1. Product Instruction

TR003BNANO series is a powerful, highly flexible, ultra low power **Bluetooth® 5.1** module based o nworld-leading **Nordic® Semiconductor nRF52833 SoC** solution, which has a 32bit Arm® Cortex™-M4 CPU with floating point unit running at 64MHz. TR003BNANO series is capable of the late st and greatest features of **Bluetooth® 5.1**, the most prominent being Direction Finding1, taking Bluetooth positioning to new heights.
TR003BNANO series brings out all nRF52833 hardware features and up to +8 dBm transmit powe r up to 5.5V supply considerations

1.1 Model Classification

TR003BNANO connect an external 2.4Ghz antenna.

FCC& IC Radiation Exposure Statement:
This equipment complies with FCC and Canada radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body.
This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

The host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not
cove red by the modular transmitter grant of certification. The final host pro duct still requires Part 15 Subpart B compliance testing with the modular transmitter installed.
The end user manual shall include all required regulatory information/warning as shown in this manual, include:
This product must be installed and operated with a minimum distance of 20 cm b etween the radiator and user body.

Déclaration d'IC sur l'exposition aux radiations:
Cet équipement est conforme aux limites d'exposition aux radiations définies par le Canada pour des environnements non contrôlés. Cet équipement doit être installé et utilisé à une distance minimum de 20 cm entre l'antenne et votre corps.
Cet émetteur ne doit pas être installé au même endroit ni utilisé avec une autre antenne ou un autre émetteur.

1.2 Key Features

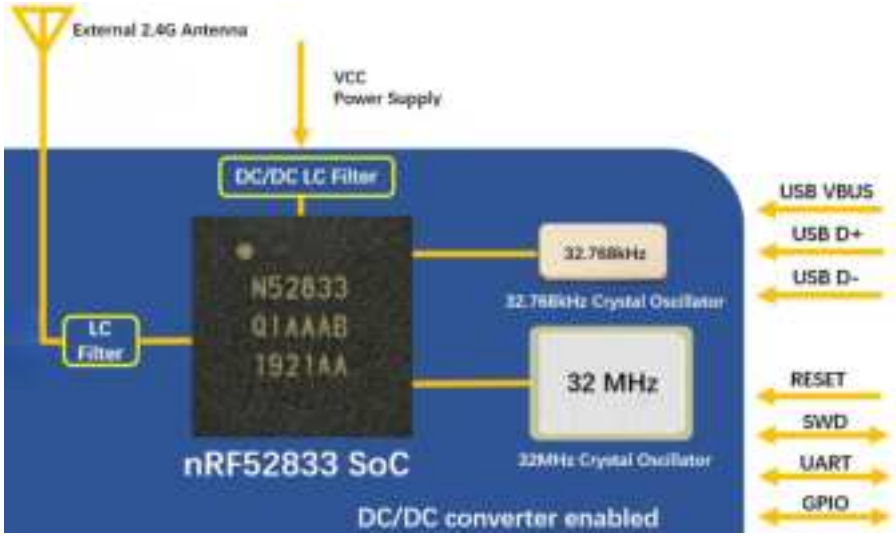
- Bluetooth® 5.1
  - Direction Finding
  - CSA#2
  - Advertising Extensions
  - Long Range
-
- Supported data rates
  - Bluetooth®: 1 Mbps, 500 kbps, and 125 kbps

- 518kB Flash and 128kB RAM
- Full set of digital interfaces including: SPI, TWI, UART, PDM, PWM, QDEC
- 12-bit, 200ksps ADC
- 128-bit AES ECB/CCM/AAR co-processor
- Individual power management for all peripherals
- On-chip DC/DC buck converter
-

Detail	Description
Mechanical design	
Dimensions	Length: 21mm±0.2mm Width: 13.8mm±0.2mm Height: 2.3mm+0.1mm/-0.15mm
Package	34 diameters of Half-holes + 20 LGA pads
PCB material	FR-4
Impedance	50Ω
Hardware	
CPU	ARM® Cortex®-M4 32-bit processor with FPU, 64 MHz
Memory	512kB flash, 128kB RAM
Interfaces	4x SPI master/3x SPI slave with EasyDMA 2x I^2C compatible two-wire master/slave 2x UART (CTS/RTS) with EasyDMA 3x real-time counter (RTC) 5x 32-bit timer with counter mode 4x 4-channel pulse width modulator (PWM) unit with EasyDMA 40 GPIOs 8x 12bit, 200ksps ADC Audio peripherals – I^2S, digital microphone interface (PDM)
Power supply	1.7V to 5.5V
Operating temperature range	-40 to 85 °C (-40 to +105 °C can be customized)
Clock control	32.768 kHz +/-20 ppm crystal oscillator
Power regulator	DC/DC regulator setup
Certifications	
USA (FCC)	FCC part 15 modular certification 47 CFR Part 15, Subpart C FCC ID: 2AMXZ-TR003BNANO
Europe (CE)	EN 300 328 V2.2.2 3.2: Effective use of spectrum allocated EN 301 489-1 V2.2.3 3.1(b): Electromagnetic Compatibility EN 301 489-17 V3.2.4 EN 62368-1: 2014+A11:2017 3.1(a): Health and Safety of the user EN 62479: 2010
Canada (ISED)	IC: 30762-TR003BNANO
Japan (MIC)	
Australia/New Zealand (RCM)	

