FMLR-72-x-STL0Z

High Performance LoRaWAN®-RF-Modules and Sensors

Description

The FMLR LoRaWAN® RF modules enable wireless connectivity to devices, systems and sensors communicating at low data-rate over a long distance. Power consumption can be optimized to run from a small-sized battery. The integrated ARM Cortex-M0+ 32-bit microcontroller runs the entire RF stack and has sufficient resources available to run user applications. The system can easily be extended with low power sensors to build production ready IoT sensor nodes.
All FMLR modules are prepared for seamless integration into LoRaWAN networks. The modules are available with additional on-board flash memory to enable Over-the-Air (OTA) update and data storage.
The module offers a frequency range from 860 MHz up to 1020 MHz. The FMLR family supports additional modulation schemes over LoRa®. These modulation schemes include (G)FSK, (G)MSK, ASK, and OOK. This enables communication with standards like Wireless M-Bus and IEEE802.15.4g. The modules also allows the emulation of proprietary systems such as Nordic NRF905 or NRF9E5 with enhanced coverage range.
In order to support fast prototyping and development, the module's firmware including the wireless stack can be updated via SWD, UART-Bootloader or OTA.

Key benefits

- LoRaWAN IoT module
- Line-of-sight range of 100 km possible
- Runs customer specific applications and existing radio stacks
- Tiny footprint: 14 x 19.5 mm
- Supports frequency range from 860 to 1020 MHz
- Fully FCC and CE certified

Applications

- Low data rate IoT use cases
- Telemetry applications
- Smart city / smart building
- Tracking and monitoring
- Smart agriculture
- Battery powered sensors
- Low power RF systems
- Remote data logging
- Industrial and home automation
- UART / SPI / I2C wireless bridging (USB optionally available)

About this Document	
Title	FMLR-72-x-STL0Z
Subtitle	High Performance LoRaWAN®-RF-Modules and Sensors
Document Type	Datasheet
Revision	1.0157
Date	07/20/20
Document Status	Preliminary
FCC ID	2AUQE14DJC

Contents

FCC: 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 undesired operation.

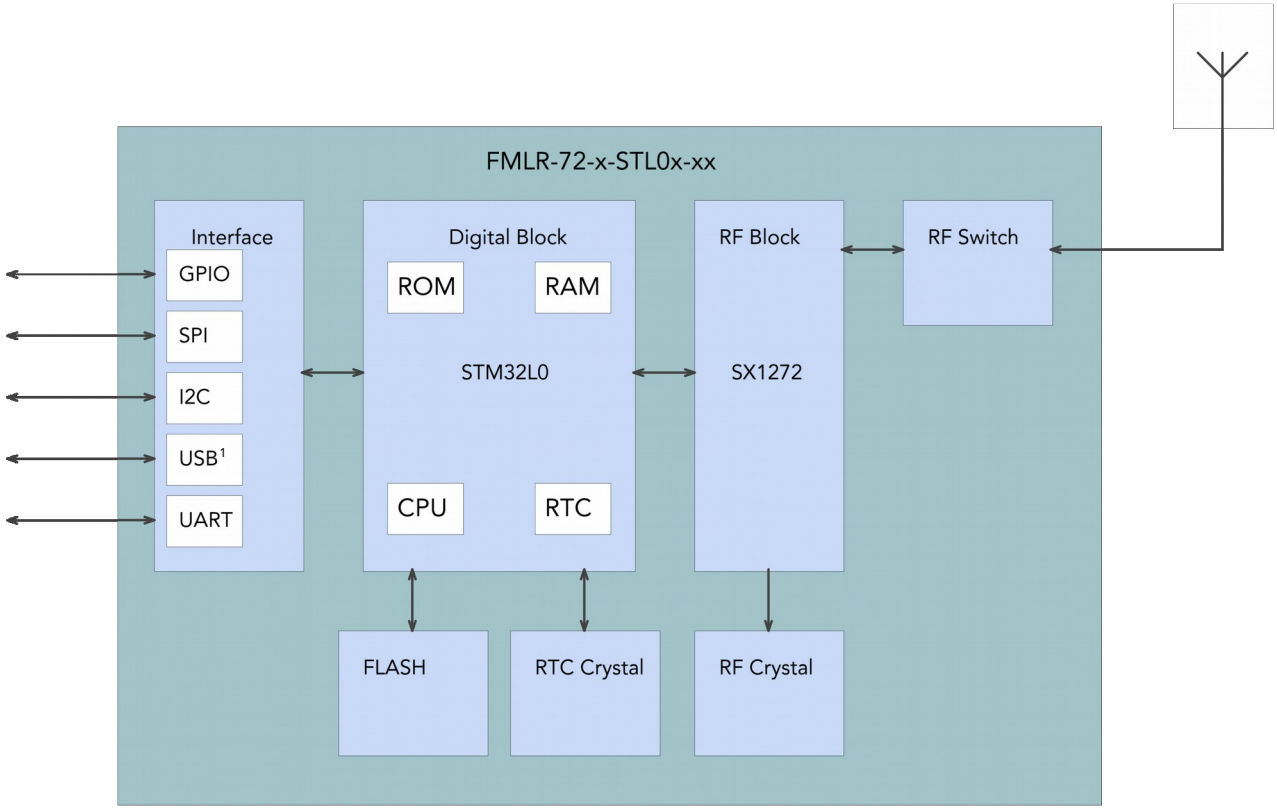
The module is FCC compliant by using antenna ANT-868-PW-QW-UFL from Linx Technologies Inc.

