



**THE DATASHEET OF
HA1630D05TEL-E**



ANALOG ICs

High-performance solutions for precision signal chain design



HIGH-PERFORMANCE SOLUTIONS FOR
PRECISION SIGNAL CHAIN DESIGN

ANALOG ICs



CONTENTS

Design Idea

DAQ on a Stick 04

Integrated Analog Solutions

Digital Power Monitors 05

Amplifiers

Precision OP Amps 06

BIPOLAR & CMOS

Op Amps/Comparators 08

Current Sense Amplifiers 10

High Speed Op Amps 12

Interface

Interface 14

Data Converters

High Speed ADC/DACs 16

Precision Data Converters 17

Voltage References 18

Digital Potentiometers 19

Timing

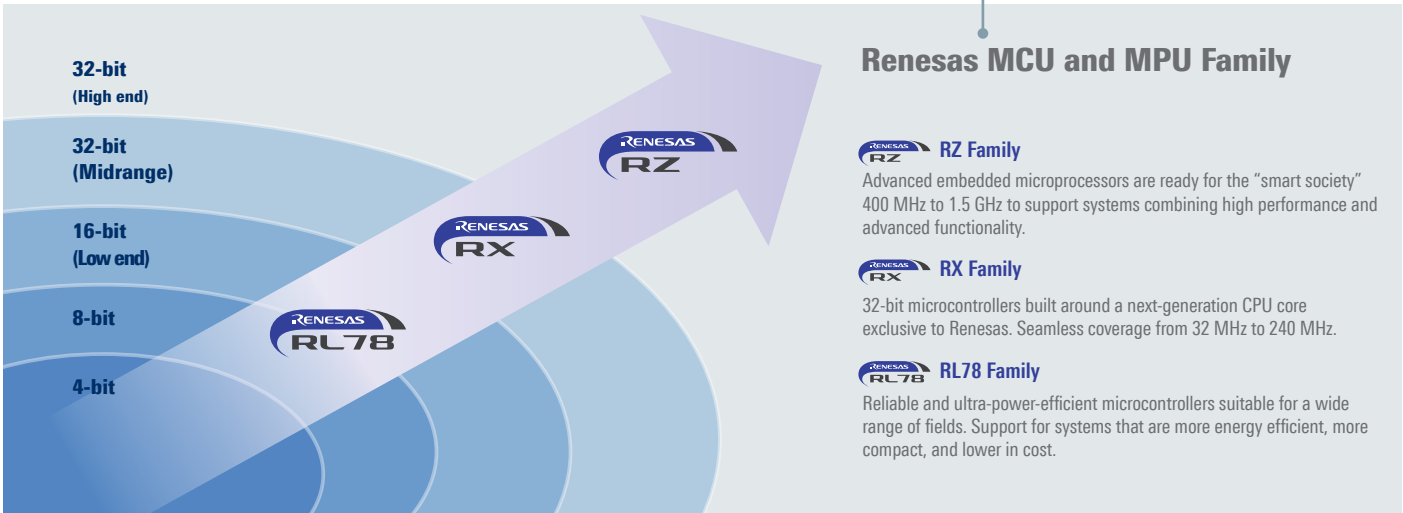
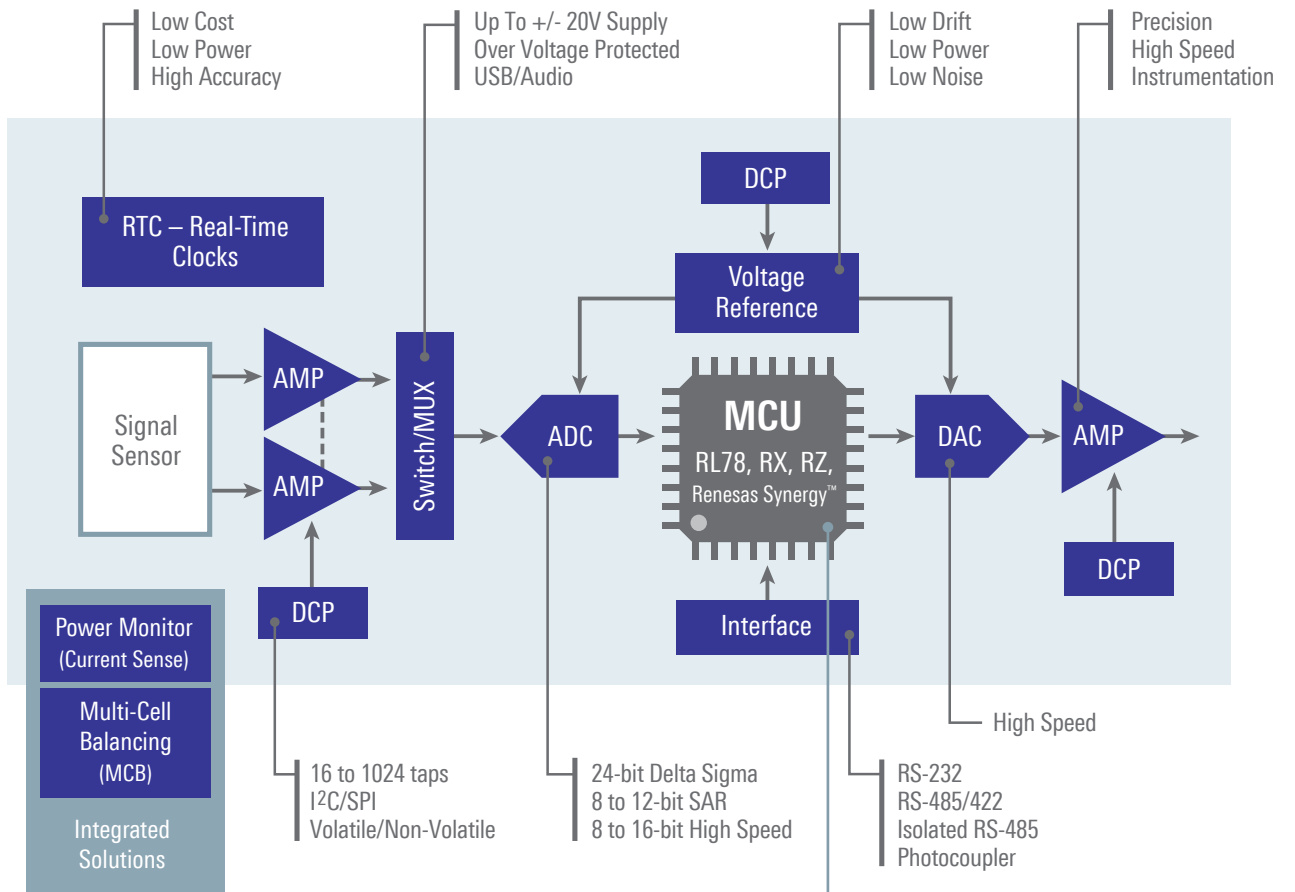
Real-Time Clocks 20

Optoelectronics

Photocouplers 22

Complete Signal Chain Solutions

Renesas' broad precision analog portfolio provides a wide range of next-gen precision instrumentation, medical, communication, and industrial process control applications where innovation, reliability, and dependability is central to the analog designs.



Design Idea

DAQ ON A STICK

Renesas Industrial Signal Chain Solutions

DAQ on a Stick Signal Solutions are snap-in USB sticks that interface strain, temperature or pressure sensors into Renesas' ultra-low power, precision analog products, which are then linearized by our industry-leading microcontrollers. The complete solution—USB plug in, hardware, and software—is ready to go. Simply plug, click, and start collecting data.

The reference solution design incorporates a low power multiplexer, precision instrumentation amplifier, 24-bit sigma-delta ADC, and a precision digital potentiometer to calibrate the system. The RL78 industry-standard microcontroller runs the stick and interfaces the sensor data into any USB port.



RTKA-GAUGE-ENG2Z

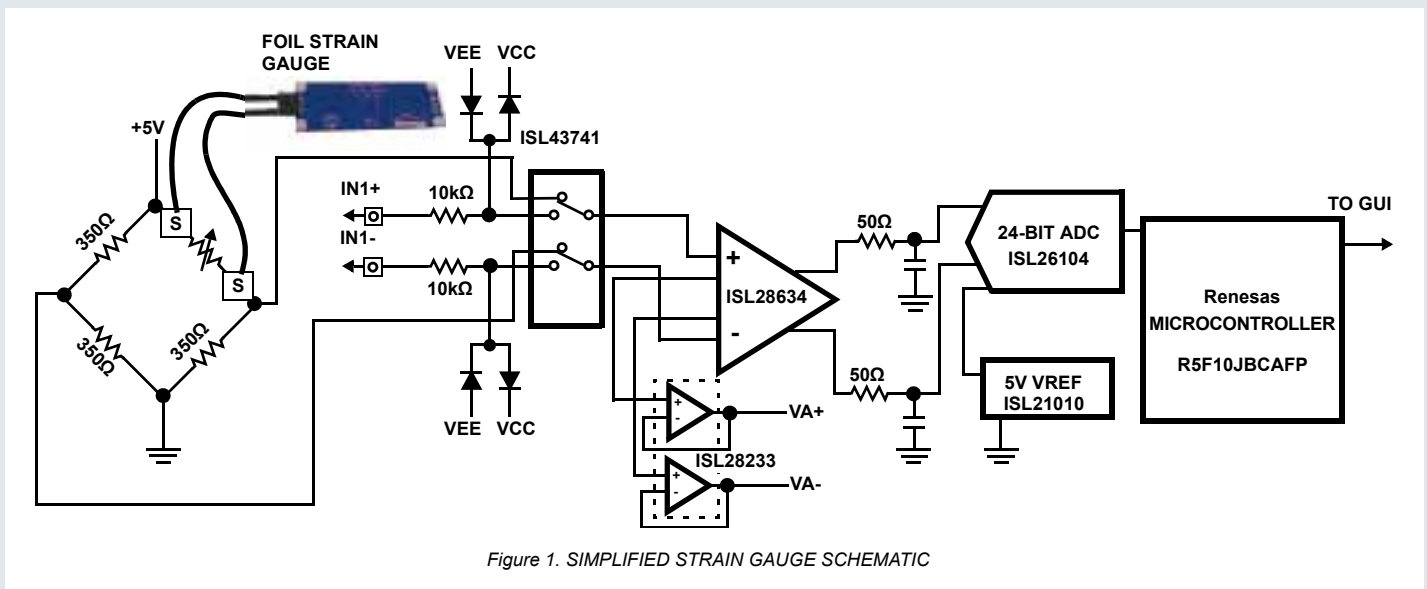


Figure 1. SIMPLIFIED STRAIN GAUGE SCHEMATIC

Key Components

| | |
|-------------|------------------------------|
| ISL28634 | Programmable Gain INAMP |
| ISL28233 | Operational Amplifiers |
| ISL43741 | Differential Mux |
| ISL21010 | 4.096 Voltage Reference |
| ISL26104 | 24-bit Delta Sigma Converter |
| R5F10JBCAFP | Integrated USB Controller |

Reference Documents

- App Note “DAQ on a Stick, Strain Gauge with Programmable Chopper Stabilized IN-Amp”, AN1853
- ISL28634 Data Sheet “5V Zero-Drift Rail-to-Rail Input/Output Programmable Gain Instrumentation Amplifier”
- ISL28233 Data Sheet “Dual Micropower, Zero-Drift, RRIO Operational Amplifier”
- ISL21010 Data Sheet “Micropower Voltage Reference”
- ISL26104 Data Sheet “Low Noise 24-bit Delta Sigma ADC”
- ISL43741 Data Sheet “Low Voltage, Single and Dual Supply, 8 to 1 Multiplexer and Differential 4 to 1 Multiplexer”
- R5F10JBCAFP Data Sheet

To learn more, visit: renesas.com/daq-on-stick

Integrated Analog Solutions

DIGITAL POWER MONITOR



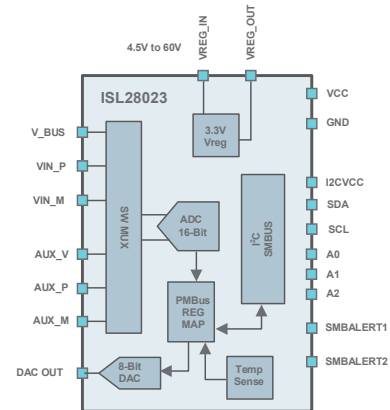
High Voltage Precision Sensing for Current, Voltage, and Power




Integrated Analog Front End for High Voltage Monitoring and Bi-directional Current Sensing

ISL28023/25

The ISL28023/25 digital power monitor is a high-side and low-side digital current sense and voltage monitor with serial interface. The "digital power monitor", or DPM, allows monitoring of power supplies, RF systems, and other high voltage applications.

