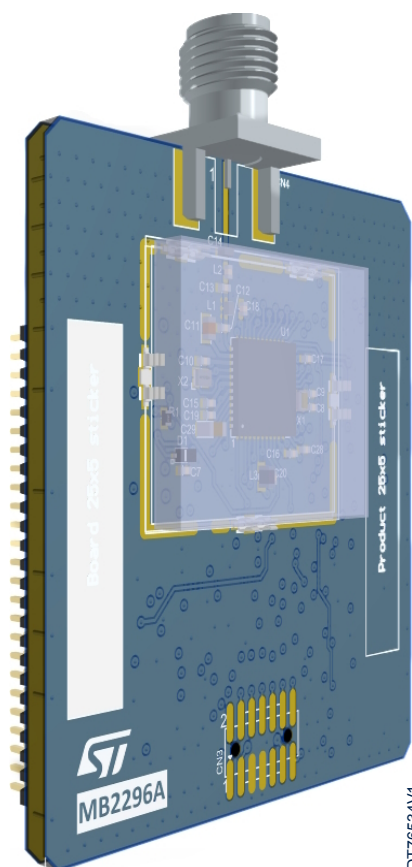


Reference designs for STM32WBA6xxx microcontrollers



STDES-WBA6I8DA0 view. Designs with different references show different layouts. Picture is not contractual. PCB color may differ.

Features

Includes ST state-of-the-art patented technology

Reference design

- Microcontroller RF board

Microcontroller

- STM32WBA6xxx microcontrollers in a variety of packages
- 2.4 GHz transceiver supporting Bluetooth® specification v5.4
- Dedicated Arm® Cortex®-M0+ processor for real-time radio layer

Connectors

- Two 50-pin miniboard headers
- ST-LINK 14-pin STDC14
- RF SMA for antenna

Power supply

- ST-LINK USB V_{BUS} through the mezzanine board (MB1801).

Debugging/Programming

- Suitable for ST-LINK/V2 and STLINK-V3 debuggers/programmers with USB re-enumeration capability through the mezzanine board: mass storage, Virtual COM port, and debug port

Software

- Comprehensive free software libraries and examples available with the [STM32CubeWBA MCU Package](#)
- Support of a wide choice of Integrated Development Environments (IDEs) including IAR Embedded Workbench®, MDK-ARM, and STM32CubeIDE

Description

The main objective of the STM32WBA6xxx microcontroller reference designs is to recommend a layout and associated BOM for dedicated applications (these boards are not for sale).

These reference designs can be manufactured from files available for download from the www.st.com website. The access to all GPIOs allows the prototyping of a complete application.

Sensitive layout parts can be extracted and pasted in any user board design with the same PCB characteristics and feature set.

The STM32WBA6xxx microcontroller reference designs are provided with the STM32WBA comprehensive software HAL library. The [STM32CubeWBA MCU Package](#) contains many software examples developed with the NUCLEO-WBA65RI Nucleo-64 board. These examples can be easily adapted for the STM32WBA6xxx microcontroller reference designs.

Product status
STDES-WBA6xxxxx
STDES-WBA6I8D51, STDES-WBA6I8DA0, STDES-WBA6U4DA0

1 General information

The STM32WBA6xxx microcontroller reference designs run the Bluetooth® LE stack on STM32WBA6xxx microcontrollers based on the Arm® Cortex®-M0+ processor.

