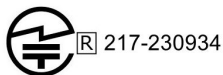


## Bluetooth® Low Energy 5.4 module



R-R-2AS-32WB1MMC001

### Features

- **Includes ST state-of-the-art patented technology**
- Integrated chip antenna, and option for external antenna
- Bluetooth® Low Energy 5.4 certified
- Supports 2 Mbits/s
- Frequency band: 2400 to 2483.5 MHz
- Advertising extension
- TX output power up to +5.5 dBm
- RX sensitivity: -96 dBm (1 Mbps)
- Dedicated Arm® Cortex®-M0+ for radio and security tasks
- Dedicated Arm® Cortex®-M4 CPU with FPU and ART (adaptive real-time accelerator), up to 64 MHz speed
- 320-Kbyte flash memory, 48-Kbyte SRAM
- Fully integrated BOM, including 32 MHz radio and 32 kHz RTC crystals
- Integrated SMPS
- Ultra-low power modes for battery longevity
- 27 GPIOs
- SWD, JTAG
- Integrated IPD for best-in-class and reliable antenna matching
- V<sub>DD</sub> range: 1.71 to 3.6 V
- Temperature range: -40 to 85 °C
- Built-in security features, such as secure firmware installation (SFI) for radio stack, PKA, AES 256-bit, RNG, PCROP, CRC, 96-bit UID, possibility to derive 48-bit UEI
- Certifications: CE, FCC, ISED, JRF, RoHS, REACH, UKCA, NCC, KC, SRRC
- 2-layer PCB

### Applications

- Home automation
- Wellness, healthcare, personal trackers
- Gaming and toys
- Beacons and accessories
- Industrial

#### Product status

STM32WB1MMC

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## 1 Introduction

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This document provides the ordering information and mechanical device characteristics of the STM32WB1MMC module. It must be read in conjunction with DS13258 and RM0473, available on [www.st.com](http://www.st.com).

For information on the Arm® Cortex® cores, refer to the Cortex® Technical Reference Manual, available from the [www.arm.com](http://www.arm.com) website.

*Note:* Arm is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere.



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## 2 Description

---

The STM32WB1MMC is an ultra-low power, small form factor, certified 2.4 GHz wireless module, supporting Bluetooth® Low Energy 5.4. Based on the STM32WB15CCY wireless microcontroller, it provides best-in-class RF performance thanks to its good receiver sensitivity and a high output power signal. Its low power features enable extended battery life time, small coin-cell batteries, or energy harvesting.

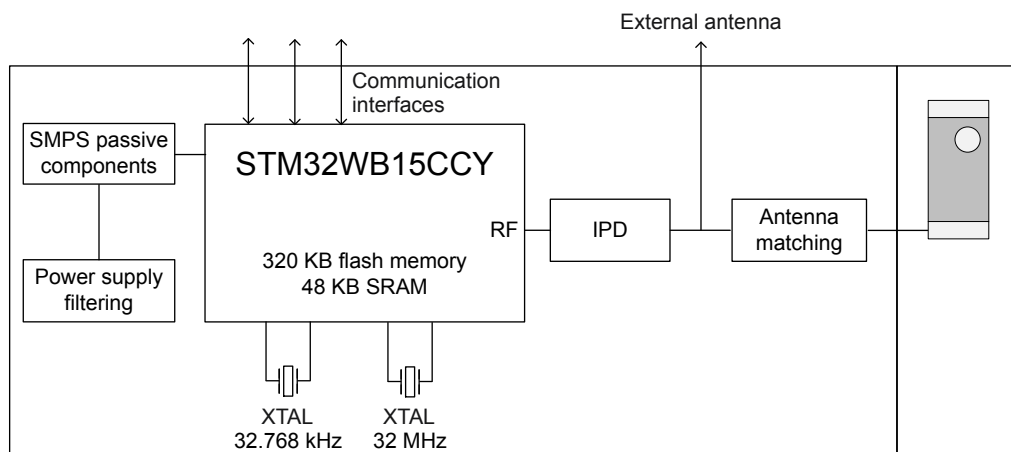
The STM32WB1MMC requires no RF expertise, and is the best way to speed up the application development and to reduce the associated costs. The module is completely protocol stack royalty-free.

### 3 Module overview

The module is a SiP-LGA77 package (system in package land grid array), based on the proven STM32WB15CCY MCU. The package includes:

- LSE and HSE crystals
- Passive components for SMPS
- Antenna matching and antenna
- IPD for RF matching and harmonics rejection

**Figure 1. Block diagram**



DT55981

#### 3.1 Power supply

The power supply requirements are identical to those of the STM32WB1x devices, detailed in the datasheet DS13258. Filtering capacitors on power supply pins and components for the SMPS are already integrated into the module.

The SMPS passive components fitted in the module are in configuration-imposing function at 4 MHz, always ON. This is the only available configuration. For additional information on the SMPS, check the reference manual or AN5246, available on [www.st.com](http://www.st.com).

#### 3.2 Clocks

As the crystals are already integrated into the package, it is not possible to use any clock in bypass mode. The module integrates a 32.768 kHz crystal for LSE, and a 32 MHz crystal for the HSE clock.

- HSE is already tuned.  
RCC\_HSECR.HSETUNE[5:0] value is loaded automatically by hardware. The RCC\_HSECR register configuration must not be changed by the user to keep the default parameters.
- LSCO and MCO outputs are available.

#### 3.3 Antenna

The rectangular module has one shorter side clearly different from the remaining finish surface. This side is unshielded and the mold cover contains the integrated antenna.

To use the internal antenna, pins 6 (ANT\_INT) and 7 (ANT\_EXT) must be connected as in [Figure 2](#).

If an external antenna is used, ANT\_IN must be shorted to ground, and ANT\_OUT connected to the external antenna matching network and to the antenna itself, as in [Figure 3](#).

*Note:* Regulatory certifications obtained by ST apply only to the module with its internal antenna. Designs with external antennas require new certifications.

Figure 2. Connections when using the internal antenna

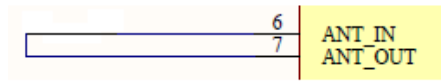
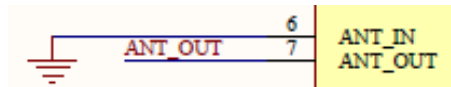


Figure 3. Connections when using an external antenna



### 3.4 OTP

The STM32WB1MMC features a 1-Kbyte one time programmable (OTP) memory for use by the end product (see DS13258 and RM0473).

