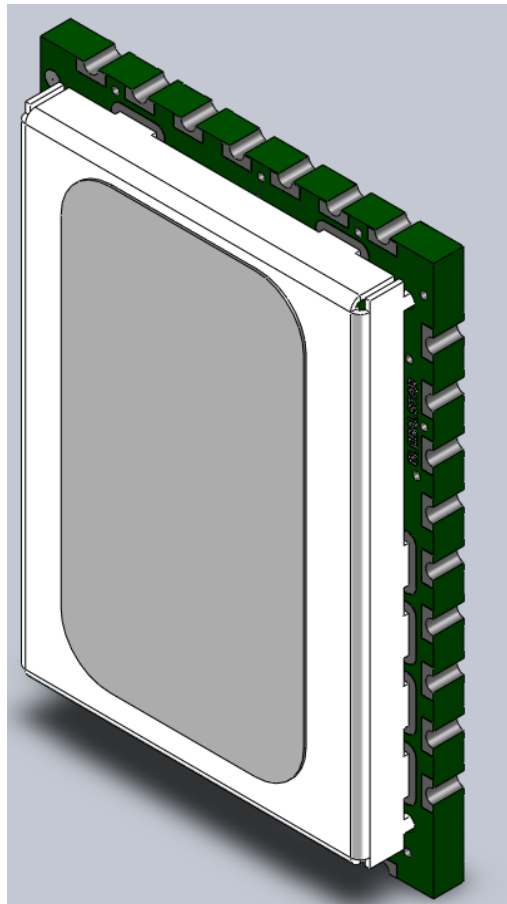


STX3 Users Manual

Globalstar Satellite Transmitter Module - Third Generation



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1 Introduction

1.1 Purpose

This document describes the physical, electrical, and functional characteristics of the STX3 satellite transmitter module. The information contained in this document is intended to provide the end user with the necessary technical information required to use the module in a custom application.

This document is intended to be used by engineers and technical management and assumes a general knowledge of basic engineering practices by the user.

Please note that Globalstar is only responsible for ensuring that the STX3 meets the published manufacturing specifications described herein.

1.2 Applicable Documents

STX-3 Reference Design

1.3 Description

The STX 3 is a simplex Satellite transmitter designed to send small packets of user defined data to a network of low earth orbiting (LEO) satellites using the Globalstar simplex satellite network. The received data is then forwarded to a user defined network interface that may be in the form of an FTP host or HTTP host where the user will interpret the data for further processing.

The STX3 is a surface mount module designed to attach to a user defined host PCB which must provide power, an RF connection to the transmit antenna, and communications with a host processor which will control the operation of the STX3. All electrical connections are provided via the castellated pads on the perimeter of the PCB.

The STX3 is a small, low-profile device with the dimensions shown below.

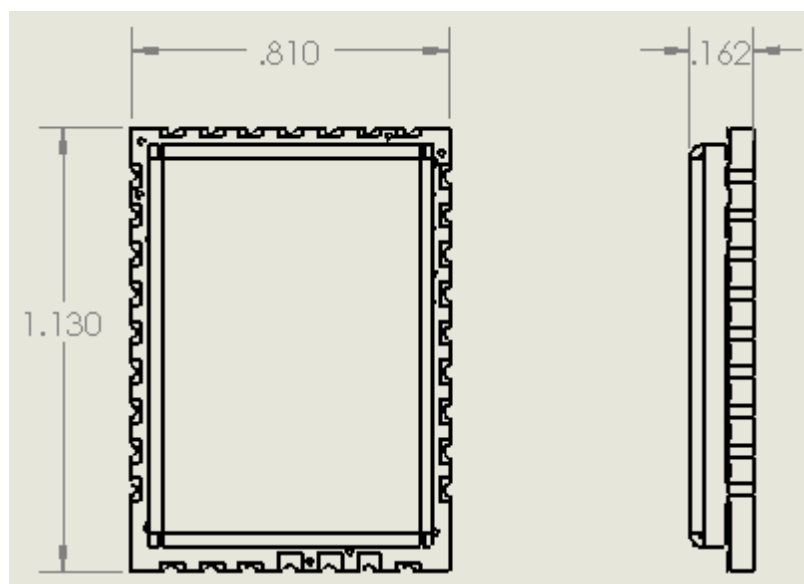


Figure 1 (dimensions in inches)

2 Application

2.1 Theory of Operation

The STX3 operates on the Globalstar LEO satellite network. LEO (Low Earth Orbit) means that there are a number of satellites in low earth orbit that constantly orbit the planet and can communicate with Globalstar devices that are within range of its current position.



Figure 2 LEO Constellation

Since the satellite position is constantly changing, simplex devices on the ground will transmit (with no knowledge of any of the satellites locations) and the transmission may be received by one or more satellites. These satellites will then relay the message to the nearest satellite gateway as shown below. Once received by the satellite gateway, the simplex message will be delivered to the simplex gateway where redundant messages are discarded and the data from the message is sent to the OEM via the Internet.

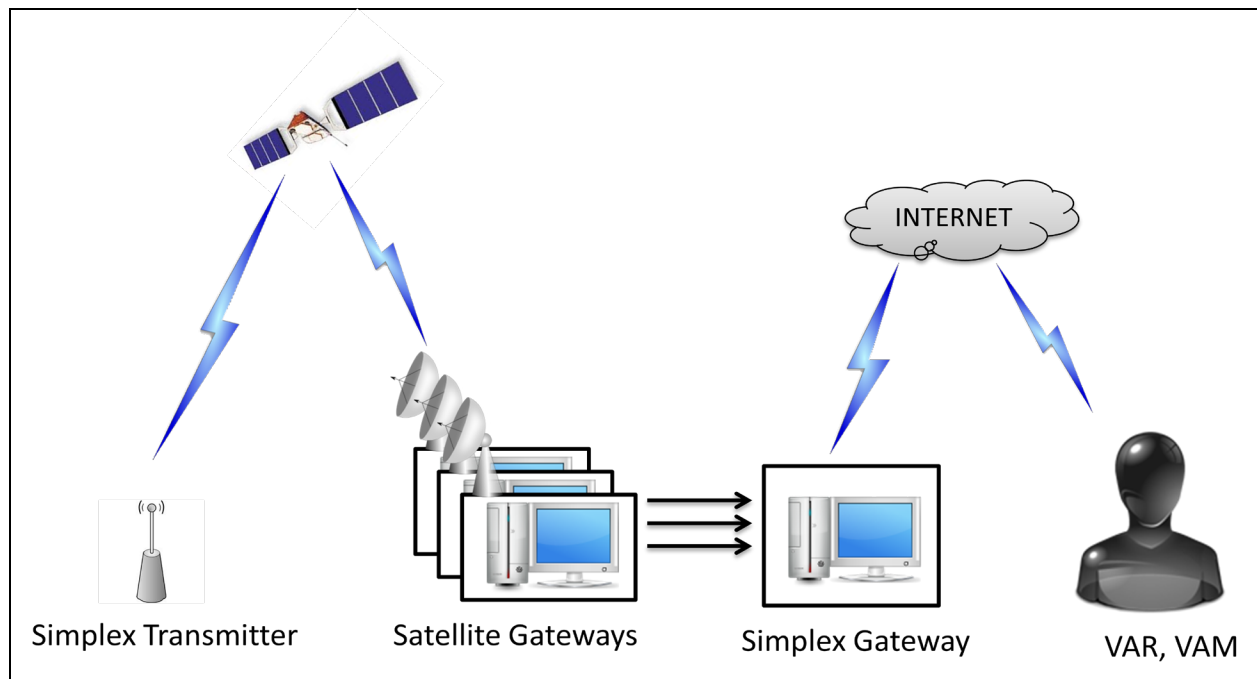


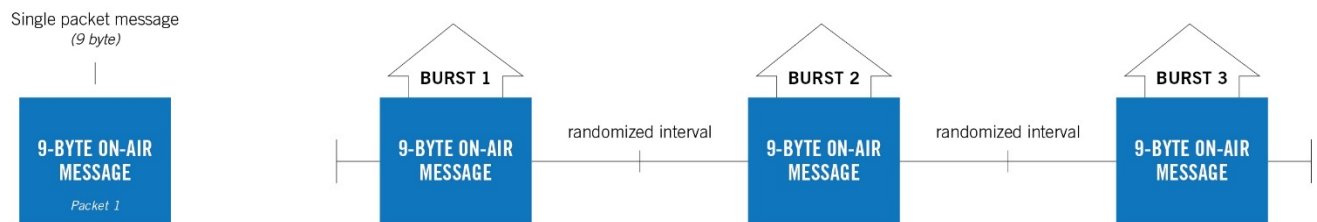
Figure 3 Simplex Messaging

Messages are composed of 1 or more 9-byte payloads. The STX3 can only transmit 9-byte on-air messages, so user payloads greater than 9 bytes will require multiple on-air packets to be transmitted for each user payload.

