FMLR 80-STM

High performance 2.4 GHz LoRa® IoT module with ranging support

FMLR 2.4 GHz low power wireless module with STM32L4 and optional flash memory

Description

FMLR-80-STM is a 2.4 GHz IoT module that provides wireless connectivity to devices and sensors in the worldwide available ISM 2.4 GHz band. In addition to the LoRa® modulation scheme, the module supports FLRC and (G)FSK modulation and features a built-in ranging engine with Time-of-Flight (ToF) functionality enabling indoor and outdoor localization. Bluetooth low energy (BLE) is also supported in either a single or dual stack configuration.

Due to its low power consumption, the module is ideal for applications with small-sized batteries. The integrated low power 32-bit ARM Cortex®-M4 microcontroller featuring 512 kB flash and 160 kB RAM offers sufficient resources to run advanced user applications with precise timing.

Features

- Semtech SX1280 based
- ToF ranging and localization hardware
- LoRa®/FLRC/GFSK with up to 1.3 MBps
- 12 dBm TX power, -132 dBm sensitivity
- ARM Cortex®-M4 MCU
- Optional ext. flash, LF-TCXO, U.FL connector
- STM32L4 MCU for stack and user app
- Tiny FMLR footprint: 14 × 19.5 mm

Applications

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

Document Information

About

File name	Document type	Date	Revision
DS-FMLR-80-STM	Datasheet	2023/05/10	2.0

Revision History

Date	Release	Changes
2021/02/25	1.0	Initial revision
2021/05/26	1.1	Changed solder profile
2021/07/08	1.2	Updated product image and BLE functionality
2021/08/09	1.3	Updated FCC info
2023/04/11	2.0	Fully revised
2023/05/10	2.1	Added difference L0/L4 variants

Table of Content

Functional Description

The **FMLR-80-STM** LoRa® and LoRaWAN® IoT module provides wireless connectivity to devices, systems, and sensors communicating with high data rates over a long distance. The 2.4 GHz modules support long-range Time-of-Flight (ToF) distance measurements for indoor and outdoor localization with an accuracy down to 5 meters. Due to its low power consumption, the module is ideal for devices running on small-sized batteries. The integrated ARM Cortex®-M4 microcontroller is capable of running entire RF stacks and has sufficient resources for user applications.