*Note:* The device uses the first and last words of this area for trimming and identification purposes. As a consequence, addresses 0x1FFF7000h to 0x1FFF7007h and 0x1FFF73F8h to 0x1FFF73FFh cannot be changed.

## 4 Available peripherals

All the peripherals available in STM32WB series microcontrollers based on the WLCSP49 package are available and accessible on this module.

The pins on the module offer access to the following system peripherals:

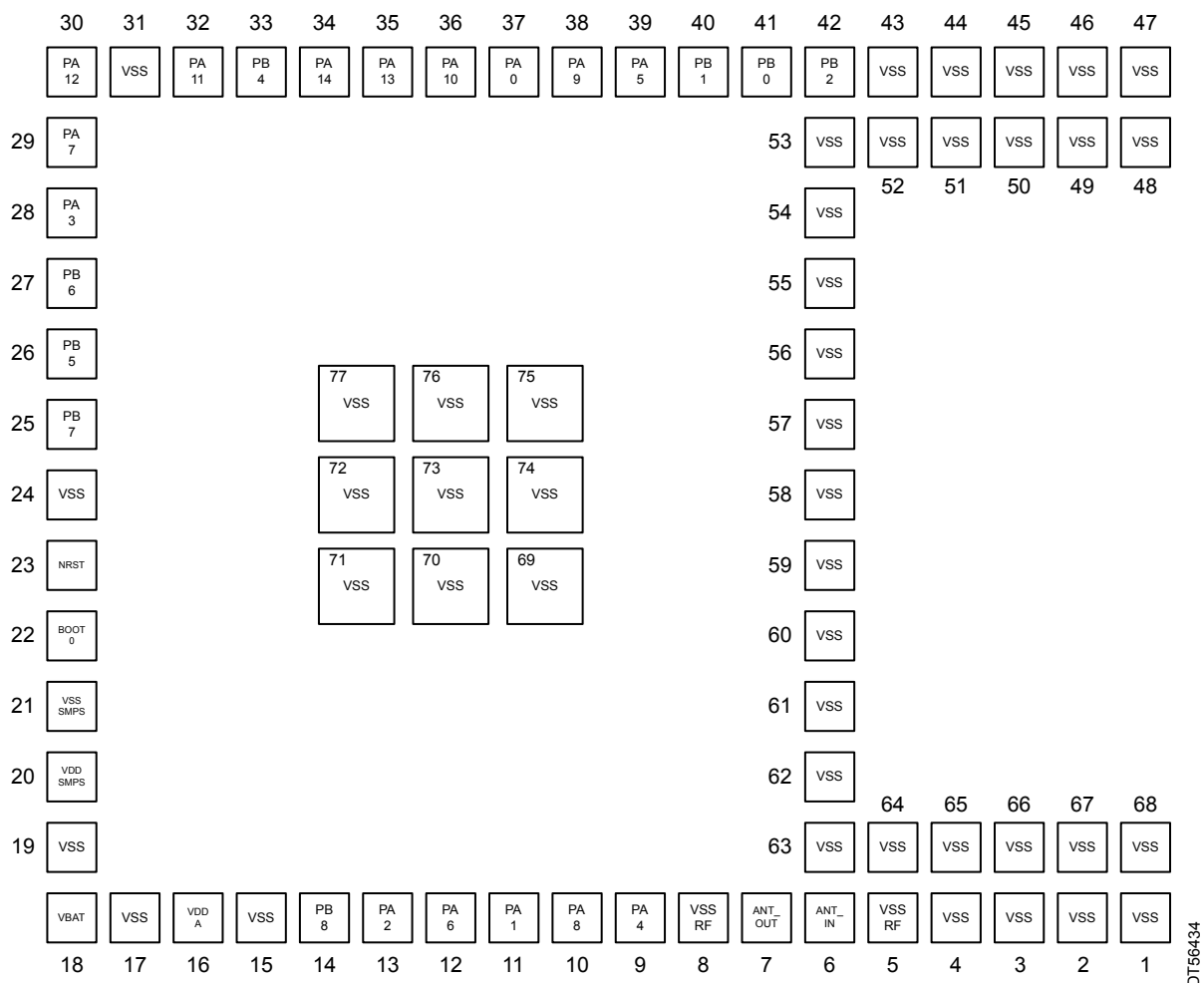
- 1× DMA controllers (seven channels each) supporting ADC, SPI, I2C, USART, AES, timers
- 1× USART (ISO 7816, IrDA, SPI master, Modbus and Smartcard mode)
- 1× LPUART (low power)
- SPI running at 32 Mbit/s
- I<sup>2</sup>C (SMBus/PMBus<sup>®</sup>)
- 1× touch sensing controller, up to 8 sensors
- 1× 16-bit, four-channel advanced timer
- 2× 16-bit, two-channel timers
- 1× 32-bit, four-channel timer
- 2× 16-bit ultra-low power timers
- 1× independent SysTick
- 1× independent watchdog
- 1× window watchdog.

The full pin description is available in DS13258.

## 5 Pin description

Figure 4 shows the module pinout package bottom view.

**Figure 4. STM32WB1MMC module pinout: bottom view**



**Table 1. STM32WB1MMC pin/ball definition**

Pin name		Pin name (function after reset)	Pin type
STM32WB1MMC	STM32WB15CCY		
1	-	VSS	S
2	-	VSS	S
3	-	VSS	S
4	-	VSS	S
5	G1	VSSRF	S
6	-	ANT_IN	I
7	-	ANT_OUT	O
8	G3	VSSRF	S
9	G7	PA4	I/O

Pin name		Pin name (function after reset)	Pin type
STM32WB1MMC	STM32WB15CCY		
10	G6	PA8	I/O
11	F7	PA1	I/O
12	F6	PA6	I/O
13	E6	PA2	I/O
14	C6	PB8	I/O
15	-	VSS	S
16	E7	VDDA	S
17	-	VSS	S
18	C5	VBAT	S
19	-	VSS	S
20	A1	VDDSMPS	S
21	C1	VSSSMPS	S
22	B6	BOOT0	I/O
23	C7	NRST	I/O
24	-	VSS	S
25	A6	PB7	I/O
26	A5	PB5	I/O
27	B5	PB6	I/O
28	D5	PA3	I/O
29	E5	PA7	I/O
30	A3	PA12	I/O
31	-	VSS	S
32	A2	PA11	I/O
33	B4	PB4	I/O
34	B3	PA14	I/O
35	B2	PA13	I/O
36	C2	PA10	I/O
37	C4	PA0	I/O
38	D3	PA9	I/O
39	D4	PA5	I/O
40	E1	PB1	I/O
41	E2	PB0	I/O
42	E4	PB2	I/O
43	-	VSS	S
44	-	VSS	S
45	-	VSS	S
46	-	VSS	S
47	-	VSS	S
48	-	VSS	S
49	-	VSS	S



