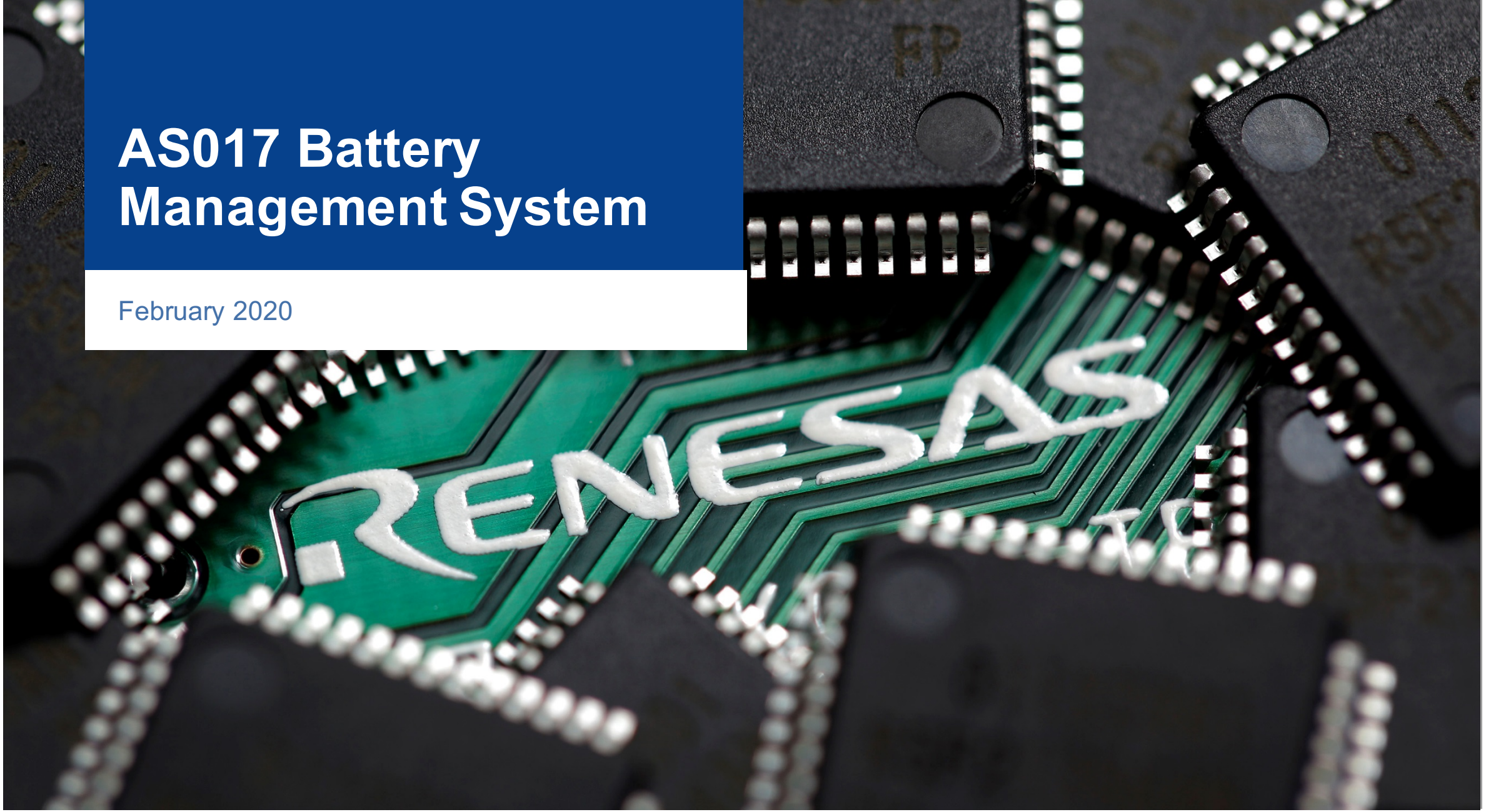
AS017 Battery Management System

February 2020



BIG IDEAS FOR EVERY SPACE RENESAS

Battery Management System

Overview

A battery management system (BMS) can be comprised of many functional blocks, including cutoff FETs, a fuel gauge monitor, cell voltage monitor, cell voltage balance, real-time clock (RTC), temperature monitors, and a state machine. There are also many types of battery management ICs available. The grouping of the functional blocks varies widely – from a simple analog front-end that offers balancing and monitoring, and requires a microcontroller (MCU), to a standalone, highly integrated solution that runs autonomously.

