
WLR089U0 Low Power LoRa[®] Sub-GHz Module Data Sheet

Introduction

The WLR089U0 is a Long Range (LoRa) transceiver module for the sub-1GHz ISM bands such as 868 MHz (Europe) and 915 MHz (North America), optimized for ultra-low-power applications. This module combines the ATSAMR34J18B SiP (System-in-Package), 32.768 kHz crystal, 32 MHz TCXO, RF switch, lumped element harmonics rejection filter, impedance matching circuits, Low Pass Filter (LPF) and required RF shielding in a compact 17 mm x 13.5 mm design. The module supports LoRa[®] and FSK modulation.

The LoRa technology is a spread spectrum protocol optimized for low data-rate, ultra-long range signaling. It is ideal for battery-powered remote sensors and controls. The module also includes USB, making it suitable for USB dongle applications or for software updates via USB.

Note: For a detailed description on the supported peripherals, refer to the [SAM R34/R35 Low Power LoRa Sub-GHz SiP Datasheet \(DS70005356\)](#).

Features

- Processor:
 - ARM Cortex -M0+ CPU running at up to 48 MHz (2.46CoreMark[®]/MHz)
 - Single-cycle hardware multiplier
 - Micro Trace Buffer (MTB)
- Memory:
 - In-system self-programmable 256 KB Flash memory
 - 32 KB Static Random Access Memory (SRAM)
 - 8 KB low power SRAM memory
- System:
 - Power-on Reset (POR) and Brown-out Reset (BOR)
 - Internal and external clock options with 48 MHz Digital Frequency Locked Loop (DFLL48M) and 48 MHz to 96 MHz Fractional Digital Phase Locked Loop (FDPLL96M)
 - External Interrupt Controller (EIC)
 - Up to 15 external interrupts
 - One Non-Maskable Interrupt (NMI)
 - 2-pin Serial Wire Debug (SWD) programming, test and debugging interface
- Operating Voltage: 1.8V – 3.5V
- Low Power Consumption
 - Transceiver:
 - RX = 12.64 mA (typical)
 - RFO_HF = 41.54 mA (typical)
 - PA_BOOST = 114.68 mA (typical)
 - MCU:
 - Standby and Backup Sleep modes
 - SleepWalking peripherals
- Temperature Range: –40°C to +85°C (Industrial)

RF/Analog Features

- Integrated LoRa Technology Transceiver:
 - 863 MHz to 928 MHz dual-band coverage
 - +18.59 dBm maximum power ($V_{CC} > 2.4 V_{DC}$)
- High Sensitivity:
 - -136 dBm (LoRaWAN[®] protocol compliant modes)
- Up to 154.59 dB Maximum Link Budget
- Robust Front-end: IIP3 = -11 dBm
- Excellent Blocking Immunity
- Fully Integrated Synthesizer with a Resolution of 61 Hz
- LoRa Technology and (G)FSK Modulations
- Preamble Detection
- 127 dB Dynamic Range RSSI
- Automatic RF Sense and Channel Activity Detection (CAD) with Ultra-Fast Automatic Frequency Control (AFC)
- Packet Engine up to 256 Bytes with Cyclic Redundancy Check (CRC)

Peripheral Information

- 16-Channel Direct Memory Access Controller (DMAC)
- 12-Channel Event System
- Three 16-bit Timer/Counters (TC), Configurable as Either of the Following:
 - One 8-bit TC with compare/capture channels
 - One 16-bit TC with compare/capture channels
 - One 32-bit TC with compare/capture channels, by using two TCs
- Two 24-bit and one 16-bit Timer/Counters for Control (TCC), with Extended Functions:
 - Up to four compare channels with optional complementary output
 - Generation of synchronized Pulse Width Modulation (PWM) pattern across port pins
 - Deterministic fault protection, fast decay and configurable dead-time between complementary output
 - Dithering that increases resolution with up to five bit and reduces quantization error
- 32-Bit Real Time Counter (RTC) with Clock/Calendar Function
- Watch-dog Timer (WDT)
- CRC-32 Generator
- One Full-speed (12 Mbps) Universal Serial Bus (USB) 2.0 Interface:
 - Embedded host and device function
 - Eight endpoints
- Up to Four Serial Communication Interfaces (SERCOM) Including One Low-Power SERCOM (SERCOM5⁽³⁾), Each Configurable to Operate as Either of the Following:
 - USART with full-duplex⁽¹⁾ or single-wire half-duplex configuration
 - I2C up to 3.4 MHz⁽²⁾
 - Serial Peripheral Interface (SPI)
 - Local Interconnect Network (LIN) client
- One 12-bit, 1 Msps Analog-To-Digital Converter (ADC) with up to Seven External Channels:
 - Differential and single-ended input
 - Automatic offset and gain error compensation
 - Oversampling and decimation in hardware to support 13-, 14-, 15- or 16-bit resolution
- Two Analog Comparators (AC) with Window Compare Function
- Peripheral Touch Controller (PTC)
 - 12-channel capacitive touch and proximity sensing
- 23 Programmable I/O Pins

Note:

1. SERCOM2 has only 2 interface lines for use so it can be used only for single-wire half-duplex configuration. USART Full duplex and SPI modes are not supported.
2. I2C support is available only in PA16, PA17, PA22 and PA23 pins.
3. SERCOM5, due to its location in Power Domain (PD0) in SAM L21, has a reduced feature set and does not support the following features:
 - DMA support
 - USART:
 - 3x or 8x oversampling
 - Flow control (RTS/CTS)
 - IrDA
 - Single wire UART according to EN54
 - Start of Frame (SOF)/End of Frame (EOF) function
 - I2C:
 - Fast mode plus (Fm+) and High-speed (Hs) mode
 - SMBus Serial Clock Low (SCL) timeout
 - 10-bit addressing
 - Power Management Bus (PMBus) group command support
 - SPI:
 - Hardware chip select
 - Wake on Serial Select (SS) assertion

Table of Contents

Introduction.....	1
Features.....	1
1. Quick References.....	6
1.1. Reference Documentation.....	6
1.2. Acronyms/Abbreviations.....	6
2. Ordering Information.....	9
3. Functional Overview.....	10
3.1. ATSAMR34J18B SiP Description.....	11
3.2. Pinout Diagram.....	12
3.3. Package Details.....	15
4. Radio Transceiver.....	16
4.1. Transceiver Validation.....	16
5. Nonvolatile Memory	17
6. Host Interface.....	18
6.1. Interconnection between SAM L21 and Transceiver within ATSAMR34J18B SiP.....	18
6.2. Programming and Debugging.....	19
7. Electrical Specifications.....	20
7.1. Absolute Maximum Ratings.....	20
7.2. Recommended Operating Conditions.....	20
7.3. Transceiver Performance Characteristics.....	20
7.4. DC Characteristics.....	22
8. Reference Circuit.....	24
9. Design Considerations.....	25
9.1. Approved External Antennas.....	25
9.2. Module Assembly Considerations.....	26
10. Packaging Information.....	27
10.1. Module Package Marking.....	27
10.2. Module Outline Drawings.....	28
11. Appendix A: Regulatory Approval.....	31
11.1. United States.....	32
11.2. Canada.....	33
11.3. Europe.....	34
11.4. Japan.....	36
11.5. Korea.....	36
11.6. Taiwan.....	37
11.7. Brazil.....	37
11.8. Other Regulatory Information.....	38

12. Document Revision History..... 39

The Microchip Website..... 40

Product Change Notification Service..... 40

Customer Support..... 40

Microchip Devices Code Protection Feature..... 40

Legal Notice..... 41

Trademarks..... 41

Quality Management System..... 42

Worldwide Sales and Service..... 43

1. Quick References

1.1 Reference Documentation

For further details, refer to the following:

- *SAM R34-R35 Low Power LoRa Sub-GHz SiP Datasheet* ([DS70005356](#))
- *SAM L21 Family Data Sheet* ([DS60001477](#))
- *SAM R34/R35 Errata Sheet* ([DS80000834](#))⁽¹⁾
- *AN2468 Production Programming of Microchip AVR® and SAM Microcontrollers Application Note* ([DS00002468](#))
- *Semtech SX1276/77/78/79 Low Power Long Range Transceiver Datasheet*
- [LoRaWAN® Regional Parameters](#)
- *WLR089U0 Module Reference Design Package* (available in www.microchip.com/WLR089U0)

Notes:

1. This Errata is also applicable for the WLR089U0 module.
2. For a complete list of development support tools and documentation, visit www.microchip.com/WLR089U0.

