
Low-Power Long Range 433/868 MHz LoRa® Technology Transceiver Module

General Features

- On-Board LoRaWAN™ Protocol Stack
- ASCII Command Interface over UART.
- Compact Form Factor: only **14.4x14.4x2.2 mm.**
- European R&TTE Directive Assessed Radio Module.



Operational

- Single Operating Voltage: 1.8V to 3.6V.
- Temperature Range: -40°C to +85°C.
- Low-Power Consumption.
- Programmable RF Communication Bit.Rate up to 300 kbps with FSK Modulation, 10937 bps with LoRa® Technology Modulation.
- Integrated MCU, Crystal, Radio Transceiver with Analog Front End, Matching Circuitry.
- 10 GPIOs shared with 2 Analog Inputs.

RF/Analog Features

- Low-Power Long Range Transceiver Operating in the 433 MHz and 868 MHz Frequency Bands.
- High Receiver Sensitivity: Down to -146 dBm.
- TX Power: Adjustable up to +17 dBm high
- Efficiency PA
- FSK, GFSK, and LoRa Technology Modulation
- Up to 15 km Coverage at Suburban and up to 5 km Coverage at Urban Area

Description

The BIT48LR Low-Power Long Range LoRa

Technology Transceiver module provides an easy to use, low-power solution for long range wireless data transmission. The advanced command interface offers rapid time to market.

The BIT48LR module complies with the LoRaWAN Class A protocol specifications. It integrates RF, a baseband controller, command Application Programming Interface (API) processor, making it a complete long range solution.

The BIT48LR module is suitable for simple long range sensor applications with external host MCU.

Applications

- Automated Meter Reading
- Home and Building Automation
- Wireless Alarm and Security Systems
- Industrial Monitoring and Control
- Machine to Machine (M2M)
- Internet of Things (IoT)



1 Electrical Specifications

1.1 Absolute Maximum Ratings

Parameter	Min.	Max.	Units
Supply Voltage, VDD with Respect to GND	0	3.8	V
Voltage on any pin with Respect to GND and VDD (VDD MAX=3.6V)	GND-0.6V	VDD+0.6V	V
Input RF level		+10	dBm
Storage temperature range	-50	150	°C
Maximum soldering temperature		260	°C

1.2 General Operating Conditions

Parameter	Min.	Typ.	Max.	Units	Condition
Power Supply	1.8	3.3	3.6	V	(1)
Operating Temperature	-30		+70	°C	
Input low-level voltage			0.25*VDD	V	VDD=1.8V-2.7V
			0.3*VDD		VDD=2.7V-3.6V
GPIO Input high voltage	0.7*VDD				VDD=1.8V-2.7V
	0.55*VDD				VDD=2.7V-3.6V
Output low-level voltage		0.1*VDD	0.2*VDD		VDD>1.8V, IOL max
Output high-level voltage	0.8*VDD	0.9*VDD			VDD>1.8V, IOL max
Input leakage current	-1	+/-0.015	+1	µA	Pull-up resistors disabled

(1): Equipment is powered by a circuit (separately approved, not investigated) that is insulated from the mains supply by an insulation not less than that between the primary and secondary circuits of a safety isolating transformer according to IEC 61558-2-6 or equivalent.

The system is considered (only) for the conditions of network environment 0 (see CEI CLC/TR 62102:2006). No over-voltage from telecommunication network possible, no subject to transient over voltages due to atmospheric discharges and faults in power distribution systems. **Max VDD and VRF Ramp Time is 3 ms.**

1.3 General Specifications

Specification	Description
Frequency band	433.050–434.790, 863.000-870.000, 902-928 MHz
Modulation Method	FSK, GFSK, and LoRa® Technology modulation
Maximum Over-the-Air Data Rate	300 kbps with FSK modulation; 10937 bps with LoRa Technology modulation
RF Connection	Board edge connection
Interface	UART
Operation Range	Up to 15 km coverage at suburban; up to 5 km coverage at urban area
Sensitivity at 1% PER	146 dBm Dependent on modulation settings, Receiver Bandwidth (RBW), and Spreading Factor (SF).
RF TX Power	Adjustable up to max. 13 dBm on 433 MHz band; max. 17 dBm on the 868/915 MHz band



