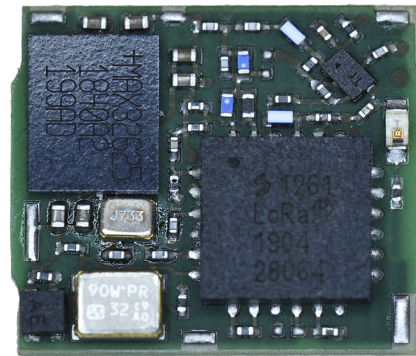


# FMLR 61-MAX

World's smallest high performance  
LoRaWAN® IoT module

Smallest FMLR sub-GHz low power  
wireless module with MAX32625 and  
Semtech SX1261



## Description

**FMLR-61-MAX** LoRa® and LoRaWAN® IoT module enables devices and sensors to communicate at low data rates or over a long distance. The integrated SX1261 transceiver supports a frequency range from 150 MHz up to 960 MHz covering all major sub-GHz ISM bands around the world. In addition to LoRa® and long range FHSS for LPWAN use cases, the module supports (G)FSK modulation.

Due to its low power consumption, the module is ideal for devices running on small-sized batteries. The integrated low power ARM Cortex®-M4 micro-controller with FPU featuring up to 512 kB flash and 160 kB RAM has sufficient resources to run user applications.

## Features

- ▶ Semtech SX1261 based
- ▶ LoRaWAN® IoT module
- ▶ Line-of-sight range of up to 100 km
- ▶ Maxim ARM Cortex®-M4F MCU
- ▶ Secure MCU option with MAX32626
- ▶ Customer application on MCU
- ▶ World smallest footprint: 8.5 × 9.3 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-61-MAX | Datasheet     | 2023/04/11 | 2        |

### Revision History

| Date       | Release | Changes            |
|------------|---------|--------------------|
| 2021/02/03 | 1.0     | Initial revision   |
| 2021/03/03 | 1.1     | New template       |
| 2021/08/09 | 1.2     | Updated FCC info   |
| 2021/11/09 | 1.3     | Pin-out correction |
| 2023/04/11 | 2       | Fully revised      |

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## Functional Description

The world's smallest **FMLR-61-MAX** LoRa® and LoRaWAN® IoT module provides wireless connectivity to devices, systems and sensors communicating with low data rates over a long distance. The integrated Semtech transceiver supports a frequency range from 150 MHz up to 960 MHz. Due to its low power consumption, the module is ideal for devices running on small-sized batteries. The integrated ARM Cortex®-M4 with FPU 32-bit microcontroller is capable of running entire RF stacks and has sufficient resources available to run user applications.

The MAX32626 variant (on request) supports additional security features such as secure boot and state-of-the-art encryption.

