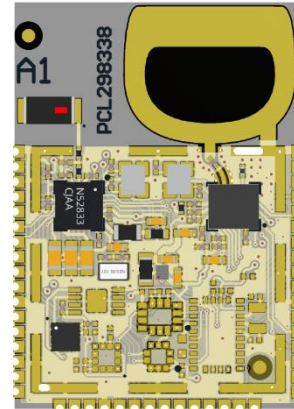


Product Overview

The Qorvo® DWM3001C is a fully integrated UWB transceiver module based on the Qorvo DW3110 IC. Integration of the DW3110 IC, nRF52833 MCU, planar UWB antenna, accelerometer, power management and crystal simplify the design cycle. The RF design is fully validated, tested, and calibrated. Low power consumption allows powering from batteries for extended periods, providing cost-effective implementation of UWB solutions.

The DWM3001C can be used in two-way ranging and TDoA applications.

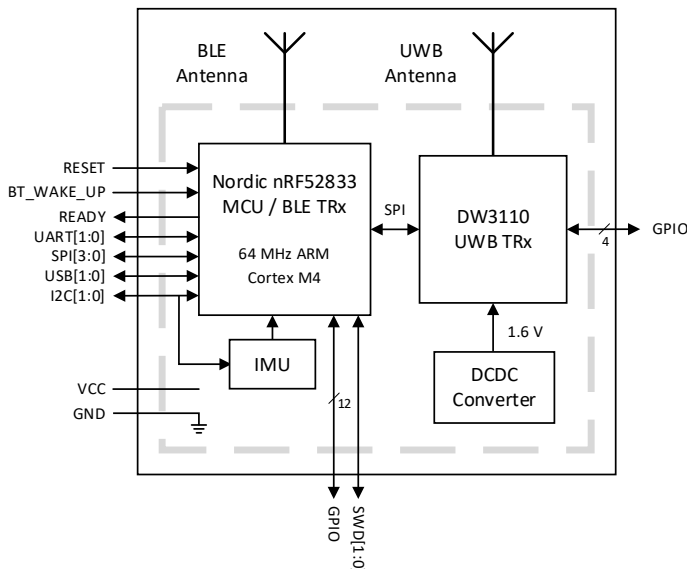
The DWM3001C is designed to be compliant to the FiRa™ PHY and MAC specifications enabling interoperability with other FiRa™ compliant devices.



48 Pin 27.1 x 19.13 mm side castellated package



Functional Block Diagram



Key Features

- IEEE 802.15.4-2015 and IEEE 802.15.4z BPRF compliant
- Fully aligned with FiRa™ PHY, MAC and certification development
- Supports Channels 5 (6.5 GHz) and 9 (8 GHz)
- FCC and ETSI certification (*ISED certification pending*)
- Nordic nRF52833 SoC with BLE transceiver
- Supply voltage VCC: 2.5 V - 3.6 V
- Bluetooth chip antenna
- AES 128/256 Security block
- Fully coherent receiver for maximum range and accuracy
- Power consumption optimized for battery applications
- Data rates of 850 kbps, 6.8 Mbps
- Maximum packet length of 1023 bytes for high data throughput applications
- Integrated MAC support features
- Backward compatible with the DWM1001C module
- Temperature range -40°C to +85°C

Applications

- Precision real time location systems (RTLS) using two-way ranging or TDoA schemes in a variety of markets.
- Location aware wireless sensor networks (WSNs)

Ordering Information

| PART NUMBER | DESCRIPTION |
|--------------|------------------------------|
| DWM3001CSR | Module – 100 pcs reel |
| DWM3001CTR13 | Module – 500 pcs on 13" reel |
| DWM3001CDK | Design Kit - MOQ 20 Units |

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DWM3001C

Fully Integrated UWB Transceiver Module

1. Overview

The DWM3001C is a module that includes the DW3110 UWB transceiver, Nordic nRF52833 MCU with BLE, ST LIS2DH12 accelerometer and peripheral components. It is factory calibrated, FiRa™ compliant and certified to FCC, ETSI and IC regulations.

The following sections describe the main functional blocks within the DWM3001C. See the functional block diagram on Page 1 for reference.

1.1 DWM3001C UWB Transceiver

The DW3110 on-board the DWM3001C is a fully integrated low-power, single chip CMOS RF transceiver IC. The DWM3001C module requires no RF design as the antenna and associated analog and RF components are on the module.

The module contains an on-board 38.4 MHz reference crystal. The crystal has been trimmed in production to reduce the initial frequency error to approximately 2 ppm, using the DW3110 IC's internal on-chip crystal trimming circuit.

Always-On (AON) memory can be used to retain DWM3001C configuration data during the lowest power operational states when the on-chip voltage regulators are disabled. This data is uploaded and downloaded automatically. Use of DWM3001C AON memory is configurable.

The on-chip voltage and temperature monitors allow the host to read the voltage on the VDD1 pin and the internal die temperature information from the DW3110.

See the DW3000 datasheet for more detailed information on device functionality, electrical specifications, and typical performance.

1.2 Nordic nRF52833 Processor

The Nordic RF52833 is an ARM® Cortex®-M4 32-bit processor with 64 MHz clock speed that also integrates a BLE radio transceiver operating in the 2.4 GHz band. It has advanced on-chip interfaces, such as USB 2.0 full speed (12 Mbps), high-speed 32 MHz SPI and type 2 near field communication (NFC-A).

1.3 ST LIS2DH12TR Accelerometer

The LIS2DH12TR from ST Microelectronics is a low power three-axis linear accelerometer with I²C digital output. RTLS tags commonly use accelerometers to initiate UWB ranging only when a tag moves so that battery life can be extended by staying in the lowest power mode by default.

1.4 Torex XC9282 DCDC Converter

The Torex XC9282 buck converter IC is chosen to provide the DW3000 1.6 V supply from the VDD module voltage supplied externally.

2. DWM3001C Calibration

Depending on the end-use applications and the system design, DWM3001C settings may need to be tuned. To help with this tuning a number of built-in functions such as continuous wave TX and continuous frame transmission can be enabled. See the DW3000 User Manual for further details.

An overview of factory calibrated items is shown in the table below:

Table 1: DWM3001C Calibrated Items

| DW3000 Calibration Item | Calibrated on DWM3001C |
|-------------------------|------------------------|
| Crystal | ✓ |
| Transmit Power | ✓ |
| Antenna Delay | ✓ |

2.1 Crystal Oscillator Trim

DWM3001C modules are calibrated at production at room temperature to minimise initial frequency error to reduce carrier frequency offset between modules and thus improve receiver sensitivity. The calibration carried out at module production will trim the initial frequency offset to less than 2 ppm, typically.

2.2 Transmitter Calibration

To maximize range, DWM3001C transmit power spectral density (PSD) should be set to the maximum allowable for the geographic region in which it will be used. For most regions this is -41.3 dBm/MHz.

As the module contains an integrated antenna, the transmit power can only be measured over the air. The Effective Isotropic Radiated Power (EIRP) must be measured, and the power level adjusted to ensure compliance with applicable regulations.

The DWM3001C provides the facility to adjust the transmit power in coarse and fine steps; 2 dB and 0.5 dB nominally. It also provides the ability to adjust the spectral bandwidth. These adjustments can be used to maximize transmit power whilst meeting regulatory spectral mask.

2.3 Antenna Delay Calibration

To measure range accurately, precise calculation of timestamps is required. To do this the antenna delay must be known. The DWM3001C allows this delay to be calibrated and provides the facility to compensate for delays introduced by PCB, external components, antenna and internal DWM3001C delays.

