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Approval Sheet

(產品承認書)

產品名稱 (Product): BT 4.2 Module (nRF52832)

產品型號 (Model No.): MDBT42Q Series

MDBT42Q-P Series

Advantage of MDBT42Q & MDBT42Q-P series:

- 1. Long working distance:
MDBT42Q: over 80 meters in open space.
MDBT42Q-P: up to 60 meters in open space.*
- 2. Granted main regional certification such as FCC (USA),
IC (Canada), TELEC (Japan), SRRC (China), NCC (Taiwan).*
- 3. RoHS and REACH compliant.*

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List of Raytac's BLE Model No.

MDBT40 & MDBT40-P Series

| Series | Nordic Solution | Raytac No. | IC Version | Antenna | RAM | Flash Memory |
|-------------------|-----------------|--------------------|------------|--------------|-------|--------------|
| MDBT40 | nRF51822 | MDBT40-128V3 | 3 | Chip Antenna | 16 kb | 128 K |
| | | MDBT40-256V3 | | | | 256 K |
| | | MDBT40-256RV3 | | | 32 kb | 256 K |
| MDBT40-P | nRF51822 | MDBT40-P128V3 | 3 | PCB Antenna | 16 kb | 128 K |
| | | MDBT40-P256V3 | | | | 256 K |
| | | MDBT40-P256RV3 | | | 32 kb | 256 K |
| MDBT40 - ANT | nRF51422 | MDBT40-ANT-256V3 | 3 | Chip Antenna | 16 kb | 256 K |
| | | MDBT40-ANT-256RV3 | | | 32 kb | |
| MDBT40 - ANT-P | nRF51422 | MDBT40-ANT-P256V3 | 3 | PCB Antenna | 16 kb | 256 K |
| | | MDBT40-ANT-P256RV3 | | | 32 kb | |
| MDBT40 Nano | nRF51822 | MDBT40-n256V3 | 3 | N/A | 16 kb | 256 K |
| MDBT40 - ANT-Nano | nRF51422 | MDBT40-ANT-n256V3 | 3 | N/A | 16 kb | 256 K |

MDBT42Q & MDBT42Q-P Series

| Series | Nordic Solution | Raytac No. | IC Version | Antenna | RAM | Flash Memory |
|-----------|-----------------|---------------|------------|--------------|-------|--------------|
| MDBT42Q | nRF52832 | MDBT42Q-512K | 1 | Chip Antenna | 64 kb | 512 K |
| MDBT42Q-P | nRF52832 | MDBT42Q-P512K | 1 | PCB Antenna | 64 kb | 512 K |

1. Overall Introduction

Raytac's MDBT42Q & MDBT42Q-P is a BT 4.0, BT 4.1 and BT 4.2 stack (Bluetooth low energy or BLE) module designed based on **Nordic nRF52832 SoC solution**, which incorporates: **GPIO, SPI, UART, I2C, I2S, PWM** and **ADC** interfaces for connecting peripherals and sensors.

Features of the module:

1. Dual Transmission mode of BLE & 2.4Ghz RF upon customer preference.
2. Compact size with **(L) 16 x (W) 10 x (H) 2.2 mm**.
3. Low power requirements, ultra-low peak, average and idle mode power consumption.
4. Be compatible with a large installed base of mobile phones, tablets and computers.
5. Fully coverage of BLE software stack. See 1.3 Profile & Service Information.
6. BLE & RF transmission switching helps products fit all operation system and most hardware.

1.1. Application

- IoT
 - Home automation
 - Sensor networks
 - Building automation
- Personal Area Networks
 - Health / fitness sensor and monitor device
 - Medical devices
 - Key-fobs and wrist watches
- Interactive entertainment devices
 - Remote control
 - Gaming controller
- Beacons
- A4WP wireless chargers and devices
- Remote control toys
- Computer peripherals and I/O devices
 - Mouse
 - Keyboard
 - Multi-touch trackpad

