User's Manual

# RTKA-BDGSTKEV2Z

## User's Manual: Evaluation Board

## Industrial Analog and Power

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# RTKA-BDGSTKEV2Z

Evaluation Board

The DAQ on a Stick, Renesas Strain Gauge is one of a series of reference designs highlighting Renesas precision products. This reference design is a self contained demonstration showing a complete signal chain solution using Renesas precision parts and a Renesas microcontroller. The complete reference design is conveniently housed in a USB stick form factor. This compact design draws power through the USB port and uses a Graphical User Interface (GUI) to display the real time voltage readings from a bridge strain gauge or a user supplied sensor. Figure 1 shows the Data Acquisition (DAQ) on a Stick connected to an external foil strain gauge.

**Figure 1. DAQ on a Stick with Strain Gauge**

Figure 2 shows a simplified schematic of the Strain Gauge design. The design uses the Renesas ISL28134 chopper amplifier, ISL22316 Digitally Controlled Potentiometer (DCP), ISL43840 dual 4-channel Mux configured as a Differential Mux, ISL21010 3.3V and 4.096V precision voltage references, ISL26102 24-bit delta sigma converter, and the R5F10JBC microcontroller.

## Ordering Information

| Part Number | Description |
|---|---|
| RTKA-BDGSTKEV2Z | Evaluation Board |

## Related Literature

For a full list of related documents, visit our website:

- ISL28134, ISL21010, ISL26102, ISL43840, ISL22316, and R5F10JBC device pages

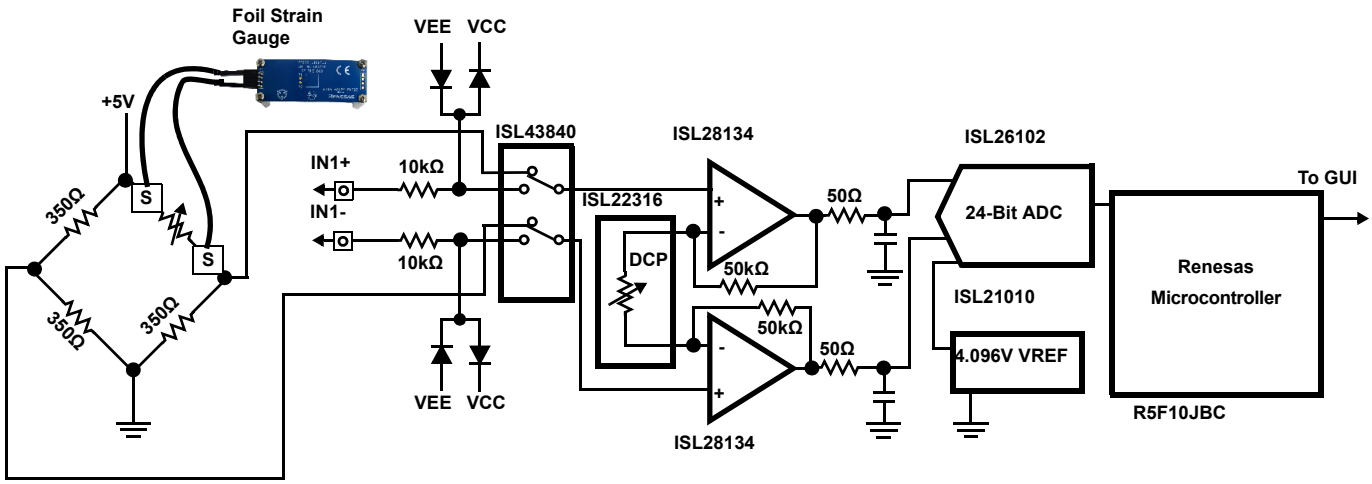


**Figure 2. Simplified Strain Gauge SchematiC**

# 1. Getting Started

## 1.1 Installing the Software and USB Drivers

Download the software and a short video on the operation of this application from the Renesas website.

The software and USB drivers must be installed on a PC running Windows NT/2000/XP/Vista/Win7/Win 8/Win 10 operating system before connecting the RTKA-BDGSTKEV2Z evaluation board to the USB port.

