BLE 5 Modules, BT840XEE

BluNor BT840XEE is a powerful, highly flexible, ultra low power Bluetooth Low Energy (BLE) using Nordic nRF52840 SoC. With an ARM Cortex™ M4F MCU, available 1MB flash, 256KB RAM, embedded 2.4GHz multi-protocol transceiver and a power amplifier. An u.FL and an MCX connectors for external antenna connection. It allows faster time to market with reduced development cost.

Bluetooth ranges are measured in environments with Low Multiple Path Interference (**LMPI**) and antenna at 5 feet (1.52 meters), typical height of thermostat in the USA. Ranges for LMPI, correlating to actual link budget, indicate the Bluetooth signal strength for penetrating walls in buildings.

Specifications:

- nRF52840 QIAA, ARM Cortex M4F, 64 MHz
- ARM® TrustZone® Cryptocell-310 co-processor
- Skyworks power amplifier SKY66112
- Complete RF solution with integrated antenna
- BLE 5 data rate: 2Mbps, 1Mbps, 500kbps,125kbps.
- DC-DC converter, inductors on board.
- Serial Wire Debug (SWD)
- Nordic SoftDevice Ready
- Over-the-Air (OTA) firmware update
- Flash/RAM: 1MB/256KB.
- 45 General purpose I/O pins
- USB 2.0 full speed (12 Mbps) controller
- QSPI 32 MHz interface
- High speed 32 MHz SPI
- Type 2 NFC-A tag with wake-on field, Touch-to-pair support
- Programmable peripheral interconnect (PPI)
- 12 bit/200 Ksps ADC, 8 configurable channels with programmable gain
- 64 level comparator

- 15 level comparator with wake-up from OFF.
- Temperature sensor
- 4x4-channel pulse width modulator (PWM)
- Audio peripherals: I2S, digital microphone interface (PDM)
- 5 x 32 bit timers with counter mode
- Up to 4x SPI masters/3x SPI slaves
- Up to 2x I2C compatible 2-wire masters/slaves
- 2x UART (CTS/RTS)
- Quadrature Demodulator (QDEC)
- 3x real time counters (RTC)
- 128-bit AES HW encryption
- SoC Receiver Sensitivity: -96 dBm at 1Mbps
- SoC TX power: programmable +8dBm to -20dBm. Up to +6 dBi antenna gain.
- Hybrid pins: 16 castellated and 45 LGA.
- 1 u.FL connector and 1 MCX connector
- Operation voltage: 1.7V to 5.5V
- Operation temperature: $-40°C$ to $+85°C$
- QDID: 108621,182626

Model Summaries

module			BT840XEE
SoC			nRF52840-QIAA
Size			15x28.0x1.9mm
BT Antenna			PA+u.FL+MCX
Max TX, radiated			
32.768 sleep crystal			Integrated
BT range,1 Mbps, LMPI			>1170 meters
BT range, 1Mbps, 1.52m			>1170 meters
BT range, 125 Kbps, LMPI.			>4500 meters
BT range, 125 kBps, 1.52m			>1920 meters
FCC ID			
Canada IC ID			
Europe CE, Australia RCM			
Japan TELEC			
Korea KCC			
Taiwan NCC			

Brazil ANTEL			
Availability			Production

1. Introduction

BluNor BT840XEE module is powerful, highly flexible, ultra low power wireless modules using Nordic nRF52840 SoCs. With an ARM Cortex^{TM} M4F MCU, 1MB flash, 256KB RAM, embedded 2.4GHz multi-protocol transceiver, and an integrated antenna, it allows faster time to market with reduced development cost.

The following is a block diagram of BT840XEE. The main clock and the sleep clock are integrated. All 45 GPIOs of
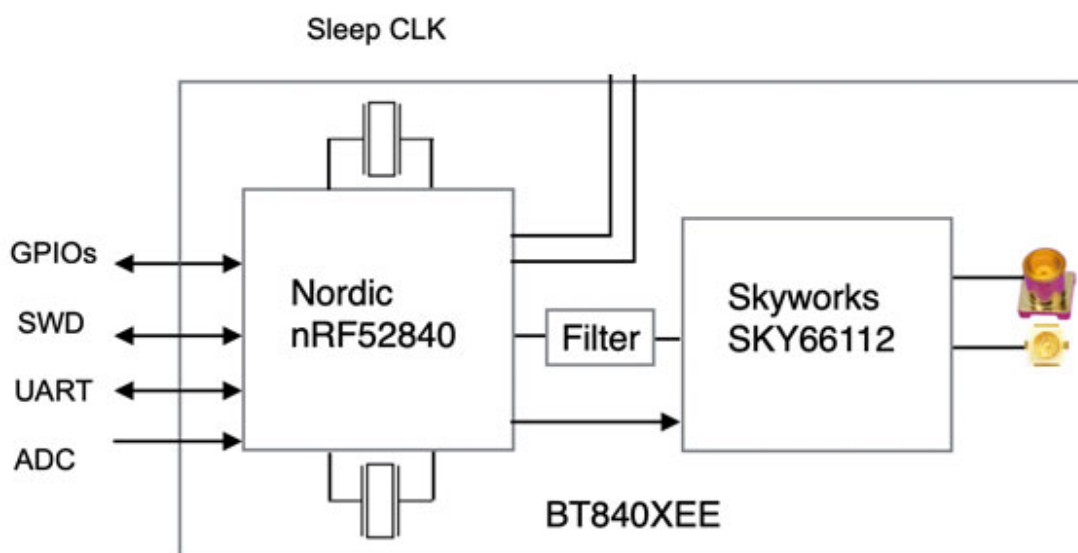
nRF52840 can be accessed from main board. Connection to an external NFC (Near Field Communication) antenna is provided.

BT840XEE

- Uses an nRF52840 QIAA with Cortex M4F MCU

- 1MB flash, 256 KB RAM

- Supports NFC

- Integrated SKY66112 power amplifier.

- Integrated 32.768 KHz sleep crystal.

- An u.FL connector for external antenna, a second MCX connector for external antenna.

- Size: 15x28x1.9mm.

2. Codes Development Using Nordic Tools

Development tools by Nordic and other third party development tools recommended by Nordic should be used.

Nordic development environment for nRF52840 offers a clean separation between application code development and embedded protocol stacks. This means compile, link and run time dependencies with the embedded stack and associated debugging challenges are removed. The Bluetooth low energy and ANT stack is a pre-compiled binary, leaving application code to be compiled stand-alone. The embedded stack interface uses an asynchronous and event driven model removing the need for RTOS frameworks.

Over-The-Air DFU

The nRF52840 is supported by an Over-The-Air Device Firmware Upgrade (OTA DFU) feature. This allows for in the field updates of application software and SoftDevice.

SoftDevices

The Nordic protocol stacks are known as SoftDevices and complement the nRF52 Series SoCs. All nRF52 Series are programmable with software stacks from Nordic. This bring maximum flexibility to application development and allows the latest stack version to be programmed into the SoC.

SoftDevices available from Nordic:
S140: Bluetooth low energy concurrent central/peripheral/observer/broadcaster stack.

Development Tools

Nordic Semiconductor provides a complete range of hardware and software development tools for the nRF52 Series devices. nRF52 DK board is recommended for firmware development.

