Product Description

CL1TC-4
Mobile Multimedia
400 Watt DVB-H L-Band
Indoor/Outdoor Transmitter

UBS-Axcera Inc.
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NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to pro-vide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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1. Introduction

1.1 Manual Overview

This manual contains the description of the CL1TC-4 Mobile Multimedia Transmitter. The manual also describes the installation, setup and operation of the Transmitter.

1.2 Safety

The CL1TC-4 Transmitter systems manufactured by UB-Axcera are designed to be easy to use and repair while providing protection from electrical and mechanical hazards. Please review the following warnings and familiarize yourself with the operation and servicing procedures before working on the transmitter system.

Hazardous Accessibility – UBS-Axcera has made attempts to provide appropriate connectors, wiring and shields to minimize hazardous accessibility.

Circuit Breakers and Wiring – All circuit breakers and wire are CE rated and are rated for maximum operating conditions.

Single Point Breaker or Disconnect - The customer should provide a single point breaker or disconnect at the breaker box for the main AC input connection to the transmitter.

Transmitter Ratings - The transmitter ratings are provided in the text of this manual along with voltage and current values for the equipment.

Protective Earthing Terminal – A main protective earthing terminal is provided for equipment required to have protective earthing.

Read All safety Instructions – All of the safety instructions should be read and understood before operating this equipment.

Retain Manuals – The manuals for the transmitter should be retained at the transmitter site for future reference. UBS-Axcera provides two manuals for this purpose; one manual can be left at the office while the other can be kept at the site.

Heed all Notes, Warnings, and Cautions – All of the notes, warnings, and cautions listed in this safety section and throughout the manual must be followed.

Follow Operating Instructions – All of the operating and use instructions for the transmitter should be followed.

Cleaning – Unplug or otherwise disconnect all power from the equipment before cleaning. Do not use liquid or aerosol cleaners. Use only a damp cloth for cleaning.

Ventilation – Openings in the cabinet and module front panels are provided for ventilation. To ensure the reliable operation of the transmitter, and to protect the unit from overheating, these openings must not be blocked.

Servicing – Do not attempt to service this product yourself until becoming familiar with the equipment. If in doubt, refer all servicing questions to qualified UBS-Axcera service personnel.

Replacement Parts – When replacement parts are used, be sure that the parts have the same functional and performance characteristics as the original part. Unauthorized substitutions may result in fire, electric shock, or other hazards. Please contact the UBS-Axcera Technical Service Department if you have any questions regarding service or replacement parts.

1.3 Contact Information

The UBS-Axcera Field Service Department can be contacted by PHONE at **724-873-8100** or by FAX at **724-873-8105**.

Before calling UBS-Axcera, please be prepared to supply the UBS-Axcera technician with answers to the following questions. This will save time and help ensure the most direct resolution to the problem.

1. What are your Name and the Call Letters for the station?
2. What are the model number and type of system?
3. Is the system digital or analog?
4. How long has the system been on the air? (Approximately when was the system installed?)
5. What are the symptoms being exhibited by the system? Include the current front panel LCD readings and what the status LED is indicating on the front panel of the drawer. If possible, include the LCD readings before the problem occurred.

1.4 Return Material Procedure

To insure the efficient handling of equipment or components that have been returned for repair, UBS-Axcera requests that each returned item be accompanied by a Return Material Authorization Number (RMA#). The RMA# can be obtained from any UBS-Axcera Field Service Engineer by contacting the UBS-Axcera Field Service Department at 724-873-8100 or by Fax at 724-873-8105. This procedure applies to all items sent to the Field Service Department regardless of whether the item was originally manufactured by UBS-Axcera.

When equipment is sent to the field on loan, the RMA# is included with the unit. The RMA# is intended to be used when the unit is returned to UBS-Axcera. In addition, all shipping material should be retained for the return of the unit to UBS-Axcera.

Replacement assemblies are also sent with the RMA# to allow for the proper routing of the exchanged hardware. Failure to close out this type of RMA# will normally result in the customer being invoiced for the value of the loaner item or the exchanged assembly.

When shipping an item to UBS-Axcera, please include the RMA# on the packing list and on the shipping container. The packing slip should also include contact information and a brief description of why the unit is being returned.
Please forward all RMA items to:

UBS-Axcera
103 Freedom Drive
P.O. Box 525
Lawrence, PA 15055-0525 USA

For more information concerning this procedure, call the UBS-Axcera Field Service Department at 724-873-8100.

UBS-Axcera can also be contacted through e-mail at **info@UBS-Axcera.com** and on the Web at **www.UBS-Axcera.com.**

1.5 Limited One Year Warranty for Axcera Products

UBS-Axcera warrants each new product that it has manufactured and sold against defects in material and workmanship under normal use and service for a period of one (1) year from the date of shipment from UBS-Axcera's plant, when operated in accordance with UBS-Axcera's operating instructions. This warranty shall not apply to tubes, fuses, batteries, bulbs or LEDs.

Warranties are valid only when and if (a) UBS-Axcera receives prompt written notice of breach within the period of warranty, (b) the defective product is properly packed and returned by the buyer (transportation and insurance prepaid), and (c) UBS-Axcera determines, in its sole judgment, that the product is defective and not subject to any misuse, neglect, improper installation, negligence, accident, or (unless authorized in writing by UBS-Axcera) repair or alteration. UBS-Axcera's exclusive liability for any personal and/or property damage (including direct, consequential, or incidental) caused by the breach of any or all warranties, shall be limited to the following: (a) repairing or replacing (in UBS-Axcera's sole discretion) any defective parts free of charge (F.O.B. UBS-Axcera's plant) and/or (b) crediting (in UBS-Axcera's sole discretion) all or a portion of the purchase price to the buyer.

Equipment furnished by UBS-Axcera, but not bearing its trade name, shall bear no warranties other than the special hours-of-use or other warranties extended by or enforceable against the manufacturer at the time of delivery to the buyer.

NO WARRANTIES, WHETHER STATUTORY, EXPRESSED, OR IMPLIED, AND NO WARRANTIES OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR FREEDOM FROM INFRINGEMENT, OR THE LIKE, OTHER THAN AS SPECIFIED IN PATENT LIABILITY ARTICLES, AND IN THIS ARTICLE, SHALL APPLY TO THE EQUIPMENT FURNISHED HEREUNDER.

1.6 Warning

☞ WARNING!!!

⋖ HIGH VOLTAGE ⋗

DO NOT ATTEMPT TO REPAIR OR TROUBLESHOOT THIS EQUIPMENT UNLESS YOU ARE FAMILIAR WITH ITS OPERATION AND EXPERIENCED IN SERVICING HIGH VOLTAGE EQUIPMENT. LETHAL VOLTAGES ARE PRESENT WHEN POWER IS APPLIED TO THIS SYSTEM. IF POSSIBLE, TURN OFF POWER BEFORE MAKING ADJUSTMENTS TO THE SYSTEM.

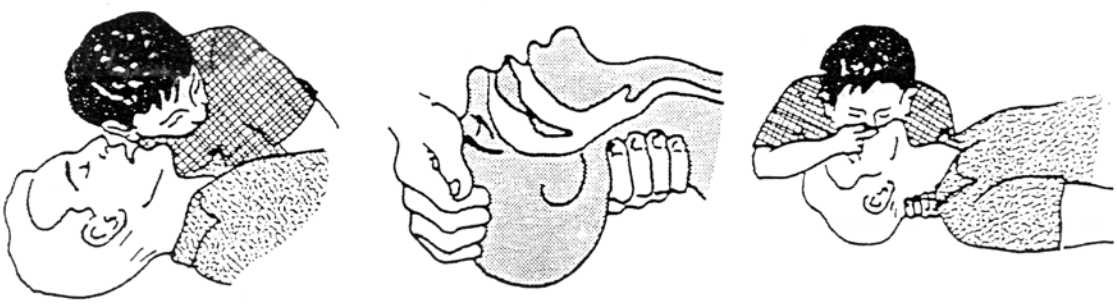
★ RADIO FREQUENCY RADIATION HAZARD ★

MICROWAVE, RF AMPLIFIERS AND TUBES GENERATE HAZARDOUS RF RADIATION THAT CAN CAUSE SEVERE INJURY INCLUDING CATARACTS, WHICH CAN RESULT IN BLINDNESS. SOME CARDIAC PACEMAKERS MAY BE AFFECTED BY THE RF ENERGY EMITTED BY RF AND MICROWAVE AMPLIFIERS. NEVER OPERATE THE TRANSMITTER SYSTEM WITHOUT A PROPERLY MATCHED RF ENERGY ABSORBING LOAD ATTACHED. KEEP PERSONNEL AWAY FROM OPEN WAVEGUIDES AND ANTENNAS. NEVER LOOK INTO AN OPEN WAVEGUIDE OR ANTENNA. MONITOR ALL PARTS OF THE RF SYSTEM FOR RADIATION LEAKAGE AT REGULAR INTERVALS.

1.7 Emergency First Aid Instructions

EMERGENCY FIRST AID INSTRUCTIONS

Personnel engaged in the installation, operation, or maintenance of this equipment are urged to become familiar with the following rules both in theory and practice. It is the duty of all operating personnel to be prepared to give adequate Emergency First Aid and thereby prevent avoidable loss of life.



RESCUE BREATHING

1. Find out if the person is breathing.

You must find out if the person has stopped breathing. If you think he is not breathing, place him flat on his back. Put your ear close to his mouth and look at his chest. If he is breathing you can feel the air on your cheek. You can see his chest move up and down. If you do not feel the air or see the chest move, he is not breathing.

2. If he is not breathing, open the airway by tilting his head backwards.

Lift up his neck with one hand and push down on his forehead with the other. This opens the airway. Sometimes doing this will let the person breathe again by himself.

3. If he is still not breathing, begin rescue breathing.

-Keep his head tilted backward. Pinch nose shut.
-Put your mouth tightly over his mouth.
-Blow into his mouth once every five seconds
-DO NOT STOP rescue breathing until help arrives.

LOOSEN CLOTHING - KEEP WARM

Do this when the victim is breathing by himself or help is available. Keep him as quiet as possible and from becoming chilled. Otherwise treat him for shock.

BURNS

SKIN REDDENED: Apply ice cold water to burned area to prevent burn from going deeper into skin tissue. Cover area with a clean sheet or cloth to keep away air. Consult a physician.

SKIN BLISTERED OR FLESH CHARRED: Apply ice cold water to burned area to prevent burn from going deeper into skin tissue. Cover area with clean sheet or cloth to keep away air. Treat victim for shock and take to hospital.

EXTENSIVE BURN - SKIN BROKEN: Cover area with clean sheet or cloth to keep away air. Treat victim for shock and take to hospital.

1.8 Abbreviations/Acronyms

AC Alternating Current

AFC Automatic Frequency Control

AGC Automatic Gain Control

ALC Automatic Level Control

AM Amplitude modulation

ARD A-line, Regenerative Translator, Digital

ATD A-line, Transmitter, Digital

AWG American wire gauge

B/D Block Diagram

BER Bit Error Rate

BRD B-line, Regenerative Translator, Digital

BTD B-line, Transmitter, Digital

BW Bandwidth

OFDM Orthogonal Frequency Division Multiplexing modulation scheme

DC Direct Current

D/A Digital to analog

DSP Digital Signal Processing

DTV Digital Television

DVB Digital Video Broadcasting

DVB-H Digital Video Broadcasting - Handheld

dB Decibel

dBm Decibel referenced to 1 milliwatt

dBmV Decibel referenced to 1 millivolt

dBw Decibel referenced to 1 watt

FEC Forward Error Correction

FM Frequency modulation

FPGA Field Programmable Gate Array

HPA High Power Amplifier

Hz Hertz

I/C Interconnect

ICPM Incidental Carrier Phase Modulation

I/P Input

IF Intermediate Frequency

LED Light emitting diode

LDMOS Lateral Diffused Metal Oxide Semiconductor Field Effect Transistor

MFN Multi-Frequency Network

MPEG Motion Pictures Expert Group

NTSC National Television Systems Committee (Analog)

O/P Output

PLL Phase Locked Loop

PCB Printed circuit board

QAM Quadrature Amplitude Modulation

RF Radio Frequency

R/P Racking Plan

S/D System Drawings

SFN Single Frequency Network

SMPTE Society of Motion Picture and Television Engineers

2 Product Description

2.1 Product Overview

The indoor/outdoor 400 Watt DVB-H L-Band transmitter is fully compliant with the DVB-T/H standard and is designed for an operating range of 1670 MHz to 1675 MHz. The transport stream input for the unit may either be a DVB-ASI signal or an Gb Ethernet (IP) input (Pro-MPEG CoP #3 / SMPTE 2022).

Figure 2-1 400 Watt DVB-H Transmitter

The compact design is a complete DVB-H transmitter system. Included in the indoor/outdoor cabinet is a modulator and high power amplifier (HPA). The transmitter system is also designed to accommodate a customer installed bandpass filter. In addition to a digital modulator board, the modulator system also includes an amplifier, bandpass filter, internal GPS receiver, I/O extension board and a system controller. The system controller is responsible for transmitter operation, configuration, management and status reporting with support for a SNMP-based Network Management System.

The cabinet also includes a 1350 Watt / 1500 VA UPS intended to supply backup power to a playout server and the modulator. This will ensure site monitoring will continue during a power outage as well as signal generation to ensure a fast recovery time once power is restored.

Key highlights of the system include

- Compact, self-contained 400 Watt transmitter
- Operating frequency range of 1670 MHz to 1675 MHz
- DVB-T/H Compliant
- Modular construction for easy maintenance
- Modulator with DVB-H modulator/system controller, amplifier, bandpass filter, on-board GPS receiver and I/O extension board
- High performance LDMOS power amplifier
- RF overdrive, high VSWR and over-temperature protection
- Variable speed (temperature controlled) DC fans
- Linear and Non-linear Digital Pre-correction
- Web interface for remote control and monitoring
- SNMP for network management of the transmitter
- Air conditioned indoor/outdoor cabinet with smoke detector (customer furnished)
- Playout server (customer furnished)
- 1350 Watt / 1500 VA UPS (customer furnished)

2.2 Cabinet Tour

The front view of the closed cabinet is shown below.

Figure 2-2 Front View of Closed Cabinet

The front view of the open cabinet is shown below.

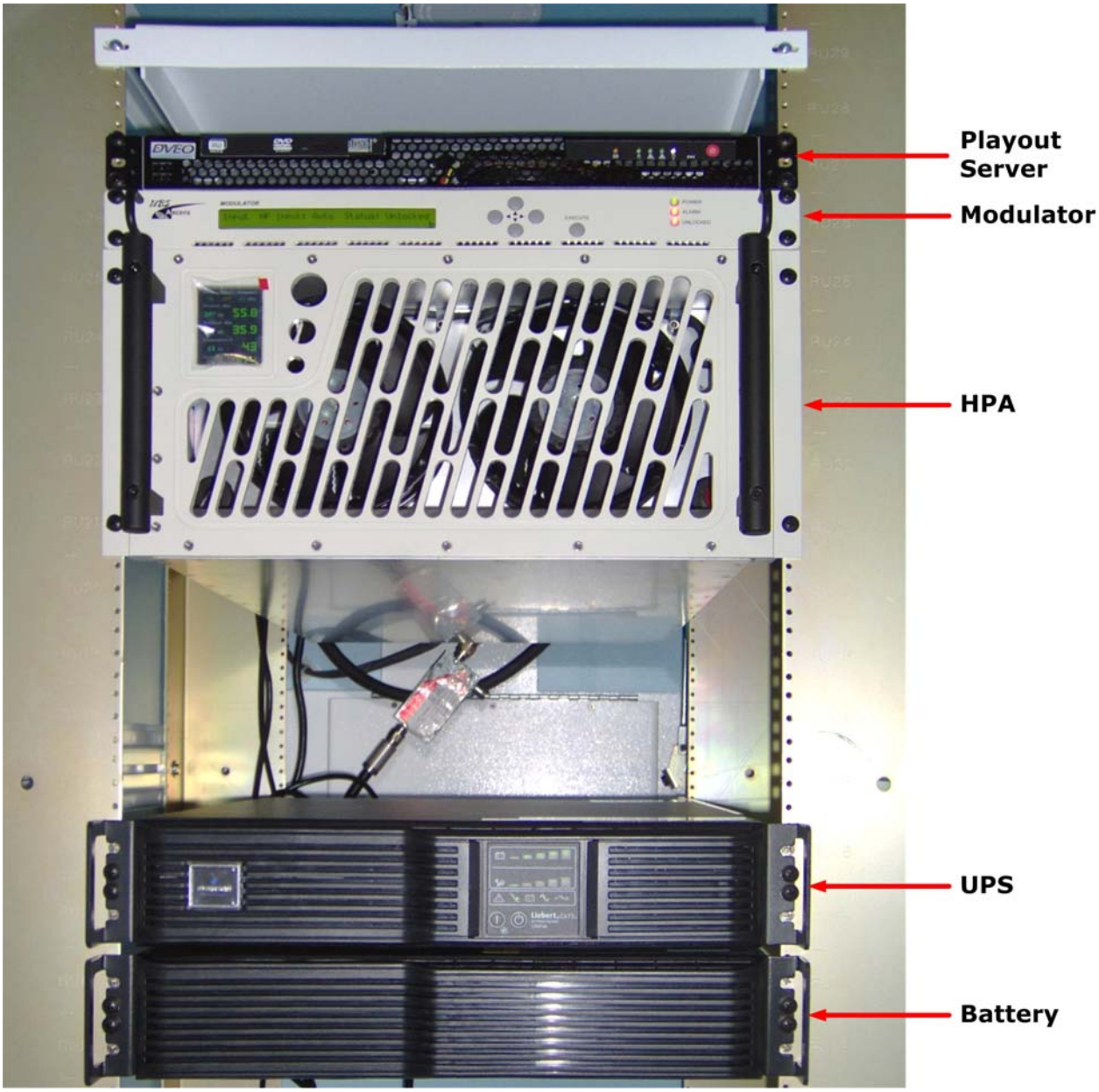


Figure 2-3 Front View of Open Cabinet

The rear view of the closed cabinet is shown below.

Figure 2-4 Rear View of Closed Cabinet

The rear view of the open cabinet is shown below.

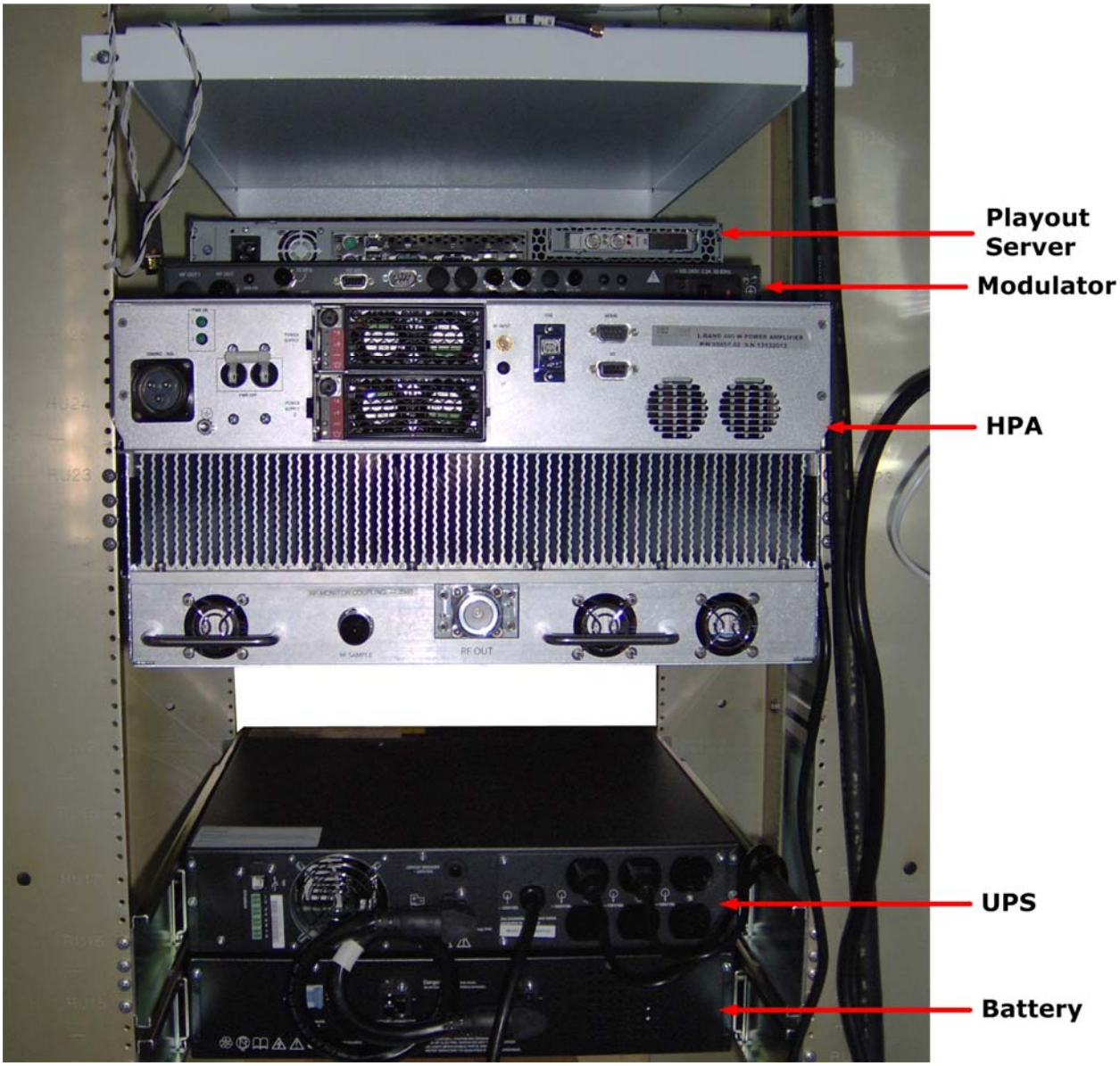


Figure 2-5 Rear View of Open Cabinet

2.3 Product Architecture

2.3.1 Transmitter Overview

The DVB-H transmitter is a compact, indoor/outdoor cabinet that comes equipped with:

- UPS (customer furnished)
- Playout Server (customer furnished)
- Modulator
- HPA

A block diagram of the system is presented in Figure 2-6. Figure 2-6 also identifies the connector types used for the various modules as well as signal levels and losses throughout the signal chain.

