MN52H Bluetooth® Low Energy Module

操作手冊

BLE Solution: Nordic NRF52840

RF IC	Crystal	UFL connector
Nordic NRF52840/V2	32MHz/20ppm Embedded	Embedded

Overview and Benefits

Overview

The MN52H from Aradconn is a highly flexible, ultra-low power, Bluetooth Low Energy module based on the nRF52840 SoC from Nordic Semiconductor. With an Arm® Cortex®-M4 with FPU 32-bit processor, embedded 2.4GHz transceiver, and integrated UFL connector. Providing full use of the nRF52840's capabilities and peripherals, which include I2C, SPI, UART, I2S, ADC, GPIO, PWM,NFC and USB interfaces.

Benefits

- **Bluetooth qualification and Regulatory certification reduce the burden to enter the market.**

- **Complete RF solution with no additional RF design, allowing faster time to launch a new product, and providing long working distance.**

  MN52H: up to 550 meters in open space. @1 Mbps

- **Compact size: (L) 15.5 x (W) 10.1 x (H) 2.1mm.**

- **Provides flexibility in the OEM's application development choice with full support for using Nordic SDK and firmware tools.**

1. Features and Application

1.1 Features

- **2.4 GHz transceiver**
  - -95 dBm sensitivity in 1Mbps Bluetooth® low energy mode
  - -103 dBm sensitivity in 125kbps Bluetooth® low energy mode(long range)
  - -20 to +8dBm TX power, configurable in 4 dB steps
  - Supported data rates:
    - Bluetooth® 5 – 2 Mbps, 1 Mbps, 500 kbps, and 125 kbp
    - IEEE 802.15.4-2006 – 250 kbps
    - Proprietary 2.4 GHz – 2 Mbps, 1 Mbps
  - 4.8 mA peak current in TX (0 dBM)
  - 4.6 mA peak current in RX
  - RSSI (1 dB resolution)
- **Arm® Cortex®-M4 32-bit processor with FPU, 64 MHz**
  - 212 EEMBC CoreMark® score running from flash memory
  - 52 µA/MHz running from flash memory
  - Serial wire debug (SWD)
- **Flexible power management**
  - 1.7 V–5.5 V supply voltage range
  - On-chip DC/DC and LDO regulators with automated low current modes
  - 1.8 V to 3.3 V regulated supply for external components
  - 0.4 µA at 3 V in System OFF mode, no RAM retention
  - 1.5 µA at 3 V in System ON mode, no RAM retention, wake on RTC
- **Memory**
  - 1MB flash/256 kB RAM
- **USB 2.0 full speed (12 Mbps) controller**
- **QSPI 32 MHz interface**
- **High-speed 32 MHz SPI**
- **Nordic SoftDevice ready with support for concurrent multi-protocol**
- **Type 2 near field communication (NFC-A) tag with wakeup-on-field and touch-to-pair capabilities**
- **12-bit, 200 ksps ADC - 8 configurable channels with programmable gain**
- **64 level comparator**
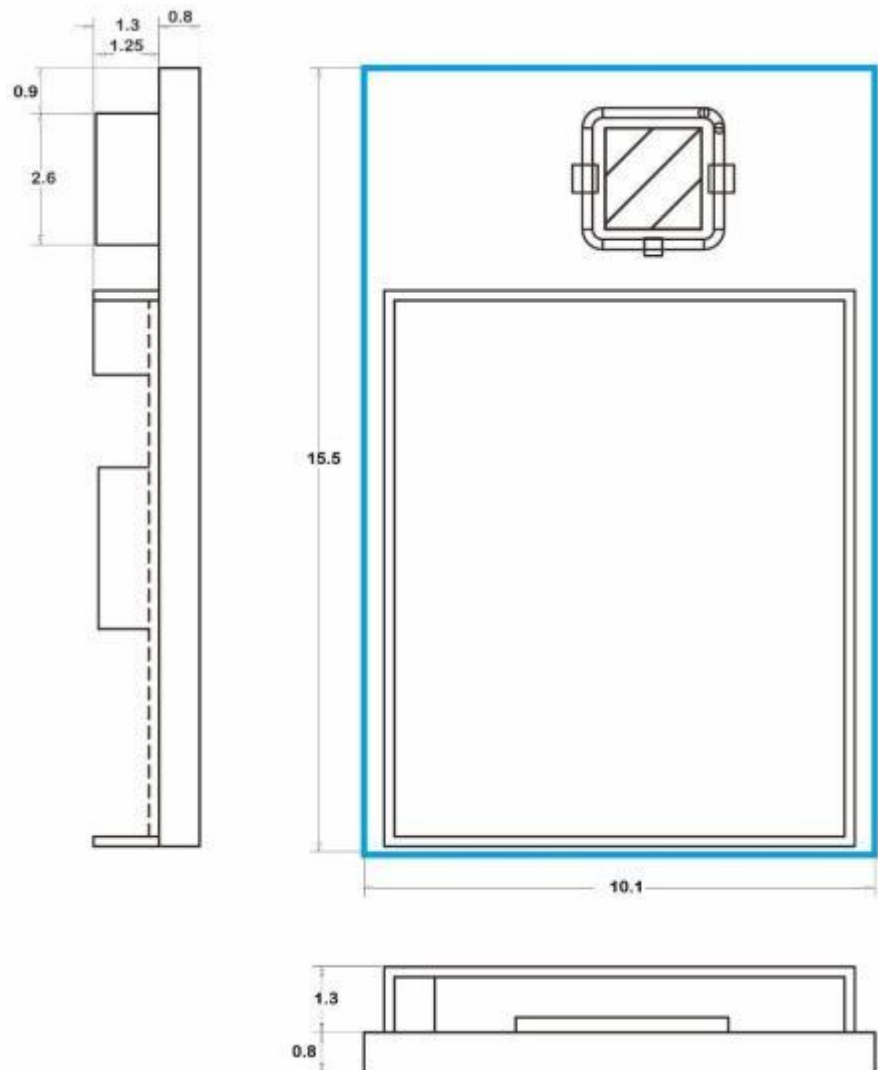- **15 level low power comparator with wakeup from System OFF mode**