Nordic software development tools can be downloaded from the following webpage.

http://infocenter.nordicsemi.com/index.jsp?topic=/com.nordic.infocenter.nrf52/dita/nrf52/development/nrf52_dev_kit.html&cp=1_1
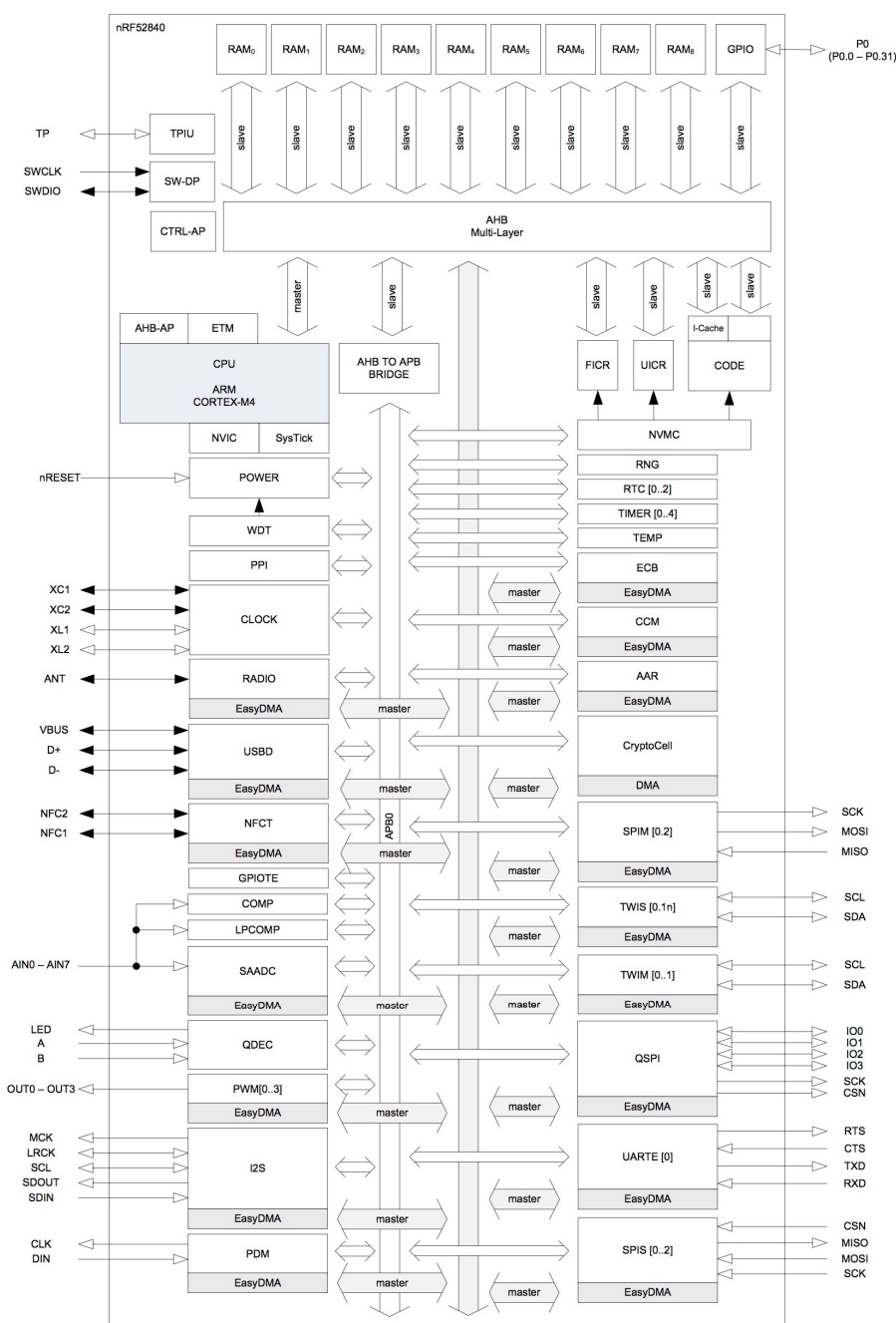
3. Product Descriptions

Brief description of nRF52840 SoC is provided. For full description of the SoC, please download from Nordic Semiconductor website.

https://www.nordicsemi.com/eng/Products/Bluetooth-low-energy

Block Diagram of nRF52840

The following is a block diagram of Nordic nRF52840 Bluetooth Low Energy (BLE) SoC. Arrows with white heads

indicate signals that share physical pins with other signals.

The 32 bit ARM Cortex M4F MCU with hardware supports for DSP instructions and floating point operations, code density and execution speed are higher than other Cortex M MCU. The Programmable Peripheral Interconnect (PPI) system provides a 20-channel bus for direct and autonomous system peripheral communication without CPU intervention. This brings predictable latency times for peripheral to peripheral interaction and power saving benefits associated with leaving CPU idle. The device has 2 global power modes ON/OFF, but all system blocks and peripherals have individual power management control which allows for an automatic switching RUN/IDLE for system blocks based only on those required/not required to achieve particular tasks.

The radio supports Bluetooth low energy and ANT. Output power is scalable from a maximum of +8dBm down to -20 dBm in 4dB steps. Sensitivity is increased to -96 dBm to -89 dBm, depending on data rate. Sensitivity for BLE is -96 dBm, and -92.5 dBm for ANT.

The NFC block supports NFC-A tags with proximity detection and Wake-on-field from low power mode. The NFC enables Out-Of-Band (OOB) Bluetooth pairing of devices and thus greatly simplifying deployment.

ARM Trustzone CryptoCell 310

ARM® TrustZone® CryptoCell-310 co-processor is a security subsystem which provides Root of Trust (RoT) and cryptographic services for a device. CryptoCell services are available to the application through a software library API, not a hardware register
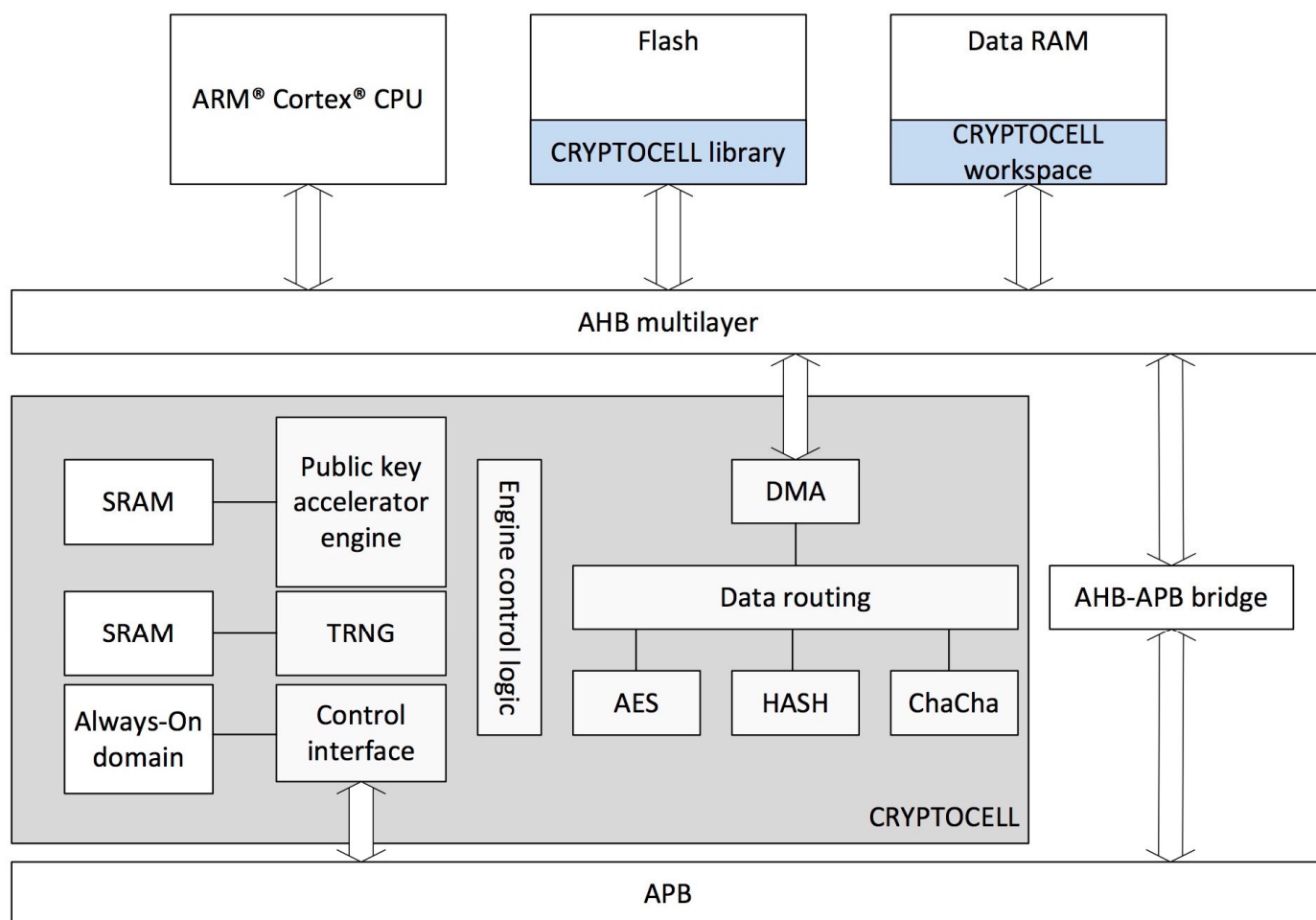
interface.

