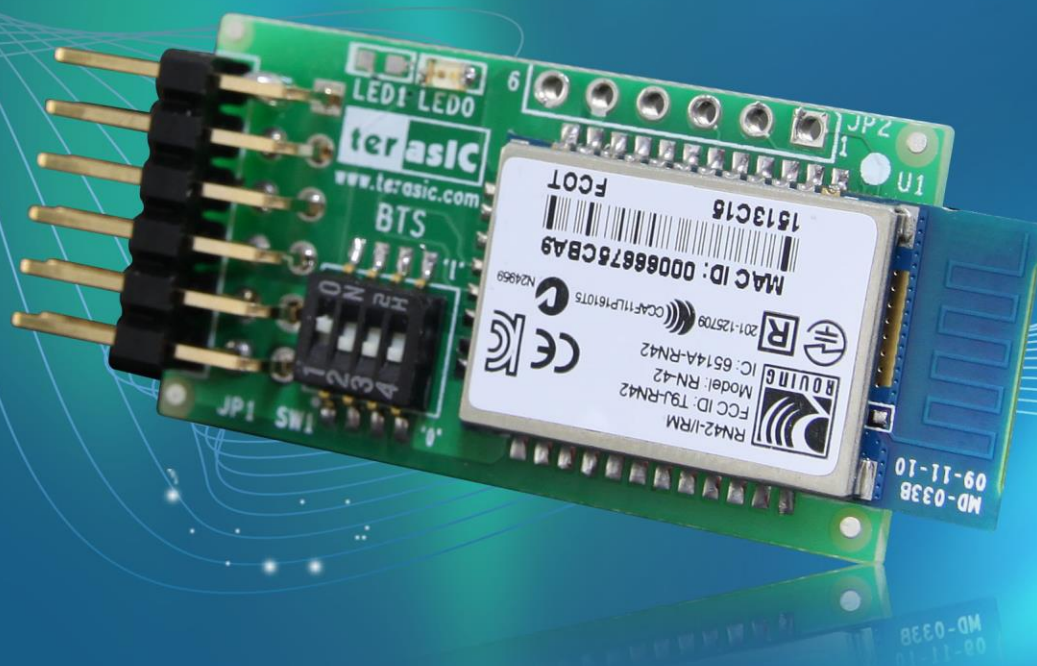


BTS-TMD

User Manual



Chapter 1	Introduction	2
1.1	Features.....	2
1.2	Getting Help	3
Chapter 2	Architecture	4
2.1	Layout and Components.....	4
2.2	Block Diagram of the BTS-TMD Board	5
Chapter 3	Board Components	6
3.1	TMD Connector.....	6
3.2	SWTICH.....	7
3.3	LED	8
Chapter 4	Design Example	9
4.1	System Block Diagram.....	9
4.2	Command Mode	10
4.3	DIP Switch Setting	10
4.4	Android Smartphone.....	11
4.5	Demonstration Source Code.....	11
4.6	Demonstration Setup	11
Chapter 5	Appendix	14
5.1	Revision History	14
5.2	Copyright Statement	14

Introduction

The Terasic BTS-TMD is a Bluetooth version 2.1 module with SPP (Serial Port Profile) profile, small form factor and low power for users who want to equip wireless capability to their design.

1.1 Features

Figure 1-1 shows a photograph of the BTS-TMD.

