

CN071

Smart Grid Fault Indicator

Unit

October 2019

Smart Grid Fault Indicator Unit

▪ Overview

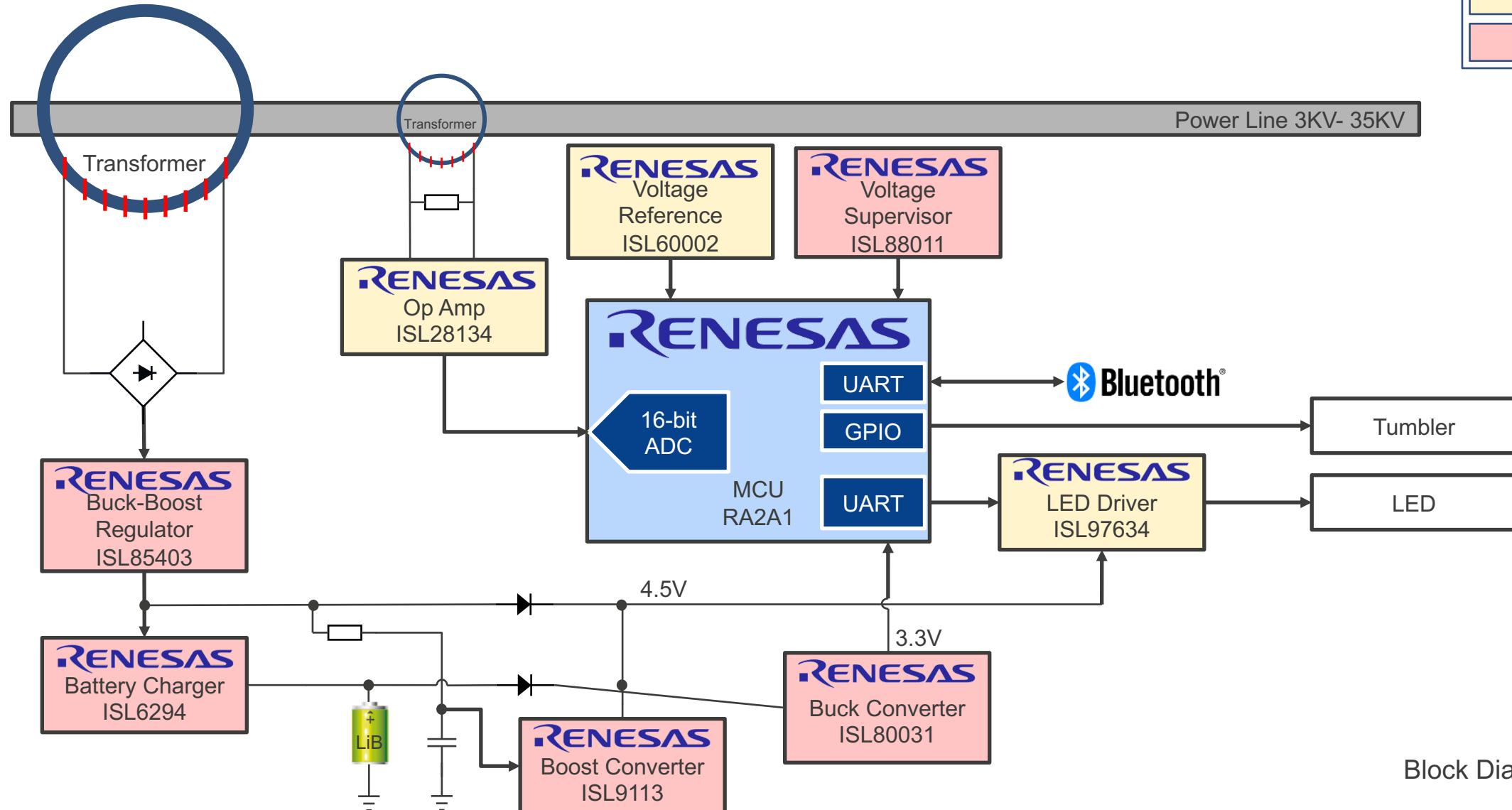
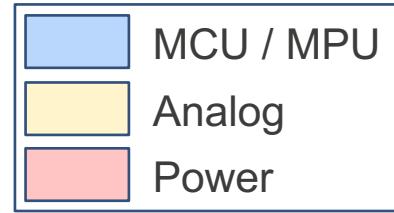
This grid fault current indicator is an example of a low power design system that shows customers the most efficient approach for system implementation.

The fault indicator unit uses Renesas' newly launched high-performance RA2 MCU series, which includes a 16-bit SAR ADC, 24-bit sigma-delta ADC, COMP, system control, touch control, super low power, etc. In the data collection unit, the RL78/G13 is a standard function MCU with low power and an abundant lineup for general purpose applications. Bluetooth® is used for communication between the two boards. Combined with Renesas' high performance power and analog solutions, this system can minimize idle quiescent current. This helps save power consumption during standby states.