- Input common mode up to 60V
- High accuracy – 0.05% error (16-bit ADC)
- User defined alerts – OV, UV, OC
- Additional features (margin DAC, voltage regulator, internal temp sensor, auxiliary channel)



| Precision Digital Power Monitors | Basic | Full Featured | Tiny Package |
|--|---|--|---|
| |  ISL28022 |  ISL28023 |  ISL28025 |
| Input Range | 0 to 60V | Opt 1: 0 to 60V Opt 2: 0 to 5.5V | Opt 1: 0 to 60V Opt 2: 0 to 5.5V |
| Primary Channel | Yes | Yes | Yes |
| LV Aux Channel | – | Yes | Voltage Only |
| Internal Temp Sensor | – | Yes | Yes |
| External Temp Sensor | – | Yes | – |
| HV Internal Regulator (3.3Vout) | – | Yes | Yes |
| Fast OC/OV/UV Alert Outputs | – | 2 | 2 |
| Margin DAC | – | Yes | – |
| Slave Addresses Available | 16 | 55 | 55 |
| User Select Conversion Mode/Sample Rate | Yes | Yes | Yes |
| User Select Fixed Period Averaging | – | Yes | Yes |
| Peak Min/Max Current Registers | – | Yes | Yes |
| I ² C/SMBus | Yes | Yes | Yes |
| PMBus | – | Yes | Yes |
| 1.2V I ² C Level Translators | – | Yes | Yes |
| High Speed (3.4 MHz) I ² C Mode | Yes | Yes | Yes |
| External Clock Input | Yes | Yes | Yes |
| Power Shutdown Mode | Yes | Yes | Yes |
| Package | 10 Ld MSOP, 16 Ld QFN | 24 Ld QFN | 16 Ld WLCSP |

Amplifiers

PRECISION OP AMPs

$V_{OS} < 1\text{mV}$ Operational Amplifiers



Unmatched Precision When Accuracy Matters

Zero Drift Amplifiers (Low Voltage Precision Op Amps)

ISL28x33, ISL28x34

Chopper-stabilized amplifiers (Zero Drift Amplifiers) offer one of the best solutions, for achieving the lowest offset voltage and drift. These amplifiers achieve high DC precision through a continuously running calibration mechanism that is implemented on-chip.

Key Features

- Low drift/reduced offset voltage over temperature (typically $< 0.5\text{nV}/^\circ\text{C}$) [Figure 1]
- Low drift/reduced offset voltage over time [Figure 2]
- Low offset voltage/reduced offset voltage (typically $< 1\mu\text{V}$) [Figure 3]
- Low offset voltage over the common mode range and power supply (CMRR & PSRR typically $> 125\text{dB}$) [figure 4]
- Eliminates or no 1/f noise [Figure 5]
- Very high open loop gain

Applications

- Bi-directional current sense
- Temperature measurement
- Medical equipment
- Electronic weigh scales

Low Drift Over Temperature

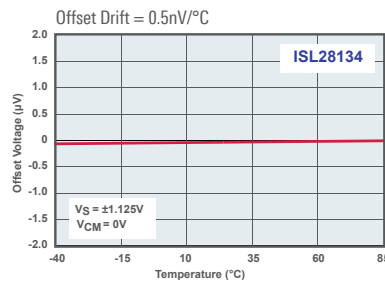


Figure 1. V_{OS} vs Temperature

Low Noise

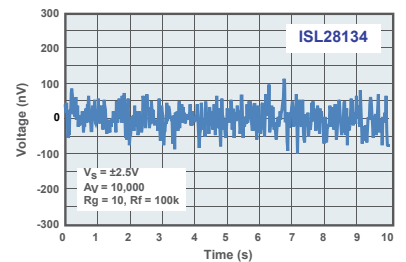


Figure 2. Input Noise Voltage 0.1Hz to 10Hz

Low Offset Voltage

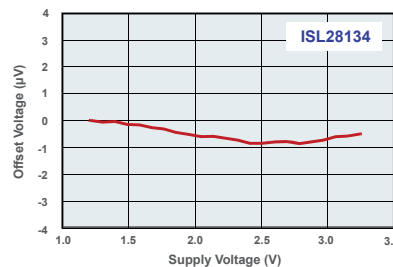


Figure 3. V_{OS} vs Supply Voltage

High CMRR/PSRR

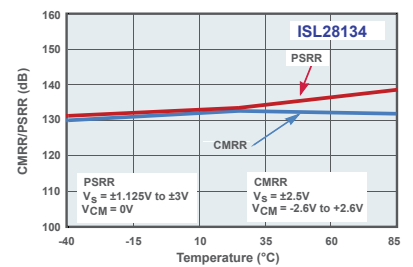


Figure 4. CMRR vs Temperature

No 1/f Noise

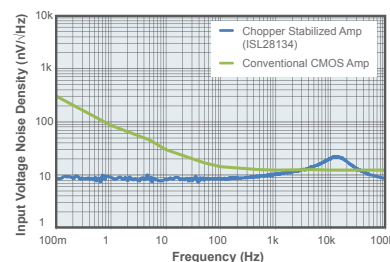


Figure 5. 5V CMOS ISL28134 vs CMOS Amp Noise Voltage Density Comparison

Tiny Package



5 Ld SOT-23 (2.9mmx2.8mm)

Precision Op Amps

| Type | | | | Part Number | | | Supply Voltage (V) | | High Precision | | | Low Power | | Low Noise | |
|----------------------------|------------------|----------------|------------------------|-------------|-----------|-----------|--------------------|-----|----------------|----------------|-------------------|--------------------|----------------|-----------|---------------|
| | | | | | | | | | Offset Voltage | Offset Voltage | TCV _{OS} | Input Bias Current | Supply Current | Slew Rate | Voltage Noise |
| Ultra Precision | Low Noise | Low Power | Low Input Bias Current | Single | Dual | Quad | Min | Max | Max @ 25°C | Max Temp | Max | Max @ 25°C | Max Temp | V/μs | @ 1kHz |
| Low Voltage | | | | | | | | | | | | | | | |
| ● (Zero-drift) | ● | | ● | ISL28134 | – | – | 2.25 | 6 | 2.5μV | 3.4μV | 15nV/°C | 300pA | 1.05mA | 1.5 | 10nV/√Hz |
| ● (Zero-drift) | | ● | ● | ISL28133* | ISL28233 | ISL28433 | 1.8 | 5.5 | 6μV | 11μV | 50nV/°C | 180pA | 35μA | 0.2 | 65nV/√Hz |
| ● | | ● | ● | ISL28130 | ISL28230 | ISL28430 | 1.8 | 5.5 | 40μV | 55μV | 150nV/°C | 250pA | 35μA | 0.2 | 65nV/√Hz |
| | | | | ISL28136 | ISL28236 | – | 2.4 | 5.5 | 150μV | 270μV | – | 35nA | 1.4mA | 1.9 | 15nV/√Hz |
| | | ● | ● | ISL28158 | – | – | 2.4 | 5.5 | 300μV | 650μV | – | 30pA | 55μA | 0.1 | 64nV/√Hz |
| | ● | | | ISL28191 | ISL28291 | – | 3 | 5.5 | 630μV | 840μV | – | 6μA | 3.9mA | 17 | 1.7nV/√Hz |
| | ● (Lowest Noise) | | | – | ISL28290 | – | 3 | 5.5 | 700μV | 900μV | – | 16μA | 13mA | 50 | 1nV/√Hz |
| | | | ● | – | ISL28288 | ISL28488 | 2.4 | 5.5 | 1.5mV | 2mV | – | 30pA | 175μA | 0.14 | 48nV/√Hz |
| | | | ● | ISL28148 | ISL28248 | – | 2.4 | 5.5 | 1.8mV | 2mV | – | 30pA | 1.4mA | 4 | 28nV/√Hz |
| | | ● (Nano-Power) | ● | ISL28194 | – | – | 1.8 | 5.5 | 2mV | 2.5mV | – | 80pA | 500nA | 0.0012 | 265nV/√Hz* |
| | | | ● | ISL28113 | ISL28213 | ISL28413 | 1.8 | 5.5 | 5mV | 6mV | 10μV/°C | 20pA | 170μA | 1 | 55nV/√Hz |
| | | | ● | ISL28114 | ISL28214 | ISL28414 | 1.8 | 5.5 | 5mV | 6mV | 10μV/°C | 20pA | 400μA | 2.5 | 40nV/√Hz |
| High Voltage (PR40) | | | | | | | | | | | | | | | |
| ● | ● | | | ISL28117B | ISL28217B | ISL28417B | 4.5 | 40 | 50μV | 110μV | 0.6μV/°C | 1nA | 680μA | 0.5 | 8nV/√Hz |
| ● | ● | | | ISL28127 | ISL28227 | – | 4.5 | 40 | 70μV | 120μV | 0.5μV/°C | 10nA | 3.7mA | 3.6 | 2.5nV/√Hz |
| ● | | | ● | ISL28107 | ISL28207 | ISL28407 | 4.5 | 40 | 75μV | 140μV | 0.65μV/°C | 300pA | 350μA | 0.32 | 13nV/√Hz |
| | ● | | | ISL28118 | ISL28218 | – | 3 | 40 | 150μV | 270μV | 1.2μV/°C | 575nA | 1.4mA | 1.2 | 5.6nV/√Hz |
| | | | | ISL28108 | ISL28208 | ISL28408 | 3 | 40 | 150μV | 330μV | 1.1μV/°C | 43nA | 1.4mA | 0.45 | 15.8nV/√Hz |
| | ● | | ● (JFET Input) | ISL28110 | ISL28210 | – | 9 | 40 | 300μV | 1.3mV | 10μV/°C | 2pA | 3.8mA | 20 | 6nV/√Hz |
| | ● | | | ISL28177 | – | – | 4.5 | 40 | 150μV | 250μV | 1.4μV/°C | 1nA | – | 0.2 | 9.5nV/√Hz |
| | ● | | | – | ISL28325 | ISL28345 | 5 | 40 | 1mV | – | 15μV/°C | 5nA | – | 0.4 | 9nV/√Hz |

* Check Data Sheet Conditions

Amplifiers

BIPOLAR & CMOS OP AMPs/COMPARATORS

Op Amps to Solve Your Design Challenges

Design Challenge #1

Energy Saving Product



- High demand for developing energy-saving products
- Adoption of energy-saving sensors such as current sensor, pressure sensor, gas sensor

Renesas Op Amp Solution

Renesas provides a full range of input and output CMOS high precision amplifier products to meet the industry-demanding requirements of accurate sensing.

| Type | V _{DD} | V _{IO} max. | SR typ. | I _s typ. | Rail-to-Rail | Dual | Quad |
|----------------|-----------------|----------------------|----------|---------------------|----------------|--|-------------|
| Low Power | 1.8 to 5.5V | ±6mV | 0.35V/μs | 1mA | Input & Output | READ2351JSP (Industrial/Automotive) | Coming soon |
| High Slew Rate | 2.5 to 5.5V | ±6mV | 8V/μs | 10mA | Input & Output | READ2302GSP (General purpose) READ2352JSP (Industrial/Automotive) | Coming soon |

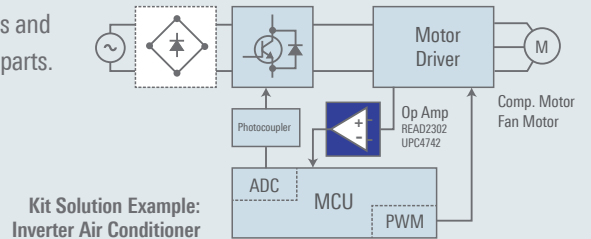
Design Challenge #2

Short Development Time



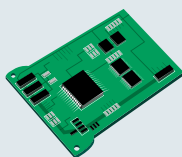
Renesas Op Amp Solution

Renesas provides total kit solutions for MCU and op amp products. Simplify the design process and reduce development turnaround time by utilizing the provided circuit diagrams and recommended parts.



