

JP151

Wearable Devices with RE01

September 2020

Wearable Devices with the RE01 32-bit MCU

Overview

Wearable devices, such as smart watches, are getting smarter and more power hungry. This is because more CPU processing is required for digital signal processing, such as voice recognition. It causes an increase in the current consumed by even our ultra-low power RE01 CPU affecting the battery life. Since the battery size of wearable device is generally quite small (ie:120mAh), this winning combo reference design replaces the RE01 MCU’s internal LDOs with external ISL9123 buck regulators. With this reference design, the RE01 CPU processing current can be reduced by half and directly contributes to an extend battery life.

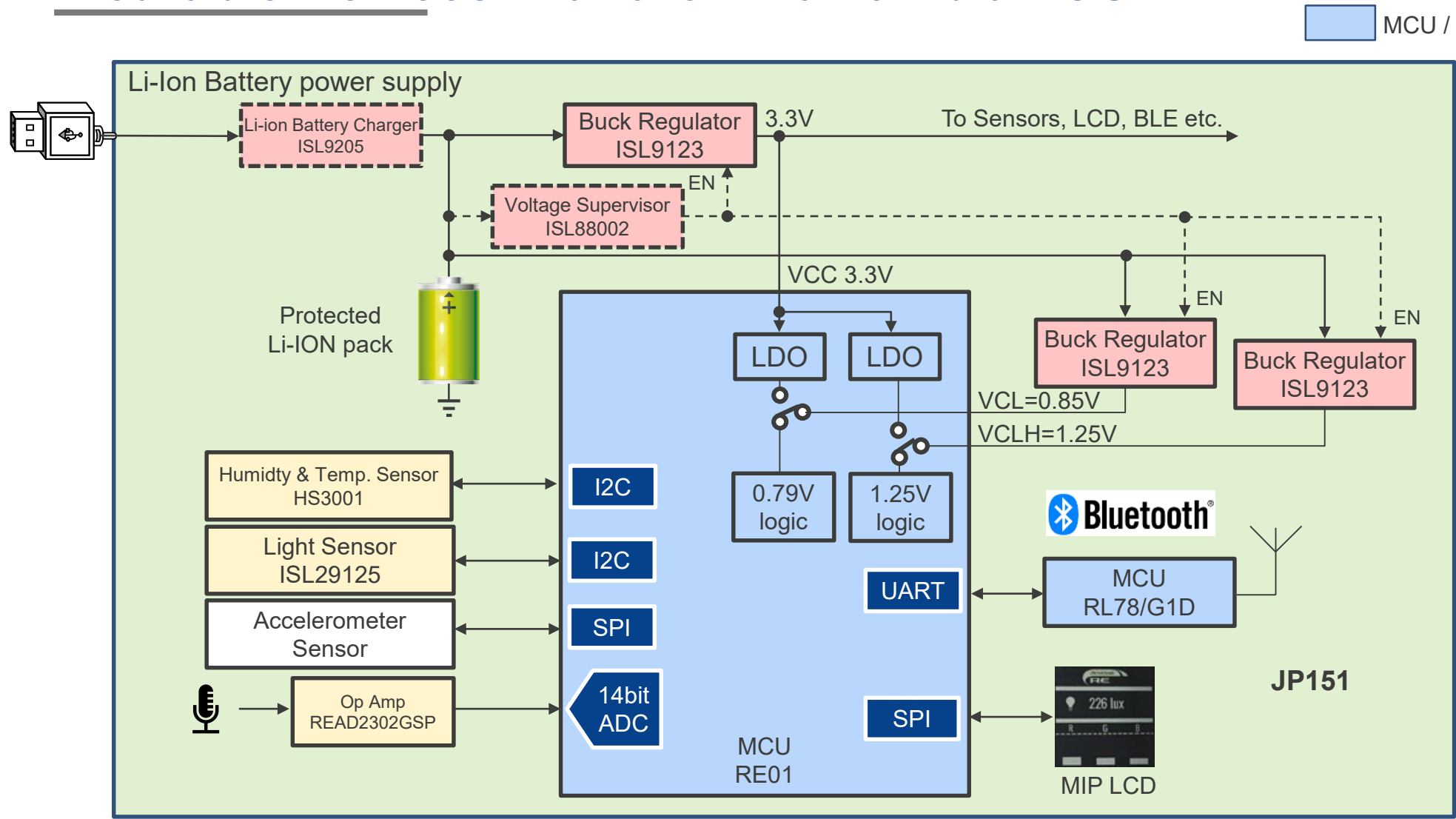
System Benefits

- The ultra-low Iq ISL9123 buck regulator enables extended battery life of wearable devices, which requires very heavy CPU processing for features such as voice recognition
- ISL29125 light sensor controls the brightness of the back light
- The READ2302 op amp amplitudes the output of the MEMS microphone to detect the voice from the RE01 14-bit ADC
- The ISL9205 battery charger charges the Li-ion battery

