

CN104

Tankless Gas Water Heater with Remote User Control

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Tankless Gas Water Heater with Remote User Control

■ Overview

This solution provides an improved user experience for a developing application - the tankless gas water heater. By utilizing two controllers - one in the kitchen and the other in the bathroom - the user can control the water temperature and amount of water remotely.

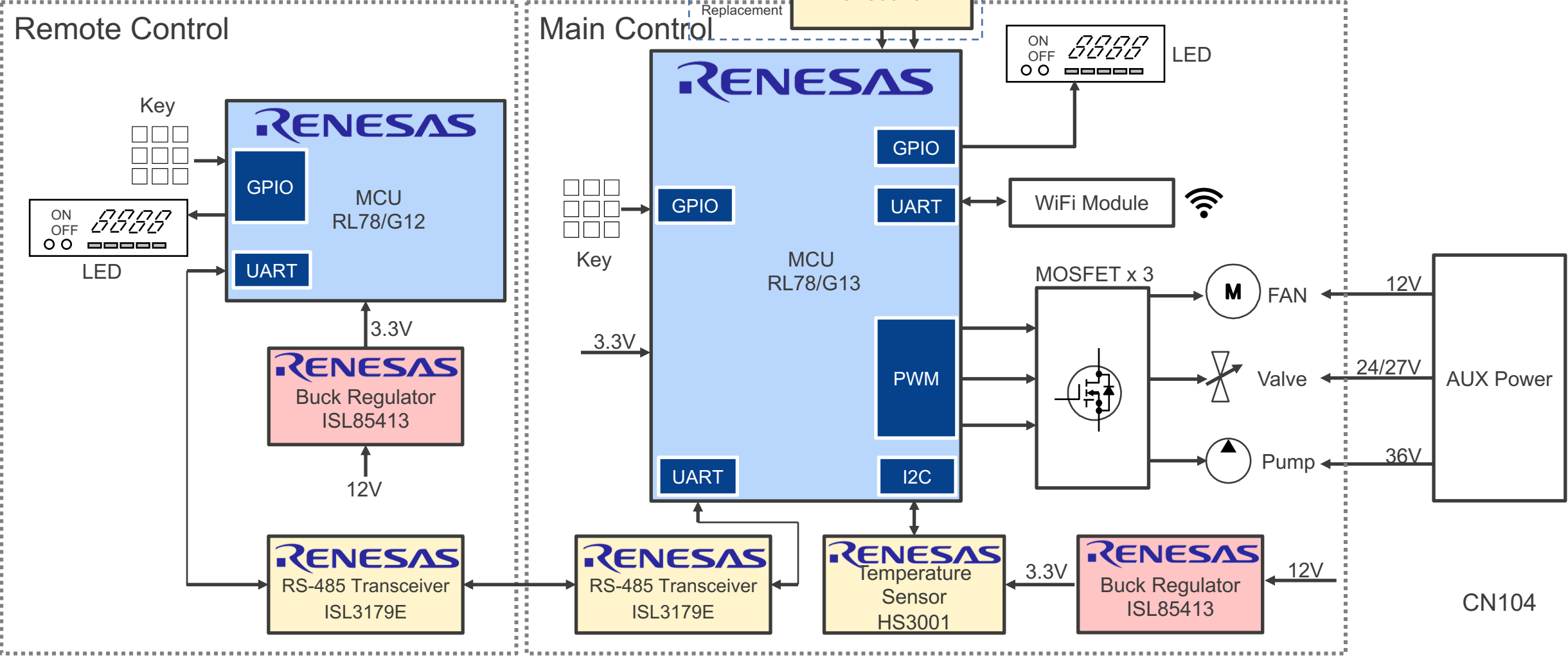
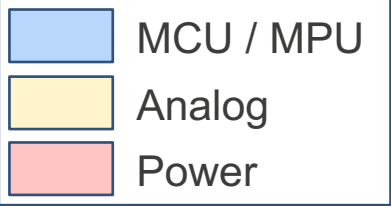
Renesas has developed this solution by utilizing a two-chip MCU solution that provides a compact design with minimal expense. The design includes an MCU, sensor and connection modules like Bluetooth® Low Energy (BLE) or Wi-Fi and a high-accuracy temperature/humidity sensor with up to $\pm 1.5\%RH$.