This reference design utilizes an ISL94212 Li-ion battery manager IC, which supervises up to 12 series of connected cells. The device provides accurate monitoring and three cell balancing modes – manual balancing mode, timed balancing and auto balance mode with extensive system diagnostics functions. The BMS IC communicates to a host MCU via an SPI interface and to other BMS IC devices using a robust, proprietary, two-wire daisy chain system.

System Benefits

- Highly integrated MCU
- Supports both standalone and daisy-chained configurations
- GUI provided export option for generation of detailed register and/or SPI communications log files

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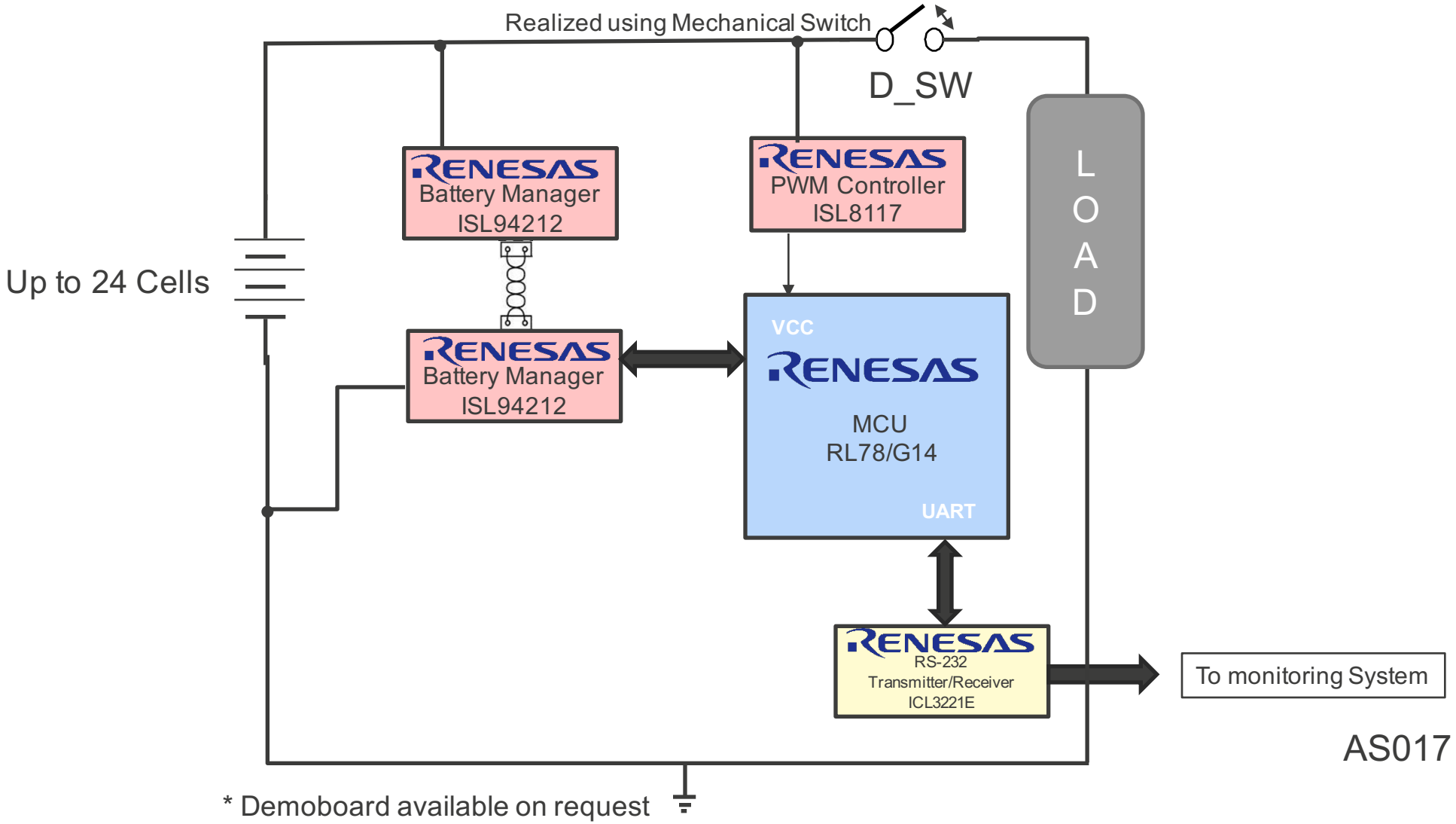
Battery Management System



