



BLUESENTRY RN-800S-CB

Bluetooth Sensor Interface

Install Guide and User Manual Version 1.0

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Overview

BlueSentry connects to industry standard sensors to provide wireless, remote signal monitoring and device control in and commercial environments. It easily attaches to analog sensor outputs and automatically takes continuous industrial measurements. Data is transferred wirelessly to PC and PDA clients using the Bluetooth Serial Port Profile (SPP). The BlueSentry can also be paired with the Roving Networks BluePort XP serial adapter or Fireplug USB dongle to create a wireless serial port connection. Software applications can control and acquire data as if they were connected to a local serial port.

BlueSentry contains a built in ADC and smart Bluetooth radio. The device is programmed over Bluetooth via simple ASCII commands. Both ASCII and binary data formats are supported. Upto 8 channels can be selected as single ended or differential measurements.

Features

- Small form factor: 1.6" X 3.0" X 0.9"
- Eight 16 bit input A/D channels, input voltage 0-5VDC at upto 3000Hz sampling rate
- High power Class 1 Bluetooth radio (12dBm output transmitter, 100 meter range) with integral chip antenna
- Equipped with Serial Port Profile, BlueSentry can be configured as either Master or Slave
- Two on board FET switches for powering external sensors
- Two general purpose inputs/outputs (15ma drive) for control
- Low power 6-12VDC (75ma) can run from 4 AAA batteries
- Low power sleep and wake on connect options
- Screw post (power in, 2 ch), RJ45 (power in, 6 ch) and 12 pin internal header connections.
- External SMA jack Antennae option, order RN-800S-E.

Applications

The BlueSentry can be used for a host of sensor applications. Some of the possible applications are:

- Remote Temperature Sensor
- Wireless Motor Control
- Remote Motion Sensors
- Wireless control and monitoring

***WARNING**

BlueSentry channel inputs do NOT have input protection, care must be taken not to exceed the maximum input voltage of +5VDC on any input, and the inputs should never be driven to negative voltages below GROUND. This will cause permanent damage to the AD circuits.

LEDs

When power is applied, both the YELLOW and GREEN LEDs will alternate about 10 times as the unit is self-testing, then the GREEN LED will blink about once per second. Once a connection is made, the GREEN LED will blink 4 times/second, and the YELLOW LED blinks when DATA is sent or commands are received from Bluetooth. As the data rate increases, this LED will flash more quickly. If the YELLOW LED comes on solid, and the GREEN LED blinks a continuous pattern, the unit either cannot communicate to the Bluetooth radio, or has failed an internal self-test. Power cycling may solve the problem.

Expansion Header

BlueSentry contains an internal 12 pin .1inch spacing header along the long edge of the circuit board. Refer to page 3 for the description of the pins.

Power Pins

BlueSentry has a built in Low Drop Out regulator which supplies clean 5V to the AD circuits. For best operation, apply 6V or more to V+ (Pin 1 on Screw Post) to get solid +5V range readings. Regulated 5VDC power can be tapped using JP1 on top header. Please refer to the board description for more details. Power draw is approx 70ma when connected, as low as 7ma average when idle, depending on settings.

Physical Ports

BlueSentry has 2 AD channels, VCC, and GND on the 4 terminal screw posts. The other 6 channels can be accessed via the RJ45 connector, or the internal 12 pin header.

RJ45 – Pin 1 on right side (LEDs on TOP)	Screw Posts- Pin1 on left side looking into connector
1-V+	1-V+
2-CH5	2-CH1
3-CH3	3-CH2
4-CH4	4-GROUND
5-GROUND	
6-CH6	
7-CH7	
8-CH8	

Data Output Formats

BlueSentry acquires signals with 16 bit accuracy, in the range of 0 to +5VDC. A value of 0x0000 represents 0 volts, a value of 0xFFFF represents 5Volts.

