RTKAOPAMPEVKIT1Z

Universal Operational Amplifier Evaluation Kit

Description

The RTKAOPAMPEVKIT1Z evaluation kit includes four pre-populated daughter cards representing key products within the Renesas operational amplifier portfolio. The kit includes a high-bandwidth general-purpose rail-to-rail input/output (RRIO) amplifier, two low-power CMOS amplifiers, and a chopper-stabilized precision amplifier featuring a maximum input offset voltage of 8µV. Each daughter card plugs directly into the on-board socket without soldering, enabling rapid evaluation of multiple devices on a common test platform.

The main evaluation board features a fully configurable analog signal path with nine resistor network locations, six routing jumpers, and a dedicated reference voltage input. By selecting appropriate resistor values and jumper settings, users can implement inverting, non-inverting, differential, voltage follower, summing, integrator, and comparator circuits without modifying the PCB.

Two BNC input connectors and one BNC output connector provide clean, low-noise interfacing to bench instruments, with a dedicated output jack for simultaneous digital multimeter monitoring. Distributed ground test points, color-coded input probe points, and a dedicated output test point put every critical node within easy reach of a scope probe. Input protection diodes at the op amp input pins protect the device under test during aggressive evaluation conditions. The on-board dual-rail supply bypassing uses 50V rated capacitors, supporting the full dual- and single-supply voltage range of the board.

Kit Contents

- RTKAOPAMPEVAL1Z (Main Board)
- Four daughter cards: (RRA78610, RRA79001, RRA79041, ISL28133A)

Features

- Four interchangeable Renesas op amp daughter cards
- Fully reconfigurable analog signal path
- Solderless circuit configuration using resistor sockets and jumpers
- Dedicated VREF input for biasing and threshold adjustment
- BNC input and output connectors for laboratory instrumentation
- Accessible test points for signal probing and characterization
- Supports dual- and single-supply operation
- Supports the following circuit configurations
  - Voltage follower
  - Follower with load
  - Low-pass filter
  - High-pass filter
  - Non-inverting amplifier
  - Inverting amplifier
  - Comparator with hysteresis
  - LED driver
  - Photodiode amplifier
  - Bidirectional current sense
  - Full differential amplifier
  - Current sense
  - Loading to V+ or V-

Specifications

- Supported supply voltage range: Determined by the installed daughter card; refer to the applicable device datasheet
- Supply bypass capacitor voltage rating: 50V
- Supply bypass: 10µF + 0.1µF per rail on both VCC+ and VCC-
- Minimum GBW across included daughter cards: 340kHz (ISL28133A)
- Minimum slew rate across included daughter cards: 0.2V/µs (ISL28133A, falling edge)
- Operating temperature: -40°C to +125°C (all four included devices)
- Compliance: RoHS, CE, Pb-free

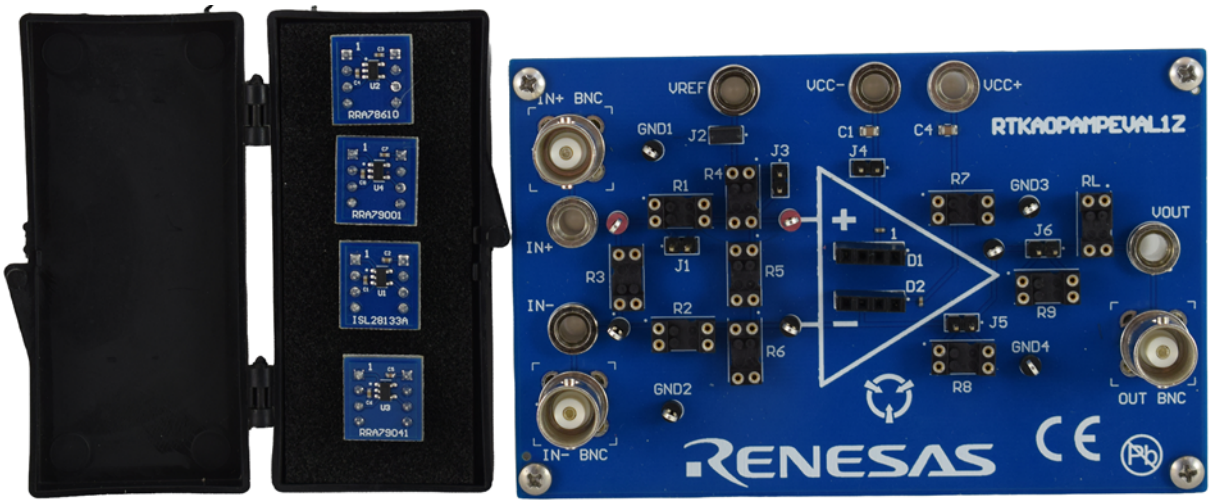

Figure 1. Evaluation Kit

Contents

1. Functional Description

1.1 Board Overview

The RTKA0PAMPEVAL1Z is built around a dual-row pin socket (D1 and D2) located at the center of the PCB. The socket accepts any of the four included op amp daughter cards, allowing easy device interchange without modifying the board.

