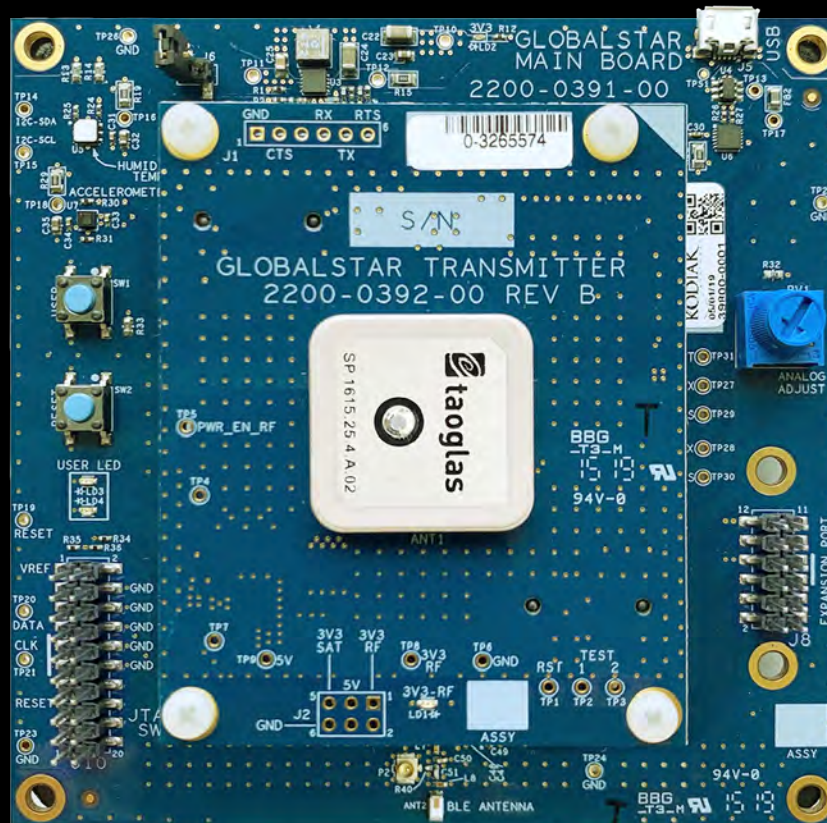


STX3 DEVELOPMENT KIT

WITH BLE TECHNOLOGY Bluetooth



USER MANUAL

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INTRODUCTION

PURPOSE

This document describes the physical, electrical, and functional characteristics of the STX3 Development Kit with Bluetooth Low Energy technology and operation of its associated serial interface and smartphone applications. The information contained in this document is intended to provide the end user with the necessary technical information required to use the STX3 Development Kit with BLE, hereby referred to as the Dev Kit.

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

APPLICABLE DOCUMENTS

- Globalstar STX3 User Manual
- Globalstar STX3 Development Kit with BLE Technology Quick Start Guide
- Globalstar STX3 Development Kit with BLE Software Design Guide

DEV KIT INCLUDES

When opening the Dev Kit box, it will include the following items shown:



DEV KIT BOARD

Transmitter and Main board stacked on top of each other. The Dev Kit is pre-programmed with demonstration firmware that supports the BLE app, serial command communication and quick test function.



LONG USB Y-CABLE

The USB Y-cable is used for connecting the Dev Kit to the host computer.

DESCRIPTION

At the heart of the Dev Kit is the Globalstar STX3 module. The STX3 module 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 Commercial IoT 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 and it is mounted on the bottom side of the Transmitter board just under the Taoglas antenna. The STX3 is electrically connected to the Nordic Bluetooth processor through the two headers that attach the two PCBs of the Dev Kit together. Also, the Main PCB provides power, an RF connection to the transmit antenna, and communications with a host processor which will control the operation of the STX3.

KEY FEATURES OF THE STX3 DEV KIT WITH BLE

- Globalstar Satellite Transmitter (STX3)
- nRF52832 flash-based ANT/ANT+, Bluetooth® low energy SoC solution (<https://www.nordicsemi.com/Products/Low-power-short-range-wireless/nRF52832>)
- 2.4GHz Chip Antenna for Bluetooth
- Multiple Interfacing Options: BLE, USB, STX3 UART
- User Controllable LEDs and button
- Humidity Sensor
- Temperature Sensor
- (3-axis) Accelerometer
- Analog adjust potentiometer
- Expansion header
- Sample code and hardware files available upon request
- Mobile App available for iOS and Android

APPLICATION

OPERATION OF GLOBALSTAR COMMERCIAL IOT NETWORK

The STX3 Dev Kit transmits messages over the Globalstar LEO (Low Earth Orbit) satellite network. These satellites continuously orbit the planet and can communicate with Globalstar devices that are within range of its current position. For additional information about the operation of the Globalstar network, please see the STX3 User Manual.

DEV KIT BLOCK DIAGRAM

The block diagram of the Dev Kit is shown below:

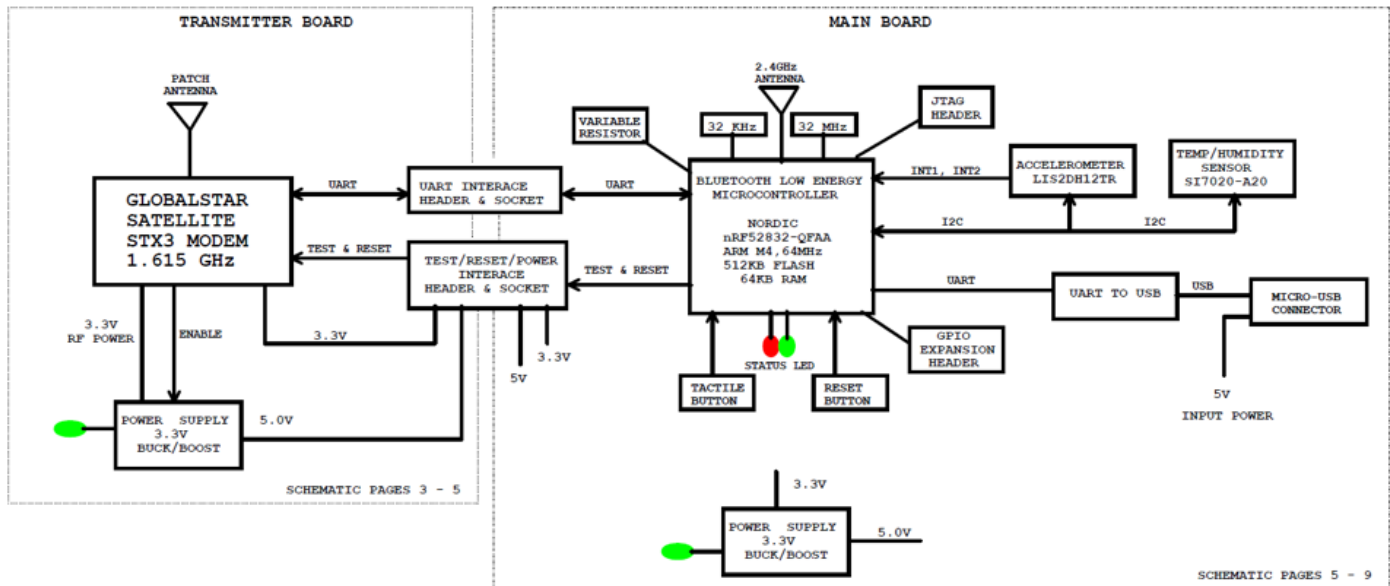


Figure 1 - STX3 Dev Kit with BLE Block Diagram

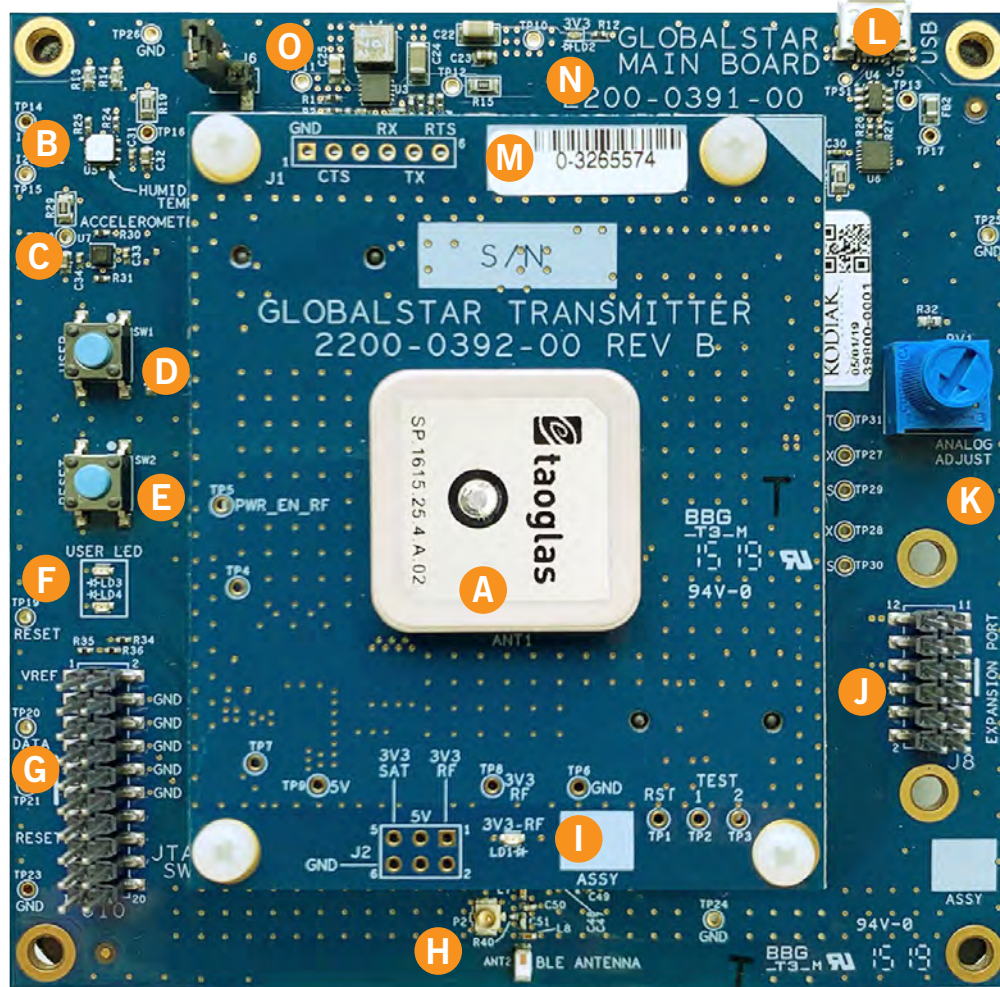
DESIGN DETAILS

The Dev Kit design is a basic implementation of the STX3 module with a power source (host computer), a USB interface, user LEDs and buttons and a few peripheral sensors. The Dev Kit is a robust extension of the Reference Design described in the STX3 User Manual.

