RZ/T2L Group

R12UM0051EJ0101
Rev.1.01
Dec.15, 2023

CN032 AC Servo Solution Hardware 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>>
Don't touch the board while power is supplied because CN032 AC servo solution board contains high voltage circuits.

Target Device

RZ/T2L Group

Related Document

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

- 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.

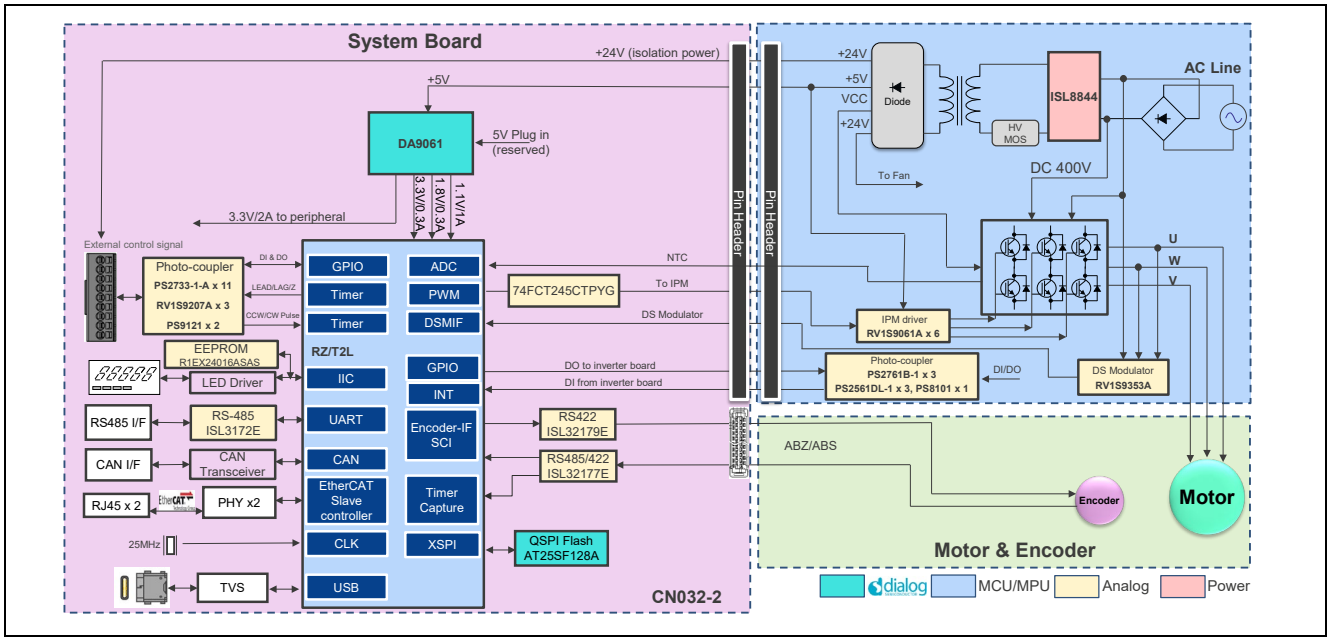


Figure 1-1 AC Servo Solution

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

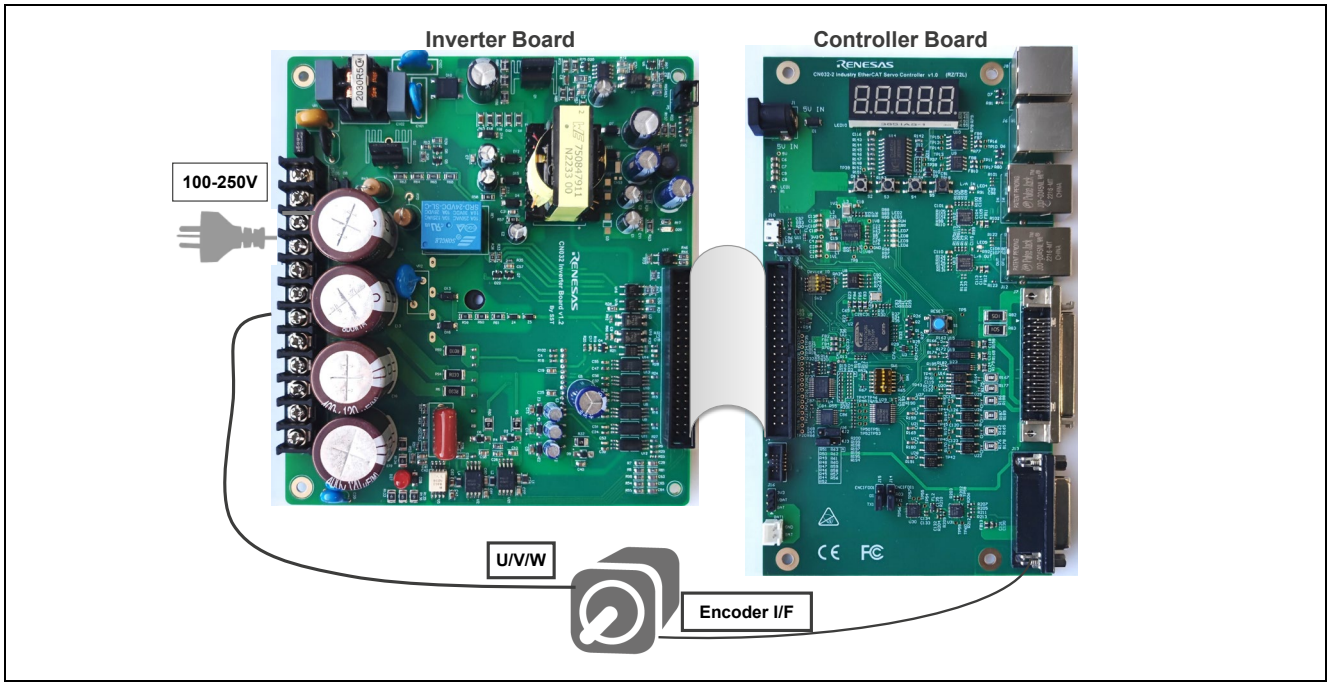


Figure 1-2 AC Servo Solution

2. General Specifications

Table 2-1 Specification's summary

Items		Description
CPU	Series	RZ/T2L Single Arm Cortex®-R52
	Package	R9A07G074M04: 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
Inverter board	150(W)×135(D)×1.6(T)	NO include protrusions, NO include component height

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

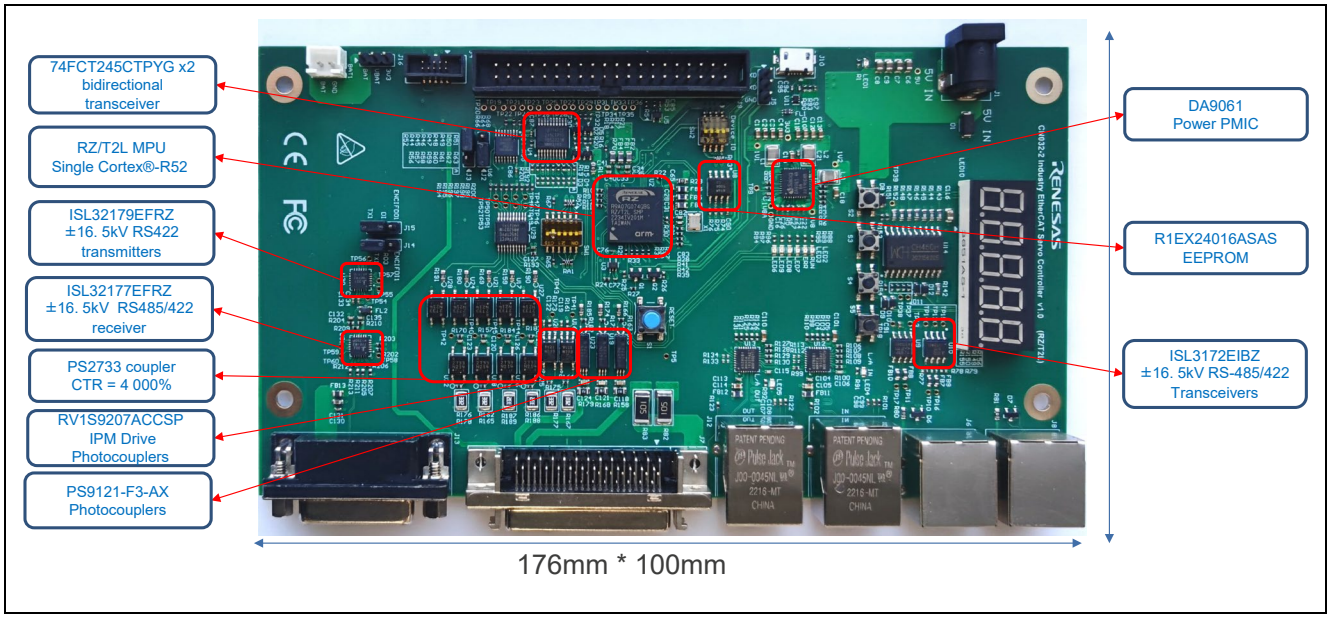


Figure 2-1 Controller board

The Inverter Board image is shown in Figure 2-2.

