

RZ/T2H Group

Bus Board for RZ/T2H User's Manual

Renesas RZ Family
RZ/T Series

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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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For Your Safety





Be sure to read the precautions and instructions in this manual before using this product.

Meaning of Notations







In this manual, items related to the safe use of the product are indicated as described below. The degree of injury to persons or damage to property that could result if the designated content in this manual is not followed is indicated as follows.

 Danger	Indicates content that, if not followed, could result in death or serious injury to the user, and which is highly urgent.
 Warning	Indicates content that, if not followed, could result in death or serious injury to the user.
 Caution	Indicates content that, if not followed, could result in injury to persons or physical damage.





Warnings Regarding Use of the Product**■ Danger Items**

 Danger	
  	<ul style="list-style-type: none"> • The product should be used only by persons (users) having a thorough knowledge of electrical and mechanical components and systems, a full knowledge of the risks associated with handling them, and training in inverter motor control and handling motors, or equivalent skills. Users should be limited to persons who have carefully read the Caution Items contained in this manual. • The product contains high-temperature components that could be dangerous. Do not touch the product or cables while power is being supplied. • Carefully check to make sure that there are no pieces of conductive materials or dust adhering to the board, connectors, and cables. • Do not touch the motor while power is being supplied. • Ensure that the motor is insulated and placed in a stable location before supplying power.

■ Warning Items

 Warning	
	High voltage is applied to the terminals during operation and for 30 seconds after power shutdown. Do not touch the terminals or the product during this period.
	Always insert plugs, connectors, and cables securely, and confirm that they are fully inserted. Incomplete connections could cause fire, burns, electric shock, or injury.
	Use the power supply apparatus specified in the manual. Failure to do so could cause fire, burns, electric shock, injury, or malfunction.
	Disconnect the power supply and unplug all cables when the system will not be used for a period of time or when moving the system. Failure to do so could cause fire, burns, electric shock, or malfunction. This will protect the system against damage due to lightning.
	Use a mechanism (switch, outlet, etc.) located within reach to turn off (disconnect) the power supply. In case of emergency, it may be necessary to cut off the power supply quickly.
	In this product, the ground of the main power supply circuit is connected to the ground of the CPU board. When the user evaluates the product, be aware that the product and the measuring instruments may be damaged depending on the connection method of the measuring instruments.
	Turn off the power supply immediately if you notice abnormal odor, smoke, abnormal sound, or overheating. Continuing to use the system in an abnormal condition could cause fire, burns, or electric shock.
	Do Not Disassemble, Modify, or Repair! Doing so could cause fire, burns, electric shock, injury, or malfunction.
	Do not use the product for any purpose other than initial evaluation of motor control in a testing room or lab. Do not integrate the product or any part of it into other equipment. Do not insert or remove cables or connectors when the product is powered on. The product has no safety case. The user must cover the product for safety protection. Failure to observe the above could cause fire, electric shock, burns, or malfunction. The product may not perform as expected if used for other than its intended purpose.

■ Caution Items

 Caution	
	Caution – Hot! The motor gets hot. Touching it could cause high-temperature burns.
	Follow the procedure specified in the manual when powering the system on or off. Failure to do so could cause overheating or malfunction.
	Caution – Static Electricity Use the antistatic band. Failure to do so could cause malfunction or unstable motion.

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1. Overview

Bus Board for RZ/T2H (hereafter, Bus Board) is an interface board to RZ/T Series Inverter Board (hereafter, Inverter Board) and RZ/T2H Evaluation Board. This product makes it easy to connect up to nine RZ/T Series Inverter Boards.

Bus Board has the following features.

- (1) Up to nine RZ/T Series Inverter Boards can be connected
- (2) Functional safety: Cuts off the PWM signals for nine axes
- (3) Detects 24V bus voltage
- (4) Detects overcurrent for nine axes

For use of this product, RZ/T2H Evaluation Board Kit and RZ/T Series Inverter Board (or an RZ/T Series Inverter Board Kit) are required. The product numbers to order RZ/T2H Evaluation Board and RZ/T Series Inverter Board (RZ/T Series Inverter Board Kit) are shown below.

RZ/T2H Evaluation Board Kit: RTK9RZT2H0S00000BJ
RZ/T Series Inverter Board: RTK0EM0000B15010BJ
RZ/T Series Inverter Board Kit: RTK0EM0000S05010BJ

1.1 Presupposition and Precautions of This Document

1. Experience of using tools: This document assumes that the user has used terminal emulation program of Integrated Development Environment (IDE) such as e² studio before.
2. Knowledge about the development subject: This document assumes that the user has a basic knowledge to modify the sample project regarding MCU/MPU and embedded system.
3. Before using this product, wear an antistatic wrist strap. If you touch this product with static charge on your body, a device failure may occur, or operation may become unstable.
4. All screen shots provided in this document is for reference. Actual screen displays may differ depending on the software and development tool version which you use.

2. Product Contents

This product consists of the following parts.

1. Bus Board (RTK0EM0000Z03000BJ) x1
2. 36-pin Flat cable x3
3. 30-pin Flat cable x5
4. 10-pin Flat cable x1
5. 1-pin cable x1

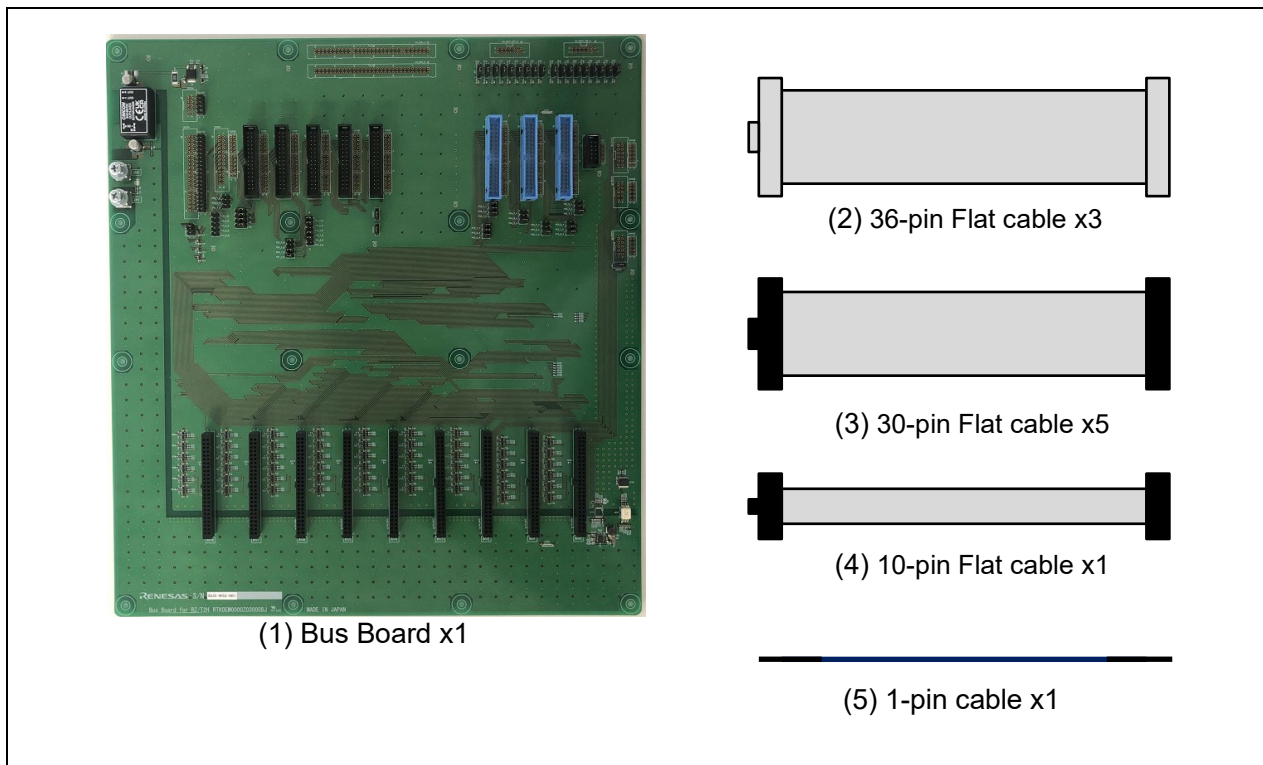


Figure 2-1 Product contents

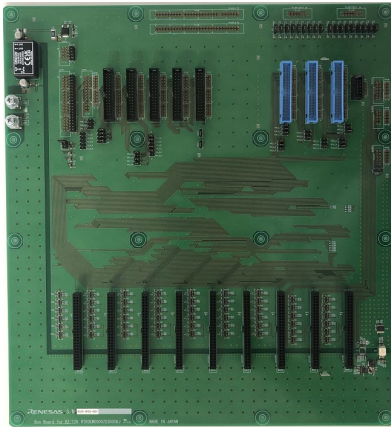
3. Product Order Information

Product number to order Bus Board: RTK0EM0000Z03000BJ

4. Hardware Configuration and Default Settings

4.1 Hardware Configuration

Table 4-1 Bus Board Specification

Item	Specification
Model name	Bus Board for RZ/T2H
Product number	RTK0EM0000Z03000BJ
External view	 <p>Note: The actual product may differ from this photo.</p>
Power supply input	DC24V
Board size	350mm(W)×381mm(L)
Operating temperature	Room temperature
Operating humidity	No condensation allowed
EMC Directive	EN61326-1:2021 EMI: Class A EMS: Industrial Electromagnetic environment
DC bus voltage detection (bus voltage detection)	Detection by resistance division
Overcurrent detection function	Uses logical OR for the overcurrent detection signals of each inverter board and outputs the result to RZ/T2H Evaluation Board
Connector	<ul style="list-style-type: none"> • Power input connector • Connector for Inverter Board x9 • Connector for RZ/T2H Evaluation Board x15 (6 connectors :DNP) • Connector for functional safety MCU PWM cutoff x2 (DNP) • Connector for functional safety MCU PWM monitoring x2 (DNP)
LED	<ul style="list-style-type: none"> • Power LED x1