The Dev Kit allows the hardware designer or firmware developer the platform to easily evaluate the STX3 and provide a platform for quickly creating new products.

The block diagram shown in [Figure 1](#) represents the features of the two boards and interfaces.

- **Transmitter Board** - The transmitter board consists of the STX3 module, patch antenna, and power supply for the STX3 RF transmitter. A standard 4 signal UART interface (not RS232) is the direct method to communicate with the STX3 module. The STX3 module includes test pins that make it easy to quickly verify the functionality of the satellite communication.
- **Main Board** - The main board includes the Bluetooth Low Energy (BLE) microcontroller by Nordic Semiconductor, accelerometer, temperature/humidity sensor, resistive potentiometer, two buttons, two LED's, USB interface, and expansion port.



LOCATION OF THE FEATURES ON THE DEV KIT

- A.** Satellite Patch Antenna for STX3
- B.** Temperature/Humidity Sensor
- C.** Accelerometer
- D.** User button. Pressing button initiates STX3 test message packet to be transmitted
- E.** Reset button, for Nordic processor
- F.** Green and Red Indicator LED's connected to processor
- G.** JTAG(SWD) programming header for Nordic processor
- H.** BLE chip antenna
- I.** Green LED indicates when RF power supply is enabled. LED is only ON during STX3 transmission
- J.** Expansion Header connected to processor
- K.** Analog potentiometer
- L.** USB connector, for applying power and serial terminal interface
- M.** Label with ESN number. Required for registration of STX3 module in Globalstar network
- N.** Green LED, indicates voltage output from main power supply
- O.** Two pin header (disables main power supply when shunt is connected across both header pins)

DEV KIT SCHEMATIC

The schematic is shown in Appendix A. The schematic consists of 9 pages organized with pages 3-5 for the circuitry on the Transmitter board and pages 5-9 for the circuitry on the Main board. The descriptions below explain a high-level description of each schematic page and its associated circuitry:

1. **Title Page** (page 1)
Includes notes on changes between the revisions of the schematic and the Table of Contents for the schematic.
2. **Block Diagram** (page 2)
Hardware architecture of the boards with interfaces to each of the boards.
3. **STX3 Transmitter module** (page 3)
This includes the STX3 transmitter with interface circuitry. All of the circuitry on this page is located on the Transmitter board.
4. **RF Power supply** (page 4)
The power supply dedicated for the RF section of the STX3 module. The buck/boost power supply is enabled and disabled by the STX3 module during transmission. The power supply is disabled when the STX3 is not transmitting. Review the STX3 data sheet on details regarding time the RF power supply is enabled. All of the circuitry on this page is located on the Transmitter board.
5. **Interface Connector and Expansion** (page 5)
This page includes the interface headers between the Transmitter board and the sockets on the Main board. Also, included are the expansion header connected to the Nordic processor and a header that interfaces directly with the STX3 module.
6. **BLE Nordic processor** (page 6)
This page includes the Nordic BLE processor, BLE chip antenna, processor controlled LED's, SWD JTAG header, reset button, user button, and all supporting components for the processor. All of the circuitry on this page is located on the Main board.
7. **Sensors** (page 7)
The sensors include 3 axis accelerometer, humidity/temperature sensor, and analog adjust resistor potentiometer. All the circuitry on the page is located on the Main board.
8. **USB and Power Input** (page 8)
The USB port provides power to the Dev Kit and allows for terminal communication to the Nordic processor. All the circuitry on this page is located on the Main board.
9. **Power Supply** (page 9)
This is the main power supply for the Dev Kit and converts the USB 5V power to 3.3V. The 3.3V from this supply is used by Transmitter and Main board. On the Transmitter board it supplies the logic voltage for the STX3 module, and supplies voltage for all of the circuitry on the Main board. Please note the 3.3V voltage does not supply power to the RF transmitter of the STX3 module on the Transmitter board. All the circuitry on this page is located on the Main board.

DEV KIT COMPONENT LOCATION

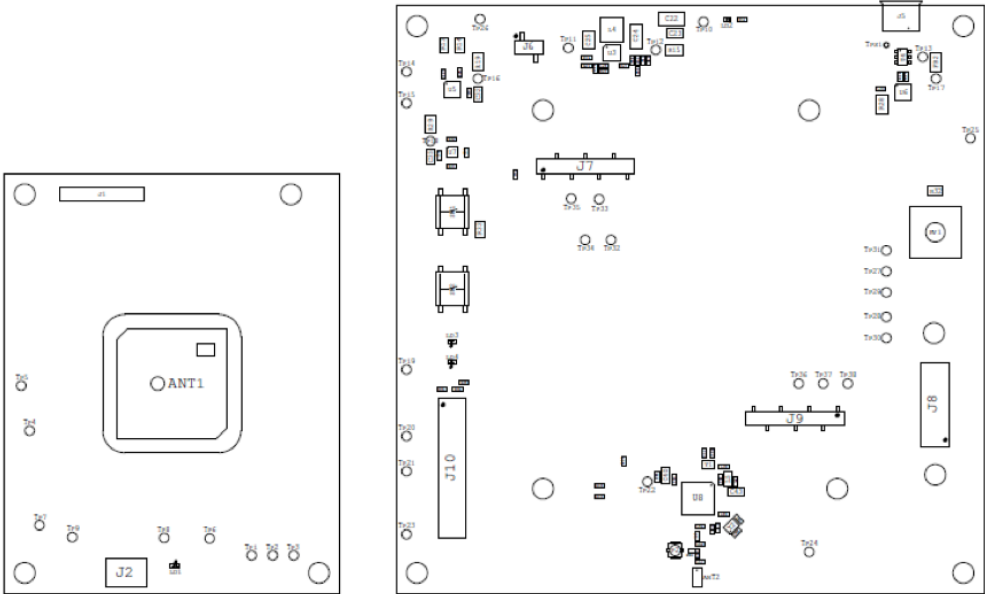


Figure 2 - STX3 Dev Kit Component Location - Top Side of PCB

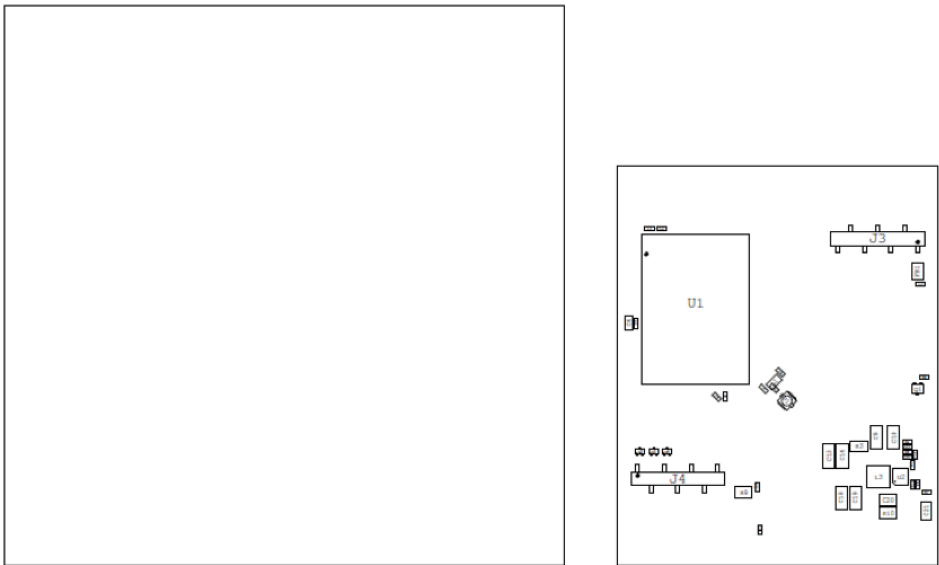


Figure 3 - STX3 Dev Kit Component Locations - Bottom Side of PCB

Table 1 - STX3 Dev Kit Operating Conditions & Parameters

Operating Temperature Range	0-40 C				
Power Supply Operational Range	1.8V - 5.2V				

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
STX3, TX output power	-40 to +85° C, VRF=3.3 volts	18.0	18.5	19.0	dB
STX3, Transmit mode supply current, Transmitter board	-40 to 85° C, VRF=3.3 volts	315	325	350	mA

SETTING UP THE DEV KIT

There are 3 main communication interfaces for the Dev Kit. These are BLE, USB and the user push-button. For controlling operation of the Dev Kit, a user may use either the downloadable smartphone app (iOS or Android) or the serial interface. Commands are used to send information over the simplex network, read from the on-board sensors, and monitor the internal operation of the STX3. Refer to the STX3 User Manual for a complete description of all commands.

DOWNLOADING SMARTPHONE APPS

Globalstar provides a free smartphone App that allows BLE communication with the Dev Kit. The app is available on the Apple App Store for iOS and Google App Store for Android. Search either app store for Globalstar and locate the one named STX3DK BLE. After downloading the app, enable Bluetooth on your phone; as the STX3DK-BLE app can only communicate with the Dev Kit if Bluetooth is enabled on your phone.

The STX3DK-BLE app icon is shown below.



Figure 4 - STX3DK-BLE App Icon

SOFTWARE TOOLS FOR DOWNLOADING FIRMWARE ONTO THE DEV KIT

The Nordic nRF52832 processor is pre-programmed with firmware that supports:

- a. Communication with the BLE app
- b. Terminal commands with a host computer using the USB connection
- c. A quick test feature

The Dev Kit supports developing your own firmware using the development environment of your choice but using the Nordic SDK environment is recommended.

