

CN191 Smart Coffee Machine

October 2019

Smart Coffee Machine

■ Overview

Renesas' coffee machine solution is based on the high-performance RA4 MCU series, a complete solution in a single chip. Integrated system features of the MCU include system control, automatic detection, human-machine interface, and touch control. The touch algorithm enables touch control and automatic water level detection so it can be used simultaneously. Combining the Renesas flow sensor enables automatic control of the coffee output.

■ System Benefits

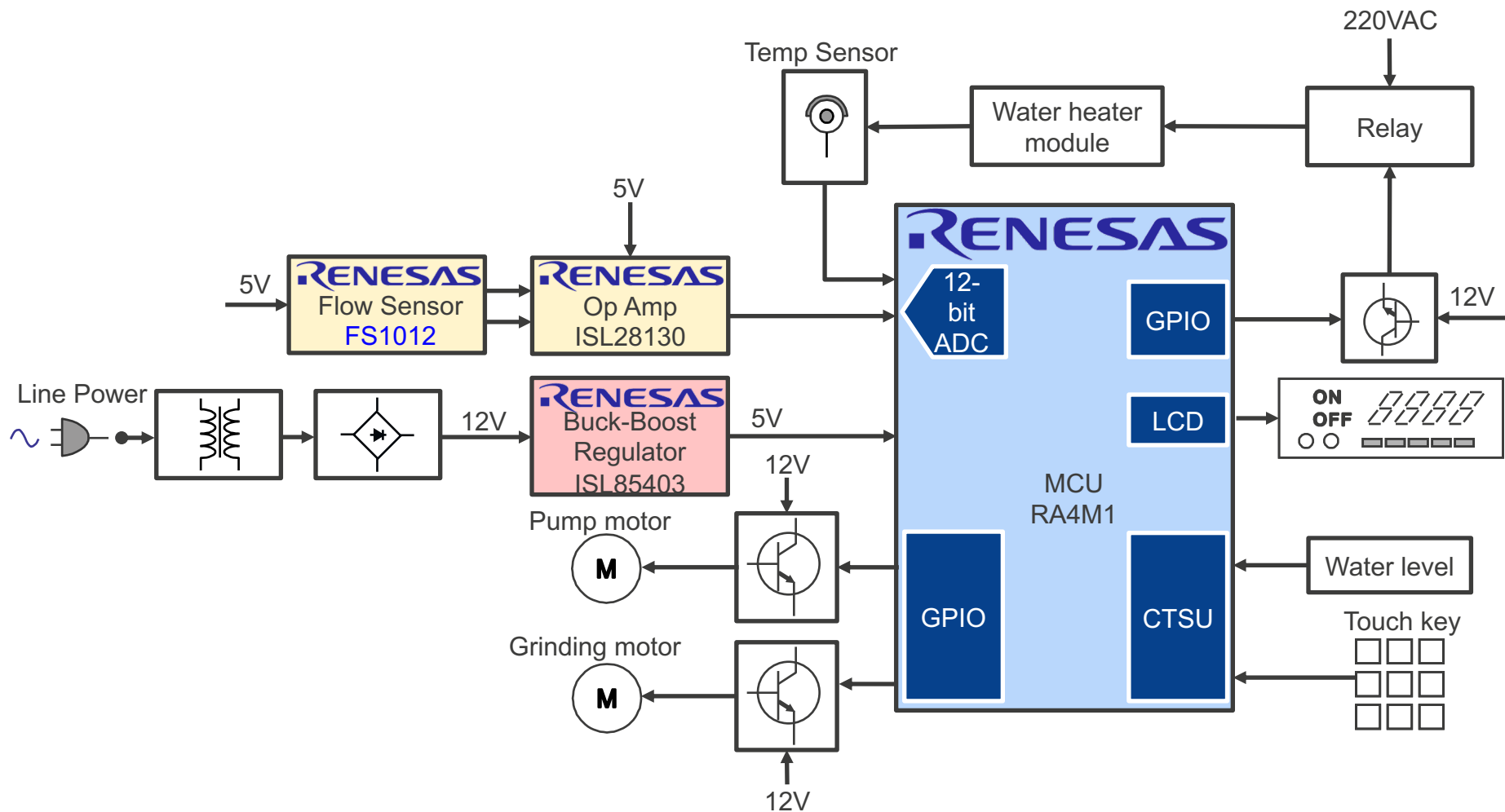
- The RA4M1 features an integrated CTSU/12-bit ADC/display/USB with high performance
- Ability to design a coffee machine with minimal components
- High-performance DC/DC and flow sensor