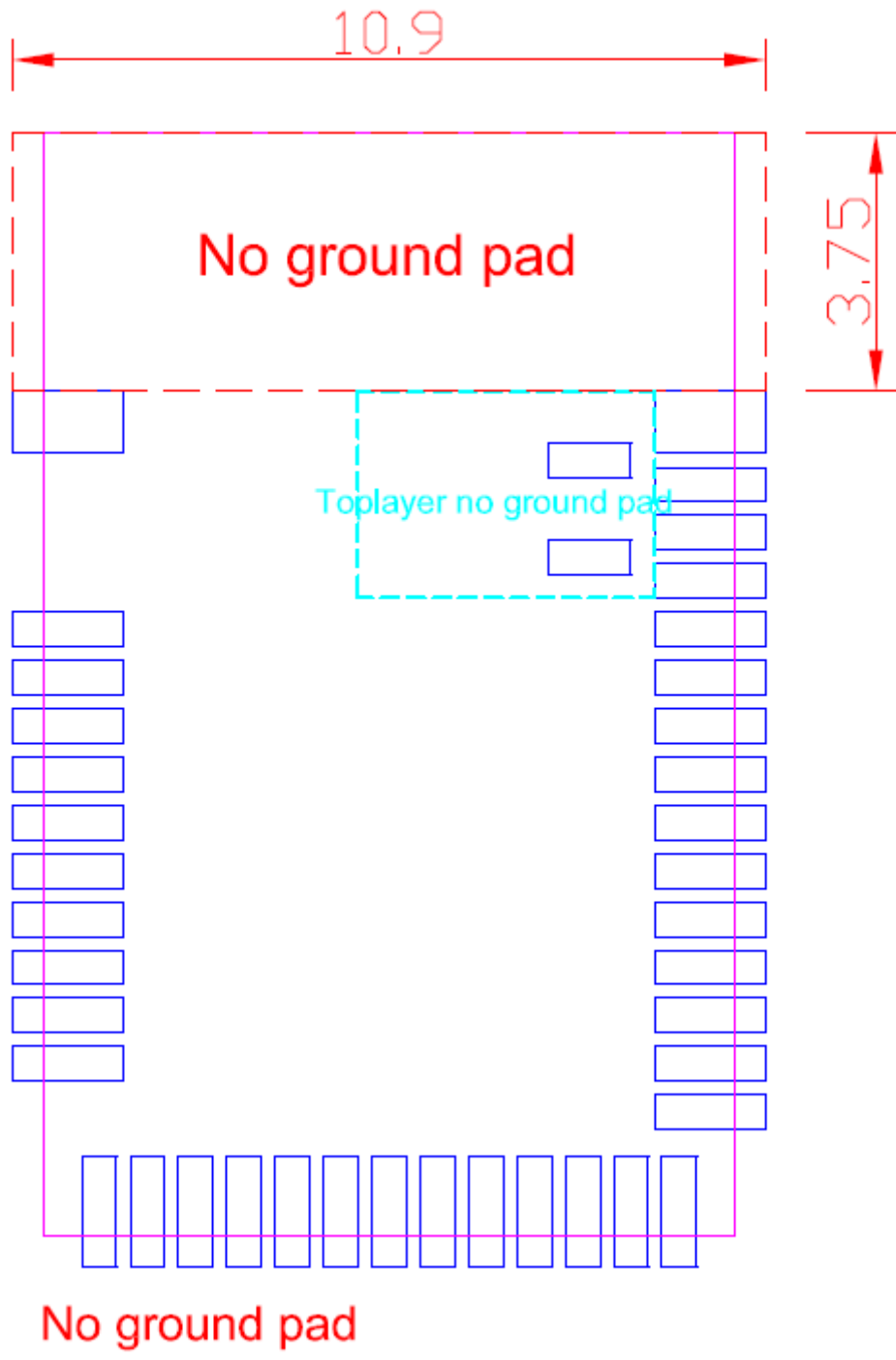
1.2. Features

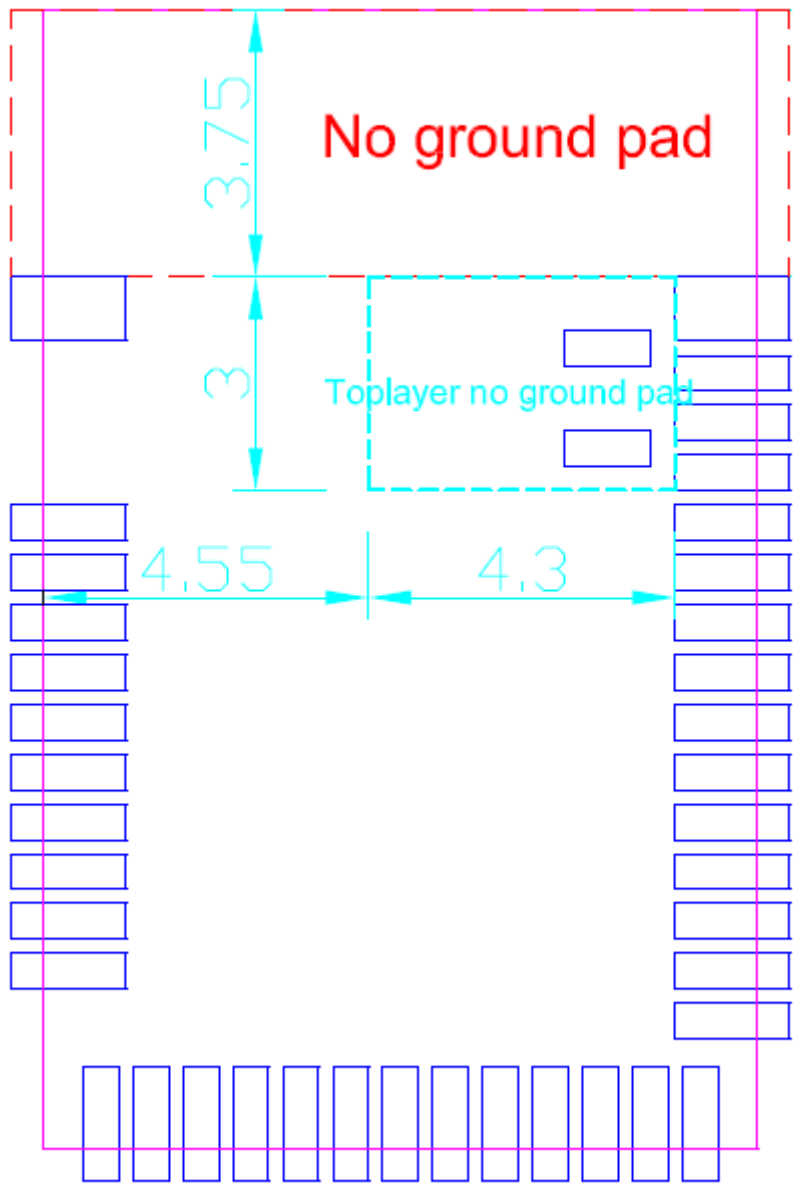
- Multi-protocol 2.4GHz radio
- 32-bit ARM Cortex – M4F processor
- 512KB flash programmed memory and 64KB RAM
- Software stacks available as downloads
- Application development independent from protocol stack
- On-air compatible with nRF51, nRF24AP and nRF24L series
- Programmable output power from +4dBm to -20dBm
- RSSI
- RAM mapped FIFOs using EasyDMA
- Dynamic on-air payload length up to 256 bytes
- Flexible and configurable 32 pin GPIO
- Programmable peripheral interface - PPI
- Simple ON / OFF global power mode
- Full set of digital interface all with Easy DMA including:
 - 3 x Hardware SPI master ; 3 x Hardware SPI slave