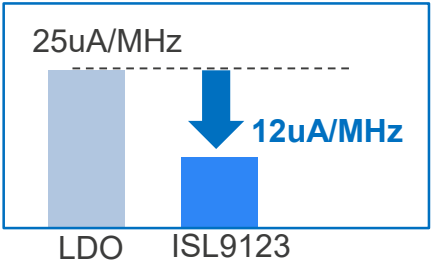
Evaluation board & Sample code				
	RE01 1.5MB		RE01 256KB	
	EV Board	Sample code	EV Board	Sample code
DCDC ISL9123	Link	Link	Link	Link
DCDC ISL9122		Link		Link
Lighting sensor ISL29125	Link + Link	Link	Link + Link	Under develop ment

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Wearable Devices with the RE01 32-bit MCU



Reduce active power of RE01 by ISL9123



Wearable Devices with the RE01 32-bit MCU

Device Category	Orderable P/N	Key Features
MCU	RE01 R7F0E01182CFP	SOTBTM 64-MHz Arm® Cortex ®- M0+ Core. Innovative SOTB™ Technology to realizes both Ultra-low Active and Ultra-low Standby Current
	RL78/G1D R5F11AGG	Bluetooth® Low Energy MCU. Bluetooth® Low Energy MCU with the lowest level of current consumption in the industry
Power	ISL9205	Li-Ion Battery Charger. Complete Charger for Li-Ion / Polymer batteries
	ISL9123	Ultra-Low IQ Buck Regulator with Bypass. Space Limited Battery Powered Applications
	ISL88002	Ultra Low Power 3Ld Voltage Supervisors. Ultra Small Package for Confined Spaces
Analog	HS3001	Relative Humidity and Temperature Sensor. High Accuracy Humidity and Temperature Measurement for Environmental Monitoring
	ISL29125	RGB Color Light Sensor. Digital RGB Color Light Sensor with IR Blocking Filter
	READ2302	6MHz GBW Dual OPAMP. High Drivability & High Slew Rate, Input Output Full Range

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RE01 – SOTB™ 64-MHz Arm® Cortex®- M0+ Core

Innovative SOTB™ Technology to realizes Both Ultra-low Active and Ultra-low Standby Current

Innovative Ultra-low Power

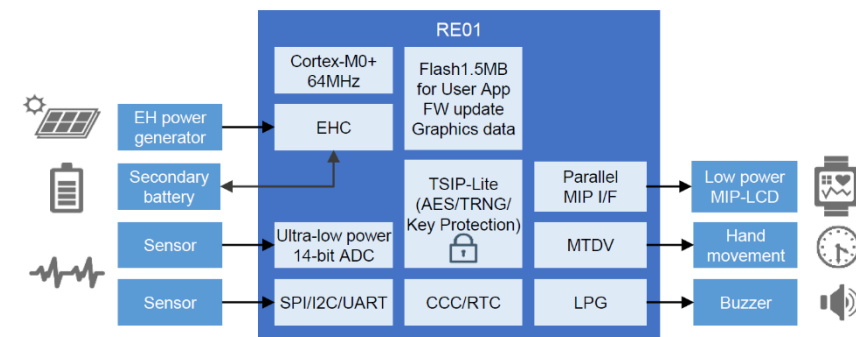
- Both ultra-low active current and ultra-low standby current
- High-speed operation (maximum 64MHz) at low voltage (1.62V)
- Ultra-low power consumption 14-bit ADC (approx. 4uA), flash (rewrite at less than 0.6mA)
- Energy harvesting control circuit and back-bias voltage control enables battery-less and maintenance free operation

