Notes and Precautions for Use

When you are using this product, you will need to accept the following:

- This reference board is intended for implementation study and initial performance evaluation for the development of functional safety-compliant motor drive and safety remote I/O function. It is not intended to be built into or integrated into the target products. Do not use the reference board for purposes other than those for which it was intended.

- The specifications of and information on this board do not guarantee the acquisition of a certificate of target functional safety standards. This board is designed for various preliminary studies and functional safety evaluation; some parts of it have redundant functions and it includes structures such as jumper blocks, so it is not suitable for functional safety applications.

- Please note that the power supply is not included in this product. Please prepare it separately.

- The CE mark on this product indicates conformance with EMC directive "2014/30/EU" and certified as "EN 55032: 2015+A11:2020" and "EN 55035: 2017+A11:2020". The UKCA mark on this product indicates conformance with Electromagnetic Compatibility Regulations "2016 No.1091" and certified as "BS EN 55032: 2015+A11:2020" and "BS EN 55035: 2017+A11:2020". The length of connection cables must be 3 meters at maximum to meet the standard.

- The product is classified as Class-A (CE: EN 55032: 2015+A11:2020, UKCA : BS EN 55032: 2015+A11:2020). Operation of this product in a residential area is likely to cause radio frequency interferences. The customer is responsible for correctly and safely handling this board in accordance with the law of your country (region).

- Unlike consumer electronic products, this product does not have protective housing because it has been developed for engineering applications. Steps must be taken against generation of static electricity. The connectors and devices must not be touched by bare hands. This board must be used by people who have a good knowledge of the risks involved in handling devices.

- In no event, Renesas Electronics Corporation will be liable for any problems resulting from the use of this product.

- All descriptions in this document are information at the time it is issued, and are subject to change without notice.

- This document must not be copied or reproduced without the permission of Renesas.

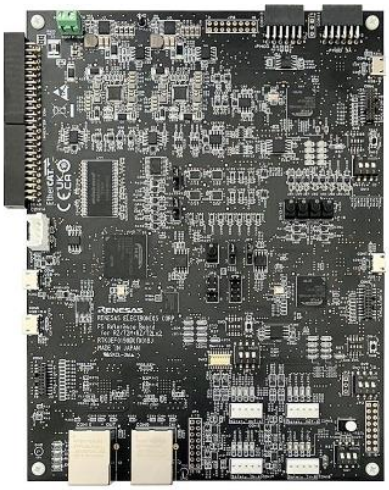
Table of Contents

1. Introduction

1.1 Package Contents

This product contains the following items (as shown in Figure 1.1.1). Please contact your sales retailer if something is missing.

Reference Board



CD-R

Includes:
- Reference Board users manual (This document)
- China RoHS hazardous substance table

Figure 1.1.1 Package Contents

1.2 Power Supply

This product contains no power supply. It should be prepared by the user. Although power lines on the board are filtered, please be careful about the noise coming in from power source and do not propagate it to the power supply section of the microprocessor.

This board cannot be powered on and off by the on-board switch. The board must be powered on and off from the regulated power supply.

Figure 1.2.1 shows specifications of power supply connector.

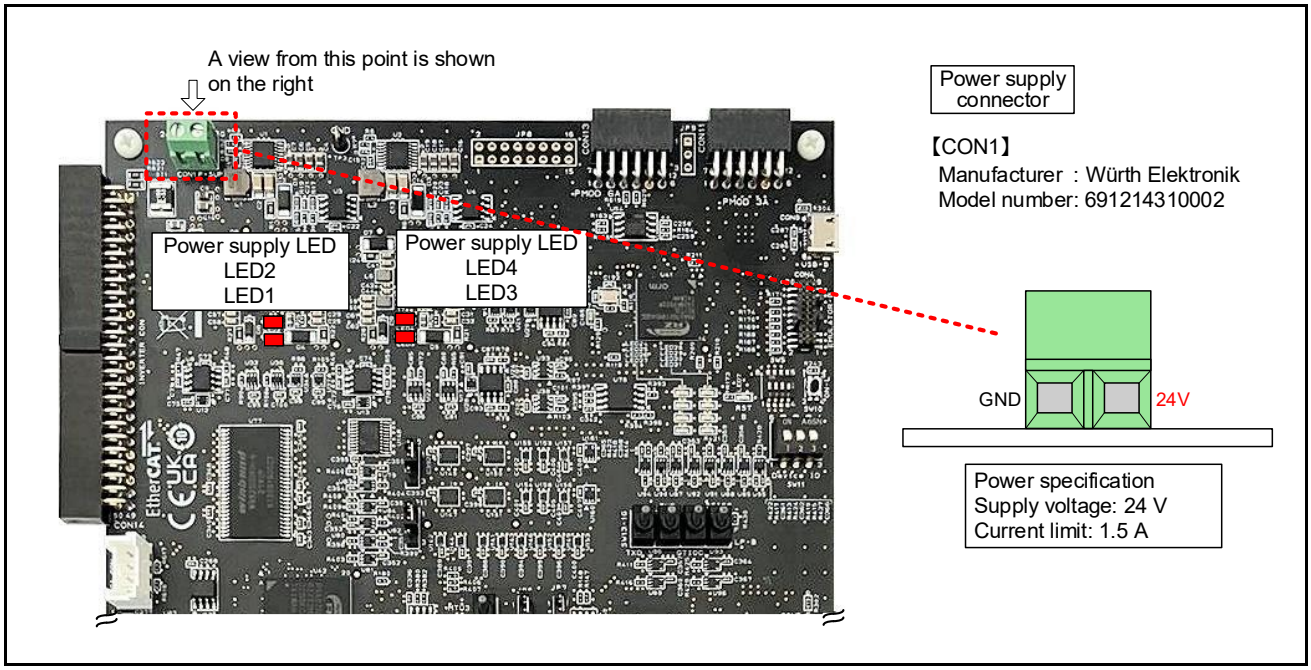


Figure 1.2.1 Power Supply Connector

[Power on procedures]

1. Turn off the power supply output of the regulated power supply.
2. Connect the power supply connector (CON1) to the regulated power supply.
3. Set the voltage output of regulated power supply to 24 V and turn on the power supply output.
4. Make sure that all 4 LEDs (LED1 - 4) are lit. *

*: If any of LEDs does not illuminate, turn the power off immediately.

2. Reference Board Overview

This reference board is intended for implementation study and initial performance evaluation for the development of functional safety motor drive and safety remote I/O function.

2.1 Key Features

This reference board has the following features:

- Two units of Renesas RZ MPU (RZ/T2L) that achieve HFT (Hardware Fault Tolerance) = 1 architecture to perform functional safety processing
- Renesas RZ MPU RZ/T2M (x1) which can be used as a motor controller and EtherCAT/Ethernet communication controller
- Dual-channel RJ45 connector, 10Base-T/100Base-TX Ethernet PHY for Ethernet communication
- Connector for connection to the Renesas RZ/T Series Inverter Board (Type name: RTK0EM0000B15010BJ)
- HFT=1-compliant UVW shutoff circuit for realization of functional safety motor drive
- Safety input and output circuits compliant with HFT=1 for realization of safety remote I/O
- JTAG connector allows connection to emulator for software development
- Status indicator LEDs (Power supply LEDs, reset LEDs, software control LEDs)

2.2 Appearance

Figure 2.2.1 shows the appearance of the board.

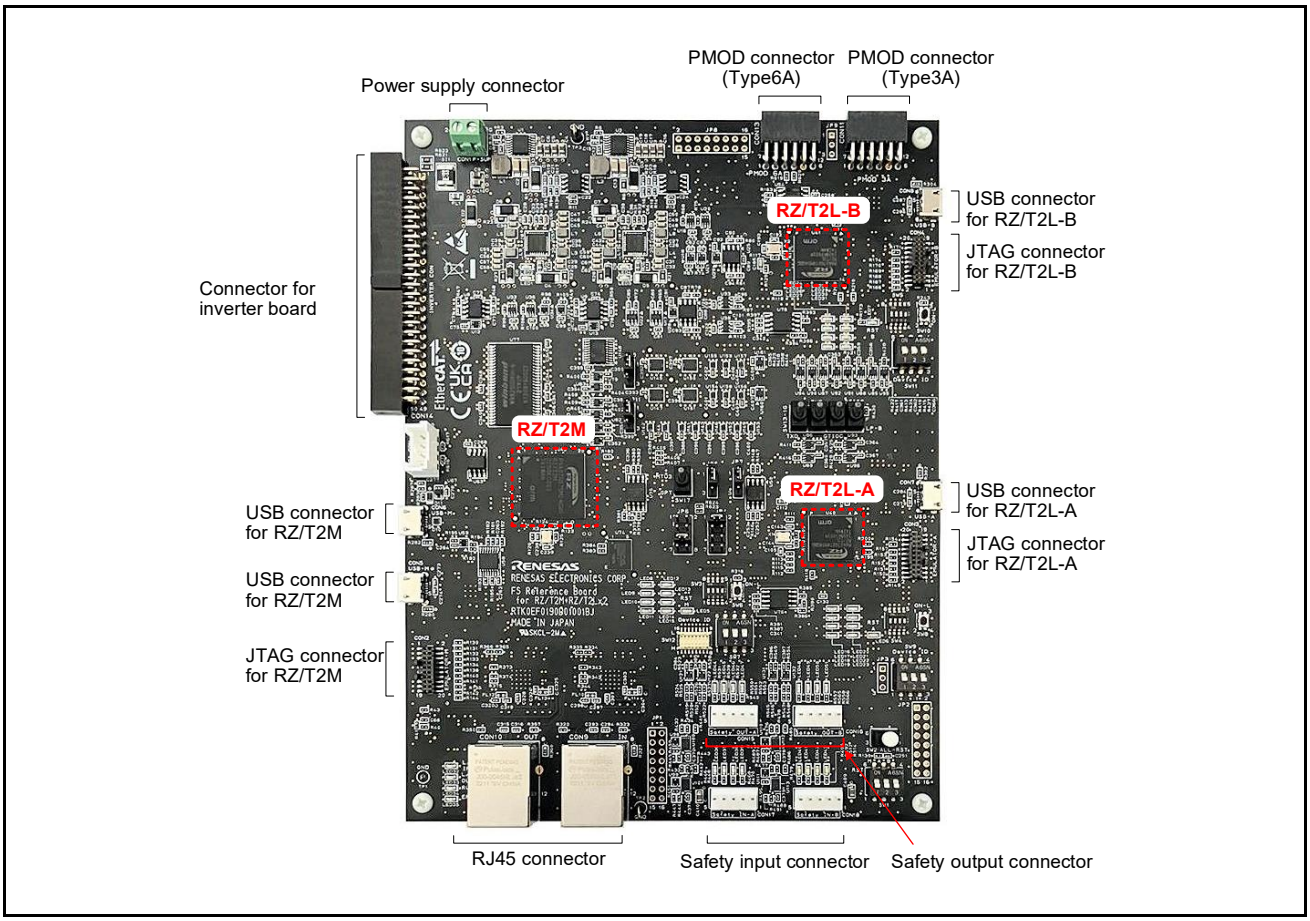


Figure 2.2.1 Functional Safety Reference Board (C Side Up)

2.3 Configuration Example

Figure 2.3.1 shows configuration example for software development.

- All three RZ MPUs provide JTAG connector which allows connection to I-Jet emulator.
- Three RZ MPUs can be reset at once and individually. The power supplied to three RZ MPUs cannot be turned on and off individually. If you want to power off each RZ MPU individually, use individual reset and maintain the reset state.

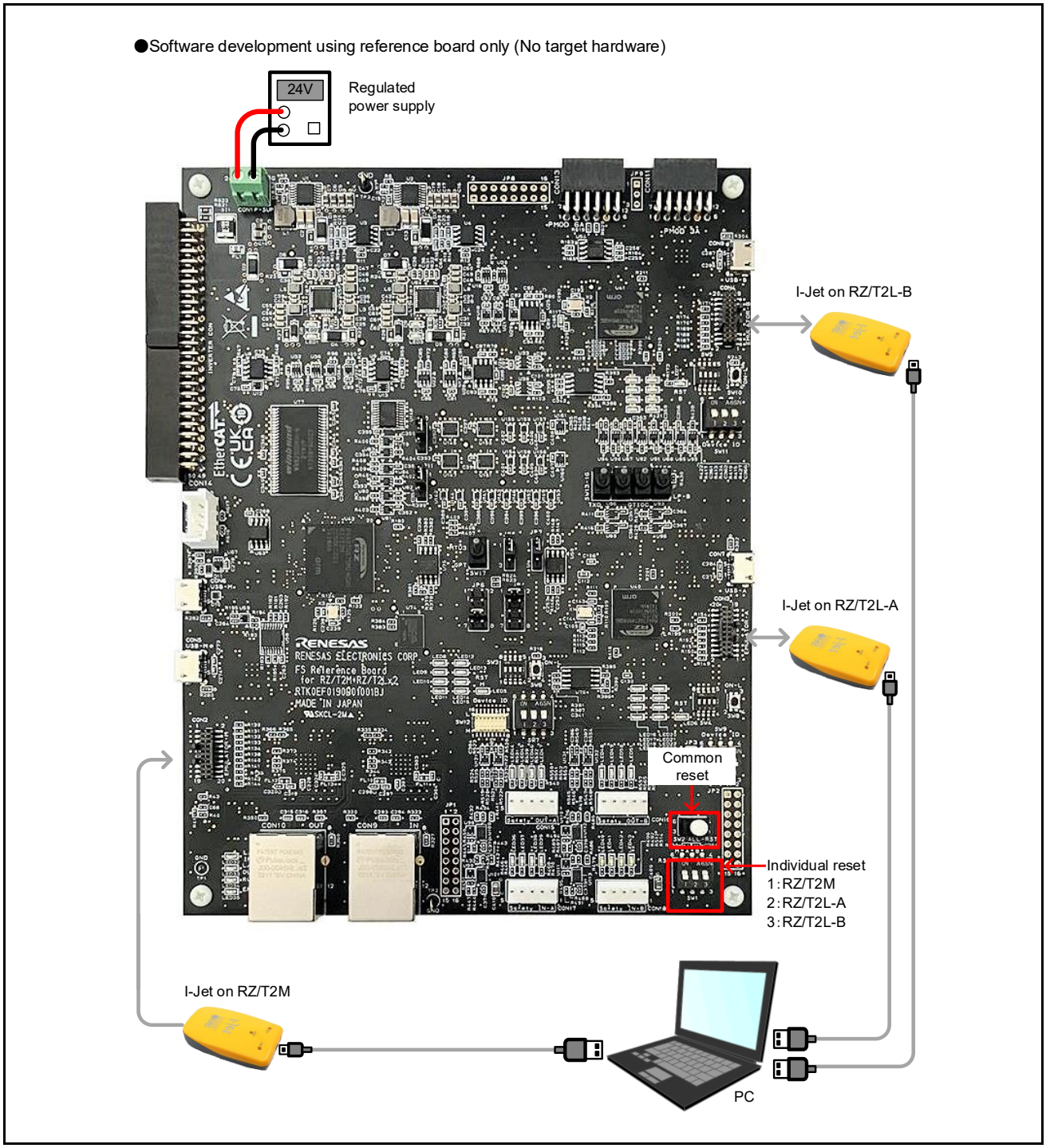


Figure 2.3.1 Configuration Example

Figure 2.3.2 shows system configuration example to use this board as a functional safety-compliant motor drive. RZ/T2M ports (timer, encoder interface, A/D converter) are connected to the connector for inverter board.

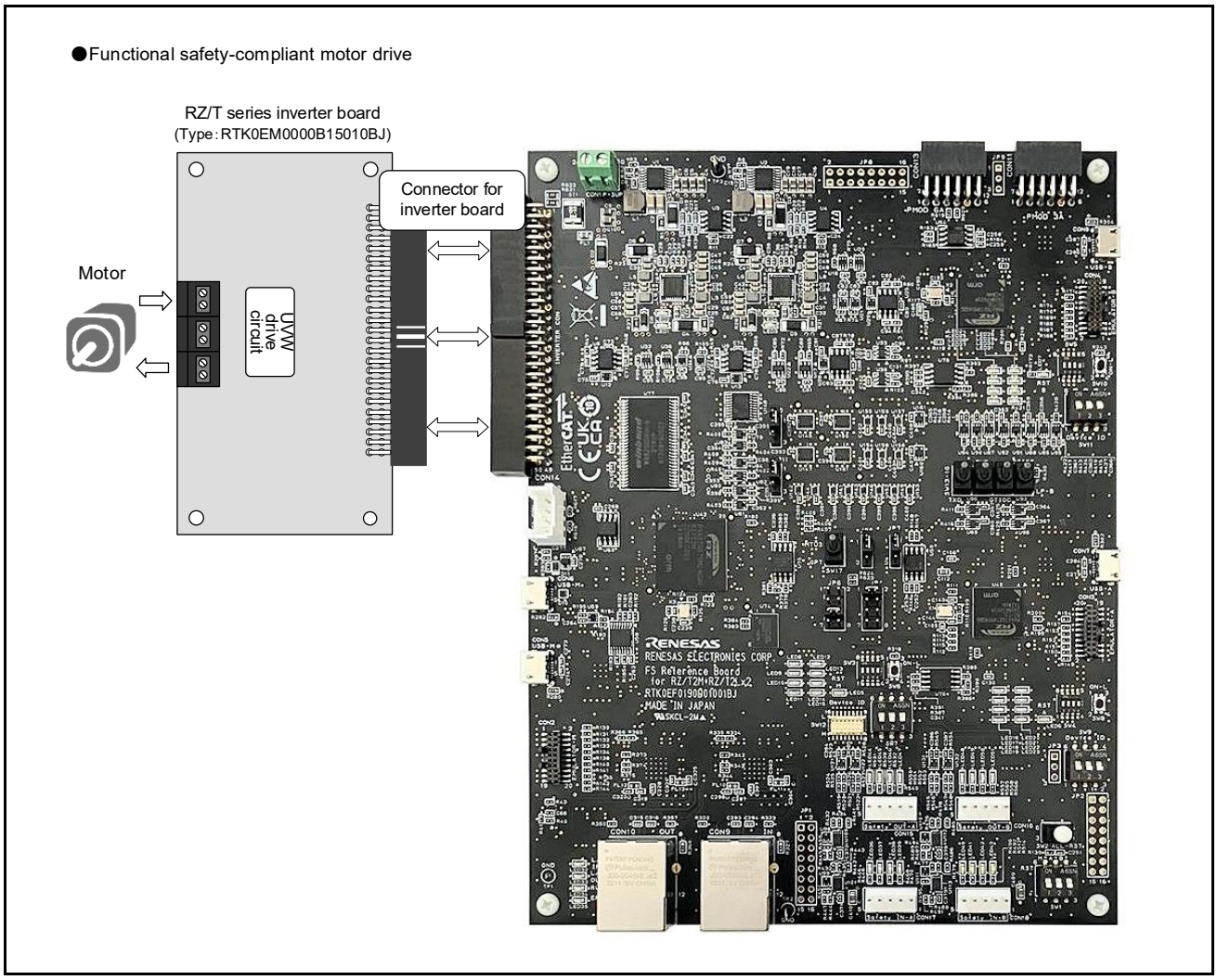


Figure 2.3.2 Configuration Example of Functional Safety-Compliant Motor Drive

2.4 Reference Board Specifications

Figure 2.4.1 shows block diagram of this reference board. Table 2.4.1 to Table 2.4.3 show specifications of this reference board. Please note that the block diagram is intended to show connection between parts on the board and not to reflect actual layout.

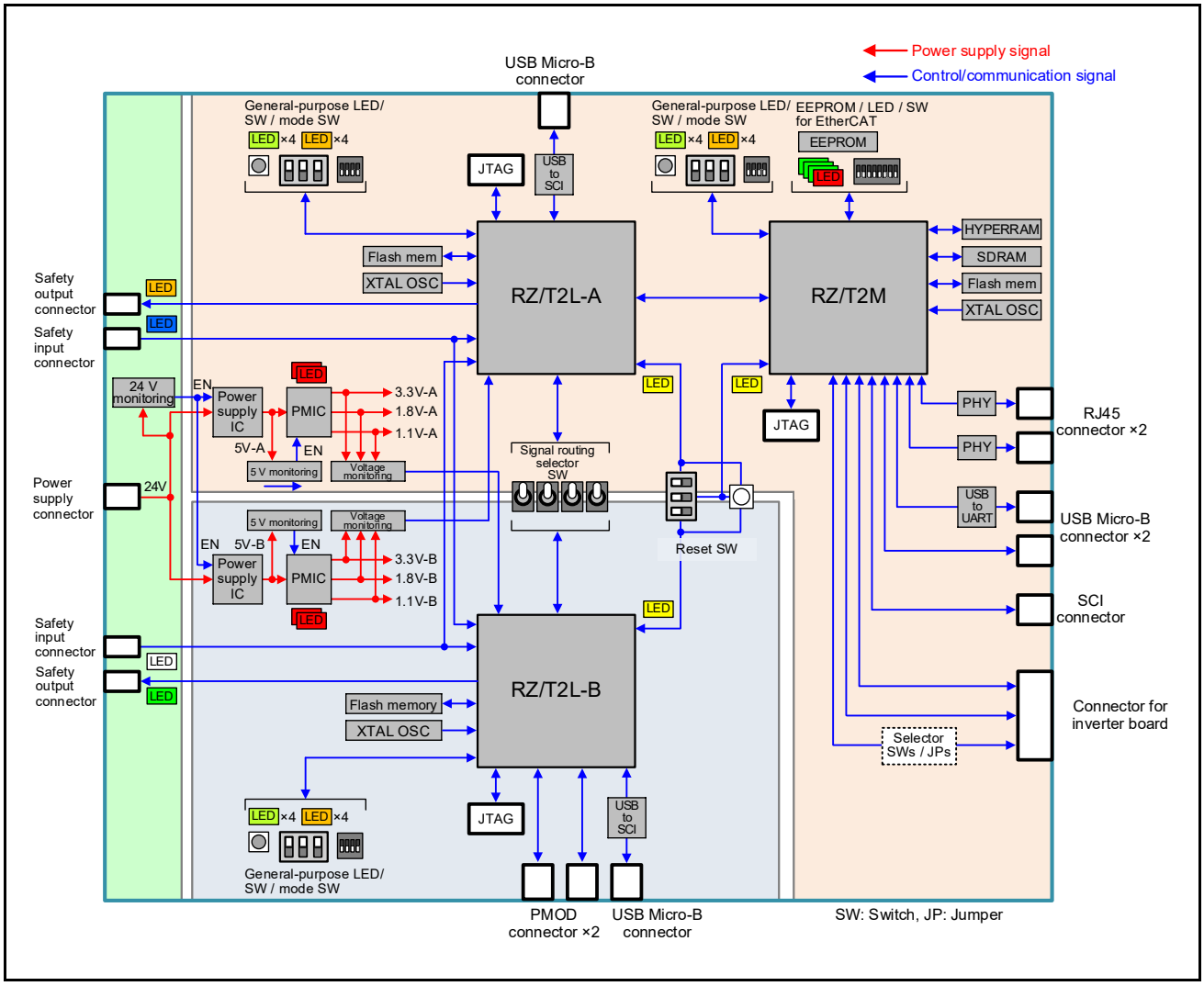


Figure 2.4.1 Block Diagram of Functional Safety Reference Board

Table 2.4.1 Functional Safety Reference Board Specifications (1)

Category	Description
MPU	Renesas Electronics RZ/T2M (×1)
	●Type name : R9A07G075M24GBG (Security function not supported) ●CPU maximum operation frequency: CPU0 800 MHz, CPU1 800 MHz ●Package : 320 pin FBGA (17×17mm) ●Memory size : CPU0-ATCM 512Kbyte, CPU0-BTCM 64 KBytes, system SRAM 2 MBytes ●Boot mode : xSPI0 boot mode (×1 boot serial flash) only
	Renesas Electronics RZ/T2L (× 2)
	●Type name : R9A07G074M04GBG (Security function not supported) ●CPU maximum operation frequency : 800 MHz ●Package : 196 pin FBGA (12 × 12mm) ●Memory size : ATCM 512 KBytes, BTCM 64 KBytes, system SRAM 1 Mbyte ●Boot mode : xSPI0 boot mode (×1 boot serial flash) only
External memory	Renesas Electronics' serial flash memory
	●Type name : AT25SF128A ●Memory size : 128 Mbits ●Package : 8-lead, 208-mil Wide Plastic Gull Wing Small Outline Package EIAJ SOIC
	HYPERRAM from Infenion Technologies
	●Type name : S70KL1282 ●Memory size : 128 Mbits ●Package : 24-ball FBGA (6 × 8mm)
	SDRAM from Winbond Electronics
	●Type name : W9825G6KH ●Memory size : 256 Mbits ●Package : TSOP II 54-pin, 400 mil (22×10mm)
MPU power supply and Power supply for peripheral circuit	Renesas Electronics' DC/DC converter and PMIC
	●Generates dual 5 V power supply from 24 V input using dual DC/DC converters (RAA211250GSP) ●Generates dual power supply for redundant system (3.3 V, 1.8 V, 1.1 V) using dual PMCIs (DA9080-61FCB2) ●Implements circuit that shuts off DC/DC converter output when 24 V DC falls below 19 V ●Implements circuit that shuts off PMIC output when voltage generated by DC/DC converter falls below 4.5 V ●Implements IC that monitors voltage generated by PMIC (3.3 V, 1.8 V, 1.1 V) ●Implements test circuit that changes reference voltage of voltage monitoring IC
PHY power supply	Renesas Electronics' DC/DC converter
	●Generates power supply for Ethernet PHY (2.5 V and 1.0 V) using DC/DC converter (ISL8088IRZ)
Ethernet communication	●RZ/T2M internal Ethernet module realizes Ethernet communication and EtherCAT * slave communication ●RJ45 connector, 10Base-T/100Base-TX Ethernet PHY are available in 2ch
UVW shutoff circuit	●HFT=1-compliant circuit to shutoff control signals of three-phase inverter (U_P/U_N, V_P/V_N, W_P/W_N) ●Signal path fault detection function

*: EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Table 2.4.2 Functional Safety Reference Board Specifications (2)

Category	Description	
I/O circuit	Safety input	●Channels: 4 ●Signal voltage: 24 V ●HFT＝1 compliant input circuit ●Signal path fault detection function
	Safety output	●Channels: 4 ●Signal voltage: 24 V ●HFT＝1 compliant output circuit ●Signal path fault detection function
Switch	This reference board implements the following switches: ●Common reset : Resets three RZ MPUs at once ●Individual reset : Performs reset and maintains reset state for individual RZ MPU ●General-purpose (Push) : General-purpose switch connected to ports and external interrupt pins on the RZ MPU One implemented for each RZ MPU ●General-purpose (Slide × 8) : General-purpose switch connected to ports on the RZ/T2M ●General-purpose (Slide × 3) : General-purpose switch connected to ports on the RZ MPU One implemented for each RZ MPU ●Cross-monitoring signal selector : Switch to change destination of communication signal and timer signal connected between RZ/T2Ls ●V_N/W_P controller signal swap : Switch to swap the V_N controller signal of the three-phase inverter circuit into the W_P controller signal (and vice versa) ●Boot mode selector : Switch to change signal level of boot mode selector pins (MD0 - MD2) *	
LED	This reference board implements the following LEDs: ●Power supply : Red × 4 (Two for RZ/T2M and RZ/T2L-A, two for RZ/T2L-B) ●Reset : Yellow × 3 (one each for RZ/T2M, RZ/T2L-A and RZ/T2L-B) ●General-purpose : Yellow-green × 12 (Four for RZ/T2M, four for RZ/T2L-A, four for RZ/T2L-B) Orange × 12 (Four for RZ/T2M, four for RZ/T2L-A, four for RZ/T2L-B) ●Safety input : White × 4 (for pins 2-5 of CON18) Blue × 4 (for pins 2-5 of CON17) ●Safety output : Green × 4 (for pins 2-5 of CON16) Orange × 4 (for pins 2-5 for CON15) ●EtherCAT : Green × 3 (for EtherCAT-IN, OUT, RUN on RZ/T2M) Red × 1 (for EtherCAT-ERR on RZ/T2M)	

*: Since the AT25SF128A is the only external boot memory (for xSPI0 x1 boot mode), boot mode selector is not available. For this reason, the switches 1-3 must be turned ON (MD [2:0] = 000b) for all SW3 - SW5 when powering ON and releasing reset. Otherwise, the board may be damaged.

Table 2.4.3 Functional Safety Reference Board Specifications (3)

Category	Description	
Jumper	●RZ/T2M pin routing selector	: Selects RZ/T2M pins connected to connector for inverter board (CON14) JP4 GTETRGA / GTETRGB / POE0# / POE10# JP5 MTCLKA / GTIOC6A JP6 GTETRGA / GTETRGB / GTETRGC / MTIOC1A * JP7 MTCLKB / GTIOC7B
	●Shutoff circuit function cancellation selector	: Enables/disables the cancellation of UVW shutoff circuit function
Connector	Power supply	●Dual input power supply connector × 1
	Inverter board	●50-pin connector × 1 For connection to inverter board which controls three-phase motor
	I/O circuit	●For safety input signal × 2 ●For safety output signal × 2
	Ethernet communication	●RJ45 connector × 2 For connection to Ethernet-related modules implemented on RZ/T2M
	USB (Micro-B)	●Micro-B for RZ/T2M × 2 ●Micro-B for RZ/T2L-A × 1 ●Micro-B for RZ/T2L-B × 1 For connection to RZ/T2M on-chip USB module For connection to RZ/T2M on-chip SCI module (via USB-SCI converter IC)
	PMOD	●Type 3A for RZ/T2L-B × 1 ●Type 6A for RZ/T2L-B × 1
	JTAG	●MIPI-20pin for RZ/T2M × 1 ●MIPI-20pin for RZ/T2L-A × 1 ●MIPI-20pin for RZ/T2L-B × 1 For connecting I-Jet available from IAR Systems
	SCI communication	●4-pin connector × 1 For connection to RZ/T2M on-board SCI module
Input power supply and Operating environment	●Voltage: 24 VDC input ●Current: max 1.5 A ●Supplied by: Power supply connector ●Operating ambient temperature: 0-50 ℃	

*: For GTETRGA and GTETRGB, resistor must be implemented for R624 or R623.
If either GTETRGA or GTETRGB is selected for JP6, the same pin must not be selected for JP4.
If selected, the power supply may short-circuit and damage the reference board.

2.5 RZ MPU General-Purpose Port Usage

Table 2.5.1 to Table 2.5.3 show general-purpose port usage of RZ MPU.

: Not available on RZ/T2M and RZ/T2L

NC: Not used (Not connected)

SW: Switch

Table 2.5.1 General-Purpose Port Usage of RZ/T2M

	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
P00	Inverter board (CON14)				Ethernet	SCI2 (CON12)		NC
P01	SPI3 (b/w T2L-A)	General-purpose LED: Yellow-green		Inverter board (CON14)			SDRAM	
P02	JTAG (Emulator connection)				SDRAM	Inverter board	MDW *1	Inverter board
P03	SDRAM				NC	SDRAM		SDRAM
P04	SDRAM				NC	Through hole	SDRAM	
P05	Ethernet			SW6	SDRAM			
P06	Ethernet							
P07	Through hole	General-purpose LED: Yellow-green		USB	Ethernet			
P08	Ethernet				Through hole		NC	Through hole
P09	Ethernet							
P10	SW12-7	SW12-8	Ethernet					
P11	HYPERRAM	Ethernet	Inverter board	Ethernet			Inverter board	Ethernet
P12	HYPERRAM							
P13	Through hole	Inverter board (CON14)		HYPERRAM		Through hole	HYPERRAM	
P14	External Flash		SDRAM	GPIO (b/w T2L-A)			Ethernet	Through hole
P15	External Flash	Inverter board (CON14)				External Flash		
P16	NC	USB-SCI0		NC	Inverter board (CON14)		SPI3 (b/w T2L-A)	
P17	Inverter board (CON14)			NC	Inverter board	GPIO (b/w T2L-A)	NC	USB-SCI0 *2
P18	General-purpose LED Orange		SCI4 (b/w T2L-A)		General-purpose LED Orange		Inverter board (CON14)	
P19	SW12-1	SW12-2	SW12-3	Inverter board	SW12-4	SW12-5	SW12-6	MDV4 *1
P20	Ethernet	EtherCAT						Inverter board
P21	SDRAM							Through hole
P22	SDRAM							
P23	Inverter board	USB-SCI0 *2	SW7-1	SW7-2	SW7-3	SDRAM		
P24						SDRAM	Inverter board (CON14)	

*1: RZ/T2M operation mode selector pin.

*2: Only one of P17_0(CTS0#) and P23_6(RTS0#) can be used.

