RENESAS

ANALOG ICs

High-performance solutions for precision
signal chain design

2024.11

HIGH-PERFORMANCE SOLUTIONS FOR PRECISION SIGNAL CHAIN DESIGN
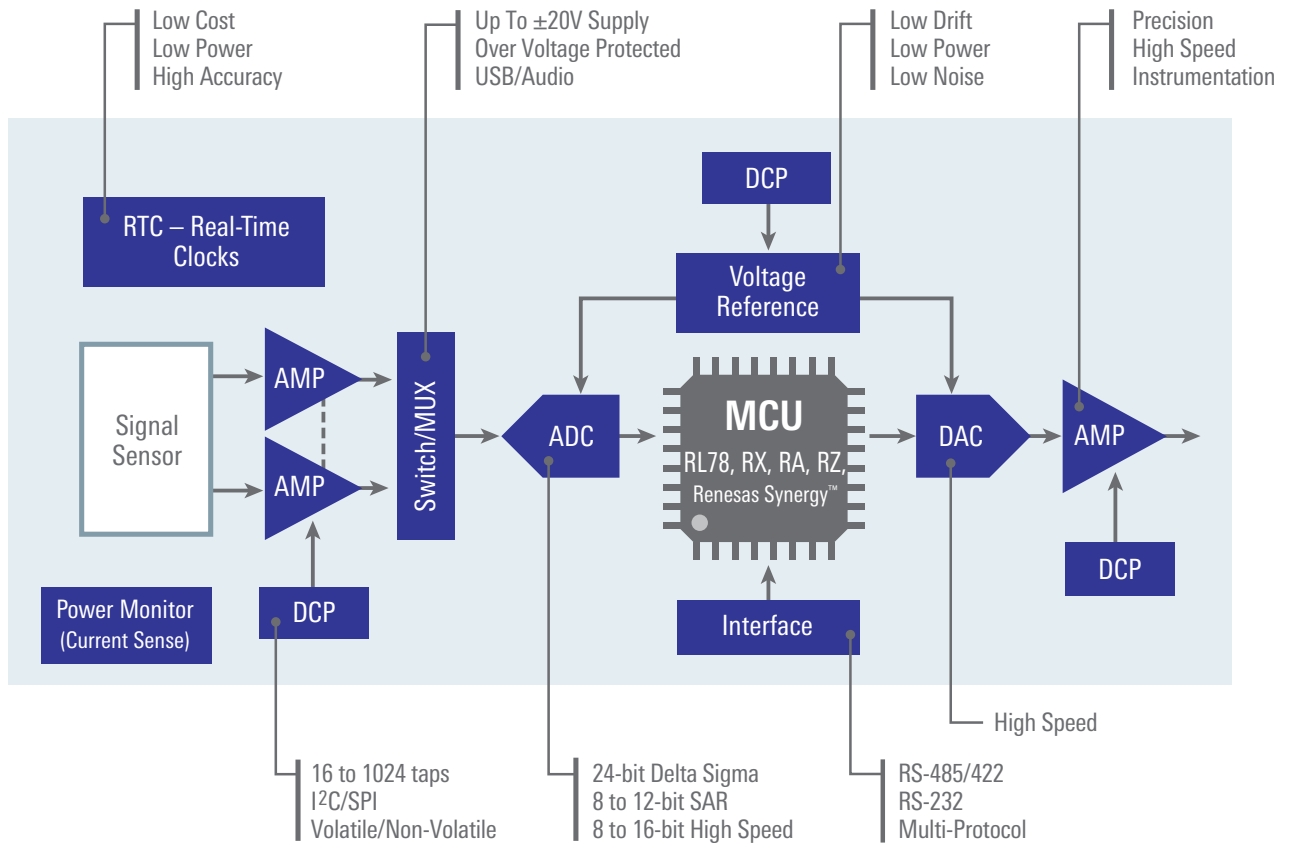# ANALOG ICs

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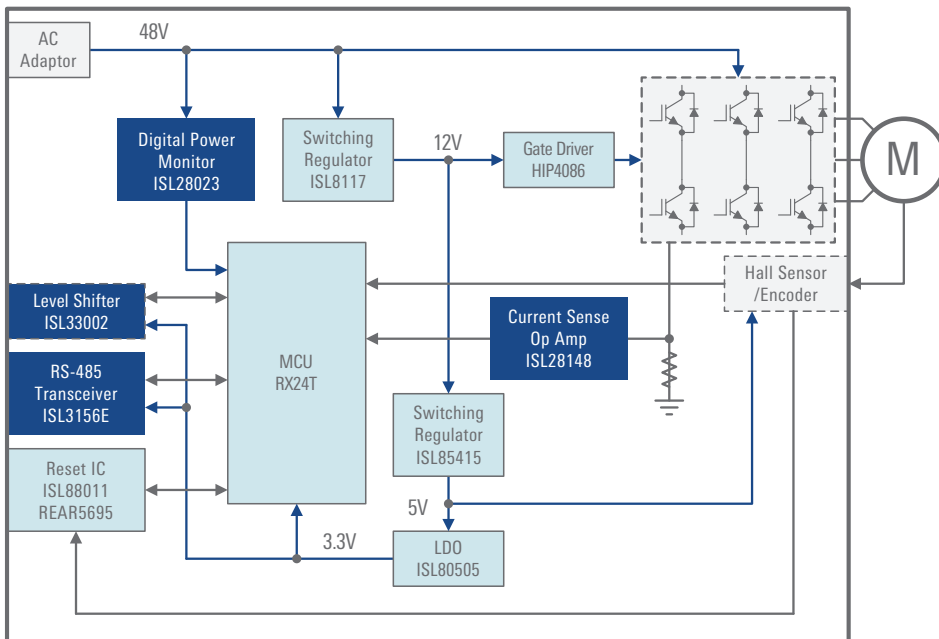
Complete Signal Chain Solutions

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

Low Cost
Low Power
High Accuracy

Up To ±20V Supply
Over Voltage Protected
USB/Audio

Low Drift
Low Power
Low Noise

Precision
High Speed
Instrumentation

RTC – Real-Time Clocks

DCP

Voltage Reference

Signal Sensor

AMP

AMP

Switch/MUX

ADC

MCU
RL78, RX, RA, RZ,
Renesas Synergy™

DAC

AMP

Power Monitor (Current Sense)

DCP

Interface

DCP

High Speed

16 to 1024 taps
I^{2}C/SPI
Volatile/Non-Volatile

24-bit Delta Sigma
8 to 12-bit SAR
8 to 16-bit High Speed

RS-485/422
RS-232
Multi-Protocol

WINNING COMBOS

Renesas Industrial Signal Chain Solutions

Renesas offers dozens of Winning Combinations - expert designs showcasing Renesas' product portfolios of Embedded Processing, Analog, Power, and Connectivity. With these engineering-vetted designs, customers can take advantage of an elevated platform for their design ideas, accelerating their product development cycle and lowering their overall risk to bring their designs to market.

Featured Solution: 48V Position Control Solution

Key Components	Key Features
ISL3156E	RS-485/RS-422 transceiver features high output drive and high ESD protection
ISL28023	High-side and Low-side digital current sense and voltage monitor with a serial interface
ISL8117	Synchronous Step-Down PWM Controller
HIP4086	3-Phase MOSFET Driver
ISL33002	I^{2}C Bus Buffer with Rise Time Accelerators and Hot Swap Capability
ISL88011	5 Ld Voltage Supervisor with Adjustable Power-On Reset, Dual Voltage Monitoring or Watchdog Timer Capability
RX24T	32-bit Microcontroller with On-chip FPU Enable to Drive Two Motors Simultaneously
ISL80505	High Performance Low Dropout Regulator
ISL85415	Synchronous Buck Regulator
ISL28148	Single Precision Rail-to-Rail Input-Output Op Amps with Very Low Input Bias Current

Solutions for BLDC motor applications have been increasing rapidly because of the demand for products that are smaller in size and provide high efficiency. The core of a BLDC motor design is a robust and reliable motor control circuit and a versatile MCU for a safe control algorithm. Key building blocks of a motor control circuit include a MOSFET driver, versatile MCU, voltage regulators, a cell balancer, and the battery charger. Analog Components highlighted in Blue.

Other Winning Combos featuring Analog products

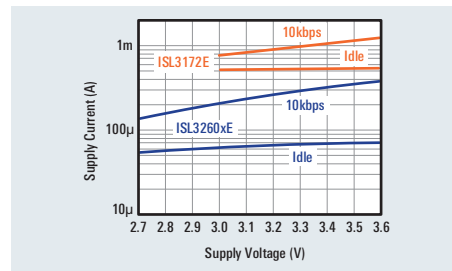| Bundle Code	Bundle Name	Segment
US041	Remote Monitoring System	Building Safety & Security
US043	48V Position Control	Factory Automation & Control
US017	Electronic Valve with Flow Meter	Appliances
US019	Remote Monitoring System (update from existing WC)	Building Safety & Security
CN039	Thermostat with Color Touchscreen and Cloud Connection	HVAC Systems
CN032	AC Servo Motor Control with Industrial Network Connections	Factory Automation & Control
CN032	AC Servo Motor Control with Industrial Network Connections	Factory Automation & Control
CN076	Edge Computing for Security Systems	Building Safety & Security
CN194	Over-The-Air Update Module for PLC Applications	Factory Automation & Control
CN104	Tankless Gas Water Heater with Remote User Control	Appliances
JP104	Robotics Solution with RZ/A2M	Robotics

Interface

INTERFACE

High Noise Immunity

The RAA78815x transceiver have Industry's highest EFT Immunity and Output Drive.
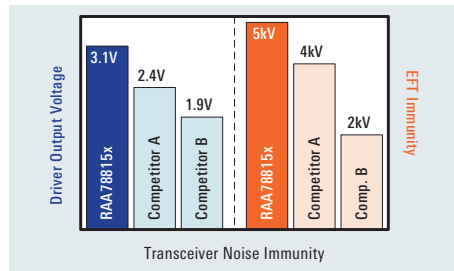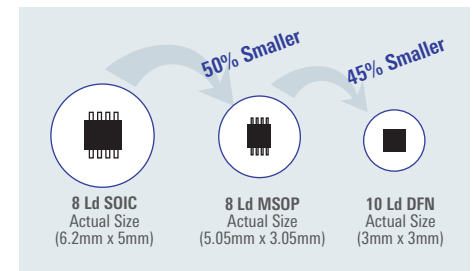

Ultra Low Supply Current

ISL3260xE Idle current is 9 times lower than that of low power transceiver ISL3172E.

Space-Saving Small Package

Reduced package size enables smaller, more compact products.

50% Smaller   45% Smaller

8 Ld SOIC
Actual Size
(6.2mm x 5mm)

8 Ld MSOP
Actual Size
(5.05mm x 3.05mm)

10 Ld DFN
Actual Size
(3mm x 3mm)

Broad Portfolio to Fit Your Needs

RS-485/422	RS-232	Multi-Protocol (RS-485 & RS-232)
■ High EFT immunity Transceivers (up to 5kV) ■ High-speed Transceivers (20 to 100Mbps) ■ Ultra-low Power Transceivers (I$_{CC}$ < 100uA) ■ Fault Protected Transceivers (V$_{BR}$ = ±60V)	■ Single, Dual, and Triple Transceivers (1 Tx/1 Rx, 2 Tx/2 Rx, 3 Tx/3 Rx) ■ 8-Channel Transceivers (5 Tx/3 Rx and 3 Tx/5 Rx)	■ Single and Dual Port devices ■ Fixed and Programmable Ports ■ Selectable RS-485 Speed (100kbps, 460kbps, 20Mbps)

RS-485/RS-422 Transceivers

RS-485 is a multi-point interface bus, meaning multiple drivers and receivers can be connected to one bus. RS-485 uses differential signaling to achieve high noise immunity. Its common-mode voltage range reaches from -7V up to +12V.