■ System Benefits

- A single power solution for the entire system, enabling continuous long distance control without interruption
- Accurate temperature and humidity control

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Tankless Gas Water Heater with Remote User Control

Device Category	P/N	Key Features
MCU	RL78/G13	-44P/64K ROM is the best fit for this application -Rich periphery -Specialized timer to driver multiple motor applications
	RL78/G12	-20Pin is very fit to do sub-control -Enough GPIO to control seg-LED display -SPI/UART for key input and 7-8m distance communication
Power	ISL85413	-Wide input voltage range of 3.5V to 40V -Continuous output current up to 300mA
Analog	ISL3179E	High ESD protected, +125°C, full fail-safe, 40Mbps RS-485/RS-422 transceivers
	HS3001	-RH accuracy: $\pm 1.5\%$ RH typical -Temperature sensor accuracy: $\pm 0.2^{\circ}\text{C}$ typical (-10 to +80°C) -Lowest power consumption: 1.0 μA average
	5P35023	Programmable VersaClock® clock generator

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RL78/G13 – Standard Functions MCU

Low Power and Abundant Lineup for General Purpose Applications

High Performance Peripheral Functions

- 43.2 DMIPS(32 MHz)
- On-chip oscillator, data flash, 10-bit A/D converter
- Built-in safety features enable support for the household appliance safety standard

(IEC/UL 60730)

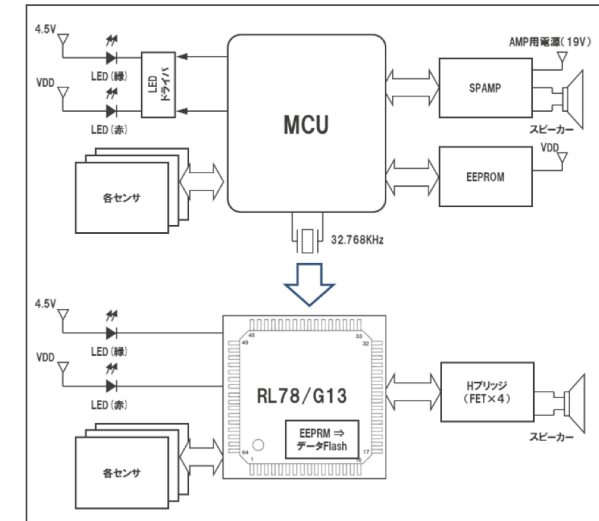
Low Power

- CPU: 66 μ A/MHz, standby (STOP): 230 nA
- 0.57 μ A (RTC_LVD, HALT mode)

Abundant Lineup

- 16-512KB ROM / 2-32KB RAM
- 20-128 pin package

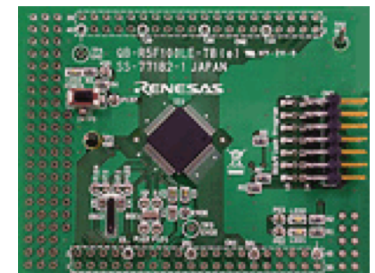
Part #	Flash ROM	RAM	Package(mm)
R5F1006/7/8x R5F1016/7/8x	16 ~ 64 KB	2 ~ 4 KB	20-LSSOP, 24-HWQFN(4 x 4), 25-WFLGA(3 x 3)
R5F100A/B/Cx R5F101A/B/Cx	16 ~ 128 KB	2 ~ 12 KB	20-LSSOP, 32-HWQFN(5 x 5), 36-WFLGA(4 x 4)
R5F100Ex R5F101Ex	16 ~ 192 KB	2 ~ 16 KB	40-HWQFN(6 x 6)
R5F100F/Gx R5F101F/Gx	16 ~ 512 KB	2 ~ 32 KB	44-LQFP(10 x 10), 48-LFQFP(7 x 7), 48-HWQFN(7 x 7)
R5F100J/Lx R5F101J/Lx	32 ~ 512 KB	2 ~ 32 KB	52-LQFP(10 x 10), 64-LQFP(12 x 12), 64-LFQFP(10 x 10), 64-VFBGA(4 x 4),
R5F100M/Px R5F101M/Px	96 ~ 512 KB	8 ~ 32 KB	80-LQFP(14 x 14), 80-LFQFP(12 x 12), 100-LQFP(14 x 20), 100-LFQFP(14 x 14),
R5F100Sx R5F101Sx	192 ~ 512 KB	16 ~ 32 KB	128-LFQFP(14 x 20)



