FTM

NOVEMBER/DECEMBER 2017

AMERICAS' EDITION

APPLICATION SPOTLIGHT:
CONNECTIVITY

ON Semiconductor
Welcome the RSL10:
The Industry's Lowest Power
Bluetooth Technology

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from Idea to Prototype

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Future Electronics/
Microsemi
RISC-V Creative Board
for Only $99.95USD

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Welcome the RSL10: The Industry's Lowest Power Bluetooth® Technology
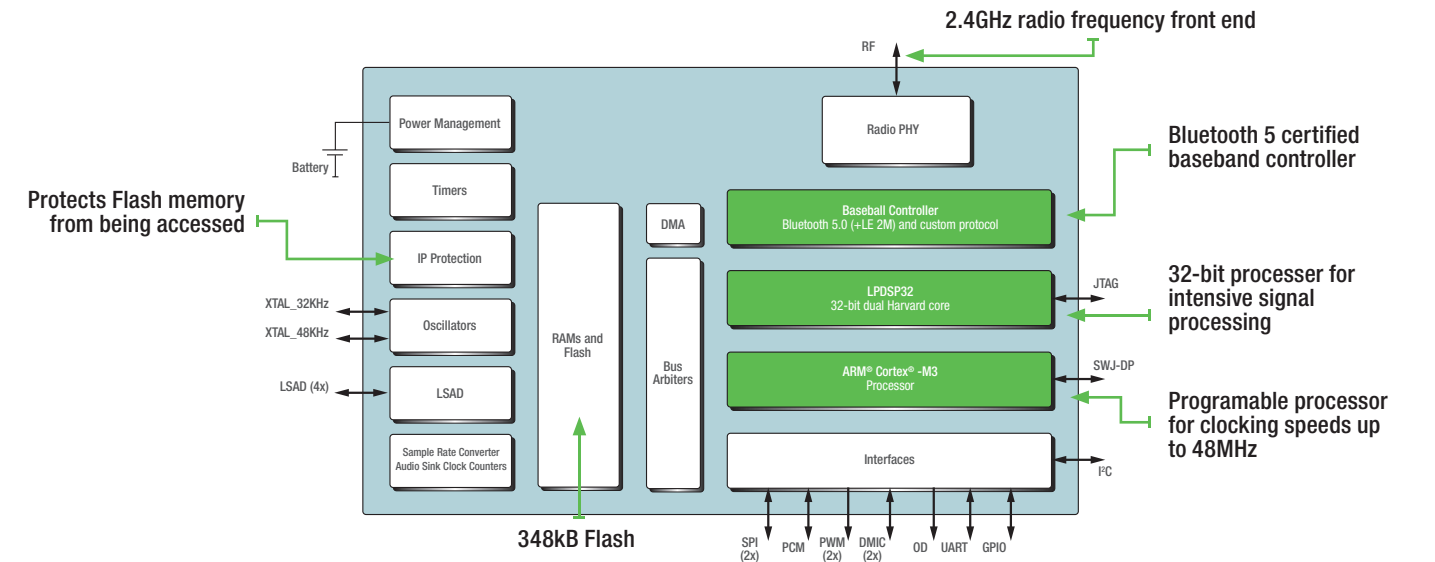
ON Semiconductor®

Wireless connectivity within the IoT space has ushered in a focused concentration on automation and control along with information analytics. Wearable devices emphasize the need for activity tracking and location awareness while medical devices require sensor driven decision analytics. These areas of focus all culminate and necessitate that the wireless connectivity within the end application have low power consumption, high performance, and be small and simple to implement.

ON Semiconductor's new RSL10 brings ultra low power wireless technology to wearables, health, IoT, and other end applications. RSL10 offers the industry's lowest power consumption in Deep Sleep Mode and Rx Mode, without sacrificing system size or performance – both of which are critical factors. Offering Bluetooth 5 functionality, the RSL10 helps provide any connected device with advanced wireless features while minimizing battery drain. ON Semiconductor has also integrated this device into a shield for use with the modular IoT Development Kit.

Unlike most other multi-protocol radio SoCs, RSL10 is specifically designed for applications using 1.2V and 1.5V batteries, and supports a voltage supply range between 1.1V and 3.3V without a required DC/DC converter. The highly integrated radio SoC features a dual core architecture and a 2.4GHz transceiver, providing the flexibility to support Bluetooth low energy technology and 2.4GHz proprietary or custom protocols.

THINK ON.

- Lowest Peak Rx power consumption (62.5nW)
- Supports Bluetooth low energy and 2.4GHz proprietary/custom protocols
- Faster data rates (up to 2Mbps provided by Bluetooth 5)
- Flexible voltage supply range: supports 1.2V and 1.5V batteries without a required external DC/DC converter
- Sophisticated dual core architecture, featuring a programmable ARM® Cortex®-M3 processor and 32-bit Digital Signal Processor (DSP) for intensive signal processing applications

THE TOOLS TO HELP
- Sophisticated Integrated Development Environment (IDE), with ARM CMSIS-Packs supporting other software
- Wide range of Bluetooth low energy protocols, sample code, and libraries
- Easy-to-use development hardware based on Arduino® form-factor

THE END APPLICATIONS
- Smart locks, lighting and IoT applications
- Wireless-enabled low voltage devices
- Pulse, glucose, and heart rate monitors
- Fitness trackers and wearables
- Hearing aids

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DIFFERENTIATING FEATURES

The Devices to Use	
RSL10 Radio SoC (QFN)	NCH-RSL10-101Q48-ABG
RSL10 Radio SoC (CSP)	NCH-RSL10-101WCS1-ABG
RSL10 Development Board	RSL10-002GEVB

2.4GHz radio frequency front end
Bluetooth 5 certified baseband controller
32-bit processer for intensive signal processing
Programable processor for clocking speeds up to 48MHz

Protects Flash memory from being accessed
348kB Flash

Semtech LoRa® Transceiver for IoT

The SX1276 transceiver features award-winning LoRa Technology that provided ultra long range spread spectrum communication and high interference immunity while minimizing current consumption.

Using Semtech's patented LoRa modulation technique SX1276 can achieve a sensitivity of over -148dBm using a low cost crystal and bill of materials. The high sensitivity, combined with the integrated +20dBm power amplifier, yields an industry leading link budget, making it optimal for any application requiring range or robustness. LoRa also provides significant advantages in both blocking and selectivity over conventional modulation techniques, which solves the traditional design compromise between range, interference immunity and energy consumption.

FEATURES

- LoRa modem
- 168dB maximum link budget
- +20dBm - 100mW constant RF output vs. V supply
- +14dBm high efficiency PA
- Programmable bit rate up to 300kbps
- High sensitivity: down to -148dBm
- Bullet-proof front end: IIP3 = -11dBm
- Excellent blocking immunity
- Low RX current of 9.9mA, 200nA register retention
- Fully integrated synthesizer with a resolution of 61Hz
- FSK, GFSK, MSK, GMSK, LoRa and OOK modulation
- Built-in bit synchronizer for clock recovery
- Preamble detection
- 127dB Dynamic Range RSSI
- Automatic RF Sense and CAD with ultra fast AFC
- Packet engine up to 256 bytes with CRC
- Built-in temperature sensor and low battery indicator

APPLICATIONS

- Internet of Things
- Automated meter reading
- Home and building automation
- Wireless alarm and security systems
- Industrial monitoring and control
- Long range irrigation systems

Order Codes

- SX1276IMLTRT: Pb-free, halogen free, RoHS/WEEE compliant product
- SX1276DVK1IAS (169MHz and 868MHz): starter kit
- SX1276RF1IAS (169MHz and 868MHz): starter kit
- SX1276DVK1JAS (433MHz and 868MHz): starter kit
- SX1276RF1JAS (433MHz and 868MHz): starter kit
- SX1276DVK1KAS (490MHz and 915MHz): starter kit
- SX1276RF1KAS (490MHz and 915MHz): starter kit

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SL900A EPC Sensor Tag and Data Logger IC

The SL900A is an EPC tag IC operating in semi-passive mode (battery-assisted passive) as well as in fully passive mode. The chip is ideal for applications using thin and flexible batteries (1.5V or 3V) for autonomous logging from the integrated temperature sensor or external sensors with time-stamp from on-chip real-time clock (RTC).

FEATURES

- Energy harvesting
- Passive and semi-passive operation
- On-chip temperature sensor
- 9k-bit EEPROM and RTC
- Integrated shelf-life algorithm

BENEFITS

- Provides supply for external circuitry
- Works with or without battery
- Enables temperature logging
- Stores up to 841 time-stamped events
- Provides expire date alert

APPLICATIONS

The SL900A device is ideal suited for:
- Monitoring and tracking of temperature-sensitive products
- Temperature monitoring of medical products
- Pharmaceutical logistics
- Monitoring of fragile goods transportation
- Dynamic shelf life applications
- RFID to SPI interface

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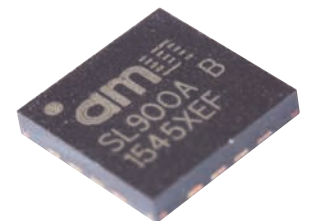
SL900 Cold Chain Management

How do you track the temperature history of perishable items like medicine, food or flowers during storage and shipment?

Go to www.FutureElectronics.com/FTM to view the demonstration video that shows how the SL900 UHF RFID data logger IC can be incorporated with a printed battery and printed antenna to create a data-logging UHF tag. Temperature readings are automatically made and stored periodically. The history can then be read using a UHF RFID reader using the EPC standard.

RF Front-End Solutions for Seamless Connectivity

Sustained progress of wireless communication technology inspires innovative and mushroom applications, such as 5-G mobile communication and Internet of Things (IoT). Wireless connection creates enhanced efficiency and productivity. As IoT continues to fuel demand, the technology-intensive RF front-end components and modules are indispensable for this development trend.

