IP address: 10.10.10.x, subnet mask: 255.255.255.0.

  In addition, the technician should bring either:

  - Straight-Through Ethernet Cable to connect the laptop to a Base Station switch.
  - Crossover Ethernet Cable to connect the laptop directly to the WMTS.
- **Tools and Utilities** – Two disks are included in the package. The technician should copy the one called *tools&utilities* to the laptop.
- **Backbone connection** – A switch or router with at least two (recommended: three) available 100 BaseT ports is required to connect the Base Station to the backbone network. The ports' designations are as follows:

  - One port for Arcadian Networks management traffic.
  - One port for data traffic.
  - An additional available port is recommended for a technician's local maintenance connection.

  If traffic prioritization is required, it is recommended that the data traffic interface be configured to prioritize ToS marked traffic.
- **Backbone connection cables** – Two Straight-Through Ethernet Cables are required to connect the Base Station to the backbone.

Antenna and Tower Recommendations

Your preliminary engineering workgroup should establish your antenna and tower requirements. Construction of sturdy, high quality antenna/tower systems will pay off in terms of coverage of your service area, the overall quality of your radiated signal, and reduced maintenance expenses. Transmitting antennas can enhance or seriously impair the transmitter output.

The selection, routing, and length of coaxial cable are extremely important in the installation. Buy the best cable you can obtain, route it via the shortest way to the antenna, and keep it straight. Do not form it into sharp bends on its way. Do not use any more cable fittings for the installation than absolutely necessary. All cautions here apply equally to all coaxial cables in the system, both input and output.

Pay attention to radial ice accumulation when designing the transmission system. It is not uncommon for at least an inch of ice to build up on the tower and antenna. This in turn significantly increases the weight, cross section, and wind loading of the system.

Attaching the transmission line to the tower is crucial to maintain a safe and reliable operation. Nylon wire ties and electrical tape will break down in the sunlight and ultimately fail, creating a potentially dangerous situation. It is important to use proper clamps and hoisting grips and also ensure that the transmission line is grounded at the tower in several locations. When high currents flow through the tower in the event of lightening strikes, some of that current will flow through the outer conductors of the transmission lines. Due to the resistance difference between the steel tower and copper transmission line, a significant voltage can be developed, often resulting in arcing between the outer jacket and outer conductor, thus pitting the conductor.

Preventative maintenance is crucial in ensuring that safety is maintained. Specifically, check that transmission line grounds are tight and are not missing any hardware. Frequently inspect support clamps or spring hangers. Consider investing in an ice break, if you haven't already done so, as shards of falling ice can damage the transmission line. Check the tower light photocells and conduit.

The better-known tower manufacturers offer complete technical and safety documentation with their towers. Be sure that you have this information as it regard wind loading, guying, etc. The best-designed antenna system will function poorly if shortcuts and compromises are used during installation. Follow the manufacturer's instructions exactly, along with an engineering data prepared for the site. Be absolutely safe and certain about this aspect since human lives may be at stake.

Electrical Service Recommendations

We recommend that a qualified, licensed local electrician be consulted for the required electrical service. We suggest local electricians because they know the local codes, they can be on site readily, and you are apt to get better overall support if you use local suppliers.

We recommend that proper AC line conditioning and surge suppression be provided on the primary AC input to the power amplifier. All electrical service should be installed with your national electrical code in your area, any applicable provincial or state codes, and good engineering practice. Special consideration should be given to lightning protection of all systems in view of the vulnerability of most transmitter sites to lightning. Lightning arrestors are recommended in the service entrance. Straight and short grounds are recommended. The electrical service must be well grounded. Do not connect the unit to an open delta primary power supply, as voltage fluctuations could harm the unit. Branch your circuits. Do not allow your lights, your workbench plugs, and your transmitting equipment to operate on one circuit breaker. Each transmitter should have its own circuit breaker, so a failure in one does not shut off the whole installation.

Shelter Security

The FCC requires that the transmitter be secure from entry or control by unauthorized persons, and that any hazardous voltages or other dangers, including most tower bases, be protected by locks or fences as necessary to protect personnel and prevent unauthorized tampering or operation. Security of the building further implies that it be secure from wildlife. Use sturdy construction materials, including sheet metal if necessary. Holes around conduit, cable, and other similar entry points should be stuffed with steel wool and caulked to prevent entry of wildlife. Other features of security for your shelter may include its location with respect to the prevailing wind conditions. A location leeward of some natural topographical feature will prevent wind damage and snowdrifts. Check the soil runoff conditions that may slow or hasten wind or water erosion and other concerns that may be unique to your location.

Unpacking and Inspection

Check the outside of the container. Carefully open the container and remove the contents. Retain all packing material that can be reassembled in the event that the equipment must be returned to the factory.

☑ **Note:** Exercise care in handling equipment during inspection to prevent damage due to rough or careless handling.

Visually inspect the contents for damage that may have occurred during shipment. Check for evidence of water damage, bent or warped chassis, loose screws or nuts, or extraneous packing material in connectors or fan failures. Inspect all connectors for bent connector pins. If the equipment is damaged, a claim should be filed with the carrier once the extent of the damage is assessed.

Physical Installation

Physically install the BSR according to the following steps. Perform the steps in the given order:

1. Follow all the prerequisite requirements (refer to Installation Prerequisites on page 3).
2. Follow the unpacking and inspection instructions (refer to Unpacking and Inspection on page 3).
3. Ensure the rack is physically stable.
4. Open the back and front doors, and visually inspect the all the components in the rack to make sure they are intact (devices, cables, connectors, etc.).
5. Make sure that the WMTS rear panel Power switch is OFF.
6. Make sure all the Power Amplifiers are OFF.
7. Connect properly the appropriate cables to the antenna ports.
8. Check for proper antenna connection, as follows: Confirm that all the RF cables (one per sector) that should be connected from the Rack's Antenna Ports to the antennas are properly connected. Check for VSWR below 1.4 on the cables (Return loss below -16 dB).

Note: For testing purposes, the antenna ports may be connected to Dummy Loads, instead of to the antennas. The Dummy Loads' power should be above 50W.

Warning: *Do not apply AC power and turn on power to the transmitter at this time, since the RF output must be properly loaded before operation.*

Initial Operation Procedure

The base station rack is adjusted and tested before shipment. The following initial operation procedure is enabling a proper operation without using of additional test equipment.

After carrying out the steps in *Installation Prerequisites*, *Unpacking and Inspection*, and *Physical Installation* , perform the following:

1. Verify that the power switch of all Pas is OFF.
2. Connect the rack's main power cord to the 110V power source.
3. Power ON the WMTS.
4. Check the WMTS LEDs. Refer to *WMTS LEDs and Connectors* on page 3.
5. Verify that the Upconverter's front panel display is active.

6. Check the Upconverter front panel display. The following lines should appear sequentially, displaying the channels' pre-selected output center frequency:

```
#1 Frequency 757.5 MHz
#2 Frequency 757.5 MHz
#3 Frequency 757.5 MHz
#4 Frequency 757.5 MHz
```

7. Perform steps 8 to 13 for each Power Amplifier (PA).
8. Power ON the PA with the rear panel On/Off switch.
9. Verify that the PA enclosure's fan is ON. You should be able to hear the fan, and feel air blowing.
10. The internal soft start circuitry of the PA turns the bias voltages off until the power supply is fully stable. The message appearing in the PA's front panel LCD indicate when the soft start is running. Once completed, the Forward and Reflected Power and Power Supply readiness messages appear on the LCD.
11. The PA's front panel LCD shows the current status of the PA. Verify that the displayed power supply voltage is approximately 30Volt DC.
12. The system was pre-adjusted for the correct output level. Check that the PA's LCD shows an output level of between 5 to 20 W.
13. Ideally, the RFL Power (Reflected Power) should read zero. However, should a high VSWR be detected, the amplifier will automatically shut down. If the expected value is not achieved, refer to *Initial Operation – Troubleshooting Issues* on page 3.
14. Repeat steps 8 to 13 for the other Power Amplifiers.
15. Verify that the Monitoring Modems front panel LEDs behave as follows:
    - Power LED is steady ON.
    - Status LED is steady ON.

Setting the WMTS Network Properties

To set the WMTS network properties, you must modify the file `regtree.txt` to contain the updated WMTS network properties, then compile it into `regtree.rtr` and download it to the WMTS. You must therefore perform the following:

- Edit and compile the Regtree.txt file, and download it to the WMTS as described in *Editing and Downloading the Regtree File* on page 3.
- Restart the WMTS described in *Restarting the WMTS* on page 3.

Make sure you have the following necessary equipment:

- PC
- Crossed Ethernet cable (or straight if there is a switch between WMTS and the PC)

Editing and Downloading the Regtree File

This process includes the following steps:

- Editing the Regtree file.
- Setting the network properties in the Regtree file.
- Compiling the Regtree file.
- Running TFTP server.
- Running WmtsConfig tool.
- Connecting to the WMTS.
- Downloading the new Regtree file.

To edit the Regtree file:

- The `regtree.txt` file is located under directory *{build}*\Wmts*{swversion}*\SET-IP. Open the `regtree.txt` using a standard text editor, such as Notepad.

> **Note:** There may be several versions of the Regtree file available (e.g., `regtree_bandA.txt`). If so, copy the version you wish to use and rename it to `regtree.txt` since that is the file that `SETIP.bat` expects as its input file.

To set the WMTS network properties in Regtree.txt:

1. Scroll down, or use the Find function, to locate the **CmtsIPAddress** entry. In this example (Figure 13) its value is `10.10.10.210`. The default network address for Arcadian Networks equipment is `10.10.10.xxx`.