RS-422 is a multi-drop interface bus, meaning only one driver but multiple receivers can connect to one bus. RS-422 also uses differential signaling. Its common-mode voltage range however is smaller and ranges from -7V up to +7V.

Note that RS-485 transceiver can be used in RS-422 networks but not vice versa. RS-422 devices cannot be used in RS-485 systems.

Renesas has a 50-year history in interface transceivers and we are still a market leader today. We have a full portfolio of RS-485/RS-422 transceivers suited to most design needs.

Transceivers with High EFT Immunity per IEC61000-4-2

Transceiver Family	V_{CC} Range (V)	EFT (kV)	Data Rates (Mbps)	V_{OD} (typ) (V)	# Devices on bus	Half / Full Duplex	Bus ESD HD / FD (kV)	Quiescent I_{CC} (µA)(RX = on)	Temp Range (°C)
RAA78815x	4.5 – 5.5	5	0.115 / 1 / 20	3.1	256	HD / FD	16.5 / 10	550	-40 to +85
RAA78817x	3.0 – 3.6	3	0.25 / 0.5 / 20	2.0	256	HD / FD	16.5 / 10	480	-40 to +85

x = 0,2,3,5,6,8

High-Speed Transceivers (DR ≥ 40Mbps)

Part Number	V_{CC} Range (V)	Data Rate (Mbps)	V_{OD} (typ)(V)	Half / Full Duplex	Devices allowed on bus	Hot Plug	IEC ESD (kV)	I_{CC} (mA)	I_{SHDN} (µA)	Temp Range (°C)
ISL3179E	3.0 – 3.6	40	2.0	Half	160	Yes	±16.5	2.6	0.05	-40 to +125
ISL3180E	3.0 – 3.6	40	2.0	Full	160	Yes	±5	2.6	0.05	-40 to +85
ISL3159E	4.5 – 5.5	40	2.8	Half	160	Yes	±15	2.6	0.05	-40 to +125
ISL3160E	4.5 – 5.5	40	2.8	Full	160	Yes	±5	2.6	1.4	-40 to +125
ISL3259E	4.5 – 5.5	100	2.8	Half	160	Yes	±15	2.6	0.05	-40 to +85

Ultra-Low Power Transceivers

Part Number	# TX	# RX	V_{CC} Range (V)	Data Rates (kbps)	Duplex	# Devices allowed on bus	Bus ESD (kV)	Quiescent I_{CC} (µA)	I_{SHDN} (µA)	Temp Range (°C)
ISL32600E	1	1	2.7 – 3.6	256	Full	256	±15	70	0.01	-40 to +125
ISL32601E	1	1	2.7 – 3.6	256	Half	256	±15	70	0.01	-40 to +125
ISL32603E	1	1	1.8 – 3.6	460	Half	256	±15	150	0.01	-40 to +125
ISL32612E	0	1	1.8 – 3.3	256 / 500	–	256	±16.5	85	–	-40 to +125
ISL32614E	1	0	1.8 – 3.3	128 / 256	–	256	±16.5	100	0.01	-40 to +125

Single RS-485/422 Drivers and Receivers

Part Number	# TX	# RX	V_{CC} Range (V)	Data Rate (Mbps)	V_{OD} (typ) (V)	V_L Pin (V)	TX / RX Enables	IEC ESD (kV)	I_{CC} (µA)	Temp Range (°C)
ISL3295E	1	0	3.0 – 5.5	20	2.0 (Vcc = 3.0V) 3.4 (Vcc = 4.5V)	–	Active High	±16.5	120	-40 to +125
ISL3298E	1	0	3.0 – 5.5	20	2.0 (Vcc = 3.0V) 3.4 (Vcc = 4.5V)	1.6	Active High	±16.5	120	-40 to +125
ISL3280E	0	1	3.0 – 5.5	20	–	–	None	±16.5	400	-40 to +125
ISL3281E	0	1	3.0 – 5.5	20	–	–	Active High	±16.5	400	-40 to +125
ISL3282E	0	1	3.0 – 5.5	20	–	1.6	Active Low	±16.5	400	-40 to +125
ISL3283E	0	1	3.0 – 5.5	20	–	–	Active Low	±16.5	400	-40 to +125

Quad RS-422 Drivers and RS-485/422 Receivers

Part Number	# TX	# RX	V_{CC} Range (V)	Data Rate (Mbps)	V_{OD} (typ) (V)	V_L Pin (V)	TX / RX Enables	IEC ESD (kV)	I_{CC} (µA)	Temp Range (°C)
RAA7884QT	4	0	3.0 – 5.5	50	2.6 (Vcc = 3.0V) 4.0 (Vcc = 4.5V)	–	Group	±16.5	0.8	-40 to +125
ISL32172E	4	0	3.0 – 5.5	32	2.6 (Vcc = 3.0V) 4.0 (Vcc = 4.5V)	–	Group	±16.5	0.6	-40 to +125
ISL32272E	4	0	3.0 – 5.5	10	2.6 (Vcc = 3.0V) 4.0 (Vcc = 4.5V)	–	Group	±16.5	0.6	-40 to +125
ISL32174E	4	0	3.0 – 5.5	32	2.6 (Vcc = 3.0V) 4.0 (Vcc = 4.5V)	–	Paired	±16.5	0.6	-40 to +125
ISL32179E	4	0	3.0 – 5.5	32	2.6 (Vcc = 3.0V) 4.0 (Vcc = 4.5V)	1.6	Individual & Group	±16.5	0.6	-40 to +125
ISL32173E	0	4	3.0 – 5.5	80	–	–	Group	±16.5	15	-40 to +125
ISL32177E	0	4	3.0 – 5.5	80	–	1.6	Individual & Group	±16.5	15	-40 to +125
ISL32273E	0	4	3.0 – 5.5	20	–	–	Group	±16.5	5.5	-40 to +125
ISL32275E	0	4	3.0 – 5.5	20	–	–	Paired	±16.5	5.5	-40 to +125
ISL32277E	0	4	3.0 – 5.5	20	–	1.6	Individual & Group	±16.5	5.5	-40 to +125
RAA7884QR	0	4	3.0 – 5.5	80	–	–	Group	±16.5	15	-40 to +125

Overvoltage Protected Transceivers

| Part Number	V_{CC} Range (V)	OVP (V)	CMVR (V)	Half / Full Duplex	Data Rates (Mbps)	Devices allowed on bus	Hot Plug	IEC ESD (kV)	I_{CC} /ISHDN (mA)	Temp Range (°C)
ISL3243xE	3.0 – 5.5	±40	±15	HD / FD	0.25 / 1.0	128	No	±15	2.1 / 0.01	-40 to +85
ISL3245xE	3.0 – 5.5	±60	±20	HD / FD	0.25 / 1 / 20	128	No	±15	2.1 / 0.01	-40 to +85
ISL3247xE	4.5 – 5.5	±60	±15	HD / FD	0.25 / 1 / 15	128	Yes	±16.5	2.3 / 0.01	-40 to +85
ISL3249xE	4.5 – 5.5	±60	±25	HD / FD	0.25 / 1 / 15	128	Yes	±16.5	2.3 / 0.01	-40 to +85

x = 0,2,3,5,6,8

RS-232 Transceivers

RS-232 is a point-to-point interface between two RS-232 transceivers. RS-232 using single-ended signaling but with positive and negative voltages, such as ±5V to ±13V.

RS-232 Transceivers with Single, Dual, and Triple Channels

Part Number	Data Rate(Mbps)	V_{CC} (V)	Shutdown* Man./Auto	High ESD (kV)	Temp Range (°C)	Package
SINGLE TRANSCEIVER (1 Tx / 1 Rx)						
ICL3221E	0.5	3 – 5	A (B)	15	-40 to +85	SSOP16, TSSOP16
ICL3226E	0.5	3 – 5	A (E)	15	-40 to +85	SSOP16
DUAL TRANSCEIVERS (2 Tx / 2 Rx)						
ICL3222E	0.5	3 – 5	M	15	-40 to +85	SOIC18, SSOP20, TSSOP20
ICL3223E	0.5	3 – 5	A (B)	15	-40 to +85	SSOP20, TSSOP20
ICL3224E	0.5	3 – 5	A (E)	15	-40 to +85	SSOP20
ICL3225E	1	3 – 5	A (E)	15	-40 to +85	SSOP20
ICL3232E	0.5	3 – 5	M	15	-40 to +125	SOIC16, SSOP16, TSSOP16, TSSOP20
ISL4223E	0.5	3 – 5	A (B)	15	-40 to +85	QFN20
TRIPLE TRANSCEIVERS (3 Tx / 3 Rx)						
ISL4270E	0.5	3.0 – 5.5	A (E)	15	-40 to +85	QFN32
ISL83387E	0.5	3.0 – 5.5	A (E)	15	-40 to +85	TSSOP24

Multi-Protocol Transceivers

Multi-Protocol transceivers support both RS-485 and RS-232 interface specifications. They can be used as compact interface solutions, or as interface bridges, converting signal from one standard to the other. Multi-Protocol transceivers are in single or dual port variants, where each port can be configured either as a full duplex RS-485 transceiver, or as a two-channel RS-232 transceiver.

Full-Duplex Level Translator for point-to-point link only
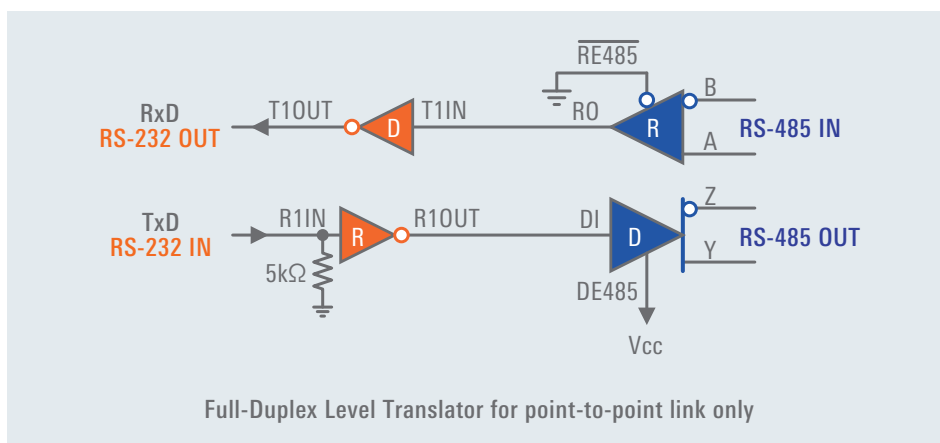
Multi-Protocol Transceivers with Single and Dual Ports

