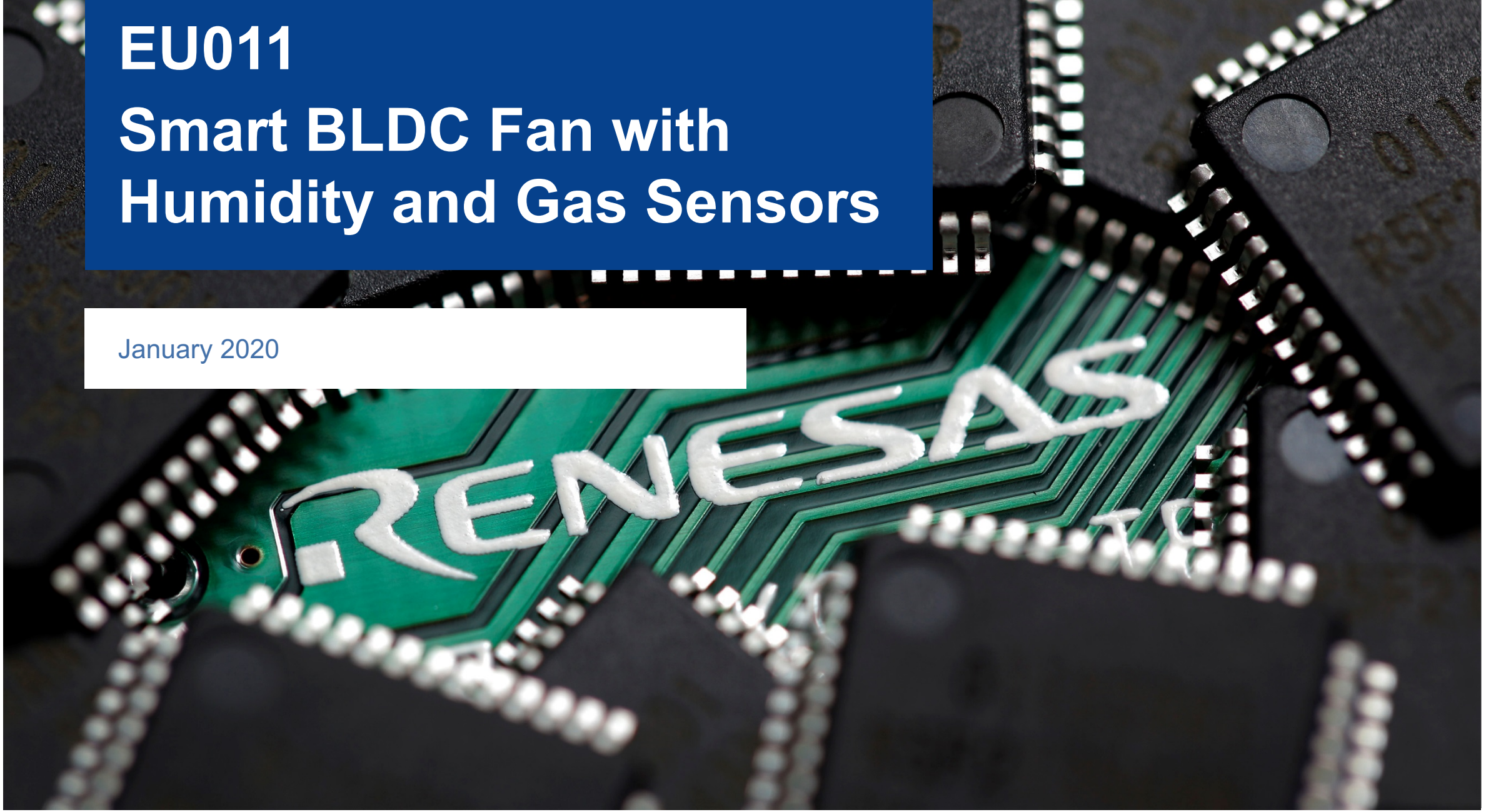
EU011
Smart BLDC Fan with Humidity and Gas Sensors