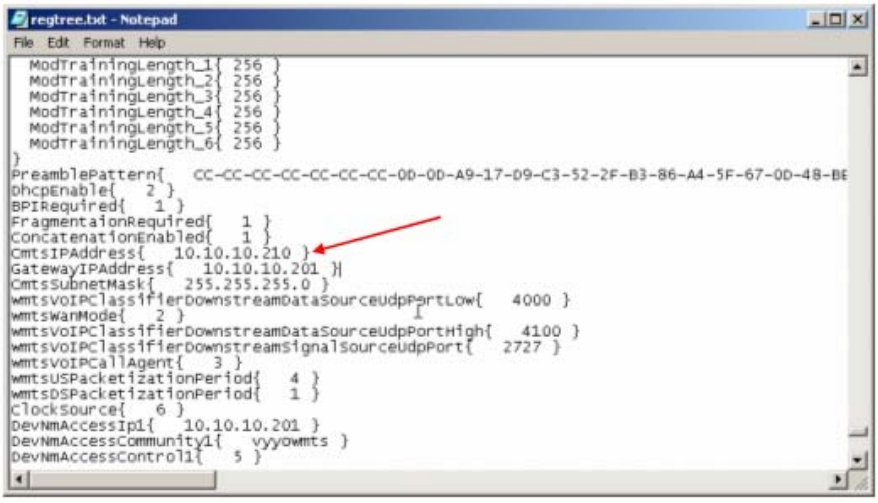


Figure 13: Regtree.txt File Contents

2. Change the following entries as follows:
   - **CmtsIPAddress** – IP address of the WMTS.

- **CmtsSubnetMask** – subnet mask of the WMTS.
- **GatewayIPAddress** – gateway IP address for the WMTS.

3. To enable SNMP access to the WMTS, change the following entries:
   - **DevNMAccessIP1** – IP address of Arcadian Networks NMS server.
   - **DevNMAccessCommunity** – SNMP community attribute for authorizing the NMS.
   - **DevNMAccessControl1** – the type of access level allowed to the NMS (1-no access, 2-read only, 3-read&write, 4-read only with traps, 5-read&write with traps, 6-traps only).

> ☑ **Note:** For proper operation of Arcadian Networks NMS do not change the **DevNMAccessControl1** and **DevNMAccessCommunity** entries.

4. To add support of a second NMS server, or any other SNMP management tool from additional server duplicate the three lines: **DevNMAccessIP1**, **DevNMAccessCommunity1**, and **DevNMAccessControl1**. Change to **DevNMAccessIP2**, **DevNMAccessCommunity2**, and **DevNMAccessControl2**, and change the values accordingly.
   For northbound NMS, you may want to set the **DevNMAccessControl2** entry to traps only or read-only with traps, to avoid management overhead on the WMTS.

To compile the Regtree file:

1. Compile `regtree.txt` by executing `SETIP.bat`, which is located in the same directory as `regtree.txt` (see Figure 14). `SETIP.bat` is a batch file that converts the `regtree.txt` text file to a special format readable by the WMTS. The resulting file is named `RegTree.rtr` and is placed in the same directory as the `regtree.txt`.

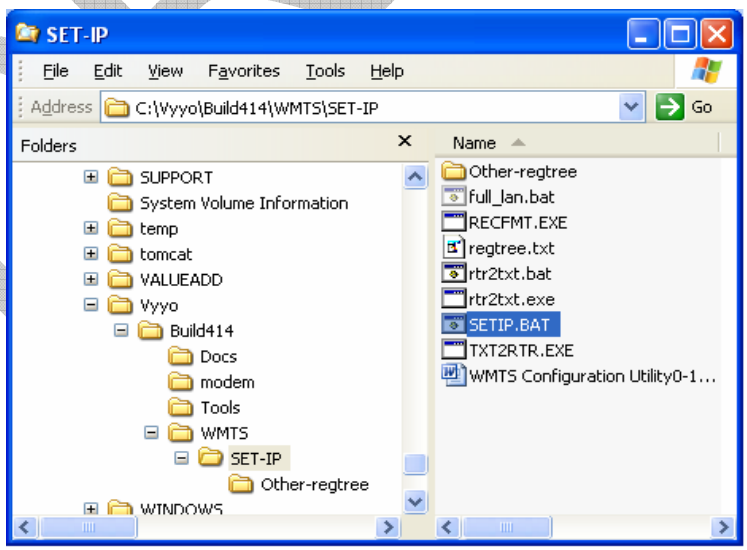


Figure 14: Location of SETIP.bat

2. Copy the `regtree.rtr` to the directory in which the WMTS image file are located.

To Run the TFTP server:

1. Open the TFTP server, in this example, `Pumpkin.exe`. You can bring up the Options dialog window by clicking **Options** (see Figure 15). This enables you to change the download directory.

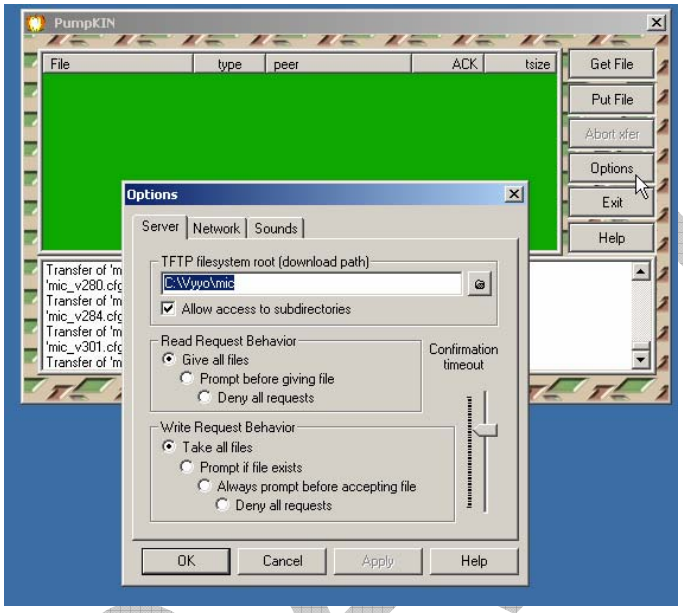


Figure 15: PumpKIN TFTP Settings

2. Change the download path to the directory path of the WMTS image files and the `RegTree.rtr` file.
3. Save the TFTP server download path as the default value by exiting and then restarting the TFTP server.

To Run the WMTSConfig tool:

1. Open WMTSConfig.exe tool to perform the download to the WMTS. This tool is located in the …\{*build*}\\`Tools\WMTSConfig` directory of the build.

   The initial screen appears.

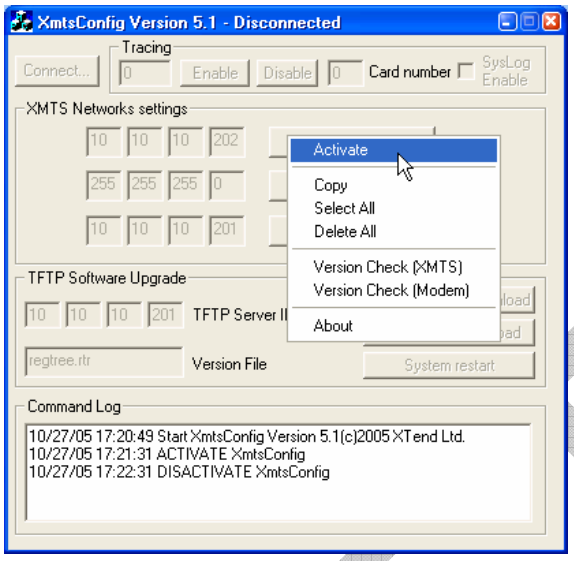


Figure 16: WMTS Configuration Tool

2. Right-click to display a popup window from which you select **Activate** (see Figure 16).

   The WMTSConfig screen is enabled.

☑ **Note**: The WMTSConfig screen is enabled for one minute only, to prevent accidental downloads and restarts. You may therefore have to activate the screen and connect to the WMTS (explained in the next step) several times during this procedure.

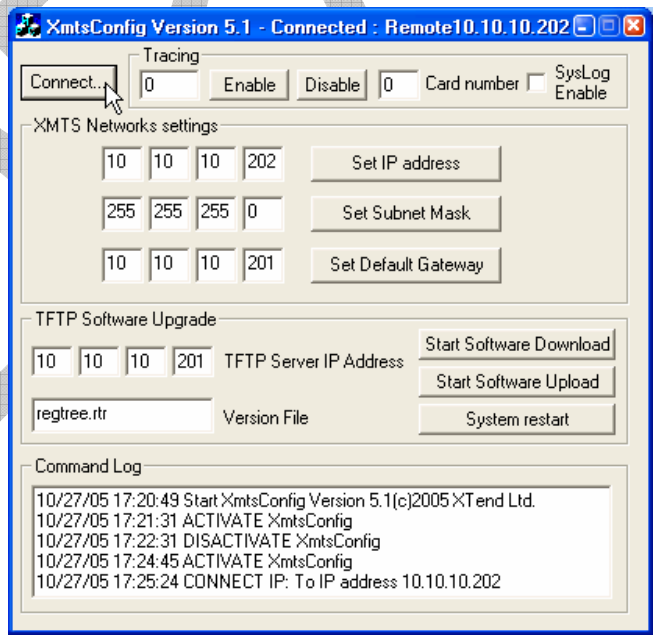


Figure 17: Active WMTS Configuration Tool

To Connect to the WMTS:

1. While the application is active, click **Connect** (see Figure 17).

   The Connect window appears, enabling you to choose the type of connection to open (Serial or IP).

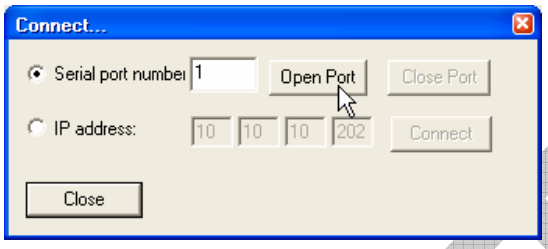


Figure 18: Specifying the Connection Type

2. Connect the Ethernet cable from the PC to the Ethernet port on the WMTS Control & Forward card.
3. In the Connect window (Figure 18):
   - Select **IP address** and specify the IP address of the WMTS.