The analog signal path flows left to right across the board. Input signals enter from the left side through IN+ and IN- terminals, pass through a configurable resistor network, are processed by the installed op amp, and then exit through the output network to OUT BNC and VOUT terminal on the right side.

1.2 Input and Feedback Networks

The board implements two symmetric resistor rails, one per input side.

1.2.1 Non-Inverting Input Path

The non-inverting signal path begins at the non-inverting input and terminates through jumper J1 and the IN+ AMP node, which connects directly to the op amp non-inverting input.

- R_6 connects IN- AMP to GND and is the reference-to-ground element on this side.
- R_8 connects IN- AMP forward to the output node and is the feedback element on this side.

For non-inverting amplifier configurations, the voltage gain is:

$$AV = 1 + (R_8 / R_6)$$

R_5 is used exclusively for VREF injection into the non-inverting rail and does not contribute to the gain equation.

1.2.2 Inverting Input Path

The inverting signal path routes the input signal through R_2 to the IN- AMP node, which connects directly to the op amp inverting input.

- R_2 serves as the input and gain-setting resistor.
- R_8 connects the IN- AMP node forward to the output node as the feedback element.

For an inverting amplifier configuration, the voltage gain is:

$$AV = -(R_8 / R_2)$$

For proper inverting operation, both J2 and J3 must be installed to connect the non-inverting input path to GND.

1.3 VREF and Biasing Components

The board includes several components that support reference-voltage injection and input biasing:

- R_4 connects the VREF turret jack to the non-inverting input path for single-supply biasing, threshold adjustment, or offset-voltage injection.
- R_3 provides an additional pull-down path on the non-inverting input.

1.4 Output Network

The output stage includes optional components for load driving and stability testing.

- R_9 is an output isolation resistor that helps prevent oscillation when driving capacitive loads such as coaxial cables and measurement instruments.
- R_L is an optional load resistor that can be populated for output-drive characterization.

1.5 Jumper Configuration

Six jumpers are provided to configure signal routing and operating modes. All routing changes can be made without soldering or PCB modifications.

1.6 Component Installation

All resistor and capacitor positions (R1-R9 and RL) are open through-hole sockets that accept standard leaded components. Components can be inserted and removed by hand without soldering, enabling rapid circuit reconfiguration.

Each op amp daughter card includes local supply bypass capacitors near the device pins. These capacitors supplement the main board bypass network formed by C1–C4, which are rated for 50V operation.

1.7 Test Points and Ground Connections

Direct probe access is provided at all critical circuit nodes:

- IN+ TP – Non-inverting op amp input
- IN- TP – Inverting op amp input
- OUT TP – Op amp output

Four ground turret posts (GND1-GND4) are distributed across the board to provide convenient ground connections for measurements.

1.8 Operational Characteristics

The RTKA0PAMPEVAL1Z does not impose a fixed operating configuration. Gain, bandwidth, filter frequency, and input/output conditions are user-defined through component selection at the resistor and capacitor socket locations. The following sections describe the practical operating boundaries of the evaluation board as shipped and should be considered before beginning circuit characterization.

1.8.1 Power Supply Range

The board supports dual- and single-supply operation. The allowable supply range is determined by the installed daughter card. The RRA78610, RRA79001, and ISL28133A share the same minimum supply requirement, while the RRA79041 supports operation at a lower supply voltage and can be operated from a single supply.

All supply bypass capacitors (C1-C4) on the main board are rated for 50V. Each daughter card also includes local bypass capacitors rated to support the full operating supply range of the installed device. No hardware changes are required to operate at any supply voltage within these limits.

1.8.2 Bandwidth Considerations

The achievable closed-loop bandwidth is bounded by the gain-bandwidth product (GBW) of the installed daughter card and the configured closed-loop gain.