4.2 Block Diagram

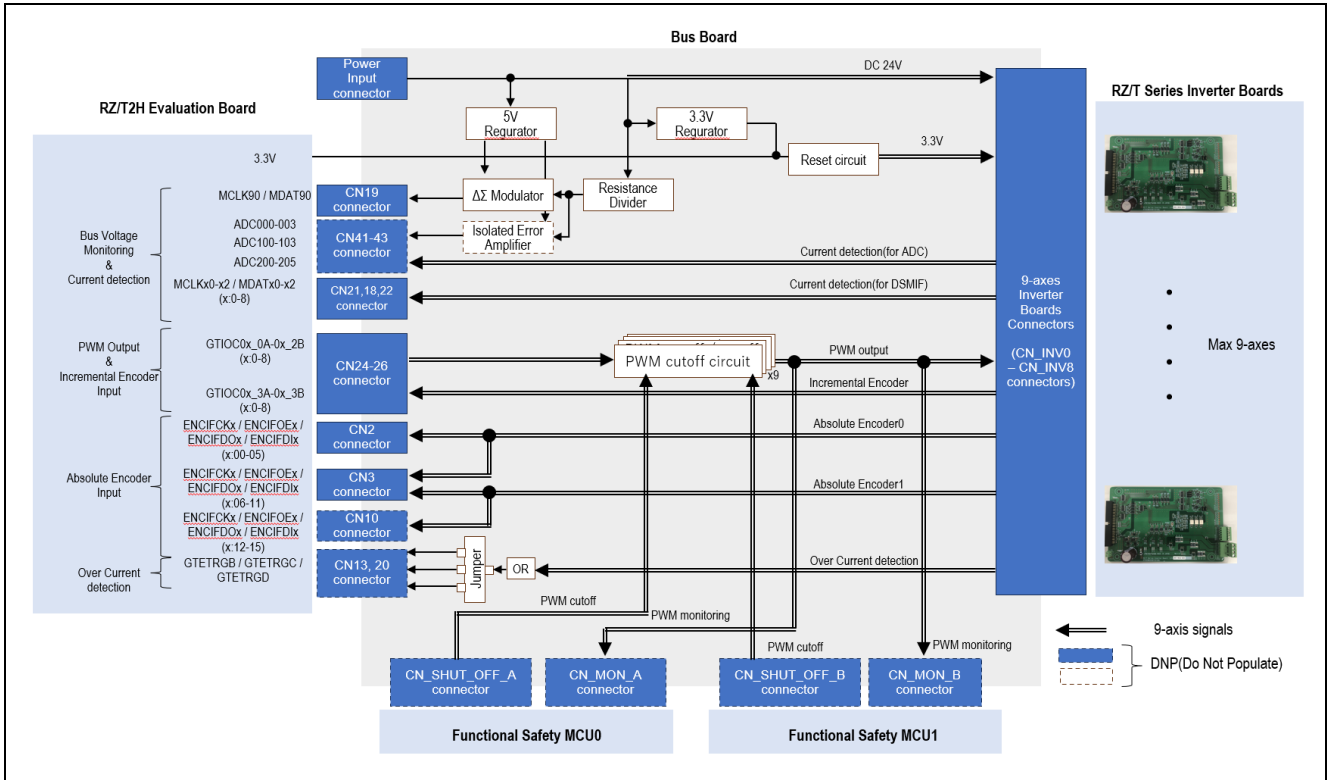


Figure 4-1 Bus Board block diagram

4.3 Board Layout

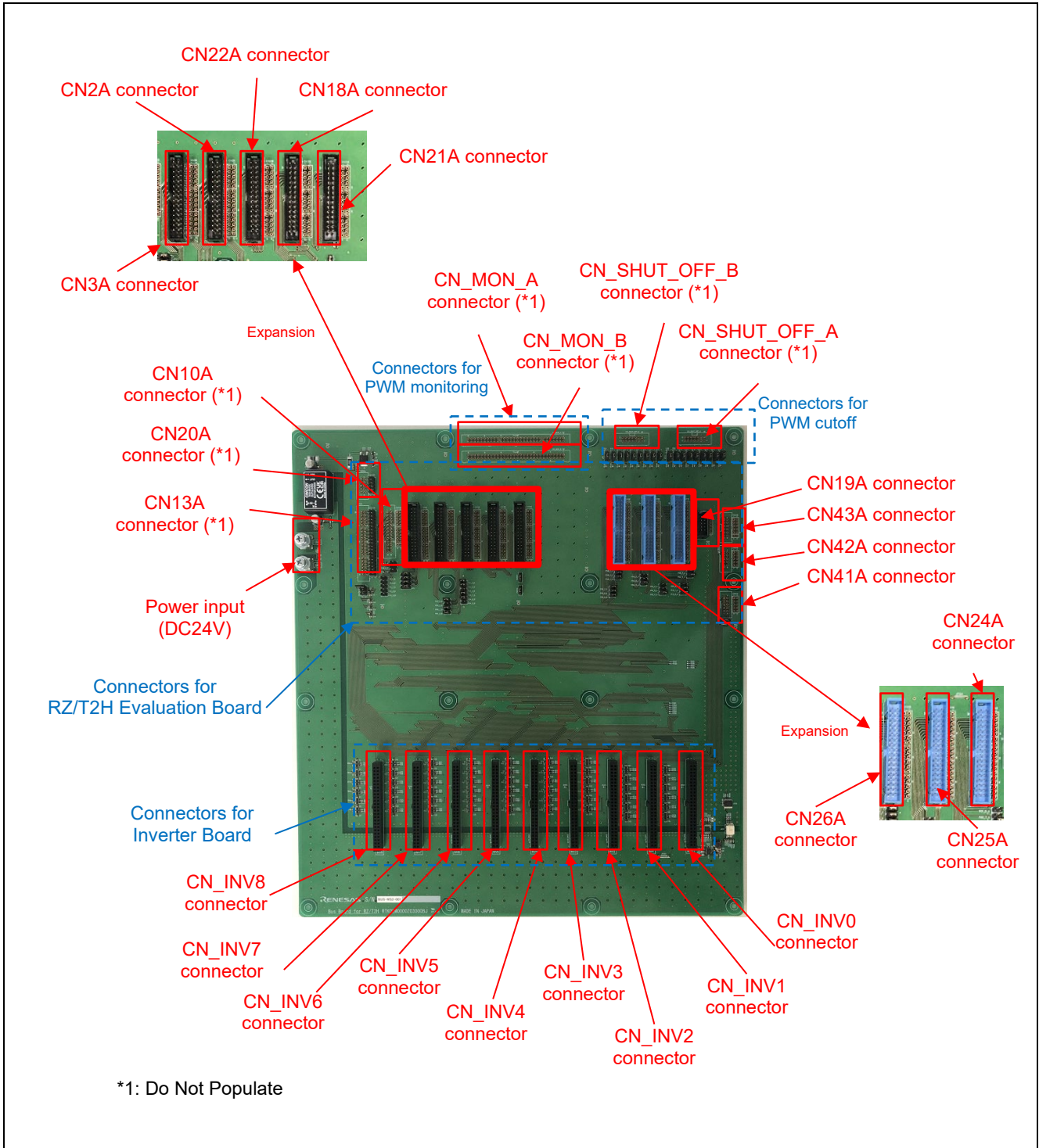


Figure 4-2 Bus Board Initial settings

4.4 Jumper Pin Settings

4.4.1 Bus Board

Default settings and functions of the jumper pins are shown below.

Table 4-2 Jumper pins of Bus Board

No	Jumper	Item	Description	Default(factory)
1	CN_OC_DET	Selection of overcurrent output pin	1-2 short:CN13:15_P17_4_GTETRGB 3-4 short:CN13:17_P17_5_GTETRGC 5-6 short:CN20:1_P17_6_GTETRGD	5-6 short
2	P00_6_A	Selection of P00_6 function	P00_6_A short: INV0:37pin	Short
	P00_6_B	Short either one to select the function	P00_6_B short: INV4:41pin	Open
3	P00_7_A	Selection of P00_7 function	P00_7_A short: INV0:38pin	Short
	P00_7_B	Short either one to select the function	P00_7_B short: INV4:42pin	Open
4	P01_0_A	Selection of P01_0 function	P01_0_A short: INV0:39pin	Short
	P01_0_B	Short either one to select the function	P01_0_B short: INV4:43pin	Open
5	P03_5_A	Selection of P03_5 function	P03_5_A short: INV2:39pin	Short
	P03_5_B	Short either one to select the function	P03_5_B short: INV2:43pin	Open
6	P04_5_A	Selection of P04_5 function	P04_5_A short: INV3:37pin	Short
	P04_5_B	Short either one to select the function	P04_5_B short: INV3:41pin	Open
7	P04_6_A	Selection of P04_6 function	P04_6_A short: INV3:38pin	Short
	P04_6_B	Short either one to select the function	P04_6_B short: INV3:42pin	Open
8	P04_7_A	Selection of P04_7 function	P04_7_A short: INV3:39pin	Short
	P04_7_B	Short either one to select the function	P04_7_B short: INV3:43pin	Open
9	P12_4_A	Selection of P12_4 function	P12_4_A short: INV5:37pin	Short
	P12_4_B	Short either one to select the function	P12_4_B short: INV5:41pin	Open
10	P12_5_A	Selection of P12_5 function	P12_5_A short: INV5:38pin	Short
	P12_5_B	Short either one to select the function	P12_5_B short: INV5:42pin	Open
11	P12_7_A	Selection of P12_7 function	P12_7_A short: INV5:39pin	Short
	P12_7_B	Short either one to select the function	P12_7_B short: INV5:44pin	Open
12	P13_0_A	Selection of P13_0 function	P13_0_A short: INV2:37pin	Short
	P13_0_B	Short either one to select the function	P13_0_B short: INV4:46pin	Open
13	P13_1_A	Selection of P13_1 function	P13_1_A short: INV2:38pin	Short
	P13_1_B	Short either one to select the function	P13_1_B short: INV4:47pin	Open
14	P13_5_A	Selection of P13_5 function	P13_5_A short: INV6:37pin	Short
	P13_5_B	Short either one to select the function	P13_5_B short: INV5:47pin	Open
15	P13_6_A	Selection of P13_6 function	P13_6_A short: INV6:38pin	Short
	P13_6_B	Short either one to select the function	P13_6_B short: INV5:48pin	Open
16	P13_7_A	Selection of P13_7 function	P13_7_A short: INV6:39pin	Short
	P13_7_B	Short either one to select the function	P13_7_B short: INV5:49pin	Open
17	P18_4_A	P18_4 function	P13_4_A short: INV7:37pin	Short
	P18_4_B	Short either one to select the function	P13_4_B short: INV6:46pin	Open
18	P18_5_A	P18_5 function	P13_5_A short: INV7:38pin	Short
	P18_5_B	Short either one to select the function	P13_5_B short: INV6:47pin	Open
19	P18_7_A	Selection of P18_7 function	P13_7_A short: INV7:39pin	Short
	P18_7_B	Short either one to select the function	P13_7_B short: INV6:49pin	Open
20	CN41C	INV0: 14pin(AN001_IV0) connection selection	CN41: 4pin (4_AN001_IV0)	2-3 short
21	CN21C	INV1: 24pin(MDAT11_A_IV) connection selection	CN21:16pin (16_P08_7_MDAT11_IV)	2-3 short
22	CN21D	INV1: 23pin(MCLK11_A_IV) connection selection	CN21:15pin (15_P08_6_MCLK11_IV)	2-3 short
23	JP1	CN3: 11pin(11_P28_5_ENCIFCK08)connection selection	1-2 short: INV0: 46pin (INV00_P28_5_ENCIFCK08)	2-3 short
			2-3 short: INV8: 46pin (INV08_P28_5_ENCIFCK08)	
24	JP2	CN3: 13pin(13_P28_6_ENCIFOE08) connection selection	1-2 short: INV0: 47pin (INV0_P28_6_ENCIFOE08)	2-3 short
			2-3 short: INV8: 47pin (INV8_P28_6_ENCIFOE08)	