Note: The WMTS is shipped with the default IP address of 10.10.10.2. If this is a first time installation use this address.

To Download RegTree.rtr:

1. In the main application window (Figure 19), in the TFTP Software Upgrade section
   - Enter your PC IP address in the **TFTP Server IP Address** field
   - Enter the file name, `regtree.rtr`, in the **Version File** field.
2. Click **Start Software Download**.

   After the download command is sent to the WMTS, a message appears in the Command Log window of the WMTSConfig tool (see Figure 19). This message does NOT indicate that the download has occurred.

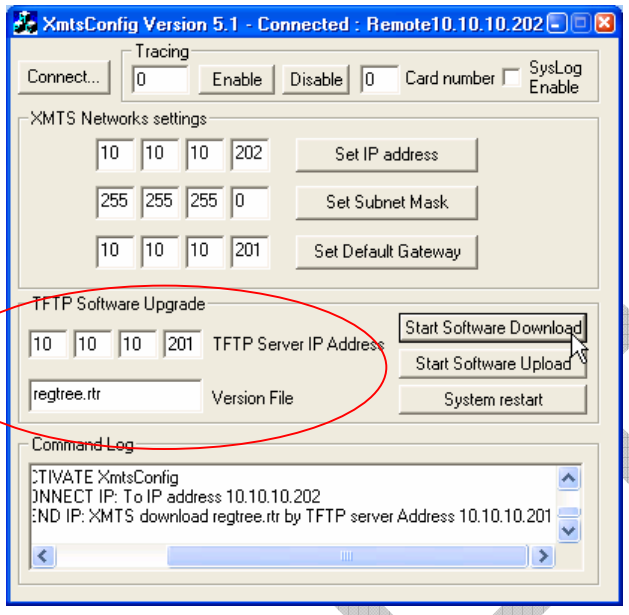


Figure 19: WMTS Download of Regtree File

Restarting the WMTS

The new RegTree properties will go into effect only after the next WMTS boot up. To restart the WMTS, click **System Reset** in the WmtsConfig tool.

Connecting the WMTS to the Backbone Network

To Connect the WMTS to the backbone network:

- Connect the Ethernet port located on the WMTS C&F card to the base station switch/router port connected to the management backbone network. The Ethernet port on the C&F card transmits and receives Arcadian Networks network management information.
- Connect the Ethernet port located on the WMTS downstream module front to the base station switch/router port connected to the data backbone network. The Ethernet port located on the downstream module transmits and receives data of devices outside the Arcadian Networks network, such as SCADA devices, security devices, and PCs.

> ☑ **Note:** The Cisco router located in the V390iA is considered outside the Arcadian Networks network.

Adding the WMTS to the NMS

Once you have the WMTS permanent IP address, you should add the WMTS to the NMS. Refer to the *NMS User Guide* for instructions.

Provisioning the Monitoring Modems

The procedure for provisioning a monitoring modem is identical to any other modem provisioning. Refer to the *NMS User Guide* for instructions. The MAC address of each monitoring modem appears on a sticker attached to the modem, visible from the rear of the Base Station rack.

Follow these guidelines:

- It is recommended to select a name for the monitoring modem that will indicate its functionality (e.g., *Monitoring modem sector A*).
- The monitoring modem configuration file should be set to a single best effort service, and must not include any QoS features such as priority or CIR.

Verifying Proper BSR Operation

The initial tests for verifying proper operations are performed using the Monitoring Modems. The tests verify proper operation of the base station rack, even before connection to the CPE modems. The MMUs monitor the three channels covered by the BTS. Each MMU monitors a single channel. MMU1 is connected to channel 1, and so on.

For each of the three channels, check the following parameters through the NMS. Verify that the actual values are within the expected values.

- Check the modem Downstream Received Power and SNR (refer to the *NMS User Guide* for instructions).
- Check the MMU Transmit Output Power (refer to the *NMS User Guide* for instructions).
- Check the channel Upstream Received SNR (refer to the *NMS User Guide* for instructions).

Parameter	Expected Value
Downstream Received Power	- 16 ± 3 dBmV
Downstream SNR	≥ 30 dB
MMU Output Power	62 ± 4 dBmV
Upstream Received SNR	≥ 22 dB

☑ **Note:** More extensive RF tests can be run using the test points (refer to *Test Points Signal Verifications* on page 3), and integration with the remote CPE modems.

4 Configuring the Base Station

> ***Caution:*** *The Base Station arrives pre-configured.*
>
> *Under ordinary circumstances, there is* ***no need*** *to configure it.*
>
> *Do not reconfigure the Base Station unless it is really necessary.*

This chapter includes the following:

- Learning the *Basic Base Station Frequency Setup*, described on page 3. This is important for an understanding of the any Base Station configuration.
- *Configuring the WMTS*, described on page 3.
- *Configuring the Upconverter*, described on page 3.

Basic Base Station Frequency Setup

The following sections describe the basic downstream and upstream frequency setup of the Base Station.

Downstream Channel Frequency Setup

The WMTS downstream channel is configured for 330 KHz width at 64QAM for each sector. The three upconverters, one per sector, are pre-set to the same RF frequency. The nominal ownconvert IF (input) frequency is 44.0 MHz and its RF (center) output frequency is 757.5 MHz. The actual RF frequency of each sector is determined by setting the related IF frequency at the WMTS using the Arcadian Networks Configuration Tool. The Upconverter includes spectral inversion, and therefore the IF-RF frequencies' association is designed accordingly (e.g., higher RF frequency is associated with lower IF frequency). For a three-sector configuration the downstream settings are as follows:

Table 2: Base Station Downstream Frequencies

Downstream Channel	Downstream Center IF Freq.	Actual Downstream Center RF Freq. After Conversion
1	44.330 MHz	757.170 MHz
2	44.0 MHz	757.500 MHz
3	43.670 MHz	757.830 MHz

Note: When a one-sector BTS is built, only channel 1 is used. For two-sectors, channels 1 and 2 are used. For three-sectors, channels 1, 2, and 3 are used.

The downstream IF frequencies are pre-assigned at the WMTS. You can change these settings using the Downstream Channel Configuration Menu of the Arcadian Networks Configuration Tool (refer to the *NMS User Guide*).

For the narrower (245 KHz) channel bandwidth use the following frequency configuration:

Table 3a: Base Station 4 channels Downstream Frequencies

Downstream Channel	Downstream Center IF Freq.	Actual Downstream Center RF Freq. After Conversion
1	44.367500 MHz	757.132500 MHz
2	44.122500 MHz	757.377500 MHz
3	43.877500 MHz	757.622500 MHz
4	43.632500 MHz	757.867500 MHz

Upstream Channel Frequency Setup

The received upstream signal from the antenna is delivered to the Downconverter, after amplification in the LNA module. The Downconverter receives a fixed upstream RF frequency (787.5 MHz) and converts it to a fixed IF frequency (44.0 MHz). All Downconverters are set to the same frequency. The actual RF received frequency is converted to IF with spectrum inversion. Each of the Upstream receivers at the WMTS receives the corresponding actual IF frequency. The actual IF frequencies are listed in

Table 4.

Each upstream channel is associated with the corresponding downstream channel in the sector. You can change the WMTS channel associations using the Upstream Channel Configuration Menu of the Arcadian Networks Configuration Tool (refer to the *NMS User Guide*).

Note: The related CPE IF TX Frequency is also set using the Upstream Channel Configuration Menu in the Arcadian Networks Configuration Tool. Use the CPE values appearing in

☑ Table 4.

☑ **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.

Table 4: Base Station Upstream Frequencies

Upstream Channel	Actual Upstream Freq. Before Conversion (MHz)	Actual IF RX Frequency (MHz)	Related CPE IF TX Frequency (MHz)
1	787.170 MHz	44.330 MHz	43.670 MHz
2	787.5 MHz	44.0 MHz	44.0 MHz
3	787.830 MHz	43.670 MHz	44.330 MHz

☑ **Note:** When a one-sector BTS is built, only channel 1 is used. For two-sectors, channels 1 and 2 are used. For three-sectors, channels 1, 2, and 3 are used.

Upstream Received level and SNR Setup

The upstream received level and the related received RF SNR are determined by the received level at the WMTS Hex card receiver input port, since the RF RX path (LNAs, Downconverter, etc) has a constant gain. The optimum RF SNR delivers the maximum SNR for the maximum required coverage. The typical RF SNR is 24 dB (for 325 KHz 16QAM upstream channel and 20 miles coverage).

The WMTS received level is adjusted through the FAT procedure for optimum RF SNR.

⚠ ***Warning:*** *Adjustment of the Upstream Received level and RF SNR should be done only by a trained technician. Decreasing the RF SNR below a certain threshold may harmfully reduce the received SNR and even stop upstream connection. Increasing the RF SNR beyond a certain level may also limit the coverage.*

☑ **Note:** The RF SNR is the RF Signal to Noise levels Ratio at the antenna (which is the same as at the WMTS receiver input). The RF SNR may vary from the SNR reported by

the receiver, since the receiver SNR is influenced by additional parameters (phase noise, interference, etc.).

The WMTS Hex card receiver input level is set using the upstream “Gain” feature in the Upstream Channel Configuration Menu of the Arcadian Networks Configuration Tool (refer to the *NMS User Guide*).
Following the Hex card receiver input level setting, and integration with the Monitoring Modem, the RF SNR should carefully be checked at the relevant test points (T5, T6, and T7). The full procedure is described in paragraph 3.3.2 of the FAT document.

Configuration Tools

The configuration tools listed below are located in the *tool&utilities* disk that arrives with the Base Station and which the technician should copy to his/her laptop.

