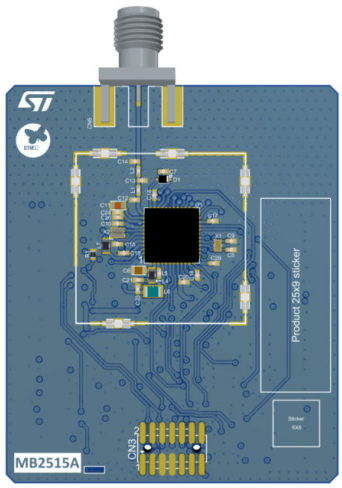
STDES-WBA2xxxxx

Data brief

Reference designs for STM32WBA2xxx MCUs



STDES-WBA2U4DSU top view. Designs with different references show different layouts. Picture is not contractual. PCB color may differ.

Product status
STDES-WBA2xxxxx
STDES-WBA2U4DSU STDES-WBA2U4DSN STDES-WBA2U4DLN STDES-WBA2T4ISU

Features

Includes ST state-of-the-art patented technology

Reference design

- Microcontroller RF board

Microcontroller

- STM32WBA2xxx microcontrollers in a variety of packages
- 2.4 GHz transceiver supporting Bluetooth® specification v6.0
- Dedicated Arm® Cortex®-M33 processor for real-time radio layer

Connectors

- Two 50-pin headers for connecting a compatible mezzanine board (MB1801)
- RF SMA connector
- STDC14 footprint for connecting an ST-LINK device

Power supply

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

Debugging/Programming

- Through the ST-LINK embedded in the mezzanine board with re-enumeration capability: 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 STM32WBA2xxx 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 STM32WBA2xxx microcontroller reference designs are provided with the STM32WBA comprehensive software HAL library. The STM32CubeWBA MCU Package contains many software examples developed with the NUCLEO-WBA25CE1 Nucleo-64 board. These examples can be easily adapted for the STM32WBA2xxx microcontroller reference designs.

1 General information

The STM32WBA2xxx microcontroller reference designs run the Bluetooth® LE stack on STM32WBA2xxx microcontrollers based on the Arm® Cortex®-M33 processor.

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2 STM32WBA2xxx microcontroller reference designs and codification

Table 1. STM32WBA2xxx microcontroller reference designs

Web reference	Board reference	MCU order number	MCU package	Number of layers	SMD or IPD	PCB characteristics
STDES-WBA2U4DSU	MB2515	STM32WBA25CEU7	UFQFPN48	4	SMD	1.6 mm FR4 with plated through holes
STDES-WBA2U4DSN	MB2301	STM32WBA23CEU7	UFQFPN48	4	SMD	1.6 mm FR4 with plated through holes
STDES-WBA2U4DLN	MB2350	STM32WBA23KEU7	UFQFPN32	4	SMD	1.6 mm FR4 with plated through holes
STDES-WBA2T4ISU	MB2439	STM32WBA25HEF7	Thin WLCSP37	4	IPD	1.6 mm FR4 with plated through holes and buried vias

Table 2. STM32WBA2xxx microcontroller reference designs codification

Example: STDES- WBA2 U 4 D SU

Device family

STDES- = STMicroelectronics reference design

Wireless product

WBA2 = Wireless Bluetooth® STM32WBA2xxx microcontrollers

Wireless microcontroller package

T = Thin WLCSP

U = UFQFPN

Number of layers

4 = Four layers

RF path configuration

D = Discrete components with direct tie

I = Connector with IPD direct tie

Configuration

SU = SMPS, USB

SN = SMPS, no USB

LN = LDO, no USB

3 Development environment

3.1 System requirements

- Multi-OS support: Windows® 10 or 11, Linux® 64-bit, or macOS®
- USB Type-A or USB Type-C® to USB Type-C® cable

Note: *macOS® is a trademark of Apple Inc., registered in the U.S. and other countries and regions.*

Linux® is a registered trademark of Linus Torvalds.