Table 2.5.2 General-Purpose Port Usage of RZ/T2L-A

	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
P00		Power supply monitoring circuit test			Low voltage monitoring	Power supply monitoring circuit test	High voltage monitoring	Power supply monitoring circuit test
P01	Safety input (CON18)				Safety input (CON17)			
P02	JTAG (Emulator connection)				NC	SCI1 (b/w T2L-B)	MDW *1	SCI1 (b/w T2L-B)
P03								
P04							Through hole	
P05	MD2 *1	Safety output circuit test						
P06	Through hole	SPI1 (b/w T2L-B)			MD0 *1	MD1 *1	Through hole	
P07				NC	SPI0 (b/w T2M)	Shutoff signal		UVW shutoff circuit
P08	SCI2 (b/w T2L-B)	Through hole	SCI2 (b/w T2L-B)	Through hole				
P09	UVW shutoff circuit		Shutoff signal monitor		USB-SCI5 *2	NC		Through hole
P10				SW9-1	SW9-2	SW9-3	SPI1 (b/w T2L-B)	SW8
P11								
P12								
P13	Safety output (CON15)				NC	GPT10 (b/w T2L-B)		
P14	External Flash		Through hole	GPIO (b/w T2M)				Through hole
P15	External Flash	Through hole			NC	External Flash		
P16					Safety input circuit test		SCI0 (b/w T2L-B)	
P17	General-purpose LED: Yellow-green			SPI0 (b/w T2M)	General-purpose LED: Yellow-green			MDD *1
P18		Through hole	SCI4 (b/w T2M)		Through hole			
P19								
P20				MDV3 *1	MDV2 *1			
P21	General-purpose LED Orange		SPI0 (b/w T2M)	USB-SCI5 *2		General-purpose LED Orange		
P22					USB-SCI5	Through hole	SPI0 (b/w T2M)	Through hole
P23	NC							
P24						Safety input circuit test		GPT (b/w T2L-B)

*1: RZ/T2L operation mode selector pin.

*2: Only one of P09_3(RTS5#) and P21_4(CTS5#) can be used.

Table 2.5.3 General-Purpose Port Usage of RZ/T2L-B

	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
P00		Power supply monitoring circuit test			Low voltage monitoring	Power supply monitoring circuit test	High voltage monitoring	Power supply monitoring circuit test
P01	Safety input (CON17)				Safety input (CON18)			
P02	JTAG (Emulator connection)				Through hole	SCI1 (b/w T2L-A)	MDW *1	SCI1 (b/w T2L-A)
P03								
P04							Through hole	
P05	MD2 *1	Safety output circuit test						
P06	Through hole	SPI1 (b/w T2L-A)			MD0 *1	MD1 *1	Through hole	PMOD Type3A (CON11) *3
P07				NC	Through hole	Shutoff signal		UVW shutoff circuit
P08	SCI2 (b/w T2L-A)	Through hole	SCI2 (b/w T2L-A)	Through hole				
P09	UVW shutoff circuit		Shutoff signal monitor		USB-SCI5 *2	NC		Through hole
P10				SW11-1	SW11-2	SW11-3	SPI1 (b/w T2L-A)	SW10
P11								
P12								
P13	Safety output (CON16)				Through hole	GPT10 (b/w T2L-A)		
P14	External Flash		Through hole		PMOD Type3A (CON11)			
P15	External Flash	PMOD Type6A (CON13)				External Flash		
P16					Safety input circuit test		SCI0 (b/w T2L-A)	
P17	General-purpose LED: Yellow-green			Through hole	General-purpose LED: Yellow-green			MDD *1
P18		PMOD Type6A (CON13)	PMOD Type3A (CON11)		Through hole	PMOD Type6A (CON13)	Through hole	
P19								
P20				MDV3 *1	MDV2 *1			
P21	General-purpose LED Orange		Through hole	USB-SCI5 *2		General-purpose LED Orange		
P22					USB-SCI5	Through hole	PMOD Type3A (CON11) *3	Through hole
P23	Through hole							
P24						Safety input circuit test		GPT (b/w T2L-A)

*1: RZ/T2L operation mode selector pin.

*2: Only one of P09_3(RTS5#) and P21_4(CTS5#) can be used.

*3: Only one of P06_0(RTS4#) and P22_1(CTS4#) can be used.

3. Reference Board Features Description

3.1 Power Supply Configuration

Figure 3.1.1 shows the power supply configuration of this reference board.

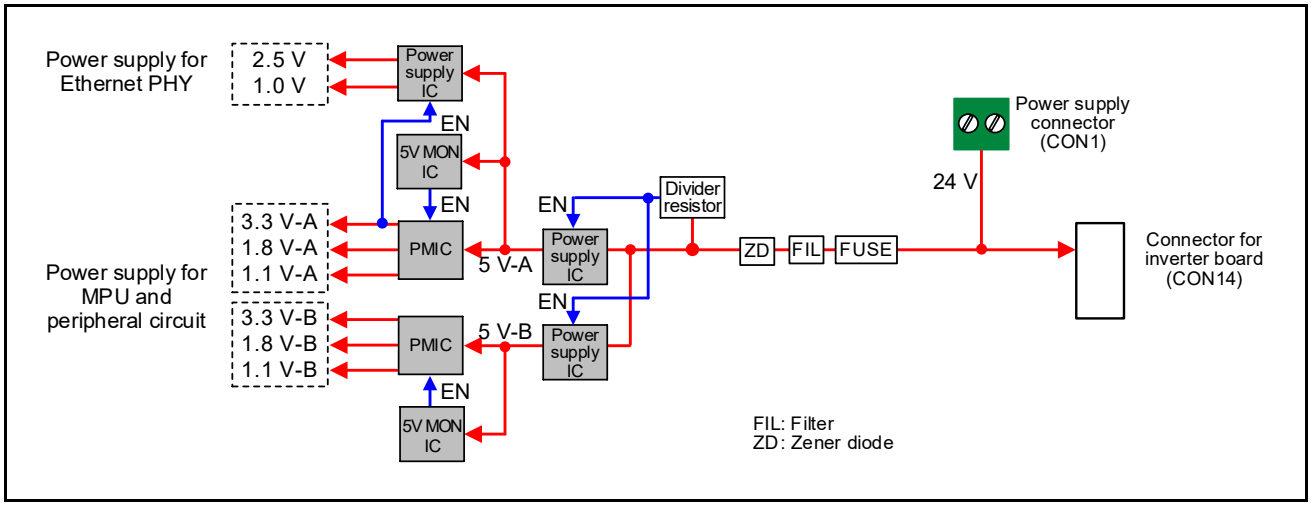


Figure 3.1.1 Functional Safety Reference Board - Power Supply Configuration

Power is supplied to the board from the power supply connector (CON1). The power supply is protected by fuse, filter and Zener diode. Dual 5V power supply is generated from 24V input. Dual power supply for MPU, peripheral circuit (3.3 V, 1.8 V, 1.1 V) and Ethernet PHY (2.5 V, 1.0 V) are generated from dual 5V.

[Notes on connectors]

This board cannot be powered on and off by the on-board switch. The board must be powered on and off from the regulated power supply.

3.2 24 V Power Supply Monitoring

The reference board has a function to monitor 24 V power supply which generates 5 V power supply (5V-A / 5V-B). 5 V power output is shut off when input power voltage falls below 19 V. 5 V power output starts again when input power voltage rises above 21 V.

3.3 5 V Power Supply Monitoring

This reference board has a function to monitor 5 V power supply (5V-A / 5V-B) consumed by MPU and peripheral circuits. Power supply to MPU and peripheral circuit is terminated if voltage falls below 4.5 V and power supply monitoring IC finds it. When the voltage rises above 4.7 V, power supply to MPU and peripheral circuit starts again.

3.4 MPU Power Supply Monitoring

This reference board has a function to monitor voltages consumed by RZ MPU (3.3 V, 1.8 V, 1.1 V), using power supply monitoring IC. Both high and low voltage thresholds are monitored.
Figure 3.4.1 shows configuration of MPU power supply monitoring circuit.

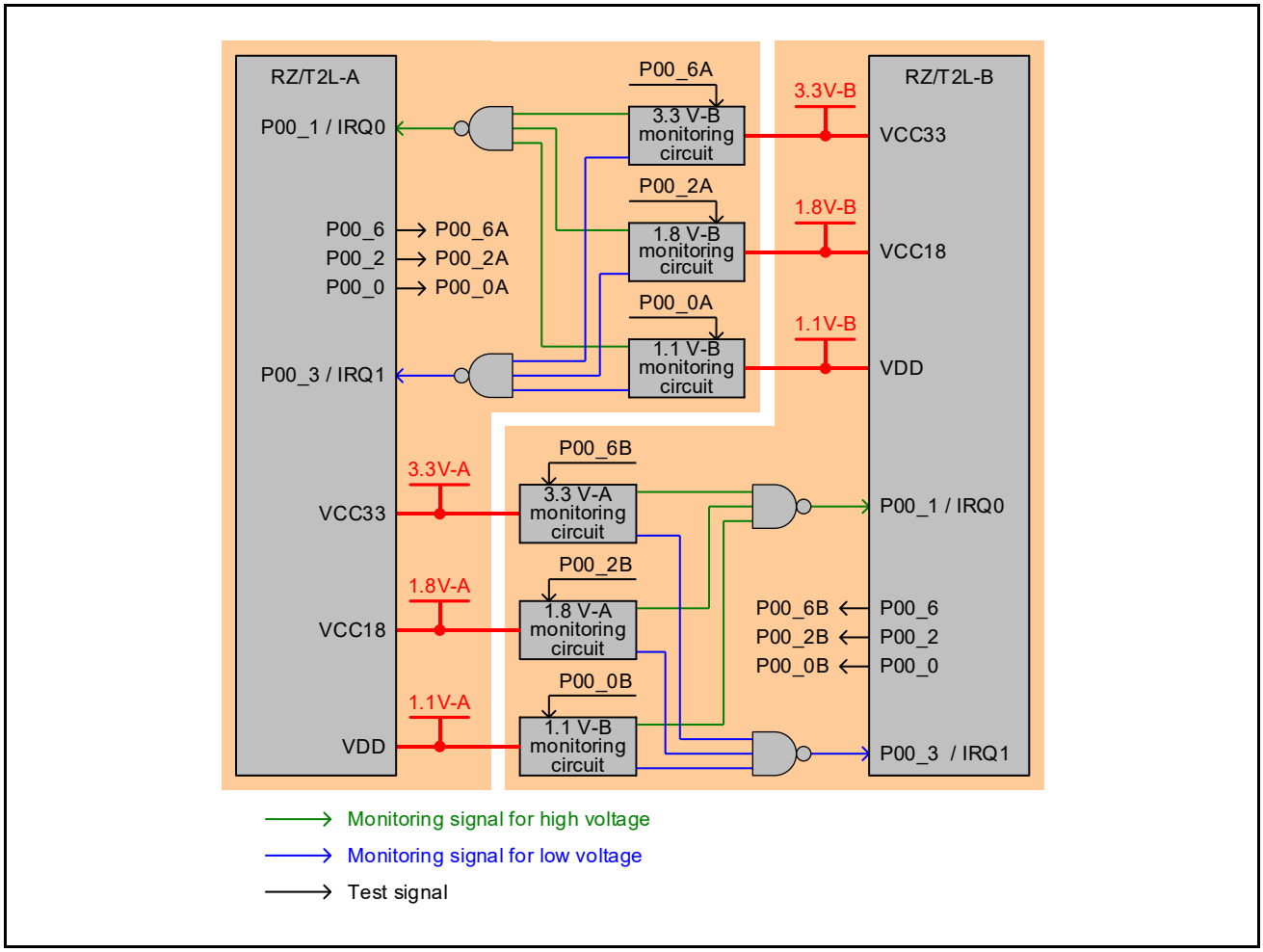


Figure 3.4.1 Configuration of MPU Power Supply Monitoring Circuit

Signal level is "H" when output voltage is normal, "L" when abnormal. As monitoring signal is processed at NAND gate, when the voltage is abnormal, "H" level is input to voltage monitoring port (P00_1, P00_3).

This board has a function to change the voltage to be monitored via RZ/T2L general-purpose ports (P00_6 / P00_2 / P00_0) to cause output signal from voltage monitoring circuit to change to "L" level. This allows the user to detect output signal faults (i.e. stuck-at and short).
Table 3.4.1 to Table 3.4.3 show output values of voltage monitoring circuit.

Table 3.4.1 3.3 V Voltage Monitoring Circuit Output Values

	Voltage	3.3 V power supply monitoring circuit output value	
		During normal operation (P00_6 = "L")	During test (P00_6 = "H")
High voltage monitoring signal		L	L
	3.55 V		
		L or H *	L
	3.40 V		
	:		
	Normal range	H	L
	:		
Low voltage monitoring signal	:		
	Normal range	H	L
	:		
	3.20 V		
		L or H *	L
	3.05 V		
		L	L

*: Output may vary depending on part precision and environmental conditions (e.g. temperature).

Table 3.4.2 1.8 V Voltage Monitoring Circuit Output Values

	Voltage	1.8 V power supply monitoring circuit output value	
		During normal operation (P00_2 = "L")	During test (P00_2 = "H")
High voltage monitoring signal		L	L
	2.00 V		
		L or H *	L
	1.90 V		
	:		
	Normal range	H	L
	:		
Low voltage monitoring signal	:		
	Normal range	H	L
	:		
	1.75 V		
		L or H *	L
	1.65 V		
		L	L

*: Output may vary depending on part precision and environmental conditions (e.g. temperature).

Table 3.4.3 1.1 V Voltage Monitoring Circuit Output Values

	Voltage	1.1 V power supply monitoring circuit output value	
		During normal operation (P00_0 = "L")	During test (P00_0 = "H")
High voltage monitoring signal		L	L
	1.25 V		
		L or H *	L
	1.15 V		
	:		
	Normal range	H	L
	:		
Low voltage monitoring signal	:		
	Normal range	H	L
	:		
	1.05 V		
		L or H *	L
	0.95 V		
		L	L

*: Output may vary depending on part precision and environmental conditions (e.g. temperature).

3.5 Singal Connection between MPUs

Figure 3.5.1 shows signal connection between RZ MPUs mounted on this reference board.

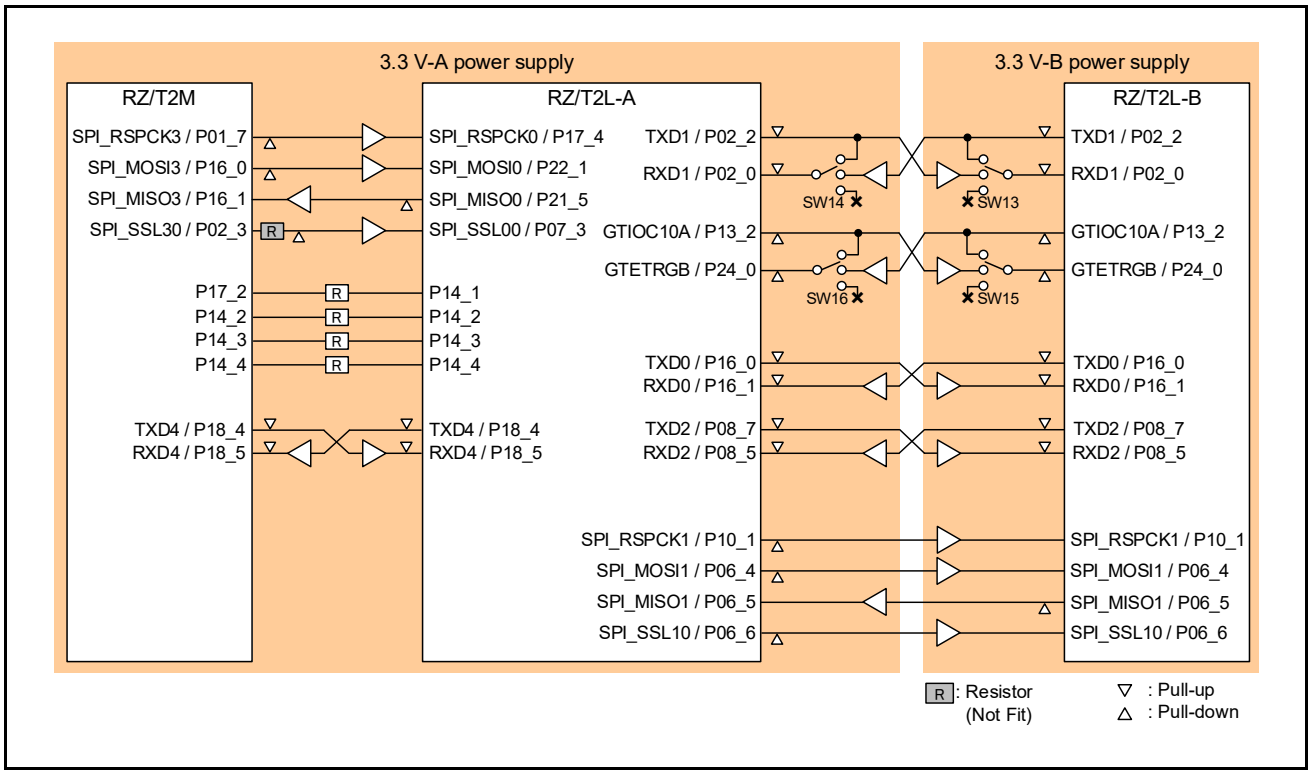


Figure 3.5.1 Signal Connection between RZ MPUs

[Between RZ/T2M and RZ/T2L-A]

- The following serial communication signals are connected between RZ/T2M and RZ/T2L-A. SPI communication is available with RZ/T2M as master and RZ/T2L-A as slave.
  - SCI 1ch (RZ/T2M: SCI4, RZ/T2L-A: SCI4)
  - SPI 1ch (RZ/T2M: SPI3, RZ/T2L-A: SPI0)

- Function for connecting signals to four general-purpose ports is available.

[Between RZ/T2L-A and RZ/T2L-B]

- The following serial communication signals and timer signals between RZ/T2L-A and RZ/T2L-B. A signal routing selector switch is inserted to the SCI1 serial communication path and GPT timer signal path. See Table 4.2.3 for details about switch settings.
  - SCI 3ch (SCI0 - SCI2)
  - SPI 1ch (SPI1)
  - GPT output (GTIOC10A)
  - GPT input (GTETRGB)

3.6 UVW Shutoff Circuit

This reference board provides an HFT=1-compliant circuit to shutoff control signals of three-phase inverter (U_P, V_P, W_P, U_N, V_N, W_N).

Figure 3.6.1 shows the configuration of UVW shutoff circuit. Table 3.6.1 shows usage of general-purpose ports on RZ/T2L. See Table 4.2.4, Table 4.3.9 and Table 4.3.10 for SW17 and JP10/JP11.

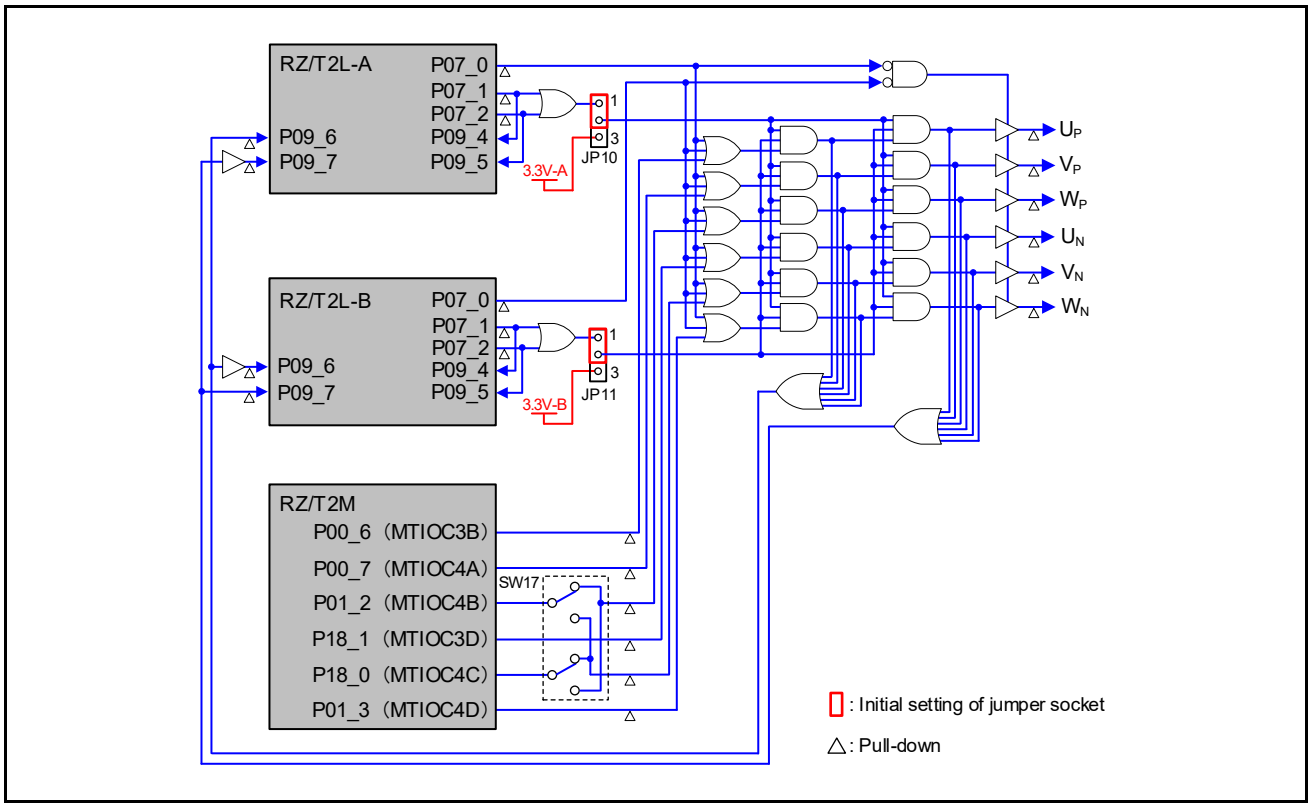


Figure 3.6.1 UVW Shutoff Circuit

Table 3.6.**1** Usage of General-Purpose Ports on RZ/T2L

Port	Application	Description
P07_0	Test EN signal	This port is used during initial setting (on startup) to test shutoff circuit. By setting output level of this port to "H", "H" signal is output from the 3-input OR gate and output level of three-phase inverter control signals becomes "L".
P07_1, P07_2	Safety control signal	These ports are used to shut of three-phase inverter control signal. By setting output level of both ports to "L", "L" signal is output from the AND gate and three-phase inverter control signals are shut off.
P09_4, P09_5	Safety control signal monitor	These ports are used to monitor safety control signal.
P09_6, P09_7	UVW signal monitor	This ports are used to monitor the UVW signals output from the AND gates. Input level is set to "L" on both ports when signal is shut off by safety control signal.

[Initial setting]

On RZ/T2L under test, confirm that input monitor of UVW signal indicates "L" by setting two safety control signal output to "L" and the test EN signal output to "H". By doing this, faults on the shutoff signal path (i.e., stuck-at and short) can be detected.

Note that, on the RZ/T2L not tested, safety control signal output must be set to "H". Also note that the test cannot be performed on two RZ/T2Ls at the same time.

[Setting during normal operation]

By setting the safety control signal output of dual RZ/T2L to "H" and the test EN signal output to "L", three-phase inverter control signal outputs remain the same as the RZ/T2M port output.

[Setting during tests]

On the RZ/T2L, set either one of the safety control signals to "L" and the other to "H", and the other way around, to confirm that safety control signal level is as expected on the safety control signal monitor. By doing this, faults on the safety control signal path (i.e., stuck-at and short) can be detected. Note that three-phase inverter controller signal outputs remain the same as the RZ/T2M port output.

3.7 Safety Input Circuit

This reference board has a 4-channel safety input circuit compliant with HFT=1 configuration.

Figure 3.7.1 shows the configuration of safety input circuit.

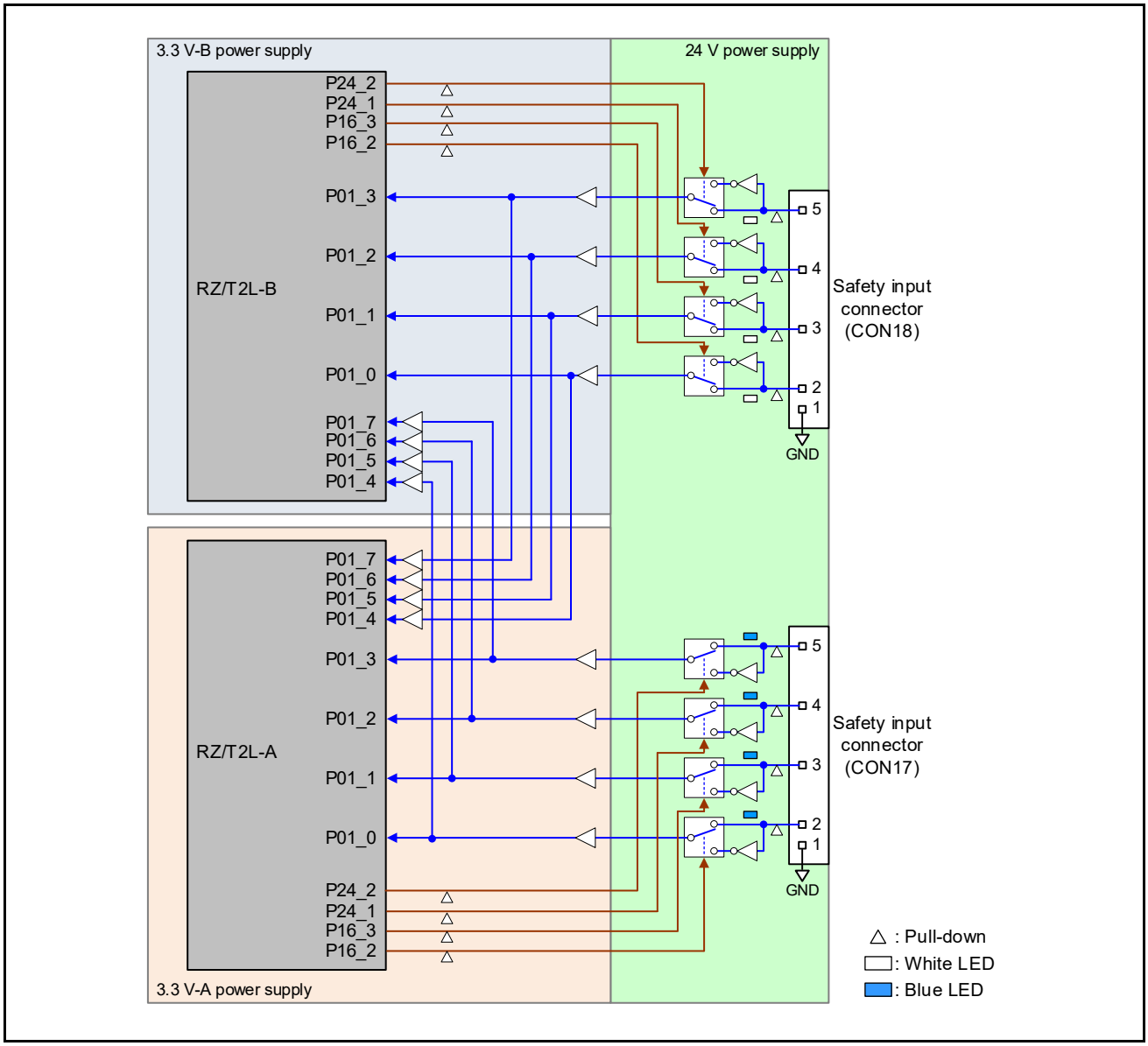


Figure 3.7.1 Safety Input Circuit Configuration

Signal input from the connector is connected to both RZ/T2Ls through the buffer. Users can monitor the level of signal input from the connector (H or L) by LED.

During normal operation, outputs of general-purpose ports on RZ/T2L (P24_2 / P24_1 / P16_3 / P16_2) shall be "L" level. Changing outputs of these ports to "H" inverses the signal input to the buffer (dashed lines in the figure). This feature allows users to detect safety input signal faults (i.e. stuck-at and short). Note that the connector input level LED stays the same if signal input to the buffer (dashed lines in the figure) is inverted.

Table 3.7.1 shows RZ/T2L port mapping for safety input connector.

Table 3.7.1 RZ/T2L Ports Mapping for Safety Input Connector

Connector		Input port		Output port for testing During normal operation: "L", During test: "H"
		RZ/T2L-A	RZ/T2L-B	
CON18	5-pin	P01_7	P01_3	RZ/T2L-B: P24_2
	4-pin	P01_6	P01_2	RZ/T2L-B: P24_1
	3-pin	P01_5	P01_1	RZ/T2L-B: P16_3
	2-pin	P01_4	P01_0	RZ/T2L-B: P16_2
CON17	5-pin	P01_3	P01_7	RZ/T2L-A: P24_2
	4-pin	P01_2	P01_6	RZ/T2L-A: P24_1
	3-pin	P01_1	P01_5	RZ/T2L-A: P16_3
	2-pin	P01_0	P01_4	RZ/T2L-A: P16_2

3.8 Safety Output Circuit

The reference board has a 4-channel safety output circuit compliant with HFT=1 configuration.

Figure 3.8.1 shows the configuration of safety output circuit.

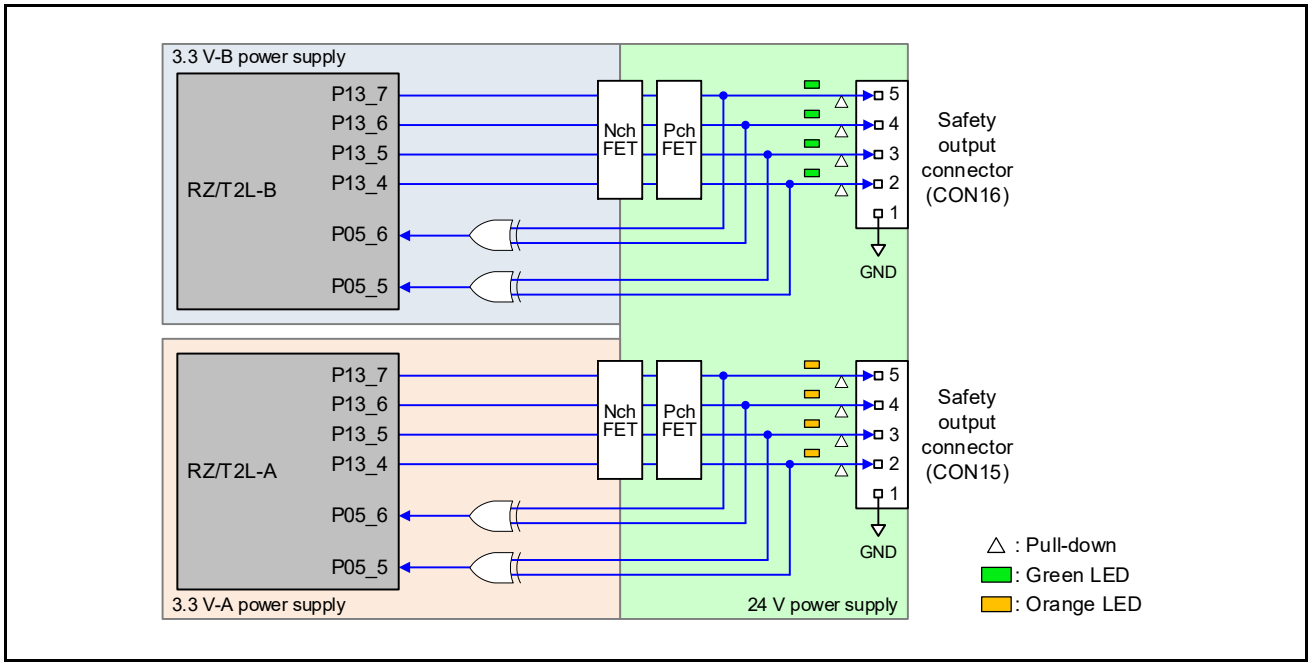


Figure 3.8.1 Safety Output Circuit Configuration

Port output on RZ/T2L is connected to safety output connector through the FET. Users can monitor the level of signal output from the connector (H or L) by LED.

Signals to safety output connector are combined into two pairs, passed through XOR gate, and looped-back to RZ/T2L general-purpose ports (P05_6 / P05_5). This feature allows users to detect safety output signal faults (i.e. stuck-at and short).

Table 3.8.1 shows RZ/T2L port mapping for safety output connector.