Table 5: Base Station Configuration Tools

Tool	Configured File or Device	Description
WMTSConfigurationFileEditor (any standard ASCII text file editor may also be used to edit the text version of the file)	Regtree.txt Regtree.rtr (downloadable version of the text file)	Regtree.txt contains the permanent IP address of the WMTS. This tool is a convenient way to edit the more common items in the file. However, when editing the WMTS IP address you must use a standard text editor. The Regtree file may be saved in either text or downloadable format using this tool.
SETIP.BAT	Regtree.txt	This batch file is used to convert the text version of the Regtree file to the downloadable format (Regtree.rtr). This batch file calls RTR2TXT.EXE and RECFMT.EXE to perform the conversion.
RTR2TXT.EXE	Regtree.rtr	Used to convert the Regtree.rtr file to a standard text file (Regtree.txt)
WMTSConfig	WMTS	Used to assign temporary IP settings to the WMTS and to download files to the WMTS. Specifically, it must be used to download the compiled version of the Regtree.txt file to the WMTS. This is primarily used during initial setup.
Arcadian Networks Configuration Tool	WMTS MIB database	This is a standalone JAVA based tool that can be accessed from the NMS. It is used to modify and configure the WMTS operating parameters.

Configuring the WMTS

You can optionally configure the WMTS upstream or downstream parameters using the Arcadian Networks Configuration Tool. To do so, refer to the *NMS User Guide*.

Configuring the Upconverter

The Upconverter includes 4 separate Upconverter modules. Three of the Upconverter modules are used, each for a sector. The fourth Upconverter is a spare unit.

The Upconverter has five front panel push buttons for control, and an LCD display. The **Output Frequency** and **Gain** of each Upconverter are sequentially displayed.

The Upconverter's Gain is adjusted through the system test to support the required output level to the antenna.

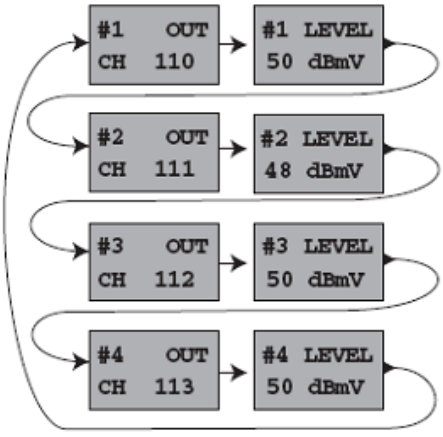
By viewing the sequential display on the LCD, verify that the frequency for all four channels is 757.5 MHz.

☑ **Note:** The Upconverter Gain is preset in the Base Station rack for the overall required downstream output level. Do not to change the Frequency and Gain settings unless a significant change has occurred.

To change the Upconverter's *Gain* using the Upconverter's LCD:

1. Depress the ◄**L** or **R**► arrow navigation keys.

   The LCD displays the modules' Gain sequentially, as shown below:



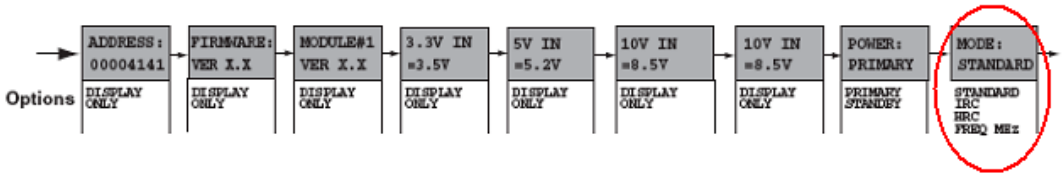
2. When the LDC displays the screen with the variable to be changed, depress and hold the central **ENTER** button for approximately one second, until a blinking cursor is displayed.

3. Press the **UP▲** or **DN▼** arrow buttons to increment or decrement the value. Select a value in the range 2 – 135 dBmV.
4. When you reach the desired value, press the **ENTER** button.

   The LCD displays an `Entry Accepted` *response.*

To change the Upconverter's *Frequency* using the Upconverter's LCD:

1. Depress the **UP▲** or **DN▼** arrow navigation keys to scroll through the advanced variables screens. The sequence is shown below:



2. Navigate to the **MODE** screen of the appropriate module. Note that the first sequence of screens corresponds to Module 1, the second to Module 2, etc.
3. Navigate to the FREQ parameter in the MODE screen.
4. When the LCD displays the screen with the variable to be changed, depress and hold the central **ENTER** button for approximately one second, until a blinking cursor is displayed.
5. Press the **UP▲** or **DN▼** arrow buttons to increment or decrement the value. The value changes in 12.5 KHz frequency increments.
6. When you reach the desired value, press the **ENTER** button.

5 Maintaining the Base Station

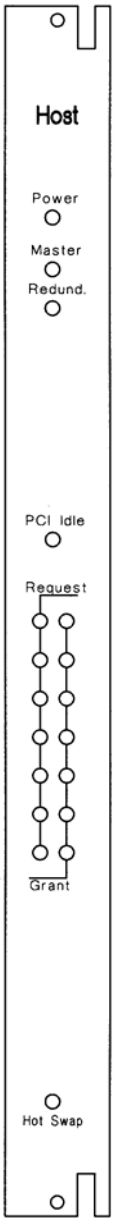
Base station maintenance includes the following:

- WMTS LED indications and connector/switch functions.
- Downconverter connectors and LEDs functions.
- Power Amplifier controls.
- Power and Signal level tracking to check that the values of the following items are within the expected value range.
- WMTS version upgrade.

WMTS LEDs and Connectors

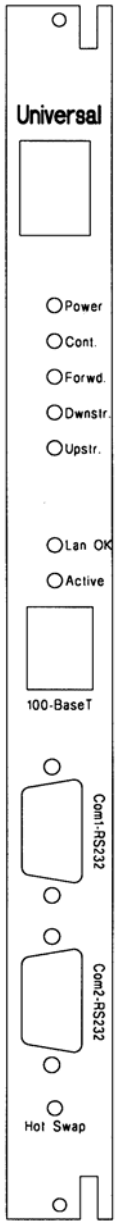
The following sections describe the functions of the LEDs and connectors/switches located on the various WMTS cards.

Host Card LEDs



LED	Color	Indication
Power	*Green*	ON when card is powered on
Master	*Green*	Lit when card is the master host card
Redundant	*Green*	Lit when card is the redundant host card
PCI Idle	*Green*	Lit when PCI Bus is active
Request	*Green*	Indicates that bus parking request is in process
Grant	*Green*	Indicates the bus parking; the last card is always granted
Hot Swap	*Red*	If lit, after pressing HOT SWAP switch, the card can be pulled out and released

Universal Cards LEDs and Connectors



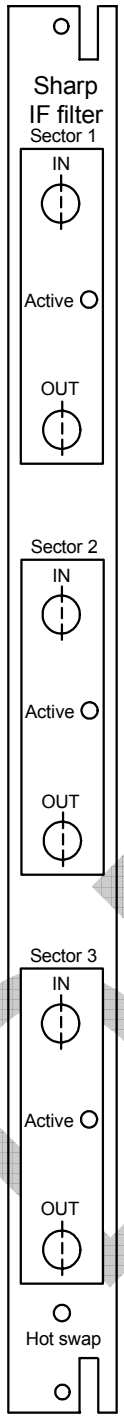
LED	Color	Indication
Dot Matrix		Channel Number (*)
Power	*Green*	ON when rear card is present
Cnt	*Green*	Flashing when Controller and Forwarder (C&F) application is active
Fwd	*Green*	Flashing when Controller and Forwarder (C&F) application is active
Dwnstr	*Green*	Indicating transmit data traffic when channel is active (only when used for downstream)
Upstr	*Green*	Indicating receive data traffic when channel is active (only when used for upstream)
100M Lan OK	Green	Indicating network integrity of the Ethernet bus
Active	*Yellow*	Flashing when traffic is transferred over Ethernet bus
Hot Swap	*Red*	If lit, after pressing HOT SWAP switch, the card can be pulled out and released

Connector/Switch	Type	Function
100 Base T	*RJ45*	Connection to router/hub
Com 1	*D-type*	RS-232 link reserved for R&D
Com 2	*D-type*	RS-232 link used for software download
Hot Swap	*Push button*	Request for Card release while system is ON

(*) A dot matrix display is located near the top of each universal card. Each display indicates the channel number assigned to the Universal Card. The C&F card is indicated as 0. The other universal cards are indicated from 1 to N, according to the card number assigned. The card number will be displayed on the transmitting universal cards attached to the modulators, and on the receiving universal cards attached to the demodulators.

System initialization phases are indicated on the C&F card dot matrix display. This display is detailed in *WMTS Digital Display and LED Indications* on page 3.

Sharp IF Filter Card LEDs



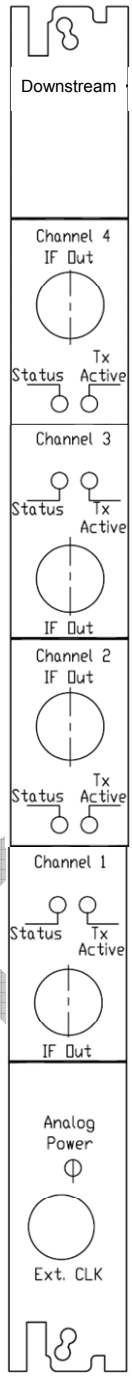
LED	Color	Indication
Active	*Green*	ON when WMTS power is on
Hot Swap	*Red*	If lit, after pressing HOT SWAP switch, the card can be pulled out and released

Connector/Switch	Type	Function
IN	*F-type*	Connection to 43100A ownconverter, used to input signals for filtering
OUT	*F-type*	Connection to 4-way splitter, used to output filtered signals
Hot Swap	*Push button*	Request for Card release while system is ON

☑ **Note:** The Sharp IF Filter card is optional.

