User's Manual

32

RH850 Evaluation Platform

RH850/U2B Starter Kit

User's Manual: Hardware

Y-ASK-RH850U2B6(-JP)
Y-ASK-RH850U2B10(-JP)

Renesas Electronics
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Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
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General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

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

1. Precaution against Electrostatic Discharge (ESD)

A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity.

Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.

2. Processing at power-on

The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.

3. Input of signal during power-off state

Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.

4. Handling of unused pins

Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.

5. Clock signals

After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.

6. Voltage application waveform at input pin

Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between VIL (Max.) and VIH (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 VIL (Max.) and VIH (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.

Table of Contents

1. Introduction

The ‘RH850/U2B Starter Kit’ serves as a simple and easy to use platform for evaluating the features and performance of Renesas Electronics’ 32-bit RH850/U2B microcontrollers.

Notes

1. This document describes the functionality of the communication board and guides the user through its operation.
   For details regarding the operation of the microcontroller, refer to the device's Hardware User’s Manual.
2. In this document active low signals are marked by an appended ‘Z’ or ‘#’ to the pin or signal name. E.g. the reset pin is named RESETZ or RESET#.
3. In this document following abbreviations are used:
   – H level, L level: high or low signal level of a digital signal, the absolute voltage value depends on the signal

1.1 Package Components Y-ASK-RH850U2Bx(-JP)

The Y-ASK-RH850U2Bx(-JP) product package consists of the items listed in Table 1.1.

The difference between the boards Y-ASK-RH850U2B6(-JP) and Y-ASK-RH850U2B10(-JP) is the RH850/U2B processor that is mounted on the PCB. Refer to chapter *1.5 Used Device* for details.

After you have unpacked the box, check if your Y-ASK-RH850U2Bx(-JP) package contains all of these items. *Table 1.1 Package Components for the Y-ASK-RH850U2Bx*(-JP) shows the packing components of the Y-ASK-RH850U2B6(-JP) and the Y-ASK-RH850U2B10(-JP) package.

Table 1.1 Package Components for the Y-ASK-RH850U2Bx(-JP)

Item	Description	Quantity
D019567	RH850/U2Bx starter kit board	1
D017765-11	RH850 starter kit license information document	1
D019988-24	Product contents list Y-ASK-RH850U2B6(-JP)	1
D019989-24	Product contents list Y-ASK-RH850U2B10(-JP)	1
226-000210-01	Renesas E2 emulator unit	1
228-000078-01	USB Cable, Type A to Type-C, 0.5m	1
230-000109-01	Parallel Cable [1x D-SUB connector 9-pin - 1x DIL connector 10-pin]	3
230-000110-01	Sub-D male to male gender changer, 9-pin	3
236-000009-05	Power supply unit, 12V/1A Incl. 4 international AC-plugs	1 (not included in starter kits with *-JP in the order code)

Note

Please keep the Y-ASK-RH850U2Bx(-JP) packing box at hand for later reuse in sending the product for repairs or for other purposes. Always use the original packing box when transporting the Y-ASK-RH850U2Bx(-JP). If packing of your product is not complete, it may be damaged during transportation.

1.2 Main Features

- Supports RH850/U2B processor
- Connection for on-chip debugging and flash memory programming
- Pin headers for direct access to all microcontroller pins
- Board configuration via PC based GUI
- External power supply (12V DC input)
- Debugging and programming interface:
  14-pin LPD/JTAG Debug Connector (e. g. for using E2 OCD Emulator or PG-FP6 Flash Programmer)
- Reset switch
- External clock circuit with a 20 MHz ceramic resonator
- Four general purpose signaling LEDs
- 16 circular LEDs
- Rotary encoder with RGB LED illuminated shaft
- Two analog signal inputs using potentiometer
- Two switches for external interrupt signal input
- Two motor control signal outputs
- Two Inputs for resolver signals for motor control
- Onboard interface connectors for :
  - Ethernet port (10BASE-T / 100BASE-TX)
  - LIN Master / SENT
  - UART via USB (VCP)
  - CAN
  - RHSB / MSPI
  - PMOD
- Operating temperature from 0 °C to +40 °C

1.3 Starter Kit Versions

The following versions of the Starter Kit are available:

Table 1.2 Y-ASK-RH850U2Bx(-JP) board versions

Board version	Schematic version
D019567_06_V0200	D019567_04_V0203
D019567_06_V0300	D019567_04_V0300

Table 1.3 shows the differences of the board versions.

Table 1.3 Y-ASK-RH850U2Bx(-JP) board version difference)

No.	Modified Function	Detailed Description of Changes	D019567_06_V0200	D019567_06_V0300
1	Flash programming of RL78	Add switch to enable or disable RL78 programming via USB interface	RL78 programming via USB is always possible.	Added switch SW4.
2	Ports used for PMOD signal #1 in PMOD modes 1A, 3A and 6A and PMOD signal #4 in PMOD mode 1A and 3A.	Used different ports on RH850/U2B.	Ports being used: Mode / Pin / RH850 Port 1A, 3A, 6A / 1 / AN02_0 1A, 3A / 4 / AN22_0	Ports being used: Mode / Pin / RH850 Port 1A, 3A, 6A / 1 / P22_4 (IRQ2) 1A, 3A / 4 / P12_1
3	FTDI	Changed power mode	Powered from VBUS on the USB connection.	Powered by 3.3V domain on the starter kit.
4	Power test connector	Changed connector type.	Used connector AMP_20021321-00014C4LF, connector assembled.	Provides footprint for connector TAG_TC2070_FP_14PIN, not assembled.

1.4 Starter Kit Board View

Below pictures show the starter kit (*Figure 1.1*) and the accessories included in the starter kit (*Figure 1.2*).

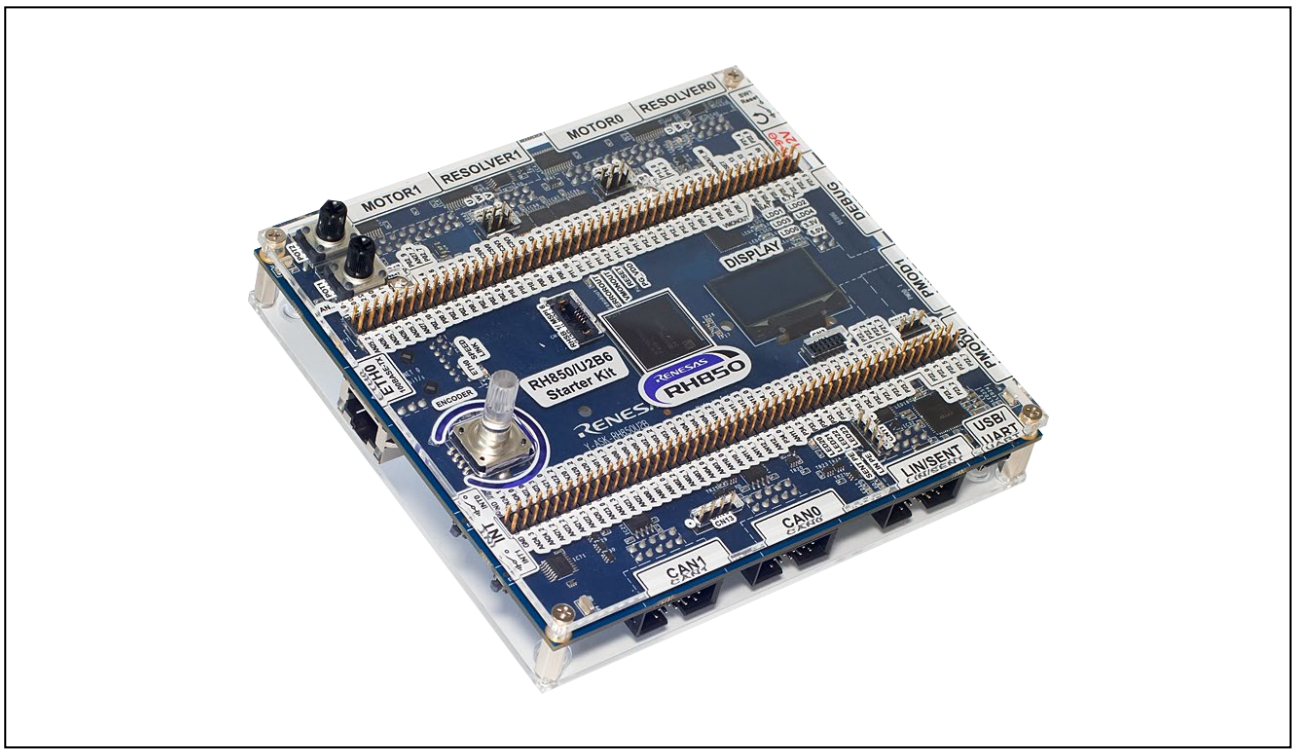


Figure 1.1 Starter kit

Figure 1.2 Starter kit accessories

The following figures provide the drawing of top and bottom views of the starter kit board including the solder pads.

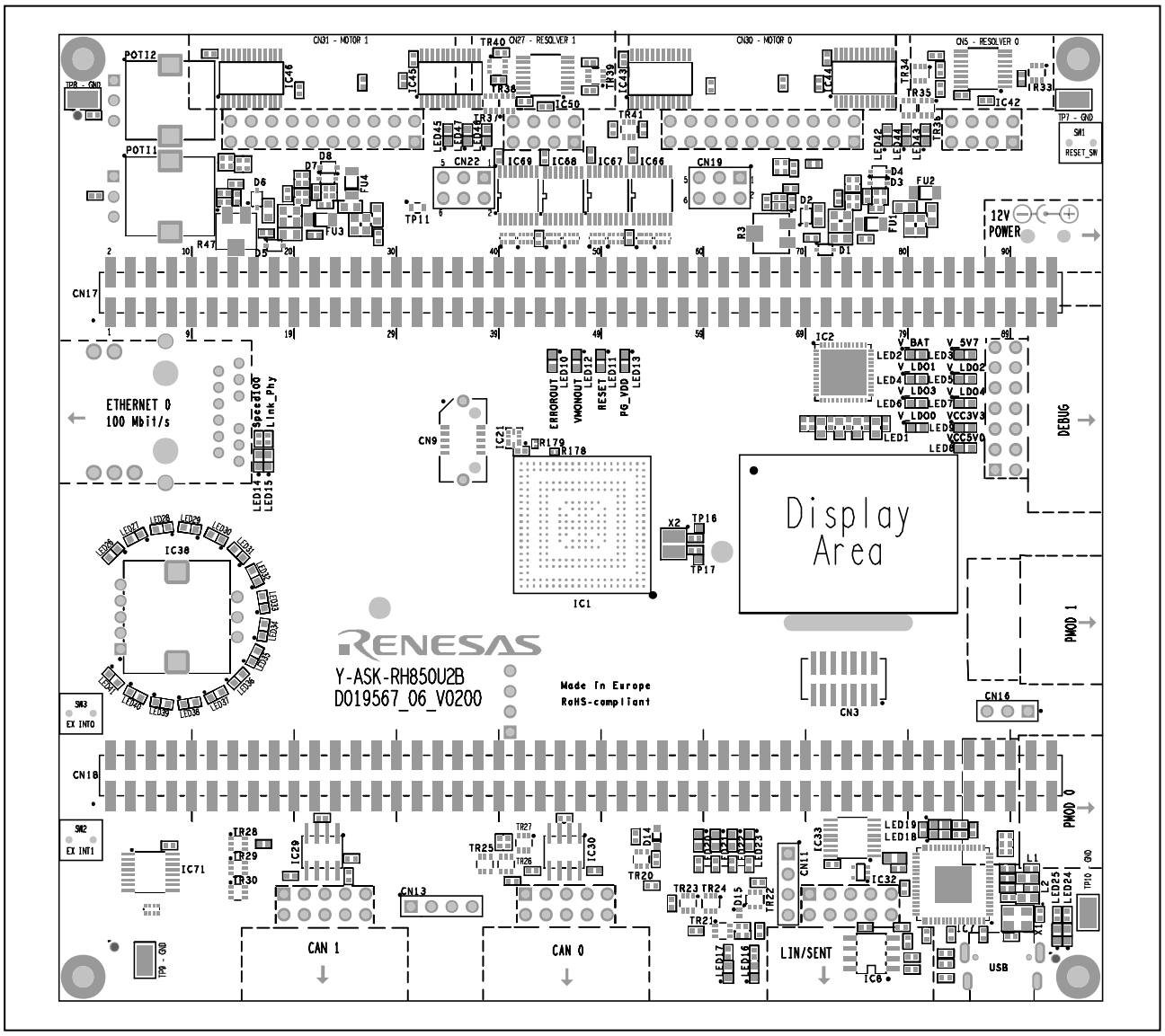


Figure 1.3 Starter kit board top view for board version D019567_06_V0200

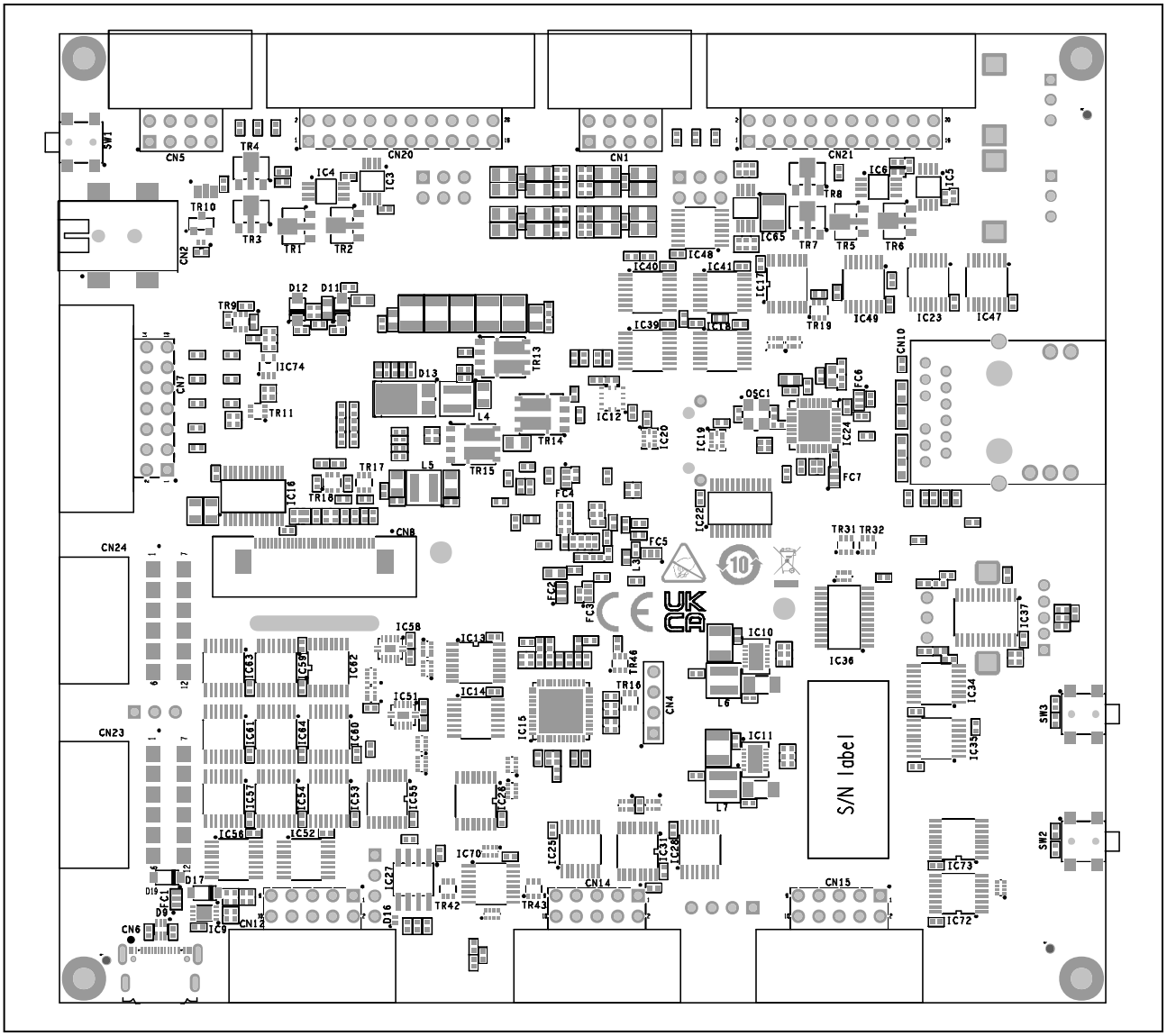


Figure 1.4 Starter kit board top view for board version D019567_06_V0200

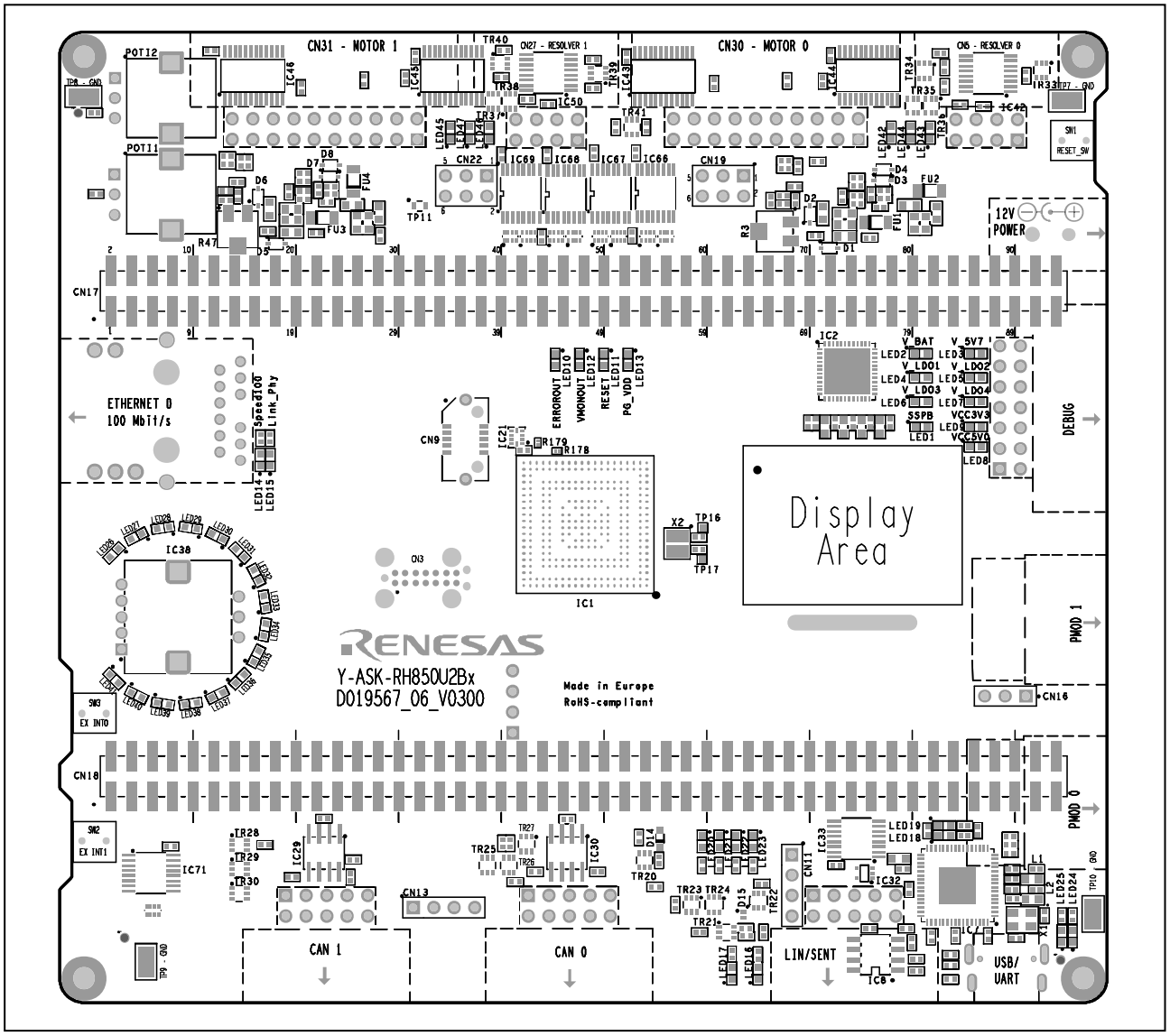


Figure 1.5 Starter kit board bottom view for board version D019567_06_V0300

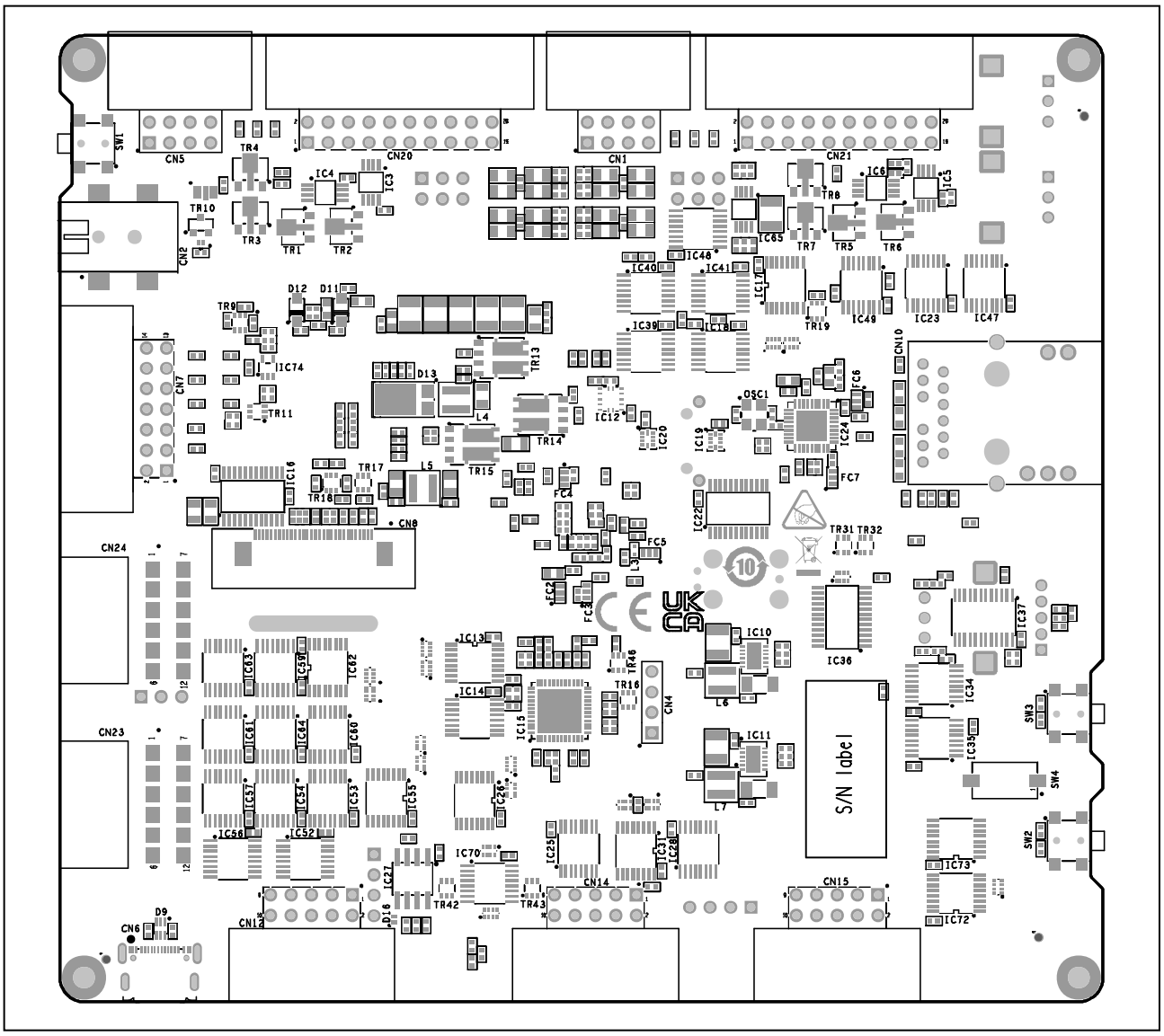


Figure 1.6 Starter kit board bottom view for board version D019567_06_V0300

1.5 Used Device

The board is designed for use with the following devices.

Table 1.4 Type names for FCC and MP devices

	FCC device	MP device	Comments
RH850/U2B6	R7F702Z2*EDBB	R7F70255*FABB-C R7F70255*AFABB-C R7F70255*BFABB-C	FCC: Sixth through ninth characters of the part name indicate U2Bx-FCC(BGA292) PKG: The last 2 characters of the part name indicate BGA292.
RH850/U2B10	R7F702Z2*EDBB	R7F70254*FABB-C R7F70254*AFABB-C	

By default the starter kit is equipped with mass production device RH850/U2B6 (R5F702556BFABB-C, Y-ASK-RH850U2B6(-JP)) or RH850/U2B10 (R5F5702546AFABB-C, Y-ASK-RH850U2B10(-JP)).

The device is soldered to the PCB.

2. Connectors, Switches and LEDs

This section provides complete lists of all connectors, switches, and LEDs.

The placement of these components on the board is depicted in the figure below.

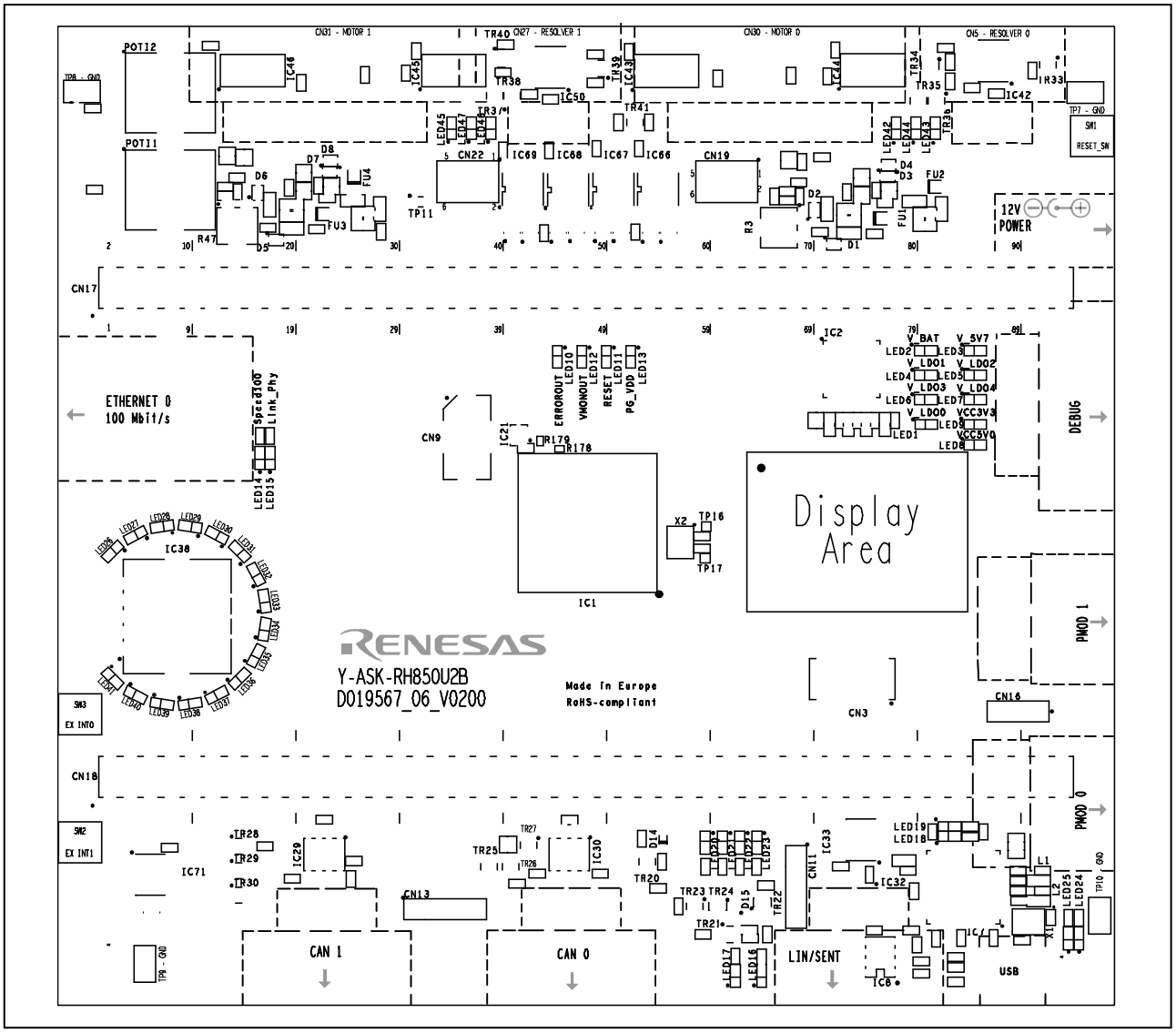


Figure 2.1 Placement of connectors and LEDs on top side of the starter for board version D019567_06_V0200

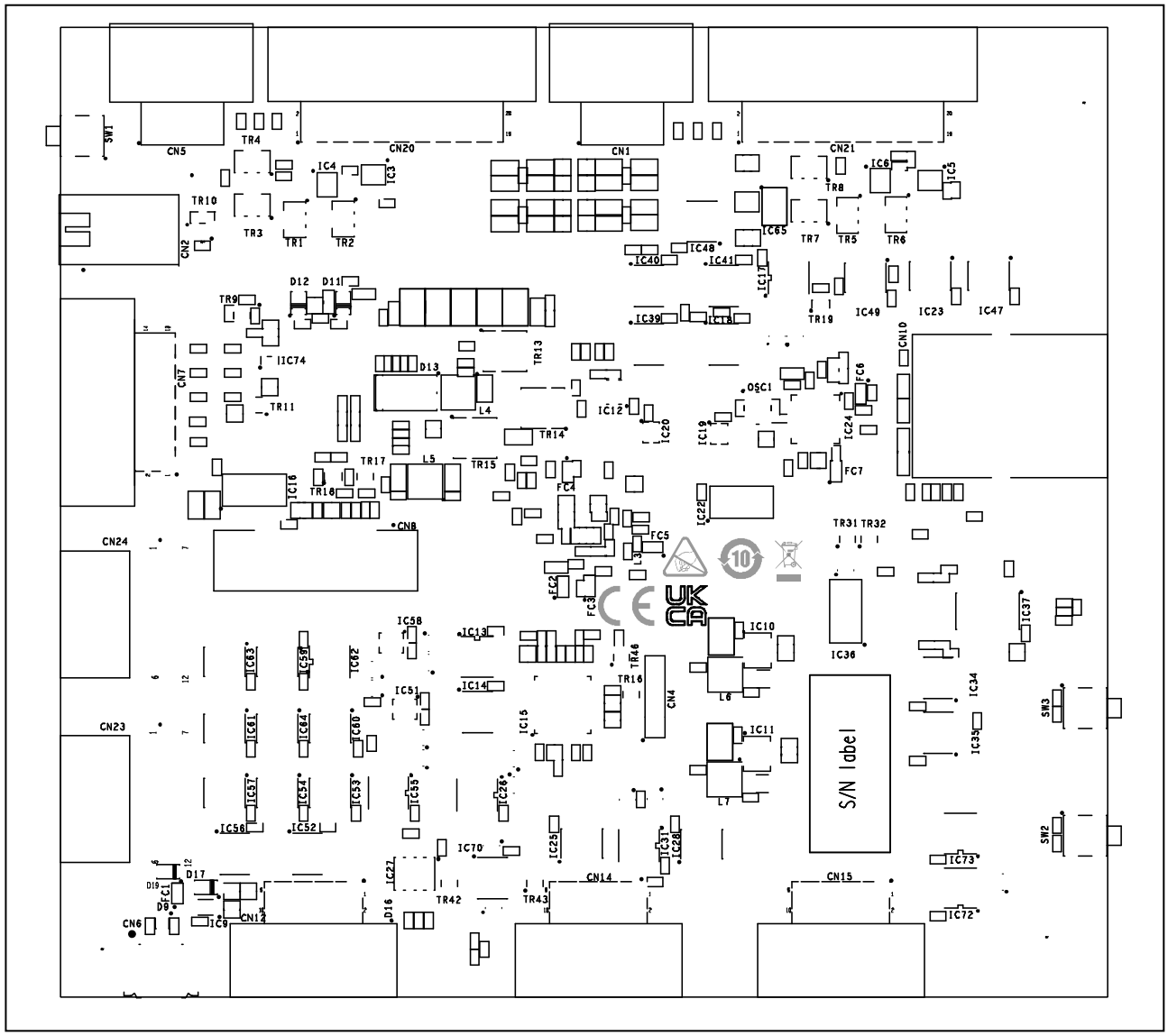


Figure 2.2 Placement of connectors on bottom side of the starter kit for board version D019567_06_V0200

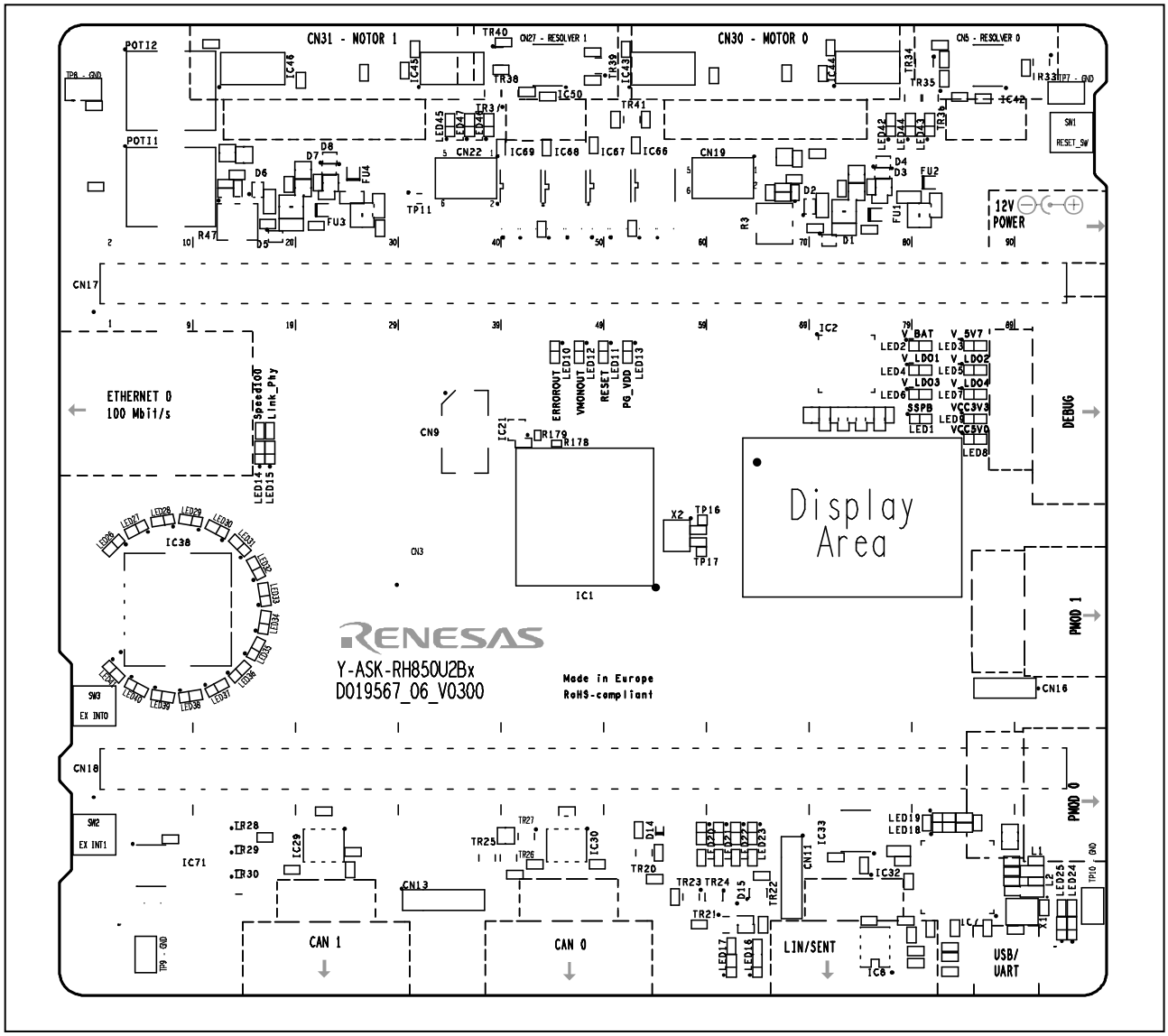


Figure 2.3 Placement of connectors and LEDs on top side of the starter for board version D019567_06_V0300

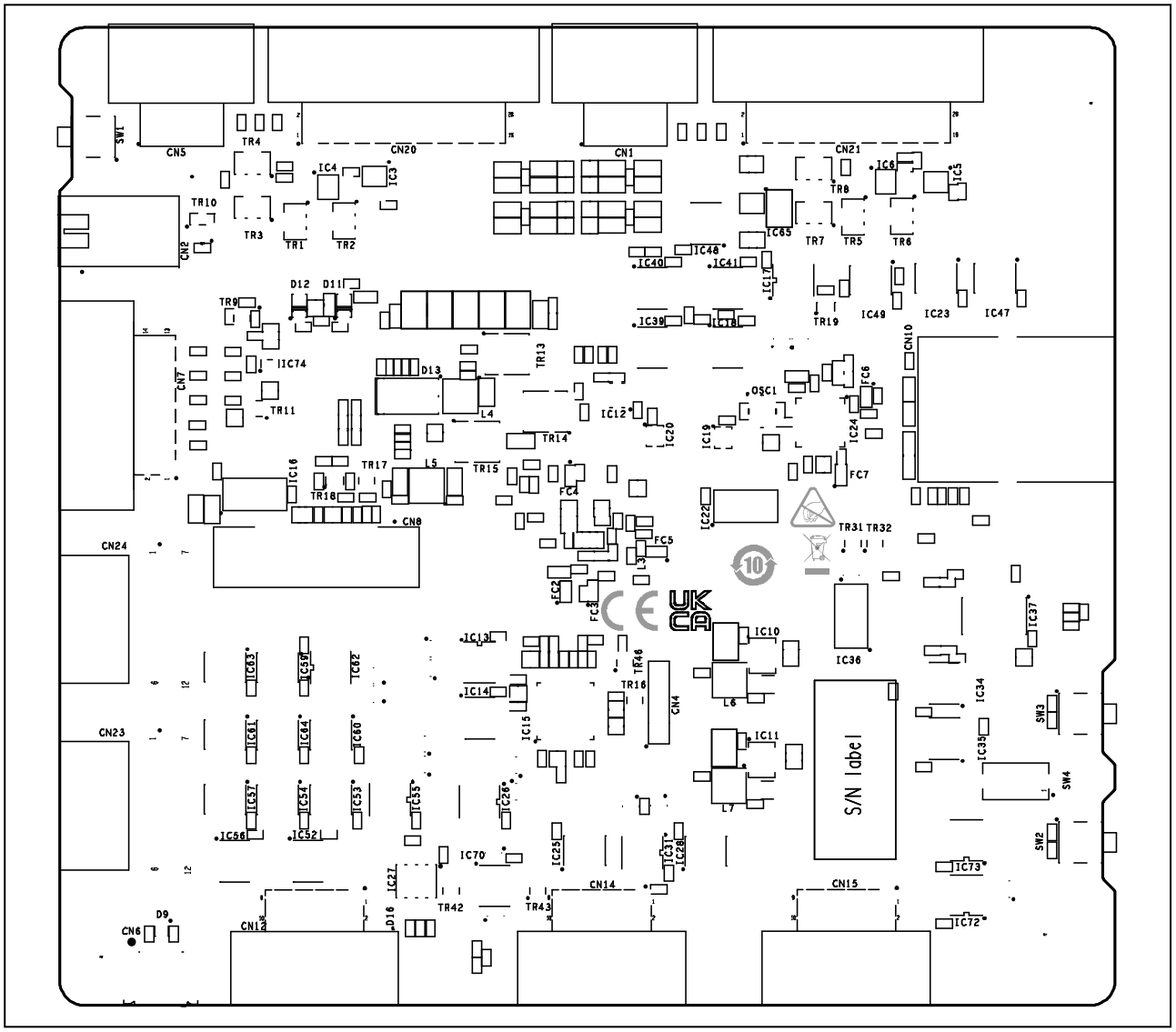


Figure 2.4 Placement of connectors on bottom side of the starter kit for board version D019567_06_V0300

2.1 Switch Overview

The following table provides an overview of all switches.

