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Aug.8, 2024

RZ/T2L Group

CN032 AC Servo Solution Controller Board Manual (for RZ/T2L)

Abstract

This document describes the specifications of the CN032 AC Motor Solution equipped with the MPU of the RZ/T2L group manufactured by Renesas Electronics. We provide an environment for evaluating RZ/T2L without the need for customers to prepare their own hardware.

<<Caution when handling the solution board>>
Be careful not to touch the board while power supply because CN032 AC servo solution board contains high voltage circuitry

Target Device

RZ/T2L Group

Related Document

- CN032 AC Servo Solution Controller Board Manual (for RZ/T2M, RZ/N2L)
- CN032 AC Servo Solution Controller Board Manual (for RZ/T2L) (this manual)
- CN032 AC Servo Solution Inverter Board Manual
- CN032 AC Servo Solution Firmware Manual
- CN032 AC Servo Solution Startup Guide (for EtherCAT)
- CN032 AC Servo Solution Startup Guide (for Motion Utility Control)

- RZ/T2L Group User's Manual: Hardware

Contents

1. Overview

1.1 AC Servo Solution Overview

CN032 AC Servo Solution kit is a solution for Servo motor drive systems equipped with Renesas Electronics' RZ/T2L and related products. CN032 AC Servo Solution consists of two boards, a controller board equipped with RZ/T2L (hereinafter referred to as the controller board) and an inverter board.

It shows the capability and feature of RZ/T2L for network communication module and motor control as references for applications.

1.2 Hardware Block Image

The CN032 AC Servo Solution block image is shown in Figure 1-1.

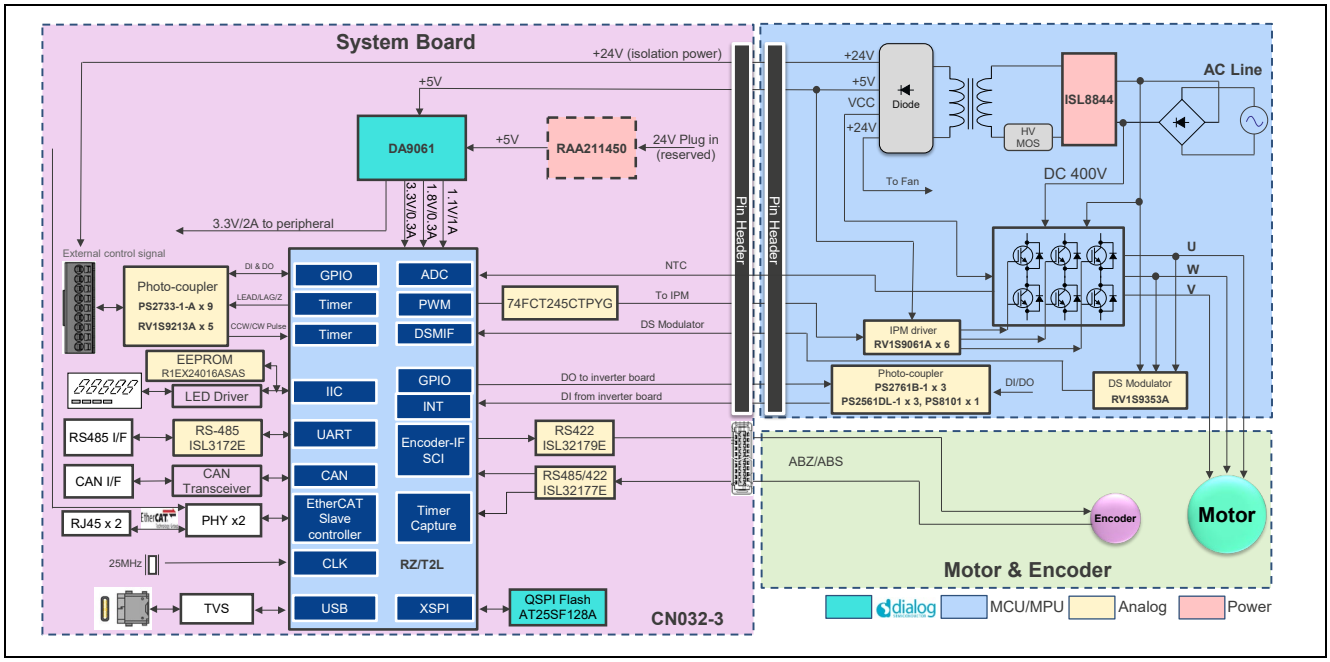

Figure 1-1 AC Servo Solution

The CN032 AC Servo Solution image is shown in Figure 1-2.

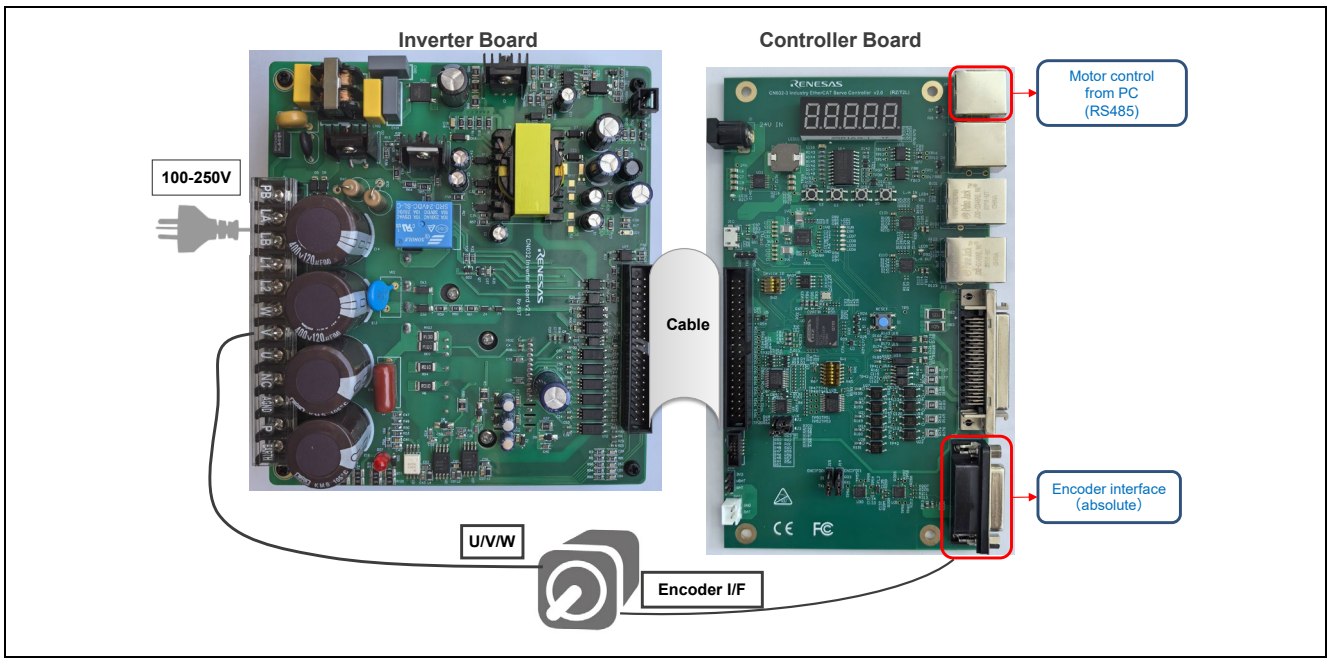

Figure 1-2 AC Servo Solution

2. General Specifications

Table 2-1 Specification's summary

Items		Description
CPU	Series	RZ/T2L Single Arm Cortex®-R52
	Package	R9A07G074M08: 196-pin FBGA
	Clock	Up to 800MHz
	ATCM/BTCM	512KB/64KB
	System RAM	1MB
IPM		PSS15S93E6 from Mitsubishi, 600V/15A
QSPI Flash		128MBIT, AT25SF128A-SHB-T (Renesas)
EEPROM		16KBIT, R1EX24016ASAS (Renesas)
Power In		100-250V AC, 1.5A max consumption
Interfaces		JTAG (10-PIN)
		EtherCAT port x 2
		Micro USB x 1
		RS485 x 1
		CAN x 1
		UART x 1
		Digital input x 6, Digital output x 8
		Display 5-bit eight-segment LED, Key x 4
		Encoder Interface x 1 (Support absolute encoder using ENCIF or SCI pins and incremental encoder)

Table 2-2 Environmental specifications

Item	Specification	Remarks
Operating temperature limit	0~40°C	At normal temperature
Operating humidity range	80% or less	No condensation

Table 2-3 Board size

Item	Specification	Remarks
Controller board	176(W)×100(D)×1.6(T)	NO include protrusions, NO include component height

The Table 2-4 Controller board and inverter board combination shows the combination of the controller board and inverter board. Operation is not guaranteed with any combination other than the following.

Table 2-4 Controller board and inverter board combination

No.	Controller board	Inverter board		
		V1.1	V1.2	V2.1
1	RZ/T2L(v1.0)	Available	Available	N/A
2	RZ/T2L(v2.0)	N/A	N/A	Available

The main parts in Controller Board v2.0 description are shown in Figure 2-1.

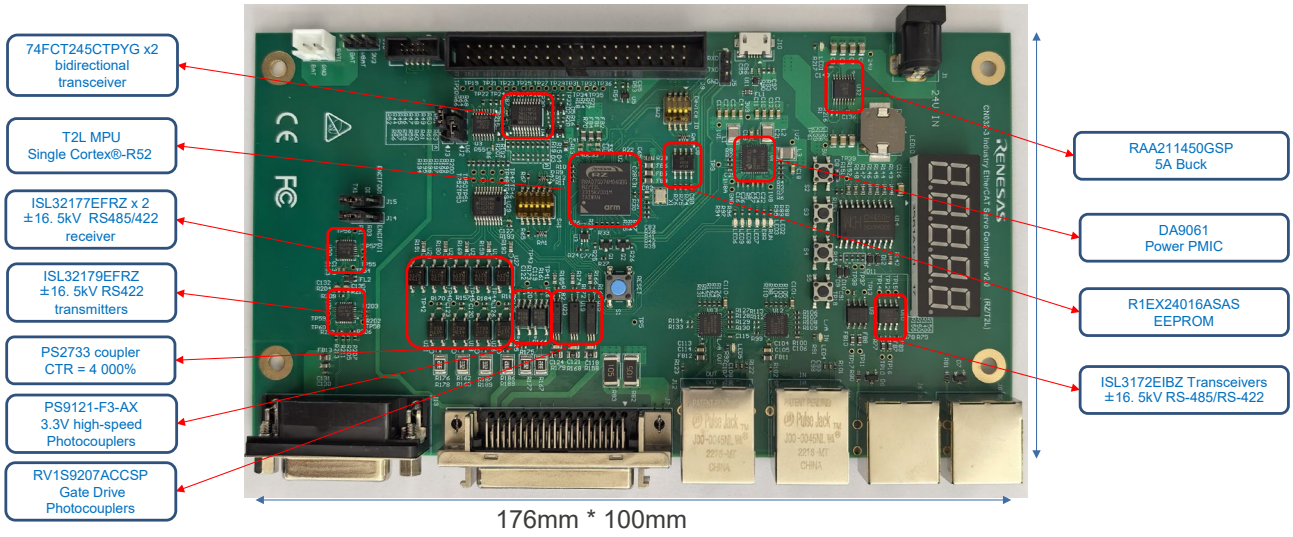

Figure 2-1 Controller Board (front)

The Controller Board image (back) is shown in Figure 2-2.