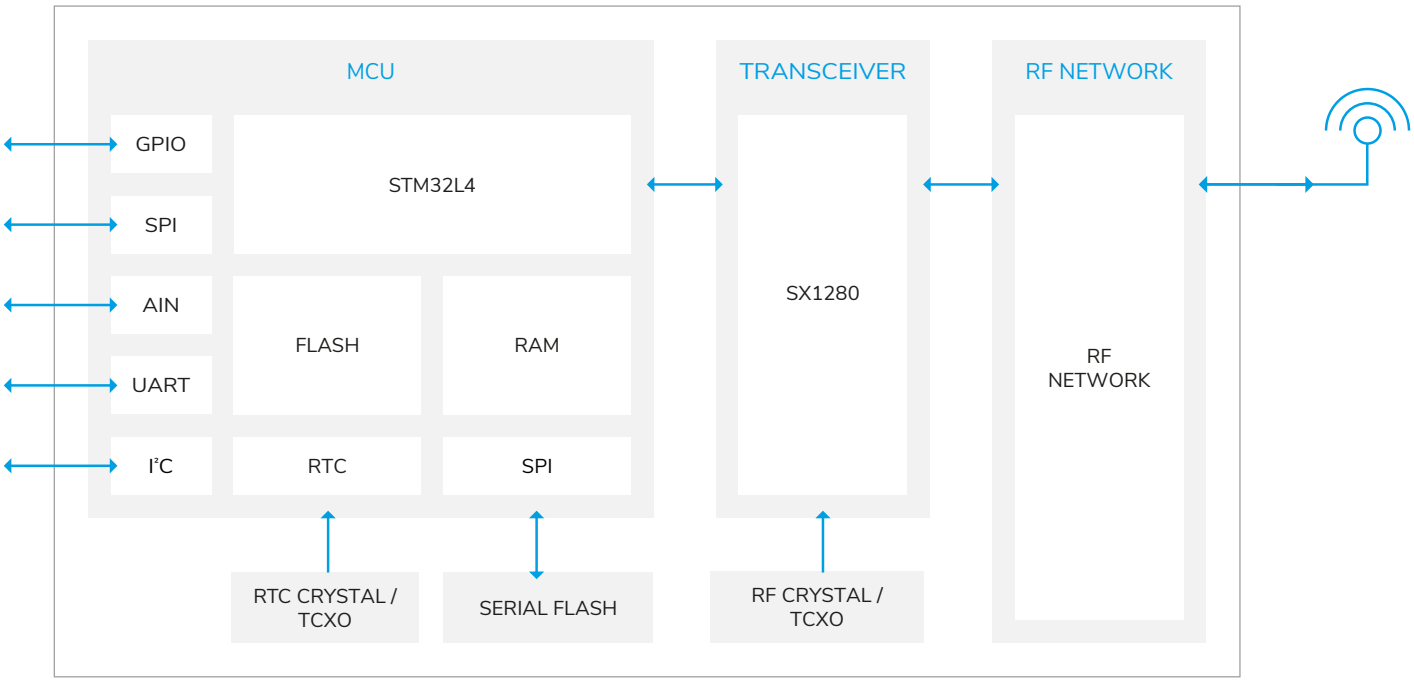


Figure 1: Block diagram FMLR-80-STM

The modules is available with additional on-board flash memory to support Over-the-Air (OTA) update and additional data storage. Additional modulation schemes such as the efficient and robust high bitrate and long range FLRC modulation are supported. Bluetooth low energy (BLE) is supported in either a single or dual stack solution. This enables the communcation with smartphones, tablets and gadgets.
The module supports Time-of-Flight (ToF) using the hardware ranging unit of the SX1280 transceiver. To increase ranging accuracy a temperature compensated oscillator (TCXO) is used as clock source for the radio transceiver.

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

Technical Specifications

Core Components

LoRa® transceiver	Semtech SX1280
Microcontroller	STM STM32L451REI6
Core	Cortex®-M4 with FPU, 80 MHz
Flash memory	512 kB
RAM	160 kB
Ext. flash, optional (-4M)	Macronix MX25R4035FZUIL0, 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	V_{DD}	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		3.6	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 (10dBm)[1]		18		mA
Current consumption, RX mode (LoRa 203kHz)[1]		6.2		mA
Current consumption, sleep mode		1.2	1.8	µA
Highest receiver sensitivity[1]			-132	dBm
RF output power[1]			12	dBm

[1]See transceiver datasheet for detailed specifications

Certifications

CE	
UKCA	
FCC	FCC ID: 2AUQEPC1Y4

FCC Caution:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause unde-sired operation.

The module is FCC compliant by using antenna 2308 from Adafruit Industries LLC.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

On-Board LED

The on-board LED is connected to port PB8. Actively drive port to low (0V) to light up LED. Drive port high or high Z to disable LED.

Differences between L0 and L4 variants

Due to differences in STM32 MCU pin out, on modules using STM32L4 devcies, port PC3 is connected to VDD. Port PC3 should always be kept in its default configuration (input with no pull up or pull down). Other pin configuration might lead to device damage or excessive current consumption!

On modules using STM32L0 port PC3 is not available as an external pin of the MCU package and pin configuration has no effect. It's recommended to keep pin in default configuration.