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

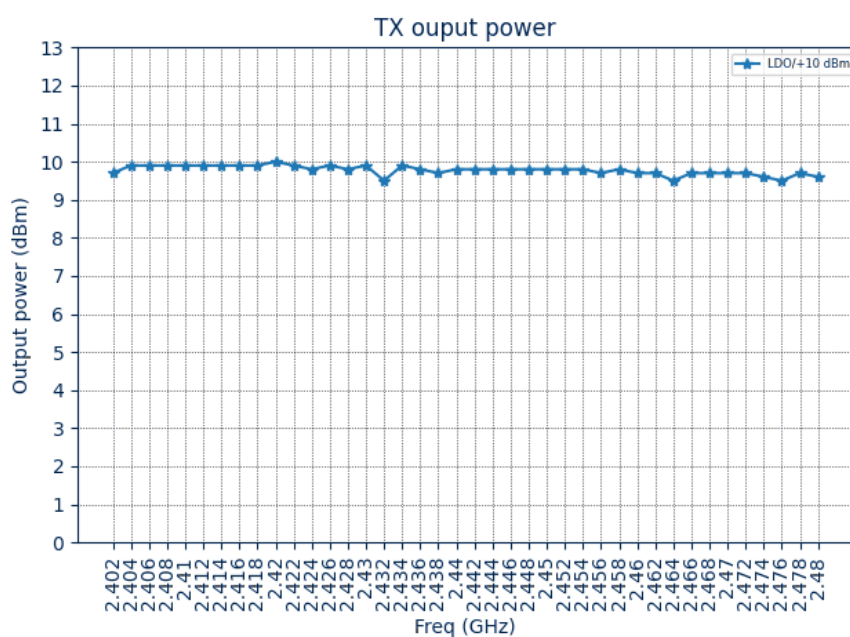


2 Main features

2.1 STM32WBA6xxx MCUs Tx power

The transmitter high output power is programmable up to +10 dBm.

Figure 1. Tx power measurement example



DT76535V1

Figure 1 is not contractual. Measurement results might vary with different designs, different measurement conditions, or both.

2.2 STM32WBA6xxx MCUs Rx sensitivity

The sensitivity is about -94 dBm at 1 Mbit/s and about -92 dBm at 2 Mbit/s.

Figure 2. Rx sensitivity measurement example

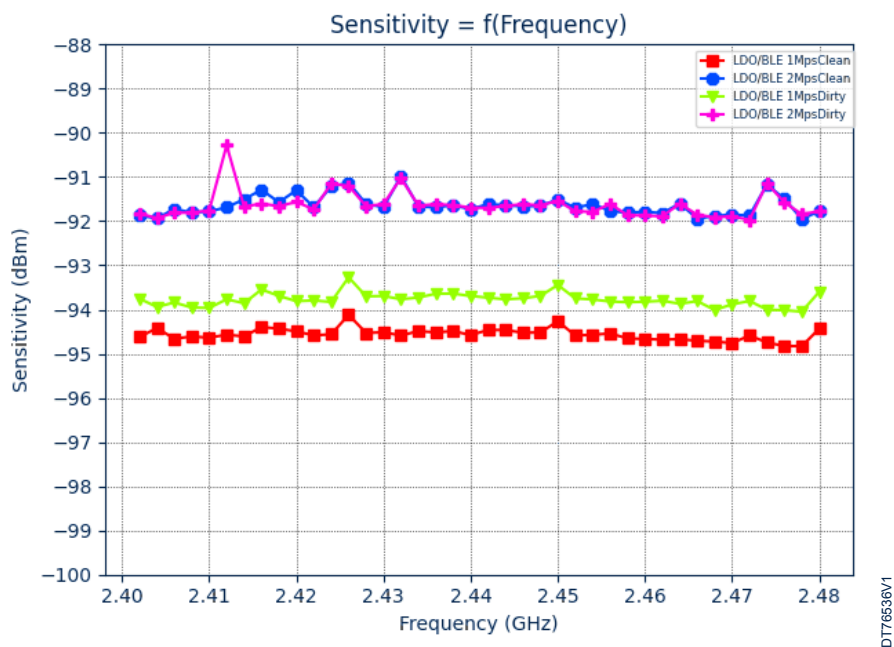


Figure 2 is not contractual. Measurement results might vary with different designs, different measurement conditions, or both.

3 Boards overview

3.1 Printed circuit boards

The STM32WBA6xxx reference designs are based on four or eight-layer PCBs with an FR4 substrate. Table 1 details the type of PCB used for each reference design.