Intelligent for IoT Device

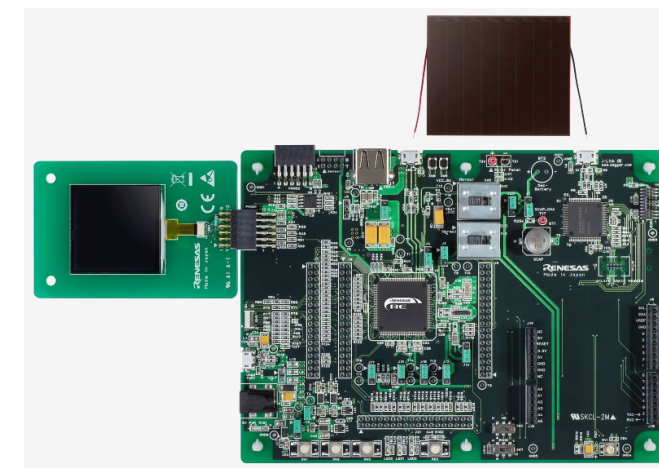
- 64MHz Arm® Cortex®-M0+ CPU 1.5M Flash with BGO and 256K SRAM
- MIP LCD controller and 2D graphic engine
- TSIP-Lite security function

Rich Peripherals

- Various analog circuits: 14-bit ADC, 12-bit DAC, comparator, temperature sensor and 3 channels LED driver
- Communication functions: USB 2.0, 2 CHs SPI, QSPI, 7 CHs SCI, 2 CHs I²C



Wearable / Hybrid Watch Example



Evaluation Kit RE01 1500KB Board

Part #	Flash/SRAM	TSIP-Lite	MLCD	Package
R7F0E017D2DBN	1.5M/256K	Yes	Yes	SXBG0156MA-A 4.5 × 4.3 mm, 0.3-mm pitch
R7F0E016D2DBN	1.5M/256K	No	Yes	
R7F0E015D2CFB	1.5M/256K	Yes	Yes	PLQP0144KA-B 20 × 20 mm, 0.5-mm pitch
R7F0E014D2CFB	1.5M/256K	No	Yes	
R7F0E015D2CFP	1.5M/256K	Yes	Yes	PLQP0100KB-B 14 × 14 mm, 0.5-mm pitch
R7F0E014D2CFP	1.5M/256K	No	Yes	

RL78/G1D – Bluetooth® Low Energy MCU

Bluetooth® Low Energy MCU with the Lowest Level of Current Consumption in the Industry

High Integration

- Power-efficient low-end microcontrollers with Bluetooth® Low Energy
- 2.4 GHz RF transceiver
 - Compliant with Bluetooth® v4.2 Low Energy (Master/Slave) specification
 - Reception sensitivity: –90 dBm
 - Max. transmission output power: 0 dBm

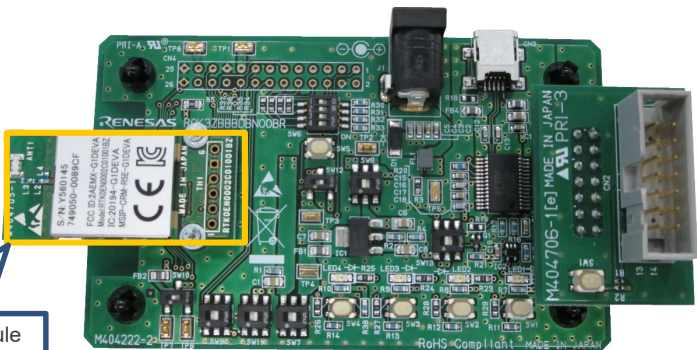
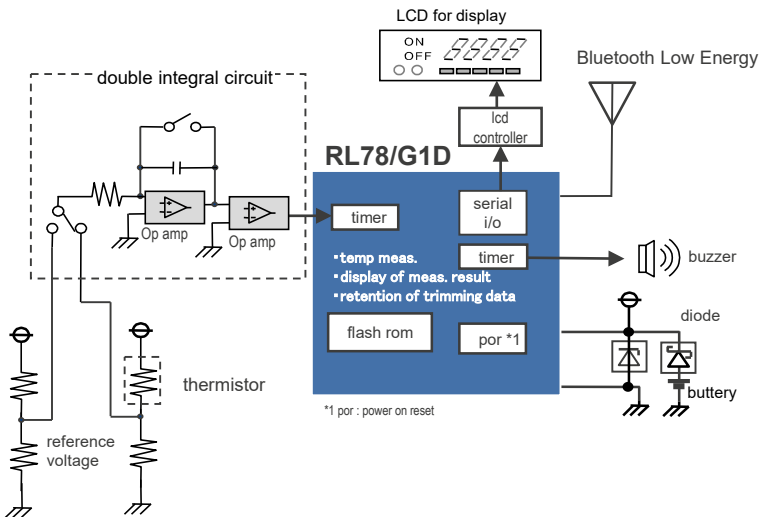
Easy to Develop and Use

- Since circuit elements necessary for connecting an antenna are built in, not only does this simplifies circuit design for the antenna connection, but also reduce BOM and overall costs.
- Software stack supports wireless updating, helping to make maintenance of user software more efficient.