Modulator Rear Card LEDs and Connectors

The modulator card holds four ports to connect four downstream channels. The two top indicators are specific for each channel, while the hot swap indicator is common to the card.

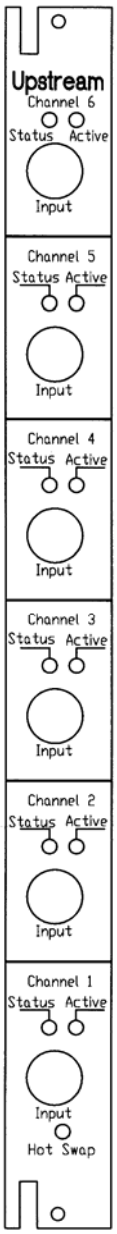


LED	Color	Indication
Status	*Green*	Lit when PLL is locked
TX Active	*Green*	Lit when downstream traffic is transferred
Analog Power	*Green*	ON when card is powered on

Connector/Switch	Type	Function
IF OUT	*F-type*	IF to RF transmitter
Hot Swap	*Push button*	Request for Card release while system is ON

Demodulator Card LEDs and Connectors

The demodulator card holds six ports to connect six upstream channels. The two top indicators are specific for each channel, the hot swap is common to the card.



LED	Color	Indication
Active	*Green*	Lit when up stream traffic is transferred
Status	*Green*	Lit when PLL is locked
Hot Swap	*Red*	If lit, after pressing HOT SWAP switch, the card can be pulled out and released

Connector/Switch	Type	Function
Input	*F-type*	IF from Downconverter
Hot Swap	*Push button*	Request for Card release while system is ON

Power Supply Cards

The Power Supply panel contains two indicators: **Power On** and **Fail**.

Downconverter Connectors and LEDs

The following table describes the ownconverter connector:

Table 6: Downconverter Connector Description

Connector designation	Connector function	Connector type
Cable in	RF IN	F Type
Out X	IF out	F Type
Power	Power In	F Type
Out 0	Not used	F Type

The following table describes the ownconverter LED indications:

Table 7: Downconverter LED indications

LED color	Indication
Red	Power ON, Unlocked
Green	Locked, Ready to use

Power Amplifier Controls

The Power Amplifier controls include the following:

PA Front Panel Controls

- **POWER** – Tactile button to turn carriers on and off. Depress for one second to turn on, and three seconds to turn the system off.

> ☑ **Note**: when the unit is plugged in, AC is supplied to the switching power supply input, but the amplifiers are still turned off. In order to turn the amplifiers on, assuming the rocker switch is turned on, wait ten seconds after plugging the PA in and push in the **POWER** tactile button. The LCD displays “Soft Start Warm Up, Please Wait”. After ten seconds, the bias voltages will turn on and you may then plug in the RF drive.

- **NAVIGATE** – Tactile button to refresh screen after the two minute screen saver times out. All monitoring and protection continues during screen saver.
- **SELECT** – Tactile button to refresh screen after the two minute screen saver times out. All monitoring and protection continues during screen saver.
- **RESET** – Tactile switch that resets the monitor and control system. The Amplifier shut down for under 0.5 seconds and comes back on with each depress of the reset

button. At the same time, all fault counters in the microcontroller software are reset and the LCD is reset in the same manner when depressing the NAVIGATE button.

PA Rear Panel Controls

- **AC ON/OFF** – AC rocker switch (SPST) to supply AC to the AC-DC switching power supply.
- **AC BREAKER** – Resettable circuit breaker, used to protect against inrush currents and high current draw from switching power supply. The thermal circuit breaker is a single pole configuration
- **REMOTE PORT** – Includes the following:
  pin 1: ground to reset microcontroller, float otherwise.
  pin 2: ground for 2 seconds to toggle carrier on/off, float otherwise.
  pin 3: common ground.
  pin 4: DC power supply sample (28Vdc nominal).

Power and Signal Level Tracking

The following parameters are tracked by the NMS. The default sampling time is every 20 minutes. Check that the values of the following items are within the expected value range. If there is a deviation, refer to *NMS Monitored Parameters* on page 3.

Parameter	Expected Value	Measured at
Downstream Received Power	- 16 ± 3 dBmV	MMU
Downstream SNR	≥ 30 dB	MMU
MMU Output Power	62 ± 4 dBmV	MMU
Upstream Received SNR	≥ 22 dB	WMTS

Upgrading the WMTS Software

> **Note:** In general, the application upgrade process is intended for trained technical support people who have authorization to perform WMTS installation and upgrades.

The software/firmware upgrade includes update of the control, upstream and downstream applications on the universal cards.

The upgrade process includes the following steps:

1. Edit and compile the Regtree.txt file, and download it to the WMTS as described in *Editing and Downloading the Regtree File* on page 3.
2. Download the updated WMTS image files (refer to *Downloading New WMTS Image Files*, on page 3).
3. Check the WMTS version (refer to *Checking the WMTS Version*, on page 3) to verify that the download has taken effect.
4. Update the Base Station label (refer to *Updating the Base Station Label* on page 3).

Make sure you have the following equipment/software necessary for the upgrade:

- PC
- Crossed Ethernet cable (or straight if there is a switch between WMTS and the PC)
- The new build, downloaded from the FTP and copied to the PC hard disk.

Downloading New WMTS Image Files

This procedure is a continuation of the WMTS upgrade process (refer to *Upgrading the WMTS Software* on page 3), in which the WMTS Configuration Tool is used.

To Download WMTS image files:

1. Open WMTSConfig.exe tool if it is not currently open. This tool is located in the …*{build}*\\`Tools\WMTSConfig` directory of the build.
   Right-click to display a popup window from which you select **Activate** (see Figure 16).

   The WMTSConfig screen is enabled.
2. In the main window of the WMTS Configuration Tool (Figure 20), perform the following in the TFTP Software Upgrade section:
   - Enter your PC IP address in the **TFTP Server IP Address** field
   - Enter the WMTS image file name, `Full_lan.txt`, in the **Version File** field.

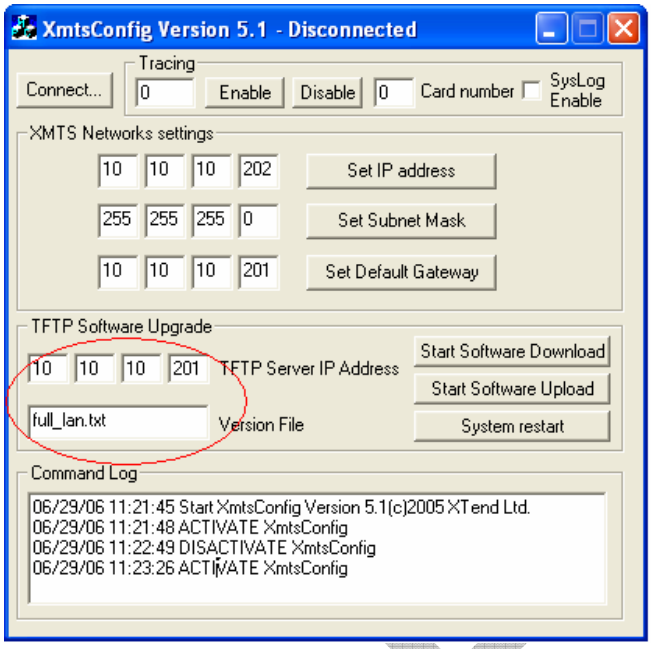


Figure 20: Download of WMTS Image File

3. Click **Start Software Download**.
4. Monitor the TFTP application window (see Figure 21) to verify that download to the WMTS has occurred.

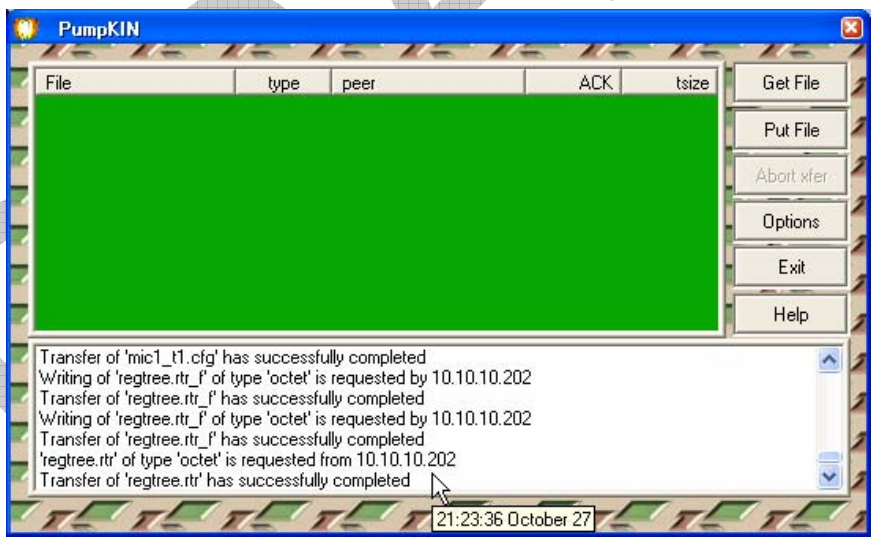


Figure 21: TFTP Download Message

5. When the file transfer is complete, click **System Restart** in the WMTS Configuration Tool window (see Figure 22).

Note: The WMTS will not execute a System Restart command before the file transfer is complete.

Verify that the last line in the Command Log window is 'WMTS Restart'. The WMTS reboots and uses the new `RegTree.rtr` file to configure itself.

