EU017
Drug Delivery

EMEA System Solutions Team (SST)
Sept. 2019   1v0

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Drug Delivery

Overview

- For Healthcare Drug Delivery, like Infusion Pumps or Insulin Pumps, exact dosing is crucial.

- Thus, measurement of real drug delivery amount plus exact control of dosing motor is required.

- Motors are typically three phase BLDC type with a few Watts, e.g. using 12V.

- For flow sensing a factory calibrated sensor or custom sensors may be used.

- Bluetooth communication, to provide an up-to-date GUI via smartphone and additional interfaces, like Ethernet or a (medical grade) isolated USB may also be needed

- Some end products may also require uninterrupted power supply, e.g. using Li Ion cells.
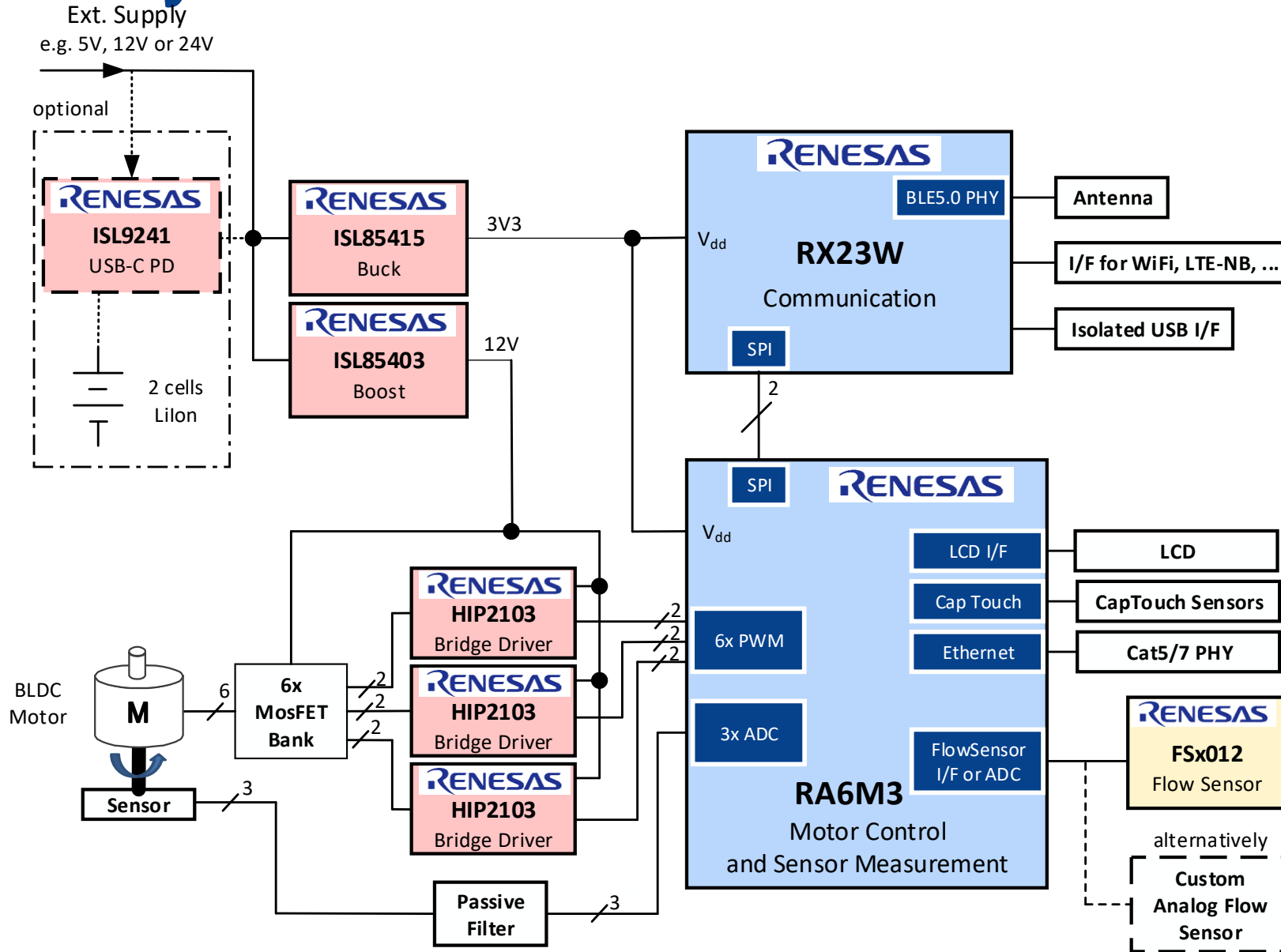
We propose a combination of two MCUs, latest RA6M3 for Motor Control and Sensor Measurement + RX23W for BLE 5 communication and appropriate analogue components, like DCDC buck / boost regulators, Li-Ion battery charger, MOSFET bridge driver and a factory calibrated flow sensor etc.

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System benefits

- Both pump types supported: Infusion Pump and Insulin Pump

- Motor Control for BLDC or PMSM with analog or hall sensors / encoder, optional gear (also with high gear ratio)

- Flow measurement: Integrated Renesas/IDT sensor or use MCU-integrated AFE for custom sensor setup

- Communication: Bluetooth® 5, WiFi, Ethernet (e.g. for Infusion Pump) and multiple serial interface for optional LTE-NB, isolated USB I/F...