Design Challenge #3

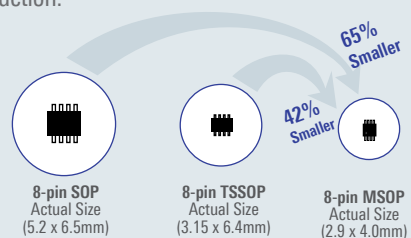
BOM Size

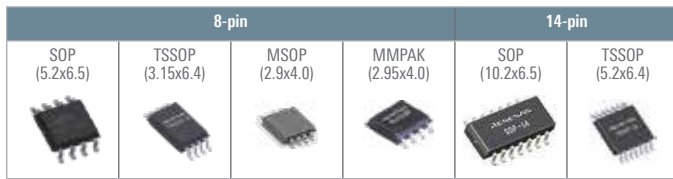


- Complex ecosystem on battery-powered small applications

Renesas Op Amp Solution

Renesas is expanding to include small MSOP package option to achieve mount area reduction.





CMOS Operational Amplifiers

| Type | Rail-to-Rail | Part Number | Power Supply Voltage (V) | V _{IO} (max) (mV) | I _{DD} (typ) (μA/ch) | SR typ (V/μs) | Channels | Package |
|----------------|--------------|--------------------------------------|--------------------------|----------------------------|-------------------------------|---------------|----------|-------------|
| Low power | Input/output | READ2351J (Industrial/Automotive) | 1.8 to 5.5 | ±6 | 40 | 0.35 | 2 | 8-pin TSSOP |
| High slew rate | Input/output | READ2302G (General purpose) | 2.5 to 5.5 | ±6 | 750 | 8 | 2 | 8-pin TSSOP |
| | Input/output | READ2352J (Industrial/Automotive) | 2.5 to 5.5 | ±6 | 750 | 8 | 2 | 8-pin TSSOP |

Bipolar Operational Amplifiers

| Type | Part Number | | Power Supply Voltage (V) | V _{IO} (max) (mV) | I _{CC} (max) (mA) | SR (typ) (V/μs) | Channels | Package |
|---------------------|-------------|-----------------|--------------------------|----------------------------|----------------------------|-----------------|-----------------|------------------|
| | Industrial | General Purpose | | | | | | |
| Single power supply | uPC451 | – | 3 to 30 | ±7 | 2 | 0.3 | 4 | 14-pin SOP/TSSOP |
| | uPC452 | uPC3403 | 3 to 32 | ±7 | 7 | 0.8 | 4 | 14-pin SOP |
| | uPC842 | uPC4742 | 3 to 32 | ±5 | 4.5 | 7 | 2 | 8-pin SOP/TSSOP |
| | uPC844 | uPC4744 | 3 to 32 | ±5 | 9 | 7 | 4 | 14-pin SOP/TSSOP |
| | uPC1251 | – | 3 to 30 | ±7 | 1.2 | 0.3 | 2 | 8-pin SOP/TSSOP |
| Low noise | uPC258 | uPC4558 | ±4 to ±16 | ±6 | 5.7 | 1 | 2 | 8-pin SOP |
| | uPC259 | uPC4560 | ±4 to ±16 | ±6 | 5.7 | 2.8 | 2 | 8-pin SOP |
| | uPC458 | uPC4741 | ±4 to ±16 | ±5 | 7 | 1 | 4 | 14-pin SOP |
| | – | uPC4570 | ±4 to ±16 | ±5 | 8 | 7 | 2 | 8-pin SOP/TSSOP |
| | – | uPC4572 | ±2 to ±7 | ±5 | 7 | 6 | 2 | 8-pin SOP |
| – | uPC4574 | ±4 to ±16 | ±5 | 12 | 6 | 4 | 8-pin SOP/TSSOP | |
| J-FET | uPC811 | – | ±5 to ±16 | ±2.5 | 3.4 | 15 | 1 | 8-pin SOP/TSSOP |
| | uPC812 | uPC4092 | ±5 to ±16 | ±3 | 6.8 | 15 | 2 | 8-pin SOP/TSSOP |
| | uPC813 | – | ±5 to ±16 | ±2.5 | 3.5 | 25 | 1 | 8-pin SOP/TSSOP |
| | uPC814 | uPC4094 | ±5 to ±16 | ±3 | 6.8 | 25 | 2 | 8-pin SOP/TSSOP |
| | uPC822 | uPC4072 | ±5 to ±16 | ±10 | 5 | 13 | 2 | 8-pin SOP/TSSOP |
| | uPC824 | uPC4074 | ±5 to ±16 | ±10 | 10 | 13 | 4 | 14-pin SOP/TSSOP |
| | uPC832 | uPC4062 | ±2 to ±16 | ±10 | 0.5 | 3 | 2 | 8-pin SOP/TSSOP |
| | uPC834 | uPC4064 | ±2 to ±16 | ±10 | 1 | 3 | 4 | 14-pin SOP/TSSOP |
| | uPC835 | – | ±5 to ±16 | ±3 | 2.2 | 5.5 | 2 | 8-pin TSSOP |
| Low power | uPC802 | – | ±1 to ±16 | ±6 | ≤0.1 | ≤1.0 | 1 | 8-pin SOP |
| General | uPC251 | uPC1458 | ±7.5 to ±16 | ±6 | 5.6 | 0.5 | 1 | 8-pin SOP |

Bipolar Comparators

| Type | Part Number | | Power Supply Voltage (V) | V _{IO} (max) (mV) | I _{CC} (max) (mA) | Tr/Tf (typ) (μs) | Channels | Package |
|---------|-------------|-----------------|--------------------------|----------------------------|----------------------------|------------------|----------|------------------|
| | Industrial | General Purpose | | | | | | |
| General | uPC177 | – | 2 to 32 | ±5 | 2 | 1.3 | 4 | 14-pin SOP/TSSOP |
| | uPC271 | – | 5 to 32 | ±7.5 | 7.5 | 0.2 | 1 | 8-pin SOP |
| | uPC272 | uPC319 | 5 to 16 | ±8 | 12.5 | 0.08 | 2 | 14-pin SOP |
| | uPC277 | – | 2 to 32 | ±5 | 1 | 1.3 | 2 | 8-pin SOP/TSSOP |

• Industrial: Products with extended temperature tolerances (125°C).

Amplifiers

CURRENT SENSE AMPLIFIERS

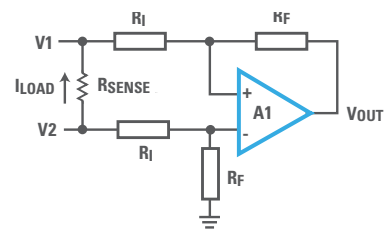
Simplify the Design of Complex Current Monitoring Circuits

Current sense amplifiers (also called current shunt amplifiers) are special-purpose operational amplifiers (op amps) that output a voltage proportional to the current flowing in a power rail. They utilize a "sense resistor" to convert the load current in the power rail to a small voltage, which is then amplified by the current sense amplifier. Renesas offers both discrete and integrated solutions.

Discrete Solution

Precision Op Amps For Current Sensing

A basic current sense amplifier is set up as a differential amplifier. The amp will reject the common mode voltage across V1 and V2, amplifying only the difference across the sense resistor (Eq. 1). Using Ohm's Law, substitute the delta V with the load current times the series resistance in Eq. 2, and solve for the load current (Eq. 3).



- A1 configured as differential amplifier
- Voltage across sense resistor amplified by A1
- Gain = R_F/R_I
- Amplifier rejects VCM across V1 and V2

$$\text{Eq. 1: } V_{OUT} = (R_F/R_I) * [V2-V1]$$

$$\text{Eq. 2: } V_{OUT} = (R_F/R_I) * [I_{LOAD} * R_{SENSE}]$$

$$\text{Eq. 3: } I_{LOAD} = (R_I/R_F) * [V_{OUT} * R_{SENSE}]$$

Most Common Discrete Solutions

| Type | Part Number | TCV _{OS} | V _{OS} Max @ 25°C | Notes |
|---------------|--------------|-------------------|----------------------------|-----------------------|
| Low Noise | ISL28290 | – | 700μV | Low cost (low side) |
| Low Drift | ISL28x30 | 150nV/°C | 40μV | Good – still low cost |
| Zero Drift | ISL28x33 | 75nV/°C | 8μV | Great |
| Zero Drift | ISL28x34 | 15nV/°C | 2.5μV | World Class |
| Standard CMOS | ISL28113/114 | 2000nV/°C | 5mV | |
| BJT | ISL28136 | 400nV/°C | 150μV | |

Generic Solution vs. Renesas High Precision Solution

Low offset voltage op amp in the sensing circuit allows for a much lower sense resistor and less wasted power.

Example – 20mA Resolution, 5A Full Current

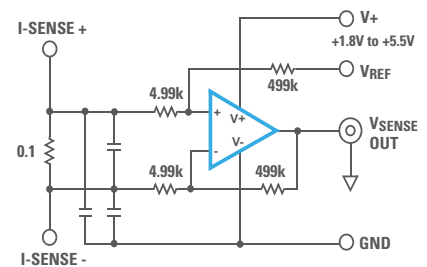
| Solution | V _{OS} | R _{sense} | R _{sense} Power Loss | Renesas Benefits |
|----------|-----------------|--------------------|-------------------------------|---------------------------------|
| Generic | 500μV | 25mΩ | 625mW | – |
| ISL28x30 | 40μV | 2mΩ | 50mW | 92% reduction in wasted power |
| ISL28x34 | 2.5μV | 125μΩ | 3mW | 99.5% reduction in wasted power |

Micropower, Low Drift, RRIO Operational Amplifiers



ISL28x30

- Ideal for low power high-side or low-side current sense applications
- 40μV max offset voltage
- 1.8V to 5.5V supply voltage
- Low quiescent power consumption 20μA (typ)



Bi-Directional Current Sense Amplifier

Integrated Solution

The Simplest Type of Current Sense Amplifiers

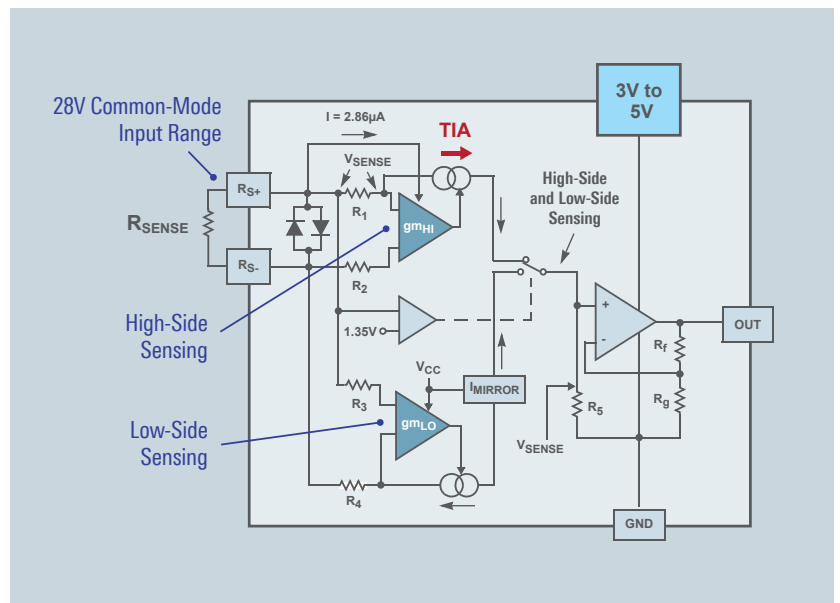
The ISL28005 and ISL28006 are ground sensing current sense amplifiers that amplify milli-volt current signals developed across sub- 1Ω sense resistors. The simplest type of current sense amplifiers use single-stage op amp circuits that take their power from the same voltage source that generates the current to be measured.

