



# Thuraya *m2m*



User Guide

Thuraya FT2225  
Satellite M2M Terminal

**ViaSat**<sup>®</sup>

**Thuraya *m2m***

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ETSI EN 301 444, ETSI EN 300 328, ETSI EN 301 489-1, ETSI EN 301 489-17, ETSI EN 301 489-20, IEC 60950-1, IEC 60950-22, Council Recommendation 1999/519/EC.

We hereby declare that all essential radio test suites have been carried out and that the above named product is in conformity to all the essential requirements of R&TTE Directive 1999/5/EC, IC/FCC Class A Part 15.

ViaSat, Inc. declares that this Satellite Modem is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. These limits are designed to provide a reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. To ensure regulatory and safety compliance, use power and interface cables according to the guidelines in this manual.

The technical documentation relevant to the above equipment will be held at:

ViaSat, Inc., 6155 El Camino Real, Carlsbad, CA, 92009, USA

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### Compliance Statement (Part 15.19)

The enclosed hardware device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received including interference that may cause undesired operation.

### Warning (Part 15.21)

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

## **INDUSTRY CANADA (IC) REGULATORY INFORMATION**

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This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie

Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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This Class A digital apparatus complies with Canadian ICES-003, RSS-Gen and RSS-210.

Cet appareil numérique de la classe B est conforme à la norme NMB-003, CNR-Gen et CNR-210 du Canada.

## **EU ROHS (RESTRICTION OF HAZARDOUS SUBSTANCES) DIRECTIVE**

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## **EU REACH (REGISTRATION, EVALUATION, AUTHORISATION AND RESTRICTION OF CHEMICALS) DIRECTIVE**

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## WARNINGS, CAUTIONS, AND NOTES

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Safety precautions or important information found in this document will normally be presented just prior to the point where the hazard is likely to be encountered. Symbols used to identify the information are defined as follows:



**WARNING:** The “Warning” icon identifies where and/or what potential problems might occur while performing configuration procedures.



**CAUTION:** The “Caution” icon identifies procedures or factors that can affect the installation and configuration of the system (may damage or render equipment inoperable).



**CAUTION:** This symbol indicates that electrostatic discharge (ESD) precautions must be observed or the equipment may be damaged.



**NOTE:** The “Note” icon identifies information important for performing configuration procedures.

## GENERAL SAFETY PRECAUTIONS

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General safety precautions are as follows:



**WARNING:** There are no user-serviceable parts inside the terminal. There are no lethal voltages inside the terminal. The terminal should only be opened by a technician that is trained and certified to service Thuraya products.



**WARNING:** This device emits radio frequency (RF) energy when in transmit mode. In order to comply with FCC RF Exposure limits, the unit must be installed in such a way as to ensure that a minimum separation distance of 1 ft (31cm) is maintained between the antenna and any nearby persons.

## ABOUT THIS MANUAL

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This manual contains information about the ThurayaM2M FT2225 Terminal including installation procedures, webpage operations, and troubleshooting procedures.

## SUPPORTING DOCUMENTATION

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The following list provides documentation associated with this user manual.

### Title

FT2225 Terminal Quick Start Guide

FT2225 Terminal AT Command Interface

Additional publications and information including user guides, white papers, application notes, release notes, software updates, training schedules, and other technical information may be found on the Thuraya website, located at: <http://thuraya.com>

## ACRONYMS

ACRONYMS AND DEFINITIONS		
<b>- A -</b>	ADC	Analog-Digital Conversion
	AES	Advanced Encryption Standard
	ANSI	American National Standards Institute
<b>-B-</b>	BIT	Built-in Self Tests
<b>- D -</b>	DHCP	Dynamic Host Configuration Protocol
<b>- H -</b>	EIA	Electronic Industries Alliance
	EIRP	Effective Isotropic Radiated Power
<b>- E -</b>	Es/No	Energy Symbol/Noise
<b>- F -</b>	FDD	Full Duplex Mode
	FIPS	Federal Information Processing Standard
	FL	Forward Link
	FPGA	Field Programmable Gate Array
	FTP	File Transfer Protocol
<b>- G -</b>	GB	Gigabyte
	GLONASS	Global Navigational Satellite System
	GNSS	Global Navigational Satellite System
	GPS	Global Positioning System
<b>- H -</b>	HTTP	Hypertext Transfer Protocol
	HW	Hardware
<b>- I -</b>	IE	Internet Explorer
	IEEE	Institute of Electrical and Electronics Engineers
	IF	Intermediate Frequency
	IP	Internet Protocol
	IP66	Ingress Protection
<b>- L -</b>	LAN	Local Area Network
	LHCP	Left-Hand Circular Polarization
	LOS	Line of Sight
<b>- M -</b>	M2M	Machine-to-Machine
	MAC	Media Access Control
	Mbps	Megabits per second
	MMI	Multi Media Interface
<b>- N -</b>	NAT	Network Address Translator

## ACRONYMS AND DEFINITIONS

<b>- O -</b>	OSD	Over The Air Software Download
	OTA	Over The Air
<b>- P -</b>	PC	Personal Computer
	PLL	Phase Locked Loop
	POST	Power On Self Tests
<b>- R -</b>	RF	Radio Frequency
	RHCP	Right-Hand Circular Polarization
	RX	Receive
<b>- S -</b>	SCADA	Supervisory Control and Data acquisition
	SSID	Service Set Identifier
<b>- T -</b>	TCP	Transmission Control Protocol
	TIA	Transmission Industry Association
	TX	Transmit
<b>- U -</b>	UDP	User Datagram Protocol
	URL	Uniform Resource Identifier
	UV	Ultra Violet
<b>- V -</b>	VDC	Voltage Direct Current
	VMS	ViaSat L-band Managed Services
<b>- W -</b>	WiFi	Wireless Local Area Network
	WLAN	Wireless Local Area Network

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# 1 INTRODUCTION

## 1.1 Introduction to the M2M FT2225 Terminal

The High Performance FT2225 Terminal is a compact, rugged fixed L-band satellite terminal designed to provide dependable, instant IP-based machine-to-machine (M2M) communications via the Thuraya M2M network(Figure 1 1). The FT2225 two-way networking capability enables both real-time monitoring and real-time control for a wide range of applications such as:

- Oil and gas mid-stream and down-stream monitoring and control
- Power grid neighborhood area networks
- Water treatment and distribution monitoring and control
- Slope monitoring
- Point-of-sales
- ATM kiosks
- Warning systems
- Perimeter and border monitoring
- Smart electrical grids and smart metering
- Open mines telemetry



Figure 1 1. FT2225 Terminal

Field devices can instantly be assessed and adjusted remotely; such as gas valves, smart grid sensors, water pumps, and reservoir level indicators, and data and voice communications. AES-256 data link layer encryption is employed to ensure the integrity of your data is not compromised.

The terminal includes embedded, beyond-line-of-sight connectivity, enabling direct communications between remote locations and with control nodes. With an IP-based network architecture and multiple wired and wireless interfaces, the ThurayaFT2225 terminal easily integrates with your existing M2M system to support any real-time remote monitoring and control application.

Rugged IP66 dust and powerful water jet resistant enclosure ensures reliable communications in the toughest environments.

The guidelines below provide an overview of the terminal's capabilities and basic operation. For detailed configurations, please contact your Thuraya FT2225 retailer, or the Thuraya customer support hotline listed at the back of this manual.

## 1.2 Features of FT2225

Key Features of the Thuraya FT2225 include:

- IP-based networking
- LHCP & RHCP operation
- Wired Ethernet and Wi-Fi interfaces
- Easy antenna pointing via an app on your smartphone or tablet
- Built-in DHCP/NAT router
- Full-duplex connectivity
- Low-latency for instant message transfer and real-time monitoring with no delays
- Embedded commercial GPS + GLONASS
- IP66
- 10-32 V DC Input
- Built-in Web MMI
- AES-256 Encryption

## 1.3 FT2225 Standard Equipment and Optional Accessories

### 1.3.1 Standard Equipment

The FT2225 features the following standard accessories:

- FT2225 Terminal
- Connector mating kit

### 1.4 Key Specifications

The key specifications for Thuraya FT2225 are summarized in Table 1.1 below.