- HMI: LCD (for infusion pump) and touch and/or gesture control, also for sterile environment

- Optional Battery management (e.g. 2x Li Ion cell for uninterrupted power supply)

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Ext. Supply
e.g. 5V, 12V or 24V

optional

RENESAS
ISL9241
USB-C PD

2 cells
LiIon

RENESAS
ISL85415
Buck

3V3

RENESAS
ISL85403
Boost

12V

RENESAS
RX23W
Communication

V_{dd}

BLE5.0 PHY → Antenna

I/F for WiFi, LTE-NB, ...

Isolated USB I/F

SPI

2

SPI

V_{dd}

RENESAS
RA6M3
Motor Control
and Sensor Measurement

LCD I/F → LCD

Cap Touch → CapTouch Sensors

Ethernet → Cat5/7 PHY

6x PWM

3x ADC

FlowSensor I/F or ADC

RENESAS
FSx012
Flow Sensor

alternatively

Custom
Analog Flow
Sensor

BLDC
Motor

M

Sensor

6

6x
MosFET
Bank

2

2

2

3

RENESAS
HIP2103
Bridge Driver

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HIP2103
Bridge Driver

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HIP2103
Bridge Driver

2
2
2

Passive
Filter

3

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Device Category	P/N	Key Features
MCU	RA6M3	120MHz ARM Cortex M4 integration with USB HS, Ethernet and TFT controller
	RX23W	32 Bit, BT5.0 MCU with enhanced security
Power	ISL9241	USB-C PD Li-Ion battery charger for 2-4 cells
	ISL85415	3-36V / 500mA output, Buck Regulator
	ISL85403	2.5A Regulator with Integrated High-side MOSFET for Synchronous Buck or Boost Buck Converter
Analog	HIP2103	60V, 1A/2A Peak, 1/2 Bridge Driver
	FSx012	Solid-State MEMS Flow Sensor Module for Liquids and Gases

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RA6M3
120MHz ARM Cortex® M4 integration with USB HS, Ethernet and TFT controller

120MHz Arm® Cortex®-M4F

- 1MB-2MB Flash + 640kB SRAM + 64kB Data Flash
- supported by an Flexible Software Package FSP
  - open and flexible ecosystem concept
  - using FreeRTOS as base
  - can be replaced and expanded by any other RTOS or middleware users require

Rich Interfaces

- TFT Controller w/ 2D Drawing Engine / Accelerator and JPEG decoder
- Capacitive Touch Sensing Unit
- Ethernet MAC Controller with DMA, IEEE 1588 PTP
- USB 2.0 High-Speed / Full-Speed, SDHI, Quad SPI, CAN 2.0, SCI (UART, Simple SPI, Simple I2C), SPI / I2C Multi-Master

Safety and Security features

Advanced analog features

Scalable from 100pin to 176pin packages

Part #	Package
RA6M3... (tbd)	See table →

FLASH / RAM	2MB / 640kB	RA6M3	RA6M3	RA6M3	RA6M3	RA6M3
	1MB / 640kB	RA6M3	RA6M3	RA6M3	RA6M3	RA6M3
Pin Count Package Size Pitch		100pin LQFP 14x14 0.5mm	144pin LQFP 20x20 0.5mm	145pin LGA 7x7 0.5mm	176pin LQFP 24x24 0.5mm	176pin BGA 13x13 0.8mm

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RX23W

Wireless communication MCU series within the RX Family

Bluetooth 5 + 54MHz / 32bit MCU with enhanced Security

- BT5.0 full function
  - including Long Range (125/250kbps), 1Mbps, 2Mbps, Advertize Extensions & Mesh support
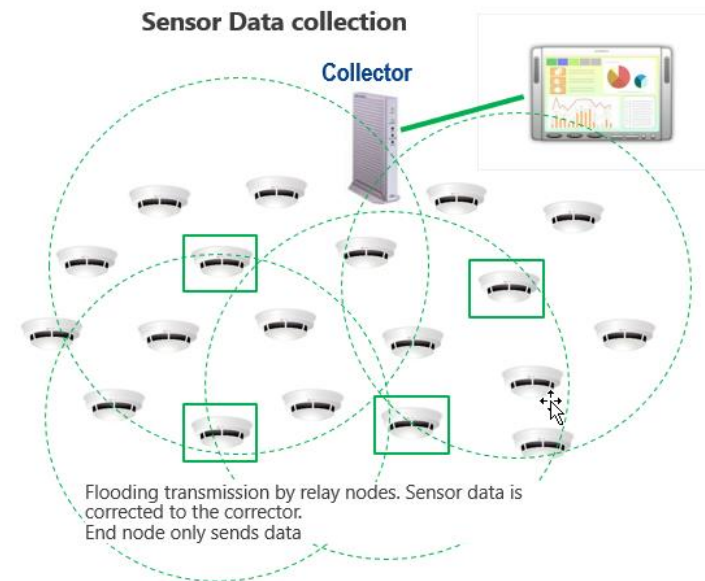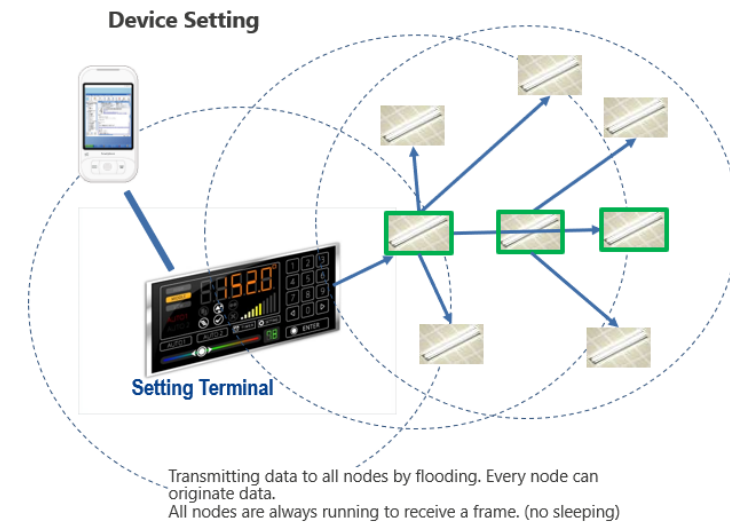 - 2x higher communication rate + 4x longer distance