 - 2 x two-wire master ; 2 x two-wire slave
 - 1 x UART (CTS / RTS)
 - PDM for digital microphone
 - I2S for audio
- Quadrature demodulator
- 12-bit / 200KSPS ADC
- 128-bit AES ECB / CCM / AAR co-processor
- Low cost external crystal 32MHz \pm 40ppm for Bluetooth ; \pm 50ppm for ANT Plus
- Low power 32MHz crystal and RC oscillators
- Wide supply voltage range 1.7V to 3.6V
- On-chip DC/DC buck converter
- Individual power management for all peripherals
- Timer counter
 - 5 x 32-bit
 - 3 x 24-bit RTC
- NFC-A tag interface for OOB pairing

1.3. Profile & Service Information

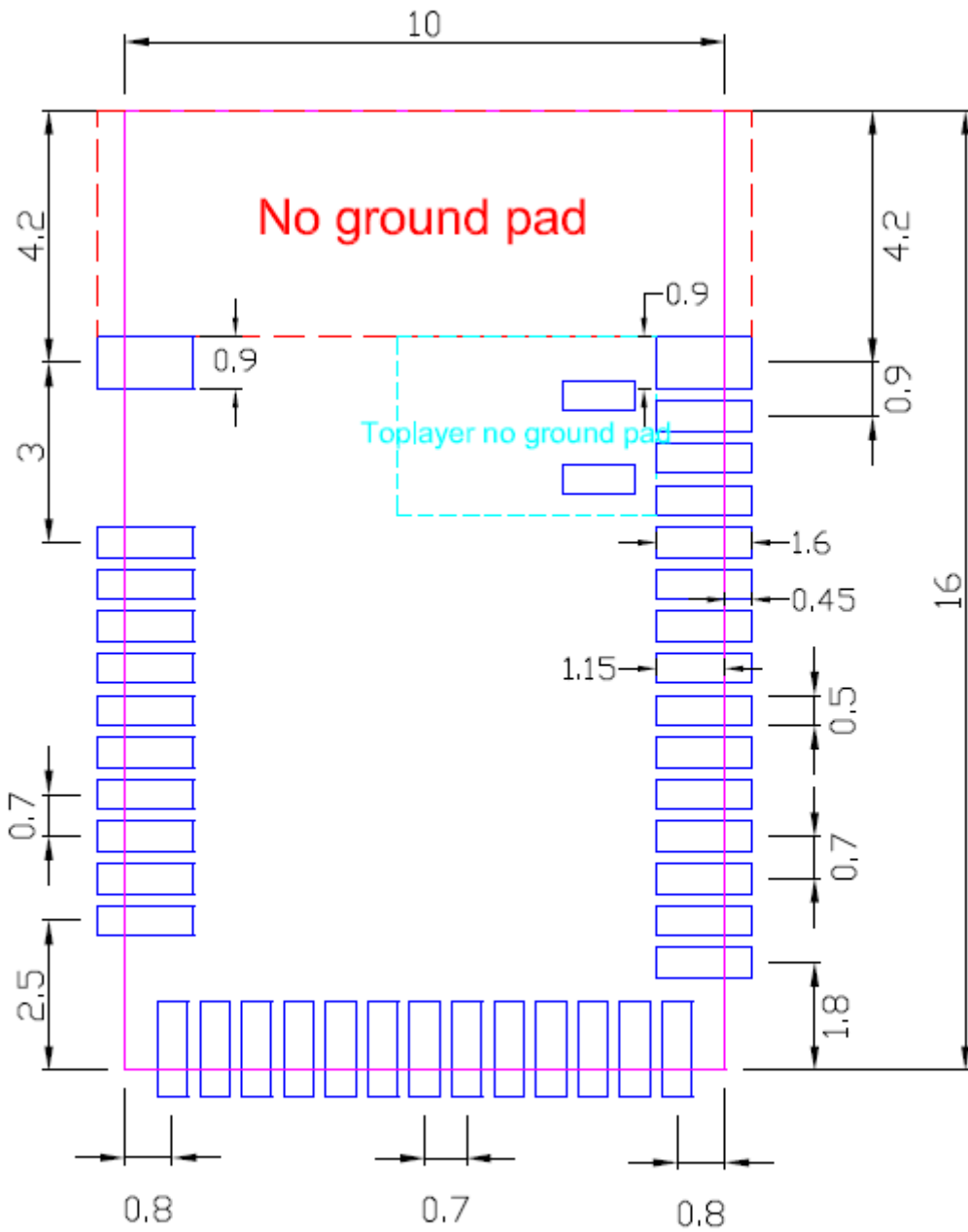
Profile & Service are supported by MDBT42Q & MDBT42Q-P as below:

| Profile Description | Service Description |
|---------------------------------|---------------------------------|
| Alert Notification Profile | Alert Notification Service |
| Blood Pressure Profile | Blood Pressure Service |
| | Device Information Service |
| Cycling Speed & Cadence Profile | Cycling Speed & Cadence Service |
| | Device Information Service |
| Glucose Profile | Glucose Service |
| | Device Information Service |
| Health Thermometer Profile | Health Thermometer Service |
| | Device Information Service |
| Heart Rate Profile | Heart Rate Service |
| | Device Information Service |
| HID over GATT Profile | HID Service |
| | Battery Service |
| Proximity Profile | Link Loss Service |
| | Immediate Alert Service |
| | TX Power Service |
| Running Speed & Cadence Profile | Running Speed & Cadence Service |
| | Device Information Service |

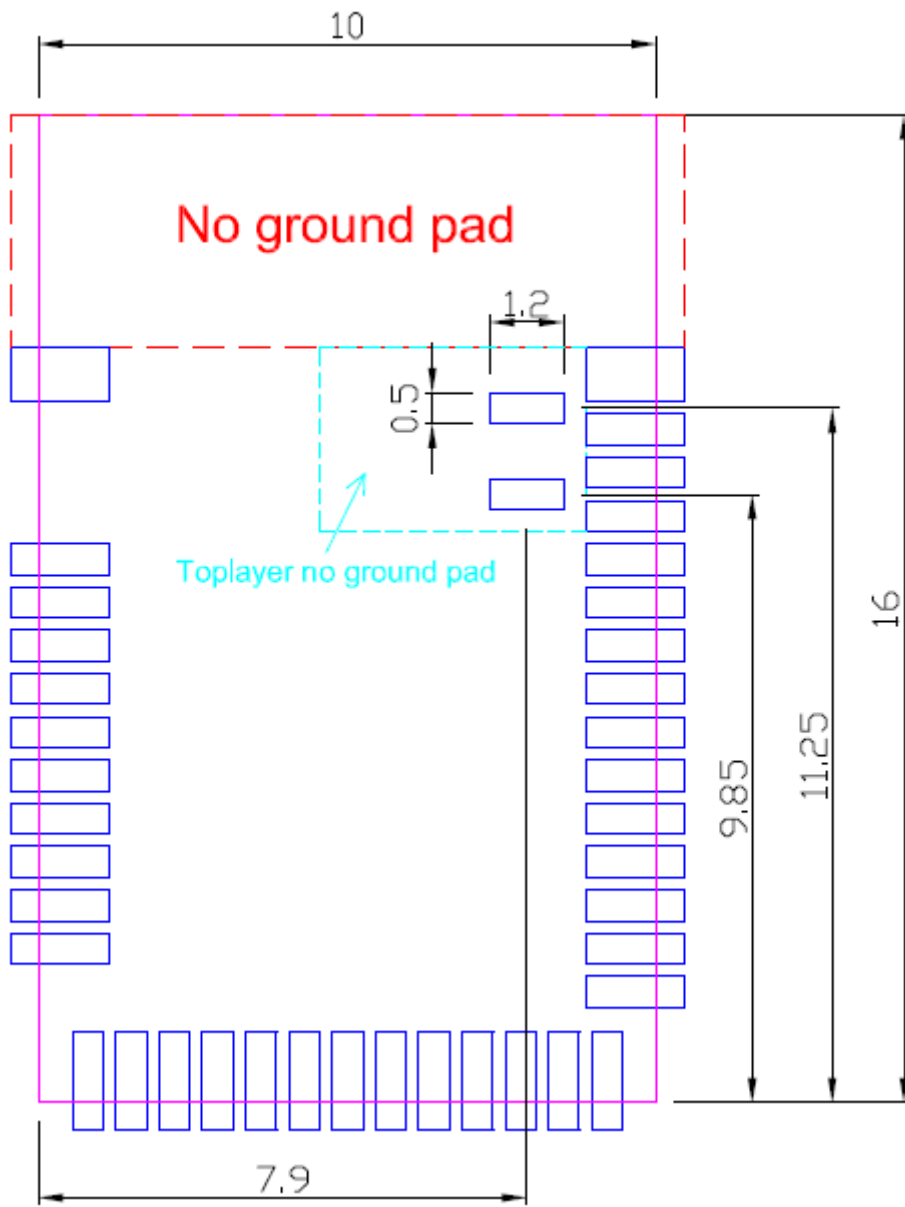




Toplayer no ground pad



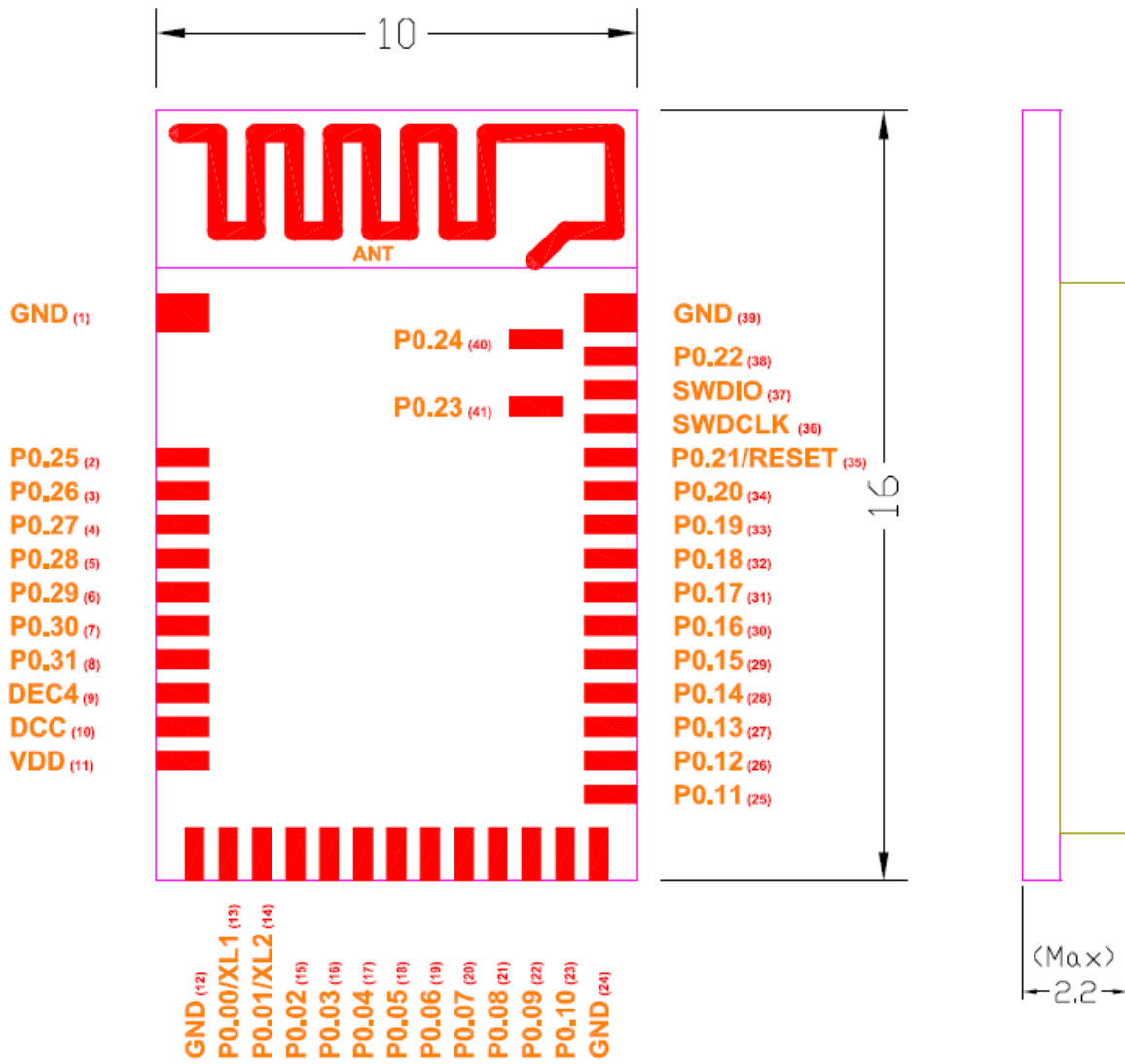
Top View (單位: mm)
recommended solder pad layout