BOM Cost Reduction Use Case



Renesas Starter Kit
for RL78/G13



QB-R5F100LE-TB
Easy Evaluation Kit

RL78/G12 – General Purpose 16-bit MCU

Compact, Low Power, High Function General-purpose, Ideal for Sub-Microcontrollers

High Performance Peripheral Functions

- 16-bit MCU with high performance: 32.4 DMIPS (24 MHz).
- On-chip oscillator, data flash, 10-bit A/D converter, CSI/UART/IIC
- Built-in safety features enable support for the household appliance safety standard (IEC/UL 60730)

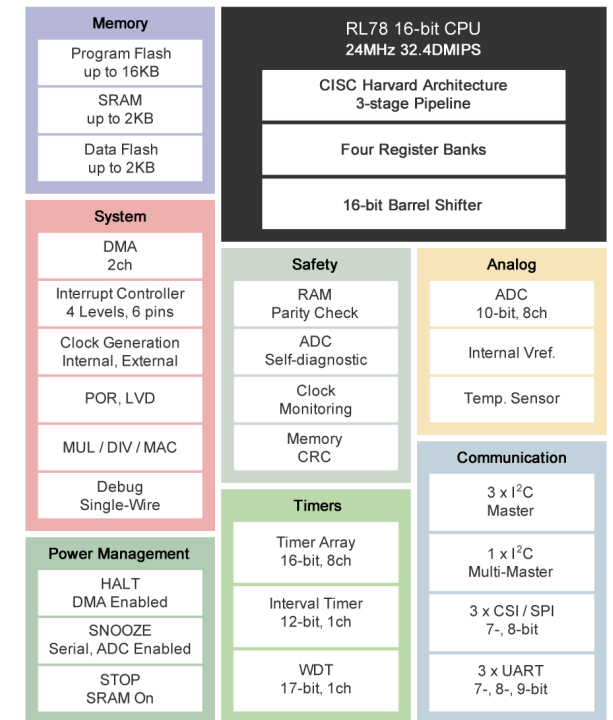
Lowest Power Consumption

- CPU: 63 μ A/MHz
- Standby (stop mode): 230 nA
- HALT, STOP, SNOOZE, 3 kinds of modes to save power

Low Cost

- 20 to 30 pin compact is perfect for sub-microcontrollers of small appliances and consumer and industrial equipment

Part #	Flash ROM	RAM	Package(mm)
R5F1026x R5F1036x	2 ~ 16 KB	256B ~ 1.5 KB	20-LSSOP(4.4 x 6.5mm, 0.65mm pitch)
R5F1027x R5F1037x	4 ~ 16 KB	512B ~ 1.5 KB	24-HWQFN(4 x 4mm, 0.5mm pitch)
R5F102Ax R5F103Ax	4 ~ 16 KB	512B ~ 2 KB	30-LSSOP(7.62mm(300), 0.65mm pitch)