## 1.2 Loading the Software

1. Click the Renesas DAQ on a Stick Software link to load the executable.
2. Follow the on-screen instructions to complete the software installation. The installation program places the user interface software in the C:\Program Files\R12UZ0045_DAQ_V250 directory.
3. To create a shortcut on your desktop, check the **Create A Desktop Icon** box during the software installation.
4. Launch the application by checking the **Launch R12UZ0045_DAQ_V250** box, then click **Finish**.

## 1.3 Running the Evaluation Software

1. After installing the software, plug the RTKA-BDGSTKEV2Z board into a USB port on the computer and click the Renesas DAQ shortcut (created in "Loading the Software") on the desktop. Figure 3 shows the desktop icon.

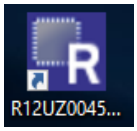


**Figure 3. Desktop Icon**

2. The green LED on the DAQ on a Stick board turns on. When the software starts, the DAQ Startup screen shown in Figure 5 on page 4 appears. With the board connected, the USB Status indicator displays "Connected 0x2032". The assigned HID code 0x2032 is verification that the software is communicating with the board.

**Note:** If the DAQ on a Stick is not connected, or a problem exists with the demonstration, the USB Status indicator displays "HID Device Not Found". If this message appears, click **Test USB Connection** to enable the connection. If the connection is still not enabled, disconnect and reconnect the device or restart the software.

3. From the DAQ Startup Screen (Figure 5), click **Instantaneous Voltage** to get a single voltage reading, select the sensor input to measure, and adjust the amplifier gain.
4. Click **Start** to go to the Measurement Display screen shown in Figure 6. The green LED on the board turns off.

## 1.4 Connecting the Sensor

The RTKA-BDGSTKEV2Z reference design provides the option to measure the strain on a foil gauge (supplied with the evaluation board) or connect your own sensor and monitor the voltage reading in the software. Select **Sensor Supplied with the Demo** or **Customer Supplied** sensor by clicking the appropriate radio button on the DAQ Startup Screen (see Figure 5). The foil gauge is the default value in the software with a gain of 115V/V. Figure 4 shows the external connector inputs that connect the sensor to the circuit shown in Figure 2.

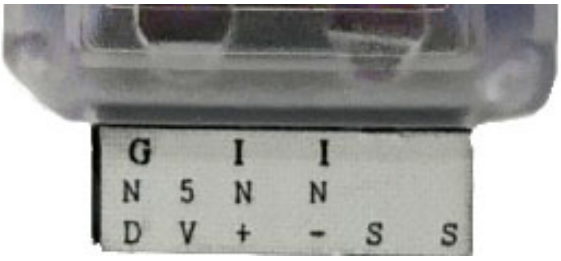


**Figure 4. Sensor Connector**

### 1.4.1 Connecting the Foil Strain Gauge

The foil gauge is supplied with the evaluation board. Complete the following steps to connect the foil gauge.

1. Plug the wires into the “S” ports (either top row or the bottom row; the columns are connected) on the DAQ on a Stick.
2. Connect the opposite end of the wires to the far edges of the foil gauge board. See Figure 5.

### 1.4.2 Connecting the User Supplied Sensor

To connect your own sensor, complete the following steps.

1. Plug the wires into the IN+ and IN- ports shown in Figure 4.
2. Select **Customer Supplied** in the DAQ Startup Screen, as shown in Figure 5. This selection causes the ISL43840 configured as a differential mux to switch the inputs. When the **Customer Supplied** option is selected, you can change the amplifier gain for the best measurement.
3. The DAQ on a Stick also provides a 5V supply and Ground connection for possible use by your sensor network.

