RTKA788152DE0000BU

RTKA788152DE0000BU, the RS-485 evaluation board, allows you to evaluate the half-duplex transceivers of the RAA78815x family of RS-485 transceivers.

Specifications

- 4.5V to 5.5V Supply Voltage
- 115kbps Half-Duplex Transceiver RAA788152

Features

- Single 115kbps Half-Duplex Transceiver
- RAA788152 (115kbps version currently installed) can be unsoldered and replaced by RAA788155 (1Mbps version) or RAA788158 (20Mbps version)
- Place holders for fail-safe biasing resistors
- Configuration jumpers to operate the transceiver as transmitter or receiver, or as a transmitter with loopback

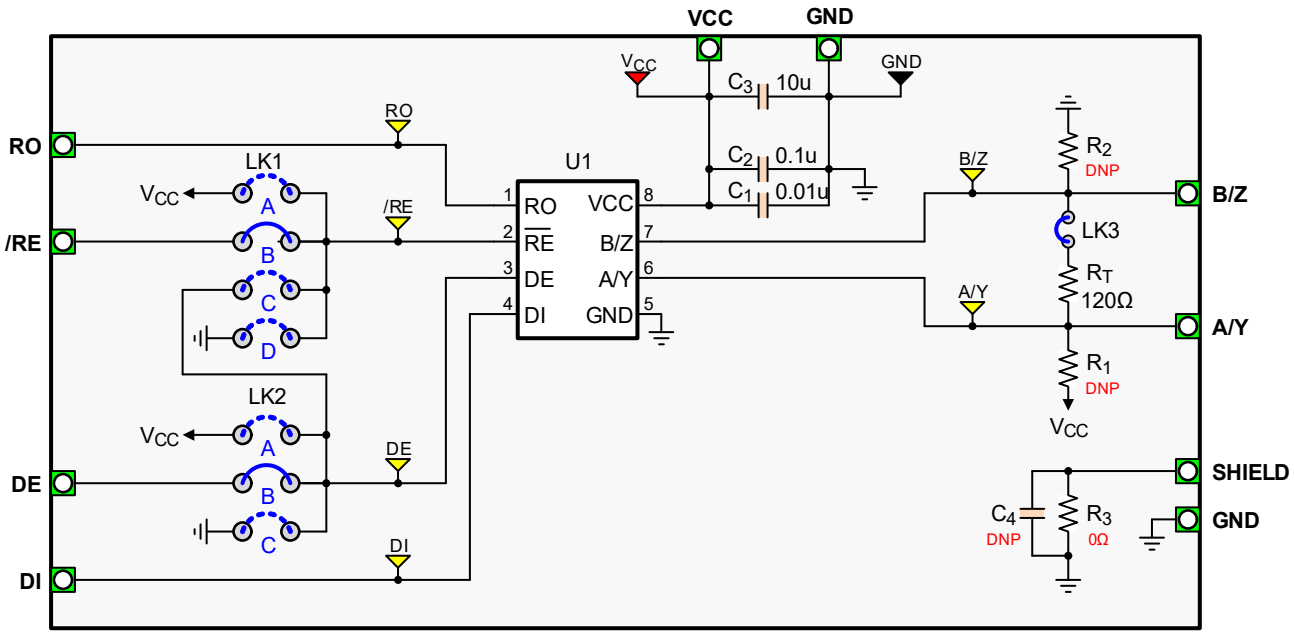

Figure 1. Block Diagram

Contents

1. Functional Description

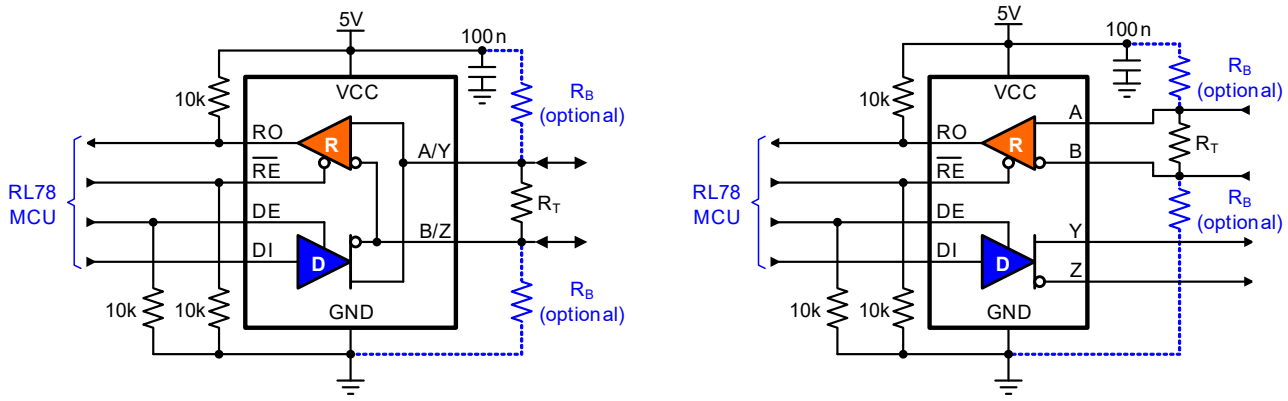

Figure 2. Typical Operating Circuits of Half-Duplex and Full-Duplex Transceivers

1.1 Operational Characteristics

1.1.1 Driver Operation

A logic high at the driver enable pin (DE) activates the driver and causes the differential driver outputs (Y and Z) to follow the logic states at the data input (DI). A logic high at DI causes Y to turn high and Z to turn low. In this case, the differential output voltage, defined as $V_{OD} = V_Y – V_Z$, is positive. A logic low at DI reverses the output states reverse, turning Y low and Z high, therefore, making V_{OD} negative. A logic low at DE disables the driver, making Y and Z high-impedance. In this condition, the logic state at DI is irrelevant. To ensure the driver remains disabled after device power-up, Renesas recommends connecting DE through a 1kΩ to 10kΩ pull-down resistor to ground.

Table 1. Driver Truth Table

Inputs			Outputs		Function
RE	DE	DI	Y	Z	
X	H	H	H	L	Actively drives bus high
X	H	L	L	H	Actively drives bus low
L	L	X	Z	Z	Driver disabled, outputs high-impedance
H	L	X	Z	Z	Shutdown mode: driver and receiver disabled for more than 600ns

1.1.2 Receiver Operation