RL78/G12 Block Diagram



QB-R5F1026A-TB Easy Evaluation Kit

ISL85413 – 300mA Synchronous Buck Regulator

Supports 3.5V-40V Input Voltage Range for Buck Regulators

Wide Working Range and a Small Package

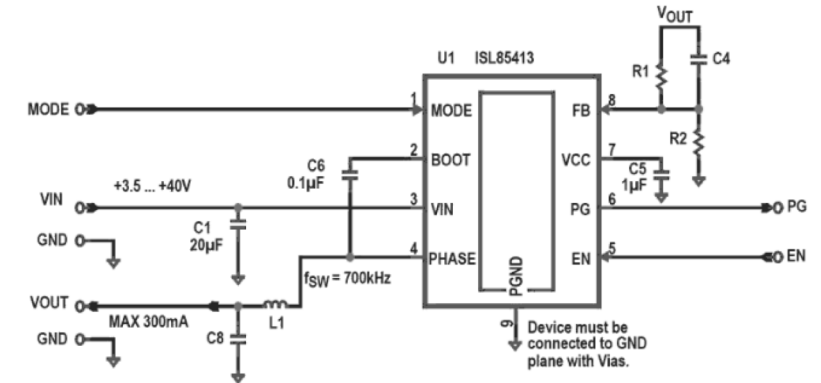
- Power input voltage range variable 3.5V to 40V
- Internal switching frequency 700kHz
- Continuous output current up to 300mA
- 3mm x 3mm TDFN

High Integration to Reduce Costs

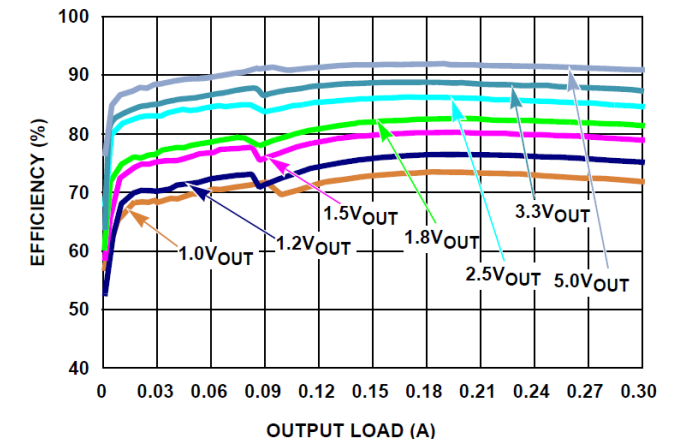
- Integrates both high-side and low-side NMOSFETs

Best Fit for Applications

- PFM mode for improved efficiency at light loads, could be disable as well
- Requires very robust design for high voltage industrial applications
- Highly efficient requirement for batter- powered applications



Typical Application Circuit



Efficiency vs Load, PFM, V_{IN} = 12V

ISL3179E High ESD Protected RS-485/RS-422 Transceivers

40Mbps, 3.3V, Full Fail-Safe, 3.3V Powered Single Transceivers

High ESD Performance

- ±16.5kV comply with IEC61000
- ESD protection on RS-485 I/O pins
- Class 3 HBM level on all other pins (ISL3179E): >9kV

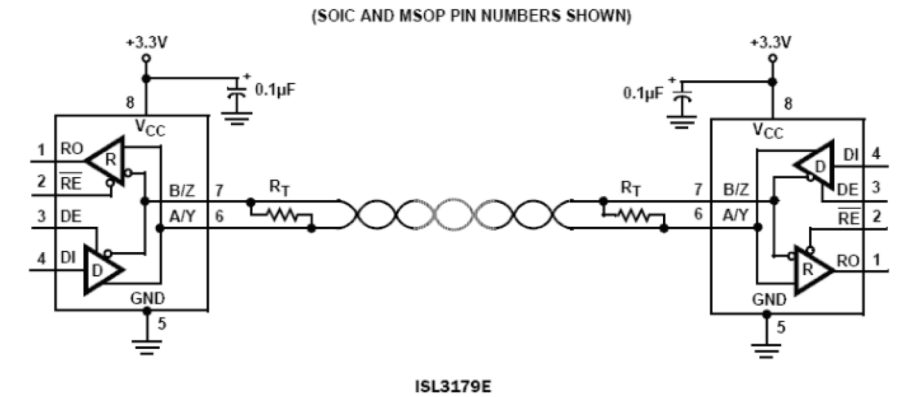
High Performance

- High data rates: up to 40Mbps
- 5V tolerant logic inputs
- 1/5 unit load allows up to 160 devices on the bus
- Meet both RS-485 and RS-422 standards

