

EU081

IP Gateway for Automatic Home or Building HVAC System

September 2020

Automatic Home or Building HVAC System Platform

IP Gateway

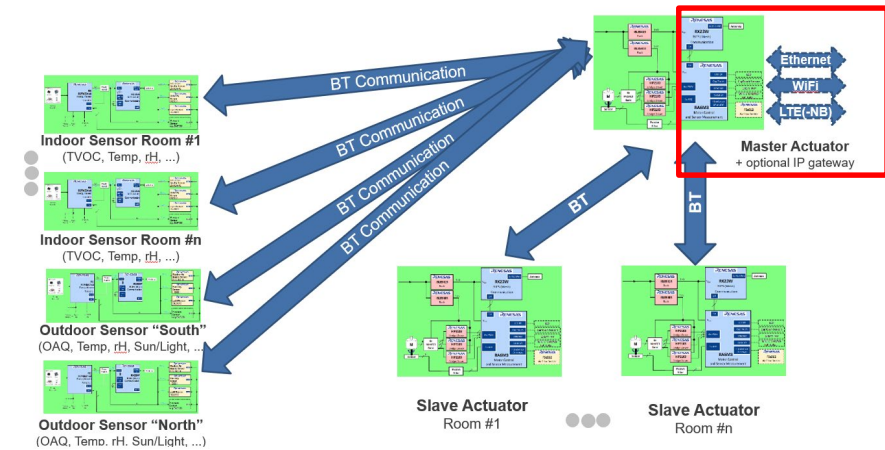
Please see EU076 for problem definition with existing / retrofit buildings, complete solution proposal and benefits.

This is the **IP Gateway Unit** as part of the proposed platform concept:

- Bluetooth Mesh communication to Master Actuator, Slave Actuator Unit(s), Indoor and Outdoor Sensor Unit(s) on the one side
- Wired or Wireless IP PHY on the other side

Overall goals:

- achieve optimum air quality in all rooms
- avoid mold
- improve energy efficiency
- improve user experience and comfortability



NOTE 1: Renesas does not have any plans to provide *end products* to the market; you, our *customers* are the experts in developing and providing such and Renesas does not claim to have the competency to do. Hence, this is just a proposal for a *potential* realization.

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IP Gateway for Automatic Home or Building HVAC System

▪ Overview

The IP gateway is an optional bridge to an Intranet or the Internet for all sensor and/or control data. HTTPS or MQTT (among other options) can be used for secure protocol requirements. Multiple PHYs could also be used, such as:

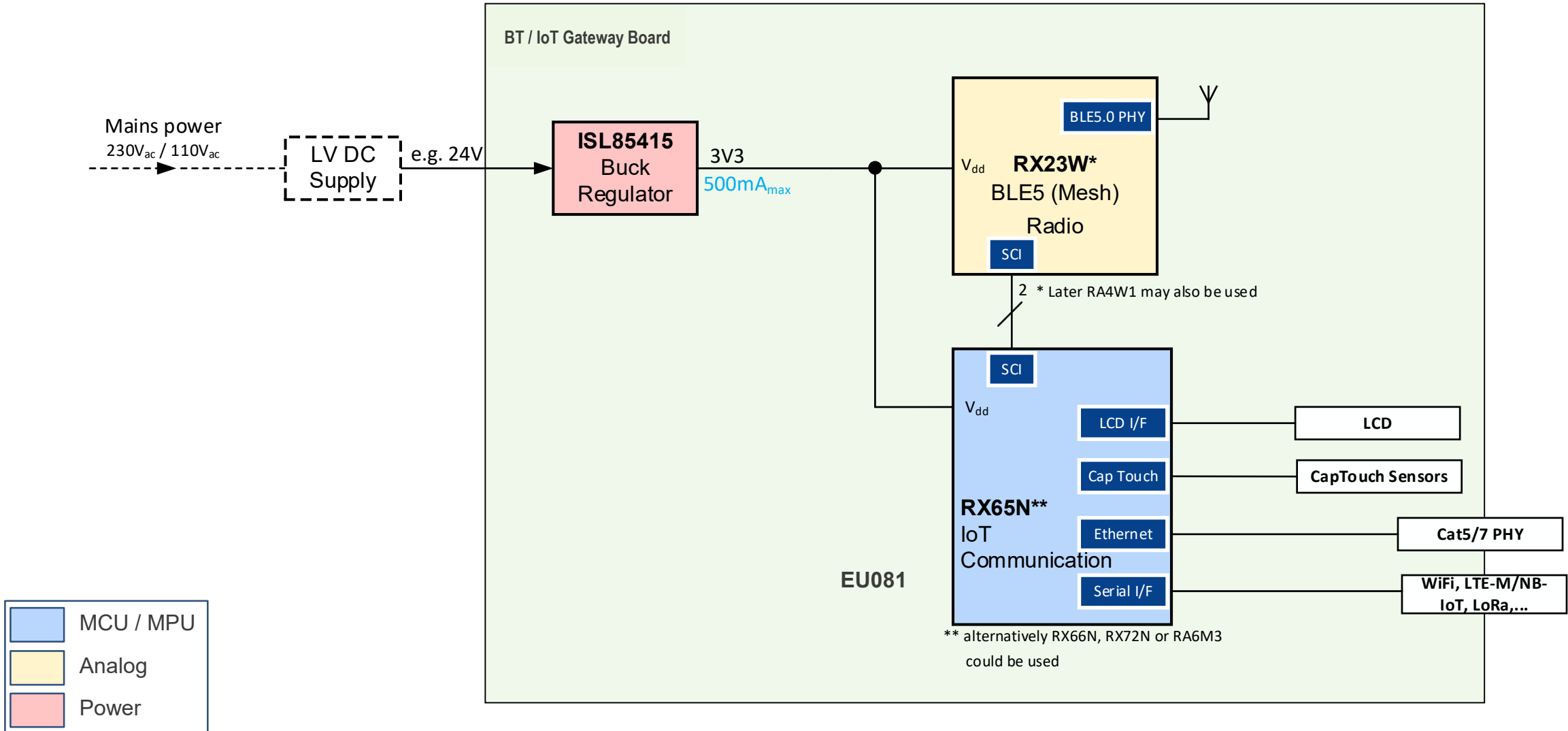
- Wi-Fi based on IEEE 802.11
- Thread, Zigbee or 6LoWPAN based on IEEE 802.15.4
- Ethernet based on IEEE 802.3
- LTE-M/-NB (depending on the geographical region and available providers)
- LoRaWAN

▪ System Benefits

- Bluetooth® 5 Mesh communication enables communication with other sensors and the actuators.
- The IP gateway function could either be a separate device or integrated in the actuator(s).
- For the power supply, mains will usually be needed for the fan/HVAC (e.g. 230V_{ac} or 110V_{ac}; or 24V_{dc}) from the building control system. Renesas has a comprehensive set of power solutions available, depending on the exact use case.

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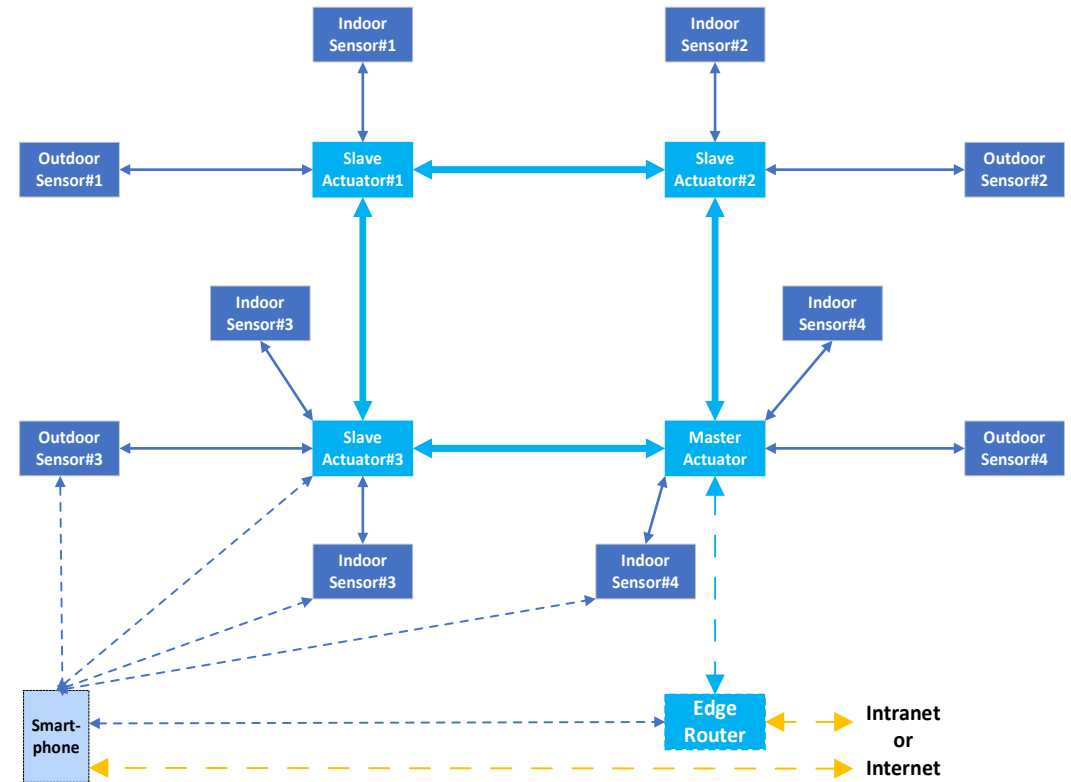
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Major advantages of Bluetooth 5 Mesh

