FRONT MATTER: Includes the general manual layout by section, customer service center information, telephone technical support information, safety precautions, and warranty/repair information.

GENERAL – SECTION 1: Provides a general description of the system to include its purpose and a high level breakdown of components. Tables list physical, environmental, and electrical characteristics; equipment supplied; optional equipment; and equipment required but not supplied.

FUNCTIONAL DESCRIPTION – SECTION 2: Describes operation of the overall equipment, any subsystems/sub functions, and the purpose/function of each module/unit.

INSTALLATION – SECTION 3: Contains instructions for the installation of the SIRIUS repeater; also references supporting engineering drawings.

TURNUP AND TEST – SECTION 4: Procedures to turn-up the DTR-0200-SA-SIRIUS repeater after installation. Also provides post-installation and post-maintenance system test procedures.

OPERATION – SECTION 5: Provides procedures/information for normal operation, use of graphical user interface, and all controls, indicators, test points, and connectors used for installation, operation, and maintenance.

MAINTENANCE – SECTION 6: Describes the maintenance philosophy and method applicable to the equipment, lists recommended test equipment, identifies and includes recommended periodic checks, includes troubleshooting/analysis information, identifies actions required after module replacement, and includes post-repair/replacement check and adjustment procedures.

APPENDIX A: Contains repeater drawings to support information presented in this Operation and Maintenance (O & M) manual.

APPENDIX B: Contains Alcatel-Lucent part numbers.

APPENDIX C: Lists locally correctable alarms, their probable causes, and suggested responses.

NORTH AMERICA CUSTOMER SERVICE CENTER
24 HOURS PER DAY, 7 DAYS PER WEEK

PHONE the Call Center at
888-252-2832 (US and Canada)
or
613-784-6100 (International)

The Call Center Agent (CSA)
Will help connect you with Technical Assistance (TAC)
Or assist you with a Repair and Return

TAC

- Phone-based technical support
- After-hour emergencies
- On-site technical support
- E-mail support ml-tac.support@alcatel-lucent.com
- Software and hardware upgrades

Repair and Return

- Module repair

Other Services Offered

- Training http://www.alcatel-lucent.com>support
  - Technical Training
- Field Services
  - Installation and test
- Registration http://www.alcatel-lucent.com>MyAccess
  - Once registered
    - From “MyAlcatel” go to “Alcatel Support Documentation”
    - Register for access to Documentation and e-mail Update notifications For Product Change Notices (PCN), Product Documentations, etc.
  - Software and Hardware upgrade documentation
- Customized and Comprehensive Service Agreements

ALCATEL-LUCENT’S PRIMARY MISSION IS SATISFYING OUR CUSTOMERS' QUALITY EXPECTATIONS.

TAC
Technical Assistance Center

Telephone Assistance, Normal Working Hours (CST 8am 5pm M-F)
TAC supports all Alcatel North America Microwave products. This includes routine questions and emergency service.

Telephone Assistance, Emergency After-Hours
- Defined as loss of traffic, standby equipment, or network visibility on traffic-bearing systems.
- Available through our Customer Service Agents (CSA).

Contact Information Ask the Customer Service Agent (CSA) for a Microwave (MW) or a Network Management Service engineer (NMS).

Creating a TAC Action Request (AR)

Please provide the following information to the Customer Service Agent (CSA):

- Last and First name
- Company name
- Telephone number
- City and state (Street address if applicable) or Site Name and Location
- Equipment type
- A brief description of the problem affecting their equipment
- Customer Priority: *High, Medium,* or *Low.*
- TL-9000 Severity as described below.

TL-9000 Severities Defined

Critical	Problems severely affecting service, traffic, capacity, or network management. They require immediate corrective action. (Ex. Loss of network management capability, loss of traffic imminent or existing).
Major	Conditions seriously affecting system operation. They require immediate attention. (Ex. processor outage, loss of standby equipment, loss of remote access, or network managers).
Minor	Problems not classified as critical or major.

SAFETY PRECAUTIONS

Personnel should use caution when installing, testing, operating, and servicing this equipment.

As with all electronic equipment, care should be taken t avoid electrical shock where substantial currents or voltages may be present.

Definitions of Danger, Warnings, Cautions, and Notes used throughout this manual are described below.

An operating procedure, practice, etc., which, if not correctly followed could result in personal injury or loss of life.

An operating procedure, practice, etc., which, if not strictly observed, could result in damage to equipment.

An operating procedure, practice, etc., which, if not strictly observed, could result in an interruption of service.

Note

An operating procedure, condition, etc., which is essential to highlight.

ELECTRICAL SAFETY: GENERAL RULES

Carefully observe the specific procedures for installation, turnup, and maintenance where AC or DC power is present and observe the following general information/rules.

- Remove rings, watches, and other metal jewelry. Short circuits in low-voltage, low-impedance DC circuits can cause severe arcing that my result in burns or eye injury. Exercise caution to avoid shorting power input terminals.
- This equipment is intended for installation in a RESTRICTED ACCESS LOCATION ONLY.
- Installation and maintenance are to be performed only by technically qualified professional personnel.

STATIC ELECTRICITY

When the above symbol or letters are displayed, observe special precautions.

An electrostatic-sensitive device can be weakened, damaged or destroyed even by a minute discharge that would even go unnoticed by a technician.

Common plastics, clothing, and paper or cardboard are the most common sources of static charges.

Common plastic, white foam, cellophane and masking adhesive tapes must not come in contact with ESS devices or their packaging.

MODULE HANDLING

To minimize risk of damage to an ESS device:

- All modules should be handled as static sensitive devices
- Heel straps are only effective while standing on conductive or static dissipative surfaces
- Ground straps, either wrist (PN 055-9357-010) or heel (PN 055-9357-020), should be worn prior to and while touching or handling modules containing ESS devices.
- Surfaces (with resistance to ground in excess of 100 Meg-ohms), such as ordinary tile, should be covered with properly grounded static dissipative runners or waxed with a static dissipative wax (PN 057-4000-006)
- Modules (even temporarily) should be stored, packed, or shipped in antistatic bags or containers
- Do not handle modules by touching the electrical components and circuit board. Use the plastic handle or other outside casing
- Use only ESS rated cleaning devices to clean modules
- Be sure to handle failed modules with the same precautions as good modules

WARRANTY/REPAIR INFORMATION

GENERAL WARRANTY PROVISIONS

Alcatel-Lucent guarantees to repair or replace, or refund the complete purchase price of any equipment, accessories or parts manufactured by Alcatel-Lucent, which are defective as to workmanship, or material, provided that:

- Notice of the claimed defect or unsuitability is given in writing to Alcatel-Lucent within the warranty period after delivery, acceptance, or use, whichever is earlier.
- The defective or unsuitable equipment, accessory, or part is returned to Alcatel-Lucent at its factory (transportation prepaid), in accordance with the instructions given in the Module Return section below.
- An inspection of the returned goods by Alcatel-Lucent at its factory indicates that the defect was not caused by abuse or improper use, maintenance, repair, or alteration by other than Alcatel-Lucent or its authorized service center.

MODULE RETURN

Call Repair and Return Customer Service Agent (CSA) at 1-888-252-2832

- To receive a Return Authorization (RA) number
- For Emergency Orders
- For Advance Replacement

Please follow this procedure when returning equipment:

For the unit(s) to be repaired, include the following information

- Serial Number of the part
- Company name, billing and shipping address, phone number, and contact name(s)
- Description of all known facts as to the nature of the failure(s)
- Purchase order number or requisition number
- Type number, part number, description of unit, and quantity to be repaired
- Description of any additional repair instructions

Note: With any correspondence the RA number must be prominently noted or marked on all shipping labels, packing lists, and other communications.

This page intentionally left blank.

1 GENERAL

1.1 INTRODUCTION

The Terrestrial Satellite Repeater is a modular solid-state device that receives audio/video multiplexed data transmissions via a SIRIUS Satellite. The repeater then processes the received data and retransmits it through tower mounted antennas to end users' receivers.

Figure 1-1 is a simplified diagram of a SIRIUS Terrestrial Repeater broadcast system.

A repeater site (part of the broadcast system) includes a Very Small Aperture Terminal (VSAT) antenna with a Low Noise Block converter (LNB) attached, a Global Positioning System (GPS) antenna, a repeater unit, and tower mounted transmitting antennas.

The repeater site interfaces to a SIRIUS Network Management Center (NMC) via TELCO lines to monitor repeater operational status.

Figure 1-2 illustrates a typical repeater site layout.

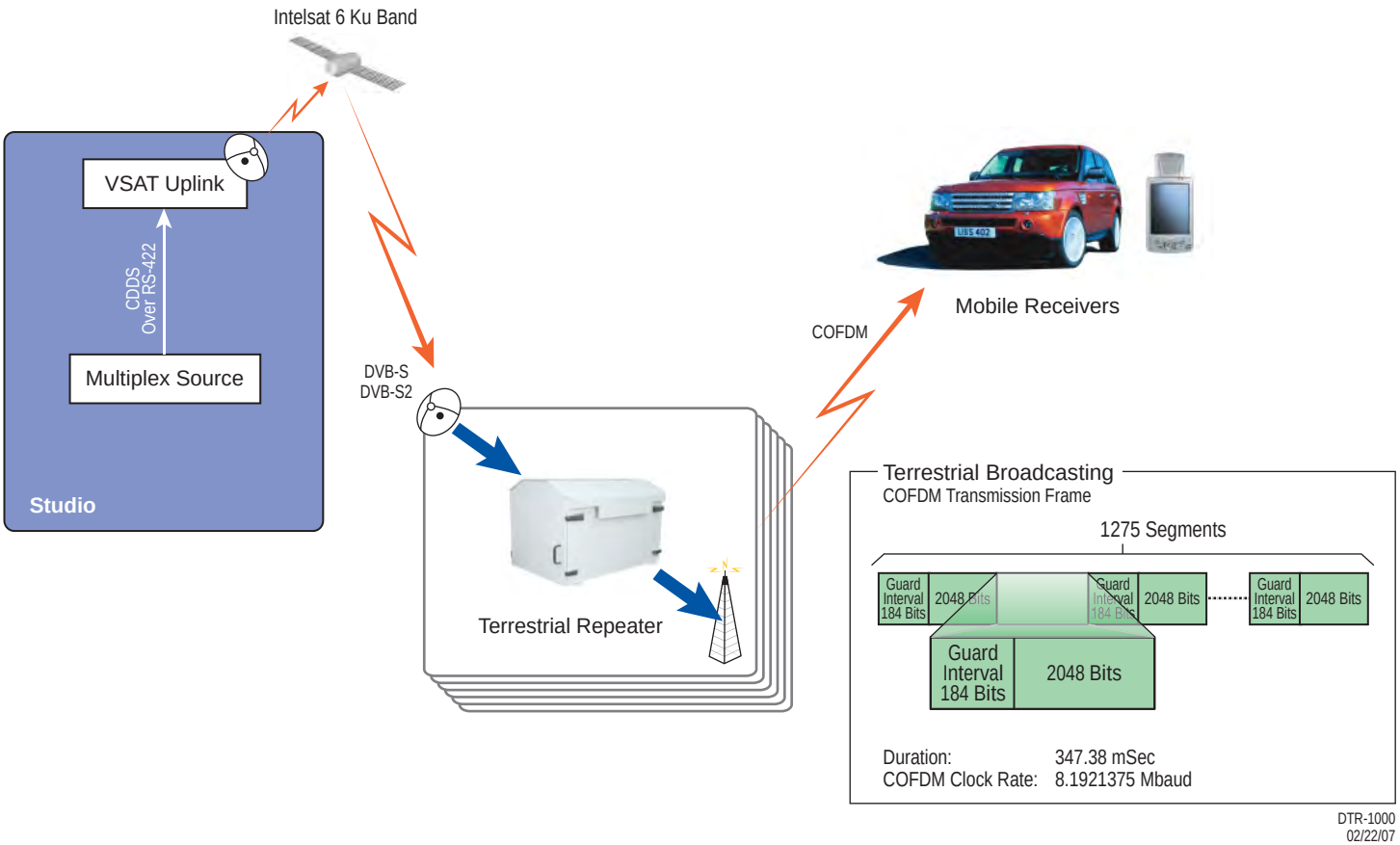


Figure 1-1 Typical Sirius Terrestrial Repeater Broadcast System

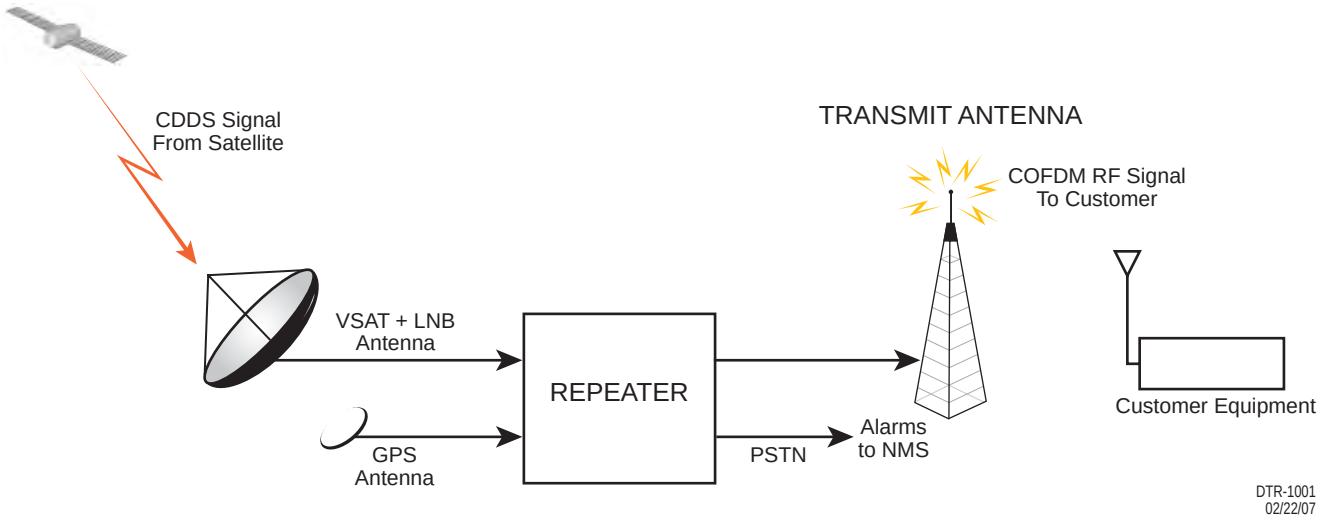


Figure 1-2 Typical Sirius Terrestrial Repeater Site

1.2 REPEATER MAIN COMPONENT BREAKDOWN

The terrestrial repeater can be divided into the following main components:

- Signal Processing Unit (SPU)
- High Power Amplifier (HPA)
- Power Distribution Unit (PDU)

The cabinet also contains the following

- Output Band Pass Filter
- Output Coupler

Each of these components is addressed in the Functional Description section of this manual.

1.3 REPEATER COMPOSITION

The repeater functional components comprise the following:

- HPA (located at the top level of the cabinet)
  - Power Amplifier
  - Module Pre-Driver
  - Splitter
  - Combiner
  - Power Supply
  - HPA Controller
- SPU (located at the middle level of the cabinet)
  - VSAT Receiver Module
  - Modulator Module
  - Main Controller Module
  - Up-Converter Module
  - Uninterruptible Power Supply (UPS)
- PDU (located t the bottom level of the cabinet)
  - Main power distribution source for the repeater
- Utility Compartment (shared with PDU)
  - Band Pass Filter
  - Output Coupler
  - Input/Output Junction Box
  - RF Detectors

The repeater cabinet contains hinged and lockable front and rear doors which provide access to the internals of the repeater. The cabinet, designed to protect the repeater internal components against adverse environmental conditions, is provided with ventilating fans and heater units.

See Figure 1-3 and Figure 1-4 for front and rear views of the repeater cabinet.

Figure 1-3 Front View of the Terrestrial Repeater

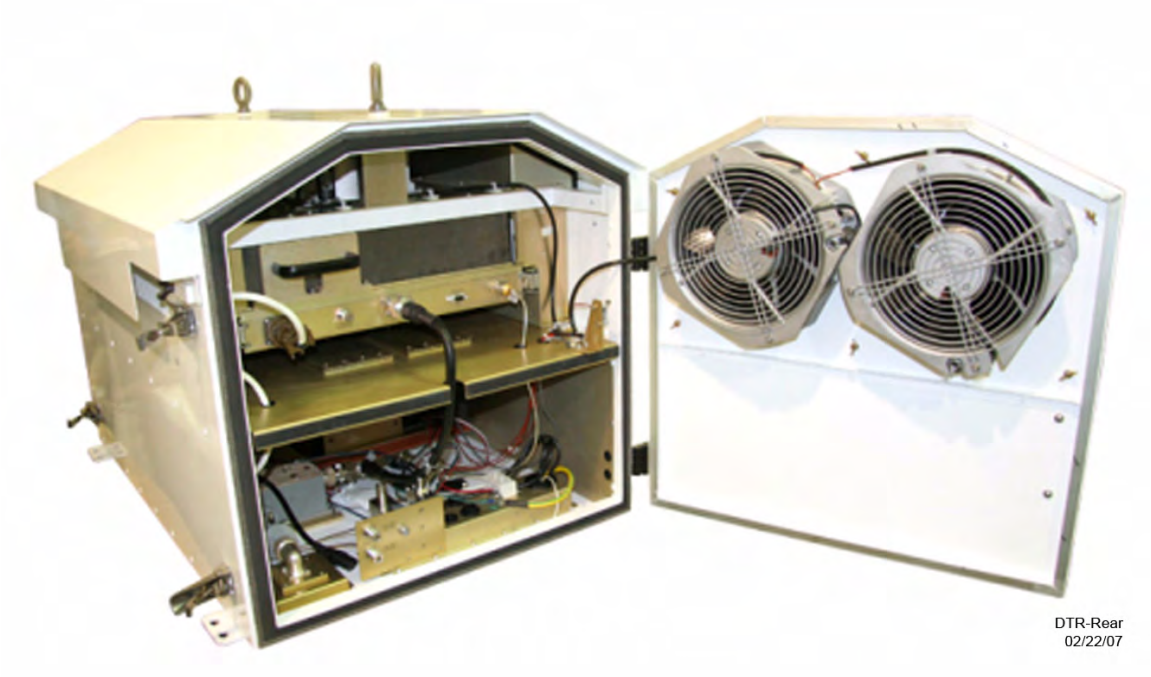
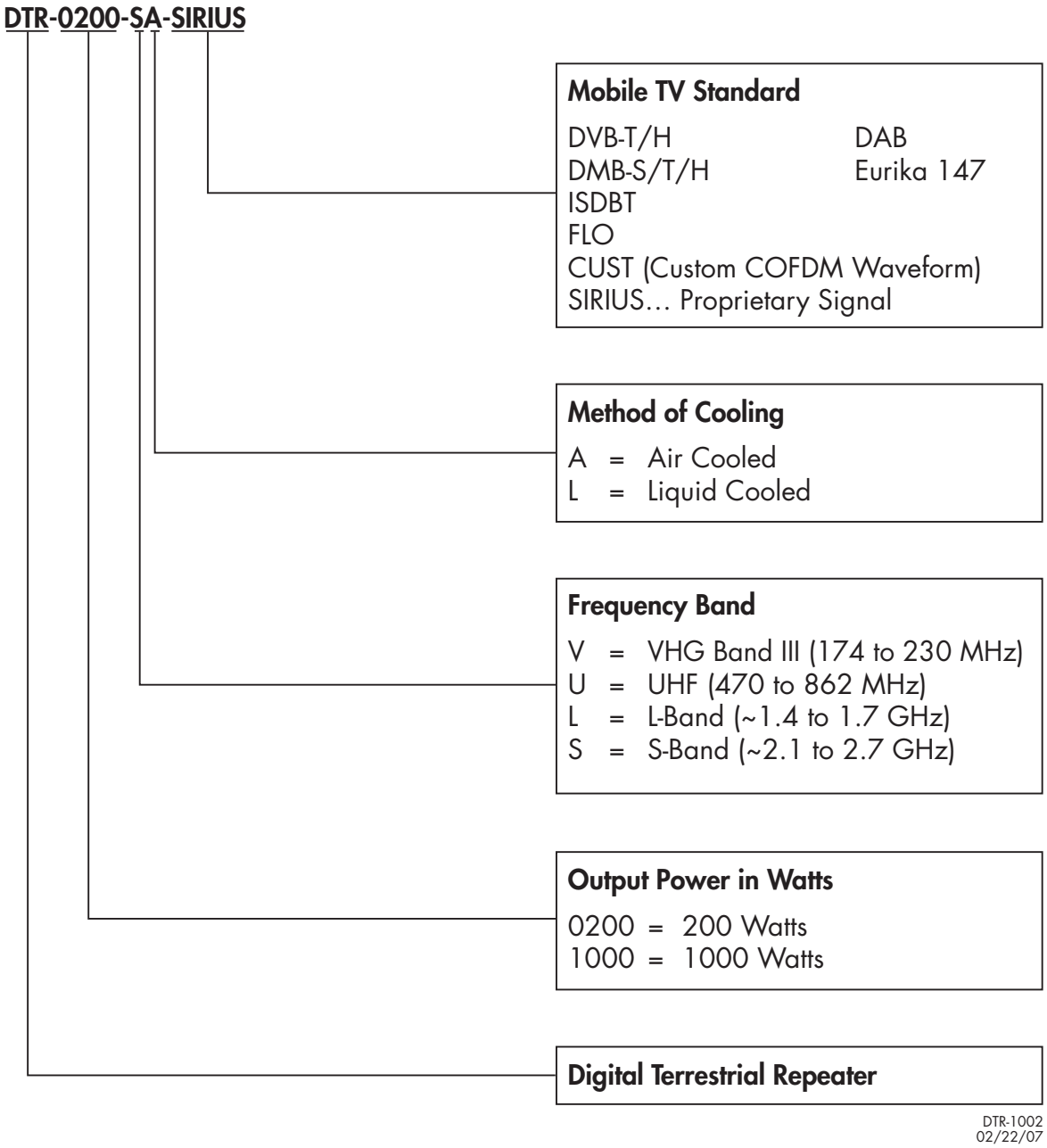


Figure 1-4 Rear View of the Terrestrial Repeater

1.4 DIGITAL TERRESTRIAL REPEATER NAMING CONVENTION



DTR-1002
02/22/07

1.5 SYSTEM CONFIGURATIONS

At the selected site the repeater can be mounted one of three ways:

- ground mount
- roof mount
- shelf mount

The repeater electrical and physical configuration is the same for either mounting.

1.6 TERRESTRIAL REPEATER TECHNICAL SPECIFICATIONS

Table 1-1 Physical, Electrical, and Environmental Specifications

Weight		Approx. 121 kg (266 lbs.)
Dimensions		60.10 x 102.55 x 67.63 cm / 26.81 x 36 x 40.38 x 26.63 in.
Cooling		Forced Air
Power Requirements		188-250VAC, 208 VAC NOMINAL, 57-63 HZ
Power Consumption		2.0 KW, TYPICAL
UPS Duration For Main Controller		5 minutes
Operating Temperature		-25ºC to +55ºC / -13ºF to +131ºF
Storage Temperature		-50ºC to +65ºC / -58ºF to +149ºF
Humidity		95% Non-condensing
Ratings/Circuit Breaker		**Max Effective Load/Circuit Breaker**
CB1 – SPU:	240V, 5A – 1.20kW @ MAX 55ºC	Max current 0.75A
CB2 - HPA:	240V, 25A – 6.00 kW @ MAX 55ºC	Max current 12.5A
CB3 - FANS:	240V, 5A – 1.20 kW @ MAX 55ºC	4 fans, 80W each – 320W total Max. current 1.5A
CB4 - EXTERNAL HEATER:	120V, 5A – 0.240 kW @ MAX 55ºC	Max. power 200W Max. current 1.7A
CB5 - AUXILIARY POWER:	120V, 10A – 0.600 kW @ MAX 55ºC	Max. current 5A
CB6 – INTERNAL HEATER:	240V, 5A – 1.20 kW @ MAX 55ºC	2 Heaters 500W (nominal) Max total. current @ 240VAC, 4.2A
CB0 – MAIN CIRCUIT BREAKER:	LINE 1 - 240V, 32A @ MAX 55ºC LINE 2 - 240V, 32A @ MAX 55ºC NEUTRAL - 32A @ MAX 55ºC	Max. load per Line and Neutral: LINE 1: Max current 25.7A LINE 2: Max current 19A NEUTRAL: Max current 6.7A

Table 1-2 Transmitter RF Output Performance

Operating Frequency	2326.25 MHz
Bandwidth	4.012 MHz
Rated Output Power	+53.0 dBm
Output Power Set Point Range	10 dB
Step Size	0.5 dB
Output Level Stability vs. Time	≤ -0.25 dB/24 hrs. max
Output Level Accuracy	≤ ±0.5 dB about selected level (+47 to +53 dBm range)
Spectral Re-growth	See Note 1 and Note 2
In-Band Carrier to Intermodulation Ratio	>25 dB
Spurious Level Outside Channel	< -60 dBm
Amplitude Flatness	Center Frequency ±2.006 MHz, ±0.5 dB
Connector Type	7/16" DIN, female, 50 ohm
Output VSWR	≤ 1.3:1

Note 1:The total RMS power in a bandwidth of 4.20 MHz centered around 2322.255 MHz, measured at the input to the antenna/cable system, is better than 40 dB down with respect to the RMS power in the transmitter COFDM signal measured at the same reference point.

Note 2:The total RMS power in a bandwidth of 4.20 MHz centered around 2330.245 MHz, measured at the input to the antenna/cable system, is better than 40 dB down with respect to the RMS power in the transmitter COFDM signal measured at the same reference point.

Table 1-3 Control Interfaces

NOC Interface	
Connector	RJ11
Standard	V90
Protocol	SNMP, WEB Interface
Ethernet Interface	
Connector	RJ45, 10/100/1000 Base T
Protocol	SNMP, WEB Interface
RS 232	
Connector	DB9 (M)
Protocol	Local Console Interface
GPS Antenna	
Connector	N-Type, female, 50 ohms, with bias voltage

Table 1-4 Repeater Signal Inputs

VSAT Ku Band (L-Band after LNB)	
Frequency Range	950 – 2150 MHz
Nominal Input Level	-65 to -25 dBm
Waveform	S1, S2
LNB Bias	Provided
Connector	F-type, female, 75 ohms
Ethernet Input	
Signal	IP multicast, standard 10/100 Base T interface
Connector	RJ45
ASI Input	
Connector	BNC, 75 ohms

Table 1-5 Signal Processing

Aggregate Data Rate	7.340625 Mbps
COFDM nominal bandwidth used	4.012 MHz
Modulation Type	Pi/4 Differential QPSK with adjustable amplitude and phase offset for hierarchical modulation
Number of Active Carriers	1000 (+2 unmodulated pilots +1 central null)
Intercarrier Spacing	4 kHz
FFT Size	2048 points (2 times oversampling)
COFDM Sampling Rate (1/T_COFDM)	4.096 MHz (with no oversampling)
COFDM FFT Rate (1/T_FFT)	3.6703125 kHz
Total Symbol Duration	272.4564 us
Useful Symbol Duration	250 us
Guard Interval	22.4564 us
COFDM Demodulator Output Symbol Rate (1/Ts)	3.6703125 Mbaud QPSK
Time and Clock Reference	Internal GPS
Phase Noise SSB	100Hz: < -72 dBc/Hz 1kHz: < -77 dBc/Hz 4kHz < -81 dBc/Hz 10kHz: < -84 dBc/Hz 100kHz: < -112 dBc/Hz 1MHz: < -123 dBc/Hz
Sirius Transmission Frame Buffering (terrestrial signal time delay)	Up to 17 frames (approx. 6 sec.)

Table 1-6 Repeater Test Ports

Repeater Out Forward Power	Connector: N-type, female, 50 ohms, Coupling: -50 dB
Repeater Out Reflected Power	Connector: N-type, female, 50 ohms, Coupling: -40 dB
HPA RF Monitor	Connector: N-type, female, 50 ohms, Coupling: -50 dB
Upconverter RF Out Monitor	Connector: SMA, female, 50 ohms, Coupling: -20 dB

Table 1-7 Repeater Test Modes

CW Signal	COFDM spectrum replaced by a single carrier 4kHz aside from the center frequency. The RMS level of the single carrier is equivalent to average RMS level of normal COFDM spectrum. The signal is intended for testing of in-band signal-to-noise ratio.
Notch Signal	Movable group-of-carriers hole for test of intermodulation and quantization noise
PRBS Signal	Empty DARS frames (PRBS sequence)

1.7 REPEATER COMPONENTS LOCATION

The repeater enclosure cabinet contains field replaceable subassemblies called “Least Replaceable Units (LRUs)” as listed in Table 1-8.

Figure 1-5 locates the repeater components including the LRUs.

The part number for the entire repeater enclosure cabinet with all electronics and internal equipment is P/N 3EM04000AA.

Table 1-8 Repeater Least Replaceable Units (LRUs)

Signal Processing Unit (SPU)	Refer to Appendix B for part numbers
High Power Amplifier (HPA)	
RF Output Coupler	
RF Detector (Two; one forward, one reflected)	
Cabinet Exhaust Fan (two exhaust fans under roof)	
Cabinet Exhaust Fan Relay	
Cabinet Intake Fan (two intake fans in rear door)	
Cabinet Intake Fan Relay	
PDU Circuit Breakers	

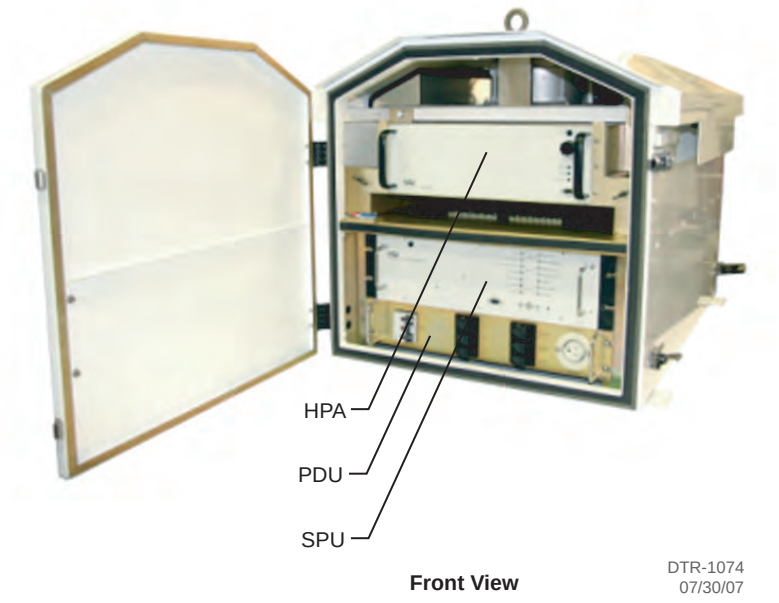


Figure 1-5 Components Location (Sheet 1 of 2)

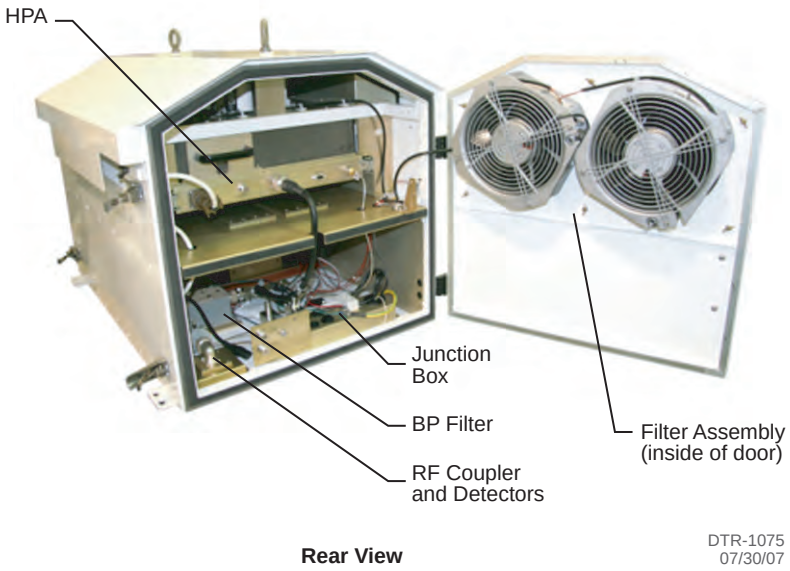


Figure 1-5 Components Location (Sheet 2 of 2)

2 FUNCTIONAL DESCRIPTION

2.1 GENERAL

This section presents a functional description of the Sirius Terrestrial Repeater.