Table 2.1 Switch overview

Connector	Function	Remark
SW1	RESET switch	refer to *7.1 RESET Circuit*
SW2	External interrupt signal EX_INT1	refer to *7.2 External Interrupt Signal*
SW3	External interrupt signal EX_INT0	refer to *7.2 External Interrupt Signal*
SW4	Enable RESET for RL78 reprogramming	refer to *6.2.3 Starter Kit Configurator Firmware Programming* only board version D019567_06_V0300 and later

2.2 Connector Overview

The following table provides an overview of all connectors.

Table 2.2 Connector overview

Connector	Function	Remark
CN1	Connector for external Resolver 1	refer to *7.15 Resolver /* Motor Interface
CN2	+12.0 V external power supply	refer to *3.1 Power Management IC (PMIC)*
CN3	Test connector for power supplies	refer to *3.3 Power Supply* Test Connector
CN4	Connector for programming the RL78 board configurator IC	refer to *6.2.3 Starter Kit Configurator Firmware Programming*
CN5	Connector for external Resolver 0	refer to *7.15 Resolver /* Motor Interface
CN6	USB C connector for UART1	refer to *7.10 UART Interface*
CN7	Debug and programming interface	refer to *5 Debug and Flash Programming Interfaces*
CN8	Display connector	refer to *7.6 OLED Graphic Display*
CN9	RHSB1/MSPI6 interface connector	refer to *7.14 RHSB1 / MSPI6 Interface*
CN10	Ethernet interface connector	refer to *7.11 Ethernet Interface*
CN11	LIN / SENT monitor connector	refer to *7.8 LIN and SENT Interfaces*
CN12	LIN / SENT interface connector	
CN13	CAN0 / CAN1 monitor connector	refer to *7.7 CAN Interfaces*
CN14	CAN0 interface connector	
CN15	CAN1 interface connector	
CN16	UART1 monitor connector	refer to *7.10 UART Interface*
CN17	Device port connectors	refer to *10.17 Device Port Connector CN17*
CN18		refer to *10.18 Device Port Connector CN18*
CN19	Resolver 0 connector	refer to *7.15 Resolver /* Motor Interface
CN20	Motor 0 connector	refer to *7.15.2 Motor Control Interfaces*
CN21	Motor 1 connector	
CN22	Resolver 1 connector	refer to *7.15.1 Resolver Circuits*
CN23	PMOD0 interface connector	refer to *7.13 PMOD Interfaces*
CN24	PMOD1 interface connector	

2.3 LED Overview

The following table provides an overview of all LED.

Table 2.3 LED overview

LED	Function	Color	Remark
LED1	PMIC active signal V_LDO0	green	refer to *3.1 Power Management IC (PMIC)*
LED2	12.0 V power supply V_BAT	green	refer to *3.4 Power Supply LEDs*
LED3	5.7 V power supply V_5V7		
LED4	3.3 V power supply V_LDO1		
LED5	3.3 V power supply V_LDO2		
LED6	3.3 V power supply V_LDO3		
LED7	5.0 V power supply V_LDO4		
LED8	5.0 V power supply VCC5V0		
LED9	3.3 V power supply VCC3V3		
LED10	ERROROUT signal	red	refer to *7.1 RESET Circuit*
LED11	RESET active signal	red	
LED12	VMONOUT signal	red	
LED13	1.09V RH850 core voltage VDD	red	
LED14	Ethernet communication signals	blue	refer to *7.11 Ethernet Interface*
LED15			
LED16	LIN interface enable signal	green	
LED17	SENT interface enable signal	green	
LED18	USB communication signal RH850	green	refer to *7.10 UART Interface*
LED19		red	
LED20	User Signalling LED	blue	refer to *7.5.2 User Signal LEDs*
LED21			
LED22			
LED23			
LED24	USB communication signal for board configurator RL78	green	refer to *6.2.3 Starter Kit Configurator Firmware Programming*
LED25		red	
LED26	Circular LED	blue	refer to *7.5.1 Circular LEDs*
LED27			
LED28			
LED29			
LED30			
LED31			
LED32			
LED33			
LED34			
LED35			
LED36			
LED37			

Table 2.3 LED overview (cont'd)

LED	Function	Color	Remark
LED38	Circular LED	blue	refer to *7.5.1 Circular LEDs*
LED39			
LED40			
LED41			
LED42	Motor 0 control signal U phase	red	refer to *7.15.2 Motor Control Interfaces*
LED43	Motor 0 control signal V phase	green	
LED44	Motor 0 control signal W phase	blue	
LED45	Motor 1 control signal U phase	red	
LED46	Motor 1 control signal V phase	green	
LED47	Motor 1 control signal W phase	blue	

3. Power Supply

The starter kit board is powered by a single 12V supply (V_BAT), which is connected to connector CN2.

Power control on the starter kit board is split to 2 parts.

One part is used for the power supply to RH850/U2B. This part uses the Renesas power management IC RAA271084.

The other part is the 3.3 V and 5.0 V power supply to the onboard peripheral hardware. This part consists of 2 Renesas buck regulators ISL85410.

3.1 Power Management IC (PMIC)

All voltages required to operate RH850/U2B are generated by the Renesas power management IC RAA271084. For more information about this device, please refer to the RAA271084 datasheet.

The power management IC has 4 LDO regulators, each of which can be fuse programmed to 3.3V or 5.0V.

The power management IC has also a buck-boost regulator DCDC1 and a buck regulator DCDC2.

The buck-boost regulator reduces the supply voltage V_BAT to 5.7V (V_5V7).

The buck regulator then generates the RH850 core voltage of 1.09V (VDD) from the 5.7V output by DCDC1.

The power management IC on the target board is programmed to provide the following voltages for RH850:

Table 3.1 RAA271084 Power Connections

RAA271084 Regulator	Output Voltage	Max. Output Current	Usage
DCDC1	5.7 V	-	RAA271084's VIN2, LDOVIN1/2 and LDOVIN3/4
DCDC2	1.09 V	-	RH850/U2B's VDDn
VCC (LDO0)	5 V	130 mA	RH850/U2B's SYSVCC, SVRAVCC & SCRDRVCC
LDO1	3.3 V	350 mA	RH850/U2B's VCC, J0VCC & OSCVCC
LDO2	3.3 V	350 mA	RH850/U2B's E0VCC, E1VCC, E2VCC & LVDVCC
LDO3	3.3 V	200 mA	Unused (EMUVCC if FCC device of RH850/U2B is used)
LDO4	5 V	200 mA	RH850/U2B's A0VCC, A1VCC, A2VCC, A0VREFH, A1VREFH, A2VREFH, ADSVCC, ADSVREFH & AFCVCC GreenPAK IC's (SLG) VDD

The power management IC has an SPI interface. This is connected to the MSPI5 interface of RH850. This interface can be used by the user application to program the configuration registers in the PMIC.

LED1 on the starter kit board is system status LED for the PMIC. If all system self-tests at power on are passed successfully this LED will be switched on.

Figure 3.1 shows the schematic of the PMIC circuit on the starter kit.

Table 3.2 lists the IO ports on the PMIC and shows what they are connected to.

Figure 3.2 shows the RAA271084 (OTP-1F.12) connections to RH850/U2B.

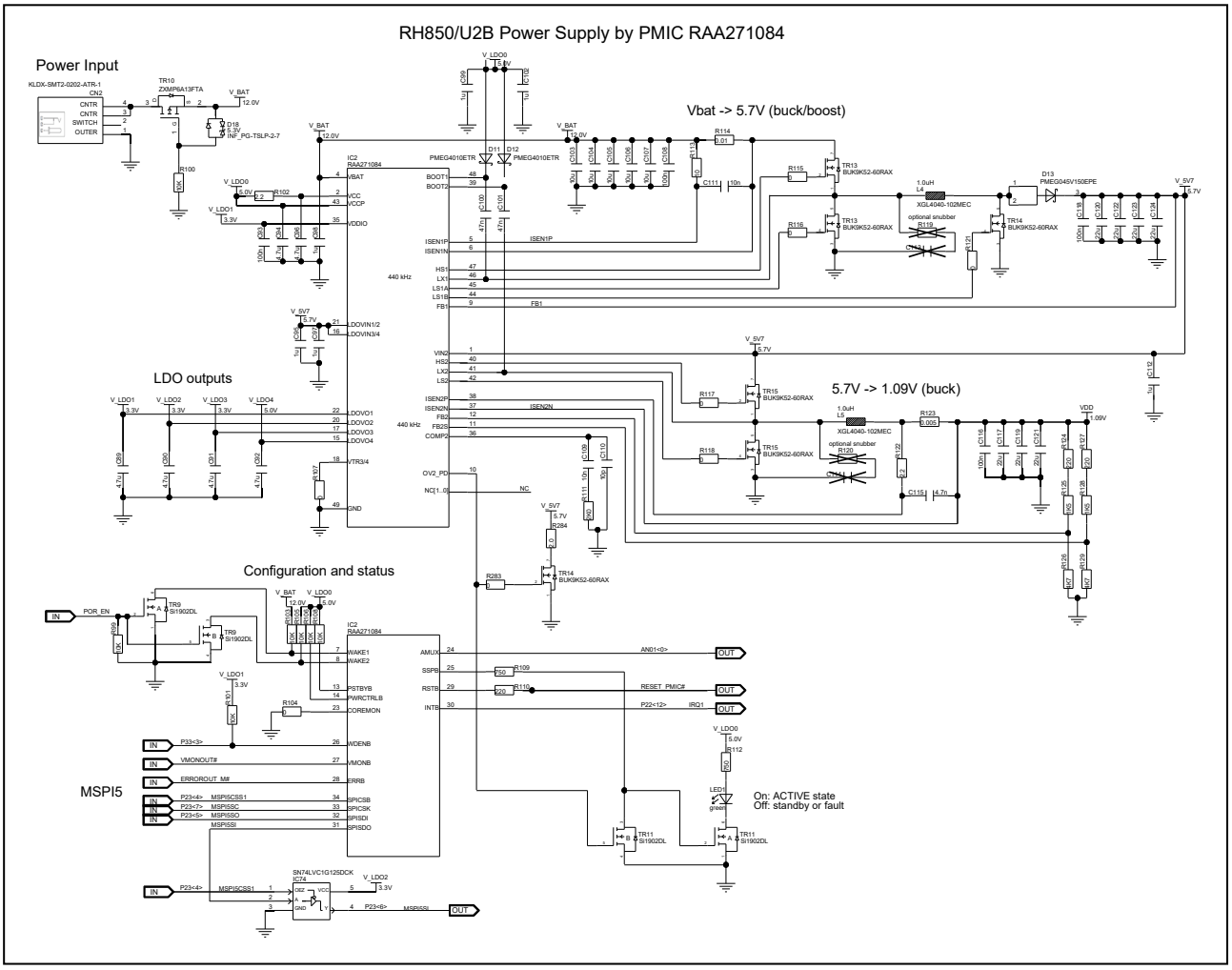


Figure 3.1 Power supply circuit for RH850/U2B on the starter kit board

Table 3.2 I/O Connections

RAA271084		RH850/U2B	Remarks
Pin#	Pin Name	Pin Name	
7	WAKE1	N.A.	Connected to external push button
8	WAKE2	N.A.	Connected to external push button
10	OV2_PD	N.A.	Function 1: Connected to external FET to limit DCDC1 OVP Function 2: Drives an external LED: Active or Standby/Fault
13	PSTBYB	N.A.	Pulled up RAA271084's VCC (LDO0)
14	PWRCTLB	N.A.	Pulled up to RAA271084's VCC (LDO0)
23	COREMON	N.A.	Can be used as external voltage monitor. Input 0.8 V typical by using resister divider.
24	AMUX	ADC (AN10_0)	
25	SSPB	N.A.	Drives an external LED: Active or Standby/Fault
26	WDENB	GPIO (P33_0)	
27	VMONB	VMONOUT	
28	ERRB	ERROROUT_M	
29	RSTB	N.A.	Connected to SLG7RN48401-A (RESET_PMIC pin 14)
30	INTB	GPIO (P22_10)	

Table 3.2 I/O Connections (cont'd)

RAA271084		RH850/U2B	Remarks
Pin#	Pin Name	Pin Name	
31	SPISDO	GPIO (P23_6)	
32	SPISDI	GPIO (P23_5)	
33	SPICLK	GPIO (P23_7)	
34	SPICSB	GPIO (P23_2)	

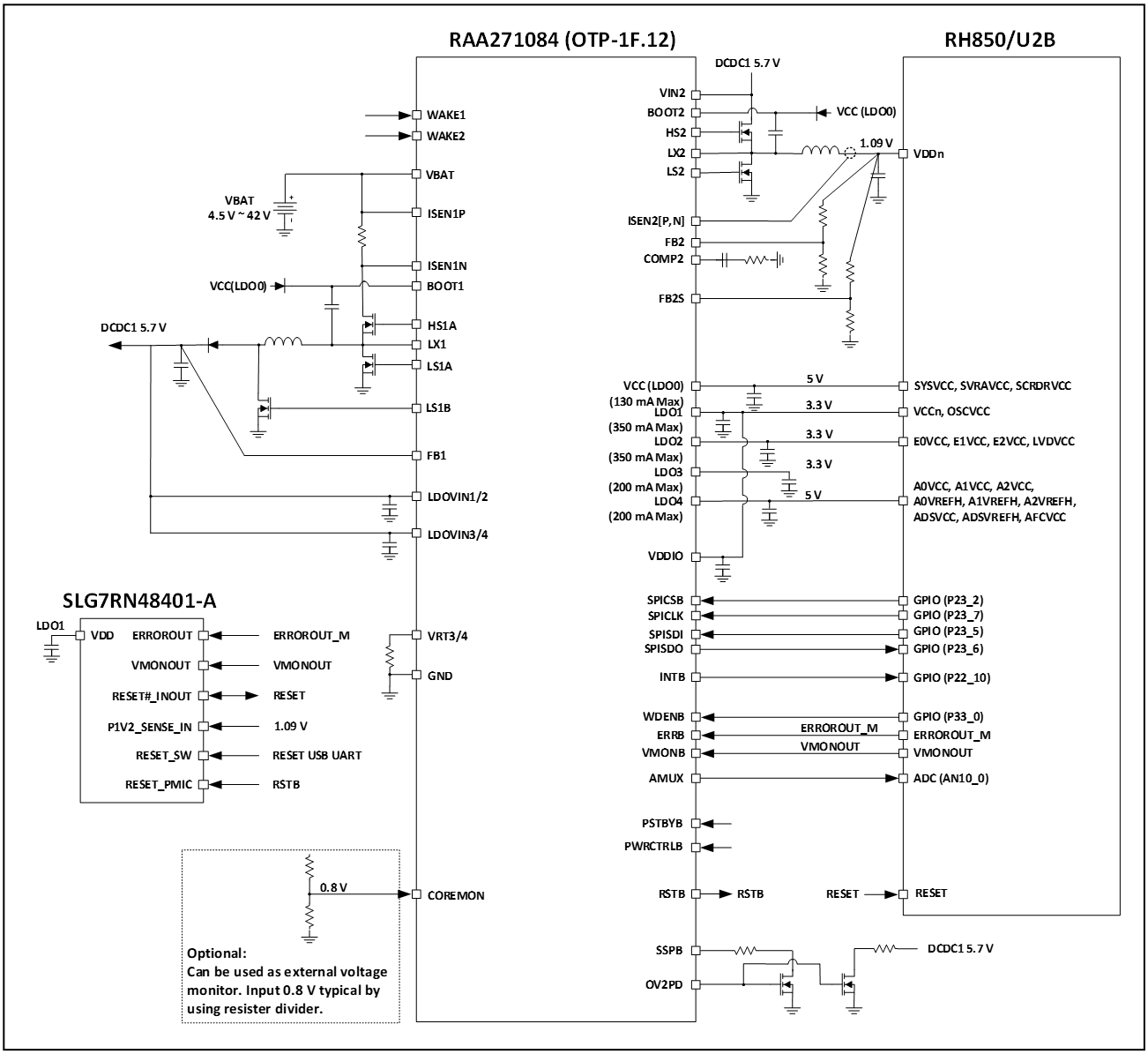


Figure 3.2 RAA271084 – RH850/U2B Application Diagram

The RAA271084 has a customer configuration saved in its embedded one-time programmable (OTP) memory. *Table 3.3* provides the OTP-1F.12 settings to support the RH850/U2B.

Table 3.3 RAA271084 OTP-1F.12 Configuration

Address	Register Name	OTP Value
0x10	OPT_SEQ_CTRL	0x00
0x11	OPT_SLOT_TIME	0x00
0x12	OPT_SLOT_DCDC	0x00
0x13	OPT_SLOT_LDO	0x00
0x14	OPT_HP	0x10
0x15	OPT_DS	0x10
0x16	OPT_TOFF_TIME	0x00
0x30	OPT_ERRB_CTRL	0x00
0x31	OPT_VMONB_CTRL	0x80
0x82	OPT_WDT_CONFIG1	0x00
0x120	OPT_FLT_RESP1	0x00
0x121	OPT_FLT_RESP2	0x00
0x122	OPT_FLT_RESP3	0x00
0x123	OPT_FLT_RESP4	0x00
0x124	OPT_FLT_RESP5	0x00
0x125	OPT_FLT_RESP6	0x00
0x126	OPT_FLT_RESP7	0x00
0x127	OPT_FLT_RESP8	0x00
0x128	OPT_FLT_SHDN1	0x00
0x129	OPT_FLT_SHDN2	0x00
0x140	OPT_INTB_MASK1	0x00
0x141	OPT_INTB_MASK2	0x00
0x142	OPT_INTB_MASK3	0x00
0x143	OPT_INTB_MASK4	0x00
0x148	OPT_SSPB_MASK1	0x00
0x149	OPT_SSPB_MASK2	0x00
0x14A	OPT_SSPB_MASK3	0x00
0x14D	OPT_SSPB_MASK5	0x00
0x150	OPT_VOUT	0x20
0x151	OPT_FB1_THRESH	0x00
0x152	OPT_FB2_THRESH	0x00
0x153	OPT_LDO1_THRESH	0x50
0x154	OPT_LDO2_THRESH	0x50
0x155	OPT_LDO3_THRESH	0x00
0x156	OPT_LDO4_THRESH	0x50
0x157	OPT_COREMON_THRESH	0x00
0x158	OPT_LDO0_THRESH	0x50
0x160	OPT_FAULT_DLY1	0x00
0x161	OPT_FAULT_DLY2	0x00
0x162	OPT_FAULT_DLY3	0x00
0x163	OPT_FAULT_DLY4	0x00

Table 3.3 RAA271084 OTP-1F.12 Configuration (cont'd)

Address	Register Name	OTP Value
0x164	OPT_FAULT_DLY5	0x00
0x200	OPT_DEV_MODE1	0x30
0x201	OPT_DEV_MODE2	0x20
0x202	OPT_DEV_MODE3	0x00
0x203	SEL_DEV_MODE1	0x00
0x204	OPT_WAIT_DISCHG1	0x00
0x205	OPT_WAIT_DISCHG2	0x00
0x206	OPT_PD_CTRL	0x00
0x207	OPT_STATE_CTRL	0x20
0x208	OPT_SS	0x00
0x209	OPT_WDENB_CTRL	0x00
0x20B	OPT_PG_CTRL	0x00
0x20E	OPT_VDDIO	0x01
0x3C1	OTP ID1	0x1F
0x3D0	OTP ID2	0x12

3.2 Buck Regulators

The starter kit has 2 voltage regulator circuits to generate the supply voltages for the onboard peripheral circuits. Each of these circuits uses a Renesas ISL85410 buck regulator.

The first one generates 5.0 V from the 12V board supply, the second one uses this 5.0 V and generates 3.3 V of it.

Figure 3.3 shows the circuit diagram of these buck regulators.

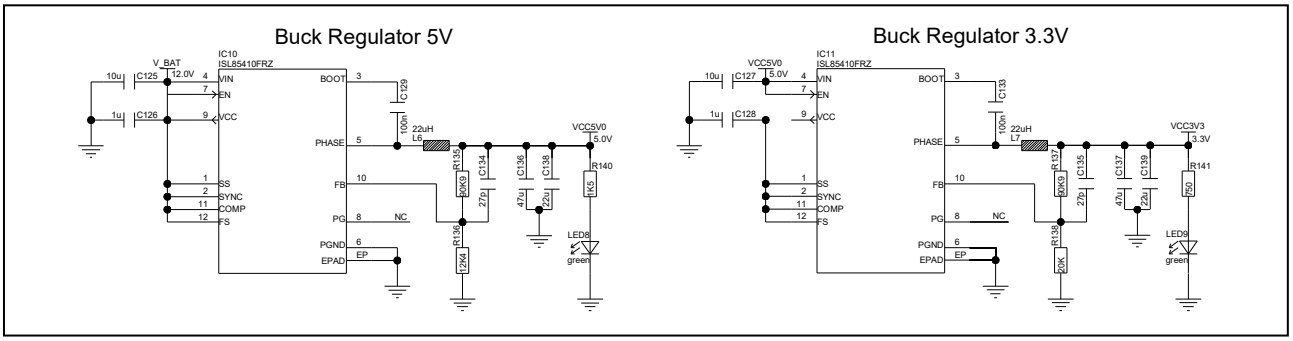


Figure 3.3 Power supply circuit for the peripherals on the starter kit board

3.3 Power Supply Test Connector

The starter kit has a possibility to easily measure all voltage levels that are available on the starter kit board.

All voltages are connected to the footprint of connector CN3.

On board version D019567_06_V0200 connector CN3 is assembled.

On board version D019567_06_V0300 connector CN3 is not assembled.

Figure 3.4 shows which voltage can be found on each pin on CN3.

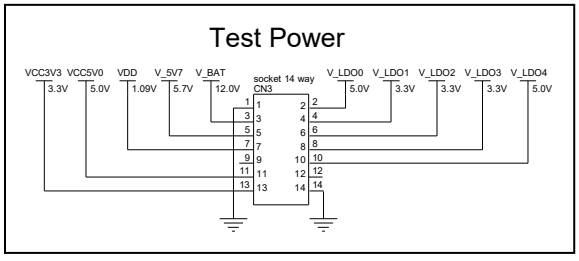


Figure 3.4 Monitor voltage levels

3.4 Power Supply LEDs

The green LEDs LED1 – LED9 indicate the availability of various voltages on the starter kit board:

- LED1 for 5.0 V LVDO0 output
- LED2 for 12.0 V power supply V_BAT
- LED3 for 5.7 V LDO input voltage V_5V7
- LED4 for 3.3 V LVDO1 output
- LED5 for 3.3 V LVDO2 output
- LED6 for 3.3 V LVDO3 output
- LED7 for 5.0 V LVDO4 output
- LED8 for 5.0 V power rail VCC5V0
- LED9 for 3.3 V power rail VCC3V3

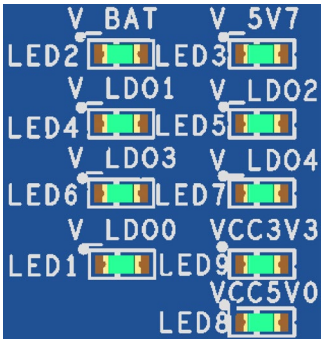


Figure 3.5 Power supply LEDs on the starter kit board

4. Clock Supply

The board has a soldered oscillator of 20MHz that can be used for device clock generation.

The RH850/U2B starter kit does not provide a possibility to input an external clock signal to the starter kit. The starter kit has 2 test points TP16 and TP17. These can, sufficient technical skills provided, be used to input an external clock signal to RH850/U2B.

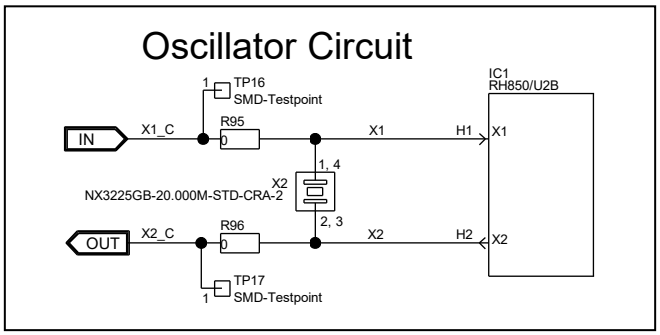


Figure 4.1 Oscillator circuit

5. Debug and Flash Programming Interfaces

For debugging and flash programming purposes debug or flash programming tools can be connected to connector CN7.

Figure 5.1 shows the circuit diagram of connector CN7.

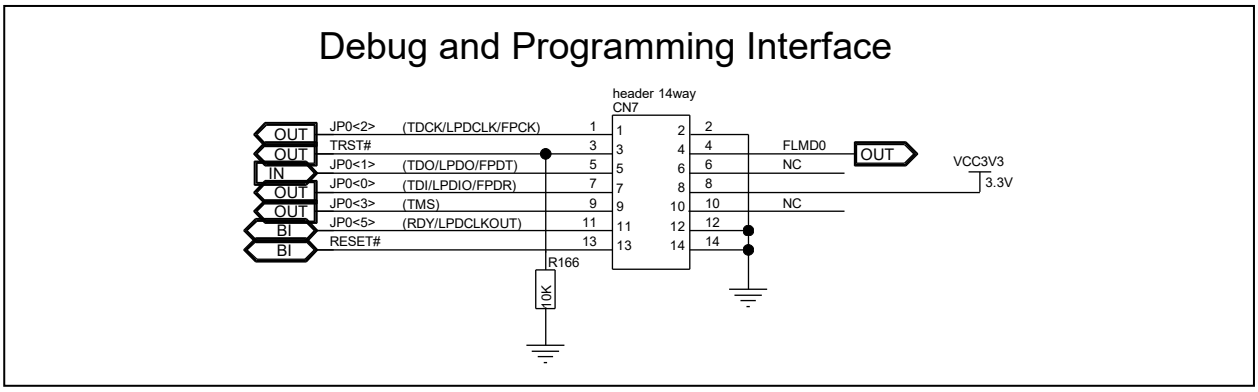


Figure 5.1 Debug and flash programming interface

The Renesas standard emulator for RH850/U2B is the E2 emulator. This can be used as emulator for debugging or as flash programmer.

To connect the E2 emulator to CN7 it is necessary to use the target connector included with the E2. To use the target connector for RH850 devices make sure switch SW1 on the is set to position [1-2].

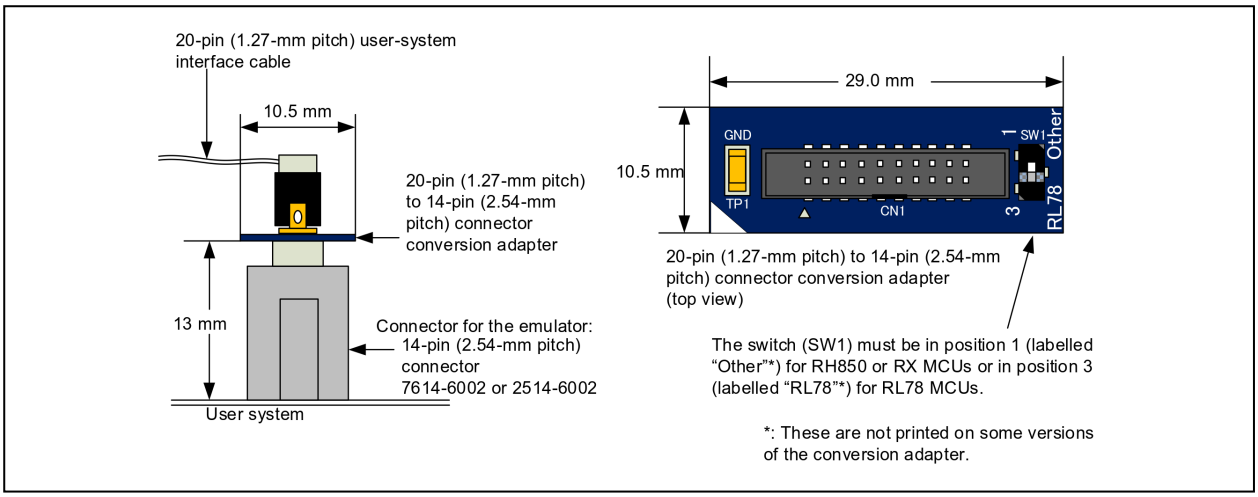


Figure 5.2 E2 target connector

6. Board Configuration

6.1 General Description

The RH850/U2B starter kit uses a design without any jumper for board configuration. The starter kit configuration is implemented using an RL78/F13 device (IC15, R5F10BGGLNA).

The configuration of the starter kit is done in a PC based configuration software.

The configurator software for Windows PC and the firmware for the RL78 on the starter kit can be downloaded from the starter kit homepage (Y-ASK-RH850U2B).

Configuration data is downloaded to RL78/F13 via virtual COM port using USB-C interface on connector CN6. Refer to chapter *7.10 UART Interfaces* for details on the UART interface.

RL78 then utilizes a synchronous interface on ports P10 – P12, P30 and P31 to download the configuration to a series of shift registers, whose output ports are used to configure the peripheral circuits on the starter kit. *Figure 6.1* and *Figure 6.2* show the circuit diagram for RL78 in different starter kit versions.