Yageo integrates circuit design capacity and group passive components resources, including material and process technology to develop modules and RF front-end component for multi-mode and multi-frequency requests.

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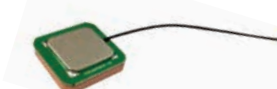
GPS Internal and External Module

FEATURES

- High gain, lower power consumption
- Operating frequency: 1.575 and 1.602GHz
- Support GPS/GLONASS/Galileo/BDS systems
- Size 8*8mm - 60*60mm

APPLICATIONS

- Automotive, drone, tracking, navigation
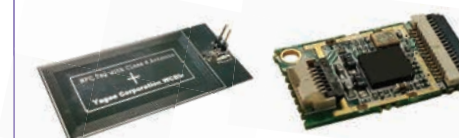
NFC (Near Field Communication/N-Tag Module)

FEATURES

- Operating frequency: 13.56MHz
- Size 30*20mm, 17*10mm
- NFC forum compliant

APPLICATIONS

- Navigation
- Speaker, IoT, wearable, headset accessory

LTCC Components (Balun, Coupler, LPF, HPF, BPF, Diplexer and Triplexer)

FEATURES

- WiFi/Bluetooth: 2.4/5GHz
- Low loss, high rejection
- 0605/1005/1608/2012/2520 size

APPLICATIONS

- Networking and cellular phone

XMC4800 Automation Board-V2

NEW PRODUCT INTRODUCTION

Designed to evaluate the capabilities of the XMC4800 Microcontroller especially in EtherCAT® slave applications, the XMC4800 Automation Board V2 utilizes Infineon's industry leading XMC ARM® Cortex®-M4 microcontroller in combination with Infineon supply, interface, communication and safety products. The XMC4800 Automation Board V2 is designed to evaluate the capabilities of the XMC4800 Microcontroller especially in EtherCAT slave applications and can be used with a wide range of development tools including Infineon's free of charge Eclipse based IDE, DAVE™.

FEATURES

• XMC4800-E196 microcontroller based on ARM Cortex-M4@144MHz - EtherCAT slave controller, 2MB Flash and 352KB RAM
• Serial wire debug interface (to connect external debugger)
• ESD and reverse current protection Isoface
• OPTIGA™ Trust E
• User RGB LED
• Real-time clock crystal
• SPI FRAM (64kB non-volatile memory)
• EtherCAT slave node (2 EtherCAT PHY and RJ45 jacks)
• 24V ISOFACE™ 8 x IN and 8 x OUT
• CAN transceiver
• Ethernet PHY and RJ45 jack
• Micro-AB USB plus

BENEFITS

• Complete automation kit gateway
• Combine powerful microcontroller with EtherCAT slave application
• Isolated interfaces for automation and industrial control
• Ethernet connectivity with software examples available
• 24V supply
• CAN connectivity
• Full software DAVE examples

The block diagram shows the main components of the XMC4800 Automation Board-V2 and their interconnections. The main building blocks are:
• XMC4800 Microcontroller in a LFBGA196 package
• 2 EtherCAT PHY with 2 RJ45 plugs
• 1 Ethernet PHY with RJ45 plug
• 24V ISOFACE 8 x IN and 8 x OUT
• RGB LED, CAN RG LED, reset push-button
• Micro-AB USB plug
• CAN transceiver with SUB 9 connector

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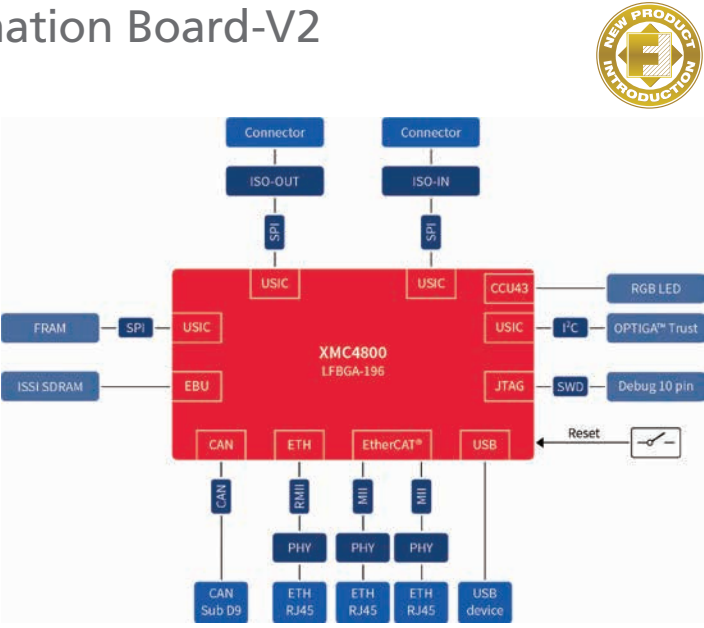
Block diagram of the XMC4800 automation board-V2

Completing Products Type	Description	Ordering Code
KIT_XMC48_AUT_BASE_V2	The XMC4800 Automation board-V2 utilizes Infineon's industry leading XMC ARM Cortex-M4 microcontroller in combination with Infineon supply, interface/communication and safety products.	KITXMC48AUTBASEV2TOBO1
XMC4800-E196K2048	ARM Cortex-M4 microcontroller	XMC4800E196K2048AAXQMA1
ISO2H823V2.5	24V 8-ch isolated output	ISO2H823V25XUMA1
SLS 32AIA020A4 USON10	OPTIGA Trust E - embedded security solution	SLS32AIA020A4USON10XTMA2
TLE6250GV33	Infineon CAN transceiver	TLE6250GV33XUMA1
IFX54441LDV	Infineon voltage regulator	IFX54441LDVXUMA1

DIGI
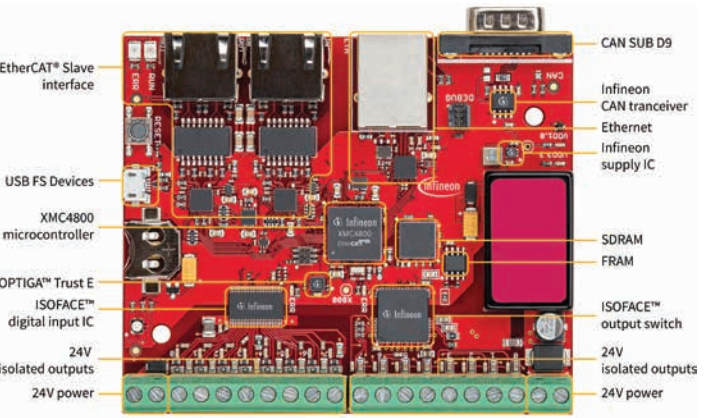
COMPLETE CAPABILITIES AND FLEXIBILITY

SBC: CC-SBP-WMX-JN58
Dev Kit: CC-WMX6UL-KIT

CONNECTCORE® 6UL SBC PRO

Powerful, secure, pre-certified connected Single Board Computer in standard form factor with complete design flexibility.

The ConnectCore 6UL SBC Pro delivers the ultimate connected off-the-shelf NXP i.MX6UL single board computer with complete capabilities and unparalleled design flexibility. Its unique pre-cerfified wireless connectivity options offer 802.11a/b/g/n/ac Wi-Fi and Bluetooth 4.2, including Bluetooth Low Energy. Out-of-box cellular integration options using the pre-certificd Digi XBee® Cellular module or third party PCI Express Mini Card modem allow you to integrate cellular connectivity without the usual cost and complexity. Digi's complete Linux support includes the built-in Digi TrustFence™ device security framework with support for secure boot, encrypted file systems, protected ports, and more.

FEATURES AND BENEFITS
– Powerful and flexible off-the shelf solution in Pico-ITX form factor
– Production-ready with minimal hardware design effort
– Rugged design with industrial operating temperature range
– Pre-certified dual-band 802.11ac Wi-Fi connectivity

FEATURES AND BENEFITS
– Out-of-box support for cellular connectivity
– On-board NFC Forum Type 2 compliant tag
– Dual 10/100 Mbit Ethernet networking
– Integrated display and camera capabilities
– Rich interface and peripheral support
– Complete Yocto Project Linux BSP with source code
– Digi TrustFence device security framework
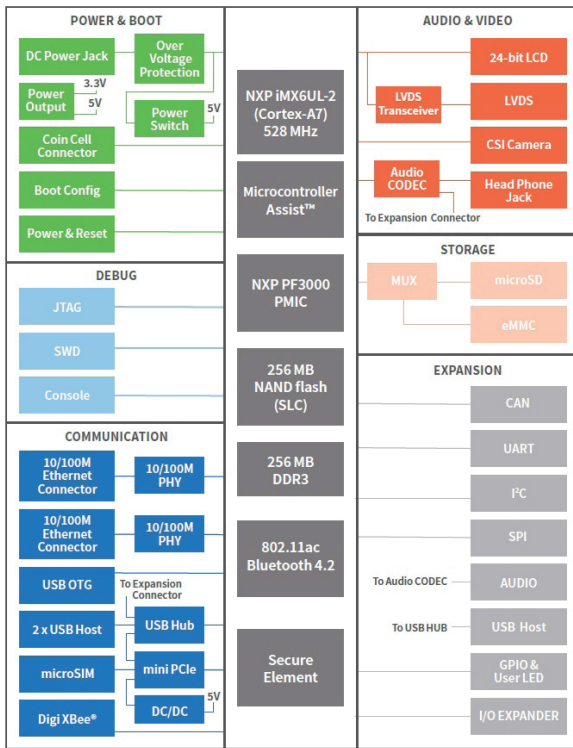
MECHANICAL DRAWING
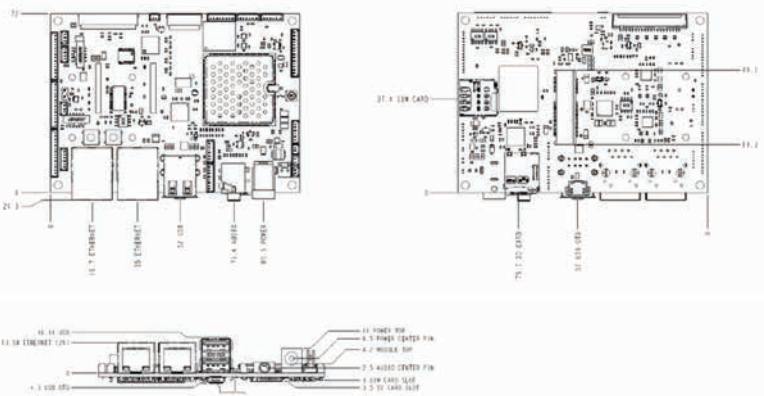
For more information or to buy products, go to www.FutureElectronics.com/FTM

Ultra Low Profile Micro USB and Next-Gen USB Type-C Empower GCT's Interconnect Range

GCT

GCT's comprehensive selection of USB connectors are designed with versatility in mind. Covering a wide variety of applications, they are available with various combinations of form factors, interface and version types to meet your exact requirements.

