RUTRONIK
ELECTRONICS WORLDWIDE

Wireless Technologies

V7.1.1

Cellular, GNSS, RFID, Short- & Long Range Wireless Solutions

Content

Our Product Portfolio

- Semiconductors
- Passive Components
- Electromechanical Components
- Displays & Monitors
- Boards & Systems
- Storage Technologies
- Wireless Technologies

Our Initiatives

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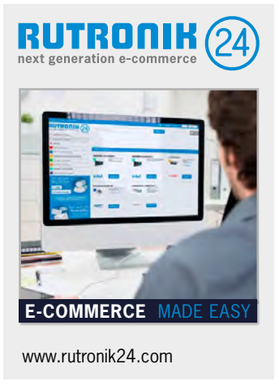

Committed to excellence

Consult – Know-how. Built-in.
The Technical Competence from RUTRONIK
Worldwide and individual consulting on the spot by competent sales staff, application engineers & product specialists.

Components – Variety. Built-in.
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Wide product range of semiconductors, passive and electromechanical components, displays & monitors, boards & systems, storage and wireless technologies for optimum coverage of your needs.

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Innovative and flexible solutions: from supply chain management to individual logistics systems.

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Quality without Compromise from RUTRONIK
The integrated management system (IMS) encompasses quality control, information security, environmental protection, occupational health and safety.

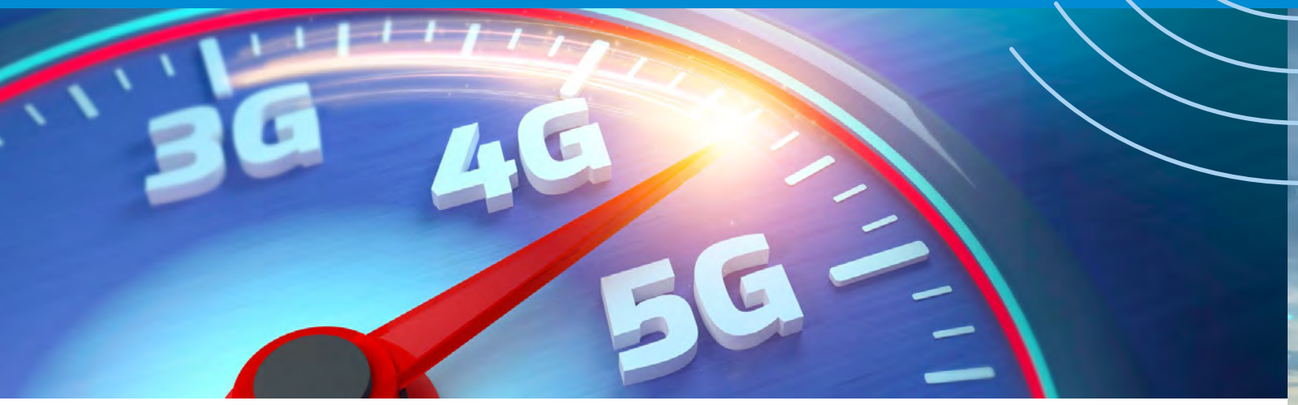
50 Years

RUTRONIK ELECTRONICS WORLDWIDE

Wireless Technologies Portfolio

Offering a product range that is unrivalled in breadth and depth, Rutronik is established as one of the largest independent global distributors with a very strong focus and technical support on wireless products. Our unique product portfolio is complemented by well-trained engineers based around the globe as well as in the wireless competence center tailored to almost all customer requirements.

Wireless Technologies	2J Antennas	Advantech	Asus	CHINMORE	EnOcean (Dolphin)	FCL Components	GARMIN	GIANTEC SEMICONDUCTOR	GNS	GradConn	iDTRONIC	Infineon Technologies	Insight SiP	intel	iVativ	Ethertronics AVX	Minew	Molex	Murata	NORDIC Semiconductor	Panasonic	Pulse a YAGEO company	ROHM SEMICONDUCTOR	SILEX	TDK	TELIC	TELIT Cinterion	Unicore	YAGEO
Bluetooth																												
Bluetooth Classic Modules						X																	X					
Bluetooth LE (Low Energy) Modules					X	X	X					X	X		X		X		X	X	X		X	X	X		X		
Bluetooth Dual Mode Modules						X						X							X		X								
Bluetooth Dual Mode System on Chips												X																	
Bluetooth LE (Low Energy) System on Chips												X								X									
Bluetooth devices (Beacons, Key Finder, Dongles etc.)			X			X							X		X		X												
GSM/GPRS/UMTS/LTE/NB-IoT/5G																													
Modules																			X	X							X		
Cards		X																									X		
Terminals		X													X											X	X		
With integrated GPS		X																		X						X	X		
SIM-Card Connectivity																											X		
GNSS																													
GPS/GNSS Modules									X								X		X								X	X	
GPS/GNSS Cards		X																											
GPS/GNSS Chips												X																X	
Ultra High Precision																											X	X	
Modules with integrated Antenna	X								X																		X		
Propritary Wireless																													
Receiver Chips												X																	
Transceiver Modules					X		X						X				X				X								
Transceiver Chips												X								X			X						
Transmitter Chips												X								X									
Gateway Solution		X															X												
USB Sticks					X		X										X			X									
Long Range Wide Area Network																													
LoRa		X											X		X	X	X		X										
Sigfox																			X										
RFID/NFC																													
Passive Reader Modules						X		X			X												X						
Passive Transponder Chips								X											X										
Passive Transponder Devices								X			X								X										
Passive Reader Chips								X																					
NFC Pairing Chip							X						X				X		X	X									
Hardware Security Solutions																													
Authentication												X																	
Trusted Computing												X																	
ZigBee™																													
System on Chips												X								X									
Modules					X	X	X						X		X		X				X		X						
WIFI																													
Modules WiFi a/b/g/n/ac						X							X	X	X			X		X		X	X		X		X		
Modules WiFi 6 (ax)													X	X			X		X		X			X			X		
Modules SubGHz-WiFi (ah)																								X					
Cards WiFi a/b/g/n/ac		X												X	X									X					
Cards WiFi 6 (ax)														X							X								
Chips WiFi a/b/g/n/ac/ax												X							X	X									
Access Points / Gateways / Routers		X	X												X		X							X					
Accessories																													
Adapter Cables	X	X		X					X									X				X							
Antennas (internal)	X			X												X		X				X						X	
Antennas (external)	X			X												X		X				X						X	
Antennas (surface mounted)	X			X												X		X				X						X	
SIM-card Holders									X							X		X											
Energy Harvester					X																								
Special Wireless Technologies																													
ADS-B									X																				
TMC									X																				
UWB																													
Modules													X				X		X										



GSM

Cellular Wireless Technologies

Cellular technologies play a crucial role in today's connected world and enable wireless communication over long distances. LTE (4G) and 5G are two advanced cellular standards that offer high data transfer speeds and reliable connectivity. LTE is currently widely used and enables fast internet on mobile devices such as smartphones and tablets. 5G, on the other hand, promises even faster speeds, lower latency and higher capacity, which forms the basis for future technologies such as the Internet of Things (IoT) and autonomous vehicles. These technologies have applications in various sectors such as telecommunications, healthcare, transportation and industry. With the continuous development and implementation of LTE and 5G, we will see even more innovative applications and services in the future.

How does cellular wireless technology work?

Cellular wireless technology enables wireless communication between mobile devices and networks. Signals are transmitted via radio waves to establish a connection.
With the imminent shutdown of 2G and 3G networks, the importance of 4G and 5G technologies is increasingly coming into focus. While 4G is already widespread and used by a large user base, 5G is still being developed, but offers significantly faster transmission rates and lower latency times.
Current figures show that over 60% of mobile users worldwide already use 4G technology, while the use of 5G is continuously increasing. According to forecasts, the majority of mobile connections will be based on 5G by 2025. It is important to note that both 4G and 5G technologies will exist in parallel to cover different requirements and usage scenarios. The future of cellular wireless technology therefore promises even faster and more reliable mobile communication for users worldwide.

LTE

LTE (Long Term Evolution) is a widely used mobile technology that offers high data rates and low latency. It is mainly used for broadband access and the transmission of multimedia content.
LTE Cat M1 (eMTC) is a variant of LTE that was specially developed for the Internet of Things (IoT). This technology is particularly suitable for applications such as smart metering, asset tracking and wearables that require reliable and energy-efficient wireless communication.
LTE NB1 (NB-IoT) is another variant of LTE that is optimized for Low-Power Wide Area Networks (LPWAN). It is ideal for IoT applications with low data volume and low bandwidth, such as smart parking lot systems, environmental sensors and remote monitoring systems. Each of these technologies offers specific benefits and use cases that enable companies to develop customized solutions for their IoT projects, increasing efficiency and opening up new business opportunities.

5G

5G is the current cellular communication system generation. With IoT-enabled devices in mind, 5G connects a higher density of devices at higher speeds and makes things lag nearly non-existent. As a result, 5G creates an excellent user experience irrespective of what applica-tion, device or service you touch. As adoption grows, they will evolve and use public and private networks to stream virtual and augmented reality and 3D video (which requires high bandwidth).
Moreover, 5G applications will be used for critical communications like factory automation, uncrewed aerial vehicles (UAVs) and more.
5G IoT will improve everyday life from personal applications to changing how we work and live. With 5G IoT, facilities will continue improving to send critical upgrades to networks without freezing functionality or overloading servers.
Previously, the focus on 5G has been primarily on its remarkable speed and minimal latency. However, the truth is that 5G represents a novel and costly technology that remains inaccessible for numerous IoT applications, even in areas with coverage.

5G RedCap

5G RedCap (Reduced Capacity) emerges as a potential solution to this challenge, offering a compromise by providing some of the speed and low latency benefits of full-fledged 5G at a significantly lower cost.
The technology is tailored for use cases where ultra-low latency isn't critical, but a decent level of data transfer speed is necessary to support the requirements of advanced applications in the future with throughput rates of 150Mbps for downloads and 50Mbps for uploads. It finds utility in applications such as wireless industrial sensors, video surveillance systems, and smart wearable devices.

LTE

Technology	Description	Performance Data
LTE & LTE-Advanced Long Term Evolution & Long Term Evolution-Advanced	▪ Long Term Evolution (LTE) is a 4G wireless broadband technology ▪ Technology was named "Long Term Evolution" because it represents the next step (4G) in a progression from GSM, a 2G standard, to UMTS, the 3G technologies based upon GSM ▪ LTE-Advanced (Long Term Evolution-Advanced) is a cellular networking standard that offers higher throughput than its predecessors	▪ LTE provides significantly increased peak data rates: 100 Mbps downstream and 30 Mbps upstream, reduced latency, scalable bandwidth capacity, and backwards compatibility with existing GSM and UMTS technology ▪ LTE Advanced can deliver up to 1 GB per second of data, which has to be compared to a maximum of 300 MB per second over LTE networks. ▪ LTE-Advanced networks use multiple-input, multiple-output (MIMO) technology
LTE Cat 1 LTE Cat M1 LTE NB1 / NB-IoT LTE Cat 1 bis	▪ IoT Focused, Lower Cost, Smaller Size, Reduced Power, Lower Data Speeds ▪ LTE Lower Categories are Low Power Wide Area Networks (LPWANs) radio technology standards developed to enable a wide range of devices and services to be connected using cellular telecommunication band ▪ LTE Cat 1 bis is evolved version of the LTE Cat 1 standard & represents a significant advancement in mobile communication for IoT and M2M applications ▪ The distinctive feature of LTE Cat 1 bis is its support for a single antenna design for IoT devices and enables IoT device manufacturers to streamline their designs and reduce costs while still benefiting from the capabilities of LTE Cat 1	▪ LTE Cat 1 provides a downlink peak rate of 10 Mbps and 5 Mbps upstream ▪ LTE Cat M1 provides a downlink and upstream peak rate of 1 Mbps ▪ LTE NB1 provides 250 Kbps as downlink peak rate up 20-250 Kbps as uplink peak rate ▪ LTE Cat 1 bis technology is recognized for its higher data rates compared to conventional LPWAN technologies It provides downlink speeds of up to 10 Mbit/s and uplink speeds of up to 5 Mbit/s, thereby offering similar data rates to LTE Cat 1
5G 5G RedCap	▪ 5G is the fifth generation of wireless technology ▪ Promises to offer faster speeds, lower latency and more reliable connections than its predecessors ▪ Huge variety of advanced technologies like millimeter wave-frequencies, massive MIMO and beamforming ▪ 5G RedCap is suitable for applications which involve simpler and lower-cost IoT devices such as sensors and actuators that send small packets of information continuously and require a long battery life	▪ Faster speed with a peak download speed of up to 20Gbps ▪ Lower latency ▪ Improved reliability: 5G uses advanced technologies like beamforming and massive MIMO to improve the reliability ▪ 5G RedCap delivers thoughput of 150Mbps downlink and 50 Mbps uplink

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Cellular Modules

xE910 Family – Unified Form Factor (UFF) and Family Concept

Telit Cinterion xE910 Unified Form Factor Family is comprised of 4G, 5G, 3GPP and 3GPP2 high category as well as LTE Cat M1 / NB-IoT products. All products share a common LGA form factor of 28.2 x 28.2 x 2.2 mm and have same electrical and programing interfaces which allows developers to implement a "design once, use anywhere" strategy.

Product Group	Description	Cellular Technology	Bands	Typical Applications	GNSS
ME910G1	The ME910G1 is the Category M1/NB2 evolution of the Telit Cinterion xE910 family, specified in the approved Release 14 of the 3GPP standard. Cat M1/NB2 devices are specifically tailored for low-data throughput IoT applications for optimized power consumption and enhanced quality of coverage. Supports the Power Saving Mode (PSM) and the extended Discontinuous Reception (eDRX), for longer battery operation.	4G (LTE Cat M1 / NB2) 2G (for EU & WW Version)	Worldwide	Cat M1/NB2 devices are specifically tailored for IoT applications, offering optimized power consumption and enhanced coverage. The ME910G1 helps increase the addressable market for LTE technology to include a broad range of new applications and use cases best served with lower maximum data rate, ultra-low power, reduced complexity and costs. Smart meters, industrial sensors, healthcare monitors, home automation, asset tracker and many more low data rate IoT devices.	Embedded GNSS non concurrent with cellular
LE910 (C1)/(C4)	The LE910x series , available as Linux und ThreadX variant is optimized for LTE low category networks Modules are available in single mode and 3G/2G fallback options. In addition to VoLTE support, the LE910 Cat 1 series are swappable with other modules in the xE910 family	4G LTE Cat 1 4G LTE Cat 4	EMEA, North America, APAC, LATAM	Ideal platform for IoT applications, mobile data and computing devices. Applications requiring lower data rates.	Embedded GNSS non concurrent with cellular
LE910R1	The LE910R1 module is a cost-optimized LTE Cat1 bis module, supporting 2G fallback as well as VoITE. It allows a smooth migration from 2G and 3G networks and offers a higher performance compared to Cat M1 and NB-IoT with respect to date rate, latency, mobility and voice support	LTE Cat 1 bis	EU, EMEA, APAC	Ideal for IoT applications, using a single antenna. Besides it's suitable for areas where cellular LPWA aren't yet activated.	Optional GNSS
LE910Q1	The LE910Q1 module is designed for industrial use and offers a cost-effective solution for connecting IoT devices. Compliant with 3GPP release (Rel) 13 LTE Cat 1 bis standards.	LTE Cat 1 bis	Global and North America variants	Ideal for various applications requiring data transmission, such as asset tracking, vehicle telematics and remote monitoring and security panels.	Optional GNSS
FE910C04	The FE910C04 module facilitates mid-speed 5G connectivity through the latest 4GPP release 17 Redcap technology Its robust design.	5G Rel 17 + LTE Cat 4	Global, North America and EMEA	Ideal for applications such as video surveillance and monitoring, industrial routers and gateways, EV charging infrastructure and machine telematics.	Embedded GNSS non concurrent with cellular


ME910G1


LE910Cx


LE910R1


LE910Q1


FE910C04

Cellular Modules

xE310 Family – Ultra Small Formfactor for Telit Cinterion LTE-M & NB-IoT Solutions

The Telit Cinterion xE310 Unified Form Factor Family for miniature IoT modules includes pin-to-pin compatible options such as Cat M1/NB2 modules. The compact xE310 family presents significant business and technical advantages for OEMs, integrators, and IoT device developers seeking low-power, cost-effective, and space-efficient solutions to propel their digital transformation endeavors throughout their operations.

Product Group	Description	Cellular Technology	Coverage	Typical Applications	GNSS
ME310M1-W1	The ME310M1 LGA module with ultra-low, best-in-class power consumption represents the latest advancement within xE310 product line, tailored for modern IoT deployments. It facilitates secure and efficient connectivity for IoT applications with minimal data requirements and includes Power Saving Mode (PSM) and extended Discontinuous Reception (eDRX), prolonging battery life of connected devices. It complies with 3GPP release 14 standards and is posed for future upgrades to Release 15,16, and 17.	LTE Cat M1/NB2	Global	The module boasts an arrange of features that makes it ideal for device OEMs, systems integrators and enterprises, including utilities that need to extend the service life of their IoT devices. Ideal for applications such as smart metering, asset tracking, e-Health and smart agriculture as well as for medical devices and wearables.	Embedded GNSS and Wi-Fi scan for outdoor and indoor positioning, non concurrent with cellular, In future: ME310M1-W3 concurrent with cellular
ME310G1-WW	ME310G1 is specifically designed for Cat M1/NB2 applications, tailored for low-data throughput IoT applications, delivering optimized power efficiency and enhanced coverage quality. Power Saving Mode (PSM) and extended Discontinuous Reception (eDRX), enables devices to intermittently wake up, transmit small data packets, and promptly return to a low-power sleep mode, conserving energy effectively.	LTE Cat M1/NB2 Optional 2G fallback	Global ME310G1-W2 supporting 410 and 450 MHz bands for metering applications	The ME310G1 empowers businesses to implement compact designs across various domains such as asset tracking, healthcare monitoring, smart metering, portable devices, industrial sensors, home automation, and numerous others. These applications leverage the module's low-power and low-data rate features to their advantage.	Embedded GNSS non concurrent with cellular
NE310L2-WW	Featuring a compact form factor and exceptionally low power usage, the NE310L2 is tailored for low-data throughput IoT applications and delivers optimized power efficiency and superior coverage quality. It creates new IoT-enabled business models by tackling connectivity and battery longevity concerns, catering to the needs of OEMs, integrators, and device developers aiming to expand data collection capabilities from their operations and clientele via IoT devices.	LTE Cat NB2 Optional 2G fallback	Global	NE310L2 empowers businesses to roll out innovative, compact designs across a multitude of application domains, encompassing smart metering, healthcare monitoring, home automation, industrial sensors, smart agriculture, asset tracking, portable devices.	No


ME310M1-W1


ME310G1-WW


NE310L2-WW

Product Group	Description	Cellular Technology	Coverage	Typical Applications	GNSS
TN23	The TN23 IoT module designed with a compact form factor ("Things" footprint of 15 x 15mm), simplifies the creation of small, battery-powered LPWA cellular devices. It's unique architecture allows the flexibility to run applications with a host processor or inside the module itself using the integrated processor dedicated to customer application for onboard processing,optimizing size and costs. TN23 supports optimized 3GPP power modes PSM and eDRx revolutionizing design possibilities for battery-operated cellular devices.	LTE Cat NB1/NB2	Global	Ideal for small payment terminals, connected sensors, track and trace solutions, metering application, monitoring for smart homes, cities and agriculture.	No
TX62/82	Cinterion TX62/82 IoT modules with "things" footprint have been engineered to deliver global LPWAN LTE connectivity from a single SKU. They support optimized 3GPP power modes PSM and eDRx designed for battery-operated cellular devices. The devices feature an integrated processor with Real-Time Operating System (RTOS) enabling hostels architecture with an SDK to build and run the entire application on the small feature-packed module.	LTE Cat M1/NB1/NB2 TX82 with 2G fallback	Global	Ideal for applications such as small payment terminals, connected sensors, monitoring for smart homes, cities and agriculture.	Optional GNSS
EXS62/ EXS82	The EXS82/62 IoT wireless module platform spearheads the transition from LTE to 5G, facilitating LPWA connectivity for countless new industrial applications, offering worldwide LTE-M and NB-IoT connectivity, with the option for 2G fallback and support for emerging 5G advancements. Providing a variety of efficient IoT-optimized data speeds, the platform is well-suited for compact, battery-operated devices situated in remote areas.	LTE Cat M/NB/2G	Global	Ideal for smart meters, asset trackers to healthcare applications, wearables, and solutions for smart cities.	Optional GNSS
PLS83	Provides a high-speed global IoT connectivity delivering 18 Band LTE Cat.4 with 2G73G fallback. It' suitable for applications that require high bandwidth plus longevity and stability of LTE networks.	LTE Cat 1/Cat 4	Global	Ideal for IoT applications such as transportation, industrial automation, gateways, security panels, telematics and asset tracking.	Optional GNSS


TN23


TX62/82


EXS62/EXS82


PLS83

Cellular Data Cards

LN 920 Cat 6 / Cat 12 / Cat 13

The LN920 M.2 data card is part of the family of Telit Cinterion highspeed data cards. Designed in M.2 (NGFF) form factor, it is the natural evolution towards 5G technology.

The LN920 is available as LTE Category (Cat) 12 (600 Mbps peak data rate DL, 150 Mbps UL), Cat 13 (400 Mbps peak data rate DL, 150 Mbps UL) and Cat 6 (300 Mbps peak data rate DL, 50 Mbps UL). This data card supports a broad set of LTE frequency bands and carrier combinations and includes 3G/HSPA+ legacy technology and a GNSS receiver, making it ideal for worldwide deployments. Compatible with 3GPP Release (Rel) 12, it is certified for global deployments across EMEA, the Americas and APAC, including specific MNO certifications in regions requiring them like APAC and NA.

Key Benefits

- Standard M.2 (NGFF) form factor
- Same form factor and pinout available as 4G Cat 12, Cat 13 and Cat 6
- 3G/HSPA+ Rel 8 for fallback to legacy networks
- Broad frequency band support, ideal for worldwide deployments and private LTE networks
- Certified with leading MNOs
- Single-side printed circuit board for optimal heat dissipation
- High-speed USB 3.0 port
- Support of up to 3xCA DL (Cat 12)
- Up to three independent firmware images onboard selectable at boot to support various network operator requirements
- State-of-the-art GNSS receiver with separate RF connector
- Internal GNSS L1 LNA, allowing the use of less expensive passive antennas and lowering the total cost of ownership
- Advanced security features: SELinux, secure boot
- Full industrial operating temperature range
- Drivers support: Windows 10, Linux
- 2 x 2 MIMO

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5G Solutions

FN990 Data Card and FE990 5G Module

The Telit Cinterion FN990 data card and FE990 5G module are designed for use in high-speed data applications such as enterprise routers, gateways, and fixed wireless access. This product offers high-speed, low-latency 5G connectivity with advanced security features, making it a suitable solution for a wide range of IoT applications that require fast and reliable connectivity. Both are capable of delivering high-speed data transfer rates with its support for 5G NR Sub-6GHz and mmWave frequencies, as well as 4G LTE-Advanced Pro. The advanced technology allows for low-latency connectivity, making it an ideal solution for applications that require real-time data transfer, such as industrial automation or virtual reality. It is designed to support future 5G features and capabilities, ensuring that devices using this module will remain relevant and functional for years to come

Key Benefits

- High-speed data transfer
- Low latency: The Telit Cinterion FN990's advanced 5G technology allows for low-latency connectivity, making it an ideal solution for applications that require real-time data transfer, such as industrial automation or virtual reality.
- Compact form factor
- Advanced security features
- The FE990 LGA module is ideal for applications that require ruggedized modems that are feature- and interface-rich with a compact footprint, suitable for high-performance enterprise and industrial applications, such as indoor and outdoor fixed wireless access, video streaming and surveillance devices, mobile and industrial routers and gateways

Telit Cinterion 5G Solutions

MV32

The Telit Cinterion MV32-W is the latest generation of 3GPP release 16 compliant 5G modem cards, a new addition to the MV series after the success of the first generation MV31. The MV32 further improves on class-leading thermal efficiency and enables unrivalled throughput performance in an extremely compact card form factor with integrated eSIM inside. With 3GPP Release 16 support, the MV32 modem card, stays at the forefront of the 5G technological evolution, combining both enhanced mobile broadband (eMBB) and ultra-reliable low latency communication (URLLC) to serve high bandwidth and mission critical applications such as industrial router/gateways, 8K video stream security and camera applications, smart manufacturing, robotics and private network implementations.

Key Benefits

- Ultra compact design- smallest 5G M.2 Adapter card in the market
- Innovative thermal design for industrial grade performance
- Single global variant delivering connectivity for 5G, LTE Cat 20, 3G fallback
- The advanced positioning technology with dual-frequency GNSS supports GPS, Glonass, Beidou and Galileo for precise positioning anywhere in the world
- Ideal for applications such as industrial gateways and enterprise routers, fixed wireless access (FWA) indoor/outdoor and high power mmWave CPEs, professional 4K/8k video broadcasting and private 5G networks

FN920C04 / FE910C04 / PVR81 – 5G RedCap

The 5G RedCap LGA modules PVR81 and FE910C04 level up performance and efficiency and are pin-to-pin and software compatible with Telit Cinterion LTE modules, as well as the FN920C04 M.2 standard adapter card. The modules are designed to maintain compatibility with R15/16 and LTE Cat 4 fallback, ensuring smooth communication and comprehensive coverage. The modules offer a forward-thinking solution that prolongs the usability of LTE Cat 1 and Cat 4 modules ensuring sustained effectiveness and functionality.

Key Features

- Global design for full flexibility and longevity with 5G technology
- Improved operational efficiency and precise GNSS positioning with support for L1 and L5 frequencies and a dedicated antenna port
- Ideal for applications such as cellular routers and gateways, fixed wireless access (FWA), connected healthcare, video surveillance and monitoring, EV charging infrastructure and machine telematics

Smart Module SE250B04 – Android IoT System-on-Module LTE Cat 4 150/50

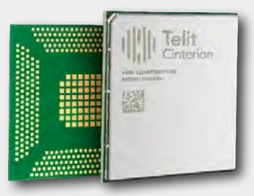
The SE250B04 series offers all-in-one package cellular LTE, Wi-Fi, Wi-Fi, Bluetooth® Low Energy, GNSS for highly flexible and integrated design. It provides a reliable and secure cellular connectivity solution for a wide range of IoT applications, with global coverage, low power consumption and secure firmware capabilities. It supports integrated peripherals like high-resolution touch displays, advanced cameras and audio and digital sensor faces.

Key Features

- Enables reliable and secure connectivity for IoT devices in one package for fast time to market
- Simplifies development and integration of IoT solutions
- Provides global coverage for IoT applications with cellular connectivity, multi-mode 4G/3G72G cellular radio for wide-area network coverage
- Low power consumption for optimized battery life and reduced maintenance
- Extended temperature range for use in a variety of environments

Key Applications

- Mobile point-of-sale (mPOS), smart cash registers and vending machines
- Smart alarms panels
- Security surveillance cameras and home automation security systems
- Smart home gateways
- Smart robots
- Handled PCs and tablets
- Telematics cameras
- Police and law enforcement equipment



IoT Terminals

LT910-EUbis – LTE Cat.1 bis Terminal for cost-optimized application

The LT910-EUbis is a compact and robust IoT terminal designed for the use in the LTE network with fallback to the GSM network. The device is based on the Telit Cinterion LE910R1-EU module is an industrial-grade, cost-optimized LTE Cat 1 bis Terminal for the use in the European region. The terminal provides industrial standard interfaces and the ability for a safe, fast and reliable data transfer. The integrated power-saving mode supports the use in applications where low power consumption is required. The LT910-EUbis terminal is ideal for use cases that require higher performance compared to Cat M1 and NB-IoT in terms of data rate, latency and mobility.

Key Features

- Based on Telit Cinterion LTE Cat 1 bis module LE910R1-EU with GSM fallback
- Interfaces: Power supply; SIM card holder lockable; FME antenna connector; RS232 (V.24/V.28) on Sub-D; USB
- Supply Voltage: 7-32V DC
- Operation temperature: -30°C - +75°C
- Support of low-power mode
- Robust & compact housing for industrial use
- Housing is mechanically compatible with GT910-G, HT910-E (G), LT910-WW (E), NT910-G
- Firmware Over-The-Air (FOTA) Update
- Optional variants on request: e.g. USB powered
- Extensive range of accessories

Key Applications

- Monitoring of vending machines
- Monitoring of data from industrial plants
- Intelligent control and monitoring of power grids
- Transmission of meter readings from electricity, gas and water meters
- Live transmission of video images
- Monitoring of heating, ventilation and air conditioning

Functionality	Interfaces	Software	Approvals
Built in UDP/TCP/PPP/HTTP/HTTPS/NTP/FTP stack	Power connector 6P6C modular jack	Telit Cinterion application development environment: AppZoneC	CE
IPv4/IPv6 stack	RS-232 interface DSUB 9-pin female		WEEE, RoHS and REACH compliant
Control via AT commands according to 3GPP	USB 2.0, connector mini USB		
TS 27.005, 27.007 and Telit Cinterion custom AT commands	Antenna connector FME (male)		
SIM application Tool Kit 3GPP TS 51.01	SIM chip option, 3 Status LEDs		

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Cellular Devices – Selection Guide

Manu-facturer	Family / Technology	Specifications		Product Name	Approvals													Use Cases	Bands	Data Speed (UL/DL)	Interfaces	Features							Evaluation Kits / Develop-ment Kits
		Product types	Form Factor		RED	CE	GCF	PTCRB	FCC	IC	KC	EMEA	Latin America	North America	APAC	Australia	Korea		GSMRE: Korrektur Tabelle GSM Wireless Katalog		USB type	Size (mm)	Surface mounting	Antenna connector	Tempe-rature Range	GNSS channels	Embedded TCP/ IP Stack	SIM Access Profile	AppZone C	
Telit Cinterion Addvantech	Cellular LPWA LTE-M, NB-IoT	LGA modules	xE310/ compact	ME310G1	•	•	•	•	•	•	•	•	•	•	•	•	•	Metering & Sensing Connected Assets, Status & Tracking	LTE-M/NB-IoT,PC3, 2G (B2, B3, B5, B8) fallback LTE: B1, B2, B3, B4, B5, B8, B12, B13, B18, B19, B20, B25, B26, B27, B28, B66, B71, B85	LTE Cat M1 (Rel14), UL up to 1Mbps, DL up to 588 Kbps, LTE Cat NB2 (Rel14), UL up to 160Kbps, DL up to 130 Kbps, EGPRS (2G fallback variants), UL up to 210Kbps, DL up to 264Kbps	2.0 HS	15 x 18 x 2.6	LGA	Single Rx, single antenna	-40 to 85	•	•	•	•	
				ME310M1	•	•	•	•	•	•		•		•				Metering & Sensing Connected Assets, Status & Tracking	LTE-M/NB-IoT, PC3 LTE: B1, B2, B3, B4, B5, B8, B8_US, B12, B13, B14, B18, B19, B20, B25, B26, B27, B28, B66, B71, B85	LTE Cat M1(Rel14), UL up to 1 Mbps, DL up to 588 Kbps, LTE Cat NB2 (Rel14), UL up to 160 Kbps, Dl up to 120 Kbps		15 x 18	LGA		-40 to 85	•	•	•	•	
				NE310L2	•	•	•	•	•	•		•	•	•	•	•	•	Meterning & Sensing	LTE: B1, B2, B3, B4, B5, B8, B12, B13, B18, B19, B20, B25, B26, B28, B66, B85 2G: B2, B3, B5, B8	LTE Cat NB2 (Rel14), UL up to 160 Kbps, Dl up to 120 Kbps, GPRS (2G fallback vari-ants), UL up to 42.8 Kbps, DL up to 85.6 Kbps		15 x 18	LGA		-40 to 85			•		
			Tx/compact	TX62/82	•	•	•	•	•	•	•	•	•	•	•	•	•	Connected Assets, Status & Tracking	LTE-M/NB-IoT, PC5, 2G fallback LTE: B1,B2, B3, B4, B5, B8, B8_US,B12, B13, B18, B19, B20, B25, B26, B27, B28, B66, B71, B85 2G: B2, B3, B5, B8	LTE Cat M1, DL: max. 300 Kbps, UL: max. 1.1Mbps, LTE Cat.NB1, DL:max. 27Kbps, UL:max. 63Kbps, LTE Cat.NB2, DL: max. 125Kbps, UL: max. 158 Kbps	2.0 HS	15.3 x 15.3 15.3 x 20.9	LGA			•	•	•		TX62 DevKit (L30960N0140A10001R) TX82 DevKit (L30960N0141A10001R)
			xE910/compact	ME910G1	•	•	•	•	•	•	•	•	•	•	•	•	•	Connected Assets, Status & Tracking Remote Monitoring & Control	Dual Mode LTE-M/NB-IoT LTE: B1, B2, B3, B4, B5, B8, B12, B13, B18, B19, B20, B25, B26, B27, B28, B66, B71, B85	LTE Cat M1 (Rel14), UL up to 1Mbps, DL up tp 588 Kbps, LTE Cat NB2 (Rel14), UL up to 160 Kbps , DL up to 120 Kbps, EGPRS (2G fallbakc variants), UL up to 210 Kbps, DL up to 264 Kbps		28.2 x 28.2 x 2.4	LGA		-40 to 85	•	•	•	•	ME910G1-WW Sample (EVT3990252444) (
			xE910/compact	ME910C1	•	•	•	•	•	•		•	•	•	•	•		Connected Assets, Status & Tracking Remote Monitoring & Control	Dual Mode M1 & NB1 LTE: B1 (2100), B2 (1900), B3 (1800), B4 (AWS 1700), B5(850), B8 (900), B12 (700), B13 (700), B18 (800), B19 (800), B20 (800), B26 (850), B28 (700) 2G: B2 (1900), B3, (1800), B5 (850), B8 (900)	LTE Cat M1, UL up to 375 Kbps, DL up to 300 Kbps, LTE Cat NB1, UL up to 62.5 Kbps, DL up to 21 Kbps, EGPRS (2G fallback), UL up to 236 Kbps, DL up to 296 Kbps	2.0 HS	28.2 x 28.2 x 2.2	LGA		-40 to 85	•	•	•	•	
			Ex/compact	EXS62/82	•	•	•	•	•	•		•	•	•				Connected Assets, Status & Tracking	LTE-M/NB-IoT, PC5, 2G fallback LTE: B1, B2, B3, B4, B5, B8, B12, B13, B18, B19, B20, B25, B26, B27, B28, B66, B71, B85 2G: B2, B3, B5, B8	LTE Cat M1 DL:max. 300 Kbps, UL: max. 1.1. Mbps, LTE Cat.NB1 DL: max. 27 Kbps, UL: max. 63 Kbps, LTE Cat. NB2 DL: max. 124 Kbps, UL: max. 158 Kbps , E/EGPRS Class 10	2.0 interface	27.6 x 18.8 x 2.3	LGA	Pads for primary LTE/GNSS antenna	-40 to 90	•	•	•		EXS62 Evaluation Module (L30960N6251A12001H) EXS82 DevKit (L30960N0131A10002R)
		Adaptr Cards	mPCIe	ME910mP-Cle	•	•	•	•	•	•	•	•		•		•	•	Remote Monitoring & Control	LTE: B1, B2, B3, B4, B5, B8, B12, B13, B18, B19, B20, B25, B26, B27, B28, B66, B71, B85	LTE Cat M1 (Rel14), UL up to 1Mbps, DL up tp 588 Kbps, LTE Cat NB2 (Rel14), UL up to 160 Kbps , DL up to 120 Kbps, EGPRS (2G fallbakc variants), UL up to 210 Kbps, DL up to 264 Kbps	2.0 HS	51 x 30 x 3.2	Adapter Card	Single Rx, single antenna	-40 to 85	•	•	•	•	
	Performance IoT LTE Cat1, Cat4, 5G RedCap	LGA modules	xE910/classic	FE910C04	available with SOP													Computing & Data Streaming Highest Data Throughput Critical, Industrial & Infrastructure	5G FR1: n1, n2, n3, n5, n7, n8, n12, n13, n14, n18,n20, n25, n26, n28, n30, n38, n40, n41, n48, n53, n66, n70, n71, n77, n78, n79 LTE: B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B30, B34, B38, B39, B40, B41, B42, B43,B48, B66, B71	5G Sub. 6 FDD and TDD operation in 5G NR Standalone, DL: 220 Mbps, UL: 100 Mbps, LTE Cat 4, DL: 150 Mbps, UL: 50 Mbps	2.0 HS	28.2 x 28.2 x 2.2	LGA	antenna port	-40 to 85	•	•	•	available with SOP	FE910C04 EVT Sample (EVT3990252389
			xE910/classic	LE910C1/ C4		•			•	•		•	•	•	•		•	Connected Asets, Status & Tracking, Remote Monitoring & Control	LTE: B1, B2, B3, B4, B5, B7, B8, B9, B12, B13, B14, B18, B20, B26, B28, B34, B38, B39, B40, B66, B71	LTE Cat 4, UL up to 50Mbps, DL up to 150 Mbps, DC-HSPA+ 42 Mbps, LTE Cat.1 , UL up to 5 Mbps, DL up to 10 Mbps	2.0 HS	28.2 x 28.2 x 2.2	LGA	Single Rx option	-40 to 85	EMEA, APAC	•	•		
			xE910/classic	LE910R1	•	•	•					•			•	•		Connected Assets, Status & Tracking	LTE: B1, B3, B5, B7, B8, B20, B28, B38, B 40, B41 2G: B3, B8	LTE Cat 1 bis, UL up to 5 Mbps, DL up to 10 Mbps	2.0 HS	28.2 x 28.2 x 2.2	LGA	Single LTE antenna	-40 to 85		•	•		
			xE910/classic	LE910Q1		•								•				Connected Assets, Status & Tracking	LTE: B1, B2, B3, B4, B5, B7, B8, B12, B13, B18, B19,B20, B25, B26, B28, B66, B34, B38, B39, B40, B41, B42	LTE Cat 1 bis, UL up to 5 Mbps, DL up to 10 Mbps	2.0 HS	28.2 x 28.2 x .24	LGA	Single LTE antenna	-40 to 85	•	•			
			Px/classic	PLS63/83	•	•	•	•	•		•		•	•	•	•		Connectd Assets, Status & Tracking Remote Monitoring & Control	LTE:B1, B2, B3, B4, B5, B7, B8, B8_US, B12, B13, B18, B19, B20,B26, B28, B66, B38, B40, B41 3G: B1, B2, B3, B4, B5, B6, B8, B19 / 2G: B2, B3, B5, B8	FDD-LTE Cat1, DL: max. 10.2 Mbps, UL: max.5.2Mbps, HSPA+ Cat.8 , DL: max. 7.2 Mbps, UL: max. 5,76 Mbps, E/GPRS Class 12, DL: max. 237 kbps, UL: max. 237kbps	2.0 HS	33 x 29 x 2.6	LGA	Pads for GNSS antennna	-40 to 85	•	•	•		
			Ex/compact	ELS62	•	•	•					•	•		•			Connected Assets, Status & Tracking	FDD-LTE Rel13: B1, B2, B3, B4, B5, B7, B8, B20, B28, B66	LTE Cat 1 bis , DL: max. 10.2Mbps, UL: max. 5.2Mbps		27.6 x 25.4	LGA	Single LTE Cat.1 antenna			•	•		
		Smart	xE250	SE250B4	•	•	•	•	•	•		•		•				Alerts & Supervision	LTE FDD: B1,B3, B5, B7, B8, B20, B28	LTE Cat 4, UL up to 50Mbps (FDD) and 30 Mbps (TDD), DL up to 150Mbps (FDD) and 130Mbps (TDD)		41 x 43	LGA	Cellular main anten-na & Rx diversity antenna pads, GNSS antenna pad	-30 to 75	•		•		
		Adapter Cards	mPCIe	LE910mP-Cle		•						•	•	•	•	•		Remote Monitoring & Control	LTE Cat4	LTE Cat 4, UL up to 50Mbps, DL up to 150 Mbps, DC-HSPA+ 42 Mbps, LTE Cat.1 , UL up to 5 Mbps, DL up to 10 Mbps		30 x 51	Adapter Card		-40 to 85					
		Adapter Cards	M.2	FN920C04		•												Computing & Data Streaming Highest Data Throughput	5G: n1, n2, n3, n5, n7, n8, n12, n13, n14, n18, n20, n25, n26, n28, n30, n38,n40, n41, n48, n53, n66, n70, n71, n77, n78, n79 LTE: B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25,B26, B28, B30, B34, B38, B39, B40, B41, B42, B43, B48, B66, B71	5G Sub.6 FDD and TDD operation in 5G NR Standalone, DL:220Mbps, UL:100Mbps, LTE Cat4, DL:150Mbps, UL:50Mbps	2.0 interface	30 x 42 x 2.3	Adapter Card	Pads for Rx diversity/ MIMO antennas, pads for GNSS antenna	-40 to 85	•		•	•	
	LTE Broadband LTE Cat6 to Cat1	Adapter Cards	mPCIe	LM960A18		•	•	•	•	•		•		•	•	•		Computing & Data Streaming Highest Data Throughput	LTE FDD: B1, B3, B25(B2), B66(B4), B26(B5/B18/B19), B7, B8, B12(B17), B13,B14(FirstNet), B20, B28, B29, B30, B32,B71 LTE TDD: B38, B39, B40, B41, B42, B43, B46, B48 (CBRS/OnGo), 3G B1, B2, B4, B5(B19), B8, B9	LTE Cat. 18GPP Rel.12, Up to 1.2Gbps DL w/4x4 MIMO +3CA,	USB 2.0/3.0	50.95 x 30 x 2.8	Adapter Card		-40 to 85	•				
		Adapter Cards	M.2	LN920	•	•	•	•	•	•	•	•	•	•	•	•	•	Computing & Data Streaming Highest Data Throughput	LTE B1,B2,B3,B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B29, B30, B38, B39, B40, B41, B42, B43, B48, B66, B71	LN920A12-WW:, - 3GPP Rel 12, 600 Mbps DL, 150 Mbps UL, - LTE FDD/TDD, up to 3xCA DL (600 Mbps, 60 MHz), - LTE FDD/TDD, up to 2xCA UL (150 Mbps, 40 MHz), - LTE 256-QAM DL, 64-QAM UL, LN920A13-WW:, - 3GPP Rel 12, 400 Mbps DL, 150 Mbps UL, - LTE FDD/TDD, up to 2xCA DL (400 Mbps, 40 MHz), - LTE FDD/TDD, up to 2xCA UL (150 Mbps, 40 MHz), - LTE 256-QAM DL, 64-QAM UL (150 Mbps, 40 MHz), LN920A6-WW:, - 3GPP Rel 12, 300 Mbps DL, 50 Mbps UL, - LTE FDD/TDD, up to 2xCA DL (300 Mbps, 40 MHz), - LTE 64-QAM DL, 16-QAM UL	USB 3.0	30 x 42 x 2.4	Adapter Card		-40 to 85	•		•		
	5G Broadband 5G eMBB	LGA Modules	xE990/ Advanced	FE990B	•	•	•	•	•	•		•	•	•				Critical, Industrial & Infrastructure	5G: n1,n3,n5,n7,n8,n12,n13,n14,n25,n26,n28,n29,n30,n38,n40 ,n41,n48,n66,n76,n77,n87,n79	FE990B40:, 5G NSA: Up to 4.9 Gbps DL, 0.55 Gbps UL , 5G SA: Up to 4.1 Gbps DL, 0.90 Gbps UL, 4G: 2 Gbps DL, 210 Mbps UL, FE990B34: , 5G NSA: Up to 3.6 Gbps DL, 0.55 Gbps UL, 5G SA: Up to 2.8 Gbps DL, 0.45 Gbps UL, 4G: 2 Gbps DL, 210 Mbps UL, 3G: 42 Mbps DL, 11 Mbps UL ,	USB 3.1 Gen 2 and 2.0	41 x 41 x 2.9	LGA	Antenna pad & ports	-40 to 85	•			•	
		Adaoter Cards	M.2	FN990	•	•	•	•	•	•	•	•	•	•	•	•	•	Critical, Industrial & Infrastructure	5G: n1,n2,n3,n5,n7,n8,n20,n25,n28,n30,n38,n40,n41,n48,n66, n71,n75,n77,n78,n79 LTE:B1,B2(B25),B3,B4(B66),B26(B5,B18,B19),B7,B8,B12(B17),B13,B14,B20,B28,;b29(DL),B30,B32(DL),B34,B38,B39,B40,B 41,B42,B43,B46(LAA),B48(CBRS),B66,B71	5G NSA up to:, 4.9 Gbps DL/0.55 Gbps UL for FN990A40, 3.4 Gbps DL/0.46 Gbps UL for FN990A28, 5G SA up to:, 4.1 Gbps DL/0.90 Gbps UL for FN990A40, 2.5 Gbps DL/0.90 Gbps UL for FN990A28, 4G up to:, 2.0 Gbps DL/211 Mbps UL for FN990A40, 1.6 Gbps DL/211 Mbps UL for FN990A28, 3G up to 42DL/11 UL Mbps	USB 3.1 Gen2	30 x 52 x 2.25	Adapter Card	Antenna for LTE/sub-6 + one GNSS	-40 to 85	•		•	•	
		Adaoter Cards	M.2	FN980	•	•			•			•		•	•			Highest Data throughput Critical, Indistrial & Infrastructure	5G: n1,n2,n3,n5,n7,n8,n12,n20,n25,n28,n38,n40,n41,n48,n66,n71,n77,n78,n79 LTE: B1,B2,B3,B4,B5,B7,B8,B12,B13,B14,B17,B18,B19,B20,B25,B26,B28,B29DL,B30,B32,B34,B38,B39,B40,B41,B42,B46(LAA),B48(CBRS),B66,B71	5G: Up to 5.5 DL/1.5 UL Gbps, 4G: Up to 2 Gbps DL/211 Mnps UL, 3G: Up to 42DL/11 UL Mbps	USB 3.1 Gen2	30 x 50 x 3.4	Adapter Card	4 antenna connectors for LTE/sub-6	-40 to 85	•		•	•	
		Adaoter Cards	M.2	MV31/32	•	•	•	•			•		•		•			Highest Data throughput Critical, Indistrial & Infrastructure	5G: n1,n2,n3,n5,n7,n8,n12,n20,n28,n66,n71 LTE:B1,B2,B3,B4,B5,B7,B8,B12,B13,B14,B17,B18,B19,B20,B25,B26,B28,B29,B30,B32,B66,B71	5G Sub6 Ghz: Max throughput DL/UL ~4 Gbps~/0.7 Gbps , LTE Cat.20: Max throughput DL/UL 2 Gbps/ 150 Mbps	USB 3.1 Gen .2 SuperSpeed	30 x 42 x 2.5	Adapter Card	3x2-in-1 IF connec-tors for mmWave antennas	-40 to 85	•			•	
Advantech	AIW 300 Series	5G	M.2	AIW-356																Max DL peak rate 3.2 Gbps NR Sub6 EN-DC / Max UL peak rate of 900Mbps	3.1.	30 x 52 x 2.3	M.2	4X 5G, 3X 5G + 1X GNSS	-30 to +75	•				
	AIW 300 Series	4G (LTE Cat. 4)	mini-PCIe	AIW-343															LTE (1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 18, 19, 20, 26, 28, 28A, 66, 71) 3G (1, 2, 3, 4, 5, 6, 8, 19) 2G (3, 8)	LTE: 150Mbps DL, 50Mbps UL	2.0	50.95 x 29.9 x 3.2	mini PCIe	2 X LTE + 1 X GPS	-20 to +55			•		
	AIW 300 Series	4G (LTE Cat. 4)	mini-PCIe	AIW-344																FDD-LTE: 150 Mbps DL, 50 Mbps UL; TDD-LTE: 130 Mbps DL, 30 Mbps UL	2.0	50.95 x 30.4 x 3.42	mini PCIe	2 LTE +1 GPS	-30 to +75	•				
	AIW 300 Series	4G (LTE Cat. 4)	mini-PCIe, M.2 3052	AIW-346															LTE (2, 4, 5, 12, 13, 14, 66, 71) WCDMA (2, 4, 5)	LTE: 150Mbps DL, 50Mbps UL	2.0	50 x 31 x 7.5		2 x LTE, 1 x I-PEX GPS	-30 to +80	•		•		
	AIW 300 Series	5G	M.2 3052 Key-B	AIW-357																Max DL peak rate 2.97 Gbps NSA EN-DC / Max UL peak rate of 1150Mbps	3.1.	30 x 52 x 2.4	M.2	4 X 5G GNSS	-30 to +70	•				

Content

What is LPWAN?

