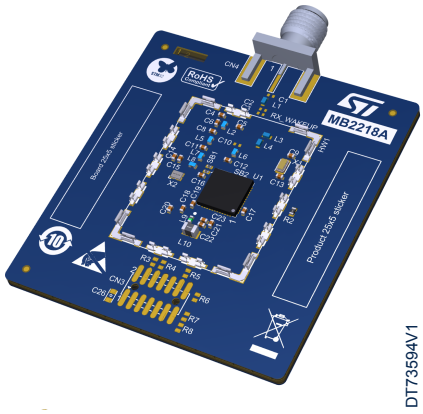
STDES-WL3xxxxx

Data brief

Reference designs for STM32WL3x microcontrollers



DT73594V1

Designs with different references show different layouts. Picture is not contractual. PCB color may differ.

Product status
STDES-WL3xxxxx
STDES-WL3C2ILL, STDES-WL3C2IMH, STDES-WL3C2IML, STDES-WL3C2SLH, STDES-WL3C2SLL, STDES-WL3C2SMH, STDES-WL3C2SML, STDES-WL3C4EEW, STDES-WL3C4SHH, STDES-WL3C4SLH, STDES-WL3C4SLL, STDES-WL3C4SMH, STDES-WL3C4SML

Features

Includes ST state-of-the-art patented technology

Reference designs

- Fully open hardware platforms
- Suitable for rapid prototyping of end nodes based on Sigfox™, Wireless M-Bus, mioty, and many other proprietary protocols

STM32WL3x microcontroller

- Ultra-low power sub-GHz wireless system-on-chip
- Programmable MCU
- Core: Arm® Cortex®-M0+ 32-bit, running up to 64 MHz
- Program memory: 64-Kbyte, 128-Kbyte, or 256-Kbyte flash memory
- RF transceiver (frequency bands: 159-185 MHz, 413-479 MHz, 826-958 MHz) supporting 2(G)FSK, 2(G)MSK, 4(G)FSK, OOK, ASK, D-BPSK, DSSS modulations
- Low-power autonomous wake-up receiver (LPAWUR)

Oscillators

- 48 MHz or 50 MHz HSE (on-board TCXO or XO)
- 32.768 kHz LSE crystal

Connectors

- 2×25 header
- SMA

Supply voltage

- 1.7 V to 3.6 V

Description

The main objective of the STM32WL3x 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 STM32WL3x microcontroller reference designs are provided with the STM32WL3x comprehensive software HAL library. The STM32CubeWL3 MCU Package contains many software examples developed with the STM32WL3x Nucleo-64 boards (NUCLEO-WL33CC1 and NUCLEO-WL33CC2). These examples can be easily adapted for the STM32WL3x microcontroller reference designs.

Using the reference designs to design the user application helps to get the right RF performance and to pass certification.

1 General information

The STM32WL3x microcontrollers in the STDES-WL3xxxxx reference designs are 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

- STM32WL3x MCUs
  - Frequency bands: 159-185 MHz, 413-479 MHz, 826-958 MHz
  - Modulations: 2(G)FSK, 2(G)MSK, 4(G)FSK, OOK, ASK, D-BPSK, DSSS
  - Rx sensitivity at 1% BER:
    - -132 dBm at 300 bit/s 169 MHz OOK
    - -132 dBm at 300 bit/s 433 MHz OOK
    - -131 dBm at 300 bit/s 868 MHz 2(G)FSK
    - -112 dBm at 38.4 bit/s 868 MHz 2(G)FSK
  - Transmitter high output power, programmable up to +20 dBm
    (up to +27 dBm with an external power amplifier only for the 159-185 MHz frequency band)
  - Transmitter medium output power, programmable up to +16 dBm
  - Transmitter low output power, programmable up to +10 dBm
- 2 and 4-layer PCBs supported
- Various frequency ranges supported