2.2 SYSTEM FUNCTIONAL OVERVIEW

Figure 2-1 shows the basic Repeater Simplified Functional Block Diagram.

The Sirius Terrestrial Repeater transmits at the 2.3265 GHz frequency with a 4.012 MHz signal bandwidth. Refer to the tables in Section 1 for the technical characteristics and the major components.

2.2.1 SIGNAL FLOW

The Sirius Terrestrial Repeater receives the video/audio Complex Digital Data Stream (CDDS) signal in a TDM format at the KuBand from the satellite by means of a Very Small Aperture Terminal (VSAT) parabolic antenna.

The CDDS signal passes through a Low Noise Block (LNB) converter to the DVB-S L-Band satellite receiver; an integral part of the Signal Processing Unit (SPU). The satellite receiver demodulates the incoming stream and outputs the processed data via the Asynchronous serial Interface (ASI) to the SIRIUS modulator stage.

The output of the modulator is an Orthogonal Frequency Division Multiplexed IF (I and Q signals).

The IF is up-converted to an S-band frequency for insertion into the High Power Amplifier (HPA). The output of the HPA goes through the output bandpass filter (BPF) where “out of band” generated signals are removed.

The output BPF signal (200W RF) goes through the output RF coupler to the tower mounted antennas and is transmitted to the end user

This page intentionally left blank.

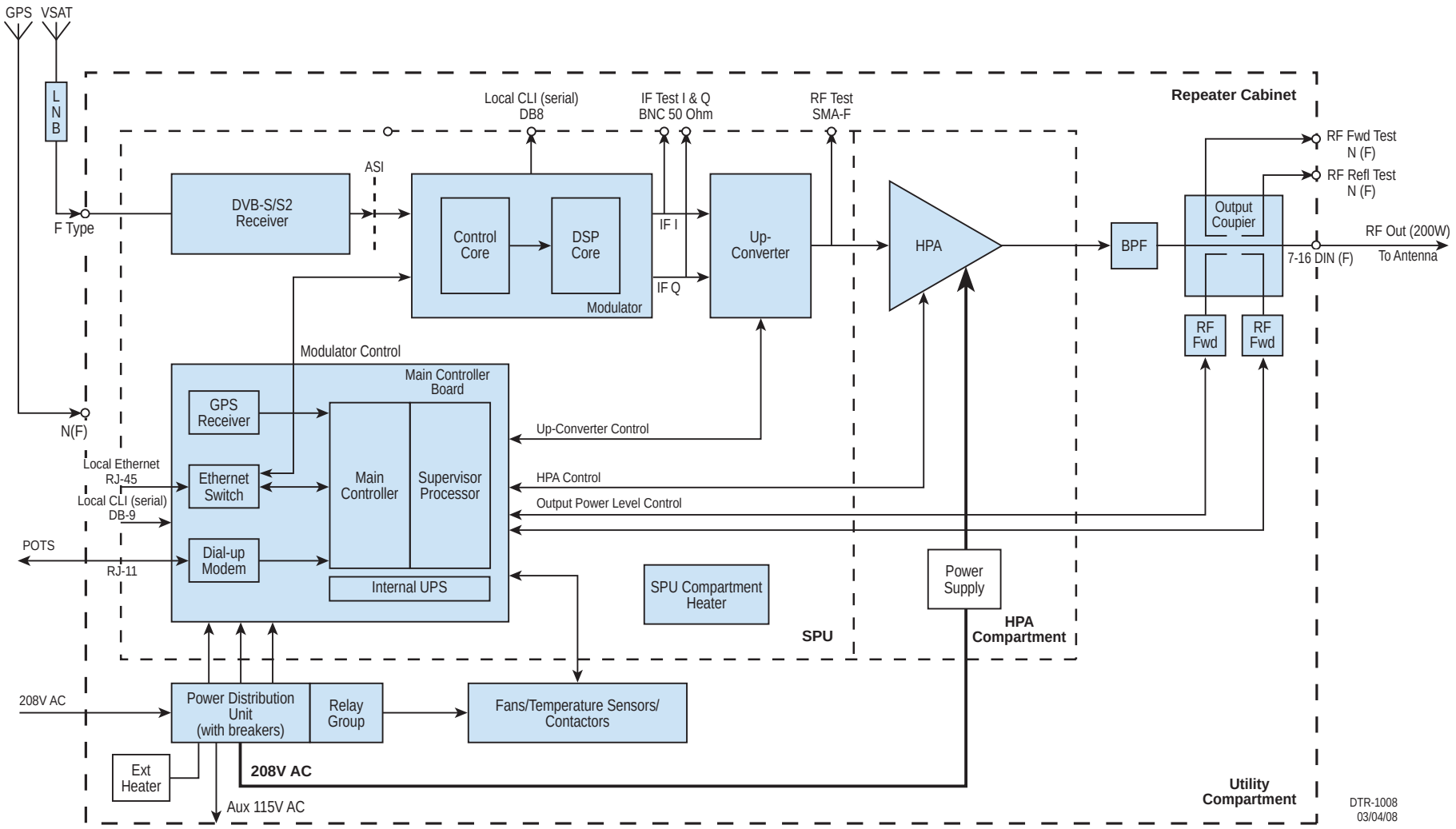


Figure 2-1 Repeater Simplified Functional Block Diagram

This page intentionally left blank.

2.3 MAIN FUNCTIONS

The Sirius Terrestrial Repeater consists of the following main functions:

- **Receiver** – Receives the down converted input signal from the VSAT Antenna/ LBN via coax cable. Processes the received signal for transmission to the modulator.
- **Transmitter** – (modulator, up converter, HPA, bandpass filter, and output coupler) Transmits the received and processed RF signal, via tower mounted antenna, to the end user's equipment.
- **Timing** – A GPS receiver provides signals for synchronization within the Signal Processing Unit (SPU).
- **Monitor and Control** – This function is primarily performed by the main controller board which receives information from all external devices, including temperature, power to antenna, output signal control parameters, and equipment condition.
- **Power Distribution** – Power is controlled and distributed by a power distribution unit (PDU) and a relay control group.

Functional description of the components involved in these main functions follows.

2.3.1 SIGNAL PROCESSING UNIT (SPU) SUB-ASSEMBLY

Figure 2-2 and Figure 2-3 respectively show a physical representation and functional block diagram of the SPU.

The primary function of the SPU is to receive the complex digital data stream (CDDS) from the VSAT satellite, modulate the received signal into a COFDM waveform, up-convert the waveform to the assigned S-Band frequency within the user's frequency plan, and forward this waveform to the HPA in the transmitter portion of the repeater.

The SPU contains the L-Band satellite receiver, modulator, up-converter, main controller, and Uninterruptible Power Supply (UPS).

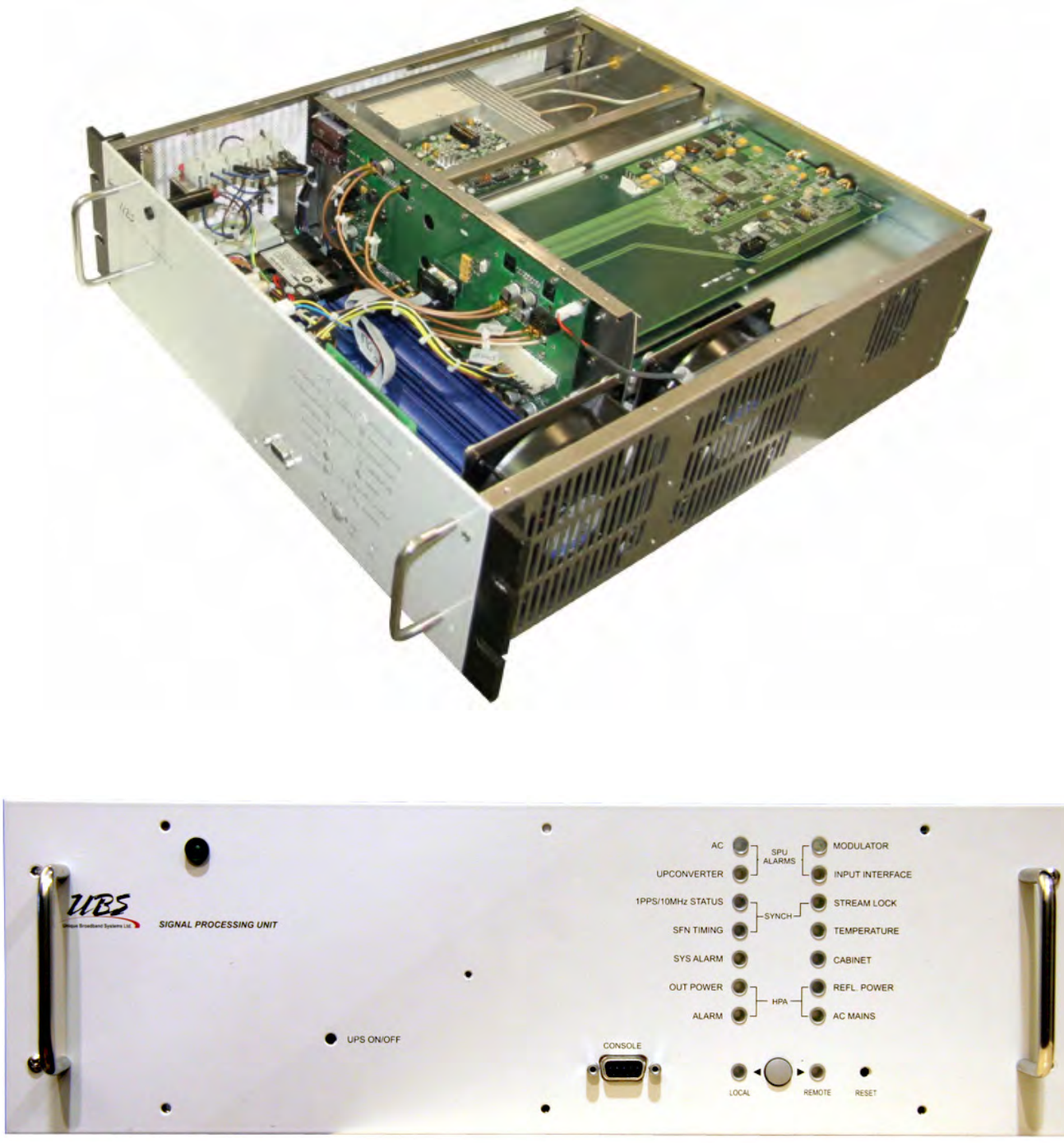
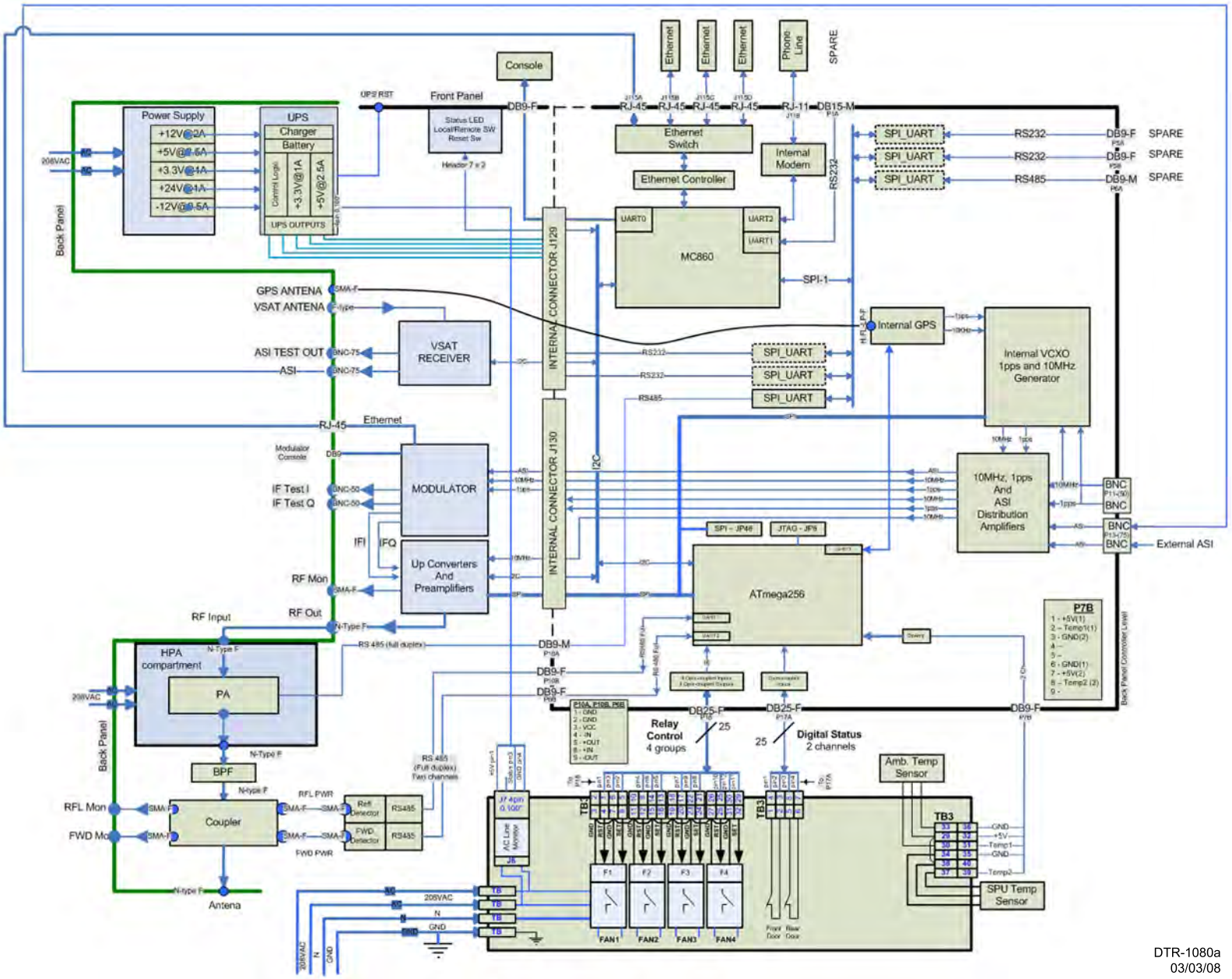


Figure 2-2 Signal Processing Unit (SPU)



DTR-1080a
03/03/08

Figure 2-3 Sirius Signal Processing Unit (SPU) Functional Block Diagram

This page intentionally left blank.

2.3.1.1 L-Band (VSAT) Receiver

The VSAT L-Band receiver connector panel is shown in Figure 2-4.

The receiver module is located on the SPU sub-assembly.

The module receives the DVB-S/S2 signal data stream (which carries the SIRIUS proprietary CDDS) from the L-band LNB module located on the Ku-band VSAT antenna.

The receiver processes the down-converted L-band signal by DVB-S/S2 transport stream removal and data recovery.

The final receiver output is a stream of CDDS encapsulated into pseudo MPEG TS packets.

Figure 2-4 VSAT (L-Band) Receiver Panel

2.3.1.2 Modulator

The modulator panel is shown in Figure 2-5.

The modulator, located on the SPU sub-assembly, converts the digital coded stream to an IF.

It receives Sirius CDDS stream input data from the L-band receiver in the form of MPEG TS packets transferred by DVB-ASI.

The modulator also receives reference system clock signals in the form of 10MHz and 1PPs from the GPS distribution amplifiers. These clock signals enter the modulator at J17A and J17B and synchronize the modulator clock and, in turn, the modulator output.

COFDM converts the MPEG TS frames to an IF in the form of I and Q signals with a center frequency of 76.25 MHz ready for up conversion.

The modulator contains a DB-9 serial port wired as a DTE device and requires a null modem cable to communicate with the serial port on a PC.

Figure 2-5 Modulator Module

2.3.1.3 Up-Converter

Figure 2-6 shows the up-converter panel. The up-converter converts the modulator IF (I and Q channels) output to S-Band.

An up converter controller applies DAC-controlled DC offset to each IF channel, attenuates and filters the channels, and then sends them to the up-converter for S-Band frequency con-version.

The 2.32625 GHz S-Band output of the up-converter feeds into the pre-driver of the HPA.

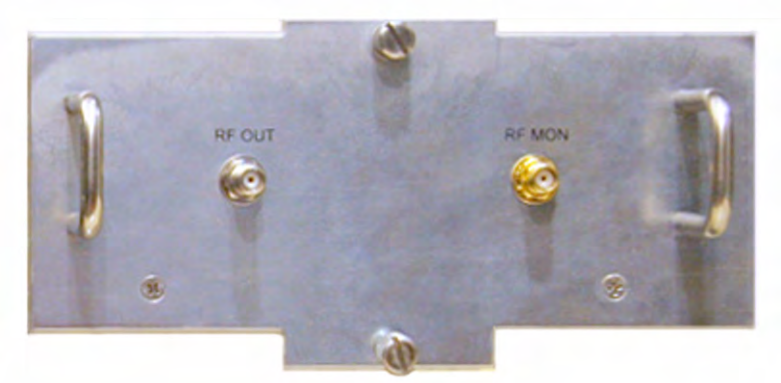


Figure 2-6 Up-Converter Module Panel

2.3.1.4 SPU Main Controller Board

See Figure 2-7 and Figure 2-8 connector panel and functional block diagram.

The main controller supports the repeater site operation, configuration, management, and status reporting. It manages power-up, power-down and RF control processes. The controller provides capability for remote upgrade of repeater software, and provides local and remote interfacing for all command and status functions (including digital, thermal, power, and RF performance of the repeater).

Control commands for status requests and operating parameter modifications from the operator interfaces are received and processed by the main controller.

The controller reports problem conditions through dedicated interfaces and also indicates current status and alarms via front panel LEDs.

Repeater identity can be configured remotely or locally via the controller. Configuration includes repeater identity (repeater name, password, local IP address, two remote NMS IP addresses, and SNMP security variables).

The functional software components of the controller are:

- Repeater protection via continuous local monitoring of all main blocks.

The output coupler, HPA, and HPA power supply are continually monitored. If any monitored parameter exceeds its threshold, the RF is shut down and the Network Management Center (NMC) is notified. Hazardous conditions shut down the repeater. Under certain conditions clearing the event will automatically restart the repeater.

- HPA RF output Automatic Power Level Control (APLC).

The APLC loop checks RF output level reported by the RF output coupler and changes the up converter out-put level.

- Performance of two-way communication with the NMC.

Communication can be via either of the following:

Dial-up modem through a PSTN line

Ethernet to the Management Center via WAN

Forward channel using the input channel and satellite return channel.

- Load, initialize, and monitor the supervisor controller, the GPS receiver, the up converter, the VSAT receiver, the modem, and the modulator.
- Perform software upgrade for the main controller, supervisor controller, and modulator.
- Monitor RF subsystems; HPA, HPA power supply, and RF coupler
- Event Logging is written to the EEPROM and accessible from WEB/embedded FTP server via NMC.
- Self monitoring and environment monitoring (temperature, fans, voltage, current)

Power-up Test – on power-up the main controller performs a self-test (POST) and waits for all other subsystems to perform POST of their major components and report results. Any main block problem causes the repeater to shut down and an attempt is made to notify the NMC. Notification is attempted via the modem or Ethernet to the NMC.

Back-up Test – continuous self-monitoring of controller and all subsystems. Anomalies are reported to NMC. Major faults cause the controller to shut down the repeater

Heartbeat – a special trap/message is transmitted regularly (transmission inter-val set by user via GUI, See Figure 5-34 in Section 5) to the NMC. This message indicates to the NMC operator that the repeater is alive; a valid connection exists between the repeater and the NMC, and the repeater main controller is operational.

- Local/remote software upgrade – software upgrade is initiated via a web browser by directly uploading the upgrade file to the controller. When the file is successfully received, the web server task will invoke the upgrade procedure. Upgrade applies to any of the controller software components or any of the other system components.
- Parameter database clearing in EEPROM will return to default settings.

The functional physical components of the controller are:

- Main Controller microprocessor chip MPC860x
- Supervisor Processor microprocessor chip ATmega2560
- GPS receiver
- Dial-up modem
- Ethernet Switch
- Internal UPS

Figure 2-7 Controller Board Panel

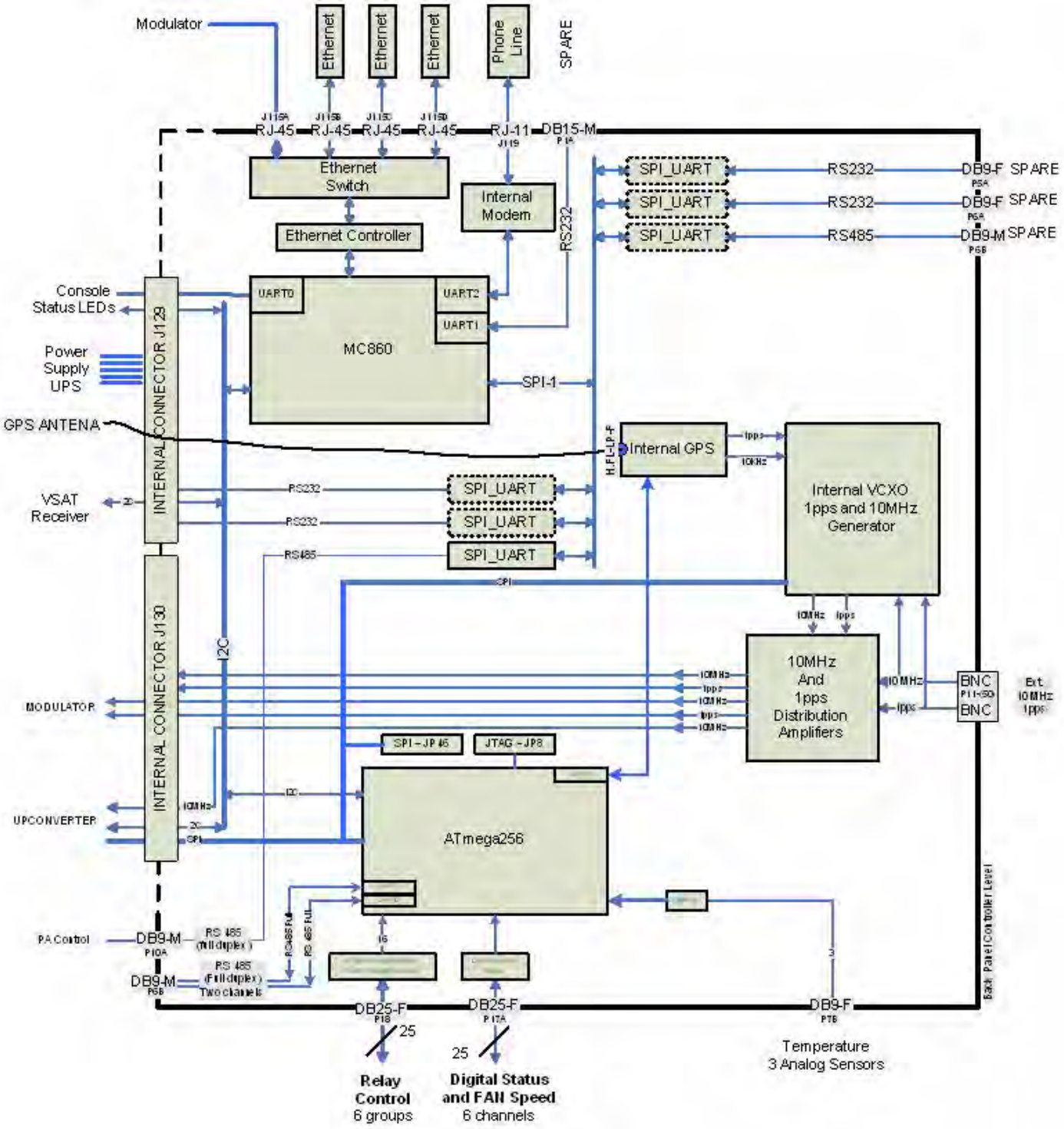


Figure 2-8 Main Controller Board Functional Block Diagram

2.3.1.4.1 Main Controller Microprocessor Chip

The MPC860 microprocessor performs all site management to include control of the GPS receiver, modem, and L-band DVB-S/S2 receiver. The controller also communicates with the SPU modules and on-board components via dedicated interfaces using soft-ware defined protocols. The MPC860 chip connects to the Ethernet, to an external monitoring/controlling console (PC), to the VSAT receiver, the internal modem, to the upconverter, to the power amplifier, and to the following front panel components: the status LED, the Local/Remote switch, and the Reset switch. The MPC860 also connects, via the module internal I2C bus, to the ATmega256 control processor (supervisor controller).

- Ethernet connection-via an internal Ethernet controller connected to an internal Ethernet switch and terminating at four RJ-45 connectors (J115A, J115B, J115C, and J115D). External Console connection via a UART (UART0) internal to the MPC860 chip and connected to module internal connector J129 (DB9-F).
- VSAT Receiver- connects to the MPC860 chip via the module internal I2C bus and internal connector J129.
- Internal Modem connection-from UART2 in the MPC860 chip to the modem and then to the RJ-11 connector at J119.
- The Upconverter-connected to the MPC860 chip via the module internal I2C bus.
- Power Amplifier connection-to the MPC860 chip via RS485 bus. This is a full duplex PA control line.
- Front panel components-the status LED, the Local/Remote switch, and the Reset switch connect to the J129 internal connector on to the I_C bus and into the main processor chip.

2.3.1.4.2 Supervisor or Control Processor

The ATmega256 chip monitors status, temperature, and RF power. The chip also controls output digital relays required for interface with the external equipment.

- Relay Control – The ATmeg a256 connects to the Relay Control Group via back panel DB25 connector P18 for fan control (four channels).
- Fan Speed & Door Monitoring – The processor connects to DB25 back panel connector P17A to receive digital inputs (up to 12 lines). Four channels are for fan speed monitoring, and two for front and back door monitoring. Six additional switches can be connected as required.
- Temperature Sensing – There are three temperature sensing thermistors (ambient, HPA compartment and SPU) connected to terminal board 3 (TB3). The processor provides +5 VDC to each thermistor and reads the temperature from -55˚C to + 180˚C of each thermistor. The TB3 connections to the processor are via DB9-F panel connector P7B.

- RF Power: Monitoring is two channel and RS485 full duplex. The path is from the reflected power and forward power detectors through DB9-M panel connector P6B into the processors UART1 and UART2. The Atmega256 processor initializes the GPS Receiver, makes all necessary settings and then monitors important stats (refer to GPS Receiver below).

2.3.1.4.3 GPS Receiver

The GPS receiver provides 10 MHz and 1 pps signals for synchronization purposes. The signals' exact alignment to a UTC/GPS second is monitored via a message received by the controller as a response to the correspondent's request. The receiver supports proprietary binary messages and also NMEA formatted message protocol. A subset of the protocols is used by the MPC860 microprocessor to control receiver operation. 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 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. The output of the GPS (1 pps and 10MHz pulses) is to the Distribution Amplifiers, which in turn feed the pulses to the Modulator and Up-converter via internal connector J130.

2.3.1.4.4 Dial-up Modem

Two chips, Si2457 and Si3018, make up an internal modem and provide the required connectivity to POTS (PSTN). The phone line connection is via an RJ11connector (J119 on the front panel). This telephone communication channel provides the main control interface for repeater monitoring by the Sirius repeater NMS. Information exchange between site and NMS is via SNMP.

2.3.1.4.5 Ethernet Switch

The Ethernet switch is a built-in 10/100 Base-T switch and provides four RJ-45 Ethernet ports allowing the controller to communicate with other Ethernet devices.

2.3.1.4.6 Uninterruptible Power Supply (UPS)

See Figure 2-9. The UPS monitors the AC line status and if the AC voltage drops, it provides +5V and +3.3V for CPU backup. The UPS provides CPU back-up power for up to 5 minutes, enough time to store the current state of the repeater, store parameters in volatile memory, notify NMS, and completely and safely shut down the repeater. The unit comprises a bank of five Ultra Capacitors, 350F/2.5V each, a DC/DC converter, over-voltage protection and charging/discharging circuitry. During repeater power-up, the capacitors charge through a current limiting resistor with the bulk of the power going to the SPU and no interruption of power during this period. When power is interrupted, the capacitors discharge to the load through the DC/DC converter at a steady five volts until they reach approximately seven volts at which time the SPU power is terminated.

A manual ON/OFF control switch is located on the front panel of the UPS and allows the unit to be manually switched on or off. This is used primarily by maintenance technicians when servicing the repeater.

An internal automatic ON/OFF switch switches the unit off when the +5 or 3.3 input voltages drop. This prevents back current feed to the power supply. The UPS has a 3-wire interface for connection of an optocoupled AC sensor.

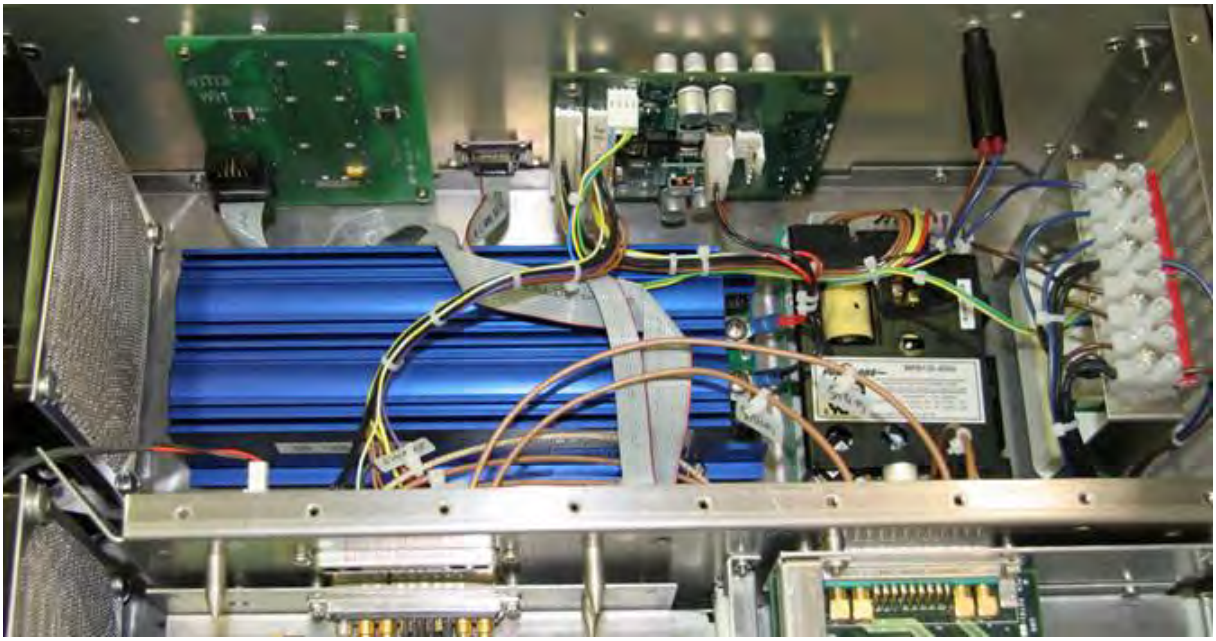


Figure 2-9 Uninterruptible Power Supply (UPS)

2.3.1.4.7 SPU Power Supply

The power supply is 208VAC, 30-50 W brick power supply AC/DC converter and provides all required voltages for the SPU:

+5V @ 3A

+3.3V@1A

+12V@2A

-12V@0.5A

+24V@1A

The power supply input is 208VAC/50-60 Hz.

2.3.1.4.8 SPU Compartment Heater

The SPU compartment heater protects the SPU enclosure from freezing and/or condensation.