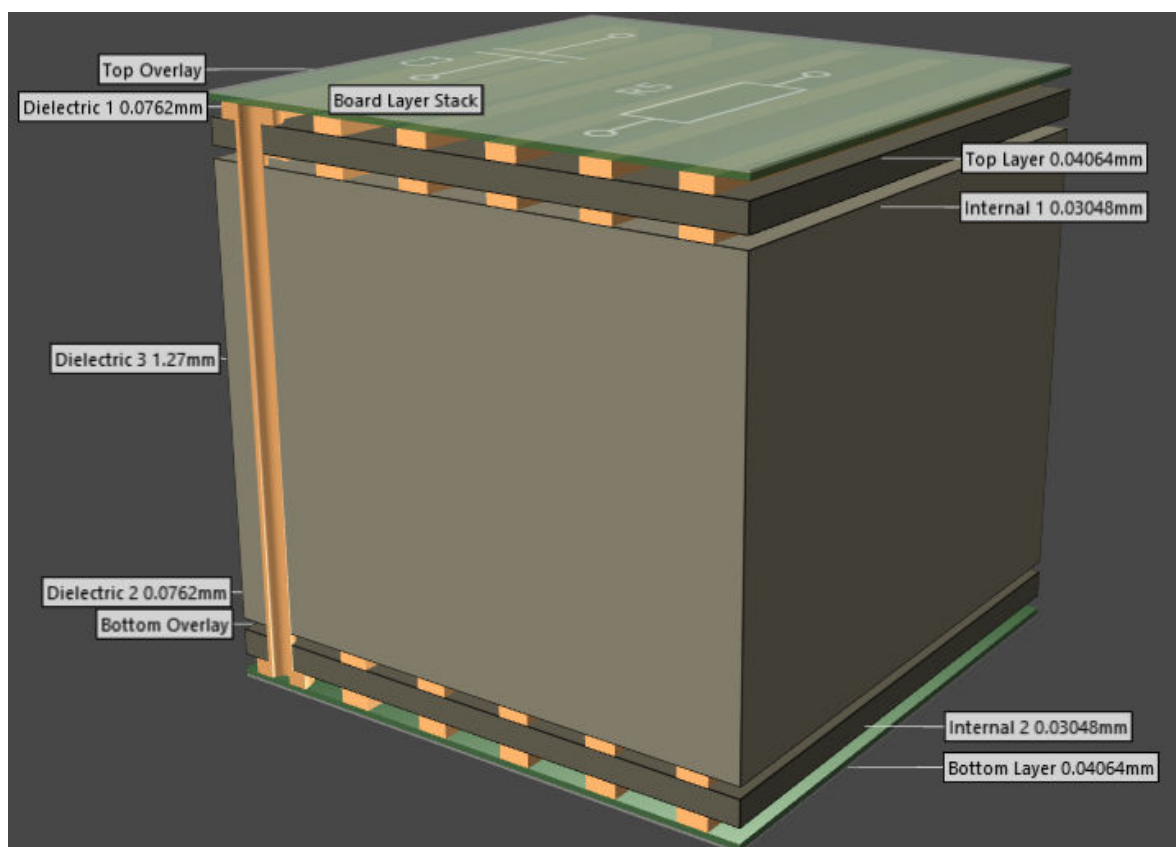
Table 1. STM32WBA6xxx microcontroller reference designs

Web reference	Board reference	Number of layers	Substrate	Vias	Thickness
STDES-WBA6I8D51	MB2327	8	FR4	Plated through holes and hidden vias	1.6 mm
STDES-WBA6I8DA0	MB2371	8	FR4	Plated through holes and hidden vias	1.6 mm
STDES-WBA6U4DA0	MB2296	4	FR4	Plated through holes	1.6 mm