Full ASCII mode data will flow in the following character displayable HEX format:

```
-SSSS 1111 2222 3333 4444 \n\r
```

SSSS is a sequence number, starts at 1, rolls at 0xFFFF

FAST ASCII mode data will flow in the following character displayable HEX format:

```
1111222233334444 \n\r
```

Binary mode data will flow in the following RAW BINARY format:

```
2DSSSS1111222233334444\r ( \r = decimal 13, 2D = '-' ).
```

FASTBinary mode data will flow in the following RAW BINARY format:

```
1111222233334444\r ( \r = decimal 13, 2D = '-' ).
```

Channel mask Mode for selecting channels

By using the "<XY" command, BlueSentry can be set to sample any number of channels. The XY value is an 8 bit map of the channels. For example, if you want channels 4 and 6, you would enter "<28". Channels are returned in order from 1-8. Default is 00, which disabled this mode.

Board Description

RJ45 Connector

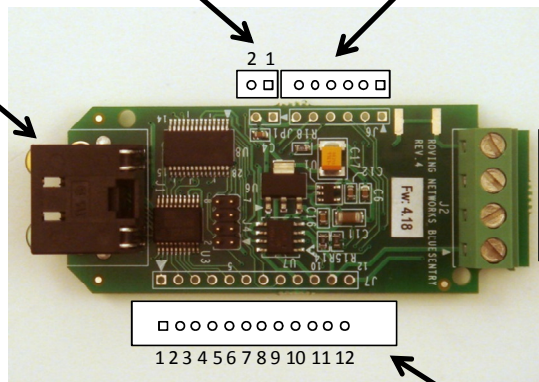
WARNING: Channel inputs must not be driven above +5VDC and below 0V GND, or permanent damage will occur

Pin	Description
1	V+
2	CH5
3	CH3
4	CH4
5	GND
6	CH6
7	CH7
8	CH8

Regulated Power Output

Pin1(JP1)=5VDC regulated,
Pin2=GND

Not Used



Screw Posts

WARNING: Channel inputs must not be driven above +5VDC and below 0V GND, or permanent damage will occur.

Apply 6VDC or more on Pin 1 to get regulated power output of 5VDC on JP1

Pin	Description
1	V+
2	CH1
3	CH2
4	GND

Expansion Header

Pin	Description
1	CH 3
2	CH 4
3	CH 5
4	CH 6
5	CH 7
6	CH 8
7	IO 1 General purpose digital IO
8	IO 2
9	POWER 1 switches 5VDC to load circuit
10	POWER 2 switches VIN to load circuit
11	VIN power input
12	System GND

LED Status (LEDs located on RJ45 connector)

Power Up: YELLOW and GREEN LED alternate about 10 times indicating self test

Connected State: GREEN LED will blink 4 times/second, YELLOW LED blinks when data is sent or commands received over Bluetooth

