

CCE4503 Evaluation Board V3

IO-Link Device

The CCE4503 Evaluation Board is designed to evaluate and demonstrate the CCE4503 IO-Link Device Transceiver.

Feature Overview

- Renesas ARM Cortex-M33 μ C RA4M2
- Programmable via SWD and USB
- Reset Button
- Power and User LED indicator
- Renesas 8 Kbit EEPROM
- Additional on-board protection circuitry
- CCE4503 3.3V IO-Link Device Transceiver
- M12 connector + terminal blocks for IO-Link interface
- HS3001 Temperature and Humidity Sensor
- SLG46826V GreenPAK (configured as LED driver)
- All pins accessible via pin-headers for microcontroller and IO-Link Device Transceiver
- Independent use of sections
- IO-Link demonstration Software Stack from IQ² Development (<https://www.iq2-development.de>)

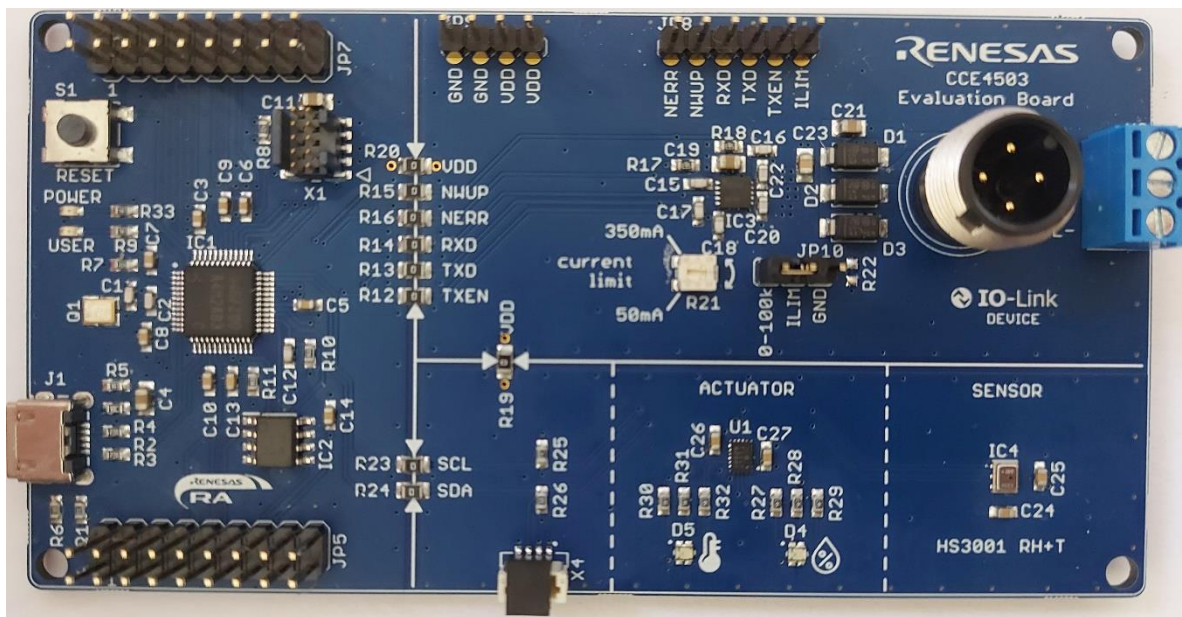


Figure 1. CCE4503 Evaluation Board V3

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1. References

- CCE4503 Datasheet, Renesas Electronics.
- RA4M2 Group Datasheet, Renesas Electronics.
- RA4M2 Group User's Manual: Hardware, Renesas Electronics
- R1EX25008ASA00I#S0 Datasheet, Renesas Electronics
- HS3001 Datasheet, Renesas Electronics
- SLG46826V Datasheet, Renesas Electronics
- IO-Link Interface and System Specification V1.1.2, IO-Link Community.

2. Introduction

The board is divided into three sections:

- **IO-Link Section**

The IO-Link section contains all necessary circuitry to use one CCE4503 3.3V (with an adjustable current limit and slew rate) including an M12 A-Coded connector and terminal block for IO-Link communication. Pin headers enable the user to control and monitor the CCE4503 externally.

- **Sensor / Actuator Section**

The sensor section contains an HS3001 temperature and humidity sensor to provide an example for measurement signals and a SLG46826V GreenPAK which is configured as multicolor LED driver to act as actuator.

- **MCU Section**

The MCU section contains a RA4M2 ARM Cortex-M33 microcontroller from Renesas to control the CCE4503 Device Transceiver as well as the provided sensor and actuator. It also contains an 8 kB EEPROM, USB and SWD debug connector and user and power LED indicators as well as a reset button.

For maximum flexibility, the sections can be used separately and independently from each other. This allows to evaluate the CCE4503 Device Transceiver with every suitable MCU.

The evaluation board is compliant to IO-Link Interface and System Specification V1.1.2

