ELECTRONIC VALVE WITH FLOW METER: OVERVIEW

Electronic valve control is essential to many industrial applications for liquids and gases. Utilizing the Renesas FS1012 flow sensor to monitor the rate of delivery, this design controls the flow via a motor-controlled valve. Two MCUs are utilized for safety concerns. The RX23T is especially designed for motor control applications and the RX231/RX65N is used to redundantly monitor the motor position, measure the gas/liquid flow, and to fulfill Safety Integration Level 2 (SIL2) standards thanks to the Functional Safety Platform software. The flow status is displayed on an LCD as well as communicated over Ethernet or RS485. This design can operate off of 12V or 24V.
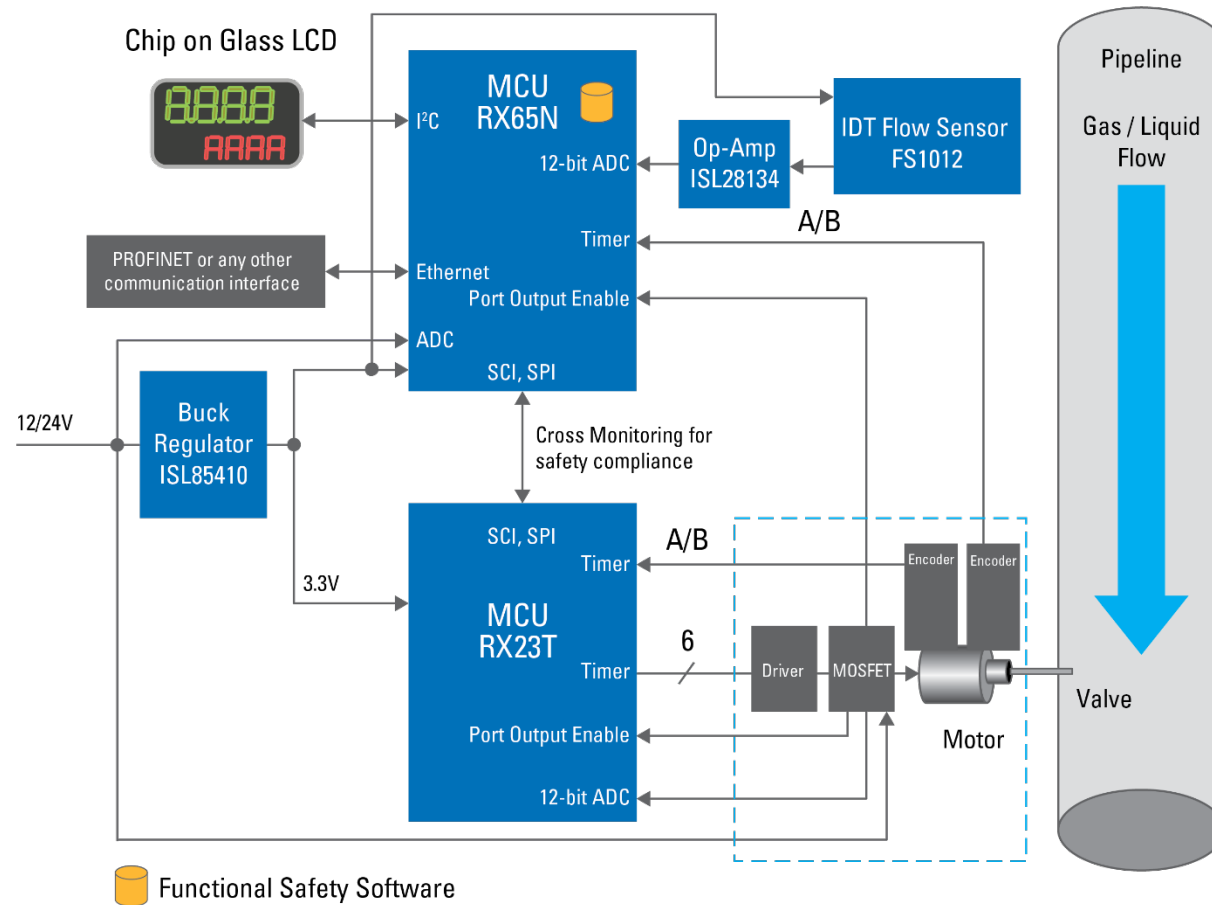
Key Features:

- Supports SIL2 standard by Functional Safety Platform Software certified by TÜV

- MEMs solid-state gas flow sensor

- RS-485 fault-protected against 15kV ESD and over-voltages up to +/-60V and up to 20Mbps data rates

WC#: US017-D28

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ELECTRONIC VALVE WITH FLOW METER: BLOCK DIAGRAM

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ELECTRONIC VALVE WITH FLOW METER: BLOCK DIAGRAM

RS485 Option

Chip on Glass LCD

MCU RX231

I²C
12-bit ADC
SCI
Port Output Enable
ADC
SCI, SPI

Op-Amp ISL28134

IDT Flow Sensor FS1012

A/B

Timer

RS-485 ISL32459E

Buck Regulator ISL85410

12/24V

5V

Cross Monitoring for safety compliance

MCU RX23T

SCI, SPI
Timer
Timer
Port Output Enable
12-bit ADC

A/B

6

Driver

MOSFET

Encoder Encoder

Motor

Valve

Pipeline

Gas / Liquid Flow

Functional Safety Software

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RX23T: INDUSTRIAL CONTROL MCU

Industrial Applications MCU series within the Renesas RX family

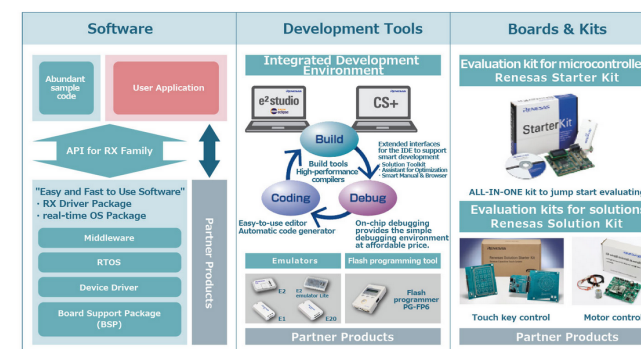| Features	Benefits	Applications

RX microcontrollers with RXv2 core
   Enhanced security
   Single Precision Floating point
   Enhanced DSP functions
• 64k/128k KB 0 wait-state FLASH
• RAM 640 KB
• Data Flash 32 KB
• 1uS ADC with 3 simultaneous S/H
• Built-in Analog Comparators (3 ch)
• Safety Functions
	• Compact code size
	• Low cost / high performance for Control applications.
	   • Fast sampling ADC for sensors
	   • Fast math processing
	• BLDC Algorithms available
	• In-circuit scope for Motor Control
		• Motor Control
		   • HVAC, Fan control
		• General Industrial

Typical application and key performances

Motor Control
Industrial Applications

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RX65N: COMMUNICATION MCU WITH ENHANCED SECURITY

Communication MCU with RXv2 core and large capacity RAM

Features	Benefits	Applications
• 32-bit MCU @ 120MHz • Ideal to carry out high-speed communication processing that is required for various communication interfaces such as Ethernet(RX65N only), USB, CAN, SD host/slave interface, and quad SPI. • Large-capacity memory of up to 2MB Flash and 640kB RAM • 100pin – 177pin packages	• RX65N and RX651 Groups are new mainstream RX microcontrollers with RXv2 core, large-capacity RAM, and enhanced security, connectivity, and HMI. • Cost optimized due to latest 40nm process technology	• Process controls and monitoring • Oil and Gas leak detection • HVAC and air control systems • CPAP and respiratory devices • Breathalyzer • Automotive MAF • Air speed and wind meter • Liquid dispensing/metering systems • Medical infusion pumps

Typical application and key performances

120-MHz 32-bit RX MCU, on-chip FPU, 240 DMIPS, up to 2-MB flash memory (supportive of the dual bank function), 640-KB SRAM, various communications interfaces including Ethernet MAC (RX65N only),
SD host interface (optional), SD slave interface (optional), quad SPI, and CAN, 12-bit A/D converter, RTC, Encryption functions (optional), CMOS camera interface, Graphic-LCD controller, 2D drawing engine
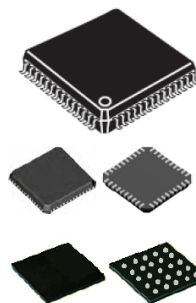
PLQP0176KB-A 24 × 24 mm, 0.5-mm pitch
PLQP0144KA-B 20 × 20 mm, 0.5-mm pitch
PLQP0100KB-B 14 × 14 mm, 0.5-mm pitch