- Temperature sensor
- 48 general purpose I/O pins
- 4x 4-channel pulse width modulator (PWM) unit with EasyDMA
- Digital microphone interface (PDM)
- 5x 32-bit timer with counter mode
- Up to 4x SPI master/3 x SPI slave with EasyDMA
- Up to 2x I2C compatible 2-wire master/slave
- I2S with EasyDMA
- 2 X UART (CTS/RTS) with EasyDMA
- Programmable peripheral interconnect (PPI)
- Quadrature decoder (QDEC)
- AES HW encryption with EasyDMA
- 3x real-time counter (RTC)
- Single crystal operation

1.2 Application

Iot	• Smart home sensors and controllers • Industrial IoT sensors and controllers
Advanced wearables	• Health / fitness sensor and monitor device • Wireless payment enabled devices
Interactive entertainment devices	• Remote control • Gaming controller
Advanced computer peripherals and I/O devices	• Mouse • Keyboard • Multi-touch trackpad

2. Mechanical specifications

2.1 Dimensions
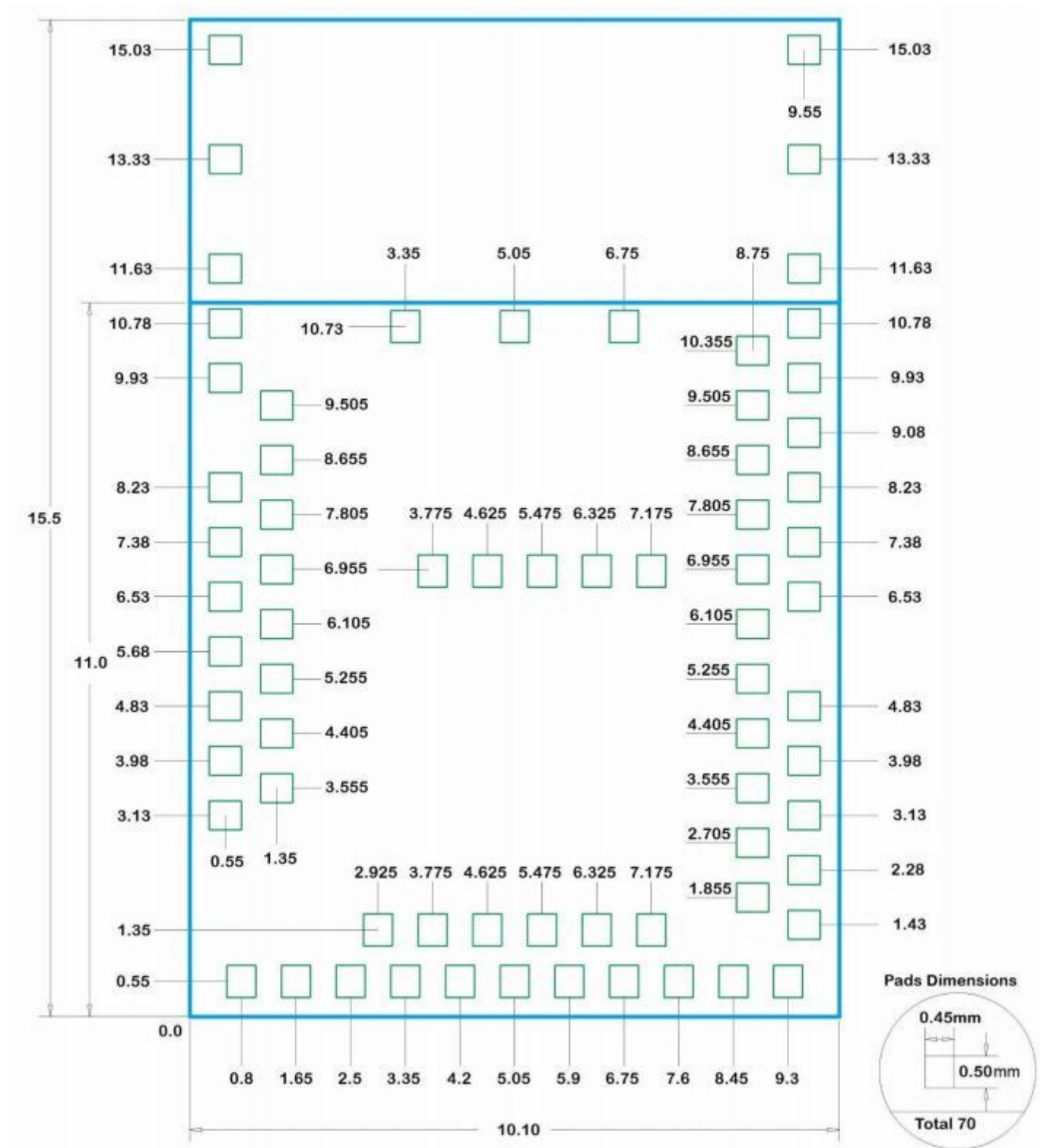

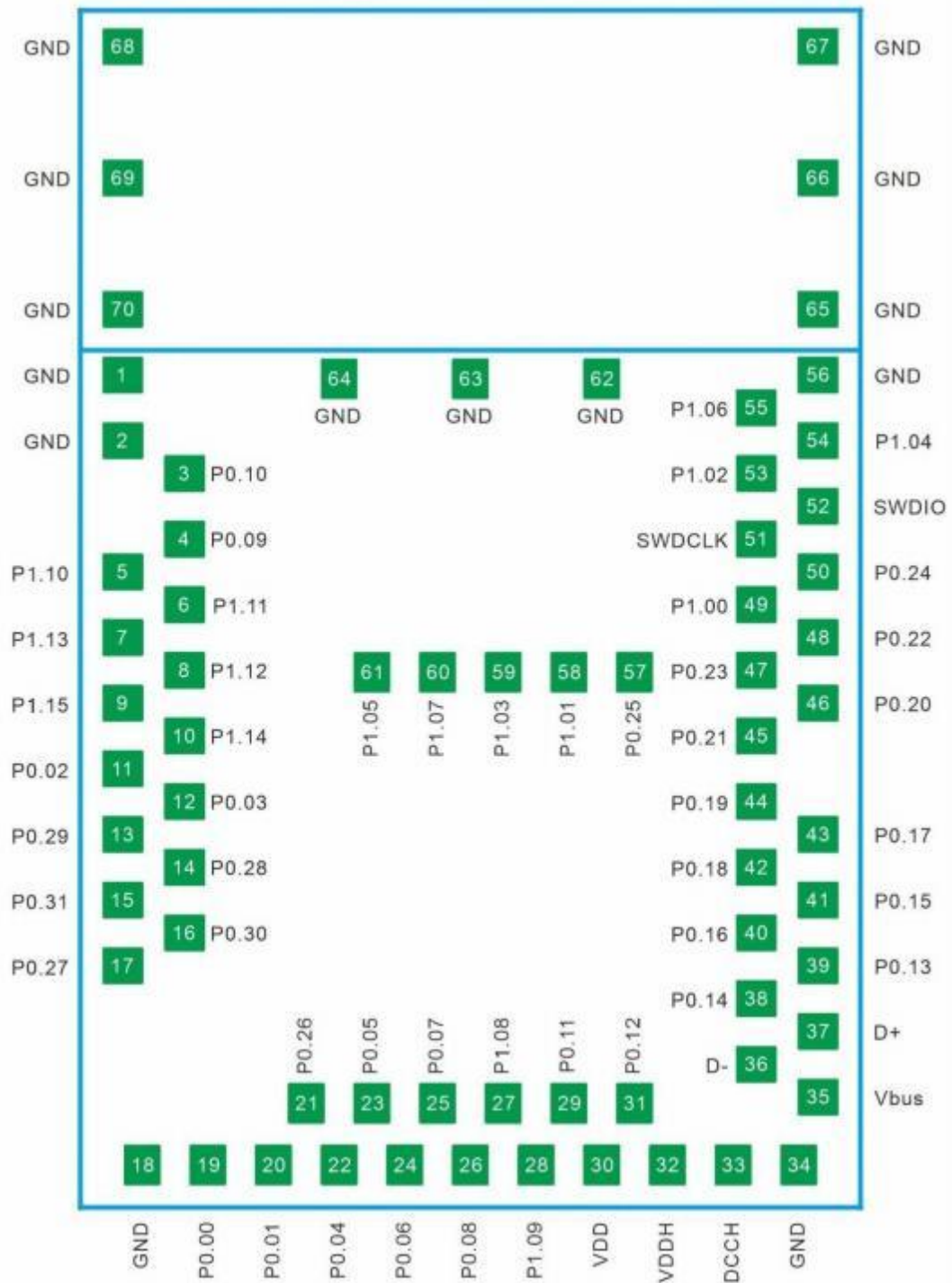**All dimensions are in millimeters.**

Item	Dimension	Tolerance
Length	15.5mm	±0.30 mm
Width	10.1mm	±0.30mm
Height	2.1mm	±0.30mm

2.2 Footprint

All dimensions are in millimeters.