To calibrate the antenna delay, range is measured at a known distance using two DWM3001C systems. Antenna delay is adjusted until the known distance and reported range agree. The antenna delay can be stored in OTP memory.*

***Note: For Engineering Samples DWM3001C.E1.0SR, DWM3001C.E1.0SQ, DWM3001C.E1.0SB and DWM3001CDKE1.0: do not use the Channel 5 Antenna Delay in OTP – use default value 16390.**

3. DWM3001C Pin Connections

3.1 Pin Numbering

DWM3001C module pin assignments are as follows (viewed from top):

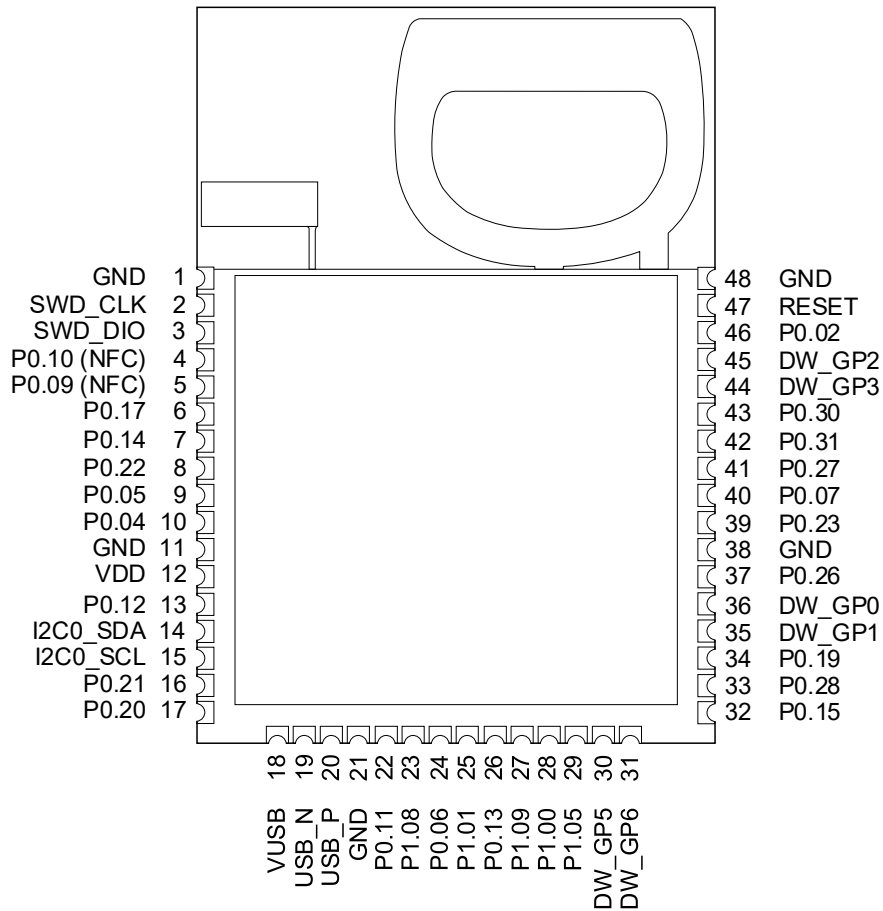


Figure 1: DWM3001C Pin Diagram



3.2 Pin Descriptions

Table 2: DWM3001C Pin Functions

| Signal Name | Pin | I/O (Default) | Description | IC Pin Reference |
|-------------------|-----|---------------|--|------------------|
| Digital Interface | | | | |
| SWD_CLK | 2 | DI | Serial wire debug clock input for debug and programming of nRF52833 processor. | [N] SWDCLK |
| SWD_DIO | 3 | DIO | Serial wire debug I/O for debug and programming of nRF52833 processor. | [N] SWDIO |
| P0.10 (NFC2) | 4 | Mixed | General purpose I/O for nRF52833 processor. NFC antenna connection. | [N] P0.10 |
| P0.09 (NFC1) | 5 | Mixed | General purpose I/O for nRF52833 processor. NFC antenna connection. | [N] P0.09 |
| P0.17 | 6 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.17 |
| P0.14 | 7 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.14 |
| P0.22 | 8 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.22 |
| P0.05 | 9 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.05 |
| P0.04 | 10 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.04 |
| P0.12 | 13 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.12 |
| I2C0_SDA | 14 | DIO | I2C data signal of nRF52833 processor and LIS2DH12TR accelerometer. | [N] P0.24 |
| I2C0_SCL | 15 | DIO | I2C clock signal of nRF52833 processor and LIS2DH12TR accelerometer. | [N] P1.04 |
| P0.21 | 16 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.21 |
| P0.20 | 17 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.20 |
| USB_N | 19 | DIO | USB D- I/O for nRF52833 processor. | [N] D- |
| USB_P | 20 | DIO | USB D+ I/O for nRF52833 processor. | [N] D+ |
| P0.11 | 22 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.11 |
| P1.08 | 23 | DIO | General purpose I/O for nRF52833 processor. | [N] P1.08 |
| P0.06 | 24 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.06 |
| P1.01 | 25 | DIO | General purpose I/O for nRF52833 processor. | [N] P1.01 |
| P0.13 | 26 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.13 |
| P1.09 | 27 | DIO | General purpose I/O for nRF52833 processor. | [N] P1.09 |
| P1.00 | 28 | DIO | General purpose I/O for nRF52833 processor. | [N] P1.00 |
| P1.05 | 29 | DIO | General purpose I/O for nRF52833 processor. | [N] P1.05 |
| DW_GP5 | 30 | DIO | General purpose I/O for DW3110 transceiver. | [D] GPIO5 |
| DW_GP6 | 31 | DIO | General purpose I/O for DW3110 transceiver. | [D] GPIO6 |
| P0.15 | 32 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.15 |
| P0.28 | 33 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.28 |
| P0.19 | 34 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.19 |
| DW_GP1 | 35 | DIO | General purpose I/O for DW3110 transceiver. | [D] GPIO1 |
| DW_GP0 | 36 | DIO | General purpose I/O for DW3110 transceiver. | [D] GPIO0 |
| P0.26 | 37 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.26 |



| Signal Name | Pin | I/O (Default) | Description | IC Pin Reference |
|-----------------------|-------------------|---------------|---|------------------|
| P0.23 | 39 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.23 |
| P0.07 | 40 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.07 |
| P0.27 | 41 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.27 |
| P0.31 | 42 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.31 |
| P0.30 | 43 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.30 |
| DW_GPIO3 | 44 | DIO | General purpose I/O for DW3110 transceiver. | [D] GPIO3 |
| DW_GPIO2 | 45 | DIO | General purpose I/O for DW3110 transceiver. | [D] GPIO2 |
| P0.02 | 46 | DIO | General purpose I/O for nRF52833 processor. | [N] P0.02 |
| RESET (P0.18) | 47 | DIO | General purpose I/O for nRF52833 processor. Active-low reset input. | [N] nRESET |
| Power Supplies | | | | |
| VDD | 12 | P | 3 V supply pin. | |
| Ground | | | | |
| GND | 1, 11, 21, 38, 48 | G | Common ground. | |

Table 3: Explanation of Abbreviations

| Abbreviation | Explanation |
|--------------|--|
| I | Input |
| IO | Input / Output |
| O | Output |
| G | Ground |
| P | Power Supply |
| PD | Power Decoupling |
| O-L | Defaults to output, low level after reset |
| O-H | Defaults to output, high level after reset |
| I | Defaults to input. |

Note: Any signal with the suffix 'n' indicates an active low signal.

4. Electrical Specifications

4.1 Nominal Operating Conditions

Table 4: DWM3001C Operating Conditions

| Parameter | Min. | Typ. | Max. | Units | Condition / Note |
|-------------------------|------|------|------|-------|------------------|
| Operating temperature | -40 | | +85 | °C | |
| Supply voltage VDD | 2.5 | | 3.6 | V | |
| Voltage on digital pins | | | 3.6 | V | |

Note: Unit operation is guaranteed by design when operating within these ranges

4.2 DC Characteristics

T_{amb} = 25 °C, all supplies centered on typical values

Table 5: DWM3001C DC Characteristics

| Parameter | Min. | Typ. | Max. | Units | Condition / Note |
|---|----------|------|----------|-------|-------------------------------------|
| Supply current SLEEP mode | | 850 | | nA | |
| Supply current CH5 IDLE mode | | 18 | | mA | |
| Supply current CH9 IDLE mode | | 32 | | mA | |
| Supply current CH5 INIT mode | | 6 | | mA | |
| Supply current CH9 INIT mode | | 6 | | mA | |
| CH5 TX: VDD | | 40 | | mA | Continuous frame transmission |
| CH9 TX: VDD | | 45 | | mA | Continuous frame transmission |
| CH5 RX: VDD | | 40 | | mA | Receiver active, no frames received |
| CH9 RX: VDD | | 45 | | mA | Receiver active, no frames received |
| Digital input voltage high | 0.7*VDD1 | | | V | |
| Digital input voltage low | | | 0.3*VDD1 | V | |
| Digital output voltage high | 0.7*VDD1 | | | V | Assumes 500 Ω load |
| Digital output voltage low | | | 0.3*VDD1 | V | Assumes 500 Ω load |
| Digital Output Drive Current GPIOx, IRQ | | | 0.8 | mA | |
| Digital Output Drive Current SPIMISO | 8 | 10 | | mA | |
| Digital Output Drive Current EXTON | 3 | 4 | | mA | |