Failed internal self test: YELLOW LED is solid, GREEN LED blinks continuously

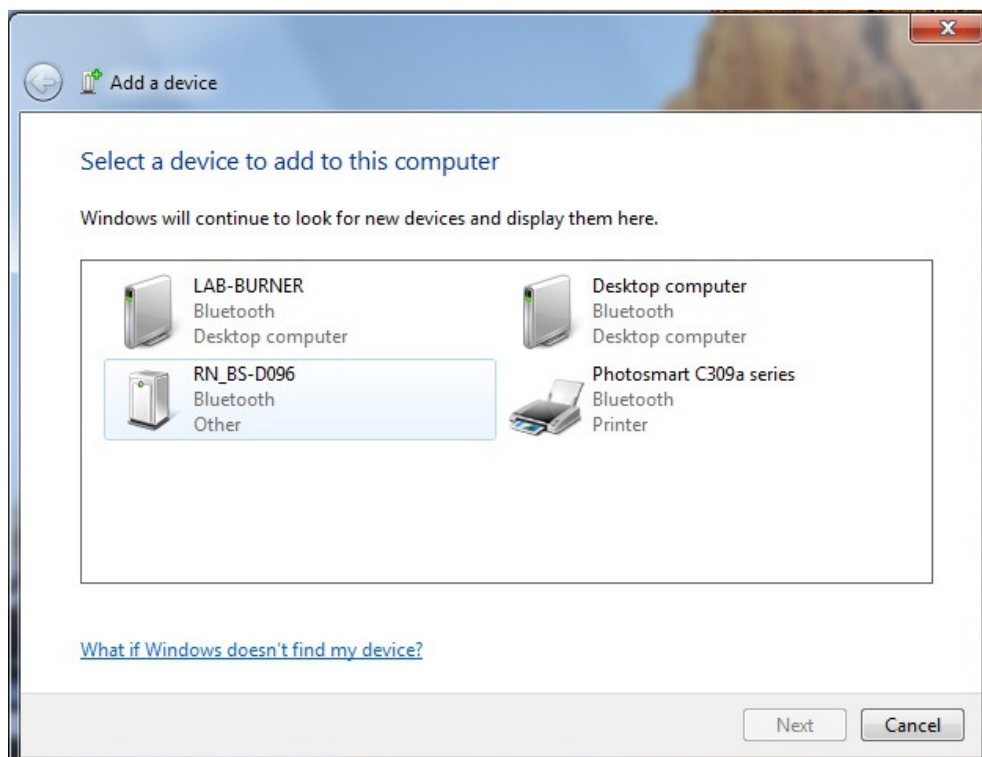
Connecting over Bluetooth

BlueSentry displays under Service discovery as "RN_BS-wxyz, where the wxyz matches the last 2 bytes of the Bluetooth address of the unit. To connect to BlueSentry, browse for services, you should see: "Sensor on RN_BSxyz" as the Profile. BlueSentry uses SPP,(Serial Port Profile) and should be connected to as a Virtual COM port on PCs, Palms, Pocket PCs, or other clients. Once connected, data will flow in both directions as if the serial port were locally attached. BlueSentry is a class 1 Bluetooth device with high power transmitter (100meters) however, actual range may be limited to 100 feet or due to internal antennae or type of client device used to connect to BlueSentry. NOTE: Only one client can connect to a BlueSentry at a time, 7 Bluesentry's (per Bluetooth limits) connected to a single PC adapter at a time.

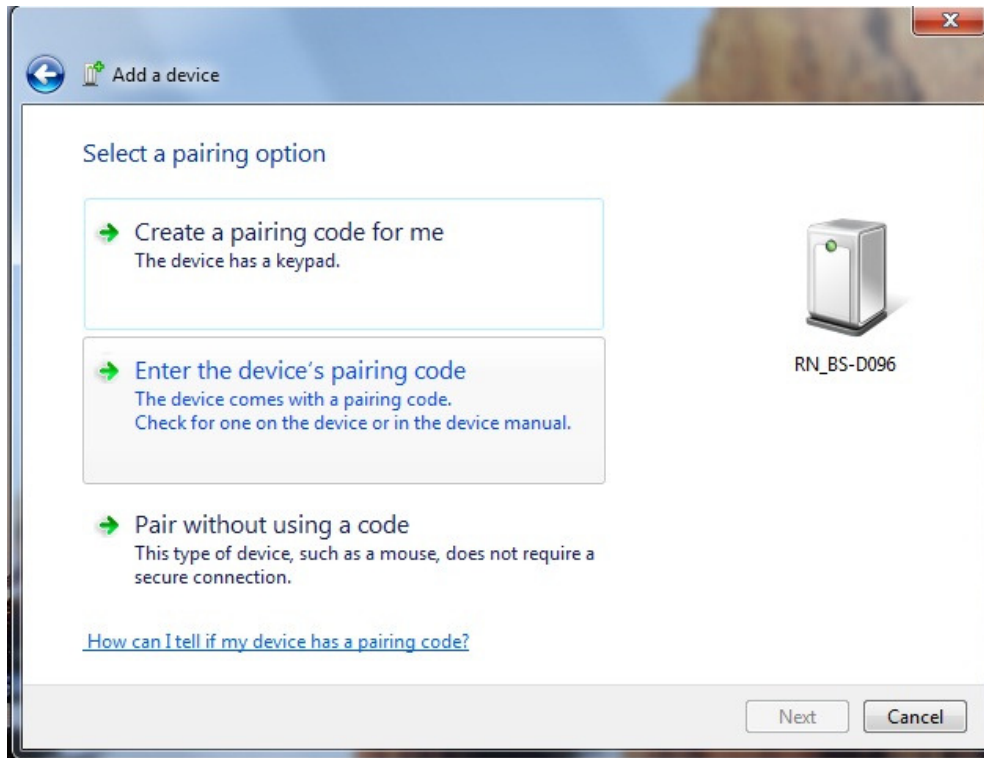
This section illustrates how to establish a connection to the BlueSentry. For this example, we are using a windows machine running Microsoft Windows 7 Operating System. Regardless of the PC operating system, the process is essentially the same: Discovery, Pairing, and Connecting.