▪ System Benefits

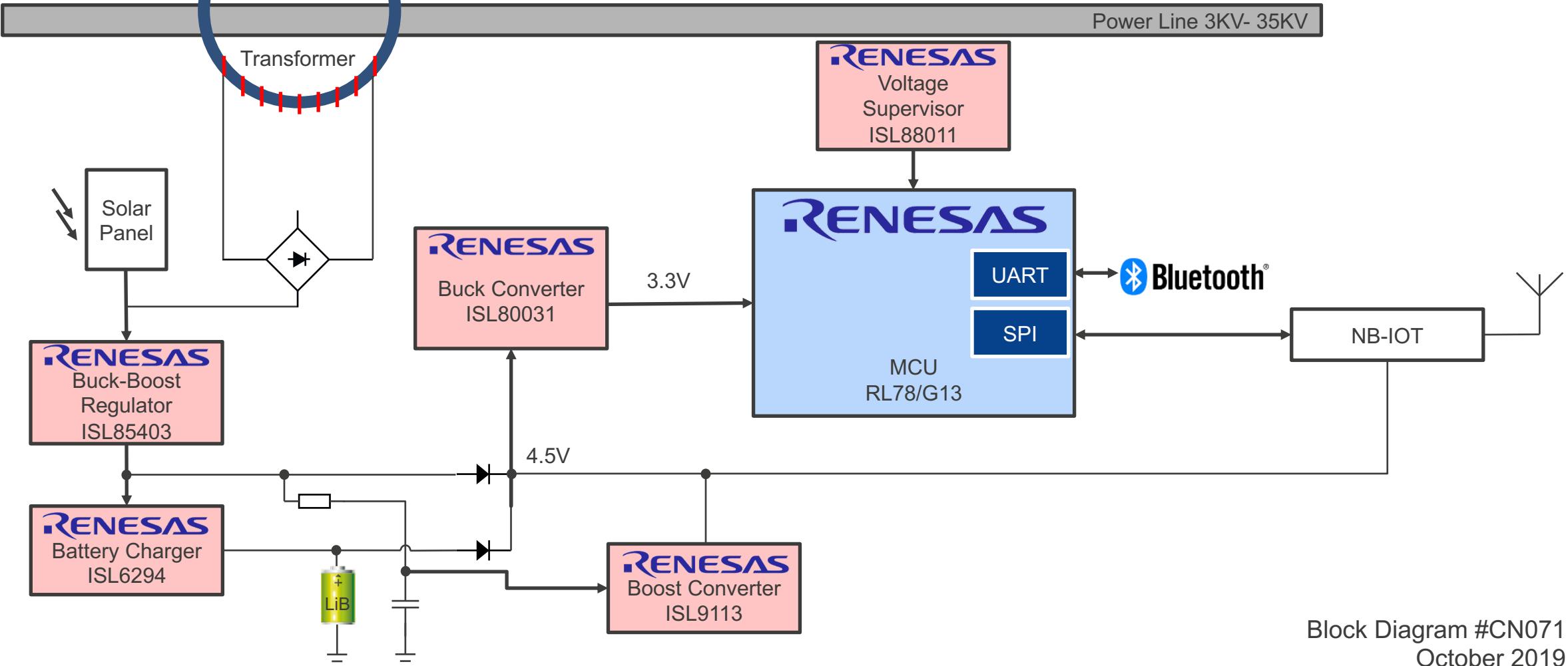
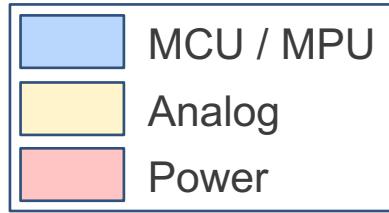
- Low quiescent power MCU solutions for optimized efficiency
- High performance analog devices for accurate system monitoring

Fault Indicator Unit



Block Diagram #CN071
October 2019

Data Collection Unit



Block Diagram #CN071
October 2019

Smart Grid Fault Indicator Unit

Device Category	P/N	Key Features
Analog	ISL60002	Precision Low Power FGA Voltage References
	ISL97634	Boost, White LED Driver with PWM Dimming
	ISL28134	5V Ultra Low Noise, Zero Drift Rail-to-Rail Precision Op Amp
MCU	RA2A1	Ultra-Low Power 48-MHz Arm® Cortex®-M23 Core with highly integrated, high-accuracy analog capabilities and offers complete analog solution for signal conditioning and measurement
	RL78/G13	The standard MCU for general-purpose with low power, high function, and abundant lineup
Power	ISL85403	40V, 2.5A, multiple functional switching regulator, $I_q = 180\mu A$
	ISL88011	Voltage Monitor with Power on Reset
	ISL9113	Low Input Voltage (support to 0.8V) and High Efficiency Synchronous Boost Converter with 1.3A Switch
	ISL80031	3A high efficiency Synchronous Buck Converter in 2x2 DFN Package
	ISL6294	High Performance Charger for Single-Cell Li-ion/Polymer Batteries