The following cryptographic features are provided.

- FIPS-140-2 certified True Random Number Generator (TRNG)

- RSA asymmetric encryption

  - Up to 2048 bit key size

  - PKCS#1 v2.1/v1.5

  - Optional CRT support

- Elliptic curve cryptography (ECC)

  - NIST FIPS 186-4 recommended curves using pseudo-random parameters, up to 521 bits:

➢ Prime field: P-192, P-224, P-256, P-384, P-521

⬤ SEC 2 recommended curves using pseudo-random parameters, up to 521 bits:

➢ Prime field: P-160, P-192, P-224, P-256, P-384, P-521

⬤ Koblitz curves using fixed parameters, up to 256 bits:

➢ Prime field: P-160, P-192, P-224, P-256

⬤ Edwards/Montgomery curves:

➢ Ed25519, Curve 25519

⬤ ECDH/ECDSA support

• Secure remote password protocol (SRP)

⬤ Up to 3072 bit operations

• Hashing functions

⬤ SHA-1, SHA-2 up to 256 bit size

⬤ keyed-hash message authentication code (HMAC)

• AES symmetric encryption

⬤ General purpose AES engine (encrypt/decrypt, sign/verify)

⬤ 128 bit key size

⬤ Supported encryption modes: ECB, CBC, CMAC/CBC-MAC, CTR, CCM/CCM*.

• ChaCha20/Poly1305 symmetric encryption

⬤ Supported keyed size: 128 and 256 bits

⬤ Authenticated encryption with associated data (AEAD) mode
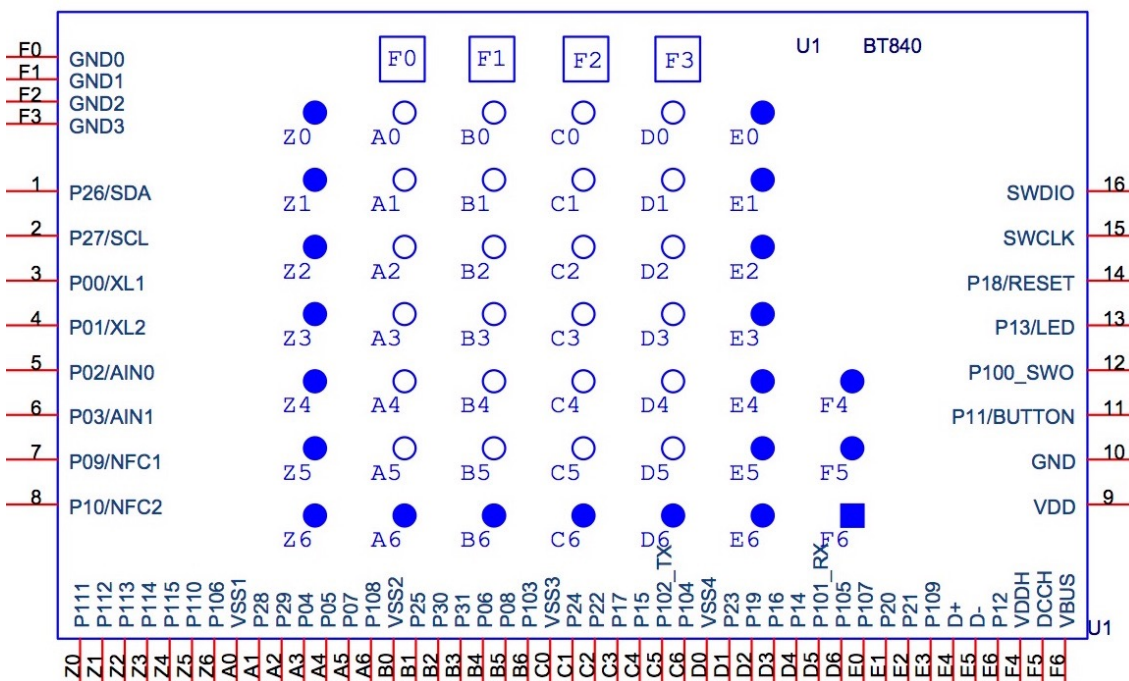
Mechanical Drawings

BT840XEE mechanical drawings
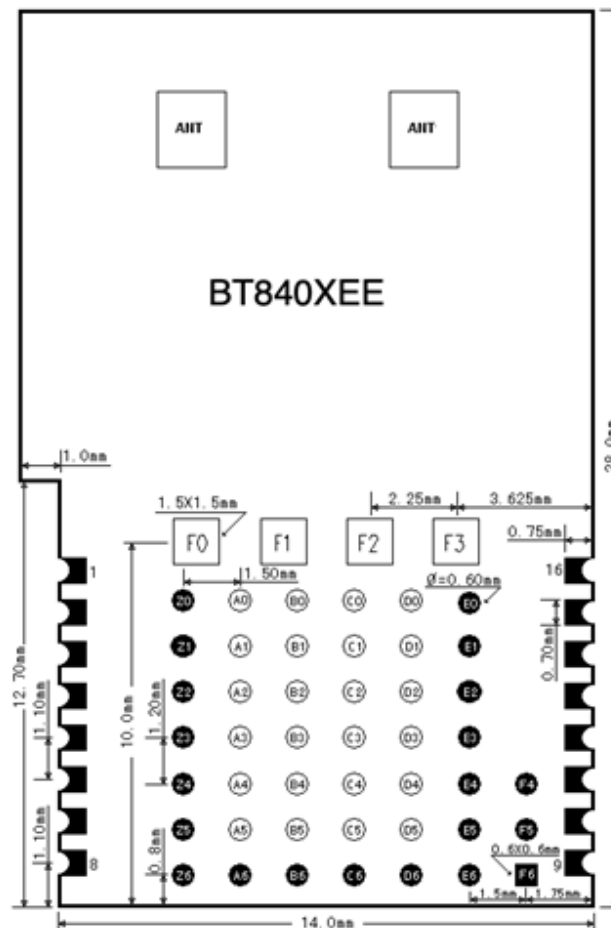
Pin Assignments of BT840

The followings are BT840 pin assignment. Pin functions are in a table in next section. Please refer to Nordic nRF52840 Product Specifications for detailed descriptions and features supported.

https://www.nordicsemi.com/eng/Products/nRF52840

BT840XEE pin assignments

BT840XEE	52840		
pin#	pin#	pin name	Descriptions
1	G1	P0.26/SDA	GPIO, configured as I2C SDA on EV-BT840
2	H2	P0.27/SCL	GPIO, configured as I2C SCL on EV-BT840
3	D2	P0.00/XL1	GPIO, connection for 32.768kHz crystal
4	F2	P0.01/XL2	GPIO, connection for 32.768kHz crystal
5	A12	P0.02/AIN0	GPIO, Analog input
6	B13	P0.03/AIN1	GPIO, Analog input
7	L24	P0.09/NFC1	GPIO, NFC antenna connection
8	J24	P0.10/NFC2	GPIO, NFC antenna connection
9	B1	VDD	DC supply 1.7V to 3.6V
10	B7	GND	Ground
11	T2	P0.11	GPIO
12	AD22	P1.00	GPIO
13	AD8	P0.13	GPIO