The Dev Kit was designed for easy connection using the Segger JLink tool:

SEGGER J-Link Tool and Software - The J-Link tool is helpful to debug and program the Nordic processor. The J-Link tool is not included with the Dev Kit but can be purchased directly from Segger (or Digikey, Mouser, etc.). The Dev Kit uses the SWD interface (SWDIO, SWCLK, Reset, Ground) to interface with the Nordic processor. On the Main board, reference designator J10 is a 2x10 header that matches the SWD interface pin out of the Segger J-Link tool.

The main board also includes test points TP19, TP20, TP21, and TP23 that are connected to SWD signals. This will allow for connecting to other tools of your choice.

Additional information regarding the programming of the Dev Kit can be found in the STX3 DK-BLE Software Design Guide and is available from your Globalstar representative.

QUICK TEST OF DEV KIT OPERATION

The quick test will have you receiving a message from the STX3 message within minutes. It is recommended that you run the quick test after first receiving the Dev Kit. The quick test does not require the smartphone App and will provide a quick method for sending a test message packet through the Globalstar network. After registering the ESN for your Dev Kit with Globalstar, the network will direct your messages from the Dev Kit to what you designated with your provided route (email, URL, etc.). The Dev Kit will need to be connected to a host computer for powering it up.

STEPS FOR THE QUICK TEST

1. Place Dev Kit board in a location outside with a clear view of the sky.
2. Connect the supplied host computer to the development kit using the provided USB Y-cable.
3. Once power is applied to the Dev Kit you will see three LEDs illuminate. The blinking LEDs (LD3 & LD4) indicate that the processor is running and the system is ready. The solid green LED (LD2) will indicate the main power supply is enabled. The processor will boot in approximately 2 seconds.
4. Simply press the USER button located on the Main board of the Dev Kit. After pressing the USER button, a green LED(LD1) on the Transmitter board will turn on for approximately 1 second and red LED on the main board will stay on. The STX3 is transmitting when this green LED is on. The STX3 module will transmit the same test message packet 3 times with a random delay between messages of 5-10 minutes. Each time the STX3 transmits, the green LED will briefly turn on and the message will be transmitted. The red LED (LD3) will stay red until all 3 messages have been transmitted.
5. The route used for the registered ESN of the Dev Kit will receive the test message packet. It may take between to 5-20 minutes to receive the message.

The quick test transmits the test message packet as defined in the STX3 User Manual.

USING THE SERIAL INTERFACE WITH THE DEV KIT

When interfacing a host computer to the Dev Kit, two USB ports on the host computer or USB hub are required. Use the USB Y-cable provided with the Dev Kit to connect between the Dev Kit and the host computer. Both Type-A USB connectors must be connected to the host computer.

The Dev Kit will appear to the host computer as a virtual COM port and will be ready to communicate with the following settings.

- Baud Rate - 115200
- Bits - 8
- Parity - None
- Stop bits – 1

A serial terminal program (for example, [puTTY](#)) can be used to communicate and configure the device. Once connected, the “?” command can be used to display a list of command options.

A simple, text-based command infrastructure has been built to provide these examples. Each command has a unique command name, followed by one or more arguments. The end of the command is indicated by end of line characters. This same serial command interface is used for both BLE and USB communications.

The following table provides a description of the serial commands.

COMMAND	SYNTAX	DESCRIPTION
Help	?	Display a list of the available commands with brief descriptions.
Send Data	data <payload>	Uses the serial packet command format to send a command using the 0x00 command ID. The payload is expected to be up to 144 bytes of hex values encoded in ASCII.
Get ESN	esn	Uses the serial packet command format to send command 0x01 to return the device electronic serial number.
Abort Transmission	abort	Uses the serial command format to send command 0x03 to abort the current message transmit sequence.
Query Bursts	bursts	Uses the serial command format to send command 0x04 to return the current number of burst remaining.
Query FW Version	firmware	Uses the serial command format to send command 0x05 to return the STX3 current firmware version.
Setup	setup <channel, bursts, interval_min, interval_max>	Uses the serial command format to send command 0x06 to setup the device. The parameters are comma separated and are entered in the decimal format. - channel – The RF Channel - bursts – The number of bursts - interval_min – The minimum burst interval - interval_max – The maximum burst interval If no arguments are used, then command 0x07 is issued to query the current setup state.
Query HW Version	hardware	Uses the serial command format to send the command 0x09 to return the STX3 hardware version.
CW Test Mode	test_cw	Uses the serial command format to send the command 0xFC01 to enter the CW test mode for 30 seconds.
Send Test Packet	test_packet	Uses the serial command format to send the command 0xFC02 to send the 0x80AAFOFOFOAAFOFOFO test packet.
Modulation Test Mode	test_modulation	Uses the serial command format to send the command 0xFC03 to send back to back test packets for 30 seconds.
Direct AT Command	<AT Command>	AT commands are supported at any time. The user types the AT command as specified in the STX3 User Manual.
Temperature	temperature	Checks the temperature using the Si7020 sensor and displays the value.
Humidity	humidity	Checks the humidity using the Si7020 and displays the value
Accelerometer	accel	Checks the current x, y, and z values of the LIS2DH12 accelerometer and displays the value

USING THE STX3 DK-BLE SMARTPHONE APP WITH THE DEV KIT

After installing the STX3DK-BLE smartphone app on your Android or iPhone device, you will need to have the Dev Kit powered before running the STX3DK-BLE app. The smartphone app will start up and begin scanning over Bluetooth, searching for Dev Kits within BLE range. Select the desired Dev Kit's ESN and the smartphone app will establish communication with the Dev Kit.

The following three screen shots show the smartphone app booting and scanning for Dev Kits.

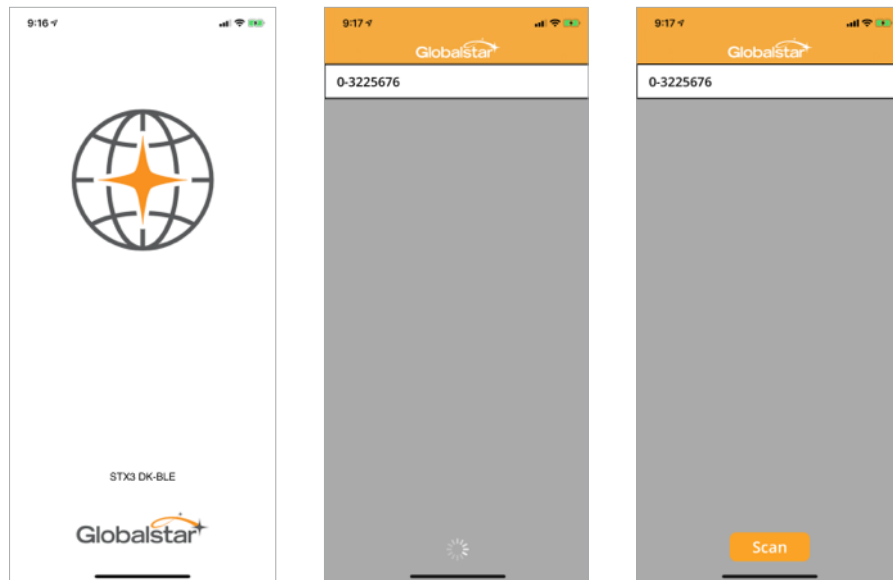


Figure 5 - STX3DK-BLE App Boot-Up Screens

When an ESN is selected, the main screen of the STX3DK-BLE smartphone app will be displayed. On the main screen, the following items will be shown:

- a) Send Data Command with its associated Send button
- b) The temperature and humidity sensor readings (with its associated Update button)
- c) The STX3 module's ESN
- d) Firmware Version of the Dev Kit
- e) Hardware Version of the Dev Kit

The following is an image of the app main screen after it has established communication with the Dev Kit.

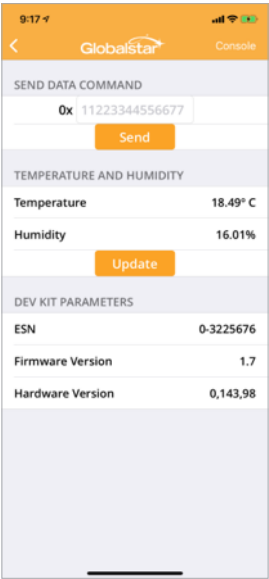


Figure 6 - STX3DK-BLE App, Main Screen

Pressing Update button will update the Dev Kit’s temperature and humidity readings in real time.

The STX3DK-BLE app communicates with the STX3 module in the same manner as if the Send Data command was issued from the serial command interface. Data values can be entered in the “Send Data Command” box. The value entered must be hexadecimal digits and correlate to the payload of the STX3’s Send Data command. See the STX3 User Manual for details on the Send Data command.

Pressing the Console button at the top right of the main screen will display the Send Commands screen. A text line is displayed along with its associated Send command button. Entering “?” in the send command line will bring up a list of supported commands. It is recommended to review the STX3 User Manual for additional information on STX3 commands. **Figure 7** shows an image of the commands list displayed in the smartphone app when a “?” is entered in the send data command line.



Figure 7 - STX3DK-BLE App Command List

SUMMARY OF STX3 COMMANDS

Below is a table that summarizes the commands that may be sent to the STX3 using either the serial interface or the smartphone app. For detailed information of individual commands, refer to the STX3 User Manual, Section 5.2 Serial Packet Mode.

NOTES

1. General Command format is: <Leader><Length><Command><Data.....><CRC1><CRC2>
2. In byte 3 of the Command Response, if the Command Value is returned, the command was acknowledged (ACK); if 0xFF is returned, the Command is negatively acknowledged (NAK).

COMMAND	SYNTAX	DESCRIPTION
Send Data	data <payload>	Uses the serial packet command format to send a command using the 0x00 command ID. The payload is expected to be up to 144 bytes of hex values encoded in ASCII.
Get ESN	esn	Uses the serial packet command format to send command 0x01 to return the device electronic serial number.
Abort Transmission	abort	Uses the serial command format to send command 0x03 to abort the current message transmit sequence.
Query Bursts	bursts	Uses the serial command format to send command 0x04 to return the current number of burst remaining.
Query FW Version	firmware	Uses the serial command format to send command 0x05 to return the STX3 current firmware version.
Setup	setup <channel, bursts, interval_min, interval_max>	Uses the serial command format to send command 0x06 to setup the device. The parameters are comma separated and are entered in the decimal format. • channel – The RF Channel • bursts – The number of bursts • interval_min – The minimum burst interval • interval_max – The maximum burst interval If no arguments are used, then command 0x07 is issued to query the current setup state.
Query HW Version	hardware	Uses the serial command format to send the command 0x09 to return the STX3 hardware version.
CW Test Mode	test_cw	Uses the serial command format to send the command 0xFC01 to enter the CW test mode for 30 seconds.
Send Test Packet	test_packet	Uses the serial command format to send the command 0xFC02 to send the 0x80AAFOFOFOAAFOFOFO test packet.
Modulation Test Mode	test_modulation	Uses the serial command format to send the command 0xFC03 to send back to back test packets for 30 seconds.
Direct AT Command	<AT Command>	Uses the AT command mode to send an AT command to the device. The command is sent directly to the modem, so every command should be prefaced with AT. The response to the AT command from the STX3 is returned to the user.