2.3.2 UPS

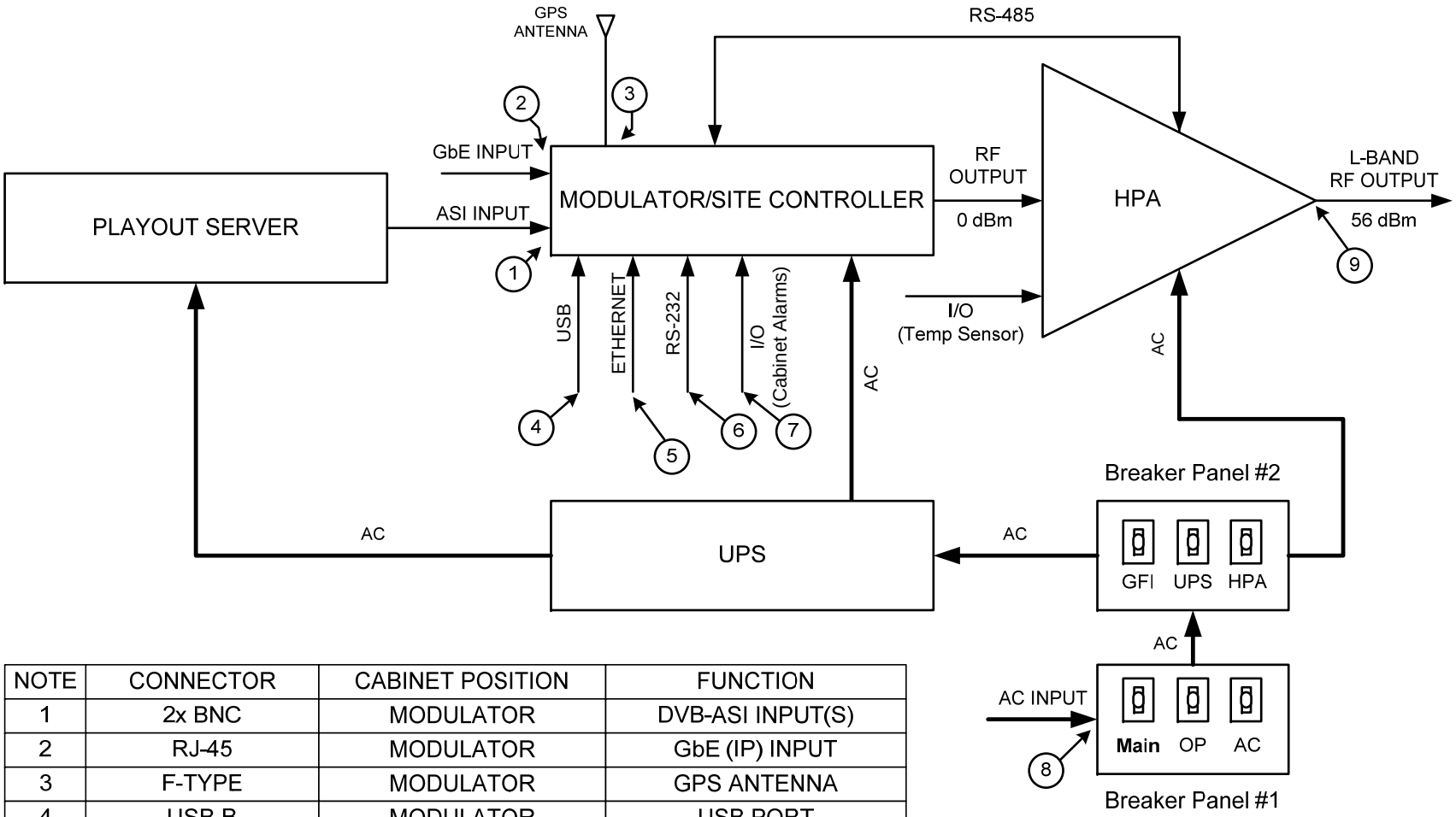
A UPS is employed to provide backup power to the playout server and modulator in the event of a power outage. This ensures that site communications and monitoring will continue during the outage and to maintain signal generation to ensure a fast recovery time once power is restored.

For details on UPS operation, please refer to the manufacturer's product manual.

2.3.3 Playout Server

The playout server provides the modulator with a transports stream over ASI.

For details on playout server operation, please refer to the manufacturer's product manual.



NOTE	CONNECTOR	CABINET POSITION	FUNCTION
1	2x BNC	MODULATOR	DVB-ASI INPUT(S)
2	RJ-45	MODULATOR	GbE (IP) INPUT
3	F-TYPE	MODULATOR	GPS ANTENNA
4	USB-B	MODULATOR	USB PORT
5	RJ-45	MODULATOR	ETHERNET PORT
6	DB-9(M)	MODULATOR	SERIAL PORT (RS-232)
7	DB-9(M)	MODULATOR	SERIAL PORT (I/O)
8	AC	CB PANEL #1	CB PANEL #2 AC POWER
9	7/16" DIN (F)	HPA	RF OUTPUT

Figure 2-6 DVB-H Transmitter Block Diagram

2.3.4 Modulator

The modulator includes

- DVB-H modulator
- Amplifier
- Bandpass filter
- GPS receiver
- I/O extension board
- System controller

Power to the modulator is protected using a UPS power backup (see Figure 2-6). This will ensure site monitoring will continue during a power outage as well as continued signal generation to ensure a fast recovery time once power is restored.

2.3.4.1 DVB-H Modulator

- The module performs DVB-H signal encoding, OFDM waveform generation and has the ability to synchronize with other stations to provide Single Frequency Network (SFN) operation.
- The module performs the frequency conversion of the OFDM signal into the required L-Band channel frequency, to drive the high power amplifier (HPA).
- Digital Linear and Non-linear pre-correctors provide compensation for the group delay introduced by the HPA output filter and the non-linear distortions produced by HPA.

The DVB-H Modulator receives a MPEG-2 structured Transport Stream on the ASI input or an IP encapsulated MPEG-2 structured Transport Stream on either of the RJ-45 Ethernet ports. The IP input is according to MPEG PRO CoP #3 FEC / SMPTE 2022 protocol.

The modulator converts the digital input streams (ASI or IP) to an OFDM waveform in accordance with DVB-T/H standards. A direct conversion process provides a single analog RF output from 1670 MHz to 1675 MHz, suitable for amplification in the high power amplifier (HPA).

Digital linear and non-linear pre-correctors (pre-distorters) significantly improve the performance of the high power amplifier. The Non-linear pre-corrector compensates for the HPA non-linearity and is able to provide separate adjustment for the low and high frequency shoulders of the wide channel spectrum. The Linear pre-corrector compensates for the group delay created by an output filter.

2.3.4.2 Amplifier

The amplifier provides up to 20 dB of gain, allowing the modulator to provide an RF output power level from -10 dBm to 0 dBm with shoulders $\geq$ 55dBc.

2.3.4.3 Bandpass Filter

Each modulator is equipped with a narrow-band output filter specifically tuned to the frequency channel assigned to the transmitter. The bandpass filter is intended to limit out-of-band emissions at the output of the modulator's internal amplifier.

2.3.4.4 GPS Receiver

The onboard GPS receiver provides accurate, high quality 10 MHz and 1PPS reference signals for transmitter synchronization and has the capability to track 12 satellites. The 10 MHz and 1PPS reference signals are provided for the modulator board as well as one 10 MHz and one 1 PPS reference signal for external devices.

The GPS receiver supports the NMEA formatted message protocol as well as the proprietary NavMan binary messages. A subset of the protocols is used by the processor in order to control the receiver.

The user has the option to set the Max GPS Holdover time, updated the system clock from the GPS and set the time zone. Following a loss of signal lock (to the GPS satellite network), the Max GPS Holdover time is the maximum length of time the system will continue to operate in a free-running mode before an alarm is issued.

2.3.4.5 I/O Extension Board

The I/O extension board provides four (4) analog pull down inputs and four (4) analog pull up inputs, which are available on the rear panel I/O port. The analog inputs are monitored by the system controller permitting the user to set the polarity and voltage threshold that trigger an alarm.

NOTE: For this application, Pin 6 has been connected to the cabinet door switch contacts, Pin 7 has been connected to the cabinet smoke detector and the Web interface has been configured accordingly.

2.3.4.6 Transmitter Controller Module

- Provides all primary site control and management functionality.
- Manages all control interfaces of the transmitter.

The modulator and HPA are connected by a RS-485 serial cable for control and monitoring (see Figure 2-6). The system controller supports transmitter operation, configuration, management and status reporting. The control includes power up, power down, RF control processes, control commands for status requests and operating parameters, etc. The transmitter identity (name, password, local IP address, SNMP, etc.) can be configured remotely or locally. Remote upgrade of the transmitter software is supported.

The system controller supports a web interface (Web GUI) for its user interface and is responsible for software and configuration management. Remote control of the transmitter is typically managed via an SNMP agent.

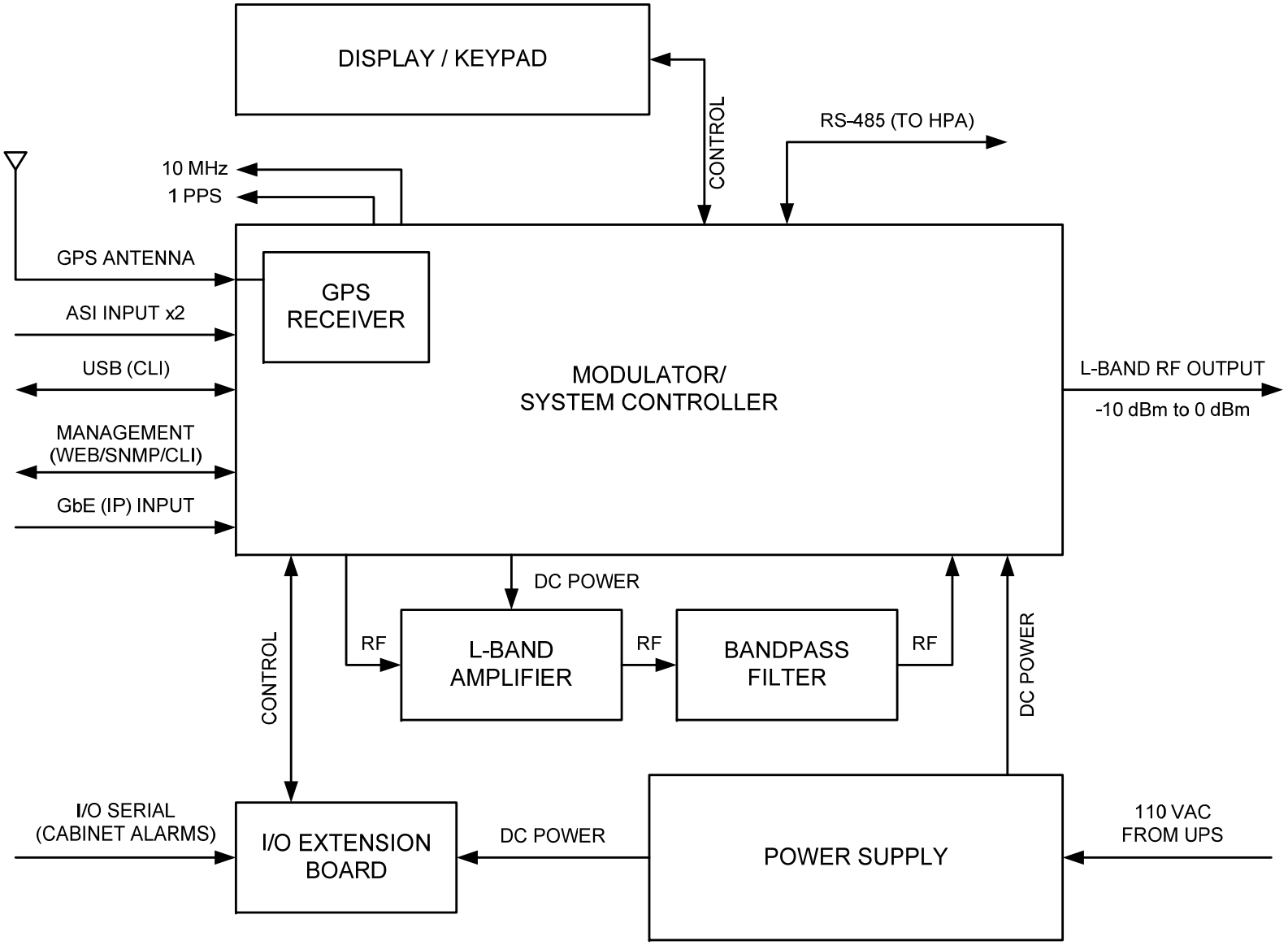


Figure 2-7 Modulator Block Diagram

2.3.5 High Power Amplifier (HPA)

- The module provides RF signal amplification up to the required 400 Watts output power level at the HPA RF output.
- The output power level is maintained via an ALC loop.
- The output forward and reverse power levels are measured by the integrated output coupler and reported to the system controller.

The main system diagram for the High Power Amplifier (HPA) is shown in Figure 2-8. This compact design employs a high efficiency LDMOS technology with a 400 Watt power rating. The HPA includes a LCD display for status messages. The HPA also includes two power supplies and has two variable speed DC fans for forced air cooling.

The HPA is designed to operate as a final amplification stage for the terrestrial L-Band transmitter system. It amplifies the L-Band terrestrial signal from the modulator up to a power level of 400 Watts, while maintaining acceptable output emission levels.

The HPA is a field-replaceable system component that includes integrated AC/DC power supplies. The HPA is designed for installation in an indoor or environmentally protected outdoor cabinet.

The HPA architecture is based on a solid state design operating in the Class A/AB linear mode over a frequency range from 1670 MHz to 1675MHz. The amplifier is fully protected against input overdrive, overheating and output load VSWR conditions. The protection circuits are all self-correcting, allowing restoration of the amplifier to the normal operational state upon removal of the fault condition.

The HPA incorporates an internal automatic self-leveling loop to maintain a constant output power level. The automatic level control (ALC) circuit will compensate for the input signal level variations and gain variations affected by changes in temperature as well as for the gain change due to devices aging.

The HPA main driver chain signal is split and feeds six individual LDMOS power modules. The output of each module is combined and fed into the combiner/coupler which includes a RF monitor port and RF detectors to measure forward and reflected power levels. The HPA controller monitors the operation parameters of the HPA, provides protection against abnormal operation conditions and communicates with the modulator system controller via a RS-485 serial link.

There are six output power modules in parallel configuration in the 400W DVB-H HPA. The rated output power level of the HPA during normal operation is 56 dBm (400W). In the event of a partial failure (the lowest current reading on one of the power modules is less than 20% of the highest current reading on one of the power modules), the HPA is capable of operating with a maximum output power level of 53 dBm. If the output power level is greater than 53 dBm, it will be automatically reduced to 53 dBm. If the output power level is less than 53 dBm, no reduction will occur.

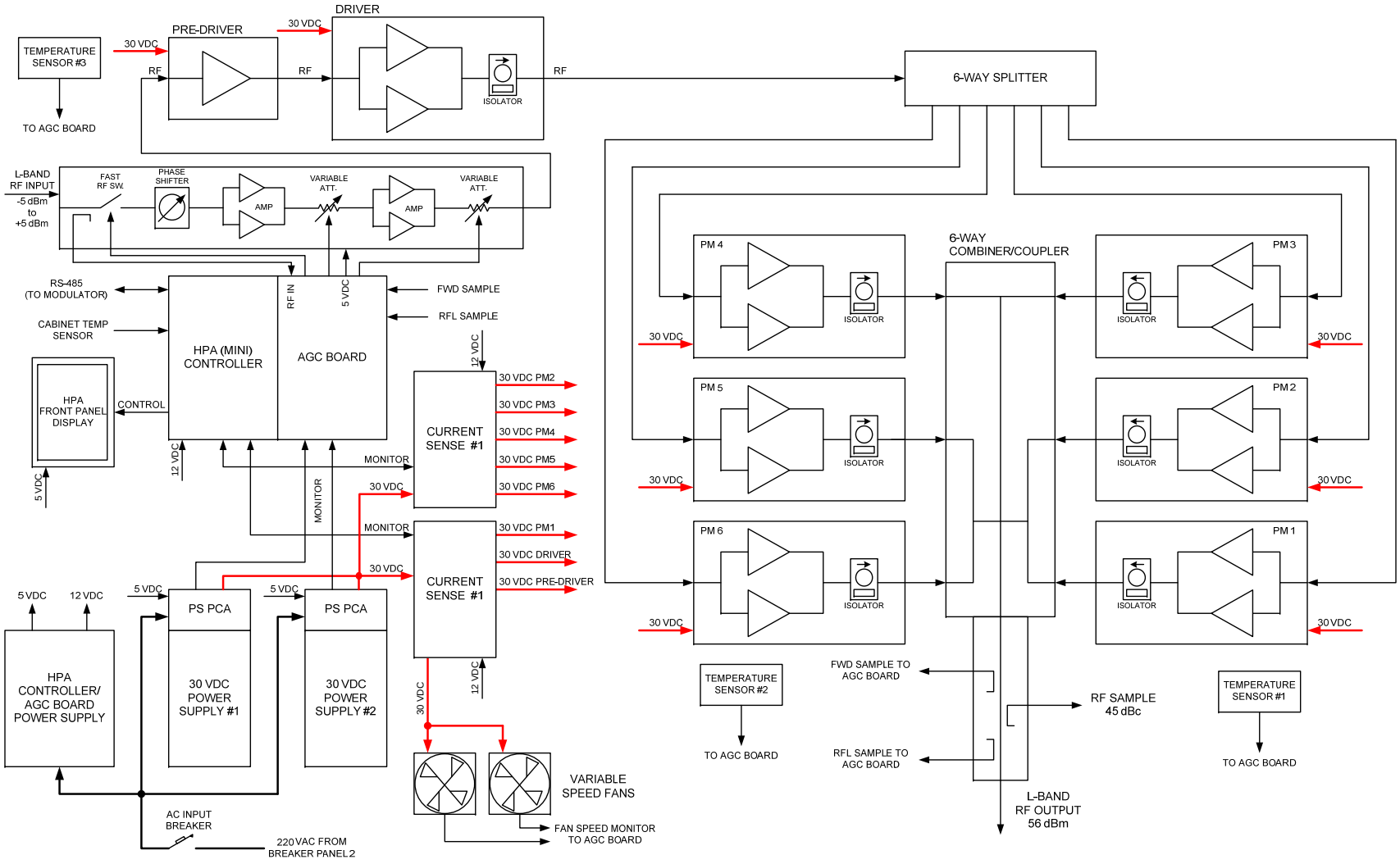


Figure 2-8 400W HPA Block Diagram

2.3.5.1 HPA Enhanced Features and Design Concepts

The HPA utilizes several innovative features designed to enhance its performance and reliability of the amplifier.

- Enhanced Heat Sink Design
- Thermally Enhanced Power Transistors
- Variable speed (temperature controlled) DC fans

The HPA employs a heat sink design that permits more equal heat distribution across the heat sink, thus reducing the maximum operating temperature. Distribution of the main heat source elements within the HPA is optimized in order to utilize the maximum thermal efficiency from the heat sink, also resulting in lower operating temperatures.

The HPA design incorporates the latest generation high power LDMOS transistors which employ a thermally enhanced package. The significant reduction in thermal resistance will allow these new generation power devices to operate with a lower junction temperature thus improving overall amplifier reliability.

The variable speed fans allow the fan speed to be increased or decreased as the HPA temperature increases or decreases. This improves overall efficiency of the HPA and the lifetime of the fans.

2.3.5.2 HPA Controller

The HPA embedded controller monitors all operating parameters and provides amplifier protection and control. It communicates with the main system controller via the RS485 interface and reports the following parameters and statuses:

- HPA input power level
- HPA forward power level
- HPA reflected power level
- HPA power supply DC voltage levels
- HPA pre-driver, driver and power module current consumption
- HPA temperature
- HPA fan speed
- HPA RF power inhibit
- HPA input overdrive alarm
- HPA output overdrive alarm
- HPA output reflected power (VSWR) alarm
- HPA failure alarm
- Over-temperature fault
- Pre-drive and driver device (current) fault
- Power module current misbalance fault (results is output power limitation)
- Power module device (current) fault
- Power Supply DC Fault
- Fan stalled alarm

The following HPA factory control commands are available via USB:

- RF Power enable/disable
- Attenuator control

The HPA is a constant gain block, which is individually calibrated in order to maintain the RF performance while operating in various conditions. The calibration is performed on the forward power sensor, reflected power sensor and input power sensor. A calibration table is stored in the internal EEPROM of the HPA controller.