No	Jumper	Item	Description	Default(factory)
25	JP3	CN3:15pin(15_P28_7_ENCIFDO08) connection selection	1-2 short: INV0: 48pin (INV0_P28_7_ENCIFDO08)	2-3 short
			2-3 short: INV8: 48pin (INV8_P28_7_ENCIFDO08)	
26	JP4	CN3:17pin(17_P29_0_ENCIFDI0) connection selection	1-2 short: INV0: 49pin (INV0_P29_0_ENCIFDI08)	2-3 short
			2-3 short: INV8: 49pin (INV8_P29_0_ENCIFDU08)	
27	JP5	/SHUT_OFF_8B (G_EN) Enable or disable (pullup)	1-2 short: /SHUT_OFF_8B(G_EN) enabled 2-3 short: /SHUT_OFF_8B(G_EN) disabled	2-3 short
28	JP6	/SHUT_OFF_7B (G_EN) Enable or disable (pullup)	1-2 short: /SHUT_OFF_7B(G_EN) enabled 2-3 short: /SHUT_OFF_7B(G_EN) disabled	2-3 short
29	JP7	/SHUT_OFF_6B (G_EN) Enable or disable (pullup)	1-2 short: /SHUT_OFF_6B(G_EN) enabled 2-3 short: /SHUT_OFF_6B(G_EN) disabled	2-3 short
30	JP8	/SHUT_OFF_5B (G_EN) Enable or disable (pullup)	1-2 short: /SHUT_OFF_5B(G_EN) enabled 2-3 short: /SHUT_OFF_5B(G_EN) disabled	2-3 short
31	JP9	/SHUT_OFF_4B (G_EN) Enable or disable (pullup)	1-2 short: /SHUT_OFF_4B(G_EN) enabled 2-3 short: /SHUT_OFF_4B(G_EN) disabled	2-3 short
32	JP10	/SHUT_OFF_3B (G_EN) Enable or disable (pullup)	1-2 short: /SHUT_OFF_3B(G_EN) enabled 2-3 short: /SHUT_OFF_3B(G_EN) disabled	2-3 short
33	JP11	/SHUT_OFF_2B (G_EN) Enable or disable (pullup)	1-2 short: /SHUT_OFF_2B(G_EN) enabled 2-3 short: /SHUT_OFF_2B(G_EN) disabled	2-3 short
34	JP12	/SHUT_OFF_1B (G_EN) Enable or disable (pullup)	1-2 short: /SHUT_OFF_1B(G_EN) enabled 2-3 short: /SHUT_OFF_1B(G_EN) disabled	2-3 short
35	JP13	/SHUT_OFF_0B (G_EN) Enable or disable (pullup)	1-2 short: /SHUT_OFF_0B(G_EN) enabled 2-3 short: /SHUT_OFF_0B(G_EN) disabled	2-3 short
36	JP14	/SHUT_OFF_8A (G_EN) Enable or disable (pullup)	1-2 short: /SHUT_OFF_8A(G_EN) enabled 2-3 short: /SHUT_OFF_8A(G_EN) disabled	2-3 short
37	JP15	/SHUT_OFF_7A (G_EN) Enable or disable (pullup)	1-2 short: /SHUT_OFF_7A(G_EN) enabled 2-3 short: /SHUT_OFF_7A(G_EN) disabled	2-3 short
38	JP16	/SHUT_OFF_6A (G_EN) Enable or disable (pullup)	1-2 short: /SHUT_OFF_6A(G_EN) enabled 2-3 short: /SHUT_OFF_6A(G_EN) disabled	2-3 short
39	JP17	/SHUT_OFF_5A (G_EN) Enable or disable (pullup)	1-2 short: /SHUT_OFF_5A(G_EN) enabled 2-3 short: /SHUT_OFF_5A(G_EN) disabled	2-3 short
40	JP18	/SHUT_OFF_4A (G_EN) Enable or disable (pullup)	1-2 short: /SHUT_OFF_4A(G_EN) enabled 2-3 short: /SHUT_OFF_4A(G_EN) disabled	2-3 short
41	JP19	/SHUT_OFF_3A (G_EN) Enable or disable (pullup)	1-2 short: /SHUT_OFF_3A(G_EN) enabled 2-3 short: /SHUT_OFF_3A(G_EN) disabled	2-3 short
42	JP20	/SHUT_OFF_2A (G_EN) Enable or disable (pullup)	1-2 short: /SHUT_OFF_2A(G_EN) enabled 2-3 short: /SHUT_OFF_2A(G_EN) disabled	2-3 short
43	JP21	/SHUT_OFF_1A (G_EN) Enable or disable (pullup)	1-2 short: /SHUT_OFF_1A(G_EN) enabled 2-3 short: /SHUT_OFF_1A(G_EN) disabled	2-3 short
44	JP22	/SHUT_OFF_0A (G_EN) Enable or disable (pullup)	1-2 short: /SHUT_OFF_0A(G_EN) enabled 2-3 short: /SHUT_OFF_0A(G_EN) disabled	2-3 short

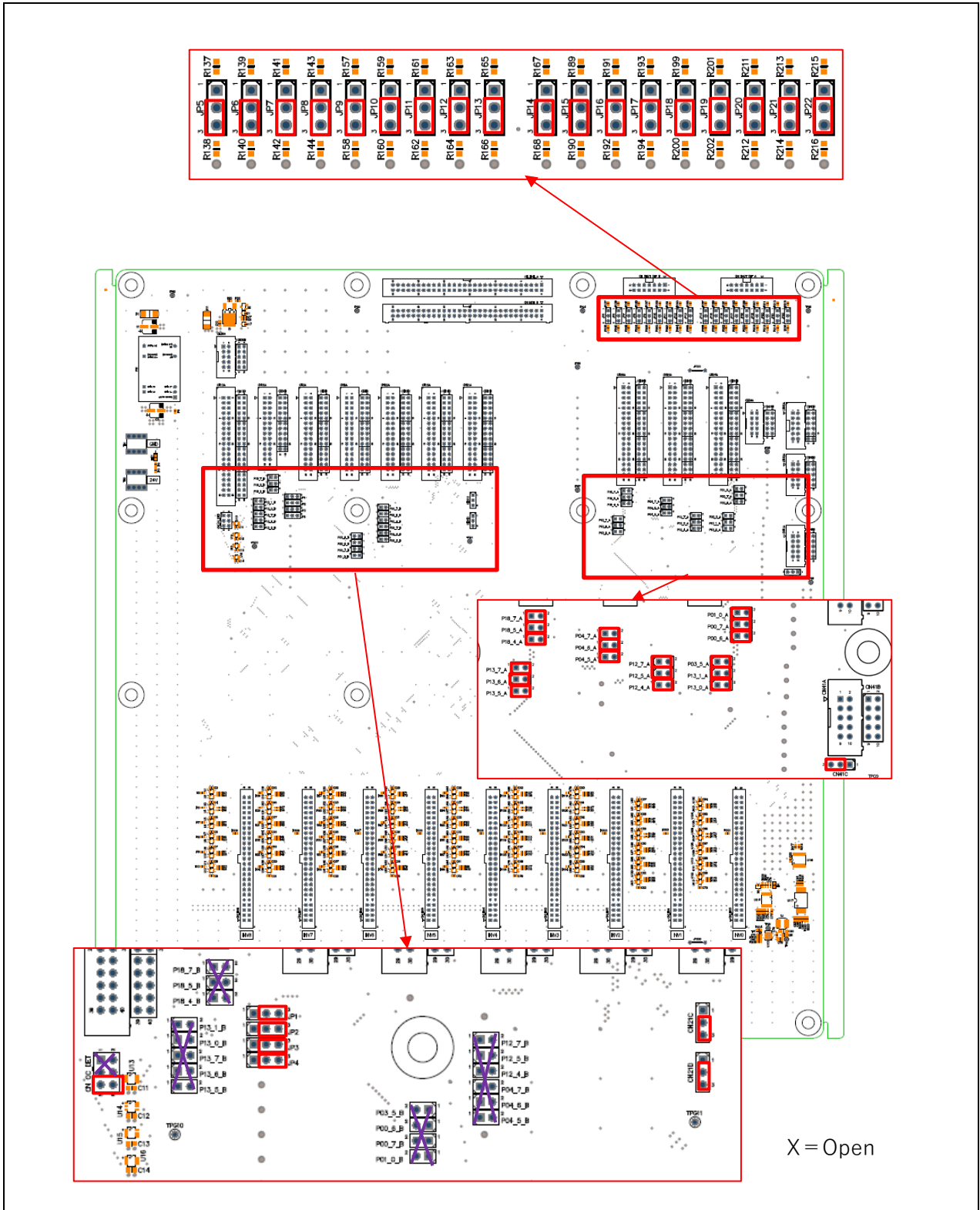


Figure 4-3 Confirming jumper pins of Bus Board

4.5 Hardware Setup

4.5.1 Board Connection

When using this product to evaluate motor control, connect the boards as shown in Figure 4-4. Inverter Boards for 9 axes (product number: RTK0EM0000S05010BJ) and RZ/T2H Evaluation Board are connected.

Make sure to put standoffs (approx. 2cm long) etc. between the Inverter Boards so that they do not touch each other.

To connect motors to Inverter Boards, users should process the motor cables. For details, refer to RZ/T Series Inverter Board / Kit User's Manual (R12UZ0155).

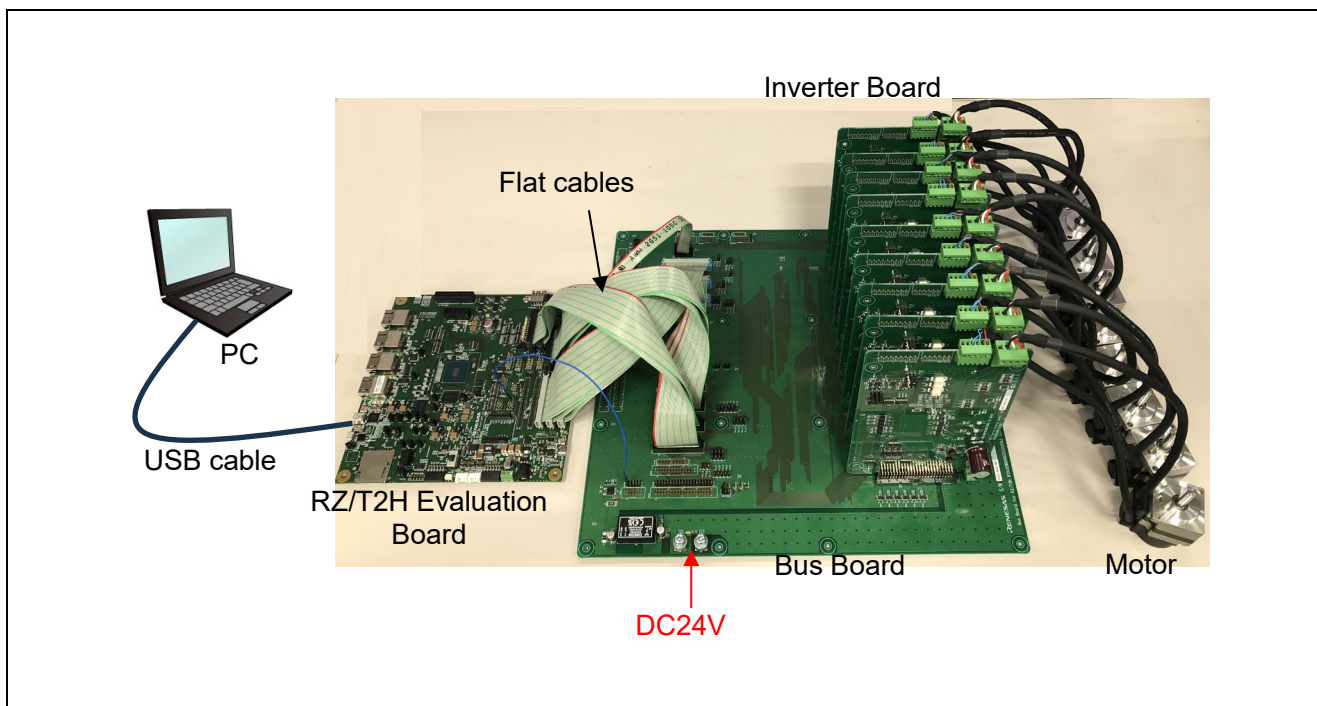


Figure 4-4 Bus Board connection

4.5.1.1 Connection between RZ/T2H Evaluation Board and Bus Board

To connect this product to RZ/T2H Evaluation Board, connect them as shown in Table 4-3.

