

US110

4-20mA Current Loop System for Industrial Control

October 2019

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■ Overview

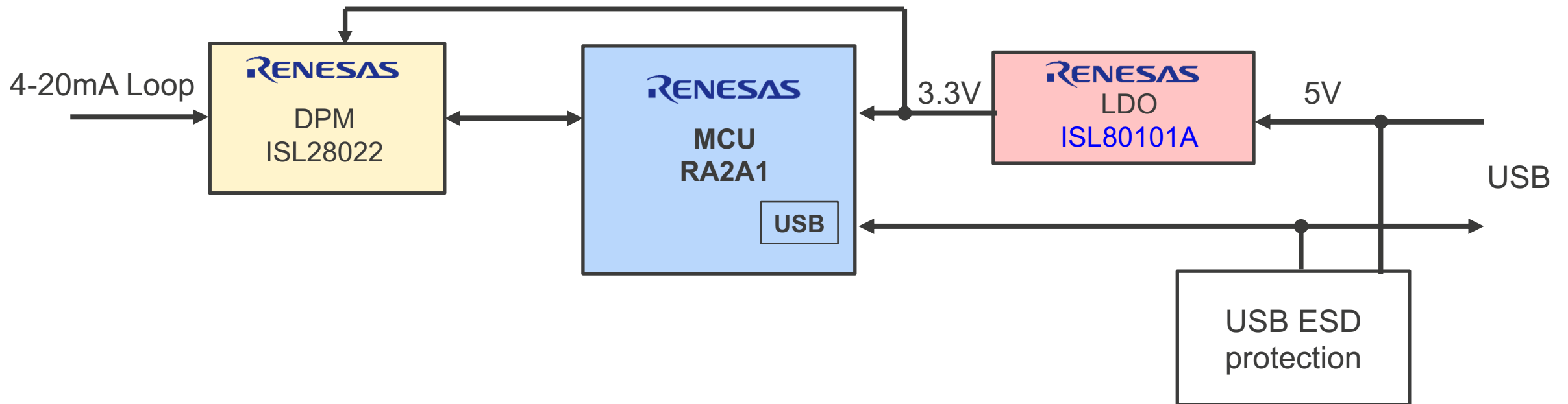
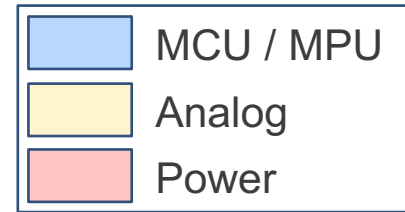
The 4-20mA current loop is the dominate standard for sensor systems in many industries, primarily because it is the simplest option to configure and connect. It also uses less wiring and connections than other signals, therefore reducing overall system cost. In addition, in large locations, it is better for traveling long distances, since current doesn't degrade like voltage does.

This winning combination shows a possible receiver solution with Renesas' precision digital power monitor (DPM), stable power source and low power processing capabilities of the Arm® Cortex-based RA2A1 MCU.

■ System Benefits

- Low power and signal processing features of Renesas' RA2A1 Arm® Cortex®-M23 microcontroller
- Precision digital power monitoring with the ISL28022 and low current consumption
- Stable voltage from Renesas' ISL9001A for low-noise and high-PSRR applications

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Block Diagram #US110
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4-20mA Current Loop System for Industrial Control

Device Category	P/N	Key Features
MCU	RA2A1 R7FA2A1AB3CFM	-MCU RA6 ARM® Cortex® M23 48MHz 256KB Flash 256KB RAM
Power	ISL80101A	High Performance 1A Linear Regulator with Programmable Current Limiting
Analog	ISL28022	Precision Digital Power Monitor