Battery Management System

Device Category	P/N	Key Features
MCU	RL78/G14 R5F104LGGFP	RL78/G14 MCU True Low Power Platform (as low as 66 µA/MHz, and 0.60 µA for RTC + LVD), 1.6 V to 5.5 V operation, 16 to 512 Kbyte Flash, 44 DMIPS at 32 MHz, for general purpose applications
POWER	ISL94212	The ISL94212 Li-ion battery manager IC supervises up to 12 series connected cells. The part provides accurate monitoring, cell balancing and extensive system diagnostics functions.
	ISL8117	The ISL8117 is a synchronous buck controller used to generate POL voltage rails and bias voltage rails for a wide variety of applications in industrial and general purpose segments. Its wide input (4.5V to 60V) and output voltage ranges (0.6V to 54V) make it suitable for telecommunication and after-market automotive applications.
ANALOG	ICL3221E	The ISL3221E is 3.0V to 5.5V powered RS-232 transmitters/receivers that meet EIA/TIA-232 and V.28/V.24 specifications, even at VCC = 3.0V. Additionally, they provide ±15kV ESD protection (IEC61000-4-2 Air Gap and Human Body Model) on transmitter outputs and receiver inputs (RS-232 pins).

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RL78/G14 – Advanced Functions MCU

Suitable for motor control as well as industrial and metering applications

Added instruction functions to CPU core

- Added multiply, divide, and multiply-accumulate instructions that enable high-speed operation by direct execution without needing to utilize library functions
- High calculation performance: 51.2 DMIPS (32 MHz)

High performance peripheral functions

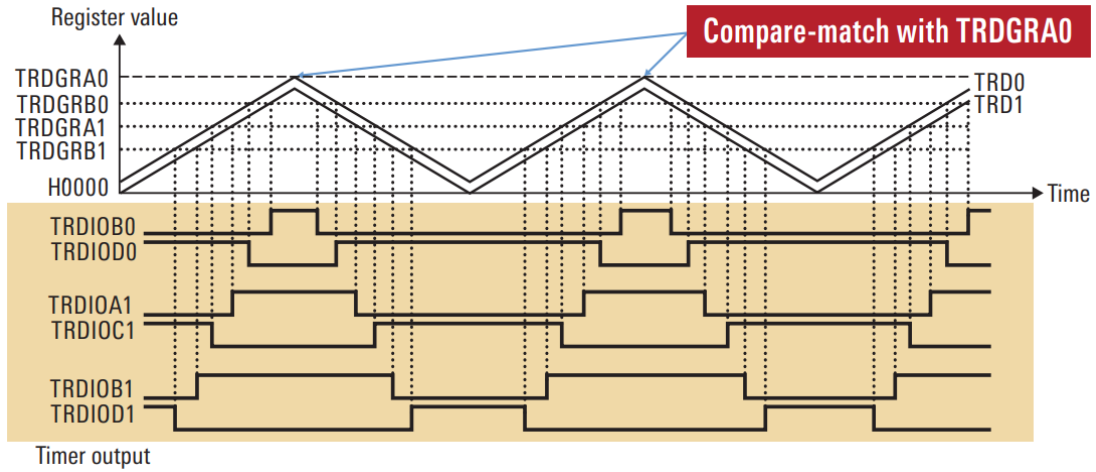
- Timer RD (Complementary PWM Mode for brushless DC motor control), Timer RG (Phase Count Mode), Timer RJ (asynchronous timer)
- Data Transfer Controller (DTC); Event Link Controller (ELC)
- Comparator, 8bit Digital Analog Converter

Easy to Develop and Use

- Scalable lineup packages, pin-counts and Flash ROM, RAM
- Released Starter Kit and Motor Solution Evaluation Kit

Part #	Flash ROM	RAM	Package(mm)
R5F104A	16 ~ 128 KB	2.5 ~ 16 KB	30-LSSOP(7.62)
R5F104B			32-HWQFN(5 × 5), 32-LQFP(7 × 7)
R5F104C			36-WFLGA(4 × 4)
R5F104E	16 ~ 192 KB	2.5 ~ 20 KB	40-HWGFN(6 × 6)
R5F104F	16 ~ 256 KB	2.5 ~ 24 KB	44-LQFP(10 × 10)
R5F104G	16 ~ 512 KB	2.5 ~ 48 KB	48-LFQFP(7 × 7), 48-HWQFN(7 × 7)
R5F104J	32 ~ 256 KB	4 ~ 24 KB	52-LQFP(10 × 10)
R5F104L	32 ~ 512 KB	4 ~ 48 KB	64-LFQFP(10 × 10), 64-LQFP(12 × 12), 64-LQFP(14 × 14)*, 64-WFLGA(5 × 5)
R5F104M	96 ~ 512 KB	12 ~ 48 KB	80-LFQFP(12 × 12), 80-LQFP(14 × 14)
R5F104P			100-LFQFP(14× 14), 100-LQFP(14 ×20)

*This product do not exist 384KB/512KB.