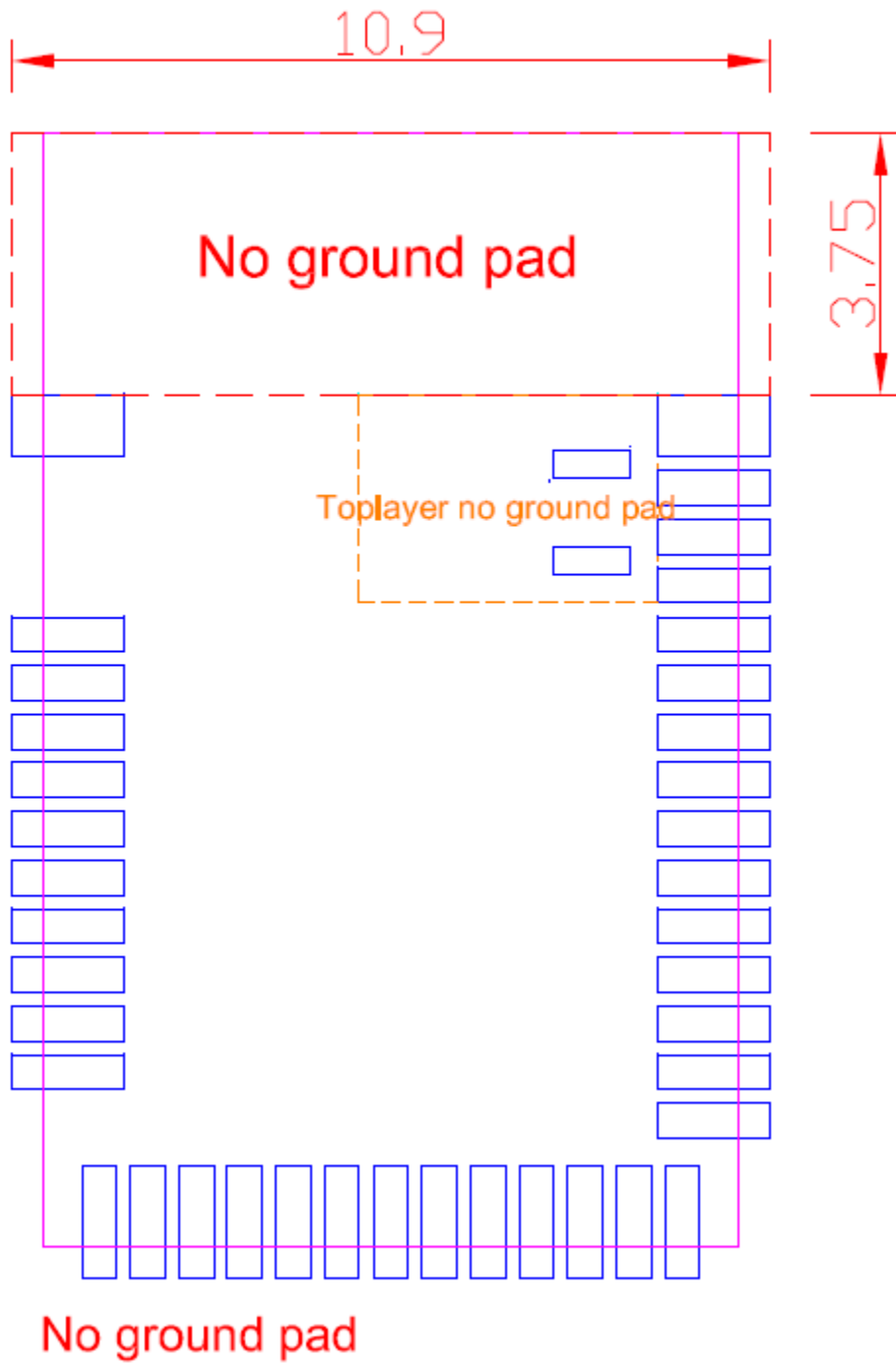
2.2. MDBT42Q-P Series

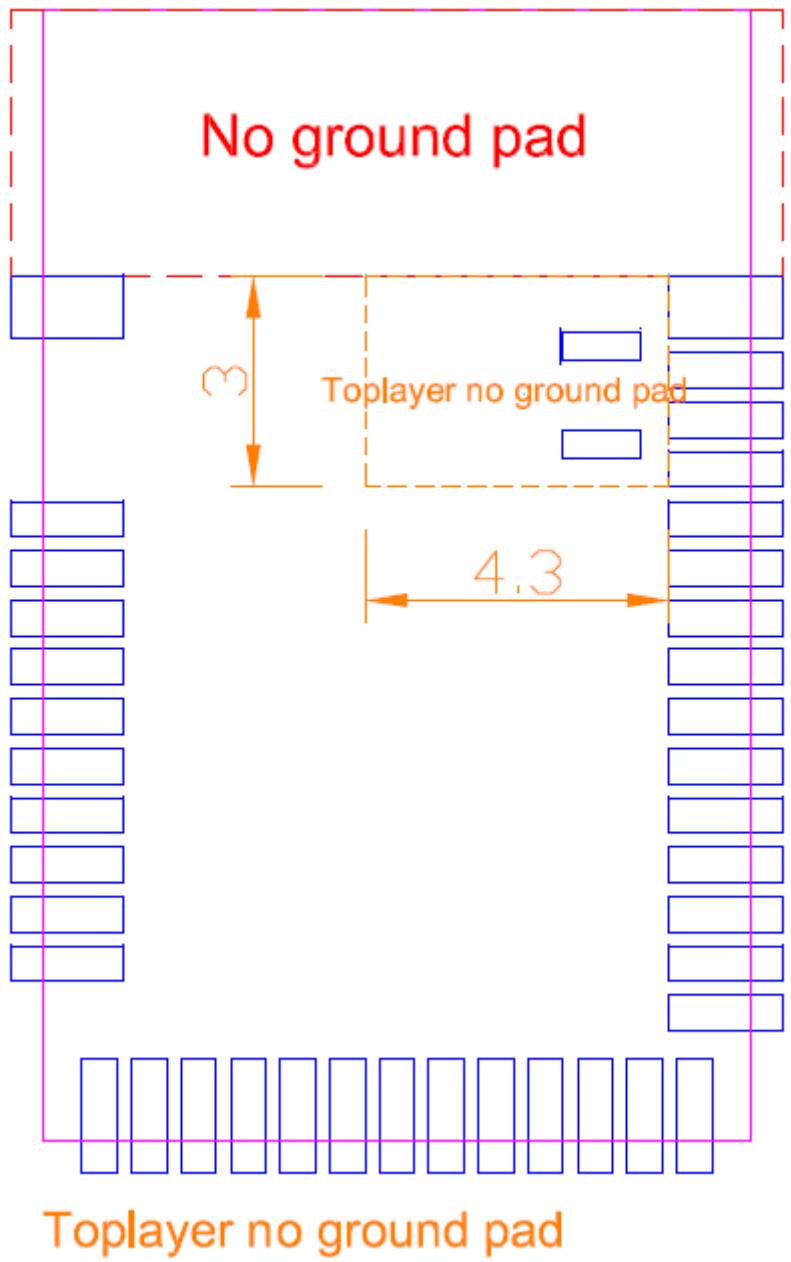
- PCB Dimensions, Pin Indication and Layout Guide