One of GCT's latest innovations available through Future Electronics is the USB3160 Vertical Micro USB connector with one of the lowest profiles available in the entire market. A mere 5.20mm height above the PCB surface, it meets the increasing demand for smaller and more compact devices. Three different shell stake lengths (0.70, 1.20 and 1.70mm) offer customers even greater flexibility when applications such as wearable and mobile technology demand compact designs. Combined with enhanced high

Perfect for **Wearable Tech**

USB3160 Ultra-Low profile Vertical Micro USB

Vertical & Horizontal **USB Type-C**

Next-Gen Data Transfer & Power Delivery

current rating for charging at 2.8A (a full 1A over standard products) this makes it perfect for fast charging application requirements.

However, if you're looking for the latest USB innovations, GCT's high performance USB Type-C connectors set new market standards in design

flexibility, transfer speed, power and usability. They are ready for next generation applications, supporting HDMI, DisplayPort and VGA. Certified to USBIF TID standards, the connectors also support USB Power Delivery standards of charging capability, with rapid charging up to 100W. The drawn metal shell design for horizontal parts provides superior EMI shielding compared to stamped sheet metal housings.

APPLICATIONS

• Consumer electronics
• Personal computing
• Docking and charging
• Mobile and smart devices

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Waterproof Micro USB Connector Provides Protection and Performance for High Moisture Applications

CUI INC®

The UJ2W-MIBH-4-SMT is a waterproof micro USB 2.0, micro B type jack connector with an Ingress Protection (IP) rating of IPX7, offering protection from liquid and moisture in challenging environments.

Thanks to its copper alloy contact terminals with 30μin gold over nickel plating and stainless steel shielding, the UJ2WMIBH-4-SMT is designed for high durability at 10,000 mating cycles. The series features a surface mount package and horizontal orientation with a voltage rating of 30Vac, current rating of 1.8A, and an operating temperature range of -25°C to +85°C. Plastic mounting ears are also included to provide added stability on the board.

Complying with the USB 2.0 standard, this micro B USB connector allows for high speed data and power transmission, making it well-suited for a variety of I/O applications in consumer and portable electronic devices that may be used in outdoor environments, including mobile computing equipment, digital audio devices, camcorders and GPS units.

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FEATURES

• USB micro B type jack
• Waterproof
• Surface mount

APPLICATIONS

• Consumer
• Portable electronics for outdoor use

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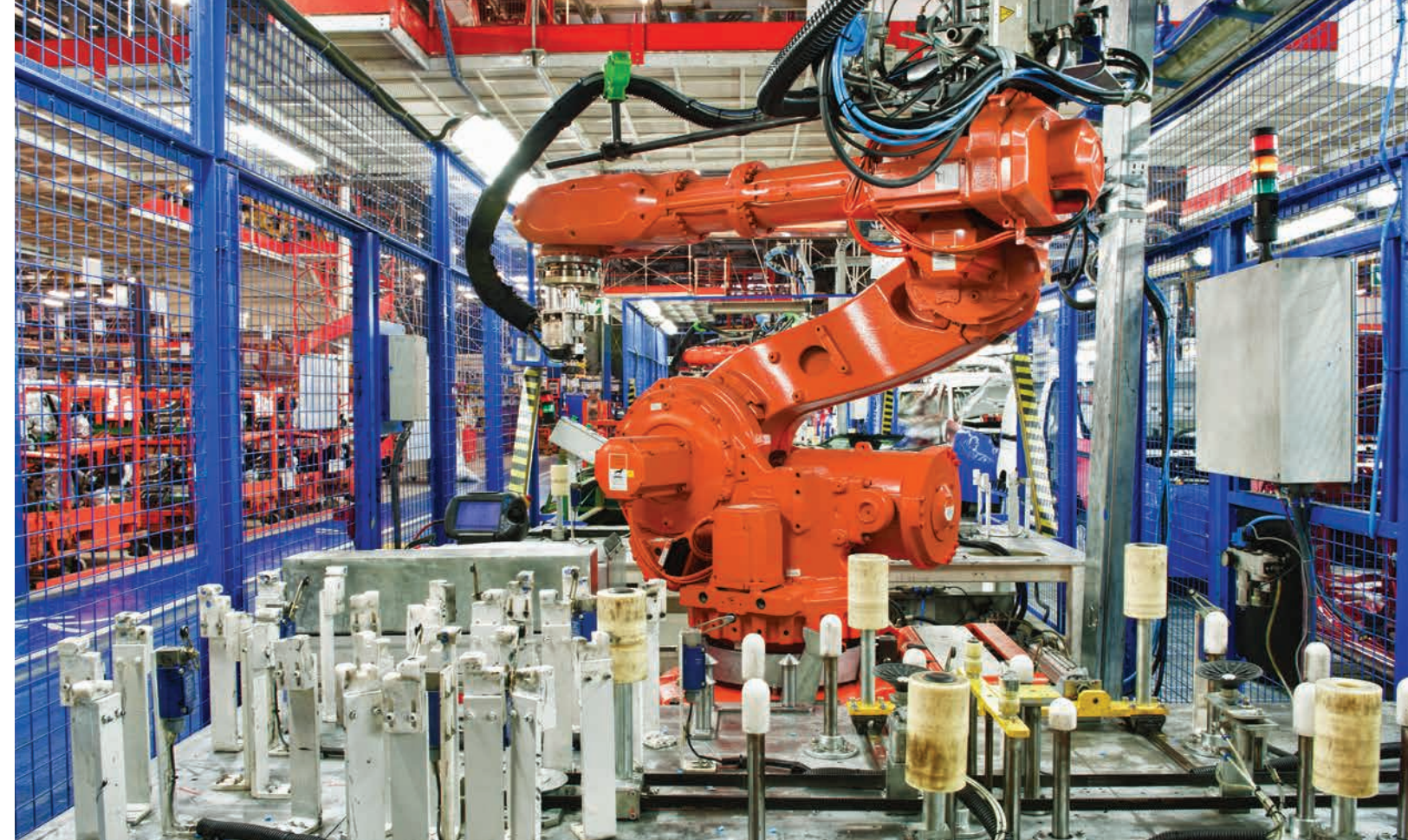
M SERIES

M12 X-CODED CIRCULARS NOW AVAILABLE!

IP67/IP68 Performance - Industrial Gigabit Ethernet

The newly released NorComp X-Coded M SERIES circular connectors are designed to run high speed Ethernet through a ruggedized IP68 M12 solution. The separated twisted pairs allow for the running of high speed Ethernet up to 10Gbps which is used in industrial networking applications and ruggedized applications requiring higher bandwidth.

This addition to the M12 Ethernet connector product line adds to the already existing D Code for the NorComp M-SERIES Circulars.

For more information or to buy products, go to www.FutureElectronics.com/FTM

NORCOMP

Modular Keystone RJ45 Jacks for PCB and Panel Applications

KEYSTONE®

Manufactured for increased durability, the Keystone RJ45 sockets can endure a minimum of 500 insertion cycles. Rated for 125VAC RMS, these jacks are fully compliant with IEEE and IEC standards. A variety of styles are available to accommodate design applications with numerous mounting and port size options.

Horizontal (right-angle) PCB modular jacks are available in thru-hole or surface mount soldering configurations. For low profile applications, request #943. For compact designs, #942 is recommended. Applications that require a deeper socket can be met by using #948. Designs for surface mount installation can utilize #944.

For devices where connectivity will be perpendicular-to-the-board, a vertical (top-entry) PCB

modular jack, #949 is offered. As part of this series, Keystone is offering a panel mount modular jack, #946 which is supplied in a 2-piece locking design to simplify and secure wiring of the jack.

These Keystone modular jacks provide a reliable connection to networks. They will mate with any plug that conforms to FCC Part 68, Subpart F.

FEATURES

- 100Base-T: fast Ethernet applications
- IEEE and IEC compliant
- Horizontal and vertical entry styles
- PCB (thru-hole, surface) and panel mount styles
- Small PC footprint ideal for high density applications
- Tool-less punch down design
- Operating temperature: -40°F to +185°F (-40° to +85°C)
- Low resistance: 35mΩ max

APPLICATIONS

- Network equipment
- Modems
- Hubs
- Switches
- Routers
- Gateways
- Repeater's bridges
- PC motherboards
- Laptops
- Notebooks

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New Precision Audio Resistor, the RS Series

NEW PRODUCT INTRODUCTION

SSM THIN FILM TECHNOLOGY SUSUMU

Susumu, an innovative precision thin film chip resistor manufacturer, introduces the RS series, a new chip resistor series specially created for audio applications.