Table 3.8.1 RZ/T2L Ports Mapping for Safety Output Connector

Connector		Output port		Input port for testing
		RZ/T2L-A	RZ/T2L-B	
CON16	5-pin	-	P13_7	RZ/T2L-B: P05_6
	4-pin	-	P13_6	
	3-pin	-	P13_5	RZ/T2L-B: P05_5
	2-pin	-	P13_4	
CON15	5-pin	P13_7	-	RZ/T2L-A: P05_6
	4-pin	P13_6	-	
	3-pin	P13_5	-	RZ/T2L-A: P05_5
	2-pin	P13_4	-	

3.9 Ethernet

This reference board has an Ethernet communication and EtherCAT slave communication function using RZ/T2M on-chip Ethernet communication module.

Figure 3.9.1 shows the outline of Ethernet communication circuit.

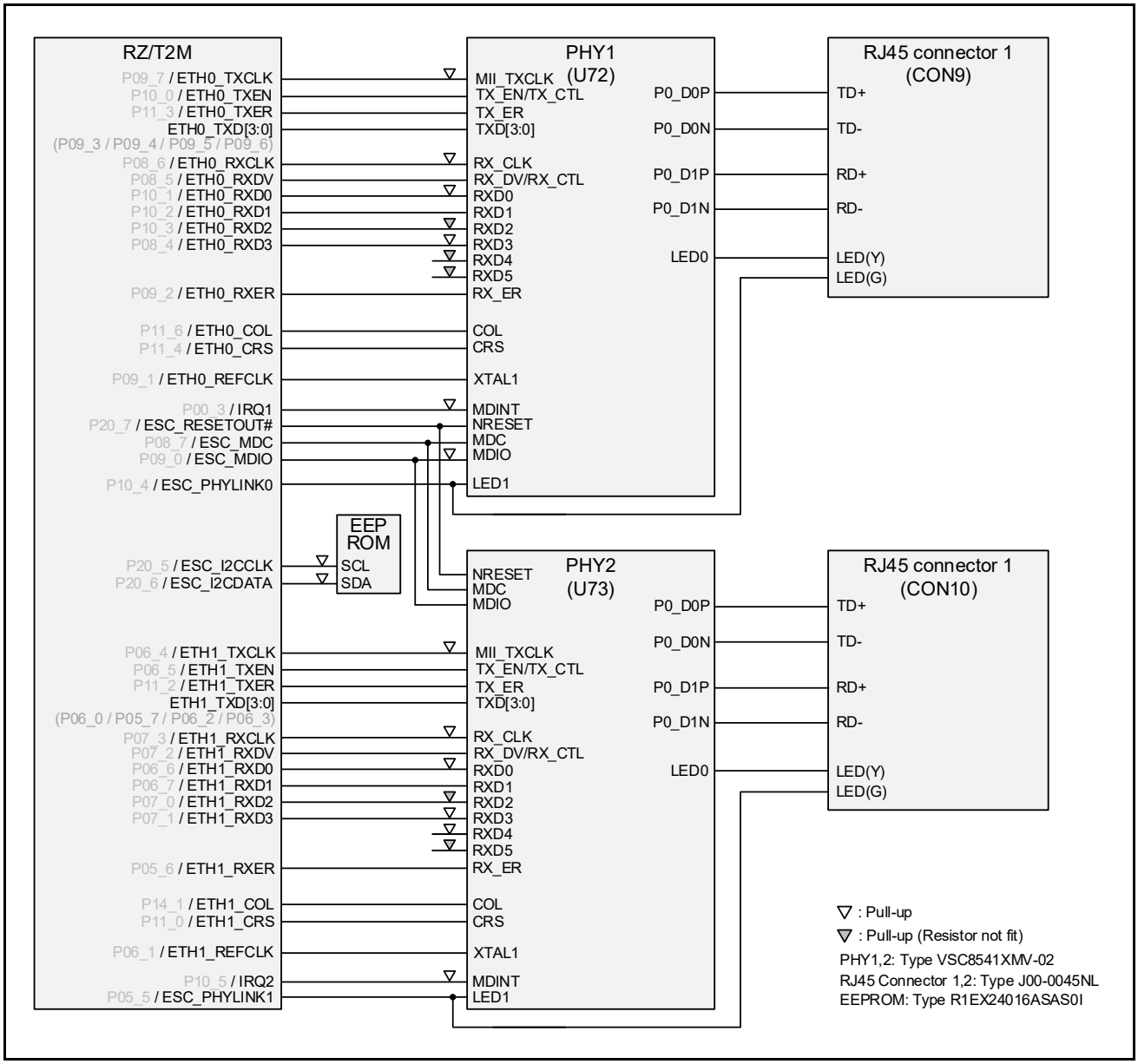


Figure 3.9.1 Ethernet Communication Circuit

[PHY default setting]

Device operation mode : Unmanaged mode

PHY address : PHY1→0, PHY2→1 (Not changeable from default)

Interface : GMII/MII mode

Link Advertisement : 10/100 FDX/HDX, auto-neg ON (disable 1000BT advertisements)

4. Connectors/Test Pins/Switches/Jumpers/LEDs

4.1 Connectors and Test Pins

Figure 4.1.1 shows placement of connectors and test pins on the board.

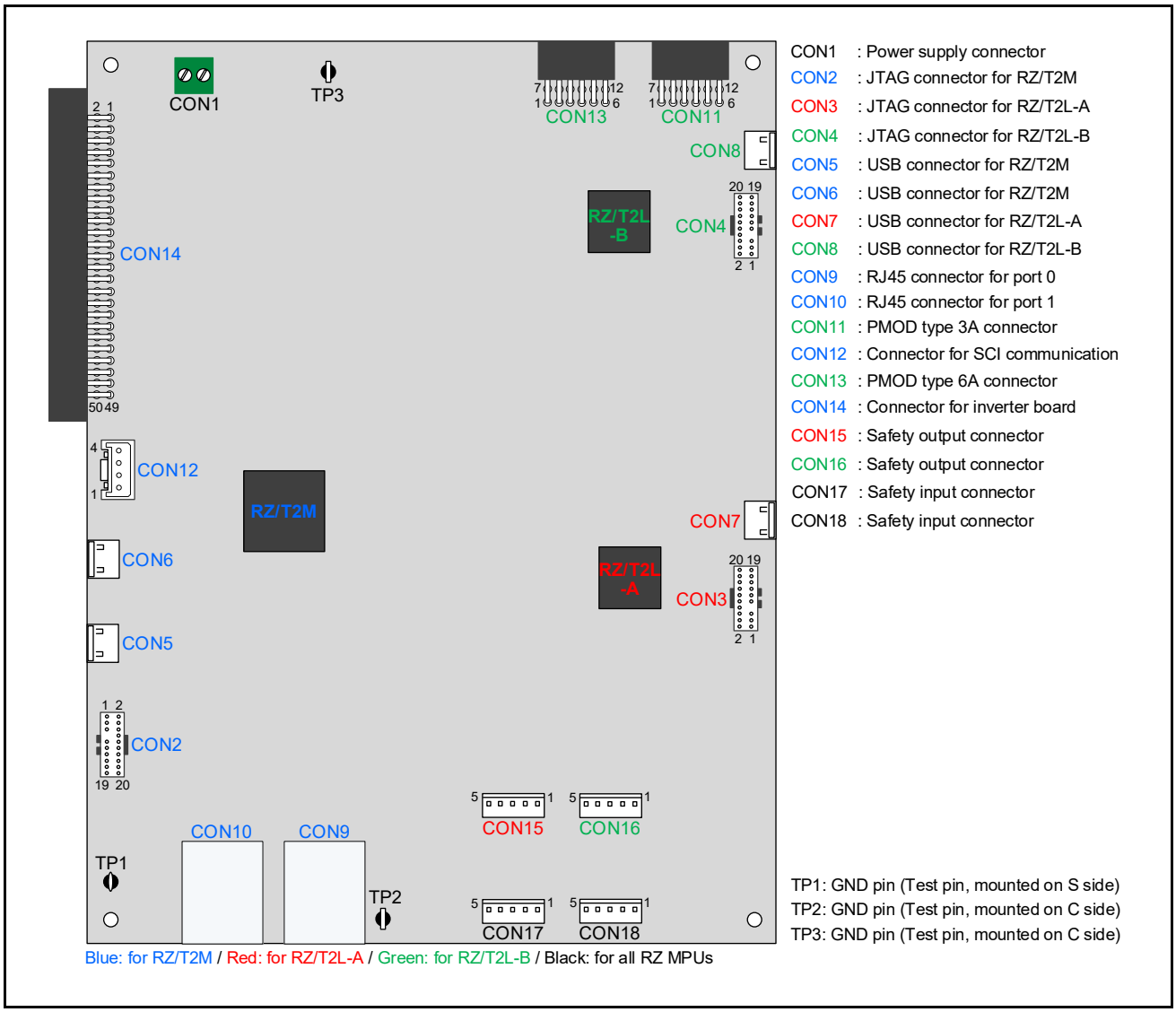


Figure 4.1.1 Functional Safety Reference Board - Connectors and Test Pins (C Side Up)

[Notes on connectors]

1. Do not plug in/out the cables to/from the connectors and do not detach the board while power is applied to the reference board.
2. Do not supply the power from IAR Systems I-Jet Emulator to the reference board when connecting I-Jet from CON2 to CON4.
3. When connecting USB cable from CON5 to CON8, plug the cable into the connector on the board first, apply the power to the board, and then plug the cable into PC. When disconnecting USB cable, detach the cable from the PC first, turn the board OFF, and then detach the cable from the board.

Table 4.1.1 to Table 4.1.8 show connector - pin mapping.

- "I" or "O" in the "Direction" column means signal direction on the basis of the reference board (I = input, O = output)
- "I/O" in the "Direction" column shows signal direction differs depending on the board usage or application programs.
- "P.U." and "P.D." in the table stands for pull-up and pull-down respectively. The "-" means no processing is performed.

Table 4.1.1 Pin Mapping for PMOD Type 3A Connector (CON11)

No.	Connector pin	Pin on RZ/T2L-B	I/O	P.U./P.D.	No.	Connector pin	Pin on RZ/T2L-B	I/O	P.U./P.D.
1	CTS4#_B	P22_1 (CTS4#) *	I/O	-	7	P14_3_B	P14_3	I/O	-
2	TXD4_B	P18_4 (TXD4)	I/O	-	8	P14_2_B	P14_2	I/O	-
3	RXD4_B	P18_5 (RXD4)	I/O	-	9	P14_1_B	P14_1	I/O	-
4	RTS4#_B	P06_0 (RTS4#) *	I/O	-	10	P14_0_B	P14_0	I/O	-
5	GND	-	-	-	11	GND	-	-	-
6	VDD3.3V_B	-	O	-	12	VDD3.3V_B	-	O	-

*: Only one of RTS4# and CTS4# can be used.

Table 4.1.2 Pin Mapping for SCI Communication Connector (CON12)

No.	Connector pin	Pin on RZ/T2M	I/O	P.U./P.D.
4	VDD3.3V_A_M	-	O	-
3	TXD2_M	P00_2 (TXD2)	I/O	P.U
2	RXD2_M	P00_1 (RXD2)	I/O	P.U
1	GND	-	-	-

Table 4.1.3 Pin Mapping for PMOD Type 6A Connector (CON13)

No.	Connector pin	Pin on RZ/T2L-B	I/O	P.U./P.D.	No.	Connector pin	Pin on RZ/T2L-B	I/O	P.U./P.D.
1	NC	-	-	-	7	P15_6_B	P15_6	I/O	-
2	NC	-	-	-	8	P15_5_B	P15_5	I/O	-
3	IIC_SCL2_B	P18_6 (IIC_SCL2)	I/O	P.U	9	P15_4_B	P15_4	I/O	-
4	IIC_SDA2_B	P18_2 (IIC_SDA2)	I/O	P.U	10	P15_3_B	P15_3	I/O	-
5	GND	-	-	-	11	GND	-	-	-
6	VDD3.3V_B	-	O	-	12	VDD3.3V_B	-	O	-

Table 4.1.4 Pin Mapping for Connector for Inverter Board (CON14)

No.	Connector pin	Pin on RZ/T2M	I/O	P.U./P.D.	No.	Connector pin	Pin on RZ/T2M	I/O	P.U./P.D.
1	VCCINV24V	-	O	-	2	VCCINV24V	-	O	-
3	VCCINV24V	-	O	-	4	VCCINV24V	-	O	-
5	GND	-	-	-	6	GND	-	-	-
7	GND	-	-	-	8	GND	-	-	-
9	AN003_M	AN003	I	-	10	NC	-	-	-
11	VDD1.8V_A_M	-	O	-	12	GND	-	-	-
13	AN000_M	AN000	I	-	14	AN001_M	AN001	I	-
15	AN002_M	AN002	I	-	16	GND	-	-	-
17	VDD3.3V_A_M	-	O	-	18	VDD3.3V_A_M	-	O	-
19	GND	-	-	-	20	GND	-	-	-
21	MCLK0_M	P00_4 (MCLK0)	I/O	-	22	MDAT0_M	P00_5 (MDAT0)	I/O	-
23	MCLK1_M	P15_3 (MCLK1)	I/O	-	24	MDAT1_M	P15_4 (MDAT1)	I/O	-
25	MCLK2_M	P15_5 (MCLK2)	I/O	-	26	MDAT2_M	P15_6 (MDAT2)		
27	GND	-	-	-	28	UP_INV_CON	P00_6 (MTIOC3B, GTIOC1A)	O	P.D
29	UN_INV_CON	P18_1 (MTIOC3D, GTIOC1B)	O	P.D	30	VP_INV_CON	P00_7 (MTIOC4A, GTIOC2A)	O	P.D
31	VN_INV_CON *1	P18_0 (MTIOC4C, GTIOC3A) P01_2 (MTIOC4B, GTIOC2B)	O	P.D	32	WP_INV_CON *1	P18_0 (MTIOC4C, GTIOC3A) P01_2 (MTIOC4B, GTIOC2B)	O	P.D
33	WN_INV_CON	P01_3 (MTIOC4D, GTIOC3B)	O	P.D	34	GND	-	-	-
35	OC-DET *2	P23_7 (GTETRGA) P24_0 (GTETRGB) P01_4 (POE0#) P02_2 (POE10#)	I/O	-	36	GND	-	-	-
37	INC-A *2	P13_5 (MTCLKA) P19_4 (GTIOC6A)	I/O	-	38	INC-B *2	P13_6 (MTCLKB) P20_0 (GTIOC7B)	I/O	-
39	INC-Z *2	P23_7 (GTETRGA) P24_0 (GTETRGB) P24_1 (GTETRGC) P11_1 (MTIOC1A)	I/O	-	40	GND	-	-	-
41	ENCIF4_M	P16_3 (ENCIF4)	I/O	-	42	ENCIF3_M	P16_2 (ENCIF3)	I/O	-
43	ENCIF2_M	P02_0 (ENCIF2)	I/O	-	44	ENCIF0_M	P11_5 (ENCIF0)	I/O	-
45	GND	-	-	-	46	ENCIF9_M	P17_7 (ENCIF9)	I/O	-
47	ENCIF8_M	P17_6 (ENCIF8)	I/O	-	48	ENCIF7_M	P17_5 (ENCIF7)	I/O	-
49	ENCIF5_M	P17_3 (ENCIF5)	I/O	-	50	GND	-	-	-

*1: For RZ/T2M pins that support 31-pin and 32-pin, either P18_0 or P01_2 is the corresponding port, depending on the SW17 setting.

*2: One of the listed ports is supported depending on the jumper setting.

Table 4.1.5 Pin Mapping for Safety Output Connector (CON15)

No.	Connector pin	Pin on RZ/T2L-A	Pin on RZ/T2L-B	I/O	P.U./P.D.
5	SAFETY_OUT4_A	P13_7	-	O	P.D
4	SAFETY_OUT3_A	P13_6	-	O	P.D
3	SAFETY_OUT2_A	P13_5	-	O	P.D
2	SAFETY_OUT1_A	P13_4	-	O	P.D
1	GND	-	-	-	-

Table 4.1.6 Pin Mapping for Safety Output Connector (CON16)

No.	Connector pin	Pin on RZ/T2L-A	Pin on RZ/T2L-B	I/O	P.U./P.D.
5	SAFETY_OUT4_B	-	P13_7	O	P.D
4	SAFETY_OUT3_B	-	P13_6	O	P.D
3	SAFETY_OUT2_B	-	P13_5	O	P.D
2	SAFETY_OUT1_B	-	P13_4	O	P.D
1	GND	-	-	-	-

Table 4.1.7 Pin Mapping for Safety Input Connector (CON17)

No.	Connector pin	Pin on RZ/T2L-A	Pin on RZ/T2L-B	I/O	P.U./P.D.
5	SAFETY_IN4_A	P01_3	P01_7	I	P.D
4	SAFETY_IN3_A	P01_2	P01_6	I	P.D
3	SAFETY_IN2_A	P01_1	P01_5	I	P.D
2	SAFETY_IN1_A	P01_0	P01_4	I	P.D
1	GND	-	-	-	-

Table 4.1.8 Pin Mapping for Safety Input Connector (CON18)

No.	Connector pin	Pin on RZ/T2L-A	Pin on RZ/T2L-B	I/O	P.U./P.D.
5	SAFETY_IN4_B	P01_7	P01_3	I	P.D
4	SAFETY_IN3_B	P01_6	P01_2	I	P.D
3	SAFETY_IN2_B	P01_5	P01_1	I	P.D
2	SAFETY_IN1_B	P01_4	P01_0	I	P.D
1	GND	-	-	-	-

[Notes on USB connector]

USB connectors CON5, CON7, CON8 are connected to the SCI on the RZ MPU (SCI0 for RZ/T2M, SCI5 for RZ/T2L-A, SCI5 for RZ/T2L-B) via the USB-SCI converter IC.

[Notes on cables]

No connector cables are included in the accessories. Please purchase commercially available cable.

Table 4.1.9 provides reference type numbers for sockets and pin headers for corresponding connectors.

Table 4.1.9 Sockets and Pin Headers

CON	Connector	Corresponding socket / pin header	
		Type number	Manufacturer
2 - 4	JTAG connector	IAR Systems I-jet MIPI-20pin	
5 - 8	USB connector	Micro-B standard product	
9, 10	RJ45 connector	RJ45 (Plug) standard product	
11, 13	PMOD connector	TSW-106-08-L-D-RA	Samtec
12	Connector for SCI communication	511630400	Molex
14	Connector for inverter board	SBH11-PBPC-D25-RA-BK	Sullins
15, 16	Safety output connector	H5P-SHF-AA	JST
17, 18	Safety input connector	H5P-SHF-AA	JST

[Notes on test pins]

GND test pins (TP1 - TP3) are placed on the left end and in the center of the PCB. TP1 is implemented on S side and TP2, TP3 on C side.

4.2 Switch

Figure 4.2.1 shows placement of switches on the board.

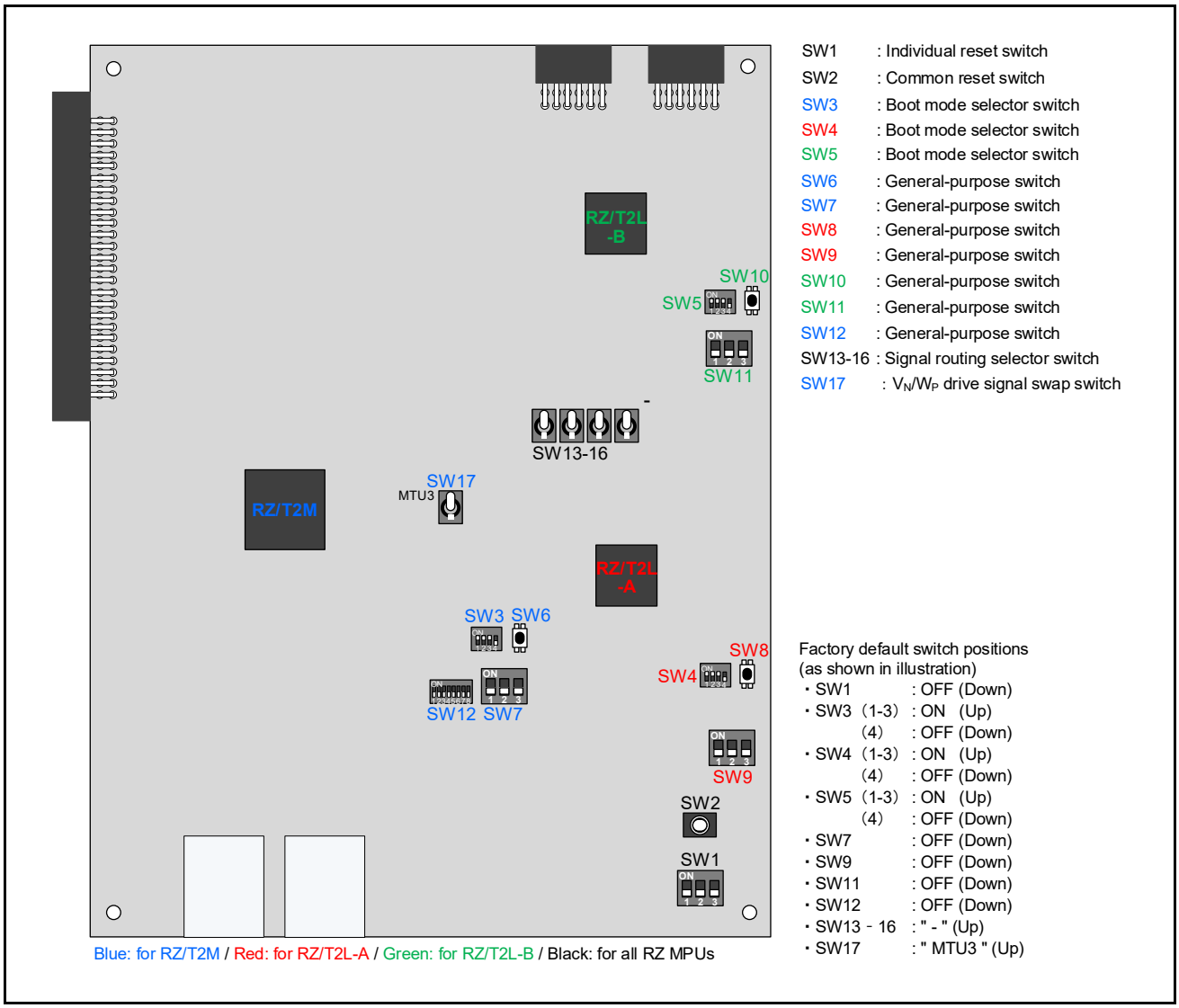


Figure 4.2.1 Functional Safety Reference Board - Switches (C Side Up)

[Reset: SW1, SW2]

The reference board has synchronous and individual reset switches. Synchronous reset switch resets three RZ MPUs at once while individual reset switch resets the RZ MPU individually.

Pressing down SW2 resets all RZ MPUs at once. After releasing the pressing, the reset state will be released in a given time.

SW1-1 resets the RZ/T2M, SW1-2 resets the RZ/T2L-A and SW1-3 resets the RZ/T2L-B. Turning the switch ON resets the corresponding RZ MPU. SW1 is slider dip switch, so reset state can be maintained.

Reset LED (LED5, LED6, LED7) illuminate when synchronous and individual resets are performed.

[Boot mode selector switch: SW3 - SW5]

SW3 - SW5 select boot mode of RZ MPUs by switching signal level of boot mode selector pins (MD0 - MD2). Since the AT25SF128A is the only external boot memory (for xSPI0 x1 boot mode), boot mode selector is not available. For this reason, the switches 1-3 must be turned ON (MD [2:0] = 000b) when powering ON and releasing reset. Otherwise, the board may be damaged.

[General-purpose switch: SW7, SW9, SW11, SW12]

SW7, SW9, SW11, SW12 are slider switches.

Table 4.2.1 shows RZ MPU input port mapping for SW7, SW9, SW11, SW12.

Table 4.2.1 RZ MPU Input Port Mapping for SW7, SW9, SW11, SW12

Switch		Input port	Corresponding MPU	Input signal level
SW7	1	P23_5	RZ/T2M	Switch OFF = "H" Switch ON = "L"
	2	P23_4		
	3	P23_3		
SW9	1	P10_4	RZ/T2L-A	
	2	P10_3		
	3	P10_2		
SW11	1	P10_4	RZ/T2L-B	
	2	P10_3		
	3	P10_2		
SW12	1	P19_7	RZ/T2M	
	2	P19_6		
	3	P19_5		
	4	P19_3		
	5	P19_2		
	6	P19_1		
	7	P10_7		
	8	P10_6		

[General-purpose switch: SW6, SW8, SW10]

SW6, SW8, SW10 are push button switches.

Table 4.2.2 shows RZ MPU input port mapping for SW6, SW8, SW10.

Table 4.2.2 RZ MPU Input Port Mapping for SW6, SW8, SW10

Switch	Input port	Corresponding MPU	Input signal level
SW6	P05_4 (IRQ12)	RZ/T2M	Switch OFF = "H" Switch ON = "L"
SW8	P10_0 (IRQ15)	RZ/T2L-A	
SW10	P10_0 (IRQ15)	RZ/T2L-B	

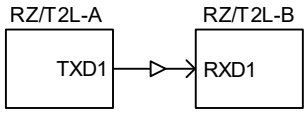
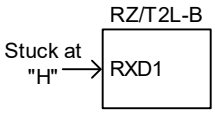
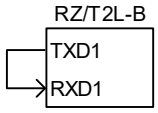
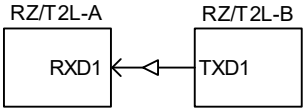
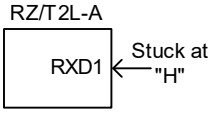
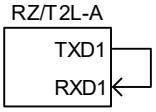
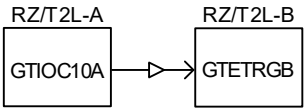
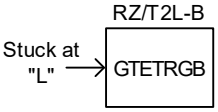
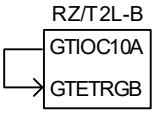
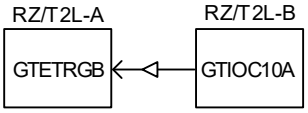
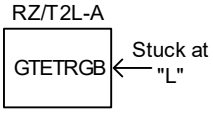
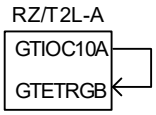
[Signal routing selector switch: SW13 - SW16]

SW13 - SW16 select connection type of communication signal (SCI) and timer signal (GPT) between RZ/T2Ls.
The following connection types are available. Set switches appropriately depending on the usage of the board.

- Normal connection
- Pseudo stuck-at fault
- Loop-back connection

Table 4.2.3 shows setting specifications of signal routing selector switch.

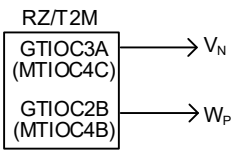
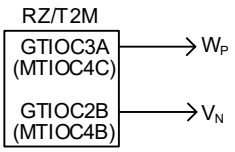
Table 4.2.3 Setting Specifications of Signal Routing Selector Switch

Switch	Up (Silkscreen: "-")	Center (Silkscreen: "F")	Down (Silkscreen: "LP-B")
	Normal connection	Pseudo stuck-at fault	Loop-back
SW13			
SW14			
SW15			
SW16			

[V_N/W_P controller signal swap switch: SW17]

SW17 is a switch to swap the V_N controller signal of the three-phase inverter circuit into W_P controller signal (and vice versa).
Table 4.2.4 shows setting specifications of V_N/W_P controller signal swap switch.

Table 4.2.4 Setting Specifications of V_N/W_P Controller Signal Swap Switch

Switch	Up (Silkscreen "MTU3")	Center	Down (Silkscreen "GPT")
SW17		Setting not allowed (Do not set to center)	

4.3 Jumper

Figure 4.3.1 shows placement of jumpers on the reference board.

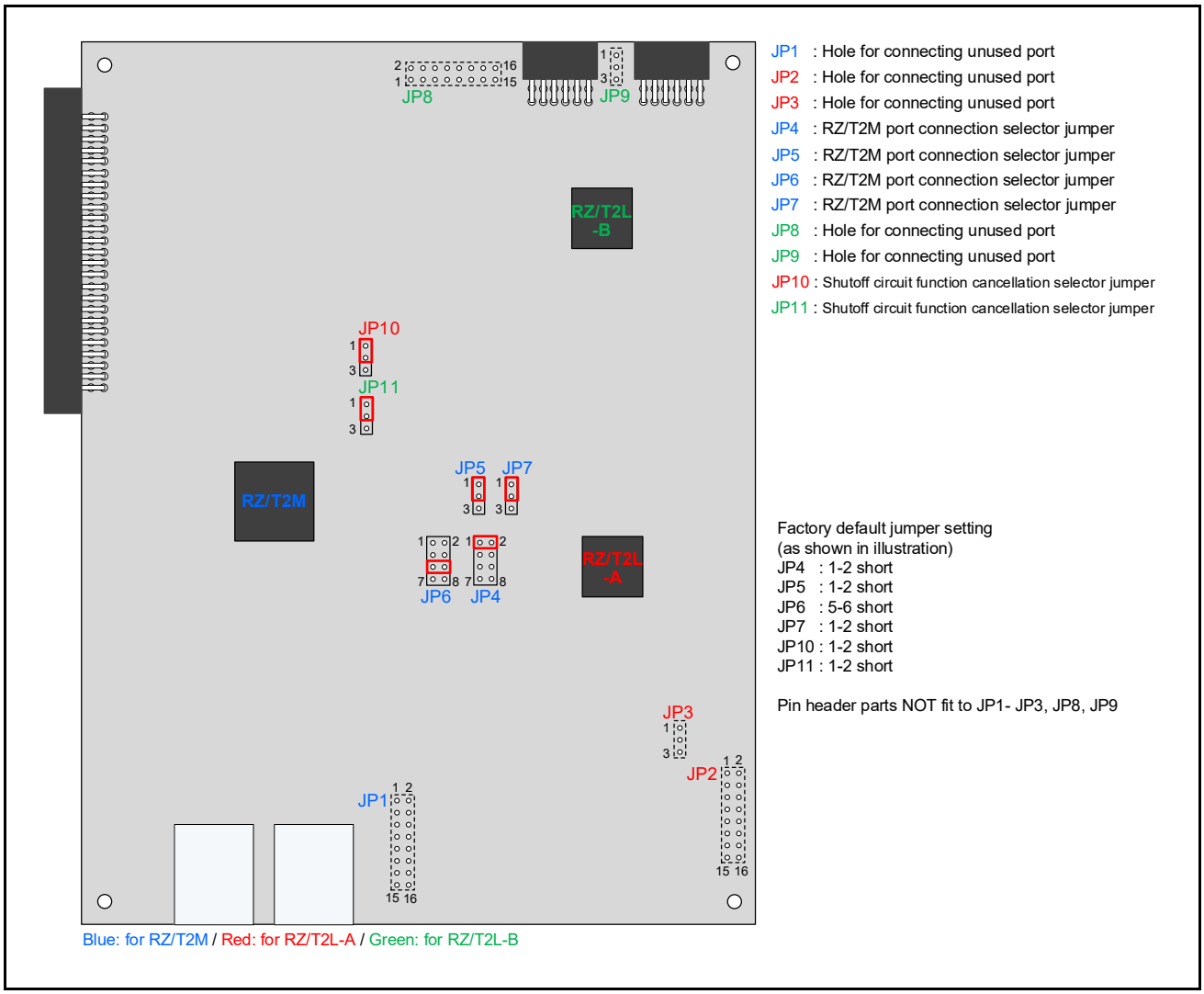


Figure 4.3.1 Functional Safety Reference Board - Jumper Position (C side Up)

[Hole for connecting unused port: JP1-JP3, JP8, JP9]

The holes on JP1 - JP3, JP8, JP10 are connected to unused ports of the RZ MPUs. Header parts do not fit.

Table 4.3.1 to Table 4.3.4 shows pin mapping specifications of JP1 to JP3, JP8, JP9.

- "I" or "O" in the "Direction" column means signal direction on the basis of the reference board
- "I/O" in the "Direction" column shows signal direction differs depending on the board usage or application programs.
- "P.U." and "P.D." in the table stands for pull-up and pull-down respectively. The "-" means no processing is performed.