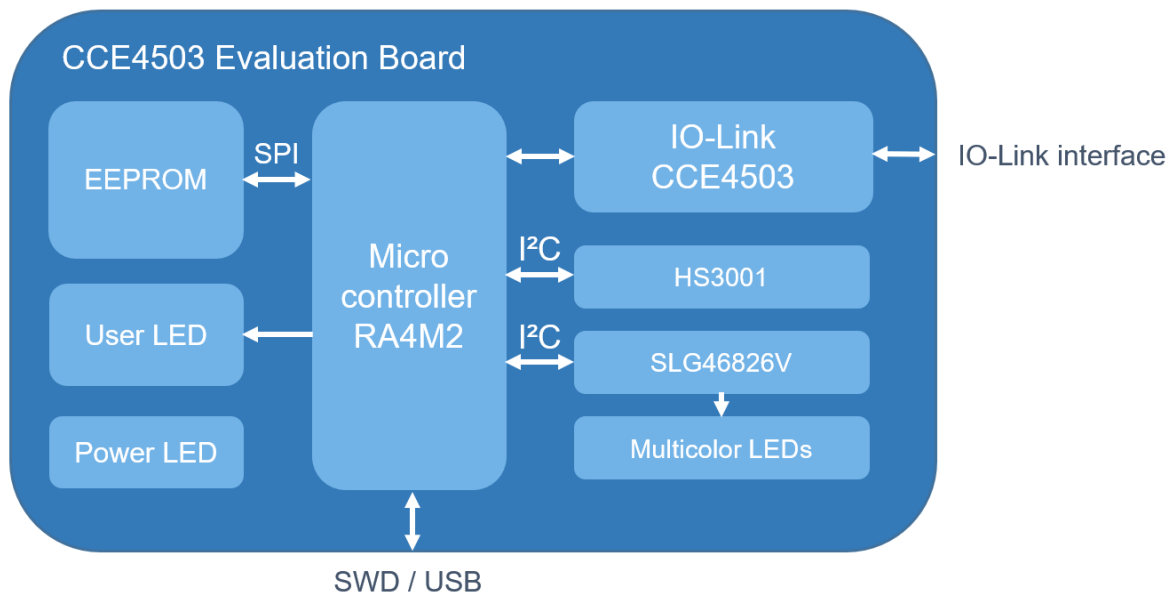


Figure 2. System Diagram

3. System Requirements

The CCE4503 Evaluation Board is ready to use with a preinstalled IO-Link device stack.

To get started, the following tools are required:

- 18-30V (24V typ.) Power Supply (IO-Link Master)
- Debug probe (for programming via SWD) or Micro USB Cable (for programming via USB)
- For programming via SWD: IDE and Coding tool, e.g. Renesas e² Studio

4. Getting Started

Programming via SWD

1. Set JP10 to connect ILIM to R21 (0-100kΩ) for adjustable current limit or to GND for maximum current.
2. Set R21 to the desired value (current limit)
3. Set Boot Mode to Single Chip (no Jumper at JP5 Pin 3 - Pin 4)
4. Connect debug probe to SWD connector (X1)
5. Power on the Evaluation Board (IO-Link interface L+ = 24V, L- = GND)
6. Start programming with your preferred IDE

Programming via USB

1. Set JP10 to connect ILIM to R21 (0-100kΩ) for adjustable current limit or to GND for maximum current.
2. Set R21 to the desired value (current limit)
3. Set Jumper to connect JP5 Pin 3 - Pin 4.
4. Connect PC to USB connector (X5)

5. Power on the Evaluation Board (IO-Link interface L+ = 24V, L- = GND)
6. Flash the software stack to the board, using the Renesas Flash Programmer (RFP)

Demonstration using the preinstalled IO-Link Stack

1. Set JP10 to connect ILIM to R21 (0-100k Ω) for adjustable current limit or to GND for maximum current.
2. Set R21 to the desired value (current limit)
3. Set Boot Mode to Single Chip (no Jumper at JP5 Pin 3 - Pin 4)
4. Import the IODD into the Master Application (IODD can be downloaded at www.Renesas.com)
5. Connect the Evaluation Board to an IO-Link Master using the M12 connector or X2
6. Start communication

For reinstalling the demonstration IO-Link software stack, please download the stack from www.Renesas.com and follow the procedures described above.

5. Power Supply

The Evaluation Board is supplied via the L+ voltage of the IO-Link interface. The CCE4503 has a wide input voltage range of 7-36V, however it is recommended to use the typical supply voltage for IO-Link devices of 18-30V (typ. 24V).

The IO-Link interface comprises L+, L- and CQ, and it can be accessed via the M12 connector or terminal clamps (X2). Three SMAJ30A TVS diodes are used to provide additional protection.

At port VDD, a regulated voltage of 3.3 V is generated by the internal LDO regulator. This regulator supplies the digital I/O pads of the CCE4503, the MCU and the sensor / actuator. VDD can supply additional external components, but the overall external load at VDD must not exceed 20mA. The current consumption of the MCU, the sensor / actuator and the external components must be respected.

6. Sections

The CCE4503 Evaluation Board is divided into three sections, the MCU section, the IO-Link section, and the Sensor/Actuator Section.

All sections can be used in combination with an IO-Link Device software stack to demonstrate a fully functional, ready-to-use IO-Link Device.

If required, all sections can be used independently of each other. The connection between the sections can be disconnected by removing the 0R resistors R12 – R16, R19, R20, R23, and R24.