ISL60002 – Low Power FGA™ Voltage References

Very High Precision Reference for Industry/Medical Applications

Very High Precision

- Absolute initial accuracy options: $\pm 1.0\text{mV}$, $\pm 2.5\text{mV}$, and $\pm 5.0\text{mV}$
- Low $20\text{ppm}/^\circ\text{C}$ temperature coefficient

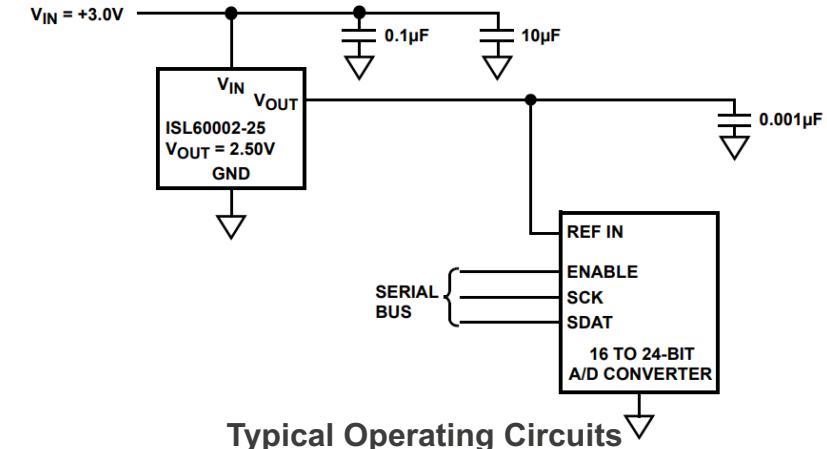
Low Power

- Ultra-low supply current: 350nA typ
- ISOURCE and ISINK = 7mA
- ISOURCE and ISINK = 20mA for ISL60002-33 only

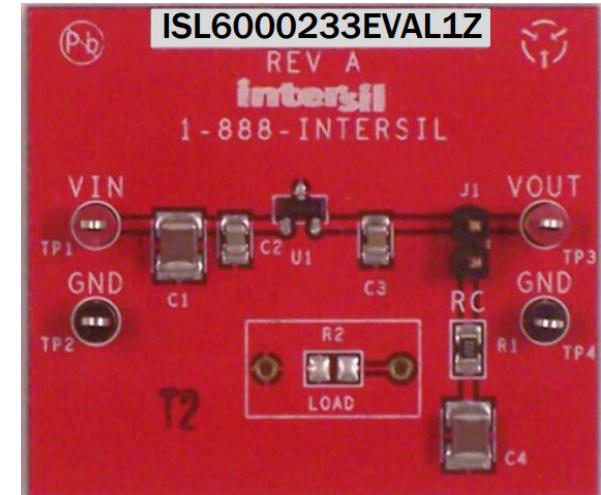
Easy to Use

- ESD protection: 5.5kV (Human Body Model)
- Standard 3 Ld SOT-23 packaging
- Reference voltages: 1.024V , 1.2V , 1.25V , 1.8V , 2.048V , 2.5V , 2.6V , 3.0V , and 3.3V
- Operating temperature range: -40°C to $+85^\circ\text{C}$

Part #	Vout Accuracy	Temp.	Package
ISL60002B10	$\pm 1.0\text{mV}$	$-40/+85$	3Ld SOT-23
ISL60002C10	$\pm 2.5\text{mV}$	$-40/+85$	3Ld SOT-23
ISL60002D10	$\pm 5.0\text{mV}$	$-40/+85$	3Ld SOT-23



Typical Operating Circuits



ISL6000233EVAL1Z Evaluation Board

ISL97634 – LED Driver with Wide PWM Dimming Range

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

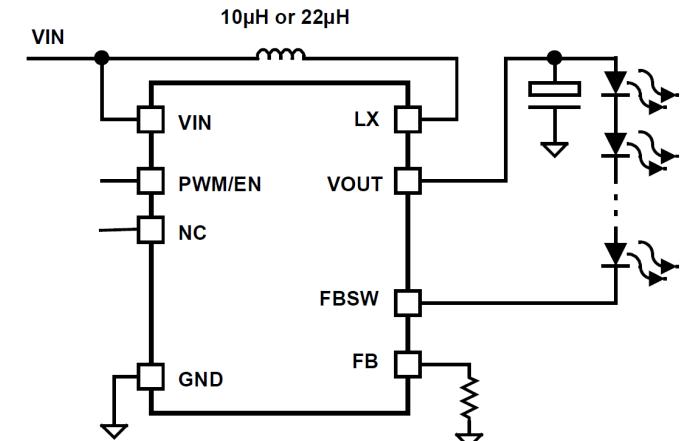
Simple and Flexible Use

- 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

High Efficient and Integrated Feature

- 8 Ld 2mmx2mm DFN
- 85% efficiency
- 1 μ A 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
SL97634IRT26Z-T	26	2.4 to 5.5	-40 to 85	8 Ld 2x3 TDFN