Table 4.3.1 JP1 Pin Mapping

No.	RZ/T2M connector pin	I/O	P.U./P.D.	No.	RZ/T2M connector pin	I/O	P.U./P.D.
1	P21_0	I/O	-	2	P04_2	I/O	-
3	P14_0	I/O	-	4	P20_4	O	P.D
5	P13_7	I/O	-	6	P20_3	O	P.D
7	P13_2	I/O	-	8	P20_2	O	P.D
9	P08_3	I/O	-	10	P20_1	O	P.D
11	P08_2	I/O	-	12	AN100	I	-
13	P08_0	I/O	-	14	AN101	I	-
15	P07_7	I/O	-	16	AN102	I	-

Table 4.3.2 JP2 Pin Mapping

No.	RZ/T2L-A connector pin	I/O	P.U./P.D.	No.	RZ/T2L-A connector pin	I/O	P.U./P.D.
1	P22_2	I/O	-	2	P06_1	I/O	-
3	P22_0	I/O	-	4	P18_6	I/O	-
5	P18_1	I/O	-	6	P18_2	I/O	-
7	P18_0	I/O	-	8	P15_6	I/O	-
9	P14_5	I/O	-	10	P15_5	I/O	-
11	P08_6	I/O	-	12	P15_4	I/O	-
13	P08_4	I/O	-	14	P14_0	I/O	-
15	P06_7	I/O	-	16	P06_0	I/O	-

Table 4.3.3 JP3 / JP9 Pin Mapping

No.	RZ/T2L-A connector pin (JP3)	I/O	P.U./P.D.	No.	RZ/T2L-B connector pin (JP9)	I/O	P.U./P.D.
1	P04_1	I/O	-	1	P04_1	I/O	-
2	P09_0	I/O	-	2	P09_0	I/O	-
3	P18_3	I/O	-	3	P18_3	I/O	-

Table 4.3.4 JP8 Pin Mapping

No.	RZ/T2L-B connector pin	I/O	P.U./P.D.	No.	RZ/T2L-B connector pin	I/O	P.U./P.D.
1	P22_2	I/O	-	2	P06_1	I/O	-
3	P22_0	I/O	-	4	P23_7	I/O	-
5	P18_1	I/O	-	6	P21_5	I/O	-
7	P18_0	I/O	-	8	P17_4	I/O	-
9	P14_5	I/O	-	10	P14_4	I/O	-
11	P08_6	I/O	-	12	P13_3	I/O	-
13	P08_4	I/O	-	14	P07_3	I/O	-
15	P06_7	I/O	-	16	P02_3	I/O	-

[RZ/T2M port connection selector jumper: JP4 - JP7]

JP4 - JP7 are jumper switches to select RZ/T2M ports for connecting to the inverter board.

Table 4.3.5 - Table 4.3.8 show setting specifications of the JP4 - JP7.

Table 4.3.5 JP4 Setting Specifications

Setting	Description
1-2 short	P23_7 (GTETRGA) connected to pin 35 of CON14
3-4 short	P24_0 (GTETRGB) connected to pin 35 of CON14
5-6 short	P01_4 (POE0#) connected to pin 35 of CON14
7-8 short	P02_2 (POE10#) connected to pin 35 of CON14

Table 4.3.6 JP5 Setting Specifications

Setting	Description
1-2 short	P13_5 (MTCLKA) connected to pin 37 of CON14
2-3 short	P19_4 (GTIOC6A) connected to pin 37 of CON14

Table 4.3.7 JP6 Setting Specifications

Setting	Description
1-2 short *	P23_7 (GTETRGA) connected to pin 39 of CON14 (Needs resistor on R624)
3-4 short *	P24_0 (GTETRGB) connected to pin 39 of CON14 (Needs resistor on R623)
5-6 short	P24_1 (GTETRGC) connected to pin 39 of CON14
7-8 short	P11_1 (MTIOC1A) connected to pin 39 of CON14

*: If either P23_7 (GTETRGA) or P24_0 (GTETRGB) is selected for JP6, the same port cannot be selected for JP4. If selected, the power supply may short-circuit and damage the reference board.

Table 4.3.8 JP7 Setting Specifications

Setting	Description
1-2 short	P13_6 (MTCLKB) connected to pin 38 of CON14
2-3 short	P20_0 (GTIOC7B) connected to pin 38 of CON14

[Shutoff circuit function cancellation selector jumper: JP10, JP11]

JP10 and JP11 are jumper switches to enable/disable the cancellation of UVW shutoff circuit function.

Table 4.3.9 and Table 4.3.10 show setting specifications of JP10 and JP11.

Table 4.3.9 JP10 Setting Specifications

Setting	Description
1-2 short	Disable cancellation of UVW shutoff circuit function (Shutoff circuit function can be enabled/disabled by port on RZ/T2L-A)
2-3 short	Enable cancellation of UVW shutoff circuit function (Shutoff circuit function is kept disabled due to voltage pulled up to 3.3 V)

Table 4.3.10 JP11 Setting Specifications

Setting	Description
1-2 short	Disable cancellation of UVW shutoff circuit function (Shutoff circuit function can be enabled/disabled by port on RZ/T2L-B)
2-3 short	Enable cancellation of UVW shutoff circuit function (Shutoff circuit function is kept disabled due to voltage pulled up to 3.3 V)

4.4 LED

Figure 4.4.1 shows placement of LEDs on the reference board.

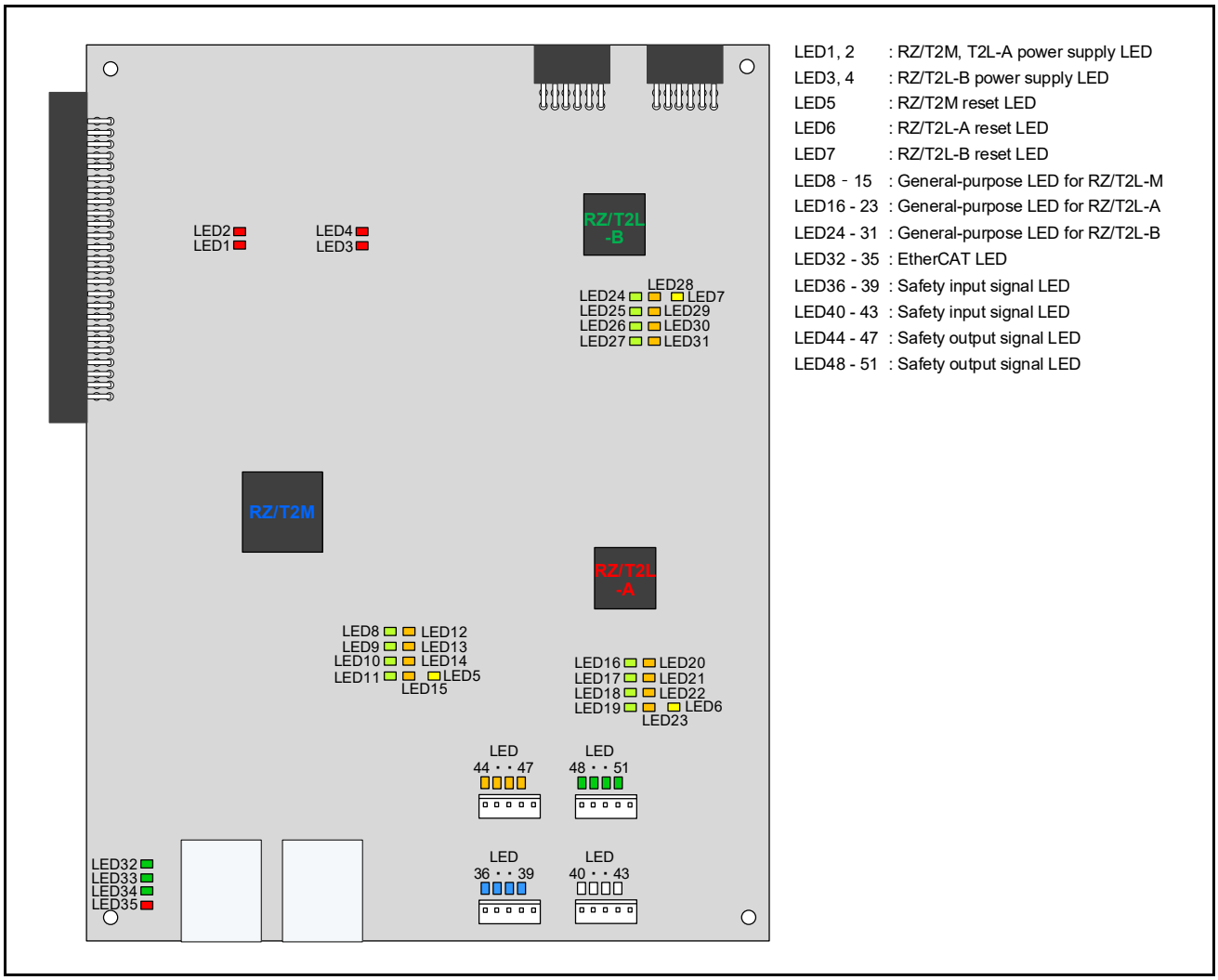


Figure 4.4.1 Functional Safety Reference Board - LED Positions (C Side Up)

Table 4.4.1 shows LED state conditions.

Table 4.4.1 LED Indication on the Reference Board

Application	#	Color	Illuminates when	#	Color	Illuminates when
Power supply	LED1	Red	Three power supplies output from PMIC on RZ/T2M and RZ/T2L-A are valid	LED3	Red	Three power supplies output from PMIC on RZ/T2L-B are valid
	LED2	Red		LED4	Red	
Reset	LED5	Yellow	RZ/T2M reset			
	LED6	Yellow	RZ/T2L-A reset	LED7	Yellow	RZ/T2L-B reset
General-purposed *1	LED8	Yel-green	RZ/T2M: P01_5 = "H"			
	LED9	Yel-green	RZ/T2M: P01_6 = "H"			
	LED10	Yel-green	RZ/T2M: P07_5 = "H"			
	LED11	Yel-green	RZ/T2M: P07_6 = "H"			
	LED12	Orange	RZ/T2M: P18_2 = "H"			
	LED13	Orange	RZ/T2M: P18_3 = "H"			
	LED14	Orange	RZ/T2M: P18_6 = "H"			
	LED15	Orange	RZ/T2M: P18_7 = "H"			
	LED16	Yel-green	RZ/T2L-A: P17_3 = "H"	LED24	Yel-green	RZ/T2L-B: P17_3 = "H"
	LED17	Yel-green	RZ/T2L-A: P17_5 = "L"	LED25	Yel-green	RZ/T2L-B: P17_5 = "L"
	LED18	Yel-green	RZ/T2L-A: P17_6 = "H"	LED26	Yel-green	RZ/T2L-B: P17_6 = "H"
	LED19	Yel-green	RZ/T2L-A: P17_7 = "H"	LED27	Yel-green	RZ/T2L-B: P17_7 = "H"
	LED20	Orange	RZ/T2L-A: P21_1 = "H"	LED28	Orange	RZ/T2L-B: P21_1 = "H"
	LED21	Orange	RZ/T2L-A: P21_2 = "H"	LED29	Orange	RZ/T2L-B: P21_2 = "H"
	LED22	Orange	RZ/T2L-A: P21_6 = "H"	LED30	Orange	RZ/T2L-B: P21_6 = "H"
	LED23	Orange	RZ/T2L-A: P21_7 = "H"	LED31	Orange	RZ/T2L-B: P21_7 = "H"
EtherCAT *2	LED32	Green	RZ/T2M: ESC_LINKACT0 = "H"			
	LED33	Green	RZ/T2M: ESC_LINKACT1 = "H"			
	LED34	Green	RZ/T2M: ESC_LEDRUN = "H"			
	LED35	Red	RZ/T2M: ESC_LEDERR = "H"			
Safety input signal	LED36	Blue	24 V applied to CON17; pin 5	LED40	White	24 V applied to CON18: pin 5
	LED37	Blue	24 V applied to CON17: pin 4	LED41	White	24 V applied to CON18: pin 4
	LED38	Blue	24 V applied to CON17: pin 3	LED42	White	24 V applied to CON18: pin 3
	LED39	Blue	24 V applied to CON17: pin 2	LED43	White	24 V applied to CON18: pin 2
Safety output signal	LED44	Orange	RZ/T2L-A: P13_7 = "H"	LED48	Green	RZ/T2L-B: P13_7 = "H"
	LED45	Orange	RZ/T2L-A: P13_6 = "H"	LED49	Green	RZ/T2L-B: P13_6 = "H"
	LED46	Orange	RZ/T2L-A: P13_5 = "H"	LED50	Green	RZ/T2L-B: P13_5 = "H"
	LED47	Orange	RZ/T2L-A: P13_4 = "H"	LED51	Green	RZ/T2L-B: P13_4 = "H"

*1: LED17 lights on when RZ/T2L-A is in reset state. LED25 lights on when RZ/T2L-B is in reset state.

*2: LED32 - LED35 are controlled by RZ/T2M built-in EtherCAT slave controller.

5. Reference Board Data

5.1 Connection Diagrams

- Connection diagrams
  1. INDEX
  2. POWER-SUPPLY_24V / 5V
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  10. RZ/T2L_B I/O-PORT
  11. RZ/T2M POWER
  12. RZ/T2M I/O-PORT
  13. JTAG CONNECTOR RST CIRCUIT
  14. T2M, T2L_A, T2L_B MODE SET
  15. USER LED, SWITCH
  16. ECAT-LED, EEPROM, 8ch-SW
  17. USB, USB-UART
  18. ETHERNET-P0 PHY RJ45-CON
  19. ETHERNET-P1 PHY RJ45-CON
  20. SPI_FLACH, SDRAM, HYPERRAM
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  22. T2L_A-T2L_B SCI / SPI / TIMER
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  26. SAFETY OUTPUT B
  27. UVW CUTOFF CIRCUIT
  28. PMOD, PIN-HEADER, INV-CON
  29. IO CONNECTOR

RTK0EF0190D01001BJ

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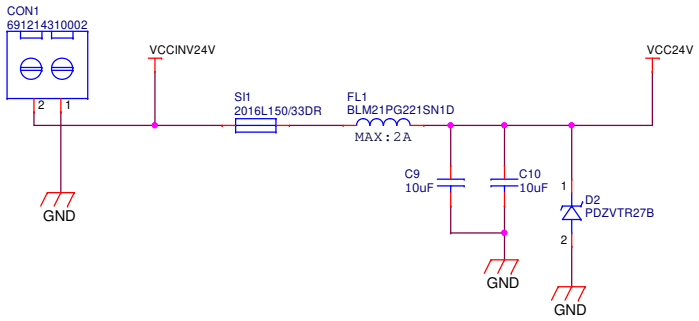
24V POWER SUPPLY



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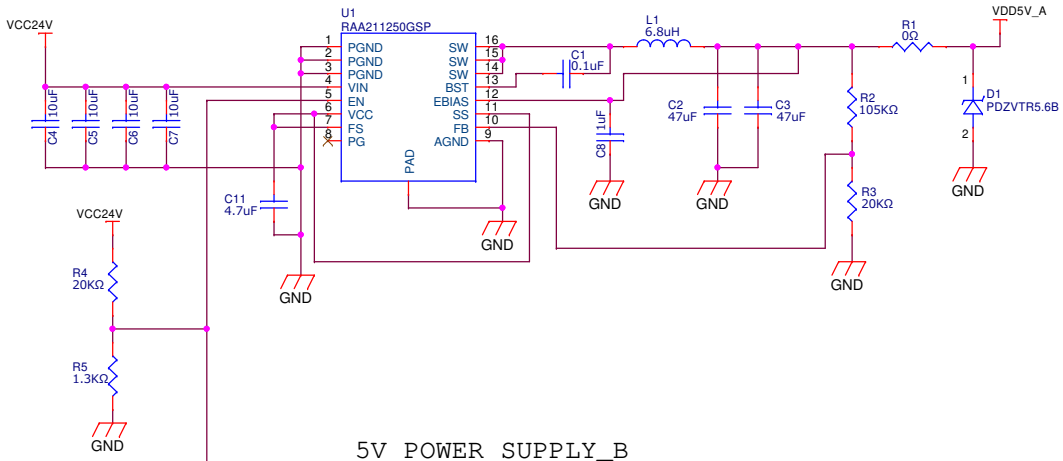

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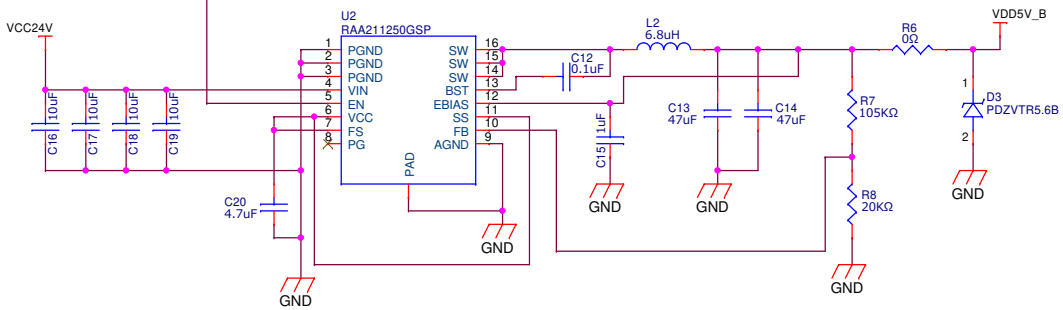
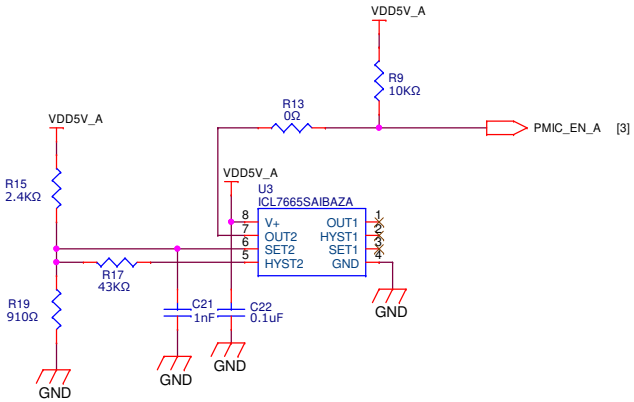
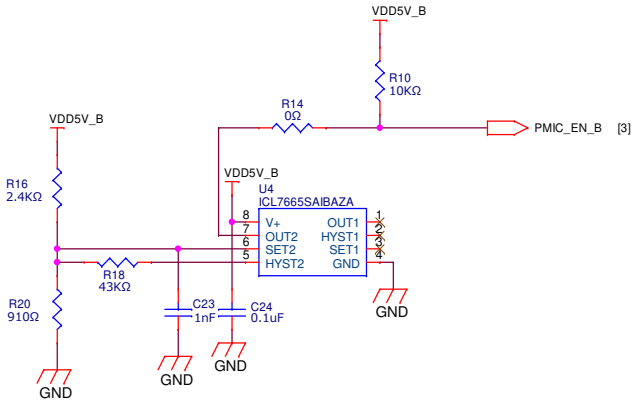
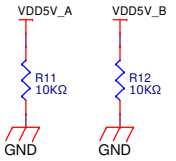


5V MONITOR A



5V MONITOR B





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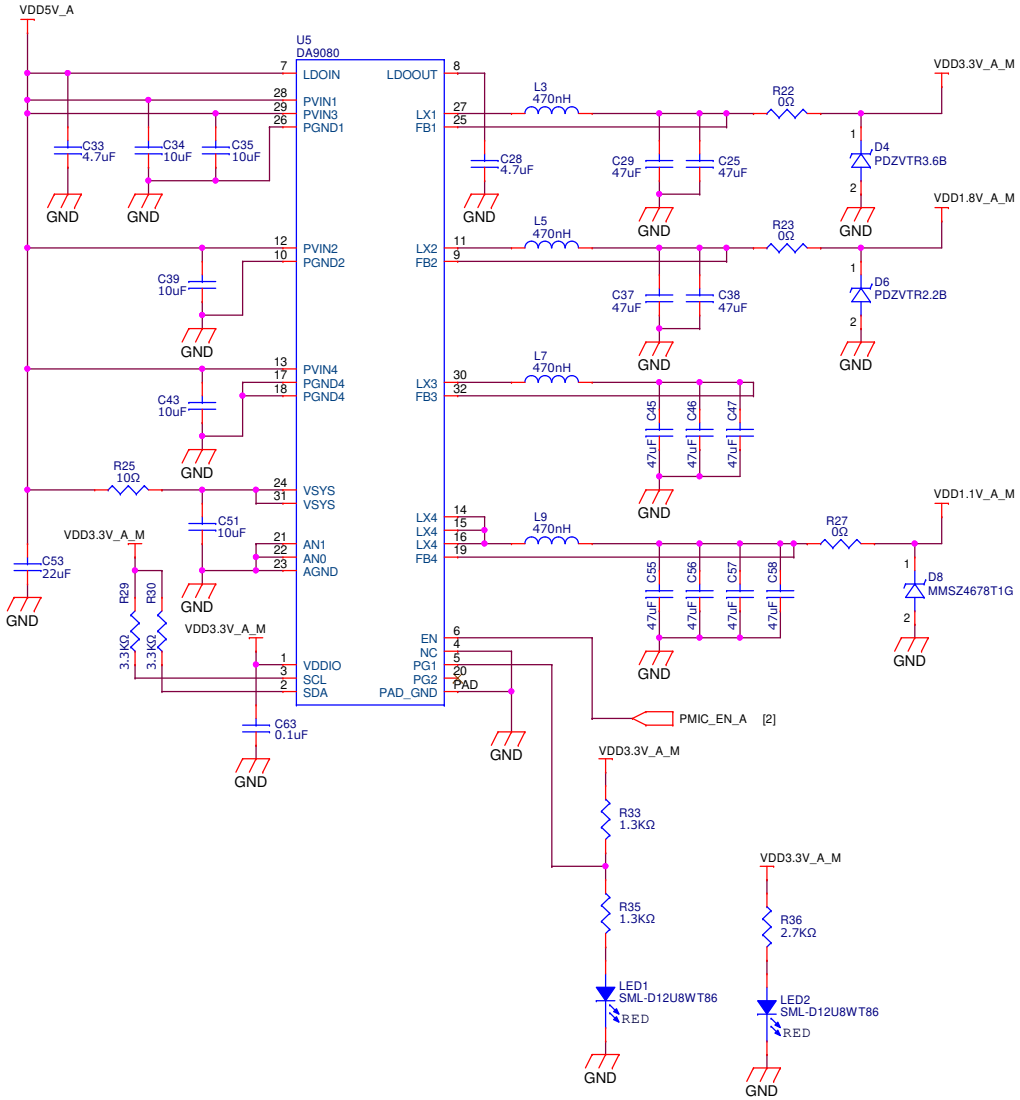
3.3V/1.8V/1.1V POWER SUPPLY_A_M



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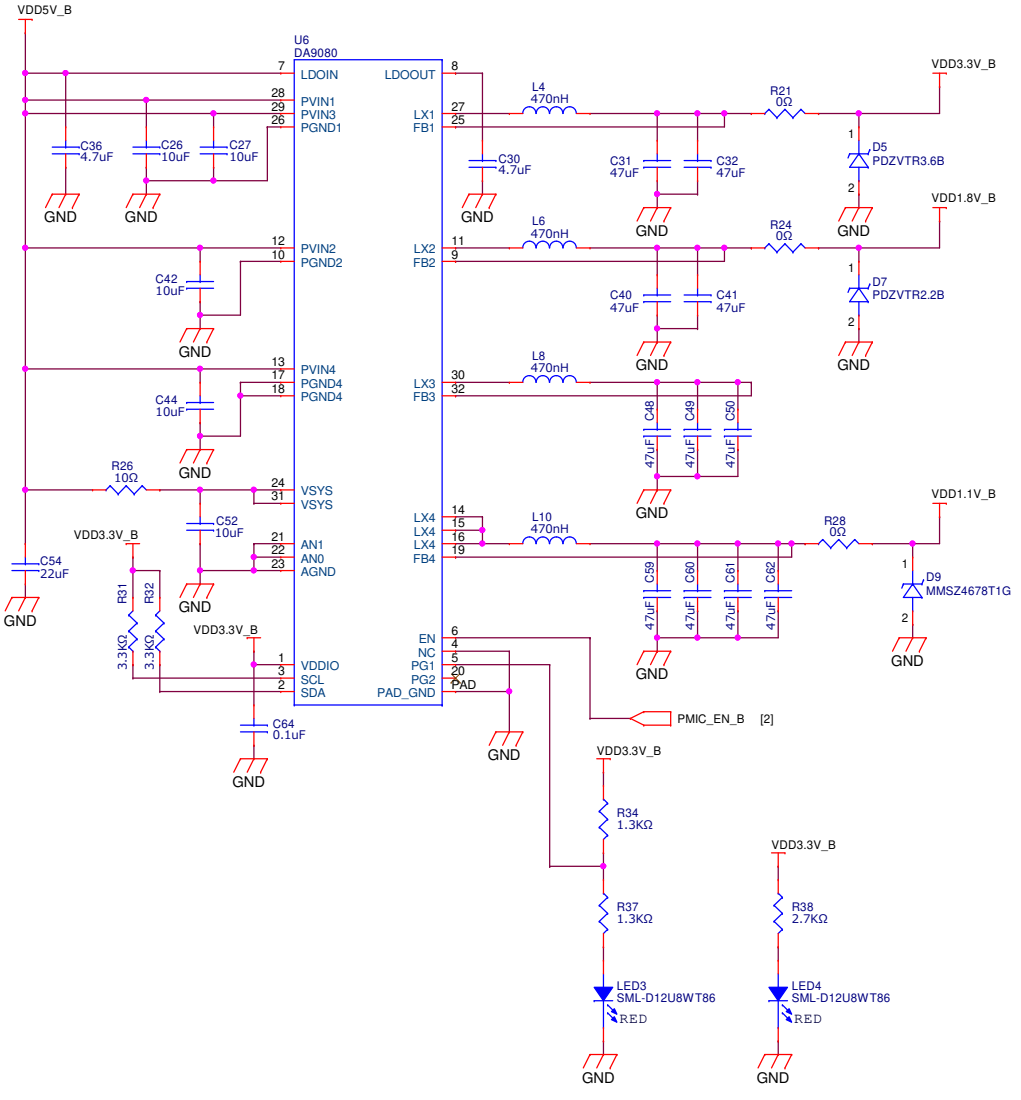

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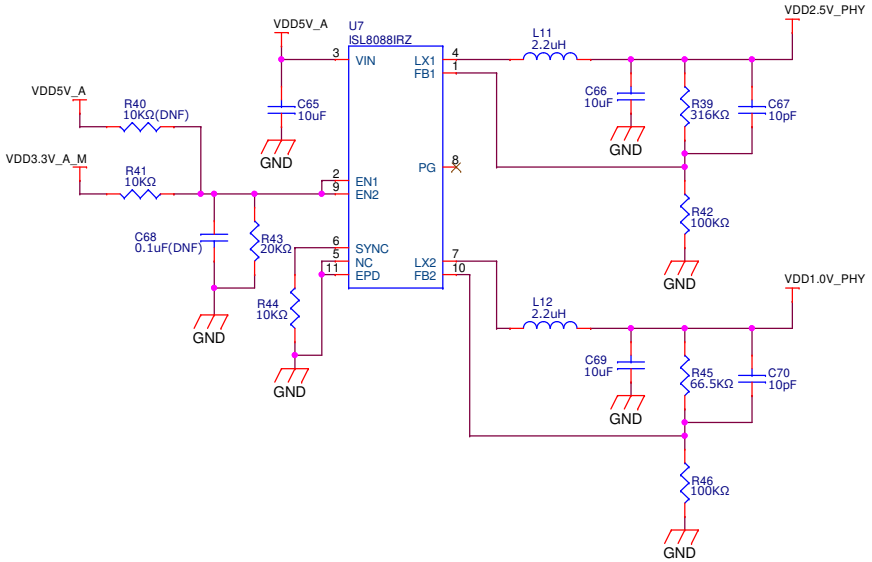
2.5V/1.0V POWER SUPPLY PHY



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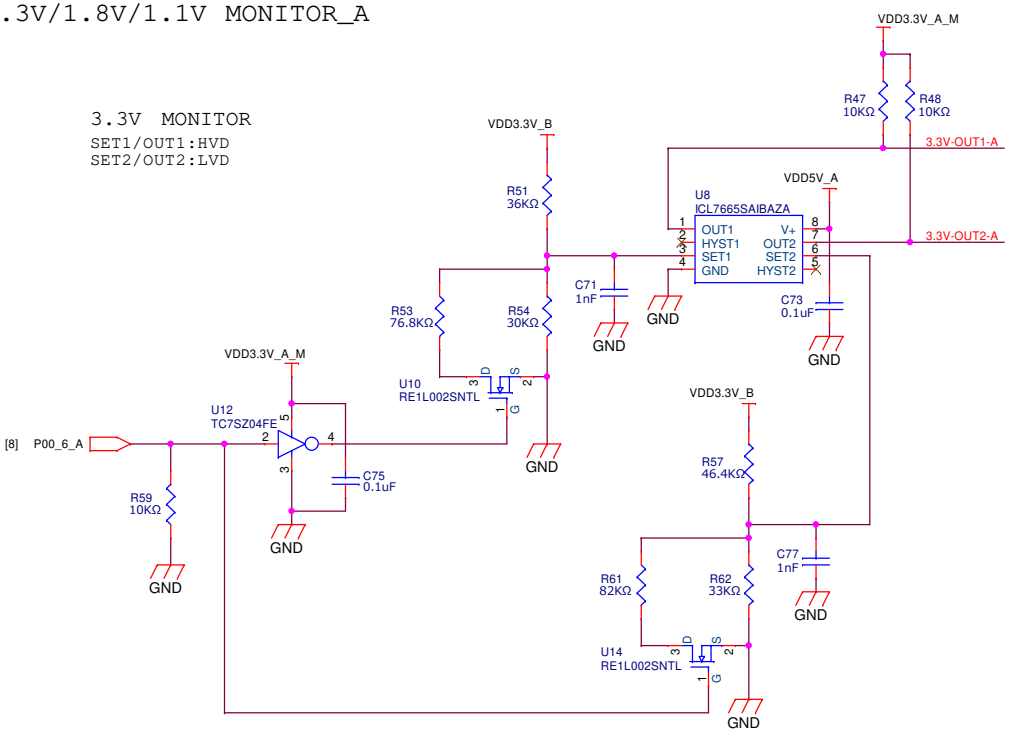
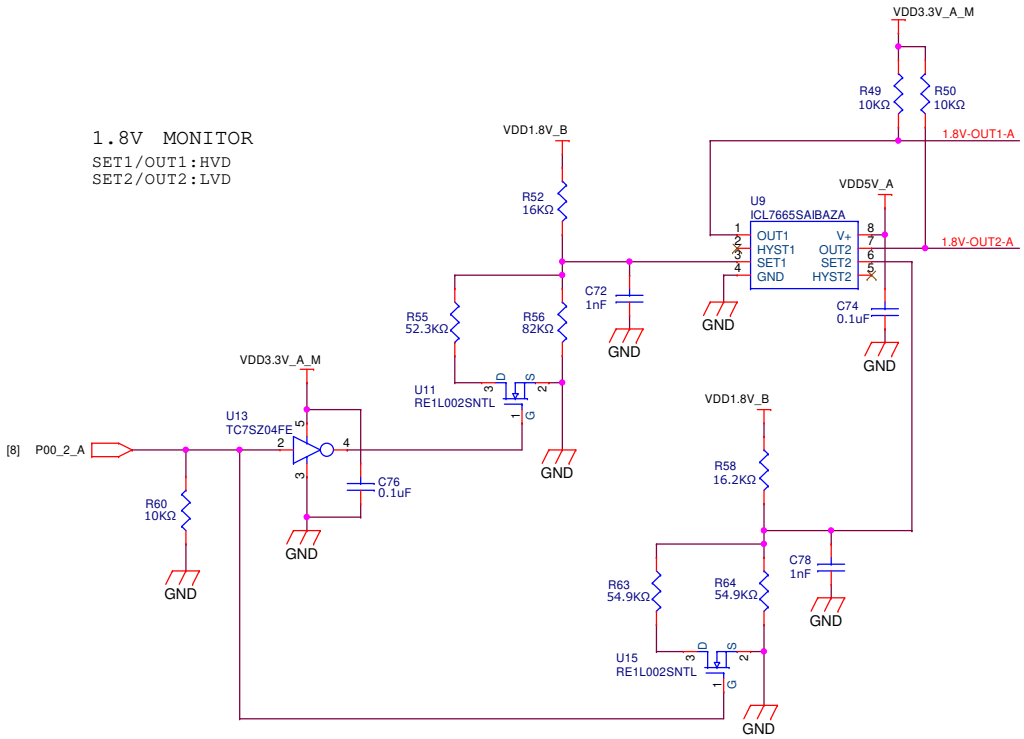
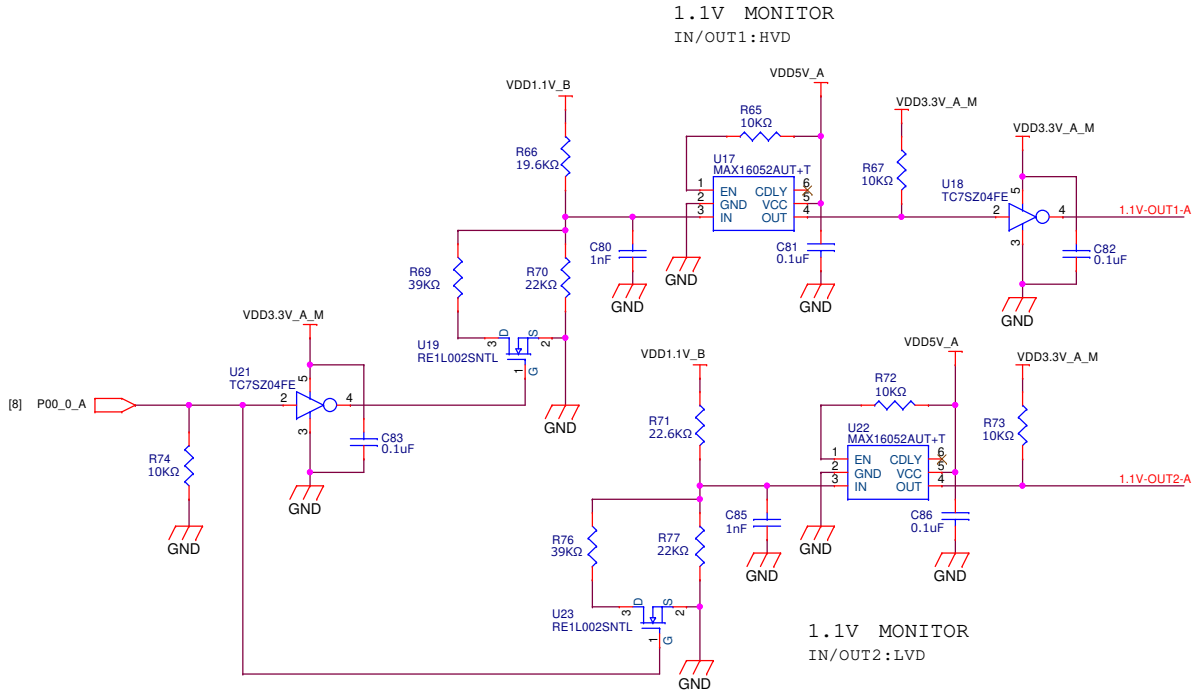
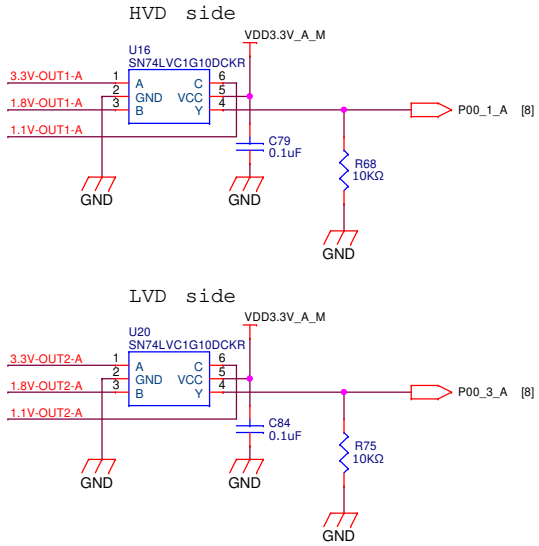
3.3V/1.8V/1.1V MONITOR_A