The HPA controller reports alarms to the system controller and maintains an internal log of alarms. Each alarm entry in this log contains the alarm ID itself along with monitored parameters prior to an alarm. This alarm log is saved in an internal EEPROM.

2.4 Breaker Panels

The two (2) breaker panels are mounted on the left wall of the cabinet (when looking at the front of the cabinet) in the top-left corner of the wall.

Circuit breaker panel 1 receives the input AC power and distributes the required power to circuit breaker panel 2, as well as the air conditioner.

Circuit breaker panel 2 receives AC power (from circuit breaker panel 1) and distributes the required power two (2) receptacles as well as the HPA. One of the receptacle provides AC power to the UPS, internal lights and smoke detector; the other is a GFI.

2.5 Control Interfaces

The modulator serves as the primary system controller responsible for configuration and management of the entire transmitter and interfaces. The physical interface for system management is the modulator Ethernet port, which supports Web, SNMP v3 (secure SNMP), and Telnet.

The modulator hosts an internal web interface (Web-GUI) accessible through its Ethernet management port. The Web-GUI is an intuitive interface allowing the user to access the current transmitter status and configure the operational parameters of the system. The Web interface uses a simple hierarchical menu structure which provides access to all transmitter parameters. Below is a snapshot of the main status screen of the Web-GUI.

The transmitter SNMP interface provides the means for remote management of the transmitter and to accept alarm traps. The notification options can be configured on a per-alarm basis. The user may decide to mask certain alarms, increase/decrease integration time to declare an alarm, etc. Alarm and logs are available via the SNMP interface and are stored in Non Volatile Memory

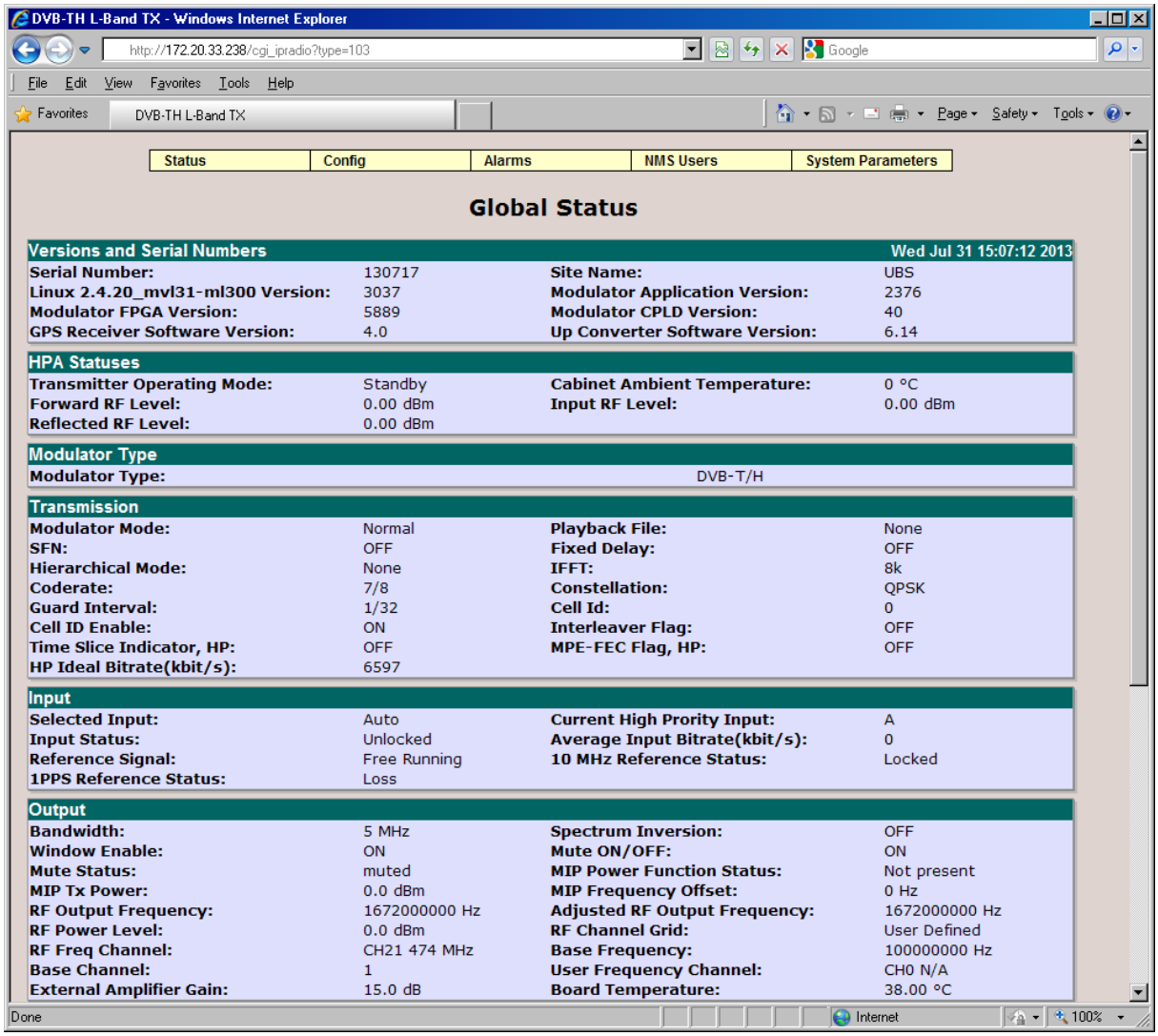


Figure 2-9 Web-GUI Main Status Page

2.6 Remote Upgrades

The main software components in the transmitter are remotely upgradeable via the modulator management interface.

3 Transmitter Technical Specifications

3.1 Modulation Standard

DVB-TH (ETSI EN 300 704 V1.6.1)	
Supported Modes IFFT	2k, 4k, 8k
Guard Intervals	1/4, 1/8, 1/16, 1/32
Code Rates	1/2, 2/3, 3/4, 5/6, 7/8
Constellations	QPSK, 16-QAM, 64-QAM
Hierarchical Mode	None, **α =** 1, 2, 4
Network Mode	SFN and MFN
Bandwidth	5MHz

3.2 Modulator Control Interfaces

Modulator Control Interfaces	
Front Panel	LCD display and cursor/execute keys
Ethernet	Connectors: 2x RJ45 Speed: 10/100/1000 Base-T
USB	Connector: USB Type B
RS232 Interface	Connector: 9-pin SUB-D (M)
RS485 Interface	Connector: 9-pin SUB-D (F) Must be connected to the HPA Serial interface
I/O Interface	Connector: 9-pin SUB-D (M) Pin 1 to Pin 4 Voltage: 0 to 10 VDC (analog input – pull down) Pin 5 to Pin 8 Voltage: 5 VDC (analog input – pull up) Must be connected to cabinet alarms
Web GUI	Internet Explorer 6.0+, Firefox, etc. Connector: Ethernet
SNMP Control Interface	Connector: Ethernet
CLI (Command Line Interface)	Connector: USB (HyperTerminal) or Ethernet (HyperTerminal or Telnet)
Alarm Relays	Connector: RS232 Two Dry Contact alarm relays, triggered by any major alarm.

3.3 Modulator Inputs

Modulator Inputs	
DVB-ASI	2 DVB-ASI inputs: BNC (F), 75 Ohm
Ethernet	2 RJ-45 Ports: Port A is active, Port B is disabled 1) GbE Transport Stream - Pro-MPEG CoP #3 / SMPTE 2022 2) Management port Protocol: WEB/Telnet/SNMP
GPS Antenna	F-type (F), 75 Ohm

3.4 Modulator Monitoring Outputs

Modulator Monitoring Outputs	
DVB-ASI	2 DVB-ASI outputs: BNC (F), 75 Ohm
RF Monitor	Connector: SMA (M), 50 Ohm Level: 30 dB below the RF output level
Clock Reference - 10 MHz	Connector: BNC (F) Frequency: 10 MHz Level: 10 dBm, ±2.5 dB Impedance: 50 Ohm or High Impedance (user selectable)
Time Reference - 1 PPS	Connector: BNC (F) Frequency: 1 PPS Level: TTL Trigger: Positive transition Impedance: 50 Ohm or High Impedance (user selectable)

3.5 Modulator RF

Modulator RF	
Connector	N-type (F), 50 Ohm
Frequency	1670 MHz to 1675 MHz
Power Level	-10 dBm to 0.0 dBm in 0.1 dB steps
Spectrum Polarity	Inverted or non-inverted, selectable
Level Stability	± 0.3 dB
Shoulder Level	< -55 dBc
Spurious Level Outside Channel	< -60 dBm at 0 dBm output power level
MER	≥ 43 dB
Amplitude Flatness Center frequency ±2.3 MHz	±0.5 dB
Group delay response: Center frequency ±2.3 MHz	300 ns, ±100ns
Phase Noise SSB (measured @ 474 MHz)	100 Hz: < -80 dBc/Hz 1 kHz: < -95 dBc/Hz 10 kHz: < -100 dBc/Hz 100 kHz: < -115 dBc/Hz 1 MHz: < -120 dBc/Hz
Return Loss	≥ 20 dB

3.6 HPA Control Interfaces

HPA Control Interfaces	
Front Panel	LCD display
USB Interface	Connector: USB Type B HPA Monitor PC GUI
Serial Interface	Connector: 9-pin SUB-D (M) Must be connected to the modulator RS485 interface
I/O Interface	Connector: 9-pin SUB-D (F) Must be connected to the cabinet temperature sensor

3.7 HPA RF Input

HPA RF Input	
Connector	SMA (F), 50 Ohm
Frequency	1670 to 1675 MHz
Power Level	-5.0 dBm to 0.0 dBm
Return Loss	≤ 1.9:1

3.8 HPA/Transmitter RF Output

HPA/Transmitter RF Output	
Connector	7/16 DIN (F), 50 Ohm
Frequency	1670 to 1675 MHz
Digital Average Output Power (before customer installed filter)	400 Watts (56 dBm)
Power Level Accuracy	± 0.5 dB
Gain	61 dB (max.)
Gain Variation over Temperature	≤ ± 1 dB
Gain Variation over 5 MHz Bandwidth	≤ 0.5 dB
In-band IMD	≤ -27 dBc
Spectral Regrowth (at rated output power)	≤ -30 dBc
Frequency Stability	Internal GPS is used for synchronization
VSWR	≤ 1.2:1
RF Sample	Connector: N-type (F), 50 Ohm Coupling Factor: 45.0 dB, ± 1 dB

3.9 Modulator Digital Pre-Correction

Pre-Correction (non-adaptive)	
Linear Pre-Correction	
Correction Points	61
Point Spacing	1/60 of nominal spectrum BW
Amplitude Correction	±10 dB
Amplitude Resolution	0.01 dB
Group Delay Correction	±2000 ns
Group Delay Resolution	1 ns
Non-Linear Pre-Correction	
Curve Formats	S 21 and VO/VI
Amplitude Scale	Linear and Logarithmic
Correction Points	Max. 256, user-defined position
Gain Correction	Max. 12 dB, subject to available headroom
Phase Correction	-6 to +30 degrees, subject to available headroom
Peak Power Clip Level	+17 dB to +7 dB (peak power relative to average RMS level)

3.10 GPS

GPS	
Recommended Antenna	Bullet III GPS antenna -Trimble model no. 57860-10 or equivalent
Receiver Architecture	L1 1575.42 MHz
12 Parallel Channels	C/A code (1.023 MHz chip rate) Code plus carrier tracking (carrier aided tracking)
Tracking Capability	12 simultaneous satellite vehicles
Acquisition Time (Time To First Fix, TTFF)	< 15 seconds typical TTFF-hot (with current almanac, position, time and ephemeris) < 150 seconds typical TTFF-cold (no stored information)
Positioning Accuracy	< 5 m, 1 – sigma < 10 m, 2 - sigma
Timing Accuracy	< 2 ns, 1 – sigma < 6 ns, 6 - sigma
Holdover Time	±1 µsec during 2 hours
10 MHz Output Signal	Internally connected to the modulator input Level: 10 dBm ±2.5 dBm, sine wave Harmonic Level: -40 dBc max.
Phase Noise	1 Hz: < -75 dBc/Hz 10 Hz: < -110 dBc/Hz 100 Hz: < -125 dBc/Hz 1 kHz: < -135 dBc/Hz 10 kHz: < -155 dBc/Hz 100 kHz: < -155 dBc/Hz
1PPS Output Signal	Internally connected to the modulator input Level: TTL

3.11 Power Supply

3.11.1 Modulator

Modulator Power Supply	
Voltage	100 - 240 VAC
Frequency	50-60 Hz
Power Consumption max	50 W max.

3.11.2 HPA

HPA Power Supply	
Voltage	195-240 VAC (220 VAC ±10%)
Frequency	50-60 Hz
Power Consumption max	2.5 kW

3.12 Environmental

Environmental	
Operating Temperature	+41° F to +113° F (+5° C to +45° C)
Storage Temperature	-40° F to +149° F (-40° C to +65° C)
Relative Humidity	max. 95%, non condensing
Cooling	Forced air

3.13 Mechanical

3.13.1 Modulator

Modulator Mechanical	
Dimensions (W x H x D)	19” x 1.73” x 20.5” (48.3 cm x 4.4 cm x 52.1 cm)
Weight (unpacked)	15 lbs. (6.8 kg)

3.13.2 HPA

HPA Mechanical	
Dimensions (W x H x D)	19” x 8.72” x 30.8” (48.3 cm x 22.2 cm x 78.2 cm)
Weight (unpacked)	77 lbs. (35 kg)

4 Installation

4.1 Unpacking and Inspection

Each transmitter is completely assembled, tested and shipped in the appropriate packaging.

Carefully unpack the transmitter and examine all shipping containers and contents for physical damage that might have occurred during shipment. If damage occurred during shipment please notify your freight carrier immediately.

Missing or damaged equipment not caused by the freight carrier should be directed to UBS-Axcera Customer Support, in order to facilitate the replacement or repair of the equipment.

Be sure to check the package contents carefully for important documents and materials.

Note 	*Retain all shipping containers for storage or re-shipment purposes. All materials returned under warranty must be packed in their original shipping containers.*

4.2 Installation Safety

The installation of the transmitter will require professional and properly trained personnel to ensure it is installed in observance of the appropriate electrical and safety codes.

4.3 Installation Overview

The transmitter can be installed by following the basic sequence below:

- Transmitter set-up
  - Check the installation surface structure, flatness and suitability
  - Position the cabinet according to site drawings
- Transmitter AC power
  - Connect the transmitter ground
  - Connect the Mains AC
- Modulator connections
  - Connect the GPS antenna to the modulator GPS input
  - Connect the WAN/LAN to the modulator Ethernet port (A or B)
- RF output
  - Connect the bandpass filter (customer furnished) to the HPA RF output
  - Connect the transmission (or transmission line jumper) to the bandpass filter output

NOTE: Detailed transmitter installation information can be found in the subsequent sections of this manual.

4.4 Cabinet Installation

4.4.1 Installation Surface

Before installing the cabinet, check the installation surface structure, flatness and suitability.

4.4.2 Cabinet Positioning

NOTE: Please refer to site drawings for cabinet positioning.

- The cabinet should be positioned within the room to allow for adequate ventilation.
- Sufficient space must be made available in front of the cabinet so that the front door can be opened and closed, allowing the user to access the playout server, modulator, HPA and UPS front panels.
- Sufficient space must be made available to the rear of the cabinets so that the rear door can opened and closed, allowing the user to access the playout server, modulator, HPA and UPS rear panels, as well as the air conditioner control panel.
- Sufficient space must be made available to the left of the cabinet (when facing the front of the cabinet) so that the breaker panels can be accessed.
- Sufficient space must be made available to the right of the cabinet (when facing the front of the cabinet) so that the cable glands can be accessed.

For safety reasons, a minimum of four people is required for any lifting and/or positioning of the transmitter. The transmitter is mounted on a pallet for easy movement using a pallet pump truck.

4.5 Mains AC Power

NOTE: Please refer to site drawings for the interconnection of the cabinet to the building Mains AC distribution panel.

4.5.1 General

A certified Electrician should install the Mains AC power cables to meet all regional and national electrical codes, and according to the transmitter electrical drawing(s).

NOTE: Please refer to the cabinet vendor's drawings for Mains AC and Frequency specifications.

WARNING

VERIFY THAT THE MAINS AC VOLTAGE IS WITHIN THE SPECIFIED RANGE AND CHECK ALL POWER CABLES FOR DAMAGE

4.5.2 Electrical Safety

- All transmitter equipment, electrical power switches and circuit breakers must be turned off during installation.
- Ensure that the Mains AC power cable connecting the main circuit breaker to the service panel is the last cable connected during installation.
- Ensure that the transmitter main circuit breaker and all PDU circuit breakers are turned off prior to working on internal transmitter parts or connecting cables.

4.5.3 Cabinet Wiring

All cabinet components are pre-wired to the cabinet breaker panels and cabinet receptacles. In this case, only the cabinet main circuit breaker needs to be connected to an external AC power source.

4.5.3.1 Cabinet Grounding

WARNING
THE CABINET MUST BE CONNECTED TO THE BUILDING/SITE MAIN GROUND TERMINAL

NOTE: Please refer to the cabinet vendor's drawings for the grounding location on the cabinet.

4.5.3.2 Mains AC Power Cable

DANGER
BEFORE YOU CONNECT THE MAINS AC POWER CABLE TO THE CABINET, DISCONNECT IT FROM THE BUILDING DISTRIBUTION PANEL

NOTE: Please refer to the cabinet vendor's drawings for the Main AC connection point on the cabinet.

4.6 Breaker Panels

4.6.1 Breaker Panel 1

Breaker panel 1 houses three circuit breakers.

Figure 4-1 Breaker Panel 1 (with front cover raised)

Breaker #	Name	Description	Breaker Use
1/2	MAIN	100A, 220 VAC	Mains AC input
3/4	POWEROUT	60A, 220 VAC	AC output to breaker panel 2
5/6	220 AC	20A, 220 VAC	Air conditioner

Table 4-1 Breaker Panel 1 Circuit Breakers

4.6.2 Breaker Panel 2

Breaker panel 2 houses three circuit breakers.

Figure 4-2 Breaker Panel 2 (with front cover raised)

Breaker #	Name	Description	Breaker Use
1	GFI	20A, 110 VAC	GFI receptacle
2	110 RECEPT	20A, 110 VAC	Receptacle which feeds UPS, cabinet lights and cabinet smoke alarm
3/4	POWERSHELF	30A, 220 VAC	HPA

Table 4-2 Breaker Panel 1 Circuit Breakers

4.7 Cabinet Sub-Assemblies

4.7.1 Modulator Installation

The user is required to connect the following cables to the modulator rear panel:

- GPS antenna RF cable to the GPS input
- WAN/LAN Ethernet cable to Ethernet port A or B

Figure 4-3 Modulator Rear Panel

NOTE: Please refer to sections 3.2, 3.3, 3.4 and 3.5 for a detailed description of the modulator rear panel interfaces.

4.7.1.1 RS232 Serial Port

The RS232 serial port is configured to provide two Alarm Relays.

The alarm relay contacts are normally open and close on alarm; when the modulator is turned off the contacts are normally closed. Each relay is software controlled and can be set to trigger on a specific alarm.

Pin No	Function
1	Relay 1 contact
2	RxD
3	TxD
4	Relay 2 contact
5	GND
6	Relay 1 contact
7	RTS
8	CTS
9	Relay 2 contact

Table 4-3 RS232 Serial Port Pin-out

4.7.1.2 I/O Serial Port

Four (4) analog pull down inputs and four (4) analog pull up inputs are available on the I/O serial port. The analog inputs are monitored by the system controller permitting the user to set the polarity and voltage threshold that trigger an alarm. See Section 6.5.2 for external voltage threshold settings and Section 6.5.1 for alarm and trap notification settings.

Pin 1 though pin 4 can be set to report an alarm when the input voltage is greater than (>) or less than (<) a user defined value. Typically, these pins would be used to monitor an active device, such as a UPS, that would provide logical voltage levels used to indicate alarm / no alarm conditions.

Pin 5 through pin 8 can be set to report an alarm when the voltage is greater than (>) or less than (<) a user defined value. These pins are factory configured to provide 5 VDC and are typically used to monitor a passive device, such as a magnetic door sensor.

NOTE: For this application, Pin 6 has been connected to the cabinet door switch contacts, Pin 7 has been connected to the cabinet smoke detector and the Web interface has been configured accordingly.

Pin No	Function	Pin Voltage
1	Analog Input (pull down)	0 to 10 VDC
2	Analog Input (pull down)	0 to 10 VDC
3	Analog Input (pull down)	0 to 10 VDC
4	Analog Input (pull down)	0 to 10 VDC
5	Analog Input (pull up)	5 VDC
6	Analog Input (pull up)	5 VDC
7	Analog Input (pull up)	5 VDC
8	Analog Input (pull up)	5 VDC
9	Ground	-

Table 4-4 I/O Serial Port Pin-out

4.7.1.3 RS485 Serial Port

The RS485 serial port is used for communication (Machine to Machine) with the HPA.