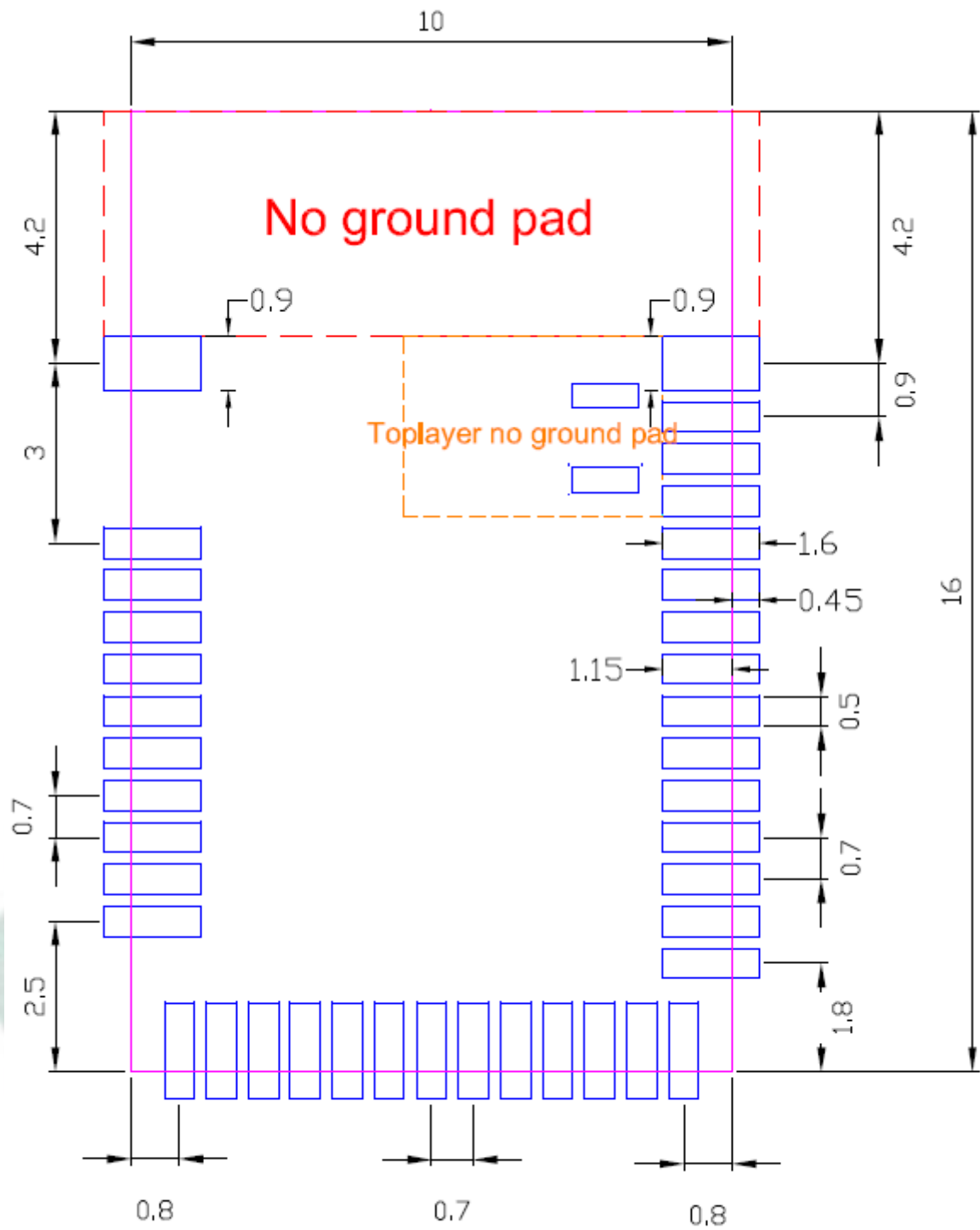
PCB SIZE: (L) 16 x (W) 10 x (H) 2.2 mm



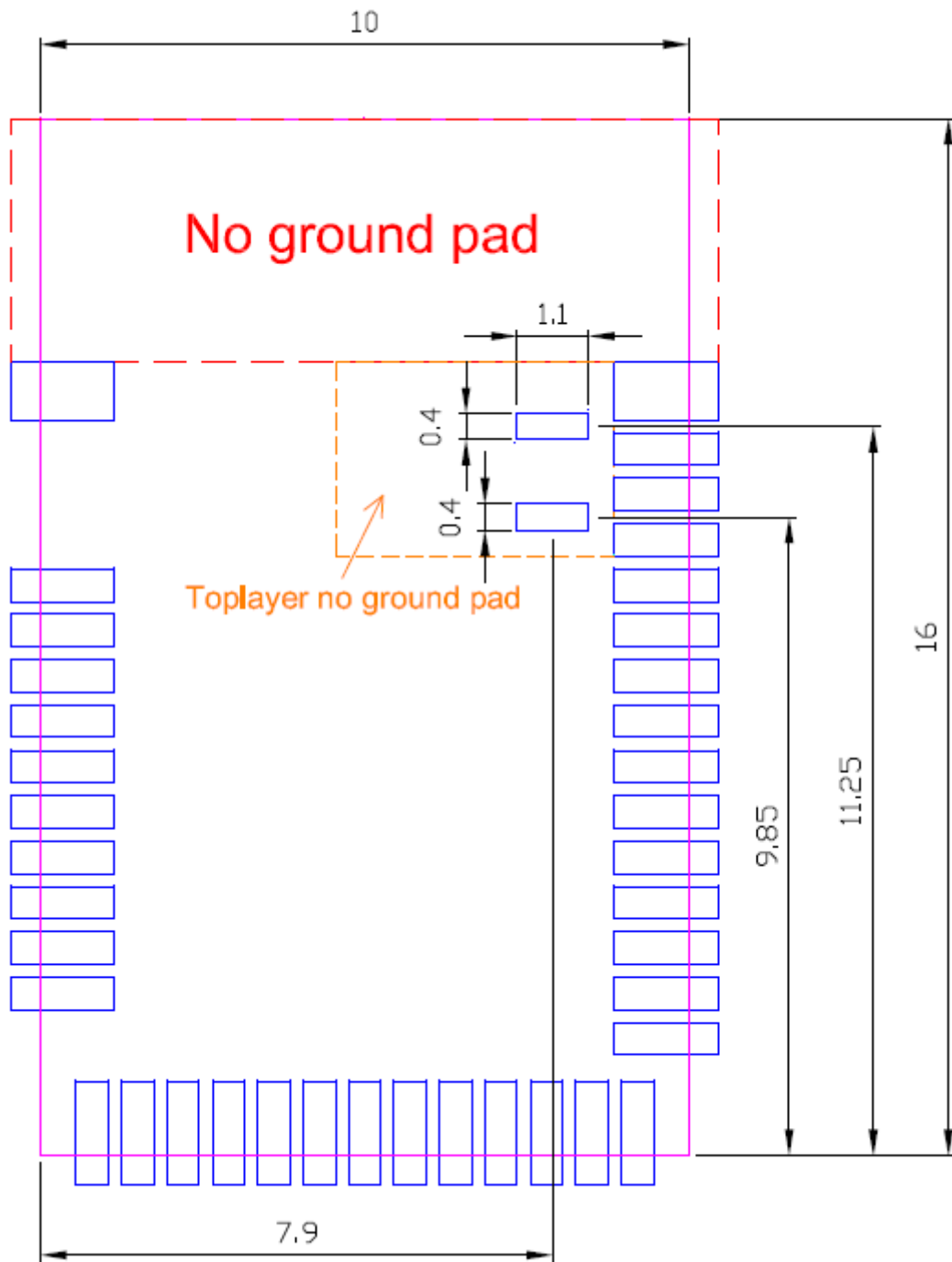
Top 單位(mm)





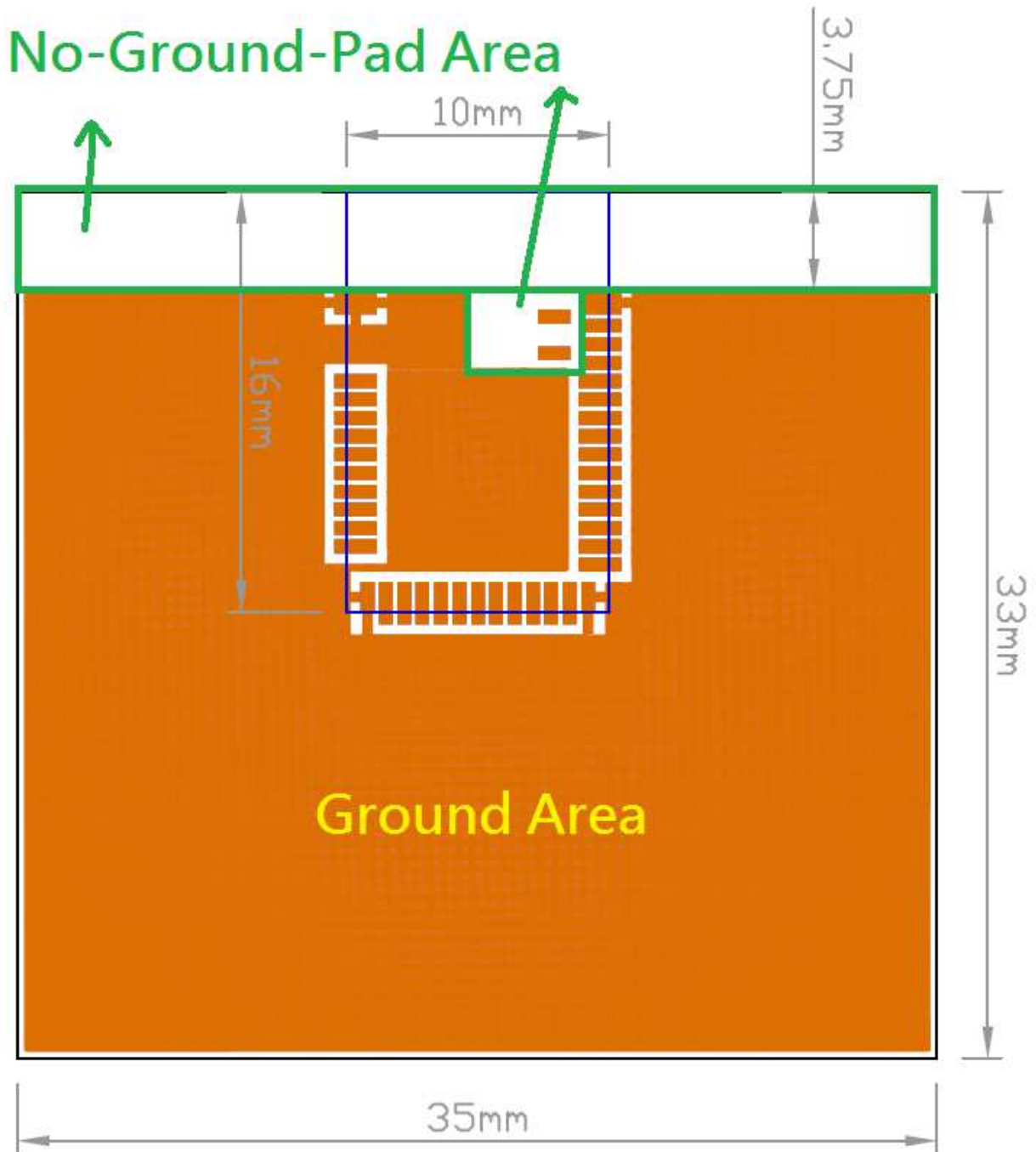


Top View (單位: mm)
recommended solder pad layout



2.3. RF Layout Suggestion (aka Keep-Out Area)

Layout is suggested following below instruction to have better wireless performance. When design is not allowed to leave such space, please make sure to keep the “No-Ground-Pad” as wider as it can.