3.2 Stacking

3.2.1 Four-layer PCB

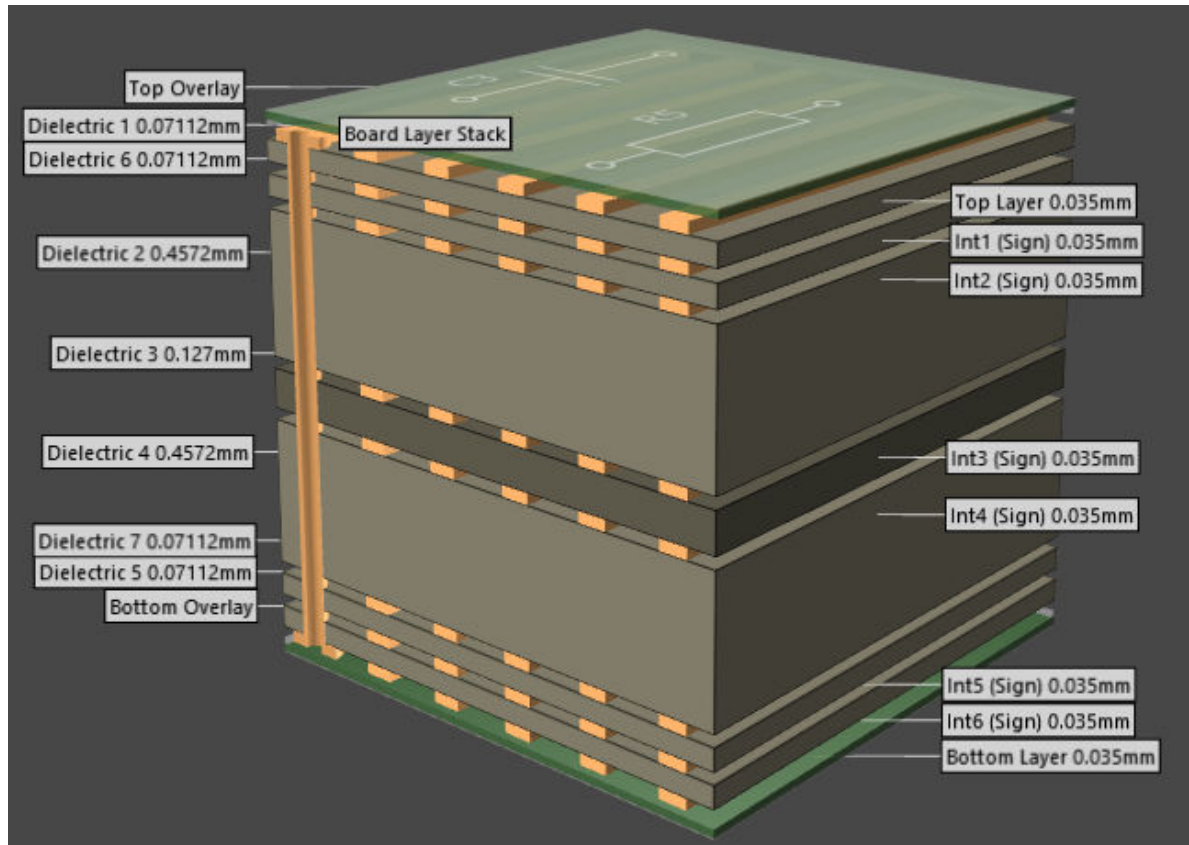
Figure 3. Stacking definition of the four-layer PCB



DT76557V1

3.2.2 Eight-layer PCBs

Figure 4. Stacking definition of the eight-layer PCBs



DT7656V1

3.3 RF path: 50-ohm coplanar line

3.3.1 Four-layer PCB

On the reference design, the coplanar line is not referenced to layer 2 but to layer 3. Due to the small thickness of the prepreg between layer 1 and layer 2, the accuracy of the lithography is essential. By using layer 3 as a reference, these constraints are alleviated.