Pin No	Function
1	Relay 1 contact
2	Ground
3	External Reset
4	Rx-
5	Tx+
6	Relay 1 contact
7	Ground
8	Rx+
9	Tx-

Table 4-5 RS485 Serial Port Pin-out

4.7.2 HPA Installation

The user is required to connect the following cable to the HPA rear panel:

- RF cable between the HPA RF Output and the bandpass filter input

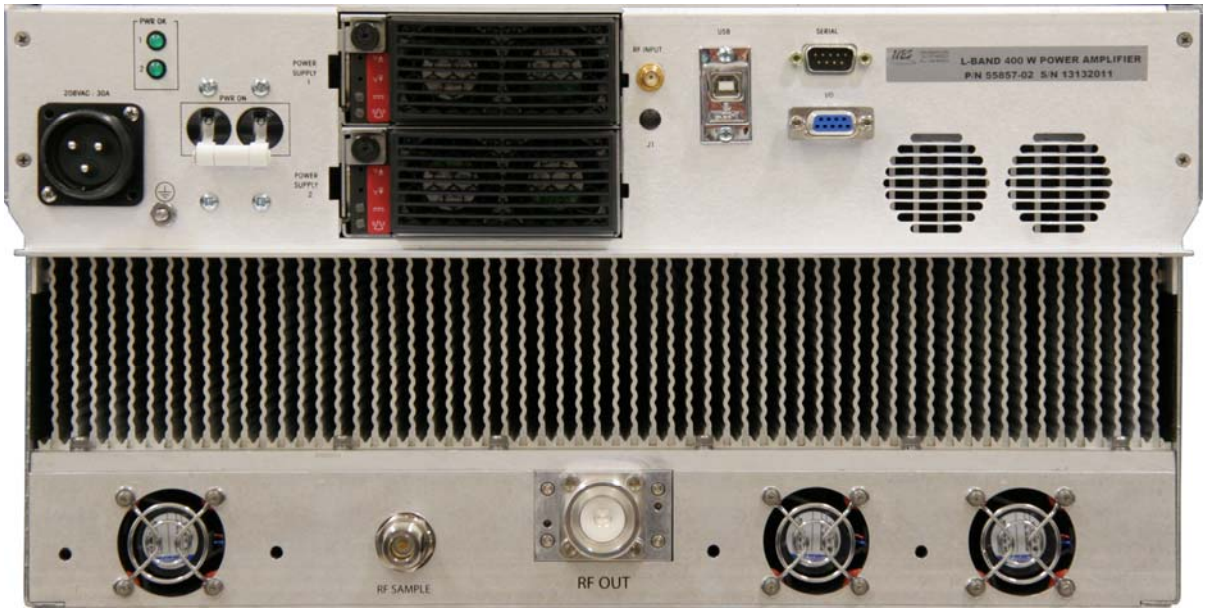


Figure 4-4 HPA Rear Panel

NOTE: Please refer to sections 3.6, 3.7 and 3.8 for a detailed description of the HPA rear panel interfaces.

4.7.2.1 Serial Port

The Serial (RS485) port is used for communication (Machine to Machine) with the modulator.

Pin No	Function
1	N/C
2	N/C
3	N/C
4	Tx-
5	Rx+
6	N/C
7	N/C
8	Tx+
9	Rx-

Table 4-6 RS485 Serial Port Pin-out

5 Commissioning and Operation

5.1 Introduction

This section outlines the installation inspection, initial on-site turn on procedure and addresses the process for monitoring and control of the CL1TC-4 Transmitter. It also provides a description of control interfaces and indicators for the transmitter.

5.2 Installation Verification

Before the transmitter can be turned on, the installation must be completed. Please check the following to ensure all interconnections have been made correctly:

- Verify that no equipment was damaged during the installation.
- Verify that the ground conductor and Mains AC power cables have been connected to the transmitter cabinet.
- Verify that all cabinet sub-assemblies have been installed correctly and that the following connections have been made:
  - Factory installed cables are connected to the modulator.
  - Factory installed cables are connected to the high power amplifier.
  - GPS antenna is connected to the modulator GPS input.
  - Transport stream is connected to the modulator ASI or GbE inputs.
  - Ethernet (WAN or LAN) cable is connected to the modulator Ethernet connector.
- Verify that the high power amplifier RF output is connected to the customer installed band pass filter and that all connections are tight.
- Verify that the RF transmission line and broadcast antenna have been swept.
- Verify that the band pass filter is connected to the broadcast antenna (or terminated into a high power load) and that all connections are tight.

5.3 Initial On-Site Turn-on Procedure

Once the CL1TC-4 transmitter is installed and all input, output and AC connections are made, the system is ready for the initial on-site turn on. Ensure that the output of the transmitter is connected to a transmission line feeding a broadcast antenna before proceeding with the turn on.

5.3.1 Transmitter AC Power-up Procedure

1. Switch on the Mains AC circuit breaker located in the building service panel.
2. Switch on the Mains AC circuit breaker located in cabinet breaker panel 1.
3. Switch on the air conditioner circuit breaker located in cabinet breaker panel 1.
4. Switch on the cabinet breaker panel 2 circuit breaker located in cabinet breaker panel 1.
5. Switch on the 110 VAC receptacle circuit breaker located in cabinet breaker panel 2.

6. Turn on the UPS by pressing the power button on the UPS front panel.
7. Turn on the playout server by pressing the power button on the playout server front panel.
8. Turn on the modulator AC power switch located on the modulator rear panel. All three front panel LED's will flash while the modulator goes through its boot-up process.
9. Turn on the HPA circuit breaker located in cabinet breaker panel 2.
10. Turn on the HPA AC power switch located on the HPA rear panel. The front panel LCD and rear panel PWR OK LED's will turn on.

5.3.2 Configuring the Transmitter

The transmitter has been factory configured with the customer specified television standard, channel bandwidth and centre frequency.

The user will be required to:

- Configure the modulator network parameters for remote network access.
- Configure the modulator transport stream input parameters.
- Configure the transmission (modulation) parameters and network mode (MFN or SFN)

5.3.2.1 Configuring the Network Parameters

The modulator must be configured correctly, before it can be placed on a network and operated remotely through either of the rear panel Ethernet connectors.

To configure modulator for remote operation, the user must:

1. Connect a PC to either of the modulator rear panel Ethernet connectors.
2. Open a Web browser.
3. Enter the default IP address of the modulator in the Web browser address bar.
4. When the login page appears, enter "admin" in the password field. **Note:** The username field must be left blank.
5. Once logged in, navigate to System Parameters -> Network Parameters and re-configure the modulator's network parameters as desired – see Figure 5-1. **Note:** The Management port refers to Ethernet connector A, while the Second Etherport refers to Ethernet connector B.
6. Once the Network Parameters have been re-configured, navigate to System Parameters -> System Reset and reset the modulator – see Figure 5-2. **Note:** The modulator must be reset for Network Parameter changes to take effect.
7. Once the modulator completes it reboot process, connect your network device to the modulator's rear panel Ethernet connector.

Note: The default IP address for the modulator is 172.20.33.69

Note: The default password for the Web GUI is "admin"

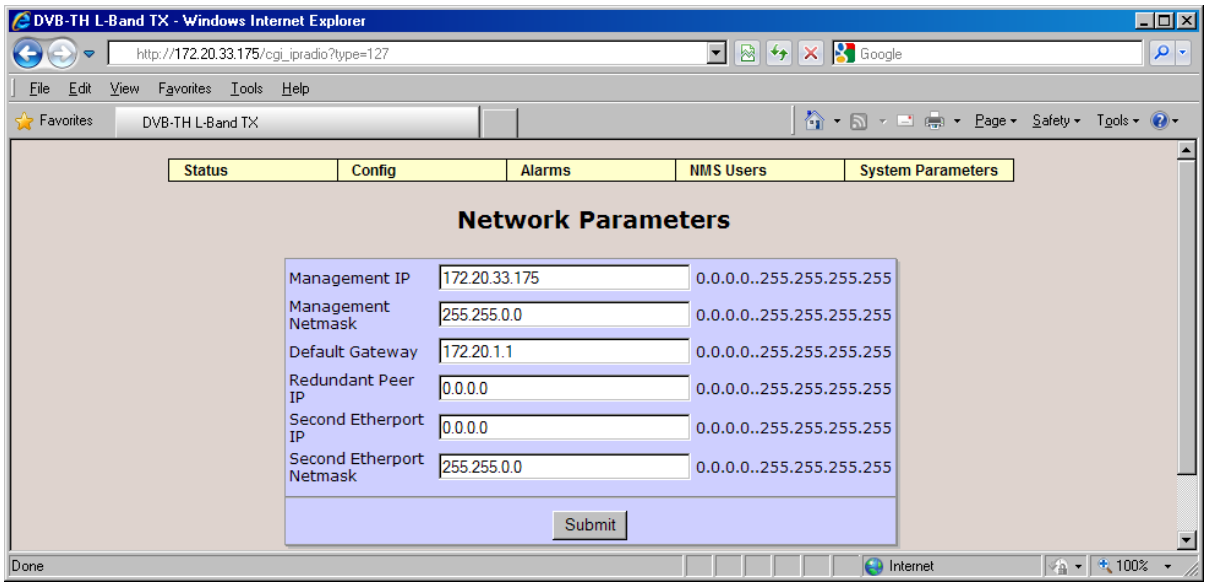


Figure 5-1 Network Parameters

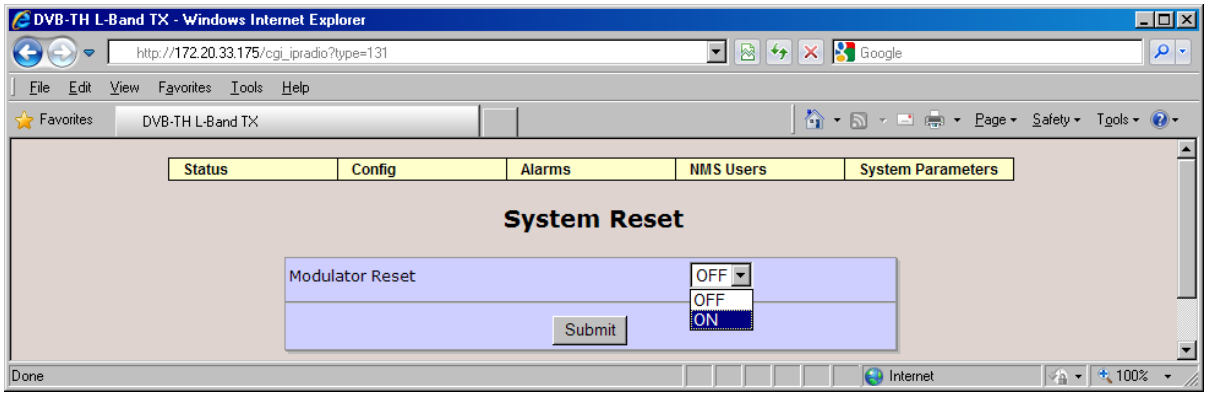


Figure 5-2 System Reset

Alternatively, the modulator front panel LCD and cursor/EXECUTE keys can be used to configure the modulator's network parameters.

1. Navigate to the Status Display window "f" and press the "Execute" button. This will take the user to a System Parameters sub-menu where the network parameters can be re-configured as desired.
2. Once the Network Parameters have been re-configured, navigate to System Parameters -> System Reset and reset the modulator.
3. Once the modulator completes it reboot process, connect your network device to the modulator's rear panel Ethernet connector.

5.3.2.2 Configuring the Input Parameters

The modulator must be configured correctly, before it can lock to the input transport stream.

1. Navigate to Config -> Input to configure the DVB-ASI or GbE (IP) input settings – see Figure 5-3.
2. When a transport stream is connected to ASI input, Selected Input can be configured for automatic selection, or the user can select the DVB-ASI input connector manually. No other input parameters need to be configured.
3. When a GbE transport stream is connected to either of the Ethernet connectors, IP Input Interface, Input Stream Dst IP and Input Stream Dst Port must be configured correctly.

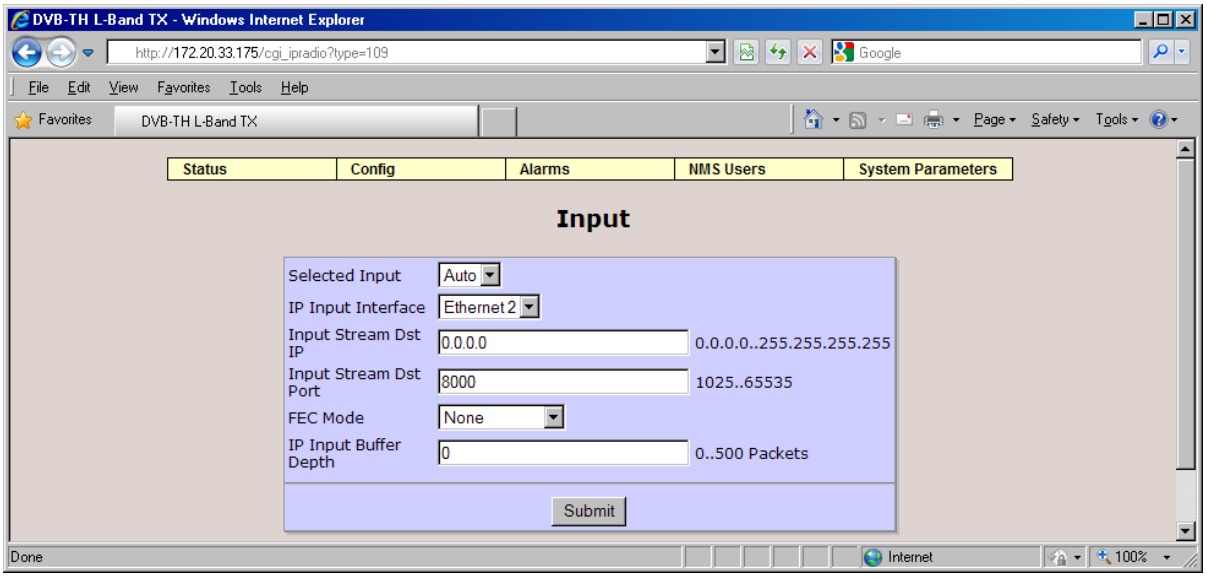


Figure 5-3 Input Configuration

5.3.2.3 Configuring the Modulation Parameters

1. Navigate to Config -> Modulator Mode to ensure Normal operation is selected – see Figure 5-4. Normal mode must be selected for OFDM carrier generation.
2. Navigate to Config -> Transmission to configure the network mode (MFN or SFN) and/or configure the DVB-H modulation parameters – see Figure 5-5.

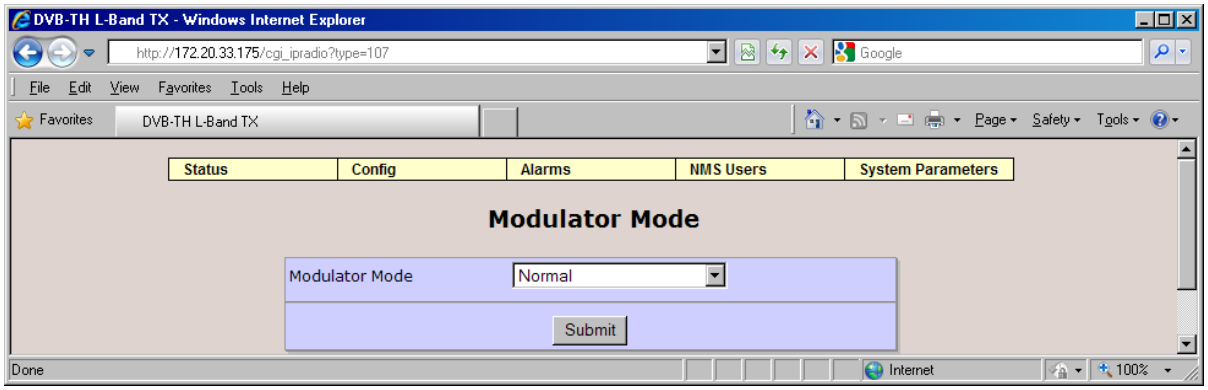


Figure 5-4 Modulator Mode

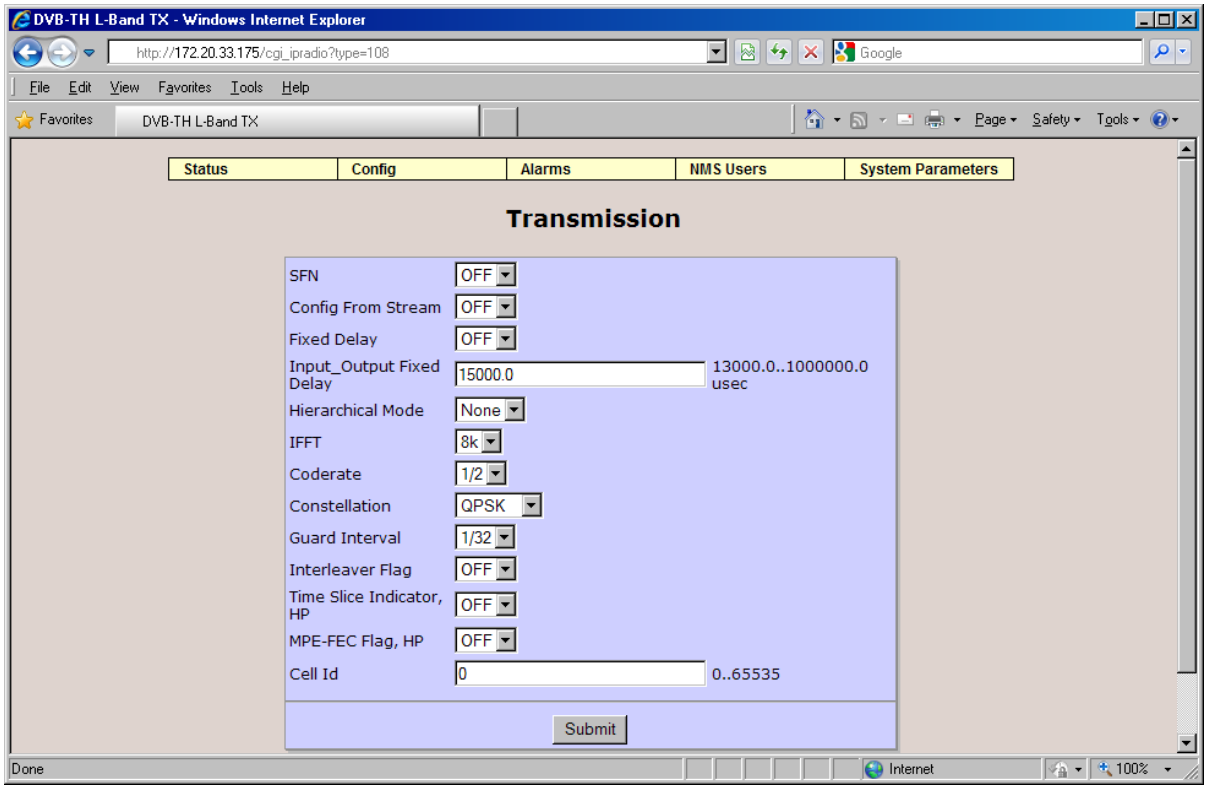


Figure 5-5 Transmission (Modulation) Parameters

5.3.3 Turning On the RF Output

1. Check the Alarm Status screen for active alarms. The only alarm present should be GPS Quality Low. The GPS Quality Low alarm will take up to 5 minutes to clear as satellites are acquired.
2. During the initial on-site turn on, it is recommended to set the transmitter output level to 46 dBm (minimum value) before the transmitter is placed in Broadcast mode. This will ensure that the effects of a transmission line or antenna fault are minimized when the RF is turned on. Navigate to Config –> HPA Control and set the output power level to 46 dBm – see Figure 5-6.
3. For SFN operation, check the Alarm Status screen to ensure that the GPS Quality Low alarm has cleared. Once the alarm has cleared, the transmitter can be placed in Broadcast mode. **Note:** For MFN operation, the GPS is not required to be locked.
4. From the HPA Control page, set the Transmitter Operating Mode to Broadcast.
5. The modulator front panel Status Display window "i", HPA front panel LCD, or Web GUI Global Status page can be used to monitor the transmitter forward and reflected power levels. Alternatively, a power meter can be connected to the HPA sample port to monitor the forward power level.
6. If the forward and reflected power levels are acceptable, increase the RF Output Power Level by 3 db and continue to monitor the forward and reflected power levels.
7. Continue to increase the RF Output Power Level by 3 dB, until the desired output level is reached (max of 56 dBm).

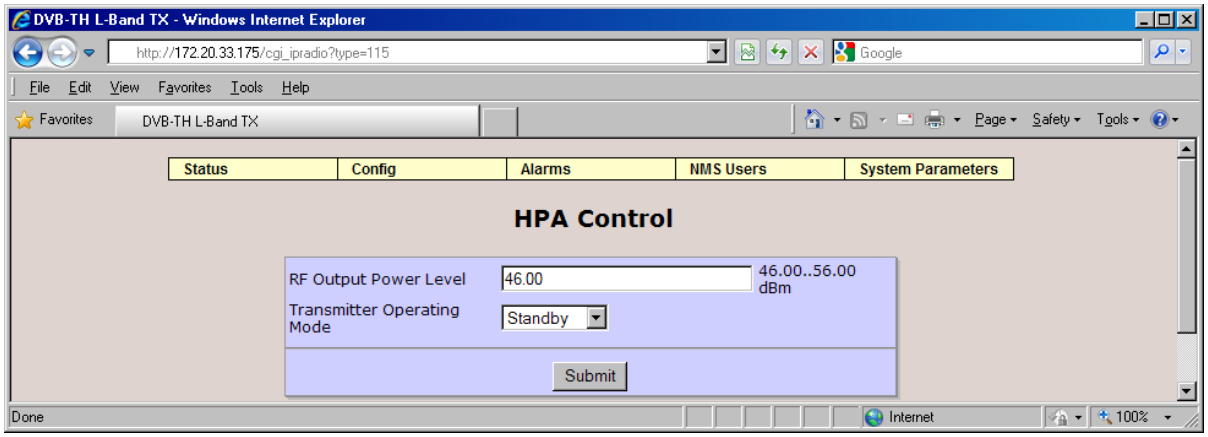


Figure 5-6 HPA Control

5.3.4 Turning Off the RF Output

Before turning off the AC power switch, the user should set the Transmitter Operating Mode to Standby. This will ensure that the next time the transmitter is powered on, it will be powered on in Standby mode.