3. Pin Assignment

Pin No.	Name	Pin function	Description
(1)	GND	Ground	The pad must be connected to a solid ground plane
(2)	GND	Ground	The pad must be connected to a solid ground plane
(3)	P0.10	Digital I/O	General-purpose I/O
	NFC2	NFC input	NFC antenna connection
(4)	P0.09	Digital I/O	General-purpose I/O
	NFC1	NFC input	NFC antenna connection
(5)	P1.10	Digital I/O	General-purpose I/O
(6)	P1.11	Digital I/O	General-purpose I/O
(7)	P1.13	Digital I/O	General-purpose I/O
(8)	P1.12	Digital I/O	General-purpose I/O
(9)	P1.15	Digital I/O	General-purpose I/O
(10)	P1.14	Digital I/O	General-purpose I/O
(11)	P0.02	Digital I/O	General-purpose I/O
	AIN0	Analog input	Analog input
(12)	P0.03	Digital I/O	General-purpose I/O
	AIN1	Analog input	Analog input
(13)	P0.29	Digital I/O	General-purpose I/O
	AIN5	Analog input	Analog input
(14)	P0.28	Digital I/O	General-purpose I/O
	AIN4	Analog input	Analog input
(15)	P0.31	Digital I/O	General-purpose I/O
	AIN7	Analog input	Analog input
(16)	P0.30	Digital I/O	General-purpose I/O
	AIN6	Analog input	Analog input
(17)	P0.27	Digital I/O	General-purpose I/O
(18)	GND	Ground	The pad must be connected to a solid ground plane
(19)	P0.00	Digital I/O	General-purpose I/O
	XL1	Analog input	Connection to 32.768kHz crystal (LFXO)
(20)	P0.01	Digital I/O	General-purpose I/O
	XL2	Analog input	Connection to 32.768kHz crystal (LFXO)
(21)	P0.26	Digital I/O	General-purpose I/O
(22)	P0.04	Digital I/O	General-purpose I/O
	AIN2	Analog input	Analog input
(23)	P0.05	Digital I/O	General-purpose I/O
	AIN3	Analog input	Analog input
(24)	P0.06	Digital I/O	General-purpose I/O
(25)	P0.07	Digital I/O	General-purpose I/O
(26)	P0.08	Digital I/O	General-purpose I/O
(27)	P1.08	Digital I/O	General-purpose I/O
(28)	P1.09	Digital I/O	General-purpose I/O
(29)	P0.11	Digital I/O	General-purpose I/O
(30)	VDD	Power	Power-supply
(31)	P0.12	Digital I/O	General-purpose I/O
Pin No.	Name	Pin function	Description
(32)	VDDH	Power	High voltage power supply

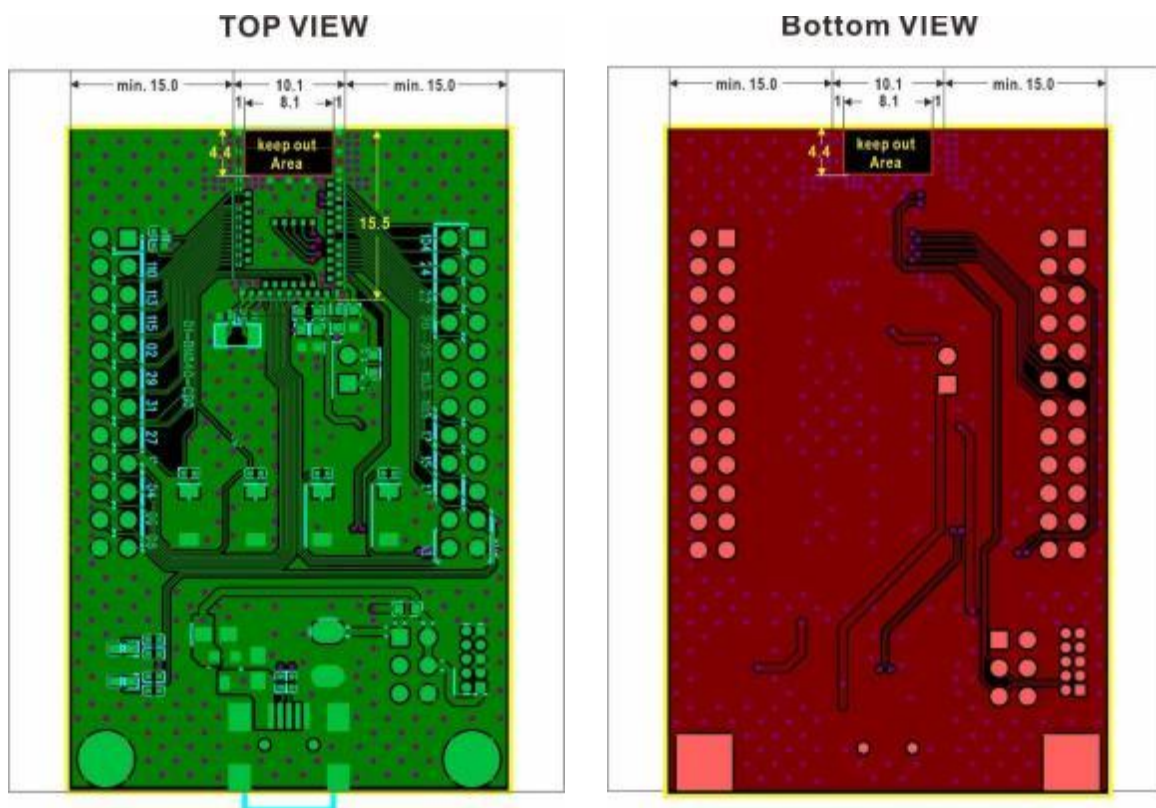| (33)	DCCH	Power	DC/DC converter output
(34)	GND	Ground	The pad must be connected to a solid ground plane
(35)	VBUS	Power	5V input for USB 3.3V regulator
(36)	D-	USB	USB D-
(37)	D+	USB	USB D+
(38)	P0.14	Digital I/O	General-purpose I/O
(39)	P0.13	Digital I/O	General-purpose I/O
(40)	P0.16	Digital I/O	General-purpose I/O
(41)	P0.15	Digital I/O	General-purpose I/O
(42)	P0.18	Digital I/O	General-purpose I/O
	nRESET		Configurable as pin RESET
(43)	P0.17	Digital I/O	General-purpose I/O
(44)	P0.19	Digital I/O	General-purpose I/O
(45)	P0.21	Digital I/O	General-purpose I/O
(46)	P0.20	Digital I/O	General-purpose I/O
(47)	P0.23	Digital I/O	General-purpose I/O
(48)	P0.22	Digital I/O	General-purpose I/O
(49)	P1.00	Digital I/O	General-purpose I/O
(50)	P0.24	Digital I/O	General-purpose I/O
(51)	SWDCLK	Debug	Serial wire debug clock input for debug and programming
(52)	SWDIO	Debug	Serial wire debug I/O for debug and programming
(53)	P1.02	Digital I/O	General-purpose I/O
(54)	P1.04	Digital I/O	General-purpose I/O
(55)	P1.06	Digital I/O	General-purpose I/O
(56)	GND	Ground	The pad must be connected to a solid ground plane
(57)	P0.25	Digital I/O	General-purpose I/O
(58)	P1.01	Digital I/O	General-purpose I/O
(59)	P1.03	Digital I/O	General-purpose I/O
(60)	P1.07	Digital I/O	General-purpose I/O
(61)	P1.05	Digital I/O	General-purpose I/O
(62)	GND	Ground	The pad must be connected to a solid ground plane
(63)	GND	Ground	The pad must be connected to a solid ground plane
(64)	GND	Ground	The pad must be connected to a solid ground plane
(65)	GND	Ground	The pad must be connected to a solid ground plane
(66)	GND	Ground	The pad must be connected to a solid ground plane
(67)	GND	Ground	The pad must be connected to a solid ground plane
(68)	GND	Ground	The pad must be connected to a solid ground plane
(69)	GND	Ground	The pad must be connected to a solid ground plane
(70)	GND	Ground	The pad must be connected to a solid ground plane