1.1V MONITOR
IN/OUT2:LVD



RTK0EF0190D01001BJ-Circuit		
Title: <3.3V/1.8V/1.1V MONITOR_A>		
Size: A3	Document Number: <ZQ24-AQ-SSSA-0035-02>	Rev: <1.01>
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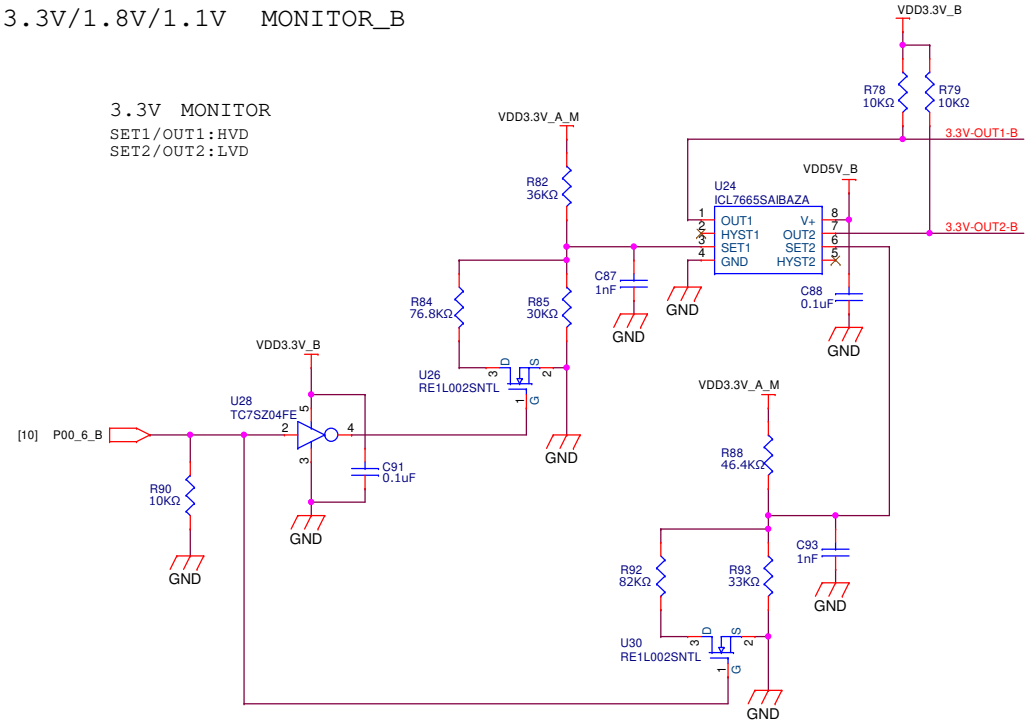
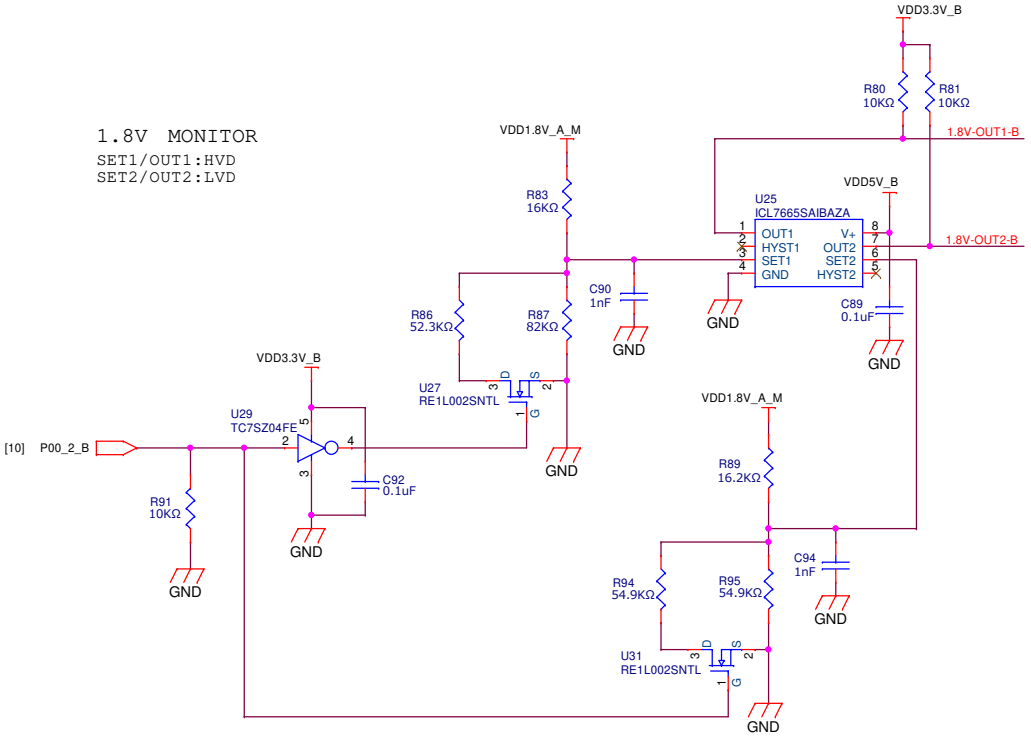
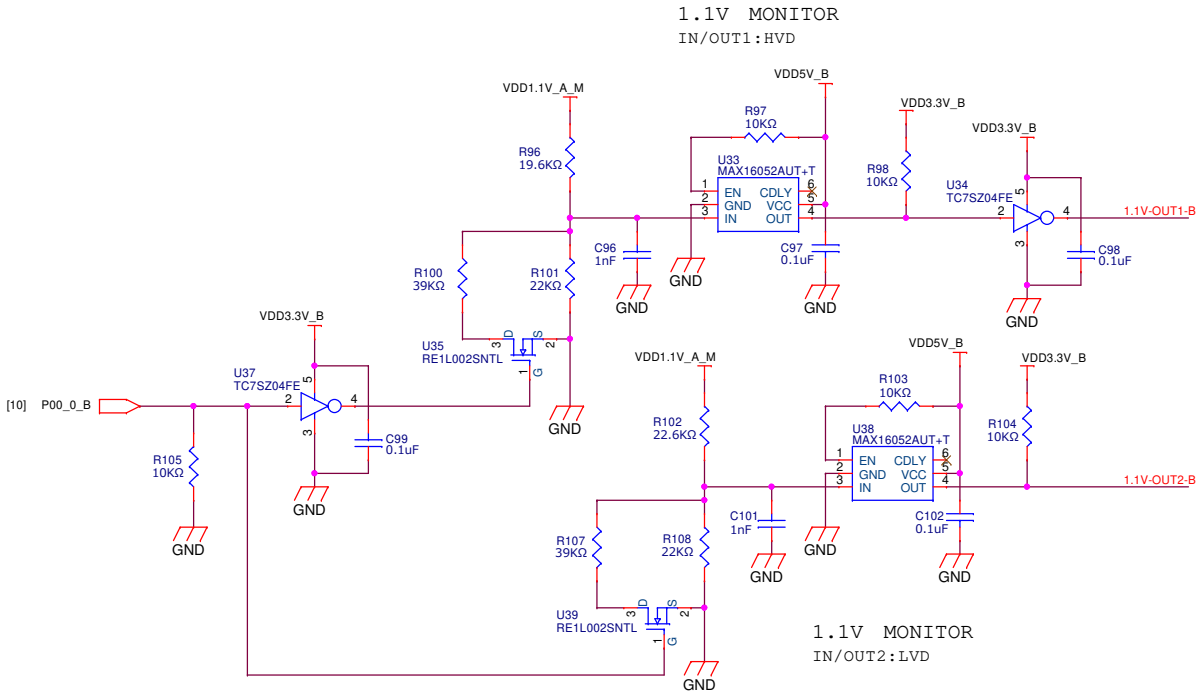
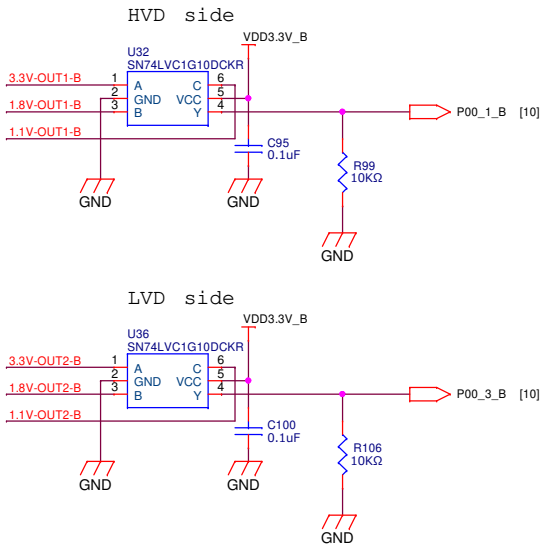
3.3V/1.8V/1.1V MONITOR_B



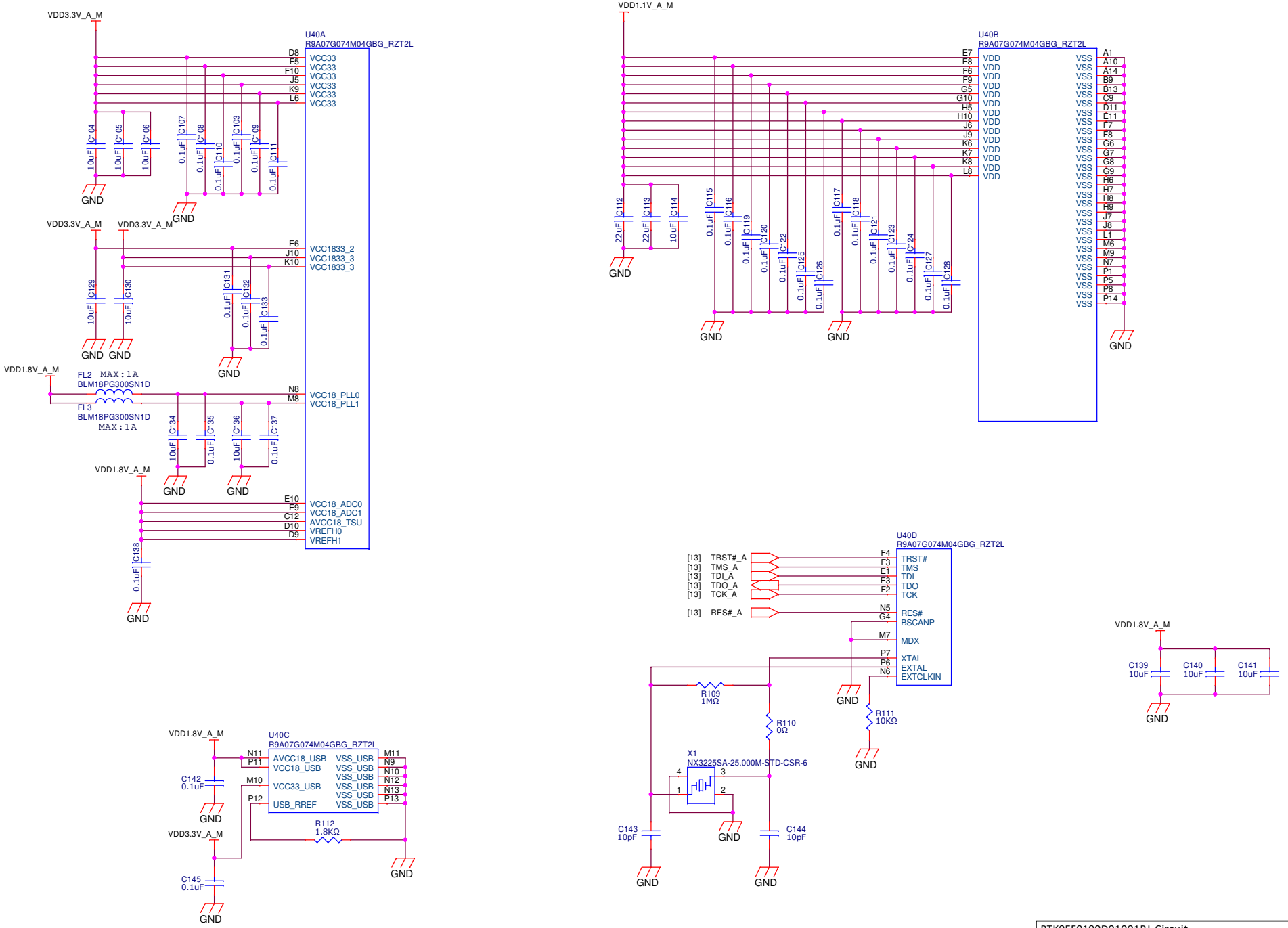






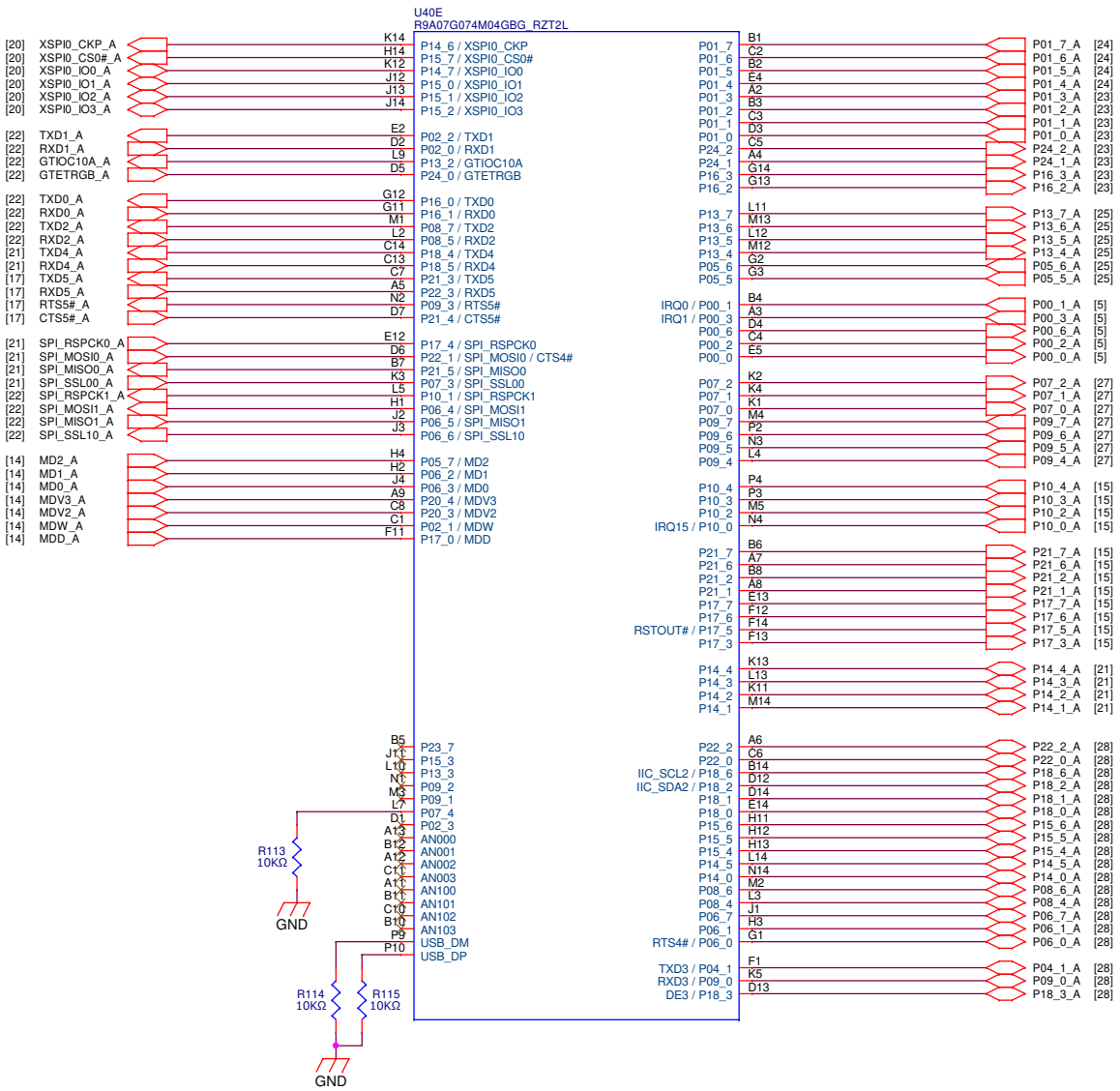
RTK0EF0190D01001BJ-Circuit		
Title	<3.3V/1.8V/1.1V MONITOR_B>	
Size A3	Document Number <ZQ24-AQ-SSSA-0035-02>	Rev <1.01>
Date: Friday, November 21, 2025	Sheet 6 of 29	

RZ/T2L_A POWER



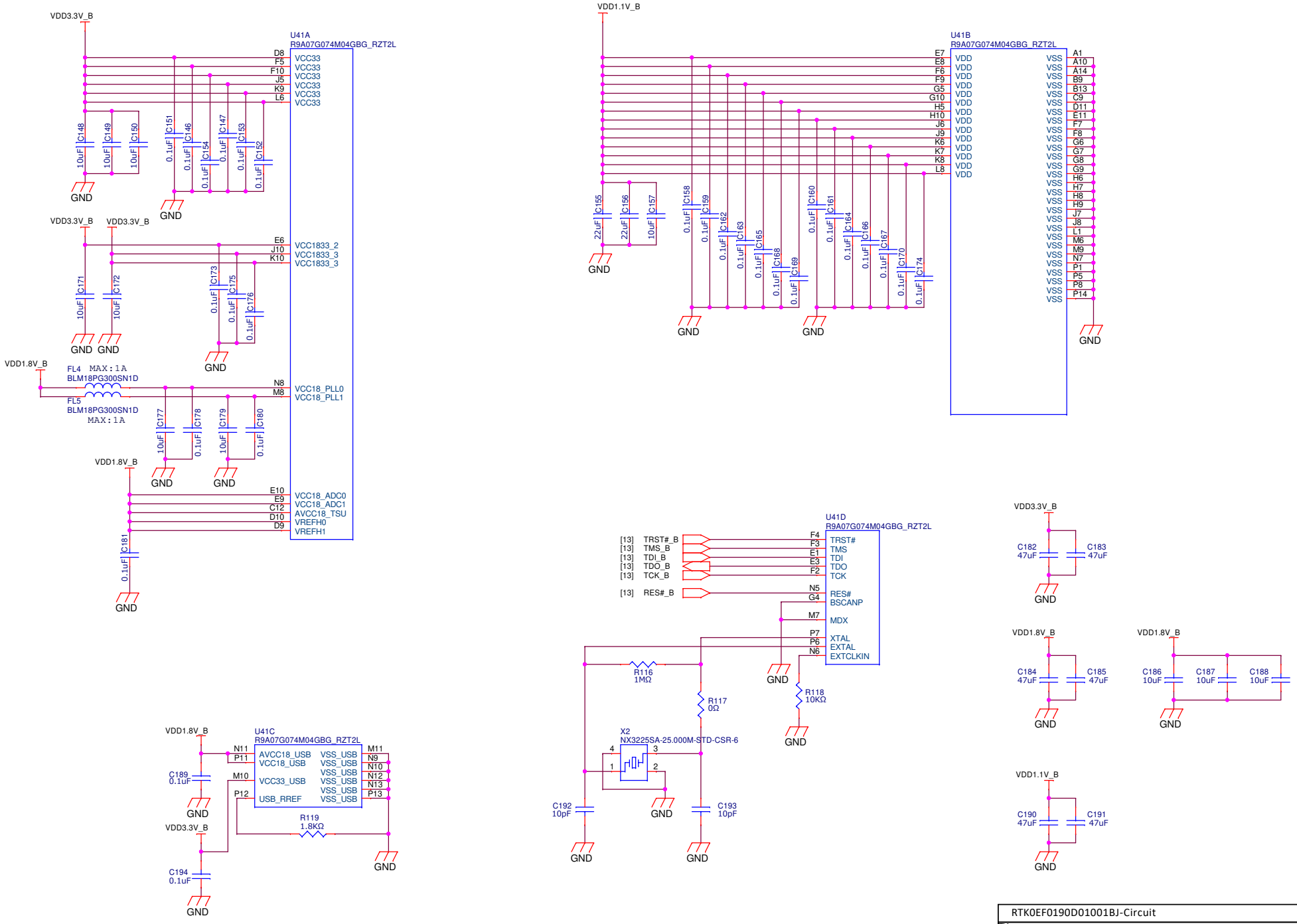
RTK0EF0190D01001BJ-Circuit		
Title <RZ/T2L_A POWER>		
Size A3	Document Number <ZQ24-AQ-SSSA-0035-02>	Rev <1.01>
Date: Friday, November 21, 2025	Sheet 7 of 29	

RZ/T2L_A I/O-PORT



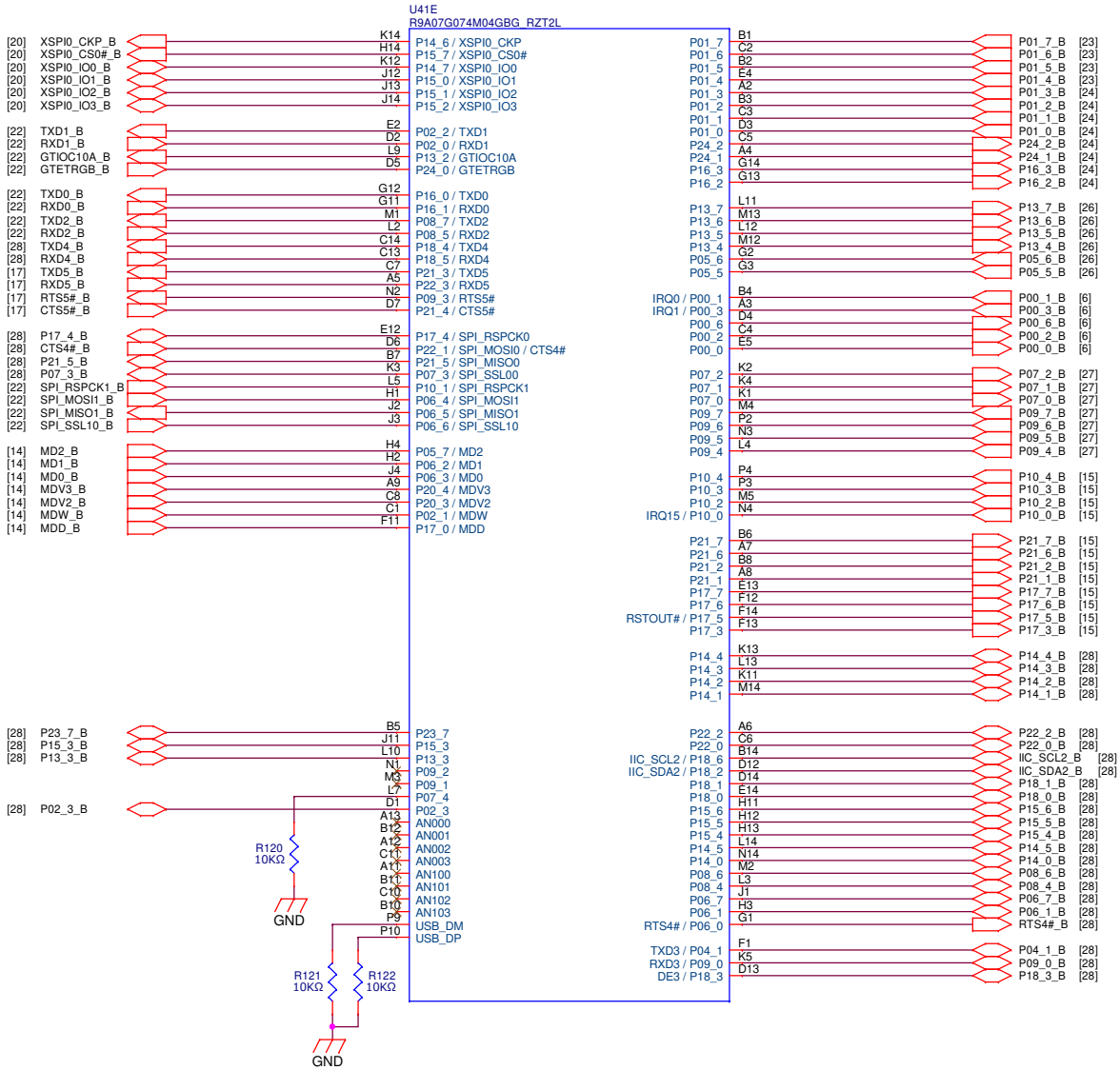
RTK0EF0190D01001BJ-Circuit		
Title <RZ/T2L_A I/O-PORT>		
Size A3	Document Number <ZQ24-AQ-SSSA-0035-02>	Rev <1.01>
Date: Friday, November 21, 2025	Sheet 8 of 29	

RZ/T2L_B POWER



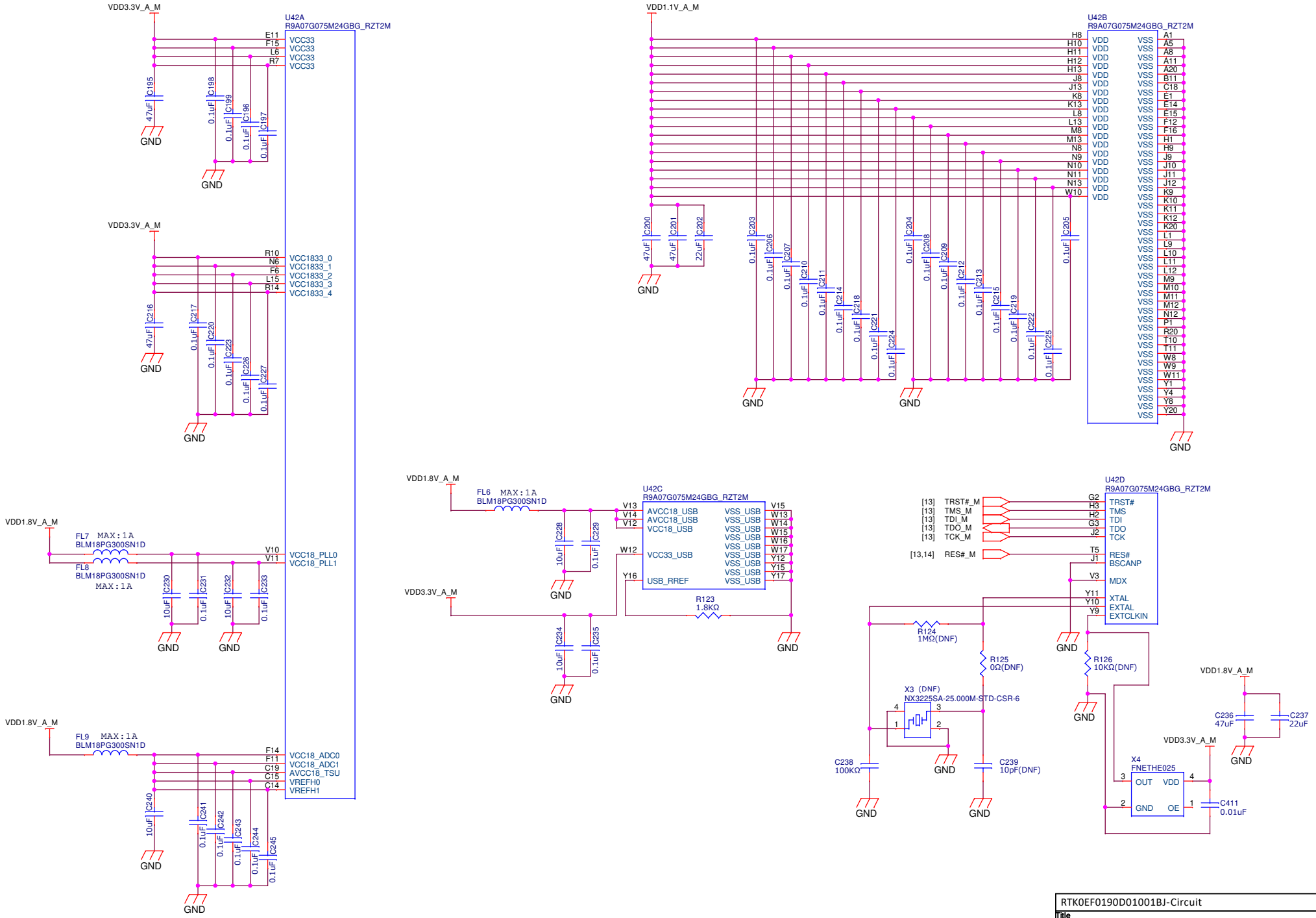
RTK0EF0190D01001BJ-Circuit	
Title	<RZ/T2L_B POWER>
Size A3	Document Number <ZQ24-AQ-SSSA-0035-02> Rev <1.01>
Date: Friday, November 21, 2025	Sheet 9 of 29

