

CN267

Power Solution for Smart Power Meter with 4G Module

August 2020

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■ Overview

A super capacitor, also known as an electrical double layer capacitor (EDLC), has features such as short charging time, high power density, long lifecycles, good temperature performance, and environmental protection. EDLCs can be used to replace traditional batteries (with defects such as electrolyte leakage) as a backup power supply. The EDLC's power can be used for data backup, wireless communication, etc., when the power is turned off for a few minutes.

Renesas' smart power meter solution is integrated with 4G communication and the EDLC to achieve a smart control and always-on system. The ISL85403 buck-boost regulator achieves self-cycling EDLC backup and could discharge the EDLC voltage as low as 0.1V (theoretically). This greatly improves the EDLC's efficiency and reduces the system cost. Additionally, the RL78/L13 microcontroller (MCU) is ideal for measurement devices and power meters with ultra-low power and a built-in segment LCD driver.

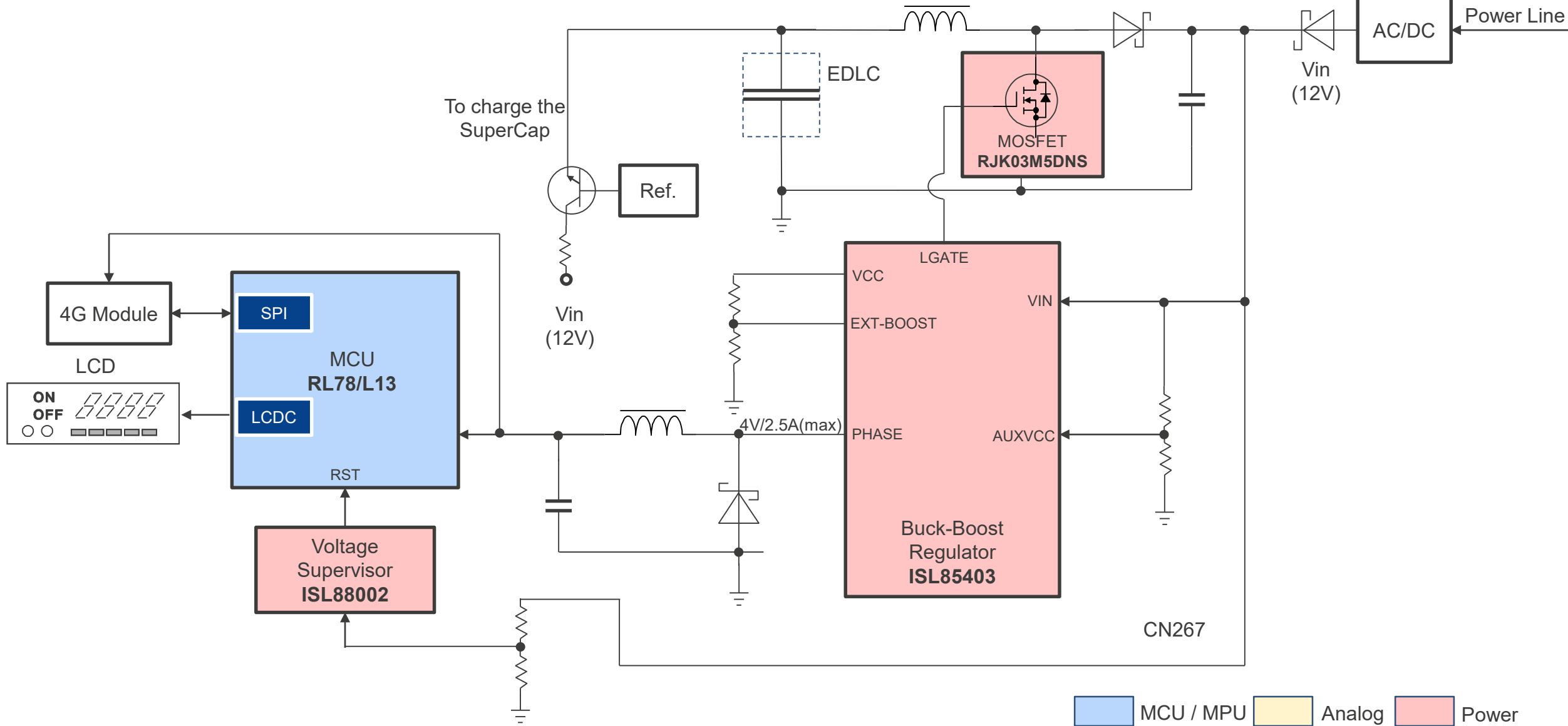
■ System Benefits

- The ISL85403 buck-boost regulator can fully utilize the power of super capacitors (can be as low as 0.3V)
- Low-cost 16-bit RL78/L13 MCU with ultra-low power and a segment LCD driver
- The best solution for battery- and EDLC-based always-on systems