HARDWARE DESCRIPTION

The hardware description section breaks down all the major circuits on the Dev Kit and how they are connected in the system. Referencing a copy of the schematic is recommended when reviewing the descriptions. The schematic is detailed in Appendix A. The Dev Kit Bill of Materials for both the Main board and Transmitter board are to be found in Appendix B.

STX3 MODULE

The Globalstar STX3 module is located on the underside of the Transmitter board, under the patch antenna. The STX3 module includes a UART bus (TX, RX, CTS, RTS) for data communication with the nRF processor on the Main board.

The STX3 module has two configuration pins that place the module into one of four modes. The modes are normal operation, transmit test packet, continuous test packet transmission (Mod Mode), and continuous carrier waveform (CW) mode. The pre-programmed firmware on the processor of the Dev Kit support the normal operating mode and test packet mode. The continuous test packet and carrier wave mode have not been implemented with the firmware on the processor.

There are two separate power domains on the STX3 module, one pin for the low power digital IO (VDIG pin). The second power input is dedicated to the RF transmitter (VRF pin) circuitry integrated in the STX3 module, and has a higher current demand at short bursts.

The recommend patch antenna for the STX3 is available from Taoglas, and Spectrum. Both patch antennas require a 60 x 60 mm ground plane for maximum performance and optimal radiated pattern.

The STX3 patch antenna and PCB layout have been tested and tuned for optimal performance. For additional details, please review the STX3 User Manual.

BLUETOOTH

The main processor by Nordic Semiconductor (nRF52832) integrates the low energy Bluetooth radio (BLE), RAM (256KB), flash (512KB), and real-time clock. This processor/BLE IC is an SOC solution located on the Main board. The processor is based on the ARM M4 core running at 64MHz. The 2.4Ghz RF section for the BLE radio uses a chip antenna with the option to connect an external antenna. The nRF SOC handles all the firmware for BLE communication, STX3 satellite transmitter module communication, plus interfacing to all the on-board sensors. The smartphone app and PC terminal command window interface support are pre-programmed in the processor. For additional details on the [nR52832 processor](#), please refer to the Nordic Semiconductors website for details.

POWER SUPPLIES

The Dev Kit supports the following methods for powering the system:

- 1. Personal Computer or USB hub** - The Dev Kit includes a Y-cable that requires two Type-A USB ports on a PC. The peak current of the Dev Kit can exceed 500mA and the Y-cable allows for power to be shared between two Type-A USB ports. Only one of the Type-A connectors includes the data signals to support the serial interface to host computer. It is recommended to use both USB Type A connections to the host computer or USB hub to prevent damaging the port.
- 2. USB Power Adapter** - The Dev Kit can be connected directly to a USB power adapter. For proper functionality, it is recommended that the USB power adapter support peak currents of ~500mA at 5V. A USB power adapter is not included with the Dev Kit.
- 3. Bench Power supply** - A bench power supply can be connected directly to Dev Kit, but the voltage must NOT exceed 5.25V and the supply should be able to support peak current of ~500mA.

DEV KIT POWER CIRCUITRY

The Dev Kit consists of two buck/boost switching power supplies that support voltages from 1.8V-5.25V. One of buck/boost power supplies is located on the Transmitter board, and is dedicated to supplying power to the RF signal on the STX3 module. The other buck/boost power supply is located on the Main board and supplies power to the Main board electronics including the digital supply for the STX3 module.

- **STX3 RF Power Supply** - The RF power supply is dedicated to the VRF pin on the STX3 module. The power supply is enabled and disabled by the STX3 module. This is a buck/boost supply and is used in a buck (step-down) configuration on the Dev Kit. The input voltage to the power supply is 5V with an output voltage of 3.3V and supports peak output current up to 1A. The power supply will maintain an output voltage of 3.3V even with input voltages down to 1.8V.
- **Main Board Power Supply** - The main power supply is a buck/boost switching supply located on the Main board. On the Dev Kit, the power supply supports an input voltage from 1.8V to 5.25V with an output voltage of 3.3V and peak output current of 1A. The main power supply supports everything on the Dev Kit except the STX3 RF power supply. The power supply also includes a 2 pin header (J6) used to temporarily disable power to the Dev Kit board without removing the USB cable. Applying the shunt across J6 will disable the main power supply.

LED'S

The Dev Kit includes four LED's with three of them located on the Main board and one located on the Transmitter board.

- **Main Board** - Green LED LD2 indicates the main power supply is enabled. The red LED LD3 is connected to the processor and will be enabled while the STX3 is establishing satellite transmission. The other green "heartbeat" LED LD4 will continue to flash slowly to indicate the processor firmware is running. The green heartbeat LED and red STX3 satellite transmission LED are controlled by the firmware on the processor.
- **Transmitter Board** - The green LED LD1 indicates the RF power supply is enabled and will be enabled for approximately 1 second.

BUTTONS

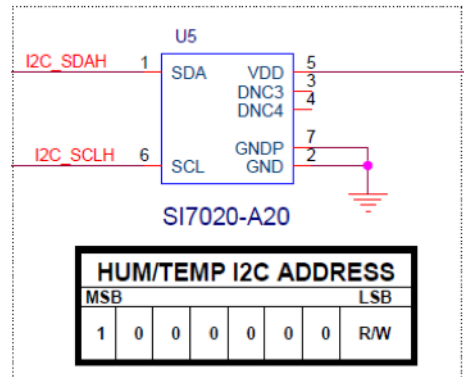
The Dev Kit has two tactile momentary buttons that are connected to the Nordic processor.

- **User Button** - The user button, SW1, is connected to GPIO P0.22 on Nordic processor and is programmed to initiate a STX3 test message packet transmission. This GPIO pin can be reconfigured in the firmware to support some other function.
- **Reset Button** - This button, SW2, resets the Nordic processor, and is not reconfigurable.

SENSORS

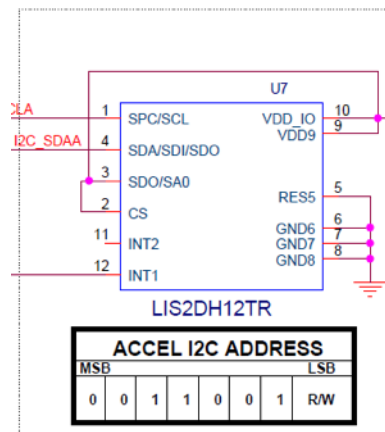
- Temperature/Humidity - This is a Silicon Labs (manufacturer part number Si7020-A20) sensor that integrates the temperature and humidity monitoring. The sensor is an I2C slave device connected to the Nordic processor. The sensor has a protective white cover on the top part of the package. The white cover should NOT be removed as it protects the sensor element from moisture. Please note the I2C bus is also shared with the accelerometer.

HUMIDITY/TEMP SENSOR



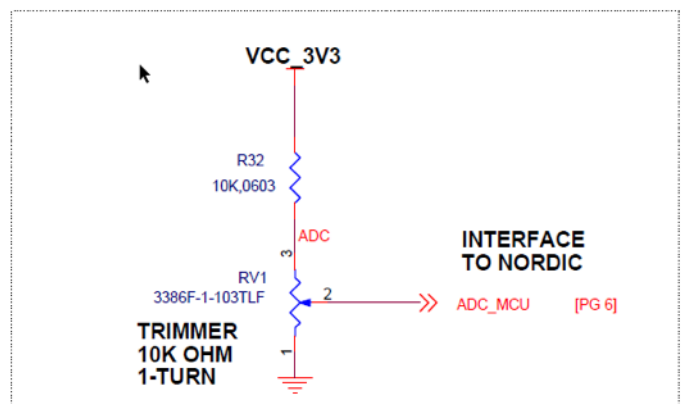
- Accelerometer - The ST Micro 3 axis accelerometer (manufacturer part number LIS2DH12TR) sensor is an I2C slave device connected to the Nordic processor. The sensor includes an interrupt signal that allows for the firmware customization. The accelerometer and temperature/humidity sensor share the same I2C bus.

3 AXIS ACCELEROMETER



- Analog Adjust Resistor Potentiometer - The Dev Kit includes an adjustable potentiometer connected to an A/D pin (P0.31/AIN7) on the Nordic processor. This is a basic 1-turn 0-10K trimmer potentiometer configured as a simple voltage divider network. The preprogrammed firmware on the Nordic processor monitors that pin.

ANALOG ADJUST/ RESISTOR TRIMMER POT



USB INTERFACE

For the Dev Kit, the micro-USB connector provides power and serial communications for the command terminal. The USB data signals are converted to UART signals (TX, RX, RTS, and CTS) with an FTDI device (manufacturer part number FT234XD). The UART signals from the FTDI device are connected to the processor.

The Dev Kit does not require the USB data signals for functionality, it is only required when communicating with the host computer using serial commands. The proper power must be connected to the USB connector for the Dev Kit to function properly.

CONNECTOR INTERFACES

The Dev Kit includes multiple connectors that interface the Main board with the Transmitter board and other connector interfaces.

- Transmitter board interfaces - There are two 1x7 headers (J3, J4) that provide the interface signals between the Main and Transmitter boards. These signals include power, UART signals, STX3 configuration, and STX3 reset. The Transmitter board also has an unpopulated 1x6 header (J1) that allows for connecting the Transmitter board to an off-board processor. A separate unpopulated 2x3 header (J2) allows for the Transmitter board to be connected to an off-board power source.
- Main board interfaces - Aside from the micro-USB, there is the 2x10 JTAG header (J10), 2x6 header (J8) for expansion and the two 1x7 socket (J7, J9) for interfacing to the Transmitter board.

