

RX24U CPU Card

R12TU0018EJ0110

Rev.1.10

User's Manual

Feb. 21, 2019

For Your Safety




Do not fail to read this manual before using the RX24U CPU card (RTK0EMX590C02000BJ) (the product).

- Follow the indications in this manual when using the product.
- This product is the option board of "24V Motor Control Evaluation System for RX23T (RTK0EM0006S01212BJ)". Please read "Warnings Regarding Use of the Product" of the 24V Motor Control Evaluation System for RX23T User's Manual, and use this product.
- Keep this manual near the product so you can refer to it whenever necessary.
- Transfer or sale of the product to third parties is prohibited without written approval.
- The purchaser or importer of the product is responsible for ensuring compliance with local regulations. In addition, the customer is responsible for ensuring that the product is handled correctly and safely, in accordance with the laws of the customer's country (region).
- All information contained in this manual represents information on products at the time of publication of this manual. Please note that the product data, specification, sales offices, contents of website, address, etc., are subject to change by Renesas Electronics Corporation without notice due to product improvements or other reasons. Please confirm the latest information on Renesas Electronics website.
- The manual for the product, and specification (the documents) are the tool that was developed for the function and performance evaluation of Renesas Electronics semiconductor device (Renesas Electronics device) mounted on the product, and not guarantee the same quality, function and performance.
- By purchasing the product or downloading the documents from Renesas Electronics website, the support services provided from Renesas Electronics is not guaranteed.

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*1 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*2 to persons or physical damage.*3

Note 1. Serious injury refers to conditions resulting in persistent after-effects and for which treatment would necessitate hospitalization or regular hospital visits, such as loss or impairment of eyesight, burns (high- or low-temperature), electric shock, bone fracture, or poisoning.

Note 2. Injury refers to conditions for which treatment would necessitate hospitalization or regular hospital visits.

Note 3. Physical damage refers to damage affecting the wider surroundings, such as the user's home or property.

Requirements related to the handling of the product are classified into the following categories.



- Marks indicating that an action is prohibited.

	<p>General Prohibition The indicated action is prohibited.</p>		<p>Example: Do Not Touch! Touching the specified location could result in injury.</p>
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- Marks indicating that an action is prohibited.






	<p>General Caution Indicates a general need for caution that is not specified.</p>		<p>Example: Caution – Hot! Indicates the possibility of injury due to high temperature.</p>
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- Marks directing that the specified action is required.







	<p>General Instruction The specified action is required.</p>		<p>Example: Turn Off (Disconnect) Power Supply! Instructs the user to turn off (disconnect) the power supply to the product.</p>
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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. • Unlike typical equipment, the product has no protective case to ensure safety, and it contains moving parts and high-temperature components that could be dangerous. Do not touch the evaluation board 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. • There are moving parts, driven by a motor. 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.
	<p>Do Not Connect Load to Motor!</p> <ul style="list-style-type: none"> • This could cause fire, burns, or injury.

■ Warning Items

 Warning	
	<p>Caution – Rotating Parts!</p> <ul style="list-style-type: none"> The system includes a motor. Touching the rotating shaft could cause high-temperature burns or injury.
	<p>Always insert plugs, connectors, and cables securely, and confirm that they are fully inserted.</p> <ul style="list-style-type: none"> Incomplete connections could cause fire, burns, electric shock, or injury.
	<p>Use the power supply apparatus specified in the manual.</p> <ul style="list-style-type: none"> Failure to do so could cause fire, burns, electric shock, injury, or malfunction.
	<p>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.</p> <ul style="list-style-type: none"> Failure to do so could cause fire, burns, electric shock, or malfunction. This will protect the system against damage due to lightning.
	<p>Use a mechanism (switch, outlet, etc.) located within reach to turn off (disconnect) the power supply.</p> <ul style="list-style-type: none"> In case of emergency, it may be necessary to cut off the power supply quickly.
	<p>Turn off the power supply immediately if you notice abnormal odor, smoke, abnormal sound, or overheating.</p> <ul style="list-style-type: none"> Continuing to use the system in an abnormal condition could cause fire, burns, or electric shock.
	<p>Do Not Disassemble, Modify, or Repair!</p> <ul style="list-style-type: none"> Doing so could cause fire, burns, electric shock, injury, or malfunction.
	<p>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.</p> <ul style="list-style-type: none"> The product has no safety case. 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	
	<p>Caution – Hot!</p> <ul style="list-style-type: none"> The motor gets hot. Touching it could cause high-temperature burns.
	<p>Follow the procedure specified in the manual when powering the system on or off.</p> <ul style="list-style-type: none"> Failure to do so could cause overheating or malfunction.
	<p>Caution – Static Electricity</p> <ul style="list-style-type: none"> Use the antistatic band. Failure to do so could cause malfunction or unstable motion.

Overview

The RX24U CPU card (RTK0EMX590C02000BJ) is an optional board for use with the 24V Motor Control Evaluation System for RX23T (RTK0EM0006S01212BJ) (the Motor RSSK). The Motor RSSK comprises a 24V system inverter board (RTK0EM0001B00012BJ) (the INV-BRD) and a RX23T CPU card (RTK0EM0013C01201BJ) (the RX23T-CRD). By replacing the RX23T-CRD with the product, motor evaluation can be performed using the RX24U.

An E1 emulator and equipment related to the Motor RSSK must be provided by the customer.

This user's manual describes the proper handling of the product. Content related to the product is presented in chapters 0 to 4 and 6 to 8. Content related to connection of the INV-BRD supplied with the Motor RSSK is presented in chapter 5. For details of the operation of the INV-BRD, refer to the Motor RSSK user's manual (R20UT3697EJ).

Target Device

RX24U microcontroller

Related Documents

- RX24U CPU Card Schematic : R12TU0019EJ
- RX24U CPU Card BOM List : R12TU0020EJ
- RX24U CPU Card PWB Pattern Drawing : R12TU0021EJ
- Renesas Solution Starter Kit
24V Motor Control Evaluation System for RX23T (Motor RSSK) User's Manual: R20UT3697EJ

Package Contents

- RX24U CPU Card Information
- Caution regarding the Motor Control Evaluation Board - RX24U CPU Card –

Abbreviations

Abbreviations	Full Name	Remarks
Motor RSSK	24V Motor Control Evaluation System for RX23T	Motor control evaluation kit for RX23T Product No.: RTK0EM0006S01212BJ
INV-BRD	24V Inverter Board	Inverter board supplied with motor control evaluation kit for RX23T Product No.: RTK0EM0001B00012BJ
RX23T-CRD	RX23T CPU Card	RX23T CPU card supplied with motor control evaluation kit for RX23T Product No.: RTK0EM0013C01201BJ

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1. Features

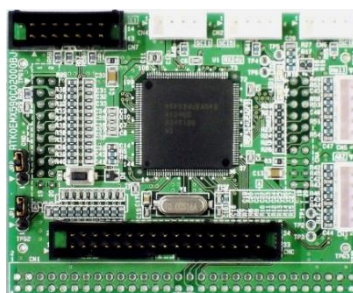
1. Populated with RX24U 32-bit microcontroller suitable for inverter control.
2. CPU card designed specifically for use with INV-BRD supplied with Motor RSK.
3. Supports writing of software to flash memory using the E1 emulator.
4. Equipped with Hall sensor input connector and encoder input connector.
5. Equipped with serial communication connector.