CN267



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MCU / MPU Analog Power

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Device Category	P/N	Key Features
MCU	RL78/L13	-Low power consumption, standard LCD microcontrollers suitable for LCD display of home appliances or measurement devices -64/80 Pin, 16-128K ROM, 1-8K RAM -Built-in LCD driver, up to 376 segments
Power	ISL85403	-High efficiency Boost-buck converter, to support fully super cap charger and discharge -Wide input voltage range 3V to 40V -Support discharge supercap voltage to lower than 0.2V
	RJK03M5DNS	Nch single power MOSFET 30V 25A 6.3mohm HWSON-8 (3.3x3.3mm)
	ISL88002	Ultra low power 3 Ld voltage supervisors

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RL78/L13 – 16-Bit Standard LCD MCU

Suitable for Home Appliances and Measurement Devices

Built-in Segment LCD Driver and Other Peripheral Functions

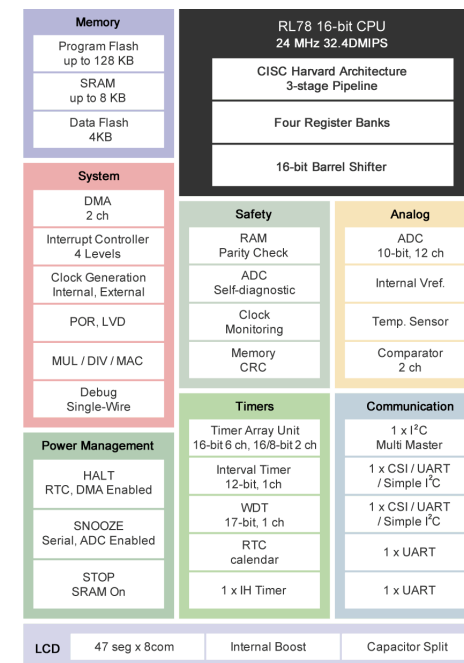
- 64/80 Pin, 16-128K ROM, 1-8K RAM
- Built-in LCD driver, up to 376 segments
- On-chip OCO/SPI/I2C/UART/TAU/KB20/12-bit interval timer/RTC2/10-bit ADC

Ultra-Low Power

- VDD = single power supply voltage of 1.6 to 5.5 V which can operate a 1.8 V device at a low voltage
- External resistance division: 1.61 μ A , internal voltage boost: 1.42 μ A, and capacitive split: 0.77 μ A
- HALT, STOP, SNOOZE, 3 kind of mode to save power

Safety Function

- RAM parity error detection, invalid memory access detection
- Frequency detection, A/D converter testing, CRC operations
- RAM/SFR guarding



RL78/L13 Block Diagram

Part #	Flash ROM	RAM	LCD Controller Segment Signal	Package
R5F10WLxxFA/FB	16-128 KB	1 ~ 8 KB	36(32)	64-LQFP(12 x 12mm 0.65 mm pitch) 64-LQFP(10 x 10mm 0.5 mm pitch)
R5F10WMxxFA/FB	16-128 KB	1 ~ 8 KB	51(47)	80-LQFP(14 x 14mm 0.65 mm pitch) 80-LQFP(12 x 12mm 0.5 mm pitch)