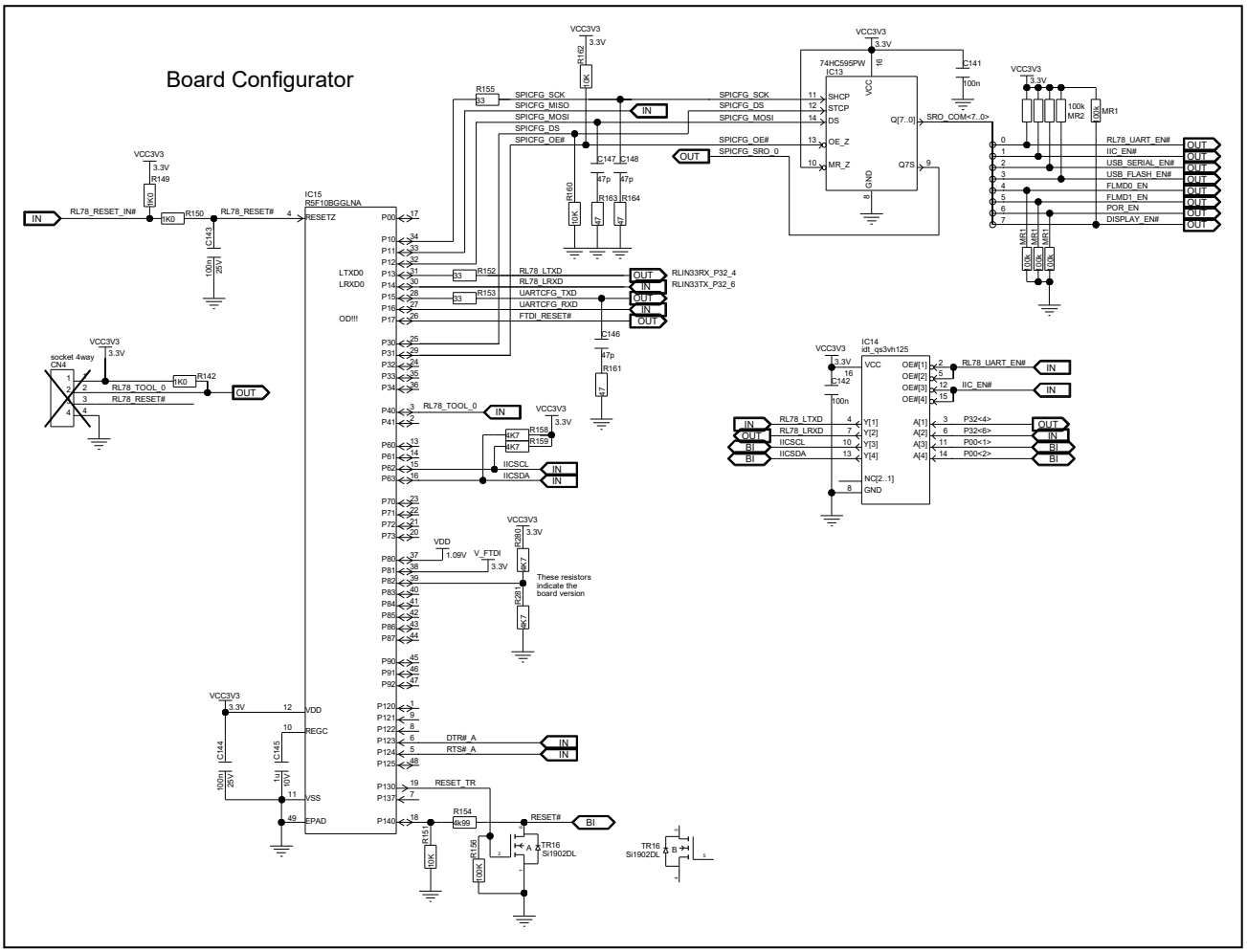


Figure 6.1 Board configurator circuit on board version D019567_04_V0200

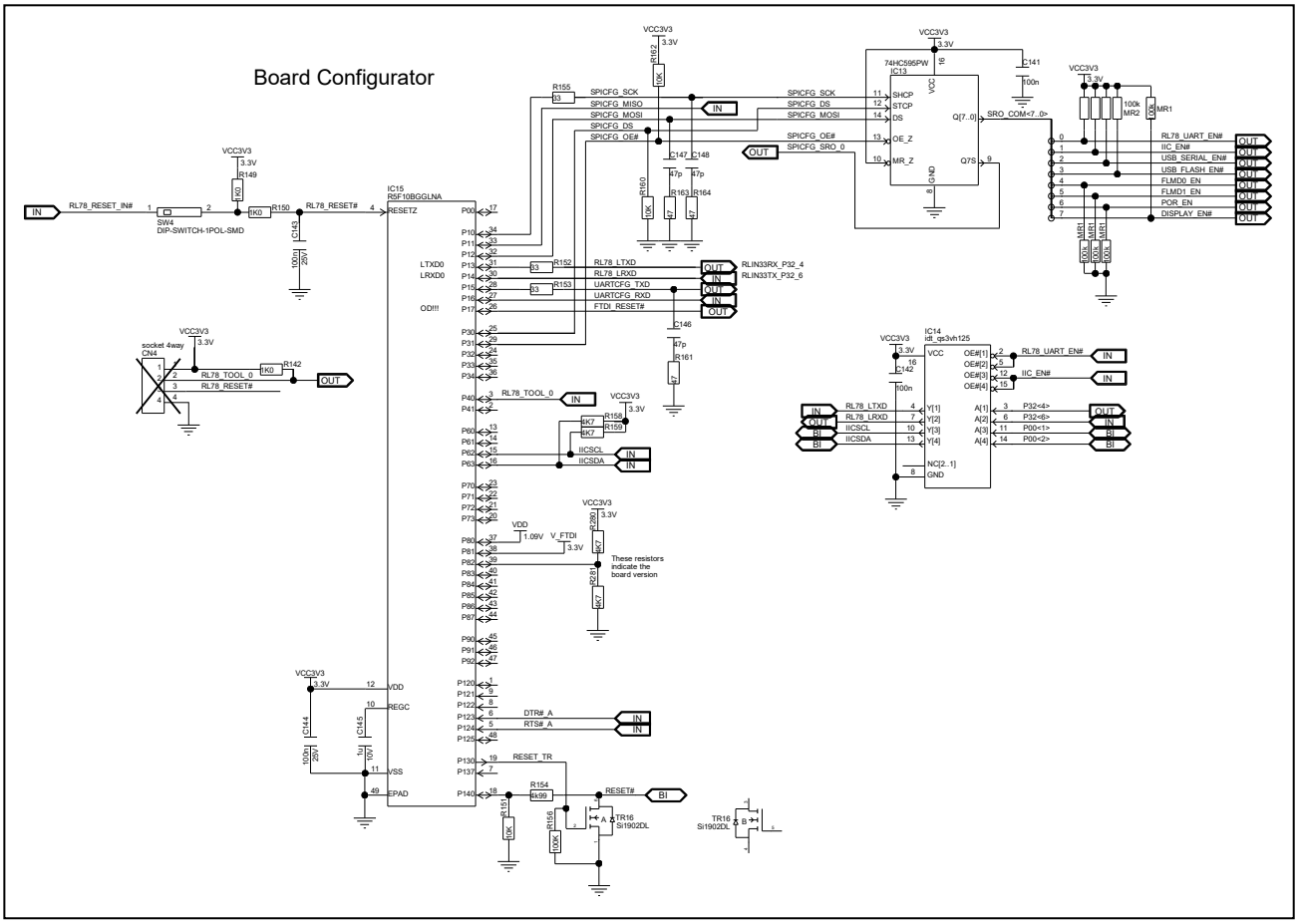


Figure 6.2 Board configurator circuit on board version D019567_04_V0300

6.2 Starter Kit Configurator Software

The starter kit is provided with a Microsoft-Windows based configuration software. This allows the activation and configuration of all onboard peripherals as well as some settings for the external modules like CAN, Ethernet and displays.

6.2.1 Starter Kit Connection

Connect a USB cable from the USB-C connector to an USB port of your Windows PC.

When the board is connected the PC should recognize two virtual COM ports and initialize those automatically.

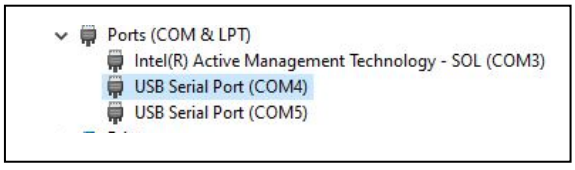


Figure 6.3 Starter kit COM ports

If you have your starter kit connected to your PC it may be that the serial ports have not been initialized. In this case, please check the windows device manager if the COM ports have been correctly initialized as shown below. Sometimes this initialization takes a little while.

When you start the ASK configurator software it will automatically look for these ports and use one of them to connect to the board. If the configurator does not find a starter kit, it will show the error message in *Figure 6.4*.

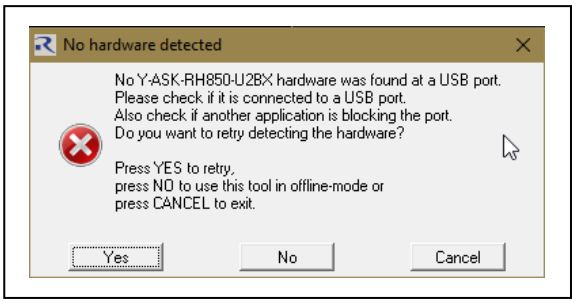


Figure 6.4 Error: No starter kit found

6.2.2 General Operation

When the main board configurator starts properly it shows such a start screen.

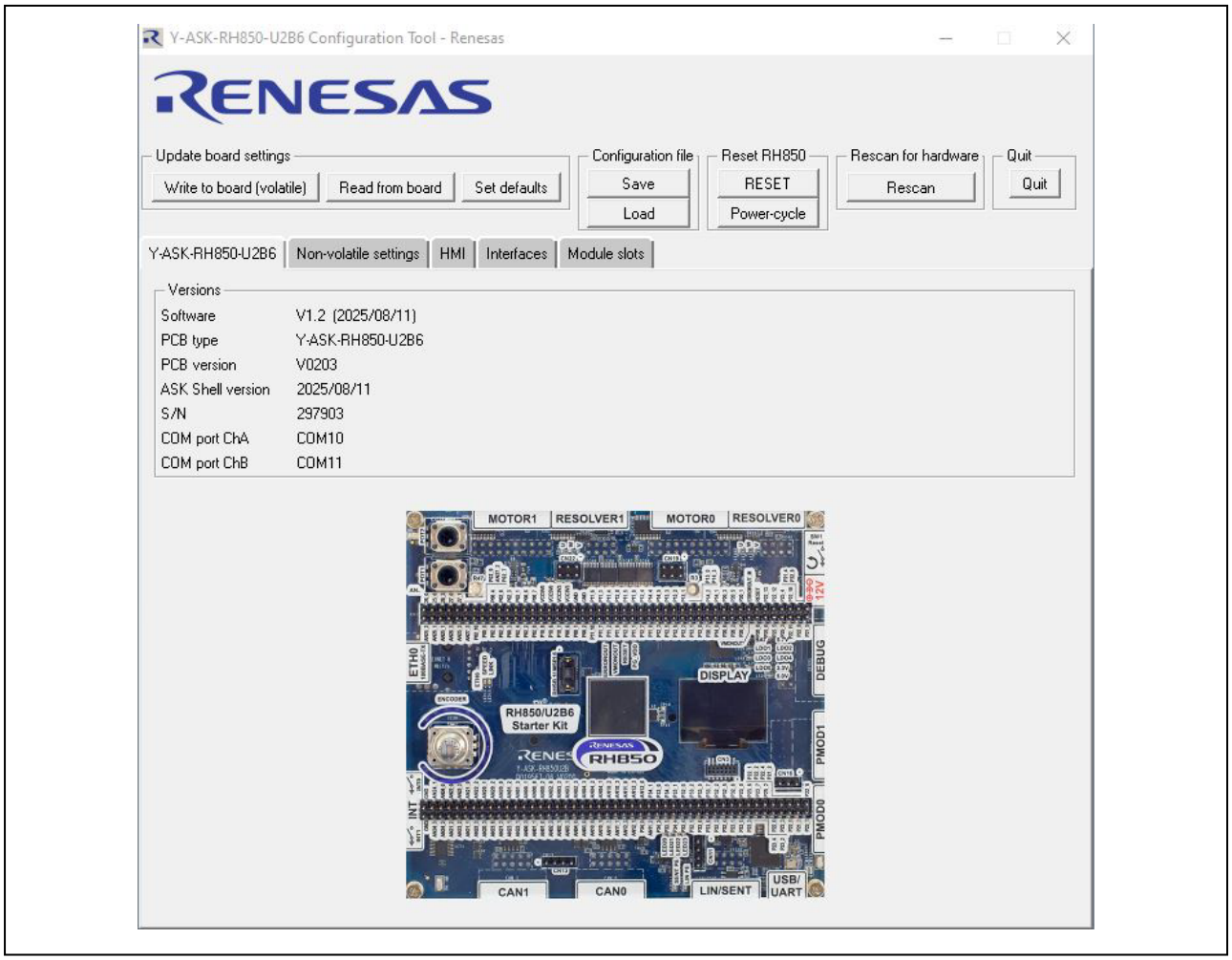


Figure 6.5 Start screen of board configurator GUI

The start screen shows various information.

- The version number for the board configurator GUI.
- The name and the version of the PCB.
- The release date for the board configurator software (ASK shell) running on RL78.
- The board serial number
- Information about the 2 COM ports provided on the USB-C interface.
    - COM port ChA is an interface to RH850/U2B
    - COM port ChB is an interface to RL78

The buttons in the upper part are for general board operation.

- Group “Update board settings”
  Button “Write to board (volatile)” – This writes the current configuration to the connected starter kit board.
  Button “Read from board” – This reads the current settings from the connected starter kit board and shows the settings in the configurator.
  Button “Set to defaults” – This sets the peripherals to a pre-defined value. All peripherals will be switched off.
- Group “Configuration file”
  The GUI supports the function to save the configuration to an external file or to load the configuration from an external file. This makes it easy to distribute configurations between colleagues.

- Group “Reset RH850”
  The GUI provides 2 buttons to reset the starter kit.
  The “RESET” button perfoms a warm start of the starter kit by only applying a RESET to the RH850/U2B processor.
  The “Powercycle” button performs a cold start of RH850/U2B. It controls the power management IC RAA271084 to switch RH850/U2B power supply off and on again.
- Group “Rescan for hardware”
  The “Rescan” button allows to search for a starter kit, that is connected to the PC if an earlier start of the GUI did not find the starter kit and the software has been started without a starter kit board connection.
- “Quit” exits the board configurator.

Below the buttons is a line of tabs for board control:

- “Y-ASK-RH850-U2B“
  This gives a short summary of the main board including software versions and hardware information on the connected starter kit board.
- “Non-volatile settings”
  This allows to have multiple configurations stored on the starter kit and to define which of these configurations should be used
- “HMI”
  The main board offers several means for user interaction, for example potentiometers, various LED, switches as interrupt inputs, the rotary encoder and the display for OLED display.
- “Interfaces”
  This tab is used to enable and configure communication interfaces included in the starter kit board. These include for example Ethernet, LIN, CAN, SENT, UART and Ethernet interfaces.
- “Module slots”
  In addition to the built-in interfaces the main board also includes some connectors providing additional functions like PMOD interfaces, high-speed interfaces RHSB1 and MSPI6, and connectors for motor control boards.

6.2.3 Starter Kit Configurator Firmware Programming

The starter kit provides 3 possibilities to reprogram the firmware in the RL78 board configuration controller.

- Using the automatic update function in the board configurator utility.
- Using the Flash Development Toolkit (FDT) via the USB-C connection.
- Using an external programmer (like E2 Lite or E2) via the CN4 connector.

Figure 6.6 and *Figure 6.7* show the circuit diagram for RL78 reprogramming.

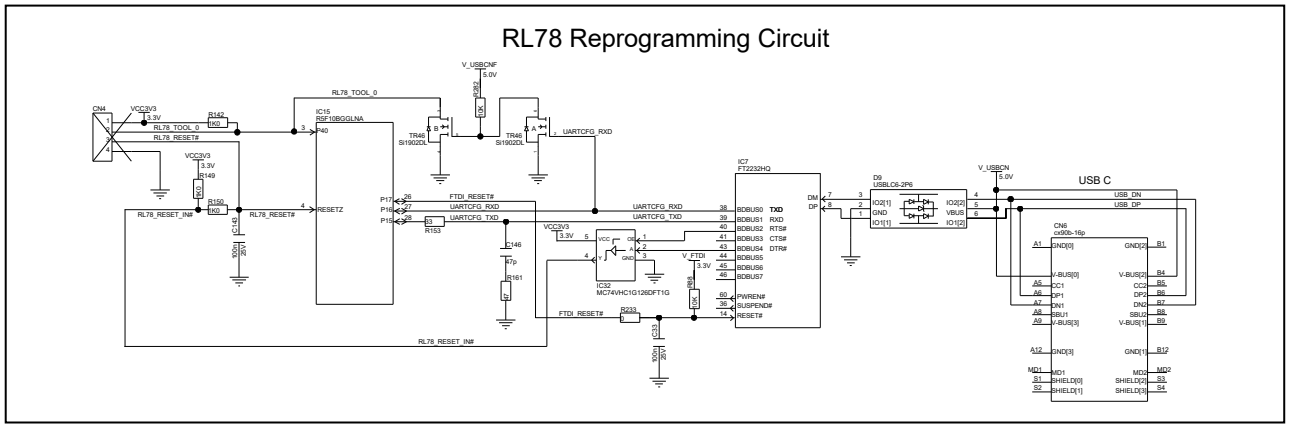


Figure 6.6 RL78 reprogramming circuit on board version D019567_04_V0200

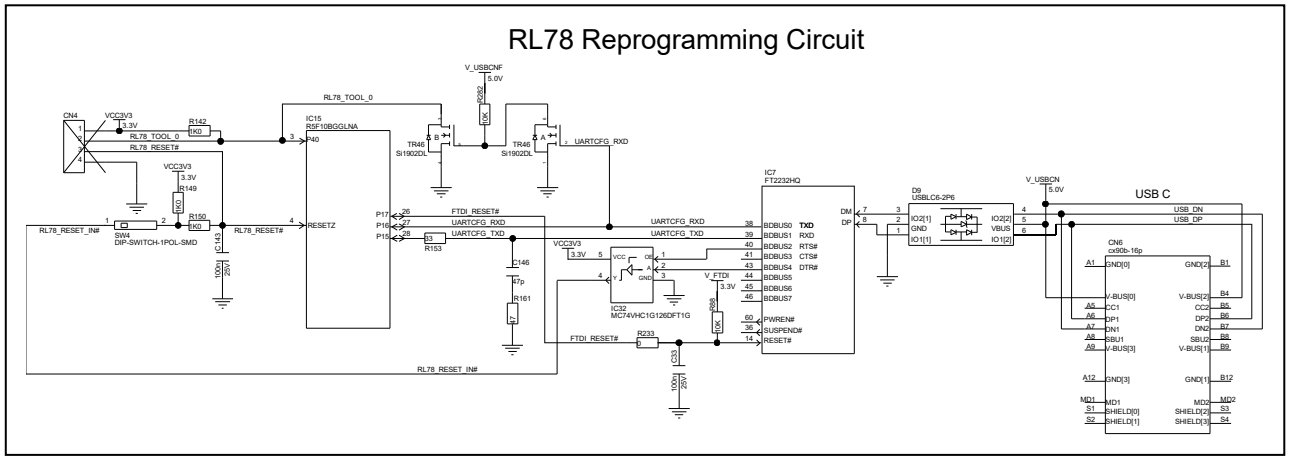


Figure 6.7 RL78 reprogramming circuit on board version D019567_04_V0300

6.2.3.1 Reprogramming RL78 with the Board Configurator

The easiest way to reprogram the board configurator RL78 is to use the firmware update function in the board configurator utility. When the configurator is started it will check the firmware version of the board configurator RL78. If it finds that the RL78 software has to be updated, it will show a corresponding dialog and ask whether the software should be updated.

Figure 6.8 shows this message.

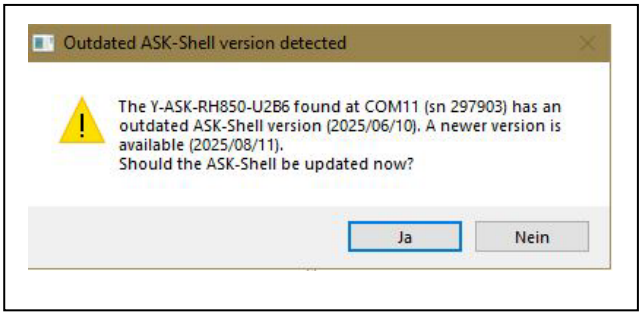


Figure 6.8 Configurator software update request

6.2.3.2 Reprogramming RL78 using RFP via USB-C Connection

Another simple way to reprogram the board configurator RL78 is to use the Renesas Flash Programmer software (RFP) via the USB-C interface. The USB controller on the starter kit registers the FTDI chip with 2 virtual COM ports on the connected PC. One of these can be used by the RFP software to program RL78.

There is a small difference between board revision D019567_04_V0200 and board revision D019567_04_V0300 (refer to *Figure 6.6* and *Figure 6.7*).

On board revision D019567_04_V0200 the RESET input on RL78 is directly connected to RESET signal generated by the FTDI USB interface. This means that the FTDI chip can always reset the board configurator and the RL78 firmware has to handle possible unwanted RESET signals.

On board revision D019567_04_V0300 the RESET signal from the FTDI chip can be interrupted by DIP switch SW4. Thus, it is possible to control that the FTDI RESET signal is only connected to RL78 if the processor has to be programmed.

6.2.3.3 Reprogramming RL78 using an External Programmer via CN4 Connector

RL78 can be programmed using a single wire UART interface. The 4-pin connector CN4 provides all necessary signals to connect an external programmer.

The standard interface of Renesas programming tools, like E2 Lite or E2, uses a 14 pin 2.54mm pitch connector.

It is possible to prepare a small adapter to connect a programmer to the starter kit and reprogram RL78.

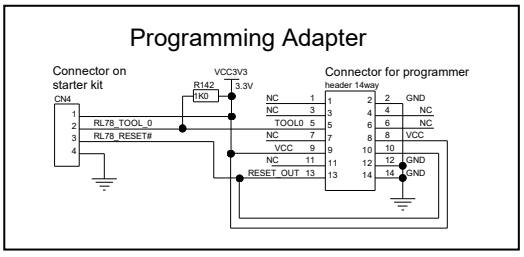


Figure 6.9 Adapter to reprogram RL78

Figure 6.9 shows the circuit diagram for such an adapter. The pull-up resistor R142 is already part of the starter kit. So, no components have to be added.

Table 6.1 lists all pins of the programmer connector and gives the reference to which pin on the starter kit this is connected.

Table 6.1 Connections on the adapter to connect a Renesas programmer to the starter kit

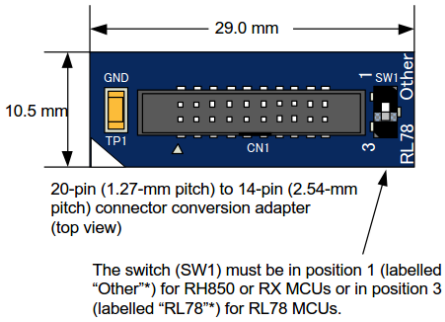
Programmer		Starter Kit		Programmer		Starter Kit	
Pin		Pin		Pin		Pin	
1	NC	---	---	2	GND	4	GND
3	NC	---	---	4	NC	---	---
5	TOOL0	2	RL78_TOOL_0	6	NC	---	---
7	NC	---	---	8	VCC	1	VCC3V3
9	VCC	1	VCC3V3	10	RESET_OUT	3	RL78_RESET#
11	NC	---	---	12	GND	4	GND
13	RESET_OUT	3	RL78_RESET#	14	GND	4	GND

If the programmer is an E2 emulator it is necessary to use an additional adapter to connect the 20 pin 1.27mm pitch cable of E2 to the 14 pin 2.54mm pitch connector.

Note

The E2 emulator is connected to the adapter using the conversion adapter RTE0T00020KCA00000R. For programming RL78, switch SW1 on the conversion adapter must be set to position 3.

Otherwise, RFP cannot connect to RL78.



To reprogram the RL78 firmware on the starter kit follow this procedure:

1. Connect emulator E1, E2 or E2 Lite to connector CN4.
2. Start RFP software.
3. Create a new project for RL78 in RFP. The exact processor type is determined automatically when RFP connects to the target device on operation start.
4. There are 3 possibilities to provide the power supply to RL78:
   - From the USB connection of connector CN6 to the PC.
   - From the board power supply on connector CN2.
   - From the emulator. In this case power supply must be switched on in the "Connect settings" in the RFP software.
5. Add the firmware file as "Program File" in RFP.
6. Push the "Start" button to execute the programming operation as defined in "Operation Settings".

7. Peripheral Circuits

7.1 RESET Circuit

The starter kit uses a GreenPAK IC SLG7RN48401-A for RESET signal control and status signal display. There are several means to trigger a RESET signal output to RH850.

The push button SW1 and the RESET signal from the power management IC are input to the GreenPAK IC and trigger a RESET signal output to RH850/U2B.

A RESET signal from an emulator connected to CN7 and a RESET signal from the board configurator RL78 can also trigger a RESET to RH850/U2B.

The lighted red LED11 indicates that a RESET signal is output to RH850/U2B.

Figure 7.1 shows the circuit diagram for the GreenPAK IC and the RESET signal input.

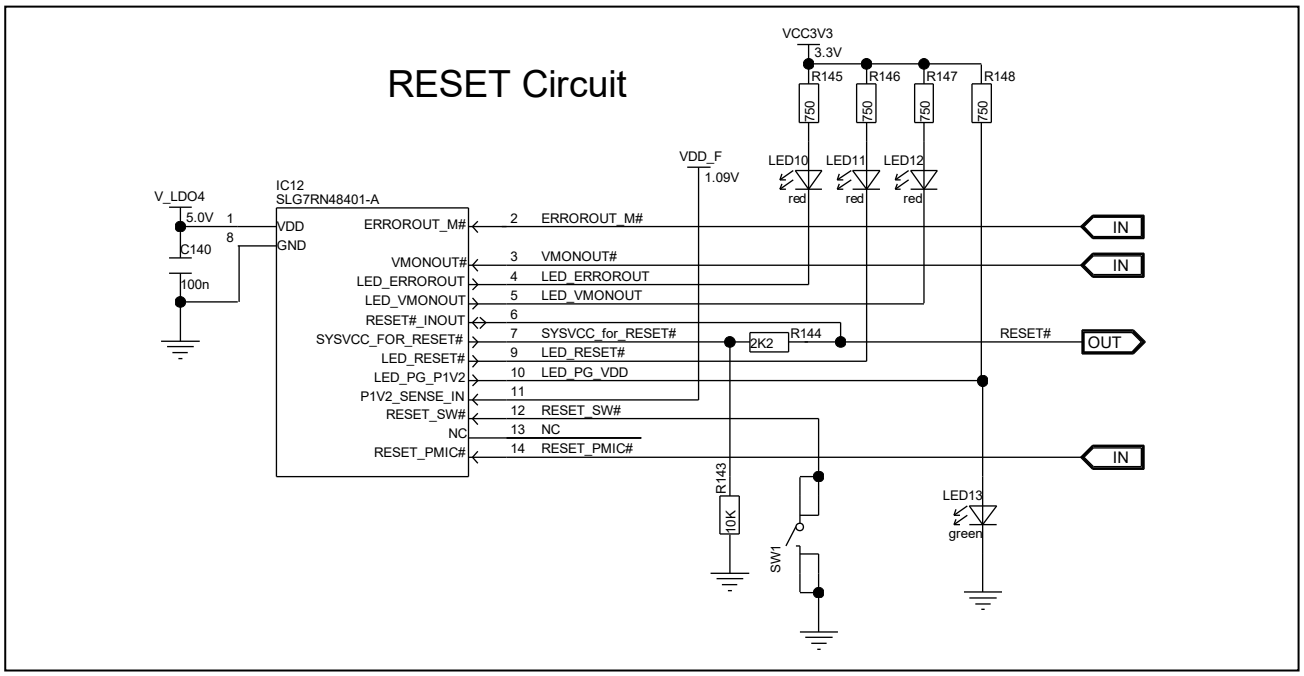


Figure 7.1 Reset circuit

The GreenPAK IC also controls output LEDs for several status signals:

- LED10 - ERROROUT_M#
- LED11 - RESET
- LED12 - VMONOUT#
- LED13 - Core voltage VDD_F

7.2 External Interrupt Signal

The RH850/U2B starter kit has 2 switches, that can be used as external interrupt inputs to RH850/U2B.

The interrupt inputs are enabled in the board configuration utility in the “HMI” settings.

SW2 generates the EX_INT0 signal. This is connected to RH850 port P10_6 / IRQ4.

SW3 generates the EX_INT1 signal. This is connected to RH850 port P14_0 / IRQ13.

Figure 7.3 shows the circuit diagram for the interrupt switches.

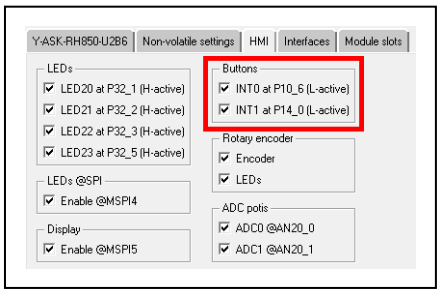


Figure 7.2 Interrupt input enable

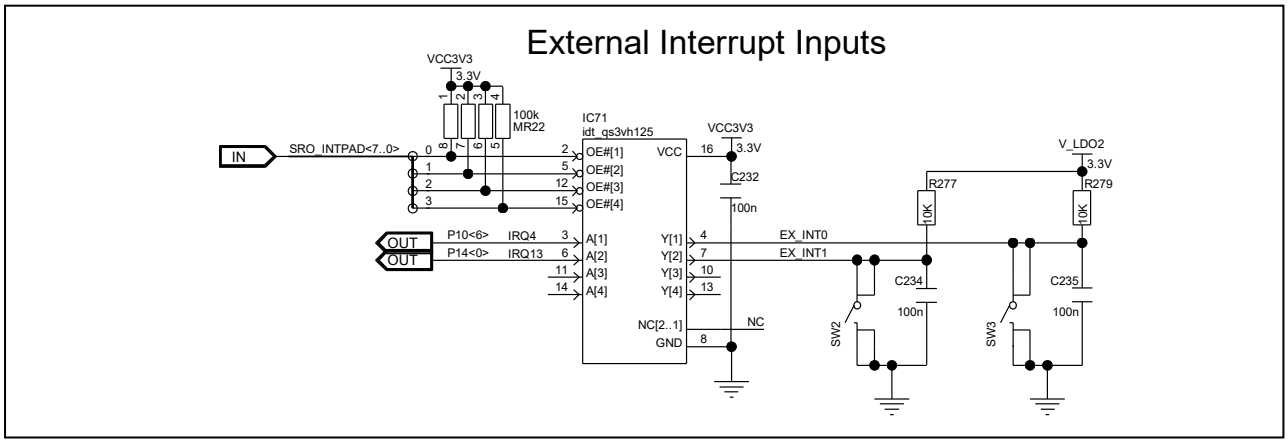


Figure 7.3 External interrupt signals

7.3 Analog Signal Input

The starter kit includes two potentiometer POTI1 and POTI2, that allow analog signal input to ports AN20_0 (POTI1) and AN20_1 (POTI2).

The analog signal inputs are enabled in the board configuration utility in the “HMI” settings.

Figure 7.5 shows the circuit diagram for the potentiometer connection.

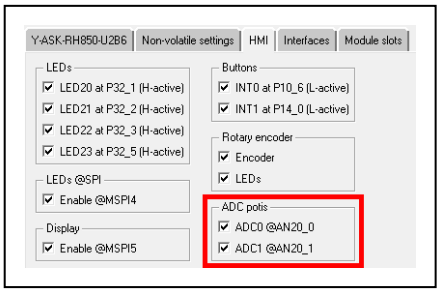


Figure 7.4 Analog input enable

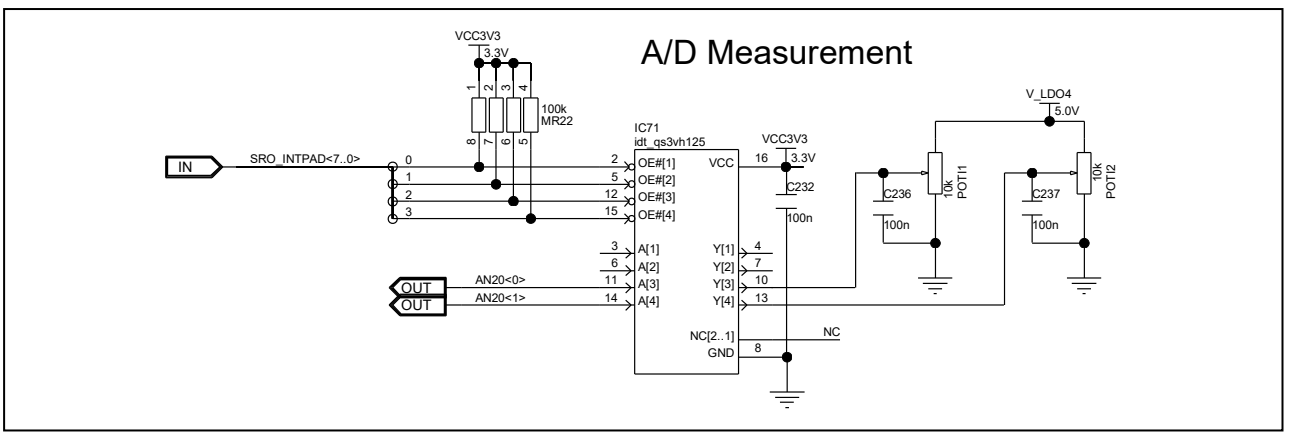


Figure 7.5 Potentiometer connection

7.4 Rotary Encoder

The starter kit incorporates a rotary encoder with illuminated shaft, a built-in push button and 2 quadrature encoder outputs.

The rotary encoder is enabled in the board configuration utility in the “HMI” settings. There is one selection for the illumination of the encoder shaft and another one for the encoders and the push button.

The push button is connected to interrupt input IRQ37 at port P34_2.

The encoder signals are input to the on-chip encoder ENCA1 on ports P34_4 and P32_0.

The illumination of the encoder shaft uses RGB LEDs. These are controlled from ports P02_3 (red), P02_8 (green) and P02_10 (blue).

Figure 7.7 shows the circuit diagram for the rotary encoder.

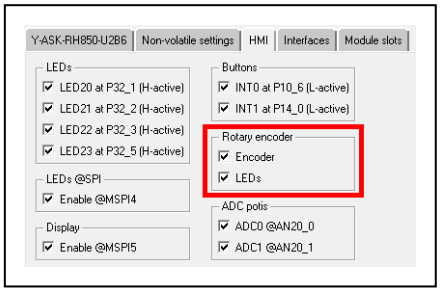


Figure 7.6 Rotary encoder enable

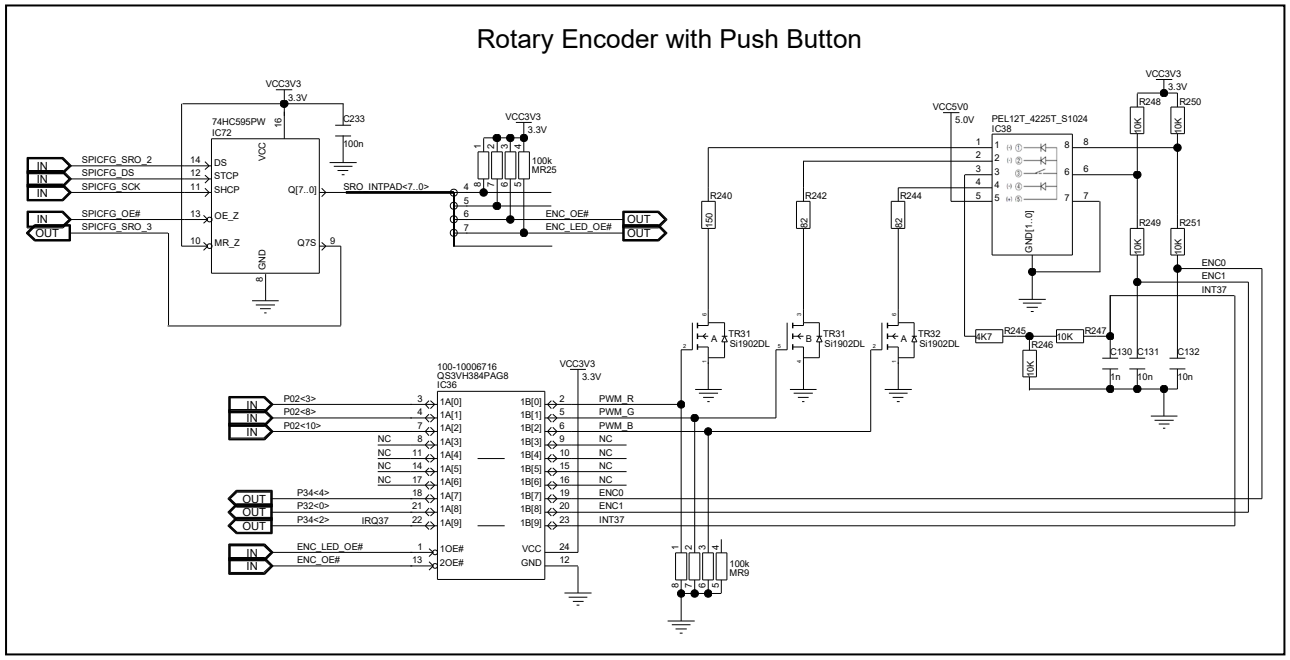


Figure 7.7 Rotary encoder

7.5 LEDs

7.5.1 Circular LEDs

The board provides 16 LEDs arranged in a circle surrounding the rotary encoder.

The signal LEDs are enabled in the board configuration utility in the “HMI” settings.

The processor interface MSPI4 is used as clock synchronous interface to communicate to the 16 channel LED driver in IC9, and ports P22_6 and P22_8 are control signals for the LED driver.

Figure 7.9 shows the circuit diagram for the SPI LED.

Table 7.1 lists the pin functions on RH850/U2B going to the SPI LEDs.

