

# WT02C40C-eng BLE 5.3,802.15.4,WiFi6 Combo Module

Ver 0.94, June 2024

WT02E40E Series are combo modules of a Nordic WiFi 6 nRF7002 SoC and a Nordic nRF5340 BLE 5.3 SoC. With a dual core ARM Cortex™ M33 MCU, up to 128MHz, quad radio-protocol transceivers, and various antenna options. They will be certified for BLE, 802.15.4, 2.4 GHz WiFi 6 and 5 GHz WiFi 6. It allows faster time to market with reduced development cost, especially for Matter applications.

**No external component needed to minimize host PCB area:** 40MHz, 32 MHz and 32.768 KHz, -40°C to +105°C, 20 PPM crystals are integrated. DCDC inductors for VDD and VDDH are integrated. Powering up sequence control circuitry is embedded.

## WiFi 6 Specifications

- Nordic nRF7002 SoC.
- Low-power and secure Wi-Fi for the IoT
- Supports IEEE 802.11 a/b/g/n/ac/ax
- Supports Target Wake Time (TWT), Orthogonal Frequency Division Multiple Access (OFDMA, Downlink and Uplink), BSS coloring
- WiFi CERTIFIED 6™, WiFi CERTIFIED™ a/b/g/n/ac, WiFi Enhanced Open™.
- Supports WPA3™, WPA2™, WPA™ - Personal and Enterprise, Protected Management Frames.
- Supports WMM®, WMM-Power Save, WiFi Agile Multiband™, WiFi Direct®.
- 2.4 GHz and 5 GHz dual-band or 2.4 GHz only
- Adjustable TX power from +5 to +19 dBm.
- Wi-Fi 6 Station (STA)
- 1 Spatial Stream (SS)
- 20 MHz channel bandwidth
- 64 QAM (MCS7), 86 Mbps PHY throughput
- Co-existence interfaces

## BLE/802.15.4 Specifications:

- nRF5340 CLAA, dual core ARM® Cortex M33
- Application Core
  - 128/64 MHz Cortex M33 with FPU and DSP instructions
  - 1MB flash, 512KB RAM
  - 8KB 2-way set associate cache
  - ARM® TrustZone® Cryptocell-312 co-processor
- Network core:
  - 64 MHz Cortex M33 with 2KB instruction cache
  - 256KB flash, 64KB RAM

- Receiver Sensitivity: -98 dBm at 1Mbps.
- TX power: programmable +3dBm to -20dBm
- BLE 5.3 data rate: 2Mbps, 1Mbps, 500kbps, 125kbps.
- IEEE 802.15.4 data rate: 250 Kbps
- DCDC inductors for VDD, VDDH on board.
- Serial Wire Debug (SWD)
- Over-the-Air (OTA) firmware update
- 48 General purpose I/O pins
- USB 2.0 full speed (12 Mbps) controller
- QSPI interface
- 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.
- Up to 3x pulse width modulator (PWM)
- Audio peripherals: I²S, digital microphone interface (PDM)
- 5 x 32 bit timers with counter mode
- Up to 3x SPI masters/3x SPI slaves
- Up to 2x I²C compatible 2-wire masters/slaves
- 2x UART (CTS/RTS)
- Quadrature Demodulator (QDEC)
- 2x real time counters (RTC)

## Miscellaneous

- Hybrid pins: 16 castellated and 45 LGA.
- Modules are "T" shape
- Operation voltage: 3.3V
- Pending Certifications: (BLE, 802.15.4, 2.4 GHz WiFi, 5GHz WiFi).
- QDID: 119517, 182626
- All modules support **approtect** features.



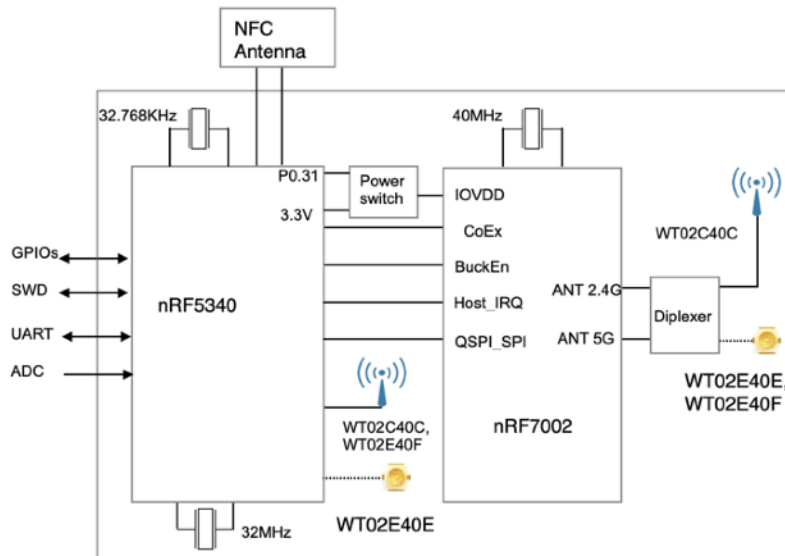
## Model Summaries

| module                       | WT02E40E        | WT02C40C        | WT02V40V        | WT02E40F        | WT02P40P        |
|------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Size W(antenna)xHxT, mm      | 14(21.8)x18     | 14(31.8)x18     | 14(22.5)x27.1   | 14(18.6)x27.8   | 14(14)x18       |
| SoCs                         | nRF5340+nRF7002 | nRF5340+nRF7002 | nRF5340+nRF7002 | nRF5340+nRF7002 | nRF5340+nRF7002 |
| Engineering samples          | WT02E40E-eng    | WT02C40C-eng    |                 |                 |                 |
| W(antenna)xHxT               | 16x28.2mm       | 16(26)x29.9     |                 |                 |                 |
| Embedded crystals            | 40M+32M+32K     | 40M+32M+32K     | 40M+32M+32K     | 40M+32M+32K     | 40M+32M+32K     |
| BT/WiFi Antenna              | u.FL/u.FL       | Chip/Chip       | Chip/chip       | u.FL/PCB        | Pads/pads       |
| 2.4GHz WiFi range, iPhone 14 |                 |                 |                 |                 |                 |
| 5GHz WiFi range, iPhone 14   |                 |                 |                 |                 |                 |
| Operating temp.              | -40°C to +85°C  | -40°C to +85°C  | -40°C to +85°C  | -40°C to +85°C  | -40°C to +85°C  |
| Evaluation board             | EV-WT02E40E     | EV-WT02C40C     | EV-WT02V40V     | EV-WT02E40F     | EV-WT02P40P     |
| Availability                 | Samples         | Samples         |                 |                 |                 |

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## 1. Introduction



WT02E40E Series are combo modules of a Nordic WiFi 6 nRF7002 SoC and a Nordic nRF5340 BLE 5.3 SoC. With a dual core ARM Cortex™ M33 MCU, up to 128MHz, quad radio-protocol transceivers, and various antenna options. They will be certified for BLE, 802.15.4, 2.4 GHz WiFi 6 and 5 GHz WiFi 6. It allows faster time to market with reduced development cost, especially for Matter applications.

### WT02E40E Block Diagram

The following is a block diagram of WT02E40E. All required crystals are embedded. Connection to an external NFC (Near Field Communication) antenna is provided. There is an u.FL connector for an external Bluetooth/Thread antenna and a second u.FL connector for an external WiFi antenna. Sister modules use chips or PCB trace antennas.

### Engineering Samples

WT Series combo modules are under revision to improve antenna performance for some and to reduce module sizes for others. The production version will be available in Q1 2024. Engineering version WT02E40E-eng and WT02C40C-eng are available till release of the production version.

### WT02E40E-eng

- An nRF5340 SoC with dual core Cortex M33 MCU, up to 128 MHz
- An u.FL connector for an external BLE/Thread antenna.
- An nRF7002 WiFi 6 SoC supports IEEE 802.11 a/b/g/n/ac/ax for both 2.4 GHz and 5 GHz bands.
- An u.FL connector for an external WiFi antenna.
- Size: 16x28.2mm

### WT02C40C-eng

- An nRF5340 SoC with dual core Cortex M33 MCU, up to 128 MHz
- An integrated chip antenna for BLE/802.15.4.
- An nRF7002 WiFi 6 SoC supports IEEE 802.11 a/b/g/n/ac/ax for both 2.4 GHz and 5 GHz bands.
- An integrated chip antenna for WiFi 6.
- Size: 16 (26 at antenna area) x 29.9 mm.



## Production Version

Production versions are “T” shaped, similar to WT02C40C-eng.

- The size of the main body (under RFI shield) is reduced for all modules.
- Antenna area is expanded to provide isolation between the Wifi antenna and the Bluetooth antenna for some.
- Antenna area is reduced for compact modules for short range applications.

## WT02C40C

- Compact module for short range applications.
- An nRF5340 SoC with dual core Cortex M33 MCU, up to 128 MHz
- An integrated chip antenna for BLE/802.15.4.
- An nRF7002 WiFi 6 SoC supports IEEE 802.11 a/b/g/n/ac/ax for both 2.4 GHz and 5 GHz bands.
- An integrated chip antenna for WiFi 6.
- Size: 14 (22.5 antenna area) x 18.0 mm.