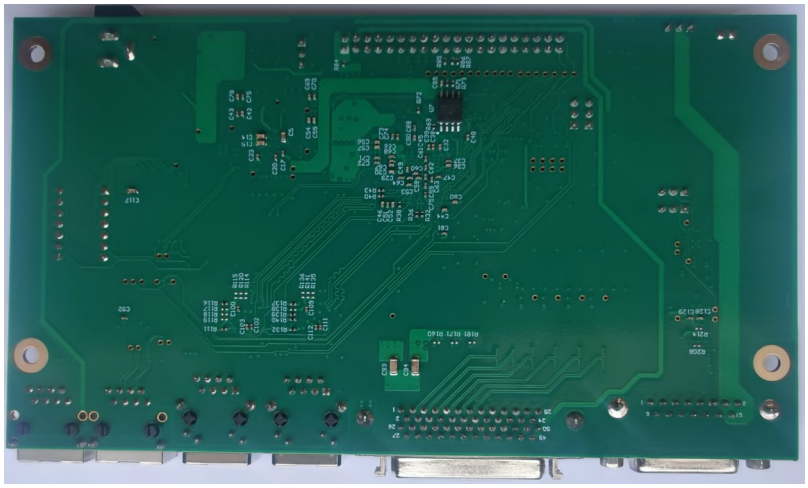

Figure 2-2 Controller Board (back)

3. Interface Description

3.1 Power Supply

Inverter board can be inputted from 100V to 250V AC, and it provides 5V to Controller board for power supply. The main power supply for Controller board consists of 5V, 3.3V, 1.8V, 1.2V, 1.1V. The PMIC power supply 1.1V/1.8V/3.3V (MCU/peripheral) and 1.2V for PHY Core.

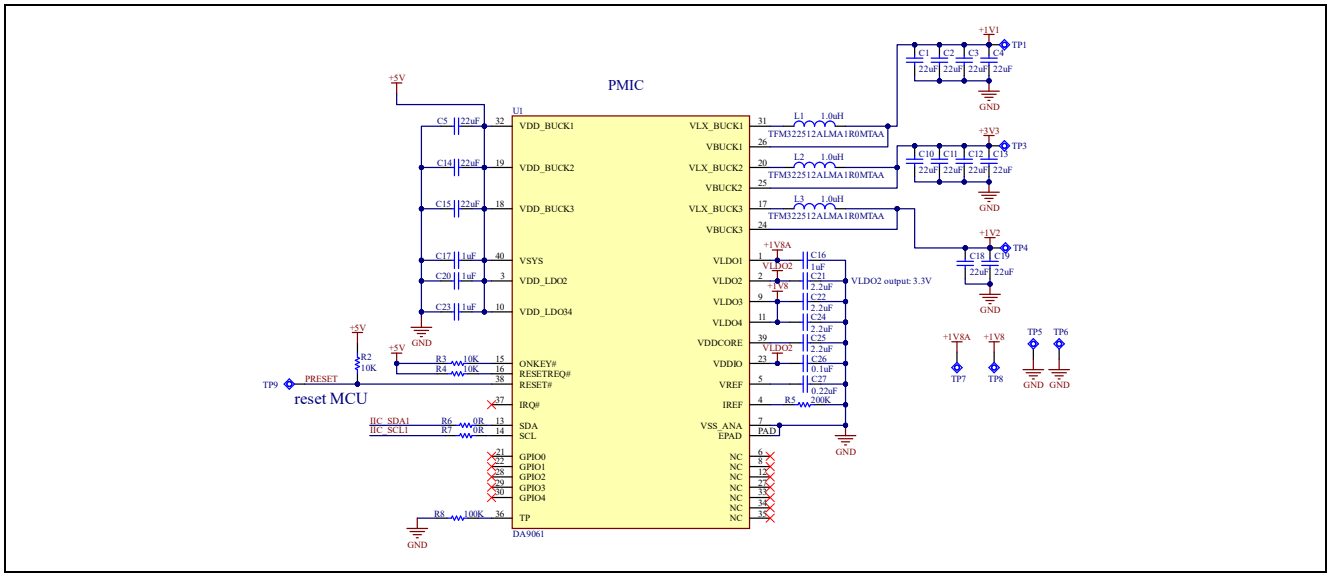

Figure 3-1 PMIC

Here is the Power on/off sequence and timing supplied from PMIC.

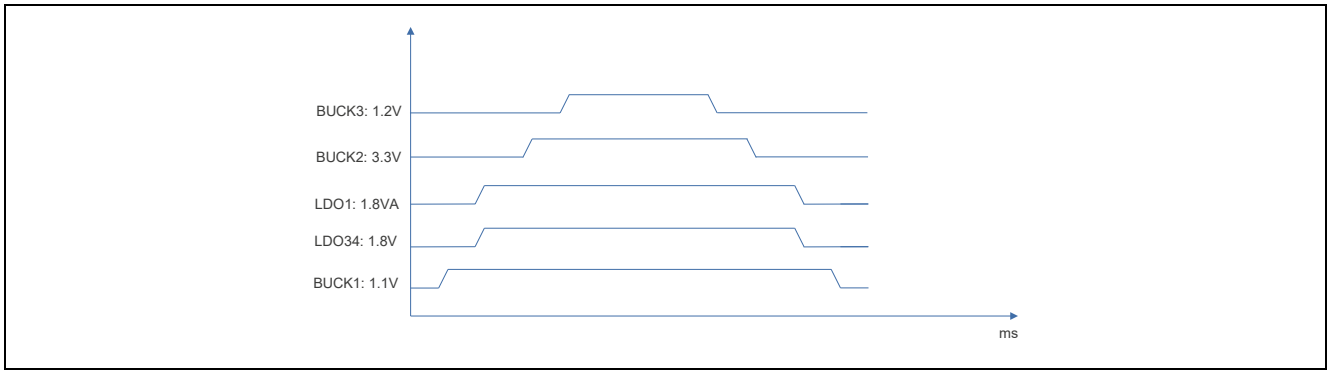

Figure 3-2 Power On/Off Sequence from PMIC

Controller board can be inputted from 12 to 24V DC from DC jack. It can be supply 5V DC from a power source other than the 5V DC power supply from the inverter board.

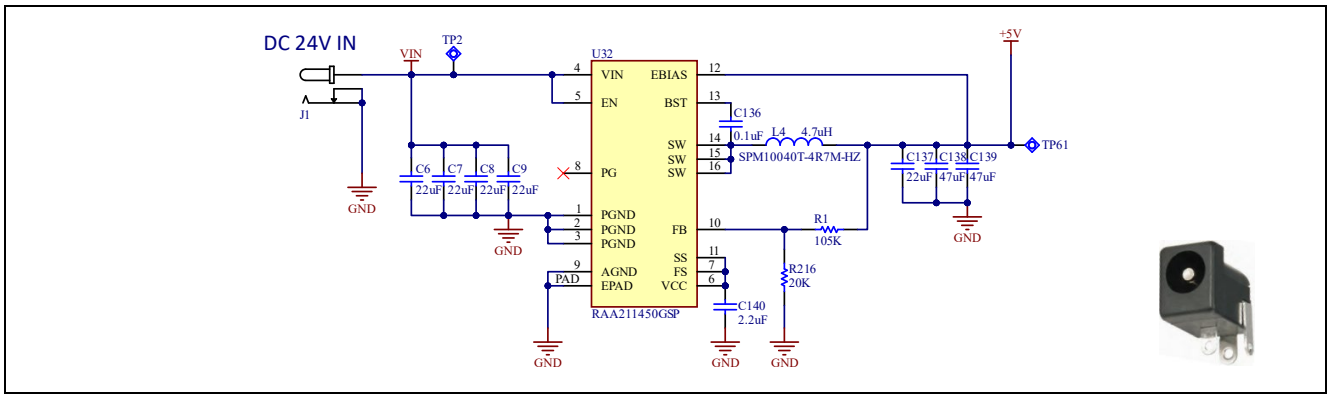

Figure 3-3 12-24V DC power supply of controller board

3.2 JTAG

Cortex 10 pin 0.05" JTAG Connector Pinout
The 10 pin cable is Samtec, part number FFSD-05-D-12.00.01-N

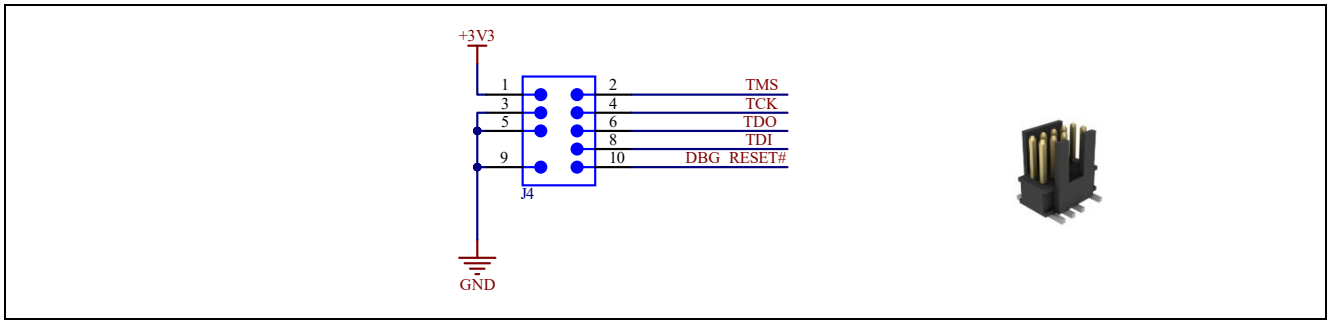

Figure 3-4 JTAG Interface

3.3 Jumper Setting

3.3.1 V/W PWM signal select

PWM signal for V/W phase is generated by using GPT or MTU3 output signal. There are 2 jumpers should be connected to set the PWM timer for motor PWM control in Controller board, that depend on software specification.