Integrated security and encryption functions

- TSIP package
- Rich communication interface, like SD host interface, USB, CAN, Capacitive Touch I/F etc.
- Up to 512kB Flash and 64kB RAM, operating in broad voltage range 1.8-3.6 V

Excellent RF performance:

- RX Sensitivity: up to -105dBm @125kps
- TX power: up to +4dBm

Part #	Enhanced Security	Package
R5F523WxADNG	--	56pin QFN, 7 x 7 x 0.4mm
R5F523WxBDNG	TSIP	56pin QFN, 7 x 7 x 0.4mm
R5F523WxADBL	--	85pin BGA, 5.5 x 5.5 x 0.5mm
R5F523WxBDBL	TSIP	85pin BGA, 5.5 x 5.5 x 0.5mm

Device Setting

Setting Terminal

Transmitting data to all nodes by flooding. Every node can originate data.
All nodes are always running to receive a frame. (no sleeping)

Sensor Data collection

Collector

Flooding transmission by relay nodes. Sensor data is corrected to the corrector.
End node only sends data

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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
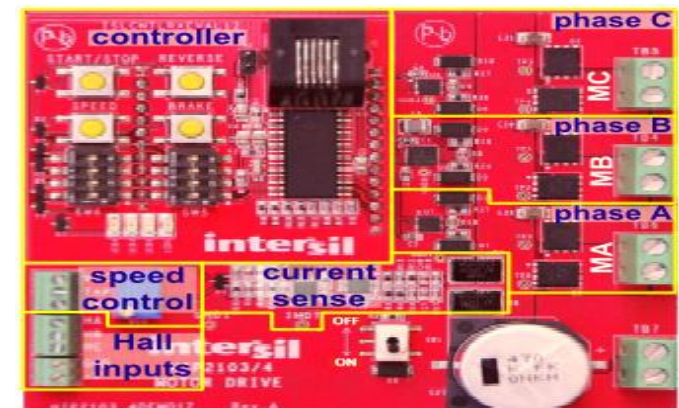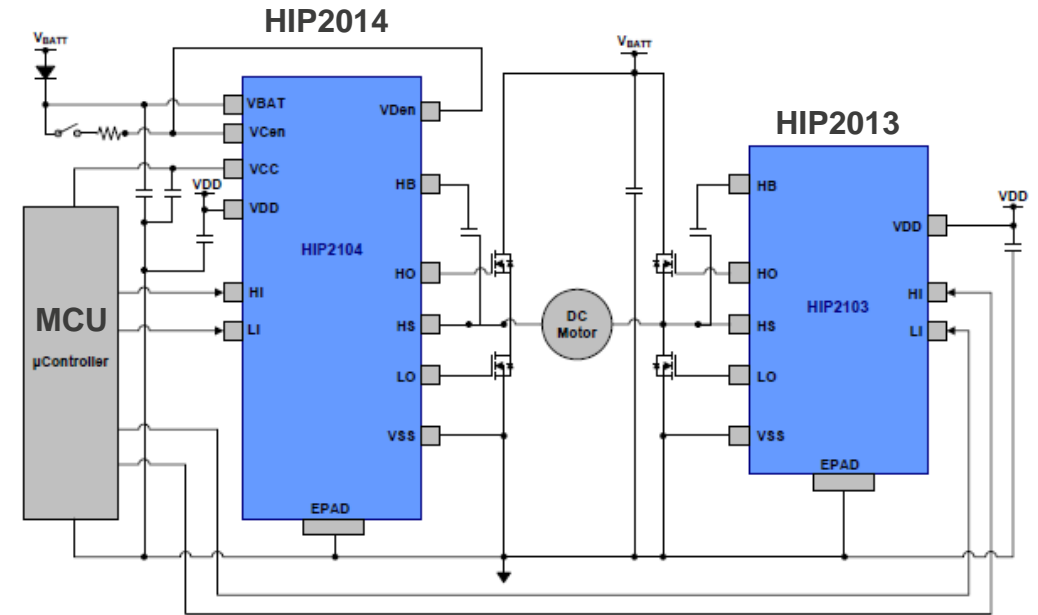
FIGURE 1. HIP2103-4DEMO1Z INPUTS AND OUTPUTS