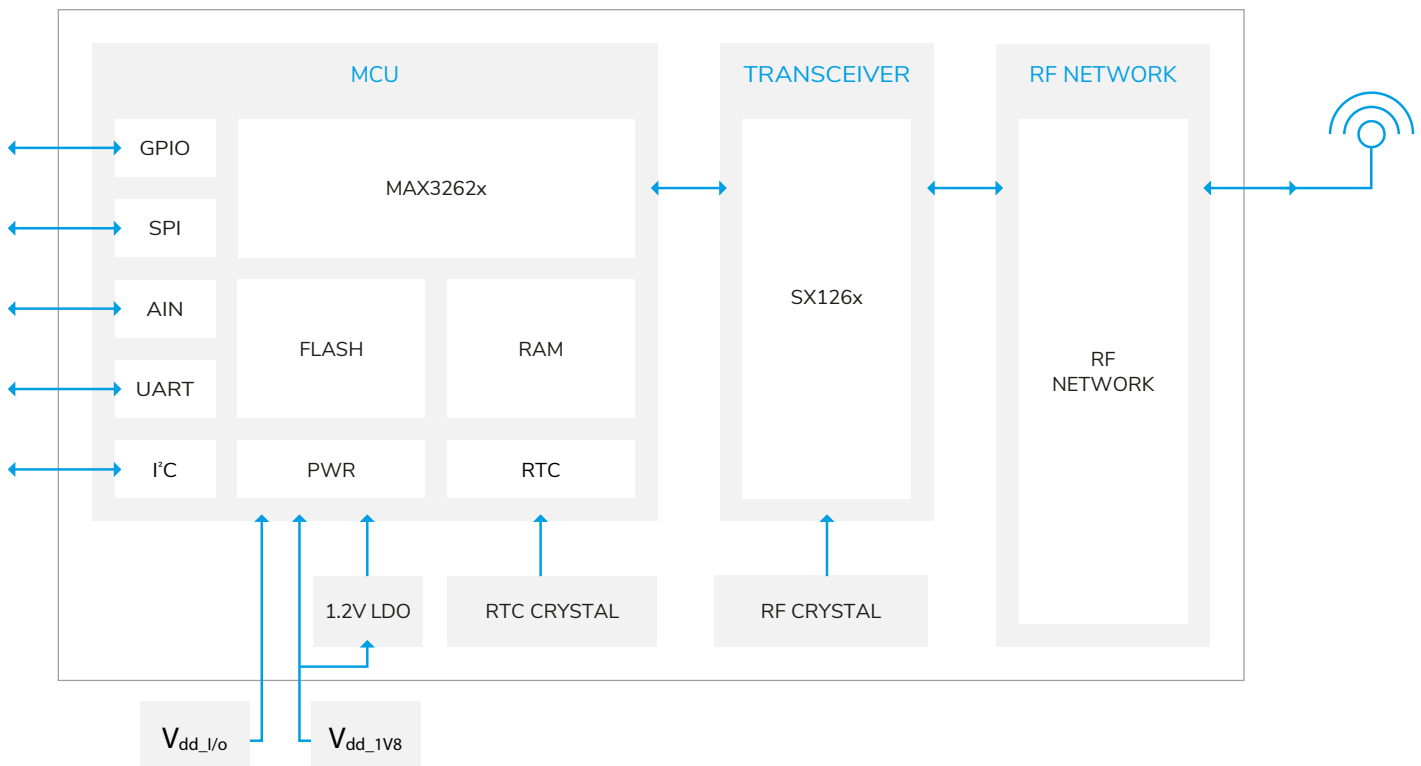


Figure 1: Block diagram FMLR-61-MAX

The modules offer sufficient data flash to support Over-the-Air (OTA) update and data storage. The **FMLR-61-MAX** supports many different modulation schemes such as LoRa®, long range FHSS and (G)FSK. This enables communication with standards like Wireless M-Bus and IEEE802.15.4g.

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

## Technical Specifications

### Core Components

|                   |                             |
|-------------------|-----------------------------|
| LoRa® transceiver | Semtech SX1261              |
| Microcontroller   | Maxim MAX32625IWYL+         |
| Core              | Cortex®-M4 with FPU, 96 MHz |
| Flash memory      | 256 kB                      |
| RAM               | 128 kB                      |

### Mechanical Specifications

|            |                    |
|------------|--------------------|
| Weight     | 1.3 g              |
| Dimensions | 8.5 × 9.3 × 1.8 mm |

### Operating Conditions

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

### Absolute Maximum Ratings

| Parameter                                           | Min  | Max  | Unit |
|-----------------------------------------------------|------|------|------|
| Ext. main supply voltage ( $V_{DD\_1V8}$ )          | -0.3 | 1.89 | V    |
| Ext. I/O supply voltage ( $V_{DD\_IO}$ )            | -0.3 | 3.6  | V    |
| Input voltage on I/O pins (GPIO, RSTN, SRSTN, JTAG) | -0.3 | 3.6  | V    |
| DC current on I/O pins (GPIO, RSTN, SRSTN, JTAG)    |      | 25   | mA   |
| Analog input A[0:1]                                 | -0.3 | 5.5  | V    |
| Analog input A[2:3]                                 | -0.3 | 3.6  | V    |
| 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 main supply ( $V_{DD\_1V8}$ ) | 1.8                       | 1.8 | 1.89 | V    |
| Standard operating voltage for I/O ( $V_{DD\_IO}$ )      | 1.8                       | 1.8 | 3.6  | V    |
| Digital IO pin input /output voltage                     | see datasheet of MAX32625 |     |      |      |
| Current consumption, TX mode (+10dBm, 3.3V) <sup>1</sup> |                           | 15  |      | mA   |
| Current consumption, TX mode (+14dBm, 3.3V) <sup>1</sup> |                           | 35  |      | mA   |
| Current consumption, RX mode <sup>1</sup>                | 4.2                       | 5.1 | 8.2  | mA   |
| Current consumption, sleep mode                          |                           | 2.5 |      | μA   |
| Highest receiver sensitivity <sup>1</sup>                |                           |     | -148 | dBm  |
| RF output power <sup>1</sup>                             |                           |     | 14   | dBm  |

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

## Certifications

CE

UKCA

FCC

FCC ID: 2AUQEF64CH

### ⚠ 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 1052620001 by Molex, 1.4 dBi gain.

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 P4.4. Actively drive port to low (0V) to light up LED. Drive port high or high Z to disable LED. LED anode is internally connected to  $V_{DD\_1V8}$ .