4.3 Receiver AC Characteristics

T_{amb} = 25 °C, all supplies centered on nominal values

Table 6: DWM3001C Receiver AC Characteristics

| Parameter | Min. | Typ. | Max. | Units | Condition / Note |
|----------------------|------|--------|------|-------|------------------|
| Centre Frequency CH5 | | 6489.6 | | MHz | |
| Centre Frequency CH9 | | 7987.2 | | | |
| Channel bandwidth | | 500 | | | Channel 5 and 9 |

4.4 Reference Clock AC Characteristics

T_{amb} = 25 °C, all supplies centered on typical values

4.4.1 Reference Frequency

Table 7: Reference Clock AC Characteristics

| Parameter | Min. | Typ. | Max. | Units | Condition / Note |
|---|------|------|------|-----------------------------|------------------|
| On-board crystal oscillator reference frequency | | 38.4 | | MHz | |
| On-board crystal aging | | ±1 | | ppm in 1 st year | |

4.5 Transmitter AC Characteristics

T_{amb} = 25 °C, all supplies centered on typical values

Table 8: DWM3001C Transmitter AC Characteristics

| Parameter | Min. | Typ. | Max. | Units | Condition / Note |
|--------------------|------|------|------|-------|------------------|
| Frequency range | 6250 | | 8250 | MHz | |
| Channel bandwidths | | 500 | | MHz | Channel 5 and 9 |



DWM3001C

Fully Integrated UWB Transceiver Module

4.6 Absolute Maximum Ratings

Table 9: DWM3001C Absolute Maximum Ratings

| Parameter | Min. | Max. | Units |
|-------------------------------------|------|------|-------|
| Voltage, VDD | -0.3 | 4.0 | V |
| Receiver Power | | 14 | dBm |
| Temperature - Storage temperature | -40 | +125 | °C |
| Temperature - Operating temperature | -40 | +85 | °C |

Stresses beyond those listed in this table may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions beyond those indicated in the operating conditions of the specification is not implied. Exposure to the absolute maximum rating conditions for extended periods may affect device reliability.

5. OTP Memory Map

The DW3000 transceiver has one-time programmable (OTP) memory storage. See the DW3000 User Manual for more details. The OTP memory map for the DWM3001C module is shown in Table 10. Calibrated items from the final module production test stage are highlighted.

| OTP Item | Cell Colour |
|--|-------------|
| Calibrated and written to OTP | |
| Read back from DW3110 and written in OTP | |
| Fixed value written to OTP | |

Table 10: DWM3001C OTP map

| OTP Address | Size (Used Bytes) | Byte_3 | Byte_2 | Byte_1 | Byte_0 | Programmed by |
|-------------|-------------------|---|-----------------|------------------------------|-----------------|-------------------|
| 0x000 | 4 | 64-bit EUID | | | | Customer |
| 0x001 | 4 | | | | | |
| 0x002 | 4 | Alternative 64-bit EUID | | | | Customer |
| 0x003 | 4 | (Selected via reg/SR register) | | | | |
| 0x004 | 4 | LDO Tune | | | | IC Prod. Test |
| 0x005 | 4 | | | | | |
| 0x006 | 4 | {"0001,0000,0001", "CHIP ID 5 nibbles (20 bits)"} | | | | IC Prod. Test |
| 0x007 | 4 | {"0001", "LOT ID – 7 nibbles (28 bits)"} | | | | IC Prod. Test |
| 0x008 | 3 | | VBAT@3.0V | VBAT@3.62V | VBAT@1.62V | IC Prod. Test |
| 0x009 | 1 | | | | Temp @ 22±2°C | IC Prod. Test |
| 0x00A | 4 | Bias Tune | | | | IC Prod. Test |
| 0x00B | 4 | Antenna Delay - Rx RF Loop | | Antenna Delay - Tx RF Loop | | IC Prod. Test |
| 0x00C | 4 | PD0A Iso. Ch9 | PD0A Iso. Ch9 | PD0A Iso. Ch5 | PD0A Iso. Ch5 | IC Prod. Test |
| | | RF2 → RF1 | RF1 → RF2 | RF2 → RF1 | RF1 → RF2 | |
| 0x00D | 4 | W.S. Lot ID [3] | W.S. Lot ID [2] | W.S. Lot ID [1] | W.S. Lot ID [0] | IC Prod. Test |
| 0x00E | 2 | | | W.S. Lot ID [5] | W.S. Lot ID [4] | IC Prod. Test |
| 0x00F | 3 | | W.S. Wafer # | W.S. Y Loc | W.S. X Loc | IC Prod. Test |
| 0x010 | 4 | Ch5 Tx Power Level - PRF16 | | | | Customer |
| 0x011 | 4 | Ch5 Tx Power Level - PRF64 | | | | Module Prod. Test |
| 0x012 | 4 | Ch9 Tx Power Level - PRF16 | | | | Customer |
| 0x013 | 4 | Ch9 Tx Power Level - PRF64 | | | | Module Prod. Test |
| 0x014 | 4 | | | | | Customer |
| 0x015 | 4 | | | | | Customer |
| 0x016 | 4 | | | | | Customer |
| 0x017 | 4 | | | | | Customer |
| 0x018 | 4 | Ch5_PGCNT | | Ch9_PGCNT | | Module Prod. Test |
| 0x019 | 4 | | | | | Customer |
| 0x01A | 4 | CH5 Rx Antenna Delay - PRF64 | | CH5 Tx Antenna Delay - PRF64 | | Module Prod. Test |
| 0x01B | 4 | CH5 Rx Antenna Delay - PRF16 | | CH5 Tx Antenna Delay - PRF16 | | Customer |