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ISL85403 – 2.5A Regulator with Integrated High Side FET
Support 3V-40V input voltage range for Buck or Buck-Boost output

Wide Working Range

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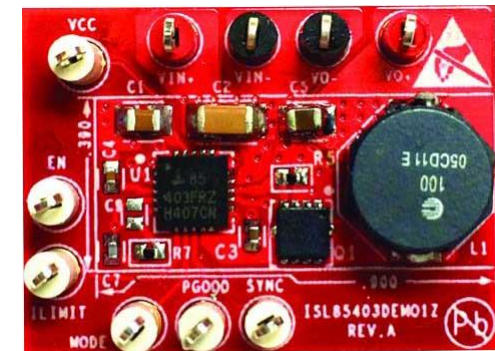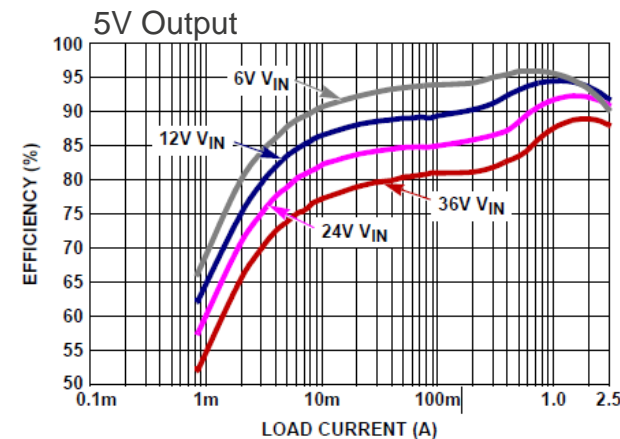- Up to 2.5A load in temperature range

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
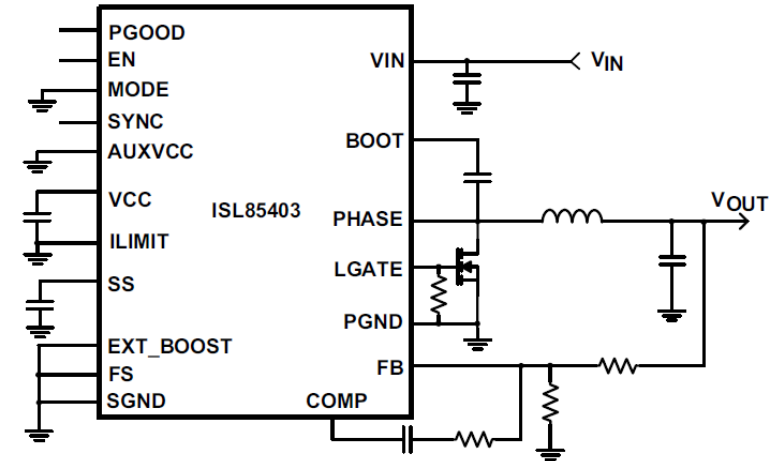
Typical Application Circuit

ISL85403EVAL1Z Evaluation Board

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

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FS1012 / FS2012
Solid-State MEMS Flow Sensor Module for Liquids and Gases
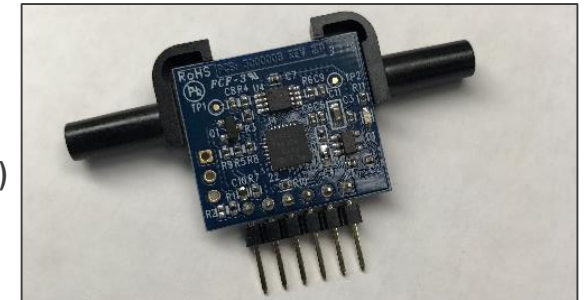
MEMS Thermopile Sensing for Gas or Liquid Flow

- Fully calibrated and compensated flow
- Robust solid isolation technology, resistant to vibration and pressure shock
- Food grade compatible version, easy cleaning and sterilization
- Fast response time + high sensitivity
- Silicon-carbide coating over MEMS flow sensor
- Digital (FS2012) or Analog output (FS1012)
- High accuracy (FS2012), typ. 2% of reading
- Low Power, 3V to 5V supply

FS1012
(mV Output)

FS2012
(Calibrated)

FloDemo
Software
(FS2012)

Part #	Calibrated	Output
FS1012	--	Analog
FS2012	Yes	Digital

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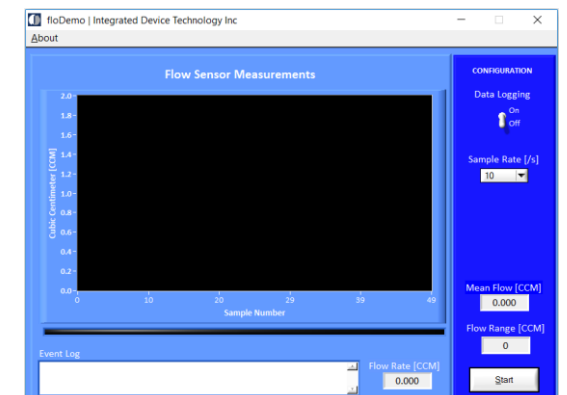
ISL85415 – 0.5A Regulator with Integrated High Side FET
Support 3V-36V Input Voltage Range for Buck Output

