BRB SBD

Iridium Short Burst Data Transmitter with GPS
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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-8 GPS
- Operates from single cell lithium poly battery (3.5 -> 4.2V).
- Remote control of transmit schedules
- Emergency / Panic button
- USB interface to set firmware parameters
- Extremely small size (1.8" x 1.8")
- Single integrated 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 the device 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 LEDs will blink rapidly for 3 seconds.
- 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.
- Position reports will NOT be sent if the HOME position is enabled, and the device is with 100 meters of this position (geofence)

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. Commands marked with a '*' can be issued "over the air" via the Iridium network in addition to the USB port.

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
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
DATA	Show the number of bytes sent/received
DYNAMIC	Set or query GPS dynamic mode
HOME	Set or query the home position

*Command can also be sent over the Iridium channel

5.1. Home Command

The device can be configured to inhibit packet transmission if it is near a specified position. If set, the device will not transmit unless it is more than 100 meters away from this home position.

The home position can be set manually using these commands

HOME LAT <latitude>

HOME LNG <longitude>

If both values are 0, this function is ignored.

The home position can be set automatically using the command

> HOME GPS

The home position will be set to the current position reported by the next valid GPS position report.

The home position can be queried using the HOME command with no argument. The home position can also be set by pressing the home button immediately after the device is powered on, while the LEDs are rapidly blinking. The first position reported by the GPS after a valid lock is obtained will be used for HOME LAT and HOME LNG.

5.2. Binary Command

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
, (comma)	0xa
-(dash)	0xb
. (period)	0xc

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

0xF0 0x20 0x18 0x04 0x07 0x13 0x40 0x29 0xab, 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.

5.3.   DYNAMIC Command

The GPS module can operate in several modes, depending on where the device is installed:

Dynamic Mode	Description	Code
Portable	Applications with low acceleration, e.g. portable devices. Suitable for most situations	0
Airborne < 4G	Only recommended for extremely dynamic environments. No 2D position fixes supported.	1
Sea	Recommended for applications at sea, with zero vertical velocity. Zero vertical velocity assumed. Sea level assumed.	2

6. Over the Air (OTA) Updats

As mentioned in the section 5, some commands can be issued via the iridium network. Commands are initiated by sending an email. To issue an OTA command, use the following format

To: data@sbd.iridium.com

Subject: <target device IEMI number>

Include an attachment named text.sbd. The attachment should contain one or more commands, each on new line.

7. Data Plan

This device requires a data plan to send and receive data packets.   Data plans are available from a wide range of service providers. Data packets can be delivered to an email address, or an IP address via TPCIP. The IMEI number must be provided during the activation process.

8. Hardware
8.1. 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 voltage 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.

8.2. 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.

8.3. USB Interface

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

8.4. Emergency Button

Shorting the BUTTON pin to ground will immediately send an emergency message.