RA2A1 – Ultra-Low Power 48-MHz Arm® Cortex®-M23 Core

Complete Analog Solution for Signal Conditioning and Measurement

High Performance

- 48MHz Arm® Cortex®-M23 CPU

Highly Integrated, High-Accuracy Analog Capabilities

- OPAMP x3
- 24-Bit S/D ADC (10 ch.) /16-Bit SAR ADC (17 ch.)
- 12-Bit DAC (1 ch.)/8-Bit DAC (2 ch.)
- Temperature Sensor (TSN)
- High-Speed Comparator x2
- Low-Power Comparator x2

Communication Interfaces

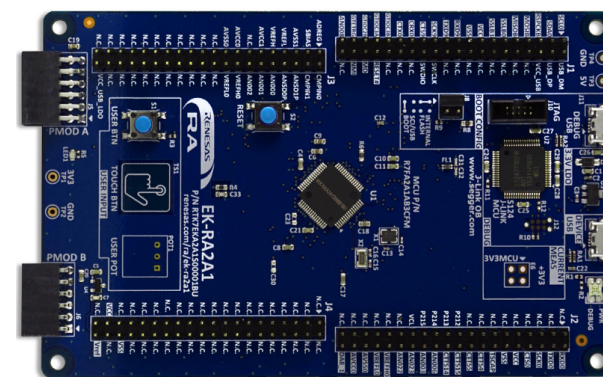
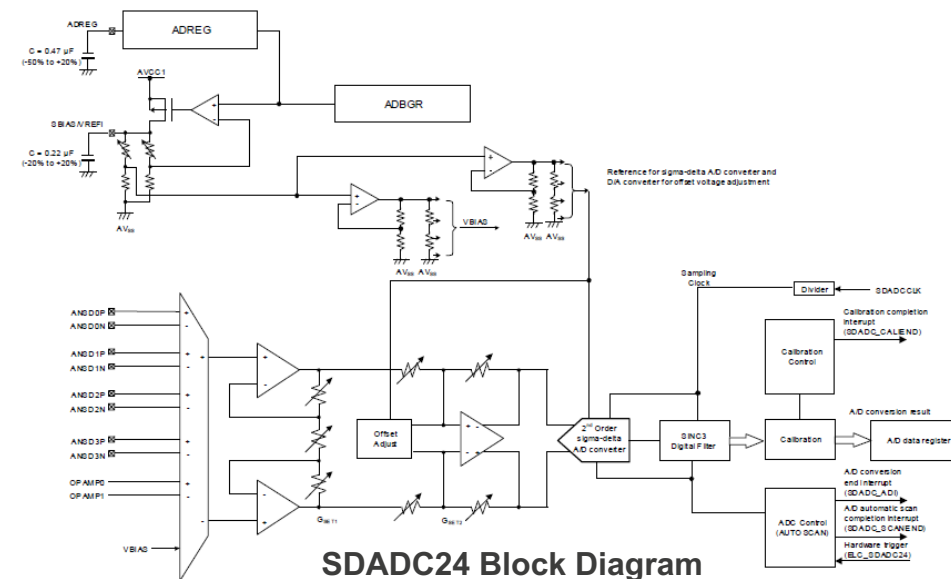
- USB 2.0 (Full Speed)
- CAN
- SCI x3/SPIx2/IICx2

HMI Interface

- Capacitive Touch Sensing Unit (26 ch.)

Wide Voltage and Low Power Consumption

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



RTK7EKA2A1S00001BU

Part #	Flash Memory	RAM	Temp	Package
R7FA2A1AB3CFJ	256KB	32KB	40 ~ 105°C	32 LQFP
R7FA2A1AB3CFM	256KB	32KB	40 ~ 105°C	64 LQFP

ISL80101A – High Performance 1A LDO

Programmable Current-Limited LDO for Telecommunications

Stable Output Voltage

- $\pm 2\%$ Adjustable V_{OUT} accuracy guaranteed over line, load and $T_J = -40-125\text{ }^{\circ}\text{C}$
- High Accuracy current limit programmable up to 1.75A