Table 4-3 Connection between RZ/T2H Evaluation Board and Bus Board

	RZ/T2H Evaluation Board connector	Bus Board connector
36-pin flat cable	CN24	CN24A
	CN25	CN25A
	CN26	CN26A
30-pin flat cable	CN22	CN22A
	CN18	CN18A
	CN21	CN21A
	CN3	CN3A
	CN2	CN2A
10-pin flat cable	CN19	CN19A
1-pin cable	CN20: 1pin	CN20B: 1pin

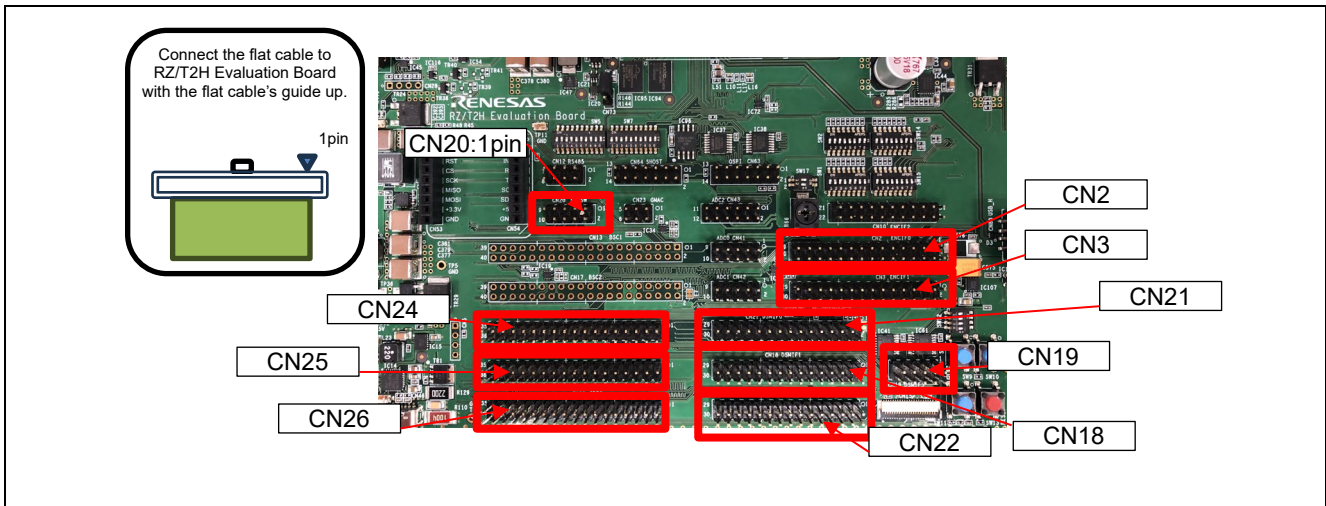


Figure 4-5 RZ/T2H Evaluation Board connector

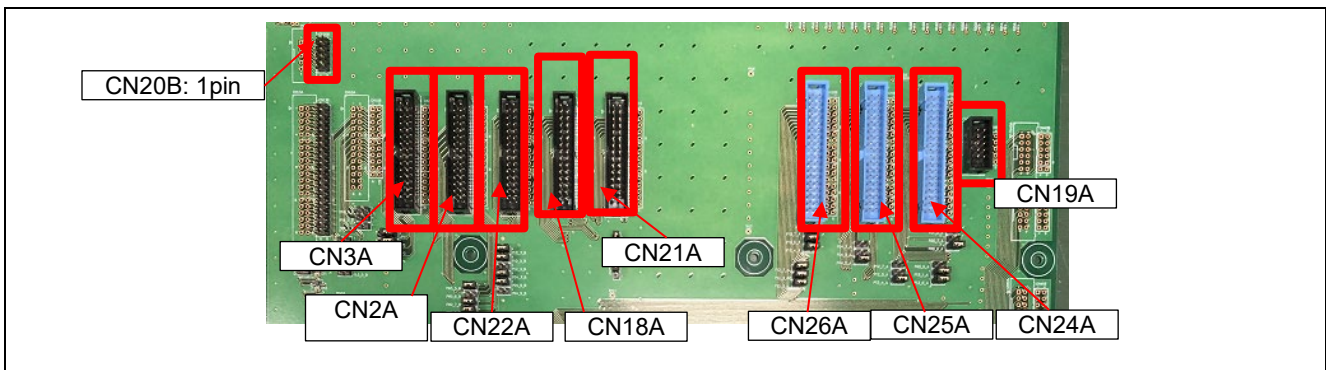


Figure 4-6 Bus Board connector

4.5.1.2 Connection between Bus Board and Inverter Board

When connecting nine Inverter Boards to this product, connect them as shown in Figure 4-7. Connect the Inverter Boards from CN_INV0.

Make sure to put standoffs (approx.2cm long) etc. between the Inverter Boards so that they do not touch each other.

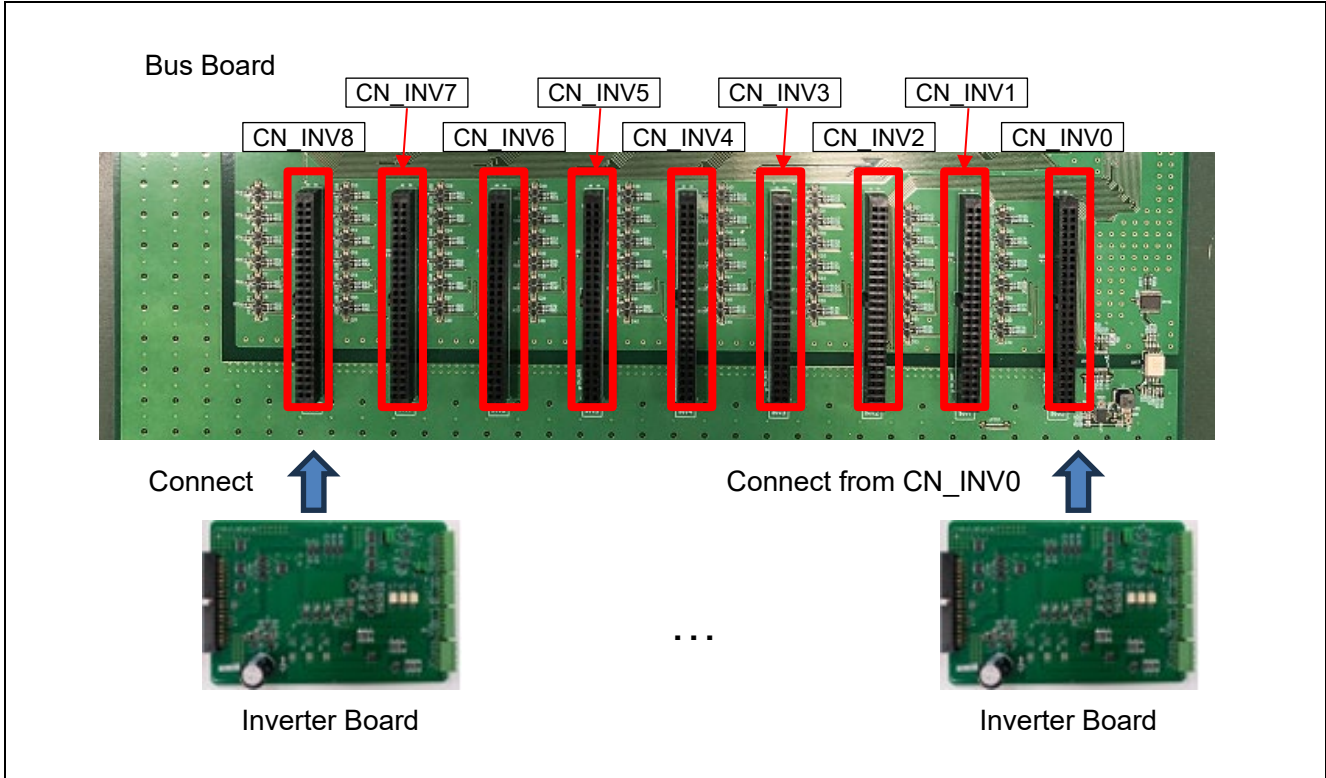


Figure 4-7 Connection between Bus Board and Inverter Board

4.5.1.3 Jumper Settings

Table 4-4 shows the jumper settings when connecting this product and nine Inverter Boards. For the jumper settings of RZ/T2H Evaluation Board and Inverter Board, refer to RZ/T2H Startup Manual (R01AN7334) included in Vector control for Permanent Magnetic Synchronous motor (9-axis) with Encoder – Absolute Encoder (R01AN7333).

Table 4-4 Bus Board jumper settings when connecting to Inverter Boards for 9 axes

No.	JP	Settings	No.	JP	Settings
1	JP1	2-3 short	33	P03_5_A	Open
2	JP2	2-3 short	34	P03_5_B	Short
3	JP3	2-3 short	35	P04_5_A	Short
4	JP4	2-3 short	36	P04_5_B	Open
5	JP5	2-3 short	37	P04_6_A	Open
6	JP6	2-3 short	38	P04_6_B	Short
7	JP7	2-3 short	39	P04_7_A	Open
8	JP8	2-3 short	40	P04_7_B	Short
9	JP9	2-3 short	41	P12_4_A	Short
10	JP10	2-3 short	42	P12_4_B	Open
11	JP11	2-3 short	43	P12_5_A	Open
12	JP12	2-3 short	44	P12_5_B	Short
13	JP13	2-3 short	45	P12_7_A	Open
14	JP14	2-3 short	46	P12_7_B	Short
15	JP15	2-3 short	47	P13_0_A	Short
16	JP16	2-3 short	48	P13_0_B	Open
17	JP17	2-3 short	49	P13_1_A	Short
18	JP18	2-3 short	50	P13_1_B	Open
19	JP19	2-3 short	51	P13_5_A	Short
20	JP20	2-3 short	52	P13_5_B	Open
21	JP21	2-3 short	53	P13_6_A	Short
22	JP22	2-3 short	54	P13_6_B	Open
23	CN41C	2-3 short	55	P13_7_A	Short
24	CN21C	2-3 short	56	P13_7_B	Open
25	CN21D	2-3 short	57	P18_4_A	Short
26	CN_OC_DET	5-6 short	58	P18_4_B	Open
27	P00_6_A	Short	59	P18_5_A	Short
28	P00_6_B	Open	60	P18_5_B	Open
29	P00_7_A	Open	61	P18_7_A	Short
30	P00_7_B	Short	62	P18_7_B	Open
31	P01_0_A	Open			
32	P01_0_B	Short			