8.5. Antenna

The device includes an integrated GPS/Iridium antenna. This antenna must face up and have an unobstructed view of the sky. For remote antenna installation, the antenna can be remove and replaced using a u.fl to SMA adapter cable.
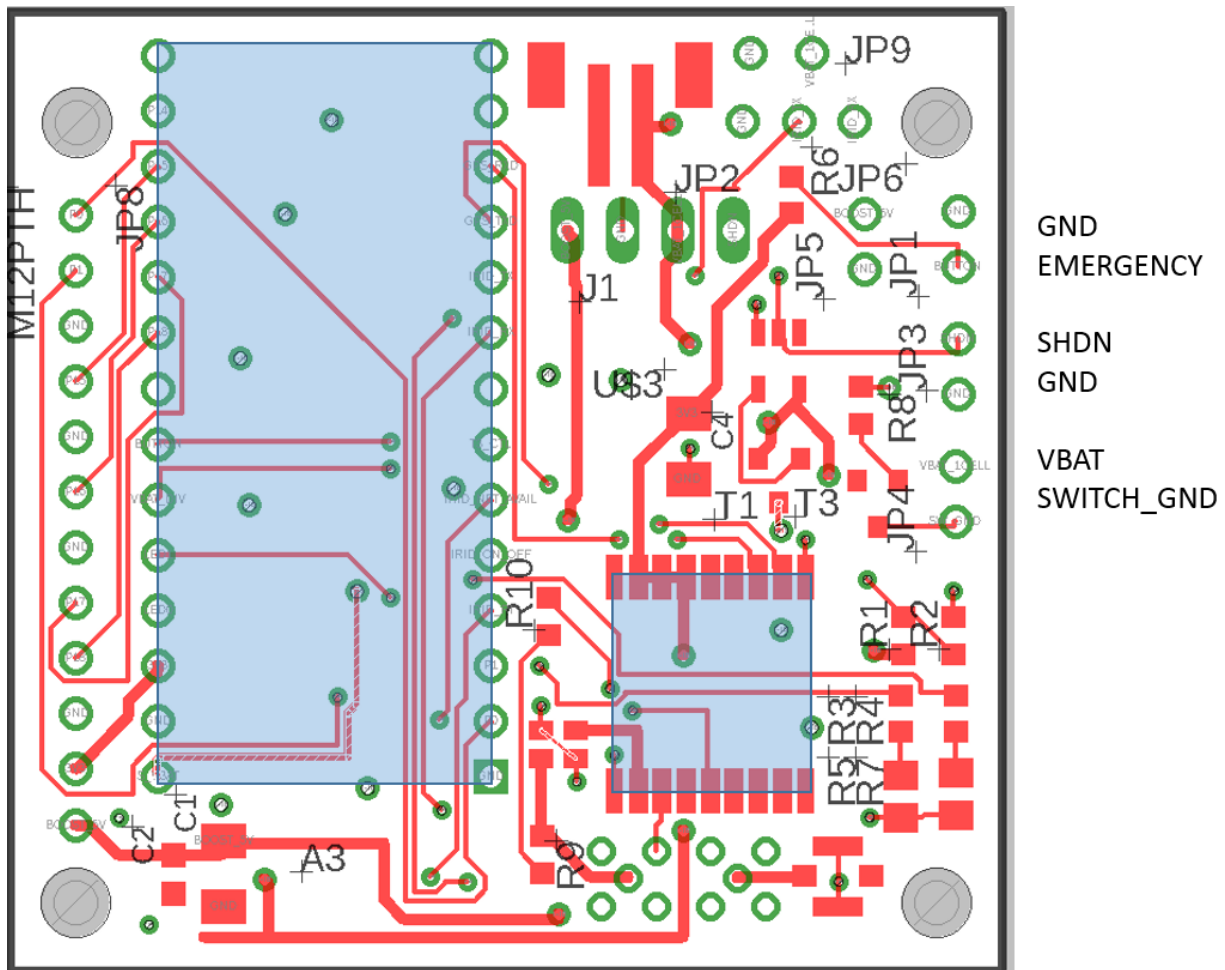
9. Data Packet Format

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

9.1. Text

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

20180407134029,45.8585,2.2944,200,0,0,400

Field 1: timestamp (YYYYMMDDHHMMSS)
Field 2: latitude (DD.dddd)
Field 3: longitude (DD.dddd)
Field 4: altitude (in meters above sea level)

Field 5: course (in degrees)
Field 6: speed (in knots)
Field 7: battery (V*100)

In this case, April 07, 2018 time 13:40:29 . The above coordinates are for the Eifel Tower in Paris. The altitude is 200 meters, course and speed are 0, and the battery is at 4.00 volts.

10. Power Consumption

The input voltage must be between 3.5 and 4.2 volts, and is designed to operate on a single cell lithium poly battery.

10.1. GPS state

After power is applied, the device will enter the GPS state, and remain in this state until a valid position is obtained, or the device times out. While in the GPS state, the device will consume approximately 150 milliamps

10.2. Iridium state

After the GPS state, the device will enter the Iridium state and remain in this state until the message is sent, or the device times out. While in the Iridium state, current consumption will vary widely, from a low of 100 milliamps to as high as 1.6 amps. The average while in this state is 250ma. The amount of time spent in this state varies. It can be as little as 10 seconds if no retries are required to establish a satellite connection, or several minutes if multiple retries are required.

10.3. Sleep state

When not in the GPS or Iridium state, the device will be in the sleep state, and will consume approximately 50 milliamps

10.4. Power consumption summary

State	Current Draw
GPS	150 mA
IRIDIUM	100mA – 1.6 A, average = 250 ma
SLEEP	50mA

11. Operating Conditions

Operating Temperature range	-40C to +85C
Operating Humidity Range	< 75% RH

| Storage Temperature range | -40C to + 85C |
| Storage Humidity Range | < 94% RH |