TEST POINTS

The Dev Kit includes a total of 39 test points spread across the Transmitter and Main boards. Many of the test points are connected to digital signals on the processor and STX3 module. There is also an array of test points that support monitoring of voltages and options for monitoring current. In the schematic, the test points will have reference designators with TPxx or TPSxx. The TPxx test points are labeled and are through holes on the PCB. The TPSxx test point is a surface mount pad on the PCB. Please refer to the full schematic for connections of each test point and PCB layout for the location of the test points.

REFERENCES

ITEM	DESCRIPTION
STX3 User Manual	The manual for the STX3 module
STX3 DK-BLE Schematic	Schematics for the development kit
Silicon Labs Si7020 Data Sheet	The temperature and humidity sensor on the development kit - https://www.silabs.com/documents/public/data-sheets/Si7020-A20.pdf
ST LIS2DH12 Data Sheet	The accelerometer on the development kit - https://www.st.com/resource/en/datasheet/lis2dh12.pdf
Segger Embedded Studio (SES)	The IDE used to create software for the development kit - https://www.segger.com/products/development-tools/embedded-studio/
Segger JLINK	The programming adapter for the development kit - https://www.segger.com/products/debug-probes/j-link/models/j-link-base/
Nordic nRF Command Line Tools	Command line programming tools for the Nordic nRF52 processor - https://www.nordicsemi.com/Software-and-Tools/Development-Tools/nRF5-Command-Line-Tools
Nordic nRF Connect	A set of tools for testing Bluetooth Low Energy products. Nordic has versions for iOS, Android, and the PC.
PuTTY	A terminal program that can be used to interact with the STX3 DK - BLE board - https://www.putty.org/
STX3 DK-BLE Mobile Applications	Android and iOS mobile applications used for interacting with the development kit.
Nordic SDK	The software development kit from Nordic - http://developer.nordicsemi.com/
Nordic documentation library	Documentation on the Nordic SDK - https://www.nordicsemi.com/DocLib

REGULATORY APPROVAL

The STX3 Dev Kit is not designed for nor meant to be used in a finished end product for re-sale. While the Globalstar STX3 Module installed in the STX3 Dev Kit meets all applicable FCC, IC and CE RED regulations for a satellite transmit module, the STX3 Dev Kit has not been tested for compliance within the limits specified the FCC or other regulatory agencies. Users are responsible for compliance with all international, national, state, and local laws, rules, and regulations that apply to the handling or use of the STX3 Dev Kit by a user or the user's employees, affiliates, contractors, representatives, agents, or designees. This includes interference with any radio communications. A sale of the STX3 Dev Kit is limited to product developers, software developers and system integrators for the purpose of evaluating the Globalstar STX3 module. The kits are not intended for consumer or household use.

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 and/or a certified regulatory compliance testing company.

RADIO ASTRONOMY SITE AVOIDANCE

The end user device must comply with the requirements for Radio Astronomy Site avoidance as specified by the Globalstar National Science Foundation agreement of 2001. It must be compliant with CFR25.213.

REGULATORY NOTICES

FCC NOTICE: The STX3 Dev Kit is designed to allow:

(1) Product developers to evaluate electronic components, circuitry, or software associated with the STX3 Dev Kit to determine whether to incorporate such items in a finished product and (2) Software developers to write software applications for use with the end product. The STX3 Dev Kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that the STX3 Dev Kit does not cause harmful interference to licensed radio stations and that the STX3 Dev Kit accepts harmful interference. Unless the assembled STX3 Dev Kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the STX3 Dev Kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

The STX3 module has received Federal Communications Commission authorization under FCC Rules Part 25 as a modular transmitter. Final installation must be in compliance with 25.213 (see 6.1 above). The 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 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.	RF Exposure 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.				
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.	AVIS: 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.				
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.	Transmit Frequencies: 1611.25 Mhz - 1618.75 Mhz (4 Channels) Max Power Out: 19.8 dBm conducted				
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.	FCC ID: L2V-STX3 ICES-003/(A/B) IC:3989A-STX3  Complies with FCC standards. FOR HOME OR OFFICE USE				
This Class B digital apparatus complies with Canadian ICES-003.	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				
Cet appareil numérique de classe B est conforme à la norme NMB-003.	Anatel Certification stamp of the STX3 module for operation in Brazil:  Modelo: STX3 08158-17-04303 				
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	<table> <tr> <td>Portuguese</td><td>Produto não acabado, de uso interno, cuja integração em outros equipamentos pode requerer nova certificação.</td></tr> <tr> <td>English</td><td>Unfinished product, for internal use, the integration of which into other equipment may require further certification.</td></tr> </table>	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.
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.				

APPENDIX A – STX3 DEVELOPMENT KIT SCHEMATIC

GLOBALSTAR STX3 SATELLITE
DEVELOPMENT/EVAULATION BOARD

TABLE OF CONTENTS

SHEET	DESCRIPTION
1	TITLE PAGE
2	SYSTEM BLOCK DIAGRAM
3	GLOBALSTAR STX3 SATELLITE
4	RF POWER SUPPLY 3.3V
5	EXPANSION INTERFACE
6	MCU/BLEETOOTH RADIO
7	ACCELEROMETER, SEEPROM
8	USB TO UART INTERFACE
9	POWER SUPPLY 3.3V
10	

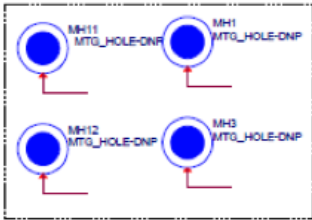
REVISION	DATE	DESCRIPTION	NAME
A	8/19/2018	Released for prototype build	P. Herron
B	3/21/2019	Added board mating keying feature changed J4 and J9. Changed C46,C50,C51,L7,L8 for RF tuning.	P. Herron

NOTES

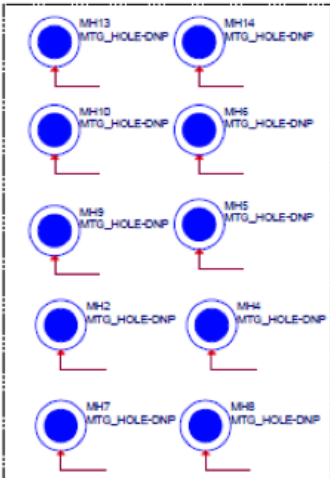
- Components marked with a **BOLD** oval will not be installed during assembly OR only for populated for prototype build.
- Please refer to the Bill of Material (BOM) which provides all necessary component information for the final assembly.
- The following parameters will apply to all components unless otherwise stated in the BOM or Schematic.

Resistor: +/- 5% or better, 1/16 Watt, 1206, 0805, 0603, 0402
Capacitor, Ceramic, +/- 20%, 1206, 0805, 0603, 0402
Power Inductance: +/- 20%
RF Chip Inductors: +/- 0.1%
- Bypass capacitors shall be distributed evenly amongst power pins of the IC power and GND pin.
- Always observe layout guidelines and documentation from the component manufacturers

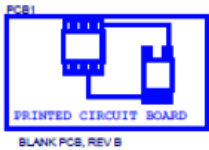
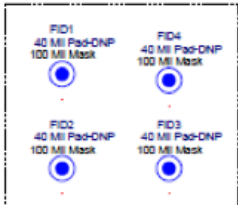
STX3 BOARD
MOUNTING HOLES



BOARD MOUNTING HOLES

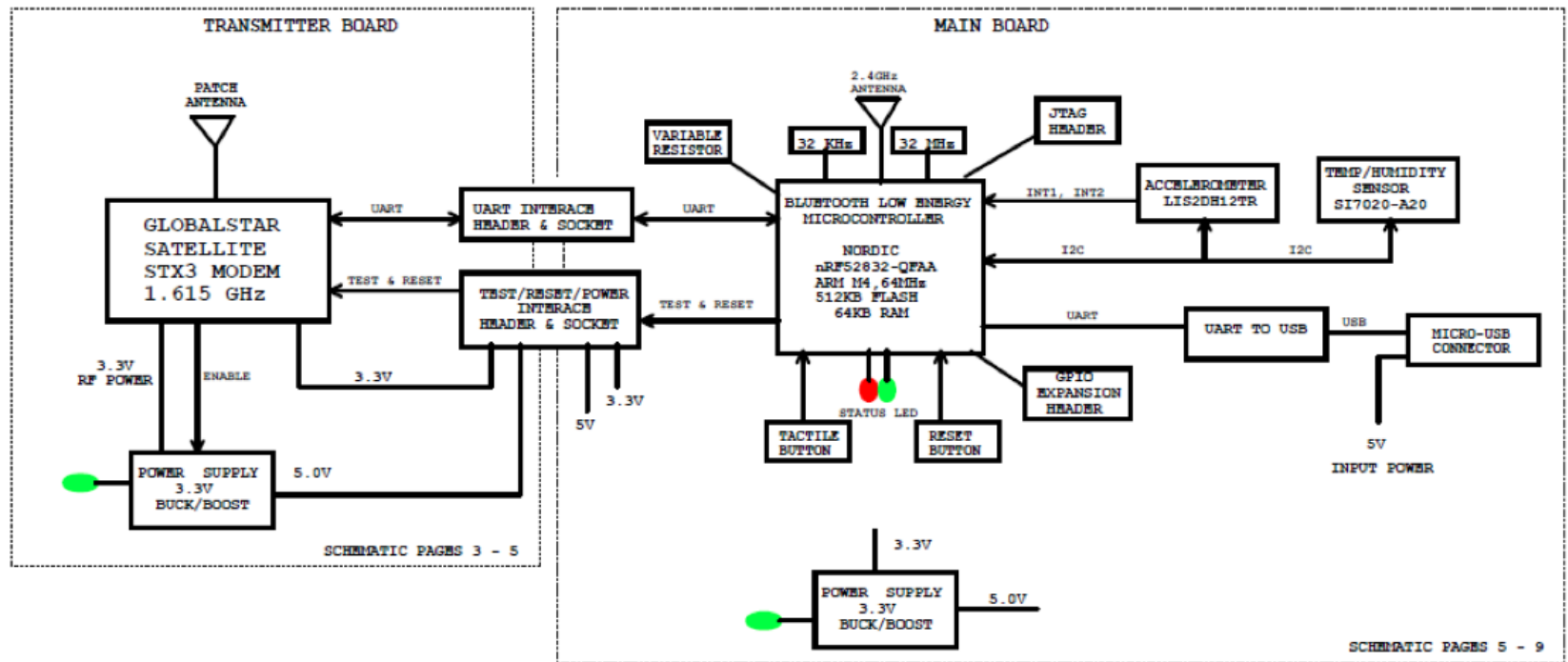


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Designer: P.HERRON		Drawing Title: STX3 SATELLITE DEVELOPMENT BOARD	
Page Title: TITLE PAGE		Copyright © 2018	
Size B	Document Number <Doc>	Date: Friday, March 22, 2019	Sheet 1 of 9