**Table 1.1. FT2225 Key Specifications**

Category	Specification
Size (LxWxH in.):	7.23" x 5.13" x 1.63"
Weight	< 2.64lbs
Power Consumption	18W max
Antenna Receive G/T	Up to -21.0 dB/K at Zenith
Antenna Transmit EIRP	Up to +4 dBW at Zenith, configurable in 0.1 dB steps
Frequency Range	Extended L-band RX: 1518.0-1559.0 MHz TX: 1626.5-1675.0 MHz
Modulation	RX: BPSK, QPSK, 8-PSK and 16-APSK TX: CRMA
Waterproof/Dustproof	Transceiver: IP 66
Humidity	up to 95% condensing at 45°C, per IEC 60068-2-30
Temperature - Operating	-40°C to +71°C
Temperature - Storage	-40°C to + 85°C
Solar Radiation	1120 W/m <sup>2</sup> ; per IEC-60068-2-5
Vibration (Operational)	Random vibration of 1.05g rms at vibration spectrum: 5 to 20 Hz: 0.02g <sup>2</sup> /Hz 20 to 150 Hz: -3dB/octave
Vibration (Survival)	Transportation vibrate per IEC 60068-2-64, Freq: 5-200Hz, ASD: 1.0m <sup>2</sup> /s <sup>3</sup>
Shock (Operational)	IEC 60068-2-64, 50m/s <sup>2</sup> , 11 ms
Shock (Survival)	Transportation shock per IEC 60068-2-29, A = 180m/s <sup>2</sup> , t = 6mS
Approval	CE, FCC, IC

## 2 GETTING STARTED

### 2.1 Unpacking

The FT2225 is shipped in packaging materials that are uniquely designed for the product. The following packing list describes the contents of a typical FT2225 shipment:

1. FT2225 Terminal
2. Mating Connector (assembly required)

Upon unpacking of the box, inventory the contents and inspect for sign of damages during shipping. Contact your retailer in case of missing contents or noticeable defects.

To get started, the additional following items are required:

1. Mount (Platform Dependent)
2. Grounding cable (Platform Dependent)
3. Phillips Screwdriver
4. Compass/inclinometer



**NOTE:** Contact your terminal integration partner for specific mounting equipment.

### 2.2 Selecting Mounting Location

The Thuraya FT2225 Terminal is designed for fixed outdoor installation. The terminal can be mounted on a pole or flat surface using one of the Installation kits (optional accessories).

Mounting location should be selected to provide the terminal with a clear line-of-sight to the operational satellite. Figure 2 1 illustrates improper vs. proper placement of the terminal. On the left, the terminal is placed in front of a tall building, resulting in an obstructed view of the satellite. On the right, the terminal is placed away from the taller building and has a clear, unobstructed view of the satellite.

Terminal should be placed as far away from any other transmit antennae as possible.

A minimum of 2 ft. from GNSS antennae is recommended.



**WARNING:** Terminal antenna should be kept at least 1 foot from direct exposure to humans.

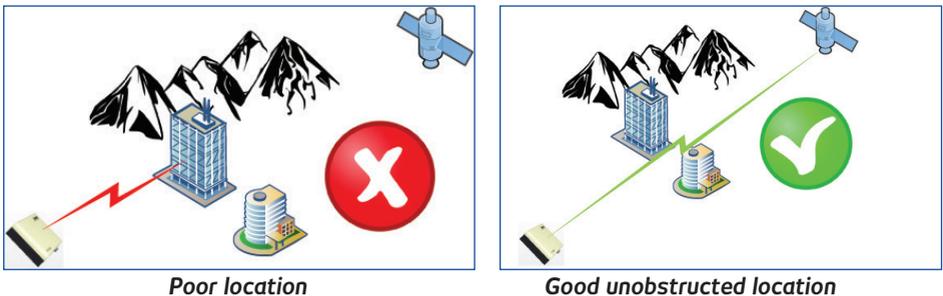


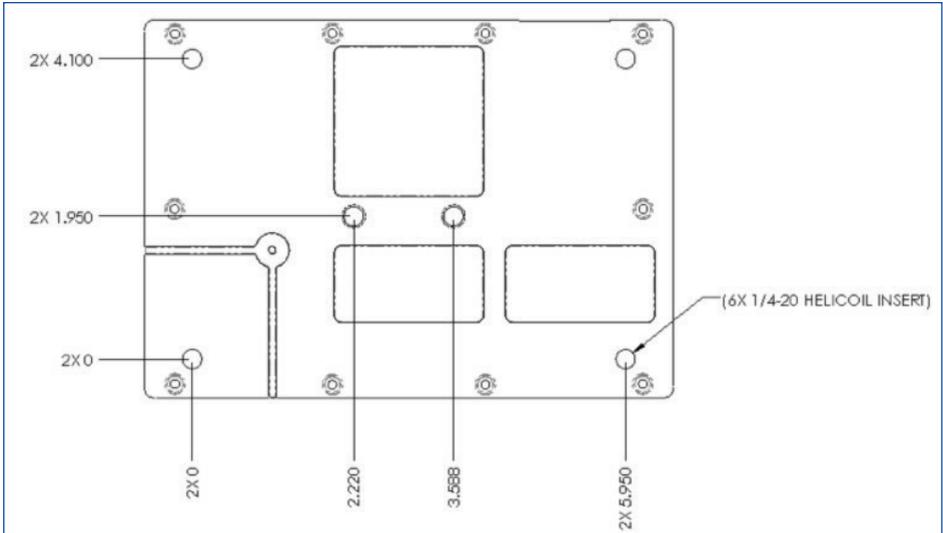
Figure 2.1. Terminal Location – Line of Sight

## 2.3 Installation

The terminal is 7.23" long by 5.13" wide (excluding connector) and 1.63" high. The terminal is designed to be hard-mounted to fixed platforms. Two .250-20 UNC-2A size mounting hole locations are located on the underside of the terminal as shown in Figure 2 2. Optimal mounting method depends on chosen location. Examples of mounting methods are illustrated in Figure 2 3.



**CAUTION:** The "Caution" icon identifies procedures or factors that can affect the installation and configuration of the system (may damage or render equipment inoperable).



**Figure 2 2. Terminal Mounting Hole Locations**

The terminal should be installed with the connector facing down or sideways, but not up. An example of installation with the connector facing down is shown in Figure 2 3.



**CAUTION:** Do not over tighten.



**CAUTION:** Do not apply pressure to the cable/connector during the installation.



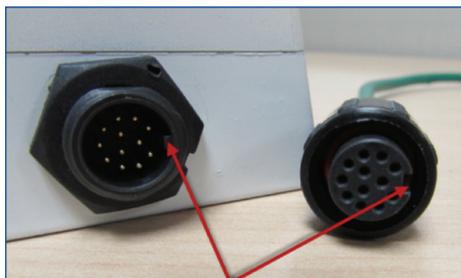
**CAUTION:** Do not force the connector pins to mate since this may damage the pins.



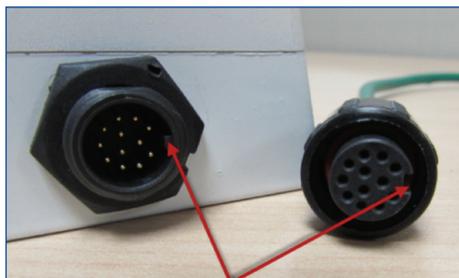
**Figure 2.3. Terminal Mounting Example**

A minimum of 4.00 inches of clearance from the connector side of the terminal is suggested for cable access and strain relief.

Reattach the connector to the terminal receptacle carefully. Align the plug tab with the receptacle tab as shown in Figure 2.4 and gently push the connector until it stops. Rotate the locking collar on the connector gently until it is properly engaged as shown in Figure 2.5. **AVOID USING A WRENCH OR PLIERS TO TIGHTEN OR LOOSEN THE CONNECTOR.** Using a tool other than your hand may result in over-torquing or damaging the internal seals.



**Figure 2.4. Key Slot**



**Figure 2.5. Cable Connector and Locking Collar**

Install adhesive-lined shrink tubing as required around the cable ends to improve cable harness performance and maximize wear life.

Install a metal cable tie holder with an outdoor rated epoxy/adhesive for best holder retention.

Secure the cable with metal tie holders and black UV-rated cable ties at intervals along the cable assembly to minimize cable and connector strain as shown in Figure 2 6.

Leave enough slack at the terminal connector end to reduce tension when installing or removing the connector.

Route the remaining cable assembly neatly for a professional installation appearance.



**CAUTION:** *Cable management and connector strain relief must be incorporated in the installation. Secure the cable at regular intervals along its length as part of the installation to prevent cable wear and eliminate strain on the terminal connector. Damage to the terminal connector interface or cable may otherwise result, leading to hardware failure.*



**Figure 2 6. Cable Management**



**CAUTION:** *Turn off Power Supply before connecting to terminal.*

After mounting the terminal to a support and reattaching the connector to the terminal, it is ready for power on.

## 2.4 Powering Up

The FT2225 terminal is designed to automatically start up when DC power is applied. An ON/OFF power switch does not exist on the terminal.

At the completion of its power-up sequence, the terminal will automatically search for GNSS and L-band satellite signals.



**CAUTION:** *Do not stand in front of the unit once power is applied.*

## 2.5 Obtaining a GNSS Fix

The Thuraya MDR M2M network does not require the terminal location to access the network. However, terminal location enables optimal customer service.