Wide Working Range

- Power input voltage range from 3V to 36V
- The device provides an easy-to-use high-efficiency, low BOM-count solution for a variety of applications.
- Up to 0.5A load over full temperature range

High Efficiency and Performance (low board space)

- Synchronous operation for high efficiency
- No compensation required
- Integrated High-side and Low-side NMOS devices
- Selectable PFM or forced PWM mode at light loads
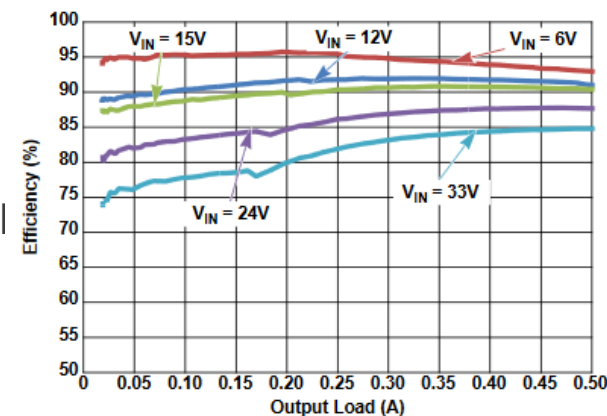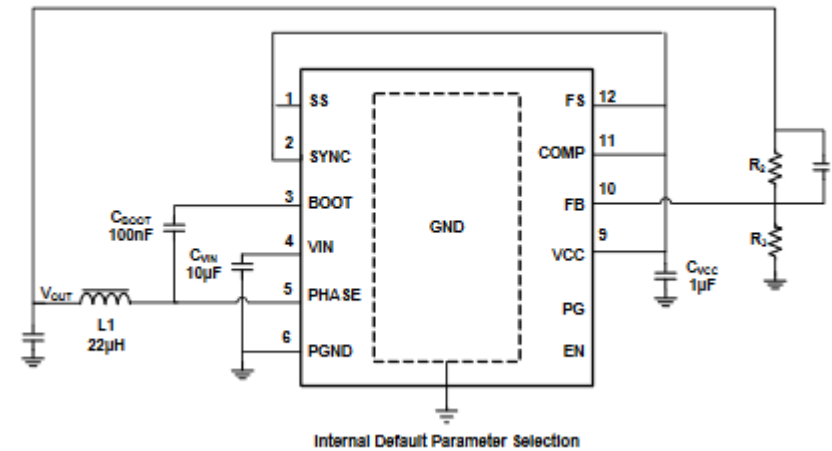- Internal fixed (500kHz) or adjustable switching frequency 300kI to 2MHz

Internal Default Parameter Selection

Figure 6. Efficiency vs Load, PFM, V_{OUT} = 5V

FIGURE 1. FRONT OF EVALUATION BOARD ISL85415DEMO2Z

Part #	V_{IN} Range(V)	Temp.(°C)	Package
ISL85415FRZ	3 to 36	-40 to 125	12 Ld DFN 4x3

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# ISL9241 – Buck-Boost Battery Charger
Configurable Battery Charger with SMBus Interface and USB Power Delivery

Digitally configurable buck-boost battery charger

- Buck-boost charger for 2-, 3-, or 4-cell Li-ion batteries
- Input voltage range: 3.9V to 23.4V (no dead zone)
- System/battery output voltage: 3.9V to 18.304V