- secure communication (Diffie-Hellmann Key Exchange, AES128 etc.)
- bidirectional packet data flow
- low power (can go down to μA average while being connected)
- no need for additional wiring
- automatic routing (with no setup for the routing itself)
- scalability of speed vs. range:
 - for four times range or
 - double speed option depending on location.





IP Gateway for Automatic Home or Building HVAC System

Device Category	P/N	Key Features
MCU	RX23W	Bluetooth 5.0 MCU w/ RX v2 core
	RX65N	120MHz RXv2 Core MCU for connectivity
Power	ISL85415	3-36V in, 0.6-34V / 500mA out Buck Regulator



RX23W – 32-bit MCU for Bluetooth 5.0 Low Energy

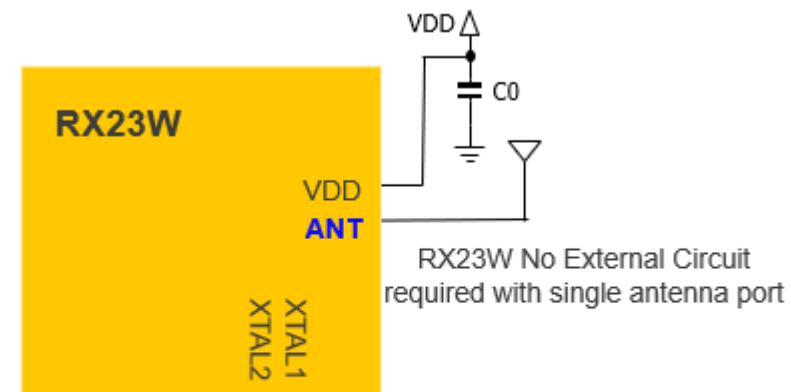
54 MHz RXv2 Core with FPU, Low Power Design, RTC and Encryption Functions

Support for Multiple Communication Functions

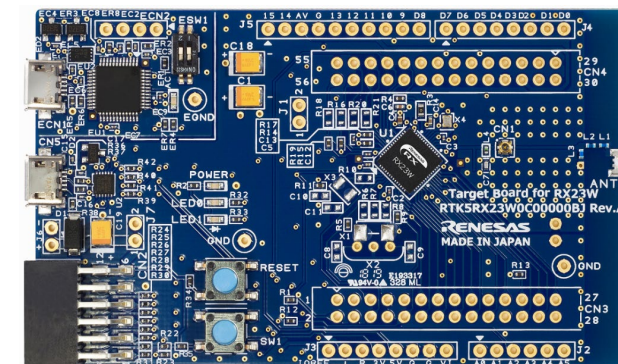
- Bluetooth Low Energy (1Channel)
- An RF transceiver and link layer compliant with the Bluetooth 5.0 Low Energy specification, also supports Bluetooth 4.2
- LE 1M PHY, LE 2M PHY, LE Coded PHY (125 kbps and 500 kbps), and LE Advertising extension support
- On-chip Bluetooth-dedicated AES-CCM (128-bit blocks) encryption circuit
- USB 2.0 host/function/On-The-Go (OTG) (one channel), full-speed = 12 Mbps, low-speed = 1.5 Mbps, isochronous transfer, and Battery Charger supported
- CAN (one channel) compliant to ISO11898-1: Transfer at up to 1 Mbps

