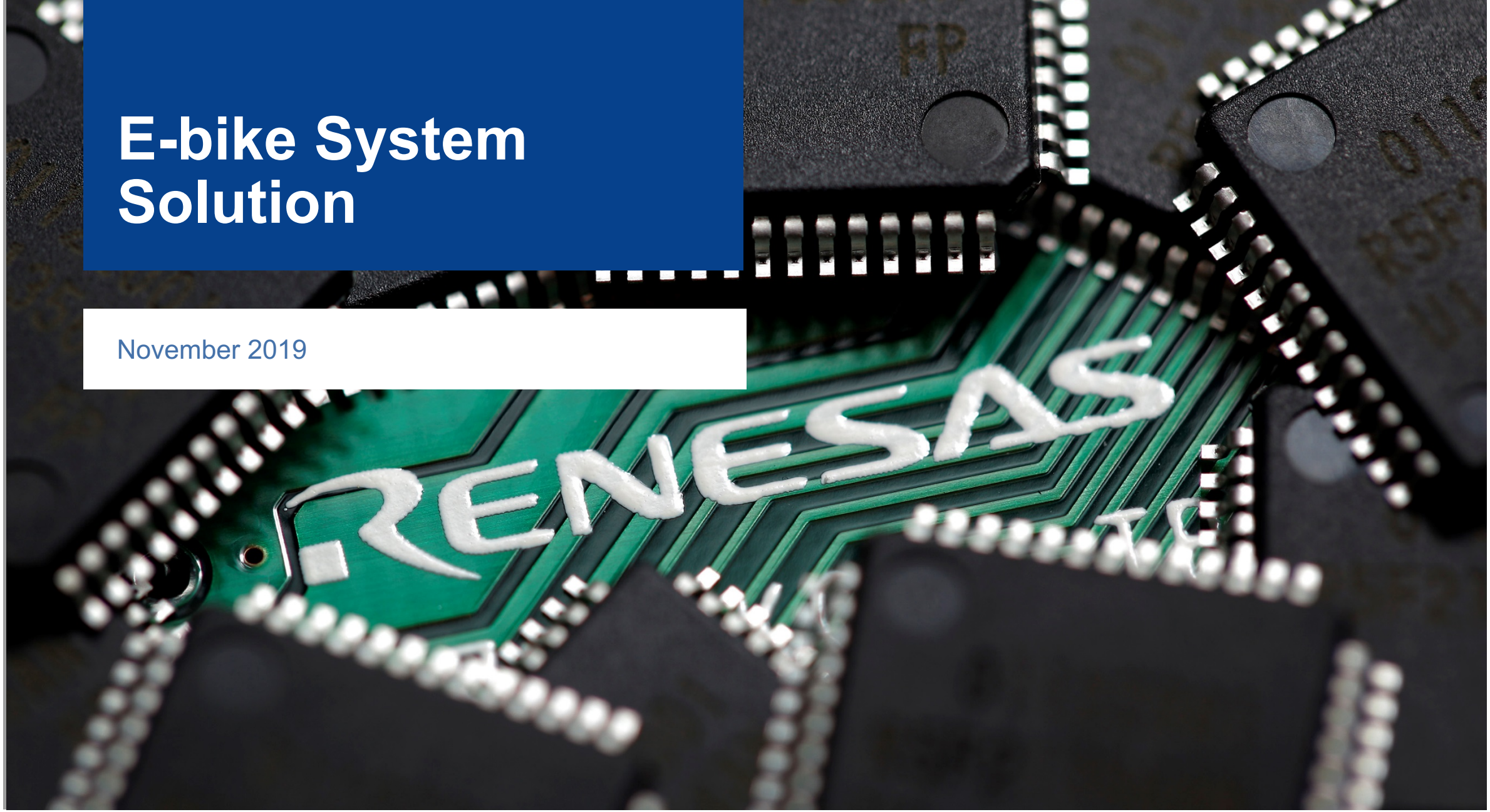
E-bike System Solution

November 2019



E-bike System Solution

Overview

On any street in China, it is common to see electronic bikes (e-bikes) being used as a mode of transportation. Over the past 10 years, manufacturers have steadily produced more than 20 million e-bikes per year. Because of the high demand, there is a need for complete solutions with high reliability and innovative features, such as new battery management solutions for features like control or electronic locks.