Module Pinout

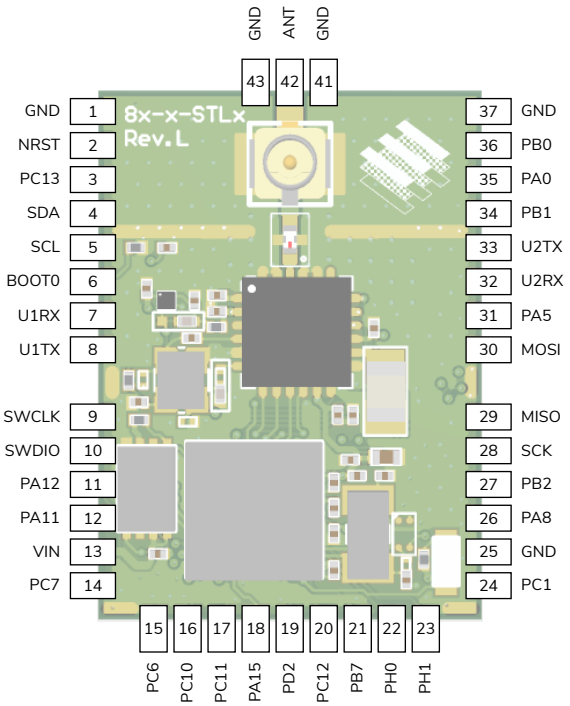


Figure 2: Module Pinout

#	Pad name	MCU pad	Description
1	GND		Ground (V_{SS})
2	NRST	NRST	MCU Reset
3	PC13	PC13	GPIO
4	SDA	PB9	I²C1, GPIO
5	SCL	PB6	I²C1, GPIO
6	BOOT0	BOOT0	MCU BOOT0
7	U1RX	PA10	UART1 RX
8	U1TX	PA9	UART1 TX
9	SWCLK	PA14	DBG Clock / GPIO
10	SWDIO	PA13	DBG Data / GPIO
11	PA12	PA12	USB P[2] / GPIO
12	PA11	PA11	USB N[2] / GPIO
13	VIN		Supply Voltage V_{DD}
14	PC7	PC7	GPIO
15	PC6	PC6	GPIO
16	PC10	PC10	GPIO
17	PC11	PC11	GPIO
18	PA15	PA15	GPIO
19	PD2	PD2	GPIO
20	PC12	PC12	GPIO

#	Pad name	MCU pad	Description
21	PB7	PB7	GPIO
22	PH0	PH0	GPIO
23	PH1	PH1	GPIO
24	PC1	PC1	GPIO
25	GND		Ground (V_{SS})
26	PA8	PA8	GPIO
27	PB2	PB2	GPIO
28	SCK[1]	PB3	SPI SCK
29	MISO[1]	PB4	SPI MISO
30	MOSI[1]	PB5	SPI MOSI
31	PA5	PA5	GPIO
32	U2RX	PA3	UART2 RX
33	U2TX	PA2	UART2 TX
34	PB1	PB1	GPIO
35	PA0	PA0	GPIO
36	PB0	PB0	GPIO
37	GND		Ground (V_{SS})
41	GND		Ground (V_{SS})
42	ANT		RF (50 Ω)
43	GND		Ground (V_{SS})

[1] If the module variant contains an external flash, these pins are connected internally and should not be used as GPIO pins!
[2] USB not available on all variants