2. Specifications

2.1 Specification

Table 2.1 Overview of RX24U CPU Card Specifications

Item	Specification
Product name	RX24U CPU card
Board product No.	RTK0EMX590C02000BJ
Supported inverter board / product No.	Supplied with 24V Motor Control Evaluation System for RX23T 24V Inverter Board / RTK0EM0001B00012BJ
Exterior view	



Note: Appearance of actual product may differ from photo.

MCU	Product group	RX24U group
	Product No.	R5F524UEADFB
	CPU max. operating frequency	80 MHz
	Bit count	32 bits
	Package / Pin count	LFQFP / 144 pins
	ROM	512 KB
	RAM	32KB
MCU input clock		10MHz
Input power supply voltage		DC 5 V ($\pm 5\%$) Selectable among the following: <ul style="list-style-type: none"> • Power supply from supported inverter board • Power supply from E1*1
Supported sensors		Hall sensor, encoder (through holes provided for signal monitoring test pins)
Supported emulator		E1 emulator
Connectors		<ul style="list-style-type: none"> • Inverter board connectors $\times 2$ • Serial communication connectors $\times 3$ • E1 connector • Hall sensor signal input connector • Encoder signal input connector • Extender board connector
Switch		MCU external reset switch
LEDs		User control LEDs $\times 2$
Operating temperature		Room temperature
Operating humidity		No condensation

Note 1. Power supply from the E1 emulator is only supported for standalone operation. Power supply from the E1 emulator is not supported when the INV-BRD is connected.

2.2 Regulatory Compliance Notices

2.2.1 European Union regulatory notices

This product complies with the following EU Directives. (These directives are only valid in the European Union.)

CE Certifications:

- Electromagnetic Compatibility (EMC) Directive 2014/30/EU
EN61326-1 : 2013 Class A

WARNING: This is a Class A product. This equipment can cause radio frequency noise when used in the residential area. In such cases, the user/operator of the equipment may be required to take appropriate countermeasures under his responsibility.

- Information for traceability
 - Authorised representative
Name: Renesas Electronics Corporation
Address: Toyosu Foresia, 3-2-24, Toyosu, Koto-ku, Tokyo 135-0061, Japan
 - Manufacturer
Name: Renesas Electronics Corporation
Address: Toyosu Foresia, 3-2-24, Toyosu, Koto-ku, Tokyo 135-0061, Japan
 - Person responsible for placing on the market
Name: Renesas Electronics Europe GmbH
Address: Arcadiastrasse 10, 40472 Dusseldorf, Germany
 - Trademark and Type name
Trademark: Renesas
Product name: RX24U CPU Card for Motor Control
Type name: RTK0EMX590C02000BJ

Environmental Compliance and Certifications:

- Waste Electrical and Electronic Equipment (WEEE) Directive 2012/19/EU

3. Block Diagram

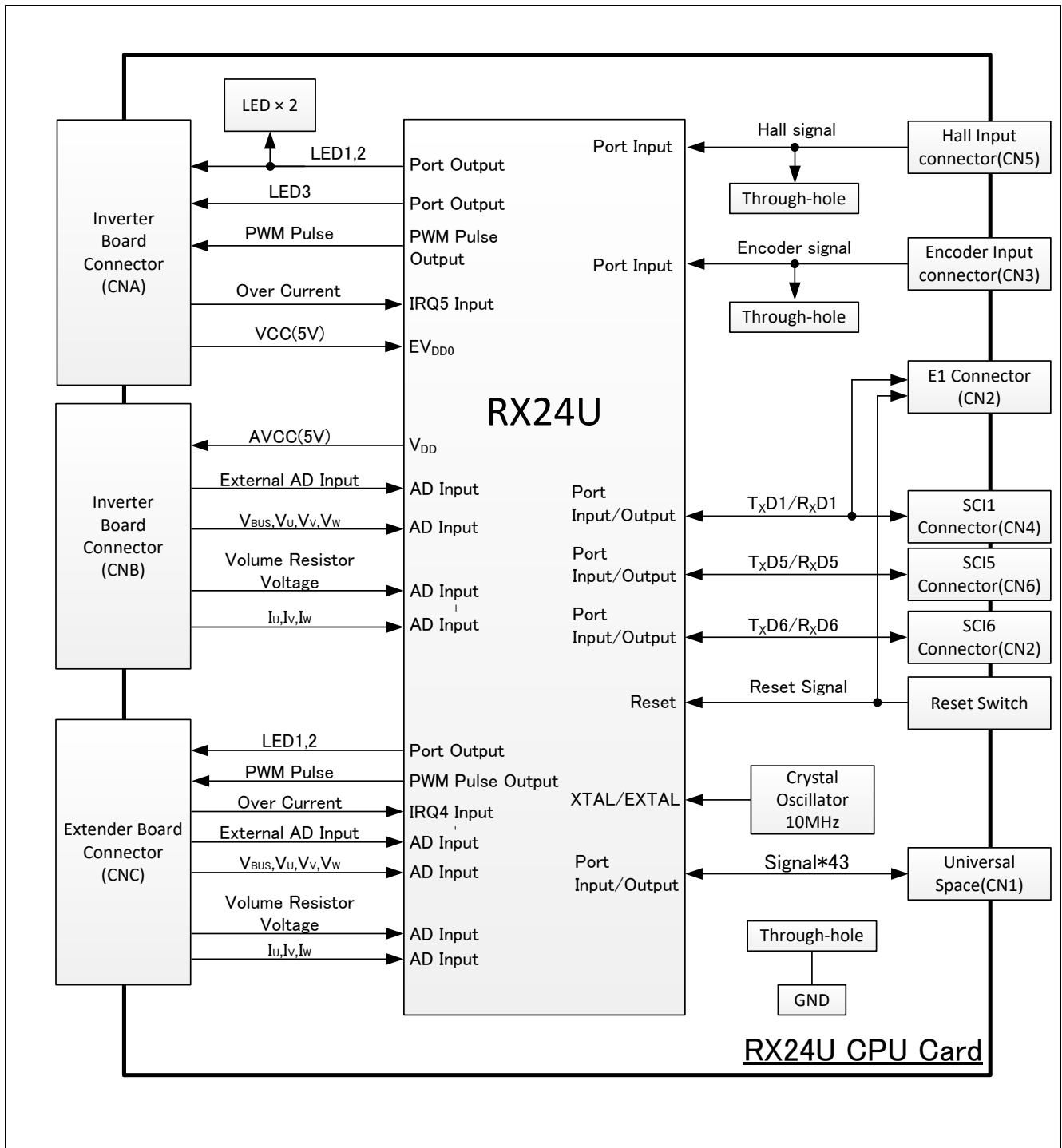


Figure 3.1 RX24U CPU Card Block Diagram

4. Layout

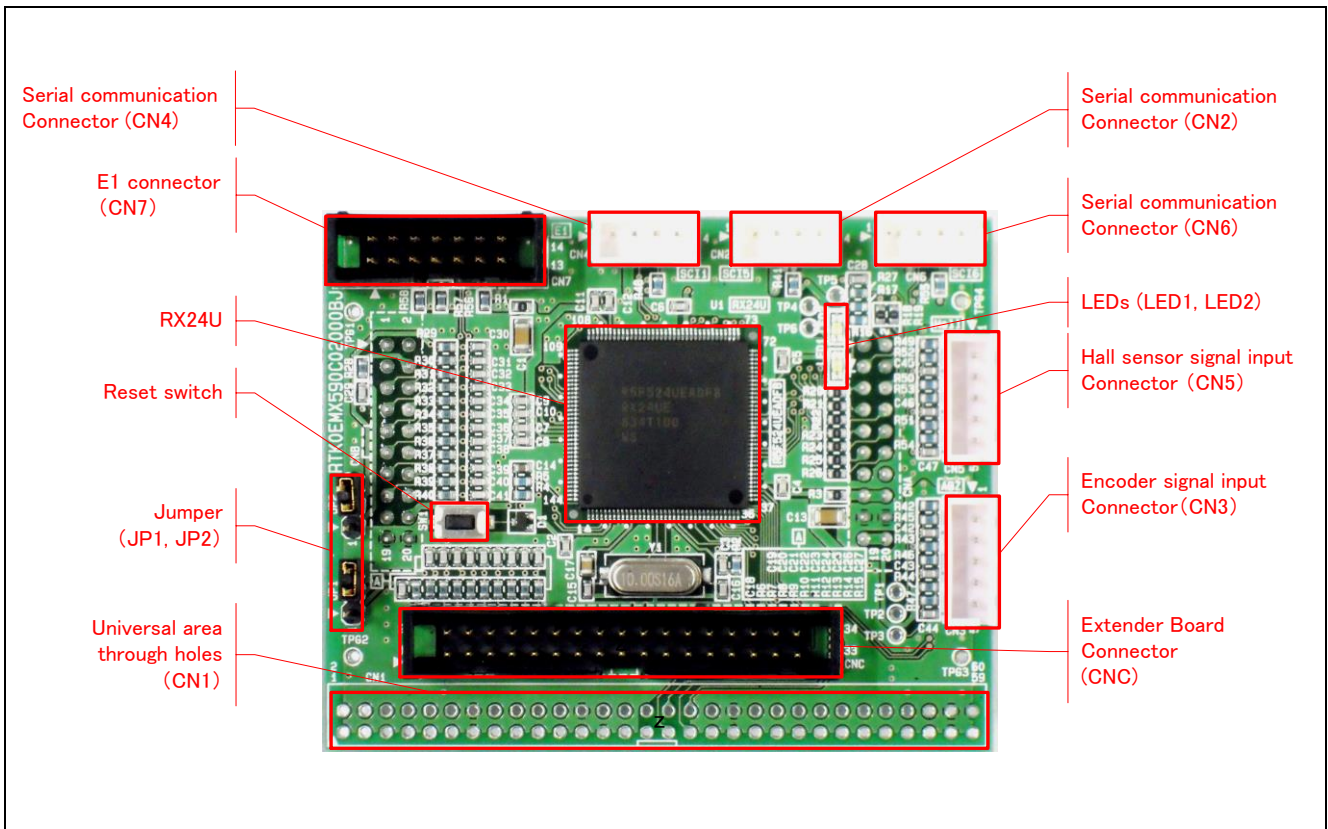


Figure 4.1 RX24U CPU Card Layout (Top View)

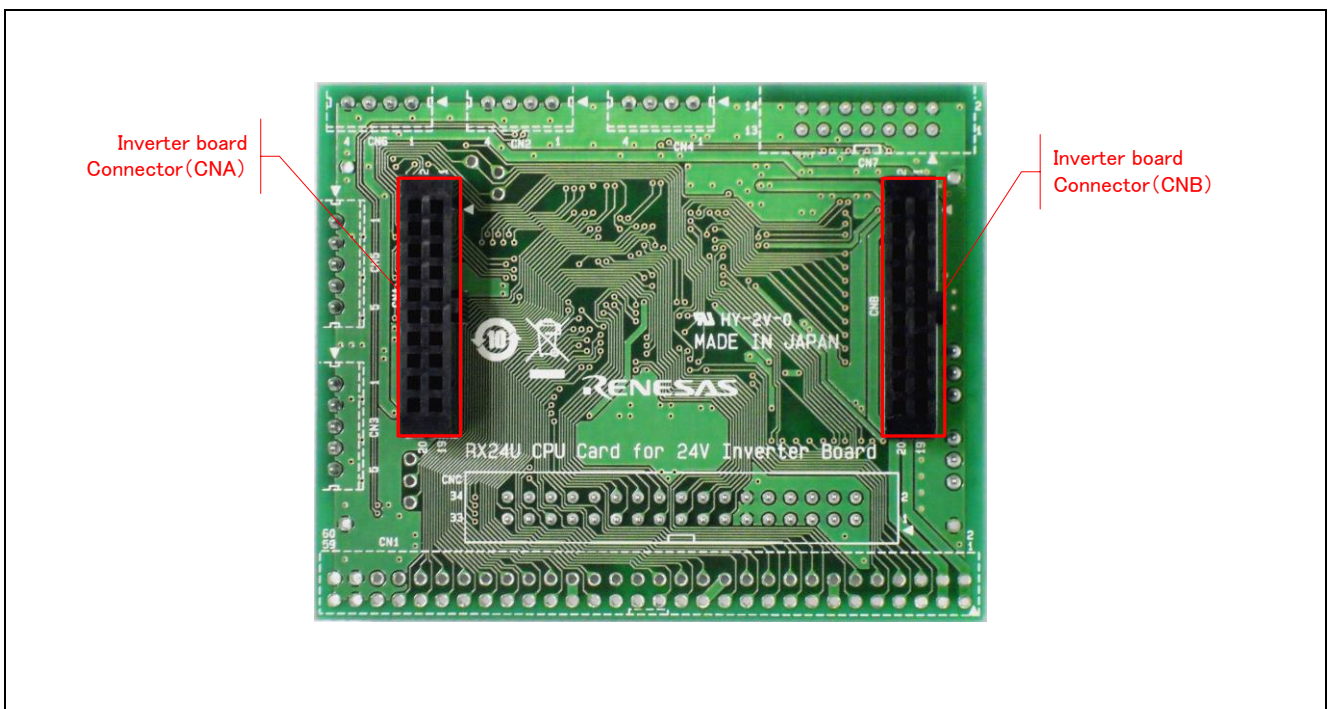


Figure 4.2 RX24U CPU Card Layout (Bottom View)

5. Usage

5.1 Quick Start

5.1.1 Preparation

Obtain the Motor RSSK, and perform the steps described in 5.1.1 and 5.1.2, Quick Start, of the user's manual. (R20UT3697EJ).

5.1.2 Replacing the CPU card

Confirm that the INV-BRD is powered off, remove the RX23T-CRD from the INV-BRD, and connect the product in its place.