Figure 5. Four-layer PCB coplanar line

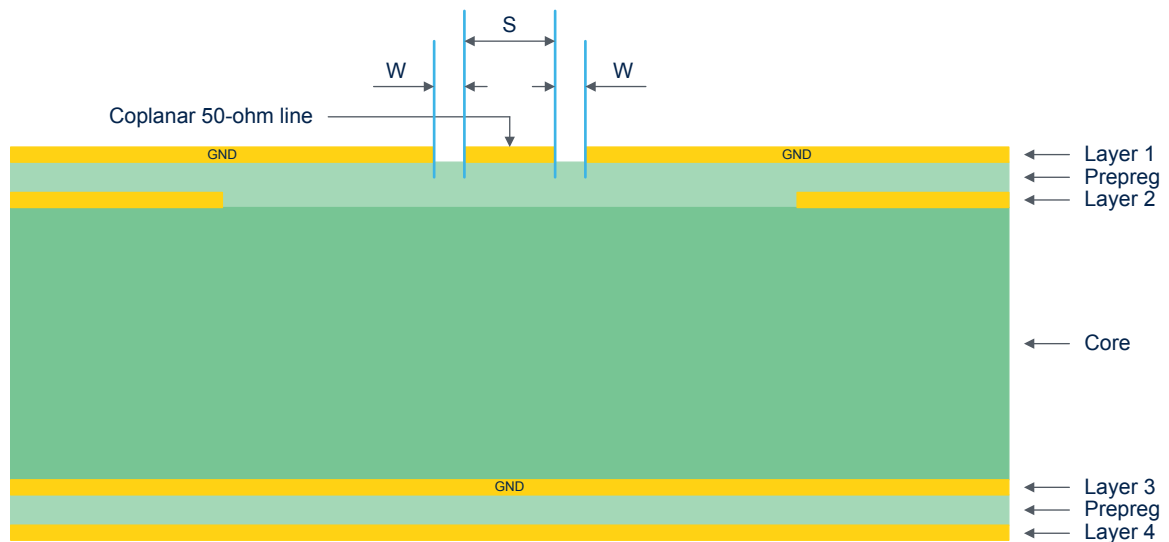


Table 2. Four-layer PCB coplanar line

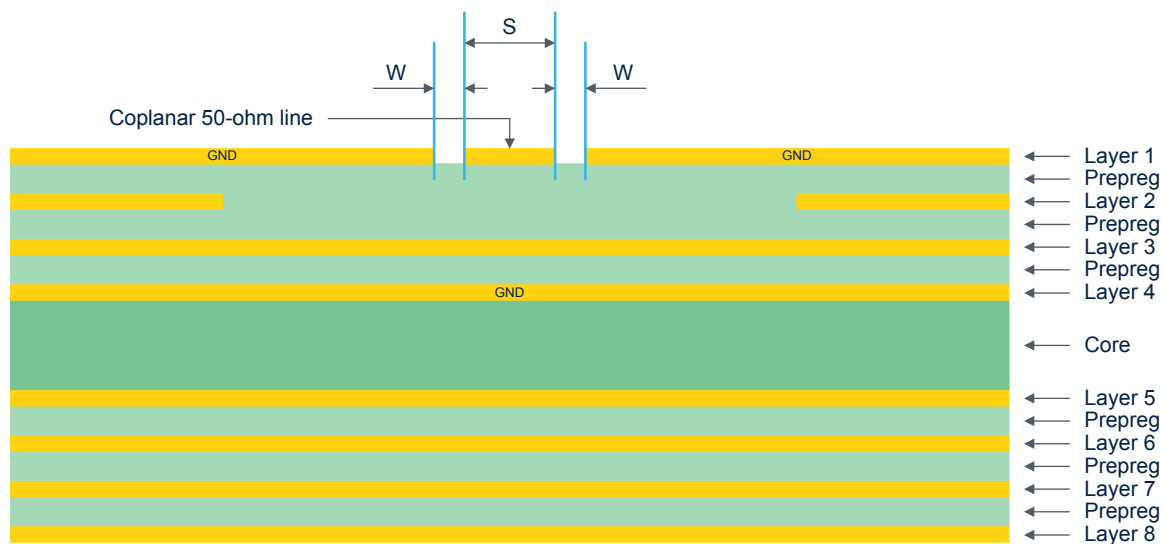
Dimension	Value
S	0.45 mm
W	0.13 mm

Note: These values account for all variations introduced by the PCB manufacturer, including lithography and materials. A detailed study is necessary for each PCB manufacturer to ensure correct impedance values and stability in long-term production.