DWM3001C

Fully Integrated UWB Transceiver Module

| | | | | | |
|------------------|---|--|------------------------------|-------------------|-------------------|
| 0x01C | 4 | CH9 Rx Antenna Delay - PRF64 | CH9 Tx Antenna Delay - PRF64 | Module Prod. Test | |
| 0x01D | 4 | CH9 Rx Antenna Delay - PRF16 | CH9 Tx Antenna Delay - PRF16 | Customer | |
| 0x01E | 1 | Frame Duration - us | | Xtal_Trim [6:0] | Module Prod. Test |
| 0x01F | 1 | Platform ID | Cal Rev | OTP Rev. | Module Prod. Test |
| 0x020 | 4 | Rx_Tune_Cal: DGS_CFG0 | | | IC Prod. Test |
| 0x021 | 4 | Rx_Tune_Cal: DGS_CFG1 | | | IC Prod. Test |
| 0x022 | 4 | Rx_Tune_Cal: DGS_CFG2 | | | IC Prod. Test |
| 0x023 | 4 | Rx_Tune_Cal: DGS_CFG3 | | | IC Prod. Test |
| 0x024 | 4 | Rx_Tune_Cal: DGS_CFG4 | | | IC Prod. Test |
| 0x025 | 4 | Rx_Tune_Cal: DGS_CFG5 | | | IC Prod. Test |
| 0x026 | 4 | Rx_Tune_Cal: DGS_CFG6 | | | IC Prod. Test |
| 0x027 | 4 | Rx_Tune_Cal: DGC_LUT_0 - CH5 | | | IC Prod. Test |
| 0x028 | 4 | Rx_Tune_Cal: DGC_LUT_1 - CH5 | | | IC Prod. Test |
| 0x029 | 4 | Rx_Tune_Cal: DGC_LUT_2 - CH5 | | | IC Prod. Test |
| 0x02A | 4 | Rx_Tune_Cal: DGC_LUT_3 - CH5 | | | IC Prod. Test |
| 0x02B | 4 | Rx_Tune_Cal: DGC_LUT_4 - CH5 | | | IC Prod. Test |
| 0x02C | 4 | Rx_Tune_Cal: DGC_LUT_5 - CH5 | | | IC Prod. Test |
| 0x02D | 4 | Rx_Tune_Cal: DGC_LUT_6 - CH5 | | | IC Prod. Test |
| 0x02E | 4 | Rx_Tune_Cal: DGC_LUT_0 - CH9 | | | IC Prod. Test |
| 0x02F | 4 | Rx_Tune_Cal: DGC_LUT_1 - CH9 | | | IC Prod. Test |
| 0x030 | 4 | Rx_Tune_Cal: DGC_LUT_2 - CH9 | | | IC Prod. Test |
| 0x031 | 4 | Rx_Tune_Cal: DGC_LUT_3 - CH9 | | | IC Prod. Test |
| 0x032 | 4 | Rx_Tune_Cal: DGC_LUT_4 - CH9 | | | IC Prod. Test |
| 0x033 | 4 | Rx_Tune_Cal: DGC_LUT_5 - CH9 | | | IC Prod. Test |
| 0x034 | 4 | Rx_Tune_Cal: DGC_LUT_6 - CH9 | | | IC Prod. Test |
| 0x035 | 4 | PLL_Lock_Code | | | IC Prod. Test |
| 0x036 - 0x05F | 4 | Unallocated | | | Customer |
| 0x060 | 4 | QSR Register (Special function register) | | | Reserved |
| 0x061 | 1 | | | Q_RR Register | Reserved |
| 0x062 - 0x077 | 4 | Unallocated | | | Customer |
| 0x078 | 4 | AES_Key [127:96] (Big endian order) | | | Customer |
| 0x079 | 4 | AES_Key [95:64] (Big endian order) | | | Customer |
| 0x07A | 4 | AES_Key [63:32] (Big endian order) | | | Customer |
| 0x07B | 4 | AES_Key [31:0] (Big endian order) | | | Customer |
| 0x07C | 4 | AES_Key [255:224] (Big endian order) | | | Customer |
| 0x07D | 4 | AES_Key [223:192] (Big endian order) | | | Customer |
| 0x07E | 4 | AES_Key [191:160] (Big endian order) | | | Customer |
| 0x07F | 4 | AES_Key [159:128] (Big endian order) | | | Customer |

6. Antenna Performance

This section details antenna radiation patterns for the DWM3001CDKE1.0 Design Kit board. Figure 2 presents a view of the measurement planes considered in this document.

Table 12 and Table 13 show antenna radiation patterns for the DWM3001C module mounted on the DWM3001CDKE1.0 carrier board at Channels 5 and 9 respectively. Three planes in the spherical space about the center of the board are measured, with V and H plots representing perpendicular vertical and horizontal components.

The DWM3001C antenna is vertically polarized, meaning that the module is intended to be positioned vertically upright when used in an RTLS system. An omnidirectional radiation pattern is seen in the XZ plane when observed by another antenna which is also vertically polarized. This is shown in the XZ plane antenna patterns, where the vertically polarized plot (V) has a circular, or omnidirectional shape.

If the antennas are oriented perpendicular relative to each other, then the polarization changes. In this case, the horizontally polarized pattern (H) applies and there are nulls at certain angles which can limit range and introduce location inaccuracy. Table 11 presents the key characteristics of the DWM3001C's antenna.

Table 11: Antenna characteristics

| | |
|---------------------------------------|----------------------------|
| Antenna Model | WB007 Dual-Hoe |
| Antenna Type | PCB Trace Monopole Antenna |
| Peak Gain (Measured on DWM3001CDK) | Ch5: 2.5dBi Ch9: 2.0dBi |
| Frequency Range | 4000 – 9000MHz |