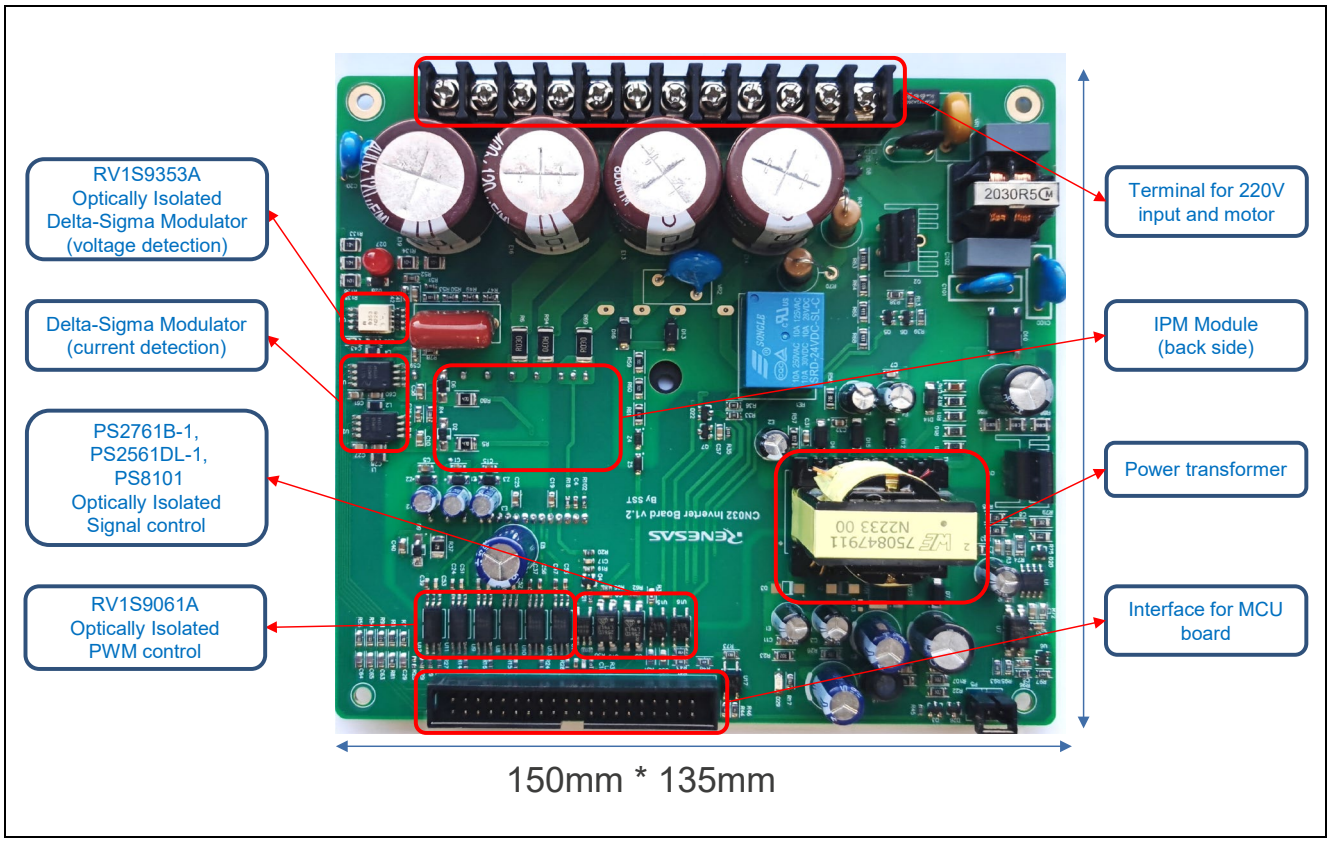


Figure 2-2 Inverter board

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 a reserve.

Controller board can be inputted from 5V 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.