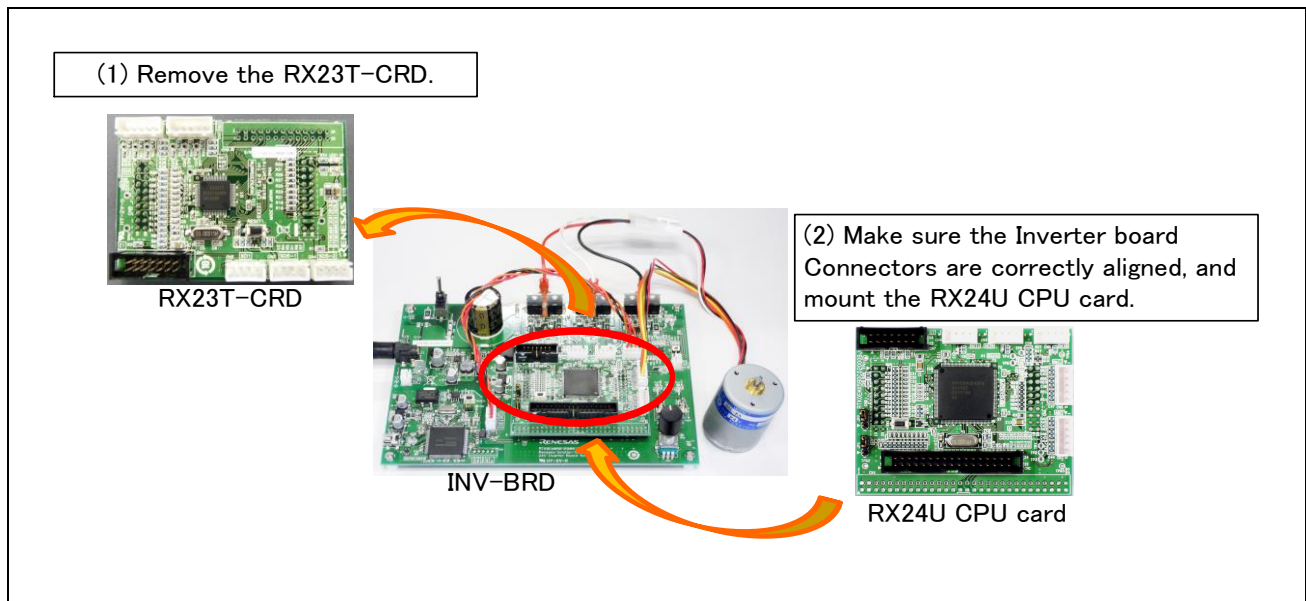


Figure 5.1 CPU card replacement

5.1.3 Preparation for Operation Test

Perform the steps described in 5.1.3 to 5.1.5 of the Motor RSSK user's manual (R20UT3697EJ) to prepare for motor drive.

5.1.4 Operation Test

Perform the steps described in 5.1.6 to 5.1.9 of the Motor RSSK user's manual (R20UT3697EJ) in the order indicated, turn on the power supply, enable motor rotation, change the motor rotation speed, and stop motor rotation.

5.1.5 Finishing the Operation Test

After the operation test is finished, confirm that the motor shaft is no longer rotating and turn off the stabilized power supply output.

5.2 Operation

5.2.1 Basic Operation

Out of the box the product is programmed with sensor-less vector control software for the RX24U. Table 5.1 lists the software specifications and the basic operations when connected to the INV-BRD.

Table 5.1 Initial Software Specifications

Item	Specification
Control method	Sensorless vector control
VR1	Clockwise turn: Motor shaft rotates clockwise. Counterclockwise turn: Motor shaft rotates counterclockwise.
SW1	ON: Motor rotation enabled OFF: Motor rotation disabled
SW2	Cancels error state: OFF → ON → OFF after an error:
LED1	ON: SW1 ON and normal state. OFF: SW1 OFF or error state.
LED2	ON: error state. OFF: normal state.

5.2.2 Canceling an Error State

If an error occurs, LED2 lights on the INV-BRD and the product, and motor rotation stops. To recover, it is necessary to turn off toggle switch SW1 and turn on toggle switch SW2 on the INV-BRD, and then turn off toggle switch SW2 again.

5.3 In Case of Abnormal Odor, Smoke, Abnormal Sound, Overheating, Etc.

The INV-BRD is equipped with a toggle switch (S1) to cut off the flow of current to the inverter. If an abnormal condition (such as abnormal odor, smoke, abnormal sound, or overheating) occurs, turn off S1 to cut off current flow to the inverter.

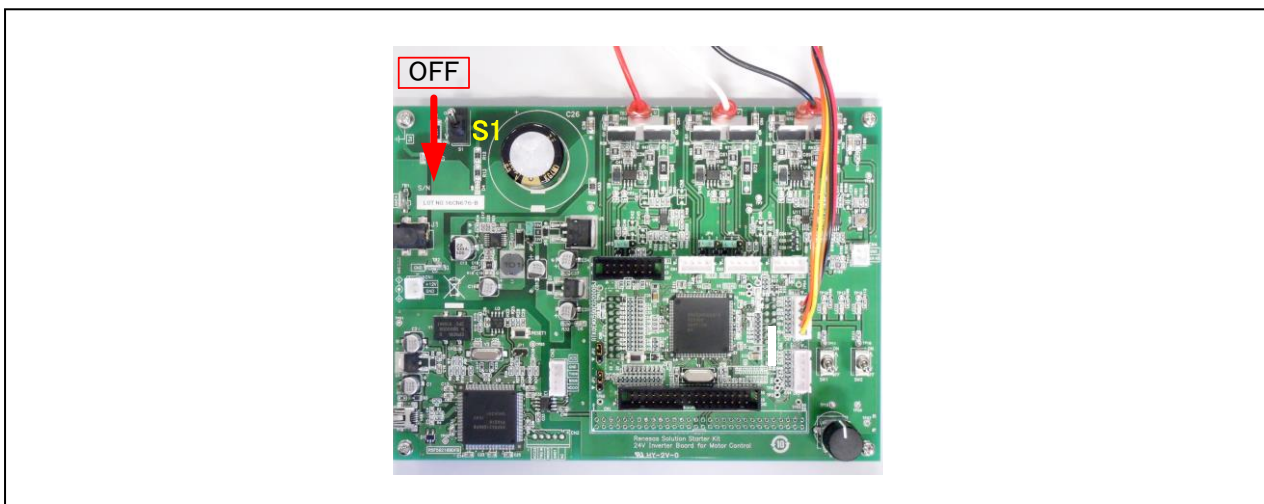


Figure 5.2 Cut off current

6. Functions

6.1 Power Supply

The product does not have a dedicated power supply connector. When connected to the INV-BRD it draws power via the connector. When not connected to the INV-BRD, it can draw power via the E1 connector. The product is not allowed to draw power via the E1 connector when it is connected to the INV-BRD.

6.2 Connecting the E1 Emulator

The E1 on-chip debugging emulator from Renesas Electronics is used to write software (program) to the flash memory of the RX24U. Software will be downloaded into the product via E1 emulator. It is also necessary to make the settings shown in Table 6.1 in the integrated development environment to enable the emulator to supply power to the product. Table 6.2 lists the pin assignments of the E1 connector.