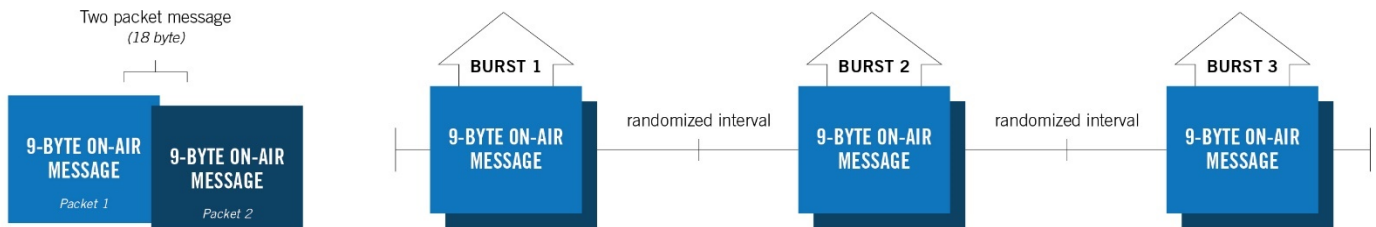


There are brief periods of time where there is no satellite in range of the simplex transmitters due to obstructions and/or satellite coverage geometry. Since a simplex device has no way of knowing if a transmitted message has been successfully received, the STX3 device is designed to send multiple (redundant) transmissions for each message being sent over the Globalstar network. The default value for the number of redundant transmissions per message is 3. This means that each message sent to the STX3 will be transmitted 3 times. Each transmission will contain the exact same data payload. The redundant transmissions of each message will be sent on a randomized 5-minute nominal interval.

The transmission sequence for a single-packet message using the default setting of 3 redundant transmissions is shown below.



The transmission sequence for a two-packet message using the default setting of 3 redundant transmissions is shown below.



For normal conditions where the transmitter has an open view of the sky, this will result in a better than 99% chance that the message will be received.

2.2 Block Diagram

The basic elements of a design utilizing the STX3 simplex transmitter are shown below.

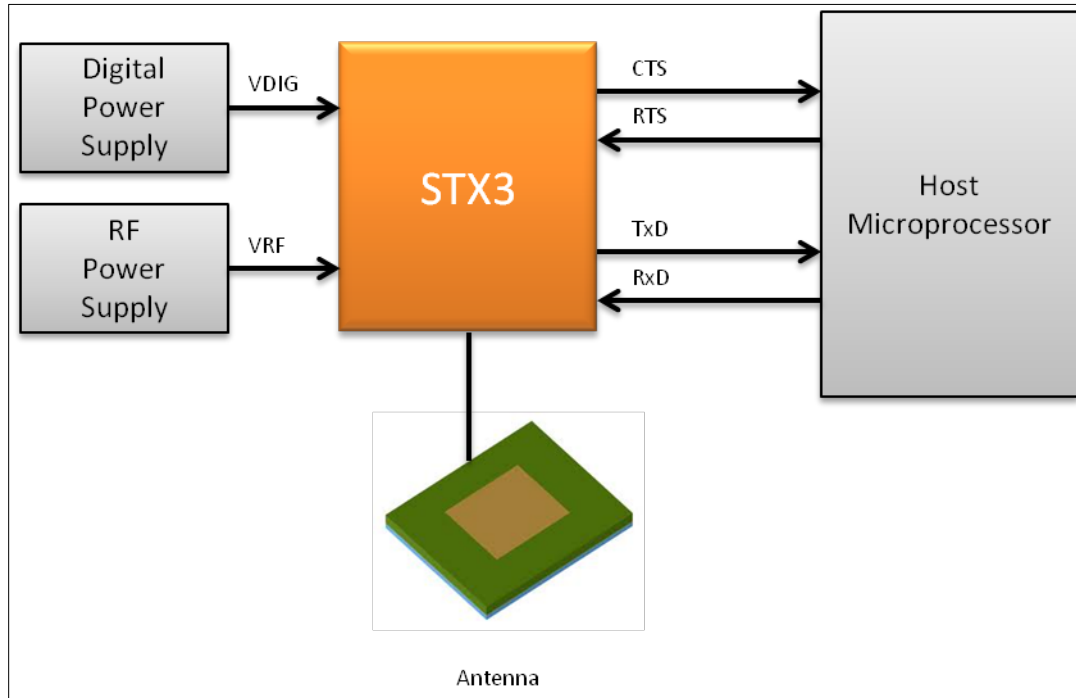


Figure 4

The STX3 provides separate power supply inputs. The digital power supply input (VDIG) is a low power input which powers the digital portion of the STX3. This provides the capability to leave the STX3 in a low power consumption state when the transmitter RF section is idle. The RF power supply input is a high power input which is only required while the STX3 is transmitting a data packet. Since the transmission duty cycle is very low, this supply may be turned off the majority of the time and only active during the transmission of a packet. Due to the random nature of the burst transmissions, an open collector output (PWR_EN) is provided by the STX3 which can directly control the high current supply for VRF. This will ensure that the RF power supply is enabled for the minimum amount of time to complete each transmission. It may also be monitored by the host to determine when each burst has been completed without the need to query the STX3 via the serial host interface.