FMLR Family Footprint

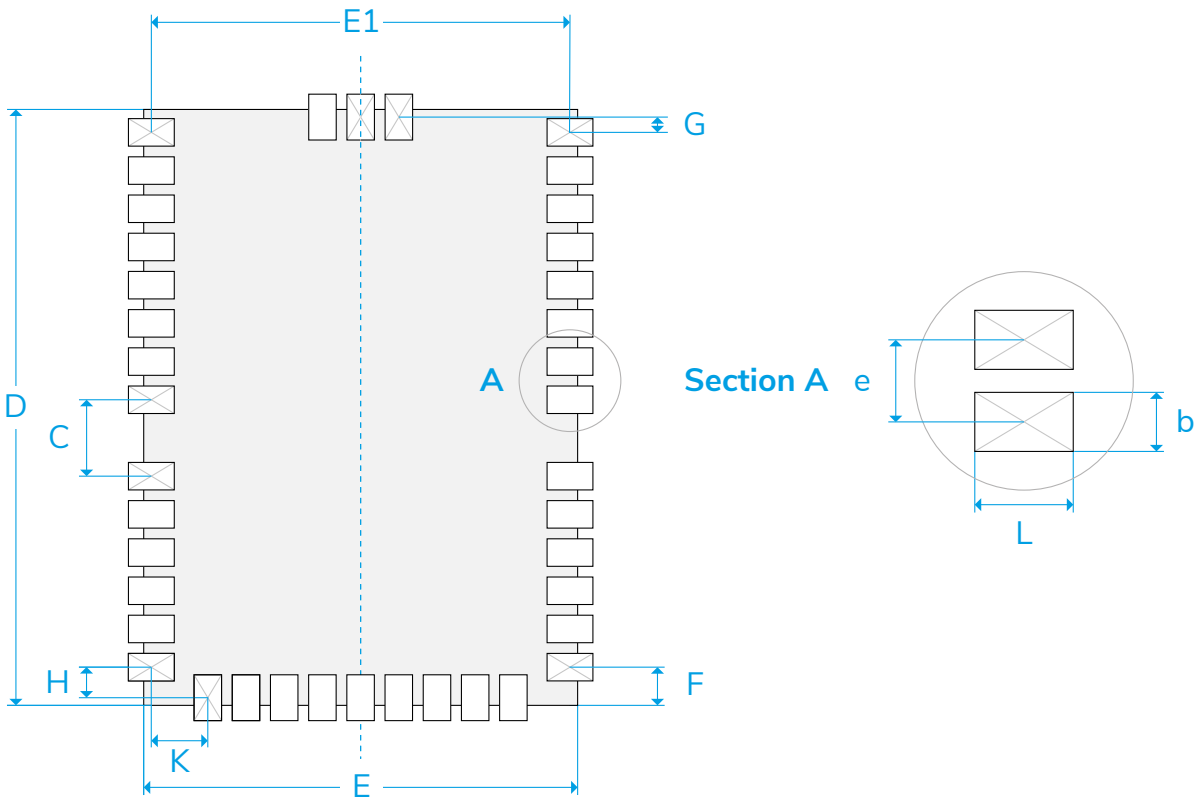


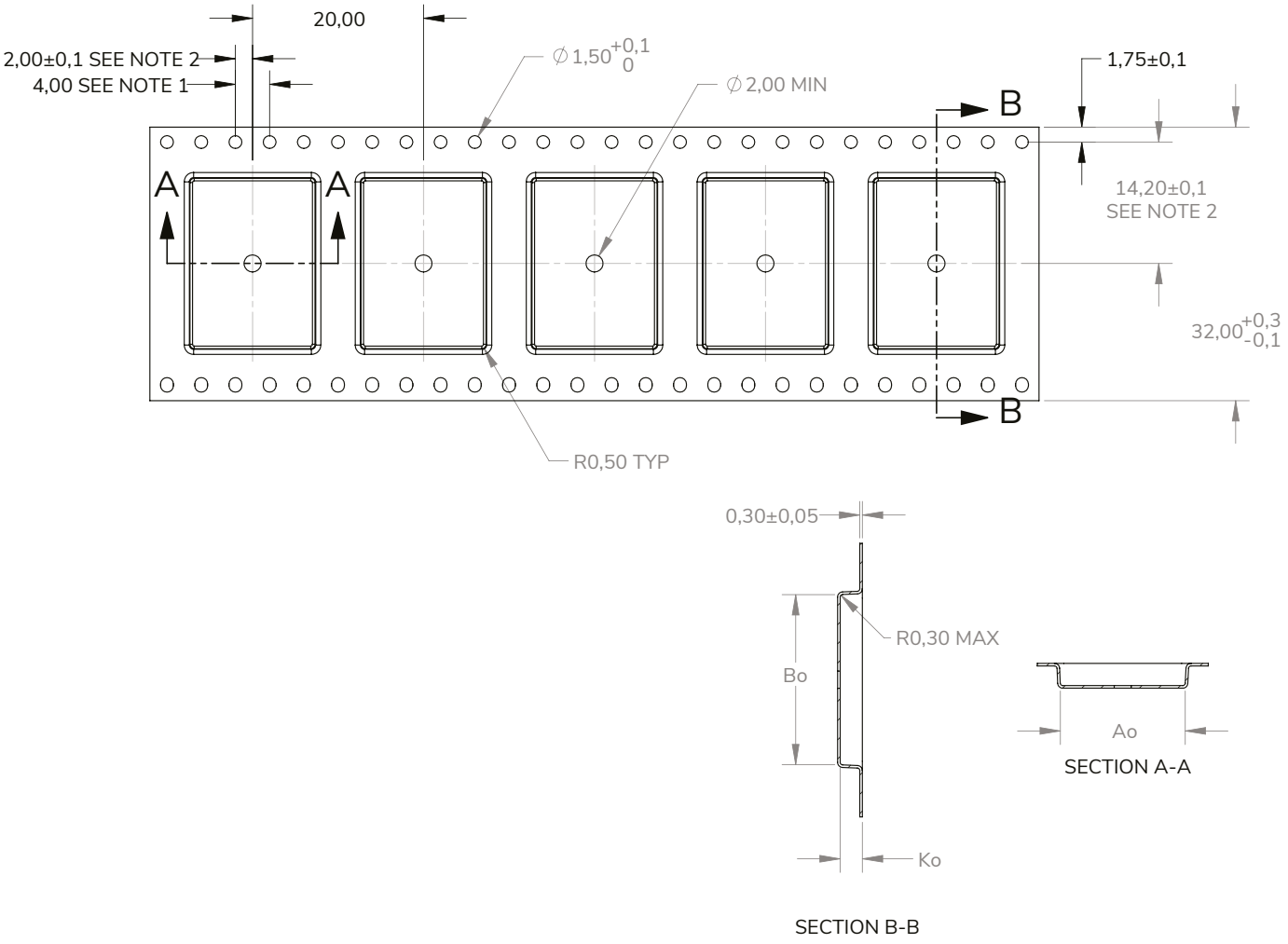
Figure 3: FMLR Module Footprint

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 [3]	14,60	0.1
Bo [3]	19,90	0.1
Ko	2,60	0.1

[1] 10 Sprocket Hole Pitch Cumulative Tolerance ±0.2

[2] Pocket Position Relative To Sprocket Hole Measured As True Position Of Pocket, Not Pocket Hole

[3] 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.