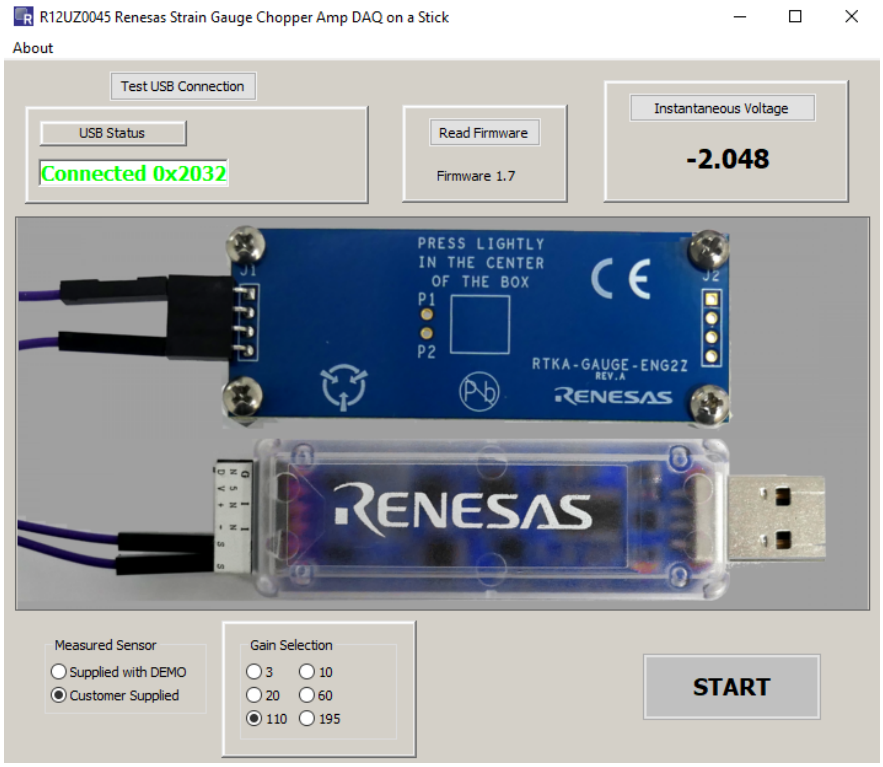


**Figure 5. DAQ Startup Screen**

Figure 6 shows the Measurement Display screen. From this screen, you can stop and start data collection, adjust the minimum and maximum X and Y axis, and go back to the setup screen by clicking Show Main. The Calibrate button zeroes out the voltage reading when the board is not under strain.

Calibration helps to give an accurate reading from time zero and is required because the board does not always return to the same deflection point after a strain is applied to the board.

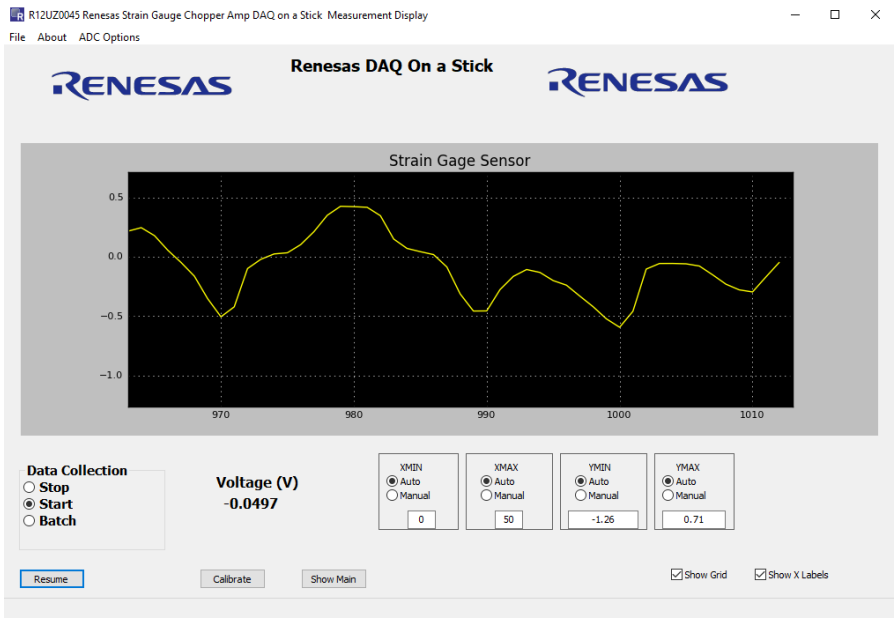


**Figure 6. Measurement Display Screen**

# 2. Design Considerations

## 2.1 ISL28134

The ISL28134 is an ideal choice for the input amplifier for a strain gauge design. The ISL28134 uses auto-correction circuitry to provide ultra low offset voltage (2.5µV) and low offset temperature drift (15nV/°C). The very low 1/f noise corner (<0.1Hz) and low input noise voltage (8nV/√Hz at 100Hz) of the amplifier makes the ISL28134 ideal for low frequency precision applications requiring very high gain and low noise. Other key features of the ISL28134 are the wide gain bandwidth and rail-to-rail input/output swing.