1.4 Current Consumption

State	CPU Mode	I CPU	TRX Mode	I TRX	Total	Units
SLEEP	SLEEP	0.590	SLEEP	0.2	0.790	uA
STANDBY	STANDBY	1.2	SLEEP	0.2	1.4	uA
IDLE	ACTIVE	4.5	SLEEP	0.0002	4.5	mA
RX 433 MHz	ACTIVE	4.5	RX	11.5	16	mA (TYP)
RX 868 MHz	ACTIVE	4.5	RX	10.3	14.8	mA (TYP)
RX 915 MHz	ACTIVE	4.5	RX	11.5	14.8	mA (TYP)
TX +13 dBm	ACTIVE	4.5	TX RFO_LF	28	32.5	mA (TYP)
TX +17 dBm	ACTIVE	4.5	TX PA_BOOST	90	94.5	mA (TYP)

The current consumption specifications are derived for the operational condition shown below:

Condition	Value	Unit
Supply Voltage	3.3	V
RF Bandwidth	125	kHz
CRC	Enabled	
Error Correction Code	4/6	
Packet Error Rate	1	%
Payload Length	64	Bytes
Preamble Length	12	Symbols
LNA Boost	OFF	
Spreading Factor	12	

1.5 Transmitted Output Power in LoRa Mode

Frequency (MHz)	Typical Output Power (dBm)
433	13
868	17
915	17

1.6 Receiver Sensitivity in LoRa Mode

Frequency (MHz)	BW (kHz)	SF	Sensitivity	Unit
433	7.8	12	-148	dBm
868	125	11	-133	
915	125	11	-133	



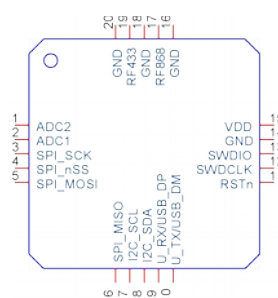
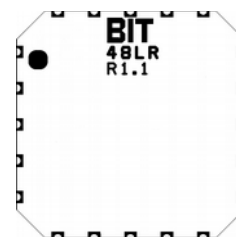
BIT48LR

Data Sheet

2 PIN-OUT

PIN #	BIT Assigned Function	Type	Optional			
			UC Pin	Analog	Timers	Comm
1	GPIO0	DIG I/O	PA08	AIN[16]	TCC1/WO[0]	
2	GPIO1	DIG I/O	PA09	AIN[17]	TCC1/WO[1]	
3	GPIO2	DIG I/O	PA17		TCC2/WO[1]	SPI SCK
4	GPIO3	DIG I/O	PA18		TCC0/WO[2]	SPI nSS
5	GPIO4	DIG I/O	PA16		TCC2/WO[0]	SPI MOSI
6	GPIO5	DIG I/O	PA19		TCC0/WO[3]	SPI MISO
7	GPIO6 / I2C SCL (1)	DIG I/O	PA23			I2C SCL
8	GPIO7 / I2C SDA (1)	DIG I/O	PA22			I2C SDA
9	UART RX	DIG IN	PA25			USB_DP (2)
10	UART TX	DIG OUT	PA24			USB_DM (2)
11	RESETn	DIG IN	Reset input, active low. To apply an external reset source to this pin, it is required to only drive this pin low during reset, and let the internal pull-up ensure that reset is released.			
12	DGB-SWCLK	DIG IN	PA30			
13	DGB-SWDIO	DIG I/O	PA31			
14	GND	0V				
15	VDD	3.3 V IN				
16	GND	0V				
17	868 ANT	868 MHz RF I/O				
18	GND	0V				
19	433 ANT	433 MHz RF I/O				
20	GND	0V				

Top View



(1) Connect an external EUI-64 Node Identity Chip (MCHP 24AA025E64)
(2) USB function is available on request as a customization

3 UART Interface

All of the BIT48LR module's settings and commands are transmitted over UART using the ASCII interface. Uart is the standard interface. USB interface is available only for custom design support.

3.1 General characteristics

The default settings for the UART interface are 115200 bps, 8 bits, no parity, 1 Stop bit, no flow control. In order to communicate via the UART interface pin P1 (OUT for module) has to be HI and pin P2 (OUT for host) have to be HI.

If host want to send an UART message, it must set the pin P2 to logic HI (for wake-up module) and wait for the module to set pin P1 to logic HI. This can be disabled by pull-up to Vdd on pin P1.

If module has to send an UART message, it must set pin P1 to logic HI (for wake-up host) and wait for the host to set pin P2 to logic HI. This can be disabled by pull-up to Vdd on pin P2.