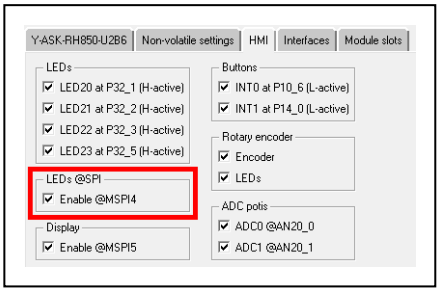


Figure 7.8 Circular LEDs enable

Table 7.1 Connection of SPI LED

RH850/U2B Signal		Signal on SPI LED driver
Port	Function	
P22_1	MSPI4CL	CLK
P22_2	MSPI4SO	SDI
P22_3	MSPI4SI	SDO
P22_5	MSPI4CSS0	Enable data input from SPI LED driver to RH850/U2B
P22_6	P22_6	OE#
P22_8	P22_8	LE

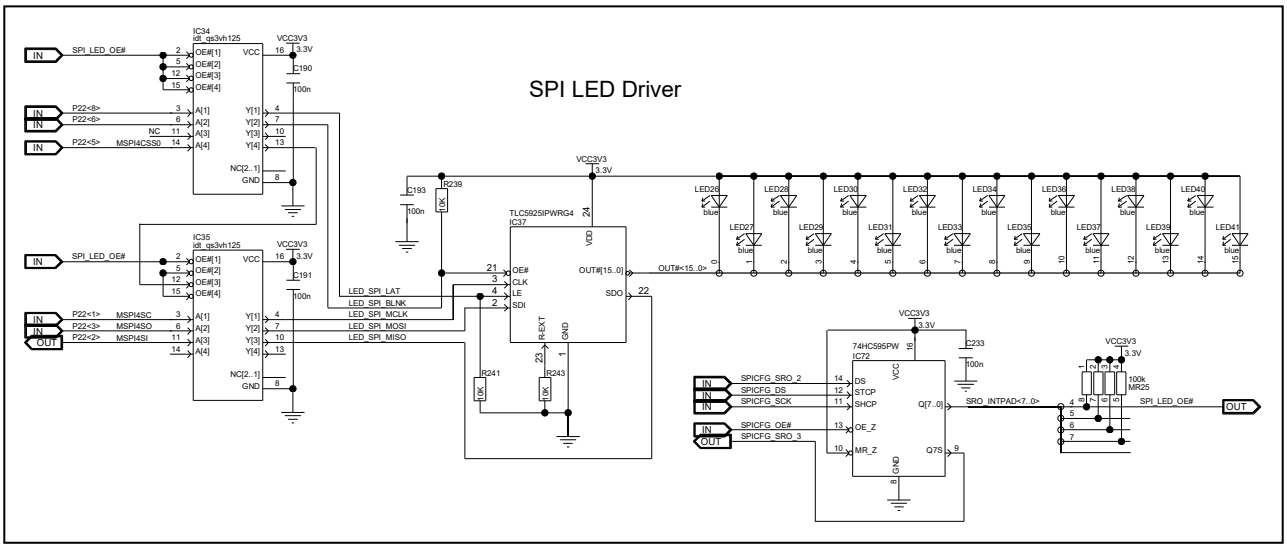


Figure 7.9 Circular LED connection

7.5.2 User Signal LEDs

Four LEDs are provided to allow for status outputs of the application software using RH850/U2B port pins.

The signal LEDs are enabled in the board configuration utility in the “HMI” settings. Each LED can be activated separately.

The RH850/U2B ports P32_1, P32_2, P32_3 and P32_4 are used as LED outputs.

Figure 7.11 shows the circuit diagram for the user LEDs.

Table 7.2 lists the ports of RH850/U2B used for the user LEDs.

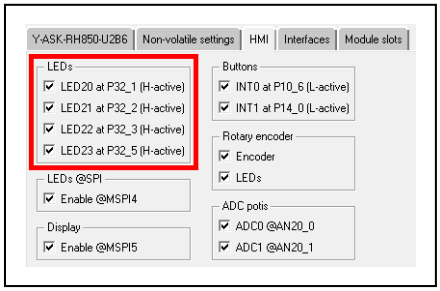


Figure 7.10 User Signal LED configuration

Table 7.2 Connection of signal LED

RH850/U2B Port	Signal LED
P32_1	LED20
P32_2	LED21
P32_3	LED22
P32_4	LED23

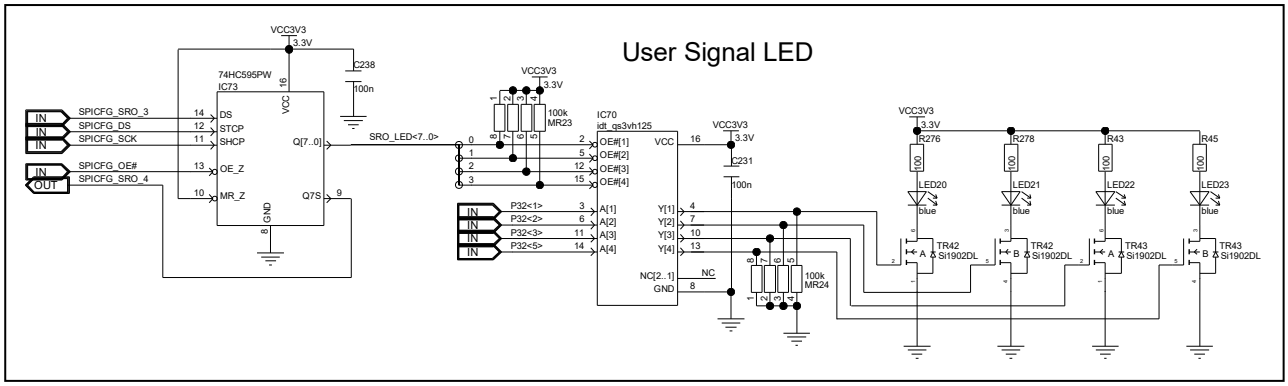


Figure 7.11 User signal LED connection

7.6 OLED Graphic Display

The RH850/U2B starter kit uses a display manufactured by EastRising Technology. The display is ER-OLED0.96-1.3B. It is a 0.96 inch display with a resolution of 128x64 pixel.

The OLED display is enabled in the board configuration utility in the “HMI” settings.

The flexible PCB coming from the display is connected to connector CN8 on the starter kit.

RH850/U2B controls the display via clock synchronuous interface MSPI5.

Figure 7.13 shows the circuit diagram for the OLED display connection.

Table 7.3 lists the pin functions on connector CN8 going to the OLED display.

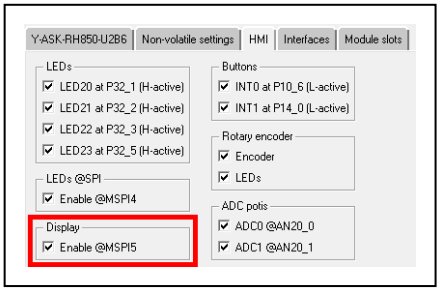


Figure 7.12 OLED display enable

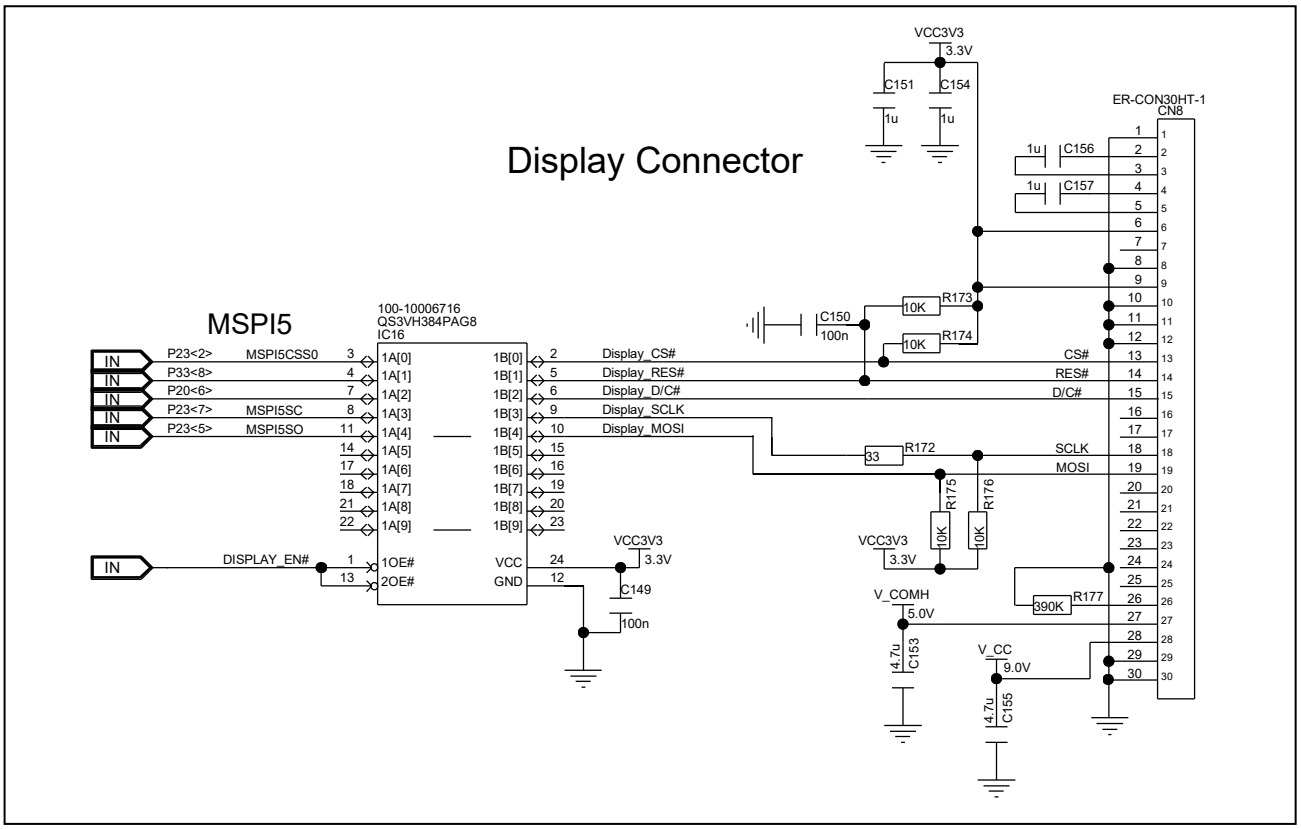


Figure 7.13 OLED display connection

Table 7.3 Display connector for EastRising Technology display

Pin	Function	RH850/U2B Processor Pin		Pin	Function	RH850/U2B Processor Pin
1	NC (GND)	GND		16	R/W#	---
2	C2P	Capacitor for charge pump		17	E/RD#	---
3	C2N			18	D0	10kOhm pull-up to VCC3V3, Port P17_3 (RIIC0SCL)
4	C1P	Capacitor for charge pump		19	D1	10kOhm pull-up to VCC3V3, Port P17_2 (RIIC0SDA)
5	C1N			20	D2	Connect to pin 19
6	VBAT	VCC3V3		21	D3	---
7	NC	---		22	D4	---
8	VSS	GND		23	D5	---
9	VDD	VCC3V3		24	D6	---
10	BS0	GND		25	D7	GND
11	BS1	10kOhm pull-up to VCC3V3		26	IREF	390kOhm pull-down
12	BS2	GND		27	VCOMH	V_COMH (5.0V)
13	CS#	10kOhm pull-up to VCC3V3, Port P2_15		28	VCC	V_CC (9.0V)
14	RES#	Reset circuit with 10kOhm pull-up to VCC3V3 and 1µF capacitor, Port P2_14		29	VLSS	GND
15	D/C#	10kOhm pull-up to VCC3V3		30	NC (GND)	GND

7.7 CAN Interfaces

The starter kit provides 2 CAN interfaces. They can be enabled in the board configuration utility in the “Interfaces” settings.

The board configurator also provides the possibility to activate bus termination on the CAN output ports and to connect pin 3 of each CAN output to GND.

It is also possible to activate a loop back function between the 2 CAN outputs.

Figure 7.15 shows the circuit diagram for the CAN interfaces.

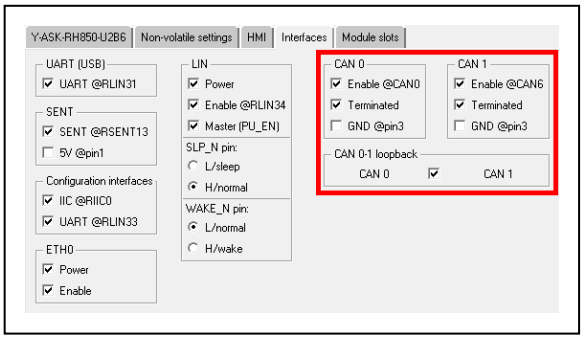


Figure 7.14 CAN configuration

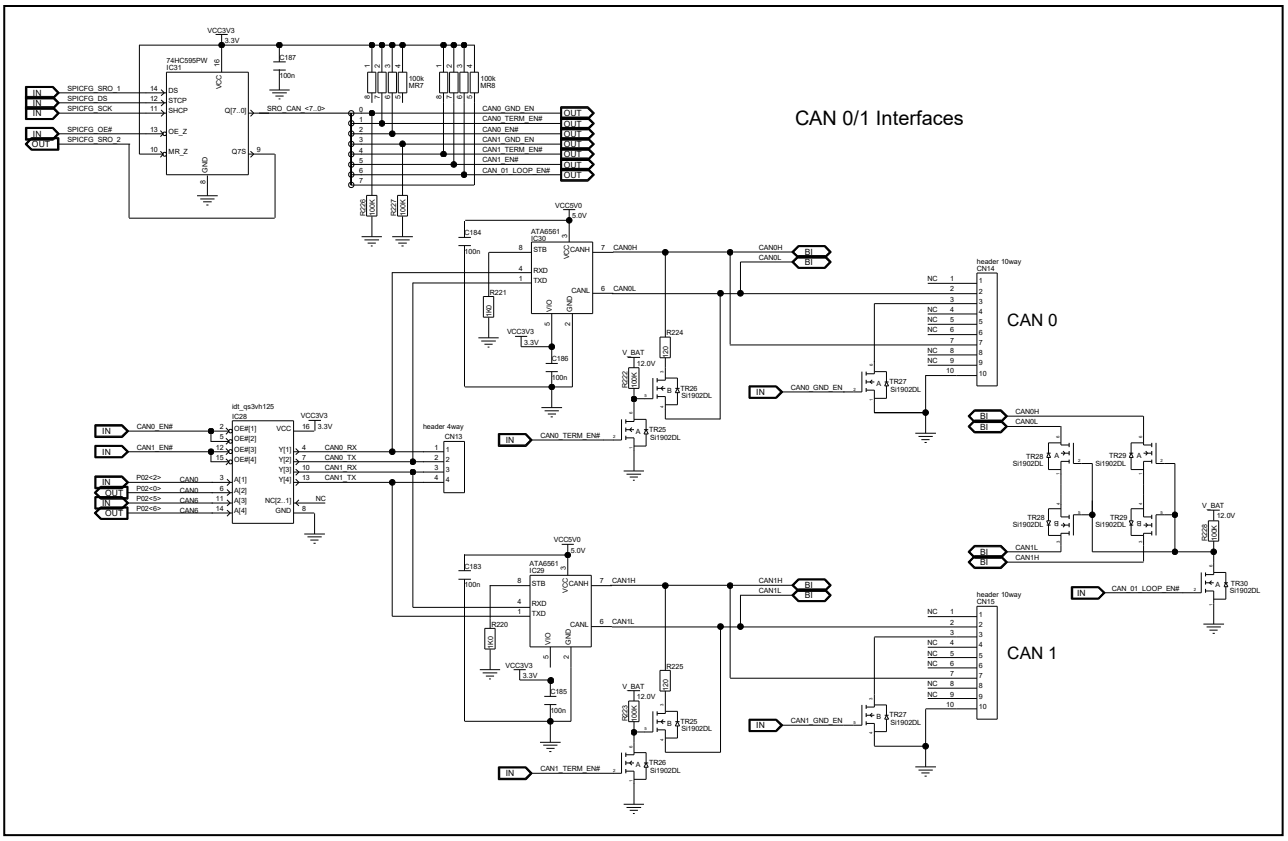


Figure 7.15 CAN interfaces

On the starter kit the CAN interfaces use the connectors CN14 and CN15 for signal output.

The CAN signals can also be measured between RH850/U2B and the CAN transceiver on connector CN13.

Table 7.4 shows which RH850/U2B ports are used for the CAN interfaces.

Table 7.5 shows which RH850/U2B ports are used for the CAN interfaces.

Table 7.6 shows the pin configuration of the CAN output ports CN14 and CN15.

Table 7.4 RH850 ports being used for CAN interfaces

CAN0		CAN1	
RH850 Port	**RH850 Function**	**RH850 Port**	**RH850 Function**
P02_0	CAN0RX	P02_5	CAN1RX
P02_2	CAN0TX	P02_6	CAN1RTX

Table 7.5 CAN measurement points

Pin	Function	Pin	Function
CN13_1	CAN0RX	CN13_3	CAN1RX
CN13_2	CAN0TX	CN13_4	CAN1RTX

Table 7.6 CAN output ports

CAN0: Connector CN14		CAN1: Connector CN15	
Pin	**Function**	**Pin**	**Function**
1	NC	1	NC
2	CAN0L	2	CAN1L
3	GND (CAN0 GND enabled)	3	GND (CAN1 GND enabled)
4	NC	4	NC
5	NC	5	NC
6	NC	6	NC
7	CAN0H	7	CAN1H
8	NC	8	NC
9	NC	9	NC
10	GND	10	GND

Refer also to *10.13 CAN Monitor Connector CN13*, *10.14 CAN0 Connector CN14* and *10.15 CAN1 Connector CN15* for details on the connectors.

7.8 LIN and SENT Interfaces

The starter kit includes a LIN Master interface and a SENT interface. The signals of both interfaces are output on connector CN12.

For details on connector CN12 please refer to *10.11 LIN and SENT Monitor* Connector CN1.

Figure 7.16 shows the circuit diagram of the LIN and SENT interface.

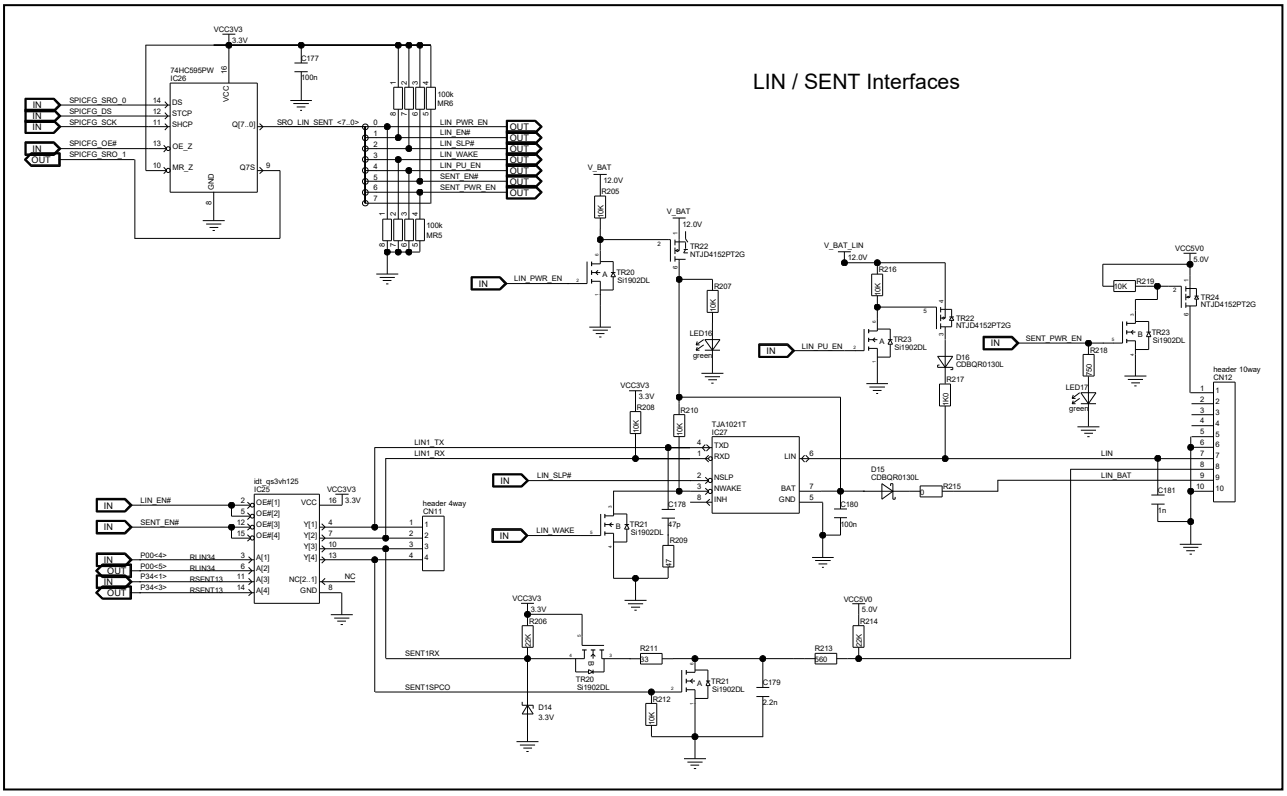


Figure 7.16 LIN and SENT interface

The connector CN12 is used for LIN and SENT output signals.

Table 7.7 LIN and SENT connector CN12

Pin	Function	Condition
1	VCC5V0	SENT power enabled in board configurator.
2	NC	
3	NC	
4	NC	
5	GND	
6	GND	
7	LIN1	LIN enabled in board configurator. Pull-up can also be enabled in board configurator.
8	SENT1	SENT enabled in board configurator.
9	LIN1_BAT	LIN Power enabled in board configurator.
10	GND	

7.8.1 LIN Interface

The LIN interface is enabled in the board configuration utility in the “Interfaces” settings.

The board configurator also provides several possibilities to configure the LIN interface.

- Power
  Enable the power supply to the LIN transceiver TJA1021.
- Enable @RLIN34
  On the RH850/U2B side the interface RLIN34 is used on the pins P00_4 (RLIN34TX) and P00_5 (RLIN34RX) for the LIN interface. The connection is activated with this setting.
- Master (PU_EN)
  This enables a pull-up on the LIN data line for a LIN Master interface.

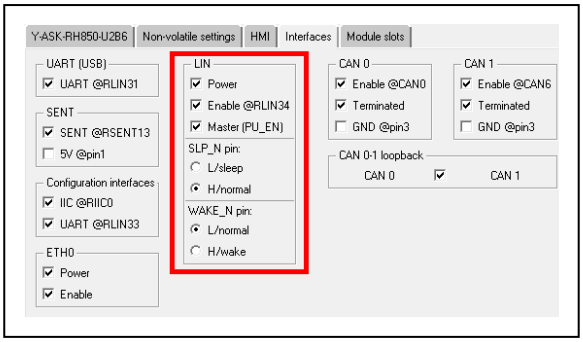


Figure 7.17 LIN / SLP_N / WAKE_N configuration

Table 7.8 LIN measurement points

Connector	Function
CN11-1	LIN1_TX (RLIN34TX)
CN11-2	LIN1_RX (RLIN34RX)

The board configurator also includes settings to define the settings for the pins SLP_N and WAKE_N on the NXP transceiver IC.

On connector CN11 it is possible to monitor the LIN signals between the processor RH850/U2B and the LIN transceiver.

7.8.2 SENT Interface

The SENT interface is enabled in the board configuration utility in the “Interfaces” settings.

RH850/U2B uses the internal module RSENT13 on ports P34_1 (RSENT13RX) and P34_3 (RSENT13SPCO) for the interface.

The board configurator has also a possibility to output the SENT power supply signal on pin 1 of connector CN12.

On connector CN11 it is possible to monitor the SENT signals between the processor RH850/U2B and the SENT output.

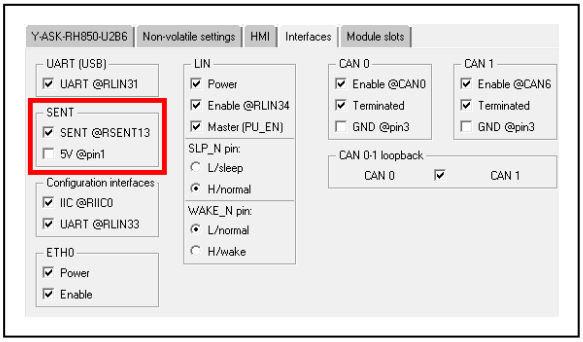


Figure 7.18 SENT configuration

Table 7.9 SENT measurement points

Switch	Function
CN11-3	SENT1RX (RSENT13RX)
CN11-4	SENT1SPCO (RSENT13SPCO)

7.9 Connection Cable for CAN and LIN Interfaces

The starter kit includes 3 connection cables from 10-pin DIL to 9-pin D-SUB, that can be used for CAN and LIN connections to external hardware.

The DIL connector can be plugged-in to the connectors CN10 and CN11 for CAN interfaces or CN12 for LIN interface.

Table 7.10 shows the connection between the 10-pin connector and the 9-pin D- SUB connector, and the functions when the cable is connected to the CAN or LIN ports.

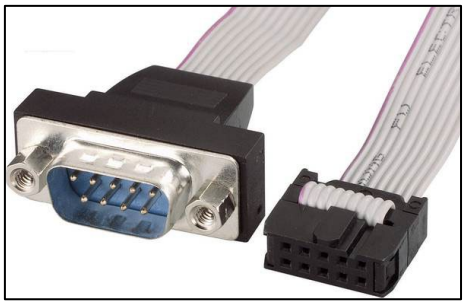


Figure 7.19 CAN / LIN cable

Table 7.10 Connection between 10-pin connector and 9-pin D-SUB connector

Pin number on DIL connector	Pin number on D-SUB connector	Function		
		When connected to CN10 (CAN0)	When connected to CN11 CAN1)	When connected to CN12 (LIN)
1	1	–	–	VCC5V0 (when SW6-1 is ON)
2	2	CANL	CANL	NC
3	3	GND (when SW7-2 is ON)	GND (when SW8-2 is ON)	GND (when SW6-3 is ON)
4	4	–	–	NC
5	5	–	–	GND
6	6	–	–	GND (SW6-6 ON)
7	7	CANH	CANH	LIN1 (SW6-2 ON)
8	8	–	–	SENT (SW6-7 ON)
9	9	–	–	LIN1_BAT (when SW8-4 is ON)
10	–			

7.10 UART Interfaces

The starter kit includes USB-C interface (connector CN6) with a dual channel USB to UART IC FTDI FT2232HQ.

One channel can be connected to RH850/U2B on ports P02_1 (RLIN31TX) and P02_4 (RLIN31RX). It is enabled in the board configurator “Interfaces” settings.

The second channel is used for software updates on the starter kit configurator IC RL78/F13. Refer to *6.2.3.2 Reprogramming RL78 using RFP via USB-C Connection*.

The starter kit has 4 LEDs to show bus activity on the two UART channels.

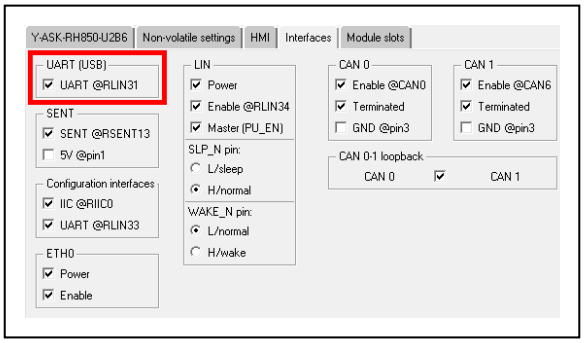


Figure 7.20 UART configuration

- LED18 and LED19 show activity on the UART interface connected to RH850/U2B.
- LED24 and LED25 show activity on the RL78/F13 reprogramming interface.

On connector CN16 it is possible to measure the UART signals between RH850/U2B and the FTDI transceiver.

Figure 7.21 shows the circuit diagram for the UART interfaces.

Table 7.11 shows the UART measurement pins on connector CN16.

Table 7.12 shows the pin configuration on the USB-C connector CN6.

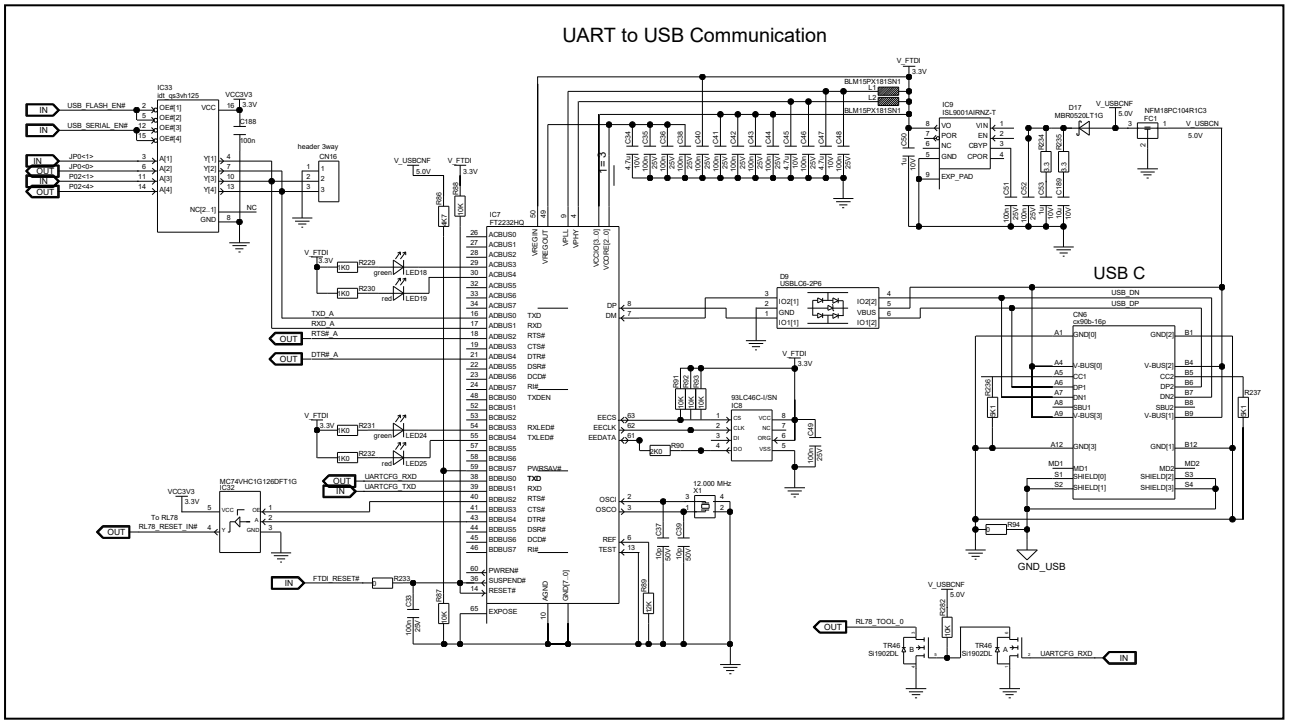


Figure 7.21 UART interface

Table 7.11 UART signal on connector CN16

Pin	Function
1	GND
2	Data signal from RH850/U2B (port P02_1) to FTDI FT2232 (ADBUS0)
3	Data signal from FTDI FT2232 (ADBUS1) to RH850/U2B (port P02_4)

Table 7.12 USB-C connector CN6

Pin	Function	Signal Name
A1	GND	
A2	–	–
A3	–	–
A4	V-BUS	V_USBCN
A5	CC1	Pull-down GND
A6	DP1	USB_DP
A7	DN1	USB_DP
A8	SBU1	–
A9	VBUS	V_USBCN
A10	–	–
A11	–	–
A12	GND	

Pin	Function	Signal Name
B12	GND	
B11	–	–
B10	–	–
B9	V-BUS	V_USBCN
B8	SBU2	–
B7	DP2	USB_DP
B6	DN2	USB_DP
B5	CC2	–
B4	VBUS	V_USBCN
B3	–	–
B2	–	–
B1	GND	

7.11 Ethernet Interface

The starter kit for RH850/U2B offers one Ethernet interface. This is a fast Ethernet interface compatible with 10BASE-T / 100BASE-TX.

The 10BASE-T/100BASE-TX Ethernet interface outputs its signals to a RJ45 connector (CN10).

The circuit diagram shows the Ethernet circuit.

The 10BASE-T/100BASE-TX interface can be enabled in the board configurator.

On the processor side the Ethernet interface is connected to the ETND0 unit on ports P11 and P25.

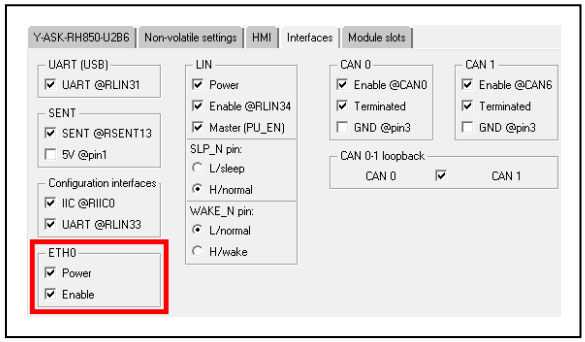


Figure 7.22 Ethernet enable

Figure 7.23 shows the circuit diagram for the Ethernet interface.

Table 7.13 shows the pin configuration on the Ethernet connector CN10.

Table 7.13 Connector CN10 for 10BASE-T/100BASE-TX Ethernet

Pin	Name	Signal	Pin	Name	Signal
1	TDPLUS	TXP	2	TDMINUS	TXN
3	RDPLUS	RXP	4	CT_TD	
5	CT_RD		6	RDMINUS	RXN
7	NC		8	GND	
9	GR_AN	Green LED, anode	10	GR_KA	Green LED, Cathode
11	YE_AN	Yellow LED, anode	12	YE_KA	Yellow LED, cathode
13	GND		14	GND	

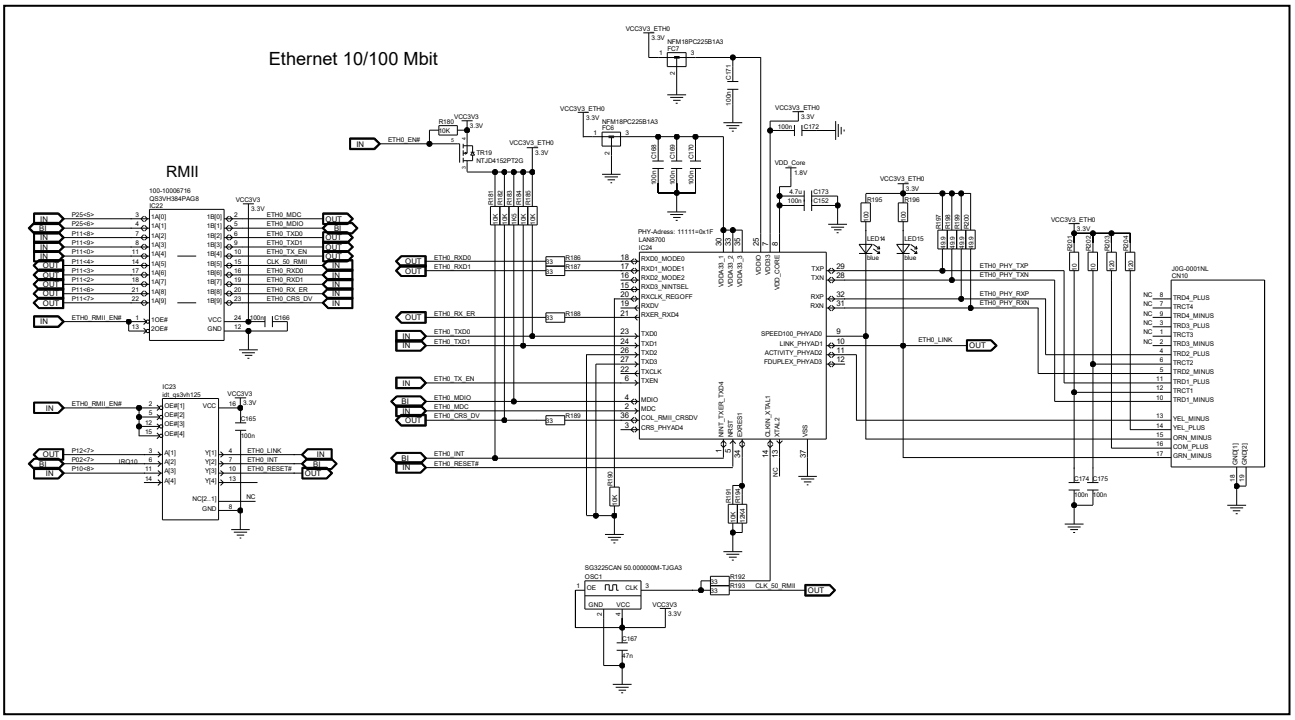


Figure 7.23 10BASE-T/100BASE-TX Ethernet interface

7.12 Configuration Interfaces

The starter kit for RH850/U2B includes 2 serial interfaces that allow RH850/U2B to communicate to the RL78 board configuration controller. One interface uses IIC protocol, the other supports UART protocol.