Pin name		Pin name (function after reset)	Pin type
STM32WB1MMC	STM32WB15CCY		
50	-	VSS	S
51	-	VSS	S
52	-	VSS	S
53	-	VSS	S
54	-	VSS	S
55	-	VSS	S
56	-	VSS	S
57	-	VSS	S
58	-	VSS	S
59	-	VSS	S
60	-	VSS	S
61	-	VSS	S
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66	-	VSS	S
67	-	VSS	S
68	-	VSS	S
69	-	VSS	S
70	-	VSS	S
71	-	VSS	S
72	-	VSS	S
73	-	VSS	S
74	-	VSS	S
75	-	VSS	S
76	-	VSS	S
77	-	VSS	S

# 6 Schematics

Figure 5. Reference board schematics

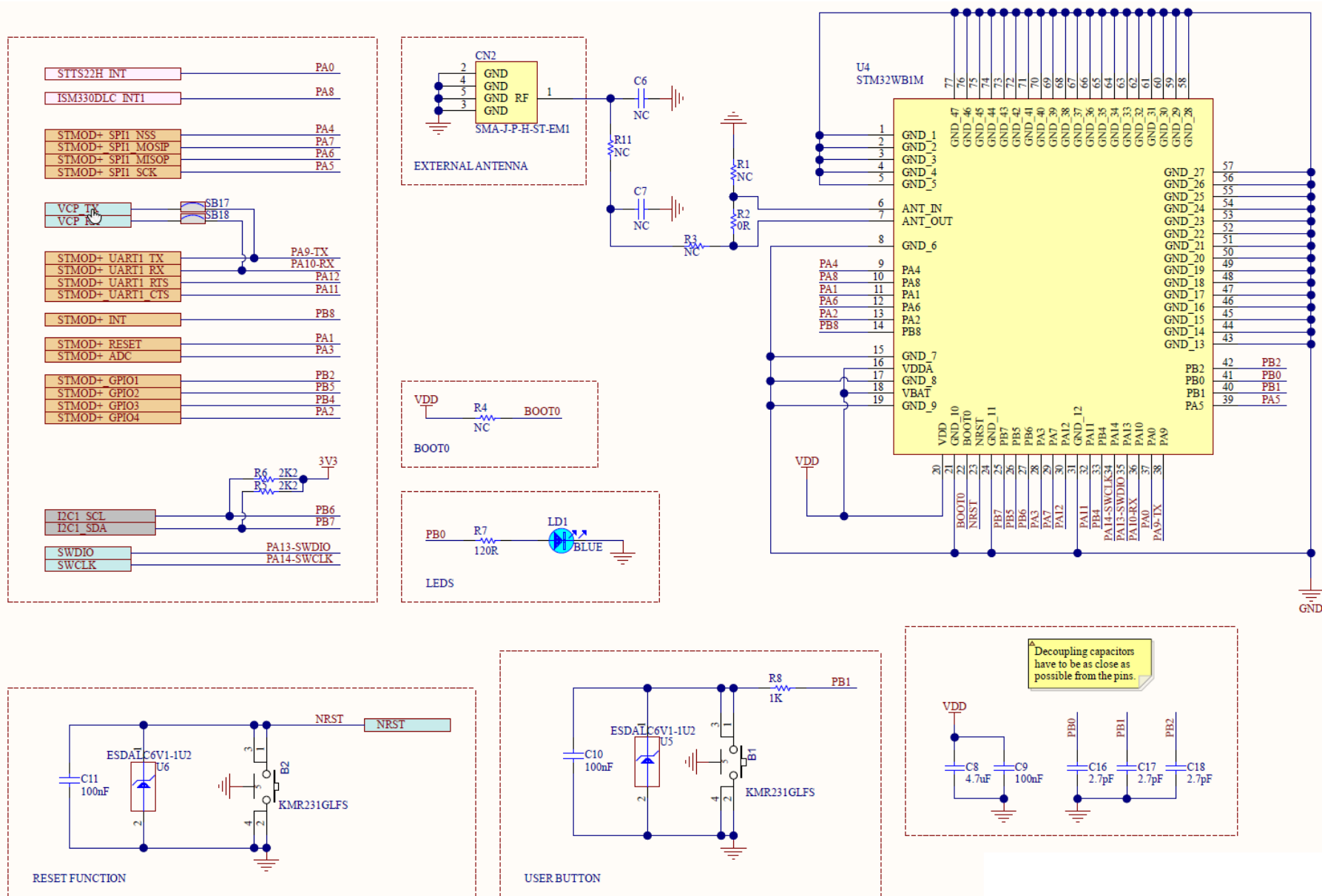


Figure 6. Top layer

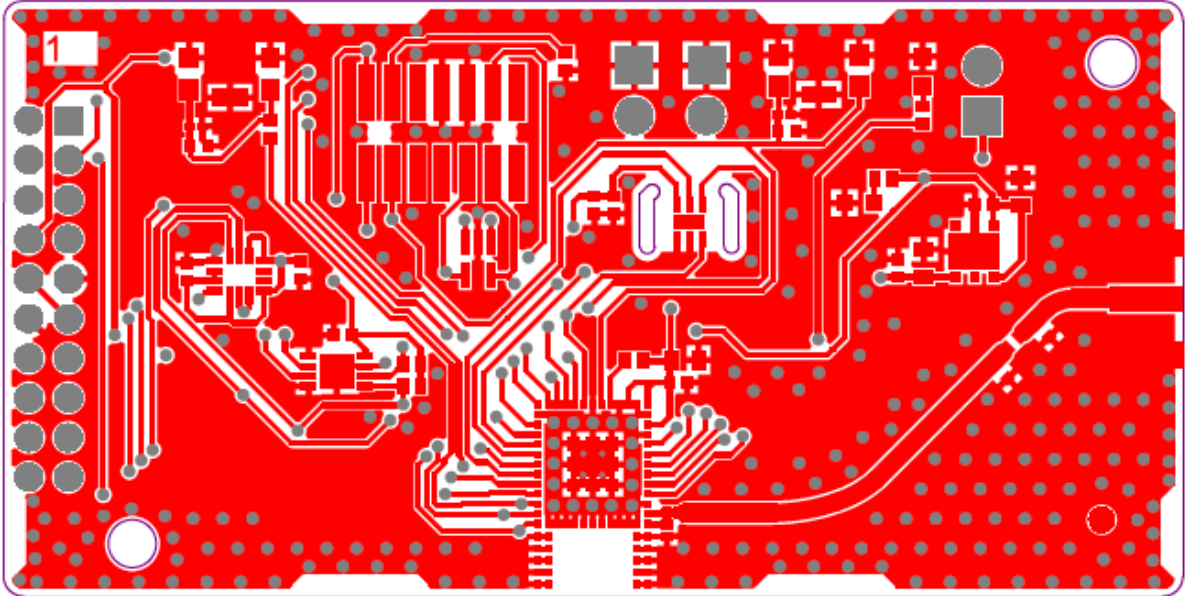
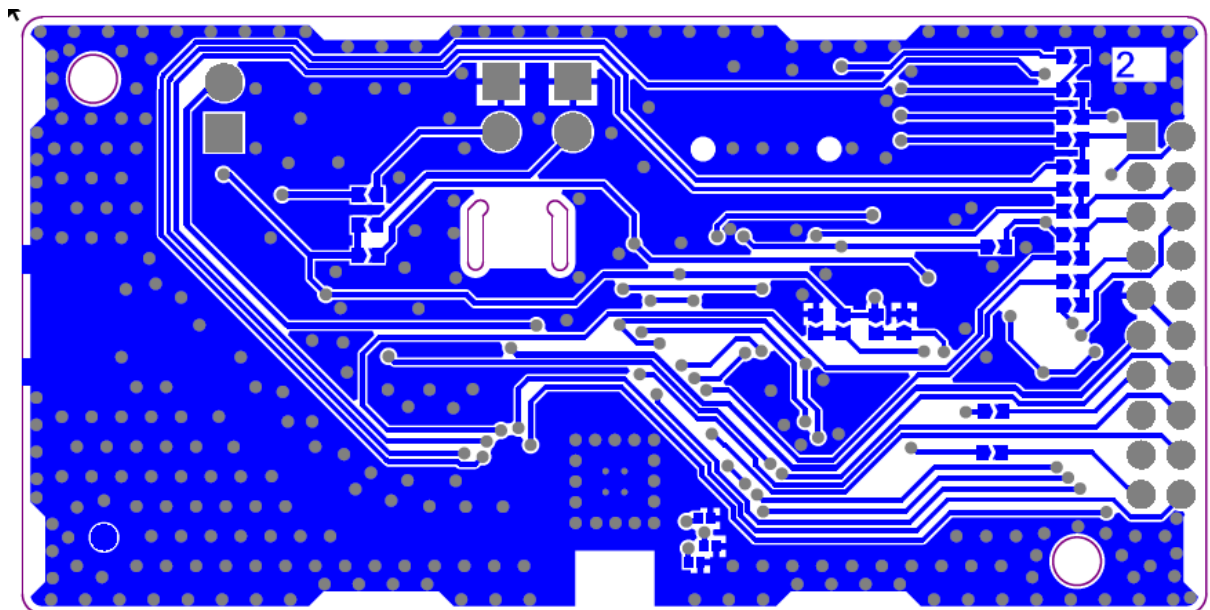


Figure 7. Bottom layer



### Sensitive GPIOs

Among the multiple GPIOs available on this product, three are particularly sensitive, namely PB0, PB1, and PB2. If possible, do not use them, and do not connect these pins. If they must be used, ensure that the connections are made with very short wires, to avoid the creation of parasitic antennas. In addition, place a small scale factor (such as 201) 2.7 pF capacitor as close as possible to the output pin, and border these tracks with the ground plane.

### Layout recommendations

Decoupling capacitors must be placed as close as possible to the pins.

100 nF capacitors on external supplies must be placed as close as possible to the supply pads of the MEMs.

## 8 Electrical characteristics

### 8.1 Operating conditions

**Table 2. STM32WB1MMC operating conditions**

Parameter	Min	Typ	Max	Unit
V <sub>DD</sub>	1.71	3.3	3.6	V
Operating ambient temperature range	-40	-	85	°C
Storing temperature range	-40	-	125	

### 8.2 Power consumption

The power consumption is identical to the regular STM32WB15. For full details refer to DS13258.

### 8.3 RF characteristics

Refer to DS13258.

### 8.4 Antenna radiation patterns and efficiency

The following figures present the radiation patterns, taken from certification measurements.