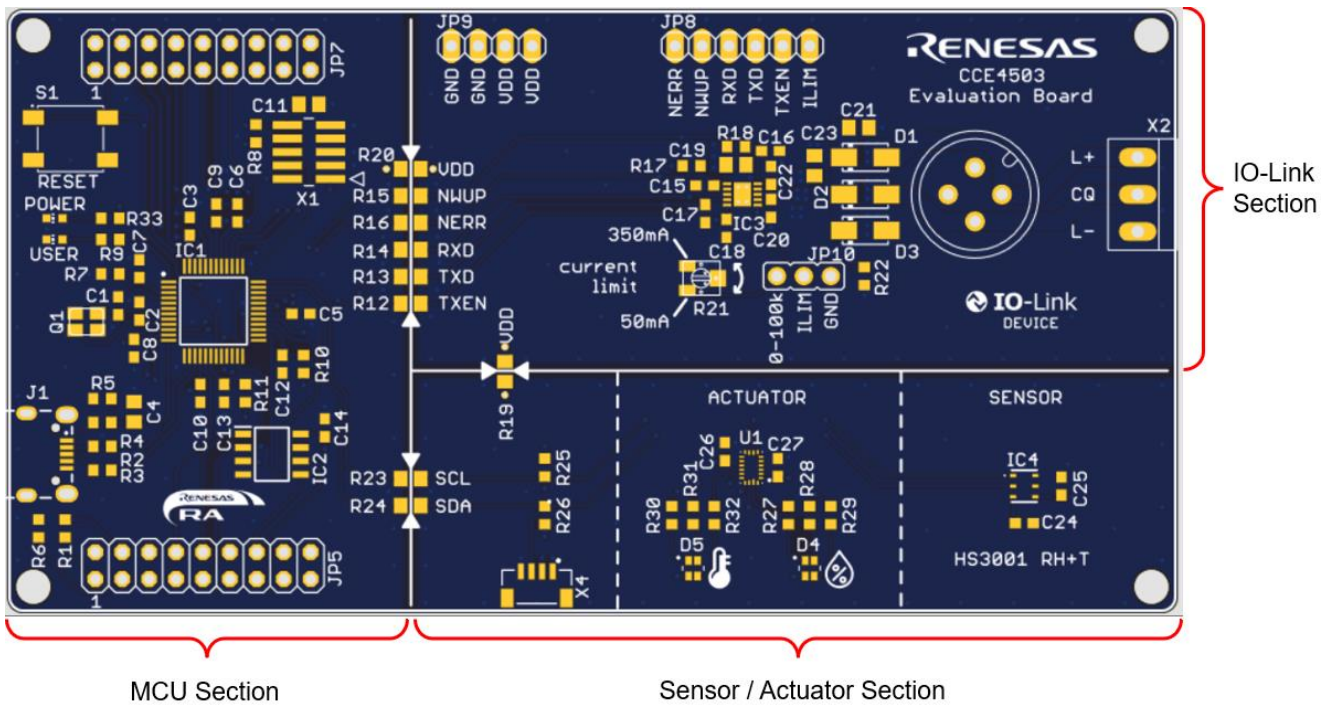


Figure 3. Sections Overview

6.1 IO-Link Section

The IO-Link section contains the CCE4503 IO-Link Device Transceiver in the 3.3V variant and the reference design for using it, IO-Link communication connectors, and connectors for the use of an external MCU.

The current limit and the slew rate can be adjusted either by using the potentiometer R21, a fixed resistor R22 (not placed) or by connecting ILIM to GND or VDD. When using R22, please remove the jumper connection on JP10.

The IO-Link communication can either be established using the M12 A-Coded connector or the terminal block X2.

If the MCU section is not used, JP8 can be used to connect any suitable external MCU to control the CCE4503.

6.2 MCU Section

The MCU section contains a RA4M2 ARM Cortex-M33 microcontroller (IC1) from Renesas and an 8 kB EEPROM (IC2) from Renesas.

Two LEDs are used to indicate the status of the Board: the “POWER” LED indicates that the Board is powered on (VDD is powered), and the “USER” LED can be freely configured by the user. The demonstration IO-Link software stack utilizes the “USER” LED as parameter to be turned on or off by the IO-Link Master.

The microcontroller can be programmed via USB (J1) or SWD interface (X1), see [4. Getting Started](#).

The MCU can be booted in two different boot modes: Single-Chip mode and USB boot mode. To select the boot mode, the corresponding jumper must be set on JP5 when a reset is released:

- Single Chip mode: no jumper at JP5
- USB boot mode: set jumper to connect JP5 pin 3 to pin 4

For maximum accessibility of the RA4M2, all relevant pins are connected to the pin-headers JP5 and JP7.

6.3 Sensor / Actuator Section

The sensor / actuator section contains a HS3001 temperature and humidity sensor and a SLG46826V GreenPAK in LED driver configuration serving as an actuator, which can be used for demonstration and evaluation of the IO-Link communication.

The HS3001 as well as the SLG46826V are controlled via I²C. Please note that the I²C pull-up resistors are placed on the sensor / actuator section.

The I²C interface can also be used by an external I²C master via X4 or JP5 pin 15 and pin 18 to easily reconfigure the GreenPAK. In the delivery state, the GreenPAK is already programmed, and no action is necessary. Resetting the GreenPAK to the delivery state can be done in three ways:

- Program manually over I²C (download the I²C register data from the Renesas website)
- Program with the *Go Configure Software Hub* using a GreenPAK Development Board (Download the GreenPAK Project File from www.Renesas.com)
- Flash the Evaluation Board with the IO-Link demonstration stack (download the IO-Link demonstration stack from www.Renesas.com)

LED D5 (temperature) and LED D4 (humidity) are used as indicators for the current temperature and humidity values. [Table 1](#) shows the standard threshold ranges.

Table 1 Temperature and humidity thresholds

		Green	Yellow	Orange	Red
Temperature In °C	Threshold range High	20-22	22-25	25-30	>30
	Threshold range Low		18-20	16-18	<16
Humidity In %	Threshold range High	45-55	55-60	60-70	>70
	Threshold range Low		30-45	20-30	<20

The thresholds can be adjusted by the IO-Link Master in the parameters section.

7. Schematic and Layout

7.1 Connectors

Figure 4 shows all connectors of the CCE4503 Evaluation Board.