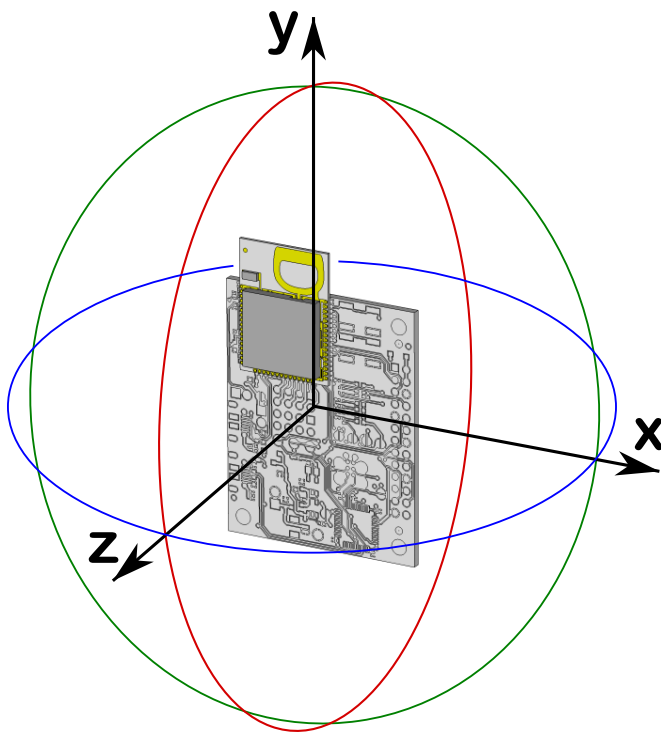


Figure 2: Antenna Radiation Planes

Table 12: Channel 5

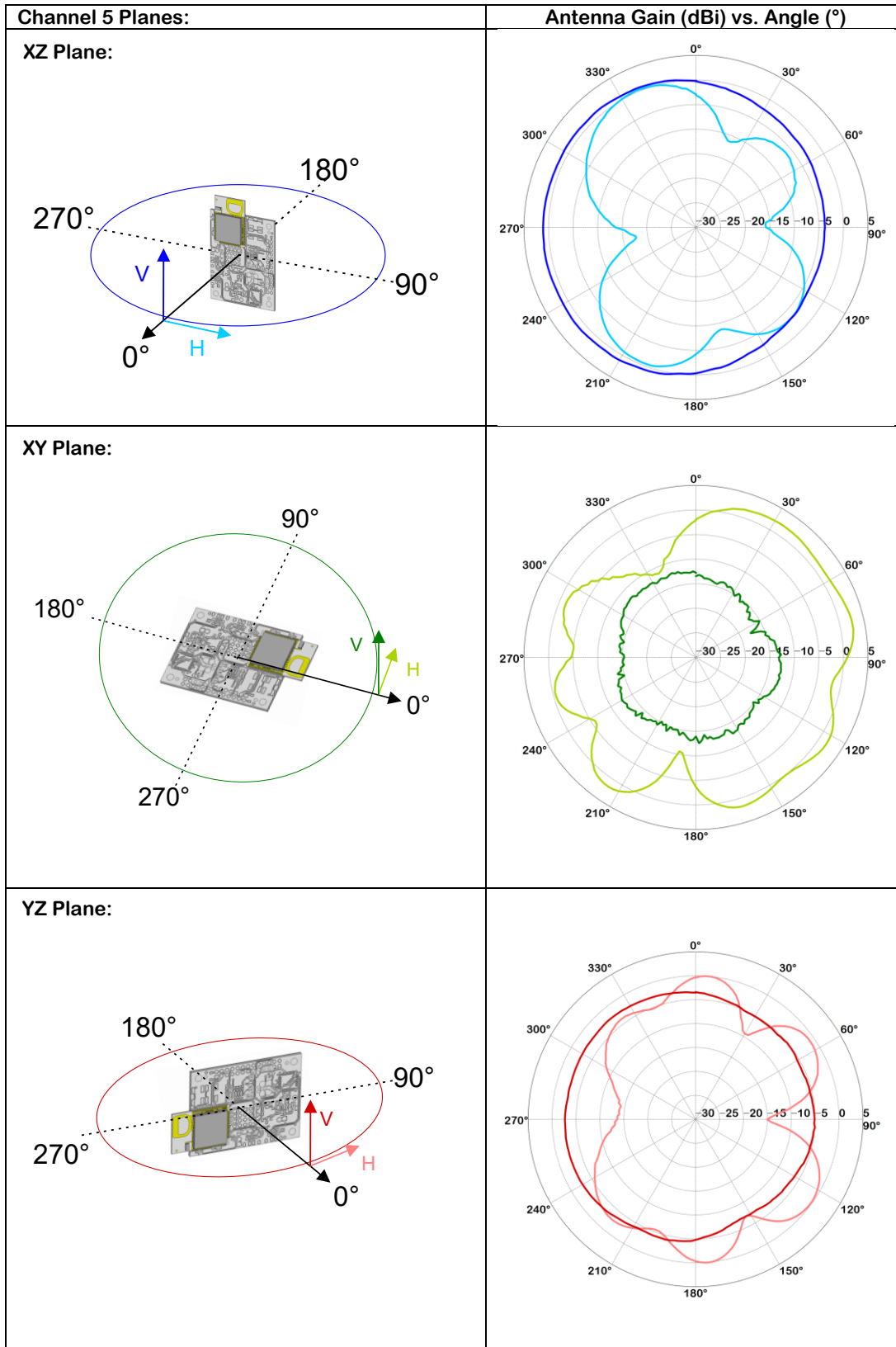
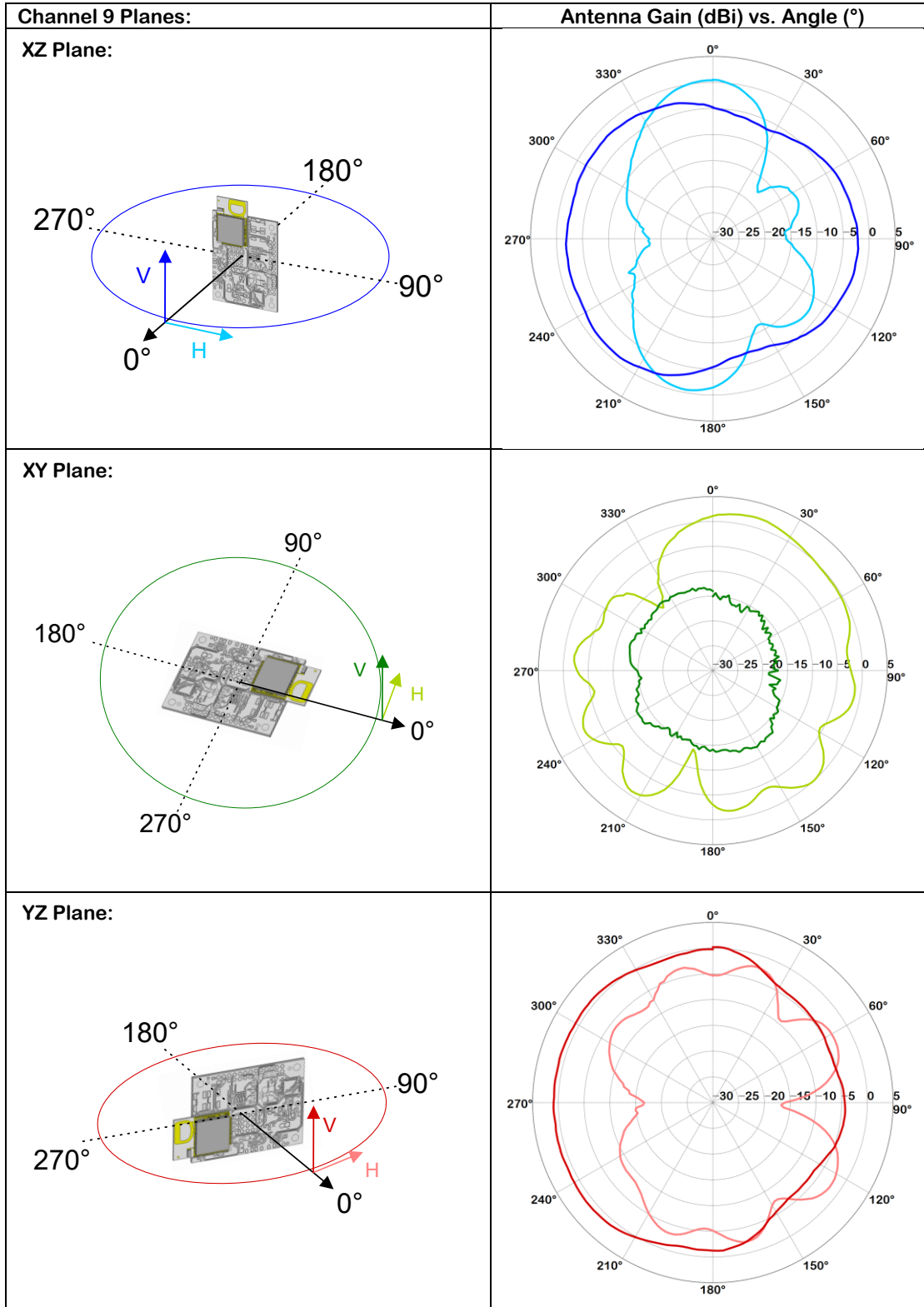


Table 13: Channel 9



7. Application Information

7.1 Application Board Layout Guidelines

When designing the PCB onto which the DWM3001C will be soldered, the proximity of the DWM3001C on-board antenna to metal and other non-RF transparent materials needs to be considered carefully. Two suggested placement schemes are shown below.

For best RF performance, ground copper should be flooded in all areas of the application board, except in the areas marked “Keep-Out Area”, where there should be no metal either side, above or below (e.g. do not place battery under antenna).

The two placement schemes below show an application board with no metallic material in the keep-out area. The diagram on the right is an application board with the antenna projecting off of the board so that the keep out area is in free space. The diagram on the left shows an application board which does not have the module in free space but has the PCB copper removed on either side (and behind) the module antenna. (Note: the rectangular area above the shield on the module is the antenna area)

It is also important to note that the ground plane on the application board affects the antenna radiation pattern. There must be a minimum spacing of 10 mm (d) without metal either side of the module antenna.

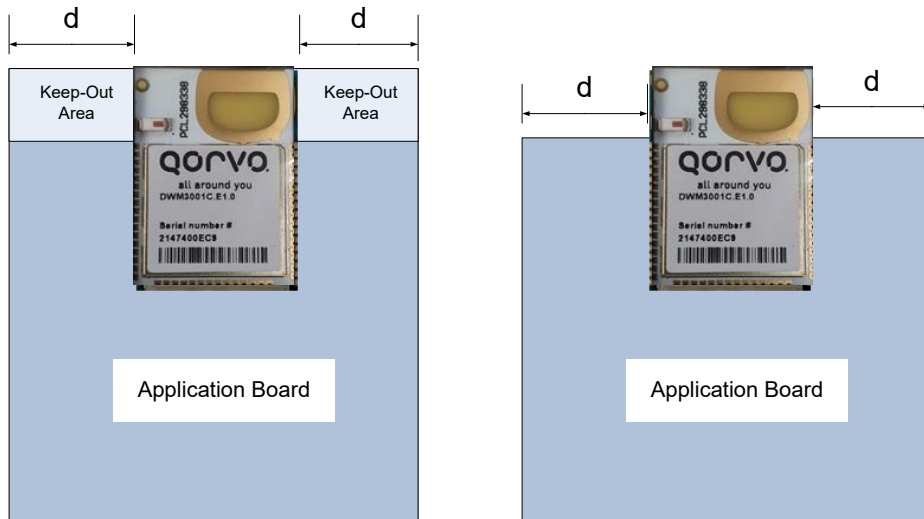


Figure 3: Board Layout

7.2 Note on Ranging Performance in Harsh Multipath Environments

As can be seen from the radiation patterns in Table 12 and Table 13, the DWM3001C antenna is cross polarized in some regions, i.e. the horizontally polarized gain is roughly equal to the vertically polarized gain. This is of benefit in maintaining a high link budget as the orientation of the module changes.

It can be found, however, that this polarization diversity can lead to variation in ranging accuracy as tags move in harsh multipath environments, such as where there are many reflections in confined indoor spaces, e.g. narrow corridors. In these applications, it is suggested to optimize the placement of the module on the carrier PCB. Avoid placing the module too close, i.e. less than 1 cm, to the edge of the PCB. This has the effect of reducing the horizontally polarized radiation component and improving resilience to multipath fading.