Figure 8. Radiaton pattern - 2402 MHz

**2D Diagram**

Plan measured  $C_{min}$ : 2402 MHz

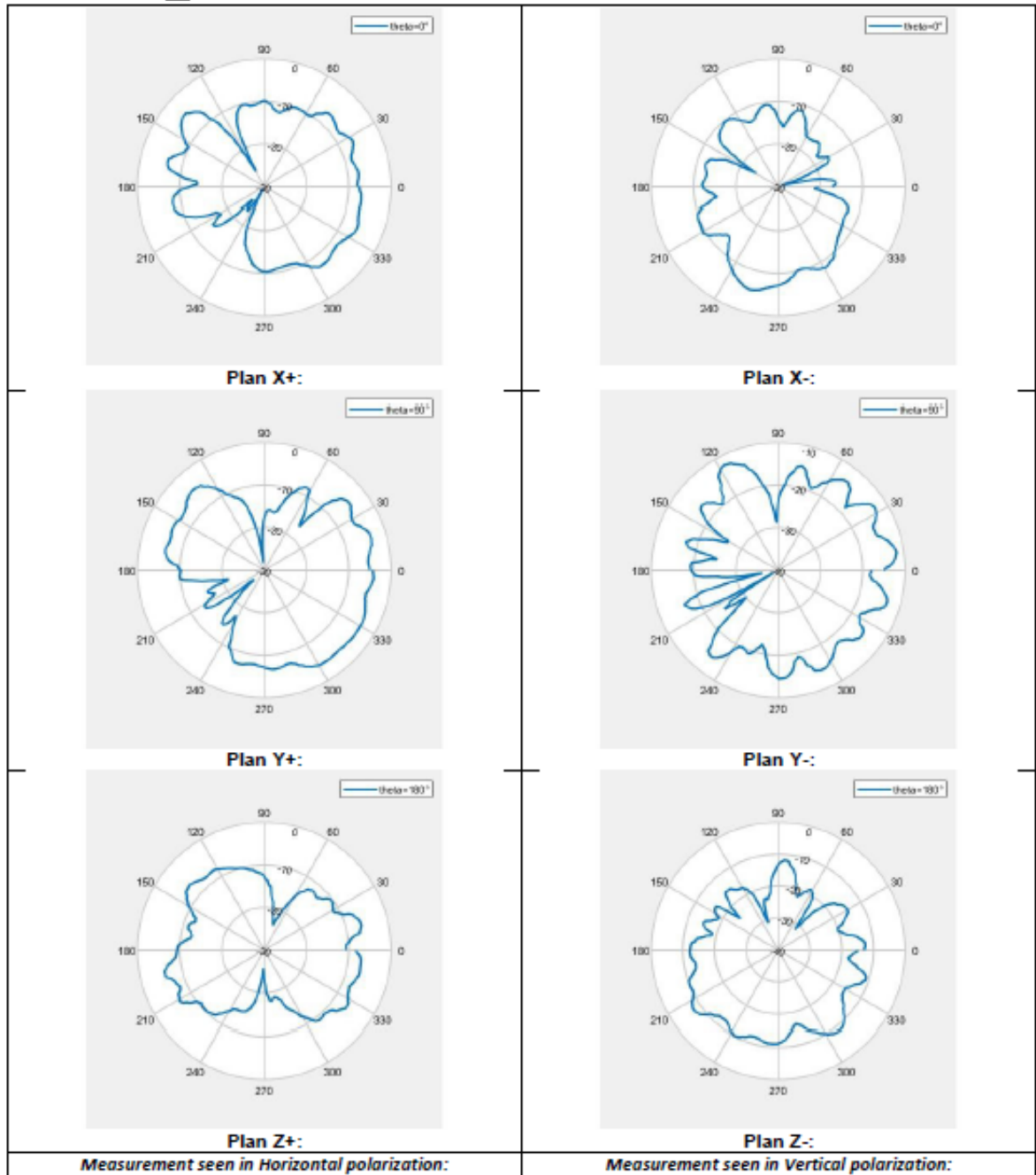


