Connect with IoT

Wireless Communication LSIs/Modules

Ver.7.0

ROHM GROUP
LAPIS
TECHNOLOGY

ROHM
SEMICONDUCTOR

ROHM Co., Ltd.

Feature

02 Low current consumption

Wireless communication LSIs and modules achieve lower current consumption by adopting power shutdown cells, low voltage drive regulators, and multi Vt low power consumption processes, contributing to lower standby power and longer battery life in portable wireless devices.

Low power technologies

- Power Cutoff Cells
- Low Voltage Regulators
- Multi Vt Low Power Processes

01 20 years of experience with CMOS RF technology

We have been working on CMOS RF development since 1998, releasing a number of products ranging from RF LSIs to SoC. And in addition to advancing RF circuit technologies such as digital control and correction technology, we are making efforts to improve performance and reduce current consumption utilizing precision CMOS processes.

20 years of experience

RF FILTER
CMOS RF Technology
MODEM

03 Broad lineup in communication distances ranging from mm to km

ROHM offers a wide lineup optimized for a variety of applications requirements, from communication distances of several mm within close reach to longer distances as much as a few kilometers.

Broad lineup

- LPWAN (Low Power Wide Area)
- Wi-Fi
- IEEE802.15.4
- 13.56MHz Wireless Charger
- Sub-GHz
- Bluetooth®

Wireless Communication LSIs/Modules Ver.7.0

Devices and equipment all around us are connected in a variety of different ways, and going forward this number is expected to only increase as the range of networked products continues to grow and a greater emphasis is placed on convenience, energy savings, and cost effectiveness. Our wireless communication LSIs and modules support the connected needs of customers in various markets by leveraging CMOS RF circuit, low power consumption, network, and other proprietary technologies. From the Sub-GHz to the 2.4GHz band, a broad lineup is offered, including modules optimized to meet application demands.

04 Built-in buck DC/DC

Step-down DC/DC is built-in to reduce current flow from the battery in portable devices such as wearables. This ensures high efficiency power consumption, even if the battery terminal voltage fluctuates, contributing to longer battery life.

Applicable LSI: ML7436N

Prolongs battery life

Constant power consumption - regardless of battery level

Conventional

MLxxxx

Power Consumption (V)

100   Battery Level (%)   1

05 Robust communication

Functions such as 2 diversity and FEC are built-in to improve wireless communication quality. This contributes to stabler communication in a variety of areas.

2 Diversity Applicable LSIs: ML7396x, ML7406x, ML7345x, ML7414, ML7404, ML7416N, ML7436N

Applicable LSIs : ML7396x, ML7414, ML7404, ML7416N, ML7436N

Stabler communication

Applicable Models

Conventional Product

Stable RF transmission even with obstacles

06 Complies with wireless communication standards

Our short-range wireless communication LSIs and modules, manufactured using thorough quality control, are optimized solutions that satisfy both transmission and reception characteristics specified by the EN300-220, FCC and Q/GDW374.3 specifications.

EN300-220 Applicable Models : ML7396D, ML7406y, ML7344Jy, ML7345, ML7345D, ML7414

FCC Applicable Models : ML7396A

Q/GDW374.3 Applicable Models : ML7344Cy, ML7345C

Broad range of wireless communication standards

EN300-220 (Europe)

FCC (North America)

Q/GDW374.3 (China)

07 Supports the latest wireless communication standards

LPWAN wireless product lineup for ultra-long-distance communication ideal for IoT. We offer models compatible with IEEE802.15.4k and Sigfox®.
Products compatible with Bluetooth® Low Energy v4.1 optimized for IoT edge nodes are also available.

Bluetooth low energy Applicable Modules: MK71511(A)-NNN, MK71521(A)-NNN

IEEE802.15.4 Compatible LSI : ML7404

Sigfox® Compatible LSIs : ML7414, ML7404

The latest wireless standards

sigfox

Bluetooth

Wi-SUN Alliance

08 Embedded MCU system

We supply system LSIs that incorporate LAPIS Technology's RF LSI and MCU in a single package. Our market-proven RF LSIs feature greater ease-of-use.

Applicable LSIs: ML7416N, ML7436N

Monolithic

MCU | LSI

Low power wireless system LSI with built-in MCU

09 Radio Law certified modules enable immediate evaluation and implementation

All ROHM wireless communication LSIs have already acquired certification under Japan's Radio Law, making it possible to immediately begin evaluation and development of wireless communication. The Bluetooth® modules MK715xx series are FCC, ISED, and CE compliant.

Applicable Modules:
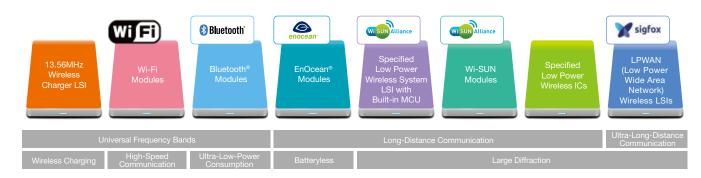MK71511(A)-NNN, MK71521(A)-NNN, BP35A1, BP35C0, BP35C0-J11, BP35C2, BP3580, BP3591, BP3595, BP3599, BP359B
EnOcean® Modules

Radio Law Certified Module

LAPIS

FC CE

10 Complete Development Environment

We offer a variety of evaluation kits, software, documents, and other materials that support customer evaluation and development of wireless characteristics.

Evaluation Kits

Lineup

Wireless Communication LSIs/Modules

A broad lineup of wireless communication LSIs and modules are offered that utilize a variety of technologies. This ensures compatibility with a range of applications and markets, from IoT, industrial equipment, and automotive to electronic toys and consumer devices. ROHM also support customer development through proposals and development tools based on decades of experience.

Wi-Fi — 13.56MHz Wireless Charger LSI
Wi-Fi — Wi-Fi Modules
Bluetooth® — Bluetooth® Modules
enocean — EnOcean® Modules
Wi SUN Alliance — Specified Low Power Wireless System LSI with Built-in MCU
Wi SUN Alliance — Wi-SUN Modules
Specified Low Power Wireless ICs
sigfox — LPWAN (Low Power Wide Area Network) Wireless LSIs

Universal Frequency Bands			Long-Distance Communication				Ultra-Long-Distance Communication
Wireless Charging	High-Speed Communication	Ultra-Low-Power Consumption	Batteryless	Large Diffraction			

	13.56MHz Wireless Charger	Wi-Fi (IEEE802.11b/g/n)	Bluetooth® low energy	Specified Low Power Wireless				LPWAN (Low Power Wide Area Network)
				EnOcean®	(Wide Area)	(Wide Area)	(Narrow Area)	
Frequency Band	13.56MHz	2.4GHz	2.4GHz	868.3/928.35/921.4MHz	900MHz	900MHz	426/429MHz	900MHz
Communication Distance	Few mm	Tens of meters	Approx. 100m	Approx. 100m	Hundreds of meters	Hundreds of meters	Hundreds of meters	Tens of kilometers
Transmission Rate	212kbps	72Mbps	1Mbps	125kbps	50kbps or more	50kbps or more	More than 9,600bps	100 to thousands of bps
Market	Worldwide			The frequency band will differ based on country				

IoT Wireless communication technologies that support IoT

01 We offer a broad lineup of low power short-and long-range wireless products optimized for IoT. This allows users to select the ideal product based on application needs, from specified low power wireless and Bluetooth® low energy to LPWAN.

02 Specified low power radio is characterized by the ability to communicate over distances of several hundred meters using very low power. Since the Sub-GHz band being used differs from the 2.4GHz band widely used for wireless LAN, Bluetooth®, and other protocols, it is less susceptible to interference, and the lower frequency makes it easy to travel around objects, facilitating communication. However, because the frequency used will vary by country, it will be necessary to adapt to the standards at each region. Wi-SUN, which is an international standard utilizing the Sub-GHz band, is expanding its applicable range to include both indoor and outdoor use.

03 Bluetooth® low energy is a 2.4GHz wireless communication standard used all over the world to communicate over a distance of several meters or less with very low power consumption. Applications include fitness/medical devices and smart watches driven by coin batteries, and are expanding to the IoT sector for data transmission and position detection utilizing beacon technology.

04 LPWAN is a new wireless protocol that allows communication over longer distances than existing short-range radio. As a result, long-distance communication up to 10km is enabled with a single device, making it possible to configure wide range networks using fewer components. Prospects include repeaters that until now were required for short-range wireless, and adoption is expected for wirelessly collecting and transmitting data over a wide area with IoT systems.

Smart Agri
Anti-disaster
Infra Monitoring
Asset Tracking

Advanced Technologies

Low power consumption products
that combine a variety of technologies

Modulation/Demodulation

· OFDM
· DSSS
· QPSK/O-QPSK
· BPSK
· FSK/GFSK
· MSK/GMSK
· ASK

Receiver Circuit

· Low IF Technology
· Zero IF Technology
· Digital IF Technology
· Double Super Heterodyne Technology
· 13.56MHz Wireless Power Reception

Transmission Circuit

· Orthogonal Modulation Technology
· Direct Modulation Technology
· High Efficiency Power Amplifier Technology
· 13.56MHz Wireless Charger

Frequency Synthesizer Circuit

· Fractional-N PLL Technology
· Phase Noise Reduction Technology

ROHM group

Wireless Communication Technologies

improve quality
and performance

PHY Processing

· Coding/Decoding Technology
· Frame Processing Technology
· FEC Technology
· IEEE802.15.4k/g/d

MAC Processing

· IEEE802.15.4e
· IEEE802.11
· Bluetooth

Device Technologies

· RF CMOS Technology

Network Technology

· Sigfox®
· Wi-SUN
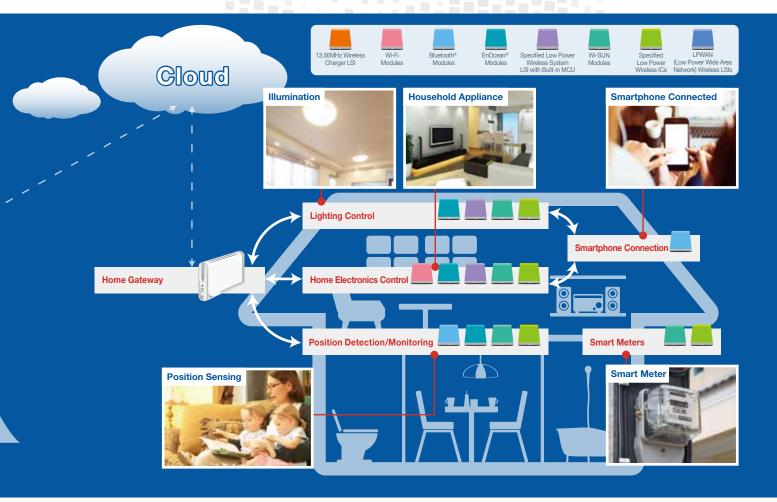
Security Technologies
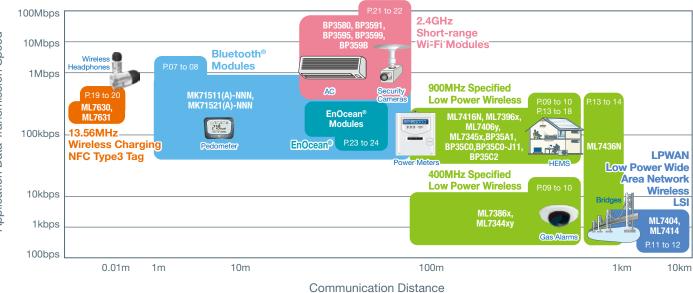
· AES 128bit/192bit/256bit
· CCM
· SHA-224/SHA-256

Cloud

| 13.56MHz Wireless Charger LSI | Wi-Fi Modules | Bluetooth® Modules | EnOcean® Modules | Specified Low Power Wireless System LSI with Built-in MCU | Wi-SUN Modules | Specified Low Power Wireless ICs | LPWAN (Low Power Wide Area Network) Wireless LSIs |

Illumination

Household Appliance

Smartphone Connected

Lighting Control

Smartphone Connection

Home Gateway

Home Electronics Control

Position Detection/Monitoring

Smart Meters

Position Sensing

Smart Meter

Communication Distance vs Data Transmission Speed

Application Data Transmission Speed (y-axis): 100bps, 1kbps, 10kbps, 100kbps, 1Mbps, 10Mbps, 100Mbps
Communication Distance (x-axis): 0.01m, 1m, 10m, 100m, 1km, 10km

- Wireless Headphones
- P.19 to 20 ML7630, ML7631
- 13.56MHz Wireless Charging NFC Type3 Tag
- Bluetooth® Modules — P.07 to 08 — MK71511(A)-NNN, MK71521(A)-NNN — Pedometer
- BP3580, BP3591, BP3595, BP3599, BP359B — P.21 to 22 — 2.4GHz Short-range Wi-Fi Modules — AC — Security Cameras
- EnOcean® Modules — EnOcean® — P.23 to 24
- Power Meters
- 900MHz Specified Low Power Wireless — ML7416N, ML7396x, ML7406y, ML7345x, BP35A1, BP35C0, BP35C0-J11, BP35C2 — P.09 to 10, P.13 to 18 — HEMS
- 400MHz Specified Low Power Wireless — ML7386x, ML7344xy — P.09 to 10 — Gas Alarms
- ML7436N — P.13 to 14
- LPWAN Low Power Wide Area Network Wireless LSI — Bridges — ML7404, ML7414 — P.11 to 12