January 2020

Smart BLDC Fan with Humidity and Gas Sensors

- **Overview**

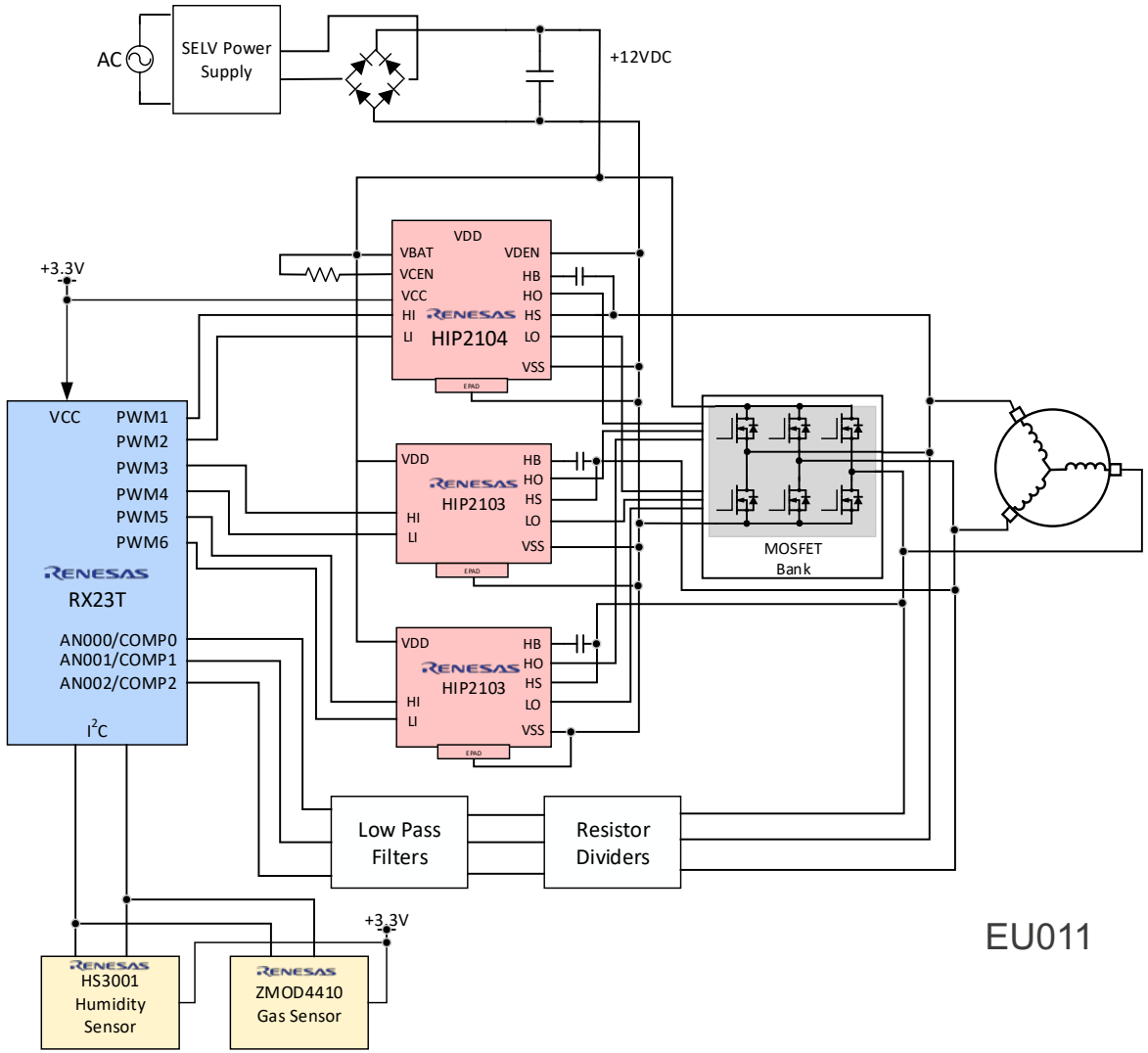
  Ventilation in buildings is important, as lack of a good, clean air supply is detrimental to health and the quality of life. In the UK, ventilation requirements are part of building regulations. According to a report from market researcher, BRE, it was estimated that poor housing costs the National Health Service in the UK £2.5bn in treatment costs. Poor indoor air quality has been linked to allergy, asthma and other chronic diseases. High levels of CO_2 can lead to drowsiness, lack of concentration and headaches.

  This solution provides a reference design for a BLDC fan controller in smart building automation applications with configurable limits.