## WT02E40F

- An nRF5340 SoC with dual core Cortex M33 MCU, up to 128 MHz
- An integrated high performance PCB trace antenna for BLE /802.15.4. This BLE PCB antenna is the same as that in the BT840F, BT840X, and BT40F.
- An nRF7002 WiFi 6 SoC supports IEEE 802.11 a/b/g/n/ac/ax for both 2.4 GHz and 5 GHz bands.
- An u.FL connector for an external WiFi antenna.
- Size: 14 (18.6 antenna area) x 27.8 mm

## WT02V40V

- An nRF5340 SoC with dual core Cortex M33 MCU, up to 128 MHz
- An integrated chip antenna for BLE/802.15.4.
- An nRF7002 WiFi 6 SoC supports IEEE 802.11 a/b/g/n/ac/ax for both 2.4 GHz and 5 GHz bands.
- An integrated chip antenna for WiFi 6.
- Size: 14 (31.8 antenna area) x 27.1 mm

## WT02E40E

- An nRF5340 SoC with dual core Cortex M33 MCU, up to 128 MHz
- An integrated chip antenna for BLE/802.15.4.
- An nRF7002 WiFi 6 SoC supports IEEE 802.11 a/b/g/n/ac/ax for both 2.4 GHz and 5 GHz bands.
- An u.FL connector for an external WiFi 6 antenna.
- Size: 14 (21.8 antenna area) x 18.0 mm

## WT02P40P

- An nRF5340 SoC with dual core Cortex M33 MCU, up to 128 MHz
- Pads for BLE/802.15.4 antenna connection on the host board.
- An nRF7002 WiFi 6 SoC supports IEEE 802.11 a/b/g/n/ac/ax for both 2.4 GHz and 5 GHz bands.
- Pads for WiFi 6 antenna connection on the host board.
- Size: 14 (14) x 18 mm

## 2. Codes Development Using Nordic Tools

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

### Over-The-Air DFU

The nRF5340 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.

### nRF Connect SDK

nRF Connect SDK is a scalable and unified software development kit for building products based on all our nRF52, nRF53 and nRF91 Series wireless devices. It offers developers an extensible framework for building size-optimized software for memory-constrained devices as well as powerful and complex software for more advanced devices and applications. It integrates the Zephyr RTOS and a wide range of samples, application protocols, protocol stacks, libraries and hardware drivers.

For developing Bluetooth Low Energy, Thread and Zigbee products, the nRF Connect SDK contains all needed software, including protocol stacks. For developing cellular IoT products it contains everything except the LTE modem firmware that must be downloaded separately from the [nRF9160 SiP product page](#). See the [cellular IoT software](#) for more details.

nRF Connect SDK also offers an unique integration of HomeKit Accessory Development Kit for developing products using both HomeKit over Thread and HomeKit over Bluetooth Low Energy. It is a highly optimized solution that enables battery-powered products with both the HomeKit Accessory Protocol (HAP) and application firmware running on a single chip. MFi licensees can get access to the HomeKit repository by contacting us via [Nordic DevZone private ticket](#).

nRF Connect SDK offers a single code base for all our devices and software components. It simplifies porting modules, libraries and drivers from one application to another, thus reducing development time. By enabling developers to pick and choose the essential software components for their application, high memory efficiency is guaranteed.

nRF Connect SDK is publicly hosted on GitHub, offers source code management with Git and has free SEGGER Embedded Studio IDE support. Nordic runs continuous integration tests on the nRF Connect SDK code to ensure robust and secure production quality code.

### Development Tools

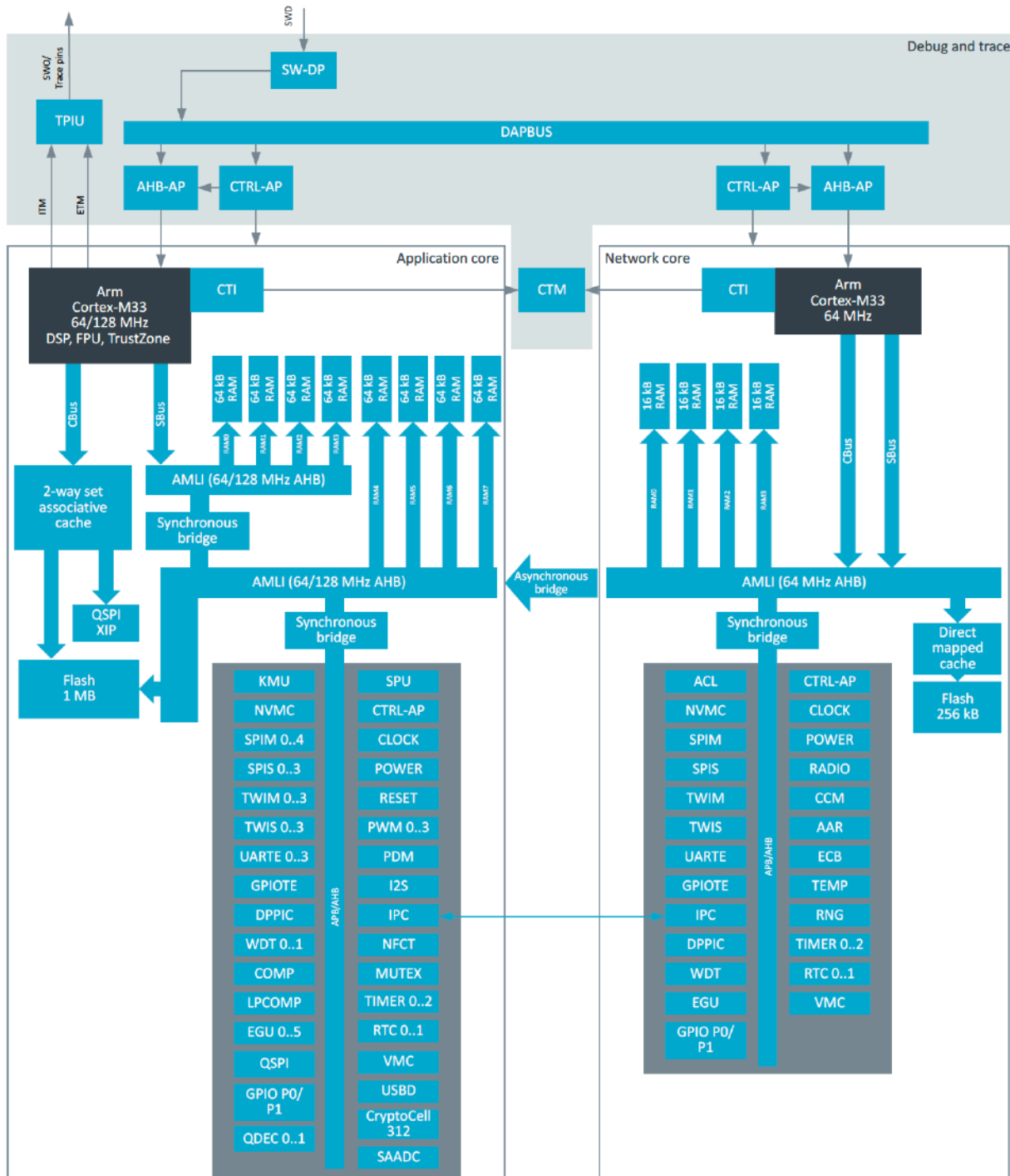
Nordic Semiconductor provides a complete range of hardware and software development tools for the nRF53 Series devices. nRF53 DK board is recommended for firmware development.

[Nordic software development tools](#) can be downloaded.

## 3. Product Descriptions

### Block Diagram of nRF5340

The following is a block diagram of Nordic nRF5340 Bluetooth Low Energy (BLE) SoC. Please visit Nordic website for [full description and product specifications](#).



nRF5340 is a wireless ultra-low power multiple core System on Chip (SoC) integrating two fully programmable Arm Cortex M33 processors, advanced security features, a range of peripherals, and a multiprotocol 2.4 GHz

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transceiver. The transceiver supports Bluetooth low energy, ANT™, and 802.15.4 and allows the implementation of proprietary 2.4 GHz protocols.

The two Arm Cortex M33 processors share the power, clock, and peripheral architecture with Nordic Semiconductor nRF51, nRF52, and nRF91 Series of PAN/LAN SoCs, ensuring minimal porting efforts. The application core is a full-featured Arm Cortex M33 processor including DSP instructions and FPU and running at up to 128 MHz with 1MB of flash and 512 KB of RAM. The option to run the application processor at 64 MHz allows the CPU to increase energy efficiency. The network core is an Arm Cortex M33 processor with a reduced feature set, designed for ultra-low power operation. It runs at a fixed 64 MHz frequency and contains 256 KB of flash and 64 KB of RAM.

The peripheral set offers a variety of analog and digital functionality enabling single chip implementation of a wide range of applications. Arm trustZone technology, Arm cryptoCell-312, and supporting blocks for system protection and key management are embedded for the advanced security needed for IoT applications.