Windows is a trademark of the Microsoft group of companies.

3.2 Development toolchains

- IAR Systems® - IAR Embedded Workbench®(1)
- Keil® - MDK-ARM(1)
- STMicroelectronics - STM32CubeIDE

1. *On Windows® only.*

3.3 Demonstration software

The demonstration software, included in the STM32Cube MCU Package corresponding to the on-board microcontroller, is preloaded in the STM32 flash memory for easy demonstration of the device peripherals in standalone mode. The latest versions of the demonstration source code and associated documentation can be downloaded from *www.st.com*.

3.4 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*.

4 Conventions

Table 3 provides the conventions used for the ON and OFF settings in the present document.

Table 3. 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

5 Measurement environment

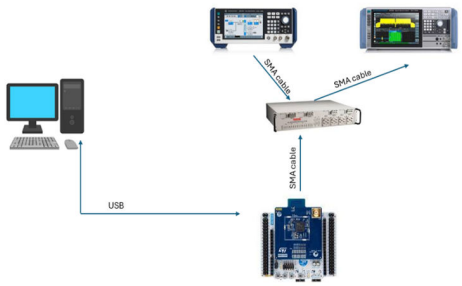
5.1 Measurement setup

The Tx and Rx measurement setup includes the following equipment:

- Spectrum analyzer R&S FSV3030
- Signal generator R&S SMBV100B
- Switch matrix Keithley S46T with SP6T 18 GHz
- PC running Windows® with Python script

Test bench loss is measured and included in the results.

Figure 1. Measurement setup



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5.2 Firmware programming

To download firmware, connect a Serial Wire Debug Port from an external probe. For example, use the STLINK-V3SET through the MB1801 mezzanine board to perform the connection.

5.3 Transparent mode and UART pins

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

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

For more information about using 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 4. UART Rx and Tx

UART	Board reference (MB1801)
Virtual COM port 1	Rx: GPIO23 Tx: GPIO24

6 Hardware layout and configuration

This section presents examples of Tx output power and Rx sensitivity measurements for each reference design. These measurements are not contractual.

For Tx, the following applies:

- Measurements are performed according to three different MCU configurations: 0 dBm, 5 dBm, and 10 dBm.
- In LDO mode, the MCU is directly supplied by the board at 3.3 V.
- In SMPS mode, the SMPS MCU feature uses the MCU low-power mode, which limits the Tx output power to 5 dBm.

This section also provides the solder bridge configuration for each reference design.

STMicroelectronics offers integrated passive device (IPD) companion chips for optimized matching, filtering, and balun functions (refer to the MLPF-WB-05D3 datasheet for further details). For optimum implementation, the use of the IPD instead of discrete matching circuitry is recommended.

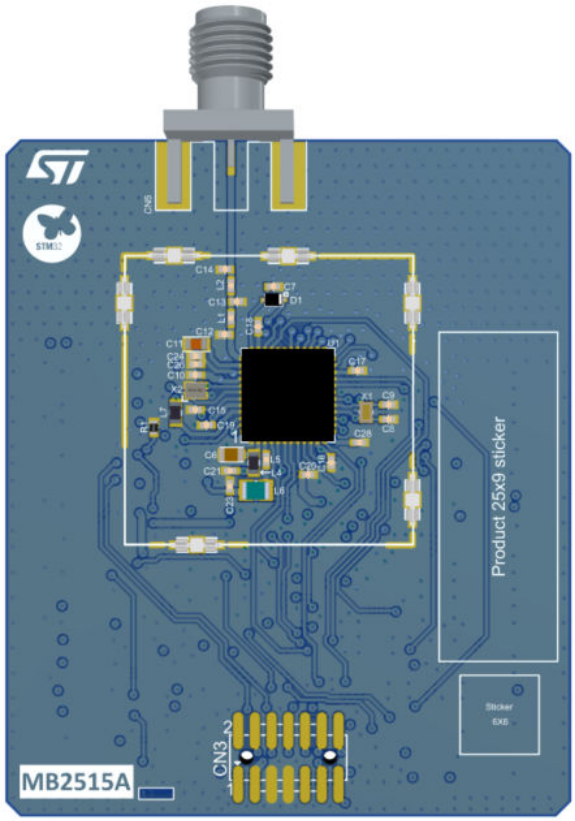
6.1 MB2515 reference board

6.1.1 Board description

The MB2515 reference board implements the STM32WBA25CEU7 UFQFPN48 package with discrete filtering.