# Module Pinout

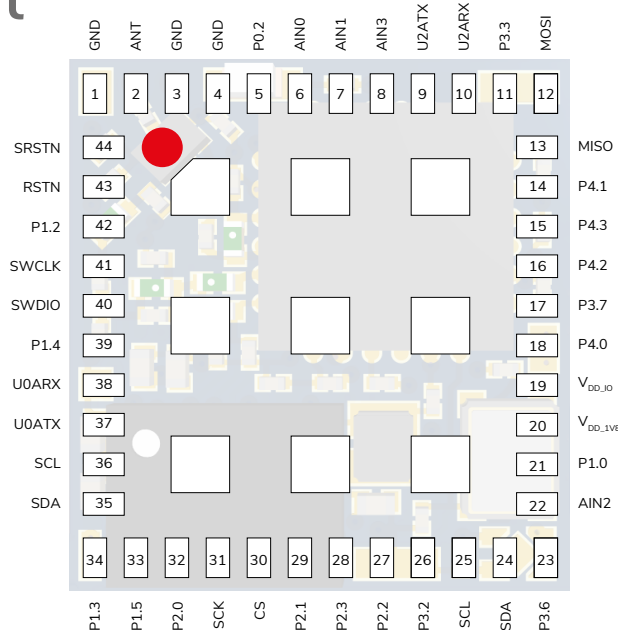


Figure 2: FMLR Pinout (top view)

| #  | Pad name | MCU pad | Description         |
|----|----------|---------|---------------------|
| 1  | GND      | GND     | Ground ( $V_{SS}$ ) |
| 2  | ANT      |         | RF Out (50 Ohms)    |
| 3  | GND      | GND     | Ground ( $V_{SS}$ ) |
| 4  | GND      | GND     | Ground ( $V_{SS}$ ) |
| 5  | P0.2     | P0.2    | GPIO                |
| 6  | AIN0     | AIN0    | Analog In 0         |
| 7  | AIN1     | AIN1    | Analog In 1         |
| 8  | AIN3     | AIN3    | Analog In 3         |
| 9  | U2ATX    | P3.1    | UART 2A TX          |
| 10 | U2ARX    | P3.0    | UART 2A RX          |
| 11 | P3.3     | P3.3    | GPIO                |
| 12 | MOSI     | P2.5    | SPI MOSI            |
| 13 | MISO     | P2.6    | SPI MISO            |
| 14 | P4.1     | P4.1    | GPIO                |
| 15 | P4.3     | P4.3    | GPIO                |
| 16 | P4.2     | P4.2    | GPIO                |
| 17 | P3.7     | P3.7    | GPIO                |
| 18 | P4.0     | P4.0    | GPIO                |
| 19 | VDD_IO   | VDD_IO  | VDD I/O             |
| 20 | VDD_1V8  | VDD_1V8 | VDD 1V8             |
| 21 | P1.0     | P1.0    | GPIO                |
| 22 | AIN2     | AIN2    | Analog In 2         |

| #  | Pad name | MCU pad | Description               |
|----|----------|---------|---------------------------|
| 23 | P3.6     | P3.6    | GPIO                      |
| 24 | SDA      | P3.4    | I <sup>2</sup> C M 1A SDA |
| 25 | SCL      | P3.5    | I <sup>2</sup> C M 1A SCL |
| 26 | P3.2     | P3.2    | GPIO                      |
| 27 | P2.2     | P2.2    | GPIO                      |
| 28 | P2.3     | P2.3    | GPIO                      |
| 29 | P2.1     | P2.1    | GPIO                      |
| 30 | CS       | P2.7    | SPI CS                    |
| 31 | SCK      | P2.4    | SPI SCK                   |
| 32 | P2.0     | P2.0    | GPIO                      |
| 33 | P1.5     | P1.5    | GPIO                      |
| 34 | P1.3     | P1.3    | GPIO                      |
| 35 | SDA      | P1.6    | I <sup>2</sup> C M0A SDA  |
| 36 | SCL      | P1.7    | I <sup>2</sup> C M0A SCL  |
| 37 | U0ATX    | P0.1    | UART 0A TX                |
| 38 | U0ARX    | P0.0    | UART 0A RX                |
| 39 | P1.4     | P1.4    | GPIO                      |
| 40 | SWDIO    | SWDIO   | MCU Debug                 |
| 41 | SWCLK    | SWCLK   | MCU Debug                 |
| 42 | P1.2     | P1.2    | GPIO                      |
| 43 | RSTN     | RSTN    | POR Reset                 |
| 44 | SRSTN    | SRSTN   | MCU Soft Reset            |