Typical Application Circuit

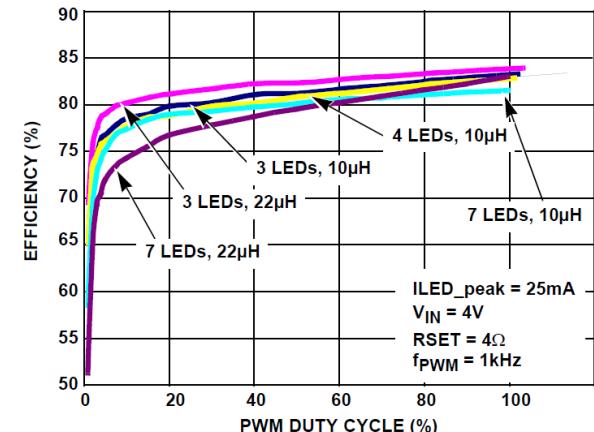


FIGURE 2. EFFICIENCY vs PWM DUTY CYCLE

Efficiency vs PWM Duty Cycle

ISL28134 – Ultra Low Noise, Zero Drift Rail-to-Rail Op Amp

Low Power Operational Amplifier for Battery-Powered Devices

Low Offset

- Low offset voltage: $2.5\mu V$, Max
- Superb offset drift: $15nV/{^\circ}C$, Max

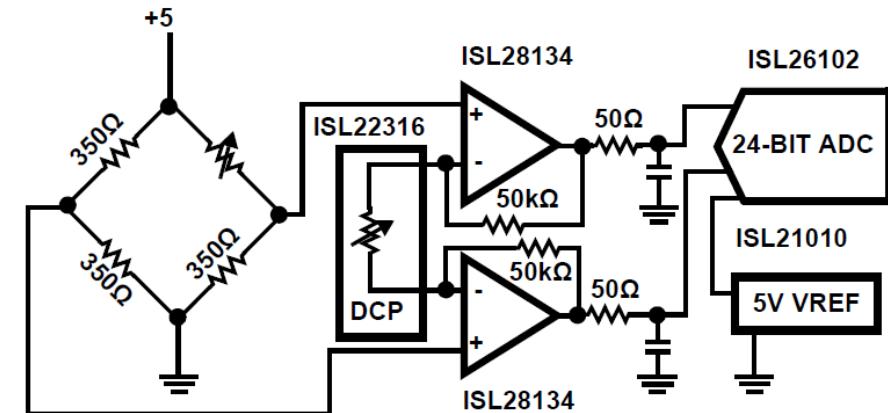
Good Dynamic Performance

- Low noise (0.01Hz to 10Hz): $250nV_{P-P}$, Typ.
- Rail-to-rail input and output: CMRR at $V_{CM} = 0.1V$ beyond V_S : $135dB$, Typ
- V_{OH} and V_{OL} : $10mV$ from V_S , Typ
- Wide bandwidth: $3.5MHz$

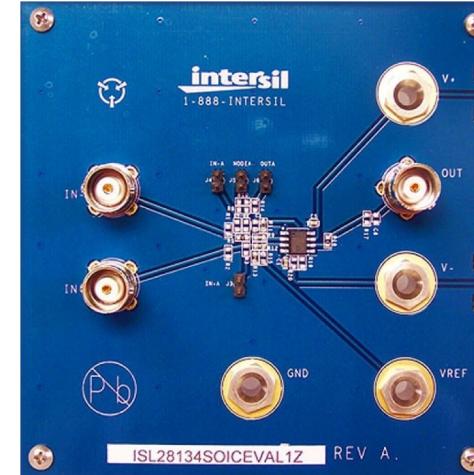
Low Power Design

- Low I_{CC} : $675\mu A$, Typ
- Single supply range: $+2.25V$ to $+6.0V$
- Dual supply range: $\pm 1.125V$ to $\pm 3.0V$

Part #	Temp.	Package
ISL28134IBZ	-40 - 85°C	8 Ld SOIC
ISL28134FHZ-T7	-40 - 125°C	5 Ld SOT-23
ISL28134FHZ-T7A	-40 - 125°C	5 Ld SOT-23



Typical Operating Circuit
(Precision Weigh Scale/ Strain Gauge)