2.4 HIGH POWER AMPLIFIER (HPA)

See Figure 2-10 and Figure 2-11 for the HPA sub-assembly front and rear panels and the HPA functional block diagram.

The HPA amplifies the S-Band terrestrial signal to an output level of 200 watts (after the output filter). The HPA is a solid-state device operating in Class A/B linear mode over a frequency range of 2305 MHz to 2360 MHz and is fully protected against input overdrive, temperature, and output load VSWR conditions. The protection circuitry is self-correcting and allows restoration of the HPA to normal operation upon removal of the fault.

The HPA is a separate sub-assembly Least Replaceable Unit (LRU) installed on sliding rails in the repeater enclosure. It contains an integrated AC/DC power supply, a pre--driver, a driver, a 5-way splitter, five individual power amplifier modules, a 5-way combiner, and an HPA controller.

Front Panel

Rear Panel

Figure 2-10 HPA Panels

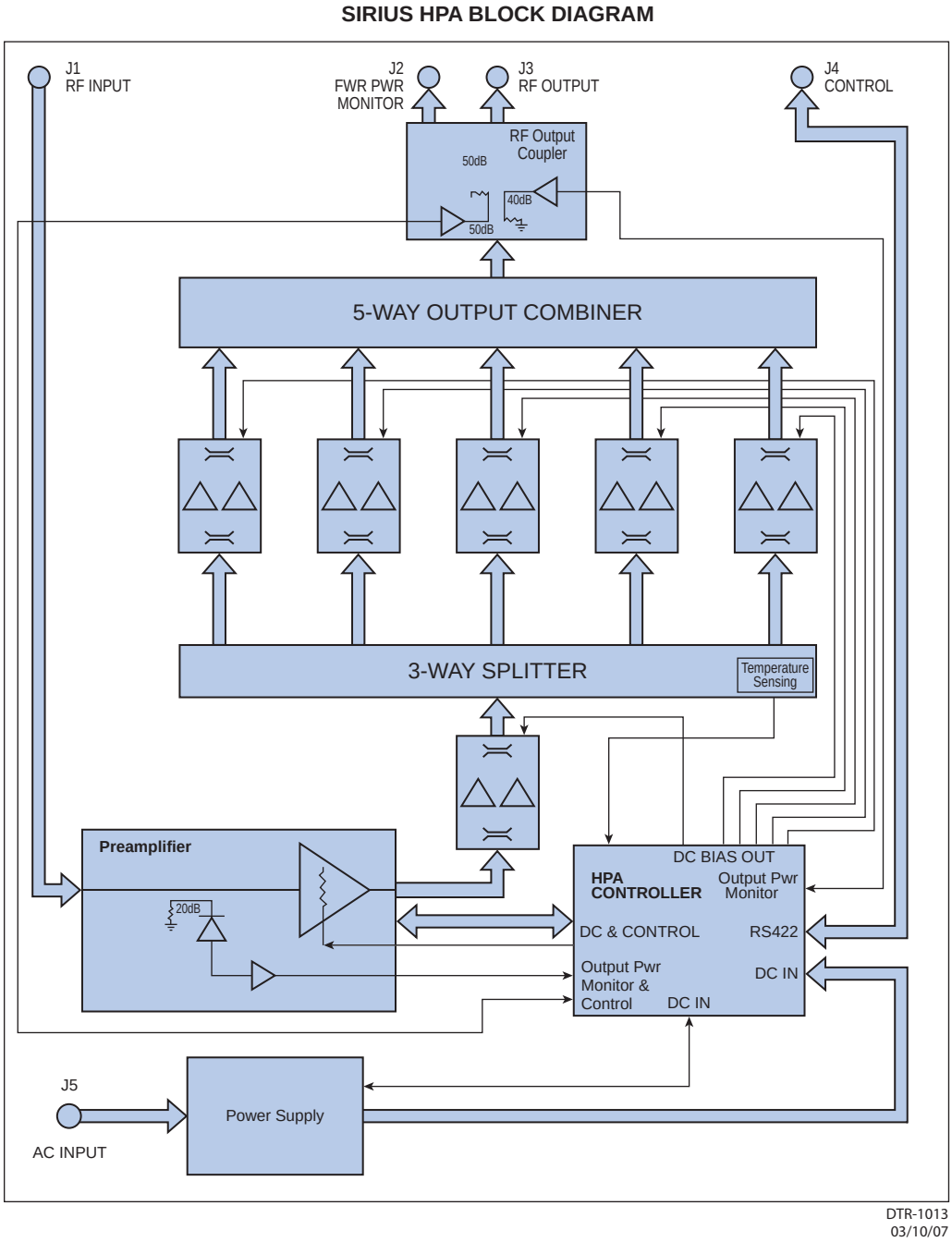


Figure 2-11 HPA Functional Block Diagram

2.4.1 HPA CONTROLLER

The HPA Controller monitors various parameters and reports current values and summary alarms to the repeater main controller via the RS485 interface. The various monitored parameters and statuses are the power modules working conditions (DC voltages and currents), the temperature inside the HPA assembly, the HPA forward and reflected power levels, input power and gain, RF power inhibit, HPA power supply enabled/disabled, input/output overdrive alarm, over-temp alarm (announced prior to shut-down), over-temp fault, HPA shut-down alarm, output device failure alarm, driver device failure alarm, HPA low gain alarm, power supply AC fault, and power supply DC fault.

The HPA Controller also performs HPA pre-driver control, provides the HPA power-up and shut-down procedure, and interfaces the HPA to the host (SPU Main Controller). If the HPA controller detects a problem with a specific PA module, it shuts down the entire HPA. The SPU main controller can restart the HPA utilizing the remaining operational PAs. If the number of faulty PAs exceeds a predetermined threshold, the HPA can not be restarted by the host.

Since the HPA is a constant gain block, it is individually calibrated to maintain RF performance under varying operating conditions. Calibration is performed on the forward, reflected, and input power sensors. A calibration table dependent on temperature and frequency is stored in the internal EEPROM of the HPA controller.

The HPA controller reports alarms to the main controller and maintains a log of alarms. Alarm entries contain the alarm ID and monitored parameters prior to alarm activation. The alarm log is stored in an internal EEPROM. The HPA controller can enable/disable the output RF and also turn the integrated power supply DC power ON and OFF.

2.4.2 HPA POWER SUPPLY

The HPA Power Supply is a high performance power source that delivers appropriate voltages and current necessary to operate the HPA at its required performance level. The power supply resides in a separate compartment inside the HPA module and employs four independent AC-to-DC converters operating in parallel. The converters' outputs are combined on a single bus and connect to the input terminal of the Power Distribution/Controller board located in the power supply compartment. The Power Supply contains supervisory circuitry to report the status of the AC input voltage and DC/DC converters operation status to the Power Distribution/Controller module. This Controller module also monitors the Power Supply DC output voltage and the current draw of each of the HPA sub-modules, and reports these parameters back to the Main System Controller via the serial port. In addition, the Power Supply has the ability to enable/disable the power to the HPA when so commanded by the Main System Controller.

2.4.3 HPA PREAMPLIFIER (PREDRIVER)

The pre-driver is the first amplifying stage of the HPA. It employs three stages of amplification-a Monolithic Microwave Integrated Circuit (MMIC) amplifier and two LDMOS transistors. The pre-driver raises the output power of the RF from the up-converter by 38 dB and feeds the amplified RF into the HPA driver amplifier. The RF signal from the pre-driver input is also coupled to the RF detector circuit which provides detected RF to the HPA controller for monitoring and gain control. The coupled RF signal is routed through a PIN diode attenuator to maintain the HPA gain control loop. The pre-driver amplifier, via a Gallium Arsenide (GaAs) MMIC RF switch, can turn the RF signal on or off by way of a logic level HIGH RF Shutdown TTL control signal.

2.4.4 HPA DRIVER AMPLIFIER

The driver amplifier, employing two parallel amplifiers, receives the RF output from the pre-driver and amplifies it by 13.3 dB. The output of the driver amplifier is fed into a five-way splitter at a power level of 43 dBm.

2.4.5 HPA POWER SPLITTER

The five-way power splitter is connects directly to the HPA driver amplifier RF output. The splitter evenly distributes this RF power to the five individual output power amplifier modules.

2.4.6 POWER AMPLIFIER MODULES

The five power amplifier modules are identical to the driver amplifier module. These modules are paralleled and receive equal inputs from the five-way power splitter. The amplifiers each contribute a gain of 13.3 dB to their respective input, the five-way combiner/coupler.

2.4.7 COMBINER/COUPLER

The five RF power amplifier outputs are combined into one via a zero-degree star combiner. Two stripline couplers provide output signal sampling. One coupler's outputs are terminated with SMA connectors and are used to provide external forward and reflected RF monitoring ports. The other coupler's outputs are detected using true-type RF detectors installed on a coupler printed circuit board. These detected signals are fed to the HPA Controller for control and monitoring purposes. The detected signals and DC power for the on-board detectors are routed through 6-pin Molex connectors installed on a coupler board. The 5-way combiner/coupler requires external +5VDC ± 0.5 volts. When the combiner/coupler is installed on the HPA chassis, the inputs are connected directly to the power modules' output pins. The output of the combiner is connected to the central conductor of the HPA output connector.

2.5 S-BAND OUTPUT FILTER

The output filter is a bandpass filter and provides attenuation of the out-of-band emissions generated by the HPA. The attenuation is to comply with the requirements of TN-SPEC-2.1.0, Terrestrial Network Technical Specification, Transmitter RF Emissions.

2.6 OUTPUT COUPLER

The output coupler, connected to the output port of the transmit filter, is the final component in the transmitter chain. The coupler samples the composite RF power level at the repeater RF output. The RF levels at the FWD and REF ports are measured with the RF detectors and reported to the repeater main controller via the RS485 interface. The output coupler provides test ports for connection to external test equipment.

2.7 POWER DISTRIBUTION

See Figure 2-12 and Figure 2-13 for a simplified block diagram and an isometric view of the Power Distribution Unit (PDU). The PDU is mounted on the bottom of the repeater cabinet (see Figure 1-5), receives the input commercial 208VAC power, and distributes required power to the repeater modules.

The PDU is comprised of seven circuit breakers, two surge protectors, two RFI power line filters, two latching relays, forty two-stage feed through terminal blocks, and one double grounding terminal. The front panel of the PDU houses the seven circuit breakers and one power outlet.

The circuit breakers are as follows:

MAIN POWER – one 32A, 250VAC, 3-pole circuit breaker controls the incoming 208VAC to the repeater from the commercial source. Throwing this breaker will remove all power from the repeater.

FANS – one 5A, 250VAC, 2-pole breaker powers the axial fans.

HPA – one 25A, 250VAC, 2-pole breaker supplies the HPA power supply. SPU – one 5A, 250VAC, 2-pole breaker supplies the SPU power supply

EXT HEATER – one 5A, 250VAC, 2-pole breaker powers the external heater

INT HEATER – one 5A, 250VAC, 2-pole breaker powers the internal heater

AUX POWER – one 10A, 250VAC, 2-pole breaker supplies 120VAC, 5A, to the AUX OUTLET.

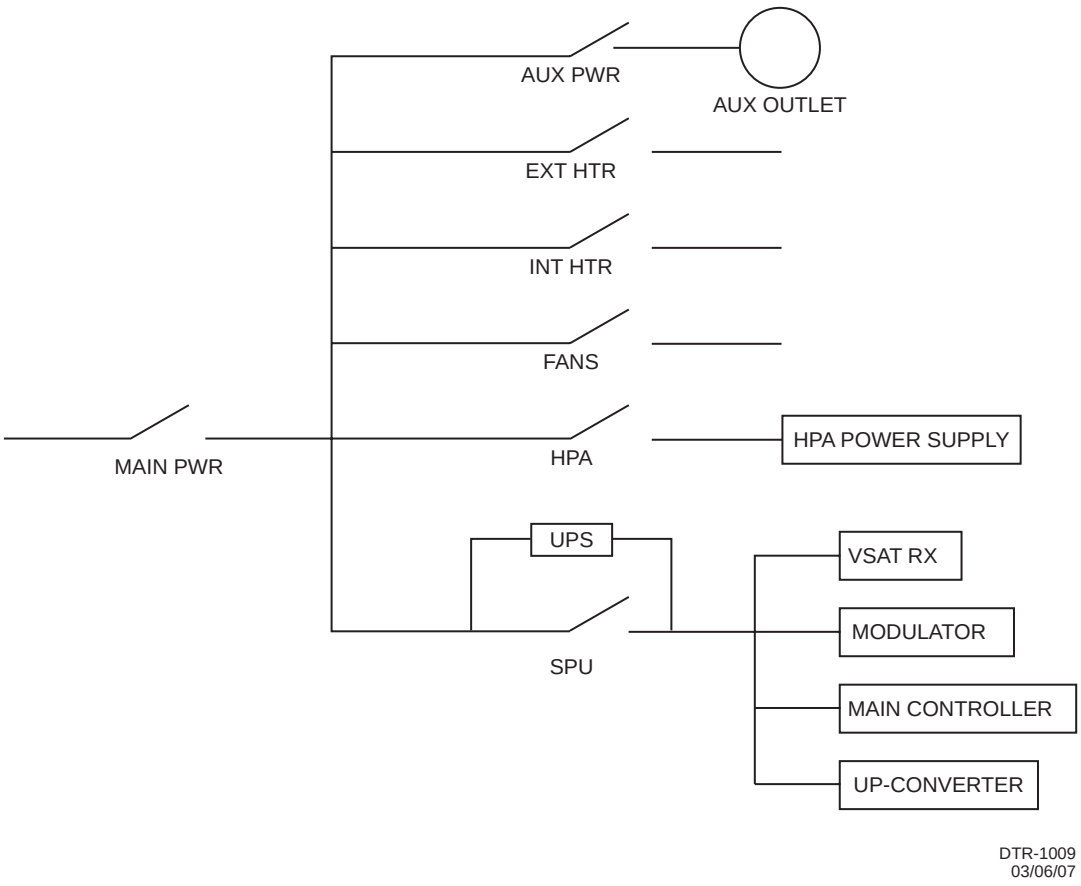


Figure 2-12 Simplified Block Diagram of Main Power Paths

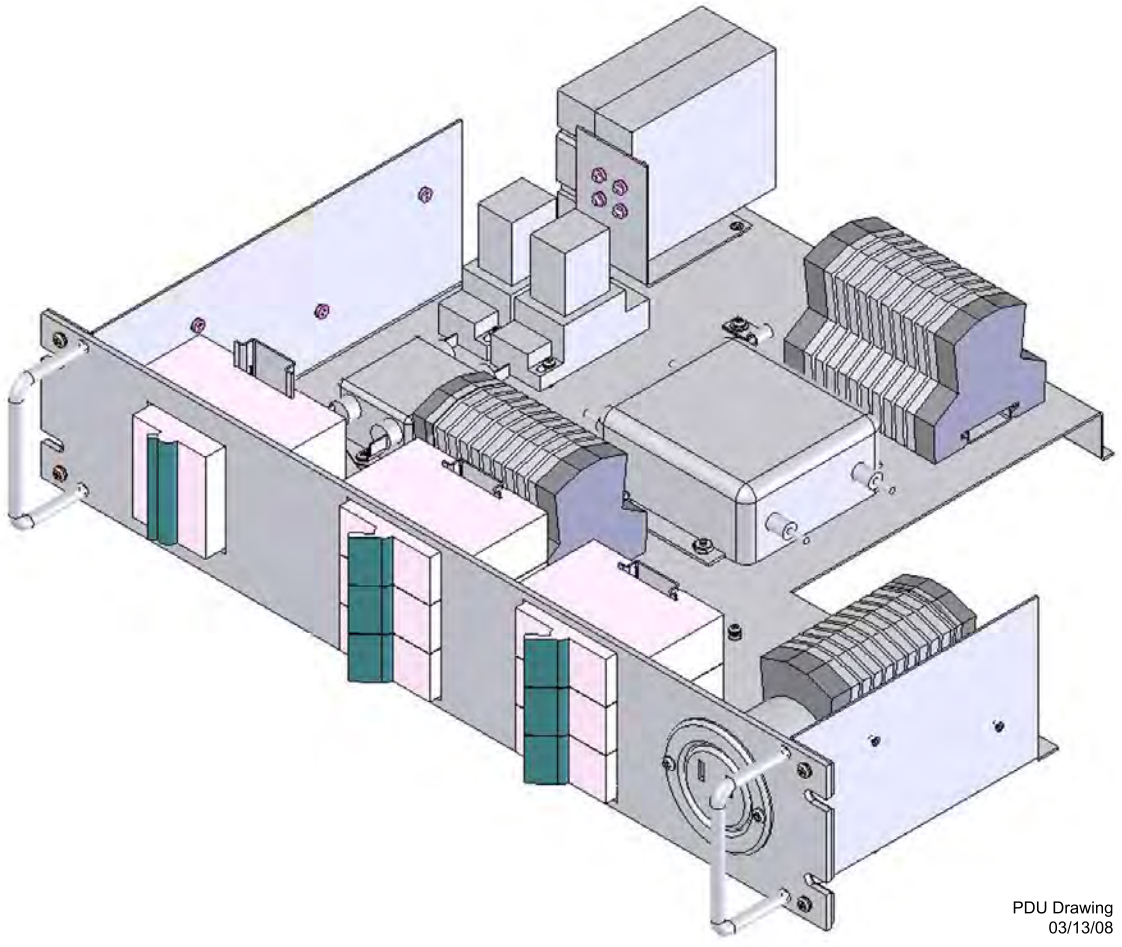


Figure 2-13 Power Distribution Unit (Sheet 1 of 2)

Figure 2-13 Power Distribution Unit (Sheet 2 of 2)

2.8 JUNCTION BOX ASSEMBLY

The junction box is mounted on the floor of the cabinet just behind the rear door. It is the interface for the external connections for the AC power line, the VSAT antenna, the GPS antenna, and the telephone line. It also houses the input power (208VAC) terminal block, lightning protectors for the VSAT receiver and GPS receiver, and the cable glands for Ethernet and telephone cables.

Figure 2-14 Junction Box Assembly

3 INSTALLATION

3.1 INTRODUCTION

This section describes the installation of Alcatel-Lucent's Sirius Digital Terrestrial Repeater, DTR-0200-SA-SIRIUS, Alcatel-Lucent part number 3EM04000AA and associated antennas at a designated site. This equipment is to be installed in a restricted access location.

3.2 SAFETY ON SITE

3.2.1 Installation Safety

Installation shall be performed by trained, qualified personnel. For installation and wiring of the SIRIUS Terrestrial Repeater and associated antennas in the USA, the installer will adhere to the applicable clauses of the National Electric Code and all applicable local codes. For installation in Canada, the installer will adhere to the applicable National Canadian Electric Code and all applicable local codes.

3.2.2 Grounding

Grounding will be in accordance with MOTOROLA STANDARDS AND GUIDELINES FOR COMMUNICATION SITES, 68P81089E50-B, 9/1/05 — UP, local codes and requirements, SIRIUS requirements, and Alcatel-Lucent construction/installation drawings in the order stated. Ensure that the grounding wire of the wiring conduit is properly attached to the customer-supplied service panel ground bar.

3.2.3 Electrical Safety

1. A readily accessible disconnect device shall be incorporated in the building installation wiring.
2. A capital letter "N" located adjacent to an electrical terminal indicates that terminal is intended exclusively for connection of the primary power neutral conductor.
3. Personnel will obey all safety/hazard/warning signs and labels.
4. All repeater equipment electrical power must be off during installation.
5. Ensure that the main power switch to the repeater equipment is turned off and a "**DANGER-DO NOT TURN ON - Personnel Working**" sign is hung on the switch prior to working on internal parts of the repeater.
6. Ensure that all repeater circuit breakers are turned off prior to working on internal parts or connecting cables of the repeater.
7. Ensure that the main power cable to the repeater PDU is the last cable to be connected to the repeater when installing repeater cables.

3.2.4 Physical Safety

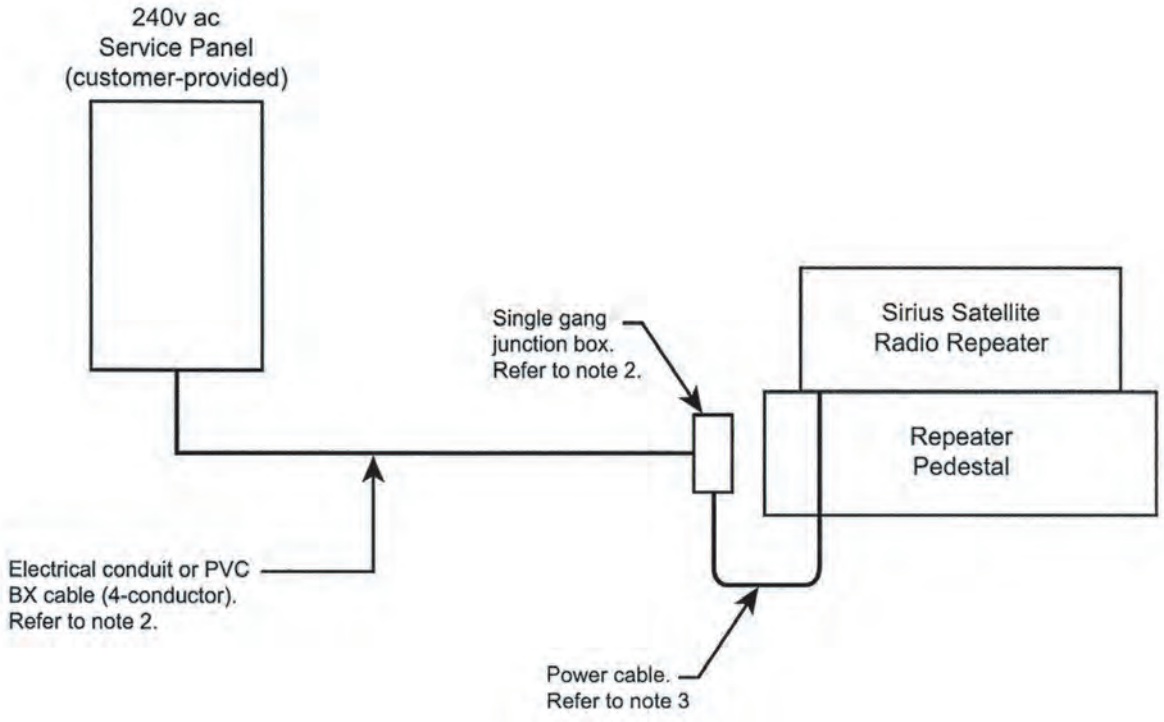
1. The repeater will be secured to the building/pad before operation.
2. Installation crew members must wear hard hats during installation.
3. A minimum of two technicians is required for any lifting and/or positioning of the repeater cabinet.

3.3 INSTALLATION OVERVIEW

Site configuration, antenna configurations and locations, electrical service location, phone line service location, and SIRIUS Repeater location, will all be in accordance with Alcatel-Lucent provided construction/installation drawings that have been approved for building permits and zoning and have been A&E stamped.

3.4 SITE POWER

Figure 3-1 depicts the recommended site ac power wiring:

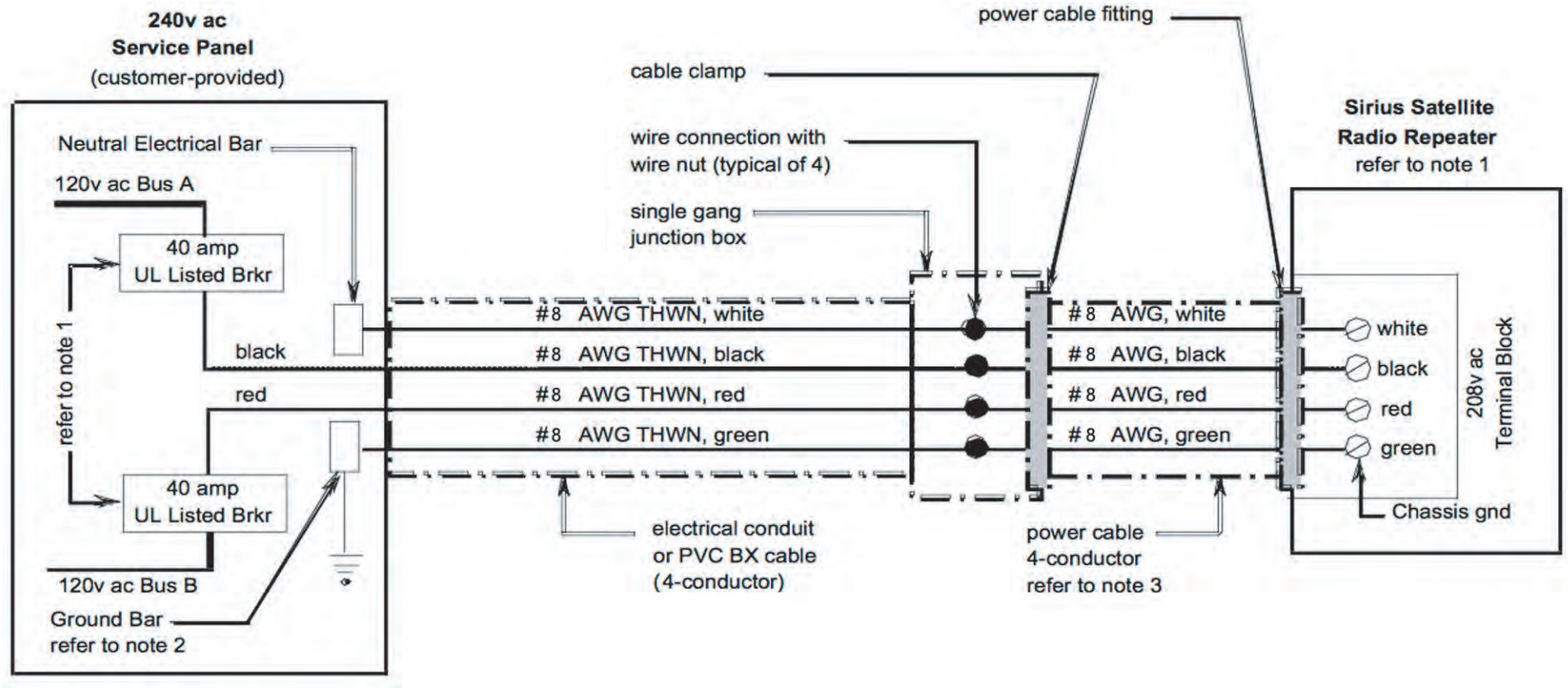


Notes:

1. Refer to Sheet 2 for ac power wiring schematic.
2. Conduit or BX cable will be routed to a single gang junction box installed on the repeater pedestal or in close proximity to the repeater enclosure.
3. 4-conductor #8 power cable will be installed between the junction box and the repeater power terminal block. Refer to Sheet 2, note 3.

DTR-1076
03/16/08

Figure 3-1 AC Wiring (Sheet 1 of 2)



Notes:

1. The repeater must be powered directly from a 240v ac service panel with 40 amp UL listed circuit breakers.
2. The green ground wire is to be connected to a safety ground derived from a copper ground plane or rod.
3. A 4-conductor #8 power cable with rubber jacket rated at 90˚C will be used.
4. The ac power wiring design and installation must conform to all local and national electrical codes.

DTR-1079
03/16/08

Figure 3-1 AC Wiring (Sheet 2 of 2)

This page intentionally left blank.

3.5 REPEATER UNPACKING AND INSPECTION

The repeater equipment containers and the Fibergrate platform containers (or whatever platform is being utilized) should be unpacked and inspected at the earliest date to ensure that all required material has been received and is in good condition. Equipment should be checked against packing lists and site drawings.

3.5.1 Freight Damage

Any damage to material while in transit should be immediately directed to the freight carrier. The carrier will issue instructions regarding freight damage claims.

3.5.2 Material Missing or Damaged

Questions pertaining to missing or damaged materials not due to the carrier should be directed to Alcatel-Lucent at Longview, Texas, telephone number 1-903-236-5200. Ask for Product Engineering.

3.6 SUGGESTED TOOL LIST

3.6.1 Installation Tools

No special tools are required to install DTR-0200-SA-SIRIUS (3EM04000AA) Repeater equipment.

3.7 ANTENNA INSTALLATION

All antenna Installation, alignment, adjustment, and connecting procedures will be in accordance with the antenna manufacturer's instruction manual, A&E stamped Alcatel-Lucent construction/installation drawings, and tower owner specific requirements.

3.8 REPEATER CABINET INSTALLATION

3.8.1 Support Base

The support base to be used will depend on the individual site and the required mounting position. Specific information is contained in the A&E Construction Drawings for the particular site.

3.9 CABLE CONNECTIONS (See Figure 3-2)

3.9.1 Module Connecting Cables and Module Connection Points

Refer to Appendix B for cable to-from descriptions and cable part numbers.

3.9.2 External Cables and Connections

Prior to making any external connections, ensure that main power to the repeater is turned off at the source and a "Warning,* Do Not Turn On, Personnel Working"*sign is hanging on the main source power switch.

3.9.2.1 External Connection Current Ratings

EXTERNAL CONNECTION	MAX CURRENT
External Heater Connection	Max. Current 1.7A @ 120 VAC
Auxiliary Power Outlet	Max. Current 5A @ 120 VAC

3.9.2.2 Chassis Ground Connection

The PDU chassis ground connecting wire will connect to the grounding terminal on the repeater junction block.

3.9.2.3 Satellite Dish Receiving Antenna (VSAT) to Repeater

The feed cable from the VSAT antenna will connect to the Repeater Junction Box VSAT IN connector. The actual cable type, length, connectors, etc., will be specified on the construction drawings.

3.9.2.4 GPS Receiving Antenna to Repeater

The feed cable from the GPS antenna will connect to the Repeater Junction Box GPS IN connector. The actual cable type, length, connectors, etc., will be specified on the construction drawings.

3.9.2.5 Repeater to Tower Mounted Transmit Antenna

The feed cable to the transmit antenna will connect to the repeater RF output connector on the underside of the repeater cabinet. The actual cable type, length, connectors, etc., will be specified on the construction drawings.

3.9.2.6 Telephone Line (TELCO) Connections

To reduce the risk of fire, use only No. 26 AWG or larger (e.g., 24 AWG) UL Listed or CSA Certified Telecommunication Line Cord.

TELCO will determine the type and length of cable to be used. Connection will be to the TELCO connector located on the rear panel of the SPU.

3.9.2.7 Electrical Service Connection

Refer to Paragraph 3.4, SITE POWER.

This page intentionally left blank.