	14	AC13	P0.18/RESET	GPIO, internal RC reset circuit, configurable as RESET pin
	15	AA24	SWDCLK	Serial Wire Debug clock input
	16	AC24	SWDIO	Serial Wire Debug I/O
Z0		B19	P1.11	GPIO
Z1		B17	P1.12	GPIO
Z2		A16	P1.13	GPIO
Z3		B15	P1.14	GPIO
Z4		A14	P1.15	GPIO
Z5		A20	P1.10	GPIO
Z6		R24	P1.06	GPIO
A0			GND	Ground
A1		B11	P0.28/AIN4	GPIO, Analog input
A2		A10	P0.29/AIN5	GPIO, Analog input
A3		J1	P0.04/AIN2	GPIO, Analog input
A4		K2	P0.05/AIN3	GPIO, Analog input
A5		M2	P0.07	GPIO
A6		P2	P1.08	GPIO
B0			GND	Ground
B1		AC21	P0.25	GPIO
B2		B9	P0.30/AIN6	GPIO
B3		A8	P0.31/AIN7	GPIO
B4		L1	P0.06	GPIO, NC for BT840X, BT840XE, PA control
B5		N1	P0.08	GPIO, NC for BT840X, BT840XE, PA control
B6		V23	P1.03	GPIO
C0			GND	Ground
C1		AD20	P0.24	GPIO
C2		AD18	P0.22	GPIO
C3		AD12	P0.17	GPIO, NC for BT840X,BT840XE, PA control
C4		AD10	P0.15	GPIO
C5		W24	P1.02	GPIO
C6		U24	P1.04	GPIO
D0			GND	Ground
D1		AC19	P0.23	GPIO
D2		AC15	P0.19	GPIO, NC for BT840 X,BT840XE, PA control
D3		AC11	P0.16	GPIO
D4		AC9	P0.14	GPIO
D5		Y23	P1.01	GPIO
D6		T23	P1.05	GPIO
E0		P23	P1.07	GPIO
E1		AD16	P0.20	GPIO

E2	AC17	P0.21	GPIO
E3	R1	P1.09	GPIO
E4	AD6	D+	USB D+
E5	AD4	D-	USB D-
E6	U1	P0.12	GPIO
F0			Ground pad
F1			Ground pad
F2			Ground pad
F3			Ground pad
F4	Y2	VDDH	High Voltage Power Supply. See Note 1.
F5	AB2	DCCH	DC to DC converter output
F6	AD2	VBUS	5V DC power for USB 3.3V regulator

Pin Function

Note 1: BT840XEE must be powered by an externally regulated DC supply to the VDD pin. To have FCC certified, maximum TX power, the DC voltage shall be 3.3V, 300 mA minimum. If you apply DC power to the VDDH pin, the internally generated DC output is not enough to power the SKYWORKS power amplifier.

Mounting BT840EE on the Host PCB

There is no restriction on mounting BT840XEE on the host PCB.

Control Skyworks Power Amplifier

BT840XEE uses SKYWORKS SKY66112-11 power amplifier. The connection diagram with control signal pins is below.
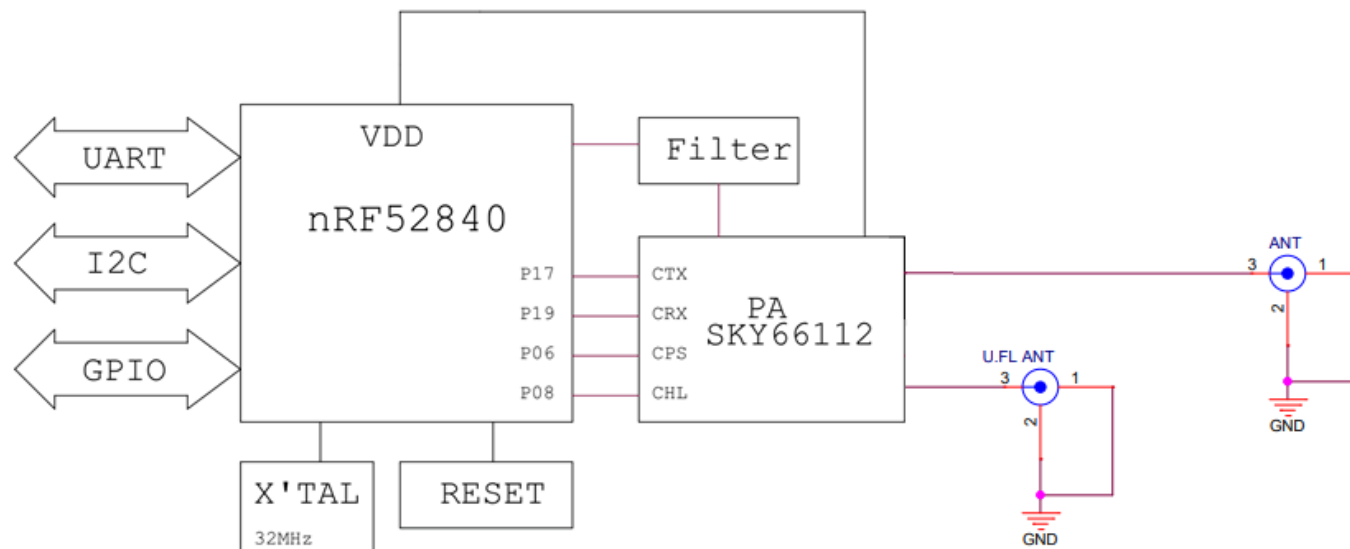
Frequency Band from 2402 MHz to 2480 MHz.

A firmware example to control Skyworks SKY66112 power amplifier is below. This firmware file can be downloaded from http://www.fanstel.com/download-document/.

- BT840XEE: Set nRF52840 MCX TX to +0 dBm. U.FL TX to +3 dBm.

Header files

#ifndef PA_LNA_H__
#define PA_LNA_H__

#include "ble.h"
#include "app_error.h"
#include "nrf_drv_gpiote.h"
#include "nrf_drv_ppi.h"

void pa_lna_init(uint32_t gpio_pa_pin, uint32_t gpio_lna_pin);

#endif

Main program.

#include "pa_lna.h"

#define APP_PA_LAN

#ifdef APP_PA_LAN

```
#define APP_PA_PIN     17
#define APP_LNA_PIN    19
#define APP_CHL_PIN 8
#define APP_CPS_PIN 6


int main(void)
{
....
#ifdef APP_PA_LAN
        nrf_gpio_cfg_output(APP_CPS_PIN);
        nrf_gpio_cfg_output(APP_CHL_PIN);
        nrf_gpio_pin_set(APP_CHL_PIN);
        nrf_gpio_pin_clear(APP_CPS_PIN); //enable
        pa_lna_init(APP_PA_PIN,APP_LNA_PIN);
#endif
....
}
```