Jumper	GPT	MTU3 (default)
J2	2-3 short	1-2 short
J3	1-2 short	2-3 short

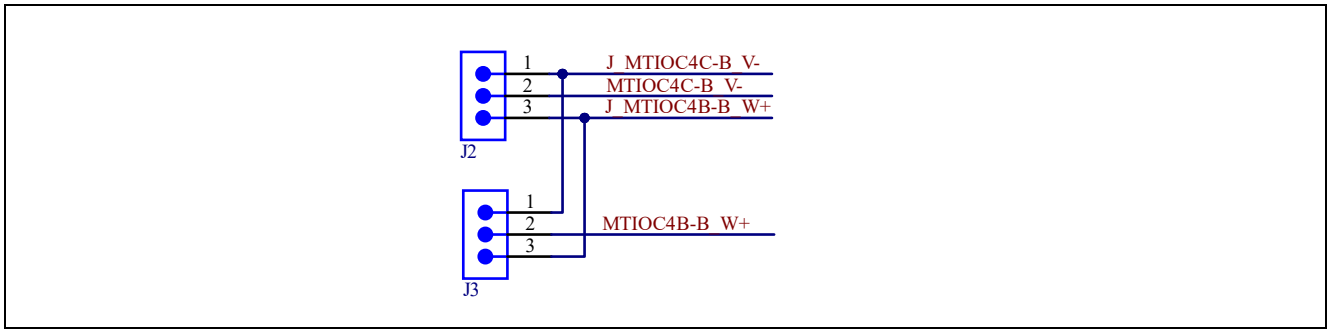

Figure 3-5 Jumper setting for V/W PWM signal

3.3.2 Encoder power supply

The encoder can be supplied the external power. If it needs the external power, power supply can be selected from 3.3V power or the external battery (VBAT).

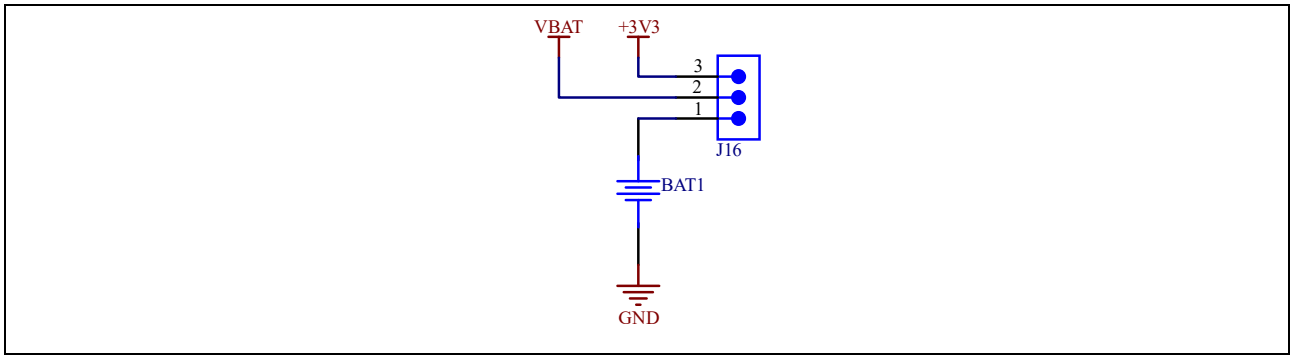

Figure 3-6 Jumper setting for encoder power supply

3.4 Dip Switch

3.4.1 Mode Switch

Selection of Operating Mode for Each Combination of Levels of Mode Setting Pins (MD2, MD1 and MD0)

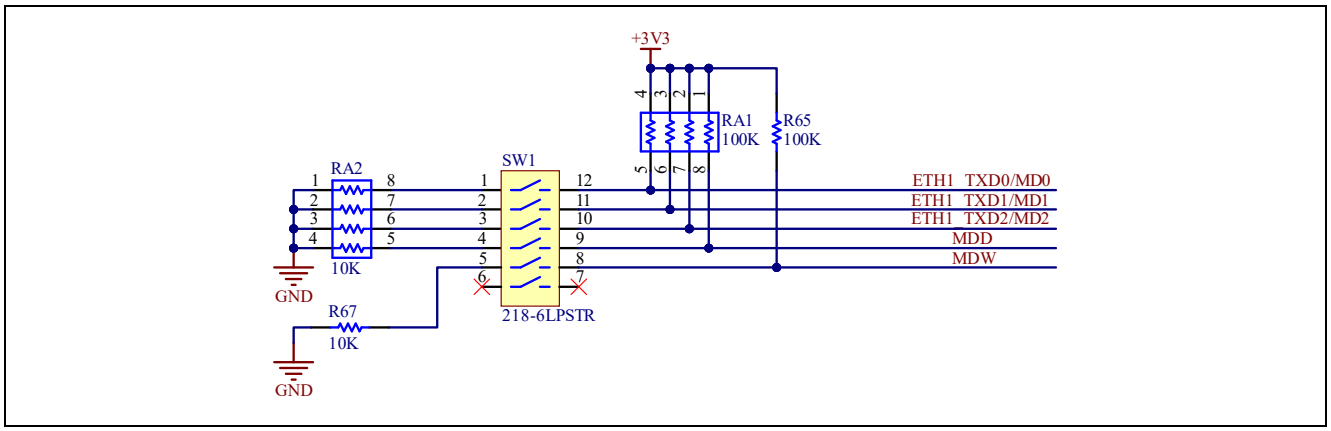

Figure 3-7 Operating Mode

Selection of Operating Mode for Each Combination of Levels of Mode Setting Pins (MD2, MD1 and MD0)

MD2	MD1	MD0	Operating Mode
0	0	0	xSPI0 boot mode (x1 boot Serial flash)
0	0	1	xSPI0 boot mode (x8 boot Serial flash)
0	1	0	16-bit bus boot mode (NOR flash)
0	1	1	32-bit bus boot mode (NOR flash)
1	0	0	xSPI1 boot mode (x1 boot Serial flash)
1	0	1	SCI (UART) boot mode
1	1	0	USB boot mode
1	1	1	Setting prohibited

Selection of JTAG Authentication by Hash

MDD	JTAG Mode
0	Normal mode JTAG Authentication by Hash is disabled.
1	JTAG Authentication by Hash mode

Selection of ATCM wait cycle

MDW	ATCM wait cycle
0	0 wait Valid for CPU operating frequency equal to or less than 400 MHz.
1	1 wait

Selection of Operating Voltage of IO domain 2 to 3 (MDV3, MDV2) with 3.3V by pull high when MCU reset.

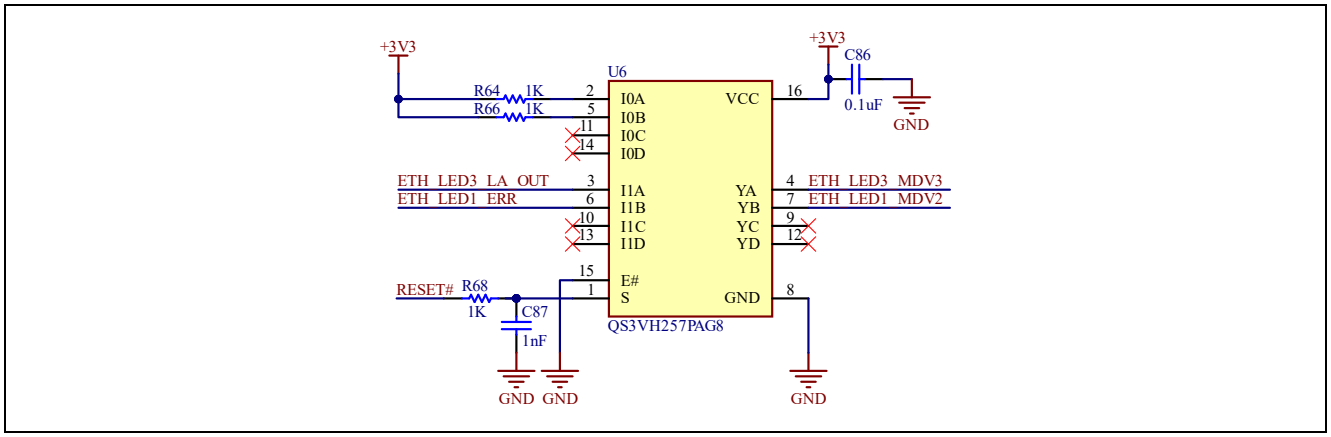

Figure 3-8 Operating Voltage

3.4.2 EtherCAT-ID Setting Switch

A board specific EtherCAT ID can optionally be set.

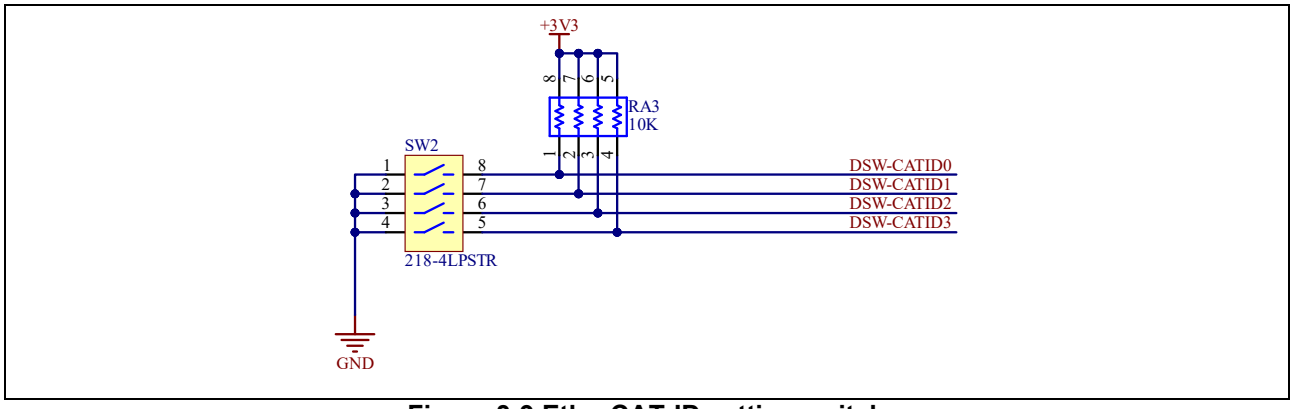

Figure 3-9 EtherCAT-ID setting switch

3.5 LEDs

There are 9 LEDs in the controller board. Please see below for the assignment.

