# BC833E Compact BLE 5.2 Module

BluNor BC833 Series module is a powerful, highly flexible, ultra low power Bluetooth Low Energy (BLE) using Nordic nRF52833 Series SoC. With an ARM Cortex™ M4F MCU, 512KB flash, 128 KB RAM, embedded 2.4GHz BLE transceiver, and an integrated PCB trace antenna. It allows faster time to market with reduced development cost.

- **Small Host PCB Area:** Size of BC833 is 10x14.3mm. It includes inductors required for DCDC converter, 32MHz main crystal, 32.768KHz (20 PPM) sleep crystal and load capacitors. No external component is required.

- **Operating temperature: -40ºC to +105ºC.**

- **Larger Pads, Easy Production**: BC833E has 24 LGA pins with larger pads.

## Specifications:

- nRF52833, ARM Cortex M4F, 64 MHz
- Complete RF solution with integrated antenna
- BLE 5 data: 1Mbps, 125kbps
- Angle of Arrival (AoA) and Angle of Departure (AoD) directional finding using Bluetooth.
- DC-DC converter, inductors on board.
- Direct powered by Lithium batteries or USB supply (up to 5.5V)
- 4.9 mA peak current at 0 dBm TX.
- 4.7 mA peak current at RX.
- 32 MHz main crystal on board.
- 32.768 KHz sleep crystal on board
- Serial Wire Debug (SWD)
- Nordic SoftDevice Ready
- Over-the-Air (OTA) firmware update
- Flash/RAM: 512KB/128KB.
- 18 General purpose I/O pins
- USB 2.0 full speed (12 Mbps) controller
- Programmable peripheral interconnect (PPI)
- 12 bit/200 Ksps ADC
- 64 level comparator
- 15 level comparator with wake-up from OFF mode
- Temperature sensor
- 4 x 32 bit timers with counter mode
- Up to 2x SPI masters/slaves
- Up to 2x I2C compatible 2-wire masters/slaves
- 1x UART (CTS/RTS)
- Quadrature Demodulator (QDEC)
- 2x real time counters (RTC)
- 128-bit AES/ECB/CCM/AAR co-processor (on the fly packet encryption)
- SoC Receiver Sensitivity: -95 dBm at 1Mbps
- SoC TX power: programmable 9.75dBm to 7.75dBm.
- LGA, 24 pins.
- Integrated PCB trace antenna or u.FLconnector
- Operation voltage: 1.7V to 5.5V
- Operation temperature: -40°C to +105°C

## Model Summaries

| | |
|---|---|
| module | BC833E |
| MCU | nRf52833 QDAA |
| Flash/RAM | 512KB/128KB |
| Size, mm | 10x14.3 |
| BT Antenna | PIFA (Max. Gain: 4.0dBi) |
| BT range,1 Mbps, LMPI | 1150 meters, est. |
| BT range, 1Mbps, 1.52m | 850 meters, est. |
| BT range, 125 Kbps, LMPI. | 3400 meters, est |
| BT range, 125 kBps, 1.52m | 1400 meters, est |
| Availability | Sample |