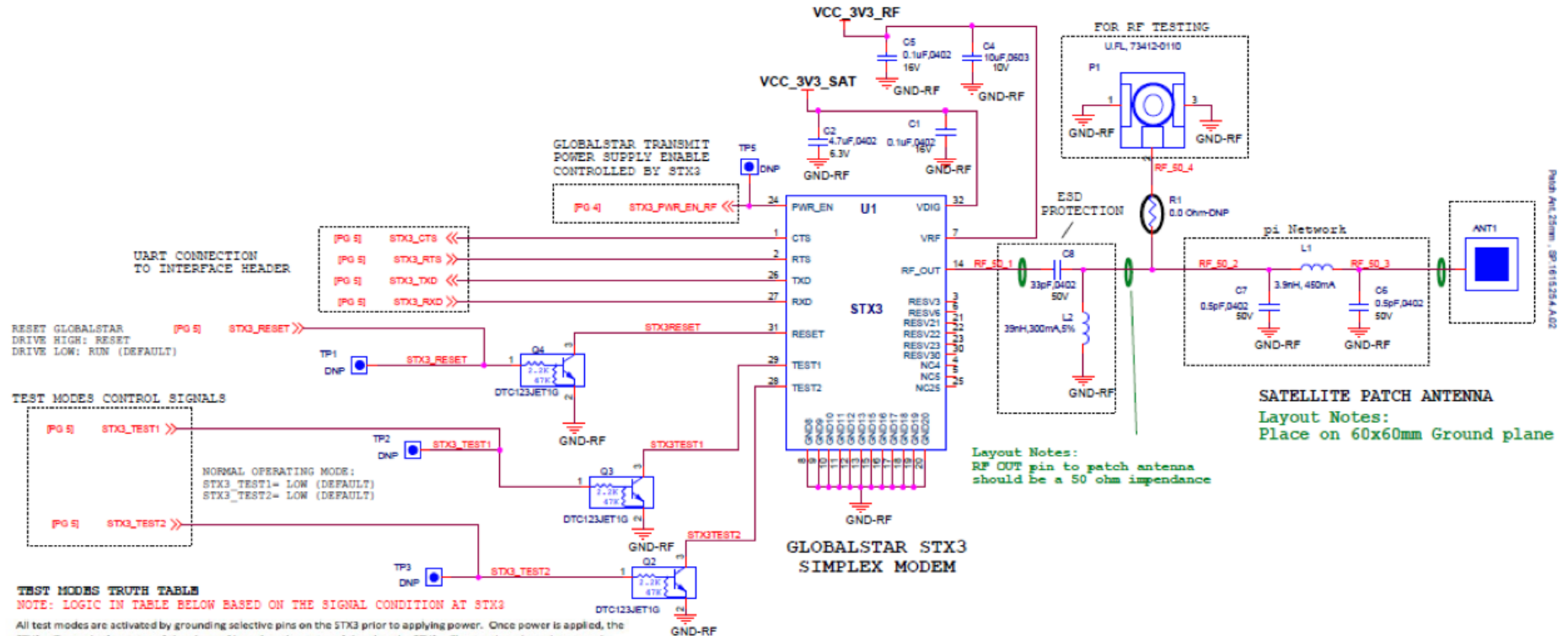
SYSTEM BLOCK DIAGRAM



SEE GLOBALSTAR DOCUMENTATION
FOR STX3 FCC MODULAR APPROVAL
GUIDELINES

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Page Title: SYSTEM BLOCK DIAGRAM			
Size: B	Document Number: <0>	Date: Thursday, March 21, 2019	Sheet: 2 of 9

GLOBALSTAR SATELLITE STX3 STX3 BOARD



TEST MODES TRUTH TABLE

NOTE: LOGIC IN TABLE BELOW BASED ON THE SIGNAL CONDITION AT STX3

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. The test packet shall comply with the Air Interface Packet format with a user information equal to the hex stream 0x80AAAF0F0F0AAAF0F0F0 where the most significant bit is transmitted first
0	1	Test Packet - The test packet shall comply with the Air Interface Packet format with a user information equal to the hex stream 0x80AAAF0F0F0AAAF0F0F0 where the most significant bit is transmitted first
1	0	CW mode - An un-modulated carrier is continuously transmitted.
1	1	Normal Operation

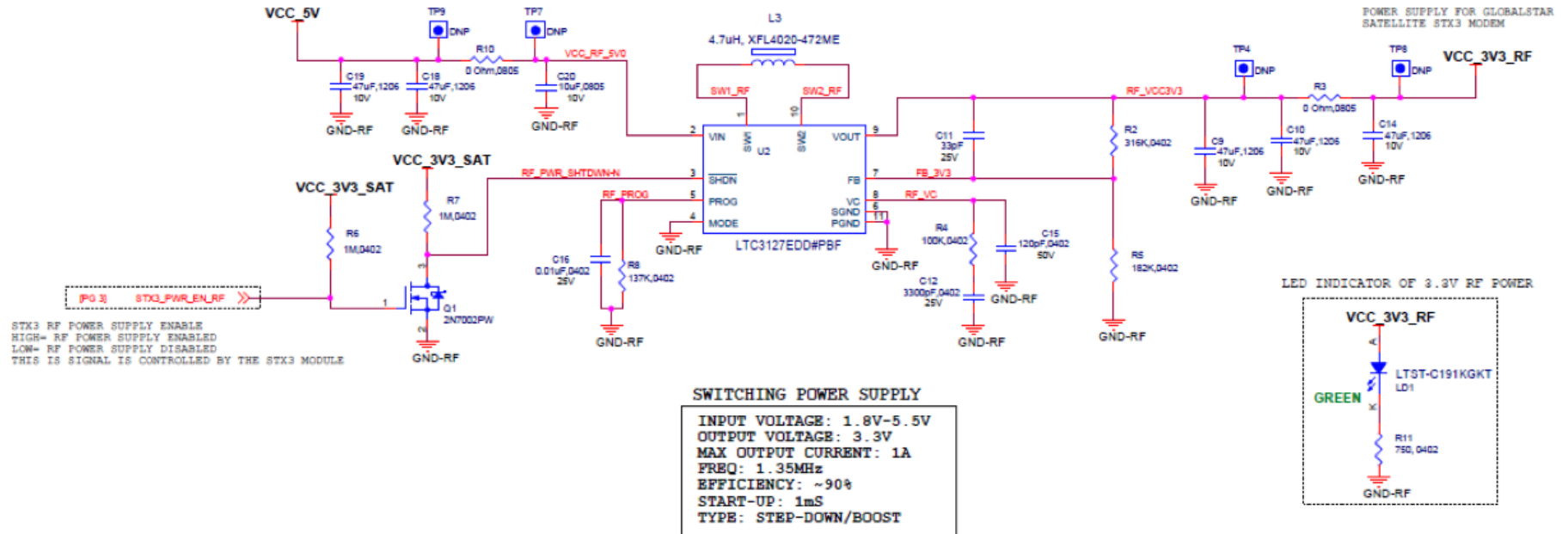
NOTE:

DNP: Do-Not-Populate

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Page Title: GLOBALSTAR STX3 SATELLITE TRANSMITTER			
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RF STX3 POWER SUPPLY

STX3 BOARD

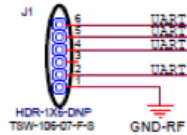


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Page Title: STX3 3.3V RF POWER SUPPLY		Copyright © 2018	
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EXPANSION HEADER OPTIONS

HEADER FOR CONNECTING
STX3 TO FTDI TTL-232-3V3 ADAPTER

NOTE: STX3 BOARD MUST NOT
BE CONNECTED TO MAIN BOARD
IF CONNECTED FTDI ADAPTER



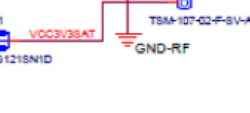
HEADER ON STX3 BOARD

STX3 UART INTERFACE

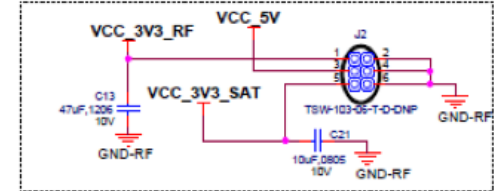
(PG 3) STX3_RTS
(PG 3) STX3_CTS
(PG 3) STX3_RXD
(PG 3) STX3_TXD

VCC_3V3_SAT

C3 0.1uF,0402
16V
GND-RF



POWER BYPASS HEADER ON STX3 BOARD



TRANSMITTER BOARD, ALL COMPONENTS ABOVE THIS LINE

MAIN BOARD, ALL COMPONENTS BELOW THIS LINE

NORDIC UART INTERFACE

(PG 6) STX3_RTS_MCU
(PG 6) STX3_CTS_MCU
(PG 6) STX3_RXD_MCU
(PG 6) STX3_TXD_MCU

RTS CTS RXD TXD

TP32 DNP
TP33 DNP
TP34 DNP
TP35 DNP

VCC_3V3

C36 4.7uF,0402
6.3V
GND

SOCKET ON MAIN BOARD

VCC_VBUS_5V

RESET TEST1 TEST2

TP36 DNP
TP37 DNP
TP38 DNP

NORDIC INTERFACE TO
STX3 RESET & TEST SIGNALS

(PG 6) STX3_RESET_MCU
(PG 6) STX3_TEST1_MCU
(PG 6) STX3_TEST2_MCU

NORDIC EXPANSION GENERAL PURPOSE I/O HEADER ON MAIN BOARD

(PG 6) MCU_GPIO_P09
(PG 6) MCU_GPIO_P010
(PG 6) MCU_GPIO_P023
(PG 6) MCU_GPIO_P024
(PG 6) MCU_GPIO_P025
(PG 6) MCU_GPIO_P026