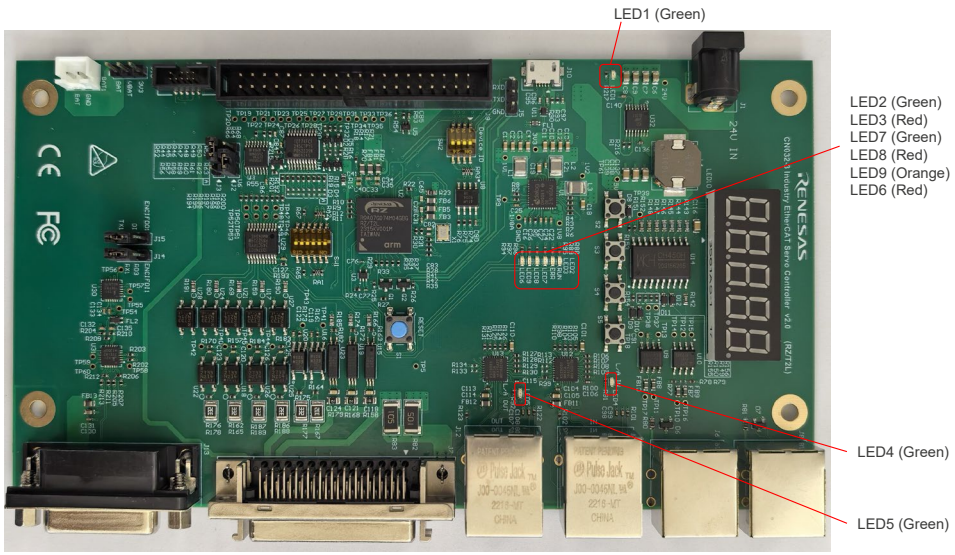

Figure 3-10 Controller board LEDs

No.	Item		Circuit number	Color	Using
1	Power supply LED	VIN	LED1	Green	Input power: Light up
2	ESC status LED	ETH_LED0	LED2	Green	RUN
3		ETH_LED1	LED3	Red	ERR
4		ETH_LED2	LED4	Green	L/A IN
5		ETH_LED3	LED5	Green	L/A OUT
6	General purpose LED	LED4_ENCIF08	LED6	Red	H: Light on/L: Light off
7		LED5	LED7	Green	H: Light on/L: Light off
8		LED6_ENCIF10	LED8	Red	H: Light on/L: Light off
9		LED7_ENCIF11	LED9	Orange	H: Light on/L: Light off

3.6 Encoder Interfaces

There are 2 encoder interfaces in the controller board, please see below for the connection.

Parts number	Type	Description
J13	Absolute Encoder Incremental Encoder	Support Absolute Encoder or Incremental Encoder. Alternative

The 15 pin D-SUB, part number D15S13A4GV00LF.

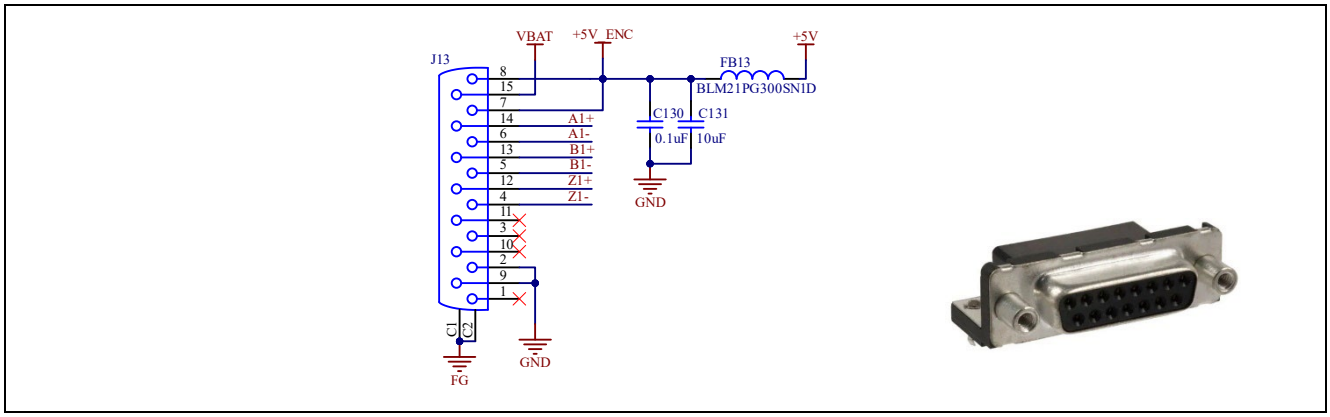

Figure 3-11 Encoder Interface

There are the receiver IC and the transmitter IC for communication with encoder.

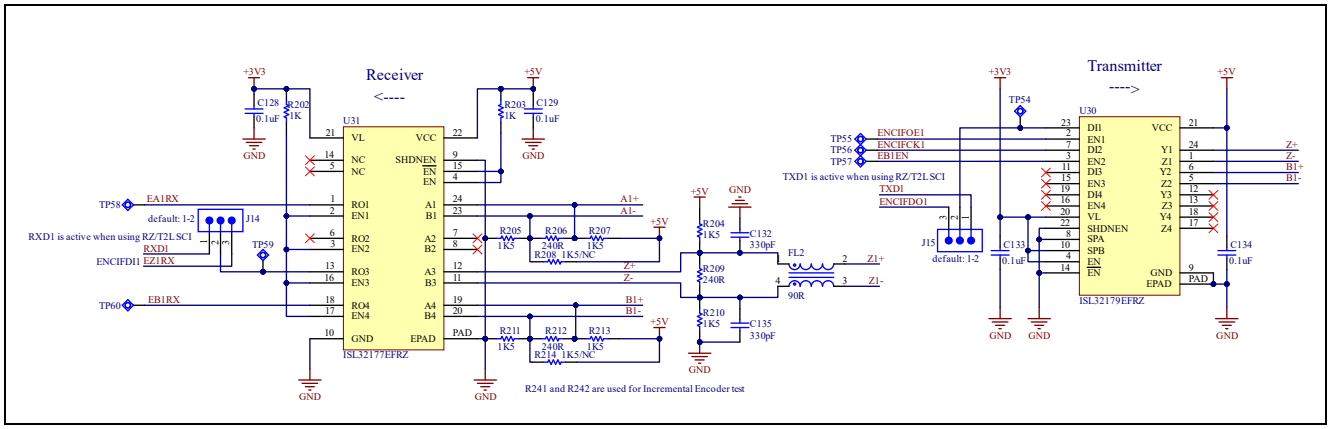

Figure 3-12 Encoder Circuit

The following jumper implement the different interface between ENCIF interface and SCI interface.

Jumper	ENCIF	SCI (default)
J14	2-3 short	1-2 short
J15	2-3 short	1-2 short

3.7 UART Interfaces

The UART function can be used to control motor by Renesas PC GUI.

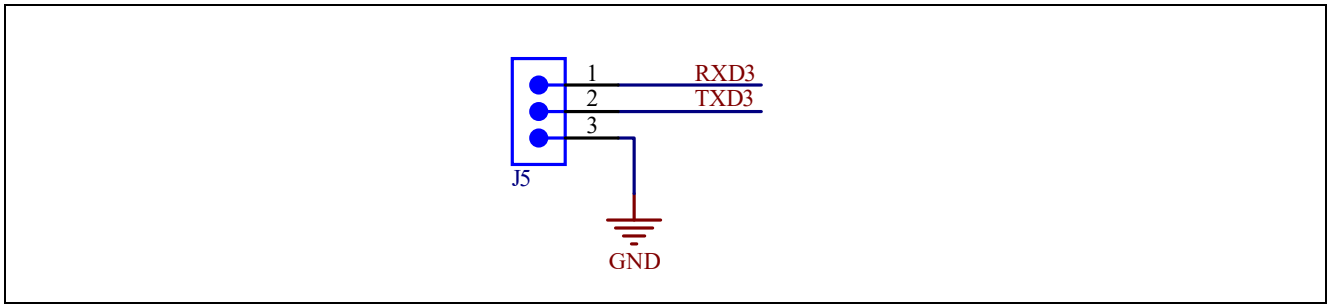

Figure 3-13 UART Interface

3.8 EtherCAT Interface

There are 2 EtherCAT interface in this system, another one is omitted in the below picture. The part number of RJ45 is J00-0045NL.