RZ/T2L_B I/O-PORT



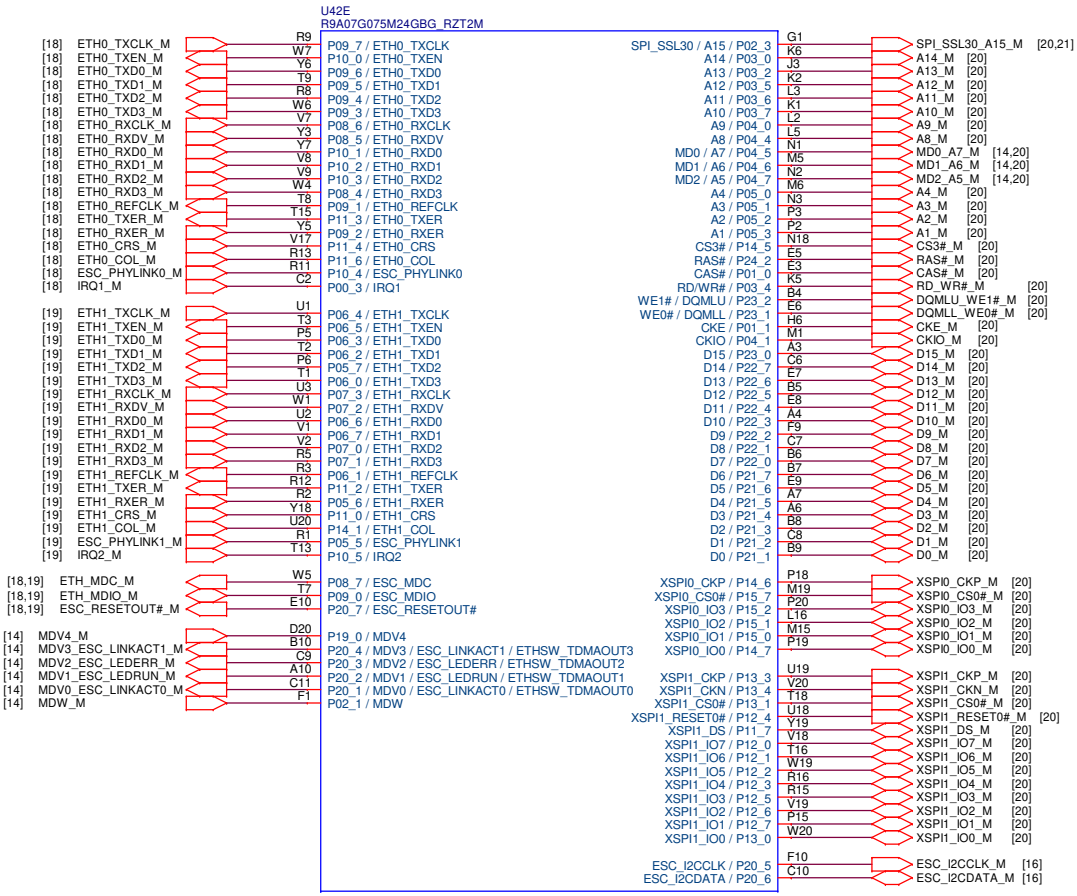
RTK0EF0190D01001BJ-Circuit			
Title	<RZ/T2L_B I/O-PORT>		
Size A3	Document Number <ZQ24-AQ-SSSA-0035-02>		Rev <1.01>
Date: Friday, November 21, 2025	Sheet 10 of 29		

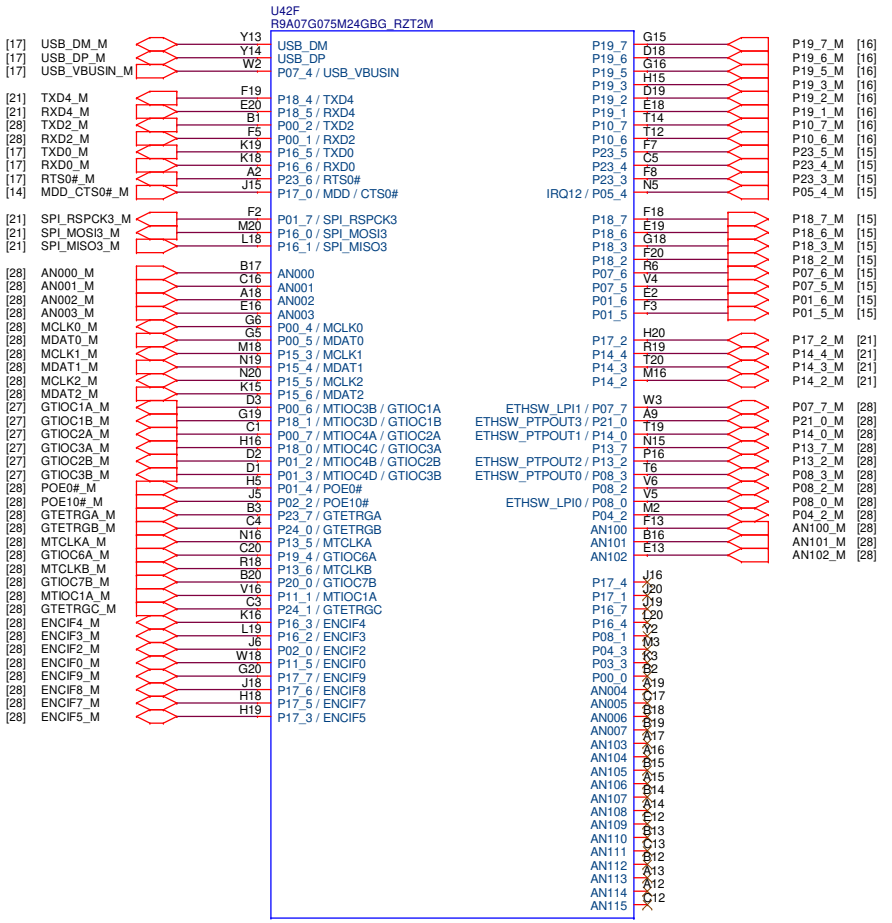
RZ/T2M POWER



RTK0EF0190D01001BJ-Circuit	
Title	<RZ/T2M POWER>
Size A3	Document Number <ZQ24-AQ-SSSA-0035-02> Rev <1.01>
Date: Friday, November 21, 2025	Sheet 11 of 29

RZ/T2M I/O-PORT





RTK0EF0190D01001BJ-Circuit		
Title <RZ/T2M I/O-PORT>		
Size A3	Document Number <ZQ24-AQ-SSSA-0035-02>	Rev <1.01>
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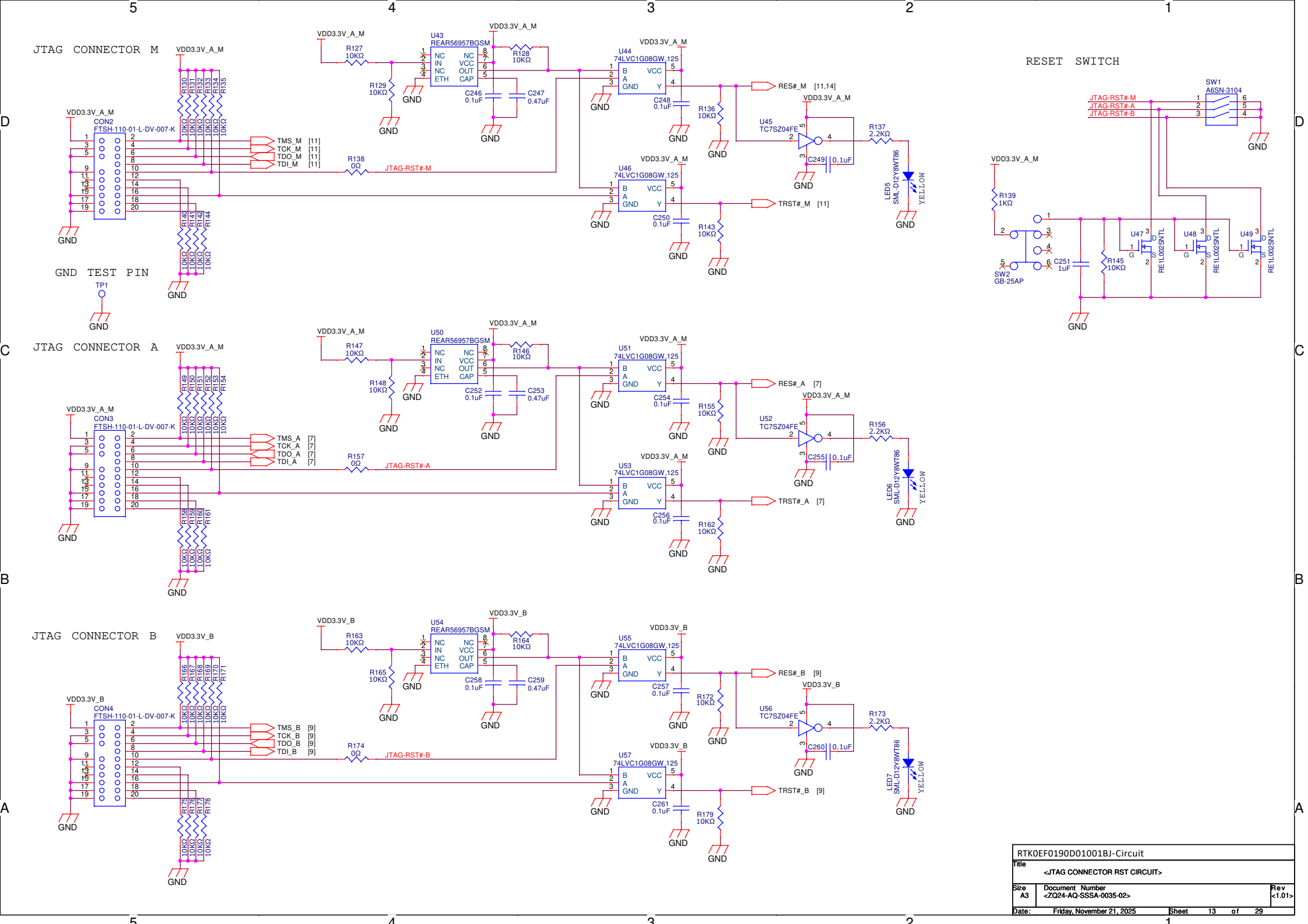

RTK0EF0190D01001BJ-Circuit	
Title	<JTAG CONNECTOR RST CIRCUIT>
Size A3	Document Number <ZQ24-AQ-SSSA-0035-02> Rev <1.01>
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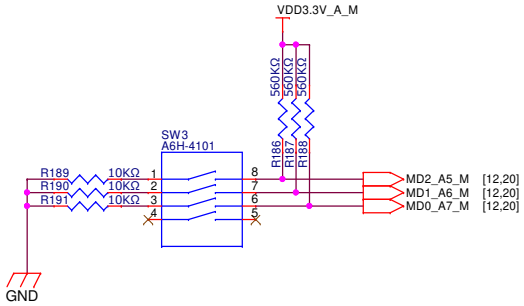
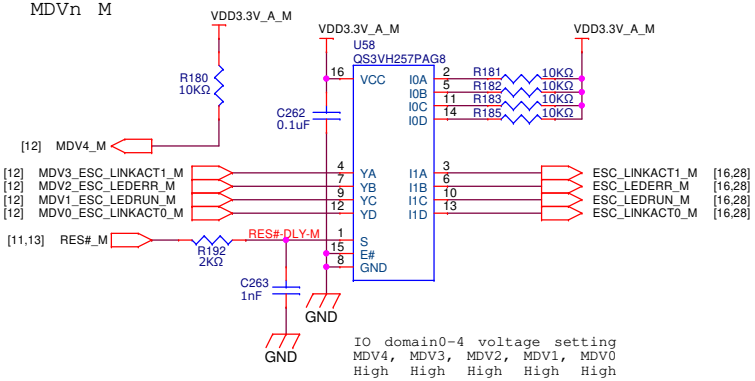
MODE SWITCH M

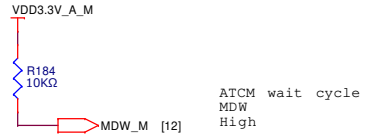


MDVn M



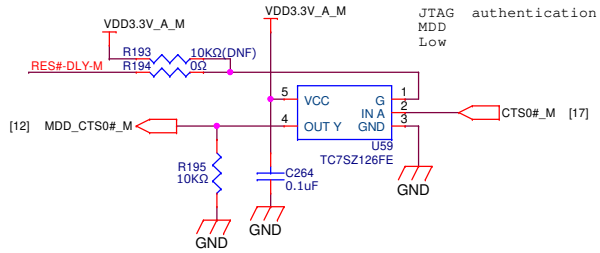
IO domain0-4 voltage setting
MDV4, MDV3, MDV2, MDV1, MDV0
High High High High High

MDW M



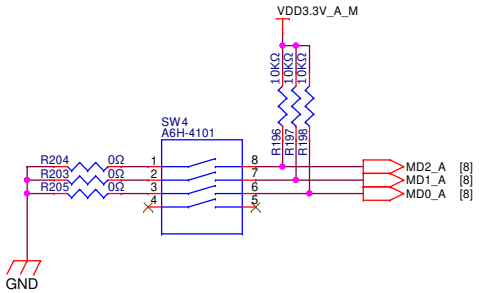
ATCM wait cycle
MDW
High

MDD M

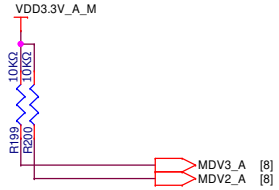


JTAG authentication
MDD
Low

MODE SWITCH A

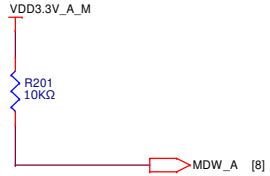


MDVn A



IO domain2,3 voltage setting
MDV3, MDV2
High High

MDW A

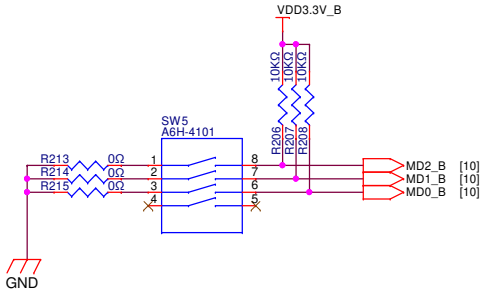


ATCM wait cycle
MDW
High

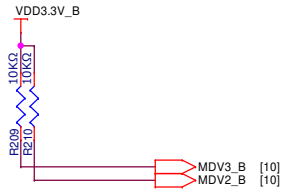
MDD A

JTAG authentication
MDD
Low

MODE SWITCH B

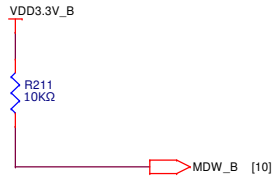


MDVn B



IO domain2,3 voltage setting
MDV3, MDV2
High High

MDW B



ATCM wait cycle
MDW
High

MDD B

JTAG authentication
MDD
Low

RTK0EF0190D01001BJ-Circuit

Title: <T2M, T2L_A, T2L_B MODE SET>

Size: A3 | Document Number: <ZQ24-AQ-SSSA-0035-02> | Rev: <1.01>

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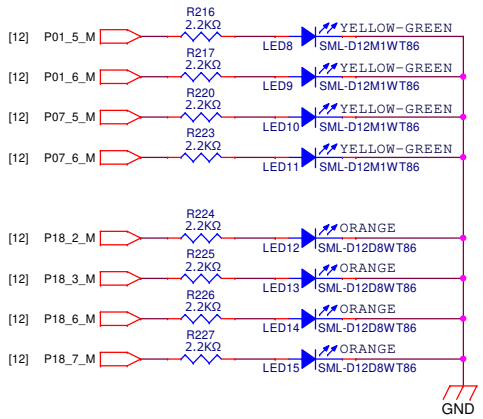
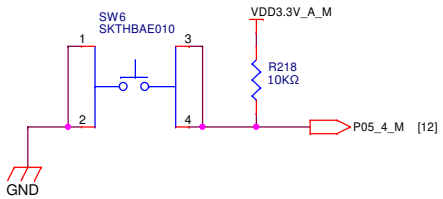
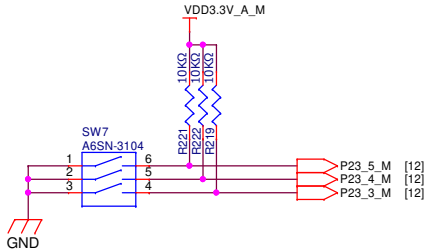
LED M



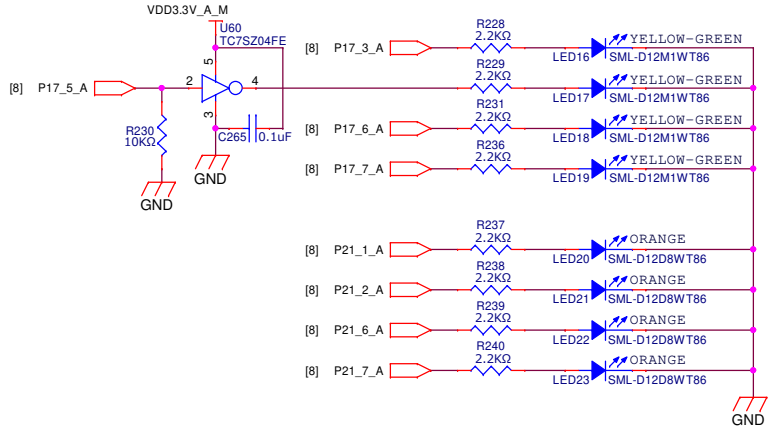
PUSH SWITCH M



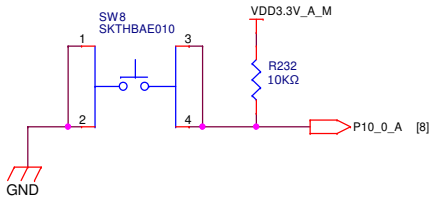
SLIDE SWITCH M



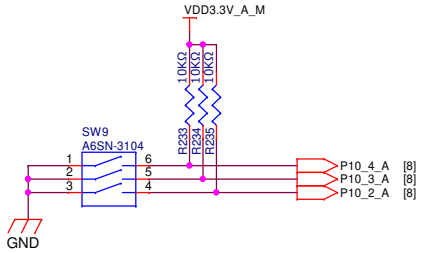
LED A



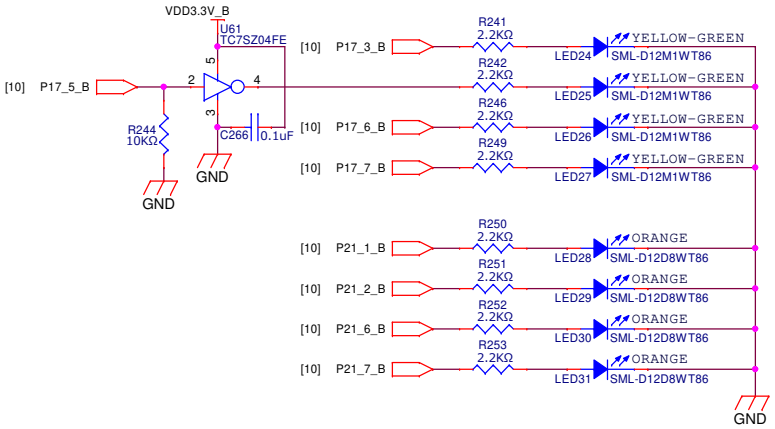
PUSH SWITCH A



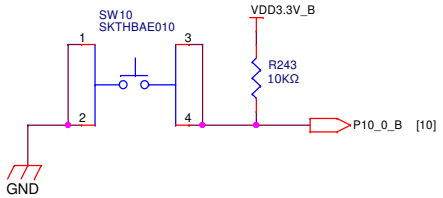
SLIDE SWITCH A



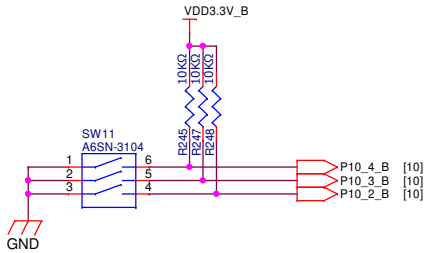
LED B



PUSH SWITCH B



SLIDE SWITCH B



RTK0EF0190D01001BJ-Circuit		
Title: <USER LED, SWITCH>		
Size: A3	Document Number: <ZQ24-AQ-SSSA-0035-02>	Rev: <1.01>
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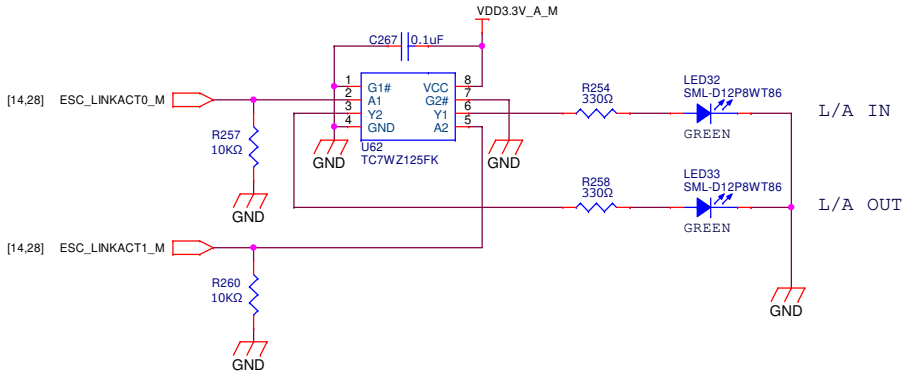
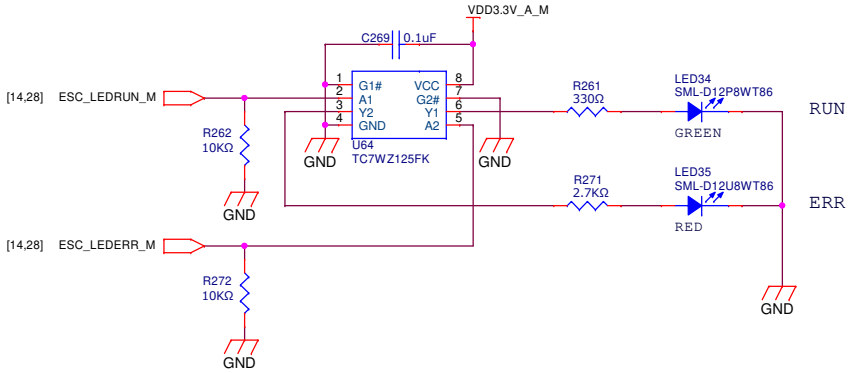
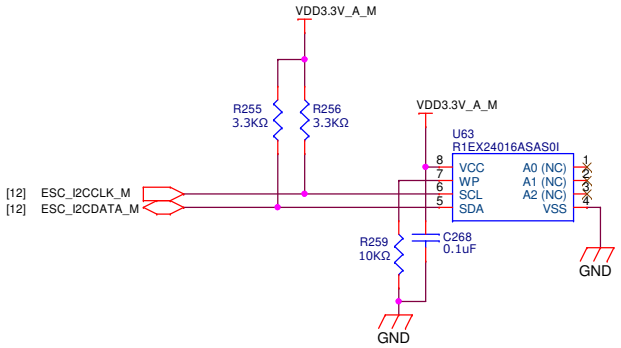
ETHERCAT LED

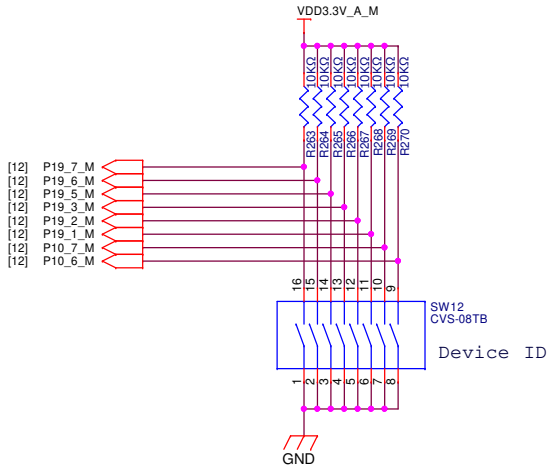




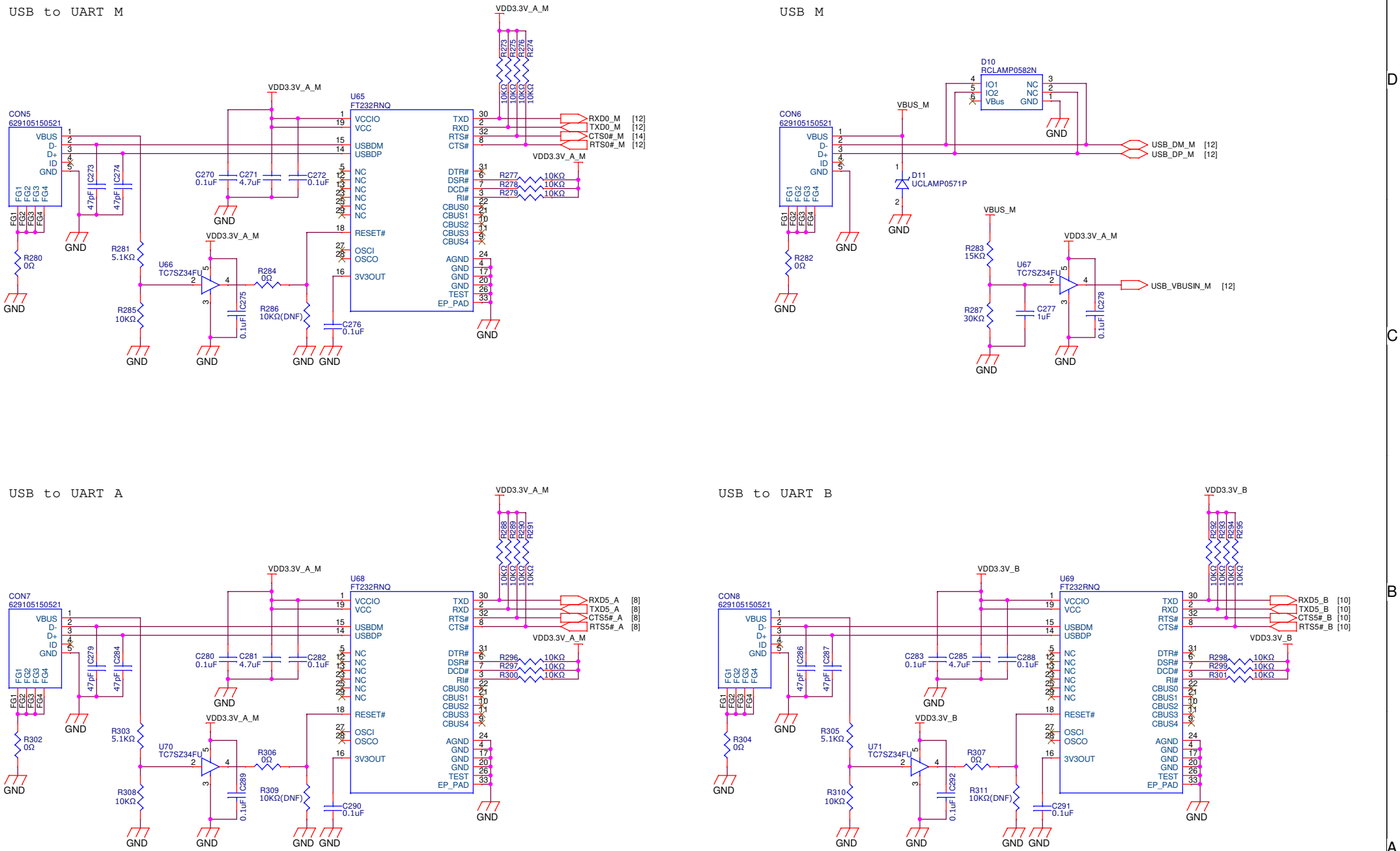
ETHERCAT EEPROM



ETHERCAT ID SWITCH



RTK0EF0190D01001BJ-Circuit		
Title: <ECAT-LED, EEPROM, 8ch-SW>		
Size: A3	Document Number: <ZQ24-AQ-SSSA-0035-02>	Rev: <1.01>
Date: Friday, November 21, 2025	Sheet 16 of 29	


USB to UART M
USB M
USB to UART A
USB to UART B
CON5
629105150521
U65
FT232RNQ
U66
TC7SZ34FU
CON6
D10
RCLAMP0582N
D11
UCLAMP0571P
U67
CON7
U68
U70
CON8
U69
U71
VDD3.3V_A_M
VDD3.3V_B
GND
VBUS_M
RXD0_M [12]
TXD0_M [12]
CTS0#_M [14]
RTS0#_M [12]
USB_DM_M [12]
USB_DP_M [12]
USB_VBUSIN_M [12]
RXD5_A [8]
TXD5_A [8]
CTS5#_A [8]
RTS5#_A [8]
RXD5_B [10]
TXD5_B [10]
CTS5#_B [10]
RTS5#_B [10]
RTK0EF0190D01001BJ-Circuit
<USB, USB-UART>
A3
<ZQ24-AQ-SSSA-0035-02>
<1.01>
Friday, November 21, 2025
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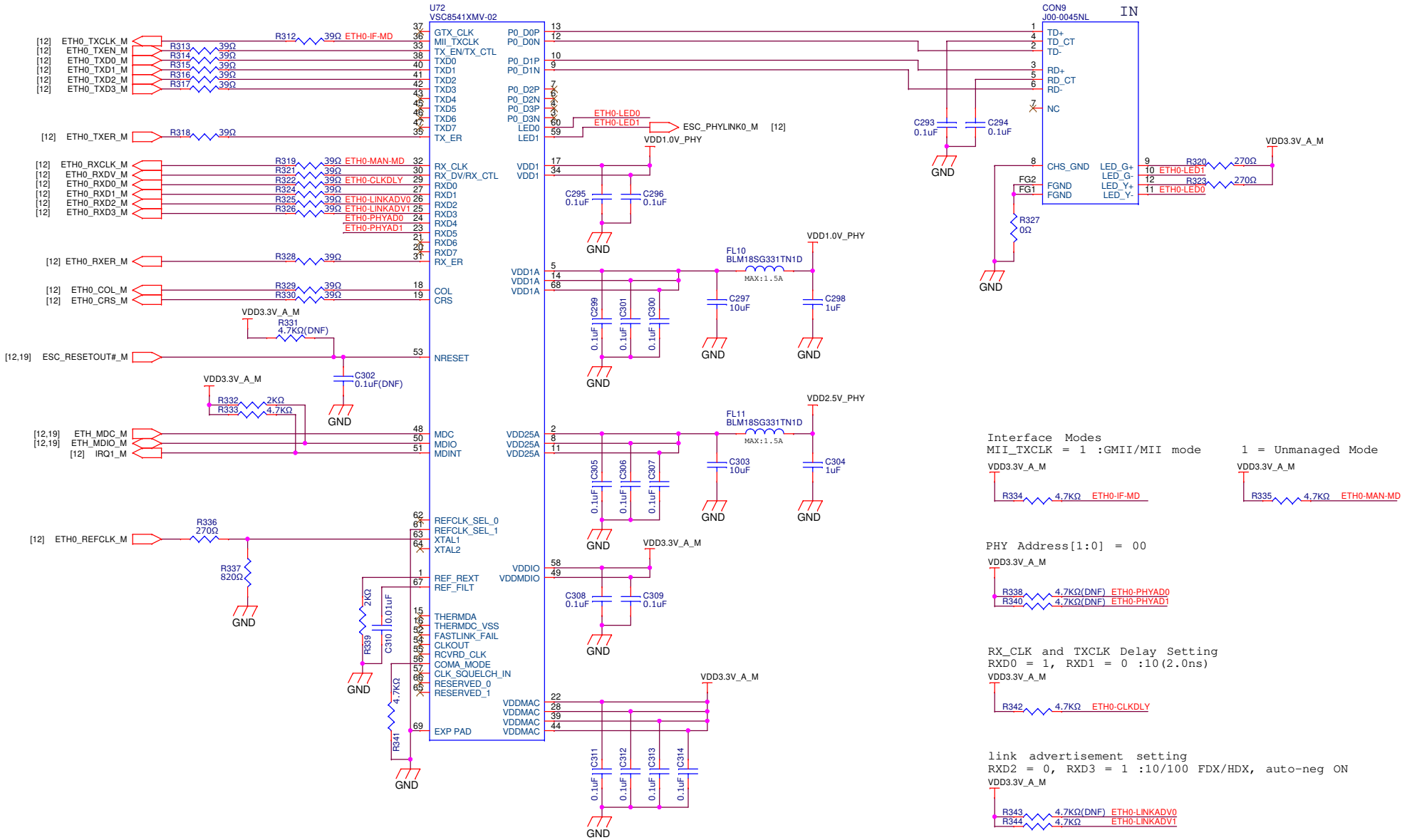