At the completion of its power-up sequence, the terminal will automatically search for GNSS and satellite signals. The default position reporting uses GPS satellites and the terminal will automatically attempt to get a new GPS lock every time it is powered on. Obtaining a lock may take up to 5 minutes upon power-up.

## 2.6 Antenna Pointing

In order to obtain the best possible signal, it is important that the terminal is pointed correctly towards the satellite. Incorrect pointing may result in poor signal quality, and in some cases prevent the terminal from being able to operate on the network.

### 2.6.1 Pointing Using Commercial Satellite Finder Apps

Appendix D: Pointing Procedure contains a list of popular antenna pointing apps. Use the Coverage map provided in Appendix C: Satellite Coverage Map to determine the appropriate satellite.

Follow directions in Appendix F: VMS Pointing Procedure to point the terminal.



**CAUTION:** Do not touch the radome when pointing the antenna in order to avoid blocking the signal.

### 2.6.2 Pointing Using Web Server

Select Antenna Pointing under the Administration tab. The RSSI meter reports a value that is proportional to receiver signal strength. Turn and tilt the antenna to fine tune pointing using the signal strength indicators. The number of green bars indicate the strength of the received signal. Try to maximize the number of bars.

## 2.7 Connecting the FT2225 to Other Equipment

### 2.7.1 Interfaces

The FT2225 Terminal offers the following wired interfaces via a multi-pin circular connector as shown in Figure 2 7 and Table 2 1.

- DC Power
- LAN

The FT2225 Terminal offers the following wireless interfaces:

- WLAN

## 2.7.2 Wired Interface

The pinout for the FT2225 Terminal connector is shown in Figure 2 7 and Table 2 1.

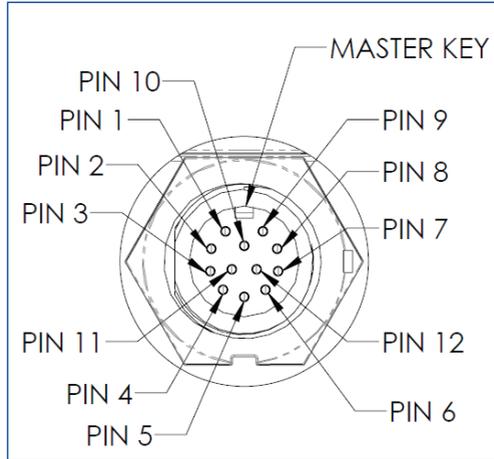


Figure 2 7. FT2225 Terminal Connector Pinout Drawing

Table 2 1. FT2225 Terminal Connector Pinout Table

Manufacturer	Terminal Connector Part Number	Cable Connector Part Number
CHOGORI	22012515-02	22012211-01

PIN NUMBER	SIGNAL NAME	DESCRIPTION
1	RX-	Ethernet RX (-)
2	RX+	Ethernet RX (+)
3	TX-	Ethernet TX (-)
4	TX+	Ethernet TX (+)
5	NC	No Connect
6	VIN RTN	Ground
7	VIN RTN	Ground
8	VIN	+10VDC to +32VDC
9	VIN	+10VDC to +32VDC
10	Reserved	Reserved
11	Reserved	Reserved
12	Reserved	Reserved

**NOTE:** The assembled cable must have a ferrite core (Laird HFA259131-0A2 or equivalent) clamped on the end nearest to the terminal connector and looped once.

## 2.7.2.1 DC Power Interface

The terminal is designed to use +10 to +32 Volt Direct Current (VDC) electrical power systems. Optimal power supply efficiency is reached when input supply voltage is closer to the lower end of the range. It is recommended to use a +12V power supply when possible. Power should be provided by a Limited Power Source type power supply with an output complying within the limits of Section 2.5 of IEC 60950-1 and a maximum output current no greater than 4A. For safety, the FT2225 should be installed in a circuit with an inline 7A slow blow fuse that will trip during extended overcurrent events, such as the BEL Fuse 3SB 7-R.

The nominal power consumption when receiving is approximately 7 Watts (W). During transmission, bursts or terminal boot up, the power draw can be up to 18W with a 2.0A surge for 5 milliseconds. It is recommended to use a power supply with a minimum power rating of 24W to provide adequate power margin as well as to support the initial turn-on current surge of 4.0A.



**WARNING:** *Observe proper grounding. Failure to ground the terminal may result in severe personal injury or death.*

Do not apply an input voltage to the terminal outside of the specified range. This will permanently damage your terminal.



**WARNING:** *Observe proper circuit protection. Power should be provided by a Limited Power Source type power supply with an output complying within the limits of Section 2.5 of IEC 60950-1 and a maximum output current no greater than 4A.*



**CAUTION:** *Observe proper Electro-static Discharge (ESD) practices during installation.*

The terminal protects against continuous inputs of -32.0 VDC to +32.0 VDC. Applying an input voltage outside this range may permanently damage the terminal and cause it to become non-operational.

The terminal offers a bonding point by using .190-32 UNF 2B threaded, blind hole. This bonding point allows the use of a threaded fastener to connect the terminal to platform potential.

The FT2225 will automatically start up when DC power is applied. There is no ON/OFF power switch.

## 2.7.2.2 Ethernet Interface

The Ethernet interface is defined by IEEE 802.3 for operation in 10Base-T and 100Base-TX modes with the exception of the connector type. Cabling for Ethernet connectivity must meet ANSI/TIA/EIA-568-A specifications for Category 5 or Category 5e cables. It is recommended that the wired Ethernet interface be used for permanent installation. Contact your terminal retailer for power/Ethernet cable or build your own cable assembly as shown in section 6.



**CAUTION:** *Use a maximum Ethernet cable length no greater than 100m (328 ft.) to ensure proper terminal operation.*

## 2.7.3 Wireless Interface

### 2.7.3.1 WLAN Interface

To connect your WLAN-enabled- device to the FT2225, follow the below steps:

1. Make sure that WLAN feature on your device is turned on.
2. Place the device near the terminal.
3. Search for available WLAN networks on your device.
4. The default SSID will be vmt\_<FTI> where <FTI> should be replaced with the fixed terminal identifier unique to your terminal. Check the label on the terminal enclosure to obtain the FTI.
5. Select the SSID of your terminal network when it appears on the list.
6. The default password is terminal.



**NOTE:** Default password of your FT2225 WLAN is **terminal**.

Encryption type is WPA2

7. It may take up to 2 minutes before a wireless connection is made and the configuration webpage is available.

## 3 CONNECTING TO THE THURAYA FT2225 TERMINAL

The terminal will attempt to log in automatically to an available satellite network as soon as it is powered on. The terminal's features can be controlled using the web interface. The user interface is presented as a web page that is accessible from the terminal. This interface is used for determining terminal operational status, satellite link status and other terminal information. This interface allows the user to perform control actions on the terminal for certain activities such as reboot, managing IP addresses/ports, and controlling default transmit power-up states.



**NOTE:** The webpage is only available through a local wired Ethernet or WLAN connection to the terminal. This interface is not accessible through the satellite network and will not transmit data over the satellite network.

### 3.1 Web Server Connection

#### 3.1.1 Address/Port Number

The web server address will be the same as the terminal IP Address. By default, the terminal IP Addresses are:

- Wired Ethernet interface: **192.168.100.1**
- WiFi interface: **192.168.200.1**

The terminal IP Addresses are defined as the Destination IP Address for incoming datagrams to the terminal. These addresses are configurable through the configuration web page. The web server port number is set to the standard port 80.

To connect to the terminal, enable DHCP settings on your PC, and enter the terminal IP address in your web browser.

If you do not wish to use the default DHCP server configuration, you will need to ensure that your PC's static IP address is on the same network as the terminal.



**NOTE:** The terminal will come from the factory with default DHCP server settings to allow easy connection.

### 3.1.2 Protocol

The web server will use the HTTP protocol for connection with the platform interface devices.

### 3.1.3 Web Browsers Supported

The FT2225 Terminal may be accessed by using the latest released version of the Google Chrome™ or Firefox® browsers.

## 3.2 Login

The web server will present a login screen for the user to access all activities shown below. Without the proper user login, no terminal functionality or status is available from the web page. The terminal will be responsive to all login requests during all modes of operation.

Contact your terminal retailer or integrator for login credentials for your terminal.



**Figure 3 1. Login Screen**

The default Username/Password is admin/admin. After a successful login, the user will be directed to the System Status page in Section 3.

After an unsuccessful login, the following web page with an error banner is presented.

