

MYTE Satellite Transmitter

Basic OEM/Integrators Installation Guide Document # HW-IS-0-0057 : Revision 170905a

FCCID: OWAMYTE

IC ID: 10540A-MYTE

Model Number: SCC-002

Author: Gary NadenSignature:Date: 10/16/2017CTOGary NadenApproval: Brandon TaylorSignature:Date: 10/16/2017Chief Hardware ArchitectBrandon Taylor

Table of Contents

SE	SECTION PAGE				
1.		CRIPTION/PURPOSE			
2.	sco	PE	4		
3. DEFINITIONS AND REFERENCES					
	3.1.	Definitions and Abbreviations	. 5		
4.	МҮТ	TE DEVICE OVERVIEW	6		
	4.1.	Satellite Messaging Method	6		
5.	ON-	AIR INTERFACE	.7		
	5.1. 5.2.	RF Modulation EMI/EMC Conformance			
6.	INT	EGRATION GUIDELINES	9		
	6.1. 6.2. 6.2.2 6.2.3 6.2.4 6.2.5 6.3.3 6.3.3 6.3.4 6.3.4	2. Power Supply	10 13 13 13 14 14 15 15 15		
7.	REV	ISION HISTORY1	.9		

3

List of Figures

SECTION	PAGE
FIGURE 1: MYTE APPROXIMATE SIZE	6
FIGURE 2: MYTE HOST FOOTPRINT (TOP SIDE VIEW).	9
FIGURE 3: MYTE EXAMPLE INTEGRATION SCHEMATIC	10
FIGURE 4: MYTE EXAMPLE INTEGRATION TOP LAYOUT	11
FIGURE 5: MYTE EXAMPLE INTEGRATION BOTTOM LAYOUT	11
FIGURE 6: MYTE EXAMPLE INTEGRATED ASSEMBLY DIAGRAM	
FIGURE 7: MYTE EXAMPLE INTEGRATED PCB STACK-UP	
FIGURE 8: MYTE LABEL	
List of Tables	
SECTION	PAGE
TABLE 1: RF CHANNELS IMPLEMENTED	
TABLE 2: FCC PART 15.109 SUMMARY	
TABLE 3: PART 25.202 SUMMARY	
TABLE 4: FN 301-441 SUMMARY.	8

1. Description/Purpose

The MYTE (SCC-002) device is a radio transmitter module that creates the radio frequency (RF) signals to relay small packets of data to the Globalstar Simplex Data Service satellite network. The MYTE serves as a communication gateway in an embedded application to send transmit-only (simplex) data. Data packets are in small, 9-byte segments. The MYTE supports 9, 18, 27 or 36-byte data payloads. The Globalstar Simplex Data Service comprises a set of low-earth-orbit (LEO) satellites operating as bent-pipe data relay devices to ground earth data collection points. This specification stipulates the operational and physical requirements for the MYTE transmitter device that is compatible with this satellite network system.

The MYTE device is the radio transmitter only and its integration must follow the follow basic guidelines/limitations.

- 1. The MYTE must be fully integrated into a larger OEM installation/application device to provide utility.
- 2. The OEM integrator is responsible for ensuring that the end-user has no manual instructions to remove or install module.
- 3. The module is limited to installation in mobile or fixed applications.

This specification provides the physical, electrical and integration requirements to enable application development.

The purpose of this document is to provide some notes on basic device integration for the MYTE transmitter module.

2. Scope

This User/Integrators Guide applies only to the Geoforce MYTE transmitter.