A logic low at the receiver enable pin ($\overline{RE}$) activates the receiver and causes its output (RO) to follow the bus voltage at the differential receiver inputs (A and B); the bus voltage is defined as $V_{AB} = V_A - V_B$. For $V_{AB} \geq -0.05V$, RO turns high, and for $V_{AB} \leq -0.2V$, RO turns low. For input voltages between -50mV and -200mV, the state of RO is undetermined, and therefore can be high or low. A logic high at $\overline{RE}$ disables the receiver, making RO high-impedance. In this condition, the polarity and magnitude of the input voltage is irrelevant. To ensure the receiver output remains high when the receiver is disabled, Renesas recommends connecting RO, using a 1kΩ to 10kΩ pull-up resistor to VCC. To enable the receiver to immediately monitor the bus traffic after device power- up, connect $\overline{RE}$ through a 1kΩ to 10kΩ pull-down resistor to ground.

Table 2. Receiver Truth Table

Inputs			Outputs	Function
RE	DE	A-B	RO	
L	X	$V_{AB} \geq -0.05V$	H	RO is data-driven high
L	X	$-0.05 > V_{AB} > -0.2V$	Undetermined	Actively drives bus low
L	X	$V_{AB} \leq -0.02$	L	RO is data-driven low
L	X	Inputs Open/Shorted	H	RO is failsafe-high
H	H	X	Z	Receiver disabled, RO is high-impedance
H	L	X	Z	Shutdown mode: driver and receiver disabled for more than 600ns

1.2 Bus and Receiver Output Voltages

1.2.1 Set Up

Before connecting measurement equipment, set up the evaluation board and make sure to remove the JP1 socket, which is a jumper connection between two output channels A/Y and B/Z. Removal of JP1 socket allows for measurement of output voltage across driver outputs. Follow the schematic diagram to enable driver by placing sockets to connect DE_J positions 1 and 2. Enable the receiver by placing the socket to connect RE#_J positions 7 and 8. Placing a socket between positions 1 and 2 connects the Driver Enable function to V_{CC} and activates the driver. Otherwise, placing a socket between positions 7 and 8 connects the Receiver Enable function to ground, and because this function is inverted, the receiver is activated. To ensure there is voltage across the bus, attach the load resistor of 60Ω over the A/Y and B/Z channels. Without this resistive load, the bus is an open circuit. Therefore, no voltage reading would be across the bus.