3.1 GPIO Recommended usage

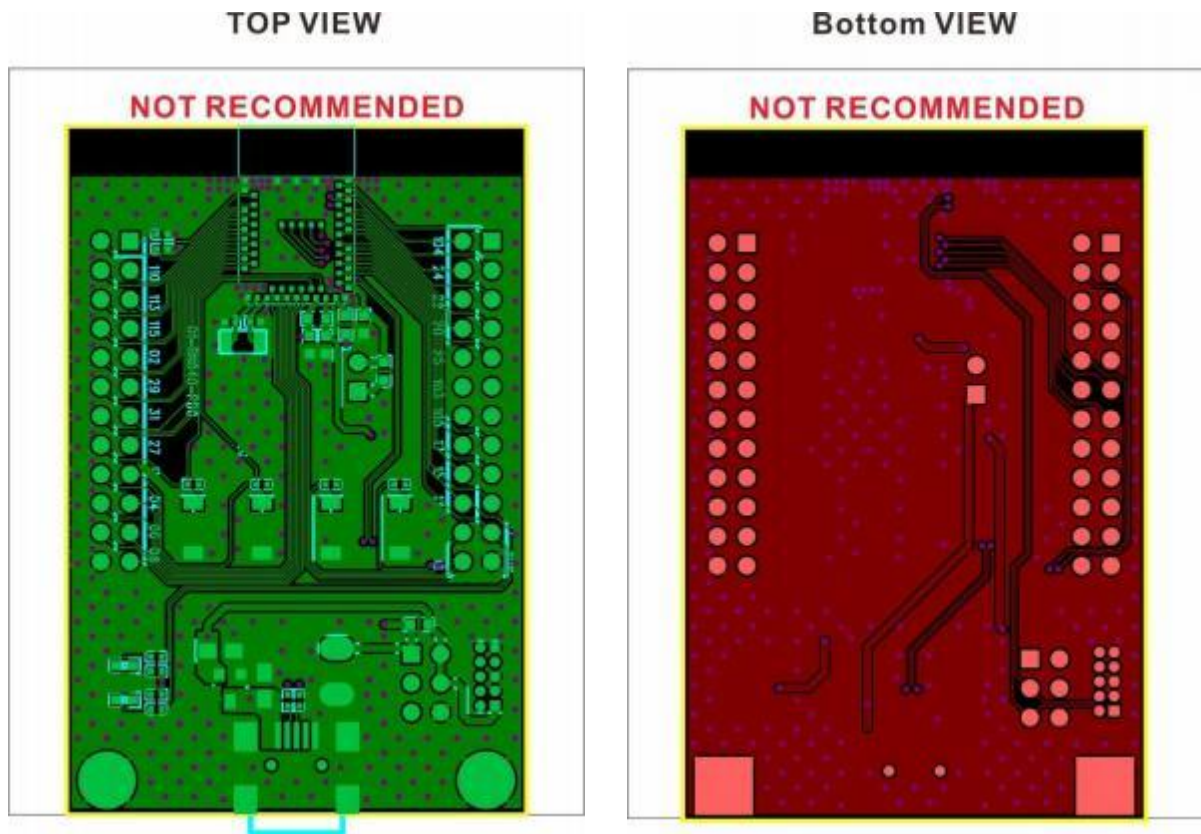| Module PIN N0.	NRF52840 GPIO	Recommended usage				
03	P0.10					
04	P0.09					
05	P1.10					
06	P1.11					
07	P1.13					
08	P1.12					
09	P1.15	These GPIO are Standard driver only				
10	P1.14					
11	P0.02	**Description(Standard driver)**	**Min.**	**Typ.**	**Max.**	**Unit**
12	P0.03	VDD ≥1.7, output set low	1	2	4	mA
13	P0.29	VDD≥ 1.7, output set high	1	2	4	mA
14	P0.28	These GPIO are low frequency I/O only : A frequency over 10kHz (UART, SPI, I2C,I2S PWM,QSPI) are not recommended.				
15	P0.31					
16	P0.30					
53	P1.02					
54	P1.04					
55	P1.06					
58	P1.01					
59	P1.03					
60	P1.07					
61	P1.05					
42	P0.18	QSPI/CSN				
44	P0.19	QSPI/SCK				
45	P0.21	QSPI				
47	P0.23	QSPI				
48	P0.22	QSPI				
49	P1.00	QSPI				