1.2 Acronyms/Abbreviations

Table 1-1. Acronyms/Abbreviations

Acronyms/Abbreviations	Description
AC	Analog Comparators
ADC	Analog-To-Digital Converter
AFC	Automatic Frequency Control
AHB	AMBA Advanced High-Performance Bus
AIN	Analog Inputs
AMBA	Advanced Microcontroller Bus Architecture
APB	AMBA Advanced Peripheral Bus
BOR	Brown-out Reset
BUPDIV	Backup Clock Division
BW	Bandwidth
CCL	Custom Control Logic
CPUDIV	CPU Clock Division
CRC	Cyclic Redundancy Check
CTS	Clear To Send
EC	Error Correction Code
EIC	External Interrupt Controller
EMI	Electro Magnetic Interference
FSK	Frequency Shift Keying
GCLK	Generic Clock Generator

.....continued	
Acronyms/Abbreviations	Description
GPIO	General Purpose I/O pin
HVIN	Hardware Version Identification Number
IPA	Isopropyl alcohol
IrDA	Infrared Data Association
IRQ	Interrupt Request
ISM	Industrial, Scientific and Medical
LIN	Local Interconnect Network
LNA	Low Noise Amplifier
LoRa	Long Range
LoRaWAN [®]	Long Range Wide Area Network
LPDIV	Low Power Clock Division
MTB	Micro Trace Buffer
NMI	Non-Maskable Interrupt
OEM	Original Equipment Manufacturer
PA	Power Amplifier
PER	Packet Error Rate
PMN	Product Marketing Name
POR	Power-on Reset
PTC	Peripheral Touch Controller
RF	Radio frequency
RFI_HF	RF Input High Frequency
RFO_HF	RF Output High Frequency
RSSI	Received signal strength indication
RSTC	Reset Controller
RTC	Real Time Counter
RTS	Request To Send
RX	Receive/Receiver
SERCOM	Serial Communication
SF	Spreading Factor
SiP	System-in-package
SMBus	System Management Bus
SP3T	Single Pole Three Throw
SRAM	Static Random Access Memory
SUPC	Supply Controller
SWD	Serial Wire Debug

.....continued

Acronyms/Abbreviations	Description
TCXO	Temperature Compensated Crystal Oscillator
TRX	Transceiver
TX	Transmit/Transmitter
UART	Universal Asynchronous Receiver Transmitter
UHF	Ultra-High Frequency
USART	Universal Synchronous and Asynchronous Receiver and Transmitter
USB	Universal Serial Bus
WDT	Watch-dog Timer
WiSUN	Wireless Smart Utility Network
WMBus	Wireless Meter Bus
WO	Waveform Outputs

2. Ordering Information

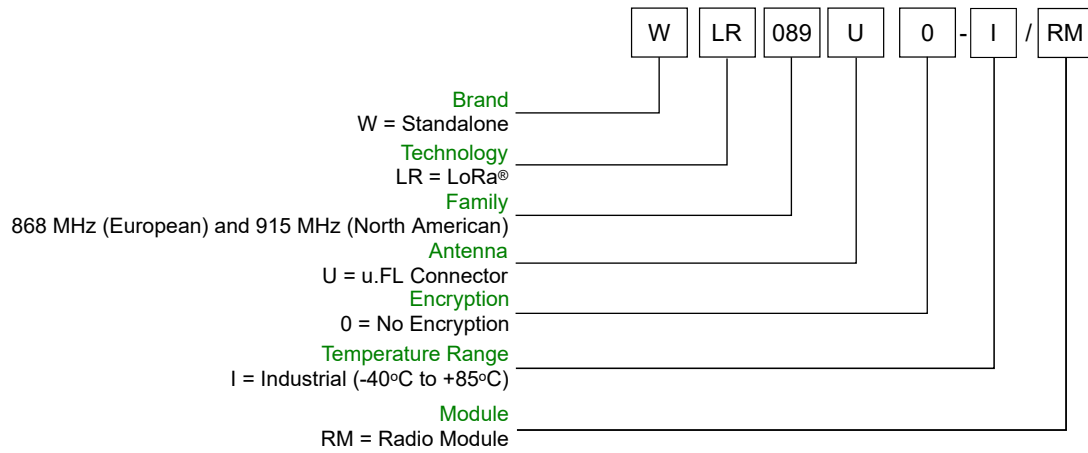
The following table provides the ordering details for the module.

Table 2-1. Ordering Information for WLR089U0

Model Number	IC Name	Description	Regulatory Approval	Ordering Code
WLR089U0	ATSAMR34J18B	Low Power Long Range (LoRa [®]) module with RF Shield CAN, u.FL connector for external antenna, castellated pads and available in Tray package.	FCC, ISED, CE, MIC, KC, NCC and Anatel	WLR089U0-I/RM

The following figure illustrates the module ordering code information.

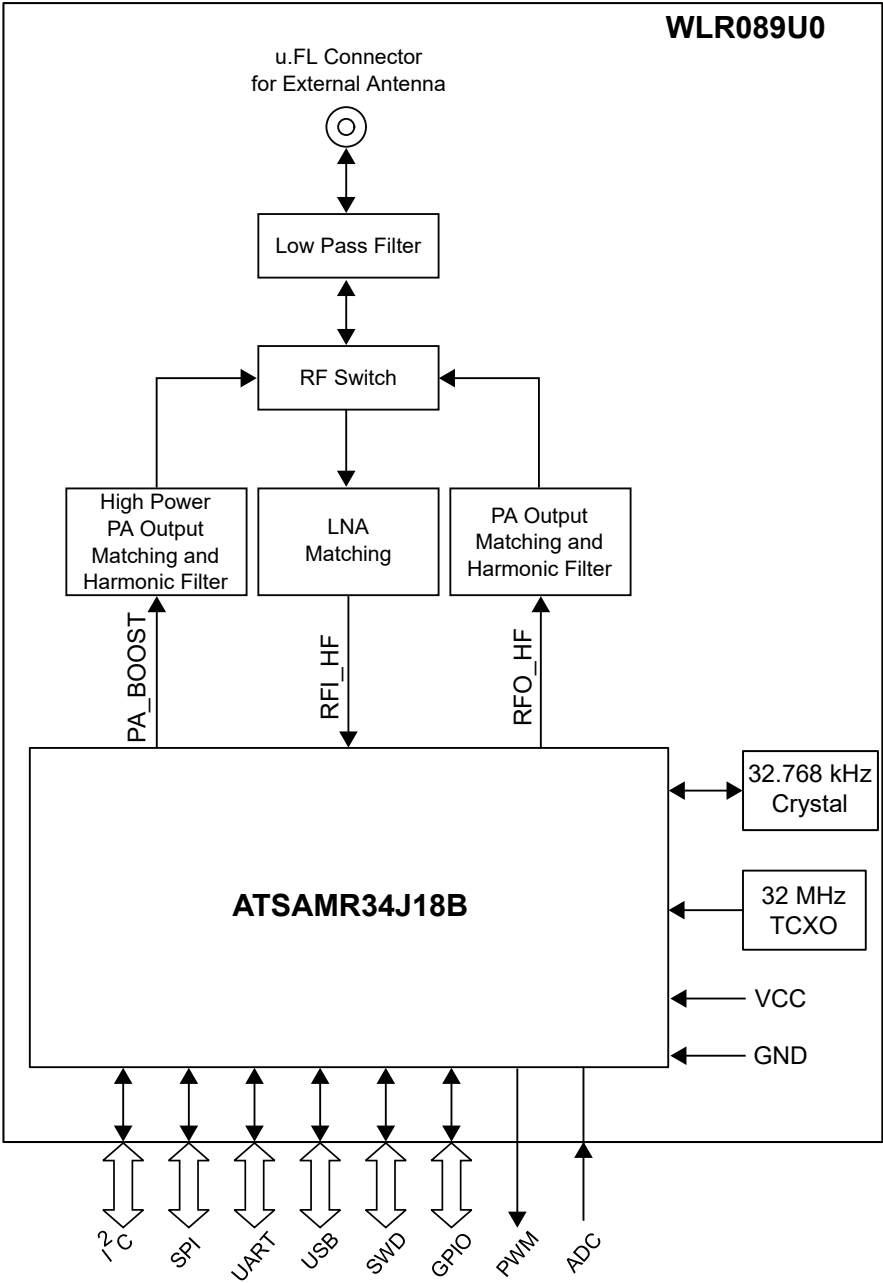
Figure 2-1. Module Ordering Code Information



3. Functional Overview

The WLR089U0 module contains ATSAMR34J18B SiP, 32.768 kHz crystal, 32 MHz TCXO, RF switch (SP3T), lumped element harmonic filter, RF matching components and a Low Pass Filter (LPF) (see the following figure).

Figure 3-1. WLR089U0 Module Block Diagram



Note: The ATSAMR34J18B SiP includes an ultra-low power SAM L21 ARM Cortex M0+ based microcontroller along with a low power long range transceiver.

3.1 ATSAMR34J18B SiP Description

The ATSAMR34J18B device is an ultra-low power microcontroller equipped with a UHF transceiver. It uses the 32-bit ARM Cortex-M0+ processor at the maximum 48 MHz (2.46 CoreMark/MHz) and offers 256 KB of Flash, 32 KB of SRAM and 8 KB of low power SRAM. Sophisticated power management technologies, such as power domain gating, SleepWalking, ultra-low power peripherals and more, allow for very low line-power consumptions.

The UHF transceiver supports LoRa and FSK modulation schemes. The LoRa technology is optimized for long-range communication with minimal line-power demand. The transceiver can work from 863 MHz to 928 MHz. The maximum transmit power is +18.59 dBm without an external amplification. Operational frequency bands and power limits are defined by local regulations and the LoRa Alliance. LoRa network stack regional options ensure compliance.

All devices have accurate low power external and internal oscillators. Different clock domains can be independently configured to run at different frequencies, enabling power-saving by running each peripheral at its optimal clock frequency, thus maintaining a high CPU frequency while reducing power consumption.

The ATSAMR34J18B device supports the following software-selectable sleep modes:

- Standby – All the clocks and functions are stopped except those selected to continue running, and all the RAMs and logic contents are retained.
- Backup – Allows achieving the lowest power consumption. In this mode, the device is entirely powered off except for the backup domain. The internal regulator is turned off and the power manager allows retaining the state of the I/O lines, preventing I/O lines from toggling during wake-up. The external wake-up function is active and the debounce counter is running if at least one external wake-up pin is enabled.

The ATSAMR34J18B device supports SleepWalking, which allows some peripherals to wake-up from sleep based on predefined conditions. Thus, allowing some internal operations like DMA transfer and/or the CPU to wake up only when needed; for example, when a threshold is crossed or a result is ready. The event system supports synchronous and asynchronous events, allowing peripherals to receive, react to and send events even in Standby mode.

The ATSAMR34J18B device has two software selectable performance levels (PL0 and PL2), allowing the user to scale down to the lowest core voltage level that supports the operating frequency.

