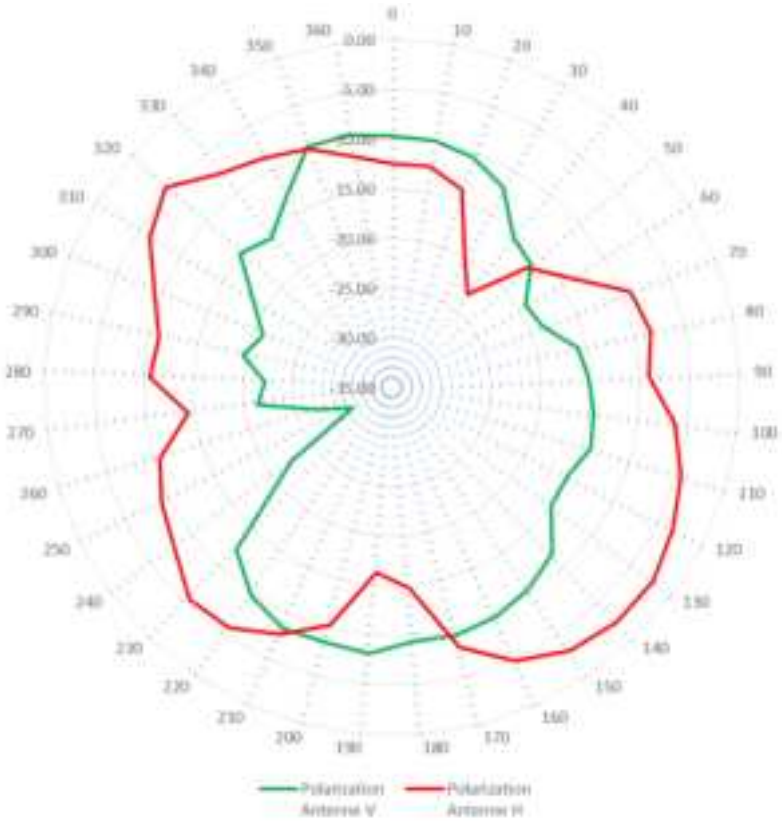
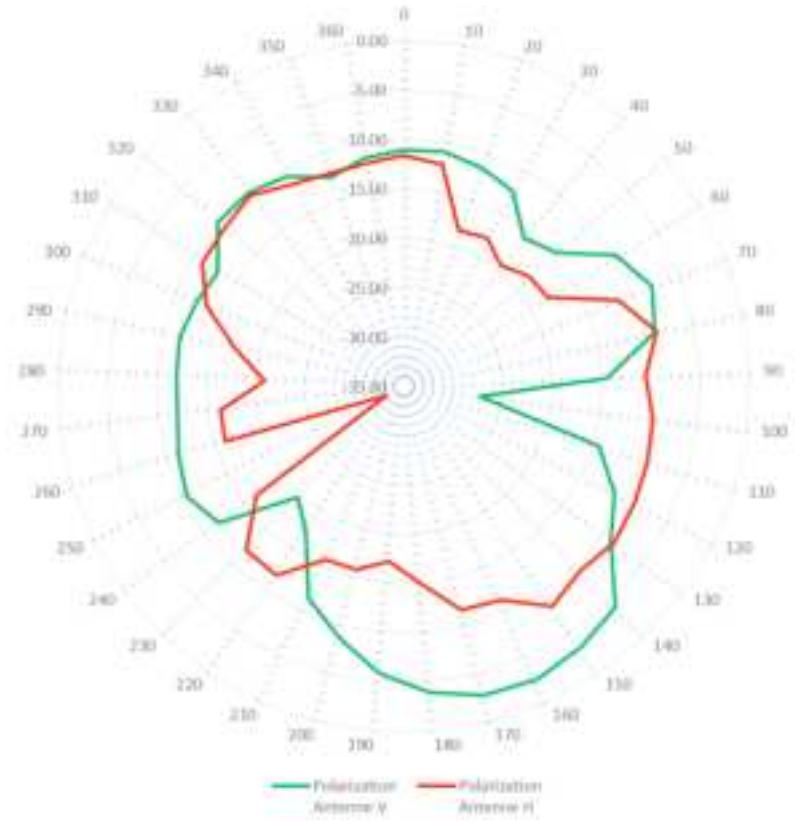
Figure 13. Antenna radiation patterns

