

Cloud & Sensor Solution for IoT Endpoints

November 2019

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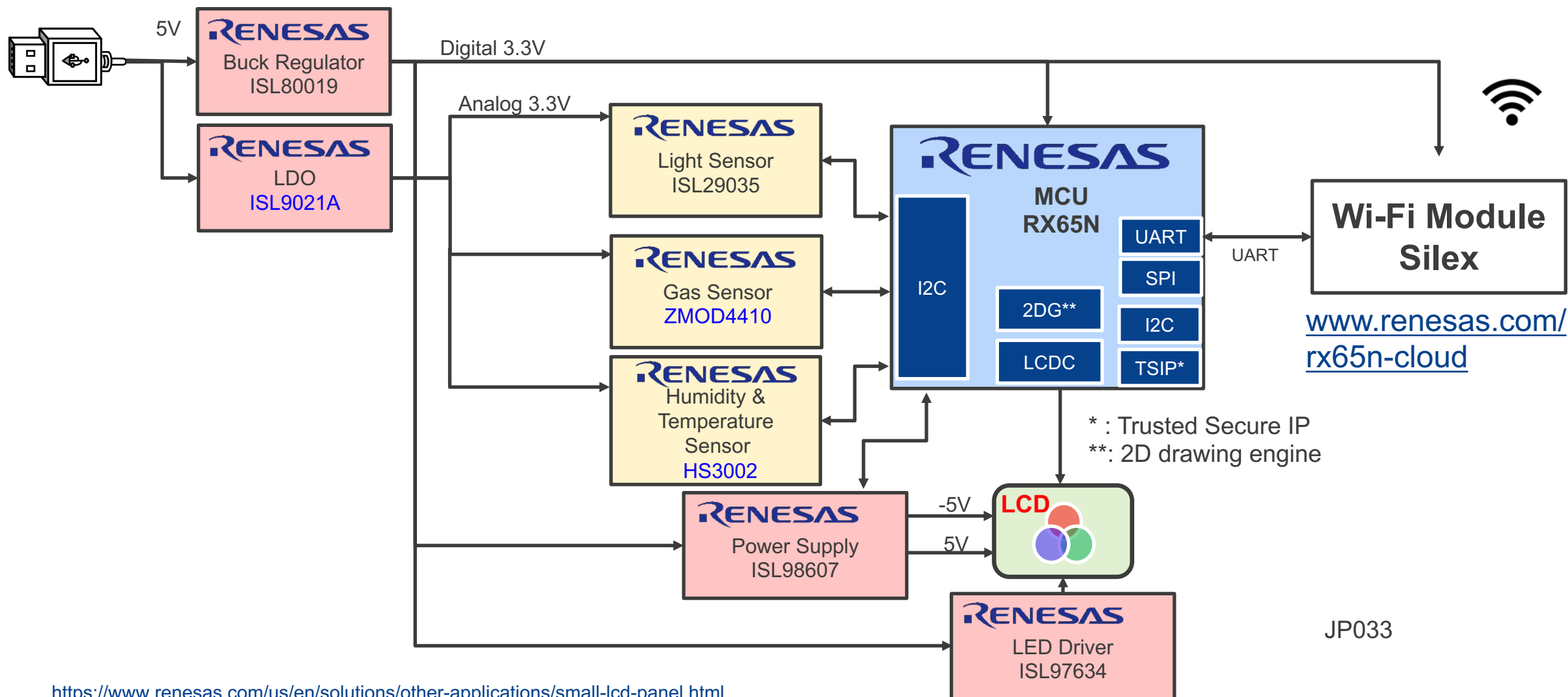
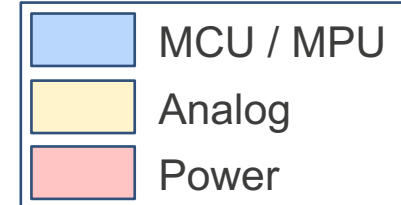
■ Overview

This reference design includes a light sensor, a temperature/humidity sensor, and gas sensor. All the data, including sensor data, can be uploaded to the cloud. The RX65N microcontroller is a next-generation general-purpose MCU, with Human Machine Interface (HMI) and security features that are ideal for IoT Edge devices. The built-in dual-bank functionality and Trusted Secure IP features allow users to establish secure cloud communications and conduct firmware updates easily and securely.