Attach V_{CC} to the power supply and set the voltage to $5V_{DC}$. Attach the Oscilloscope channel 1 and channel 2 probes to the A/Y and B/Z channels accordingly for bus voltage reading. For channel 3, attach to RO for receiver output voltage reading. Connect the pulse generator to driver input (DI) and set it up for square wave function.

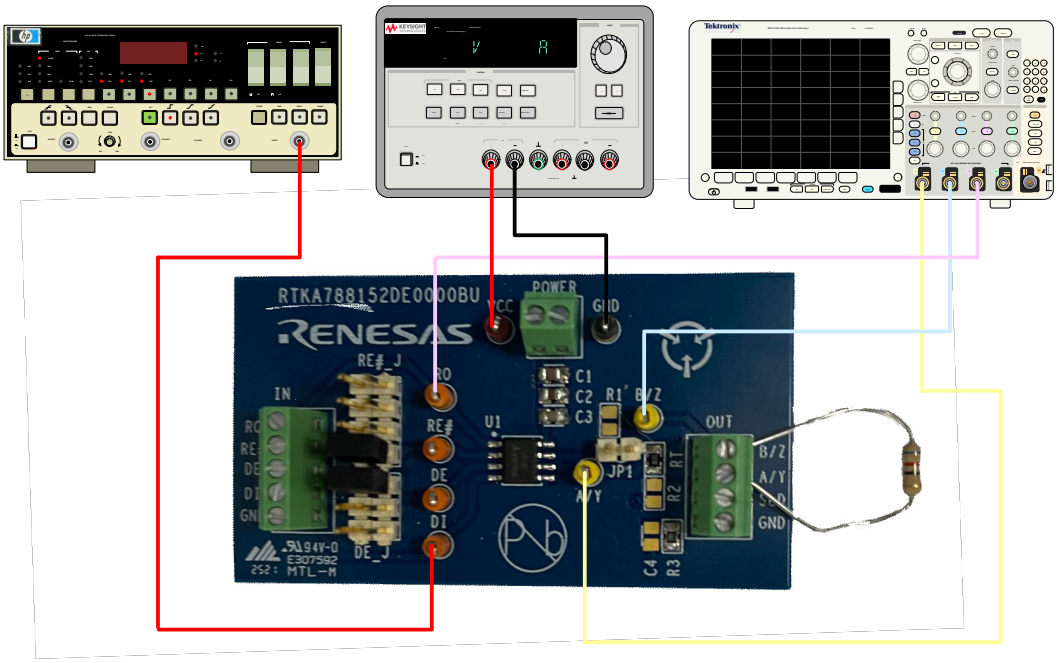

Figure 3. Setup for Bus and Receiver Output Voltage Measurement with Oscilloscope, Power Supply, and Function Generator