XY axis



Z axis



8 Thermal characteristics

The thermal characteristics of the STM32WB5MMG are defined below and the constant values are given in Table 4 where:

- $\Theta_{JA,}$ is the junction-to-ambient thermal resistance (EIA/JESD51-2 and EIA/JESD51-6).
  Θ_{JA} represents the resistance to the heat flows from the chip to ambient air. It is an indicator of package heat dissipation capability. Lower $\Theta_{JA,}$ means better overall thermal performance and 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.
- Ψ_{JT} is the junction-to-top-center thermal characterization parameter (EIA/JESD51-2 and EIA/JESD51-6).
  Ψ_{JT} is used for estimating the junction temperature by measuring T_T in an actual environment and is calculated as follows:
  $\Psi_{JT} = (T_J - T_T) / P_H$
  where T_T = temperature at the top-center of the package.
- Θ_{JC} is the junction-to-case thermal resistance.
  Θ_{JC} represents the resistance to the heat flows from the chip to package top case. Θ_{JC} is important when external heat sink is attached on package top and is calculated as follows:
  $\Theta_{JC} = (T_J – T_C) / P_H$
  where T_C = case temperature attached with a cold plate.
- Θ_{JB} is the junction-to-board thermal resistance (EIA/JESD51-8).
  Θ_{JB} represents the resistance to the heat flows from the chip to PCB. Θ_{JB} is used in compact thermal models for system-level thermal simulation and 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. STM32WB5MMG thermal characteristics

Symbol	T_J(°C)	T_T(°C)	Ψ_{JT}(°C/W)	Θ_{JA}(°C/W)	Θ_{JB}(°C/W)	Θ_{JC}(°C/W)
Value	97.36	96.98	0.38	37.36	24.58	16.21