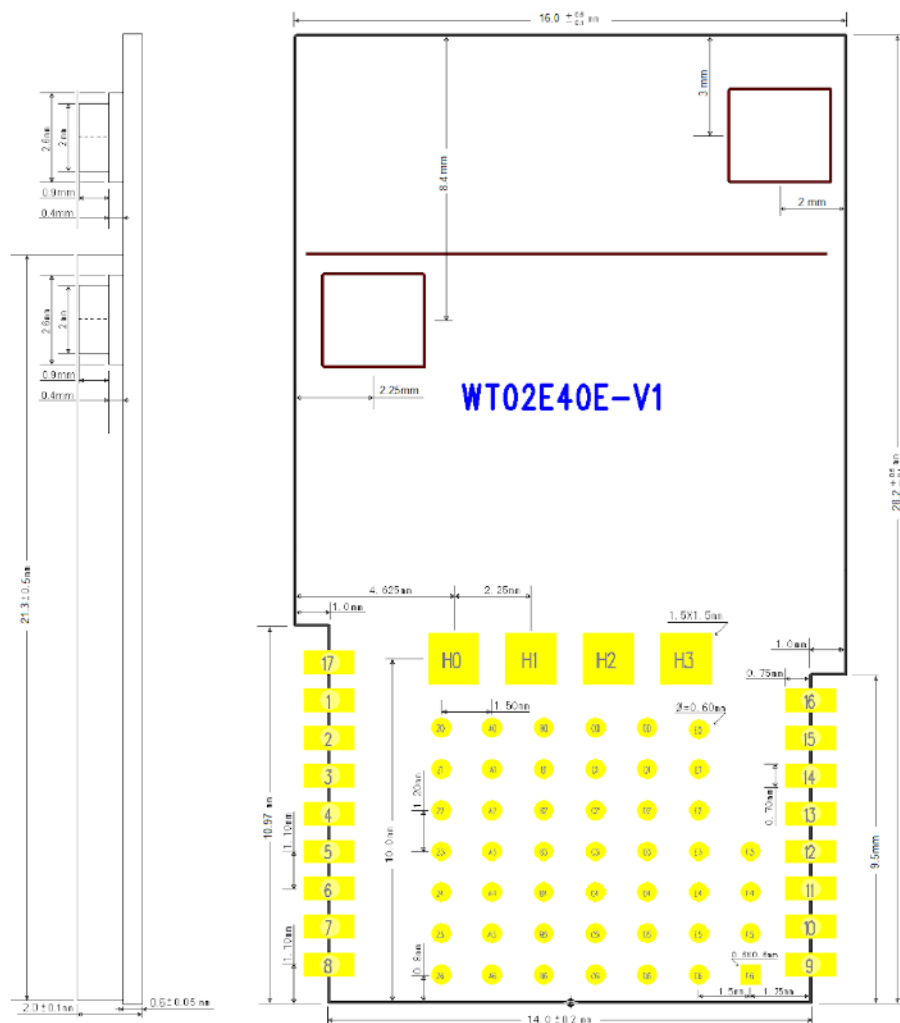
## Mechanical Drawings

Soldering pads for WT02E40E is the same as that of the nRF5340 modules, BT40F and BT40N. Due to different antenna designs, the sizes of modules are different.

Two types of pins are available to meet different application requirements.

- 16 castellated pins for application needing limited number of IOs. SMT equipment is not required for soldering castellated pins.
- 45 LGA (Land Grid Array) pins to access all 48 GPIOs of nRF52840 when needed.

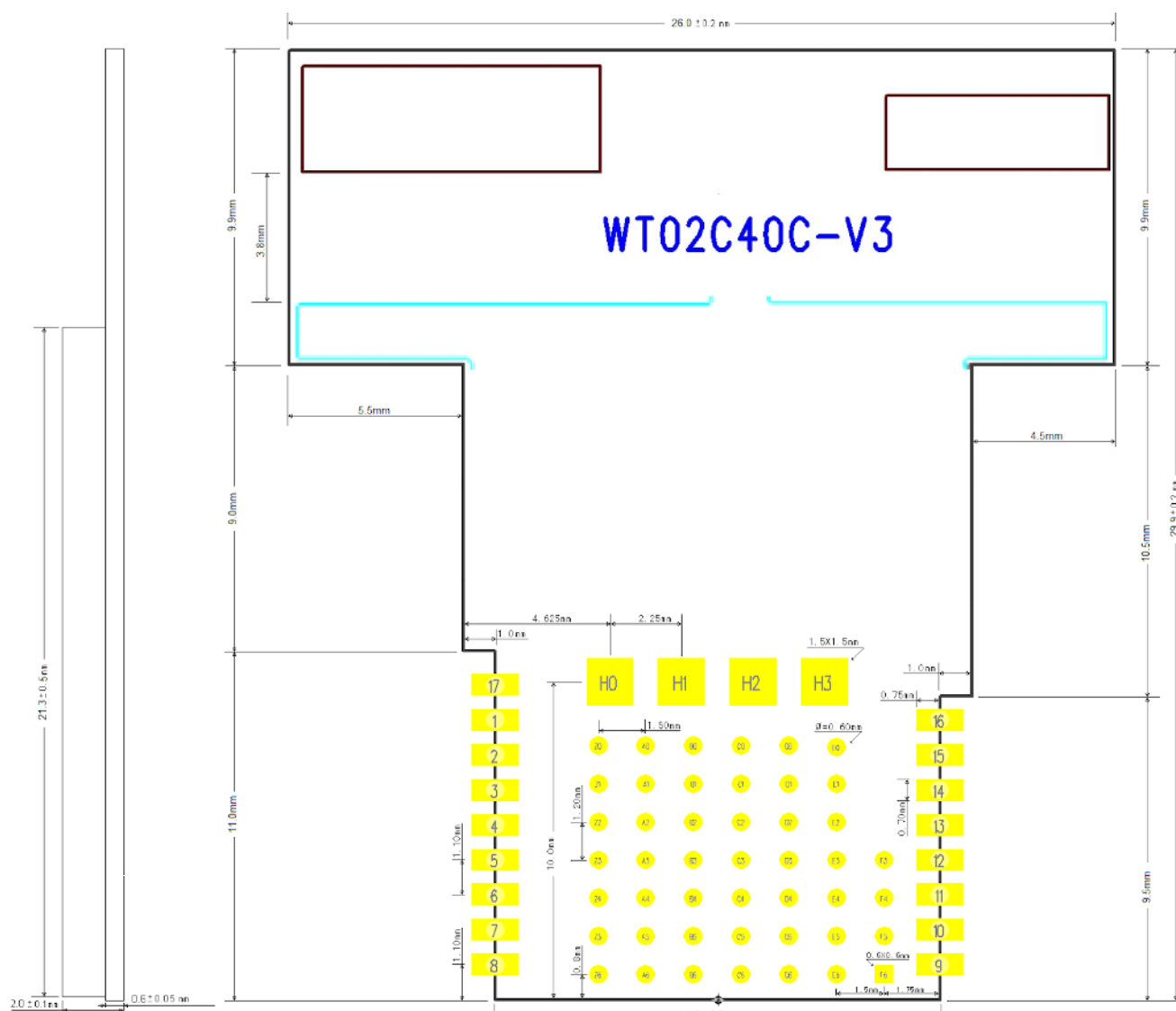
The following is WT02E40E-eng mechanical drawings, top view.



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WT02C40C-eng mechanical drawings, top view.



WT02V40V mechanical drawings, top view.