1.2.2 Measurement Graphs

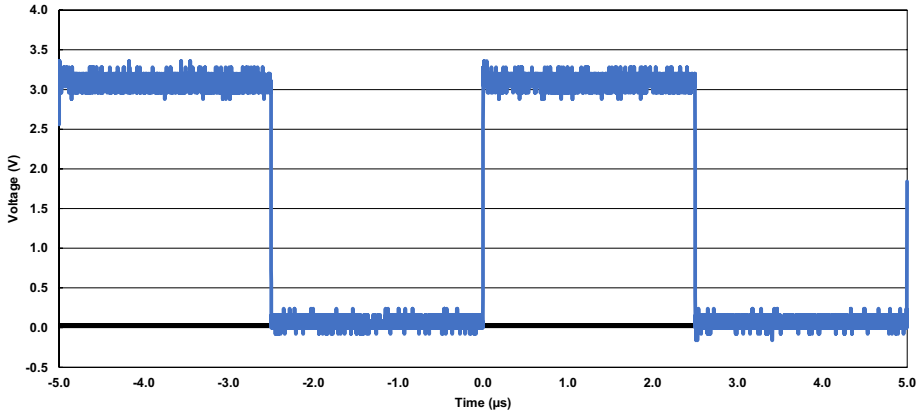

Figure 4. Driver Input Voltage vs Time

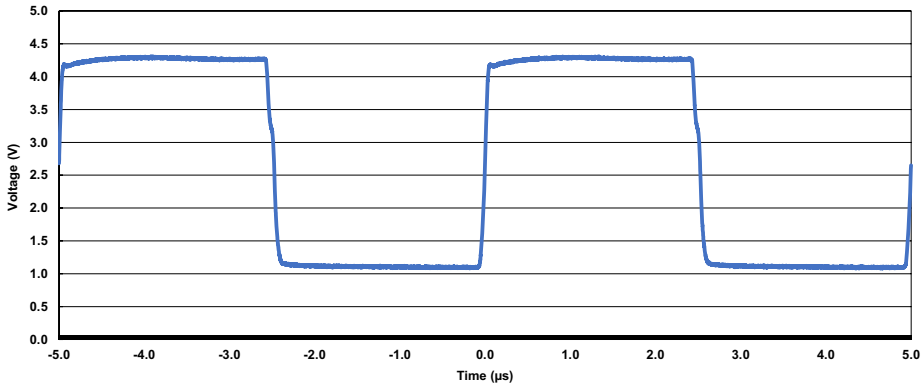

Figure 5. A/Y Channel Output Voltage vs Time

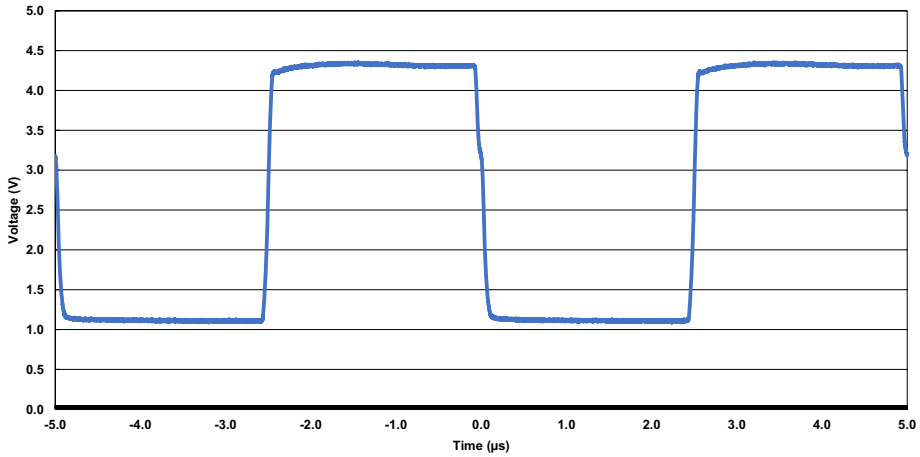

Figure 6. B/Z Channel Output Voltage vs Time

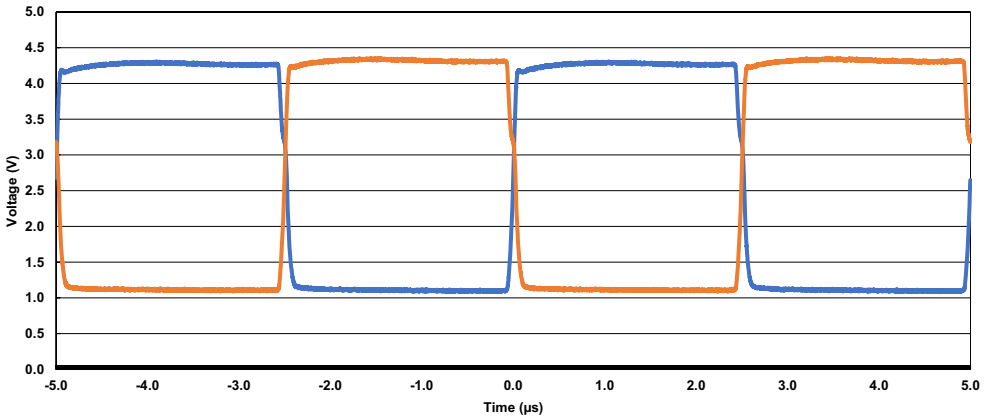

Figure 7. Bus Output Voltages vs Time