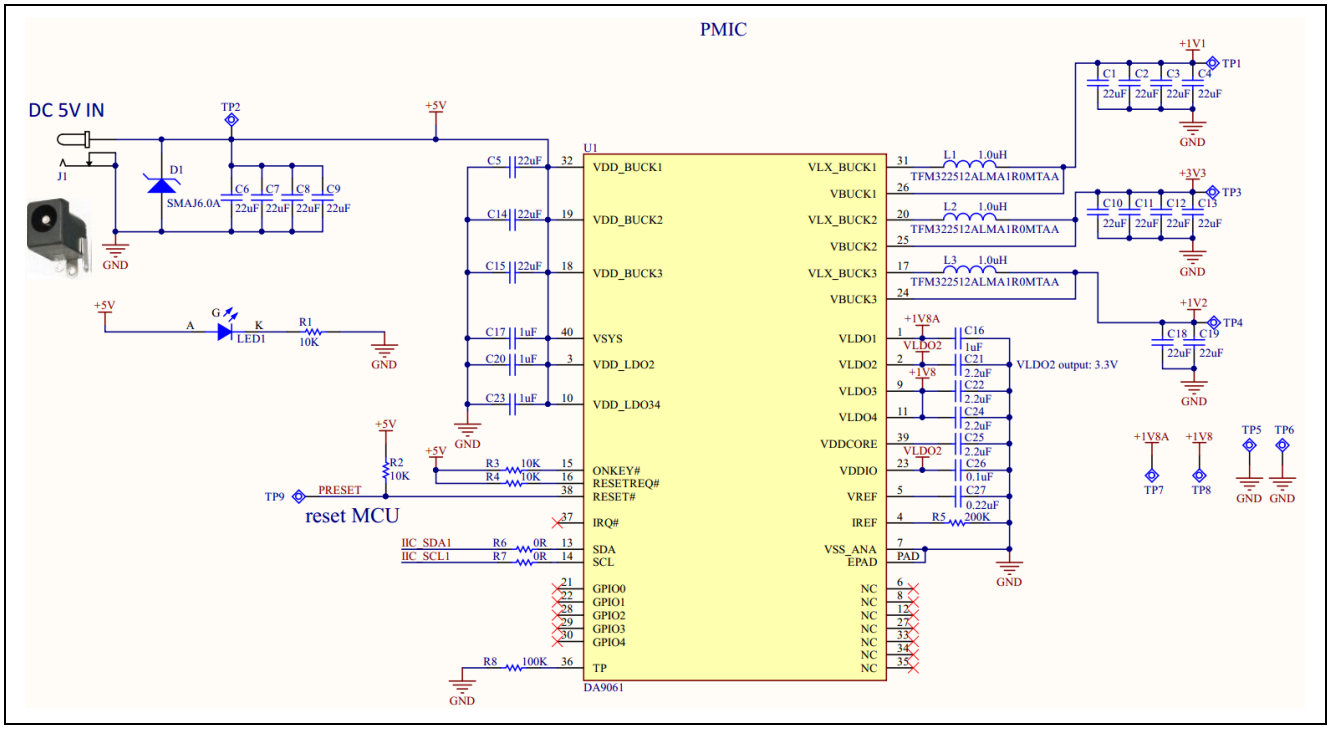


Figure 3-1 PMIC

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

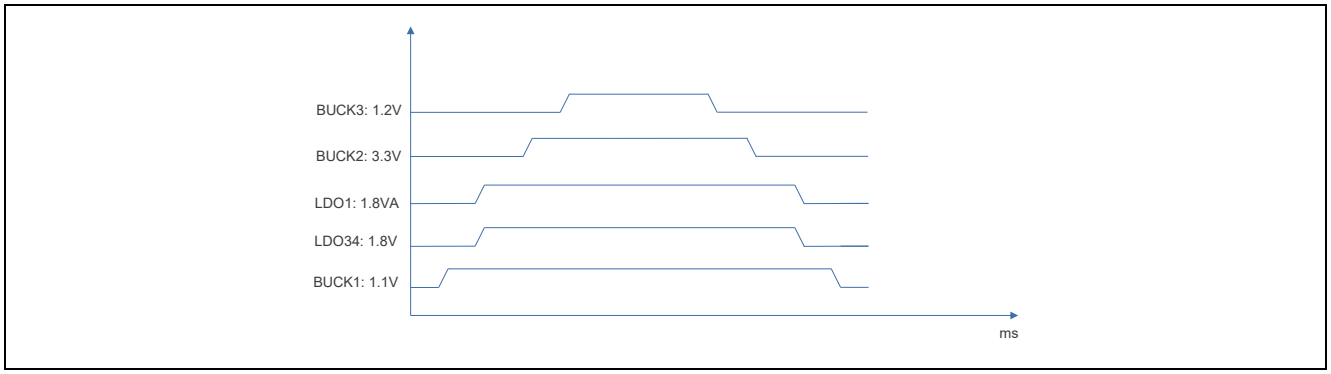


Figure 3-2 Power On/Off Sequence from PMIC

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

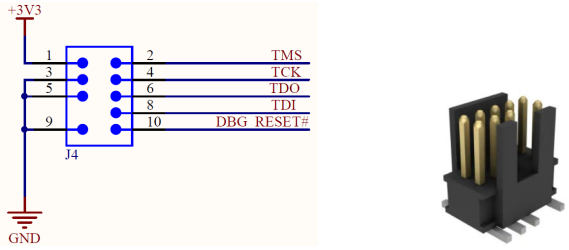


Figure 3-3 JTAG Interface

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

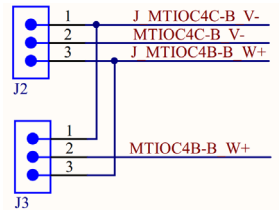


Figure 3-4 Jumper setting for V/W PWM signal

3.3.2 Encoder signal select

J14 and J15 jumper settings are for encoder signal selection. Refer to Section 3.6 Encoder Interfaces as details.

3.3.3 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).

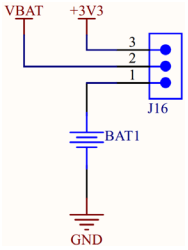


Figure 3-5 Jumper setting for encoder power supply

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)

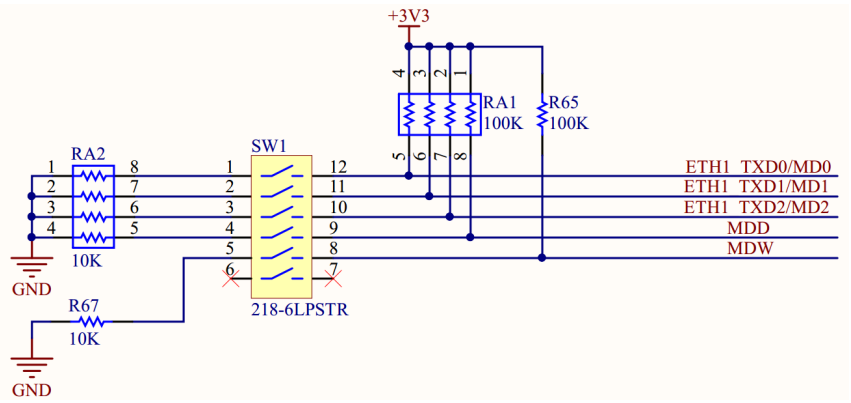


Figure 3-6 Operating Mode

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 400MHz.
1	1 wait

Note) Function in gray font above are not supported.

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

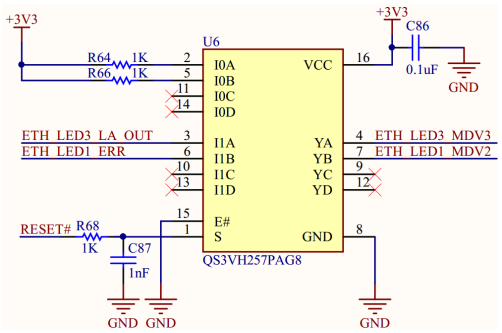


Figure 3-7 Operating Voltage

3.4.2 EtherCAT-ID Setting Switch

A board specific EtherCAT ID can optionally be set.

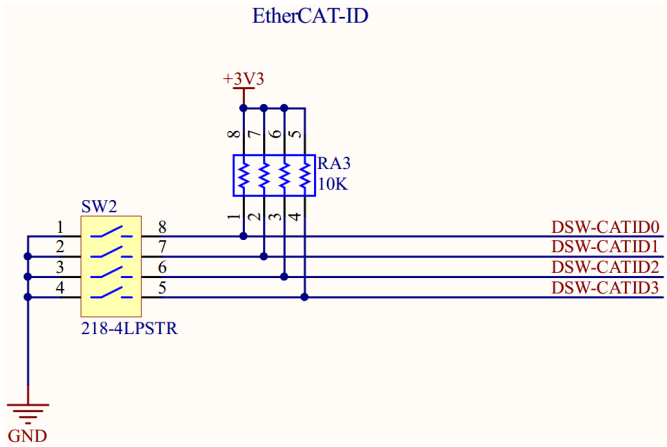


Figure 3-8 EtherCAT-ID setting switch

3.5 LEDs

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

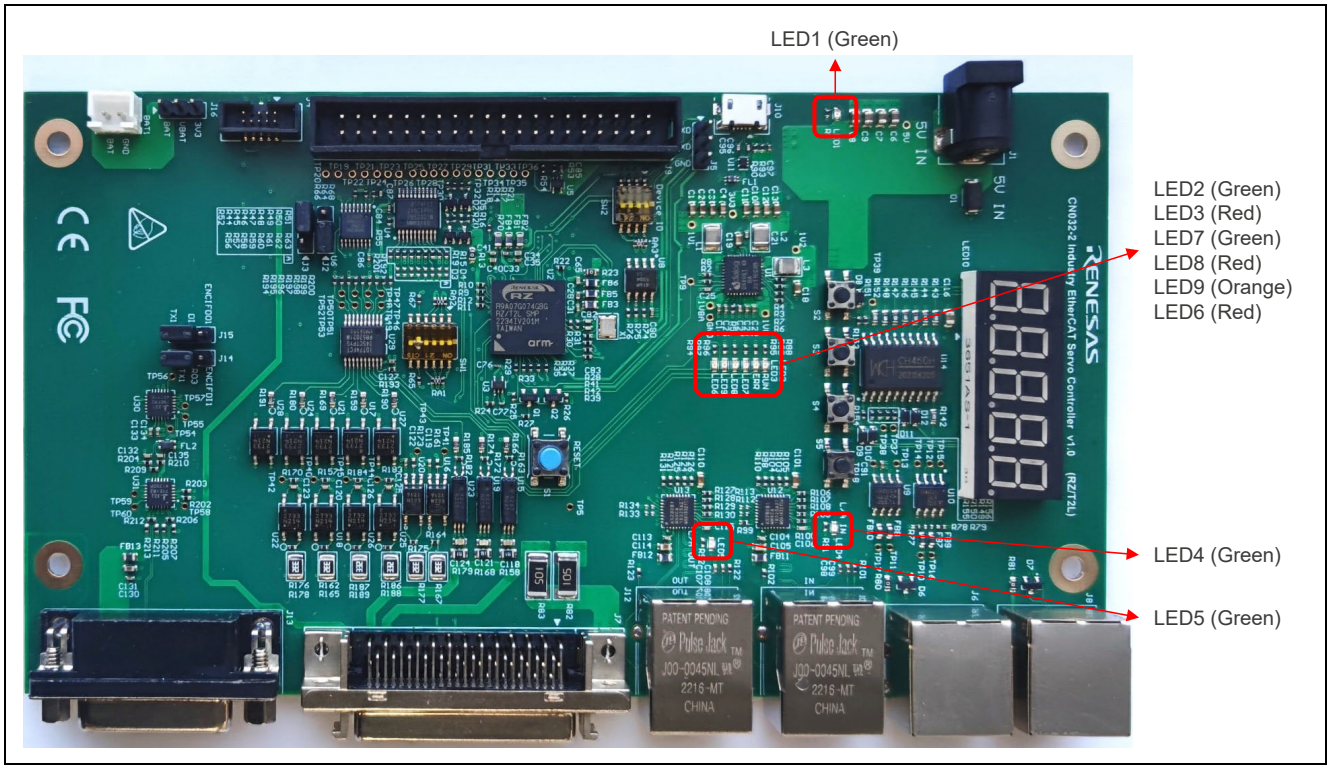


Figure 3-9 Controller board LED

No.	Item		Silk name	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.