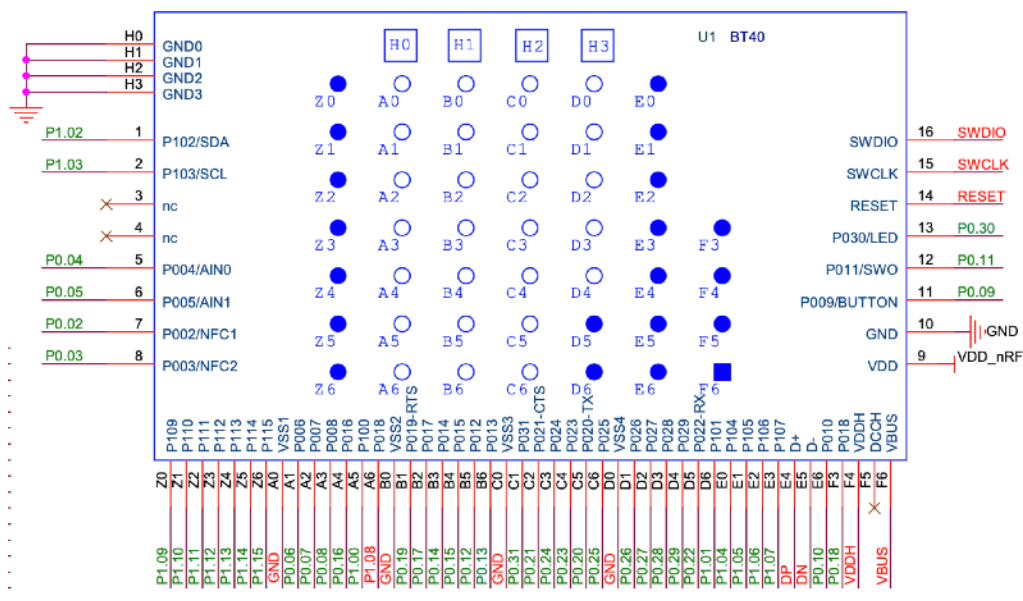


## Pin Assignments of WT02E40E

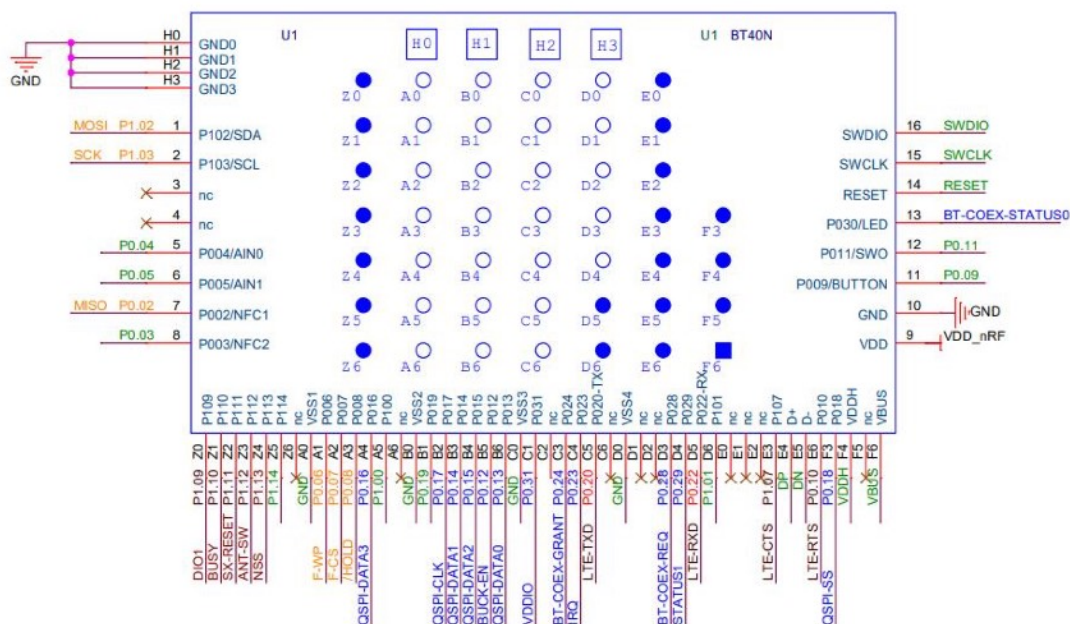
The followings are WT02E40E pin assignment. Pin functions are in a table in next section. Please refer to Nordic [nRF5340 Product Specifications](#) for detailed descriptions and features supported.

BT40F, BT40N, and WT02C40C have compatible footprints. Pin assignments are below. Firmware configuration is required to upgrade module on the PCB.

### BT40F pin assignments



### BT40N pin assignments.





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## Pin Functions

The nRF5340 GPIO pins used to manage nRF7002 inside WT02C40C are in **blue** color in the **Descriptions** column. These pins are NC (No Connect) on the module.

BT40N/NE has the same soldering pads as BT40F. It uses 9 GPIO pins internally to control the power amplifier, nRF21540. These pins are described in **red** color in the **Descriptions** column. The SPI pins may be shared with other SPI devices. Avoid using these pins as GPIO pins if you need Bluetooth range upgrade.

| BT40/BT40N | WT02C40C | nRF5340 |            |                                                                                              |
|------------|----------|---------|------------|----------------------------------------------------------------------------------------------|
| pin#       | pin#     | pin#    | pin name   | Descriptions                                                                                 |
| 1          | 1        | AE1     | P1.02      | GPIO, configured as I2C SDA on EV board                                                      |
| 2          | 2        | AF2     | P1.03      | GPIO, configured as I2C SCL on EV board                                                      |
| 3          | 3        | N1      | NC         | NC, 32.768 KHz crystal embedded.                                                             |
| 4          | 4        | R1      | NC         | NC, 32.768 KHz crystal embedded.                                                             |
| 5          | 5        | V2      | P0.04/AIN0 | GPIO, Analog input                                                                           |
| 6          | 6        | Y2      | P0.05/AIN1 | GPIO, Analog input                                                                           |
| 7          | 7        | W1      | P0.02/NFC1 | GPIO, NFC antenna connection                                                                 |
| 8          | 8        | AA1     | P0.03/NFC2 | GPIO, NFC antenna connection                                                                 |
| 9          | 9        | A19     | VDD        | DC supply 1.7V to 3.6V. <b>3.3V nominal for WT02C40C Series, 2.9V minimum, 3.6V maximum.</b> |
| 10         | 10       | A25     | VSS        | Ground                                                                                       |
| 11         | 11       | AJ1     | P0.09/MOSI | GPIO; BT40F, high speed SPI_MOSI.                                                            |
| 12         | 12       | AK4     | P0.11      | GPIO                                                                                         |
| 13         | NC       | B24     | P0.30      | GPIO; <b>NC for WT02C40C, used as COEX_Status 0 internally for nRF7002.</b>                  |
| 14         | 14       | AC31    | /RESET     | GPIO, reset with internal pull up, active low.                                               |
| 15         | 15       | W31     | SWDCLK     | Serial Wire Debug clock input                                                                |
| 16         | 16       | AA31    | SWDIO      | Serial Wire Debug I/O                                                                        |
|            | 17       |         | Vbat-3.3V  | <b>To nRF7002 pin 31 BUCKVBATS and pin 25 BUCKVBAT. 3.3V.</b>                                |
|            | 17       |         | WiFi feed  | <b>For WT02P40P only. WiFi RF connection to an antenna on the host board.</b>                |
|            | 18       |         | GND        | <b>For WT02P40P only. WiFi antenna ground.</b>                                               |
|            | 19       |         | BLE feed   | <b>For WT02P40P only. BLE RF connection to an antenna on the host board.</b>                 |
|            | 20       |         | GND        | <b>For WT02P40P only. WiFi antenna ground.</b>                                               |
| Z0         | Z0       | AK26    | P1.09      | GPIO                                                                                         |
| Z1         | Z1       | R31     | P1.10      | GPIO                                                                                         |
| Z2         | Z2       | B20     | P1.11      | GPIO;                                                                                        |
| Z3         | Z3       | B18     | P1.12      | GPIO;                                                                                        |
| Z4         | Z4       | A17     | P1.13      | GPIO;                                                                                        |
| Z5         | Z5       | B16     | P1.14      | GPIO                                                                                         |
| <b>Z6</b>  | Z6       | B14     | P1.15      | <b>GPIO, Connected to nRF21540 SCK pin internally for BT40N.</b>                             |
| A0         | A0       | A25     | VSS        | Ground                                                                                       |
| A1         | A1       | AB2     | P0.06/AIN2 | GPIO, Analog input                                                                           |
| A2         | A2       | AD2     | P0.07/AIN3 | GPIO, Analog input                                                                           |
| A3         | A3       | AH2     | P0.08/SCK  | GPIO; BT40F, high speed SPI clock                                                            |
| A4         | A4       | AL9     | P0.16/IO3  | GPIO; BT40F, high speed SPI IO3                                                              |
| A5         | A5       | M2      | P1.00      | GPIO                                                                                         |
| <b>A6</b>  | A6       | AL23    | P1.08      | <b>GPIO, Connected to nRF21540 MOSI pin internally for BT40N.</b>                            |
| B0         | B0       |         | VSS        | Ground                                                                                       |