1. **Discovery:** The BlueSentry must be discoverable by simply turning it on. The YELLOW and GREEN LEDs will alternate about 10 times as the unit is self-testing, then the GREEN LED will blink about once per second. This indicates that the BlueSentry is ready to establish a connection.

On your PC open the Bluetooth device manager and click on "Add" a new device. The Bluetooth device manager is located in the bottom right corner of your screen in the taskbar. The Bluetooth device manager will display a list of all the Bluetooth devices that are discoverable. BlueSentry displays under Service discovery as "RN_BS-wxyz, where the wxyz matches the last 2 bytes of the Bluetooth address of the unit.



- Pairing:** Next you must pair with the device by double clicking on RN_BS-wxyz in the list. Select "Enter the device's pairing code" option from the list. Enter the default pin code of 1234. Once the Bluetooth device manager completes you will see a message to the effect, "Bluetooth device installed on COMX" where COMX is unique to your machine. In some cases the Bluetooth device manager will create two COM ports, in this case you only want to use the COM port labeled "outgoing".



- Connecting:** To establish a Bluetooth connection, open up the COM port assigned to the device from either your application or a terminal emulator. Once connected, data will flow in both directions as if the serial port were locally attached.

Operation

Once connected to BlueSentry over Bluetooth SPP, you are ready to acquire data. The following commands listed below can be used to operate the unit. Each command is a single character. Results are immediate, however, any commands given do not survive a power cycle and must be re-issued if the unit is powered down or rebooted remotely. The ? sign will show on your terminal emulator about once every two seconds, telling you that BlueSentry is ready for your command. To start getting output, just send the \$ sign.

List of commands

Command	Description	Default
\$	Toggle AD continuous output	
!	stop AD continuous output	
*	perform a single acquisition	
+	speed up the rate (max rate is 18000/ 0x12 = 1KHz on1 ch, Fast ASCII mode)	$\frac{18000}{0X4650} = 1.00Hz$
-	slow down the acquire rate	
,	set comma delimited output in ASCII/ mode	space delimited
1,2,3,4,5,6,7,8	set the number of channels desired	Channel 4
<XY	set the channel mask a bitmap of channels to sample	00
a	set output mode to ASCII	fast mode off
b	set output mode to BINARY	
c	toggle output FAST mode (no start header ,sequence number, or space/comma)	
d	set an exact delay value (enter 4 hex digits, A-F or a-f is ok ex: F3A4)	
e	echo character back (to test the link)	
f	send data at the maximum frequency	
g	display settings, channel, speed, mode, io ports and power info	
i	read GPIO port, format returned is XY, only lower 2 bits of the byte are valid	
k XY	set the counter mode mask	00
m	toggle AD mode from single ended to differential	single ended
n	display unit serial number (this is also the Bluetooth address)	
o XY	set GPIO. format = oXY, X=in/out mask (1=out, 0=in), Y=value. (ex: o11 sets IO1= output=5V, o20 sets IO2=output=0V, o00 sets back to an input)	
p X	Set Power outputs, Power1=bit 0, Power2=bit1, example p 1 turns ON power 1, p2 turns on power 2, p3 turns on both, p0 turns off both	
q	toggle sending the "?" prompt every second.	
r	Reset to default values (delay, channels, mode, does not reset sleep or UP timers)	
s	sleep(unit will disconnect, and will wake up when re-connected)	
t xx	sleep after XX(hex) seconds of no activity (enter 00 to disable sleep)	
u	display elapsed UP timer since power up reset in days, hours, minutes, seconds	
v	display version info	
y XY	Set the threshold value for counter mode	80 hex = 2.5Volts
z	reset elapsed UP timer to zero.	
X <string>	Send Bluetooth Radio configuration commands (CAUTION: see section below)	

Bluetooth Radio Configuration Commands

WARNING

In NO instance should the Baud rate or Parity settings be modified, these are fixed at the proper settings and changing these settings will cause the BlueSentry to fail power up diagnostics and make the device inoperable. Use caution when executing the commands.