This board can be configured in SMPS or LDO mode, depending on the solder bridge settings.

Figure 2. MB2515 top view



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Picture is not contractual.

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

6.1.2 Solder bridge configuration

Table 5. MB2515 solder bridge configurations

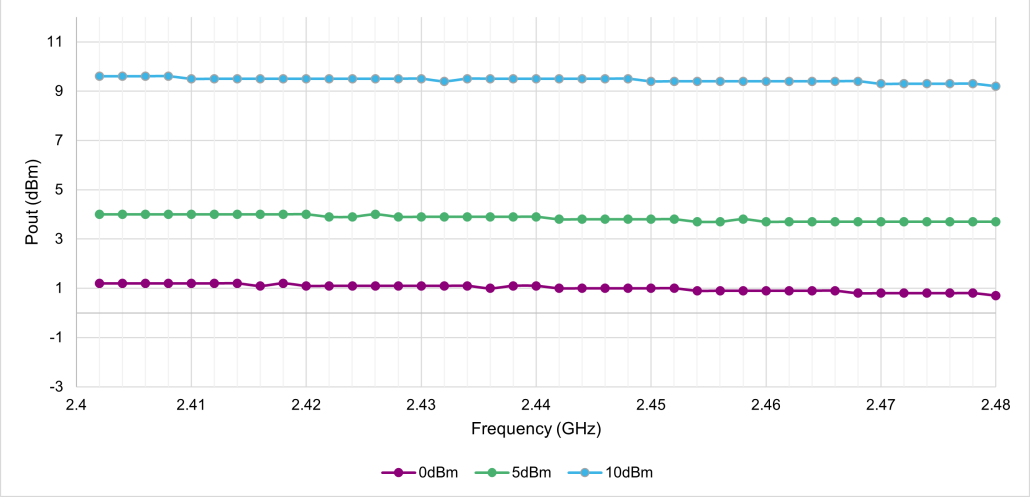
Solder bridge function	Solder bridge number	Solder bridge state	Description
LSE control (32.768 kHz)	SB37/SB38	ON	LSE provided by external 32.768 kHz LSE CLK
		OFF	LSE not provided by external 32.768 kHz LSE CLK
HSE control (32 MHz)	SB39/SB40	ON	HSE provided by external 32 MHz HSE CLK
		OFF	HSE not provided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

1. *SB6 and SB41 are mutually exclusive. Only one of these solder bridges must be ON at a time.*
2. *The RF PA is not powered when the solder bridge is OFF.*

6.1.3 Tx power measurements

For the measurements in Figure 3, MB2515 is configured in LDO mode.