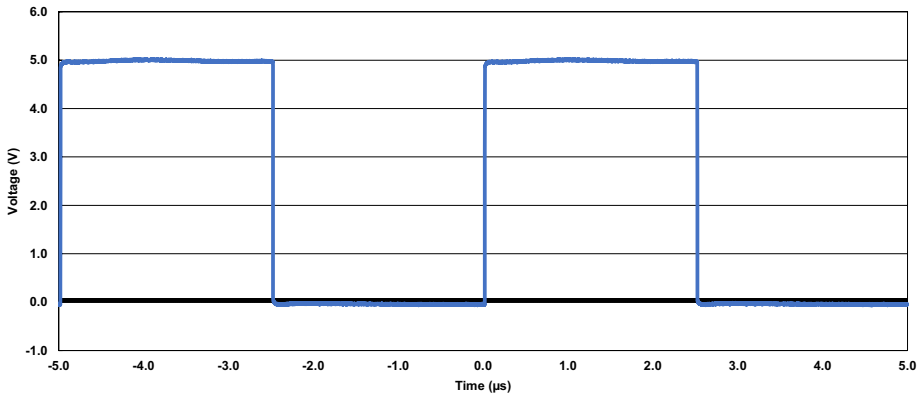

Figure 8. Receiver Output Voltage vs Time

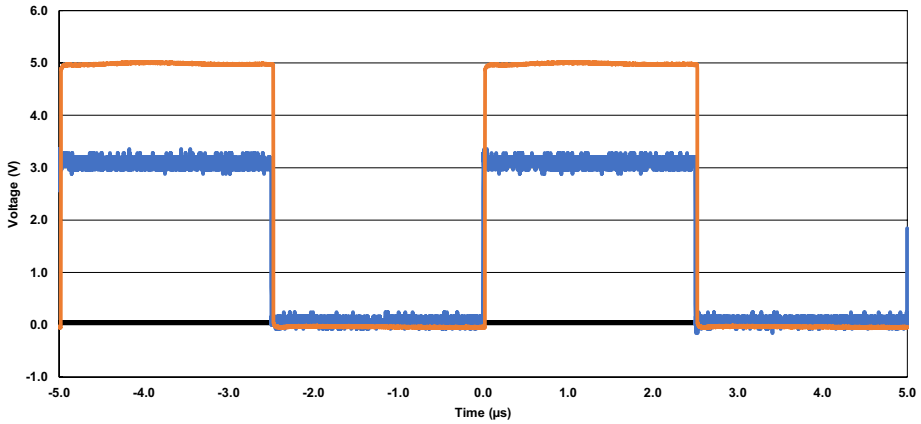

Figure 9. Driver Input Voltage vs Receiver Output Voltage

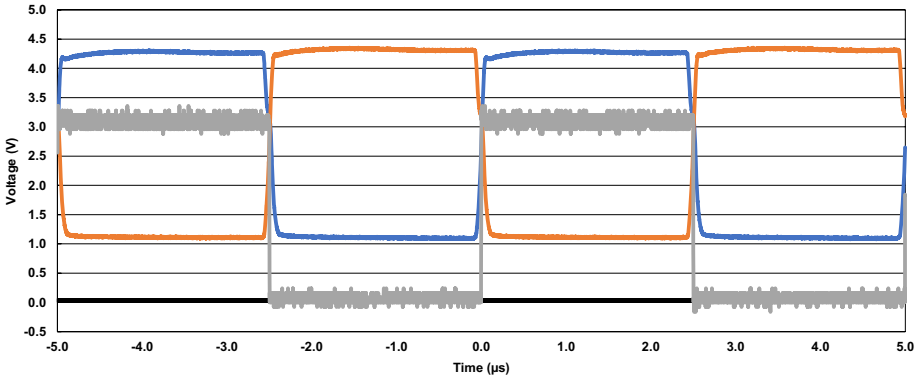

Figure 10. Bus Output Voltage vs Receiver Output Voltage

2. Board Design

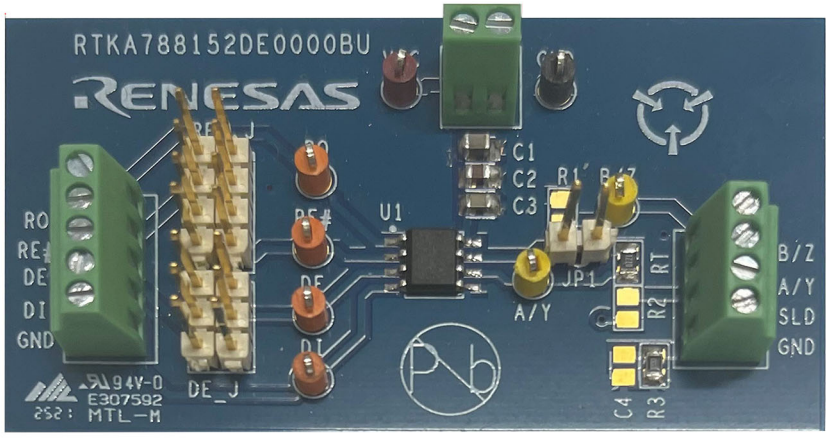

Figure 11. RTKA788152DE0000BU Evaluation Board (Top)