These connections are intended to give RH850 the possibility to directly modify the configuration of the starter kit.

The IIC interface uses on RH850 side the RIIC0 interface on ports P00_1 and P00_2.

The UART interface uses on RH850 side the RLIN33 interface on ports P32_4 and P32_6.

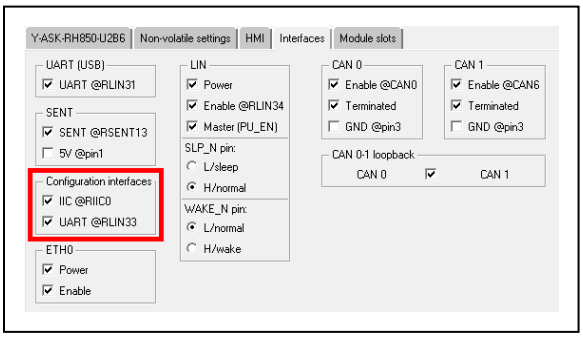


Figure 7.24 Configuration interfaces enable

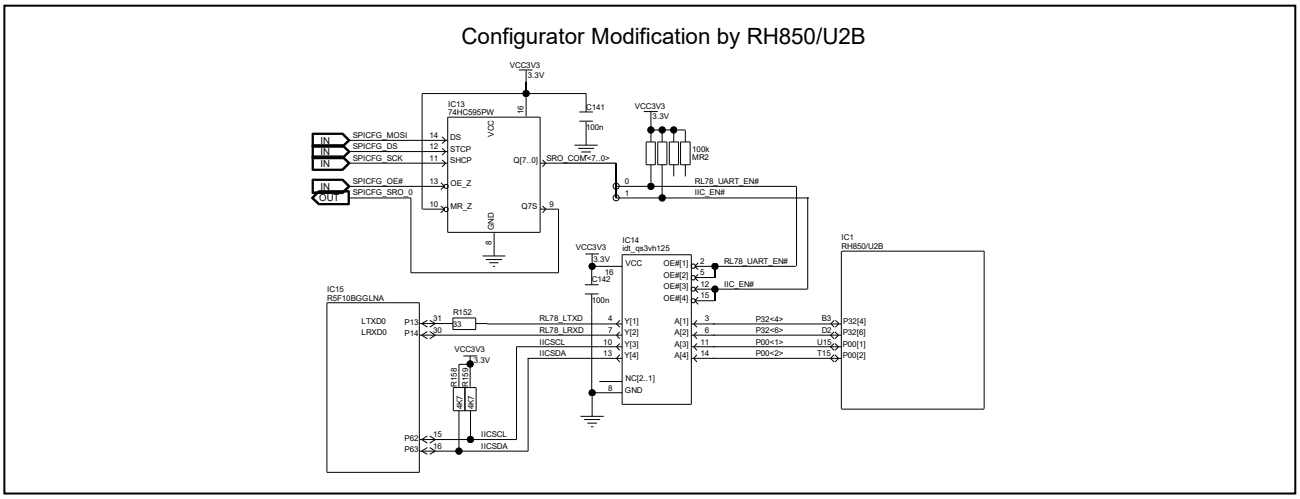


Figure 7.25 Connection of RH850/U2B to RL78/F13

7.13 PMOD Interfaces

The starter kit for RH850/U2B includes 2 PMOD interfaces. They support the PMOD modes 1A, 2A, 3A, and 6A.

The starter kit configurator can select which functions the PMOD interfaces support.

Figure 7.27 shows the circuit diagram for board version D019567_04_V0200.

Figure 7.28 shows the circuit diagram for board version D019567_04_V0300.

Table 7.14 and *Table 7.15* show the pin configurations on the PMOD connectors and which RH850 functions are being used.

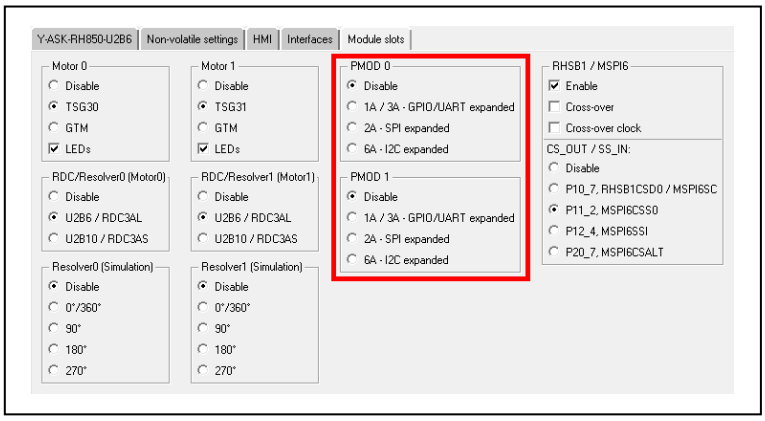


Figure 7.26 RHSB1 / MSPI6 enable

There are differences in the ports being used on the different board versions. The differences between the board versions are also shown in *Table 7.14* and *Table 7.15*.

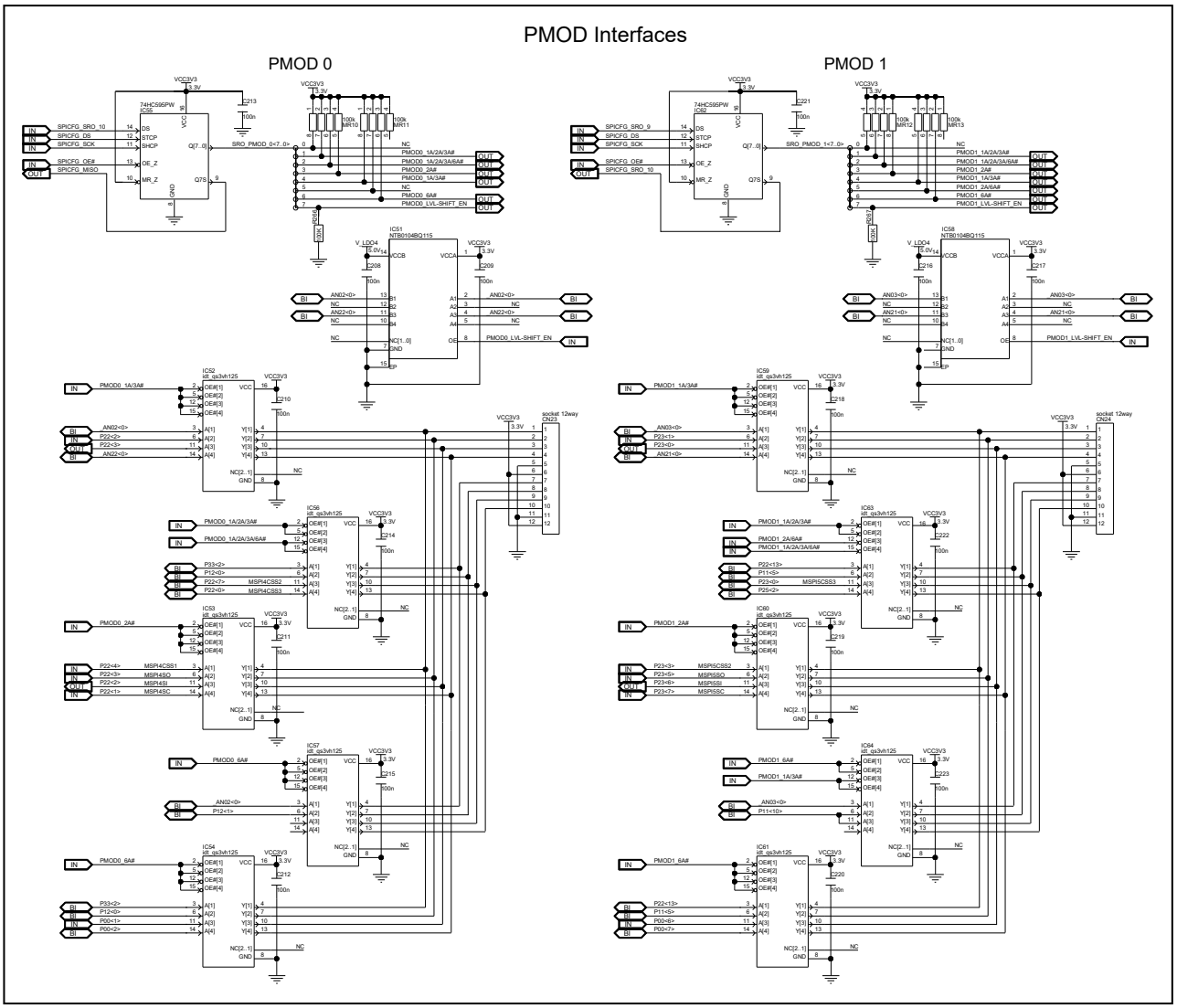


Figure 7.27 PMOD circuit diagram on board version D019567_04_V0200

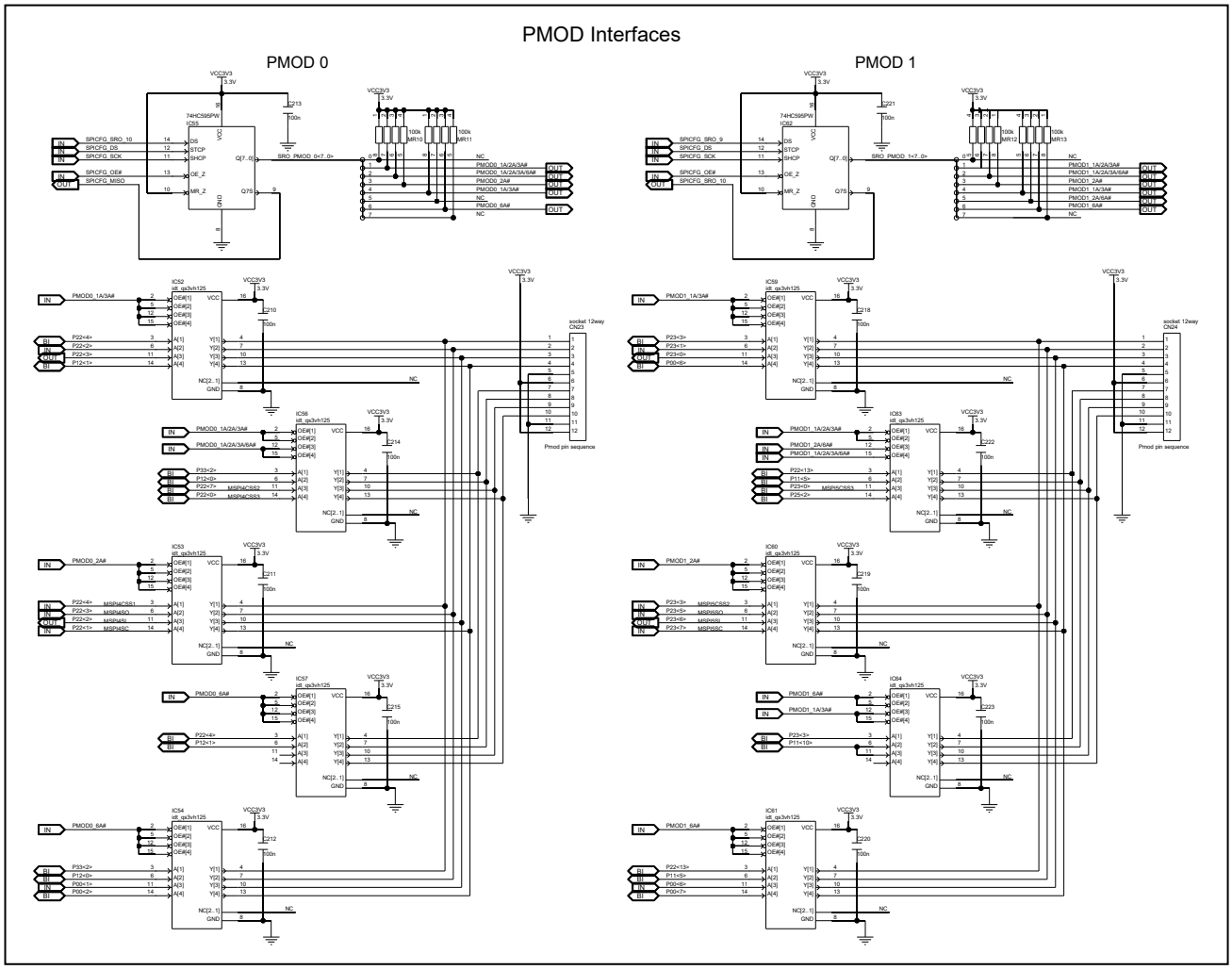


Figure 7.28 PMOD circuit diagram on board version D019567_04_V0300

Table 7.14 PMOD0 pin configuration

Pin	Expanded GPIO (type 1A)		Expanded SPI (type 2A)		Expanded UART (type 3A)		Expanded I2C (type 6A)	
	PMOD signal	RH850 signal	PMOD signal	RH850 signal	PMOD signal	RH850 signal	PMOD signal	RH850 signal
1	GPIO	AN02_0 (P40_2) *1 P22_4 *2	CS	MSPI4CSS1 (P22_4)	CTS (GPIO)	AN02_0 (P40_2) *1 P22_4 *2	NC	P33_2
2	GPIO (PWM)	P22_2 (TOM1_10)	MOSI	MSPI4SO (P22_3)	TXD	RLIN32TX (P22_2)	NC	P12_0
3	GPIO	P22_3	MISO	MSPI4SI (P22_2)	RXD	RLIN32RX (P22_3)	SCL	RIIC0SCL (P00_1)
4	GPIO	AN22_0 (P40_4) *1 P12_1 *2	SCK	MSPI4SC (P22_1)	RTS	AN22_0 (P40_4) *1 P12_1 *2	SDA	RIIC0SDA (P00_2)
5	GND	GND	GND	GND	GND	GND	GND	GND
6	VCC	VCC3V3	VCC	VCC3V3	VCC	VCC3V3	VCC	VCC3V3
7	GPIO	P33_2	GPIO (INT)	P33_2	GPIO (INT)	P33_2 (IRQ8)	GPIO	AN02_0 (P40_2) *1 P22_4 *2

Pin	Expanded GPIO (type 1A)		Expanded SPI (type 2A)		Expanded UART (type 3A)		Expanded I2C (type 6A)	
	PMOD signal	RH850 signal	PMOD signal	RH850 signal	PMOD signal	RH850 signal	PMOD signal	RH850 signal
8	GPIO (PWM)	P12_0 (TOM1_4)	GPIO (RESET)	P12_0	GPIO (RESET)	P12_0	GPIO	P12_1
9	GPIO	P22_7	GPIO (CS2)	P22_7 (MSPI4CSS2)	GPIO	P22_7	GPIO	P22_7
10	GPIO	P22_0	GPIO (CS3)	P22_0 (MSPI4CSS3)	GPIO	P22_0	GPIO	P22_0
11	GND	GND	GND	GND	GND	GND	GND	GND
12	VCC	VCC3V3	VCC	VCC3V3	VCC	VCC3V3	VCC	VCC3V3

*1 Board version D019567_04_V0200, including level shifter (IC51)
*2 Board version D019567_04_V0300

Table 7.15 PMOD1 pin configuration

Pin	Expanded GPIO (type 1A)		Expanded SPI (type 2A)		Expanded UART (type 3A)		Expanded I2C (type 6A)	
	PMOD signal	RH850 signal	PMOD signal	RH850 signal	PMOD signal	RH850 signal	PMOD signal	RH850 signal
1	GPIO	AN03_0 (P40_10) *1 P23_3 *2	CS	MSPI5CSS2 (P23_3)	CTS (GPIO)	AN03_0 (P40_10) *1 P23_3 *2	NC	P22_13
2	GPIO (PWM)	P23_1 (TOM1_1)	MOSI	MSPI5SO (P23_5)	TXD	RLIN323TX (P23_1)	NC	P11_5
3	GPIO	P23_0	MISO	MSPI5SI (P23_6)	RXD	RLIN323RX (P23_0)	SCL	RIIC1SCL (P00_6)
4	GPIO	AN21_0 (P40_12) *1 P00_6 *2	SCK	MSPI5SC (P23_7)	RTS	AN21_0 (P40_12) *1 P00_6 *2	SDA	RIIC1SDA (P00_7)
5	GND	GND	GND	GND	GND	GND	GND	GND
6	VCC	VCC3V3	VCC	VCC3V3	VCC	VCC3V3	VCC	VCC3V3
7	GPIO	P22_13	GPIO (INT)	P22_13 (IRQ13)	GPIO (INT)	P22_13 (IRQ13)	GPIO	AN03_0 (P40_10) *1 P23_3 *2
8	GPIO (PWM)	P11_5 (TAUD1O14)	GPIO (RESET)	P11_5	GPIO (RESET)	P11_5 (TAUD1O14)	GPIO	P11_10
9	GPIO	P11_10	GPIO (CS2)	P23_0 (MSPI5CSS3)	GPIO	P11_10	GPIO	P23_0
10	GPIO	P25_2	GPIO (CS3)	P25_2	GPIO	P25_2	GPIO	P25_2
11	GND	GND	GND	GND	GND	GND	GND	GND
12	VCC	VCC3V3	VCC	VCC3V3	VCC	VCC3V3	VCC	VCC3V3

*1 Board version D019567_04_V0200, including level shifter (IC58)
*2 Board version D019567_04_V0300

7.14 RHSB1 / MSPI6 Interface

The starter kit provides access to high speed serial interfaces using RH850/U2B RHSB1 and MSPI6 interface. The high speed serial interface signals are output to connector CN9.

These interface are enabled in the board configurator.

The configurator settings also allows to change the pins for the data signals, change the ports for the clock signals and select the source for the chip select signal.

Figure 7.30 RHSB1 / MSPI6 interface shows the circuit diagram for this interface.

Table 7.16 RHSB1/MSPI6 connector CN9 gives an overview of the possible settings.

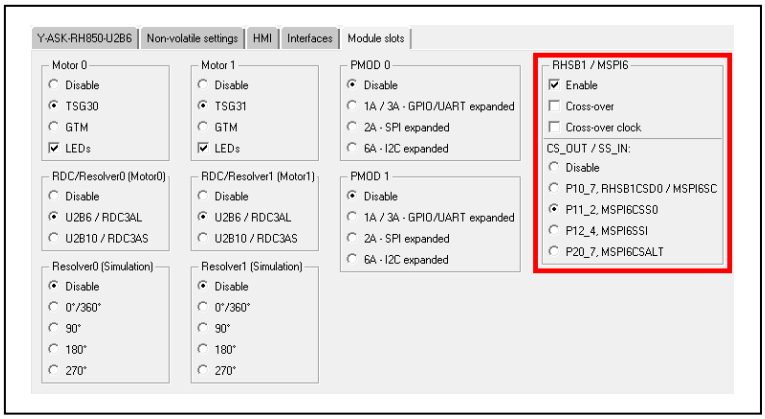


Figure 7.29 RHSB1 / MSPI6 enable

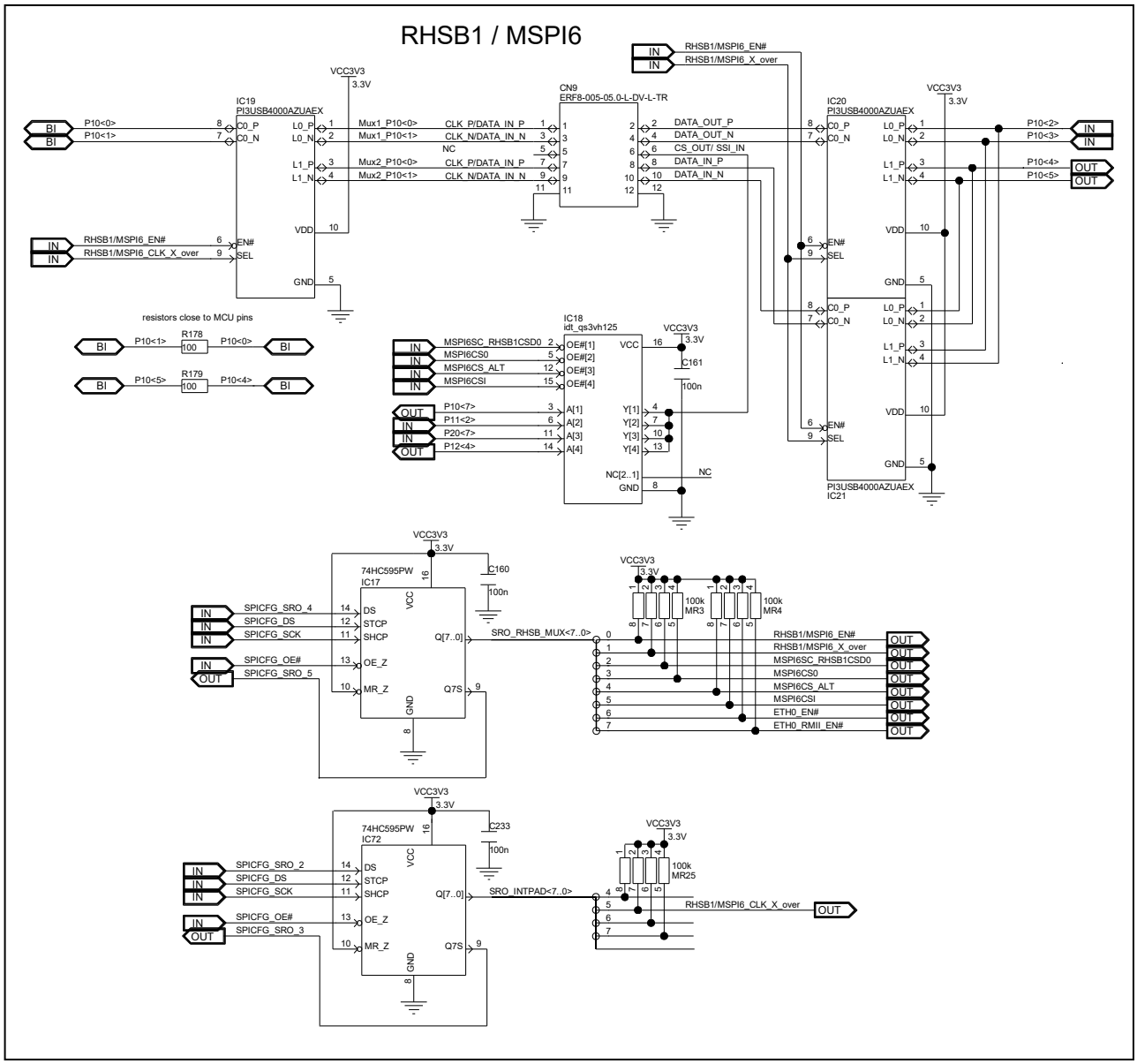


Figure 7.30 RHSB1 / MSPI6 interface

Table 7.16 RHSB1/MSPI6 connector CN9

Pin	RHSB1 / MSPI6 cross-over clock not checked		RHSB1 / MSPI6 cross-over clock checked	
	Device port	Function	Device port	Function
1	P10_0	CLK_P (MSPI6_SCKP) DATA_IN_P (RHSB1MCSIP)	–	–
3	P10_1	CLK_N (MSPI6_SCKN) DATA_IN_N (RHSB1MCSIN)	–	–
5	–	–	–	–
7	–	–	P10_0	CLK_P (MSPI6_SCKP) DATA_IN_P (RHSB1MCSIP)
9	–	–	P10_1	CLK_N (MSPI6_SCKN) DATA_IN_N (RHSB1MCSIN)
11	–	GND	–	GND

Pin	CS signal source selection	Port being used
6	MSPI6SC / RHSB1CSD0	P10_7
	MSPI6CS0	P11_2
	MSPI6CS_ALT	P20_7
	MSPI6CSI	P12_4

Pin	RHSB1 / MSPI6 cross-over not checked		RHSB1 / MSPI6 cross-over checked	
	Device port	Function	Device port	Function
2	P10_4	DATA_IN_P (RHSB1MCSIP / MSPI6_SIP)	P10_2	DATA_OUT_P (RHSB1SOP / RHSB1MCSOP / RHSB1NMSOP / MSPI6_SOP)
4	P10_5	DATA_IN_N (RHSB1MCSIN / MSPI6_SIN)	P10_3	DATA_OUT_N (RHSB1SON / RHSB1MCSON / RHSB1NMSON / MSPI6_SON)
8	P10_2	DATA_OUT_P (RHSB1SOP / RHSB1MCSOP / RHSB1NMSOP / MSPI6_SOP)	P10_4	DATA_IN_P (RHSB1MCSIP / MSPI6_SIP)
10	P10_3	DATA_OUT_N (RHSB1SON / RHSB1MCSON / RHSB1NMSON / MSPI6_SON)	P10_5	DATA_IN_N (RHSB1MCSIN / MSPI6_SIN)
12	–	GND	–	GND

7.15 Resolver / Motor Interface

The starter kit includes 2 resolver circuits that allow the signal connection from the motor control hardware to the resolver ports of RH850/U2B.

RH850/U2B6 and RH850/U2B10 devices use different resolver to digital converter circuits resulting in different board configurations. Thus there are different settings in the board configurator.

Figure 7.32 shows the circuits generating the various control signals for the resolver and motor control circuits.

Figure 7.33 shows the dedicated power supply circuits for the resolver and motor control circuits.

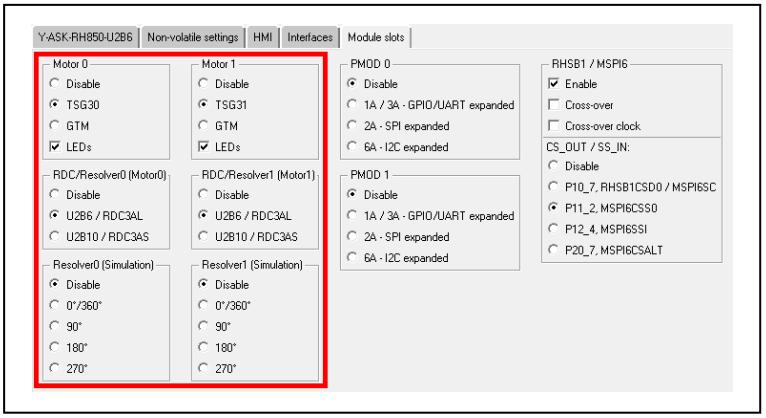


Figure 7.31 Resolver and motor control configuration

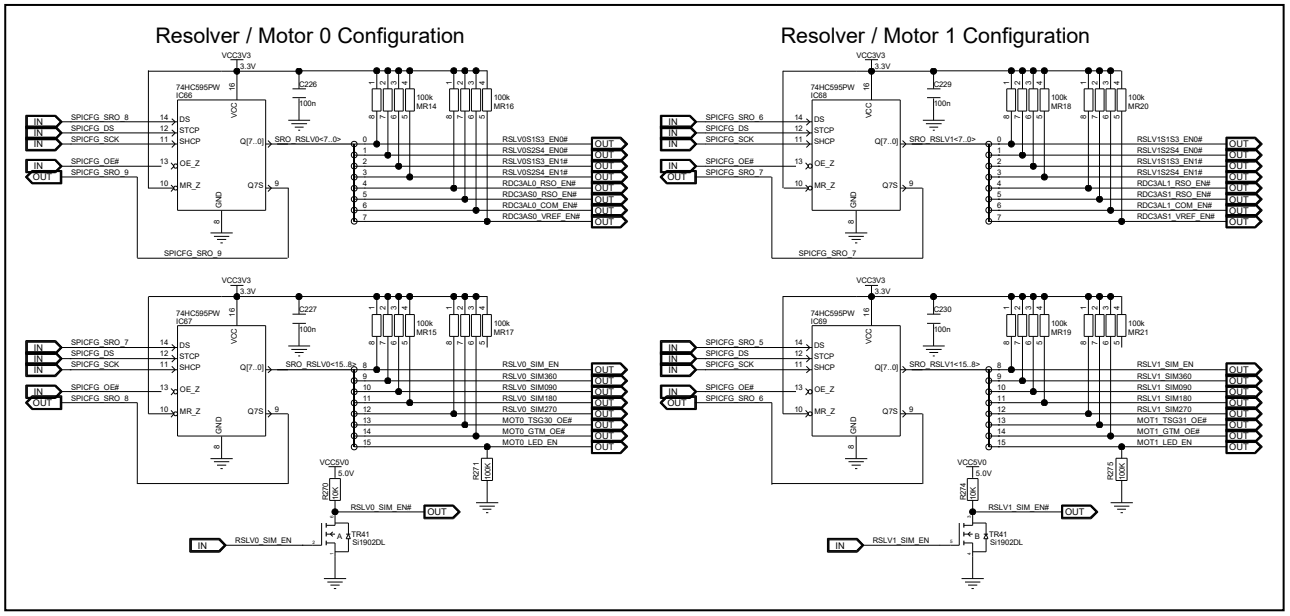


Figure 7.32 Resolver / Motor configuration

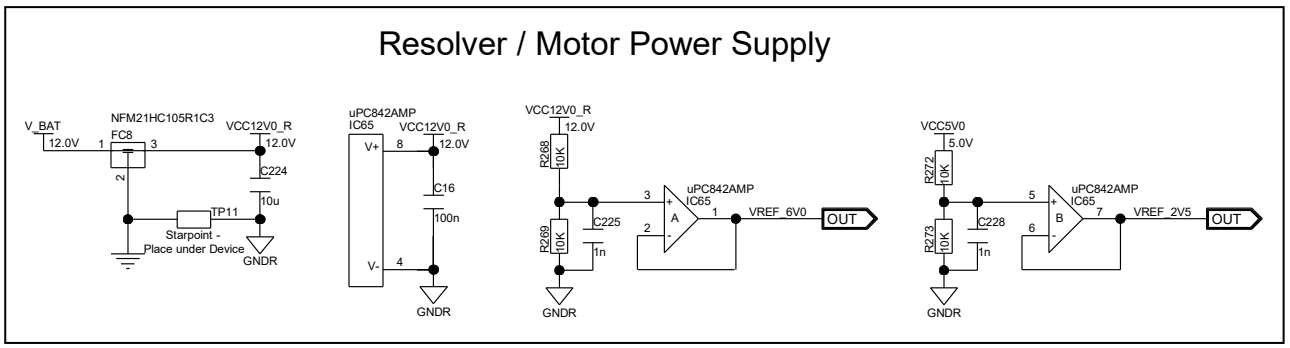


Figure 7.33 Dedicated power supplies for resolver and motor circuits

7.15.1 Resolver Circuits

The resolver to digital converter circuit on RH850/U2B6 devices is called RDC3AL. It uses the analog input AN24_0 – AN24_3 for resolver 0 and the analog inputs AN26_0, AN26_2, AN27_1 and AN27_2 for resolver 1.

The resolver to digital converter circuit on RH850/U2B10 devices is called RDC3AS. It uses the analog input AN01_2, AN01_3, AN04_1 and AN04_3 for resolver 0 and the analog inputs AN22_2, AN22_3, AN23_2 and AN23_3 for resolver 1.

Table 7.17 lists ports used for resolver functions on RH850/U2B6.

Table 7.18 lists ports used for resolver functions on RH850/U2B10.

Table 7.19 and *Table 7.20* show the pin configurations of the resolver connectors CN5 (resolver 0) and CN1 (resolver 1).

Figure 7.34 and *Figure 7.35* show the circuit diagrams for the resolver circuits.

Table 7.17 RH850/U2B6 Resolver connection

Resolver 0		Resolver 1	
Device Port	**Resolver Signal**	**Device Port**	**Resolver Signal**
AN24_3	RSLV0_S1	AN27_2	RSLV1_S1
AN24_2	RSLV0_S3	AN27_1	RSLV1_S3
AN24_0	RSLV0_S2	AN26_0	RSLV1_S2
AN24_1	RSLV0_S4	AN26_2	RSLV1_S4

Table 7.18 RH850/U2B10 Resolver connection

Resolver 0		Resolver 1	
Device Port	**Resolver Signal**	**Device Port**	**Resolver Signal**
AN24_3	RSLV0_S1	AN27_2	RSLV1_S1
AN24_2	RSLV0_S3	AN27_1	RSLV1_S3
AN24_0	RSLV0_S2	AN26_0	RSLV1_S2
AN24_1	RSLV0_S4	AN26_2	RSLV1_S4

Table 7.19 Resolver 0 connector CN5

Pin	Device port
1	RSLV0_S1
3	RSLV0_S3
5	RSLV0_S2
7	RSLV0_S4

Pin	Device port
2	RSLV0_R1
4	RSLV0_R2
6	Pull-up VCC5V0
8	GNDR

Table 7.20 Resolver 1 connector CN1

Pin	Device port
1	RSLV1_S1
3	RSLV1_S3
5	RSLV1_S2
7	RSLV1_S4

Pin	Device port
2	RSLV1_R1
4	RSLV1_R2
6	Pull-up VCC5V0
8	GNDR

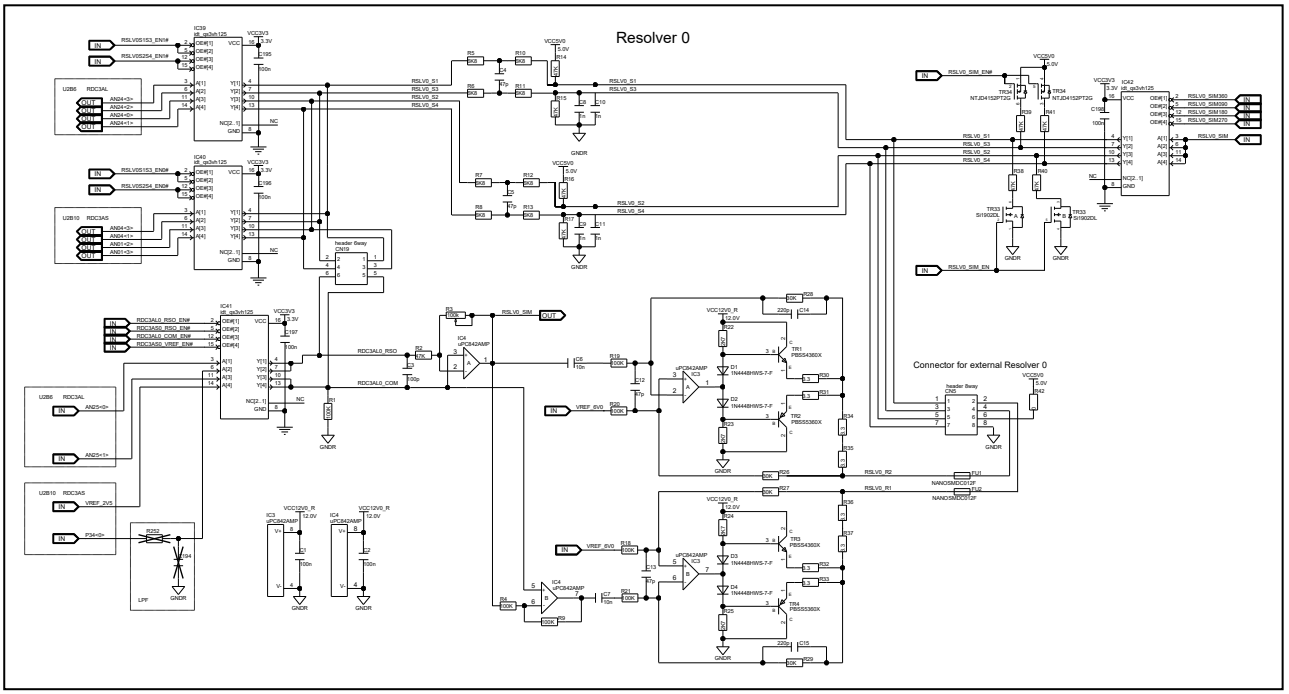


Figure 7.34 RH850/U2B6 Resolver 0 interface

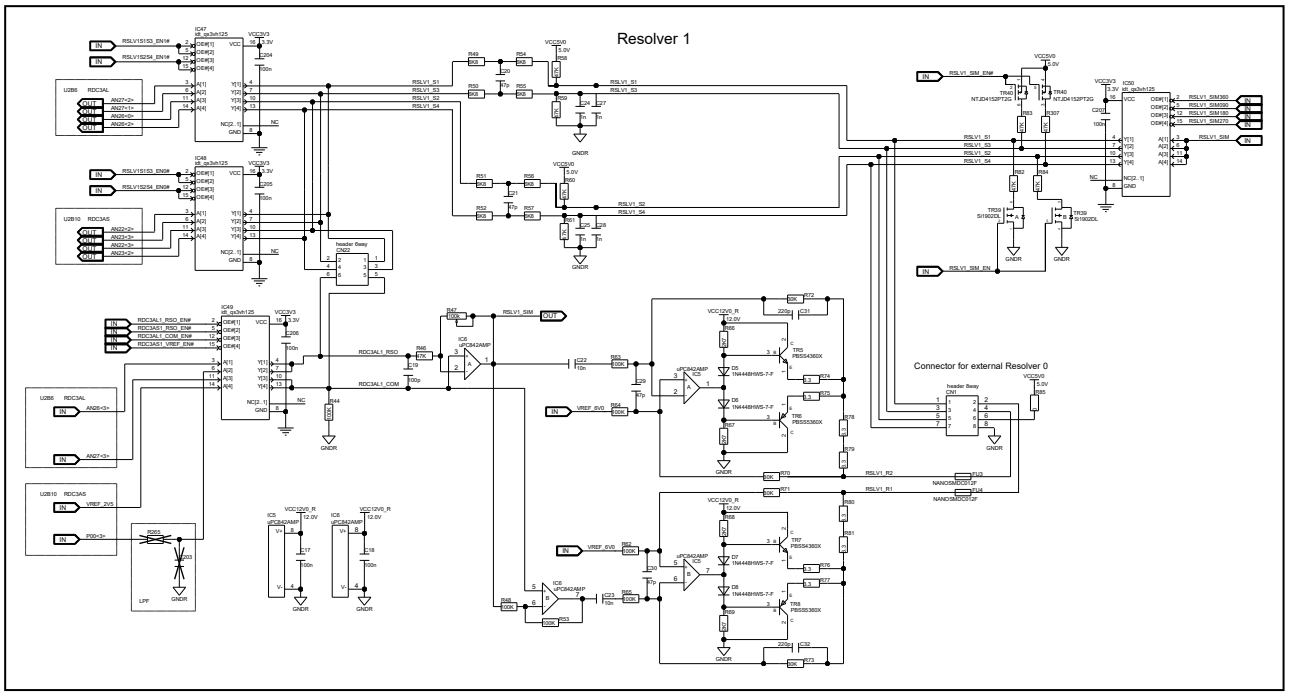


Figure 7.35 RH850/U2B6 Resolver 1 interface

7.15.2 Motor Control Interfaces

The starter kit provides two connectors for 3-phase motor connections. Connector CN20 is used for Motor 0, connector CN21 is used for Motor 1.