Figure 3. MB2515 Tx power measurements



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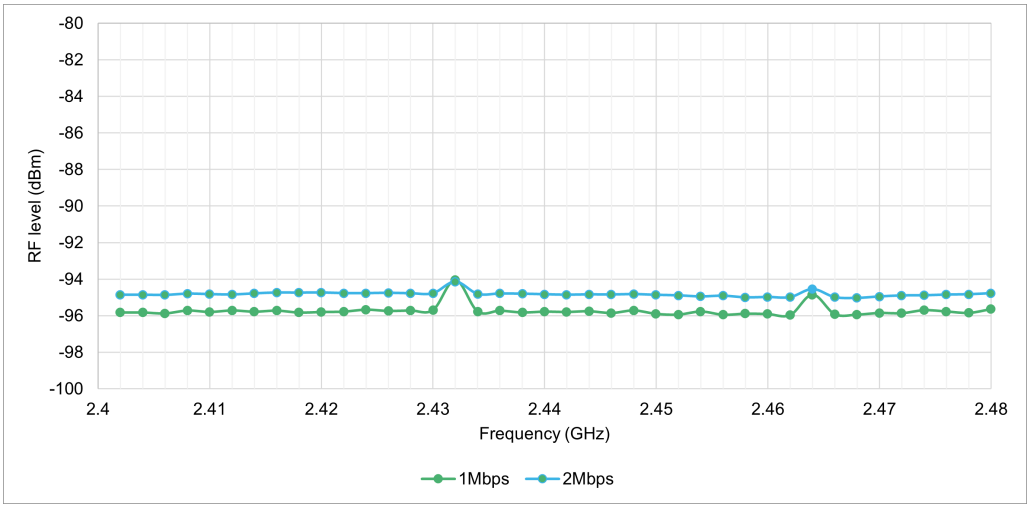
6.1.4 Rx sensitivity measurements

Figure 4. MB2515 Rx sensitivity measurements



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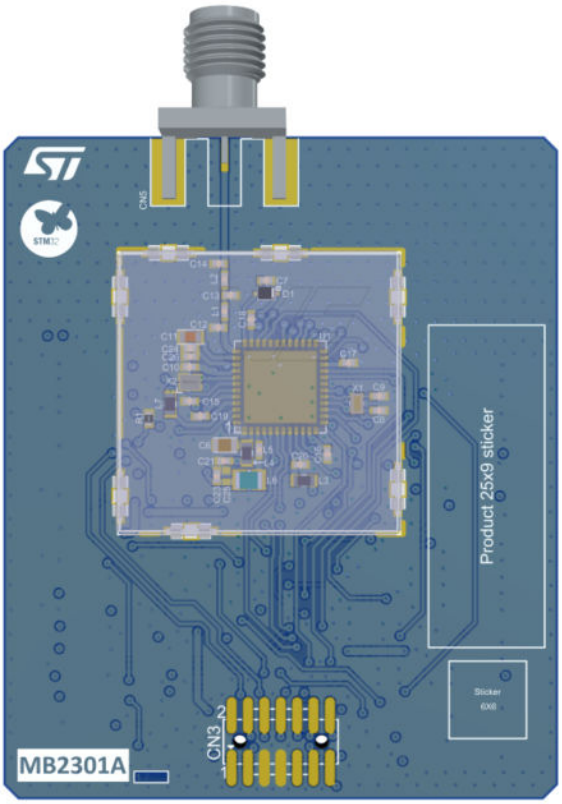
6.2 MB2301 reference board

6.2.1 Board description

The MB2301 reference board implements the STM32WBA23CEU7 UFQFPN48 package with discrete filtering. This board can be configured in SMPS or LDO mode, depending on the solder bridge settings.

Figure 5. MB2301 top view



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Picture is not contractual.