Low Power Network (LPN) or Low Power Wide Area Network (LPWAN) is a new technology where a high network coverage and low power consumption are the key criteria in the operation of such a wireless network.

There are currently numerous technologies from which IoT decision makers can choose. From a technology point-of-view, they differentiate broadly into 2 major categories:

1. LPWAN technologies operate in unlicensed bands, typically in the Sub 1 GHz area. All technology contenders belonging to this category can be considered proprietary, i.e. all Intellectual Property Rights (IPRs) are either owned by one or by a limited number of companies.

   SigFox and LoRa, among others, belong to this category. As the name suggests, networks operating in unlicensed band can be deployed by virtually anyone.

2. The second category covers those technologies which operate in licensed bands, which are accessible only to mobile network operators which have purchased appropriate licenses from local regulatory authorities.

   This category of LPWAN technologies is standardized by the 3GPP (3rd Generation Partnership Project), an international standards organization which has also produced the standards for the GSM, UMTS and LTE mobile network technologies.

   The technologies known as NB-IoT and LTE Cat-M1 are the key LPWAN options which have been standardized by the 3GPP.

Feature	Cat M1	Cat NB1 / Cat NB2 / NB-IoT	LoRa	SigFox
Radio Spectrum	Licensed	Licensed	Unlicensed	Unlicensed
Guaranteed QoS	Yes	Yes	No	No
Latency	Milliseconds – Seconds	Seconds	Seconds – Minutes	Seconds – Minutes
Roaming	Global	Global	Local	Single network
Peak Data Rate	375 kbps (DL/UL)	27.2 / 62.5 kbps (DL/UL) Cat NB2: 159kbps/127 kbps	5.5 – 50 kbps	100 / 500 bps (UL/DL)
Range	Basement	Underground	Underground	Underground
Mobility	Vehicular (full handover)	Nomadic (no handover)	No	No
Voice support	Yes	No	No	No
Battery life	5-10 years	10 years +	10 years +	10 years +
Module cost	Low	Low	Low	Low
SIM Card	Yes	Yes	No	No

Dual Radio Devices with Integrated Antennas

Bluetooth LE / ANT+ / NFC / LoRa Mixed Solutions

The InsightSIP “Ready-to-go” RF modules offer you the fast, low risk way to deploy your IoT infrastructure, with fully CE, FCC, IC, Telec and Bluetooth SiG certified solutions. All modules are based on Nordic Semiconductor’s SoCs.

Part Number	ISP4520-EU	ISP4520-US	ISP4520-AS
Main protocol	LoRa		
BT Features	Bluetooth LE 5.0		
Other protocol	BT Mesh - ANT		
LoRa Tx Power	+14 dBm	+22 dBm	+14 dBm
BT Tx Power	+4 dBm		
LoRa Chip	SX1261	SX1262	SX1261
BT Chip	nRF52832		
Processor	Cortex M4F		
Flash	512 kB		
RAM	64 kB		
GPIOs (ADCs)	23 (8)		
Interfaces	(High Speed) SPI, TWI, UART, PWM, PDM		
NFC tag	Yes		
Temperature	85°C		
Dimensions	9.8 mm x 17.2 mm x 1.7 mm		

INSIGHTSIP

ISP4520 – LPWAN LoRa / BLE Module

Worldwide LoRa band coverage through EU (EMEA), US (Americas) and AS (Asia) versions.

For large spectrum of IoT applications:

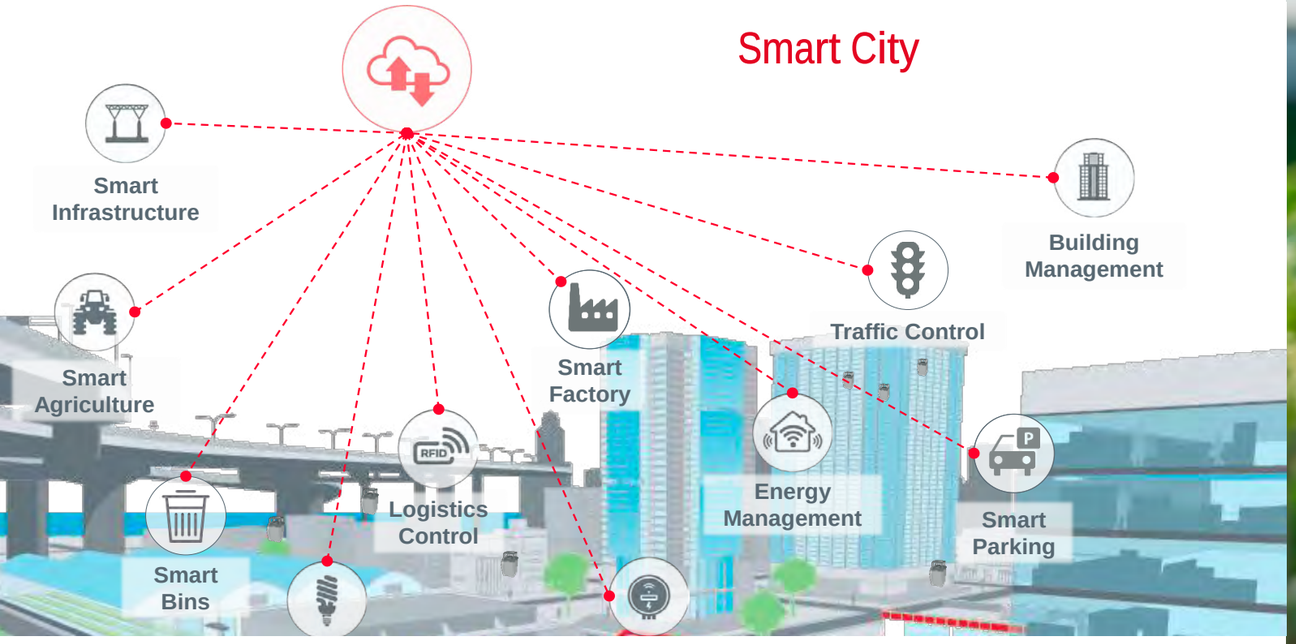
- Smart cities / Smart retail
- Industrial Internet
- Big data / Data science
- Energy engagement / Smart grids

LoRa Module

MINEWSEMI
Wholly-owned subsidiary of Minew

MINEW

Model No.		Antenna	ChipSet	Dimensions (mm)	Transmission Range	Transmission Power	Reception Sensitivity	GPIO
MS21SF1		IPEX	SX1262/LLCC68	16.4*15*3	5KM	+22dBm	-146dBm	5
MS23F1		/	STM32WLE5CCU6	20.72*19.13*3.2	5KM	+20dBm	-146dBm	24
MS24SF1		PCB+IPEX	nRF52840+SX1262	27*23.5*2.8	5KM	+22dBm	-146dBm	35
ME25LS01		/	nRF52840+LR1110	25.5*19*2.6	5KM	BLE: +6dBm LoRa: +22dBm	BLE: -96dBm LoRa: -136dBm	44



Unlicensed Modules – LoRa

muRata
INNOVATOR IN ELECTRONICS

LBAA0XV2GT Module

The Type 2GT is Murata´s newest release to the LoRaWAN module Family with a size of 9.98 x 8.7 x 1.74 max mm. Based on Semtech LR1121 Chipset.

Key Features
- Radio Chip: Semtech LR1121
- Multi-band LoRa & LR-FHSS
- Communication Over:
  - Sub-GHz
  - 2.4 GHz & Satellite S-Band
- External Antenna
- Host Interface: SPI, GPIOs
- LGA package with 48 pads
- RF Tx Power:?
- Operation Temperature: -40°C to +85°C
- Metal Shield Can Package
- Low current consumption Rx mode?
- VDDdd: 1.8V to 3.6V
- Radio Certification (FCC / IC / TELEC)

Key Applications:
- Asset Management
- Smart Building
- Smart Agriculture
- Crowd Control
- Sensor End Node

LBAA0QB1SJ Module

The Type 1SJ is Murata's LoRaWAN module and with a size of only 10 x 8.0 x 1.6 mm it is one of the smallest on the market. It is based on the Semtech SX1262 and the STM32L with a Cortex M0+ processor for stack and application is integrated. The module has a lower power consumption and higher output than previous products.

Key Features
- Radio Chip: Semtech SX1262
- MCU STM32L Cortex M0+ (192 kBytes Flash)
- Open MCU for Application
- External Antenna
- Host interfaces: UART, SPI, I²C
- Other interfaces: GPIO/ADC
- LGA (56 pads)
- RF Tx Power: +14 dBm (+21.5 dBm with PA boost)
- Operating Temperature Range: -40°C to +85°C
- Resin Mould package
- Low current consumption Rx mode
- Vcc: 2.0 V to 3.6 V

Key Applications
- Asset/Animal Tracking
- Smart Parking
- Smart Agriculture
- Fuel/Water Management
- Smart Waste
- Smart Home

Industry's Smallest Size and Lightweight Design

In the development of IoT devices, there are many situations where compact, lightweight, and well-designed modules such as wearables are required. Murata's LPWA module is the smallest module available in the industry, making it ideal for use in hardware designs.

Content

Licensed Modules – LTE Cat.M1 & NB-IoT

Telit Cinterion

ME310M1 Series – LTE Cat M1/NB2 LGA Module

Enabling a new generation of massive power efficient IoT device deployments and catering low-data throughput IoT applications, the ME310M1 series, with 3 worldwide variants is a next-generation member of Telit Cinterion's xE310 prodcut family. Exceeding market demands for optimized power consumption and enhanced qualit yof coverage, Cat M1/NB2 devices are specifically tailored for low data throughput IoT applications. The ME310M1 enhances coverage and provides superior in-building penetration, making them ideal for the growing number of OEM devices, system integrators and enterprises such as utilities that need to extend the lifecycle service of their IoT devices.

Key Features
- LTE UE Category M1 (1.4 MHz), NB2 (200 kHz)
- Single Rx, single antenna
- PSM, eDRX, Extended Coverage
- 3GPP Rel 14 compliant
- Control via AT commands according to 3GPP TS 27.005, 27.007 and customized Telit Cinterion AT commands
- Extended temperature range: -40° C to +85° C
- Supply voltage: Nominal: 3.8 V dc
- Over-the-air firmware update
- Embedded GNSS and Wi-Fi scan for outdoor and indoor positioning

Key Benefits
- Compact form factor, optimized for high yield and low cost manufacturing
- Global SKU with future support for non-terrestrial networks (NTN)
- Ultra-low, best-in-class power consumption profile
- Embedded GNSS and Wi-Fi scan for outdoor and indoor positioning

Key Applications
- Smart metering/agriculture
- Asset tracking
- Industrial sensors
- Medical devices and wearables

Software Development Kits

nRF91 DK

The nRF9160 DK is an affordable, pre-certifed single-board development kit for evaluation and development on the nRF9160 SiP for LTE-M, NB-IoT and GNSS. It also includes an nRF52840 board controller that for example can be used to build a Bluetooth Low Energy gateway.

Nordic Thingy:91

The Thingy:91 is an easy-to-use battery-operated prototyping platform for cellular IoT using LTE-M, NB-IoT and GNSS. It is ideal for creating Proof-of-Concept (PoC), demos and initial prototypes in your cIoT develop-ment phase.

nRF 9 SERIES

Low Power SiP with Integrated LTE-M, NB-IoT and GNSS Wireless Modem

NORDIC SEMICONDUCTOR

nRF9160 – Cellular IoT System-in-Package

The nRF9160 SiP is making the latest LTE technology accessible for a wide range of applications and developers. With the fully integrated SiP and pre-certification for global operation, it solves the complex wireless design challenges as well as the comprehensive set of qualifications needed to utilize cellular technology. By integrating an application pro-cessor, multimode LTE-M/NB-IoT/GNSS modem, RF front-end (RFFE) and power management in a 10x16x1.04 mm package, it offers the most compact solution for cellular IoT (cIoT) on the market. Targeting asset tracking applications, the nRF9160 SiP has built-in support for nRF Cloud Location Services. These services provide built in GNSS and LTE location support with assisted GPS, predicted GPS, single-cell and multi-cell location services.

Key Features

- Fully integrated SiP for cellular IoT
- Multimode LTE-M/NB-IoT modem with integrated RF front-end
- 700-2200 MHz LTE band support
- Certified for global operation
- Dedicated application processor and memory
- 10x16x1.04 mm LGA package
- Arm TrustZone + Arm CryptoCell

Applications

- Logistics and asset tracking
- Smart city & smart agriculture
- Predictive maintenance & industrial
- Wearables & medical

Feature	nRF9160-SIAA	nRF9160-SIBA	nRF9160-SICA
Wireless Protocol	LTE-M only product	NB-IoT only product	LTE-M/NB-IoT/ GNSS product
Type	System in Package		
CPU	64 MHz Arm Cortex-M33		
FPU	x		
DSP Instruction Set	x		
Cache	x		
Memory	1 MB Flash / 256 kB RAM		
Clocks	64 MHz / 32 kHz		
Arm Trustzone	x		
Arm CryptoCell	310		
Root-of-trust	x		
Secure key storage	x		
AES encryption	x		
LTE-M/NB-IOT/GPS Modem	x		
LTE band support in hardware	B1-B5, B8, B12-B14, B17-B20, B25-B26, B28 and B66		
Frequencies	700-2200 MHz		
Maximum TX Power	23 dBm		
RX Sensitivity	-108 dBm (LTE-M), -114 dBm (NB-IoT), -155 dBm (GPS)		
Antenna interface	50 Ω single-ended		
TWI, SPI, UART	4xTWI/SPI/UART		
PWM	4		
PDM	x		
I2S	x		
ADC, Comparator	ADC		
Timer, RTC	3, 2		
Temperature Sensor	x		
Applications	Sensor networks, Smart energy, Smart agriculture, Logistic and asset tracking, Industrial Systems, Smart Buildings, Retail and monitor devices, Medical devices, Wearables		
Certifications	nordicsemi.com/9160cert		
Operating Temp.	-40 to 85 °C		
Supply Voltage Range	3.0 V to 5.5 V		
Development Kits	nRF9160 DK, Nordic Thingy:91		
Packages	10x16x1.04 mm LGA		

LPWAN Modules with DECT NR+ modem

Introducing DECT NR+, the world's first non-cellular 5G standard

DECT NR+ (DECT New Radio plus or previously referred to as DECT-2020 NR) is one of the latest radio protocols for IoT applications. This non-cellular radio standard is recently included as part of the 5G standards by the ITU. NR+ employs a self-healing, decentralized, and autonomous mesh network, making it easy to add new devices and eliminating any single points of failure. It has a flexible and highly scalable network structure that has use-cases and applications across many industries. NR+ utilizes known cellular techniques and provides a robust standardized solution that is unmatched by any other non-cellular technologies.

nr+

Applications

NR+ fills a genuine gap in the IoT ecosystem in terms of large-scale machine-to-machine operations that will allow enterprise IoT customers to build their own low-cost private networks. Moreover, it is also the first non-cellular radio standard to be recognized as a radio technology fulfilling the formal IMT-2020 5G requirements, for both Ultra-Reliable Low Latency Communication (URLLC) and massive Machine Type Communication (mMTC) use cases.
NR+ can be valuable both as a low-cost alternative to existing solutions and unrealized applications. Many next-generation applications are being held back due to needing the reliability and low latency of a wired connection, but without the physical constraints of wires, and NR+ can offer exactly that.

Markets

- Smart Agriculture
- Smart City
- Smart Metering
- Industrial IoT

LPWAN Modules with DECT NR+ modem

NEW nRF91 series products – Low power SiP's with integrated DECT NR+ modem, LTE-M/NB-IoT and GNSS

The products within the nRF91 series sets a new standard for highly integrated System-in-Package (SiP) solutions, specifically designed for cellular IoT and DECT NR+ applications. Leveraging low-power LTE technology, advanced processing capabilities, and robust security features, the nRF91X1 offers unparalleled performance and versatility. It offers enhanced capabilities compared to its predecessor (nRF9160), including DECT NR+ support and 3GPP release 14 LTE-M/NB-IoT support.

Main Benefits

- Enhanced Capabilities: improved features uncluding support for DECT NR+ and 3GPP Release 14 LTE-M/NB-IoT LTE stack.
- Global Connectivity and Power Efficiency: The integrated modem of the nRF91X1 enables global connectivity without regional limitations, and include new unique modem features for further power saving and ease of use.
- Unleashing the Potential of DECT NR+: Harness the capabilities of the DECT NR+ stack with the nRF91X1, enabling massive mesh applications that prioritize reliability, secure connections, long range, and scalability.
- Compared to its predecessor (nRF9161), the nRF9151 boasts a significant footprint reduction of 20% and brings additional support for Power Class 5 20 dBm.

Key Features

- Fully integrated SiP with 64 MHz Arm Cortex-M33 and multimode LTE-M/NB-IoT modem with GNSS and DECT NR+ modem
- 700-2200 MHz LTE band support
- 1.9 GHz DECT NR+ band support
- Certified for global operation
- Dedicated programmable application processor and memory
- 1 MB flash + 256 KB RAM
- Arm TrustZone + Arm CryptoCell 310

Applications

- Asset Tracking
- Smart Metering
- Smart City
- Smart Agriculture
- Predictive maintenance
- Portable Medical Devices
- Industry 4.0

nRF9161 SiP

10 x 16 mm

nRF9151 SiP

12 x 11 mm

nRF9131 mini SiP

11 x 7 mm

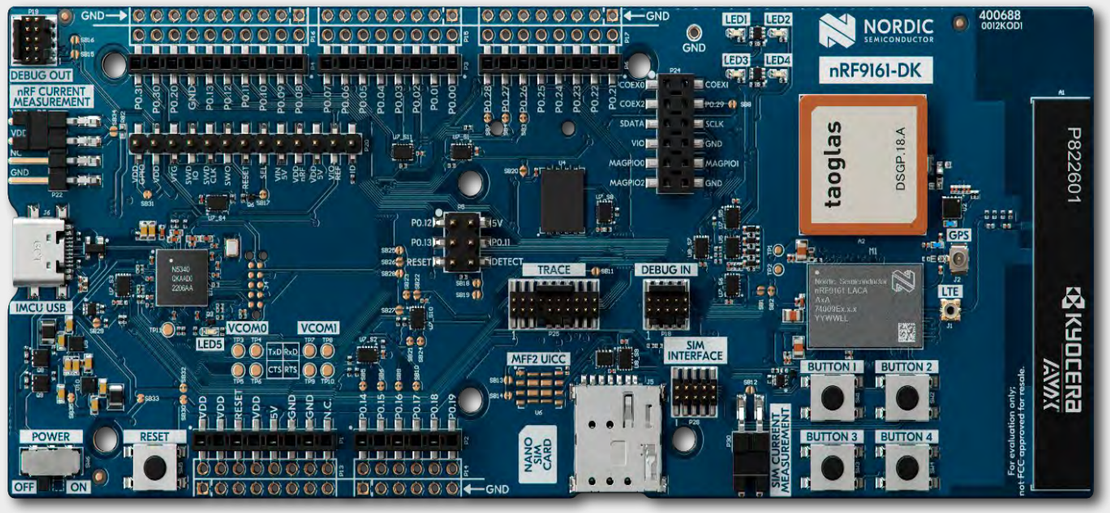
LPWAN Modules with DECT NR+ modem

nRF9161 DK - Cellular IoT development kit for LTE-M, NB-IoT, GNSS and DECT NR+

The nRF9161 DK is an affordable, pre-certified single board development kit for evaluation and development on the nRF9161 System-in-Package (SiP) for LTE-M, NB-IoT, GNSS and DECT NR+. It has a dedicated LTE-M, NB-IoT and DECT NR+ antenna that supports a wide range of bands to operate globally. The nRF9161 DK has the same coverage as the nRF9161 SiP. LTE bands B1-B5, B8, B12, B13, B17-B20, B25, B26, B28, B65, B66 and B85 are supported.

Key Features

- Multimode LTE-M/NB-IoT and DECT NR+ modem GNSS antenna
- LTE-M/NB-IoT and DECT NR+ antenna
- Arduino Uno form factor
- 4 LEDs / buttons user-programmable
- SEGGER J-Link OB Debugger with debug out support
- UART interface through VCOM port
- USB connection for debug/programming and power
- Bundled with a SIM card, preloaded with data



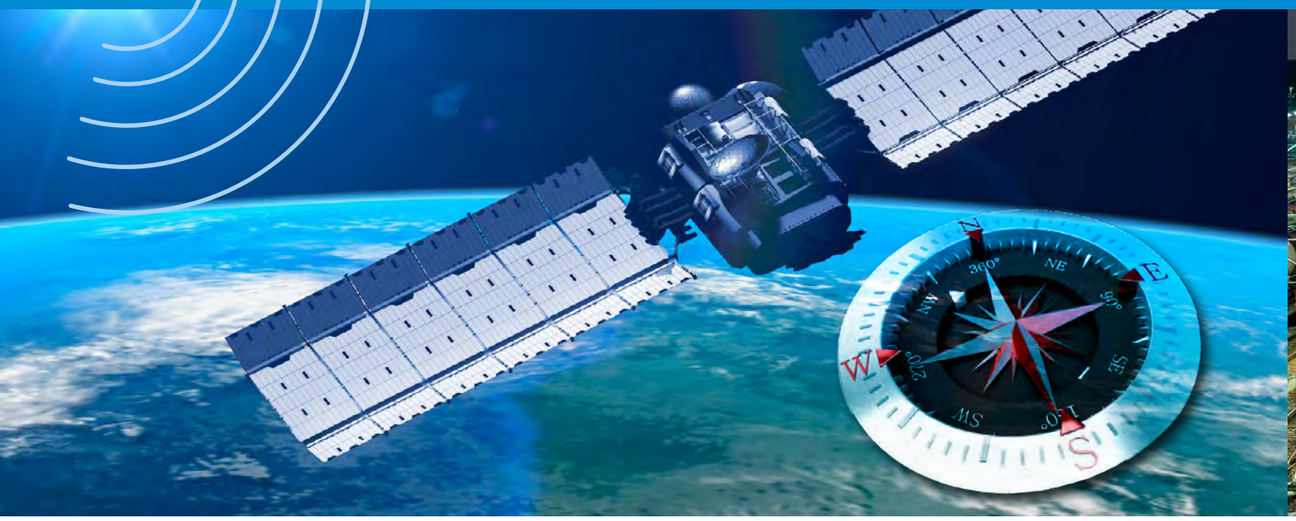
LPWAN Chips & Modules – Selection Guide

LPWAN / SubGHz Modules

Manufacturer	Name	Technology / Protocol					Unlicensed Bands					Licensed Bands									Fall-back	Modulation					Radio Data Rate	Max.Transmit Power TX (dBm)	Max. Input Sensitivity RX (dBm)	Supply Voltage Range (V)	Temperature Range (°C)	MCU		Memory				Interface										Package (Size in mm)	Evaluation Kit/ Development Kit
		LoRa	SigFox	LTE Cat. M1	LTE NB-IoT	Other	433M	868M	915M	920M	2.4G	600M	700M	800M	850M	900M	1700	1800	1900	2100	2G	GFSK	FSK	BPSK	CSS	OFDM					Yes	No	Flash	RAM	EEPROM	No	GPIO	UART	SPI	I²C	USB	ADC	RS232, TTL	PWM		
Insight SiP	ISP4520-EU	x				BLE 5.3		x			x															LoRa Radio in 868Mhz band	+4	1.8 - 3.6	-96	1.7 - 3.6	-30 to 85	x		512/256 KB	64/32KB			x	x	x	x		x			9.8 x 17.2 x 1.7	ISP4520-EU-DK
	ISP4520-US	x				BLE 5.3			x		x															LoRa Radio in 923Mhz band	+4	1.8 - 3.6	-96	1.7 - 3.6	-30 to 85	x		512/256 KB	64/32KB			x	x	x	x		x			9.8 x 17.2 x 1.7	ISP4520-US-DK
	ISP4520-AS	x				BLE 5.3				x	x															LoRa Radio in 923Mhz band	+4	1.8 - 3.6	-96	1.7 - 3.6	-30 to 85	x		512/256 KB	64/32KB			x	x	x	x		x			9.8 x 17.2 x 1.7	ISP4520-AS-DK
Murata	CMWX1ZZABZ	x	x												x	x							x				up to 300 Kbps	+18.5	– 135.5	2.2 - 3.6	-40 to 85	x		192KB	20KB	6KB			x	x	x	x					12.5 x 11.6 x 1.76	ST - B-L072Z-LRWAN1
	LBAA0QB1SJ	x													x	x							x						– 135.5	2.2 - 3.6	-40 to 85	x					x	x	x	x	x	x			10.0 × 8.0 × 1.6	
	LBAA0XV2DT	x													x	x							x							1.8 - 3.6	-40 to 85						x		x						9.98 × 8.70 × 1.74	
	LBEU5ZZ1WL	x				BLE 5.3									x	x							x							3.0 - 3.3	-40 to 85						x	x	x	x	x	x			17 × 17.5 × 2.15	
	LBAA0X-V2GT-001	x																												-1.8 - 3.6	-40 to 85						x		x						9.98 x 8.7 x 1.74	
	LBAD0XX1SC			x	x																									2.85 - 4.35	-40 to 85							x								11.1 x 11.4 x 1.5	
	LBAD0XX1WG			x	x																									2.85 - 4.35	-40 to 85							x								12.2 x 12.0 x 1.6	
	LBAD0ZZ1SE			x	x																									3.3 - 5.0	-40 to 85						x	x	x	x		x		x	15.4 x 18.0 x 2.5	
Telit Cinterion	ME910C1-WW			x	x	Optional GNSS							x	x	x	x	x	x	x	x	x					x						x				x	x	x	x	x	x				ME910C1-WW Interface Board
	ME310M1-WW			x	x	Optional GNSS																				x	LTE Cat M1: UL up to 1 Mbps DL up to 588 Kbps LTE Cat NB2: UL up to 160 Kbps DL up to 120 Kbps	+23	– 108.2	2.5 - 4.5	-40 to 85							x	x	x	x	x					ME310M1-W1 Module DVT Sample
	ME310G1-WW			x	x	Optional GNSS							x	x	x	x	x	x	x	x	x					x		+23 (+33 2G)					x				x	x	x	x	x	x				
	ME910G1-WW			x	x	Optional GNSS						x	x	x	x	x	x	x	x	x	x					x		+23 (+33 2G)					x				x	x	x	x	x	x				
	TX82			x	x	Optional GNSS																		x			LTE Cat M1: DL: max. 300 kbps, UL: max.1.1 Mbps LTE Cat.NB1: DL: max.27 kbps, UL: max. 63kbps LTE Cat.NB2: DL: max. 124 kbps, UL: max. 158 kbps	20	-114	3.1-4.6	-40 to 85			x	x			x		x	x		x				
	TX62			x	x	Optional GNSS																					LTE Cat M1: DL: max. 300 kbps, UL: max. 1.1 Mbps LTE Cat.NB1: DL: max. 27 kbps, UL: max. 63 kbps LTE Cat.NB2: DL: max. 124 kbps, UL: max. 158 kbps	20	-107																		
Nordic	nRF9160-SIAA			x									B13/ B28*	B20	*	B8*	B4*	B3*	*	B1*						x	UL 300 DL 375	+23	-108	3.0 - 5.5	-40 to 85	x		1 MB	256 kB			x	x	x	x		x		x	10 x 16 x 1.2	nRF9160 DK, Thingy:91
	nRF9160-SICA			x	x	GNSS							B13/ B28*	B20	*	B8*	B4*	B3*	*	B1*							UL 300 (M1) DL 375 (M1) UL 30 (NB1) DL 60 (NB1)	+ 23	-108 (LTE-M) -114 (NB-IoT)	3.0 - 5.5	-40 to 85	x		1MB	256kB			x	x	x	x		x		x	10 x 16	nRF9160 DK, Thingy:91
	nRF9161-LACA			x	x	GNSS, DECT NR+							B13/ B28*	B20	*	B8*	B4*	B3*	x	B1*							UL 300 (M1) DL 375 (M1) UL 30 (NB1) DL 60 (NB1)	+ 23	-108 (LTE-M) -114 (NB-IoT)	3.0 - 5.5	-40 to 85	x		1MB	256kB			x	x	x	x		x		x	10 x 16	nRF9161 DK, Thingy 91X
	nRF9151-LACA			x	x	GNSS, DECT NR+																							+ 23, + 20																	12 x 11	
	nRF9131-LACA			x	x	GNSS, DECT NR+																							+ 23																	11 x 7	
Minew	MS21SF1	x							x													x	x					22	-146	1.8-3.7	40 to 85		x				x	x		x						MS21SF1	x
	MS23SF1	x						x														x	x					20.5	-146	1.8-3.6			x	256kB	64kB			x	x	x	x		x			MS23SF1	x
	MS24SF1	x				BLE					x	x	x	x	x	x						x	x					22	-146	1.8-3.7			x				x	x	x	x	x	x				MS24SF1	x
	ME25LS01	x				BLE+Wi-Fi+GNSS					x	x	x	x	x	x						x	x					22	-125	1.8-3.7			x	1MB	512kB			x	x	x	x	x			x		ME25LS01	x

*more certifications coming

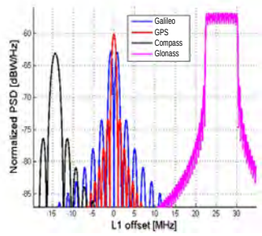
Content



GNSS

Global Navigation Satellite Systems (GNSS)

A Global Navigation Satellite System (GNSS) is a system of satellites providing autonomous geo-spatial positioning with global coverage. It allows small electronic receivers to determine their locations to a high precision by using time signals transmitted along a line of sight by radio from satellites.



Operational Navigation Constellations

- GPS (24-satellite constellation + 6 backup SVs)
- Glonass (24-satellite constellation + 6 backup SVs)

Navigation Constellations in Development

- Galileo (currently 18 SVs launched)
- Beidou (currently 19 SVs launched)

USA

- CDMA
- 24+6 orbiting SV
- 6 orbital planes with 4 SV each
- Frequencies (MHz): 1575.42 (L1), 1227.6 (L2), 1176.45 (L5)
- Each SV is identified by its own ID

RUSSIA

- FDMA
- 24+6 orbiting SV
- 3 orbital planes with 8 SV each
- Frequencies (MHz): 1602 (L1) + k1, 1246 (L2) + k2, where: k1=(-7 to +13) *562.5 KHz k2=(-7 to +13) *437.5 KHz
- Each SV is identified by its own frequency

EUROPE

- CDMA
- 24+6 orbiting SV
- Frequencies (MHz): 1575.42 (E1), 1227.6 (L2), 1176.45 (E5A), 1207.14 (E5B), 1278.75 (E6)
- Each SV is identified by its own ID

CHINA

- CDMA
- 5 Geostationary SV +27+5 orbiting SV
- Frequencies (MHz): 1561.098 (B1), 1207.14 (B2), 1268.52 (L5)
- Interface control document (ICD) “test version” published in October 2011
- Each SV is identified by its own ID

GNSS Technologies

System	USA	Russia	EU	China	Japan
Type	Global	Global	Global	Global	Regional
Date Deployed	1995	1995/2011	2016 / 2018	2015/2020	Future (ex. 2020?)
Frequency	L1=1575.42 MHz	L1=1602 MHz	E1=1575.42 MHz	B1=1561.098 MHz	L1--SAIF =1575.42 MHz
Num. of Satellites	24-32	~ 30	27-30	30-35	4

GNSS Wireless Modules – GPS/BDS/GLONASS/Galileo/QZSS

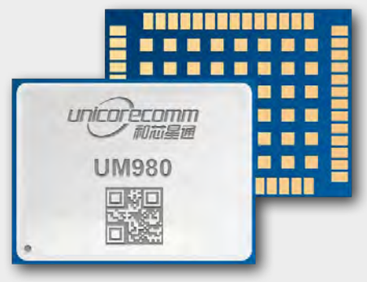
unicore
a BDStar company

UM980 – All-constellation Multi-frequency High Precision RTK Positioning Module

UM980 is Unicore’s new-generation proprietary high-precision RTK positioning module. By combining advanced hardware design and exclusive algorithms, UM980 supports BDS B1I/B2I/B3I/B1C/B2a/B2b*, GPS L1/L2/L5, GLONASS L1/L2, Galileo E1/E5a/E5b, QZSS L1/L2/L5, and SBAS. The built-in multi-frequency anti-jamming technology realizes enhanced RTK engine calculation working on multiple modes and frequencies, which significantly improves RTK initialization speed, measurement accuracy and reliability in complex environments such as city blocks and tree shades. Relying on the excellent performance, UM980 is well suited for high precision navigation and positioning applications such as UAV, lawn mower, precision agriculture, surveying and mapping and intelligent driving.

Key Features

- Based on the new generation GNSS SoC - NebulasIV, which integrates RF, baseband, and high precision algorithm 17.0 x 22.0 x 2.6 mm SMD
- Supports on-chip RTK positioning calculation on all systems and multiple frequencies
- Supports BDS B1I/B2I/B3I/B1C/B2a/B2b + GPS L1/L2/L5 + GLONASS L1/L2 + Galileo
- E1/E5a/E5b + QZSS L1/L2/L5 + SBAS
- All-system multi-frequency RTK engine and advanced RTK technology
- Independent tracking of each frequency and 60dB narrowband anti-jamming technology



About Unicore

Technical Side

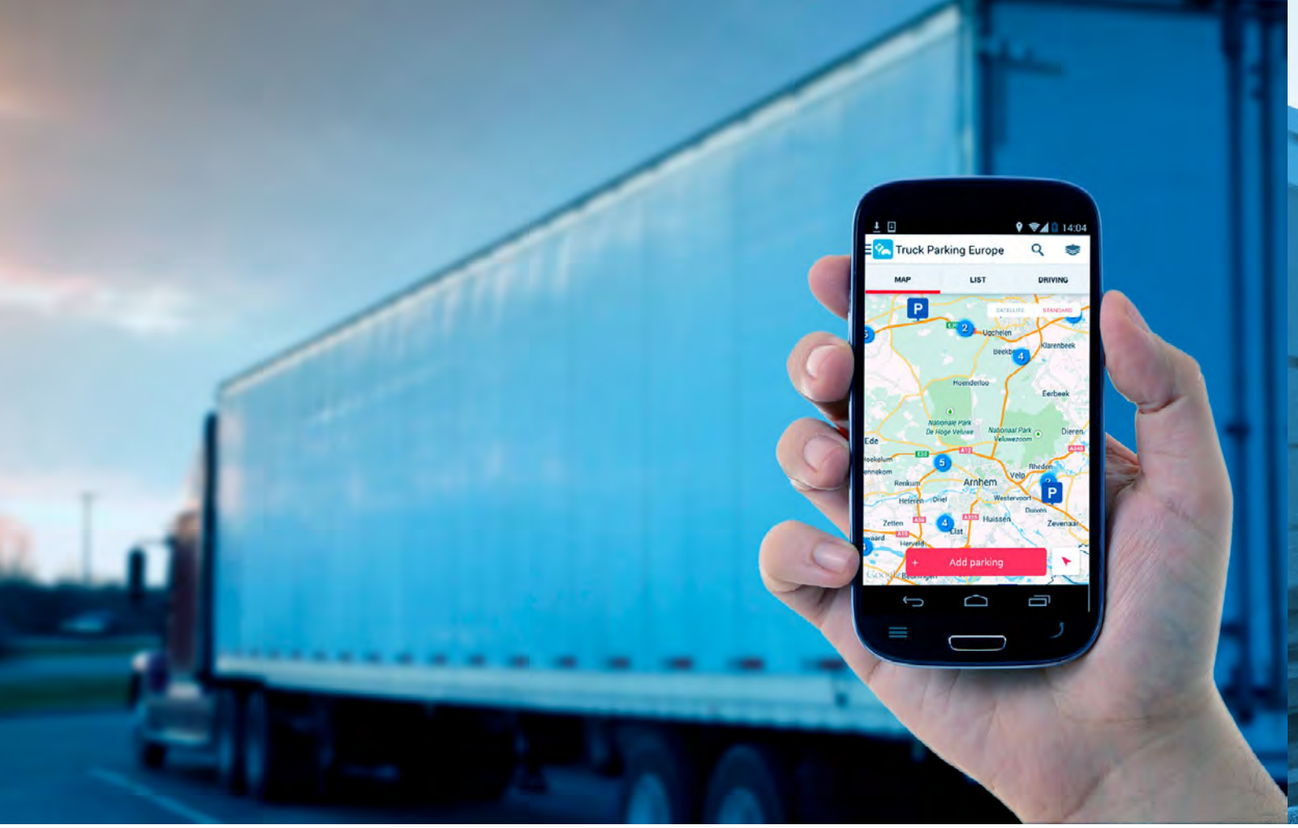
- More than 10 years of experiences in positioning
- Customized functions available for key accounts

Product Side

- Varies accuracy options from centimeter to meter level
- Solid success stories with world famous brands and partners
- High reliability with large shipments each and every month
- Whole solution available from hardware to software

Support

- Efficient technical support
- Designated Sales and FAE



GNSS Wireless Modules

SE873K5 – Multi-Constellation Smart Antenna GNSS

The SE873K5 is the latest addition to Telit Cinterion SE873 family and is the natural migration path from SE873 and SE873Q5.The SE873K5 is a multi-constellation receiver in 7x7x2.25 mm QFN-like package including embedded SQI flash, RTC, TCXO. The SE873K5, thanks to its small package, the latest generation chipset, and the advanced power modes is the ideal solution for wearable, light portable devices and battery powered solutions.

Key Benefits

- Latest generation chipset
- Complete GNSS module, including TCXO, RTC, and flash memory
- Full GNSS compliance: GPS, Glonass, Galileo and BeiDou
- Flexible power management modes allow improvement to the battery life
- Supports both local and server-based A-GNSS for improved TTFFs
- Satellite Based Augmentation System (SBAS) corrections increase positioning accuracy
- Battery-friendly 1.8 V GPIO

Application Fields

- Fleet management systems
- European GPS-assisted road tolling systems
- Cellular base stations
- In-car navigation systems
- Automotive telematics
- GPS-based personal sports training monitors

Content

GNSS Wireless Modules

SE868K5 – Multifrequency and Multiconstellation Positioning Receiver Module

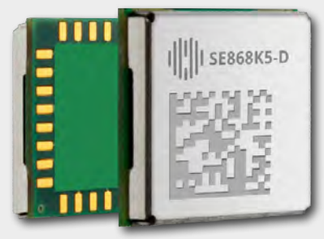
SE868K5 as single-frequency (SF) using only the L1 band and multifrequency (D) using L1/E1 and L5/E5 band are multiconstellation positioning receiver modules of the xE868 Telit Cinterion form factor family. Both are pin-out compatible with SE868SY family and legacy products JF2 and SE868 V3.

Key Benefits

- SE868K5-SF ultralow power consumption and multiple low power modes
- Pre-selection SAW filter for best immunity and coexistence with other radios
- SE868K5-SF/D Embedded LNA allows optimal performance even with passive antennas
- Full GNSS compliance: GPS, GLONASS, Galileo, BeiDou and QZSS
- PVT logging

Application Fields

- Fleet management systems
- E-mobility applications
- Road tolling systems
- Automotive telematics systems
- Wearable sports training monitors
- Drones



GNSS Wireless Modules

SE868K5-RTK – Multifrequency and Multiconstellation Positioning Receiver Module with Real Time Kinematics (RTK)

The SE868K5-RTK is a multifrequency and multiconstellation positioning receiver module with Real Time Kinematics (RTK) capabilities, using two frequencies (L1/E1 and L5/E5) for enhanced location accuracy and reduction of multipath effect in urban areas. In addition to its standard capabilities, with the injection of differential corrections, the SE868K5-RTK can achieve centimeter level accuracy.