Figure 9. Radiaton pattern - 2440 MHz

Plan measured  $C_{mig}$ : 2440 MHz

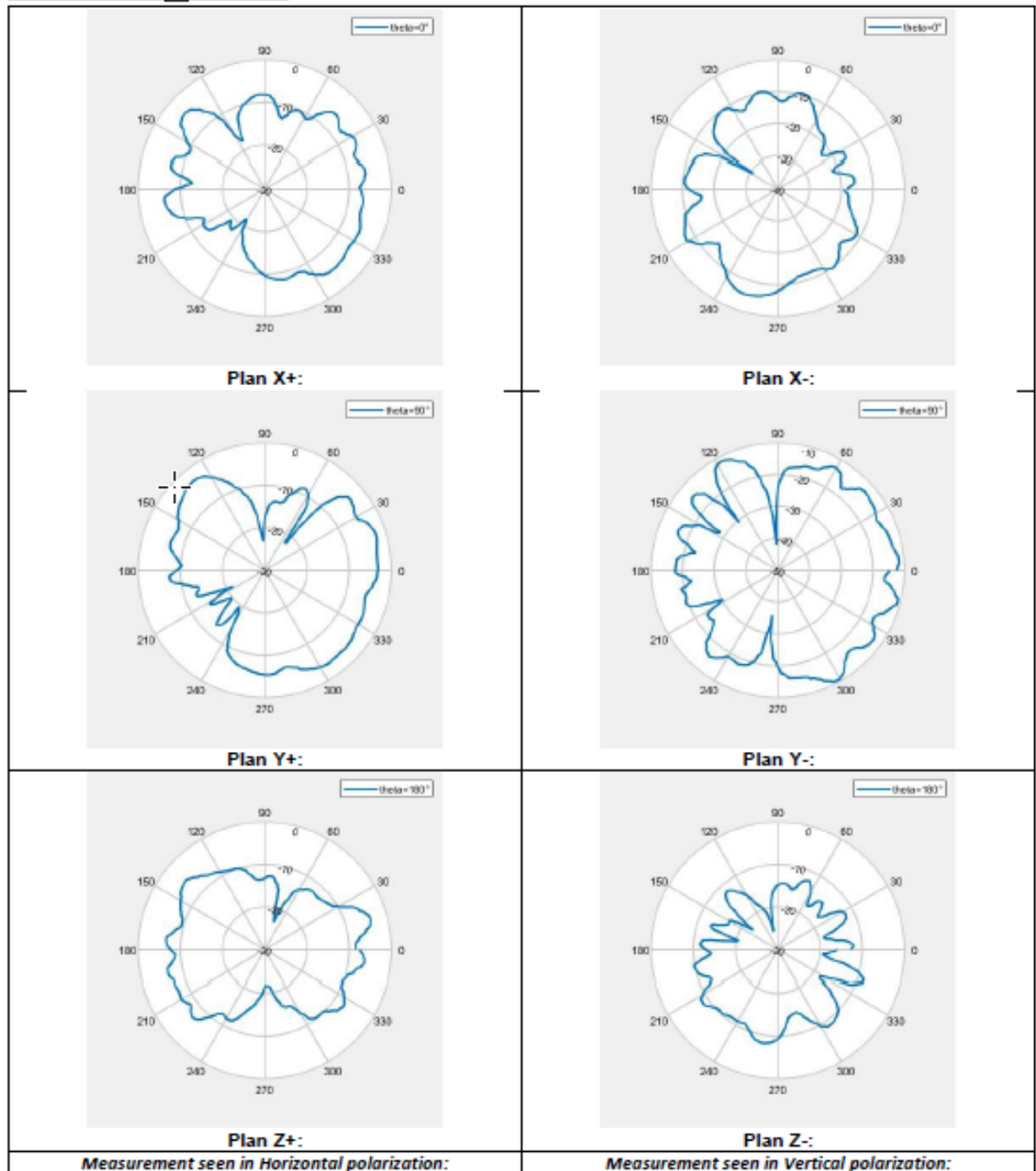
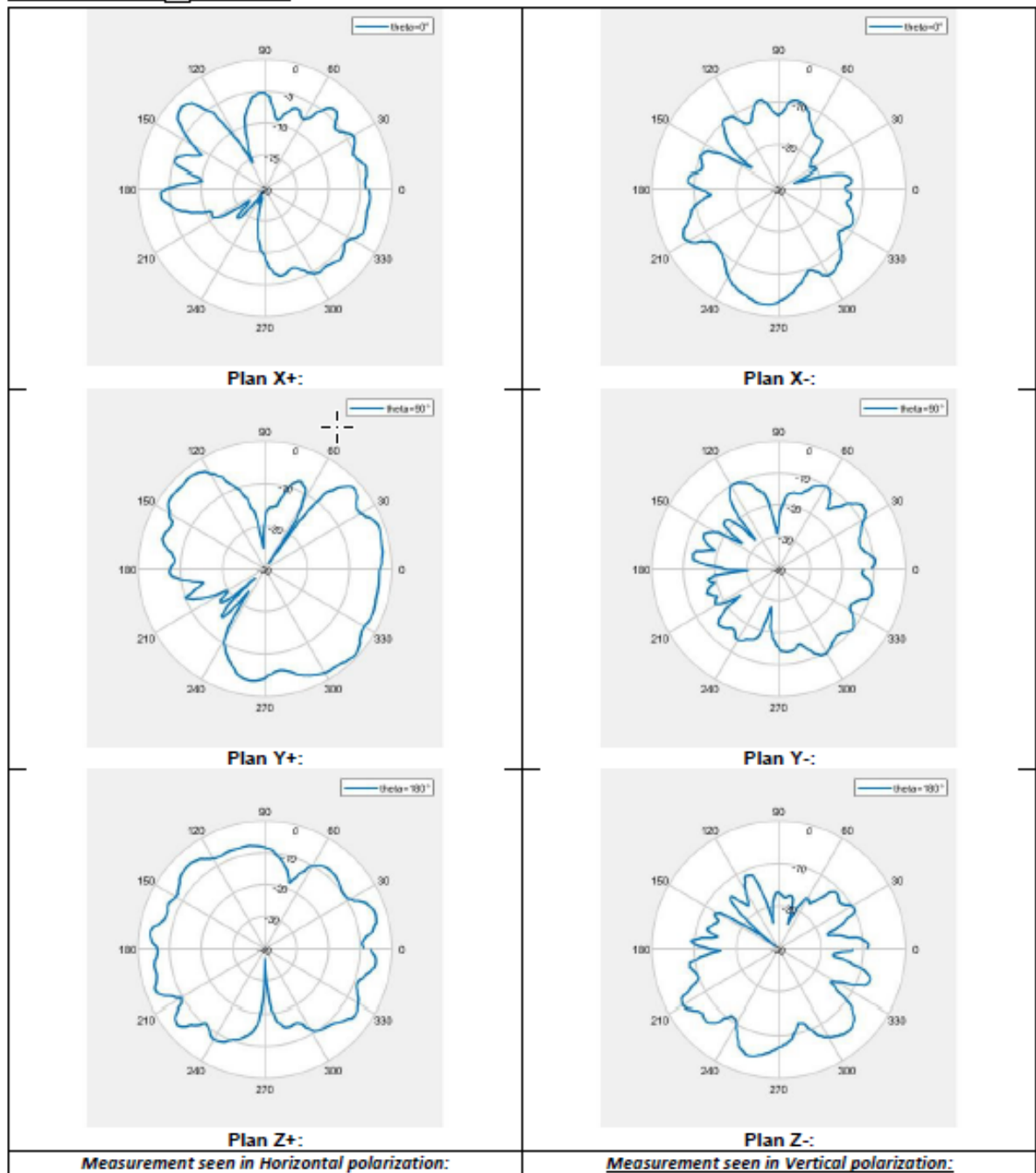


