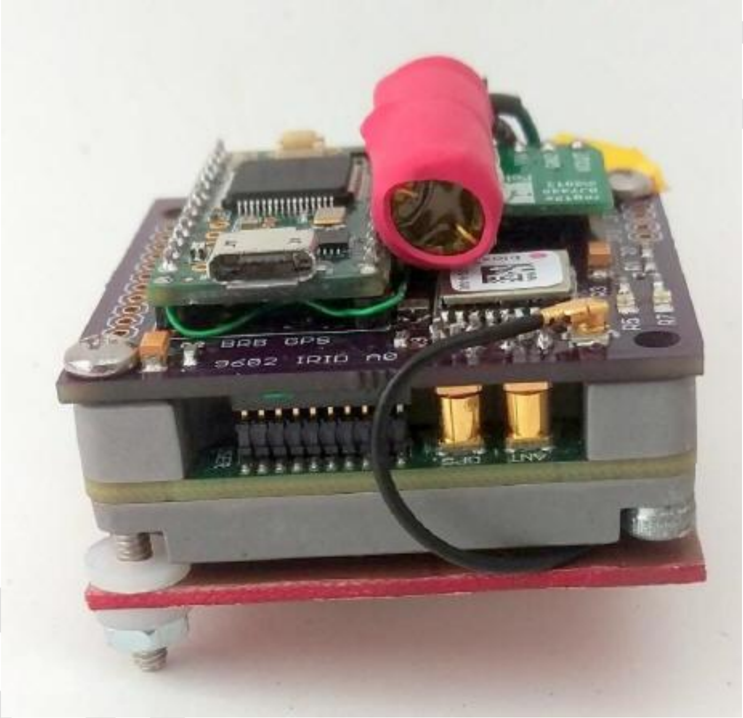
BRB SBD

Iridium Short Burst Data Transmitter with GPS
BigRedBee, LLC
Ver 0.4, April 2018

This is a preliminary document. The hardware has been in use for more than one year, but the documentation is just now being compiled. Please contact info@bigredbee.com for clarification or requests for additional information.



1. Overview

The BRB SBD is a small platform developed for the Iridium ® 9602 Short Burst Data (SBD) modem.

- Iridium 9602 SBD modem
- MK20DX256 32-bit Cortex-M4 CPU
- 56 channel ublox Max-7 GPS
- Operates from single cell lithium poly battery (3.5 -> 4.2V).
- Low standby power consumption, less than 180 uA
- Remote control of transmit schedules
- Emergency / Panic button
- USB interface for modifying firmware parameters

- Extremely small size (1.8” x 1.8”)
- Single antenna for both GPS and Iridium

2. Description

The BRB SBD is a GPS enabled device that allows reliable communication anywhere on the globe. The microcontroller schedules transmissions at a user defined interval, and sends a message containing the current GPS position. The message is received by the Iridium satellite network, relayed to centralized ground station, and finally sent as an email to the user. The SBD is a bi-directional device, capable of receiving as well as transmitting messages.

3. Transmission Schedule

The BRB SBD transmission schedule is controlled by two parameters, *delay* and *validhrs*. The *delay* is the number of minutes between transmitted messages. *Validhrs* is a 24-bit value indicating that transmissions are allowed during the corresponding 1 hour timeslot (UTC time).

For example, if *delay* = 30, and *validhrs* = 0x000FFF (or 000000000000111111111111), then it would transmit every 30 minutes between the hours of 00:00 (midnight) and 11:59am UTC time. No messages are sent or received if the bit in validhrs corresponding to the current time is zero.

4. Normal Operation

- After power is applied, the on-board LED will blink 5 times.
- The GPS will attempt to get a valid fix During this time, the LED will blink at a 1 hz rate. After a fix is acquired, the GPS is turned off.
- If a transmission is allowed at this time, the Iridium 9602 will be enabled and messages sent and received. During this time, the LED will be solidly ON. After the messages are sent and received, the Iridium 9602 is powered off.
- The board goes to sleep for the number of minutes in the delay value.

5. USB based commands

After the device is powered on, status information can be observed and commands issued over the USB interface. The following commands can be issued while the device is awake and waiting for a GPS fix.