3. Definitions and References

3.1. Definitions and Abbreviations

The following definitions used herein shall have the meanings as defined below:

- **BPSK**: Binary Phase Shift Keyed modulation. This is the data modulation incorporated by the MYTE compliant with the Globalstar Simplex Data Service.
- **b) EIRP**: Effective Isotropic Radiated Power.
- c) **EMI**: Electro Magnetic Interference.
- **d) ESN**: Electronic Serial Number. Unique serialization number for each transmitter.
- e) **EVM**: Error Vector Magnitude: A measure of BPSK modulation quality.
- f) DSSS: Direct Sequence Spread Spectrum. This is the spreading method coupled with BPSK
- g) **Globalstar**: The term "Globalstar" means Globalstar, Inc., a Delaware USA Corporation having offices at 461 South Milpitas Blvd, Milpitas, California 95035
- h) Globalstar Simplex Data Service: The term "Globalstar Simplex Data Service" refers to communications from simplex transmitters relayed over Globalstar's network of low earth orbit satellites to Globalstar gateways for distribution to end customers.
- i) **GPS**: The term GPS is an acronym meaning global positioning system.
- **LEO**: The term LEO is an acronym meaning low earth orbit.
- **PRS**: Pseudo Random Sequence. The digital method for creating the DSSS spreading code.
- RAS: Radio Astronomy Service. Regions of restricted frequency use compliant with the Globalstar radio spectrum license.
- m) RF: Radio Frequency
- **n) RTU**: Remote Telemetry Unit, generically used as the device that contains the MYTE integrated into it as the satellite communication means.
- •) **TCXO**: Temperature Compensated Crystal Oscillator.

4. MYTE Device Overview

The MYTE device is a radio transmitter module that contains the functionality to accept configuration and data from a host application and convey data to the Globalstar Simplex Data Service satellite system.



FIGURE 1: MYTE APPROXIMATE SIZE

4.1. Satellite Messaging Method

The MYTE device manages all the required messaging to be compliant to the Globalstar Simplex Data Service. The application interface need only configure the device once and send data to the MYTE using the I2C serial interface. The MYTE will queue the data to be sent and manage the process of transmitting the data to the satellite system.

Because the messages are transmitted unsolicited and without the benefit of a two-way data link with the satellite system, each message is transmitted several times with a random delay component between transmits of roughly 7±2 minutes. Recommended configuration setting transmits each message three times with time delays between each transmission to allow for the satellite constellation to shift in position. The configuration parameters of the MYTE allow for adjustment of number of transmissions and time delays between transmissions. This overview is provided to briefly demonstrate how the MYTE functions in order for application developers to understand how the simplex system operates. Integrators should know that sending a message for transmit may therefore take up to 20 minutes to complete the transmit sequence. This does not mean that system latency is typically that long, but because the MYTE has no way to discern if the message was successful on first or subsequent attempts, it will repeat the message transmit per configuration setting. The satellite system will deliver the first received message captured, typically the first message and thus the probabilistic system latency is seconds, not minutes. Nevertheless, on rare occasions the system may miss the first message and the data packet will have a new chance for packet delivery success on subsequent trials.

5. On-Air Interface

The MYTE transmits data in a radio format compatible with the Globalstar Simplex Data Service. This section provides a brief overview of the operation of the network service. Greater detail can be found in the requirements definitions set forth by Globalstar.

5.1. RF Modulation

The MYTE transmits data using Direct Sequence Spread Spectrum (DSSS) carrier with a Binary Phase Shift Keyed (BPSK) data modulation. The MYTE can be configured to send data on one of four radio center frequencies. Globalstar operational requirements for channel usage must be observed by application developers. Generally, channel A is used for North American operations except where the device is in proximity of Radio Astronomy Sites (RAS), where channel C is prescribed. Use in other global regions uses channel C. The channels are specified as:

RF Channel
Channel A = 1611.25 MHz center frequency
Channel B = 1613.75 MHz center frequency
Channel C = 1616.25 MHz center frequency
Channel D = 1618.75 MHz center frequency

TABLE 1: RF CHANNELS IMPLEMENTED

Nominal Transmit output power shall be 18 dBm \pm 2 dB RMS overall operating conditions.