Thin film resistors have been known to have better frequency characteristics, less noise, and less signal distortion than other types of resistors. It seems clear that for audio applications, the natural choice should be a thin film resistor. However until now, the usage of thin film resistors has been limited to high end audio despite the fact that the most popular audio devices on the market today are smart phones and automotive audio systems. Susumu contends that the sound quality of these popular audio systems can be improved significantly by utilizing thin film resistors, such as Susumu's RG series. However, Susumu wanted to make the RG

series even better for all audio systems. After numerous prototypes, simulations, and evaluations by sound professionals, Susumu discovered that design methods of resistive patterns and terminal materials had the most impact on sound quality. The RS series was born as a series of thin film resistors targeted specifically for high quality Hi Fi audio applications.

The RS series is a perfect solution for any sound circuits including digital analog converter circuits. If you are interested in improving the sound quality of your audio devices, from high end to personal mobile devices, Susumu's RS series is the answer to your needs.
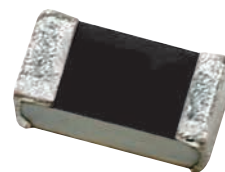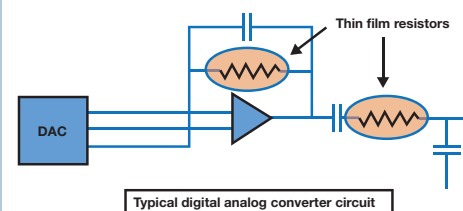
PERFORMANCE CHARACTERISTICS

- Current noise: -40dB or less (typical)
- Frequency performance: up to GHz level (depending on resistance value)
- Tolerance: ±0.1%, ±0.5%
- TCR: ±25ppm
- Resistance range: 47-100KΩ
- Power ratings: 1/16W (1005 size), 1/8W (2012 size).
- Gold terminal available upon request

Thin film resistors

DAC

Typical digital analog converter circuit

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Next Generation **Networking Solutions**

Leveraging the depth of our **HW** and **SW** teams and breadth of **suppliers**, **Future Networking Solutions enables customers to get to market quickly** with the latest technologies that meet their design goals.

SUPPLIERS

Future Networking Solutions has assembled a team of world class manufacturers. Each one is leading the industry with the next generation product lines to meet the toughest design challenges.

HW TEAM

Our hardware team consists of industry experts with networking circuit design, having come from industry giants such as Freescale, Actel, Lattice and IBM. Together we have more than 50+ years of experience offering solutions and technical support to customers.

SW TEAM

Our software team consists of industry experts with Linux Kernel and SDK tools, coming from industry giants such as Cavium, Freescale, nVidia and Marvell.

System block diagram

Flash | eMMC | DRAM

Oscillator

Timing

Networking Processor

Temperature

I/O Expander

Secure Element

RTC

1G/2.5/10G/40G Ethernet

PCIe | USB3

Ethernet Switch | Copper PHY | Optical PHY | PCIe Switch | USB Hub

Power Over Ethernet | Magnetics | FPGA | Wireless Communication

DC/DC Power | Optical Transceivers | Wireless Communication

AC/DC Power | Connectors | Redriver/Retimer

FNS-Technology Coverage

PROCESSORS, SOM/SBC, PHY/SWITCHES, TIMING, BRIDGES/REDRIVERS, MEMORY, OPTICAL TRANSCEIVERS, FPGA, WIRELESS, POWER, INTERCONNECT

For more information about Future Networking Solutions,
please contact FNS.Support@FutureElectronics.com or visit:
www.FutureElectronics.com

FUTURE Networking Solutions
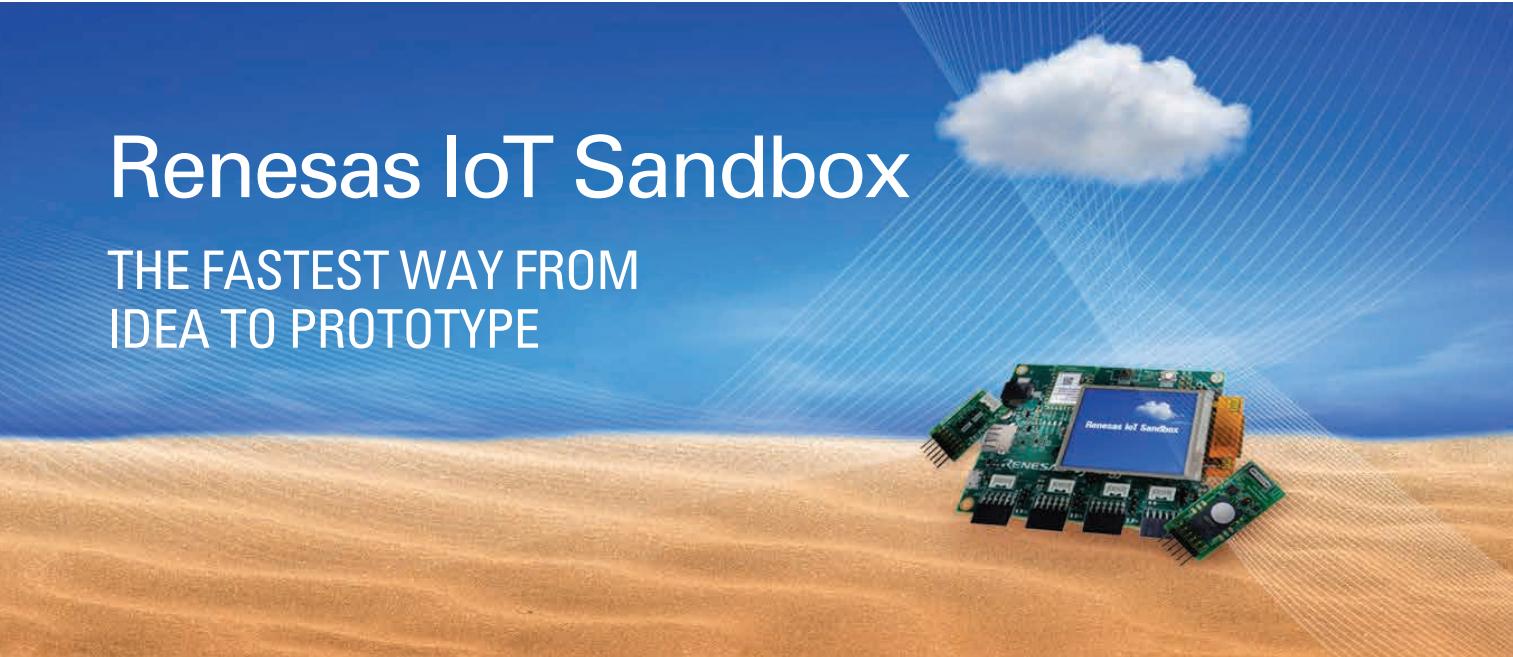
Renesas IoT Sandbox

THE FASTEST WAY FROM IDEA TO PROTOTYPE

Renesas IoT Sandbox allows you to rapidly create IoT applications using cloud services and real-time workflows. All functions needed for development are included, from connecting to the cloud and processing device data, to IoT-centric libraries with analytics functions for predicting trends and detecting anomalies.

Renesas IoT Sandbox aggregates all event data from any source, whether it's sensors, mobile apps, or an existing cloud, and performs real-time processing to extract intelligence or implement automation. With Renesas IoT Sandbox, you can focus on the application's logic while the Sandbox quickly extracts intelligent insights to power your applications.
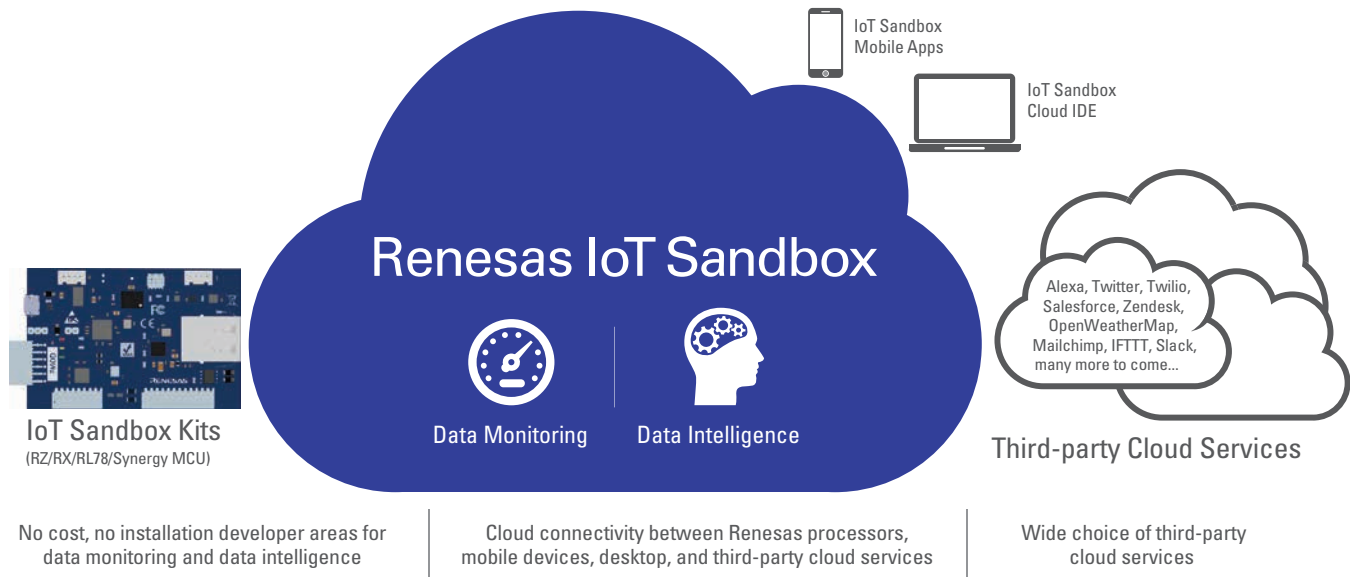
- No cost or installation developer areas for data monitoring and data intelligence
- Cloud connectivity between Renesas processors, mobile devices, desktop, and third-party cloud services
- Wide choice of third-party cloud services

Renesas IoT Sandbox

IoT Sandbox Mobile Apps
IoT Sandbox Cloud IDE

Data Monitoring   Data Intelligence

Third-party Cloud Services

Alexa, Twitter, Twilio, Salesforce, Zendesk, OpenWeatherMap, Mailchimp, IFTTT, Slack, many more to come...