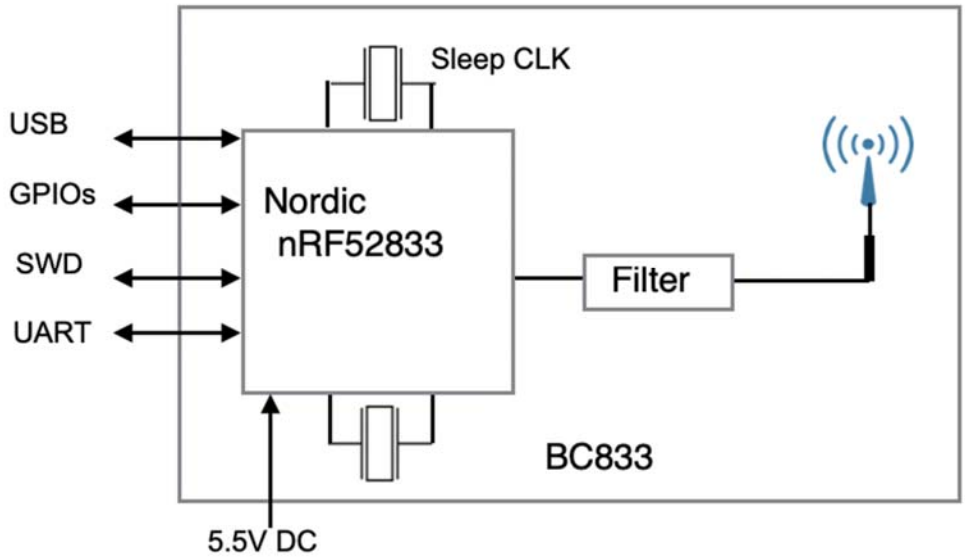
# BC833E Compact BLE 5.2 Module

## 1. Introduction

BluNor BC833 Series are powerful, highly flexible, ultra low power wireless modules using Nordic nRF52833 SoCs. With an ARM Cortex™ M4F MCU, 512KB flash, 128KB RAM, embedded 2.4GHz BLE transceiver, and an integrated antenna, it allows faster time to market with reduced development cost.

Antenna circuit, main clock, and sleep clock are integrated. All 18 GPIOs of nRF52833 QDAA can be accessed from main board.

### Block Diagram




### BC833E, Compact, Ultra Long Range BLE 5.1 Module with u.FL

- nRF52833, Cortex M4F MCU, 64 MHz
- 512KB flash, 128 KB RAM
- 24 LGA pins, 18 GPIOs
- An u.FL connector for external antenna
- Size 10x14.3mm
- Bluetooth range with ANT060: 3400 meters at 125 Kbps, estimated.

# 2. Codes Development Using Nordic Tools

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

## Easy, fast and safe code development

Nordic development environment for BC820 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 BC820 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