This design uses a combination of an advanced MCU, power and BMS devices to provide a complete solution for any kind of e-bike.

System Benefits

- Mature solution support with motor control algorithm, supports both square and sinewave drivers
- High accuracy battery charge monitor that improves distance

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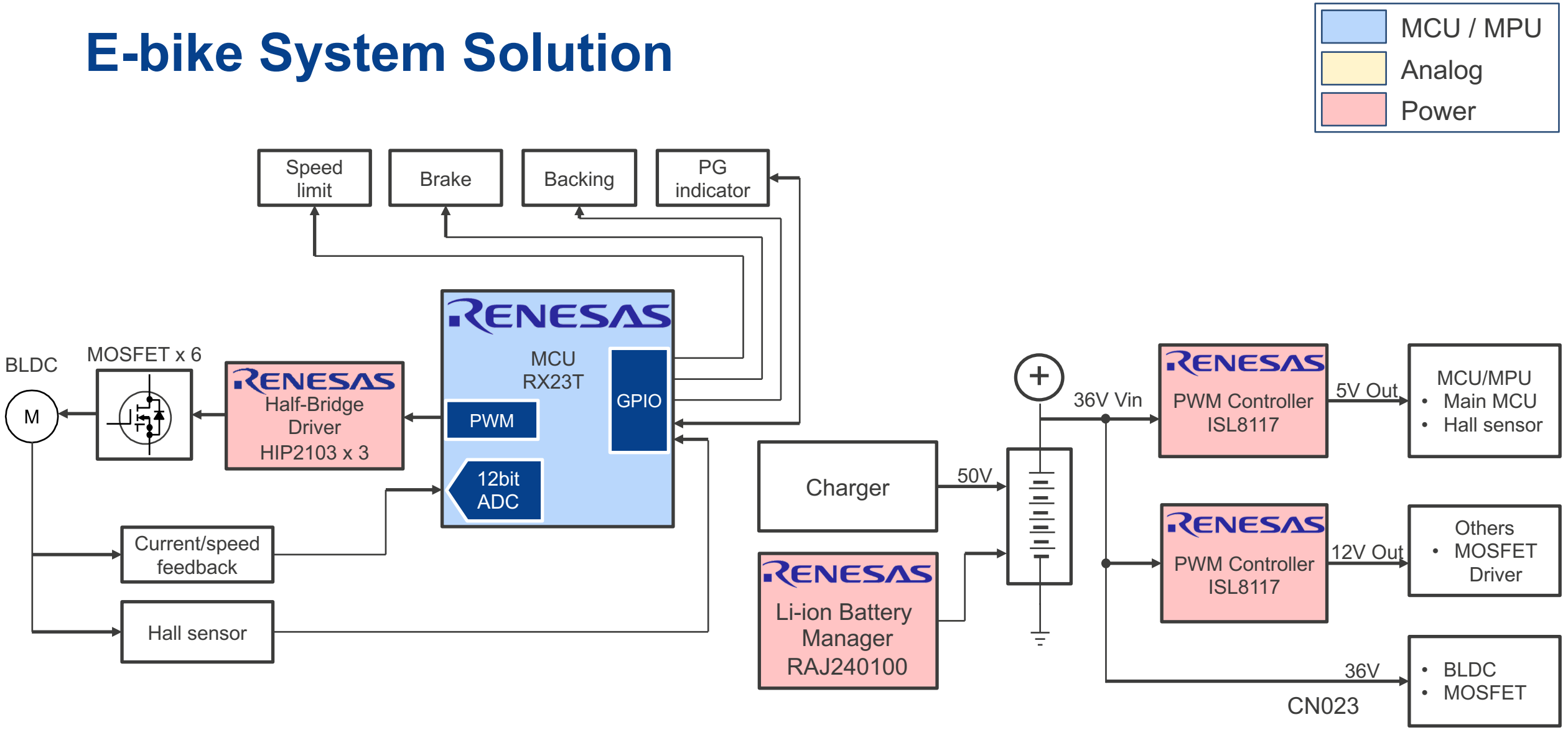
E-bike System Solution