2.1 Schematic Diagrams

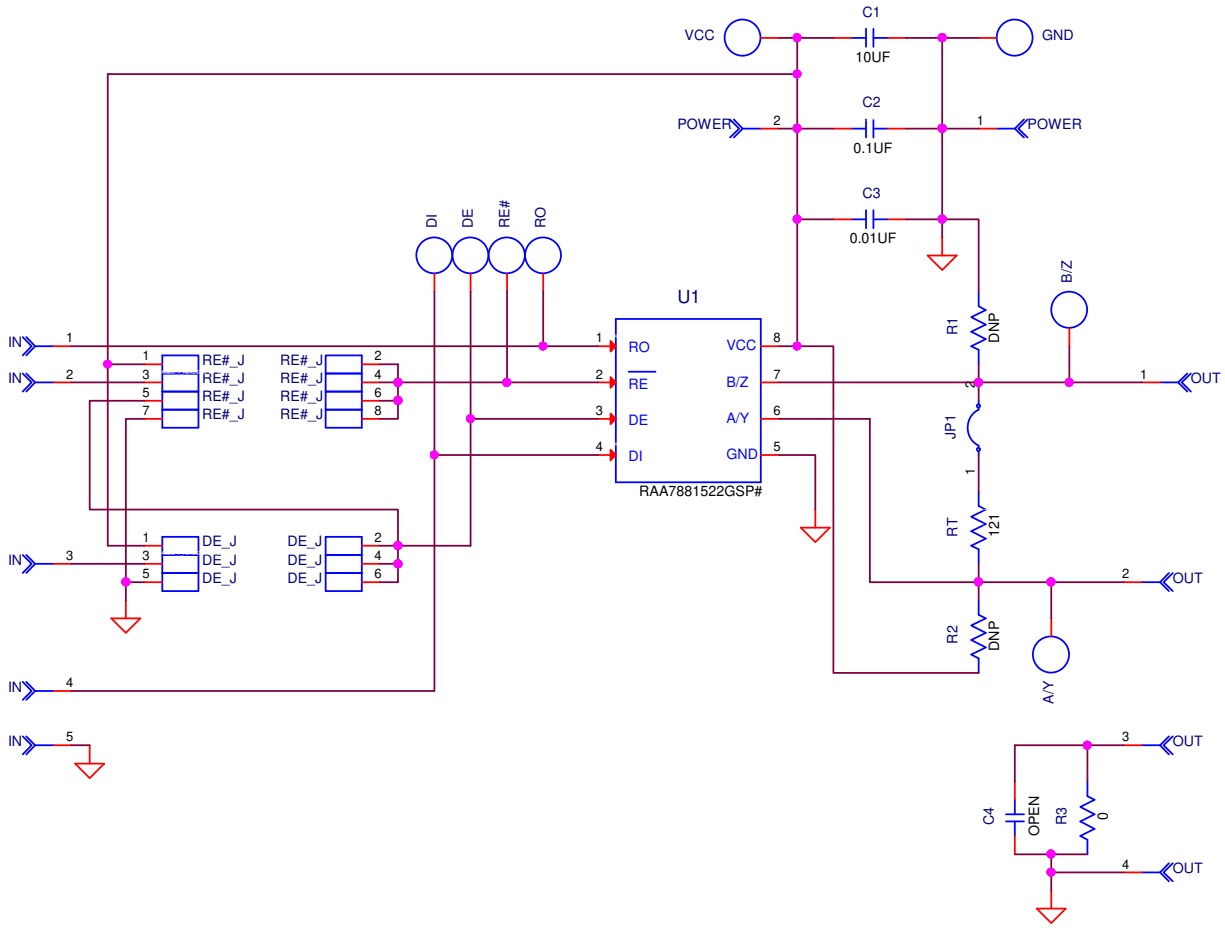

Figure 12. RTKA788152DE0000BU Schematic

2.2 Bill of Materials

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part Number
1	POWER	2 Position at 100 Mil Micro-Pitch Terminal Block	Phoenix	1725656
1	OUT	4 Position at 100 Mil Micro-Pitch Terminal Block	Phoenix	1725672
1	IN	In-line 5 pins x 0.1 inch 6A Terminal Block	Phoenix	1725685
1	VCC	Miniature Red Test Point 0.100 Pad 0.040 Thole	Keystone	5000
1	GND	Miniature Black Test Point 0.100 Pad 0.040 Thole	Keystone	5001
4	DE, DI, RO, RE#	Miniature Orange Test Point 0.100 Pad 0.040 Thole	Keystone	5003
2	A/Y, B/Z	Miniature Yellow Test Point 0.100 Pad 0.040 Thole	Keystone	5004
1	DE_J	Dual Row Vertical PCB Connector	Molex	90151-3X06
1	RE#_J	Dual Row Vertical PCB Connector	Molex	90151-3X08

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part Number