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

Functional Description

The FMLR-72-x-STL0Z is a compact low-power wide-area network (LPWAN) wireless module that supports the LoRaWAN long-range wireless protocol.
The external antenna module measures just 14 x 19.5 mm or 14 x 22.75 mm in the chip antenna variant. This makes it an extraordinarily small LoRa Module with an integrated antenna. The module includes a Semtech SX1272 ultra-long-range spread-spectrum wireless transceiver and an STM32L0Z series ARM Cortex M0+ 32 bit microcontroller (MCU) with an internal flash size of 192 kB.
It is capable of sending with up to 20 dBm and receiving with a sensitivity of -137dBm. This allows the module to be placed in high density urban or long range rural environments and connect a large variety of sensors to LoRaWAN and proprietary networks based on LoRa, (G)FSK, (G)MSK, ASK, OOK coding schemes. Examples are Wireless M-Bus, IEEE802.15.4g, Nordic NRF905 and NRF9E5 emulation.

Block Diagram



[1] USB Interface is optinally available

Absolute Maximum Ratings

Symbol	Ratings	Min	Max	Unit
V_{DD} - V_{SS}	External main supply voltage (on all Power Pins)	-0.3	3.6	V
V_{IN}	Input Voltage any Pin	V_{SS} - 0.3	V_{DD}	V
I_{PIN}	DC current on any Pin		10	mA
T_{STG}	Storage Temperature	-40	+85	°C

WARNING!
Stressing the device beyond the "Absolute Maximum Ratings" may cause permanent damage.

These are stress ratings only. The product is not protected against over voltage or reversed voltages. Use protection diodes to limit voltage spikes to the boundaries given above.

Operation Conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DD}	Standard operating Voltage	-	1.8	-	3.6	V
V_{IL}	Digital IO Pin Low Input Voltage	-	V_{SS}	-	0.4*V_{DD}	V
V_{IH}	Digital IO Pin High Input Voltage	-	0.7*V_{DD}	-	V_{DD}	V
V_{OL}	Digital IO Pin Low Output Voltage	-	0	-	0.4	V
V_{OH}	Digital IO Pin High Output Voltage	-	V_{DD}-0.4	-	-	V
$\sum I_{SUPPL}$	Current Consumption	TX mode (14 dBm)	-	25.5	-	mA
		RX Mode	-	8.2	-	mA
		Sleep Mode	-	1.4	-	µA
P_{RFIN}	Highest receiving sensitivity	-	-	-	-137	dBm
RF_{OUT}	RF Output Power	V_{DD} > 2.4 V (DC)	-	-	20	dBm
		V_{DD} < 2.4 V (DC)	-	-	17	dBm
RX_{FSK}	Receiver sensitivity FSK Mode	1.2kbps	-	-123	-	dBm
		38.4 kbps	-	-110	-	dBm
RX_{LORA}	Receiver sensitivity LoRa Mode	SF12 @ 125 kHz	-	-137	-	dBm
		SF6 @ 500 kHz	-	-111	-	dBm
RX_{SNR}	Receiver signal to noise ratio	SF12	-	-20	-	dB
		SF6	-	-5	-	dB
T_{OPT}	Operating Temperature	-	-40	-	+85	°C