: Changed from the default settings

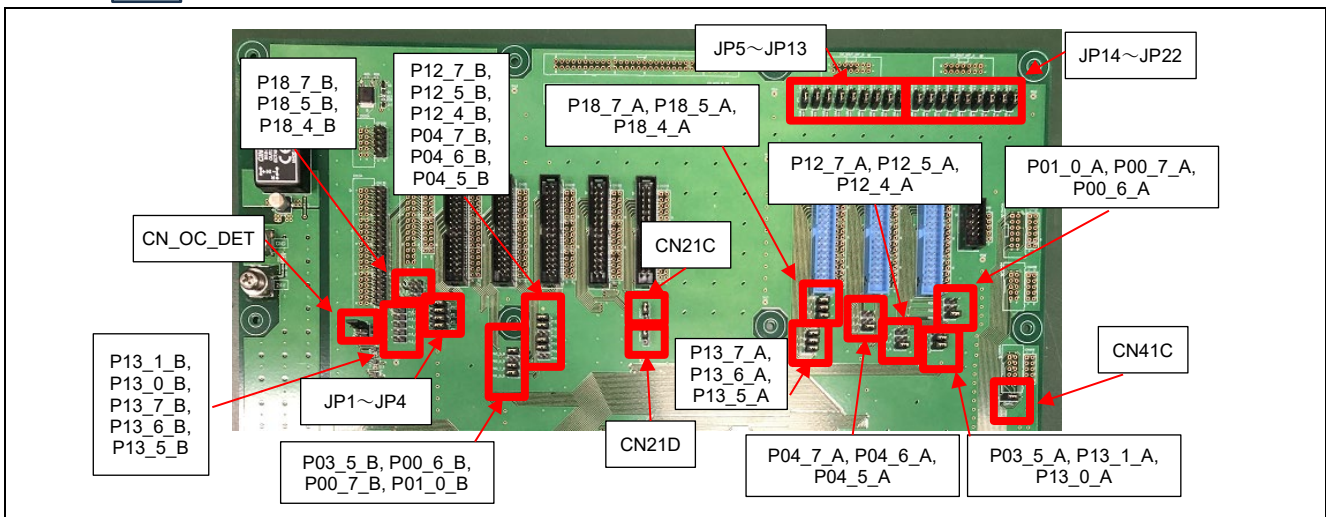


Figure 4-8 Bus Board jumper settings

4.5.2 Power Supply

Use an AC adapter or stabilized power supply to supply DC24V through the power input connector of Bus Board.

For power supply to RZ/T2H Evaluation Board, refer to RZ/T2H Evaluation Board User's Manual (R20UT5317).

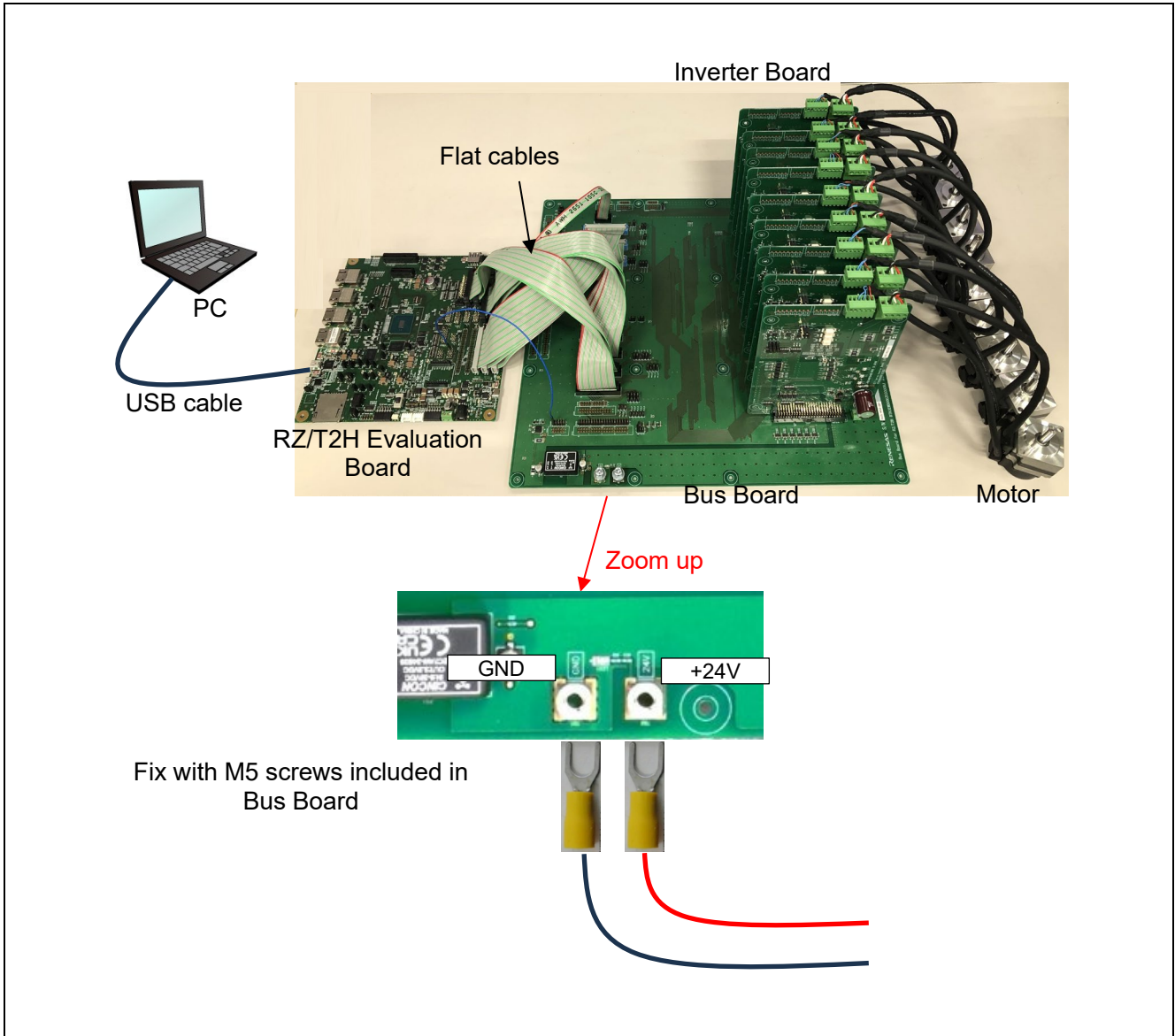


Figure 4-9 Power supply

*1: Motor drive current of 1A or more may be required for each Inverter Board.

5. Bus Board Specification

This section describes Bus Board specifications.

5.1 Functions

5.1.1 5V power supply, 3.3V power supply, and reset circuit

Bus Board generates 5V and 3.3V from DC24V. 3.3V is supplied to each Inverter Board, and it is possible to switch between 3.3V of RZ/T2H Evaluation Board (default) and 3.3V of Bus Board with 0Ω resistor.

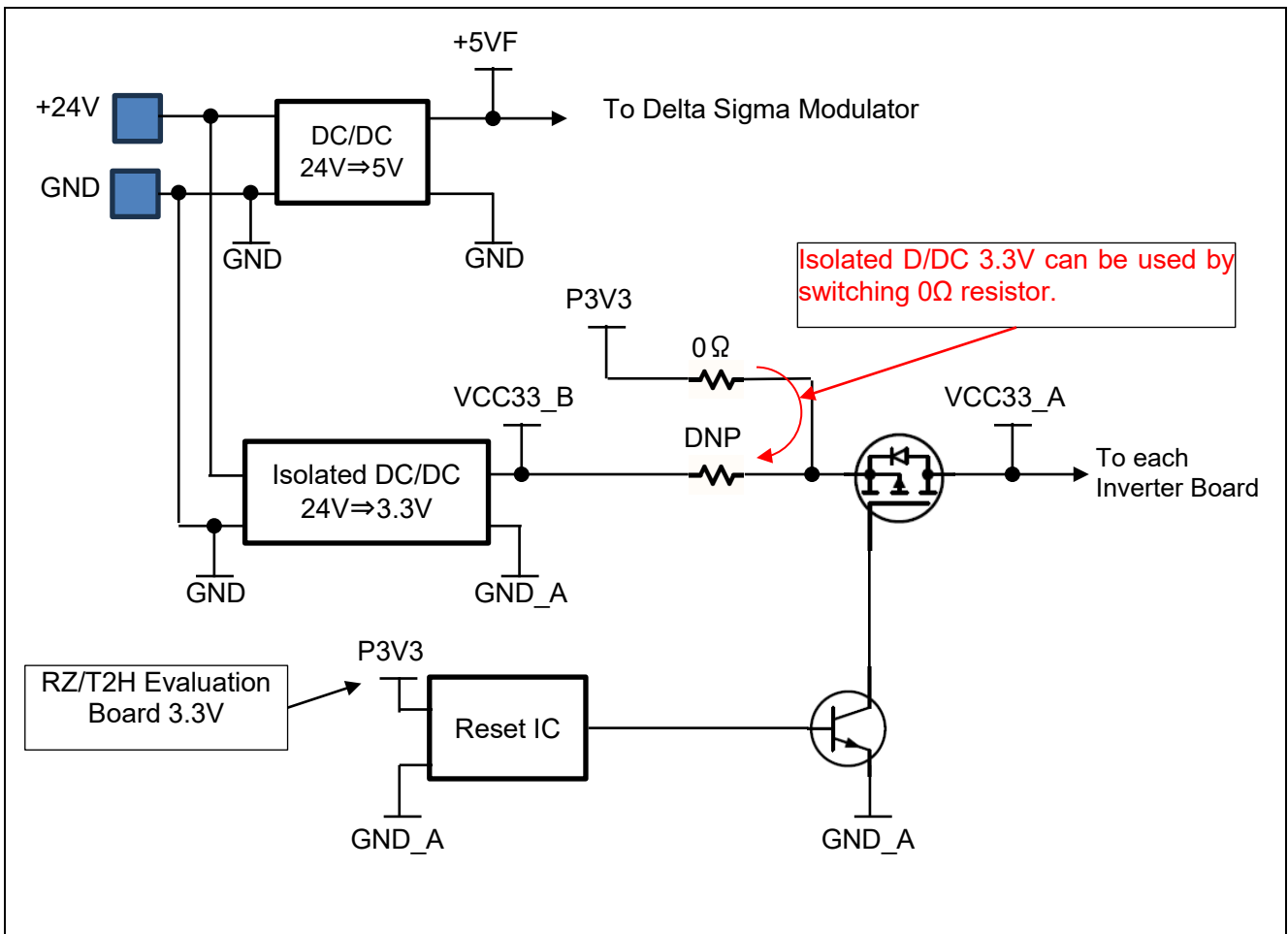


Figure 5-1 Power supplies of 5V and 3.3V, and reset circuit

5.1.2 Bus Voltage Detection

Bus Board has a circuit that inputs a voltage (approx. 198mV), which is divided from power supply of 24V with resistor, into a Delta Sigma Modulator and inputs the modulator's output to the DSMIF terminal of RZ/T2H. The relation between the bus voltage (24V) and the detection voltage (VIN + voltage) is described by the following equation.