IoT Sandbox Kits
(RZ/RX/RL78/Synergy MCU)

No cost, no installation developer areas for data monitoring and data intelligence

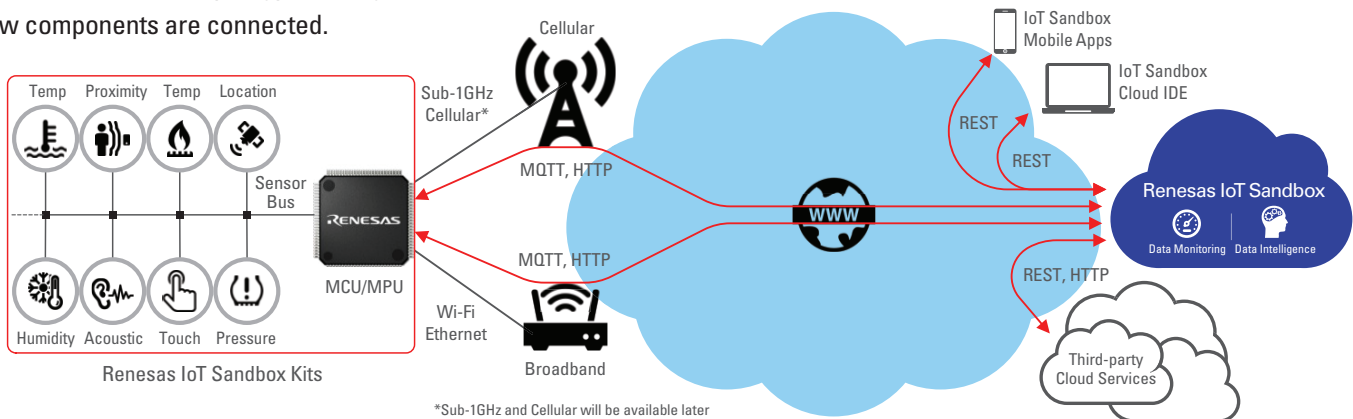Cloud connectivity between Renesas processors, mobile devices, desktop, and third-party cloud services

Wide choice of third-party cloud services

Renesas IoT Sandbox Developer Areas

	Data Monitoring	Data Intelligence
Description	Great for visual data monitoring using dashboards and population control by batch updates	Use near real-time data to make intelligent personalized actions based on 100% programmatic Python workflows
Application examples	Gym Management, Fleet Management, Weather Station, and Smart Gardening	Fitness Monitors, Smart Power Tools, Building Access, and Smart Appliances
Time frame	Prototyping in minutes	Prototyping in hours
Cloud type	Open cloud connection	Secured cloud connection

Renesas IoT Sandbox Network Topology

End-to-end network topology showing how components are connected.

Temp   Proximity   Temp   Location
Sensor Bus
Humidity   Acoustic   Touch   Pressure
MCU/MPU
Renesas IoT Sandbox Kits

Cellular
Sub-1GHz Cellular*
MQTT, HTTP
MQTT, HTTP
Wi-Fi Ethernet
Broadband

WWW

REST
REST
REST, HTTP

IoT Sandbox Mobile Apps
IoT Sandbox Cloud IDE

Renesas IoT Sandbox
Data Monitoring   Data Intelligence

Third-party Cloud Services

*Sub-1GHz and Cellular will be available later

Developer Community Resources

Build your IoT development skills by using such resources as the IoT Community. The IoT Community provides tutorials, including step-by-step guidance using the Renesas Synergy™ SK-S7G2 and S3A7 kits, live training sessions, community discussion, and other testing and learning activities.

iotcommunity.io

Renesas IoT Sandbox Compatible Kits

Renesas offers a wide choice of kits and will continue to create more kits that are supported by Renesas IoT Sandbox and loaded with tutorials. Listed below are kits currently available for your immediate IoT prototyping experience.
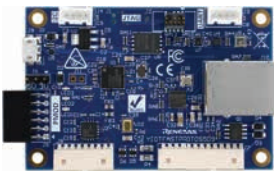
Synergy S5D9
IoT Fast Prototyping Kit
bit.ly/RenesasS5D9PrototypingKit

Synergy S3A7
IoT Fast Prototyping Kit
PN: YIOTFASTPROTOS3A7

Synergy SK-S7G2
Starter Kit
PN: YSSKS7G2E30

RX231 Wi-Fi Cloud
Connectivity Kit
bit.ly/RX231ConnectivityKit

RENESAS

Configurable Display Switch CDS1 for the Most Distinguished HMI Applications

SCHURTER
ELECTRONIC COMPONENTS

NEW PRODUCT INTRODUCTION

SCHURTER introduces a new generation of human-machine interfaces with the CDS1, a switch-sized input system using capacitive touch technology. The intuitive operation with the touch of a finger, swipe or rotation on the touchscreen conveniently resembles that of a smartphone.

Plug-and-Play couldn't be easier. Unpack, connect and immediately begin using the machine simulator (Windows) provided. Fully configurable, the user decides on the imagery to be used for selection. The selection is then activated with just a swipe of the bright round OLED display. Tap the home LED to return to the home screen. Change up the image or add features like subtle fade-in and fade-out. The same flexibility applies to the glass screen, e.g. any symbols on the softkeys are possible. All images, graphics and animations can be loaded to its 4MB internal mass storage via Micro USB 2.0 interface. Standard machine control communication interfaces I^2C, SPI or RS232 are available.

The CDS1 is mounted on the front panel from the rear using a special mounting ring and screws.

It has a seal protection rating of IP67 when used with the O-ring, IP40 without. An added aluminum decorative ring accentuates the design. Supply voltage is 3.3VDC. Display is 16-bit color OLED, 128 x 128 pixel. The touchscreen is full size PCAP. Operating temperature is -20°C to +60°C. Applications include high end industrial appliances, professional audio, commercial food service appliances, sophisticated home appliances, equipment and appliances such as vending, service kiosks used in specialty public venues, and specialty lab equipment.

Order Number	Description	Power Connector
Note: Design kit needed to get started		
3-102-423	10 Piece Production Pack	Not Applicable
3-102-436	Design-In Kit	US and EU Adapters

To view videos, go to www.FutureElectronics.com/FTM

Animated video highlights a few applications enhanced by the innovative CDS1 Switch.

CDS1 offers many fully configurable functions. Selections are activated with just a swipe of your finger.

Start your design today by ordering your Design Kits! Part Number: 3-102-436

To buy products or download data, go to **www.FutureElectronics.com/FTM**

FEATURES

Many innovative possibilities are offered by the CDS1 Switch!
• Fast design-in process
• Input and display system in a single unit - compact size
• Standardized interface (I^2C, SPI or RS232)
• Low cost and suitability for serial production
• Customized adaptations in design, technology and production

APPLICATIONS

• High end industrial appliances
• Professional audio systems
• Commercial food service applications
• Home appliances
• Kiosks
• Lab equipment

THD series - high performance fans designed specifically for the following applications:

TELECOM
NETWORKING
DATA CENTER / SERVER
CLOUD STORAGE

THD series innovation with bionic blade fan

The THD series boasts newly designed bionic blades inspired by nature's most powerful winged predators. This fan series represents the most *quiet*, *powerful*, and *efficient design* Delta has to offer. Engineers managed to apply the posture and wing structures of an osprey in flight to design fan blades via parameterized and simulated processes. By simulating the curve of an osprey's wing in flight, the new THD series fan reduces fan noise up to 6dB-A. THD fans offer different sizes of products, from SQ80mm to OD200mm.

Products Features
● Higher performance at lower noise
● More powerful cooling solution
● 45% higher bionic fan efficiency
● High strength blade design
● Advanced motor driving tech

For more information or to buy products, go to www.FutureElectronics.com/FTM

ΛELTA

FUTURE ELECTRONICS

Intersil's ISL95338: Bidirectional, Buck-Boost Voltage Regulator

NEW PRODUCT INTRODUCTION

intersil
A Renesas Company

The ISL95338 is a bidirectional, buck-boost voltage regulator, which provides buck-boost voltage regulation and protection features. Intersil's advanced R3™ technology is used to provide high light-load efficiency, fast transient response, and seamless DCM/CCM transitions.

The ISL95338 takes input power from a wide range of DC power sources (conventional AC/DC ADPs, USB PD ports, travel ADPs, etc.) and safely converts it to a regulated voltage up to 24V. The ISL95338 can also convert a wide range DC power source connected at its output (system side) to a regulated voltage to its input (ADP side). This bidirectional buck-boost regulation feature makes its application very flexible.

ISL95338 includes various system operation functionalities such as Forward mode enable, Reverse mode enable, programmable soft-start

time, adjustable V_{OUT}, in both forward direction and reverse direction. The protection functionalities include OCP, OVP, UVP, OTP, etc.

The ISL95338 has serial communication via SMBus/I²C that allows programming of many critical parameters, to deliver a customized solution. These programming parameters include, but are not limited to: output current limit, input current limit, and output voltage setting.

The ISL95338 is available in compact RoHS compliant 32 Ld 4 x 4 TQFN package.

ISL95338

- Active switching for negative voltage transitions
- Bypass mode in both directions
- Forward mode enable, reverse mode enable
- OCP, OVP, UVP, and OTP protection
- SMBus and auto-increment I²C compatible

FEATURES

- Bidirectional buck, boost, and buck-boost operation
- Input voltage range 3.8V to 24V (no dead zone)
- Output voltage up to 20V
- Up to 1MHz switching frequency
- Programmable soft-start time
- LDO output for VDD and VDDP
- System status alert function
- Bidirectional internal discharge function

APPLICATIONS

- Storage/Flash drives
- Power banks
- Other portable consumer devices

ISL8215M: 15A 42V Single-Channel DC/DC Step Down Power Module

NEW PRODUCT INTRODUCTION

The ISL8215M power module is a single channel synchronous step down complete power supply capable of delivering up to 15A of continuous current. Operating from a single 7V to 42V wide input power rail and integrating the controller, power inductor and MOSFETs, the ISL8215M is optimized for space constrained and battery operated applications.