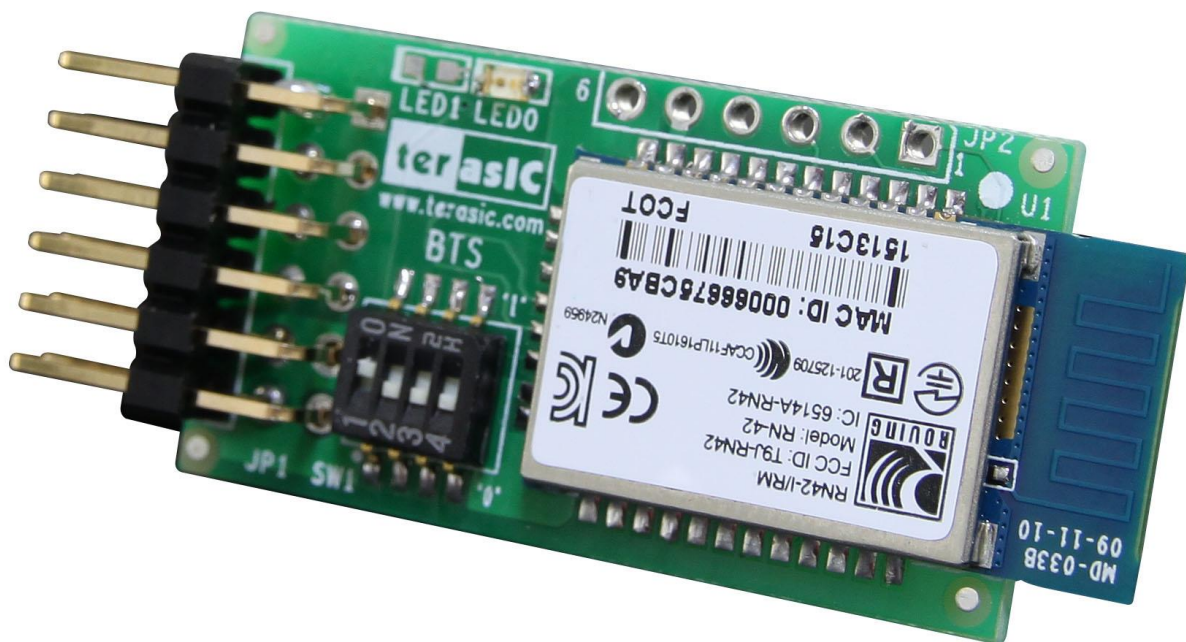


Figure 1-1 Exterior View

The key features of the card are listed below:

- Fully qualified Bluetooth® version 2.1 module, supports version 2.1 + Enhanced Data Rate (EDR)
- Sustained SPP data rates: 240 Kbps (slave), 300 Kbps (master)
- HCI data rates: 1.5 Mbps sustained, 3.0 Mbps burst in HCI mode

1.2 Getting Help

Here is information of how to get help if you encounter any problem:

Terasic Technologies

Tel: +886-3-550-8800

Email: support@terasic.com

This chapter provides information about architecture and block diagram of the BTS-TMD board.

2.1 Layout and Components

The picture of the Terasic BTS-TMD is shown in **Figure 2-1** and **Figure 2-2**. It depicts the layout of the board and indicates the locations of the connectors and key components.