■ System Benefits

- Allows for safe and secure connection to the cloud
- The Renesas RX65N Cloud Kit simplifies secure IoT endpoint device connections to Amazon Web Services (AWS) and makes it easy for embedded designers to get a fast start on their designs and connect to the AWS cloud
- Light, temperature/humidity, and gas sensors included in the reference design

Cloud & Sensor Solution for IoT Endpoints



<https://www.renesas.com/us/en/solutions/other-applications/small-lcd-panel.html>

Cloud & Sensor Solution for IoT Endpoints

Device Category	P/N	Key Features
MCU	RX65N, RX651	RXv2 core, security and various connectivity. 120MHz high performance and low power consumption with large ROM/RAM capacity.
Power	ISL80019	Vin 5.5V/1.5A/2x2mm sync buck DC/DC. Compact synchronous buck regulators for space limited applications. 1MHz switching frequency, providing superior transient response.
	ISL9021A	250mA single LDO. Low IQ, low noise and high PSRR (75dB@10kHz, 50dB @1MHz).
	ISL98607	Power supply for small size displays. High efficiency, dual output rails (+/-) can be adjusted up to $\pm 5.7V$.
	ISL97634	LED driver with wide PWM dimming range. Highly efficient and integrated PWM boost LED driver up to 26V output.
Analog	ISL29035	Integrated digital light sensor with interrupt. Ambient and infrared light-to-digital converter with I ² C(SMBus compatible) interface.
	ZMOD4410	Indoor Air Quality Sensor Platform. TVOC sensor for Indoor Air Quality applications. Very low average power consumption down to 1mW.
	HS3002	Relative humidity and temperature sensor. High accuracy humidity and temperature measurement for environmental monitoring. Excellent stability. 0.1%RH per year drift.

JP033

RX65N,RX651 – RXv2, Security and Various Connectivity

120MHz High Performance and Low Power Consumption with Large ROM/RAM Capacity

Key Features:

- RXv2 Core 120 MHz operation (34 CoreMark/mA)
- 2.7 to 3.6V operation with low power consumption
- Program Flash up to 2 MB, SRAM up to 640 KB
- Dual Bank ROM function convenient for firmware update *₁
- Wide Package Lineup from small 64pin to 176-pin

Security Functions:

- Memory Protect Function : Protects Code Flash ROM from unintended access
- Trusted secure IP *₁ : Protects Key Data from disclosure
- Various Encryption Engines : AES, TRNG, TDES *₁, RSA*₁, SHA*₁

Various Connectivity and Human Machine Interfaces:

- Ethernet, USB, CAN, SD host/slave, and SPI/QSPI
- USB2.0 x 2 (FS/HS) SD x 2 MMC host interface
- TFT-LCD controller and 2D drawing engine to run Color LCD Display *₁

P/N Example :

*₁ : Only products with 1.5 MB or more code flash memory

Group	Part #	CPU (MHz)	ROM (MB)	RAM (KB)	Trusted Secure IP	Ethernet	I2C,UART, SPI,QSPI	ADC	LCDC, 2D engine	Package
RX65N	R5F565NEDDFP	120	2	640	No	Yes	Yes	Yes	Yes	100LFQFP
	R5F565NEHDFP				Yes					
RX651	R5F5651EDDBP				No	No			64LFBGA	
	R5F5651EHDFM				Yes					64LFQFP

<https://www.renesas.com/products/microcontrollers-microprocessors/rx/rx600/rx65n-651.html>

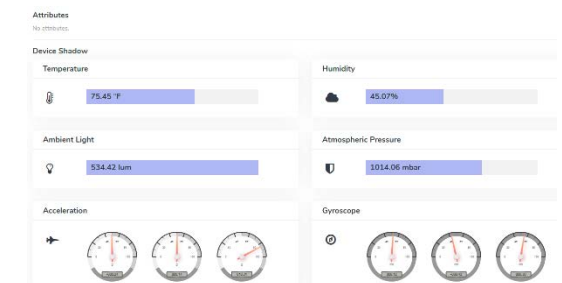
RX65N Cloud Kit

[RTK5RX65N0S0*000BE] * [0]: EU and JP, [1] : US

powered by  Amazon FreeRTOS Qualified



RX65N [R5F565NEDDFP]