Low Power Consumption

- Achieved the lowest level of current consumption in the industry (3 V operation)
 - 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)
- Different standby mode for MCU:HALT, STOP, SNOOZE
- Low power saving mode with 6 setting (min. 0.1 µA) for RF part

Part #	Flash ROM	RAM	Package
R5F11AGG	128KB	12KB	48-pin HWQFN (6 × 6) (0.4mm pitch)
R5F11AGH	192KB	16KB	
R5F11AGJ	256KB	20KB	



RTK0EN0001D01001BZ
RL78/G1D Evaluation Board

ISL9205 – Li-Ion Battery Charger

Complete Charger for Li-Ion / Polymer batteries

Single IC Solution for Charging

- Integrated pass element and current sensor
- Charge current from 50mA to 900mA

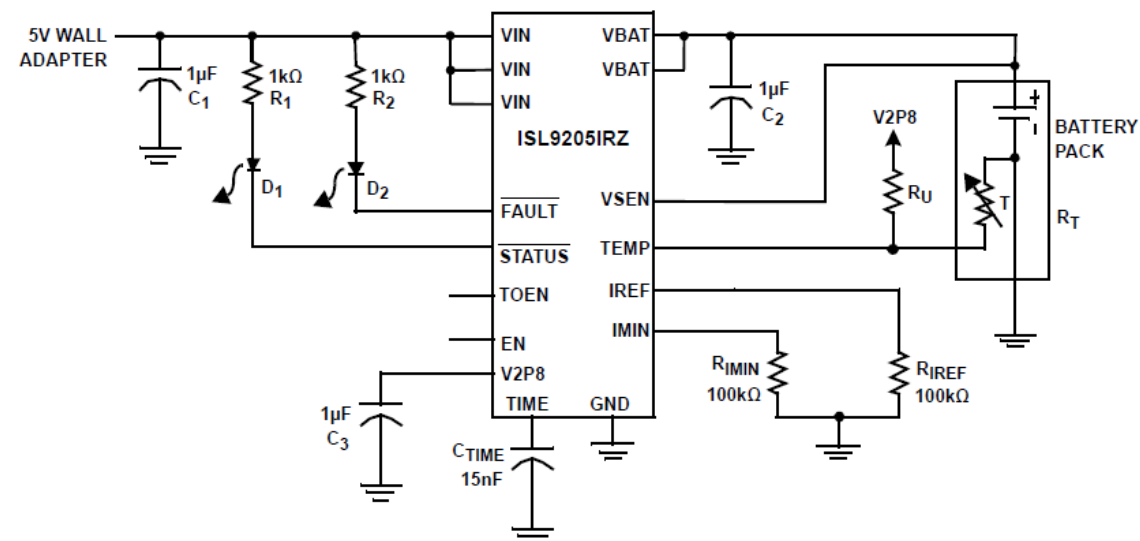
Multiple Charge Modes

- Adjustable CC & End of Charge current via external resistors
- Ability to operate as pulse charger for current limited inputs
- Trickle charge for fully discharged batteries

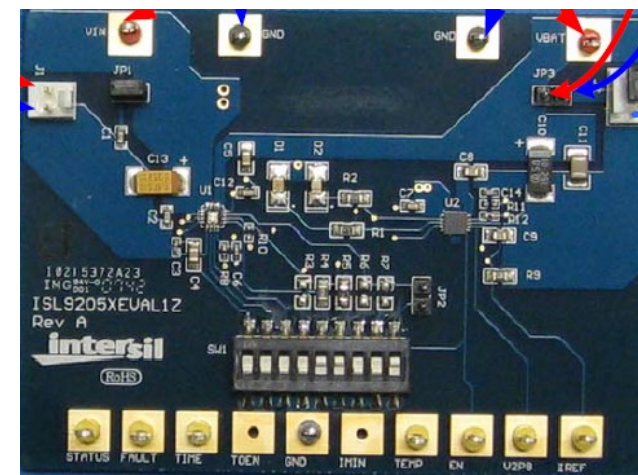
Protection Features

- Incorporates Therma guard to prevent over temperature
- Foldback of charge current during over temperature events
- Ability to monitor temperature of battery pack