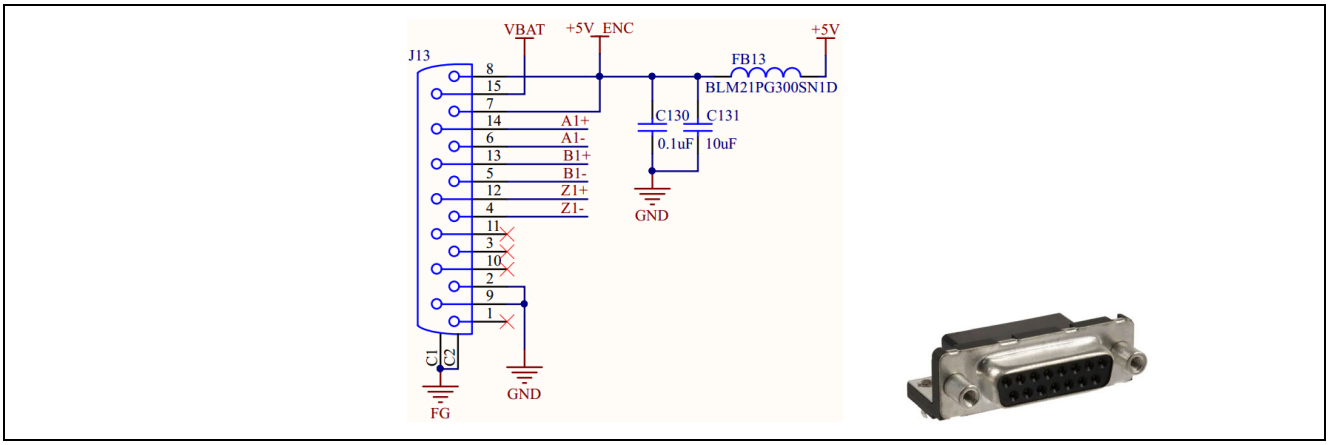


Figure 3-10 Encoder Interface

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

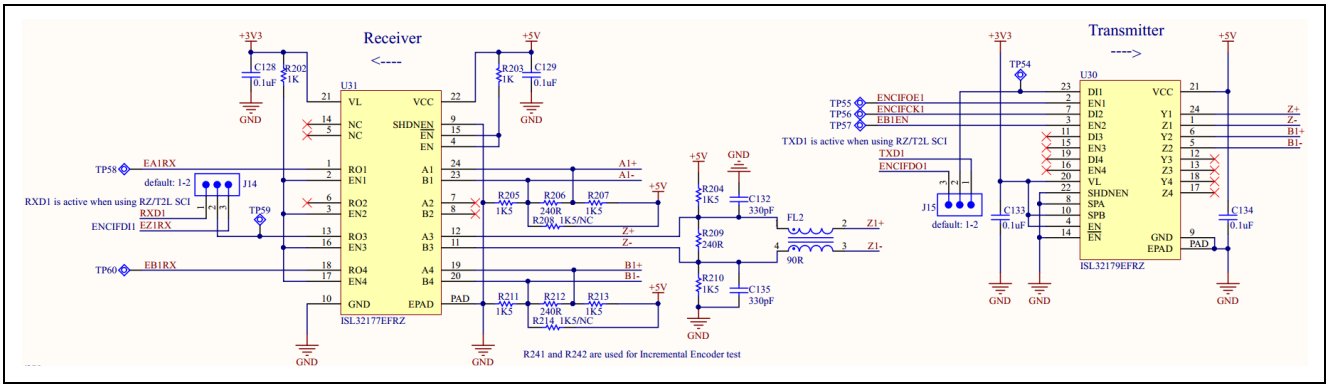


Figure 3-11 Encoder Circuit

There are 2 kinds of interfaces for encoder processing that switch by J14 and J15, an encoder signal is inputted to SCI for Tamagawa encoder, or the signal is inputted to ENCIF for Endat 2.2, BiSS-C, A-format and HIPERFACE-DSL.

Jumper	SCI (default) for Tamagawa encoder	ENCIF for other than Tamagawa encoder
J14	1-2 short	2-3 short
J15	1-2 short	2-3 short

3.7 UART Interfaces

The UART interface is a reserved function for user.

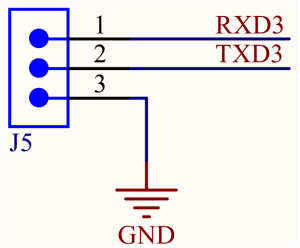


Figure 3-12 UART Interface

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.

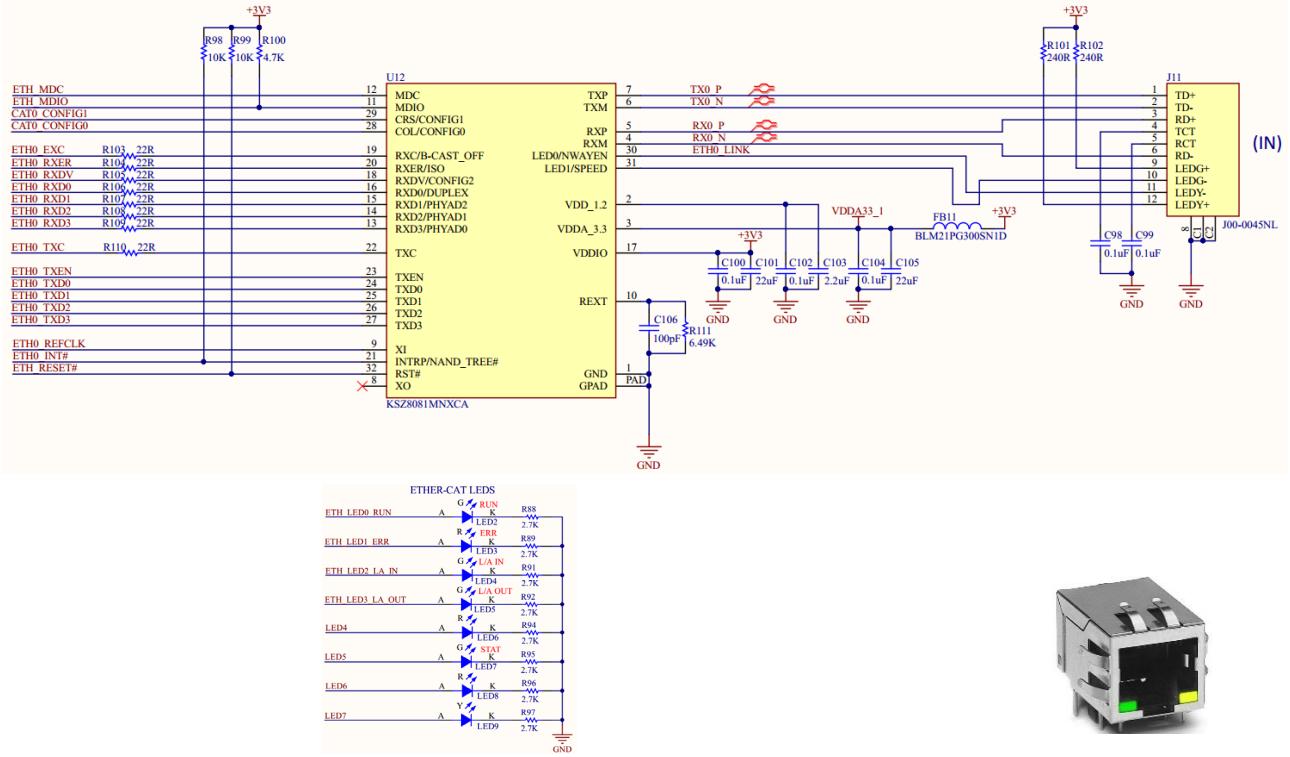


Figure 3-13 EtherCAT Interface

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 J6 and J8 that used for products interconnection, part number MTJ-889X1-FSE.