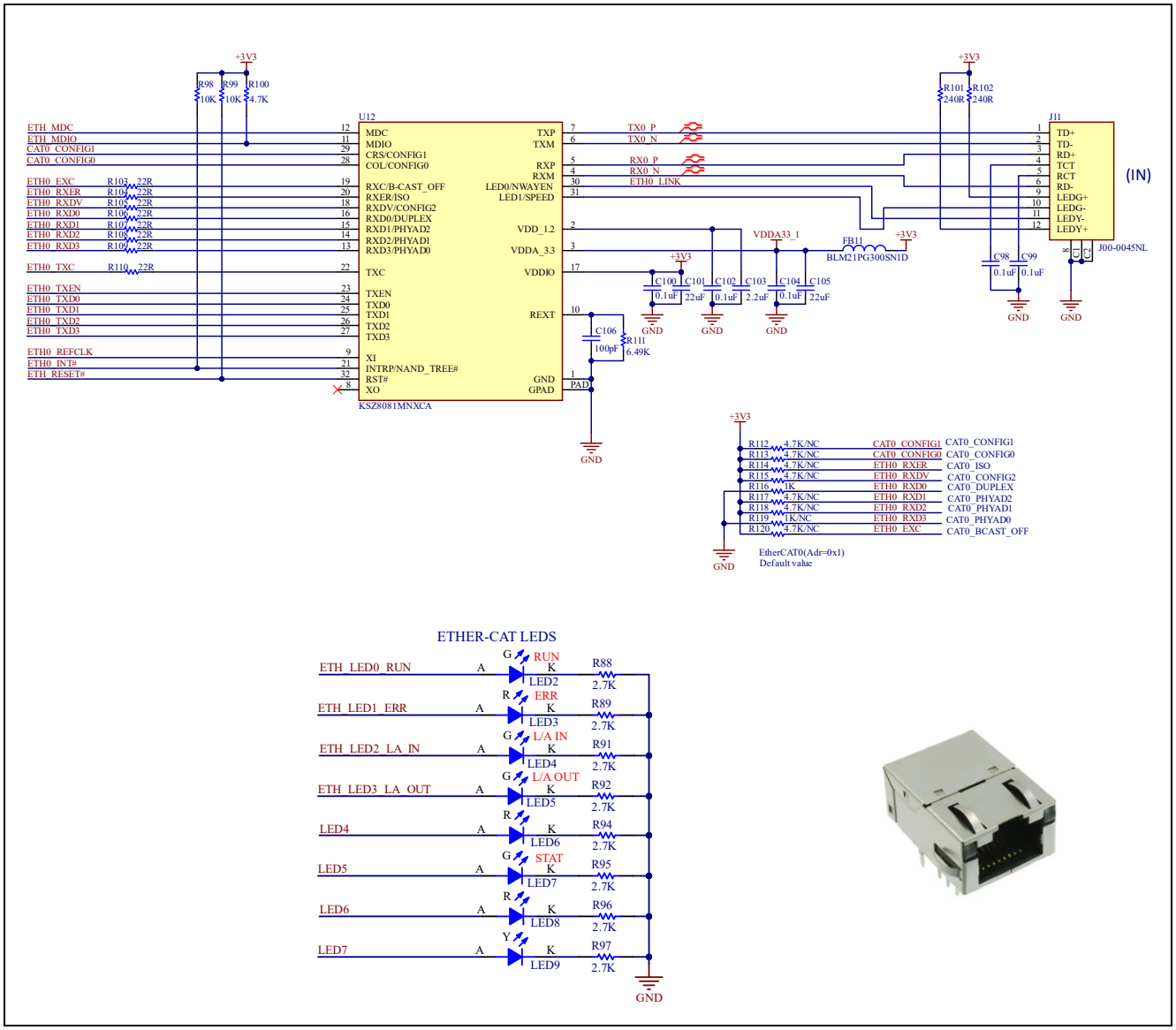

Figure 3-14 EtherCAT Interface

3.9 RS485&CAN Interfaces

The user can use the CAN and RS485 function with RJ45 connector, which only has physical connection function. There are 2 same RJ45 connector that used for products interconnection, part number MTJ-889X1-FSE.

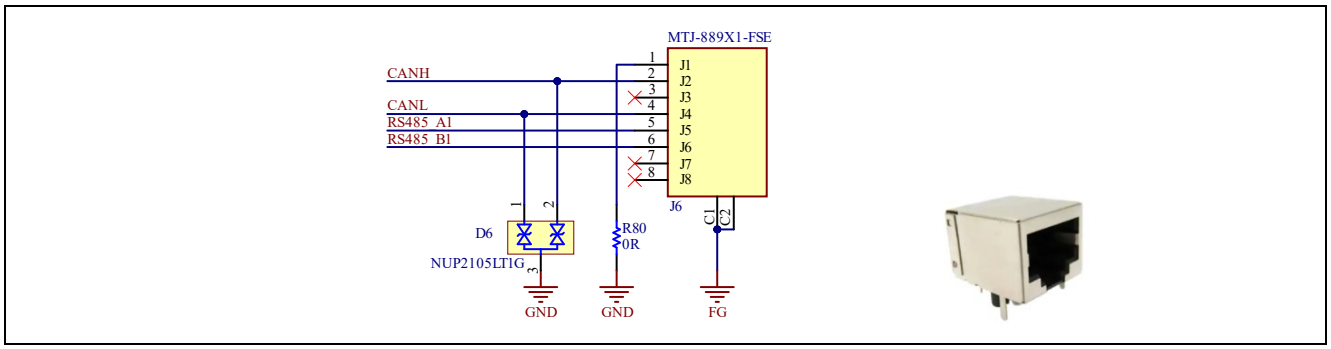

Figure 3-15 RS485&CAN Interface

3.10 USB Interface

The micro–B USB connector used for MCU works on USB boot mode, part number 10118192-0001LF.

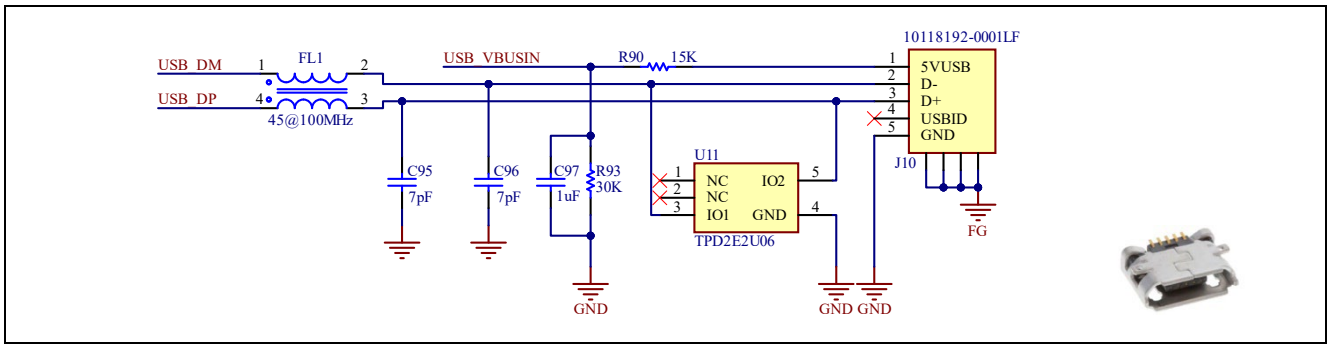

Figure 3-16 USB Interface

3.11 External Control Interface

The external control interface support 8 channel digital output and 8 channel digital input control, part number 6368355-1.

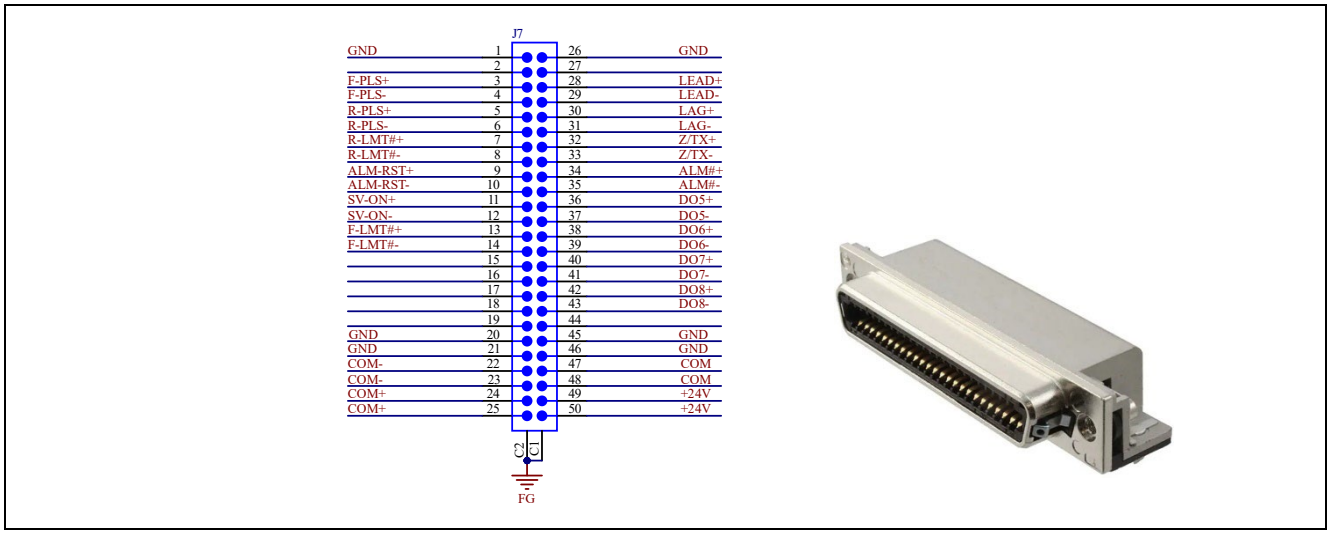

Figure 3-17 External Control Interfaces Interface

3.12 User Interface

A 5-bit eight-segment LED and 4 keys are used for user operation, which are control by driver IC CH450H.

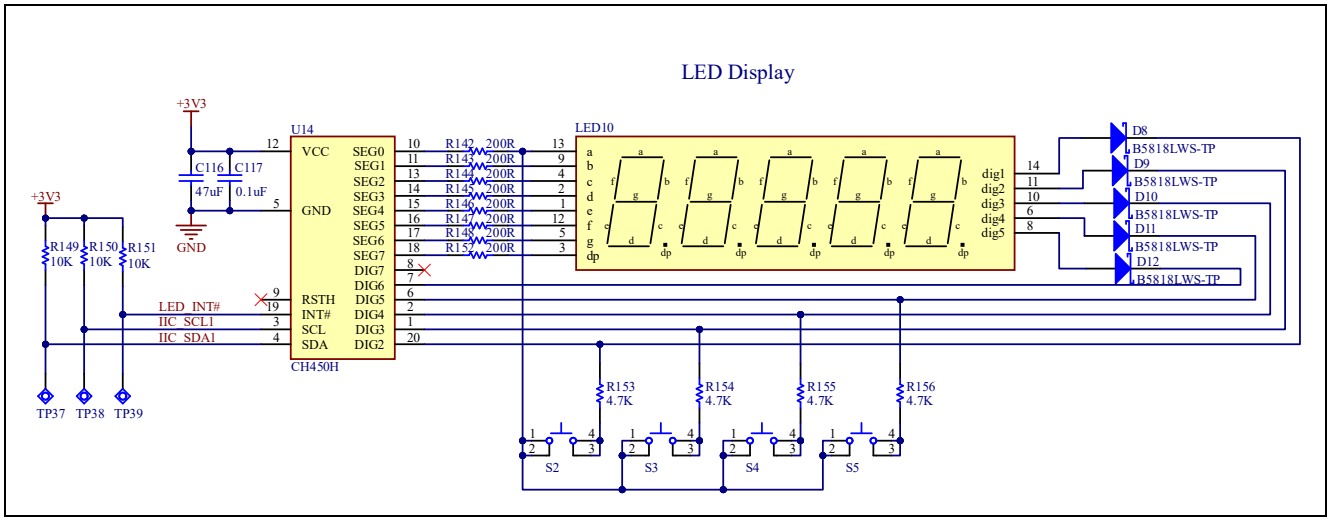

Figure 3-18 User Interface

3.13 Inverter Board Interface

The system board gets 5V power supply from the inverter board through below interface. It makes motor control by U/V/W signals, 3 channels DS Modulator signal, and input/output signals.