Different Charge Modes

- Narrow Voltage Direct Charging (NVDC)
- Hybrid Power Buck Boost (HPBB/Bypass) charging
- Switch between the modes is possible using firmware control.
- Bypass mode is supported using a controller's firmware, allowing the adapter to provide power directly to the system.
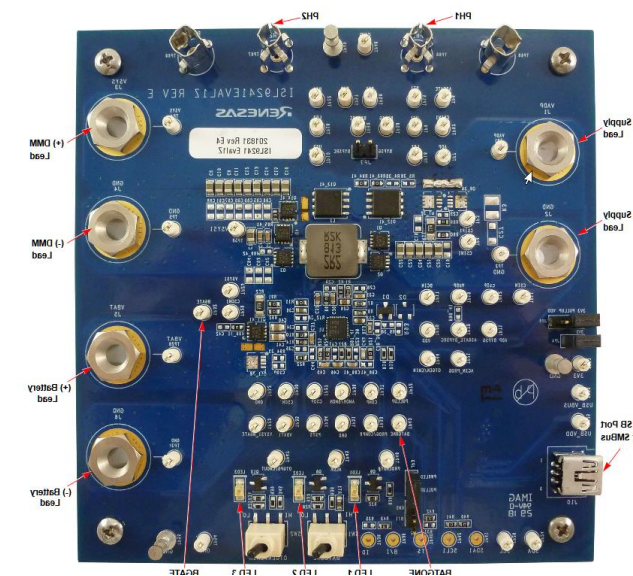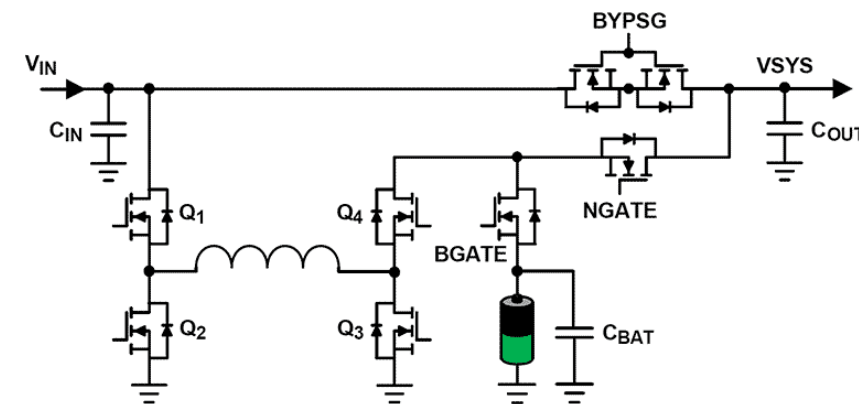
Part #	Input Voltage Range	System/Battery Output Voltage	Temp.Range	Batteries	Package
ISL9241HRTZ	3.9V to 23.4V	3.9V to 18.304V	-10°C – 100°C	2-4	32 Ld 4x4 TQF
ISL9241IRTZ	3.9V to 23.4V	3.9V to 18.304V	-40°C – 100°C	2-4	32 Ld 4x4 TQF

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FURTHER IMPROVEMENTS

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IMPROVED UNINTERRUPTED POWER SUPPLY

The proposed battery charger ISL9241 provides an easy to implement, low BOM count way by combining charging and protection functions in one chip.

However, for increased safety, a solution balancing and supervising each individual Li-Ion cell may be more suitable, especially when >=2 cells are used. Such solution could consist ISL94202 for balancing and supervision + ISL95538 for charging.