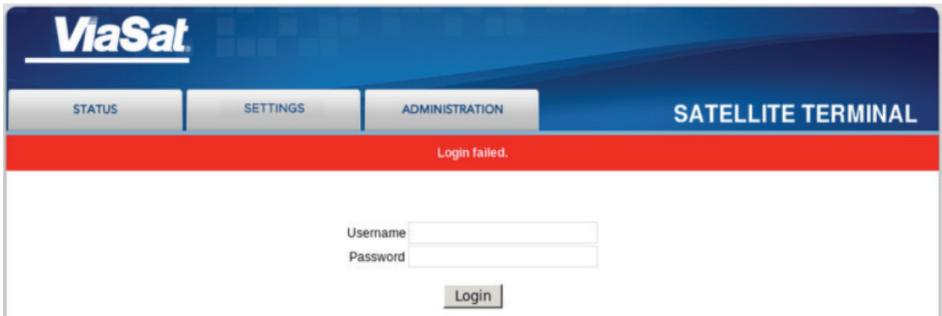


Figure 3 2. Failed Login

### 3.3 Status Tab

The status bar is included at the top of each page. It displays the current status of the connection to the network and the latest GPS information (Figure 3 3).

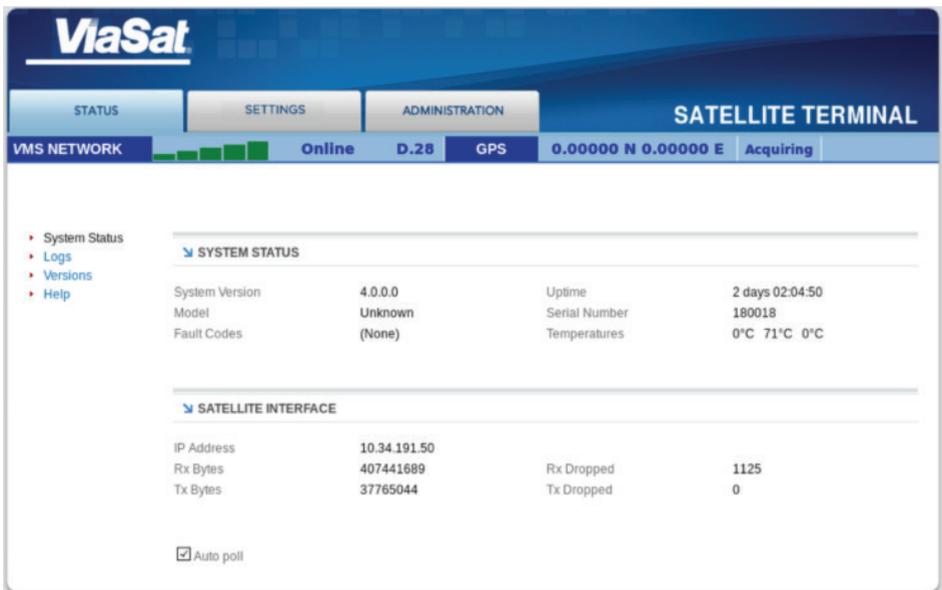


Figure 3 3. Status Tab

#### 3.3.1 Network

The received signal strength bars indicate the current received signal strength. The number of bars that are green indicate the strength of the received signal for the modulation scheme being used on the current received forward link. The more bars there are the stronger the signal.

The status field shows the current state of the terminal on the network. Possible statuses are shown below in Table 3 1:



**NOTE:** Signal strength will vary based on factors such as terminal location, current data rate, and service plan.

The GNSS fields show the current location. The location will only be valid when the terminal has acquired enough GPS/GLONASS satellites for a valid fix.

**Table 3 1. Network Status**

Status Field	Status Meaning
Searching	Terminal is searching for the forward link
Acquired	Terminal has acquired a forward link
Registering	Terminal is registering with the network
Online	Terminal logged in to the network and ready for use
Offline	Terminal logged off the network
Re-Registering	Terminal requesting to re-login

### 3.3.2 GNSS

The GNSS fields show the current location. The location will only be valid when the terminal has acquired enough GPS/GLONASS satellites for a valid lock.

### 3.3.3 System Status

System status displays general information about the current system (Table 3 2).

The Tx Bytes and Rx Bytes fields display the number of bytes sent and received over the satellite. The Tx Dropped field displays the number of outgoing packets intended to be sent over the satellite link but were dropped due to queue limitations, encryption failure or other transmit errors. The Rx Dropped field displays the number of incoming packets that were dropped due to space limitations, decryption failure, data integrity check failure or other reception errors.

The Temperature field displays current temperature in Celsius within the terminal.



**CAUTION:** If you are experiencing issues with your terminal or observing fault codes after reboot attempts, contact customer support.

Table 3 2. System Status Fault Codes

Description	Fault Code	Action
General fault	0x01 - 0x53	Reboot the terminal.
Over temp fault	0x61 - 0x63	Place terminal in environment less than +70°C and power off until terminal cools down.
Under temp fault	0x69 -0x6B	Place terminal in environment greater than -40°C until terminal warms up.
Power fault	0x70 or other	Reboot the terminal.

### 3.3.4 Logs

The Logs page allows the user to view or display system log files. All log files with the exception of the NV (Non-Volatile) Log are volatile and are not maintained through reboots. The NV Log contains high priority information that is saved through reboots (Figure 3 4).



Figure 3 4. Logs Pane

#### System Log

The System Log displays information about the operating system environment, including drivers and devices.

#### Control Message Manager

The Control Message Manager processes network control messages and maintains the terminal login state.

## Web Administration

This log file contains information about actions performed by or when using the Web Administration interface.

## AT Server

The AT Server logs interactions between the internal AT command server and external AT clients.

## GPS

The GPS provides information regarding the internal GPS receiver and client.

## NV Log

The NV logs high-priority terminal information that is maintained through reboots.

## 3.3.5 Versions

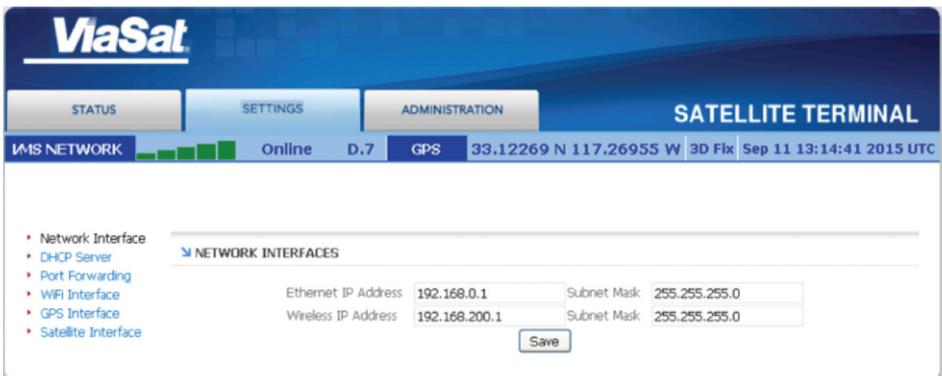
This field displays the version number of each terminal software component.

## 3.4 Settings Tab

The settings tab lists terminal settings that can be modified by the user. A description of each setting is listed below.

### 3.4.1 Network Interface

The Network Interface pane allows the user to set both the wired and wireless IP/subnet mask for the terminal (Figure 3 5).



The screenshot shows the ViaSat web interface for a satellite terminal. The top navigation bar includes 'STATUS', 'SETTINGS', and 'ADMINISTRATION'. The 'SETTINGS' tab is active, and the 'NETWORK INTERFACES' section is expanded. The interface displays the following configuration:

Interface Type	IP Address	Subnet Mask
Ethernet	192.168.0.1	255.255.255.0
Wireless	192.168.200.1	255.255.255.0

A 'Save' button is located below the configuration fields. The top status bar shows 'IMS NETWORK' with a signal strength indicator, 'Online', 'D.7', 'GPS', and coordinates '33.12269 N 117.26955 W'. The date and time are '3D Fix Sep 11 13:14:41 2015 UTC'.

Figure 3 5. Network Interface Pane

Configure the Ethernet interface IP Address and Subnet Mask. These fields must be in dot notation (a.b.c.d) and contain a valid IP address.



**CAUTION:** Modifying the IP Address and Subnet Masks can result in loss of connectivity to the terminal. See Section 4 for more information on network configuration settings and examples.

## 3.4.2 DHCP Server

There are two options for DHCP server configuration: dynamic and static (Figure 3 6).

### Dynamic Assignments

The DHCP server can be configured with a pool of IP addresses that it will lease to clients.

The Pool Start and Pool End fields are set to the start and end IP addresses. The Netmask field is set to the subnet mask that a client should use. Each of these fields must be a valid IP address or subnet mask in dot notation (a.b.c.d).

The lease time is the time in minutes that a lease given to a client will be valid.