LINEUP

Bluetooth® — 2.4GHz Short-range Wireless — Bluetooth® Modules >>>> P.07

				Core Spec 5.2	ARIB T66	EN300 328	FCC part15	Cortex-	RAM	Flash		Product									
M module	2.4 G	Tx	Rx	LE	Core Spec 5.2	ARIB T66	EN300 328	FCC part15	Cortex-M4	192 KB	24 KB	New MK71511-NNN	1M bps	2M bps	Pattern	Master Slave	APL Blank	32 MHz Crystal	32.768 kHz Crystal	-40c +85c
M module	2.4 G	Tx	Rx	LE	Core Spec 5.2	ARIB T66	EN300 328	FCC part15	Cortex-M4	192 KB	24 KB	New MK71511A-NNN	1M bps	2M bps	Pattern	Master Slave	APL Blank	32 MHz Crystal		-40c +85c
M module	2.4 G	Tx	Rx	LE	Core Spec 5.2	ARIB T66	EN300 328	FCC part15	Cortex-M4F	512 KB	64 KB	New MK71521-NNN	1M bps	2M bps	Pattern	Master Slave	APL Blank	32 MHz Crystal	32.768 kHz Crystal	-40c +85c
M module	2.4 G	Tx	Rx	LE	Core Spec 5.2	ARIB T66	EN300 328	FCC part15	Cortex-M4F	512 KB	64 KB	New MK71521A-NNN	1M bps	2M bps	Pattern	Master Slave	APL Blank	32 MHz Crystal		-40c +85c

Wi-SUN Alliance — Sub-GHz Short-range Wireless — Specified Low Power Wireless LSIs >>>> P.09

												Product							
LSI	426 M	Tx				ARIB T67		RCR 30			SPI	DI	ML7386x	2400 bps	7200 bps			Thin QFN	-40c +85c
LSI	750~960 M	Tx	Rx		ARIB T108	15.4 d/g AVAILABLE	EN300 220	FCC part15	Wi-SUN	SPI	DIO	ML7396x	50K bps	400K bps			Thin QFN	-40c +85c
LSI	750~960 M	Tx	Rx			15.4 AVAILABLE	EN300 220	Wireless M-Bus	Wi-SUN	SPI	DIO	ML7406y	1200 bps	500K bps	Interval		Thin QFN	-40c +85c
LSI	160~510 M	Tx	Rx		ARIB T67	Q/GDW 374.3	RCR 30	EN300 220	Wireless M-Bus	SPI	DIO	ML7344xy	1200 bps	15K bps	Interval		Thin QFN	-40c +85c
LSI	160~960 M	Tx	Rx		ARIB T67	15.4 d/g AVAILABLE	RCR 30	EN300 220	Wireless M-Bus	SPI	DIO	ML7345x	1200 bps	100K bps	Interval		Thin QFN	-40c +85c
LSI	315~960 M	Tx	Rx	ARIB T67 / ARIB T108	15.4 d/g AVAILABLE	RCR 30	EN300 220	Wireless M-Bus	SIG FOX	SPI	DIO	ML7414	100 bps	100K bps	Interval		Thin QFN	-40c +85c

sigfox — Sub-GHz Long-range Wireless — LPWAN (Low Power Wide Area Network) Wireless LSI >>>> P.11

											Product								
LSI	315~960 M	Tx	Rx	ARIB T67 / ARIB T108	15.4 d/g AVAILABLE / 15.4k AVAILABLE	RCR 30	EN300 220	Wireless M-Bus	SIG FOX	SPI	DIO	ML7404	100 bps	100K bps	80K cps	200K cps	Interval		Thin QFN	-40c +85c
LSI	315~960 M	Tx	Rx	ARIB T67 / ARIB T108	15.4 d/g AVAILABLE	RCR 30	EN300 220	Wireless M-Bus	SIG FOX	SPI	DIO	ML7414	100 bps	100K bps			Interval		Thin QFN	-40c +85c

Sub-GHz Short-range Wireless — Specified Low Power Wireless System LSI with Built-in MCU >>>>> P.13

Product	Specifications
New ML7436N	LSI / 400~960M / 2.4G / Tx / Rx / ARIB T108 / ARIB T67 / ARIB T66 / 15.4 d/g AVAILABLE / Cortex-M3 / EN300 220 / Wireless M-Bus / FCC part15 / Wi-SUN / 1024 KB / 256 KB / 1200 bps / 300K bps / FEC / Interval / Security / 2-Diversity / TQFP / -40℃ +85℃
ML7416N	LSI / 750~960M / Tx / Rx / ARIB T108 / 15.4 d/g AVAILABLE / Cortex-M0+ / Wi-SUN / 512 KB / 64 KB / 50K bps / 400K bps / Security / 2-Diversity / BGA / -40℃ +85℃

Sub-GHz Short-range Wireless — Wi-SUN Modules >>>>> P.15

Product	Specifications
BP35A1	M module / 920M / Tx / Rx / ARIB T108 / 15.4 d/g AVAILABLE / Wi-SUN / UART / 100K bps / 20mW / Pattern / -20℃ +80℃
BP35C0	M module / 920M / Tx / Rx / ARIB T108 / 15.4 d/g AVAILABLE / Wi-SUN / UART / 100K bps / 20mW / -30℃ +85℃
BP35C0-J11	M module / 920M / Tx / Rx / ARIB T108 / 15.4 d/g AVAILABLE / Wi-SUN / UART / 100K bps / 1mW / 10mW / 20mW / -30℃ +85℃
BP35C2	M module / 920M / Tx / Rx / ARIB T108 / 15.4 d/g AVAILABLE / Wi-SUN / USB / 100K bps / 20mW / Chip / -20℃ +50℃
New BP35C5	M module / 920M / Tx / Rx / ARIB T108 / 15.4 d/g AVAILABLE / FCC part15 / Wi-SUN / UART / 50K bps / 100K bps / 300K bps / 20mW / 2-Diversity / -30℃ +85℃

13.56MHz Wireless Charger — 13.56MHz Wireless Charger Chipset >>>>> P.19

Product	Specifications
ML7631	LSI / 13.56M / Tx / I²C / Thin QFN / -40℃ +85℃
ML7630	LSI / 13.56M / Rx / I²C / 200mW / Type Tag 3 / WCSP / -40℃ +85℃

2.4GHz Short-range Wireless — Wi-Fi Modules >>>>> P.21

Product	Specifications
BP3580	M module / 2.4G / Tx / Rx / ARIB T66 / Wi-Fi / USB / SDIO / UART / ~72.2 Mbps / WPA WPA2 / TCP/IP Built in / 2-Diversity / -40℃ +85℃
BP3591	M module / 2.4G / Tx / Rx / ARIB T66 / FCC part15 / Wi-Fi / USB / SDIO / UART / ~72.2 Mbps / WPA WPA2 / TCP/IP Built in / Chip / -40℃ +85℃
BP3595	M module / 2.4G / Tx / Rx / ARIB T66 / FCC part15 / Wi-Fi / USB / SDIO / UART / ~72.2 Mbps / WPA WPA2 / TCP/IP Built in / Pattern / -40℃ +85℃
BP3599	M module / 2.4G / Tx / Rx / ARIB T66 / FCC part15 / Wi-Fi / USB / SDIO / UART / ~72.2 Mbps / WPA WPA2 / TCP/IP Built in / Chip / -40℃ +85℃
BP359B	M module / 2.4G / Tx / Rx / ARIB T66 / Wi-Fi / UART / ~72.2 Mbps / WPA WPA2 / SSL/TLS Built in / TCP/IP Built in / Chip / -40℃ +70℃

928MHz Batteryless Communication — EnOcean® Modules >>>>> P.23

Communication frequencies based on the radio laws of each country are being prepared. Please refer to page 23 for additional information.

Icon Descriptions

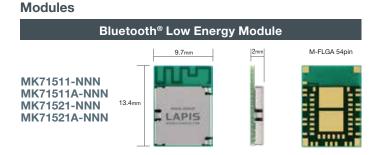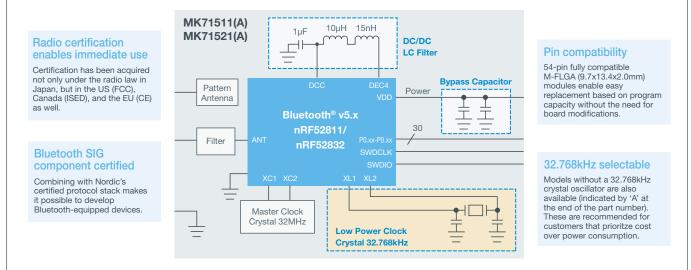| Category	Icons
Product Form Factor	LSI / M module
Transmission/Reception	Tx / Rx
Compatible RCR Standard	RCR 30
Bluetooth® Low Energy	LE
Data Transmission Rate bps	100 bps / 1200 bps / 2400 bps / 4800 bps / 7200 bps / 15K bps / 50K bps / 100K bps / 250K bps / 300K bps / 400K bps / 500K bps / 1M bps / 2M bps
Data Transmission Rate cps	80K cps / 200K cps
Memory I/F	WPA WPA2
Integrated Antenna Type	Chip / Pattern
Compatible ARIB Standards	ARIB T66 / ARIB T67 / ARIB T108
Compatible IEEE Standards	15.4 d/g AVAILABLE / 15.4k AVAILABLE
Built-in Low-Power General-Purpose CPU	Cortex-M0+ / Cortex-M3 / Cortex-M4 / Cortex-M4F
Compatible EU Standards	EN300 220 / EN300 328 / Wireless M-Bus
Intermittent Reception Operation	Interval
Crystal Oscillator	32.768 kHz Crystal / 32 MHz Crystal
Memories	24 KB / 64 KB / 192 KB / 256 KB / 512 KB / 1024 KB
Wi-Fi	Wi-Fi
Wi-SUN	Wi-SUN
Sigfox®	SIG FOX
Compatible US Standards	FCC part15
Security Compatible	(lock icon)
Built-in TCP/IP Protocol Stack	TCP/IP Built in / SSL/TLS Built in
Wireless Frequency Bands	13.56M / 160~510M / 160~960M / 315~960M / 400~960M / 426M / 750~960M / 920M / 2.4G
Host I/F	USB / SPI / DI / DIO / SCI / SDIO / UART / I²C
Bluetooth® Core Specification	Core Spec 5.2
Compatible Chinese Standards	Q/GDW 374.3
Transmission Output	200mW
Support for 2 Diversity Antenna	(2-diversity icon)
Package Type	Thin QFN / WCSP / BGA / TQFP
Operating Temperature	-40℃ +85℃ / -40℃ +70℃ / -30℃ +85℃ / -30℃ +80℃ / -25℃ +85℃ / -25℃ +65℃ / -20℃ +85℃ / -20℃ +80℃ / -20℃ +70℃ / -20℃ +60℃ / -20℃ +50℃
Charging Power	OUTPUT 10mW / OUTPUT .1mW ·1mW / OUTPUT 100mW / 1mW / 10mW / 20mW
NFC I/F	Type Tag 3
FEC	FEC
Internal Applications	APL Blank
Connection Type	Master Slave

06

2.4GHz Short-range Wireless

Bluetooth® Modules

LAPIS Technology offers easier-to-use Bluetooth® Low Energy modules. The entire Bluetooth Low Energy module lineup is Bluetooth SiG Component certified. Combining with Nordic's certified protocol stack makes it possible to develop Bluetooth equipped devices. In addition, all peripheral devices required for antenna operation are built in, and radio certification has been acquired not only in Japan, but in the US (FCC), Canada (ISED), and EU (CE) as well.

Bluetooth LINEUP

Type	Frequency	Communication	Certification Standard	Memory Flash/RAM		Part No.	Data Rate		Antenna	Role	Internal Applications	Crystal Oscillator		Operating Temperature
M module	2.4 G	Tx Rx	LE Core Spec 5.2	192 KB	24 KB	New **MK71511-NNN** Bluetooth 5	1M bps	2M bps	Pattern	Master Slave	APL Blank	32 MHz Crystal	32.768 kHz Crystal	-40c +85c
M module	2.4 G	Tx Rx	LE Core Spec 5.2	192 KB	24 KB	New **MK71511A-NNN** Bluetooth 5	1M bps	2M bps	Pattern	Master Slave	APL Blank	32 MHz Crystal		-40c +85c
M module	2.4 G	Tx Rx	LE Core Spec 5.2	512 KB	64 KB	New **MK71521-NNN** Bluetooth 5	1M bps	2M bps	Pattern	Master Slave	APL Blank	32 MHz Crystal	32.768 kHz Crystal	-40c +85c
M module	2.4 G	Tx Rx	LE Core Spec 5.2	512 KB	64 KB	New **MK71521A-NNN** Bluetooth 5	1M bps	2M bps	Pattern	Master Slave	APL Blank	32 MHz Crystal		-40c +85c

Please refer to page 6 for icon descriptions.

Modules

Bluetooth® Low Energy Module

MK71511-NNN
MK71511A-NNN
MK71521-NNN
MK71521A-NNN

9.7mm
13.4mm
2mm
M-FLGA 54pin

Bluetooth Modules Function/Block Diagram

MK71511(A)
MK71521(A)

Radio certification enables immediate use

Certification has been acquired not only under the radio law in Japan, but in the US (FCC), Canada (ISED), and the EU (CE) as well.

Bluetooth SIG component certified

Combining with Nordic's certified protocol stack makes it possible to develop Bluetooth-equipped devices.

1µF 10µH 15nH

DC/DC LC Filter

Pattern Antenna

Filter

Bluetooth® v5.x
nRF52811/
nRF52832

ANT

DCC   DEC4
VDD

P0.xx-P0.xx
SWDCLK
SWDIO

XC1 XC2   XL1 XL2

Power

Bypass Capacitor

30

Master Clock Crystal 32MHz

Low Power Clock Crystal 32.768kHz

Pin compatibility

54-pin fully compatible M-FLGA (9.7x13.4x2.0mm) modules enable easy replacement based on program capacity without the need for board modifications.

32.768kHz selectable

Models without a 32.768kHz crystal oscillator are also available (indicated by 'A' at the end of the part number). These are recommended for customers that prioritze cost over power consumption.