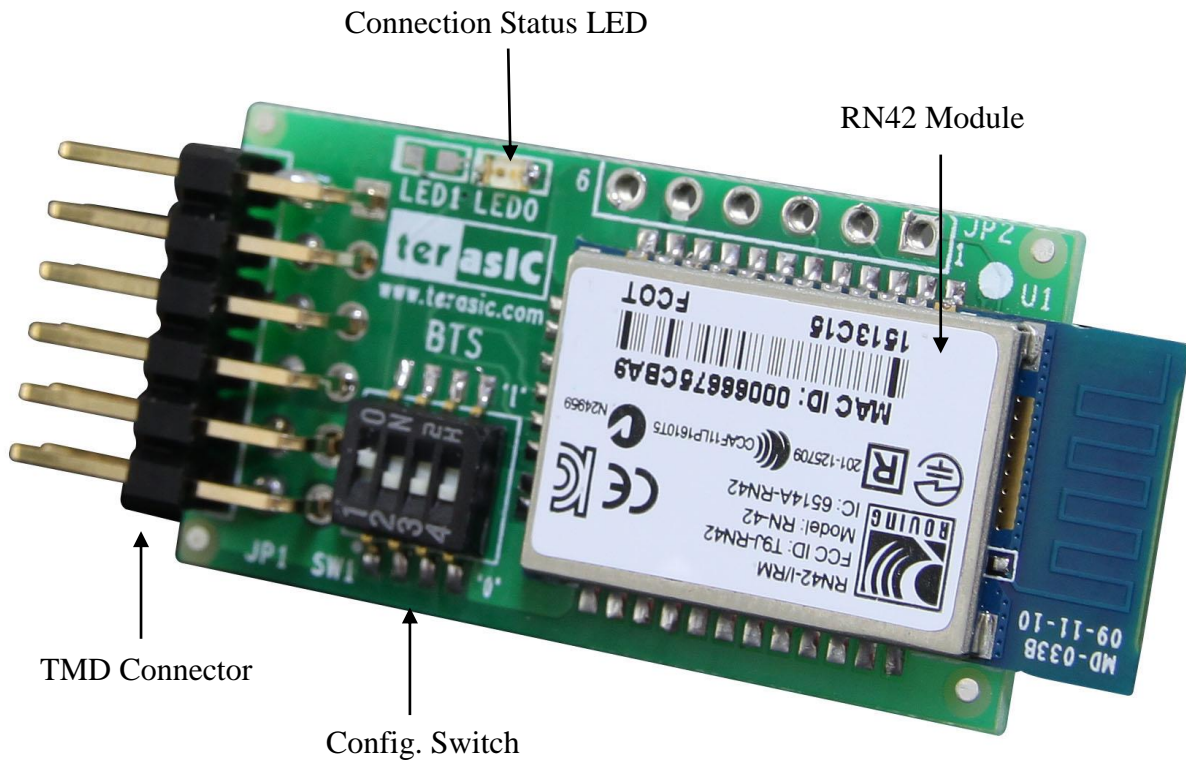


Figure 2-1 BTS-TMD and Component Diagram (top view)

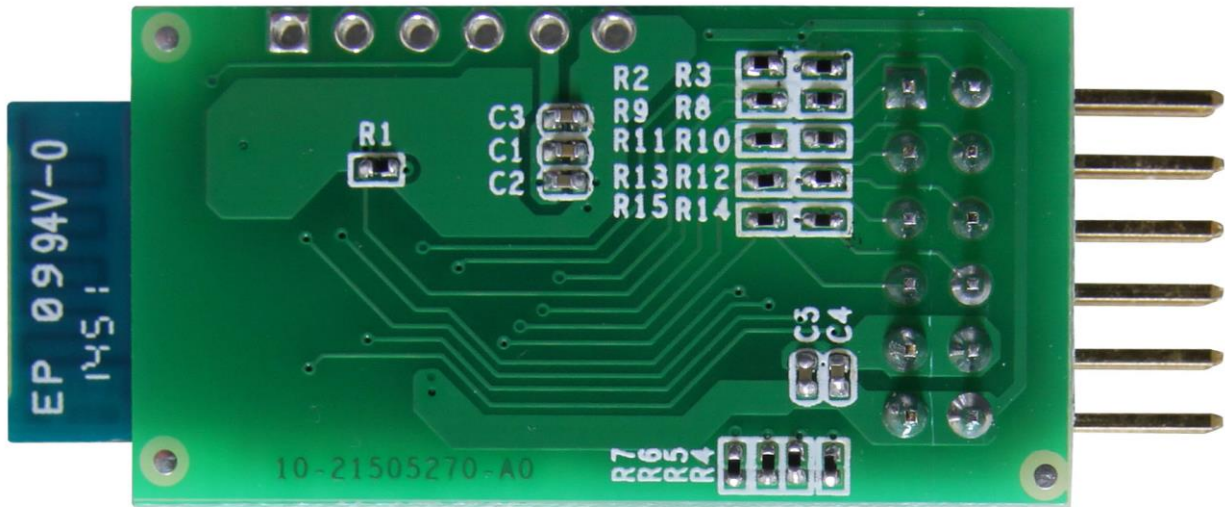


Figure 2-2 BTS-TMD and Component Diagram (bottom view)

2.2 Block Diagram of the BTS-TMD Board

Figure 2-3 shows the block diagram of the BTS-TMD card.