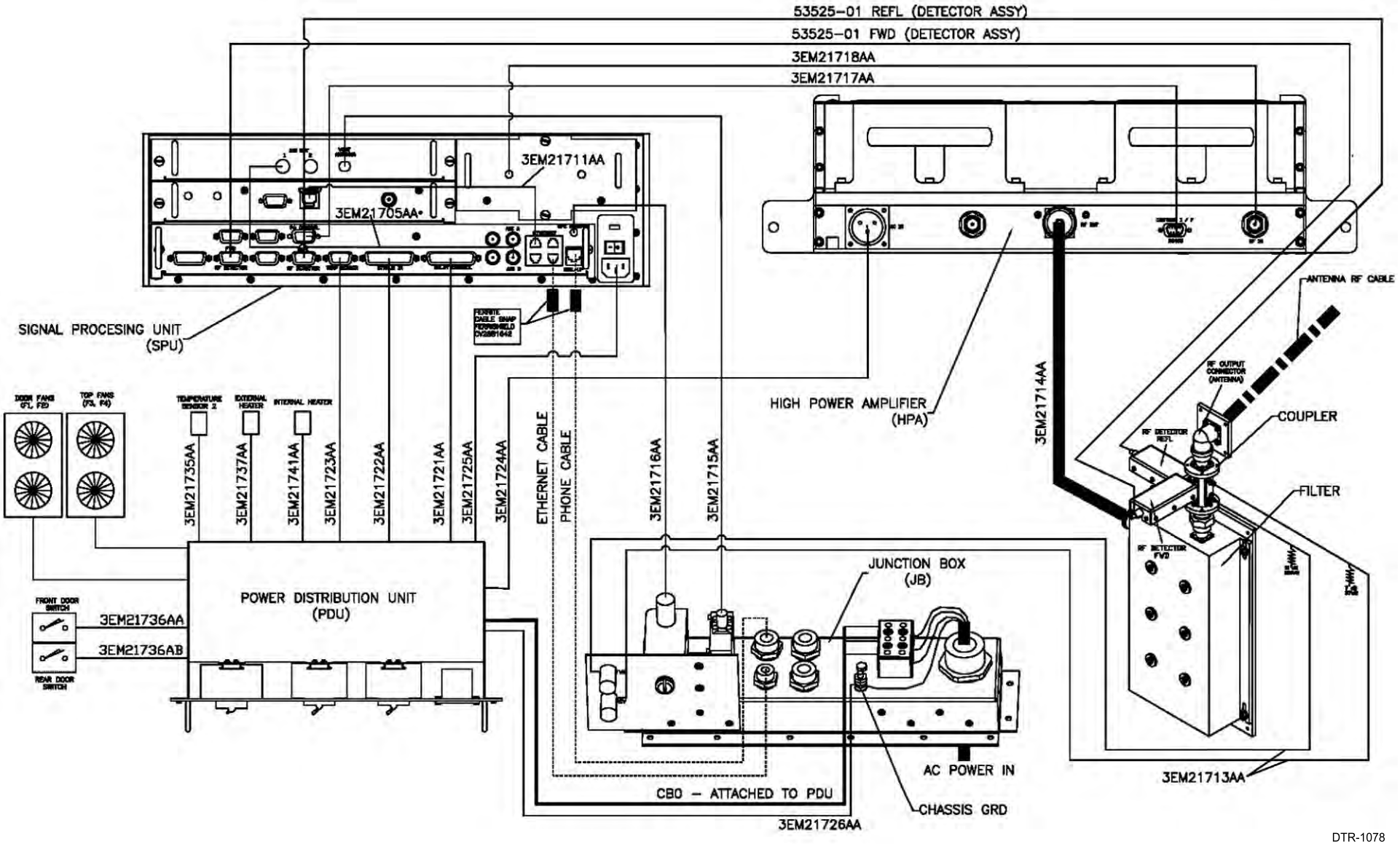


Figure 3-2 Repeater Interconnection Diagram

This page intentionally left blank.

3.10 POST-INSTALLATION INSPECTION/TEST

Post installation inspecting/testing is described below as phase one, two, and three inspecting and/or testing. Phase one and two inspecting/testing is to satisfy the site owner that the system conforms to the owner's requirements. Phase three testing is the Alcatel-Lucent SIRIUS field test performed after installation or major equipment maintenance to ensure that the repeater is performing according to SIRIUS requirements. An inspection/test form template is provided at the end of this section. A field test report form template is provided at the end of the Turn-up and Testing section of this manual.

3.10.1 Inspection/Test Phases

Post installation inspection/testing will normally consist of three phases involving the site owner's representative, Alcatel-Lucent's representative, and SIRIUS Radio's representative. A written record of each phase will be made identifying the specific inspections and/or test(s) accomplished and the satisfactory or unsatisfactory result(s) of each. A copy of the results will be furnished to each participating representative.

3.10.1.1 Phase One Inspection/Testing

Phase one inspection/testing will be performed at the discretion of the site owner's representative. The purpose is to ensure that Alcatel-Lucent installed equipment meets all requirements established by the site owner. The site owner's representative(s) in conjunction with the Alcatel-Lucent representative and the SIRIUS Radio representative will be involved in the inspection/testing process. Deficiencies will be identified, recorded, and presented to the Alcatel-Lucent representative for correction.

3.10.1.2 Phase Two Inspection/Testing

Phase two will only be required if there were discrepancies found during the phase one inspection/testing. After correction of the discrepancies, the site owner's representative, Alcatel-Lucent's representative, and SIRIUS Radio's representative will once again be involved in an inspection/test to ensure satisfactory correction. Results of the phase two inspection/testing will be recorded and signed by all representatives and a copy distributed to each.

3.10.1.3 Phase Three Testing

Phase three testing consists of The Alcatel-Lucent representative in conjunction with a SIRIUS Radio representative performing repeater system field testing to ensure satisfactory system operation. Final test results will be recorded and signed by each representative who in turn will receive a signed copy.

3.10.2 Repeater System Field Testing

Refer to Section 4, Turn-Up and Testing in this manual for the system field test procedure and Paragraph 3.11, Post Installation Inspection/Test Form template.

This page intentionally left blank.

3.11 POST INSTALLATION INSPECTION/TEST FORM

POST INSTALLATION INSPECTION/TEST		
SITE NAME/LOCATION		
Installation Inspection/Test Phase (circle one) 1 2		**Test Date**
Site Owner Rep (print name)		(signature)
Alcatel-Lucent Rep (print name)		(signature)
Sirius Radio Rep (print name)		(signature)
Inspection/Test Performed	**Sat / Unsat**	**Comments/Discrepancies**

DTR-1081
07/28/07

This page intentionally left blank.

4 TURN-UP AND TESTING

4.1 GENERAL

This section describes the procedures required to turn-up and test the DTR-0200-SA-SIRIUS repeater (ALU Part Number 3EM04000AA) after replacement of the Signal Processor Unit (SPU), software upgrading, and/or other maintenance. These procedures consist of repeater provisioning and field testing.

Note

These procedures require GUI software screen access. For screen access procedures, refer to the Operations section of this manual.

4.2 TEST EQUIPMENT REQUIRED

Refer to Table 4-1 for required test equipment. Become familiar with the operation of any test equipment before using it. Operating instructions for test equipment are not included in this manual except for precautionary notes or special instrument settings required for performance of a test procedure. When further information regarding test equipment is required, refer to the equipment manufacturer's instructional data.

Table 4-1 Test Equipment Required

Type
Power Meter
Power Meter Test Sensor
PC/Laptop

4.3 REPEATER PROVISIONING

Provisioning is the process of checking, changing, and/or installing parameter values to allow the repeater to operate from its assigned location. Normally, no parameter changes will be required except after replacement of the SPU.

1. Turn on repeater power
2. Connect computer to repeater controller Ethernet port
3. Access repeater GUI
4. Set repeater to Standby mode
5. Provision Repeater (check, change, install parameters as indicated by GUI screen readings and consistent with local network engineering requirements)
6. Return repeater to Broadcast mode
7. Connect repeater to NMC.

4.4 FIELD TESTS

The purpose of the field test is to verify that the repeater meets specifications after on-site repair. The field test will be performed with the Ku-Band Receive Chain of the specific site.

A field test report form is provided to record the operating conditions and critical performance parameters of the repeater after repair. This report should be kept on file and referred to whenever the repeater is retested (after maintenance, etc.).

4.4.1 Test Set-Up

1. Remove power from repeater by opening repeater main power circuit breaker on the PDU (see Figure 4-1).

Figure 4-1 PDU Circuit Breaker Panel

2 Set up the test system as shown in Figure 4-2.

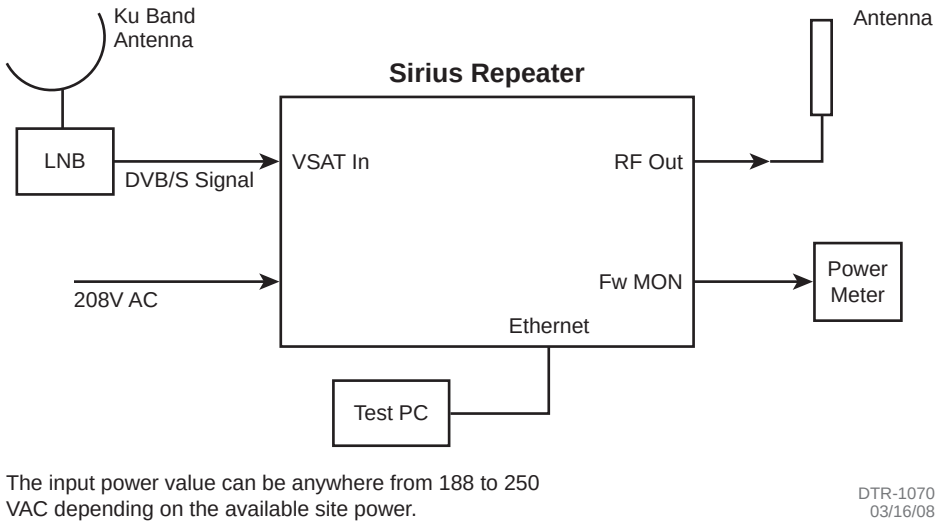


Figure 4-2 Field Test Setup For Terrestrial Repeater

- Connect the power meter to the FWD RF MONITOR connector on the junction box panel.
- Enter into the power meter the dB offset value listed at the FWD RF MONITOR connector. See Figure 4-3.

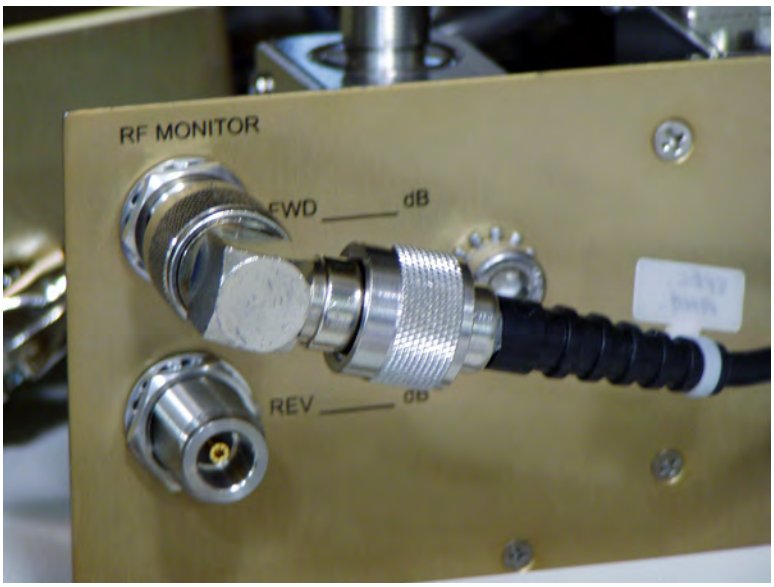


Figure 4-3 RF Monitor Connectors on Junction Box Panel

- The Ethernet connection for the PC is on the back panel of the Main Controller (one of the Ethernet ports in the four port block). See Figure 4-4.

Figure 4-4 Ethernet Ports on Main Controller Back Panel

- The input power value can be anywhere from 188 to 250 VAC depending on the available site power.

4.4.2 Operating Mode

1. Power up the repeater.
2. Wait 5 minutes (after the Main Controller finishes initialization).
3. Start GUI.
4. Access the Repeater Operating Mode screen and set repeater to Standby Mode (see Figure 4-5).

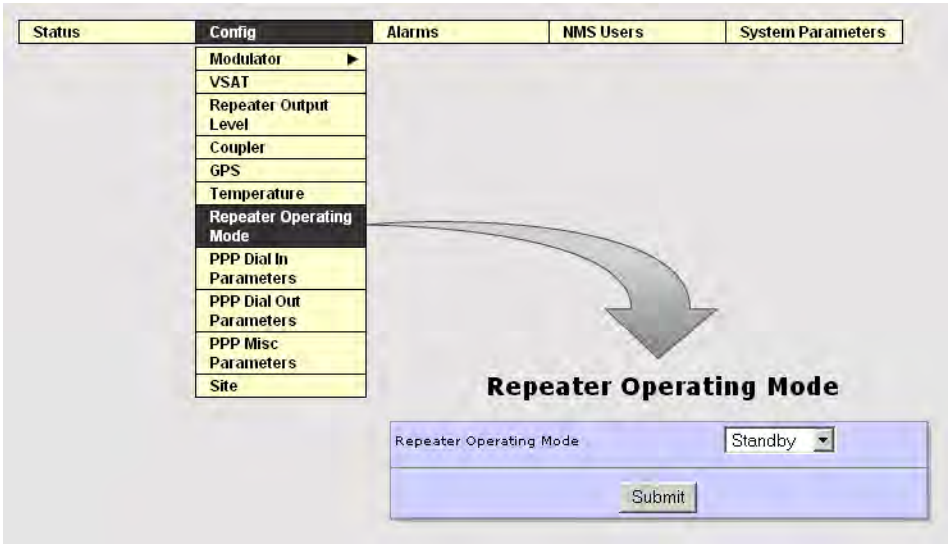


Figure 4-5 Repeater Operating Mode

4.4.3 Alarm Checking

1 Access to Alarm Log and read system faults/alarms from controller (see Figure 4-6).

2 No fault/alarm shall be reported other than Cabinet Rear Door Open. This alarm will appear because of the PC connection to the rear panel of the Main Controller.

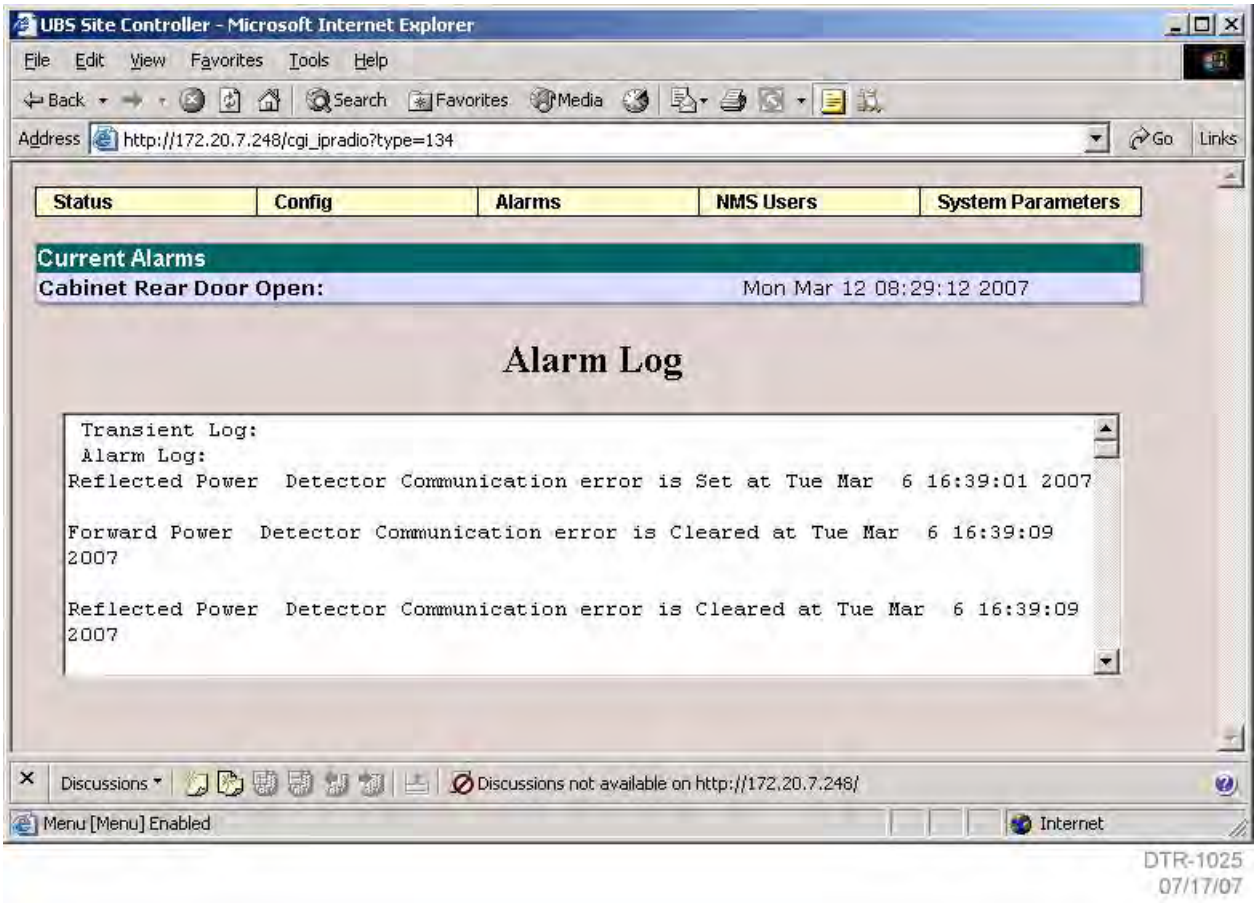


Figure 4-6 GUI Alarm Log

4.4.4 Software/Firmware Configuration Test

1 Access the Global Status screen.

2 Check and record software/firmware versions used in the repeater.

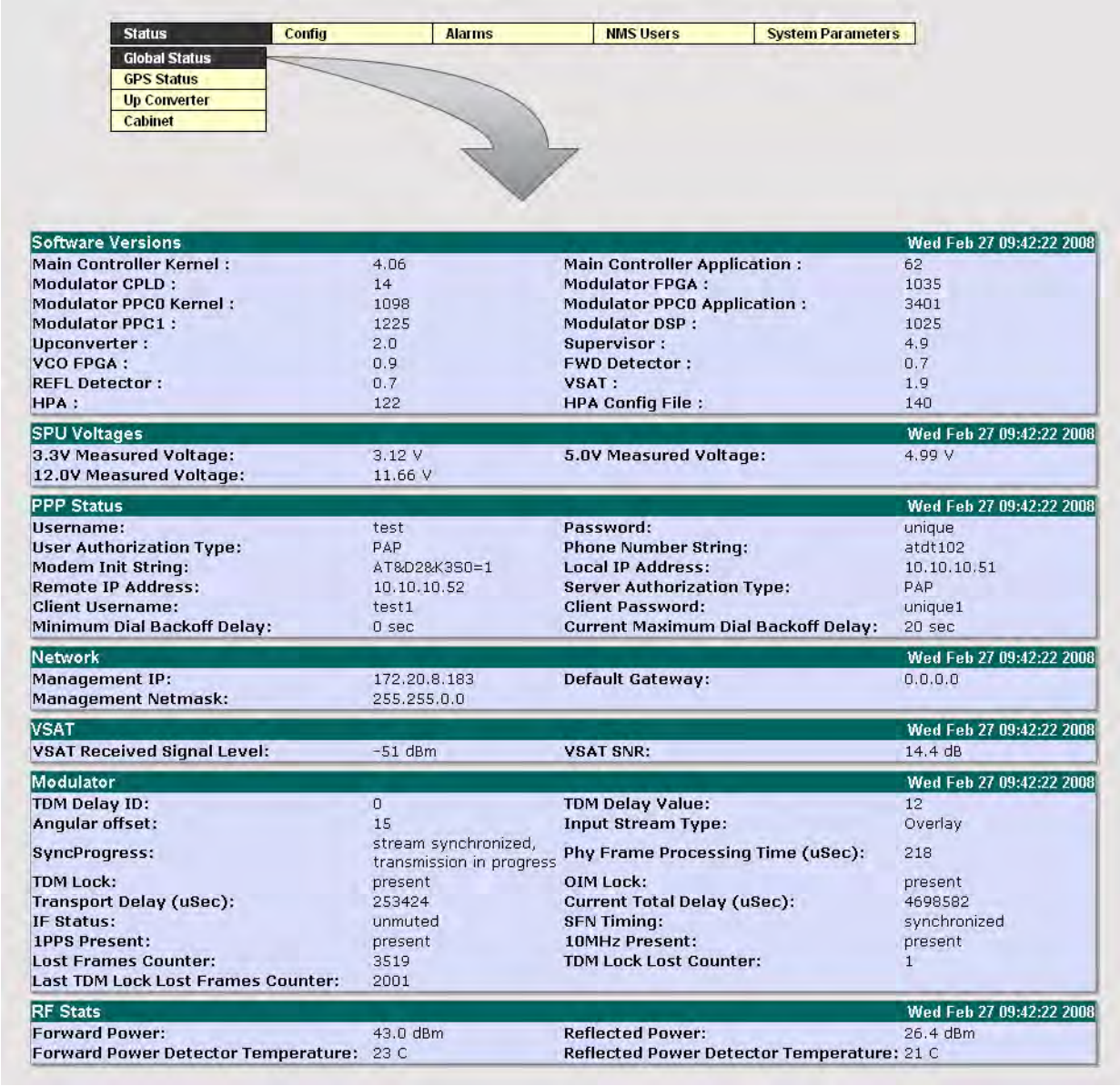


Figure 4-7 Global Status Screen

3 The version numbers shall match those defined by the repeater configuration.

4.4.5 VSAT Receiver Test

1 View the Global Status screen.

2 Confirm that the receive antenna is correctly pointed at the satellite (determined by VSAT Receiver Signal Strength reading on GUI screen).

3 Ensure that the receive antennas are correctly pointed at the satellite (determined by signal strength reading on GUI screen).

4 If necessary, reconfigure the repeater VSAT receiver to match the satellite signal.

Note

Default settings are in place for the repeater for DVBS Standard (DVBS1), Polarization (Horizontal), Band (Low) and Symbol Rate (8417361). In the factory VSAT Frequency is set to 1222.000 MHz. All of the settings are based on the SIRIUS satellite broadcast signal and are made in the factory. The only settings that could need to be changed in the field based on a change in the SIRIUS satellite broadcast signal would be Frequency and Symbol Rate.

5 Verify that the TDM lock is present, and that the VSAT SNR is better than 10 dB.

4.4.6 GPS Receiver Test

Verify from the GUI Global Status screen that 1 PPS and 10 MHz signals are present.

4.4.7 Output Power Test

1 Access the Repeater Operating Mode screen (see Figure 4-5).

2 Set the Repeater Operating Mode to Broadcast.

3 Access the Modulator Mode screen (Figure 4-8).

4 Set the Modulator Operating Mode to CW.

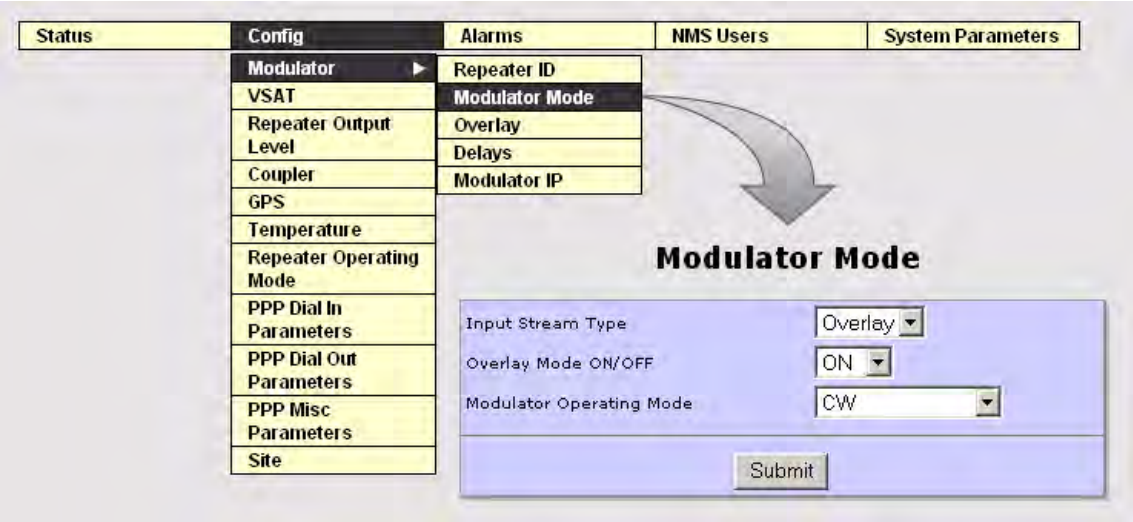


Figure 4-8 Modulator Mode Screen

5 Set RF output power to +53.0 dBm, and measure the RF output power at the junction box forward coupled jack, CPL FWR, with power meter. The measured RF power level shall be within ±0.5 dB from the set RF power level indicated on the GUI Global Status screen.

6 Remove the power meter from the FWD RF MONITOR connector.

No alarm shall be reported other than door(s) open.

4.5 CONNECT REPEATER SYSTEM TO NMC

Coordinate with NMC and place repeater in remote operating condition.

4.6 FIELD TEST REPORT

FIELD TEST REPORT		
SITE:		
DATE OF TEST:		
TEST TECHNICIAN **Printed Name:** _____ **COMPANY:** _____ **Printed Name:** _____ **COMPANY:** _____		
Test	**Requirement**	**Result**
Alarm Check	**No fault/alarm**	
Firmware Configuration	**Match versions in SPU, Controller, and HPA**	
VSAT Receiver	**S/N ratio>10dB**	
GPS Receiver	**1 ppm and 10MHz present**	
Output Power	**Within ±0.5 dB of set power level**	

DTR-1073
05/16/08

This page intentionally left blank.

5 OPERATION

5.1 GENERAL

This section addresses control, communication, and parameter modifications of the DTR-0200-SA-SIRIUS terrestrial repeater. It also provides descriptions of controls, indicators, test points, and connectors for the repeater.

Refer to Paragraph 5.7 for repeater operating procedures.

Refer to Paragraph 5.8 for controls and indicators.

5.2 CONTROL AND COMMUNICATION

The DTR-0200-SA-SIRIUS terrestrial repeater can operate in either of two conditions; remote control condition or local control condition

5.2.1 Remote Control Condition

In the remote control condition the Network Management Center (NMC) operator can control and monitor the repeater from his/her position via telephone line dial-up, and by use of WEB and SNMP interfaces to perform network management.

5.2.2 Local Control Condition

In the local control condition the technician can control and monitor the repeater from the terrestrial site location. The technician uses a laptop PC for local control and maintenance procedures. The PC communicates with the repeater via Ethernet and Graphical User Interface (using Internet Explorer) or Command Line Interface (CLI) protocol using the RS-232 Comm Port.

5.2.3 Control and Communication Interfaces

There are three interface ports provided for control and communication. They are:

- RS-232 Serial Port (DB9) –used for local control, status information, initial setup, and troubleshooting. Access is local via laptop PC and the supported protocol is Command Line Interface (CLI).
- V90 Modem Port (RJ11) – used for remote control and status information. Access is from the NMC via dial-up modem and telephone and the supported protocols are SNMP, WEB Interface, and Telnet.
- Ethernet Port (RJ45) – used for local control and LAN access. Access is local and the supported protocols are SNMP, WEB Interface, and Telnet.

5.2.4 Remote/Local Control Switching

The normal condition for repeater operation is the remote control condition. For a technician to perform testing and maintenance from the local terrestrial site, the repeater must be switched to the local control condition. Switching is activated by the use of an SPU front panel push-button switch. LEDs on either side of the switch identify the repeater control condition as being in local or remote. Placing the repeater in the local

mode prevents a remote operator from accidentally turning on the HPA from the remote site and applying high RF level from the repeater. This could seriously injure the technician working on the repeater at the local site and/or damage the repeater.

5.3 MODES OF OPERATION

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

5.3.1 Repeater Operating Modes

The three repeater operating modes are Broadcast, Standby, and Manual. The repeater's normal operating mode is Broadcast. Under normal, no-fault, conditions if the repeater has an AC power shut-down, upon return of power its AC power-up algorithm will restore operation to the same mode of operation prior to the loss of power.

5.3.1.1 Broadcast Mode

This mode allows the repeater to transmit real signals or test signals, run all the protection loops and ALC. This is the normal operating mode for the repeater. It receives its input signal from the satellite, or generates a test signal, and transmits an orthogonal frequency division multiplexing (OFDM) signal for terrestrial broadcast. In this mode, the Main Controller automatically maintains all repeater functions. To operate in the Broadcast mode, the following conditions must be met:

- The repeater must be receiving an input signal and be locked to the input stream (if the modulator is in the test mode, the VSAT satellite signal presence is ignored).
- The ALC loop must be running.
- There must be good GPS signal quality (if the modulator is in the test mode, the GPS signal presence is ignored).
- There must be no modulator alarms.
- There must be no VSAT alarms (if the modulator is in the test mode, the VSAT satellite signal presence is ignored).
- There must be no GPS alarms (if the modulator is in the test mode, the GPS signal presence is ignored).
- There must be no Up-converter alarms.
- There must be no Reflected Power alarms.

5.3.1.2 Standby Mode

In this mode the repeater is off the air and affirms that the HPA is off while all other components are operating normally. The up-converter output is muted, ALC is off, and the HPA is switched off by disabling the HPA power supply.

The operating conditions in the Standby mode are:

- AC power is applied to the SPU, HPA, and fans.
- The HPA power supply is disabled.
- The HPA RF switch is OFF.
- The Up-converter output is muted.
- The cabinet fans are turned on.

5.3.1.3 Manual Mode

This mode allows manual control of the repeater for the technician to perform maintenance and/or testing or troubleshooting. In the Manual Mode most commands can only be accessed through the "administrator" login. The operator must log in as a system administrator using the default password "ipradmin". The operator now has authority to alter parameters.

The manual mode must be used with caution. If parameters are changed indiscriminately, unintentional damage to the repeater and loss of factory settings could occur.

When the repeater is switched to the Manual Mode, it maintains all its system settings which were in effect prior to the switchover. The RF output DAC last value will remain until changed by the operator. The range of DAC values is limited to those within the minimum and maximum permitted values required to maintain the up-converter output power.

5.3.2 Modulator Operating Modes

- The modulator has seven operating modes:
- Standby Mode
- Run Mode
- CW Mode
- Two Tones Mode
- Notch Mode
- Comb Mode
- PRBS Mode

Of these seven operating modes, the technician will only use Standby Mode and Run Mode. All other modes are for factory use only.

5.4 GRAPHICAL USER INTERFACE (GUI)

The GUI WEB interface uses a PC for maintenance and support of the repeater, and for fault and status reporting. The interface uses a simple hierarchical menu structure which is user friendly and provides access to parameters. The parameters are classified in five categories; Status, Configuration, Alarms, NMS User, and System Parameter. Figure 5-1 shows the GUI Main Menu which, in addition to providing current repeater operating information, provides access to set up or change parameters as required. The parameter categories and their pull down submenus are accessed from the GUI Main Menu. These submenu screens are self-explanatory and subdivide the repeater's status and parameters according to their functionalities. See Figure 5-2.