MCU_GPIO_P030 (PG 6)
MCU_GPIO_P029 (PG 6)
MCU_GPIO_P028 (PG 6)
MCU_GPIO_P027 (PG 6)

TSM-105-01-T-DV-A

NOTE:
DNP: Do-Not-Populate

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STX3 SATELLITE DEVELOPMENT BOARD

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MAIN BOARD TO STX3 BOARD INTERFACE AND NORDIC EXPANSION

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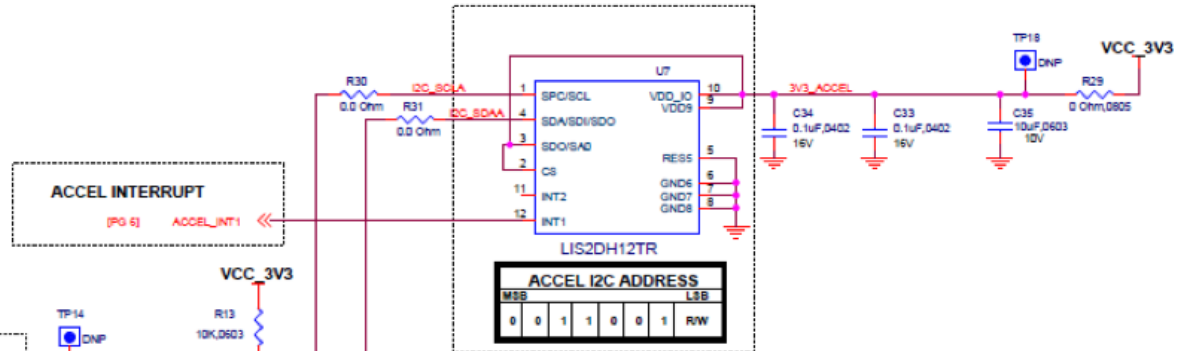
Date: Thursday, March 21, 2019

Sheet 5 of 9

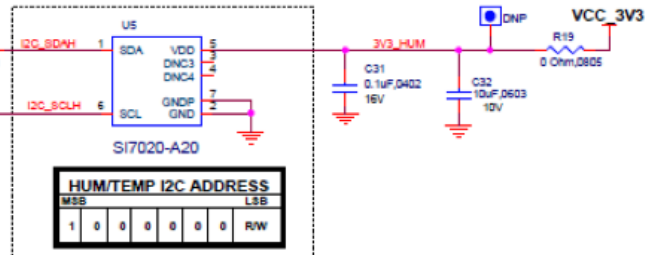
Rev B

ACCELEROMETER AND HUMIDITY/TEMP SENSOR MAIN BOARD

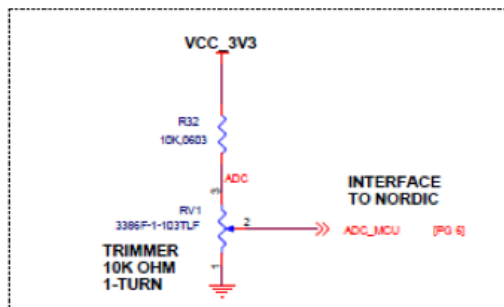
3 AXIS ACCELEROMETER



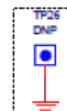
HUMIDITY/TEMP SENSOR



ANALOG ADJUST/ RESISTOR TRIMMER POT



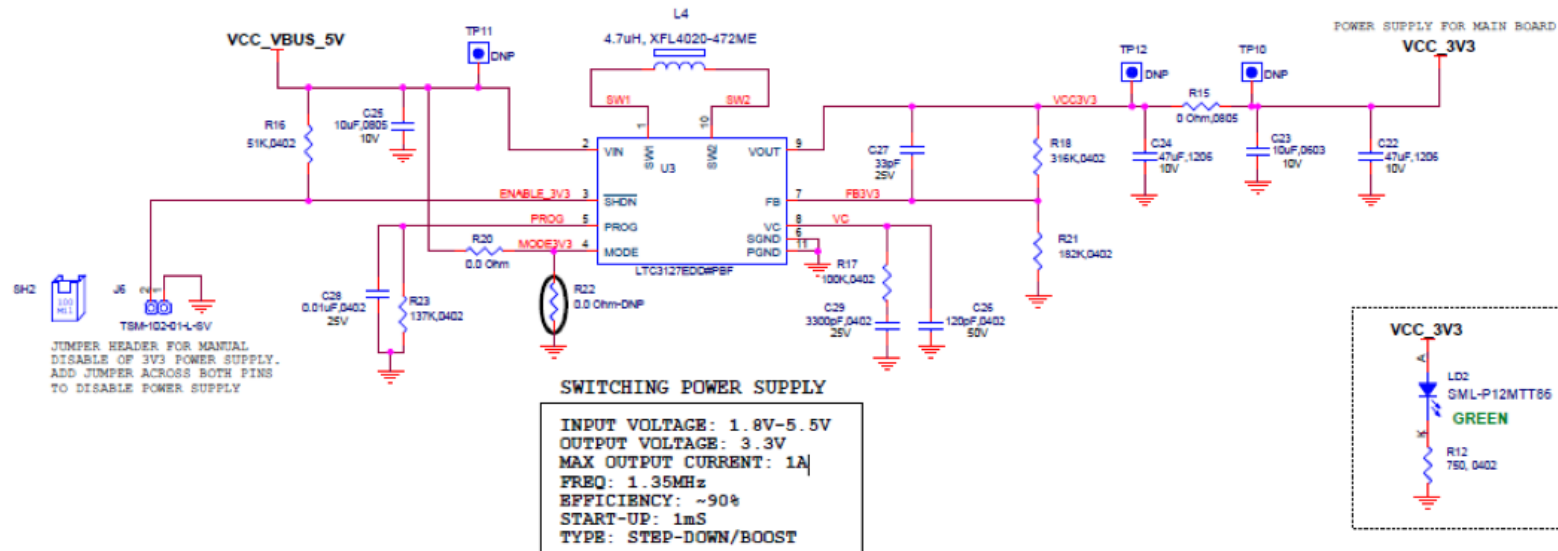
GROUND TEST POINT



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Page Title: ACCELEROMETER AND HUMIDITY/TEMPERATURE SENSOR			
SUC: B	Document Number <Doc>	Date: Thursday, March 21, 2019	Sheet 7 of 9

MAIN POWER SUPPLY

MAIN BOARD



NOTE:

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Page Title: 3.3V POWER SUPPLY			
Size: B	Document Number: <Doc>	Date: Thursday, March 21, 2015	Sheet: 5 of 5
Rev: B			

APPENDIX B – STX3 DEVELOPMENT KIT BILL OF MATERIAL LISTS

TRANSMITTER BOARD BILL OF MATERIAL

Item	Quantity	Reference	Part	Manufacturer	Manufacturer P/N	Alternate P/N	Description
1	1	ANT1	Patch Ant, 25mm , SP.1615.25.4.A.02	Taoglas	SP.1615.25.4.A.02		PATCH ANT 3DBI 1615MHZ 25MM SQ
3	4	C1,C3,C5,C17	0.1uF,0402	Venkel	C0402X7R160-104KNE		CAP, Ceramic, 0.1uF, 16V, 10%, X7R, 0402 SMD
4	1	C2	4.7uF,0402	Venkel	C0402X5R6R3-475MNP		CAP, Ceramic, 4.7uF, 6.3V, 20%, X5R, 0402 SMD
5	1	C4	10uF,0603	VENKEL	C0603X5R100-106KNP		CAP CER 10uF 10V 10% X5R 0603
6	2	C6,C7	0.5pF,0402	Murata Electronics	GJM1555C1HR50WB01D		CAP, Ceramic, 0.5pF, 50V, +-0.05pF, NP0, 0402
7	1	C8	33pF,0402	Murata	GJM1555C1H330GB01		CAP, Ceramic, 33pF, 50V, 2%, C0G, 0402 SMD
8	6	C9,C10,C13,C14,C1	47uF,1206	MURATA	GRM31CR61A476ME15L		CAP, Ceramic, 47uF, 10V, 20%, X5R, 1206 SMD
9	1	C11	33pF	Venkel	C0402C0G250-330JNE		CAP, 33pF, 25V, 5%, C0G, SMD 0402
10	1	C12	3300pF,0402	Venkel	C0402X7R250-332KNE		CAP, Ceramic, 3300pF, 25V, 10%, X7R, 0402
11	1	C15	120pF,0402	Taiyo Yuden	UMK105CG121JV-F		CAP CER 120PF 50V 5% NP0 0402
12	1	C16	0.01uF,0402	Venkel	C0402X7R250-103JNE		CAP, Ceramic, 0.01uF, 25V, 5%, X7R, 0402 SMD
13	2	C20,C21	10uF,0805	VENKEL	C0805X5R100-106MNE		CAP CER 10uF 10V 20% X5R 0805
30	1	FB1	BLM21PG121SN1D	Murata Electronics	BLM21PG121SN1D		FERRITE CHIP 120 OHM 0805
36	1	J3	TSM-107-02-F-SV-A	SAMTEC	TSM-107-02-F-SV-A		Header,1x7, SMT, 100mil
37	1	J4	TSM-107-02-F-SV-A-004	SAMTEC	TSM-107-02-F-SV-A-004		Header,1x7, SMT, 100mil, pin 4 omitted
44	1	LD1	LTST-C191KGKT	Lite-On	LTST-C191KGKT		LED GREEN CLEAR 0603 SMD
48	1	L1	3.9nH, 450mA	Murata	LQG18HN3N9S00D		FIXED IND 3.9NH 450MA 150 MOHM, 0603
49	1	L2	39nH,300mA,5%	Murata	LL1005-FH39NJ	LQG15HS39NG02	Inductor 39nH,300mA,2%,0402
50	1	L3	4.7uH, XFL4020-472ME	Coilcraft	XFL4020-472MEC		Inductors Power 4.7uH 20% 2.0A
58	1	P1	U.FL, 73412-0110	MOLEX	73412-0110		U.FL, RF Connector, 50ohm, 0-5GHz SMD
60	1	Q1	2N7002PW	Fairchild Semi or NXP	2N7002W, 2N7002PW		MOSFET N-CH 60V 115MA SC70
61	3	Q2,Q3,Q4	DTC123JET1G	ON Semi	DTC123JET1G		TRANS NPN BIAS 50V 100MA SC75
64	1	R2	316K,0402	Venkel	CR0402-16W-3163FT		RES 316K OHM 1/16W 1% 0402 SMD
65	3	R3,R9,R10	0 Ohm,0805	Venkel	CR0805-10W-000T		RES 0 OHM 1/10W 0805 SMD
66	1	R4	100K,0402	Venkel	CR0402-16W-1003FT		RES 100K OHM 1% 1/16W, 0402 SMD
67	1	R5	182K,0402	Venkel	CR0402-16W-1823FT		RES 182K OHM 1/16W, 1% 0402
68	2	R6,R7	1M,0402	Venkel	CR0402-16W-1004FT		RES 1M OHM,1%,1/16W,0402
69	1	R8	137K,0402	Vishay	CRCW0402137KFKED		RES 137K OHM 1/16W, 1% 0402
70	1	R11	750, 0402	Venkel	CR0402-16W-751JT		RES 750 OHM 1/16W, 5%, 0402
87	1	U1	STX3	Globalstar	STX3		RF GlobalStar satellite link
88	1	U2	LTC3127EDD#PBF	Linear Tech	LTC3127EDD		Power Supply, Buck 1A, Adj
97	1	PCB2	TRANSMITTER BOARD BLANK PCB, REV B				BLANK PRINTED CIRCUIT BOARD, REV B