## 2.2 ISL26102 24-Bit ADC

The ISL26102 is a complete analog front-end with dual differential multiplexed inputs for high resolution measurements. The ISL26102 features a third order modulator providing up to 21.4-bit noise-free performance (10Sps). The 24-bit delta-sigma analog-to-digital converter includes a very low-noise amplifier with programmable gain. Although this application demonstration uses an input buffer amplifier (ISL28134), the high input impedance of the ISL26102 allows direct connection of sensors such as load cell bridges to ensure the specified measurement accuracy without a buffer amplifier.

To initiate a correct power-up reset, diode D1, resistor $R_3$ and capacitor $C_8$ implement a simple RC delay to ensure the $\overline{\text{PDWN}}$ transitions from low to high after both power supplies have settled to specified levels.

## 2.3 ISL21010 (3.3V) Voltage Reference

The ISL21010CFH333 is a precision 3.3V, low dropout micropower band-gap voltage reference, which provides a ±0.2% accurate reference. The ISL21010 provides up to 25mA output current sourcing with low 150mV dropout voltage. The low supply current and low dropout voltage combined with high accuracy make the ISL21010 ideal for precision low powered applications.

## 2.4 ISL21010 (4.096V) Voltage Reference

The ISL21010CFH341 is a precision 4.096V, low dropout micropower band-gap voltage reference, which provides a ±0.2% accurate reference. The ISL21010 provides up to 25mA output current sourcing with low 150mV dropout voltage. The low supply current and low dropout voltage combined with high accuracy make the ISL21010 ideal for precision low powered applications.

## 2.5 ISL22316 DCP

The ISL22316 is a low noise, low power $I^2C$™ bus, 128 tap DCP. The DCP can be used as a three-terminal potentiometer or as a two-terminal variable resistor in a wide variety of applications including control, parameter adjustments, and signal processing.

## 2.6 ISL43840 Low-Voltage, Dual 4-to-1 Multiplexer

The ISL43840 is a precision, bidirectional, analog switch configured as a dual 4-channel multiplexer/demultiplexer. In this design, the mux is configured as a differential mux. The mux is designed to operate from a single +2V to +12V supply or from a ±2V to ±6V supply. The ISL43840 has low charge injection with 1pC (maximum) at VS = ±5V.