3 Physical Characteristics

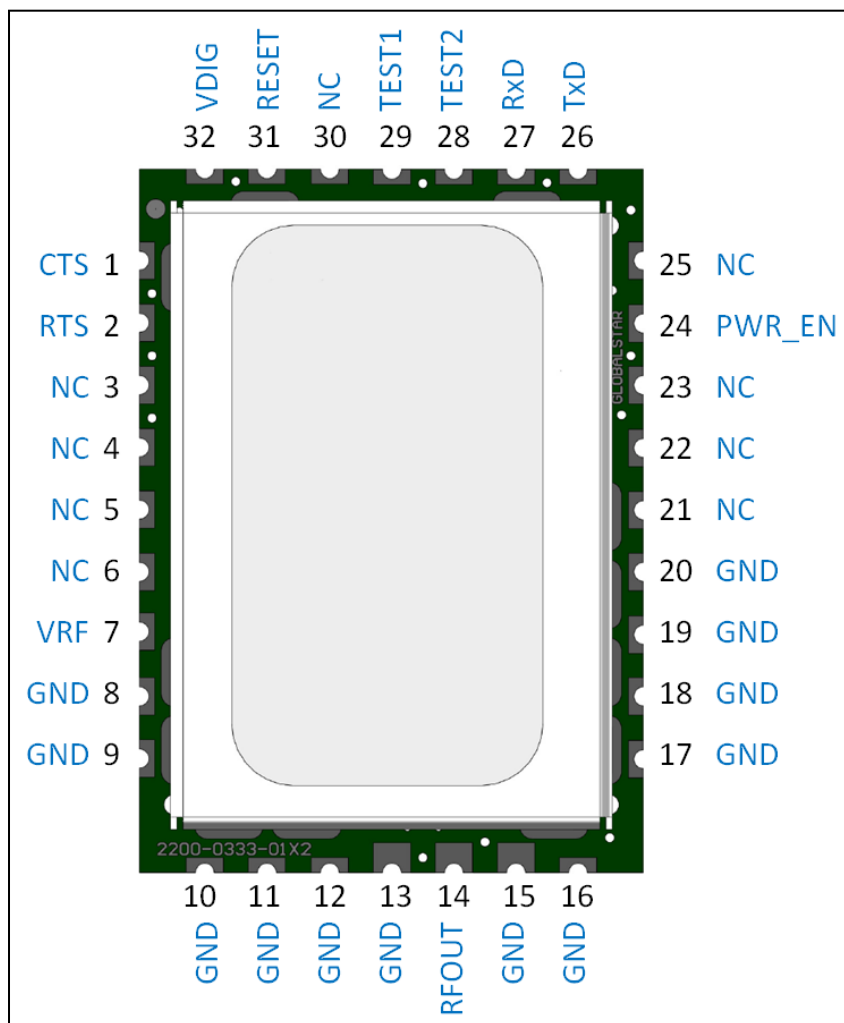


Figure 5 Top View

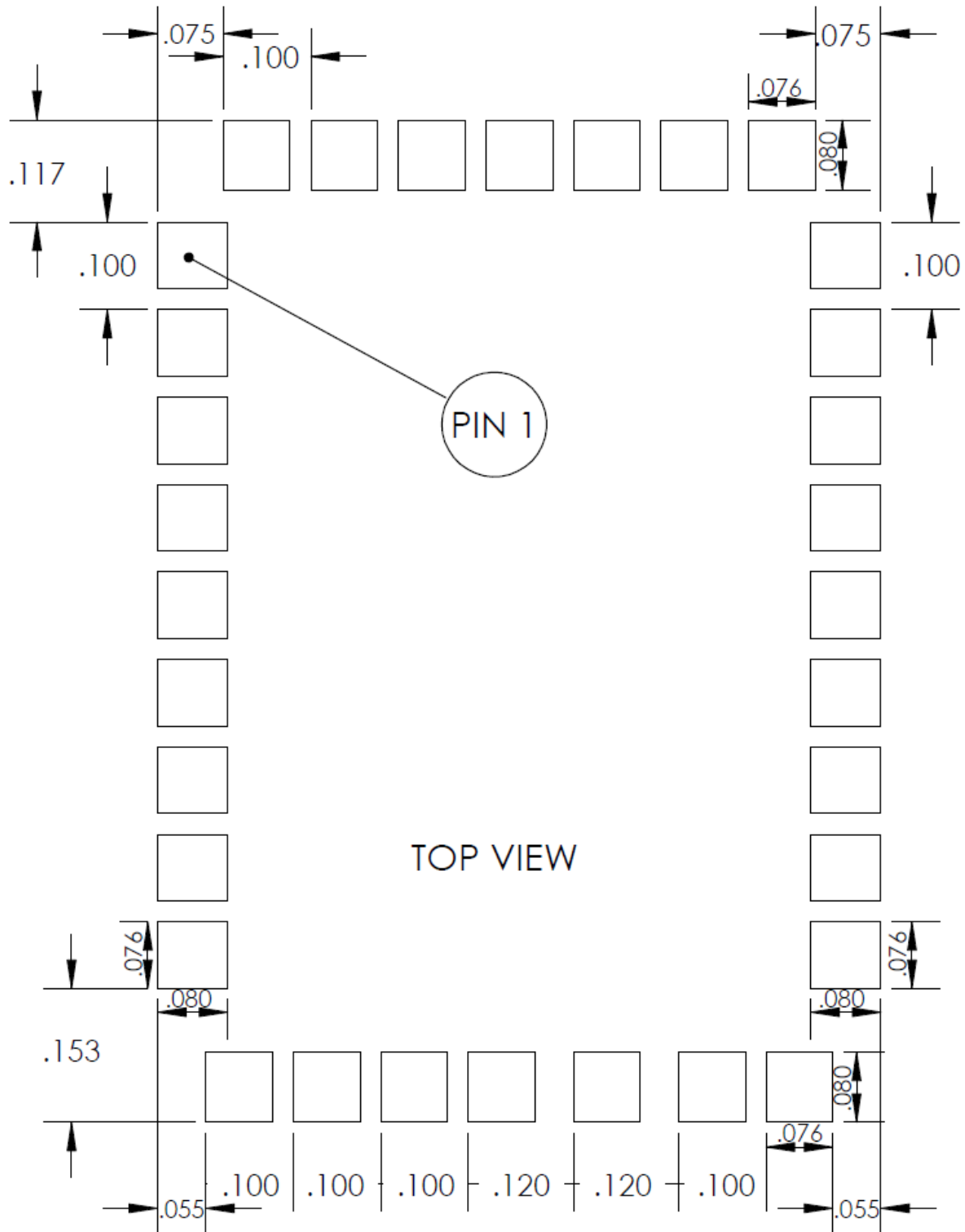


Figure 6 Recommended PCB footprint layout (dimensions in inches)

PIN	NAME	TYPE	Description
1	CTS	Output	5V tolerant, weak internal pull-up, may be pulled up to 5V max external
2	RTS	Input	5V tolerant, weak internal pull-up
3	RESERVED	No Connect	Do NOT connect
4	NC	No Connect	
5	NC	No Connect	
6	RESERVED	No Connect	Do NOT connect
7	VRF	Power In	3.0 to 3.6 Volts, 350 mA max load @ 3.3V, ripple 50 mV (pk-pk) max
8	GND	Ground	
9	GND	Ground	
10	GND	Ground	
11	GND	Ground	
12	GND	Ground	
13	GND	Ground	
14	RFOUT	Output	50 ohm single ended antenna connection, use impedance matched trace
15	GND	Ground	
16	GND	Ground	
17	GND	Ground	
18	GND	Ground	
19	GND	Ground	
20	GND	Ground	
21	RESERVED	No Connect	
22	RESERVED	No Connect	
23	RESERVED	No Connect	
24	PWR_EN	Output	Open collector output to control VRF supply. VRF must be stable within 25ms after assertion.
25	NC	No Connect	
26	TxD	Output	5V tolerant, weak internal pull-up, may be pulled up to 5V max external
27	RxD	Input	5V tolerant, weak internal pull-up
28	Test2	Input	internal pull-up, only drive with open collector or ground, no external voltage to be applied
29	Test1	Input	internal pull-up, only drive with open collector or ground, no external voltage to be applied
30	RESERVED	No Connect	Do NOT connect
31	RESET	Input	Only drive with open collector, no external voltage to be applied
32	VDIG	Power In	3.0 to 5.0 Volts, 50 mA max load @ 3.3V, ripple 50 mV (pk-pk) max

Operational Modes

Sleep Mode	Vcc is applied to the unit, no transmissions are pending, no serial activity
Active Mode	The STX3 is active and responding to the serial port but is not transmitting
Standby Mode	The STX3 is inactive between transmission bursts, but is not transmitting
Transmit Mode	The unit is transmitting an RF packet

Parameter	Test Conditions	Min	Typ	Max	Unit
TX output power	25° C, Vcc=Vrf=3.3 volts, 50 ohm load	18.75	19.0	19.75	dB
Transmit mode supply current	-30 to 85° C, Vcc=Vrf=3.3 volts, 50 ohm load	325	390	475	mA
Active mode supply current	-30 to 85° C, Vcc = 3.3 volts	2	2.25	3	mA
Standby mode supply current	-30 to 85° C, Vcc = 3.3 volts	3	12	55	μA
Sleep mode supply current	-30 to 85° C, Vcc = 3.3 volts	3	7	50	μA

4 Reference Design

The following is a reference design which illustrates a typical implementation of a simplex transmitter device using the STX3 and a commercially available antenna. OEM designs are required to follow these guidelines with respect to the antenna configuration and layout. Physical layout, PCB size and stack-up, component part numbers, etc. may vary. However, the following conditions must be met in order to comply with the STX3 modular grant.

1. The antenna used must be a patch antenna.
2. The antenna peak gain must not exceed 5.1 dB.
3. The antenna must be passively connected to the RF output of the STX3 using a 50-ohm nominal impedance printed circuit trace. No connectors are allowed on the antenna connection.

If any of the above conditions are not met, the OEM device must be submitted for FCC Part 25 testing (and any additional certification testing required in the intended geographical service area).

In addition, it is strongly recommended that the OEM design include ESD protection circuitry as specified below. The circuit below provides a DC blocking capacitor as well as a shunt inductor to short any static discharge from the antenna to ground.

The values and part numbers below have been tested and provide ESD protection with minimal insertion loss.