3 STM32WL3x microcontroller reference designs and codification

Table 1. STM32WL3x microcontroller reference designs

Web reference	Board reference	MCU order code	MCU package	Number of layers	SMD, IPD, or external PA	HSE crystal frequency	Optimized BOM target
STDES-WL3C2ILL	MB2176	STM32WL33CCV6	VFQFPN48	2	IPD	50 MHz	433 MHz/10 dBm
STDES-WL3C2IMH	MB2176	STM32WL33CCV6	VFQFPN48	2	IPD	48 MHz	868 MHz/14-16 dBm
STDES-WL3C2IML	MB2176	STM32WL33CCV6A	VFQFPN48	2	IPD	50 MHz	433 MHz/14-16 dBm
STDES-WL3C2SLH	MB2168	STM32WL33CCV6	VFQFPN48	2	SMD	48 MHz	868 MHz/10 dBm
							915 MHz/10 dBm
STDES-WL3C2SLL	MB2168	STM32WL33CCV6	VFQFPN48	2	SMD	50 MHz	433 MHz/10 dBm
STDES-WL3C2SMH	MB2168	STM32WL33CCV6	VFQFPN48	2	SMD	48 MHz	868 MHz/14-16 dBm
STDES-WL3C2SML	MB2168	STM32WL33CCV6	VFQFPN48	2	SMD	50 MHz	433 MHz/14 dBm
STDES-WL3C4EEW	MB2158	STM32WL33CCV6A	VFQFPN48	4	SMD, external PA	48 MHz	169 MHz/27 dBm
STDES-WL3C4SHH	MB2218	STM32WL33CCV6	VFQFPN48	4	SMD	48 MHz	915 MHz/20 dBm
STDES-WL3C4SLH	MB2218	STM32WL33CCV6	VFQFPN48	4	SMD	48 MHz	868 MHz/10 dBm
STDES-WL3C4SLL	MB2218	STM32WL33CCV6	VFQFPN48	4	SMD	50 MHz	433 MHz/10 dBm
STDES-WL3C4SMH	MB2218	STM32WL33CCV6	VFQFPN48	4	SMD	48 MHz	868 MHz/14-16 dBm
STDES-WL3C4SML	MB2218	STM32WL33CCV6	VFQFPN48	4	SMD	50 MHz	433 MHz/14-16 dBm

Table 2. STM32WL3x microcontroller reference designs codification

Example:	STDES-	WL3	C	2	S	L	H

Device family

STDES- = STMicroelectronics reference design

Wireless products

WL3 = Ultra-low-power long-range STM32WL3x microcontrollers

Wireless microcontroller package

C = VFQFPN48, 48 pins

K = VFQFPN32, 32 pins

Reference design number of layers

2 = 2 layers

4 = 4 layers

Antenna matching and Tx/Rx path connection to the antenna

I = IPD

S = SMD

E = SMD with external PA controlled by the MCU

Power mode

L = low power (up to +10 dBm)

M = medium power (up to +14/16 dBm)

H = high power (up to +20 dBm)

E = extended range (up to +27 dBm)

Frequency band

W = 159-185 MHz

L = 413-479 MHz

H = 826-958 MHz

4 Hardware layout and configuration

4.1 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*.

The VFQFPN48 package's bill of materials is also applicable to the VFQFPN32 package.

4.2 IPD (integrated passive device)

STMicroelectronics develops integrated passive device (IPD) companion chips for optimized matching, filtering, and balun. The IPD is an all-in-one very compact solution covering the following use cases:

- 10 dBm at 433 MHz
- 16 dBm at 433 MHz
- 16 dBm at 868 MHz
- 20 dBm at 915 MHz

4.3 Output power selection

The reference designs can be tailored to meet the specific output power requirements.

Table 3. Solder bridge configurations

Output power	SB1	SB2
Not applicable	OFF	OFF
10 dBm	OFF	ON
14/16 dBm	ON	OFF
20 dBm	ON	ON

4.4 Radio setting

Depending on the reference design, use the settings indicated in the table below to achieve the best performance for each radio configuration.