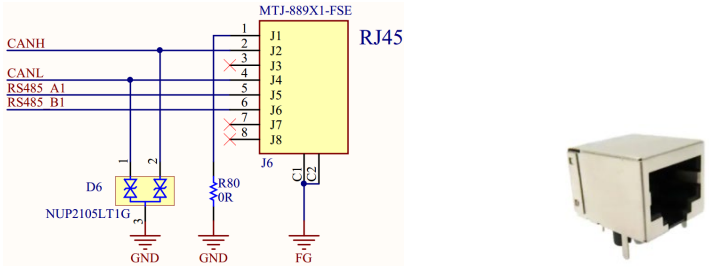


Figure 3-14 RS485&CAN Interface

3.10 USB Interface

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

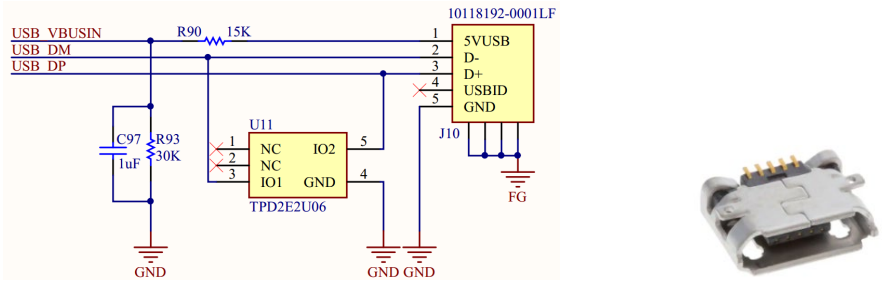


Figure 3-15 USB Interface

3.11 External Control Interface

The external control interface support 8 channel digital output and 6 channel digital input control, part number HL-SCSI50HB90. SCSI-50P connector can be used as a male terminal.

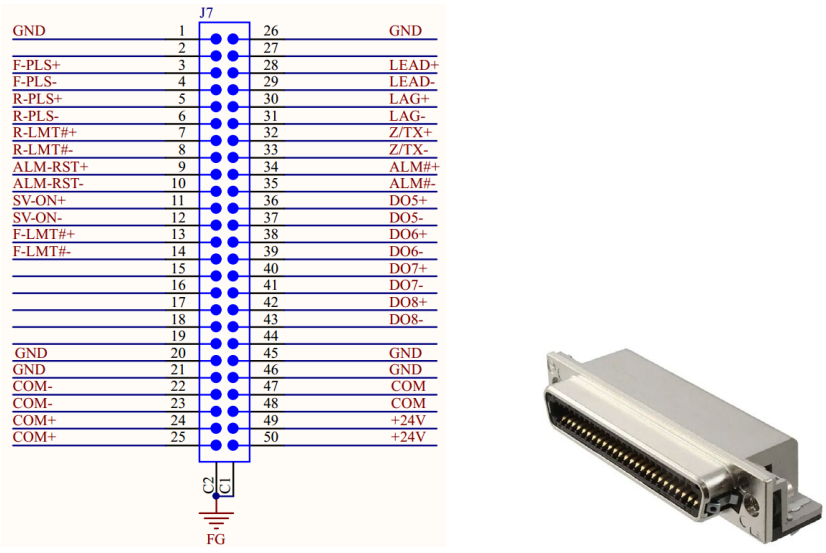


Figure 3-16 External Control Interfaces Interface

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.

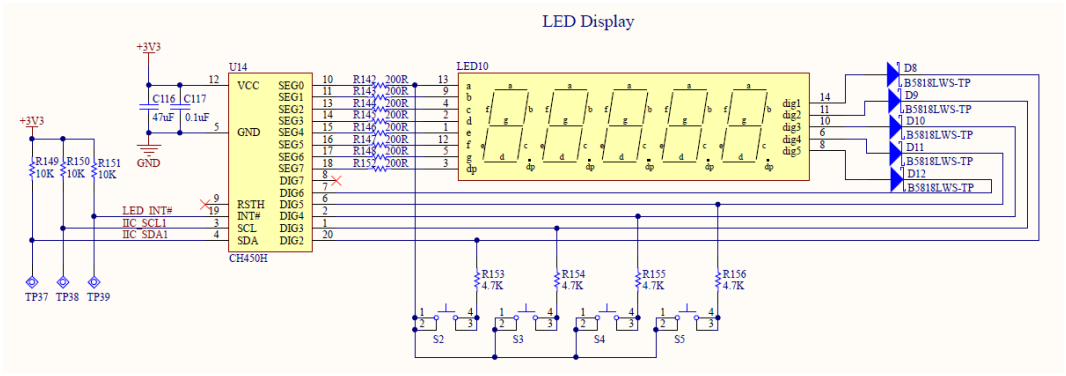
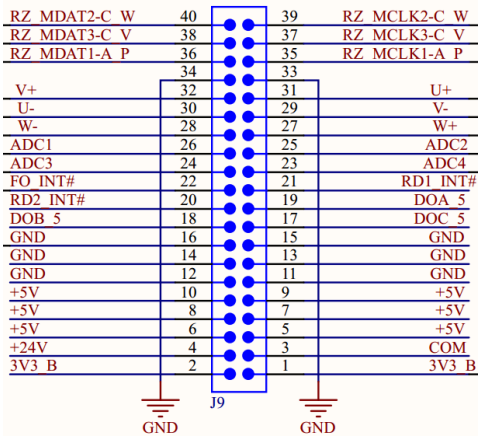


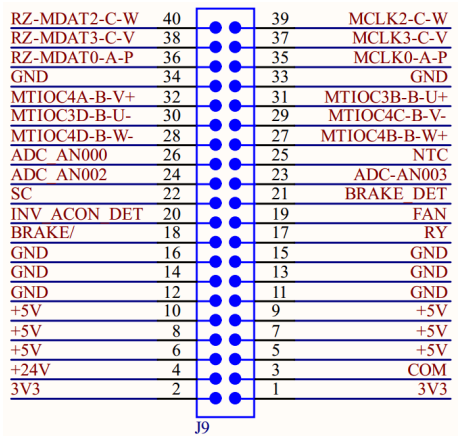
Figure 3-17 User Interface

3.13 Interface between Controller Board and Inverter Board

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.



Controller board side



Inverter board side

Figure 3-18 Power Board Interface

3.14 Inverter Board Interface

The inverter board need to be inputted 100-250V AC for motor power and controller power. L1/L2 is input to IPM for motor power, and LA/LB is input to transformer for controller power, they are dividual.

P/AGND also can input DC power for motor power, if don't input AC power from L1/L2.

PB is for brake control.

EARTH is for ground of 100-250V power and motor FG.

Pin2-8 and pin12 are the necessary input for achieving the motor servo control.

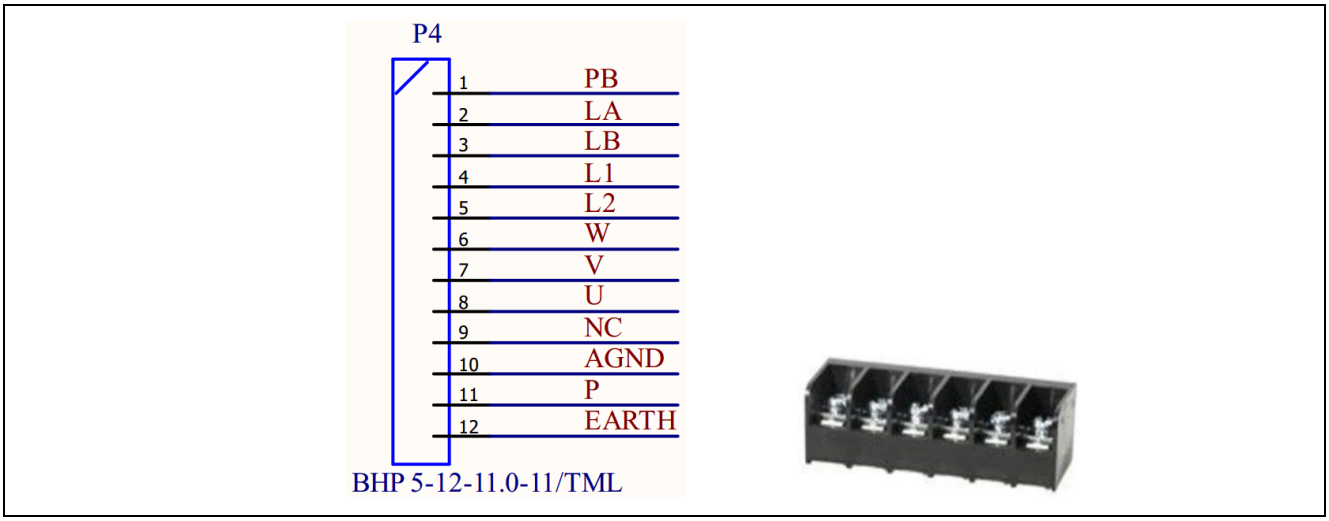


Figure 3-19 Inverter Board Interface

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
5-1	RS232 to USB converter, used to PC control by Renesas GUI
5-2	RS485 to USB converter, used to PC control by Renesas GUI