3.3.2 Eight-layer PCBs

On the reference designs, the coplanar line is not referenced to layer 2 but to layer 4. Due to the small thickness of the prepreg between layer 1 and layer 2, the accuracy of the lithography is essential. By using layer 4 as a reference, these constraints are alleviated.

Figure 6. Eight-layer PCBs coplanar line



DT7650V1

Table 3. Eight-layer PCBs coplanar line

Dimension	Value
S	0.480 mm
W	0.127 mm

Note: These values account for all variations introduced by the PCB manufacturer, including lithography and materials. A detailed study is necessary for each PCB manufacturer to ensure correct impedance values and stability in long-term production.

3.4 Top views

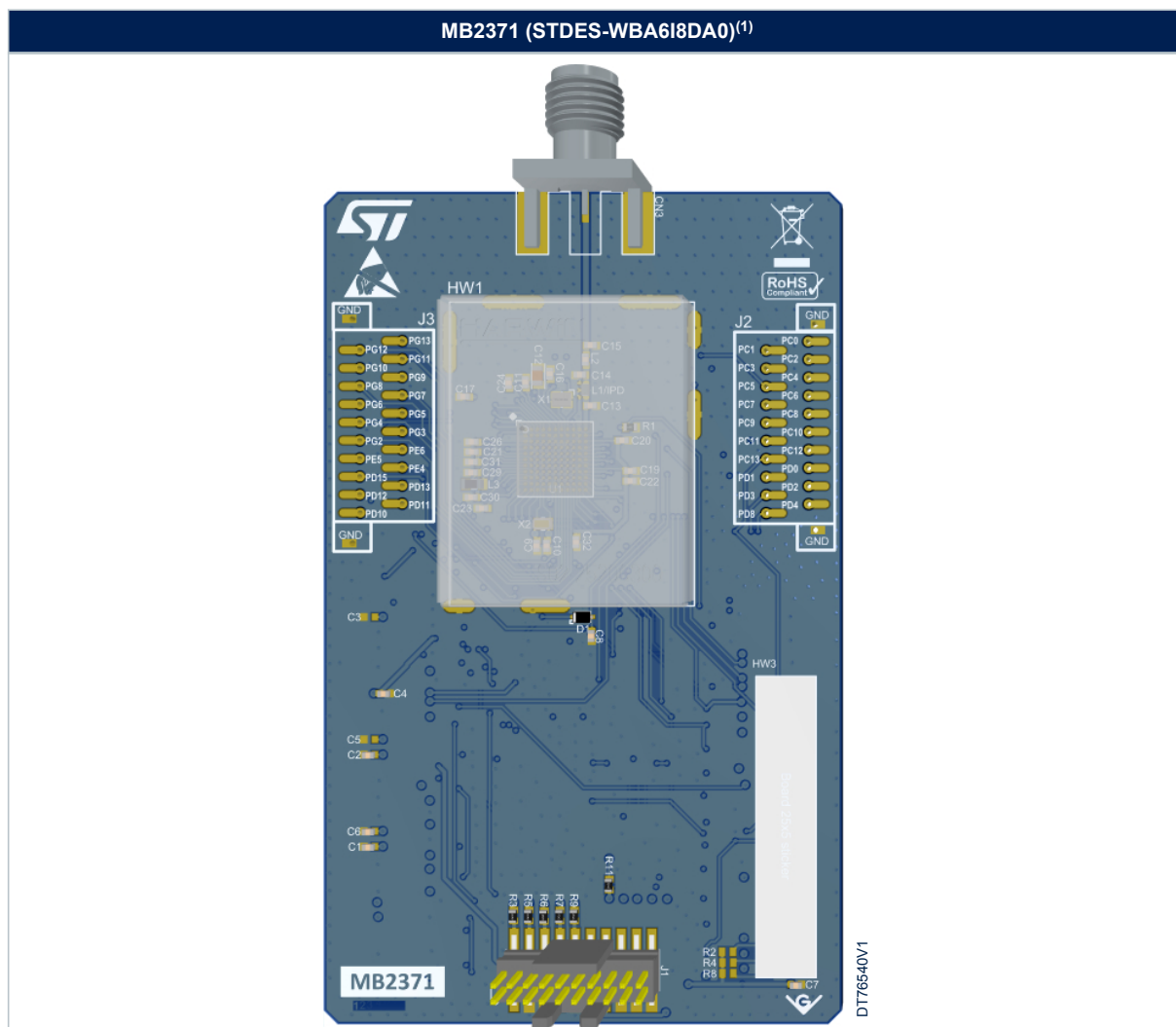
The STM32WBA6xxx reference designs include various STM32WBA6xxx packages. Table 4 and Table 5 present the board top views of the different STM32WBA6xxx reference designs.