Micropower, Current Sense Amplifier with Voltage Output



ISL28005/6

- High- or low-side uni-direction current sense
- Low power consumption, $50\mu\text{A}$ (typ)
- TIA Architecture:
 - Input sense voltage converted to current
 - Current fed into 5V TIA for ADC drive
 - Constant 100kHz BW across gain
- Internal fixed gain for high accuracy and low TCV_{OS}



Current Sense Amplifiers

| Part Number | Supply Voltage Range | Input Common Mode Range | V_{OS} max @ 25°C | V_{OS} Max Temp | CMRR Min Temp | PSRR Min Temp | Gain Range | Gain Accuracy @ 25°C | Gain Accuracy Temp | I_{S} Max @ 25°C | I_{S} Max Temp | Package |
|-------------|----------------------|-------------------------|--|--------------------------|---------------|---------------|---------------------------|------------------------------------|--------------------|---|-------------------------|--------------------------|
| | V | V | μV | μV | dB | dB | V/V | % | % | μA | μA | |
| ISL28005 | 2.7 to 28 | 0 to 28 | 500 | 500 | 105 | 90 | 20, 50, 100 | 2 | 3 | 59 | 59 | 5 Ld SOT-23 |
| ISL28006 | 2.7 to 28 | 0 to 28 | 250 | 300 | 105 | 90 | 20, 50, 100, Adj (20-100) | 0.7 | 1 | 62 | 62 | 5 Ld SOT-23, 6 Ld SOT-23 |

Amplifiers

HIGH SPEED OP AMPS

Renesas' high speed op amp portfolio delivers best-in-class performance-to-power ratio with superior drive and slew rate performance at full bandwidths. This makes our operational amplifiers the perfect choice for video and high speed data transmission, A/D buffering, and high frequency filtering.

Unmatched SFDR-to-Power Ratio

ISL55210, ISL55211

The ISL55210 is a very wide band, voltage feedback, fully differential amplifier (FDA) intended for high dynamic range ADC input interface applications. This voltage feedback FDA design includes an independent output common mode voltage control.

Intended for very high dynamic range ADC interface applications at the lowest quiescent power (115mW), the ISL55210 offers a 4.0GHz gain bandwidth product with a very low input noise of $0.85\text{nV}/\sqrt{\text{Hz}}$.

In a balanced differential I/O configuration, with $2\text{V}_{\text{P-P}}$ output into a 200Ω load configured for a gain of 15 dB, the IM3 terms are $\leq 100\text{dBc}$ through 110MHz. With a minimum operating gain of $2\text{V}/\text{V}$ (6dB), the ISL55210 supports a wide range of higher gains with minimal BW or SFDR degradation. Its ultra-high differential slew rate of $5,600\text{V}/\mu\text{s}$ ensures clean large signal SFDR performance or a fast settling step response.

Key Features

- Gain bandwidth product: 4.0GHz
- Input voltage noise: $0.85\text{nV}/\sqrt{\text{Hz}}$
- Differential slew rate: $5,600\text{V}/\mu\text{s}$
- $2\text{V}_{\text{P-P}}$, 2-tone IM3 (200Ω) 100MHz: -109dBc
- Supply voltage range: 3.0V to 4.2V
- Quiescent power (3.3V supply): 115mW

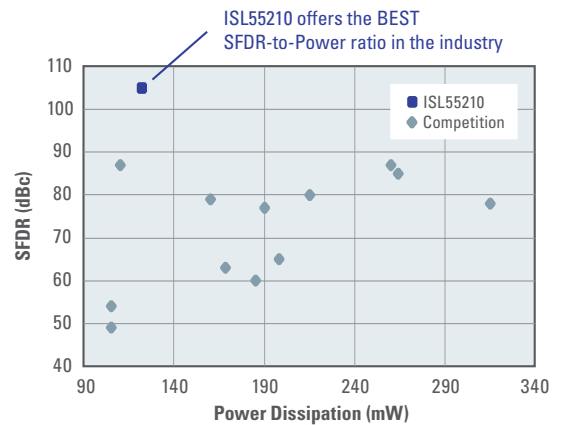
Applications

- Low power, high dynamic range ADC interface
- Differential mixer output amplifier
- SAW filter pre/post driver
- Differential comms-DAC output driver

Fully Differential Amplifiers

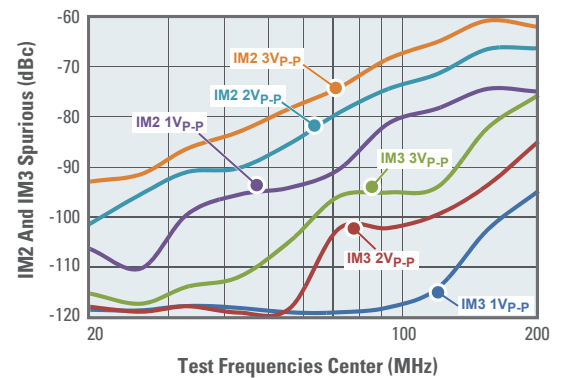
| Part Number | # of Channels | Topology | V _S Min (V) | V _S Max (V) | BW (MHz) | Gain (V/V) | Slew Rate (V/ μsec) | Noise (nV/ $\sqrt{\text{Hz}}$) | I _S Max (mA) | I _{OUT} (mA) | V _{OS} Max (mV) | I _B Max (μA) | RR In | RR Out | Headroom (V) | Shutdown |
|-------------|---------------|----------|------------------------|------------------------|----------|------------|---------------------------------|---------------------------------|-------------------------|-----------------------|--------------------------|--------------------------------------|-------|--------|--------------|----------|
| ISL55210 | 1 | FDA | 3 | 4.2 | 4000 | RES | 5600 | 0.85 | 38.5 | 30 | 1.6 | 140 | No | No | 1 | Yes |
| ISL55211 | 1 | FDA | 3 | 4.2 | 1400 | 2, 4, 5 | 5600 | 0.85 | 38.5 | 30 | 1.6 | 140 | No | No | 1 | Yes |

World Best SFDR at Lowest Power



Ultra-low Distortion

Suitable for driving high speed ADCs in first and higher Nyquist zone applications



High Speed Op Amps

| Part Number | | | | Tech | Supply Voltage (V) | | Min Gain | Bandwidth | | Slew Rate (V/ μ s) | Voltage Noise @ 10kHz (nV/ \sqrt Hz) | V _{OS} Max @ 25°C (mV) | I _S Max @ 25°C (mA) | Package | | | |
|---|-------------------|-----------|----------|--------------|--------------------|-------|--------------------|----------------------|-------------|------------------------|--|---------------------------------|--------------------------------|----------------------------------|-------------------------|------------------|---------|
| Single | Dual | Triple | Quad | | Min | Max | | -3dB (MHz) | 0.1dB (MHz) | | | | | Single | Dual | Triple | Quad |
| Rail-to-Rail, Voltage Feedback Amplifiers | | | | | | | | | | | | | | | | | |
| EL8101 | EL8201 | – | – | VFA | 3 | 5/5.5 | 1 | 200 | 20 | 200 | 10 | 6 | 2.4 | SOIC-8, SOT23-6, SOT23-5 | MSOP-10, SOIC-8 | – | – |
| – | – | EL8302* | – | VFA | 3 | 5.5 | 1 | 500 | 35/36 | 600 | 12 | 8/7 | 6.2 | – | – | SOIC-16, QSOP-16 | – |
| Current Feedback Amplifiers | | | | | | | | | | | | | | | | | |
| EL5160* EL5161 | – | – | – | CFA | 5 | 10 | 1 | 200 | 10 | 1700/1300 | 4 | 5 | 0.85 | SOIC-8, SOT23-6, SOT23-5 | – | – | – |
| EL5162* EL5163 | EL5262* EL5263 | EL5362* | EL5462 | CFA | 5 | 12 | 1 | 500 | 30 | 4000/2500 | 3 | 5 | 2 | SOIC-8, SOT23-6, SC70-5, SOT23-5 | MSOP-10, SOIC-8, MSOP-8 | SOIC-16, QSOP-16 | SOIC-14 |
| EL5164* EL5165 | – | EL5364* | – | CFA | 5 | 12 | 1 | 600 | 50 | 4700 | 2.1 | 5 | 4.2 | SOIC-8, SOT23-6, SOT23-5 | – | SOIC-16, QSOP-16 | – |
| EL5166* EL5167 | – | – | – | CFA | 5 | 12 | 1 | 1.4GHz | 100 | 6000 | 1.7 | 5 | 9.3 | SOIC-8, SOT23-6, SC70-5, SOT23-5 | – | – | – |
| Slew Enhanced, Voltage Feedback Amplifiers | | | | | | | | | | | | | | | | | |
| – | EL5202* EL5203 | – | – | VFA | 3 | 10 | 1 | 400 | – | 2200 | 12 | 5 | 5.8 | – | MSOP-10, SOIC-8, MSOP-8 | – | – |
| EL5104* EL5105 | EL5204* EL5205 | – | – | VFA | 4 | 13 | 1 | 700 | – | 3000 | 10 | 10/18 | 11 | SOIC-8, SOT23-6, SOT23-5 | MSOP-10, SOIC-8, MSOP-8 | – | – |
| High Voltage (Up to 30V) | | | | | | | | | | | | | | | | | |
| ISL55001 | ISL55002 | – | ISL55004 | VFA | 5 | 30 | 1 | 200, 220 | – | 280/300 | 12 | 3 | 9.25 | SOIC-8 | SOIC-8 | – | SOIC-14 |
| Fully Differential Amplifiers | | | | | | | | | | | | | | | | | |
| ISL55210, ISL55211 | – | – | – | FDA | 3 | 4.2 | RES/ 2, 4, 5 | 4GHz, 1.4GHz | – | 5600 | 0.85 | 1.6 | 38.5 | TQFN-16 | – | – | – |
| Fixed Gain Amplifiers | | | | | | | | | | | | | | | | | |
| EL5106* | – | EL5306* | – | Gain | 5 | 12 | Fixed: +1,+2,-1 | 350 | 20 | 4500 | 2.8 | 10 | 1.82 | SOT23-6 | – | SOIC-16, QSOP-16 | – |
| – | – | EL5308* | – | Gain | 5 | 12 | Fixed: +1,+2,-1 | 450 | 40 | 4500 | 2 | 8 | 4.35 | – | – | SOIC-16, QSOP-16 | – |
| – | – | ISL55033* | – | Gain | 3 | 5.5 | Fixed: +2, +4 | 400 | 40/60 | 2350/2500 | 35/50 | 9/10 | 8.5 | – | – | TQFN-12 | – |
| Differential Line Drivers/Receivers | | | | | | | | | | | | | | | | | |
| Drivers | | | | | | | | | | | | | | | | | |
| EL5170* | – | – | – | Diff | 4.75 | 11 | 2 | 100 | 12 | 1100 | 28 | 25 | 8.4 | SOIC-8, MSOP-8 | – | – | – |
| EL5171 | – | – | – | Diff | 4.75 | 11 | 2 | 250 | 50 | 700/800 | 26 | 25 | 8.2 | SOIC-8 | – | – | – |
| – | – | EL5373* | – | Diff | 4.75 | 11 | 2 | 450 | 60 | 900/1100 | 25 | 30 | 14 | – | – | QSOP-24 | – |
| EL5174 | – | – | – | Diff | 4.75 | 11 | 2 | 550 | 120 | 1100 | 21 | 25 | 14 | SOIC-8 | – | – | – |
| EL5177* | – | – | – | Diff | 4.75 | 11 | ADJ | 550 | 120 | 1100 | 21 | 25 | 14 | MSOP-10 | – | – | – |
| – | – | EL5378* | – | Diff | 4.75 | 11 | 2 | 700 | 45 | 850/1000 | 18 | 30 | 14 | – | – | QSOP-28 | – |
| Receivers | | | | | | | | | | | | | | | | | |
| EL5172* | – | – | – | Diff | 4.75 | 11 | ADJ | 250 | 25 | 800 | 26 | 25 | 7 | SOIC-8, MSOP-8 | – | – | – |
| EL5175* | – | EL5375* | – | Diff | 4.75 | 11 | ADJ | 550 | 60 | 900 | 21 | 30/40 | 11 | SOIC-8, MSOP-8 | – | QSOP-24 | – |
| RF Gain Block/Amps | | | | | | | | | | | | | | | | | |
| ISL55012, ISL55014, ISL55015 | – | – | – | Single-ended | 3 | 5.5 | 18, 17.2, 13.5 | 2.4, 2.75, 2.9GHz | – | – | – | – | 63.5, 63 | SC70-6 | – | – | – |
| ISL55016 | – | – | – | Diff | 4.5 | 5.5 | 17.1 | 2.2GHz | – | – | – | – | 104 | TDFN-6 | – | – | – |