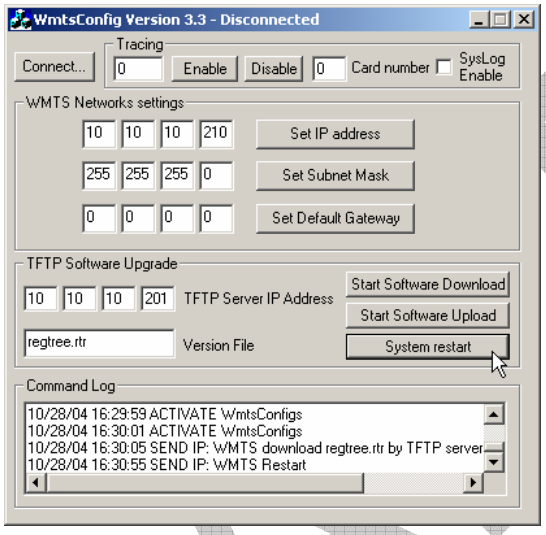


Figure 22: System Restart Message

Note: The WMTSConfig Command Log only displays messages sent to the WMTS. It does not know whether any of the commands succeeded.

Checking the WMTS Version

This procedure is a continuation of the WMTS upgrade process (refer to *Upgrading the WMTS Software* on page 3), in which the WMTS Configuration Tool is used.

To Verify the WMTS version:

1. Open WMTSConfig.exe tool if it is not currently open. This tool is located in the …*{build}*\`Tools\WMTSConfig` directory of the build.
   Right-click to display a popup window from which you select **Activate** (see Figure 16).

   The WMTSConfig screen is enabled.

2. Right click any open area in the main window of the WMTS Configuration Tool to bring up the popup menu.

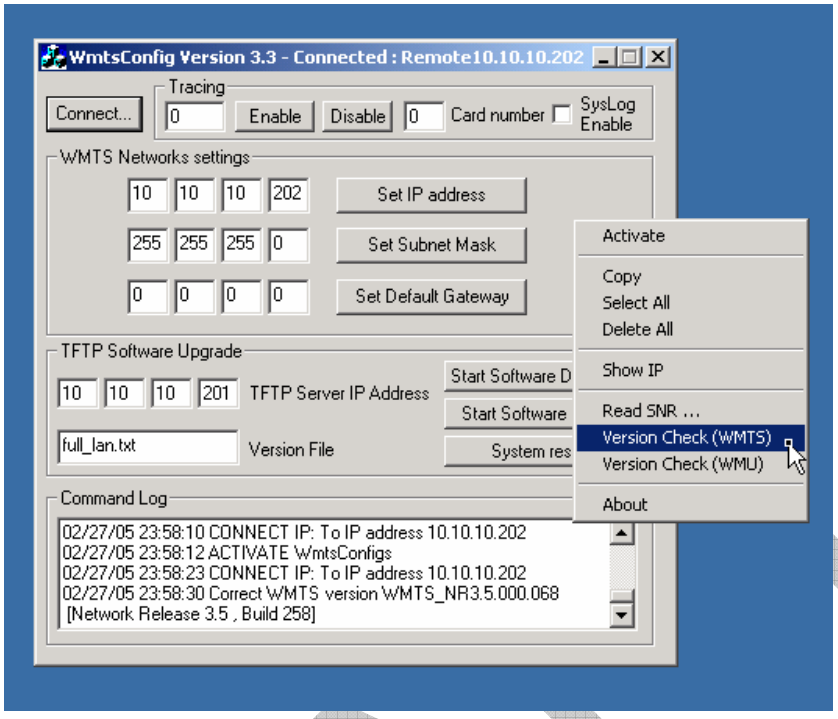


Figure 23: Viewing the WMTS Version

3. Select **Version Check (WMTS)** from the popup menu (Figure 23). The WMTS version is displayed in the Command Log window.

Updating the Base Station Label

To update the label:

1. Update the WMTS SW version number printed on the label to the new SW version number (see Figure 24). The label is located on the upper side of the BTS Rack.

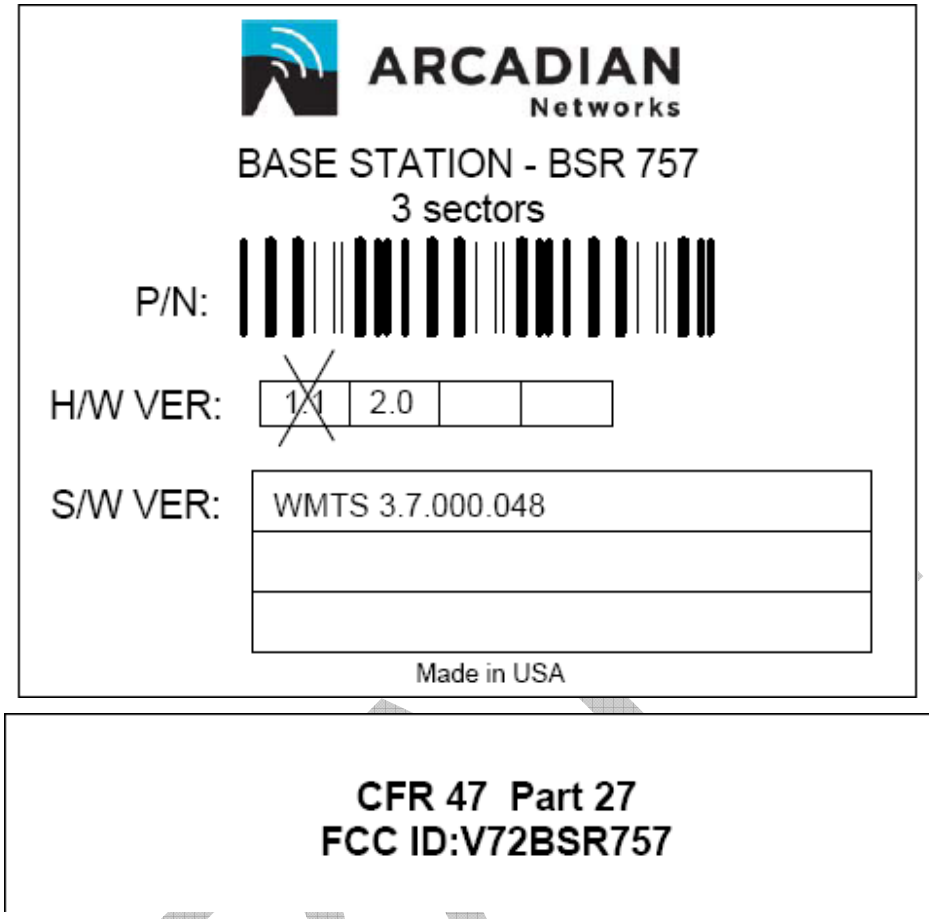


Figure 24: Base Station Label

6 Troubleshooting

This chapter provides troubleshooting information.

On-Site Troubleshooting

General Troubleshooting Guidelines

The first and most important aspect of troubleshooting is to be systematic. Note where you looked and what you found.

Look first for the obvious.

- Make a physical inspection of the entire facility. Are all necessary connections properly made? Do you see any signs of obvious damage within the equipments?
- Is the AC power ON to the site and the equipment? Check fuses and circuit breakers if necessary.
- Are all the switches in the correct operating position?
- Is the input signal present?
- Check PA LCD readings for presence of forward and reflected power and 30 V DC supply levels.

Initial Operation – Troubleshooting Issues

The following troubleshooting issues relate to the *Initial Operation Procedure* on page 3. These issues may occur during the course of initial operation. The recommended corrections do not require any external test equipment.

Symptom	Possible Fault	Correction
The WMTS LEDs are not lit	UPS or WMTS are not operating	1. Check UPS On/Off switch. 2. Check WMTS On/Off switch.
A WMTS LED behaves abnormally		Restart WMTS using the rear panel On/Off switch.

Symptom	Possible Fault	Correction
Upconverter LCD display not lit	Power cord not properly connected	Check power cord connection.
Upconverter frequency value in LCD display not correct	The value was changed by mistake.	Set the frequency to the correct value (746.5 MHz). For instructions, refer to *Configuring the Upconverter* on page 3.
Power Amplifier LED & fan not operating	AC power not connected to the Power Amplifier	3. Check power cord connection. 4. Check UPS operation.
Power Amplifier display not lit	The screen saver is in operation	Push the front panel NAVIGATE tactile button to refresh display
Power Amplifier display indicates HIGH REFLECTED POWER(1)	Output cable or antenna not connected	Check cables and antenna connection
Power Amplifier display shows a Voltage Indication that differs from about 30V	Internal fault	Call technician or replace PA
Power Amplifier display indicates OUTPUT POWER below 5W	Low drive power to the PA (or wrong display)	5. Check cables connection. 6. Validate WMTS and Upconverter operation. 7. Compare PA reported received level to the FAT result (section 5.1.2.1 in the FAT document). 8. Check the MMU reported received level. Compare to the FAT result (section 5.1.3.1). 9. If the level difference is more than 4 dB, call a technician to perform RF test point signal verification. ☑ **Note:** Output level can be increased by increasing the Upconverter gain on the Upconverter front panel.

Symptom	Possible Fault	Correction
Power amplifier display indicates OUTPUT POWER above 20W	High drive power to the PA (or wrong display)	10. Compare PA reported received level to the FAT result (section 5.1.2.1). 1. Check the MMU reported received level. Compare to the FAT result (section 5.1.3.1). 2. If the level difference is more than 4 dB, call a technician. ☑ **Note:** Output level can be decreased by decreasing the Upconverter gain on the Upconverter front panel.
Power amplifier display indicates AMPLIFIER OVERDRIVEN (2)	Excessive PA input level	Check the PA input level on TP5, TP6, TP7.
MMU acquires downstream signal, but doesn't finish upstream registration process	Upstream spectrum Inversion is not ON	Check the Spectrum Inversion box on the Arcadian Networks Configuration Tool Upstream menu (refer to the *NMS User Guide* for instructions). It should be ON.

When the HIGH REFLECTED POWER message appears, the PA shuts down for five minutes, after which it turns back on and checks again for high VSWR. It then returns to the same power level it was set to.