Any UART message has to be terminated by a carriage return and a new line character (\r\n - 0x0D 0x0A).

3.2 UART API

To issue commands to the BIT48LR module, the user sends keywords followed by optional parameters. Commands (keywords) are case-sensitive, and spaces must not be used in parameters. Hex input data can be uppercase or lowercase. String text data, such as OTAA used for the join procedure, can be uppercase or

lowercase.

The use of shorthand for parameters is *NOT* supported.

Depending on the command, the parameter may expect values in either decimal or hexadecimal form; refer to the command description for the expected form. For example, when configuring the frequency, the command expects a decimal value in Hertz such as 868100000 (868.1 MHz). Alternatively, when configuring the LoRaWAN device address, the hex value is entered into the parameter as aabbccdd. To enter a number in hex form, use the value directly. For example, the hex value 0xFF would be entered as FF.

3.3 UART Command table

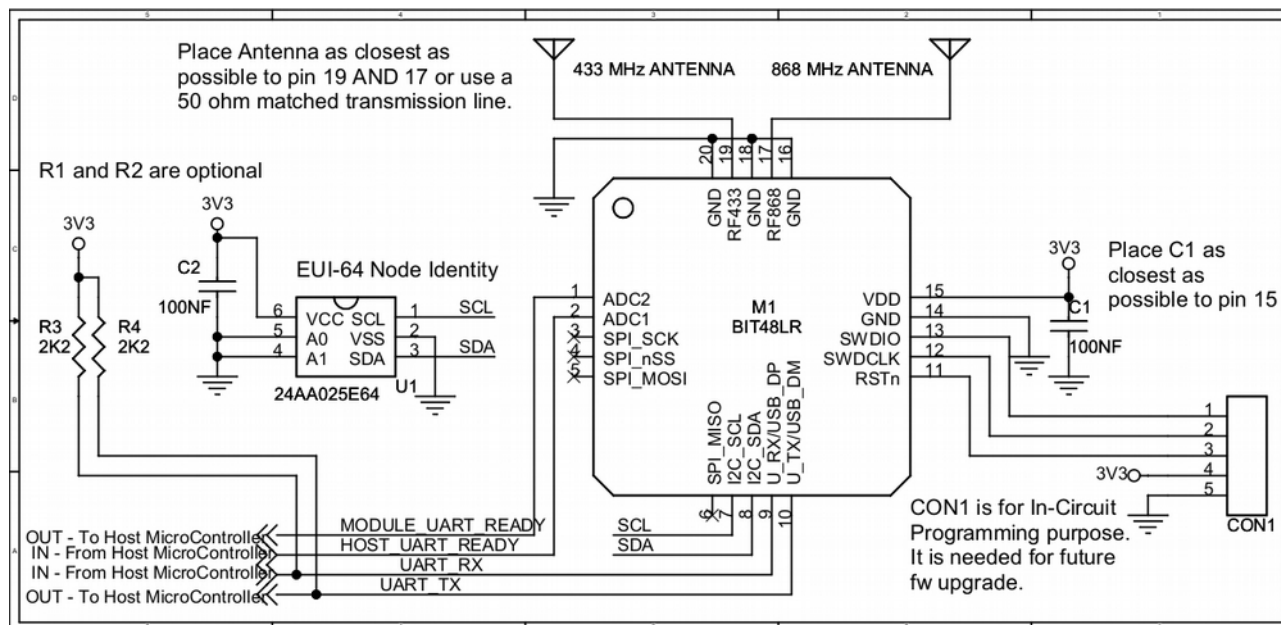
There are three general command categories, as shown in [Table 2-1](#).

TABLE 2-1: COMMAND TYPES

Command Type	Keyword	Description
System	<sys>	Issues system level behavior actions, gathers status information on the firmware and hardware version, or accesses the module user EEPROM memory.
LoRaWAN™ Class A and Class C Protocols	<mac>	Issues LoRaWAN Class A and Class C protocols network communication behaviors, actions and configuration commands.
Transceiver commands	<radio>	Issues radio specific configurations, directly accessing and updating the transceiver setup.

See “BIT48LR LoRa® Technology Module Command Reference User’s Guide” for a detailed description.

