US110-420RECEVZ

Standard 4mA to 20mA Loop - Industrial Receiver Development Kit

Description

The 4mA to 20mA current loop is the dominant standard for sensor systems in many industries, because it is the option that is simplest to configure and connect. This receiver reduces the overall system cost by using less wiring and connections than other signals. In large locations, the signal can travel long distances, because the current does not degrade like voltage. Also resistant to surrounding noise, the board uses a standard 4mA to 20mA loop that makes it best for transmitting data over large distances in industrial environments. For enhanced system protection, additional isolation can be added.

Features

- Simple and accurate readings on a 4mA to 20mA loop
- 7-segment LCD display for low power
- System can run off loop power or separate power
- Pmod™ for optional wireless connectivity

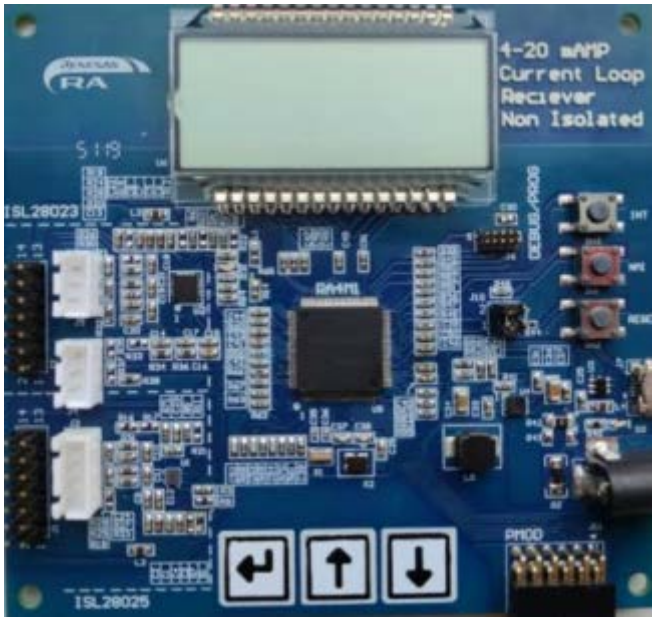

Figure 1. US110-420RECEVZ Board

Contents

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1. Functional Description

The 4mA to 20mA loop receiver board is built around the ISL28022 digital power monitor (DPM), which measures the differential voltage across a sense resistor to determine the loop current. This data is read by the RA4M1 Arm Cortex-M-based microcontroller (MCU) that processes and displays the measured current on a 7-segment display. The system is powered by the ISL85412 DC/DC buck regulator that generates a stable 3.3V supply and operates either from the loop voltage or an external USB power source. Also, USB communication and protection circuitry are integrated to support external interfacing. For clarity on the functional description, refer to the block diagram (Figure 2) and the components of the board with connections (Figure 3).