Renesas RX Dashboard

ISL80019/19A – 2.7V to 5Vin, 1.5A Sync Buck DC/DC

Compact Synchronous Buck Converters with High Efficiency at Light Loads

Compact Footprint for Space-Limited Applications

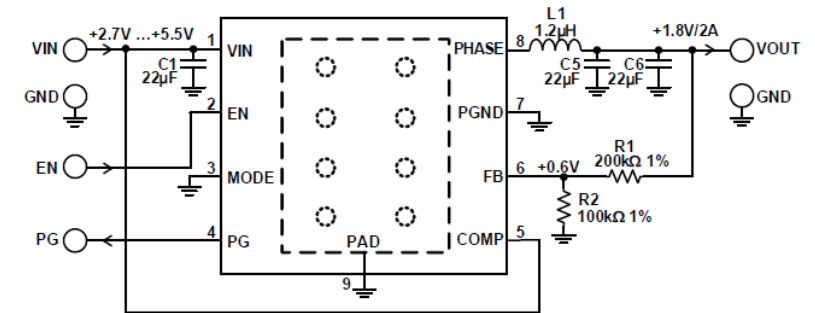
- 8 pin 2mmx2mm TDFN
- 1MHz or 2MHz switching frequency allows the use of small inductors
- The high-side PMOS eliminates external bootstrap capacitor

High Efficiency

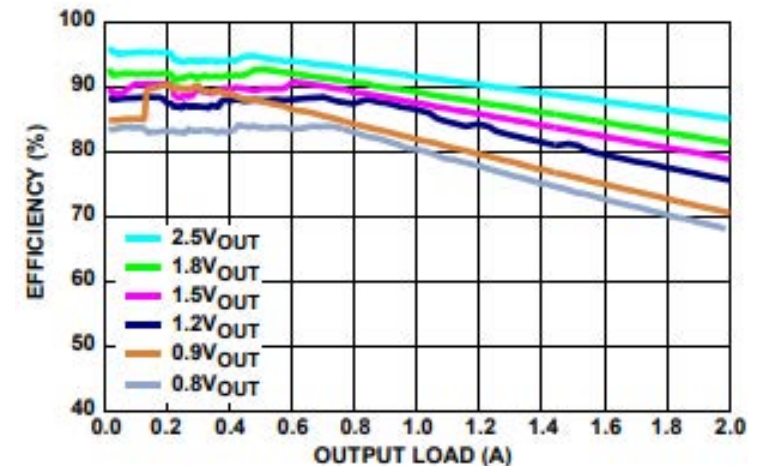
- Integrated very low $r_{DS(ON)}$ MOSFETs maximize efficiency up to 95%
- 100% duty cycle (1MHz version)
- Optional PFM reducing switching losses at light loads
- Low Quiescent Current (<35uA)

Excellent Safety

- Overcurrent and short circuit protection
- Over-temperature/thermal protection
- V_{IN} Undervoltage Lockout and V_{OUT} Overvoltage Protection
- Negative current protection



Typical Application Circuit



Efficiency vs Load

$F_{SW} = 1\text{MHz}$, $V_{IN} = 3.3\text{V}$, $\text{MODE} = \text{PFM}$, $T_A = +25^\circ\text{C}$

Part #	I _{out} (A)	F _{SW} (MHZ)	V _{IN} Range(V)	V _{OUT} Range(V)	Package
ISL80019xRZ-T	1.5	1	2.7 to 5.5	0.6 to 5.5	2x2 TDFN
ISL80019AxRZ-T	1.5	2	2.7 to 5.5	0.6 to 5.5	2x2 TDFN

ISL9021/9021A – 250mA Single LDO

Low IQ, Low Noise and High PSRR LDO

Stable Output Voltage

- 250mA guaranteed continuous output current
- $\pm 1.8\%$ output accuracy over-temperature/load/line