## 2.7 Bill of Materials

| Part Number | Ref Des | Qty | Value | Tol. | Voltage | PWR | Package Type | JEDEC Type | MFR | Description |
|---|---|---|---|---|---|---|---|---|---|---|
| GRM21BR71C475KA73L | C1 | 1 | 4.7µF | 10% | 16V | | 805 | CAP_0805 | Murata | Ceramic Cap |
| Generic | C7, C12, C13, C20 | 4 | 0.01µF | 10% | 16V | | 402 | CAP_0402 | Various | Multilayer Cap |
| Generic | C5, C8, C9, C11, C14, C25, C27 | 7 | 0.1µF | 10% | 16V | | 402 | CAP_0402 | Various | Multilayer Cap |
| Generic | C21, C22 | 2 | 0.01µF | 10% | 25V | | 603 | CAP_0603 | Various | Multilayer Cap |
| 250R07C100JV4T | C23, C24 | 2 | 10pF | 5% | 25V | | 402 | CAP_0402RF | Johanson-Tech | C Series High-Q Chip Cap |
| Generic | C2, C3, C10, C26 | 4 | 1µF | 20% | 16V | | 603 | CAP_0603 | Various | Ceramic Cap |
| Generic | C6 | 1 | 0.33µF | 10% | 25V | | 603 | CAP_0603 | Various | Multilayer Cap |
| Generic | C17, C18 | 2 | OPEN | 5% | OPEN | | 603 | CAP_0603 | Various | Multilayer Cap |
| Generic | C15 | 1 | 2.2µF | 10% | 16V | | 805 | CAP_0805 | Various | Multilayer Cap |
| Generic | C4 | 1 | 10µF | 10% | 16V | | 1206 | CAP_1206 | Various | Multilayer Cap |
| 597-3311-407 | D1 | 1 | | | | | SMD | DIA_LED1206 | Dialight | Surface Mount Green LED |
| BAT54 | D2 | 1 | | | | | SINGLE | SOT23 | Diodes | 30V Schottky Diode |
| MMSD4148T1 | D3 - D6 | 4 | | | | | SOD123 | SOD123 | ON-Semi | Switching Diode |
| 48037-1000 | J1 | 1 | | | | | MOLEX1 | CON_USB_MOLEX_480371000 | Molex | Right Angle USB A-Type Receptacle |
| PPPC062LJBN-RC | J2 | 1 | | | | | DIP | CONN12 | Sullins | 12 Pin Header 2.54mmx2.54mm (.100) Connector RA |
| 251206102Y1 | L1 | 1 | 1µH | | | | SMD | SM1206 | Fair-Rite | Ferrite Bead |
| Generic | R7, R11, R27 | 3 | 0 | 0% | | 1/16W | 402 | RES_0402 | Various | Thick Film Chip Resistor |
| Generic | R2, R3 | 2 | 100 | 1% | | 1/16W | 402 | RES_0402 | Various | Thick Film Chip Resistor |
| Generic | R8 | 1 | 1k | 1% | | 1/16W | 402 | RES_0402 | Various | Thick Film Chip Resistor |
| Generic | R1, R4, R15, R16 | 4 | 10k | 1% | | 1/16W | 402 | RES_0402 | Various | Thick Film Chip Resistor |
| Generic | R28 | 1 | 220 | 1% | | 1/16W | 402 | RES_0402 | Various | Thick Film Chip Resistor |
| Generic | R5, R6, R31 | 3 | 4.99k | 1% | | 1/16W | 402 | RES_0402 | Various | Thick Film Chip Resistor |
| Generic | R12, R13 | 2 | 49.9k | 1% | | 1/16W | 402 | RES_0402 | Various | Thick Film Chip Resistor |
| Generic | R9, R10 | 2 | 49.9 | 1% | | 1/16W | 402 | RES_0402 | Various | Thick Film Chip Resistor |

| Part Number | Ref Des | Qty | Value | Tol. | Voltage | PWR | Package Type | JEDEC Type | MFR | Description |
|---|---|---|---|---|---|---|---|---|---|---|
| Generic | R30 | 1 | DNP | 0.1 | | DNP | 603 | RES_0603 | Various | Thick Film Chip Resistor (Do Not Populate) |
| Generic | R14, R29 | 2 | DNP | 1% | | DNP | 402 | RES_0402 | Various | Thick Film Chip Resistor (Do Not Populate) |
| Generic | R20, R23, R26 | 3 | 1 | 0.1% | | 1/10W | 805 | RES_0805 | Various | Thick Film Chip Resistor |
| Generic | R19, R22, R25 | 3 | 100 | 0.1% | | 1/10W | 805 | RES_0805 | Various | Thick Film Chip Resistor |
| Generic | R18, R21, R24 | 3 | 249 | 0.1% | | 1/10W | 805 | RES_0805 | Various | Thick Film Chip Resistor |
| ISL26102AVZ | U1 | 1 | | | | | TSSOP | TSSOP24_173_256 | Renesas | 24 Pin 173 Mil TSSOP Package |
| ISL21010CFH341Z | U2 | 1 | | | | | SOT | SOT23-3 | Renesas | 3 Pin SOT23-3 Package |
| ISL28134FHZ | U3, U4 | 2 | | | | | SMD | SOT23-5 | Renesas | 5 Pin SOT23 Package |
| ISL43840IRZ | U5 | 1 | | | | | QFN | QFN20_157X157_197_EP | Renesas | 20 Lead Quad Flat Package (Pb-Free) |
| ISL22316UFRT | U6 | 1 | | | | | DFN3X3B | TDFN10_118X118_197_EPB | Renesas | 10 Lead 3 X 3 0.5 Pitch Thin Dual Flat Package with E-Pad |
| R5F10JBCANA | U7 | 1 | | | | | QFN-S | QFN32_197X197_197_EPA | Renesas | 32 Lead Quad Flat Package (Pb-Free) |
| IP422OCZ6 | U8 | 1 | | | | | SOT457 | SOT457 | NXP | Dual USB 2.0 Integrated ESD Protection |
| ISL54054IRUZ | U9 | 1 | | | | | 1_2X1A | UTDFN6_47X39_157_A | Renesas | 6 Pin UTDFN-1.2X1A 0.4 Pitch Package |
| ISL21010CFH333Z | U10 | 1 | | | | | SOT | SOT23-3 | Renesas | 3 Pin SOT23-3 Package |
| MCR03EZPFX3001 | R17 | 1 | 3k | 1% | | 1/10W | 603 | RES_0603 | ROHM | Metal Film Chip Resistor |
| PAD_50 | P1, P2 | 2 | | | | | THOLE | PAD-50 | Various | 0.050 Pad with 0.031 Plated Thru Hole |
| NX5032GA-12.000M-LN-CD-1 | Y1 | 1 | | | | | SM | XTAL_NX5032GA | NDK | 12.000MHz SM Crystal |