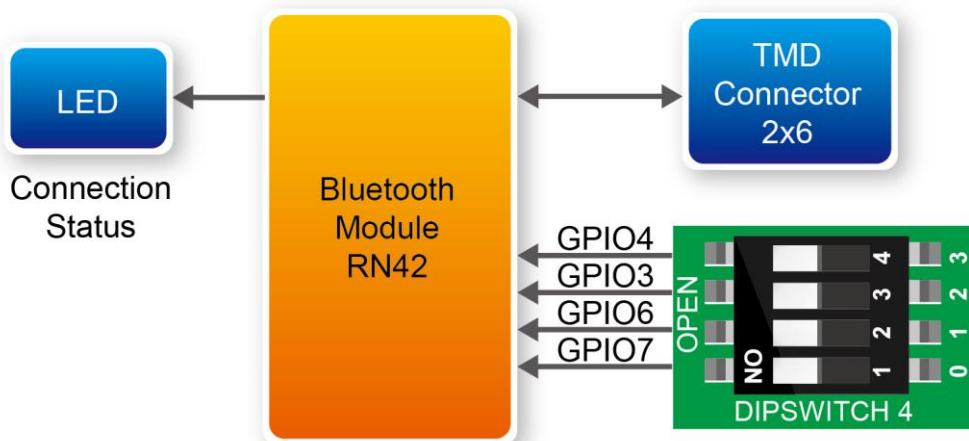


Figure 2-3 Block Diagram of BTS-TMD

Board Components

This chapter describes the specifications of the on board components.

3.1 TMD Connector

This TMD connector is an interface to connect BTS-TMD and host/FPGA. And there is an UART interface and GPIOs on it, as show **Figure 3-1**.

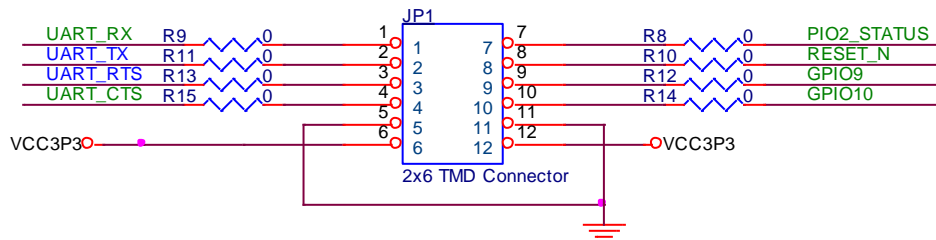
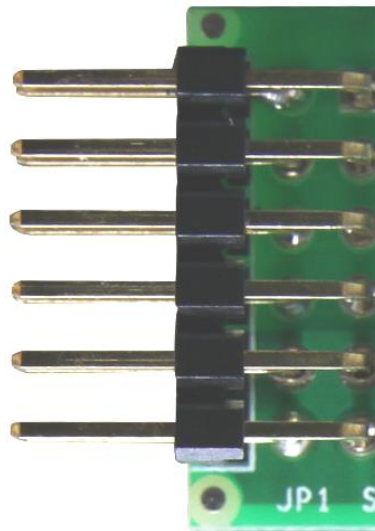


Figure 3-1 TMD Connector

Table 3-1 gives the wiring information of the TMD connector.

Table 3-1 Pin assignments and descriptions on TMD connector

Pin Numbers	Name	Description
1	UART_RX	UART Receive RN42 Input
2	UART_TX	UART Transmit RN42 Output
3	UART_RTS	UART RTS
4	UART_CTS	UART CTS
5	GND	PCB Ground
6	VCC3P3	3.3V Power Input
7	PIO2_STATUS	High when connected, low otherwise
8	RESET_N	Active-low reset
9	GPIO9	IO
10	GPIO10	IO
11	GND	PCB Ground
12	VCC3P3	3.3V Power Input

3.2 SWITCH

There is a dip-switch to configure this Bluetooth module, it is high level when switch to ON position, as show **Figure 3-2** and **Figure 3-3** as show the schematic view of SW1.