5.2. EMI/EMC Conformance

The MYTE shall carry an FCC Part 25 modular device certification, stipulating a maximum antenna gain of +5 dBi. In addition, the MYTE shall be verified compliant to FCC Part 15 and EN 301-441 for EU use.

FCC Part 15.109

Absolute Frequency	Offset from Carrier	EIRP	Measurement Bandwidth / Method
30 to 88	-	90 μV/m	10 meters
88-216	-	150 μV/m	10 meters
216-960	-	210 μV/m	10 meters
Above 960	-	300 μV/m	10 meters

TABLE 2: FCC PART 15.109 SUMMARY

Part 25,202

Absolute Frequency	Offset from Carrier	EIRP	Measurement Bandwidth / Method
Frequency Offset	Below -6.25 MHz	-35 dBc	4 KHz Average
(Authorized bandwidth	-6.25 to −1.25 MHz	-35 dBc	4 KHz Average
2.5 MHz)	-2.5 to −1.25 MHz	-25 dBc	4 KHz Average
Frequency	1.25 to 2.5 MHz	-25 dBc	4 KHz Average
Offset	2.5 to 6.25 MHz	-35 dBc	4 KHz Average
(Authorized Bandwidth 2.5 MHz)	Above 6.25 MHz	-35 dBc (Assuming 18dBm output power)	4 KHz Average

TABLE 3: PART 25.202 SUMMARY

EN 301-441

Absolute Frequency	Offset from Carrier	EIRP	Measurement Bandwidth / Method
0.1 to 30		-36 dBm	10 KHz Peak-Hold
30 to 1000		-36 dBm	100 KHz Peak-Hold
1000 to 1559		-30 dBm	1 MHz Average
1559 to 1580.42		-40 dBm	1 MHz Average
1580.42 to 1605		-40 dBm	1 MHz Average
1605 to 1610		-40 dBm to 20 dBm ¹	1 MHz Average
	-17.75 to -3.05 MHz	-26 dBm	30 KHz Average
Frequency	-3.05 to -2.165 MHz	-26 dBm to -23 dBm ¹	30 KHz Average
Offset	-2.615 to −1.9 MHz	-15 dBm	30 KHz Average
(Does not apply below	-1.9 to −1.475 MHz	-15 dBm to -8.5 dBm ¹	30 KHz Average
1610 MHz)	-1.475 to −1.41 MHz	-8.5 dBm to -5 dBm ¹	30 KHz Average
	-1.41 to −1.25 MHz	-5 dBm	30 KHz Average
	1.25 to 1.41 MHz	-5 dBm	30 KHz Average
Frequency	1.41 to 1.475 MHz	-5 dBm to -8.5 dBm ¹	30 KHz Average
Offset	1.475 to 1.9 MHz	-8.5 dBm to -15 dBm ¹	30 KHz Average
(Does not apply above	1.9 to 2.615 MHz	-15 dBm	30 KHz Average
1628.5 MHz)	2.165 to 3.05 MHz	-23 dBm to -26 dBm ¹	30 KHz Average
	3.05 to 17.75 MHz	-26 dBm	30 KHz Average
1628.5 to 1631.5		-30 dBm	30 KHz Average
1631.5 to 1636.5		-30 dBm	100 KHz Average
1636.5 to 1646.5		-30 dBm	300 KHz Average
1646.5 to 1666.5		-30 dBm	1 MHz Average
1666.5 to 2200		-30 dBm	3 MHz Average
2200 to 12,750	T 4. EN 20	-30 dBm	3 MHz Peak Hold

TABLE 4: EN 301-441 SUMMARY

¹ Limit in dB varies linearly

6. Integration Guidelines

Integrating the MYTE into an application requires compliance with the network operation guidelines as set forth by Globalstar. This section highlights the primary guidelines and restrictions; however, users must consult with Globalstar for any updates or changes to operation that govern use of the Simplex Satellite service.