SKY66112 control codes.

```
#include <stdint.h>
#include <string.h>

#include "pa_lna.h"
#include "ble.h"
#include "app_error.h"
#include "nrf_drv_gpiote.h"
#include "nrf_drv_ppi.h"

void pa_lna_init(uint32_t gpio_pa_pin, uint32_t gpio_lna_pin)
{
  ble_opt_t opt;
  uint32_t gpiote_ch = NULL;
  ret_code_t err_code;

  memset(&opt, 0, sizeof(ble_opt_t));

  err_code = nrf_drv_gpiote_init();
  if(err_code != NRF_ERROR_INVALID_STATE)
    APP_ERROR_CHECK(err_code);

  err_code = nrf_drv_ppi_init();
```

```
//if(err_code != MODULE_ALREADY_INITIALIZED)
   APP_ERROR_CHECK(err_code);

nrf_ppi_channel_t ppi_set_ch;
nrf_ppi_channel_t ppi_clr_ch;

err_code = nrf_drv_ppi_channel_alloc(&ppi_set_ch);
APP_ERROR_CHECK(err_code);

err_code = nrf_drv_ppi_channel_alloc(&ppi_clr_ch);
APP_ERROR_CHECK(err_code);

nrf_drv_gpiote_out_config_t config = GPIOTE_CONFIG_OUT_TASK_TOGGLE(false);

if((gpio_pa_pin == NULL) && (gpio_lna_pin == NULL))
{
   err_code = NRF_ERROR_INVALID_PARAM;
   APP_ERROR_CHECK(err_code);
}

if(gpio_pa_pin != NULL)
{
   if(gpiote_ch == NULL)
   {
      err_code = nrf_drv_gpiote_out_init(gpio_pa_pin, &config);
      APP_ERROR_CHECK(err_code);

      gpiote_ch = nrf_drv_gpiote_out_task_addr_get(gpio_pa_pin);
   }

   // PA config
   opt.common_opt.pa_lna.pa_cfg.active_high = 1;   // Set the pin to be active high
   opt.common_opt.pa_lna.pa_cfg.enable      = 1;   // Enable toggling
   opt.common_opt.pa_lna.pa_cfg.gpio_pin    = gpio_pa_pin; // The GPIO pin to toggle tx
}

if(gpio_lna_pin != NULL)
{
   if(gpiote_ch == NULL)
   {
      err_code = nrf_drv_gpiote_out_init(gpio_lna_pin, &config);
      APP_ERROR_CHECK(err_code);

      gpiote_ch = nrf_drv_gpiote_out_task_addr_get(gpio_lna_pin);
   }

   // LNA config
   opt.common_opt.pa_lna.lna_cfg.active_high  = 1; // Set the pin to be active high
   opt.common_opt.pa_lna.lna_cfg.enable       = 1; // Enable toggling
   opt.common_opt.pa_lna.lna_cfg.gpio_pin     = gpio_lna_pin;  // The GPIO pin to toggle rx
}
```

```
    // Common PA/LNA config
    opt.common_opt.pa_lna.gpiote_ch_id  = (gpiote_ch - NRF_GPIOTE_BASE) >> 2;   // GPIOTE channel used for radio
pin toggling
    opt.common_opt.pa_lna.ppi_ch_id_clr = ppi_clr_ch;   // PPI channel used for radio pin clearing
    opt.common_opt.pa_lna.ppi_ch_id_set = ppi_set_ch;   // PPI channel used for radio pin setting

    err_code = sd_ble_opt_set(BLE_COMMON_OPT_PA_LNA, &opt);
    APP_ERROR_CHECK(err_code);
}
```

4. Bluetooth Range

Settings for Certification Testings

Settings for BT840XEE:

• nRF52840 SoC TX is set to +2dBm for FCC and ISED testings.

• nRF52840 SoC TX is set to -4 dBm for CE and RCM testings.

• BT840XEE passes FCC, ISED, CE, and RCM certification testings with ANT000, a 0dBi antenna.

• BT840XEE passes FCC and ISED certification testings with ANT060, a 6 dBi antenna.

• VDD is set to 3.3V.

Bluetooth ranges are measured with settings for FCC certification testings.

Bluetooth Range Measurements

Bluetooth range measurement reports and hex codes used in measurements can be downloaded from **Bluetooth Range Measurements** section of this webpage. Settings for passing FCC certification testing is used.

http://www.fanstel.com/download-document/

Bluetooth ranges are measured between 2 modules on evaluation boards for various height of antenna. On the first measurement, both antennas are pointing to sky and facing each other. The second antenna is rotated by 30 degrees

Antenna, top view   Rotated by 30 degrees

Bluetooth range measurement
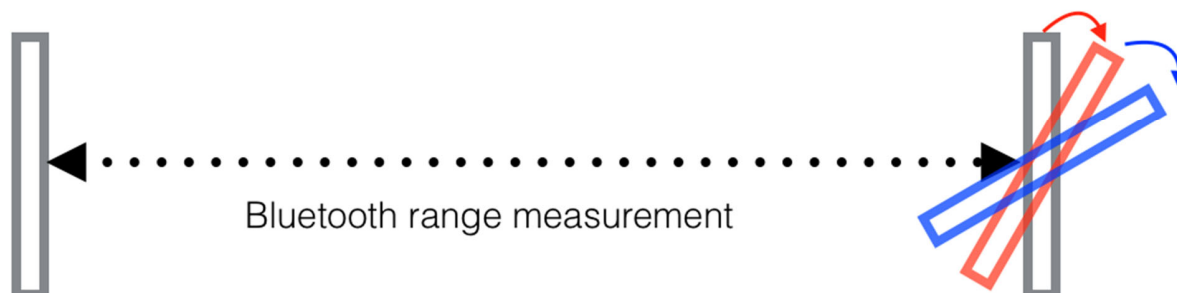
clockwise after each measurement.

Bluetooth range is specified as the average of 12 measurements with the least significant digit truncated.

  • 1.52 meters (60 inches) is typical height of thermostat in the USA.

  • 0.55 meter (21.5 inches) is typical height of antenna if an IoT device is plugged into a wall AC outlet in the USA. When USB840F USB dongle is plugged into a smart phone charger plugging into a wall AC outlet to collect Bluetooth sensor data or to be used as a Bluetooth signal repeater.

- Low Multiple Path Interference (**LMPI**). For longer range measurement, antenna must be higher to have LMPI. To have LMPI, 60% clearance is required. For example, if transmitter and receiver is 1000 meters away, both antennas

Distance, m 2400MHz	10	50	100	200	400	600	1000	1500	2000	3000	5000	10000
Fresnel Zone radius, m	0.55	1.24	1.75	2.48	3.51	4.29	5.54	6.79	7.84	9.60	12.40	17.53
80% clearance, m	0.44	0.99	1.40	1.98	2.81	3.44	4.44	5.43	6.27	7.68	9.92	14.03
60% clearance, m	0.33	0.74	1.05	1.49	2.10	2.58	3.33	4.07	4.70	5.76	7.44	10.52

must be 3.33 meters above ground and away from any obstruction.

The followings are Bluetooth range measurement results.

Antenna height	LMPI	1.52 meters	0.55 meter
BT840XEE with ANT000 range, 125 Kbps	>4500 meters	1920 meters	
BT840XEE with ANT000 range, 1Mbps	1170 meters	1170 meters	

-

- Bluetooth ranges of BT840X and BT840XE at 125 Kbps and LMPI, is verified to exceed 4500 meters, maximum range of test site used in May 2019.

- Range of BT840XE with +21.0 dBm max TX is longer than BT840X with +22.6 dBm max TX. Antenna ANT000 is almost omni-directional. The integrated antenna of BT840X is not. Range is shorter for some angles. Result is the average of 12 measurements.

- The Bluetooth range between two BT840XE and ANT060 is not measured yet.

Recommendation for Long Range Applications

The followings are certification test result summaries of long range nRF52840 modules. Antenna gain is added to TX power measured by FCC test labs. FCC test labs measure the maximum transmission power of all frequencies to make sure none exceeds FCC regulation.

BT840F Bluetooth range is average of 12 measurements. BT840X, BT840XE, and BT840E are verified at ranges indicated. Theoretical ranges are longer. We can not verify because of test site limitation.

module	BT840F	BT840F	BT840E	BT840X	BT840XE
BT Antenna	PCB trace	PCB trace	ANT060	PCB trace + PA	PA+ANT060
Max TX FCC, ISED	+8.8 dBm	+6.7 dBm	+14.4 dBm	+22.6 dBm	+27.0 dBm
Max TX, CE, RCM (EIRP)	+8.5 dBm	+5.4 dBm	+8.2 dBm	+16.07 dBm	+16.07 dBm
BT range,1 Mbps (FCC TX)		1000 meters		1170 meters	>1170 meters
BT range, 125 Kbps(FCC TX)	3000M, est.	2300 meters	>3400M, est.	>4500 meters	>4500 meters
FCC ID	X8WBT840F	X8WBT840	X8WBT840F	X8WBT840X	X8WBT840X
CE	Compliant	Compliant	Compliant	Compliant	Compliant
RCM	Compliant	Compliant	Compliant	Compliant	Compliant
TELEC	201-190710/00	201-190710/00	201-190710/00		

Receiver sensitivity gain of the SKY66112 LNA (Low Noise Amplifier) in BT840X/XE is measured at 1.5 dB. Transmitter gain is 22.6-8.8=13.6 dB. BT840E is certified with a 6dBi antenna ANT060.