COMMAND	Comments
+++	Enter command mode
AT	Simply response with “OK”

DELAY*	Set or Get the delay value (number of minutes)
VALIDHRS*	Set or Get the hours during which the device will transmit messages
VBAT	Report the battery voltage
HELP	Display the list of commands
GPSTIMEOUT*	The number of minutes to wait before giving up on getting GPS lock
SBDTIMEOUT	The number of minutes to wait before giving up on SBD transmission
IRID	Set or Get the Iridium disable value
ECHO*	If set, received commands will be echoed back over the Iridium channel
GO	Resume normal operation
SBDTEST	Do a quick test of communication between the microcontroller and IRID 9602
VER	Print the firmware version
BINARY	Text (0) or Binary (1) data packet

*Command can also be sent over the Iridium channel

6. Hardware

6.1. Power Supply

Power is applied to the VIN and GND pins. The power regulation circuitry is designed for a single cell lithium polymer battery with a voltage range between 3.5 and 4.2 volts. This directly powers the microcontroller, and the power regulator.

An onboard power regulator boosts this voltage up to the 5 volts required by the Iridium 9602 SBD modem. The 9602 may draw up to 1 amp for very short periods of time, so a large (1Farad) capacitor sits on the output of the 5V regulator to provide the necessary current. The 5V output of the regulator is available on the 5V pin.

The microcontroller has a 3.3V power output pin. This provides power to the GPS module.

6.2. Manual Shutdown /Reset

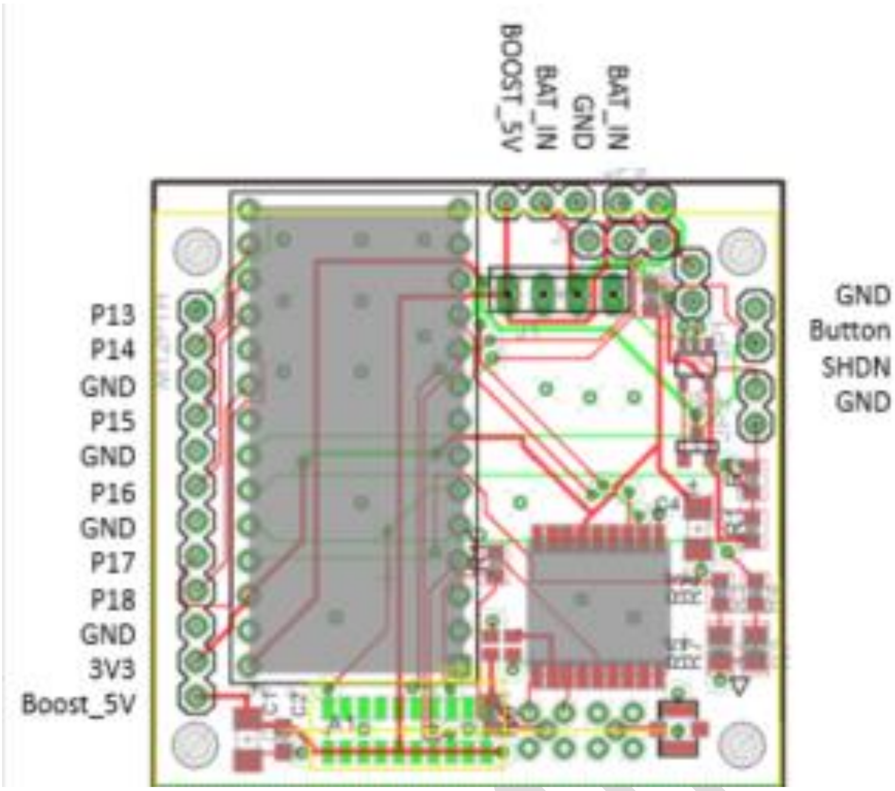
Shorting the SHDN pin to ground shuts down the power regulator, and (via a power FET) switches of the voltage input to the microcontroller.

6.3. USB Interface

After the device is powered on, status information can be observed and commands issues over the USB interface

6.4. Emergency Button

Shorting the BUTTON pin to ground will immediately send



7. Data Packet Format

The transmitted data packet contains the position and some other fields as documented below.