With high efficiency, including a selectable light load mode, and low thermal resistance, the ISL8215M permits full power operations without any heatsink over most conditions. It also provides fast transient response and excellent loop stability while a 40ns typical minimum on-time allows single step low duty cycle down conversions to point-of-load voltages.

The ISL8215M only requires a few external components to operate with its pin strapping configuration technology and provides high power density solution in a reduced footprint.

The module implements a programmable soft-start to reduce the inrush current from the input

supply. A dedicated enable pin and power-good flag allow for easy system power rails sequencing with voltage tracking capability. Input under-voltage lockout (UVLO), over-temperature, programmable overcurrent, output over-voltage, and output pre bias start-up protections ensure safe operations under abnormal operating conditions.

The ISL8215M is available in a compact RoHS compliant thermally-enhanced 9 x 13 x 5.3mm HDA package.

Industry's First 15A, 42V Analog Power Module

42V intersil ISL8215M UP TO 12V 15A

- Programmable soft start or voltage tracking
- Complete protection
- UVLO, programmable overcurrent, over-voltage, and over-temperature
- Prebias output start-up

FEATURES

- 15A single-channel complete power supply
- Integrates controller, MOSFETs, and inductor
- 7V to 42V wide input voltage range
- Adjustable output voltage
- 0.6V to 12V wide output voltage range
- 40ns on-time low duty cycle conversion capable
- ±1.5% accuracy over line, load, and temperature
- Up to 96.5% efficiency
- 300kHz to 2MHz adjustable PWM operations
- External synchronization up to 1MHz
- Selectable light-load PSM/DEM efficiency mode
- Enable pin and power-good flag

APPLICATIONS

- Industrial and medical equipment
- Aftermarket automotive
- Telecom and datacom equipment

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Introducing Future Electronic's latest Creative Board with RISC-V Core

ONLY $99⁹⁵ (USD)

The Future Electronics Creative Board with the Igloo2 FPGA now brings Risc-V to another level! A 32 bit RISC-V processor is pre-programmed into the IGLOO2 on the RISC-V Creative Board. Firmware engineers can start developing their C/C++ code out of the box using SoftConsole IDE version 5.1 or higher. The complete Microsemi Mi-V RISC-V ecosystem contains the following:

- Out of the box reference design runs a hello world demo on the Creative Board
- Recently introduced RISC-V IP core
- Libero development software to modify FPGA logic for your design
- SoftConsole 5.1 IDE for Linux – and Windows. Includes a compiler and debugger for Microsemi's RISC-V IP core
- Microsemi IGLOO2 FPGA 25k LE device to develop your design
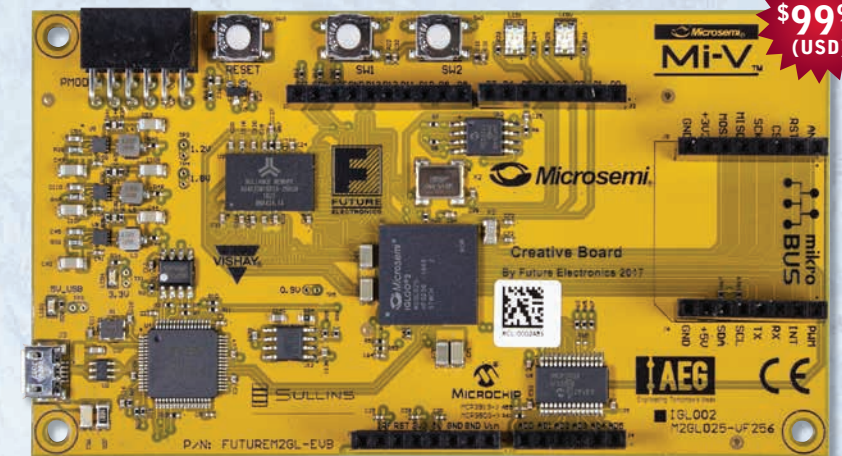
The Creative Board Also Features:

- LX7167 step-down converter, 32M x 16-bit DDR2 synchronous DRAM (SDRAM), 64Mb serial flash, 6 channel synchronous 16/24-bit resolution Delta-Sigma A/D converters, embedded FlashPro 5, Arduino™ compatible expansion headers, MikroBUS expansion headers, and PMod™ expansion connector.
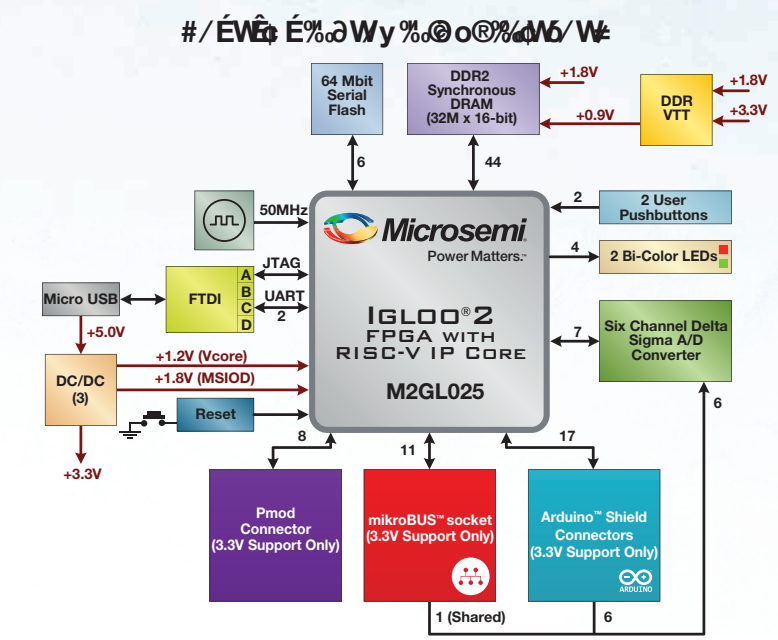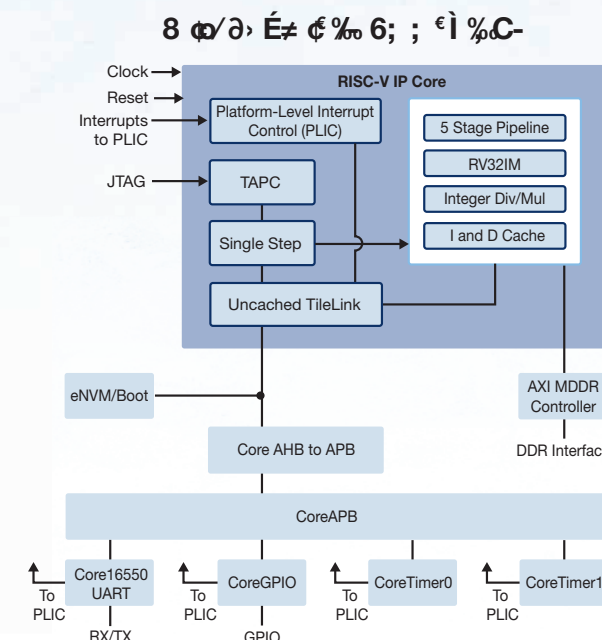
Order your Creative Board part# FUTUREM2GL-EVB today!

Microsemi
Power Matters.™

600V CoolMOS™ P7 Power MOSFET

Infineon

NEW PRODUCT INTRODUCTION

Power MOSFET with optimized balance of ease-of-use and highest energy efficiency

The 600V CoolMOS P7 is the successor of the 600V CoolMOS P6 series, targeting a broad range of applications ranging from low power SMPS up to highest power levels. The 600V CoolMOS P7 is Infineon's most well-balanced CoolMOS technology in terms of combining ease-of-use (e.g. low ringing) with excellent efficiency performance and reasonable price.
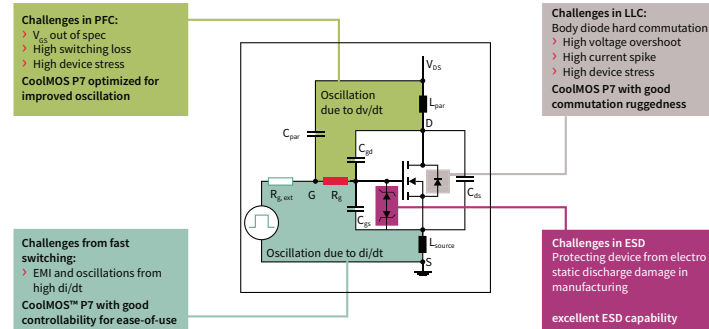
600V CoolMOS P7 achieves up to 1.5% better efficiency and 4.2°C lower MOSFET temperature versus competitor offerings. Its gate charge Qg and Eoss are 30 to 60% lower compared to previous CoolMOS families and competition, which leads to reduced driving and switching losses that allow high efficiency in various power classes. Furthermore, the optimized $R_{DS(ON)}$ enables smaller footprints and higher power density.

The excellent ease-of-use level of the 600V CoolMOS P7 results from carefully selected integrated gate resistors. In addition, 600V CoolMOS P7 comes with an outstanding body diode ruggedness which makes it the perfect fit for hard and soft switching applications. Finally, the 600V CoolMOS P7 offers an excellent ESD robustness of >2kV (HBM) over the whole portfolio in order to improve assembly yield. For products with $R_{DS(ON)}$ values higher than 100mΩ, the high ESD level is guaranteed by an integrated Zener diode.