2. Circuit Design

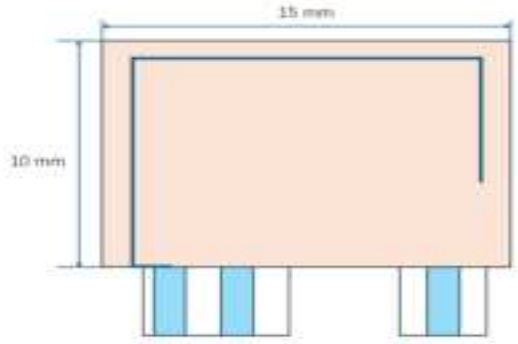
2.1 Block Diagram



2.2 PCB Antenna

The PCB antenna part number 132-347688A-03 connect the RF module tough the trace of carrie boards and details trace of antenna as below reference spec. And Antenna spec and gain information as below table.

The antenna manufacture is CHINA DRAGON TECHNOLOGY LIMITED



Frequency	2400-2500 ISM band
Peak Gain	2.4G:max 2.5dBi
Impedance	50 Ohm
Azimuth Beam width	Omni-directional

3. Mechanical specifications

3.1 Module Mechanical Dimensions

Symbol	Min.	Typ.	Max.
Length	-0.2mm	21mm	+0.2mm
Width	-0.2mm	13.8mm	+0.2mm
Height (PCB only)	-0.08mm	0.8mm	+0.08mm
Height (with shield)	-0.15mm	2.3mm	+0.1mm

3.2 Recommended PCB land pads

Symbol	Typ.
Half-hole Pad (Bottom)	0.8mm x 0.8mm
LGA Square Pad	0.8mm x 0.6mm
LGA Round pad	1mm (diameter)
Diameter of Half-hole	0.55mm

4. Pin Assignment

TR003BNANO module pin diagram (Rear View)

Pin No.	Name	Type	Description
1	P0.25	Digital I/O	General purpose I/O
2	P0.23	Digital I/O	General purpose I/O
3	P0.03	Digital I/O	General purpose I/O
	AIN1	Analog input 1	SAADC/COMP/LPCOMP input
4	P0.02	Digital I/O	General purpose I/O
	AIN0	Analog input 0	SAADC/COMP/LPCOMP input
5	P0.28	Digital I/O	General purpose I/O
	AIN4	Analog input 4	SAADC/COMP/LPCOMP input
6	P0.29	Digital I/O	General purpose I/O
	AIN5	Analog input 5	SAADC/COMP/LPCOMP input
7	P0.30	Digital I/O	General purpose I/O
	AIN6	Analog input 6	SAADC/COMP/LPCOMP input
8	P0.31	Digital I/O	General purpose I/O
	AIN7	Analog input 7	SAADC/COMP/LPCOMP input
9	VDD	Power	Power Supply
10	GND	Power	Ground
11	P0.27	Digital I/O	General purpose I/O
12	P0.26	Digital I/O	General purpose I/O

Pin No.	Name	Type	Description
13	P0.04	Digital I/O	General purpose I/O
	AIN2	Analog input 2	SAADC/COMP/LPCOMP input
14	P0.06	Digital I/O	General purpose I/O
15	P0.05	Digital I/O	General purpose I/O
	AIN3	Analog input 3	SAADC/COMP/LPCOMP input
16	P0.08	Digital I/O	General purpose I/O
17	P0.09	Digital I/O	General purpose I/O
	NFC1	NFC input	NFC antenna connection
18	P0.10	Digital I/O	General purpose I/O
	NFC2	NFC input	NFC antenna connection
19	SWDCLK	Debug	Serial wire debug clock input for debug and programming
20	SWDIO	Debug	Serial wire debug I/O for debug and programming
21	P0.07	Digital I/O	General purpose I/O
	TRACECLK	Trace clock	Trace buffer clock
22	P0.11	Digital I/O	General purpose I/O
	TRACEDATA[2]	Trace data	Trace buffer TRACEDATA
23	P0.12	Digital I/O	General purpose I/O
	TRACEDATA[1]	Trace data	Trace buffer TRACEDATA
24	P0.13	Digital I/O	General purpose I/O
25	P0.14	Digital I/O	General purpose I/O
26	P0.15	Digital I/O	General purpose I/O
27	P0.16	Digital I/O	General purpose I/O
28	P0.17	Digital I/O	General purpose I/O
29	P0.18	Digital I/O	General purpose I/O
	nRESET		Configurable as pin RESET
30	P0.20	Digital I/O	General purpose I/O
31	P0.21	Digital I/O	General purpose I/O
32	P0.22	Digital I/O	General purpose I/O
33	P0.24	Digital I/O	General purpose I/O
34,35	GND	Power	Ground
36	P1.05	Digital I/O	General purpose I/O
37	P1.03	Digital I/O	General purpose I/O
38	GND	Power	Ground
39	GND	Power	Ground
40	P0.19	Digital I/O	General purpose I/O
41	VDDH	Power	High voltage power supply
42	GND	Power	Ground
43	P1.08	Digital I/O	General purpose I/O