## FMLR Family Footprint

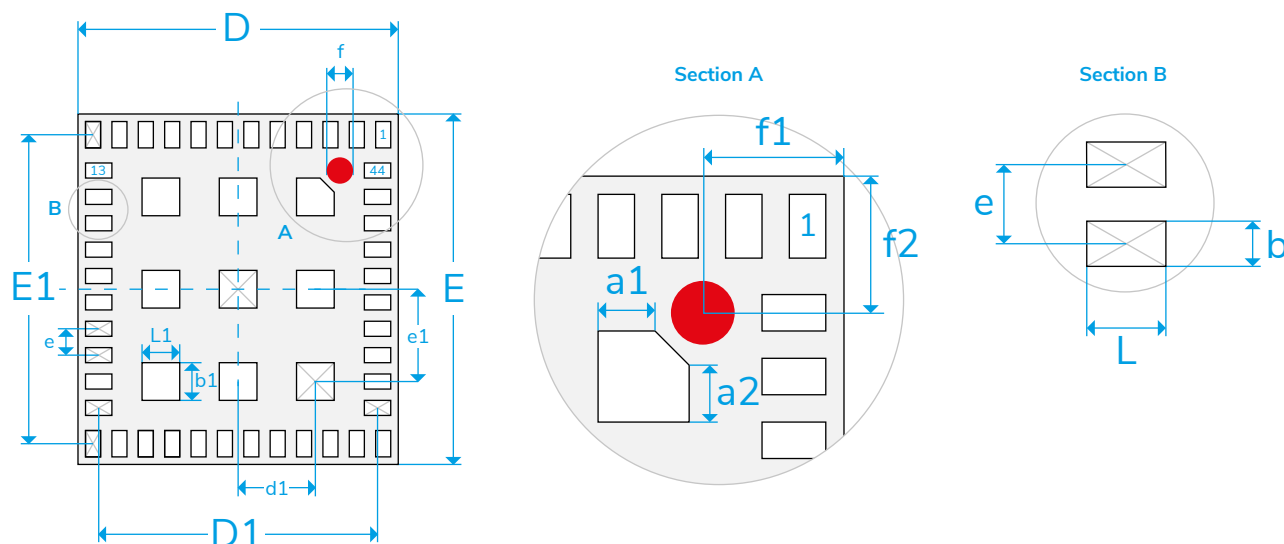


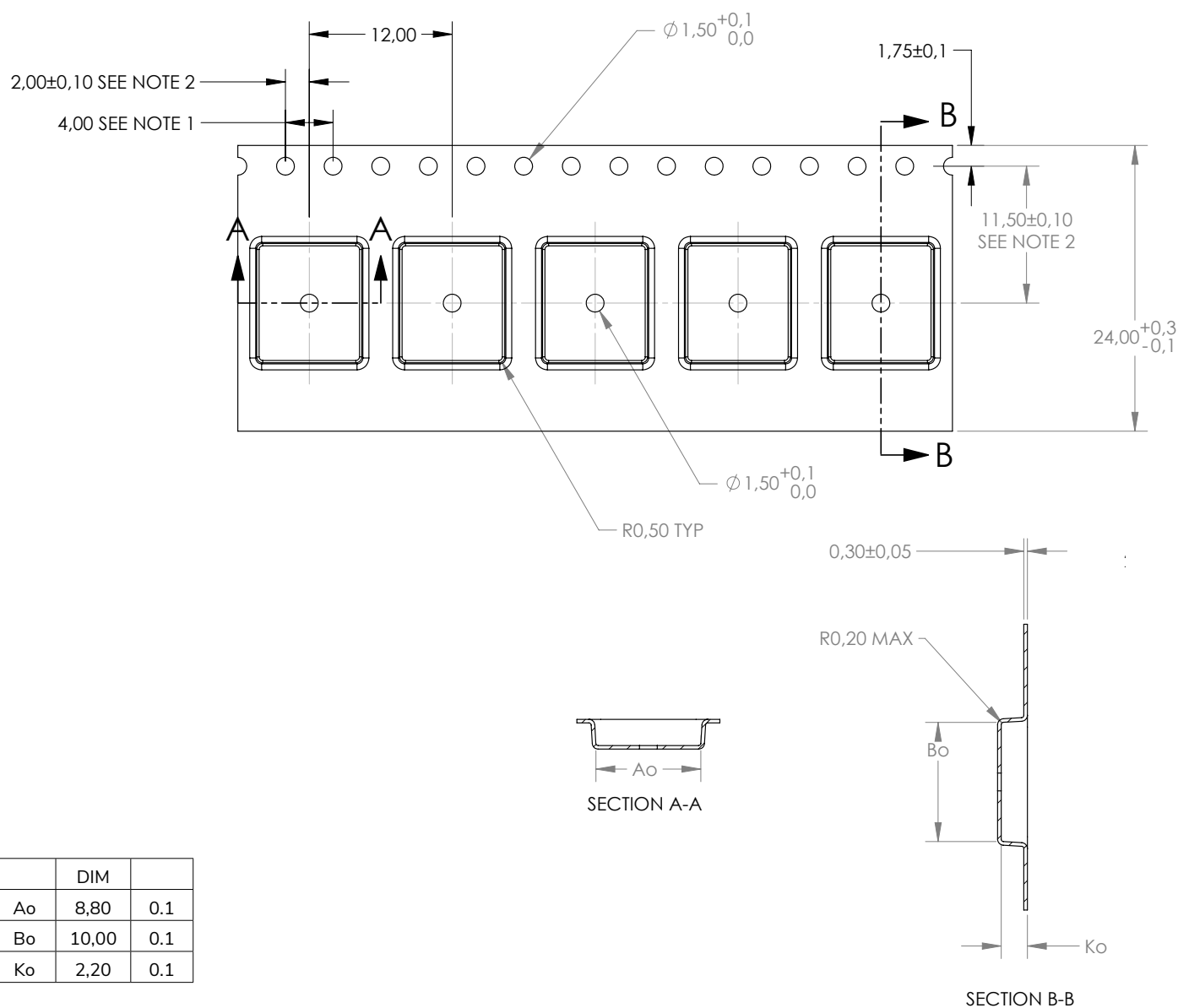
Figure 3: FMLR Module Footprint (bottom view)

### FMLR Footprint Dimensions\*

| Dimension (see Figure 3: FMLR Module Footprint)      | Min | Typ   | Max |
|------------------------------------------------------|-----|-------|-----|
| a1                                                   |     | 0.625 |     |
| a2                                                   |     | 0.625 |     |
| f1                                                   |     | 1.5   |     |
| f2                                                   |     | 1.55  |     |
| D                                                    |     | 8.5   |     |
| E                                                    |     | 9.3   |     |
| D1                                                   |     | 7.4   |     |
| E1                                                   |     | 8.2   |     |
| e                                                    |     | 0.7   |     |
| b                                                    |     | 0.4   |     |
| L                                                    |     | 0.7   |     |
| b1                                                   |     | 1     |     |
| L1                                                   |     | 1     |     |
| d1                                                   |     | 2.05  |     |
| e1                                                   |     | 2.45  |     |
| f (GND plane allowed. No bare copper in this region) |     | 0.7   |     |

\*All dimensions in mm

## Tape Information



- 10 Sprocket hole pitch cumulative tolerance  $\pm 0.2$
- Pocket position relative to sprocket hole measured as true position of pocket, not Pocket hole.
- $A_o$  and  $b_o$  are measured on a plane at a distance „r“ above the bottom of the pocket.

All dimensions in mm

Tolerances unless - specified

1 PL  $\pm 0.2$

2 PL  $\pm 0.10$



## Recommended Soldering Conditions

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

Reflow process should be finished within 1 cycle.