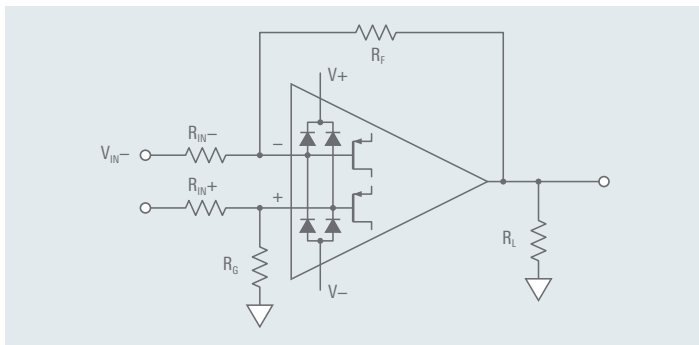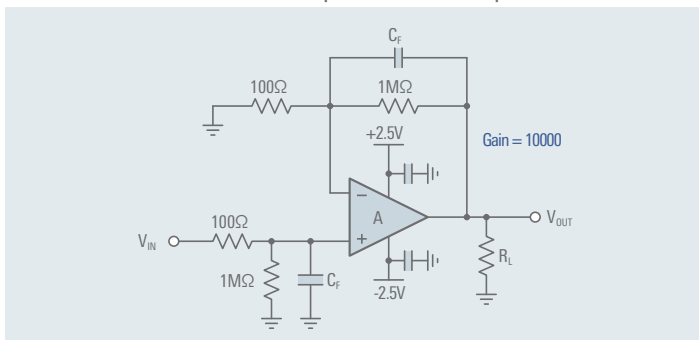| Part Number | # Ports | Config. | Data Rate (Mbps) | | V_{CC} (V) | VL-Pin (1.8V) | RXEN Polarity | Loopback | ESD (kV) | Temp Range (ºC) | Package |
			RS-485	RS-232							
ISL33337E	2	Fixed	20, 0.115	0.4	3	No	Low	No	15	-40 to +85	QFN40
ISL33354E	2	Fixed	20, 0.115	0.4	5	No	Low	No	15	-40 to +85	SSOP28
ISL81387	1	Prog.	20, 0.46, 0.115	0.65	5	No	High	Yes	15	-40 to +85	SOIC20, SSOP20
ISL3330	1	Prog.	20, 0.46	0.4	3	No	High	Yes	15	-40 to +85	SSOP20
ISL3331	1	Prog.	20, 0.46, 0.115	0.4	3	Yes	High and Low	Yes	15	-40 to +85	QFN40
ISL81334	2	Prog.	20 , 0.46 , 0.115	0.65	5	No	None	Yes	15	-40 to +85	SOIC28, SSOP28
ISL41334	2	Prog.	20, 0.46, 0.115	0.5	5	Yes	Low	Yes	15	-40 to +85	QFN40
ISL3332	2	Prog.	20	0.4	3	No	None	Yes	15	-40 to +85	SSOP28
ISL3333	2	Prog.	20, 0.46, 0.115	0.4	3	Yes	Low	Yes	15	-40 to +85	QFN40

Amplifiers

AMPLIFIERS

General Purpose Op-Amps

The general purpose op-amp has low voltage amplifiers, high voltage amplifiers, low offset voltage amplifiers, high slew rate amplifiers, rail-to-rail amplifiers, and more. Adaptable and versatile to many applications such as audio, white goods and industrial equipment.
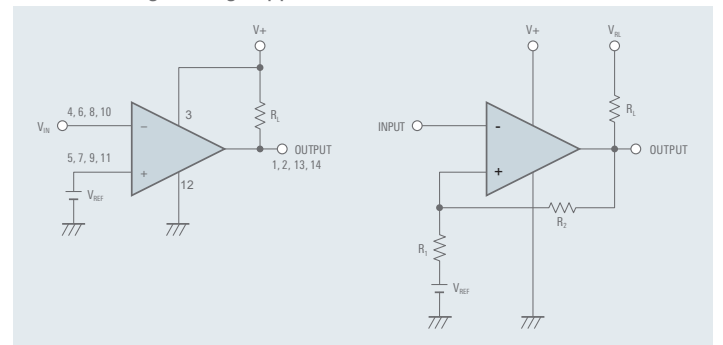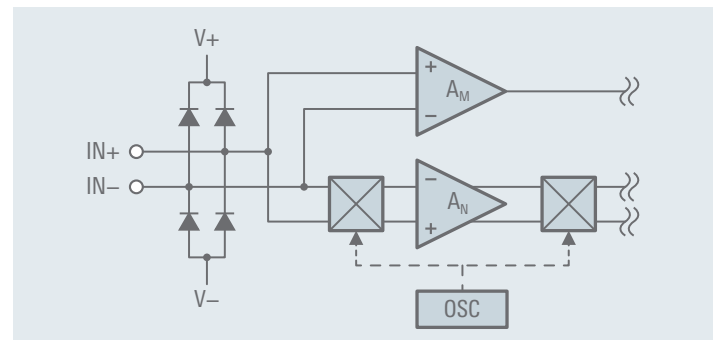

Comparators

We offers a diverse comparator portfolio that includes nano power comparators, high-speed CMOS comparators, and precision quad comparators. Our general-purpose comparators utilize CMOS processes suitable for low voltage, low power consumption and fast response. General-purpose comparators with expanded temperature operation suitable for high voltage applications are also available.

High Precision Op-Amps (Zero Drift)

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.

High-Speed Op-Amps

Our high-speed op-amps include amplifiers with low offset and rail-to-rail outputs for precision applications, high slew rate devices, and fully differential amplifiers with ultra-low distortion for driving high-speed ADCs.

GENERAL PURPOSE 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.

CMOS Operational Amplifiers

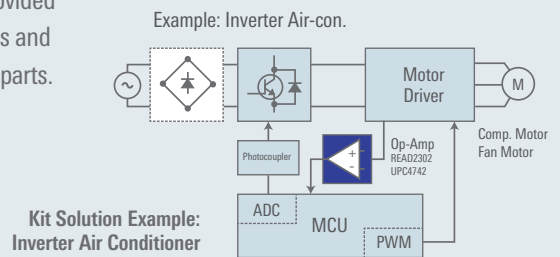| Type	V_{DD}	V_{IO} max.	SR typ.	Rail-to-Rail	Dual	Quad
Low power	1.8 to 5.5V	±6mV	0.35V/μs	Input/output	READ2303G (General Purpose)	READ4303G (General Purpose)
	1.8 to 5.5V	±6mV	0.35V/μs	Input/output	READ2353J (Automotive)	READ4353J (Automotive)
High slew rate	2.5 to 5.5V	±6mV	8V/μs	Input/output	READ2304G (General Purpose)	READ4304G (General Purpose)
	2.5 to 5.5V	±6mV	8V/μs	Input/output	READ2354J (Automotive)	READ4354J (Automotive)

Design Challenge #2

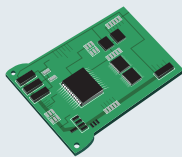### Short Development Time

Renesas Op-Amp Solution

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

Example: Inverter Air-con.

Motor Driver

M

Comp. Motor Fan Motor

Photocoupler

Op-Amp READ2302 UPC4742

ADC

MCU

PWM

Kit Solution Example: Inverter Air Conditioner
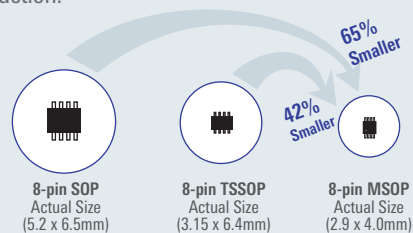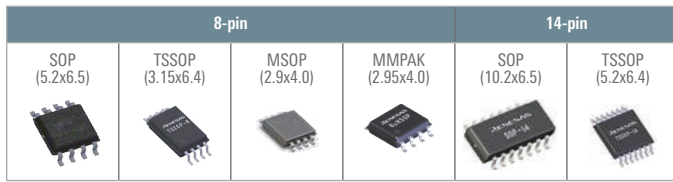

Design Challenge #3

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.

65% Smaller

42% Smaller

8-pin SOP
Actual Size
(5.2 x 6.5mm)

8-pin TSSOP
Actual Size
(3.15 x 6.4mm)

8-pin MSOP
Actual Size
(2.9 x 4.0mm)

8-pin				14-pin	
SOP (5.2x6.5)	TSSOP (3.15x6.4)	MSOP (2.9x4.0)	MMPAK (2.95x4.0)	SOP (10.2x6.5)	TSSOP (5.2x6.4)

CMOS Op-Amps

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 (Automotive)	1.8 to 5.5	±6	40	0.35	2	8-pin TSSOP
	Input/output	READ2303G (General Purpose)	1.8 to 5.5	±6	40	0.35	2	8-pin TSSOP/MSOP
	Input/output	READ2353J (Automotive)	1.8 to 5.5	±6	40	0.35	2	8-pin TSSOP
	Input/output	READ4303G (General Purpose)	1.8 to 5.5	±6	40	0.35	4	14-pin TSSOP
	Input/output	READ4353J (Automotive)	1.8 to 5.5	±6	40	0.35	4	14-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 (Automotive)	2.5 to 5.5	±6	750	8	2	8-pin TSSOP
	Input/output	READ2304G (General Purpose)	2.5 to 5.5	±6	750	8	2	8-pin TSSOP/MSOP
	Input/output	READ2354J (Automotive)	2.5 to 5.5	±6	750	8	2	8-pin TSSOP
	Input/output	READ4304G (General Purpose)	2.5 to 5.5	±6	750	8	4	14-pin TSSOP
	Input/output	READ4354J (Automotive)	2.5 to 5.5	±6	750	8	4	14-pin TSSOP
High voltage High slew rate	Output only	READ2606G (General Purpose)	4.5 to 32	±9	700	8	2	8-pin TSSOP
	Output only	READ2656J (Automotive)	4.5 to 32	±9	700	8	2	8-pin TSSOP
	Input/output	READ4606G (General Purpose)	4.5 to 32	±9	700	8	4	14-pin TSSOP
	Input/output	READ4656J (Automotive)	4.5 to 32	±9	700	8	4	14-pin TSSOP

Bipolar Op-Amps

Most of Industrial's products are also compatible with automotive applications.

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	µPC451	–	3 to 30	±7	2	0.3	4	14-pin SOP/TSSOP
	µPC452	µPC3403	3 to 32	±7	7	0.8	4	14-pin SOP
	µPC842/A	µPC4742	3 to 32	±5	4.5	7	2	8-pin SOP/TSSOP/MSOP*
	µPC844	µPC4744	3 to 32	±5	9	7	4	14-pin SOP/TSSOP
	µPC1251	–	3 to 30	±7	1.2	0.3	2	8-pin SOP/TSSOP/MSOP
Low V_{IO}	REAC1251G	–	3 to 30	±1	1.4	0.3	2	8-pin SOP/TSSOP/MSOP
	REAC1251J (Automotive)	–	3 to 30	±1	1.4	0.3	2	8-pin SOP/TSSOP/MSOP
	REAC842G	–	3 to 32	±1	6	7	2	8-pin SOP/MSOP
	REAC842J (Automotive)	–	3 to 32	±1	6	7	2	8-pin SOP/MSOP
Low noise	µPC258	µPC4558	±4 to ±16	±6	5.7	1	2	8-pin SOP
	µPC259	µPC4560	±4 to ±16	±6	5.7	2.8	2	8-pin SOP
	µPC458	µPC4741	±4 to ±16	±5	7	1	4	14-pin SOP
	–	µPC4570	±4 to ±16	±5	8	7	2	8-pin SOP/TSSOP
	–	µPC4572	±2 to ±7	±5	7	6	2	8-pin SOP
	–	µPC4574	±4 to ±16	±5	12	6	4	14-pin SOP/TSSOP
J-FET	µPC811	–	±5 to ±16	±2.5	3.4	15	1	8-pin SOP
	µPC812	µPC4092	±5 to ±16	±3	6.8	15	2	8-pin SOP
	µPC813	–	±5 to ±16	±2.5	3.5	25	1	8-pin SOP
	µPC814	µPC4094	±5 to ±16	±3	6.8	25	2	8-pin SOP
	µPC822	µPC4072	±5 to ±16	±10	5	13	2	8-pin SOP
	µPC824	µPC4074	±5 to ±16	±10	10	13	4	14-pin SOP
	µPC832	µPC4062	±2 to ±16	±10	0.5	3	2	8-pin SOP
	µPC834	µPC4064	±2 to ±16	±10	1	3	4	14-pin SOP
	µPC835	–	±5 to ±16	±3	2.2	5.5	2	8-pin MSOP
Low power	µPC802	–	±1 to ±16	±6	≤0.1	≤1.0	1	8-pin SOP
General	µPC251	µPC1458	±7.5 to ±16	±6	5.6	0.5	1	8-pin SOP

* MSOP corresponds to uPC842A only

Amplifiers

General Purpose Op-Amps

All general-purpose op-amps feature ground sensing capability. Most op-amps, however, possess rail-to-rail capability to enhance the dynamic input and output signal range and thus, signal integrity. Amongst these amplifiers, the ultra-low power op-amp, ISL28194, has a supply current of only 330nA, which makes it ideal for battery-powered applications.