ISL28134SOICEVAL1Z Precision Op Amp Evaluation Board

RA2A1 – Ultra-Low Power 48-MHz Arm® Cortex®-M23 Core

Complete Analog Solution for Signal Conditioning and Measurement

High Performance

- 48MHz Arm® Cortex®-M23 CPU

Highly Integrated, High-Accuracy Analog Capabilities

- OPAMP x3
 - 24-Bit S/D ADC (10 ch.) /16-Bit SAR ADC (17 ch.)
 - 12-Bit DAC (1 ch.)/8-Bit DAC (2 ch.)
 - Temperature Sensor (TSN)
 - High-Speed Comparator x2
 - Low-Power Comparator x2

Communication Interfaces

- USB 2.0 (Full Speed)
 - CAN
 - SCI x3/SPI x2/ IICx2

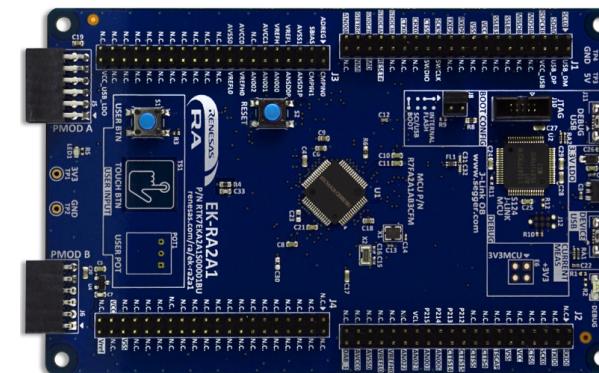
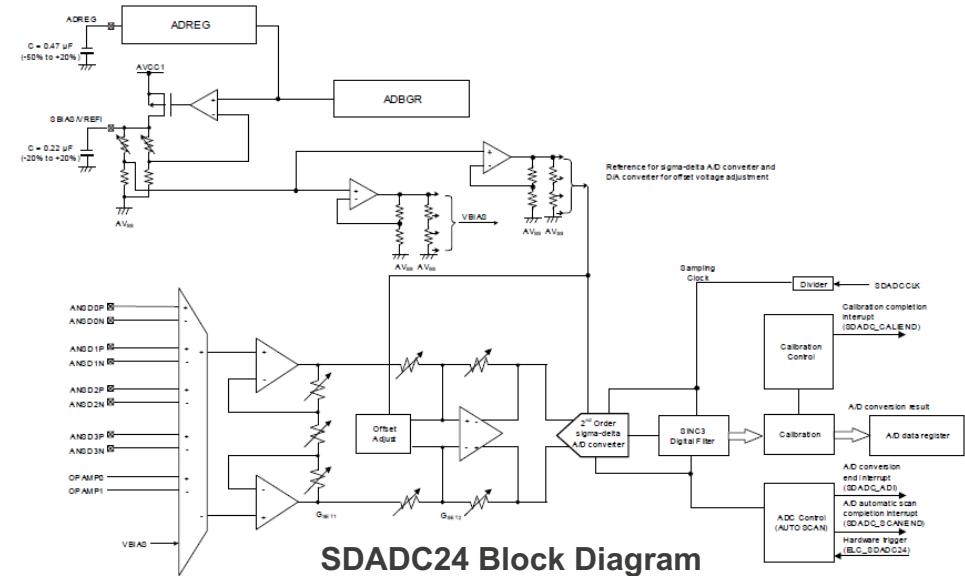
HMI Interface

- Capacitive Touch Sensing Unit (26 ch.)

Wide Voltage and Low Power Consumption

- Wide operating voltage range of 1.6V to 5.5V
 - Various Low Power Modes

Part #	Flash Memory	RAM	Temp	Package
R7FA2A1AB3CFJ	256KB	32KB	40~105°C	32 LQFP
R7FA2A1AB3CFM	256KB	32KB	40~105°C	64 LQFP



RTK7EKA2A1S00001BU

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)

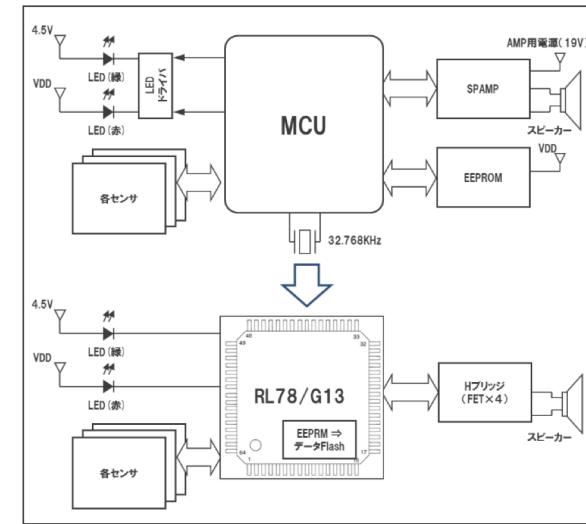
Low Power

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

Easy to Develop and Use

- Scalable lineup packages, pin-counts and Flash ROM, RAM
- Released starter kit and evaluation Kit