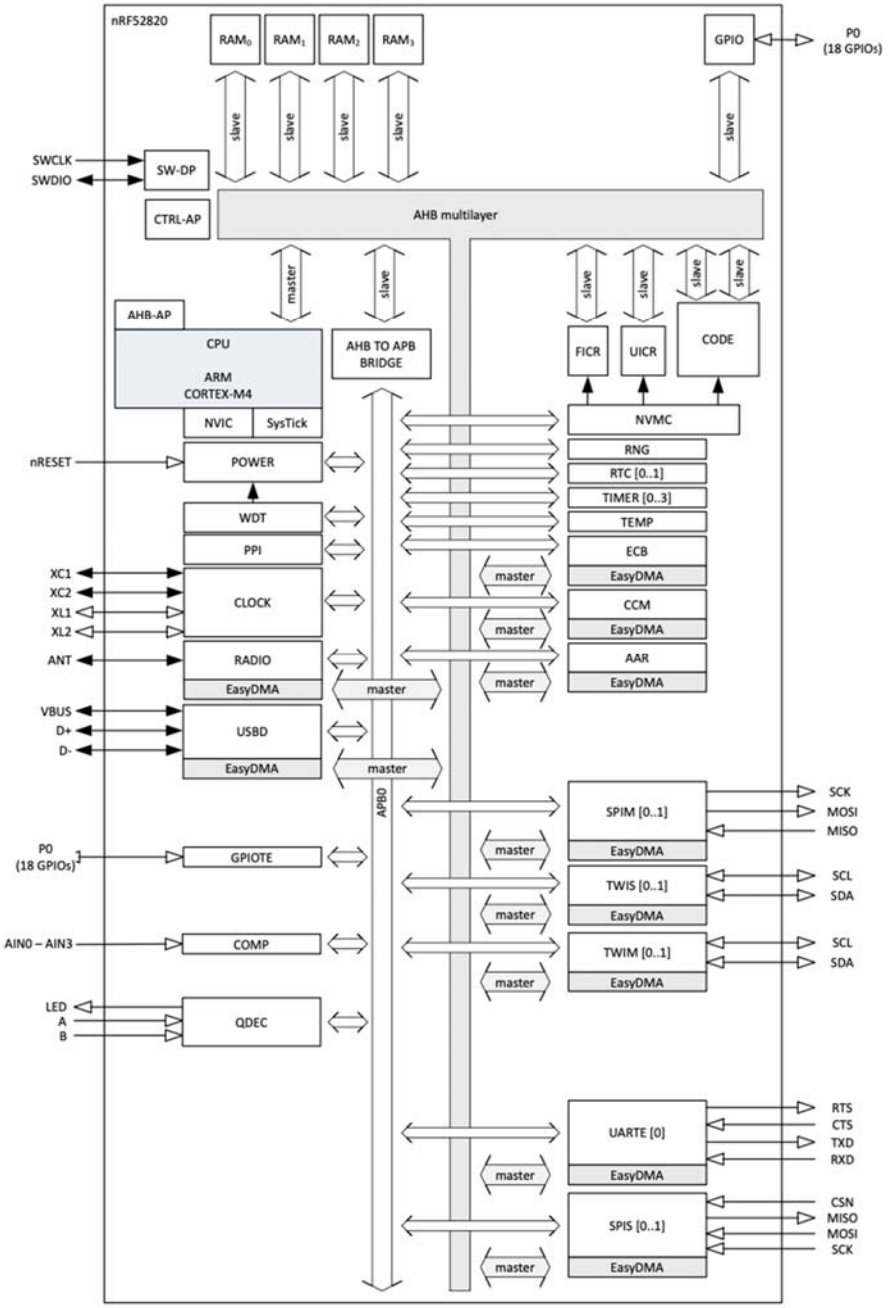
# 3. Product Descriptions

Brief description of nRF52820/833 SoC is provided. For full description of the SoC, please download from Nordic Semiconductor website.

https://www.nordicsemi.com/Products/Low-power-short-range-wireless/nRF52820

## Block Diagram of nRF52833

The following is a block diagram of Nordic nRF52833 Bluetooth Low Energy (BLE) SoC. Arrows with white



