



CN253 Bathroom Odor Detector

May 2020

Bathroom Odor Detector

■ Overview

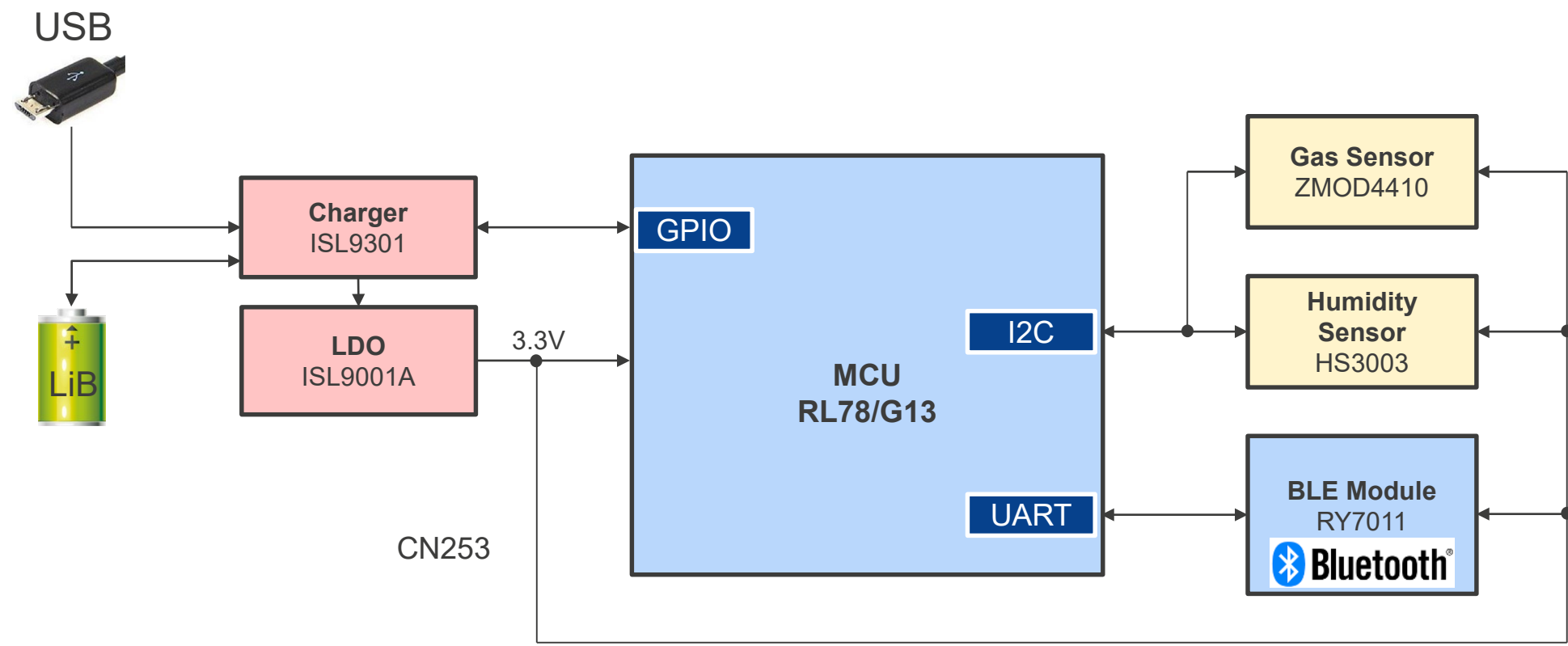
The combination of Renesas' ZMOD4410 Total Volatile Organic Compounds (TVOC) and indoor air quality sensor, HS3003 temperature and humidity sensor, and RL78/G13 microcontroller (MCU) enables users to detect gases in the bathroom. Odor levels, temperature and humidity values can be monitored through a handy device by using a Bluetooth® module. The RL78/G13 MCU is suitable for industrial applications with high-performance peripheral functions, low power and an abundant lineup of MCUs. All the power on the sensor board is provided by the ISL9001A high-performance LDO and Li-ion battery. The ISL9301 is a high input voltage charger with a power path management charger for single-cell Li-ion/Polymer batteries.