POINT 01

Ideal for industrial equipment

LAPIS Technology Bluetooth Low Energy modules support a wide range of applications, from consumer to industrial equipment. Designed in consideration for industrial equipment that require exposure to severe conditions, the modules provide the high reliability needed to ensure long-term use, for example by not only guaranteeing temperature, but also forming the antenna in the intermediate layer to prevent it from being damaged on the surface.
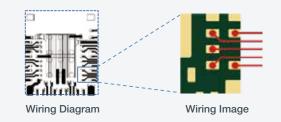
Enables stable, long-term use

POINT 02

Enables mounting on inexpensive 2-layer boards

LAPIS Technology's Bluetooth Low Energy modules utilize a unique pad layout that enables all signals to be extracted on the surface. This allows customers to reduce board costs by mounting on inexpensive 2-layer substrates.

Supports the development of compact low-cost equipment

Wiring Diagram   Wiring Image

POINT 03

Software write shipping service
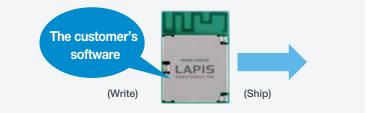
LAPIS Technology's Bluetooth Low Energy modules can be written with customer-developed software before shipment. Utilizing LAPIS Technology's shipment inspection equipment to write customer software provides a low-cost writing service.

Low-cost software implementation

The customer's software

(Write)   (Ship)

POINT 04

Connectivity tested safety module

LAPIS Technology's Bluetooth Low Energy module supports connectivity testing with commercially available smartphones and tablets. This allows customers to verify connectivity in advance in a variety of devices before development, ensuring worry-free use and making it possible to proceed with commercialization.

Facilitates commercialization

OK!

MK715x1EK1 and MK715x1EK1A Evaluation Kits

LAPIS Technology offers evaluation kits for the MK71511 and MK71521.
Two types are available, a simply type (MK715x1EK1) and Arduino pin-compatible type (MK715x1EK1A).
This enables immediate evaluation. What's more, general-purpose LEDs and switches are built that can be freely configured for application development.
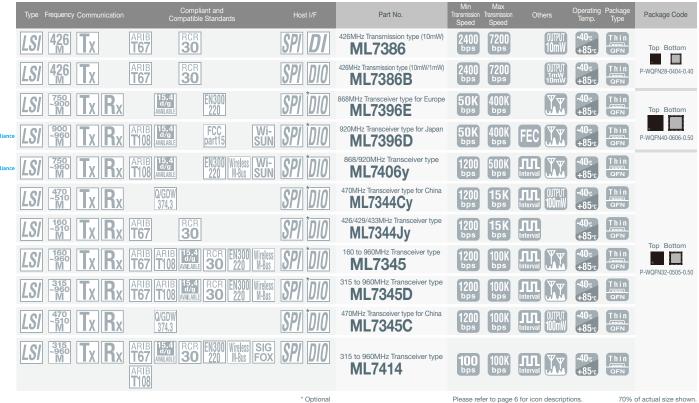
Simple, Compact Evaluation Kit: MK715x1EK1

Arduino Pin-Compatible Evaluation Kit: MK715x1EK1A

USB

MK715x1EK1

Specifications

| Part No.	Supply Voltage (V)	Functions	Bluetooth Authentication	Internal Flash/ RAM	Built-In Crystal Oscillator	Integrated Antenna	Operating Temperature (°C)	Size (mm)
New **MK71511-NNN**	1.7 to 3.6	Bluetooth low energy Applicable Modules	Ver.5.2	Flash: 192KB RAM: 24KB	32MHz 32.768kHz	Pattern	−40 to +85	9.7×13.4×2.0
New **MK71511A-NNN**	1.7 to 3.6	Bluetooth low energy Applicable Modules	Ver.5.2		32MHz	Pattern	−40 to +85	9.7×13.4×2.0
New **MK71521-NNN**	1.7 to 3.6	Bluetooth low energy Applicable Modules	Ver.5.2	Flash: 512KB RAM: 64KB	32MHz 32.768kHz	Pattern	−40 to +85	9.7×13.4×2.0
New **MK71521A-NNN**	1.7 to 3.6	Bluetooth low energy Applicable Modules	Ver.5.2		32MHz	Pattern	−40 to +85	9.7×13.4×2.0
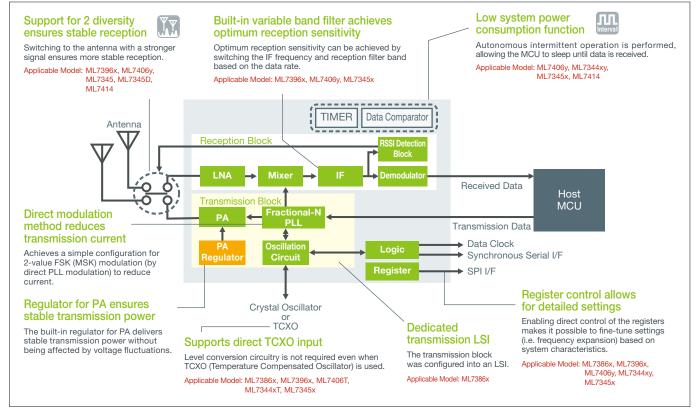
Specified Low Power Wireless LSIs

LAPIS Technology Sub-GHz specified low power wireless LSIs have been adopted in a variety of applications, including telemeters, fire alarms, home security, and industrial remote control. And the broad lineup supports adoption in smart meters which have become increasingly popular in recent years. Each LSI undergoes thorough quality control and allow customers to develop products that meet all laws and regulations for transmission and reception.

LINEUP

Type	Frequency	Communication	Compliant and Compatible Standards	Host I/F	Part No.	Min Transmission Speed	Max Transmission Speed	Others	Operating Temp.	Package Type	Package Code
LSI	426M	Tx	ARIB T67 / RCR 30	SPI DI	ML7386 — 426MHz Transmission type (10mW)	2400 bps	7200 bps	OUTPUT 10mW	-40℃ +85℃	Thin QFN	Top Bottom
LSI	426M	Tx	ARIB T67 / RCR 30	SPI DIO	ML7386B — 426MHz Transmission type (10mW/1mW)	2400 bps	7200 bps	OUTPUT 1mW 10mW	-40℃ +85℃	Thin QFN	P-WQFN28-0404-0.40
LSI	750~900M	Tx Rx	15.4 d/g AVAILABLE / EN300 220	SPI DIO*	ML7396E — 868MHz Transceiver type for Europe	50K bps	400K bps		-40℃ +85℃	Thin QFN	Top Bottom
LSI	900~960M	Tx Rx	ARIB T108 / 15.4 d/g AVAILABLE / FCC part15 / Wi-SUN	SPI DIO*	ML7396D — 920MHz Transceiver type for Japan	50K bps	400K bps	FEC	-40℃ +85℃	Thin QFN	P-WQFN40-0606-0.50
LSI	750~960M	Tx Rx	ARIB T108 / 15.4 d/g AVAILABLE / EN300 220 / Wireless M-Bus / Wi-SUN	SPI DIO*	ML7406y — 868/920MHz Transceiver type	1200 bps	500K bps	Interval	-40℃ +85℃	Thin QFN	
LSI	470~510M	Tx Rx	Q/GDW 374.3	SPI DIO*	ML7344Cy — 470MHz Transceiver type for China	1200 bps	15K bps	Interval OUTPUT 100mW	-40℃ +85℃	Thin QFN	
LSI	160~510M	Tx Rx	ARIB T67 / RCR 30	SPI DIO*	ML7344Jy — 426/429/433MHz Transceiver type	1200 bps	15K bps	Interval	-40℃ +85℃	Thin QFN	Top Bottom
LSI	160~960M	Tx Rx	ARIB T67 / ARIB T108 / 15.4 d/g AVAILABLE / RCR 30 / EN300 220 / Wireless M-Bus	SPI DIO*	ML7345 — 160 to 960MHz Transceiver type	1200 bps	100K bps	Interval	-40℃ +85℃	Thin QFN	P-WQFN32-0505-0.50
LSI	315~960M	Tx Rx	ARIB T67 / ARIB T108 / 15.4 d/g AVAILABLE / RCR 30 / EN300 220 / Wireless M-Bus	SPI DIO*	ML7345D — 315 to 960MHz Transceiver type	1200 bps	100K bps	Interval	-40℃ +85℃	Thin QFN	
LSI	470~510M	Tx Rx	Q/GDW 374.3	SPI DIO*	ML7345C — 470MHz Transceiver type for China	1200 bps	100K bps	Interval OUTPUT 100mW	-40℃ +85℃	Thin QFN	
LSI	315~960M	Tx Rx	ARIB T67 / ARIB T108 / 15.4 d/g AVAILABLE / RCR 30 / EN300 220 / Wireless M-Bus / SIGFOX	SPI DIO	ML7414 — 315 to 960MHz Transceiver type	100 bps	100K bps	Interval	-40℃ +85℃	Thin QFN	

* Optional   Please refer to page 6 for icon descriptions.   70% of actual size shown.

Specified Low Power Wireless LSIs Function/Block Diagram

Support for 2 diversity ensures stable reception

Switching to the antenna with a stronger signal ensures more stable reception.

Applicable Model: ML7396x, ML7406y, ML7345, ML7345D, ML7414

Built-in variable band filter achieves optimum reception sensitivity

Optimum reception sensitivity can be achieved by switching the IF frequency and reception filter band based on the data rate.

Applicable Model: ML7396x, ML7406y, ML7345x

Low system power consumption function

Autonomous intermittent operation is performed, allowing the MCU to sleep until data is received.

Applicable Model: ML7406y, ML7344xy, ML7345x, ML7414

TIMER | Data Comparator

Reception Block: LNA → Mixer → IF → Demodulator → Received Data
RSSI Detection Block

Antenna

Transmission Block: PA ← Fractional-N PLL
PA Regulator | Oscillation Circuit ↔ Logic → Data Clock / Synchronous Serial I/F
Register → SPI I/F

Crystal Oscillator or TCXO

Host MCU
Transmission Data

Direct modulation method reduces transmission current

Achieves a simple configuration for 2-value FSK (MSK) modulation (by direct PLL modulation) to reduce current.

Regulator for PA ensures stable transmission power

The built-in regulator for PA delivers stable transmission power without being affected by voltage fluctuations.

Supports direct TCXO input

Level conversion circuitry is not required even when TCXO (Temperature Compensated Oscillator) is used.

Applicable Model: ML7386x, ML7396x, ML7406T, ML7344xT, ML7345x

Dedicated transmission LSI

The transmission block was configured into an LSI.

Applicable Model: ML7386x

Register control allows for detailed settings

Enabling direct control of the registers makes it possible to fine-tune settings (i.e. frequency expansion) based on system characteristics.

Applicable Model: ML7386x, ML7396x, ML7406y, ML7344xy, ML7345x

POINT 01

Standards compliance (IEEE) supports interconnectivity

In addition to basic transmission/reception functions, support for IEEE802.15.4d and IEEE802.15.4g packet transmission/reception along with whitening and CRC attachment functions are provided. Interconnectivity is also enabled using standard protocols.

Applicable Model: ML7396x, ML7406y, ML7345x

Configure systems using products from other companies

POINT 02

2 diversity compatibility ensures stable reception

When radio waves are transmitted, the frequency waves will continue to spread.
However, due to reflection and other phenomena, areas with predominately weaker signals may not be always be constant, since in actual space both weak and strong signals exist.
2 diversity is a technology that utilizes 2 antennas to capture bit synchronization signals at the beginning of the transmission frame, then selects the antenna receiving the stronger signal to achieve stable reception.

Applicable Model: ML7396x, ML7406y, ML7345, ML7345D, ML7414

2 diversity operation captures stronger signals

POINT 03

Address filter reduces device power consumption

A variety of devices that utilize the same frequency as specified low power systems exist. To distinguish between data intended for the target device or other equipment, a special system-level data string is placed at the beginning of the data packet. Conventional specified low-power products typically only include a wireless block and function for outputting demodulated data, so an external MCU is needed to perform data discrimination. Unfortunately, this requires that the MCU continually operate when receiving data. In contrast, with autonomous operation a built-in timer enables intermittent receiving operation and a comparator is utilized to detect special data patterns, allowing the MCU to operate only when relevant data is received. This reduces operating time vs conventional solutions, even with the same system configuration.