MAIN BOARD BILL OF MATERIAL

Item	Quantity	Reference	Part	Manufacturer	Manufacturer P/N	Alternate P/N	Description
2	1	ANT2	2.4GHz Chip Antenna	Johanson Tech	2450AT18A100E		2.4GHz Chip Antenna, -0.5dB,SMT
14	2	C22,C24	47uF,1206	MURATA	GRM31CR61A476ME15L		CAP, Ceramic, 47uF, 10V, 20%, X5R, 1206 SMD
15	3	C23,C32,C35	10uF,0603	VENKEL	C0603X5R100-106KNP		CAP CER 10uF 10V 10% X5R 0603
16	1	C25	10uF,0805	VENKEL	C0805X5R100-106MNE		CAP CER 10uF 10V 20% X5R 0805
17	1	C26	120pF,0402	Taiyo Yuden	UMK105CG121JV-F		CAP CER 120PF 50V 5% NPO 0402
18	1	C27	33pF	Venkel	C0402C0G250-330JNE		CAP, 33pF, 25V, 5%, COG, SMD 0402
19	1	C28	0.01uF,0402	Venkel	C0402X7R250-103JNE		CAP, Ceramic, 0.01uF, 25V, 5%, X7R, 0402 SMD
20	1	C29	3300pF,0402	Venkel	C0402X7R250-332KNE		CAP, Ceramic, 3300pF, 25V, 10%, X7R, 0402
21	8	C30,C31,C33,C34,	0.1uF,0402	Venkel	C0402X7R160-104KNE		CAP, Ceramic, 0.1uF, 16V, 10%, X7R, 0402 SMD
22	1	C36	4.7uF,0402	Venkel	C0402X5R6R3-475MNP		CAP, Ceramic, 4.7uF, 6.3V, 20%, X5R, 0402 SMD
23	2	C37,C38	6pF,0402	Venkel	C0402C0G250-6R0CNE		CAP, Ceramic, 6pF, 25V, +0.25pF, COG, SMD 0402
24	1	C40	4.7uF,0603	Venkel	C0603X5R100-475MNP		CAP, Ceramic, 4.7uF, 10V, 20%, X5R, 0603 SMD
25	1	C43	1uF,0603	Venkel	C0603X5R250-105KNE	Venkel, C0603X7R160-105KNP	CAP, Ceramic, 1uF, 25V or 16V,10%, X5R, 0603
26	2	C45,C49	12pF,0402	MURATA	GRM1555C1H120GA01D	Venkel C0402C0G500-120GNP	CAP, 12pF, 50V, 2%, COG, SMD 0402
27	2	C46,C51	0.5pF,0402	Murata Electronics	GJM1555C1HR50WB01D		CAP, Ceramic, 0.5pF, 50V, +0.05pF, NPO, 0402
28	2	C47,C48	100pF,0402	Venkel	C0402C0G250-101KNE		CAP, Ceramic, 100pF, 25V, 10%, COG, 0402
29	1	C50	0.3pF,0402	Johanson	500R0750R3AV4T		CAP,Ceramic, 0.3pF, 50V, +/-0.05pF, COG/NPO 0402
31	1	FB2	BLM21PG1215N1D	Murata Electronics	BLM21PG1215N1D		FERRITE CHIP 120 OHM 0805
32	1	FB3	BLM15HG1025N1D	Murata	BLM15HG1025N1D		FILTER CHIP 1000 OHM 250MA 0402
38	1	J5	10118193-0001LF, USB Micro B	FCI	10118193-0001LF		CON RCPT MICRO USB B R/A
39	1	J6	TSM-102-01-L-SV	Samtec	TSM-102-01-L-SV		CONN HEADER 2POS .100" SNGL SMD
40	1	J7	SSM-107-F-SV	Samtec	SSM-107-F-SV		SOCKET 1x7, SMT, 2.54mm
41	1	J8	TSM-106-01-T-DV-A	Samtec	TSM-106-01-T-DV-A		Header, 12pin, SMT, Vert, 100mil
42	1	J9	SSM-107-F-SV-004	Samtec	SSM-107-F-SV-004		SOCKET 1x7, SMT, 2.54mm, Pin4 plugged
43	1	J10	TSM-110-01-T-DV-A	Samtec	TSM-110-01-T-DV-A		Header,2x10 SMT,2.54MM
45	1	LD2	SML-P12MTT86	Rohm Semi	SML-P12MTT86		LED YLW/GRN 0.2MM 35MCD 0402 SMD
46	1	LD3	LTST-C191KRKT	Lite-On	LTST-C191KRKT		LED RED CLEAR 0603 SMD
47	1	LD4	LTST-C191KGKT	Lite-On	LTST-C191KGKT		LED GREEN CLEAR 0603 SMD
51	1	L4	4.7uH, XFL4020-472ME	Coilcraft	XFL4020-472MEC		Inductors Power 4.7uH 20% 2.0A
52	1	L5	10uH,80mA,+/-10%	Taiyo Yuden	LBMF1608T100K		Inductor 10uH,80mA,+/-10%,0603
53	1	L6	15nH,0402	Taiyo Yuden	HK100515NJ-T	Venkel, LMCI1005-15NJT	FIXED IND 15NH 320MA 460 MOHM 0402
54	1	L7	5.6nH,0402	Murata	LQP15MN5N6B02D		Inductor 5.6uH,140mA,+/-0.1nH,0402
55	1	L8	2.7nH,0402	Murata	LQP15MN2N7B02D		Inductor 2.7uH,220mA,+/-0.1nH,0402
57	1	PCB1	MAIN BOARD BLANK PCB, REV B				BLANK PRINTED CIRCUIT BOARD, REV B
59	1	P2	U.FL, 73412-0110	MOLEX	73412-0110		U.FL, RF Connector, 50ohm, 0-5GHz SMD
62	1	RV1	3386F-1-103TLF	Bourns	3386F-1-103TLF		TRIMMER 10K OHM 0.5W PC PIN TOP
71	3	R12,R38,R39	750, 0402	Venkel	CR0402-16W-751JT		RES 750 OHM 1/16W, 5%, 0402
72	4	R13,R14,R32,R33	10K,0603	Venkel	CR0603-16W-103JT		RES 10K OHM 1/16W 5% 0603 SMD
73	4	R15,R19,R28,R29	0 Ohm,0805	Venkel	CR0805-10W-000T		RES 0 OHM 1/10W 0805 SMD
74	3	R16,R36,R37	51K,0402	Venkel	CR0402-16W-513JT		RES 51K OHM 1/16W 5% 0402 SMD
75	1	R17	100K,0402	Venkel	CR0402-16W-1003FT		RES 100K OHM 1% 1/16W, 0402 SMD
76	1	R18	316K,0402	Venkel	CR0402-16W-3163FT		RES 316K OHM 1/16W 1% 0402 SMD
77	7	R20,R24,R25,R30,	0.0 Ohm	Venkel	CR0402-16W-000T		RES 0.0 OHM 1/16W 0402 SMD
78	1	R21	182K,0402	Venkel	CR0402-16W-1823FT		RES 182K OHM 1/16W, 1% 0402
80	1	R23	137K,0402	Vishay	CRCW0402137KFKED		RES 137K OHM 1/16W, 1% 0402
81	2	R26,R27	27, 0402	YAG3343CT-ND	RT0402FRE0727RL		RES 27 OHM 1/16W 1% 0402 SMD
82	1	SH2	SHUNT, SNT-100-BK-T	SAMTEC	SNT-100-BK-T		Jumper/Shunt, 2 Position, 100 Mil
83	2	SW1,SW2	PTS6455M435MTR92 LFS	C&K	PTS6455M435MTR92 LFS		Tactile Switch, SPST-NO,SMT
89	1	U3	LTC3127EDD#P8F	Linear Tech	LTC3127EDD		Power Supply, Buck 1A, Adj
90	1	U4	SRV05-4A.TCT	Semtech	SRV05-4A.TCT		TVS DIODE 5V 4CH BI SOT23-6
91	1	U5	SI7020-A20	Silicon Labs	SI7020-A20-GM1		IC Temp/Humid Sensor DFN6
92	1	U6	FT234XD	FTDI	FT234XD		IC USB SERIAL BASIC UART 12DFN
93	1	U7	LS2DH12TR	ST MICRO	LS2DH12TR		IC ACCELEROMETER 3 AXIS 12LGA
94	1	U8	nRF52832-QFAA	Nordic Semi	nRF52832-QFAA		Nordic 2.4GHz, BLE, ARM M4, 48 QFN
95	1	Y1	32.768kHz, 9pF, 20PPM	Abracon	AB506-32.768KHZ-9-T		CRYSTAL 32.768KHZ, 9pF, +20ppm, SMD
96	1	Y2	32.0MHz, 15ppm,15ppm	AKER	C1E-32.000-8-1515-R		Crystal, 32MHz,15ppm,15ppm,8pF,2.5x1.6mm