■ System Benefits

- Renesas' MCU and Bluetooth® Low Energy (BLE) module control the system and wireless communication via BLE
- Includes a high-performance/high-input voltage charger and low-input voltage/high-PSRR LDO for an integrated solution
- The ZMOD4410 gas sensor module is a software configurable platform used for indoor air quality applications

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Bathroom Odor Detector



MCU / MPU Analog Power

Bathroom Odor Detector

Device Category	P/N	Key Features
MCU	RL78/G13 R5F102xx	Low consumption current (CPU: 63 μ A/MHz, standby (STOP): 230 nA) and a high performance of 32.4 DMIPS (24 MHz)
	RY7011	Bluetooth® Low Energy module, compact module with built-in 32 MHz crystal resonator for RF and antenna
Power	ISL9301	Fully integrated high input voltage single-cell Li-ion battery charger with power path management function
	ISL9001A	300mA output current and output voltage can be programmed from 0.8V to 5.5V. (TJ= -40°C to +125°C)
Analog	ZMOD4410	Leading high sensitivity and long term stability, enables customer to release product families via SW changes, internationally accepted definition of Indoor Air Quality (IAQ), calculation of estimated carbon dioxide (eCO ₂)
	HS3003	Highly-accurate, fully-calibrated relative humidity and temperature sensor

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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)

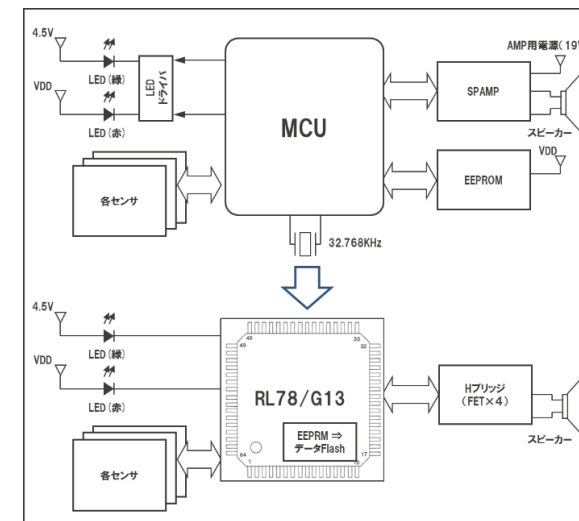
Low Power

- 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

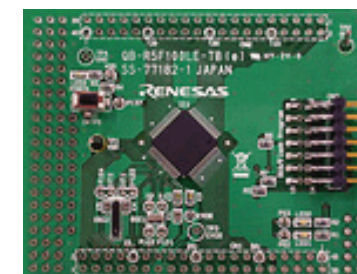
Part #	Flash ROM	RAM	Package(mm)
R5F1006/7/8x R5F1016/7/8x	16 ~ 64 KB	2 ~ 4 KB	20-LSSOP, 24-HWQFN(4 x 4), 25-WFLGA(3 x 3)
R5F100A/B/Cx R5F101A/B/Cx	16 ~ 128 KB	2 ~ 12 KB	20-LSSOP, 32-HWQFN(5 x 5), 36-WFLGA(4 x 4)
R5F100Ex R5F101Ex	16 ~ 192 KB	2 ~ 16 KB	40-HWQFN(6 x 6)
R5F100F/Gx R5F101F/Gx	16 ~ 512 KB	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

RX7011 – Bluetooth® Low Energy Module

Compact Module with Built-in 32 MHz Crystal Resonator for RF and Antenna



High Integration

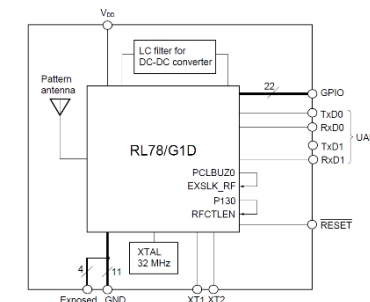
- The RL78/G1D module (RX7011) contains the RL78/G1D, a 32 MHz crystal resonator for RF chip, and an antenna, all in a compact (8.95 x 13.35 x 1.7 mm) module
- GPIO 24 pins mounted, These can use the UART, I2C, SPI, Timer, ADC
- RF transceiver is certified with Bluetooth® v4.2 Specification (Low Energy Single mode)

