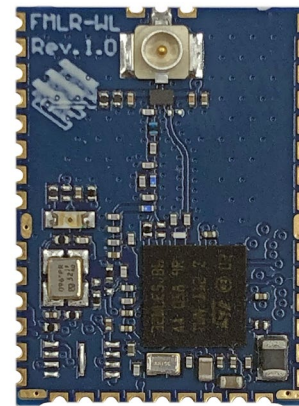


# FMLR WL-STE5

High performance sub-GHz  
multi-protocol IoT module

FMLR sub-GHz multi-protocol  
low power wireless module with  
STM32WL and optional flash  
memory



## Description

**FMLR-WL-STE5** is a multi-protocol IoT module for devices and sensors. The module supports LoRa®, (G)FSK, (G)MSK, and BPSK modulation schemes and is fully compatible with standardized or proprietary protocols such as LoRaWAN®, Sigfox™, WM-Bus, and mioty®.

Due to its low power consumption, the module is ideal for applications running on small-sized batteries. The 32-bit ARM Cortex®-M4 MCU featuring up to 256 kB flash and 64 kB SRAM offers sufficient resources to run advanced wireless stacks and user applications.

## Features

- ▶ Multi-protocol device with LoRaWAN®, Sigfox™, WM-Bus, and mioty®
- ▶ Up to 22 dBm TX output power
- ▶ ARM Cortex®-M4 MCU
- ▶ Optional ext. flash, U.FL connector
- ▶ TCXO to support narrow band protocols
- ▶ STM32WLE5 for stack and user application
- ▶ Tiny FMLR footprint: 14 × 19.5 mm

## Applications

- ▶ Asset tracking
- ▶ Health care
- ▶ Industry 4.0
- ▶ Smart agriculture
- ▶ Smart building
- ▶ Smart city
- ▶ Smart metering
- ▶ Smart retail
- ▶ Supply chain and logistics

## Document Information

### About

File name	Document type	Date	Revision
DS-FMLR-WL-STE5	Datasheet	2022/09/08	2.0

### Revision History

Date	Release	Changes
2022/02/25	1.0	Initial revision
2022/09/08	2.0	Fully revised

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## Functional Description

The **FMLR-WL-STE5** multi-protocol IoT module provides wireless connectivity to devices, systems, and sensors communicating with high data rates over a long distance. The Sub-GHz module supports LoRa®, (G)FSK, (G)MSK and BPSK modulation schemes and is fully compatible with standardized or proprietary protocols such as LoRaWAN®, Sigfox™, WM-Bus, and mioty®. Due to its low power consumption, the module is ideal for applications running on small-sized batteries. The integrated ARM Cortex®-M4 32-bit microcontroller with integrated PA (output power 22 dBm) and LNA (sensitivity up to -148 dBm) can run entire wireless stacks and has sufficient resources to run user applications.