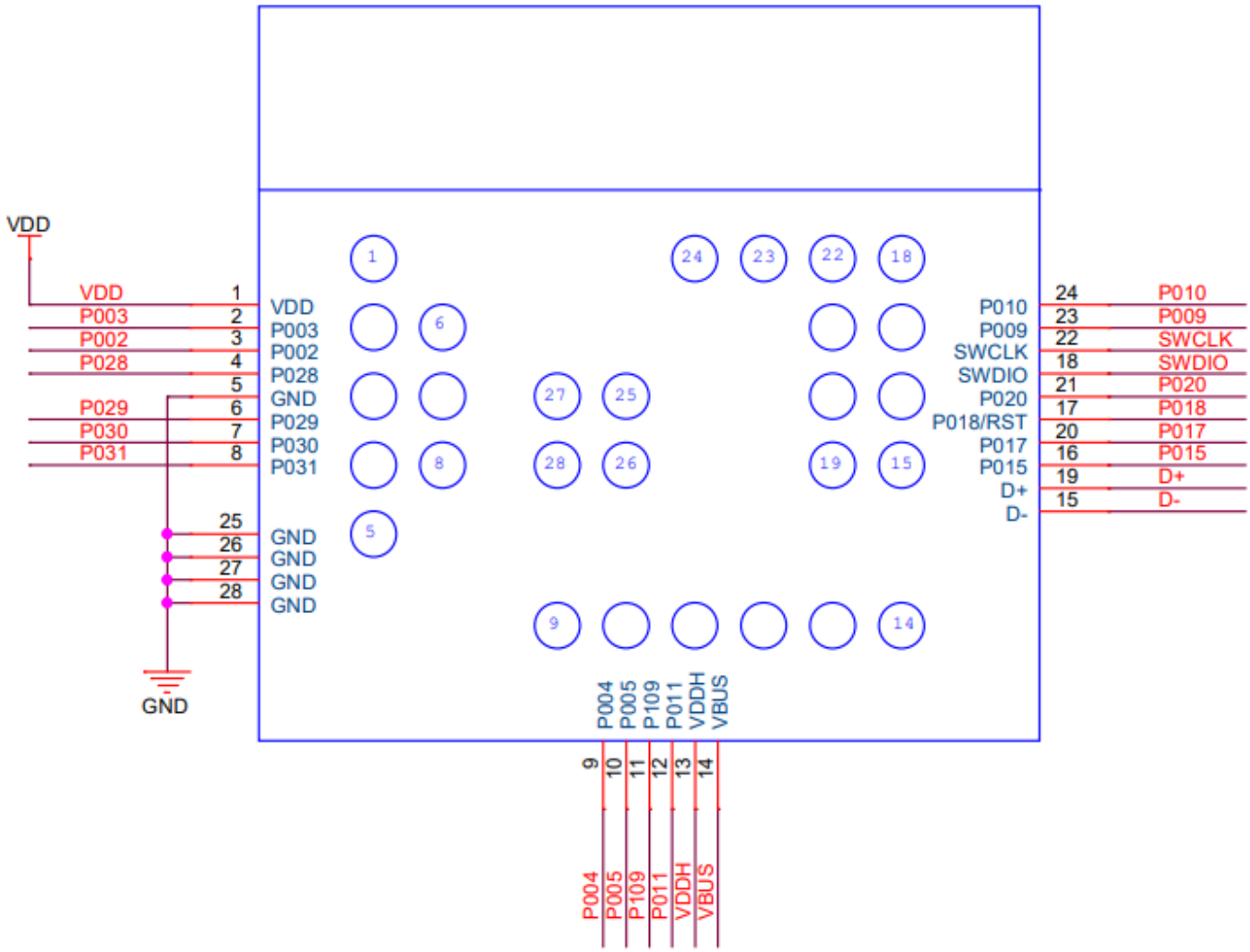

heads indicate signals that share physical pins with other signals.

The 32 bit ARM Cortex M4 MCU with hardware supports for DSP instructions, 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.

## Pin Assignments of BC833E

The followings are BC833E pin assignment. Pin functions are in  a table in next section. Please refer to Nordic nRF52833 Product Specifications for detailed descriptions and features supported.



## Pin Function

| BC833/E pin# | 52833 pin# | BC833/E Pin name | Descriptions |
|---|---|---|---|
| 1 | 30 | VDD | Power supply |
| 2 | 31 | P003 | GPIO, analog input |
| 3 | 32 | P002 | GPIO, analog input |
| 4 | 33 | P028 | GPIO, analog input |
| 5,25~28 | 41 | GND | Ground |
| 6 | 34 | P029 | GPIO, analog input |
| 7 | 35 | P030 | GPIO, analog input |
| 8 | 36 | P031 | GPIO, analog input |
| 9 | 4 | P004 | GPIO, analog input |
| 10 | 5 | P005 | GPIO, analog input |
| 11 | 6 | P109 | GPIO |
| 12 | 7 | P011 | GPIO |
| 13 | 9 | VDDH | High voltage power supply |
| 14 | 10 | VBUS | 5V input for 3.3 V regulator |
| 15 | 12 | D- | USB D- |
| 16 | 14 | P015 | GPIO |
| 17 | 16 | P018 | GPIO, configurable as RESET |
| 18 | 19 | SWDIO | Serial Wire Debug IO |
| 19 | 13 | D+ | USB D+ |
| 20 | 15 | P017 | GPIO |
| 21 | 17 | P020 | GPIO |
| 22 | 20 | SWDCLK | Serial Wire Debug clock input |
| 23 | 22 | P009 | GPIO |
| 24 | 23 | P010 | GPIO |

# 4. Bluetooth Range Measurements

Bluetooth range measurement hex codes can be downloaded from **Bluetooth Range Measurements** section of this webpage.

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

Description of measurement site, measurement methods, and range raw data are available at:

https://www.fanstel.com/testreport/

## Estimated Measurement Results

Bluetooth ranges are measured for antennas at two heights.

- 1.52 meters or 5 feet, the typical height of thermostat in the USA.
- Low Multiple Path Interference (LMPI) or 60% Fresnel zone clearance.

| Data rate/Antenna height, meters | BC833E-ANT060* |
|---|---|
| 1Mbps/1.52 meters, between modules | 850M |
| 125Kbps/1.52 meters, between modules | 1400M |
| 1Mbps/LMPI, between modules | 1150M |
| 125Kbps/LMPI, between modules | 3400M |
| 1Mbps/1.52 meters with an Android phone | |

## Deployment Recommendations

- To have the best Bluetooth data reception, direct line of sight between 2 devices should be away from ground or wall.
- If one device must be installed closer to ground or a wall, install other devices far away from a wall or ground.
- Indoor condition is different for different building. We suggest testing Bluetooth data reception in the building with the worst case condition.