$$VIN + [V] = \frac{1 \times 10^3}{120 \times 10^3 + 1 \times 10^3} \times 24[V]$$

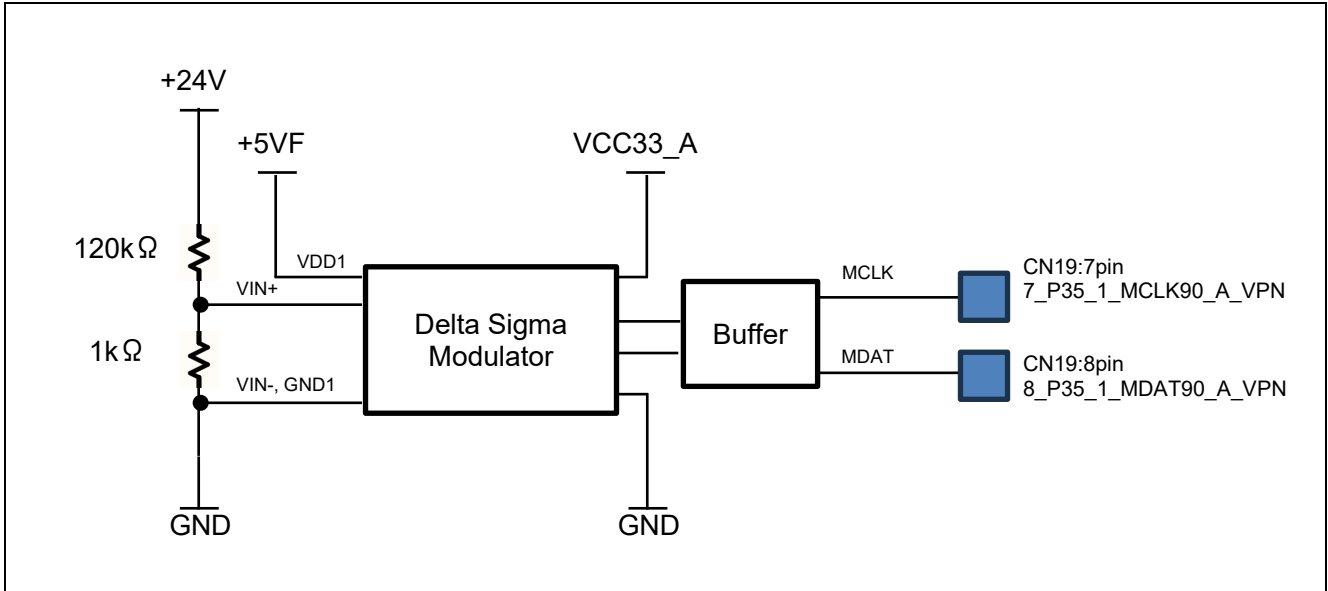


Figure 5-2 Bus voltage detection

5.1.3 Overcurrent Detection Signal

Bus Board uses logical OR (OC_DET_INVx_OUT (x: 0~8)) for the overcurrent detection signals of each inverter board and outputs the results to RZ/T2H Evaluation Board. The output to RZ/T2H Evaluation board can be changed with the jumper CN_OC_DET.

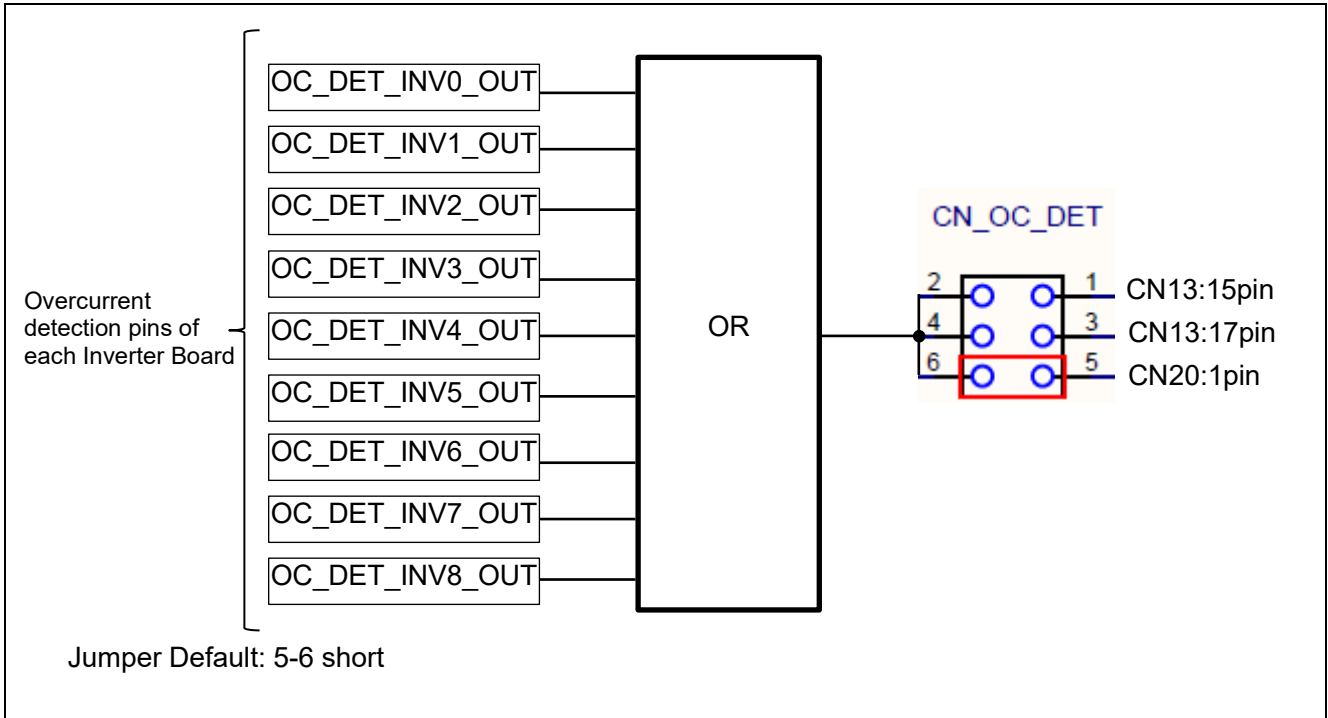


Figure 5-3 Overcurrent detection

5.1.4 PWM Cutoff Circuit

Bus board has a circuit that cuts off six lines of the PWM signal for each axis. For the signal to be cut off, two channels are provided per one axis (CN_SHUT_OFF_A and CN_SHUT_OFF_B connector), and they are supposed to be cut off from the two external MCUs for functional safety (Functional Safety MCU0/1 (hereafter, FuSa MCU0/1)). Also, the terminals for monitoring PWM signals to be input to each Inverter Board are provided (CN_MON_A and CN_MON_B connector), allowing external Fusa MCU0 and MCU1 to monitor the PWM signals.

To enable the PWM cutoff function, make the jumpers from JP5 to JP22 1-2 short. To disable this function, make the jumpers from JP5 to JP22 2-3 short.

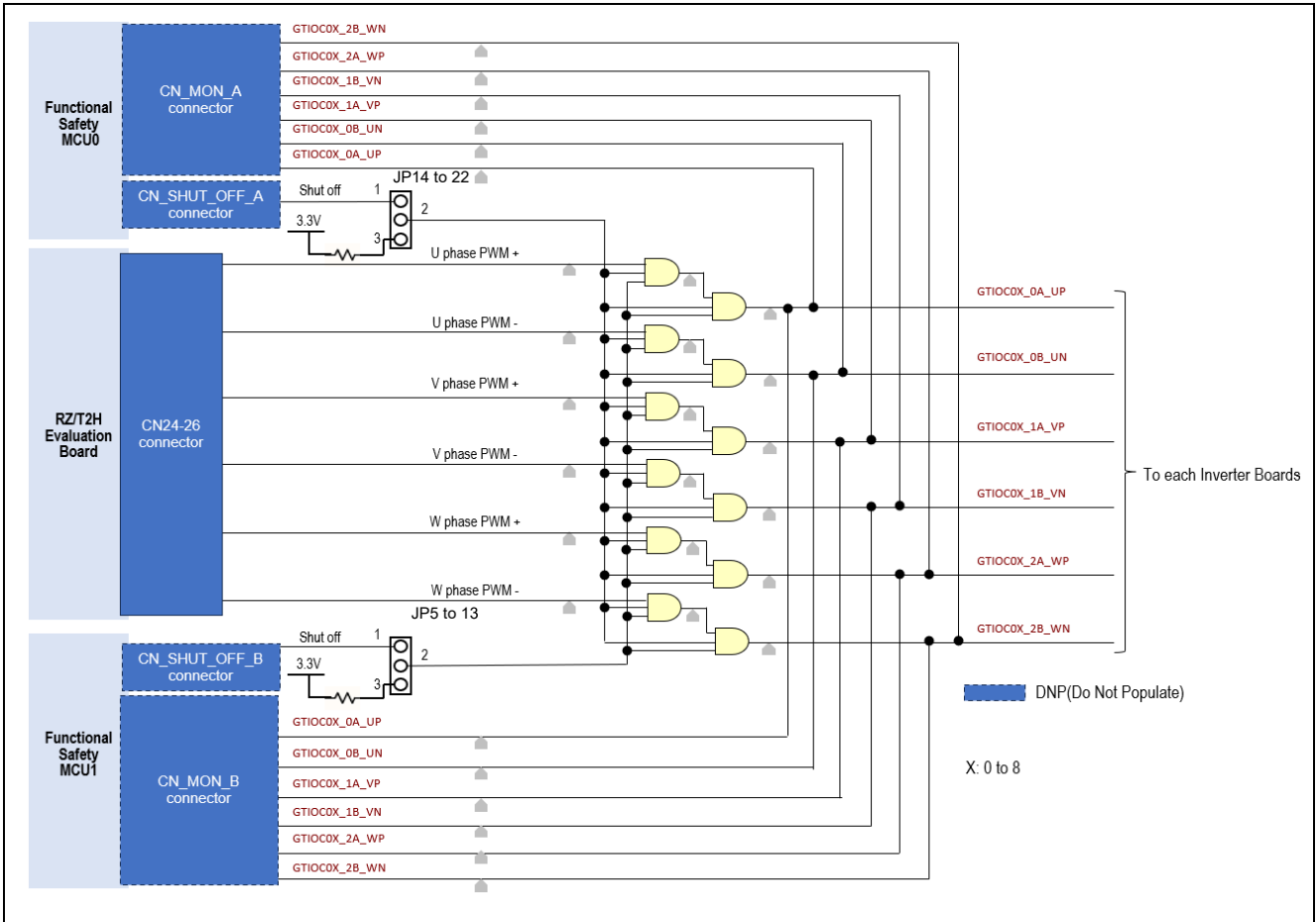


Figure 5-4 PWM cutoff circuit

5.1.4.1 CN_SHUT_OFF_A / CN_SHUT_OFF_B

CN_SHUT_OFF_A and CN_SHUT_OFF_B are shown in Table 5-1.