6.1. Mechanical Interface

The MYTE is a board-level module that integrates into the host application via the surface mount pads shown below. The MYTE top-side host solder footprint is shown below.

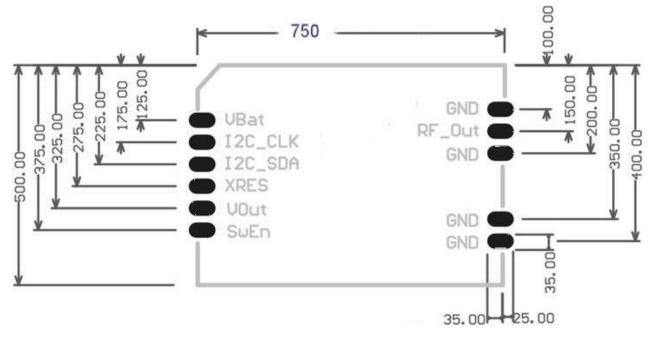


FIGURE 2: MYTE HOST FOOTPRINT (TOP SIDE VIEW)

Module height is 100 mils. All dimensions in mils (thousandths of an inch).

The MYTE is an RF module assembly. Therefore, care should be taken in application design to ensure the power and data signals are electrically clean. Running RF or digital signals under the MYTE module is not advised. It is preferred to provide a solid ground plane on the top layer of the application board layout.

6.2. Electrical Integration

6.2.1. Integration Schematic and Layout

The MYTE's integration electrically should take into consideration power requirements, microstrip design and antenna placement. A sample integrators schematic and layout information is provided here.

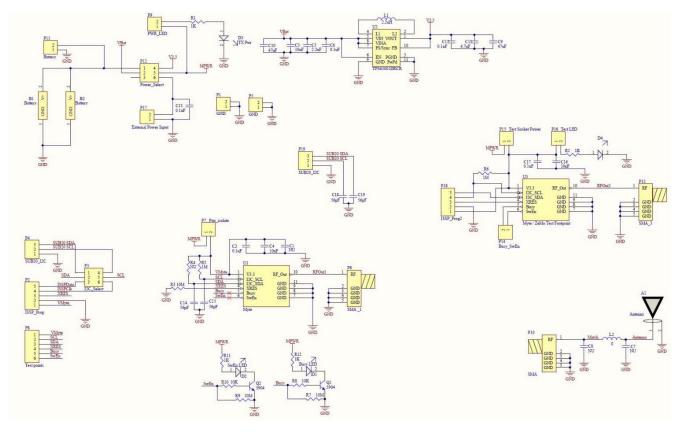


FIGURE 3: MYTE EXAMPLE INTEGRATION SCHEMATIC

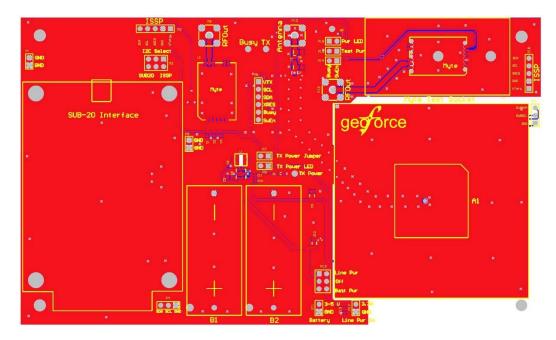


FIGURE 4: MYTE EXAMPLE INTEGRATION TOP LAYOUT

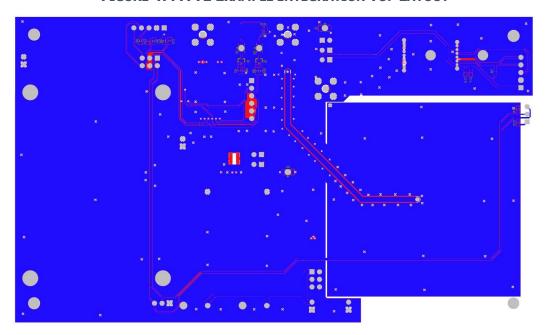


FIGURE 5: MYTE EXAMPLE INTEGRATION BOTTOM LAYOUT

Integrators Note: This module must not be incorporated into any other device or system without retesting for compliance as a composite system and can only be used with a host antenna circuit trace layout design in strict compliance with the OEM instructions provided. Different antenna length and trace layout designs shall be considered of a different type and require separate approvals under a class II permissive change.