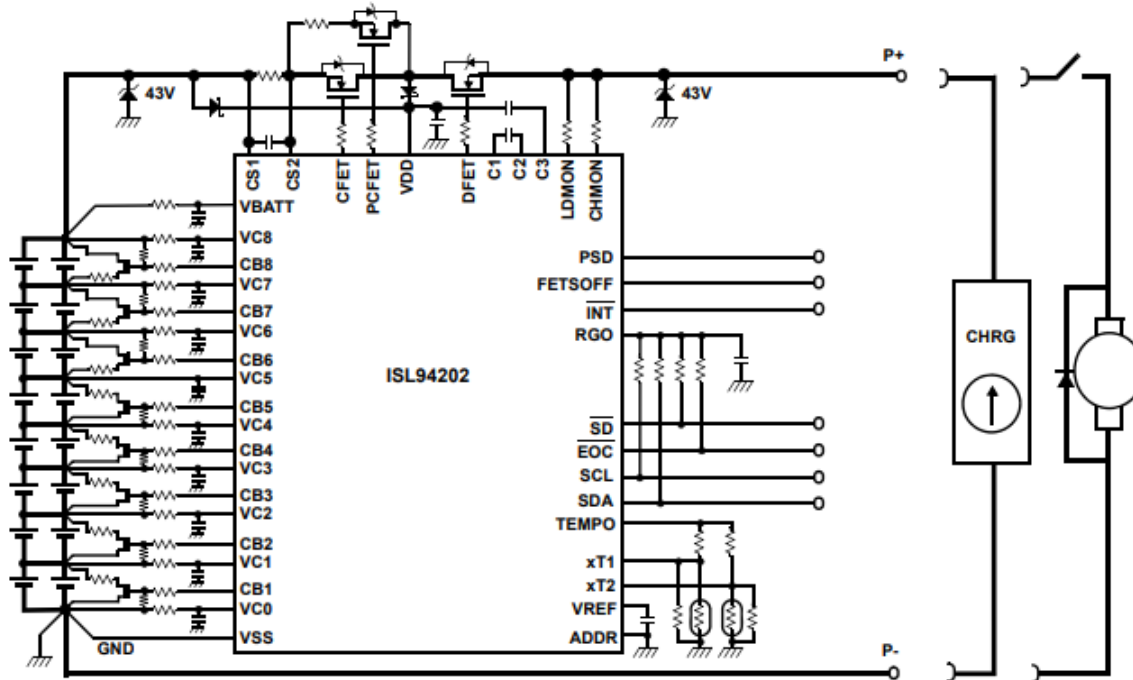For a more detailed proposals, please get in touch with us.
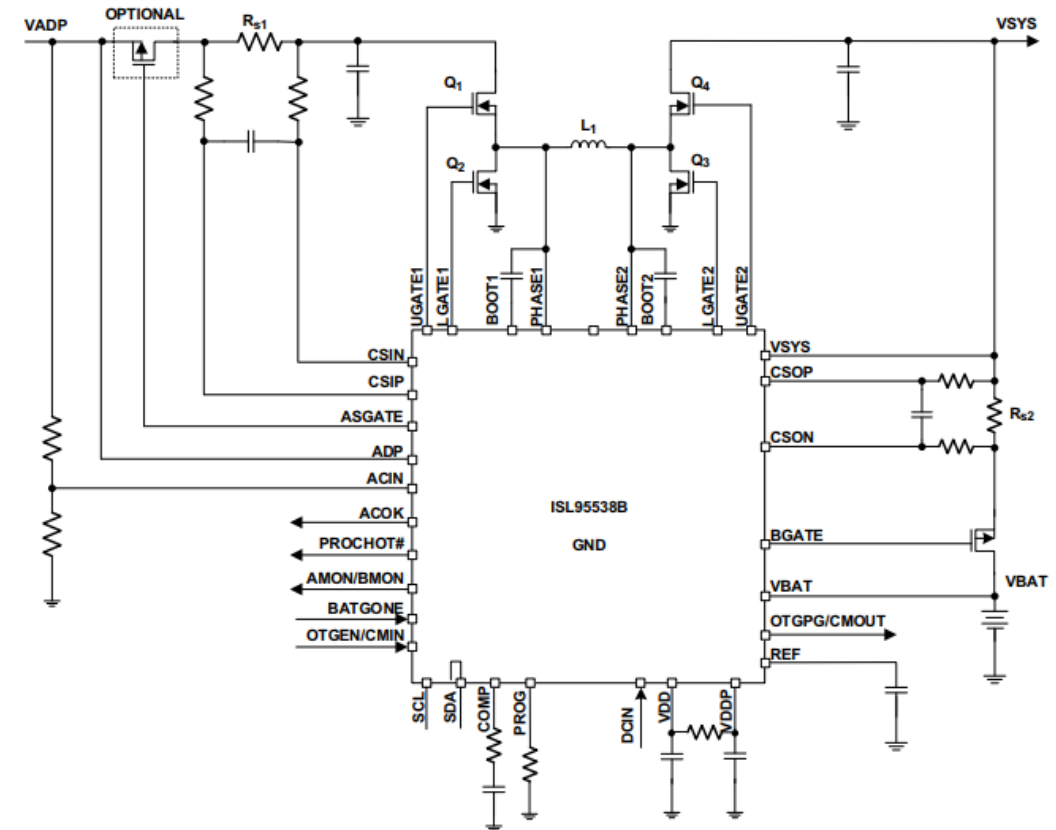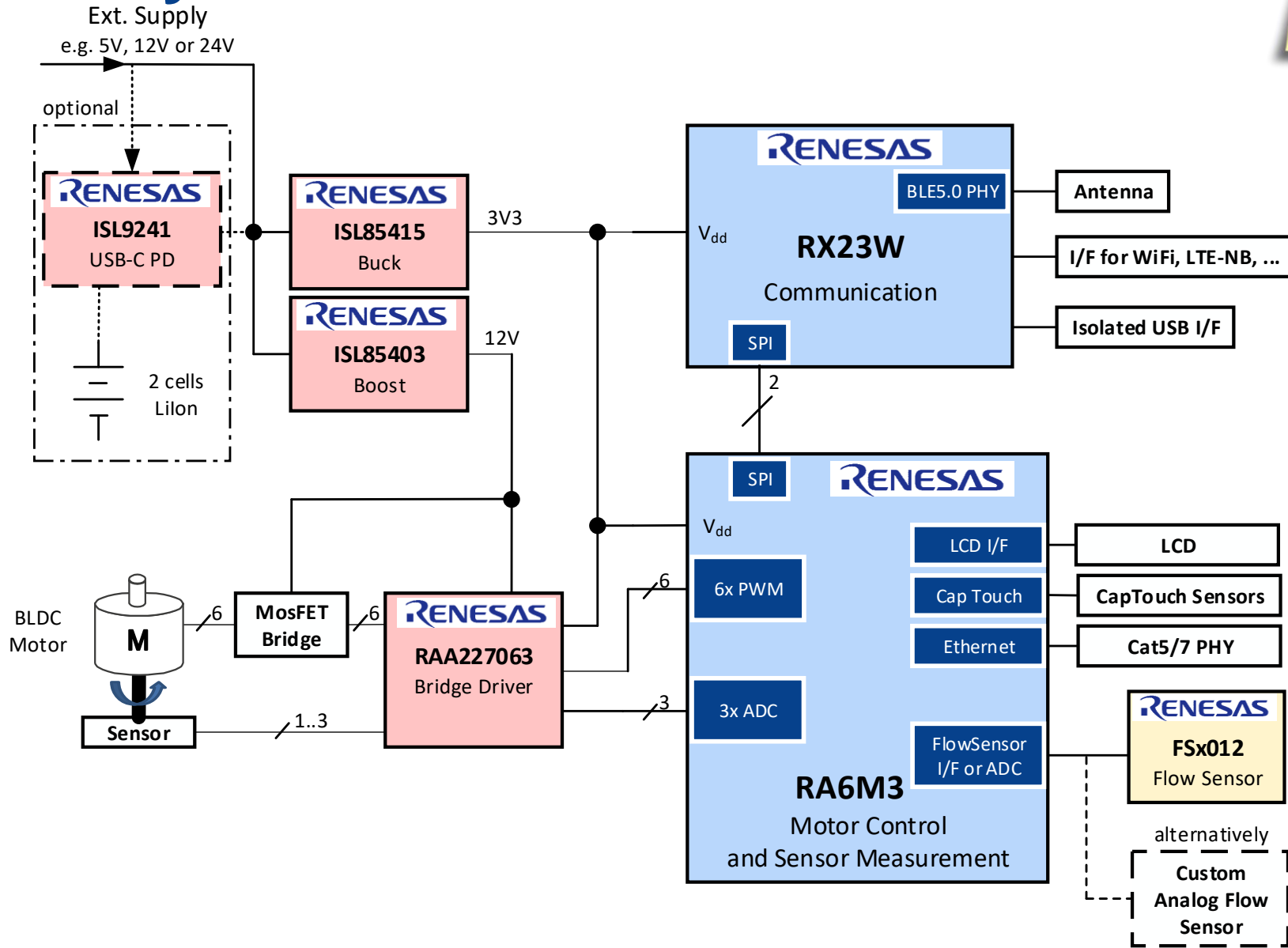