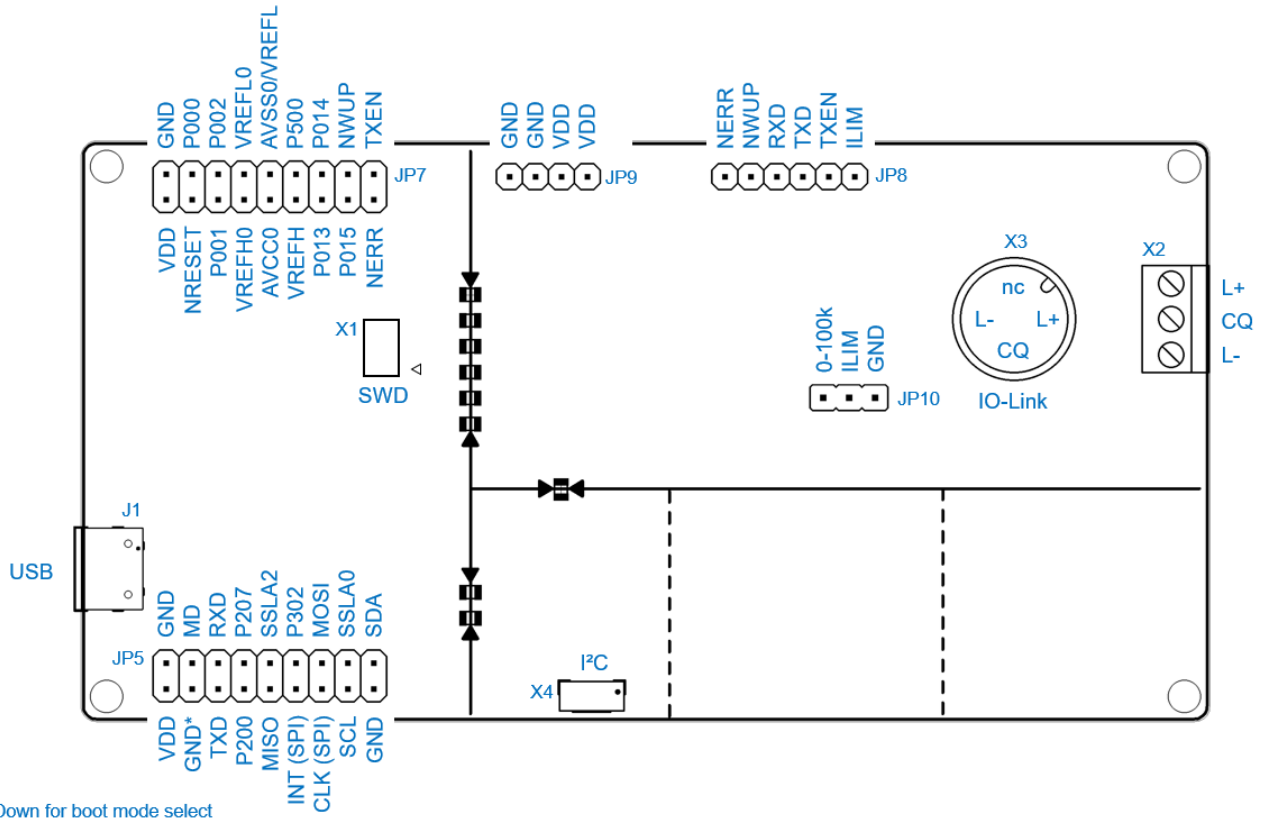


Figure 4. Connectors

7.2 Schematic

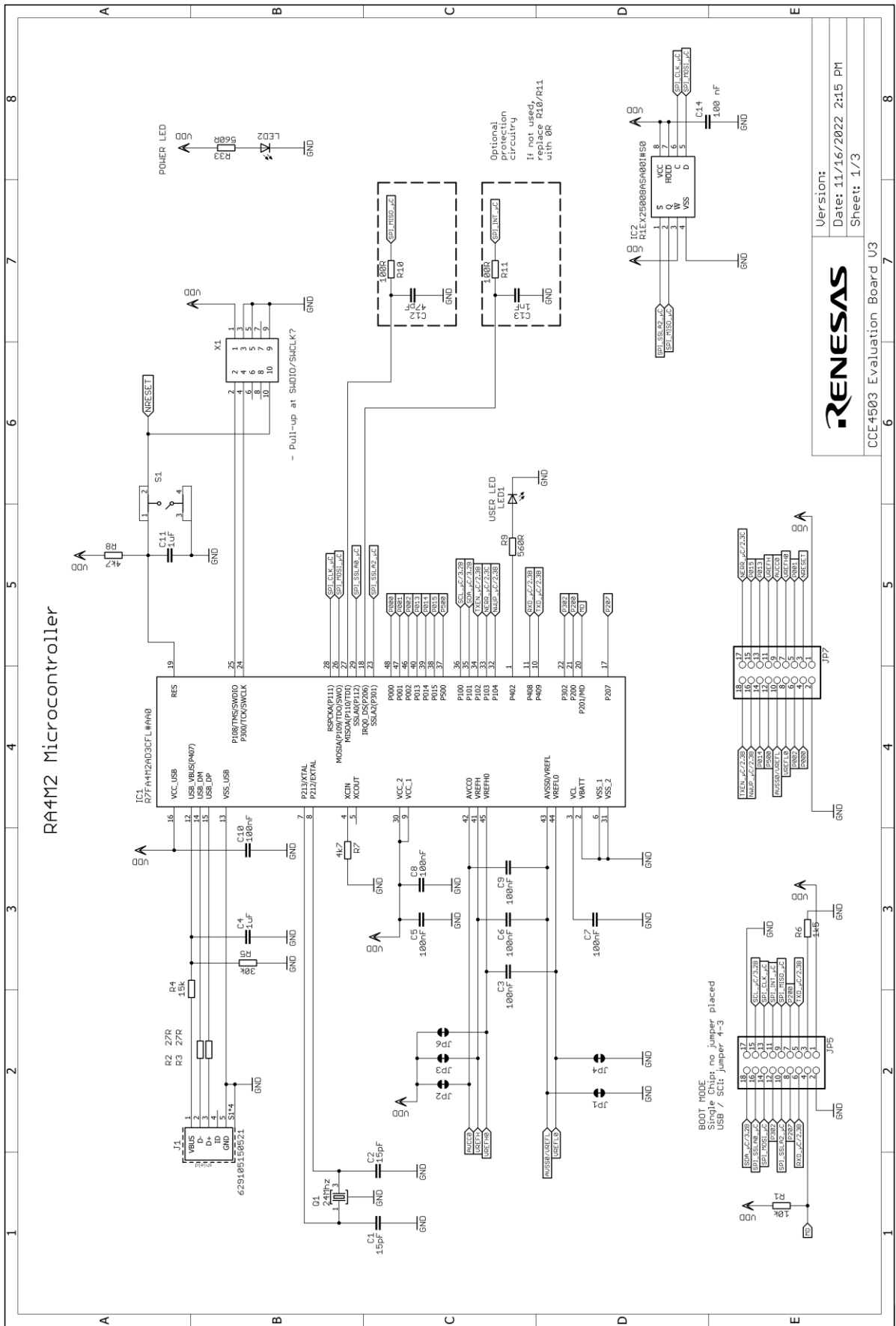