- **System Benefits**
  - Precise, factory calibrated sensors
  - Energy efficient BLDC control for fans
  - Activates the fan only when volatile organic compounds (VOC), moisture or CO_2 are detected
  - High Performance MCU + FPU designed for motor control. The MCU has all the functions required for an efficient BLDC motor control solution.
  - Configurable alarm/interrupt output with static and adaptive levels

*** BRE. Briefing Paper: The Cost of Poor Housing to the NHS. 2011.** EU011

Smart BLDC Fan with Humidity and Gas Sensors



Smart BLDC Fan with Humidity and Gas Sensors

Device Category	P/N	Key Features
MCU	RX23T R5F523T5ADFM	32-bit FPU MCU for controlling a single inverter. 64pin LQFP (0.5mm pitch), 128KB FLASH 12KB RAM. TA = -40 to +105ºC
Analog	ZMOD4410	TVOC sensor for Indoor Air Quality (IAQ) applications
	HS3001	Relative humidity and temperature sensor
Power	HIP2104	60V, 1A/2A, half-bridge driver with integrated LDO
	HIP2103	60V, 1A/2A, half-bridge driver

EU011

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

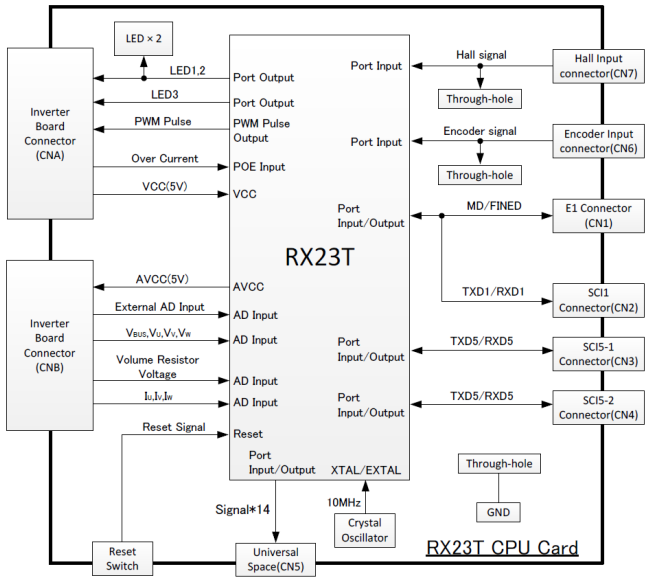
Suitable for Inverter Control

- 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

HS300x – Relative Humidity and Temperature Sensor

High Accuracy Humidity and Temperature Measurement for Environmental Monitoring

High Accuracy

- ±1.5%RH accuracy (HS3001)
- ±0.2°C temperature accuracy (HS3001, HS3002)

Excellent Stability

- 0.1%RH per year drift
- MEMS silicon-carbide sensor technology

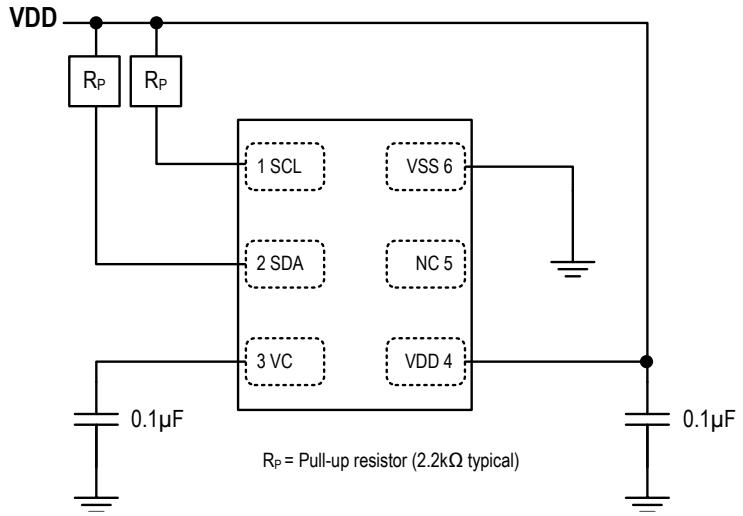
Fast Response

- Less than 6 seconds humidity response, in still air
- Less than 2 seconds temperature response