- If you use the same module for both sides, BT840X/XE provides the best range. However, power consumption of BT840X/XE is high, battery life is short.

- If your beacons and sensors do not use Fanstel long range modules, BT840E with ANT060 provides the best receiver sensitivity in gateway application.

BT840/BT840E/BT840F were re-certified in 2019 for both Bluetooth and IEEE 802.15.4 in 2019. Modules with date codes 2001 or newer are made per 2019 FCC certification specifications.

BT840XE Maximum Link Budget Calculation

BT840XE is FCC and ISED certified with ANT060, a 6 dBi antenna. Using the following specifications:

- nRF52840 receiver sensitivity is -95 dBm at 1Mbps per Nordic product specifications.

- nRF52840 receiver sensitivity is -103 dBm at 125 Kbps per Nordic product specifications.

- SKY66112 receiver gain is measured at 1.5 dB by Fanstel. The receiver gain is 11 dB per Skyworks data sheets. Fanstel measures the increase in Bluetooth range in the Arizona desert without and with SKY66112.

- BT840XE Max TX power is +21.0 dBm per FCC test report.

- Maximum gain of ANT060 is 6 dBi per antenna manufacturer.

The link budget between two BT840XE.

- Up to 129 dB at 1Mbps.

- Up to 137 dB at 125 Kbps.

5. AT Commands

AT command codes are used in production testing. They are not erased before shipping. If you develop your own codes, please do *chiperase* and reprogram with your codes.

User manual and the newest AT Commands hex codes can be downloaded from **AT Command Hex Codes, Bluetooth 5** section of this web page.
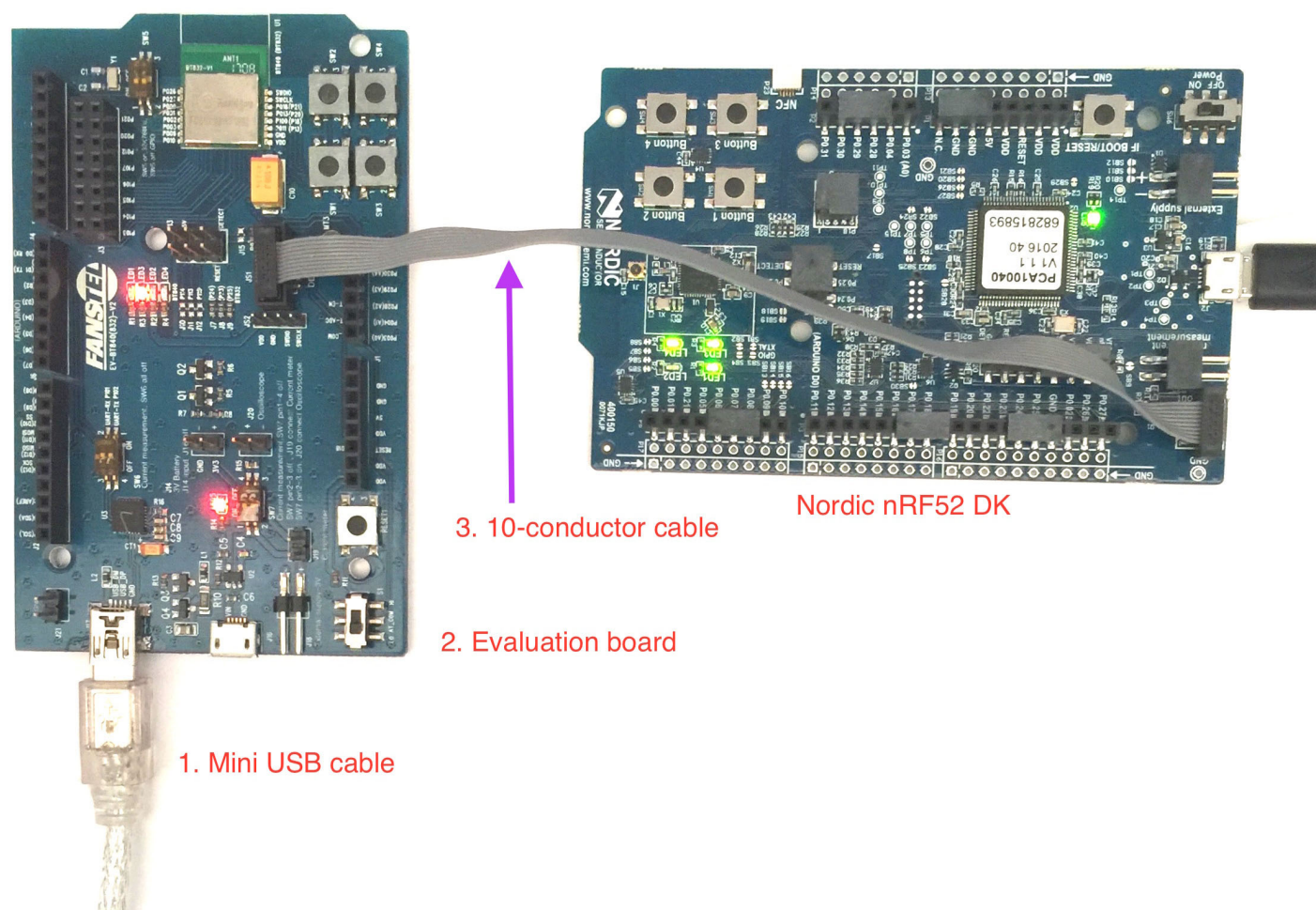
http://www.fanstel.com/download-document/

AT commands can be used on UART interface and SPI interface. The preloaded codes use UART interface.

6. BT840F Evaluation Board

An evaluation board consists of the followings:

• Mini USB cable

• Evaluation board

• 10-conductor cable for connection to Nordic nRF52 DK (DK is not included)

Nordic nRF52 DK

3. 10-conductor cable

2. Evaluation board

1. Mini USB cable

Nordic Development Tools

A Nordic nRF52 DK is recommended for programming this evaluation board. Nordic development tools can be downloaded from:

https://www.nordicsemi.com/eng/Products/nRF52840

Many application examples can be downloaded from Nordic website.

Some firmware, Android OS, and iOS app codes can be downloaded from **Bluetooth 5 Codes section** of this Fanstel webpage.

http://www.fanstel.com/download-document/

BT840 firmware can be used in all nRF52840 modules, e.g., BT840, BT840F, and BT840E.

Android OS Apps

The following Android OS apps are available for download from Google Play Store:

BlueNor nrf5x: to use with Bluetooth 5 stacks, AT commands, or Slave firmware. Master firmware does not connect to a smartphone. Source codes can be downloaded from http://www.fanstel.com/download-document/

BlueNor Mesh: to use with BlueNor mesh firmware to send command to any node in a mesh. Node number is displayed when acknowledgement is received. Source codes will be uploaded to Fanstel website when supporting Bluetooth 5.

iOS Apps

The following iOS apps can be downloaded from Apple APP Store.

BlueNor Mesh: to use with BlueNor mesh firmware to send command to any node in a mesh. Node number is displayed when acknowledgement is received.
BlueNor nrf5x firmware, apps, and source codes will be uploaded when ready.