* = With enable pin

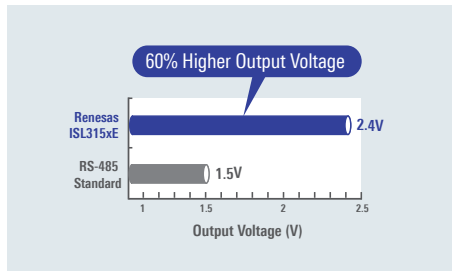
Interface

INTERFACE



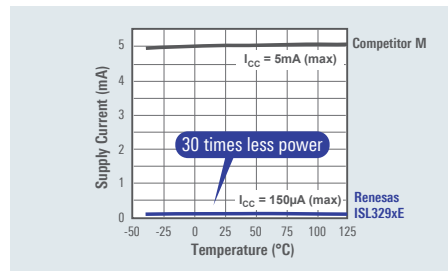
High Noise Immunity

Provides enhanced noise immunity and can drive longer cable lengths or more cable terminations.



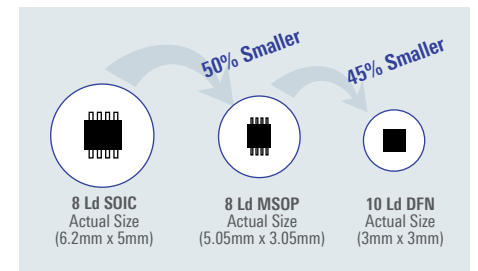
Ultra Low Supply Current

ISL328xE and ISL329xE draw 30 times less power than competitive device.



Space-Saving Small Package

Reduced package size enables smaller, more compact products.



Broad Portfolio to Fit Your Needs

| RS-232 | RS-232/RS-485 | Isolated RS-485 |
|--|---|--|
| | | |
| <ul style="list-style-type: none"> Single Transceiver (1 Tx/1 Rx) Dual Transceivers (2 Tx/2 Rx) Dual Transceivers + Extra Receiver (2 Tx/3 Rx) Triple Transceivers (3 Tx/3 Rx) 8-Channel Transceivers (5 Tx/3 Rx) 8-Channel Transceivers (3 Tx/5 Rx) | <ul style="list-style-type: none"> Standard 5V/3V RS-485 Transceivers Ultra-Low Power RS-485 Transceivers ISL3260XE 1.8V to 3.3V, Micro-Power $\pm 15kV$ ESD Overtoltage Protected RS-485 Transceivers Dual Protocol Transceivers <ul style="list-style-type: none"> – Programmable ISL813xx, ISL413xx, ISL333x – Fixed ISL333xxE (See next page) | <ul style="list-style-type: none"> 40Mbps, Ultra-low EMI Isolated RS-485 Transceiver ISL32740E/41E Industry's Smallest Package Isolated RS-485 Transceiver ISL32704E (See next page) |

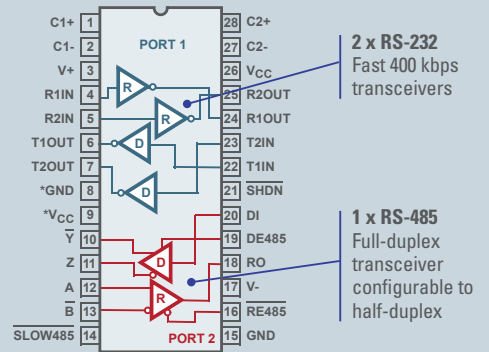
Dual Protocol Transceivers

Two-Port, Dual Protocol Transceivers Allow Designers to Replace Two Chips with a Single Device

ISL3333xE/5xE

- Fixed-port devices
 - Simpler device that is more cost-effective
 - QFN package saves even more board space
- Support dual protocol
 - Two ports, one for RS-232 and one for RS-485
 - Selectable data rate for RS-485

Fixed Dual Protocol Transceivers (ISL33334E)



Dual Protocol RS485/RS-232 (Fixed and Configurable)

| Part Number | # of Ports | Port Assignment | V _{CC} (V) | DR (Mbps) RS-485 | DR (kbps) RS-232 | Package |
|---------------|------------|-----------------|---------------------|------------------|------------------|-----------------------------------|
| ISL33334E/37E | 2 | Fixed | 3.3 | 20, 0.115 | 400 | 28 Ld SSOP, 40 Ld QFN |
| ISL33354E/57E | 2 | Fixed | 5 | 20, 0.115 | 460 | 28 Ld SSOP, 40 Ld QFN |
| ISL3330E/1E | 1 | Config. | 3.3 | 20, 0.46, 0.115 | 400 | 20 Ld SSOP, 28 Ld SSOP, 40 Ld QFN |
| ISL3332E/3E | 2 | Config. | 3.3 | 20, 0.46, 0.115 | 400 | 20 Ld SSOP, 28 Ld SSOP, 40 Ld QFN |
| ISL41334E | 2 | Config. | 5 | 20, 0.46, 0.115 | 650 | 40 Ld QFN |
| ISL81334E | 2 | Config. | 5 | 20, 0.46, 0.115 | 650 | 28 Ld SSOP, 28 Ld SOIC |
| ISL41387E | 1 | Config. | 5 | 20, 0.46, 0.115 | 650 | 40 Ld QFN |
| ISL81387E | 1 | Config. | 5 | 20, 0.46, 0.115 | 650 | 20 Ld SSOP, 20 Ld SOIC |

Galvanically Isolated RS-485 Transceiver

Industry's Smallest Isolated RS-485 Transceiver

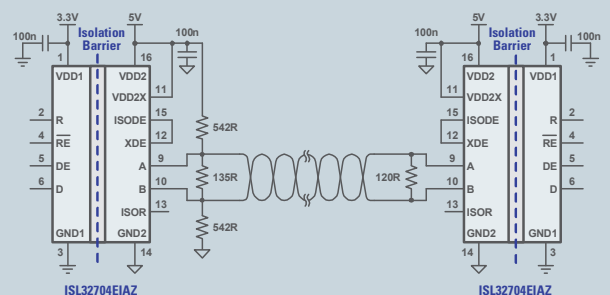
ISL32704E

The ISL32704E isolated RS-485 transceiver provides 4Mbps bi-directional data transmission for Industrial Internet of Things (IIoT) networks.

The high speed device delivers industry-leading EMI and common-mode transient immunity in a small 4mm x 5mm QSOP package that's **70% smaller** than competing solutions.

- Galvanically isolated using giant magnetoresistance (GMR) technology
- 2.5kVRMS isolation; 600VRMS working voltage (50% higher than the closest competitor)
- Very low EMI, no board level shielding needed
- Supports 3V to 5V power supplies

Giant Magnetoresistance (GMR) Technology to Provide Galvanic Isolation

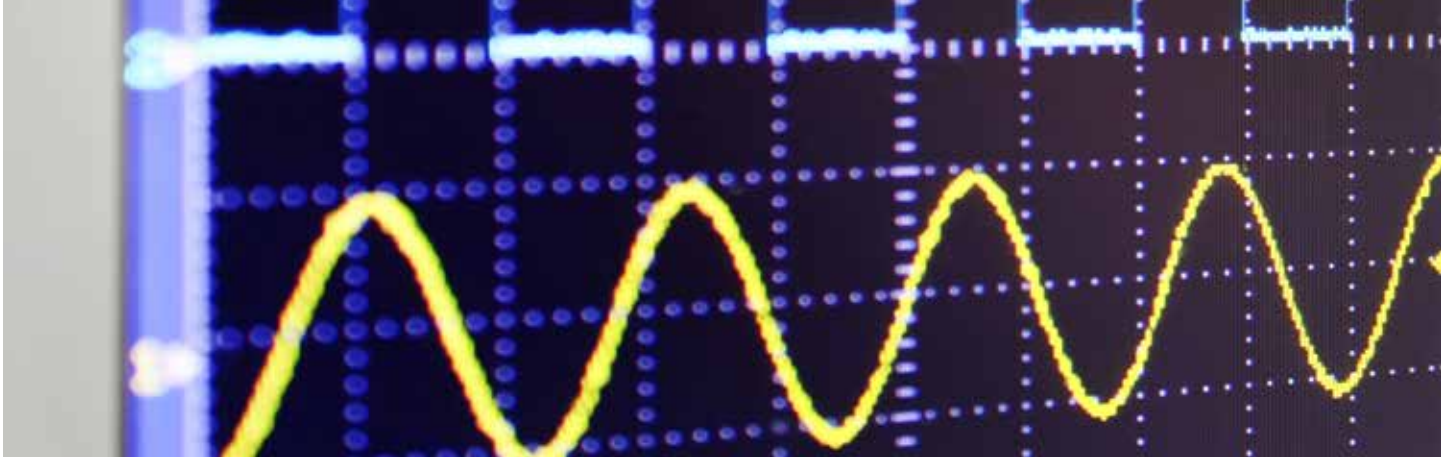


Galvanically Isolated RS-485 Transceiver

| Part Number | Data Rate | Duplex | Isolation Rating | Working Voltage | V _{DD1} | V _{DD2} | I _{DD1} | I _{DD2} | Package |
|-------------|-----------|--------|------------------|-----------------|------------------|------------------|------------------|------------------|-------------------------|
| ISL32740E | 40Mbps | Half | 2.5kV | 600Vrms | 3V to 5.5V | 4.5V to 5.5V | 3 to 4mA | 5mA | 16 Ld SOIC |
| ISL32741E | 40Mbps | Half | 6kV | 1000Vrms | 3V to 5.5V | 4.5V to 5.5V | 3 to 4mA | 5mA | 16 Ld SOIC |
| ISL32704E | 4Mbps | Half | 2.5kV | 600Vrms | 3V to 5.5V | 4.5V to 5.5V | 3 to 4mA | 5mA | 16 Ld QSOP, 16 Ld WSOIC |

Data Converters

HIGH SPEED ADC/DACs



High Speed ADCs

Innovative FemtoCharge[®] CMOS technology yields ultra-high performance ADCs that consume a fraction of the power of the competition.