Smart Coffee Machine

MCU / MPU

Analog

Power



Block Diagram #CN191
October 2019

Smart Coffee Machine

Device Category	P/N	Key Features
MCU	RA4M1	High efficiency 48-MHz Arm® Cortex®-M4 core, 256-KB code flash memory, 32-KB SRAM, Segment LCD Controller, Capacitive Touch Sensing Unit, USB 2.0 Full-Speed Module, 14-bit A/D Converter, 12-bit D/A Converter, security and safety features.
Power	ISL85403	Integrated High-side MOSFET for Synchronous Buck or Boost Buck Converter, Wide input voltage range 3V to 40V, Capable of 2.5A output current
Analog	ISL28130	A single micropower, low offset drift operational amplifiers that are optimized for single and dual supply operation from 1.8V to 5.5V and $\pm 0.9V$ to $\pm 2.75V$.
	FS1012	Robust “solid” isolation technology, Sensitive at low flow rates and differential pressure levels, Millivolt output.

RA4M1 – High Efficiency 48-MHz Arm® Cortex®-M4 Core

For Applications Needing HMI/Control/Security/Graphical and Capacitive Touch

High Performance

- 48MHz Arm® Cortex®-M4 CPU

Highly Integrated Capabilities

- 256KB Flash and 32KB SRAM
- 14-Bit ADC (25 ch.)
- 12-Bit DAC (1 ch.)/ 8-Bit DAC (2 ch.)

Communication Interfaces

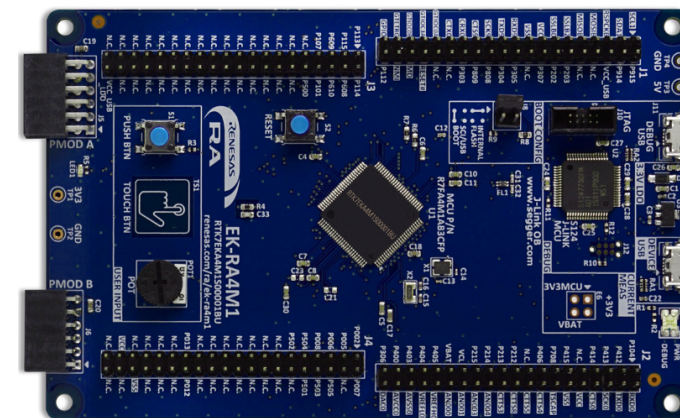
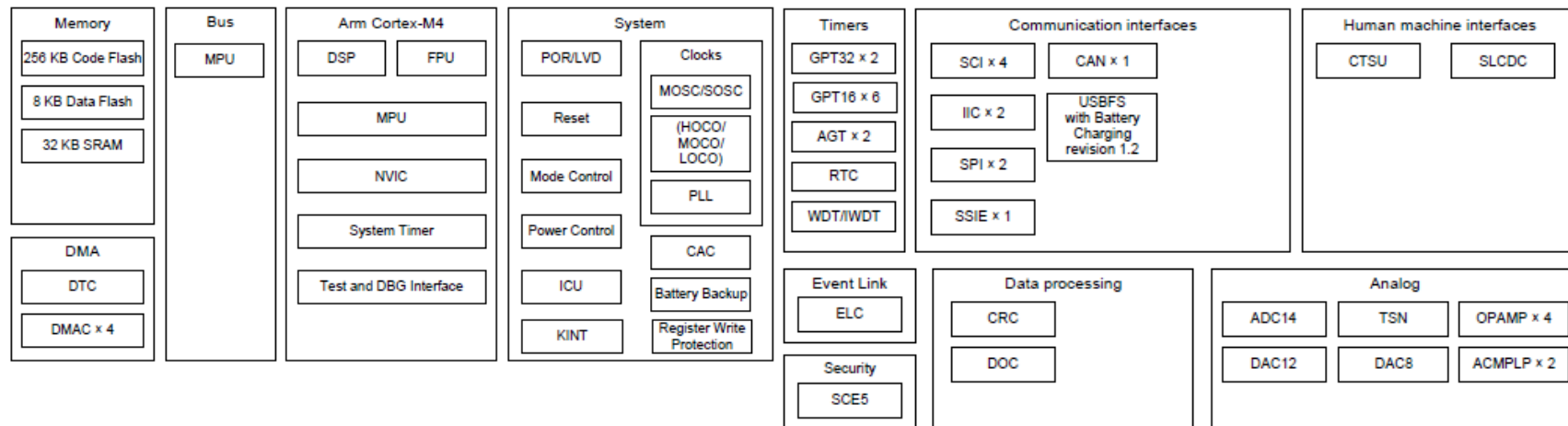
- USB 2.0 (Full Speed)
- CAN
- SCI x4/SPIx2/IICx2

HMI Interface

- Capacitive Touch Sensing Unit (27 ch.)
- Segment LCD Controller - up to 34 segments x 8 commons