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

6.2.2 Solder bridge configuration

Table 6. MB2301 solder bridge configurations

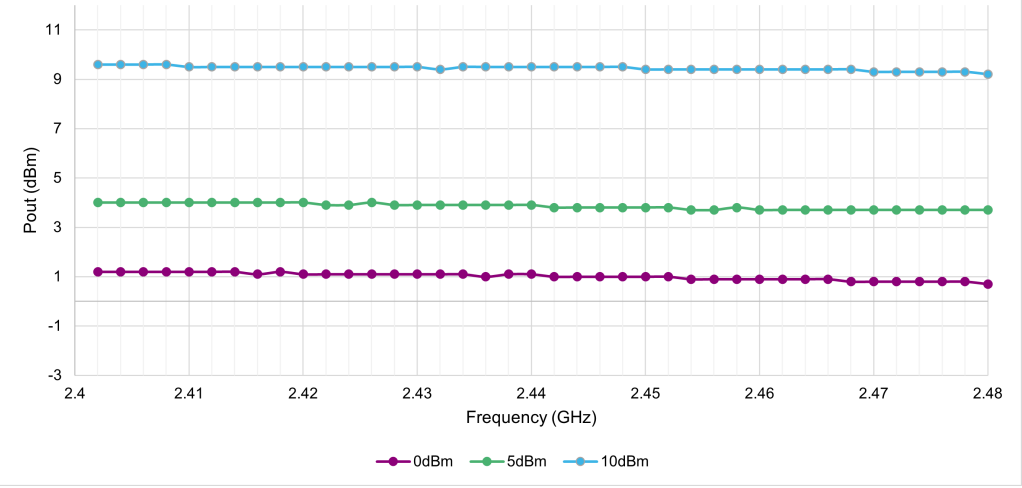
Solder bridge function	Solder bridge number	Solder bridge state	Description
LSE control (32.768 kHz)	SB37/SB38	ON	LSE provided by external 32.768 kHz LSE CLK
		OFF	LSE not provided by external 32.768 kHz LSE CLK
HSE control (32 MHz)	SB39/SB40	ON	HSE provided by external 32 MHz HSE CLK
		OFF	HSE not provided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

1. *SB6 and SB41 are mutually exclusive. Only one of these solder bridges must be ON at a time.*
2. *The RF PA is not powered when the solder bridge is OFF.*

6.2.3 Tx power measurements

For the measurements in Figure 6, MB2301 is configured in LDO mode.

Figure 6. MB2301 Tx power measurements



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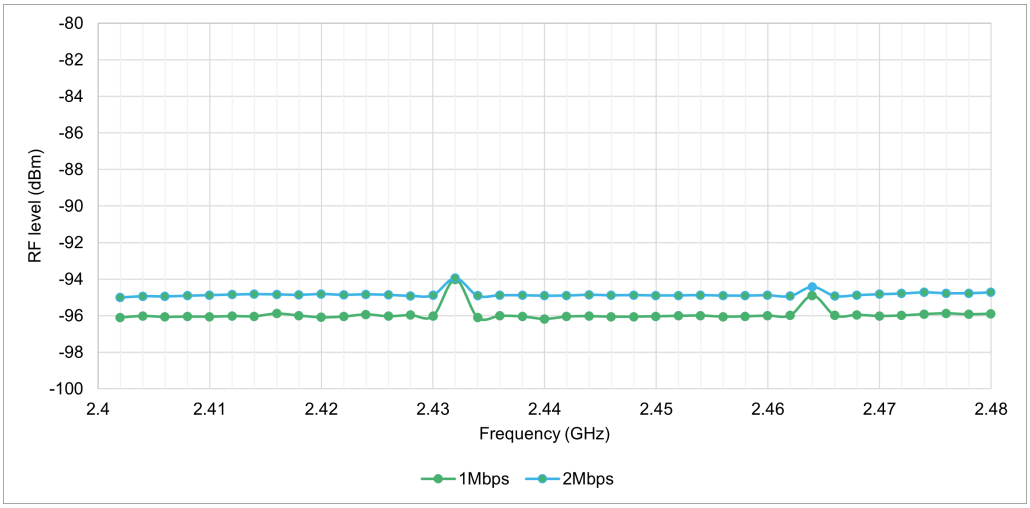
6.2.4 Rx sensitivity measurements