Key Benefits

- Real Time Kinematics support up to 10 Hz (RTCM 3.x input)
- Footprint compatible with SE868K5 family, with SE868SY family, and with legacy JF2 and SE868V3 variants
- Full GNSS compliance: GPS, GLONASS, Galileo, BeiDou and QZSS
- SAW filter for optimal coexistence with other radios
- Embedded LNA allows optimal performance even with passive antennas
- Support ephemeris file injection (A-GNSS) as well as on-board emphemeris prediction (A-GPS)
- PVT Logging

Application Fields

- Fleet management systems
- E-mobility applications
- Lawn mowers/robots
- Precision Agriculture
- Automotive telematics systems
- Drones

Gateway Solutions

Smart IoT Gateway Solutions

The smart IoT gateways solution SGX31 and SGL81 offer an out-of-the-box connectivity for faster time to market with simplified plug-and-play integration. The EGX81/82 supporting LTE Cat M, NB-IoT and 2G fallback represents an efficient gateway solution with flexible interfacing options.

Key applications:

- Industrial monitoring/sensors
- Asset tracking
- Security and agricultural applications
- Video surveillance
- Robotics & Industry 4.0
- Remote maintenance & control
- Smart cities/meters/agriculture & vending machines
- Healthcare applications

SGX31

Key Benefits

- Flexible, cost-effective platform for connecting industrial assets
- Cat M, NB-IoT connectivity with 2G fallback
- Connectivity with data speeds of up tp 300kbps

SGL81

Key Benefits

- Easy-to-use migration option for gateway applications
- LTE Cat 4 connectivity with seamless 3G/2G fallback
- Connectivity with data speeds 150Mbps

EGX81/82

Key Benefits

- Simple and reliable plug-and-play cellular connectivity
- LTE Cat M/NB-IoT with 2G fallback
- High efficiency for a long life by leveraging power clas 5 (20dBm) and efficient eDRX and PSM

GNSS Modules – Selection Guide

Manufacturer	Part Name	Chipset	Sensitivity (in dBm)			Power (in mW)		Power (in µW)	Interface				Features										Time to First Fix (90%@ -130 dBm)		Antenna Typ		Dimensions (mm)	Pack-age	Evaluation Kit / Development Kit
			Acquisi-tion	Naviga-tion	Tracking	Acquisi-tion	Tra-cking	Power bKup	NMEA Out-put	DGPS/ RTCM Input	MEMS Port	Others	1 PPS (ns RMS)	PPS output	GPS	Glo-nass	Gali-leo	Bei-dou	NAVIC	SBAS	QZSS	LNA	Hot start	Cold start	GPS Patch antenna	GPS Chip antenna			
Telit Cinterion	SL869L-V2	MT3333	- 148 dBm	-160 dBm	- 162 dBm	86	76	23	x			UART, I2C	x	x	x	x	x	x		x	x	x	1s	< 28s			16 x 12.2 x 2.4	LCC	EVK-SL869L-V2S
	SL869-V3	ST Teseo 3	- 147 dBm	-158 dBm	- 162 dBm	171	147	251	x	x		UART, I2C	x	x	x	x	x	x		x	x	x	1s	< 35s			16 x 12.2 x 2.4	LCC	EVK-SL869-V3
	SL871L	MT3333	-147 dBm	-160 dBm	-163 dBm	86	76	21	x			UART			x	x	x	x		x	x	x	1s	< 31s			10.1 x 9.7 x 2.4	LCC	EVK-SL871L
	SL871L-S	MT3337	-147 dBm	-161 dBm	-164 dBm	64	54	21	x			UART			x					x	x	x	1s	< 31s			10.1 x 9.7 x 2.4	LCC	EVK-SL871L-S
	SE868K3-A	MT3333	-148 dBm	-161 dBm	-164 dBm	111	99	59	x			UART, I2C, SPI, GPIO	x	x	x	x	x			x	x	x	1s	< 35s	x		11 x 11 x 6.1	QFN	EVK-SE868K3-A
	SE868K3-AL	MT3333	-146 dBm	-157 dBm	-157 dBm	111	99	59	x			UART, I2C, SPI, GPIO	x	x	x	x	x			x	x	x	1s	< 35s	x		11 x 11 x 4.1	QFN	EVK-SE868K3-AL
	SE868K5-D/I	MT AG3335MN	-146 dBm	-165 dBm	-165 dBm	54	59	36	x	x		UART, I2C, SPI	x	x	x	x	x	x		x	x	x	1s	<28s			11 x 11 x 2.8	QFN	SE868K5D/I EVK
	SE868K5-RTK	MTAG3335MN	-146 dBm	-165 dBm	-165 dBm	70	70	36	x	x		UART, I2C, SPI	x	x	x	x	x	x		x	x	x	1s	<28s			11 x 11 x 2.8	QFN	DVT3990252433
	SE878K3-A		-148 dBm	-163 dBm	-165 dBm	93	34		x			UART, I2C, SPI	x	x	x	x	x	x		x	x	x	1s	< 35s	x		18 x 18 x 6.1	QFN	EVK-SE878K3-A
	SE868K7-A	MT3337	-148 dBm	-163 dBm	-164 dBm	85	71	21	x			UART, GPIO	x	x	x					x	x	x	1s	< 35s	x		11 x 11 x 6.1	QFN	EVK-SE868K7-A
	SE868SY-D/SF		-148 dBm	-164 dBm	-164 dBm	50	36	60	x	x		UART, I2C, SPI	x	x	x	x	x	x		x	x	x	1s	<21s	x		11 x 11 x 2.8	QFN	SE868SY EVK
	SE873K5	MTAG3335MN	-148 dBm	-148 dBm	-148 dBm	41	42		x			UART, I2C, SPI	x	x	x	x	x	x		x	x	x	1.5s	<29s			7 x 7 x 2.25	QFN	SE873K5EVK
GNS	TC6000GN	TI CC4000	-147 dBm	-162 dBm	-162 dBm				x			UART	x	x	x					x	x		1s	< 34s			10 x 9.3 x 2.3	LGA	TC6000GN Starter Kit
	TC6000GTIM	TI CC4000	-146 dBm	-162 dBm	-162 dBm				x			UART	x	x	x					x	x	x	1s	< 34s			10 x 9.3 x 2.3	LGA	TC6000GTIM Starter Kit
	GNS2301	SirFStarV	-146 dBm	-160 dBm	-165 dBm				x	x		UART, I2C, SPI	x	x	x	x	x	x		x	x	x	1s	< 35s			10 x 9.3 x 2.1	SMD	GNS2301 GPS/GLONASS Starter Kit
	GNS802	SirFStarV	-146 dBm	-160 dBm	-165 dBm				x	x		UART, I2C, SPI	x	x	x	x	x			x	x	x	1s	< 35s		x	16 x 10 x 2.1	SMD	GNS802 GPS/GLONASS Starter Kit
	GNS3301	MT3333	-148 dBm	-165 dBm	-165 dBm				x	x		UART	x	x	x	x	x			x	x		1s	< 34s			10 x 9.3 x 2	SMD	GNS3301 GPS/GLONASS Starter Kit
	GNS3301B	MT3333	-148 dBm	-165 dBm	-165 dBm				x	x		UART	x	x	x			x		x	x		1s	< 34s			10 x 9.3 x 2	SMD	GNS3301B GPS Starter Kit
	GNS902	MT3333	-148 dBm	-165 dBm	-165 dBm				x	x		UART	x	x	x	x				x	x	x	1s	< 35s		x	16 x 10 x 2.1	SMD	GNS902 GPS/GLONASS Starter Kit
	GNS902B	MT3333	-148 dBm	-165 dBm	-165 dBm				x	x		UART	x	x	x	x		x		x	x	x	1s	< 35s		x	16 x 10 x 2.1	SMD	GNS902B GPS Starter Kit
	GNS2201	MT3337	-148 dBm	-165 dBm	-165 dBm				x	x		UART	x	x	x					x	x	x	1s	< 34s			10 x 9.3 x 2	SMD	GNS2201 GPS Starter Kit
	GNS202	MT3337	-148 dBm	-165 dBm	-165 dBm				x	x		UART	x	x	x					x	x	x	1s	< 34s		x	16 x 10 x 2.1	SMD	GNS202 GPS Starter Kit
	GNS502	TI CC4000	-145 dBm	-161 dBm	-161 dBm				x	x		UART	x	x	x					x	x	x	1s	< 34s		x	16 x 10 x 2.1	SMD	GNS502 GPS Starter Kit
	GNS601uLP	MT3339	-148 dBm	-165 dBm	-165 dBm				x	x		UART	x	x	x					x	x	x	1s	< 35s	x		16 x 16 x 6	SMD	GNS 601uLP Starter Kit
	GNS302uLP	MT3339	-148 dBm	-165 dBm	-165 dBm				x	x		UART	x	x	x					x	x	x	1s	< 35s		x	10 x 15.7 x 2	SMD	GNS 302uLP Starter Kit
Minew	MS31SN1		-148 dBm	-160 dBm	-162 dBm					x		UART			x	x		x		x	x		1s	< 35s			10.1 x 9.7 x 2.4	SMD	
	MS32SN1		-148 dBm	-160 dBm	-165 dBm							UART			x						x		1s	≤29s			10.1 x 9.7 x 2.4	SMD	
	MS32SN4		-148 dBm	-160 dBm	-165 dBm										x						x		1s	≤29s			18.2 x 18.2 x 6.8	SMD	
	MS33SN1		-148 dBm	-160 dBm	-165 dBm					x		UART			x	x	x	x		x	x		1s	≤24s			10.1 x 9.7 x 2.4	SMD	
	MS34SN2		-148 dBm	-160 dBm	-165 dBm					x		UART		x	x	x	x	x		x	x		1s	≤28s			16 x 12.2 x 2.4	SMD	
	MS34SN3		-148 dBm	-160 dBm	-165 dBm					x		UART		x	x	x	x	x		x	x		1s	≤28s			22 x 17 x 2.4	SMD	
	MS34SNA		-148 dBm	-160 dBm	-165 dBm					x		UART			x	x	x	x		x	x		1s	≤24s			17 x 22	SMD	
	MS35SN1		-148 dBm	-160 dBm	-165 dBm					x		UART		x	x	x	x			x	x		1s	≤28s			10.1 x 9.7 x 2.4	SMD	
	MS35SN2		-148 dBm	-160 dBm	-165 dBm					x		UART		x	x	x	x			x	x		1s	≤28s			16 x 12.2 x 2.4	SMD	
	MS36SN4		-148 dBm	-160 dBm	-165 dBm				x	x		UART	x		x	x	x	x			x		≤2s	≤27s			16 x 21 x 2.6	SMD	
	MS37SN2		-148 dBm	-160 dBm	-167 dBm				x	x		UART	x		x	x	x	x			x		1s	≤24s			16 x 12.2 x 2.4	SMD	

GNSS Cards – Selection Guide

Manufacturer	Part Name	Chipset	Sensitivity (in dBm)		Power (in mA)		Interface			Features										Time to First Fix (90%@ -130 dBm)		Antenna Typ		Dimensions (mm)	Package
			Acquisi-tion	Tracking	Acquisi-tion	Tracking	NMEA Output	DGPS/ RTCM Input	Others	Acquisi-tion channels	1 PPS (ns RMS)	PPS output	GPS	Glo-nass	Galileo	Beidou	SBAS	QZSS	Deep sleep	Hot start	Cold start	GPS Patch Antenna	GPS Chip Antenna		
Advantech	EWM-G110H01E Half-size Mini-PCIe card	u-blox NEO-M8U	-160 dBm	-167dBm						72	30 ns		x	x	x	x	x	x		1,5s	26s	UFL Connector			
Advantech	AIW-210 XU-001 M.2 2242 card	u-blox NEO-M9N	-160 dBm	-167dBm						92	30 ns		x	x	x	x	x	x		2s	24s	UFL Connector			

UWB

What is Ultra-Wide-Band (UWB)?

Ultra-Wide-Band (UWB) is based on the use of an extremely wide frequency spectrum for wireless communication. Unlike traditional wireless technologies such as WLAN or Bluetooth, which use narrow frequency bands, UWB utilizes a very wide frequency range, typically spanning several GHz (3,1 – 10,6 GHz). This wide frequency band usage is key to the performance of UWB and enables a variety of applications, including precise positioning, high-resolution positioning and fast data transmission.

The IEEE 802.15.4z standard defines the specific parameters for the operation of UWB systems. This standard defines how UWB devices modulate, encode and transmit their signals to ensure interoperability and regulatory compliance.

In general, UWB technology is based on the transmission of very short, fast pulses over a wide frequency spectrum. These pulses can have a duration of only a few nanoseconds and are often so short that they require only a tiny amount of energy per pulse. By using spread spectrum and modulation techniques, UWB devices can transmit high-bandwidth data while ensuring compliance with regulatory requirements and minimizing interference with other radio technologies.

UWB devices also often utilize advanced signal processing techniques, such as multipath propagation processing.

UWB / BLE Modules

MINEW

MS01SF1 –BLE & UWB Combo Module

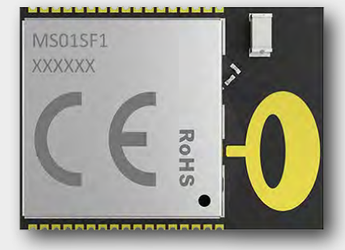
MS01SF1 is an Ultra-Wideband(UWB) transceiver & Bluetooth low energy 5.2 module integrated with the latest Decawave DW3120 SoC for indoor positioning and the advanced Nordicsemi nRF52833 SoC as the central processor. It supports BLE and NFC connectivity and other protocols, including Thread/ Zigbee/IEEE 802.15.4. This module can be used in a broad range of UWB applications, provides 2-way ranging or TDoA location systems to locate assets with a precision of 10 cm and supports data rates of up to 6.8 Mbps simultaneously.

Key Features

- Bluetooth Low Energy 5.2
- UWB IEEE 802.15.4z
- Thread, Zigbee, NFC
- PCB+Ceramics Antennas
- UWB section based on Devawave DW3120
- BLE section based on Nordic Semi nRF52833
- Configurable 23 GPIOs (BLE) and 4 GPIOs (UWB)
- Dimension of 26.12x19.13x3.2mm
- 10-30 cm Ranging Accuracy
- Temperature -40 to +85 °C

Applications

- Security warning devices
- Smart meters
- Building automation
- Agricultural sensors
- Smart cities
- Retail store sensors
- Street lighting
- Environmental sensors
- Smart parking
- Smart medical

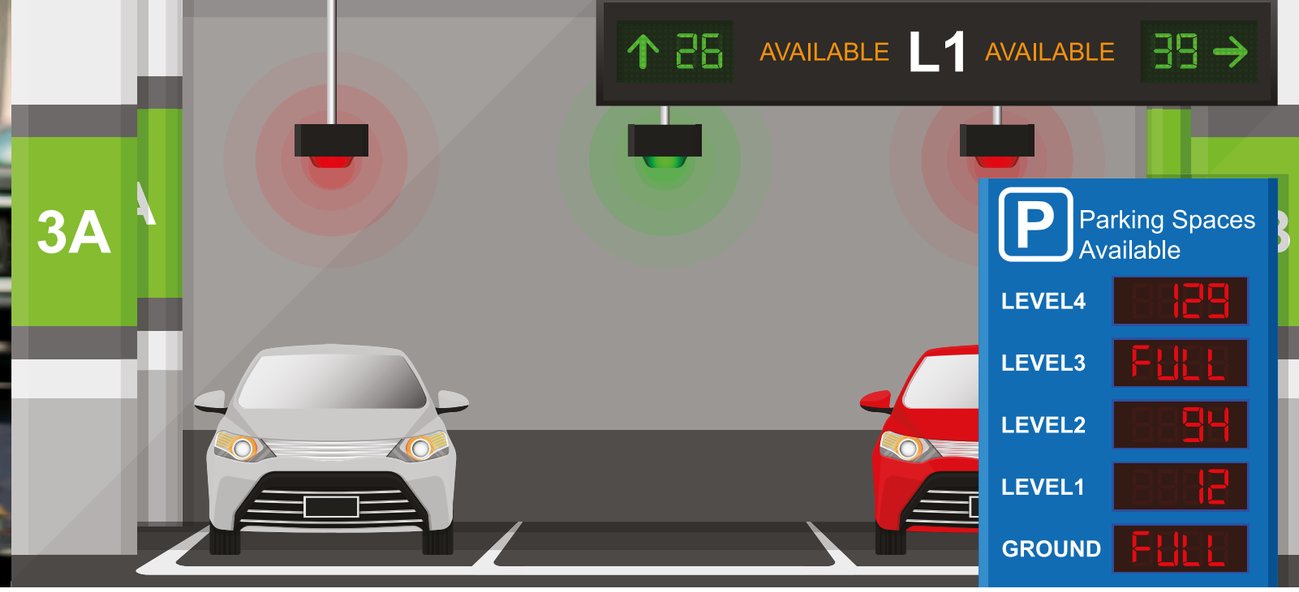


Selection Guide UWB

INSIGHTSIP MINEW muRata INNOVATOR IN ELECTRONICS

Manufacturer	Name	Used Ics	CPU Core	Flash / RAM	UWB Channel	UWB Frequenzy (MHz)	Bluetooth specification	Max.Transmit Power TX (dBm)	Supply Voltage Range (V)	Input Sensitivity RX (dBm)	Interfaces										Antenna		Operating Temperatue	Size (mm)	Package	Evaluation Kit / Development Kit
											GPIO	PCM	SPI	UART	JTAG	ADC	I²C	USB	RS-232	other	Intergrated Antenna	Without Antenna				
Murata	LBUA5QJ2AB	Qorvo QM33120W Nordic nRF52840	Arm Cortex-M4	1MB / 256kB	5 & 9	6250 - 8250	BLE 5.2	8	2.5 - 5.5	-92			x	x			x	x				x	40°C + 80°C	10.5 x 8.3 x 1.44	LGA	LBUA5QJ2AB-828EVB
	LBUA2ZZ2DK	NXP Trimension SR040 NXP QN9090	Arm Cortex-M4	640kB / 152kB	5 & 9	6250 - 8250	BLE 5.0		1.9 - 3.6					x							x		30°C + 80°C	19.6 x 18.2 x 2.3	LGA	LBUA2ZZ2DK-EVK
	LBUA0VG2BP	NXP Trimension SR150	Arm Cortex-M33	- / 128kB	5 & 9	6250 - 8250	-		1.71 - 1.98				x	x								x	30°C + 80°C	6.6 x 5.8 x 1.2	LGA	LBUA0VG2BP-EVK-P
Insight SiP	ISP3080-UX	Qorvo QM33110 Nordic nRF52833	Arm Cortex-M4	512kB / 128kB	5 & 9	6490 - 7987	BLE 5.1	8	2.4 - 3.6	-93			x	x				x		PWM	x		40°C + 85°C	12 x 12 x 1.5	LGA	ISP3080-UX-DK
Minew	MS01SF17	Qorvo DW3120 Nordic nRF52833	Arm Cortex-M4	512kB / 128kB	5 & 9	6240 - 7987	BLE 5.2	8	2.8 - 3.6	-94			x	x			x			PWM	PCB, Ceramic		40°C + 85°C	26.12 x 19.13 x 3.2		

Content



BLE/UWB Combo Module

INSIGHTSIP

ISP3080 – Ultra-Wide Band and Bluetooth Low Energy

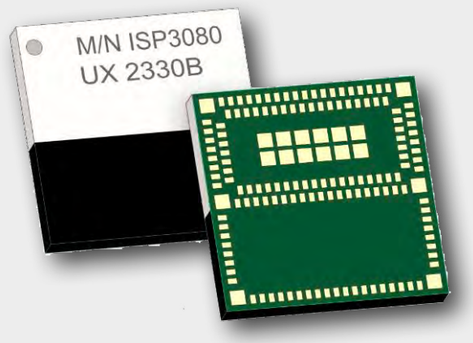
This highly miniaturized LGA module, 12 x 12 x 1.5 mm, is based on the QM33110 UWB transceiver and nRF52833 BLE chip. Using a simple user interface via the SPI connection and integrating a Cortex™ M4 CPU, flash and RAM memory combined with optimized antennas, ISP3080 offers the perfect stand-alone ranging module solution for RTLS, access control and indoor positioning applications. The module also includes a 3D accelerometer to allow for low power modes with wake up dictated by movement.

Key Features

- UWB IEEE 802.15.4z
- Bluetooth Low Energy 5.1 Direction Finding and Long Range
- BT Mesh, Thread, Zigbee, ANT+ NFC
- Fira Compatible – Near Field Interaction
- Fully integrated RF Matching and Antenna UWB 6.5 GHz band 5 and 8.0 GHz band 9 BLE 2.4 GHz
- Integrated 32 MHz & 32 kHz Clocks
- Integrated ultra-low-power high-performance accelero-meter MEMS LIS2DE12
- DC/DC converter with loading circuit
- Based on Nordic Semiconductor nRF52
- UWB section based on Qorvo QM33110
- BLE section based on Nordic Semi nRF52833
- Configurable 23 GPIOs including 5 ADCs
- 8 QM33110 GPIOs for UWB functions
- Digital interfaces USB, QSPI, SPI, UART, I²S, PDM, PWM
- Power supply 2.4 to 3.6V
- Very small size 12 x 12 x 1.5 mm
- Temperature -40 to +85 °C

Applications

- Find Me applications with accurate distance
- Precision Real Time Location Systems (RTLS) for Healthcare, Sport and Wellness
- Consumer, Industrial…
- Security bubble
- Access control
- Indoor positioning



UWB-Modules

muRata
INNOVATOR IN ELECTRONICS

Ultra Wide Band (UWB) technology is good for secure and precise distance measurement which is based on Time of Flight (ToF) of radio waves.

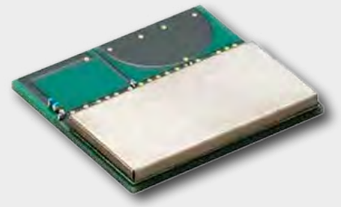
The Type 2AB from Murata is designed as Ultra-small, high quality and lower power consumption UWB module. Ideally suited for small, battery operated IoT devices and applications. It supports UWB Ch 5 & 9 and supports Bluetooth 5.2 with the integrated BLE Wireless MCU.

The Murata Type 2DK is also all-in-one UWB + Bluetooth® LE combo module which integrates NXP Trimension™ SR040 UWB Chipset, NXP QN9090 Bluetooth® LE Wireless MCU, integrated antennas and peripheral components. Ideally suited for UWB Tag/Tracker which operates by coin-cell battery, and general IoT devices. It supports also UWB Ch 5 & 9 and Bluetooth 5.0 similar to the Type 2AB.

The Murata Type 2BP is the ultra-small UWB module which includes NXP's SR150 UWB chipset, clock, filters and peripheral components. It supports UWB Ch 5 & 9 without the Bluetooth feature and is very compact with a size of 6.6 × 5.8 × 1.2(max)mm.

Name	Used Ics	UWB Channel	Size (mm)	Package	UWB Frequenzy (MHz)
LBUA5QJ2AB-828	Qorvo QM33120W Nordic nRF52840	5 & 9	10.5 x 8.3 x 1.44	LGA	6250 - 8250
LBUA2ZZ2DK-882	NXP Trimensi-on SR040 NXP QN9090	5 & 9	19.6 x 18.2 x 2.3	LGA	6250 - 8250
LBUA0VG2BP-741	NXP Trimensi-on SR150	5 & 9	6.6 x 5.8 x 1.2	LGA	6250 - 8250

LBUA5QJ2AB-828



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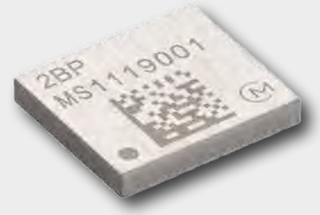


LBUA0VG2BP-741

What is the difference between Wireless LAN and WiFi?

WLAN is a type of Local Area Network (LAN) that uses high frequency radio waves rather than wires to communicate and transmit data. As wired networks connect devices to the internet by using cables, WLAN is a flexible data communication system implemented as an extension or an alternative to wired LANs. WLAN usually provides a connection through an access point to the wider internet. This gives users the ability to move around within a local coverage area and still be connected to the network.

The term “WiFi” refers on one hand to a company consortium of 300 companies, which certifies devices with wireless interface. On the other hand, WiFi is also the associated brand name, as products which are certified according to the guidelines of the WiFi-alliance are labeled with its logo.

Which WLAN Network Standards exist?

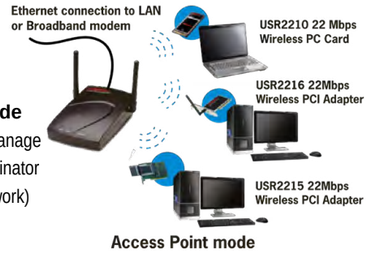
802.11 refers to a family of specifications developed by the IEEE (Institute of Electrical and Electronics Engineers) for WLAN technology. 802.11 specifies an over-the-air interface between a wireless client and a base station or between two wireless clients.

There are several specifications in the 802.11 family

Standard	Released	Modulation	Frequency	Bandwidth	Highest Data-rate
802.11 (Legacy)	1997	DSSS, FHSS	2.4 GHz	20 MHz	2 Mbps
802.11 b	1999	DSSS	2.4 GHz	20 MHz	11 Mbps
802.11 a	1999	OFDM	5 GHz	20 MHz	54 Mbps
802.11 g	2003	DSSS, OFDM	2.4 GHz	20 MHz	54 Mbps
802.11 h	2006	OFDM	5 GHz	20 MHz	54 Mbps
802.11 n (WiFi 4)	2009	OFDM	2.4 / 5 GHz	20 MHz / 40 MHz	72 - 600 Mbps
802.11 p	2010	OFDM	5 GHz	10 MHz	27 Mbps
802.11 ad	2012	64-QAM SC-OFDM	60 GHz	2 GHz	6930 Mbps
802.11 ac (WiFi 5)	2013	256-QAM OFDM	5 GHz	80 MHz / 160 MHz	433 - 6933 Mbps
802.11 ah (WiFi Halow)	2016	OFDM	915 MHz	2 MHz	150 Kbps
802.11 ax (WiFi 6)	2019	1024-QAM OFDMA	2.4 / 5 GHz	80MHz / 160 MHz	600 - 9600 Mbps
802.11 ax (WiFi 6E)	2020	1024-QAM sOFDMA	2.4 / 5 / 6 GHz	80MHz / 160 MHz	600 - 9600 Mbps
802.11 be (WiFi 7)	2024	4096-QAM OFDMA	2.4 / 5 / 6 GHz	320 MHz	1440 - 23050 Mbps

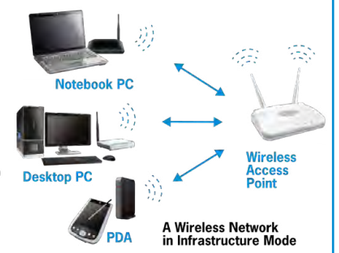
The 802.11 standard defines different operating modes:

- **Access Point Mode**
  The module should manage a network itself (coordinator and router in one network)

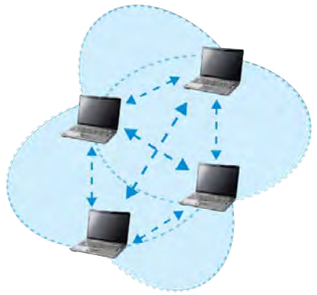


Access Point mode

- **Infrastructure Mode**
  The module has to connect to an existing access point to join a network



A Wireless Network in Infrastructure Mode



- **Ad hoc Mode**
  Module can be connected to one or more other devices without having a coordinator (an access point is not involved here). The ad hoc network is a decentralized type of network as it does not rely on a pre-existing infrastructure such as routers or access points. Here each wireless node forwards data to other nodes until the receiver is reached

- **WiFi-Direct**
  This standard enables devices to connect quickly with each other without requiring a wireless access point or a router (e.g. camera and printer)

Which Wireless Safety Standards are applicable?

Wi-Fi Protected Access (WPA) and Wi-Fi Protected Access II (WPA2) are two security protocols and security certification programs developed by the Wi-Fi Alliance to secure wireless computer networks. WPA (sometimes referred to as the draft IEEE 802.11i standard) became available in 2003. The Wi-Fi Alliance intended it as an intermediate measure in anticipation of the more secure and complex WPA2.

WPA superseded the previous security specification Wired Equivalent Privacy (WEP), which had shown to have security vulnerabilities. WPA implemented a subset of a draft of 802.11i. WPA2 has replaced it in 2004 and is therefore called IEEE 802.11i-2004 or 802.11i. WPA2, which requires testing and certification by the Wi-Fi Alliance, implements the mandatory elements of IEEE 802.11i. In particular, it introduces CCMP, a new AES-based encryption mode with strong security. Certification began in September, 2004; from March 13, 2006, WPA2 certification is mandatory for all new devices to bear the Wi-Fi trademark.

What are Wireless Operation Modes?

There are several kinds of hardware that may be used to implement a WiFi wireless network:

- Wireless adapters or network interface controllers (NICs) are network cards with the 802.11 standard which let a machine connect to a wireless network.
- Access points (AP, sometimes called hotspots) can let nearby WiFi-equipped stations access a wired network to which the access wwpoint is directly connected.

(Please see graphics on the top)

Content

Dual Band Wi-Fi IC: Nordic's first Wi-Fi Product

nRF7002 an Ultra-Low Power, Dual-Band Wi-Fi 6 Companion IC

The nRF70 Series comprises three Wi-Fi companion ICs. The nRF7001 offers low-power 2.4 GHz connectivity, while the nRF7002 operates in both the 2.4 and 5 GHz bands. The nRF7000 is designed purely for active and passive scanning of Wi-Fi networks. These ICs ensure excellent coexistence with Bluetooth LE devices, advanced power saving with TWT and OFDMA for efficient uplink and downlink communication.

The nRF70 Series devices are designed for Internet of Things (IoT) applications and are ideal for adding modern Wi-Fi 6 capabilities to existing Bluetooth® Low Energy, Thread, or Zigbee systems, as well as adding Wi-Fi Access Point scanning capabilities to LTE/GPS systems.

Application Fields

- White goods
- Home automation
- Fitness equipment
- Lighting control
- Printer
- Smart meters
- Media player
- POS terminal
- Patient monitors
- Asset Tracking

nRF7002 Wi-Fi Companion IC

Low-power, advanced security, seamless coexistence

- 2.4 GHz and 5 GHz Dual-band
- Low-power and Secure Wi-Fi for the IoT
- Ideal coexistence with Bluetooth LE
- Supported in nRF Connect SDK
- Wi-Fi 6 Station (STA)
- Complies with 802.11a/b/g/n/ac/ax
- 1 Spatial Stream (SS)
- 20 MHz channel bandwidth
- 64 QAM (MCS7), 86 Mbps PHY throughput
- OFDMA (Downlink and Uplink)
- BSS Coloring
- TWT
- SPI / QSPI
- Co-existence interfaces

nRF7001 Wi-Fi Companion IC

Low-power, advanced security, seamless coexistence

- 2.4 GHz single-band
- Low-power and Secure Wi-Fi for the IoT
- Ideal coexistence with Bluetooth LE
- Supported in nRF Connect SDK
- Wi-Fi 6 Station (STA)
- Complies with 802.11b/g/n/ax
- 1 Spatial Stream (SS)
- 20 MHz channel bandwidth
- 64 QAM (MCS7), 86 Mbps PHY throughput
- OFDMA (Downlink and Uplink)
- BSS Coloring
- TWT
- SPI / QSPI
- Co-existence interfaces

nRF7000 Wi-Fi Companion IC

SSID-based Wi-Fi locationing

- Ideal for SSID-based Wi-Fi locationing
- 2.4 GHz and 5 GHz Dual-band
- Coexistence with Bluetooth LE
- Supported in nRF Connect SDK
- BSS Coloring
- SPI / QSPI
- Co-existence interfaces

WiFi 6E Modules

SX-PCEAX – Industry´s First Tri-band Wi-Fi 6E 2x2 PCIe Module

The SX-PCEAX, based on Qualcomm's QCA2066, is one of the first Wi-Fi 6E modules. To increase the overall capacity and performance, the SX-PCEAX has been equipped with the 6 GHz band (Wi-Fi 6E) in addition to the 2.4 and 5 GHz bands plus Bluetooth 5.2 BR/EDR/HS/LE.
WiFi6e works with the same standard as WiFi6 but with an extended spectrum of additional up to 1.2GHz. Access to the 6GHz frequency brings more bandwidth, faster speeds and lower latency, as well as is ideal for future-proof devices.
Silex's Wi-Fi 6e module family is certified for Europe, North America, Japan and Canada and is available in several sizes and form factors to meet a wide range of requirements. The SX-PCEAX is used in medical applications, especially in the field of imaging diagnostics, storage/logistics applications such as self-propelled trucks or intelligent production lines, as well as in industrial environments.

SX-PCEAX-AP/6E Access Point Module

Silex's SX-PCEAX-AP Series modules are embedded wireless LAN modules utilizing Qualcomm's QCN9072 chipset, designed specifically for access points, gateways, and routers in medical and industrial settings. The SX-PCEAX-AP Wi-Fi 6 module ensures stable communication in both 2.4GHz and 5GHz frequency bands, even in congested wireless environments. On the other hand, the SX-PCEAX-AP6E Wi-Fi 6E module offers connectivity in the less crowded 6GHz spectrum. By combining both Wi-Fi 6 and 6E modules, a seamless Wi-Fi access point compatible with 2.4GHz, 5GHz, and 6GHz frequencies can be achieved.

SX-SDMAX - Dual-band Wi-Fi 6 plus Bluetooth® Combo SDIO Module Powered by NXP

The SX-SDMAX is a dual-band Wi-Fi 6 (2.4 GHz/5 GHz) module with Bluetooth v5.3 BR/EDR/LE capabilities, utilizing the NXP IW611 chipset. It supports the latest 802.11ax standard, ensuring reliable and secure wireless connectivity. Designed for plug-and-play integration, it offers enhanced performance with low latency, high throughput, and low power consumption, making it ideal for use with NXP i.MX series and other platforms. It excels in dense environments, facilitating improved communication capabilities.

Model	Frequency	Bluetooth	Temperature	Size (mm)	Package
SX-PCEAX	2,4 / 5 / 6 GHz	LE v. 5.2	-20 to 65°C	14.0 x 18.0 x 1,9 29.85 x 26.65 x 2,9 22.0 x 30.0 x 2.7	M.2 LGA Type 1418 Half-size mini PCIe Card M.2 1630 Card
SX-PCEAX-AP	2,4 / 5 GHz	-	-40 to 85°C	29.85 x 50.80 x 4,55	Mini PCIe Express Card
SX-PCEAX-AP6E	6GHz	-	-40 to 85°C	29.85 x 50.80 x 4,55	Mini PCIe Express Card
SX-SDMAX	2,4 / 5 GHz	LE v. 5.3	-40 to 85°C	17.0 x 18.0 x 2.65 60.0 x 26.0 x 2,65	Surface Mount Micro SD Card

Single and Dual Band Wi-Fi Modules

WE310F5 and WE310K6

The WE310 Wi-Fi family includes fully integrated, single as well as dual band Wi-Fi and Bluetooth® Low Energy 5 IoT modules with low-cost, high-speed and serial-to-wireless connection to MCU, providing faster development times and market availability. They are compliant with industry standards and global regulatory and industry certification requirements. The fully integrated WE310K6 dual band combo of Wi-Fi6 with BT and BLE5.2 provides an easy, cost-effective way for manufacturers to add wireless connectivity to their products.

Key Features

WE310F5 – Single band Wi-Fi Modules

- Fully integrated, single-band Wi-Fi and Bluetooth® Low Energy 5.0 combination IoT module
- Low power consumption
- Advanced Security features (including WPA3)
- Variants with (WE310F5-I) and without (WE310F-P) antennas

WE310K6 – Dual band Wi-Fi Modules

- Dual band 2.4 GHz and 5 GHz
- Fully integrated dual band Wi-Fi, BT and Bluetooth® Low Energy 5.2 combo IoT module
- Advanced security features (including WPA3) with integrated crypto hardware

Applications

- Industrial automation
- Sensor gateways
- Condition-based monitoring
- Security panel
- Energy management
- Inspection camera
- Data logger
- Building automation
- Smart Home
- Thermostat
- Air purifier
- Air conditioner
- Security/monitoring camera
- Pet food dispenser

Single, Dual and Tri Band Wi-Fi Modules

Type 1YN

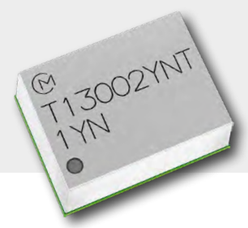
The Murata Type 1YN single band WiFi IEEE 802.11 b/g/n and Bluetooth BR/EDR/ LE 5.2 combo module comes with a very small form factor of only 6.95 x 5.15 x 1.1 mm. It is based on Infineons CYW43439 chipset.

Key Benefits

- 2.4 GHz WiFi + Bluetooth module
- Based on Infineon CYW43439
- IEEE 802.11 b/g/n
- Bluetooth BR/EDR/LE 5.2
- FCC/IC certified, EN compliant by Reference Antenna design
- Package: LGA (46 pads)
- Support for CubeMX, i.MX

Key Features

- Host interaces: SDIO / UART, PCM
- External Antenna
- 6.95 x 5.15 x 1.1 mm
- Operating Temperature: -30°C to +70°C
- WiFi Transmit Power: +19 dBm max
- Bluetooth Transmit Power: +14dBm max (Class 1)



Type 2AE

The Type 2AE is based on Infineon's CYW4373E and supports WiFi 802.11 a/b/g/n/ac and Bluetooth 5.2 BR/EDR/LE. Data rates on WiFi are up to 433 Mbps and 3Mbps PHY data rate on Bluetooth. The small form factor of only 8.0 x 7.8 x 1.15 mm makes the module a perfect solution for size-sensitive applications, but also for IoT, smart home and gateways.

Key Benefits

- 2.4 + 5 GHz WiFi + Bluetooth moudle
- Based on Infineon CYW4373E
- IEEE 802.11 a/b/g/n/ac
- Bluetooth BR/EDR/LE 5.2
- FCC/IC certified
- Support for Linux, Modus, i.MX Yocto

Key Features

- Host interfaces: SDIO / UART, USB
- External Antenna
- Operating Temperature: -40°C to +85°C
- WiFi Transmit Power: +19.5 dBm
- Bluetooth Transmit Power: +14 dBm

Type 2EA

The Murata Type 2EA is a Wi-Fi 6E plus Bluetooth BR/EDR/LE 5.3 module based on the new Infineon CYW55573 Chip with tri-band capability (2.4GHz, 5GHz and 6GHz) and 2×2 MIMO. It has a small form-factor of only 12.5 x 9.4 x 1.2 mm and connectors for external antennas. It can be used in applications in the Smart Home area like e.g. camera systems, as well as in AV/VR applications.

Key Features

- IEEE 802.11 a/b/g/n/ac/ax + BR/EDR/LE 5.3
- 2.4 GHz + 5 GHz + 6 GHz
- Based on Infineon CYW55573
- 2×2 MIMO
- Host interface: PCIe, SIDO for Wi-Fi / UART, PCM for Bluetooth
- Support for i.MX+Linux
- Dimension: 12.5 x 9.4 x 1.2 mm
- External antennas (Optional dedicated Bluetooth Antenna)

Target Applications

- Smart Home (e.g. camera systems)
- AV/VR applications

Dual Band Wi-Fi Modules

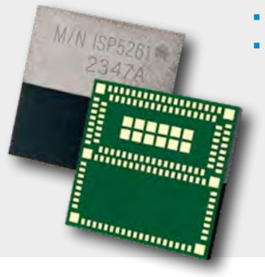
ISP5261-WX • Wi-Fi 6 and Bluetooth Low Energy Module

This module act as a fully functioning Bluetooth LE and Wi-Fi radio node, with only a battery required. It forms the core of an autonomous IOT device requiring Bluetooth LE and Wi-Fi connectivity.

INSIGHTSIP

Key Features

- Based on NXP RW612
- Wi-Fi 6 IEEE 802.11ax/ac/n/a/g/b/e/i/k/v/w
- Wi-Fi dual-band 2.4GHz / 5GHz support, 20 MHz channel bandwith
- Bluetooth Low Energy 5.3 Long Range, and Wi-Fi Coexistence
- 802.15.4
- Matter, Thread
- Fully integrated RF Matching and Antennas
- Wi-Fi & Bluetooth at 2.4 GHz, Wi-Fi at 5 GHz
- Integrated 40 MHz & 32.768 kHz Crystals
- DC/DC converters with loading circuit
- 4MB of QSPI flash memory, 1.2MB SRAM
- Configurable 64 GPIOs including ADC & DAC
- Digital interfaces USB, QSPI, UART, I²S, PDM, PWM
- Power supply 3.3V
- Temperature -40 to +85 °C



Key Applications

- Smart home devices
- Enterprise and industrial automation
- Smart accessories
- Smart energy

Combo WiFi 4 & WiFi 6 Modules

The WiFi modules support Wi-Fi 4/6 and Bluetooth 5, making it highly versatile in applications such as smart homes, consumer electronics, wearable devices and more.

MINEW

Model No.	Picture	Antenna	SoCset	Dimension (mm)	Wi-Fi Version	Bluetooth Version	SPI Flash	RAM	GPIO
MS11SF1		PCB	ESP32-C3FN4	16.6*13.2*2.2	Wi-Fi 4 (802.11 b/g/h)	BLE 5.0	4MB	400KB	22
MS12SF1		PCB+IPEX	nRF7002+nRF5340	27*23.5*2.8	Wi-Fi 6 (802.11 ax)	BLE 5.3	1MB+256KB	512KB+64KB	29
MS13SF1		PCB	ESP32-D0WD-V3	25.5*18*2.2	Wi-Fi 4 (802.11 b/g/n)	BLE 4.2	8M+448KB	520KB+16KB	21
MS15SF1		PCB	ESP32-C6FH4	16.6*13.2*2.2	Wi-Fi 6 (802.11 ax)	BLE 5.3	4MB+320KB	512KB+16KB	22

WiFi 5 & Wi-Fi 6 Dual Band Modules

Panasonic

WiFi 5 & Bluetooth 5.2 (BR, EDR, LE)

PAN9028

Key Features

- 2.4 + 5 GHz Wi-Fi 5 + Bluetooth Classic & LE
- Based on NXP 88W8987
- Interface: SDIO (Wi-Fi) & UART (BT)
- OS Support: Linux, Android, FreeRTOS for i.MX RT
- Size: 24 x 12 x 2.8 [mm]
- Operating Temp: -30 to +85 °C

Key Benefits

- Included PMIC for simple HW design & reduction of BOM costs
- Possibility to switch between Chip Antenna & Bottom Pad
- Power Tables stored on OTP to fulfill regional regulatory requirements

Antenna Variants

- Integrated chip antenna
- Terminal antenna via bottom pad

Further antenna variants on request

Regulatory certification

WiFi 6 Bluetooth 5.2 (BR, EDR, LE) (& 802.15.4)

PAN9019 (A)

Key Features

- 2.4 + 5 GHz Wi-Fi 6 + Bluetooth Classic & LE + 802.15.4 (PAN9019A)
- Based on NXP IW611 / IW612
- Interface: SDIO (Wi-Fi) & UART (BT)
- OS Support: Linux, Android, FreeRTOS/Zephyr for i.MX RT
- Size: 15.3 x 12 x 2.5 [mm]
- Operating Temp: -40 to +85 °C

Key Benefits

- Size optimized
- Multiple antenna options
- Flexible handling of Power Tables via binary files for regional regulatory requirements

Antenna Variants

- External chip antenna
- External PCB antenna
- External terminal antenna

Further antenna variants on request

Regulatory certification

Infrastructure

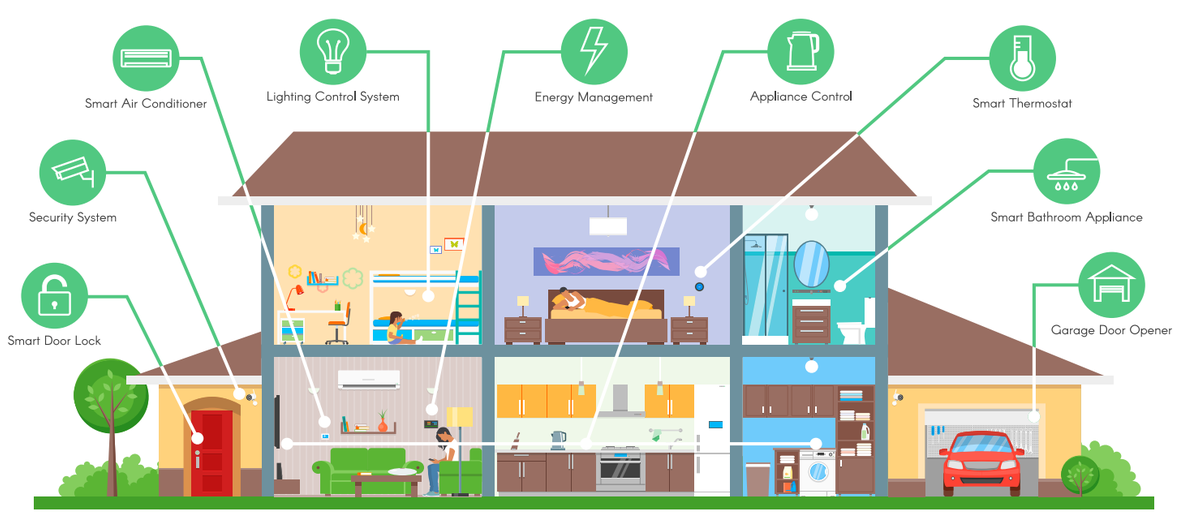
- EV Charging
- Professional Equipment

Medical

- Equipment
- Diagnostic
- Patient Monitoring

Smart Home / Building

- Home Appliance
- HVAC
- Gateways



Dual Band Wi-Fi Modules

Telit Cinterion

WE866 Wi-Fi Family

Integrating Wi-Fi™ to your IoT solution is simplified with the use of Telit Cinterion's pre-certified Wi-Fi modules. This new & upcoming WE866 variants offer a rich feature set while packed in a small footprint. See what low energy Wi-Fi and Wi-Fi + Bluetooth combo solutions can do by integrating Telit Cinterion's line of fully certified modules.