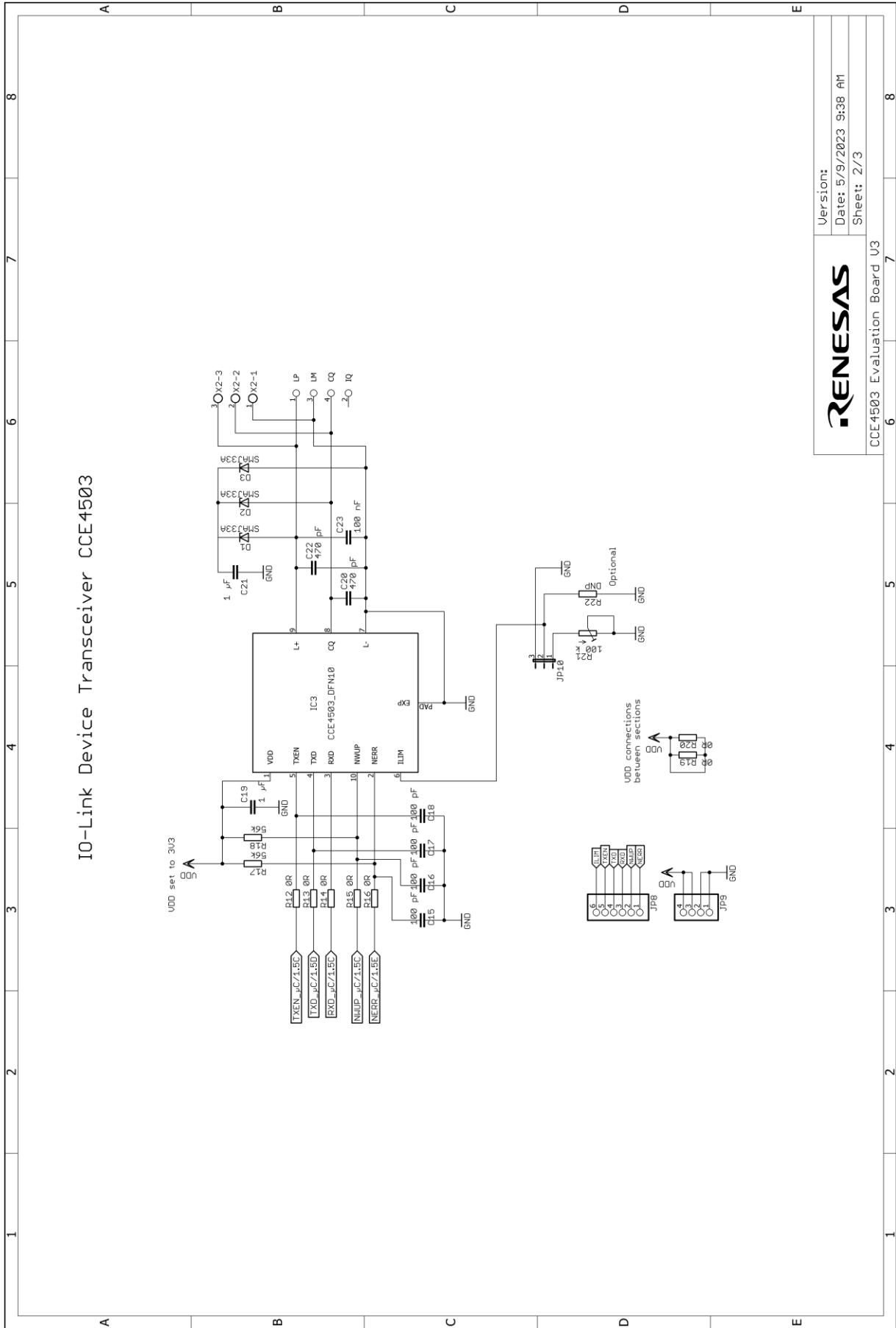
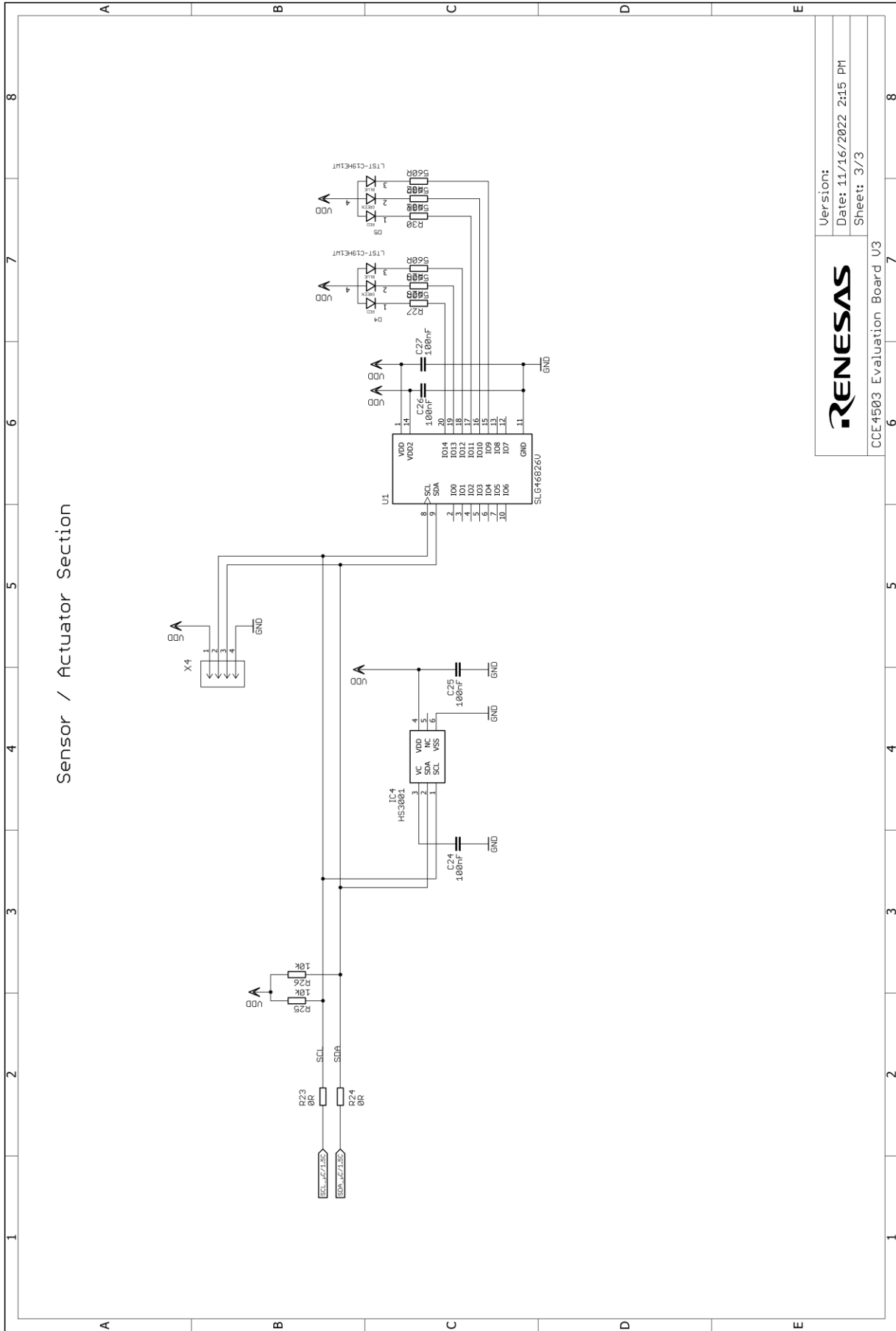