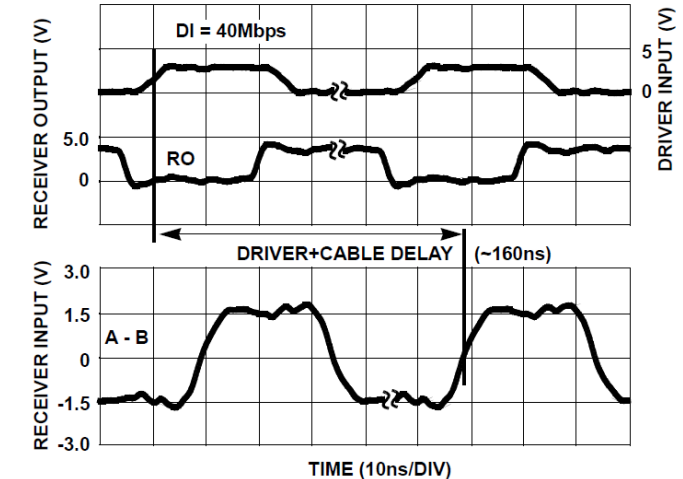
Best Fit for Applications

- Meter application
- Home appliance
- Other communication modules

Part #	Temp. Rang(°C)	Data rate	Work mode	Package
ISL3179EFBZ	-40~+125	40Mbps	RS-485/422 Half	8 Ld SOIC
ISL3179EFUZ	-40~+125	40Mbps	RS-485/422 Half	8 Ld MSOP
ISL3179EFRZ	-40~+125	40Mbps	RS-485/422 Half	10 Ld DFN
ISL3179EIBZ	-40~+85	40Mbps	RS-485/422 Half	8 Ld SOIC
ISL3179EIUZ	-40~+85	40Mbps	RS-485/422 Half	8 Ld MSOP
ISL3179EIRZ	-40~+85	40Mbps	RS-485/422 Half	10 Ld DFN



Typical System Block



Driver and Receive Waveforms Driving 100' (31m) of CAT5 Cable (Double Terminated with 120Ω)

HS3001 – Digital Relative Humidity & Temperature Sensor

Highly-accurate, Fully-calibrated, Fast Response Time, and Excellent Stability

Highly Accurate

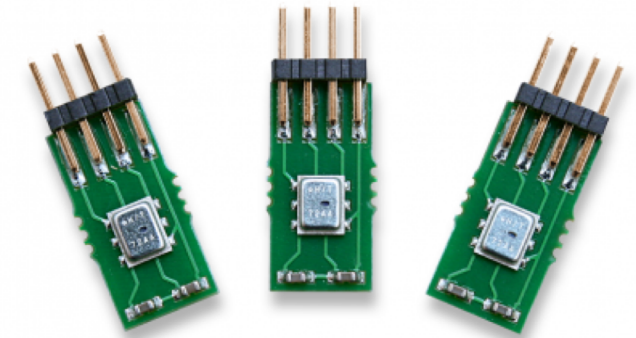
- RH accuracy: $\pm 1.8\%$ RH typical
- Temperature sensor accuracy: $\pm 0.2^{\circ}\text{C}$ typical (-10 to $+80^{\circ}\text{C}$)
- 14-bit resolution: 0.01% RH (typical)

Fast Response and Low Power

- Fast RH response time (typical 6 seconds)
- Low power consumption: $1.0\mu\text{A}$ average (one RH+T measurement per second, 8-bit resolution, 1.8V supply)

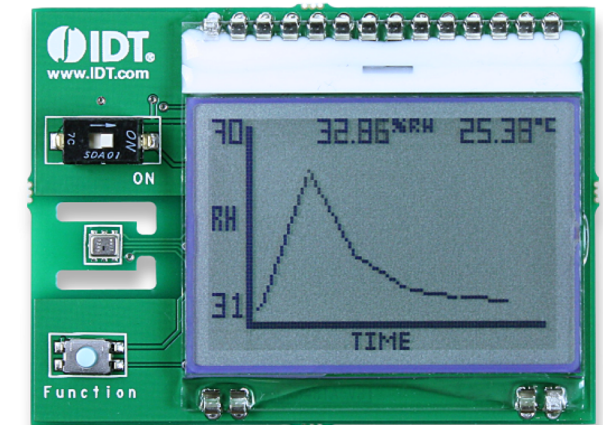
Easy to Use

- Internally corrected and compensated for accurate operation over a wide range of temperature and humidity levels. No user calibration of the output data is required.