Table 5-1 CN_SHUT_OFF_A and CN_SHUT_OFF_B

CN_SHUT_OFF_A connector / CN_SHUT_OFF_B connector		
Pin No	Pin name	Description
1	VCC33_A	3.3V
2	VCC33_A	3.3V
3	GND_A	GND
4	GND_A	GND
5	SHUT_OFF_0X_IN	CN_INV0 PWM cutoff signal
6	SHUT_OFF_1X_IN	CN_INV1 PWM cutoff signal
7	SHUT_OFF_2X_IN	CN_INV2 PWM cutoff signal
8	SHUT_OFF_3X_IN	CN_INV3 PWM cutoff signal
9	SHUT_OFF_4X_IN	CN_INV4 PWM cutoff signal
10	SHUT_OFF_5X_IN	CN_INV5 PWM cutoff signal
11	SHUT_OFF_6X_IN	CN_INV6 PWM cutoff signal
12	SHUT_OFF_7X_IN	CN_INV7 PWM cutoff signal
13	SHUT_OFF_8X_IN	CN_INV8 PWM cutoff signal
14	GND_A	GND

X: A(CN_SHUT_OFF_A) or B(CN_SHUT_OFF_B)

5.1.4.2 CN_MON_A / CN_MON_B

CN_MON_A and CN_MON_B are shown in Table 5-2.

Table 5-2 CN_MON_A and CN_MON_B

CN_MON_A connector / CN_MON_B connector		
Pin No	Pin name	Description
1	GND_A	GND
2	GTIOC00_0A_UP	CN_INV0 U-phase PWM+
3	GTIOC00_0B_UN	CN_INV0 U-phase PWM-
4	GTIOC00_1A_VP	CN_INV0 V-phase PWM+
5	GTIOC00_1B_VN	CN_INV0 V-phase PWM-
6	GTIOC00_2A_WP	CN_INV0 W-phase PWM+
7	GTIOC00_2B_WN	CN_INV0 W-phase PWM-
8	GTIOC01_0A_UP	CN_INV1 U-phase PWM+
9	GTIOC01_0B_UN	CN_INV1 U-phase PWM-
10	GTIOC01_1A_VP	CN_INV1 V-phase PWM+
11	GTIOC01_1B_VN	CN_INV1 V-phase PWM-
12	GTIOC01_2A_WP	CN_INV1 W-phase PWM+
13	GTIOC01_2B_WN	CN_INV1 W-phase PWM-
14	GND_A	GND
15	GTIOC02_0A_UP	CN_INV2 U-phase PWM+
16	GTIOC02_0B_UN	CN_INV2 U-phase PWM-
17	GTIOC02_1A_VP	CN_INV2 V-phase PWM+
18	GTIOC02_1B_VN	CN_INV2 V-phase PWM-
19	GTIOC02_2A_WP	CN_INV2 W-phase PWM+
20	GTIOC02_2B_WN	CN_INV2 W-phase PWM-
21	GTIOC03_0A_UP	CN_INV3 U-phase PWM+
22	GTIOC03_0B_UN	CN_INV3 U-phase PWM-
23	GTIOC03_1A_VP	CN_INV3 V-phase PWM+
24	GTIOC03_1B_VN	CN_INV3 V-phase PWM-
25	GTIOC03_2A_WP	CN_INV3 W-phase PWM+
26	GTIOC03_2B_WN	CN_INV3 W-phase PWM-
27	GND_A	GND
28	GTIOC04_0A_UP	CN_INV4 U-phase PWM+
29	GTIOC04_0B_UN	CN_INV4 U-phase PWM-
30	GTIOC04_1A_VP	CN_INV4 V-phase PWM+
31	GTIOC04_1B_VN	CN_INV4 V-phase PWM-
32	GTIOC04_2A_WP	CN_INV4 W-phase PWM+
33	GTIOC04_2B_WN	CN_INV4 W-phase PWM-
34	GTIOC05_0A_UP	CN_INV5 U-phase PWM+
35	GTIOC05_0B_UN	CN_INV5 U-phase PWM-
36	GTIOC05_1A_VP	CN_INV5 V-phase PWM+
37	GTIOC05_1B_VN	CN_INV5 V-phase PWM-
38	GTIOC05_2A_WP	CN_INV5 W-phase PWM+
39	GTIOC05_2B_WN	CN_INV5 W-phase PWM-
40	GND_A	GND
41	GTIOC06_0A_UP	CN_INV6 U-phase PWM+
42	GTIOC06_0B_UN	CN_INV6 U-phase PWM-
43	GTIOC06_1A_VP	CN_INV6 V-phase PWM+
44	GTIOC06_1B_VN	CN_INV6 V-phase PWM-
45	GTIOC06_2A_WP	CN_INV6 W-phase PWM+
46	GTIOC06_2B_WN	CN_INV6 W-phase PWM-
47	GTIOC07_0A_UP	CN_INV7 U-phase PWM+
48	GTIOC07_0B_UN	CN_INV7 U-phase PWM-

CN_MON_A connector / CN_MON_B connector		
Pin No	Pin name	Description
49	GTIOC07_1A_VP	CN_INV7 V-phase PWM+
50	GTIOC07_1B_VN	CN_INV7 V-phase PWM-
51	GTIOC07_2A_WP	CN_INV7 W-phase PWM+
52	GTIOC07_2B_WN	CN_INV7 W-phase PWM-
53	GND_A	GND
54	GTIOC08_0A_UP	CN_INV8 U-phase PWM+
55	GTIOC08_0B_UN	CN_INV8 U-phase PWM-
56	GTIOC08_1A_VP	CN_INV8 V-phase PWM+
57	GTIOC08_1B_VN	CN_INV8 V-phase PWM-
58	GTIOC08_2A_WP	CN_INV8 W-phase PWM+
59	GTIOC08_2B_WN	CN_INV8 W-phase PWM-
60	GND_A	GND

5.2 Pin Assignment

The connection of each Inverter Board connector (CN_INV0 - CN_INV8) and the connectors for RZ/T2H Evaluation Board (CN2A, CN3A, CN10A, CN13A, CN18A - CN22A, CN24A - CN26A, and CN41A - CN43A) is shown below.

■ CN_INV0

Table 5-3 Connection of CN_INV0 connector and connectors for RZ/T2H Evaluation Board

Inverter Board connector			Connector for RZ/T2H Evaluation Board		Remarks
Pin No	Category	Description	Connector name	Pin No	
11	ADC	VCC18_AVDDREF_ADC0	CN41A	9	
12		AVSS_ADC0		5	
13		U-phase current A/D input		2	
14		V-phase current A/D input		4	CN21C: 2-3short
15		W-phase current A/D input		6	
16		AVSS_ADC0		5	
21	Delta Sigma Modulator	U-phase DSMIF clock	CN21A	7	
22		U-phase DSMIF data		8	
23		V-phase DSMIF clock		5	
24		V-phase DSMIF data		6	
25		W-phase DSMIF clock		3	
26		W-phase DSMIF data		4	
28	PWM	U-phase PWM +	CN24A	3	
29		U-phase PWM -		4	
30		V-phase PWM +		5	
31		V-phase PWM -		6	
32		W-phase PWM +		7	
33		W-phase PWM -		8	
37	Incremental Encoder	A-phase		9	P00_6 A: short
38		B-phase		10	P00_7 A: short
39		Z-phase		11	P01_0 A: short
41	Absolute Encoder0	ENCIF clock	CN2A	3	
42		ENCIF output enable		5	
43		ENCIF data output		7	
44		ENCIF data input		9	
46	Absolute Encoder1	ENCIF clock	CN3A	11	JP1: 1-2short
47		ENCIF output enable		13	JP2: 1-2short
48		ENCIF data output		15	JP3: 1-2short
49		ENCIF data input		17	JP4: 1-2short

■ CN_INV1

Table 5-4 Connection of CN_INV1 connector and connectors for RZ/T2H Evaluation Board

Inverter Board connector			Connector for RZ/T2H Evaluation Board		Remarks
Pin No	Category	Description	Connector name	Pin No	
11	ADC	VCC18_AVDDREF_ADC1	CN42A	9	
12		AVSS_ADC1		5	
13		U-phase current A/D input		2	
14		V-phase current A/D input		4	
15		W-phase current A/D input		6	
16		AVSS_ADC1		5	
21	Delta Sigma Modulator	U-phase DSMIF clock	CN21A	17	
22		U-phase DSMIF data		18	
23		V-phase DSMIF clock		15	CN21D: 2-3short
24		V-phase DSMIF data		16	CN21C: 2-3short
25		W-phase DSMIF clock		13	
26		W-phase DSMIF data		14	
28	PWM	U-phase PWM +	CN24A	15	
29		U-phase PWM -		16	
30		V-phase PWM +		17	
31		V-phase PWM -		18	
32		W-phase PWM +		19	
33		W-phase PWM -		20	
37	Incremental Encoder	A-phase		21	
38		B-phase		22	
39		Z-phase		24	
41	Absolute Encoder0	ENCIF clock	CN2A	2	
42		ENCIF output enable		4	
43		ENCIF data output		6	
44		ENCIF data input		8	
46	Absolute Encoder1	ENCIF clock	CN3A	12	JP1: 1-2short
47		ENCIF output enable		14	JP2: 1-2short
48		ENCIF data output		16	JP3: 1-2short
49		ENCIF data input		18	JP4: 1-2short

■ CN_INV2

Table 5-5 Connection of CN_INV2 connector and connectors for RZ/T2H Evaluation Board

Inverter Board connector			Connector for RZ/T2H Evaluation Board		Remarks
Pin No	Category	Description	Connector name	Pin No	
11	ADC	VCC18_AVDDREF_ADC2	CN43A	10	
12		AVSS_ADC2		6	
13		U-phase current A/D input		1	
14		V-phase current A/D input		3	
15		W-phase current A/D input		5	
16		AVSS_ADC2		6	
21	Delta Sigma Modulator	U-phase DSMIF clock	CN21A	27	
22		U-phase DSMIF data		28	
23		V-phase DSMIF clock		25	CN21D: 2-3short
24		V-phase DSMIF data		26	CN21C: 2-3short
25		W-phase DSMIF clock		23	
26		W-phase DSMIF data		24	
28	PWM	U-phase PWM +	CN24A	27	
29		U-phase PWM -		28	
30		V-phase PWM +		29	
31		V-phase PWM -		30	
32		W-phase PWM +		31	
33		W-phase PWM -		32	
37	Incremental Encoder	A-phase	CN24A	33	P13_0_A: short
38		B-phase		34	P13_1_A: short
39		Z-phase		35	P03_5_A: short
41	Absolute Encoder0	ENCIF clock	CN2A	11	
42		ENCIF output enable		13	
43		ENCIF data output		15	P03_5_B: short
44		ENCIF data input		17	
46	Absolute Encoder1	ENCIF clock	CN3A	21	
47		ENCIF output enable		23	
48		ENCIF data output		25	
49		ENCIF data input		27	

■ CN_INV3

Table 5-6 Connection of CN_INV3 connector and connectors for RZ/T2H Evaluation Board