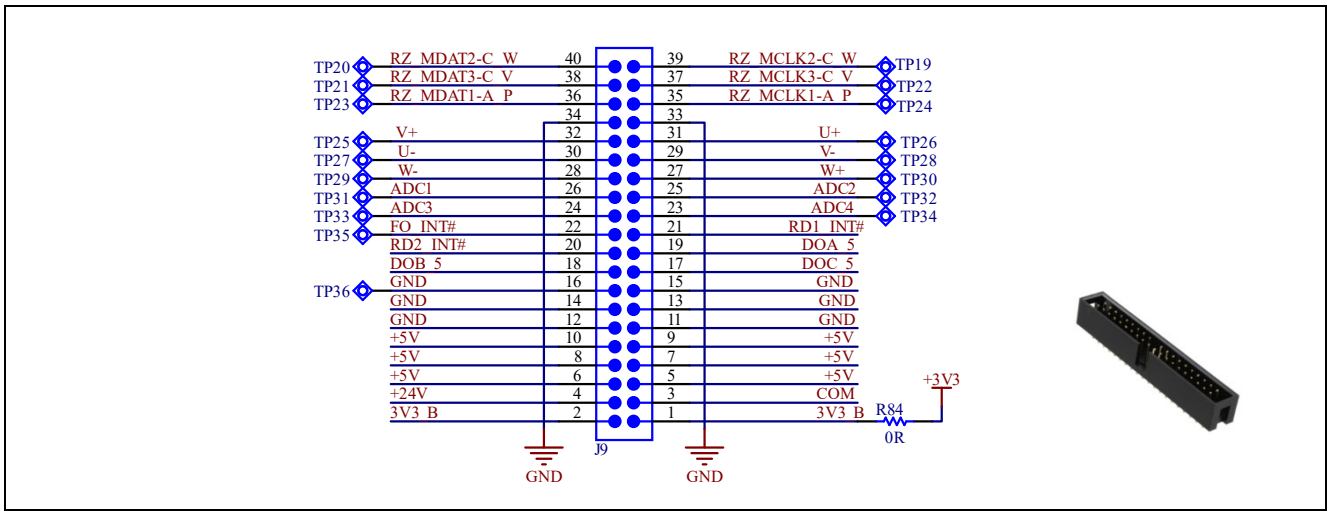

Figure 3-19 Inverter Board Interface

3.14 5V Buffer Circuitry to Inverter Board

Figure 3-20 shows the PWM buffer circuitry to inverter board, the signals output are high after power-on, because these signals are pulled-up by 3.3V pull-up resistor, which depends on the related gate circuitry of inverter board.

Note: the Buffer IC should operate in high-impedance state at initial state by making OE pin pulled-up, because the signals may output low level transiently before 3.3V fully power on. For this case, a software control (GPIO) for OE pin is necessary to allow the output of Buffer IC after securing enough time for input side of buffer IC to be pulled-up.

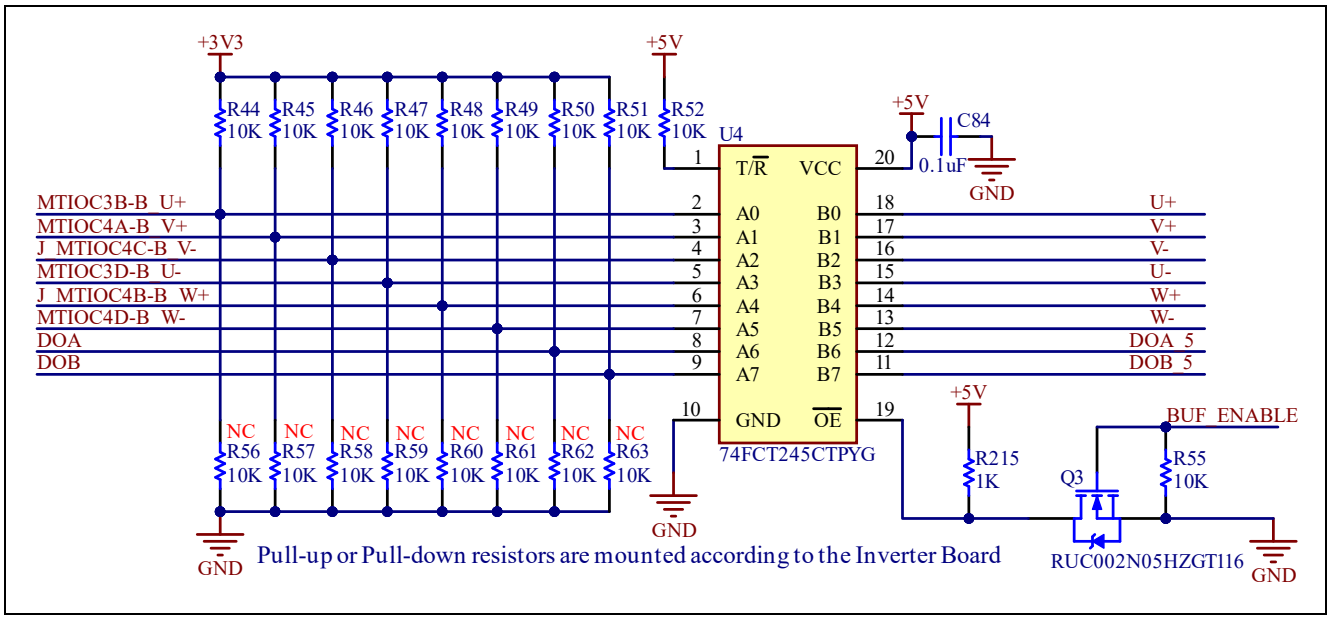

Figure 3-20 5V Buffer Circuit to Inverter Board

4. Controller Board, Inverter Board Connection Configuration

The connection configuration for CN032 AC Servo Solution image is shown in Figure 4-1.

The cables for the system launch should be connected.

Item	Cables
1	100-250V AC input, Three-wire, L/N/GND
2	Motor cable, U/V/W/shell
3	Encoder cable, D-SUB 15-pin
4	40-pin cable that connects Controller board with Inverter board
5	USB to RS485 converter, used to PC control by Renesas GUI

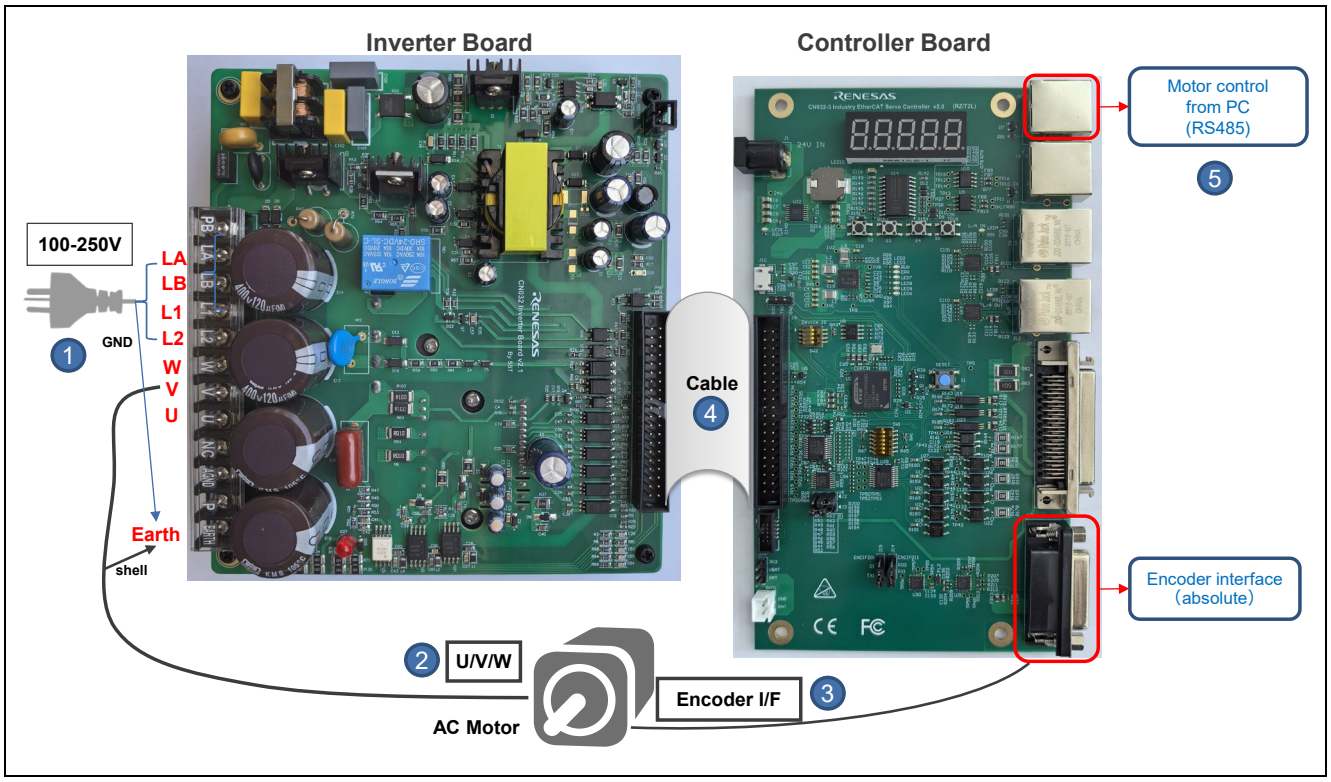

Figure 4-1 Connection Configuration

5. Detection Circuit

Table 5-1 is shown the current and voltage detection circuits mounted on the inverter board and the RZ/T2L connection destinations.

Table 5-1 List of detection circuits

No	Circuit	Pin Number	Function	Circuit diagram silk name
1	Fault detection circuit	P01_4	IRQ3-A	FO_INT#
2	Current detection circuit (V/W) (ΔΣ modulator)	P15_6	MDAT2	RZ_MDAT2-C_W
		P15_5	MCLK2	RZ_MCLK2-C_W
		P22_0	MDAT3	RZ_MDAT3-C_V
		P21_7	MCLK3	RZ_MCLK3-C_V
3	Busbar voltage detection circuit (220V) (ΔΣ modulator)	P15_4	MDAT1	RZ_MDAT1-A_P
		P15_3	MCLK1	RZ_MCLK1-A_P

5.1 Fault Detection Circuit

The fault detection circuit is used to detect short-circuit protection, under-voltage protection and over temperature protection by IPM module. The fault signal VFO outputs low level when SC, UV or OT protection works, which is open drain type. You can protect the inverter board and motor by monitoring fault signal VFO and forcing the PWM output to go into the Hi-Z state when the output is low.