HS300x ICs (relative)

Part #	Description	Package
HS3001	$\pm 1.5\%$ RH (Typical)	$3.0 \times 2.41 \times 0.8\text{mm}$, 6-LGA (LHG6D1)
HS3002	$\pm 1.8\%$ RH (Typical)	$3.0 \times 2.41 \times 0.8\text{mm}$, 6-LGA (LHG6D1)
HS3003	$\pm 2.8\%$ RH (Typical)	$3.0 \times 2.41 \times 0.8\text{mm}$, 6-LGA (LHG6D1)
HS3002	$\pm 3.8\%$ RH (Typical)	$3.0 \times 2.41 \times 0.8\text{mm}$, 6-LGA (LHG6D1)



SDAH02 Evaluation Kit

5P35023 – VersaClock® 3S Programmable Clock Generator

Clock Generator for low-power, consumer and PCIe Gen1-3 applications

Key Features

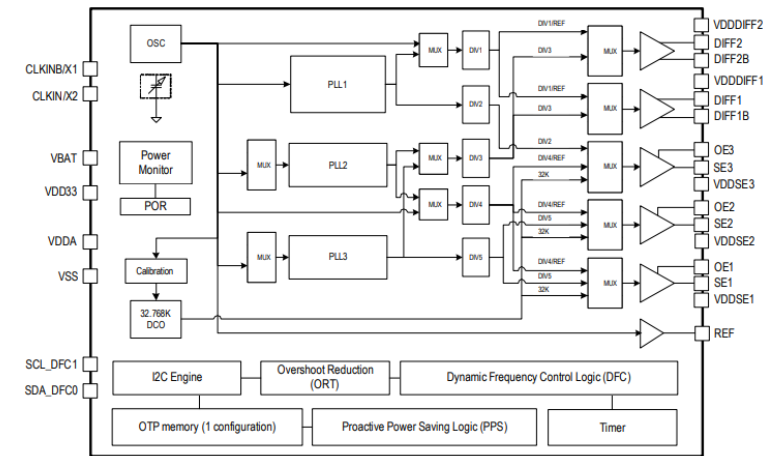
- Configurable OE pin function as OE, PD#, PPS or DFC control function
- Configurable PLL bandwidth; minimizes jitter peaking
- Two PLLs support independent spread spectrum clocks to lower system EMI

Power Savings

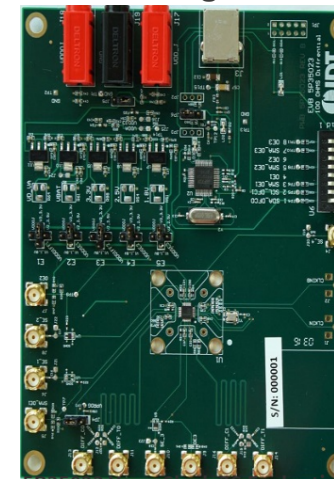
- PPS: Proactive Power Saving features save power during the end device power down mode
- PPB: Performance Power Balancing feature allows minimum power consumption based on required performance
- DFC: Dynamic Frequency Control feature allows user to dynamically switch between and up to 4 different frequencies smoothly

Output Features

- 2 DIFF outputs with configurable LP-HSCL, LVDS, LVPECL, LVCMOS output pairs. 1MHz–500MHz (160MHz with LVCMOS mode)
- 3 LVCMOS outputs: 1MHz–160MHz
- Maximum 8 LVCMOS outputs as REF + 3 × SE + 2 × DIFF_T/C as LVCMOS



Block Diagram



5P35023 Eval Board

Part #	Temp.	Package
5P35023-000NLG1	--40 to +85°C	24 lead 4x4mm VFQFPN
5P35023-000NLG2	--40 to +105°C	24 lead 4x4mm VFQFPN

[Renesas.com](https://www.renesas.com)