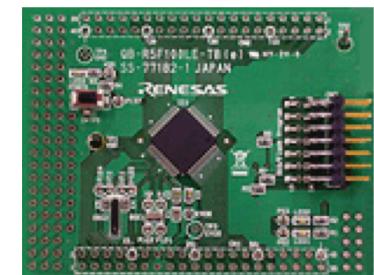
Part #	Flash ROM	RAM	Package(mm)
R5F1006/7/8x R5F1016/7/8x	16 ~ 64 KB	2 ~ 4 KB	20-LSSOP, 24-HWQFN(4 x 4), 25-WFLGA(3 x 3)
R5F100A/B/Cx R5F101A/B/Cx	16 ~ 128 KB	2 ~ 12 KB	20-LSSOP, 32-HWQFN(5 x 5), 36-WFLGA(4 x 4)
R5F100Ex R5F101Ex	16 ~ 192 KB	2 ~ 16 KB	40-HWQFN(6 x 6)
R5F100F/Gx R5F101F/Gx	16 ~ 512 KB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

ISL85403 – 2.5A Regulator with Integrated High Side FET

Support 3V-40V Input Voltage Range for Buck or Boost-buck Output

Wide Working Range

- Power input voltage range from 3V to 40V
- Support both step down (buck) or boost-buck outputs
- Up to 2.5A load over full temperature range

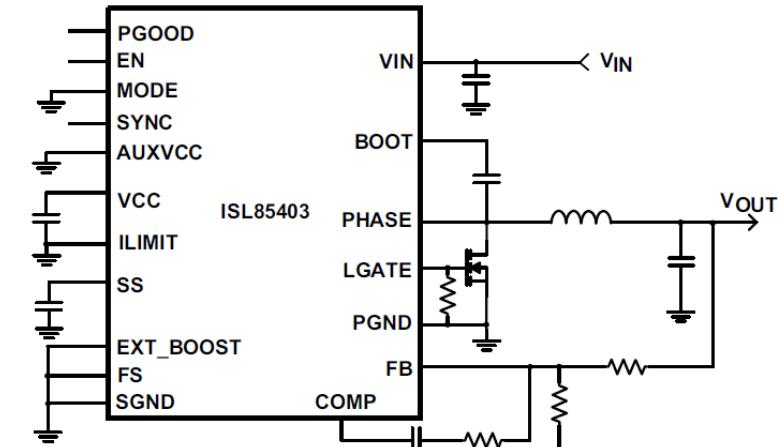
High Efficiency

- Optional external low side FET for higher efficiency
- Selectable PWM / PFM modes
- 300uA input quiescent PFM mode current
- Less than 5uA shutdown current

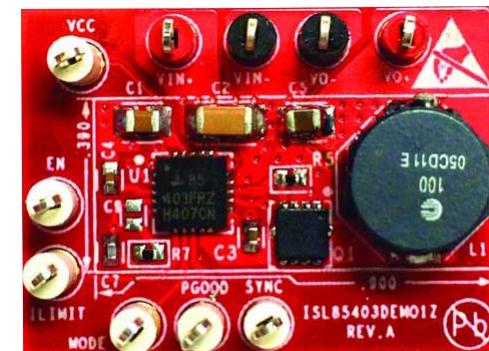
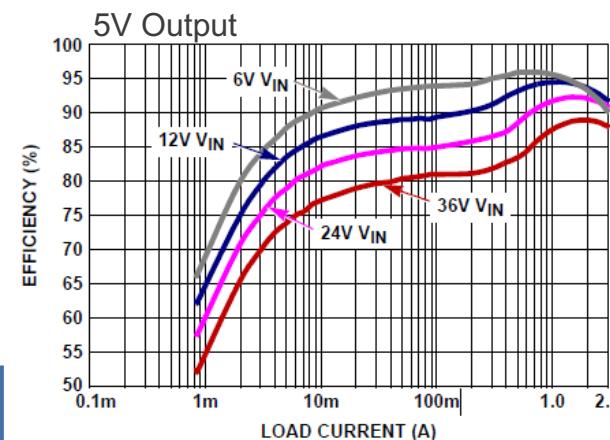
High Performance

- 200KHz to 2.2MHz frequency range
- +/- 1% voltage regulation accuracy

Part #	V _{IN} Range(V)	Temp.(°C)	Package
ISL85403FRZ-T	3 to 40	-40 to 125	20 Ld 4x4 QFN