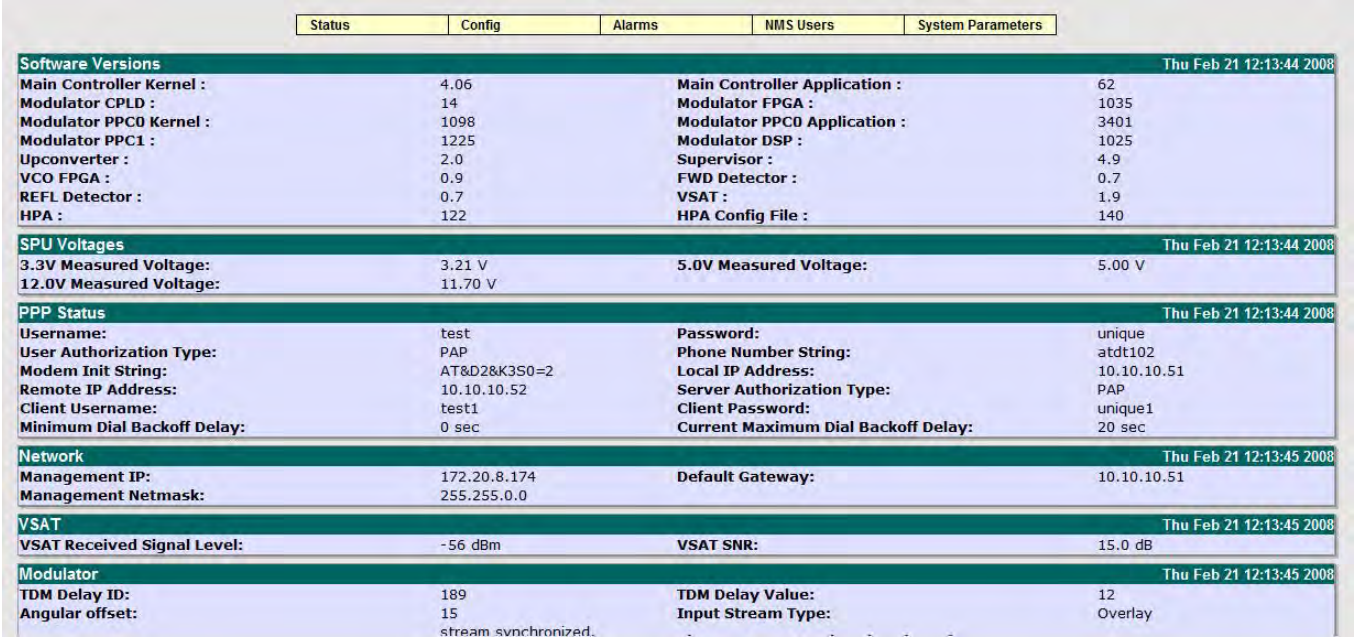


Figure 5-1 GUI Main Menu

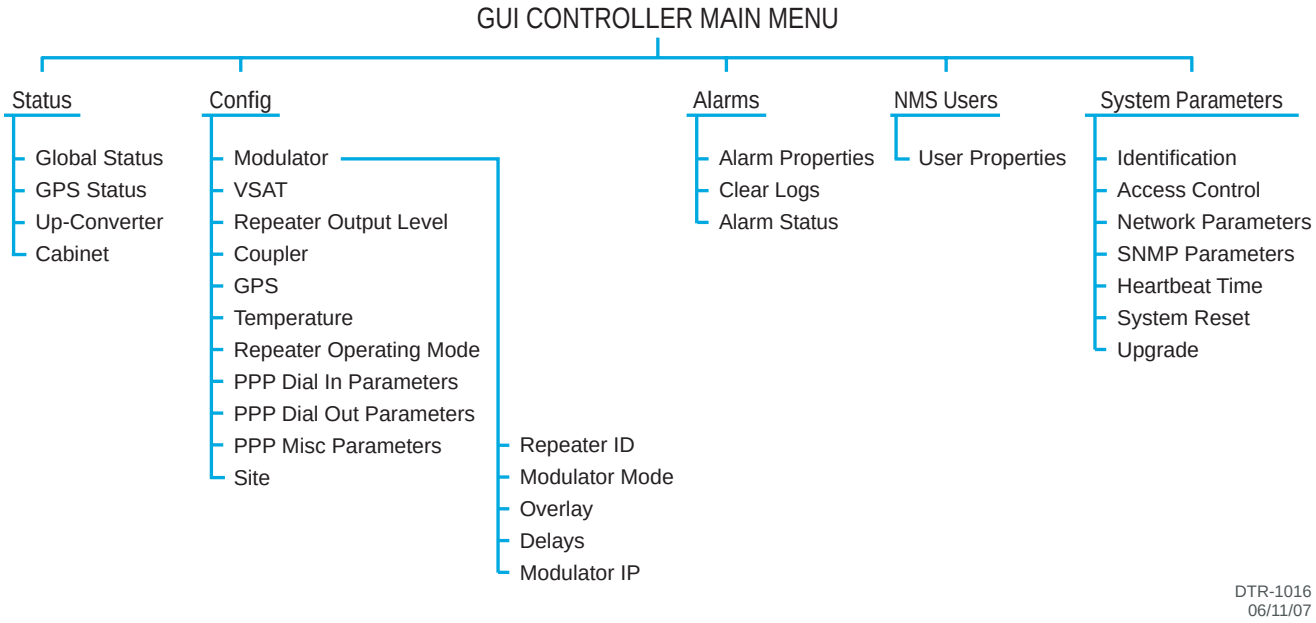


Figure 5-2 GUI Pull-Down Menus

5.5 GUI MENU DESCRIPTIONS

5.5.1 Status Sub-Menu Breakdown

Status shows the repeater current operating status.

To access the Status sub-menu; GUI Main Menu => Status

The Status sub-menus are divided as follows:

Global Status

GPS Status

Up Converter

Cabinet

Their individual GUI screens follow.

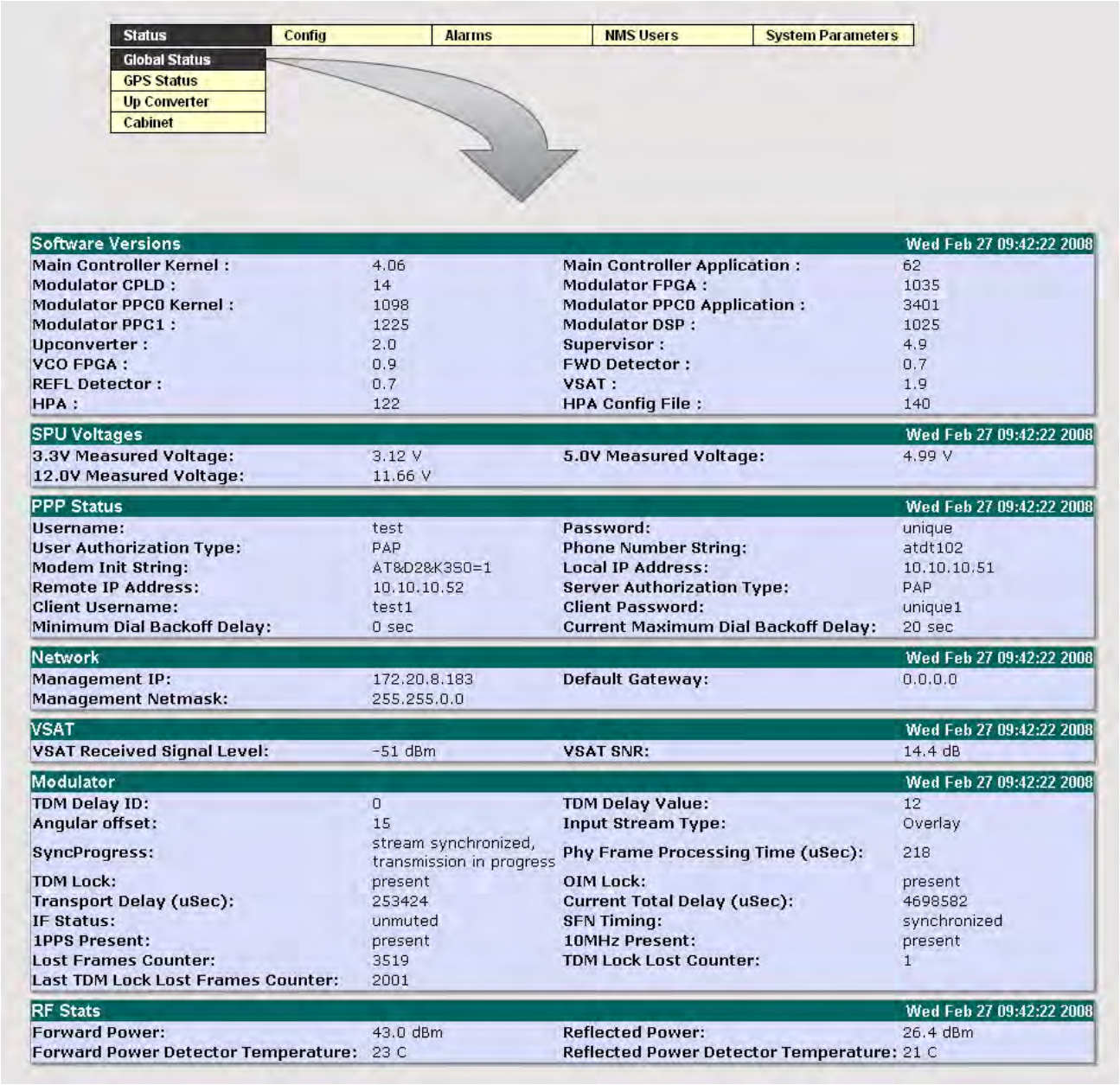


Figure 5-3 Global Status Screen

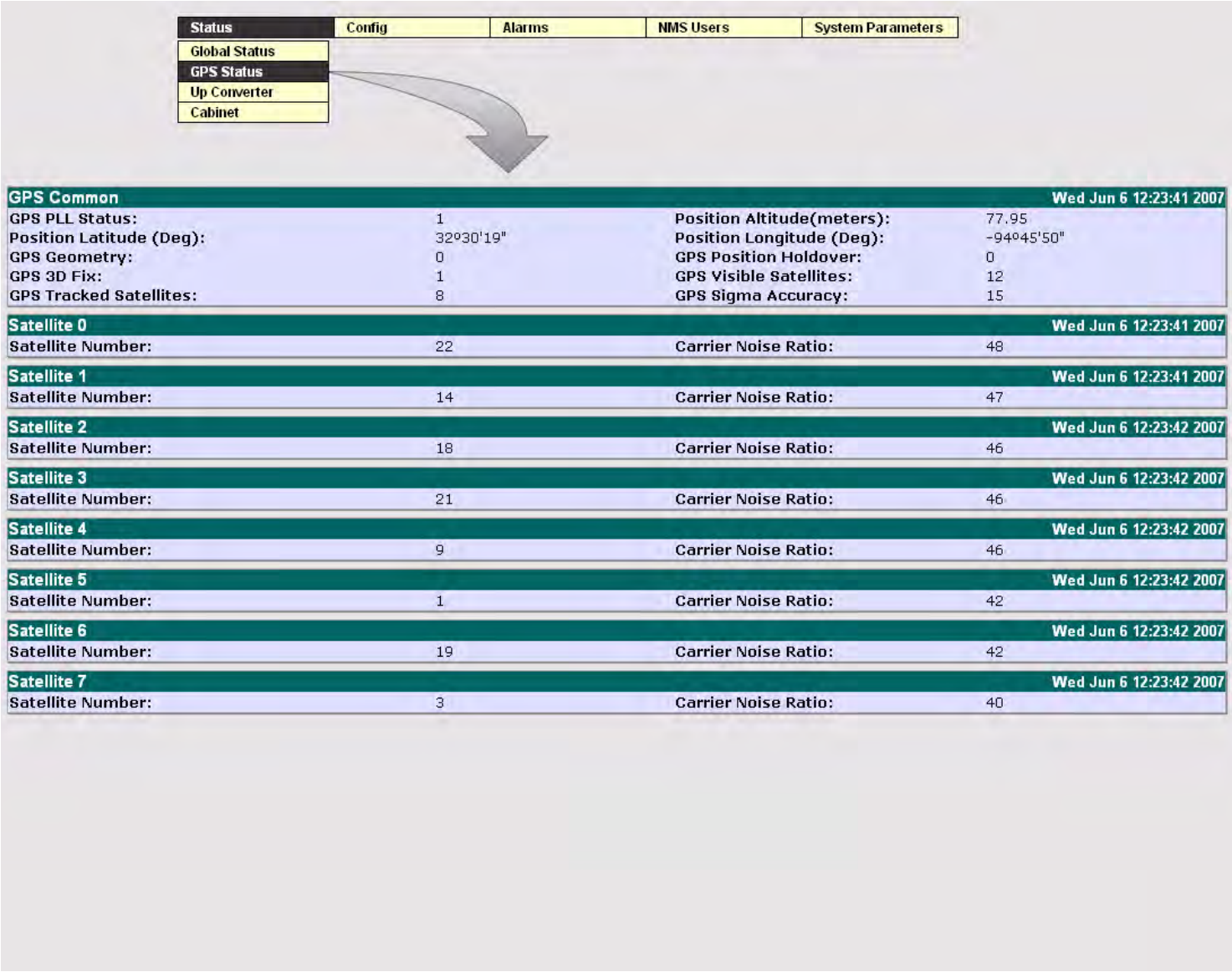


Figure 5-4 GPS Status Screen

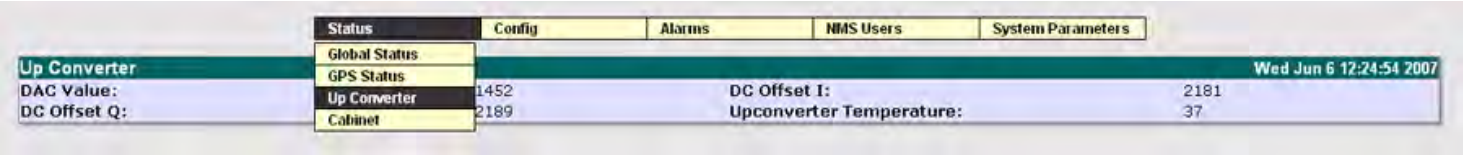


Figure 5-5 Up-Converter Status Screen

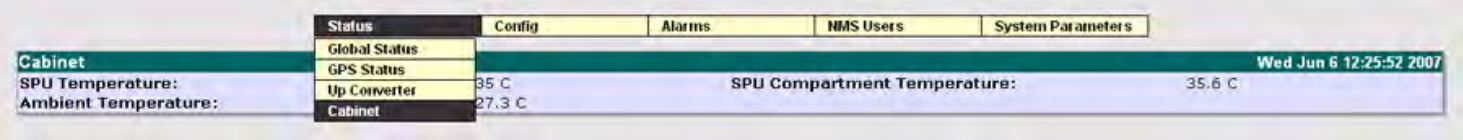


Figure 5-6 Cabinet Status Screen

5.5.2 Configuration (Config) Sub-Menu Breakdown

Configuration screens allow modification of the parameters according to operator requirements. To access the Configuration sub-menu; GUI Main Menu =>Config

The Configuration sub-menus are divided as follows:

Modulator

VSAT

Repeater Output Level

Coupler

GPS

Temperature

Repeater Operating Mode

PPP Dial In Parameters

PPP Dial Out Parameters

PPP Misc Parameters

Site

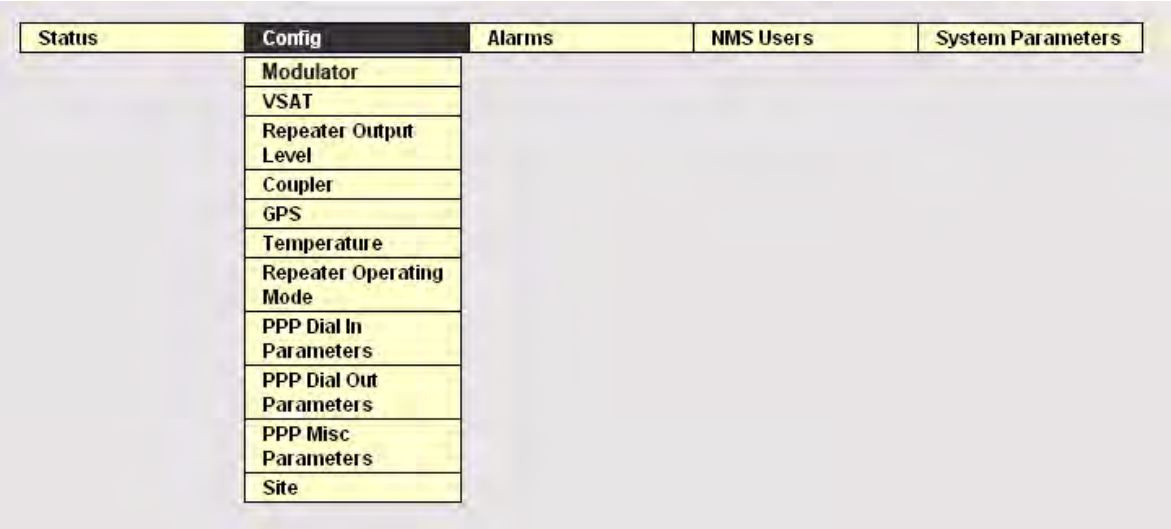


Figure 5-7 GUI Main Menu Config Drop-Down Menu

Config Modulator breaks down into a further sub-menu as follows:

Repeater ID

Modulator Mode

Overlay

Delays

Modulator IP

To access the Modulator sub-menu; GUI Main Menu=>Config=>Modulator=> (sub-menu selection). See Figure 5-8.

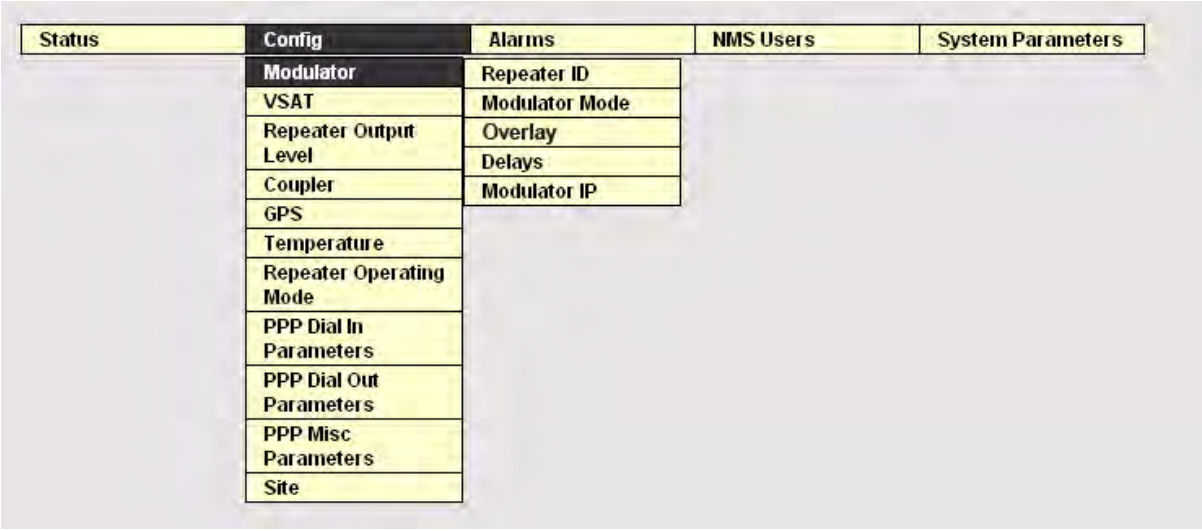


Figure 5-8 Config Modulator Sub-Menu

Figure 5-9 through Figure 5-13 show the individual screens accessed via the Config Modulator sub- menu.

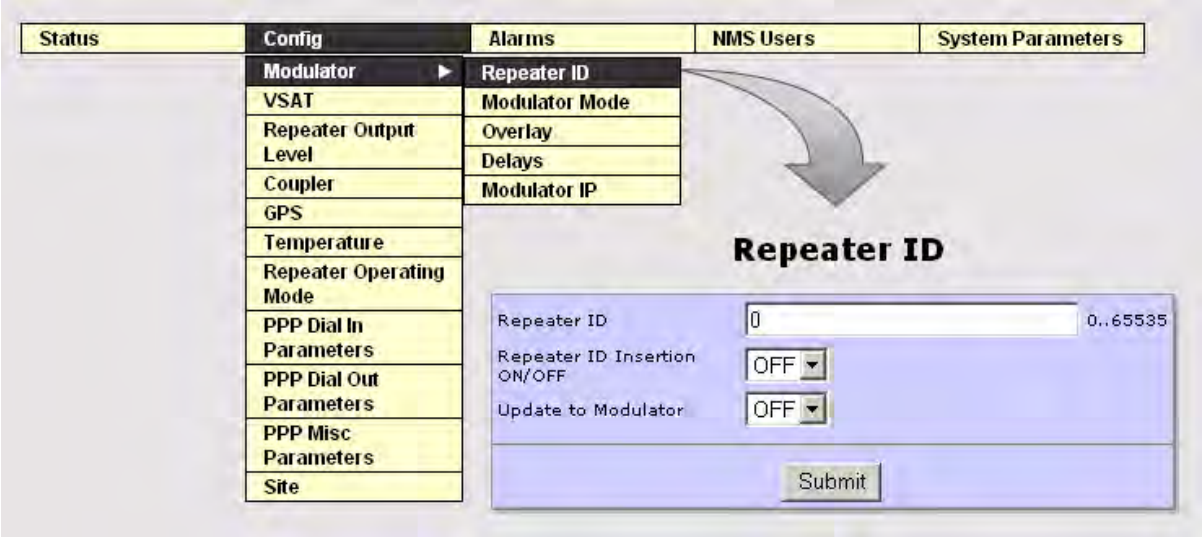


Figure 5-9 Repeater ID Screen

The Modulator Mode screen, Figure 5-10, allows changeover from Repeater Operating Mode to Modulator Operating Mode (refer to para Paragraph 5.3.2). Mode selection is from the Modulator Mode drop-down screen and allows access to the following modes (only Standby and Run are used in the field, the remaining five are for factory use only):

Standby

Run

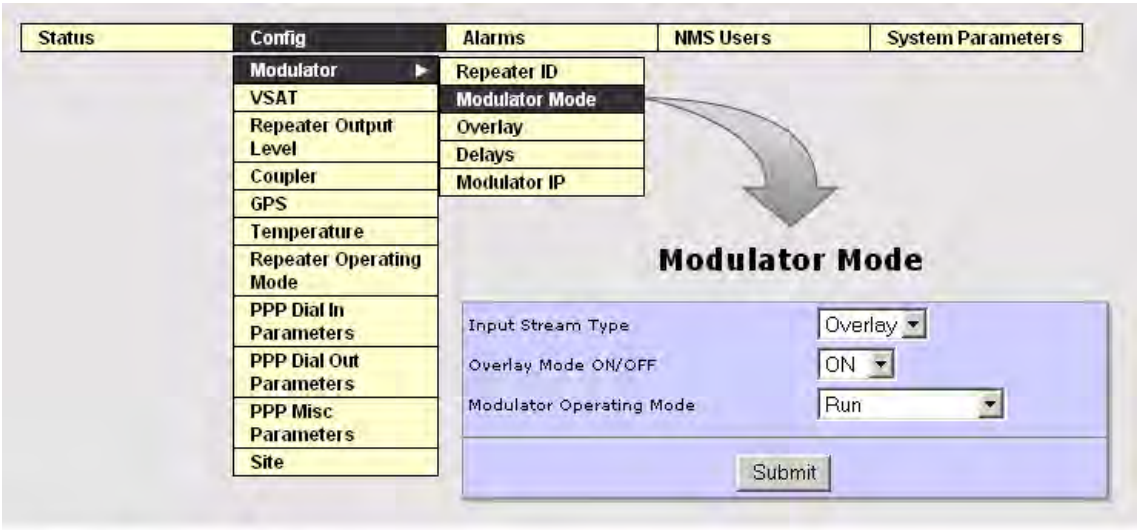
CW

Two Tones

Notch

Comb

PRBS Spectrum



Input Stream Type

Overlay – supports overlay content (video + audio)

Overlay Mode

ON for overlay mode modulation

Modulator Operating Mode – Defines the type of output

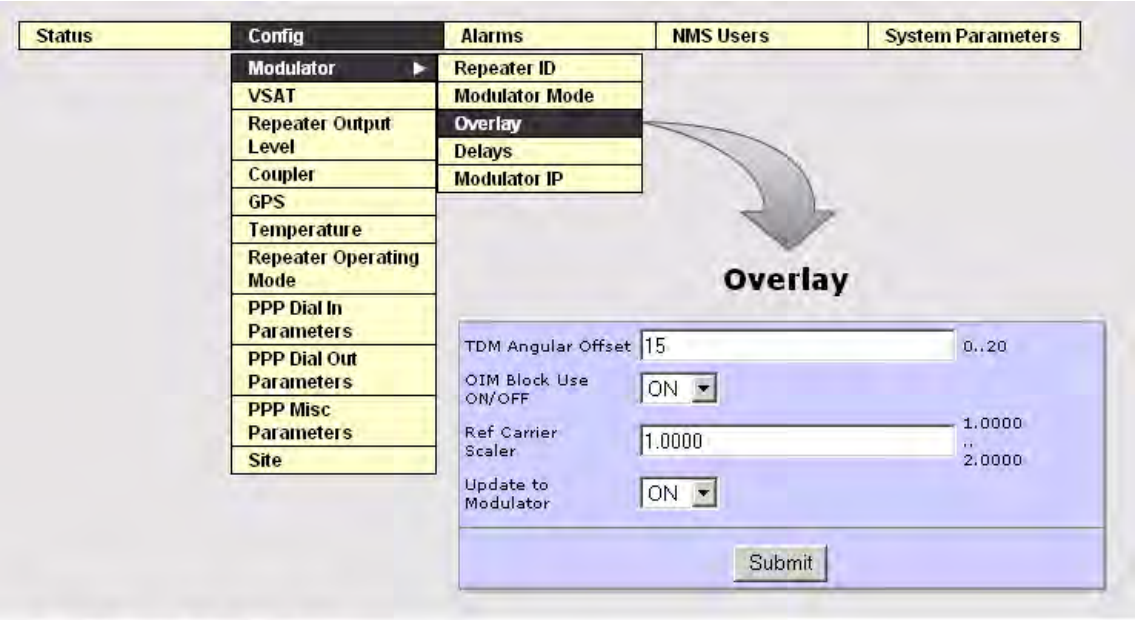
Standby – internal mode for debugging purposes

Run – normal mode used to process the input stream and generate output spectrum

Test Modes – CW, Two Tones, Notch, Comb, PRBS Spectrum

DTR-1083
08/25/07

Figure 5-10 Modulator Mode Screen



TDM Angular Offset
Default = 15

OIM Block Use (overlay identification marker)
On – parameters for overlay use are taken from input stream

Ref Carrier Scaler
Default = 1

DTR-1084
08/25/07

Figure 5-11 Overlay Screen

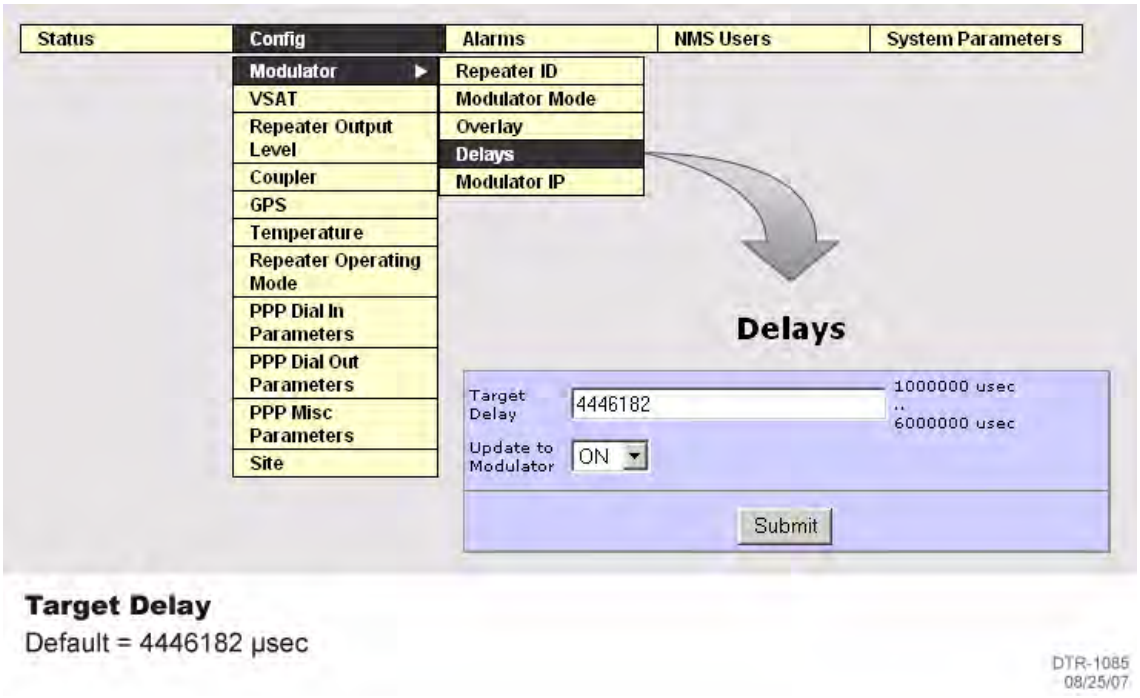


Figure 5-12 Delays Screen

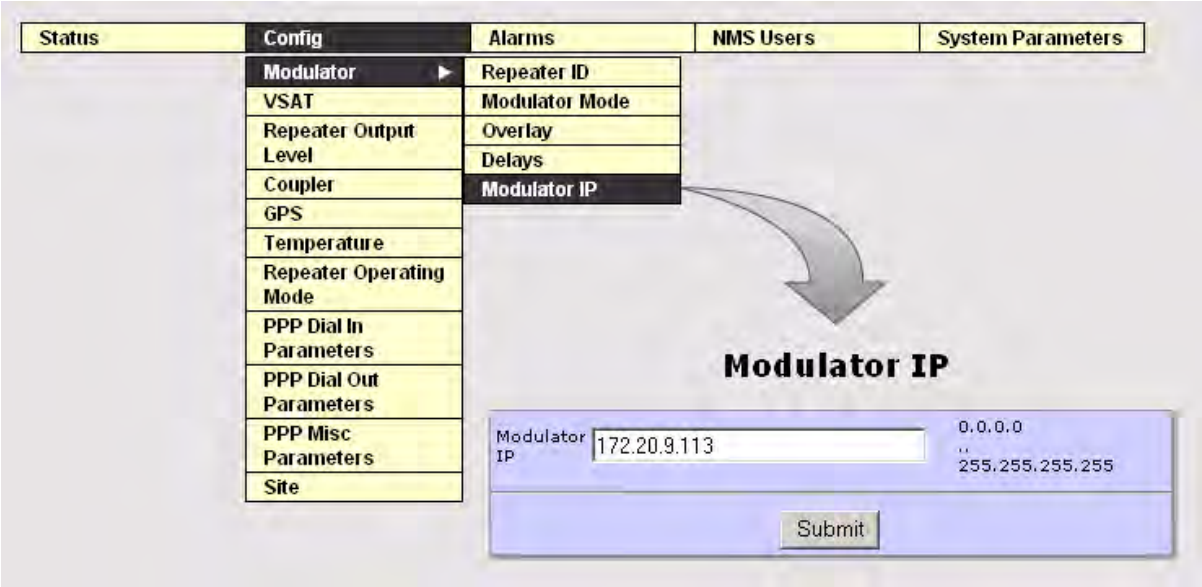


Figure 5-13 Modulator IP Screen

The remainder of the Config menu displays the following screens:

VSAT

Repeater Output Level

Coupler

GPS

Temperature

Repeater Operating Mode

PPP Dial In Parameters

PPP Dial Out Parameters

PPP Misc Parameters

Site

Figure 5-14 through Figure 5-23 show the individual aforementioned screens accessed via the Config menu.