The device utilizes a power domain gating technique with retention to turn off some logic areas to minimize leakage current consumption while retaining their logic states. This technique is fully handled by hardware.

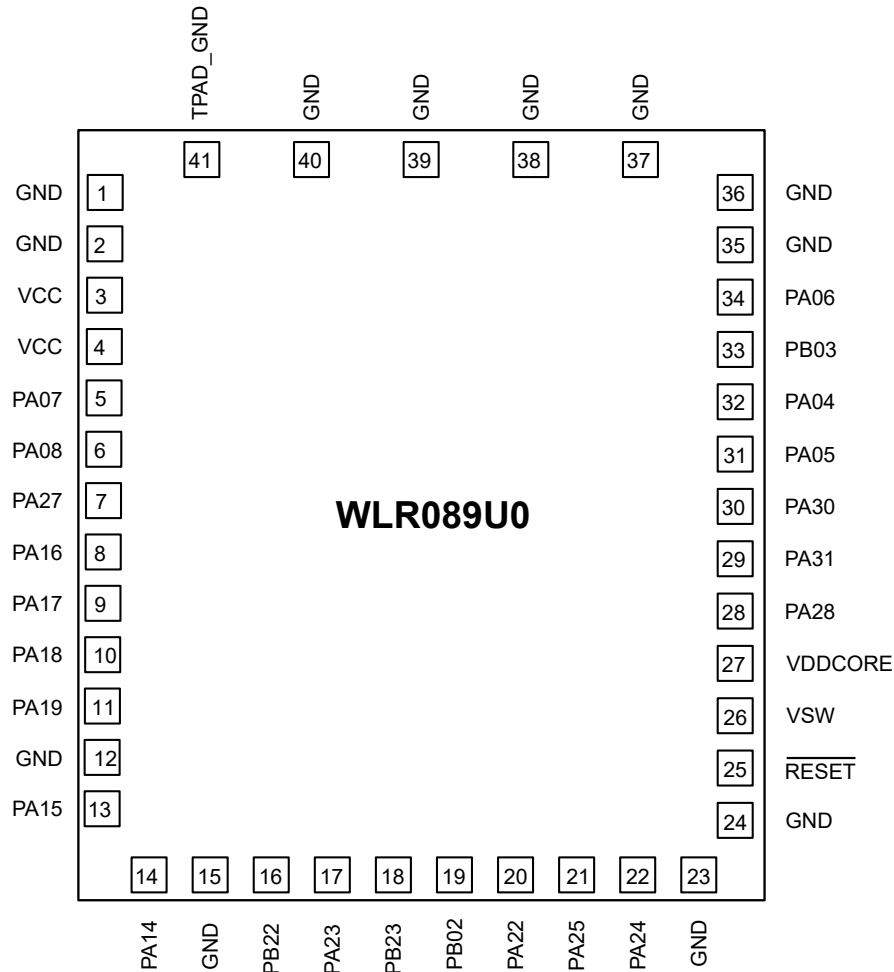
The Flash program memory can be reprogrammed through the Serial Wire Debug (SWD) interface. The same interface can also be used for non-intrusive, on-chip debugging of application code.

The ATSAMR34J18B device is supported with a full suite of programs and system development tools, including C compilers, macro assemblers, program debugger/simulators, programmers and evaluation kits.

3.2 Pinout Diagram

The WLR089U0 module pinout diagram is shown in the following figure.

Figure 3-2. WLR089U0 Module Pinout Diagram



The following table describes the module pin assignment and descriptions. The ATSAMR34J18B pin numbers are added here for reference. For more details on the SiP pin descriptions, refer to [SAM R34/R35 Low Power LoRa Sub-GHz SiP Datasheet \(DS70005356\)](#).

Table 3-1. WLR089U0 Module Pinout Assignment

WLR089U0 Module			ATSAMR34J18B SiP	
Pin No.	Pin Name	Possible Peripheral Function ⁽¹⁾	SiP Pin No.	Pin Function
1	GND	—	B5, B7, D4, D6, B3, E2, A2, B2, E1, F2, G2, G3, G5, G6, G7 and H5	Ground
2				
3	VCC	—	A7, A8, G4 and H8	VDDIN, VDDIO2, VDDIO1 and VBAT_DIG, respectively
4				

WLR089U0

Functional Overview

.....continued				
WLR089U0 Module			ATSAMR34J18B SiP	
Pin No.	Pin Name	Possible Peripheral Function ⁽¹⁾	SiP Pin No.	Pin Function
5	PA07	ADC_AIN[7]	F3	EIC_EXTINT[7], RSTC_EXTWAKE[7], ADC_AIN[7], AC_AIN[3], SERCOM0/PAD[3], TCC1/WO[1], CCL0/OUT[0]
6	PA08	GPIO	F4	EIC_NMI, ADC_AIN[16], PTC_X[0], PTC_Y[6], SERCOM0/PAD[0], SERCOM2/PAD[0], TCC0/WO[0], TCC1/WO[2], CCL1/IN[3]
7	PA27	GPIO	E4	EIC_EXTINT[15], GCLK_IO[0]
8	PA16	SERCOM1_I2C_SDA	F7	EIC_EXTINT[0], PTC_X[4], SERCOM1/PAD[0], SERCOM3/PAD[0], TCC2/WO[0], TCC0/WO[6], GCLK_IO[2], CCL0/IN[0]
9	PA17	SERCOM1_I2C_SCL	E6	EIC_EXTINT[1], PTC_X[5], SERCOM1/PAD[1], SERCOM3/PAD[1], TCC2/WO[1], TCC0/WO[1], GCLK_IO[3], CCL0/IN[1]
10	PA18	PWM_T0_W2	E7	EIC_EXTINT[2], PTC_X[6], SERCOM1/PAD[2], SERCOM3/PAD[2], TC4/WO[0], TCC0/WO[2], AC/CMP[0], CCL0/IN[2]
11	PA19	PWM_T0_W3	E8	EIC_EXTINT[3], PTC_X[7], SERCOM1/PAD[3], SERCOM3/PAD[3], TC4/WO[1], TCC0/WO[3], AC/CMP[1], CCL0/OUT[0]
12	GND	—	B5, B7, D4, D6, B3, E2, A2, B2, E1, F2, G2, G3, G5, G6, G7 and H5	Ground
13	PA15	GPIO	G8	EIC_EXTINT[15], SERCOM2/PAD[3], TC4/WO[1], TCC0/WO[5], GCLK_IO[1]
14	PA14	GPIO	F8	EIC_EXTINT[14], SERCOM2/PAD[2], TC4/WO[0], TCC0/WO[4], GCLK_IO[0]
15	GND	—	B5, B7, D4, D6, B3, E2, A2, B2, E1, F2, G2, G3, G5, G6, G7 and H5	Ground
16	PB22	SERCOM5_SPI_MOSI	E5	EIC_EXTINT[6], SERCOM5/PAD[2], TC3/WO[0], GCLK_IO[0], CCL0/IN[0]
17	PA23	SERCOM5_SPI_Serial_Select	D7	EIC_EXTINT[7], PTC_X[11], SERCOM3/PAD[1], SERCOM5/PAD[1], TC0/WO[1], TCC0/WO[5], USB/SOF 1kHz[6], GCLK_IO[7], CCL2/IN[1]
18	PB23	SERCOM5_SPI_CLK	C7	EIC_EXTINT[7], SERCOM5/PAD[3], TC3/WO[1], GCLK_IO[1], CCL0/OUT[0]

WLR089U0

Functional Overview

.....continued				
WLR089U0 Module			ATSAMR34J18B SiP	
Pin No.	Pin Name	Possible Peripheral Function ⁽¹⁾	SiP Pin No.	Pin Function
19	PB02	SERCOM5_SPI_MISO	B4	EIC_EXTINT[2], ADC_AIN[10], SERCOM5/PAD[0], TC2/WO[0], SUPC/OUT[1], CCL0/OUT[0]
20	PA22	GPIO	D8	EIC_EXTINT[6], PTC_X[10], SERCOM3/PAD[0], SERCOM5/PAD[0], TC0/WO[0], TCC0/WO[4], GCLK_IO[6], CCL2/IN[0]
21	PA25	USB_DP[6]	C8	EIC_EXTINT[13], SERCOM3/PAD[3], SERCOM5/PAD[3], TC1/WO[1], TCC1/WO[3], USB/DP[6], CCL2/OUT[2]
22	PA24	USB_DM[6]	B8	EIC_EXTINT[12], SERCOM3/PAD[2], SERCOM5/PAD[2], TC1/WO[0], TCC1/WO[2], USB/DM[6], CCL2/IN[2]
23	GND	—	B5, B7, D4, D6, B3, E2, A2, B2, E1, F2, G2, G3, G5, G6, G7 and H5	Ground
24	GND	—		Ground
25	RESET	RESET_N	B6	RESET
26	VSW	VSW	A6	VSW
27	VDDCORE	VDDCORE	A5	VDDCORE
28	PA28	GPIO	C6	EIC_EXTINT[8], GCLK_IO[0]
29	PA31	SWDIO ⁽²⁾	D5	EIC_EXTINT[11], SERCOM1/PAD[3], TCC1/WO[1], SWDIO ⁽²⁾ , CCL1/OUT[1]
30	PA30	SWDCLK ⁽²⁾	C5	EIC_EXTINT[10], SERCOM1/PAD[2], TCC1/WO[0], SWCLK ⁽²⁾ , GCLK_IO[0], CCL1/IN[0]
31	PA05	SERCOM0_UART_RX	C4	EIC_EXTINT[5], RSTC_EXTWAKE[5], ADC_AIN[5], AC_AIN[1], SERCOM0/PAD[1], TCC0/WO[1], CCL0/IN[1]
32	PA04	SERCOM0_UART_TX	D3	EIC_EXTINT[4], RSTC_EXTWAKE[4], VREFB, ADC_AIN[4], AC_AIN[0], SERCOM0/PAD[0], TCC0/WO[0], CCL0/IN[0]
33	PB03	SUPC_VBAT	C3	EIC_EXTINT[3], ADC_AIN[11], SERCOM5/PAD[1], TC2/WO[1], SUPC/VBAT
34	PA06	PTC_Y4	E3	EIC_EXTINT[6], RSTC_EXTWAKE[6], ADC_AIN[6], AC_AIN[2], PTC_Y[4], SERCOM0/PAD[2], TCC1/WO[0], CCL0/IN[2]