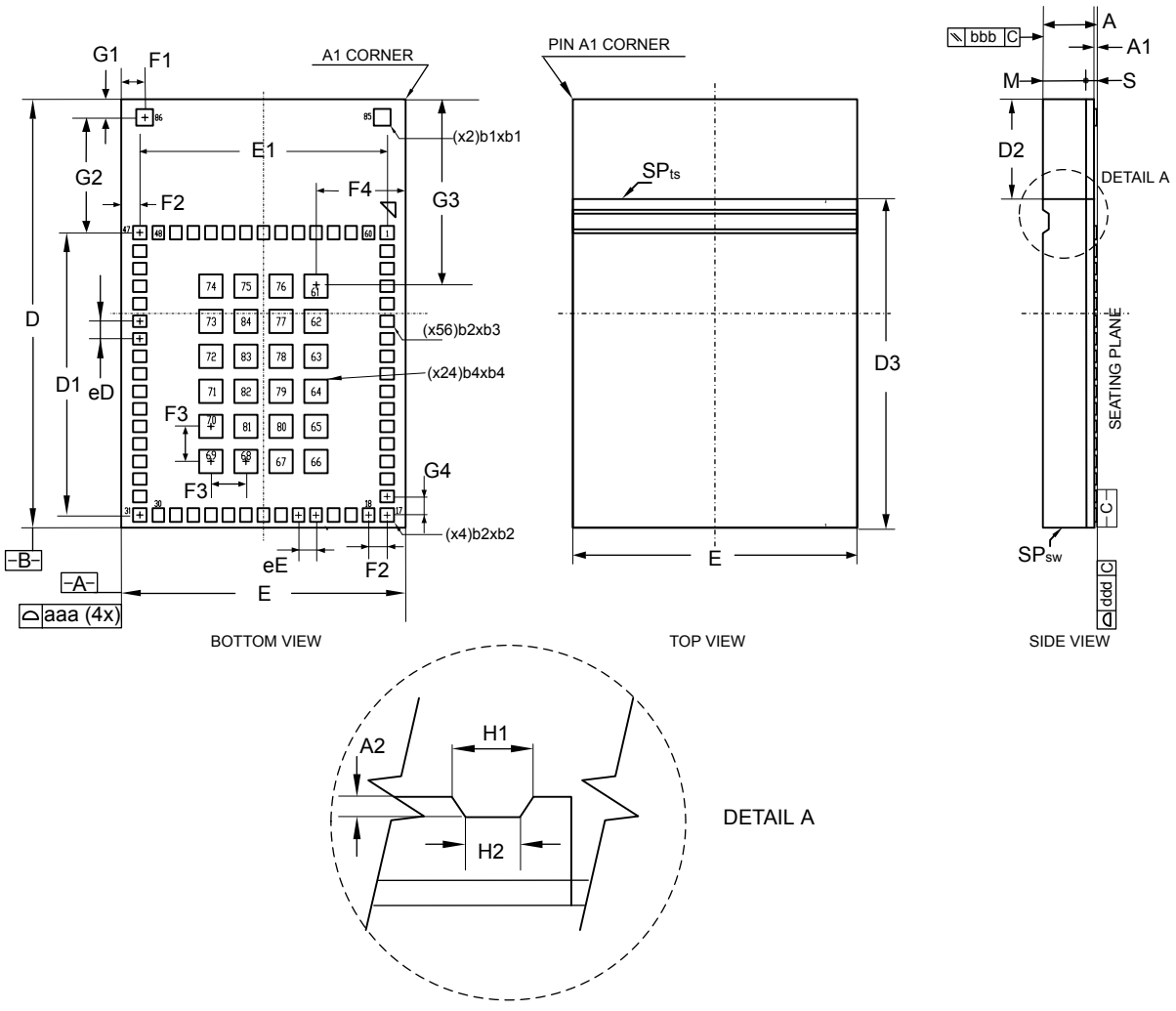
9 Package information

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. ECOPACK is an ST trademark.

9.1 SiP-LGA86 package information

This SiP-LGA is a 86 pin, 7.3 x 11mm, system in package land grid array package.

Figure 14. SiP-LGA86 - Outline



1. *Drawing is not to scale.*

Table 5. SiP-LGA86 - Mechanical data

Symbol	Description	Min	Typ	Max	Unit
A	Total thickness		1.382±0.046		mm
A1	Pre-solder		40±20[1]		µm
			30±20[2]		
A2	-		0.150		mm
M	Mold thickness		1.100		mm
S	Substrate thickness		0.242		
D	Body length	10925	11.000	11.075	
D1	Lead pitch length		7.250		
D2	-		2.563		
D3	-		8.438		
eD	Lead pitch length		0.450		
E	Body width	7.225	7.300	7.375	
eE	Lead pitch width		0.450		
b1	-		0.430		
b2	-		0.350		
b3	-		0.300		
b4	-		0.600		
F1	-		0.600		
F2	-		0.475		
F3	-		0.900		
F4	-		2.300		
G1	-		0.465		
G2	-		2.960		
G3	-		4.800		
G4	-		0.475		
H1	-		0.600		mm
H2	-		0.400		mm
SP_{ts}[3]	Top surface sputter	3	-	6	µm
SP_{sw}[4]	Side wall sputter	1	-	3	µm
aaa	Package edge tolerance		0.075		mm
bbb	Mold flatness		0.100		
ddd	Coplanarity		0.100		

1. *Peripheral pads*
2. *Inner pads*
3. *Top surface sputter*
4. *Side wall sputter*

9.2 Board design

For information and recommendations related to board design, landing pads, stencils and the solder reflow profile for LGA packages, refer to *Guidelines for design and board assembly of land grid array packages* (AN 5886).