Figure 7. **MB2301 Rx sensitivity measurements**



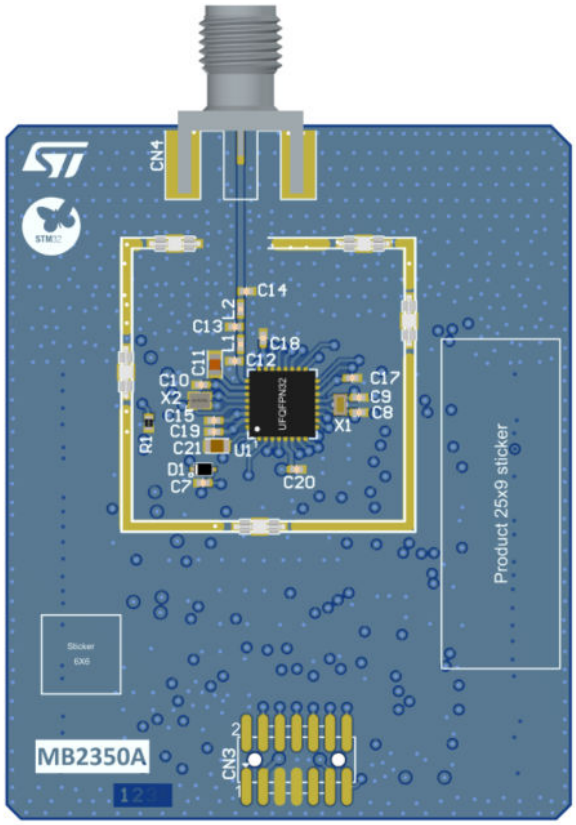
DT81050V1

6.3 MB2350 reference board

6.3.1 Board description

The MB2350 reference board implements the STM32WBA23KEU7 UFQFPN32 package with discrete filtering.

Figure 8. MB2350 top view



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Picture is not contractual.

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

6.3.2 Solder bridge configuration

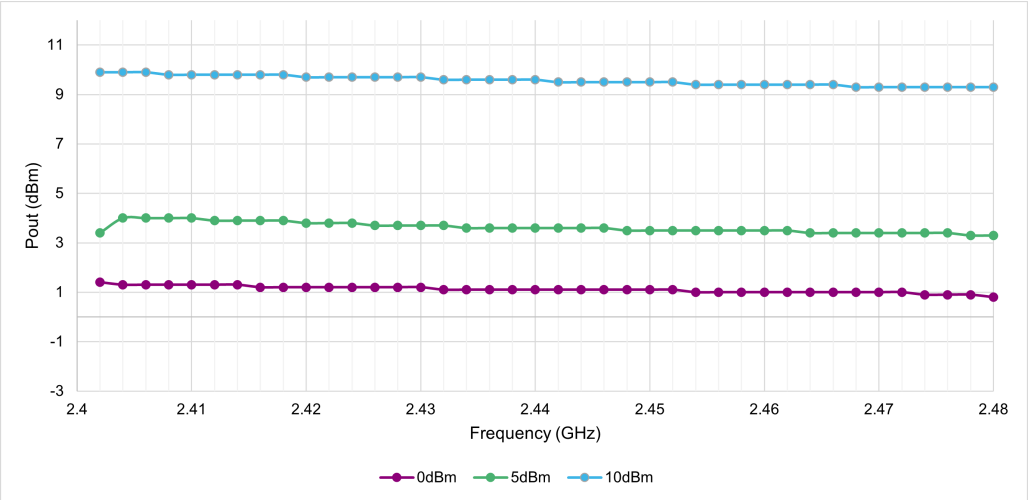
Table 7. MB2350 solder bridge configurations

Solder bridge function	Solder bridge number	Solder bridge state	Description
LSE control (32.768 kHz)	SB37/SB38	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	ON	HSE provided by external 32 MHz HSE CLK
		OFF	HSE not provided by external 32 MHz HSE CLK

6.3.3 Tx power measurements

For the measurements in Figure 9, MB2350 is configured in LDO mode.