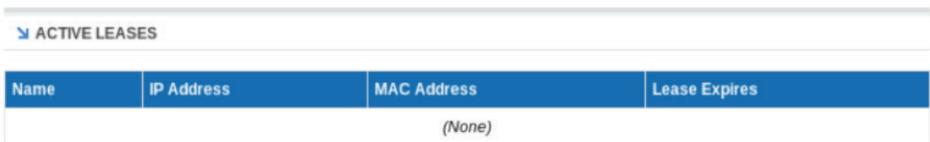
### Static Assignments

The DHCP server can also be configured to provide a static IP address to a particular network device. The network device is determined by its hardware MAC address. Each time the DHCP server gets a request from a device that matches the MAC address the assigned IP address will be given to the device.

The Name field is the hostname of the network device that will be assigned a static IP address. This name must not contain any white space and should consist of alphanumeric characters, hyphens or underscores. The MAC Address field is set to the MAC address of the network device. This field must be specified as follows: xx:xx:xx:xx:xx:xx, where xx is a two-digit hexadecimal number. The IP Address field specifies the IP address to be assigned to the network device with the corresponding MAC address. The IP address is specified in dot notation (a.b.c.d).

### Active Leases Table

Any currently active DHCP assignments are shown in the Active Leases and Static IP Assignments in Figure 3 6.



The screenshot shows a table titled "ACTIVE LEASES" with a blue header and a white body. The header has four columns: "Name", "IP Address", "MAC Address", and "Lease Expires". The body of the table is empty, with the word "(None)" centered below the header.

Name	IP Address	MAC Address	Lease Expires
(None)			

Figure 3 6. DHCP Server - Active Leases

## Ethernet DHCP Address Pool

The IP address allocation and lease time for the wired Ethernet dynamically-assigned DHCP address pool is configured in Figure 3 7.

ETHERNET DHCP DYNAMIC ADDRESS POOL				
Pool Start	Pool End	Netmask	Lease Minutes	
192.168.1.100	192.168.1.200	255.255.255.0	1440	Save

Figure 3 7. DHCP Server - Wired Ethernet DHCP Dynamic Address Pool

## WIFI DHCP Address Pool

The IP address allocation and lease time for the WLAN dynamically-assigned DHCP address pool is configured in Figure 3 8.

WIFI DHCP DYNAMIC ADDRESS POOL				
Pool Start	Pool End	Netmask	Lease Minutes	
				Save

Figure 3 8. DHCP Server - WLAN DHCP Dynamic Address Pool

## Static IP Assignments

The IP address to MAC pairing for static IP assignments is contained in Figure 3 9.

STATIC IP ASSIGNMENTS			
Name	IP Address	MAC Address	
(None)			

Figure 3 9. DHCP Server - Static IP Assignments Table

## Static Routes

Static routes are configured and listed in Figure 3 10



The image shows two screenshots from a DHCP server interface. The top screenshot is titled 'STATIC ROUTES' and displays a table with three columns: 'Destination', 'Netmask (CIDR)', and 'Gateway'. Each column has an input field below it, and there is an 'Add' button to the right. The bottom screenshot is titled 'STATIC ROUTE TABLE' and shows a table with the same three columns: 'Destination', 'Netmask (CIDR)', and 'Gateway'.

Figure 3 10. DHCP Server - Static Routes Tables

### 3.4.3 Port Forwarding

The terminal provides a network address translator (NAT) that creates a private network for devices attached to the terminal. Devices behind the terminal NAT are invisible to any hosts outside the terminal NAT.

The only way to access a device behind the terminal is either:

- Have the device behind the terminal initiate the connection
- Create a port forwarding assignment to the device in the terminal

Port forwarding allows incoming UDP or TCP packets destined for a specific port to be forwarded to a network device (client or host) “behind” the terminal NAT. The incoming packet will be forwarded to the destination port and IP address defined by the port forwarding rule. Using port forwarding assigns the port being forwarded to a single host IP address and excludes this port from being used by any other host.



**CAUTION:** *Modifying port forwarding settings can result in loss of connectivity to the network. See Section 4 for details on network configuration and examples.*

### Port Forward Assignments

Any currently active port forwarding assignments will be shown in the Port Forwarding Assignments table (Figure 3 11).

To add a port forwarding configuration, enter the following information into the Port Forwarding table:

1. **Name** – Set to the logical name of the service being forwarded. This name must not contain any white space and should consist of alphanumeric characters, hyphens or underscores.

2. **Incoming Port** – Set to the port number of the service to be forwarded, such as 21 for FTP.
3. **Protocol** – Select between UDP/TCP/Both.
4. **Server IP** – Set to the IP address, in dot notation, of the host that the packets will be forwarded to.
5. **Server Port** – Set to the port number on the Server IP that the packets will be sent to. This port can be the same as the Incoming Port, but does not need to be.
6. When complete, click **Add** and the assignment will show up in the Port Forwarding Assignments shown in Figure 3 11 .

▾ **PORT FORWARDING**

Name	Incoming Port	Protocol	Server IP	Server Port	
<input style="width: 90%;" type="text"/>	<input style="width: 90%;" type="text"/>	UDP ▾	<input style="width: 90%;" type="text"/>	<input style="width: 90%;" type="text"/>	<input type="button" value="Add"/>

▾ **PORT FORWARDING ASSIGNMENTS**

Name	Incoming Port	Protocol	Server IP	Server Port	
(None)					

Figure 3 11. Port Forwarding Pane

### 3.4.4 Wi-Fi Interface

The Wi-Fi Interface pane is used to configure your wireless access point interface for the WLAN (Figure 3 12).

To configure the access point settings set the following:

1. **SSID** – This is also known as your network name. Provide a unique SSID for the network. The name must not exceed 32 keyboard characters.
2. **Network Password** – The terminal uses WPA2 encryption and requires a password. Use this field to set the network password for the WLAN. The network password must be at least eight characters long but cannot be more than 63 characters.
3. **Channel** – Choose a transmit channel for your WLAN. Channels 1,6, and 11 are the primary transmission channels used. If interference is experienced on those channels then use one of the other channels.
4. Click **Save**.

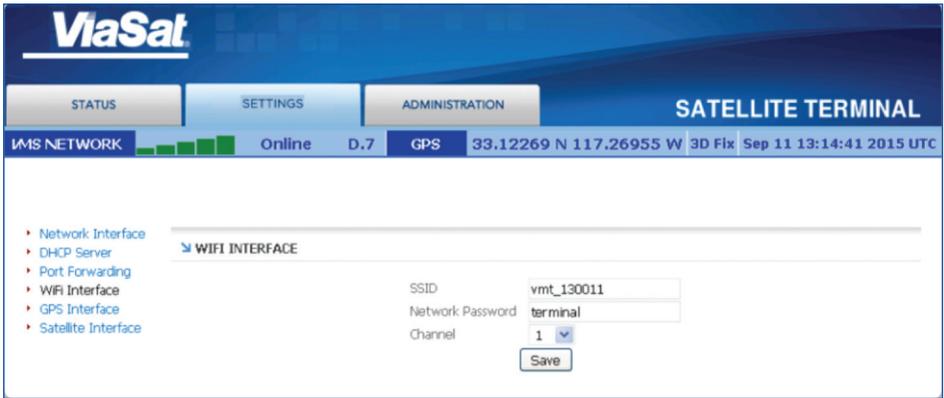


Figure 3 12. WiFi Interface Pane

### 3.4.5 GPS/GLONASS Interface

The GPS/GLONASS Interface pane is used to select the operating mode for the GPS/GLONASS location services (Figure 3 13).

Select the pull-down for the desired mode and click **Save**.



Figure 3 13. GPS/GLONASS Interface Pane

### 3.4.6 Satellite Interface

Configure the satellite interface transmit settings. These settings can be used to inhibit terminal transmissions, both in real-time and at boot up (Figure 3 14).

**NOTE:** *If terminal transmit is inhibited at boot up it will not be able to communicate on the network until transmit is enabled.*

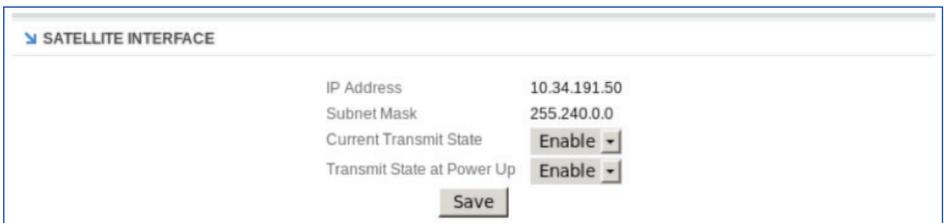


Figure 3 14. Satellite Interface Pane

The IP Address and Subnet Mask fields contain the external (Satellite Interface) address configuration assigned to your terminal. These fields are assigned by your service provider.

**Current Transmit State** – Allows you to disable your terminals ability to transmit. For normal operation, this should be set to Enabled. If disabled, your terminal will not be able to send data over the satellite interface.

**Transmit State at Power Up** – Allows you to alter the power up behavior so that the terminal will not transmit when powered up. For normal operation, this should be set to Enabled. If disabled, your terminal will not be able to send data over the satellite interface upon power up.