1	C1	Ceramic CAP	Murata	GRM21BR61E106MA73
1	C3	Multilayer Cap	Various	Generic
1	C2	Multilayer Cap	Various	Generic
1	C4	Multilayer Cap	Various	Generic
2	R1, R2	Metal Film Chip Resistor (Do Not Populate)	Various	Generic
1	R3	Thick Film Chip Resistor	Various	Generic
1	RT	Thick Film Chip Resistor	Various	Generic
1	JP1	Two Pin Jumper	Various	Generic
1	U1	RS-485 Transceiver	Renesas Electronics	RAA7881522GSP#

2.3 Board Layout

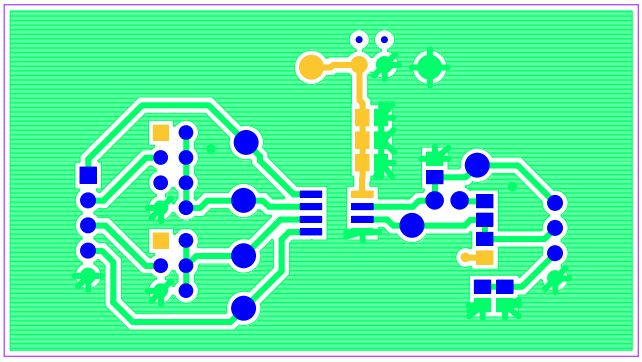

Figure 13. Top Layer

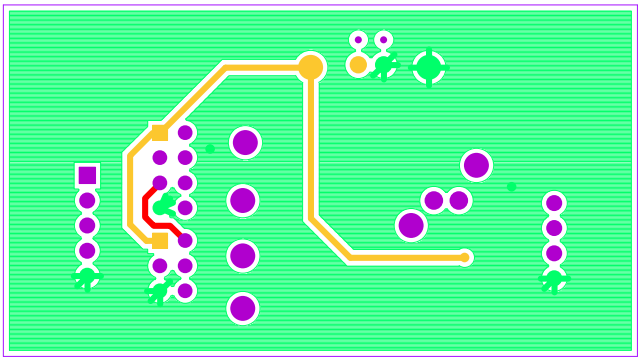

Figure 14. Bottom Layer

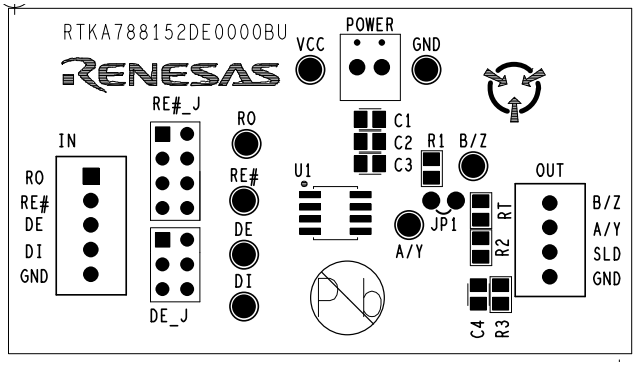

Figure 15. Top Silkscreen

3. Ordering Information

Part Number	Description
RTKA788152DE0000BU	RAA788152 Evaluation Board

4. Revision History

Revision	Date	Description
1.00	Oct 6, 2021	Initial release

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