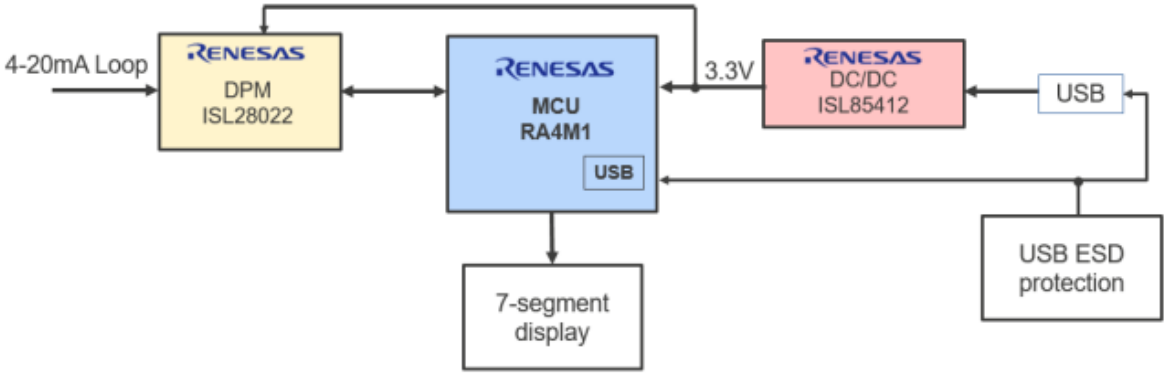

Figure 2. Block Diagram

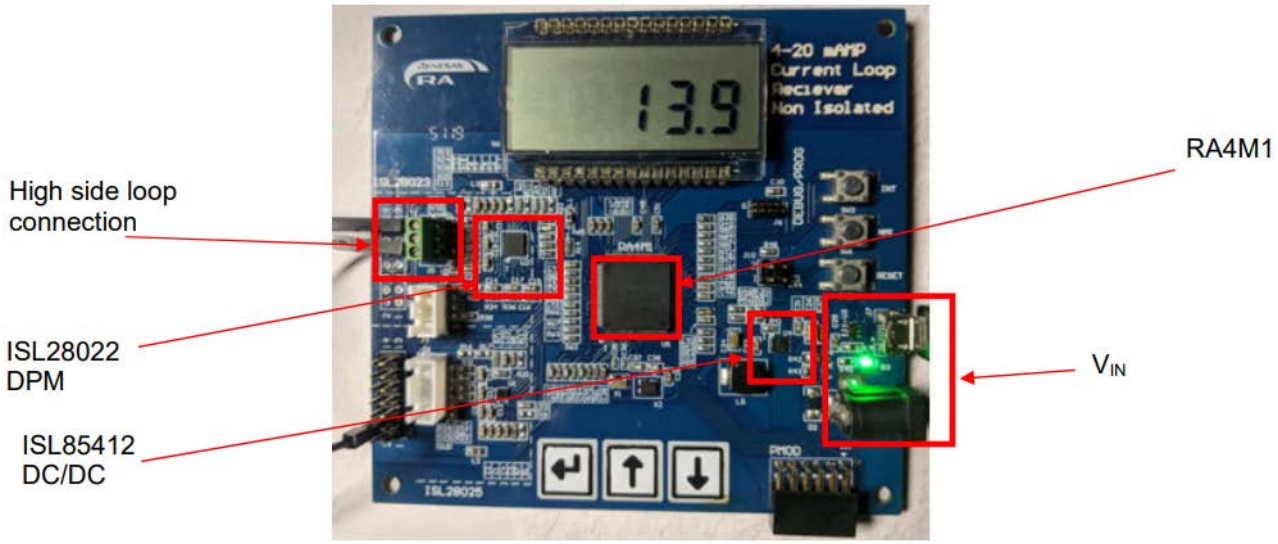

Figure 3. Board Devices and Connections

1.1 System State Machine

The following helps understand the functional description through using the System State Machine: At reset, the system performs a hardware initialization followed by a communication check with the ISL28022 DPM. If communication fails, the RA4M1 MCU displays an error code (Err1) on the 7-segment display. After communication is established, the DPM is configured and interrupt lines (IRQ2/IRQ7 or IRQ3/IRQ10) are enabled based on the specific board configuration. The main execution loop reads voltage and current values from the ISL28022 registers (0x8B and 0x8C), calculates the loop current, and verifies it against expected

thresholds. If the voltage drops below 3V or the current is outside the valid range (<4mA), the corresponding error codes are shown (NoV, Err2). The Alert_handle() function monitors fault conditions by reading the status of the DPM status registers (0x7A, 0x7B, and 0x7D), and it updates the display to indicate overvoltage (OV), undervoltage (UV), overcurrent (OC), or over-temperature (OT). Unclassified faults result in an Err3 display to ensure robust fault diagnostics (see Figure 4).