## 3.5 Administration Tab

The Administration tab provides additional information and settings such as file uploads and user administration.

### 3.5.1 Antenna Pointing

This field applies to the terminal only. To achieve optimum satellite link performance and stability, the terminal should be pointed directly towards the satellite. Section 2.6 contains details on how to optimally point the terminal. This pane reports the current receive signal strength indicator (RSSI) of the terminals satellite network link (Figure 3 15).



Figure 3 15. Antenna Pointing Pane

### 3.5.2 Crypto

Displays status of the encryption engine used to provide data security (Figure 3 16).

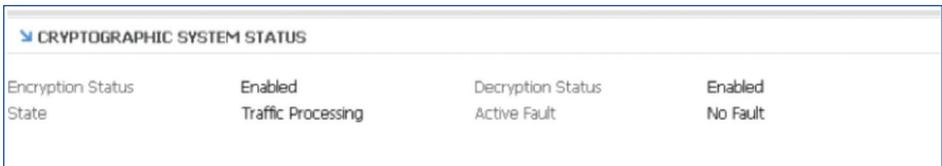


Figure 3 16. Crypto Pane

### 3.5.3 File Upload

The file upload function is used to upload terminal configuration files (Figure 3 17).



**CAUTION:** Improper file uploads can cause severe damage to the terminal. File uploads should only be attempted if directed by customer or integrator support.



Figure 3 17. File Upload Pane

### 3.5.4 HW Diagnostics

Hardware diagnostics executes any or all of the terminal built-in tests. These diagnostics test the basic functionality of the hardware components of the terminal. They can aid in finding the cause of any hardware faults reported by the terminal. These tests should only be run when the terminal is offline (Figure 3 18).

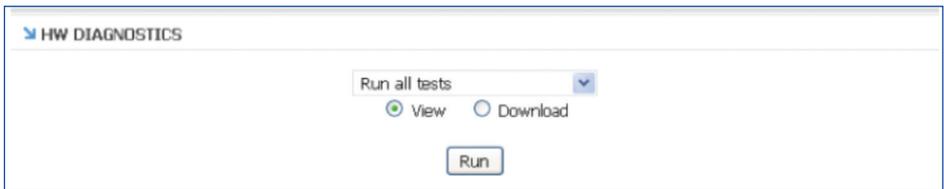


Figure 3 18. HW Diagnostics Pane

### 3.5.5 Logout

Initiates log out from the current webpage session (Figure 3 19).

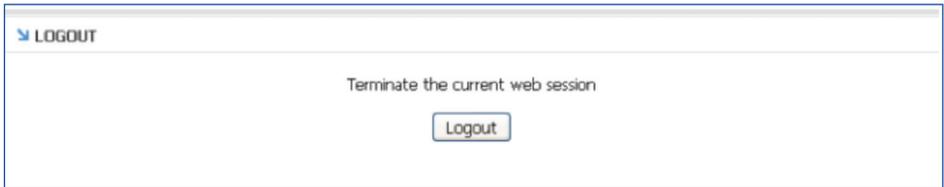


Figure 3 19. Logout Pane

### 3.5.6 Net Diagnostics

Network diagnostics initiates pings to the destination IP address up to a maximum count of 10 times. The results of the pings will be displayed (Figure 3 20).

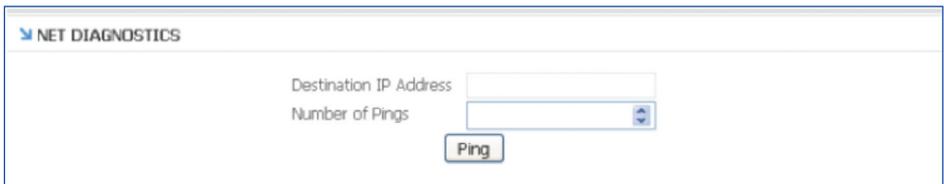


Figure 3 20. Net Diagnostics Pane

### 3.5.7 OSD Status

Over-the-Air Software Download (OSD), downloads new software into the terminal using the satellite link instead of a local file upload. This page displays the current status of any downloads in progress. OSD is a “trickle file download”, using only idle capacity in the satellite link sent in the background of transporting of user data (Figure 3 21).

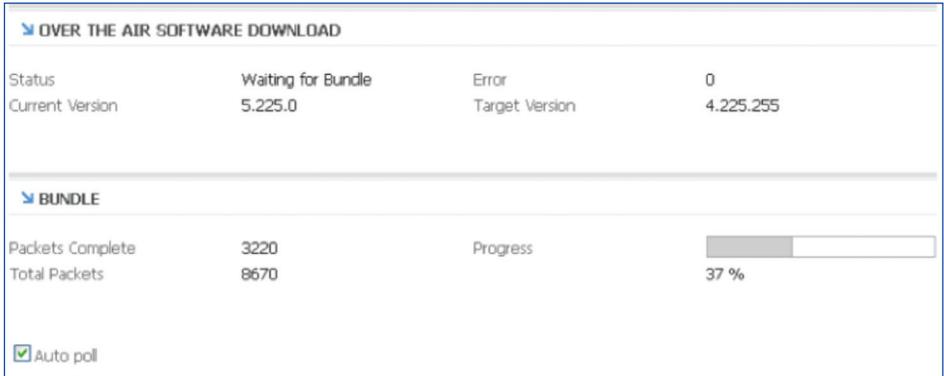


Figure 3 21. OSD Status Pane

### 3.5.8 Reboot

Initiates a reboot of the terminal (Figure 3 22).

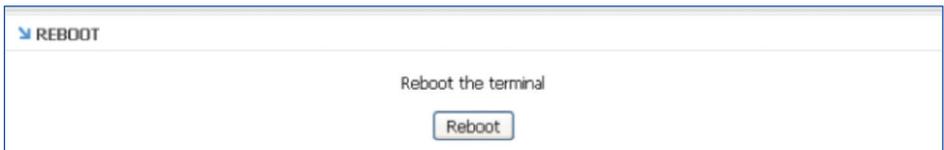


Figure 3 22. Reboot Pane

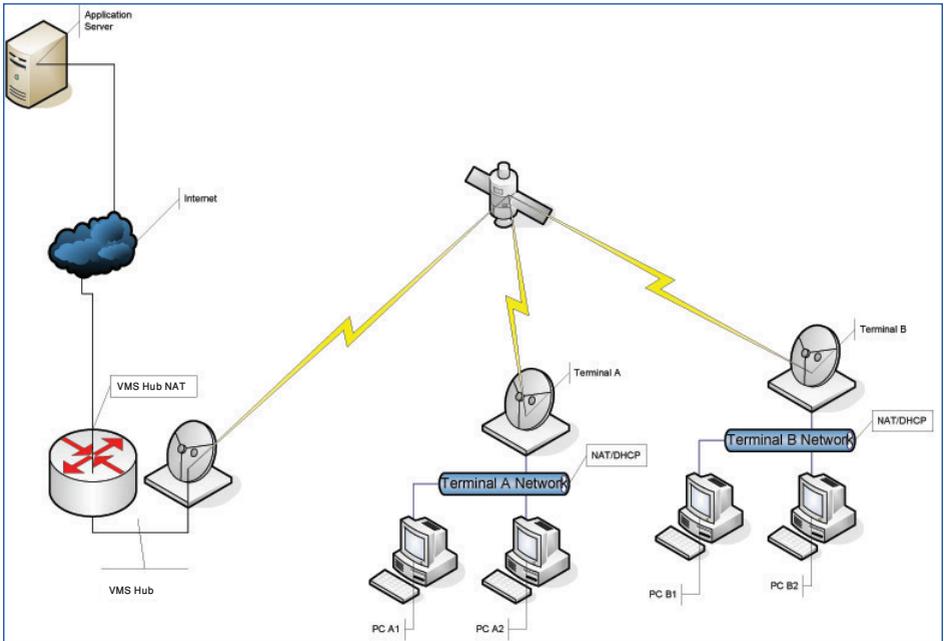
## 4 IP DATA INTERFACE

The following section details the VMS network architecture, and provides instructions for setting up typical configurations on the VMS network to use as a reference.

### 4.1 IP Network Architecture

Network devices communicating through the VMS hub (which is located in the Thuraya Primary Gateway in Sharjah, UAE) with network devices behind terminals in the network must use the IP network architecture and IP address scheme outlined in Figure 4-1.

The following illustration shows an example network. An application server connects to the VMS Hub through the Internet to communicate with two terminals, where each terminal has two clients behind it.



**Figure 4 1. VMS Network Architecture**

The IP network architecture uses two NAT devices between an external device connecting via the Internet and network devices behind the terminal. One NAT exists at the gateway to the VMS Hub and another at the terminal.