When the AMPLIFIER OVERDRIVEN message appears, the PA shuts down for one minute, after which it turns back on and checks again for an overdriven amplifier. It then returns to the same power level it was set to.

WMTS Digital Display and LED Indications

During system initialization, the universal cards' digital display combined with the C&F four LED indicators, provide detailed information about the status of the WMTS, as detailed below.

If problems occur in the initialization process, observe these indicators and check if the indications are accurate. This information should be recorded and transmitted to Arcadian Networks Support as an aid in identifying faults.

Digital Display Indications at System Initialization for all Universal Cards

- H – Start of initialization
- X – Hardware failure
- Y – Missing software file

- x – Missing software file
- Z – Hardware failure
- W – Memory read error
- V – Read error from flash memory
- U – Application download to flash memory
- m – Mapping
- L – Download to FPAG
- M – End of download
- e –No initialization
- g- Jump to application
- s- Suspend application
- ? – Default card mapping
- 2 – Default mapping
- 3 – Address acknowledge
- 4 – End of mapping
- 5 – N/A
- 6 – Memory address
- 7 – End of memory download
- 8 – End of address mapping
- 9 – End of initialization

C&F Card LED Indicators

Function	LED Status			
	Cnt	Fwd	Dwnst	Upst
Set card base address	Off	Off	Off	On
Set window base address	Off	Off	On	Off
Set download address	Off	Off	On	On
Download application to card	Off	On	Off	On
Download firmware	Off	On	On	On
Set entry point	On	Off	Off	Off
Set label to card	On	Off	Off	On
End of download	On	Off	Off	On

WMTS Troubleshooting

Symptom	Recommended Action
None of the LEDs are on	1. Check the On/Off Switch and see that its state is ON. 2. Check if the power cable is connected. 3. Check the fuse box and see if the fuses are conductible. 4. If all of the above is working properly, call a technician.
The LEDs in one of the card are not on	1. Check if the card is inserted properly. 2. If the card is not inserted properly then power down the WMTS, pull the card out, and insert it back in again. Make sure that the card is inserted using the same parallel rails and that it is pushed in all the way. 3. If the card was or is now inserted properly and the LEDs still are not working, call a technician.
No connection between the WMTS and the PC	1. Check if the “Control & Forward” card is connected to the network of the PC directly / through a hub or switch. 2. Check the PC network interface card and see that it is not disabled. 3. Check if the PC and the “Control & Forward” card are on the same network and subnet. 4. If all of the above is correct and there is still no connection between the PC and the WMTS, call a technician.
None of the Modems are up	1. Check if the downstream cable is connected to the appropriate channel. 2. Check if the upstream cable is connected to the appropriate channel. 3. Check if the “DHCP” server is on and is working properly. 4. Check if the “TIME-OF-DAY” server is on and is working properly. 5. Check if the “TFTP” server is on and is working properly.
One of the power supplies is reporting a failure	1. Check if the DC power supply is connected properly. 2. Change the DC power supply with a new power supply. 3. If the problem isn’t solved, call a technician.
The fans report a failure	1. Check if the fans drawer is inserted properly. 2. Change the fans drawer with a new drawer. 3. If the problem isn’t solved, call a technician.

Remote Troubleshooting Via the NMS

There are several parameters that are measured by either the WMTS or the MMU. These parameters are polled periodically by the NMS, and kept in a database for statistics. A threshold can be set for some of these parameters. When such a threshold is crossed, the NMS issues an alarm event. The following is a list of these parameters, and their functionality.

NMS Monitored Parameters

Channel Statistic Parameters at the Monitoring Modem

- **Downstream Received Power** – Checks all the downstream TX path (WMTS downstream card output, Upconverter, PA, Diplexer, Directional power, and cables), and the monitoring path (splitter, combiner, attenuators) to the MMU.
  Monitoring the downstream received power enables long term tracking of this path.
- **Downstream SNR** – Checks the TX signal quality, from the WMTS downstream card output, through the Upconverter and PA.
  Monitoring the Downstream SNR enables long term tracking of signal quality.
- **Upstream Output Power** – Checks the receiver path, from the MMU through the monitoring path (splitter, combiner, attenuators) and the entire upstream receiver path (LNA module, Downconverter, to the WMTS Hex card RX port).
  Tracing the output level enables validating the stability of the US path.

Channel Statistic Parameters at the Channel

- **Upstream Received SNR** – Checks the entire upstream receiver signal path. It enables validation of US signal quality and proper operation. This test can also be used as an indication for external interference.

NMS Troubleshooting Tests – Troubleshooting Procedures

The following are trouble shooting procedures for cases where the measurements differ from the expected levels. Note that the FAT results for the device are included in the package.

Parameter	Expected Value	Possible Fault	Correction
Downstream Received Power	- 16 ± 3 dBmV	Fault in one of the following: WMTS DS card, Upconverter, PA, splitters, cables and connectors.	Call technician to check test point and compare with the FAT results.
Downstream SNR	≥ 30 dB	Fault in one of the following: WMTS DS card, Upconverter, PA.	Call technician to check test point and compare with the FAT results.
MMU Output Power	62±4 dBmV	Fault in one of the following: LNAs, Downconverter, WMTS Hex US card, cables and connectors.	Call technician to check test point and compare with the FAT results.
Upstream Received SNR	≥ 22 dB	Fault in one of the following: LNAs, Downconverter, WMTS Hex US card	Call technician to check test point and compare with the FAT results.

Test Points Signal Verifications

The Base Station rack is pre-adjusted and tested before shipment. After the initial operating process, all base station's functions should operate properly, and **no adjustment is needed**. Most functions can be tested using the MMU, via the NMS. The MMU tests enable long-term local and remote tracking and monitoring of the system performances.

The RF test points enable more in-depth tracking of the downstream and upstream signal. The downstream test points are used for monitoring the signal level, as well as the signal quality (spectrum re-growth and side lobes). The upstream test points are used to check the upstream signal level, the SNR, and the Signal to External Interference ratio. The tests you can run using the tests points are **not required** for initial operation. They should be performed only if there is a significant difference between the measured and expected results.

The following table describes the RF Test points and the related expected nominal levels with the spectrum analyzer setting for these tests. For comparison, the table includes also the FAT (Factory Accepted Test) expected results and related FAT paragraph with the tests conditions. Note that for a real comparison you should follow the full FAT procedure as described in the related paragraph.

> **Note:** The following tests should be performed by a **trained technician** only. These tests require external equipment such as a calibrated Spectrum Analyzer.

Test point #	Sector	Function	Expected Level	
			Nominal Value	FAT Value
1	1	Upconverter output	49±3 dBmV (1)	34±2 dBmV (2) par. 5.1.1.3
2	2			
3	3			
4	All	Downstream cluster combined signal (3)	5±4 dBmV each channel (1)	5±3 dBmV each channel (1) par. 5.1.1.3
5	1	Upstream Post LNA RF signal	Level: -54±4 dBm (1) SNR: 24±3 dB (4)	
6	2			
7	3			
8	1	Upstream Post Downconverter IF signal(6)	Level: -43±4 dBm (1) Noise level -31 ± 3 dBmv (5) SNR: 24±3 dB (4)	Noise level -31 ± 3 dBmv (5) par. 5.2.2.3
9	2			
10	3			

(1) Measured with Spectrum Analyzer set at: RBW=1 MHz, VBW=1 KHz

(2) Measured with Spectrum Analyzer set at: RBW=10 KHz, VBW=300 Hz

(3) The downstream signal level at this test point is about 84 dB below the Base Station output power. This test point can serve to connect an external modem to the system for testing purposes.

(4) Measured with Spectrum Analyzer at: RBW=100 KHz, VBW=3 KHz

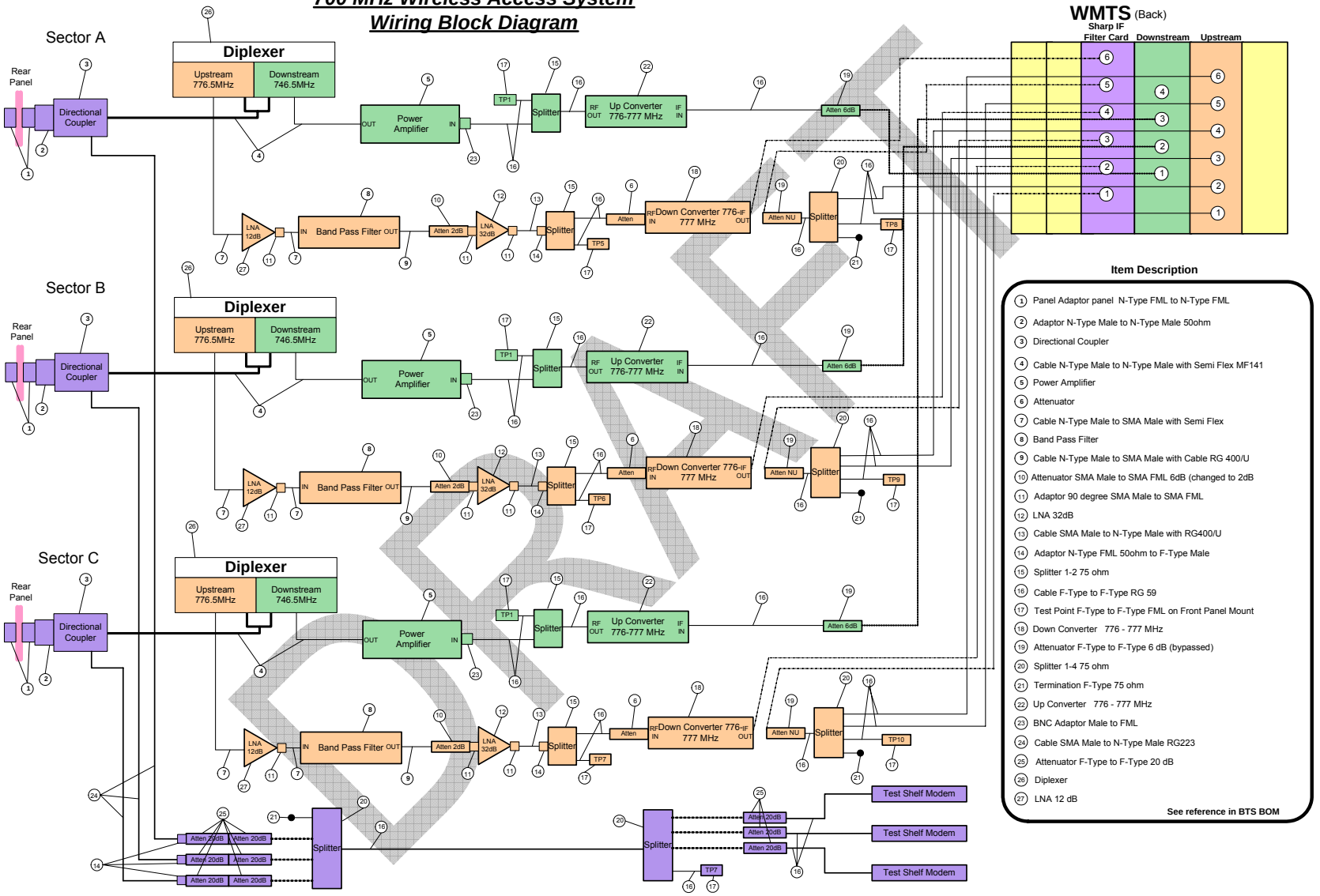
(5) Measured with Spectrum Analyzer at: RBW=10 KHz, VBW=100 KHz