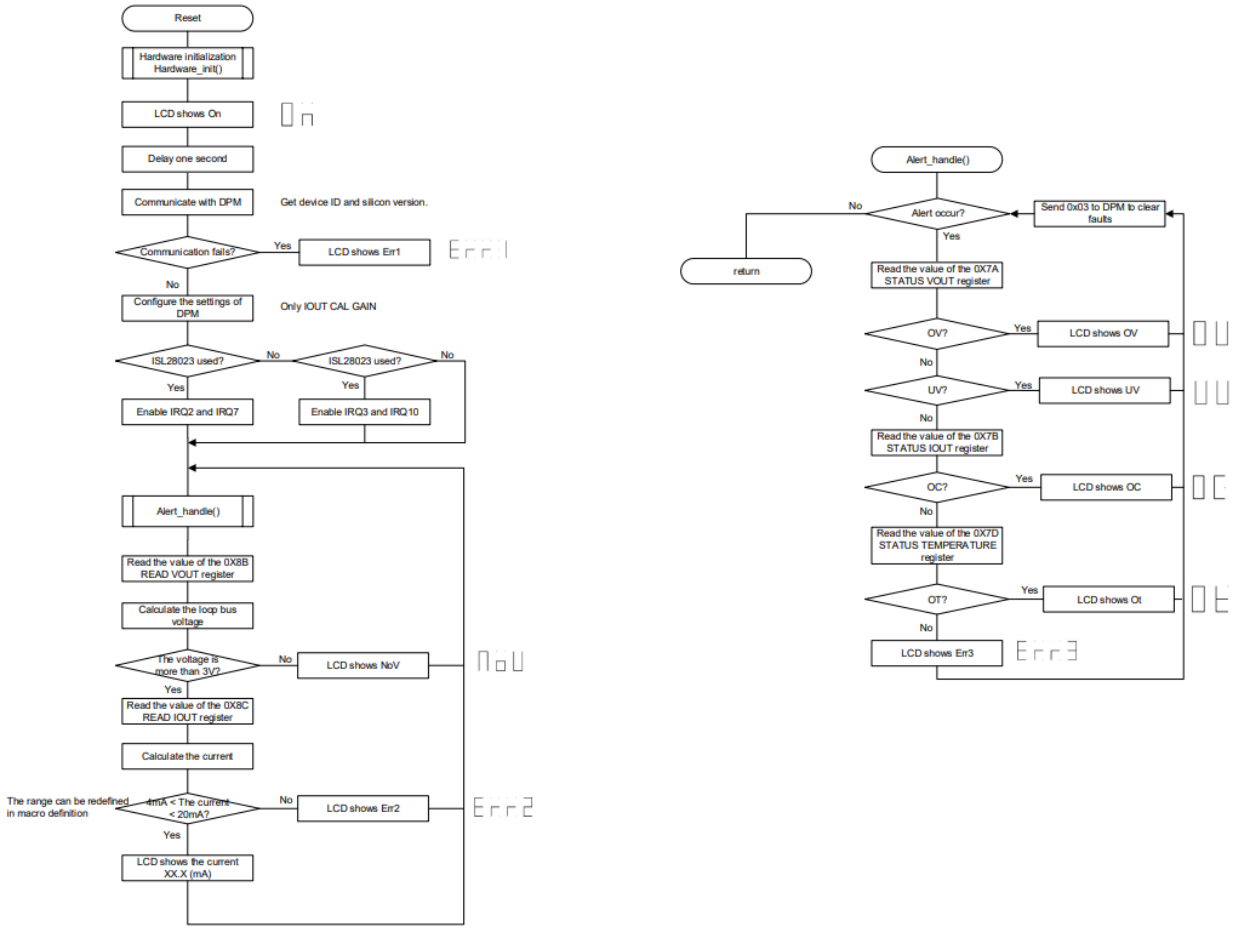

Figure 4. System State Machine

1.2 Operational Characteristics

The US110 board operates with an input voltage between 3.5V to 40V, and a loop voltage of 3V to 40V. The loop is set up to measure from 4mA to 20mA. This board is already programmed and non-isolated.

1.3 Setup and Configuration

The setup for this receiver board assumes that the user has a 4mA to 20 mA transmitter; although, the testing functionality can be verified using the following: a DC source power supply, a resistor, a few wires, and a breakout board. Refer to Figure 5 and Figure 6 for connection diagrams.

1.3.1 Step-by-Step Instructions to Test the Functionality of the Board Using a DC Power Supply

1. Use a USB cable to power the board through its USB port. Connect the cable to a wall USB adapter (power brick) for power supply. When powered on, a green LED on the board lights up indicating that the board is operational.
   Caution: In this step, do not connect the board to the transmitting DC power supply.

2. After the green LED lights up , the LCD briefly displays **On** for 1 second (Figure 7, a); next, **NoV** appears on the LCD (Figure 7, b) indicating that the bus voltage is below 3V.
3. Make the following connections with the power completely off:
   (Refer to Figure 6 for a simplified view of the input connections and expected output.)
   - Connect the V+ terminal of the power supply to either VINP or VBUS on the board.
   - Attach a 1kΩ resistor to the VINM terminal.
   - Connect the other side of the resistor to the V– terminal of the power supply.
   - Finally, connect the V– terminal to Ground (pin 3 of J10) on the board.
4. Set the power supply to 10V. Verify all the connections before turning on the DC power source.
5. If the setup is correct, the LCD displays the measured current value in mA (see Figure 7, c), which would be 10.0 for this procedure.
6. If the LCD does not show a numeric value, refer to Figure 8 for different LCD display states and corresponding probable causes.