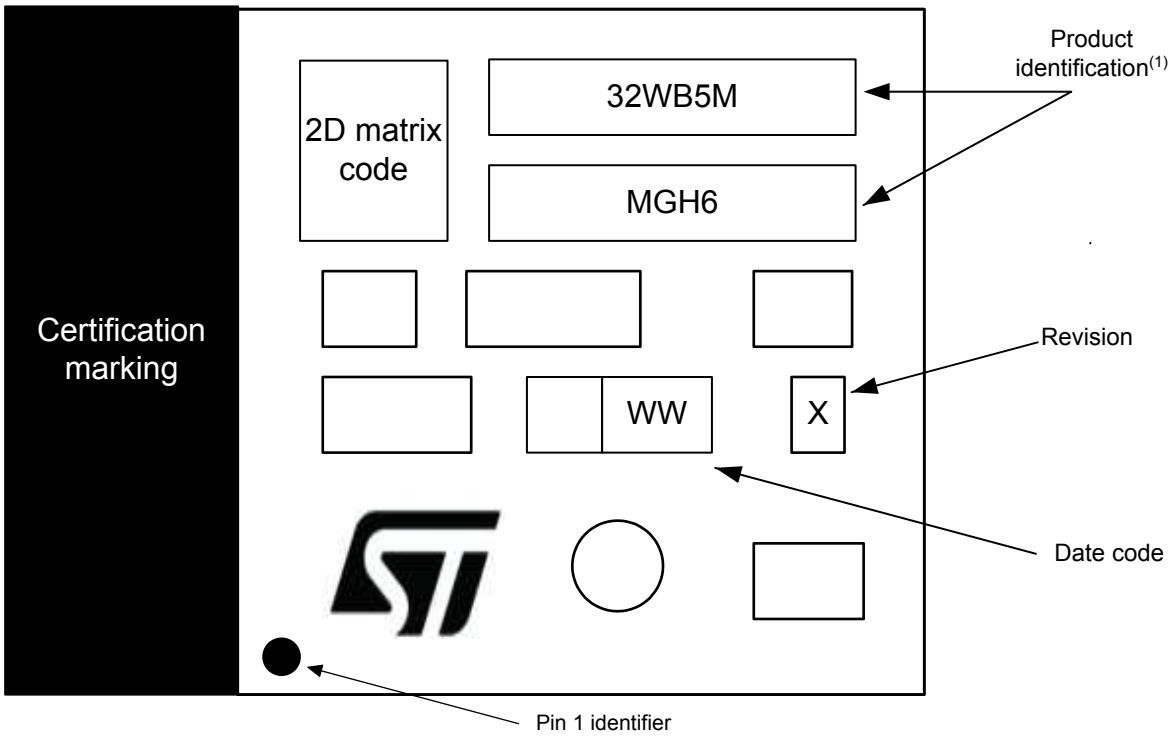
9.3 Device marking for SiP-LGA86

The following figure gives an example of topside marking versus pin 1 position identifier location.

The printed markings may differ depending on the supply chain.

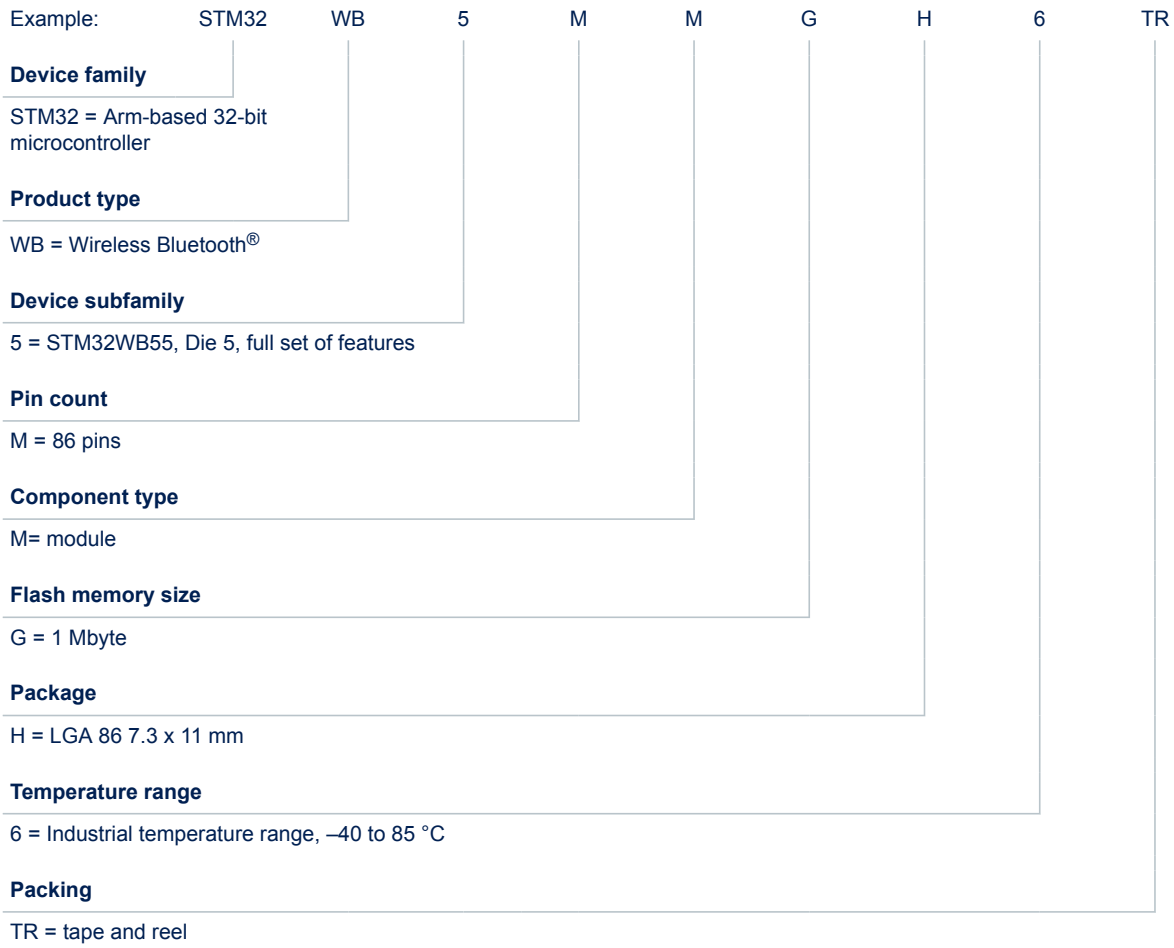
Other optional marking or inset/upset marks, which depend on supply chain operations, are not indicated below.