In RH850/U2B there are two possibilities to generate the motor control signals. One is to use a dedicated motor control timer (TSG3), the other is to use the Generic Timer Module (GTM). The desired interface is selected in the board configurator interface (see *Figure 7.31*).

Figure 7.36 Motor interface show the circuit diagrams of the motor control interfaces.

Table 7.21 Motor 0 connector CN20 and *Table 7.22 Motor 1 connector CN21* show the port connections for both motor connectors.

Table 7.21 Motor 0 connector CN20

Pin	Signal	Device Port		Pin	Signal	Device Port
		TSG30 selected	GTM selected			
1	U_Phase_0	P21_2	P20_0	2	IuFB	AN00_2
3	U_Phase_1	P21_3	P20_1	4	IvFB	AN00_0
5	V_Phase_0	P21_4	P20_2	6	IwFB	AN00_1
7	V_Phase_1	P21_5	P20_3	8	DIOn_0	P12_2
9	W_Phase_0	P25_4	P20_4	10	DIOn_1	P12_3
11	W_Phase_1	P25_3	P20_5	12	GND	
13	U_Phase_2	P12_4		14	U_Phase_Enc	P22_9
15	V_Phase_2	P12_5		16	V_Phase_Enc	P22_10
17	W_Phase_2	P12_6		18	W_Phase_Enc	P22_11
19	---			20	---	

Table 7.22 Motor 1 connector CN21

Pin	Signal	Device Port		Pin	Signal	Device Port
		TSG30 selected	GTM selected			
1	U_Phase_0	P13_0	P33_4	2	IuFB	AN10_2
3	U_Phase_1	P13_1	P33_5	4	IvFB	AN10_0
5	V_Phase_0	P13_2	P33_6	6	IwFB	AN10_1
7	V_Phase_1	P13_3	P33_7	8	DIOn_0	P12_8
9	W_Phase_0	P14_5	P33_0	10	DIOn_1	P12_9
11	W_Phase_1	P14_4	P33_1	12	GND	
13	U_Phase_2	P13_0		14	U_Phase_Enc	P14_1
15	V_Phase_2	P13_1		16	V_Phase_Enc	P14_2
17	W_Phase_2	P13_2		18	W_Phase_Enc	P14_3
19	---			20	---	

Each motor control circuit includes 3 LEDs in red, green and blue. The LEDs are connnected to the signals U_Phase_0 (red), V_Phase_0 (green) and W_Phase_0 (blue) of each motor and show the activity of the motor control signals.

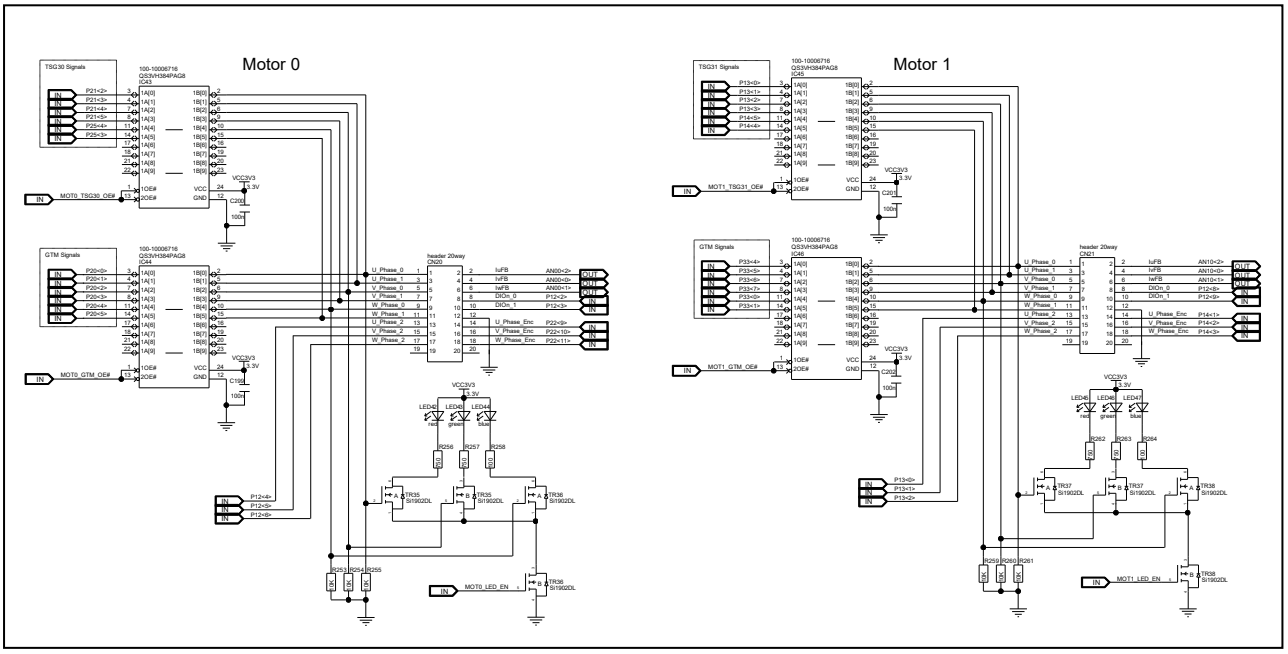


Figure 7.36 Motor interface

8. Development Tools

8.1 E2 On-Chip Debug Emulator [RTE0T00020KCE00000R]

The E2 on-chip debug emulator is a powerful debugging tool with flash programming functions which supports various Renesas microcontrollers. It offers enhanced debug features for RH850 microcontrollers such as:

- Software Trace Function
- CAN Communications Time Measurement Solution
- Support of external trigger signals (input and output)

Technical details about E2, the latest manuals and the actual version of the USB driver can be found on the Renesas website for E2: E2 emulator [RTE0T00020KCE00000R] | Renesas

8.2 Software Development Tools

The following software development tools are included in the starter kit package:

- Green Hills MULTI IDE (90 days evaluation version)
- IAR Embedded Workbench EWRH850 for Renesas RH850 (128KB kickstart version or 30 days evaluation version)
- CS+ integrated development environment with compiler CC-RH (compiler is 60 days evaluation version, afterwards it can be used as 256KB code size limited version)
- Renesas Flash Programmer (Renesas Flash Programmer (Programming GUI) | Renesas)
- Renesas Smart Configurator (Smart Configurator | Renesas)

Installation and usage of these tools is described in the RH850 starter kit license information document (D017765-11), which is also part of the Starter Kit package.

9. RH850/U2B Starter Kit Example Software

Example software for the RH850/U2B Starter Kit can be downloaded from the following website:

https://www.renesas.com/y-ask-rh850u2b#design_development

A description of the sample software is included in each package.

10. Connectors

10.1 Resolver 1 Connector CN1

Please refer to *7.15.1Resolver Circuits* for details on the function of these pins.

Table 10.1 Resolver 1 connector CN1

Pin	Device port
1	RSLV1_S1
3	RSLV1_S3
5	RSLV1_S2
7	RSLV1_S4

Pin	Device port
2	RSLV1_R1
4	RSLV1_R2
6	Pull-up VCC5V0
8	GNDR

10.2 Power Supply Connector CN2

Please refer to *3 Power Supply* for details on the function of these pins.

Table 10.2 Power supply connector CN2

Pin	Function
1	GND
2	–
3	+12V
4	+12V

10.3 Power Supply Test Connector CN3

Please refer to *3.3 Power Supply Test Connector* for details on the function of these pins.

This connector is not assembled on board version D019567_06_V0300.

Table 10.3 Power supply test connector CN3

Pin	Device port
1	GND
3	V_BAT (12.0V)
5	V_5V7 (5.7V)
7	VDD (1.09V)
9	NC
11	VCC5V0 (5.0V)
13	VCC3V3

Pin	Device port
2	V_LDO0 (5.0V)
4	V_LDO1 (3.3V)
6	V_LDO2 (3.3V)
8	V_LDO3 (3.3V)
10	V_LDO4 (5.0V)
12	NC
14	GND

10.4 RL78 Programming Connector CN4

Please refer to *3.3 Power Supply Test Connector* for details on the function of these pins.

This connector is not assembled.

Table 10.4 RL78 programming connector CN3

Pin	Function
1	VCC3V3
2	RL78_TOOL_0
3	RL78_RESET#
4	GND

10.5 Resolver 0 Connector CN5

Please refer to *7.15.1Resolver Circuits* for details on the function of these pins.

Table 10.5 Resolver 0 connector CN5

Pin	Device port
1	RSLV0_S1
3	RSLV0_S3
5	RSLV0_S2
7	RSLV0_S4

Pin	Device port
2	RSLV0_R1
4	RSLV0_R2
6	Pull-up VCC5V0
8	GNDR

10.6 USB-C Connector CN6

Please refer to *7.10 UART Interface* for details on the function of these pins.

Table 10.6 USB-C connector CN6

Pin	Function	Signal Name
A1	GND	
A2	–	–
A3	–	–
A4	V-BUS	V_USBCN
A5	CC1	Pull-down GND
A6	DP1	USB_DP
A7	DN1	USB_DP
A8	SBU1	–
A9	VBUS	V_USBCN
A10	–	–
A11	–	–
A12	GND	

Pin	Function	Signal Name
B12	GND	
B11	–	–
B10	–	–
B9	V-BUS	V_USBCN
B8	SBU2	–
B7	DP2	USB_DP
B6	DN2	USB_DP
B5	CC2	–
B4	VBUS	V_USBCN
B3	–	–
B2	–	–
B1	GND	

10.7 Debug Connector CN7

Please refer to *5 Debug and Flash Programming Interfaces* for details on the debug connection.

Table 10.7 On-chip debug connector CN7

Pin	Function	Device port
1	TDCK / LPDCLK / FPCK	JP0_2
3	TRST#	
5	TDO / LPDO / FPDT	JP0_1
7	TDI / LPDIO / FPDR	JP0_0
9	TMS	JP0_3
11	RDY / LPDCLKOUT / –	JP0_5
13	RESET#	

Pin	Function	Device port
2	GND	
4	FLMD0	
6	–	
8	VCC3V3	
10	–	
12	GND	
14	GND	

10.8 OLED Display Connector CN8

Please refer to 7.6 OLED Graphic Display for details on the display connection

Table 10.8 Display connector CN8 for EastRising Technology display

Pin	Function	RH850/U2B Processor Pin		Pin	Function	RH850/U2B Processor Pin
1	NC (GND)	GND		16	R/W#	---
2	C2P	Capacitor for charge pump		17	E/RD#	---
3	C2N			18	D0	10kOhm pull-up to VCC3V3, Port P17_3 (RIIC0SCL)
4	C1P	Capacitor for charge pump		19	D1	10kOhm pull-up to VCC3V3, Port P17_2 (RIIC0SDA)
5	C1N			20	D2	Connect to pin 19
6	VBAT	VCC3V3		21	D3	---
7	NC	---		22	D4	---
8	VSS	GND		23	D5	---
9	VDD	VCC3V3		24	D6	---
10	BS0	GND		25	D7	GND
11	BS1	10kOhm pull-up to VCC3V3		26	IREF	390kOhm pull-down
12	BS2	GND		27	VCOMH	V_COMH (5.0V)
13	CS#	10kOhm pull-up to VCC3V3, Port P2_15		28	VCC	V_CC (9.0V)
14	RES#	Reset circuit with 10kOhm pull-up to VCC3V3 and 1µF capacitor, Port P2_14		29	VLSS	GND
15	D/C#	10kOhm pull-up to VCC3V3		30	NC (GND)	GND

10.9 RHSB1/MSPI6 Connector CN9

Please refer to 7.14 RHSB1 / MSPI6 Interface for details on the function of these pins.

Table 10.9 RHSB1/MSPI6 connector CN9

Pin	SW2-2 = ON (RHSB1/MSPI6_MUX)		SW2-2 = OFF (RHSB1/MSPI6_MUX)	
	Device port	Function	Device port	Function
1	P10_0	CLK_P, DATA_IN_P (RHSB1MCSIP / RHSB1FCLP / MSPI6_SCKP)	–	–
3	P10_1	CLK_N, DATA_IN_N (RHSB1MCSIN / RHSB1FCLN / MSPI6_SCKN)	–	–
7	–	–	P10_0	CLK_P, DATA_IN_P (RHSB1MCSIP / RHSB1FCLP / MSPI6_SCKP)
9	–	–	P10_1	CLK_N, DATA_IN_N (RHSB1MCSIN / RHSB1FCLN / MSPI6_SCKN)

Pin	Device port	Function
5	-	-
6	JP2 / CN23.6pin 1-3 / - / P10_7 3-5 / 2-4 / P11_2 3-5 / 4-6 / P12_4	RHSB1CSD0 MSPI6CSS0 MSPI6SSI
11	–	GND
12	–	GND

Pin	SW2-3 = ON (RHSB1/MSPI6_MUX_2)		SW2-3 = OFF (RHSB1/MSPI6_MUX_2)	
	Device port	Function	Device port	Function
2	P10_4	DATA_IN_P (MSPI6_SIP)	P10_2	DATA_OUT_P (RHSB1MCSOP / RHSB1SOP / MSPI6_SOP)
4	P10_5	DATA_IN_N (MSPI6_SIN)	P10_3	DATA_OUT_N (RHSB1MCSON / RHSB1SON / MSPI6_SON)
8	P10_2	DATA_OUT_P (RHSB1MCSOP / RHSB1SOP / MSPI6_SOP)	P10_4	DATA_IN_P (MSPI6_SIP)
10	P10_3	DATA_OUT_N (RHSB1MCSON / RHSB1SON / MSPI6_SON)	P10_5	DATA_IN_N (MSPI6_SIN)

10.10 Ethernet Connector CN10

Please refer to *7.11 Ethernet Interface* for details on the function of these pins.

Table 10.10 10BASE-T/100BASE-TX Ethernet connector CN10

Pin	Name	Signal	Pin	Name	Signal
1	TDPLUS	TXP	2	TDMINUS	TXN
3	RDPLUS	RXP	4	CT_TD	
5	CT_RD		6	RDMINUS	RXN
7	NC		8	GND	
9	GR_AN	Green LED, anode	10	GR_KA	Green LED, Cathode
11	YE_AN	Yellow LED, anode	12	YE_KA	Yellow LED, cathode
13	GND		14	GND	

10.11 LIN and SENT Monitor Connector CN11

Please refer to *7.8 LIN and SENT Interfaces* for details on the function of these pins.

Table 10.11 LIN and SENT monitor connector CN11

Pin	Function	Condition
1	LIN1_TX	LIN enabled in board configurator.
2	LIN1_RX	
3	SENT1RX	SENT enabled in board configurator.
4	SENT1SPCO	

10.12 LIN and SENT Connector CN12

Please refer to *7.8 LIN and SENT Interfaces* for details on the function of these pins.

Table 10.12 LIN and SENT connector CN12

Pin	Function	Condition
1	VCC5V0	SENT power enabled in board configurator.
2	NC	
3	NC	
4	NC	
5	GND	
6	GND	
7	LIN1	LIN enabled in board configurator. Pull-up can also be enabled in board configurator.
8	SENT1	SENT enabled in board configurator.
9	LIN1_BAT	LIN Power enabled in board configurator.
10	GND	

10.13 CAN Monitor Connector CN13

Please refer to *7.7 CAN Interfaces* for details on the function of these pins.

Table 10.13 LIN and SENT monitor connector CN11

Pin	Function	Condition
1	CAN0_RX	CAN0 enabled in board configurator.
2	CAN0_TX	
3	CAN1_RX	CAN1 enabled in board configurator.
4	CAN1_TX	

10.14 CAN0 Connector CN14

Please refer to *7.7 CAN Interfaces* for details on the function of these pins.

Table 10.14 CAN0 connector CN14

Pin	Function	Condition
1	NC	
2	CAN0L	CAN0 enabled in board configurator. Termination can also be enabled in board configurator.
3	GND	Pin 3 on GND enabled in board configurator.
4	NC	
5	NC	
6	NC	
7	CAN0H	CAN0 enabled in board configurator. Termination can also be enabled in board configurator.
8	NC	
9	NC	
10	GND	

10.15 CAN1 Connector CN15

Please refer to *7.7 CAN Interfaces* for details on the function of these pins.

Table 10.15 CAN1 connector CN15

Pin	Function	Condition
1	NC	
2	CAN1L	CAN1 enabled in board configurator. Termination can also be enabled in board configurator.
3	GND	Pin 3 on GND enabled in board configurator.
4	NC	
5	NC	
6	NC	
7	CAN1H	CAN1 enabled in board configurator. Termination can also be enabled in board configurator.
8	NC	
9	NC	
10	GND	

10.16 UART Monitor Connector CN16

Please refer to *7.10 UART Interface* for details on the function of these pins.

Table 10.16 UART signal on connector CN16

Pin	Function
1	GND
2	Data signal from RH850/U2B (port P02_1) to FTDI FT2232 (ADBUS0)
3	Data signal from FTDI FT2232 (ADBUS1) to RH850/U2B (port P02_4)

10.17 Device Port Connector CN17

The device port connectors provide direct access to RH850/U2B port pins.

Table 10.17 Device port connector CN17

Pin	Device port
1	AN25_2
3	AN26_1
5	AN25_1
7	AN26_3
9	AN25_3
11	AN27_3
13	P02_10
15	P00_5
17	P02_8

Pin	Device port
2	AN2_0
4	AN2_0
6	AN2_2
8	AN2_0
10	AN2_1
12	P02_9
14	AN27_2
16	P02_7
18	P00_4

Table 10.17 Device port connector CN17 (cont'd)

19	P02_5	20	P02_6
21	P00_3	22	P02_3
23	P02_4	24	P02_1
25	P02_2	26	P00_6
27	P02_2	28	P00_6
29	P10_8	30	VCC5V0
31	P10_6	32	VCC5V0
33	P10_7	34	VCC3V3
35	P00_0	36	VCC3V3
37	P00_1	38	GND
39	P00_2	40	GND
41	P11_10	42	P11_6
43	P11_7	44	P11_3
45	P11_22	46	P11_4
47	P11_9	48	P12_8
49	P12_9	50	P11_5
51	P11_1	52	P11_8
53	P12_7	54	P12_4
55	P11_0	56	P14_4
57	P12_3	58	P14_5
59	P12_5	60	P13_3
61	P12_6	62	P13_2
63	P12_2	64	P13_1
65	P12_1	66	P13_0
67	P12_0	68	P14_3
69	P20_7	70	P14_2
71	P14_0	72	P14_1
73	P20_6	74	P20_3
75	P20_2	76	P20_5
77	P20_4	78	P20_1
79	VMONOUT#	80	ERROROUT_M#
81	P20_0	82	FLMD0
83	P25_6	84	P22_13
85	P25_5	86	P22_12
87	P25_3	88	P25_4
89	P22_11	90	P22_10
91	P22_9	92	P21_4
93	P21_5	94	P22_8

10.18 Device Port Connector CN18

The device port connectors provide direct access to RH850/U2B port pins.

Table 10.18 Device port connector CN18

Pin	Device port
1	GND
3	AN24_3
5	AN24_2
7	AN21_2
9	AN23_2
11	AN21_1
13	AN22_3
15	AN20_3
17	AN23_0
19	AN21_3
21	AN23_1
23	AN22_1
25	AN00_3
27	AN01_1
29	AN01_0
31	AN02_2
33	AN02_1
35	AN03_3
37	AN04_0
39	AN03_0
41	AN10_0
43	AN10_1
45	AN11_3
47	AN11_1
49	AN12_2
51	AN12_1
53	P34_0
55	AN11_2
57	P34_2
59	P33_3
61	P34_4
63	P33_4
65	P32_1
67	P33_6
69	P33_8
71	P32_3
73	P32_4

Pin	Device port
2	GND
4	AN24_1
6	AN24_0
8	AN22_0
10	AN23_3
12	AN21_0
14	AN22_2
16	AN20_1
18	AN20_2
20	AN20_0
22	AN01_2
24	AN01_3
26	AN00_1
28	AN00_0
30	AN00_2
32	AN02_0
34	AN03_2
36	AN03_1
38	AN02_3
40	AN04_3
42	AN04_2
44	AN04_1
46	AN10_2
48	AN10_3
50	AN11_0
52	AN12_3
54	AN12_0
56	P34_1
58	P33_0
60	P34_3
62	P33_1
64	P32_0
66	P33_2
68	P33_5
70	P33_7
72	P32_2
74	P32_5

Table 10.18 Device port connector CN18 (cont'd)

75	P23_1	76	P32_6
77	P23_5	78	P23_0
79	P23_3	80	P23_6
81	P23_4	82	P23_7
83	P23_2	84	P25_2
85	P22_0	86	P22_1
87	P22_3	88	P22_2
89	P22_5	90	P22_4
91	P21_3	92	P21_2
93	P22_7	94	P22_6

10.19 Resolver 0 Monitor Connector CN19

Please refer to *7.15.1 Resolver Circuits* for details on the function of these pins.

Table 10.19 Resolver 0 monitor connector CN19

Pin	Signal name	Pin	Signal name
1	RSLV0_S1	2	RSLV0_S3
3	RSLV0_S2	4	RSLV0_S4
5	RDC3AL0_COM	6	RDC3AL0_RSO

10.20 Motor Connector CN20

Please refer to *7.15.2 Motor Control Interfaces* for details on the function of these pins.

Table 10.20 Motor 0 connector CN20

Pin	Signal	Device Port		Pin	Signal	Device Port
		TSG30 selected	GTM selected			
1	U_Phase_0	P21_2	P20_0	2	IuFB	AN00_2
3	U_Phase_1	P21_3	P20_1	4	IvFB	AN00_0
5	V_Phase_0	P21_4	P20_2	6	IwFB	AN00_1
7	V_Phase_1	P21_5	P20_3	8	DIOn_0	P12_2
9	W_Phase_0	P25_4	P20_4	10	DIOn_1	P12_3
11	W_Phase_1	P25_3	P20_5	12	GND	
13	U_Phase_2	P12_4		14	U_Phase_Enc	P22_9
15	V_Phase_2	P12_5		16	V_Phase_Enc	P22_10
17	W_Phase_2	P12_6		18	W_Phase_Enc	P22_11
19	---			20	---	

10.21 Motor Connector CN21

Please refer to *7.15.2 Motor Control Interfaces* for details on the function of these pins.

Table 10.21 Motor 1 connector CN21

Pin	Signal	Device Port		Pin	Signal	Device Port
		TSG31 selected	GTM selected			
1	U_Phase_0	P13_0	P33_4	2	IuFB	AN10_2
3	U_Phase_1	P13_1	P33_5	4	IvFB	AN10_0
5	V_Phase_0	P13_2	P33_6	6	IwFB	AN10_1
7	V_Phase_1	P13_3	P33_7	8	DIOn_0	P12_8
9	W_Phase_0	P14_5	P33_0	10	DIOn_1	P12_9
11	W_Phase_1	P14_4	P33_1	12	GND	
13	U_Phase_2	P13_0		14	U_Phase_Enc	P14_1
15	V_Phase_2	P13_1		16	V_Phase_Enc	P14_2
17	W_Phase_2	P13_2		18	W_Phase_Enc	P14_3
19	---			20	---	

10.22 Resolver 1 Monitor Connector CN22

Please refer to *7.15.1 Resolver Circuits* for details on the function of these pins.

Table 10.22 Resolver 1 monitor connector CN19

Pin	Signal name
1	RSLV1_S1
3	RSLV1_S2
5	RDC3AL1_COM

Pin	Signal name
2	RSLV1_S3
4	RSLV1_S4
6	RDC3AL1_RSO

10.23 PMOD0 Connector CN23

Please refer to *7.13 PMOD Interfaces* for details on the function of these pins.

Table 10.23 PMOD0 pin configuration

Pin	Expanded GPIO (type 1A)		Expanded SPI (type 2A)		Expanded UART (type 3A)		Expanded I2C (type 6A)	
	PMOD signal	RH850 signal	PMOD signal	RH850 signal	PMOD signal	RH850 signal	PMOD signal	RH850 signal
1	GPIO	AN02_0 (P40_2) *1 P22_4 *2	CS	MSPI4CSS1 (P22_4)	CTS (GPIO)	AN02_0 (P40_2) *1 P22_4 *2	NC	P33_2
2	GPIO (PWM)	P22_2 (TOM1_10)	MOSI	MSPI4SO (P22_3)	TXD	RLIN32TX (P22_2)	NC	P12_0
3	GPIO	P22_3	MISO	MSPI4SI (P22_2)	RXD	RLIN32RX (P22_3)	SCL	RIIC0SCL (P00_1)
4	GPIO	AN22_0 (P40_4) *1 P12_1 *2	SCK	MSPI4SC (P22_1)	RTS	AN22_0 (P40_4) *1 P12_1 *2	SDA	RIIC0SDA (P00_2)
5	GND	GND	GND	GND	GND	GND	GND	GND
6	VCC	VCC3V3	VCC	VCC3V3	VCC	VCC3V3	VCC	VCC3V3
7	GPIO	P33_2	GPIO (INT)	P33_2	GPIO (INT)	P33_2 (IRQ8)	GPIO	AN02_0 (P40_2) *1 P22_4 *2
8	GPIO (PWM)	P12_0 (TOM1_4)	GPIO (RESET)	P12_0	GPIO (RESET)	P12_0	GPIO	P12_1
9	GPIO	P22_7	GPIO (CS2)	P22_7 (MSPI4CSS2)	GPIO	P22_7	GPIO	P22_7
10	GPIO	P22_0	GPIO (CS3)	P22_0 (MSPI4CSS3)	GPIO	P22_0	GPIO	P22_0
11	GND	GND	GND	GND	GND	GND	GND	GND
12	VCC	VCC3V3	VCC	VCC3V3	VCC	VCC3V3	VCC	VCC3V3

*1 Board version D019567_04_V0200, including level shifter (IC51)
*2 Board version D019567_04_V0300

10.24 PMOD1 Connector CN24

Please refer to *7.13 PMOD Interfaces* for details on the function of these pins.

Table 10.24 PMOD1 pin configuration

Pin	Expanded GPIO (type 1A)		Expanded SPI (type 2A)		Expanded UART (type 3A)		Expanded I2C (type 6A)	
	PMOD signal	RH850 signal	PMOD signal	RH850 signal	PMOD signal	RH850 signal	PMOD signal	RH850 signal
1	GPIO	AN03_0 (P40_10) *1 P23_3 *2	CS	MSPI5CSS2 (P23_3)	CTS (GPIO)	AN03_0 (P40_10) *1 P23_3 *2	NC	P22_13
2	GPIO (PWM)	P23_1 (TOM1_1)	MOSI	MSPI5SO (P23_5)	TXD	RLIN323TX (P23_1)	NC	P11_5
3	GPIO	P23_0	MISO	MSPI5SI (P23_6)	RXD	RLIN323RX (P23_0)	SCL	RIIC1SCL (P00_6)
4	GPIO	AN21_0 (P40_12) *1 P00_6 *2	SCK	MSPI5SC (P23_7)	RTS	AN21_0 (P40_12) *1 P00_6 *2	SDA	RIIC1SDA (P00_7)
5	GND	GND	GND	GND	GND	GND	GND	GND
6	VCC	VCC3V3	VCC	VCC3V3	VCC	VCC3V3	VCC	VCC3V3
7	GPIO	P22_13	GPIO (INT)	P22_13 (IRQ13)	GPIO (INT)	P22_13 (IRQ13)	GPIO	AN03_0 (P40_10) *1 P23_3 *2
8	GPIO (PWM)	P11_5 (TAUD1O14)	GPIO (RESET)	P11_5	GPIO (RESET)	P11_5 (TAUD1O14)	GPIO	P11_10
9	GPIO	P11_10	GPIO (CS2)	P23_0 (MSPI5CSS3)	GPIO	P11_10	GPIO	P23_0
10	GPIO	P25_2	GPIO (CS3)	P25_2	GPIO	P25_2	GPIO	P25_2
11	GND	GND	GND	GND	GND	GND	GND	GND
12	VCC	VCC3V3	VCC	VCC3V3	VCC	VCC3V3	VCC	VCC3V3

*1 Board version D019567_04_V0200, including level shifter (IC58)
*2 Board version D019567_04_V0300

11. Mechanical Dimensions

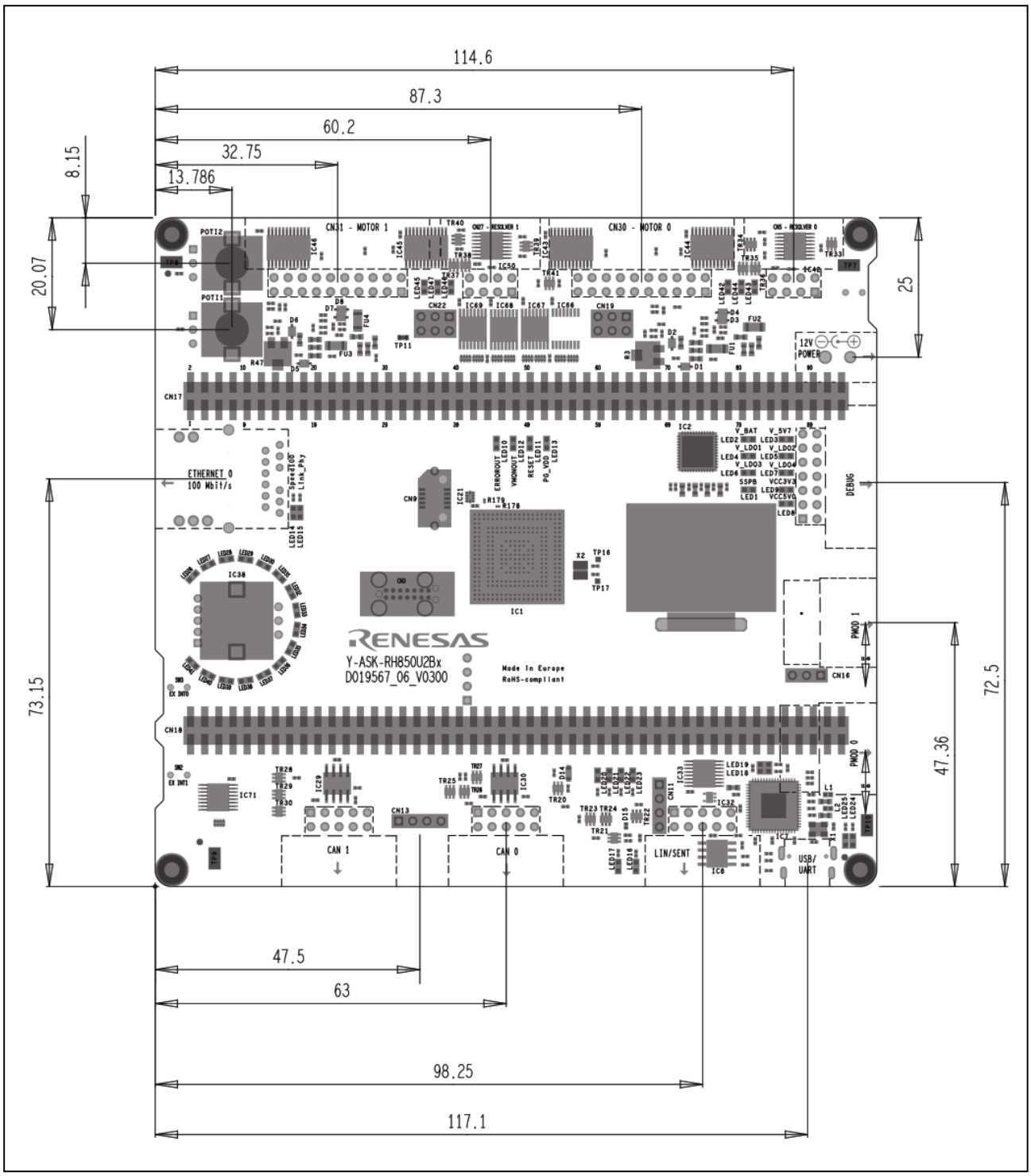


Figure 10.1 Mechanical dimensions

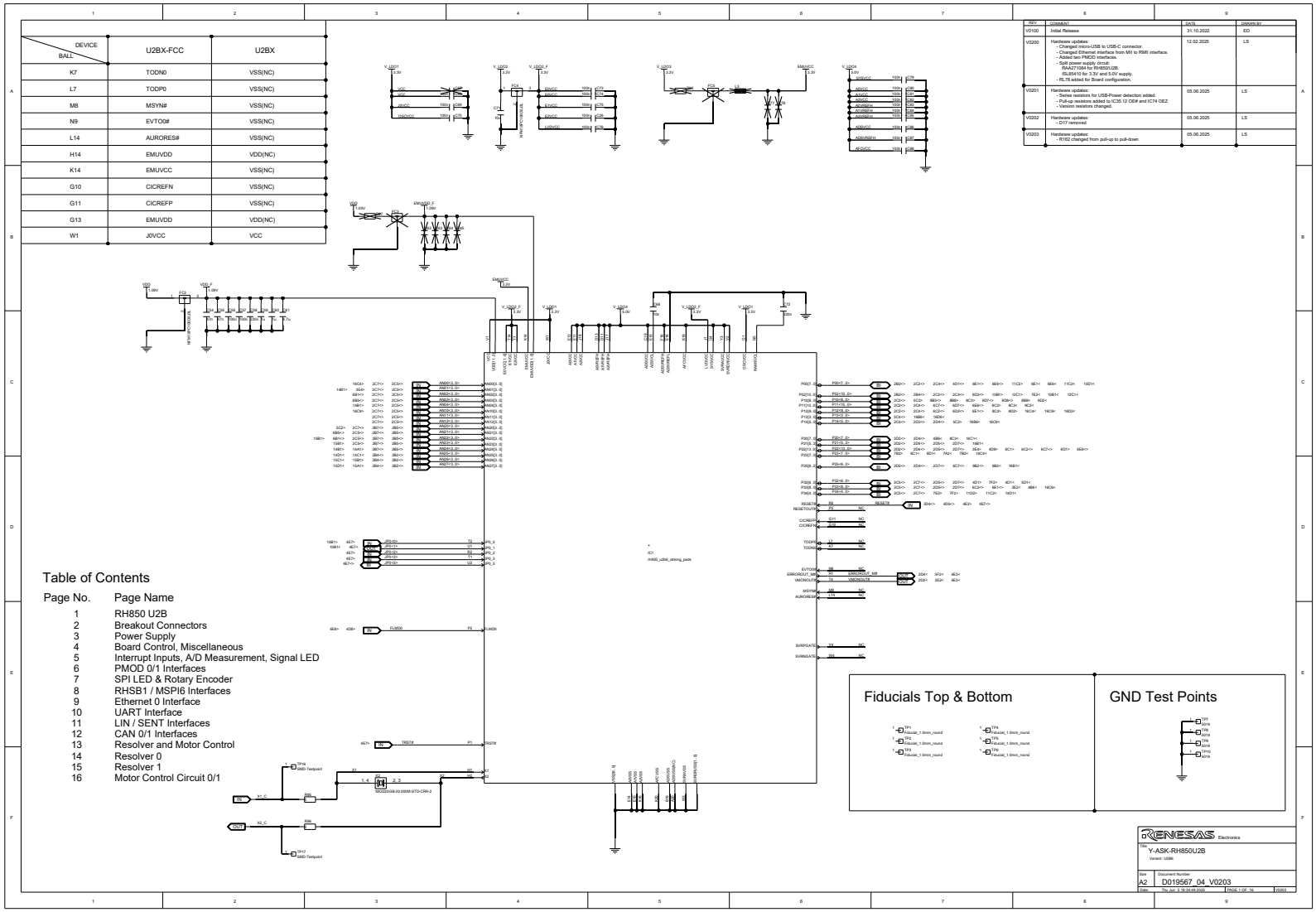
12. Schematics

CAUTION

The schematics shown in this document are not intended to be used as a reference for mass production. Any usage in an application design is the sole responsibility of the customer.