High Efficiency

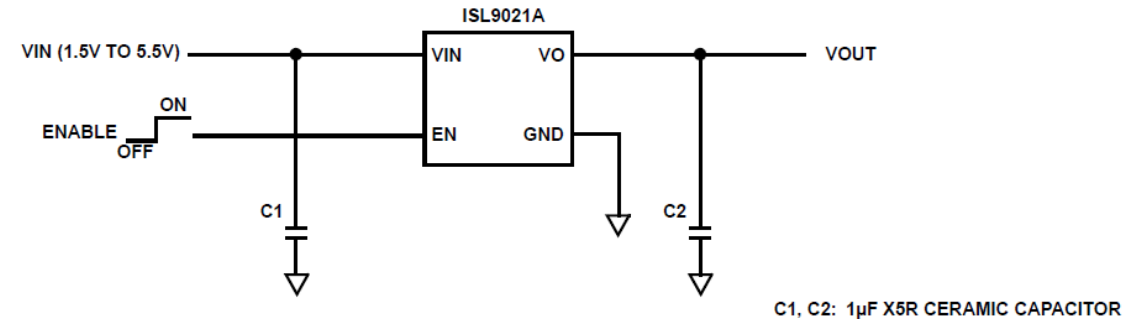
- Dropout voltage: $< 150\text{mV}$ @ 250mA
- Enable Control : Typically $< 0.1\mu\text{A}$ (typ) when disable

High Performance

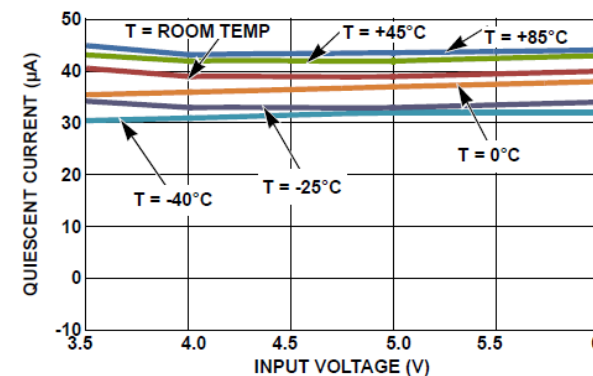
- High PSRR: 75dB @ 10kHz, 50dB @ 1MHz
- Low quiescent current: 35 μA

Excellent Safety

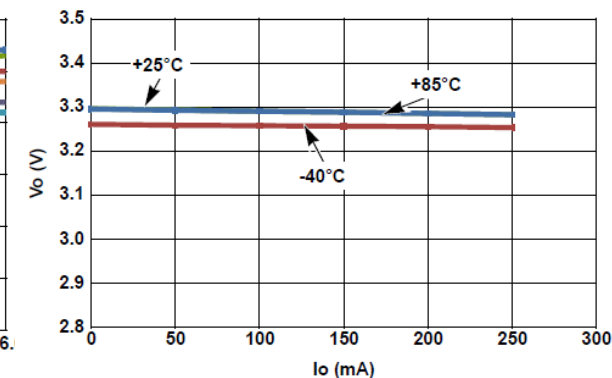
- Soft-start limits input current surge during enable
- Current limit and overheat protection



Typical Application Circuit



Quiescent Current vs Input Voltage



Load regulation vs Temperature

Part #	Vin (V)	Vout (V)	Iout (A)	Package
ISL9021	1.5V to 5.5V	1.2V to 3.3V	0.25	6 Ld μTDFN
ISL9021A	1.5V to 5.5V	1.2V to 3.3V	0.25	6 Ld μTDFN

ISL98607 – Power Supply for Small Size Displays

High Efficiency, Dual Output Rails (+/-) can be Adjusted up to $\pm 5.7V$

Dual Output for Displays

- Dual output (positive & negative) for powering displays
- Adjustable output, default is $\pm 5V$