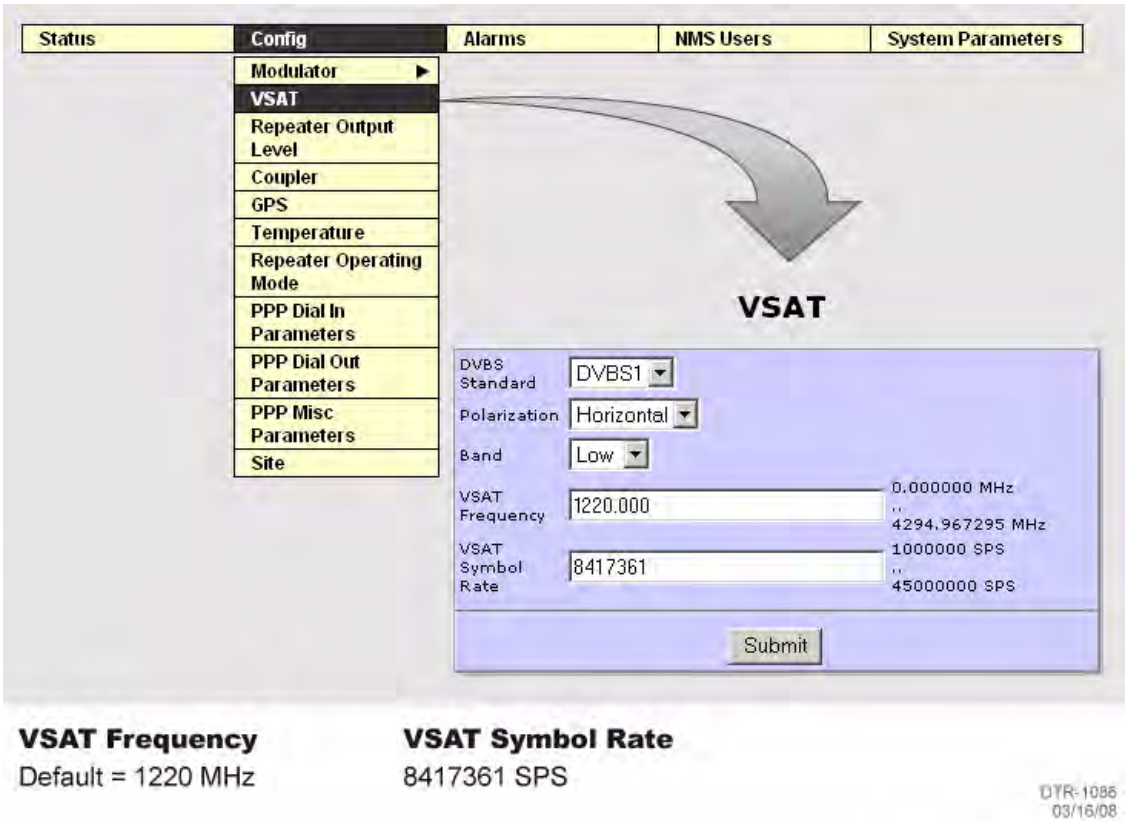


Figure 5-14 VSAT Screen

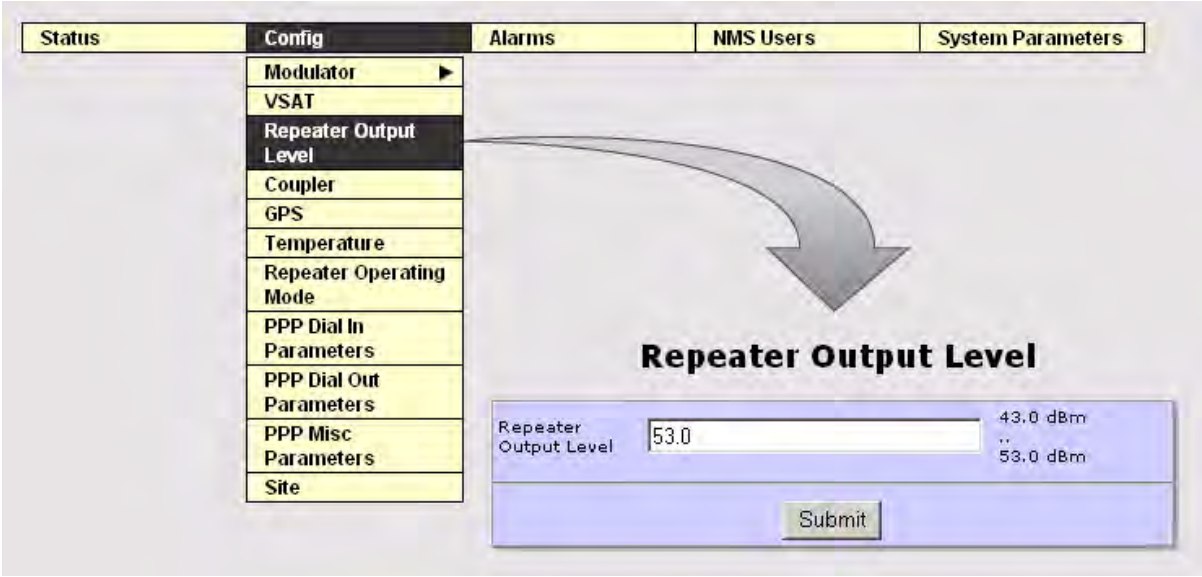


Figure 5-15 Repeater Output Level Screen

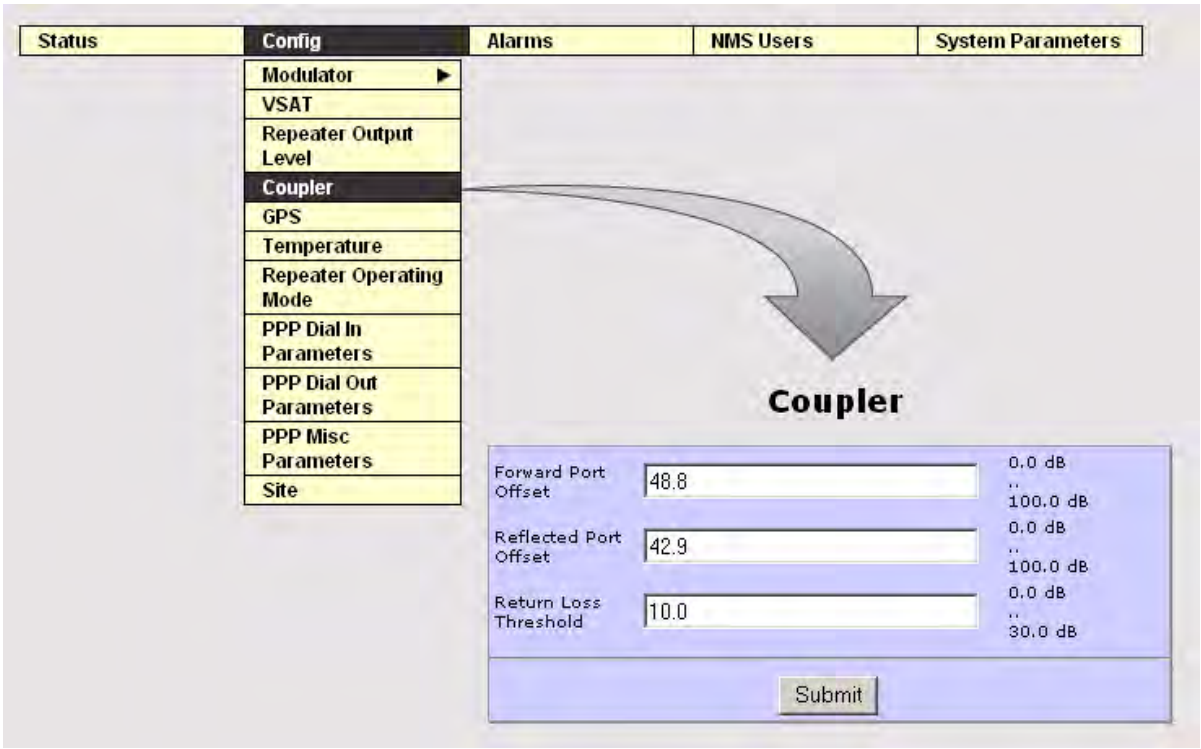
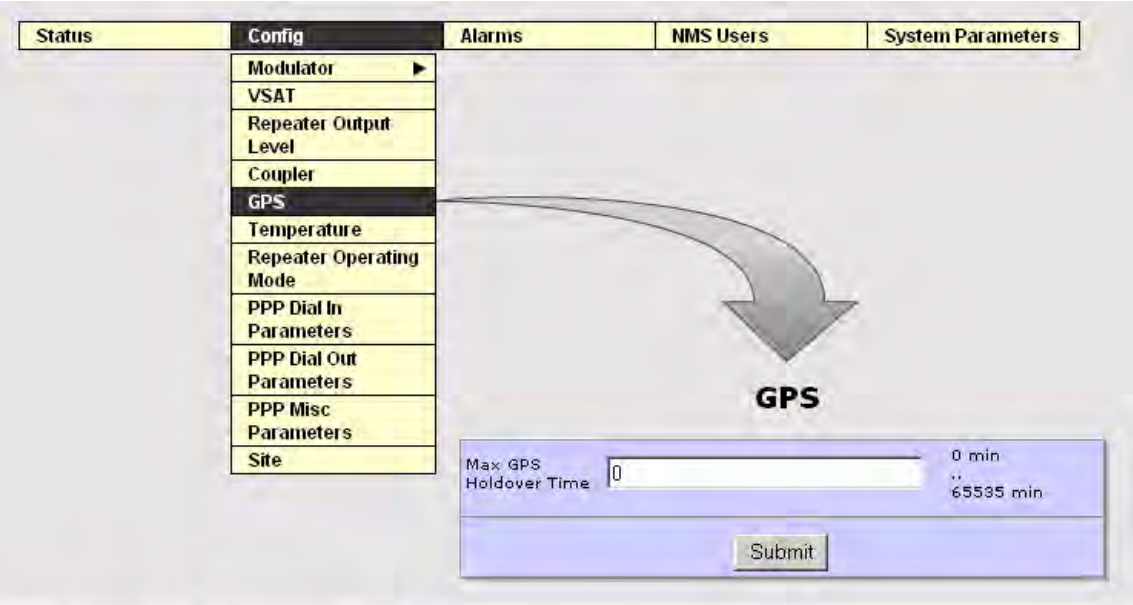


Figure 5-16 Coupler Screen



Max GPS Holdover Time

Allows repeater to track synchronization. If modulator operating mode is Run and repeater operating mode is Broadcast, this parameter is used to switch off the HPA if synch to the GPS satellite is lost beyond a specified number of minutes. The entry determines the number of minutes the GPS signal can disappear without switching off the HPA.

Value 0 = infinity

Value 1 through 65535 = minutes

Every time the GPS Quality Low Alarm is set, a timer is triggered and if the alarm is still present when the value of the timer is equal to the value of the Max GPS Holdover Time the HPA is turned off. The repeater then goes through the normal initialization sequence.

DTR-1087
08/25/07

Figure 5-17 GPS Screen

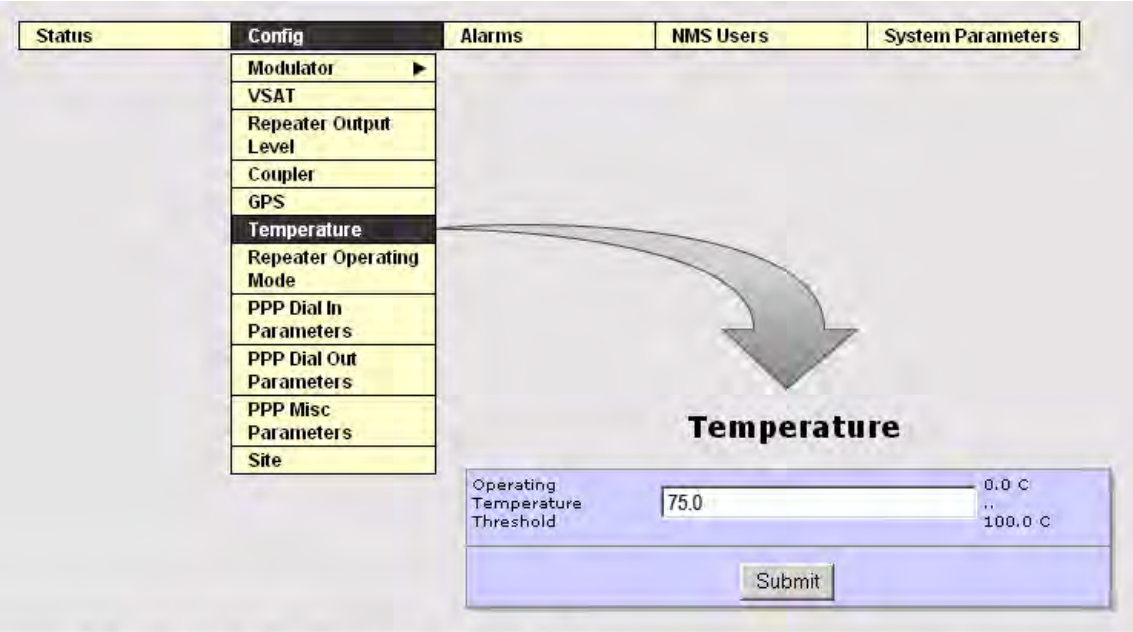
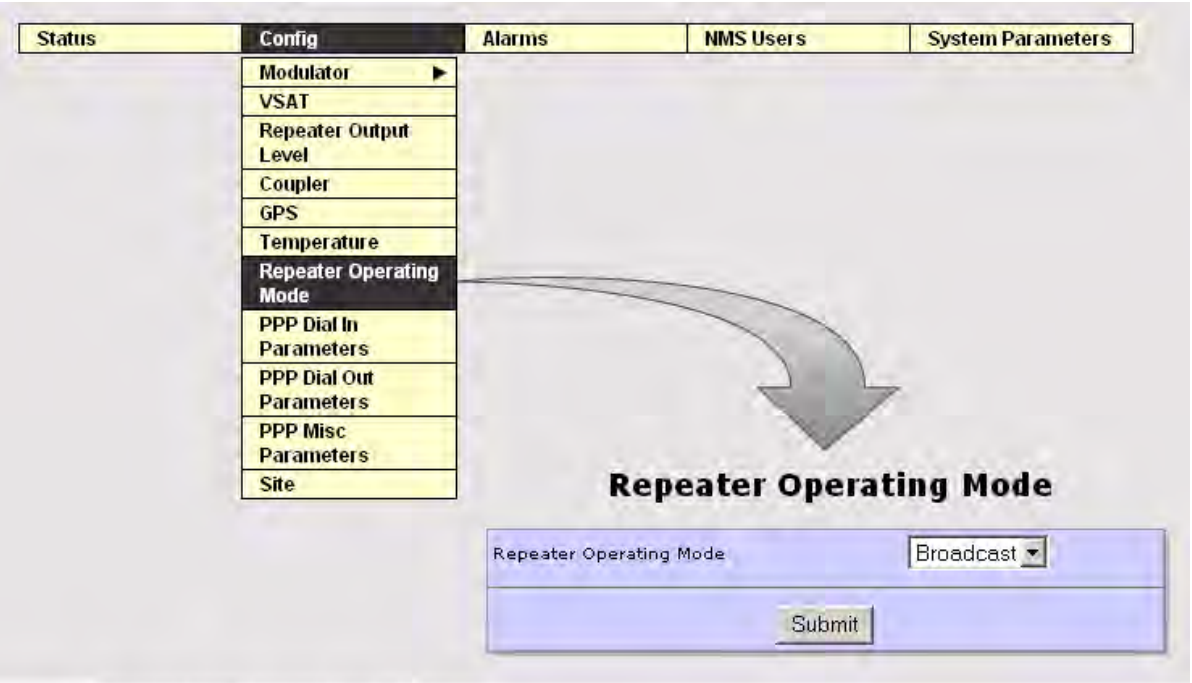


Figure 5-18 Temperature Screen



Repeater Operating Mode

Defines the state of repeater operation.

Standby – HPA is shut down and cannot be turned on.

Broadcast – repeater performs condition checks and if all is OK it switches on the HPA and maintains the ALC target.

Manual – repeater can be controlled by the operator. This allows the operator to perform low level troubleshooting. Parameters in this mode can only be accessed in the administrator GUI and cannot be accessed via SNMP.

DTR-1089
08/25/07

Figure 5-19 Repeater Operating Mode Screen

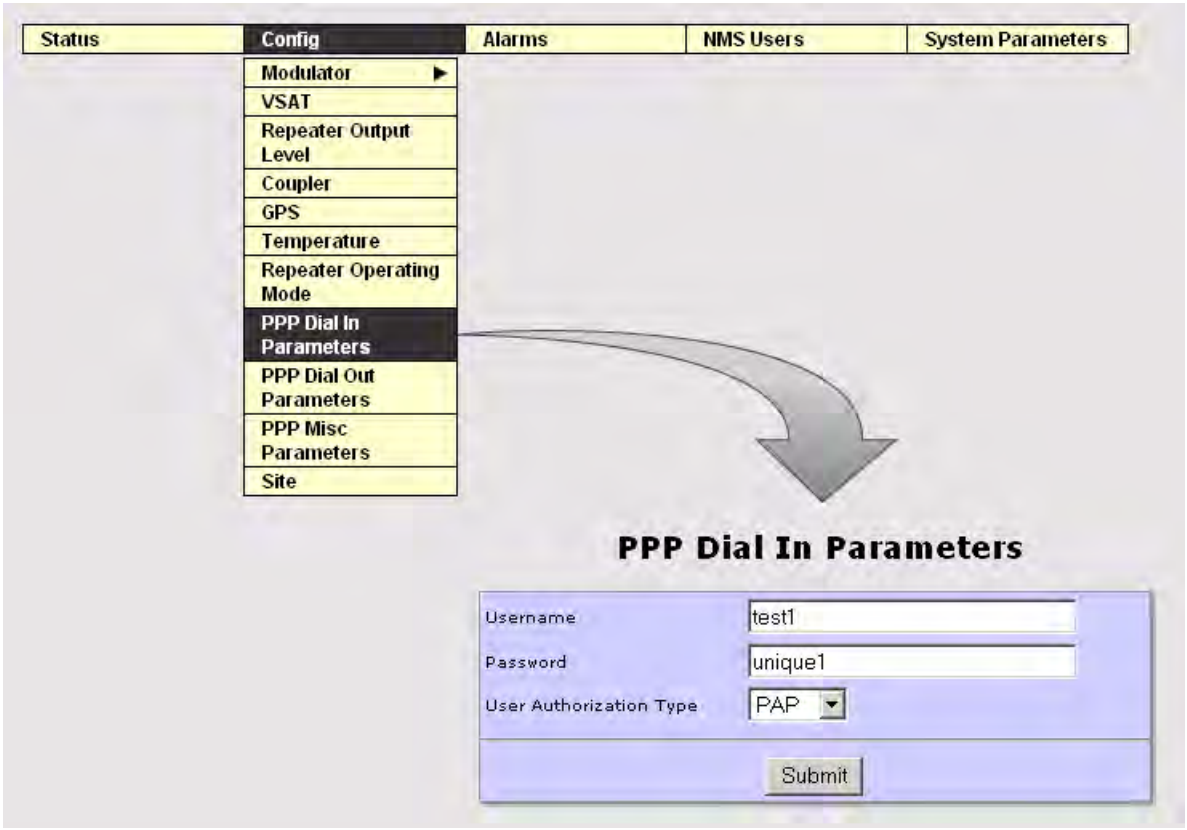
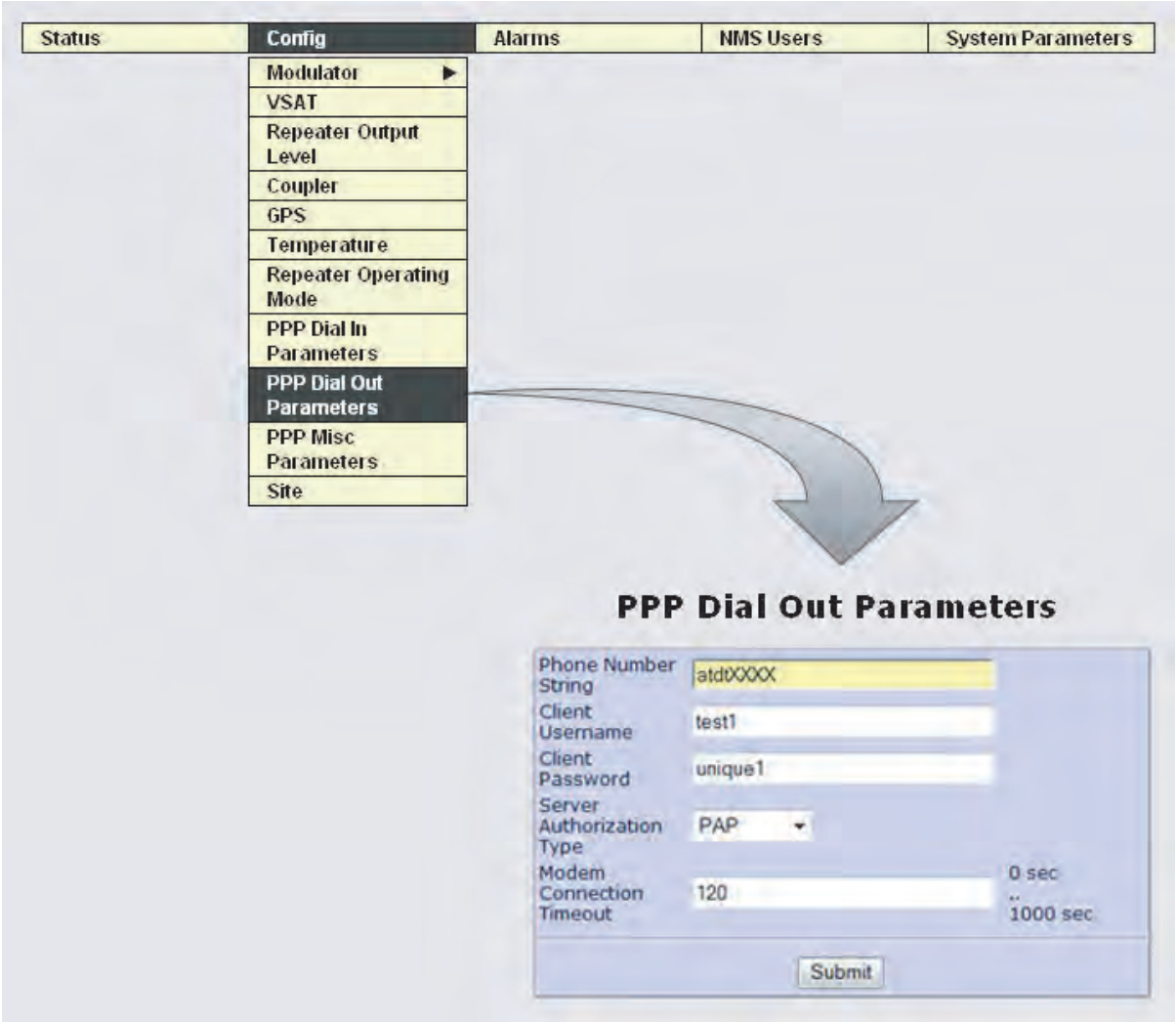


Figure 5-20 PPP Dial In Parameters Screen



Phone Number String – Always begin with ATDT then add phone number of NMC. If required, precede number with external line prefix.

Modem Connection Timeout – For dial out reliability do not use less then 120.

DTR-1098
03/06/08

Figure 5-21 PPP Dial Out Parameters Screen

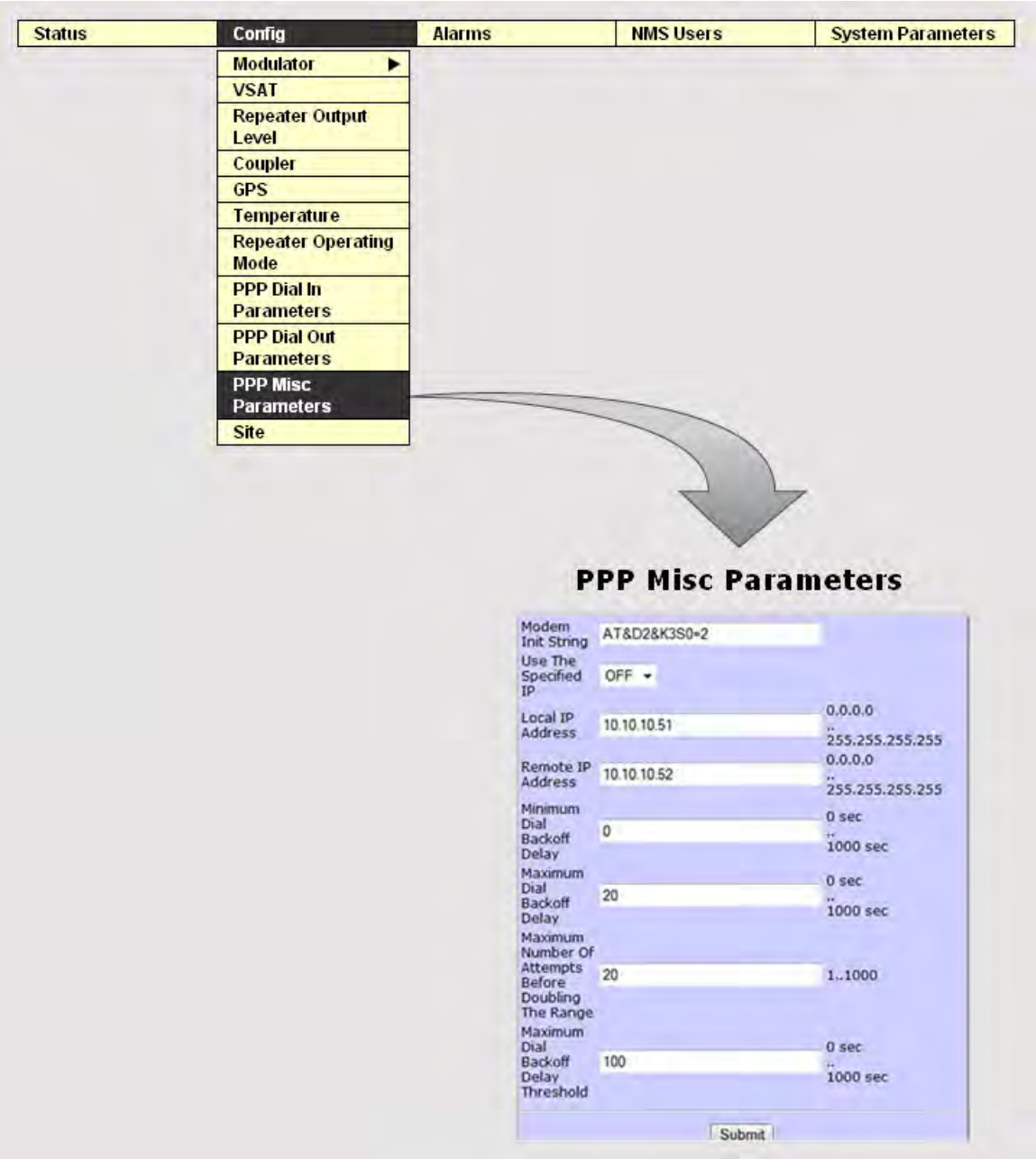


Figure 5-22 PPP Misc Parameters Screen

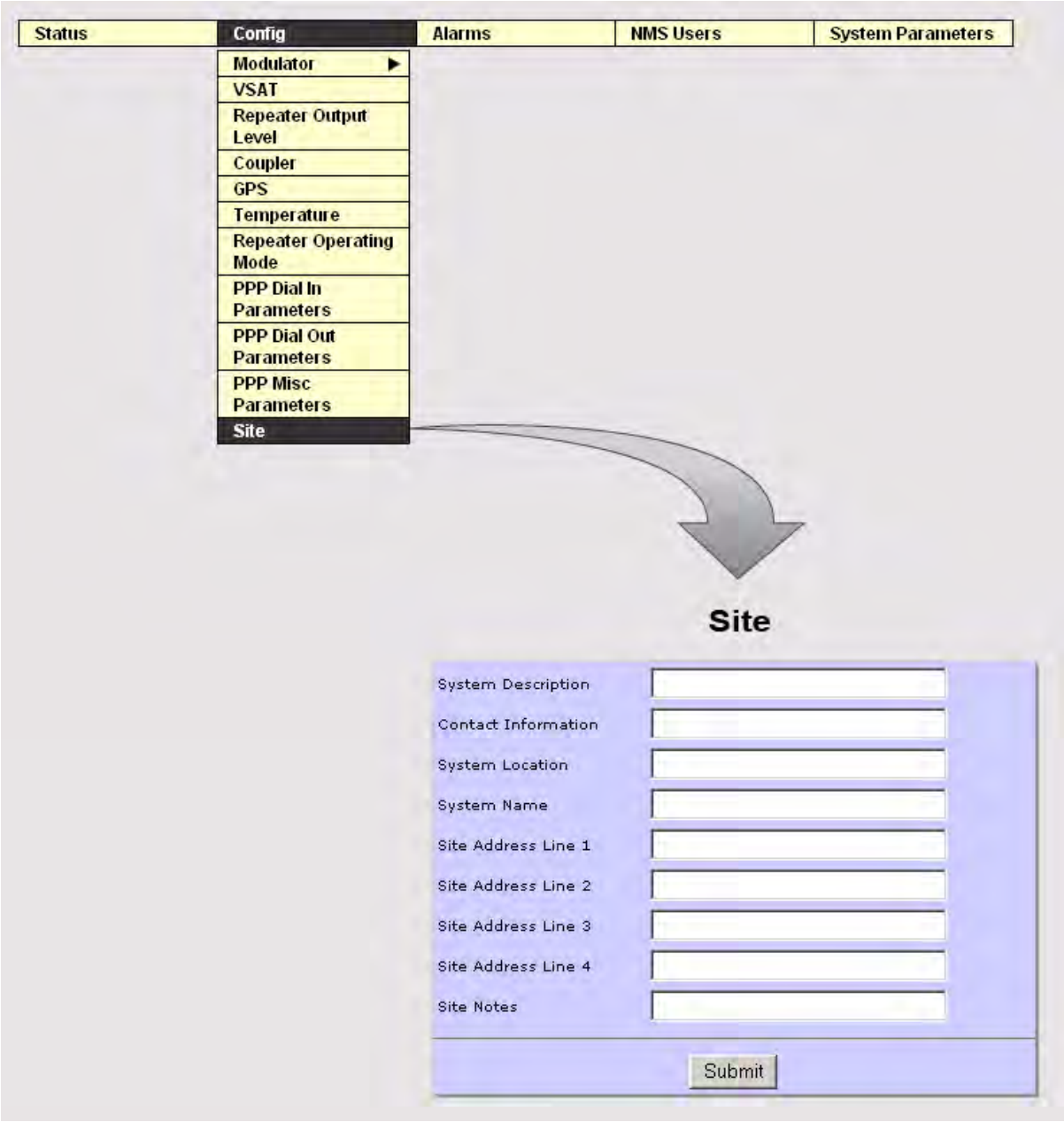


Figure 5-23 Site Screen

5.5.3 Alarms Sub-Menu Breakdown

Alarms shows the repeater current alarm status, alarm log, and allows the user to configure alarms according to user requirements.

To access the Alarms sub-menu; GUI Main Menu => Alarms

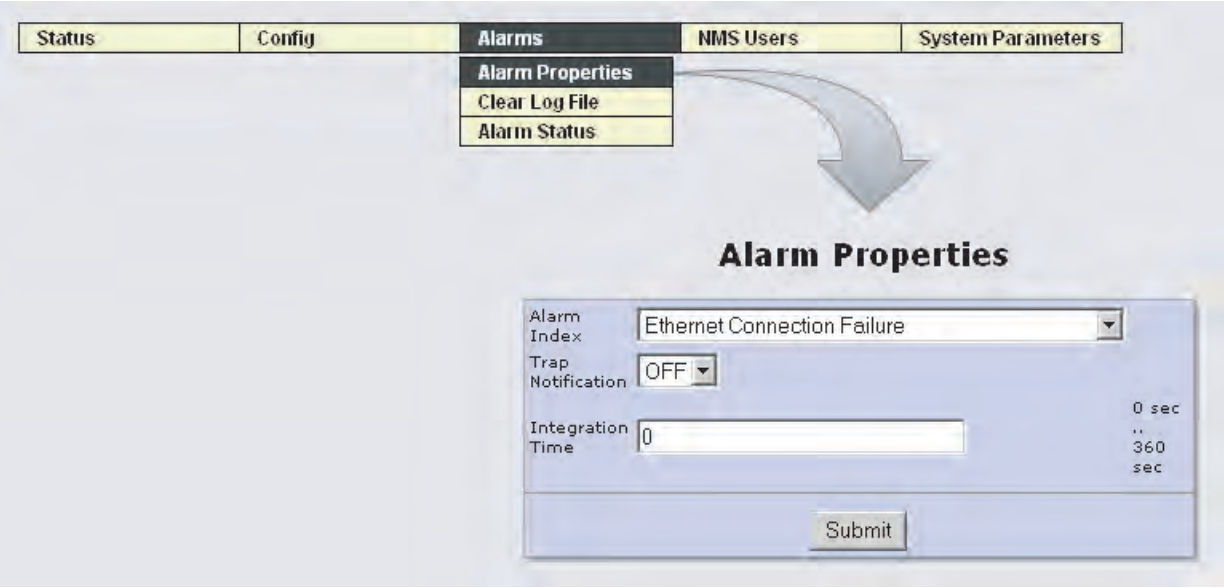
The Alarm sub-menus are divided as follows:

Alarm Properties

Clear Log File

Alarm Status

The individual GUI screens follow.



Integration Time = Time in seconds that the repeater software will sample the condition causing the alarm - to make sure the cause is present during the whole period of time. This is used when the alarm changes from Cleared to Set. Value 0 means that the first time the condition is detected, the alarm will be set.