Part Number	Channels (#)	Supply Range (V)	Vos (Max) (mV)	IBIAS (nA)	IS (per amp) (mA)	Bandwidth (MHz)	Slew Rate (V/µs)	Rail-to-Rail	Temperature Range (°C)
CA3130	1	5 – 16	5	0.005	2	15	30	-Vs	-55 to +125
CA3140	1	4 – 36	5	0.01	4	4.5	9	-Vs	-55 to +125
EL5x20	x = 2, 4	4.5 – 16.5	12	50	0.75	12	10	In/Out	-40 to +125
EL5420T	4	4.5 – 19	13	50	0.75	12	12	In/Out	-40 to +85
ISL24021	1	4.5 – 19	15	10	2.8	25	18	In/Out	-40 to +85
ISL28x13	x = 1, 2, 4	1.8 – 5.5	5	0.003	0.13	2	1	In/Out	-40 to +125
ISL28x14	x = 1, 2, 4	1.8 – 5.5	5	0.003	0.039	5	2.5	In/Out	-40 to +125

Bipolar Comparators

| Type | Part Number | | Power Supply Voltage (V) | V_{IO} (max) (mV) | Icc (max) (mA) | Tr/Tf (typ) (µs) | Channels | Package |
	Industrial	General Purpose						
General	µPC177	–	2 to 32	±5	2	1.3	4	14-pin SOP/TSSOP
	µPC271	–	5 to 32	±7.5	7.5	0.2	1	8-pin SOP
	µPC272	µPC319	5 to 16	±8	12.5	0.08	2	14-pin SOP
	µPC277	–	2 to 32	±5	1	1.3	2	8-pin SOP/TSSOP/MSOP

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

Amplifiers

PRECISION OP-AMPs: V$_{OS}$ < 1mV

Unmatched Precision When Accuracy Matters

Zero Drift Amplifiers
(Low Voltage Precision Op-Amps)

ISL28134, ISL28x33, ISL28x30

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.
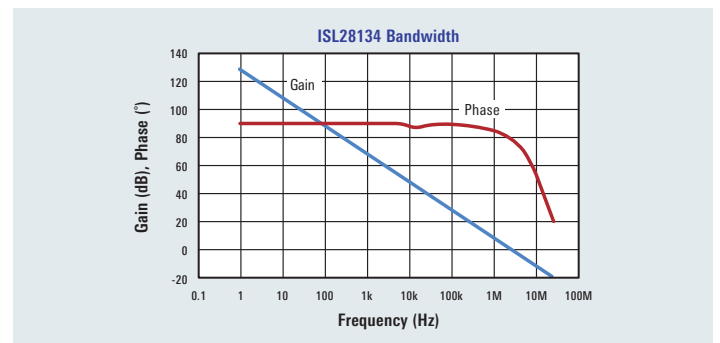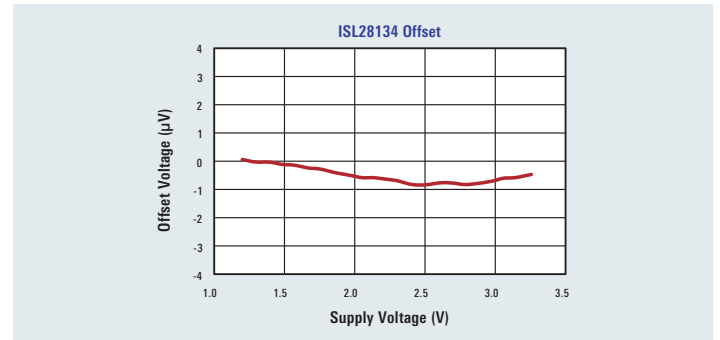
Key Features ISL28134

- Low offset voltage over supply range (typically < 0.2µV)
- Low offset voltage over temperature (typically < 0.5nV/ºC)
- No 1/f noise
- Low wideband noise (typically 8nV/√Hz)
- Very high open loop gain (174dB)
- Wide Bandwidth (3.5MHz)
- Packages: Standard SOIC-8 and Tiny SOT-23-5 (2.9mm x 2.8mm)

Applications

High-Precision Signal Conditioners

- High-Gain Amplifiers
- Current Sensing
- Temperature Measurements
- Weight Scales
- Instrumentation
- Medical Equipment
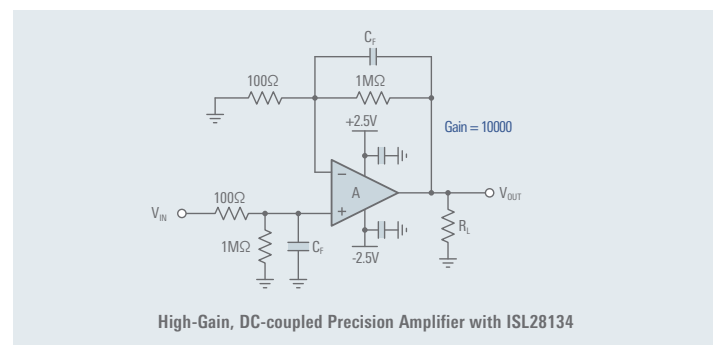
ISL28134 Offset

ISL28134 Bandwidth

High-Gain, DC-coupled Precision Amplifier with ISL28134

Part Number	Channels (#)	Supply Range (V)	V$_{OS}$ (Max) (mV)	IBIAS (nA)	IS (per amp) (mA)	Bandwidth (MHz)	Slew Rate (V/µs)	Rail-to-Rail	Noise (nV/√Hz)
ISL28x30	x = 1, 2, 4	1.8 – 5.5	0.04	0.25	0.02	0.4	0.2	In/Out	65
ISL28x33	x = 1, 2, 4	1.8 – 5.5	0.008	0.03	0.018	0.4	0.2	In/Out	65
ISL28134	1	2.25 – 6	0.0025	0.12	0.675	3.5	1.5	In/Out	8

High-Voltage Precision Op-Amps

Our high-voltage precision amplifiers feature low noise, high slew rate, and very low offset voltage, making them the ideal choice for applications where precision and low noise are important, such as precision medical and analytical instrumentation, sensor conditioning, precision power supply controls, industrial controls, and photodiode amplifiers. All devices operate over the extended temperature range from -40°C to +125°C.

Part Number	Channels (#)	Supply Range (V)	Vos (Max) (mV)	IBIAS (nA)	IS (per amp) (mA)	Bandwidth (MHz)	Slew Rate (V/µs)	Noise (nV/√Hz)	Temperature Range (ºC)
ISL28x07	x = 2, 4	4.5 – 40	0.075	0.015	0.21	1	0.32	13	-40 to 125
ISL28x08	x = 1, 2, 4	3 – 40	0.15	-13	0.185	1.2	0.45	16	-40 to 125
ISL28x10	x = 1, 2	9 – 40	0.3	0.0003	2.55	12.5	23	6	-40 to 125
ISL28x17	x = 2, 4	4.5 – 40	0.05	1	0.44	1.5	0.5	8	-40 to 125
ISL28x18	x = 1, 2	3 – 40	0.15	-230	0.85	4	1.2	5.6	-40 to 125
ISL28x27	x = 1, 2	4.5 – 40	0.07	10	2.8	10	3.6	2.5	-40 to 125
ISL28177	1	4.5 – 40	0.15	0.2	1.18	0.6	0.2	9.5	-40 to 125

High-Speed Op-Amps

High Speed Amplifiers
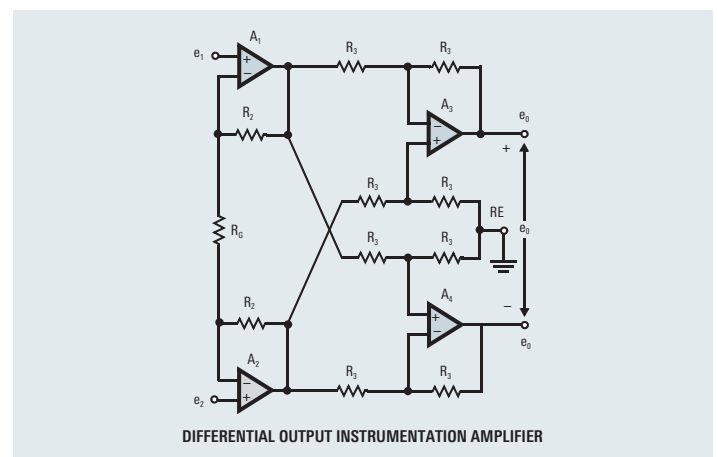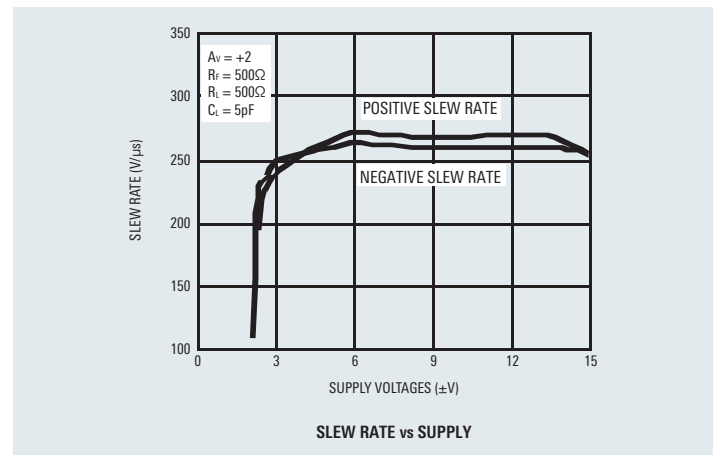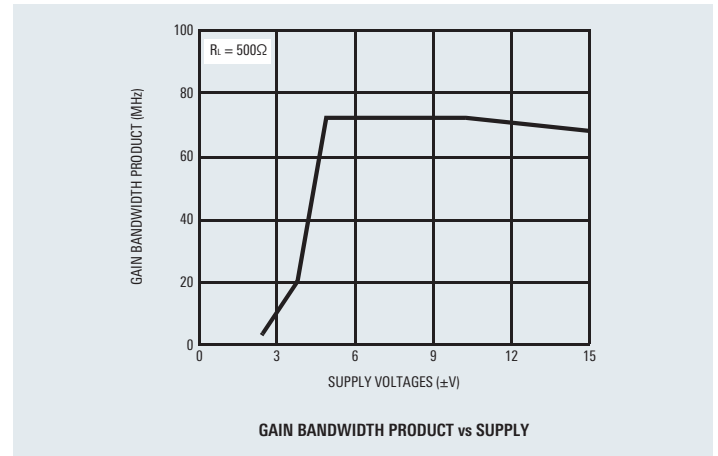
ISL55001, ISL28x91

Our high-speed op-amps include amplifiers with low offset and rail-to-rail outputs for precision applications, high slew rate devices, and fully differential amplifiers with ultra-low distortion for driving high-speed ADCs.