Figure 5. Schematics 1



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CCE4503 Evaluation Board V3	

Figure 6. Schematics 2



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CCE4503 Evaluation Board V3	
Sheet: 3/3	

Figure 7. Schematics 3

7.3 Bill of Materials

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part Number
2	C1, C2	CAP, SMD, 0603, 15pF, 50V, 10%, X7R	Any	Any
1	C12	CAP, SMD, 0603, 47pF, 50V, 10%, X7R	Any	Any
1	C13	CAP, SMD, 0603, 1nF, 50V, 10%, X7R	Any	Any
4	C15, C16, C17, C18	CAP, SMD, 0603, 100pF, 50V, 10%, X7R	Any	Any
2	C19, C21	CAP, SMD, 0805, 1μF, 50V, 10%, X7R	Any	Any
2	C20, C22	CAP, SMD, 0603, 470pF, 50V, 10%, X7R	Any	Any
1	C23	CAP, SMD, 0805, 100nF, 50V, 10%, X7R	Any	Any
12	C3, C5, C6, C7, C8, C9, C10, C14, C24, C25, C26, C27	CAP, SMD, 0603, 100nF, 50V, 10%, X7R	Any	Any
2	C4, C11	CAP, SMD, 0805, 1μF, 50V, 10%, X7R	Any	Any
3	D1, D2, D3	TVS DIODE 33VWM 53.3VC DO214AC	Littlefuse Inc.	SMAJ33A
2	D4, D5	LED RGB DIFFUSED CHIP SMD	Lite-on Inc.	LTST-C19HE1WT
2	LED1, LED2	LED GREEN CLEAR SMD	Lite-on Inc.	LTST-C191KGKT
1	IC1	MCU RA4 ARM CM33 100MHZ 512K/128	Renesas Electronics	R7FA4M2AD3CFL#AA0
1	IC2	EEPROM 8KBIT SPI 5MHZ 8SOP	Renesas Electronics	R1EX25008ASA00I#S0
1	IC3	IO-Link Device Transceiver	Renesas Electronics	CCE4503
1	IC4	SENSOR HUMIDITY 90% RH SMD	Renesas Electronics	HS3001
1	J1	CONN RCPT USB2.0 MICRO B SMD R/A	Würth Elektronik	629105150521
5	JP1, JP2, JP3, JP4, JP6	Trace Cut Jumper	-	-
1	JP10	CONN HEADER VERT 3POS 2.54MM	Würth Elektronik	61300311121
2	JP5, JP7	CONN HEADER VERT 18POS 2.54MM	Würth Elektronik	61301821121
1	JP8	CONN HEADER VERT 6POS 2.54MM	Würth Elektronik	61300611121
1	JP9	CONN HEADER VERT 4POS 2.54MM	Würth Elektronik	61300411121
1	Q1	CRYSTAL 24.0000MHZ 10PF SMD	Diodes Incorporated	FL2400022
3	R1, R25, R26	RES, SMD, 0603, 10kOhm, 50V, 1.0%, 100mW	Any	Any
2	R10, R11	RES, SMD, 0603, 100Ohm, 50V, 1.0%, 100mW	Any	Any
9	R12, R13, R14, R15, R16, R19, R20, R23, R24	RES, SMD, 0805, 0 Ohm, 50V, 1.0%, 100mW	Any	Any

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2	R17, R18	RES, SMD, 0603, 56kOhm, 50V, 1.0%, 100mW	Any	Any
2	R2, R3	RES, SMD, 0603, 270Ohm, 50V, 1.0%, 100mW	Any	Any
1	R21	TRIMMER 100K OHM 0.125W J LEAD	TT Electronics/BI	22AR100KLFTR
1	R22	RES, SMD, 0603	DNP	DNP
1	R4	RES, SMD, 0603, 15kOhm, 50V, 1.0%, 100mW	Any	Any
1	R5	RES, SMD, 0603, 30kOhm, 50V, 1.0%, 100mW	Any	Any
1	R6	RES, SMD, 0603, 1.5kOhm, 50V, 1.0%, 100mW	Any	Any
2	R7, R8	RES, SMD, 0603, 4.7kOhm, 50V, 1.0%, 100mW	Any	Any
8	R9, R27, R28, R29, R30, R31, R32, R33	RES, SMD, 0603, 560Ohm, 50V, 1.0%, 100mW	Any	Any
1	S1	SWITCH TACTILE SPST-NO 0.05A 12V	Würth Elektronik	430481035816
1	U1	GPAK MIXED SIGNAL MATRIX	Renesas Electronics	SLG46826V
1	X1	CONN HEADER SMD 10POS 1.27MM	Samtec Inc.	FTSH-105-01-F-DV-K
1	X2	TERM BLK 3POS SIDE ENT 3.5MM PCB	Würth Elektronik	691103110003
1	X3	M12 Connector	Binder	09 0431 212 04
1	X4	CONN HEADER SMD 4POS 1MM	TE Connectivity	1734595-4