12.1 Y-ASK-RH850U2B6 (D019567_06_V0200)

12.1.1 RH850 U2B



DEVICE / BALL	U2BX-FCC	U2BX
K7	TODN0	VSS(NC)
L7	TODP0	VSS(NC)
M8	MSYN#	VSS(NC)
N9	EVTO0#	VSS(NC)
L14	AURORES#	VSS(NC)
H14	EMUVDD	VDD(NC)
K14	EMUVCC	VSS(NC)
G10	CICREFN	VSS(NC)
G11	CICREFP	VSS(NC)
G13	EMUVDD	VDD(NC)
W1	J0VCC	VCC

REV	COMMENT	DATE	DRAWN BY
V0100	Initial Release	31.10.2022	ED
V0200	Hardware updates: - Changed micro-USB to USB-C connector. - Changed Ethernet interface from MII to RMII interface. - Added two PMOD interfaces. - Split power supply circuit: RAA271084 for RH850U2B. ISL85410 for 3.3V and 5.0V supply. - RL78 added for Board configuration.	12.02.2025	LS
V0201	Hardware updates: - Series resistors for USB-Power detection added. - Pull-up resistors added to IC35.12 OE# and IC74 OE2 - Version resistors changed.	05.06.2025	LS
V0202	Hardware updates: - D17 removed	05.06.2025	LS
V0203	Hardware updates: - R162 changed from pull-up to pull-down	05.06.2025	LS

Table of Contents

Page No.	Page Name
1	RH850 U2B
2	Breakout Connectors
3	Power Supply
4	Board Control, Miscellaneous
5	Interrupt Inputs, A/D Measurement, Signal LED
6	PMOD 0/1 Interfaces
7	SPI LED & Rotary Encoder
8	RHSB1 / MSPI6 Interfaces
9	Ethernet 0 Interface
10	UART Interface
11	LIN / SENT Interfaces
12	CAN 0/1 Interfaces
13	Resolver and Motor Control
14	Resolver 0
15	Resolver 1
16	Motor Control Circuit 0/1

Fiducials Top & Bottom

GND Test Points

RENESAS Electronics

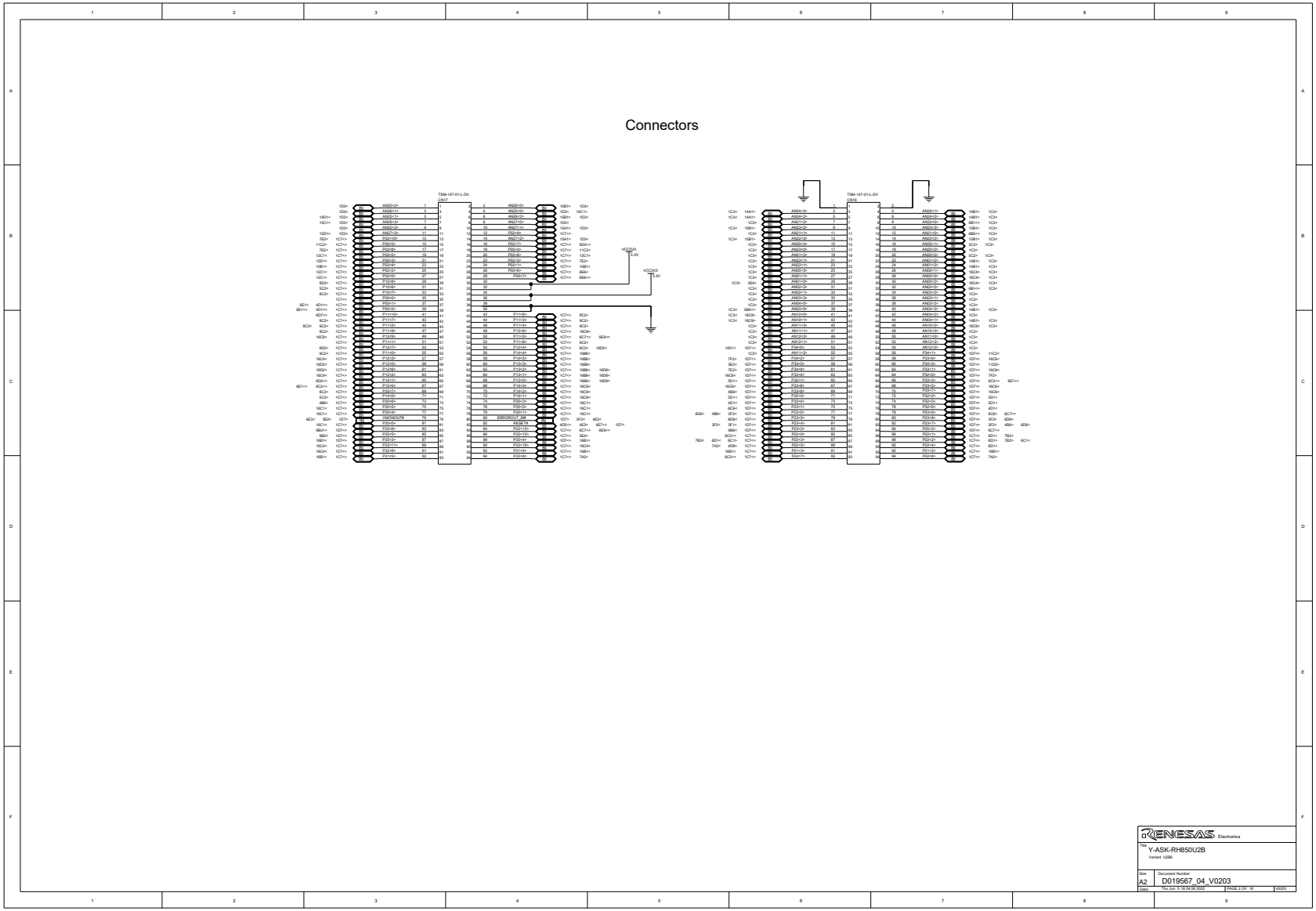
Title: Y-ASK-RH850U2B

Variant: U2B6

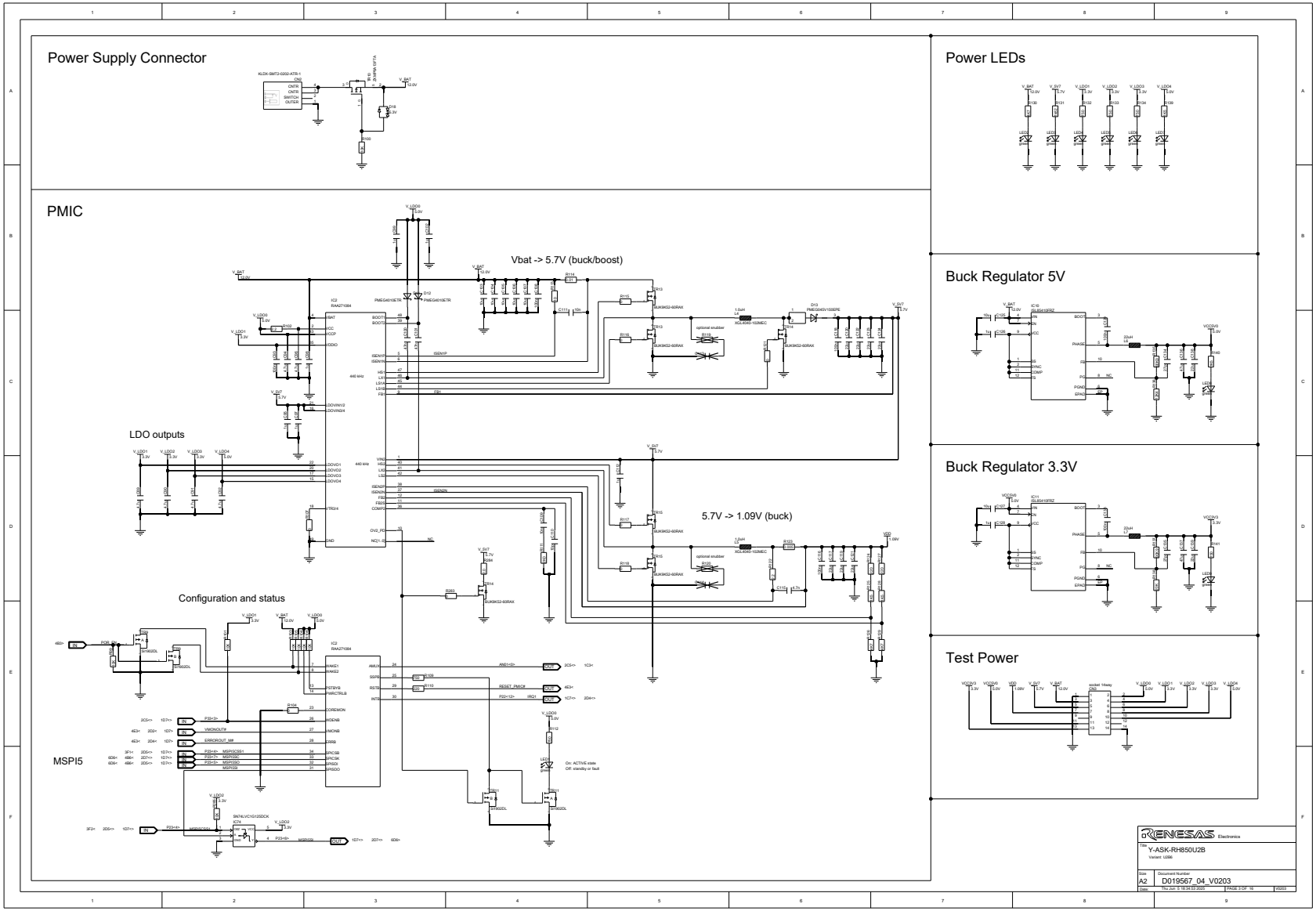
Size: A2 | Document Number: D019567_04_V0203

Date: Thu Jun 5 16:34:49 2025 | Sheet 1 OF 16 | D0003

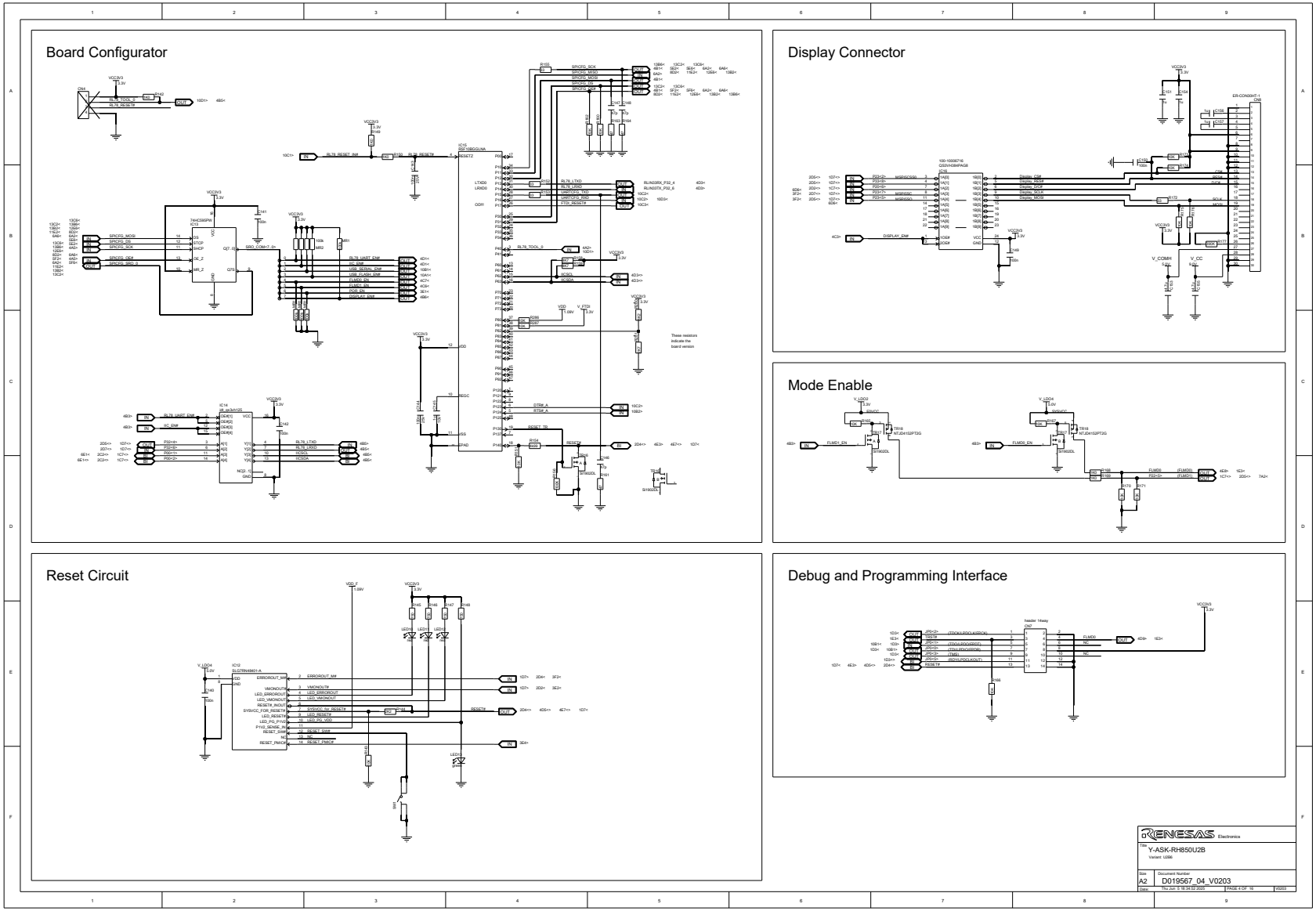
12.1.2 Breakout Connectors



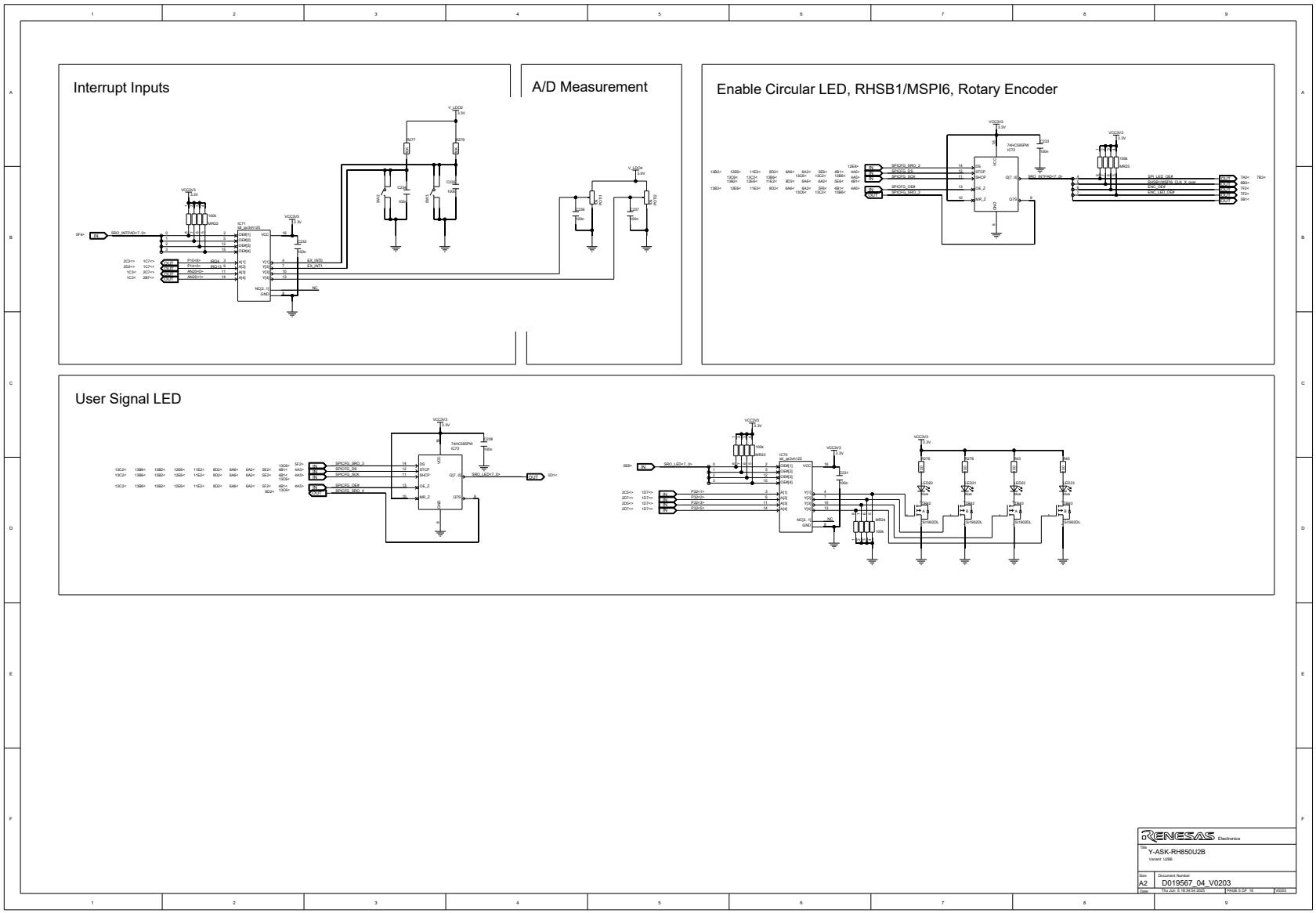
12.1.3 Power Supply



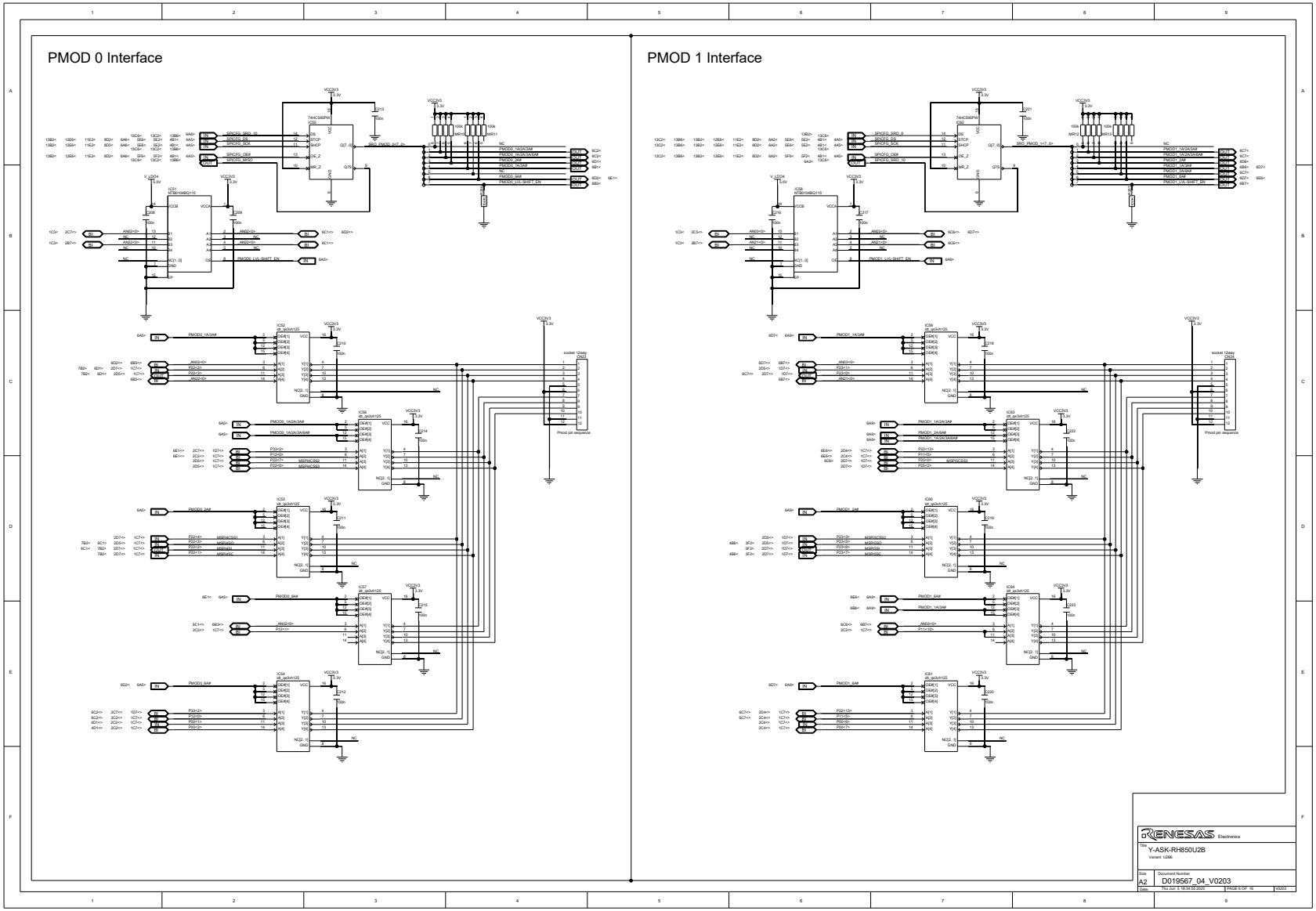
12.1.4 Board Control, Miscellaneous



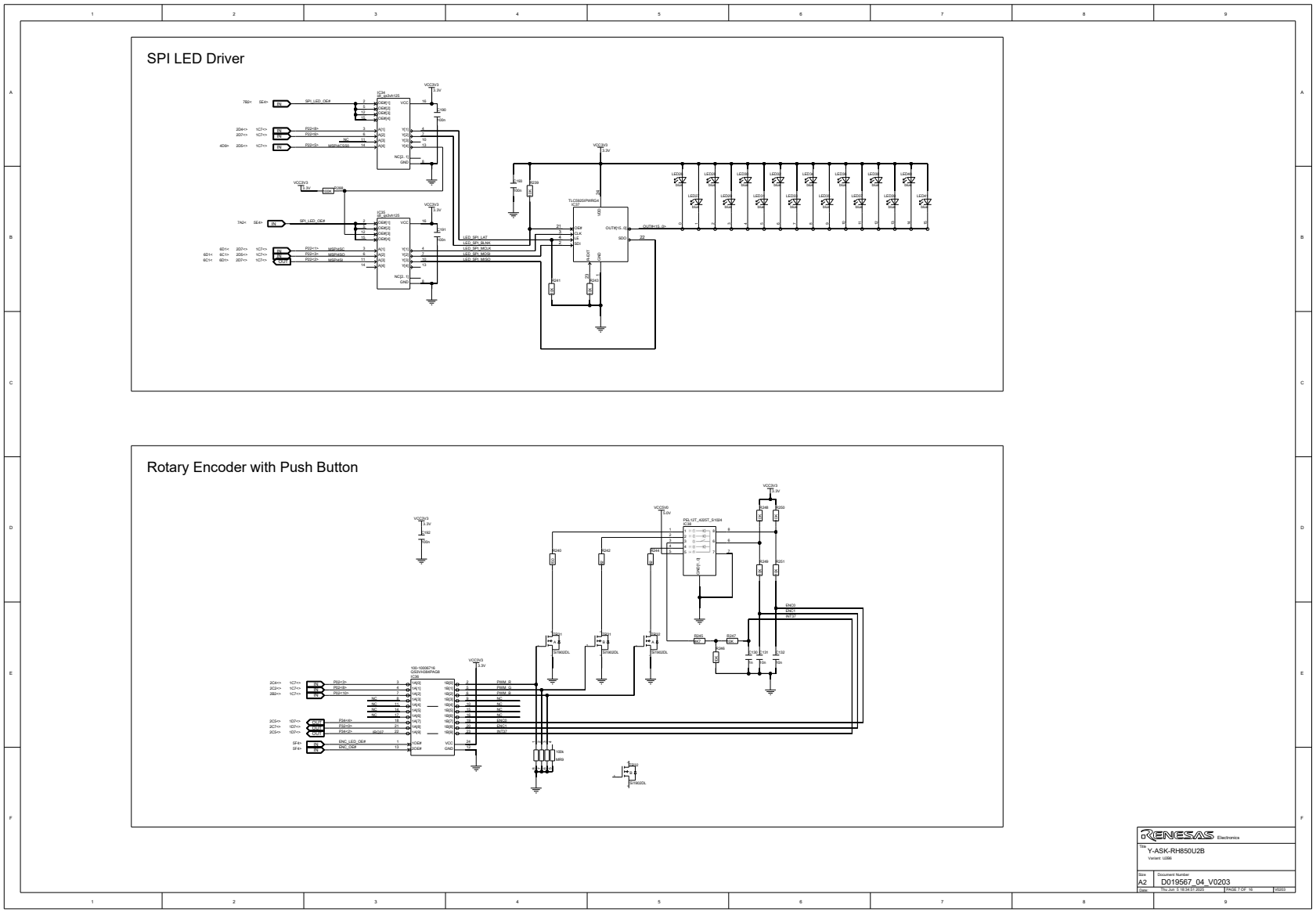
12.1.5 Interrupt Input, A/D Measurement, Signal LED