Applicable Model: ML7396x, ML7406y, ML7344xy, ML7345x, ML7414

Built-in address filter function minimizes MCU load, reducing power consumption

Specifications

| Part No.	Supply Voltage (V)	Supported Frequencies (MHz)	Supported Standards	Operating Temperature (°C)	Clock Input	Package Code
ML7386	1.8 to 3.6	426	ARIB STD-T67, RCR STD-30	−25 to +85	—	P-WQFN28-0404-0.40
ML7386B	1.8 to 3.6	426	ARIB STD-T67, RCR STD-30	−25 to +85	—	P-WQFN28-0404-0.40
ML7396E	1.8 to 3.6	868	ETSI EN300-220, IEEE802.15.4g	−40 to +85	—	P-WQFN40-0606-0.50
ML7396D	1.8 to 3.6	915/920	FCC part15, ARIB STD-T108, IEEE802.15.4d/g, Wi-SUN	−40 to +85	—	P-WQFN40-0606-0.50
ML7406y	1.8 to 3.6	868	ETSI EN300-220, EN13757-4:2011, IEEE802.15.4g, Wi-SUN	−40 to +85	y=(C)rystal input y=(S)PXO direct input y=(T)CXO direct input	P-WQFN32-0505-0.50
ML7344Cy	3.3 to 3.6 (100mW)	470	Q/GDW374.3	−40 to +85	y=(C)rystal input y=(S)PXO direct input y=(T)CXO direct input	P-WQFN32-0505-0.50
ML7344Jy	1.8 to 3.6	426/429/433	ARIB STD-T67, RCR STD-30	−40 to +85	y=(C)rystal input y=(S)PXO direct input y=(T)CXO direct input	P-WQFN32-0505-0.50
ML7345	1.8 to 3.6	169/426/429/433/ 868/915/920	ARIB STD-T67, ARIB STD-T108, RCR STD-30 ETSI EN300-220, EN13757-4:2013, IEEE802.15.4d/g	−40 to +85	—	P-WQFN32-0505-0.50
ML7345D	1.8 to 3.6	426/429/433/ 868/915/920	ARIB STD-T67, ARIB STD-T108, RCR STD-30 ETSI EN300-220, EN13757-4:2013, IEEE802.15.4d/g	−40 to +85	—	P-WQFN32-0505-0.50
ML7345C	3.3 to 3.6 (100mW)	470	Q/GDW374.3	−40 to +85	—	P-WQFN32-0505-0.50
ML7414	1.8 to 3.6	315 to 960	ARIB STD-T67, ARIB STD-T108, RCR STD-30 ETSI EN300-220, EN13757-4:2013, Sigfox® (Rev 2.E) IEEE802.15.4d/g	−40 to +85	—	P-WQFN32-0505-0.50
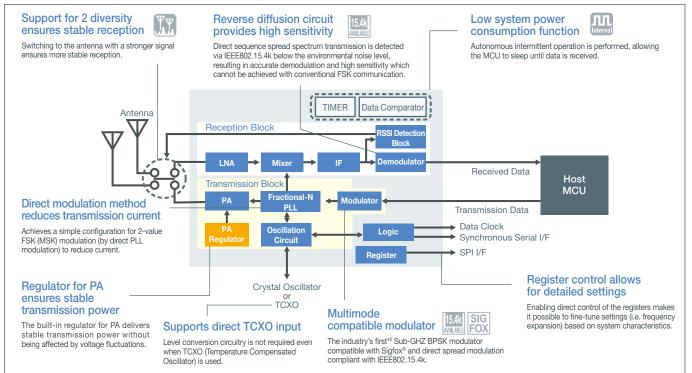
LPWAN (Low Power Wide Area Network) Wireless LSI

LAPIS Technology's LPWA (Low Power Wide Area) IC is compatible with Sigfox's wireless protocol which is expected to see widespread adoption for IoT wireless communication and has already been adopted in over 70[1] countries around the world, primarily in Europe. It is the first in the world[2] to support the international IEE802.15.4K standard which is extremely robust against interference from the same system and can cover more terminals under one network, and the first[2] 2+1 mode wireless communication LSI compatible with IEEE802.15.4g, a near-field communication method used as the physical layer for Wi-SUN.

*1 As of January 2020 (from Sigfox HP)   *2 LAPIS Technology October 2017 study (Only the ML7404 supports IEEE802.15.4k)

sigfox LINEUP

Type	Frequency	Communication	Compliant and Compatible Standards					Host I/F	Part No.	Min Transmission Speed	Max Transmission Speed	Others	Operating Temp.	Package Type	Package Code
LSI	315~960M	Tx Rx	ARIB T67 / ARIB T108	15.4 d/g AVAILABLE	RCR 30	EN300 220	Wireless M-Bus	SPI DIO / SIG FOX	315-960MHz Transceiver type **ML7404**	100 bps / 80K cps	100K bps / 200K cps	FEC	-40℃ +85℃	Thin QFN	Top Bottom P-WQFN32-0505-0.50
			ARIB T108	15.4k AVAILABLE											
LSI	315~960M	Tx Rx	ARIB T67 / ARIB T108	15.4 d/g AVAILABLE	RCR 30	EN300 220	Wireless M-Bus	SPI DIO / SIG FOX	315-960MHz Transceiver type **ML7414**	100 bps	100K bps	Interval	-40℃ +85℃	Thin QFN	Top Bottom P-WQFN32-0505-0.50

Please refer to page 6 for icon descriptions.   55% of actual size shown.

LPWAN (Low Power Wide Area Network) Wireless LSI Function/Block Diagram

Support for 2 diversity ensures stable reception

Switching to the antenna with a stronger signal ensures more stable reception.

Reverse diffusion circuit provides high sensitivity

Direct sequence spread spectrum transmission is detected via IEEE802.15.4k below the environmental noise level, resulting in accurate demodulation and high sensitivity which cannot be achieved with conventional FSK communication.

Low system power consumption function

Autonomous intermittent operation is performed, allowing the MCU to sleep until data is received.

Direct modulation method reduces transmission current

Achieves a simple configuration for 2-value FSK (MSK) modulation (by direct PLL modulation) to reduce current.

Regulator for PA ensures stable transmission power

The built-in regulator for PA delivers stable transmission power without being affected by voltage fluctuations.

Supports direct TCXO input

Level conversion circuitry is not required even when TCXO (Temperature Compensated Oscillator) is used.

Multimode compatible modulator

The industry's first[2] Sub-GHZ BPSK modulator compatible with Sigfox® and direct spread modulation compliant with IEEE802.15.4k.

Register control allows for detailed settings

Enabling direct control of the registers makes it possible to fine-tune settings (i.e. frequency expansion) based on system characteristics.

Block diagram elements: Antenna, TIMER, Data Comparator, Reception Block, RSSI Detection Block, LNA, Mixer, IF, Demodulator, Transmission Block, PA, Fractional-N PLL, Modulator, PA Regulator, Oscillation Circuit, Logic, Register, Crystal Oscillator or TCXO, Host MCU, Received Data, Transmission Data, Data Clock, Synchronous Serial I/F, SPI I/F

POINT 01

In addition to IEEE802.15.4k and Sigfox® for LPWAN, support is provided for the near-field IEEE802.15.4g standard

No wireless method is perfect. Each one is suitable for different purposes. Various LPWAN protocols have been proposed, but each has its advantages and disadvantages, and even the suitability of the LPWAN method itself may be called into question. In response, we are offering a proposal. Base installation is unnecessary, and terminals are cheap. Sigfox® has been adopted in 70 countries around the world[1], primarily in Europe. IEEE802.15.4k is strong against interference from the same system, can accommodate a larger number of terminals in the same network, and enables easy connection even in urban areas with wireless congestion. In addition to these 2 LPWAN methods, our 2+1 mode wireless LSI is the first[2] to support the IEEE802.15.4g standard, a short-range communication protocol used as the physical layer for Wi-SUN that provides faster speeds than LPWAN. This LSI is the ML7404.
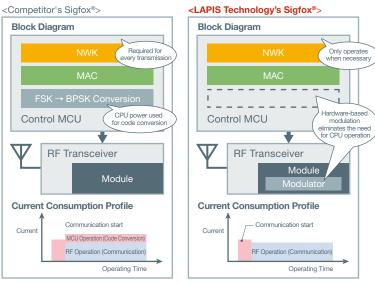
2+1 mode advantages

WW Backbone
ADSL, etc.
HTTP, etc.
Billing
sigfox Cloud
Domestic Population Coverage: 95%[3]
ADSL, etc.
Enables interpolation of area coverage from IEEE802.15.4x via Sigfox® bridge communication
Sigfox® radio waves cannot reach

*3 Published by Kyocera Communication Systems Co., Ltd. in June 2020

POINT 02

The first[2] hardware-based BPSK modulator for Sigfox®. Contributes to lower set power consumption

Sigfox® utilizes BPSK modulation, which is not used in conventional Sub-GHz communication. However, conventional Sigfox® compatible wireless communication LSIs do not support BPSK modulation, making it necessary to create BPSK symbol data using control MCU software. But this requires that the control MCU be activated each time wireless communication is performed, resulting in unnecessary set power consumption. In contrast, the ML7404 and ML7414 integrate a hardware-based BPSK modulation circuit that supports Sigfox®.This eliminates the need for the control MCU to operate (in the physical layer) during wireless communication, reducing system power consumption.

Advantages of hardware-based BPSK modulation

POINT 03
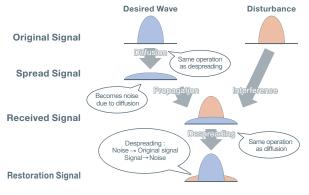
Compatible with the strongest IEEE802.15.4k standard against interfering waves

The LPWAN is tasked with accommodating a number of terminals within a cell that other wireless methods cannot compete with. As a result, disturbance tolerance in the same system is considered to be an extremely important factor in LPWAN.
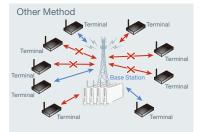
We offer the industry's first[2] ASSP (Application Specific Standard Product) -based wireless transceiver compliant with IEEE802.15.4k, which utilizes the DSSS (Direct Sequence Spread Spectrum) technique that provides greater resistance to interference within the same system and security against interception. As a result, it is strong in urban areas, and can accommodate more terminals under one network.

Applicable Model: ML7404

IEEE802.15.4k advantages

Advantages of the same system disturbance tolerance

POINT 04

Sigfox® verified reference design offered

A Sigfox® Verified reference design is available that integrates the ML7416S protocol control MCU with the ML7404 wireless transceiver.

In addition to the BOM list and circuit/layout diagrams for this design, various driver software is provided free of charge.

Applicable Model: ML7404

MK74Q0410 reference design for Japanese market
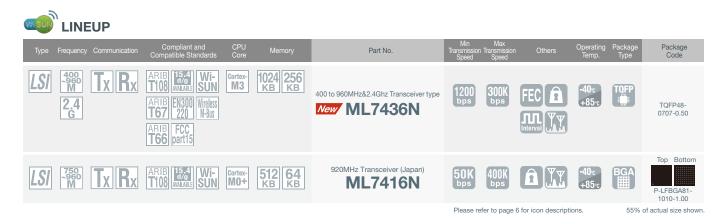
Specifications

Part No.	Supply Voltage (V)	Supported Frequencies (MHz)	Supported Standards	Operating Temperature (°C)	Package Code
ML7404	1.8 to 3.6	315/426/429/433/470/868/915/920	ARIB STD-T67, ARIB STD-T108, RCR STD-30, ETSI EN300-220, EN13757-4:2013, IEEE802.15.4d/g, IEEE802.15.4k, Sigfox® Rev 2.E	−40 to +85	P-WQFN32-0505-0.50
ML7414	1.8 to 3.6	315 to 960	ARIB STD-T67, ARIB STD-T108, RCR STD-30, ETSI EN300-220, EN13757-4:2013, Sigfox® (Rev 2.E), IEEE802.15.4d/g	−40 to +85	P-WQFN32-0505-0.50

Specified Low Power Wireless System LSI with Built-in MCU

Wi SUN Alliance

LAPIS Technology's market-proven Sub-GHz specified low power wireless system LSI integrates a high-performance MCU optimized for implementing the protocol stack and is designed to meet the needs of the expanding IoT market, including HEMS/BEMS.

LINEUP

Type	Frequency	Communication	Compliant and Compatible Standards	CPU Core	Memory		Part No.	Min Transmission Speed	Max Transmission Speed	Others	Operating Temp.	Package Type	Package Code
LSI	400~960M / 2.4G	Tx Rx	ARIB T108 / 15.4 d/g AVAILABLE / Wi-SUN / ARIB T67 / EN300 220 / Wireless M-Bus / ARIB T66 / FCC part15	Cortex-M3	1024 KB	256 KB	400 to 960MHz&2.4Ghz Transceiver type **New ML7436N**	1200 bps	300K bps	FEC / Interval	-40℃ +85℃	TQFP	TQFP48-0707-0.50
LSI	750~960M	Tx Rx	ARIB T108 / 15.4 d/g AVAILABLE / Wi-SUN	Cortex-M0+	512 KB	64 KB	920MHz Transceiver (Japan) **ML7416N**	50K bps	400K bps		-40℃ +85℃	BGA	Top Bottom P-LFBGA81-1010-1.00

Please refer to page 6 for icon descriptions.

55% of actual size shown.

Specified Low Power Wireless System LSI with Built-in MCU — Function/Block Diagram

Built-in high performance low power MCU

Cortex®-M0+ decreases current by 30% and improves processing power by 10%

CorTex M3 or CorTex M0+

Store all layers up to the HEMS profile in the high capacity flash ROM

All layers up to Echonet Lite for HEMS devices can be stored in the large capacity internal 1024KB (Max) memory.

512 KB or 1024 KB

Compatible with OTA (Over The Air) ISP

2 flash controllers support 512KB × 2 (or 265KB × 2) memory for firmware updates from external systems.

CPU

SWD
DAP | MTB | SysTick
Cortex®-M3 or M0+ CPU Up to 81MHz or 40MHz
NVIC
WIC

Flash Control
Flash Control
Flash
Flash Memory

AHB SRAM Brg
AHBRAM

Supports data flash

Allows for high reliability data rewrites.

Single-cycle I/O
AHB-lite

STD GPIO | AHB/APB Bridge | CRYPTO (AES, SHA) | TRNG | Flash DMA | System Control | DMAC

Multilayer path

Enables program rewriting without placing a load on the CPU.

APB

Reset Control

UART | SPI | I2C | GPIO | Timer | RTC
RAND | SSIS | WDT | FTM | CLK Timer | RF-IF
ADC | VDET | TEMP. | RC OSC (34MHz or 16MHz)

Power Management

Registers
RC OSC (32kHz)
X'tal OSC (32.768kHz)

PLL

Clock Control

RF

Antenna

Sub-GHz

2.4GHz (ML7436N)

32.768kHz

48MHz or 36MHz

Hardware-based encryption processing engine

Built-in encryption processing engine and DMA controller ensure that the main part of the encryption processing engine is hardware-based, significantly decreasing software load.

Built-in low-speed oscillation circuit reduces the number of external parts

The integrated 32kHz RC circuit eliminates the need for an external oscillator.

Support for 2 diversity ensures stable reception

Switching to the antenna with a stronger signal ensures more stable reception.