E-bike System Solution

Device Category	P/N	Key Features
MCU	RX23T	-32-bit MCU with 40MHz op frequency -On-chip FTU simplifies the calculation of motor control algorithm
Power	RAJ240100	-Built-in self-diagnostic functions for microcontroller and analog front-end (AFE) -Low power mode for safe storage -Monitors up to 10 cells voltage and temperature
	ISL8117	-Wide input voltage range: 3V to 60V -Wide output voltage range: 0.6V to 54V -Adjustable switching frequency 300kHz to 2MHz
	HIP2103	-Half bridge drivers designed for applications using DC motors, three-phase brushless DC motor -Integrated a 12V linear regulator and a 3.3V linear regulator -60V maximum bootstrap supply voltage

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RX23T – 32-bit FPU MCU for Controlling a Single Inverter

40 MHz RX v2 Core with FPU, 5V Power Supply and Highly Accurate 12-Bit ADC

High Performance and Low Power Design

- Max. operating frequency: 40MHz
- Enhanced DSP: 32-bit multiply-accumulate and 16-bit multiply-subtract instructions
- Built-in FPU: 32-bit single-precision floating point(compliant to IEEE754)
- Divider, fast interrupt, CISC Harvard architecture with 5-stage pipeline
- Variable-length instructions, ultra-compact code
- 3 low power consumption modes, software standby mode(with RAM retention) < 0.45 µA

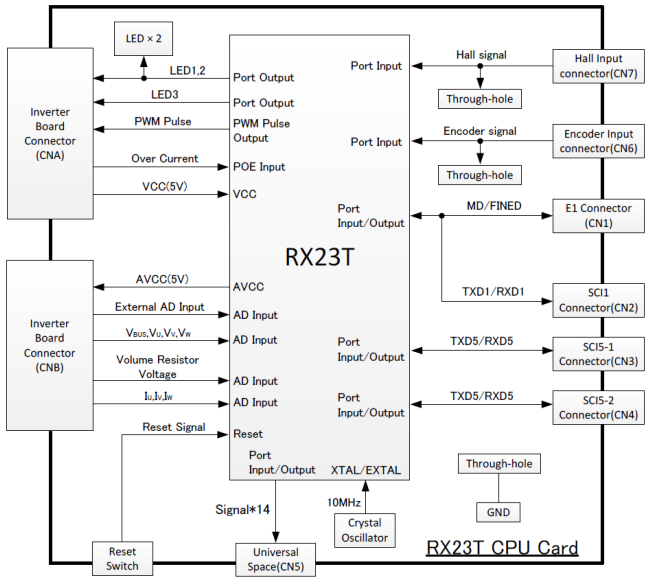
Suitable for Inverter Control

- Enhanced DSP and FPU modules
- 40MHz PWM (three-phase complementary output x 2ch)

Rich Peripheral Functions

- Up to 4 communications channels
- Up to 12 extended-function timers
- 12-bit ADC: 10ch
- Useful functions for IEC60730 compliance

Part #	ROM (Kbytes)	RAM (Kbytes)	Temp.(°C)	Package
R5F523T5ADFM	128	12	-40 to 85	LFQFP64/0.50
R5F523T3ADFD	64	12	-40 to 85	LQFP52/0.65
R5F523T5AGFM	128	12	-40 to 105	LFQFP64/0.50
R5F523T3AGFL	64	12	-40 to 105	LFQFP48/0.50



System Block

Evaluation Kits

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FGIC/ RAJ240xxx – One-chip Solution for BMS