Key Features

- Dual band (2.4GHz/5GHz) Wi-Fi modules for high bandwidth IoT applications
- International regulatory certifications
- Industrial grade temperature range
- Proprietary technology delivers power consumption savings of up to 97% when compared to the IEEE standard and competitors

Applications

- Connected home
- Wearables
- Healthcare
- Automobiles
- Audio/video
- Smart Home / Smart Energy
- Industrial controls, monitoring

Specifications	WE866C6-P	WE310G4-I/-P
Frequency	2.4 & 5 GHz	2.4 GHz/5 GHz
IEEE 802.11	802.11 a/b/g/n/ac	802.11 a/b/g/n
Bluetooth	BT/BLE5	BLE 5.0
IEEE 802.15.4	-	-
ANT	-	-
TCP/IP	Yes	Yes
Drivers	Linux	-
MCU	Cortex M4-F	Cortex-M23
Internal Flash	4MB	4MB
Operating Temp.	-40°C to +85°C	-40°C to +85°C
Operating Voltage	3.3 V	3.3 V
Peripherals	SDIO 3.0, UART, PCM	SDIO, SPI, UART, ADC, PWM, GPIO, I2S, I2C, USB
Antenna options	External (RF Pad)	Internal and external antenna
Certifications	FCC, IC, CE, TELEC, ANATEL, WPC-ETA, KC, SRRC, RCM	FCC, IC, RED
Dimensions	13 x 15 x 2.2 mm	Integrated antenna (WE310G4-I): 18 x 15 mm (LGA package) – WE310F5-I P2P compatible External antenna (WE310G4-P): 14.3 x 13.1 mm (LGA package) – WE310F5-P P2P compatible

WE866C6-P – Application Fields

Transportation / Mobility

- Aftermarket/OEM telematics
- Fleet management
- Asset tracking
- Intelligent transportation
- Car phone
- OBD (onboard diagnostics)

Industrial / Infrastructure

- Condition-based monitoring
- Agriculture
- Video surveillance
- Healthcare equipment monitoring

Commercial / Enterprise

- Commercial building automation
- Patient monitoring
- Home security and automation
- Kiosks, vending, POS

Dual and Tri Band Wi-Fi Modules & Cards

intel

Intel WiFi 5, WiFi 6, WiFi 6E and WiFi 7 M.2 Cards

Since more than 20 years WiFi is connecting the world and the technology is developing fast. Intel is participating in this development and offers various solutions, to fullfill users different requirements. From WiFi 5 (IEEE 802.11 ac), over WiFi 6/6E (IEEE 802.11 ax) to the newest evolution WiFi 7 (IEEE 802.11 be), Intels offers M.2 cards in different versions.

Type	WiFi 5 9560*	WiFi 5 9462*	WiFi 5 9461*
Code Name	Jefferson Peak 2	Jefferson Peak 1	Jefferson Peak 1
Estimated SW support until	Q4 2026		
TX/RX Streams	2x2	1x1	
Bands	2.4 GHz, 5 GHz		
Max Speed	1.73 Gbps	433 Mbps	433 Mbps
Integrated Bluetooth	V5.1		
From Factor	M.2 2230 M.2 1216 (SMD)		
Supported Operating Systems	Microsoft Windows 10, Linux, Chrome		
System Interface Type	CNVio, GPIO		
Use Conditions	PC Client		
vPRO support possible	Yes	No	No

Type	WiFi 6E AX210	WiFi 6E AX211*	WiFi 6E AX411*	WiFi 7 BE200**	WiFi 7 BE201*	WiFi 7 BE202
Code Name	Typhoon Peak 2	Garfield Peak 2	Garfield Peak 4	Gale Peak 2	Fillmore Peak 2	Misty Peak 2
Estimated SW support until	Q4 2028	Q4 2028	Q4 2028	Q3 2030	N/A	Q3 2030
TX/RX Streams	2x2					
Bands	2.4 GHz, 5 GHz, 6 GHz					
Max Speed	2.4 Gbps	2.4 Gbps	3 Gbps	5.8 Gbps	5 Gbps	2.4 Gbps
Integrated Bluetooth	V5.2			V5.4		
From Factor	M.2 2230 M.2 1216 (SMD)					
Supported Operating Systems	Windows 10, 64-bit, Google Chrome OS, Linux	Windows 10, Linux	Windows 10, Linux	Windows 11, Windows 10, Linux	Windows, Linux, ChromeOS	Windows 11, Windows 10, Linux
System Interface Type	PCIe (WiFi), USB (BT)	CnVio2	CNVio2	PCIe (WiFi), USB (BT)	CNVio3	PCIe (WiFi), USB (BT)
Use Conditions	PC Client, Industrial, Embedded	PC Client	PC Client	PC Client, Industrial, Embedded	PC Client	PC Client
vPRO support possible	Yes	Yes	Yes	Yes	Yes	No

*CRF (Companion RF) modules
**Still in development phase of embedded and industrial versions

WLAN Modules – Selection Guide

Manufacturer	Name	Frequency			WLAN Protocol										Other Protocols		WLAN Software on Module				WLAN Security								Antenna		Chipset	Certifications	Interfaces					Ope-rating Temp. ()	Size (mm)	Package	Evaluation Kit / Development Kit	Drivers	Comments
		2.4GHz	2.4GHz / 5GHz	6 GHz	802.11a	802.11b	802.11g	802.11n	802.11ac	802.11ad	802.11ah	802.11ax	802.11be	Bluetooth	Other	TCP/IP	Access Point	WiFi-Direct	Web Server	WPA2	WPA2-Enterprise	WPA3	WPS	WPS2	WAPI	SSL/TLS	Intergrated Antenna	Antenna Connector				SDIO	SPI	UART	USB	Other						
Silex	SX-PCEAC		x		x			3T/3R	3T/3R																			uFL	Atheros AR9280	FCC/IC/ETSI/TELEC					PCIe	0 to 60	30x27x4.5	Mini PCIe			Speed up to 1.3Gbps
	SX-PCEAX		x	x	x	x	x	x	x			2T/2R		5.2			x	x				x						2x uFL	Qualcomm QCA2066	FCC, CE, IC, TELEC				x	WiFi: PCIe BT: USB	-20 to +65	14.0x18.0x1.9 29.85x26.65x2.9 22.0x30.0x2.7	M.2 LGA Type 1418 half-size mini PCIe Card M.2 2230 Card			
	SX-PCEAC2		x		x	x	x	x	2T/2R					5.0				x										2x uFL	Qualcomm QCA6174A-5	FCC, IC, CE, TELEC				x	WiFi: PCIe BT: USB	-20 to +70	12.0x16.0x1.44 30.0x26.8x2.54 16.5x30.0x2.34	SMT M.2 LGA Type 1216 Half-size mini PCIe Card M.2 1630 Card	SX-PCEAC2-EVK	Linux, ath10k, Windows	
	SX-PCEAC-DB R2		x		x	x	x	3T/3R	3T/3R															x				uFL	Qualcomm Atheros QCA9880	FCC, IC, ETSI, TELEC, MIC					PCIe	0 to 60	29.9x50.8x4.0	Mini PCIe			Speed up to 1.3Gbps
	SX-PCEAN2c SX-PCEAN2i		x		x	x	x	2T/2R												x		x						uFL	Atheros AR9582 Atheros AR9592	FCC / TELEC					PCIe	0 to +60 -40 to +85	29.85x26.80x3.45	Half-size Mini PCIe		Linux	
	SX-SDMAC(+)/ SX-SDPAC		x		x	x	x	x	1T/1R					5.0			x	x		x		x		x			x	uFL or onboard	QCA9377-3	FCC, IC, CE, TELEC	x		x			-20 to 85/ -40 to 85	24x24x3.4	Surface Mount	SX-6K3-EVK-SB AR6003 WLAN Radio Evaluation Kit (Includes SX-SDMGN-2830C	Linux, Windows 10, Windows 10 IoT, Windows Embed-ded Compact 7 and 2013, FreeRTOS	Link Rate upto 433 Mbps
	SX-USBAC		x		x	x	x	x	1T/1R					5.0			x	x		x		x		x				uFL or onboard	QCA9377-7	FCC, IC, CE, TELEC				x		-40 to +85	22 x 21 x 2.95 (SMT)	Surface Mount		Linux, ath10k, Windows	
	SX-ULPGN-BTZ		x		x	x	x	1T/1R						5.0	x	x											x		QCA4020	FCC, IC, CE, TELEC						-20 to 80	33.5x28.6x3.2	Surface Mount	SX-ULPGN-BTZ -EVK		
	SX-SDMGN-2830C	x				x	x	1T/1R												x					x			uFL	Atheros AR6103	FCC, CE	72 Mbps					-20 to 85	24x24x3.4	Surface Mount	SX-6K3-EVK-SB AR6003 WLAN Radio Evaluation Kit (Includes SX-SDMGN-2830C	Reference Driver: Linux, Android, WinCE	Speed up to 72.2Mbps
	SX-ULPGN	x				x	x	1T/1R								x	x	x		x									QCA4010	FCC, IC, CE						0 to +70	30x16x2.6	Surface Mount			
	SX-59HLS		x		x	x	x	1T/1R								x			x	x									QCA4012-2	FCC, IC, CE, TELEC				x		0 to +70	43x20x2.5	Surface Mount	SX-59HLS-EVK		
	SX-590		x		x	x	x	x	1T/1R							x				x			x				PCB	uFL	NXP i.Mx6ULL ARM Cortex-A7, 528MHz	FCC, IC, CE, TELEC		10				-40 to 85	55x30x 9.25	Surface Mount		Linux	
	SX-SDMAH									x																	MHF1		MM6108		X	X				-40 to 85	17 × 18 × 2.65	60-pin LGA	SX-SDMAH-EVK (US) SX-SDMAH-EVB (US)		
	SX-SDMAX	x	x		x	x	x	x	x			1T/1R		5.3			x	x		x	x	x	x	x	x	x		uFL	IW611	FCC, IC, CE, TELEC	X				SDIO	-40 to +85	17 × 18 × 2.65	44-pins Land Grid Array (Direct Solder)			
	SX-PCEAX-AP/6E	x	x	x	x	x	x	x	x			2T/2R					x	x		x	x	x	x	x	x	x		uFL	QCN9072	FCC, IC, CE, TELEC					PCIe	-40 to +85	29.85 x 50.80 x 4.55	Mini PCI Express Card			
	SX-PCEBE	x	x	x	x	x	x	x	x			2T/2R		5.3			x	x		x	x	x	x	x	x	x		uFL	QCN9272	FCC, IC, CE, TELEC					PCIe	-40 to +85	SX-PCEBE-SMT: 16.0 x 20.0 SX-PCEBE-M2: 22.0 x 30.0	Surface Mount M.2		OS Support - Linux Basic Functionality - Station - Access Point - WPA3 - IEEE802.1X (TLS, TTLS, PEAP) - WPS2.0 * - Wi-Fi Direct *	
	IM-100	x	x		x	x	x	x	x			1T/1R		5.3		x	x	x	x	x	x	x	x	x	x			uFL or trace	RW610	FCC, IC, CE, TELEC	x	x	x		RNDIS, Ethernet	-40 to +85	17.0 x 18.0 x 2.65				

Content

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Manufacturer	Name	Frequency			WLAN Protocol										Other Protocols		WLAN Software on Module				WLAN Security							Antenna		Chipset	Certifications	Interfaces					Ope-rating Temp. ()	Size (mm)	Package	Evaluation Kit / Development Kit	Drivers	Comments
		2.4GHz	2.4GHz / 5GHz	6 GHz	802.11a	802.11b	802.11g	802.11n	802.11ac	802.11ad	802.11ah	802.11ax	802.11be	Bluetooth	Other	TCP/IP	Access Point	WiFi-Direct	Web Server	WPA2	WPA2-Enterprise	WPA3	WPS	WPS2	WAPI	SSL/TLS	Intergrated Antenna	Antenna Connector			SDIO	SPI	UART	USB	Other						
Intel	Wireless-AC 9560		x		x	x	x	2T/2R	2T/2R					5.0			x	x		x			x			x		uFL	Jefferson Peak 2	FCC/IC/CE				x	CNVi	0 to +80	22x30x2.4 12x16x1.57	M.2 2230 M.2 1216 card		Microsoft Windows 10, Linux (limited feature support), Chrome	CRF (Companion RF) module; 1.73 Gbps
	Wireless-AC 9461		x		x	x	x	1T/1R	1T/1R					5.0			x	x		x			x			x		uFL	Jefferson Peak 1	FCC/IC/CE				x	CNVi	0 to +80	22x30x2.4 12x16x1.57	M.2 2230 card M.2 1216 card			433 Mbps
	Wireless-AC 9462		x		x	x	x	1T/1R	1T/1R					5.0			x	x		x			x			x		uFL	Jefferson Peak 1	FCC/IC/CE				x	CNVi	0 to +80	22x30x2.4 12x16x1.57	M.2 2230 card M.2 1216 card			CRF (Companion RF) module; 433 Mbps
	Wireless AX210		x	x	x	x	x	x	x			2T/2R		5.2						x	x	x				x		uFL	Typhoon Peak 2						WiFi: PCIe BT: USB	0 to +80 -40 to +85	22x30x2.4 12x16x1.65	M.2 2230 M.2 1216	Embedded Kit: AX210.NGWGE.NVK Industrial Kit: AX210.NGWGI.NVK	Windows 11, 64-bit*, Windows 10, 64-bit*, Linux*	
	Wireless AX211		x	x	x	x	x	x	x			2T/2R		5.2				x		x	x	x				x		uFL							CNVio2	0 to 80	22x30x2.4 12x16x1.65	M.2 2230 M.2 1216		Windows 11, 64-bit*, Windows 10, 64-bit*, Linux*, Chrome OS*	CRF (Companion RF) module
	Wireless AX411		x	x	x	x	x	x	x			2T/2R		5.2						x	x	x						uFL	Garfield Peak 4						CNVio2	0 to 80	22x30x2.4 16x25x1.65	M.2 2230 M.2 1625		Windows 11, 64-bit*, Windows 10, 64-bit*, Linux*	CRF (Companion RF) module
	Wireless BE200		x	x	x	x	x	x	x			2T/2R	x	5.4				x		x		x						uFL	Gale Peak 2						WiFi: PCIe BT: USB	0 to 80	22x30x2.4 12x16x1.65	M.2 2230 M.2 1216		Windows 11, Windows 10, Linux	
	Wireless BE201		x	x	x	x	x	x	x			2T/2R	x	5.4				x		x		x						uFL	Fillmore Peak 2						CNVio3	0 to 80	22x30x2.4 12x16x1.65	M.2 2230 M.2 1216		Windows, Linux, ChromeOS	CRF (Companion RF) module
	Wireless BE202		x	x	x	x	x	x	x			2T/2R	x	5.4				x		x		x						uFL	Misty Peak 2						WiFi: PCIe BT: USB	0 to 80	22x30x2.4 12x16x1.65	M.2 2230 M.2 1216		Windows 11, Windows 10, Linux	
Panasonic	PAN9520	x				x	x	x									x	x		x	x	x					x		Espressif ESP32-S2	EU CE RED / FCC / IC under preparation		x	x		"QSPI, I²C, I²S, GPIO"	-40 to 85	24 x 13 x 3.1	Surface Mount	PAN9520 Eval Board / ENW49D01AZKF	Fully embedded	
	PAN9026		x		x	x	x	1T/1R						4.2	x		8 clients			x					x		x		Marvell® 88W8977	CE/FC/IC	x		x			-30 to 85	17.5 x 10.0 x 2.6	Surface Mount	PAN9026 EVALKIT / ENWF9201AYEF	Linux / Android Driver	
	PAN9028		x		x	x	x	x	x					5.0	x					x					x		x		Marvell® 88W8977		x		x			-30 to 85	17.5 x 10.0 x 2.6	Surface Mount		Linux / Android Driver	Scheduled for autumn 2019
Telit Cinterion	WE310F5 single band with integrated/external antenna	x				x	x	x						5.0			x	x	x	x		x				x	x			RED/FCC/IC/RCM/ Jate-Telec/NCC/ Anatel/SRRC/KCC/ WPC	x	x	x			-40 to 85	Integrated antenna WE310F5-1: 18 x 15 External antenna (WE310F5-P): 14.3 x 13.1	LGA package	WE310F5-I EVK		
	WE310K6 dual band		x		x	x	x	x	x			x		5.2			x			x		x								RED/FCC/IC			x			-40 to 85	18 x 15 x 2.6	LGA package	WE310K6-P EVK	Linux	
	WE866C6-P		x						x					5.0			x	x												FCC/IC/RED/UKCA/ Japan(TELEC)/ Brazil(ANATEL)/ Peru(MPC)/ INDIA(WPC-ETA)	x		x			-40 to 85	15 x 13 x 2.2	LGA package	WE866C6-P EVK	Linux	
	WE310G4-I/P		x		x	x	x	x						5.0			x	x	x	x		x			x	x	x			FCC/IC/RED	x	x	x			-40 to 85	WE310G4-I: 18 x 15 WE310G4-P: 14.3 x 13.1	LGA package	WE310G4-I EVK		
Advantech	EWM-W194M201E		x		x	x	x	2T/2R	x					5.0						x		x		x				2x MHF4	NXP 88W8997		x		x			-30 to 85	22x30x2,85	M.2 2230 card		Linux (Kernel v4.0 and above)	
	EWM-W306S01E		x		x	x	x	2T/2R	x					5.1						x		x		x				2x MHF4	Marvell 88W8997		x		x		PCIe	-30 to 85	12x16x1,85	M.2 1216 LGA		Linux OS	
	AIW-163BR		x		x	x	x	2T/2R	x			x		5.2						x		x		x				2x MHF4	Realtek RTL 8852BE					x	PCIe	0 to 70	30x22x2,2	M.2 2230 A-E Key card		Windows 10	
	AIW-164SN		x		x	x	x	x	x			x		5.3						x		x				x			NXP 88W9098		x		x		PCIe	-40 to 85	20x18x2,8	LGA		Linux	
	AIW-165BN		x		x	x	x	x	x			x		5.3						x		x				x			NXP 88W9098				x		PCIe	-40 to 85	28x30x3,95	M.2 2830 E Key card		Linux	
	AIW-168BM		x	x								x		5.3						x		x		x	x			2x MHF4	MTK 7922					x	PCIe	-10 to 70	22 x 30 x 2.3	M.2 2230 E key		Windows 11	
	AIW-170BQ-001		x	x		x	x	x	x			x		5.3						x		x		x	x			2x MHF4	WCN6856/QCA2066					x	PCIe	-40 to 85	22 x 30 x 2.2	M.2 2230, E-key card		Windows/Linux	
	AIW-171HQ-001			x		x	x	x	x			x		5.3						x		x		x	x			2x MHF4	WCN6856/QCA2066					x	PCIe	-40 to 85	29.85 x 26.65 x 4.2	Mini PCIe		Windows/Linux	
Insight SiP	ISP5261		x			x	x	x	x			x		5.3	Matter, Thread	x	x	x	x	x	x	x				x	x		NXP RW612	CSA, CE, FCC, IC, TELEC, KCC		x	x	x	I²C,PDM, PWM, DM	-40 to +85	12 x 12 x 1.8	LGA	x		
iVativ	MIST	x				x	x	x								x				x			x			x			Qualcomm QCA4010	FCC, IC, CE						Standard: 0 to 85 Storage: -40 to 85	16 x 20 x 2.1	LGA			
	AVIC	x				x	x	x												x			x			x			Qualcomm QCA4010 and CSR8811	FCC, IC, CE							16 x 20 x 2.1	LGA			
	RILA	x				x	x	x								x				x			x			x			Qualcomm QCA4010	FCC, IC, CE							16 x 20 x 2.1	LGA			
	BALI		x						x											x			x						Qualcomm QCA9377	FCC, IC, CE, BT SIG	x			x	PCIe	-40 to 85	11.8 x 12 x 1.6 LGA	M.2 1630 M.2 2230 Half-size Mini PCIe			
	EVIA		x						x											x			x						Qualcomm QCA9377	FCC, IC, CE	x			x	PCIe	-40 to +85	11.8 x 12 x 1.6 12 x 16 x 1.9	Surface Mount M.2 1630, M.2 2230 Half-Size Mini PCIe / Mini PCIe			Supported Ecosystem: WICED, i.MX
Minew	MS11SF1	x				x	x	x						5.0														PCB	ESP32-C3FN4			x	x	x	I²C, I2S, ADC, TWAI	-40 to +85	16.60 x 13.20 x 2.20				
	MS12SF1		x									x		5.3														PCB+ IPEX	nRF7002+nRF5340				x		-40 to +85	27 x 23.5 x 2.4				
	MS13SF1	x				x	x	x						4.2														PCB	ESP32-D0WD		x	x	x		-40 to +85	25.5 x 18 x 2.2				
	MS15SF1	x				x	x	x				x		5.3	Zigbee													PCB	ESP32-C6FH4		x		x	I²C	-40 to +105	16.60 x 13.20 x 2.20				
	MS93MFZ	x				x	x	x																				IPEX3	MTK MT7628NN				x	x	-40 to +85	38.5 x 26				

Content

WLAN Modules – Selection Guide

Manufacturer	Name	Frequency			WLAN Protocol									Other Protocols		WLAN Software on Module				WLAN Security							Antenna		Chipset	Certifications	Interfaces					Operating Temp. ()	Size (mm)	Package	Evaluation Kit / Development Kit	Drivers	Comments
		2.4GHz	2.4GHz / 5GHz	6 GHz	802.11a	802.11b	802.11g	802.11n	802.11ac	802.11ad	802.11ah	802.11ax	802.11be	Bluetooth	Other	TCP/IP	Access Point	WiFi-Direct	Web Server	WPA2	WPA2-Enterprise	WPA3	WPS	WPS2	WAPI	SSL/TLS	Intergrated Antenna	Antenna Connector			SDIO	SPI	UART	USB	Other						
Murata	Type 1LV		x		x	x	x	x						5.0 + BR/ EDR															Infineon CYW43012	FCC/IC, EN compliant by Reference Antenna design	x		x		PCM, I²S	-20 to +70	10.0 x 7.2 x 1.4	LGA (106 pads)	CY8CKIT-062S2-43012 (Infineon)		Supported Ecosystem: CubeMX, i.MX
	Type 1YN	x				x	x	x						5.2 + BR/ EDR															Infineon CYW43439	FCC/IC, EN compliant by Reference Antenna design	x		x		PCM	-30 to +70	6.95 x 5.15 x 1.1	LGA (46 pads)			Supported Ecosystem: CubeMX, i.MX
	Type 2AE		x		x	x	x	x	x					5.2 + BR/ EDR															Infineon CYW4373E	FCC/IC, EN compliant by Reference Antenna design	x		x	x	PCIe, PCM	-40 to +85	8.0 x 7.8 x 1.25	LGA (72 pads)			Supported Ecosystem: WICED
	Type 1GC		x		x	x	x	x																					Infineon CYW43907	FCC/IC, EN compliant by Reference design		x	x	x	GPIO, I²S, MII, RMII, IC	-30 to +85	10.0 x 10.0 x 1.2	LGA (136 pads)	CYW943907AEVAL1F		Supported Ecosystem: WICED
	Type 1LD	x				x	x	x						5.2 + BR/ EDR															Infineon CYW43438 + STM32F412 Cortex M4	FCC/IC/TELEC, EN compliant by Reference Desgin		x	x		I²C, GPIO, JTAG	-40 to +85	8.9 x 7.8 x 1.2	LGA (70 pads)	LBEE5PA1LD-TEMP-A		Supported Ecosystem: i.MX RT, i.MX
	Type 1ZM		x		x	x	x	x	x					5.1 + BR/ EDR															NXP 88W8987	FCC/IC, EN compliant by Reference Antenna design	x		x			-20 to +75	10.2 x 9.3 x 1.55	LGA (94 pads)			Supported Ecosystem: i.MX
	Type 1YM		x		x	x	x	x	x					5.2 + BR/ EDR															NXP 88W8997	FCC/IC, EN compliant wuth Flex PCB Antenna	x		x	x	PCIe	-30 to +85	11.8 x 8.4 x 1.3	LGA (120 pads)			Supported Ecosystem: i.MX RT, i.MX
	Type 1XK		x		x	x	x	x						5.2 + BR/ EDR															NXP IW416	FCC/IC, EN compliant by Reference Antenna design	x		x			-40 to +85	9.1 x 8.3 x 1.3	LGA (81 pads)			Supported Ecosystem: i.MX RT
	Type 2DS	x				x	x	x																			x		NXP 88M8801	FCC/IC, CE compliant	x			x		-40 to +85	25 x 14 x 2.32	LGA (88 terminations)			
	Type 1GC-imp005		x		x	x	x	x																					CYW43907	FCC/IC Reference Certified		x	x		GPIO, I2C, Ethernet (RMII)	-30 to +85	10.0 x 10.0 x 1.2	Shielded Resin			
	Type 1LD-Ayla	x				x	x	x																					CYW43438	FCC/IC Reference Certified		x	x			-40 to +85	8.9 x 7.8 x 1.2	Shielded Resin			
	Type 1PJ		x		x	x	x	x	x					5.0 BR/ EDR/LE															QCA9377-3	FCC/IC Reference Certified	x		x		PCM, I2S	-30 to +85	7.2 x 7.4 x 1.25	Shielded Resin			
	Type 1PS		x		x	x	x	x	x																				CYW54907	FCC/IC Reference Certified		x	x		GPIO, I2C, Ethernet (RMII)	-30 to +50	10.0 x 10.0 x 1.2	Shielded Resin			
	Type 1XA		x		x	x	x	x	x					5.2 BR/ EDR/LE															CYW54591	FCC/IC Reference Certified			x		PCIe, PCM, I2S	-40 to +85	11.4 x 8.9 x 1.4	Shielded Resin			
	Type 1XL		x		x	x	x	x	x				x	5.3 BR/ EDR/LE 2MPHY															88W9098	FCC/IC Reference Certified	x		x		PCIe, PCM	-40 to +60	19.1 x 16.5 x 2.1	Metal Can			
	Type 2BC		x		x	x	x	x	x					5.2 BR/ EDR/LE															CYW4373	FCC/IC Reference Certified	x		x	x	PCM, GPIO	-20 to +70	8.0 x 7.8 x 1.15	Shielded Resin			
	Type 2BZ		x		x	x	x	x	x					5.2 BR/ EDR/LE															CYW54590	FCC/IC Reference Certified	x		x		PCM, I2S	-40 to +85	11.4 x 8.9 x 1.4	Shielded Resin			
	Type 2DL		x		x	x	x	x	x				x	5.3 BR/ EDR/LE															IW611	FCC/IC Reference Certified	x		x		I2S, PCM, GPIO	-40 to +85	7.7 x 8.8 x 1.3	Shielded Resin			
	Type 2EL		x		x	x	x	x	x				x	5.3 BR/ EDR/LE 2MPHY															IW612	FCC/IC Reference Certified	x		x		GPIO, SPI	-40 to +85	7.7 x 8.8 x 1.3	Shielded Resin			
	Type 2GF		x		x	x	x	x	x					5.3 BR/ EDR/LE															CYW43022	FCC/IC Reference Certified	x		x		PCM	-20 to +70	10.0 x 7.2 x 1.5	Shielded Resin			
	Type 2XK		x		x	x	x	x						5.2 BR/ EDR/LE															IW416	FCC/IC Reference Certified	x		x		PCM	-40 to +85	9.1 x 8.3 x 1.3	Shielded Resin			
	Type 2XS		x		x	x	x	x	x				x	5.3 BR/ EDR/LE 2MPHY															88W9098	FCC/IC Reference Certified	x		x		PCIe, PCM	-40 to +60	19.1 x 16.5 x 2.1	Metal Can			
	Type ABR	x				x	x	x																					88MW320	FCC/IC Reference Certified						-30 to +85	22 x 19 x 2.4	Metal Can			
	Type 2FR		x		x	x	x	x	x				x	5.3															NXP RW612					x		-40 to +85	12.0 x 11.0 x 1.4	LGA (140 pads)			
	Type 2FP		x		x	x	x	x	x				x	5.3															NXP RRW610					x		-40 to +85	12.0 x 11.0 x 1.4	LGA (140 pads)			
	Type 2FY		x	x	x	x	x	x	x				x	5.3 B/EDR/															Infineon CYW55513		x		x			-30 to +85	7.9 x 7.3 x 1.1	LGA (72 pads)			

Wi-Fi Companion IC

Manufacturer	Name	Frequency			WLAN Protocol									Other Protocols		WLAN Software on Module				WLAN Security							Antenna		Chipset	Certifications	Interfaces					Operating Temp. ()	Size (mm)	Package	Evaluation Kit / Development Kit	Drivers	Comments
		2.4GHz	2.4GHz / 5GHz	6 GHz	802.11a	802.11b	802.11g	802.11n	802.11ac	802.11ad	802.11ah	802.11ax	802.11be	Bluetooth	Other	TCP/IP	Access Point	WiFi-Direct	Web Server	WPA2	WPA2-Enterprise	WPA3	WPS	WPS2	WAPI	SSL/TLS	Intergrated Antenna	Antenna Connector			SDIO	SPI	UART	USB	Other						
Nordic	nRF7002		x		x	x	x	x	x			x								x	x	x									x					-40 to +85	6 x 6	QFN48 package	nRF7002 DK, nRF7002 EK		
	nRF7001		x			x	x	x				x																								-40 to +85	6 x 6	QFN48 package			
	nRF7000		x			x	x	x				x																								-40 to +85	6 x 6	QFN48 package			

What is Bluetooth®?

Bluetooth is a wireless technology standard implemented for exchanging data over usually short distances from fixed and mobile devices, building Personal Area Networks (PANs). Here, short-wavelength microwaves in the ISM band from 2.4 to 2.485 GHz are used.

Bluetooth is managed by the Bluetooth Special Interest Group (SIG), which today has more than 38,000 member companies in the area of telecommunication, computing, networking, and consumer electronics. The term “Bluetooth” covers a number of different versions which evolved over the last years. Today, classic Bluetooth is differentiated from the latest Bluetooth standards 4.0-5.4, which are known as Bluetooth Low Energy / Bluetooth Dual Mode. Actually, Bluetooth Low Energy and Classic Bluetooth have to be seen independently from each other (an exception are Dual Mode modules or chips, where both standards, Classic Bluetooth and Bluetooth Low Energy can be used). While the overall difference between the diverse versions of Classic Bluetooth consists of an improved enhancement of the transferred data rate, the most recent Bluetooth Low Energy standard is rather classified as an individual standard which was designed to create low data rate networks using a minimum amount of power.

Furthermore, it does not only enable point-to-point connection but also mesh topology for establishing many-to-many device communications.

Common Bluetooth Versions and Their Characteristics

Bluetooth-Version	Description	Release Date	Max. Date Rate	Comment
1.0 + 1.0B	Basic-Rate Mode	Jul 99	732.2 kbit/s	Obsolete
1.1	Basic-Rate Mode	Feb 01	732.2 kbit/s	Obsolete
1.2	Basic-Rate Mode	Nov 03	1 Mbit/s	Obsolete
2.0 + EDR	Enhanced Data Rate	Nov 04	2.1 Mbit/s	Obsolete
2.1 + EDR	Enhanced Data Rate	Aug 07	2.1 Mbit/s	Easy pairing of devices compared to older Bluetooth-versions
3.0 + HS	Bluetooth High Speed	Apr 09	3 - 24 Mbit/s	Add. HS-channel available; can reach a date rate of 24 Mbit/s
3.0 + EDR	Enhanced Data Rate	Apr 09	3 Mbit/s	With additional Wi-Fi Hardware
4.0 LE	Bluetooth Low Energy	Dec 09	220 kbit/s	Bluetooth Low Energy is not compatible to Classic Bluetooth
4.0 DM	Bluetooth Dual Mode or Low Energy	Dec 09	LE: up to 220 kbit/s Classic: up to 24 Mbit/s	Bluetooth Dual Mode is compatible to Classic Bluetooth & Bluetooth Low Energy
4.1	Bluetooth Dual Mode or Low Energy	Dec 13	LE: up to 220 kbit/s Classic: up to 24 Mbit/s	Seamlessly with other wireless technologies, an essential link for the IoT
4.2	Bluetooth Dual Mode or Low Energy	Dec 14	LE: up to 1 Mbit/s Classic: up to 24 Mbit/s	Improved privacy + increase speed, soon-to-be ratified profile will enable IP connectivity
5.0	Bluetooth Dual Mode or Low Energy	Dec 16	LE: up to 2 Mbit/s Classic: up to 24 Mbit/s	4x range, 2x speed and 8x broadcasting message capacity compared to previous version
5.1	Bluetooth Dual Mode or Low Energy	Jan 19	LE: up to 2 Mbit/s Classic: up to 24 Mbit/s	Direction finding using Angle of Arrival or Angle of Departure
5.2	Bluetooth Dual Mode or Low Energy	Jan 20	LE: up to 2 Mbit/s Classic: up to 24 Mbit/s	
5.3	Bluetooth Dual Mode or Low Energy	Jul 21	LE: up to 2 Mbit/s Classic: up to 24 Mbit/s	LE Audio and Auracast™
5.4	Bluetooth Dual Mode or Low Energy	Feb 23	LE: up to 2 Mbit/s Classic: up to 24 Mbit/s	new features such as PAwR and Encrypted Advertisement Data + bi-directional communication

What are Bluetooth® Profiles?

The Bluetooth profile is an individual application layer on top of the Bluetooth HCI (Host Controller Interface) layer. In order to use Bluetooth technology, a device must be compatible with the subset of Bluetooth profiles necessary to use the desired services. The way a device uses Bluetooth technology depends on its profile capabilities. The profiles provide standards, which manufacturers follow to allow devices to use Bluetooth in the intended manner. Bluetooth Low Energy is using other profiles than Classic Bluetooth – based on top of GAP and GATT, which can be user-defined.

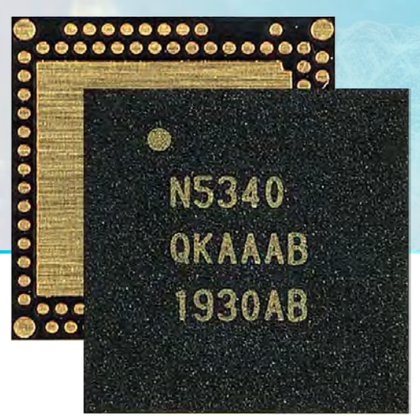
New Security Regulations

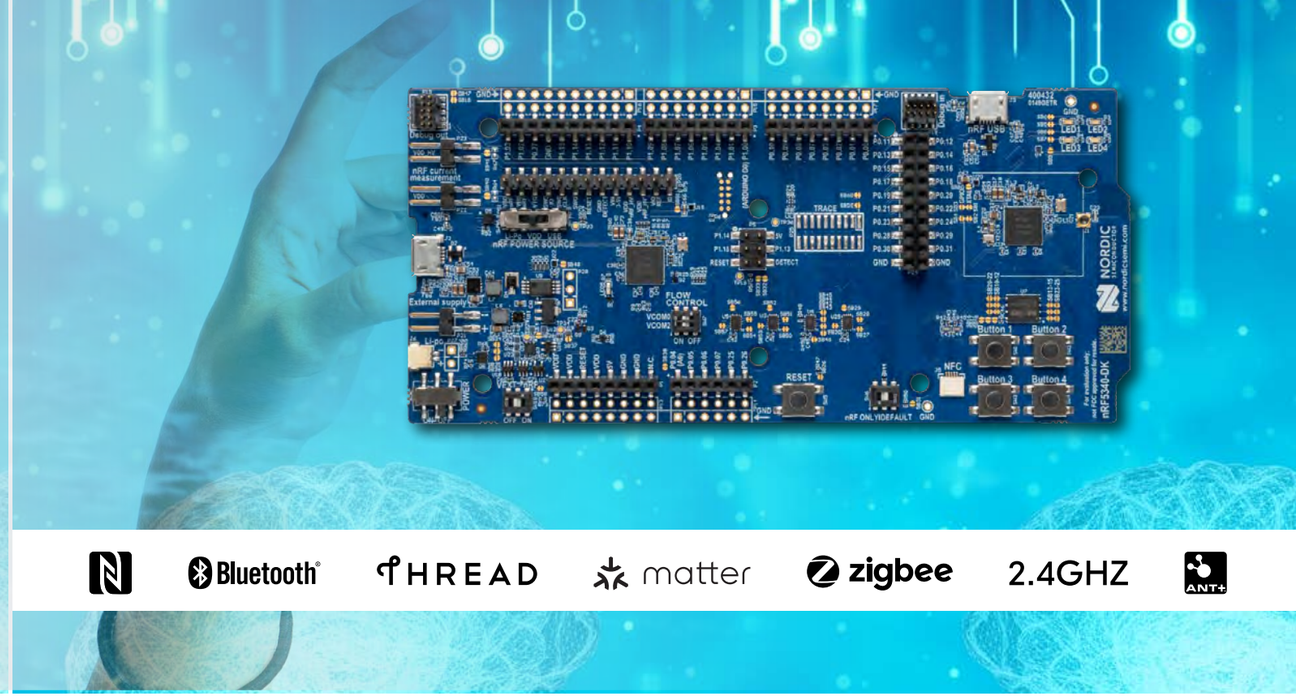
Security standards are a major topic at Bluetooth SIG. To keep this standard high, safe and always available, several standards for developing Bluetooth applications have to be maintained: Lately the new EN ETSI and RED (Radio Equipment Directive – 2014/53/EU) regulation were released which implicate duties for manufacturers.

Especially for body-close applications you need to carrying out SAR measurements and a special Bluetooth declaration process is required.

Bluetooth Profiles

Profile	Description	Application	Bluetooth Type
SPP	Serial Port Profile	Serial data transfer	Classic
A2DP	Advance Audio Distribution Profile	Streaming of audio multimedia	LE
HDP	Health Device Profile	Facilitates transmission of Medical Device Data	
HID	Human Interface Device Profile	For devices with which the end-user interacts directly	
HCI	Host Controller Interface	Interface between BT Hardware and application profiles	
iAP	iPhone Accessory Profile	support the development of accessories for Apple devices such as the iPhone or iPad.	
GAP	Generic Access Profile	Provides basis for all other profiles + defines how two Bluetooth® units establish a connection with each other	
GATT	Generic Attribute Profile	Provides profile discovery and description services for Bluetooth® SMART protocol	





Bluetooth® Low Energy

nRF5340 - Dual-core SoC

nRF5340 – Dual-Core Bluetooth 5.4 SoC supporting Bluetooth LE, Bluetooth mesh, NFC, Matter, Thread and Zigbee

The nRF5340 is the world's first wireless SoC with two Arm® Cortex®-M33 processors. The combination of two flexible processors, the advanced feature set, and an operating temperature up to 105 °C, makes it the ideal choice for LE Audio, professional lighting, advanced wearables, and other complex IoT applications.

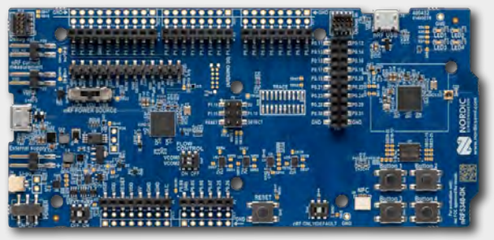
Key Features

- High-performance application processor
  - 128/64 MHz Arm Cortex-M33 with FPU & DSP instructions
  - 1 MB Flash + 512 kB low leakage RAM
  - 8 kB 2-way set associative cache
- Fully-programmable network processor
  - 64 MHz Arm Cortex-M33 with 2 kB instruction cache
  - 256 kB Flash + 64 kB RAM
  - Ultra-low power
- Next level security
  - Trusted execution with Arm TrustZone
  - Hardware accelerated cryptography with Arm CryptoCell-312
  - Secure Key Storage
  - Secure bootloader with root-of-trust and DFU
- Bluetooth Low Energy
  - Bluetooth 5.4
  - LE Audio
  - Direction Finding
  - 2 Mbps, Advertising Extensions and Long Range
- Bluetooth mesh
- Thread, Zigbee and 802.15.4
- NFC
- Full range of digital interfaces with EasyDMA
  - Full-speed USB
  - 96 MHz encrypted QSPI
  - 32 MHz high-speed SPI
- 105 °C extended operating temperature
- 1.7-5.5 V supply voltage range

Start your Development today!

nRF5340 DK

Development kit for the nRF5340, a dual-core Bluetooth 5.4 SoC supporting Bluetooth Low Energy, Bluetooth mesh, NFC, Matter, Thread and Zigbee.

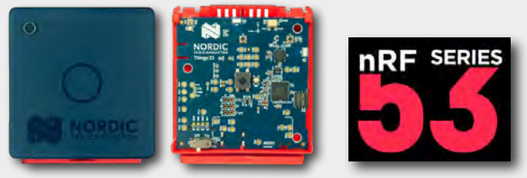


nRF5340 Audio DK

The nRF5340 Audio DK is a development kit for Bluetooth LE Audio applications. It contains everything needed to get started with development. Better audio quality, longer playtime, and Auracast™ features.

Nordic Thingy:53

The Thingy:53 is Nordic's rapid prototyping platform, based on the nRF5340 System-on-Chip (SoC), the current flagship dualcore wireless SoC.
With integrated sensors for motion, sound, light and environmental factors, it is the perfect platform for building proof-of-concepts and developing new prototypes in a very short time.



Power Profiler Kit II

The Power Profiler Kit II (PPK2) is an affordable, flexible tool that measures the real-time power consumption of your designs. The PPK2 can measure current on any external board (e.g. nRF5 Series or nRF91 Series DKs).

Coming soon!

Bluetooth® Low Energy SoC

NORDIC SEMICONDUCTOR

nRF54H20

nRF54H20 is a compact all-in-one solution that can replace multiple components on the PCB, reducing design size. For example, an application MCU, an external flash, and a wireless SoC can be replaced with a single compact nRF54H20. In addition, its excellent energy efficiency enables smaller batteries to be used, further reducing both the design size and cost.

Main Benefits

- Reduced design size/ highly integrated SoC
- Prolonged battery life/ reduced battery size
- Providing long range: Best-in-class multiprotocol radio
- State-of-the-art protection against security threats

Key Features

- Multiple Arm Cortex-M33 processors, clocked up to 320 MHz
- Multiple RISC-V coprocessors
- 2 MB non-volatile memory
- 1 MB RAM
- Bluetooth Low Energy, LE Audio, Bluetooth mesh, Thread, and Matter
- New peripherals: High-speed USB (480 Mbps), CAN FD controller, 2 x I3C and 14-bit ADC
- Designed for PSA Certified Level 3 IoT security standard
- Physical security

Applications

- Advanced wearables
- Smart home and Matter
- Medical and healthcare
- LE Audio
- Industrial
- Gaming
- Virtual reality and augmented reality
- E-mobility

nRF54L15

nRF54L15 is the first System-on-Chip (SoC) in the nRF54L Series. It is an ultra-low power Bluetooth 5.4 SoC with a new best-in-class multiprotocol radio and advanced security features. nRF54L Series takes the popular nRF52 Series to the next level with excellent processing power and efficiency, expanded memory, and new peripherals, all in a more compact package.