.....continued				
WLR089U0 Module			ATSAMR34J18B SiP	
Pin No.	Pin Name	Possible Peripheral Function ⁽¹⁾	SiP Pin No.	Pin Function
35	GND	—	B5, B7, D4, D6, B3, E2, A2, B2, E1, F2, G2, G3, G5, G6, G7 and H5	Ground
36	GND	—		Ground
37	GND	—		Ground
38	GND	—		Ground
39	GND	—		Ground
40	GND	—		Ground
41	TPAD_GND	—		Thermal Pad Ground

Notes:

1. The peripheral function indicated in this column is based on the reference design. This is one of the possibilities as each WLR089U0 pin supports several multiplexed peripheral functions mentioned in the pin function column.
2. This function is only activated in the presence of a debugger.

3.3 Package Details

The following table provides the WLR089U0 module package details.

Table 3-2. WLR089U0 Package Information

Parameter	Value	Units
Package size	17x13.5	mm
Pad count	41	—
Total thickness	2.8	mm
Pad pitch	1	mm
Pad width	0.7	mm

Note: For more information on the package dimensions, refer to [10.2 Module Outline Drawings](#).

4. Radio Transceiver

Note: The ATSAMR34J18B SiP incorporates a LoRa transceiver.

The integrated Sub-GHz transceiver supports LoRa technology spread spectrum modulation, combining ultra-long range communications and high interference immunity with extremely low current consumption. Receive sensitivity of -136 dBm can be achieved in LoRaWAN protocol compliant mode using a TCXO and bill of materials.

The transmit section offers two integrated power amplifiers. The highly efficient RFO port delivers up to +14.35 dBm for the European region and battery conservation. The high-powered PA_BOOST port delivers up to +18.59 dBm of raw RF power with high-voltage supplies. This combination of high power and high RX sensitivity yields an industry-leading link budget, making it ideal for any application requiring long-range, low-data-rate communications. LoRa technology also provides significant advantages in both blocking and selectivity over conventional modulation techniques, solving the traditional design compromise between range, interference robustness and energy consumption. For maximum flexibility, the user may decide on the spread spectrum modulation bandwidth (BW), spreading factor (SF) and forward error correction rate. Another benefit of the spread spectrum modulation is that each spreading factor is orthogonal; thus, multiple transmitted signals can occupy the same channel without interfering.

This transceiver offers bandwidth options ranging from 125 kHz to 500 kHz with spreading factors ranging from 7 to 12.

4.1 Transceiver Validation

The WLR089U0 module has been extensively tested using LoRa modulation for 863-928 MHz frequency range. Validation of the WLR089U0 module was performed at frequencies typically used in LoRa applications.

5. Nonvolatile Memory

The WLR089U0 provides the user with a readable Nonvolatile Memory (NVM) space called user row, programmed in the factory. The base address for the application is 0x804008. The following table shows the implemented data structure.

Table 5-1. NVM (User Row) Data

Address Offset	Field Name	Field Description	Length
BaseAddr. + 0x00	MIB_REVISION	Data structure revision. 0x1501	2 bytes
+ 0x02	MAC_IEEE_ADDRES S	Module specific IEEE MAC Address	8 bytes
+ 0x0A	BOARD_SERIAL	Module specific serial number	10 bytes
+ 0x14	PART_NO	Product specific part number	8 bytes
+ 0x1C	PCBA_REV	Product PCB/assembly revision	1 byte
+ 0x1D	XTAL_TRIM	Reference crystal calibration value	1 byte
+ 0x1E	CRC16	Checksum for this data structure	2 bytes

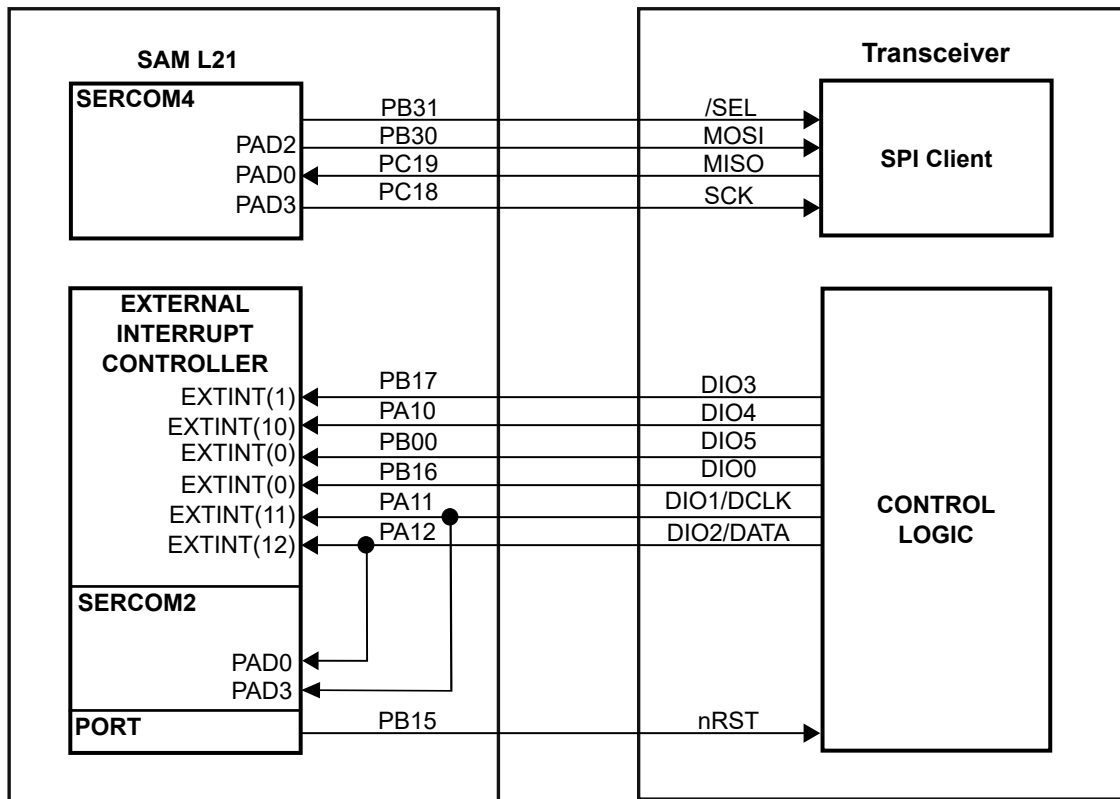
BOARD_SERIAL, PART_NO and XTAL_TRIM for this WLR089U0 module is programmed with 0xFF. As the module uses TCXO on board, XTAL_TRIM is not applicable. The MAC_IEEE_ADDRESS is stored little-endian with the first byte stored at the lowest address.

6. Host Interface

6.1 Interconnection between SAM L21 and Transceiver within ATSAMR34J18B SiP

This section describes the transceiver to microcontroller interface. The interface is comprised of a client SPI and additional control signals. This interface is connected to a SAM L21 host interface as shown below. The SERCOM4 and GPIO signals dedicated to the CPU-TRX interface are not externally exposed and may not be used for any other purposes.

Figure 6-1. Microcontroller to Transceiver Interface



The SPI is used for register, Frame Buffer and SRAM access. The additional control signals are connected to the GPIO/IRQ interface of the microcontroller. The table below introduces the radio transceiver I/O signals and their functionalities.

Table 6-1. Microcontroller Interface Signal Description

TRX Signal	CPU Signal Name	Description
/SEL	PB31	SPI select signal, active-low
MOSI	PB30	SPI data (Host Out Client In) signal
MISO	PC19	SPI data (Host In Client Out) signal
SCLK	PC18	SPI clock signal
nRST	PB15	Transceiver Reset signal, active-low
DIO0	PB16	Digital I/O, software-configured

.....continued		
TRX Signal	CPU Signal Name	Description
DIO1	PA11	Digital I/O, software-configured
DIO2	PA12	Digital I/O, software-configured
DIO3	PB17	Digital I/O, software-configured
DIO4	PA10	Digital I/O, software-configured
DIO5	PB00	Digital I/O, software-configured

6.2 Programming and Debugging

The SWD interface on the WLR089U0 module is supported by Microchip's programmers and debuggers like Atmel-ICE, SAM-ICE™ and an on-board Embedded Debugger in the WLR089 Xplained Pro. It is also supported by several third-party programmers and debuggers. For programming and/or debugging the WLR089U0 module:

1. Connect the Programmer/Debugger with the module using the Serial Wire Debug (SWD) interface.
2. Select the Device as WLR089U0.

Notes: For more details, refer the following documents:

- For Programming and Debugging, refer to the *Atmel-ICE, SAM-ICE or WLR089 Xplained Pro Board User Guide*.
- For Microchip, third-party programmers and third-party programming houses, refer to the *AN2468 Production Programming of Microchip AVR® and SAM Microcontrollers Application Note (DS00002468)*.
- Connecting to any other programming or debugging tool, refer to that specific *programmer's guide or debugger's user guide*.