Renesas Starter Kit for RL78/L13



RL78/L13 EVB



ISL85403 – 2.5A Regulator with Integrated High Side FET

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

Wide Working Range

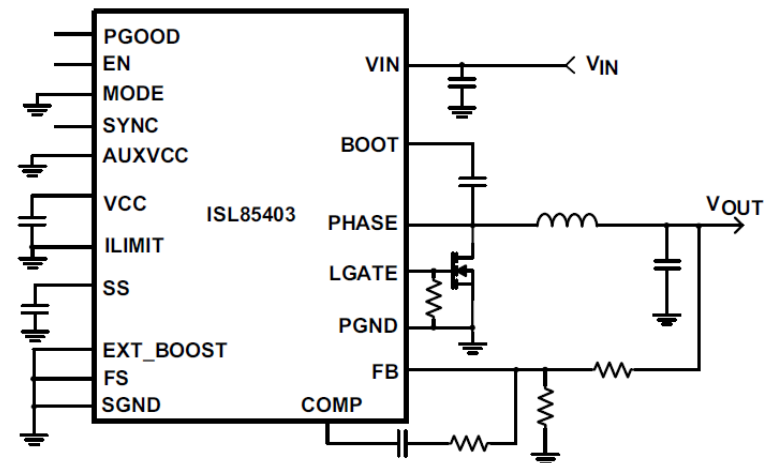
- Power input voltage range from 3V to 40V
- Support both step down (buck) or boost+buck outputs
- Up to 2.5A load over full temperature range

High Efficiency

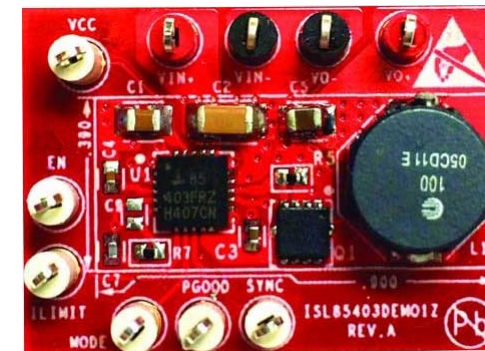
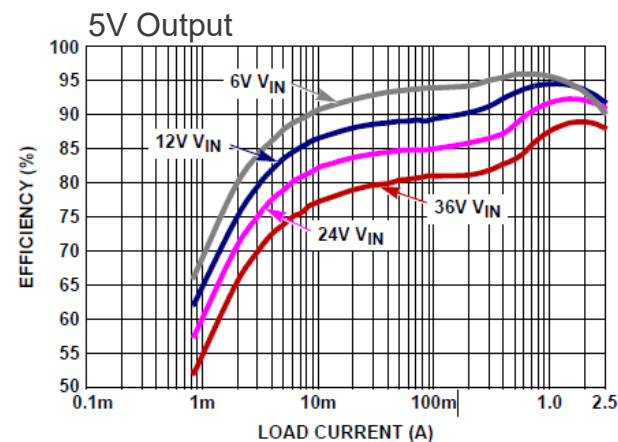
- Optional external low side FET for higher efficiency
- Selectable PWM / PFM modes
- 300uA input quiescent PFM mode current
- Less than 5uA shutdown current

High Performance

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



Typical Application Circuit



ISL85403EVAL1Z Evaluation Board

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



RJK03M5DNS – Nch Single Power MOSFET 30V 25A

Support for High-Efficiency Drive and Low Heat Design

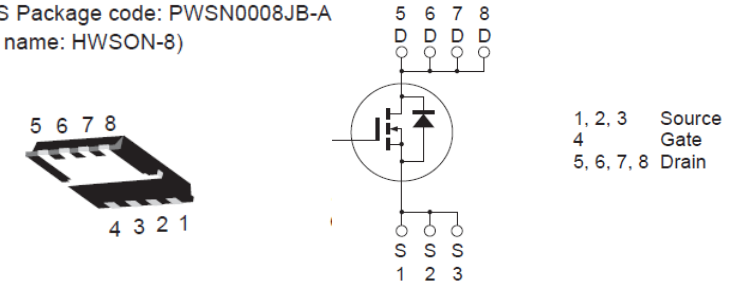
High Performance

- Low on-state resistance:
 $R_{DS(on)} = 5.2 \text{ m}\Omega$ typ. (at $V_{GS} = 10 \text{ V}$)
 $R_{DS(on)} = 6.4 \text{ m}\Omega$ typ. (at $V_{GS} = 4.5 \text{ V}$)
- Low drive current
- High speed switching
 Turn-on delay time $t_{d(on)}$ 3.7ns(Typ)
 Rise time t_r 3.0ns(Typ)
 Turn-off delay time $t_{d(off)}$ 21.7ns(Typ)
 Fall time t_f 7.0ns(Typ)
- Capable of 4.5V gate driver