Easy to Develop and Use

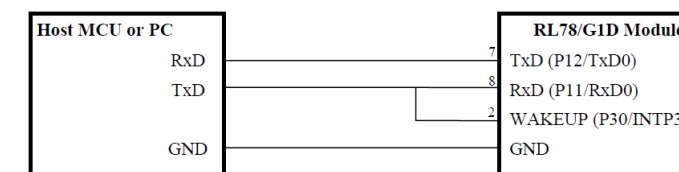
- The module has been tested and found to comply with global regulatory certification for Japan, FCC, IC, and CE as well as Bluetooth® SIG certification
- The module inherits the functional pins of the RL78/G1D, so not only can you use it for modem configuration, but you can also leverage the strengths of the microcontroller for embedded configuration

Low Power Consumption

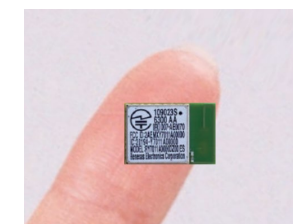
- RL78/G1D module support Bluetooth® Low Energy and achieved the lowest level of current consumption in the industry
 - RF transmitter active normal mode: 4.3 mA, Low power mode: 2.6 mA
 - RF receiver active normal mode: 3.5 mA
 - Average current: 9.1 µA (1-second intervals, connection maintained, CC-RL compiler)



RL78/G1D module (RX7011) Block Figure



Connections to the host microcontroller



RL78/G1D module (RX7011)
(RX7011A000DZ00)

Size: 8.95 × 13.35 × 1.7 mm

Part #	Flash ROM	RAM	Package
RX7011A000DZ00	256KB	20KB	42-pin LGA (8.95 × 13.35mm)

ISL9301- Charger for Single-cell Li-ion/Polymer Batteries

High Input Voltage Charger With Power Path Management

Fully Integrated with Power Path Management

- Complete Charger for Single-Cell Li-ion/Polymer Batteries
- Integrated Disconnect Switch to Disconnect the Battery
- Power Path Management Optimize Charge and System Currents

High Performance

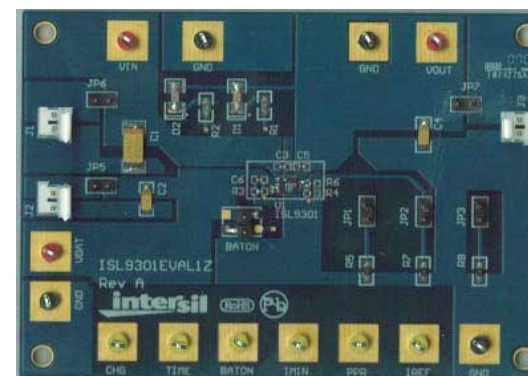
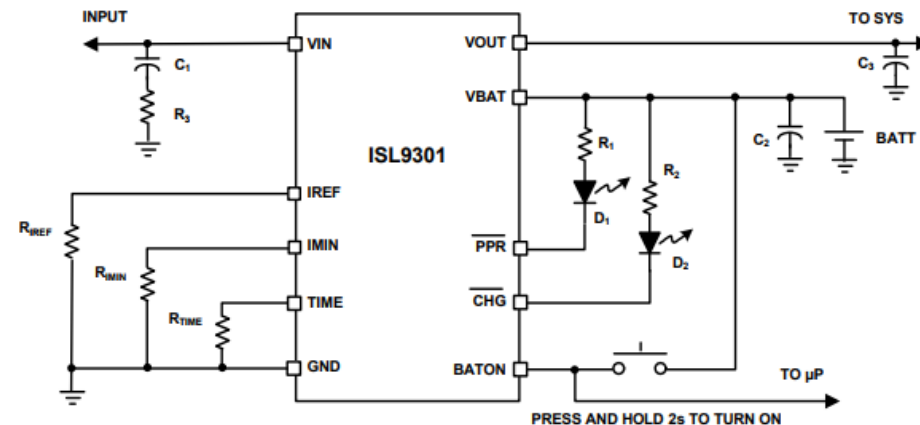
- 1% Charger Output Voltage Accuracy
- 28V Maximum Voltage at VIN pin