## 2.8 RTKA-BDGSTKEV2Z Evaluation Board Layout

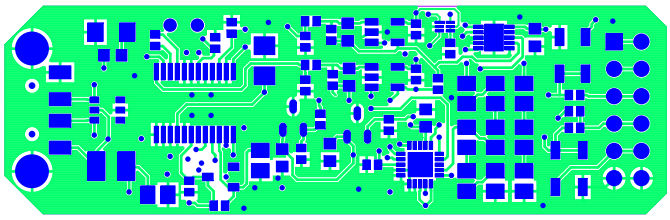

Figure 7. Top Layer

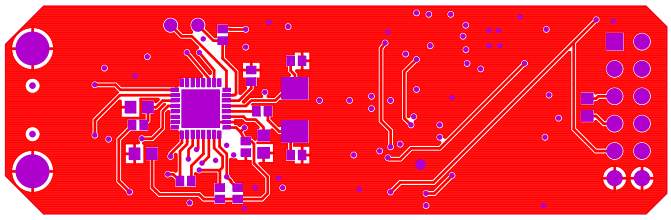

Figure 8. Bottom Layer

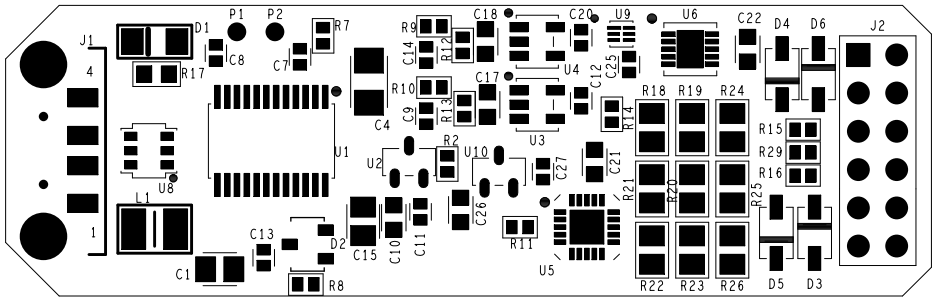


Figure 9. Top Assembly Drawing