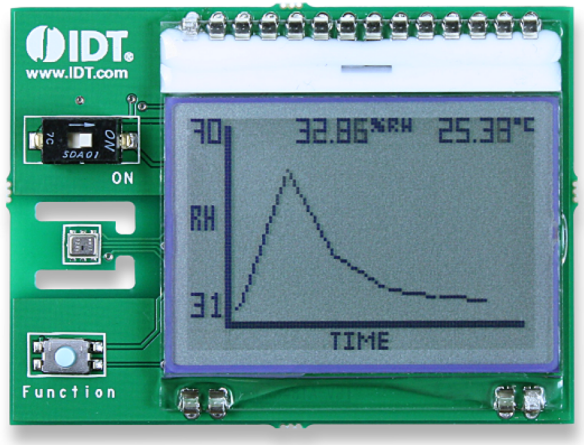
Extended Supply Voltage

- 2.3V to 5.5V, 24.4µA at 3.3V (one RH+Temp per second)
- 1.8V custom order

Part #	Feature	Package
HS3001	±1.5%RH	3×2.41×0.8 LGA
HS3002	±1.8%RH	3×2.41×0.8 LGA
HS3003	±2.8%RH	3×2.41×0.8 LGA
HS3004	±3.8%RH	3×2.41×0.8 LGA



Typical Operating Circuit



SDAH02 Evaluation Kit

ZMOD4410 – Indoor Air Quality Sensor Platform

TVOC Sensor for Indoor Air Quality Applications

Flexible Measure Target

- Measurement of total organic compounds (TVOC)
- Concentrations and indoor air quality (IAQ)
- Module algorithm estimates carbon dioxide level (eCO_2)
- Algorithm to set a control signal to trigger an external action based on IAQ and odor change
- Configurable alarm/interrupt output with static and adaptive levels

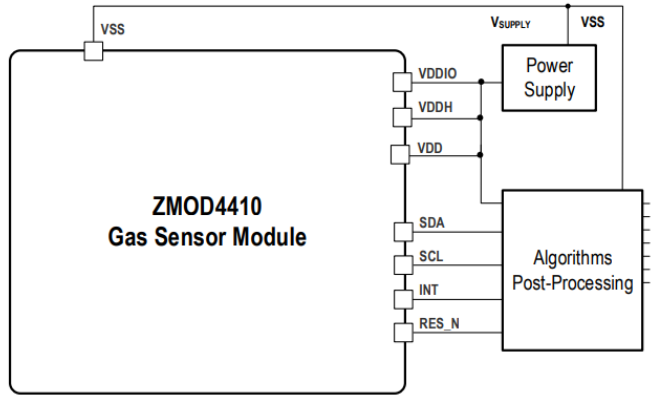
Low Power

- Very low average power consumption down to 1mW
- Excellent for low-voltage and low-power battery applications

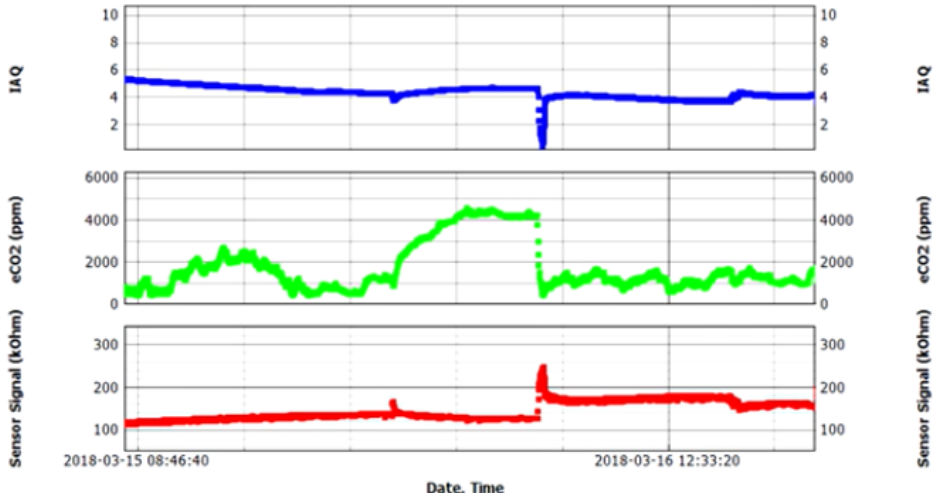
Easy to Use

- ZMOD4410 Evaluation Kit
- Manuals, application notes, blog, and white papers
- Instructional videos
- Programming libraries, example codes, and algorithm support to optimize performance
- Third-party certification for compliance with well-accepted international IAQ standards