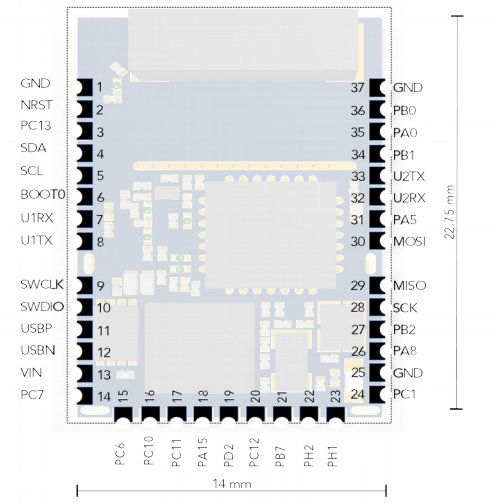
Variants

Partnumber	RF Path	Size	Controller	Internal Flash Size
FMLR-72-U-STL0Z-(4M)	U.FL connector	14 x 19.5 x 3.5 mm[3]	STM32L071Z[2]	192 kB
FMLR-72-P-STL0Z-(4M)	Antenna pad	14 x 19.5 x 2.2 mm	STM32L071Z[2]	192 kB
FMLR-72-C-STL0Z-(4M)	On board antenna	14 x 22.75 x 5.2 mm	STM32L071Z[2]	192 kB

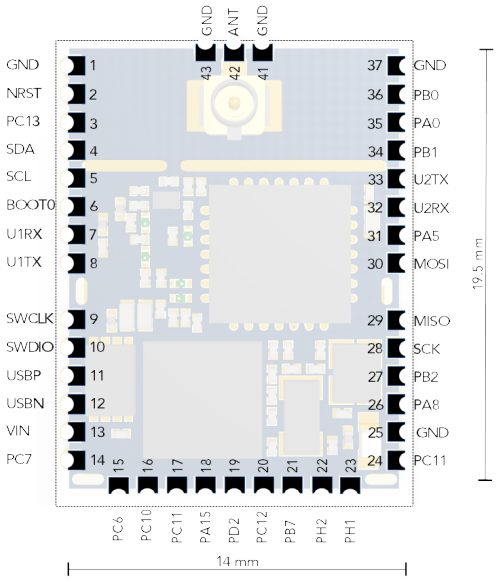
[2] Options for other STM32 variants and external flash (4 Mbit) are available on request, such as USB, Cortex-M4 with FPU
[3] With U.FL antenna connected. 14 x 19.5 x 2.5 mm without a connected antenna.

Please also refer to the FMLR part numbering scheme on the Miromico website:
https://miromico.ch/portfolio/fmlr_stm/part-numbering-schema/

Dimensions and Pinout



FMLR-72-C-STL0Z-(4M)



FMLR-72-U-STL0Z-(4M) and FMLR-72-P-STL0Z-(4M)

#	Pad Name	MCU Pad	Description
1	GND		Ground (V_{SS})
2	NRST	NRST	MCU Reset
3	PC13	PC13	MCU PC13
4	SDA	PB9	MCU I2C SDA
5	SCL	PB6	MCU I2C SCL
6	BOOT0	BOOT0	MCU BOOT0
7	U1RX	PA10	MCU UART1 RX
8	U1TX	PA9	MCU UART1 TX
9	SWCLK	PA14	MCU Debug CLK
10	SWDIO	PA13	MCU Debug Data
11	USBP	PA12	MCU USB Data Positive (L073)
12	USBN	PA11	MCU USB Data Negative (L073)
13	VIN		Supply Voltage
14	PC7	PC7	MCU PC7
15	PC6	PC6	MCU PC6
16	PC10	PC10	MCU PC10
17	PC11	PC11	MCU PC11
18	PA15	PA15	MCU PA15
19	PD2	PD2	MCU PD2
20	PC12	PC12	MCU PC12