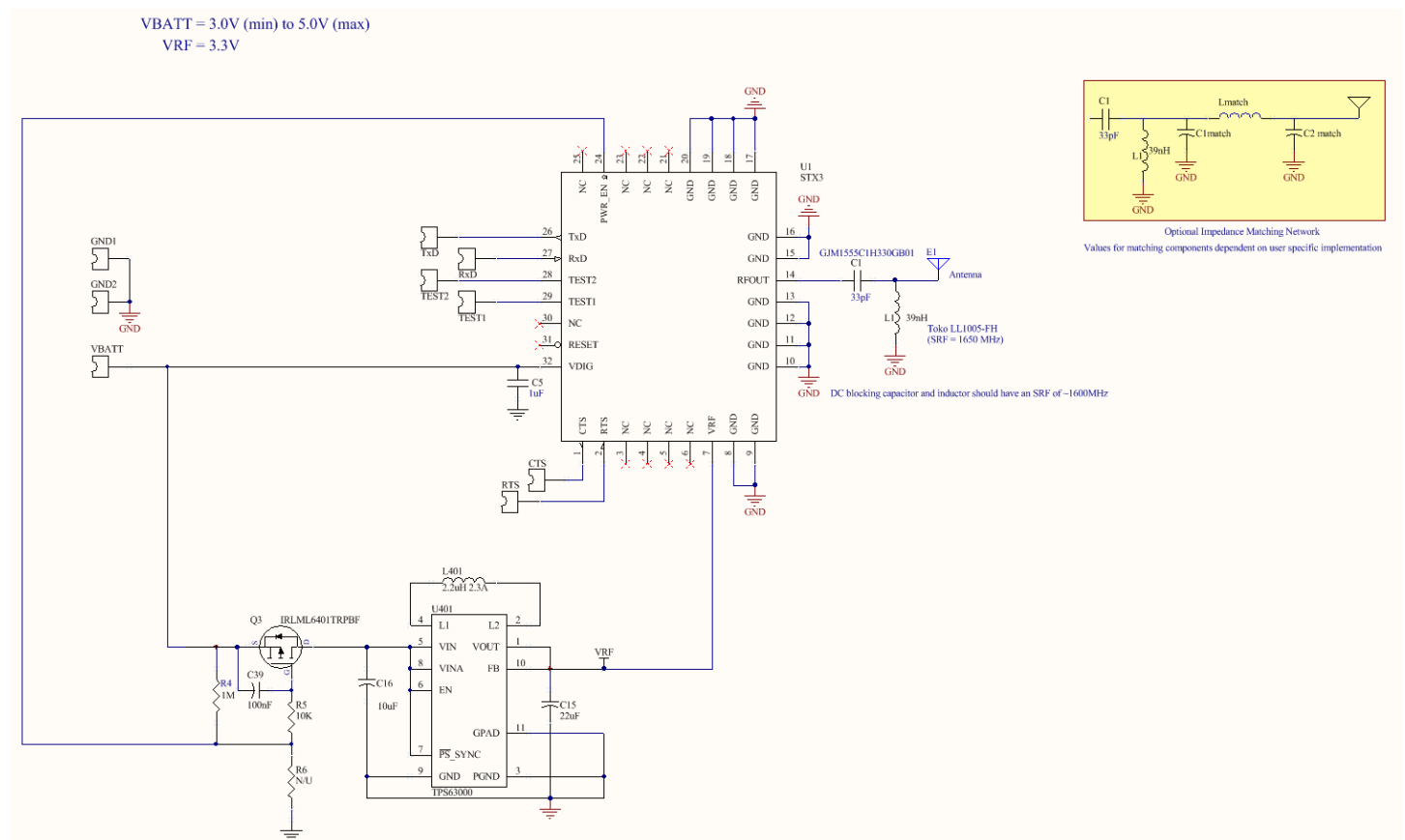


Figure 7 Reference Design Schematic

4.1 Antenna Requirements

The ideal antenna is a ceramic patch that has left hand circular polarization. This antenna should have a gain of between -1dB and 5.1dB in the spatial area between 25 degrees and 90 degrees elevation.

The STX3 has Modular Certification from the FCC (USA) and Industry Canada (Canada) when used with an antenna that meets the specifications above. This means that, in general, no further FCC Part 25 testing or IC testing is required when using an approved antenna (recommended antennas are listed in Appendix A of this document) in accordance with the Globalstar-specified implementation requirements listed in this document. Note however, that regulatory requirements are subject to change at any time, and it is the responsibility of the integrator to ensure that the product is fully compliant with all applicable regulations in whatever markets the integrator is selling the product.

Final installation must be in compliance with 25.213. The antenna installation and operating configuration of this transmitter must satisfy MPE categorical Exclusion Requirements of 2.1091. The antenna used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be collocated or operating in conjunction with any other antenna or transmitter.

1.1.Trace and Cable Losses

The Antenna port (Pin 22) is designed to interface to a 50 Ohm antenna. This connection should feed to the antenna by means of a 50 Ohm impedance trace on the circuit board. The following example impedance calculation is for a co-planar waveguide trace on the top layer of a standard 0.063" FR-4 2-layer board material (60-mil core material) with a dielectric $\epsilon_r \approx 4.6$ and 1/2 oz. Copper.

AppCAD - [CPW]

File Calculate Select Parameters Options Help

Coplanar Waveguide ☒ With Groundplane ☐ No Groundplane

Calculate Z0 [F4]

Diagram labels: L=1000, H=60, W=44, G=8, T=1.7, ϵ_r

Dielectric: $\epsilon_r = 4.6$

FR-4

Frequency: 1612 GHz

Length Units: mils

Elect Length = 227.483 λ

Elect Length = 81893.9 degrees

1.0 Wavelength = 4.396 mil

$V_p = 0.600$ fraction of c

$\epsilon_{eff} = 2.77$

Shape factor = 0.733

Normal

[Click for Web: APPLICATION NOTES - MODELS - DESIGN TIPS - DATA SHEETS - S-PARAMETERS](#)

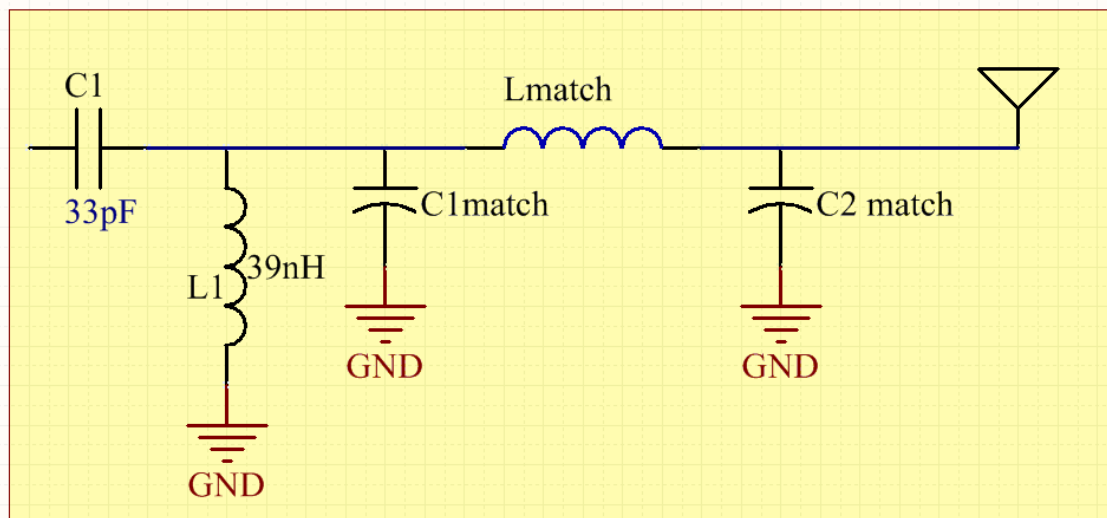
Figure 8 Controlled Impedance Calculation

4.2 Effect of Plastic on Radiation

The design of the enclosure must take into consideration the proximity of any material to the antenna. There should be no conducting material over the antenna. The enclosure must also provide a minimum of 100 mils clearance around the antenna to minimize the effect of the enclosure on the antenna performance.

The final design should include a measurement of the antenna performance when inside the enclosure. The enclosure may affect the performance of the antenna by changing the characteristic impedance of the antenna (de-tuning).

A matching network may be required in the antenna feed to offset the effect of the enclosure and ensure proper performance of the antenna. Values for matching components are dependent on the user specific implementation.



Optional Impedance Matching Network

Values for matching components dependent on user specific implementation

Figure 9 Antenna Matching Network

The measured return loss should be maintained below -10dB across the operating frequency range of 1610-1620 MHz.

4.3 Power Supply Design

The power supply is sourced by a 3.0V - 5.0V input (VBATT). The digital supply (VDIG) is provided directly from the VBATT supply. VDIG provides the standby power for the STX3. In standby mode, the STX3 will respond to serial commands via the serial port.

For the high-current active mode, the RF supply (VRF) is provided by a buck/boost switching power supply which can provide the high current required for transmissions over the satellite network. The open collector output of the STX3 (PWR_EN) is used to turn on the high-current supply during transmissions. This allows the circuit to maintain a low stand-by sleep current when not actively transmitting. The VRF power must be stable within 25ms after PWR_EN is activated.

The VBATT supply must be capable of providing up to 475 mA of current during the packet transmissions.