High Performance and Low Power Design

- Operation from single 1.8 to 3.6V supply, up to 512KB Flash and 64KB RAM
- Capacitive Touch Sensing Unit: 12Keys (Self), 36 Keys (Mutual)
- Max. operating frequency: 54 MHz, Capable of 88.56 DMIPS in operation at 54 MHz
- Enhanced DSP and FPU modules
- RTC capable of operating on the battery backup power supply
- Security: 128- or 256-bit key length of AES for ECB, CBC, GCM, others. TRNG and Safe management of Keys, IEC60730 Compliant



Low Cost System Block



Target Board for RX23W – RTK5RX23W0C00000B

Part #	ROM (Kbytes)	RAM (Kbytes)	Security Functions	Package
R5F523W8ADNG#30	512	64	N/A	QFN/56/0.4
R5F523W7ADNG#30	384	64	N/A	QFN/56/0.4
R5F523W8BDNG#30	512	64	Available	QFN/56/0.4
R5F523W7BDNG#30	384	64	Available	QFN/56/0.4



RX65N – 120MHz RXv2 Core MCU

Large ROM/RAM, Enhanced Security, Connectivity and HMI

High Performance and Wide Product Lineup

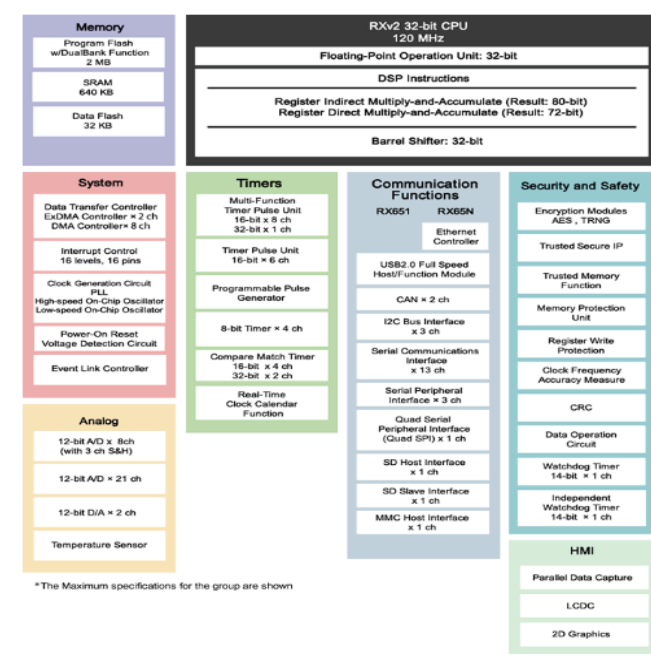
- RXv2 Core 120 MHz operation (34 CoreMark/ma), on-chip FPU
- Up to 2M ROM / 640K RAM, supportive of the dual bank function
- Wide package lineup : 64-pin (4.5mm x 4.5mm, BGA) to 176-pin

Rich Peripheral/Security Functions

- 16-bit TPUa, MTU3a, 8-bit TMRa (4ch), 16-bit CMT(4ch), 32-bit CMTW(2ch)
- 12-bit A/D (8 ch for unit 0, 21ch for unit 1), 12-bit D/A (2ch)
- DMACAa (8ch), DTCb (1ch), EXDMAC(2ch), DMAC for Ethernet controller(1ch)
- Various communication peripheral such as Ethernet, USB, CAN, SD host/slave interface, and quad SPI
- Security: AES, TRNG, TDES, RSA, SHA

Low Power Design and Architecture

- Operation from a single 2.7- to 3.6-V supply
- Low power consumption: A product that support all peripheral functions draws only 0.19mA/MHz(Typ.)
- RTC is capable of operation from a dedicated power supply
- Four low-power modes