Wide Voltage and Low Power Consumption

- Wide operating voltage range of 1.6V to 5.5V
- Various Low Power Modes



RTK7EKA4M1S00001BU

Part #	Flash Memory	RAM	Temp	Package
R7FA4M1AB3CFP	256KB	32KB	40 ~ 105°C	100 LQFP
R7FA4M1AB3CFM	256KB	32KB	40 ~ 105°C	64 LQFP

ISL85403 – 2.5A Regulator with Integrated High Side FET

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

Wide Working Range

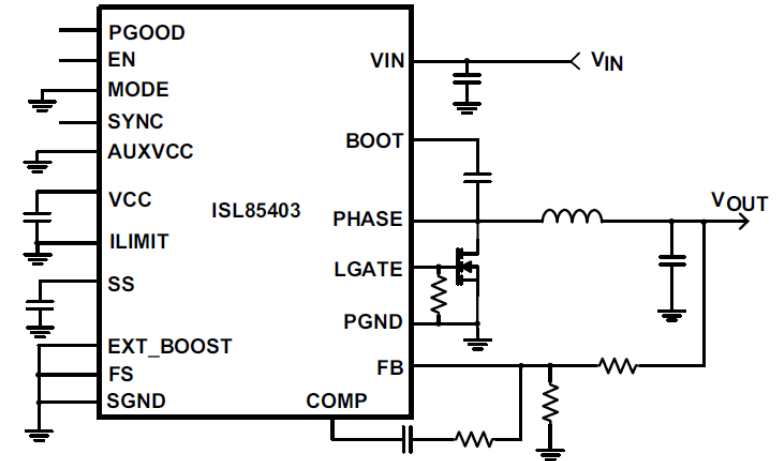
- Power input voltage range from 3V to 40V
- Support both step down (buck) or boost-buck outputs
- Up to 2.5A load over full temperature range

High Efficiency

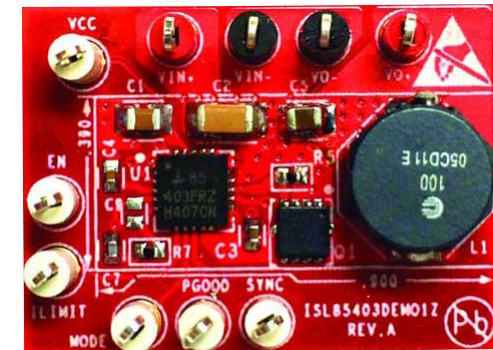
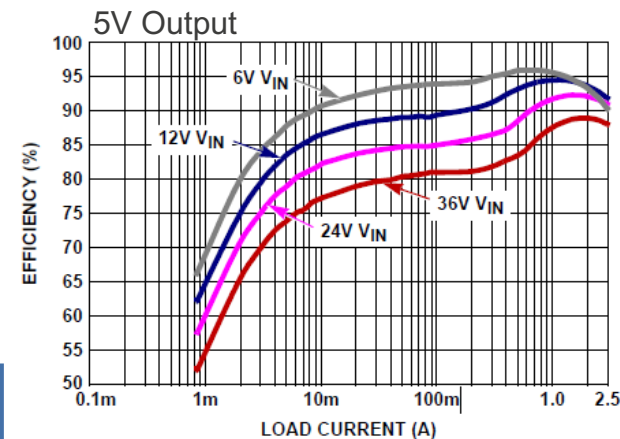
- Optional external low side FET for higher efficiency
- Selectable PWM / PFM modes
- 300uA input quiescent PFM mode current
- Less than 5uA shutdown current

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

ISL28130 – Low Power/Drift RRIO Operational Amplifier

Low Power Operational Amplifier for Battery-Powered Devices

Low Offset

- Low input offset voltage: 40 μ V, Max
- Low offset drift: 150nV/°C, Max.
- Input bias current: 250 pA, Max.