Interface Modes
MII_TXCLK = 1 :GMII/MII mode 1 = Unmanaged Mode

VDD3.3V_A_M
R334 4.7KΩ ETH0-IF-MD

VDD3.3V_A_M
R335 4.7KΩ ETH0-MAN-MD

PHY Address[1:0] = 00

VDD3.3V_A_M
R338 4.7KΩ(DNF) ETH0-PHYAD0
R340 4.7KΩ(DNF) ETH0-PHYAD1

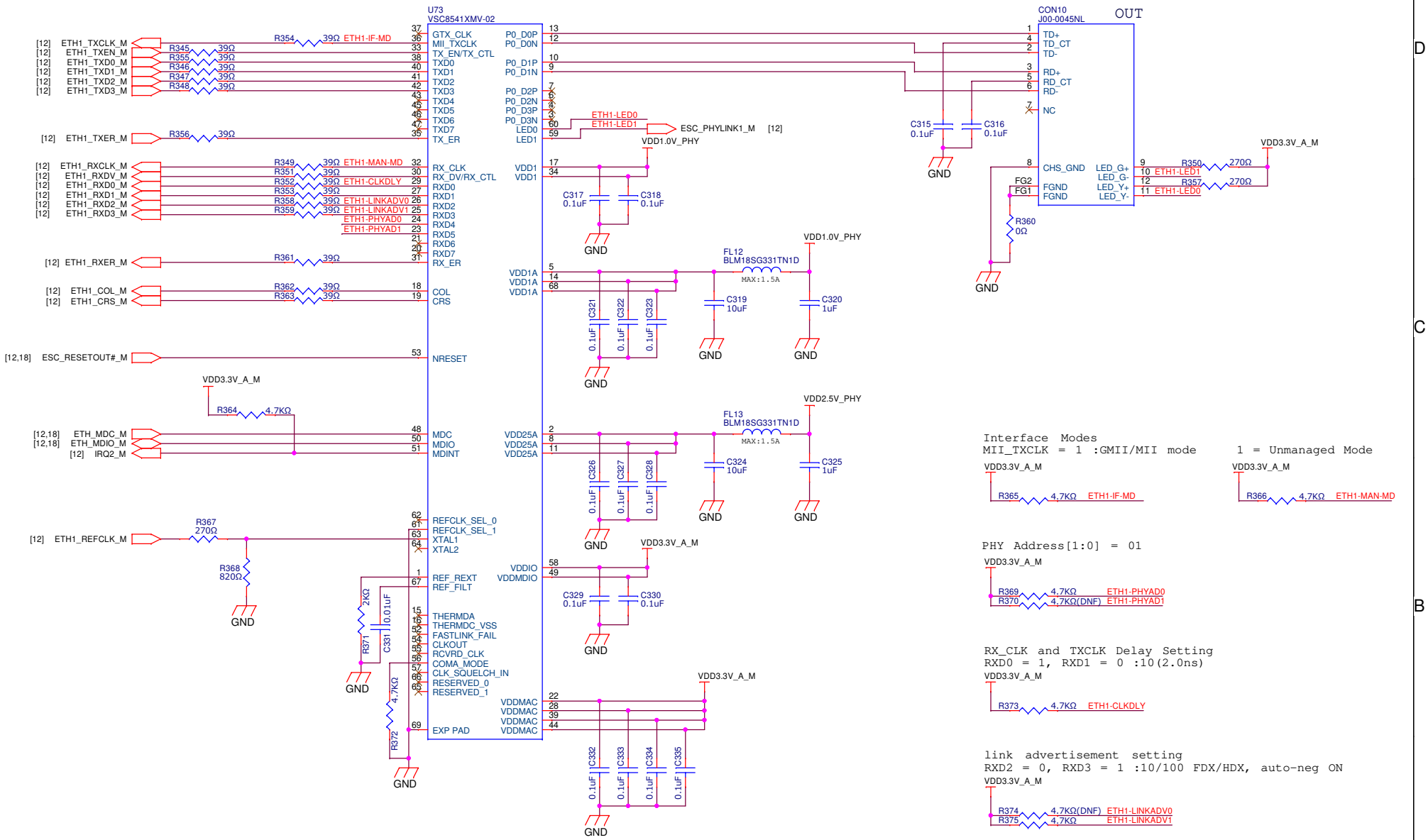
RX_CLK and TXCLK Delay Setting
RXD0 = 1, RXD1 = 0 :10(2.0ns)

VDD3.3V_A_M
R342 4.7KΩ ETH0-CLKDLY

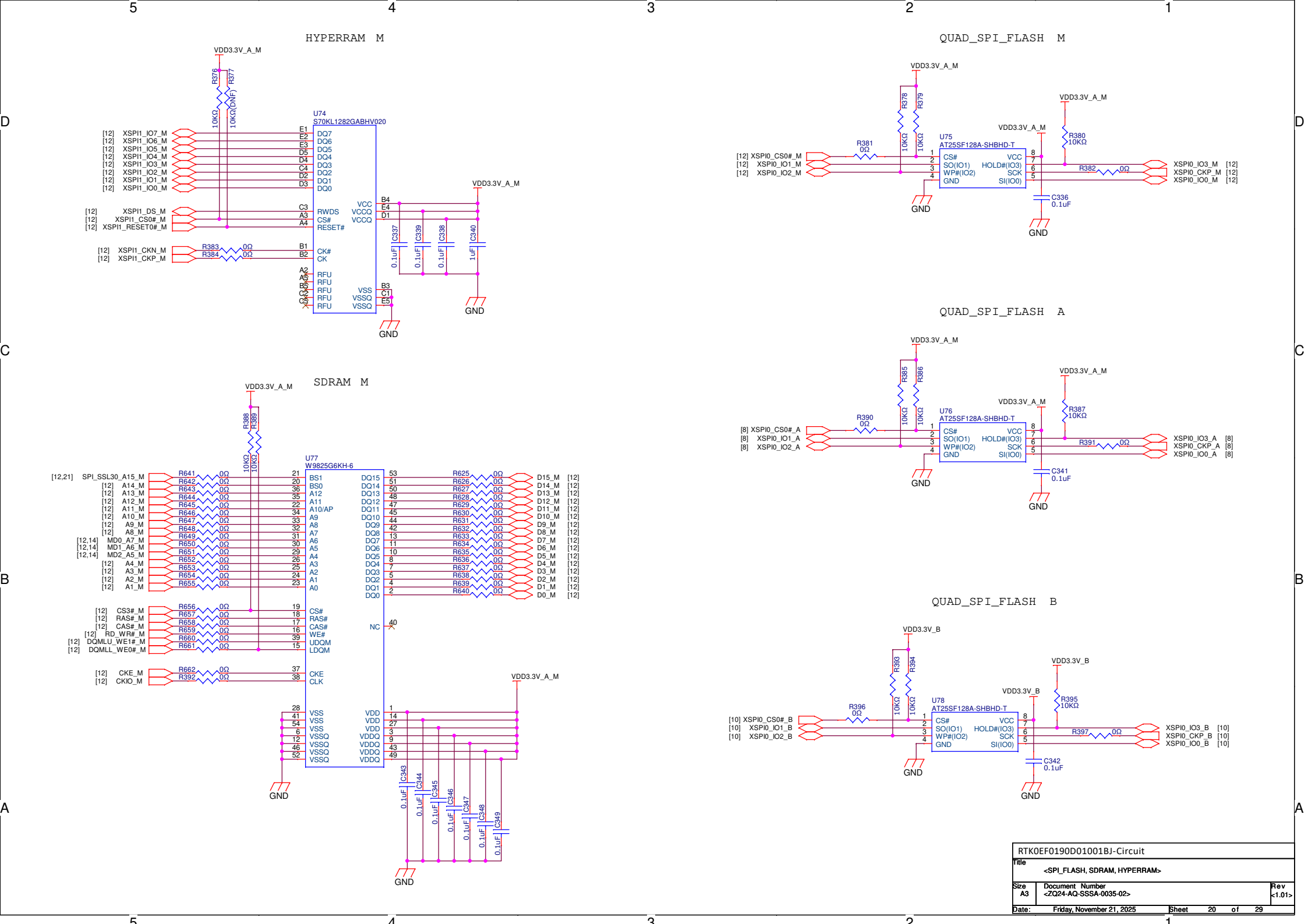
link advertisement setting
RXD2 = 0, RXD3 = 1 :10/100 FDX/HDX, auto-neg ON

VDD3.3V_A_M
R343 4.7KΩ(DNF) ETH0-LINKADV0
R344 4.7KΩ ETH0-LINKADV1

RTK0EF0190D01001BJ-Circuit		
Title <ETHERNET-P0 PHY RJ45-CON>		
Size A3	Document Number <ZQ24-AQ-SSSA-0035-02>	Rev <1.01>
Date: Friday, November 21, 2025	Sheet 18 of 29	



RTK0EF0190D01001BJ-Circuit			
Title	<ETHERNET-P1 PHY RJ45-CON>		
Size A3	Document Number <ZQ24-AQ-SSSA-0035-02>		Rev <1.01>
Date: Friday, November 21, 2025		Sheet 19 of 29	


HYPERRAM M
VDD3.3V_A_M
R376
R377
10KΩ
10KΩ(DNF)
U74
S70KL1282GABHV020
[12] XSPI1_IO7_M
[12] XSPI1_IO6_M
[12] XSPI1_IO5_M
[12] XSPI1_IO4_M
[12] XSPI1_IO3_M
[12] XSPI1_IO2_M
[12] XSPI1_IO1_M
[12] XSPI1_IO0_M
[12] XSPI1_DS_M
[12] XSPI1_CS0#_M
[12] XSPI1_RESET0#_M
[12] XSPI1_CKN_M
[12] XSPI1_CKP_M
R383 0Ω
R384 0Ω
DQ7
DQ6
DQ5
DQ4
DQ3
DQ2
DQ1
DQ0
RWDS
CS#
RESET#
CK#
CK
RFU
VCC
VCCQ
VSS
VSSQ
C337 0.1uF
C339 0.1uF
C338 0.1uF
C340 1uF
GND
QUAD_SPI_FLASH M
R378
R379
10KΩ
R381 0Ω
U75
AT25SFF128A-SHBHD-T
[12] XSPI0_CS0#_M
[12] XSPI0_IO1_M
[12] XSPI0_IO2_M
CS#
SO(IO1)
WP#(IO2)
GND
VCC
HOLD#(IO3)
SCK
SI(IO0)
R380 10KΩ
R382 0Ω
XSPI0_IO3_M [12]
XSPI0_CKP_M [12]
XSPI0_IO0_M [12]
C336 0.1uF
SDRAM M
R388
R389
10KΩ
U77
W9825G6KH-6
[12,21] SPI_SSL30_A15_M
[12] A14_M
[12] A13_M
[12] A12_M
[12] A11_M
[12] A10_M
[12] A9_M
[12] A8_M
[12,14] MD0_A7_M
[12,14] MD1_A6_M
[12,14] MD2_A5_M
[12] A4_M
[12] A3_M
[12] A2_M
[12] A1_M
[12] CS3#_M
[12] RAS#_M
[12] CAS#_M
[12] RD_WR#_M
[12] DQMLU_WE1#_M
[12] DQMLL_WE0#_M
[12] CKE_M
[12] CKIO_M
BS1
BS0
A12
A11
A10/AP
A9
A8
A7
A6
A5
A4
A3
A2
A1
A0
CS#
RAS#
CAS#
WE#
UDQM
LDQM
CKE
CLK
NC
DQ15
DQ14
DQ13
DQ12
DQ11
DQ10
DQ9
DQ8
DQ7
DQ6
DQ5
DQ4
DQ3
DQ2
DQ1
DQ0
D15_M [12]
D14_M [12]
D13_M [12]
D12_M [12]
D11_M [12]
D10_M [12]
D9_M [12]
D8_M [12]
D7_M [12]
D6_M [12]
D5_M [12]
D4_M [12]
D3_M [12]
D2_M [12]
D1_M [12]
D0_M [12]
VSS
VDD
VSSQ
VDDQ
C343 0.1uF
C344 0.1uF
C345 0.1uF
C346 0.1uF
C347 0.1uF
C348 0.1uF
C349 0.1uF
QUAD_SPI_FLASH A
R385
R386
10KΩ
R390 0Ω
U76
AT25SFF128A-SHBHD-T
[8] XSPI0_CS0#_A
[8] XSPI0_IO1_A
[8] XSPI0_IO2_A
R387 10KΩ
R391 0Ω
XSPI0_IO3_A [8]
XSPI0_CKP_A [8]
XSPI0_IO0_A [8]
C341 0.1uF
QUAD_SPI_FLASH B
VDD3.3V_B
R393
R394
10KΩ
R396 0Ω
U78
AT25SFF128A-SHBHD-T
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[10] XSPI0_IO1_B
[10] XSPI0_IO2_B
R395 10KΩ
R397 0Ω
XSPI0_IO3_B [10]
XSPI0_CKP_B [10]
XSPI0_IO0_B [10]
C342 0.1uF
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Title
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Size A3
Document Number
<ZQ24-AQ-SSSA-0035-02>
Rev <1.01>
Date: Friday, November 21, 2025
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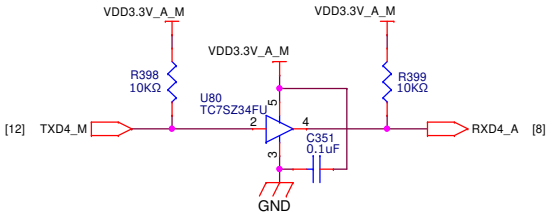
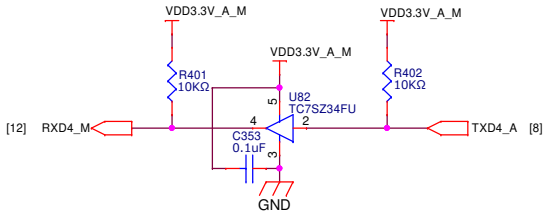
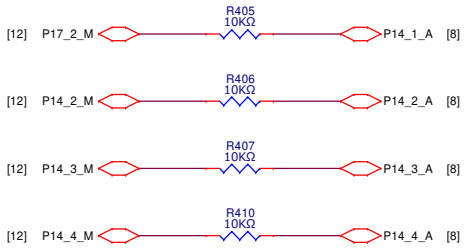
SERIAL I/F-1





GPIO I/F



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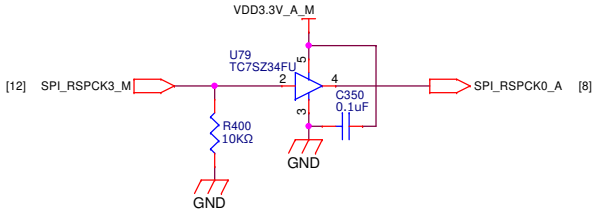

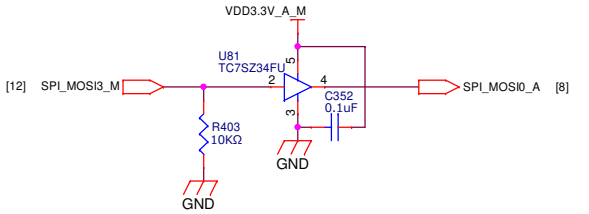

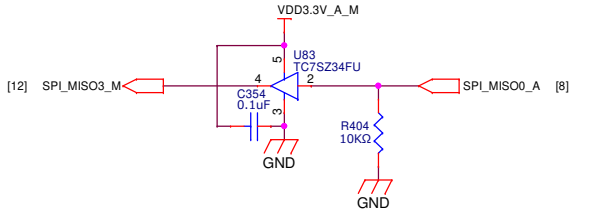

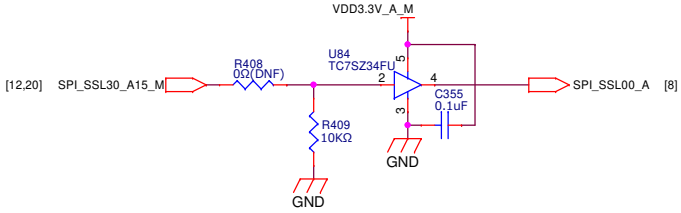

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Size A3	Document Number <ZQ24-AQ-SSSA-0035-02>	Rev <1.01>
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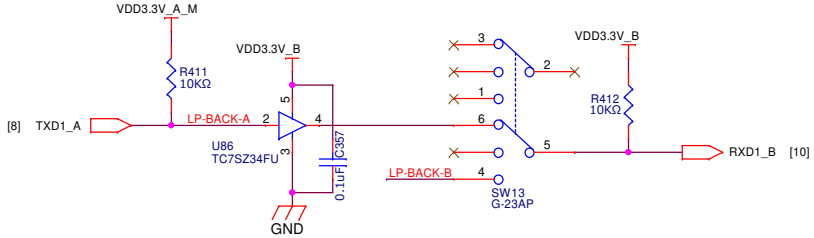
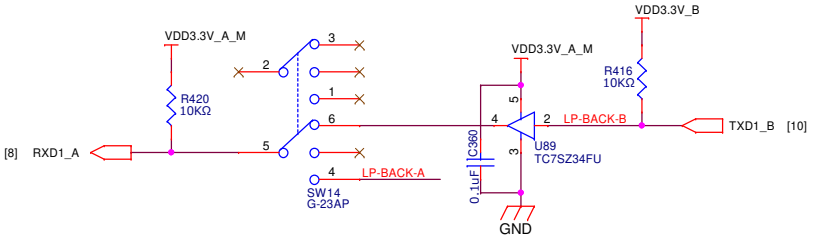
SERIAL I/F-1





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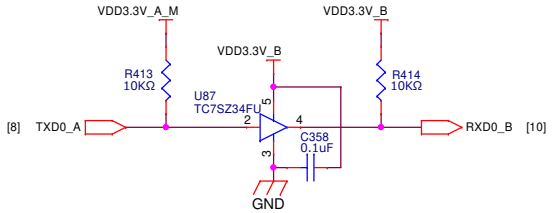

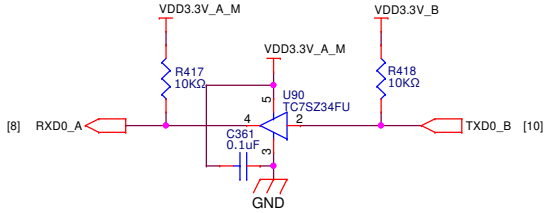

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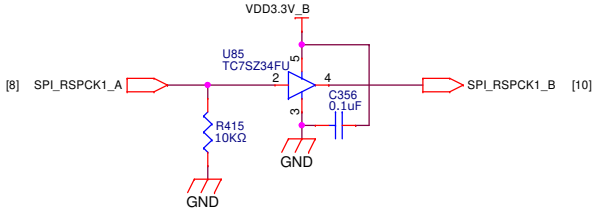
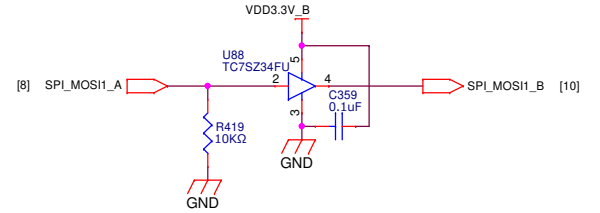
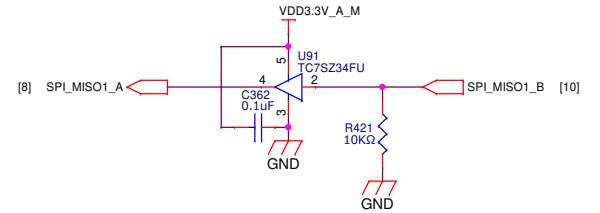
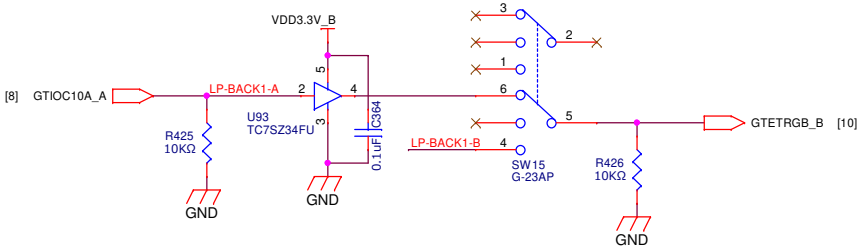
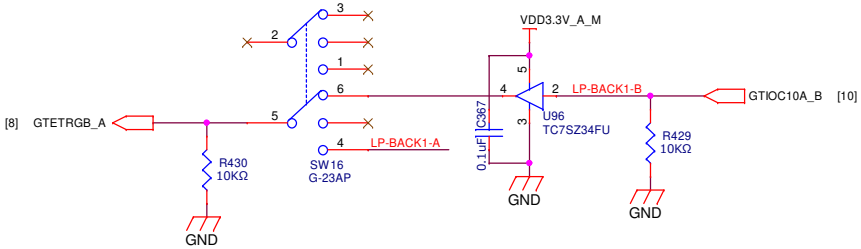






TIMER I/F





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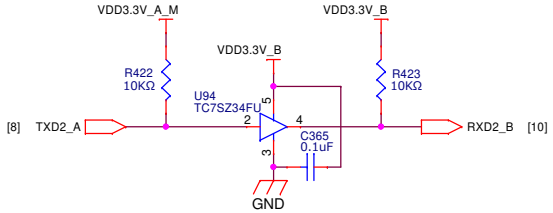

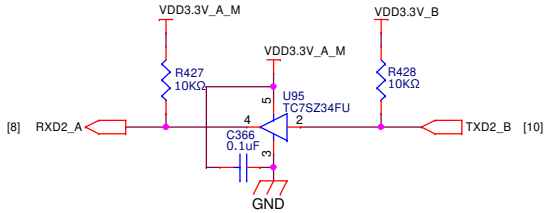

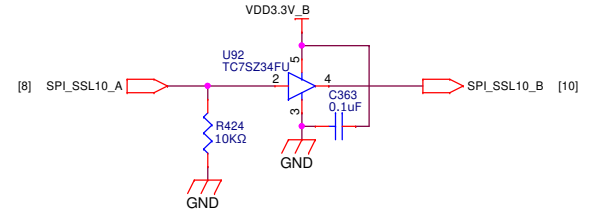

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Size A3	Document Number <ZQ24-AQ-SSSA-0035-02>	Rev <1.01>
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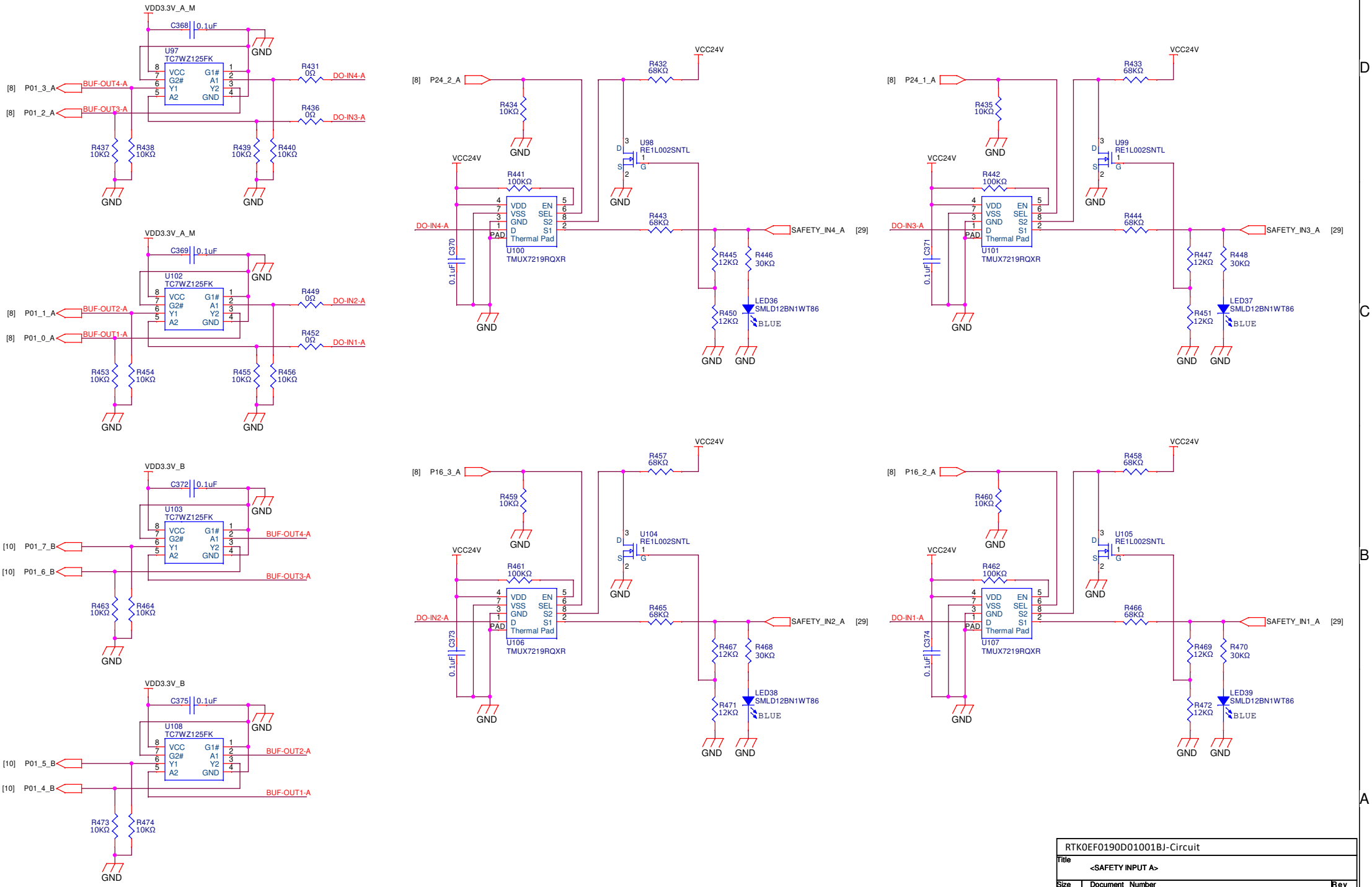
SAFETY INPUT A



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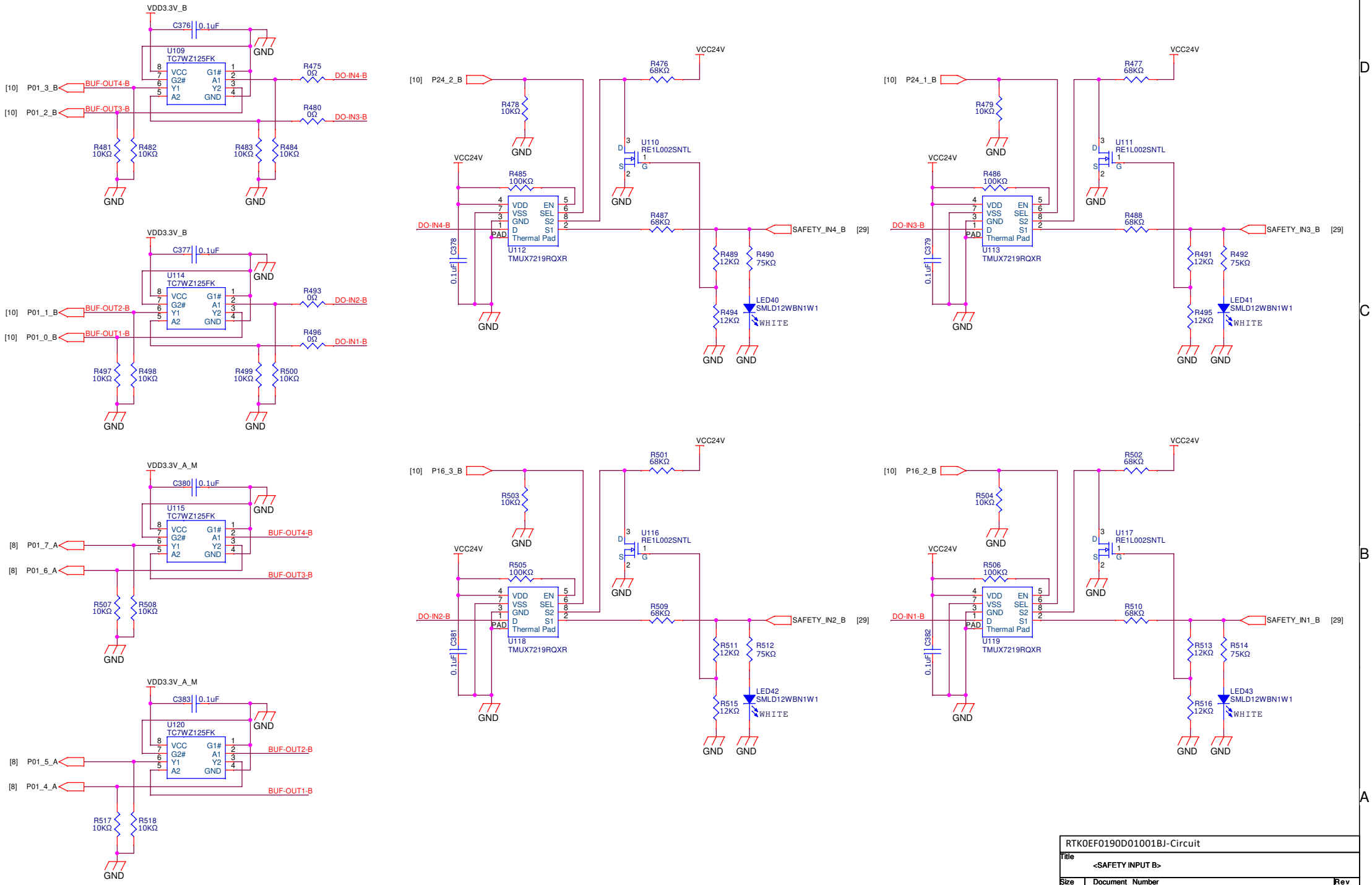
Size A3	Document Number <ZQ24-AQ-SSSA-0035-02>	Rev <1.01>
Date: Friday, November 21, 2025	Sheet 23 of 29	

SAFETY INPUT B



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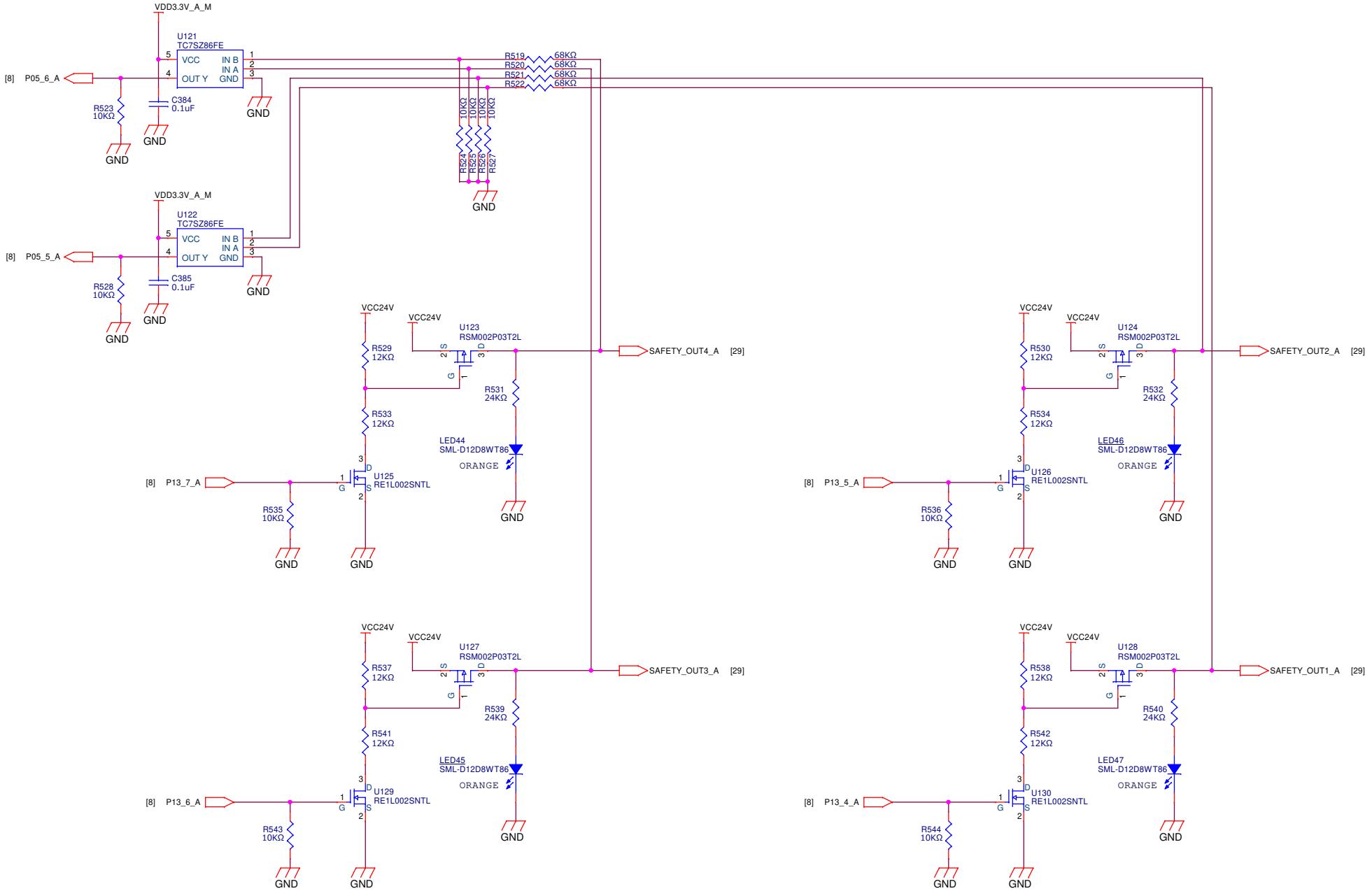
Title <SAFETY INPUT B>		
Size A3	Document Number <ZQ24-AQ-SSSA-0035-02>	Rev <1.01>
Date: Friday, November 21, 2025	Sheet 24 of 29	