Part #	V _{BAT}	V _{sen}	Temp	Timeout	Package
ISL9205IRZ-T	4.2	Yes	Yes	Yes	16L 3x3 TQFN
ISL9205AIRZ-T	4.2	Yes	No	No	10L 3x3 TQFN
ISL9205BIRZ-T	4.2	Yes	No	Yes	10L 3x3 TQFN
ISL9205CIRZ-T	4.256	Yes	No	Yes	10L 3x3 TQFN
ISL9205DIRZ-T	4.2	No	Yes	Yes	10L 3x3 TQFN



Typical Application Circuit



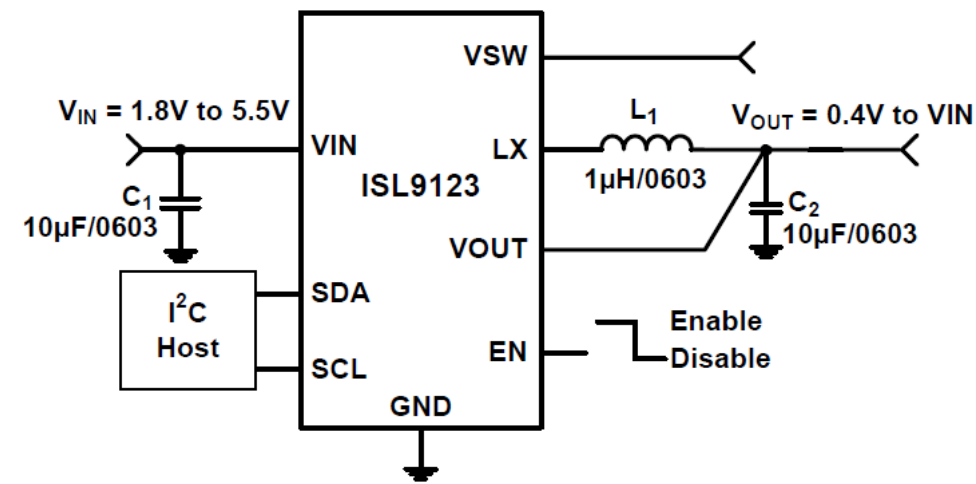
Evaluation Board

ISL9123 – Ultra-Low IQ Buck Regulator with Bypass

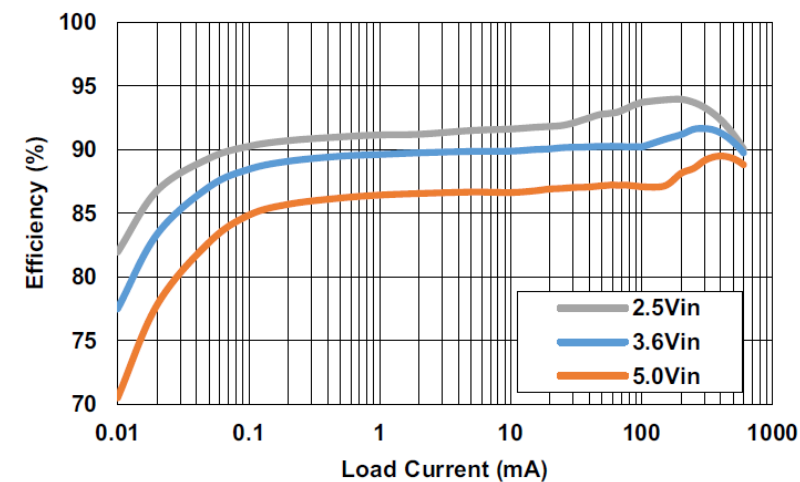
Space-Limited Battery Powered Applications

Ultra Low and Efficient Power

- Ultra Low $I_q = 950\text{nA}$
 - 80% efficiency at $10\mu\text{A}$ load
 - 97% peak efficiency
- Input voltage range: 1.8V to 5.5V
- Output voltage range: 0.4 to 5.375V
- Output current: up to 600mA ($V_{IN} = 3.6\text{V}$, $V_{OUT} = 1.8\text{V}$)
- Selectable Forced and Auto Bypass power saving modes