Figure 3-2 SW1

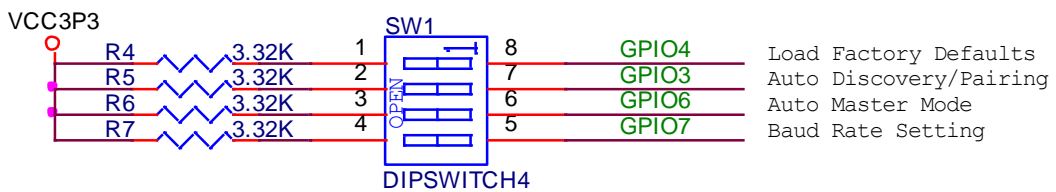


Figure 3-3 Schematic view of SW1

The functions of SW1 describe as below.

- GPIO4: This switch can be used to reset the module to its factory default settings, which is critical in situations where the module has been misconfigured. To reset the module to the factory defaults, GPIO4 should be high on power-up and then toggle low, high, low, high with a 1 second wait between the transitions.
- GPIO3: Move this switch to ON position (high level), it enables auto discovery feature.
- GPIO6: Move this switch to ON position (high level), it enables auto master mode.
- GPIO7: Move this switch to ON position (high level) it set baud-rate 9600 bps, otherwise 115k bps.

3.3 LED

There is an LED on board, it is driven by GPIO5, and it blinks at various speeds to indicate status (see Table 3-2). **Figure 3-24** shows the location of LED0.

Table 3-2 Connection Status

<i>Connection Status</i>	<i>Description</i>
Toggle at 1 Hz	The module is discoverable and waiting for a connection.
Toggle at 10 Hz	The module is in command mode.
Low	The module is connected to another device over Bluetooth.



Figure 3-2 LED0

Design Example

This chapter shows how to connect the MAX 10 NEEK board and BTS-TMD Bluetooth module. The bundle communicates with a smart device via Bluetooth 2.1. The data retrieved from the humidity and temperature sensor HDC 1000 on MAX 10 NEEK board will be transmitted to the SPP (Serial Port Profile) software on the smart device via Bluetooth SPP protocol.