By using the "x" command, you can access a number of configuration parameters of the Bluetooth radio on the BlueSentry. For example, you can change the Bluetooth Name, service profile name, pincode, and many other features. You can also setup the BlueSentry to automatically connect out as a master to a pre-defined Bluetooth slave (such as roving networks BluePort serial adapter).

The "x" command tunnels a string to the on board Bluetooth module. Commands are entered in the same format as the commands on Roving Networks embedded radios and BluePort serial adapters.

Each time you enter a command, the BlueSentry will disconnect from your remote Bluetooth side, reset the radio, set the command, and then reset again. You must then re-connect to the BlueSentry. The best way to utilize this feature is to send the command: "xST,60", which will change the remote configuration timer (which allows the Bluetooth radio to accept configuration over Bluetooth upon powerup) to 60 seconds.

You can then re-connect to the BlueSentry, type "\$\$\$<cr>", and you will get the full remote configuration menu of the radio. Once you have completed making configuration changes, you should send the command "ST,0" to remove the remote configuration timer (so in the future you can immediately connect to BlueSentry and communicate to the main program upon power ups) .

For a complete list of commands, refer to the document :
<http://www.rovingnetworks.com/documents/BlueportII-ref-guide.pdf>

CAUTION: changing the Radio settings can cause your device to act in strange ways or possibly become disabled. For example, once you set master mode, you cannot connect back into the BlueSentry to reconfigure it, you must have the BlueSentry connect out to an SPP capable slave device which can run a terminal emulator so you can remote configure it again.

Differential Mode

By using the "m" command, BlueSentry can be set to operate the AD in differential mode. Default is single ended, with channels referenced to ground. In differential mode, the channels are paired, 1-2, 3-4, 5-6, 7-8 and the resulting measurement is the delta between channels. The first channel is +, the second is -. The output data produced will be a 16 bit value for each pair, for example, if maxchan =4, you will get 2 readings.

Data Rates

BlueSentry acquires signals at about 5Kz per sample. The maximum transfer rate is limited due to the Bluetooth serial speed of 230Kbps. Although BlueSentry acquires the signals at a much higher rate (5KHz), data is not sent over the Bluetooth link at this speed. The data from the four channels is multiplexed and sent over the limited Bluetooth bandwidth of 230kbps. If only one channel is sampled, the output data rate is close to 2kHz, but the data rate decreases as the number of channels multiplexed are increased.

The output rate is set by $18000 / (D)$, where **D** is the delay value Standard delay values set by the + and - , and f commands are:

CHAN	DELAY	MAX ASCII	DELAY	MAX FAST ACSII	DELAY	MAX BINARY
1	0X0018	750 Hz	0X0012	1000 Hz	0X0009	2000 Hz
2	0X0030	375 Hz	0X0024	500 Hz	0X0012	1000 Hz
3	0X0048	250 Hz	0X0036	333 Hz	0X001B	750 Hz
4	0X0060	187.5 Hz	0X0048	250 Hz	0X0024	500 Hz

For example, to set a rate of exactly 200Hz, D = 90 decimal, or 005A hex. So you would type "d005A" to set that delay value. The hex value 0x4650 = exactly 1 second rate. The fastest rate possible is 3Khz, in FAST BINARY mode, with a delay value of 0x0006

Power Consumption

When connected to 5VDC supply, the module draws the current as shown:

Sate	BT not connected	BT connected
Idle	20mA	40mA
Fast AD		60mA
Sleep mode	7mA	

BlueSentry can be put to sleep with the 's' character command. The processor stops, And all circuits go low power. The Bluetooth radio will disconnect, then stay awake to listen for incoming connections. The unit can be awakened from sleep automatically by re-connecting via Bluetooth.

Counter Mode

For each channel, a counter mode can be enabled. In this mode, the high byte of the reading is compared to the previously stored reading. If the difference is greater than the threshold (default is 0x80, or 2.5Volts) a counter is incremented. The result will be sent as ABXX, where AB is the count from 0 to 255, and XX should be ignored. Counter mode can be enabled for any of the channels, by using the K command, and setting a bit to 1 for each channel. For example, if counter mode on channels 0 and 2 is desired, set the mask to 0x05 by sending "k05".