The ISL28133A establishes the lower bandwidth limit of the kit at 340kHz, and the RRA78610 establishes the upper limit at 10MHz. As the closed-loop gain increases, stray capacitance at the IN+ AMP and IN- AMP nodes reduce the effective phase margin. For gains greater than 100V/V, a small feedback capacitor in parallel with R7 or R8 is recommended to maintain stability regardless of the installed daughter card.

1.8.3 Input Voltage Range

All four daughter-card amplifiers feature rail-to-rail input stages, allowing the input common-mode range to extend to both supply rails. Input signals must always remain within the applied supply range.

1.8.4 Output Swing and Load Considerations

All four daughter-card amplifiers feature rail-to-rail outputs. Output swing headroom relative to the supply rails increases as output current demand increases.

When RL is populated with values below 2kΩ, a noticeable reduction in output swing may occur. The voltage drop across R9 under load should also be considered when making precision output measurements at OUT BNC. To eliminate this error, measure the output directly at OUT TP, which is located upstream of R9.

1.8.5 Component Value Ranges

The through-hole component sockets (R1-R9 and RL) accept standard leaded resistors and capacitors. Resistor values ranging from a few ohms to several megaohms can be installed, supporting all gain, filter, and trans-impedance configurations listed in this guide.

For filter configurations, the socket positions accept leaded capacitors from a few picofarads to several microfarads, depending on lead spacing. If a target corner frequency requires a value that cannot be achieved with a single component, multiple components can be installed in series or parallel within the same socket position to obtain the required effective value.

1.9 Setup and Configuration

The RTKA0PAMPEVAL1Z ships preconfigured as a voltage-follower (buffer) configuration. Components are not required in any socket position. Install a daughter card, verify that J1, J5, and J6 are installed, and perform the following steps.

1. Apply a ±2.5V supply to the VCC+ and VCC- terminals. Connect the GND of the power supply to GND on the board (GND1-4).
2. Set the power-supply current limits according to the installed device datasheet.
3. Apply a 1kHz, $1V_{P-P}$ sine wave to the IN+ BNC connector.
4. Monitor the output at OUT BNC.
5. Verify that the output tracks the input at gain of 1 with no phase shift.
6. Increase the input frequency to observe the unity-gain bandwidth of the installed device.

Typical bandwidth limits are:

- RRA78610 – Near 10MHz
- RRA79001 – Near 1MHz
- RRA79041 – Near 350kHz
- ISL28133A – Near 340kHz

To compare devices:

1. Remove power from the board.
2. Replace the daughter card.
3. Repeat the test procedure.

No component or jumper changes are required between devices, making the buffer configuration the simplest method for direct bandwidth comparison under identical test conditions.

Note: If output ringing is observed during high-frequency testing with the RRA78610, populate R9 with a small series resistor to isolate capacitive loading at the OUT BNC connector.

- For single-supply operation, populate J4. ***Important***: Input signal must be properly biased to VCC+/2.
- For dual-supply operation, do not populate J4
- J1 closed, populated with jumper
- J5 closed, populated with jumper
- J6 closed, populated with jumper

Figure 2. Buffer Configuration

- For single-supply operation, populate J4. ***Important***: Input signal must be properly biased to VCC+/2.
- For dual-supply operation, do not populate J4
- J2, J3 closed with jumpers (IN+ to GND)
- J1 and R1 stay open (unpopulated)
- R2 and R8 populated with resistors with required gain ratio (-R8/R2)
- J6 closed

Figure 3. Inverting Amplifier Configuration

- For single-supply operation, populate J4. ***Important***: Input signal must be properly biased to VCC+/2.
- For dual-supply operation, do not populate J4.
- J1 closed, populated
- R6 and R8 populated with resistors with required gain ratio (1+R8/R6)
- J6 closed

Figure 4. Non-Inverting Amplifier Configuration

- Dual-supply operation only, do not populate J4
- J1 and R1 open, unpopulated
- J2 and J3 closed, populated with jumpers
- Input through IN-/IN- BNC
- R2 populated with required lead resistor
- R8 populated with required lead resistor and required lead capacitor in parallel
- J6 closed
- Gain = - R_8/R_2
- Corner frequency calculation

$$f_C = \frac{1}{2\pi R_8 C_8}$$

Figure 5. Inverting Low-Pass Filter Configuration

- Dual-supply operation only, do not populate J4.
- Populate R1 & R4 with equal resistance
- Input through IN+ and VREF
- R6 populated with required lead resistor
- R8 populated with required lead resistor
- J6 closed
- $V_{OUT} = V_{IN} + VREF$ for R8 = R6