PTLG0177KA-A 8 × 8 mm, 0.5-mm pitch
PTLG0145KA-A 7 × 7 mm, 0.5-mm pitch
PTLG0100JA-A 7 × 7 mm, 0.65-mm pitch

PLBG0176GA-A 13 × 13mm, 0.8-mm pitch

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RX231: 32 BIT, WIDE VIN MCU WITH BUILT-IN FPU

Motor Control MCU series within the RX Family

Features	Benefits	Applications
• 32-bit MCU @ 54MHz • RX231 microcontrollers operate in a broad voltage range from 2.7 V to 5.5 V • Have rich communication interface such as SD host interface, USB, and CAN • Integrated with security function, encryption function, and touch key. • Up to 512kB Flash and 64kB RAM • 48pin, 64pin and 100pin LQFP packages	• The RX231 Group is 32-bit microcontroller with built-in FPU (floating-point processing unit) that enables it to easily program complex inverter control algorithms. RX24T Group enables simultaneous control of up to 3 motors by max 80 MHz operating frequency CPU core and motor control peripherals.	• Industrial automation • Industrial process control • Office Automation • Home Appliance • Healthcare • IoT

Typical application and key performances

54-MHz 32-bit RX MCUs, built-in FPU, 88.56 DMIPS, up to 512-KB flash memory, up to 14 communication functions including USB 2.0 full-speed host/function/OTG, CAN, SD host interface, serial sound interface, cap-touch, 12-bit A/D, 12-bit D/A, RTC, AES, MPU security functions
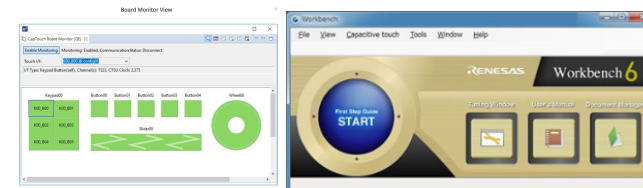
PLQP0100KB-B 14 × 14 mm, 0.5 mm pitch
PLQP0064KB-C 10 × 10 mm, 0.5 mm pitch
PLQP0048KB-B 7 × 7 mm, 0.5 mm pitch

PWQN0064KC-A 9 × 9 mm, 0.5 mm pitch
PWQN0048KB-A 7 × 7 mm, 0.5 mm pitch

PTLG0100KA-A 5.5 × 5.5 mm, 0.5 mm pitch
PWLG0064KA-A 5 × 5 mm, 0.5 mm pitch

Capacitive Touch Development Tool: "QE for Capacitive Touch" or " Workbench6"

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ISL85410: HIGH INTEGRATED POWER BUCK

Features	Benefits	Applications
• Wide input voltage range: 3V to 40V • Continuous output current up to 1A	• Integrates both high-side and low-side NMOS FETs and features a PFM mode for improved efficiency at light loads. This feature can be disabled if a forced PWM mode is needed. • By integrating both NMOS devices and providing internal configuration options, minimal external components are required, which reduces BOM count and complexity of design	• Smart meter AMR • Smart building control • Smart street light • Smart home appliance control

Typical application and key performances

• High efficiency low BOM count solution for a variety of applications.
• Internal fixed frequency (500kHz) or adjustable switching frequency (300kHz to 2MHz)
• For high-voltage industrial applications and an efficient solution for battery powered applications.