7.4 Board Layout

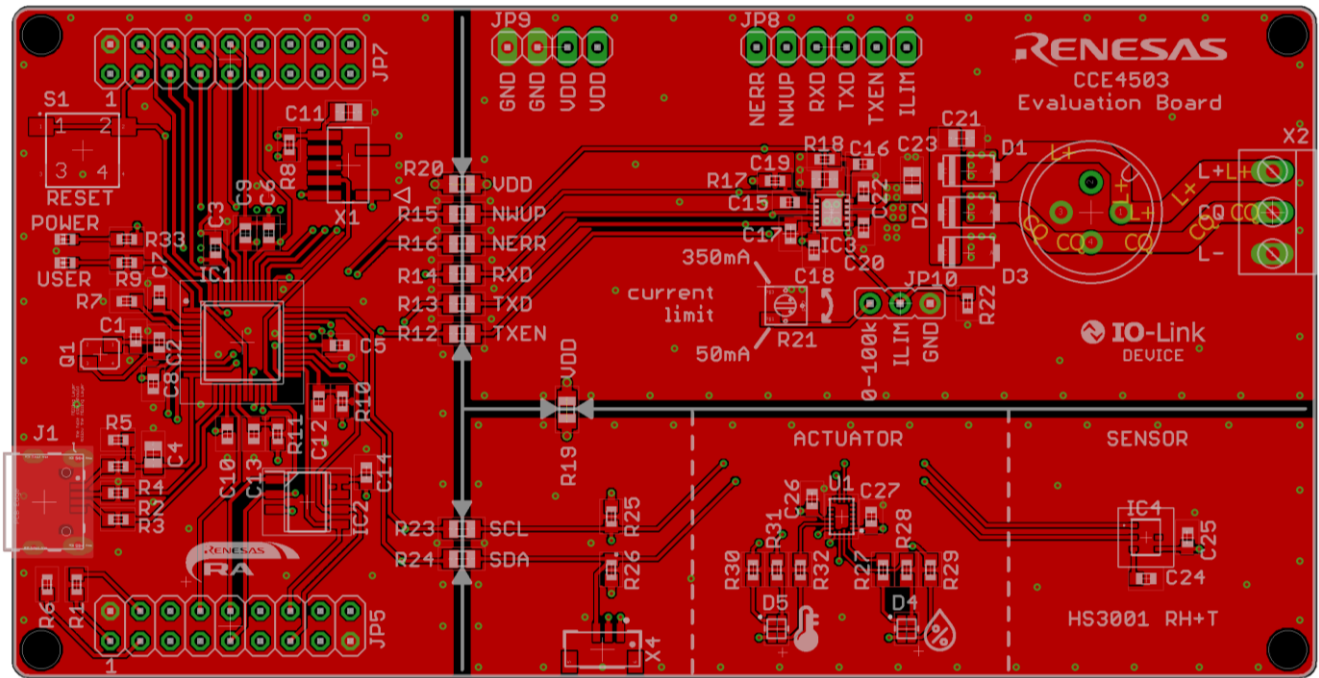


Figure 8. Top Layer

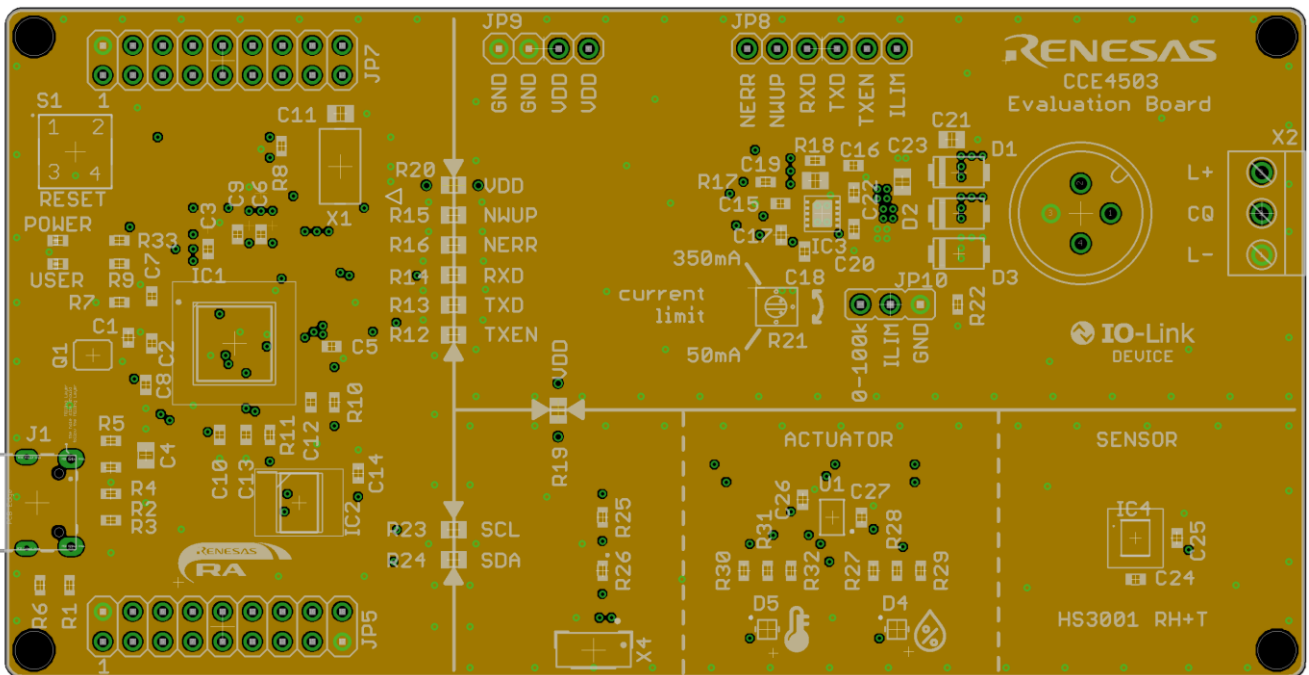


Figure 9. Second Layer (GND)