Key Features ISL55001

- 220MHz -3dB Bandwidth
- Unity-gain Stable
- Low Supply Current: 9mA @ VS = ±15V
- Wide Supply Range: ±2.5V to ±15V Dual-Supply and 5V to 30V Single-Supply
- High Slew Rate: 300V/μs
- Fast Settling: 75ns to 0.1% for a 10V Step
- Wide Output Voltage Swing: -12.75V/+13.6V with VS = ±15V, RL = 1k

Applications

- Video Amplifiers
- Single-supply Amplifiers
- Active Filters/Integrators
- High Speed Sample-and-Hold
- High Speed Signal Processing
- ADC/DAC Buffers
- Pulse/RF Amplifiers
- Pin Diode Receivers
- Log Amplifiers
- Photo Multiplier Amplifiers
- Difference Amplifier

GAIN BANDWIDTH PRODUCT vs SUPPLY

SLEW RATE vs SUPPLY

DIFFERENTIAL OUTPUT INSTRUMENTATION AMPLIFIER

High-Speed Op-Amps

Our high-speed op-amps include amplifiers with low offset and rail-to-rail outputs for precision applications, high slew rate devices, and fully differential amplifiers with ultra-low distortion for driving high-speed ADCs.

Part Number	Channels (#)	Topology	Supply Range (V)	Bandwidth (MHz)	Slew Rate (V/µs)	Noise (nV/√Hz)	2nd HD (dB)	3rd HD (dB)	IS per amp (mA)	V_{OS} (Max) (mV)
Voltage Feedback Amplifiers with Rail-to-Rail Outputs										
ISL28191	1	VFA	3 – 5.5	61	17	1.7	-76	-70	2.6	0.63
ISL28291	2	VFA	3 – 5.5	61	17	1.7	-76	-70	2.6	0.63
EL8201	2	VFA	3 – 5.5	200	200	10	-62	-65	2	6
Voltage Feedback Amplifiers with Enhanced Slew Rate										
ISL55001	1	VFA	5 – 30	220	300	12	-72	-80	9	3
ISL55002	2	VFA	5 – 30	200	300	12	-72	-80	8.5	5
Fully Differential Amplifiers										
ISL55210	1	FDA	3 – 4.2	2200	5600	0.85	-105	-120	35	1.4
Current Feedback Amplifiers										
EL5160	1	CFA	5 – 10	200	1700	4	-74	-50	0.75	5
EL5161	1	CFA	5 – 10	200	1700	4	-74	-50	0.75	5
EL5x62	x = 1, 2, 4	CFA	5 – 12	500	4000	3			1.5	5
EL5263	2	CFA	5 – 12	500	2500	3			1.5	5
EL5166	1	CFA	5 – 12	1400	6000	1.7	-70	-78	8.5	5
Differential Line Drivers and Receivers										
EL5172	1	VFA	5 – 11	250	800	26	-59	-60	6	25
EL5375	3	VFA	5 – 11	550	900	21	-65	-78	9.6	40
EL5378	3	VFA	5 – 11	700	1000	18	-83	-88	12.5	30

CURRENT SENSING

Current sensing is a fundamental requirement in a wide range of electronic applications. Measuring current drop across a sense resistor is the most commonly used method due to being low cost, having high measurement accuracy, allowing a large measurable current range, and being capable to measure DC and AC currents.

Discrete Solution

Precision Op Amps for Current Sensing

A basic current sense amplifier is an op-amp configured as a difference amplifier. The diff-amp rejects the common mode voltage present at the points V_1 and V_2 and amplifies only the voltage difference across the sense resistor by the circuit gain. A separate reference voltage sets the midpoint of the output voltage around which the amplified input voltage swings. Substituting the voltage difference with the load current times the sense resistance and solving for the load current gives:

$$I_L = (V_O - V_{REF}) / (R_S \cdot G)$$

Bidirectional Current Sensing
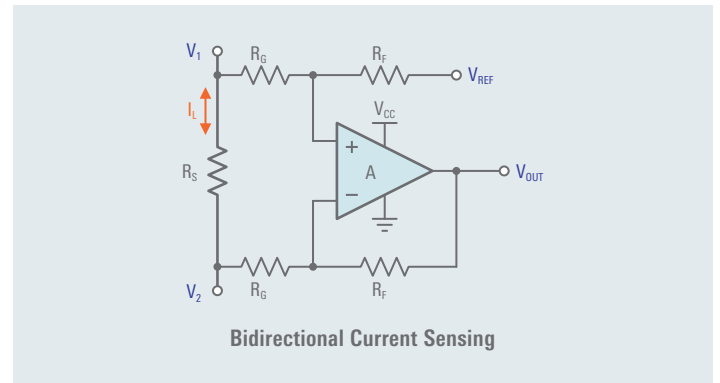
Most Common Discrete Solutions

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	ISL28134	15nV/°C	2.5µV	World Class
Standard CMOS	ISL28113 ISL28114	2µV/°C	5mV	
Standard CMOS	READ2302 READ2303 READ2304	–	6mV	
Standard Bipolar	REAC1251	1µV/°C	1mV	
Autotrim	SLG47004V	12.6µV/C (not trimmed) 5µV/C (trimmed)	243µV	Additional analog switches and digital macrocells

Generic versus High-Precision Solution

Using a 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$_S$	R$_S$ Power Loss	Benefits
Generic	500µV	25mΩ	625mW	–
ISL28x30	40µV	2mΩ	50mW	92% Power Savings
ISL28134	2.5µV	125µΩ	3mW	99.5% Power Savings

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 unidirectional current sense
- Low power consumption, 50µA (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$_{OS}$
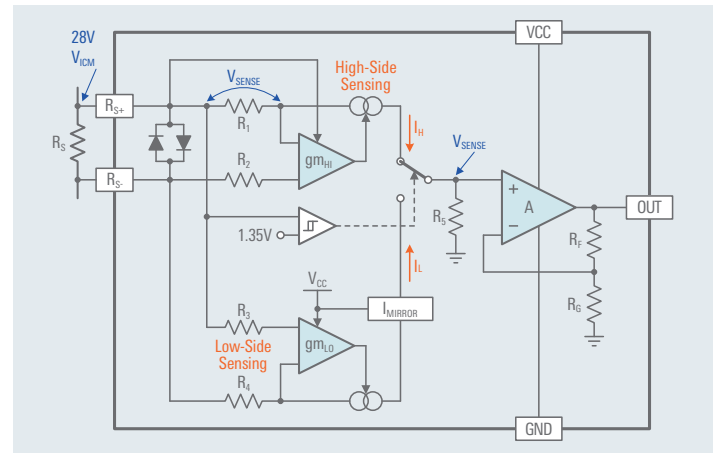
Current Sense Amplifiers

Part Number	Supply Range (V)	V$_{ICM}$ Range (V)	V$_{OS}$ Max @ 25°C (µV)	V$_{OS}$ Max Temp (µV)	CMRR Min Temp (dB)	PSRR Min Temp (dB)	Gain Range (V/V)	Gain Accuracy @ 25°C (%)	Gain Accuracy Temp (%)	Is Max @ 25°C (µA)	Is Max Temp (µA)	Package
ISL28005	2.7 to 28	0 to 28	500	500	105	90	20, 50, 100	2	3	59	59	SOT-23-5
ISL28006	2.7 to 28	0 to 28	250	300	105	90	20, 50, 100 Adj (20–100)	0.7	1	62	62	SOT-23-5 SOT-23-6

High Voltage Precision Sensing for Current, Voltage, and Power

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

ISL28022/23/25

The ISL28022/23/25 digital power monitors are high-side and low-side digital current sense and voltage monitors 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 (ISL28023)
- User defined alerts – OV, UV, OC
- Additional features (margin DAC, voltage regulator, internal temp sensor, auxiliary channel)
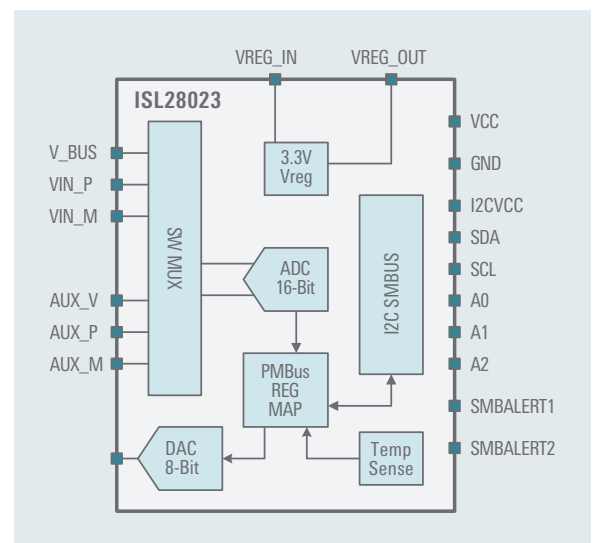
Current Sense Amplifiers

Part Number	Category	Primary Channel	LV AUX Channel	Accuracy	Current Measure LSB	Offset Voltage	Fast Alert Outputs	Package
ISL28022	Basic	0 to 60V	–	0.3%	10µV	75µV	–	MSOP10, QFN16
ISL28023	Full Featured	0 to 60V/12V	0 to V$_{CC}$	0.05%	2.5µV	30µV	2	QFN24
ISL28025	Tiny Package	0 to 60V/12V	0 to V$_{CC}$	0.1%	2.5µV	30µV	2	WLCSP-16

PHOTOCOUPLERS

Providing Highly Reliable, High Accuracy Small Footprint Solutions

Renesas MCU

Low-voltage

Feedback

Renesas Photocouplers

Drive Signal

Renesas Power Devices

High voltage

Renesas Strength

High Reliability

IGBT Drive (PS9332)

- Built-in IGBT protection to prevent from overcurrent
- Miller clamp and DESAT detection

High Accuracy

Digital output (RV1S9353A)

Decoder

A/D Converter

SHIELD

Δ-∑ Modulators

- Contribution
  Direct connection to RZ/T
- Features
  - High precision: Gain ±0.5% MAX.
  - Effective Number of Bit (ENOB) 13.8 bits TYP.
  - Input Offset Voltage Drift vs. Temperature 2.5 µV/℃ MAX.

Small Package + High Temp Operation

SO16 (8mm)

LSDIP (15mm)

LSO5 (8mm)

- T_A = 125℃ guaranteed

Featured Products

Transistor output coupler for ultra-low input current

Input current I_F=50 µA drive RV1S2x51A, RV1S2x55A

- Contribution
  The high CTR in the low input current region enables low power consumption of the application and control of multiple photocouplers by an MCU.
- Features
  - High CTR 300% or more
  - High temperature compatible 115°C
  - Creepage distance/Pin pitch
    15/1.27mm (RV1S2451A)
    8.2/1.3mm (RV1S225xA)
    4/1.27mm (RV1S295xA)

RV1S2x51A DC Input

RV1S2x55A AC Input

New
RV1S2x51A
RV1S2x55A

Conventional Darlington transistor

Conventional Single transistor

CTR [%]

IF [mA]
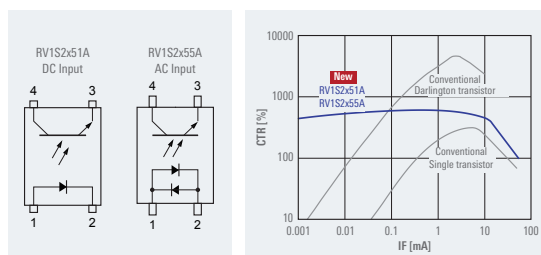
LSSO5(5pin)/LSSOP(4pin)

- Downsizing while maintaining long creepage (35% reduction in mounting area compared to LSO5)
- Lineup: IGBT drive, IPM drive, 15 Mbps, Transistor output