The wide variety of $R_{DS(ON)}$ from 37mΩ to 600mΩ in both through-hole and surface mount (SMD) packages makes 600V CoolMOS P7 suitable for applications such as lighting, TV sets, notebook adapters, PC power, solar inverters, servers, telecom rectifiers and for EV charging. For the first time products are qualified for standard and industrial grade, allowing the customer to choose the correct type for the application requirements.

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Challenges in PFC:
› V_{DS} out of spec
› High switching loss
› High device stress
CoolMOS P7 optimized for improved oscillation

Oscillation due to dv/dt

Oscillation due to di/dt

Challenges from fast switching:
› EMI and oscillations from high di/dt
CoolMOS™ P7 with good controllability for ease-of-use

Challenges in LLC:
Body diode hard commutation
› High voltage overshoot
› High current spike
› High device stress
CoolMOS P7 with good commutation ruggedness

Challenges in ESD
Protecting device from electro static discharge damage in manufacturing
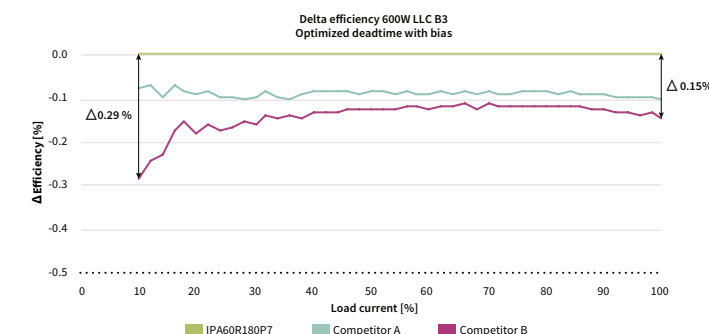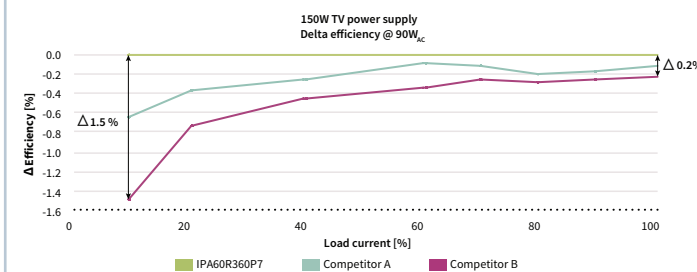**excellent ESD capability**

FEATURES

- Outstanding commutation ruggedness
- Optimized balance between efficiency and ease-of-use
- Significant reduction of switching and conduction losses
- Excellent ESD robustness >2kV (HBM) for all products
- Better $R_{DS(ON)}$/package products compared to competition enabled by a low $R_{DS(ON)}$ x A (below 1Ω x mm²)
- Large portfolio with granular $R_{DS(ON)}$ selection qualified for a variety of industrial and consumer grade applications

BENEFITS

- Suitable for hard and soft switching (PFC and LLC)
- Ease-of-use and fast design-in through low ringing tendency and usage across PFC and PWM stages
- Simplified thermal management due to low switching and conduction losses
- Higher manufacturing quality due to >2kV ESD protection
- Increased power density solutions enabled by using products with smaller footprint
- Suitable for a wide variety of applications and power ranges

APPLICATIONS

- Lighting
- PC power
- Solar
- Server
- Telecom
- EV-Charging

150W TV power supply
Delta efficiency @ 90V$_{AC}$

Δ Efficiency [%]
Δ 1.5 %
Δ 0.2%
Load current [%]
IPA60R360P7   Competitor A   Competitor B

Delta efficiency 600W LLC B3
Optimized deadtime with bias

Δ Efficiency [%]
Δ 0.29 %
Δ 0.15%
Load current [%]
IPA60R180P7   Competitor A   Competitor B

FUTURE ELECTRONICS

Driving efficiency takes pole position

Nexperia is a dedicated global leader in Discretes, Logic and MOSFET devices and became independent at the beginning of 2017.

Focused on efficiency, Nexperia produces consistently reliable semiconductor components at high volume: 85 billion annually. Our extensive portfolio meets the stringent standards set by the Automotive industry. And industry-leading small packages, produced in our own manufacturing facilities, combine power and thermal efficiency with best-in-class quality levels. Built on over half a century of expertise, Nexperia has 11,000 employees across Asia, Europe and the U.S. supporting customers globally.

Nexperia, the Efficiency Company.

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nexperia
EFFICIENCY WINS.

Powering the Age of IoT - CoinPower

VARTA

VARTA's CoinPower, the industry's first rechargeable tiny lithium-ion coin cell, is powering the IoT by meeting the market demand for more energy in smaller sizes.

With 6 patented innovations, CoinPower is now the preferred battery choice for manufacturers of space-constrained, portable devices that have high power drain requirements on batteries with 60mAh, 85mAh or 120mAh of capacity. Used in Bluetooth, wireless, wearable, medical and industrial electronics, they ensure durability, reliability, high capacity and long cycle life.

These high performance cells are enclosed in a strong, stable stainless steel patented casing which provides reduced risk of damage during assembly into end equipment and high tolerance to shock and vibration.

The footprint of the cell protection circuitry is considerably smaller than complex PCBs associated with custom battery packs. An integrated safety mechanism activates when the cell is subjected to abusive conditions and disconnects and shuts down the cell before it enters an unsafe state. The cells are rated to withstand extreme 12V/3C over-charging conditions – well above industry standards of 1C.

- 10% to 30% higher density vs. all other competitors in the microbattery market
- Extended life time 500 full cycles at 80% of initial capacity
- Highest drain capability
- Best mechanical stability (compared to pouch cells) almost zero swelling by design
- Easy to handle in production, hard case button cell design
- Not sensitive to scratches and dents
- Extended efficiency safety
- Fully automated cell production with the highest reliability
- Technology protected by key innovations – 6 patents filed

CoinPower Rechargeable Li-Ion Button Cells

QUALITY: MADE IN GERMANY

- Key innovations for wearables
- With capacities from 60mAh to 120mAh
- Low internal impedance
- No memory effect
- Excellent charge and discharge characteristics
- 0% lead, 0% mercury and 0% cadmium
- Safe and reliable (UL recognition)
- Battery designs in various assemblies or direct contacting

KEY FEATURES/BENEFITS

- Increasing comfort by smaller designs and lighter products for end-users
- Charge for a moment, use for hours…ready-to-go in 15 minutes
- Top quality performance for audio or wireless/radio signals
- Cost savings on the assembly stage of the application production
- Simplified design process saves time and cost
- Best in class product life
- Reduced assembly complexity by inclusion of cell protection electronics on the application board
- Robust high mechanical stability

APPLICATIONS

- Bluetooth headsets
- Smart keys
- Drug delivery
- Wearable technology
- Energy harvesting backup
- Medical applications/ smart capsules
- Fitness trackers
- Sensors (portable, security, medical, sensing)
- Wireless networks
- Smart watches/smart toys
- Industry 4.0 sensors
- Energy harvesting
- Automotive
- Industrial/robotic
- IT/communications

Product Overview

Type Designation	Voltage (V)	Capacity (mAh)	Diameter (mm)	Height (mm)	Weight (g)
CP 1254 A3	3.7	60	12.1	5.4	1.6
CP 1454 A3	3.7	85	14.1	5.4	2.4
CP 1654 A3	3.7	120	16.1	5.4	3.2

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How to Successfully Connect IoT Devices to the Cloud:
NB-IoT and LoRaWAN Technologies Compared

For the past few years, Machine-to-Machine (M2M) and Internet of Things (IoT) applications have relied on 2G and 3G cellular telephone networks for wide-area connectivity. Consumer demand for high speed broadband coverage on the smartphone has led network providers to supplement these older protocols with the new high-bandwidth 4G, also called LTE, technology. While LTE networks provide an excellent service for consumers who wish to stream high quality video on the move and who are prepared to pay a premium for it, M2M users need a different, price-sensitive network for their low power, low data-rate, long-range applications.

This means that an opportunity has arisen for dedicated Low Power Wide-Area Networks (LPWANs) to fill the void. There are many contenders in this space, but two network technologies have taken a lead: LoRaWAN™, and Narrowband-IoT (NB-IoT), a cellular LTE technology developed by the 3GPP industry consortium which also defines the 3G and LTE network standards.

There are distinct differences between the performance and features of these two competing standards. Is there room for both of them in the market, and is one more likely to take more market share?

Competitor 1: LoRaWAN

LoRaWAN is an LPWAN specification intended for 900MHz wireless sensor nodes in local private networks or in regional and nationwide public networks. The protocol provides interoperability among nodes without the need for complex local installations. The network architecture is laid out in a star topology, in which gateways relay messages between sensor nodes, network servers and application servers.
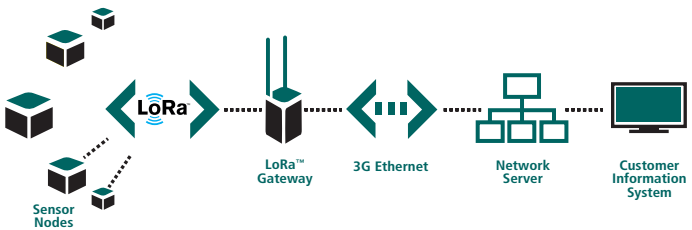

Figure 1: LoRaWAN network topology

The LoRaWAN gateway is connected to the network server by way of Ethernet, cellular or WLAN (Wi-Fi) routers, while sensor nodes use chirp modulation to connect to the gateways, as shown in Figure 1. The span between a node and a gateway can stretch to many miles. The LoRaWAN air protocol uses different frequency channels and data rates, and uses wideband linear frequency-modulated pulses (chirps), the frequency of which increases or decreases over a certain period of time to encode information.

The protocol's maximum data rate ranges from 0.3kbits/s to 50kbits/s. To maximize the battery life of sensor nodes and to make the best use of network capacity, the network server uses an adaptive data rate to manage the effective data rate and the RF output for each node.