Part #	Operation Condition	Package
ZMOD4410AI1V ZMOD4410AI1R	1.7-3.6V -40° to +65° Est. CO2 400-5000ppm Ethanol in air 0-1000ppm	3.0 × 3.0 × 0.7mm, 12-LGA



ZMOD4410 typical application



Measuring IAQ and Est CO_2 level with ZMOD4410

BIG IDEAS FOR EVERY SPACE RENESAS

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

High Voltage Drivers for Industrial Motor Control

Flexible Half-Bridge Drivers

- Supports half bridge, full bridge, and 3-phase 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

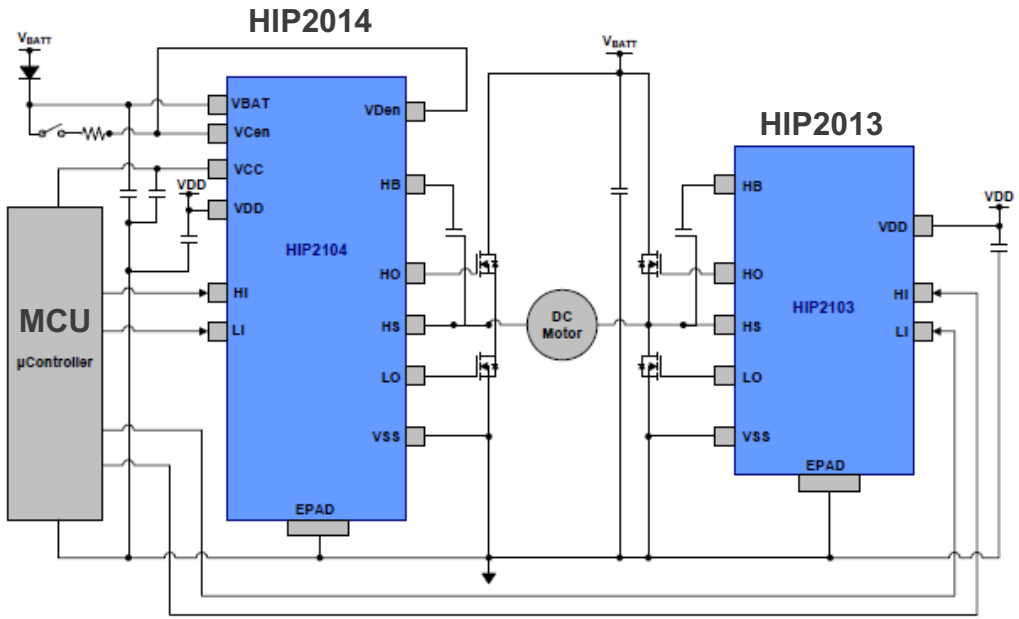
Sleep Mode

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

Integrated LDO (HIP2104)

- HIP2104 includes integrated 12V & 3.3V LDOs
- Provides bias to external MCU plus HIP2103 & HIP2104 drivers

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



Typical Application Circuit

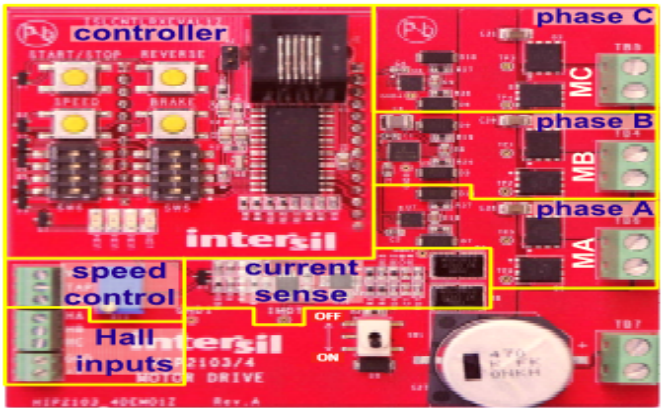


FIGURE 1. HIP2103-4DEMO1Z INPUTS AND OUTPUTS

Renesas.com