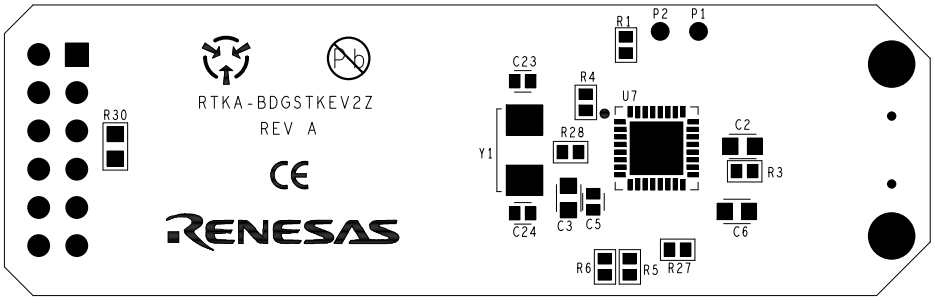


Figure 10. Bottom Assembly Drawing

## 2.9 RTKA-BDGSTKEV2Z Schematic

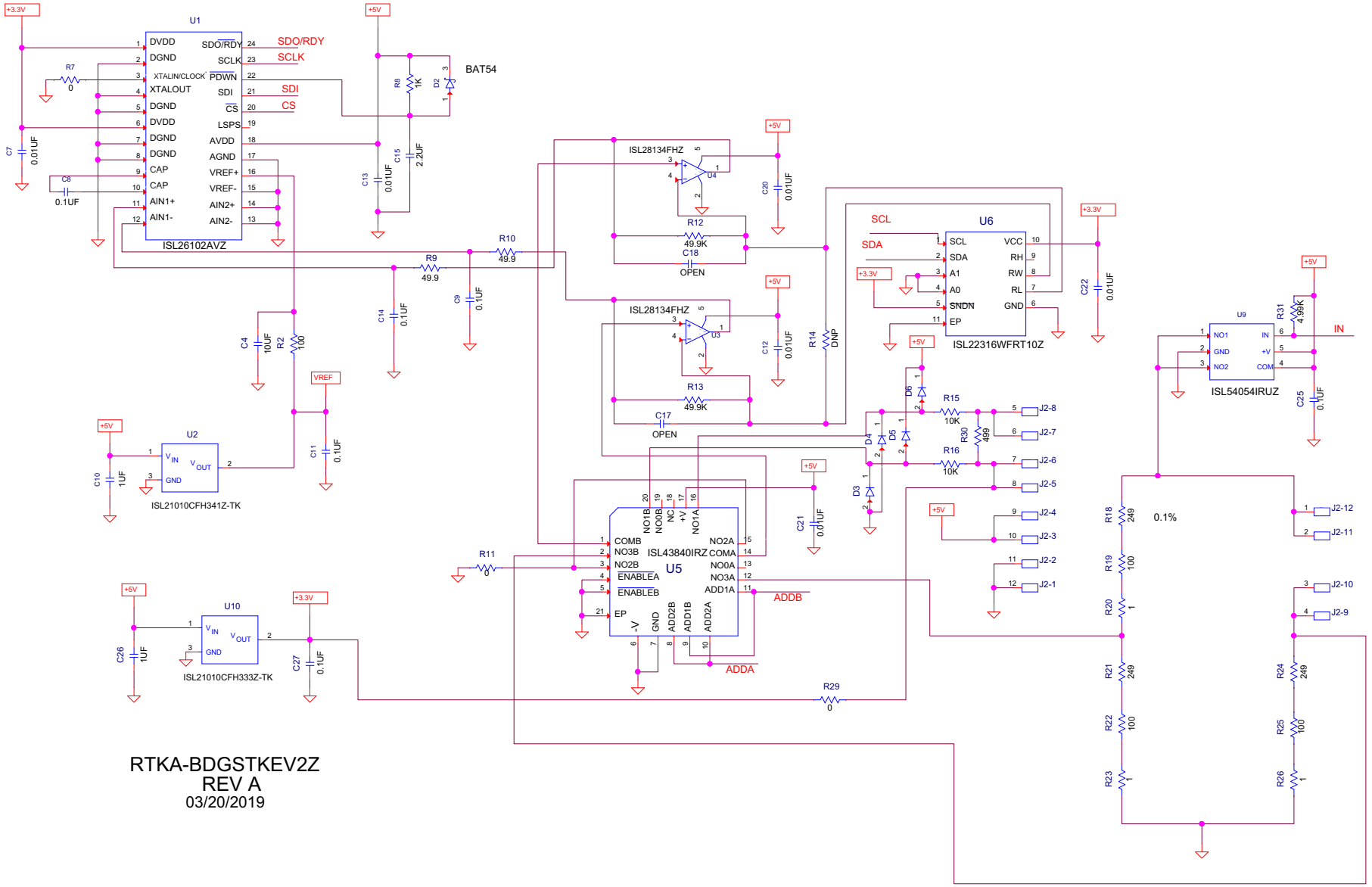


**Figure 11. RTKA-BDGSTKEV2Z Strain Gauge Schematic**

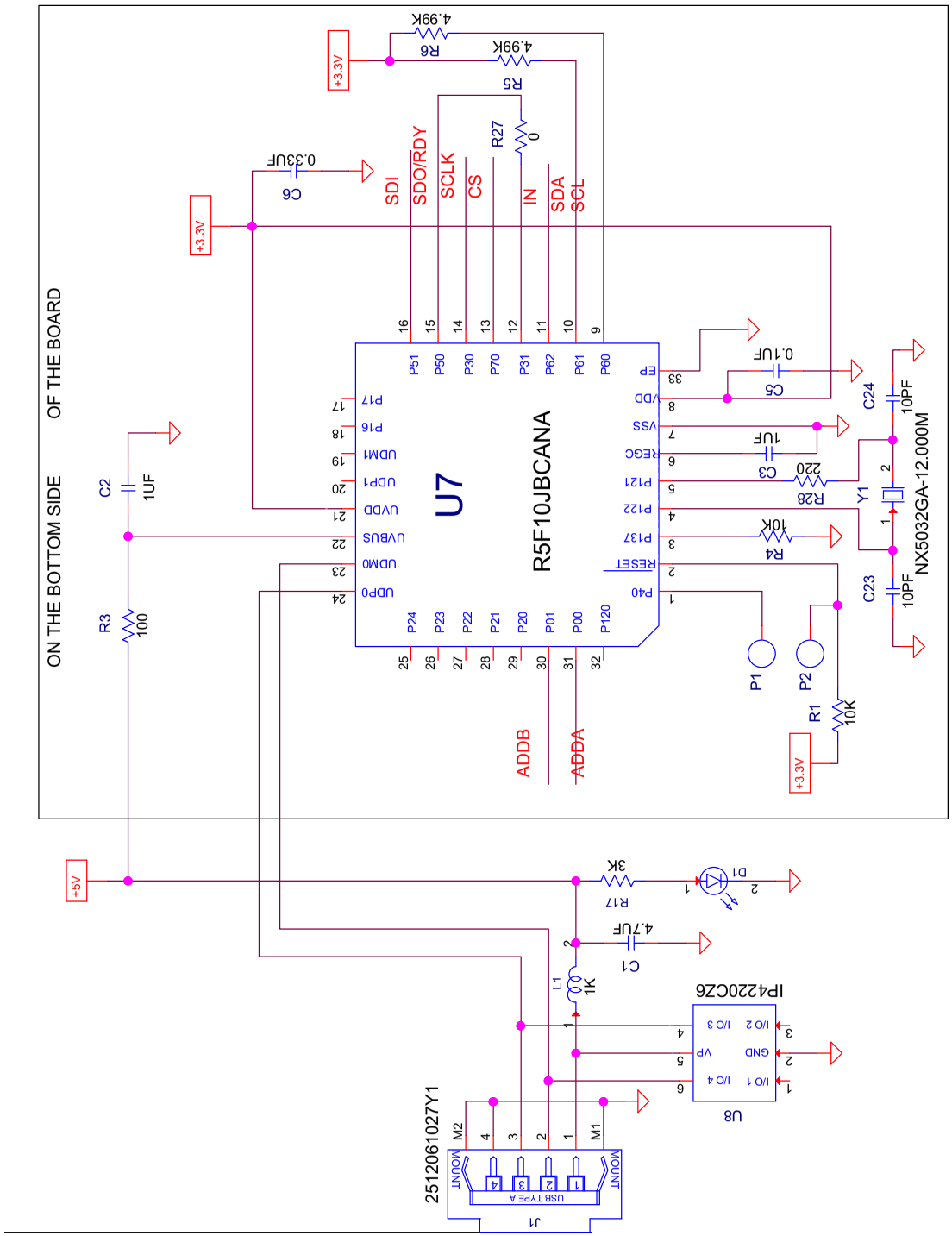


**Figure 12. RTKA-BDGSTKEV2Z MCU Schematic**

# 3. Revision History

| Rev. | Date | Description |
|---|---|---|
| 2.00 | Jul.9.19 | Updated Bill of Materials |
| 1.01 | Jun.5.19 | Updated ISL21010 information. |
| 1.00 | Apr.5.19 | Initial release. |

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