8. Package Information

8.1 Module Drawings

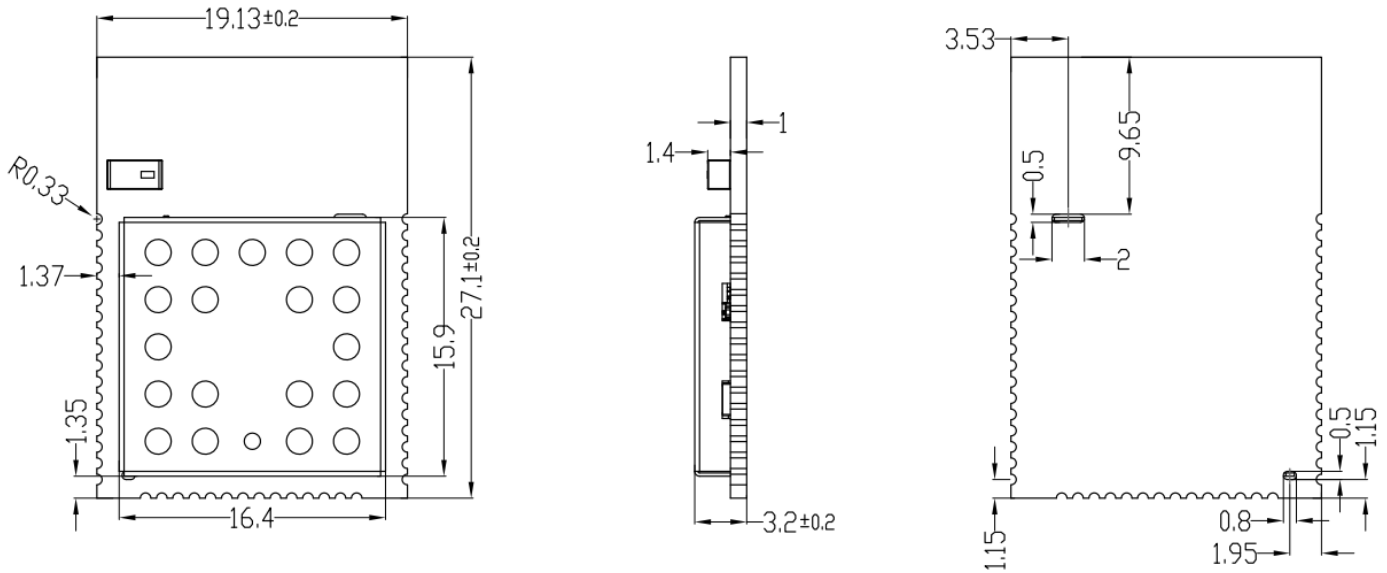


Figure 4: Module Package Size (mm)

8.2 Module Land Pattern

The diagram below shows the DWM3001C module land pattern.

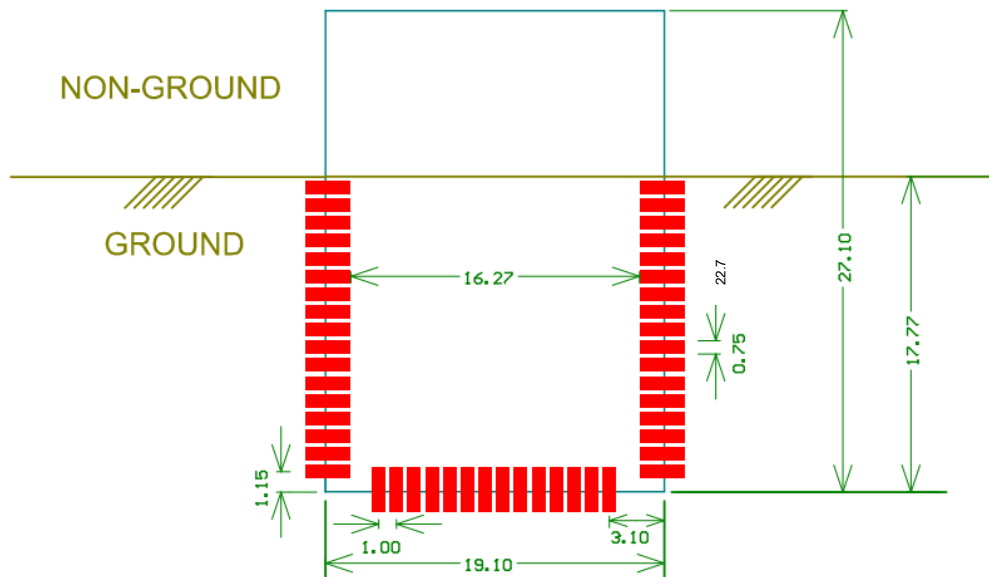


Figure 5: Module Land Pattern (mm)

8.3 Module Marking Information

Each module has a label on the shield with a serial number in the following format:

YY WW 4 SSSSS

Where:

| | |
|-------|---|
| YY | indicates the year |
| WW | indicates the week of the year |
| 4 | indicates the DWM3001C module |
| SSSSS | indicates the module manufacturing number |