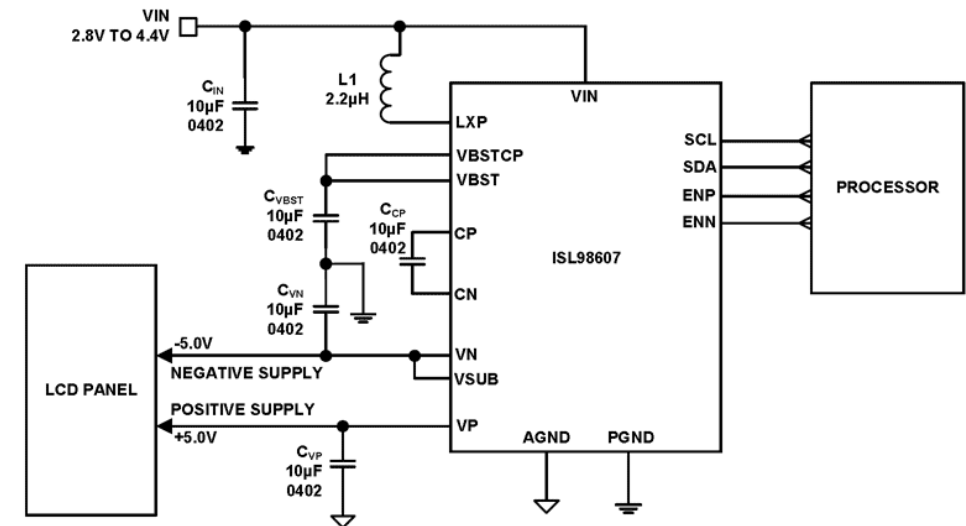
High Efficiency and Integrated Features

- Integrates synchronous rectification MOSFETs and inverting charge pump, which maximizes conversion efficiency
- >85.5% efficiency with 12mA load between VP and VN
- Integrated compensation and feedback circuits
- I²C adjustable output voltages and settings
- Integrated VP/VN discharge resistors
- 1 μA shutdown supply current

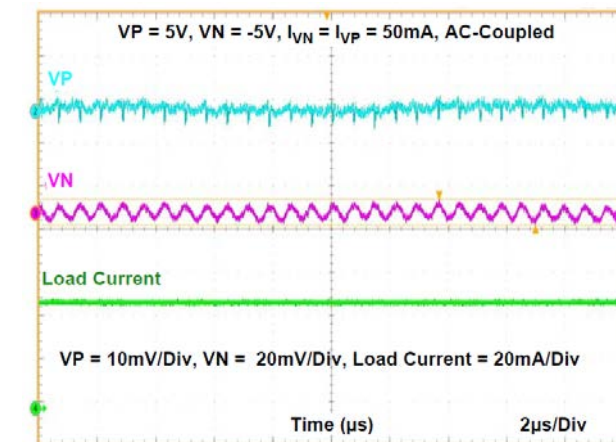
Compact Footprint for Space-Limited Applications

- 1.82x2.15mm WLCSP and 20 Ld 3x4mm TQFN packages
- 21mm² solution PCB area

Part #	V _{IN} Range(V)	Temp.(°C)	Package
ISL98607IRTZ-T	2.8 to 4.4	-40 to 85	20 Ld 3x4 TQFN
ISL98607EIAZ-T	2.8 to 4.4	-40 to 85	20 Ball (4x5 bump, 0.4mm pitch) WLCSP



Typical Application Circuit



VP and VN Output Voltage Ripple – 50mA Load

ISL97634 – LED Driver with Wide PWM Dimming Range

Highly Efficient and Integrated PWM Boost LED Driver Up to 26V Output

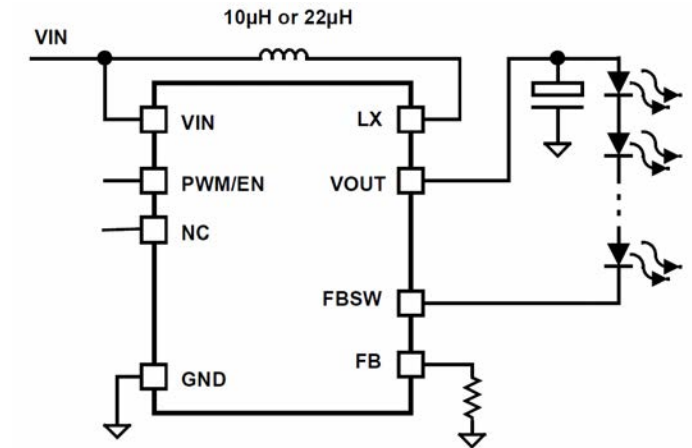
Simple and Flexible Use

- Drives up to 26V output
- Integrated over-voltage protection (OVP) of 14V, 18V, and 26V for various number of LEDs in series
- PWM dimming control from DC to 32kHz
- 2.4V to 5.5V input