5.4 Control and Communication

The Transmitter can be controlled and monitored locally (on-site), or remotely from a Network Management System (NMS).

5.4.1 Control and Communication Interfaces

There are two interfaces port provided for control and communication:

- Ethernet Port A or B (RJ-45) – used for local control with a laptop PC and remote access through a LAN. Web GUI, SNMP and CLI (Telnet and HyperTerminal) protocols are supported.
- USB Port (Type B) – used for local control, initial setup, status information and troubleshooting with a laptop PC. A Command Line Interface (CLI) telnet session is the supported protocol.

For a detailed description of the Web-GUI interface refer to Section 6.

For a detailed description of the CLI interface refer to Section 7.

5.4.2 Local Access

The transmitter can be controlled and monitored locally (on site) through Ethernet Port A or B and/or the USB port with a PC. The modulator front panel LCD and cursor/execute keys can also be used for local access.

The Ethernet ports provide access to the Web GUI and CLI (through Telnet). The USB interface provides access to the CLI, which allows the operator to perform initial setup/troubleshooting when network connectivity is not available or desired.

5.4.3 Remote Access

The Network Management System (NMS) operator can control and monitor the transmitter remotely through Ethernet Port A or B and LAN using the Web GUI and/or SNMP interfaces.

5.5 Modes of Operation

There are two main parameter groups which determine the operating mode, the Transmitter Operating Mode parameter group and the Modulator Operating Mode parameter group.

5.5.1 Transmitter Operating Modes

The chief transmitter operating modes are Broadcast and Standby.

If the transmitter experiences an AC power interruption under normal, no fault conditions, the transmitter's AC power-up algorithm will restore the mode of operation that was active prior to the AC power interruption, once power is restored.

5.5.1.1 Broadcast Mode

The transmitter normally operates in broadcast mode, allowing it to transmit a broadcast signal and run all protection loops and ALC. It receives a transport stream signal, or generates an internal test signal and transmits an OFDM signal for terrestrial broadcast. In this mode, all transmitter functions are automatically maintained by the modulator controller.

To operate in broadcast mode, the following conditions must be met:

- The transmitter must be receiving an input signal and be locked to the input stream (if the modulator is in test mode, the input signal presence is ignored).
- The ALC loop must be running.
- For Single Frequency Network (SFN) operation, the system must have a GPS signal lock with no alarms (if the modulator is in test mode, the GPS signal presence is ignored).
- There must be no modulator alarms.
- There must be no HPA alarms.

5.5.1.2 Standby Mode

In this mode the transmitter output is muted by turning the HPA RF switch off and muting the modulator output.

The operating conditions in Standby Mode are:

- AC power is supplied to the modulator and HPA
- The HPA RF switch is off
- The modulator output is muted

5.5.2 Modulator Operating Modes

The five modulator modes are: Normal, CW, Test 1 (Carriers Removed), Record and Playback.

In Normal mode, the modulator generates a complete DVB-H waveform. CW and Test 1 are special test modes not used in regular operation. The CW mode generates a narrow-band frequency tone and the Test 1 mode suppresses a set of OFDM carriers in the center of the band (useful for checking for interference, factory configurable). Record and Playback are described in Section 6.4.1.

5.6 Indicators and Controls

The transmitter main subassemblies have individual indicators and controls used in normal operation. This includes:

- DVB-H Modulator
- HPA

5.6.1 Modulator

5.6.1.1 Front Panel

The two line by forty characters LCD display, in conjunction with four cursor keys and an EXECUTE button allow easy operation of the modulator. Three LED are provided as status indicators. For a detailed description of front panel operation, please refer to Section 8.

Figure 5-7 Modulator Front Panel

LED	Description
POWER (Green)	This Green LED indicates that the modulator AC power supply has been turned on.
ALARM (Red)	This Red LED indicates that there is an active transmitter alarm.
UNLOCKED (Red)	This Red LED indicates that the modulator has failed to synchronize to the incoming transport stream or if the incoming transport stream is absent.
NOTE: All LEDs flash green during the boot-up process.	

Table 5-1 Modulator Front Panel Status LEDs

Pushbutton	Function
EXECUTE	Used to enter the configuration menu system (GENERIC or SPECIFIC) from a status display window, to enter a sub-menu and confirm changes made to configurable parameters.
▲ (up)	Used to scroll through the different status display windows, exit the current menu and enter a higher-level menu, increase alpha-numerical parameters or abort confirmation of a change.
▼ (down)	Used to scroll through the different status display windows, exit the current menu and enter a sub-menu, decrease alpha-numerical parameters or abort confirmation of a change.
◄ (left) ► (right)	Used to scroll horizontally through the Config menus, the parameter listings and the parameter characters, in the case of editable parameters. They are also used to increase and decrease % parameters.

Table 5-2 Modulator Front Panel Pushbutton Functions

5.6.2 HPA

5.6.2.1 Front Panel

The HPA front panel LCD indicates the status of the HPA Forward Power, Reflected Power, Temperature and Current as well as several other parameters.

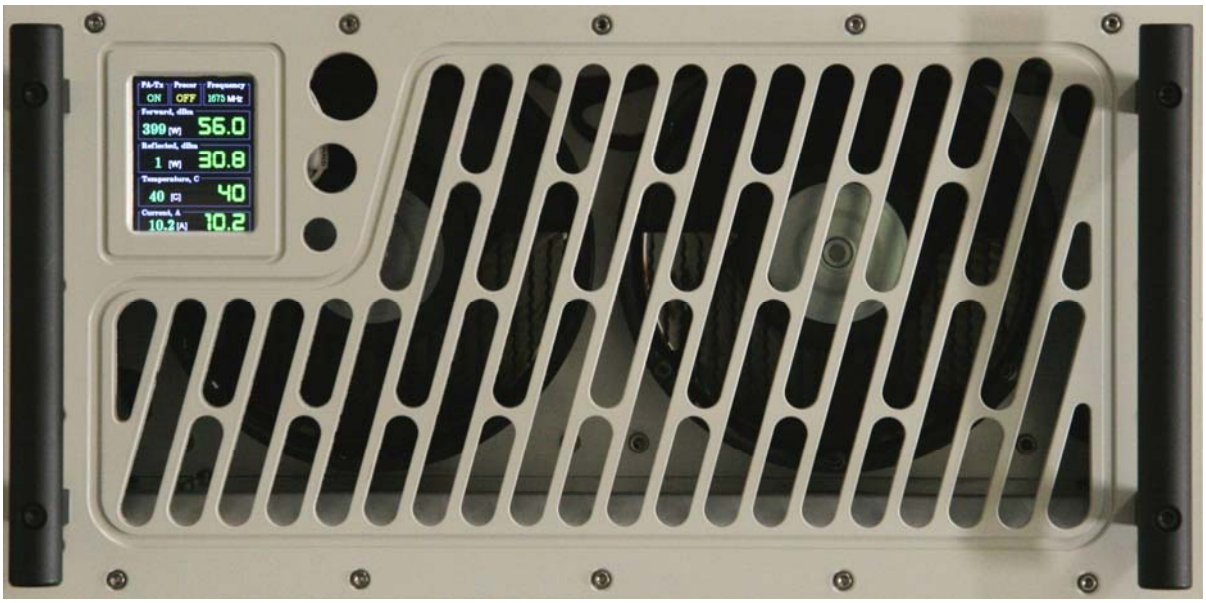


Figure 5-8 HPA Front Panel

Figure 5-9 HPA Front Panel LCD (Standby Mode)

Figure 5-10 HPA Front Panel LCD (Broadcast Mode)

Parameter	Description
Forward, dBm (W)	Displays the HPA forward (output) power measured by the internal HPA combiner/coupler RF detector.
Reflected, dBm (W)	Displays the HPA reflected power measured by the internal HPA combiner/coupler RF detector.
Temperature, C	Displays the highest temperature measured by one of the HPA temperature sensors.
Current, A	Displays the highest current measured on one of the power modules.
PA-Tx	Indicates the HPA transmission status (ON or OFF)
Precor	Not used for this application (always OFF).
Frequency	Indicates the transmitter frequency, which is set by the modulator.

Table 5-3 HPA Front Panel LCD Status

5.6.2.2 Rear Panel

The HPA rear panel includes two AC status LED's.

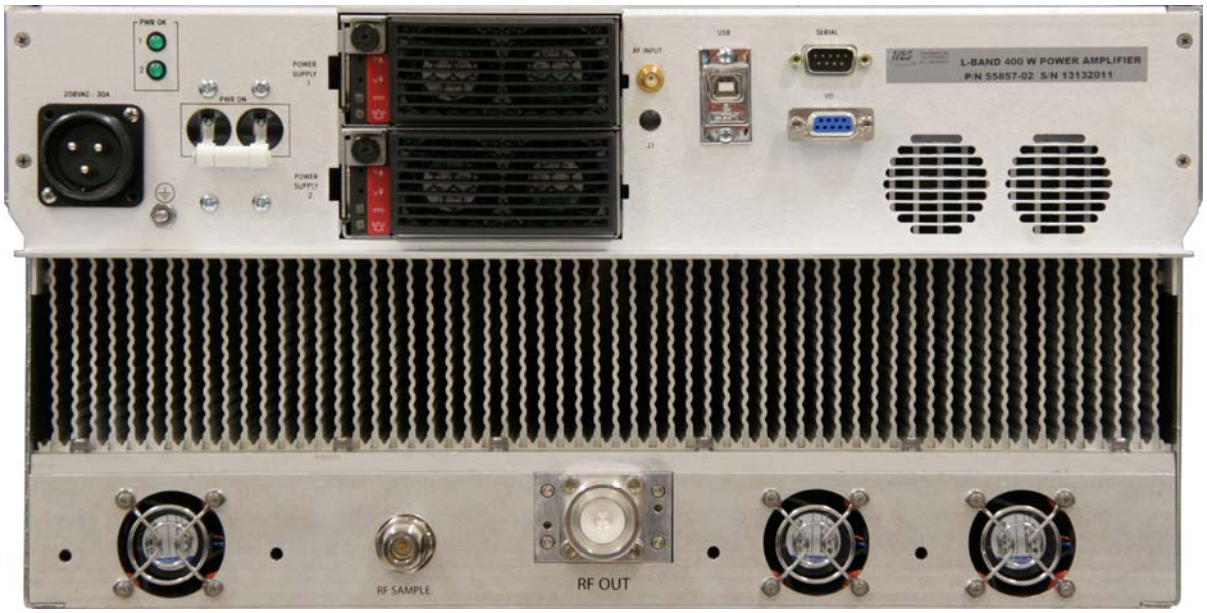


Figure 5-11 HPA Rear Panel

LED	Color	Description
PWR OK 1	OFF	Power supply 1 AC input is not present.
	Green	Power supply 1 AC/DC input is present.
PWR OK 2	OFF	Power supply 2 AC input is not present.
	Green	Power supply 2 AC/DC input is present.

Table 5-4 HPA Rear Panel LEDs

6 Web GUI Interface

6.1 Introduction

The transmitter parameters can be reviewed or changed using the Web GUI Interface. The Web GUI interface is an intuitive interface allowing the user to access the current transmitter status and set up the operational parameters of the transmitter. The Web GUI interface uses a simple hierarchical menu structure which provides access to the transmitter parameters.

The modulator needs to be assigned an IP address in order to access the Web GUI. The transmitter is shipped from the factory with a default IP address of 172.20.33.69, but the user will need to modify the IP address of each unit according to the local network. The IP address can be accessed and modified from the console interface (CLI) or front panel interface.

6.2 Access and Navigation

6.2.1 Login

Connect either locally or remotely via the modulator Ethernet port:

- Open a web browser window (e.g., Internet Explorer, Firefox, etc.) and enter the modulator IP address. For example: http://172.20.33.69/
- The first menu page is the login page.
- The User Name field must be kept blank, while the default password for normal access is "admin".

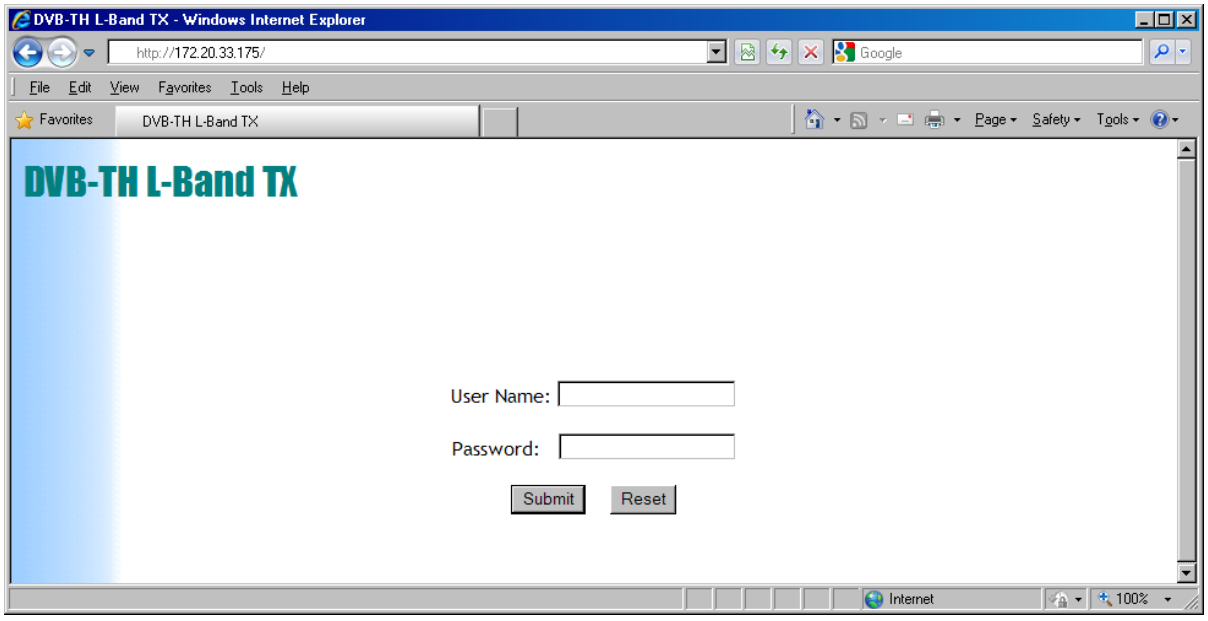


Figure 6-1 Login Screen

Once the user successfully logs in, the Global status page is displayed. This page provides global status information for the transmitter system.

6.2.2 Global Status Page

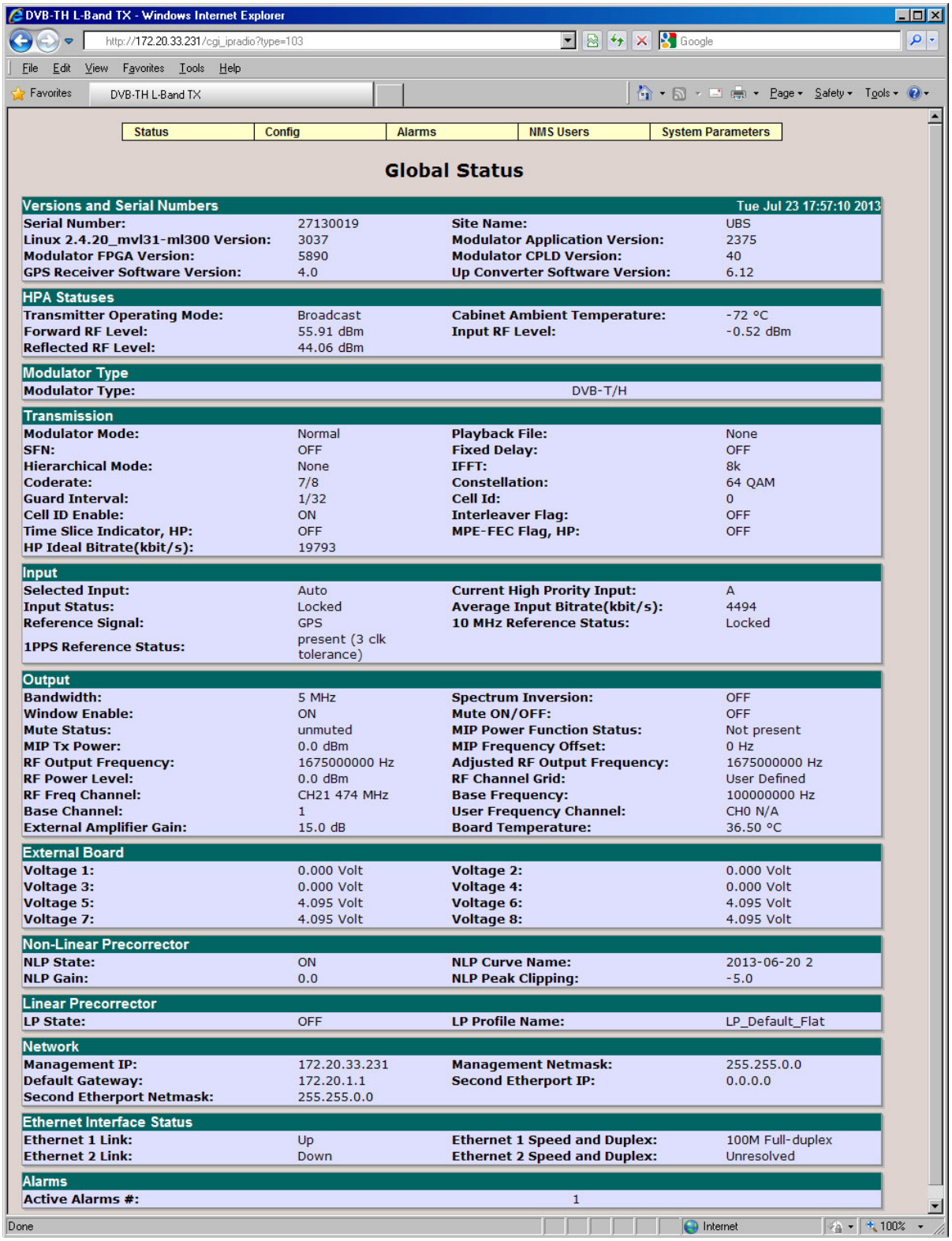


Figure 6-2 Transmitter Global Status Page (MFN Mode)

6.2.3 GUI Navigation and Structure

The Global Status page seen in Figure 6-2 demonstrates the hierarchical structure of the Web GUI interface. Along the top of the screen are a row of five icons with pull down menus. The five menu categories accessible via the Web GUI interface are:

1) Status – Displays the current operating status of the transmitter
2) Config – Provides access to change the transmitter operating parameters
3) Alarms – Provides alarm status and settings as well as alarm log information
4) NMS Users – Set user(s) log in authorization, passwords and other information
5) System Parameters – Set access control, network and SNMP parameters as well as system reset and software upgrades

The menu tree for the Web GUI is shown below:

Status	Config	Alarms	NMS Users	System Parameters
⬇	⬇	⬇	⬇	⬇
Global Status	Modulator Mode	Alarm Properties	User Properties	Identification
GPS Status	Transmission	External Voltage Alarm Setting		Access Control
HPA	Input	Log Management		Network Parameters
	Output	Alarm Log		SNMP Parameters
	RF Channels			System Time
	User RF Channels			Heartbeat Time
	Non-linear Pre-corrector			System Reset
	Linear Pre-corrector			Download Config Files(s)
	HPA Control			Upgrade and Files Upload
	GPS			List Uploaded Files
	Site			

Table 6-1 Web GUI Menu Structure

6.2.4 Changing Parameters

Before changes to system parameters are accepted, the user must first click the submit button. The example below has the user clearing the Alarm Log in the Log Management screen.

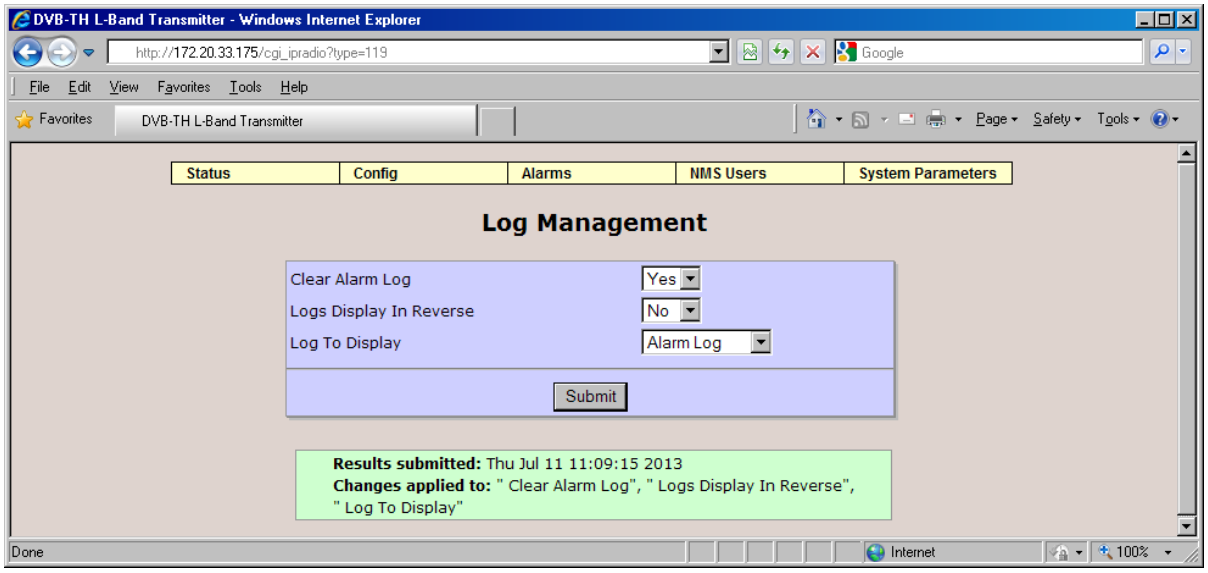


Figure 6-3 Example of Submitting a Parameter Change

Once the user has selected "Yes" for the Clear Alarm Log pull down box, the user will then need to click Submit. At that time a small green box will appear at the bottom of screen confirming the change.