Typical Operating Circuits



Efficiency vs Load current

Part #	Default V_{OUT}	Package
ISL9123IINZ-T	3.0V	8L 1.8x1.0mm WLCSP
ISL9123IICZ-T	1.8V	8L 1.8x1.0mm WLCSP
ISL9123II4Z-T	1.0V	8L 1.8x1.0mm WLCSP

ISL88001/2/3 – Ultra Low Power 3Ld Voltage Supervisors

Ultra Small Package for Confined Spaces

Single Voltage Monitoring Supervisor

- Fixed-Voltage Options Allow Precise Monitoring of +1.8V, +2.5V, +3.0V, +3.3V and +5.0V Power Supplies
- Ultra Low 160nA Supply Current
- ±1.2% Voltage Threshold Accuracy

Popular Voltage Trip Points

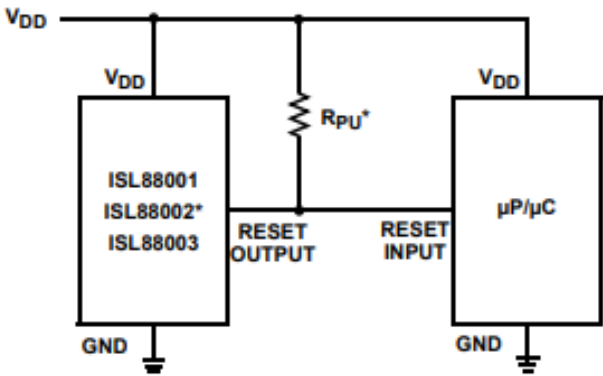
- Trip points are available for standard power supplies from 1.8V to 5.0V
- 190ms Power-On Reset Timeout
- Reset Signal Valid Down to VDD = 1V

Simple Board Design

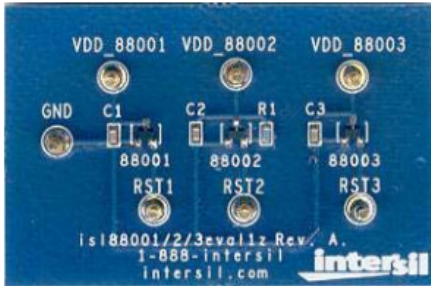
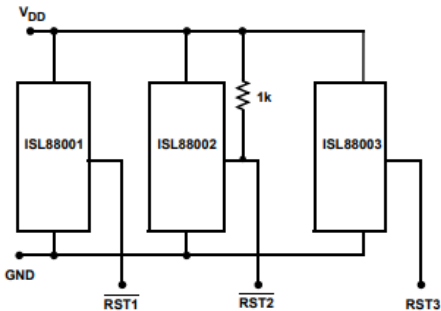
- No external components necessary

Part #	Nominal V _{THVDD} (V)	Temp.	Package
ISL88001IH46Z-T7A	4.62	-40/+85	3Ld 2.92x 1.3mm SOT-23
ISL88001IH44Z-T7A	4.38	-40/+85	3Ld 2.92x 1.3mm SOT-23
ISL88001IE46Z-T7A	4.62	-40/+85	3Ld 2 x 1.24mm SC70
ISL88001IE31Z-T7A	3.07	-40/+85	3Ld 2 x 1.24mm SC70

Note: Many other output voltage and package options. See website.



Typical Operating Circuits
(*necessary for ISL88002)