Main Benefits

- Takes nRF52 Series to the next level
- State-of-the-art protection against security threats
- Providing long range: Best-in-class multiprotocol radio
- Prolonged battery life/ reduced battery size

Key Features

- 128 MHz Arm Cortex-M33 processor
- 1.5 MB non-volatile memory
- 256 KB RAM
- Bluetooth Low Energy, Bluetooth mesh, Thread, and Matter
- New peripherals: Global RTC, 14-bit ADC, and a software-defined peripheral enabled by a RISC-V coprocessor
- Designed for PSA Certified Level 3 IoT security standard
- TrustZone isolation, side-channel protection, and tamper detection
- Ultra-compact packages

Applications

- PC accessories, gaming controllers, and remotes
- Virtual reality and augmented reality
- Smart home and Matter
- Medical devices
- Industrial IoT

Bluetooth® Low Energy Module

Panasonic

PAN178x – Bluetooth® Low Energy 5.1

The PAN178x Series RF Module is a high technology device featuring the Nordic nRF52 Series Single-Chip Controller and is ideal for IoT Wireless Connectivity applications.

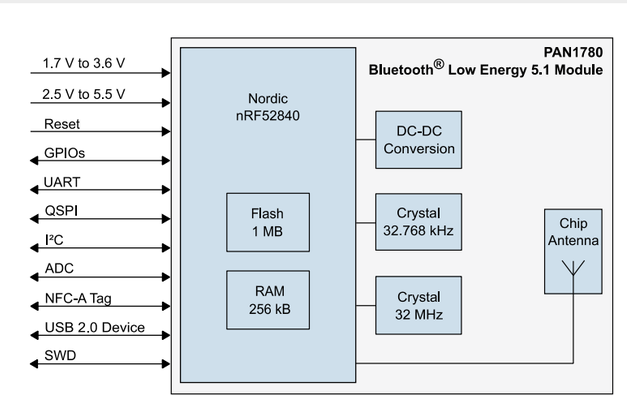
PAN1780 – the Flagship based on nRF52840

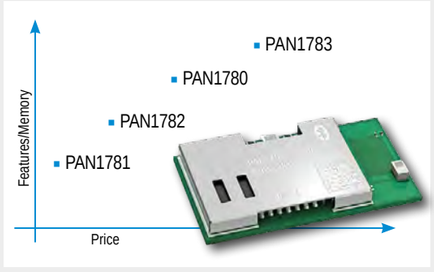
- Bluetooth 5 & 802.15.4
- Support of Matter, BLE Mesh, Zigbee, Thread and Wireless
- All 48 GPIOs available
- Extended certifications
- U.FL connector and AT Command Set variants
- Separate 32 kHz Crystal Oscillator
- Small size of 15.6 x 8.7 x 2 [mm]

Broad portfolio based on

- From low- to high-end feature chipsets
- Integrated antenna and u.FL connector versions
- With or without AT Command stack variants

Block Diagram





Infrastructure

- EV Charging
- Professional Equipment
- Smart Lighting

Medical

- Equipment
- Diagnostic
- Patient Monitoring

Smart Home / Building

- Home Appliance
- HVAC
- Gateways

Production Line Panasonic

100% end-of-line tested	European development & production
0 ppm failure rate	Produced according to IATF 16949
Certified for CE RED, FCC, ISED, MIC, KCC, RCM, SRRC	

PAN1780	PAN1780AT	PAN1770	PAN1781	PAN1782	PAN1783
Bluetooth Low Energy 5.3			Bluetooth Low Energy 5.1	Bluetooth Low Energy 5.1	Bluetooth Low Energy 5.x
nRF52840			nRF52820	nRF52833	nRF5340
ARM® Cortex® -M4F			ARM® Cortex® -M4	ARM® Cortex® -M4	2x ARM® Cortex® -M33
1MB Flash, 256kB RAM	AT Command Set	1MB Flash, 256kB RAM	256kB Flash, 32kB RAM	512kB Flash, 128kB RAM	1 MB Flash & 512 KB RAM 256 KB Flash & 64 KB RAM
Chip Antenna		u.FL connector	Chip Antenna	Chip Antenna	Chip Antenna
15.6 x 8.7 x 2 [mm]					

Bluetooth THREAD matter zigbee

Bluetooth® Low Energy

Fast-Track Your IoT Deployment with Insight SiP Solutions

INSIGHT SIP

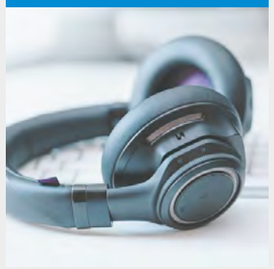
The InsightSIP “Ready-to-go” RF modules offer you the fast, low risk way to deploy your IoT infrastructure, with fully CE, FCC, IC, Telec and Bluetooth SiG certified solutions. All modules are based on Nordic Semiconductor’s SoCs.

INDUSTRIAL SOLUTIONS

SMART HOME & LIGHTING

MEDICAL WEARABLES

AUDIO SOLUTIONS



ISP1507-AX

- All purpose device
- Core Bluetooth feature set
- Large application capacity
- Balanced price/performance trade off

ISP1807-LR

- High-capacity Flash/RAM
- Advanced Bluetooth features
- Long range
- Angle of arrival
- Mesh
- Rich I/O set

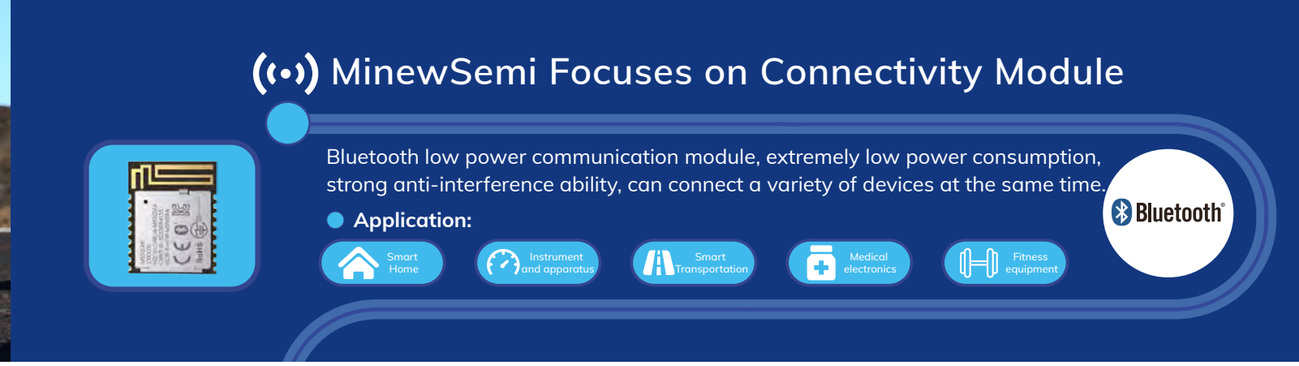
ISP1907-LL / ISP1907-HT

- Connectivity node
- Simple applications
- Cost effective solution
- Simple angle of arrival tag

ISP2053-AX

- High end dual core architecture
- Power optimized
- Advanced security features
- BLE audio support
- Advanced real time capability
- Trust Zone

Part Number	ISP1507-AX	ISP1807-LR	ISP1907-LL	ISP1907-HT	ISP2053-AX
Bluetooth	5.0	5.0	5.1	5.1	5.2
BT Features	Bluetooth LE	Bluetooth LE Long Range	Bluetooth LE Long Range Dir. Finding	Bluetooth LE Long Range Dir. Finding	Bluetooth LE Long Range Dir. Finding - Audio
Other protocol	BT Mesh - ANT	BT Mesh - ANT Thread - Zigbee	BT Mesh - ANT	BT Mesh Thread - Zigbee	BT Mesh - ANT Thread - Zigbee
Tx Power	+ 4 dBm	+ 8 dBm	+ 4 dBm	+ 8 dBm	+ 3 dBm
Chip	nRF52832	nRF52840	nRF52811	nRF52833	nRF5340
Processor	Cortex M4F	Cortex M4F	Cortex M4	Cortex M4F	2 x Cortex M33
Flash	512 kB	1 MB	192 kB	512 kB	1 MB + 512 kB
RAM	64 kB	256 kB	24 kB	128 kB	256 kB + 64 kB
Security	-	Cryptocell	-	-	TrustZone - Cryptocell
GPIOs (ADCs)	30 (8)	46 (8)	13 (3)	30 (8)	46 (8)
Interfaces	(High Speed) SPI, TWI, UART, PWM, PDM (Applicable for all)				
NFC tag	Yes	Yes	-	Yes	Yes
USB	-	Yes	-	Yes	Yes
Temperature	85°C	85°C	85°C	105°C	105°C
Dimensions	8 mm x 8 mm x 1 mm (Applicable for all)				



Bluetooth® Low Energy Modules

MINEW

Bluetooth® LE Module – Overview

Cutting edge Nordic Semiconductor nRF52 series SoCs enables MinewSemi Bluetooth Low Energy module collections with multiple protocol capabilities, high flexibility and ultra low power. Global certifications and preloaded MinewSemi Uart firmware reduce customers’ BOM cost and time-to-market for multi IoT applications. With multi Nordic nRF52805/nRF52810/nRF52832/nRF52833/nRF52840 SoCs, higher performance PCB/Ceramic and u.FL antenna type, integrated DC/DC and 32.768Khz crystal oscillator, MinewSemi module will meet your requirements in different IoT industries.

Model Series	MS52SF1 Series	MS52SF2 Series	MS51SF1 Series	MS50SF7 Series	MS53SF1 Series	MS53SF2 Series	MS88SFA Series	MS88SFB Series
Model No.	MS52SF11	MS52SF21	MS51SF11	MS50SF71	MS53SF11	MS53SF21	MS88SFA8	MS88SFB8
Antenna	PCB	PCB	PCB	PCB	PCB	PCB	PCB/IPEX	PCB/IPEX
SoCset	Telink TLSR8208	Telink TLSR8208	Nordic nRF52833	Nordic nRF52832	BlueNRG-355M	BlueNRG-332AC	Nordic nRF52833/840	Nordic nRF52833
Max Range	80M	80M	80M	80M	300M	500M	600M	600M
Dimension(mm)	15.8*12*2	20*12*2	9.8*8.4*2	9.8*8.4*2	20*12*2	20*12*2	23.2*17.4*2	23.2*17.4*2
Flash	128KB	128KB	512KB	512KB	256KB	192KB	1M/512KB	512KB
RAM	16KB	16KB	128KB	64KB	64KB	24KB	256KB/128KB	128KB
Sensitivity(RX)	-97dBm	-97dBm	-96dBm	-96dBm	-97dBm	-97dBm	-96dBm	-96dBm
Transmission Power	-45~+10dBm	-45~+10dBm	-40~+8dBm	-40~+4dBm	--20~+8dBm	-20~+8dBm	~+20dBm	~+20dBm
Current(TX)	0dBm-9.5mA	0dBm-9.5mA	0dBm-4.9mA	0dBm-5.3mA	0dBm-4.3mA	0dBm-4.3mA	Peak:150mA	Peak:200mA
Current(RX)	9.1mA	9.1mA	4.6mA	5.4mA	3.4mA	3.4mA	/	/
GPIO	14	15	20	24	25	19	29	29
Certification	SRRC,BQB,FCC,CE REACH,ROHS	/	/	/	/	/	CE,FCC,REACH, ROHS	REACH,ROHS
Firmware	1. For module based on nRF52811/833/840, it is null module without any firmware preloaded in default. 2. For module based on nRF52805/810/832, it has the UART-Slave/Master firmware preloaded in default. We can provide UART command list if needed.							

Content

Bluetooth® Low Energy Module

muRata
INNOVATOR IN ELECTRONICS

BLE v5.2 Module - LBCA1HN2EG (Type 2EG)

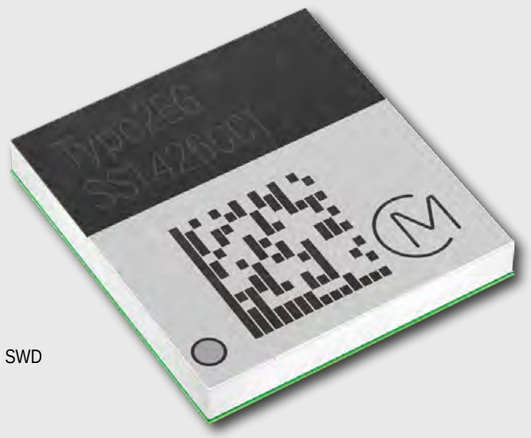
The latest Type 2EG module consists of OnSemi´s RSL15, a 48MHz crystal for timing and an on-board antenna. The module provides a Serial Port Interface (SPI) and UART Interface to Arm Cortex´s M33 processor.

Features

- Bluetooth® v5.2
  - Higher throughput
  - Increased broadcast capacity
  - Improved channel co-existence algorithm (SCA)
  - Long range
  - Proximity
- onsemi RSL15 SoC
- Built-in ARM Cortex M33 core with 80kB RAM (including 64kB user RAM) and 512kB Flash
- Dimension 7.4 mm x 7.0 mm x 1.0 (max.) mm
- Packaging: LGA
- Antenna Configuration:
  - Built-in PCB antenna
  - Optional external antenna from pin pad
- Max. transmit power: 6 dBm
- Receive sensitivity: -96 dBm @ 1Mbps
- Ultra-low power
  - TX 4.3 mA @ 0dBm
  - RX 2.7 mA @ 1Mbps
  - Sleep mode 36nA @3V VBAT
- Host interface: UART, SPI Peripheral interfaces:
  15 GPIO, ADC, DAC, PWM, I2C, UART, SPI (QSPI), PCM and Debug SWD
- Operating temperature range: -40ºC to 85ºC
- RoHS compliant
- MSL Level 3 in accordance with JEDEC J-STD-020
- Regulatory certificates: FCC, ISED, ETSI, TELEC

Target Markets

- Building automation
- Industrial IoT
- Healthcare
- Consumer applications



infineon

AIROC™ Bluetooth® and Bluetooth® Low Energy Solutions

Infineon's AIROC™ Bluetooth® Low Energy-only and dual-mode Bluetooth® solutions deliver the most reliable and highest performing connectivity for your applications. These SoC's are supported in ModusToolbox™ Software and Tools with copious Bluetooth® code examples as well as in-house AIROC™ globally certified modules for rapid time to market.

AIROC™ Bluetooth® Low Energy portfolio consists of the CYW20736, CYW20835 and their respective modules, as well as the PSoC™ 4 Bluetooth® LE and PSoC™ 6 Bluetooth® LE System-on-Chip (SoC) devices and fully certified modules.

Product	SDK	CPU	Flash (KB)	RAM (KB)	GPIOs	Bluetooth LE Max Tx Power	RX Sensitivity
AIROC™ CYW20835	ModusToolbox™	96 MHz Arm® Cortex®-M4	External	384	24	12 dBm	-94.5 dBm
PSoC™ 4 MCU w/ Bluetooth® LE	PSoC™ Creator	48 MHz Arm® Cortex®-M0	Up to 256KB	Up to 32	36	3 dBm	-91 dBm
PSoC™ 63 MCU w/ Bluetooth® LE	ModusToolbox™	150 MHz Arm® Cortex®-M4 & 100 MHz Arm® Cortex®-M0	Up to 1MB	Up to 288	Up to 84	4 dBm	-95 dBm

AIROC™ CYW20835 Bluetooth® LE SoC

is designed to support the entire spectrum of Bluetooth® Low Energy IoT device use cases like home automation, sensors, lighting, Bluetooth® Mesh, and wireless input devices.

PSoC™ 63 MCU with AIROC™ Bluetooth® LE

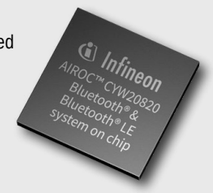
is a dual core, highly optimized, flexible and ultra low power, machine learning ready microcontroller with Bluetooth® Low Energy for IoT applications.

The dual-mode Bluetooth® portfolio includes Bluetooth® SIG -compliant, devices and modules that integrate Bluetooth® standard profiles and protocols for embedded applications.

Product	CPU	Flash (KB)	RAM (KB)	GPIOs	Basic rate Max Tx Power	EDR 2Mbps Max Tx Power	EDR 2Mbps Rx Sensiivity	LE Max Tx Power	LE RX Sensitivity
AIROC™ CYW20706	48 MHz Arm® Cortex®-M3	External	352	24	12 dBm	9 dBm	-95.5 dBm	9 dBm	-96.5 dBm
AIROC™ CYW20719	96 MHz Arm® Cortex®-M4	1 MB	512	Up to 40	5 dBm	0 dBm	-94 dBm	5.5 dBm	-95.5 dBm
AIROC™ CYW20721	96 MHz Arm® Cortex®-M4	1 MB	512	Up to 40	5 dBm	0 dBm	-94 dBm	5.5 dBm	-95.5 dBm
AIROC™ CYW20819	96 MHz Arm® Cortex®-M4	256	176	22	5 dBm	0 dBm	-94.5 dBm	4.5 dBm	-95 dBm
AIROC™ CYW20820	96 MHz Arm® Cortex®-M4	256	176	22	11.5 dBm	2.5 dBm	-94 dBm	11.5 dBm	-94.5 dBm

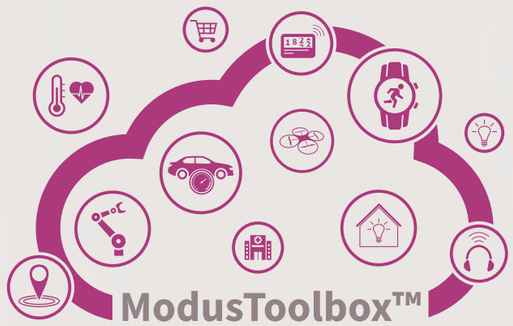
AIROC™ CYW20820 Bluetooth® & Bluetooth® LE SoC

Bluetooth® and Bluetooth® LE connectivity that is 5.2 core spec compliant. An integrated Arm® Cortex®-M4 processor with a floating point, enables high performance compute capabilities.



AIROC™ CYW20819 Bluetooth® & Bluetooth® LE SoC

The CYW20819 is a Bluetooth® 5.2 core spec compliant device for IoT applications. The CYW20819 employs high levels of integration to minimize external components, reducing the device footprint and the costs associated with implementing Bluetooth® solutions.



AIROC™ Bluetooth® Modules

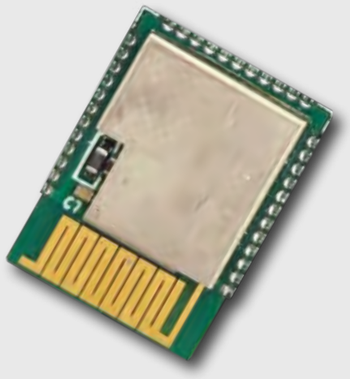
All of the AIROC™ Bluetooth® modules are fully integrated, globally certified, programmable modules designed to help you build your products faster and easier.

Product	Size (mm)	Base Chip	FLASH	RAM	GPIO	LE Range (meters, LoS)	Bluetooth core spec.	Bluetooth LE	Bluetooth Classic	Operating Temp.	Evaluation Kit
CYBT-343026-01	12 x 15.5 x 1.95	AIROC™ CYW20706	512 KB SFLASH	352 KB	11	250	5	Yes	Yes	-30~85°C	CYBT-343026-EVAL
CYBT-413055-02	12.0 x 16.3 x 1.70	AIROC™ CYW20719	1 MB	512 KB	17	75	5	Yes	Yes	-30~85°C	CYBT-413055-EVAL
CYBT-483056-02	12.75 x 18.59 x 1.80	AIROC™ CYW20719	1 MB	512 KB	15	1 km	5	Yes	Yes	-30~85°C	CYBT-483056-EVAL
CYBT-483062-02	12.75 x 18.59 x 1.80	AIROC™ CYW20721	1 MB	512 KB	15	1 km	5	Yes	Yes	-30~85°C	N/A
CYBLE-343072-02	13.3 x 21.89 x 1.95	AIROC™ CYW20835	512 KB SFLASH	352 KB	24	225	5.2	Yes	No	-30-85°C	CYBLE-343072-EVAL-M2B
CYBT-243053-02	12x16.61x1.7	AIROC™ CYW20820	256 KB	176 KB	22	200	5	Yes	Yes	-30-85°C	CYBT-243053-EVAL
CYBT-213043-02	12.0 x 16.6 x 1.70	AIROC™ CYW20819	256 KB	176 KB	22	75	5	Yes	Yes	-30~85°C	CYBT-213043-EVAL

AIROC™ CYW20820 Bluetooth® LE Modules

These modules like the CYBT-243053-02 are highly integrated modules.

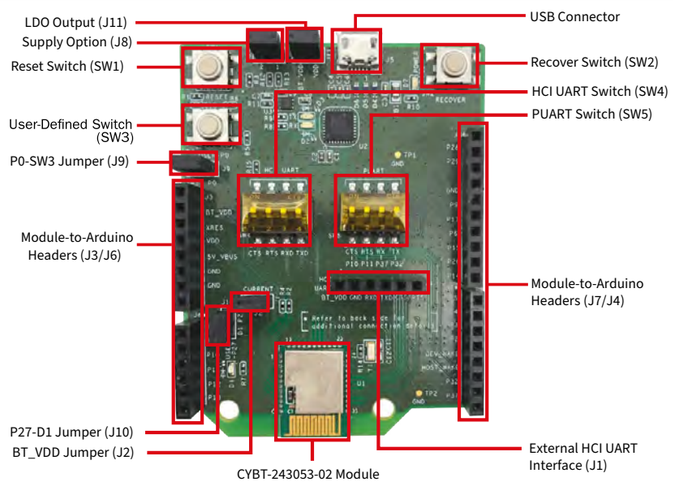
Globally certified to support fast time-to-market and supported by the AIROC™ Bluetooth® SDK in ModusToolbox™ software.



AIROC™ CYBT-243053-02 Module

AIROC™ CYW20820 Bluetooth® LE Module Evaluation Kit

The Infineon AIROC™ CYW20820 Bluetooth® LE Module Evaluation Kit (CYBT-243053-EVAL) enables you to evaluate and develop single-chip AIROC™ Bluetooth® applications using the CYBT-243053-02 module.



CYBT-243053-02 Module

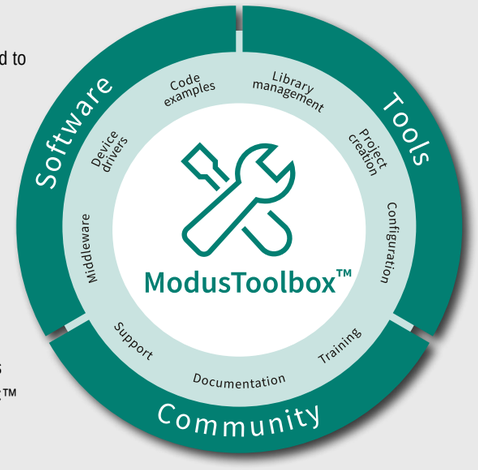
Bluetooth® SDK along with the ModusToolbox™ Software

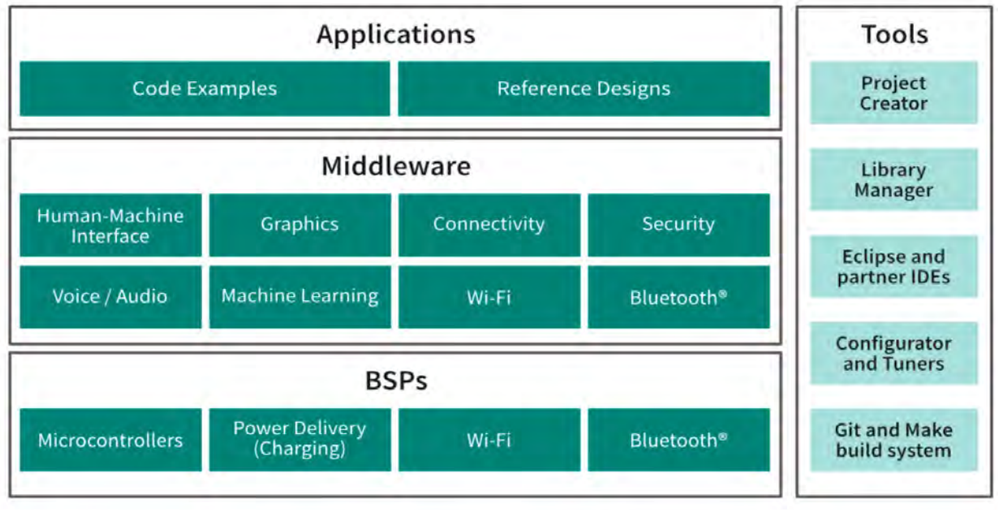
Building your product has never been easier or faster

The Bluetooth® SDK, embedded within ModusToolbox™, contains everything you need to build applications following dual-mode (BR + EDR + Bluetooth® LE).

The Bluetooth® SDK integrated within the ModusToolbox™ software and tools and Bluetooth® configurator tools form a powerful but easy-to-use toolset that helps you create amazing Bluetooth®-enabled IoT solutions such as beacons, trackers, smart watches, audio devices, HID device (remotes, mice, and keyboards) medical devices, and home automation platforms.

ModusToolbox™ was built to make the developers life easy. It is a collection of easy-to-use software and tools enabling rapid development of Infineon MCUs, covering applications from embedded sense and control to wireless and cloud-connected systems using AIROC™ Wi-Fi, AIROC™ Bluetooth® and AIROC™ Wi-Fi and combo devices.





Bluetooth® SoC's – Selection Guide

Manuf-acturer	Name	Bluetooth specification	Software/Profile													NFC	BLE Max. Trans-mit Power TX (dBm)	BT EDR 2 Mbps Sensiti-vity RX (dBm)	BT EDR 2Mpbs Max. Transmit Power (dBm)	Supply Voltage Range (V)	BT EDR 2 Mbps Sensiti-vity RX (dBm)	BLE Sensitivity RX (dBm)	MCU		Memory						Interfaces											Operating Temp. (°C)	Size (mm)	Package	Evaluation Kit / Development Kit	Balun	Crystal
			SPP	HCI	HID	HSP	ATT	GAP	GATT	L2CAP	LL	SM	ANT	Gazell									Yes	No	Flash	NVM	RAM	ROM	SRAM	No	GPIO	PCM	SPI	UART	JTAG	ADC	I²C	SWD	USB						
Bluetooth Low Energy																																													
Nordic Semiconductor	nRF54H20-CKAA (coming soon)	5.4															+10					-100	Multiple Cortex M33 Multiple RISC-V			2MB	1MB															4.7 x 4.3	WLCSP		On-chip balun	
	nRF54L15-QFAA (coming soon)	5.4															+8					-98	Cortex M33 RISC-V			1.5MB	256kB															6 x 6	QFN		On-chip balun	
	nRF54L15-CAAA (coming soon)	5.4															+8					-98	Cortex M33 RISC-V			1.5MB	256kB															2.4 x 2.2	WLCSP		On-chip balun	
	nRF54L15-CBAA (coming soon)	5.4															+8					-98	Cortex M33 RISC-V			1.5MB	256kB															2.4 x 2.2	WLCSP		On-chip balun	
	nRF5340-QKAA	5.4		x	x		x	x	x	x	x	x	x	x	x			+3	1.7 - 5.5		-98	2 x Cortex M33		1 MB 256kB		512kB 64kB			48		x	x		x	x		x		-40 to +105	7 x 7	QFN94	nRF5340 DK, nRF5340 Audio DK, Thingy:53	On-chip balun	XTAL_2016 XTAL_2012
	nRF5340-CLAA	5.4		x	x		x	x	x	x	x	x	x	x	x			+3	1.7 - 5.5		-98	2 x Cortex M33		1 MB 256kB		512kB 64kB			48		x	x		x	x		x		-40 to +105	4.4 x 4.0	WLCSP95	nRF5340 DK, nRF5340 Audio DK, Thingy:53	On-chip balun	XTAL_2016 XTAL_2012
	nRF52840-QIAA	5.4		x	x		x	x	x	x	x	x	x	x	x			+8	1.7 - 5.5		-95 to -103	Cortex M4F		1 MB		256 kB			48		x	x		x	x	x	x		-40 to +85	7 x 7	aQFN73	nRF52840 DK / nRF52840 Dongle	On-chip balun	XTAL_2016 XTAL_3215
	nRF52840-QFAA	5.4		x	x		x	x	x		x	x	x	x	x			+8	1.7 - 5.5		-95 to -103	Cortex M4F		1 MB		256 kB			30		x	x		x	x		x		-40 to +85	6 x 6	QFN48	nRF52840 DK / nRF52840 Dongle	On-chip balun	XTAL_2016 XTAL_2012
	nRF52840-CKAA	5.4		x	x		x	x	x	x	x	x	x	x	x			+8	1.7 - 5.5		-95 to -103	Cortex M4F		1 MB		256 kB			48		x	x		x	x	x	x		-40 to +85	3.5 x 3.6	WLCSP94	nRF52840 DK / nRF52840 Dongle	On-chip balun	XTAL_2016 XTAL_2012
	nRF52833-QIAA	5.4		x	x		x	x	x	x	x	x	x	x	x			+8	1.7 - 5.5		-89 to -103	Cortex-M4		512 kB		128 kB			42		x	x		x	x		x		-40 to +105	7 x 7	aQFN73	nRF52833 DK	On-chip balun	XTAL_2016 XTAL_3215
	nRF52833-QDAA	5.4		x	x		x	x	x	x	x	x	x	x	x			+8	1.7 - 5.5		-89 to -103	Cortex-M4		512 kB		128 kB			18		x	x		x	x		x		-40 to +105	5 x 5	QFN40	nRF52833 DK	On-chip balun	XTAL_1612 XTAL_2012
	nRF52833-CIAA	5.4		x	x		x	x	x	x	x	x	x	x	x			+8	1.7 - 5.5		-89 to -103	Cortex-M4		512 kB		128 kB			42		x	x		x	x		x		-40 to +105	3.2 x 3.2	WLCSP95	nRF52833 DK	On-chip balun	XTAL_1612 XTAL_2012
	nRF52832-QFAA	5.4		x	x		x	x	x	x	x	x	x	x	x			+4	1.7 - 3.6		-89 to -96	Cortex-M4		512 kB		64 kB			32		x	x		x	x	x			-40 to +85	6 x 6	aQFN48	nRF52 DK / Nordic Thingy:52	On-chip balun	XTAL_2016 XTAL_3215
	nRF52832-QFAB	5.4		x	x		x	x	x	x	x	x	x	x	x			+4	1.7 -3.6		-89 to -96	Cortex-M4		256 kB		32 kB			32		x	x		x	x	x			-40 to +85	6 x 6	aQFN48	nRF52 DK / Nordic Thingy:52	On-chip balun	XTAL_2016 XTAL_3215
	nRF52832-CIAA	5.4		x	x		x	x	x	x	x	x	x	x	x			+4	1.7 -3.6		-89 to -96	Cortex-M4		512 kB		64 kB			32		x	x		x	x	x			-40 to +85	3.0 x 3.2	WLCSP50	nRF52 DK / Nordic Thingy:52	On-chip balun	XTAL_2016 XTAL_2012
	nRF52820-QDAA	5.4		x	x		x	x	x	x	x	x	x					+8	1.7 - 5.5		-89 to -103	Cortex-M4		256 kB		32 kB			18		x	x						x	-40 to +105	5 x 5	QFN40	nRF52833 DK	On-chip balun	XTAL_1612 XTAL_2012
	nRF52820-CFAA	5.4		x	x		x	x	x	x	x	x	x					+8	1.7 - 5.5		-89 to -103	Cortex-M4		256 kB		32 kB			18		x	x						x	-40 to +105	2.5 x 2.5	WLCSP	nRF52833 DK	On-chip balun	XTAL_1612 XTAL_1610
	nRF52811-QFAA	5.4		x	x		x	x	x	x	x	x	x					+4	1.7 - 3.6		-94 to -104	Cortex M4		192 kB		24 kB			32		x	x		x		x			-40 to +85	6 x 6	QFN48	nRF52840 DK	On-chip balun	XTAL_2016 XTAL_3215
	nRF52811-QCAA	5.4		x	x		x	x	x	x	x	x	x					+4	1.7 - 3.6		-94 to -104	Cortex M4		192 kB		24 kB			17		x	x		x		x			-40 to +85	5 x 5	QFN32	nRF52840 DK	On-chip balun	XTAL_2016 XTAL_3215
	nRF52811-CAAA	5.4		x	x		x	x	x	x	x	x	x					+4	1.7 - 3.6		-94 to -104	Cortex M4		192 kB		24 kB			15		x	x		x		x			-40 to +85	2.48 x 2.46	WLCSP	nRF52840 DK	On-chip balun	XTAL_2016 XTAL_2012
	nRF52810-QFAA	5.4		x	x		x	x	x	x	x	x	x					+4	1.7 -3.6		-96	Cortex M4		192 kB		24 kB			32		x	x		x		x			-40 to +85	6 x 6	QFN48	nRF52 DK	On-chip balun	XTAL_2016 XTAL_3215
	nRF52810-QCAA	5.4		x	x		x	x	x	x	x	x	x					+4	1.7 -3.6		-96	Cortex M4		192 kB		24 kB			16		x	x		x		x			-40 to +85	5 x 5	QFN32	nRF52 DK	On-chip balun	XTAL_2016 XTAL_3215
	nRF52810-CAAA	5.4		x	x		x	x	x	x	x	x	x					+4	1.7 -3.6		-96	Cortex M4		192 kB		24 kB			15		x	x		x		x			-40 to +85	2.48 x 2.46	WLCSP33	nRF52 DK	On-chip balun	XTAL_2016 XTAL_2012
	nRF52805-CAAA	5.4		x	x		x	x	x	x	x	x	x					+4	1.7 -3.6		-97	Cortex-M4		192 kB		24 kB			10		x	x		x					-40 to +85	2.48 x 2.46	WLCSP28	nRF52 DK	On-chip balun	XTAL_2016 XTAL_2012
Infineon	AIROC™ CYW20706	5.2	x	x	x	x	x	x	x	x	x	x					+9	+9	1.62 - 3.6 (VBAT) 2.25 - 2.94 (VDDPA)	-95.5	-96.5	Cortex®-M3				352 kB	848 kB			24	x	x	x	x	x	x	x			-30 to +85	4.5 x 4.0	49-pin FBGA	AIROC™ CYW920706WCDEVAL	On-chip balun	
	AIROC™ CYW20719	5.1	x	x	x		x	x	x	x	x	x	x				+5.5	0	1.76 - 3.63	-94	-95.5	Cortex®-M4		1 MB		512 kB	2 MB			40	x	x	x	x	x	x	x			-30 to +85	5 x 5 (QFN) 3.2 x 3.1 (WLCSP)	40-QFN WLCSP	AIROC™ CYW920719B2Q40EVB-01	On-chip balun	
	AIROC™ CYW20721	5.1	x	x	x	x	x	x	x	x	x	x	x				+5.5	0	1.76 - 3.63	-94	-95.5	Cortex®-M4		1 MB		512 kB	2 MB			40	x	x	x	x	x	x	x			-30 to +85	5 x 5 (QFN) 3.2 x 3.1 (WLCSP)	40-QFN WLCSP	AIROC™ CYW920721M2EVK-01 AIROC™ CYW920721M2EVK-02 AIROC™ CYW920721M2EVB-03	On-chip balun	
	AIROC™ CYW20736	5.2		x			x	x	x	x	x	x					+4	N/A	1.62 - 3.63	N/A	-93	Cortex®-M3				60 kB	320 kB			14		x	x	x	x	x	x			-30 to +85	5 x 5	32-QFN	AIROC™ CYW920736M2EVB-01	On-chip balun	
	AIROC™ CYW20819	5.2	x	x	x		x	x	x	x	x	x					+4.5	0	1.71 - 3.3		-95	Cortex®-M4		256 kB		176 kB	1 MB			22	x	x	x	x	x	x	x			-30 to +85	4.5 x 4.5	62-pin FPBGA	AIROC™ CYW920819M2EVB-01	On-chip balun	
	AIROC™ CYW20835	5.2		x	x		x	x	x	x	x	x					+12	N/A	1.625 - 3.63	N/A	-94.5	Cortex®-M4				384 kB	2 MB			24	x	x	x	x	x	x	x			-30 to +85	7 x 7	QFN (60-pin)	AIROC™ CYW920835M2EVB-01	On-chip balun	
	AIROC™ CYW20820	5.2	x	x	x		x	x	x	x	x	x					+11.5	2.5	1.71 - 3.3 2.375 - 2.625 (PAVDD)	-94	-94.5	Cortex®-M4		256 kB		176 kB	1 MB			22	x	x	x	x	x	x	x			-30 to +85	4.5 x 4.5	62-pin FPBGA	AIROC™ CYW920820M2EVB-01	On-chip balun	
	AIROC™ CYW20829	5.4		x					x			x					+10	N/A	1.70 - 3.6	-95	-106	Cortex M33				256 kB	64 kB			x	x	x	x	x	x	x	x			-40 to +85	6 x 6	56-pin QFN	AIROC™ CYW920829M2EVK-02		
	AIROC™ CYW89820	5.4		x			x		x	x		x					+11.5	2.5	1.71 - 3.3	-94	-94.5	Cortex M4		256 kB		176 IB	1 MB			x	x	x	x			x				-40 to +105	7 x 7	48-pin WQFN			

*continuosly updated | **CSA2, Long Reach, Codec phy, High Speed up to 2 Mbps, enhanced broadcasting

Bluetooth® Modules – Selection Guide

Manufacturer	Name	Bluetooth specification	Bluetooth class	Stack/Profile																										Max. Transmit Power TX (dBm)	Supply Voltage Range (V)	Input Sensitivity RX (dBm)	Used Ics	Interfaces											Antenna		Operating Temp. (°C)	Size (mm)	Package	Evaluation Kit / Development Kit
				SPP	HCI	HDP	ATT	GAP	GATT	L2CAP	HID	HSP	HFP	DUN	RFCOMM	SDP	A2DP	AVRCP	iAP	SDAP	SMP	LL	SM	Gazell	TI	Other								GPIO	PCM	SPI	UART	JTAG	ADC	I²C	USB	RS-232	other	Intergrated Antenna	Without Antenna				
Bluetooth Classic																																														
Panasonic	PAN13x5B	2.1	1		x																									+10	1.8 - 4.8	-93	CC2560B	x	x		x							Chip	x	-40 to 85	9.0 x 6.5 x 1.8 (w/o antenna) 9.0 x 9.5 x 1.8 (w/ antenna)	SMD	
Bluetooth Low Energy																																														
EnOcean	STM 550B																									Energy harvesting Sensor					+4	Energy Harvesting											PCB		-25 to 65	40.0x40.0x13mm	Switch module	
	PTM 216B	5.4																								Energy harvesting light switch					+4	Energy Harvesting											PCB		-25 to 65	40.0x40.0x11.2mm	Switch module	
	PTM 215ZE																									ZigBee					+7	Energy Harvesting											PCB		-25 to 65	40.0x40.0x11.2mm	Switch module	
Fujitsu	FWM7BLZ20	4.2	2				x	x	x	x													x	x												x					NFC-A	PCB		40 to 85	15.7 x 9.8 x 1.7	SMD	FWM7BLZ20-EVB2-EF2
	FWM7BLZ20-109049	4.2	2				x	x	x	x													x	x									x (30)		x	x		x	x				PCB		40 to 85	15.7 x 9.8 x 1.7	SMD	FWM7BLZ20-EVB2-EB2
	FWM7BLZ20-109062	4.2	2				x	x	x	x													x	x									x (30)		x	x		x	x				PCB		40 to 85	15.7 x 9.8 x 1.7	SMD	FWM7BLZ20-EVB2-EB2
	FWM7BLZ20B	5.0	2				x	x	x	x													x	x									x (30)		x	x		x	x				PCB		40 to 85	15.7 x 9.8 x 1.7	SMD	FWM7BLZ20-EVB2-EB2
	FWM7BLZ20B-109077	5.0	2				x	x	x	x													x	x									x (30)		x	x		x	x				PCB		40 to 85	15.7 x 9.8 x 1.7	SMD	FWM7BLZ20-EVB2-EB2
	FWM7BLZ22 (As of now, this is not a Bluetooth qualified product yet.)"	-																															x (20)			x		x		x				x	40 to 85	7.5 x 7.9 x 1.7	SMD	TBA
InsightSIP	ISP1507-AX	5.0	2				x	x	x	x													x	x	x								x	x	x	x		x	x			NFC-A	x		-40 to 85	8 x 8 x 1	LGA	ISP1507-AX-EB ISP1507-AX-TB
	ISP1807-LR	5.3	1				x	x	x	x													x	x	x								x	x	x	x		x	x	x		NFC-A	x		-40 to 85	8 x 8 x 1	LGA	ISP1807-LR-EB
	ISP1907-LL	5.3	2				x	x	x	x													x	x	x								x	x	x	x		x	x			PDM	x		-40 to 85	8 x 8 x 1	LGA	ISP1907-LL-EB ISP1907-LL-TB
	ISP1907-HT	5.3	1				x	x	x	x													x	x	x								x		x	x		x	x	x		PDM	x		-40 to 105	8 x 8 x 1	LGA	ISP1907-HT-EB ISP1907-HT-TB
	ISP2053-AX	5.3	2				x	x	x	x													x	x	x								x		x	x				x		QSPI, I^2S, PDM, PWM	x		-40 to 105	8 x 8 x 1	LGA	ISP2053-AX-EB
Panasonic	PAN1740	4.0	2						x																					+0	2.35 - 3.3	-93	DA14580	x		x	x		x	x				Chip		40 to 85	9.0 x 9.5 x 1.8	SMD	PAN1740-EMK, PAN1740-KIT
	PAN1740A	5.0	2																																													
	PAN1780(AT) PAN1770	5.1	2																											+8	1.7 - 5.5	-95	nRF52840	x		x	x		x	x	x		PWM, QDEC, NFC, COMP	Chip	u.FL	40 to 85	15.6 x 8.7 x 2	SMD	ENW89854AUKF (PAN1780) ENW89854AVKF (PAN1780AT) ENW89854CXKF / ENW89854CZKF
	PAN1781	5.1	2																											+8	1.7 - 5.5	-95	nRF52820	x		x	x			x	x		QDEC	Chip		40 + 85	15.6 x 8.7 x 2	SMD	ENW89857AXKF
	PAN1782	5.1	2																											+8	1.7 - 5.5	-95	nRF52833	x		x	x		x	x	x		PWM, QDEC, NFC, COMP	Chip		40 to 85	15.6 x 8.7 x 2	SMD	ENW89858AXKF
	PAN1783	5.x	2																											+3	1.7 - 5.5	-98	nRF5340	x		x	x		x	x	x		PWM, QDEC, NFC	Chip	x	40 to 85	15.6 x 8.7 x 2	SMD	tbd
	PAN4620	4.2	2																							IEEE802.15.4					+3	1.8 - 4.2	-98	NXP® Kinetis® KW41Z	x		x	x		x	x			TSI, DAC	Chip		40 + 85	15.6 x 8.7 x 1.9	SMD	
Minew	MS44SF1	5.2																												+8	1.7 - 5.5	-95	nRF52820	x		x	x				x			PCB		40 + 105	20 x 12 x 2	SMT	
	MS45SF1	5.3																												+3	1.7 - 5.5	-98	nRF5340	x		x	x				x			PCB		40 + 85	18.5 x 12.5 x 2	SMT	
	MS46SF1	5.0																												+4	1.7 - 3.6	-95	nRF52805	x		x	x							PCB		40 + 85	15.8 x 12 x 2	SMT	
	MS48SF2	4.0																												+5	1.7 – 3.6	-97	m1805	x			x	x						PCB		40 + 85	15.8 × 12 ×2	SMT	
	MS50SFA1	5.0																												+4	1.7 – 3.6	-96	nRF52832/ nRF52810	x		x	x							PCB		40 + 85	15.8 × 12 ×2	SMT	
	MS50SFA2	5.0																												+4	1.7 – 3.6	-96	nRF52832/ nRF52810	x		x	x							Ceramic		40 + 85	15.8 × 12 ×2	SMT	
	MS50SFB1	5.0/5.1																												+4	1.7 – 3.6	-96	nRF52832/ nRF52810	x		x	x		x					PCB		40 + 85	20 x 12 x 2	SMT	
	MS50SFB2	5.0																												+4	1.7 – 3.6	-96	nRF52832/ nRF52810	x		x	x		x					Ceramic		40 + 85	20 x 12 x 2	SMT	
	MS50SFB3	5.1																												+4	1.7 – 3.6	-97	nRF52832/ 811/ 810	x		x	x		x					IPEX		40 + 85	20 x 12 x 2	SMT	
	MS50SF7	5.0																												+4	1.7 – 3.6	-96	nRF52832	x		x	x							PCB		40 + 85	9.8 x 8.4 x 2	SMT	
	MS51SF1	5.2																												+8	1.7 - 5.5	-96	nRF52833	x		x	x							PCB		40 + 105	9.8 x 8.4 x 2	SMT	
	MS52SF1	5.0																												+10	1.8 – 3.6	-97	TLSR8208	x			x				x			PCB/IPEX		40 + 85	15.8 × 12 ×2	SMT	
	MS52SF2	5.0																												+10	1.8 – 3.6	-97	TLSR8208	x			x				x			PCB		40 + 85	15.8 × 12 ×2	SMT	
	MS53SF1	5.2																												+8	1.7 – 3.6	-97	BlueNRG-355M	x			x							PCB		40 + 85	20 x 12 x 2	SMT	
	MS53SF2	5.3																												+8	1.7 – 3.6	-97	BlueNRG-332AC	x			x							PCB		40 + 105	20 x 12 x 2	SMT	
	MS88SF2	5.0/5.1																												+8	1.7 - 5.5	-103	nRF52840/ nRF52833	x		x	x				x			PCB/IPEX		40 + 85/ +105	23.2 X 17.4 x 2	SMT	
	MS88SF3	5.0																												+8	1.7 - 5.5	-103	nRF52840/ nRF52833	x		x	x				x			PCB		40 + 85/ +105	18.5 x 12.5 x 2	SMT	
	MS88SFA	5.2																												+20	1.7 - 5.5	-96	nRF52840/ nRF52833	x		x	x							PCB/IPEX		40 + 85/ +105	23.2 X 17.4 x 2	SMT	
	MS88SFB	5.2																												+20	1.7 - 5.5	-96	nRF52833	x		x	x							PCB/IPEX		40 + 105	23.2 X 17.4 x 2	SMT	
Murata	WSM-BL241-ADA-008	5.0	2					x	x	x														x		LL, SM					+4	1.7 - 3.6	-93	nRF52832	x		x	x		x	x				PCB		-40 to 85	7.4 x 7.0 x 0.9	LGA	WSM-BL241-ADA-008DK
	Type 2EG	5.2																												+6	1.71 - 3.46	-96	Onsemi RSL15			x	x							PCB		-40°C to 85°C	7.4 x 7.0 x 1.0	LGA	LBCA1HN2EG-EVK