POINT 01

2 flash ROM banks support OTA (Over The Air) ISP

1024KB (512KB) flash ROM can be used as 512KB (256KB) × 2 banks. This makes it possible to easily configure systems capable of firmware updates to meet the needs of the IoT market along with Wi-SUN updates, bug fixes, and security enhancements.

HGW

Built-in Wi-SUN Stack

| ECONET Lite |
| TLS/PANA |
| (TCP/) UDP |
| IPv6 (/RPL) |
| 6LoWPAN |
| IEEE802.15.4/4a |
| IEEE802.15.4g |

AC
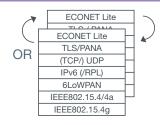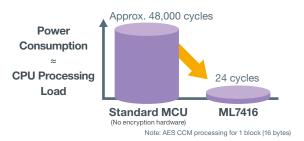
ML7436N: 512KB x 2 configurable
(ML7416N: 256KB x 2 configurable)

OR

| ECONET Lite |
| TLS/PANA |
| (TCP/) UDP |
| IPv6 (/RPL) |
| 6LoWPAN |
| IEEE802.15.4/4a |
| IEEE802.15.4g |
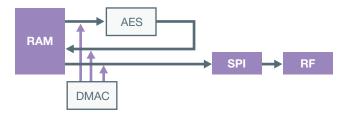
POINT 02

Integrated security hardware engine

Security processing is reduced by over 2000×, improving performance while reducing power consumption.

Power Consumption ≈ CPU Processing Load

Approx. 48,000 cycles

24 cycles

Standard MCU (No encryption hardware) **ML7416**

Note: AES CCM processing for 1 block (16 bytes)

Built-in Hardware Encryption Engine

Encryption Key Length: 128/192/256bit
Authentication/Encryption Modes: AES-CCM/GCM
Basic Encryption Modes: AES-ECD/CBC/CTR/OFB

RAM — AES — SPI — RF
DMAC

POINT 03
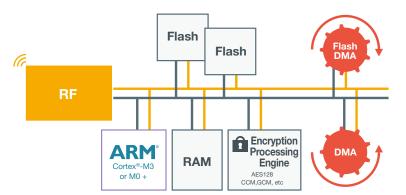
Built-in power supply isolation function reduces power consumption during standby

During standby when no data is being transmitted/received ultra-low power consumption is achieved by only supplying power to the purple areas at left in the Function/Block Diagram that are necessary for time division. In addition, it is possible to partially cut off power supply to memory blocks with large working currents depending on usage.

POINT 04

Multilayer path application

Enables program rewriting without impacting CPU load.

RF

Flash
Flash
Flash DMA

ARM® Cortex®-M3 or M0 +

RAM

Encryption Processing Engine
AES128 CCM,GCM, etc

DMA

Specifications

Part No.	Supply Voltage (V)	Supported Frequencies (MHz)	Supported Standards	CPU Core Operating Frequency (MHz)	Operating Temperature (°C)	Package Code
New **ML7436N**	2.6 to 3.6	400 to 960 2400	ARIB STD-T108, T67, T66 ETSI EN300-220, IEEE802.15.4d/g, Wi-SUN Wireless M-bus, FCC, Port 15	up to 81	–40 to +85	P-TQFP48-0707-0.50
ML7416N	1.8 to 3.6	750 to 960	ARIB STD-T108, IEEE802.15.4d/g, Wi-SUN	up to 40	–40 to +85	P-LFBGA81-1010-1.00

Sub-GHz Short-range Wireless
Wi-SUN Modules

Wi SUN Alliance
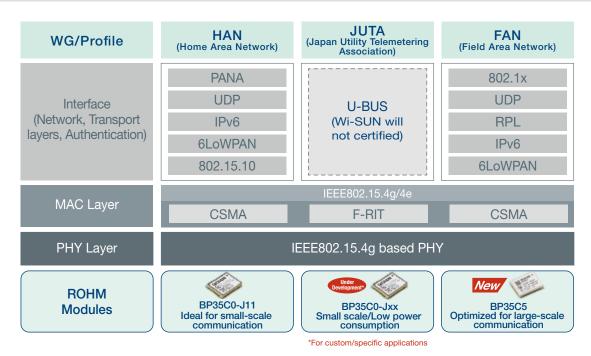
ROHM Wi-SUN wireless communication modules integrate a protocol stack compatible with the Wi-SUN standard. The capability of transmitting and receiving over longer distances with very low power makes them ideal for smart utilizes such as smart meters as well as M2M and IoT applications.

LINEUP

Type	Frequency	Communication	Compliant and Compatible Standards	Host I/F	Part No.	Transmission Speed	Antenna	Output	Operating Temp.
M module	920 M	Tx Rx	ARIB T108 / 15.4 d/g AVAILABLE / Wi-SUN	UART	920MHz Transceiver type for Japan **BP35A1**	100K bps	Pattern	20mW	-20℃ +80℃
M module	920 M	Tx Rx	ARIB T108 / 15.4 d/g AVAILABLE / Wi-SUN	UART	920MHz Transceiver type for Japan **BP35C0**	100K bps		20mW	-30℃ +85℃
M module	920 M	Tx Rx	ARIB T108 / 15.4 d/g AVAILABLE / Wi-SUN	UART	920MHz Transceiver type for Japan **BP35C0-J11**	100K bps	1mW 10mW 20mW		-30℃ +85℃
M module	920 M	Tx Rx	ARIB T108 / 15.4 d/g AVAILABLE / Wi-SUN	USB	920MHz Transceiver type for Japan **BP35C2**	100K bps	Chip	20mW	-20℃ +50℃
M module	920 M	Tx Rx	ARIB T108 / 15.4 d/g AVAILABLE / Wi-SUN FCC part15	UART	920/915MHz Transceiver Type for Japan/US *New* **BP35C5**	50K bps 100K bps 300K bps		20mW	-30℃ +85℃

Please refer to page 6 for icon descriptions.

Modules

Connector Type	Surface Mount Type	USB Dongle Type
BP35A1	BP35C0 / BP35C5 / BP35C0-J11	BP35C2

Wi-SUN Profile and ROHM Compatible Modules

WG/Profile	HAN (Home Area Network)	JUTA (Japan Utility Telemetering Association)	FAN (Field Area Network)
Interface (Network, Transport layers, Authentication)	PANA / UDP / IPv6 / 6LoWPAN / 802.15.10	U-BUS (Wi-SUN will not certified)	802.1x / UDP / RPL / IPv6 / 6LoWPAN
MAC Layer	IEEE802.15.4g/4e		
	CSMA	F-RIT	CSMA
PHY Layer	IEEE802.15.4g based PHY		
ROHM Modules	BP35C0-J11 Ideal for small-scale communication	Under Development* BP35C0-Jxx Small scale/Low power consumption	New BP35C5 Optimized for large-scale communication

*For custom/specific applications

Wi-SUN HAN Compatible Modules
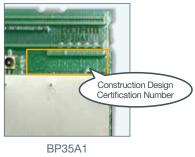
BP35C0/BP35C0-J11/BP35C2 Function/Block Diagram

Pre-adjusted transmission power
The adjusted transmission power value and MAC address are loaded before shipment.

ML7416N built in
LAPIS Technology's RFIC is integrated.

BP35C2

BP35C0/BP35C0-J11

Antenna

filter		Host MCU
RF SW	TRX_SW	
LC filter	**ML7416N (RF+MCU)**	UART / **HOST I/F**
		UART / USB
OSC 36MHz	OSC 32.768kHz	LDO / USB

Antenna-equipped module
Built-in antenna and pre-adjusted wireless characteristics facilitate development.

IEEE802.15.4g qualified
Enables development of an IEEE802.15.4g-compatible communication system.

USB I/F
USB-compatible I/F. Facilitates connection to downstream systems.
Applicable Model: BP35C2

Usage Notes

When developing products using ROHM Wi-SUN modules, it is also necessary to develop application software.
Many applications are supported by third parties. Sample code for demonstrating and evaluating our modules can be downloaded from our website.
Also, please refer to our website for technical support.

POINT 01

Certification under Japan's Radio Law enables immediate use

ROHM wireless communication modules have obtained certification under Japan's Radio Law. And the pre-tuned wireless characteristics of the internal antenna allows customers to immediately begin development and evaluation without the need for complicated characteristics adjustment. Of course, Radio Law certification is not needed for the customer's device.

Radio Law certification enables immediate evaluation and implementation

Construction Design Certification Number

BP35A1

POINT 02

Wi-SUN certified, registered as a CTBU
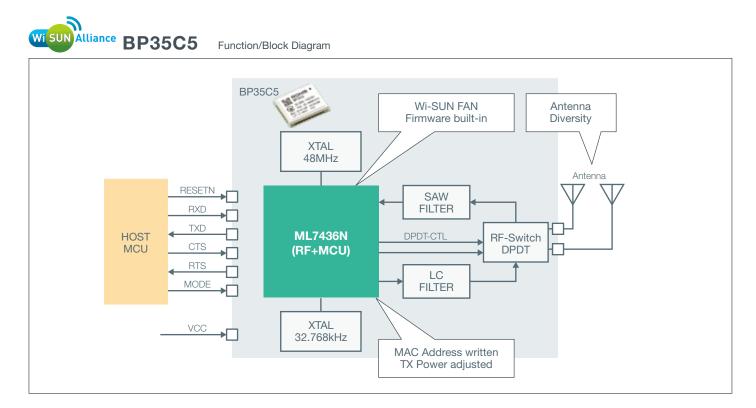
The BP35A1/BP35C0/BP35C0-J11 wireless communication modules have already obtained Wi-SUN certification. The BP35C2 USB dongle is also certified. The modules are also registered as CTBUs (Certified Test Bed Units) by the Wi-SUN Alliance, playing the role as reference units for Wi-SUN communication (Wi-SUN for ECHONET Lite Profile).

Applicable Model: BP35A1, BP35C0, BP35C0-J11, BP35C2

Worry-free Wi-SUN communication as a CTBU

Wi SUN Alliance

Product Certificate

Wi-SUN ECHONET Profile Certified

Wi-SUN Alliance — BP35C5 Function/Block Diagram

BP35C5

- Wi-SUN FAN Firmware built-in
- Antenna Diversity

HOST MCU
- RESETN
- RXD
- TXD
- CTS
- RTS
- MODE
- VCC

XTAL 48MHz

ML7436N (RF+MCU)

XTAL 32.768kHz

SAW FILTER

DPDT-CTL

LC FILTER

RF-Switch DPDT

Antenna

MAC Address written TX Power adjusted

Usage Notes

When developing products using ROHM Wi-SUN modules, it is also necessary to develop application software.
Many applications are supported by third parties. Sample code for demonstrating and evaluating our modules can be downloaded from our website.
Also, please refer to our website for technical support.

POINT 01
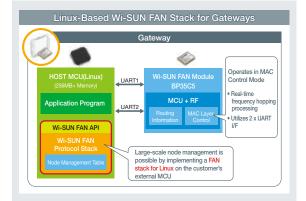
Supports multi-hop mesh networks

Support for multi-hop communication (relay function) is provided by implementing RPL centered on RFC6550 (up to 20 hops), enabling bidirectional mesh-type communication. This makes it possible to automatically optimize the hop route - even in the event of communication failure due to newly constructed buildings or other surrounding obstacles - ensuring high reliability communication.
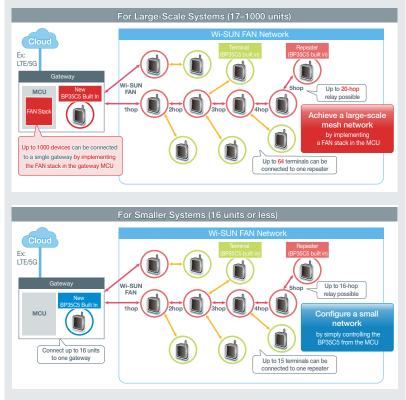
A maximum of 1,000 simultaneous connections can be achieved by installing a FAN stack for large systems in the master gateway MCU (20 hops between repeaters and 64 terminals per repeater).

The BP35C5 incorporates a Wi-SUN FAN stack in the internal memory that gives users the option of constructing a simple small-scale system connecting up to 16 devices to the gateway without an external MCU.

Linux-Based Wi-SUN FAN Stack for Gateways

Gateway

HOST MCU(Linux) (256MB+ Memory)
Application Program
Wi-SUN FAN API
Wi-SUN FAN Protocol Stack
Node Management Table

UART1
UART2

Wi-SUN FAN Module BP35C5
MCU + RF
Routing Information | MAC Layer Control

Operates in MAC Control Mode
• Real-time frequency hopping processing
• Utilizes 2 x UART I/F

Large-scale node management is possible by implementing a FAN stack for Linux on the customer's external MCU

ROHM Module Solutions

For Large-Scale Systems (17–1000 units)

Cloud
Ex: LTE/5G

Gateway
MCU
New BP35C5 Built In
FAN Stack

Wi-SUN FAN Network
Terminal (BP35C5 built in)
Repeater (BP35C5 built in)

Wi-SUN FAN
1hop 2hop 3hop 4hop 5hop
Up to 20-hop relay possible

Up to 1000 devices can be connected to a single gateway by implementing the FAN stack in the gateway MCU

Achieve a large-scale mesh network by implementing a FAN stack in the MCU

Up to 64 terminals can be connected to one repeater

For Smaller Systems (16 units or less)

Cloud
Ex: LTE/5G

Gateway
MCU
New BP35C5 Built In

Wi-SUN FAN Network
Terminal (BP35C5 built in)
Repeater (BP35C5 built in)

Wi-SUN FAN
1hop 2hop 3hop 4hop 5hop
Up to 16-hop relay possible

Connect up to 16 units to one gateway

Configure a small network by simply controlling the BP35C5 from the MCU

Up to 15 terminals can be connected to one repeater

POINT 02

Supports channel hopping

Scheduled channel switching minimizes mutual interference even with increased communication traffic At the same time, it is possible configure a robust system strong against radio interference and noise while performing confidential communication.