(6) Inserting the Sharp IF Filter and the attenuator before the V3100 (for gain compensation) does not change the Test Points levels (up to ± 1 dB).

> **Note:** When a one-sector BTS is built, only channel 1 is used. For two-sectors, channels 1 and 2 are used. For three-sectors, channels 1, 2, and 3 are used.

Cabling Information

If a cable disconnects, use the following diagram to learn how to re-connect it.


700 MHz Wireless Access System
Wiring Block Diagram
Sector A
Sector B
Sector C
Rear Panel
Directional Coupler
Diplexer
Upstream 776.5MHz
Downstream 746.5MHz
Power Amplifier
Splitter
Up Converter 776-777 MHz
Atten 6dB
LNA 12dB
Band Pass Filter
Atten 2dB
LNA 32dB
Down Converter 776-777 MHz
Atten NU
Atten
TP1
TP5
TP6
TP7
TP8
TP9
TP10
Atten 20dB
Test Shelf Modem
WMTS (Back)
Sharp IF Filter Card
Downstream
Upstream
DRAFT
Item Description
1 Panel Adaptor panel N-Type FML to N-Type FML
2 Adaptor N-Type Male to N-Type Male 50ohm
3 Directional Coupler
4 Cable N-Type Male to N-Type Male with Semi Flex MF141
5 Power Amplifier
6 Attenuator
7 Cable N-Type Male to SMA Male with Semi Flex
8 Band Pass Filter
9 Cable N-Type Male to SMA Male with Cable RG 400/U
10 Attenuator SMA Male to SMA FML 6dB (changed to 2dB
11 Adaptor 90 degree SMA Male to SMA FML
12 LNA 32dB
13 Cable SMA Male to N-Type Male with RG400/U
14 Adaptor N-Type FML 50ohm to F-Type Male
15 Splitter 1-2 75 ohm
16 Cable F-Type to F-Type RG 59
17 Test Point F-Type to F-Type FML on Front Panel Mount
18 Down Converter 776 - 777 MHz
19 Attenuator F-Type to F-Type 6 dB (bypassed)
20 Splitter 1-4 75 ohm
21 Termination F-Type 75 ohm
22 Up Converter 776 - 777 MHz
23 BNC Adaptor Male to FML
24 Cable SMA Male to N-Type Male RG223
25 Attenuator F-Type to F-Type 20 dB
26 Diplexer
27 LNA 12 dB
See reference in BTS BOM

☑ **Note:** The Sharp IF Filter card is optional. Without the Sharp IF Filter card, the connection between the Down Converter and the Attenuator is a straight wire.

A Technical Specifications

BRS-757 Base Station Specifications

	Parameter	Specification
General	Dimensions	23” width x 90” height x 27.5” depth
	Rack door opening space	30” in front and in back
	Operating temperature	10 – 40ºC
	Humidity	Up to 80% (non condensed)
	Power consumption	2400W
RF	Duplexing method	FDD
	Downstream frequency	757-758 MHz
	Downstream frequency accuracy	5 KHz
	Downstream modulation	QPSK, 16QAM, 64QAM (256QAM optional)
	Downstream Output Power	10 W Typical (11.83 W max) @ 330 KHz 6 W Typical (7.51 W max) @ 245 KHz
	Downstream channel BW	330 KHz (245 KHz optional)
	Upstream frequency	787-788 MHz
	Upstream modulation	QPSK, 16QAM
	Upstream channel BW	325 KHz (250 KHz optional)
	Upstream RX level	Adjustable, typical -90 dBm (for 20 miles coverage)
	Upstream SNR for BER < 10E-6	19 dB
	Upstream adjacent channel capability	Up to 10 dBc

	Parameter	Specification
	Upstream out of band interference mitigation (with Sharp IF Filter card) Note that the Sharp IF Filter card is optional.	+50dBc for single interferer @ 300KHz from channel edge +40dBcfor dual interferers @ 300KHz from channel edge
Connection to antenna	Cable length	50-400’
	Cable loss	2-3 dB typical

WMTS Specifications

	Parameter	Specification
Mechanical	Mounting	Rack mount
	Dimensions	19” x 15” x 15”, 48.26 x 38 x 38 cm
	Operating temperature	32ºF – 104ºF, 0ºC to 40ºC
	Power supply	110 VAC
	Power consumption	84 Watts
IF	IF frequency range	40-46 MHz
	Channel bandwidth	Down 330 KHz (245 KHz optional) Up 325 KHz (250 KHz optional)
	Modulation	down 64QAM (QPSK, 16QAM, 256QAM optional) Up 16QAM (QPSK optional)
	FEC	Reed Solomon / Trellis decoding
Interfaces	LAN	RJ45, Full duplex 100 BaseT
	Downstream channel	F-Type
	Upstream channel	F-Type
Performance	Downstream Channel	1.1 Mbps
	Upstream Channel	700 Kbps
Access Protocol		TDMA (DOCSIS based)
Security	Encryption	64 bits 3-DES
	Key Management	DOCSIS BPI, 1024 bits RSA public key
QoS	Downstream classification	Up to 3 classifiers by: ■ VLAN ID ■ TCP/UDP source & destination ports
	Downstream scheduling	Priority queuing Up to three data priority queues
	Upstream scheduling	Up to 256 prioritized services
Management	Protocol	SNMPv1
	MIBs	MIB II(RFC-1213), Bridge MIB (RFC-1493), Interfaces group MIB (RFC-2233), DOCSIS RF MIB (RFC-2670), DOCSIS BPI MIB

V3300 Downconverter Specifications

Parameter	Specification
Input frequency	787.5 MHz
Output Frequency	44 MHz
Spectrum inversion	Yes
Flatness @ 44 ±1MHz	±0.3 dB
Frequency accuracy	<3 KHz
Gain	18 dB
Phase noise [dBc/Hz]	■ -80 @ 500 Hz ■ -95 @ 1 KHz ■ -100 @10KHz ■ -105 @100KHz
Output P1dB	+10 dBm
Supply	6.5 V, 870 mA
Dimensions	180 x 88 x 50 mm
MTBF	428000 h

Upconverter Specifications

	Parameter	Specification
IF Input	IF frequency	44 MHz
	IF bandwidth	6 MHz
	Input impedance	75Ω
	IF return loss	20 dB min
	Input level nominal	+ 35 dBmV ±1 dB
QAM Output	Output frequency range	757 – 758 MHz
	QAM bandwidth	6 MHz
	Frequency step	12.5 KHz
	Output level	35 to 52 dBmV @ nominal input level
	Display error	± 2 dB max
	Level adjustment range	15 dB min
	RF output impedance	75Ω
	RF return loss	10 dB min
	Spurious	-60 dBc
	Broadband noise	-75 dBc min (4 MHz BW@ +50 dBmV output)
	Phase noise	1 KHz, -57 dBc min 10 KHz, -95 dBc min 10 KHz, -104 dBc min
	Frequency stability	±5 KHz
Mechanical	Dimensions	1.75" x 19" x 18.5" 4.45 x 48.26 x 47 cm
	Mounting	Standard EIA wide rack mount
	Weight	9.5 lbs, 43.Kg
Power	Requirement	110 VAC
	Frequency	50-60 Hz
	Consumption	31 W
Environmental	Operating temperature	32°F to +122°F, +0°C to +50°C
	Storage temperature	-20°C to +70°C
	Humidity	0 to 90% RH

Power Amplifier Specifications

	Parameter	Specification
Transmission Performance	Adjustable gain	38-49 dB
	QAM output power	40W max (over drive protection)
	P1dB minimum	130W
	VSWR protected	RF output into open (internal isolator installed)
	Input return loss	Min -16 dB
	Output return loss	Min -18 dB
	Spurious emission	> 60 dBc
	Harmonic suppression	> 60 dBc
Electrical Characteristics	Input RF connector	BNC
	Output RF connector	N-Type
	EMI Filtered max AC power	7A AC Max, 110V
Physical characteristics	Minimal rack space	3U
	Weight	45 lbs, 20.4 Kg
	Operating temperature	32˚F to +113˚F, +0˚C to +45˚C

UPS Specifications

The UPS is a Powerware model 5125-2400.

The UPS User Guide can be found at:
http://lit.powerware.com/ll_download.asp?file=1383b.pdf.