Figure 6. Non-Inverting Summing Amp

2. Board Design

Figure 7. RTKAOPAMPEVAL1Z Evaluation Board (Top)

2.1 Schematic Diagrams

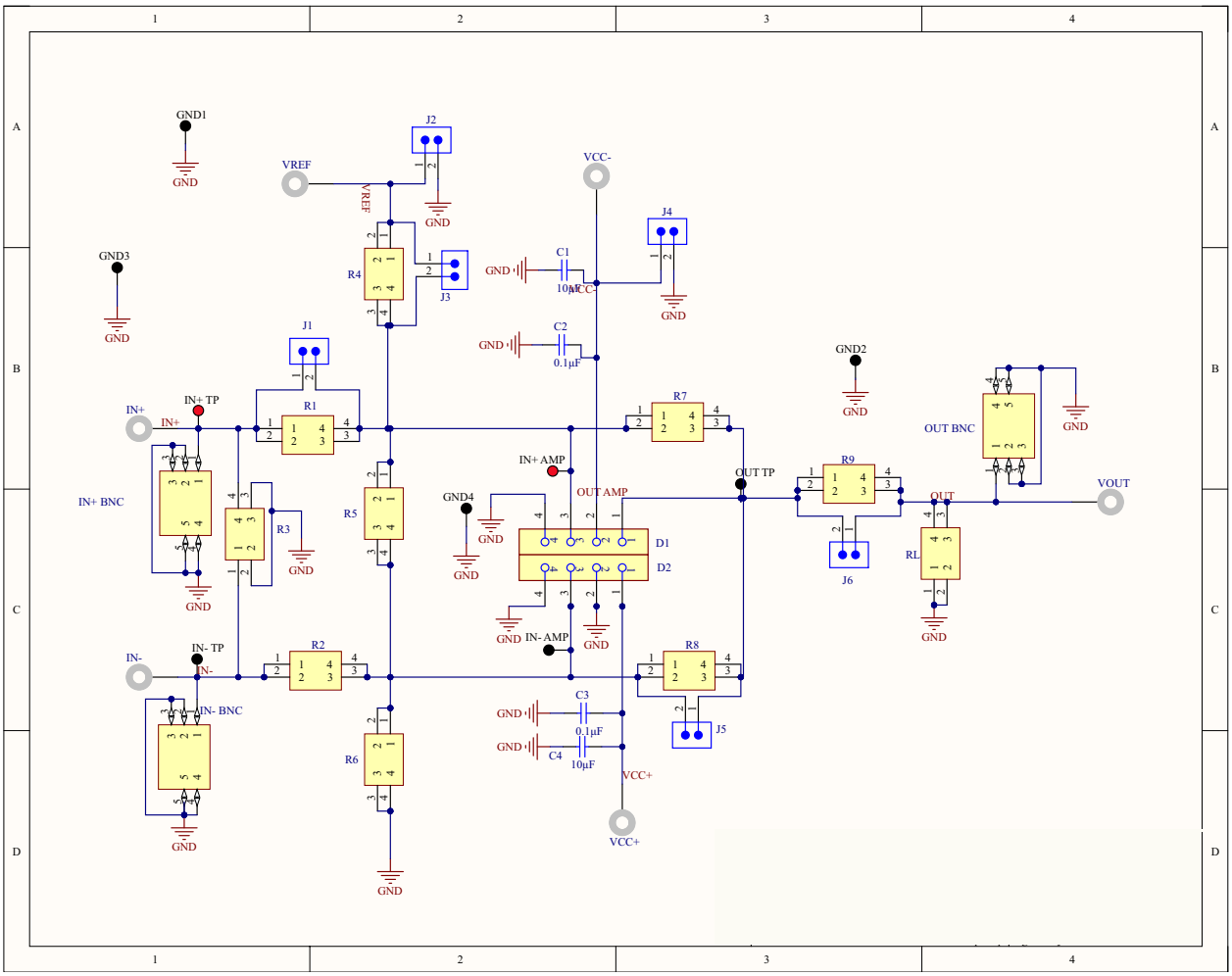

Figure 8. RTKAOPAMPEVKIT1Z Schematic

2.2 Bill of Materials

2.2.1 Main Board

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part Number
2	C1, C4	CAP, CER, 0805, 10µF, 50V, 10%, X5R, RoHS	Wurth Elektronik	CGA0805X5R106K500MT
2	C2, C3	CAP, CER, 0402, 0.1µF, 50V, 10% X5R, RoHS	Vishay	VJ0402Y104KXJCW1BC
2	D1. D2	Board to Board & Mezzanine Connectors Tiger Buy Socket Strip with PCB Tails,.100Pitch	Samtec	SSW-104-02-G-S
7	GND1, GND2, GND3, GND4, IN-AMP, IN-TP, OUTTP	Test Point, Black, Through Hole, RoHS, Bulk	Keystone	5011
3	IN- BNC, IN+ BNC, OUTBNC	BNC Connector JACK, Female Socket 50Ω Through Hole Solder	Amphenol	031-5329-51RFX
6	IN-, IN+, VCC-, VCC+, VOUT, VREF	Test Jack, 4MM DIA Test Plugs, 10A, 1.94MM, 50V, Black, 571 Series	Keystone	575-8
2	IN+AMP, IN+TP	Test Point, Red, Through Hole, RoHS, Bulk	Keystone	5010

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part Number
6	J1, J2, J3, J4, J5, J6,	THT Vertical Pin Header WR-PHD, Pitch 2.54mm, Single Row, 2 pins	Wurth Elektronik	61300211121