Figure 9. MB2350 Tx power measurements



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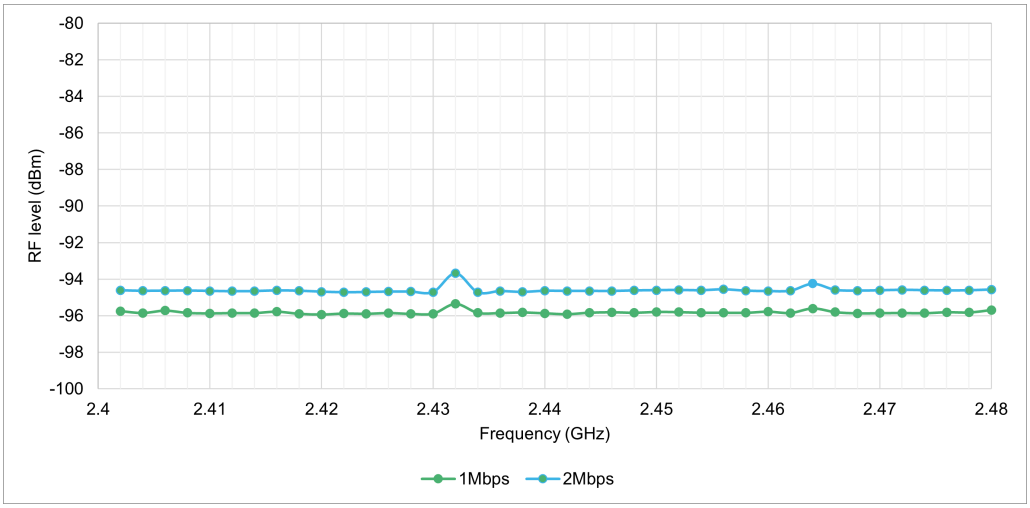
6.3.4 Rx sensitivity measurements

Figure 10. MB2350 Rx sensitivity measurements



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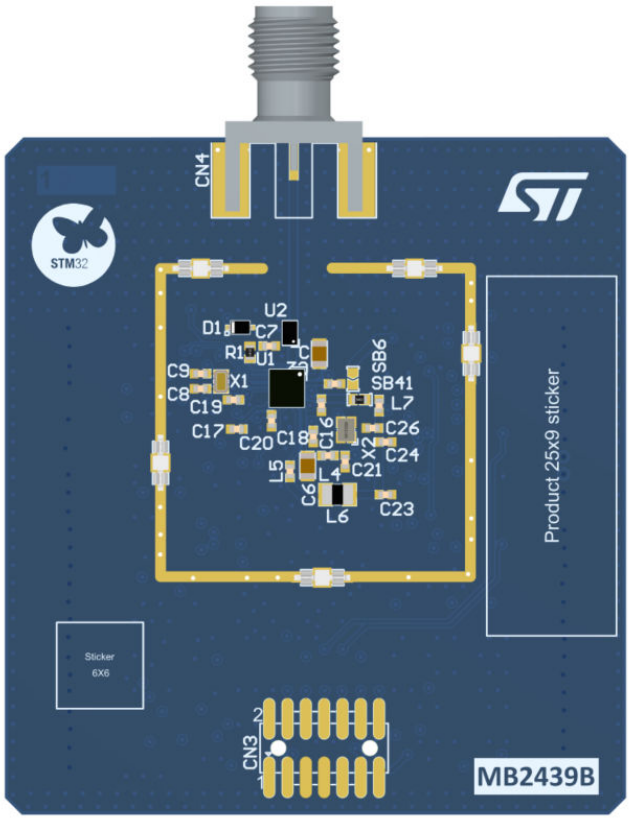
6.4 MB2439 reference board

6.4.1 Board description

The MB2439 reference board implements the STM32WBA25HEF7 Thin WLCSP37 package with discrete filtering.

This board can be configured in SMPS or LDO mode, depending on the solder bridge settings.

Figure 11. MB2515 top view



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Picture is not contractual.