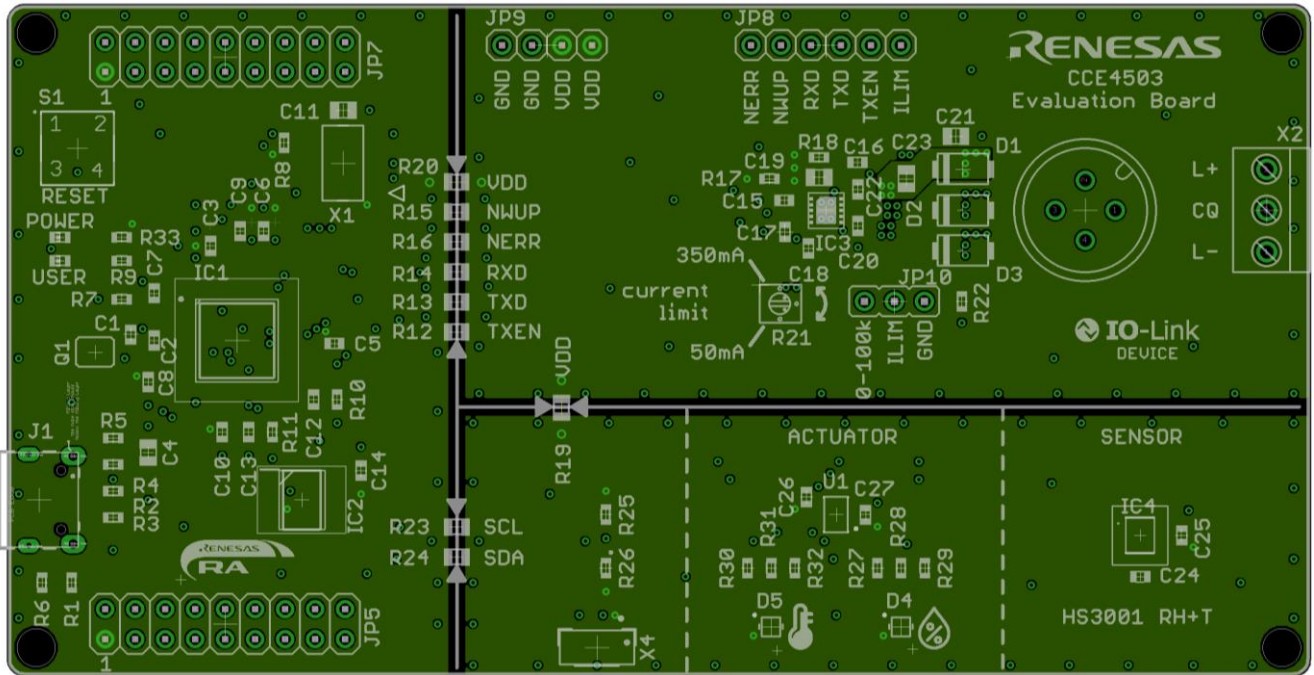


Figure 10. Third Layer (Supply)

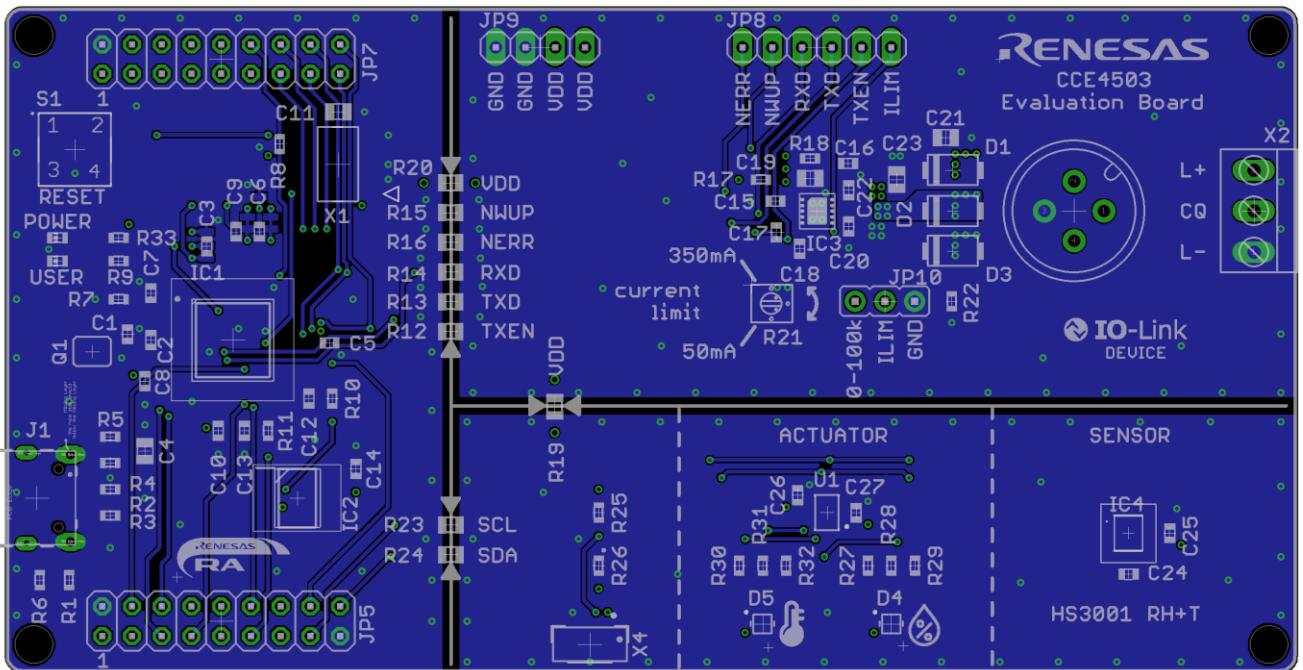


Figure 11. Bottom Layer

8. Ordering Information

Part Number	Description
CCE4503-EVAL-V3	CCE4503 Evaluation Board V3

9. Revision History

Revision	Date	Description
1.1	May 09, 2023	Updated naming (CCE4503 Device IC → CCE4503 Device Transceiver)
1.0	Jan 06, 2022	Initial release.

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