Table 4. Radio setting

Web reference	Optimized BOM target	SMPS level	PA drive mode	PA_LEVEL7	Degeneration mode
STDES-WL3C2ILL	433 MHz/10 dBm	1.4 V	TX	0x4C	ON
STDES-WL3C2IMH	868 MHz/14 dBm	1.4 V	TX_HP	0x51	ON
	868 MHz/16 dBm	1.6 V	TX_HP	0x51	ON
STDES-WL3C2IML	433 MHz/14 dBm	1.4 V	TX_HP	0x51	ON
	433 MHz/16 dBm	1.7 V	TX_HP	0x51	ON
STDES-WL3C2SLH	868 MHz/10 dBm	1.4 V	TX	0x51	ON
		1.5 V	TX	0x51	OFF
	915 MHz/10 dBm	1.4 V	TX	0x4F	ON
		1.4 V	TX	0x51	OFF
STDES-WL3C2SLL	433 MHz/10 dBm	1.4 V	TX	0x4C	ON
		1.4 V	TX	0x51	OFF
STDES-WL3C2SMH	868 MHz/14 dBm	1.7 V	TX_HP	0x51	ON
		1.9 V	TX_HP	0x51	OFF
	868 MHz/16 dBm	2.1 V	TX_HP	0x51	ON
		2.4 V	TX_HP	0x51	OFF
STDES-WL3C2SML	433 MHz/14 dBm	1.6 V	TX_HP	0x51	ON
		1.8 V	TX_HP	0x51	OFF
	433 MHz/16 dBm	1.9 V	TX_HP	0x51	ON
		2.4 V	TX_HP	0x51	OFF
STDES-WL3C4EEW	169 MHz/27 dBm	1.4 V	TX_HP	0x35	OFF
STDES-WL3C4SHH	915 MHz/20 dBm	2.1 V	TX + TX_HP	0x51	ON
STDES-WL3C4SLH	868 MHz/10 dBm	1.4 V	TX	0x51	ON
		1.5 V	TX	0x51	OFF
STDES-WL3C4SLL	433 MHz/10 dBm	1.3 V	TX	0x4E	ON
		1.3 V	TX	0x4E	OFF
STDES-WL3C4SMH	868 MHz/14 dBm	1.4 V	TX_HP	0x51	ON
		1.6 V	TX_HP	0x51	OFF
	868 MHz/16 dBm	1.8 V	TX_HP	0x51	ON
		2.3 V	TX_HP	0x51	OFF
STDES-WL3C4SML	433 MHz/14 dBm	1.4 V	TX_HP	0x51	ON
		1.5 V	TX_HP	0x51	OFF
	433 MHz/16 dBm	1.8 V	TX_HP	0x51	ON
		2.2 V	TX_HP	0x51	OFF

5 Conventions

Table 5. **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 6. Document revision history

Date	Revision	Changes
14-Nov-2024	1	Initial release.
22-Jan-2025	2	Added reference designs STDES-WL3C4SLH and STDES-WL3C4SMH: • Updated *Product status link* • Updated *Table 1. STM32WL3x microcontroller reference designs* • Updated *Table 4. Radio setting* Updated the maximum value of PA_LEVEL7 from 0x53 to 0x51 in *Table 4. Radio setting*. Added a remark about the applicability of VFQFPN48's bills of materials to VFQFPN32-based reference designs in *Section 4.1: Schematics and BOM (bill of materials)*.
18-Feb-2025	3	Updated the maximum value of PA_LEVEL7 from 0x53 to 0x51 in *Table 4. Radio setting* for STDES-WL3C2SLL.
14-Apr-2025	4	Added reference designs STDES-WL3C2ILL, STDES-WL3C2IMH, STDES-WL3C2IML, STDES-WL3C2SMH, STDES-WL3C2SML, STDES-WL3C4SLL, and STDES-WL3C4SML: • Updated *Product status* • Updated Table 1. STM32WL3x microcontroller reference designs • Updated Table 4. Radio setting Updated Section 4.1: EDA resources.

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