4 Layout design notes
4.1 Recommended RF layout and ground plane

It is recommended to place the module:

• In the center (horizontal) of any mother PCB edge, with GND planes to the left and right

• Keep out Area should be included in the corresponding position of the antenna in each layer.

• Add via hole around GND pads on the mother PCB as many as you can, especially on the four corners and antenna area.

4.2 Not Recommended RF layout and ground plane

4.3 Antenna keep out when proximity to Metal

• The minimum safe distance for metals without seriously compromising the antenna tuning is 4cm (bottom, top, left, right).

• Metal close to the antenna (bottom, top, left, right) will degrade RF performance. Any metal closer than 2 cm will significantly degrade RF performance.

5. Electrical Specification

5.1 Operation Conditions (工作環境)

Parameter	Min.	Nom.	Max.	Units
VDD (independent of DCDC)	1.7	3.0	3.6	V
VDDH (independent of DCDC)	2.5	3.7	5.5	V
VBUS (USB supply voltage)	4.35	5.0	5.5	V
VDD rise time (0V to 1.7V)			60	ms
VDDH rise time (0V to 3.7V)			100	ms
Operating temperature	-40	25	85	°C

Important: The on-chip power-on reset circuitry may not function properly if the rise times exceed the specified maximum.

5.2 System Clock (系統時脈)

The MN52H requires two clocks, a high frequency clock and a low frequency clock.

- The high frequency clock (HFCLK)

HFCLK is provided on-module by a high-accuracy 32 MHz/±20 ppm crystal for radio and CPU operation.

- The low frequency clock (LFCLK)

LFCLK can be provided internally by an RC oscillator (±250 ppm) with calibration, or externally by a 32.768 kHz crystal.

Internal 32.768 kHz RC oscillator (LFRC)

Description	Min.	Typ.	Max.	Unit
Nominal frequency		32.768		kHz
Frequency tolerance for LFRC after calibration (calibration performed at least every 8 seconds)			±500	ppm
Run current for 32.768 kHz RC oscillator		0.7		uA
Startup time for 32.768 kHz RC oscillator		1000		us

External 32.768 kHz crystal oscillator (LFXO)

Parameter	Description	Min.	Typ.	Max.	Unit
	Crystal frequency		32.768		kHz
	Frequency tolerance requirement for BLE stack			±500	ppm
	Frequency tolerance requirement for ANT stack			±50	ppm
	Run current for 32.768 kHz crystal oscillator		0.23		uA
CL	Load capacitance			12.5	pF
C0	Shunt capacitance			2	pF
RS	Equivalent series resistance			100	Kohm
PD	Drive level			0.5	uW
Cpin	Input capacitance on XL1 and XL2 pads		4		pF

An external crystal provides the lowest power consumption and greatest accuracy.

Using the internal RC oscillator with calibration provides acceptable performance for BLE stack at a reduced cost and slight increase in power consumption.

Important:

- The ANT protocol requires the use of an external crystal for high accuracy.
- Nordic SDK example program P0.00/P0.01 as external LFXO, you need an external crystal to work.
- Nordic SDK example program P0.00/P0.01 as external LFXO, if you would like to reduce material cost, save layout space or requires 2 more GPIO for application. you need program P0.00/P0.01 as internal LFRC.