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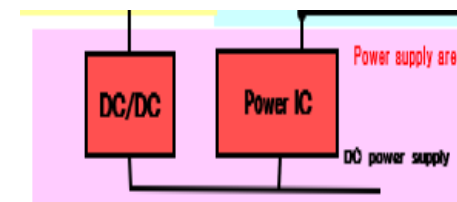
ISL28134: CHOPPER STABILIZED SINGLE OR DUAL SUPPLY OPAMP

Ultra Low Noise, Zero Drift Rail-to-Rail Precision Op Amp

Features	Benefits	Applications
• Rail-to-rail inputs and outputs -CMRR at VCM = 0.1V beyond VS: 135dB, typ -V_{OH} and V_{OL}: 10mV from V_S, typ • No 1/f noise corner down to 0.1Hz • Low offset voltage: 2.5µV, Max • Superb offset drift: 15nV/°C, Max • Wide bandwidth: 3.5MHz	• It uses auto-correction circuitry to provide very low input offset voltage, drift and a reduction of the 1/f noise corner below 0.1Hz. • It achieves ultra low offset voltage, offset temperature drift, wide gain bandwidth and rail-to-rail input/output swing while minimizing power consumption.	• Sensor gain amps • Precision low drift, low frequency ADC drivers • Precision voltage reference buffers • Thermopile, thermocouple, and other temperature sensors front-end amplifiers • Inertial sensors • Process control systems

Typical application and key performances

PRECISION WEIGH SCALE / STRAIN GAUGE

V_{OS} HISTOGRAM V_S = 5V

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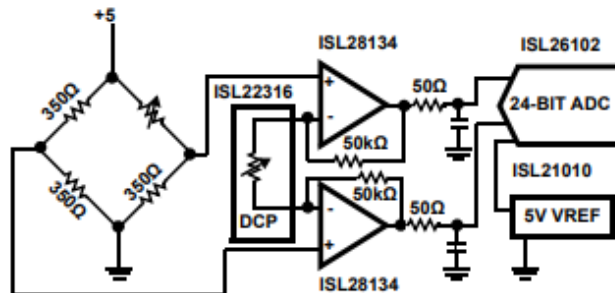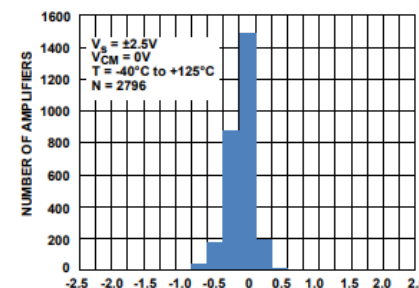
FS2012/FS1012: GAS OR LIQUID FLOW SENSOR

High Performance Solid-State MEMS Flow Sensor

| Features	Benefits	Applications

• MEMS Thermopile sensing
• Silicon-carbide coating over MEMS flow sensor
• Low Power, 3V to 5V supply
• Digital and Analog output (FS2012)
• High accuracy (FS2012), 2% of reading (typical)
• Flexible product versions:
  • mV sensor voltage output
  • Fully calibrated and compensated flow for air or liquid
	• Gas or Liquid flow
	• Robust solid isolation technology
	• No cavity in MEMS element to cause clogging
	• Resistant to vibration and pressure shock
	• Food grade compatible version
	• Fast response time
	• High sensitivity
	• Easy cleaning and sterilization
	• .
		• Process controls and monitoring
		• Oil and Gas leak detection
		• HVAC and air control systems
		• CPAP and respiratory devices
		• Breathalyzer
		• Automotive MAF
		• Air speed and wind meter
		• Liquid dispensing/metering systems
		• Medical infusion pumps

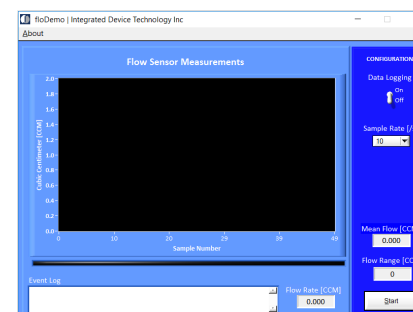## Typical application and key performances

FS1012
(mV Output)
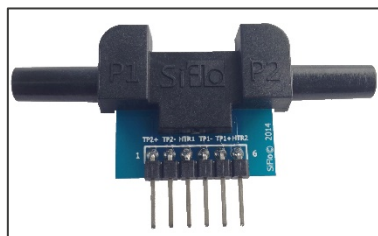
FS2012
(Calibrated)
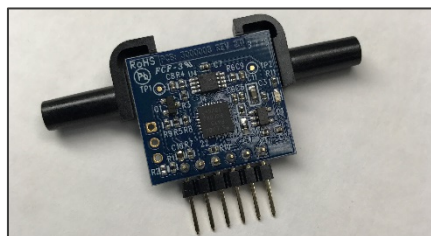
FloDemo Software (FS2012)