7. Electrical Specifications

This section provides the WLR089U0 module electrical specifications.

7.1 Absolute Maximum Ratings

The following table provides the absolute maximum ratings for the WLR089U0 module.

Table 7-1. Absolute Maximum Ratings

Symbol	Parameter	Min.	Max.	Unit
V_{CC}	Power supply voltage	0	3.6	V
$V_{PIN}^{(1)}$	Pin voltage with respect to GND and V_{CC} (V_{CC} MAX = 3.6V)	GND-0.6V	$V_{CC}+0.6V$	V
$P_{RF}^{(1)}$	Input RF level	—	+10	dBm
$T_{storage}^{(1)}$	Storage temperature	-50	150	°C
V_{ESD}	Electrostatic Discharge (ESD) ⁽²⁾	—	±4	kV

Notes:

1. These values are derived from the ATSAMR34J18B SiP.
2. The contact discharge test was performed by coupling planes (horizontal coupling plane and the vertical coupling plane).

⚠ CAUTION Stresses beyond those listed in the above table may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to the absolute maximum rating conditions for extended periods may affect device reliability.

7.2 Recommended Operating Conditions

The following table provides the recommended operating conditions for the WLR089U0 module.

Table 7-2. Recommended Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit
T_{OP}	Operating temperature range	-40	25	85	°C
V_{CC}	Supply voltage	1.8	3.3	3.5	V

7.3 Transceiver Performance Characteristics

The following data shows the WLR089U0 performance as a combined system under the following conditions:

- Modulation = LoRa
- $V_{CC} = 3.3 V_{DC}$
- Temperature = 25°C
- $F_{RF_XTA} = 32.000000$ MHz +/- 1 ppm (TCXO)
- DFLL = 48 MHz

- BW = 125 kHz
- SF = 12
- EC = 4/6
- PER = 1%
- CRC = Enabled
- Payload = 64 bytes
- Preamble = 12 symbols
- Matched Impedance

Estimates for the module's ACTIVE state are derived using the CoreMark benchmarking algorithm, a 48 MHz DFLL clock and a 3.3 V_{DC} supply to show a conservative estimation of power consumption. Results are related to CPU activity, clock speed and temperature, which can be optimized further.

7.3.1 Transmitter Output Power

Table 7-3. Transmitter Output Power

Frequency (MHz)	Output Port	Modulation Mode	Power Setting	Typical Output Power (dBm)
915	PA_BOOST	CW	20	18.39
915	PA_BOOST	LoRa	20	18.52
868	RFO_HF	CW	15	14.35
868	RFO_HF	LoRa	15	14.17

7.3.2 Transmitter Phase Noise

Table 7-4. Phase Noise

Offset	Phase Noise (dBc/Hz)
10k	-101.74
50k	-102.14
400k	-113.73
1M	-118.05

7.3.3 Receiver Sensitivity

Table 7-5. Receiver Sensitivity in LoRa Mode

Frequency (MHz)	Bandwidth (kHz)	Spreading Factor	Sensitivity (dBm)
915	125	12	-136
868	125	12	-136

Table 7-6. Receiver Sensitivity in FSK Mode

Frequency (MHz)	Conditions	Bit Rate (kbps)	Sensitivity (dBm)
868	Frequency deviation (FDA) = 5 kHz, Rx bandwidth = 10 kHz (Single Side Bandwidth)	1.2	-118
		4.8	-117

7.3.4 Blocking

Table 7-7. Blocking in LoRa Mode

Frequency (MHz)	1 MHz	2 MHz	10 MHz	Unit
915	89	94	100	dB (TYP)
868	89	94	100	dB (TYP)

7.3.5 Transmitter High-Power Operation

Supply high voltage to V_{CC} to operate in the High-Power mode. For some regions, additional EMI filtering may be needed at High-Power mode. The following table lists the operational parameters and their values for the High-Power mode.

Table 7-8. High-Power Operational Parameters

Parameter	Value
RF Output Power (max.)	+18.59 dBm
V_{CC} (min.)	2.4 V_{DC}
V_{CC} (max.)	3.5 V_{DC}
Typical Current	114.68 mA
Max. Duty Cycle (max.)	1%
VSWR (max.)	3:1

7.4 DC Characteristics

7.4.1 Current Consumption

The following table provides the current consumption values of the transceiver.

Table 7-9. Current Consumption ⁽¹⁾ ⁽²⁾

Mode/ Parameter	MCU Mode	Transceiver Conditions	Measured Current (Typical)	Units
TX mode ⁽³⁾	ACTIVE	TX; North American band, f_{RF} = 915 MHz, TX power setting = 20, PA = ON	114.68	mA
		TX; North American band, f_{RF} = 915 MHz, TX power setting = 17, PA = ON	93.64	
		TX; North American band, f_{RF} = 915 MHz, TX power setting = 15, PA = OFF	38.44	
		TX; North American band, f_{RF} = 915 MHz, TX power setting = 7, PA = OFF	25.24	
		TX; European band, f_{RF} = 868 MHz, TX power setting = 15, PA = OFF	41.54	
		TX; European band, f_{RF} = 868 MHz, TX power setting = 7, PA = OFF	25.68	

.....continued

Mode/ Parameter	MCU Mode	Transceiver Conditions	Measured Current (Typical)	Units
RX mode	ACTIVE	RX; North American band, $f_{RF} = 915$ MHz, Bandwidth = 125 kHz	12.64	mA
		RX; North American band, $f_{RF} = 915$ MHz, Bandwidth = 250 kHz	13.34	
		RX; European band, $f_{RF} = 868$ MHz, Bandwidth = 125 kHz	12.68	
		RX; European band, $f_{RF} = 868$ MHz, Bandwidth = 250 kHz	13.36	
Low power modes	Standby	Sleep	1.608	μ A
	Backup	Sleep	642	nA

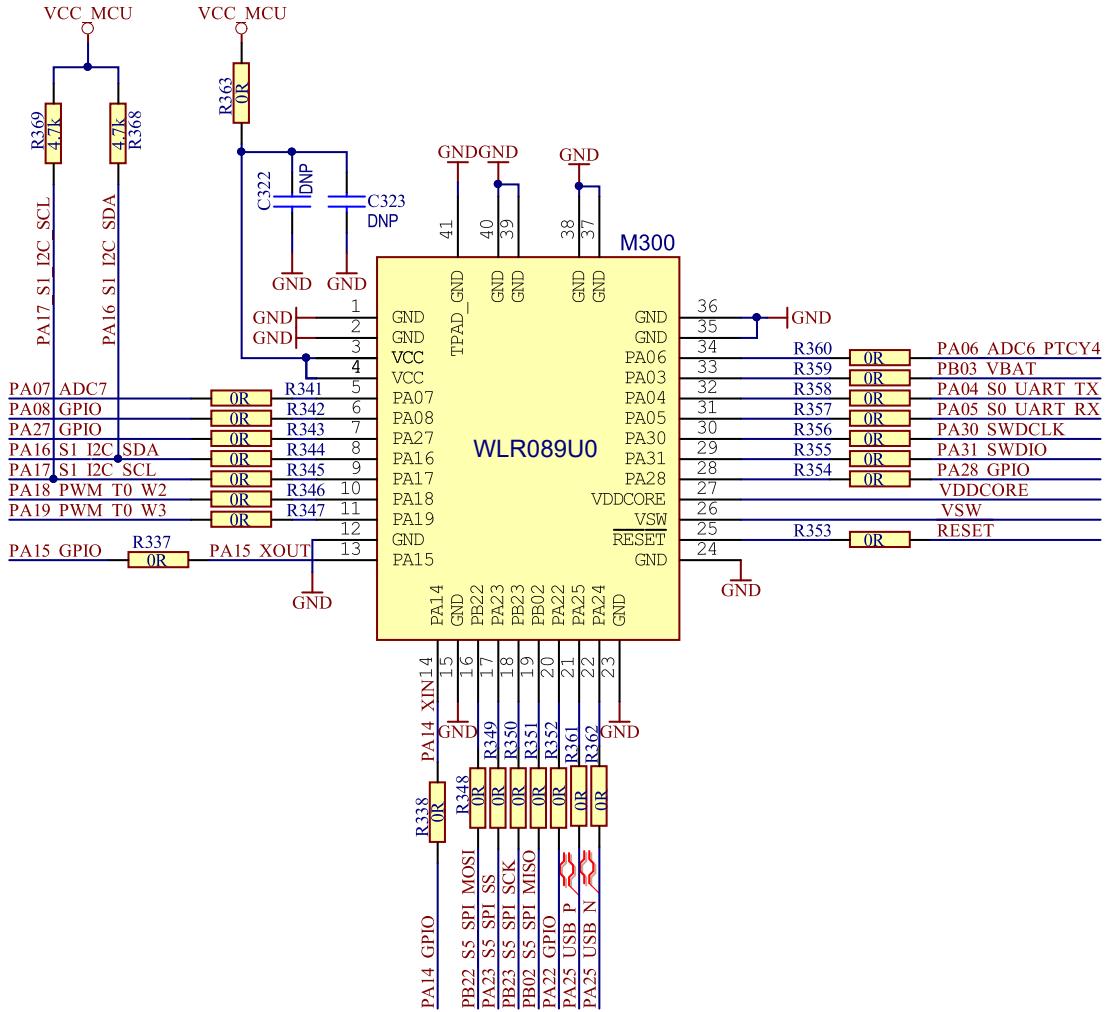
Notes:

1. This parameter is characterized but not tested in manufacturing.
2. The following are the typical conditions for the measurement:
 - Operating Conditions:
 - VDD = 3.3V and Temperature at 25°C
 - CPU is running on Flash with two Wait states in PL2
 - Low power cache is enabled and BOD33 (Brown-out detector on On-chip Switching mode regulator output (VSWOUT)/battery input voltage (VBAT) is disabled
 - Transceiver conditions as specified in the table
 - Oscillators:
 - XOSC (crystal oscillator) is disabled
 - When MCU is in Active Performance Level 2 (PL2) mode, the DFLL48M is running at 48 MHz in Open-Loop mode
 - Clocks:
 - In the PL2 mode, DFLL48M is running in the Open-Loop mode and is used as the main clock source
 - The clock masks and dividers are at Reset values: All AHB and APB clocks are enabled, CPUDIV = 1, BUPDIV = 1 and LPDIV = 1
 - I/Os are configured in the Digital Functionality Disabled mode. Except for PA04 and PA05, which are used to provide the UART input to the device
3. RF output is terminated with 50 Ω when the module is transmitting a Continuous Wave (CW) tone

8. Reference Circuit

The following figure illustrates the reference application schematics for the WLR089U0 module.