Additionally, Note the test and evaluation requirements for inclusion into the Globalstar network far exceed the requirements for OEM Integration according to these instructions. Consult Globalstar integration guidelines for additional test and gualification requirements for module integration.

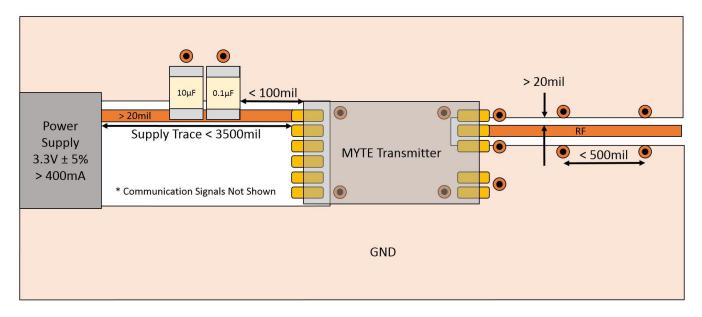


FIGURE 6: MYTE EXAMPLE INTEGRATED ASSEMBLY DIAGRAM

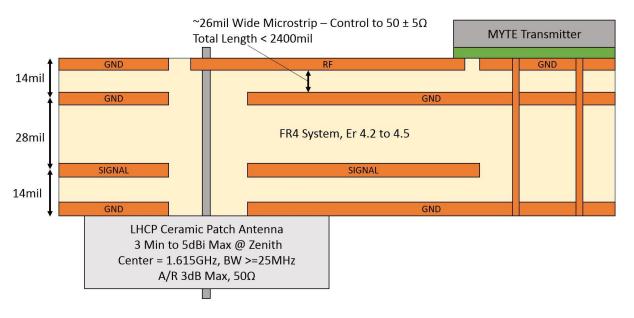


FIGURE 7: MYTE EXAMPLE INTEGRATED PCB STACK-UP

6.2.2. Power Supply

The module is to be powered at $3.3V \pm 5\%$, including transients induced by changes in current draw. The module power supply must be decoupled with $0.1\mu F$ and $10\mu F$ low ESR ceramic capacitors as close to the power supply connection as possible but no further than 100mil. The power supply must be capable of delivering pulse current in excess of 400mA. The power supply connection trace should be kept as short as possible and shall be of at least 20mil width, no longer than 3500mil, and shall not exceed 0.10hm.

6.2.3. RF Interface

In order to guarantee compliance with FCC Part 25 Modular Transmitter requirements and avoid the possibility of generating unintentional emissions, the interface between the transmitter module and an approved antenna must strictly adhere to the following design requirements. The RF connection on the host board must be connected to an approved antenna via a microstrip or stripline transmission line. The impedance of this trace must be controlled to 50±50hm and its length shall not exceed 2400mil. The transmission line layer should be surrounded by a ground plane spaced at least 20mil from the edges of the trace. Stitching vias between the transmission line layer ground plane and the ground plane counterpoise(s) shall be placed at least every 500mil along the length of the trace. No signal traces are to pass below the transmitter module or transmission line on adjacent (counterpoise) layer(s) or within 20mil of any transmission line vias or antenna feed pin on any layer. A ground plane with multiple stitching vias should be placed under the extents of the module.

6.2.4. Antenna Guidelines

The MYTE may be integrated with an antenna with a maximum directivity gain of +5dBi or less, such as the Spectrum Advanced Specialties Products antenna part number PA25-1615-025SA or PA451615-1575SA (dual band sat+gps) or Tallysman Wireless part numbers TW2515 or TW11-0006-X.