Industry first package

LSO5

New LSSO5

0.65 mm

8.2 mm
Half lead pitch compared to conventional package

8.0 mm

Reduction of mounting area

Reduced area

35%

LSO5

LSSO5

IC-Output
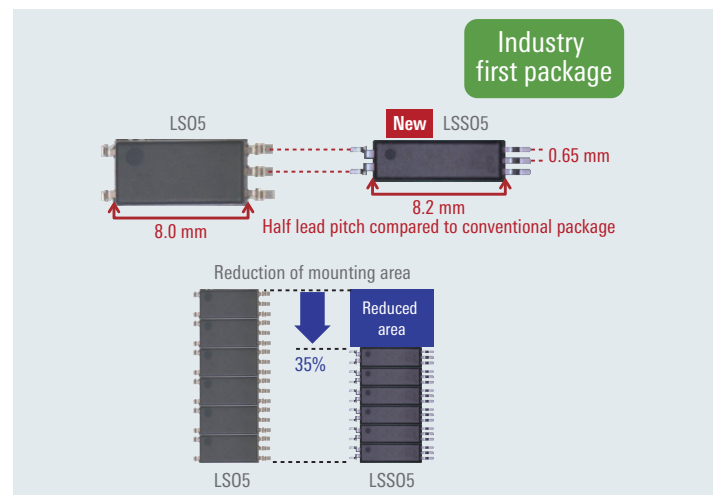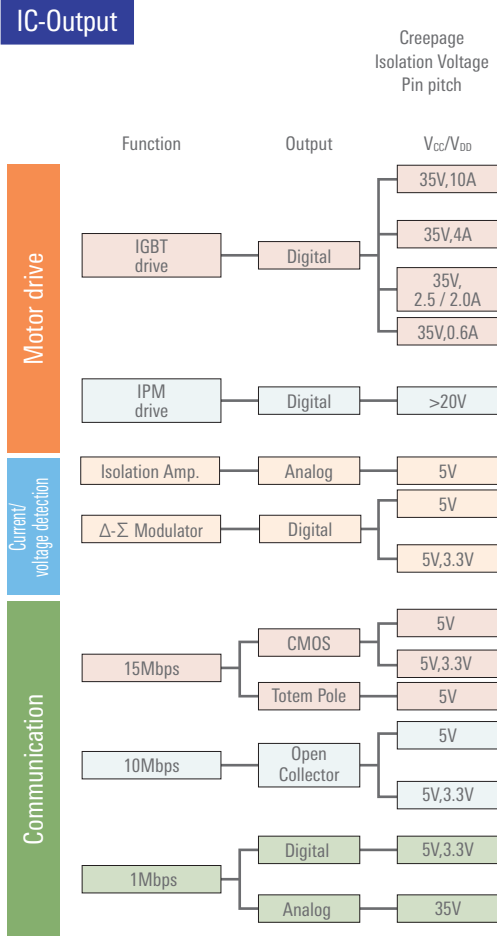
Function	Output	V_{CC}/V_{DD}	DIP8 7/8 mm 5 kV 2.54 mm	SDIP6/8 7/8 mm 5 kV 1.27 mm	LSDIP8 15 mm 7.5 kV 1.27 mm	LS05 8 mm 5 kV 1.27 mm	SO5 4.2 mm 3.75 kV 1.27 mm	LSSO5 8.2 mm 5 kV 0.65 mm	SO8 4 mm 2.5 kV 1.27 mm	SO16 8 mm 5 kV 1.27 mm
IGBT drive	Digital	35V,10A			RV1S9993A RV1S9994A					
		35V,4A			RV1S9991A RV1S9992A	RV1S9091A RV1S9092A		RV1S9291A RV1S9292A		
		35V, 2.5 / 2.0A	PS9531	PS9331 PS9332	PS9905	PS9031		RV1S9231A		PS9402
		35V,0.6A	PS9506	PS9307A				RV1S9207A		
IPM drive	Digital	>20V	PS9513	PS9313 PS9303 PS9309		PS9013 RV1S9062A PS9009 RV1S9061A	PS9113 RV1S9162A RV1S9161A	RV1S9213A RV1S9262A RV1S9209A RV1S9261A		
Isolation Amp.	Analog	5V	PS8551A	PS8352A						
Δ-Σ Modulator	Digital	5V	PS9551A							
		5V,3.3V		RV1S9353A RV1S9355A RV1S9356A						
15Mbps	CMOS	5V		PS9351			PS9151		PS9851-1 PS9851-2	
		5V,3.3V			RV1S9960A	RV1S9060A	RV1S9160A	RV1S9260A		
	Totem Pole	5V					PS9123			
10Mbps	Open Collector	5V	PS9587	PS9317		PS9001	PS9117A		PS9817A-1 PS9817A-2	
		5V,3.3V		PS9324	PS9924		PS9124		PS9821-1 PS9821-2	
1Mbps	Digital	5V,3.3V					PS9122		PS9822-1 PS9822-2	
	Analog	35V	PS8501 PS8502	PS8302	PS8902		PS8101		PS8802-1 PS8802-2	

Transistor-Output
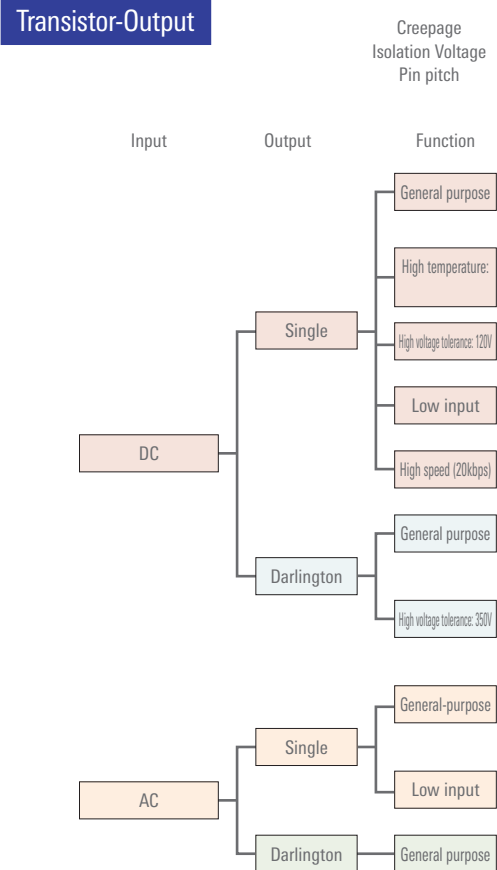
Input	Output	Function	DIP4 7/8 mm 5 kV 2.54 mm	LSOP 8 mm 5 kV 2.54 mm	SOP 5 mm 3.75 kV 2.54 mm	LSSOP4 8.2 mm 5 kV 1.3 mm	LSDIP8 15 mm 7.5 kV 1.27 mm	SSOP 4/4.5/5 mm 1.5/2.5/3.75 kV 0.8/1.27 mm	Flat lead 4 mm 2.5 kV 1.27 mm
DC	Single	General purpose			PS2701A-1			PS2801C-1/4	
		High temperature:	PS2561D-1 PS2561F-1	PS2381-1	PS2761B-1	RV1S2281A		PS2861B-1	
		High voltage tolerance: 120V			PS2703-1				PS2913-1
		Low input			PS2711-1	RV1S2211A RV1S2251A	RV1S2451A	PS2811-1/4 PS2841-4A/4B	PS2911-1 RV1S2951A
		High speed (20kbps)	PS2514-1						
	Darlington	General purpose	PS2562-1		PS2702-1			PS2802-1/4	
		High voltage tolerance: 350V	PS2533-1 PS2535-1		PS2733-1			PS2833-1/4	PS2933-1
AC	Single	General-purpose	PS2565-1		PS2705A-1	RV1S2285A		PS2805C-1/4	
		Low input			PS2715-1	RV1S2255A		PS2815-1/4 PS2845-4A	PS2915-1 RV1S2955A
	Darlington	General purpose	PS2506-1		PS2706-1				

REAL-TIME CLOCKS

ISL1208

I²C Real Time Clock/Calendar, Low Power RTC with Battery Backed SRAM

- Real Time Clock/Calendar
  - Tracks Time in Hours, Minutes, and Seconds
  - Day of the Week, Day, Month, and Year
  - Settable to the Second, Minute, Hour, Day of the Week, Day, or Month
- Automatic Backup to Battery or Super Capacitor – 400nA Battery Supply Current
- 2 Bytes Battery-Backed User SRAM
- Single Alarm
- On-Chip Oscillator Compensation
- I²C Interface - 400kHz Data Transfer Rate
- Small Package Options
  - 8 Ld MSOP and SOIC Packages
  - 8 Ld TDFN Package

On-Chip Crystal Compensation Network
Corrects for crystal oscillator's drift over temperature.

Flexible Alarm
Allows users to set to the second, minute, hour, day of the week, day, or month.

Only 400nA Battery Supply Current

Automatic Backup to Battery or Super Cap
Provides a backup supply voltage to the device in the event that V$_{DD}$ supply fails.

The InterSeal™ Battery Saver Seal
Prevents initial battery current drain prior to first use.

Applications

- Utility Meters
- HVAC Equipment
- Audio/Video Components
- Set-Top Box/Television
- Modems
- Network Routers, Hubs, Switches, Bridges
- Cellular Infrastructure Equipment
- Fixed Broadband Wireless Equipment
- Pagers/PDA
- POS Equipment
- Test Meters/Fixtures
- Office Automation
- Home Appliances
- Computer Products
- Other Industrial/Medical/Automotive

Part Number	Alarms	#Fout frequencies	Battery Backup	Reseal	Memory (Bytes)	Event detection	Event time stamp	Bat timestamp	Auto DST adjust	Temp sensor	Power monitoring	Integrated Crystal
ISL12057	2	4										
ISL12058	2	4										
ISL12008	1	1	✓	✓								
ISL1208	1	15	✓		S2							
ISL1220	1	15	✓		S8							
ISL1209	1	15	✓		S2	✓						
ISL1219	1	15	✓		S2	✓	✓					
ISL1221	1	15	✓		S2	✓	✓					
ISL12022	1	15	✓	✓	S128			✓	✓	✓	✓	
ISL12026	2	3	✓		E512							
ISL12022M	1	15	✓	✓	S128			✓	✓	✓	✓	✓
ISL12020M	1	15	✓	✓	S128			✓	✓	✓	✓	✓

Data Converters
HIGH SPEED ADC/DACs
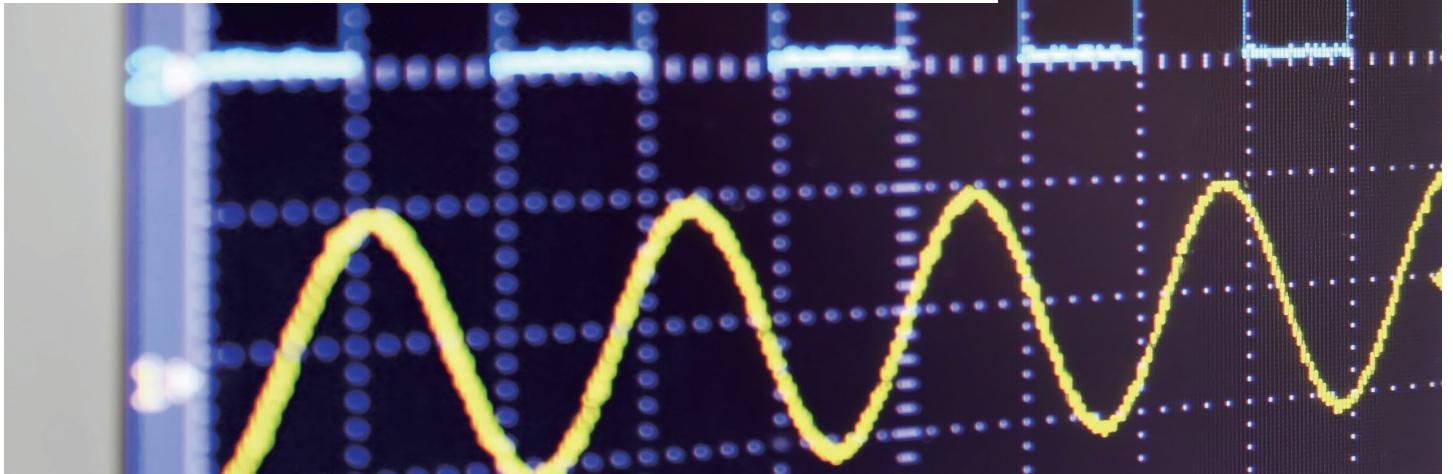
High Speed ADCs