Inverter Board connector			Connector for RZ/T2H Evaluation Board		Remarks
Pin No	Category	Description	Connector name	Pin No	
21	Delta Sigma Modulator	U-phase DSMIF clock	CN18A	7	
22		U-phase DSMIF data		8	
23		V-phase DSMIF clock		5	
24		V-phase DSMIF data		6	
25		W-phase DSMIF clock		3	
26		W-phase DSMIF data		4	
28	PWM	U-phase PWM +	CN25A	3	
29		U-phase PWM -		4	
30		V-phase PWM +		5	
31		V-phase PWM -		6	
32		W-phase PWM +		7	
33		W-phase PWM -		8	
37	Incremental Encoder	A-phase		9	P04_5_A: short
38		B-phase		10	P04_6_A: short
39		Z-phase		11	P04_7_A: short
41	Absolute Encoder0	ENCIF clock	CN2A	12	P04_5_B: short
42		ENCIF output enable		14	P04_6_B: short
43		ENCIF data output		16	P04_7_B: short
44		ENCIF data input		18	
46	Absolute Encoder1	ENCIF clock	CN3A	20	
47		ENCIF output enable		22	
48		ENCIF data output		24	
49		ENCIF data input		26	

■ CN_INV4

Table 5-7 Connection of CN_INV4 connector and connectors for RZ/T2H Evaluation Board

Inverter Board connector			Connector for RZ/T2H Evaluation Board		Remarks
Pin No	Category	Description	Connector name	Pin No	
21	Delta Sigma Modulator	U-phase DSMIF clock	CN18A	17	
22		U-phase DSMIF data		18	
23		V-phase DSMIF clock		15	
24		V-phase DSMIF data		16	
25		W-phase DSMIF clock		13	
26		W-phase DSMIF data		14	
28	PWM	U-phase PWM +	CN25A	15	
29		U-phase PWM -		16	
30		V-phase PWM +		17	
31		V-phase PWM -		18	
32		W-phase PWM +		19	
33		W-phase PWM -		20	
37	Incremental Encoder	A-phase		21	
38		B-phase		22	
39		Z-phase		23	
41	Absolute Encoder0	ENCIF clock	CN2A	21	P00_6 B: short
42		ENCIF output enable		23	P00_7 B: short
43		ENCIF data output		25	P01_0 B: short
44		ENCIF data input		27	
46	Absolute Encoder1	ENCIF clock	CN10A	3	P13_0 B: short
47		ENCIF output enable		5	P13_1 B: short
48		ENCIF data output		7	
49		ENCIF data input		9	

■ CN_INV5

Table 5-8 Connection of CN_INV5 connector and connectors for RZ/T2H Evaluation Board

Inverter Board connector			Connector for RZ/T2H Evaluation Board		Remarks
Pin No	Category	Description	Connector name	Pin No	
21	Delta Sigma Modulator	U-phase DSMIF clock	CN18A	27	
22		U-phase DSMIF data		28	
23		V-phase DSMIF clock		25	
24		V-phase DSMIF data		26	
25		W-phase DSMIF clock		23	
26		W-phase DSMIF data		24	
28	PWM	U-phase PWM +	CN25A	27	
29		U-phase PWM -		28	
30		V-phase PWM +		29	
31		V-phase PWM -		30	
32		W-phase PWM +		31	
33		W-phase PWM -		32	
37	Incremental Encoder	A-phase		33	P12_4_A: short
38		B-phase		34	P12_5_A: short
39		Z-phase		36	P12_7_A: short
41	Absolute Encoder0	ENCIF clock	CN2A	20	P12_4_B: short
42		ENCIF output enable		22	P12_5_B: short
43		ENCIF data output		24	
44		ENCIF data input		26	P12_7_B: short
46	Absolute Encoder1	ENCIF clock	CN10A	2	
47		ENCIF output enable		4	P13_5_B: short
48		ENCIF data output		6	P13_6_B: short
49		ENCIF data input		8	P13_7_B: short

■ CN_INV6

Table 5-9 Connection of CN_INV6 connector and connectors for RZ/T2H Evaluation Board

Inverter Board connector			Connector for RZ/T2H Evaluation Board		Remarks
Pin No	Category	Description	Connector name	Pin No	
21	Delta Sigma Modulator	U-phase DSMIF clock	CN22A	7	
22		U-phase DSMIF data		8	
23		V-phase DSMIF clock		5	
24		V-phase DSMIF data		6	
25		W-phase DSMIF clock		3	
26		W-phase DSMIF data		4	
28	PWM	U-phase PWM +	CN26A	3	
29		U-phase PWM -		4	
30		V-phase PWM +		5	
31		V-phase PWM -		6	
32		W-phase PWM +		7	
33		W-phase PWM -		8	
37	Incremental Encoder	A-phase		9	P13_5_A: short
38		B-phase		10	P13_6_A: short
39		Z-phase		11	P13_7_A: short
41	Absolute Encoder0	ENCIF clock	CN3A	3	
42		ENCIF output enable		5	
43		ENCIF data output		7	
44		ENCIF data input		9	
46	Absolute Encoder1	ENCIF clock	CN10A	11	P18_4_B: short
47		ENCIF output enable		13	P18_5_B: short
48		ENCIF data output		15	
49		ENCIF data input		17	P18_7_B: short

■ CN_INV7

Table 5-10 Connection of CN_INV7 connector and connectors for RZ/T2H Evaluation Board

Inverter Board connector			Connector for RZ/T2H Evaluation Board		Remarks
Pin No	Category	Description	Connector	Pin No	
21	Delta Sigma Modulator	U-phase DSMIF clock	CN22A	17	
22		U-phase DSMIF data		18	
23		V-phase DSMIF clock		15	
24		V-phase DSMIF data		16	
25		W-phase DSMIF clock		13	
26		W-phase DSMIF data		14	
28	PWM	U-phase PWM +	CN26A	15	
29		U-phase PWM -		16	
30		V-phase PWM +		17	
31		V-phase PWM -		18	
32		W-phase PWM +		19	
33		W-phase PWM -		20	
37	Incremental Encoder	A-phase	CN3A	21	P18_4_A: short
38		B-phase		22	P18_5_A: short
39		Z-phase		24	P18_7_A: short
41	Absolute Encoder0	ENCIF clock	CN3A	2	
42		ENCIF output enable		4	
43		ENCIF data output		6	
44		ENCIF data input		8	
46	Absolute Encoder1	ENCIF clock	CN10A	12	
47		ENCIF output enable		14	
48		ENCIF data output		16	
49		ENCIF data input		18	

■ CN_INV8

Table 5-11 Connection of CN_INV8 connector and connectors for RZ/T2H Evaluation Board

Inverter Board connector			Connector for RZ/T2H Evaluation Board		Remarks
Pin No	Category	Description	Connector	Pin No	
21	Delta Sigma Modulator	U-phase DSMIF clock	CN22A	27	
22		U-phase DSMIF data		28	
23		V-phase DSMIF clock		25	
24		V-phase DSMIF data		26	
25		W-phase DSMIF clock		23	
26		W-phase DSMIF data		24	
28	PWM	U-phase PWM +	CN26A	27	
29		U-phase PWM -		28	
30		V-phase PWM +		29	
31		V-phase PWM -		30	
32		W-phase PWM +		31	
33		W-phase PWM -		32	
37	Incremental Encoder	A-phase		33	
38		B-phase		34	
39		Z-phase		12	
41	Absolute Encoder0	ENCIF clock	CN3A	11	JP1: 2-3short
42		ENCIF output enable		13	JP2: 2-3short
43		ENCIF data output		15	JP3: 2-3short
44		ENCIF data input		17	JP4: 2-3short

6. Design and Manufacture Information

You can obtain information on the design and manufacture of this product from [renesas.com](https://www.renesas.com).

7. Information on Regulations

This product complies with the following directive.

- EMC Directive : 2014/30/EU (EN61326-1:2021)

EMI : Class A

EMS : Industrial Electromagnetic Environment

Measures for compliance with regulations:

1. Ferrite Core (Manufacturer: SEIWA, Product No.: E04SR200935A, 1 turn)

Attach two cores to the motor cable of the first axis, one core to each of the motor cables of the second through ninth axis and one core to the encoder cable of the first axis.

2. Ferrite Core (Manufacturer: TDK, Product No.: ZCAT2035-0930, 1 turn)

Attach one core to each of the motor cables of the second through ninth axis and one core to each of the encoder cables of the second through ninth axis.

3. Ferrite Core (Manufacturer: TDK, Product No.: ZCAT6819-5230D, 1 turn)

Attach two cores to the 30-pin flat cable connecting between CN18 on RZ/T2H Evaluation Board and CN18A on Bus Board, two cores to the 30-pin flat cable connecting between CN21 on RZ/T2H Evaluation Board and CN21A on Bus Board, two cores to the 30-pin flat cable connecting between CN22 on RZ/T2H Evaluation Board and CN22A on Bus Board, one core to the 36-pin flat cable connecting between CN24 on RZ/T2H Evaluation Board and CN24A on Bus Board, one core to the 36-pin flat cable connecting between CN25 on RZ/T2H Evaluation Board and CN25A on Bus Board, and one core to the 36-pin flat cable connecting between CN26 on RZ/T2H Evaluation Board and CN26A on Bus Board.

4. Ferrite Core (Manufacturer: TDK, Product No.: ZCAT4625-3430D, 1 turn)

Attach one core to the 30-pin flat cable connecting between CN2 on RZ/T2H Evaluation Board and CN2A on Bus Board, and one core to the 30-pin flat cable connecting between CN3 on RZ/T2H Evaluation Board and CN3A on Bus Board.

5. Ferrite Core (Manufacturer: KGS, Product No.: GTFC-25-15-12, 3 turns)

Attach one core to the 10-pin flat cable connecting between CN19 on RZ/T2H Evaluation Board and CN19A on Bus Board

6. Ferrite Core (Manufacturer: SEIWA, Product No.: E04SR301334, 1 turn)

Attach one core to the 10-pin flat cable connecting between CN19 on RZ/T2H Evaluation Board and CN19A on Bus Board.

7. Ferrite Core (Manufacturer: TDK, Product No.: ZCAT3035-1330, 1 turn)

Attach one core to the 10-pin flat cable connecting between CN19 on RZ/T2H Evaluation Board and CN19A on Bus Board.

8. Ferrite Core (Manufacturer: SEIWA, Product No.: E04SR401938, 8 turns)

Attach one core to the 15V AC adaptor of RZ/T2H Evaluation Board.

9. Ferrite Core (Manufacturer: KGS, Product No.: KRFC-9, 3 turns)

Attach one core to the 15V AC adaptor of the RZ/T2H Evaluation Board.

10. Ferrite Core (Manufacturer: SEIWA, Product No.: E04SR301334, 4 turns)

Attach one core to the DC24V power supply cable.

11. Ferrite Core (Manufacturer: TDK, Product No.: ZCAT1518-0730, 2 turns)

Attach one core to the DC24V power supply cable.

12. Ferrite Core (Manufacturer: : KGS, Product No.: KRFC-10, 2 turns)

Attach one core to the DC24V power supply cable.

8. Website and Support

In order to learn, download tools and documents, apply technical support for RZ family MCU/MPU and its kit, visit the below website.

- RZ Product Information [renesas.com/rz](https://www.renesas.com/rz)
- Renesas Support [renesas.com/support](https://www.renesas.com/support)

Revision History

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		Page	Summary
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