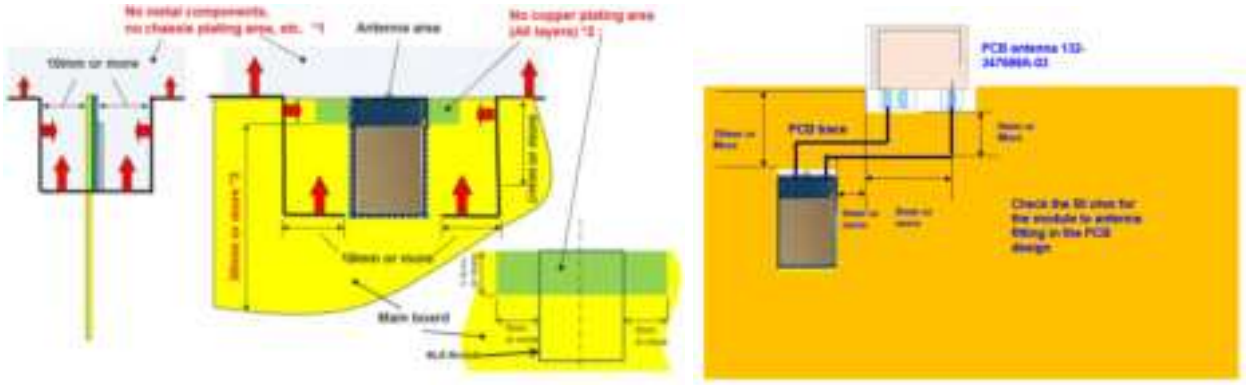
Pin No.	Name	Type	Description
44	P1.09	Digital I/O	General purpose I/O
	TRACEDATA[3]	Trace data	Trace buffer TRACEDATA
45	VBUS	Power	5 V input for USB 3.3 V regulator
46	D-	USB	USB D-
47	D+	USB	USB D+
48	GND	Power	Ground
49	P1.00	Digital I/O	General purpose I/O
	TRACEDATA[0]/ SWO	Trace data	Trace buffer TRACEDATA/ Serial wire output
50	P1.01	Digital I/O	General purpose I/O
51	P1.02	Digital I/O	General purpose I/O
52	P1.04	Digital I/O	General purpose I/O
53	P1.06	Digital I/O	General purpose I/O
54	P1.07	Digital I/O	General purpose I/O

Note：Please refer to Nordic nRF52833 Product Specifications for detailed descriptions and features supported about the Pin assignments.

5. Mounting Suggestion

For external antenna modules (TR003BNANO needs to connect an external antenna to the carrie board and then antenna part number 132-347688A-03), you need to refer to the external antenna design requirements. This antenna connected directly from the module to the antenna, no any component connected in between.

Recommended module mounting example:



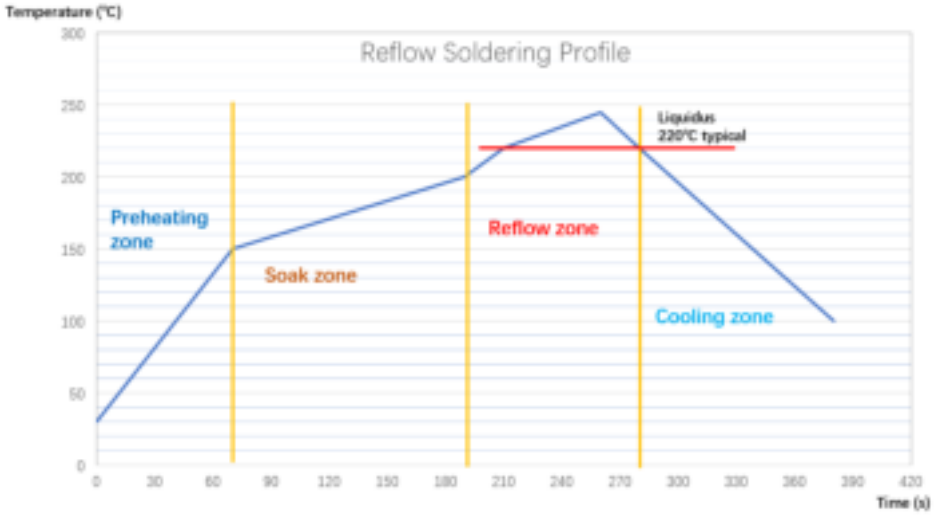
- Please do not place any metal components in blue shaded space (*1), such as signal line and metal chassis as possible except for main board while mounting the components in *1 space on the main board is allowed except for no copper plating area (*2).
- (*2) This area is routing prohibited area on the main board. Please do not place copper on any layer.
- (*3) Characteristics may deteriorate when GND pattern length is less than 30mm. It should be 30 mm or more as possible.
- For the best Bluetooth range performance, the antenna area of module shall extend 3 mm outside the edge of main board, or 3 mm outside the edge of a ground plane. Ground plane shall be at least 5 mm from the edge of the antenna area of module.
- All module GND pins MUST be connected to main board GND. Place GND vias close to module GND pads as possible. Unused PCB area on surface layer can flooded with copper but place GND vias regularly to connect copper flood to inner GND plane. If GND flood copper underside the module then connect with GND vias to inner GND plane.
- Even when above mentioned condition is satisfied, communication performance may be significantly deteriorated depending on the structure of the product. Bluetooth range performance is degraded if a module is placed in the middle of the main board.
- For main board layout:
    - Avoid running any signal line below module whenever possible.
    - No ground plane below antenna.
    - If possible, cut-off the portion of main board below antenna.

7. Cautions

7.1 Reflow Soldering

Reflow soldering is a vitally important step in the SMT process. The temperature curve associated with the reflow is an essential parameter to control to ensure the correct connection of parts. The parameters of certain components will also directly impact the temperature curve selected for this step in the process.

Temperature-Time Profile for Reflow Soldering:



- The standard reflow profile has four zones: **①preheat, ②soak, ③reflow, ④cooling**. The profile describes the ideal temperature curve of the top layer of the PCB.
- During reflow, modules should not be above 260°C and not for more than 30 seconds.

Specification	Value
Temperature Increase Rate	<2.5°C/s
Temperature Decrease Rate	Free air cooling
Preheat Temperature	0-150°C
Preheat Period (Typical)	40-90s
Soak Temp Increase Rate	0.4-1°C/s
Soak Temperature	150-200°C
Soak Period	60-120s
Liquidus Temperature (SAC305)	220°C
Time Above Liquidous	45-90s
Reflow Temperature	230-250°C
Absolute Peak Temperature	260°C

Example of SMT reflow soldering:

Note: The module is LGA package. Please be careful of the amount of solder paste. The module may be lifted due to excess solder.

7.2 Usage Condition Notes

- Follow the conditions written in this specification, especially the recommended condition ratings about the power supply applied to this product.
- 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).
- 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.
- The supply voltage should not be exceedingly high or reversed. It should not carry noise and/ or spikes.
- This product away from other high frequency circuits.
- Keep this product away from heat. Heat is the major cause of decreasing the life of these products.
- Avoid assembly and use of the target equipment in conditions where the products' temperature may exceed the maximum tolerance.
- This device complies with Part 15C of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.
- Do not use dropped products.
- Do not touch, damage or soil the pins.
- Pressing on parts of the metal shield or fastening objects to the metal shield will cause damage.

TR003BNANO Bluetooth Module User Manual

FCC Caution: The user is cautioned that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules and Industry Canada licence-exempt RSS standard(s). 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.

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.

NOTE: 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.

TR003Bnano Bluetooth Module

User Manual

FCC& IC Radiation Exposure Statement:
This equipment complies with FCC and Canada radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body.
This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. Déclaration d'IC sur l'exposition aux radiations:
Cet équipement est conforme aux limites d'exposition aux radiations définies par le Canada pour des environnements non contrôlés. Cet équipement doit être installé et utilisé à une distance minimum de 20 cm entre l'antenne et votre corps.
Cet émetteur ne doit pas être installé au même endroit ni utilisé avec une autre antenne ou un autre émetteur.

FCC Statements

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.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Radiation Exposure Statement

The modular can be installed or integrated in mobile or fix devices only. This modular cannot be installed in any portable device, for example, USB dongle like transmitters is forbidden.
This modular complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This modular must be installed and operated with a minimum distance of 20 cm between the radiator and user body.

If the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module.

When the module is installed inside another device, the user manual of this device must contain below warning statements:
1. 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.
2. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
The devices must be installed and used in strict accordance with the manufacturer's instructions as described in the user documentation that comes with the product.

The host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.
The end user manual shall include all required regulatory information/warning as shown in this manual, include:
This product must be installed and operated with a minimum distance of 20 cm between the radiator and user body.