Table 6.1 E1 Emulator Power Supply Settings

Connection to INV-BRD	Power Supply Setting of E1 Emulator
Connected	Power supply not allowed*1
Not connected	5 V power supply

Note 1. When connected to the INV-BRD, the product must draw power from the INV-BRD.

Table 6.2 Pin Assignments of E1 Connector (CN2)

Pin No.	Pin Function	RX24U Connection Pins	Pin No.	Pin Function	RX24U Connection Pins
1	NC	—	2	GND	EVSS0/VSS
3	NC	—	4	NC	
5	TXD_1	PD3/TXD1	6	NC	—
7	MD/FINED_1	MD/FINED	8	VCC	VCC
9	NC	—	10	NC	—
11	RXD_1	PD5/RXD	12	GND	VSS/AVSS
13	RESET_1	RES#	14	GND	VSS/AVSS

Note: See a supplement to the E1/E20 emulator user's manual.

6.3 Connecting the Inverter Board

The product connects to the INV-BRD via the inverter board connectors (CNA and CNB). Table 6.3 and Table 6.4 list the pin assignments of the inverter board connectors.

Table 6.3 Pin Assignments of Inverter Board Connector (CNA)

Pin No.	Pin Function	RX24U Connection Pins	Pin No.	Pin Function	RX24U Connection Pins
1	LED1#	PA2	2	LED2#	PA1
3	PFC_G1#	PD7	4	VRL	PB3
5	FO#	P70/POE0#	6	NC	P55/AN211
7	WN1	P76/MTIOC4D	8	VN1	P75/MTIOC4C
9	UN1	P74/MTIOC3D	10	WP1	P73/MTIOC4B
11	VP1	P72/MTIOC4A	12	UP1	P71/MTIOC3B
13	SW1#	P80	14	SW2#	P81
15	5V	VCC	16	5V	VCC
17	GND	VSS	18	GND	VSS
19	3.3V	—	20	3.3V	—

Table 6.4 Pin Assignments of Inverter Board Connector (CNB)

Pin No.	Pin Function	RX24U Connection Pins	Pin No.	Pin Function	RX24U Connection Pins
1	AVCC	AVCC	2	AVCC	AVCC
3	NC	—	4	NC	PGAVSS1
5	IU1	P44/AN100	6	IV1	P45/AN101
7	IW1	P46/AN102	8	VPN	P64/AN204
9	TEMP1	P65/AN205	10	VU1	P61/AN201
11	VV1	P62/AN202	12	VW1	P63/AN203
13	VAC	P51/AN207	14	IPFC	P52/AN208
15	VR1	P53/AN209	16	RSVIN1	P54/AN210
17	VCCIO	VCC	18	VCCIO	VCC
19	GND	VSS	20	GND	VSS

6.4 Connecting the Serial Communication

The product communicates with the UART via the serial communication connectors. There are three serial communication connectors: CN4, CN6, and CN7. Table 6.5 lists their pin assignments. Use CN6 when using a tool such as waveform display in conjunction with the INV-BRD.

Table 6.5 Pin Assignments of Serial Communication Connectors (CN2, CN4, CN6)

Connector No.	Pin No.	Pin Function	RX24U Connection Pins
CN2	1	5V	VCC
SCI5	2	RX24U transmit side	PB5/TXD5
	3	RX24U receive side	PB6/RXD5
	4	GND	VSS
CN6	1	5V	VCC
SCI1	2	RX24U transmit side	PD3/TXD1**
	3	RX24U receive side	PD5/RXD1**
	4	GND	VSS
CN6	1	5V	VCC
SCI6	2	RX24U transmit side	PB2/TXD6
	3	RX24U receive side	PB1/RXD6
	4	GND	VSS

Note 1. TXD / RXD of SCI1 is shared with E1. Please do not use the SCI1 during E1 connection.

6.5 Hall Sensor Signal Input

The product is equipped with a Hall sensor signal input connector. Using this connector it is possible to input the Hall sensor signal from the motor supplied with the Motor RSSK directly to the product. The signal input to the product is pulled up to 5 V and passed through an RC filter before being input to the RX24U. Table 6.6 lists the pin assignments of the Hall sensor signal input connector, and Table 6.7 lists connector information.

Table 6.6 Pin Assignments of Hall Sensor Signal Input Connector (CN5)

Pin No.	Pin Function	RX24U Connection Pins
1	5V	VCC
2	GND	VSS
3	HU	P10/IRQ0
4	HV	P11/IRQ1
5	HW	P01/IRQ4

Table 6.7 Hall Sensor Signal Input Connector Information

Part	Product No.	Manufacturer
Connector (CN5)	B5B-XH-A	J.S.T. Mfg. Co. Ltd.

6.6 Encoder Signal Input

The product is equipped with an encoder signal input connector. This makes it possible to input the encoder signal to the RX24U. The signal input to the product is pulled up to 5 V and passed through an RC filter before being input to the RX24U. Table 6.8 lists the pin assignments of the signal input connector, and Table 6.9 lists connector information.

Table 6.8 Pin Assignments of Encoder Signal Input Connector (CN3)

Pin No.	Pin Function	RX24U Connection Pins
1	5V	VCC
2	GND	VSS
3	A-phase	P33
4	B-phase	P32
5	Z-phase	PA5

Table 6.9 Encoder Signal Input Connector Information

Part	Product No.	Manufacturer
Connector (CN3)	B5B-XH-A	J.S.T. Mfg. Co. Ltd.

6.7 Connecting the Extender Board

This product is equipped with Extender board Connector. This connector can connect Extender Board (RTK0EM0000Z02000BJ) via the cable. This makes it possible to control two INV-BRDs. In other words, this product can drive two motors. Table 6. 10 lists the pin assignments of the Extender board Connector.

Table 6. 10 Pin Assignments of Extender boards Connector

CNC Pin No.	CNC Pin Function	RX24U Connection Pins	CNC Pin No.	CNC Pin Function	RX24U Connection Pins
1	PGAVSS_2	PGAVSS0	2	VPN_2	P20/AN016
3	IU_2	P40/AN000	4	IV_2	P47/AN103
5	IW_2	P60/AN200	6	TEMP_2	P50/AN206
7	VU_2	P41/AN001	8	VV_2	P42/AN002
9	VW_2	P43/AN003	10	VR_2	P21/AN116
11	GND	VSS	12	GND	AVSS
13	LED1#_2	P22	14	LED2#_2	P23
15	LED3#_2	P24	16	FO#_2	P96/POE4#
17	WN_2	P90/MTIOC7D	18	VN_2	P91/MTIOC7C
19	UN_2	P92/MTIOC6D	20	WP_2	P93/MTIOC7B
21	VP_2	P94/MTIOC7A	22	UP_2	P95/MTIOC6B
23	SW1#_2	P15	24	SW2#_2	P16
25	GND	VSS	26	GND	VSS
27	ENC_A_2	P31/MTCLKC	28	ENC_B_2	P30/MTCLKD
29	ENC_Z_2	PA3/MTIOC2A	30	GND	VSS
31	GND	VSS	32	HALL_U_2	PD4/IRQ2
33	HALL_V_2	PB4/IRQ3	34	HALL_W_2	PD6/IRQ5

6.8 Extension of Unused Pins

To facilitate general use of the product, the unused pins of the RX24U are extended through universal connector through holes in the board. Table 6.11 lists the pin assignments of the universal area through holes.