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

Competitive Advantages

- Between half and one fifth the power 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

Speed	8-bit	10-bit	12-bit	14-bit	16-bit
500+	ISLA118P50	ISLA110P50 KAD5510P-50	ISLA112P50 ISLA212P50 KAD5512P-50	ISLA214P50	
250–350		KAD5510P-25 KAD5610P-25	ISLA212P25 ISLA222P25 ISLA222S25 KAD5512(H)P-25 KAD5612P-25	KAD5514P-25 ISLA224P25	ISLA216P25
130–210		KAD5510P-21 KAD5610P-21 KAD5510P-17 KAD5610P-17	KAD5512(H)P-21 KAD5612P-21 ISLA222S20 KAD5512(H)P-17 KAD5612P-17 ISLA222P13	KAD5514P-21 ISLA214P20 ISLA224P20 ISLA224S20 KAD5514P-17	ISLA216P20 ISLA216S20 ISLA216P13
Up to 125		KAD5510P-12 KAD5610P-12	KAD5512(H)P-12 KAD5512P-12	KAD5514P-12 ISLA224P12	

Single   Dual

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 Comms
- Broadband Microwave Repeaters
- Military and SDR Radios

DACs	8-bit	10-bit	12-bit	14-bit
260 MSPS			ISL5857	
130–210 MSPS		ISL5761	ISL5861	ISL5961
60–125 MSPS	HI5660			

Single

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

Measurement Accuracy (bits) vs **Conversion Rate, Samples per Second**

19-24 bits, 1kSPS to 4kSPS
ISL26102/104 Delta-Sigma
ISL26132/134 Delta-Sigma

12-18 bits, 10kSPS to 1MSPS
ISL2631x SAR
ISL267xx SAR
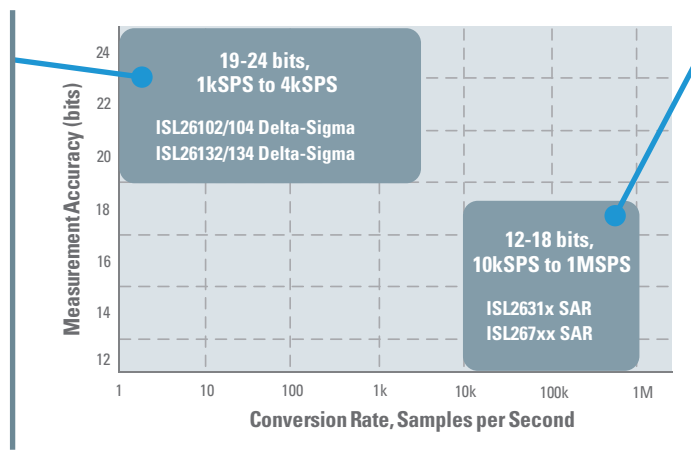
Successive Approximation (SAR) ADCs

- 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	Part Number	INL (%FS)	Noise	Power Consumption	Analog Supply Voltage Range	Digital Supply Voltage Range	Package	Technical Highlight
24-bit	4kSPS	ISL26102	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	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	Part Number	± INL (Integral Non-Linearity) (LSB)	SFDR	Power Consumption	Analog Supply Voltage (min)	Analog Supply Voltage (max)	Pkg Type	Temp Range (°C)
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	125kSPS	ISL26313	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	ISL26321 , ISL26322	0.7	96dB	11mW, 15mW	2.7V	5.25V	SOIC8, TSSOP16	-40 to +125
	1MSPS	ISL26712	0.4	-87dB	3.75mW	2.7V	5.25V	DFN8, SOT8	-40 to +85

Data Converters

DIGITAL POTENTIOMETERS PORTFOLIO

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. Renesas offers the widest selection of low-to-high resolution digital potentiometers (DCPs) in single, dual and quad configurations that are accurate, easy to adjust and reduce manufacturing complexity.

X9C102, X9C103, X9C104, X9C503
Digitally Controlled Potentiometer

- Three-Wire Serial Interface
- $1k\Omega$, $10k\Omega$, $50k\Omega$, $100k\Omega$
- 100 Wiper Tap Points
  - Wiper Position Stored in Non-volatile Memory and Recalled on Power-up
- 99 Resistive Elements
  - Temperature Compensated
  - End-to-End Resistance, $\pm20\%$
  - Terminal Voltages, $\pm5V$
- Low Power CMOS
  - $V_{CC} = 5V$
  - Active Current, 3mA max.
  - Standby Current, $750\mu A$ max. High Reliability
- Reliability
  - Endurance, 100,000 Data Changes per Bit
  - Register Data Retention, 100 years
- 8 lead SOIC or PDIP
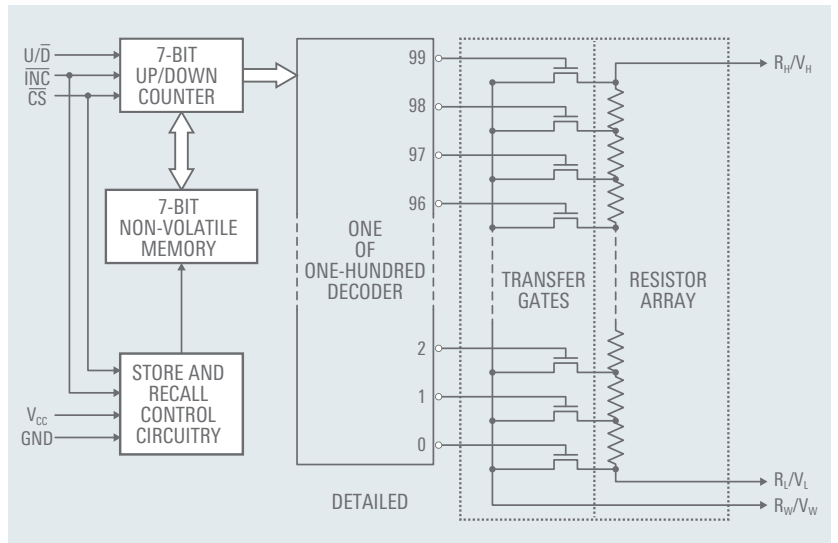
Tap	Part Number	Resistance kΩ	Channels	Interface
32	ISL23511	10	1	Pushbutton
128	ISL23318	10, 100	1	I²C
	ISL23418	50	1	SPI
	ISL90727, 8	10, 50	1	I²C
	ISL23315	10, 100	1	I²C
	ISL23328	10	2	I²C
256	ISL23415	10, 100	1	SPI
	ISL23325	10, 100	2	I²C
	ISL23425	10, 100	2	I²C
	ISL90842	10, 50	4	I²C
1024	SLG47004V	100	2 (rheostat mode), 1 (potentiometer mode)	I²C, internal custom logic circuit

Other Options with Volatile Memory

Nonvolatile				
Tap	Part Number	Resistance kΩ	Channels	Interface
32	ISL22511	10	1	Pushbutton
	X9313	1, 10, 50	1	3-Wire (Up/Down)
	X9315	10, 50, 100	1	3-Wire (Up/Down)
	X9511	10	1	Pushbutton
64	X9241A	2, 10, 50	1	2-Wire
	X9401	10	4	SPI
100	X9317	10, 50	1	3-Wire (Up/Down)
	X9318	10	1	3-Wire (Up/Down)
	X9C102, 3, 4	1, 10, 100	1	3-Wire(Up/Down)
	X9C503	50	1	3-Wire (Up/Down)
128	ISL223x6	10	x = 1, 2, 4	I²C
	ISL223x6WM	10	x = 1, 2, 4	I²C
	ISL22317	10, 50, 100	1	I²C
	ISL95311	10	1	I²C
256	ISL958x0	2.5, 10, 50	x = 1, 2	I²C
	X9252	2, 10	4	2-Wire, 3-Wire (Up/Down)
	ISL22424	10	2	SPI
	X9271, X9251, X9259	50	1, 4	SPI, 2-Wire
	X9250, X9258	50, 100	4	SPI , 2-Wire

Other Options with non-Volatile Memory

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.

Figure 1
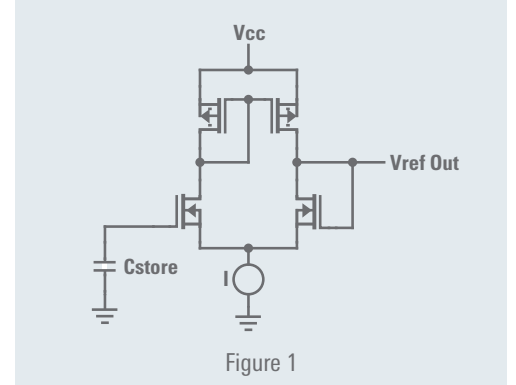
Ultra-Low Power, General Purpose Voltage Reference

ISL21080

The ISL21080 analog voltage references feature low supply voltage operation at ultra-low 310nA typical. Additionally, the ISL21080 family features ensured initial accuracy as low as ±0.2% and 50ppm/°C temperature coefficient.

These references are ideal for general purpose portable applications to extend battery life at lower cost. The ISL21080 is provided in the industry standard 3 Ld SOT-23 pinout.

- Supply current: 310nA typ
- Reference output voltage options:
  – 0.9V, 1.024V, 1.25V, 1.5V, 2.048V, 2.5V, 3.0V, 3.3V, 4.096V
- Output voltage noise: 30µV$_{P-P}$ typ
- Temperature Range: -45ºC to +85ºC
- Tempco: 50ppm/°C max
- Output current capability: ±7mA
- Package: 3 Ld SOT-23

Figure 2. I$_{IN}$ vs V$_{IN}$ over Temperature
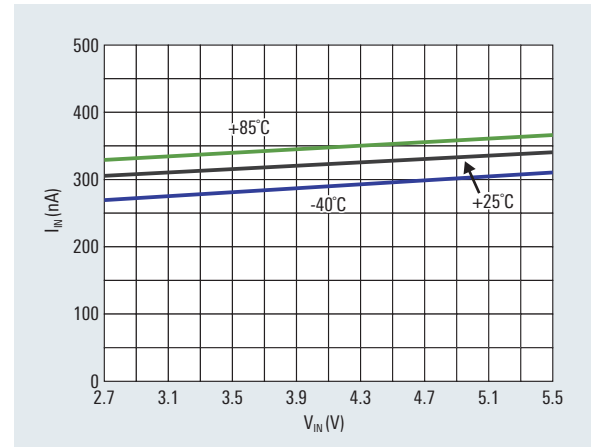
Precision Voltage References

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

Reset IC

VOLTAGE DETECTING, SYSTEM RESETTING IC

High Voltage Bipolar Reset IC detect power supply volyage & protect equipments.

Reset IC is useful for resetting various logic circuits such as MCU. With built in delay circuit, user can easily change its delay time with an external capacitor.