6.3 Status Menu

The Status menu contains the following pull-down items (see Figure 6-4 below).

- Global Status
- GPS Status
- HPA

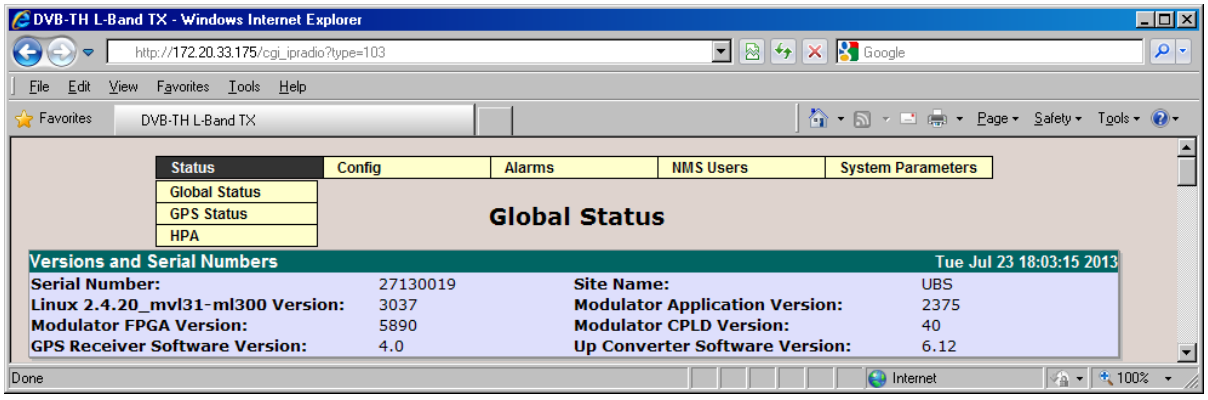


Figure 6-4 Status Menu

6.3.1 Global Status

The Global status page appears upon login and provides general information about parameter settings and the transmitter's alarm status. The list of parameters will change dynamically as the transmission mode (MFN or SFN) and/or transport stream input (ASI or IP) is changed. See Figure 6-2, Figure 6-5 and Figure 6-6 for details.

The drop down menus, located at the top of the status page, provide links to other pages that control various parameters and alarm functions.

- **Versions and Serial Numbers**: Displays the software and firmware version number for each of the main software components of the modulator.
- **HPA Statuses**: Displays the Transmitter Operating Mode (**Broadcast, Standby or Manual**) Input, Forward and Reflected RF power levels for the HPA as well as the Cabinet Ambient Temperature.
- **Modulator Type**: Displays the modulator waveform selected (**DVB-T/H**).
- **Transmission**: Displays the Modulator Mode (**Normal or CW**), the SFN status (**ON or OFF**), the OFDM parameter settings and the Ideal Bit Rate. The statuses of the MIP offset functions are only displayed when SFN mode is enabled.
- **SFN Parameters**: Displays the Transmitter ID, the Local Delay Offset set by the user, the MIP Maximum delay and MIP Time offset as included in the MIP and the resulting Adjusted SFN Delay. This window is only available when SFN mode is enabled.
- **Input**: Displays the Selected Input (**Auto, A, B or IP**), Input Status (**Locked or Unlocked**) and the status of the 10 MHz and 1PPS Reference inputs.
- **IP Input**: Displays the IP Input status, Input Stream Destination IP Address and Port, Buffer Depth, Packet Size, FEC Mode, Input Bit Rate and Packet information. This window is only available when an IP input has been selected.
- **Output**: Displays the Bandwidth, RF Output Frequency, RF Output Power Level, Spectrum Inversion (**ON or OFF**), parameters related to the pre-defined and User Channel Grids (not uses for this application) as well as MIP parameters.

  The Mute setting (**ON or OFF**) and Mute status (**Muted or Unmuted**) are also displayed. The output might be muted as a result of an active alarm, even though the Mute setting is set to OFF.
- **External Board**: Displays the voltage on each of the I/O port pins.
- **Non-Linear Pre-corrector**: Displays the status of the Non-linear Pre-corrector.
- **Linear Pre-corrector**: Displays the status of the Linear Pre-corrector.
- **Network**: Displays the modulator IP Addresses, Default Gateway and the Management Netmask.
- **Ethernet Interface Status**: Displays the link status and speed.
- **Alarms**: Displays the number of active alarms

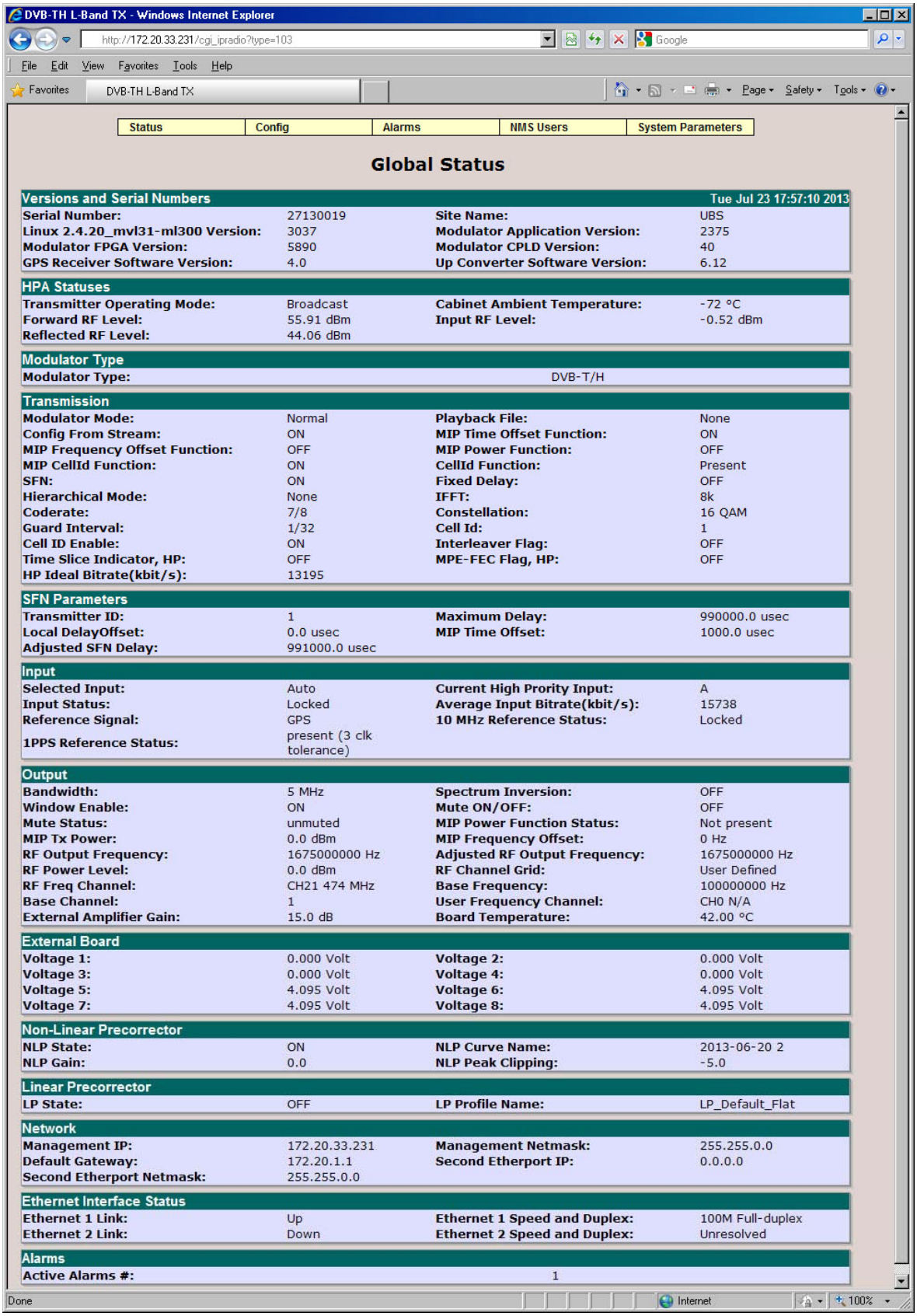


Figure 6-5 Transmitter Global Status Page (SFN Mode, ASI Input)

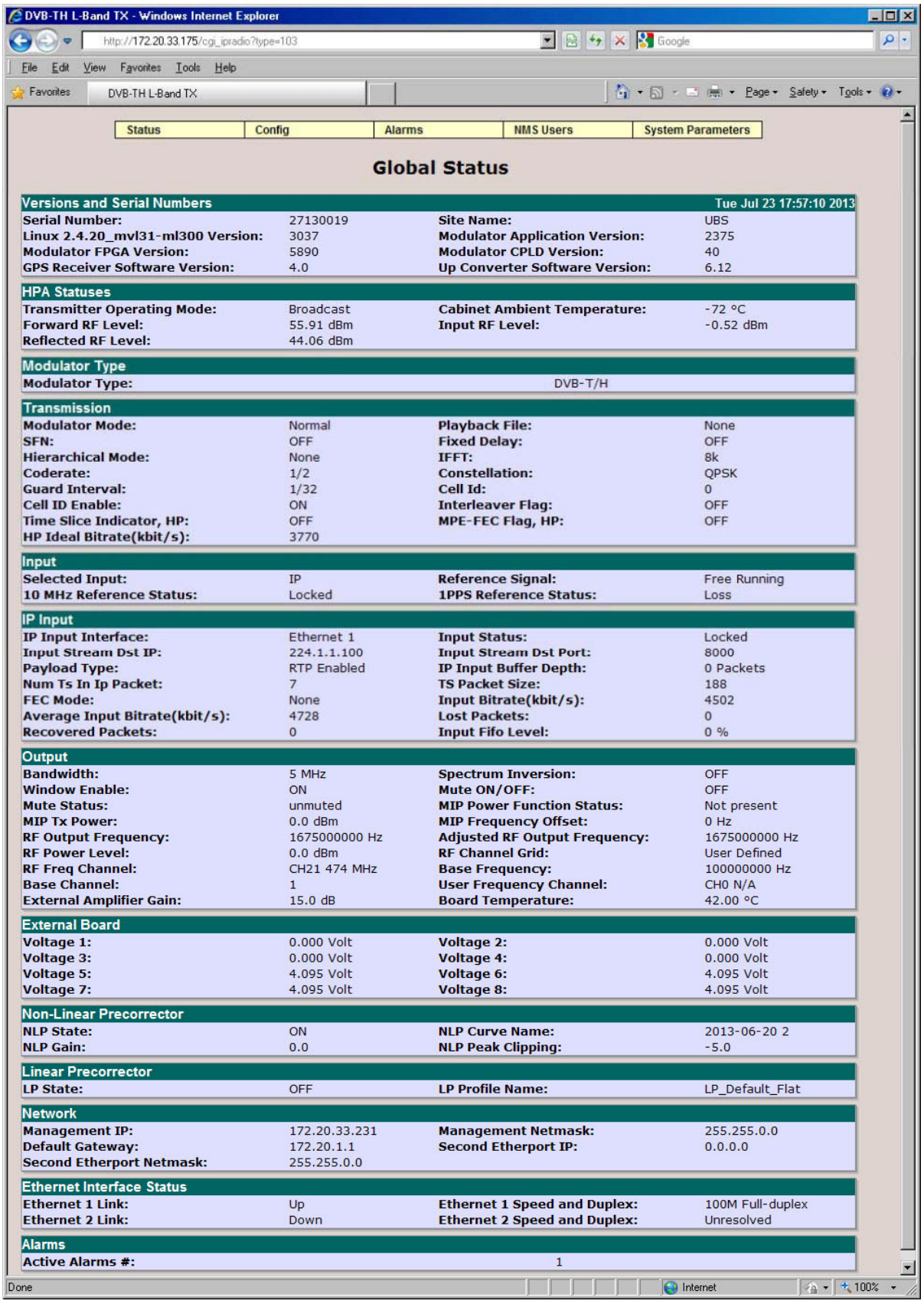


Figure 6-6 Transmitter Global Status Page (MFN Mode, IP Input)

6.3.2 GPS Status

The GPS Status page provides access to GPS receiver information including the lock status and the number of visible satellites, as well as the exact location and time.

- **GPS Common:** Indicates the GPS PLL Status (**Lock or Unlock**), Position Altitude, Position Latitude, Position Longitude, 3D Fix, Number of Visible and Tracked Satellites, and Sigma Accuracy. GPS Common will also indicate if the System Clock is updated from the GPS and it will display the System Timezone.
- **Satellites:** Indicates the satellite number and corresponding carrier to noise ratio.

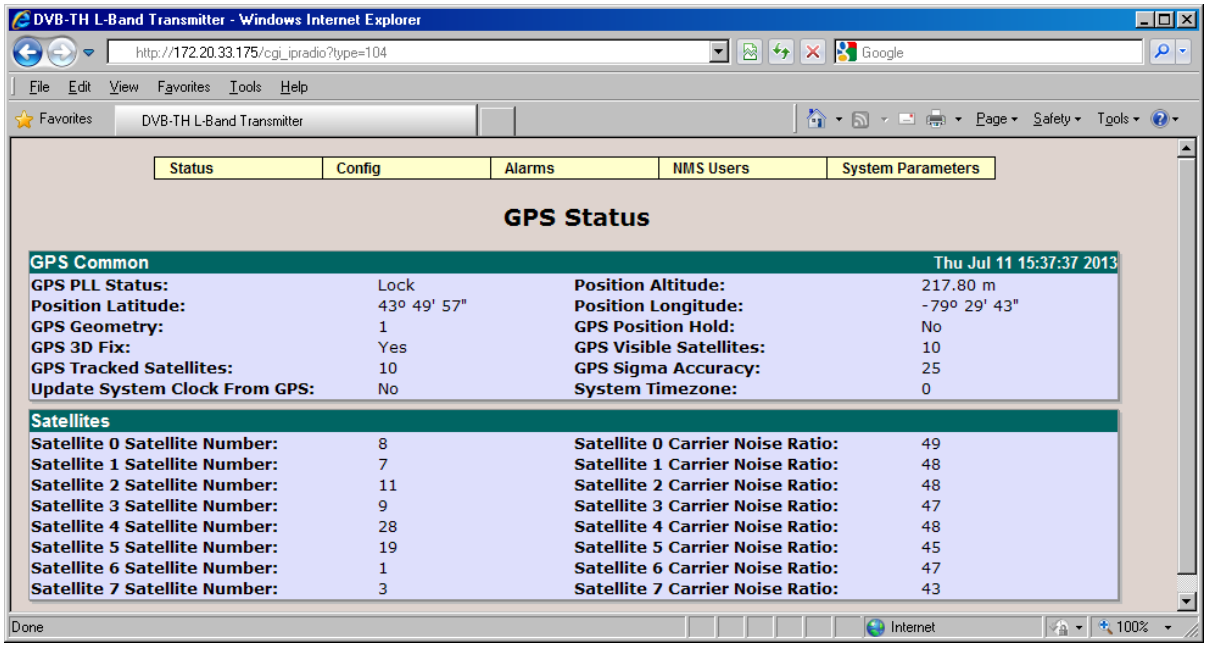


Figure 6-7 GPS Status

After initialization, the GPS starts tracking the satellites to determine its position; the accuracy of the GPS output signals depends on the GPS satellite reception. The GPS PLL Status will indicate "Lock" when the quality of the received GPS signals are higher than the minimum reception level and the minimum number of tracked satellites is reached. GPS 3D Fix will occur when a minimum of 4 satellites are tracked. The GPS will then display Position Latitude, Longitude and Altitude.

The output of the GPS (1 PPS and 10 MHz pulses) is fed to the Distribution Amplifiers, which in turn feed the pulses to the modulator and up-converter.

The Controller communicates continuously with the GPS to deter-mine if the GPS is still operating correctly and still receiving the satellite signals, etc., or if it has any alarm (malfunction) to report.

A PLL (Phase Locked Loop) Status Unlocked event can be the result of an antenna under-current (antenna open) or antenna over-current (short), a poor GPS 3D Fix (minimum requirement is 4 satellites). In general, conditions that result in a poor GPS signal quality.

6.3.3 HPA

The HPA page provides access to HPA information including the HPA TX On status (On of Off), Input, Forward and Reflected power levels as well as sub-module current values and heat sink temperature values.

- **HPA Statuses:** Displays the HPA Controller Firmware and CPLD versions as well as the Input, Forward and Reflected RF (power) levels.
- **HPA Settings:** Displays the HPA Tx On status (**ON or OFF**), RF Output Power Level (target), Precorrector Enable (**OFF**), Freeze ALC (**ON or OFF**) and RF Input Frequency.
- **Power Supply Voltage Levels:** Displays the DC voltage for HPA Power Supply 1 and HPA Power Supply 2.
- **HPA Current Levels:** Displays the current consumption for the Pre-Driver, Driver and Power Modules.
- **HPA Temperature Sensors and Fans:** Displays the temperature readings for the Pre-Driver and Power Module heat sink temperature sensors as well as the fan speed for the front panel fans.
  - Temperature Sensor 1 – Power Module heat sink
  - Temperature Sensor 2 – Power Module heat sink
  - Temperature Sensor 3 – Pre-Driver heat sink

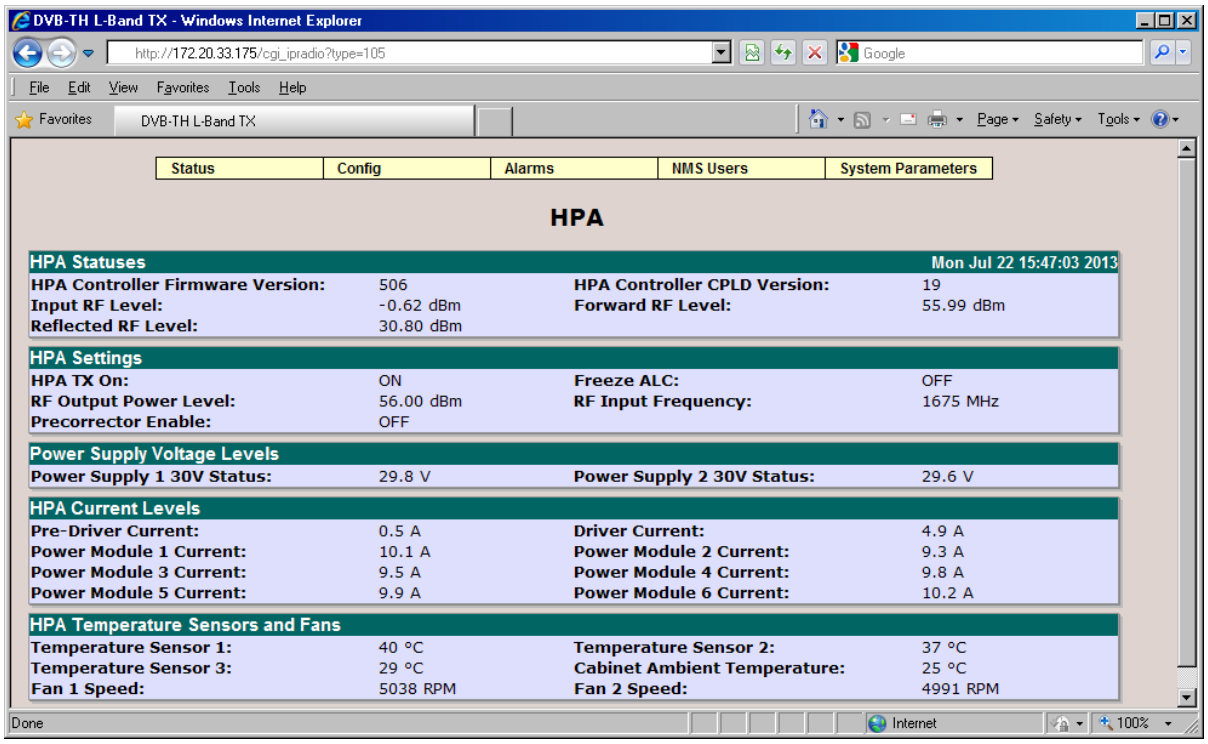


Figure 6-8 HPA

6.4 Config Menu

The Config menu contains the following pull-down items (see Figure 6-9 below).