1) Data transmission profile embedded

Content

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Manufacturer	Name	Bluetooth specification	Bluetooth class	Stack/Profile																										Max. Transmit Power TX (dBm)	Supply Voltage Range (V)	Input Sensitivity RX (dBm)	Used Ics	Interfaces									other	Antenna		Operating Temp. (°C)	Size (mm)	Package	Evaluation Kit / Development Kit
				SPP	HCI	HDP	ATT	GAP	GATT	L2CAP	HID	HSP	HFP	DUN	RFCOMM	SDP	A2DP	AVRCP	iAP	SDAP	SMP	LL	SM	Gazell	TI	Other						GPIO	PCM	SPI	UART	JTAG	ADC	I²C	USB	RS-232		Intergrated Antenna	Without Antenna				
...Bluetooth Low Energy																																													
TDK	SESUB-PAN-T2541	4.0	2																						TI	+0	-0.3 - 3.9	-70	TI CC2541	x			x		x	x				x	-20 to 70	4.6 x 5.6 x 1.0	SESUB LGA	SESUB-PAN-T2541EVK
	SESUB-PAN-D14580	4.1	2						x																	+0	-0.1 - 3.6	-94	DA14580	x		x	x		x	x					x	-20 to 70	3.5 x 3.5 x 1.0	SESUB BGA	SESUB-PAN-D14580EVK
Telit	BlueMod+S	4.1	2						x																Terminal I/O GATT central role Automation I/O	+4	1.8 - 3.6		nRF51822	x		x	x		x	x				x		-20 to + 75	17 x 10 x 2.6	LGA, 49 pins	BueEva+S, BlueDev+S
	BlueMod+S42	4.2	2						x																Terminal I/O LUA	+5	1.7 - 3.6	-93	nRF52832	x		x	x		x	x				x		-40 to + 85	17 x 10 x 2.6	LGA, 49 pins	BlueEva+S42, BlueDev+S42
	BlueMod+S42M	4.2	2						x																Terminal I/O	+0	1.7 - 3.6	-94		x		x	x		x	x				x		0 to + 70	17 x 10 x 2.6	LGA, 49 pins	BlueEva+S42M, BlueDev+S42M
	BlueMod+W42	4.2	2						x																WIREPAS (Mesh)	+5	1.7 - 3.6	-93	nRF52832	x		x	x		x	x				x		-40 to + 85	17 x 10 x 2.6	LGA, 49 pins	
	BlueMod+S50	5.0	2						x																Terminal I/O	+5	1.7 - 3.6	-93	nRF52832	x		x	x		x	x				x		-40 to + 85	17 x 10 x 2.6	LGA, 49 pins	BlueEva+S50, BlueDev+S50
iWaitv	RENO	5.0	1					x	x	x												x				+8	1.7v - 5.5v	-92	nRF52840	x	x	x	x		x	x	x			x		-40 to + 85	10 x 15 x 1.5, 0.5 pitch	LGA	RENO DVK
	NILE	5.0	1					x	x	x															IEEE802.15.4	+8	1.7 - 5.5	-92	nRF52840	x	X		X		X	X	X			x		-40 to + 85	10 x 15 x 1.5, 0.5 pitch	LGA	NILE DVK
	NEVA	5.4	1				x	x	x	x												x	x			IEEE802.15.4	+8	1.7 - 5.5	-96	nRF52833	x		x	x			x				x		-40 to + 105	10 x 15 x 1.6, 0.5 pitch	LGA	NEVA DVK
	ELBE	5.4					x	x	x	x													x			IEEE802.15.4	+4	1.7 - 3.6	-96	nRF52811	x		x	x			x				x		-40 to + 85	10 x 15 x 1.6, 0.5 pitch	LGA	ELBE DVK
	OHIO	5.4					x		x	x												x	x				+4	1.7 - 3.6	-96	nRF52810	x		x	x			x				x		-40 to + 85	10 x 15 x 1.6, 0.5 pitch	LGA	OHIO DVK
	TISA	5.4					x		x	x												x	x				+4	1.7 - 3.6	-97	nRF52805	x		x	x			x				x		40 to + 85	10 x 15 x 1.6, 0.5 pitch	LGA	TISA DVK
Infineon	CYBLE-333073-02	5.2	1		x		x		x								x					x	x	x		12 dBm	2.5 - 3.6	- 94.5 dBm	AIROC™ CYW20835	x	x	x	x		x	x					RF-Pad	-30 to + 85	13.31 x 21.89 x 1.95	45-pad SMT	N/A
	CYBLE-333074-02	5.2	1		x		x	x	x	x	x						x					x	x	x		+12	2.5 - 3.6	-94.5	AIROC™ CYW20835	x	x	x	x	x	x	x				x		-30 to + 85	13.3 x 21.89 x 1.95	43-pad SMT	CYBLE-333074-EVAL-M2B
	CYBLE-343072-02	5.2	1		x		x	x	x	x	x						x					x	x	x		+12	2.5 - 3.6	-94.5	AIROC™ CYW20835	x	x	x	x	x	x	x				x		-30 to + 85	13.3. x 21.89 x 1.95	43-pad SMT	CYBLE-343072-EVAL-M2B
	CYW20829B0-P4TAI100	5.4	2		x		x	x	x	x	x											x	x	x		10 dBm	2.75 - 3.6	–106.0	AIROC™ CYW20829	x	x	x	x	x	x	x				x		-40 to + 85	14.5 x 19 x 1.95	41-pad SMT	CYW920829B0M2P4TAI100EVK
	CYW20829B0-P4EPI100	5.4	2		x		x	x	x	x	x											x	x	x		10 dBm	2.75 - 3.6	–106.0	AIROC™ CYW20829	x	x	x	x	x	x	x					RF-Pad	-40 to + 85	14.5 x 19 x 1.95	41-pad SMT	CYW920829B0M2P4EPI100EVK
	CYW20822-P4TAI040	5.0	2				x	x	x	x							x					x	x	x		+4	3.3	-101	CYW20822	x		x	x		x	x				x		-30 to + 85	20.2 x 10.5 x 2.3	27-pad SMT	CYW920822M2P4TAI040-EVK
	CYW20822-P4EPI040	5.0	2				x	x	x	x							x					x	x	x		+4	3.3	-101	CYW20822	x		x	x		x	x					RF-Pad	-30 to + 85	20.2 x 10.5 x 2.3	27-pad SMT	CYW920822M2P4EPI040-EVK
	CYBLE-416045-02	5.0	2		x		x	x	x	x							x					x	x	x		+4.0	1.71 - 3.6	-20	PSoC™ 63-BLE	x	x	x	x	x	x	x	x			x		-30 to + 85	14 x 18.5 x 2.0	43-pad SMT	CYBLE-416045-EVAL
	CYBLE-224116-01	5.1																								20 dBm	1.9 - 5.5	- 95.0 dBm	PSoC™ 4-BLE	x		x	x		x	x				x		-40 to +105	9.5 x 15.4 x 1.80	32-pad SMT	N/A
	CYBLE-012011-00	5.1	2		x		x	x	x	x							x					x	x	x		+3	1.71 - 5.5	-87	PSoC™ 4-BLE	x		x	x		x	x				x		-40 to + 85	14 x 19 x 2.0	31-pad SMT	CYBLE-012011-EVAL
	CYBLE-212020-01	5.1	2		x		x	x	x	x							x					x	x	x		+3	1.71 - 5.5	-87	PSoC™ 4-BLE	x		x	x		x	x				x		-40 to + 85	14 x 19 x 2.0	31-pad SMT	CYBLE-212020-EVAL
	CYBLE-022001-00	5.1	2		x		x	x	x	x							x					x	x	x		+3	1.71 - 5.5	-87	PSoC™ 4-BLE	x		x	x		x	x				x		-40 to + 85	10 x 10 x 1.8	21-pad SMT	CYBLE-022001-EVAL
	CYBLE-222014-01	5.1	2		x		x	x	x	x							x					x	x	x		+3	1.71 - 5.5	-87	PSoC™ 4-BLE	x		x	x		x	x				x		-40 to + 85	10 x 10 x 1.8	22-pad SMT	CYBLE-222014-EVAL
	CYBLE-014008-00	5.1	2		x		x	x	x	x							x					x	x	x		+3	1.71 - 5.5	-87	PSoC™ 4-BLE	x		x	x			x				x		-40 to + 85	11 x 11 x 1.8	32-pad SMT	CYBLE-014008-EVAL
	CYBLE-214015-01	5.1	2		x		x	x	x	x							x					x	x	x		+3	1.71 - 5.5	-87	PSoC™ 4-BLE	x		x	x		x	x				x		-40 to + 85	11 x 11 x 1.8	32-pad SMT	CYBLE-214015-EVAL
	CYBLE-212006-01	5.1	2		x		x	x	x	x							x					x	x	x		+3	1.71 - 5.5	-87	PSoC™ 4-BLE	x		x	x		x	x				x		-40 to + 85	15 x 23 x 2.0	30-pad SMT	CYBLE-212006-EVAL
	CYBLE-202007-01	5.1	2		x		x	x	x	x							x					x	x	x		+3	1.71 - 5.5	-87	PSoC™ 4-BLE	x		x	x		x	x					x	-40 to + 85	15 x 23 x 2.0	30-pad SMT	CYBLE-202007-EVAL
	CYBLE-202013-11	5.1	2		x		x	x	x	x							x					x	x	x		+3	1.71 - 5.5	-87	PSoC™ 4-BLE	x		x	x		x	x					x	-40 to + 85	15 x 23 x 2.0	30-pad SMT	CYBLE-202013-EVAL
Silex	SX-23BT	5.0	2																							+4.0	3.3	-90	Renesas RX23W								x			x	MHF4 connector	-40 to + 85	16 x 10 x 2.7	LGA	SX-23BT-EVK
Bluetooth Dual Mode																																												
Panasonic	PAN1316B PAN1326B	4.1/2.1	1		x				x																	+10	1.8 - 4.8	-93	CC2564B	x	x		x			x				x	x	-40 to + 85	9.0 x 6.5 x 1.8 9.0 x 9.5 x 1.8	SMD	PAN1326B-DB / ENW89819AZKF
	PAN1316C PAN1326C2	5.1	1		x																				Blue Radios	+11.5	1.7 - 4.8	-93	CC2564C	x	x		x			x				x	x	-40 to + 85	9.0 x 6.5 x 1.8 9.0 x 9.5 x 1.8	SMD	PAN1326C EVALKIT / ENW89819AYKF
Telit Cinterion	BlueMod+S50	5	1	x					x																Terminal I/O	+8	2.5 - 3.6			x		x	x		x	x				x	x	-40 to + 85	17 x 10 x 2.6	SMD	BlueEva+SR
Fujitsu	FWM7BTZ61	5,2		x			x	x	x	x						x	x				x	x	x		FDC	+4	1.71 - 3.3	-93		x (10)			x			x				PCB		-30 to + 85	17.6 x 10.6 x 1.9	SMD	
Infineon	CYBT-213043-02	5.0	2	x	x		x	x	x	x						x	x			x		x	x	x			+4	1.71 - 3.3	-95	AIROC™ CYW20819	x	x	x	x	x	x	x				x		-30 to + 85	12.0 x 16.6 x 1.7	35-pad SMT	CYBT-213043-EVAL
	CYBT-343026-01	5.0	1	x	x		x	x	x	x	x		x			x	x	x	x	x		x	x	x			+9	2.3 - 3.6	-96.5	AIROC™ CYW20706	x	x	x	x	x	x	x				x		-30 to + 85	12.0 x 15.5 x 1.95	24-pad SMT	CYBT-343026-EVAL
	CYBT-333032-02	5.0	1	x	x		x	x	x	x	x		x			x	x	x	x	x		x	x	x			+9	2.3 - 3.6	-96.5	AIROC™ CYW20706	x	x	x	x	x	x	x					x	-30 to + 85	12.0 x 13.5 x 1.95	24-pad SMT	CYBT-333047-EVAL
	CYBT-343151-02	5.0	2		x				x	x							x										+9	2.3 - 3.6	-96.5	AIROC™ CYW20706	x	x	x	x	x	x	x				x		-30 to + 105	12 x 15.5 x 1.95 mm	24-pad SMT	N/A
	CYBT-353027-02	5.0	1	x	x		x	x	x	x	x		x			x	x	x	x	x		x	x	x			+9	2.3 - 3.6	-96.5	AIROC™ CYW20707	x	x	x	x	x	x	x				x		-30 to + 85	9.0 x 9.0 x 1.75	19-pad SMT	CYBT-353027-EVAL
	CYBT-413055-02	5.0	2		x												x										+4	1.76 - 3.63	-95	AIROC™ CYW20719	x	x	x	x		x	x				x		-30 to + 85	12 x 16.3 x 1.70 mm	30-pad SMT	N/A
	CYBT-423054-02	5.0	1	x	x		x	x	x	x	x		x			x	x		x	x		x	x	x			+4.0	1.76 - 3.63	-95.5	AIROC™ CYW20719	x	x	x	x	x	x	x				x		-30 to + 85	11.0 x 11.0 x 1.70	28-pad SMT	CYBT-423054-EVAL
	CYBT-483056-02	5.0	1	x	x		x	x	x	x	x		x			x	x		x	x		x	x	x			+20	1.76 - 3.63	-95.0	AIROC™ CYW20719	x	x	x	x	x	x	x				x		-30 to + 85	12.75 x 18.59 x 1.8	34-pad SMT	CYBT-483056-EVAL
	CYBT-413061-02	5.0	1	x	x		x	x	x	x	x	x	x			x	x	x	x	x		x	x	x			+4.0	1.76 - 3.63	-95.0	AIROC™ CYW20721	x	x	x	x	x	x	x				x		-30 to + 85	12.0 x 16.3 x 1.70	30-pad SMT	N/A
	CYBT-423060-02	5.0	1	x	x		x	x	x	x	x	x	x			x	x	x	x	x		x	x	x			+4.0	1.76 - 3.63	-95.0	AIROC™ CYW20721	x	x	x	x	x	x	x				x		-30 to + 85	11.0 x 11.0 x 1.70	28-pad SMT	N/A
	CYBT-483062-02	5.0	1	x	x		x	x	x	x	x	x	x			x	x	x	x	x		x	x	x			+20	1.76 - 3.63	-95.0	AIROC™ CYW20721	x	x	x	x	x	x	x				x		-30 to + 85	12.75 x 18.59 x 1.8	34-pad SMT	N/A
	CYBT-263064-02	5.0	1		x		x		x	x							x										+15	1.71. - 3.3	-95	AIROC™ CYW20819	x	x	x	x			x					x	-30 to + 85	12.5 × 19 × 1.85 mm	35-pad SMT	N/A
	CYBT-263065-02	5.0	1		x			x	x								x										+15	1.71. - 3.3	-95	AIROC™ CYW20819	x	x	x	x			x					x	-30 to + 85	12.5 × 19 × 1.85 mm	35-pad SMT	N/A
	CYBT-273063-02	5.0	1		x		x	x	x								x										+15	1.71. - 3.3	-95	AIROC™ CYW20819	x	x	x	x			x				x		-30 to + 85	12.5 × 19 × 1.85 mm	35-pad SMT	N/A
	CYBT-223058-02	5.0	2		x				x	x																	+4	1.71 - 3.3	-95	AIROC™ CYW20819	x	x	x	x		x	x				x		-30 to + 85	11 x 11 x 1.70 mm	35-pad SMT	N/A
	CYBT-253059-02	5.0	2		x				x	x																	+10.5	2.6 - 3.3	-94.5	AIROC™ CYW20820	x	x	x	x		x	x				x		-30 to + 85	11 x 11 x 1.70 mm	35-pad SMT	N/A
	CYBT-243053-02	5.0	2		x		x	x	x								x										+10.5	2.6 - 3.3	-94.5	AIROC™ CYW20820	x	x	x	x		x	x				x		-30 to + 85	12 x 16.61 x 1.70 mm	35-pad SMT	CABT-24053-EVAL

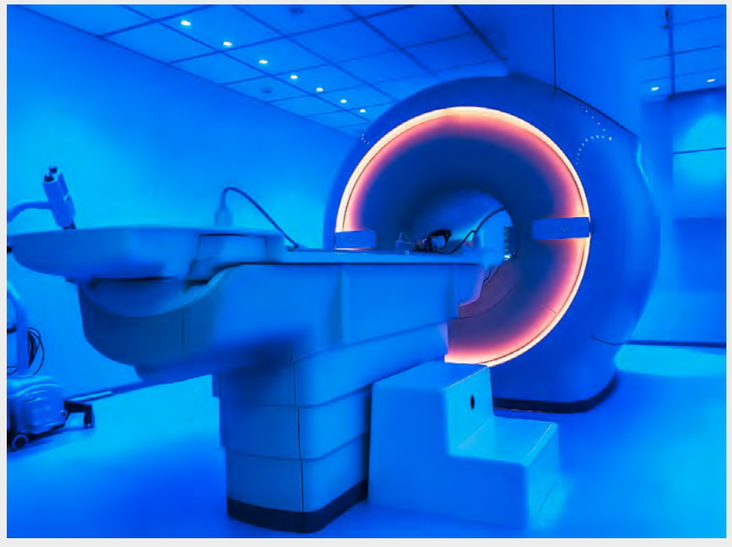
What is ISM?

The industrial, scientific and medical (ISM) radio bands are radio bands that are internationally reserved for the use of radio frequency (RF) energy for industrial, scientific and medical purposes. ISM covers frequency bands from 125 kHz to 50 GHz.

That means that not only the worldwide operating 2.4 GHz band is supported by ISM, but also the European (169 MHz, 433 MHz, 868 MHz) as well as the US-American (315 MHz, 915 MHz) SubGHz bands. Consequently, ISM covers the frequency bands intended for short-range radio technology applications.

SubGHz ISM radio frequency solutions as well as 2.4 GHz ISM radio frequency solutions are presented in this chapter. Still, ISM has to be differentiated from other wireless technologies which use the same frequency bands.

At Rutronik, the classification group ISM covers all solutions which do not belong to WiFi, Bluetooth, ZigBee, RFID, GSM or GPS.



Wireless Control Receiver ICs

The Wireless Control Receiver series from Infineon is made up by a group of very low power consumption single chip ASK and ASK/FSK Superheterodyne Receivers (SHR) for the sub 1 GHz frequency bands. The ICs offer a high level of integration and need only a few external components.

TDA5240, TDA5235 & TDA5225 – High sensitivity, low-power receiver familiy SmartLEWIS RX+

Features:

- Multi-band (300-320, 425-450, 863-870, 902-928 MHz) for worldwide operation coverage
- 10.5 Hz high resolution Sigma-Delta Fractional-N PLL
- One crystal frequency for all supported frequency bands
- Integrated IF-filter but also optional external CER filter possible
- Low supply current: 0,8 µA in Power down, 12 mA for Run mode
- Datarate up to 112 kchip/s
- ESD protection +/-2kV on all pins
- Digital RSSI peak detectors
- On-chip temperature sensor
- Voltage supply range 3.3 / 5.0 V
- Temperature range -40 to +105 °C
- Automotive Qualified
- Higher sensitivity due to improved noise figure and reducible noise bandwidth
- Programmable on-chip channel bandpass filter
- Improved channel selectivity due to dual conversion architecture
- Improved blocking performance against co-channel interference
- Full finest resolution sigma-delta PLL
- Both 3.3V and 5V-compatible I/O interface to microcontroller
- Configurable AGC and AFC for improved dynamic range and handling of freq.offsets

Additional Features for TDA5240 & TDA5235

- Highest sensitivity receiver: Typ. -118 dBm for FSK, Typ. -116 dBm for ASK
- Autonomous receive mode leads to reduced noise of host processor, improved sensitivity and reduced power consumption of the system
- Up to 4 (TDA5240) / 2 (TDA5235) parallel parameter sets and up to 12 different frequency channels (TDA5240 only)
- Several embedded encodings and modulation schemes
- Support for additional encodings biphase and NRZ
- Ultrafast Fallback Wake-up criterion reduces receiver's active time (and average current consumption), when no data available
- More configuration options for autonomous polling schemes

Applications

- Remote keyless entry systems
- Remote start applications
- Tire pressure monitoring
- Remote control units
- Cordless alarm systems
- Remote metering

SubGHz Chips Selection Guide

Manufacturer	Name	Mode			Modulation Scheme										Max. Transmit Power TX (dBm)	Supply Voltage Range (V)	Frequency Range (Hz)							Temperature Range (°C)	Max. Input Sensitivity RX (dBm)	Multi-Channel		MCU		Memory				Interface									Package (Size in mm)	Evaluation Kit/ Development Kit
		TRX	RX	TX	ASK	2-/FSK	GFSK	MSK	GMSK	OOK	BPSK	O-QPSK	CSS			169M	315M	345M	433M	868M	915M	960M			Yes	No	Yes	No	Flash	RAM	EEPROM	No	GPIO	GPO	UART	SPI	JTAG	I²C	ADC		
Receiver																																											
Infineon	TDA5240		x		x	x										3.0-3.6 / 4.5-5.5	x	x	x	x	x	x		-40 to 105	FSK: 102 / ASK: 116	x			x			x									TSSOP-28	Evaluation Board TDA5240 434 MHz Evaluation Board TDA5240 868 MHz
	TDA5225		x		x	x										3.0-3.6 / 4.5-5.5	x	x	x	x	x	x		-40 to 105	FSK: 118/ ASK: 116	x			x			x									TSSOP-28	Evaluation Board TDA5225 868 MHz
	TDA5235		x		x	x										3.0-3.6 / 4.5-5.5	x	x	x	x	x	x		-40 to 105	FSK: 102 / ASK: 116		x		x			x									TSSOP-28	Evaluation Board TDA5235 315 MHz Evaluation Board TDA5235 434 MHz Evaluation Board TDA5235 868 MHz Evaluation Board TDA5235 915 MHz

SubGHz Modules Selection Guide

Manufacturer	Name	Mode			Modulation Scheme										Max.Transmit Power TX (dBm)	Supply Voltage Range (V)	Frequency Range (Hz)									Temperature Range (°C)	Input Sensitivity RX (dBm)	Multi-Channel		MCU		Memory				Interfaces													Package (Size in mm)	Evaluation Kit / Development Kit
		TRX	RX	TX	ASK	(2-(FSK)	GFSK	MSK	GMSK	OOK	BPSK	O-QPSK	CSS			169M	315M	345M	433M	868M	902M	928M	915M	960M			Yes	No	Yes	No	Flash	RAM	EEPROM	No	GPIO	GPO	UART	SPI	JTAG	I²C	ADC	DAC	PWM	USB	CAN	RS232TTL		
EnOcean	TCM 300	X			X										+3	2.6 to 4.5					x					-25 to 85	-96		X	X		32kB	2kB			X		X	X		X	X	X					22 x 19 x 3	EDK 350
	TCM 300U	X				X									+1	2.6 to 4.5						x				-25 to 85	-98		X	X		32kB	2kB			X		X	X		X	X	X					22 x 19 x 3	EDK 350U
	TCM 310	X			X										+3	2.6 to 4.5					x					-25 to 85	-96		X		X							X									22 x 19 x 3	EDK 350
	TCM 310U	X				X									+1	2.6 to 4.5						x				-25 to 85	-98		X		X							X									22 x 19 x 3	EDK 350U
	TCM 320	X			X										+3	2.6 to 3.3					x					-25 to 85	-96		X	X		32kB	2kB			X		X	X		X	X	X					36.5 x 18 x 5.5	EDK 350
	TCM 320U	X				X									+1	2.6 to 3.3						x				-25 to 85	-98		X	X		32kB	2kB			X		X	X		X	X	X					36.5 x 18 x 5.5	EDK 350U
	TCM 330	X			X										+5	3.0 to 3.3					x					-25 to 85	-96		X	X		32kB	2kB			X		X	X		X	X	X					22 x 19 x 3	
	TCM 330U	X				X									+1	3.0 to 3.3						x				-25 to 85	-98		X	X		32kB	2kB			X		X	X		X	X	X					22 x 19 x 3	
	TCM 410J	X				X									+0	2.6 to 5.0							x			-25 to 85	-95		X	X		64kB	4kB	8kB		X		X	X		X	X	X					22 x 19 x 3	
	TCM 515	X			X										+10	2.0 to 3.6					x					-40 to 85	-92		X		X							X									19 x 14.7 x 3	
	TCM 515U	X				X									+1	2.0 to 3.6						x				-40 to 85	-98		X		X							X									19 x 14.7 x 3	
	PTM 210		X	X											+5	el. dyn. power generator					x					-25 to 65			X		X																	40 x 40 x 11.2	
	PTM 210U		X		X										+5	el. dyn. power generator						x				-25 to 65			X		X																	40 x 40 x 11.2	EDK 350U
	PTM 210J		X		X										+0	el. dyn. power generator							x			-25 to 65			X		X																	40 x 40 x 11.2	EDK 400J
	PTM 215		X	X											+5	el. dyn. power generator					x					-25 to 65			X		X																	40 x 40 x 11.2	EDK 350
	PTM 535		X	X											+5	ECO 260 / energy impulse					x					-25 to 65			X		X																	26.2 x 21.15 x 3.5	
	PTM 535J		X		X										+0	ECO 260 / energy impulse							x			-25 to 65			X		X																	26.2 x 21.15 x 3.5	
	STM 300	X			X										+3	2.1 to 4.5					x					-25 to 85	-96		X	X		32kB	2kB			X		X	X		X	X	X					22 x 19 x 3.1	EDK 350
	STM 300U	X				X									+1	2.1 to 4.5						x				-25 to 85	-98		X	X		32kB	2kB			X		X	X		X	X	X					22 x 19 x 3.1	EDK 350U
	STM 320		X	X											+5	solar cell					x					-20 to 60			X	X		32kB	2kB															43 x 16 x 6	
	STM 320U		X		X										+99	solar cell						x				-20 to 60			X	X		32kB	2kB															43 x 16 x 6	
	STM 329		X	X											+5	solar cell					x					-20 to 60			X	X		32kB	2kB															43 x 16 x 6	
	STM 330		X	X											+6.4	solar cell					x					-20 to 60			X	X		32kB	2kB															43 x 16 x 8	EDK 350
	STM 331		X	X											+5	solar cell					x					-20 to 60			X	X		32kB	2kB															43 x 16 x 8	EDK 350
	STM 331U		X		X										+99	solar cell						x				-20 to 60			X	X		32kB	2kB															43 x 16 x 8	EDK 350U
	STM 332U		X		X										+102	solar cell						x				-20 to 60			X	X		32kB	2kB															43 x 16 x 8	EDK 350U
	STM 333U		X		X										+99	solar cell						x				-20 to 60			X	X		32kB	2kB															43 x 16 x 8	EDK 350
	STM 350		X	X											+5	solar cell					x					-20 to 60			X	X		32kB	2kB															50 x 16 x 10	
	STM 350U		X		X										+99	solar cell						x				-20 to 60			X	X		32kB	2kB															50 x 16 x 10	
	STM 400J	X			X										+0	2.1 to 5.0							x			-25 to 85	-95		X	X		64kB	4kB	8kB		X		X			X	X	X					22 x 19 x 3	EDK 400J
	STM 429J		X		X										+0	solar cell							x			-25 to 60			X	X		64kB	4kB	8kB														43 x 16 x 6	
	STM 431J		X		X										+0	solar cell							x			-25 to 60			X	X		64kB	4kB	8kB														43 x 16 x 8	EDK 400J
	STM 550														+5 dBm	solar cell					x	x	x			-5°C to +45°C																						40 x 40 x 13 mm	
	USB 300/500U/400J	X													+3	USB					x	x	x			0 to 50	-96																	Type A			70 x 23 x 9	

RFID/NFC

What Does RFID Mean?

RFID stands for Radio Frequency Identification and is a special kind of wireless communication to identify or count an object contactless. On one side there is a RFID-reader, like a terminal or handheld device. On the other side there is a transponder, like a tag or a label. Within a smartphone there is both a transponder and a reader.

In a passive RFID system, the reader emits a field of energy and data. The transponder uses the energy and data to read its memory and sends the contents back to the reader. In an active RFID system, the transponder has its own battery, which enables a much larger memory size, greater range and faster communication.

Technologies

Parameter	Low Frequency	High Frequency	Ultra High Frequency
Frequency	125 kHz	13.56 MHz	868 – 915 MHz
Reading Distance (typical)	1 m	5 cm	10 m
Reading Rate	slow	depending on ISO-standards	fast
Humidity	No influence	No influence	Negative influence
Metal	Negative influence	Negative influence	No influence
ISO Standards	11784/85, 14223 and 18000-2	14443, 15693 and 18000-3	14443, 15693 and 18000-6
Applications	Admission control, going away barrier, gas reading	Asset management, ticketing, tracking & tracing, group collection	Pallet collection, container tracking

It is also possible to make own active RFID systems by using components of 868 MHz or 2.4 GHz, which can be found in other chapters of this catalogue.

What is the difference between RFID and NFC?

NFC means Near-Field-Communication and is based on the RFID-technology. However, NFC can be seen as an “extension” or “specialisation” of the RFID-technology. NFC transfers low data rates on a short distance (max. 10cm) and stands out for a safe way of data transfer. It also provides standardized application data packets.

While data transfer based on RFID-technology has to take place between an active and a passive party, with NFC it is also possible peer-to-peer (between two active parties, e.g. a checkout counter in a supermarket and a NFC-mobile). The frequency band reserved for NFC-technology is standardized on an individual wave-band (135kHz; 13,56MHz, ISO 18000-2, -3; 22536).

Content

Transponder Applications Examples

ISO and Hybrid Cards
Available 125 kHz, 13.56 MHz and UHF IC technologies.
Cards can be customized with different personalization and encoding options.

Smartlabels and Tickets
Adhesive labels, Windshield Labels, Multi-Purpose Labels, Logistic Single Labels

Special Tags
On-Metal Tags, High Temperature Tags, Laundry Tags, Heavy Duty Tags, etc.

Keyfobs and Wristbands
All keyfobs and wristbands are waterproof and can be printed and personalized.

Disctags
These tags are all available with different diameters, with printing and with/without centre hole.

RFID Modules, Readers & Passive Transponders

NFC Panel Reader – NEO

The RFID HF | NFC Panel Reader - NEO is a compact RFID reading and writing device with an integrated 80 cm long cable (other cable lengths available on request). It is ideal for integration into existing control panels or cabinets within access controls on machines for employee identification, Industry 4.0 environments, or data exchange via NFC.

Product Features

- Dimensions: Panel cut-out: 22,3 mm
- Cable Length: 80 cm
- Housing Material: ABS
- Power Supply: 5 Vdc via USB or RS232
- IP Protection Class: IP65
- Operating Systems:
  - Windows 7 and higher
  - Linux (3.x.x., 2.6.x)
- Antenna: integrated
- Operating Temperature: -20 °C to +80 °C

Frequency Range	Supported Standards
UHF	ISO 18000-63
HF / NFC	ISO 14443A/B ISO 15693 ISO 18000-3M3
LEGIC	Prime + Advant
LF	EM4200 Hitag-1 Hitag-S

NFC Desktop Reader – NEO 2

The HF | NFC | Desktop Reader - NEO 2 is a modern RFID desktop reader with USB 2.0 interface. The USB RFID reader is the perfect device for the latest IoT applications in companies and is ideal for a wide range of applications in retail, telecommunications, banking or healthcare. It supports the RFID standards LF, HF / NFC, LEGIC or UHF.

Product Features

- Dimensions: 115 × 70 × 17 mm
- Housing Material: ABS
- Power Supply: USB VCP + HID or PC/SC
- Operating Systems:
  - Windows 7 and higher
  - Linux (3.x.x., 2.6.x)
- Antenna: Integrated
- Operating Temperature: -20 °C to +70 °C
- Interface: USB 2.0 VCP/HID (Plug-and-play), CH340E Chip, PC/SC

BLUEBOX Professional RFID

BLUEBOX professional RFID is a family of highly sophisticated RFID controllers, readers, antennas and solutions allowing easy system integration.

BLUEBOX Unique Advantages

- Ruggedized product design and enclosures (All components minimum IP67 or IP54)
- Available for
  - UHF 860–960 MHz (ISO18000-6C, EPC Class1 Gen2),
  - HF 13.56 MHz (ISO15693, ISO14443A/B, ISO 18000-3)
  - LF 125 kHz (ISO18000-2, ISO11784/11785)
- Solutions for Near Field, Short-, Mid- and Long-Range appl.
- Contr. with integr. antenna or for running 1, 2 and 4 antennas
- Extended range of application specific antennas
- Outstanding read / write performance and reading distances
- Possibility of using diff. RFID standards in parallel in one application
- Multiple Interface Options (USB, CANbus, RS232/485, Ethernet, Profibus, Profinet, etc.)
- Integrated Webserver for remote access to Controller
- Suitable for Stand-Alone operation
- Integrated I/O ports
- Micro SD slot for memory extension
- Diagnostic interface
- Several Standard Read Modes like Buffered Read Mode, Scan Mode, Notification Mode, RSSI Mode
- Unique SDK for all BLUEBOX products
- BLUEBOX SHOW applications software
- M12 connections for trouble-free and secure connection and installation (optional RJ45 for UHF CX Controller)

Passive RFID Transponders – Overview

With its large portfolio of chips iDTRONIC covers the total frequency bandwith of LF, HF and UHF RFID transponders.

Freq.	IC Version	ISO-Standard	Memory Cap.
UHF	NXP NTAG203	ISO/IEC 14443A	168 Byte
	Alien UHF Higgs 3 Gen2	ISO/IEC 18000-6C	64 Byte
	UHF U-Code Gen2	ISO 18000-6C	16 Byte
HF	NXP Mifare Ultralight (UL)	ISO 14443 A	64 Byte
	NXP Mifare Ultralight (UL) C	ISO 14443 A	192 Byte
	NXP Mifare Classic Mini	ISO 14443 A (1-3)	320 Byte
	NXP Mifare Classic 1K	ISO 14443 A	1024 Byte
	NXP Mifare Classic 4K	ISO 14443 A	4096 Byte
	NXP Mifare MF1S20 (mini)	ISO 14443	A 320 Byte
	NXP Mifare MF1S50 (1K)	ISO 14443 A	1024 Byte
	NXP Mifare MF1S70 (4K)	ISO 14443 A	4096 Byte
	NXP Mifare DESFire EV1 (2K)	ISO 14443 A (1-3)	2048 Bytes
	NXP Mifare DESFire EV1 (4K)	ISO 14443 A (1-3)	4096 Byte
	NXP Mifare DESFire EV1 (8K)	ISO 14443 A (1-3)	8192 Byte
	NXP Mifare Plus S 2K	ISO 14443 A	1 kB
	NXP Mifare Plus S 4K	ISO 14443 A	4 kB
	NXP Mifare Plus X 2K	ISO 14443 A	1 kB
	NXP Mifare Plus X 4K	ISO 14443 A	4 kB
	NXP I-Code SLI	ISO 15693	128 Byte
	NXP I-Code SLI-S (2K)	ISO 15693	256 Byte
	LEGIC MIM256	ISO 14443 A	256 Byte
	LEGIC MIM1024	ISO 14443 A	1024 Byte
	TI Tag-it HF-I	ISO 15693	256 Byte
	LEGIC Advant 1024	ISO 14443 / 15693	128 Byte
	LEGIC Advant 2048	ISO 14443 / 15693	256 Byte
	STM SRI512	ISO 14443 B	64 Byte
	STM LRI2K	ISO 15693	256 Byte
	STM SRI4K	ISO 14443 B	512 Byte
LF	Contactl. EM4100/4200	Read Only	8 Byte
	Contactl. Card EM4450/4550	ISO 11784/85	125 Byte
	Atmel Temic 5567	ISO 11784/88	363 Byte
	NXP Hitag 1	ISO 11784/88	256 Byte
	NXP Hitag 2	ISO 11784/88	32 Byte
	NXP Hitag S256	ISO 11784/88	256 Byte
	NXP Hitag S2048	ISO 11784/88	2 kB

Freq.-Range	Desktop Reader	Various Controller with integrated Antenna	Various Controller with up to 4 ports for external Antenna	M30 Cylindrical Reader (metal)	Various M18/M30 Cylindrical Antennas	Various other Short Range, Mid Range and Long Range Antennas
UHF Reading Distance	Up to 30 cm	Up to 3 m	Up to 10 m	up to 50 cm*	Up to 20 cm	
HF Reading Distance	Up to 15 cm	Up to 15 cm	Up to 15 cm	Up to 8 cm	Up to 6 cm	Up to 80 cm
LF Reading Distance	Up to 10 cm	Up to 15 cm	Up to 30 cm	Up to 6 cm	Up to 8 cm	Up to 13 cm

*IP67

Transponder Chips – Selection Guide

Parameters	Manufacturer	Transponder Chip	Frequency (Hz)			Standard							Storage Type		Package						
			LF	HF	UHF	ISO 15693	ISO 14443	ISO 14443-2	ISO 14443-3	ISO 14443-4	JISX 6319-4 (FeliCa)	Other	EEPROM	FeRAM	SO8	TSSOP8	UFDFPN8	Wafer	16-pin QFN	24-pin QFN	Other
Dual Interface RFID	Infineon	NAC1080		13.56					Type A				60 kB								
	Giantec	GT23SC4479		13.56					x				x					x			
		GT23SC4489		13.56					x				x					x			
		GT23SC8899-1/2/3/4		13.56					x			NFC Forum Type2	x					x			
		GT23SC8899C-1/3/4		13.56					x			NFC Forum Type2	x								XDFN4
		GT23SC6699-1/2		13.56					x			NFC Forum Type2	x			x	x				
		GT23SC4419-1/2/3		13.56		x						NFC Forum Type5	x					x			
	Fujitsu	MB97R8110			x							ISO 18600-6 Type C, EPCglobal C1G2 Ver.1.2.0		8kB				x			
		MB89R118C		13.56		x	x					ISO 18000-3		2kB				x			
Single Interface RFID	Fujitsu	MB97R8050			x							ISO 18600-6 Type C, EPCglobal C1G2 Ver.1.2.0		256Byte				x			
	Fujitsu	MB97R8120			x							ISO 18600-6 Type C, EPCglobal C1G2 Ver.1.2.0		8kB				x			
	Fujitsu	MB89R119B		13.56		x	x							256 Byte				x			
	Fujitsu	MB89R112A		13.56		x	x					ISO 18000-3		9kB				x		x	

Active RFID Tags – Selection Guide

Manufacturer	Part Name	RFID RX Frequency			ISM TRX Frequency (MHz)				Temp. Range (°C)	MCU		Memory		Dimension
		LF	HF	UHF	315	433	868	915		Yes	No	Flash	EEPROM	
Murata	LXMS33HCNG-134		x						-40 +85°C	x		896 bits	64 bits	3.2 x 3.2 mm
	LXMS33HCNK-171		x						-40 +85°C	x		384 bits	64 bits	3.2 x 3.2 mm
	LXTBKYSCNN-018		x						-40 +85°C			1152 bits	56 bits	6.4 x 6.4 x 1.0 mm
	LXMSJZNCMD-217			x			x	x	-40 +85°C					1.2 x 1.2 x 0.55 mm
	LXMSJZNCMF-210			x			x	x	-40 +85°C					1.2 x 1.2 x 0.55 mm
	LXMS21ACMF-218			x			x	x	-40 +85°C					2.0 x 1.2 x 0.5 mm
	LXMS21ACMD-220			x			x	x	-40 +85°C					2.0 x 1.2 x 0.5 mm
	LXMSJZNCMH-225			x			x	x	-40 +85°C					1.2 x 1.2 x 0.55 mm
	LXMS21NCMH-230			x			x	x	-40 +85°C					2.0 x 1.25 x 0.55 mm
	LXTBKZMCMG-010			x			x	x	-40 +85°C					6 x 2.0 x 2.3 mm