DTR-1100
03/06/08

Figure 5-24 Alarm Properties Screen

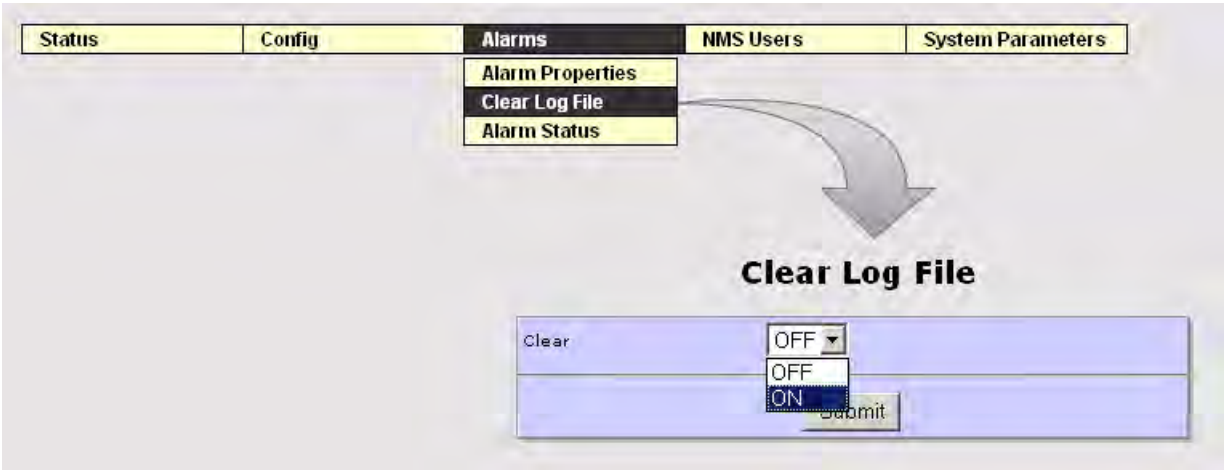


Figure 5-25 Clear Log File Screen

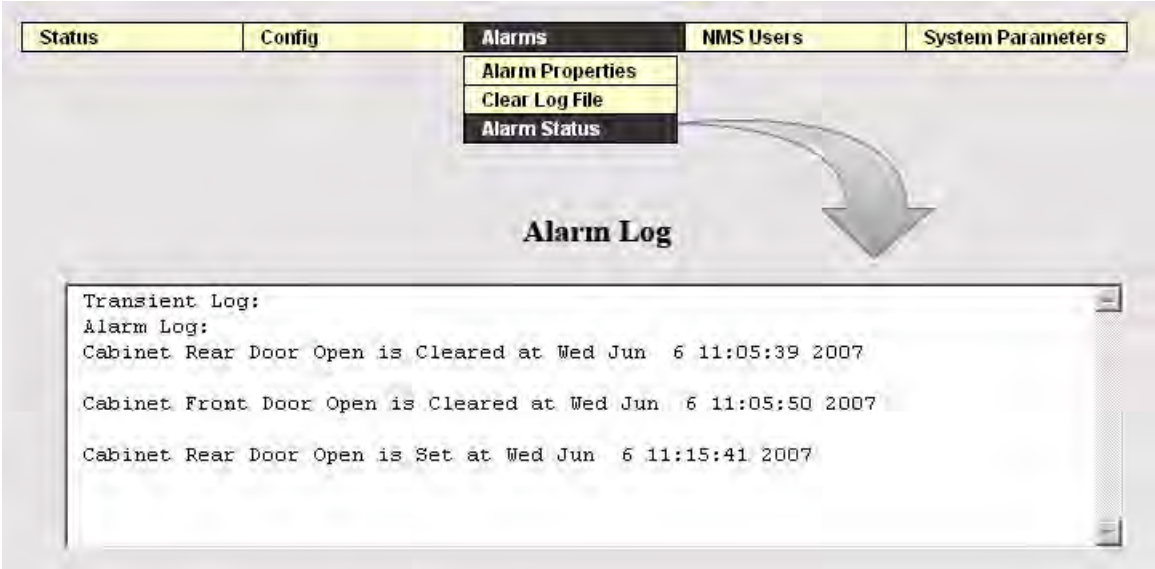


Figure 5-26 Alarm Status Screen

5.5.4 NMS Users Sub-Menu Breakdown

The NMS Users screen shows identification and authorization parameters. To access the NMS Users sub-menu; GUI Main Menu => NMS Users => User Properties. See Figure 5-27.

Figure 5-27 Access to User Properties Screen

5.5.5 System Parameters Menu

To access the System Parameters sub-menu: GUI Main Menu=>System Parameters. See Figure 5-28.

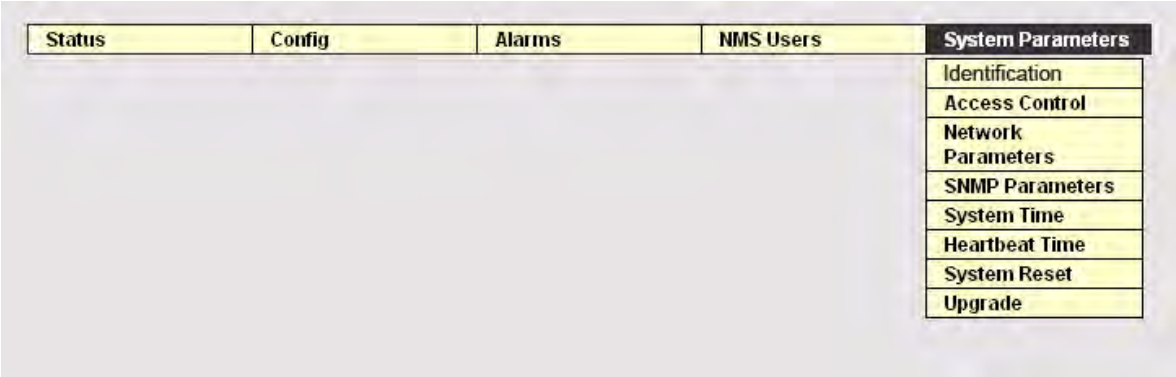


Figure 5-28 Access to System Parameters Sub-Menu

The System Parameters sub-menu is divided as follows:

Identification

Access Control

Network Parameters

SNMP Parameters

System Time

Heartbeat Time

System Reset

Upgrade

The individual GUI screens follow:

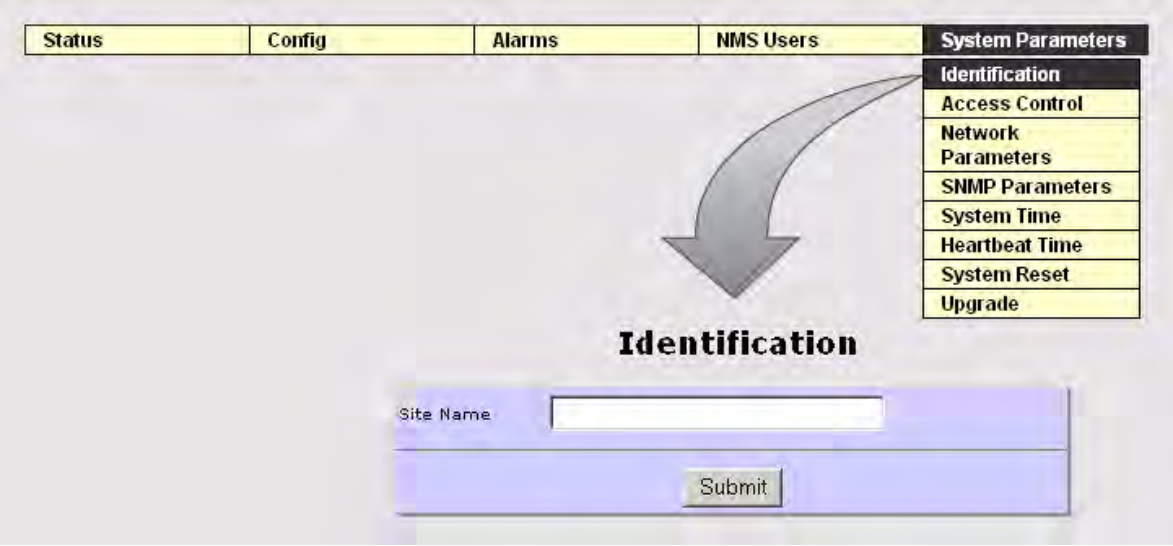


Figure 5-29 System Parameters Identification Screen

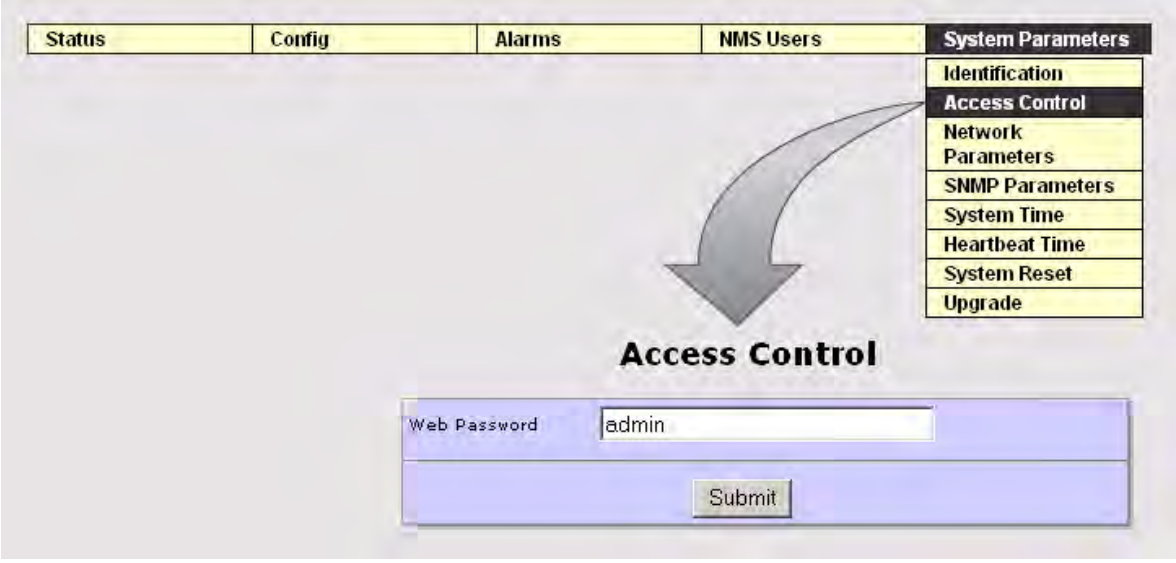


Figure 5-30 System Parameters Access Control Screen

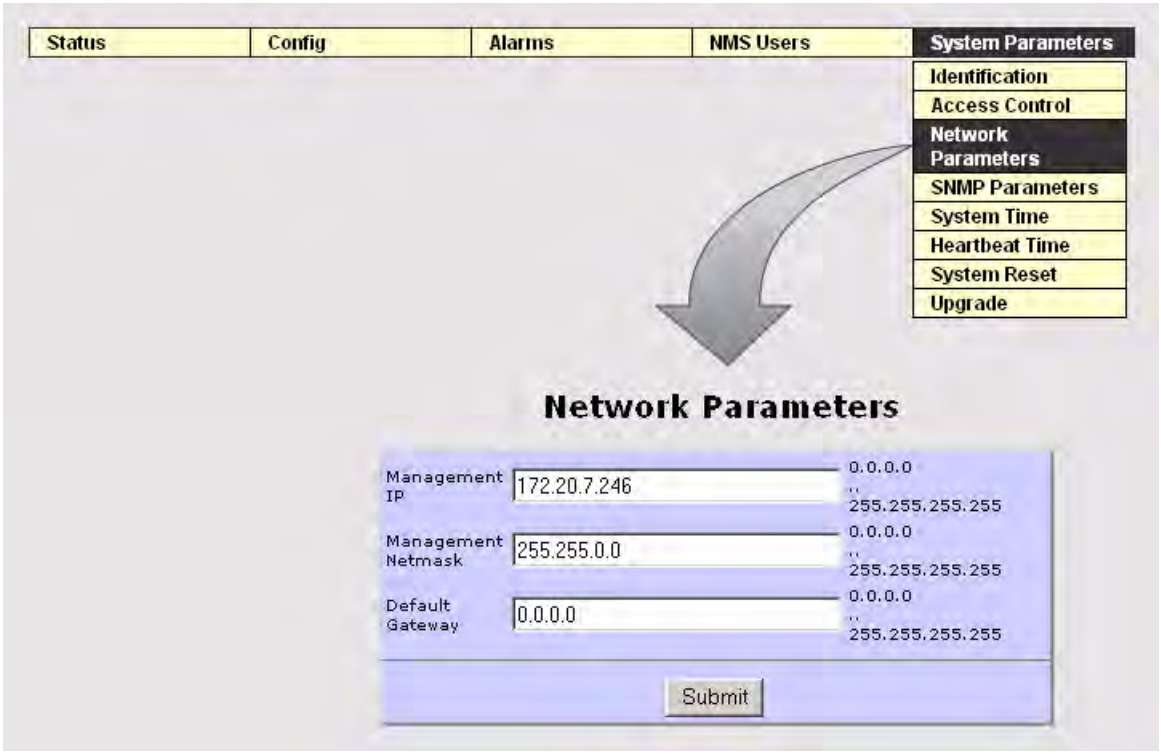


Figure 5-31 System Parameters Network Parameters Screen

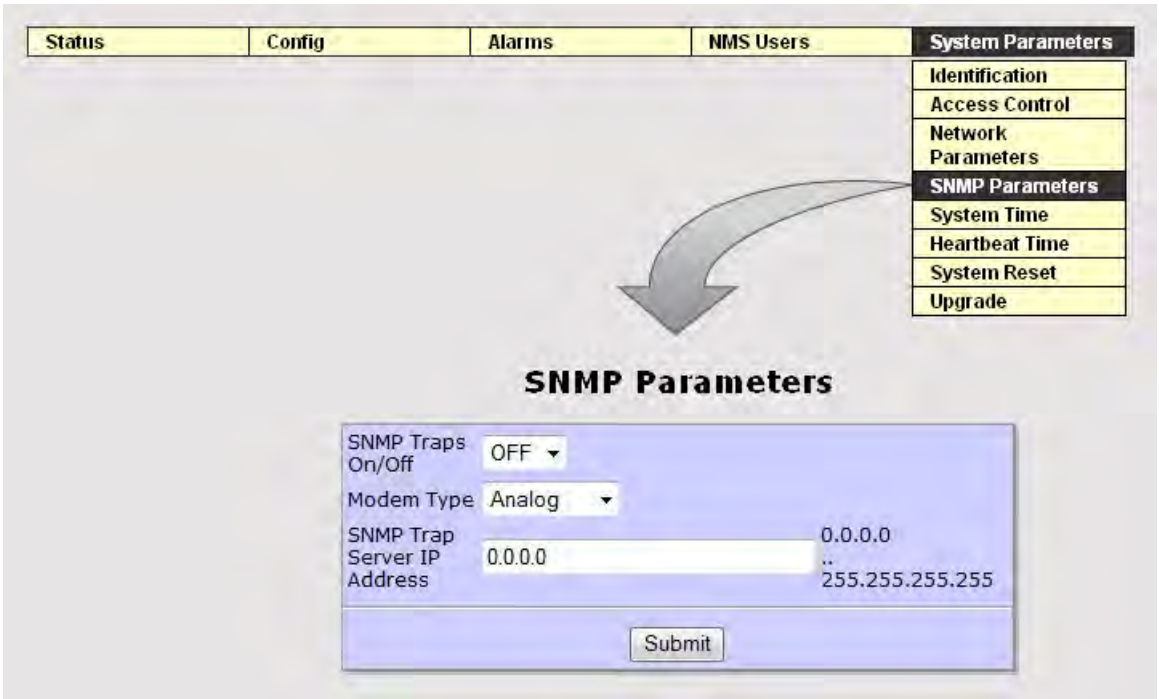


Figure 5-32 System parameters SNMP Parameters Screen

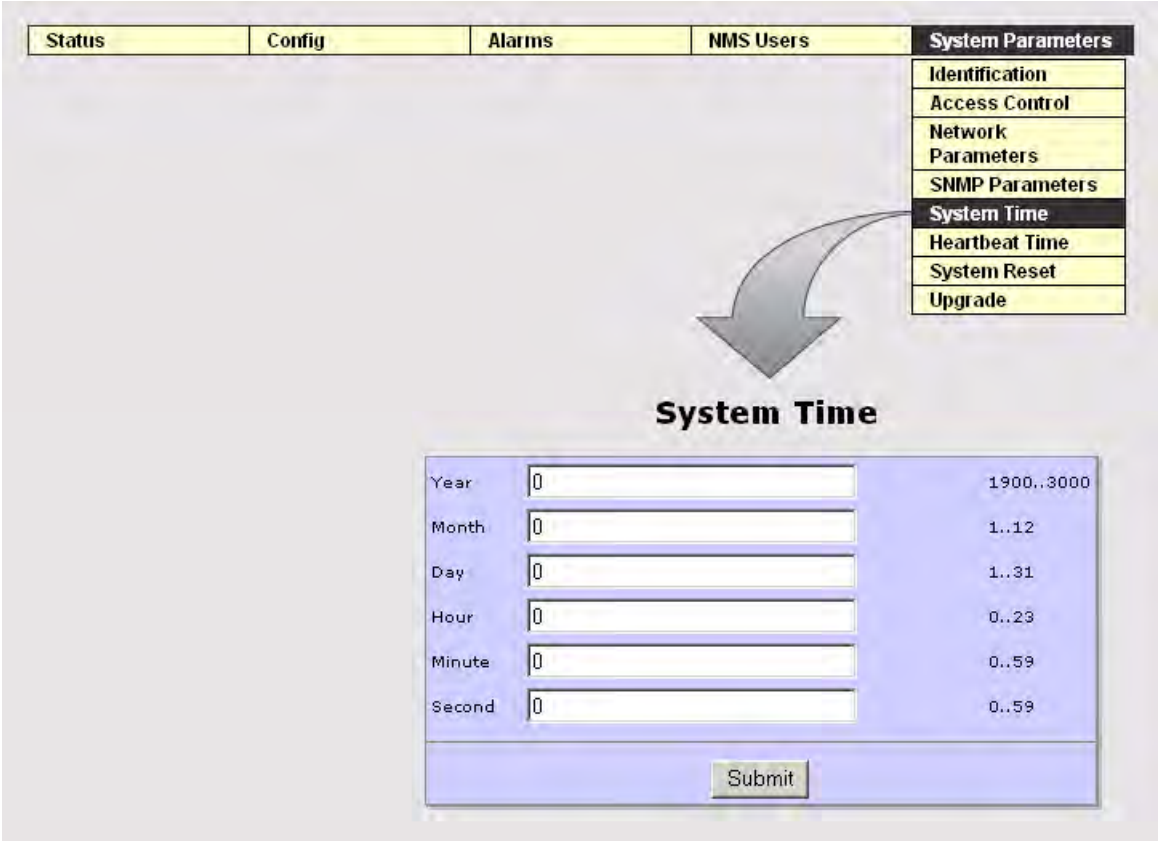
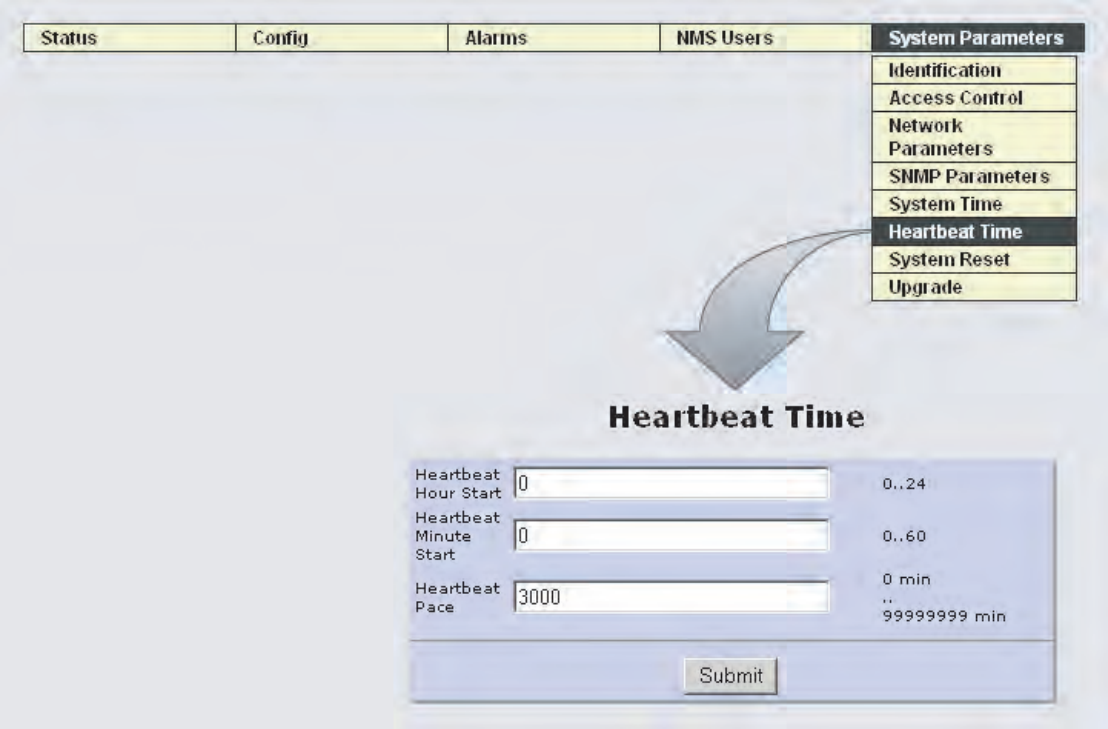


Figure 5-33 System Parameters System Time Screen



The Heartbeat screen allows the user to set the Heartbeat transmission interval to the NMC

Heartbeat Hour Start*
Reference hour from the current day

Heartbeat Minute Start*
Reference minute

Heartbeat Pace
Interval in minutes that the heartbeat traps are generated.

Warning

A Heartbeat pace of less than 10 minutes could prevent remote dial-in and possibly require local access in order to perform any reconfiguration.

* Hour and minute define a reference point from which the heartbeat alarm will be generated. Changes to the heartbeat alarm property require a reset.

Refer to Section 2, Functional Description, Paragraph 2.3.1.4, SPU Main Controller Board, for Heartbeat information.

DTR-1090
03/05/08

Figure 5-34 System Heartbeat Time Screen

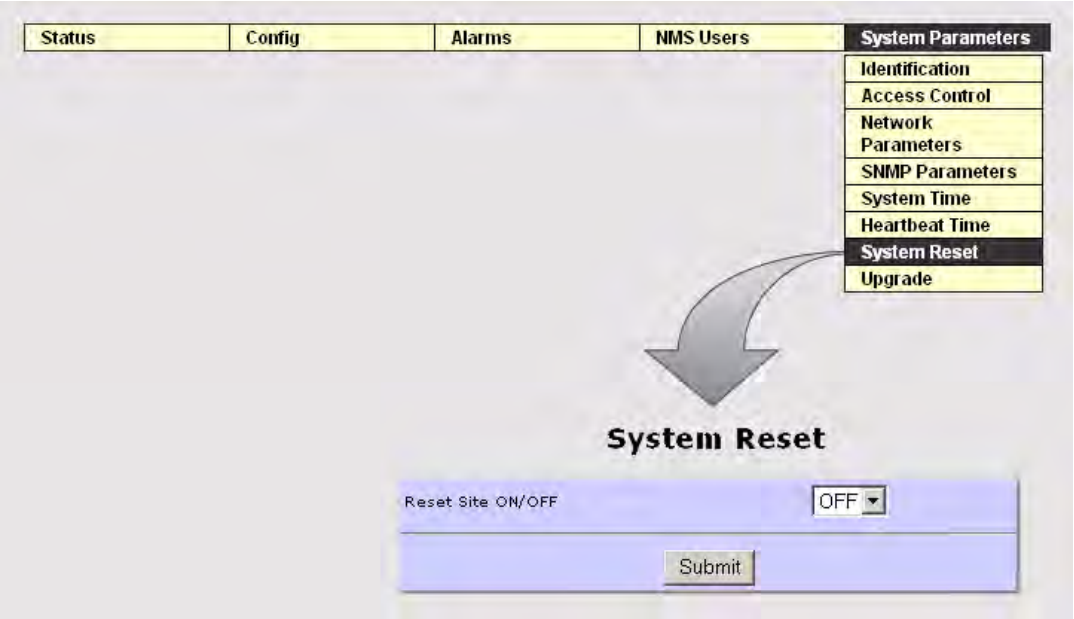


Figure 5-35 System Parameters System Reset Screen

The Upgrade screen allows the operator to upgrade system components by using the Browse button to select the proper upgrade file (e.g.; Main Controller, Supervisor Controller, VSAT Controller, Modulator [PPCO, PPCI, DSP, FPGA], Up-Converter, HPA). After file selection, click on “Start Download”. See Figure 5-36.

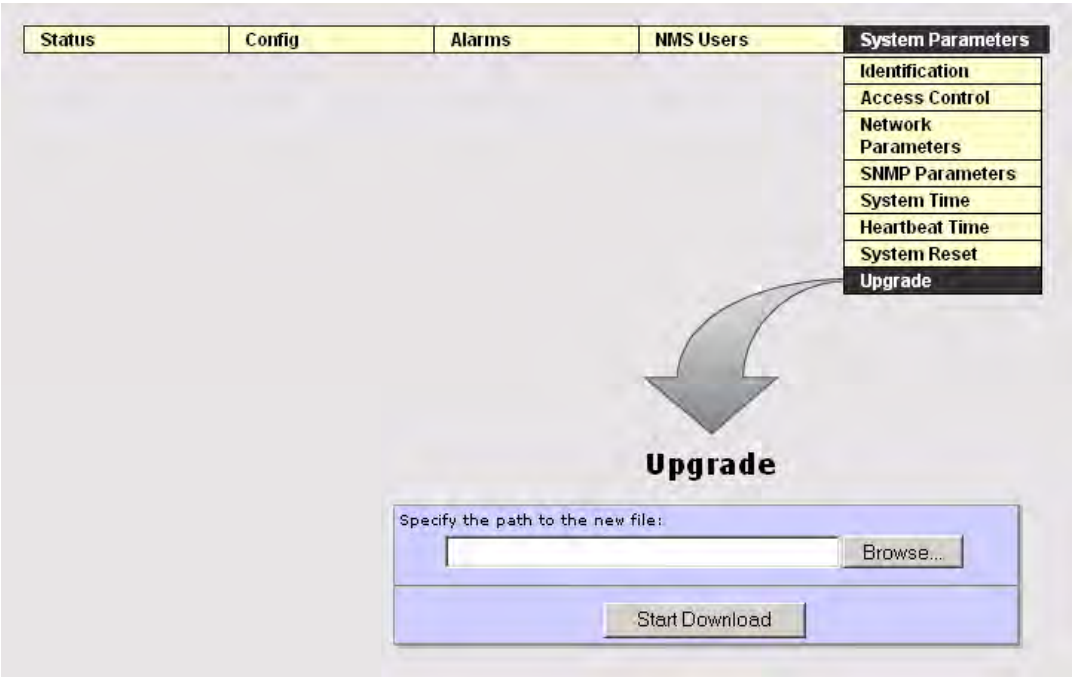


Figure 5-36 System Parameters Upgrade Screen

As upgrade starts, a pop-up dialog box displays with the current upgrade status information. See Figure 5-37.

Note

Screen may be slow to display status.

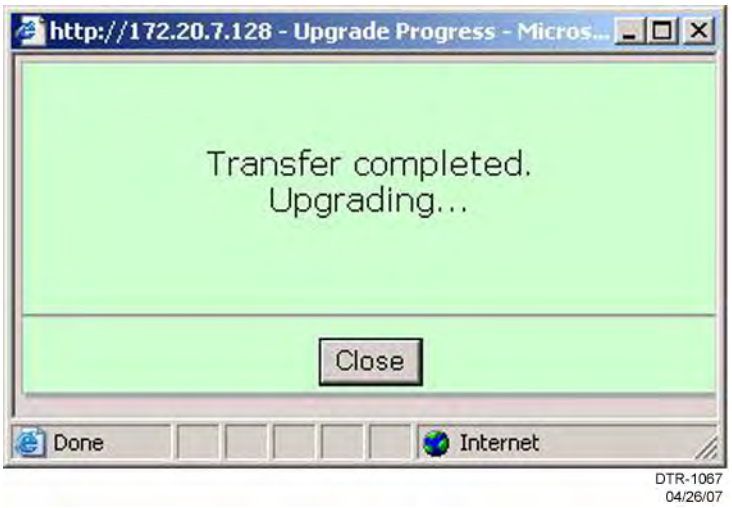


Figure 5-37 Upgrade Dialog Box (Sheet 1 of 2)

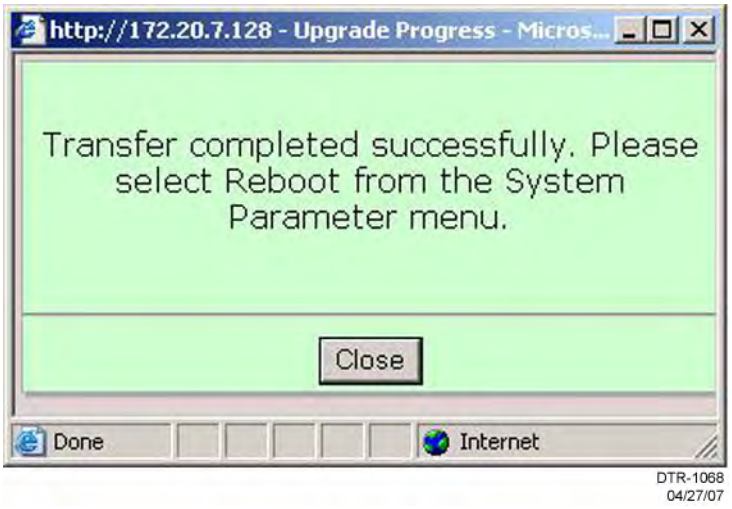


Figure 5-38 Upgrade Dialog Box (Sheet 2 of 2)

Note

The web server is a single threaded server, and as such, allows only one connection at a time. This means an upgrade via phone line can take 10 minutes or more for file transfer. This is dependent upon speed and file size. During transfer, the pop-up dialog box remains blank and only starts showing information after the file is completely transferred.

5.6 COMMAND LINE INTERFACE (CLI)

The CLI can be accessed via the serial RS-232 port located on the SPU front panel. (COMM PORT setting= 9600-8-n-1) or the telnet (port 26).

To use CLI, after system boot, establish connection to the RS-232 or TELNET interface.

Press “Enter” to obtain the Login prompt. See Figure 5-39.

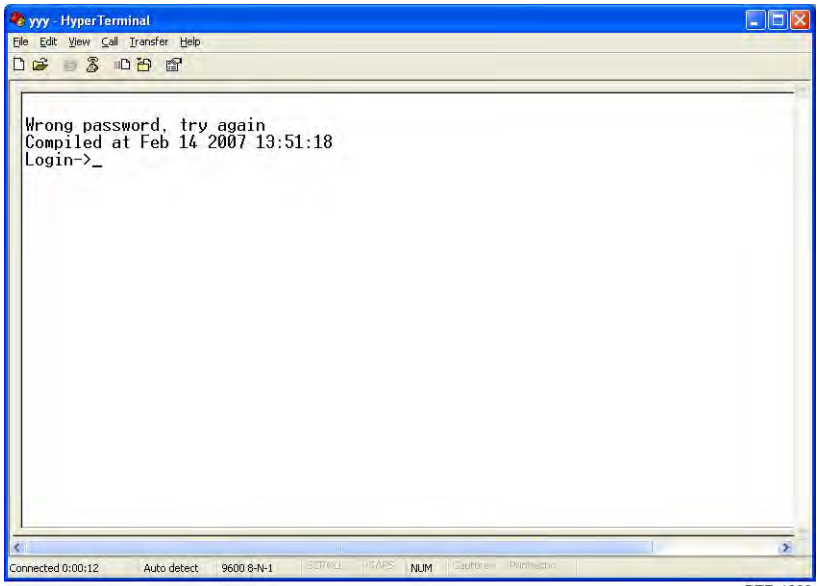


Figure 5-39 CLI Login Prompt

At login, the default password is “admin.” This can be changed through the Web password parameter.