LoRaWAN has three classes of end-point devices to address different applications. It implements several layers of encryption, including a network-level unique network key (EUI64), an application-level unique application key (EUI64), and a device-specific key (EUI128) at the node level.

Class A devices have bidirectional communications; one transmission is followed by two receive slots. This is the lowest power option and would typically be used in a Smart City application.

Class B devices are similar, but have an option for additionally scheduled receive slots. This option means the server can be notified when the end node is receiving. A typical use case would be an automatic irrigation system.

Class C nodes transmit periodically, but are otherwise in receive mode. Typically they would be used in a smart street lighting application.

Modules for implementing a LoRa sensor node are available from Microchip, Murata, MultiTech and Laird, as shown in Figure 2. LoRaWAN gateways are available from MultiTech, as shown in Figure 3.

Public LoRaWAN networks are now in operation in parts of Europe and North America. Information about LoRaWAN network installations can be found via the LoRa Alliance, a consortium of hundreds of technology companies and network service providers, which promotes and regulates the LoRaWAN standard (www.lora-alliance.org).

Competitor 2: NB-IoT on LTE Networks

Figure 2: Laird's RM1 LoRa module

LTE technology is notably different from previous generations of cellular networks with regard to carrier frequency and bandwidth, as shown in Figure 4. A number of 4G LTE bands are specified by the standard, and they vary depending on country as well as carrier. These licensed spectrums are split into Frequency Division Duplexing (FDD) and Time Division Duplexing (TDD) types where the FDD spectrum requires pair bands, one for uplink and one for downlink, and the TDD uses a single band as uplink and downlink on the same frequency but separated in time.

Fig. 3: MultiTech's MultiConnect® Conduit™ LoRaWAN gateway

Some 31 pairs of LTE bands operate at frequencies between 452MHz and 3.6GHz, and an additional 12 TDD bands are between 703MHz and 3.8GHz. The higher frequencies allow for faster transmission in urban areas, while lower frequencies offer additional range but less bandwidth in rural areas. These bands typically offer between 10MHz and 20MHz of bandwidth for data transfer, although they can be split up into smaller 1.4MHz, 3.0MHz and 5.0MHz bands.
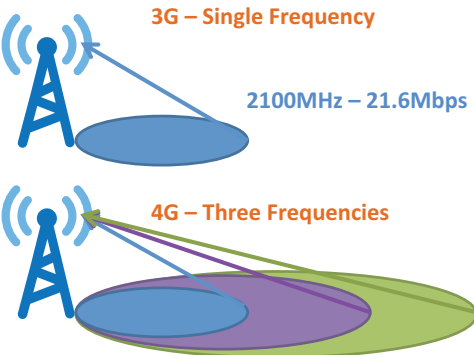

Figure 4: LTE networks use multiple frequency bands to optimise for coverage and data rate

As its name suggests, a Narrowband-IoT network uses smaller, 200kHz bands. Maximum Transmit power is 23dBm, and the maximum data rate on an NB-IoT link is 200kbits/s.

One of the advantages of NB-IoT is that it operates within a licensed spectrum, which means that it provides a secure and established public network for use by IoT businesses, without the risk of interference or jamming to which the LoRaWAN unlicensed frequency bands are exposed.

What is more, NB-IoT technology was developed specifically for use by IoT applications that have low data usage and by devices which require long battery lifetimes. In Europe, network carrier Vodafone has been taking the lead in NB-IoT network deployment; it has clearly calculated that the technology allows it to extend usage of its LTE network infrastructure by providing cost effective support for low data-rate applications, such as sensing and monitoring devices.

Head-to-Head Comparison

The choice between using a LoRaWAN or an NB-IoT network for a particular application can involve the consideration of many parameters. The first thing to consider is whether public infrastructure is available in the area in which the application's nodes are to operate. If an application is to run in an urban or suburban area which already has good LTE network coverage, then support for NB-IoT service might be relatively easy to secure.

Conversely, in tightly defined areas of operation such as a university campus, or in remote rural areas with no LTE coverage, a quicker or more cost effective option might be to install a private LoRaWAN network. Even if there is LTE coverage available, the business case might still favor LoRaWAN; it is a matter of balancing capital expenditure against operational expenditure. There is an upfront cost to installing a private LoRaWAN network, but once in place it is normally cheap to run and is free of subscription fees. This requires the private network owner to have the skills and resources to perform network commissioning and management.

By contrast, the use of a public NB-IoT network has no upfront cost, because the network has already been put in place by a mobile phone network operator, but continuing operation requires the payment of regular subscription charges to the carrier.

Another issue to consider is regulatory and carrier certification costs. In both cases, products with LoRaWAN and NB-IoT embedded modules will require CE regulatory certification in Europe for intentional and unintentional emissions. NB-IoT devices will also require carrier certification from the network service provider.

Other considerations are the cost and size of the embedded module for the application, as well as data rate and range. In the case of both LoRaWAN and NB-IoT, chip suppliers and module manufacturers have brought prices and sizes in line with existing technologies such as Wi-Fi, ZigBee and Bluetooth technologies. Modules are now available that measure just 24 x 24mm, and prices are on target to fall to a level similar to those of other RF protocols as adoption of the technologies widens.

And while the capabilities of LoRaWAN and NB-IoT are equally suitable to many applications, at the margins either technology might be a clearly superior choice. For instance, at a very low data rate of 300bits/s, LoRaWAN can achieve an extraordinarily long range of 15km in open space. Some applications with a low data requirement might need this long range, which could mean that NB-IoT would be unsuitable.

Alternatively, some applications might need a guaranteed 150kbits/s data rate over the entire coverage area, a requirement which NB-IoT can meet and a LoRaWAN network cannot.

Is There a Winner?

It is clear from the above that both the LoRaWAN and NB-IoT network technologies have features which will appeal strongly to developers and manufacturers of IoT devices and systems. The choice between the two comes down largely to a mix of:

• **Technical Requirements**: Such as range and coverage, and data usage
• **Implementation and Ranagement Considerations:** Carriers such as Vodafone will make it easy to get a customer's NB-IoT connection up and running quickly. Other carriers will provide a similar service to users of public LoRaWAN networks. Setting up and running a private LoRaWAN network requires some expertise in network management.
• **Cost:** Is it more profitable to minimize capital or operational expenditure?
• **Timing:** LoRaWAN network rollouts are under way, but in Europe LTE networks are already widely available, and some will quickly be ready to run NB-IoT services.

In either case, the Future Connectivity Solutions division of Future Electronics is on hand to provide advice to OEMs and systems developers, and to support them in development and volume production by supplying components, modules and cloud connectivity services.

	LoRaWAN	NB-IoT
Spectrum	Unlicensed	Licensed
Bandwidth	500kHz to 125kHz	180kHz
Peak Data Rate	300bits/s to 50kbits/s on downlink and uplink	500bits/s to 200kbits/s on downlink 300bits/s to 180kbits/s on uplink
Number of Messages Per Day	Unlimited	Unlimited
Duplex Communication	No	Half-duplex
Power Efficiency	Very high	Medium
Peak Current at Maximum Transmit Power	32mA	120mA to 300mA
Sleep Current	1µA	5µA
Latency (Maximum Guaranteed)	<10s	1.6s to 10s

Table 1: Comparison of the features of NB-IoT and LoRaWAN technologies

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World's Best RF Performance
Delivered in a Fully Certified BT 4.2 Module
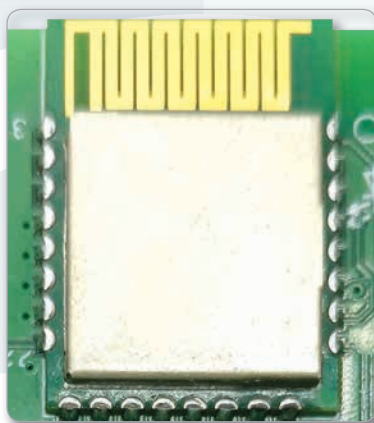## Cypress EZ-BT WICED® Module for the IoT

Cypress Semiconductor has introduced the CYBT-343026-01, a fully integrated Bluetooth® Smart Ready wireless module based on the Cypress CYW20706 Bluetooth SoC

Conforming to the specifications of the Bluetooth 4.2 standard, the CYBT-343026-01 EZ-BT™ module is supported by an industry leading dual mode Bluetooth stack (Classic + BLE). It features an Arm® Cortex®-M3 microcontroller core for stand-alone operation without an external host controller.

The module includes a crystal oscillator, passive components, 512kbytes of serial Flash memory and a power amplifier which enables it to achieve Class I or Class II output power capability. It supports peripheral functions including an ADC and four PWMs, provides UART, I^{2}C and serial peripheral interfaces, and offers a Bluetooth audio channel. It also includes up to 11 GPIOs.

Flexible development options include both Cypress EZ-Serial which provides simple access to the most common hardware and communication features, along with additional support for the full featured WICED Studio Eclipse based IDE for more advanced development.

The CYBT-343026-01 is fully qualified by the Bluetooth Special Interest Group, which validates manufacturers' Bluetooth compliance test results. It is housed in a 12.0 × 15.5 × 2.0mm package. In addition, the CYBT-343026-01 module includes regulatory certification for FCC (USA), ISED (Canada), CE (Europe), and MIC (Japan).

CYBT-343026-01: Cypress EZ-BT WICED Module

APPLICATIONS
- Medical devices
- Industrial systems
- PC accessories
- Toys
- Remote controls
- Gaming controllers
- Beacons

FEATURES
- 12dBm maximum Transmit power in Classic Bluetooth mode
- Receive sensitivity:
  - -93.5dBm in Classic Bluetooth mode
  - -96.5dBm in Bluetooth Low Energy mode
- 16-bit delta-sigma ADC
- Castellated solder pad connections
- Operating temperature range: -30°C to +85°C

For more information or to buy products, go to www.FutureElectronics.com/FTM