Highly Efficient and Integrated Features

- 8 Ld 2mmx2mm DFN
- 85% efficiency
- 1μA shutdown current
- Integrated schottky diode
- Output disconnect switch

Part #	OVP Options(V)	V _{IN} Range(V)	Temp.(°C)	Package
ISL97634IRT14Z-T	14	2.4 to 5.5	-40 to 85	8 Ld 2x3 TDFN
ISL97634IRT18Z-T	18	2.4 to 5.5	-40 to 85	8 Ld 2x3 TDFN
ISL97634IRT26Z-T	26	2.4 to 5.5	-40 to 85	8 Ld 2x3 TDFN



Typical Application Circuit

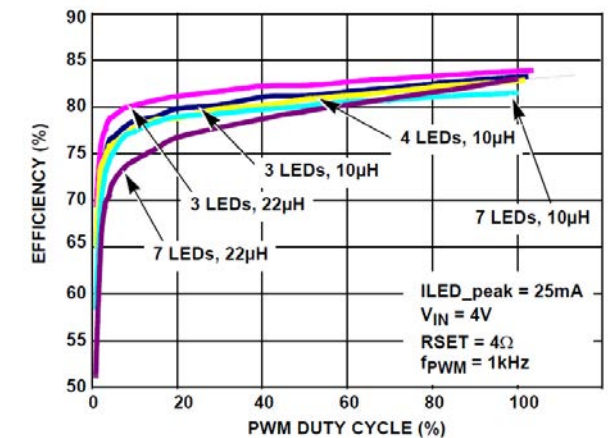


FIGURE 2. EFFICIENCY vs PWM DUTY CYCLE

Efficiency vs PWM Duty Cycle

ISL29035 – Integrated Digital Light Sensor with Interrupt

Ambient and Infrared Light-to-digital Converter with I²C(SMBus compatible) Interface

Integrated Functions and Small Package

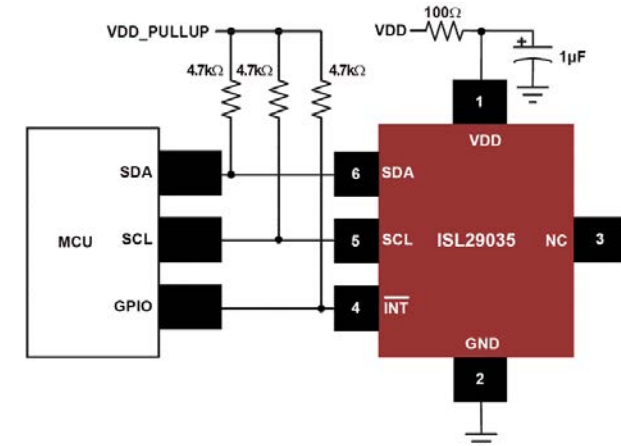
- 6 pin 1.5mmx1.3mm ODFN
- On-chip 16-bit ADC
- I²C (SMBus compatible) interface
- Integrated noise reduction 50/60Hz

High Performance

- Dynamic Range 1: 4,200,000
- Close to human eye response with excellent IR/UV rejection
- Operation across -40 to +85°C

Low Power Design

- Normal operation 57uA
- 2 power down mode support shutdown current < 0.51uA



Typical Operating Circuits



ISL29035EVAL1Z Evaluation Board

Part #	ALS Sensing	Interrupt Pin	Package
ISL29034IROZ	Yes	No	4 Ld 1.5x1.3 ODFN
ISL29035IROZ	Yes	Yes	6 Ld 1.5x1.6 ODFN