2.4. Pin Assignment

| Pin No. | Name | Pin function | Description |
|---------|--------------|--------------|--|
| (1) | GND | Ground | The pad must be connected to a solid ground plane |
| (2) | P0.25 | Digital I/O | General-purpose digital I/O |
| (3) | P0.26 | Digital I/O | General-purpose digital I/O |
| (4) | P0.27 | Digital I/O | General-purpose digital I/O |
| (5) | P0.28 | Digital I/O | General-purpose digital I/O |
| | AIN4 | Analog input | SAADC/COMP/LPCOMP input |
| (6) | P0.29 | Digital I/O | General-purpose digital I/O |
| | AIN5 | Analog input | SAADC/COMP/LPCOMP input |
| (7) | P0.30 | Digital I/O | General-purpose digital I/O |
| | AIN6 | Analog input | SAADC/COMP/LPCOMP input |
| (8) | P0.31 | Digital I/O | General-purpose digital I/O |
| | AIN7 | Analog input | SAADC/COMP/LPCOMP input |
| (9) | DEC4 | Power | 1V3 regulator supply decoupling. Input from DC/DC converter. Output from 1V3 LDO . |
| (10) | DCC | Power | DC/DC converter output pin |
| (11) | VDD | Power | Power-supply pin |
| (12) | GND | Ground | The pad must be connected to a solid ground plane |
| (13) | P0.00 | Digital I/O | General-purpose digital I/O |
| | XL1 | Analog input | Connection to 32.768khz crystal (LFXO) |
| (14) | P0.01 | Digital I/O | General-purpose digital I/O |
| | XL2 | Analog input | Connection to 32.768khz crystal (LFXO) |
| (15) | P0.02 | Digital I/O | General-purpose digital I/O |
| | AIN0 | Analog input | SAADC/COMP/LPCOMP input |
| (16) | P0.03 | Digital I/O | General-purpose digital I/O |
| | AIN1 | Analog input | SAADC/COMP/LPCOMP input |
| (17) | P0.04 | Digital I/O | General-purpose digital I/O |
| | AIN2 | Analog input | SAADC/COMP/LPCOMP input |
| (18) | P0.05 | Digital I/O | General-purpose digital I/O |
| | AIN3 | Analog input | SAADC/COMP/LPCOMP input |
| (19) | P0.06 | Digital I/O | General-purpose digital I/O |
| (20) | P0.07 | Digital I/O | General-purpose digital I/O |
| (21) | P0.08 | Digital I/O | General-purpose digital I/O |

| Pin No. | Name | Pin function | Description |
|---------|--------------|---------------|---|
| (22) | P0.09 | Digital I/O | General-purpose digital I/O |
| | NFC1 | NFC input | NFC antenna connection |
| (23) | P0.10 | Digital I/O | General-purpose digital I/O |
| | NFC2 | NFC input | NFC antenna connection |
| (24) | GND | Ground | The pad must be connected to a solid ground plane |
| (25) | P0.11 | Digital I/O | General-purpose digital I/O |
| (26) | P0.12 | Digital I/O | General-purpose digital I/O |
| (27) | P0.13 | Digital I/O | General-purpose digital I/O |
| (28) | P0.14 | Digital I/O | General-purpose digital I/O |
| | TraceData(3) | | Trace port output |
| (29) | P0.15 | Digital I/O | General-purpose digital I/O |
| | TraceData(2) | | Trace port output |
| (30) | P0.16 | Digital I/O | General-purpose digital I/O |
| | TraceData(1) | | Trace port output |
| (31) | P0.17 | Digital I/O | General-purpose digital I/O |
| (32) | P0.18 | Digital I/O | General-purpose digital I/O |
| | TraceData(0) | | Trace port output |
| (33) | P0.19 | Digital I/O | General-purpose digital I/O |
| (34) | P0.20 | Digital I/O | General-purpose digital I/O |
| | TraceCLK | | Trace port clock output |
| (35) | P0.21 | Digital I/O | General-purpose digital I/O |
| | RESET | | Configurable as system RESET pin |
| (36) | SWDCLK | Digital input | Serial Wire debug clock input for debug and programming |
| (37) | SWDIO | Digital I/O | Serial Wire debug I/O for debug and programming |
| (38) | P0.22 | Digital I/O | General-purpose digital I/O |
| (39) | GND | Ground | The pad must be connected to a solid ground plane |
| (40) | P0.24 | Digital I/O | General-purpose digital I/O |
| (41) | P0.23 | Digital I/O | General-purpose digital I/O |

2.5. GPIO Located Near the Radio

Below remarks are extracted from Nordic's nRF52832 Spec. Any updates shall refer to Nordic's official release as final reference.

20.2.1 GPIO located near the radio

Radio performance parameters, such as sensitivity, may be affected by high frequency digital I/O with large sink/source current close to the Radio power supply and antenna pins.

Table 23: GPIO recommended usage on page 109 identifies some GPIO that have recommended usage guidelines to maximize radio performance in an application.



Table 23: GPIO recommended usage

| Pin | GPIO | Recommended usage |
|-----|-------|------------------------------------|
| 27 | P0.22 | Low drive, low frequency I/O only. |
| 28 | P0.23 | |
| 29 | P0.24 | |
| 37 | P0.25 | |
| 38 | P0.26 | |
| 39 | P0.27 | |
| 40 | P0.28 | |
| 41 | P0.29 | |
| 42 | P0.30 | |

3. Main Chip Solution

| RF IC | Crystal Frequency |
|-----------------|-------------------|
| Nordic NRF52832 | 32MHZ |

4. Shipment Packaging Information

| Antenna | Model |
|----------------------|--|
| Chip/Ceramic Antenna | MDBT42Q-512K |
| |  |
| PCB/Printed Antenna | MDBT42Q-P512K |
| |  |

- Unit Weight of Module: MDBT42Q-512K: 0.64g/pc ; MDBT42Q-P512K: 0.62g/pc
- Packaging Type: Tray only
- Minimum Package Quantity (MPQ): 88 pcs per Tray
- Carton Contents: 1760 pcs per carton (20 Full Tray + 1 Empty Tray)
- Dimension of Carton: (L) 37 x (W) 21 x (H) 13 cm
- Gross Weight: approx. 2.80 kgs per full carton (contains 1760pcs)



4.1. Marking on Metal Shielding



5. Specification

5.1. Absolute Maximum Ratings

| Note | Min. | Max. | Unit |
|------------------------------------|---|-------------|--------------------|
| Supply voltages | | | |
| VDD | -0.3 | +3.9 | V |
| VSS | | 0 | V |
| I/O pin voltage | | | |
| $V_{I/O}$, VDD \leq 3.6 V | -0.3 | VDD + 0.3 V | V |
| $V_{I/O}$, VDD $>$ 3.6 V | -0.3 | 3.9 V | V |
| NFC antenna pin current | | | |
| $I_{NFC1/2}$ Radio | | 80 | mA |
| RF input level | | 10 | dBm |
| Environmental (QFN package) | | | |
| Storage temperature | -40 | +125 | °C |
| MSL | Moisture Sensitivity Level | 2 | |
| ESD HBM | Human Body Model | 4 | kV |
| ESD CDM _{QF} | Charged Device Model (QFN48, 6x6 mm package) | 750 | V |
| Flash memory | | | |
| Endurance | 10 000 | | Write/erase cycles |
| Retention | 10 years at 40°C | | |

5.2. Operation Conditions

| Symbol | Parameter | Min. | Nom. | Max. | Units |
|--------------|--|------|------|------|-------|
| VDD | Supply voltage, independent of DCDC enable | 1.7 | 3.0 | 3.6 | V |
| t_{R_VDD} | Supply rise time (0 V to 1.7 V) | | | 60 | ms |
| TA | Operating temperature | -40 | 25 | 85 | °C |

Important: The on-chip power-on set circuitry may not function properly for rise times longer than the specified maximum.