Programmable /Easy Control

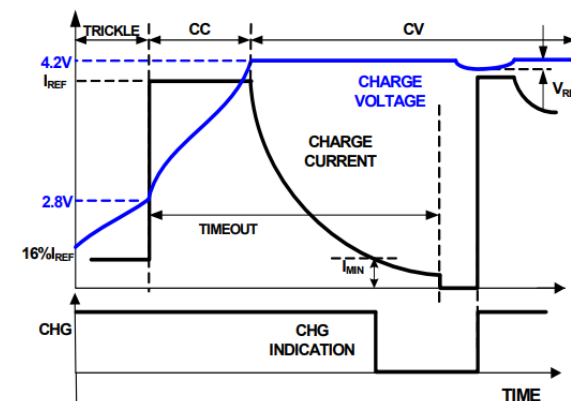
- Programmable Charge Current & End-of-Charge Current
- Power Presence and Charge Indications

Safety & Battery Protection

- Charge Current Thermal Foldback for Thermal Protection
- Trickle Charge for Fully Discharged Batteries
- Intelligent Timeout Interval Based on Actual Charge Current



ISL9301EVAL1Z: evaluation tool for single-cell Li-ion battery



Part #	Temp Range (°C)	Package
ISL9301IRZ	-40 to +85	10 Ld 3x3 DFN
ISL9301IRZ-T	-40 to +85	10 Ld 3x3 DFN

ISL9001A – V_{OUT} 1.5V to 3.3V/300mA LDO

LDO with Low I_{SUPPLY} and High PSSR

High Performance

- Excellent load regulation: <0.1% voltage change across full range of load current
- High PSRR: 90dB @ 1kHz

Stable Output Voltage

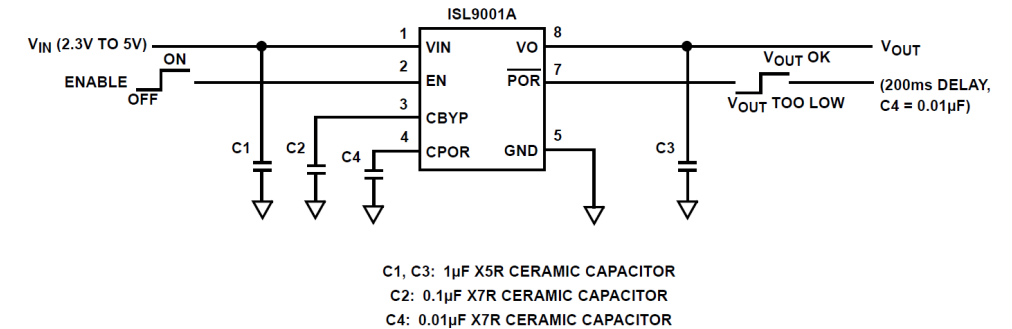
- $\pm 1.8\%$ V_{OUT} accuracy over all operating conditions
- Stable with 1 μ F to 10 μ F ceramic capacitor

High Efficiency

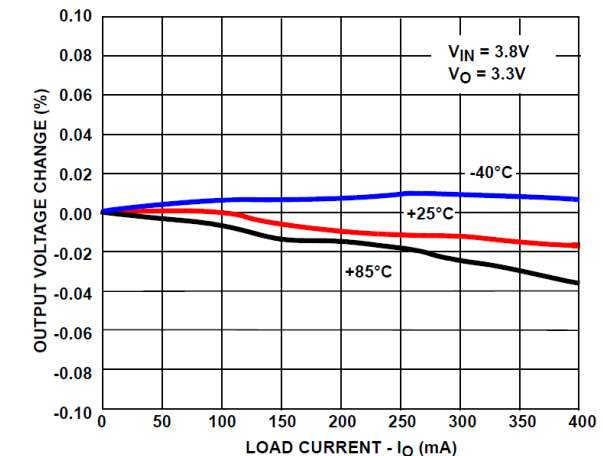
- Extremely low quiescent current: 25 μ A
- Low dropout voltage: typically 200mV @ 300mA