ZMOD4410 – Indoor Air Quality Sensor Platform

TVOC Sensor for Indoor Air Quality Applications

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

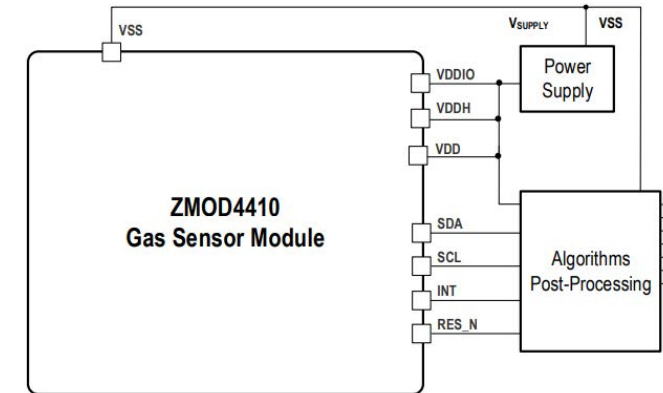
Low Power

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

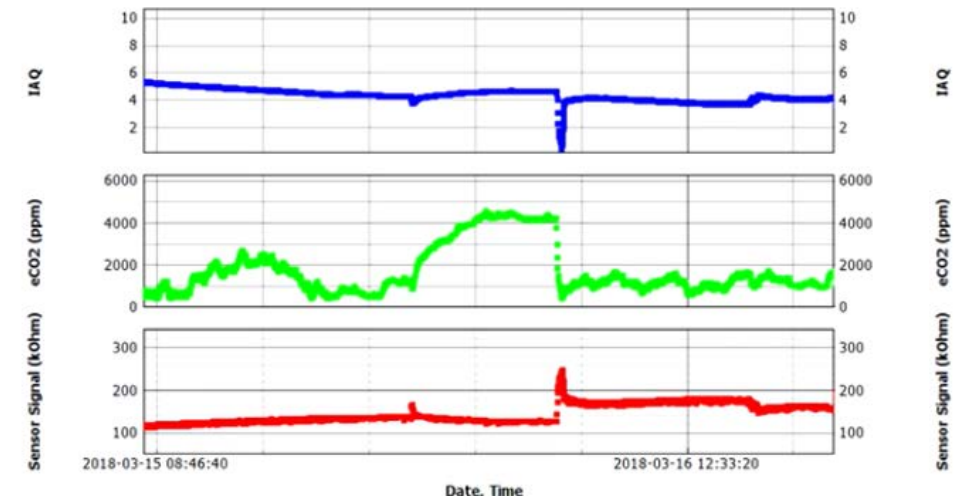
Easy to Use:

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

Part #	Operation Condition	Package
ZMOD4410	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

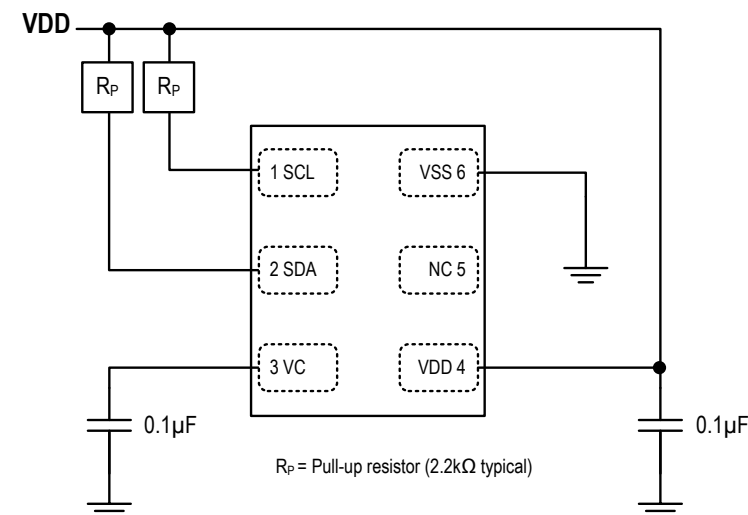
Fast Response

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

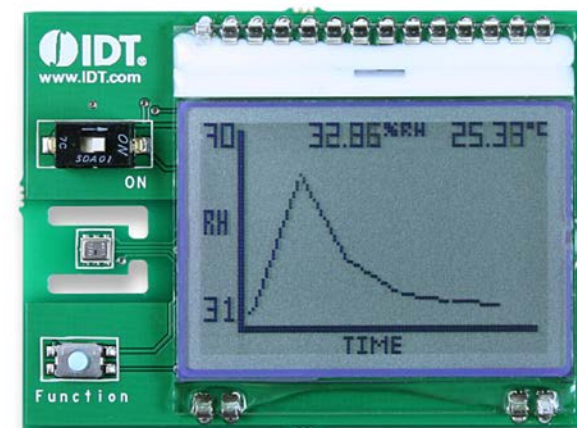
Extended Supply Voltage

- 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](https://www.renesas.com)