Figure 10. Radiaton pattern - 2480 MHz

Plan measured  $C_{max}$ : 2480 MHz





## 9 Package information

In order to meet environmental requirements, ST offers these devices in different grades of **ECOPACK** packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

### 9.1 Device marking for SiP-LGA77

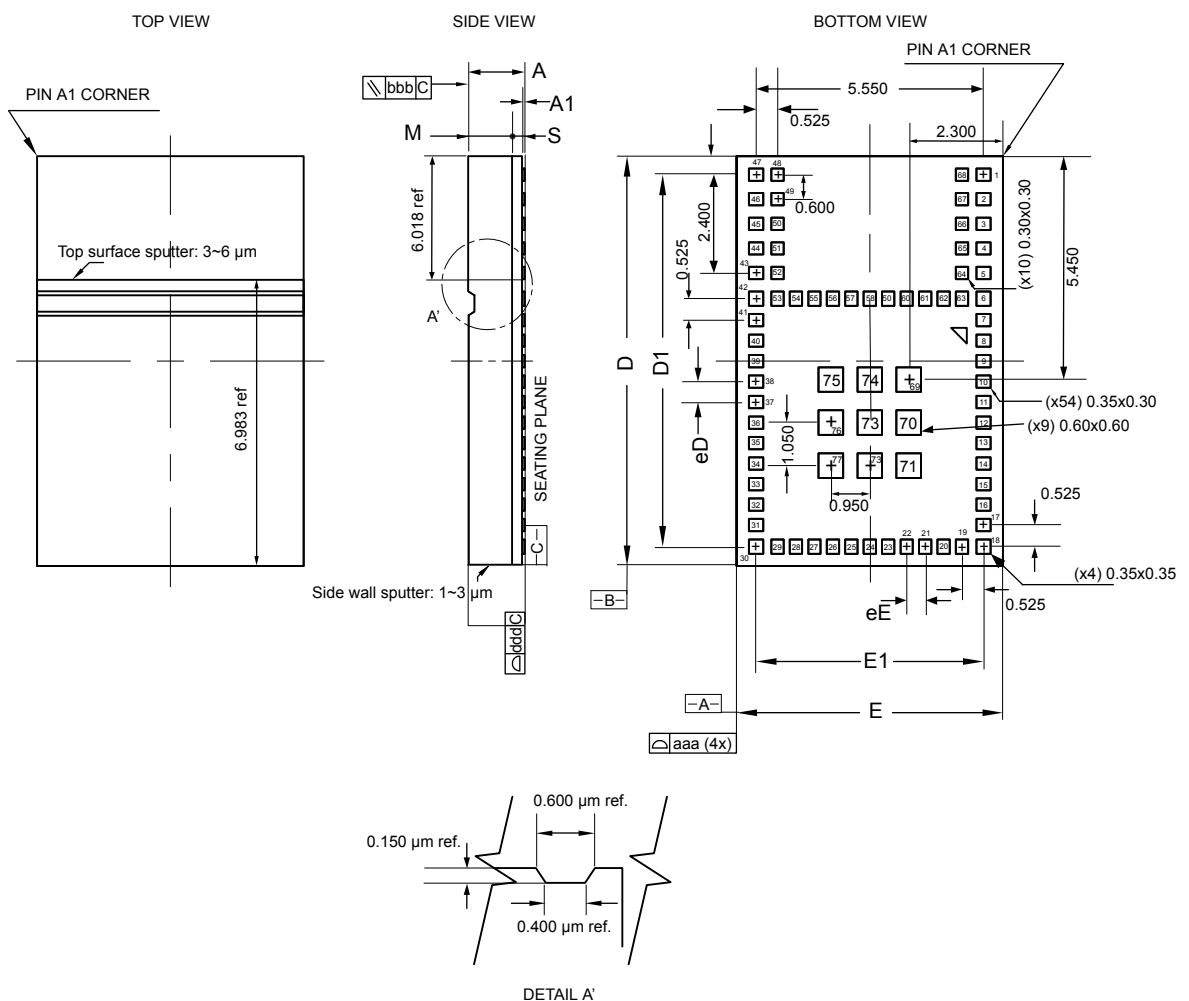
Refer to technical note “Reference device marking schematics for STM32 microcontrollers and microprocessors” (TN1433) available on [www.st.com](http://www.st.com), for the location of pin 1 / ball A1, as well as the location and orientation of the marking areas versus pin 1 / ball A1.