No external amplifiers, trace antennas, or antennas other than those which meet the following requirements are permitted under the terms of the modular approval:

Antenna Type: Left-Hand Circularly Polarized Ceramic Patch

Nominal Impedance: 500hm

• Antenna Gain: 3dBi Minimum to 5dBi Maximum at Zenith

Nominal Center Frequency: 1.615GHz

Bandwidth: >= 25MHz

Axial Ratio: 3dB Maximum at Zenith

Special attention must be given to antenna performance as specified in Globalstar document GS-07-1247.

6.2.5. Composite System Compliance Testing

The integrator of a module of this type shall be responsible for ensuring compliance for unintentional emissions per FCC Part 15.107 and 15.109 and RSS-170 on the composite system as a whole. Failure to perform these tests may result in non-compliance with FCC and IC emissions limits.

6.2.6. Composite System Integration Test

The integrated product design shall be evaluated for compliance by removing the patch antenna and connecting an un-terminated end of a coaxial cable of known cable loss at 1.6GHz to the antenna feed point. The other end of the coaxial cable will be connected to a spectrum analyzer capable of measuring a +25dBm signal at 1.6GHz with 100kHz and 3MHz bandwidths.

The spectrum analyzer shall be configured for a center frequency of 1.61125GHz, span of 10MHz, reference level of +25dBm, average detector, range of 100dB, resolution and video bandwidths of 3MHz, sweep time of <100msec, and trace configured for maximum hold. The application processor shall command the MYTE transmitter to transmit a 9-byte packet on Channel A via the I2C interface. The power measured by the spectrum analyzer at the center frequency shall be between +18dBm and +20dBm minus the known cabling losses.

The spectrum analyzer resolution and video bandwidths shall be then set to 100kHz, the maximum trace hold reset. The application processor on the host board will then instruct the MYTE transmitter to transmit another 9-byte packet on Channel A via the I2C interface. The primary band average power shall be averaged from 1.610625GHz to 1.611875GHz and the sideband powers averaged from 1.609188GHz to 1.609812GHz and from 1.612688GHz to 1.613312GHz. Both averaged sideband powers shall be at least 20dB lower than the average primary band power.

6.2.7. Composite System Production Test

Production testing of end products incorporating the MYTE transmitter module shall be verified to comply with relevant emissions standards by measurement of the radiated spectrum over the duration of a transmit event. A spectrum analyzer capable of measuring a 1.61125GHz signal with 100kHz bandwidth shall be connected to a receiving antenna through a low-loss coaxial cable. The receiving antenna shall be nominal 500hm LHCP ceramic patch type with center frequency of 1615MHz±10MHZ, 1dB BW >= 25MHz, A/R 3dB Max, Gain of 3dBi min to 5dBi max at zenith. The antenna shall be positioned about 200cm above the production device under test such that the zenith of both transmit and receive antennas are pointed directly at one another.

The spectrum analyzer shall be configured for a center frequency of 1.61125GHz, span of 10MHz, average detector, reference level of +10dBm, range of 100dB, resolution and video bandwidths of 100kHz, sweep time of <100msec, and trace configured for maximum hold. The application processor shall command the MYTE transmitter to transmit a 9-byte packet on Channel A via the I2C interface. The primary band average power shall be averaged from 1.610625GHz to 1.611875GHz and the sideband powers averaged from 1.609188GHz to 1.609812GHz and from 1.612688GHz to 1.613312GHz. Both averaged sideband powers shall be at least 20dB lower than the average primary band power.

6.3. Regulatory Certifications and MYTE Labeling

The application that incorporates the MYTE device must be properly certified for the region of operation. MYTE will carry modular certifications for FCC, IC. In addition, the MYTE has completed EN 301-441 radio testing for potential use in the EU. These test results may be obtained from Geoforce, Inc. The integrator however must secure operational certifications and testing of the final integrated product in compliance with regional regulatory restrictions including the required marking of the end device.