6. BN52H evaluation board (參考線路圖)

BN52H is a full-featured evaluation board for MN52H that supports:
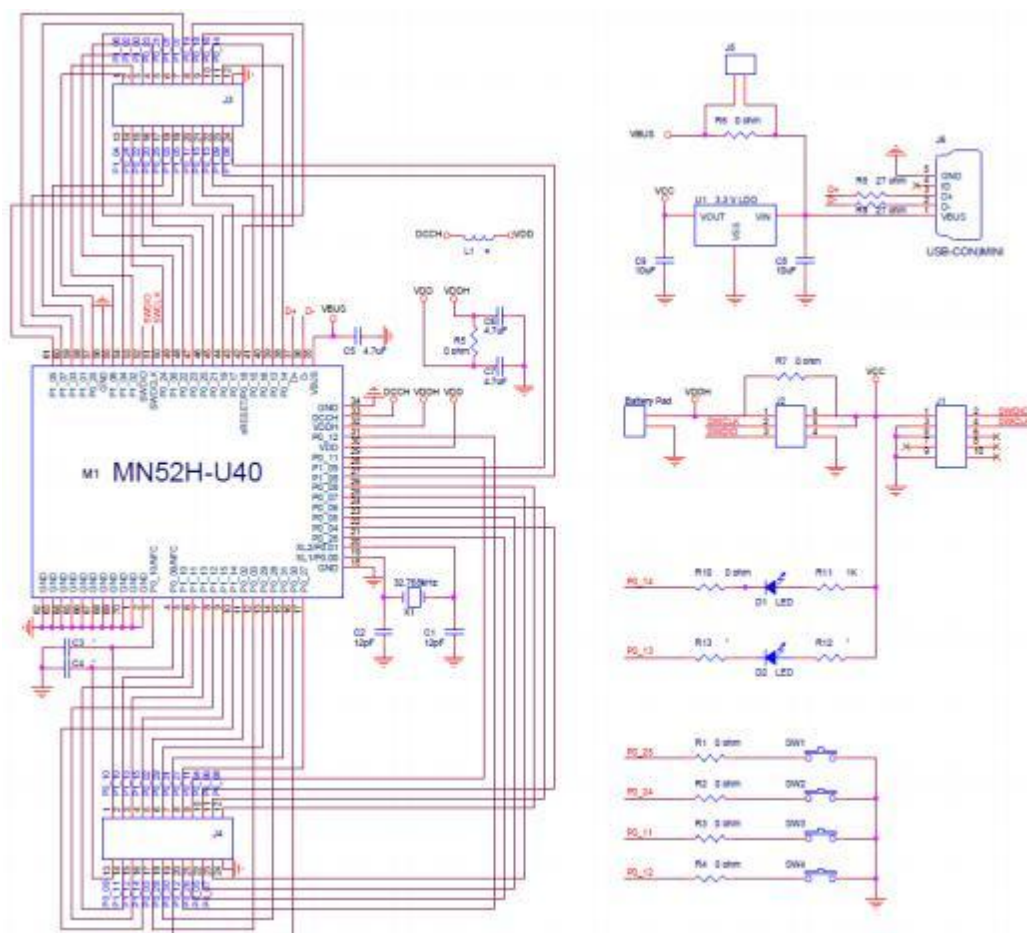
 M1:MN52H module

J6: A power over mini-USB

J3/J4: Complete I/O pinout to headers

J1: On-board programming and debugging interface

X1:32.768 kHz crystal

D1: One user LED
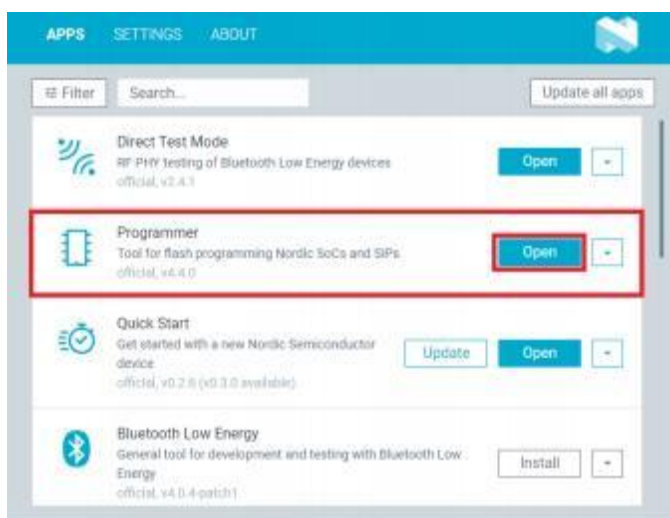
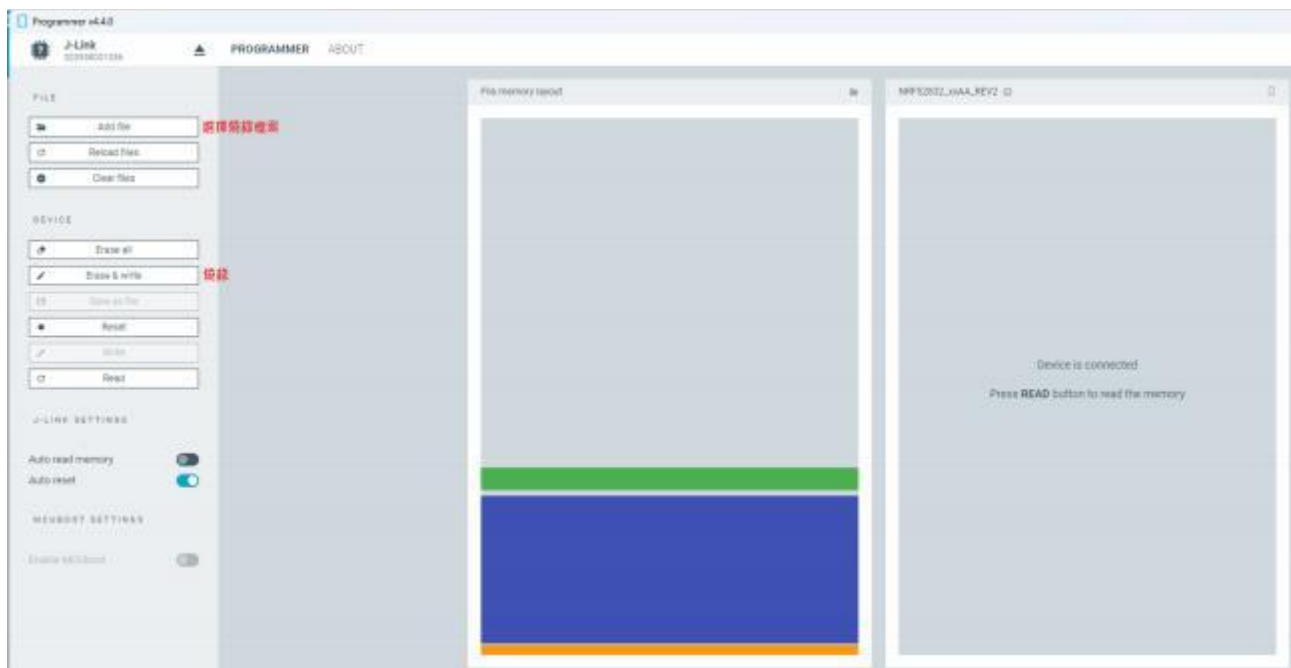SW1/SW2/SW3/SW4: Four user buttons