Figure 8-1. Reference Application Schematic



9. Design Considerations

9.1 Approved External Antennas

The WLR089U0 module is tested and approved for use with the antennas listed in the following table.

To use with other antennas, the OEM installer must be authorized by the respective regulatory agencies to ensure compliance.

Table 9-1. List of Approved External Antennas

No.	Part Number	Manufacturer	Antenna Gain (dBi)	Antenna Type	Regulatory Authority ⁽¹⁾				Cable Length/ Remarks
					FCC ⁽²⁾⁽³⁾	ISED/MIC/ Anatel ⁽⁴⁾ / NCC	CE	KC	
1	RFA-S1-C55H1-150D034	Alead technology	2.0	Half-wave dipole	X	X	X	X	150 mm
2	RFA-ZW-C55-B70-D034	Alead technology	2.0	Half-wave dipole	—	—	X	X	SMA to u.FL cable (ASMA-UFL-10) of length 203.20 mm used as adapter
3	AEACAC053010-S868	Abracon	2	Compact, low profile whip antenna	—	—	X	—	SMA to u.FL cable (ASMA-UFL-10) of length 203.20 mm used as adapter
4	TH-89F-150mm-IPEX	BJTEK NAVIGATION, INC.	1.5	Half-wave dipole	X	X	X	X	150 mm
5	ANT-868-PW-QW-UFL	Linx	1.6	¼-wave monopole antenna	—	—	X	—	216 mm
6	ANT-916-PW-QW-UFL	Linx	1.8	¼-wave monopole antenna	—	—	X	X	216 mm
7	GWF-152XMPXX-H015	Joymax Electronics Co., Ltd	2	Half-wave dipole	X	X	X	X	153 mm
8	GWF-152XRSXX-H015	Joymax Electronics Co., Ltd	2	Half-wave dipole	X	X	X	X	Antenna has 156 mm cable with RP-SMA plug and RP-SMA receptacle to u.FL cable of length 50 mm used as adapter ⁽²⁾⁽³⁾
9	6610D13081-100	Kinsun	2	Half-wave dipole	X	X	—	X	100 mm
10	6610C03061	Kinsun	2	Half-wave dipole	X	X	X	X	RP-SMA to u.FL cable of length 203.20 mm used as adapter ⁽²⁾⁽³⁾
11	6610-868MHz	Kinsun	2	Half-wave dipole	—	—	X	—	150 mm

.....continued

No.	Part Number	Manufacturer	Antenna Gain (dBi)	Antenna Type	Regulatory Authority ⁽¹⁾				Cable Length/ Remarks
					FCC ⁽²⁾⁽³⁾	ISED/MIC/ Anatel ⁽⁴⁾ / NCC	CE	KC	
12	DL868&915M-F-01	Dolin Electronics Co., Ltd	2	¼-wave monopole antenna	—	—	X	X	150 mm
13	DL868&915M-R-H76	Dolin Electronics Co., Ltd	2	¼-wave monopole antenna	—	—	X	X	SMA to u.FL cable (ASMA-UFL-10) of length 203.20 mm used as adapter
14	RFDPA131015IMBB301	PSA Walsin technology Corporation	0.90	Half-wave dipole	X	X	X	X	150 mm
15	RFA-ZW-C55-B-RP-D034	Alead technology	2.0	Half-wave dipole	X	X	X	X	RP-SMA to u.FL cable of length 203.20 mm used as adapter ⁽²⁾⁽³⁾

Notes:

1. 'X' denotes the antennas covered under the certification.
2. If the end product using the Module is designed to have an antenna port that is accessible to the end user, then a unique (non-standard) antenna connector (as permissible by FCC) must be used (e.g., RP (Reverse Polarity)-SMA socket).
3. If an RF coaxial cable is used between the module RF output and the enclosure, then a unique (non-standard) antenna connector must be used in the enclosure wall for interfacing with the antenna.
4. Recommended antennas for Anatel Certification; not approved by Anatel.
5. Contact the antenna vendor for detailed antenna specifications to review suitability to end-product operating environment and to identify equivalent alternatives.

9.2 Module Assembly Considerations

The WLR089U0 module is assembled with an EMI Shield to ensure compliance with EMI emission and immunity rules. The EMI shield is made of a Cold Rolled Steel (common or ordinary low carbon steel) material with Matte Tin Pre-plating. Use IPA solutions and similar solvents to clean the WLR089U0 module. However, cleaning solutions that contain acid must never be used on the module.

9.2.1 Conformal Coating

The modules are not intended for use with a conformal coating and the customer assumes all risks (such as the module reliability, performance degradation and so on) if a conformal coating is applied to the modules.

9.2.2 Reflow Profile Information

For information on the reflow process guidelines, refer to the "Solder Reflow Recommendation" Application Note (www.microchip.com/DS00233).

10. Packaging Information

This chapter provides the information on package markings, dimension and footprint of the WLR089U0 module.

10.1 Module Package Marking

The following figure shows the WLR089U0 module packaging information.

Figure 10-1. Module Package Marking Information



Legend:

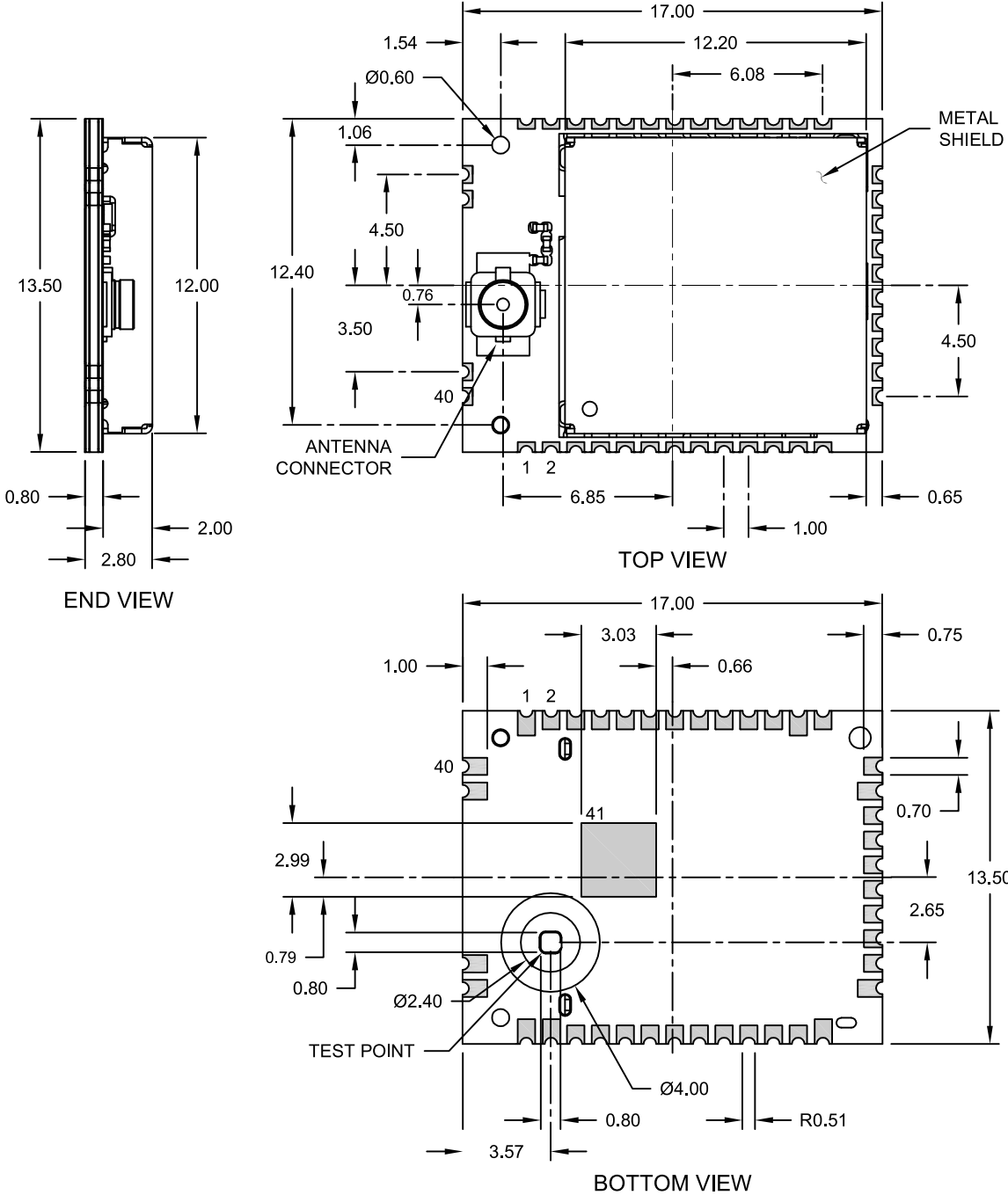
- XX....X Module part number and version and regulatory designator
- YY: Year code (last 2 digits of calendar year)
- WW Week code (week of January 1 is week "01")
- NNN Alphanumeric traceability code

10.2 Module Outline Drawings

This section provides the package dimension details of the WLR089U0 module.