4.4 Bill of Materials

Designator	Quantity	Manufacturer Part Number	Manufacturer
C1	1	GRM155R71A104KA01D	MURATAELEC
C15	1	EMK316BJ226ML-T	TAIYOYUDEN
C16	1	TMK212BBJ106KG-T	TAIYOYUDEN
C39	1	GRM033R61A104ME15D	MURATAELEC
C5	1	0603ZD474KAT2A	AVXCORP
E1	1	PA25-1615-025SA	SPECTRUMCO
L1	1	BLM18HG471SN1D	MURATAELEC
L401	1	SRU5018-100Y	BOURNS
Q3	1	IRLML6401TRPBF	INTERNATIONAL RECTIFIER
R4	1	ERJ-1GEJ105C	PANASONIC
R5	1	RK73B1HTTC103J	KOASPEEREL
R6	1	#N/A	#N/A
U1	1	2200-0333-01 (STX3)	Globalstar
U401	1	TPS63001DRCR	TEXASINSTR

4.5 PCB Layout

The design has been laid out on a two-layer PCB consisting of a 60-mil core of FR-4 with ½ ounce copper clad.

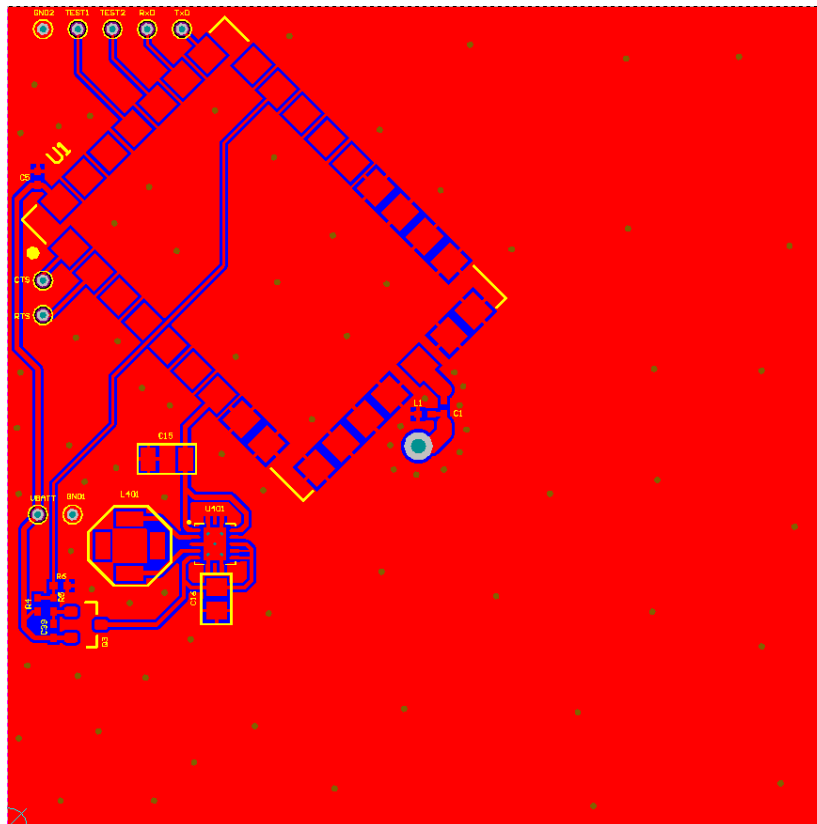


Figure 9 Component Side

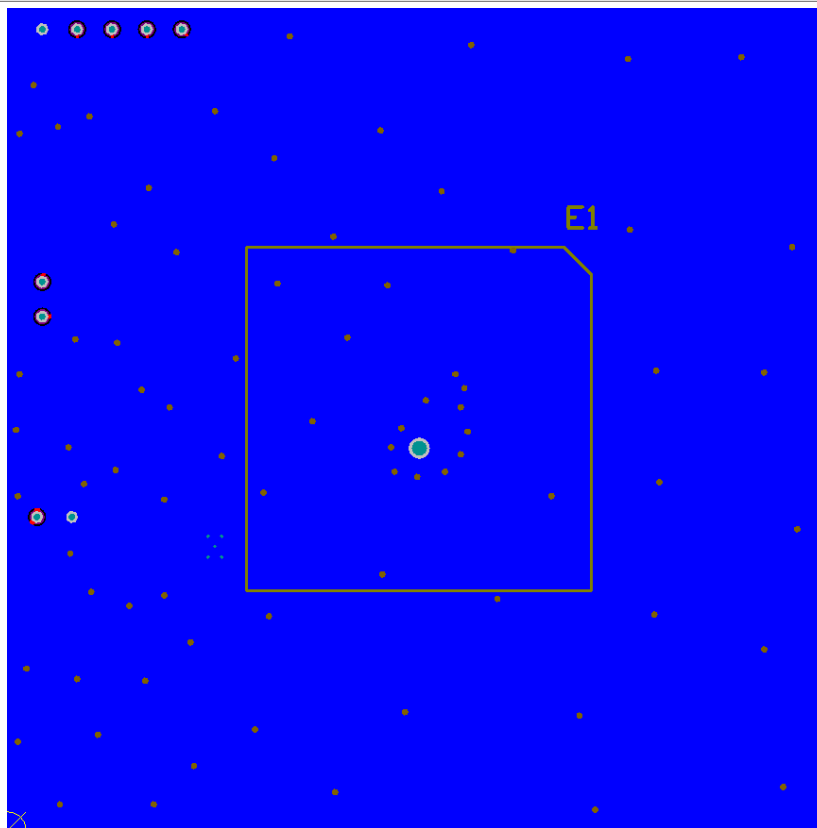


Figure 10 Antenna Side

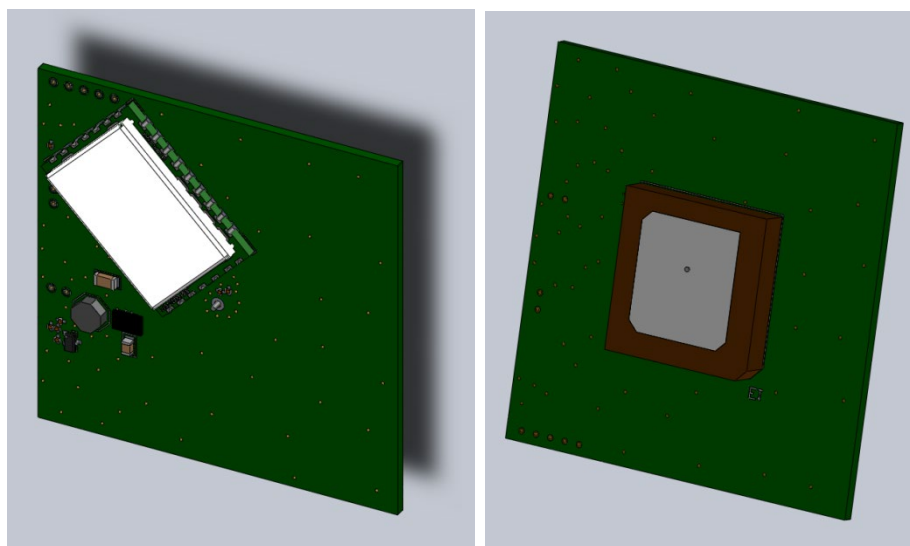


Figure 11 Top and Bottom Views

5 Application Programming Interface

5.1 Serial Port

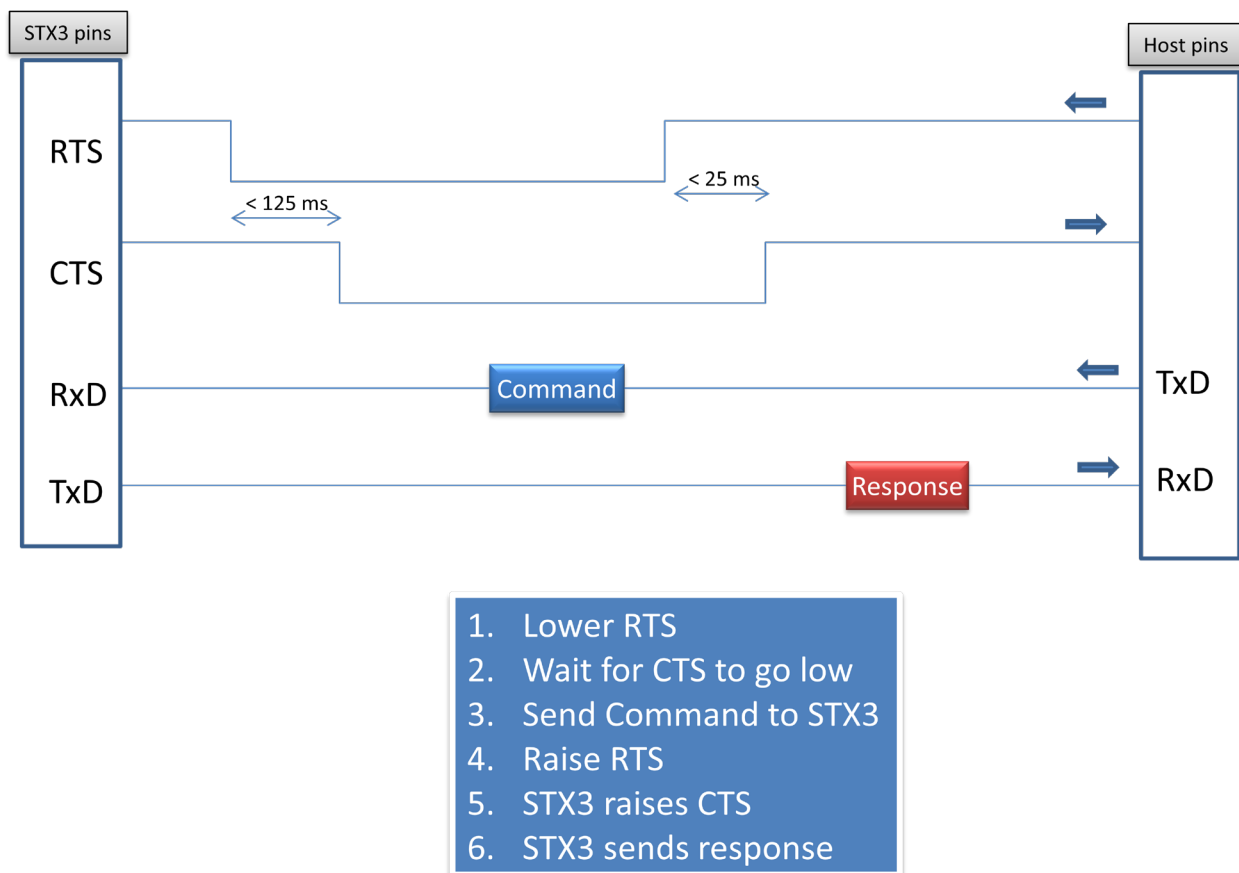
A half-duplex (0-3.0V) TTL asynchronous serial port (UART) is the primary interface to the user equipment. The serial port operates with the serial parameters of 9600bps, 8 data bits, no parity, 1 stop bit.

The RX data input and the RTS inputs are 5V tolerant. The TX data and CTS outputs are 0-3.0V TTL.

RS232 input levels are not supported. RS232 data must be converted to TTL before being sent to the unit.

Each command from the DTE to the modem (STX) is sent in a serial packet. Upon receiving the command, the modem answers to the DTE and, if applicable, executes the command.

In order to wake up the modem (STX) from sleep mode and to indicate the end of the serial packet, each serial packet must be framed by activating RTS before the first byte of the command and deactivating RTS after the last byte of the command.



5.2 Serial Packet Mode

This mode is the legacy mode of operation as implemented in the STX2 which consists of binary data packets.

5.2.1 Serial Packet Format

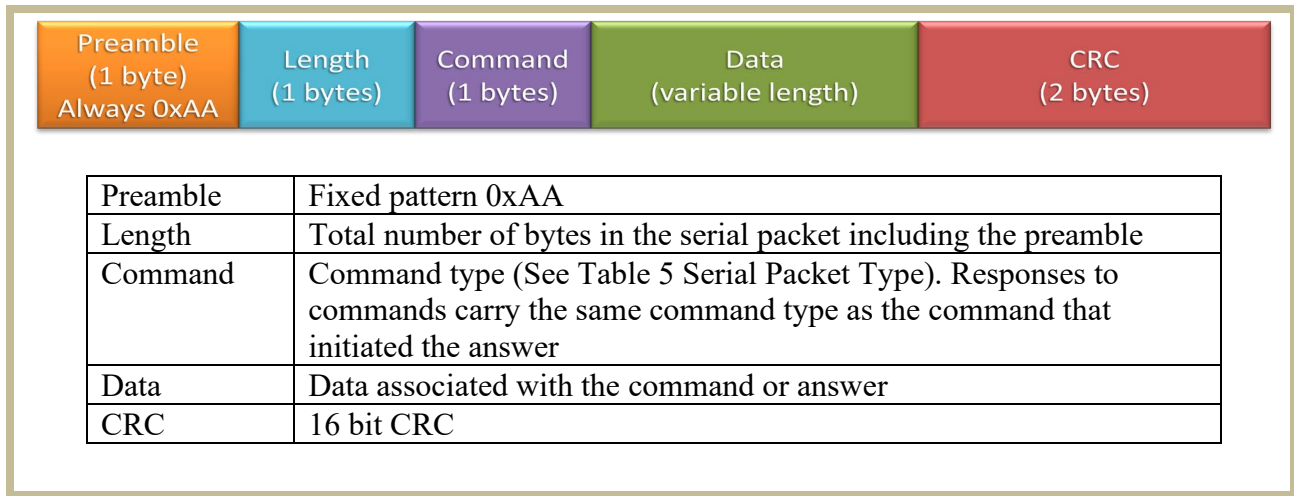


Figure 12 Serial Packet Format

5.2.2 Serial Packet Commands

For all serial packet commands as described below:

- AA is the **Preamble**.
- NN is the **Length**.
- XX is an unspecified byte value
- CLSB is the least significant **CRC** byte
- CMSB is the most significant **CRC** byte