5.3. Electrical Specifications

5.3.1. General Radio Characteristics

| Symbol | Description | Min. | Typ. | Max. | Units |
|--------------------|---------------------------------|------|-----------|------|-------|
| f_{OP} | Operating frequencies | 2360 | | 2500 | MHz |
| $f_{PLL,PROG,RES}$ | PLL programming resolution | | 2 | | kHz |
| $f_{PLL,CH,SP}$ | PLL channel spacing | | 1 | | MHz |
| $f_{DELTA,1M}$ | Frequency deviation @ 1 Msps | | ± 170 | | kHz |
| $f_{DELTA,BLE,1M}$ | Frequency deviation @ BLE 1Msps | | ± 250 | | kHz |
| $f_{DELTA,2M}$ | Frequency deviation @ 2 Msps | | ± 320 | | kHz |
| $f_{sk_{SPS}}$ | On-the-air data rate | 1 | | 2 | Msps |

5.3.2. Radio Current Consumption (Transmitter)

| Symbol | Description | Min. | Typ. | Max. | Units |
|--------------------------|--|------|------|------|-------|
| $I_{TX,PLUS4dBm,DCDC}$ | TX only run current (DCDC, 3V) $P_{RF} = +4$ dBm | | 7.5 | | mA |
| $I_{TX,PLUS4dBm}$ | TX only run current $P_{RF} = +4$ dBm | | 16.6 | | mA |
| $I_{TX,0dBm,DCDC}$ | TX only run current (DCDC, 3V) $P_{RF} = 0$ dBm | | 5.3 | | mA |
| $I_{TX,0dBm}$ | TX only run current $P_{RF} = 0$ dBm | | 11.6 | | mA |
| $I_{TX,MINUS4dBm,DCDC}$ | TX only run current DCDC, 3V $P_{RF} = -4$ dBm | | 4.2 | | mA |
| $I_{TX,MINUS4dBm}$ | TX only run current $P_{RF} = -4$ dBm | | 9.3 | | mA |
| $I_{TX,MINUS8dBm,DCDC}$ | TX only run current DCDC, 3V $P_{RF} = -8$ dBm | | 3.8 | | mA |
| $I_{TX,MINUS8dBm}$ | TX only run current $P_{RF} = -8$ dBm | | 8.4 | | mA |
| $I_{TX,MINUS12dBm,DCDC}$ | TX only run current DCDC, 3V $P_{RF} = -12$ dBm | | 3.5 | | mA |
| $I_{TX,MINUS12dBm}$ | TX only run current $P_{RF} = -12$ dBm | | 7.7 | | mA |
| $I_{TX,MINUS16dBm,DCDC}$ | TX only run current DCDC, 3V $P_{RF} = -16$ dBm | | 3.3 | | mA |
| $I_{TX,MINUS16dBm}$ | TX only run current $P_{RF} = -16$ dBm | | 7.3 | | mA |
| $I_{TX,MINUS20dBm,DCDC}$ | TX only run current DCDC, 3V $P_{RF} = -20$ dBm | | 3.2 | | mA |
| $I_{TX,MINUS20dBm}$ | TX only run current $P_{RF} = -20$ dBm | | 7.0 | | mA |
| $I_{TX,MINUS40dBm,DCDC}$ | TX only run current DCDC, 3V $P_{RF} = -40$ dBm | | 2.7 | | mA |
| Symbol | Description | Min. | Typ. | Max. | Units |
| $I_{TX,MINUS40dBm}$ | TX only run current $P_{RF} = -40$ dBm | | 5.9 | | mA |
| $I_{START,TX,DCDC}$ | TX start-up current DCDC, 3V, $P_{RF} = 4$ dBm | | 4.0 | | mA |
| $I_{START,TX}$ | TX start-up current, $P_{RF} = 4$ dBm | | 8.8 | | mA |

5.3.3. Radio Current Consumption (Receiver)

| Symbol | Description | Min. | Typ. | Max. | Units |
|------------------------|--|------|------|------|-------|
| $I_{RX,1M,DCDC}$ | RX only run current (DCDC, 3V) 1MSPS / 1MSPS BLE | | 5.4 | | mA |
| $I_{RX,1M}$ | RX only run current 1MSPS / 1MSPS BLE | | 11.7 | | mA |
| $I_{RX,2M,DCDC}$ | RX only run current (DCDC, 3V) 2MSPS | | 5.8 | | mA |
| $I_{RX,2M}$ | RX only run current 2MSPS | | 12.9 | | mA |
| $I_{START,RX,1M,DCDC}$ | RX start-up current (DCDC 3V) 1MSPS / 1MSPS BLE | | 3.5 | | mA |
| $I_{START,RX,1M}$ | RX start-up current 1MSPS / 1MSPS BLE | | 7.5 | | mA |

5.3.4. Transmitter Specification

| Symbol | Description | Min. | Typ. | Max. | Units |
|-------------|--|------|------|---------|-------|
| P_{RF} | Maximum output power | | 4 | 6 | dBm |
| P_{RFC} | RF power control range | | 24 | | dB |
| P_{RFCR} | RF power accuracy | | | ± 4 | dB |
| $P_{RF1,1}$ | 1st Adjacent Channel Transmit Power 1 MHz (1 MspS) | | -25 | | dBc |
| $P_{RF2,1}$ | 2nd Adjacent Channel Transmit Power 2 MHz (1 MspS) | | -50 | | dBc |
| $P_{RF1,2}$ | 1st Adjacent Channel Transmit Power 2 MHz (2 MspS) | | -25 | | dBc |
| $P_{RF2,2}$ | 2nd Adjacent Channel Transmit Power 4 MHz (2 MspS) | | -50 | | dBc |

5.3.5. Receiver Operation

| Symbol | Description | Min. | Typ. | Max. | Units |
|-------------------------|---|------|------|------|-------|
| $P_{RX,MAX}$ | Maximum received signal strength at < 0.1% PER | | 0 | | dBm |
| $P_{SENS,IT,1M}$ | Sensitivity, 1MSPS nRF mode ¹⁵ | | -93 | | dBm |
| $P_{SENS,IT,SP,1M,BLE}$ | Sensitivity, 1MSPS BLE ideal transmitter, ≤ 37 bytes BER= $1E-3^{16}$ | | -96 | | dBm |
| $P_{SENS,IT,LP,1M,BLE}$ | Sensitivity, 1MSPS BLE ideal transmitter ≥ 128 bytes BER= $1E-4$ 17 | | -95 | | dBm |
| $P_{SENS,IT,2M}$ | Sensitivity, 2MSPS nRF mode ¹⁸ | | -89 | | dBm |