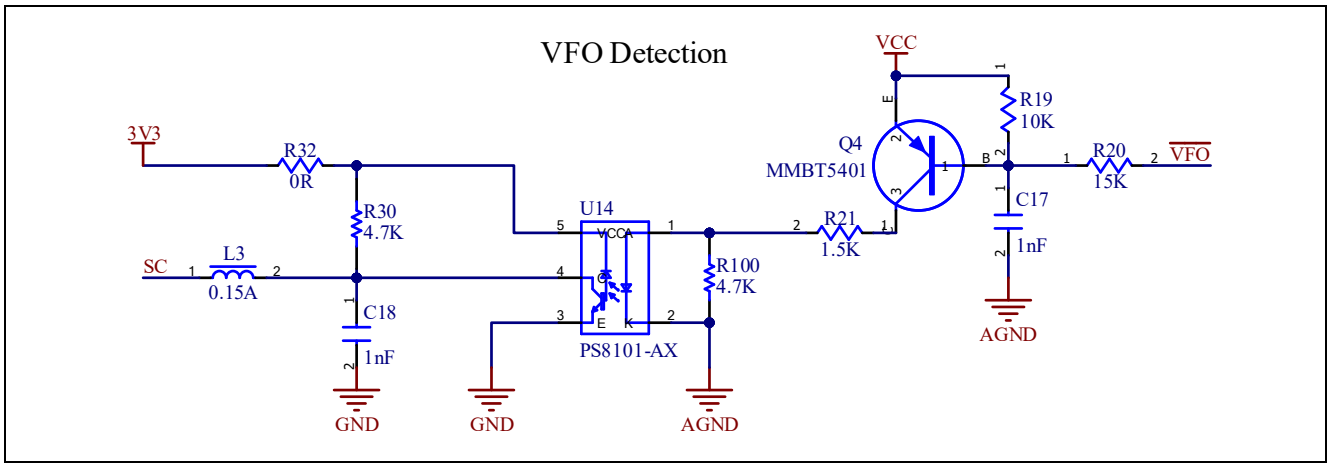

Figure 5-1 Fault Detection Circuit

5.2 Current Detection Circuit (V/W)

The Phase current detection (V/W) are realized through 2 channel Delta-Sigma Modulator. The Phase current (U) can be calculated by software.

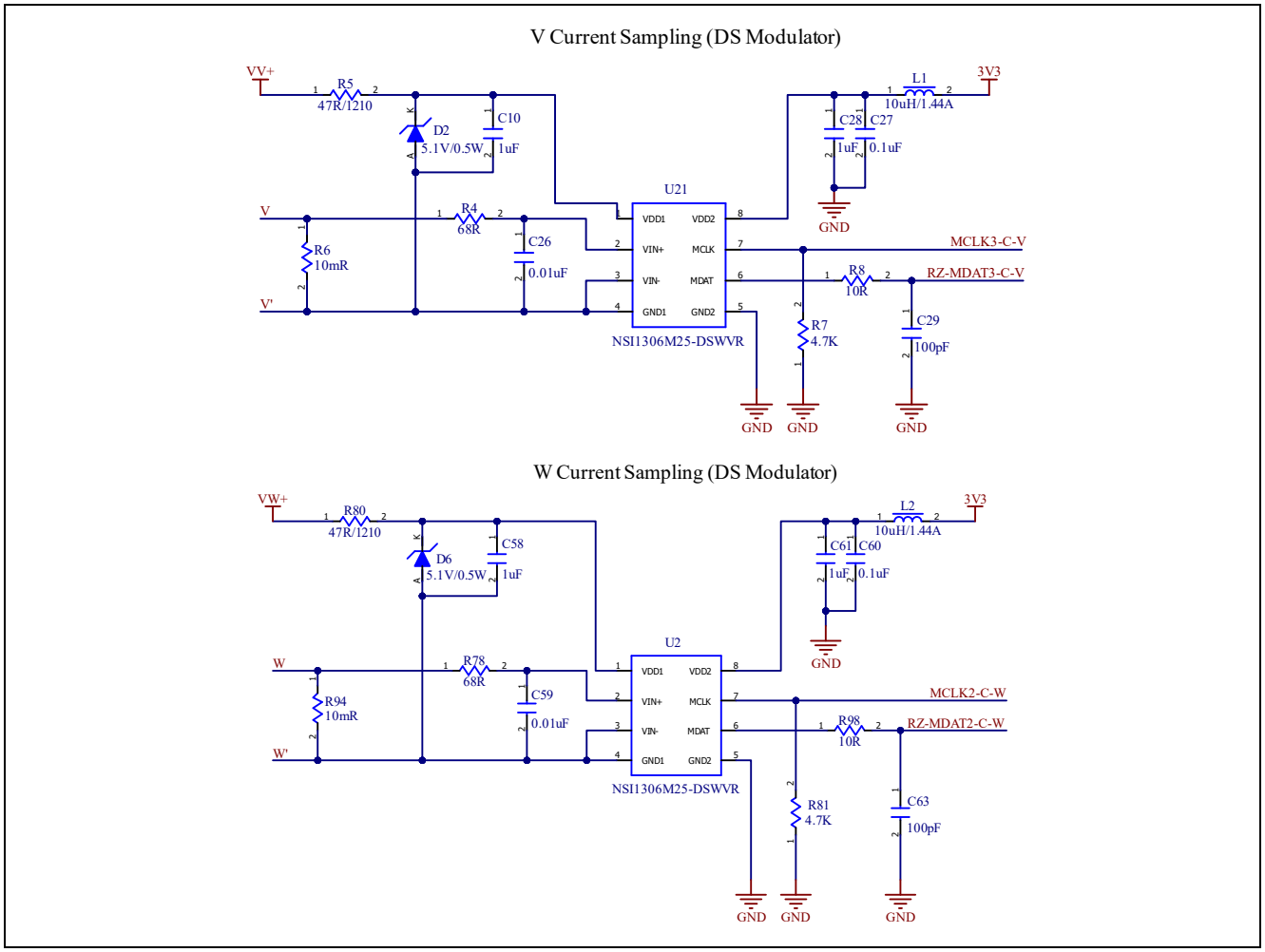

Figure 5-2 Current Detection Circuit (V/W)

5.3 Bus Voltage Detection Circuit (220V)

The bus voltage detection is realized through 1 channel Delta-Sigma Modulator.

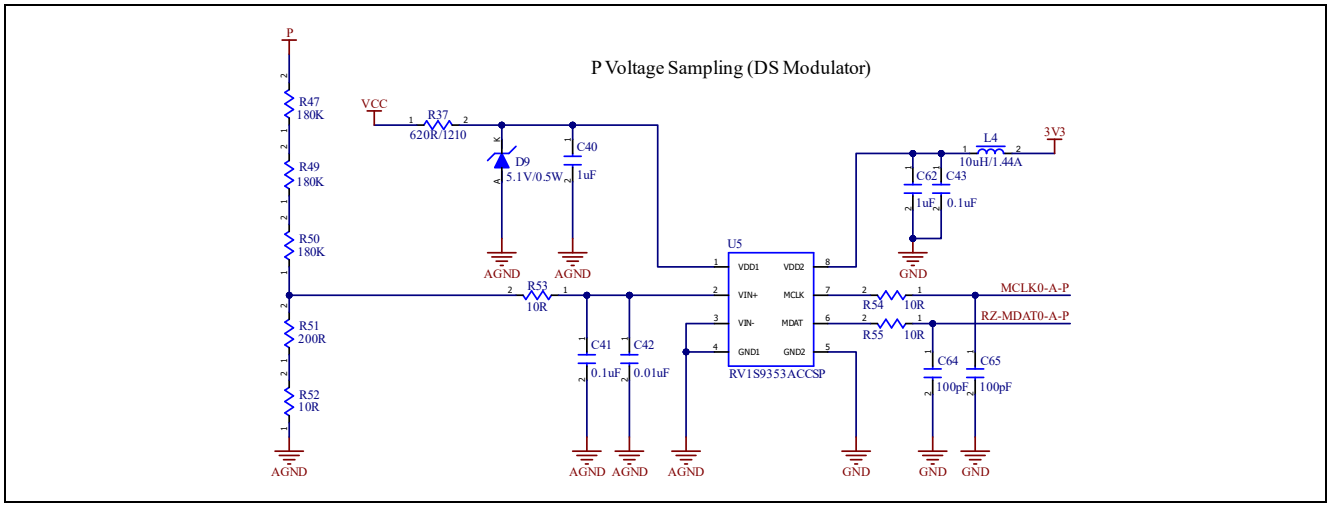

Figure 5-3 Bus Voltage Detection Circuit (220V)

6. Precaution for Operation

When using this kit, please kindly comply with the following 1 to 3:

1. Use stable power supply with current 1[A] limit setting to inverter board.
2. Do not use DC12-24[V] power supply jack to controller board.
   ※The power of controller is supplied from the inverter board.
3. Even after turning off, please do not touch the inverter board when high voltage LED(D27) is on which could be about 3 minutes or more.

If motor malfunctions or makes noise during use, please turn off the power to the inverter board immediately.

If this malfunction symptom continues, please contact our sales office or agency.

7. MCU Pin Map

Table 7-1 Pin Map (1/5)

No.	BGA 196	Pin Name	Signal name
1	E5	P00_0	Digital output 8
2	B4	P00_1	F-LMT# Signal input (IRQ0)
3	C4	P00_2	Digital output 6
4	A3	P00_3	LED7
5	D4	P00_6	U+ (MTIOC3B-B)
6	D3	P01_0	V- (MTIOC4C-B)
7	C3	P01_1	U- (MTIOC3D-B)
8	B3	P01_2	W+ (MTIOC4B-B)
9	A2	P01_3	W- (MTIOC4D-B)
10	B2	P01_5	V+ (MTIOC4A-B)
11	E4	P01_4	FO_INT# (IRQ3)
12	C2	P01_6	RS485 (D/R)
13	B1	P01_7	Encoder1-EB1EN
14	D2	P02_0	CANTX1
15	C1	P02_1	Mode setting (MDW)
16	E2	P02_2	F-PLS Signal input (MTIOC2A)
17	D1	P02_3	CANRX1
18	E3	P02_4	JTAG (TDO)
19	E1	P02_5	JTAG (TDI)
20	F3	P02_6	JTAG (TMS)
21	F2	P02_7	JTAG (TCK)
22	F1	P04_1	TXD3
23	G3	P05_5	ETH1_LINK
24	G2	P05_6	ETH1_RXER
25	H4	P05_7	ETH1_TXD2 / Mode setting (MD2)
26	G1	P06_0	ETH1_TXD3
27	H3	P06_1	ETH1_REFCLK
28	H2	P06_2	ETH1_TXD1 / Mode setting (MD1)
29	J4	P06_3	ETH1_TXD0 / Mode setting (MD0)
30	H1	P06_4	ETH1_TXC
31	J2	P06_5	ETH1_TXEN
32	J3	P06_6	ETH1_RXD0
33	J1	P06_7	ETH1_RXD1
34	K1	P07_0	ETH1_RXD2
35	K4	P07_1	ETH1_RXD3
36	K2	P07_2	ETH1_RXDV
37	K3	P07_3	ETH1_EXC
38	L7	P07_4	USB_VBUSIN
39	L3	P08_4	ETH0_RXD3
40	L2	P08_5	ETH0_RXDV
41	M2	P08_6	ETH0_EXC
42	M1	P08_7	ETH_MDC
43	K5	P09_0	ETH_MDIO
44	M3	P09_1	ETH0_REFCLK