The counter is reset after each delay period. To utilize this counter, the frequency of the signal being counted divided by the delay value should be < 255 or the counter will overflow. For example, if the signal is 1KHz, the delay value should be no greater than 0.25 second, or a hex value of 0x1194 or faster. Because the sample rate is 5Khz, the maximum frequency that can be counted is limited to around 2.5Khz/ number of channels being sampled.

POWER1 supplies the clean 5VDC output of the LDO regulator to load circuits via a power MOSFET. The LDO has an 800ma load current limit and depending on the environment temperature may have a lower thermal drop out as the regulator on board does not have a heat sink. The impedance of the FET switch is about 0.1 ohms.

POWER2 switches the input voltage to load circuits. The impedance of this MOSFET switch is about 0.1 ohms.

IO1 and IO2 are general purpose digital IO (25ma current limit).

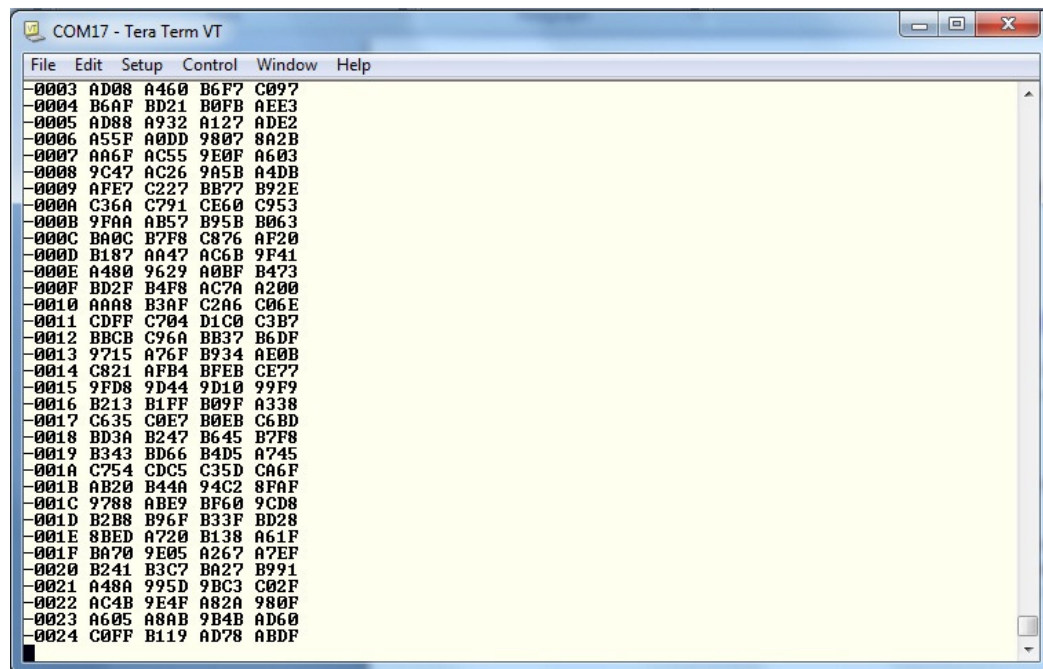
Access to regulated 5VDC output power

In some cases it may be useful to tap the 5VDC regulated power used internally by the BlueSentry. This power is available on Jumper JP1 pin 1, which is the square pin (pin 2 is GND). 5VDC is also available on Pin 1 of the 8 pin box header, J4, pin 1 has the small white arrow pointing to it.

BlueSentry Example:

The following example illustrates some of the features of the BlueSentry with screenshots to familiarize you with its capabilities.