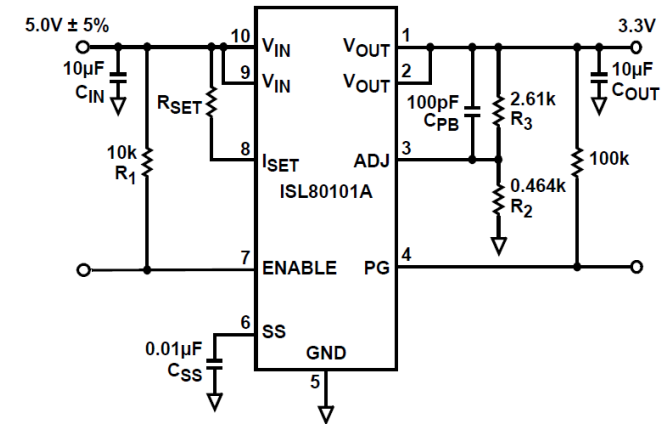
High Performance

- Very low 212mV dropout voltage at $V_{IN}=4.5\text{V}$
- Very fast transient response
- $100\mu\text{V}_{\text{RMS}}$ output noise

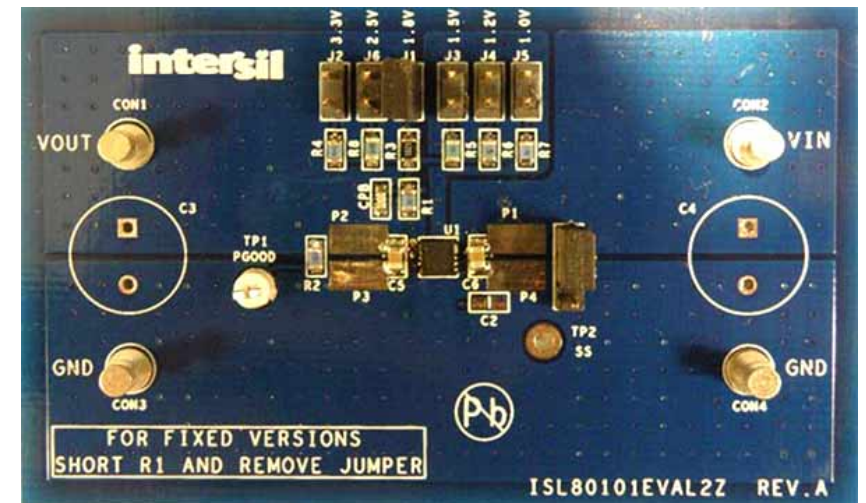
Excellent Safety

- Power good output
- Programmable soft-start
- Over temperature protection

Part #	V_{OUT}	Programmable I_{LIMIT}	Package
ISL80101	1.8V, 2.5V, 3.3V, 5V, ADJ	No	10Ld 3x3 DFN
ISL80101A	0.8-5V	Yes	10Ld 3x3 DFN



Typical Application Circuit



ISL80101EVAL2Z 1A LDO Evaluation Board

ISL28022/23/25 – 60V, 0.05%, Bi-directional DPM

Precision Current, Voltage, Power Sensing AFE with Real Time Alerts

Current, Voltage, Power Monitoring / Sensing

- Current Sense: High-side, Low-side, Bi-directional
- Wide Common-mode Input Voltage Range: 0V to 60V