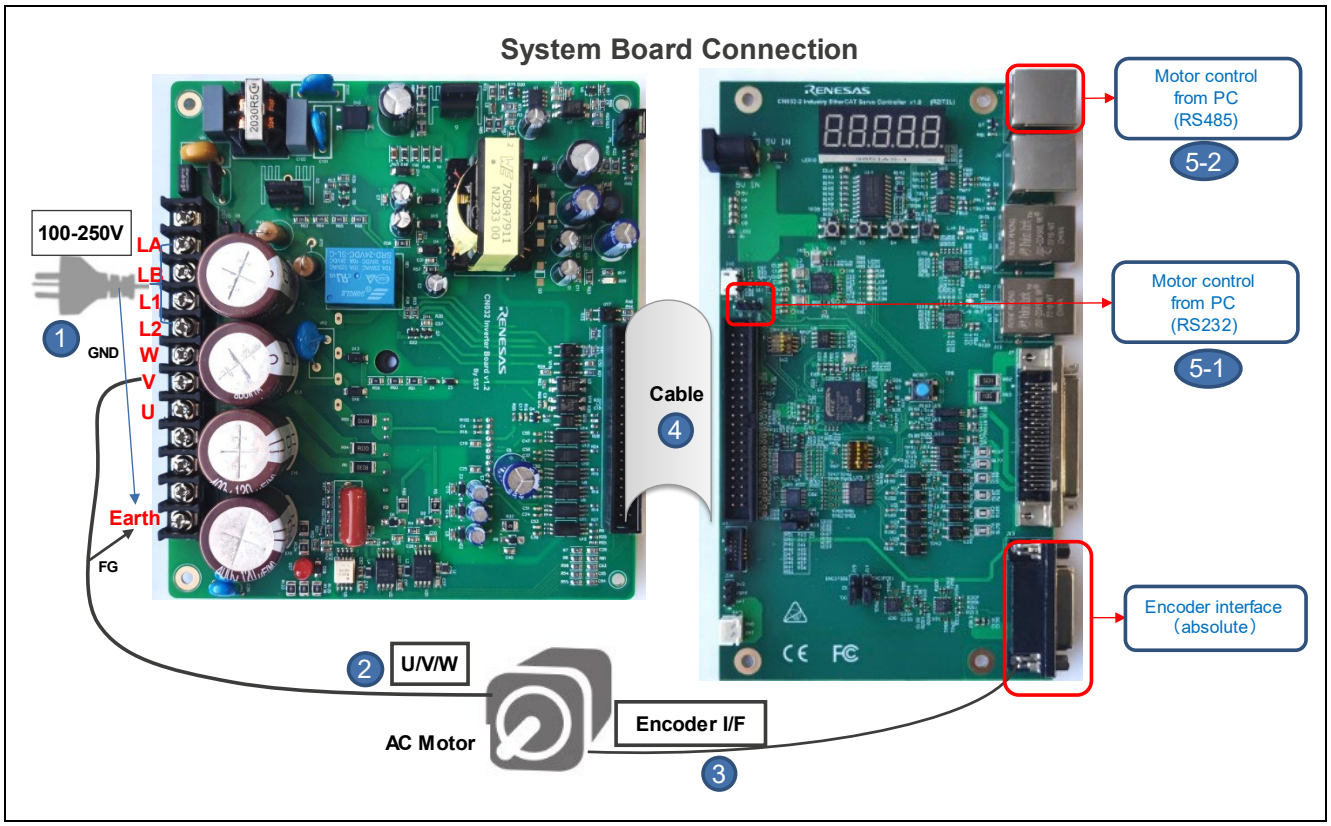


Figure 4-1 Connection Configuration

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 motor solution 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.

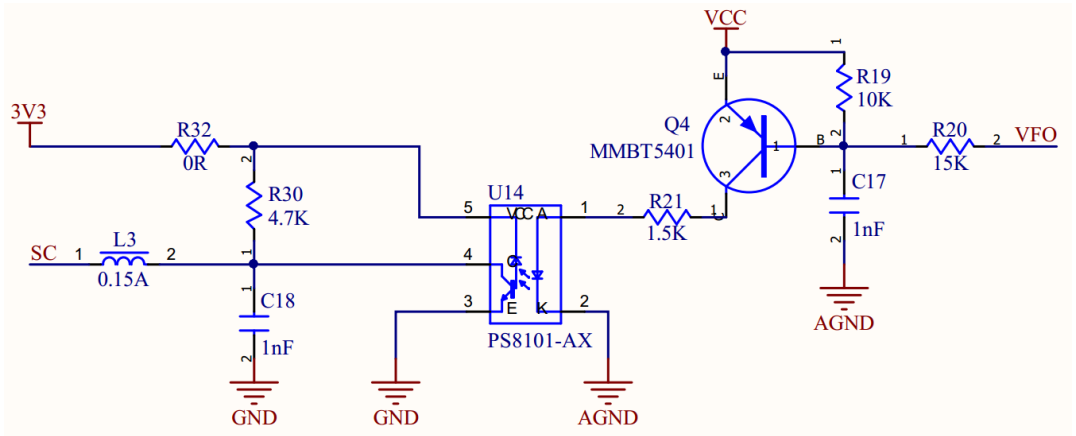


Figure 5-1 Fault Detection Circuit

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.