Figure 15. SiP-LGA86 marking example



1. 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.

10 Ordering information



Note: 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 Certification

The STM32WB5MMG module certifications status is detailed in the table below:

Table 6. Certification status

Certification		Revision Y	Revision X
Bluetooth Low Energy	RF-PHY	X	X
802.15.4 (Zigbee)	RF-PHY	X	X
EU	RED	X	X
USA	FCC	X	X
Canada	ISED-PCB	X	X
China	SRRC	Pending	X
Japan	JRF	X	X
Korea	KC or MSIP	X	X
Taiwan	NCC	X	X
EU	ROHS	X	X
EU	REACH	X	X
Russia	GOST	X	Pending

The following sections detail some of the module certifications from sample regions.
All certifications reports are available on STM32WB5MMG page.

11.1 BLE(RF_PHY) certification

The STM32WB5MMG module has obtained BLE RF_PHY certification.
The module is published under BLE SIG web site.

11.2 CE certification

The STM32WB5MMG module has obtained CE certification.
The module is provided with CE marking.

Figure 16. CE certification logo

11.3 UKCA certification

The STM32WB5MMG module has obtained UKCA certification.

The module is provided with UKCA marking.

Figure 17. UKCA certification logo

11.4 FCC certification

The STM32WB5MMG module complies with part 15 of the FCC Rules.

The FCC ID is YCP-STM32WB5M001 for version Y, and YCP-32WB5MMGH02 for version X.

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.

11.5 ISED certification

The STM32WB5MMG module has been tested and found compliant with the ISED RSS-247 and RSS-Gen rules. The IC ID is 8976A-STM32WB5M01 for version Y and 8976A-32WB5MMGH02 for version X .

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.

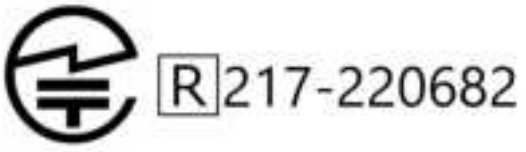
11.6 JRF certification

The STM32WB5MMG is certified in Japan with certification number:

- 005-102490 for rev Y
- 217-220682 for rev X.

The JRF logo is the following:

Figure 18. JRF certification logo



11.7 NCC certification

The STM32WB5MMG rev X is certified in Taiwan with NCC certification number: CCAJ23LP3C40T2.

The STM32WB5MMG rev Y is certified in Taiwan with NCC certification number: CCAN20LP0740T3.

Figure 19. NCC certification logo

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。

系統廠商應於平台上標示「本☐ 品 ☐ 含射頻模組：圖片 XXXyyyLPDzzzz-x」字樣

For low-power radio frequency equipment that has obtained certification, companies, firms or users are not allowed to change the frequency, increase the power, or change the characteristics and functions of the original design without approval. The use of low-power radio-frequency equipment must not affect flight safety and interfere with legal communications; if any interference is found, it should be stopped immediately, and it can only be used after improvement to no interference. The aforementioned legal communication refers to radio communication operated in accordance with the provisions of the Telecommunications Management Act. Low-power radio frequency equipment must endure the interference of legal communication or industrial, scientific and medical radio wave radiation electrical equipment. System manufacturers should mark the words "This product contains a radio frequency module: XXXyyyLPDzzzz-x" on the platform.