High Precision

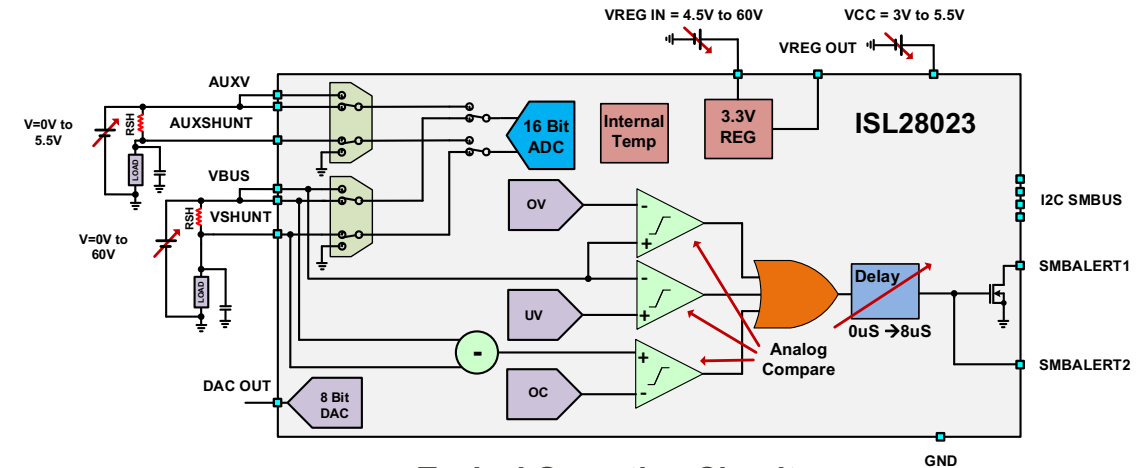
- 16 bit sigma delta ADC
- 0.05% Current and Voltage gain error (ISL28025)

Real time Alerts

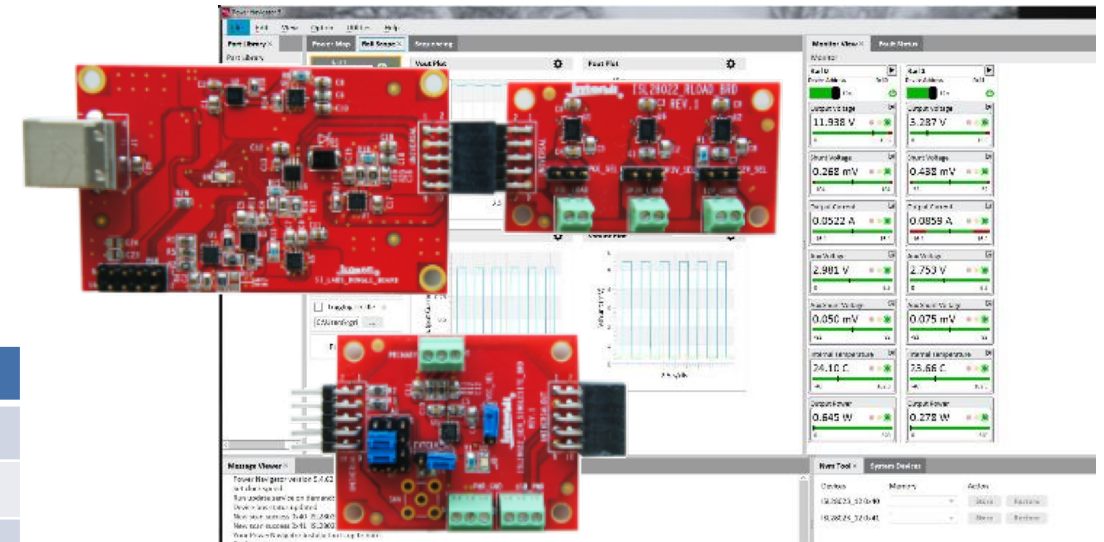
- Over/Under Voltage, Over Current Fault Monitoring
- Programmable delay

Integrated Features

- 3.3V Regulator
- Internal Temp Sensor (1°C accuracy)
- 8 bit DAC (ISL28023/25)



Typical Operating Circuit



Evaluation Kit

Part #	CM V	Ch	DAC	I2C Add	Pkg
ISL28025FI60Z-T7A	60 V	2	No	55	16L 2x2 WLCSP
ISL28023FR60Z-T7A	60 V	2	Yes	55	24L 4x4 QFN
ISL28022FUZ-T7A	60 V	1	No	16	16L 3x3 QFN

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