REMARK:

- **When using internal 32.768kHz RC oscillator, please remove X1 / C1 / C2 and calibration performed at least every 8 seconds**

7.如何燒錄檔案
7.1 下載 NRFConnect for Desktop

7.2 選擇要燒錄的程式/燒錄

NCC 警語：

「取得審驗證明之低功率射頻器材，非經核准，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。低功率射頻器材之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。前述合法通信，指依電信管理法規定作業之無線電通信。低功率射頻器材須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。」

FCC

15.19 Labeling requirements.
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.

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

15.105 Information to the user.
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

RF warning for Mobile device:
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

This module is intended for OEM integrators only. Per FCC KDB 996369 D03 OEM Manual v01 guidance, the following conditions must be strictly followed when using this certified module:

KDB 996369 D03 OEM Manual v01 rule sections:

2.2 List of applicable FCC rules
This module has been tested for compliance to FCC Part 15

2.3 Summarize the specific operational use conditions
The module is tested for standalone mobile RF exposure use condition. Any other usage conditions such as co-location with other transmitter(s) or being used in a portable condition will need a separate reassessment through a class II permissive change application or new certification.

2.4 Limited module procedures
Not application

2.5 Trace antenna designs
Not application

2.6 RF exposure considerations
This equipment complies with FCC mobile 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 & your body. If the module is installed in a portable host, a separate SAR evaluation is required to confirm compliance with relevant FCC portable RF exposure rules.

2.7 Antennas

The following antennas have been certified for use with this module; antennas of the same type with equal or lower gain may also be used with this module. The antenna must be installed such that 20 cm can be maintained between the antenna and users.

	Antenna type	Manufacturer	Antenna peak gain (dBi)
Antenna Information	PCB	Pluse Electronics	2.2
	PCB	Pluse Electronics	3.3
	Dipole	Pluse Electronics	2
	PCB	Arad Connectivity Co., Ltd.	0.8
	Ceramics	Arad Connectivity Co., Ltd.	1.05

2.8 Label and compliance information

The final end product must be labeled in a visible area with the following: "Contains FCC ID: 2BLIDMN52H". The grantee's FCC ID can be used only when all FCC compliance requirements are met.

2.9 Information on test modes and additional testing requirements

This transmitter is tested in a standalone mobile RF exposure condition and any co-located or simultaneous transmission with other transmitter(s) or portable use will require a separate class II permissive change re-evaluation or new certification.

2.10 Additional testing, Part 15 Subpart B disclaimer

This transmitter module is tested as a subsystem and its certification does not cover the FCC Part 15 Subpart B (unintentional radiator) rule requirement applicable to the final host. The final host will still need to be reassessed for compliance to this portion of rule requirements if applicable.
As long as all conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

IMPORTANT NOTE:
 In the event that these conditions can not be met (for example certain laptop configurations or co -location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

Manual Information To the End User:
The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual

OEM/Host manufacturer responsibilities
OEM/Host manufacturers are ultimately responsible for the compliance of the Host and Module. The final product must be reassessed against all the essential requirements of the FCC rule such as FCC Part 15 Subpart B before it can be placed on the US market. This includes reassessing the transmitter module for compliance with the Radio and EMF essential requirements of the FCC rules. This module must not be incorporated into any other device or system without retesting for compliance as multi-radio and combined equipment