- Modulator Mode
- Transmission
- Input
- Output
- RF Channels
- User RF Channels
- Non-Linear Precorrector
- Linear Precorrector
- HPA Control
- GPS
- Site

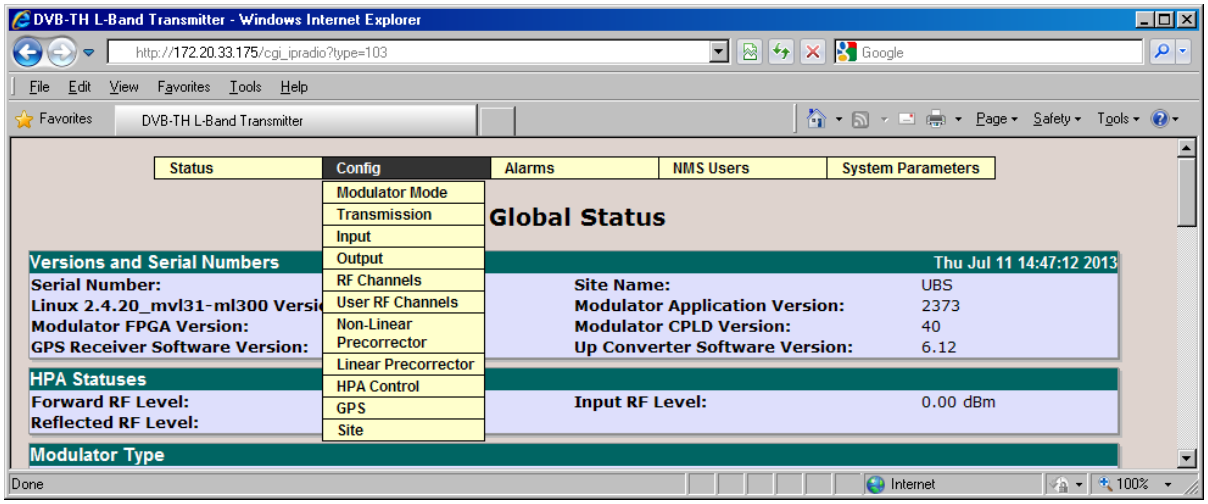


Figure 6-9 Config Menu

The Configuration menu provides access to change the transmitter operating parameters. The operating parameters and their range of values or settings are also accessible through the CLI interface and modulator front panel interface.

6.4.1 Modulator Mode

This page allows the users to select the Modulator Mode and the Test Mode.

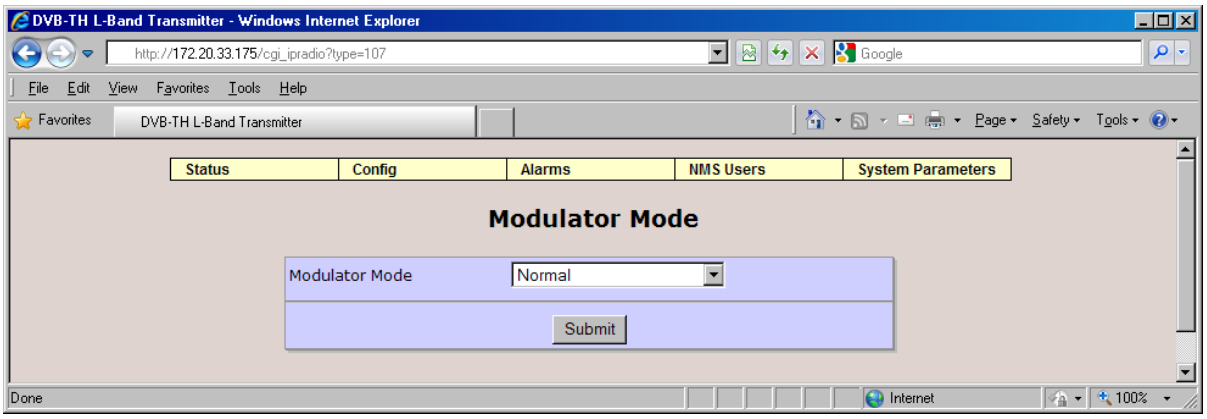


Figure 6-10 Modulator Mode Configuration

The available parameters are:

Item	Option
Modulator Mode	Normal, CW, Test1 (Carriers Removal), Record , Playback

Table 6-2 Modulator Mode Parameters

CW and Test 1 are special test modes not used in regular operation. The CW mode generates a narrow-band frequency tone. This is useful for phase noise measurements or to view background noise. The Test 1 mode suppresses a subset of the carriers from the center of the DVB-H signal. This is useful for simulating a notch fading event or to view the background noise present in the band. In the "Test 1" mode, usually 500 carriers are removed. The number of removed carriers can be factory configured from between 100 to 800 via the advanced access interface.

The Record mode allows the user to record a input data stream (limit of 16 megabytes) for later playback. The modulator must first be set to SFN mode, a valid SFN input stream must be present and no input stream alarms can be reported.

After recording, the modulator will automatically switch back to Normal mode. The user can check the Global Status page to see that the modulator is back in Normal mode and that the stream has been recorded. The user can check also the "List Uploaded Files" screen under "System Parameters" to see the file name displayed.

In the Playback mode the recorded input stream is used to generate a modulator output. This is useful for detailed system testing especially when an input signal is not available or for benchmark testing using a known test signal.

6.4.2 Transmission

The Transmission page allows the user to select the network type (MFN or SFN), set the modulation parameters and configure a number of SFN parameters.

The Transmission page will change dynamically, depending on the Modulator Mode selected (MFN, SFN or SFN with Config From Stream On). The user has the option to configure the modulation parameters from the incoming stream (MIP) or locally.

In SFN mode, a network of modulator operating at the same frequency are all synchronized using special timing packets (MIP) embedded in the input transport stream as well as GPS timing information. If the SFN mode is disabled, the system will operate in MFN mode where all modulators in a network work independently of one another.

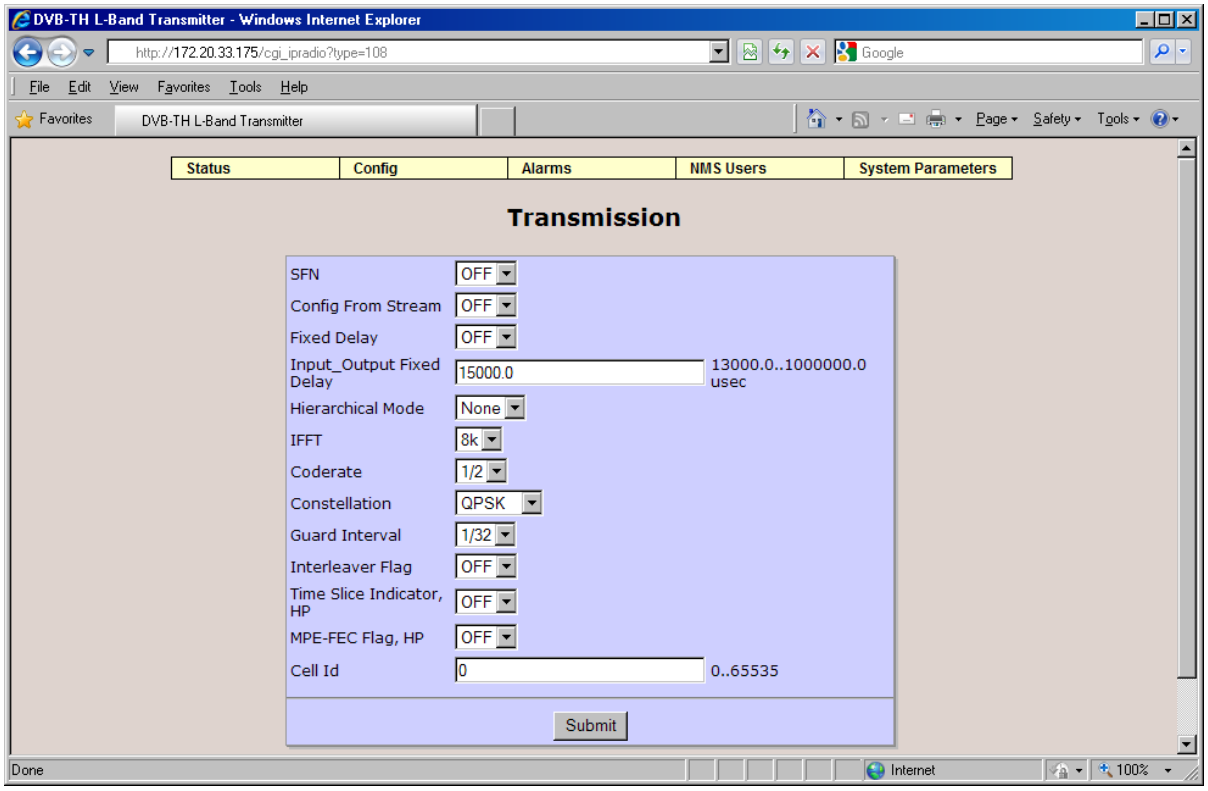


Figure 6-11 Transmission Configuration (MFN)

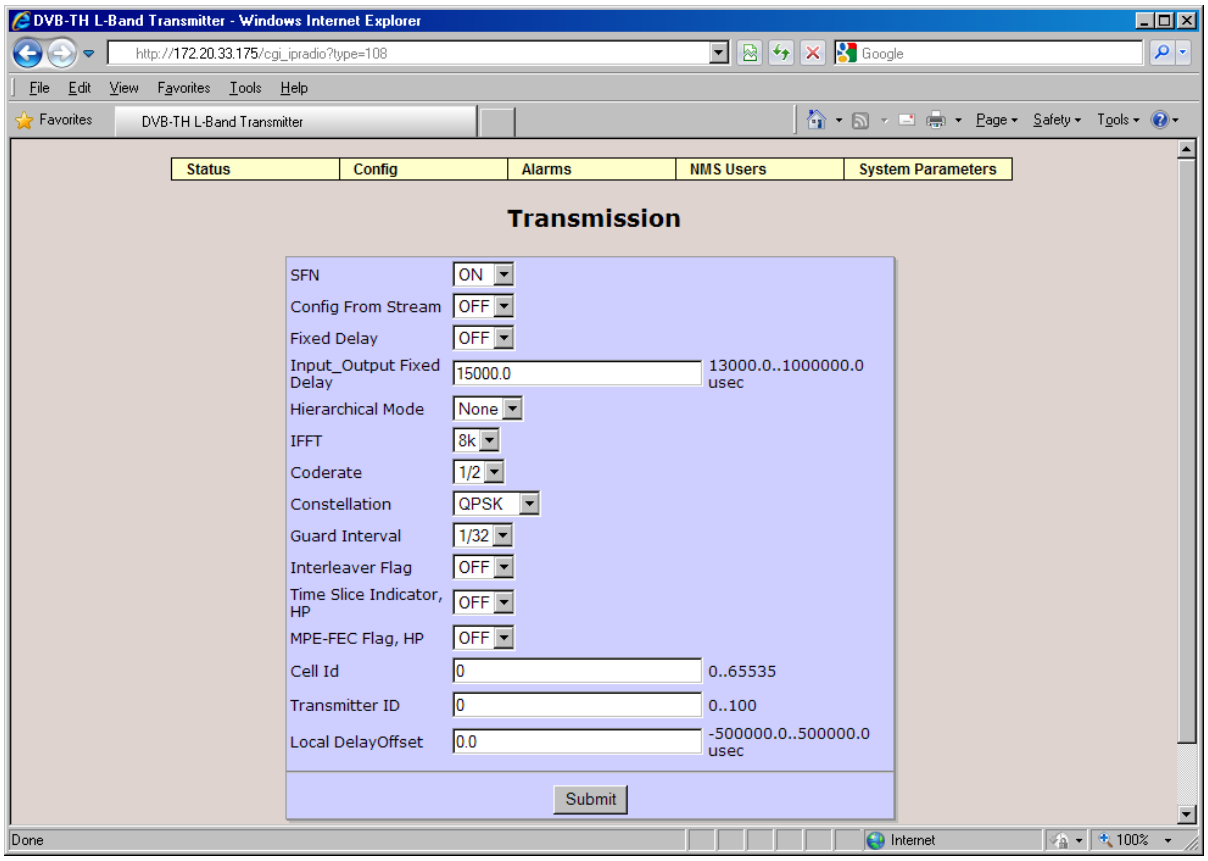


Figure 6-12 Transmission Configuration (SFN – No Config from Stream)

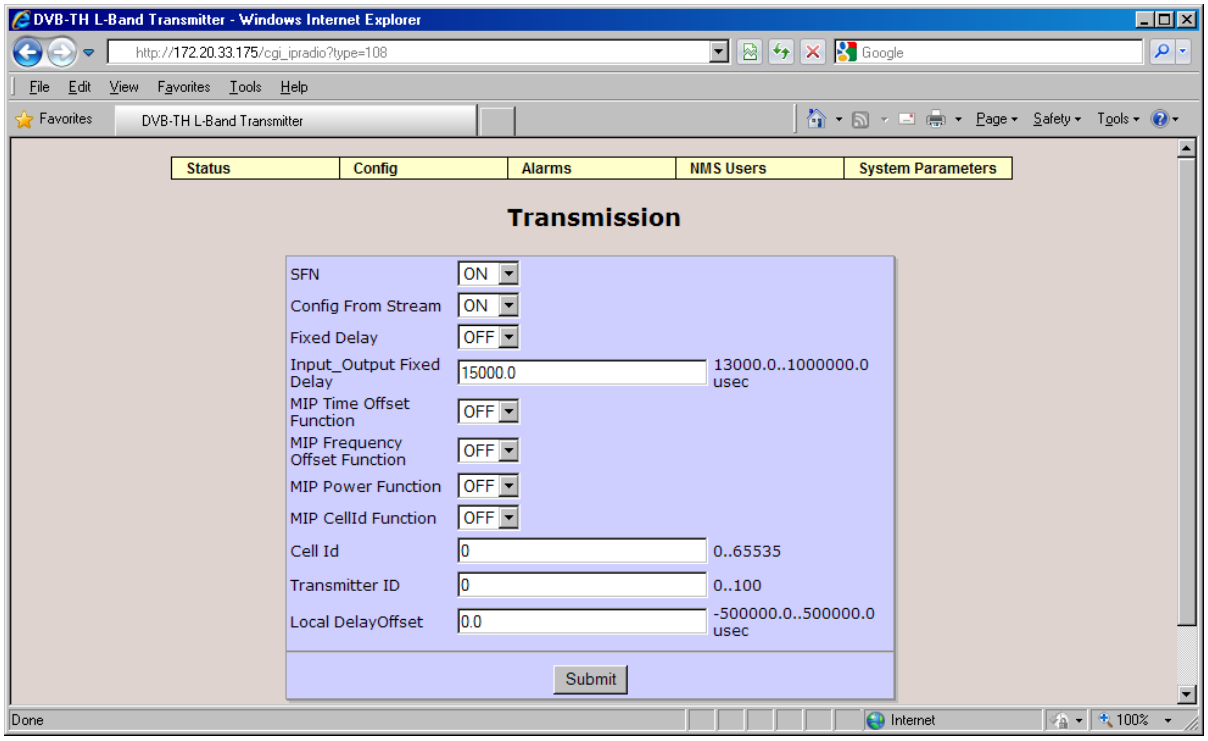


Figure 6-13 Transmission Configuration (SFN – Config from Stream)

The available parameters for MFN and SFN mode are:

Item	**Option**
SFN	OFF, ON
Config From Stream	ON, OFF If "Config From Stream" is ON, the modulation parameters are set from the input SFN data stream and the other modulation parameters of this web-page are ignored. If it is set to OFF, the modulation parameters can be configured locally. Only relevant when SFN is enabled.
Fixed Delay	OFF, ON If "Fixed Delay" is ON, the output stream will be synchronized to the input stream. Only relevant when an ASI input is present.
Input_Output Fixed Delay	Range: 13000 μsec .. 1 second Only relevant when an ASI input is present.
Hierarchical Mode	None, aEq1, aEq2, aEq4
IFFT	2k, 8k, 4k
Coderate	1/2, 2/3, 3/4, 5/6, 7/8
Constellation	QPSK, 16 QAM, 64 QAM
Guard Interval	1/32, 1/16, 1/8, 1/4
Interleaver Flag	OFF, ON Only relevant for a 2k and 4k IFFT.
Time Slice Indicator, HP	OFF, ON
MPE-FEC Flag, HP	OFF, ON
Cell ID	Range: 0 .. 65535
Transmitter ID	Range: 0 .. 100 Only relevant when SFN is enabled.
Local Delay Offset	Range: -500000.0 .. +500000.0 μsec Only relevant when SFN is enabled.

Table 6-3 Transmission Parameters (MFN and SFN Mode)

The available parameters for SFN mode with Config From Stream On are:

Item	**Option**
SFN	OFF, ON
Config From Stream	ON, OFF
Fixed Delay	OFF, ON
Input_Output Fixed Delay	Range: 13000 μsec .. 1 second
MIP Time Offset Function	OFF, ON
MIP Frequency Offset Function	OFF, ON
MIP Power Function	OFF, ON
MIP Cell ID Function	OFF, ON
Cell ID	Range: 0 .. 65535
Transmitter ID	Range: 0 .. 100
Local Delay Offset	Range: -500000.0 .. +500000.0 μsec

Table 6-4 Transmission Parameters (SFN Mode with Config From Stream On)

All of the above parameters are described in the DVB-TH standard. The above list includes a number of optionalMIP parameters for remote adjustment of the transmitter signal:

- MIP Time Offset Function (tx_time_offset_function)

  The tx_time_offset_function is used to apply a deliberate offset in time of the transmitted DVB-TH signal, relative to the reference transmission time (STS+maximum_delay) modulo 10^7

- MIP Frequency Offset Function (tx_frequency_offset_function)

  The tx_frequency_offset_function is used to apply a deliberate frequency offset of the centre frequency of the emitted DVB-TH signal relative to the centre frequency of the RF channel.

- MIP Power Function (tx_power_function)

  The tx_power_function can be used to remotely configure the transmitter ERP.

- MIP CellId Function (cell_id_function)

  The cell_id_function can be used to configure the cell identifier of the transmitter.

6.4.3 Input

The Input page allows the user to select ASI port A, ASI port B, Auto selection between ASI ports or an IP input.

To configure the modulator with an IP (GbE TS) input, the user must set the Selected Input to IP Input and configure the IP Input Interface, Input Stream Dst IP and Input Stream Dst Port accordingly – see Figure 6-15.

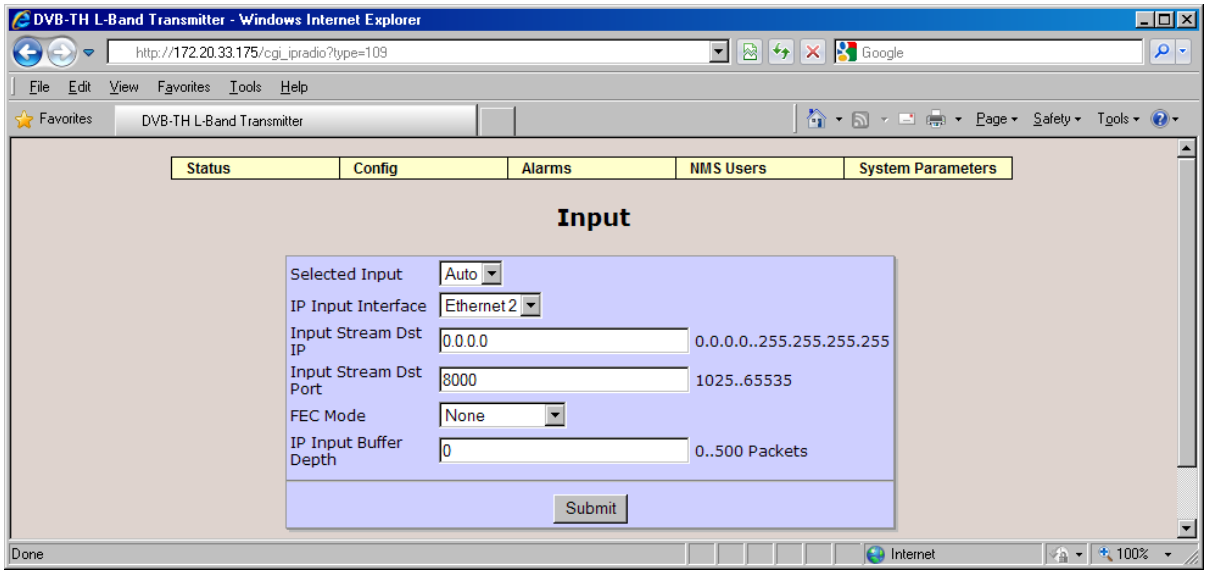


Figure 6-14 ASI Input Configuration

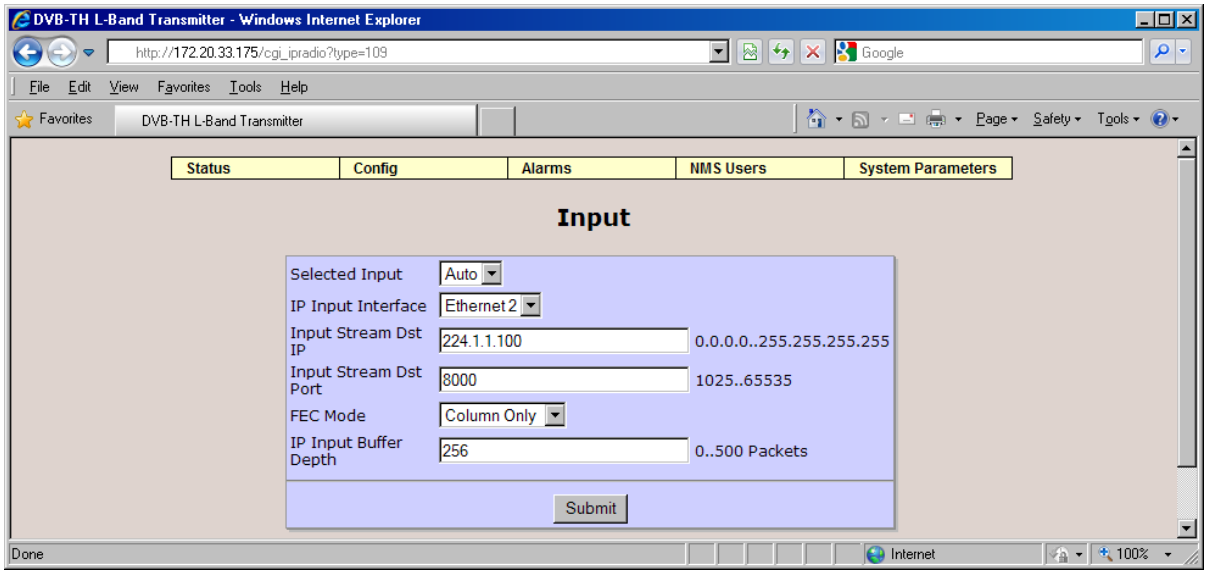


Figure 6-15 IP Input Configuration

The available parameters are:

Item	**Selection**
Selected Input	A, B, Auto, IP Choice of ASI port A, ASI port B, Auto selection between ASI ports or an IP input.
IP Input Interface	Ethernet 1, Ethernet 2 If Selected Input is set to IP this will determine which Ethernet port is selected for the input stream.
Input Stream Dst IP	Standard IP address: 0.0.0.0..255.255.255.255 Relevant only if Selected Input is set to IP and Fixed Delay is OFF.
Input Stream Dst Port	Range: 1025 .. 65535 Relevant only if Selected Input is set to IP and Fixed Delay is OFF.
FEC Mode	None, Column Only, Column + Row Relevant only if Selected Input is set to IP and Fixed Delay is OFF. This sets the Forward error Correction (FEC) mode for the IP input as per the Pro MPEG CoP#3 standard for FEC protection of MPEG-2 transport streams over an IP network.
IP Input Buffer Depth	Range: 0 .. 500 Packets Relevant only if Selected Input is set to IP and Fixed Delay is OFF.