ISL88001/2/3EVAL1Z Evaluation Board

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

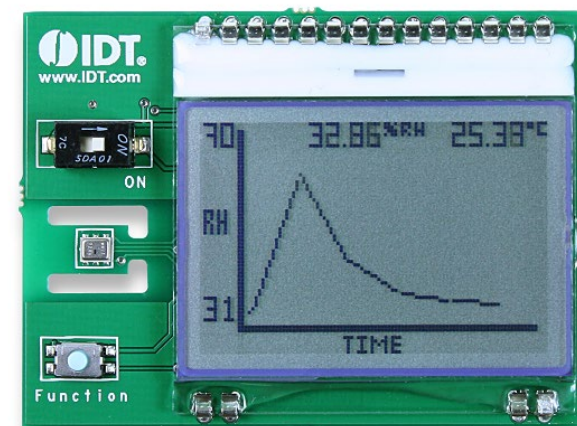
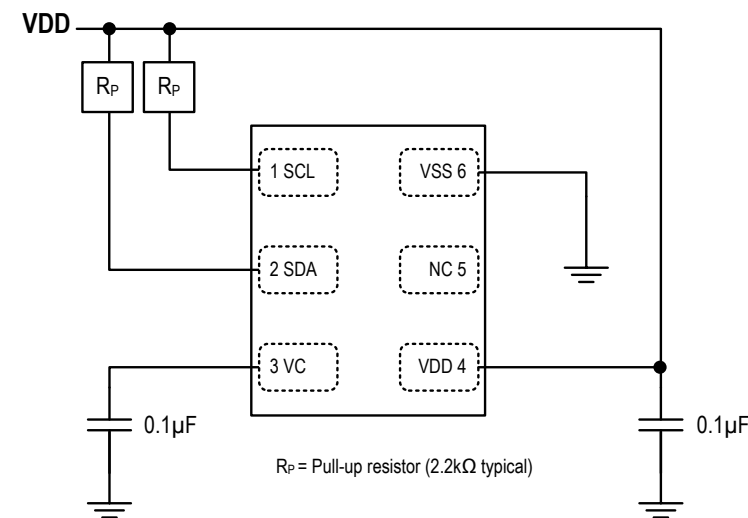
Fast Response

- Less than 4 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



SDAH02 Evaluation Kit

ISL29125 – RGB Color Light Sensor

Digital RGB Color Light Sensor with IR Blocking Filter

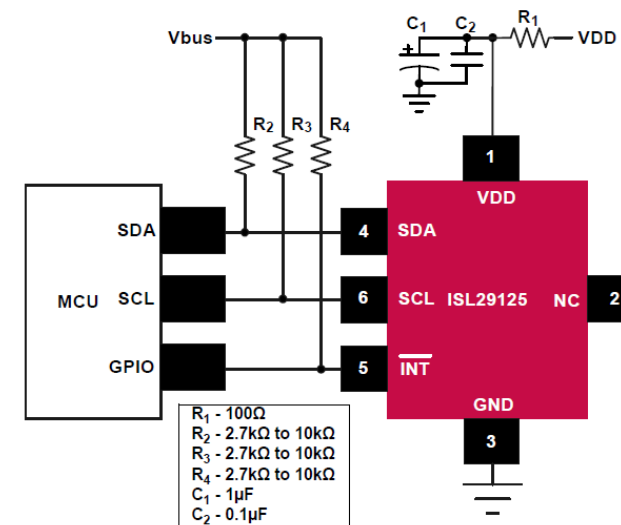
High Sensitivity, Accurate and Flexible Design

- Selectable range (Via I²C)
- I²C (SMBus compatible) output
- ADC resolution 16 bits
- Programmable interrupt windows
- Two optical sensitivity ranges:
Range 0 = 5.7m lux to 375 lux
Range 1 = 0.152 lux to 10,000 lux

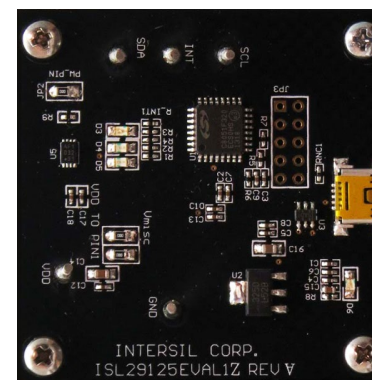
Low Power and Small Package

- 56μA operating current, 0.5μA shutdown current
- Operating power supply 2.25 to 3.63V
- I²C power supply 1.7V to 3.63V
- 6 Ld ODFN (1.65x1.65x0.7mm) package