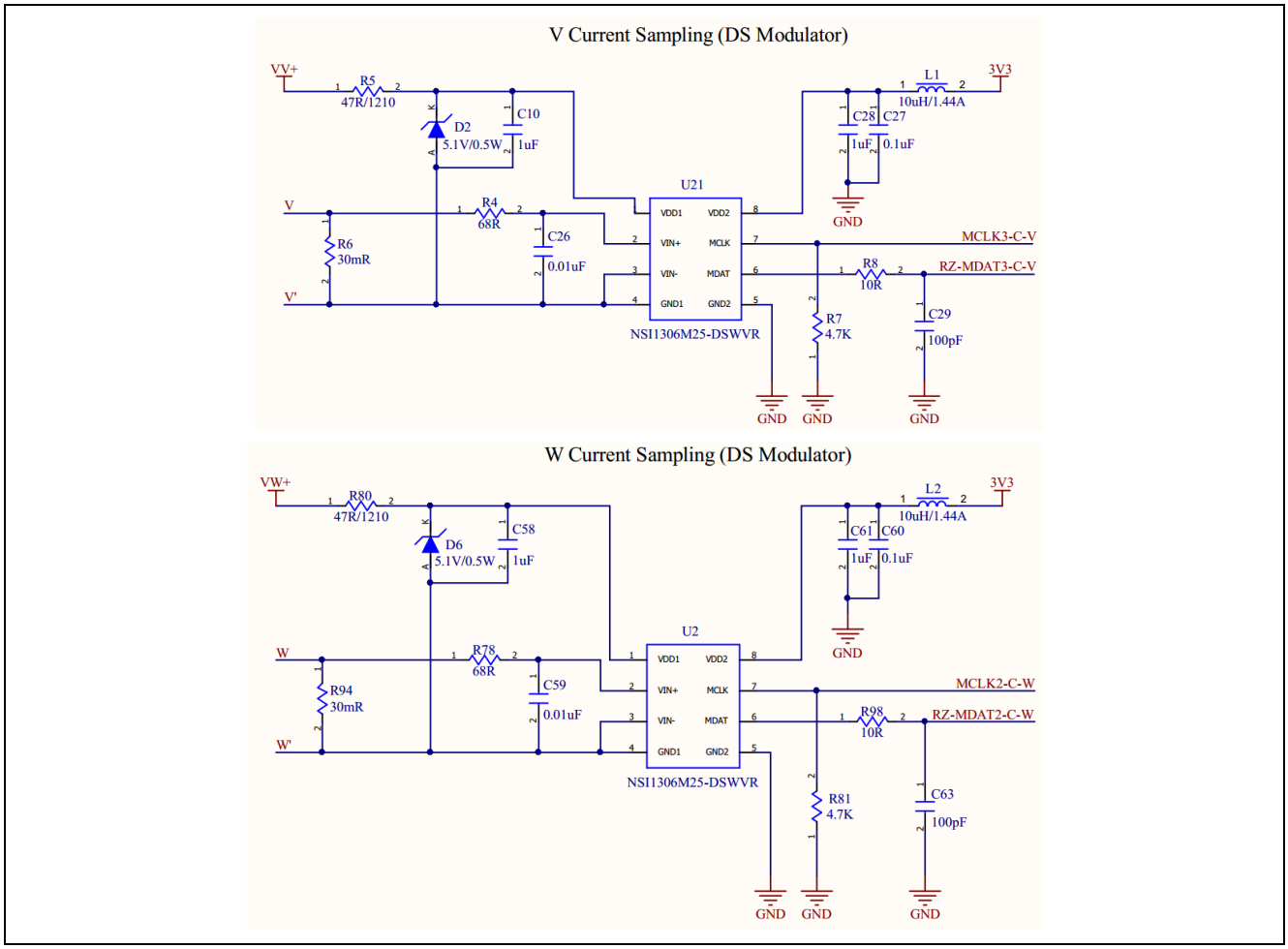


Figure 5-2 Current Detection Circuit (V/W)

5.3 Bus Voltage Detection Circuit (220V)

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

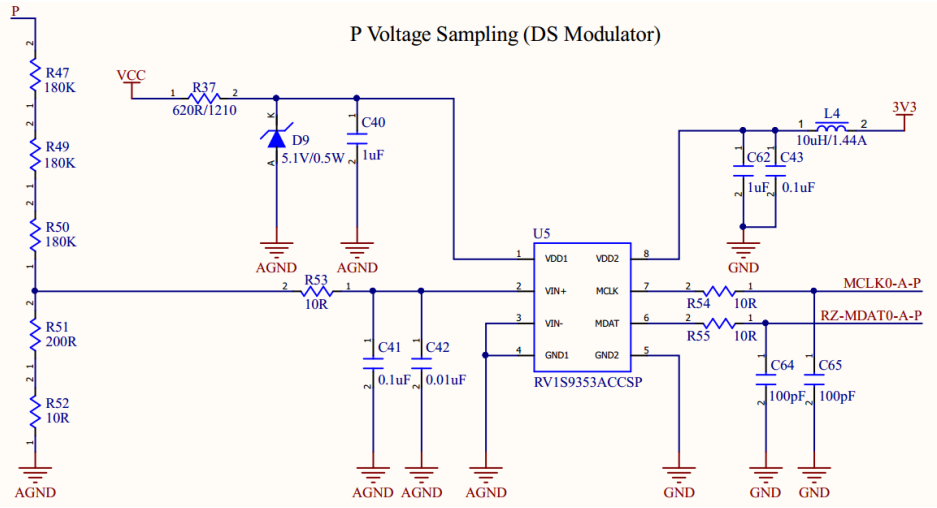


Figure 5-3 Bus Voltage Detection Circuit (220V)

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 6-1 Pin Map (1/5)

Pin number	Pin Name	Signal Name	Function
A13	AN000	ADC_AN000	-
B12	AN001	ADC_AN001	-
A12	AN002	ADC_AN002	-
C11	AN003	ADC_AN003	-
A11	AN100	NC	-
B11	AN101	NC	-
C10	AN102	NC	-
B10	AN103	NC	-
C12	AVCC18_TSU	-	-
N11	AVCC18_USB	-	-
G4	BSCANP	-	-
P6	EXTAL	-	-
N6	EXTCLKIN	GND	-
M7	MDX	GND	-
E5	P00_0	RZ_DO_CTL8	GPIO(output)
B4	P00_1	F_LMT#	IRQ0
C4	P00_2	RZ_DO_CTL6	GPIO(output)
A3	P00_3	LED7	GPIO(output)
D4	P00_6	MTIOC3B-B_U+	MTIOC3B
D3	P01_0	MTIOC4C-B_V-	MTIOC4C
C3	P01_1	MTIOC3D-B_U-	MTIOC3D
B3	P01_2	MTIOC4B-B_W+	MTIOC4B
A2	P01_3	MTIOC4D-B_W-	MTIOC4D
B2	P01_4	FO_INT#	POE0#
E4	P01_5	MTIOC4A-B_V+	MTIOC4A
C2	P01_6	RS485/DR	GPIO(output)
B1	P01_7	EB1EN	None
D2	P02_0	CANTX1	CANTX1
C1	P02_1	MDW	None
E2	P02_2	F-PLS	GPIO(input)
D1	P02_3	CANRX1	CANRX1
E3	P02_4	TDO	SWD_TDO
E1	P02_5	TDI	SWD_TDI
F3	P02_6	TMS	SWD_TMS_SWDIO
F2	P02_7	TCK	SWD_TCK_SWCLK
F1	P04_1	TXD3	TXD3
G3	P05_5	ETH1_LINK	ESC_PHYLINK1
G2	P05_6	ETH1_RXER	IRQ12
H4	P05_7	ETH1_TXD2/MD2	ETH1_TXD2
G1	P06_0	ETH1_TXD3	ETH1_TXD3
H3	P06_1	ETH1_REFCLK	ETH1_REFCLK
H2	P06_2	ETH1_TXD1/MD1	ETH1_TXD1
J4	P06_3	ETH1_TXD0/MD0	ETH1_TXD0
H1	P06_4	ETH1_TXC	ETH1_TXCLK_TXC

Table 6-2 Pin Map (2/5)

Pin number	Pin Name	Signal Name	Function
J2	P06_5	ETH1_TXEN	ETH1_TXEN_TXCTL
J3	P06_6	ETH1_RXD0	ETH1_RXD0
J1	P06_7	ETH1_RXD1	ETH1_RXD1
K1	P07_0	ETH1_RXD2	ETH1_RXD2
K4	P07_1	ETH1_RXD3	ETH1_RXD3
K2	P07_2	ETH1_RXDV	ETH1_RXDV_CRSDC_RXCTL
K3	P07_3	ETH1_EXC	ETH1_RXCLK_REF_CLK_RXC
L7	P07_4	USB_VBUSIN	USB_VBUSIN
L3	P08_4	ETH0_RXD3	ETH0_RXD3
L2	P08_5	ETH0_RXDV	ETH0_RXDV_CRSDV_RXCTL
M2	P08_6	ETH0_EXC	ETH0_RXCLK_REF_CLK_RXC
M1	P08_7	ETH_MDC	GMAC_MDC
K5	P09_0	ETH_MDIO	GMAC_MDIO
M3	P09_1	ETH0_REFCLK	ETH0_REFCLK
N1	P09_2	ETH0_RXER	IRQ0
N2	P09_3	ETH0_TXD3	ETH0_TXD3
L4	P09_4	ETH0_TXD2	ETH0_TXD2
N3	P09_5	ETH0_TXD1	ETH0_TXD1
P2	P09_6	ETH0_TXD0	ETH0_TXD0
M4	P09_7	ETH0_TXC	ETH0_TXCLK_TXC
N4	P10_0	ETH0_TXEN	ETH0_TXEN_TXCTL
L5	P10_1	ETH0_RXD0	ETH0_RXD0
M5	P10_2	ETH0_RXD1	ETH0_RXD1
P3	P10_3	ETH0_RXD2	ETH0_RXD2
P4	P10_4	ETH0_LINK	ESC_PHYLINK0
L9	P13_2	ESC_I2CCLK-B	ESC_I2CCLK
L10	P13_3	ESC_I2CDATA-B	ESC_I2CDATA
M12	P13_4	ETH_RESET#	ESC_RESETOUT#
L12	P13_5	EA1RX	None
M13	P13_6	EB1RX	None
L11	P13_7	DSW-CATID0	GPIO(input)
N14	P14_0	LED5	GPIO(output)
M14	P14_1	DSW-CATID2	GPIO(input)
K11	P14_2	LED_INT#	IRQ6
L13	P14_3	DSW-CATID3	GPIO(input)
K13	P14_4	LED6	GPIO(output)
L14	P14_5	R-PLS	GPIO(input)
K14	P14_6	XSPI0_CKP	XSPI0_CKP
K12	P14_7	XSPI0_IO0	XSPI0_IO0
J12	P15_0	XSPI0_IO1	XSPI0_IO1
J13	P15_1	XSPI0_IO2	XSPI0_IO2
J14	P15_2	XSPI0_IO3	XSPI0_IO3
J11	P15_3	RZ_MCLK1-A_P	MCLK1
H13	P15_4	RZ_MDAT1-A_P	MDAT1
H12	P15_5	RZ_MCLK2-C_W	MCLK2
H11	P15_6	RZ_MDAT2-C_W	MDAT2