4.1 System Block Diagram

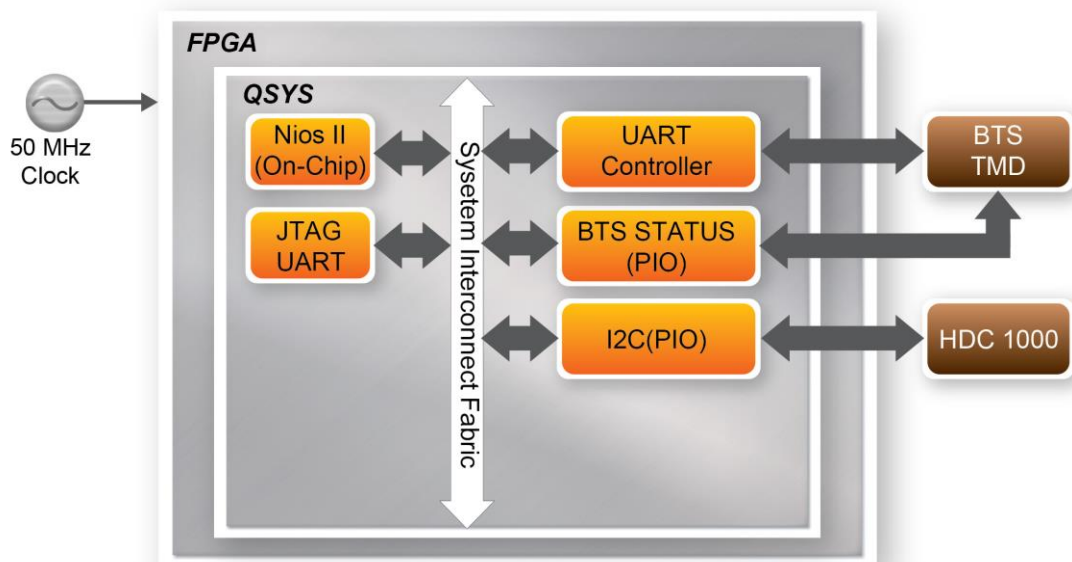


Figure 4-1 Block diagram of BTS-TMD demonstration

Figure 4-1 shows the system block diagram of this demonstration. The main Nios II program is stored in on-chip memory. The UART controller provides access for Nios II process to communicate with the BTS-TMD module via UART interface and transmit data. The BTS STATUS reads the connection status of BTS TMD. The I2C module reads the humidity and temperature of surrounding environment from the HDC 1000 chip via I2C protocol.

4.2 Command Mode

The BTS-TMD module uses RN-42 Bluetooth module from Microchip. The FPGA communicates with the module via UART and PIO interfaces. The UART interface is used to transmit data and send commands to the module. Users must send a special characters \$\$\$ to the module to enter the Command Mode prior to sending commands. Users can exist Command Mode by sending another special characters --\r. For other command set, please refer to the user guide of RN-42. This demonstration does not exercise the Command Mode.

4.3 DIP Switch Setting

The DIP switch setting in this demonstration is 0000 by default. For other settings, please refer to [Table4.1](#).

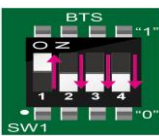
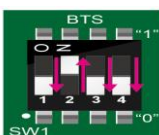
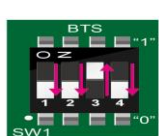
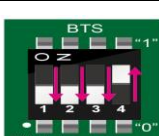
Function	Switch(icon)	Switch(value) (LSB->MSB)
Factory Reset		1000
Auto. Discovery/ Pairing		0100
Auto. Connect		0010
Baud Rate		0001

Table 4.1 BTS-TMD mode

- Factory Reset: Switch the LSB of the DIP switch three times when the module is powered up to reset and restore the factory setting, as shown in [Figure4-2](#). The LED will keep flashing for a second to indicate the reset is complete.
- Auto. Discovery/Pairing: This mode can let users pair specific device classes only and filter out others, but it requires users to designate the device classes in Command Mode first.
- Auto. Connect: This mode will connect pre-defined address of Bluetooth device, but it requires users to assign the address in Command Mode first.
- Baud Rate Setting: The baud rate will be set from 115200 to 9660 in this mode.



Figure 4-2 Reset and restore the factory setting

For more setting details, please refer to the user guide of RN-42.

4.4 Android Smartphone

This demonstration uses Android smartphone as the Bluetooth device. The information about the humidity and temperature of MAX 10 NEEK board will be transmitted to the Android smartphone after the installation of Bluetooth related APK. If users would like to transmit other information or message, please refer to the Nios II program and modify the contents accordingly.

4.5 Demonstration Source Code

- Quartus project directory: BTS_TMD
- Nios II Eclipse project workspace: BTS_TMD/software