10	R1, R2, R3, R4, R5, R6, R7, R8, R9, RL	CONN Socket Through Hole 4POS 2.54MM	Preci-Dip	110-87-304-41-001101

2.2.2 Daughter Cards

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part Number
1	U1	Single Micro-Power, High-Precision Operational Amplifier	Renesas	ISL28133AFHZ-T7
1	U2	Single, Low Voltage 10MHz Rail-to-Rail Operational Amplifier	Renesas	RRA78610-P3J
1	U3	Single, Ultra-Low Power, RRIO, Operational Amplifier	Renesas	RRA79041-P3J
1	U4	Single, Low-Power, RRIO, 1MHz General Purpose Operational Amplifier	Renesas	RRA79001-P3J
8	P1, P2, P3, P4, P5, P6, P7, P8	4-position, Single-Row Male Pin Header Connector, 2.54mm pitch	Hanxia	HX PZ2.54-1x4P ZZ
8	C1, C2, C3, C4, C5, C6, C7, C8	CAP, CER, 0402, 0.1uF, 50V, 10% X5R, RoHS	Vishay	VJ0402Y104KXJCW1BC

2.3 Board Layout

2.3.1 Main Board

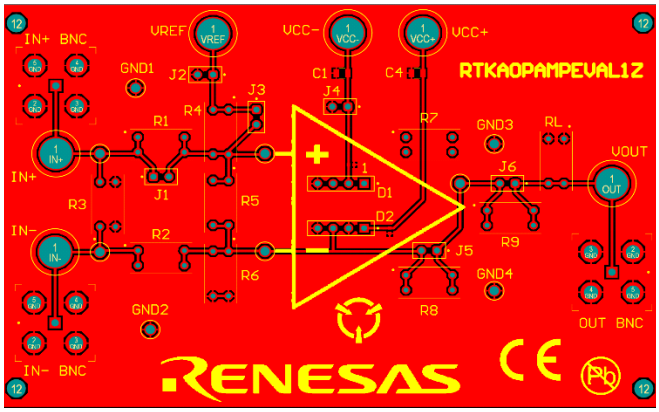

Figure 9. Top Layer

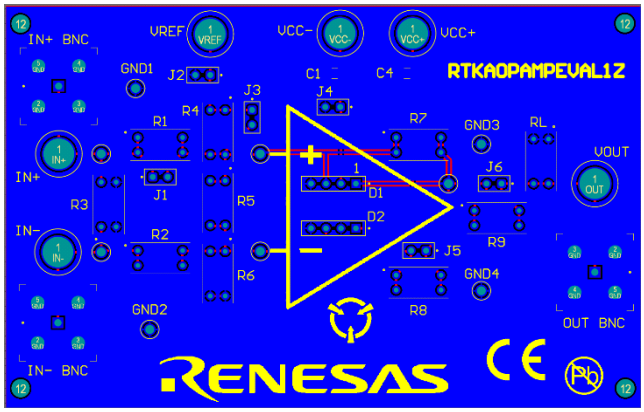

Figure 10. Bottom Layer

3. Ordering Information

Part Number	Description
RTKAOPAMPEVKIT1Z	Universal Operational Amplifier Evaluation Kit

4. Revision History

Revision	Date	Description
1.00	Aug 21, 2026	Initial release.

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