Single Chip Build in MCU+AFE

Reduce total cost

- One chip solution minimize PCB size and cost
- One chip reduced production cost

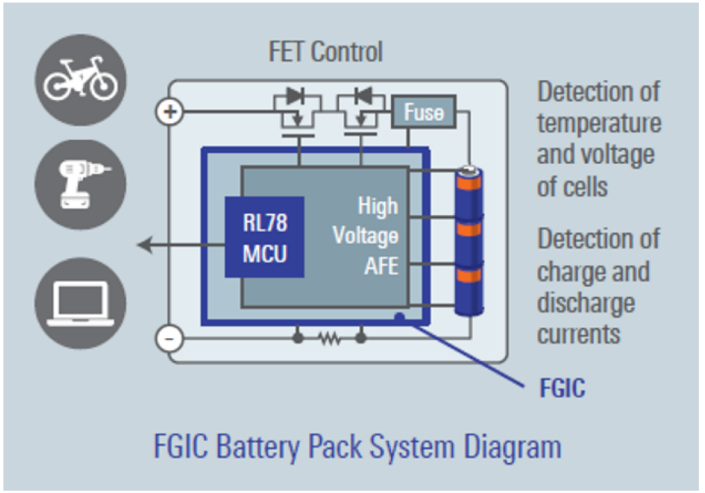
High Accuracy on battery monitor

- High-precision delta-sigma A/D converter for U/I detecting, no need external ADC
- A dedicate circuit simultaneous measurement of battery voltage and current

Wide application coverage

- High side Nch MOSFET drive circuit embedded with 100mA output
- 1-10 cells charging support
- 4-50V voltage range
- Typical applications: E-bike / Notebook BAT charging / Power tools and Drone

Part #	Cells	Voltage	ROM/RAM	PKG
RAJ240500	1-3	4-25V	128/5.5K	40-pin QFN
RAJ240080	2-5	4-28V	64/5.5K	48-pin LQFP
RAJ240100	3-10	4-50V	128/7K	64-pin LQFP



FGIC application block diagram

RAJ240xxx Evaluation Board

ISL8117 – Synchronous Step-Down PWM Controller

60V Synchronous Step-Down PWM 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 simple power supply designs.

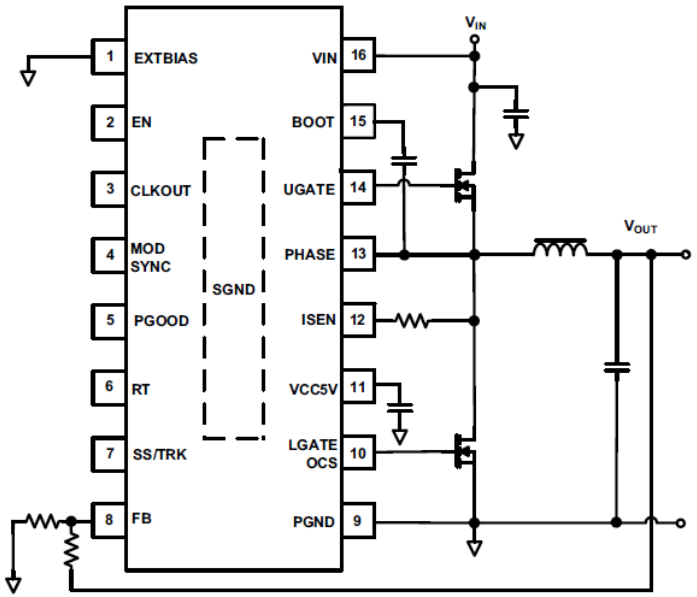
Wide Working Range

- 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 with SR soft-start
- Adaptive shoot-through protection
- Complete protection: Overcurrent, overvoltage, over-temperature, undervoltage

Part #	#of output	Vin Rang(V)	Iout (max)(A)	Vout Rang(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