Table 6-3 Pin Map (3/5)

Pin number	Pin Name	Signal Name	Function
H14	P15_7	XSPI0_CS0	XSPI0_CS0
G12	P16_0	RS485/TXD0	TXD0
G11	P16_1	RS485/RXD0	RXD0
G13	P16_2	ENCIFCK1	None
G14	P16_3	ENCIFOE1	GPIO(output)
F11	P17_0	MDD	None
F13	P17_3	LAG	GPIO(output)
E12	P17_4	LEAD	GPIO(output)
F14	P17_5	Z/TX	GPIO(output)
F12	P17_6	ALM#	GPIO(output)
E13	P17_7	RXD3	RXD3
E14	P18_0	DSW-CATID1	GPIO(input)
D14	P18_1	RD1_INT#	IRQ10
D12	P18_2	DOC	GPIO(output)
D13	P18_3	DOA	GPIO(output)
C14	P18_4	R-LMT#	IRQ1
C13	P18_5	DOB	GPIO(output)
B14	P18_6	RD2_INT#	IRQ11
C8	P20_3	ETH_LED1/MDV2	ESC_LEDERR
A9	P20_4	ETH_LED3/MDV3	ESC_LINKACT1
A8	P21_1	IIC_SCL1	IIC_SCL1
B8	P21_2	IIC_SDA1	IIC_SDA1
C7	P21_3	ETH_LED0_RUN	ESC_LEDRUN
D7	P21_4	RZ_DO_CTL7	GPIO(output)
B7	P21_5	SV-ON	GPIO(input)
A7	P21_6	ETH_LED2_LA_IN	ESC_LINKACT0
B6	P21_7	RZ_MCLK3-C_V	MCLK3
C6	P22_0	RZ_MDAT3-C_V	MDAT3
D6	P22_1	ALM-RST	GPIO(input)
A6	P22_2	ENCIFDO1	None
A5	P22_3	EZ1RX	None
B5	P23_7	RZ_DO_CTL5	GPIO(output)
D5	P24_0	RXD1	RXD1
A4	P24_1	LED4	GPIO(output)
C5	P24_2	TXD1	TXD1
N5	RES#	RESET#	-
F4	TRST#	NC	-
P9	USB_DM	USB_DM	-
P10	USB_DP	USB_DP	-
P12	USB_RREF	GND	-
E10	VCC18_ADC0	-	-
E9	VCC18_ADC1	-	-
N8	VCC18_PLL0	-	-
M8	VCC18_PLL1	-	-
P11	VCC18_USB	-	-
E6	VCC1833_2	-	-

Table 6-4 Pin Map (4/5)

Pin number	BGA 196	Pin Name	Signal name
J10	VCC1833_3	-	-
K10	VCC1833_3	-	-
D8	VCC33	-	-
F5	VCC33	-	-
F10	VCC33	-	-
J5	VCC33	-	-
K9	VCC33	-	-
L6	VCC33	-	-
M10	VCC33_USB	-	-
E7	VDD	-	-
E8	VDD	-	-
F6	VDD	-	-
F9	VDD	-	-
G5	VDD	-	-
G10	VDD	-	-
H5	VDD	-	-
H10	VDD	-	-
J6	VDD	-	-
J9	VDD	-	-
K6	VDD	-	-
K7	VDD	-	-
K8	VDD	-	-
L8	VDD	-	-
D10	VREFH0	-	-
D9	VREFH1	-	-
A1	VSS	-	-
A10	VSS	-	-
A14	VSS	-	-
B9	VSS	-	-
B13	VSS	-	-
C9	VSS	-	-
D11	VSS	-	-
J10	VCC1833_3	-	-
E11	VSS	-	-
F7	VSS	-	-
F8	VSS	-	-
G6	VSS	-	-
G7	VSS	-	-
G8	VSS	-	-
G9	VSS	-	-
H6	VSS	-	-
H7	VSS	-	-
H8	VSS	-	-
H9	VSS	-	-
J7	VSS	-	-
J8	VSS	-	-

Table 6-5 Pin Map (5/5)

Pin number	BGA 196	Pin Name	Signal name
L1	VSS	-	-
M6	VSS	-	-
M9	VSS	-	-
N7	VSS	-	-
P1	VSS	-	-
P5	VSS	-	-
P8	VSS	-	-
P14	VSS	-	-
M11	VSS_USB	-	-
N9	VSS_USB	-	-
N10	VSS_USB	-	-
N12	VSS_USB	-	-
N13	VSS_USB	-	-
P13	VSS_USB	-	-
P7	XTAL	-	-
L1	VSS	-	-
M6	VSS	-	-
M9	VSS	-	-
N7	VSS	-	-

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 this system, 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
U3	Renesas RZ-T2L MCU	Renesas	R9A07G074M04	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	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

BOM List from Inverter Board

Designator	Description	Manufacturer	Mfg Part Number	Quantity
U3, U7, U19	OPTOISOLATOR 5KV TRANS 4SMD	Renesas	PS2561DL-1	3
U5	DELTA-SIGMA MODULATOR (OPTOCPLR)	Renesas	RV1S9353A	1
U8, U9, U10, U11, U12, U13	15Mbps IPM Drive Photocouplers	Renesas	RV1S9061A	6
U14	OPTOISO 3.75KV PUSH PULL 6SO	Renesas	PS8101-AX	1
U15, U16, U17	OPTOISOLATOR 3.75KV TRANS 4SOP	Renesas	PS2761B-1	3

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Feb.28, 2023	–	First Edition issued
1.01	Dec.14, 2023	13 19 other	Parts number of External Control Interface corrected. Precaution added. Typo fixed.

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.

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You shall be responsible for determining what licenses are required from any third parties, and obtaining such licenses for the lawful import, export, manufacture, sales, utilization, distribution or other disposal of any products incorporating Renesas Electronics products, if required.
5. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
6. Renesas Electronics products are classified according to the following two quality grades: “Standard” and “High Quality”. The intended applications for each Renesas Electronics product depends on the product’s quality grade, as indicated below.
   "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.
   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.

   Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user’s manual or other Renesas Electronics document.
7. No semiconductor product is absolutely secure. Notwithstanding any security measures or features that may be implemented in Renesas Electronics hardware or software products, Renesas Electronics shall have absolutely no liability arising out of any vulnerability or security breach, including but not limited to any unauthorized access to or use of a Renesas Electronics product or a system that uses a Renesas Electronics product. RENESAS ELECTRONICS DOES NOT WARRANT OR GUARANTEE THAT RENESAS ELECTRONICS PRODUCTS, OR ANY SYSTEMS CREATED USING RENESAS ELECTRONICS PRODUCTS WILL BE INVULNERABLE OR FREE FROM CORRUPTION, ATTACK, VIRUSES, INTERFERENCE, HACKING, DATA LOSS OR THEFT, OR OTHER SECURITY INTRUSION (“Vulnerability Issues”). RENESAS ELECTRONICS DISCLAIMS ANY AND ALL RESPONSIBILITY OR LIABILITY ARISING FROM OR RELATED TO ANY VULNERABILITY ISSUES. FURTHERMORE, TO THE EXTENT PERMITTED BY APPLICABLE LAW, RENESAS ELECTRONICS DISCLAIMS ANY AND ALL WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO THIS DOCUMENT AND ANY RELATED OR ACCOMPANYING SOFTWARE OR HARDWARE, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE.
8. When using Renesas Electronics products, refer to the latest product information (data sheets, user’s manuals, application notes, “General Notes for Handling and Using Semiconductor Devices” in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
12. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
13. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
14. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.

(Note1) “Renesas Electronics” as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.

(Note2) “Renesas Electronics product(s)” means any product developed or manufactured by or for Renesas Electronics.

(Rev.5.0-1 October 2020)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

Contact information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:
www.renesas.com/contact/.