Complementary PWM mode operation example

Renesas Starter Kit for RL78/G14

RL78 Family Motor Solution Evaluation Kit

24V Motor Control Evaluation System for RX23T

RL78/G14 CPU Card for Motor Control

ISL94212 – Multi-Cell Li-Ion Battery Manager

Complete Charger for Li-Ion CoO2, Li-ion Mn2O4, and Li-ion FePO4 batteries

Single IC Solution for Charging

- Supervises up to 12 series connected cells
- Cell voltage measurement accuracy ±10mV

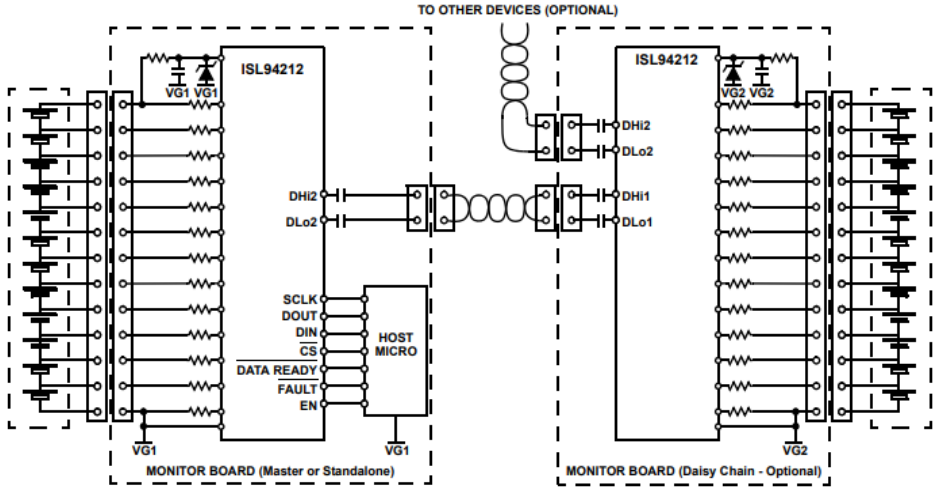
Charging Features

- Cell voltage scan rate of 19.5µs per cell (234µs to scan 12 cells)
- 14-bit pack voltage and temperature measurements
- Pack voltage measurement accuracy ±180mV

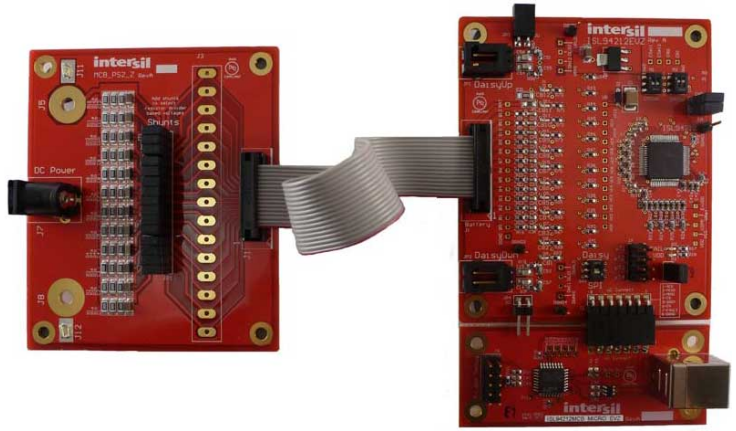
Protection Features

- Internal temperature monitoring, up to four external temperature inputs
- Integrated system diagnostics for all key internal functions
- Integrated watchdog shuts down device if communication is lost

Part #	V_{BAT}	Temp	Package
ISL94212INZ	5.1	Yes	64Ld 10x10 TQFP
ISL94212INZ-T	5.1	Yes	64Ld 10x10 TQFP



Typical Application Circuit



ISL94212EVKIT1Z Evaluation Board

ISL8117 – Synchronous Step-Down DC/DC Controller

60V Synchronous Step-Down PWM DC/DC Controller with Wide Vin & Vout Range

Easy to Use

- Low pin count, fewer external components, and default internal values makes the ISL8117 an ideal solution for quick-to-market power supply designs.