Modular Certification Restrictions:

- The MYTE is authorized only for mobile devices. Installation in portable devices is not permissible.
- The MYTE must be installed in such a way as to prevent approach within 20 cm of the transmitting antenna. Integrators must ensure that the product user's manual includes the standard 20 cm warning to end users.
- The MYTE may not be collocated with any other transmitter.

6.3.1. MYTE Device Labeling

The MYTE device (Model SCC-002) is marked with the FCC ID and IC certification number as shown below.



FIGURE 8: MYTE LABEL

Actual size of the label is 0.500" x 0.4375"

6.3.2. MYTE Serialization and ESN Coding

Each MYTE transmitter label will also contain a Micro-QR barcode and human readable Electronic Serial Number (ESN). The left-most digit in the labeled ESN is the manufacture ID, so as shown above, the ESN is 2-3000000. The ESN notation is decimal, with the Manufacture ID weighted as 2^23. The formula below provides the conversion for the ESN labeling to hexadecimal notation used in ESN reads from the MYTE.

$$ESN_{hex} = (MFG ID * 2^23) + ESN_{dec}$$

For the example label above:

$$ESN_{hex} = 0x012DC6C0 = (2 * 2^23) + 3000000$$

6.3.3. Integrated Product Labelling and FCC Regulatory Markings

When the MYTE is incorporated into a product, the product must be appropriately labeled. The application designer must ensure the product labeling is accurate and complete. At a minimum, it must contain a statement or marking to designate the device contains the radio transmitter.

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"Contains Transmitter Module FCC ID: OWAMYTE" or "Contains FCCID: OWAMYTE"
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Consult the regulatory requirements for product marking for the latest requirements for each region or application for the application product to ensure compliance.

Note Conspicuously:

This equipment has been tested and found to comply with the limits for a Class B device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- -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.

Caution: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment

Note Conspicuously:

NOTICE: This equipment complies with the FCC RF Exposure Limits. A minimum of 20 centimeters (8 inches) separation between the device and the user and all other persons should be maintained.

Note Conspicuously:

WARNING: Changes or modifications not expressly approved by Geoforce may render the device non-compliant to FCC and other regulatory body standards for operation and may void the user's authority to operate the equipment.

6.3.4. Industry Canada Guidelines

If the MYTE is to be integrated into a device to be used in Canada, the required notices are specified in the RSS documents (including RSS-Gen) applicable to the equipment model. These notices are required to be shown in a conspicuous location in the user manual for the equipment, or to be displayed on the equipment model. If more than one notice is required, the equipment model(s) to which each notice pertains should be identified. Suppliers of radio apparatus shall provide notices and user information in both English and French.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

The above notice may be affixed to the device instead of displayed in the user manual.

User manuals for transmitters equipped with detachable antennas shall also contain the following notice in a conspicuous location:

This radio transmitter (identify the device by certification number, or model number if Category II) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Le présent émetteur radio (identifier le dispositif par son numéro de certification ou son numéro de modèle s'il fait partie du matériel de catégorie I) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

User manuals for license-exempt radio apparatus shall contain the following or equivalent notice in a conspicuous location in the user manual or alternatively on the device or both.

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

6.4. Globalstar Certifications

The application that incorporates the MYTE device must be properly approved for use by Globalstar before use over their network. This will include proper channelization for regional use and other radio telemetry requirements. Contact Globalstar for RTU certification procedures. Special attention must be given to channelization of use as specified in Globalstar document GS-07-1248.

DOCUMENT # HW-IS-0-0057; Revision 170905a | Geoforce Inc.

Revision History 7.

Rev	Description	Approval	Date
170905a	Initial Release	Approval B. Taylor	16 Oct 17