Table 6.11 Pin Assignments of Universal Area Through Holes (CN1)

Pin No.	RX24U Connection Pins	Pin No.	RX24U Connection Pins
1	UVCC	2	UVCC
3	AVCC	4	AVCC
5	P00	6	P02
7	PE6	8	PE5
9	PE4	10	PE3
11	PE1	12	PE0
13	VSS	14	VSS
15	PD2	16	PD1
17	PD0	18	PF3
19	PF2	20	PF1
21	PF0	22	PB7
23	PB0	24	VSS
25	VSS	26	PC6
27	PC5	28	PC2
29	PC1	30	PC0
31	PA7	32	PA6
33	PA4	34	PA0
35	P35	36	P34
37	VSS	38	VSS
39	P17	40	P14
41	P13	42	P12
43	P82	44	P83
45	P84	46	PC3
47	PC4	48	P25
49	P26	50	P27
51	PG0	52	PG1
53	PG2	54	NC
55	NC	56	NC
57	VSS	58	VSS
59	VSS	60	VSS

6.9 Reset Circuit

The product is equipped with a reset circuit for resetting the microcontroller at power-on reset and external reset. To apply an external reset to the microcontroller, press the pushbutton (SW1).

6.10 Crystal Resonator

This product is mounted crystal oscillator (Y1) on 10MHz.

6.11 LEDs

Two LEDs are mounted on the product for use in debugging programs and general system applications. Each turns on when the output on the corresponding port is low-level and turns off when the output is high-level. Table 6.12 lists the pin assignments corresponding to the LEDs.

Table 6.12 RX24U CPU Card LED Connection Pin Assignments

Corresponding RX24U Port		LED1	LED2
PA2	High-level output	Off	—
	Low-level output	On	—
PA1	High-level output	—	Off
	Low-level output	—	On

6.12 JP1, JP2

JP1 and JP2 should be short-circuited between 2-3Pin.

Table 6.13 Jumper JP1 and JP2 configuration

JP1, JP2 configuration	Function	
	JP1	JP2
Open	Setting Prohibited	Setting Prohibited
1pin to 2pin short-circuited	Connect MCU (PGAVSS0 pin) to CNC (1 pin)	Connect MCU (PGAVSS1 pin) to CNB (4 pin)
2pin to 3pin short-circuited (At the time of shipment)	Connect MCU (PGAVSS0 pin) to GND	Connect MCU (PGAVSS1 pin) to GND

7. Details of RX24U CPU Card

7.1 RX24U Features

1. 32-bit microcontroller with RXv2 CPU core for motor control
2. On-chip 32-bit single-precision floating point unit (FPU)
3. Ability to output three-phase complementary PWM waveforms on three channels
4. Ability to set timer interrupt as A/D trigger
5. Three 12-bit A/D converter units with a total of 22 channels
6. Channel-dedicated sample and hold function
7. On-chip programmable gain amplifier and comparator
8. Timer output stop (Hi-Z) function
9. On-chip independent watchdog timer