Part #	ROM	RAM	Data Flash	Package
R5F565N4xDxx	512K	256k	None	64-LFQFP,64-LFBGA,100-LFQFP,100-TFLGA, 144-LFQFP, 145-TFLGA
R5F565N7xDxx	768K	256K	None	64-LFQFP,64-LFBGA,100-LFQFP,100-TFLGA, 144-LFQFP, 145-TFLGA
R5F565N9xDxx	1M	256K	None	64-LFQFP,64-LFBGA,100-LFQFP,100-TFLGA, 144-LFQFP, 145-TFLGA
R5F565NCxDxx	1.5M	640K	32K	64-LFQFP,64-LFBGA,100-LFQFP,100-TFLGA, 144-LFQFP, 145-TFLGA, 176-LFQFP, 176-LPBFA, 177-TFLGA
R5F565NExDxx	2M	640K	32K	64-LFQFP,64-LFBGA,100-LFQFP,100-TFLGA, 144-LFQFP, 145-TFLGA, 176-LFQFP, 176-LPBFA, 177-TFLGA

System Block



Renesas Starter Kit for RX65N



ISL85415 – 0.5A Regulator with Integrated High Side FET

Support 3V-36V Input Voltage Range for Buck Output

Wide Working Range

- Power input voltage range from 3V to 36V
- The device provides an easy-to-use high-efficiency, low BOM-count solution for a variety of applications.
- Up to 0.5A load over full temperature range

High Efficiency and Performance (Low Board Space)

- Synchronous operation for high efficiency
- No compensation required
- Integrated High-side and Low-side NMOS devices
- Selectable PFM or forced PWM mode at light loads
- Internal fixed (500kHz) or adjustable switching frequency 300kHz to 2MHz

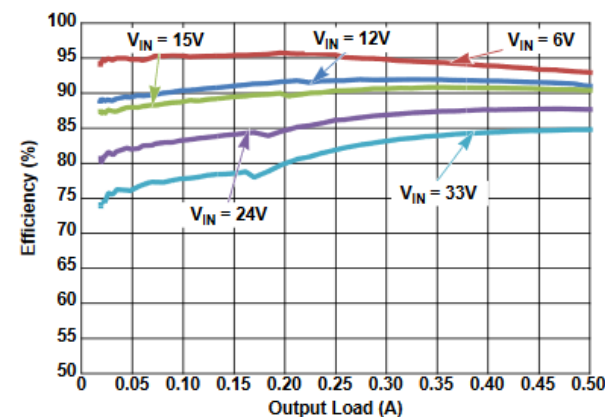
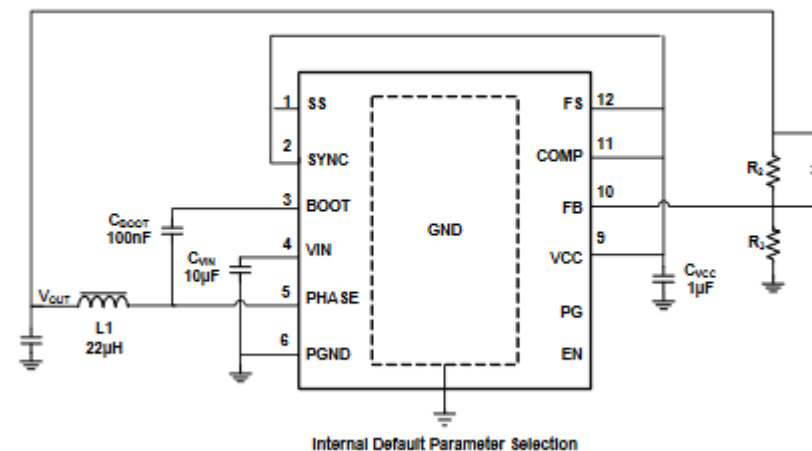


Figure 6. Efficiency vs Load, PFM, V_{OUT} = 5V



FIGURE 1. FRONT OF EVALUATION BOARD ISL85415DEMO2Z

Part #	V _{IN} Range(V)	Temp.(°C)	Package
ISL85415FRZ	3 to 36	-40 to 125	12 Ld DFN 4x3

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