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|    |    |      |            |                                                                                          |
|----|----|------|------------|------------------------------------------------------------------------------------------|
| B1 | B1 | AL13 | P0.19      | GPIO                                                                                     |
| B2 | B2 | AK12 | P0.17/SCK  | GPIO; BT40F, QSPI clock.                                                                 |
| B3 | B3 | AK8  | P0.14/IO1  | GPIO; BT40F, QSPI IO1                                                                    |
| B4 | B4 | AK10 | P0.15/IO2  | GPIO; BT40F, QSPI IO2                                                                    |
| B5 | NC | AK6  | P0.12/DCX  | GPIO; BT40F, high speed SPI DCX; NC for WT02C40C, used internally as BUCKEN for nRF7002. |
| B6 | B6 | AL5  | P0.13/IO0  | GPIO, BT40F, QSPI IO0                                                                    |
| C0 | C0 |      | VSS        | Ground                                                                                   |
| C1 | NC | B22  | P0.31      | GPIO; NC for WT02C40C, used internally as IOVDD Control for nRF7002.                     |
| C2 | C2 | AL15 | P0.21      | GPIO; Connected to nRF21540 TX_EN pin internally for BT40N.                              |
| C3 | NC | AL27 | P0.24      | GPIO; NC for WT02C40C, used internally as COES_Grant for RF7002.                         |
| C4 | NC | AK20 | P0.23      | GPIO; NC for WT02C40C, used internally as Host IRQ for nRF7002.                          |
| C5 | C5 | AK16 | P0.20      | GPIO                                                                                     |
| C6 | C6 | AK28 | P0.25/AIN4 | GPIO, BT40F, analog input; Connected to nRF21540 MISO pin internally for BT40N.          |
| D0 | D0 |      | VSS        | Ground                                                                                   |
| D1 | D1 | AL29 | P0.26/AIN5 | GPIO, BT40F, analog input; Connected to nRF21540 PDN pin internally for BT40N.           |
| D2 | D2 | AK30 | P0.27/AIN6 | GPIO; BT40F, analog input; Connected to nRF21540 RX_EN pin internally for BT40N.         |
| D3 | NC | AE31 | P0.28/AIN7 | GPIO, BT40F, analog input; NC for WT02C40C, used internally as COEX-REQ for nRF7002.     |
| D4 | NC | U31  | P0.29      | GPIO; NC for WT02C40C, used internally as COEX_Status 1 for nRF7002.                     |
| D5 | D5 | AK18 | P0.22      | GPIO                                                                                     |
| D6 | D6 | P2   | P1.01      | GPIO                                                                                     |
| E0 | E0 | AL19 | P1.04      | GPIO; Connected to nRF21540 MODE internally for BT40N.                                   |
| E1 | E1 | AK22 | P1.05      | GPIO; Connected to nRF21540 ANT-SEL internally for BT40N.                                |
| E2 | E2 | AL21 | P1.06      | GPIO; Connected to nRF21540 CSN pin internally for BT40N.                                |
| E3 | E3 | AK24 | P1.07      | GPIO                                                                                     |
| E4 | E4 | B2   | D+         | USB D+                                                                                   |
| E5 | E5 | B4   | D-         | USB D-                                                                                   |
| E6 | E6 | AK2  | P0.10/MISO | GPIO, BT40F, high speed SPI MISO                                                         |
| H0 | H0 |      |            | Ground pad                                                                               |
| H1 | H1 |      |            | Ground pad                                                                               |
| H2 | H2 |      |            | Ground pad                                                                               |
| H3 | H3 |      |            | Ground pad                                                                               |
| F3 | F3 | AK14 | P0.18/CSN  | GPIO, BT40F, QSPI chip select                                                            |
| F4 | F4 | E1   | VDDH       | High Voltage Power Supply, 2.5V to 5.5V. 3.3V for WT02C40C, engineering version.         |
| F5 | F5 | J1   | NC         | BT40F, No connect, L,C circuit embedded.                                                 |
| F6 | F6 | A5   | VBUS       | 5V DC power for USB 3.3V regulator                                                       |

## nRF5340 and NRF7002 Internal Connection

The WLCSP version of nRF5340 and the WLCSP version of nRF7002 are used in the WT02C40C Series combo modules. The internal connections are shown below.

| WT02C40C Internal connection |           |              |                  |
|------------------------------|-----------|--------------|------------------|
| nRF5340 CLAA                 |           | nRF7002 CEAA |                  |
| Pin                          | Port name | Pin          | Pin name         |
| J6                           | P0.12     | J5           | BUCK-EN          |
| K10                          | P0.13     | B2           | QSPI-DATA0       |
| K9                           | P0.14     | B4           | QSPI-DATA1       |
| L9                           | P0.15     | A3           | QSPI-DATA2       |
| K8                           | P0.16     | B6           | QSPI-DATA3       |
| L7                           | P0.17     | C1           | QSPI-CLK         |
| K7                           | P0.18     | C3           | QSPI-SS          |
| H3                           | P0.23     | B10          | IRQ              |
| K2                           | P0.24     | A11          | BT-COEX-GRANT    |
| E3                           | P0.28     | B8           | BT-COEX-REQ      |
| E2                           | P0.29     | A9           | SW-CTRL1/STATUS1 |
| C4                           | P0.30     | A5           | BT-COEX-STATUS0  |
| C5                           | P0.31     | B12          | IOVDD            |

## Using Internal Load Capacitors for the High Frequency Oscillator

The external load capacitors for the 32MHz crystal are not mounted. An Epson or equivalent +/-10 PPM crystal is connected to XC1 and XC2 pins. The Bluetooth signal frequencies are within specifications if the internal load capacitors are not enabled. Use the following procedures to **set the internal load capacitors to 11 pF for BT40F**, the Bluetooth signal frequency is measured to be within 5 PPM at 25°C. **The settings for WT02C40C are to be determined.**

The internal load capacitors can be programmed from 7.0 pF to 20 pF in 0.5 pF steps. The addresses and description of registers for programming the value of load capacitors are from the [Nordic nRF5340 Product Specifications](#).

| Base address                            | Domain                                                                                | Peripheral | Instance                                                                        | Secure mapping | DMA security | Description | Configuration |
|-----------------------------------------|---------------------------------------------------------------------------------------|------------|---------------------------------------------------------------------------------|----------------|--------------|-------------|---------------|
| OSCILLATORS :                           |                                                                                       |            |                                                                                 |                |              |             |               |
| 0x50004000                              |                                                                                       |            | S                                                                               |                |              |             |               |
| Programmable capacitance of XC1 and XC2 |                                                                                       |            |                                                                                 |                |              |             |               |
| Bit number                              | 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 |            |                                                                                 |                |              |             |               |
| ID                                      |                                                                                       |            |                                                                                 |                |              |             | B A A A A A   |
| Reset 0x00000000                        | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0                       |            |                                                                                 |                |              |             |               |
| ID                                      | R/W                                                                                   | Field      | Value ID                                                                        | Value          | Description  |             |               |
| Register                                | Offset Security Description                                                           |            |                                                                                 |                |              |             |               |
| XOSC32MCPAS                             | 0x5C4                                                                                 |            | Programmable capacitance of XC1 and XC2                                         |                |              |             | Retained      |
| XOSC32KI.BYPASS                         | 0x6C0                                                                                 |            | Enable or disable bypass of LFCLK crystal oscillator with external clock source |                |              |             | Retained      |
| XOSC32KI.INTCAP                         | 0x6D0                                                                                 |            | Control usage of internal load capacitors                                       |                |              |             | Retained      |

To program the load capacitance, settings in the file `cpu_app prj.conf`:

```
CONFIG_SOC_ENABLE_LFXO=y
CONFIG_SOC_LFXO_CAP_INT_7PF=y
CONFIG_SOC_HFXO_CAP_INTERNAL=y
CONFIG_SOC_HFXO_CAP_INT_VALUE_X2=25
CONFIG_BUILD_WITH_TFM=y

## X2= 14 7pf   0x400045c4=0x102
## X2= 15 7.5pf 0x400045c4=0x103
## X2= 16 8pf   0x400045c4=0x104
## X2= 17 8.5pf 0x400045c4=0x105
## X2= 18 9pf   0x400045c4=0x106
## X2= 19 9.5pf 0x400045c4=0x107
## X2= 20 10pf   0x400045c4=0x107
## X2= 21 10.5pf 0x400045c4=0x108
## X2= 22 11pf   0x400045c4=0x109 //BT40 default
## X2= 23 11.5pf 0x400045c4=0x10A
## X2= 24 12pf   0x400045c4=0x10B
## X2= 25 12.5pf 0x400045c4=0x10C //recover default
## X2= 26 13pf   0x400045c4=0x10D
## X2= 27 13.5pf 0x400045c4=0x10E
## X2= 28 14pf   0x400045c4=0x10F
## X2= 29 14.5pf 0x400045c4=0x110
## X2= 30 15pf   0x400045c4=0x111
## X2= 31 15.5pf 0x400045c4=0x112 //BC40 default
## X2= 32 16pf   0x400045c4=0x113
.....
```

Alternatively, the load capacitance can be programmed using commands.

```

C:\Users\Leo>nrfjprog --memrd 0x500045c4
0x500045C4: 0000010C          |....|

C:\Users\Leo>nrfjprog --memrd 0x500045c4
0x500045C4: 00000102          |....|

C:\Users\Leo>nrfjprog --memrd 0x500045c4
0x500045C4: 00000102          |....|

C:\Users\Leo>nrfjprog --memrd 0x500045c4
0x500045C4: 00000102          |....|

C:\Users\Leo>nrfjprog --memrd 0x500045c4
0x500045C4: 0000010B          |....|

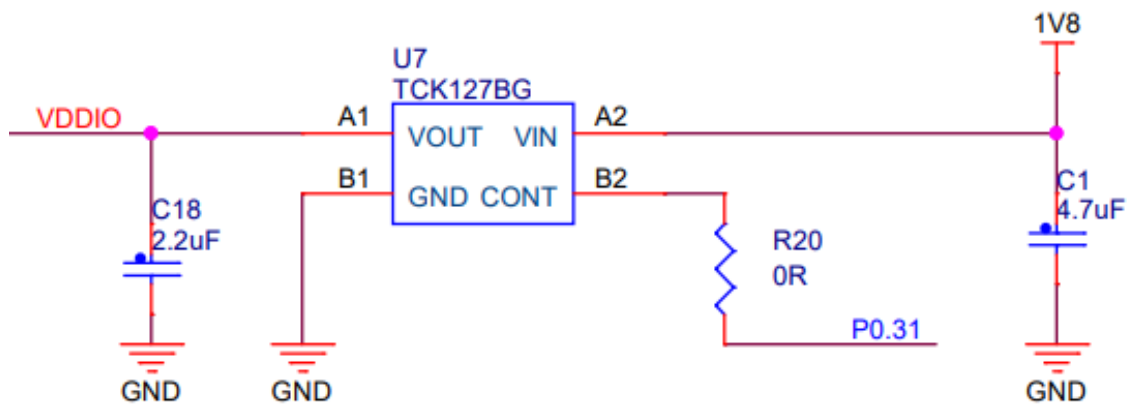
C:\Users\Leo>nrfjprog --memrd 0x500045c4
0x500045C4: 0000010D          |....|

C:\Users\Leo>nrfjprog --memrd 0x500045c4
0x500045C4: 0000010C          |....|

C:\Users\Leo>
    
```