Figure 1.1   Typical Application Diagram

Figure 1. Typical Application Circuit

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PREVIEW

Integrated Motor Driver RAA227063

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Drug Delivery

Drug Delivery

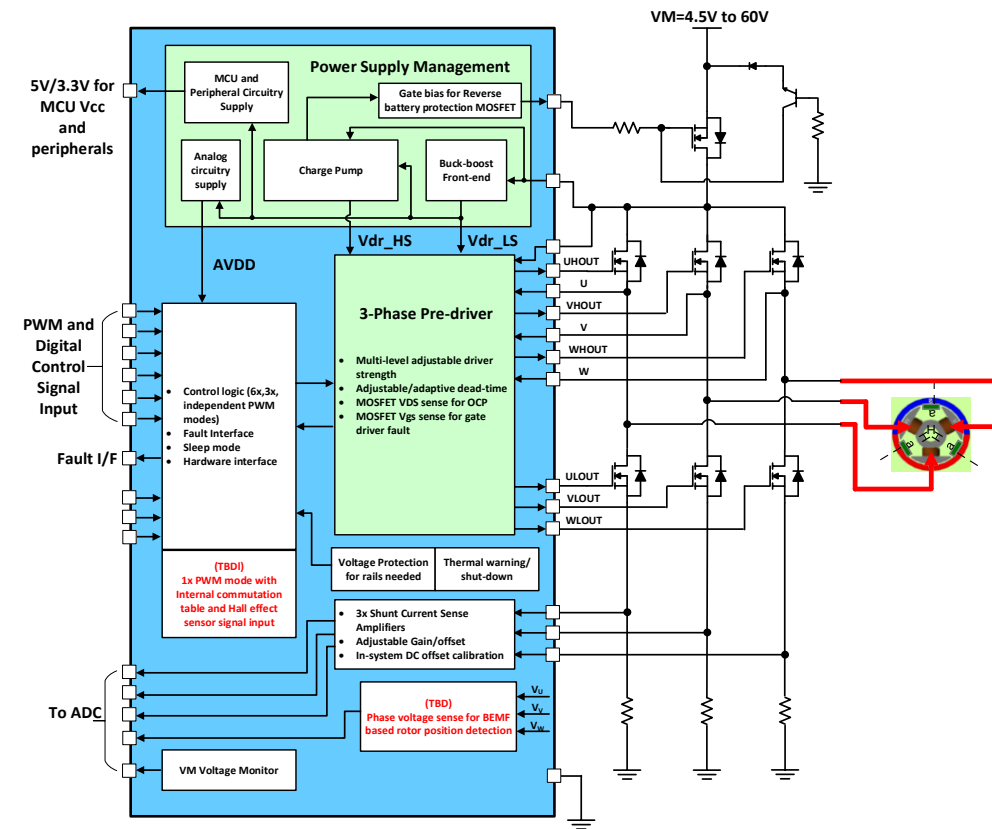| Device Category	P/N	Key Features
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	RX23W	32 Bit, BT5.0 MCU with enhanced security
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	ISL85403	2.5A Regulator with Integrated High-side MOSFET for Synchronous Buck or Boost Buck Converter
Analog	RAA227063	3-phase, 60V Smart Motor Driver
	FSx012	Solid-State MEMS Flow Sensor Module for Liquids and Gases

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RAA227063
3-phase, 60V Smart Motor Driver

- **Flexible, powerful gate drive**
  - programmable levels of drive
  - programmable dead-time
  - shoot-through protection
  - Charge pump enables 100% DC high-side FET

- **Integrated power supplies and current sensing**
  - 3 current-sense amps (in-system offset calibration)
  - 500mA buck-boost DC/DC for FET gate drive voltage supply
  - 200mA / 3.3V or 5V (selectable) LDO

- **Robust with extensive protection features**
  - Reverse battery protection
  - Under- and over-voltage, over-temp, over-current, and gate drive fault sensing
  - SPI I/F communicates fault status

Part #	Package
RAA227063	(tbd)

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