SAFETY OUTPUT A



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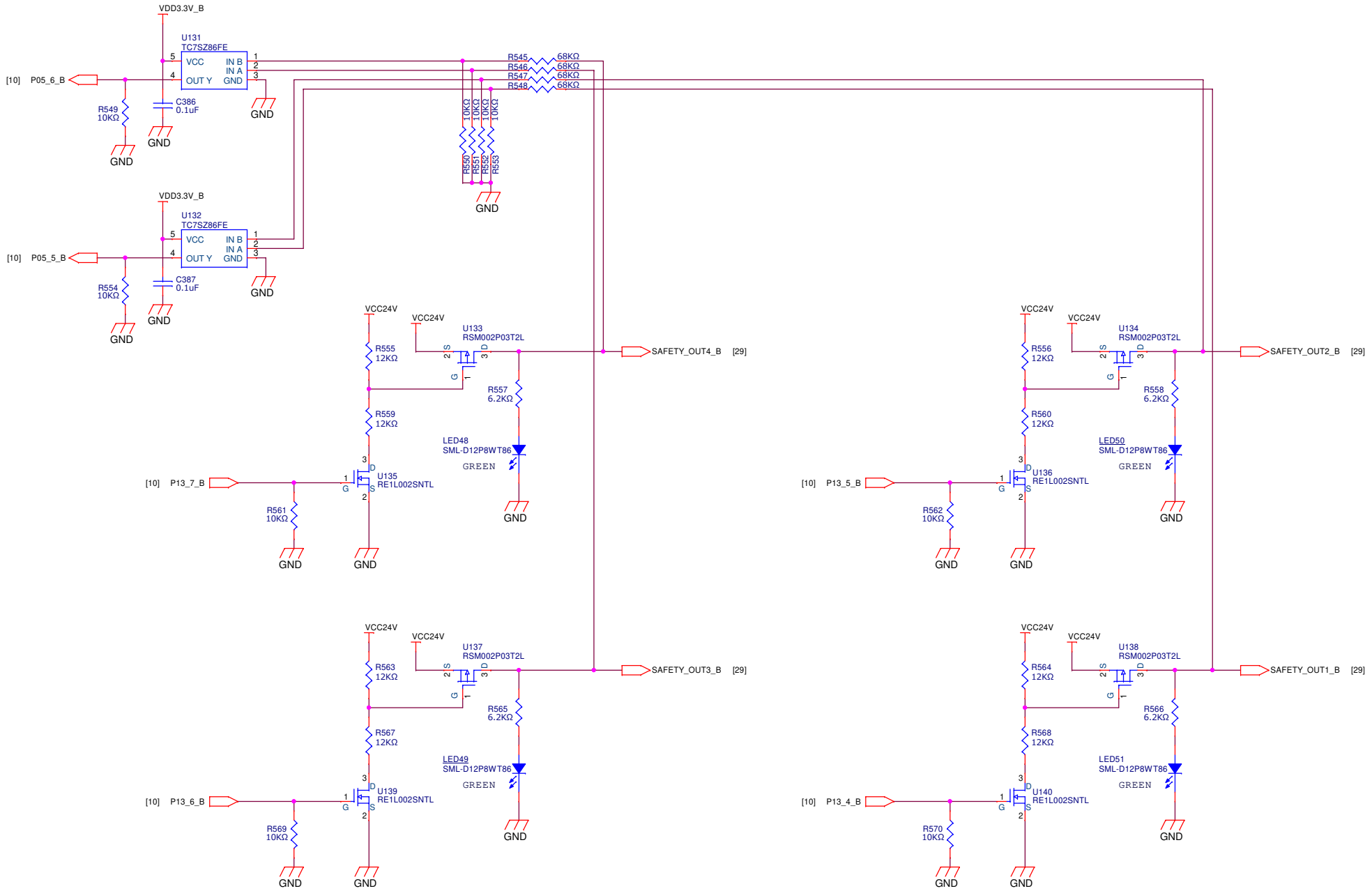
Title <SAFETY OUTPUT A>		
Size A3	Document Number <ZQ24-AQ-SSSA-0035-02>	Rev <1.01>
Date: Friday, November 21, 2025	Sheet 25 of 29	

SAFETY OUTPUT B



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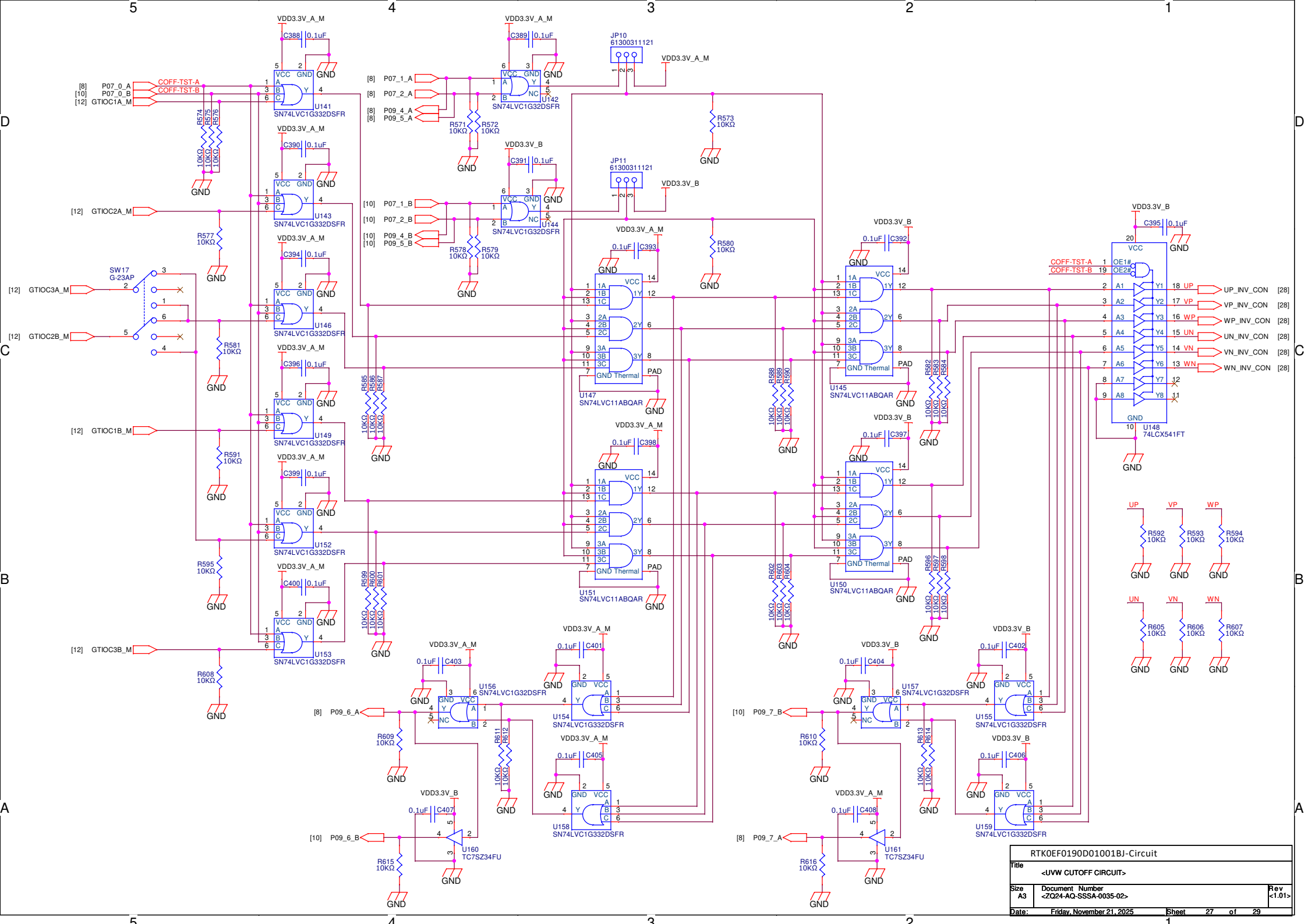
Size A3	Document Number <ZQ24-AQ-SSSA-0035-02>	Rev <1.01>
Date: Friday, November 21, 2025	Sheet 26 of 29	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COFF-TST-B
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GTIOC2A_M
GTIOC3A_M
GTIOC2B_M
GTIOC1B_M
GTIOC3B_M
P07_0_A
P07_0_B
P07_1_A
P07_2_A
P09_4_A
P09_5_A
P07_1_B
P07_2_B
P09_4_B
P09_5_B
P09_6_A
P09_6_B
P09_7_B
P09_7_A
SW17
G-23AP
JP10
61300311121
JP11
61300311121
U141
U142
U143
U144
U145
U146
U147
U148
U149
U150
U151
U152
U153
U154
U155
U156
U157
U158
U159
U160
U161
SN74LVC1G332DSFR
SN74LVC11ABQAR
74LCX541FT
TC7SZ34FU
VDD3.3V_A_M
VDD3.3V_B
GND
UP
VP
WP
UN
VN
WN
UP_INV_CON
VP_INV_CON
WP_INV_CON
UN_INV_CON
VN_INV_CON
WN_INV_CON
RTK0EF0190D01001BJ-Circuit
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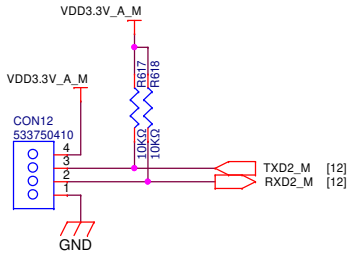
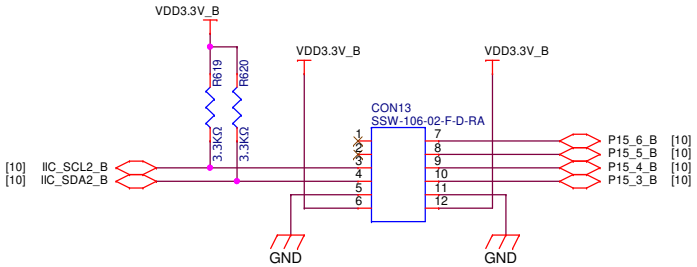
A3
<ZQ24-AQ-SSSA-0035-02>
<1.01>
Friday, November 21, 2025
27
29

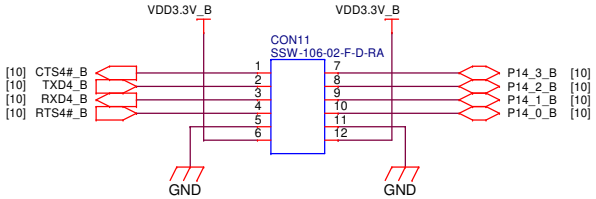
SCI CON



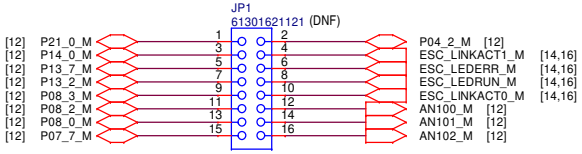
PMOD TYPE6A



PMOD TYPE3A

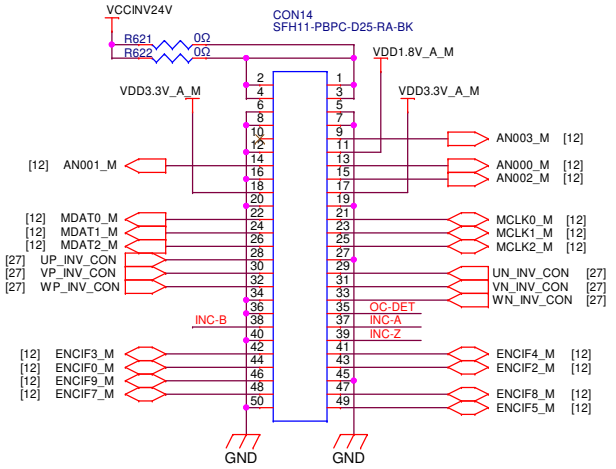


GPIO PIN HEADER1 M

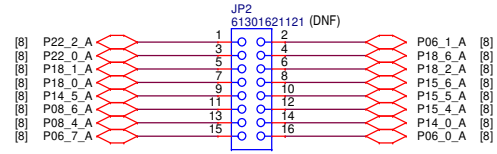


GND TEST PIN

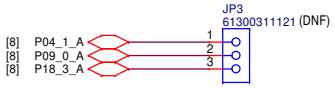
INVERTER CON

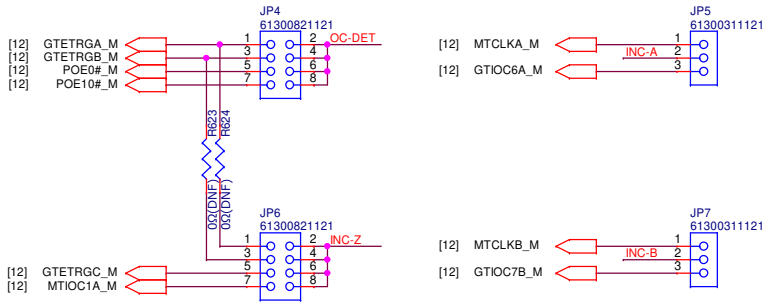


GPIO PIN HEADER1 A

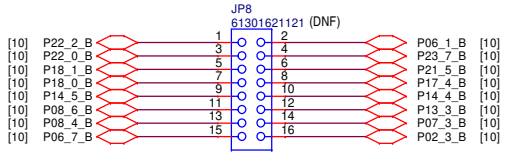


GPIO PIN HEADER2 A

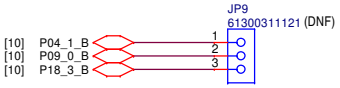




GPIO PIN HEADER1 B



RZ/T2L_B GPIO PIN HEADER2



GND TEST PIN

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Title <PMOD, PIN-HEADER, INV-CON>		
Size A3	Document Number <ZQ24-AQ-SSSA-0035-02>	Rev <1.01>
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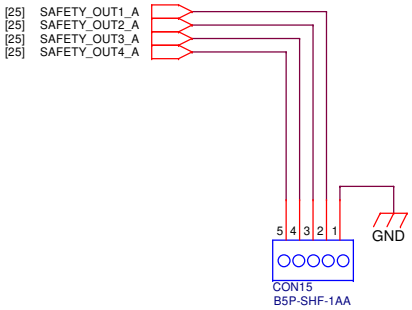
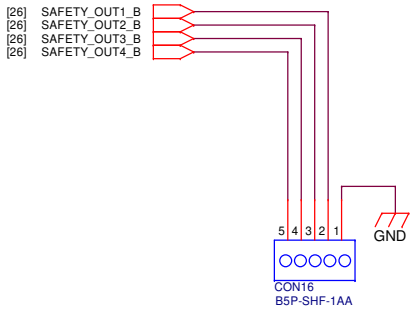
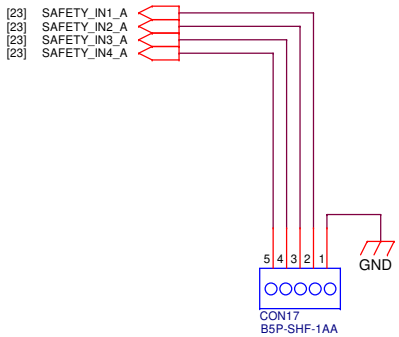
SAFETY OUTPUT A



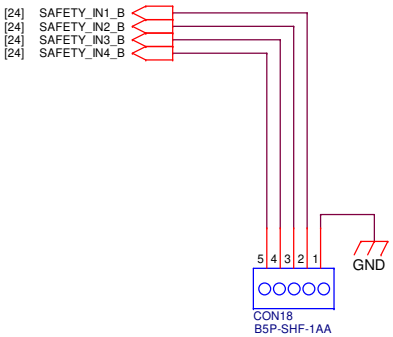
SAFETY OUTPUT B

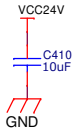


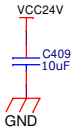
SAFETY INPUT A



SAFETY INPUT B







RTK0EF0190D01001BJ-Circuit		
Title <IO CONNECTOR>		
Size A3	Document Number <ZQ24-AQ-SSSA-0035-02>	Rev <1.01>
Date: Friday, November 21, 2025	Sheet 29 of 29	

5.2 Parts list

Table 5.2.1 Parts List (1 of 5)

No.	Part Name		Specification	
	Category	Part #	Model number	Manufacturer
1	IC	U1,U2	RAA211250GSP	Renesas
2	IC	U3,U4,U8,U9,U24,U25	ICL7665SAIBAZA	Renesas
3	IC	U5,U6	DA9080-61FCB2	Renesas
4	IC	U7	ISL8088IRZ	Renesas
5	IC	U10,U11,U14,U15,U19,U23,U26,U27,U30, U31,U35,U39,U47-U49,U98,U99,U104,U105, U110,U111,U116,U117,U125,U126,U129, U130,U135,U136,U139,U140	RE1L002SNTL	ROHM
6	IC	U12,U13,U18,U21,U28,U29,U34,U37,U45, U52,U56,U60,U61	TC7SZ04FE	Toshiba
7	IC	U16,U20,U32,U36	SN74LVC1G10DCKR	Texas Instruments
8	IC	U17,U22,U33,U38	MAX16052AUT+T	Analog Devices
9	IC	U40,U41	R9A07G074M04GBG	Renesas
10	IC	U42	R9A07G075M24GBG	Renesas
11	IC	U43,U50,U54	REAR56957BGSM	Renesas
12	IC	U44,U46,U51,U53,U55,U57	74LVC1G08GW,125	Nexperia
13	IC	U58	QS3VH257PAG8	Renesas
14	IC	U59	TC7SZ126FE	Toshiba
15	IC	U62,U64,U97,U102,U103,U108,U109,U114, U115,U120	TC7WZ125FK	Toshiba
16	IC	U63	R1EX24016ASAS0I	Renesas
17	IC	U65,U68,U69	FT232RNQ	FTDI
18	IC	U66,U67,U70,U71,U79-U96,U160,U161	TC7SZ34FU	Toshiba
19	IC	U72,U73	VSC8541XMV-02	Microchip Technology
20	IC	U74	S70KL1282GABHV020	Infineon Technologies
21	IC	U75,U76,U78	AT25SF128A-SHBHD-T	Renesas
22	IC	U77	W9825G6KH-6	Winbond
23	IC	U100,U101,U106,U107,U112,U113,U118, U119	TMUX7219RQXR	Texas Instruments
24	IC	U121,U122,U131,U132	TC7SZ86FE	Toshiba
25	IC	U123,U124,U127,U128,U133,U134,U137, U138	RSM002P03T2L	ROHM
26	IC	U141,U143,U146,U149,U152-U155,U158, U159	SN74LVC1G332DSFR	Texas Instruments
27	IC	U142,U144,U156,U157	SN74LVC1G32DSFR	Texas Instruments
28	IC	U145,U147,U150,U151	SN74LVC11ABQAR	Texas Instruments
29	IC	U148	74LCX541FT	Toshiba
30	Fuse	SI1	2016L150/33DR	Littelfuse
31	Crystal oscillator	X1-X2,X3	NX3225SA-25.000M-STD-CSR-6	NDK
32	Crystal oscillator	X4	FNETHE025	Diodes Incorporated
33	LED	LED1-LED4,LED35	SML-D12U8WT86	ROHM

NOTE: Parts that are interchangeable (e.g. general-purpose logic, resistor, capacitor) may be replaced with equivalents from other manufacturers.

NOTE 2: Parts marked in red do not fit

Table 5.2.2 Parts List (2 of 5)

No.	Part Name		Specification	
	Category	Part #	Model number	Manufacturer
34	LED	LED5-LED7	SML-D12Y8WT86	ROHM
35	LED	LED8-LED11,LED16-LED19,LED24-LED27	SML-D12M1WT86	ROHM
36	LED	LED12-LED15,LED20-LED23,LED28-LED31, LED44-LED47	SML-D12D8WT86	ROHM
37	LED	LED32-LED34,LED48-LED51	SML-D12P8WT86	ROHM
38	LED	LED36-LED39	SMLD12BN1WT86	ROHM
39	LED	LED40-LED43	SMLD12WBN1W1	ROHM
40	Diode	D1,D3	PDZVTR5.6B	ROHM
41	Diode	D2	PDZVTR27B	ROHM
42	Diode	D4,D5	PDZVTR3.6B	ROHM
43	Diode	D6,D7	PDZVTR2.2B	ROHM
44	Diode	D8,D9	MMSZ4678T1G	onsemi
45	Diode	D10	RCLAMP0582N	Semtech
46	Diode	D11	UCLAMP0571P	Semtech
47	Connector	CON1	691214310002	Würth Elektronik
48	Connector	CON2-CON4	FTSH-110-01-L-DV-007-K	Samtec
49	Connector	CON5-CON8	629105150521	Würth Elektronik
50	Connector	CON9,CON10	J00-0045NL	Pulse Electronics
51	Connector	CON11,CON13	SSW-106-02-F-D-RA	Samtec
52	Connector	CON12	533750410	Molex
53	Connector	CON14	SFH11-PBPC-D25-RA-BK	Sullins Connector Solutions
54	Connector	CON15-CON18	B5P-SHF-1AA	JST
55	Switch	SW1,SW7,SW9,SW11	A6SN-3104	Omron Electronics
56	Switch	SW2	GB-25AP	NKK Switches
57	Switch	SW3-SW5	A6H-4101	Omron Electronics
58	Switch	SW6,SW8,SW10	SKTHBAE010	Alps Alpine
59	Switch	SW12	CVS-08TB	Nidec Components
60	Switch	SW13-SW17	G-23AP	NKK Switches
61	Jumper	JP1,JP2,JP8	61301621121	Würth Elektronik
62	Jumper	JP5,JP7,JP10,JP11 JP3,JP9	61300311121	Würth Elektronik
63	Jumper	JP4,JP6	61300821121	Würth Elektronik
64	Capacitor	C1,C12,C22,C24,C63,C64,C73-C76,C79, C81-C84,C86,C88,C89,C91,C92,C95, C97-C100,C102,C246,C248-C250,C252, C254-C258,C260-C262,C264-C270,C272, C275,C276,C278,C280,C282,C283, C288-C296,C299-C301,C305-C309, C311-C318,C321-C323,C326-C330, C332-C339,C341-C408 C68,C302	C1005X7R1H104K050BB	TDK

NOTE 1: Parts that are interchangeable (e.g. general-purpose logic, resistor, capacitor) may be replaced with equivalents from other manufacturers.

NOTE 2: Parts marked in red do not fit.

Table 5.2.3 Parts List (3 of 5)

No.	Part Name		Specification	
	Category	Part #	Model number	Manufacturer
65	Capacitor	C103,C107-C111,C115-C128,C131-C133, C135,C137,C138,C142,C145-C147, C151-C154,C158-C170,C173-C176,C178, C180,C181,C189,C194,C196-C199, C203-C215,C217-C227,C229,C231,C233, C235,C241-C245	GRM033R61E104KE14D	Murata
66	Capacitor	C2,C3,C13,C14	GRT31CR61A476KE13L	Murata
67	Capacitor	C25,C29,C31,C32,C37,C38,C40,C41, C45-C50,C55-C62,C182-C185,C190,C191, C195,C200,C201,C216,C236	GRM188R60J476ME15D	Murata
68	Capacitor	C4-C7,C9,C10,C16-C19,C409,C410	GRM21BR61H106KE43L	Murata
69	Capacitor	C26,C27,C34,C35,C39,C42-C44,C51,C52, C65,C66,C69,C104-C106,C114,C129,C130, C134,C136,C139-C141,C148-C150,C157, C171,C172,C177,C179,C186-C188,C228, C230,C232,C234,C240,C297,C303,C319, C324	GRM155R61A106ME11D	Murata
70	Capacitor	C8,C15,C251,C277,C298,C304,C320,C325, C340	C1005X5R1V105K050BC	TDK
71	Capacitor	C11,C20,C28,C30,C33,C36,C271,C281,C285	C1005X5R1A475K050BC	TDK
72	Capacitor	C21,C23,C71,C72,C77,C78,C80,C85,C87, C90,C93,C94,C96,C101,C263	C1005C0G1H102J050BA	TDK
73	Capacitor	C53,C54,C112,C113,C155,C156,C202,C237	C1608X5R1A226M080AC	TDK
74	Capacitor	C67,C70,C143,C144,C192,C193 ,C239	C1005C0G1H100D050BA	TDK
75	Capacitor	C247,C253,C259	C1005X5R1V474K050BC	TDK
76	Capacitor	C273,C274,C279,C284,C286,C287	C1005C0G1H470J050BA	TDK
77	Capacitor	C310,C331	C1005X7R1H103K050BB	TDK
78	Capacitor	C411	GRM1885C1H103JA01D	Murata
79	Resistor	C238	MCR01MZPF1003	ROHM
80	Resistor	R13,R14,R110,R117,R125,R138,R157,R174, R194,R203-R205,R213-R215,R284,R306, R307,R381-R384,R390-R392,R396,R397, R431,R436,R449,R452,R475,R480,R493, R496,R625-R662 R408,R623,R624	ERJ-2GE0R00X	Panasonic
81	Resistor	R280,R282,R302,R304,R327,R360	ERJ-3GEY0R00V	Panasonic
82	Resistor	R1,R6,R21-R24,R27,R28,R621,R622	PMR10EZPJ000	ROHM
83	Resistor	R2,R7	ERJ-2RKF1053X	Panasonic
84	Resistor	R3,R4,R8,R43	ERJ-2RKF2002X	Panasonic
85	Resistor	R5,R33-R35,R37	ERJ-2RKF1301X	Panasonic

NOTE 1: Parts that are interchangeable (e.g. general-purpose logic, resistor, capacitor) may be replaced with equivalents from other manufacturers.

NOTE 2: Parts marked in red do not fit.

Table 5.2.4 Parts List (4 of 5)

No.	Part Name		Specification	
	Category	Part #	Model number	Manufacturer
86	Resistor	R9-R12,R41,R44,R47-R50,R59,R60,R65, R67,R68,R72-R75,R78-R81,R90,R91, R97-R99,R103-R106,R111,R113-R115, R118,R120-R122,R126-R136,R140-R155, R158-R172,R175-R185,R189-R191, R195-R202,R206-R212,R218,R219,R221, R222,R230,R232-R235,R243-R245,R247, R248,R257,R259,R260,R262-R270, R272-R279,R285,R288-R301,R308,R310, R376,R378-R380,R385-R389,R393-R395, R398-R407,R409-R430,R434,R435, R437-R440,R453-R456,R459,R460,R463, R464,R473,R474,R478,R479,R481-R484, R497-R500,R503,R504,R507,R508,R517, R518,R523-R528,R535,R536,R543,R544, R549-R554,R561,R562,R569-R618 R40,R193,R286,R309,R311,R377	ERJ-2RKF1002X	Panasonic
87	Resistor	R15,R16	ERA-3AEB242V	Panasonic
88	Resistor	R17,R18	ERA-3AEB433V	Panasonic
89	Resistor	R19,R20	ERA-3AEB911V	Panasonic
90	Resistor	R25,R26	RC0402FR-0710RL	YAGEO
91	Resistor	R29-R32,R255,R256,R619,R620	ERJ-2RKF3301X	Panasonic
92	Resistor	R36,R38,R271	ERJ-2RKF2701X	Panasonic
93	Resistor	R39	ERJ-2RKF3163X	Panasonic
94	Resistor	R42,R46,R441,R442,R461,R462,R485,R486, R505,R506	ERJ-2RKF1003X	Panasonic
95	Resistor	R45	ERJ-2RKF6652X	Panasonic
96	Resistor	R51,R82	ERA-3AEB363V	Panasonic
97	Resistor	R52,R83	ERA-3AEB163V	Panasonic
98	Resistor	R53,R84	ERA-3AEB7682V	Panasonic
99	Resistor	R54,R85	ERA-3AEB303V	Panasonic
100	Resistor	R287,R446,R448,R468,R470	ERJ-2RKF3002X	Panasonic
101	Resistor	R55,R86	ERA-3AEB5232V	Panasonic
102	Resistor	R56,R61,R87,R92	ERA-3AEB823V	Panasonic
103	Resistor	R57,R88	ERA-3AEB4642V	Panasonic
104	Resistor	R58,R89	ERA-3AEB1622V	Panasonic
105	Resistor	R62,R93	ERA-3AEB333V	Panasonic
106	Resistor	R63,R64,R94,R95	ERA-3AEB5492V	Panasonic
107	Resistor	R66,R96	ERA-3AEB1962V	Panasonic
108	Resistor	R69,R76,R100,R107	ERA-3AEB393V	Panasonic
109	Resistor	R70,R77,R101,R108	ERA-3AEB223V	Panasonic

NOTE 1: Parts that are interchangeable (e.g. general-purpose logic, resistor, capacitor) may be replaced with equivalents from other manufacturers.

NOTE 2: Parts marked in red do not fit.

Table 5.2.5 Parts List (5 of 5)

No.	Part Name		Specification	
	Category	Part #	Model number	Manufacturer
110	Resistor	R71,R102	ERA-3AEB2262V	Panasonic
111	Resistor	R109,R116,R124	ERJ-2RKF1004X	Panasonic
112	Resistor	R112,R119,R123	ERJ-2RKF1801X	Panasonic
113	Resistor	R137,R156,R173,R216,R217,R220, R223-R229,R231,R236-R242,R246, R249-R253	ERJ-2RKF2201X	Panasonic
114	Resistor	R139	ERJ-2RKF1001X	Panasonic
115	Resistor	R186-R188	ERJ-2RKF5603X	Panasonic
116	Resistor	R192,R332,R339,R371	ERJ-2RKF2001X	Panasonic
117	Resistor	R254,R258,R261	ERJ-2RKF3300X	Panasonic
118	Resistor	R281,R303,R305	ERJ-2RKF5101X	Panasonic
119	Resistor	R283	ERJ-2RKF1502X	Panasonic
120	Resistor	R312-R319,R321,R322,R324-R326, R328-R330,R345-R349,R351-R356,R358, R359,R361-R363	ERJ-2RKF39R0X	Panasonic
121	Resistor	R320,R323,R336,R350,R357,R367	ERJ-2RKF2700X	Panasonic
122	Resistor	R333-R335,R341,R342,R344,R364-R366, R369,R372,R373,R375 R331,R338,R340,R343,R370,R374	ERJ-2RKF4701X	Panasonic
123	Resistor	R337,R368	ERJ-2RKF8200X	Panasonic
124	Resistor	R432,R433,R443,R444,R457,R458,R465, R466,R476,R477,R487,R488,R501,R502, R509,R510,R519-R522,R545-R548	ERJ-2RKF6802X	Panasonic
125	Resistor	R445,R447,R450,R451,R467,R469,R471, R472,R489,R491,R494,R495,R511,R513, R515,R516,R529,R530,R533,R534,R537, R538,R541,R542,R555,R556,R559,R560, R563,R564,R567,R568	ERJ-2RKF1202X	Panasonic
126	Resistor	R490,R492,R512,R514	ERJ-2RKF7502X	Panasonic
127	Resistor	R531,R532,R539,R540	ERJ-2RKF2402X	Panasonic
128	Resistor	R557,R558,R565,R566	ESR01MZPF6201	ROHM
129	Filter	FL1	BLM21PG221SN1D	Murata
130	Filter	FL2-FL9	BLM18PG300SN1D	Murata
131	Filter	FL10-FL13	BLM18SG331TN1D	Murata
132	Inductor	L1,L2	SPM5015T-6R8M-LR	TDK
133	Inductor	L3-L10	HMLQ25201B-R47MSR	Cyntec
134	Inductor	L11,L12	MLP2012S2R2MT0S1	TDK
135	Test pin	TP1-TP3	LC-22-G-Black	MAC8
136	Jumper socket	for JP4-JP7,JP10, JP11	60900213421	Würth Elektronik
137	Switch cap	for SW2	AT-4063-W	NKK

NOTE 1: Parts that are interchangeable (e.g. general-purpose logic, resistor, capacitor) may be replaced with equivalents from other manufacturers.

NOTE 2: Parts marked in red do not fit.

6. Revision History

Revision History	RZ/T2M + RZ/T2L × 2 Functional Safety Reference Board: User's Manual

Rev.	Date	Description	
		Page	Summary
1.00	Sep 03, 2024	—	First edition
1.01	Nov 21, 2025	50, 69, 71～73	Modification of schematic and bill of materials due to change of clock supply parts for RZ/T2M.

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General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)
   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on
   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state
   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins
   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals
   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin
   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
7. Prohibition of access to reserved addresses
   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.
8. Differences between products
   Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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