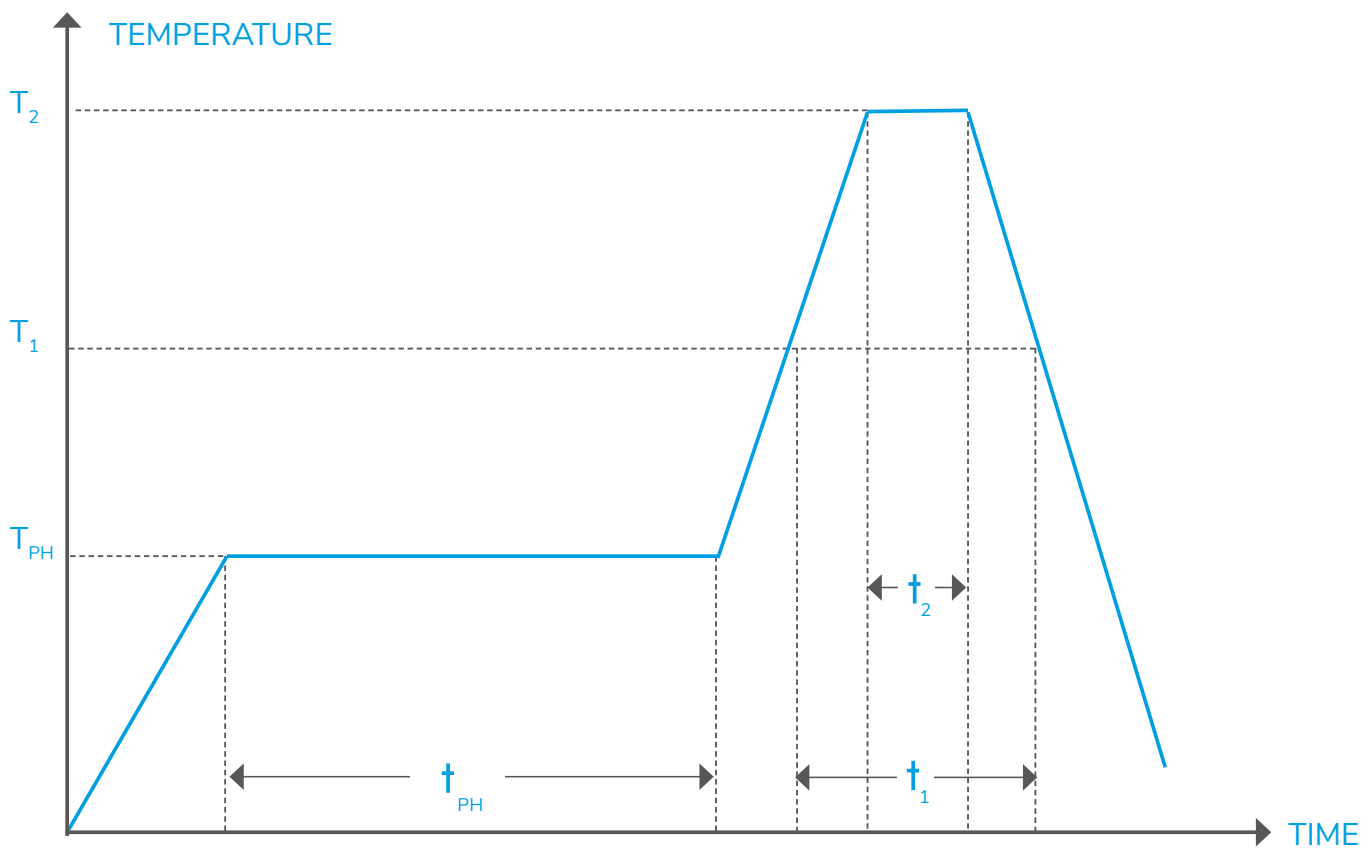


Figure 4: Soldering Profile

### 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-61-max">miromico.ch/fmlr-61-max</a>   |
| Technical documentation  | <a href="https://docs.miromico.ch/modules">docs.miromico.ch/modules</a> |

## Device Options

| Product ID      | MCU options |              |              |            |            | RF     |        |
|-----------------|-------------|--------------|--------------|------------|------------|--------|--------|
|                 | Cortex®-M4+ | 512 kB flash | 256 kB flash | 160 kB RAM | 128 kB RAM | SX1261 | SX1262 |
| FMLR-61-P-MA625 | ✓           |              | ✓            |            | ✓          | ✓      |        |

Options for other MAX3262x or SX126x variants are available on request.

## Keep in Touch

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