The terminal NAT provides security to the network behind the terminal by blocking access to devices within the terminal network from the Internet and devices connected to the VMS Hub. Port forwarding in the terminal must be configured to allow access through the terminal NAT for applications to communicate with devices within the terminal network.

Any device within the terminal network must also be configured to use the terminal as its default gateway to the Internet and any devices connected to the VMS Hub. This may be accomplished by using the DHCP server in the terminal or by configuring a default gateway manually on each device within the terminal network.

In order to connect a PC or any other device over the VMS network through the terminal, you must properly configure your device and terminal. The instructions below are for a typical configuration to establish connectivity. Your terminal retailer or integrator may give you specific instructions to establish a custom network connection in lieu of the instructions below.

For a typical configuration, follow these steps:

1. Determine the applications that will be communicating with devices attached to the terminal via the terminal LAN/WLAN.
2. For each application determine the protocol used (UDP or TCP) and the port numbers that these applications will be using.
3. Set your device's IP settings to use DHCP.
4. Plug your device into the terminal Ethernet cable. The terminal will by default assign a unique IP address to your device.
5. Login to the terminal webpage interface. See Section 3.2. Select the Settings tab.
6. Select the Port Forwarding option.
7. Enter the Port Forwarding information, which includes:
  - a. Application Port
  - b. Protocol
  - c. IP Address of the device these packets will be forwarded to.
  - d. Port number these packets will be forwarded to. This will typically be the same as the Application Port.
8. Press Add.
9. Perform steps 7-8 for each application port that needs to be forwarded.

## 5 TROUBLESHOOTING, MAINTENANCE, AND TECHNICAL SUPPORT

The FT2225 is designed to be very reliable and rugged. The terminal performs automated self-tests and also provides for alarms, manual self-tests, and system resetting to further evaluate the cause for, and possibly correct, any unexpected functionality. A further list of problems that might arise, their possible causes, and potential remedies is provided in section 5.2

### 5.1 Self Tests

The FT2225 has various self-tests to detect fault conditions. These tests run on startup and periodically during the terminal operation. These tests can run manually through the HW Diagnostics section 3.5.4. A list of these self-tests are provided in Table 5 1.

**Table 5 1. Self Tests**

Self Tests	Description
Ethernet Controller	Verifies the operation of the Ethernet controller chip.
Information Assurance	Verifies the operation of the data encryption and decryption.
McBSP1 Serial Interface	Verifies the operation of the forward link decoder.
McBSP4 Serial Interface	Verifies the ADC operation.
FPGA	Verifies that the FPGA has been programmed correctly and the device driver has been loaded.
Temperature Sensor	Reads the current temperature of the board.
NAND Flash	Reads a known test pattern from flash sector.
DDR SDRAM	Performs a walking ones, walking zeros, and address line RAM tests
MIMO	Verifies the RF transceiver's device id
ENSM	Verifies that RF transceiver's operational state is FDD.
Real Time Clock	Verifies the real time clock's device id.
Rx Synthesizer	Verifies that the RX PLL is locked.
Tx Synthesizer	Verifies that the TX PLL is locked.
Display Ethernet Status	Displays the number of Ethernet packets received and sent and the link status.
Display Current OBIT results	Displays result of the current online BIT tests.
Display POST Results	Displays the result of the power on self-tests.

## 5.2 Troubleshooting Guide

Faults may be detected by visual observation or by a built-in test (BIT). Problems uncovered during preventive maintenance, or while the terminal is in service, their possible cause, and recommended corrective action(s) are described in Table 5.2.

**Table 5.2. Troubleshooting Guide**

<b>Problem/Observation</b>	<b>Possible Cause</b>	<b>Corrective Action</b>
<b>Cannot access terminal web server</b>	Terminal not Power on Incorrect IP address Cable is not plugged in correctly	Reboot the terminal.
<b>Terminal not responding to web server interface</b>	Software error	Power Cycle Terminal
<b>Web Server shows no position fix</b>	Terminal position is unknown, GNSS signal is weak	Provide terminal with unobstructed view of sky as much as possible. Try to point terminal straight upward to receive GPS fix, then reposition terminal toward L-band satellite.
<b>Web MMI status show terminal does not exit searching mode</b>	Receive signal strength is too low View toward satellite is blocked	Reposition antenna (see Appendix D FT2225 Pointing Procedure) Ensure that no object is in front of antenna.
<b>WiFi Connection cannot be established</b>	Your device is too far from terminal	
<b>Terminal cannot login or Terminal does not exit searching mode</b>	No signal or weak signal Interference	Provide terminal with unobstructed view of sky as much as possible. Perform antenna pointing as necessary. Move terminal away from nearby satellite terminals.

Faults may be visually observed as error codes on the Web MMI Status page as Table 5.3. Web MMI Status

Fault Code	Description	Recommended Action
0x01 - 0x53	General fault	Reboot the terminal.
0x61 - 0x63	Over temp fault	Place terminal in environment less than +70°C and power off until terminal cools down.
0x69 -0x6B	Under temp fault	Place terminal in environment greater than -40°C until terminal warms up.
0x70 or other	Power fault	Reboot the terminal.

Table 5.3. Web MMI Status

## 5.3 Preventive Maintenance

Preventative maintenance is the systematic, scheduled care and inspection of equipment to prevent equipment failure and to reduce downtime. The primary preventative maintenance for the FT2225 is to keep the equipment clean and dust free. Use a soft brush, moist sponge, and a clean cloth for this purpose. The radome should be visually inspected for any attached substances, which could potentially obstruct functionality (e.g., mud on the radome).

In addition, to ensure proper functionality and full operating potential of FT2225 Terminal capabilities, the unit should be visually inspected for cracks, corrosion, and loose mating connector.

## 5.4 Warranty

For warranty information and repairs, please contact your service provider.

Thuraya warrants the Thuraya FT2225 Satellite M2M terminals free of defects in material, design and workmanship for the period of twelve months (12) from the date of shipment of terminals from Thuraya to the Service Partner. For more details related to the warranty terms and conditions please refer to the Thuraya FT2225 M2M Warranty Service Program

## 5.5 Serviceable Parts

The FT2225 terminal contains no user-serviceable parts.

## 5.6 Customer Support

Customers can contact Thuraya with questions at:

### **Thuraya Customer Care Center**

From Thuraya network: **100**

From any other networks: **+88216 100 100**

Fax: **+971 6 8828444**

Email: **customer.care@thuraya.com**

### **Product Inquiries**

For sales and product inquiries:

Email: **m2m@thuraya.com**

Web: **www.thuraya.com/**

### **Mailing Address**

Thuraya Tower

TECOM

Dubai – UAE

P.O. Box 283333

# APPENDIX A POWER/ETHERNET CABLE ASSEMBLY INSTRUCTION

This section provides guidelines for the Value-Added Resellers or end-user to assemble the power/Ethernet cables. The solder cup connector kit ships with the terminal.

## A.1 Required Tools

The following tools are required to assemble the power/Ethernet cable:

- Utility knife or similar
- 22-26 AWG wire stripper
- Diagonal cutters
- Long-nose pliers
- Soldering iron and solder

## A.2 Connector Information

See Section 2.7.2 for connector pinout information and ferrite core requirements.

## A.3 Cable Specification

The cable selection for this application is influenced by three main principles: current capacity, outdoor application and shielding.

The operating input voltage range for the terminal is 10 to 32 VDC and draws 1.7 amperes. If the application requires an extended cable length, it is necessary to calculate the cable voltage drop to determine if the terminal is able to receive the minimum 9 volts for operation.

Exposure to outdoor elements can degrade the insulation of the cable and allow moisture to penetrate the conductor and subsequently degrade the copper conductor. It is highly recommended that the cable chosen shall be able to withstand UV rays.

Cable shielding is a critical design element over long distance. The cable selection can adversely be affected by EMI/RFI/ESI. Ideally, multi-shield (foil & braid) is recommended. This design has superior shielding characteristics from signal interferences.

## A.4 Cable Assembly Steps

Use a utility knife to remove 12mm of the outer jacket of the cable and use diagonal cutters to remove any shielding as shown in Figure A 1. Carefully remove 2-3mm of insulation from the wires using a wire stripper. Avoid nicking the center conductor as you strip the insulation from the wire.