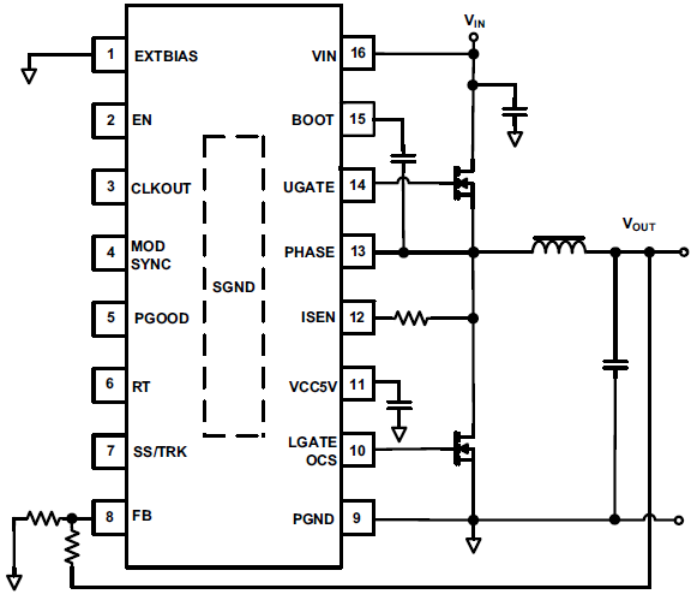
Wide Working Range

- Wide input voltage range: 4.5V to 60V
- Wide output voltage range: 0.6V to 54V

System Safe Design

- Programmable soft-start
- Supports pre-biased output at startup
- Adaptive shoot-through protection prevents MOSFET damage
- Complete protection: Overcurrent, overvoltage, over-temperature, undervoltage

Part #	#of output	Vin Range (V)	Iout (max)(A)	Vout Range (V)	Package
ISL8117FRZ	1	4.5-60	30	0.6-54	16Ld 4x4 DFN
ISL8117FVEZ	1	4.5-60	30	0.6-54	16Ld HTSSOP



Typical Operation Circuits

ISL80019xEVAL1Z Evaluation Board

ICL3221 – Low Power RS-232 Transmitter/Receiver

1µA Supply-Current, +3V to +5.5V, 250kbp

Communication Speed

- 250kbps data rate min.

Key Features

- Wide power supply range: single +3V to +5.5V
- Low supply current in power down state: 1uA
- ESD protection for RS-232 I/O pins to ±15kV (IEC61000)
- On-chip voltage converters require only four external 0.1µF capacitors

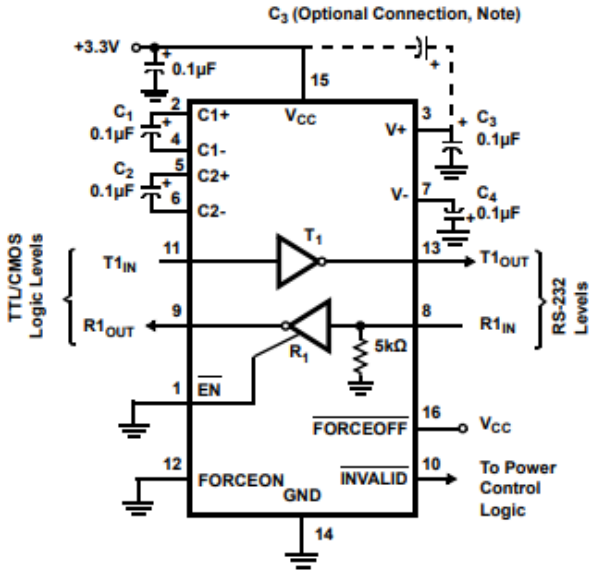
Good Connectivity

- RS-232 compatible with VCC = 2.7V

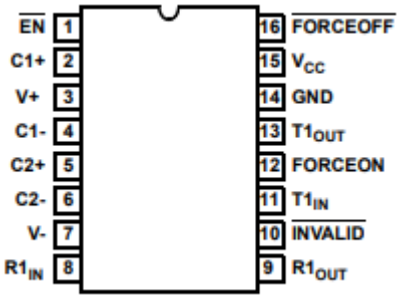
Industry Standard

- Meets EIA/TIA-232 and V.28/V.24 specifications at 3V

Part #	Temp. Rang	MOQ	Package
ICL3221CAZ	0 to +70	3080	16 Ld 5x4.4mm SSOP
ICL3221CAZ-T	0 to +70	2000 (T&R)	16 Ld 5x4.4mm SSOP
ICL3221IAZ	-40 to +85	3080	16 Ld 5x4.4mm SSOP
ICL3221IAZ-T	-40 to +85	2000 (T&R)	16 Ld 5x4.4mm SSOP



Typical Operating Circuits



Pin out

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