Reader Modules – Selection Guide

Parameters	Manufacturer	Description	Order Code	Reader Type		Frequency (Hz)			Supported Standard														Supported Tags	Power Supply	Interface							Antenna	Dimensions (mm)
				Module	Stick	LF	HF	UHF	ISO 11784	ISO 11785	ISO 15693	ISO 14443 A	ISO 14443 B	ISO 14443-2 B	ISO 14443-3 B	ISO 18000-6C	ISO 18092	ISO 18000-3	ISO 7816	ISO 19092	JISX 6319-4 (FeliCa)				USB	I²C / O	TTL	TCP/IP	SAM slot	RS232	RS485		
Embedded HF Modules with integrated antenna	iDTRONIC	HF | NFC Embedded Reader R835 - TTL HF | NFC Embedded Reader R835 - USB HF | NFC Embedded Reader R835 - HID HF | NFC Embedded Reader R835 - PC/SC	OEM-DES-R835-TTL OEM-DES-R835-USB OEM-DES-R835-HID OEM-DES-R835-PCSC	x			13.56M				EM4135, EM4043, EM4x33, EM4x35, I-Code SLI/SLIX/DNA, M24LR16/64, TI Tagit HF-I, SRF55Vxx (my-d vicinity)	Read/Write: MIFARE® Classic Mini /1K /4K, MIFARE Ultralight®, MIFARE Ultralight® C, MIFARE Ultralight® Nano, MIFARE® DESFire®EV1, MIFARE® DESFire® Light, MIFARE® Smart MX, MIFARE® Plus S / X, MIFARE® Pro X, NTAG 21x, NTAG 424 Read UID only: Read UID only of all other ISO14443A RFID tags	SRI4K, SRIX4K, AT-88RF020, 66CL160S, SR176								see supported Standard	5 V	USB, HID, PCSC	x					integrated	58.4 × 35 × 4.7
Embedded HF / NFC Modules with external antenna	iDTRONIC	OEM HF | NFC Embedded Module M890 - TTL OEM HF | NFC Embedded Module M890 - USB OEM HF | NFC Embedded Module M890 - HID OEM HF | NFC Embedded Module M890 - RS232 OEM HF | NFC Embedded Module M890 - PC/SC	OEM-DES-M890-TTL OEM-DES-M890-USB OEM-DES-M890-HID OEM-DES-M890-RS232 OEM-DES-M890-PCSC	x			13.56M													PSAM = 1 (optional)			see supported Standard	3.3 ~ 5 Vdc	USB VCP, USB HID, PC/SC	x			x	x		external	22 × 42 × 3 mm (TTL) 22 × 53 × 5 mm (USB, RS232)
Embedded HF / NFC Module MULTI ISO with external antenna	iDTRONIC	OEM HF | NFC Embedded Module M900 - TTL OEM HF | NFC Embedded Module M900 - USB OEM HF | NFC Embedded Module M900 - HID OEM HF | NFC Embedded Module M900 - PC/SC	OEM-DES-M900-TTL OEM-DES-M900-USB OEM-DES-M900-HID OEM-DES-M900-PCSC	x			13.56M															see supported Standard	3.3 Vdc	x	x						external	25 × 16.5 × 2.8
Embedded HF Module LEGIC with external antenna	iDTRONIC		OEM-LEG-M800-TTL-FLEX	x			13.56M				x	x										LEGIC PRIME / Advant	5 V	x	x						external	31 x 26 x 4
Embedded HF Module LEGIC with integrated antenna	iDTRONIC	OEM HF Module LEGIC with antenna	OEM-LEG-R800-TTL OEM-LEG-R800-232	x			13.56M				x	x										LEGIC PRIME / Advant	5 V	x	x			x			integrated	82 x 57 x 10
OEM RFID LF Modules & Readers	iDTRONIC	OEM RFID LF Reader ONLY / TTL	OEM-LF-R810-TTL	x		125k			x	x												R/O chips EM4200	5 V								integrated	30 x 8,5
OEM RFID UHF Modules & Readers	iDTRONIC	OEM RFID UHF Stick Reader EVO / USB	OEM-UHF-R830-USB-SR01		x			860-925M								incl. EPC Class 1 Gen 2						ALIEN Higgs3 Gen2 NXP U-Code GSXM / G2XL	20dBm / 100 mW (can be regulated with SW)	x							integrated	80 x 21 x 12
	iDTRONIC	OEM RFID UHF Module / TTL	OEM-UHF-M800-TTL / 232	x				860-925M								incl. EPC Class 1 Gen 2						ALIEN Higgs3 Gen2 NXP U-Code GSXM / G2XL	27dBm / 100mW (can be regulated with SW)			x		x			UFL connector for external antenna available	31 × 38 × 6.5
	iDTRONIC	UHF Module MULTI ISO TTL / USB	OEM-UHF-M900-TTL/USB	x				860-925M								incl. EPC Class 1 Gen 2						ALIEN Higgs3 Gen2 NXP U-Code GSXM / G2XL	27dBm / 100mW (can be regulated with SW)	x	x						UFL connector for external antenna available	25 x 30 x 5
	iDTRONIC	Embedded UHF RFID Module TTL / USB	OEM-UHF-M950-TTL / 232	x				860-925M								incl. EPC Class 1 Gen 2						ALIEN Higgs3 Gen2 NXP U-Code GSXM / G2XL	27dBm / 100mW (can be regulated with SW)	x	x						UFL connector for external antenna available	66 x 45 x 6.5

Reader Devices – Selection Guide

Parameters	Manufacturer	Description	Order Code	Frequency (Hz)			ISO 15693	ISO 14443 A	ISO 14443 B	ISO 18000-6C	ISO 18000-3	Supported Tags	Power Supply	Interface USB	Antenna	Dimensions (mm)	Weight (g)
				LF	HF (NFC)	UHF											
USB Readers	iDTRONIC	NFC Stick Reader EVO - USB VCP HID	R-Stick-EVO-NFC										5V	x	internal	75 x 20 x 10	
		HF | NFC Desktop Reader - NEO 2 - USB HF | NFC Desktop Reader - NEO 2 - HID HF | NFC Desktop Reader - NEO 2 - PC/SC	R-DT-NEO2-HF/NFC-USB R-DT-NEO2-HF/NFC-HID R-DT-NEO2-HF/NFC-PC/SC										5V	x	internal	115 x 70 x 17	
		HF | LF Desktop Reader - NEO 2 - USB HF | LF Desktop Reader - NEO 2 - HID	R-DT-NEO2-HF/LF-USB R-DT-NEO2-HF/LF-HID										5V	x	internal	115 x 70 x 17	
		LEGIC Desktop Reader NEO2 - USB LEGIC Desktop Reader NEO2 - HID LEGIC 4500M Desktop Reader NEO2 - USB	R-DT-NEO2-LEG R-DT-NEO2-LEG-HID R-DT-NEO2-LEG-45M										5V	x	internal	115 x 70 x 17	
		LF Desktop Reader NEO2 - USB LF Desktop Reader NEO2 - USB VCP HID	R-DT-NEO2-LF-USB R-DT-NEO2-LF-HID										5V	x	internal	115 x 70 x 17	
		NDEF Desktop Reader - NEO 2	R-DT-NEO2-NDEF-USB										5V	x	internal	115 x 70 x 17	
		UHF Desktop Reader NEO2 - USB UHF Desktop Reader NEO2 - USB HID	R-DT-NEO2-UHF-USB R-DT-NEO2-UHF-USB-HID										5V	x	internal	115 x 70 x 17	
Cylindrical Readers	iDTRONIC	UHF Cylindrical Reader BLUEBOX - RS232 UHF Cylindrical Reader BLUEBOX - RS485 UHF Cylindrical Reader BLUEBOX - SAE J1939 UHF Cylindrical Reader BLUEBOX - CANopen	R-IN-UHF-5224U R-IN-UHF-5225U R-IN-UHF-5226U R-IN-UHF-5227U			865-868M				incl. Class 1 Gen2		Alien Higgs 2/3/4m Impinj Monza, NXP UCODE, etc.	10-36VDC		internal	M30 x 1.5 x 90.65	115
		HF | NFC Cylindrical Reader BLUEBOX - M12 without cable - RS232 HF | NFC Cylindrical Reader BLUEBOX - M12 without cable - RS485 HF | NFC Cylindrical Reader BLUEBOX - Cable 1.5 m with open ends - RS232 HF | NFC Cylindrical Reader BLUEBOX - Cable 1.5 m with open ends - RS485	R-IN-HF-5224H R-IN-HF-5225H R-IN-HF-5227H R-IN-HF-5228H		13,56M		x	x	x			MIFARE Familiy	10-36VDC	x	internal	M30 x 1.5x 78	220
Short Range Readers	iDTRONIC	UHF Short Range Reader BLUEBOX - RS232/RS485	R-IN-UHF-5721U										10-36VDC		internal	120 x 122 x 37	400
Mid Range Readers	iDTRONIC	UHF Mid Range Reader BLUEBOX - Basic Version ETSI UHF Mid Range Reader BLUEBOX - Real Time Clock ETSI UHF Mid Range Reader BLUEBOX - Wiegand Interface ETSI UHF Mid Range Reader BLUEBOX - CANbus (J1939)	R-IN-UHF-5426U-G R-IN-UHF-5426U-RTC-G R-IN-UHF-5427U-G R-IN-UHF-5428U-G										10-36VDC		internal	190 × 190 × 80	
Long Range Readers	iDTRONIC	UHF Long Range Reader BLUEBOX - RJ45 Ethernet + RS232/485 UHF Long Range Reader BLUEBOX - RJ45 Ethernet + RS232/485 + Real Time Clock UHF Long Range Reader BLUEBOX - M12 Ethernet + RS232/485 UHF Long Range Reader BLUEBOX - M12 Ethernet + RS232/485 + Real Time Clock UHF Long Range Reader BLUEBOX - M12 Wiegand UHF Long Range Reader BLUEBOX - M12 CANbus (SAE J1939 or CANopen) + Ethernet	R-IN-UHF-5345U R-IN-UHF-5345U-RTC R-IN-UHF-5346U R-IN-UHF-5346U-RTC R-IN-UHF-5347U R-IN-UHF-5348U			840-960M				incl. Class 1 Gen 2		Alien Higgs 2/3/4, Impinj Monza, NXP UCODE, etc.	10-36VDC		Two external (50 Ω) TNC-female	110 × 140 × 62	700
Panel Readers	iDTRONIC	HF | NFC Panel Reader NEO - USB HF | NFC Panel Reader NEO - RS232	HF | NFC Panel Reader NEO - USB HF | NFC Panel Reader NEO - RS232		13.56M		EM4135, EM4043, EM4x33, EM4x35, ICode SLI / SLIX, M24LR16/64, TI Tag-it HF-I, SRF55Vxx (my-d vicinity)	Read/write: MIFARE® Classic/1K/4K, MIFARE Ultralight®/C, MIFARE® DESFire®EV1/2, MIFARE® Smart MX, MIFARE® Plus S / X, MIFARE® Pro X, NTAG 21x, Read UID only of all other ISO14443A RFID tags	SRI4K, SRIX4K, AT88RF020, 66CL160S, SR176		I-Code ILT-M		5VDC	x	internal	Panel cut-out: ø 22.3 mm Cable Length: 80 cm (other lengths on request)	35
Wall Readers	iDTROonic	HF | NFC Access Reader EVO - TCP / IP HF | NFC Access Reader EVO - RS485 HF | NFC Access Reader EVO - TCP / IP (Read-Only)	R-EA-WR-ET-HF R-EA-WR-485-HF R-EA-WR-ET-HF-RO		13.56M								12 Vdc (±5 % regulated)		internal	110 × 56 × 18	50
		HF | NFC Access Reader NEO - RS485	R-EA-WR-ID500-HF-485		13.56M							MIFARE® Classic Mini / 1K / 4K	5Vdc or 12 Vdc (±5 % regulated)	x	internal	100 × 46 × 20	50
		HF | NFC CANbus Reader - IGNITE-SMART	R-PROF-DES-LOCK-CAN-125 R-PROF-DES-LOCK-CAN-250 R-PROF-DES-LOCK-CAN-500										5VDC		internal	81 x 68 x 24	

Protocols

Wireless Protocols / Proprietary Protocols

Further technologies are available to build up wireless mesh networks. Some protocols are based on top of the IEEE802.15.4 specification (PHY and MAC layer specification) which is the standard for low data rate, low power networks. The advantage is the possibility to change the transceiver from one supplier to another, so you are more independent than using a single source. The disadvantage is the specification itself. The DSSS modulation, having 5 MHz per channel and only 16 channels available is very often not the perfect choice for an application because it needs more energy and frequency resources than other modulation schemes. Also IEEE802.15.4 solutions are often based on SoCs instead of separated transceiver and microcontroller. In case of using a SoC the advantage of being independent from a single source is not given.

Thread

Thread is based on IEEE 802.15.4. At the network and transport layers. Thread uses a combination of IPv6, 6LowPAN (IPv6 over Low power Wireless Personal Area Networks), UDP (user Datagram Protocol) and DTLS (Datagram Transport Layer Security).
The application layer can be defined individually.

As it is using IPv6, Thread can be used to integrate home automation devices directly to the IoT, without the need of making any protocol and address conversion. IPv6 has a strong encryption and authentication mechanism integrated – the IPsec.

Part of this security protocol is:

- Interoperability
- Cryptographic protection of the transmitted data
- Access control
- Integrity of data
- Authentication of transmitter (user authentication)
- Encryption
- Authentication of keys
- Administration of keys (key management)
- The Thread Group has some strong market drivers in its board, so we would not wonder if it will be the de facto standard for home applications soon.

ZigBee

Zigbee is based on IEEE 802.15.4. The technology supports large mesh networks and operates globally in 2.4 GHz unlicensed bands. Transport and application layers are defined by the CSA which aims to create IoT standards.

Zigbee is already widely adopted and includes a mature application layer called the Zigbee Cluster Library. Zigbee uses the counter mode (CTR) encryption, which has a 128 bit AES length and the cipher block chaining (CBC) with a 128 bit AES for the generation of the message integrity code (MIC). Within Zigbee a Trust Center (TC) device is determining and approving who wants to join the network. The Trust Center either instructs the router to authenticate the joined device or force it to leave.

There are three types of Zigbee security keys to protect the data: link, network and master/ application keys. All of them are symmetric.

EnOcean delivers under their Dolphin brand energy harvesting solutions also for 2.4 GHz ZigBee systems. The PTM 216Z for examples enables the realization of battery-less wall switches for smart home applications using the ZigBee Green Power standard. The use of ECO 200 plus the transmitter module PTM 535Z allows the design of e.g. remote controls, key card switches or industrial switches.

Matter

Matter aims to make it easy for developers to create a secure and reliable solution. If you want your products to be interoperable with the major smart home ecosystems, Matter is the way to go. Matter, which began as Project CHIP (Connected Home over IP) started in December 2019.

The starting companies were Amazon, Apple, Google, and others including Nordic Semiconductor. The goal is to agree on a unified application layer standard for connected things at home.

Matter is using Thread, Wi-Fi + Ethernet for transport and Bluetooth® LE for commissioning. All Matter devices based on Thread are required to feature Bluetooth® LE concurrently to enable adding new devices to a network. Wi-Fi can be used for low and high bandwidth applications.

It can be used for devices in range of the local Wi-Fi. Thread is an IPv6-based mesh protocol that targets low bandwidth applications. It is the go-to option for battery-powered devices that require the best energy efficiency and for simple actuators like smart plugs or light bulbs. Most mains-connected Thread devices work as a Thread router and will expand the network's range. Thread is a self-healing low-power mesh that can adapt to new devices or to devices being removed from the network.

6LowPan

6LowPan is an acronym for IPv6 over low power Wireless Personal Area Networks and is another protocol using IEEE 802.15.4. The working group IETF (Internet Engineering Task Force) created the basis for connecting wireless sensor networks with the internet. The specialty of this protocol is that it is not proprietary and is an open IoT networking protocol. It is able to connect to the internet and thus offers the possibility to allocate an unique IP address to every single device. Furthermore in contrast to other proprietary protocols it is able to communicate with other IEEE 802.15.4 devices and can operate with devices on other IP networks link (e.g. Wi-Fi).

Well suitable applications for 6LowPan can be found in e.g. building management, transport business and healthcare management.

EnOcean Wireless Standard

The EnOcean radio standard (ISO/IEC 14543-3-1X) operates in license-free 868 MHz (Europe, RED regulations), 902 MHz (North America, FCC/IC specifications) and 928 MHz (Japan, ARIB specification) frequency bands with 1% duty cycle and a reliable radio range of approx. 30m indoors and 300 meters in free field. For sending a signal in the EnOcean standard there is only an extremely small amount of energy necessary: Already 50 µWs are enough for a standard EnOcean energy harvesting wireless module to transmit a signal. Radio telegrams are of extremely short signal duration of maximum one millisecond enabling maintenance free sensor designs. Communication of the EnOcean solutions is possible via Gateways to bus systems like KNX, LON, DALI, BACnet or TCP/IP.

Wirepas

Wirepas connectivity technology is an automated multi-hop, self-configuring, self-healing low power wide-area mesh network. It's an ideal solution for large-scale industrial and infrastructure IoT applications such as smart meters and smart cities.

All the Wirepas Connectivity intelligence is in the network. The devices decide the best actions by themselves locally. No central network management is needed. The local decision-making ensures that the devices always operate the similar way, independent of the network size or the devices' locations within the network. Through Wirepas, devices can automatically choose their role according to the situation. This means that every device is a possible routing point for forwarding data. The user does not need to define the roles of the devices, this is done automatically depending on what the optimal topology is at a given time.

Wirepas devices can act synchronously, and co-operatively select the times and channels used for communication. All the available channels in a given band can be used. Whenever two devices want to communicate with each other they know the channel and the exact times to send and receive. This way all unnecessary overhead, such as overhearing, idle listening, and intra-network collisions, are removed. Furthermore Wirepas devices can communicate data over multiple hops. The topology is optimized continuously and adapts to changes in the environment and the network. For each device there are multiple routing options (next hops), and multiple Gateways (backhaul connection) can be used in the same network.

Content

Antennas

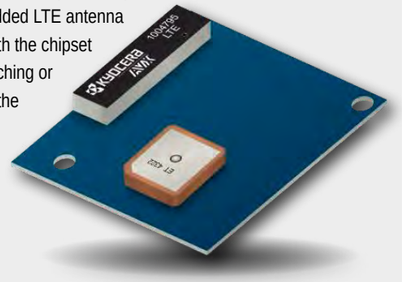
Active Antenna Band Switching
for Small IoT Devices

1004795-EC646-01 Evaluation Board

KYOCERA AVX evaluation board 1004795-EC646-01 is engineered to reduce the number of device design iterations, improve accuracy, and hasten product time-to-market for low- and high-band frequencies (700–960MHz and 1.71–2.17GHz) for 4G, LTE Cat-M, NB-IoT, and LPWA.
Engineers can test the band switching and antenna performance on a typical board size of IoT devices, reducing the number of prototype iterations.
The EVB uses the standard FR4 embedded LTE antenna 1004795 together with the chipset EC646 for band switching or aperture tuning.

Nordic nRF9160 Reference Design on a 53 x 53 mm PCB

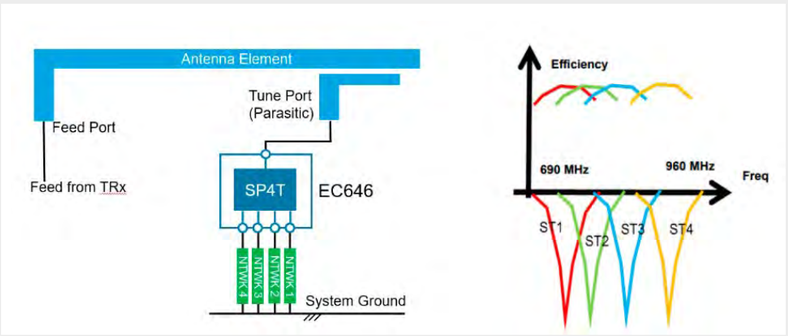
The LTE Antenna Band Switching Solution and GPS for nRF9160 is an easy-to-use battery-operated prototyping platform for cellular IoT using LTE-M, NB-IoT and GPS. It is ideal for creating Proof-of-Concept (PoC), demos and initial prototypes in the IoT development phase. The small form factor nRF9160 antenna solution that KYOCERA AVX offers for easy implementation and premium performance consists of the standard FR4 embedded LTE antenna 1004795 together with the chipset EC646 for band switching or aperture tuning. For the GPS frequency the small patch antenna 1004322 is used.



Key Features
- Evaluation board size: 45.5 x 60mm
- Frequency:
  700 – 960MHz / 1700 – 2170 MHz
- 4 active stages
- Efficiency: 18 – 30%
- Connector: SMA

Application Fields
- Asset trackers
- Industrial sensors
- Small IoT devices

1004795-EC646-01 Evaluation Board Diagrams



Next-Gen IoT Connectivity
with DECT NR+

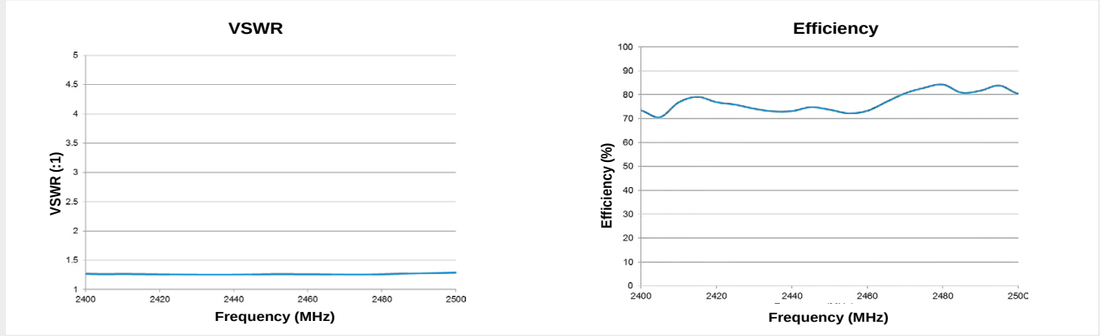
1001013 – DECT NR+ SMD Antenna

Experience the full potential of the next generation in wireless communication with KYOCERA AVX's antenna part number 1001013, now optimized for DECT NR+, a new cutting-edge technology employed in the newest Nordic DECT NR+ capable SiPs, such as nRF9161, nRF9131 and nRF9151.
This antenna is a gateway to excellent efficiency, compactness, and reliability in IoT applications spanning from industrial sensors to smart grids.
Engineered specifically for the 1880-1930 MHz band, the 1001013 antenna provides exceptional performance without the need for additional LTE bands.
This allows for a smaller form factor (based on the antenna footprint), perfectly suited for DECT NR+ exclusive applications.
This antenna has also the capability to work over metal surfaces, thanks to the versatile design to work off or on ground.

Key Features
- FR4 antenna
- Off and On ground capabilities
  (works over metal surfaces!)
- Size: 15.0 x 3.2 x 3.3 mm
- Frequency: 1.9 GHz
- Efficiency: 80%
- SMT

Application Fields
- Smart Metering
- Smart Lighting
- Asset trackers
- Industrial sensors
- Smart Cities

VSWR and Efficiency Plots (Off-Ground) – Typical performance on 50 x 70 mm PCB



Content

Embedded Antennas

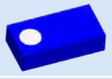
Manufacturer	Part	Picture	Standard								Antenna Type	Frequencies	Peak Gain (dBi)	Efficiency (%)	VSWR	Size (mm)	Polarization	Return loss (dB)	Temperature (C)	Impedance (Ohm)
			RFID	GSM / 2G	UMTS / 3G	LTE / 4G	ISM Standard	Bluetooth	WLAN	GNSS	UWB										
KYOCERA AVX	P822601			X	X	X	X					PCB	698-960 MHz 1710-2700 MHz 3300-3800 MHz	2.6 4.0 2.8	68 60 59	2.5:1	49.6 x 8.0 x 3.2	Linear	-7,5	-40 to +85	50
	1004795			X	X	X	X					PCB	617-960 MHz 1710-2200 MHz 2500-2700 MHz	1.6 3.1 1.7	64 55 53	2.5:1 2.5:1 3.0:1	36.0 x 9.0 x 3.2	Linear	-7.5 -7.5 -6.0	-40 to +85	50
	1001013						X	X				PCB	2400-2485 MHz or 1.9 GHz	2.6 1.6	76 80	1.5:1	15.0 x 3.2 x 3.3	Linear	-14	-40 to +85	50
	1000146							X	X			Stamped Metal	2400-2485 MHz 5150-5850 MHz 5925-7125 MHz	1.7 4.1 3.8	81 68 64	2.0:1 2.0:1 2.2:1	17.85 x 6.9 x 4.3	Linear	-9.5 -9.5 -8.5	-50 to +125	50
	1002427						X		X	X		Stamped Metal	868-915 MHz 2400-2485 MHz or 1560-1606 MHz	3.0 3.4 1.8	67 61 65	2.0:1	31.2 x 2.28 x 3.9	Linear	-9.5	-50 to +125	50
	1001312						X	X			X	Ceramic	2400-2485 MHz or 6000 – 8500 MHz	1.88 4.8	62 84	1.8:1 2.0:1	2.0 x 1.2 x 0.55	Linear	-11 -9.5	-50 to +125	50
	M830120									X		Ceramic	1559-1610 MHz or 1575.2 MHz 1227.6 MHz 1176.45 MHz	1.8 2.7 2.8 2.7	70 80 76 77	2.0:1 2.0:1 2.5:1 2.5:1	8.00 x 3.00 x 1.33	Linear	-9.5 -9.5 -7.5 -7.5	-40 to +85	50
	M620720						X					Ceramic	863 – 870 MHz or 902 – 928 MHz	0.30 0.75	58 60	1.6:1 2.5:1	6.00 x 2.00 x 1.08	Linear	-12.7 -7.5	-40 to +85	50
	9001978							X	X		X	Chip	2400-2485MHz or 2400-2485MHz 5150-5850MHz or 6000-8500MHz	3.5 3.0 3.0 5.7	68 65 50 80	2.5:1 2.1:1 7.0:1 2.6:1	1.00 x 0.55 x 0.40	Linear	-7.5 -9 -2.5 -7	-55 to +125	50
	9002137									X		Chip	1559-1610 MHz or 1575.2 MHz 1227.6 MHz 1176.45 MHz	2	65 75 86 72	2.0:1 1.5:1 1.7:1 2.0:1	1.00 x 0.55 x 0.40	Linear	-9.5 -14 -12 -7.5	-55 to +125	50
	9001157									X		Patch	1563-1587 MHz 1593-1610MHz	3.8 4.3	65 71	3.2:1	18.0 x 18.0 x 4.0	RHCP	-5.6	-40 to +85	50
	1002649									X		Patch	1559-1563 MHz 1575 MHz 1559-1591 MHz 1593-1610 MHz	5.0 5.5 5.5 5.5	-	1.4:1	25.0 x 25.0 x 6.7	RHCP	-15	-40 to +85	50

Manufacturer	Part	Picture	Standard									Antenna Type	Frequencies	Peak Gain (dBi)	Efficiency (%)	VSWR	Size (mm)	Polarization	Return loss (dB)	Temperature (C)	Impedance (Ohm)
			RFID	GSM / 2G	UMTS / 3G	LTE / 4G	ISM Standard	Bluetooth	WLAN	GNSS	UWB											
Yagoe / Pulse	W3008C						x	x	x			Ceramic	2400-2483.5 MHz	~1.3	68	*	3.2 x 1.6 x 1.1	Linear	-8	-40 to +85	50
	W3008						x	x	x			Ceramic	2400-2483.5 MHz	~1.1	66	*	3.2 x 1.6 x 1.1	Linear	-4	-40 to +85	50
	W3325			x								Ceramic	791-960 MHz	~1.3	>55	*	14 x 7 x 1.5	Vertical	5dB	-40 to +85	50
	W3326			x	x							Ceramic	791 - 960 MHz 1710 - 2170 MHz	~0.6 ~2.3	>50 >55	*	20 x 7 x 1.5	Vertical	5dB	-40 to +85	50
	W3043						x	x	x	x		Ceramic	1575.42 MHz 2400-2483.5 MHz	~0.35 ~4	43 70	*	3.2 x 1.6 x 1.1	Linear	-15 -12	-40 to +85	50
	W3340										x	Ceramic	6-8.5 GHz	>1.5	>65	*	3.2 x 1.6 x 1.1	Linear	9	-40 to +85	50
	W3540										x	Ceramic	2700-8200 MHz	~5.89	81	~2:1	12.5 x 10.6 x 0.8	Vertical	10	-40 to +85	50
	W3015L						x					Ceramic	433 MHz	~2.5	35	*	10 x 3.2 x 4	Linear	*	-40 to +85	50
	W3078						x	x	x			Ceramic	2400 – 2483.5 MHz 4950 – 5850 MHz	~1,7 ~4,3	65 80	* *	3.2 x 1.6 x 1.1	Linear	-10 -6	-40 to +85	50
	W3079						x	x	x			Ceramic	2400–2483.5 MHz 5150–5850 MHz	~2.4 ~5.7	70 77	< 1.9 < 2.5	3.2 x 1.56 x 1.1	Linear	* *	-40 to +85	50
	W7001		x									Flex Stamp	13.56 MHz	*	*	*	25 x 25 x 0.12	*	*	-40 to +85	50 / 80

Content

Embedded Antennas

Manufacturer	Part	Picture	Standard								Antenna Type	Frequencies	Peak Gain (dBi)	Efficiency (%)	VSWR	Size (mm)	Polarization	Return loss (dB)	Temperature (C)	Impedance (Ohm)
			RFID	GSM / 2G	UMTS / 3G	LTE / 4G	ISM Standard	Bluetooth	WLAN	GNSS	UWB										
Yageo/Pulse	W7002		x									13.56 MHz	*	*	*	94.6 x 56.8 x 3.65	*	*	-40 to +85	50 / 80
	W3211					x					Ceramic	902-928 MHz	~1.35	43	*	10 x 3.2 x 5	Linear	-10	-40 to +85	50
	W3214					x					Ceramic	863-873 MHz	~1	38	*	10 x 3.2 x 5	Linear	-20	-40 to +85	50
	W3012					x					Ceramic	902 – 928 MHz	~2	70	*	10 x 3.2 x 4	Linear	-6	-40 to +85	50
	W3796		x	x	x						Ceramic	698-960 MHz 1427.9-1660.5 MHz 1695-2200 MHz 2300-2700 MHz	~1.5 ~2 ~5.5 ~5	65 55 75 70	~3:1	40 x 7 x 3	Linear	6dB	-40 to +85	50
	W3544A		x	x							Ceramic	824 - 960 MHz 1710 - 1880 MHz 1850 - 1990 MHz 1920 - 2170 MHz	~-1.9 ~-1.3 ~-1.3 ~-1.66	65 74 74 68	*	7.65 x 26 x 3	Linear	-4.1 -4.6 -16.3 -12.3	-40 to +85	50
	W3070		x	x	x							880-960 MHz 1710-1880 MHz	~1.2 ~2.5	65 60	*	10 x 3.2 x 2	Linear	-5.1 -5.8	-40 to +85	
	W3056						x	x	x		Ceramic	1558-1616 MHz 2.4-2.5 GHz	~0.5 ~2	45 65	*	10 x 3.2 x 1.5	Linear	-5 -7	-40 to +85	50
	W3320					x		x			Ceramic	868/915 MHz 2.4 GHz	~1 ~3	64 68	*	3.2 x 10 x 2	Vertical	<-7dB <-5dB	-40 to +85	50

Manufacturer	Part	Picture	Standard								Antenna Type	Frequencies	Peak Gain (dBi)	Efficiency (%)	VSWR	Size (mm)	Polarization	Return loss (dB)	Temperature (C)	Impedance (Ohm)
			RFID	GSM / 2G	UMTS / 3G	LTE / 4G	ISM Standard	Bluetooth	WLAN	GNSS	UWB										
Yageo/Pulse	ANT3216LL-00R2400A							x	x		Ceramic	2.4 GHz	5	*	*	3.2x1.6x1.2	Linear	~10	-40 to +105	50
	ANT1608LL-14R2400A						x	x	x		Ceramic	2.4 GHz	2.0	*	6.0 max	1.6x0.8x0.4	Linear	~8	-40 to +105	50
	ANT-1818B00AT1575S									x	Patch	1575 MHz	2	*	1.5 max	18x18x2	RHCP	~10	-40 to +105	50
	ANT8010LL-05R1516A									x	Ceramic	1575-1602 MHz	1.69	*	*	8.0x1.0x1.0	Linear	~10	-40 to +105	50
	ANT 1818B00BT1516									x	Patch	1575-1606 MHz	2.59	*	2:1	18x18x4	RHCP	~10	-40 to +105	50
	ANT-2525B00DT1516S									x	Patch	1575-1606 MHz	5	*	2	25x25x4	RHCP	~10	-40 to +105	50
	ANT1204LL-00R0918A			x							Ceramic	900 MHz 1800 MHz	1.6 1.08	*	3.0 max	12.0x4.4x1.2	Linear	~10	-40 to +105	50
	ANT3505B002T-WPENS			x	x						Ceramic	824-960 MHz 1710 - 2170 MHz	2.9	*	2.8 max 3.5 max	35x5x6	Linear	~7	-40 to +105	50

*Not specified by supplier

Internal Antennas

Manufacturer	Part	Picture	Standard								Antenna Type	Frequencies	Peak Gain (dBi)	Efficiency (%)	Size (mm)	Polarization	Cable Length (mm)	Connector	Impedance
			GSM / 2G	UMTS / 3G	LTE / 4G	ISM Standard	Bluetooth	WLAN	GNSS	**NFC**									
2J	2JF0415P					x					FPC / Adhesive	868 MHz 915 MHz	2.7 3.6	58 77	25 x 70 x 0.2	Linear	100	U.FL compa-tible	50
KYOCERA AVX	1000423						X	X			Screw Mount	2400-2485 MHz 5150-5850 MHz	0.6 4.5	57 75	40.0 x 15.0 x 6.4	Linear	-	MHF / U.FL compa-tible	50
	1002289		X	X	X	X					FPC / Adhesive	698-960 MHz 1710-2700 MHz	2.9 4.3	74 58	53.6 x 25.1 x 0.2	Linear	25 - 300	MHF or SMA	50
	W3-Family						X	X			PCB or FPC / Adhesive	2400-2485 MHz 5150-5850 MHz 5925-7127 MHz	2.3 5 2.5	70 60 65	35.20 x 8.50 x 0.40	Linear	50 - 300	MHF or MHF4L	50
	9001815F0		X	X	X	X					FPC / Adhesive	600-960 MHz 1415-2690 MHz 3400-3800 MHz 5150-5850 MHz	1.5 4.6 3.8 4.8	35 60 47 56	102 x 14.5 x 0.2	Linear	50-300	MHF or MHF4L	50
	9001169									X	FPC / Adhesive	1575 MHz	~15	55	41 x 15.5	Linear	50-300	MHF / U.FL com-patible	50
Yageo / Pulse	W3915		x	x						x	PCB	880-960 MHz 1710-2170 MHz 1565-1605 MHz	1 2 0.5	50 75 55	74 x 19	Linear	100	U.FL compa-tible	50
	W3334B0150					x	x	x			Adhesive	2400-2500 MHz 4900-6000 MHz	4 5.5	50 70	4.3 x 15.3 x 0.1	Linear	150	U.FL compa-tible	50
	W3554B0140		x	x	x	x	x	x		x	FPC / Adhesive	698-960 MHz 1400-1600 MHz 1710-2690 MHz 3300-3800 MHz 4900-6000 MHz	1.9 2.5 3.2 3.3 3.5	45 53 66 57 37	30 x 120 x 0.2	Linear	143	U.FL compa-tible	50
	W3312XXXXXX					x					FPC / Adhesive	863-928 MHz	0.8	45	75 x 15	Linear	100	U.FL compa-tible	50

Manufacturer	Part	Picture	Standard								Antenna Type	Frequencies	Peak Gain (dBi)	Efficiency (%)	Size (mm)	Polarization	Cable Length (mm)	Connector	Impedance
			GSM / 2G	UMTS / 3G	LTE / 4G	ISM Standard	Bluetooth	WLAN	GNSS	**NFC**									
Yageo	ANTX100P001B24553						x	x			PCB	2400 - 2500 MHz 5150 - 5875 MHz	4.6 3.9	81 62	50 x 10 x 0.95	Linear	100	U.FL / I-PEX	50
	ANTX100P001BWPEN3		x	x							PCB	850-960 MHz 1800-2100 MHz	5.1 5.0	68 76	50 x 10 x 0.95	Linear	100	U.FL / I-PEX	50
iDTRONIC	A910: 20 × 30 mm - M8 U.FL A911: 20 x 30 mm - M8 U.FL									x	PCB	13.56 MHz			20x30 20x40			U.FL or Molex PicoBlade 53261	50
	A912: 35 × 50 mm - M8 U.FL									x					35x50				
	A913: 80 × 80 mm - M8 U.FL									x					80x80				
	A914: 60 × 80 mm - M8 U.FL									x					60x80				
	A915: 45 × 86 mm - M8 U.FL									x					45x86				
	A916: 49 × 55 mm - M8 U.FL									x					49x55				

*Not specified by supplier

Content

External Antennas

Manufacturer	Part	Picture	Standard: GSM / 2G	UMTS / 3G	LTE / 4G	ISM Standard	Bluetooth	WLAN	GNSS	Antenna Type	Frequencies	Peak Gain (dBi)	Eff. (%)	VSWR	Size (mm)	Polarization	Cable Length (mm)	Connector	Impedance (Ohm)
2J	2J301M		x	x						Magnetic Mount	824-960 MHz	~1.7	~49	~1.6:1	30.9 x 71.5	Linear	3000	SMA-Male	50
											1710-2170 MHz	~0.3	~28	~1.8:1	30.9 x 71.5	Linear	3000	SMA-Male	50
	2J664B		x	x		x	x	x		Body Mount	824-2400 MHz	~2.2	*	<2.6:1	77.4 x 15.9	Linear	2500	FME-Female	50
	2J620PF		x	x					x	Adhesive Mount	824-960 MHz	~1.5	~43	~1.6:1	Ø77 x 12	Linear	3000	SMA-Male	50
											1710-2170 MHz	~0.5	~32	~2.4:1					
	2J6602B					x	x	x		Screw Mount	2410-2490 GHz	~4.9	~48.7	~1.5:1	Ø77.3 x 15	Linear	3000	RP-SMA-Male	50
											4920-5925 GHz	~4.5	~29.2	~1.5:1					
	2J5115-XXX					x				Adhesive Mount, Flexible	433/ 868/ 915 MHz	3,4	62,4	1,2	122 x 14 x 6	Linear	3000	multiple connectors available	50
	2J0202					x	x	x		Connector Mount	2410-2490 GHz	~4.0	~60	~1.4:1	56 x 9.5	Linear	-	RP-SMA-Male	50
											4920-5925 GHz	~5.2	~83	~1.7:1					
	2J050		x	x			x	x		Connector Mount	824-2400 MHz	~2.2	*	<2.5:1	54 x 6.7-9.65	Vetical	-	SMA-Male	50
	2J6A24BA		x	x	x					Screw Mount	698-960 MHz	~-0.8	~35	~2.8:1	Ø77.3 x 65.5	Linear	3000	SMA-Male	50
											1710-2170 MHz	~2.5	~51	~1.7:1	Ø77.3 x 65.6				
											2500-2700 MHz	~3.4	~49	~1.3:1	Ø77.3 x 65.7				
	2J300M		x	x	x					Magnetic Mount	698-960 MHz	~1.0	~47	~1.9:1	Ø31 x 72	Linear	3000	SMA-Male	50
											1710-2170 MHz	~2.4	~39	~1.5:1					
											2500-2700 MHz	~2.1	~36	~1.3:1					
	2J670B		x	x			x	x	x	Body Mount	824-2170 MHz	2.2 max	*	<2:1	77.3 x 36.5	Horizontal	2500	C1(Mobile): FME-Female; C2 (Navigation): SMA-Male	50
											1575.42 MHz	*	*	<1.2:1		RHCP			
	2J0B15					x				Connector Mount	433/ 868/ 915 MHz	1,2	69,3	1,8	44-48 x 19,1 x 9	Linear	-	SMA-Male-R/A	50
	2J6050PGF		x	x	x	x	x	x	x	Adhesive Mount	698-960 MHz	~2.9	~55.6	~2.2:1	80 x 76 x 16	Linear	3000	SMA-Male	50
											1710-2170 MHz	~3.2	~56.0	~1.2:1					
											2500-2700 MHz	~2.1	~38.7	~2.2:1					
											2410-2490 MHz	~3.2	~50	~1.3:1				RP-SMA-Male	
											4920-5925 MHz	~4.2	~30	~1.3:1					
											1575-1606 MHz	*	*	<=1.4:1 dB		RHCP		SMA-Male	
	2J7624B		x	x	x	x	x	x	x	Screw Mount	698-960 MHz	2.6	56	2.1:1	Ø50 x 50.08	Linear	3000	SMA-Male	50
											1710-2170 MHz	3.2	56	1.8:1					
											2500-2700 MHz	1.4	38	2.5:1					

Manufacturer	Part	Picture	Standard: GSM / 2G	UMTS / 3G	LTE / 4G	ISM Standard	Bluetooth	WLAN	GNSS	Antenna Type	Frequencies	Peak Gain (dBi)	Eff. (%)	VSWR	Size (mm)	Polarization	Cable Length (mm)	Connector	Impedance (Ohm)
KYOCERA AVX	X9000984		X	X	X	X				Connector Mount	790 – 960 MHz 1710 – 2170 MHz	3.4 4.7	40 40	3.5:1 3.0:1	196.00 x Ø6.00	Linear	-	SMA or RP-SMA Male	50
	X9001091						X	X		Connector Mount	2400-2485 MHz 5150-5850 MHz	1.8 4.0	75 80	1.5:1 1.8:1	84.0 x Ø9.35	Linear	-	SMA or RP-SMA Male	50
	X9001376		X	X	X	X				Connector Mount	790-960 MHz 1710-2170 MHz	1.16 2.50	63 62	2.0:1 2.5:1	180.0 x Ø12.98	Linear	-	SMA or RP-SMA Male	50
	X1005245		X	X	X	X			X	Adhesive Mount	698 – 960 MHz 1710 – 2700 MHz 1561 MHz, 1575 MHz, 1602 MHz	4.2 3.5 28	48 60	2.0:1	136.2 x 72.4 x 12.7	Linear RHCP	1000-3000	SMA-Male (others available)	50
	X9001248		X	X	X	X				Magnet Mount	698-960 MHz, 1710-2690 MHz	1.8 1.9	54 36	3.5:1 3.0:1	112.0 x Ø29.0	Linear	1000-3000	SMA Male or RP-SMA Male (others available)	50
	1002857								X	Connector Mount	1575 MHz	-3,0	27	2.0:1	34.93 x Ø15.0	RHCP	-	SMA-Male	50
chinmore	AA-C02MT07FME -397		x							Magnetic Mount	900 MHz	~0.45	75	1.26:1	Ø26.7 x 79	Linear	3000	FME-Female	50
											1800 MHz	~1.05	48	1.69:1					
	AA-C13M05SMA -1107		x							Magnetic Mount	900 MHz	~1.71	60	1.85:1	Ø52.2 x 343.7	Linear	3000	SMA-Male	50
											1800 MHz	~3.68	63	1.69:1					
	EM-B10.0X106-069						x	x		Connector Mount	2.4 GHz	~3.5	45	1.7:1	Ø67.5 x 108.0	Linear	-	SMA-Male	
	EM-W117G-2ANT -240					x				Connector Mount	868 MHz	0~3	*	2.0:1	Ø37 x 112.6	Vertical	-	SMA-Male	50
	GS-10D174MCX -198								x	Adhesive Mount	1575.42 MHz	~3.8	*	2.0:1	38.2 x 34.2	RHCP	300	MCX-Male	50
	CA-C09-1SMAM -094		x							Adhesive Mount	840-960 MHz	~3.06	59	1.72:1	129.5 x 22.8	Linear	3000	SMA-Male (90°)	50
											1760-1860 MHz	~5.23	88	1.30:1					
	EM-B9.3X33.0-168						x	x		Connector Mount	2.4 GHz	1.3	*	2.0:1	Ø9.4 x 33	Vertical	-	SMA-Male	50
	EM-9.10X55.8-058		x	x						Connector Mount	824-960 MHz	~2.3	*	2.5:1	Ø6.5 x 56.6	Vertical	-	SMA-Male	50
											1710-2170 MHz	~2.5							
	EM-W79B-7ANT-108		x	x						Connector Mount	824-2170 MHz	~2.8	*	5.6:1	Ø9.3 x 114	Vertical	-	FME-Female	50
	CA-C09-1FMEF-019		x	x						Adhesive Mount	900-1800 MHz	~1,78	42	1.36:1	129.5 x 22.8	Linear	3000	FME-Female	50
												~4.77	81	1.45:1					
Yageo / Pulse	W5028x					x	x	x		Connector Mount	2.4-2.5 GHz	1.9	>80	*	Ø10 x 128	Vertical	-	RP-SMA-Male	50
											5.15-5.85 GHz	3.8	>50						
	W5084x		x	x	x					Connector Mount	698-960 MHz	2	58	3 max	228.84	Vertical	-	TNC-Male/ SMA-Male	50
											1400-2690 MHz	4	78	3.6 max					
											3400-3700 MHz	5	60	3 max					
	W5017					x				Connector Mount	868-928 MHz	0.9	70	2.5 max	179	Vertical	-	SMA-Male	50

*Not specified by supplier

Content

Why is Security important?....