Under Japan's Radio Law, there is a transmission time limit of only 6 minutes per hour when using one channel, but this can be extended to 12 minutes per hour utilizing multiple channels through channel hopping.

Disturbance

Communicates by switching channels to avoid interference

922.4   928.0   MHz

POINT 03

Enables high data rates
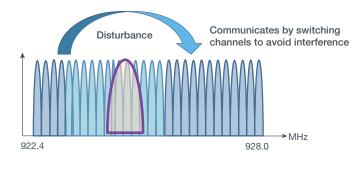
Wi-SUN FAN supports data rates of 50kbps and 150kbps. The BP35C5 also supports 300kbps.

A high data rate allows data to be sent at high speed, reducing transmission time along with power consumption while suppressing mutual interference due to increased communication traffic.

LPWA data comparison

300kbps

150kbps

50kbps

0.1kbps, etc.

Other Method   Wi-SUN FAN

POINT 04

Wi-SUN FAN certified

The BP35C5 is a Wi-SUN FAN certified module. Embedding the module allows users to develop Wi-SUN FAN-compatible products without the need to undergo the certification process. (Must be a Wi-SUN Alliance member to use the Wi-SUN logo) The moduled complies with radio laws in Japan and the US.

Wi-SUN FAN qualification facilitates commercialization; radio law compliant

Instantly begin broadcasting and evaluation development

North America (FCC)

Japan (TELEC)
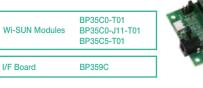
Evaluation Boards

Evaluation boards enable immediate use

For evaluating the BP35C0/BP35C0-J11/BP35C5

- RS-232C I/O
- USB-UART conversion
- Compatible with USB bus power

Wi-SUN Modules	BP35C0-T01 BP35C0-J11-T01 BP35C5-T01
I/F Board	BP359C

- USB I/F

Wi-SUN Modules	BP35C2-J11-T01

For evaluating BP35A1

- RS-232C I/O
- USB-UART conversion
- Compatible with USB bus power

Wi-SUN Modules	BP35A1
Adapter Board	BP35A7A
I/F Board	BP359C

Evaluation board configuration

Combination No.	Host CPU I/F Type	Wi-SUN Modules	Adapter Board	I/F Board
1	UART	BP35A1	BP35A7A	BP359C
2		BP35C0-T01	–	BP359C
3		BP35C0-J11-T01	–	BP359C
4		BP35C1-J11-T01	BP35A7A	BP359C
5		BP35C5-T01	–	BP359C
6	USB	BP35C2-J11-T01	–	–

Specifications
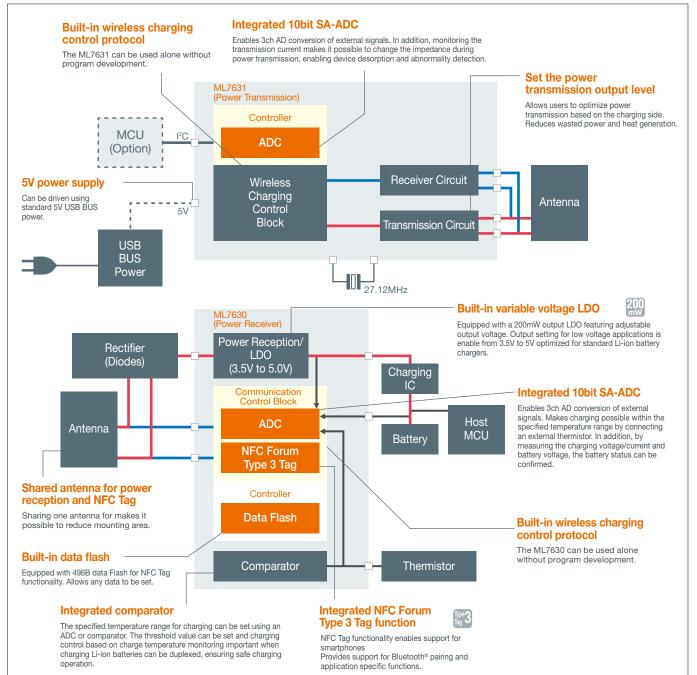
Part No.	Supply Voltage (V)	Host CPU I/F	Supported Standard	Built-In System IC	Operating Temperature (°C)	Size (mm)
BP35A1	2.7 to 3.6 (Single power supply)	UART	Wi-SUN/B Route	ML7396B (LAPIS Technology)	−20 to +80	22.0×33.5×3.9
BP35C0	2.6 to 3.6 (Single power supply)	UART	Wi-SUN/B Route/ HAN	ML7416N (LAPIS Technology)	−30 to +85	15.0×19.0×2.6
BP35C0-J11	2.6 to 3.6 (Single power supply)	UART	Wi-SUN/B Route/ Enhanced HAN	ML7416N (LAPIS Technology)	−30 to +85	15.0×19.0×2.6
BP35C2	4.5 to 5.5 (Single power supply)	USB	Wi-SUN/B Route/ HAN	ML7416N (LAPIS Technology)	−20 to +50	21.4×49.7×8.5
New **BP35C5**	2.6 to 3.6 (Single power supply)	UART	Wi-SUN FAN	ML7436N (LAPIS Technology)	−30 to +85	15.0×19.0×2.6

13.56MHz Wireless Charger Chipset

LAPIS Technology's wireless charger chipset combines power transmission and reception LSIs for wireless charging utilizing the 13.56MHz band. This makes it possible to reduce antenna size, enabling greater miniaturization of the wireless charging block.

LINEUP

Type	Frequency	Communication	Host I/F	Part No.	Charging Power	NFC I/F	Operating Temp.	Package Type	Package Code
LSI	13.56 M	Tx	I²C	13.56MHz Wireless Power Transmission **ML7631**			-40℃ +85℃	Thin QFN	Top Bottom P-WQFN32-0505-0.50-A63
LSI	13.56 M	Rx	I²C	13.56MHz Wireless Power Reception **ML7630**	200 mW	Type Tag 3	-40℃ +85℃	WCSP	Top Bottom S-UFLGA34-2.59x2.59-0.4-W

Please refer to page 6 for icon descriptions. 70% of actual size shown.

13.56MHz Wireless Charger LSI Function/Block Diagram

Built-in wireless charging control protocol

The ML7631 can be used alone without program development.

Integrated 10bit SA-ADC

Enables 3ch AD conversion of external signals. In addition, monitoring the transmission current makes it possible to change the impedance during power transmission, enabling device desorption and abnormality detection.

Set the power transmission output level

Allows users to optimize power transmission based on the charging side. Reduces wasted power and heat generation.

5V power supply

Can be driven using standard 5V USB BUS power.

ML7631 (Power Transmission)

Controller

ADC

MCU (Option) — I²C — Wireless Charging Control Block — Receiver Circuit — Antenna — Transmission Circuit

USB BUS Power — 5V

27.12MHz

Built-in variable voltage LDO

Equipped with a 200mW output LDO featuring adjustable output voltage. Output setting for low voltage applications is enable from 3.5V to 5V optimized for standard Li-ion battery chargers.

ML7630 (Power Receiver)

Rectifier (Diodes) — Power Reception/ LDO (3.5V to 5.0V)

Communication Control Block

ADC

NFC Forum Type 3 Tag

Charging IC

Battery

Host MCU

Integrated 10bit SA-ADC

Enables 3ch AD conversion of external signals. Makes charging possible within the specified temperature range by connecting an external thermistor. In addition, by measuring the charging voltage/current and battery voltage, the battery status can be confirmed.

Shared antenna for power reception and NFC Tag

Sharing one antenna for makes it possible to reduce mounting area.

Antenna

Controller

Data Flash

Built-in data flash

Equipped with 496B data Flash for NFC Tag functionality. Allows any data to be set.

Comparator

Thermistor

Built-in wireless charging control protocol

The ML7630 can be used alone without program development.

Integrated comparator

The specified temperature range for charging can be set using an ADC or comparator. The threshold value can be set and charging control based on charge temperature monitoring important when charging Li-ion batteries can be duplexed, ensuring safe charging operation.

Integrated NFC Forum Type 3 Tag function

NFC Tag functionality enables support for smartphones
Provides support for Bluetooth® pairing and application specific functions.

POINT 01

Utilizing a smaller antenna contributes to greater space savings

Performing wireless charging at 13.56MHz makes it possible to use a smaller antenna on the order of 1μH. For example, adopting an ultra-compact cube antenna reduces board area by approx. 50% compared to the charging area utilized by conventional Micro USB connectors.

Saves valuable board space

Conventional	New Wireless Charging Solution
MicroUSB connector 10×8mm / Mounting Board / 80mm²	Mounting Board / Cube Antenna for Power Reception 4×4mm / ML7630 2.6×2.6mm / Peripheral Components / 40mm²

50% smaller

POINT 02

MCU-less design saves space and enables system configuration without the need for software development

Both the ML7630 and ML7631 integrate all functions necessary for power reception/transmission in a single chip, making it possible to achieve wireless charging control without an MCU. This eliminates the need for software development while contributing to set miniaturization by reducing the space required for the MCU.

Standalone design (No control software needed)

POINT 03

200mW output LDO and temperature management support Li-ion battery charging

The ML7630 integrates a 200mW output LDO capable of charging Li-ion batteries by using a charging IC at the output. In addition, the built-in 10bit AD converter and comparator provide programmable temperature control (temperature detection, threshold management) important for Li-ion batteries, ensuring high reliability charging control.

Receiver LSI (ML7630)

POINT 04

Integrated NFC Forum Type3 Tag function

The ML7630 incorporates NFC Forum Type3 Tag functionality that makes it possible to read Tag information written in the internal ROM from NFC-equipped devices such as smartphones, providing support for Bluetooth pairing using NFC touch that eliminates the need for screen or switch operation.

NFC Forum Type 3 Tag

POINT 05
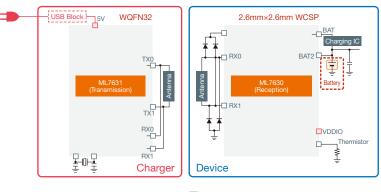
Module lineup planned
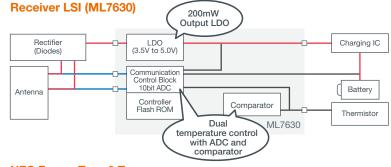
ROHM is developing antenna-type modules equipped with the ML7630 and ML7631. Antenna matching has been performed to obtain maximum efficiency and enable immediate operation, significantly reducing customer design load.

	Evaluation Module Example (Under Development)	
Type	TX	RX
Product Image		
Part No.	BP3621-T01	BP3622-T01
Tentative Product Size (mm)	30.0×50.0	20.0×30.0
Antenna Size (mm)	24.0×24.0	16.0×16.0
Charging Power (mW)	—	approx. 200
Board	PCB (h=approx. 0.2mm)	
Host I/F	Flexible/harness connectors	
Functions	Power transmission + Communication	Charging + Communication
Features	High tolerance against misalignment	

Specifications

Part No.	Features	Functions	I/F	Data Flash	ADC (Method)	Operating Temperature (°C)	Package Code
ML7631	Wireless Power Transmission	Adjustable transmission power	I²C Slave×1ch	496B	10bit (SA type) ×3ch	−40 to +85	P-WQFN32-0505-0.50-A63 (WQFN32)
ML7630	Wireless Power Reception	200mW Max output	NFC Forum Type3 Tag I²C Slave×1ch	496B	10bit (SA type) ×3ch	−40 to +85	S-UFLGA34-2.59x2.59-0.4-W (WCP34)

2.4GHz Short-range Wireless

Wi-Fi Modules Wi-Fi
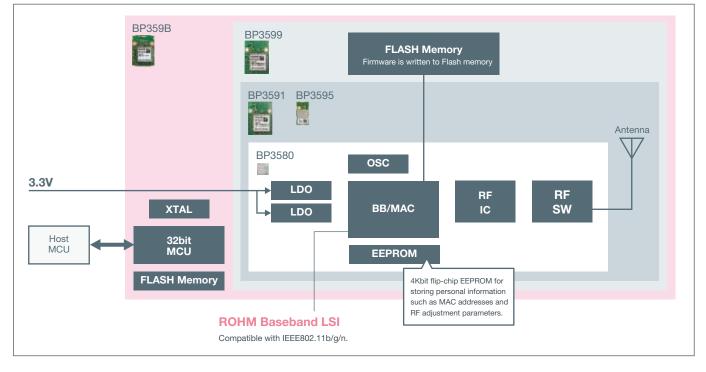
ROHM Wi-Fi modules perform all authentication and encryption (supplicant and WPS) internally. Models that include the TCP/IP protocol stack are also offered, reducing MCU load while improving system performance.

Wi-Fi LINEUP

Type	Frequency	Communication	Compliant and Compatible Standards	Host I/F	Part No.	Transmission Speed	Antenna	Encryption	Other	Operating Temp.
M module	2.4G	Tx Rx	ARIB T66	Wi-Fi / USB SDIO UART	High-Speed Data Transmission **BP3580**	~72.2 Mbps		WPA WPA2	TCP/IP Built in	-40℃ +85℃
M module	2.4G	Tx Rx	ARIB T66 / FCC part15	Wi-Fi / USB SDIO UART	High-Speed Data Transmission **BP3591**	~72.2 Mbps	Chip	WPA WPA2	TCP/IP Built in	-40℃ +85℃
M module	2.4G	Tx Rx	ARIB T66 / FCC part15	Wi-Fi / USB SDIO UART	High-Speed Data Transmission **BP3595**	~72.2 Mbps	Pattern	WPA WPA2	TCP/IP Built in	-40℃ +85℃
M module	2.4G	Tx Rx	ARIB T66 / FCC part15	Wi-Fi / USB SDIO UART	High-Speed Data Transmission **BP3599**	~72.2 Mbps	Chip	WPA WPA2	TCP/IP Built in	-40℃ +85℃
M module	2.4G	Tx Rx	ARIB T66	Wi-Fi / UART	High-Speed Data Transmission **BP359B**	~72.2 Mbps	Chip	WPA WPA2	SSL/TLS Built in / TCP/IP Built in	-40℃ +70℃

Please refer to page 6 for icon descriptions.