Table 7-2 Pin Map (2/5)

No.	BGA 196	Pin Name	Signal name
45	N1	P09_2	ETH0_RXER
46	N2	P09_3	ETH0_TXD3
47	L4	P09_4	ETH0_TXD2
48	N3	P09_5	ETH0_TXD1
49	P2	P09_6	ETH0_TXD0
50	M4	P09_7	ETH0_TXC
51	N4	P10_0	ETH0_TXEN
52	L5	P10_1	ETH0_RXD0
53	M5	P10_2	ETH0_RXD1
54	P3	P10_3	ETH0_RXD2
55	P4	P10_4	ETH0_LINK
56	L9	P13_2	ESC_I2CCLK-B
57	L10	P13_3	ESC_I2CDATA-B
58	M12	P13_4	ETH_RESET#
59	L12	P13_5	Encoder1-EA1RX (MTCLKA)
60	M13	P13_6	Encoder1-EB1RX (MTCLKB)
61	L11	P13_7	DSW-CATID0
62	N14	P14_0	LED5
63	M14	P14_1	DSW-CATID2
64	K11	P14_2	LED_INT# (IRQ6)
65	L13	P14_3	DSW-CATID3
66	K13	P14_4	LED6
67	L14	P14_5	R-PLS Signal input (IRQ15)
68	K14	P14_6	XSPI0_CKP
69	K12	P14_7	XSPI0_IO0
70	J12	P15_0	XSPI0_IO1
71	J13	P15_1	BUF_ENABLE
72	J14	P15_2	NC
73	J11	P15_3	DS Modulator 1 (MCLK1-C)
74	H13	P15_4	DS Modulator 1 (MDAT1-C)
75	H12	P15_5	DS Modulator 2 (MCLK2-C)
76	H11	P15_6	DS Modulator 2 (MDAT2-C)
77	H14	P15_7	XSPI0_CS0
78	G12	P16_0	RS485 (TXD0)
79	G11	P16_1	RS485 (RXD0)
80	G13	P16_2	Encoder1-EZ1EN (ENCIFOE1)
81	G14	P16_3	Encoder1-EB1TX (ENCIFCK1)
82	F11	P17_0	Mode setting (MDD)
83	F13	P17_3	Digital output 2 (LAG)
84	E12	P17_4	Digital output 1 (LEAD)
85	F14	P17_5	Digital output 3 (Z-TX)
86	F12	P17_6	Digital output 4 (ALM#)
87	E13	P17_7	RXD3
88	E14	P18_0	DSW-CATID1
89	D14	P18_1	RD1_INT# (IRQ10)
90	D12	P18_2	Output control C for Inverter Board

Table 7-3 Pin Map (3/5)

No.	BGA 196	Pin Name	Signal name
91	D13	P18_3	Output control A for inverter board
92	C14	P18_4	R-LMT# Signal input (IRQ1)
93	C13	P18_5	Output control B for Inverter Board
94	B14	P18_6	RD2_INT# (IRQ11, Reserved)
95	C8	P20_3	LED1 / Mode setting (MDV2)
96	A9	P20_4	LED3 / Mode setting (MDV3)
97	A8	P21_1	SCL1
98	B8	P21_2	SDA1
99	C7	P21_3	LED0
100	D7	P21_4	Digital output 7
101	B7	P21_5	SV-ON Signal input (IRQ6)
102	A7	P21_6	LED2
103	B6	P21_7	DS Modulator 3 (MCLK3-C)
104	C6	P22_0	DS Modulator 3 (MDAT3-C)
105	D6	P22_1	ALM-RST Signal input (IRQ13)
106	A6	P22_2	Encoder1-EZ1TX (ENCIFDO1, Reserved)
107	A5	P22_3	Encoder1-EZ1RX (ENCIFDI1, Reserved)
108	B5	P23_7	Digital output 5
109	D5	P24_0	RXD1
110	A4	P24_1	LED4
111	C5	P24_2	TXD1
112	A13	AN000	Reserved
113	B12	AN001	Reserved
114	A12	AN002	Reserved
115	C11	AN003	Reserved
116	A11	AN100	NC
117	B11	AN101	NC
118	C10	AN102	NC
119	B10	AN103	NC
120	G4	BSCANP	Connect to GND
121	P6	EXTAL	25M CRYSTAL inpit
122	P7	XTAL	25M CRYSTAL output
123	N6	EXTCLKIN	Connect to low
124	M7	MDX	Connect to GND
125	N5	RES#	RESET#
126	F4	TRST#	Connect external reset input
127	P9	USB_DM	USB_DM
128	P10	USB_DP	USB_DP
129	P12	USB_RREF	USB_RREF
130	E10	VCC18_ADC0	Connect to +1V8
131	E9	VCC18_ADC1	Connect to +1V8
132	N8	VCC18_PLL0	Connect to +1V8
133	M8	VCC18_PLL1	Connect to +1V8
134	P11	VCC18_USB	Connect to +1V8
135	N11	AVCC18_ USB	Connect to +1V8
136	C12	AVCC18_TSU	Connect to +1V8

Table 7-4 Pin Map (4/5)

No.	BGA 196	Pin Name	Signal name
137	D10	VREFH0	Connect to +1V8
138	D9	VREFH1	Connect to +1V8
139	M11	VSS_USB	Connect to GND
140	N9	VSS_USB	Connect to GND
141	N10	VSS_USB	Connect to GND
142	N12	VSS_USB	Connect to GND
143	N13	VSS_USB	Connect to GND
144	P13	VSS_USB	Connect to GND
145	M10	VCC33_USB	Connect to +3V3
146	D8	VCC33	Connect to +3V3
147	F5	VCC33	Connect to +3V3
148	F10	VCC33	Connect to +3V3
149	J5	VCC33	Connect to +3V3
150	K9	VCC33	Connect to +3V3
151	L6	VCC33	Connect to +3V3
152	E6	VCC1833_2	Connect to +3V3
153	J10	VCC1833_3	Connect to +3V3
154	K10	VCC1833_3	Connect to +3V3
155	E7	VDD	Connect to +1V1
156	E8	VDD	Connect to +1V1
157	F6	VDD	Connect to +1V1
158	F9	VDD	Connect to +1V1
159	G5	VDD	Connect to +1V1
160	G10	VDD	Connect to +1V1
161	H5	VDD	Connect to +1V1
162	H10	VDD	Connect to +1V1
163	J6	VDD	Connect to +1V1
164	J9	VDD	Connect to +1V1
165	K6	VDD	Connect to +1V1
166	K7	VDD	Connect to +1V1
167	K8	VDD	Connect to +1V1
168	L8	VDD	Connect to +1V1
169	A1	VSS	Connect to GND
170	A10	VSS	Connect to GND
171	A14	VSS	Connect to GND
172	B9	VSS	Connect to GND
173	B13	VSS	Connect to GND
174	C9	VSS	Connect to GND
175	D11	VSS	Connect to GND
176	E11	VSS	Connect to GND
177	F7	VSS	Connect to GND
178	F8	VSS	Connect to GND
179	G6	VSS	Connect to GND
180	G7	VSS	Connect to GND
181	G8	VSS	Connect to GND
182	G9	VSS	Connect to GND

Table 7-5 Pin Map (5/5)

No.	BGA 196	Pin Name	Signal name
183	H6	VSS	Connect to GND
184	H7	VSS	Connect to GND
185	H8	VSS	Connect to GND
186	H9	VSS	Connect to GND
187	J7	VSS	Connect to GND
188	J8	VSS	Connect to GND
189	L1	VSS	Connect to GND
190	M6	VSS	Connect to GND
191	M9	VSS	Connect to GND
192	N7	VSS	Connect to GND
193	P1	VSS	Connect to GND
194	P5	VSS	Connect to GND
195	P8	VSS	Connect to GND
196	P14	VSS	Connect to GND

8. BOM List for Renesas Key Parts

Renesas provides the complete design files for this AC Servo Solution application, includes SCH, PCB, BOM, etc.

Here are the Renesas Key parts used in controller board, for more information, please refer to the related files from Renesas.

BOM List from Controller Board

Designator	Description	Manufacturer	Mfg Part Number	Quantity
U1	PMIC for Applications Requiring up to 6 A	Renesas	DA9061-16AM1	1
U2	Renesas RZ-T2L MCU	Renesas	R9A07G074M04GBG#AC0	1
U3	IC GATE AND 1CH 2-INP USV	Toshiba	TC7SH08FU	1
U4, U29	IC TXRX NON-INVERT 5.25V 20SSOP	Renesas	74FCT245CTPYG	2
U6	IC BUS SWITCH 4 X 2:1 16TSSOP	Renesas	QS3VH257PAG8	1
U7	IC FLASH 128MBIT SPI/QUAD 8SOIC	Renesas	AT25SF128A-SHB-T	1
U8	IC EEPROM 16KBIT I2C 400KHZ 8SOP	Renesas	R1EX24016ASAS	1
U10	IC TRANSCEIVER HALF 1/1 8SOIC	Renesas	ISL3172EIBZ	1
U15, U19, U23	OPTO COUPLER IN 10V~30V 5-LSSO	Renesas	RV1S9207ACCSP-10YV#SC0	3
U16, U20	OPTO COUPLER IN 2.7V~3.6V 5-SO	Renesas	PS9121-F3-AX	2
U17, U18, U21, U22, U24, U25, U26, U27, U28	OPTOISOLATOR 2.5KV DARL 4SMD	Renesas	PS2733-1-A	9
U30	IC DRIVER 4/0 24QFN	Renesas	ISL32179EFRZ	1
U31	IC RECEIVER 0/4 24QFN	Renesas	ISL32177EFRZ	1
U32	4.5V to 42V, 5A, DC/DC Synchronous Step-Down Regulator	Renesas	RAA211450GSP#HA0	1

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Feb.28, 2023	-	First Edition issued
1.01	Dec.14, 2023	1 19 Other	Parts number of External Control Interface corrected. Precaution added. Typo fixed.
2.00	Jun.12, 2024	1 4 5 Other	Related Document updated. Add table about Controller board and inverter board combination. Remove inverter board image, added controller board image (back). Typo fixed; image updated.
2.01	Aug.8,2024	1	Related Document updated.

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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