# 5. Production

## Preloaded Firmware

Production testing codes are not erased before shipping from factory. To load your firmware, please erase the entire chip and re-program using instruction below.

//program BT840 Bootloader+Softdevice+Application hex

nrfjprog -f NRF52 --program BT840_AT_3in1PC181113.hex --chiperase --reset

//The file BT840_AT_3in1PC181113.hex = softdevice S140v6.1.1+BT840_AT_UARTwithout32K+bootloader

## AT Command Codes

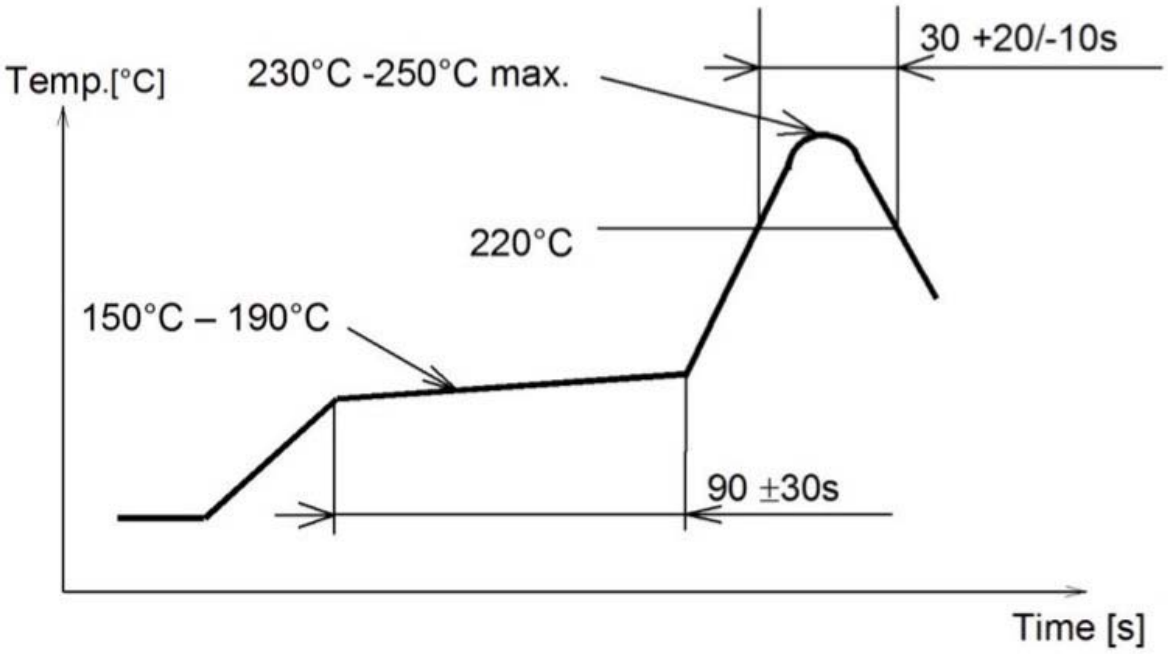
AT command codes are used for production testing. Up to date codes can be downloaded from:

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

You can erase and reprogram with your codes. Or, use AT command codes as preloaded.

If you need a special version of codes, programming services are available with MOQ and programming charges.

## 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.

(10) For more details on LGA (Land Grid Array) soldering processes refer to the application note.

### *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

Production modules are delivered in reel, 1000 modules in each reel.

## 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.

**Federal Communications Commission (FCC) Statement**

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.

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:**
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

This equipment has been tested and meets applicable limits for radio frequency (RF) exposure. During testing, device radios are set to their highest transmission levels and placed in positions that simulate use near the body and limbs, with 0mm separation. The highest reported Body and Limbs SAR values are 0.23 W/kg and 0.12 W/kg respectively.

The device has been tested and complied with 47 CFR Part 15, Subpart C 15.247

**Note: The end product shall has the words "Contains Transmitter Module FCC ID: 2BAPHBC833M"**

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system.