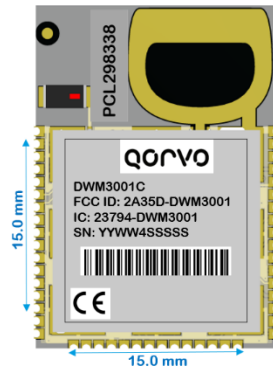


Figure 6: Module Marking

8.4 Module Solder Profile

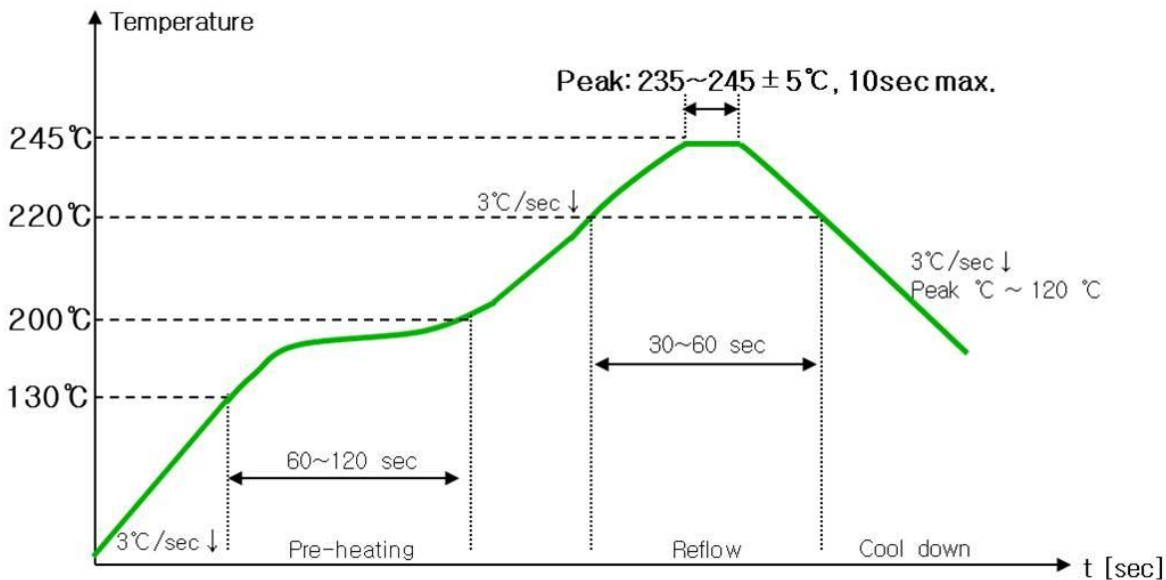


Figure 7: DWM3001C Module Solder Profile

9. Tape and Reel Information

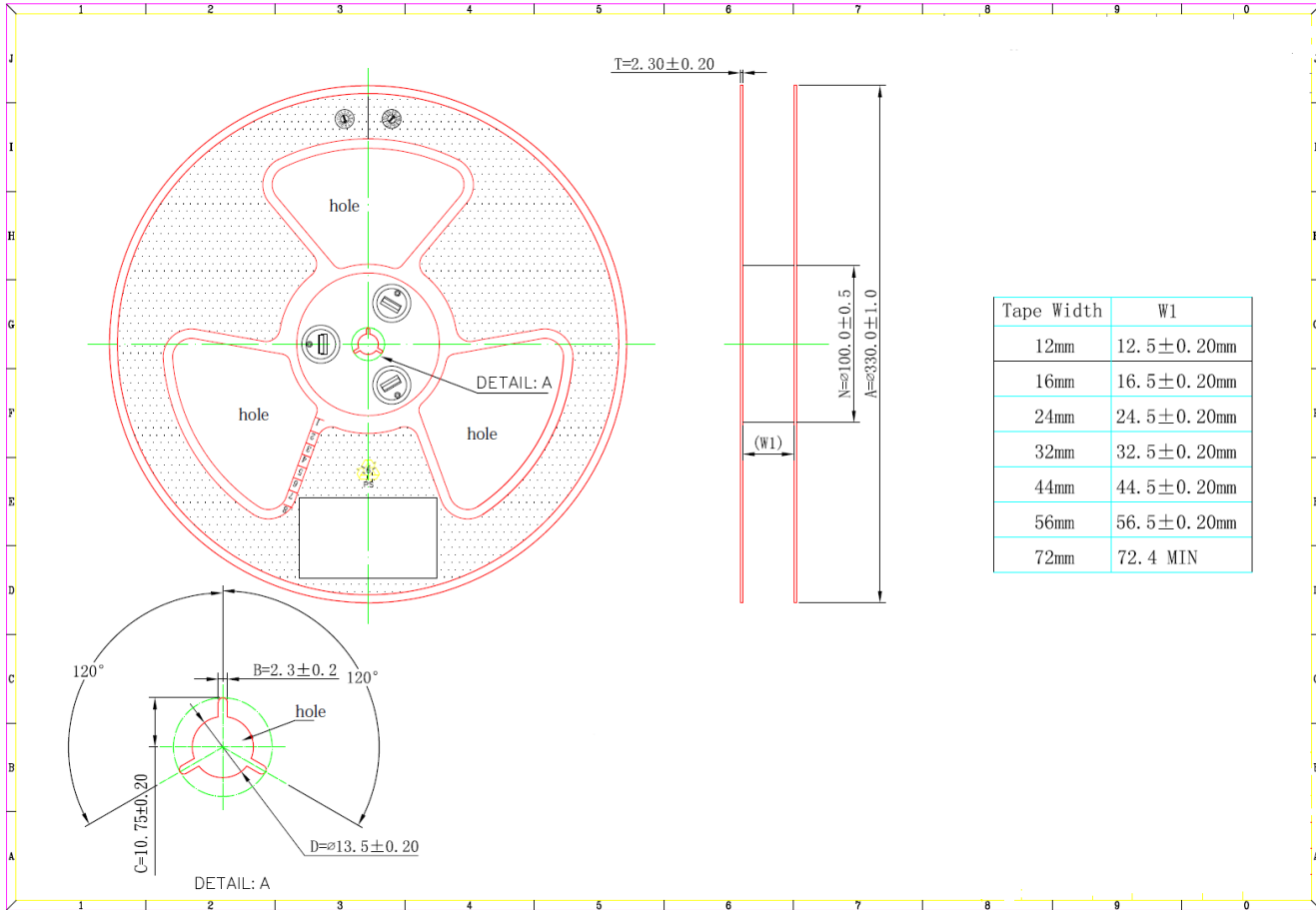


Figure 8: Tape and Reel Dimensions

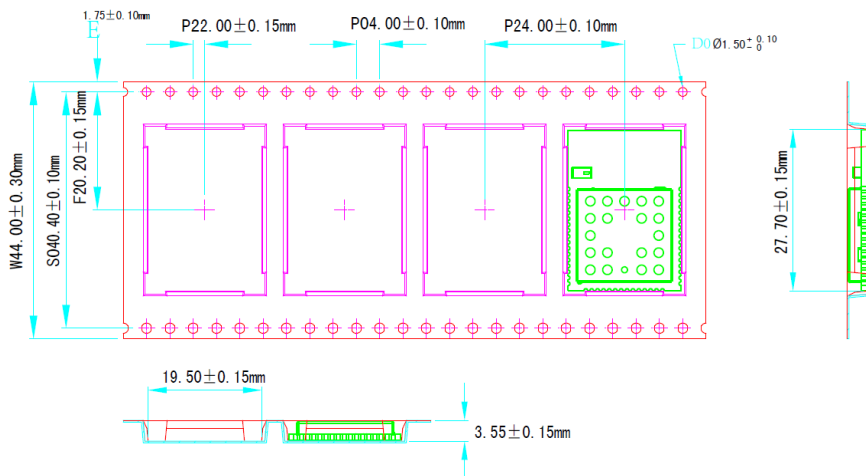


Figure 9: Tape Dimensions

10. Regulatory Information

The information below is valid for the DWM3001C module only.

US FCC ID: 2A35D-DWM3001, Canada ISED/IC: 23794-DWM3001 (ISED certification is pending)

FCC and ETSI Test reports available to download at: <https://www.qorvo.com/products/p/DWM3001C>

DWM3001C certification approval is valid only for the following UWB RF settings:

Table 14: UWB RF Settings

| UWB Parameters | Description | Notes |
|-----------------|---------------------|-------|
| UWB Channel | Channel 5 (6.5 GHz) | Fixed |
| UWB Channel | Channel 9 (8 GHz) | Fixed |
| Data Rate | 6.81 Mbps | Fixed |
| PRF | 64 MHz | Fixed |
| Preamble Length | 64 | Fixed |
| Preamble Code | 9 | Fixed |
| PHR | 850 | Fixed |

10.1 European Union requirements

10.1.1 Radio Equipment Directive

The DWM3001C Module has been certified for use in European Union countries. A copy of the EU Declaration of Conformity is available for download on our website.

If these modules are incorporated into a product, the manufacturer must ensure continuing compliance of the final product to the Radio Equipment Directive 2014/53/EU. The manufacturer must then draw up a new written EU Declaration of Conformity as per RED Article 18.

Furthermore, the manufacturer must ensure the final product does not exceed the specified power ratings, antenna specifications, and/or installation requirements as specified in this document. If any of these specifications are exceeded in the final product, the manufacturer must assess whether additional compliance testing is required.

IMPORTANT: The “CE” marking must be in compliance with the RED Article 19. It must be affixed to a visible location on the OEM product. The CE mark shall have a height of at least 5mm except where this is not possible on account of the nature of the apparatus. The CE marking must be affixed visibly, legibly, and indelibly.





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10.1.2 ETSI harmonised standards

The DWM3001C module conforms with the requirements of the following ETSI standards:

Table 15: ETSI Standards

| RED reference | Standard No | Title | Edition / Date |
|------------------------|---------------|---|----------------|
| Article 3.1a | EN 62479 | Assessment of the compliance of low-power electronic and electrical equipment with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz) | 2010 |
| Article 3.1b | EN 301 489-1 | ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard for ElectroMagnetic Compatibility | 2019-11 V2.2.3 |
| Article 3.1b (for BLE) | EN 301 489-17 | ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for Broadband Data Transmission Systems; Harmonised Standard for ElectroMagnetic Compatibility | 2020-09 V3.2.4 |
| Article 3.1b (for UWB) | EN 301 489-33 | ElectroMagnetic compatibility (EMC) standard for radio equipment and services; Part 33: Specific conditions for Ultra-WideBand (UWB) devices; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU | 2019-04 V2.2.1 |
| Article 3.2 (for BLE) | EN 300 328 | Wideband transmission systems; Data transmission equipment operating in the 2.4GHz band; Harmonised Standard for access to radio spectrum | 2019-07 V2.2.2 |
| Article 3.2 (for UWB) | EN 302 065-1 | Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Part 2: Requirements for UWB location tracking; Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU | 2016-11 V2.1.1 |

Please refer to Qorvo's website for DWM3001C ETSI tests reports:

<https://www.qorvo.com/products/p/DWM3001C>



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10.2 United States (FCC)

This device complies with Part 15 of the FCC Rules:

Operation is subject to the following 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 and Modifications not expressly approved by Qorvo Ltd. can void your authority to operate this equipment under Federal Communications Commission rules.

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

To fulfil FCC Certification requirements, an OEM manufacturer must comply with the following regulations:

1. The DWM3001C modular transmitter must be labelled with its own FCC ID number, and, if the FCC ID 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. This exterior label can use wording such as the following:

IMPORTANT : Contains FCC ID: 2A35D-DWM3001. This equipment 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 (FCC 15.19).