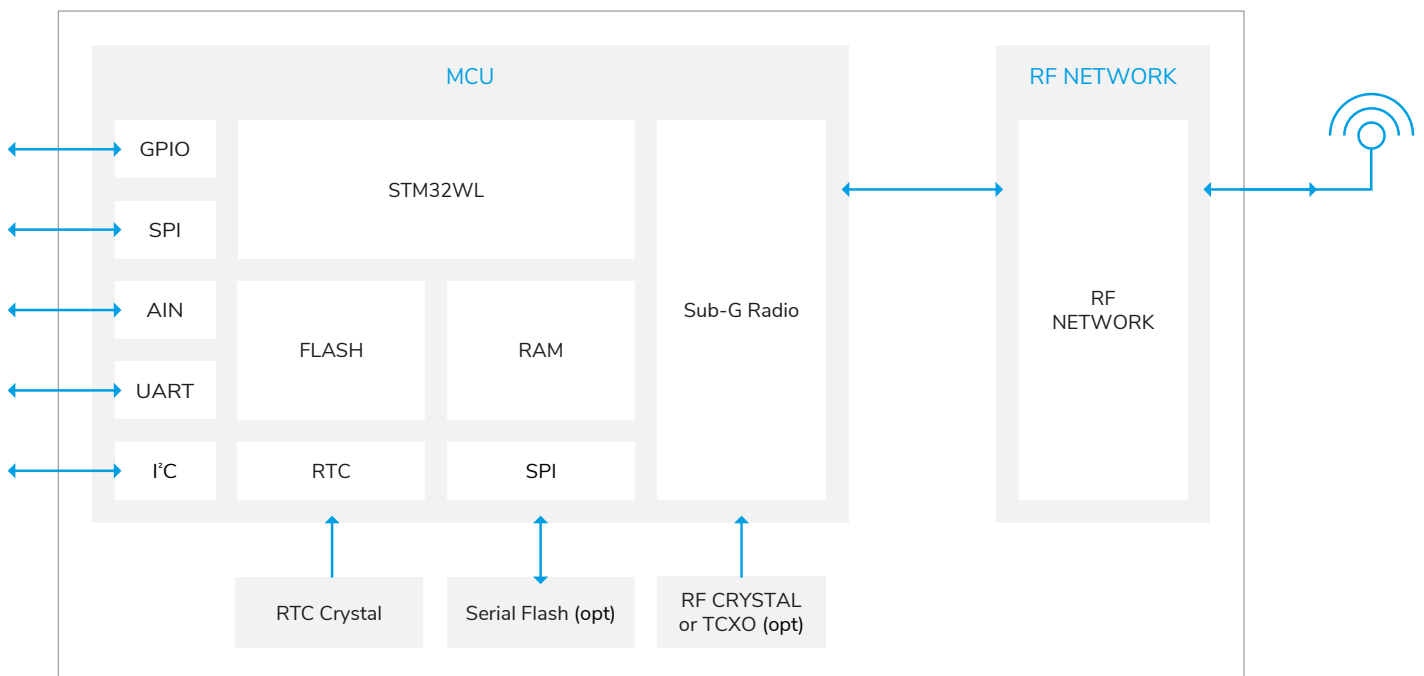


Figure 1: Block diagram FMLR-WL-STE5

The module is available with additional on-board flash memory to support Over-the-Air (OTA) update and additional data storage. An optional low-power high precision temperature compensated oscillator (TCXO) for the radio is available.

To support fast prototyping and development, the firmware, including the wireless stack, can be updated via SWD or UART bootloader.

# Technical Specifications

## Core Components

SoC/Microcontroller	STM32WLE5JBI6 / STM32WLE5JCI6
Core	Cortex®-M4, 48 MHz
Flash memory	128 kB / 256 kB
RAM	48 kB / 64 kB
Ext. flash, optional (-4M)	MX25R4035FZUILO, 512 kB

## Mechanical Specifications

Weight	2 g
Dimensions	14 × 19.5 × 2 mm

## Operating Conditions

Temperature	-20 – 85 °C
Humidity	0 – 95 % RH, non-condensing

## Absolute Maximum Ratings

Parameter	Min	Max	Unit
Ext. supply voltage on all power pins ( $V_{DD}$ )	-0.3	3.6	V
Input voltage on any pin	$V_{SS} - 0.3$	3.6	V
DC current on any pin		15	mA
Storage temperature	-40	+85	°C

**⚠ WARNING!**

Stressing the device beyond the «Absolute Maximum Ratings» may cause permanent damage.

## Operating Conditions

Parameter	Min	Typ	Max	Unit
Standard operating voltage ( $V_{DD}$ )	1.8		3.5	V
Digital IO pin input low voltage	$V_{SS}$		$0.3 \cdot V_{DD}$	V
Digital IO pin input high voltage	$0.7 \cdot V_{DD}$		$V_{DD}$	V
Digital IO pin output low voltage	0		0.4	V
Digital IO pin output high voltage	$V_{DD} - 0.4$		$V_{DD}$	V
Current consumption, TX mode (22 dBm, 868-915 MHz) <sup>1</sup>			120	mA
Current consumption, RX mode (LoRa 125 kHz) <sup>1</sup>		4.82		mA
Current consumption, stop 2 mode, RTC enabled <sup>1</sup>		1		$\mu$ A
Highest receiver sensitivity <sup>1</sup>			-148	dBm
RF output power <sup>1</sup>			22	dBm

<sup>1</sup>See STM32WL datasheet for detailed specifications

## Certifications

CE

UKCA

LoRaWAN<sup>®</sup> certification

pending

FCC

pending

## On-Board LED

The on-board LED is connected to port PD8. Actively drive port low (0V) to light up LED. Drive port high or high Z to disable LED.