Table 6-5 Input Parameters

6.4.4 Output

The Output page allows the user to Mute the modulator output, set the Spectrum Inversion and modify the RF Output Frequency and the modulator RF Power Level.

The menu options vary depending if the system is configured for SFN with "Config From Stream" enabled or MFN operation (see section 6.4.2). When the system is in MFN mode the user can select the transmission bandwidth. If "Config From Stream" is enabled when SFN mode is enabled, the bandwidth option is not available. The next two figures show the Output configuration screen for both MFN and SFN operation.

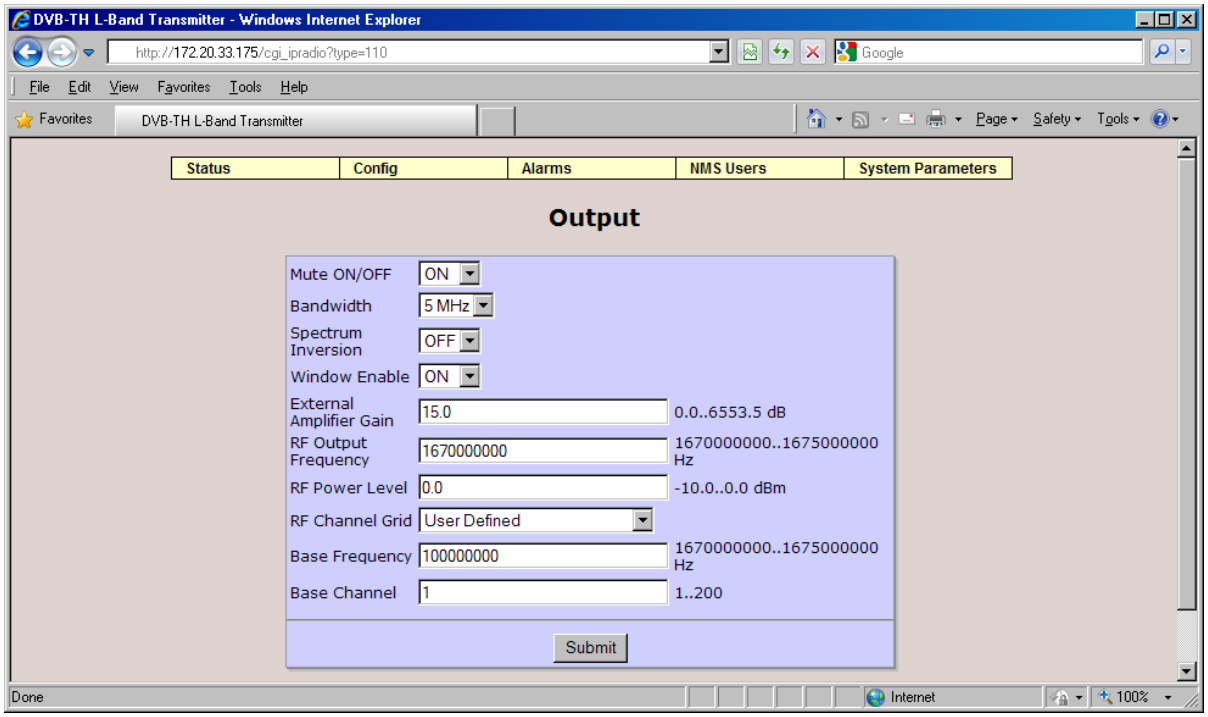


Figure 6-16 Output Configuration (MFN Mode)

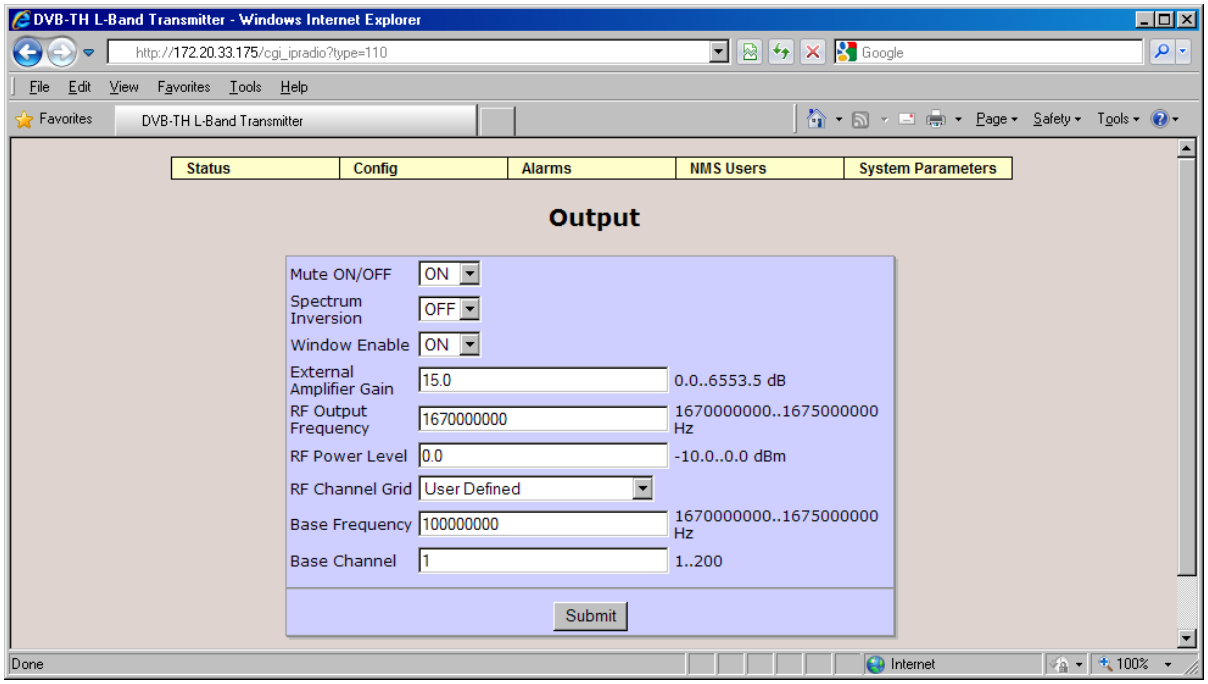


Figure 6-17 Output Configuration (SFN Mode – Config From Stream On)

The available parameters are:

Item	Selection
Mute ON/OFF	OFF, ON
Bandwidth	5 MHz Bandwidth selection is only available in MFN mode
Spectrum Inversion	OFF, ON
Window Enable	OFF, ON
External Amplifier Gain	Range: 0.0.. 6553.5 dB Is used for the MIP power function.
RF Output Frequency	Range: 167000000 .. 167500000 Hz
RF Power Level	Range: -10.0 .. 0.0 dBm
RF Channel Grid	DVBT UHF 8M 474-858 MHz, User Defined
Base Frequency	Range: 167000000 .. 167500000 Hz
Base Channel	Range: 1 .. 200

Table 6-6 Output Parameters

6.4.5 RF Channels

Note: RF Channels is not used for this application and should not be modified by the user.

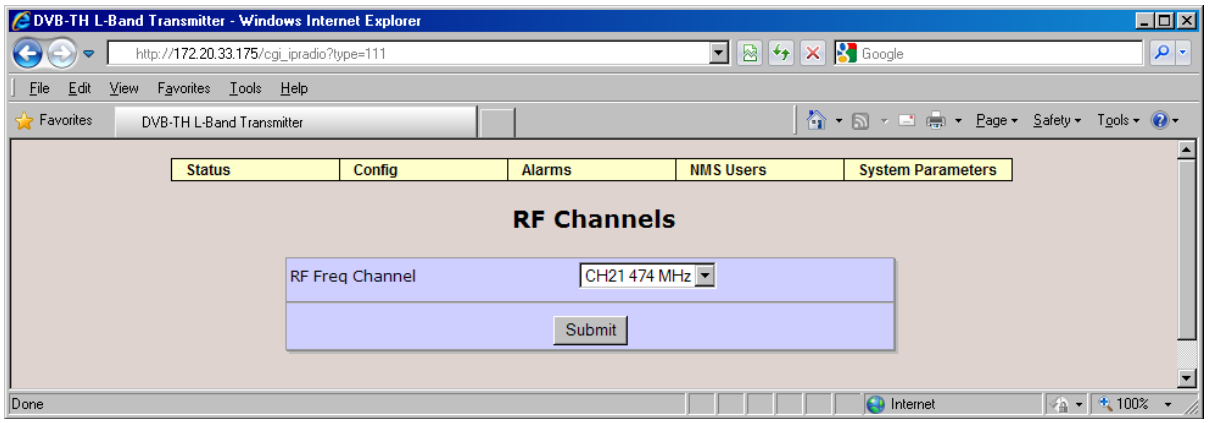


Figure 6-18 RF Channels Configuration

6.4.6 User RF Channels

Note: User RF Channels is not used for this application and should not be modified by the user.

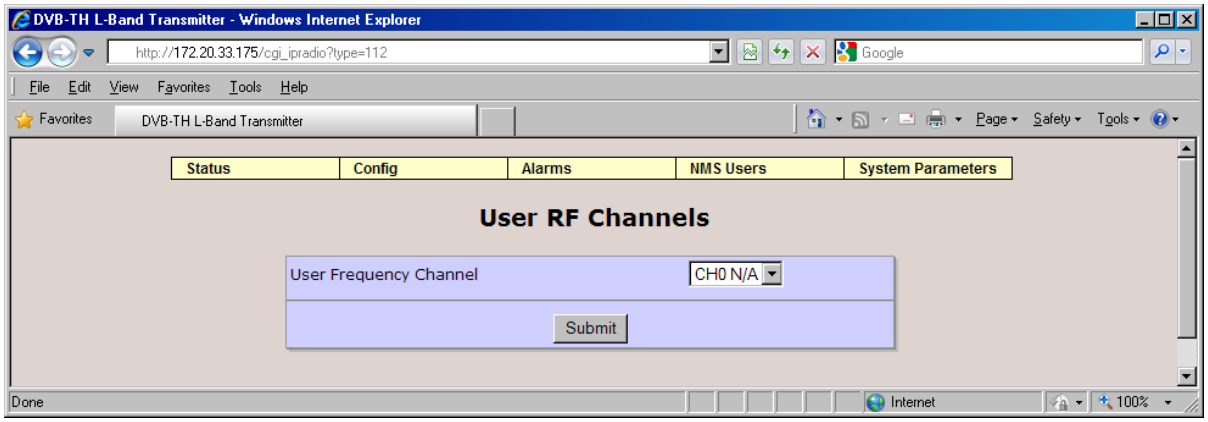


Figure 6-19 User RF Channels Configuration

6.4.7 Non-Linear Pre-corrector

This page allows the user to select the NLP (Non-Linear pre-corrector) Profile state and profile.

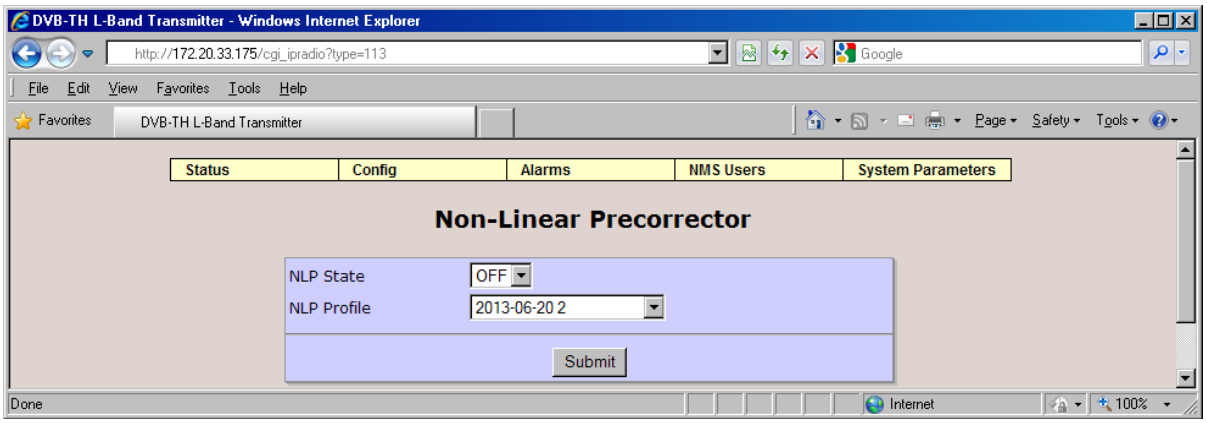


Figure 6-20 Non-Linear Pre-corrector Configuration

Item	Selection
NLP State	OFF, ON
NLP Profile	A selection of different NLP profile files

Table 6-7 Non-Linear Pre-corrector Parameters

6.4.8 Linear Pre-corrector

This screen pages the user to select the LP (Linear pre-corrector) State and profile.

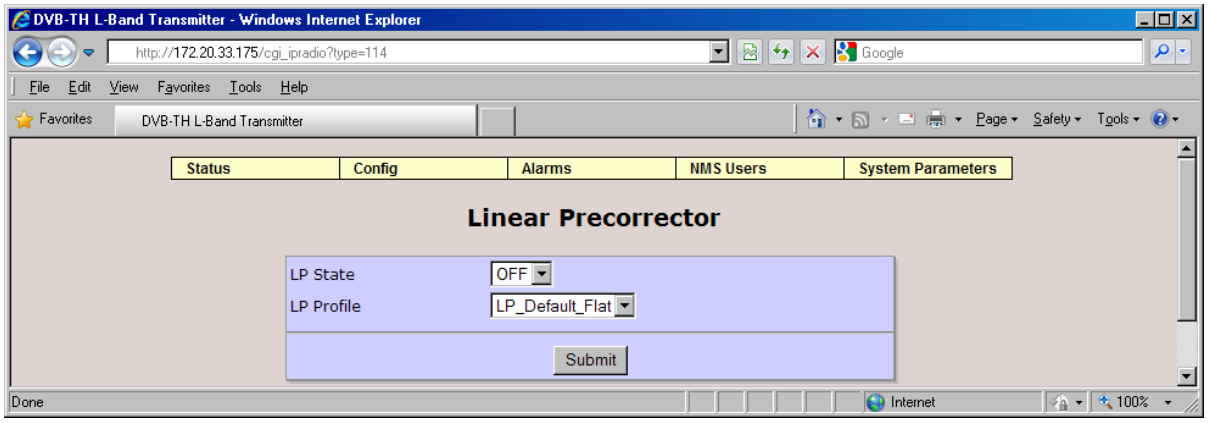


Figure 6-21 Linear Pre-corrector Configuration

Item	Selection
LP State	OFF, ON
LP Profile	A selection of different LP profile files

Table 6-8 Linear Pre-corrector Parameters

6.4.9 HPA Control

The HPA Control page contains a drop down menu that allows the user to set the transmitter to one of the following modes:

- Standby
- Broadcast
- Manual

Broadcast mode represents normal operation. Standby mode disables the transmitter output. In Manual mode the HPA behaves as a simple amplifier and the modulator control of the HPA output is limited to setting the input drive level to the HPA.

The RF Output Power Level allows the user to set the output power level to a value between 46 dBm and 56 dBm.

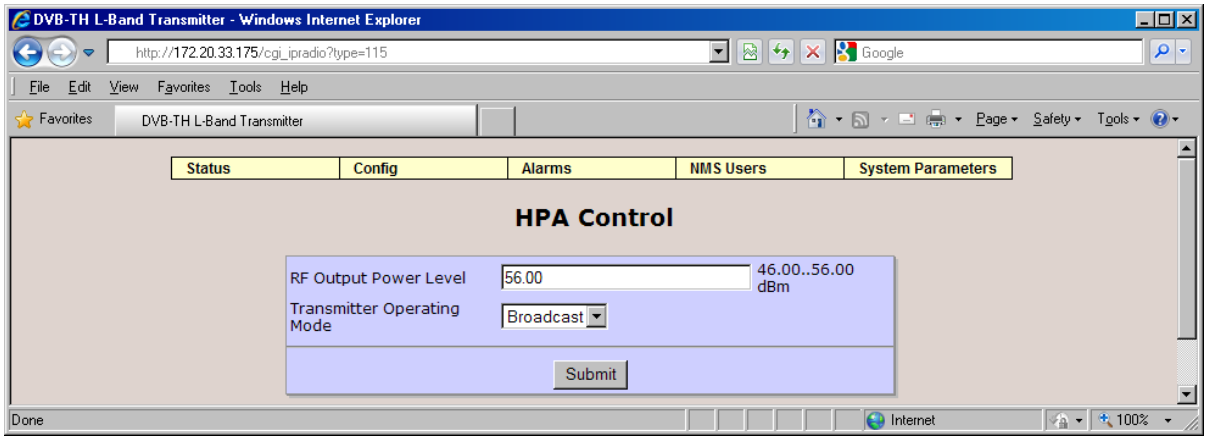


Figure 6-22 HPA Control Configuration

The available parameters are:

Item	Selection
RF Output Power Level	Range: 46.00 .. 56.00 dBm
Transmitter Operating Mode	Standby, Broadcast, Manual

Table 6-9 Non-Linear Pre-corrector Parameters

6.4.10 GPS

The most important parameter for the GPS menu is the Max GPS Holdover Time parameter. Following a loss of signal lock to the GPS satellite network, the Max GPS Holdover time is the maximum length of time the system will continue to operate in a free-running mode before an alarm is issued leading to a possible transmitter shutdown condition. It is imperative for a SFN network for all transmitters to be synchronized to GPS at all times.

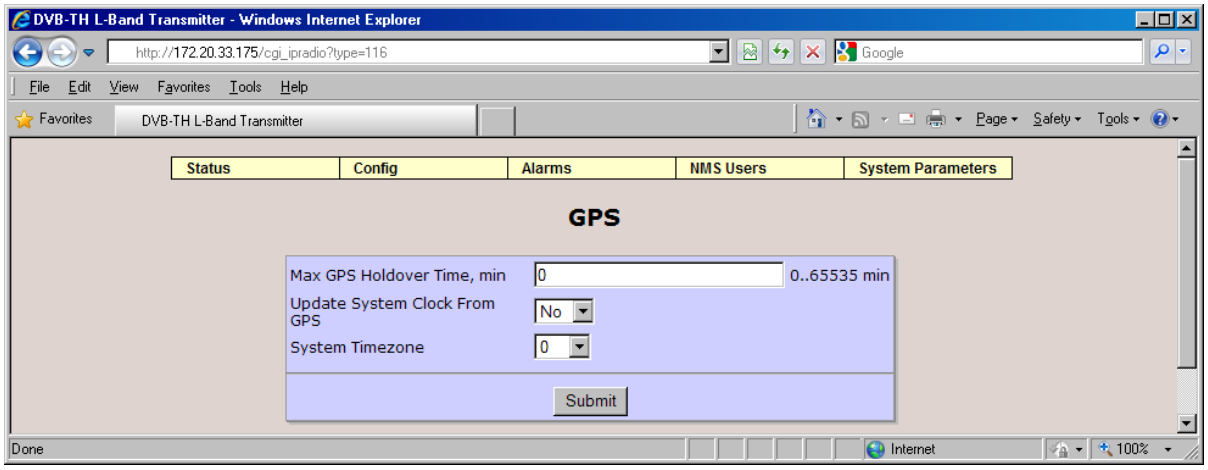


Figure 6-23 GPS Configuration

The available parameters are:

Item	Option
Max GPS Holdover Time, min	Range: 0 .. 65535 min
Update System Clock From GPS	No, Yes
System Timezone	-11 to 11 hours

Table 6-10 GPS Parameters