## Powering Up Sequence

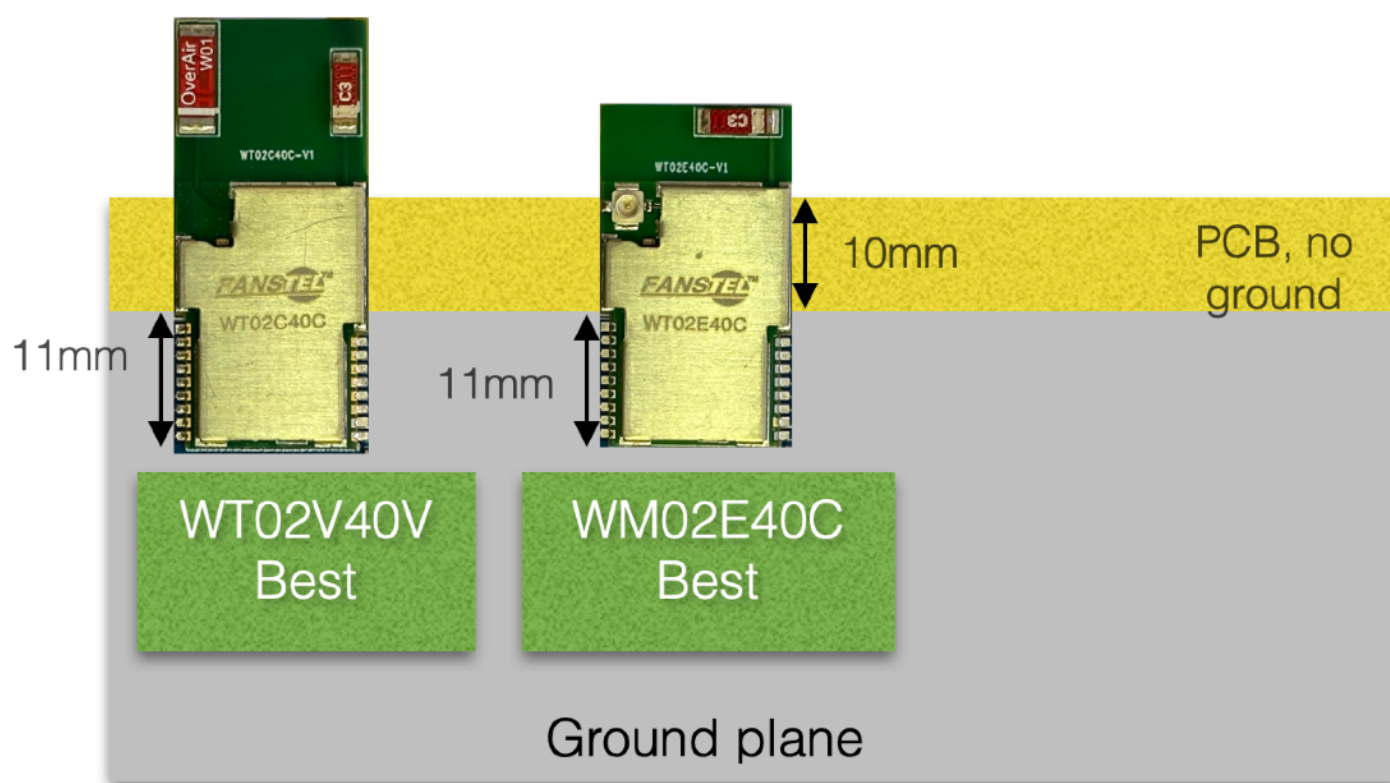
The following circuitry is embedded in WT20E40E series combo modules to control powering up sequence. Please use P0.31 to control 3.3V power supply to nRF7002.



## Mounting WT02V40V Module on the Host PCB

WT02C40C series modules are called WT02V40V in this section as the module mounting guidelines are not applicable to WT02E40E with two u.FL connectors.

- The size of antenna area varies Fromm a module to another. A ground plane shall cover the castellated pin area of the module or 11 mm from the bottom edge. This ground plane is shown in gray color area below.
- A PCB area without ground or any signal trace shall extend for 10mm or more as shown in yellow color area below.
- [EV-WT02E40E Gerber files](#) can be used as a PCB layout example.



For the best Bluetooth and WiFi range performance, keep all external metal at least 30mm from the antenna area.

**Host Board Design for Low Cost or Long Range**

On nRF53 series SoCs, Nordic offers various memory options and protocol supports. Fanstel offers various antenna and power amplifier options. A host board can be designed to accommodate these nRF53 modules. Our suggestions for host PCB design:

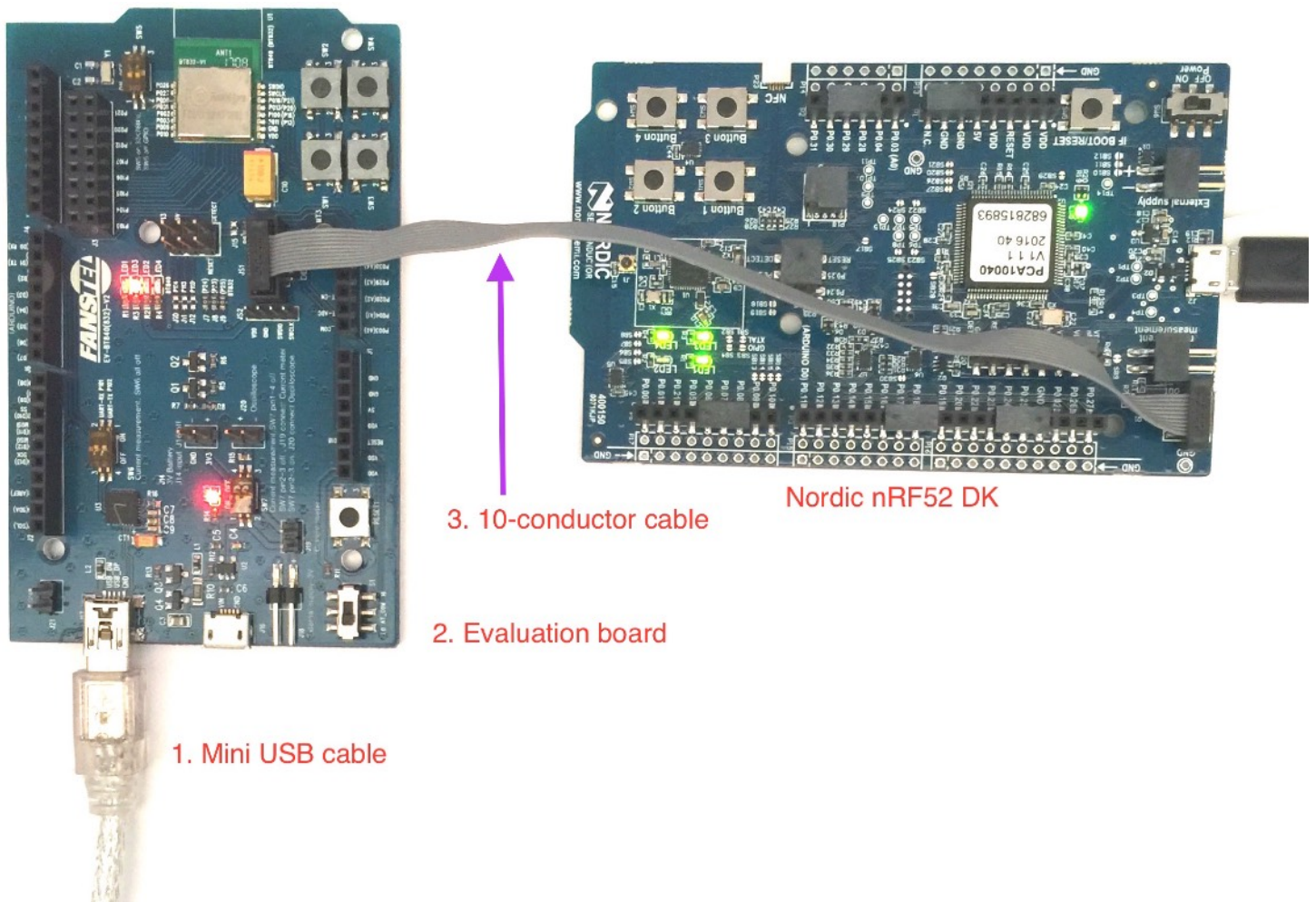
- use a 4 or more layers PCB.
- Use library component from EV-WT02E40F Gerber files. They can be downloaded from <http://www.fanstel.com/download-document/>. It has 16 castellated pins plus 45 LGA pins.
- WT02E40F soldering pad footprint is compatible with that of BT40F and BT40N (nRF5340+nRF21540).
- As much ground plane under WT02E40F, on top side of host PCB as possible. Use EV-WT40E40F Gerber files as an example.