Competitive Advantages

- **14-bit:** higher sampling rate (250MSPS), one-third the power (390mW) of the competition
- **12-bit:** same sampling rate (500 MSPS), less than one-fifth the power (432mW) of the competition
- **8/10-bit:** higher sampling rate (500MSPS), almost half the power (428mW) of the competition
- Superior wideband capabilities
- Compact footprint
 - The industry's first dual 12-bit 250MSPS ADC family
 - 500 MSPS option is 2 to 3.6x smaller than the competition

Applications

- Communications
- Networking
- Instrumentation
- Industrial
- Video and imaging

| | 8-bit | 10-bit | 12-bit | 14-bit |
|----------------|------------|-----------------------|--|--------------------|
| 500+ MSPS | ISLA118P50 | ISLA110P50 5510-50 | ISLA112P50 5512-50 | |
| 250-350 MSPS | | 5610-25 | 5512-25 5612-25 | 5514-25 |
| 130-210 MSPS | | 5610-21 5610-17 | 5512-21 5512-17 5612-21 5612-17 | 5514-21 5514-17 |
| Up to 125 MSPS | | 5610-12 | 5512-12 5612-12 | 5514-12 |

Pin-Compatible Families
Simplify the selection process and enable design re-use

Single KAD55XX Dual KAD56XX

High Speed DACs

Key Features

- Excellent dynamic performance (ISL5957):
 - Nyquist SFDR at 10MHz = 75dBc
 - UMTS ACPR at 19.2MHz = 71dB
- GSM SFDR at 11MHz (20MHz window) = 94dBc
- +3.3V supply, low power 103mW @130MSPS
- Adjustable full-scale output current (2 to 20mA)
- Pin compatible family of single and duals

Applications

- Wireless Communications
- Broadband Microwave Repeaters
- Military and SDR Radios

| Resolution | Part Number | Speed |
|------------|-------------|-------------------|
| 14-bit | ISL5957 | 260MSPS |
| | ISL5927 | 260MSPS, Dual |
| | ISL5961 | 210/130MSPS |
| | ISL5929 | 210/130MSPS, Dual |
| 12-bit | ISL5857 | 260MSPS |
| | ISL5827 | 260MSPS, Dual |
| | ISL5861 | 210/130MSPS |
| | ISL5829 | 210/130MSPS, Dual |
| 10-bit | ISL5757 | 260MSPS |
| | ISL5727 | 260MSPS, Dual |
| | ISL5761 | 210/130MSPS |
| | ISL5729 | 210/130MSPS, Dual |
| 8-bit | ISL5627 | 260MSPS, Dual |
| | ISL5629 | 210/130MSPS, Dual |
| | HI5660 | 125/60MSPS |

Data Converters

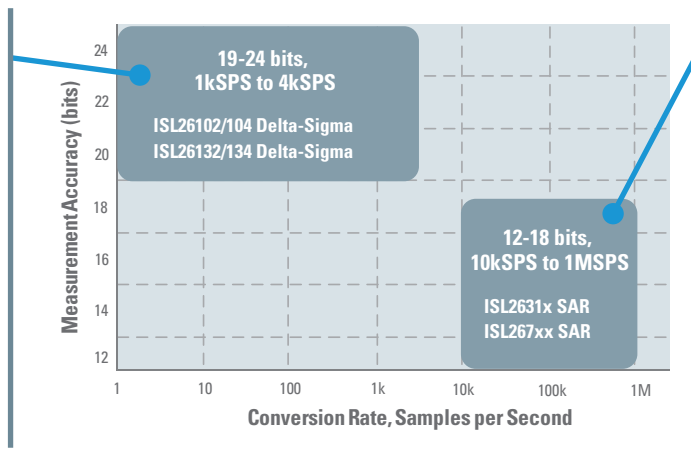
PRECISION DATA CONVERTERS

24-bit Delta-Sigma Converters

- High resolution (24-bit)
- Lower conversion rate

Applications

- Weigh scales
- Dynamic weighing
- Manufacturing systems
- Temperature and load sensors
- Load safety systems
- Scientific instrumentation



Successive Approximation (SAR) ADCs

- Medium to high-resolution ADCs (up to 12-bit)
- High conversion rate
- Low power

Applications

- Process controllers
- Human-machine interface devices
- Pressure and flow sensors
- Switchgear
- Safety monitors



- Robotic controls
- Automotive systems

24-bit Delta-Sigma Converters

| Resolution | Max Conv Rate | 2-Channel | 4-Channel | INL (%FS) | Noise | Power Consumption | Analog Supply Voltage Range | Digital Supply Voltage Range | Package | Technical Highlight |
|------------|-----------------|-----------|-----------|-----------|-----------|-------------------|-----------------------------|------------------------------|--------------------|--|
| 24-bit | 4kSPS | ISL26102 | ISL26104 | 0.0002 | 7nV/√Hz | 33.75mW | 4.75 - 5.25V | 2.7 - 5.25V | 24 and 28 Ld TSSOP | Programmable gain amplifier with gains of 1 to 128 |
| | 10SPS and 80SPS | ISL26132 | ISL26134 | 0.0002 | 1.2μV/√Hz | 50mW | 5V | 2.7V | 24 and 28 Ld TSSOP | Up to 21.6 Noise-free bits |

SAR ADC

| Resolution | Max Conv Rate | Single-channel | 2-channel | 4-channel | 8-channel | ± INL (Integral Non-Linearity) (LSB) | SFDR | Power Consumption | Analog Supply Voltage (min) | Analog Supply Voltage (max) | Pkg Type | Temp Range (°C) | |
|------------|---------------|------------------------------|--------------------|--------------------|-----------|--------------------------------------|-------|-------------------|-----------------------------|-----------------------------|----------------|-----------------|------------|
| 8-bit | 1MSPS | ISL26708 | — | — | — | 0.03 | -68dB | 3.75mW | 2.7V | 5.25V | DFN8, SOT8 | -40 to +85 | |
| 10-bit | 1MSPS | ISL267440 | — | — | — | 0.5 | -76dB | 2mW | 2.7V | 5.25V | MSOP8, SOT8 | -40 to +85 | |
| | | ISL26710 | — | — | — | 0.1 | -82dB | 3.75mW | 2.7V | 5.25V | DFN8, SOT8 | -40 to +85 | |
| 12-bit | 20kSPS | ISL2671286 | — | — | — | 1 | -83dB | 1.4mW | 4.5V | 5.25V | SOIC8 | -40 to +85 | |
| | 125kSPS | — | ISL26312, ISL26313 | ISL26314, ISL26315 | ISL26319 | 0.7 | 96dB | 11mW | 2.7V | 5.25V | SOIC8, TSSOP16 | -40 to +125 | |
| | 200kSPS | ISL267817 | — | — | — | 1 | -85dB | 2.15mW | 4.75V | 5.25V | MSOP8, SOIC8 | -40 to +85 | |
| | 250kSPS | ISL26320, ISL26321, ISL26322 | ISL26323 | ISL26325, ISL26324 | ISL26329 | 0.7 | 96dB | 11mW, 15mW | 2.7V | 5.25V | SOIC8, TSSOP16 | -40 to +125 | |
| | 555kSPS | ISL267452 | — | — | — | 1 | -76dB | 3.75mW | 2.7V | 5.25V | SOT8 | -40 to +85 | |
| | 1MSPS | ISL267450/A | — | — | — | — | 1 | -82dB | 3.75mW | 3V | 5.25V | MSOP8, SOIC8 | -40 to +85 |
| | 1MSPS | ISL26712 | — | — | — | — | 0.4 | -87dB | 3.75mW | 2.7V | 5.25V | DFN8, SOT8 | -40 to +85 |

Data Converters

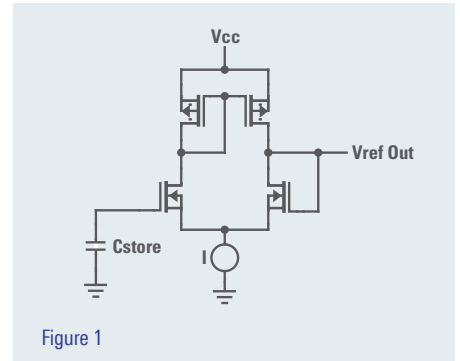
VOLTAGE REFERENCES

Renesas offers a wide range of precision voltage references in both FGA™ and Bandgap technology.

Accurate and Stable Voltage Reference with Floating Gate Analog Technology (FGA™)

Renesas' revolutionary Floating Gate Analog (FGA™) voltage reference circuits are not dependent on the voltage produced by a silicon junction. FGA technology produces extraordinarily accurate and stable reference voltages by storing a precise charge on a floating gate cell that is essentially unaffected by external influences such as variation in temperature, input voltage, and time.

The floating gate voltage is buffered with a high quality CMOS amplifier as shown in the simplified diagram in Figure 1.



Ultra-Low Noise, Precision Voltage Reference

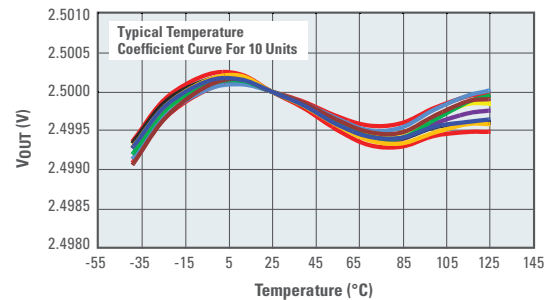
ISL21090

The ISL21090 is an ultra-low noise, high DC accuracy precision voltage reference with a wide input voltage range of 3.7V to 36V. The ISL21090 is ideal for high-end instrumentation, data acquisition, and processing applications requiring high DC precision where low noise performance is critical.