# Module Pinout

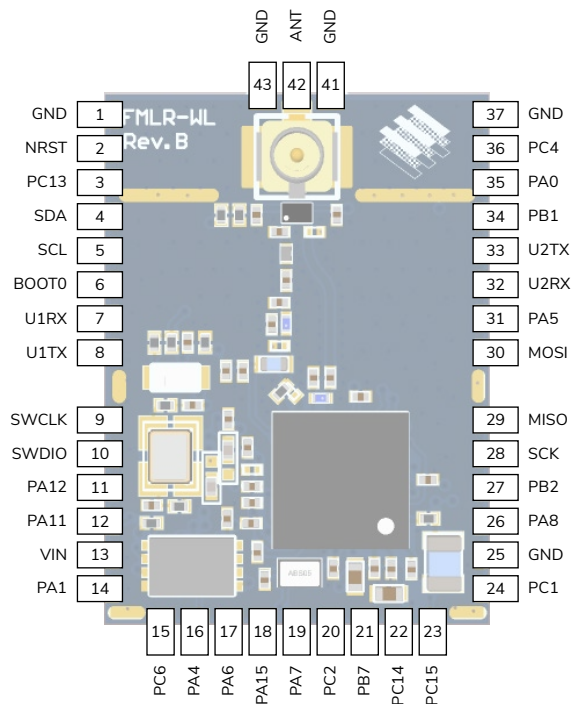


Figure 2: Module Pinout

#	Pad name	MCU pad	Description	#	Pad name	MCU pad	Description
1	GND		Ground ( $V_{SS}$ )	21	PB7	PB7	GPIO
2	NRST	NRST	MCU Reset	22	PC14	PC14	GPIO
3	PC13	PC13	GPIO	23	PC15	PC15	GPIO
4	SDA	PB9	I <sup>2</sup> C1, GPIO	24	PC1	PC1	GPIO
5	SCL	PB6	I <sup>2</sup> C1, GPIO	25	GND		Ground ( $V_{SS}$ )
6	BOOT0	BOOT0	MCU BOOT0	26	PA8	PA8	GPIO
7	U1RX	PA10	UART1 RX	27	PB2	PB2	GPIO
8	U1TX	PA9	UART1 TX	28	SCK <sup>1</sup>	PB3	SPI SCK
9	SWCLK	PA14	DBG Clock / GPIO	29	MISO <sup>1</sup>	PB4	SPI MISO
10	SWDIO	PA13	DBG Data / GPIO	30	MOSI <sup>1</sup>	PB5	SPI MOSI
11	PA12	PA12	GPIO	31	PA5	PA5	GPIO
12	PA11	PA11	GPIO	32	U2RX	PA3	UART2 RX
13	VIN		Supply Voltage $V_{DD}$	33	U2TX	PA2	UART2 TX
14	PA1	PA1	GPIO	34	PB1	PB1	GPIO
15	PC6	PC6	GPIO	35	PA0	PA0	GPIO
16	PA4	PA4	GPIO	36	PC4	PC4	GPIO
17	PA6	PA6	GPIO	37	GND		Ground ( $V_{SS}$ )
18	PA15	PA15	GPIO	41	GND		Ground ( $V_{SS}$ )
19	PA7	PA7	GPIO	42	ANT		RF (50 $\Omega$ )
20	PC2	PC2	GPIO	43	GND		Ground ( $V_{SS}$ )

<sup>1</sup> If the module variant contains an external flash, these pins are connected internally and should not be used as GPIO pins!