1.3.2 Step-by-Step Instructions for Using the US110-420RECEVZ Board with a 4mA to 20mA Current Loop Transmitter:

1. First, refer to the pinout board connections shown in Figure 5 (left)**,** which includes labels for the +IN, –IN, VBUS, and GND terminals.
2. Connect the 4mA to 20mA transmitter to these pins according to the transmitter wiring specifications.
3. When properly connected and powered up, the system begins to operate automatically. No additional configuration is required.

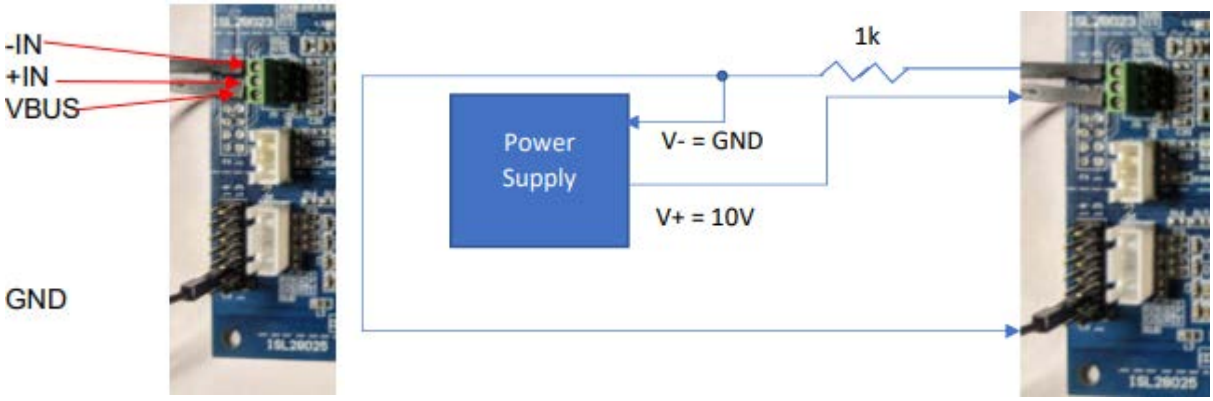

Figure 5. Pinout Board Connections, Left
Input Connections for Testing with Power Supply, Right

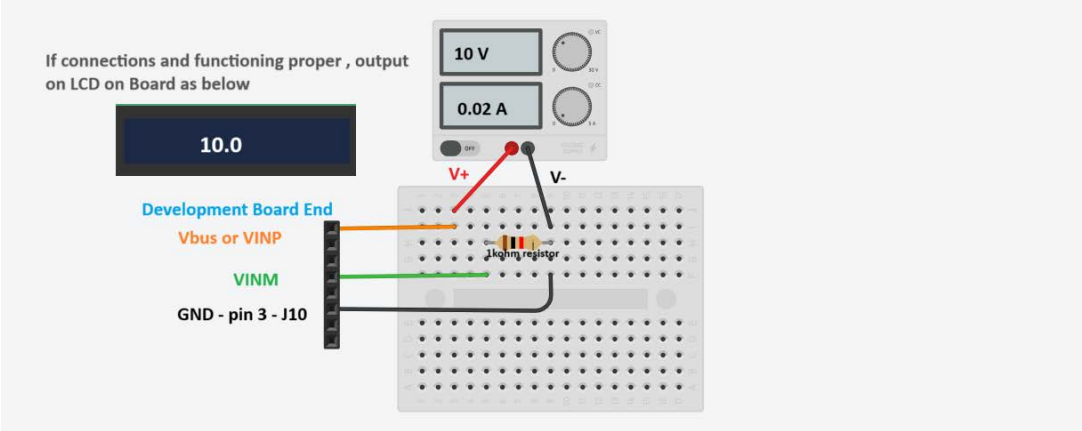

Figure 6. Simplified Overview to Input Connections and Expected Output

(a) **(b)** **(c)**

Figure 7. (a) On Displays When the LCD Turns On During the First Second
(b) NoV Displays when the Bus Voltage < 3V
(c) Current Displays in mA when the Power Supply is On and the Connections are Correctly Set

Display Content		Description
On		The system is powered on.
NoV		No bus voltage status
OV		Over voltage status
UU		Under voltage status
OC		Over current status
Ot		Over temperature status
Err1		Communication with DPM over I2C fails.
Err2		The current is out of the range (4mA ~ 20mA).
Err3		Other errors

Figure 8. LCD Display States

2. Ordering Information

Part Number	Description
US110-420RECEVZ	Standard 4-20mA Loop - Industrial Receiver Development Kit

3. Revision History

Revision	Date	Description
1.00	Jul 11, 2025	Initial release.

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