- Reference output voltage options:
 - 1.25V, 2.5V, 5.0V, 7.5V
- Initial accuracy: ±0.003% (1.25V option)
- Output voltage noise: 1μV_{P-P} typ (0.1Hz to 10Hz) (1.25V option)
- Supply current: 750μA typ (1.25V option)
- Tempco: 7ppm/°C max
- Output current capability: 20mA
- Line regulation: 8ppm/V (1.25V option)
- Load regulation: 2.5ppm/mA (1.25V option)

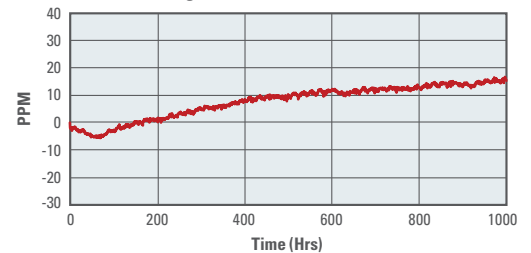
Temperature Drift (Coefficient)

ISL21090 Typical Temperature Coefficient



Long Term Drift

ISL21090 Long Term Drift Data (1000 Hrs)



Precision Voltage References

| Type | Part Number | V _{OUT} | | | | | | | | | | Temp Coefficient (max) | I _S (typ) | I _S (max) | V _S (min) | V _S (max) | Initial Accuracy (% V _{OUT} @2.5V) | Output Noise (0.1Hz to 10Hz) (typ) | Hysteresis (ppm) | Pkg Type | Temp Range (°C) | | | | |
|-----------------|-------------|------------------------------|--------|------|-------|------|------|--------|------|------|----|------------------------|----------------------|----------------------|----------------------|----------------------|---|------------------------------------|------------------|-------------|-----------------------|------------------------------------|---------|-------|------------|
| | | 0.9V | 1.024V | 1.2V | 1.25V | 1.5V | 1.8V | 2.048V | 2.5V | 2.6V | 3V | | | | | | | | | | | 3.3V | 4.096V | 5V | 7.5V |
| Low Noise | ISL21090 | | | | • | | | | • | | | | | • | • | 7ppm/°C | 750μA (1.25V Option) | 1.28mA | 3.7V | 36V | ±0.03% (1.25V Option) | 1.0μV _{PP} (1.25V option) | – | SOIC8 | -40 to 125 |
| Low Cost | ISL21010 | | • | | • | • | | • | • | | | | | • | | 50ppm/°C | 48μA | 100μA | 2.2V | 5.5V | 0.2% | 58μV _{PP} (2.048V option) | 100 | SOT3 | -40 to 125 |
| | ISL21080 | • | • | | • | • | | • | • | | | | | • | • | 50ppm/°C | 300nA | 1.5μA | 2.7V | 5.5V | <0.7% | 30μV _{PP} | 100 | SOT3 | -40 to 85 |
| NanoPower | ISL60002 | | • | • | • | | • | • | • | • | | | | | | 20ppm/°C | 350nA | 900nA | 2.7V | 5.5V | <0.49% | 30μV _{PP} | 100 | SOT3 | -40 to 85 |
| | X60003 | | | | | | | | | | | | | • | • | 10ppm/°C (B grade) | 500nA | 900nA | 4.5V | 9V | <0.1% | 30μV _{PP} | 150/100 | SOT3 | -40 to 85 |
| With Comparator | ISL21440 | 1.182V ±0.5% with Comparator | | | | | | | | | | – | 0.46μA | 6.5μA | 2V | 11V | 0.5% | – | Programmable | DFN8, MSOP8 | -40 to 125 | | | | |

Data Converters







DIGITAL POTENTIOMETERS

Digital potentiometers replace mechanical potentiometers and trim resistors in applications where digital control allows microprocessor interfacing and extended functionality. Compared to mechanical potentiometers, electronic potentiometers are more accurate, easier to adjust, and they reduce manufacturing complexity.

Lowest Voltage

| Specification | Renesas DCP | Competition | Renesas Benefit |
|-------------------------|---|--|---|
| Analog Voltage | 1.7V to 5.5V | 1.8V to 5.5V 2.7V to 5.5V | Operational when battery starts draining. |
| Digital Voltage | 1.2V to 5.5V | Same as analog voltage, lowest is 1.8V | Eliminate level shifter for I ² C/SPI when μ C has low voltage I/O pins. |
| Low Current Consumption | 2.5 μ A - 1CH 3 μ A - 2CH 5 μ A - 4CH | Up to 2x more power consumption | Drains up to 50% less battery power. |

Smaller Package

| Type | Renesas Part Number | Renesas DCP | Competition | Renesas Benefit |
|--------|--|--|---|-----------------|
| Single | ISL23315, ISL23415, ISL23318, ISL23418 |  μ TQFN (2.1x1.6mm) |  SC-70 (2x2.1mm) | 20% Smaller |
| Dual | ISL23325, ISL23425, ISL23328, ISL23428 |  μ TQFN (2.6x1.8mm) |  QFN (4x4mm) | 48% Smaller |
| Quad | ISL23345, ISL23445, ISL23348, ISL23448 |  QFN (3x4mm) |  QFN (4x4mm) | 25% Smaller |

Digital Potentiometer Portfolio

- **Single 16-Tap (4-bits)**
X9116 – 10k Ω , Up-Down
- **Single 32-Tap (5-bits)**
D X9314 – 10k Ω , Log Taper, Up-Down
X9315 – 10k Ω / 50k Ω / 100k Ω , Up-Down
D X9511 – 10k Ω , Push Button
- **Single 100-Tap (~6.65-bits)**
X9317 – 10k Ω / 50k Ω / 100k Ω , Up-Down
X9318 – 10k Ω , Up-Down
X9319 – 10k Ω / 50k Ω , Up-Down
D X9C102 – 1k Ω , Up-Down
D X9C103 – 10k Ω , Up-Down
D X9C104 – 100k Ω , Up-Down
D X9C503 – 50k Ω , Up-Down
D X9C303 – 32k Ω , Log Taper, Up-Down
- **Single 128-Tap (7-bits)**
ISL22316 – 10k Ω , I²C
ISL22317 – 10k Ω , 1% Tolerance, I²C
E ISL95311 – 10k Ω , I²C
E ISL95310 – 50k Ω , Up-Down
- **Single 256-Tap (8-bits)**
ISL95810 – 10k Ω / 50k Ω , I²C
- **Single 1024-Tap (10-bits)**
D X9110 – 100k Ω , SPI
X9111 – 100k Ω , SPI
D X9118 – 100k Ω , 2-Wire
X9119 – 100k Ω , 2-Wire

- **Dual 128-Tap (7-bits)**
ISL22326 – 10k Ω , I²C
- **Dual 256-Tap (8-bits)**
X95820 – 10k Ω / 50k Ω , I²C
D X9268 – 50k Ω / 100k Ω , 2-Wire
D ISL22424 – 10k Ω , SPI

- **Quad 64-Tap (6-bits)**
D X9408 – 2.5k Ω / 10k Ω , 2-Wire
- **Quad 128-Tap (7-bits)**
ISL22346 – 10k Ω / 50k Ω , I²C
- **366Quad 256-Tap (8-bits)**
X95840 – 10k Ω / 50k Ω , I²C
D X9250 – 50k Ω / 100k Ω , SPI
X9251 – 50k Ω , SPI
X9252 – 2k Ω / 10k Ω , 2-Wire
D X9258 – 50k Ω / 100k Ω , 2-Wire
X9259 – 50k Ω , 2-Wire

Special Function DCPs

- **Dual Audio DCP – Integrated Output Buffer Amps and Audio Detect**
ISL22102 – 32k Ω , Log Taper, Push Button, 0 to -72dB Dynamic Range
- **Low Voltage 1% Tolerant Precision DCP & Low Temperature Coefficient**
ISL22317 – 10k Ω , I²C
- **TFT/LCD Programmable VCOM Calibrator (128 Step)**
ISL45041 – I²C
ISL45042 – Up-Down
- **Military Temperature (-55°C to 125°C) Non-Volatile DCP**
ISL22316WM (Single) – 10k Ω , I²C
ISL22326WM (Dual) – 10k Ω , I²C
ISL22346WM (Quad) – 10k Ω , I²C

Volatile (No EEPROM Memory)

- **Single 32-Tap (5-bits)**
ISL23511 – 10k Ω , Push Button
ISL90461 – 10k Ω / 50k Ω / 100k Ω , Up-Down, 2-Pin, Rheostat
ISL90462 – 10k Ω / 50k Ω , Up-Down, 2-Pin, Voltage Divider Only
- **Single 128-Tap (7-bits)**
ISL90726 – 10k Ω / 50k Ω , I²C, Rheostat
ISL90727/28 – 10k Ω / 50k Ω , I²C, Voltage Divide Only
ISL23318 – 10k Ω / 50k Ω / 100k Ω , I²C, Low Voltage
ISL23418 – 100k Ω , SPI, Low Voltage
- **Single 256-Tap (8-bits)**
ISL23315 – 100k Ω , I²C, Low Voltage
ISL23415 – 100k Ω , SPI, Low Voltage
- **Dual 32-Tap (5-bits)**
ISL22102 – 32k Ω , Log Taper, Audio Detect, Push Button
- **Dual 128-Tap (7-bits)**
ISL23328 – 10k Ω / 100k Ω , I²C, Low Voltage
ISL23428 – 10k Ω / 100k Ω , SPI, Low Voltage
- **Dual 256-Tap (8-bits)**
ISL23325 – 10k Ω / 100k Ω , I²C, Low Voltage
ISL23425 – 10k Ω / 100k Ω , SPI, Low Voltage
- **Quad 256-Tap (8-bits)**
ISL90841 – 50k Ω , I²C
ISL90842 – 10k Ω / 50k Ω , I²C

E Extended positive terminal voltage

D Positive and negative terminal voltage

Timing

REAL-TIME CLOCKS



Pick the Right RTC to Fit Your Design Needs



Basic

- External crystal (no external caps required), minimal features



Low Cost

- External crystal, battery backup, 1 to 8 bytes SRAM



Feature Rich

- External crystal, temperature compensation, ≥ 128 bytes SRAM or EEPROM memory, tamper/event detection, unique ID, etc.



High Accuracy Modules

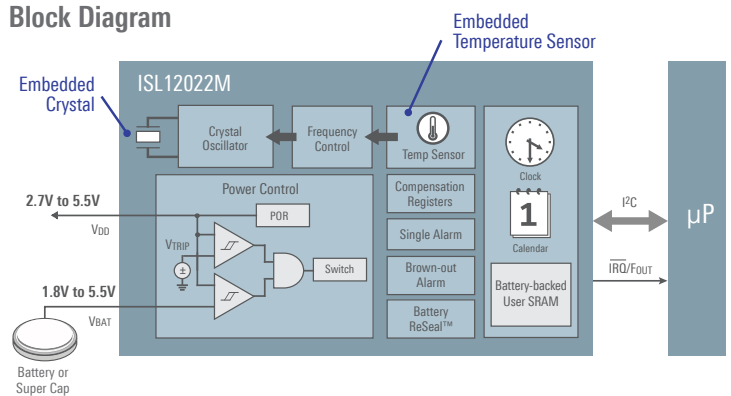
- Integrated crystal and temperature compensation

High Accuracy 3-in-1 RTC Module (RTC + Embedded Crystal + Temp Sensor)

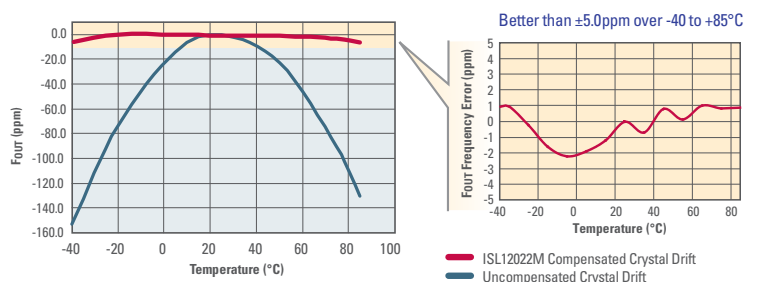
ISL12022M

- ± 5 ppm accuracy (-40°C to $+85^{\circ}\text{C}$)
 - Factory programmed RTC for optimal accuracy
 - On-board temperature sensor
 - Embedded crystal
 - Reliable timekeeping and power management
 - Backup battery management
 - V_{DD} and battery status monitors and switchover time stamp
 - Battery ReSeal™ function extends battery shelf life
- User programmability
 - I²C interface
 - 128 bytes battery-backed user SRAM
- Solution for industrial applications
 - Provides low-drift time source for patient event time stamp
 - Reliable clock solution for patient monitoring (ECG)