Parts marked as “ES”, “E” or accompanied by an Engineering Sample notification letter, are not yet qualified and therefore not approved for use in production. ST is not responsible for any consequences resulting from such use. In no event will ST be liable for the customer using any of these engineering samples in production. ST’s Quality department must be contacted prior to any decision to use these engineering samples to run a qualification activity.

### 9.2 LGA77 package information (B0HQ)

This LGA is a 77-lead, 10 x 6.5 mm, 0.45/0.50 mm pitch, land grid array package.

Figure 11. LGA77 - Outline



1. All dimensions, except where are indicated, are in millimeters.
2. Drawing is not in scale.

**Table 3. LGA77 - Mechanical data**

Symbol	millimeters			inches		
	Min	Typ	Max	Min	Typ	Max
A	1.372 ± 0.046			0.0540 ± 0.0018		
A1	0.030 ± 0.020			0.0012 ± 0.0008		
D	9.900	10.000	10.100	0.3898	0.3937	0.3976
E	6.400	6.500	6.600	0.2520	0.2559	0.2598
D1	9.075			0.3573		
E1	5.550			0.2185		
eD	0.500			0.0197		
eE	0.450			0.0177		
M	1.100 REF			0.0433 REF		
S	0.24 REF			0.0094 REF		
Lead width	0.300 x 0.300			0.118 x 0.0118		
	0.350 x 0.300			0.0138 x 0.0118		
	0.350 x 0.350			0.0138 x 0.0138		
	0.600 x 0.600			0.0236 x 0.0236		
aaa	0.100			0.0039		
bbb	0.100			0.0039		
ddd	0.100			0.0039		

1. Values in inches are converted from mm and rounded to four decimal digits.

### 9.3 Thermal characteristics

The device thermal characteristics are defined below, and the constant values are given in Table 4:

- $\Theta_{JA}$  is the junction-to-ambient thermal resistance (EIA/JESD51-2 and EIA/JESD51-6)  
 $\Theta_{JA}$  represents the resistance to the heat flowing from the chip to ambient air. It is an indicator of package heat dissipation capability, a lower  $\Theta_{JA}$  means better overall thermal performance. It is calculated as follows:  

$$\Theta_{JA} = (T_J - T_A) / P_H$$
 where:
  - $T_J$  = junction temperature
  - $T_A$  = ambient temperature
  - $P_H$  = power dissipation.
- $\Psi_{JT}$  is the junction-to-top-center thermal characterization parameter (EIA/JESD51-2 and EIA/JESD51-6).  
 $\Psi_{JT}$  is used for estimating the junction temperature by measuring  $T_T$  in an actual environment. It is calculated as follows:  

$$\Psi_{JT} = (T_J - T_T) / P_H$$
 where  $T_T$  = temperature at the top-center of the package.
- $\Theta_{JC}$  is the junction-to-case thermal resistance.  
 $\Theta_{JC}$  represents the resistance to the heat flowing from the chip to package top case.  $\Theta_{JC}$  is important when an external heat sink is attached on package top. It is calculated as follows:  

$$\Theta_{JC} = (T_J - T_C) / P_H$$
 where  $T_C$  = case temperature attached with a cold plate.

- $\Theta_{JB}$  is the junction-to-board thermal resistance (EIA/JESD51-8).  
 $\Theta_{JB}$  represents the resistance to the heat flowing from the chip to PCB.  $\Theta_{JB}$  is used in compact thermal models for system-level thermal simulation. It is calculated as follows:  
 $\Theta_{JB} = (T_J - T_B) / P_H$   
 where  $T_B$  = board temperature with ring cold plate fixture applied.

**Table 4. Thermal characteristics**

Symbol	Max $T_J$ (° C)	$T_T$ (° C)	$\Psi_{JT}$ (° C/W)	$\Theta_{JA}$ (° C/W)	$\Theta_{JB}$ (° C/W)	$\Theta_{JC}$ (° C/W)
Value	99.65	99.53	0.26	37.36	16.96	14.41

## 9.4 Board design

For information and recommendations related to board design, landing pads, stencils and the solder reflow profile for LGA packages, refer to AN 5886 "Guidelines for design and board assembly of land grid array packages", available on [www.st.com](http://www.st.com).

## 10 Ordering information

**Table 5. Ordering information scheme**

Example:	STM32	WB	1	M	M	C	H	6	TR
<b>Device family</b>									
STM32 = Arm-based 32-bit microcontroller									
<b>Product type</b>									
WB = wireless Bluetooth									
<b>Device subfamily</b>									
1 = STM32WB15 die 1, full set of features									
<b>Pin count</b>									
M = 77 pins									
<b>Component type</b>									
M = module									
<b>Flash memory size</b>									
C = 320 Kbytes									
<b>Package</b>									
H = LGA77 6.5 x 10 mm									
<b>Temperature range</b>									
6 = industrial temperature range, -40 to 85 °C									
<b>Packing</b>									
TR = tape and reel									

For a list of available options (such as speed and package) or for further information on any aspect of this device, contact your nearest ST sales office.

## 11 Certifications

The STM32WB1MMC module, with its internal antenna, has passed the following certifications:

- BLE (RF\_PHY)
- CE (RED)
- FCC
- ISED
- REACH
- ROHS
- Taiwan
- KC

Certifications for China (SRRC) are in progress. All certification reports are available on the STM32WB1MMC webpage.

### 11.1 BLE(RF\_PHY) certification

The module has obtained BLE RF\_PHY certification.

The module is published under BLE SIG web site.