- High Voltage Bipolar
  Supply Voltage: 18V MAX.
- Detecting Voltage
  REAR56953A,B: 4.25V fix (No need ext. resistor)
  REAR56957A,B: 2 to 15V (Change by ext. resistor R1, R2)
  REAR56958B: 2 to 15V (Change by ext. resistorR1, R2)
- Delay Time
  Large delay time with a capacitor of small capacitance
  TYP.: 3.4 ms (Cd=0.01uF), changed by delay capacitor
- Applications
  Industrial
  Consumer

Note: For system with 12V DC output from AC/DC converter.
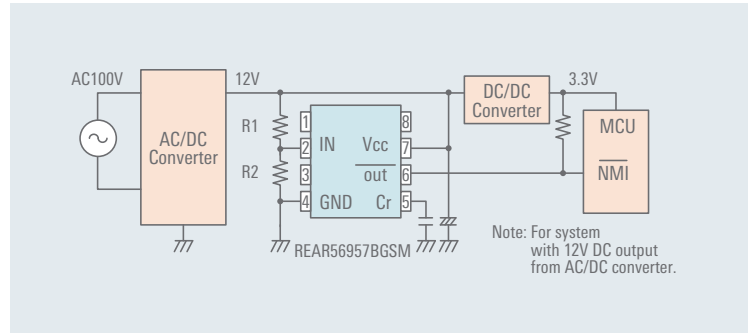
Part Number	Detecting Voltage [Typ.] (V)	Reset Mode	Out-put Type	Package	Block Diagram	Operating Waveform
REAR56953AGSM	4.25	Low	Built-in load	SOP8		
REAR56953BGSM	4.25	Low	Open collector	SOP8		
REAR56957AGSM	1.25 (Variable 2 to 15V)	Low	Built-in load	SOP8		
REAR56957BGSM	1.25 (Variable 2 to 15V)	Low	Open collector	SOP8		
REAR56958BGSM	1.25 (Variable 2 to 15V)	High	Open collector	SOP8		

Switches & Multiplexers

ANALOG SWITCHES

Renesas' broad portfolio of analog switches and multiplexers (MUX) provide excellent performance across a wide input voltage range. Products include 40V operation down to low voltage USB switching. The following figures and tables only show a fraction of the most commonly preferred analog switches and multiplexers. This portfolio includes single, dual and quad channels of single-pole single-throw and single-pole dual-throw switches, as well as single and dual dual-pole single-throw and dual-pole dual-throw switches, both available in normal-open (NO) and normal-closed (NC) configurations. For selective switching of multiple signal inputs, the input configurations of our multiplexers range from single and dual 4:1 and 8:1 and 16:1.

SPST   SPDT   DPST   DPDT   MUX 1:n

Single, Dual, and Quad Channel Switches
and 4, 8, and 16 Channel Multiplexers
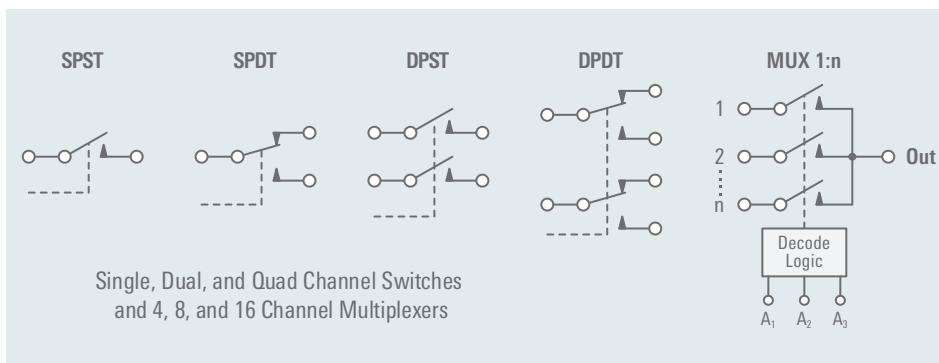
Data acquisition is the process of sampling signals that measure real-world physical conditions and converting the resulting samples into digital numeric values. Data acquisition circuitry includes sensors that convert physical parameters to electrical signals, signal conditioning circuitry, and analog to digital converters.

Data acquisition applications require analog switch and multiplexer products with low charge injection and parasitic capacitance to minimize switching errors and settling time in the input multiplexer and sample and hold circuits. Renesas offers high performance for these parameters, enabling high sampling rates and accuracy. In addition, Renesas also offers switches with low on-resistance that are suitable for mode switch, filtering, and programmable gain control applications.

Inverting Amplifier Gain is varied using an Analog Switch

Data Acquisition of multiple Sensors using a Multiplexer
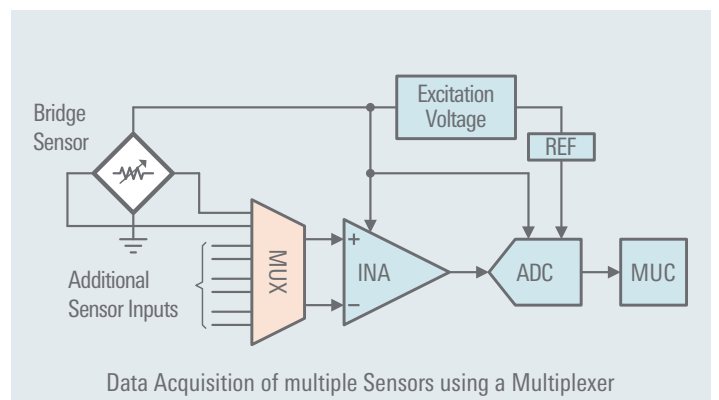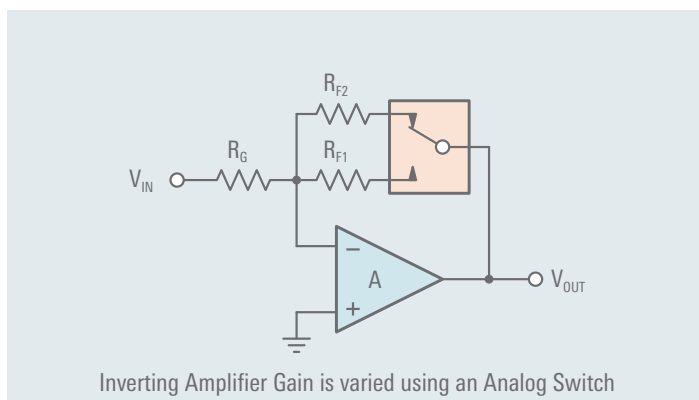
Analog Switches

Part Number	Configuration	TON (ns)	TOFF (ns)	Charge Injection (pC)	Drain Cap (pF)	Leakage (nA)	RDS-on (Ω)	Source Cap (pf)	Supply Voltage (V)	IS (μA)
DG403	DPST x 2, NO, NC	100	60	60	39	0.04	20	12	5 to 34, ±5 to ±20	0.01
DG411	SPST x 4, NO	110	100	5	35	0.1	25	9	5 to 34, ±5 to ±20	0.0001
DG412	SPST x 4, NC	110	100	5	35	0.1	25	9	5 to 34, ±5 to ±20	0.0001
DG413	SPST x 4, NO, NC	110	100	5	35	0.1	25	9	5 to 34, ±5 to ±20	0.0001
DG441	SPST x 4, NO	150	90	1	16	0.08	50	4	5 to 34, ±5 to ±20	15
DG444	SPST x 4, NO	120	110	1	16	0.08	50	4	5 to 34, ±5 to ±20	0.001
HI-201	SPST x 4, NO	185	220	10	11	2	55	5.5	±15 (Typ)	500
ISL43120	SPST x 2, NO	25	17	5	21	0.01	11	8	2.7 to 12	0.0001
ISL43141	SPST x 4, NO	40	15	1	14	0.01	50	7	2 to 12, ±2 to ±6	0.05
ISL43144	SPST x 4, NO	52	40	5	34	0.2	18	10	2 to 12, ±2 to ±6	0.01
ISL43L110	SPST x 1, NO	8	5	89	160	30	0.24	68	1.1 to 4.5	0.05
ISL84714	SPDT x 1	7.5	2.9	20	100	2	0.44	40	1.65 to 3.6	0.018
ISL84715	SPST x 4, NO	9	5	70	160	3	0.26	68	1.65 to 3.6	0.018
ISL84053	SPDT x 3	50	40	2	14	0.002	60	3	2 to 12, ±2 to ±6	0.1
SLG47004V	SPST x 2, NO	200 (Pull Down), 625 (Pull Up)	200 (Pull Down), 625 (Pull Up)	N/A	3.6 to 10.2 (depending on the PIN selected)	17	53 (N-ch), 3 (P-ch)	10.2	2.5 (±4%) to 5 (±10%)	N/A

Analog Multiplexers

Part Number	Configuration	TON (ns)	TOFF (ns)	Charge Injection (pC)	Drain Cap (pF)	Leakage (nA)	RDS-on (Ω)	Source Cap (pf)	Supply Voltage (V)	IS (μA)
DG406	1 x 16:1	150	70	40	180	0.04	50	8	5 to 34, ±5 to ±20	0.08
DG408	1 x 8:1	115	105	20	37	1	40	3	5 to 34, ±5 to ±20	0.2
DG409	2 x 4:1	115	105	20	25	1	40	3	5 to 34, ±5 to ±20	0.2
HI-546	1 x 16:1	300	300	4	52	0.1	1200	10	±5 to ±18	0.5
ISL84051	1 x 8:1	50	40	2	26	0.002	60	3	2 to 12, ±2 to ±6	0.0001
ISL84052	2 x 4:1	50	40	2	18	0.002	60	3	2 to 12, ±2 to ±6	0.0001
ISL84781	1 x 8:1	16	14	39	485	15	0.41	65	1.6 to 3.6	0.00005

AnalogPAK™ SLG47004V

Programmable Mixed-Signal Matrix with In-System Programmability and Analog Features

Low energy consumption, miniaturization and functional integration are the main trends in modern consumer electronics. AnalogPAK products perfectly accomplish these requirements.

AnalogPAK embedded high-performance analog blocks, such as operational amplifiers, can be configured and controlled by customer-defined logic functions to implement various Wake/Sleep scenarios as well as improve accuracy. All macrocells are packed in one IC to achieve a high integration level of common analog and digital components.

The SLG47004 builds upon the flexibility of the GreenPAK™ | Renesas traditional mixed-signal solution by integrating a mix of advanced analog features including op amps with programmable bandwidth, 10-bit digital rheostats, analog switches, and a chopper analog comparator. The unique Auto-Trim feature highlights the ability of this GreenPAK device to periodically tune its rheostat value to either compensate for system error sources or reconfigure circuit parameters. The SLG47004 provides dynamic Power Down control for all analog and digital blocks to optimize power consumption performance. Common applications include sensor interfaces, ADC analog front-ends, configurable amplifiers, tunable filters, and a variety of other analog circuits. This multi-time programmable solution is built into a tiny 3mm x 3mm package.

Product ID	Nominal V$_{DD}$	GPIOs (#)	Special Features	ACMP Analog Comparator (#)	CNT/DLY (Max) (#)	LUTs (Max) (#)	DFF (Max) (#)	Pipe Delay	# of Programmable Delays (#)	Oscillator Type	Temperature Sensor (ch) (#)	Interface	Pkg. Dimensions (mm)
SLG47004	2.4-5.5	8	2x Op Amp or 1x In-Amp, 2x Rheostat, 2x An Switch, 2-Ch Auto-Trim, EEPROM, Pattern Generator	3	7	20	18	16-stage	1	RC OSC, LF OSC, Ring OSC	1	Absolute Voltage, GPIO, I²C, Switch Output	3.0 x 3.0, TQFN

Winning Combo: Drive Circuit for a Heating or Inductive Coil | Renesas

Software Tool (free and GUI-based): Go Configure™ Software Hub | Renesas

Tools: SLG47004 - Design & Development | Renesas

Application Notes: Documentation & Downloads Search | Renesas Electronics Corporation

How Does AnalogPAK Work in Practice?

MEMO

■Contact Us
https://www.renesas.com/contact-us

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