Table 4. Top view examples (1 of 2)

The image displays two evaluation boards side-by-side. The left board is the MB2296, which has a STM32 Nucleo microcontroller and a 25x5 sticker. The right board is the MB2327, which also has a STM32 Nucleo microcontroller and a 25x5 sticker. Both boards are blue PCBs with various components and connectors. The MB2296 board has a 25x5 sticker and a 25x5 sticker. The MB2327 board has a 25x5 sticker and a 25x5 sticker.

1. *Picture is not contractual.*

Table 5. Top view examples (2 of 2)



1. Picture is not contractual.

4 STM32WBA6xxx microcontroller reference designs and codification

Table 6. STM32WBA6xxx microcontroller reference designs

Web reference	Board reference	MCU order code	MCU package	Number of layers	SMD or IPD
STDES-WBA6I8D51	MB2327	STM32WBA65PII6	UFBGA121	8	SMD
STDES-WBA6I8DA0	MB2371	STM32WBA62PII6	UFBGA121	8	SMD
STDES-WBA6U4DA0	MB2296	STM32WBA62CIU6	UFQFPN48	4	SMD

Table 7. STM32WBA6xxx microcontroller reference designs codification

Example:	STDES-	WBA6	I	8	D	A0
Device family						
STDES- = STMicroelectronics reference design						
Wireless product						
WBA6 = Wireless Bluetooth® STM32WBA6xxx microcontrollers						
Wireless microcontroller package						
I = UFBGA121 U = UFQFPN48						
Number of layers						
4 = Four layers 8 = Eight layers						
Antenna matching and path connection to antenna						
D = Discrete components with direct tie						
Output power mode or power supply mode						
A0 = 10 dBm, LDO 51 = 5 dBm, SMPS						

Note: The STM32WBA6xxx microcontroller reference designs do not include the dedicated integrated passive device (IPD) for optimized matching, filtering, and balun. Consequently, the codification scheme omits the character related to the IPD implementation.

5 Hardware layout and configuration

5.1 EDA resources

All board design resources, including schematics, EDA databases, manufacturing files, and the bill of materials, are available from the corresponding product page at www.st.com.

5.2 Integrated passive device (IPD)

- STMicroelectronics develops integrated passive device (IPD) companion chips for optimized matching, filtering, and balun (see the [MLPF-WB-04D3](#) datasheet for details).
- The IPD is an all-in-one very compact solution covering each package.

5.3 Solder bridges

The reference designs can be configured to meet the specific requirements of the application. Refer to the board schematics for details.