BT840F V4 EvaluationBoard Schematics

Evaluation board schematics and Gerber files can be downloaded from

http://www.fanstel.com/download-document/
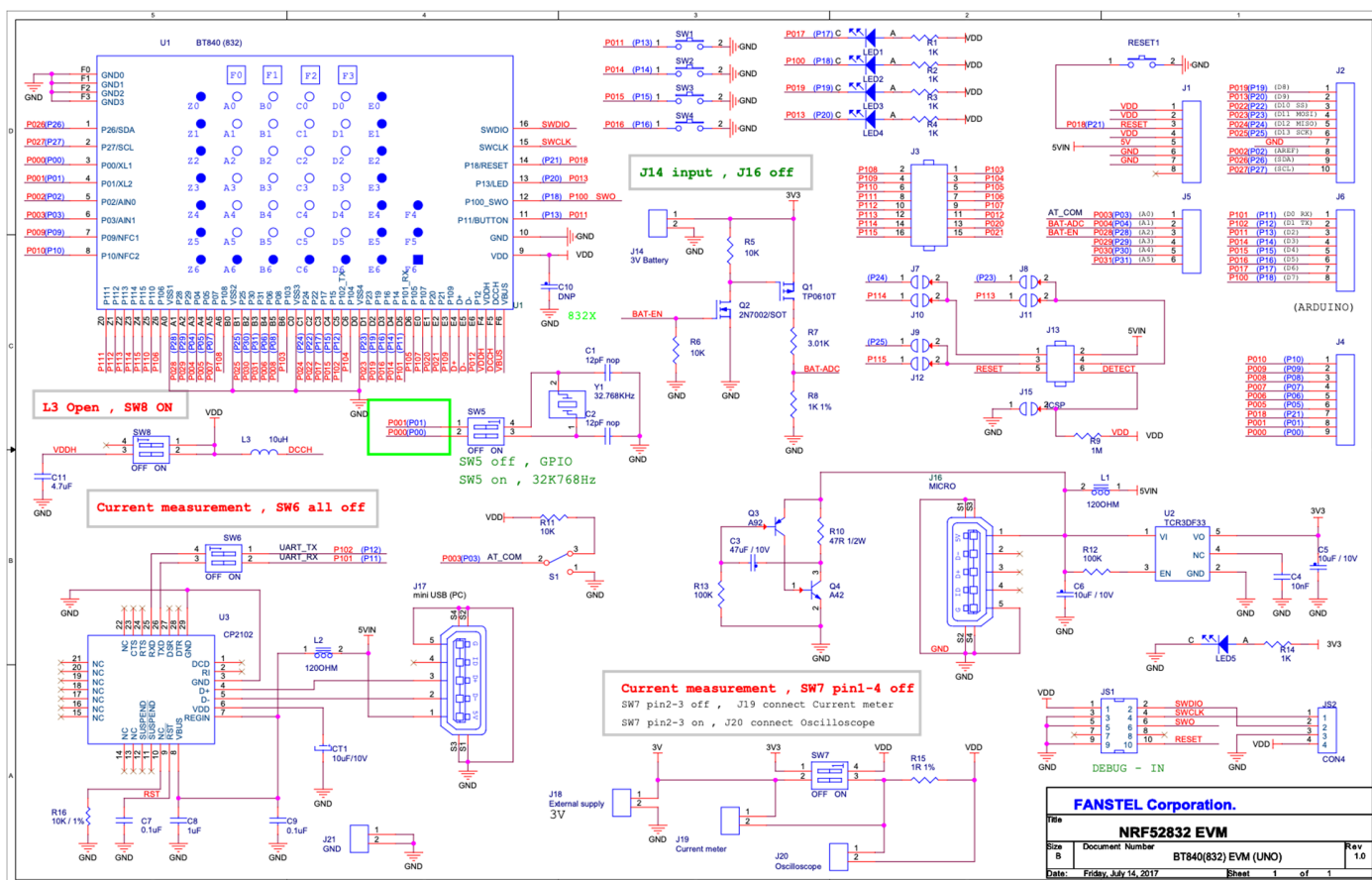
Evaluation board can be used as a reference design for using modules. EV BT840F V4 is designed for the BT840F soldering pads with 61 pins. These 21 pins in solid dark color are for BT840F.

EV BT840F V4 evaluation board is developed for BT840F and BT832X. It can be used for BT832 and BT832F. Pins in solid color are used only for BT840F. Blue color pin names around U1 BT840(832) are for BT832/BT832F/BT832X. Red color pin names are for BT840F/BT840/BT840E. Firmware pin configuration is required for a host board to accommodate BT840F/BT840/BT840E and BT832/BT832F/BT832X.

Additional feature enhancements for version V4 evaluation board:

1. It has the same foot print as Arduino Uno R3. Additional connectors are added for connection to extra GPIO pins of BlueNor modules.

2. EV BT840F is not an UNO R3 compatible board. You can use Nordic develop tools to develop firmware for many UNO R3 compatible shields.

3. Portable smartphone charger can be used to power this board. The circuitry to the left of micro USB connector, J16 produces periodic load to prevent portable smartphone charger from shutting down.

Suggestion for Battery Power Application

Standby current consumption is important for battery-powered product. We suggest adding a 32.768 kHz crystal and 2 capacitors on host board. The 32MHz main clock won't be active at idle state to save power.

Two inductors required for on-board DC to DC converter are inside BT840F. You can enable DCDC converter to have lower power consumption.

7. Miscellaneous

Soldering Temperature-Time Profile for Re-Flow Soldering

Maximum number of cycles for re-flow is 2. No opposite side re-flow is allowed due to module weight.
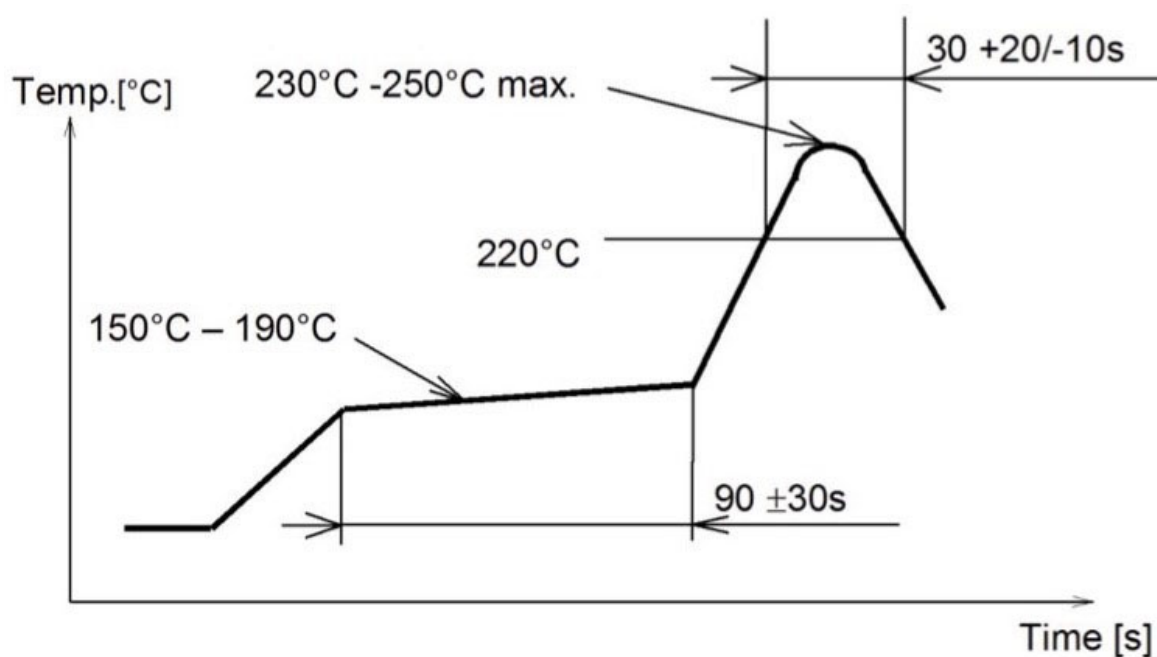
Cautions, Design Notes, and Installation Notes

Failure to follow the guidelines set forth in this document may result in degrading of the product's functions and damage to the product.