Modules

Surface Mount type	Built-in Antenna type	Compact type with Built-in Antenna	Built-in Antenna/Flash Memory type	Internal Antenna/MCU type
BP3580	BP3591	BP3595	BP3599	BP359B

Wi-Fi Modules Function/Block Diagram

BP359B
BP3599
FLASH Memory
Firmware is written to Flash memory
BP3591 BP3595
BP3580
OSC
Antenna
3.3V
LDO
LDO
BB/MAC
RF IC
RF SW
XTAL
Host MCU ↔ 32bit MCU
FLASH Memory
EEPROM
4Kbit flip-chip EEPROM for storing personal information such as MAC addresses and RF adjustment parameters.

ROHM Baseband LSI
Compatible with IEEE802.11b/g/n.

Usage Notes

ROHM Wi-Fi modules are wireless communication modules. When developing products using this module it is also necessary to develop application and device drivers.
The device drivers are offered on our website as sample code (Linux). Other OS and applications are supported by third parties.
Also, please refer to our website for technical support.
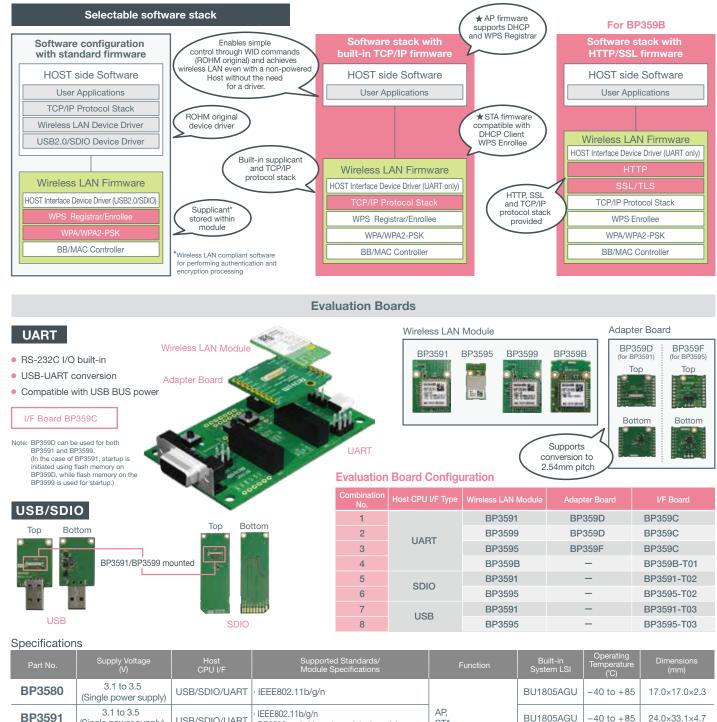
POINT 01

Certification under Japan's Radio Law enables immediate use

ROHM wireless communication modules have acquired certification under Japan's Radio Law. Built-in antenna and pre-adjusted wireless characteristics allow for immediate broadcasting and application evaluation/development. Of course this eliminates the need to certify customer sets.

Radio Law certification enables immediate evaluation and implementation

BP3580	BP3591	BP3595	BP3599	BP359B

The construction type certificatin number

POINT 02

Selectable software stack

Software configuration with standard firmware

HOST side Software
- User Applications
- TCP/IP Protocol Stack
- Wireless LAN Device Driver
- USB2.0/SDIO Device Driver

Wireless LAN Firmware
- HOST Interface Device Driver (USB2.0/SDIO)
- WPS Registrar/Enrollee
- WPA/WPA2-PSK
- BB/MAC Controller

*Wireless LAN compliant software for performing authentication and encryption processing

Enables simple control through WID commands (ROHM original) and achieves wireless LAN even with a non-powered Host without the need for a driver.

ROHM original device driver

Built-in supplicant and TCP/IP protocol stack

Supplicant* stored within module

★ AP firmware supports DHCP and WPS Registrar

Software stack with built-in TCP/IP firmware

HOST side Software
- User Applications

Wireless LAN Firmware
- HOST Interface Device Driver (UART only)
- TCP/IP Protocol Stack
- WPS Registrar/Enrollee
- WPA/WPA2-PSK
- BB/MAC Controller

★ STA firmware compatible with DHCP Client WPS Enrollee

HTTP, SSL and TCP/IP protocol stack provided

For BP359B

Software stack with HTTP/SSL firmware

HOST side Software
- User Applications

Wireless LAN Firmware
- HOST Interface Device Driver (UART only)
- HTTP
- SSL/TLS
- TCP/IP Protocol Stack
- WPS Enrollee
- WPA/WPA2-PSK
- BB/MAC Controller

Evaluation Boards

UART

- RS-232C I/O built-in
- USB-UART conversion
- Compatible with USB BUS power

I/F Board BP359C

Note: BP359D can be used for both BP3591 and BP3599.
(In the case of BP3591, startup is initiated using flash memory on BP359D, while flash memory on the BP3599 is used for startup.)

Wireless LAN Module

Adapter Board

UART

Wireless LAN Module

BP3591	BP3595	BP3599	BP359B

Adapter Board

BP359D (for BP3591)	BP359F (for BP3595)
Top	Top
Bottom	Bottom

Supports conversion to 2.54mm pitch

USB/SDIO

Top	Bottom		Top	Bottom

BP3591/BP3599 mounted

USB

SDIO

Evaluation Board Configuration

Combination No.	Host CPU I/F Type	Wireless LAN Module	Adapter Board	I/F Board
1	UART	BP3591	BP359D	BP359C
2	UART	BP3599	BP359D	BP359C
3	UART	BP3595	BP359F	BP359C
4	UART	BP359B	—	BP359B-T01
5	SDIO	BP3591	—	BP3591-T02
6	SDIO	BP3595	—	BP3595-T02
7	USB	BP3591	—	BP3591-T03
8	USB	BP3595	—	BP3595-T03

Specifications

Part No.	Supply Voltage (V)	Host CPU I/F	Supported Standards/ Module Specifications	Function	Built-in System LSI	Operating Temperature (°C)	Dimensions (mm)
BP3580	3.1 to 3.5 (Single power supply)	USB/SDIO/UART	· IEEE802.11b/g/n	AP, STA (infrastructure mode), STA (ad hoc mode)	BU1805AGU	−40 to +85	17.0×17.0×2.3
BP3591	3.1 to 3.5 (Single power supply)	USB/SDIO/UART	· IEEE802.11b/g/n · BP3580 and chip-antenna into 1 module		BU1805AGU	−40 to +85	24.0×33.1×4.7
BP3595	3.1 to 3.5 (Single power supply)	USB/SDIO/UART	· IEEE802.11b/g/n · The small size type of BP3591		BU1805AGU	−40 to +85	15.3×27.6×2.6
BP3599	3.1 to 3.5 (Single power supply)	USB/SDIO/UART	· IEEE802.11b/g/n · Type with flash memory mounted on BP3591 · Firmware is written in a flash memory		BU1805AGU	−40 to +85	24.0×33.1×4.7
BP359B	3.1 to 3.5 (Single power supply)	UART	· IEEE802.11b/g/n · Type with MCU and flash memory mounted on BP3591 · Firmware is written in a flash memory	STA (infrastructure mode)	BU1805AGU	−40 to +70	24.0×33.1×4.7

Sub-GHz Batteryless Communication

EnOcean® Modules

enocean®

EnOcean® modules combine ultra-low power communication elements with power generating devices that utilize energy harvesting technology (i.e. light, electromagnetic induction). The wire-free, batteryless design allows installation virtually anywhere and eliminates the need for periodic maintenance. In addition, interconnectivity makes it easy to add devices.

LINEUP

Product Name	Compliant and Compatible Standards	Part No. Wireless Frequency 928.35MHz (Japan)	Part No. Wireless Frequency 868.3MHz (EU/China)	Part No. Wireless Frequency 921.4MHz (Asia*)	Overview	Operating Temp.	Image
Switch Modules	ARIB T108	PTM 210J	PTM 210		Wireless switch modules for push mechanisms. Integrates a switch power generation element and wireless communication module.	-25℃ +65℃	
Circuit Boards for Switch Modules	ARIB T108	PTM 430J	PTM 330		Wireless transmission board modules for switches. Used in combination with electromagnetic induction generator elements for switches.	-25℃ +65℃	
Electromagnetic Induction Generator Element for Switch Modules		ECO 200			Power generating switch elements that generate electricity using electromagnetic induction. Used in combination with switch module circuit boards.	-25℃ +65℃	
Humidity Sensor Modules	ARIB T108	STM 429J	STM 329		Used for open/close detection of doors and windows. Power generated from weak indoor light using photovoltaic cells is used to wirelessly transmit open/close status.	-20℃ +60℃	
Humidity Sensor Modules	ARIB T108	STM 431J	STM 331	*New* STM 431T	Can be used as temperature sensors. Power generated from weak indoor light using photovoltaic cells is used to wirelessly transmit temperature data.	-20℃ +60℃	
Humidity Sensor Modules		HSM 100			An expansion board for temperature sensor modules that adds a humidity sensor. Includes a connector for connecting to temperature sensor modules.	-20℃ +60℃	
Wireless Energy Harvesting Modules	ARIB T108	STM 400J	STM 300		Wireless modules optimized for energy harvesting.	-25℃ +85℃	
Programmable Wireless Modules for Transmission/Reception	ARIB T108	TCM 410J	TCM 310		Programmable transceiver modules that can be used for receiving signals from switch modules.	-25℃ +85℃	
USB Receiver Modules	ARIB T108	USB 400J	USB 300	*New* USB 500T	Transceiver modules that support USB connection.	-20℃ +50℃	

*Target Countries: Thailand, Vietnam, Singapore, Malaysia, Taiwan, etc.
Please refer to page 6 for icon descriptions.

EnOcean® Module EDK 400J Evaluation Kit

Programming kit ideal for application/firmware development, prototyping, and training purposes.

Kit Contents
- PTM 210J (Switch Modules)
- USB 400J (USB Receiver Module)
- PTM 430J (Circuit Boards for Switch Modules)
- ECO 200 (Electromagnetic Induction Generator Element for Switch Modules)
- STM 431J (Temperature Sensor Modules)
- STM 400J (Wireless Energy Harvesting Module) *1
- EOP 350 (Programming Board) *2
- USB Cable (for connecting the EOP 350 to a PC)

Dolphin V4 API (S/W)
Requires purchase of EDK 400J
- Library files
- Peripheral functions manual
- Sample source code

Dolphin V4 Suite (S/W)
Software bundle that performs program writing, product settings, and chip calibration

Keil Integrated Development Environment (µVision)
In conjunction with Dolphin V4 API/Suite (S/W), makes it possible to carry out a series of firmware (F/W) development tasks such as original firmware coding, compiling, and writing.

Dolphin View
An evaluation tool for evaluating and analyzing EnOcean® wireless signals

Note: Representative image

*1 STM 400 in the EDK 400J is mounted on a dedicated board for connecting to EOP 350.
*2 Used when rewriting firmware for STM 400J and STM 431J.

Usage Notes
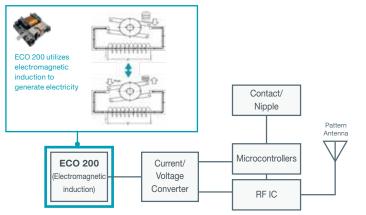
EnOcean® modules are wireless communication modules. When developing products using these modules, it is also necessary to develop application software.
Many applications are supported by third parties.
For technical information on these products, please refer to EnOcean® GmbH's website.

POINT 01

Wireless communication without batteries

Combining ultra-low-power wireless communication devices with energy harvesting technology capable of generating electricity from a push of a switch, temperature differences, or even light makes batteryless, wireless communication possible. The batteryless design eliminates the need for maintenance, enabling easy installation even in places conventionally difficult to install. In addition, ultra-low power communication 10x lower than the IEEE802.15.4 standard (i.e. ZigBee®) is achieved. And application support is provided in the form of an easy-to-use module, facilitating practical use.

PTM 210J block diagram and ECO 200 operating principle

ECO 200 utilizes electromagnetic induction to generate electricity

POINT 02

Wire-free design reduces installation time

EnOcean® modules require no wiring, making it possible to reduce both labor and wiring costs.
Installation work is minimized. And no wiring allows for easy removal and reinstallation virtually anywhere.
The wire-free design lends a clean aesthetic that makes it an attractive option for buildings and hotels. It has also been used to light up important cultural assets.
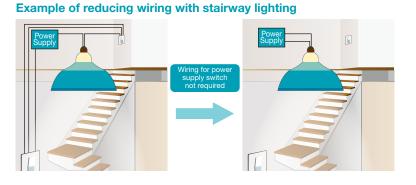
Example of reducing wiring with stairway lighting

Wiring for power supply switch not required

POINT 03

Certification under Japan's Radio Law enables immediate use

EnOcean® products for Japan are certified under Japan's Radio Law, allowing for immediate use by incorporating in existing sets.

Note: EnOcean® products are available in multiple frequency bands to support the radio laws in different countries. Therefore, it is necessary to select the EnOcean® product according to the frequency band of the country used (destination).