11.8 SRRC certification

The module STM32WB5MMG has received regulatory approval in China (SRRC) with CMIIT ID 2023DP14302.

11.9 KC certification

Applicant : STMicroelectronics SAS
Equipment Name: 특정소출력 무선기기(무선데이터통신시스템용 무선기기)
Basic Model Number: STM32WB5MMGH
Certification No.: R-R-2AS-32WB5MMGH002
Manufacturer / Country of Origin: STMicroelectronics SAS / France
Date of manufacture: notation separately

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) and/or Security Evaluation standard for IoT Platforms (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 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 7. **Document revision history**

Date	Revision	Changes
12-Nov-2020	1	Initial release.
16-Jul-2021	2	Added: • Power supply • SMPS • Clocks • Antenna • Two layer reference board design • BLE(RF_PHY) certification Updated: • Features • Figure 1. STM32WB5MMG module block diagram • Section 3.3: Clocks • Section 5: Pin description • STM32WB5MMG pin/ball definition • Section 6.2.2: Enclosure effects • Figure 8. Four layer reference board schematics • Section 7.4: Antenna radiation patterns and efficiency • Section 9.1: SiP-LGA86 package information • Section 11: Certification • Section 11.1: BLE(RF_PHY) certification
09-Nov-2022	3	Added: • Section 3.1: Versions • Section 3.5: One time programming (OTP) • Figure 8. Four layer reference board schematics for version X • Figure 9. Four layer PCB layout for version X • Figure 10. Two layer reference board schematics for version X • Figure 11. Two layer PCB layout for version X • Section 11.3: UKCA certification • Section 11.9: KC certification • Section 12: Important security notice Updated: • Cerfication images • Bluetooth Bluetooth® Low Energy protocol version support throughout the document • Document title • Section Features • Certification logo representation • Section 1: Introduction • Section 2: Description • Split Section 3: Module overview into a separate section • Section 3.1: Versions • Figure 1. STM32WB5MMG module block diagram • Section 3.2.1: SMPS • Section 3.3: Clocks • Section 5: Pin description • Table 1. STM32WB5MMG pin/ball definition • Section 6.1: Pin recommendations • Section 6.2.4: Sensitive GPIOs • Table 5. SiP-LGA86 - Mechanical data • Figure 8. Four layer reference board schematics for version Y • Figure 10. Four layer PCB layout for version Y • Figure 12. Two layer reference board schematics for version Y • Figure 14. Two layer PCB layout for version Y

Date	Revision	Changes
09-Nov-2022	3	• Section 9.3: Device marking for SiP-LGA86 – Section 9.1: SiP-LGA86 package information – Table 5. SiP-LGA86 - Mechanical data • Section 9.3: Device marking for SiP-LGA86 – Figure 15. SiP-LGA86 marking example • Figure 15. SiP-LGA86 marking example • Section 8: Thermal characteristics • Section 11: Certification • Section 11.4: FCC certification • Section 11.5: ISED certification • Section 11.6: JRF certification • Section 11.7: NCC certification Removed: Solder reflow recommendations section
01-Mar-2023	4	Updated: • Product status • Figure 1. STM32WB5MMG module block diagram • Section 5: Pin description – Figure 2. STM32WB5MMG module pinout: bottom view • Section 6.1: Pin recommendations • Section 6.2.5: Four layer reference board design – Figure 8. Four layer reference board schematics for version X • Section 6.2.6: Two layer reference board design – Figure 10. Two layer reference board schematics for version X • Section 7.4: Antenna radiation patterns and efficiency – Added Figure 13. Antenna radiation patterns • Section 9.2: Board design Removed: • "Four layer reference board schematics for version Y" figure • "Four layer PCB layout for version Y" figure • "Two layer reference board schematics for version Y" figure • "Two layer PCB layout for version Y" figure
10-Mar-2023	5	Updated: • Figure 11. Two layer PCB layout for version X • Section 3.2: Power supply • Section 5: Pin description
21-Sep-2023	6	Updated: • Title • Figure 8. Four layer reference board schematics for version X • Figure 10. Two layer reference board schematics for version X • References to DS11929
26-Feb-2024	7	Updated: • Figure 13. Antenna radiation patterns • Table 6. Certification status • Section 11.4: FCC certification • Section 11.5: ISED certification • Section 11.7: NCC certification • Section 11.8: SRRC certification Removed Tape and reel packing

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