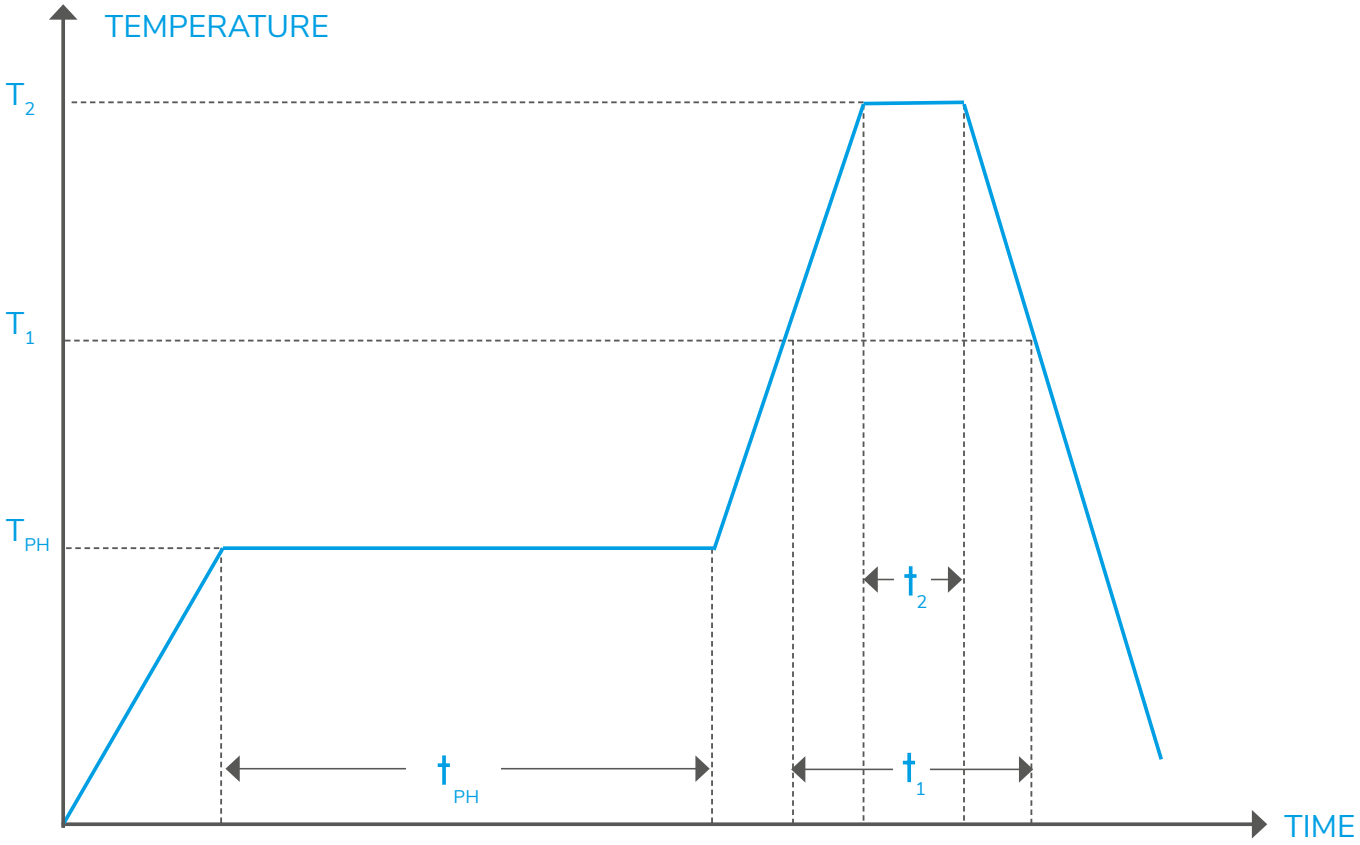


Figure 4: Soldering Profile

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	https://miromico.ch/fmlr-80-stm
Technical documentation	https://docs.miromico.ch/modules

Device Options

Product ID	MCU options				RF		
	Cortex®-M4	512KB flash	160KB RAM	4Mbit Flash	ToF ranging	U.FL connect.	Antenna pad
FMLR-80-P-STL4E-TCXO	✓	✓	✓		✓		✓
FMLR-80-U-STL4E-TCXO	✓	✓	✓		✓	✓	
FMLR-80-P-STL4E-4M-TCXO	✓	✓	✓	✓	✓		✓
FMLR-80-U-STL4E-4M-TCXO	✓	✓	✓	✓	✓	✓	

Options for other STM32 variants (USB, Cortex®-M0+/M4 with FPU, etc.) and external flash sizes are available on request.

Keep in Touch

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