Excellent Safety

- Current limit and overheat protection



Typical Application Circuit



Output Voltage Change vs Load Current

Part #	Vout (V)	Temp.(°C)	Package
ISL9001AIRBZ-T	1.5	-40 to +85	8Ld 2x3 DFN
ISL9001AIRCZ-T	1.8	-40 to +85	8Ld 2x3 DFN
ISL9001AIRFZ-T	2.5	-40 to +85	8Ld 2x3 DFN
ISL9001AIRJZ-T	2.8	-40 to +85	8Ld 2x3 DFN
ISL9001AIRKZ-T	2.85	-40 to +85	8Ld 2x3 DFN
ISL9001AIRNZ-T	3.3	-40 to +85	8Ld 2x3 DFN

ZMOD4410 – Indoor Air Quality Sensor Platform

TVOC Sensor for Indoor Air Quality Application

Flexible Measure Target

- Measurement of total organic compounds (TVOC)
- Concentrations and indoor air quality (IAQ)
- Module algorithm estimates carbon dioxide level (eCO₂)
- Algorithm to set a control signal to trigger an external action based on IAQ and odor change
- Configurable alarm/interrupt output with static and adaptive Levels

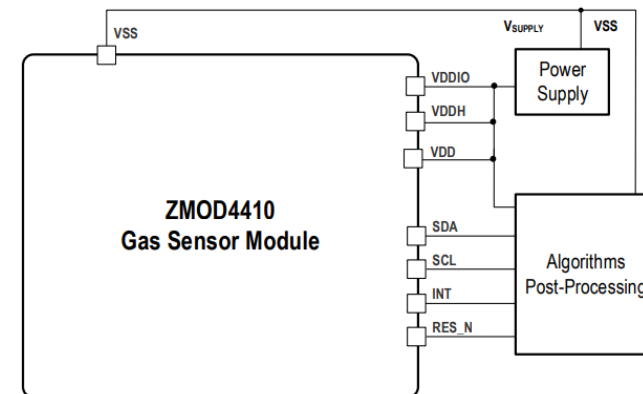
Low Power

- Very low average power consumption down to 1mW
- Excellent for low-voltage and low-power battery applications

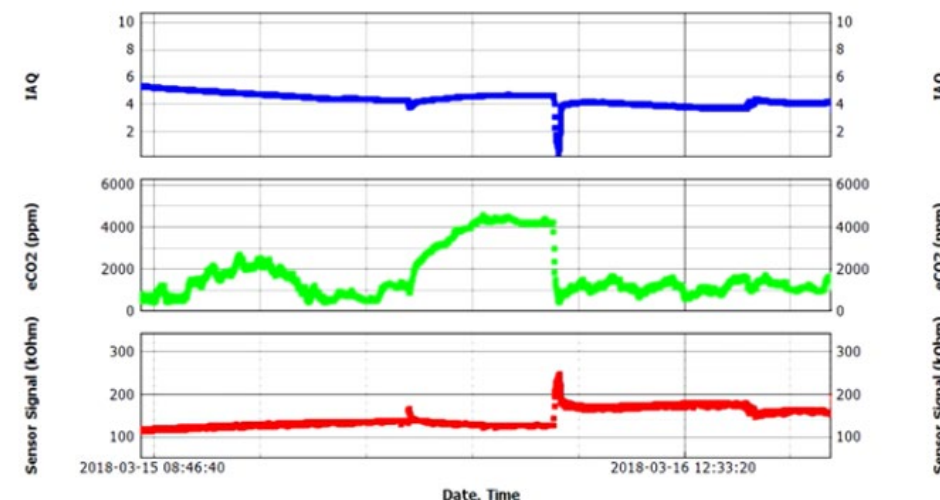
Easy to Use

- ZMOD4410 Evaluation Kit
- Manuals, application notes, blog, and white papers
- Instructional videos
- Programming libraries, example codes
- Algorithm support to optimize performance
- Third-party certification for compliance with well-accepted international IAQ standards