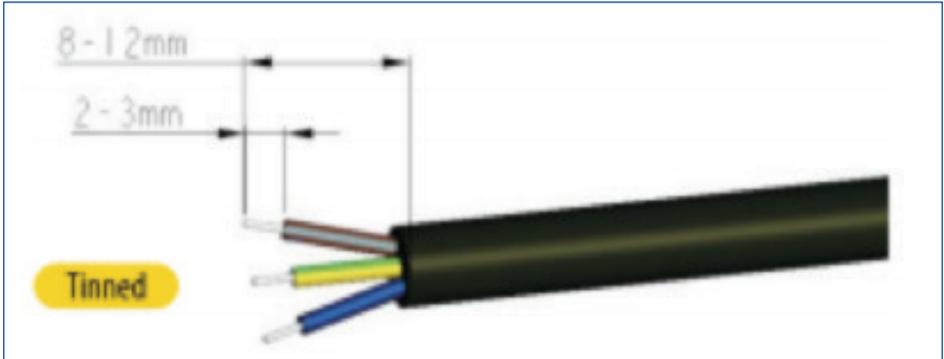


Figure A 1. Cable Assembly Preparation

The bare ends on the stripped wire may require twisting to prevent fraying when the connector parts are slid over the cable. Slide the items over the cable in sequential order as shown in Figure A 2. Observe that the seal ring and red gasket are present.



Figure A 2. Connector Part Description

Apply a thin coat of solder for tinning on the bare wires and on the connector socket contacts in preparation of soldering the wires to the end connector contacts as shown in Figure A 3.



**Figure A 3. Cable Assembly - Step 1**

Assemble the gasket into the clamp ring. The gasket is directional and the flat surface should be installed on the housing side as shown in Figure A 4.



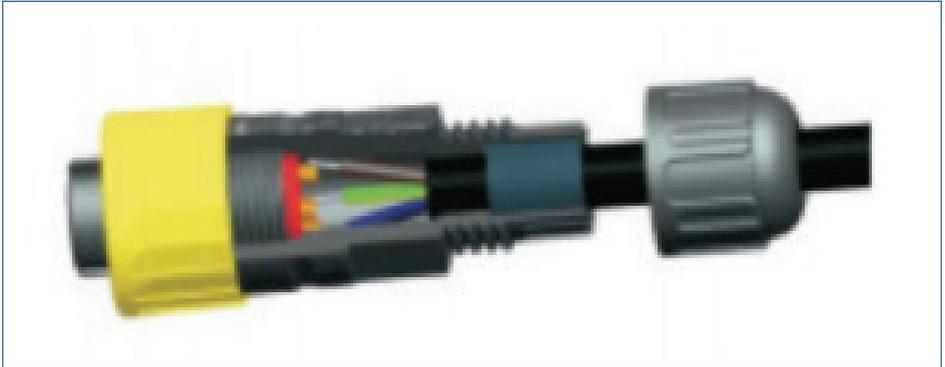
**Figure A 4. Cable Assembly - Step 2**

Assemble the clamp ring to the housing as shown in Figure A 5.



**Figure A 5. Cable Assembly - Step 3**

Slide the seal ring to the end of the clamp ring as shown in Figure A 6.



**Figure A 6. Cable Assembly - Step 4**

Assemble the seal nut and clamp ring as shown in Figure A 7.



**Figure A 7. Cable Assembly - Step 5**

## APPENDIX B POLE MOUNT

The FT2225 can be mounted on any flat surface that is as wide as the bottom outline as shown in Figure 4 and installed onto a pole using the pole mount adapter.

Instructions are included to install the terminal on any vertical position on a pole or on a horizontal support. The vertical pole or horizontal support must have sufficient height to achieve an unobstructed view to the satellite.

### B.1 Required Tools

The following tools are required to assemble and attach the terminal to a pole.

- Crescent wrench
- Philips screwdriver
- Flat blade screwdriver
- Pliers

### B.2 Required Materials

The following materials are required to assemble and attach the terminal to a pole.

- Pole mount adapter and kit
- Stainless steel hose clamps
- Hardware kit

### B.3 Installation Steps

The following are the installation steps to assemble and attach the terminal to a pole.

1. Audit the antenna bracket hardware kit.
2. Remove the bracket parts from the hardware kit.
3. Pre-assemble the pieces to prepare for installation.
4. Attach the upper bracket assembly and terminal adapter to the mounting pole.
5. Attach the lower bracket assembly to the antenna support/mounting pole.
6. Attach the FT2225 terminal to the adapter plate and secure bolts/nuts.
7. Adjust terminal adapter plate in the direction of the satellite and ensure there is no obstructed view to the satellite.
8. Tighten the bolts and nuts at the joints.
9. Route and secure FT2225 cable assembly along the pole using metal tie mounts. Use self-tapping screws to secure the metal tie mounts to the pole.
10. Install the cable assembly to the metal tie mounts and secure using black cable ties. A cable service loop may be required at joints to allow re-pointing of the terminal.
11. Leave a cable service loop/slack at the FT2225 connector to ease connector termination. This will allow the installer to re-terminate the connector with ease.

# APPENDIX C SATELLITE COVERAGE MAPS

Figure C 1. Thuraya Satellite Coverage Map

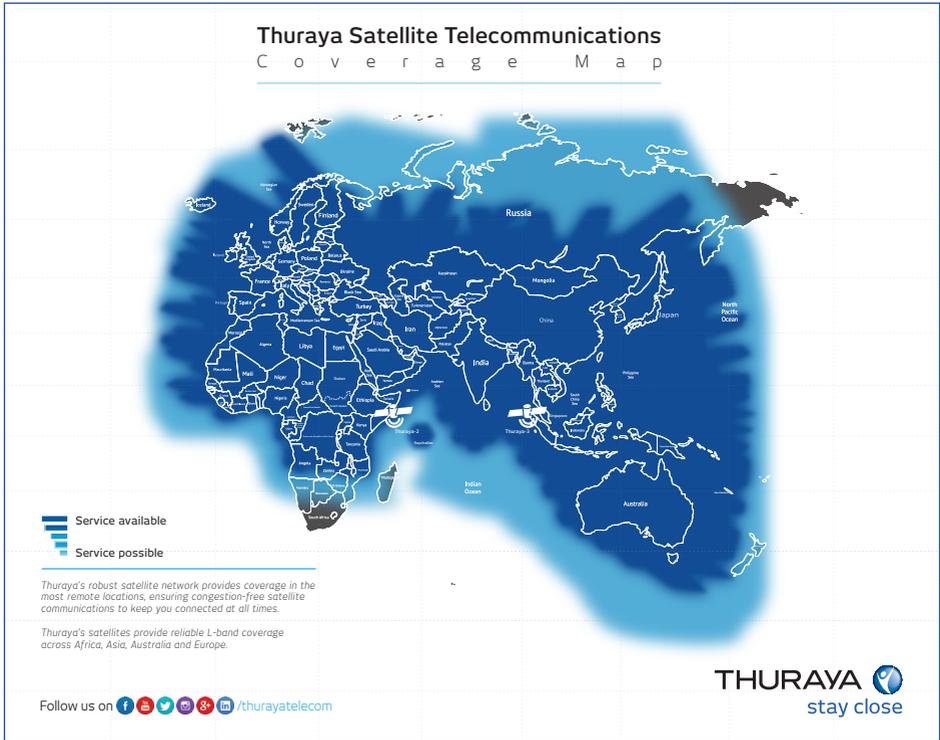


Figure C 2. LightSquared SkyTerra-1 Satellite Coverage Map

## APPENDIX D FT2225 POINTING PROCEDURE



**CAUTION:** Do not attempt to point the FT2225 towards a satellite during a rain/thunder storm. Doing so can cause personal injury or damage the equipment.

A Satellite finder application for your smart phone is the easiest method to locate a geostationary satellite wherever you are. The recommended Satellite Pointing Programs for smartphones are listed below.

### iPhone

Satellite Locator: <https://itunes.apple.com/us/app/satellitelocator/id540894938?mt=8>

Dish Pointer: <https://itunes.apple.com/us/app/dishpointer-ar-pro/id321914743?mt=8>

### Android

Satellite Director: <https://play.google.com/store/apps/details?id=zekitez.com.satellitedirector&hl=en>

Satellite Pointer: <https://play.google.com/store/apps/details?id=com.tda.satpointer&hl=en>

Dish Pointer: <https://play.google.com/store/apps/details?id=com.dishpointer.dparpro&hl=en>

The FT2225 antenna peaking procedure is used to ensure the terminal has an unobstructed LOS to the satellite.

1. Enable your Satellite Finder/Locator apps on our mobile phone and point to the sky.
2. Move your mobile phone up and down and left and right to get a satellite arc on a live video display. You will see satellites line up along the arc and see if there are any obstructed buildings/trees blocking the line of sight.
3. Place the FT2225 terminal/support in a spot where the Satellite Finder has an unobstructed LOS to the satellite to begin antenna peaking.
4. View Section 3.3 Status Page and observe the Es/No reading.
5. Very slowly optimize the FT2225 in azimuth from east to west direction and observe the Es/No reading. The Es/No should be at a maximum signal when peaked.
6. Repeat step 2 for elevation direction.
7. Once it is apparent that the signal does not increase in strength make a mark on the antenna mount to indicate it is peaked in azimuth and elevation.
8. Tighten the azimuth and elevation bolts or clamp bolts.
9. If necessary, repeat these steps to confirm the FT2225 is peaked.

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