4.6 Demonstration Setup

1. Please make sure both Quartus II and USB-Blaster II driver are installed on the host PC.
2. Connect the BTS-TMD module to the TMD expansion header of MAX 10 NEEK board.
3. Connect USB cable to the USB-Blaster II connector (J8) on the MAX 10 NEEK board and the host PC.
4. Power on the MAX 10 NEEK board.
5. Locate the "*BTS_TMD\demo_batch*" folder. Execute "*test.bat*" to start the configuration and download the demo application to the FPGA. **Figure 4-3** shows the successful message after execution.

```

Altera Nios II EDS 15.0 [gsd]
D:\Home\Nios\Desktop\NEEK18\BTS-TMD_demo_batch\altera\15.0.145\quartus\bin\64
\quartus_pgm.exe -n jtag -c 1 -o "jsgolden_top.sof"
Info:
Info: Booting Quartus II 64-Bit Programmer
Info: Version 15.0.0 Build 145 04/22/2015 64-Bit Full Version
Info: Copyright (C) 1991-2015 Altera Corporation. All rights reserved.
Info: Your use of Altera Corporation's design tools, logic functions
Info: and other software and tools, and its AMP partner logic
Info: functions, and any output files from any of the foregoing
Info: (including device programming or simulation files), and any
Info: associated documentation or information are expressly subject
Info: to the terms and conditions of the Altera Program License
Info: Subscription Agreement, the Altera Quartus II License Agreement,
Info: the Altera MegaCore Function License Agreement, or other
Info: applicable license agreement, including, without limitation,
Info: that some may be for the sole purpose of programming logic
Info: devices manufactured by Altera and sold by Altera or its
Info: authorized distributors. Please refer to the applicable
Info: agreement for further details.
Info: Processing started: Wed Jul 22 18:29:54 2015
Info: Command: quartus_pgm -n jtag -c 1 -o golden_top.sof
Info: C213045: Being programmed cable "NEEK18 USB-1"
Info: C213011: Being programming file golden_top.sof with checksum 0x005C176B for
Info: device 10001000F46452001
Info: C509960: Started Programmer operation at Wed Jul 22 18:29:54 2015
Info: C109916: Configuring device index 1
Info: C109917: Device 1 contains JTAG ID code 0x0105000
Info: C109907: Configuration succeeded -- 1 device(s) configured
Info: C109911: Successfully performed operation(s)
Info: C109913: JTAG Programmer operation at Wed Jul 22 18:29:55 2015
Info: Quartus II 64-Bit Programmer was successful, 0 errors, 0 warnings
Info: Peak virtual memory: 251 megabytes
Info: Processing ended: Wed Jul 22 18:29:55 2015
Info: Elapsed time: 00:00:01
Info: Total CPU time on all processors: 00:00:01
Info: Cable "NEEK18 USB-1", device 1, instance 0x00
Resetting and pausing target processor: OK
Initializing CPU cache (if present)
OK
Downloaded 95KB in 0.1s
Verified OK
Starting processor at address 0x01040240
nios2-terminal: connected to hardware target using JTAG UART on cable
nios2-terminal: "NEEK18 USB-1", device 1, instance 0
nios2-terminal: (Use the IDE stop button or Ctrl-C to terminate)
Manufacturer ID is 5449
Device ID is 1000
Read Configuration Data - 0x1000
Acquisition mode: Temperature and Humidity are acquired in sequence. Temperature f
Info:
Temperature Measurement Resolution: 14 bit.
Humidity Measurement Resolution: 14 bit.
Test success
Waiting....

```

Figure 4-3 Launch the BTS-TMD demonstration from the "demo_batch" folder

6. Users can download and install the Bluetooth APK from the link below to perform associated test. <https://play.google.com/store/apps/details?id=Qwerty.BlueoothTerminal>
7. Press Task Navigation Key after the installation. Select Connect a device – Secure to start searching for Bluetooth device, as shown in **Figure 4.4**. The BTS-TMD will appear as RNTB-XXXX (each and every BTS-TMD device comes with different combination of characters and numbers for the last-four digit).



Figure 4.4 Connect a device - secure

If the connection is established successfully, the LED on BTS-TMD will stay ON. The data will be transmitted from the BTS-TMD to the smartphone, as shown in **Figure 4-5**.



Figure 4-5 The data gathered on a smartphone after executing the demonstration

Chapter 5

Appendix

5.1 Revision History

<i>Version</i>	<i>Change Log</i>
V1.0	Initial Version (Preliminary)

5.2 Copyright Statement

Copyright © 2015 Terasic Technologies. All rights reserved.

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Terasic:](#)

[P0418](#)