Threats resulting from new technologies regularly make the headlines – whether thefts of vehicles with Keyless Go, illicit surveillance scandals, data theft, disclosure of passwords on the Internet, or phishing attacks. However, the greatest damage is in most cases not suffered by the users: Once negative publicity has stuck to a product, or a manufacturer, it becomes a serious threat to the business.

Encryption technologies offer comparatively cost-effective protection. When handling personal data, encryption is required by data protection laws in any case.

Security is Always a System

The issue of security is often neglected in relation to embedded systems especially. The result: Industrial spies can use hacked devices to penetrate the entire corporate network, gain access to the company's intellectual property (IP) and business secrets, and manipulate data.

Users of smart home devices might unintentionally disclose information to potential thieves through their security cameras, or even open doors and windows for them by way of automated control systems.

Automobiles are also subject to virtually infinite vulnerabilities thanks to autonomous driving and over-the-air firmware updates. When such cases become known, customers trust in the device – or even the entire business – is lost.

In view of this, encryption should be top of the priority list for all manufacturers of connected products. In order to understand encryption, it is helpful to consider what its aims are. These are focused on three key areas: authenticity, confidentiality, integrity.

When a user wirelessly connects multiple products in his home, for example, it is important that only authorized products can join the network, and that both the data in the network and the complete system are protected.

That is to say, protection must be in place against unauthorized access to the network (authenticity), data tapping (confidentiality) and manipulation (integrity).

State-of-the-art cryptography covers all three aspects. It is available in two fundamentally different modes: symmetric and asymmetric encryption.

Hardware or Software?

Each encryption method can be implemented by software or hardware. Software-based encryption entails the major disadvantage that the program is not an autonomous self-contained unit, but is always dependent on its environment, such as the operating system. It is susceptible to errors and attacks as a result. And there is another negative: As the microcontroller or processor of an embedded system additionally has to handle the complex encryption and decryption, loss of performance is inevitable.

The opposite case is represented by encryption using specially developed ICs. Their sole function is encryption, so there is no performance loss. Many encryption ICs are additionally protected against physical attacks. The security of those components – and also of the keys – is thus independent of the security of the overall system.

Encryption ICs in different designs meet the requirements of a range of applications: Simple authentication chips, such as the Infineon OPTIGA™ Authenticate S, use asymmetric encryption (ECC163), and are good choice for the authentication of original accessories in consumer electronics for example. The OPTIGA™ Trust M with ECC 521 and SH 512 assures authentication of medical equipment, in smart homes, in industry, or in cloud computing authentication for license management for example.

Encrypted Smart Home

A simple practical example illustrates the use of encryption ICs: In a smart home, simple authentication chips such as the OPTIGA™ Authenticate S ensure that only authorized devices – such as shutter controls or surveillance cameras installed by the user – are able to log in to the central smart home gateway.

A OPTIGA™ TPM in the central gateway assures key storage, firmware updates, and the transfer of all data to the Cloud. As a result, the e.g. Smart Home owner can be certain that authenticity, confidentiality and integrity are assured.

Selection Guide

Manu-facturer	Part Name	Security Level	Functionality	NVM (Data)	Cryptography	Type of Host System	Inter-face	Package
Infineon	OPTIGA™ TPM SLM 9670	CC EAL 4+	Security Cryptocontroller for Trusted Platform Modules	6.9 kByte	ECC, ECC BN-256, ECC NIST P-256, ECC NIST P-256, RSA1024, RSA2048, HMAC, SHA-1, SHA-256	Embedded Linux / Windows / MCU without OS / proprietary OS	SPI	PG-VQFN-32
	OPTIGA™ TPM SLB 9672	CC EAL 4+	Security Cryptocontroller for Trusted Platform Modules	51 kByte	Up to RSA4096 and ECC NIST P384 HMAC and up to SHA2-384 and AES-256	Windows / Linux	SPI	PG-UQFN-32
	OPTIGA™ TPM SLB 9673 FW26.xx	CC EAL 4+	Security Cryptocontroller for Trusted Platform Modules	51 kByte	Up to RSA4096 and ECC NIST P384 HMAC and up to SHA2-384 and AES-256	Windows / Linux	I2C	UQFN-32
	OPTIGA™ Trust M	CC EAL 6+	Connected device security	Up to 10 kB user memory	ECC: NIST curves up to P-521, Brainpool r1 curve up to 512	MCU without OS / proprietary OS / RTOS, Embedded Linux	I2C with shielded connection	USON-10
	OPTIGA™ Trust M Express	CC EAL 6+	Secure IoT devise deployment to the cloud	Up to 10 kB user memory	ECC: NIST curves up to P-521, Brainpool r1 curve up to 512, RSA with keys up to 2048 bits	MCU without OS / proprietary OS / RTOS, Embedded Linux	I2C with shielded connection	USON-10
	OPTIGA™ Trust M MTR	CC EAL 6+	Secured matter compatibility	10 kByte	AES key up to 256, HMAC up to SHA512, TLS v1.2 PRF and HKDF up to SHA512	MCU without OS / proprietary OS / RTOS, Embedded Linux	I2C with shielded connection	USON-10
	OPTIGA™ Authenticate S	CC EAL 6+	Enhanced device authentication	3 types of lockable NVM sizes (1 K, 2 K, 5 Kbit)	ECC 163-bit	Host code software – with new OS library	GPO, SWI, I2C	PG-TSNP-6-12
	OPTIGA™ Authenticate NBT*	CC EAL 6+	Secured device authentication, configuration & activation	8KB	ECDSA-based asymmetric cryptography (NIST P-256), AES-128-based symmetric cryptography	MCU without OS / proprietary OS / RTOS, Embedded Linux	NFC, I2C	PG-USON-8-8
	OPTIGA™ Trust Charge	CC EAL 6+	Qi Authentication for inductive wireless charging	10 kByte	ECC: NIST P256/P384, SHA-256, TRNG, DRNG	Wireless Charging MCU, host SW for typical MCUs provided	I2C	PG-USON-10-2,-4
	OPTIGA™ Connect Consumer	CC EAL 6+	eSIM for cellular-connected consumer devices	800 kByte	RSA up to 2048 bit, ECC up to 521 bit, NIST P-256, Brainpool256r1, FRP256V1	Cellular Modem + LPA (Android or Windows)	UART	XFWLB-25-3, VQFN-8-4
	OPTIGA™ Connect IoT	CC EAL 5+	eSIM for cellular-connected IoT devices	350 kByte	SHA, DES, AES, ECC, RSA, COMP128, MILENAGE, TUAK, CAVE	Cellular Modem	UART	PG-VQFN-8-4

*) From June onwards

Content

OPTIGA™ TPM – Trusted Platform Module

Certified Security high-end controllers for computing, IoT networking & embedded applications

OPTIGA™ TPM (Trusted Platform Module) is a standardized security controller which protects the integrity and authenticity of devices and systems in embedded networks. Built on proven technologies and supporting the latest TPM 2.0 standard, OPTIGA™ TPM highlights include secured storage for keys, certificates and passwords as well as dedicated key management. As the established, trusted market and innovation leader in the Trusted Computing space, we offer a broad portfolio of certified OPTIGA™ TPM security controllers based on the Trusted Computing Group (TCG) standard to suit all needs.

Key Features

- High-end security controller with advanced crypto-graphic algorithms implemented in hardware (e.g. RSA & ECC256, SHA-256, AES)
- Common Criteria (EAL4+) and FIPS security certification
- Flexible integration with SPI and I2C interface support
- Extended temperature range (-40 to +85 °C) for a variety of applications

Benefits

- Reduced risk based on proven technology
- Fast time to market through concept reuse and standardized approach
- Flexibility thanks to wide range of security functions as well as dedicated key management
- Easy integration into all platform architectures and operating systems

Target Applications

- PC and embedded computing
- Printers
- Network equipment
- Industrial control systems
- Smart Home / Smart City security and automation
- Energy generation and distribution systems
- Automotive electronics

Overview of OPTIGA™ TPM Family

SLB 9670	SLM 9670	SLI 9670	SLB 9672 FW15.xx	SLB 9672 FW 16.xx	SLB 9673
▪ SPI Interface ▪ TPM 2.0 compliant ▪ TCG and Common Criteria EAL 4+ ▪ FIPS 140-2 certified ▪ VQFN-32 package	▪ SPI Interface ▪ TPM 2.0 certified ▪ TCG and Common Criteria EAL 4+ ▪ FIPS 140-2 certified ▪ Industrial quality grade ▪ VQFN-32 package	▪ SPI interface ▪ TPM 2.0 certified ▪ TCG and Common Criteria EAL 4+ ▪ FIPS 140-2 certified ▪ Automotive qualific. (AEC-Q100) ▪ VQFN-32 package	▪ SPI interface ▪ Optimized for Computing (laptops desktops /servers) ▪ TPM 2.0 Certified ▪ TCG and Common Criteria EAL 4+ ▪ UQFN-32 package ▪ FIPS 140-2 certified	▪ SPI interface ▪ Enhanced security features for IoT networking and connected devices ▪ TPM 2.0 certified ▪ TCG and Common Criteria EAL 4+ ▪ UQFN-32 package ▪ FIPS 140-2 certified	▪ I2C Interface ▪ Enhanced security features for IoT networking and connected devices ▪ TPM 2.0 certified ▪ TCG, Common Criteria and FIPS Certifications ▪ UQFN-32 package

OPTIGA™ TPM – TPM SLM 9670

Standardized and certified TPM 2.0 security solution for industrial & demanding applications

The OPTIGA™ TPM SLM 9670 addresses the requirements of industrial and other demanding applications where an extended temperature range, an extended lifetime and industrial-grade quality are key.
Pushing beyond the qualifications processes performed for standard TPMs, the OPTIGA™ TPM SLM 9670 is qualified according to the industrial JEDEC JESD47 standard to enable the requisite performance under demanding environmental conditions.

OPTIGA™ TPM SLM 9670 offers high levels of flexibility to address innovative use cases of Smart Factories and Industry 4.0 that call for robust security:

- Strong digital device ID and device authentication
- Secured communication for data confidentiality and IP protection
- Integrity protection of devices and software incl. software updates

A ready-to-use security building block, SLM 9670 is equipped with a variety of functions to secure industrial devices and systems.

These include:

- Key storage and management
- Identification and authentication
- Signature generation and verification
- Software and firmware integrity attestation
- Secured logging and secured time

Key Features

- SPI Interface
- TPM 2.0 certified
- Common Criteria EAL 4+, FIPS 140-2 level 2 certified
- Industrial quality grade
- VQFN-32 package
- Asymmetric Cryptography: ECC, ECC BN-256, ECC NIST P-256, ECC NIST P-256, RSA1024, RSA2048
- Symmetric Cryptography: HMAC, SHA-1, SHA-256

Benefits

- Standardized security chip compliant with TCG TPM 2.0 standard
- Secured storage for critical data and secrets
- Advanced protection mechanisms against physical and logical attacks
- Support for cryptographic algorithms RSA-1028, RSA-2048, ECC NIST P256, ECC BN256, SHA-1, SHA-256
- Ext. temp. range: -40 to 105 °C
- Ext. lifetime: 20 years
- JEDEC JESD47 industrial qualification
- Security evaluated and certified independently

Target Applications

- Industrial PCs, servers, Programmable Logic Controllers (PLC)
- Network infrastructure devices & equipment like gateways, routers, wireless access points, and switches

OPTIGA™ TPM SLB 9672

Ready-to-use TPM with SPI interface and PQC-protected firmware update mechanism, optimized for PCs and servers

OPTIGA™ TPM SLB 9672 is Infineon's standardized, ready-to-use Trusted Platform Module with an SPI interface that serves as a robust foundation to identify and authenticate PCs, servers, and connected devices, and to protect data integrity and confidentiality. Feature-rich, ready for current and future security challenges OPTIGA™ TPM SLB 9672 is future-proof – it comes with extended memory and stronger cryptographic algorithms, and is the first TPM in the market that offers a PQC-protected firmware update mechanism. Integrated resiliency features allow the TPM firmware to be recovered in compliance with the NIST SP 800-193 Platform Firmware Resiliency Guidelines. This, combined with improved computational performance, takes system security to the next level.

OPTIGA™ TPM SLB 9672 is available in two versions:

OPTIGA™ TPM SLB 9672 FW15.xx

this standardized and certified security solution is the primary choice for Microsoft Windows environment/ecosystem and connected devices with PC architecture.

Target Applications

- Home & Office devices:
  Laptops / Desktops / Tablets, Servers, Enterprise Printers

OPTIGA™ TPM SLB 9672 FW16.xx

Compared with the FW15.xx version, the FW16.xx version offers flexible configuration options, enhanced security features including AES bulk encryption, configuration of the TPM's unique ID, and configuration of the endorsement primary seed.

Target Applications

- Home & Office devices: Enterprise printers
- Smart Building: Surveillance camera
- Industrial Automation: Factory robots, Programmable Logic Controllers (PLC)
- Network infrastructure: Routers, Switches, Access Point, Gateway, 5G Equipment

Key Features

- High- end standardized security controller
- PQC-protected firmware update mechanism
- Support for latest specifications of TCG TPM 2.0 standard (rev. 1.59)
- TCG, CC and FIPS certifications
- Windows HLK certification
- Support for various cryptographic algorithms: up to RSA-4096, AES-128, AES-256, ECC NIST P256, ECC BN256, ECC NIST P384, SHA-1, SHA2-256, SHA2-384
- Extended non-volatile memory (51 kB)
- SPI interface
- Thin PG-UQFN-32 package

Benefits

- Proven, standardized turnkey security solution
- High confidence level based on common criteria and FIPS certification
- faster cryptographic operations (2-4 times faster, depending on the functions)
- Easy integration with Windows and Linux OS Plattforms

OPTIGA™ TPM SLB 9673 FW26.xx

Ready-to-use TPM with a PQC-protected firmware update mechanism, optimized for embedded systems with an I2C interface

OPTIGA™ TPM SLB 9673 FW26.xx is the latest addition to the OPTIGA™ TPM family targeted at connected devices that require enhanced security features. This standardized, ready-to-use security solution comes with an I2C interface.
It serves as a robust foundation to identify and authenticate network infrastructure and light industrial machines such as factory robots and Programmable Logic Controllers (PLC). In addition, it protects data integrity and confidentiality.

OPTIGA™ TPM SLB 9673 FW26.xx

is future-proof thanks to a PQC-protected firmware update mechanism, extended memory, and strong algorithms. Integrated resiliency features allow the TPM firmware to be recovered in compliance with the NIST SP 800-193 Platform Firmware Resiliency Guidelines.

OPTIGA™ TPM SLB 9673 FW26.xx gives "things" a unique identification number so they can connect to the IoT or the network. This number can be used to track IoT devices and equipment on the networks, and to validate their access rights. To avoid the risk of counterfeit, this number is protected from being be modified. A set of configurable commands is available to set the TPM up according to application-specific needs during platform manufacturing.

Its enhanced security features include AES bulk encryption, configuration of the TPM-unique ID, and a configurable endorsement primary seed.

Key Features

- I2C interface up to 1 MHz
- Extended non-volatile memory (51 kB)
- Support for latest cryptographic algorithms: up to RSA-4096, ECC NIST P384, SHA2-384
- TCG TPM2.0 (revision 1.59), CC and FIPS certifications
- PQC-protected firmware upgrade mechanism using XMSS signatures
- Thin UQFN-32 package
- Extended temperature range: (-40°C to 105°C)

Benefits

- Proven, standardized turnkey security solution
- High confidence level based on Common Criteria and FIPS certifications
- Easy integration with Linux OS platforms
- Faster cryptographic operations than previous generation

Target Applications

- Home & Office devices: Enterprise printers
- Industrial Automation: Factory robots, Programmable Logic Controllers (PLC)
- Smart Building: Surveillance Camera
- Health & Lifestyle: Monitoring System
- Renewable Energy:
  Solar energy farms, Electrical windmills
- Smart Mobility: EV charging
- Network infrastructure: Routers, Switches, Access point, Gateway, 5G Equipment

OPTIGA™ Trust M

Secured cloud service provisioning – the easy way!

Cloud services and AI are driving a wave of innovative applications. The number of devices connected to these applications is growing, presenting great opportunities – but also increased security risks. Responding to a growing focus on embedded systems amongst attackers, Infineon offers the OPTIGA™ Trust M solution, a high-end security controller optimized for connected devices.

It provides extremely flexible, high-performance, secured access to any major cloud provider for industrial and building automation, smart home and consumer applications.

Key Features

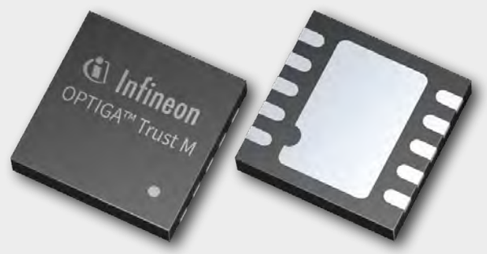
- CC EAL6+ (high) certified high-end security controller
- I²C interface with shielded connection
- Hibernate mode for zero power consumption
- USON-10 package (3 x 3 mm)
- Standard and extended temperature ranges: -40 to +105 °C
- Up to 10 kB user memory
- Configurable device security monitor
- Lifetime of 20 years for industrial and infrastructure applications
- Cryptographic ToolBox
- MIT licensed software framework on GitHub

Benefits

- Secured zero-touch provisioning
- Easy integration
- Future-proof security
- Performance
- MIT licensed software

Target Applications

- Industrial and building automation
- Smart home
- Consumer devices
- Drones



OPTIGA™ Trust M Express

The easiest way to securely deploy IoT devices to the cloud at scale

OPTIGA™ Trust M Express is a pre-provisioned Secure Element that simplifies the integration of security in IoT devices. It makes it easier to claim the devices and transfer the certificates to the product cloud at scale. The Infineon cloud service automates the IoT device certificate registration and device provisioning in the product cloud. This solution simplifies the production flow, accelerates time-to-market, and increases cost efficiency.

Key Features

- Pre-provisioned with Ready-to-use certificates / keys
- AWS multi-account registration
- Azure IoT Hub pre-registration
- Infineon cloud service support
- CC EAL6+ (high) certified
- ECC: NIST curves up to P-521
- Brainpool r1 curve up to 512 bits
- RSA with keys up to 2048 bits
- AES key up to 256 bits
- HMAC up to SHA-512
- TLS v1.2 PRF + HKDF up to SHA-512
- TRNG/DRNG random number generator
- Cryptographic toolbox commands
- SHA-256, ECC and RSA® features,
- AES, HMAC and key derivation

Benefits

- Off-the-shelf secure elements
- Ready to connect to Azure and AWS
- Automated device provisioning
- Product-to-cloud provisioning
- Simple device claiming process
- No manual intervention required
- Faster design-in process
- Easy-to-use developer kit
- NDA-free product documentation
- Robust Security

Target Applications

- Smart Home
- Smart Buildings
- Smart Mobility
- Smart Cities
- Industrial IoT
- Healthcare / Lifestyle

OPTIGA™ Trust M MTR

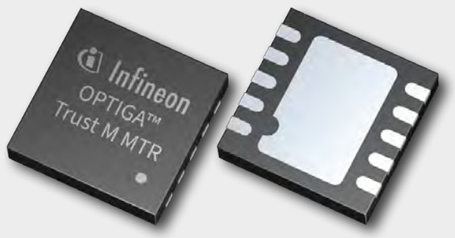
The easiest way to add Matter and security to your smart home devices

OPTIGA™ Trust M MTR is our OPTIGA™ Trust M discrete security solution combined with a Matter provisioning service. It is Matter-certified and works with any MCU/SoC, making it easy to add secured Matter compatibility to existing IoT designs. Working closely with our partner Kudelski IoT, we offer late-stage personalized Device Attestation Certificate injection to give OEMs the flexibility to update DACs right up until the start of production.

Key Features
- CSA Certified Matter certificates
- Pre-provisioned TLS certificates
- CC EAL 6+ certified
- ECDH, ECDSA
- ECC NIST Curves up to P521
- Cryptographic toolbox
- ECC 512 and RSA up to 2K key size
- AES, HMAC and Key derivation
- TRNG AIS-31 certified
- Built-in crypto accelerator

Benefits
- Easy to add Matter compatibility
- Works with any MCU/MPU
- Allows retention of existing designs
- Personalized DAC for download
- High flexibility
- Allows creation of multiple variants
- Robust Security
- NDA-free product documentation

Target Applications
- Smart Home
  - Lighting
  - Blindes/Shades
  - Climate Control
  - Television
  - Access Control
  - Surveillance Camera, Alarm
  - Gateway Access Point
  - Speaker



OPTIGA™ Authenticate S

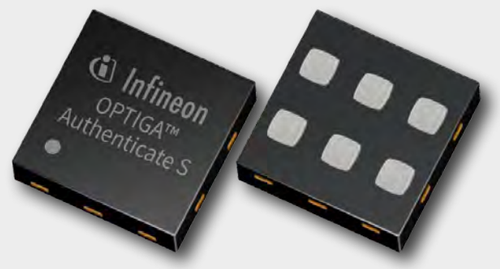
Enhanced device authentication to protect against counterfeits

Infineon's anti-counterfeit turnkey solution, combining enhanced device authentication with unprecedented levels of configuration flexibility. OPTIGA™ Authenticate S gives each product a secret key so it can be authenticated at the point of use, and so products can be tracked and traced throughout the supply chain. With its rich set of 16 customization options, it supports even the most complex authentication requirements – all on a single, tiny footprint. OPTIGA™ Authenticate S is suited to an ever-expanding range of applications, from single-use disposables and rechargeable batteries for smartphones, portable devices and e-mobility solutions, to computing and robotic systems in highly complex IoT environments. The turnkey solution comes with full system integration support including embedded software, host software and advanced ecosystem support tools based on the latest PSoC™ 6 MCUs. An NDA is required.

Key Features
- 4 ECC authentication modes (one-way, mutual, host binding and host support)
- 4 lifecycle counters with independent kill structures
- 3 types of lockable NVM Sizes (1K, 2K, 5Kbit)
- 3 temperature options (-40 to 85°C / -40 to 105°C / -40 to 120°C)
- 2 ECC 163-bit key pairs and 193-bit ODC
- 2 Serial communication options (SWI & I2C + GPO)
- Host code software – with new OS library
- 1.5 x 1.5 x 0.38 mm PG-TSNP-6-12 package
- Infineon proprietary protection against reverse engineering (PRE)
- High-end security controller certified to Common Criteria EAL6+ (high)

Benefits
- Rich customization options
- Effortless implementation – full turnkey solution – full system integration support
- Additional customer services, such as alerts when spare parts need replacing
- Security to rely on – e.g. enhanced HW security with extended key length
- Freedom to design even very small products – tiny package of 1.5 mm²

Target Applications
- Batteries and accessories and battery powered tools, such as portable decives, e-scooters
- Replacement parts (water filters, printer cartridge, purifiers)
- Electronics (power tools, wearable devices, multicopters and drones)



OPTIGA™ Authenticate NBT

Contactless authentication and secured configuration of IoT devices

The OPTIGA™ Authenticate NBT is a high-performance NFC-I2C bridge tag which enables IoT device authentication and secured configuration with just a tap. The bridge tag is embedded in the IoT device and is connected to internal components like the microcontroller (MCU) via the I2C interface. It facilitates communication between NFC-enabled devices such as smart phone and I2C-connected components. The product harnesses Infineon's much-acclaimed Integrity Guard security architecture, and provides symmetric and asymmetric cryptographic operations as well as password-based data protection schemes.
These makes the product ideal for secured configuration of an electronic device without display such as industrial control panel, data logging in patient monitors, activation of shared mobility vehicles, and commissioning of non-powered smart bulbs prior to installation.

Key Features

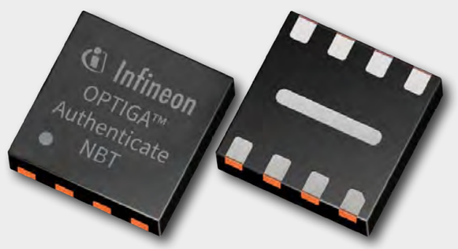
- NFC Forum Type 4 Tag certification, Common Criteria EAL 6+ certification (for hardware and the crypto library), Personal Health Device Communication (PHDC) compliant
- 106 to 848 kbit/s data transfer rate for contactless interface
- I2C standard mode, fast mode, fast mode 'plus' clock frequencies
- Device verification through ECDSA-based asymmetric cryptography, AES-128-based symmetric cryptography
- 32-bit password-based verification
- 78 pF on-chip tuning capacitance
- Storage capacity of 8 KB user NVM
- Chip-individual pre-provisioned certificate

Benefits

- Easy configuration of electronic devices using an NFC-enabled smart phone/reader
- Reduces system costs by eliminating the need for displays, keys and knobs
- Ultra-fast data rates provide enhanced user experience with just a tap
- Safeguards against unauthorized access by ensuring that only authorized personnel can modify device parameters
- High on-chip tuning capacitance for supporting smaller antenna designs
- Large on-chip memory

Target Applications

- Industrial applications (for device configuration and sensor data logging)
- Healthcare applications (for data logging, NFC PHDC-compliant device communication and disposable authentication)
- Shared e-bikes (for device activation/deactivation)
- Smart home devices (for easy customer onboarding, passive commissioning and remote diagnostics)



OPTIGA™ Trust Charge

The trusted authentication solution for wireless charging

Infineon's OPTIGA™ Trust Charge is a turnkey solution providing secured device authentication for inductive wireless charging according to the Qi 1.3 wireless charging standard. Secured authentication with OPTIGA™ Trust Charge contributes to device and user safety by protecting against fake chargers. The turnkey setup – with full system integration support and all key and certificate material preprogrammed – minimizes customer effort for design, integration and deployment.

OPTIGA™ Trust Charge comes with preprogrammed locked OS, locked application code, and host-side modules to integrate with host microcontroller software. Integration support includes a reference board and documentation for rapid design-in.

Key Features

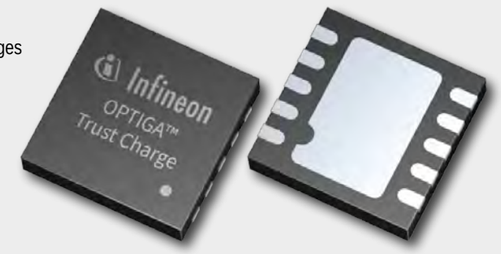
- WPC Qi 1.3 authentication
- Common Criteria EAL6+ (high) certified hardware
- ECDSA P-256 authentication
- NIST P-256, SHA-2 cryptography
- Up to 10 kB user memory
- Qi certificate format
- PKI
- I²C serial communication
- USON10-2 package (3 x 3 mm)
- Extended temperature range version available
- Full turnkey solution incl. drivers, SW library, preimplemented certificate(s) and key pair(s)

Benefits

- Protection of consumers against fake charging devices
- Turnkey solution with full system integration support including embedded software, host software, a development board, a reference board and documentation
- WPC-specific personalized keys and certificates preloaded at secured Infineon fabs
- Tiny package (3 x 3 mm) optimized for small devices
- Versions for standard and extended temperature ranges

Target Applications

- Mobile phones
- Tablets
- Cameras
- Accessories and other small personal electronic devices with charging according to the Qi standard
- Health tech devices



Content

OPTIGA™ Connect Consumer

eSIM turnkey solution for cellular-connected consumer devices

OPTIGA™ Connect Consumer is a ready-to-connect embedded SIM (eSIM) solution for consumer devices. It is especially suited to extending cellular connectivity to smaller devices like smart watches, fitness trackers and other wearables. OPTIGA™ Connect Consumer represents the next generation of eSIMs implementing GSMA´s technical specification for mobile consumer devices. This turnkey solution securely authenticates the device to the subscribed carrier networks of choice. Remote SIM provisioning (RSP) allows the user to change or add carriers over the air provided the device is equipped with a local profile assistant (LPA). Generally speaking, SIM-based cellular connectivity is more resistant to security breaches than typical wireless network connections as it provides end-to-end encryption and secured key exchange.

Key Features

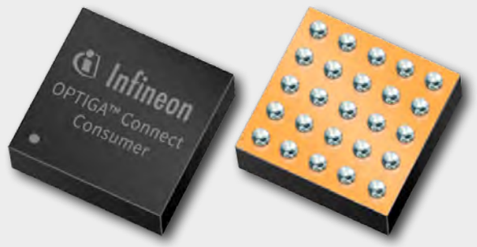
- Compliant with network technologies 2G, 3G, 4G (LTE), 5G
- Network Access Applications SIM, USIM, CSIM, RUIM and ISIM
- Remote SIM Provisioning (RSP) compliant with GSMA SGP.22 v2.2.2
- Compliant with Trusted Connectivity Alliance (TCA) eUICC Profile Package V2.3.
- Interoperable with MNOs offering commercial eSIM services
- Chip-scale (2.9 x 2.5 x 0.4 mm) and ETSI MFF2 (5.0 x 6.0 mm) packages
- Up to 800 kB free memory for MNO profiles, applications, and data (supporting integration of additional applets)
- Certified and tested solution according to GSMA

Benefits

- Increased customer convenience
- More design flexibility by providing an ultra-small package size
- Future-ready device
- Based on a solid security platform
- Interoperable
- Turnkey solution with lower design-in and qualification effort

Target Applications

- Smartphones
- Tablets
- Wearables
- Laptops
- Access Points
- Consumer IoT Devices



OPTIGA™ Connect IoT

Turnkey eSIM solution for cellular-connected IoT devices

OPTIGA™ Connect IoT is a ready-to-connect embedded SIM (eSIM) solution for cellular IoT devices. This turnkey solution allows easy, secured and cost-optimized deployment and management of cellular-enabled IoT devices at scale. It comes with a pre-installed GSMA-compliant operating system and pre-integrated connectivity capabilities. Supported by the partner Tata Communications, this eSIM offers global cellular network coverage with a choice of 640+ networks across 200 countries. End-to-end connectivity management extending from design through manufacture to deployment reduces complexity, offers full visibility into IoT devices and simplifies control. It addresses today's key pain points in connectivity management, namely interoperability across different vendors' GSMA subscription management platforms, local service deployment options, technical support, cost and coverage.

Key Features

- Reprogrammable eSIM
- Compliant with GSMA remote SIM provisioning specification SGP.02 v3.2 Support 2G, 3G, 4G, 5G LTE-M, NB IoT1)
- ETSI TS102 221 and ETSI TS102 671 compliance
- MFF2 (QFN8) package (other packages on request)
- Supported interface: ISO7816- UART
- Voltage classes: A, B, C › Industrial grade (-40 to +105°C)
- Data retention: 10 years
- Common criteria EAL5+ certified hardware
- Free memory available for storage of up to 10 operator profiles
- Bootstrap connectivity with global cellular coverage (640+ networks, 200 countries/ territories)
- Adjustable data plan
- Single secured access point to remote data and connectivity management via partner portal

Benefits

- Ready to connect with onboarded bootstrap
- Global cellular coverage
- Flexible connectivity services for IoT devices
- Free choice of Mobile Network Operator (MNO)
- Cost-effective, pervasive (worldwide) and secured connectivity
- Easy deployment and management of cellular IoT at scale
- Reduced complexity through interoperability and connectivity management Simplified path to market
- Single SKU for all applications and regions
- Open for integration of additional applets
- Low power consumption

Target Applications

- Smart Home (Security Cameras, alarms, air conditioning, access control)
- Smart city (security cameras, lighting, park sensors)
- Smart energy (metering, storage, distribution)
- Industry automation (factory automation, asset tracking)
- Wearables (Health monitoring)

Energy Harvesting

Energy Converters

Energy can be found everywhere – in the movement of doors and windows or machine components, the vibration of motors, chang-es in temperature or vari-ances in luminance level. These energy sources, which usually remain unused, can be tapped into by means of energy harvesting to power electronic devices and transmit wireless signals. This principle is the basis of energy harvesting wireless technology from EnOcean.

EnOcean
Self–powered IoT

The World of Energy Harvesting Wireless Technology

Sending a wireless signal over the EnOcean standard requires only a small amount of energy. This energy can be generated by so called energy converters, which convert energy from the environment into electric energy. Due to the fact that no further power supply is required, the product can be designed to be maintenance-free. Electric energy can be harvested from temperature differences, light and motion.

The EnOcean Energy Harvesters are intended for powering the international standard ISO/IEC 14543-3-!X (EnOcean standard). This standard is optimized for ultra-low power wireless application and energy harvesting. The EnOCean ISO/IEC standard uses different license-free frequency bands in the SubGHz range to meet the specifics and legal regulations of countries all around the world, for example:

- 868 MHz for Europe and China
- 902 MHz for North America and Canada
- 928 MHz for Japan

EnOcean's energy harvesting solutions can also connect to the Zigbee/IEEE 802.15.4 standard as well as to Bluetooth® networks which both use the worldwide available 2.4 GHz frequency band.

Application Fields

- Building and Home automation: HVAC, lighting, shutter control…
- Ultra-low power devices
- Consumer LED lighting control
- Window contact sensors
- Temperature sensors
- Humidity sensors

ECO 260

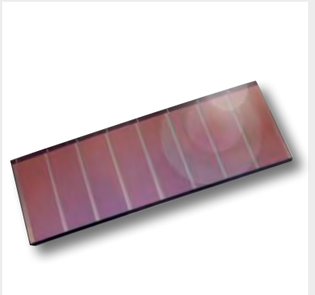
Kinetic Energy Harvesting

The kinetic converter in combination with a wireless module enables numerous battery-free switch applications Energy from a switching operation (button pressure):

- Electrodynamic energy converter
- Energy generation from kinetic motion
- Typically more than 1,000,000 switching cycles at 25 °C
- For small and flat switch designs

ECS 300

Solar Cell for Self-Powered Wireless Sensors



Solar cell for energy harvesting wireless sensors ECS 300.

Form Factor: 35.0 × 12.8 × 1.1 mm

- Indoor solar cell
- Designed for use with EnOcean STMicroelectronics sensors
- The small ECS 300 is ideal for unidirectional sensor applications

ECT 310 Perpetuum

Thermo Energy Harvesting

Ultra-low power DC/DC converter for thermal energy harvesters.

Heat dissipation as energy source

- Standard peltier element
- Usage of minimum temperature difference
- Maintenance free, full integration
- Allows energy harvesting actuators

Content

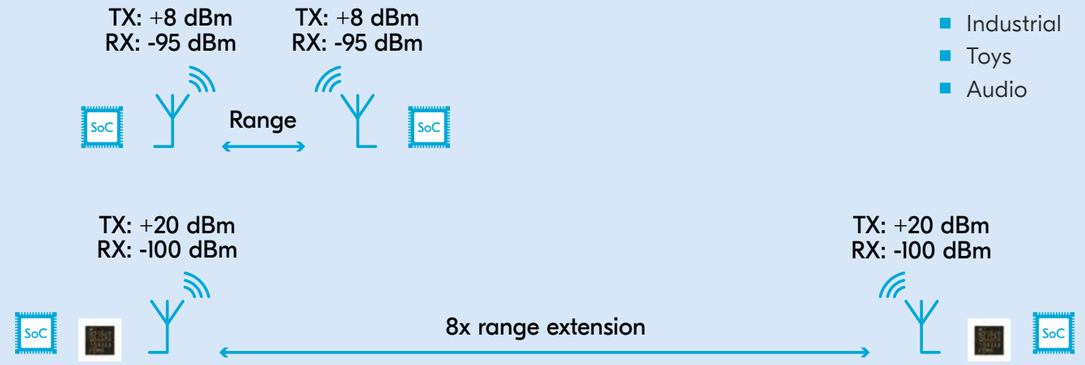
Introduction to Power Management

nPM Series – Extremely Compact Power Management IC (PMIC) with Power Path and Charging

Nordic Semiconductor leverages its extensive experience in ultra-low power wireless technology to develop power management ICs, enabling industry-leading low power wireless solutions.

Type	nPM1300	nPM1100	nPM6001
nPM FAMILY			
Buck regulator	2	1	4
Battery charger	✓	✓	
LDO	2		2
Load switch	2		
Termination voltage	3.5 to 4.45 V	4.1 to 4.2 V, or 4.25 to 4.35 V	
Max charging current	800mA	400mA	
Dynamic power-path management	✓	✓	
Thermal protection	✓	✓	
Battery compatibility	LiFePO4, Li-ion, LiPo	Li-ion, LiPo	
Input voltage	4 to 5.5 V	4.1 to 6.7 V	3 to 5.5 V
USB compliance	Type-C	✓	
Regulated output voltage	1 to 3.3 V	1.8 to 3 V	0.5 to 3.3 V
Max current per buck	200 mA, 200 mA	150mA	550 mA, 200 mA, 150 mA, 150 mA
System monitoring	System, input bus and battery voltages. Battery current and temperature. Die temperature.		
Fuel gauge	✓		
Hard system reset	✓		
Timed wake-up	✓		✓
Watchdog timer	✓		✓
Ship / hibernate mode	✓	✓	✓
Brown-out detector	✓	✓	✓
LED drivers, GPIOs	3, 5	2, 0	0, 3
Control interface	TWI	Pin-configurable	TWI
Regulatory compliance	CE, JEITA, RoHS	CE, JEITA, RoHS	CE, RoHS
Operating tempetature	-40 to 85°C	-40 to 85°C	-40 to 85°C
Package Dimensions	5x5 mm QFN32, 3.1x2.4 mm WLCSP	4x4 mm QFN24, 2.1x2.1 mm WLCSP	2.2x3.6 mm WLCSP
Evaluation kits	nPM1300 EK	nPM1100 EK	nPM6001 EK

Figure of link budget improvement Overview



Link budget improvement for the nRF21540-DK compared to the nRF52840-DK.

- Professional lighting
- Smart Home
- Industrial
- Toys
- Audio

Introduction to Range Extender

nRF21 Series – RF front end module (FEM)

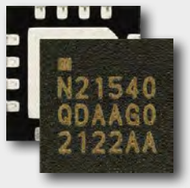
The range and link robustness of Nordic nRF52 and nRF53 Series SoCs fulfill the requirements of most applications and use-cases, but sometimes adding an RF front-end module (FEM) is the correct choice. An RF FEM increases the range at which two wireless devices can communicate, while also enhancing link robustness. Combining the nRF21540 RF FEM with an nRF52 or nRF53 Series SoC can boost range between 6.3-10x.

Key Features

- Supports
  - Bluetooth® Low Energy (incl. Bluetooth mesh)
  - Thread and Zigbee (802.15.4)
  - Proprietary 2.4 GHz
- Adjustable output power in small increments up to +21 dBm
- +13 dB receive gain with 2.5 dB noise figure
- Two antenna ports for antenna diversity
- Control interface via GPIOs, SPI, or a combination
- -40°C to +105°C operating temperature range
- 1.7 V to 3.6 V input supply range
- 4 x 4 mm QFN16 package
- When combined with an nRF52 or nRF53 Series SoC:
  Up to 6.3-10x range increase /
  -100 dBm RX sensitivity (Bluetooth LE, 1 Mbps)
- Current consumption:
  TX tuned to +20 dBm: 110 mA / RX: 2.9 mA
- Power down mode: 30 nA

Applications

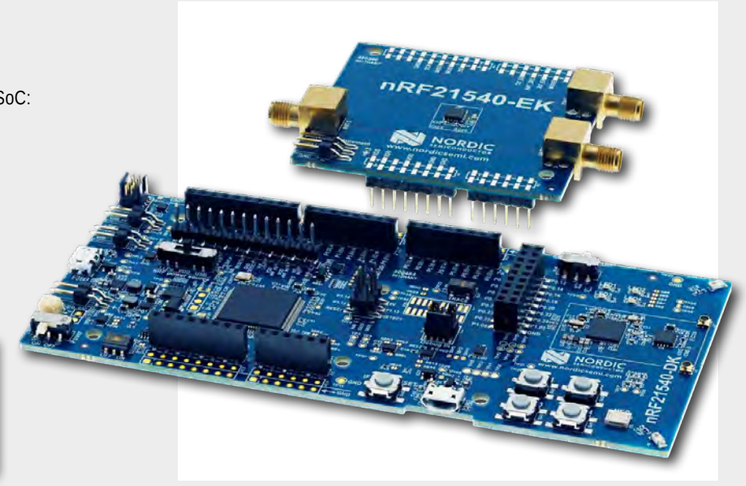
- Asset tracking and RTLS
- Professional lighting
- Smart Home
- Industrial
- Toys



nRF21540 Development Bundle

The nRF21540 DB consists of the nRF21540 development kit (DK) and the nRF21540 evaluation kit (EK).

The nRF21540 DK is the perfect tool to develop products that require the range extension capabilities or link budget improvements provided by the nRF21540 RF front-end module (FEM). The nRF21540 EK can connect to lab equipment via SMA connectors to monitor the RF FEM's performance.



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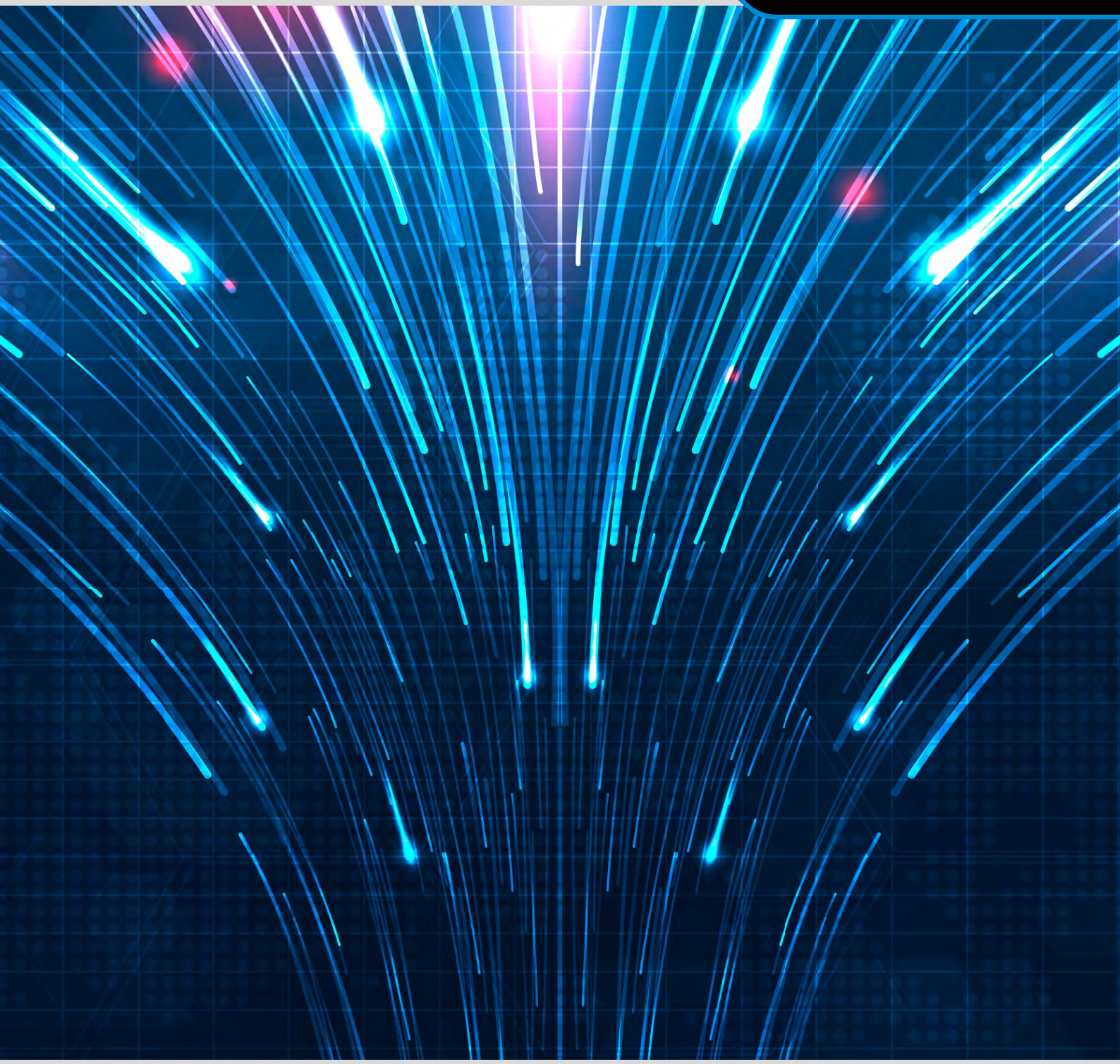

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