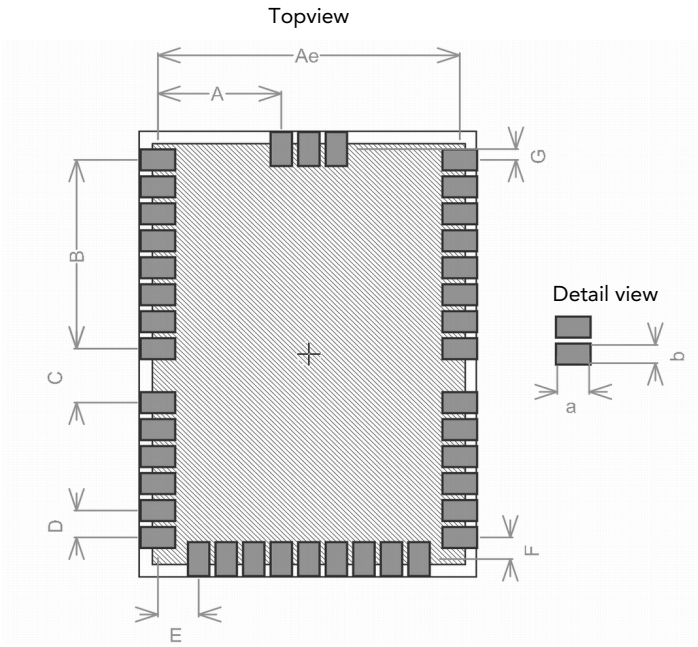
#	Pad Name	MCU Pad	Description
21	PB7	PB7	MCU PB7
22	PH2	PH0	MCU PH2
23	PH1	PH1	MCU PH1
24	PC1	PC1	MCU PC1
25	GND		Ground (V_{SS})
26	PA8	PA8	MCU PA8
27	PB2	PB2	MCU PB2
28	SCK	PB3	MCU SPI SCLK[4]
29	MISO	PB4	MCU SPI MISO[4]
30	MOSI	PB5	MCU SPI MOSI[4]
31	PA5	PA5	MCU SPI CSS
32	U2RX	PA3	MCU UART2 RX
33	U2TX	PA2	MCU UART2 TX
34	PB1	PB1	MCU PB1
35	PA0	PA0	MCU PA0
36	PB0	PB0	MCU PB0
37	GND		Ground (V_{SS})
41	GND		Ground (V_{SS})
42	ANT		RF Out (50 Ohms)
43	GND		Ground (V_{SS})

[4] **IMPORTANT:** If the module variant contains an external flash, these pins are connected internally and should not be used as GPIO pins!