EnOcean® product list

Part No. / Region	928.35MHz Japan	868.30MHz EU/China	921.4MHz Asia*
Switch Modules	PTM 210J	PTM 210	
Circuit Boards for Switch Modules	PTM 430J	PTM 330	
Electromagnetic Induction Generator Element for Switch Modules			
Magnetic Contact Modules	STM 429J	STM 329	
Temperature Sensor Modules	STM 431J	STM 331	New STM 431T
Humidity Sensor Modules			
Wireless Energy Harvesting Modules	STM 400J	STM 300	
Programmable Wireless Modules for Transmission/Reception	TCM 410J	TCM 310	
USB Receiver Modules	USB 400J	USB 300	New USB 500T

*Target Countries: Thailand, Vietnam, Singapore, Malaysia, Taiwan, etc.

Specifications

Part No. 928.35MHz (Japan)	Part No. 868.30MHz (EU/China)	Supply Voltage	Antenna	Operating Temperature (°C)	Dimensions (mm)
PTM 210J	PTM 210	Supply from internal ECO 200	Pattern Antenna	−25 to +65	40.0×40.0×11.2
PTM 430J	PTM 330	Supply from external ECO 200	Whip Antenna	−25 to +65	26.2×21.15×3.5
ECO 200		Electromagnetic induction power generation: 120μJ Min at 2V	—	−25 to +65	29.3×19.5×7.0
STM 429J	STM 329	Solar power generation	Helical Antenna	−20 to +60	64.8×16.0×5.4
STM 431J	STM 331	Solar power generation	Helical Antenna	−20 to +60	64.8×16.0×8.4
HSM 100		Supply from STM 431J	—	−20 to +60	18.0×13.0×3.5
STM 400J	STM 300	2.1 to 5.0V (2.5V startup voltage)	—	−25 to +85	22.0×19.0×3.1
TCM 410J	TCM 310	2.6 to 5.0V	—	−25 to +85	22.0×19.0×3.1
USB 400J	USB 300	(via USB)	Pattern Antenna	−20 to +50	70.0×23.0×9.0

Bluetooth® Modules — 2.4GHz Short-range Wireless

Part No.	Supply Voltage (V)	Operating Temp. (°C)	Bluetooth Authentication	Radio Law Certification	Module Specifications	Built-in Flash/RAM	Built-in Crystal Oscillator	Built-in Antenna	Dimensions (mm)	Package Code
New MK71511-NNN	1.7 to 3.6	−40 to +85	Ver5.2 (Single mode)	TELEC/FCC/ISED/CE	Role: Master/Slave Application: Blank	Flash: 192KB RAM: 24KB	32MHz 32.768kHz	Pattern	9.7×13.4×2.0	M-FLGA54-9.7X 13.4-0.80-9Y
New MK71511A-NNN							32MHz			M-FLGA54-9.7X 13.4-0.80-9Y
New MK71521-NNN						Flash: 512KB RAM: 64KB	32MHz 32.768kHz			M-FLGA54-9.7X 13.4-0.80-9Y
New MK71521A-NNN							32MHz			M-FLGA54-9.7X 13.4-0.80-9Y

Specified Low Power Wireless LSIs — Sub-GHz Short-range Wireless (Wi-SUN Alliance)

Part No.	Supported Standards	Frequency Bands (MHz)	Supply Voltage (V)	Modulation Method	FEC Mode	Control I/F	Transmission Rate (kbps)	Transmission Output (mW)	Reception Sensitivity	Operating Temp. (°C)	Clock Input	Package Code	Halogen Free*2
ML7386	ARIB STD-T67 RCR STD-30	426	1.8 to 3.6	2-FSK MSK	—	Synchronous serial (Control) DIO (DATA)	2.4, 4.8, 7.2	10	—	−25 to +85	—	P-WQFN28-0404-0.40	✓
ML7386B								1/10					✓
ML7396E	EN300-220 EN1357-4:2011	750 to 900	1.8 to 3.6	2-(G) FSK (G) MSK	IEEE 802.15.4g compliant		to 50, 100, 150, 200, 400	1/10/20	−107dBm [100kbps, BER=0.1%]*1		—	P-WQFN40-0606-0.50	✓
ML7396D	ARIB STD-T108 EN300-220	900 to 960										P-WQFN40-0606-0.50	✓
ML7406y	EN300-220 EN1357-4:2011 IEEE802.15.4g	750 to 900	1.8 to 3.6	2-(G) FSK (G) MSK	—		to 500	1/10/20	−106dBm [100kbps, BER=0.1%]*1		y=(C)rystal input y=(S)PXO input y=(T)CXO input	P-WQFN32-0505-0.50	✓
ML7344Cy	Q/GDW374.3	160 to 510	3.3 to 3.6 (100mW)	2-(G) FSK (G) MSK	—		to 15	20/100	−117dBm [4.8kbps, BER=0.1%]*1			P-WQFN32-0505-0.50	✓
ML7344Jy	ARIB STD-T67 RCR STD-30		1.8 to 3.6		—			1/10/20				P-WQFN32-0505-0.50	✓
ML7345	ARIB STD-T67 ARIB STD-T108 RCR STD-30 EN300-220 EN13757-4:2013 IEEE802.15.4g	160 to 960	1.8 to 3.6	2-(G) FSK (G) MSK 4-(G) FSK	—	Synchronous serial (Control) DIO (DATA)	to 100	1/10/20	−123dBm [2.4kbps, BER=1%]*1	−40 to +85	—	P-WQFN32-0505-0.50	✓
ML7345D		315 to 960			—				−119.5dBm [2.4kbps, BER=1%]*1		—	P-WQFN32-0505-0.50	✓
ML7345C	Q/GDW374.3	470 to 510	3.3 to 3.6 (100mW)		—			20/100	−123dBm [2.4kbps, BER=1%]*1		—	P-WQFN32-0505-0.50	✓
ML7414	ARIB STD-T67 ARIB STD-T108 Sigfox®(Rev 2.E) RCR STD-30 EN300-220 EN13757-4:2013 IEEE802.15.4g	315 to 960	1.8 to 3.6	2-(G) FSK (G) MSK 4-(G) FSK BPSK (TX only)	IEEE 802.15.4g compliant			1/10/20	−106dBm [100kbps, BER=1%]*1		—	P-WQFN32-0505-0.50	✓

*1 BER refers to Bit Error Rate.   *2 Halogen-free products are indicated by the √ mark. For details, please contact a sales representative.

LPWAN (Low Power Wide Area Network) Wireless LSI — Sub-GHz Long-range Wireless (sigfox)

Part No.	Supported Standards	Frequency Bands (MHz)	Supply Voltage (V)	Modulation Method	FEC Mode	Control I/F	Transmission Rate (kbps)	Transmission Output (mW)	Reception Sensitivity	Operating Temp. (°C)	Package Code	Halogen Free*2
ML7404	ARIB STD-T67 ARIB STD-T108 RCR STD-30 EN300-220 EN13757-4:2013 Sigfox®(Rev 2.E) IEEE802.15.4k IEEE802.15.4g	315 to 960	1.8 to 3.6	2-(G) FSK (G) MSK 4-(G) FSK BPSK	IEEE 802.15.4g compliant	Synchronous serial (Control) DIO (DATA)	to 100kbps (xFSK) 80k to 200kcps (DSSS)	1/10/20	−119.5dBm [2.4kbps, BER=1%]*1	−40 to +85	P-WQFN32-0505-0.50	✓
ML7414	ARIB STD-T67 ARIB STD-T108 Sigfox®(Rev 2.E) RCR STD-30 EN300-220 EN13757-4:2013 IEEE802.15.4g			2-(G) FSK (G) MSK 4-(G) FSK BPSK (TX only)			to 100kbps		−106dBm [100kbps, BER=1%]*1		P-WQFN32-0505-0.50	✓

*1 BER refers to Bit Error Rate.   *2 Halogen-free products are indicated by the √ mark. For details, please contact a sales representative.

Specified Low Power Wireless System LSI with Built-in MCU — Sub-GHz Short-range Wireless (Wi-SUN Alliance)

Part No.	Supported Standards	Supported Frequencies (MHz)	Supply Voltage (V)	Modulation Method	CPU Core	Memory Resources	Transmission Rate (kbps)	Transmission Output (mW)	Reception Sensitivity	Operating Temp. (°C)	Package Code	Halogen Free*2
New ML7436N	ARIB STD-T66 ARIB STD-T67 ARIB STD-T108 EN300-220 FCC part15 IEEE802.15.4g	400 to 960 2400	2.6 to 3.6	2-(G) FSK (G) MSK 4-(G) FSK	Cortex®-M3 (to 81MHz)	FLASH1024KB, RAM256KB	1.2 to 300	1/10/20	−107dBm [100kbps, BER=1%]*1	−40 to +85	P-TQFP48-0707-0.50	✓
ML7416N	ARIB STD-T108	750 to 960	1.8 to 3.6	2-(G) FSK (G) MSK	Cortex®-M0+ (to 40MHz)	FLASH512KB, RAM64KB	to 50, 100, 150, 200, 400		−106dBm [100kbps, BER=0.1%]*1		P-LFBGA81-1010-1.00	✓

*1 BER refers to Bit Error Rate.   *2 Halogen-free products are indicated by the √ mark. For details, please contact a sales representative.

Sub-GHz Short-range Wireless — Wi-SUN Modules

Part No.	Supply Voltage (V)	Host CPU I/F	Supported Standard	Built-in System LSI	Operating Temp. (°C)	Dimensions (mm)
BP35A1	2.7 to 3.6 (Single power supply)	UART	Wi-SUN/B Route	ML7396B (LAPIS Technology)	−20 to +80	22.0×33.5×3.9
BP35C0	2.6 to 3.6 (Single power supply)	UART	Wi-SUN/B Route/ HAN	ML7416N (LAPIS Technology)	−30 to +85	15.0×19.0×2.6
BP35C0-J11	2.6 to 3.6 (Single power supply)	UART	Wi-SUN/B Route/ Enhanced HAN	ML7416N (LAPIS Technology)	−30 to +85	15.0×19.0×2.6
BP35C2	4.5 to 5.5 (Single power supply)	USB	Wi-SUN/B Route/ HAN	ML7416N (LAPIS Technology)	−20 to +50	21.4×49.7×8.5
New BP35C5	2.6 to 3.6 (Single power supply)	UART	Wi-SUN FAN	ML7436N (LAPIS Technology)	−30 to +85	15.0×19.0×2.6

13.56MHz Wireless Charger — 13.56MHz Wireless Charger Chipset

Part No.	Features	Power (V)	Operating Frequency (MHz)	Data Flash (Byte)	Functions	I/F	ADC (Method)	Source	Operating Temp. (°C)	Package Code	Halogen-Free*1
ML7631	Power Transmission	5	6.78	496	Transmission Power Adjust Control	I²C slave×1ch	10bit (SA type) × 3ch	27.12MHz (Crystal)	−40 to +85	P-WQFN32-0505-0.50-A63	✓
ML7630	Power Transmission	Generated from magnetic field	0.2 to 6.78	496	200mW Output Output Voltage setting	NFC Forum Type3 Tag I²C slave×1ch	10bit (SA type) × 3ch	Generated from magnetic field	−40 to +85	S-UFLGA34-2.59x2.59-0.40-W (WCSP34)	✓

*1 Halogen-free products are indicated by the √ mark. For details, please contact a sales representative.

2.4GHz Short-range Wireless — Wi-Fi Modules

Part No.	Supply Voltage (V)	Host CPU I/F	Supported Standards/ Module Specifications	Functions	Built-in System LSI	Operating Temp. (°C)	Dimensions (mm)
BP3580	3.1 to 3.5 (Single power supply)	USB/SDIO/UART	· IEEE802.11b/g/n	AP, STA (infrastructure mode), STA (ad hoc mode)	BU1805AGU	−40 to +85	17.0×17.0×2.3
BP3591	3.1 to 3.5 (Single power supply)	USB/SDIO/UART	· IEEE802.11b/g/n · BP3580 and chip-antenna into 1 module	AP, STA (infrastructure mode), STA (ad hoc mode)	BU1805AGU	−40 to +85	24.0×33.1×4.7
BP3595	3.1 to 3.5 (Single power supply)	USB/SDIO/UART	· IEEE802.11b/g/n · The small size type of BP3591	AP, STA (infrastructure mode), STA (ad hoc mode)	BU1805AGU	−40 to +85	15.3×27.6×2.6
BP3599	3.1 to 3.5 (Single power supply)	USB/SDIO/UART	· IEEE802.11b/g/n · Type with flash memory mounted on BP3591 · Firmware is written in a flash memory	AP, STA (infrastructure mode), STA (ad hoc mode)	BU1805AGU	−40 to +85	24.0×33.1×4.7
BP359B	3.1 to 3.5 (Single power supply)	UART	· IEEE802.11b/g/n · Type with MCU and flash memory mounted on BP3591 · Firmware is written in a flash memory	STA (infrastructure mode)	BU1805AGU	−40 to +70	24.0×33.1×4.7

Sub-GHz Batteryless Communication — EnOcean® Modules

Part No. 928.35MHz (Japan)	Supply Voltage	Antenna	Operating Temp. (°C)	Dimensions (mm)
PTM 210J	Supply from internal ECO 200	Pattern Antenna	−25 to +65	40.0×40.0×11.2
PTM 430J	Supply from external ECO 200	Whip Antenna	−25 to +65	26.2×21.15×3.5
ECO 200	Electromagnetic induction power generation: 120μJ Min at 2V	—	−25 to +65	29.3×19.5×7.0
STM 429J	Solar power generation	Helical Antenna	−20 to +60	64.8×16.0×5.4
STM 431J	Solar power generation	Helical Antenna	−20 to +60	64.8×16.0×8.4
HSM 100	Supply from STM 431J	—	−20 to +60	18.0×13.0×3.5
STM 400J	2.1 to 5.0V (Startup voltage 2.5V)	—	−25 to +85	22.0×19.0×3.1
TCM 410J	2.6 to 5.0V	—	−25 to +85	22.0×19.0×3.1
USB 400J	(via USB)	Pattern Antenna	−20 to +50	70.0×23.0×9.0

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