7.2 RX24U Pin Assignments

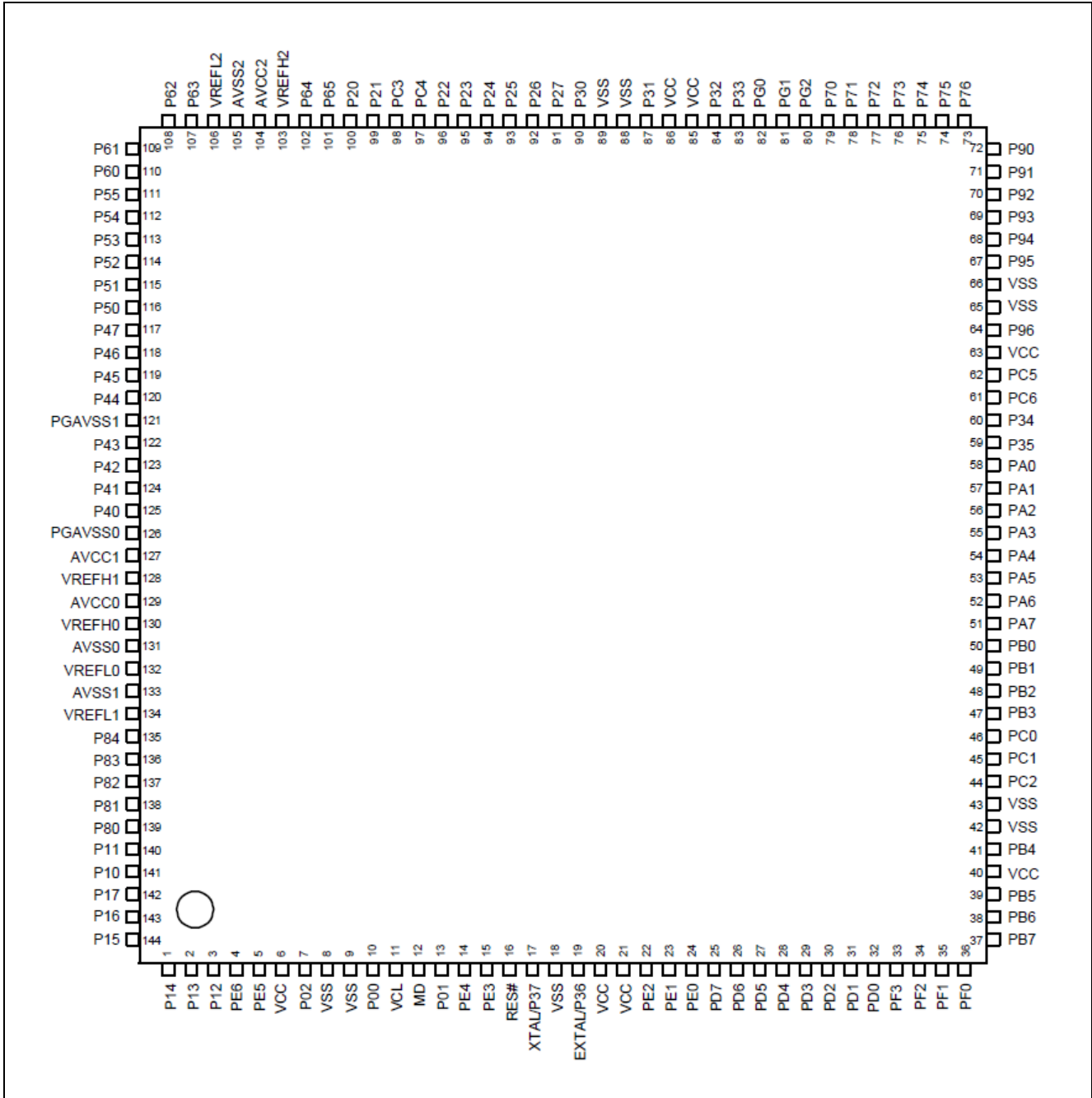


Figure 7.1 RX24U Pin Assignments

7.3 List of RX24U Pin Functions

Table 7.1 List of RX24U Pin Functions

Pin No.	RX24U Pin Functions	CPU Card Connection	INV-BRD Connection (N.C. : No connected)
1	P14/MTIOC4B/GTIOC2A	CN1-40	N.C.
2	P13/MTIOC4A/GTIOC1A	CN1-41	N.C.
3	P12/MTIOC3B/GTIOC0A	CN1-42	N.C.
4	PE6/POE10#/IRQ3	CN1-7	N.C.
5	PE5/IRQ0	CN1-8	N.C.
6	VCC	VCC	VCC
7	P02/MTIOC9D/CTS1#/RTS1#/SS1#/IRQ5/ADST0	CN1-6	N.C.
8	VSS	VSS	VSS
9	VSS	VCC	VSS
10	P00/IRQ2/ADST1	CN1-5	N.C.
11	VCL	Connect to capacitor	N.C.
12	MD/FINED	CN7-7	N.C.
13	P01/POE12#/IRQ4/ADST2	CN5-5	Hall sensor (W)
14	PE4/MTCLKC/POE10#/IRQ1	CN1-9	N.C.
15	PE3/MTCLKD/POE11#/IRQ2	CN1-10	N.C.
16	RES#	RESET CN7-13	N.C.
17	XTAL/P37	Crystal oscillator (10MHz)	MCU oscillating
18	VSS	VSS	VSS
19	EXTAL/P36	Crystal oscillator (10MHz)	MCU oscillating
20	VCC	VCC	VCC
21	VCC	VCC	VCC
22	PE2/POE10#/NMI	Pull down	N.C.
23	PE1/MTIOC9D/TMO5/CTS5#/RTS5#/SS5#/SSLA3	CN1-11	N.C.
24	PE0/MTIOC9B/TMCI1/TMCI5/RXD5/SMISO5/SSCL5/SSLA2	CN1-12	N.C.
25	PD7/MTIOC9A/TMRI1/TMRI5/GTIOC3A/TXD5/SMOSI5/SSDA5/SSLA1	CNA-3	N.C.
26	PD6/MTIOC9C/TMO1/GTIOC3B/CTS1#/RTS1#/SS1#/CTS11#/RTS11#/SS11#/SSLA0/IRQ5/ADST0	CNC-34	N.C.
27	PD5/TMRI0/TMRI6/GTECLKA/RXD1/SMISO1/SSCL1/RXD11/SMISO11/SSCL11/IRQ3	CN4-3, CN7-11	Communication port
28	PD4/TMCI0/TMCI6/GTECLKB/SCK1/SCK11/IRQ2	CNC-32	N.C.
29	PD3/TMO0/GTECLKC/TXD1/SMOSI1/SSDA1/TXD11/SMOSI11/SSDA11	CN4-2	Communication port
30	PD2/TMCI1/TMO4/GTIOC0A/SCK5/MOSIA	CN1-15	N.C.
31	PD1/TMO2/GTIOC0B/MISOA	CN1-16	N.C.
32	PD0/TMO6/GTIOC1A/RSPCKA	CN1-17	N.C.
33	PF3/TMO7/CTS11#/RTS11#/SS11#/CRXD/COMP0	CN1-19	N.C.
34	PF2/TMO3/SCK11/CTXD/COMP1	CN1-19	N.C.
35	PF1/TMO5/RXD11/SMISO11/SSCL11/COMP2	CN1-20	N.C.
36	PF0/TMO1/TXD11/SMOSI11/SSDA11/COMP3	CN1-21	N.C.
37	PB7/GTIOC1B/SCK5	CN1-22	N.C.

Pin No.	RX24U Pin Functions	CPU Card Connection	INV-BRD Connection (N.C. : No connected)
38	PB6/GTIOC2A/RXD5/SMISO5/SSCL5/IRQ5	CN2-3	Communication port
39	PB5/GTIOC2B/TXD5/SMOSI5/SSDA5	CN2-2	Communication port
40	VCC	VCC	VCC
41	PB4/POE8#/GTETRQ/GTECLKD/CTS5#/RTS5# /SS5#/IRQ3	CNC-33	N.C.
42	VSS	VSS	VSS
43	VSS	VSS	VSS
44	PC2/SCK8/ADSM0/GTADSM0	CN1-28	N.C.
45	PC1/TXD8/SMOSI8/SSDA8/ADSM1/GTADSM1	CN1-29	N.C.
46	PC0/RXD8/SMISO8/SSCL8/COMP3	CN1-30	N.C.
47	PB3/MTIOC0A/CACREF/SCK6/RSPCKA	CNA-4	N.C.
48	PB2/MTIOC0B/TMRI0/TXD6/SMOSI6/SSDA6 /SDA0/ADSM0	CN6-2	Communication port
49	PB1/MTIOC0C/TMCI0/RXD6/SMISO6/SSCL6 /SCL0/ADSM1	CN6-3	Communication port
50	PB0/MTIOC0D/TMO0/TXD6/SMOSI6/SSDA6 /MOSIA/ADTRG2#	CN1-21	N.C.
51	PA7/TMO2/ADSM0	CN1-31	N.C.
52	PA6/TMO6/ADSM1	CN1-32	N.C.
53	PA5/MTIOC1A/TMCI3/RXD6/SMISO6/SSCL6 /MISOA/IRQ1/ADTRG1#	CN3-5	Encoder (Z-phase)
54	PA4/MTIOC1B/TMCI7/SCK6/RSPCKA/ADTRG0#	CN1-33	N.C.
55	PA3/MTIOC2A/TMRI7/SSLA0/GTADSM0	CNC-29	N.C.
56	PA2/MTIOC2B/TMO7/CTS6#/RTS6#/SS6#/SSLA1 /GTADSM1	CNA-1	LED1
57	PA1/MTIOC6A/TMO4/SSLA2/CRXD/ADTRG0#	CNA-2	LED2
58	PA0/MTIOC6C/TMO2/SSLA3/CTXD	CN1-34	N.C.
59	P35/TMO0/CTS8#/RTS8#/SS8#/GTADSM0	CN1-35	N.C.
60	P34/TMO4/CTS9#/RTS9#/SS9#/GTADSM1	CN1-36	N.C.
61	PC6/MTIOC1A/RXD11/SMISO11/SSCL11	CN1-26	N.C.
62	PC5/MTIOC1B/TXD11/SMOSI11/SSDA11	CN1-37	N.C.
63	VCC	VCC	VCC
64	P96/POE4#/CTS8#/RTS8#/SS8#/IRQ4	CNC-16	N.C.
65	VSS	VSS	VSS
66	VSS	VSS	VSS
67	P95/MTIOC6B	CNC-22	N.C.
68	P94/MTIOC7A	CNC-21	N.C.
69	P93/MTIOC7B	CNC-20	N.C.
70	P92/MTIOC6D	CNC-19	N.C.
71	P91/MTIOC7C	CNC-18	N.C.
72	P90/MTIOC7D	CNC-17	N.C.
73	P76/MTIOC4D/GTIOC2B	CNA-7	W-phase PWM input
74	P75/MTIOC4C/GTIOC1B	CNA-8	V-phase PWM input
75	P74/MTIOC3D/GTIOC0B	CNA-9	U-phase PWM input
76	P73/MTIOC4B/GTIOC2A	CNA-10	W+phase PWM input
77	P72/MTIOC4A/GTIOC1A	CNA-11	V+phase PWM input
78	P71/MTIOC3B/GTIOC0A	CNA-12	U+phase PWM input
79	P70/POE0#/CTS9#/RTS9#/SS9#/IRQ5	CNA-5	Overcurrent detection