- If an improperly formatted command is received, the STX3 will return a NAK response:

AA 05 FF A1 CB

5.2.2.1 Send Data (0x00)

The Send Data command requests the STX3 to send from 1 to 144 data bytes over the Globalstar Simplex network.

0x00

header	len	cmd	payload 1	payload 2	payload 3	..	payload N	CRC1	CRC2
AA	NN	00	XX	XX	XX	XX	XX	CLSB	CMSB

Example Command: AA 0E 00 01 02 03 04 05 06 07 08 09 BE E8

Response: AA 05 00 D9 C4

The example above commands the STX3 to send 9 bytes of **user defined data** over the Globalstar Simplex network. If the STX3 receives a properly formatted Send Data command, it returns an acknowledge response as shown above. If the command is not properly formatted, it will return the NAK response AA 05 FF A1 CB.

5.2.2.2 Query Electronic Serial Number (ESN) (0x01)

The Electronic Serial Number command requests the STX3 to respond with the units Electronic Serial Number (ESN).

0x01

header	len	Cmd	CRC1	CRC2
AA	05	01	50	D5

Command: AA 05 01 50 D5

Response:

header	len	Cmd	ESN				CRC1	CRC2
AA	09	01	XX	XX	XX	XX	86	7A

Example Response: AA 09 01 00 23 18 60 86 7A

Where the ESN returned is 2300000.

5.2.2.3 Abort Transmission (0x03)

The Abort Transmission command requests the STX3 to abort the current message transmit sequence over the Globalstar Simplex network.

0x03

header	len	Cmd	CRC1	CRC2
AA	05	03	42	F6

Command: AA 05 03 42 F6

Response: AA 05 03 42 F6

5.2.2.4 Query Bursts Remaining (0x04)

The Query Bursts Remaining command requests the STX3 to return the current number of bursts remaining the current message transmit sequence over the Globalstar Simplex network.

0x04

header	len	cmd	CRC1	CRC2
AA	05	04	FD	82

Command: AA 06 04 00 F4 33

Response:

Header	Len	04	count	CRC1	CRC2
AA	05	04	XX	CC	CC

Example Response: AA 06 04 00 F4 33

Where the bursts remaining returned is: 0

5.2.2.5 Query Firmware Version (0x05)

The Query Firmware Version command requests the STX3 to return the current firmware version.

0x05

header	Len	cmd	CRC1	CRC2
AA	05	05	74	93

Command: AA 05 05 74 93

Response:

header	Len	4	FW major	FW minor	CRC1	CRC2
AA	7	5	XX	XX	CC	CC

Example Response: AA 07 05 01 07 E0 6A

Where the firmware version returned is: 1.7

5.2.2.6 Setup (0x06)

The Setup command requests the STX3 to use the specified current setup parameters. These are stored in non-volatile memory.