Note: For the most recent package dimension drawings, see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>.

Figure 10-2. WLR089U0 Module Package Outline Drawings

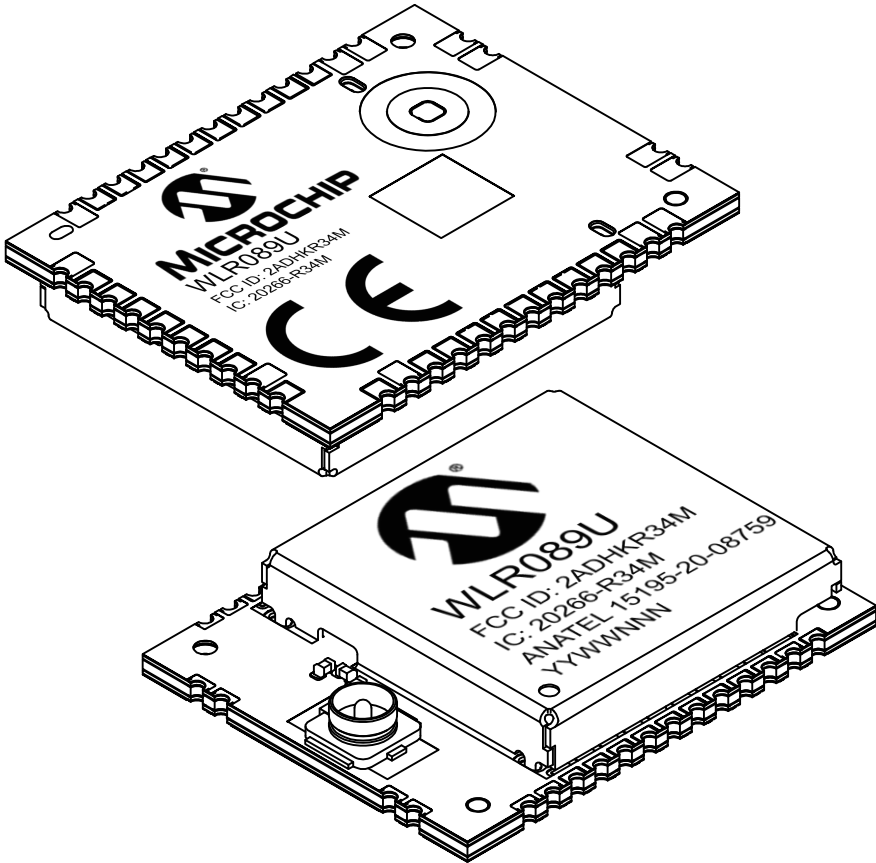


- 1. The module pins are arranged with a 1 mm pitch distance. The module is designed symmetrically.

WLR089U0

Packaging Information

Figure 10-3. WLR089U0 Module Package Outline Drawings – Contd.,



11. Appendix A: Regulatory Approval

The WLR089U0 module has received regulatory approval from the following countries:

- WLR089U0
 - United States/FCC ID: 2ADHKR34M
 - Canada/ISED:
 - IC: 20266-R34M
 - HVIN: WLR089U0
 - PMN: WLR089U
 - Europe/CE
 - Japan/MIC: 005-102607
 - Korea/KCC: R-R-mcp-WLR089U0
 - Taiwan/NCC: CCAN20Y11330T3
 - ANATEL: 15195-20-08759

For USA/Canada, the module has been certified for the modulation modes listed below. The user must ensure that the module works only on the 902-928 MHz frequency band.

- Operating Channels:
 - 500 kHz bandwidth:
 - 903 MHz ~ 927.5 MHz
 - 8 Upstream Channels, Channel Spacing 1.6 MHz
 - 8 Downstream Channels, Channel Spacing 0.6 MHz
 - 125 kHz bandwidth:
 - 902.3MHz ~ 927.5MHz
 - 64 Channels, Channel Spacing 200 kHz
 - 902.3MHz ~ 927.3 MHz
 - 26 Channels, Channel Spacing 1 MHz
- Modulation: LoRa®
- Spreading Factor:
 - 500 kHz bandwidth: 7~12
 - 125 kHz bandwidth: 7~10

The host product manufacturer must ensure that the RF behavior adheres to the certification (for example, FCC, ISED) requirements when the module is installed in the final host product.

For Europe, the module has been certified for the modulation modes listed below. The user must ensure that the module work only on the 868-868.6 MHz frequency band.

- Operating Channels:
 - 125 kHz bandwidth:
 - 868.1 MHz ~ 868.5 MHz
 - 3 Channels, Channel Spacing 200 kHz
- Modulation: LoRa®
- Spreading Factor: 125 kHz bandwidth: 7~12

Notes:

1. Tests are done only on the worst-case modes.
2. The availability of some specific channels and/or operating frequency bands are country-dependent and must be programmed at the Host product factory to match the intended destination. Regulatory bodies prohibit exposing the settings to the end user. This requirement needs to be taken care of via Host implementation.

11.1 United States

The WLR089U0 module has received Federal Communications Commission (FCC) CFR47 Telecommunications, Part 15 Subpart C “Intentional Radiators” single-modular approval in accordance with Part 15.212 Modular Transmitter approval. Single-modular transmitter approval is defined as a complete RF transmission sub-assembly, designed to be incorporated into another device, that must demonstrate compliance with FCC rules and policies independent of any host. A transmitter with a modular grant can be installed in different end-use products (referred to as a host, host product, or host device) by the grantee or other equipment manufacturer, then the host product may not require additional testing or equipment authorization for the transmitter function provided by that specific module or limited module device.

The user must comply with all of the instructions provided by the Grantee, which indicate installation and/or operating conditions necessary for compliance.

A host product itself is required to comply with all other applicable FCC equipment authorization regulations, requirements, and equipment functions that are not associated with the transmitter module portion. For example, compliance must be demonstrated: to regulations for other transmitter components within a host product; to requirements for unintentional radiators (Part 15 Subpart B), such as digital devices, computer peripherals, radio receivers, etc.; and to additional authorization requirements for the non-transmitter functions on the transmitter module (i.e., Suppliers Declaration of Conformity (SDoC) or certification) as appropriate (e.g., Bluetooth and Wi-Fi transmitter modules may also contain digital logic functions).

11.1.1 Labeling and User Information Requirements

The WLR089U0 module has been labeled with its own FCC ID number, and if the FCC ID is not visible when the module is installed inside another device, then the outside of the finished product into which the module is installed must display a label referring to the enclosed module. This exterior label must use the following wording:

<ul style="list-style-type: none"> • For WLR089U0
Contains Transmitter Module FCC ID: 2ADHKR34M or Contains FCC ID: 2ADHKR34M
<p>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.</p>

The user's manual for the finished product must include the following statement:

<p>This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:</p> <ul style="list-style-type: none"> • Reorient or relocate the receiving antenna • Increase the separation between the equipment and receiver • Connect the equipment into an outlet on a circuit different from that to which the receiver is connected • Consult the dealer or an experienced radio/TV technician for help

Additional information on labeling and user information requirements for Part 15 devices can be found in KDB Publication 784748, which is available at the FCC Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB) apps.fcc.gov/oetcf/kdb/index.cfm.

11.1.2 RF Exposure

All transmitters regulated by FCC must comply with RF exposure requirements. KDB 447498 General RF Exposure Guidance provides guidance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to Radio Frequency (RF) fields adopted by the Federal Communications Commission (FCC).

From the FCC Grant: Output power listed is conducted. This transmitter is restricted for use with the specific antenna(s) tested in this application for Certification.

The antenna(s) used with this transmitter must be installed to provide a separation distance of at least 20 mm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. Users and installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance.

11.1.3 Approved Antennas

To maintain modular approval in the United States, only the antenna types that have been tested shall be used.

The testing of the WLR089U0 module was performed with the antenna types listed in [Table 9-1](#). It is permissible to use a different antenna, provided the same antenna type and antenna gain (equal to or less than) is used. An antenna type comprises antennas having similar in-band and out-of-band characteristics (refer to the specification sheet for cutoff frequencies). To use with other antenna types, the OEM installer must be authorized by the FCC to ensure compliance.

11.1.4 Helpful Web Sites

- Federal Communications Commission (FCC): www.fcc.gov.
- FCC Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB) apps.fcc.gov/oetcf/kdb/index.cfm.

11.2 Canada

The WLR089U0 module has been certified for use in Canada under Innovation, Science and Economic Development Canada (ISED, formerly Industry Canada) Radio Standards Procedure (RSP) RSP-100, Radio Standards Specification (RSS) RSS-Gen and RSS-247. Modular approval permits the installation of a module in a host device without the need to recertify the device.

11.2.1 Labeling and User Information Requirements

Labeling Requirements (from RSP-100 - Issue 11, Section 3): The host product shall be properly labeled to identify the module within the host device.

The Innovation, Science and Economic Development Canada certification label of a module shall be clearly visible at all times when installed in the host device; otherwise, the host product must be labeled to display the Innovation, Science and Economic Development Canada certification number of the module, preceded by the word “Contains” or similar wording expressing the same meaning, as follows:

<ul style="list-style-type: none"> • For WLR089U0
<p>Contains IC: 20266-R34M</p>

User Manual Notice for License-Exempt Radio Apparatus (from Section 8.4 RSS-Gen, Issue 5, March 2019): User manuals for license-exempt radio apparatus shall contain the following or equivalent notice in a conspicuous location in the user manual or alternatively on the device or both:

This device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's license-exempt RSS(s). Operation is subject to the following two conditions:

(1) This device may not cause interference;

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. L'appareil ne doit pas produire de brouillage;

2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Transmitter Antenna (From Section 6.8 RSS-GEN, Issue 5, March 2019): User manuals, for transmitters shall display the following notice in a conspicuous location:

This radio transmitter [IC: 20266-R34M] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Le présent émetteur radio [IC: 20266-R34M] a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés cidessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué pour tout type figurant sur la liste, sont strictement interdits pour l'exploitation de l'émetteur.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi) and required impedance for each.