Pin No.	RX24U Pin Functions	CPU Card Connection	INV-BRD Connection (N.C. : No connected)
80	PG2/GTETR9/SCK9/COMP0	CN1-53	N.C.
81	PG1/TXD9/SMOSI9/SSDA9/COMP1	CN1-52	N.C.
82	PG0/RXD9/SMISO9/SSCL9/COMP2	CN1-51	N.C.
83	P33/MTIOC3A/MTCLKA/TMO0/SSLA3	CN3-3	Encoder (A-phase)
84	P32/MTIOC3C/MTCLKB/TMO6/SSLA2	CN3-4	Encoder (B-phase)
85	VCC	VCC	VCC
86	VCC	VCC	VCC
87	P31/MTIOC0A/MTCLKC/TMRI6/SSLA1/IRQ6	CNC-27	N.C.
88	VSS	VSS	VSS
89	VSS	VSS	VSS
90	P30/MTIOC0B/MTCLKD/TMCI6/SSLA0/IRQ7/COMP3	CNC-28	N.C.
91	P27/MTIOC1A	CN1-50	N.C.
92	P26/MTIOC9A/CTS1#/RTS1#/SS1#/ADST0	CN1-49	N.C.
93	P25/MTIOC9C/SCK1/ADST1	CN1-48	N.C.
94	P24/MTIC5U/TMCI2/TMO6/RSPCKA/COMP0/DA0	CNC-15	N.C.
95	P23/MTIC5V/MO2/CACREF/MOSIA/COMP1/DA1	CNC-14	N.C.
96	P22/MTIC5W/TMRI2/TMO4/MISOA/ADTRG2#/COMP2	CNC-13	N.C.
97	PC4/TXD1/SMOSI1/SSDA1/ADST2	CN1-47	N.C.
98	PC3/RXD1/SMISO1/SSCL1	CN1-46	N.C.
99	P21/MTCLKA/MTIOC9A/TMCI4/IRQ6/ADTRG1#/AN116	CNC-10	N.C.
100	P20/MTCLKB/MTIOC9C/TMRI4/IRQ7/ADTRG0#/AN016	CNC-2	N.C.
101	P65/AN205	CNB-9	External A/D input
102	P64/AN204	CNB-8	Bus line voltage detection
103	VREFH2	AVCC	AVCC
104	AVCC2	AVCC	AVCC
105	AVSS2	AVSS	AVSS
106	VREFL2	AVSS	AVSS
107	P63/AN203/IRQ7	CNB-12	W-phase voltage detection
108	P62/AN202/IRQ6	CNB-11	V-phase voltage detection
109	P61/AN201/IRQ5	CNB-10	U-phase voltage detection
110	P60/AN200/IRQ4	CNC-5	N.C.
111	P55/AN211/IRQ3	CNA-6	N.C.
112	P54/AN210/IRQ2	CNB-16	N.C.
113	P53/AN209/IRQ1	CNB-15	VR/switch voltage detection
114	P52/AN208/IRQ0	CNB-14	N.C.
115	P51/AN207	CNB-13	N.C.
116	P50/AN206	CNC-6	N.C.
117	P47/AN103	CNC-4	N.C.
118	P46/AN102/CMPC12/CMPC13/CMPC30/CMPC31	CNB-7	W-phase current detection
119	P45/AN101/CMPC02/CMPC03/CMPC20/CMPC21	CNB-6	V-phase current detection
120	P44/AN100/CMPC10/CMPC11/CMPC32/CMPC33	CNB-5	U-phase current detection
121	PGAVSS1	CNB-4	PGAVSS
122	P43/AN003	CNC-9	N.C.
123	P42/AN002	CNC-8	N.C.

Pin No.	RX24U Pin Functions	CPU Card Connection	INV-BRD Connection (N.C. : No connected)
124	P41/AN001	CNC-7	N.C.
125	P40/AN000/CMPC00/CMPC01/CMPC22/CMPC23	CNC-3	N.C.
126	PGAVSS0	CNC-1	N.C.
127	AVCC1	AVCC	AVCC
128	VREFH1	AVCC	AVCC
129	AVCC0	AVCC	AVCC
130	VREFH0	AVCC	AVCC
131	AVSS0	AVSS	AVSS
132	VREFL1	AVSS	AVSS
133	AVSS1	AVSS	AVSS
134	VREFL0	AVSS	AVSS
135	P84/TXD8/SMOSI8/SSDA8	CN1-45	N.C.
136	P83/RXD8/SMISO8/SSCL8	CN1-44	N.C.
137	P82/MTIC5U/TMO4SCK6	CN1-43	N.C.
138	P81/MTIC5V/TMCI4/TXD6/SMOSI6/SSDA6	CNA-14	Toggle switch (SW2)
139	P80/MTIC5W/TMRI4/RXD6/SMISO6/SSCL6	CNA-13	Toggle switch (SW1)
140	P11/MTIOC3A/MTCLKC/TMO3/IRQ1	CN5-4	Hall sensor (V)
141	P10/MTIOC9B/MTCLKD/TMRI3/POE12#/CTS6# /RTS6#/SS6#/IRQ0	CN5-3	Hall sensor (U)
142	P17/MTIOC4D/GTIOC2B	CN1-39	N.C.
143	P16/MTIOC4C/GTIOC1B	CNC-24	N.C.
144	P15/MTIOC3D/GTIOC0B	CNC-23	N.C.

8. Caution Items

The product includes some unused pins that have not been processed. For information on accurate pin processing, refer to the hardware manual of the microcontroller.

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Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Apr. 5, 2017	—	First edition issued
1.10	Feb. 21, 2019	22	Correct Table 7.1

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9. 不可将瑞萨电子产品和技术用于或者嵌入日本国内或海外相应的法律法规所禁止生产、使用及销售的任何产品或系统中。也不可将瑞萨电子产品或技术用于(1)与大规模杀伤性武器（例如核武器、化学武器、生物武器或运这些武器的导弹，包括无人机(UAV)的开发、设计、制造、使用、存储等相关的任何目的；(2)与常规武器的开发、设计、制造或使用相关的任何目的；(3)扰乱国际和平与安全的任何其他目的，并且不可向任何第三方销售、出口、租赁、转让、或让与瑞萨电子产品或技术，无论直接或间接知悉或者有理由知悉该第三方或任何其他方将从事上述活动。用户必须遵守对各方或交易行司法管辖权的任意国家和地区政府所公布和管理的任何适用出口管制法律法规。
10. 瑞萨电子产品的买方或分销商，或者分销、处置产品、或以其他方式向第三方出售或转让产品的任何其他方有责任事先向所述第三方通知本文件规定的内容和条件。
11. 在事先未得到瑞萨电子书面认可的情况下，不得以任何形式部分或全部再版、转载或复制本文件。
12. 如果对本文件所记载的信息或瑞萨电子产品有任何疑问，请向瑞萨电子的营业部门咨询。
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