## 4. WT02C40C Evaluation Board

An evaluation board consists of the followings:

- Mini USB cable
- Evaluation board
- 10-conductor cable for connection to Nordic nRF53 DK (DK is not included)

The EV board can be programmed by using a Nordic nRF53 DK board, connected as below. (Photo to be updated)



## **Nordic Development Tools**

A Nordic nRF5340 DK is recommended for programming this evaluation board. Visit Nordic website for [nRF5340 DK description and product brief](#).

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/>

**BT40** firmware can be used in all nRF5340 modules without power amplifier, e.g., WT02E40F, WT02E40E, WT02C40C, BT40F and BT40E.

## **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.

**EV-WT02E40E EvaluationBoard Schematics**

Evaluation board [EV-WT02E40F schematics and Gerber files](#) is available at Fanstel website.

Evaluation board can be used as a reference design for using modules. EV-WT02C40C is designed for the WT02C40C soldering pads with 61 pins. This EV board can also be used for WT02V40V and WT02E40F modules.

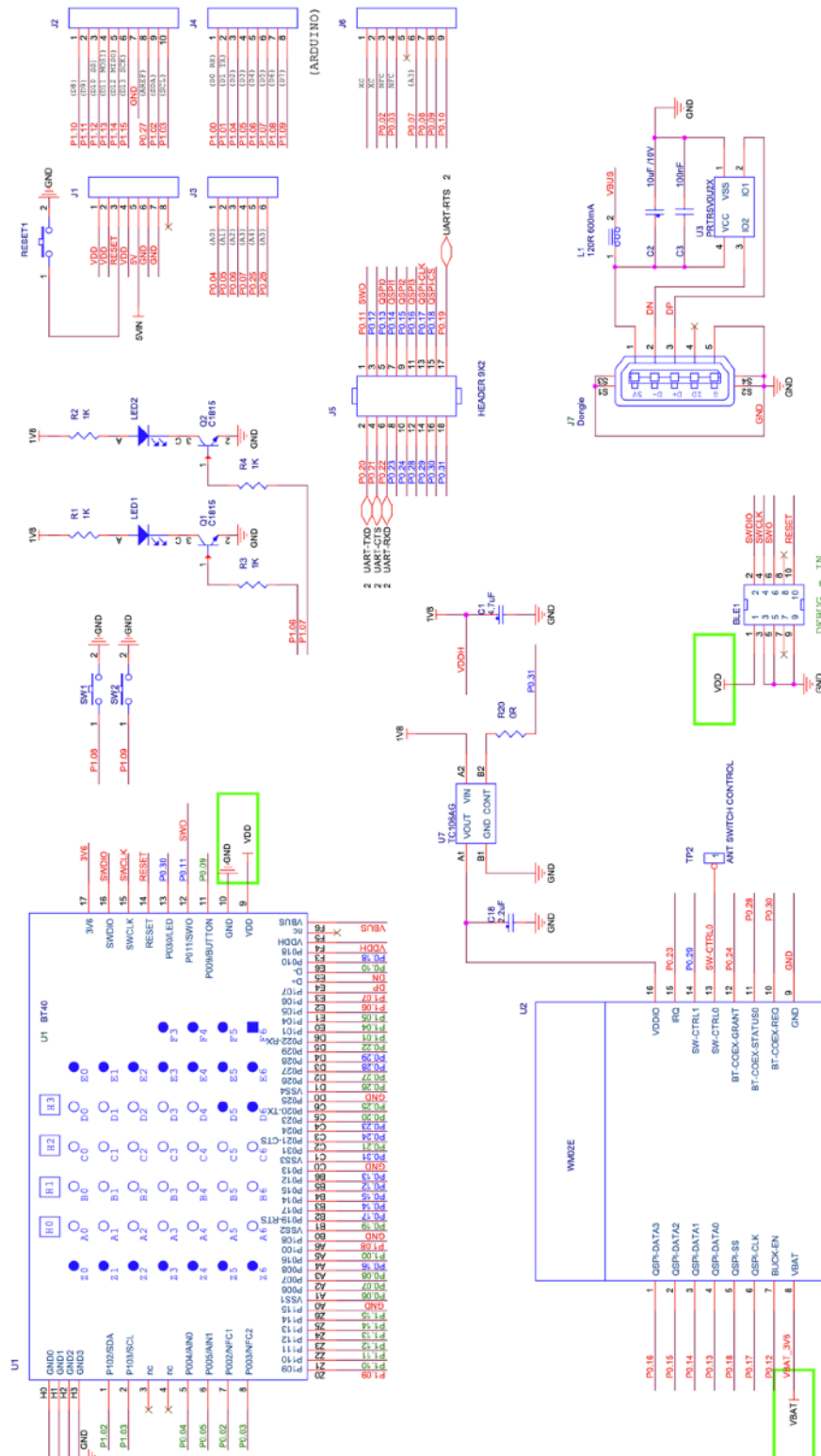
These EV board schematics are for both the companion module WM02C Series and the combo module WT02C40C series.

- As a combo module evaluation board, the companion module location U2, is not mounted.
- The combo module under evaluation is mounted at the U1 location.
- The power switch at U7 for powering up sequencing is not mounted. The power switch is embedded inside the combo module.

## EV Board Schematics for Engineering Versions

EV-WM02C-V3 board schematics for WM02C-eng and WT02C40C-eng, page 1.

- EV-WM02C: WM02C-eng is mounted on the WM02C pad. BT40F is mounted on the BT40 pad.
- EV-WT02C40C: WT02C40C-eng is mounted on the BT40F pad. DNP for the WM02C pad.
- A nominal 3.3V DC supply is connected to pint 9 and Pin 17. Pin 17 is removed in the production WT02C40C.

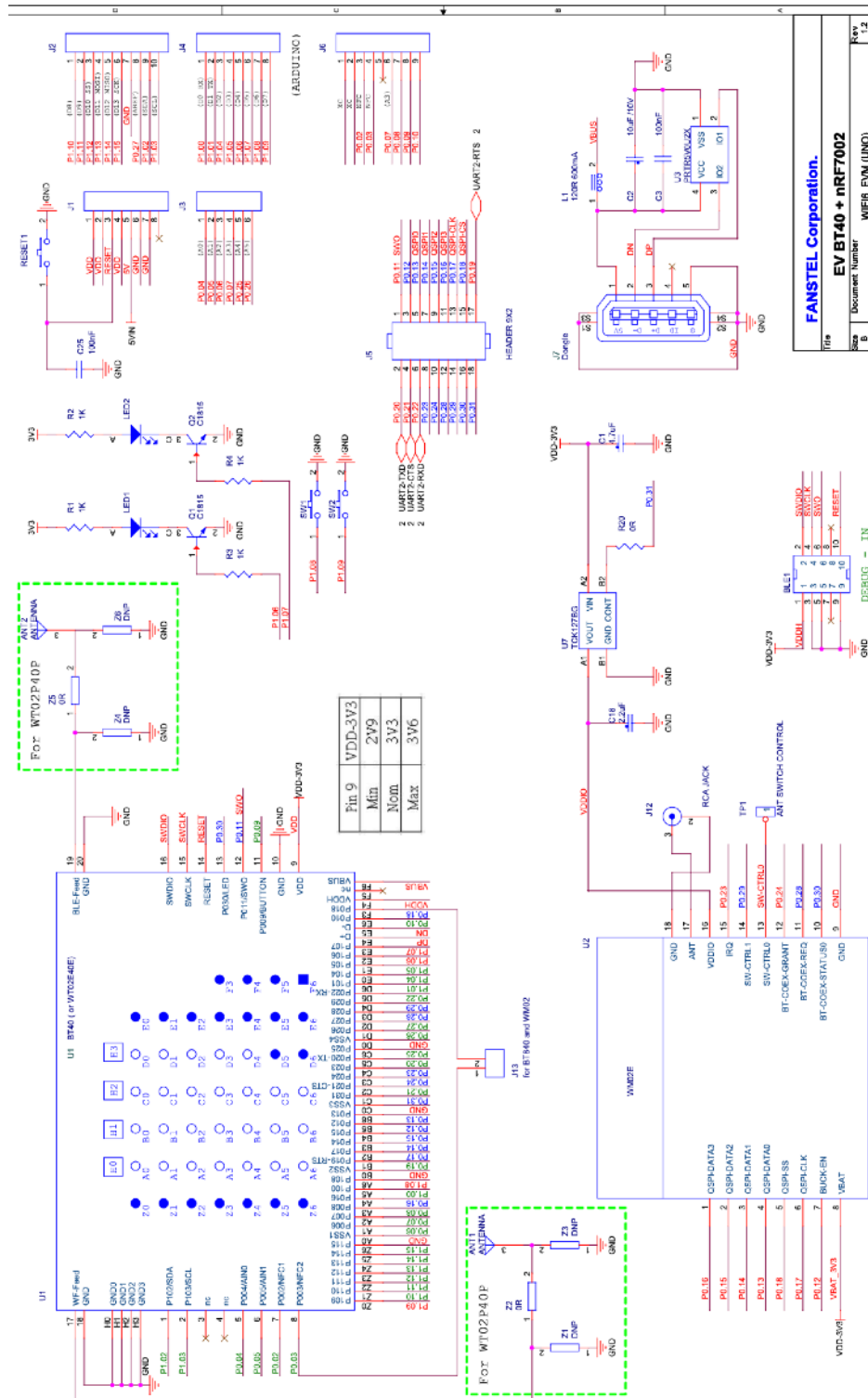




## EV Board Schematics for Production Versions

EV WM02C-V6B EV board schematics for WM02C and WT02C40C, page 1.