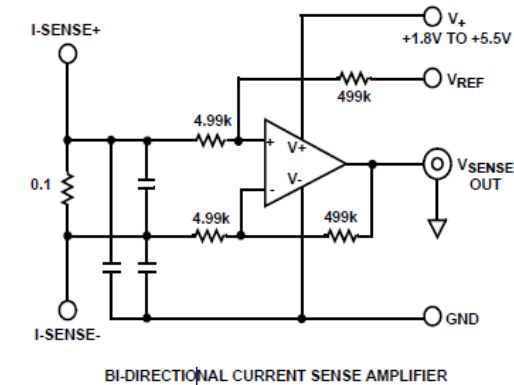
Good Dynamic Performance

- Low noise (0.01Hz to 10Hz): 1.1 μ VP-P, Typ.
- Rail-to-rail input and output

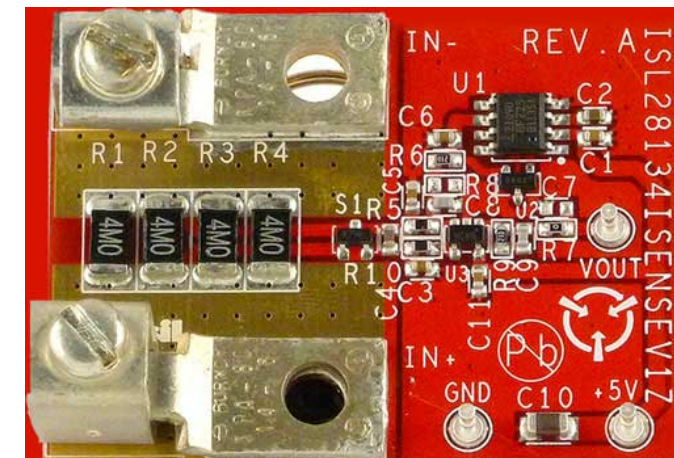
Low Power Design

- Quiescent current (per amplifier): 20 μ A, Typ.
- Single supply range: +1.8V to +5.5V
- Dual supply range: \pm 0.9V to \pm 2.75V

Part #	Temp.	Package
ISL28130FHZ	-40 - 125°C	5 Ld SOT-23
ISL28130CEZ	0 - 70°C	5 Ld SC-70
ISL28230CUZ	0 - 70°C	8 Ld MSOP
ISL28230FRZ	-40 - 125°C	8 Ld 3x3 DFN
ISL28430CBZ	0 - 70°C	14 Ld SOIC
ISL28430FVZ	-40 - 125°C	14 Ld TSSOP



Typical Operating Circuit



ISL2813xxSENSEV1Z Precision Current Sense Op Amp

FS1012 – Gas or Liquid Flow Sensor Module

Highly Sensitive/Fast Response at Low Flow Rates for Low Power Industry Applications

Capable of Measuring Medium

- Gas or liquid medium
- Wetted materials consist of a glass fiber reinforced PA66 resin, epoxy, and silicon carbide

Fast Response and Low Power

- Fast response: <5ms
- Low power consumption: Millivolt output

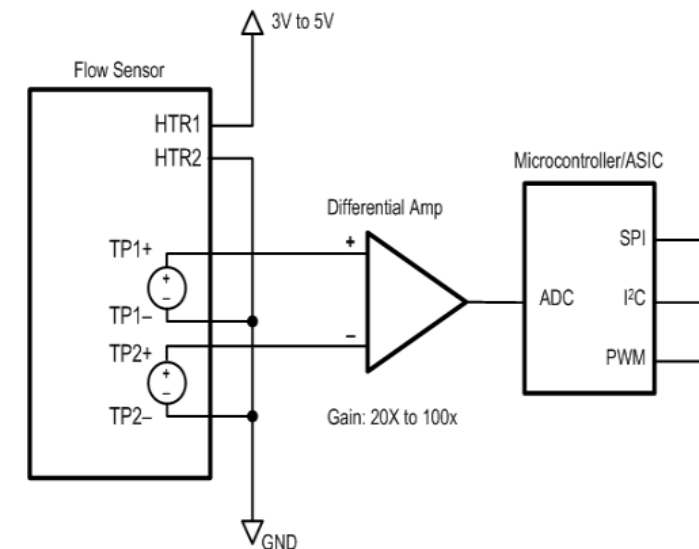
High Performance Robust in Use

- Robust “solid” isolation technology
- Resistant to surface contamination
- No cavity to cause clogging
- Resistant to vibration and pressure shock
- Sensitive at low flow rates and differential pressure levels
- Supply voltage: 3V to 5V
- Module operating temperature range: 0°C to +85°C

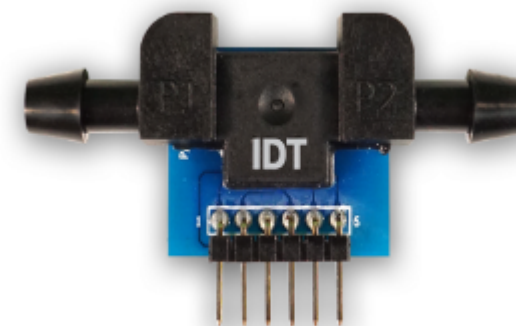
Part #	Parameter	Maximum
FS1012-1020-NG	Gas Flow	2(2000) SLPM(SCCM)
FS1012-1020-NG	Gas Flow	10(10000) SLPM(SCCM)
FS1012-1001-LQ	Liquid Flow	0.5(500) SLPM(SCCM)
FS1012-1002-LQ	Liquid Flow	1.0(1000) SLPM(SCCM)

SLPM: Standard liter per minute.

SCCM: Standard cubic centimeter per minute.



FS1012 Typical Circuit



FS1012 Module (front)

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