7.1. Text

When the BINARY control value is set to 0, the data packet looks like this:

20180407134029,40.766926,-73.293991,25,0.1,0,0.00

Field 1 is the timestamp in the format YYYYMMDDHHMMSS. In this case, April 07, 2018 at UTC time 13:40:29
Field 2 is the Latitude
Field 3 is the Longitude
Field 4 is the Altitude (in meters above sea level)
Field 5 is the Speed (in knots)
Field 6 is the heading (in degrees)
Field 7 is the battery voltage

7.2. Binary

When the BINARY control parameter is sent to one, the ASCII characters are encoded as a 4-bit value, with two characters in a single byte. The binary encoded string is roughly half the size of the ASCII string. The encoding is described in the table below:

ASCII Character (8 bits)	Encoded Value (4 bits)
0-9	0x0 – 0x9
-(dash)	0xa
, (comma)	0xb
. (period)	0xc

Using the example above, the binary version would look like this:

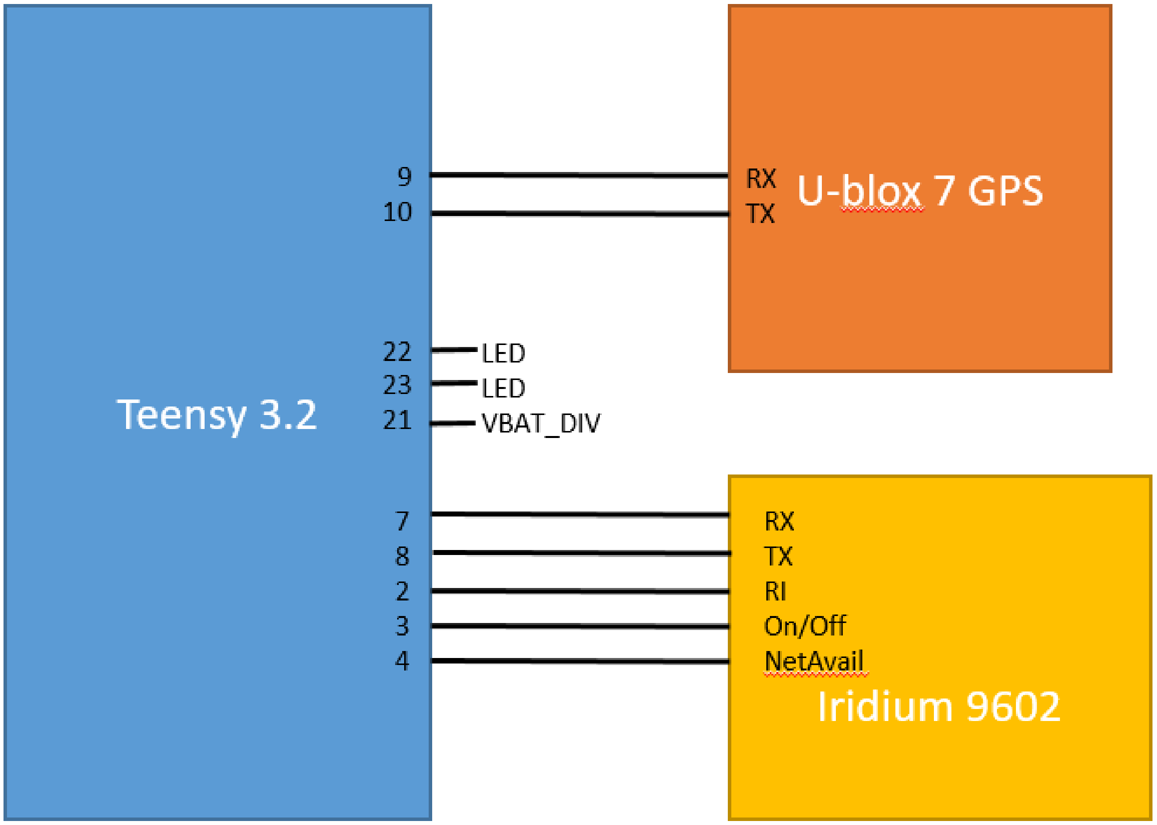
0xF0 0x20 0x18 0x04 0x07 0x13 0x40 0x29 0xb4, etc.

Note that the first byte, with a value of 0xF0, is used to indicate that this is a binary message and not an ASCII encoded message. If the message contains an odd number of bytes, the last nibble is padded with 0xF.

8. Open Source Firmware Libraries

For those that may want to write their own firmware, the BRB SBD hardware is compatible with several Arduino libraries. The microcontroller is compatible with the Teensy 3.2 libraries from www.pjrc.com . The GPS module can be managed with the TinyGPS library from http://arduiniana.org and the Iridium module is compatible with the Mikal Hart's IridiumSBD library located at https://github.com/mikalhart/IridiumSBD

The following diagram shows the connections between the microcontroller, GPS and Iridium modules.


Teensy 3.2
9
10
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23
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2
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4
LED
LED
VBAT_DIV
RX
TX
U-blox 7 GPS
RX
TX
RI
On/Off
NetAvail
Iridium 9602