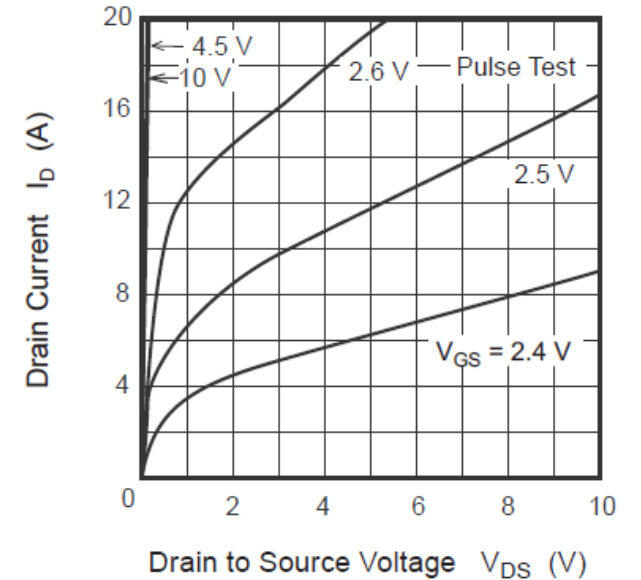
Best Fit for Applications

- MOSFETs suitable for switching (motor drive, etc.) and load switch applications
- Low on-resistance, high-speed switching, and high-robustness

RENESAS Package code: PWSN0008JB-A
 (Package name: HWSON-8)



Pin Arrangement and Package



Typical Output Characteristics

Part #	Drain to Source Voltage(V)	Gate to Source Voltage(V)	Drain Current(A)	Package
RJK03M5DNS-00#J5	30	20	25	HWSON-8



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

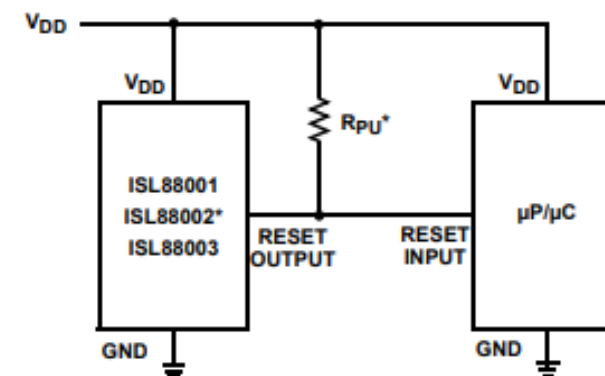
- Trip points are available for standard power supplies from 1.8V to 5.0V
- 190ms Power-On Reset Timeout
- Reset Signal Valid Down to VDD = 1V

Simple Board Design

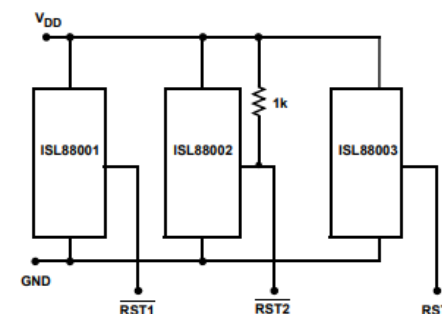
- No external components necessary

Part #	Nominal V _{THVDD} (V)	RESET	Temp.	Package
ISL88001IH46Z-T	4.62	Push-Pull RST	-40/+85	3Ld SOT-23
ISL88001IH44Z-T	4.38	Push-Pull RST	-40/+85	3Ld SOT-23
ISL88001IE46Z-T	4.62	Push-Pull RST	-40/+85	3Ld SC70
ISL88001IE31Z-T	3.07	Push-Pull RST	-40/+85	3Ld SC70
ISL88002IE46Z-T	4.62	Open Drain RST	-40/+85	3Ld SC70
ISL88002IE26Z-T	2.63	Open Drain RST	-40/+85	3Ld SC70

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



Typical Operating Circuits
(*necessary for ISL88002)



ISL88001/2/3EVAL1Z Evaluation Board

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