11.2.2 RF Exposure

All transmitters regulated by Innovation, Science and Economic Development Canada (ISED) must comply with RF exposure requirements listed in RSS-102 - Radio Frequency (RF) Exposure Compliance of Radio communication Apparatus (All Frequency Bands).

This transmitter is restricted for use with a specific antenna tested in this application for certification, and must not be co-located or operating in conjunction with any other antenna or transmitters within a host device, except in accordance with Canada multi-transmitter product procedures.

The installation of the transmitter must ensure that the antenna has a separation distance of at least 35 mm from all persons or compliance must be demonstrated according to the ISED SAR procedures.

11.2.3 Approved Antennas

The testing of the WLR089U0 module was performed with the antennas listed in [Table 9-1](#).

11.2.4 Helpful Web Sites

Innovation, Science and Economic Development Canada (ISED): www.ic.gc.ca/.

11.3 Europe

The WLR089U0 is a Radio Equipment Directive (RED) assessed radio module that is CE marked and has been manufactured and tested with the intention of being integrated into a final product.

The WLR089U0 module has been tested to RED 2014/53/EU Essential Requirements mentioned in the following European Compliance table.

Table 11-1. European Compliance

Certification	Standards	Article
Safety	EN 62368	3.1a
Health	EN 62479	
EMC	EN 301 489	3.1b
Radio	EN 300 220	3.2

The ETSI provides guidance on modular devices in the “*Guide to the application of harmonised standards covering articles 3.1b and 3.2 of the RED 2014/53/EU (RED) to multi-radio and combined radio and non-radio equipment*” document available at http://www.etsi.org/deliver/etsi_eg/203300_203399/203367/01.01.01_60/eg_203367v010101p.pdf.

Note: To maintain conformance to the standards listed in the preceding European Compliance table, the module shall be installed in accordance with the installation instructions in this data sheet and shall not be modified. When integrating a radio module into a completed product, the integrator becomes the manufacturer of the final product and is therefore responsible for demonstrating compliance of the final product with the essential requirements against the RED.

11.3.1 Labeling and User Information Requirements

The label on the final product that contains the WLR089U0 module must follow CE marking requirements.

11.3.2 Conformity Assessment

From ETSI Guidance Note EG 203367, section 6.1, when non-radio products are combined with a radio product:

If the manufacturer of the combined equipment installs the radio product in a host non-radio product in equivalent assessment conditions (i.e. host equivalent to the one used for the assessment of the radio product) and according to the installation instructions for the radio product, then no additional assessment of the combined equipment against article 3.2 of the RED is required.

11.3.2.1 Simplified EU Declaration of Conformity

Hereby, Microchip Technology Inc. declares that the radio equipment type WLR089U0 is in compliance with Directive 2014/53/EU.

The full text of the EU declaration of conformity for this product is available at www.microchip.com/wwwproducts/en/WLR089U0 (available under *Documents > Certifications*).

11.3.3 Approved Antennas

The testing of the WLR089U0 module was performed with the antennas listed in [Table 9-1](#).

11.3.4 Helpful Websites

A document that can be used as a starting point in understanding the use of Short Range Devices (SRD) in Europe is the European Radio Communications Committee (ERC) Recommendation 70-03 E, which can be downloaded from the European Communications Committee (ECC) at: <http://www.ecodocdb.dk/>.

Additional helpful web sites are:

- Radio Equipment Directive (2014/53/EU):
https://ec.europa.eu/growth/single-market/european-standards/harmonised-standards/red_en
- European Conference of Postal and Telecommunications Administrations (CEPT):
<http://www.cept.org>
- European Telecommunications Standards Institute (ETSI):
<http://www.etsi.org>
- The Radio Equipment Directive Compliance Association (REDCA):
<http://www.redca.eu/>

11.4 Japan

The WLR089U0 module has received type certification and is required to be labeled with its own technical conformity mark and certification number as required to conform to the technical standards regulated by the Ministry of Internal Affairs and Communications (MIC) of Japan pursuant to the Radio Act of Japan.

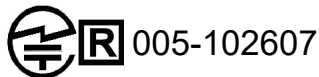
Integration of this module into a final product does not require additional radio certification provided installation instructions are followed and no modifications of the module are allowed. Additional testing may be required:

- If the host product is subject to electrical appliance safety (for example, powered from an AC mains), the host product may require Product Safety Electrical Appliance and Material (PSE) testing. The integrator should contact their conformance laboratory to determine if this testing is required
- There is an voluntary Electromagnetic Compatibility (EMC) test for the host product administered by VCCI: www.vcci.jp/vcci_e/index.html

11.4.1 Labeling and User Information Requirements

The label on the final product which contains the WLR089U0 module must follow Japan marking requirements. The integrator of the module should refer to the labeling requirements for Japan available at the Ministry of Internal Affairs and Communications (MIC) website.

For the WLR089U0 module, due to a limited module size, the technical conformity logo and ID are displayed in the data sheet and packaging and cannot be displayed on the module label. The final product in which this module is being used must have a label referring to the type certified module inside:



11.4.2 Helpful Web Sites

- Ministry of Internal Affairs and Communications (MIC): www.tele.soumu.go.jp/e/index.htm.
- Association of Radio Industries and Businesses (ARIB): www.arib.or.jp/english/.

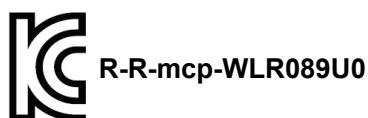
11.5 Korea

The WLR089U0 module has received certification of conformity in accordance with the Radio Waves Act. Integration of this module into a final product does not require additional radio certification provided installation instructions are followed and no modifications of the module are allowed.

11.5.1 Labeling and User Information Requirements

The label on the final product which contains the WLR089U0 module must follow KC marking requirements. The integrator of the module should refer to the labeling requirements for Korea available on the Korea Communications Commission (KCC) website.

Due to the limited size of the WLR089U0 module, the KC mark and certificate number are displayed only in the data sheet and is not displayed on the module label. The final product requires the KC mark and certificate number of the module:



11.5.2 Helpful Websites

- Korea Communications Commission (KCC): www.kcc.go.kr.

- National Radio Research Agency (RRA): rra.go.kr.

11.6 Taiwan

The WLR089U0 module has received compliance approval in accordance with the Telecommunications Act. Customers seeking to use the compliance approval in their product should contact Microchip Technology sales or distribution partners to obtain a Letter of Authority.

Integration of this module into a final product does not require additional radio certification provided installation instructions are followed and no modifications of the module are allowed.

11.6.1 Labeling and User Information Requirements

For the WLR089U0 module, due to the limited module size, the NCC mark and ID are displayed in the data sheet and packaging and cannot be displayed on the module label:



The user's manual should contain following warning (for RF device) in traditional Chinese:

根據 NCC LP0002 低功率射頻器材技術規範_章節 3.8.2:

取得審驗證明之低功率射頻器材，非經核准，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。

低功率射頻器材之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。

前述合法通信，指依電信管理法規定作業之無線電通信。

低功率射頻器材須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。

11.6.2 Helpful Web Sites

National Communications Commission (NCC): www.ncc.gov.tw

11.7 Brazil

The WLR089U0 received compliance approval in accordance with the Telecommunications Act of the Federal Republic of Brazil National Telecommunications Agency (ANATEL). Customers seeking to use the compliance approval in their product must contact Microchip Technology Inc. sales or distribution partners to obtain a Letter of Authority.

Modelo: WLR089U0



15195-20-08759

"Este equipamento não tem direito à proteção contra interferência prejudicial e não pode causar interferência em sistemas devidamente autorizados".

The End product (Host) manual must include the following statement:

Este product contém a placa Modelo WLR089U0 código de homologação ANATEL 15195-20-08759.

11.7.1 Helpful Web Sites

- ANATEL: www.anatel.gov.br.

11.8 Other Regulatory Information

- For information about other countries' jurisdictions not covered here, refer to the specific product listed in the www.microchip.com/wwwproducts/en/WLR089U0 (available under *Documents > Certifications*).
- If the customer needs another regulatory jurisdiction certification or to recertify the module for other reasons, contact Microchip for the required utilities and documentation.

12. Document Revision History

Revision	Date	Section	Description
B	02/2021	Document	Updated Master and Slave with Host and Client as per Corporate Social Responsibility (CSR) recommendation
		2. Ordering Information	Updated with four countries regulatory information (Japan, Korea, Taiwan and Brazil) in Table 2-1
		9.1 Approved External Antennas	Updated with four countries regulatory information (Japan, Korea, Taiwan and Brazil) and added a note 4 in the Table 9-1
		10.1 Module Package Marking	Updated Figure 10-1 with ANATEL ID
		10.2 Module Outline Drawings	Updated Figure 10-3 with ANATEL ID
		11. Appendix A: Regulatory Approval	<ul style="list-style-type: none"> • Updated 11.3 Europe section as per the standard • Added following countries regulatory information: <ul style="list-style-type: none"> – 11.4 Japan, 11.5 Korea, 11.6 Taiwan and 11.7 Brazil • Updated 11.8 Other Regulatory Information with the WLR089U0 website
A	08/2020	Document	Initial Revision

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