Table 8. Solder bridge configurations

Solder bridge function	Board reference			Solder bridge state	Description
	MB2296	MB2327	MB2371		
LSE control (32.768 kHz)	SB37/SB38	SB38/SB40	SB38/SB40	ON	LSE provided by external 32.768 kHz LSE CLK
				OFF	LSE not provided by external 32.768 kHz LSE CLK
HSE control (32 MHz)	SB39/SB40	SB37/SB39	SB37/SB39	ON	HSE provided by external 32 MHz HSE CLK
				OFF	HSE not provided by external 32 MHz HSE CLK
PA power supply LDO	SB6	SB41 ⁽¹⁾	SB42	ON ⁽²⁾	RF PA power supply 3V3
PA power supply SMPS	-	SB42 ⁽¹⁾	-	ON ⁽²⁾	RF PA power supply SMPS

1. SB41 and SB42 are mutually exclusive. Only one of these solder bridges must be ON at a time on MB2327.

2. The RF PA is not powered when the solder bridge is OFF.

6 **Firmware programming**

To download firmware, it is enough to connect a serial-wire debug port from an external probe. For example, the [STLINK-V3SET](#) through the MB1801 mezzanine board can be used to perform the connection easily.

7 Transparent mode and UART pins

To test the RF performance using the transparent mode firmware, a UART must be connected. The DUT UART Rx and Tx pins are indicated on the CN1 connector of both the miniboard and the mezzanine board (MB1801):

- Pin 45 VCP1_RX (GPIO23)
- Pin 47 VCP1_TX (GPIO24)

For more information about how to use the transparent mode firmware for performance measurements, refer to the *RF test panel* section of the user manual *STM32CubeMonitor-RF software tool for wireless performance measurements* ([UM2288](#)).

Table 9. UART Rx and Tx

UART	Board reference		
	MB2296	MB2327	MB2371
Virtual COM port 1	Rx: GPIO23 Tx: GPIO24	Rx: GPIO23 Tx: GPIO24	Rx: GPIO23 Tx: GPIO24

8 Conventions

Table 10. Conventions for solder bridges

Convention	Definition
Solder bridge SBx ON	SBx connections closed by 0 Ω resistor
Solder bridge SBx OFF	SBx connections left open

Revision history

Table 11. Document revision history

Date	Revision	Changes
24-Apr-2025	1	Initial release.

Contents

1	General information	2
2	Main features	3
2.1	STM32WBA6xxx MCUs Tx power	3
2.2	STM32WBA6xxx MCUs Rx sensitivity	4
3	Boards overview	5
3.1	Printed circuit boards	5
3.2	Stacking	5
3.2.1	Four-layer PCB	5
3.2.2	Eight-layer PCBs	6
3.3	RF path: 50-ohm coplanar line	7
3.3.1	Four-layer PCB	7
3.3.2	Eight-layer PCBs	8
3.4	Top views	8
4	STM32WBA6xxx microcontroller reference designs and codification	11
5	Hardware layout and configuration	12
5.1	EDA resources	12
5.2	Integrated passive device (IPD)	12
5.3	Solder bridges	12
6	Firmware programming	13
7	Transparent mode and UART pins	14
8	Conventions	15
	Revision history	16
	List of tables	18
	List of figures	19

List of tables

Table 1.	STM32WBA6xxx microcontroller reference designs	5
Table 2.	Four-layer PCB coplanar line	7
Table 3.	Eight-layer PCBs coplanar line	8
Table 4.	Top view examples (1 of 2)	9
Table 5.	Top view examples (2 of 2)	10
Table 6.	STM32WBA6xxx microcontroller reference designs	11
Table 7.	STM32WBA6xxx microcontroller reference designs codification	11
Table 8.	Solder bridge configurations	12
Table 9.	UART Rx and Tx	14
Table 10.	Conventions for solder bridges	15
Table 11.	Document revision history	16

List of figures

Figure 1.	Tx power measurement example	3
Figure 2.	Rx sensitivity measurement example.	4
Figure 3.	Stacking definition of the four-layer PCB	5
Figure 4.	Stacking definition of the eight-layer PCBs	6
Figure 5.	Four-layer PCB coplanar line	7
Figure 6.	Eight-layer PCBs coplanar line	8

IMPORTANT NOTICE – READ CAREFULLY

STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST's terms and conditions of sale in place at the time of order acknowledgment.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of purchasers' products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. For additional information about ST trademarks, refer to www.st.com/trademarks. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2025 STMicroelectronics – All rights reserved