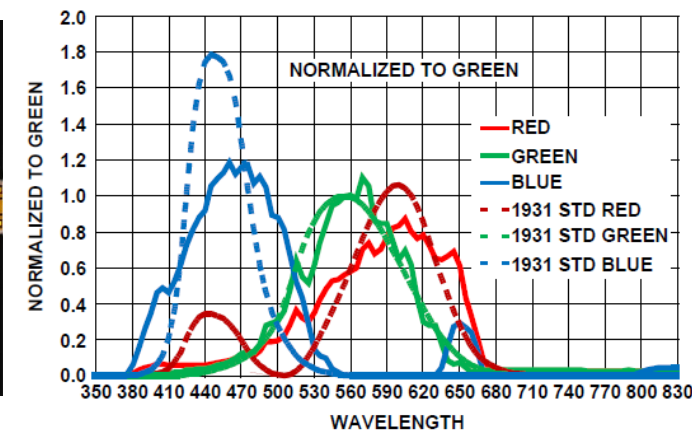
Part #	Temp range	Tape and Reel Quantity	Package
ISL29125IROZ-T7	-40 to 85 °C	3000	6 Ld 1.65 x 1.65 ODFN
ISL29125IROZ-T7A	-40 to 85 °C	250	6 Ld 1.65 x 1.65 ODFN



Typical Application Diagram



ISL29125EVAL1Z
Evaluation Board



Normalized Spectral
Response for RGB Sensing

READ2302G – 6MHz GBW Dual Op Amp

High Drivability & High Slew Rate, Input Output Full Range

High Performance

- High slew rate SR = 8V/μs Typ.
- 6MHz GBW
- Low input offset voltage $V_{IO} \leq \pm 6.0\text{mV}$
- Low input bias current $I_B \leq (1\text{pA})$.
- Supply current (per channel) $I_{DD} = 0.75\text{mA}$ Typ.

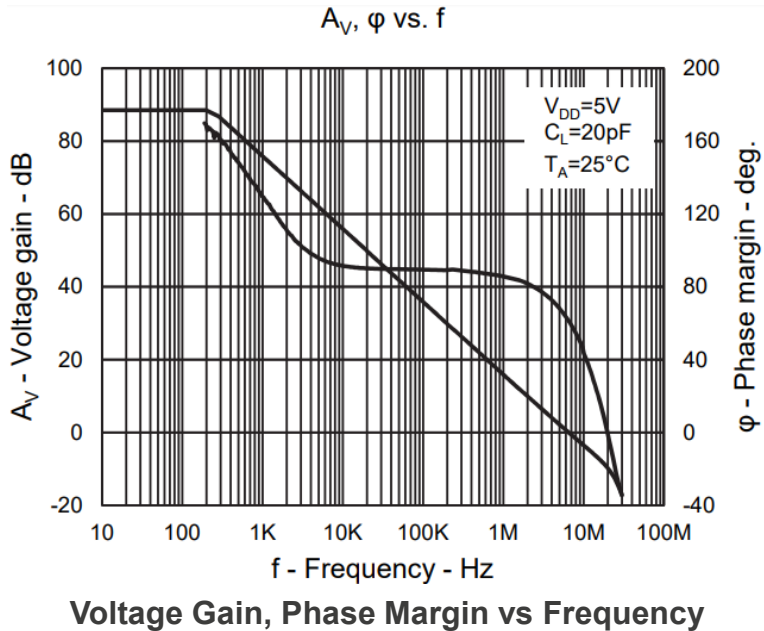
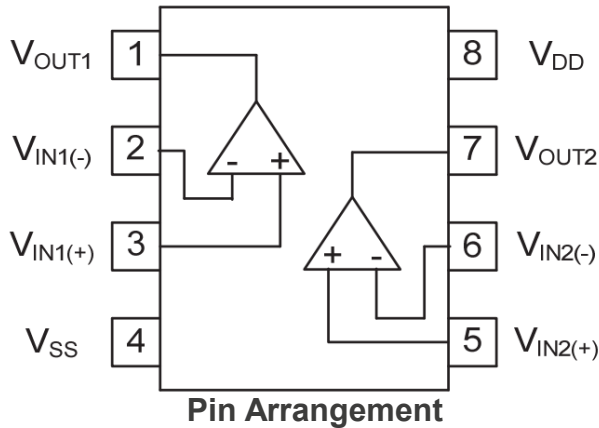
Easy to Use

- Low Voltage Single Supply : $V_{DD} = 2.5\text{V}$ to 5.5V
- Output Full Range : $V_{OUT} : V_{SS}+0.1\text{V}$ to $V_{DD}-0.1\text{V}(@I_o=5\text{mA})$
- Wide Operating temperature : -40°C to $+105^{\circ}\text{C}$

Compact Size

- Ultra-small 8 pins TSSOP packages
- Dual channel

Part #	Product type quality level	Package
READ2302GSP	High slew rate with Normal quality level	TSSOP8



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