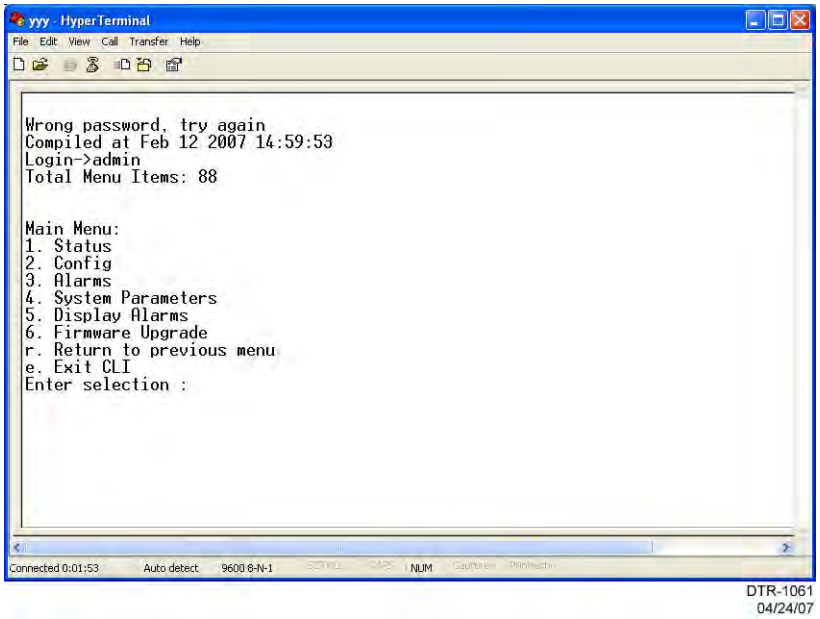


Figure 5-40 CLI Main Menu Screen

5.7 REPEATER OPERATING PROCEDURES

5.7.1 Local/Remote Operation

The repeater can be controlled and monitored either locally on site or remotely from a network management center (NMC). The SPU front panel LOCAL REMOTE switch controls the operating mode of the repeater.

All locally performed actions require the repeater to be in the LOCAL operating condition. Prior to switching the repeater to LOCAL, the on-site technician will coordinate with the NMC operator. This will prevent conflicting actions between the NMC and on-site operators and preclude possible personnel injury and/or equipment damage.

5.7.1.1 Local Operation

For repeater local control (during initial setup and/or maintenance sessions, etc.) and status information, a PC can be connected to the LAN and established via the Ethernet (RJ45) port which provides access to the Web and GUI interface. This is the preferred method.

An alternate access method is via the RS-232 (DB9) serial port using the Command Line Interface (CLI) protocol. The RS-232 provides access to CLI and allows the operator to perform initial setup and/or troubleshooting when network connectivity may not be available or desired.

5.7.1.2 Setting to Local Operating Condition

1. Coordinate with the NMC operator.
2. Press the SPU front panel LOCAL/REMOTE switch to change to the LOCAL position (see Figure 5-41).
3. Wait for the LOCAL LED to switch from Red to Green (approximately 2.5 minutes).

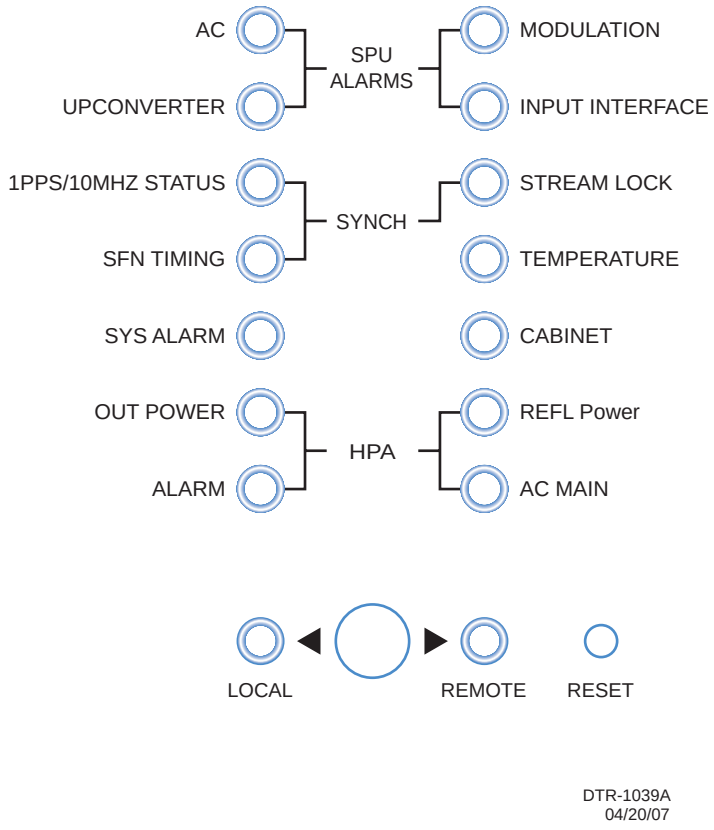


Figure 5-41 SPU Front Panel Local/Remote Switch

5.7.1.3 Steps to Access the Repeater in Local Operating Condition via Ethernet

1. Connect the PC to the Ethernet (RJ45) port on the back panel of the controller. See Figure 5-42.

Figure 5-42 Main Controller Back Panel Ethernet Connection

2. Access the repeater using the Internet Explorer browser and the repeater IP address. When the repeater finishes booting, the Login screen displays. See Figure 5-43.

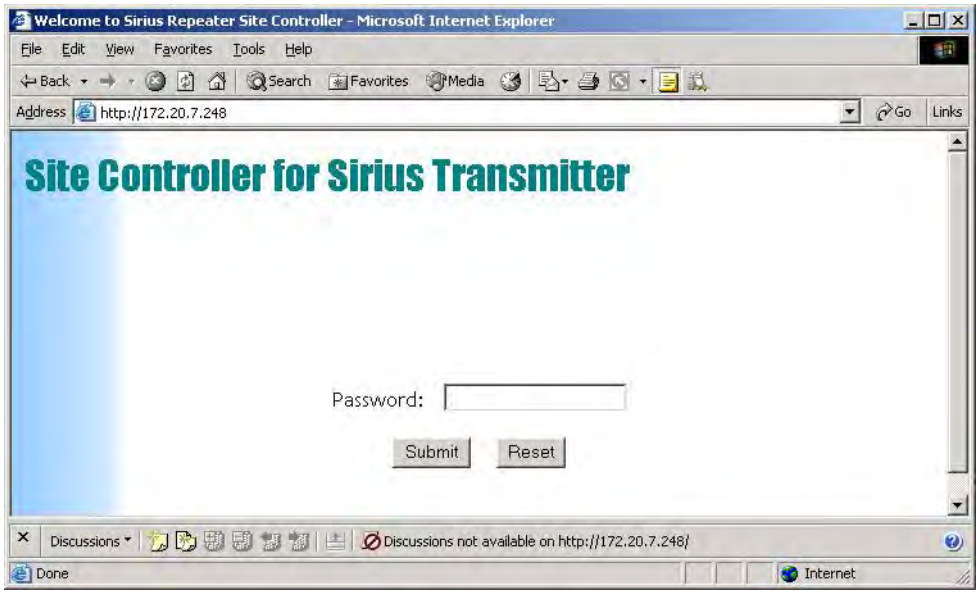


Figure 5-43 Login Screen

3. On the Login screen, enter the repeater password (default = admin).
4. To access the repeater status information or to modify parameters, use the GUI Web interface.

5.7.1.4 Steps to Access the Repeater in Local Operating Condition via RS-232

1. Connect PC to RS-232 Console Port (SPU front panel) using a straight cable.
2. Access the repeater via the HyperTerminal and using CLI commands.

Note

The Modulator can also be directly accessed using an RS-232 Null Modem cable connected to the Modulator RS-232 LOCAL PORT connector on the modulator back panel, and using CLI commands.

5.7.1.5 Remote Operation

Remote repeater access and communication is via V90 modem (RJ11) and a dial up telephone line connected to the Network Management Center (NMC).

When an alarm occurs, the repeater's main controller attempts to establish communication with the NMC through the dial up modem. If the phone line is busy, the controller will retry after a pre-determined time period. Once the main controller finishes sending all the traps to the NMC, the controller switches to a slave mode. In the slave mode, the controller waits for a connection to be established with the NMC using preconfigured SNMPv3 parameters. This allows NMC to poll its parameters/status or make changes to various system parameters.

5.7.2 Operating Modes

Operating mode configuration can occur in either of two main parameter groups; Repeater Operating Mode parameters or Modulator Operating Mode parameters.

5.7.2.1 Repeater Operating Modes

In general, under no fault conditions, the repeater AC power up algorithm will restore repeater operation to the existing mode condition prior to AC shutdown (if the repeater was in Standby prior to AC shut down, upon reapplication of AC the repeater would return to Standby). There are three repeater operating modes:

1). Standby mode

2). Broadcast mode

3). Manual mode

Mode selection is via the GUI Main Menu. From the Main Menu select Config => Repeater Operating Mode => Standby, Broadcast, or Manual. See Figure 5-44.

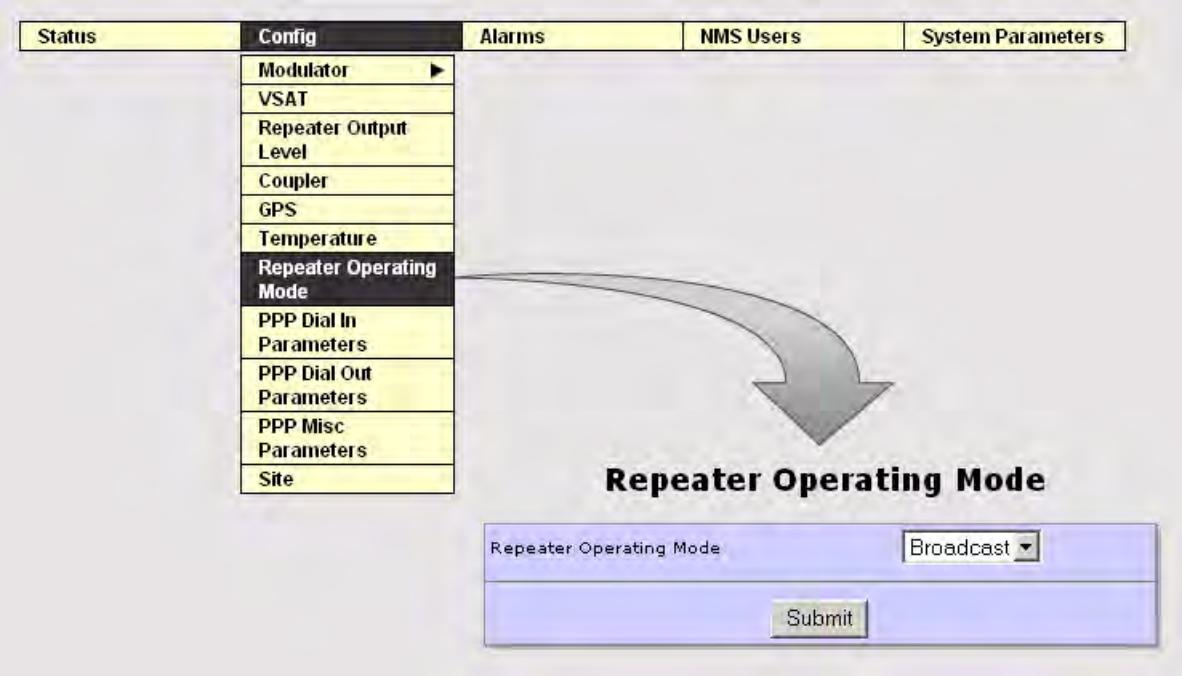


Figure 5-44 Repeater Operating Mode Screen

5.7.2.1.1 Standby Mode

The Standby Mode is used to take the repeater off the air without removing all power. The up-converter output is muted, ALC is off, and the HPA is switched off by disabling the HPA power supply.

Following are the repeater operating conditions when in the Standby Mode:

- AC power is applied to the SPU, HPA, and fans
- HPA power supply is disabled
- HPA RF switch is off
- Up-converter output is muted
- Cabinet fans are turned on

5.7.2.1.2 Broadcast Mode

The Broadcast Mode is the normal operating mode for the repeater and allows the repeater to transmit either real (satellite input) or internally generated test signals, transmit OFDM signals for terrestrial broadcast, and run all the protection loops/ ALC. In this mode, all repeater functions are automatically maintained by the Main Controller.

5.7.2.1.3 Manual Mode

The Manual Mode is for testing and troubleshooting. Refer to the Maintenance section of this manual for use of the Manual Mode. When switched to the Manual mode, the repeater maintains all the system settings that were in effect in the previous mode.

Table 5-1 summarizes the repeater status under the three modes of operation.

Table 5-1 Summary of Repeater Status Under the Three Modes of Operation

	Standby Mode	Broadcast Mode (Real Signal)	Broadcast Mode (Test))	Manual Mode
Satellite Input	On or Off	On	On or Off	On or Off (if no satellite input)
Up Converter Output	Muted	On	On	On
HPA RF Output	Muted	On	On	On or Off (user must turn HPA on or off as required).
ALC	Off	On	On	Off
SPU AC & DC Power	On	On	On	On
HPA AC & DC Power	Off	On	On	On or Off
Fans Assemblies (Rear door fans will not operate with cabinet rear door open).	On	On	On	On
IF Output	On or Off (depends on state of modulator)	On	On	On or Off (user must unmute IF as required).
GPS	On or Off	On	On or Off	On or Off

5.7.2.2 Modulator Modes

There are seven modulator operating modes but only two are used in the field; the remainder are factory modes. The two modes used by the operator/technician are:

1). Standby mode

2). Run

Mode selection is via the GUI Main Menu. From the Main Menu select Config =>Modulator => Modulator Mode => Standby or Run. See Figure 5-45.

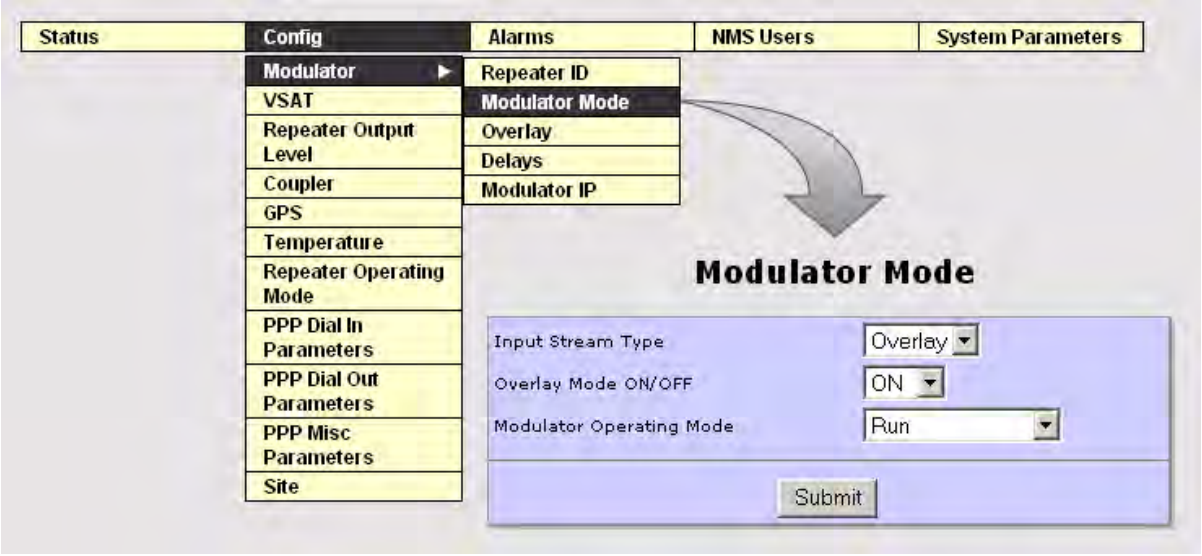


Figure 5-45 Modulator Mode Screen

5.8 CONTROLS, INDICATORS, AND CONNECTORS

Controls, indicators, and connectors used in normal operation or referenced in procedures are shown in Figure 5-46 through Figure 5-53.

5.8.1 Signal Processing Unit (SPU) Controls and Indicators

The SPU front panel has a series of LED indicators to warn of SPU Alarms, Sync conditions, and HPA alarms and conditions. Specific alarms appear on the GUI ALARM screen and are addressed in Appendices D and E. Also on the front panel is the Local Remote push-button switch and its related indicator LEDs. Front panel indicators are addressed in Figure 5-46.

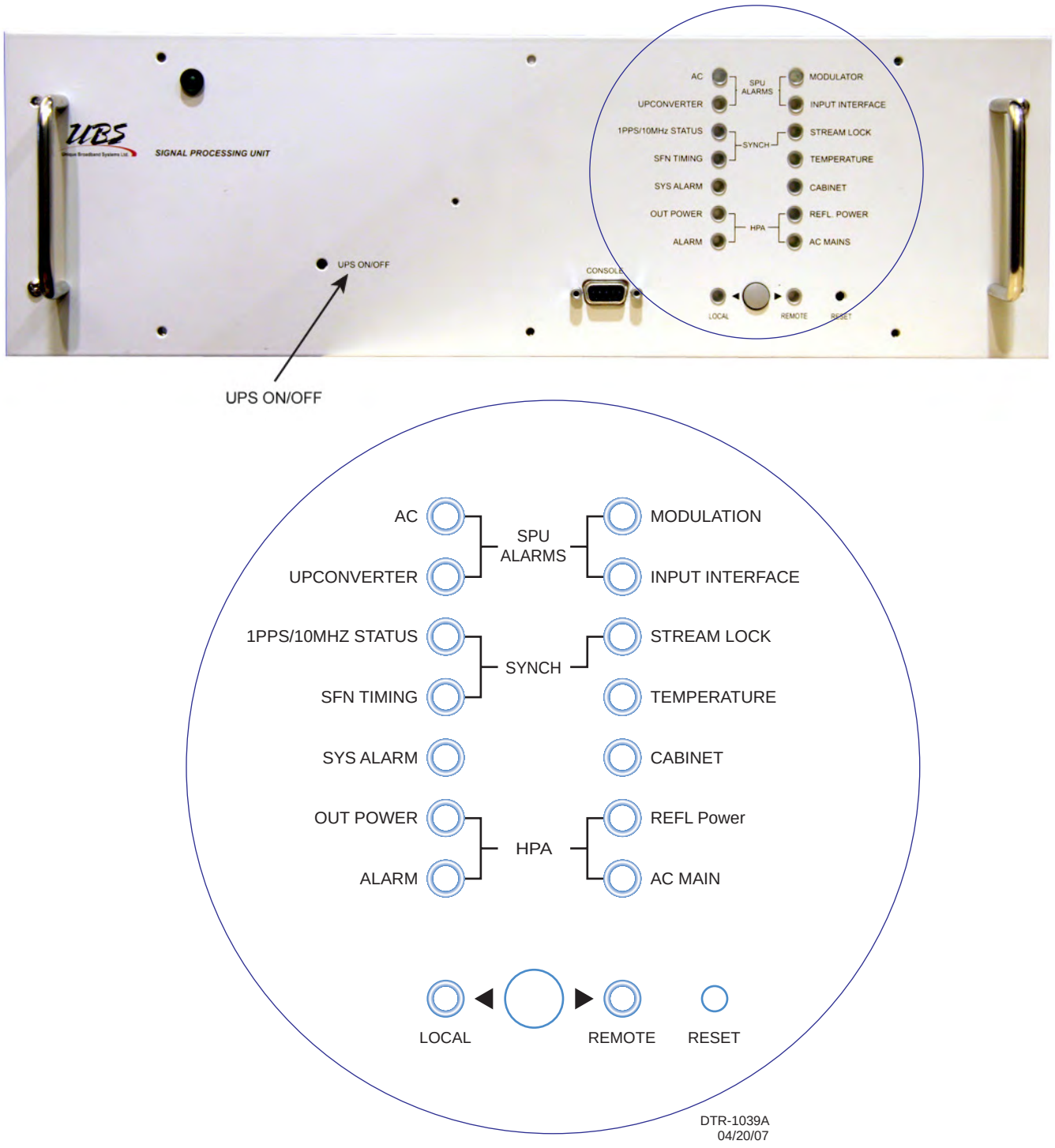


Figure 5-46 Signal Processing Unit (SPU) Front Panel (Sheet 1 of 3)

SPU ALARMS

INDICATOR	COMMENTS	INDICATION
AC	Fault occurs when 12 Vdc is out of limits	Normal = Green Fault Alarm = Red
MODULATOR	Caused by any alarm from the modulator including Communication error with the modulator	Normal = Green Fault Alarm = Red
UPCONVERTER	This LED is red when there is a communication error with the upconverter or the upconverter's LO PLL is not locked	Normal = Green Fault Alarm = Red
INPUT INTERFACE	VSAT Communication error or any error coming from the VSAT	Normal = Green Fault Alarm = Red

SYNCHRONIZATION ALARMS

1 PPS/10MHz STATUS	PLD not locked or 1PPS/10MHz alarms on the modulator	Normal = Green Fault Alarm = Red
STREAM LOCK	No lock to input stream alarm from the modulator	Normal = Green Fault Alarm = Red
SFN TIMING	An alarm from the modulator indicating that the Single Frequency Network margins are violated	Normal = Green Fault Alarm = Red

HPA ALARMS

OUT POWER	HPA Forward Power Fault	Normal = Green Fault Alarm = Red
REFL POWER	HPA Reflected power fault or Repeater Reflected power fault	Normal = Green Fault Alarm = Red
ALARM	Any alarm from the HPA will cause the LED to go red	Normal = Green Fault Alarm = Red
AC MAINS	Any summary alarm from the HPA power supply modules will cause the LED to go red	Normal = Green Fault Alarm = Red

.

Figure 5-46 Signal Processing Unit (SPU) Front Panel (Sheet 2 of 3)

SUMMARY ALARMS

INDICATOR	COMMENTS	INDICATION
TEMPERATURE	Alarm when Ambient temperature goes too high over the Operating Temperature Threshold.	Normal = Green Fault Alarm = Red
SYS ALARM	LED goes red for any alarm in the system	Normal = Green Fault Alarm = Red
CABINET	Currently behaves the same way as Temperature LED	Normal = Green Fault Alarm = Red

OTHER CONTROLS / CONNECTORS / INDICATORS

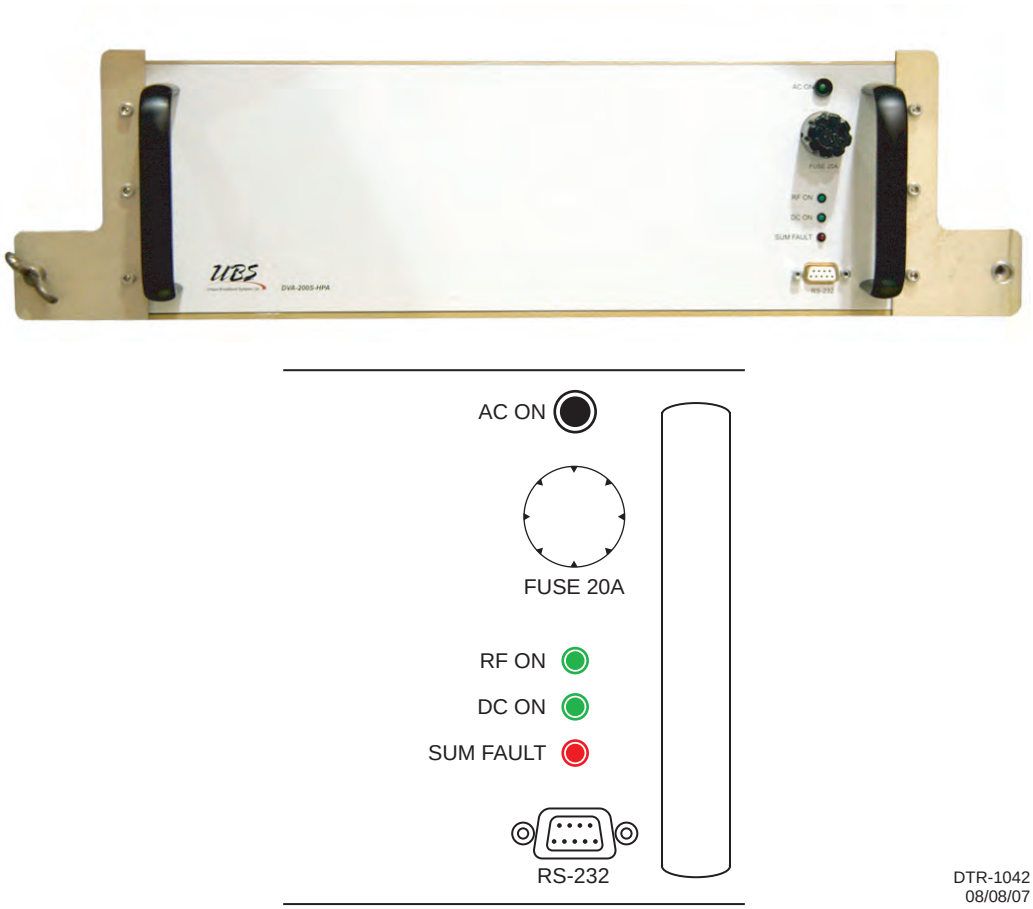
CONTROL/ CONNECTOR/ INDICATOR	COMMENTS	INDICATION
UPS ON/OF	Push-button switch	When the SPU is powered off, holding the push-button keeps the UPS off
CONSOLE	RS-232 connector for external console	
LOCAL/REMOTE	Mode switch and mode indicators. Press twice to switch to Local and disconnect the HPA	Individual LEDs indicate mode
RESET	Push-button to reset controller	

Figure 5-46 Signal Processing Unit (SPU) Front Panel (Sheet 3 of 3)

5.8.2 High Power Amplifier (HPA) Controls and Indicators

5.8.2.1

The HPA front panel houses four status LEDs; AC ON, RF ON, DC ON, and SUM FAULT. The panel also houses a type DB-9 RS-232 connector and a 15A Fuse Holder. See Figure 5-47.



CONTROL/INDICATOR	COMMENTS	INDICATION
AC ON	Indicates 204VAC into HPA power supply	LED Green
RF ON	HPA internal RF switch is enabled and RF power is present at HPA output	LED Green
DC ON	HPA power supply is enabled and DC voltage is applied to the amplifier	LED Green
SUM FAULT	Internal fault. Specific fault message sent via RS-485 interface to Main Controller	LED Red (only on during fault)
RS-232	Future connecting point for external console	

Figure 5-47 HPA Front Panel

5.8.2.2

The HPA rear panel houses five connectors; AC IN, RF MONITOR, RF OUT, CONTROL IF, and RF IN. See Figure 5-48.

CONNECTORS	COMMENTS
AC IN	Connects to PDU for AC power
RF MONITOR	For monitoring/testing. Terminated with 50 ohm load
RF OUT	Connects to output bandpass filter
CONTROL I/F	Connects to Main Controller PA Control connector
RF IN	Connects to Up-Converter RF OUT connector

Figure 5-48 HPA Rear Panel

5.8.3 Power Distribution Unit (PDU) Front Panel Controls

The PDU front panel houses seven circuit breakers for controlling repeater electrical power. There is also an auxiliary power receptacle for future use. See Figure 5-49.

CONTROL	COMMENTS
MAIN POWER	Removes all power from the entire repeater cabinet.
FANS	Removes power from the four axial fans; two on the top of the HPA and two on the back door of the cabinet.
HPA	Removes input power from the HPA drawer.
SPU	Removes input power from the SPU drawer.
AUX POWER	Removes power from the AUX receptacle.
EXTERNAL HEATER	This is an optional connection for use by the customer as desired.
INTERNAL HEATER	Removes power from the SPU area heater. The heater is not part of the SPU.
AUX OUTLET	Controlled by AUX POWER CB. Supplies 120v, 5A.

Figure 5-49 Power Distribution Unit Front Panel

5.8.4 VSAT Receiver Rear Panel Connectors

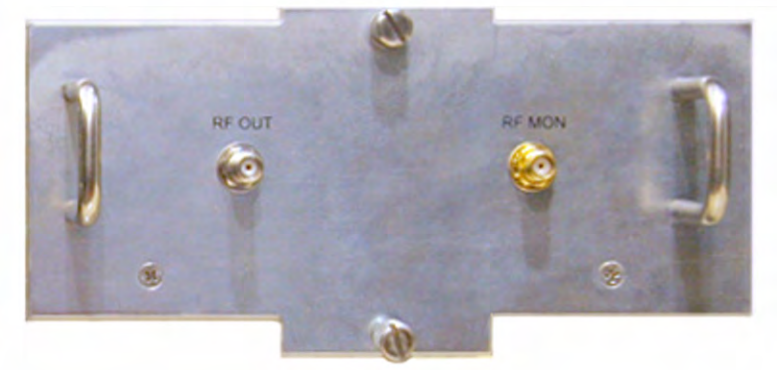
The VSAT Receiver rear panel has three connectors; ASI OUT 1, ASI OUT 2, and VSAT ANTENNA. See Figure 5-50.

CONNECTOR	COMMENTS
ASI OUT 1	Not connected
ASI OUT 2	Connects to ASI B on Main Controller
VSAT ANTENNA	Connects to VSAT antenna signal cable

Figure 5-50 VSAT Receiver Rear Panel

5.8.5 Up-Converter Rear Panel Connectors

The Up-converter rear panel has two connectors; RF OUT and RF MON. See Figure 5-51.



CONNECTOR	COMMENTS
RF OUT	Connects to HPA RF IN
RF MON	Not connected

Figure 5-51 Up-Converter Rear Panel

5.8.6 Modulator Rear Panel Connectors

The Modulator rear panel has five connectors; IF MON I, IF MON Q, LOCAL PORT, ETHERNET, and ASI IN MON. See Figure 5-52.

CONNECTOR	COMMENTS
IF MON I	Not connected
IF MON Q	Not connected
LOCAL PORT	RS-232 Serial Port (DB9 connector) for PC direct connection to Modulator via null modem cable. Used to access parameters and status via CLI protocol.
ETHERNET	Connects to Main Controller ETHERNET connection to allow communication between Main Controller and Modulator.
ASI IN MON	Not connected

Figure 5-52 Modulator Rear Panel

5.8.7 Main Controller Rear Panel Connectors

The Main Controller rear panel has 20 connectors; MODEM, spare (3), FWD RF DETECTOR, REFL RF DETECTOR, PA CONTROL, TEMP.SENSOR, STATUS IN, RELAY CONTROL, 10MHZ, 1PPS, ASI A, ASI B, ETHERNET 10/100/1000 BASE T (4), GPS ANT, DIAL-UP. See Figure 5-53.

CONNECTOR	COMMENTS
MODEM	Not connected
FWD RF DETECTOR	Connects to RF forward power detector for RF monitoring
REFL. RF DETECTOR	Connects to RF reflected power detector for RF monitoring
PA CONTROL	Connects to HPA Control I/F
TEMP.SENSOR	Connects to PDU
STATUS IN	Connected to Status Cable inside repeater and indicates Door Status
RELAY CONTROL	Connected to Relay Cable inside repeater and indicates Relay Status
10 MHZ	Not connected
1 PPS	Not connected
ASI A	Not connected
ASI B	Connected to VSAT RX ASI OUT 2
ETHERNET 10/100 BASE T	There are four Ethernet connectors. Any one of the four must connect by cable to the Modulator back panel Ethernet connector. This provides communication between the Modulator and Main Controller. The remaining three Ethernet connectors connect to external equipment such as a PC (for troubleshooting, parameter monitoring, etc.).
GPS ANT	Connects to GPS Antenna cable.
DIAL-UP	Phone cable connection

Figure 5-53 Main Controller Rear Panel