Block Diagram



High Accuracy Even in Extreme Temperature Conditions

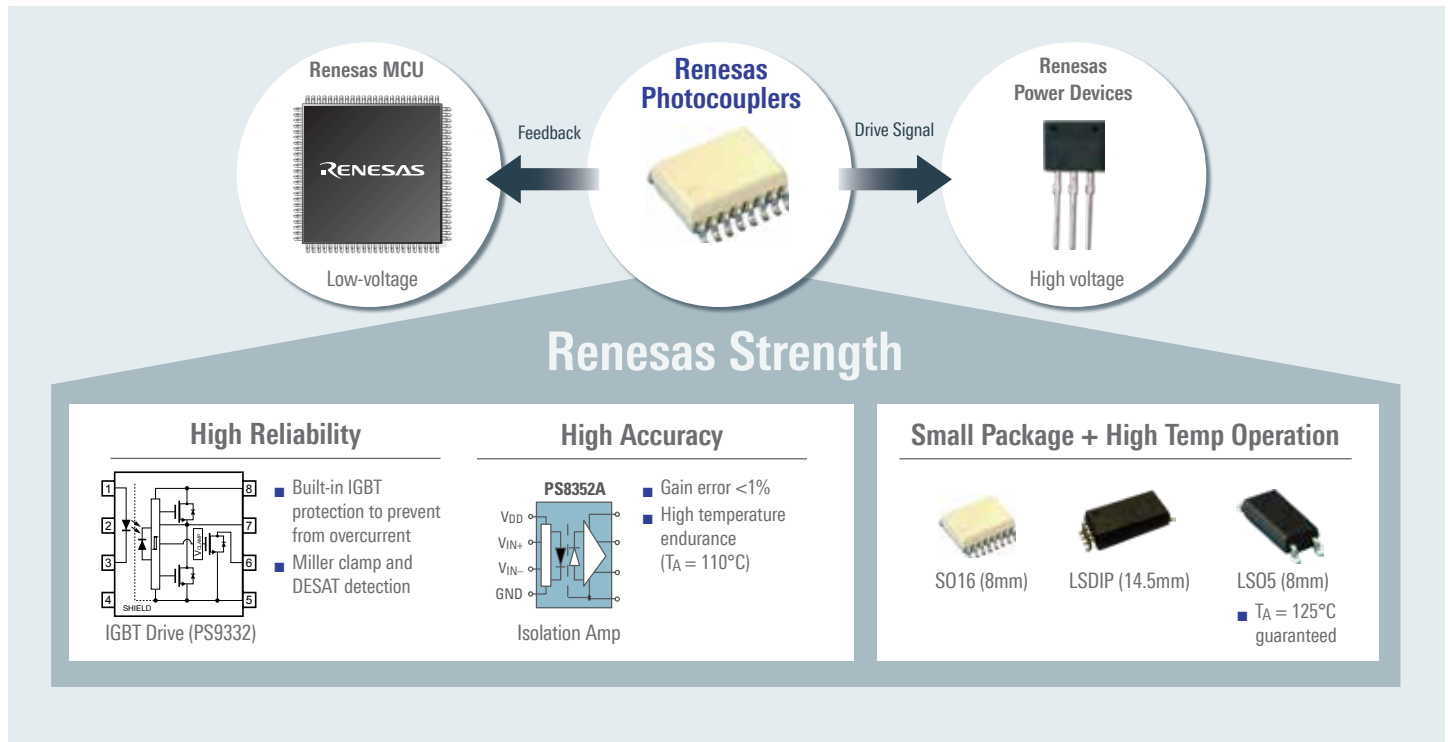


Real-Time Clocks

| Category/Special Features | | Part Number | Other Functions | | | | | | | | | Memory | Package |
|---------------------------------|---|-------------|-----------------|------------|-------------------|-----------------|-----------|---------------|-----------|--------------------|-------------------|------------------|---------------------------------------|
| | | | Event Detection | Time Stamp | Batt Sw Timestamp | Auto DST Adjust | Temp Comp | Power Monitor | Unique ID | Integrated Crystal | Crystal Capacitor | | |
| High Accuracy RTC Module | With Embedded Crystal & Temp Compensation | ISL12020M | | | • | • | • | • | | • | | 128 Bytes SRAM | 20 Ld DFN |
| | | ISL12022M | | | • | • | • | • | | • | | 128 Bytes SRAM | 20 Ld SOIC |
| Feature Rich RTC | With On-Chip Temp Sensor | ISL12022 | | | • | • | • | • | | | | 128 Bytes SRAM | 20 Ld SOIC |
| | With Embedded Unique ID | ISL12024 | | | | | | | • | | | 512x8-Bit EEPROM | 8 Ld SOIC, 8 Ld TSSOP |
| | | ISL12025 | | | | | | | • | | | 512x8-Bit EEPROM | 8 Ld SOIC |
| | With Integrated EEPROM & CPU Supervisory Function | ISL12026A | | | | | | | | | | 512x8-Bit EEPROM | 8 Ld SOIC, 8 Ld TSSOP |
| | | ISL12027A | | | | | | | | | | 512x8-Bit EEPROM | 8 Ld TSSOP |
| | | ISL12028 | | | | | | | | | | 512x8-Bit EEPROM | 14 Ld SOIC, 14 Ld TSSOP |
| Low Cost | With Battery Backup | ISL12008 | | | | | | | | | | | 8 Ld SOIC |
| | | ISL12082 | | | | | | | | | | | 8 Ld SOIC |
| | With Battery-Backed SRAM | ISL1208 | | | | | | | | | | 2 Bytes SRAM | 8 Ld MSOP, 8 Ld SOIC, 8 Ld TDFN |
| | | ISL1218 | | | | | | | | | | 8 Bytes SRAM | 8 Ld MSOP, 8 Ld SOIC |
| | | ISL1220 | | | | | | | | | | 8 Bytes SRAM | 10 Ld MSOP |
| | With Battery-Backed SRAM, Event Detection | ISL1209 | • | | | | | | | | | 2 Bytes SRAM | 10 Ld MSOP |
| | | ISL1219 | • | • | | | | | | | | 2 Bytes SRAM | 10 Ld MSOP |
| | | ISL1221 | • | • | | | | | | | | 2 Bytes SRAM | 10 Ld MSOP |
| Basic | With IRQ, Alarm, Timers | ISL12057 | | | | | | | | | • | | 8 Ld MSOP, 8 Ld SOIC |
| | | ISL12058 | | | | | | | | | | | 8 Ld MSOP, 8 Ld SOIC, 8 Ld μ TDFN |

PHOTOCOUPLERS

Providing Highly Reliable, High Accuracy Small Footprint Solutions



Featured Products

IGBT Drive Photocouplers

- A gate drive coupler drives the gate of an IGBT device. Available output currents are 0.6A and 2.5A
- The package lineup includes LS05 and SDIP, ensuring 8mm creepage distance, as well as a 14.5mm creepage type, LSDIP.

LSDIP (creepage distance 14.5mm)

Isolation Voltage: 7.5kVr.m.s.

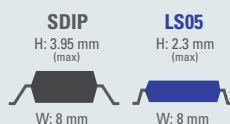


- Reduces the power loss of customer systems at higher voltages
- Substantially reduces the customer's cost in comparison with conventional package

LS05 (height: 2.3mm max.)

TA = 125°C Guaranteed

- 8mm creepage to support 400V-class equipment
- TA = 125°C for greater heat dispersion design margin
- Smaller mounting area than conventional SDIP package
 - Smaller footprint and lower BOM cost

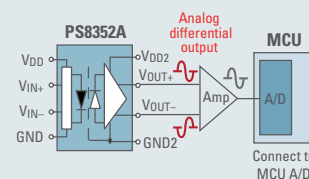
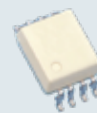


Analog or Digital Isolation Amplifiers

- Isolation amplifiers (analog output) enable accurate current and voltage monitoring
- Delta-sigma modulator (digital output) are optically coupled one-bit data stream output isolators.

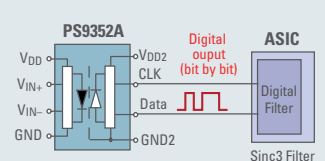
PS8352A (analog output)

Isolation amplifier produces differential output at eight times the voltage of the input analog voltage.



PS9352A (digital output)




Delta-sigma modulator converts the input analog voltage to bit-by-bit digital data.



IC Output Photocouplers

| Category | Function | Output | V _{CC} /V _{DD} | DIP8 7mm/8mm | SDIP6/8 7mm/8mm | LSDIP8 14.5mm | LSO5 8mm | S05 4.2mm | S016 8mm |
|------------------------------|--------------------------|-------------------|----------------------------------|---|---|--|---|---|--|
| | | | |  |  |  |  |  |  |
| Motor Drive | IGBT Drive | Digital | 35V 2.5/2.0A | PS9531 | PS9331 PS9332 | PS9905 | PS9031 | – | PS9402 |
| | | | 35V 0.6A | PS9506 | PS9307A | – | – | – | – |
| | IPM Drive | Digital | >20V | PS9513 | PS9313 PS9303 PS9309 | – | PS9013 PS9009 | PS9113 | – |
| Current/Voltage Detection | Isolation Amplifier | Analog | 5V | PS8551A | PS8352A | – | – | – | S08 4mm  |
| | $\Delta\Sigma$ Modulator | Digital | 5V | PS9551A | PS9352A | – | – | – | – |
| Communication | 15Mbps | CMOS | 5V | – | PS9351 | – | – | PS9151 | PS9851-1 PS9851-2 |
| | | Totem Pole | 5V | – | – | – | – | PS9123 | – |
| | 10Mbps | Open Collector | 5V | PS9587 | PS9317 | – | PS9001 | PS9117A | PS9817A-1 PS9817A-2 |
| | | | 3.3V/5V | – | PS9324 | PS9924 | – | PS9124 | PS9821-1 PS9821-2 |
| | 1Mbps | Digital | 3.3V/5V | – | – | – | – | PS9122 | PS9822-1 PS9822-2 |
| | | Analog | 35V | PS8501 PS8502 | PS8302 | PS8902 | – | PS8101 | – |

Transistor Output Photocouplers

| Input | Output | Function | DIP4 7mm | LSOP 8mm | SSOP 5mm | SSOP 4mm | SSOP Common Lead 4mm | Flat Lead 4mm |
|-------|------------|-------------------------|---|---|--|---|---|---|
| | | |  |  |  |  |  |  |
| DC | Single | General Purpose | – | – | PS2701A-1 | PS2801C-1 PS2801C-4 | – | – |
| | | High Temp. (110, 115°C) | PS2561D-1 PS2561F-1 | PS2381-1 | PS2761B-1 | PS2861B-1 | – | – |
| | | High Voltage (120V) | – | – | PS2703-1 | – | – | – |
| | | Low Input | – | – | PS2711-1 | PS2811-1 PS2811-4 | PS2841-4A PS2841-4B | PS2911-1 PS2913-1 |
| | | High Speed (20kbps) | PS2514-1 | – | – | – | – | – |
| | Darlington | General Purpose | PS2562-1 | – | PS2702-1 | PS2802-1 PS2802-4 | – | – |
| | | High Voltage (350V) | PS2533-1 PS2535-1 | – | PS2733-1 | PS2833-1 PS2833-4 | – | – |
| AC | Single | General Purpose | PS2565-1 | – | PS2705A-1 | PS2805C-1 PS2805C-4 | – | – |
| | | Low Input | – | – | PS2715-1 | PS2815-1 PS2815-4 | PS2845-4A | PS2915-1 |
| | Darlington | General Purpose | PS2506-1 | – | PS2706-1 | – | – | – |

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