Typical Application Circuit



ISL85403EVAL1Z Evaluation Board

ISL88011/2/3/4/5 – 5 Lead Voltage Supervisor

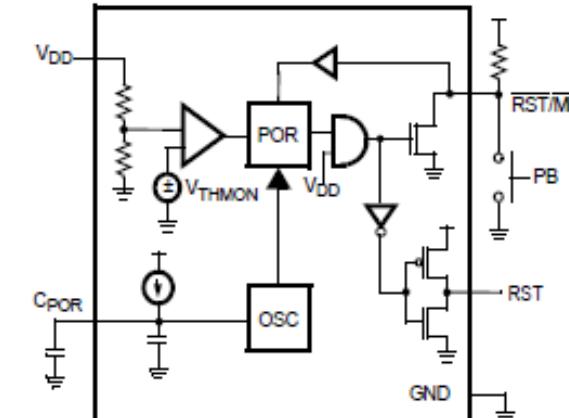
Adjustable Power-On Reset, Dual Voltage Monitoring or Watchdog Timer Capability

Supervisory Family

- Family products for every supervisory need
- Fixed or adjustable voltage options
- Adjustable POR timeout delay options
- Manual reset input on all devices
- Watchdog timer with 1.6s normal and 51s start-up timeout durations
- Manual reset input

Low Power and high performance

- Ultra low 5.5 μ A supply current
- Accurate $\pm 1.5\%$ voltage threshold



ISL88011

FUNCTION	ISL88011	ISL88012	ISL88013	ISL88014	ISL88015
Active-Low Reset (RST)	x	x	x	x	x
Active-High Reset (RST)	x	x	x		
Watchdog Timer (WDI)			x		x
Dual Voltage Supervision		x			
Adjustable POR Timeout (CPOR)	x			x	
Manual Reset Input (MR)	x	x	x	x	x
Fixed Trip Point Voltage	x	x	x		
Adjustable Trip Point Voltage		x		x	x

ISL9113 – Low Voltage 1.3A Boost Converter

Low Input Voltage Low Quiescent Current Synchronous Boost Converter

High Efficiency

- Up to 95% peak efficiency
- 20 μ A quiescent current with less than 1 μ A shutdown current

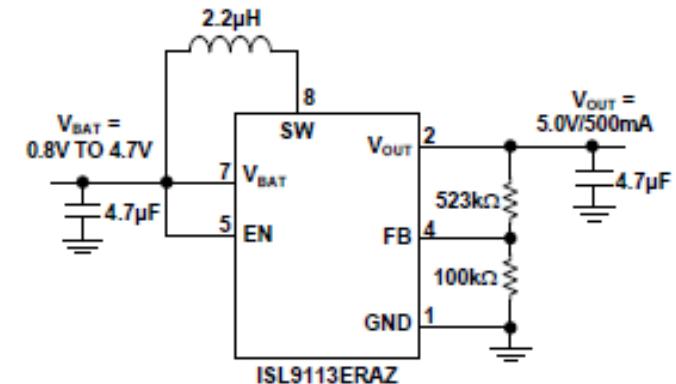
Compact for Space-Limited Applications

- 8 Ld 2mmx2mm DFN
- 1.8MHz switching frequency, allowing for the use of small inductors
- High-side PMOS eliminates the need for an external boot capacitor

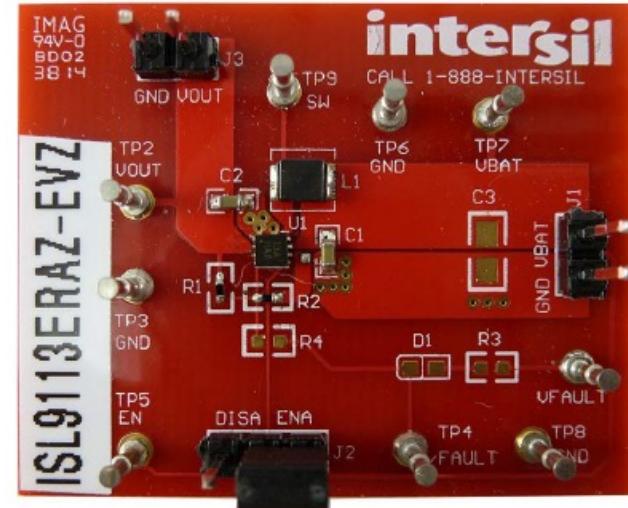
Excellent Safety

- Overcurrent and short circuit protection
- Over-temperature/thermal protection
- V_{IN} undervoltage Lockout and V_{OUT} overvoltage protection
- Output disconnected during shutdown

Part #	Vout (V)	V_{IN} Range(V)	Temp.(°C)	Package
ISL9113ERAZ-T	Adjustable	0.8 to 4.7	-20 to 85	8 pin 2x2 DFN
ISL9113ER7Z-T	5	0.8 to 4.7	-20 to 85	8 pin 2x2 DFN
ISL9113EIAZ-T	Adjustable	0.8 to 4.7	-20 to 85	6 Bump WLCSP
ISL9113EI9Z-T	5.1	0.8 to 4.7	-20 to 85	6 Bump WLCSP