Please refer to Qorvo's website for DWM3001C FCC tests reports: <https://www.Qorvo.com/product/dwm3001-module>

10.2.1 Radio and Television Interference

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 the 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.

You may also find helpful the following booklet, prepared by the FCC: "How to Identify and Resolve Radio-TV Interference Problems." This booklet is available from the U.S. Government Printing Office, Washington D.C. 20402.



10.3 Regulatory Host Integration Instructions

This module has been granted modular approval for portable applications. OEM integrators for host products may use the module in their final products without additional FCC / ISED* certification if they meet the following conditions. Otherwise, additional FCC / ISED* approvals must be obtained.

- The host product with the module installed must be evaluated for simultaneous transmission requirements. The host integrator installing this module into their product must ensure that the final composite product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation. When configuring the module, PC or Linux console applications such as Tera Term or PuTTY may be used, for more details, contact Qorvo Technical Support.
- Note that antennas mounted on outdoor structures, such as antennas mounted on the outside of a building or on a telephone pole, or any fixed outdoors Infrastructure are prohibited for use with this device.
- The user's manual for the host product must clearly indicate the operating requirements and conditions that must be observed to ensure compliance with current FCC/ISED* RF exposure guidelines.
- A label must be affixed to the outside of the host product with the following statements:
 - This device contains FCC ID: 2A35D-DWM3001
 - This equipment contains equipment certified under IC: 23794-DWM3001 (*Subject to ISED certification grant*).

The final host / module combination may also need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device.

If the final host / module combination is intended for use as a portable device (see classifications below) the host manufacturer is responsible for separate evaluations/approvals for the SAR requirements from FCC Part 2.1093 and RSS-102.

10.4 Device Classifications

Since host devices vary widely with design features and configurations module integrators shall follow the guidelines below regarding device classification and simultaneous transmission and seek guidance from their preferred regulatory test lab to determine how regulatory guidelines will impact the device compliance. Proactive management of the regulatory process will minimize unexpected schedule delays and costs due to unplanned testing activities.

The module integrator must determine the minimum distance required between their host device and the user's body. The FCC provides device classification definitions to assist in making the correct determination. Note that these classifications are guidelines only; strict adherence to a device classification may not satisfy the regulatory requirement as near-body device design details may vary widely. Your preferred test lab will be able to assist in determining the appropriate device category for your host product and if a KDB or PBA must be submitted to the FCC.

10.5 FCC Definitions

Portable: (§2.1093) — A portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is / are within 20 centimeters of the body of the user.

10.6 Simultaneous Transmission Evaluation

This module has not been evaluated or approved for simultaneous transmission as it is impossible to determine the exact multi-transmission scenario that a host manufacturer may choose. Any simultaneous transmission condition established through module integration into a host product must be evaluated per the requirements in KDB447498D01(8) and KDB616217D01,D03 (for laptop, notebook, netbook, and tablet applications).

As mentioned above, the DWM3001C has been granted modular approval as a "Portable" device. However, end-customer Portable applications may require further RF exposure (SAR) evaluations. It is also possible that the host / module combination will need to undergo further testing for FCC Part 15 compliance regardless of the device classification. Your preferred test lab will be able to assist in determining the exact tests which are required on the host / module combination.



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10.7 Operating Requirements and Conditions

The design of DWM3001 complies with U.S. Federal Communications Commission (FCC) guidelines respecting safety levels of radio frequency (RF) exposure for Portable devices.

10.8 Miscellaneous

Except as otherwise described above, the DWM3001C BLE and UWB transmitters meets all requirements for SAR or RF Exposure, intended or unintended, under FCC, ISED*, and ETSI rules. The BLE radio falls well below the limit determined for <5mm separation (a "body-worn" device) and, for a UWB radio operating above 6GHz, there are currently no exposure limits specified.

All products developed by the user incorporating the DWM3001C must be approved by the relevant authority governing radio emissions in any given jurisdiction prior to the marketing or sale of such products in that jurisdiction and user bears all responsibility for obtaining such approval as needed from the appropriate authorities.

**ISED certification is pending.*

11. Glossary

Table 16: Glossary of Terms

| Abbreviation | Full Title | Explanation |
|--------------|--|--|
| EIRP | Equivalent Isotropic Radiated Power | The amount of power that a theoretical isotropic antenna (which evenly distributes power in all directions) would emit to produce the peak power density observed in the direction of maximum gain of the antenna being used. |
| ETSI | European Telecommunication Standards Institute | Regulatory body in the EU charged with the management of the radio spectrum and the setting of regulations for devices that use it. |
| FCC | Federal Communications Commission | Regulatory body in the USA charged with the management of the radio spectrum and the setting of regulations for devices that use it. |
| GPIO | General Purpose Input / Output | Pin of an IC that can be configured as an input or output under software control and has no specifically identified function. |
| IEEE | Institute of Electrical and Electronic Engineers | Is the world's largest technical professional society. It is designed to serve professionals involved in all aspects of the electrical, electronic, and computing fields and related areas of science and technology. |
| PLL | Phase Locked Loop | Circuit designed to generate a signal at a particular frequency whose phase is related to an incoming "reference" signal. |
| PPM | Parts Per Million | Used to quantify very small relative proportions. Just as 1% is one out of a hundred, 1 ppm is one part in a million. |
| RF | Radio Frequency | Generally used to refer to signals in the range of 3 kHz to 300 GHz. In the context of a radio receiver, the term is generally used to refer to circuits in a receiver before down-conversion takes place and in a transmitter after up-conversion takes place. |
| RTLS | Real Time Location System | System intended to provide information on the location of various items in real-time. |
| SFD | Start of Frame Delimiter | Defined in the context of the IEEE 802.15.4-2011 standard. |
| SPI | Serial Peripheral Interface | An industry standard method for interfacing between IC's using a synchronous serial scheme first introduced by Motorola. |
| SRRC | Chinese State Radio Regulatory Commission | The radio regulation authority of the People's Republic of China with responsibilities including spectrum management and frequency allocation. |
| TWR | Two Way Ranging | Method of measuring the physical distance between two radio units by exchanging messages between the units and noting the times of transmission and reception. Refer to Qorvo's website for further information. |
| TDoA | Time Difference of Arrival | Method of deriving information on the location of a transmitter. The time of arrival of a transmission at two physically different locations whose clocks are synchronized is noted and the difference in the arrival times provides information on the location of the transmitter. |
| UWB | Ultra-Wideband | A radio scheme employing channel bandwidths of, or in excess of, 500 MHz. |
| WSN | Wireless Sensor Network | A network of wireless nodes intended to enable the monitoring and control of the physical environment. |

12. Revision History

| Revision | Change Description |
|----------|---|
| A | Initial Release (Preliminary) |
| B | Revised to add Regulatory Information, ESD and RoHS compliance, E1.0 Ch5 ant del note, antenna radiation patterns, solder profile and T&R information |
| C | Added FiRa™ certified logo |
| D | Updated ordering information, corrected ST part number to LIS2DH12TR |
| E | Updated radio certification information |

13. Further Information

Qorvo develops semiconductor solutions, software, modules, reference designs - that enable real-time, ultra-accurate, ultra-reliable local area micro-location services. Qorvo's technology enables an entirely new class of easy to implement, highly secure, intelligent location functionality and services for IoT and smart consumer products and applications.

For further information on this or any other Qorvo product, please refer to our website www.qorvo.com.

Handling Precautions

| Parameter | Rating | Standard |
|----------------------------------|---------|------------------------|
| ESD - Charged Device Model (CDM) | 1000V | ANSI/ESDA/JEDEC JS-002 |
| ESD – Human Body Model (HBM) | 2000V | ANSI/ESDA/JEDEC JS-001 |
| MSL – Moisture Sensitivity Level | Level 3 | IPC/JEDEC J-STD-020 |



Caution!
ESD-Sensitive Device

RoHS Compliance

This part is compliant with 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment) as amended by Directive 2015/863/EU.

This product also has the following attributes:

- Antimony Free
- TBBP-A (C₁₅H₁₂Br₄O₂) Free
- SVHC Free



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Contact Information

For the latest specifications, additional product information, worldwide sales, and distribution locations:

Web: www.qorvo.com

Tel: 1-844-890-8163

Email: customer.support@qorvo.com

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