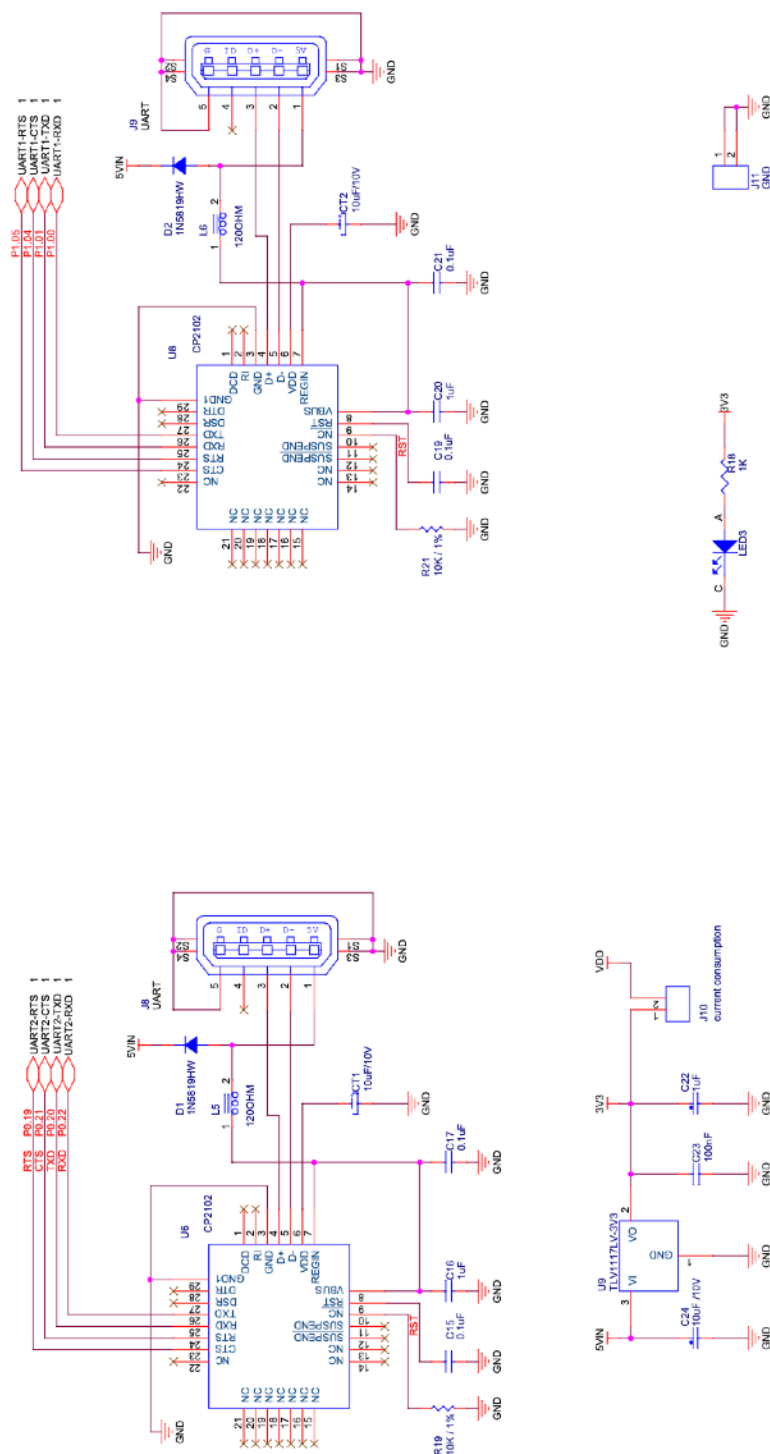
- EV-WM02C: WM02C is mounted on the WM02C pad. BT40F is mounted on the BT40 pad.
- EV-WT02C40C: WT02C40C is mounted on the BT40F pad. DNP for the WM02C pad.
- A nominal 3.3V DC supply is connected to pint 9 and Pin 17.



# WT02C40C-eng BLE 5.3,802.15.4,WiFi6 Combo Module

Ver 0.94, June 2024

EV-WM02C-V6B EV boards schematics for WM02C and WT02C40C, page 2



**Suggestion for Battery Power Application**

Standby current consumption is important for battery-powered product. To reduce host board area, the followings are embedded in modules:

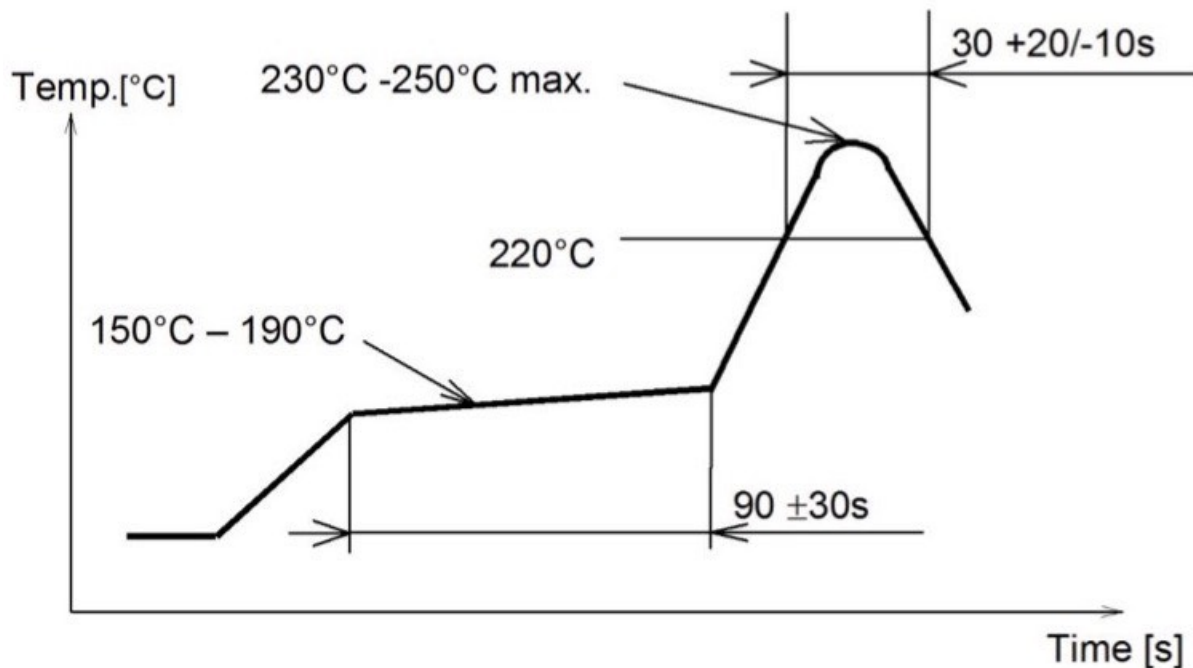
- 32 MHz, 20PPM main crystal.
- 32.768 KHz, 20PPM sleep crystal and load capacitors.
- 40 MHz crystal for nRF7002.
- Inductors and capacitors required for VDD power supply DC to DC converter.
- Inductors and capacitors required for VDDH power supply DC to DC converter.

No external component is required. DCDC converter shall be enabled to reduce power consumption.

## 5. 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 2019, can be used to track silicon version of SoC, module PCB version, and production test code version.



(K) Cust. PO:2630427  


(4K) Cust. PO line:00003  


(P) Cust. P/N : 1914-1019-2-ND  


(1T) Lot :D0V218B-0000000  




(Q) QTY :1000  


(1P) MFG P/N : BT840F  


(6D) Ship Date :20190522  


(9D) Date : 1920  


(4L) COO: CN  


|             |        |
|-------------|--------|
| MSL         | 3/260℃ |
| (E)         | e4     |
| <b>RoHS</b> |        |

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.

## 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

- Feb. 2023, Ver. 0.90: Initial draft release
- April 2023, Ver.0.91: Update module photos and mechanical drawings
- April 2023, Ver. 0.92: Update module mechanical drawings.
- July 2023, Ver. 0.93: Update module photos.
- June 2024, Ver. 0.94: Final update for WT02C40C engineering version. Production version specifications to be released in July.

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