4 Typical Application



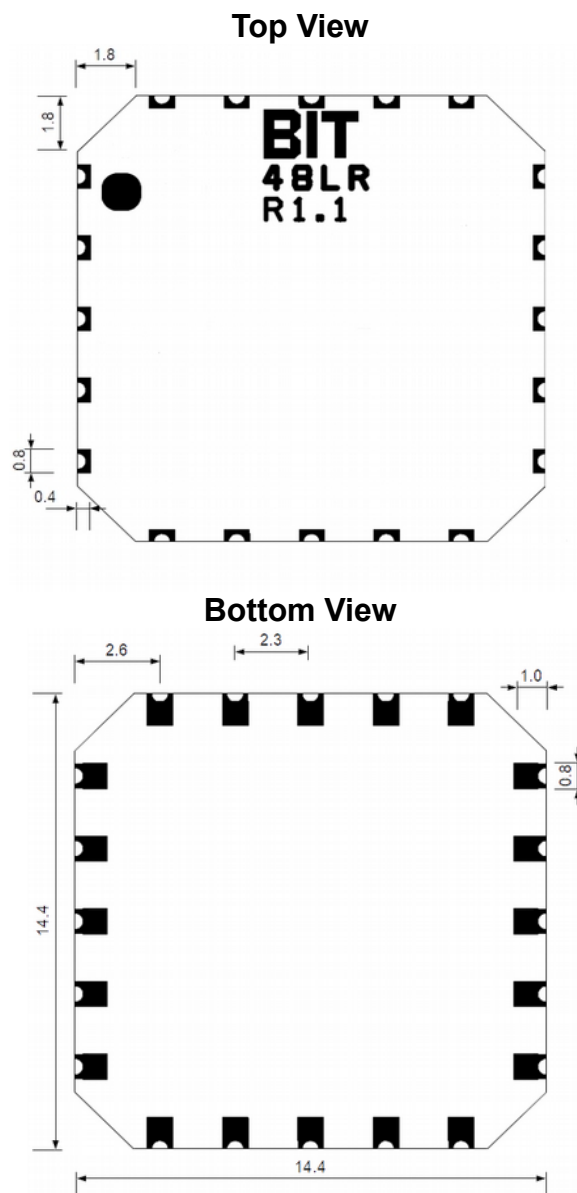
4.1 Product customization

There are 10 I/O available (1 UART or USB, 1 I2C, 1 SPI, 2 ADC).

Ask us if you want to customize the module or if you want to develop your own application with the use of all the available I/O. The MCU on board is MICROCHIP SAM R34/R35 (ultra-low power microcontroller combined with a UHF transceiver). Please contact the Distributors closest to you for further information.

Leave unused pins unconnected.

5 Mechanical Dimension (mm)



6 Soldering profile Recommendation

JEDEC standard IPC/JEDEC J-STD-020D.1 (page 7 and 8), Pb-Free Assembly is recommended.

The standard requires that the heat dissipated in the "surroundings" on the PCB is taken into account. The peak temperature should be adjusted so that it is within the window specified in the standard for the actual motherboard.

Aperture for paste stencil is normally areal-reduced by 20-35%, please consult your production facility for best experience aperture reduction. Nominal stencil thickness of 0.1-0.12 mm recommended.



BIT48LR

Data Sheet

7 Packaging Information

Orderable device	Status	Package Type	Pins	Package Qty	Eco Plan	MSL Peak Temp
BIT48LR	ACTIVE	MLF	20	96	Green (RoHS & no Sb/Br)	Level-2-260C-1 YEAR

8 General Information

8.1 Disclaimer

B.I.T. srl believes the information contained herein is correct and accurate at the time of this printing. However, B.I.T. srl reserves the right to make changes to this product without notice. B.I.T. srl does not assume any responsibility for the use of the described product; neither does it convey any license under its patent rights, or the rights of others. The latest updates are available at the BIT website or by contacting BIT directly.

As far as possible, major changes of product specifications and functionality, will be stated in product specific Errata Notes published at the BIT website. Customers are encouraged to sign up to the Developers Newsletter for the most recent updates on products and support tools.

Compliance with regulations is dependent on complete system performance. It is the customer's responsibility to ensure that the system complies with regulations.

8.2 Life Support Policy

This BIT product is not designed for use in life support appliances, devices, or other systems where malfunction can reasonably be expected to result in significant personal injury to the user, or as a critical component in any life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness. B.I.T. srl customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify B.I.T. srl for any damages resulting from any improper use or sale.

Revision list

Revision	Data	Description	Fw Version
00.90	2019-07-19	<ul style="list-style-type: none">Changed some pin definition	0.9.b
00.01	2018-12-13	<ul style="list-style-type: none">First Release	0.1.b



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