0x06

Command:

header	len	04	RESERVED				RF channel	# of Bursts	Interval Min	Interval Max	RESERVED	CRC1	CRC2
AA	0E	06	XX	XX	XX	XX	XX	XX	XX	XX	XX	CC	CC

Where:

- RF channel : Valid values are: 0 = Channel A, 1 = Channel B, 2 = Channel C, 3 = Channel D
- # of bursts: Valid values are: 0x01 thru x14 (1 to 20 bursts)
- Minimum Burst Interval: Units of 5 seconds. Valid values are: 0x01 thru 0x3C (5 to 300 seconds)
- Maximum Burst Interval: Units of 5 seconds. Valid values are: 0x02 thru 0x78 (10 to 600 seconds)

Example Command: AA 0E 06 00 00 00 00 00 00 03 18 30 00 CE 9C

Where the setup information is:

- RF channel : 00 Channel A
- # of bursts: 03 3 bursts per message
- Minimum Burst Interval: 18 $0x18 = 24, 24 \times 5 = 120$ seconds
- Maximum Burst Interval: 30 $0x30 = 48, 48 \times 5 = 240$ seconds

5.2.2.7 Query Setup (0x07)

The Query Setup command requests the STX3 to return the current setup parameters.

0x07

header	len	cmd	CRC1	CRC2
AA	05	07	66	B0

Command: AA 05 07 66 B0

Response:

header	len	04	RESERVED				RF channel	# of Bursts	Interval Min	Interval Max	RESERVED	CRC1	CRC2
AA	0E	07	XX	XX	XX	XX	XX	XX	XX	XX	XX	CC	CC

Where:

- RF channel : Valid values are: 0 = Channel A, 1 = Channel B, 2 = Channel C, 3 = Channel D
- # of bursts: Valid values are: 0x01 thru x14 (1 to 20 bursts)
- Minimum Burst Interval: Units of 5 seconds. Valid values are: 0x01 thru 0x3C (5 to 300 seconds)
- Maximum Burst Interval: Units of 5 seconds. Valid values are: 0x02 thru 0x78 (10 to 600 seconds)

Example Response: AA 0E 07 00 23 18 60 **00 03 18 30** 00 5D 60

Where the setup information returned is:

- RF channel : 00 Channel A
- # of bursts: 03 3 bursts per message
- Minimum Burst Interval: 18 $0x18 = 24, 24 \times 5 = 120$ seconds
- Maximum Burst Interval: 30 $0x30 = 48, 48 \times 5 = 240$ seconds

5.2.2.8 Query Hardware Version (0x09)

The Query Hardware Version command requests the STX3 to return the current hardware version information.

0x09

header	len	Cmd	CRC1	CRC2
AA	05	09	18	59

Command: AA 05 09 18 59

Response:

header	len	04	Device Code		Board Rev	CPU Rev	Radio Rev	CRC1	CRC2
AA	0A	09	00	01	XX	XX	XX	CC	CC

Where:

- Device Code : Always 1 for STX3
- Board Revision: STX3 hardware revision
- CPU Revision: STX3 CPU revision
- Radio Revision: STX3 radio revision

Example Response: AA 0A 09 00 01 00 8E 62 E5 5E

Where the revision information returned is:

- Board Revision: 00
- CPU Revision: 8E
- Radio Revision: 62

5.2.2.9 CW Test Mode (0xFC 0x01)

The CW Test Mode command requests the STX3 to enter the CW test mode. This will cause the STX3 to output a CW signal for 30 seconds after which it will turn off the RF output and return to sleep mode.

0xFC 0x01

header	Len	Cmd	Sub Cmd	CRC1	CRC2
AA	06	FC	01	B5	90

Command: AA 06 FC 01 B5 90

Response: AA 05 FC 3A F9

5.2.2.10 Send Test Packet (0xFC 0x02)

The Send Test Packet command requests the STX3 to transmit a single test packet. This test packet consists of the following payload:

0x80AAFOFOFOAAFOFOFO

0xFC 0x02

header	Len	Cmd	Sub Cmd	CRC1	CRC2
AA	06	FC	02	2E	A2

Command: AA 06 FC 02 2E A2

Response: AA 05 FC 3A F9

5.2.2.11 Modulation Test Mode (0xFC 0x03)

The Modulation Test Mode command requests the STX3 to enter the Modulation test mode. This will cause the STX3 to output back-to-back test packets continuously for 30 seconds after which it will turn off the RF output and return to sleep mode.

0xFC 0x03

header	Len	Cmd	Sub Cmd	CRC1	CRC2
AA	06	FC	03	A7	B3

Command: AA 06 FC 03 A7 B3

Response: AA 05 FC 3A F9

5.3 Example CRC calculation routines for serial packets

The following example is written in the C programming language where:

int = 32 bits, short = 16 bits, char = 8 bits

```
unsigned short crc16_lsb(unsigned char *pData, int length)
{
    unsigned char i;
    unsigned short data, crc;

    crc = 0xFFFF;

    if (length == 0)
        return 0;

    do
    {
        data = (unsigned int)0x00FF & *pData++;
        crc = crc ^ data;

        for (i = 8; i > 0; i--)
        {
            if (crc & 0x0001)
                crc = (crc >> 1) ^ 0x8408;
            else
                crc >>= 1;
        }
    } while (--length);

    crc = ~crc;

    return (crc);
}
```

USAGE:calculate the CRC for a message and update the message CRC

```
unsigned short crc = crc16_lsb(msg, msg [1]-2);
msg [msg [1]-2] = (unsigned char) (crc&0xFF);
msg [msg [1]-1] = (unsigned char) (crc>>8);
```

The following example is written in the Java programming language:

```
char crc16_lsb(byte pData[], int length)
{
    int pData_i = 0;
    char s1,s2;

    byte i;
    char data, crc;

    crc = (char) 0xFFFF;
    if (length == 0)
        return 0;
    do
    {
        data = (char)((char)0x00FF & pData[pData_i++]);
        crc = (char)(crc ^ data);
        for (i = 8; i > 0; i--)
        {
            if ((crc & 0x0001) != 0)
                crc = (char)((crc >> 1) ^ 0x8408);
            else
                crc >>= 1;
        }
    } while (--length != 0);

    crc = (char)~crc;

    return (crc);
}
```

USAGE:calculate the CRC for a message and update the message CRC

```
byte msg[];      int len;
char crc = crc16_lsb(msg,len-2);
msg[len-2] = (byte)((short)crc & (short)0xff);
msg[len-1] = (byte)((short)crc >> 8);
```

5.4 AT commands

Command	Response	Comments
AT		This command is used to check communication between the module and the host.
	OK	STX3 is ready for normal operation
	ERROR	STX3 is not ready for operation, an error condition exists
AT+GSN? AT+CGSN?		Request product serial number identification
	+GSN: <n-nnnnnnn>	product serial number identification (ESN)
	ERROR	Unable to retrieve ESN
AT+GMM? AT+CGMM?	+GMM: STX3	Request model identification (hardware version).
AT+GMI? AT+CGMI?	+GMI: GLOBALSTAR	Request manufacturer identification
AT+GMR? AT+CGMR?		Request revision identification (firmware version).
	+GMR: <MM.mm>	MM=Major Revision, mm=Minor Revision Example: +GMR: 01.00
	ERROR	Unable to retrieve revision identification
AT+CMGS=<hhhh..hh>		Send message up to 144 data bytes specified by hexadecimal string Example: AT+CMGS=AA5511A53311A53311
	OK	Message Burst In Progress
	ERROR	Invalid message or modem error
AT+CMGSL=<Lat, NS, Lng, EW, hhhhhh>		Send location message with 3 data bytes specified by hexadecimal string. Lat: ddmm.mmmm dd: decimal degrees, mm.mmmm minutes NS: hemisphere (N/S) Lng: dddmm.mmmm ddd: decimal degrees, mm.mmmm minutes

		EW: hemisphere (E/W) hhhhh: hexadecimal value of 3 byte payload Example: AT+CMGSL=3025.9857,N,09005.2182,W,A53311
	OK	Message Burst In Progress
	ERROR	Invalid message or modem error
AT+CANX		Cancel running transmission.
	OK	Command OK (This command will never return an error. If no transmission is running, it will simply do nothing. This makes it possible for user code to just blindly send this command before any command to transmit if desired.)
AT+CGNTR?		Request the remaining number of total packet transmissions remaining in a running burst. The value returned by this query will represent the number of packets in the message times the number of burst transmissions remaining. For example, if two transmissions remain in the burst of a 4 packet message, a value of 8 will be returned. If no burst is in progress, a value of 0 will be returned. This command will never return an error.
	+CGNTR: <n>	n= Number of packets left in the burst Example: +CGNTR: 8
AT+CDFC=<channel number>		Set the default channel. Valid values are 0 – 3. Example: AT+CDFC=2
	OK	Command OK, channel was successfully set.
	ERROR	ERROR. Typically means channel number is out of range.
AT+CFDC?		Request current channel.
	+CFDC: <n>	N= current channel, a number between 0 and 3.
AT+CBNT=<Number of tries>		Set number of transmissions in burst. <Number of tries> = the number of transmissions in the burst. Range must be 1 – 16. Value may be sent in decimal or HEX format. HEX is indicated with a leading "0x".
	OK	Command OK, number of tries successfully set.
	ERROR	Unable to set number of tries. Most likely reason is that the number requested was out of range. Must be 1 – 16.