# FMLR Family Footprint

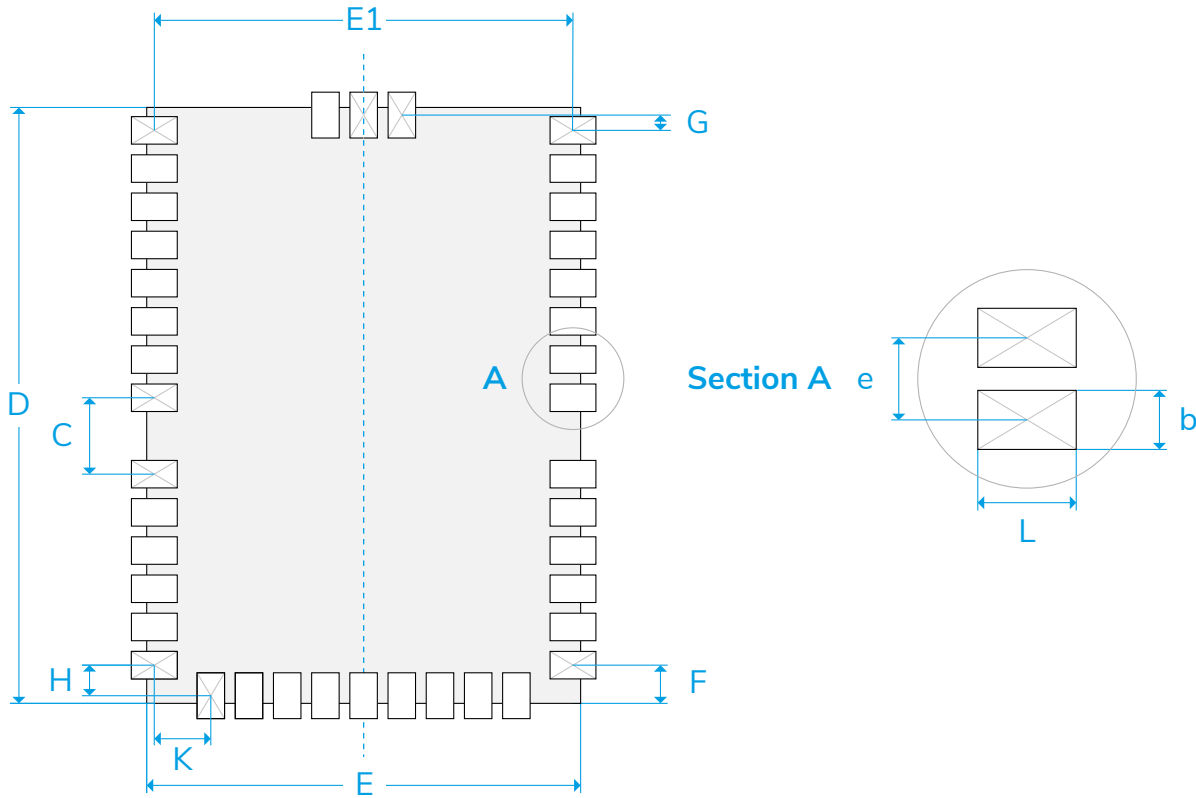


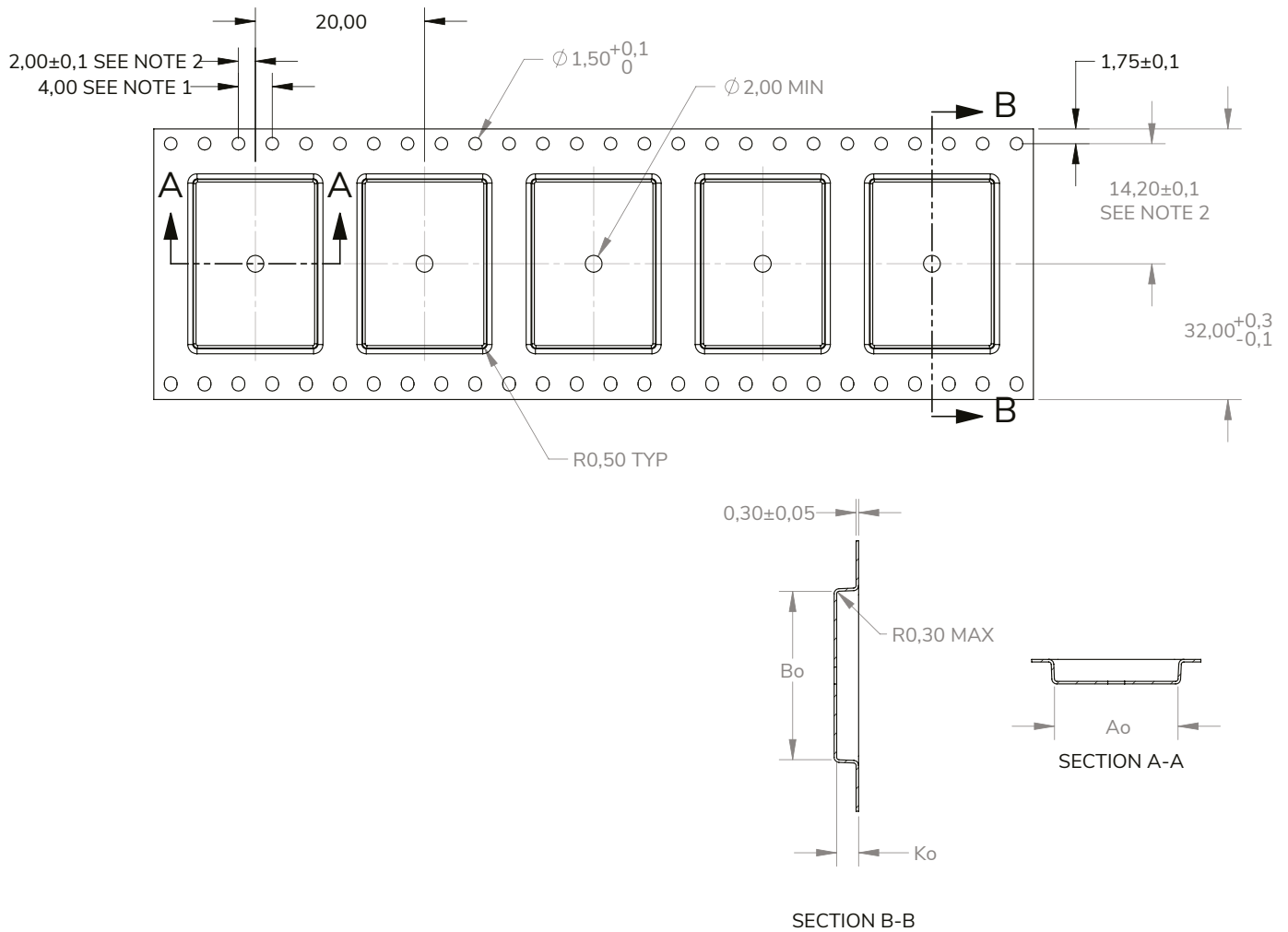
Figure 3: FMLR Module Footprint

## FMLR Footprint Dimensions\*

Dimension (see Figure 3: FMLR Module Footprint)	Min	Typ	Max
b	0.85	0.9	0.95
C		2.5	
D		19.5	
E		14.2	
E1		13.7	
e		1.25	
F		1.25	
G		0.5	
H		1	
K		1.85	
L	1.45	1.5	1.55

\*All dimensions in mm

# Tape Information



	DIM	±
Ao <sup>3</sup>	14,60	0.1
Bo <sup>3</sup>	19,90	0.1
Ko	2,60	0.1

<sup>1</sup> 10 Sprocket Hole Pitch Cumulative Tolerance ±0.2

<sup>2</sup> Pocket Position Relative To Sprocket Hole Measured As True Position Of Pocket, Not Pocket Hole

<sup>3</sup> Ao And Bo Are Measured On A Plane At A Distance „R“ Above The Bottom Of The Pocket.

All dimensions in mm

Tolerances unless – specified

1 PL ± 0.2

2 PL ± 0.10



## Recommended Soldering Conditions

The following graph shows a typical temperature profile for the module soldering process. The exact values to be used in production are highly dependent on other parameters of the soldering process, such as soldering paste, PCB design, soldering process, etc.

Reflow process should be finished within 2 cycles.