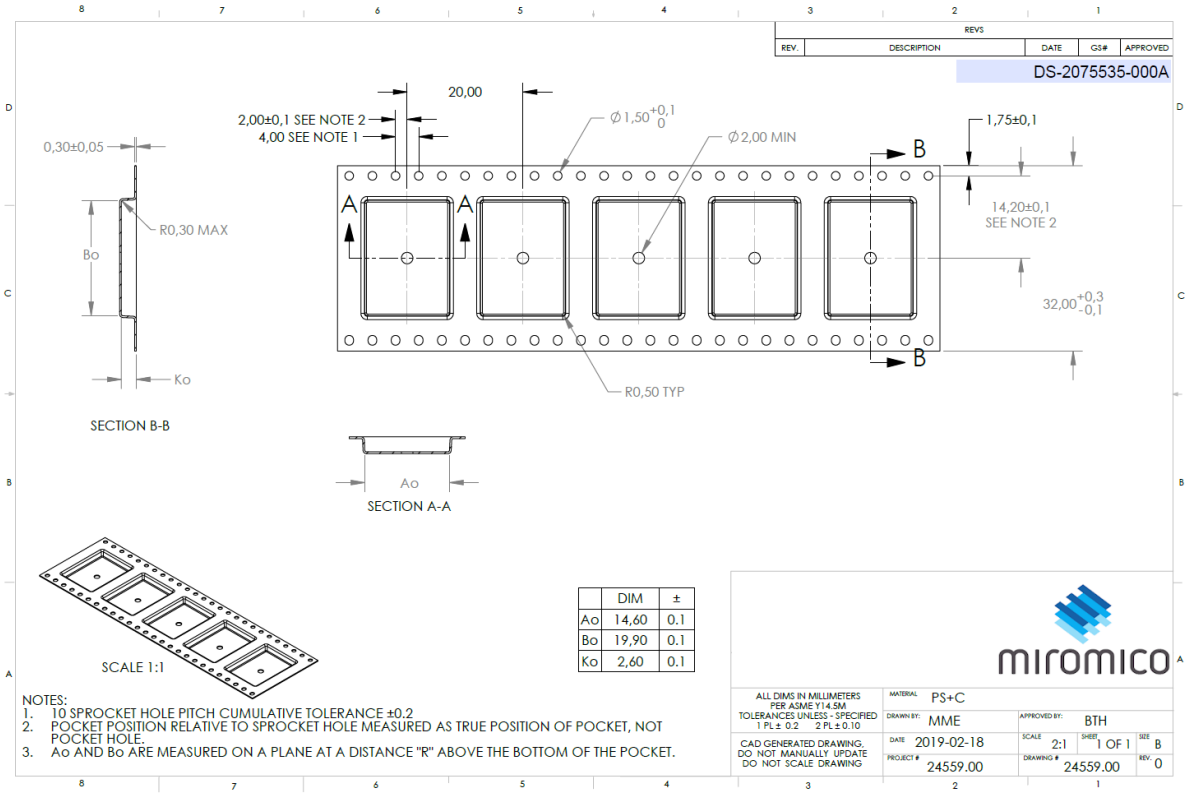
Footprint FMLR Family

Dimension	Min.	Typ.	Max.
A		5.6	
Ae		13.7	
B		8.75	
C		2.5	
D		1.25	
E		1.85	
F		1	
G		0.5	
a	1.45	1.5	1.55
b	0.85	0.9	0.95

All measurements in mm



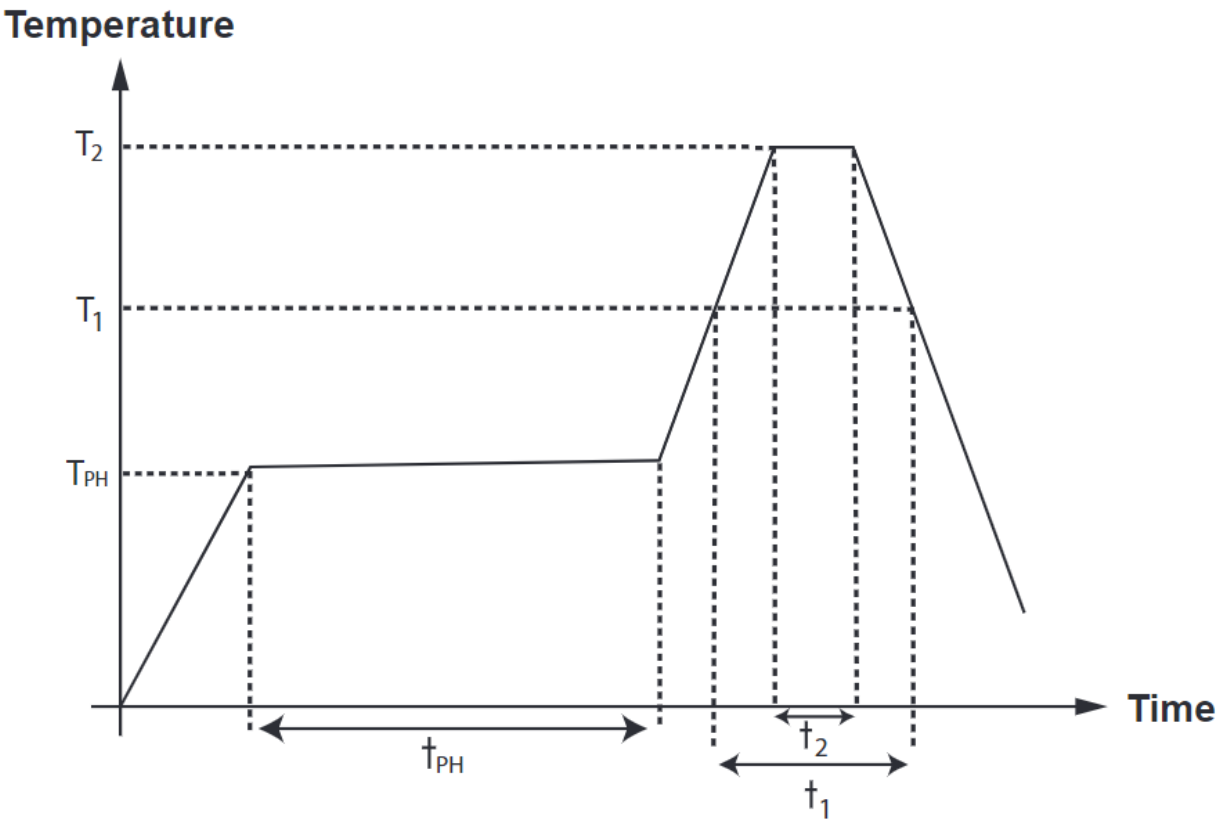
Tape Information



Recommended Soldering Condition

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.



Step	Temperature condition
Preheat	T_{PH} = 150 °C to 180°C t_{PH} = 120 s
Heating	T_1 = 220°C t_1 = 60 s
Solder	T_2 = 255°C t_2 = 5 s