### 11.2 CE certification

The STM32WB1MMC module has obtained CE certification, and is provided with CE marking.

Figure 12. CE certification logo



### 11.3 FCC certification

The STM32WB1MMC module complies with part 15 of the FCC Rules.

The FCC ID is YCP-32WB1MMCH01.

The module label includes the corresponding FCC ID.

The operation is subject to the following two conditions:

- This device may not cause harmful interference
- This device must accept any interference received, including interference that may cause undesired operation.

*Note:* This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

#### Label requirements

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

#### Documentation requirements

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### Integration requirements

Co-location of this module with other transmitters that operate simultaneously are required to be evaluated using the multi-transmitter procedures.

The host integrator must follow the integration instructions provided in this document and ensure that the composite-system end product complies with the requirements by a technical assessment or evaluation to the rules and to KDB Publication 996369.

The host integrator installing this module into their product must ensure that the final composite product complies with the requirements by a technical assessment or evaluation to the rules, including the transmitter operation and should refer to guidance in KDB 996369.

## 11.4 ISED certification

The STM32WB1MMC module has been tested and found compliant with the ISED RSS-247 and RSS-Gen rules. The IC ID is 8976A-32WB1MMCH01.

This module contains license-exempt transmitter(s) that comply with Innovation, Science and Economic Development Canada's license-exempt RSS(s). Operation is subject to the following two conditions:

- This module may not cause interference
- This module must accept any interference, including interference that may cause undesired operation of the module.

L'émetteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

- L'appareil ne doit pas produire de brouillage.
- L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

## 11.5 JRF certification

The STM32WB1MMC module is certified in Japan with certification number 217-230934.

Figure 13. JRF logo



## 11.6 NCC certification

The STM32WB1MMC is certified in Taiwan with NCC certification number CCAN24Y10600T7.

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

For module:

此模組於取得認證後將依規定於模組本體標示審驗合格標籤，並要求平台廠商於平台上標示本產品內含發射器模組



### 11.7 KC certification

Applicant company name: STMicroelectronics (Rousset) SAS  
 Equipment: Module for Bluetooth Low Energy, STM32WB1MMC  
 Manufacturing date: Notified separately  
 Manufacturer: STMicroelectronics (Rousset) SAS, France

Figure 14. KC logo



R-R-2AS-32WB1MMC001

### 11.8 SRRC certification

The module STM32WB1MMC has received regulatory approval in China (SRRC) with CMIIT ID 24J31B9F8878.

## 12 Important security notice

The STMicroelectronics group of companies (ST) places a high value on product security, which is why the ST product(s) identified in this documentation may be certified by various security certification bodies and/or may implement our own security measures as set forth herein. However, no level of security certification and/or built-in security measures can guarantee that ST products are resistant to all forms of attacks. As such, it is the responsibility of each of ST's customers to determine if the level of security provided in an ST product meets the customer needs both in relation to the ST product alone, as well as when combined with other components and/or software for the customer end product or application. In particular, take note that:

- ST products may have been certified by one or more security certification bodies, such as Platform Security Architecture ([www.psacertified.org](http://www.psacertified.org)) and/or Security Evaluation standard for IoT Platforms ([www.trustcb.com](http://www.trustcb.com)). For details concerning whether the ST product(s) referenced herein have received security certification along with the level and current status of such certification, either visit the relevant certification standards website or go to the relevant product page on [www.st.com](http://www.st.com) for the most up to date information. As the status and/or level of security certification for an ST product can change from time to time, customers should re-check security certification status/level as needed. If an ST product is not shown to be certified under a particular security standard, customers should not assume it is certified.
- Certification bodies have the right to evaluate, grant and revoke security certification in relation to ST products. These certification bodies are therefore independently responsible for granting or revoking security certification for an ST product, and ST does not take any responsibility for mistakes, evaluations, assessments, testing, or other activity carried out by the certification body with respect to any ST product.
- Industry-based cryptographic algorithms (such as AES, DES, or MD5) and other open standard technologies which may be used in conjunction with an ST product are based on standards which were not developed by ST. ST does not take responsibility for any flaws in such cryptographic algorithms or open technologies or for any methods which have been or may be developed to bypass, decrypt or crack such algorithms or technologies.
- While robust security testing may be done, no level of certification can absolutely guarantee protections against all attacks, including, for example, against advanced attacks which have not been tested for, against new or unidentified forms of attack, or against any form of attack when using an ST product outside of its specification or intended use, or in conjunction with other components or software which are used by customer to create their end product or application. ST is not responsible for resistance against such attacks. As such, regardless of the incorporated security features and/or any information or support that may be provided by ST, each customer is solely responsible for determining if the level of attacks tested for meets their needs, both in relation to the ST product alone and when incorporated into a customer end product or application.
- All security features of ST products (inclusive of any hardware, software, documentation, and the like), including but not limited to any enhanced security features added by ST, are provided on an "AS IS" BASIS. AS SUCH, TO THE EXTENT PERMITTED BY APPLICABLE LAW, ST DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, unless the applicable written and signed contract terms specifically provide otherwise.



## Revision history

**Table 6. Document revision history**

Date	Version	Changes
03-Mar-2023	1	Initial release.
28-Jul-2023	2	Updated <a href="#">Features</a> and <a href="#">Sensitive GPIOs</a> . Added certification logos on cover page. Updated <a href="#">Figure 4</a> . STM32WB1MMC module pinout: bottom view. Added <a href="#">Section 11.5</a> : JRF certification. Minor text edits across the whole document.
05-Sep-2023	3	Updated document title and image on cover page. Updated <a href="#">Features</a> and <a href="#">Section 2</a> : Description.
26-Jan-2024	4	Updated <a href="#">Features</a> , <a href="#">Section 11.3</a> : FCC certification, and <a href="#">Section 11.4</a> : ISED certification. Removed former <a href="#">Section 11</a> : Tape and reel.
19-Jun-2024	5	Updated <a href="#">Features</a> and <a href="#">Section 11</a> : Certifications. Added Taiwan certification logo on cover page. Added <a href="#">Section 11.6</a> : NCC certification and <a href="#">Section 12</a> : Important security notice.
09-Jul-2024	6	Updated <a href="#">Features</a> and <a href="#">Section 11</a> : Certifications. Updated Taiwan certification logo and added Korean certification logo on cover page. Updated <a href="#">Section 11.6</a> : NCC certification. Added <a href="#">Section 11.7</a> : KC certification.
16-Aug-2024	7	Updated <a href="#">Features</a> . Added <a href="#">Section 11.8</a> : SRRC certification.

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