Typical Application Circuit



ISL9113ERAZ Evaluation Board

ISL80031 – 3A Synchronous Buck Converter

Low Quiescent Current High Efficiency with 2x2 DFN Package

High Efficiency

- Up to 95% peak efficiency
- 35 μ A quiescent current

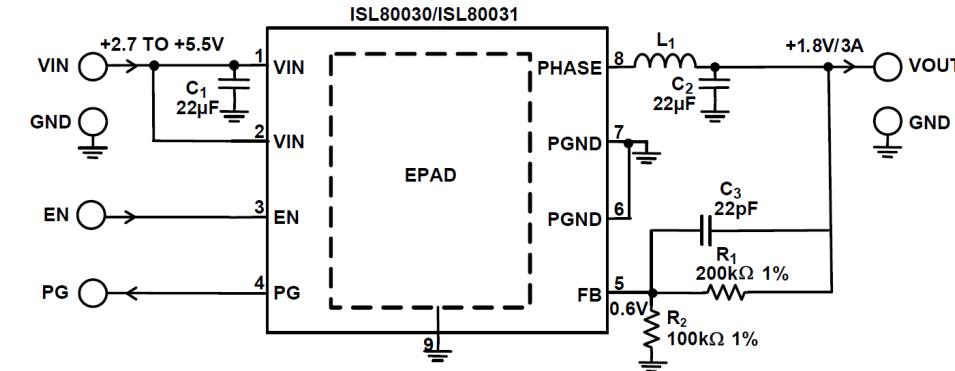
Compact Footprint for Space-Limited Applications

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

Excellent Safety

- Overcurrent and short circuit protection
- Over-temperature/thermal protection
- V_{IN} undervoltage Lockout and V_{OUT} overvoltage protection
- Negative current protection

Part #	Iout (MAX)(A)	V_{IN} Range(V)	f _{sw} (MHZ)	Temp.(°C)	Package
ISL80031FRZ-T	3	2.7 to 5.5	1	-40 to 125	8 pin 2x2 DFN
ISL80031AFRZ-T	3	2.7 to 5.5	2	-40 to 125	8 pin 2x2 DFN



Typical Application Circuit



ISL80031DEMO1Z Evaluation Board

ISL6294 – High Voltage Charger

28V Input, CC/CV Charger for Li-Ion Batteries

Complete Charger for Single Cell Li-Ion/Polymer Batteries

- Integrated pass element and current sensor
- CC/CV charge profile
- Trickle charge for discharged batteries

Programmable Settings via Resistors

- Adjustable charge current (100mA to 900mA)
- Adjustable end of charge current

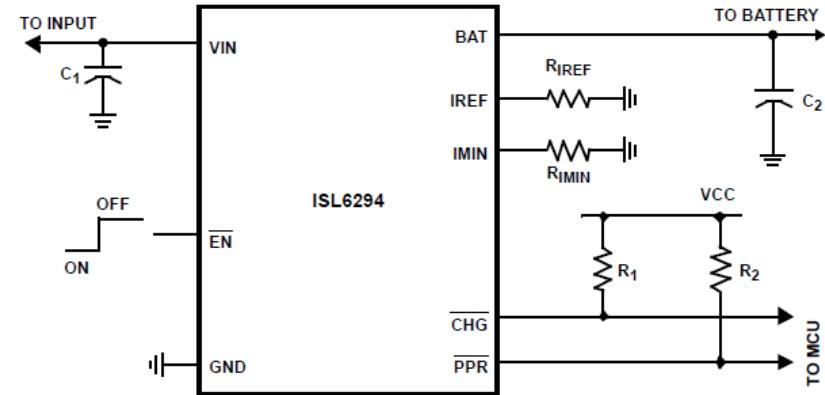
Indicators for Simple Connection to MCUs

- Power Presence (PPR) and Charge (CHG) indicators

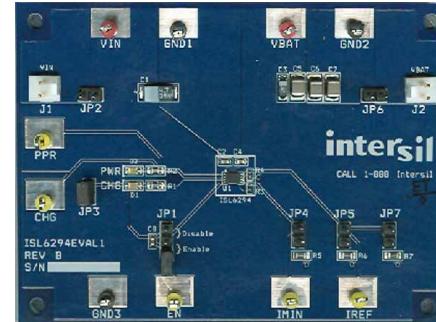
Input Supply

- Nominal operation of 4.5V to 6.5V
- Maximum of 28V input voltage
- Input over-voltage protection of 6.8V

Part #	Charge Current	Temp (°C)	Package
ISL6294IRZ-T	100 to 900 mA	-40/+85	8L 2x3 DFN
ISL6924IBZ-T	100 to 600 mA	-40/+85	8L SOIC



Typical Operating Circuits



ISL6924EVAL1Z Evaluation Board

Renesas.com