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

6.4.2 Solder bridge configuration

Table 8. MB2439 solder bridge configurations

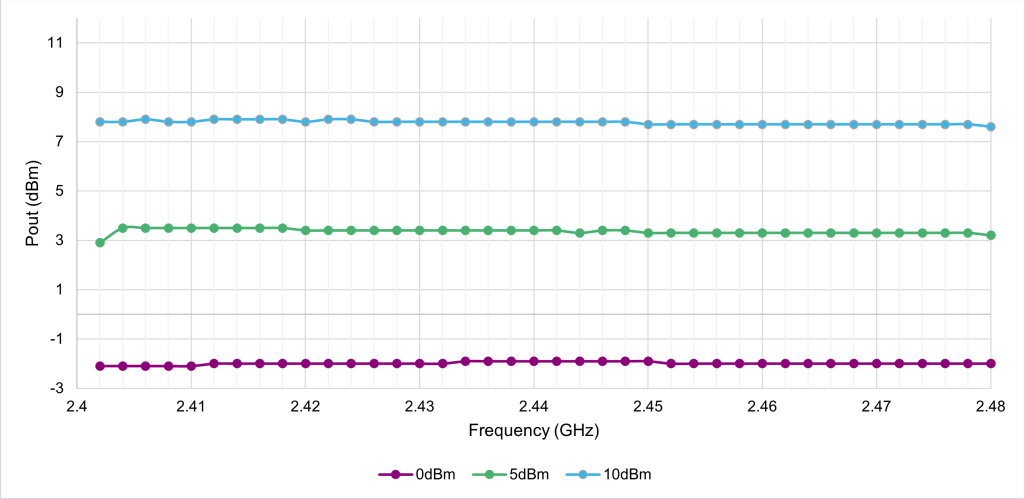
Solder bridge function	Solder bridge number	Solder bridge state	Description
LSE control (32.768 kHz)	SB37/SB38	ON	LSE provided by external 32.768 kHz LSE CLK
		OFF	LSE not provided by external 32.768 kHz LSE CLK
HSE control (32 MHz)	SB39/SB40	ON	HSE provided by external 32 MHz HSE CLK
		OFF	HSE not provided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

1. *SB6 and SB41 are mutually exclusive. Only one of these solder bridges must be ON at a time.*
2. *The RF PA is not powered when the solder bridge is OFF.*

6.4.3 Tx power measurements

For the measurements in Figure 12, MB2439 is configured in LDO mode.

Figure 12. MB2439 Tx power measurements



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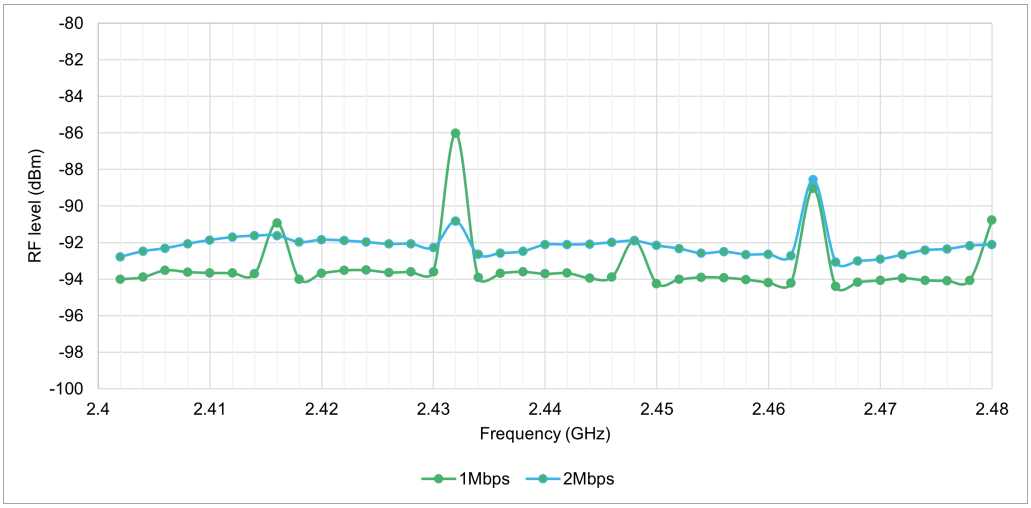
6.4.4 Rx sensitivity measurements

Figure 13. **MB2439 Rx sensitivity measurements**



DT81056V1

Revision history

Table 9. **Document revision history**

Date	Revision	Changes
26-Mar-2026	1	Initial release.

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