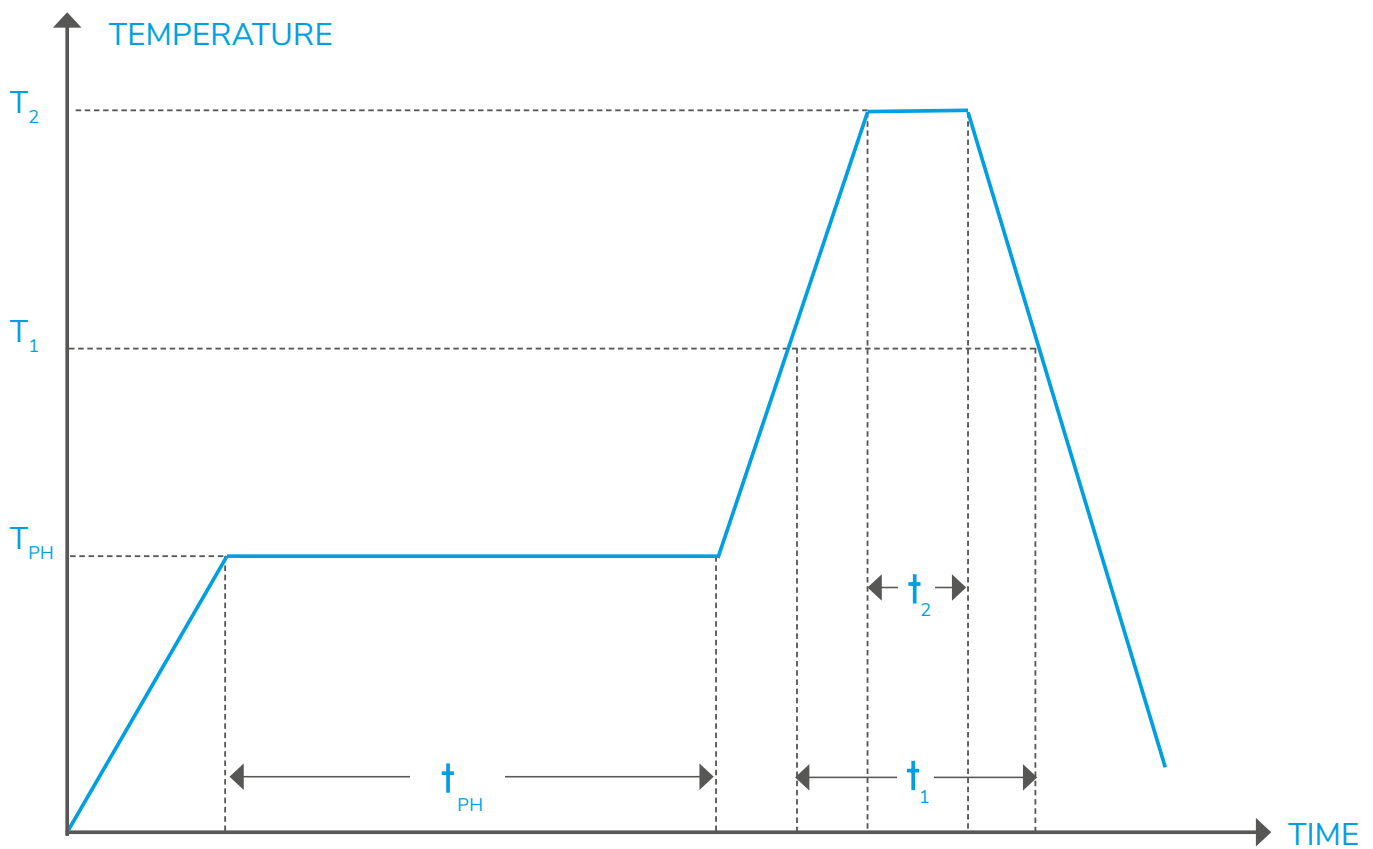


Figure 4: Soldering Profile

### Soldering Conditions

Step (see Figure: Soldering Profile)	Temperature	Time
Preheat ( $T_{PH}$ , $t_{PH}$ )	150 to 180 °C	120 s
Heating ( $T_1$ , $t_1$ )	220 °C	60 s
Reflow ( $T_2$ , $t_2$ )	255 °C	5 s

## Additional Documentation

### Additional Resources

Product information page	<a href="https://miromico.ch/fmlr-wl-ste5">https://miromico.ch/fmlr-wl-ste5</a>
Technical documentation	<a href="https://docs.miromico.ch/datasheets/modules.html">https://docs.miromico.ch/datasheets/modules.html</a>

## Device Options

Product ID	MCU options				RF	
	Cortex <sup>®</sup> -M4	128KB flash	256KB flash	4Mbit flash	U.FL connector	Antenna pad
FMLR-WL-U-STE5B	✓	✓			✓	
FMLR-WL-P-STE5B	✓	✓				✓
FMLR-WL-U-STE5C	✓		✓		✓	
FMLR-WL-P-STE5C	✓		✓			✓

Options for other STM32WL variants, TCXO, output power connections and external flash sizes are available on request.

## Keep in Touch

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