Design Notes

(1) Follow the conditions written in this specification, especially the control signals of this module.

(2) The supply voltage has to be free of AC ripple voltage (for example from a battery or a low noise regulator output). For noisy supply voltages, provide a decoupling circuit (for example a ferrite in series connection and a bypass capacitor to ground of at least 47uF directly at the module).

(3) This product should not be mechanically stressed when installed.

(4) Keep this product away from heat. Heat is the major cause of decreasing the life of these products.

(5) Avoid assembly and use of the target equipment in conditions where the products' temperature may exceed the maximum tolerance.

(6) The supply voltage should not be exceedingly high or reversed. It should not carry noise and/or spikes.

(7) this product away from other high frequency circuits.

Notes on Antenna and PCB Layout

(1) Don't use a module with internal antenna inside a metal case.

(2) For PCB layout:

- Avoid running any signal line below module whenever possible,
- No ground plane below antenna,
- If possible, cut-off the portion of main board PCB below antenna.

Installation Notes

(1) Reflow soldering is possible twice based on the time-temperature profile in this data sheets. Set up the temperature at the soldering portion of this product according to this reflow profile.

(2) Carefully position the products so that their heat will not burn into printed circuit boards or affect the other components that are susceptible to heat.

(3) Carefully locate these products so that their temperatures will not increase due to the effects of heat generated by neighboring components.

(4) If a vinyl-covered wire comes into contact with the products, then the cover will melt and generate toxic gas, damaging the insulation. Never allow contact between the cover and these products to occur.

(5) This product should not be mechanically stressed or vibrated when reflowed.

(6) If you want to repair your board by hand soldering, please keep the conditions of this chapter.

(7) Do not wash this product.

(8) Refer to the recommended pattern when designing a board.

(9) Pressing on parts of the metal cover or fastening objects to the metal will cause damage to the unit.

Usage Condition Notes

(1) Take measures to protect the unit against static electricity. If pulses or other transient loads (a large load applied in a short time) are applied to the products, check and evaluate their operation before assembly on the final products.

(2) Do not use dropped products.

(3) Do not touch, damage or soil the pins.

(4) Follow the recommended condition ratings about the power supply applied to this product.

(5) Electrode peeling strength: Do not add pressure of more than 4.9N when soldered on PCB

(6) Pressing on parts of the metal cover or fastening objects to the metal cover will cause damage.

(7) These products are intended for general purpose and standard use in general electronic equipment, such as home appliances, office equipment, information and communication equipment.

Storage Notes

(1)The module should not be stressed mechanically during storage.

(2)Do not store these products in the following conditions or the performance characteristics of the product, such as RF performance will be adversely affected:

- Storage in salty air or in an environment with a high concentration of corrosive gas.

- Storage in direct sunlight

- Storage in an environment where the temperature may be outside the range specified.

- Storage of the products for more than one year after the date of delivery storage period.

(3) Keep this product away from water, poisonous gas and corrosive gas.

(4) This product should not be stressed or shocked when transported.

(5) Follow the specification when stacking packed crates (max. 10).

Safety Conditions

These specifications are intended to preserve the quality assurance of products and individual components. Before use, check and evaluate the operation when mounted on your products. Abide by these specifications, without deviation when using the products. These products may short-circuit. If electrical shocks, smoke, fire, and/or accidents involving human life are anticipated when a short circuit occurs, then provide the following failsafe functions, as a minimum.

(1)Ensure the safety of the whole system by installing a protection circuit and a protection device.

(2)Ensure the safety of the whole system by installing a redundant circuit or another system to prevent a dual fault causing an unsafe status.

Other Cautions

(1)This specification sheet is copyrighted. Reproduction of this data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices.

(2)Do not use the products for other purposes than those listed.

(3)Be sure to provide an appropriate failsafe function on your product to prevent an additional damage that may be caused by the abnormal function or the failure of the product.

(4)This product has been manufactured without any ozone chemical controlled under the Montreal Protocol.

(5)These products are not intended for other uses, other than under the special conditions shown below. Before using these products under such special conditions, check their performance and reliability under the said special conditions carefully to determine whether or not they can be used in such a manner.

- In liquid, such as water, salt water, oil, alkali, or organic solvent, or in places where liquid may splash.

- In direct sunlight, outdoors, or in a dusty environment

- In an environment where condensation occurs.

- In an environment with a high concentration of harmful gas.

(6) If an abnormal voltage is applied due to a problem occurring in other components or circuits, replace these products with new products because they may not be able to provide normal performance even if their electronic characteristics and appearances appear satisfactory.

(7) When you have any question or uncertainty, contact Fanstel.

Packaging and Lot Number

Production modules are delivered in reel, 1000 modules in each reel. Lot number for modules made after May

Lot: **D0 V2 18B - 00 00 000**

D0: 2 digits, version number of SoC.
V2: 2 digits, version number of module PCB.
18B: the first 2 digits for production test codes released year and the last digit for month in hex format. A=October, B=November, C=December. 18B was released in November 2018.
00 00 000, 7 digits, reserved for 2nd SoC for modules with 2 SoCs.

2019, can be used to track silicon version of SoC, module PCB version, and production test code version.

FCC LABEL

The Original Equipment Manufacturer (OEM) must ensure that the OEM modular transmitter must be labeled with its own FCC ID number. This includes a clearly visible label on the outside of the final product enclosure that displays the contents shown below. If the FCC ID is not visible when the equipment is installed inside another device, then the outside of the device into which the equipment is installed must also display a label referring to the enclosed equipment

The end product with this module may subject to perform FCC part 15 unintentional emission test requirement and be properly authorized.

This device is intended for OEM integrator only.

Revision History

• Sep. 2022, Ver. 0.99: Initial release

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Federal Communications Commission (FCC) Statement

15.21
You are cautioned that changes or modifications not expressly approved by the part responsible for compliance could void the user's authority to operate the equipment.

15.105(b)
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.

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

of the device.

- **FCC RF Radiation Exposure Statement**
-
- 1) This Transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

2) This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed.
Note: The end product shall has the words "Contains Transmitter Module FCC ID: X8WBT840XEE"

Canada, Industry Canada (IC)

(1)   This Class B digital apparatus complies with Canadian ICES-003
Cet appareil numérique de classe B est conforme à la norme NMB-003.

This device complies with Industry Canada licence-exempt RSS standard(s).Operation is subject

to the following two conditions: (1) this device may not cause interference, and (2) this device

must accept any interference, including interference that may cause undesired operation of the

Le present appareil est conforme aux CNR d'Industrie Canada applicables auxappareils radio exempts de licence.L'exploitation est

autorisée aux deux conditions suivantes :

(1) l'appareil ne doit pas produire de brouillage, et

(2) l'utilisateur de l'appareil doit accepter tout brouillage adioélectrique subi, même si le brouillage est susceptible d'en compromettre

le fonctionnement.

Canada, avis d'Industry Canada (IC)

"Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de
licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de
brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le
brouillage est susceptible d'en compromettre le fonctionnement."
Déclaration d'exposition aux radiations:
Cet équipement est conforme aux limites d'exposition aux rayonnements ISEDétablies pour un environnement
non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source
de rayonnement et votre corps.

(Modular approval) End Product Labeling:
The final end product must be labeled in a visible area with the following: "Contains IC: 4100A-BT840XEE".

Caution: Exposure to Radio Frequency Radiation.

To comply with RSS 102 RF exposure compliance requirements

OEMstatement

The Original Equipment Manufacturer (OEM) must ensure that the OEM modular transmitter must be labeled with its own FCC ID number.
This includes a clearly visible label on the outside of the final product enclosure that displays the contents shown below. If the FCC ID is not
visible when the equipment is installed inside another device, then the outside of the device into which the equipment is installed must also
display a label referring to the enclosed equipment

The end product with this module may subject to perform FCC part 15 unintentional emission test requirement and be properly authorized.
This device is intended for OEM integrator only