AT+CBNT?		Request number of tries setting for bursts.
	+CBNT: <n>	<n>= number of tries set for bursts.
AT+CBTMIN=<seconds>		Set the minimum time between transmissions in the burst in seconds. Acceptable range is 5 – 300 seconds. Value will be truncated by the device to the nearest divisible of 5. For example, if the number 207 is sent, the device will set the minimum to 205 seconds. Number may be sent in decimal or HEX format. HEX is indicated by a leading “0x”.
	OK	Command accepted and time set.
	ERROR	Time not set, most likely reason is the number was out of range.
AT+CBTMIN?		Query the minimum time between transmissions in the burst.
	+CBTMIN: <n>	Minimum time between transmissions in a burst, in seconds.
AT+CBTMAX=<seconds>		Set the maximum time between transmissions in the burst in seconds. Acceptable range is <CBTMIN> – 600 seconds. Value will be truncated by the device to the nearest divisible of 5. For example, if the number 532 is sent, the device will set the minimum to 530 seconds. Number may be sent in decimal or HEX format. HEX is indicated by a leading “0x”.
	OK	Command accepted and time set.
	ERROR	Time not set, most likely reason is the number was out of range.
AT+CBTMAX?		Query the maximum time between transmissions in the burst.
	+CBTMAX: <n>	Maximum time between transmissions in a burst, in seconds.
AT+BDREV?		Query the board revision of the STX3
	+BDREV: <n>	Board revision. TBD if this will even be implemented for the STX3, if unimplemented, will always return 0.
AT+PRREV?		Query the processor (CPU) revision of the Globalstar ASIC.
	+PRREV: <n>	Processor revision.
AT+RAREV?		Query the “radio” revision (revision of the transmitter side of the Globalstar ASIC).
	+RAREV: <n>	Transmitter revision.

6 Test Modes

The STX3 provides several test modes intended to aid in manufacturing testing and certification testing.

All test modes are activated by grounding selective pins on the STX3 prior to applying power. Once power is applied, the STX3 will sample the states of the pins and based on the states of the pins, the STX3 will enter the selected test mode. For normal operation these pins must be left floating or in a high (logic 1) state.

The following tables define the different test modes available in the STX3.

TEST1	TEST2	Mode
0	0	Mod Mode (continuous transmission) - A test packet is continuously transmitted for 30 seconds then transmissions will cease. The test packet shall comply with the Air Interface Packet format with a user information equal to the hex stream 0x80AAF0F0F0AAF0F0F0 where the most significant bit is transmitted first
1	0	Test Packet - The test packet shall comply with the Air Interface Packet format with a user information equal to the hex stream 0x80AAF0F0F0AAF0F0F0 where the most significant bit is transmitted first
0	1	CW mode - An un-modulated carrier is continuously transmitted.
1	1	Normal Operation

The channels are selected via the Rx and RTS pins as follows

RX	RTS	Channel
0	0	B
0	1	C
1	0	Reserved
1	1	Channel specified in the flash setup. To specify channel A, it must be the default channel specified in the flash setup. See Setup command for details.

7 REGULATORY APPROVAL

The STX3 module has received regulatory approvals for modular devices in the United States and Canada. Modular device approval allows the end user to place the STX3 module inside a finished product and not require regulatory testing for an intentional radiator (RF transmitter), provided no changes or modifications are made to the module circuitry. Changes or modifications could void the user's authority to operate the equipment. The end user must comply with all of the instructions provided by the Grantee, which indicate installation and/or operating conditions necessary for compliance. The integrator is still responsible for testing the end product for any additional compliance requirements required with this module installed (digital device emission, PC peripheral requirements, etc.) in the specific country that the end device will be marketed. For more information on regulatory compliance, refer to the specific country radio regulations in the following sections.

7.1 Radio Astronomy Site Avoidance

The end product must comply with CFR 25.213 (FCC - Protection of Radio Astronomy Service).

7.2 Regulatory Notices

The STX3 has received Federal Communications Commission authorization under FCC Rules Part 25 as a modular transmitter. Final installation must be in compliance with CFR 25.213 (see 7.1 above). The antenna installation and operating configurations of this transmitter must satisfy MPE categorical Exclusion Requirements of 2.1091. The antenna used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be collocated or operating in conjunction with any other antenna or transmitter.

The STX3 module will satisfy FCC/IC modular transmitter requirements only when used with the antenna type specified in Appendix A. No power amplifiers may be used under the terms of this modular approval. No trace antennas or any other type of antenna are approved for use under the terms of this modular approval. It is permissible to use different antenna manufacturers provided the same antenna type that has similar inband and out-of-band radiation patterns and antenna gain (equal to or less than the antenna gain listed above) is used. The module provides a surface mount pad for the RF output which must be internally attached passively via the PCB to the approved antenna. **No antenna connector, cable, or any other type of antenna may be used.** In order for any device to obtain certification from Globalstar for use on the Globalstar satellite network under this modular approval, all conditions listed above must be met. Use of any antenna other than those listed in Appendix A will require proof of compliance (peak gain).

The STX3 module has been labeled with its own FCC and Industry Canada (IC) ID numbers, and if the FCC/IC ID numbers are not visible when the module is installed inside another device, then the outside of the finished product into which the module is installed must also display a label referring to the enclosed module:

Contains Transmitter Module FCC ID: L2V-STX3 IC: 3989A-STX3
This 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.

The user's manual should include the following statements:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC 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.

WARNING: Changes or modifications not expressly approved by Globalstar 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.

This 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.

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de classe B est conforme à la norme NMB-003.

DECLARATION OF CONFORMITY FOR EUROPEAN CUSTOMERS: Hereby, Globalstar declares that this STX3 is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU. The declaration of conformity may be consulted at www.globalstar.com/regulatory

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

Avis d'exposition RF: Cet équipement est conforme aux RSS-102 Limites d'exposition RF. Un minimum de 20 centimètres (8 pouces) entre l'appareil et l'utilisateur et toutes les autres personnes devrait être maintenue.

Transmit Frequencies: 1611.25 Mhz - 1618.75 Mhz (4 Channels)
Max Power Out: 19.8 dBm conducted.

FCC ID: L2V-STX3
ICES-003/(A/B)
IC:3989A-STX3



Complies with FCC standards.
FOR HOME OR OFFICE USE

The STX3 has been so constructed that the product complies with the requirement of Article 10(2) as it can be operated in at least one Member State as examined and the product is compliant with Article 10(10) as it has no restrictions on being put into service in all of the EU except Ireland. The STX3 cannot be marketed in Ireland.



Not to be Marketed in Ireland

Anatel Certification stamp for operation in Brazil:



Modelo: STX3

08158-17-04303



7 8 9 8 3 2 4 6 5 0 2 5 3

Portuguese	Produto não acabado, de uso interno, cuja integração em outros equipamentos pode requerer nova certificação.
English	Unfinished product, for internal use, the integration of which into other equipment may require further certification.

8 Appendix A – Antenna Manufacturers

Listed below are discrete antennas which are known to meet the antenna requirements of the modular grant when placed on an appropriate ground plane.

The antenna manufacturers are not listed in any particular order. Globalstar does not make any recommendations with respect to antenna manufacturers and is providing this list as a convenience to integrators.

Manufacturer	Manf. Part Number	Reference Ground Plane Size
API Technologies	PA25-1615-025SA	60mmx60mm
Taoglas	SP.1615.25.4.A.02	60mmx60mm