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ISL32459E: +/- 60V FAULT AND HIGH ESD PROTECTION RS-485

Fault Protected, Extended Common-Mode Range, RS-485/RS-422 Transceiver with ±15kV ESD

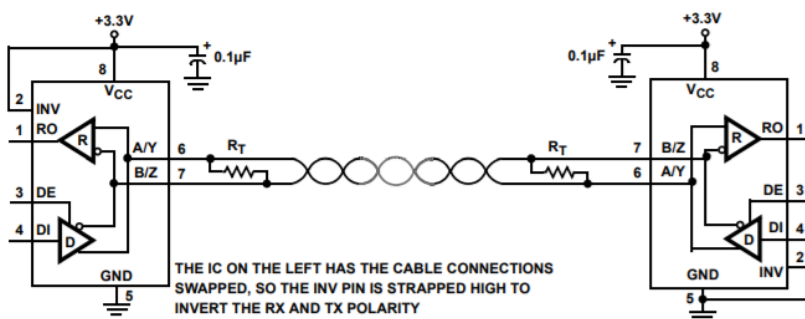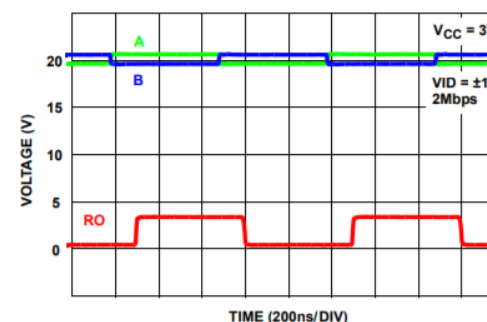| Features	Benefits	Applications
• Fault Protected RS-485 bus pins up to +/- 60V • Extended common-mode range +/-20V • Full fail-safe protection • Cable invert pin corrects for reversed cable connections while maintaining Rx full fail-safe functionality • Driver drives up to 128 unit loads • 20Mbps data rate • 15kV HBM ESD bus-pin protection	• The RS-485 bus pins (driver outputs and receiver inputs) are protected against overvoltages up to ±60V, and against ±15kV ESD strikes. • These transceivers operate in environments with common-mode voltages up to ±20V (exceeds the RS-485 requirement) and provide cable invert functionality, making this RS-485 family one of the most robust on the market. • The device is compatible with 3.3V and 5V input supplies, allowing interface to standard microcontrollers without additional level shifting.	• Utility meters and automated meter reading systems • Air conditioning systems • Security camera networks • Building lighting and environmental control systems • Industrial and process control networks

Typical application and key performances

TYPICAL OPERATION CIRCUIT USING CABLE INVERT FUNCTION

THE IC ON THE LEFT HAS THE CABLE CONNECTIONS SWAPPED, SO THE INV PIN IS STRAPPED HIGH TO INVERT THE RX AND TX POLARITY

>20Mbps EVEN WITH +/-20V COMMON-MODE VOLTAGE

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ELECTRONIC VALVE WITH FLOW METER

- **System benefits**
  - Accurate flow rate meas. through Renesas's high-precision analog/sensor devices
  - Flow control with high performance motor control MCU
  - Enhanced safety and high scalability design

Device Category	P/N	Key Features
MCU	RX23T	RXv2 Core, FPU, DSP, Max to 40 MHz, max 128K RAM, best for inverter control.
MCU	RX231	RXv2 Core, FPU, DSP, 48pin, 256K Flash, Rich Communication.
MCU	RX651	RX V2 Core with up to 2MB FLASH, High-Integration, General Purpose MCU.
Power	ISL85410	1A synchronous buck regulator with an input range of 3V to 40V, with integrated MOSFET
Analog	ISL28134	High precision with zero drift; Rail to Rail input and output; No 1/f noise corner down to 0.1Hz; wide supply range from 2.25V to 6.0V
Sensor	FS1012	Able to measure a gas or liquid medium, high accuracy with 2% of reading (typical), fast response (<5ms); low power application
Analog	ISL32459E	Full fail-safe protection; extended common-mode range +/-20V; fault protected RS-485 bus pins up to +/- 60V; 20Mbps data rate

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