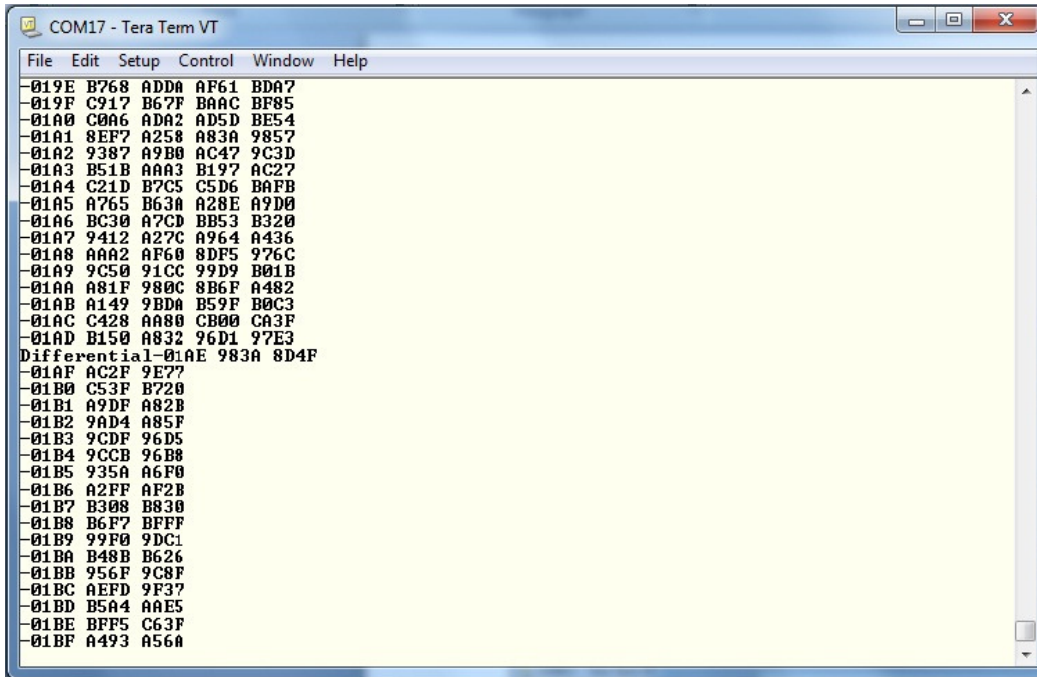
1. Connect to the BlueSentry as described in the "Connecting over Bluetooth" section.
2. Once the connection is made, the BlueSentry will start displaying data from sensor inputs. By default, it shows the data of the first four channels (Channel 1 through 4). The first column is the sequence number and the next four columns is the data output from the four channels



```

COM17 - Tera Term VT
File Edit Setup Control Window Help
-0003 AD08 A460 B6F7 C097
-0004 B6AF BD21 B0FB AEE3
-0005 AD88 A932 A127 ADE2
-0006 A55F A0DD 9807 8A2B
-0007 AA6F AC55 9E0F A603
-0008 9C47 AC26 9A5B A4DB
-0009 AFE7 C227 BB77 B92E
-000A C36A C791 CE60 C953
-000B 9FAA AB57 B95B B063
-000C BA0C B7F8 C876 AF20
-000D B187 AA47 AC6B 9F41
-000E A480 9629 A0BF B473
-000F BD2F B4F8 AC7A A200
-0010 AAA8 B3AF C2A6 C06E
-0011 CDFE C704 D1C0 C3B7
-0012 BBCB C96A BB37 B6DF
-0013 9715 A76F B934 AE0B
-0014 C821 AFB4 BFE8 CE77
-0015 9FD8 9D44 9D10 99F9
-0016 B213 B1FF B09F A338
-0017 C635 C0E7 B0EB C6BD
-0018 BD3A B247 B645 B7F8
-0019 B343 BD66 B4D5 A745
-001A C754 CDC5 C35D CA6F
-001B AB20 B44A 94C2 8FAF
-001C 9788 ABE9 BF60 9CD8
-001D B2B8 B96F B33F BD28
-001E 8BED A720 B138 A61F
-001F BA70 9E05 A267 A7EF
-0020 B241 B3C7 BA27 B991
-0021 A48A 995D 9BC3 C02F
-0022 AC4B 9E4F A82A 980F
-0023 A605 A8AB 9B4B AD60
-0024 C0FF B119 AD78 ABDF
  
```

3. To switch to differential mode, use the "m" command. Default setting is single ended, wherein the channels are referenced to ground. In differential mode, the channels are paired, 1-2, 3-4, 5- 6, 7-8 and the resulting measurement is the delta between the channels. The first channel is + and the second channel is -. In our case, since we have 4 channels being displayed, after the "m" command, we will have two channels being displayed at output (1-2 and 3-4).



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