Part #	Operation Condition	Package
ZMOD4410AI1V ZMOD4410AI1R	1.7-3.6V -40° to +65° Est. CO2 400-5000ppm Ethanol in air 0-1000ppm	3.0 × 3.0 × 0.7mm, 12-LGA



ZMOD4410 typical application



Measuring IAQ and Est CO2 level with ZMOD4410

HS300x – Relative Humidity and Temperature Sensor

High Accuracy Humidity and Temperature Measurement for Environmental Monitoring

High Accuracy

- $\pm 1.5\%$ RH accuracy (HS3001)
- $\pm 0.2^{\circ}\text{C}$ temperature accuracy (HS3001, HS3002)

Excellent Stability

- 0.1% RH per year drift
- MEMS silicon-carbide sensor technology

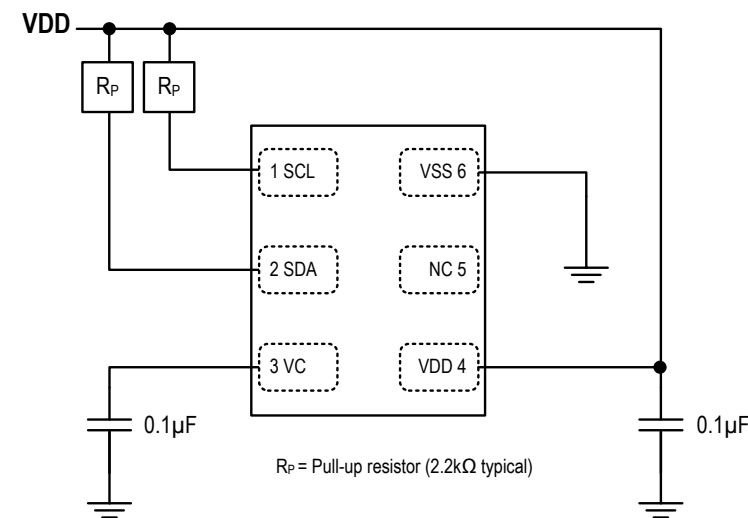
Fast Response

- Less than 6 seconds humidity response, in still air
- Less than 2 seconds temperature response

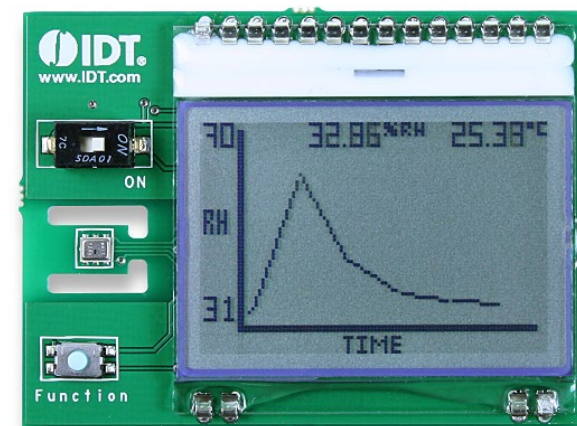
Extended Supply Voltage

- 2.3V to 5.5V, 24.4 μA at 3.3V (one RH+Temp per second)
- 1.8V custom order

Part #	Feature	Package
HS3001	$\pm 1.5\%$ RH	3 \times 2.41 \times 0.8 LGA
HS3002	$\pm 1.8\%$ RH	3 \times 2.41 \times 0.8 LGA
HS3003	$\pm 2.8\%$ RH	3 \times 2.41 \times 0.8 LGA
HS3004	$\pm 3.8\%$ RH	3 \times 2.41 \times 0.8 LGA



Typical Operating Circuit



SDAH02 Evaluation Kit

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