HIP2103/4 – 60V, 1A/2A, Half-Bridge Driver

High Voltage Drivers for Industrial Motor Control

Optimized Half-Bridge Drivers

- Supports half bridge, full bridge configurations
- Enables DC and 3 phase BLDC motors

Independent High/Low Inputs

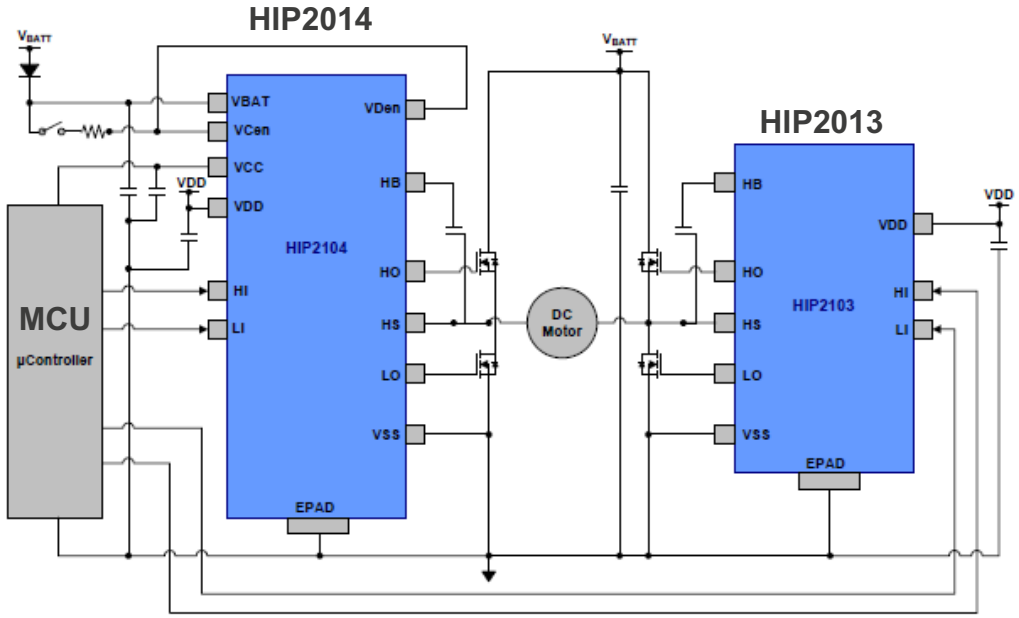
- Reduces connections to MCU and lowers cost
- Supports 3.3V and 5V signals

Sleep Mode

- Low quiescent current (5uA) with unique sleep mode
- Allows direct connection to battery without disconnect switch

Integrated LDO (HIP2104)

- Option with integrated 12V & 3.3V LDO (HIP2014)
- Provides bias to external MCU



Part #	UVLO	VCC Reg	VDD Reg	Package
HIP2103FRTAAZ-T	4.0V	N/A	N/A	8L 3x3 TDF
HIP2104FRTAAZ-T	4.0V	3.3V	12V	12L 4x4 DFN

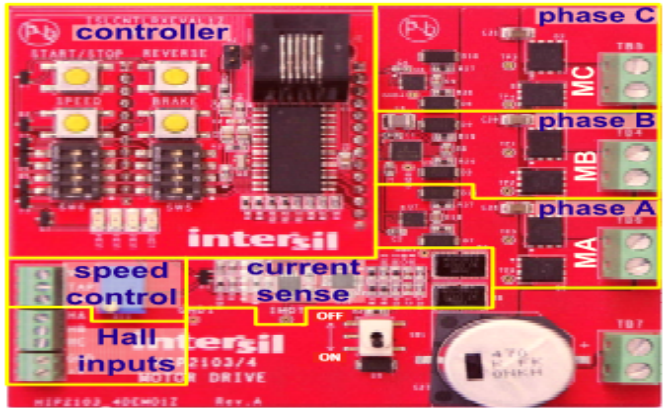


FIGURE 1. HIP2103-4DEMO1Z INPUTS AND OUTPUTS

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