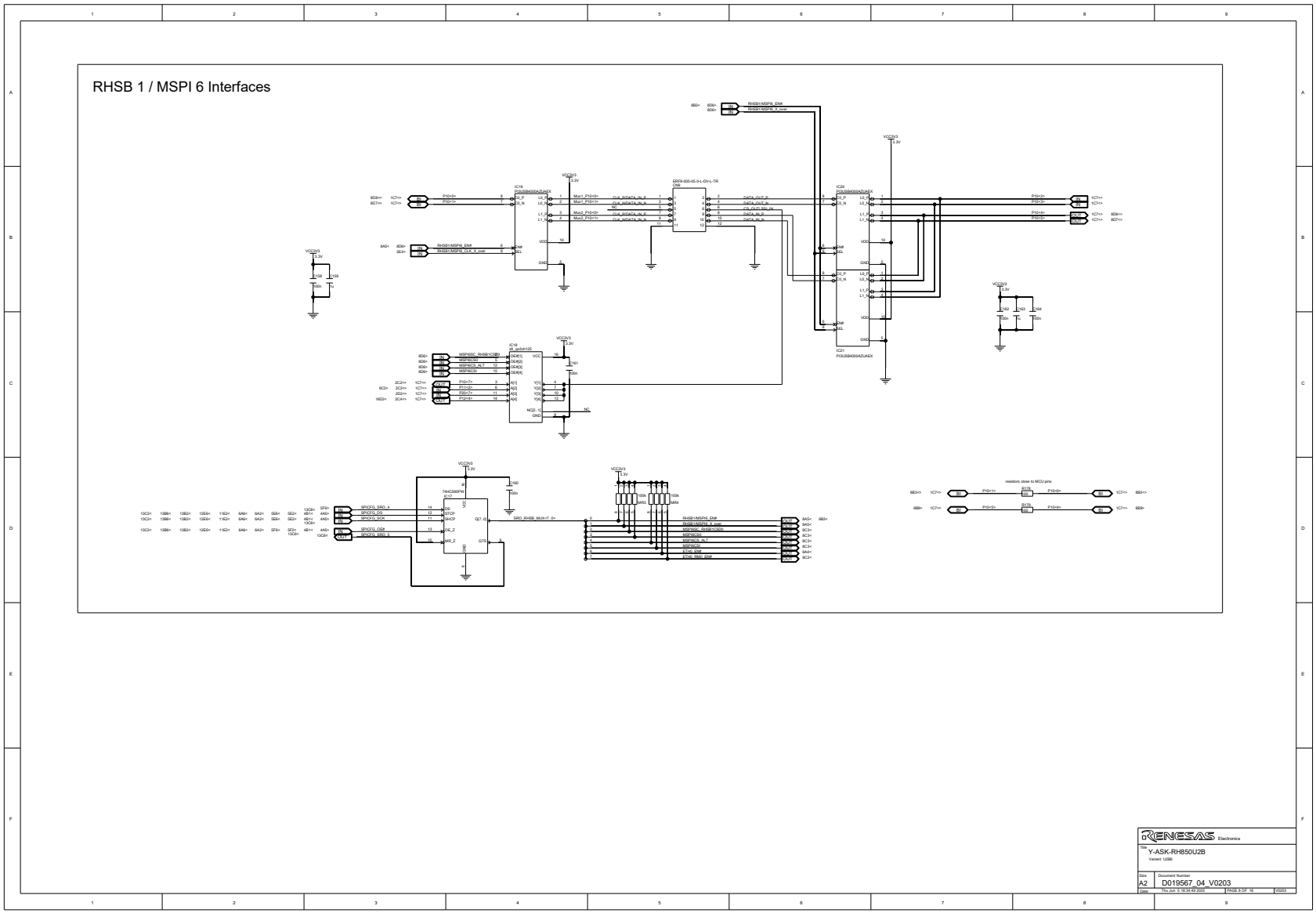
12.1.6 PMOD 0/1 Interfaces



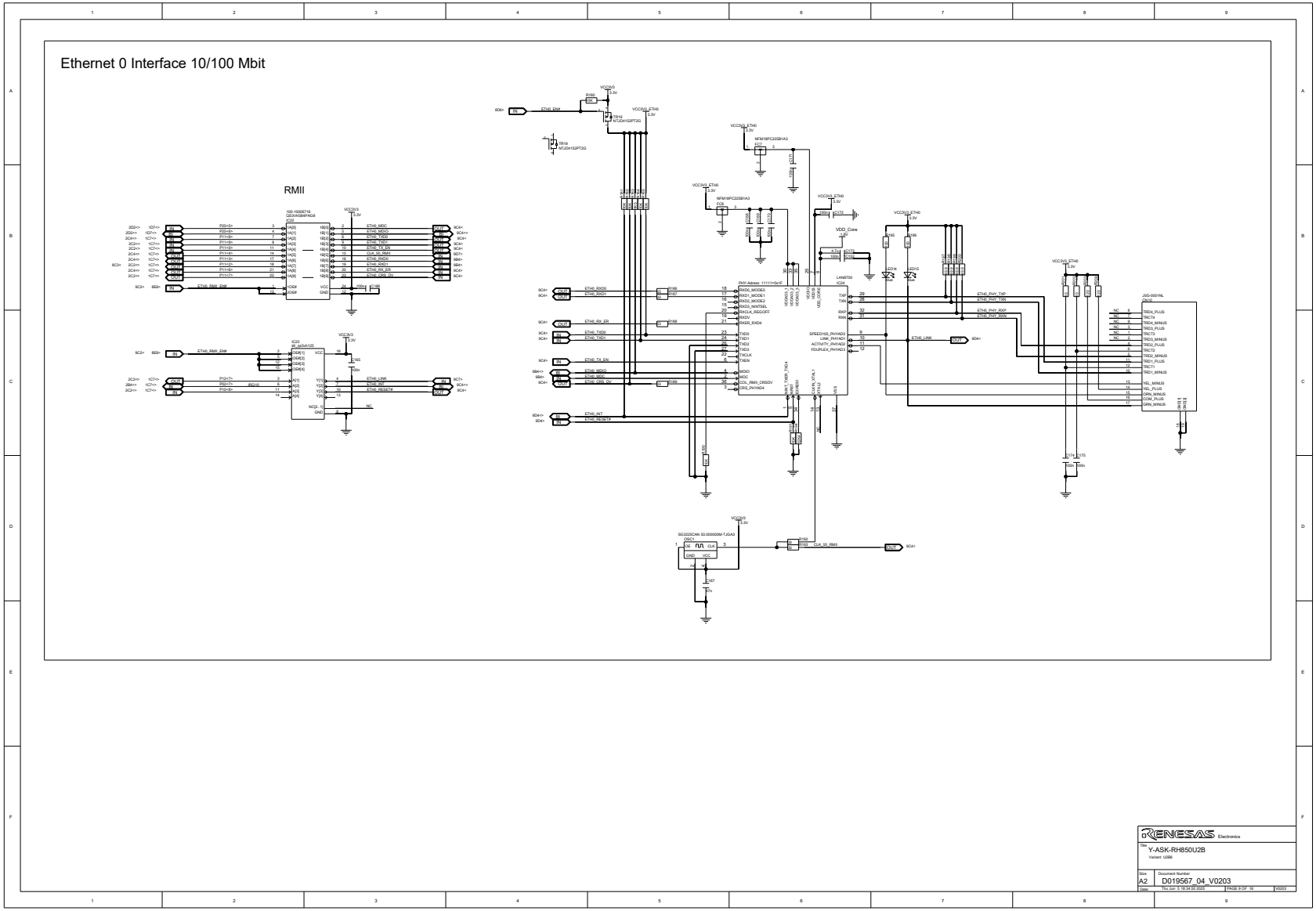
12.1.7 SPI LED & Rotary Encoder



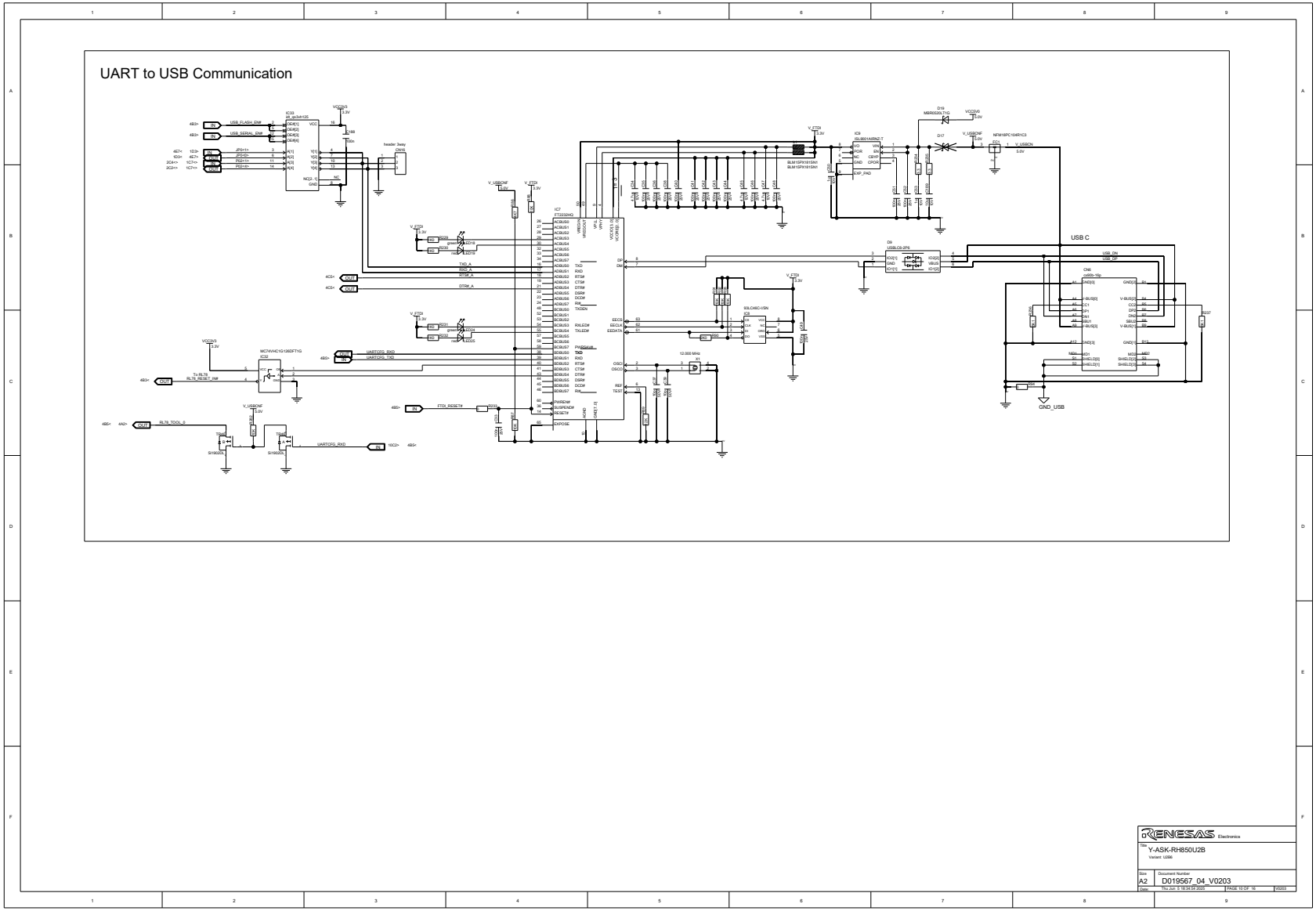
12.1.8 RHSB1 / MSPI6 Interfaces



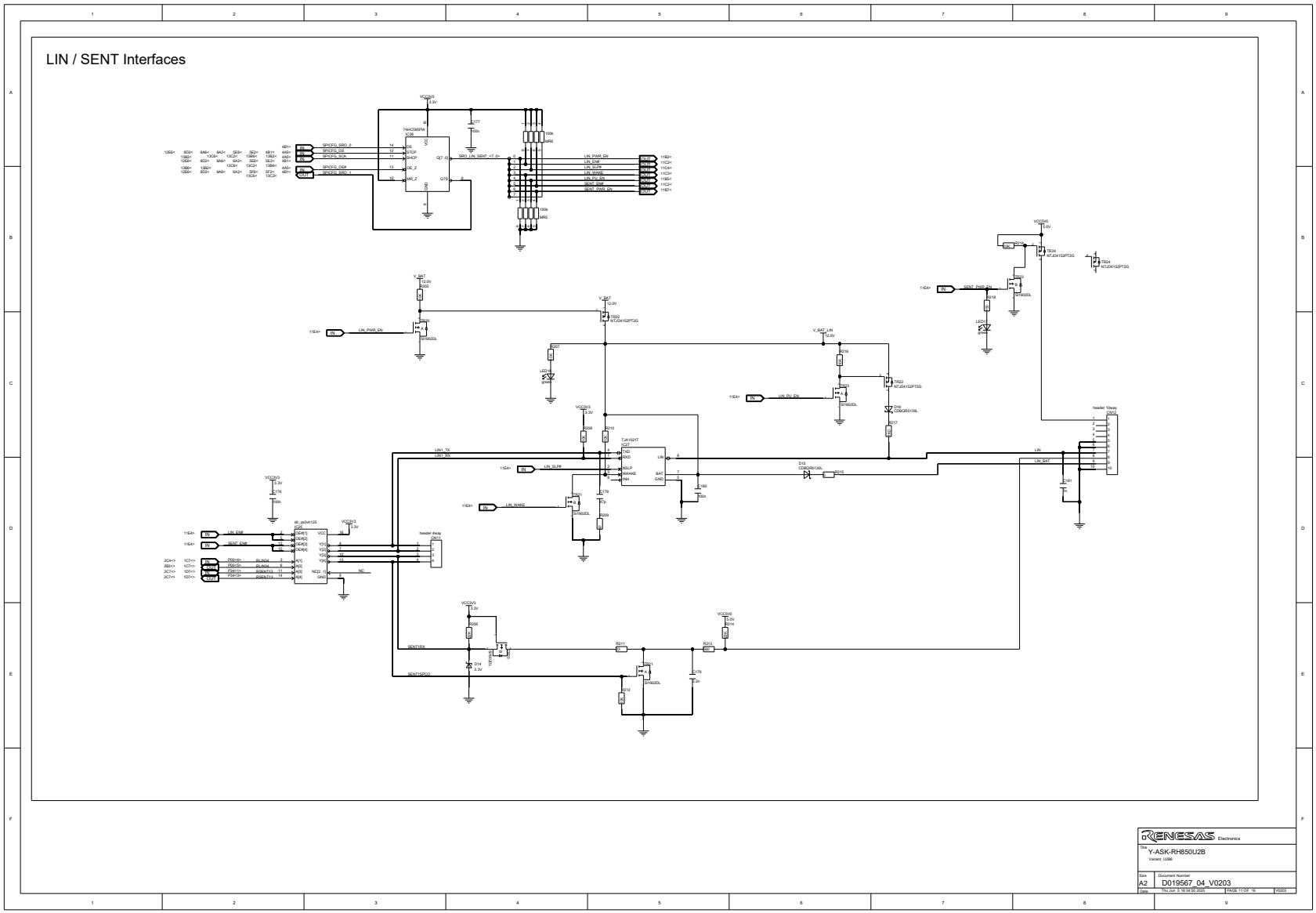
12.1.9 Ethernet Interface



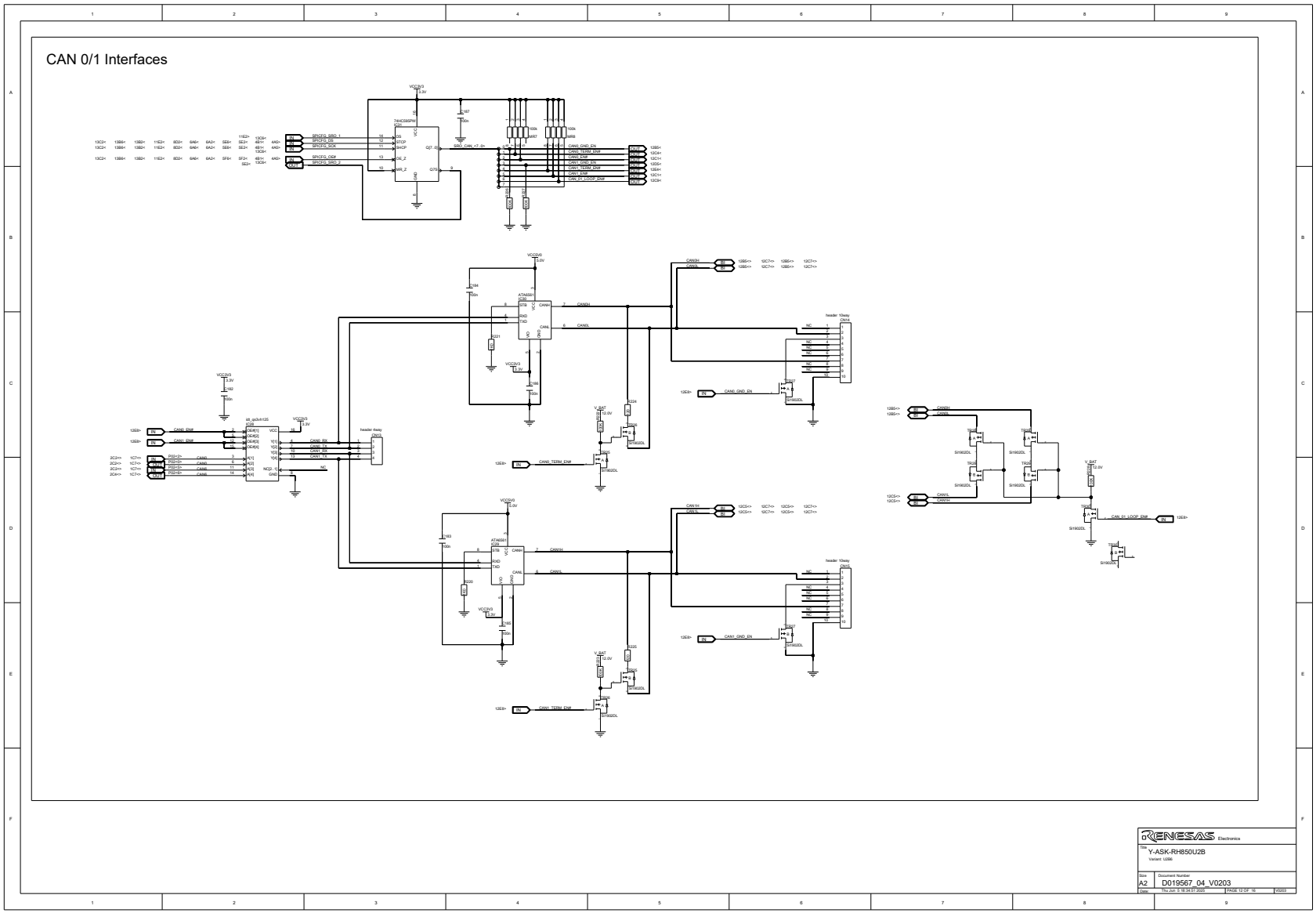
12.1.10 UART Interface



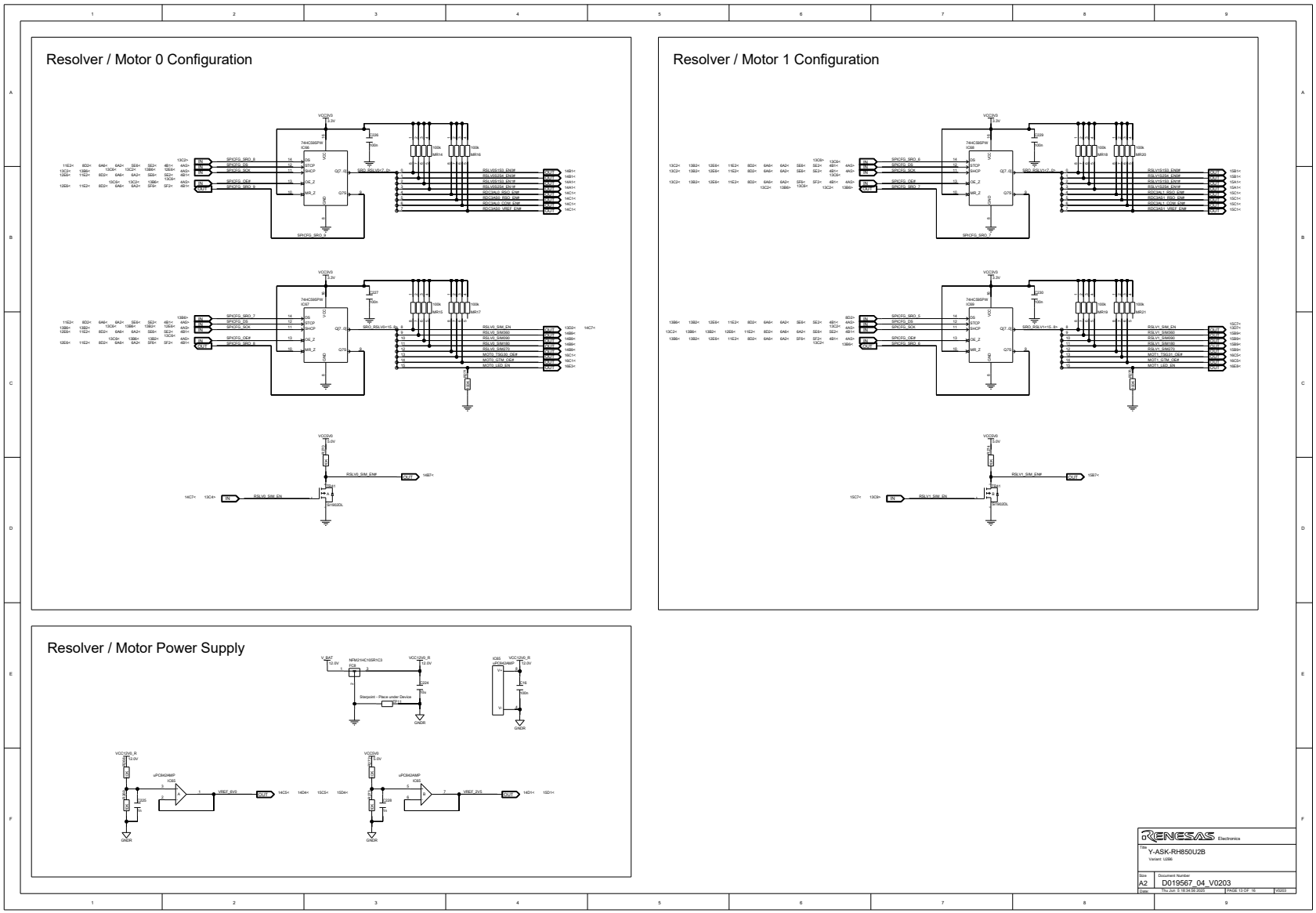
12.1.11 LIN / SENT Interfaces



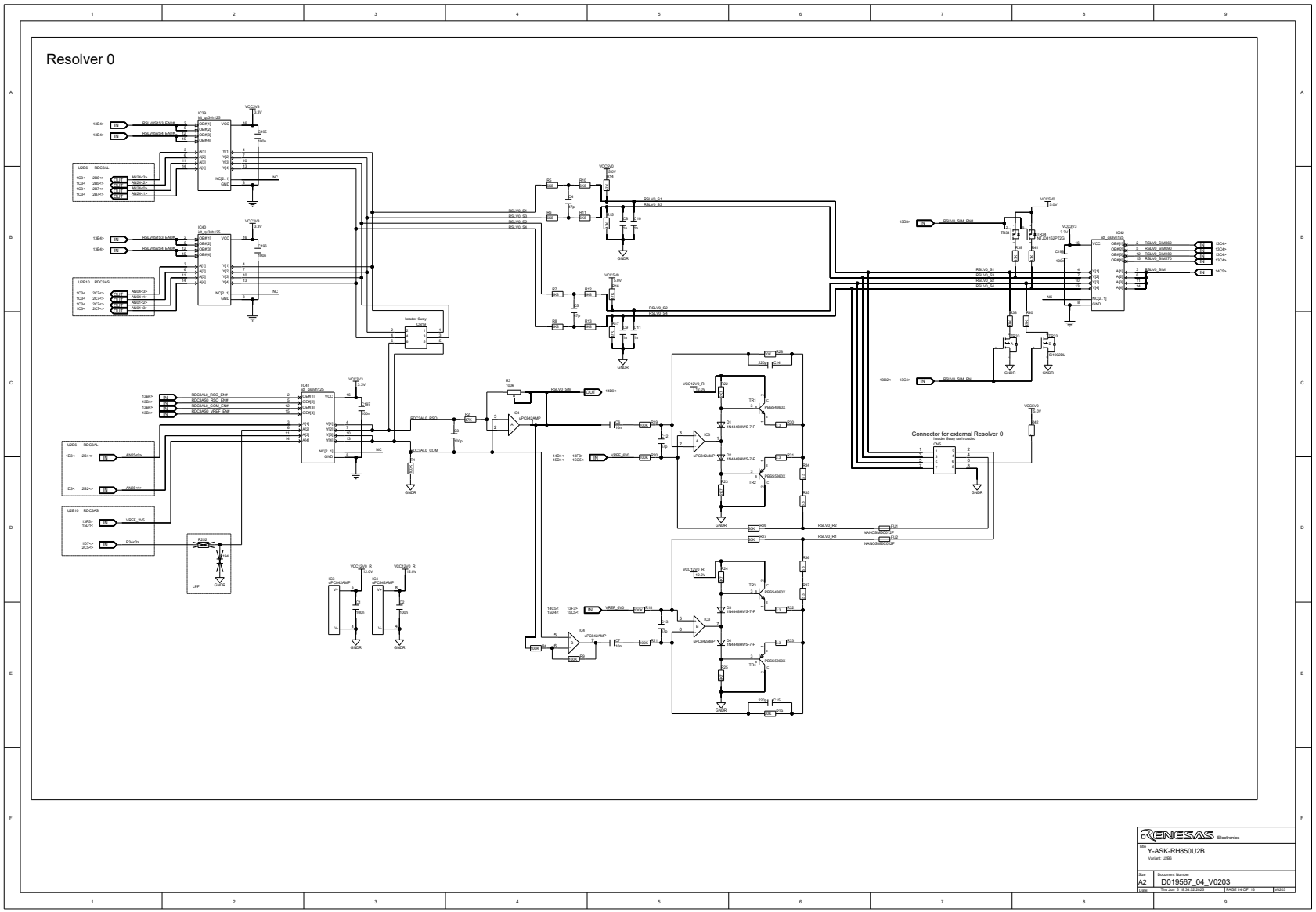
12.1.12 CAN 0/1 Interfaces



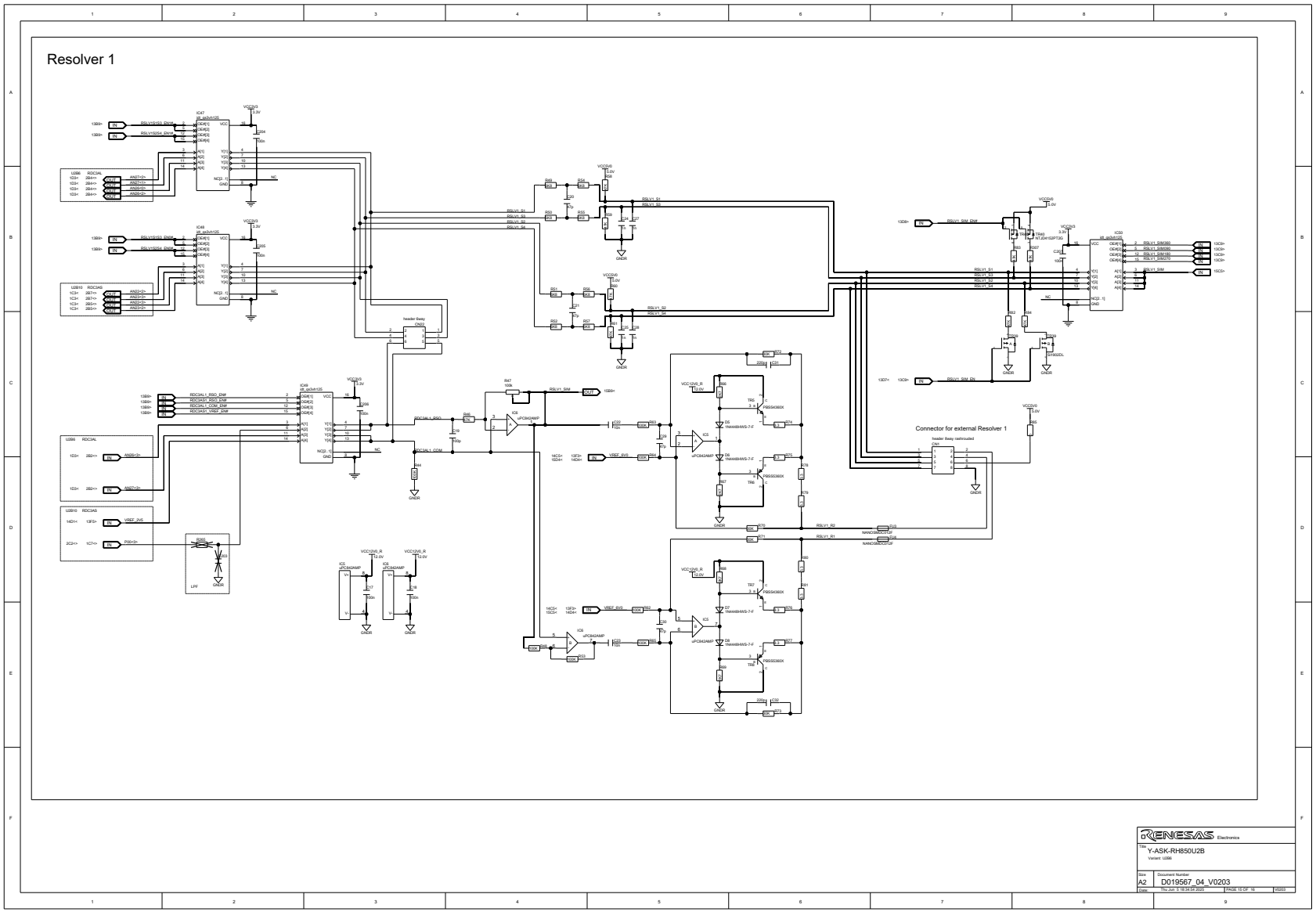
12.1.13 Resolver and Motor Control



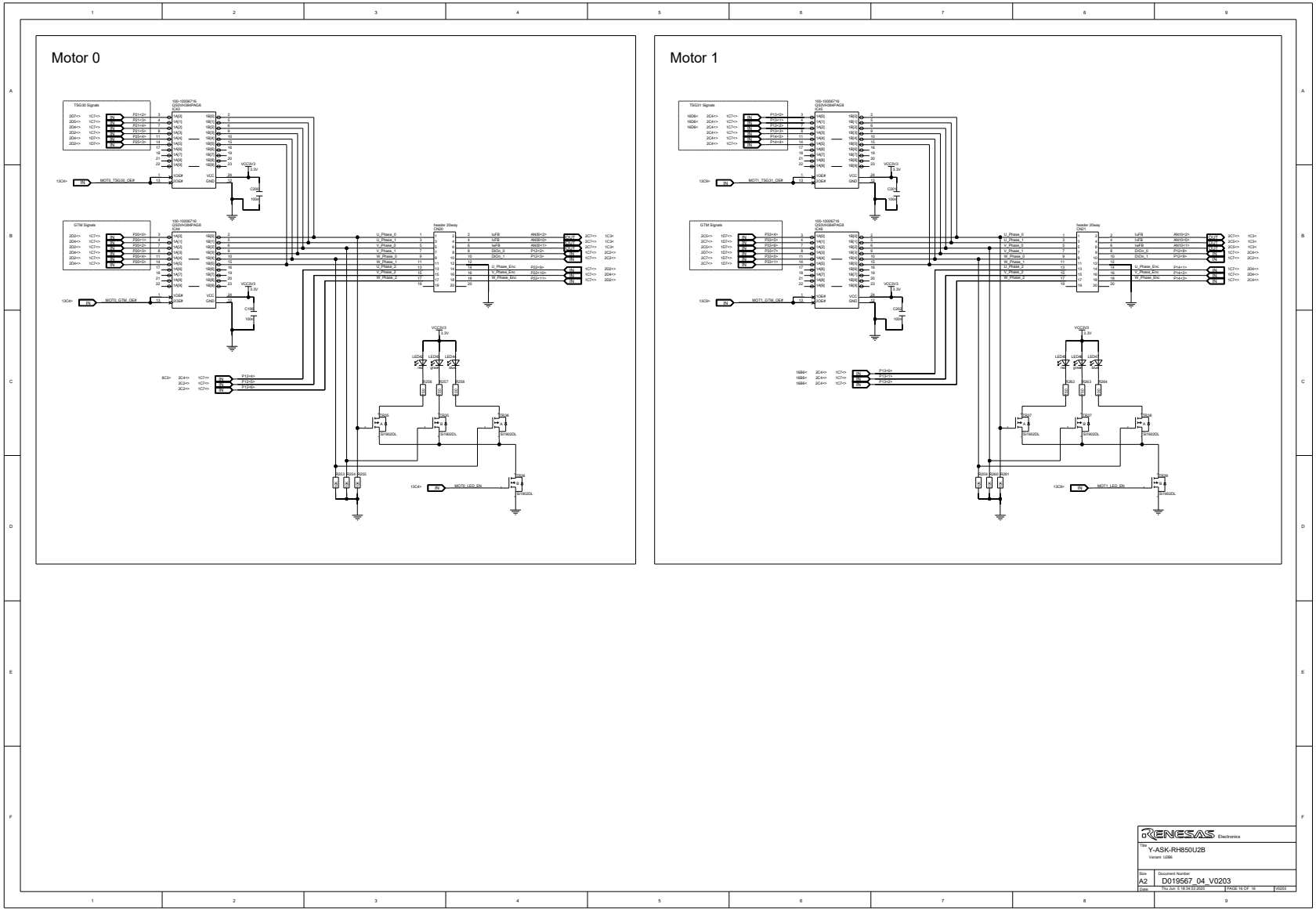
12.1.14 Resolver Circuit 0



12.1.15 Resolver Circuit 1

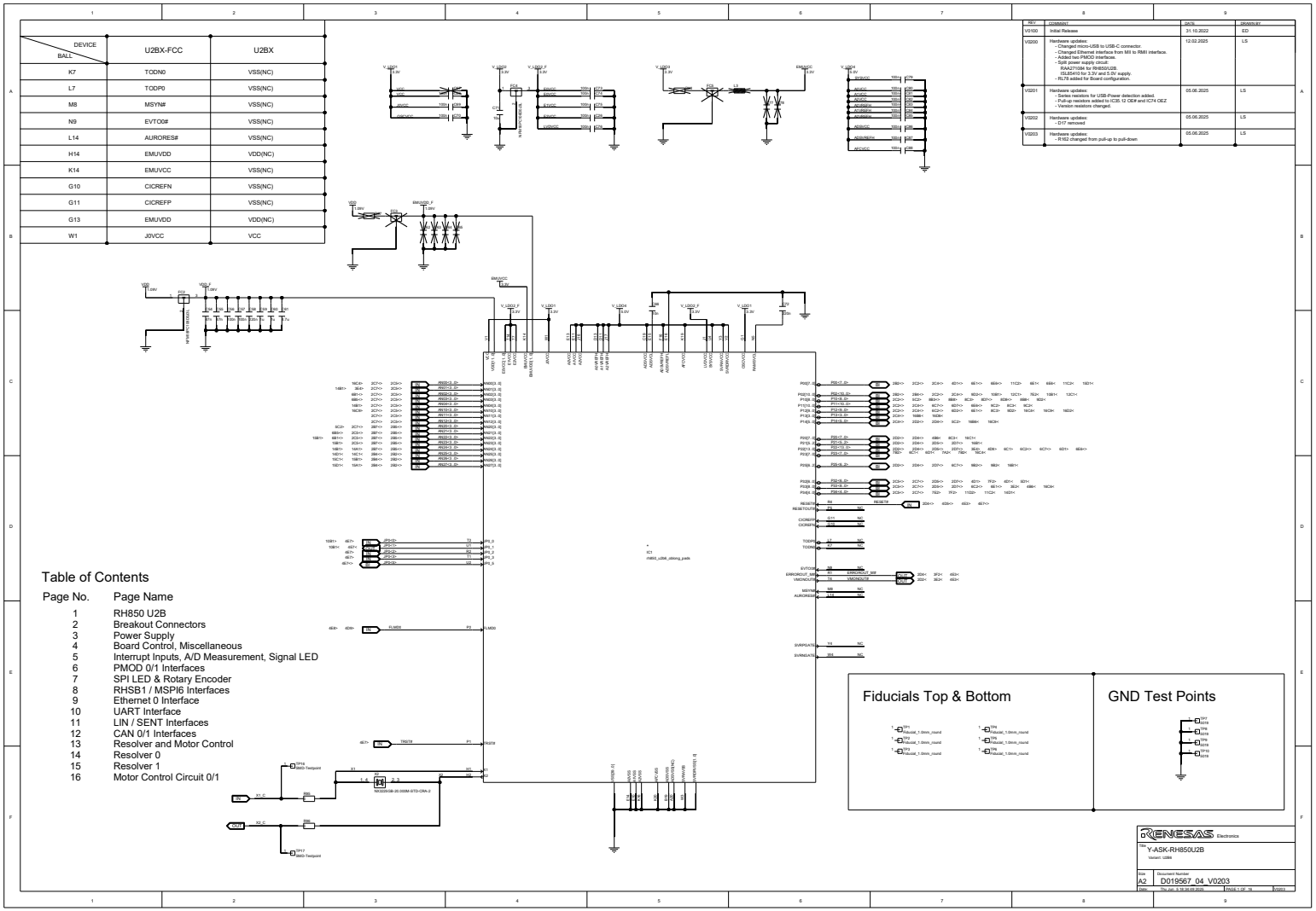


12.1.16 Motor Control Circuit 0/1



12.2 Y-ASK-RH850U2B6 (D019567_06_V0300)

12.2.1 RH850 U2B



DEVICE / BALL	U2BX-FCC	U2BX
K7	TODN0	VSS(NC)
L7	TODP0	VSS(NC)
M8	MSYN#	VSS(NC)
N9	EVTO0#	VSS(NC)
L14	AURORES#	VSS(NC)
H14	EMUVDD	VDD(NC)
K14	EMUVCC	VSS(NC)
G10	CICREFN	VSS(NC)
G11	CICREFP	VSS(NC)
G13	EMUVDD	VDD(NC)
W1	J0VCC	VCC

REV	COMMENT	DATE	DRAWN BY
V0100	Initial Release	31.10.2022	ED
V0200	Hardware updates: - Changed micro-USB to USB-C connector. - Added Ethernet interface from MII to RMII interface. - Added two PMOD interfaces. - Split power supply circuit: RAA271094 for RH850/U2B, ISL85410 for 3.3V and 5.0V supply. - RL78 added for Board configuration.	12.02.2025	LS
V0201	Hardware updates: - Series resistors for USB-Power detection added. - Pull-up resistors added to IC35, 12 OE# and IC74 OE2 - Version resistors changed.	05.06.2025	LS
V0202	Hardware updates: - D17 removed.	05.06.2025	LS
V0203	Hardware updates: - R162 changed from pull-up to pull-down	05.06.2025	LS

Table of Contents

Page No.	Page Name
1	RH850 U2B
2	Breakout Connectors
3	Power Supply
4	Board Control, Miscellaneous
5	Interrupt Inputs, A/D Measurement, Signal LED
6	PMOD 0/1 Interfaces
7	SPI LED & Rotary Encoder
8	RHSB1 / MSPI6 Interfaces
9	Ethernet 0 Interface
10	UART Interface
11	LIN / SENT Interfaces
12	CAN 0/1 Interfaces
13	Resolver and Motor Control
14	Resolver 0
15	Resolver 1
16	Motor Control Circuit 0/1

Fiducials Top & Bottom

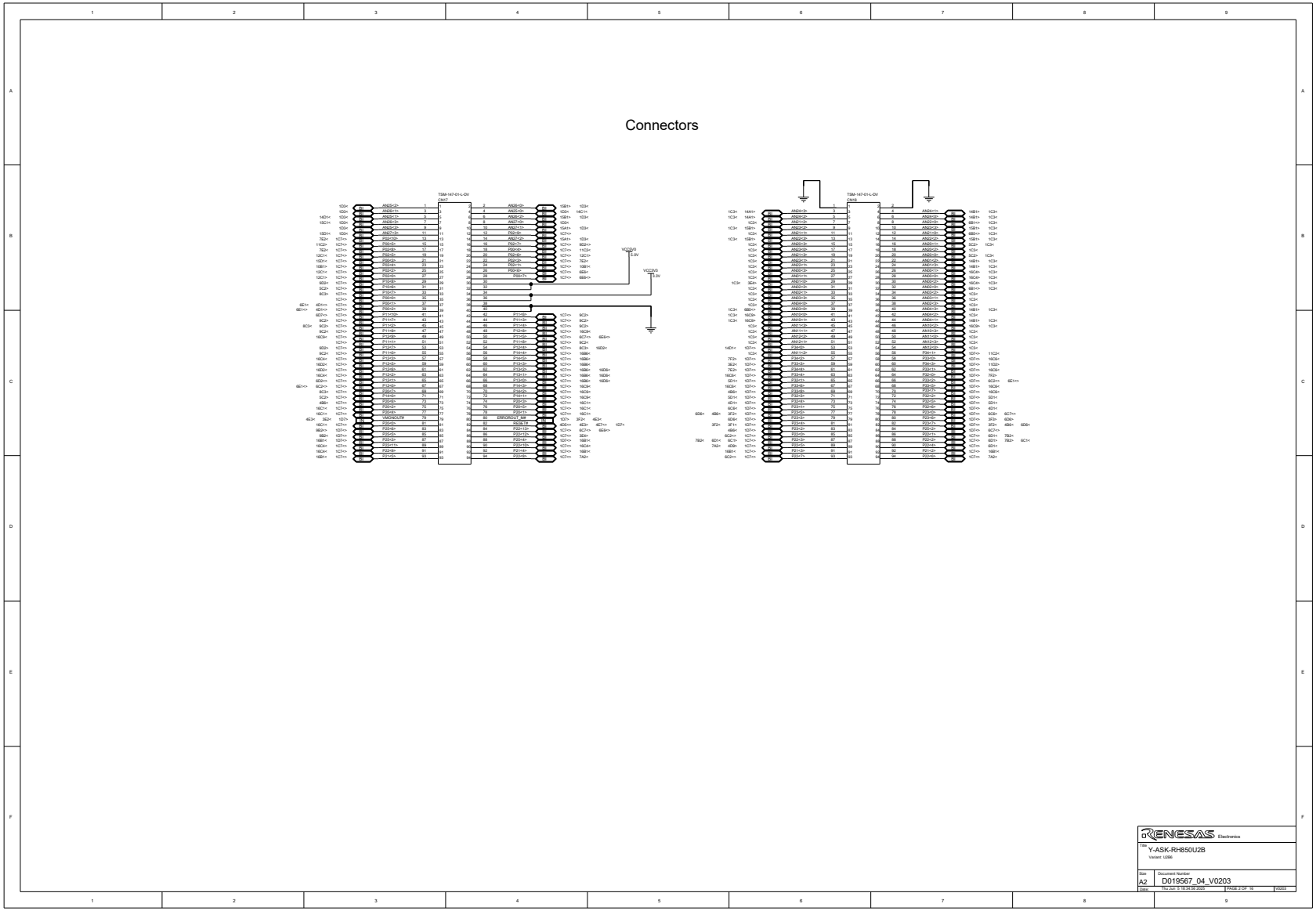
GND Test Points

RENESAS Electronics

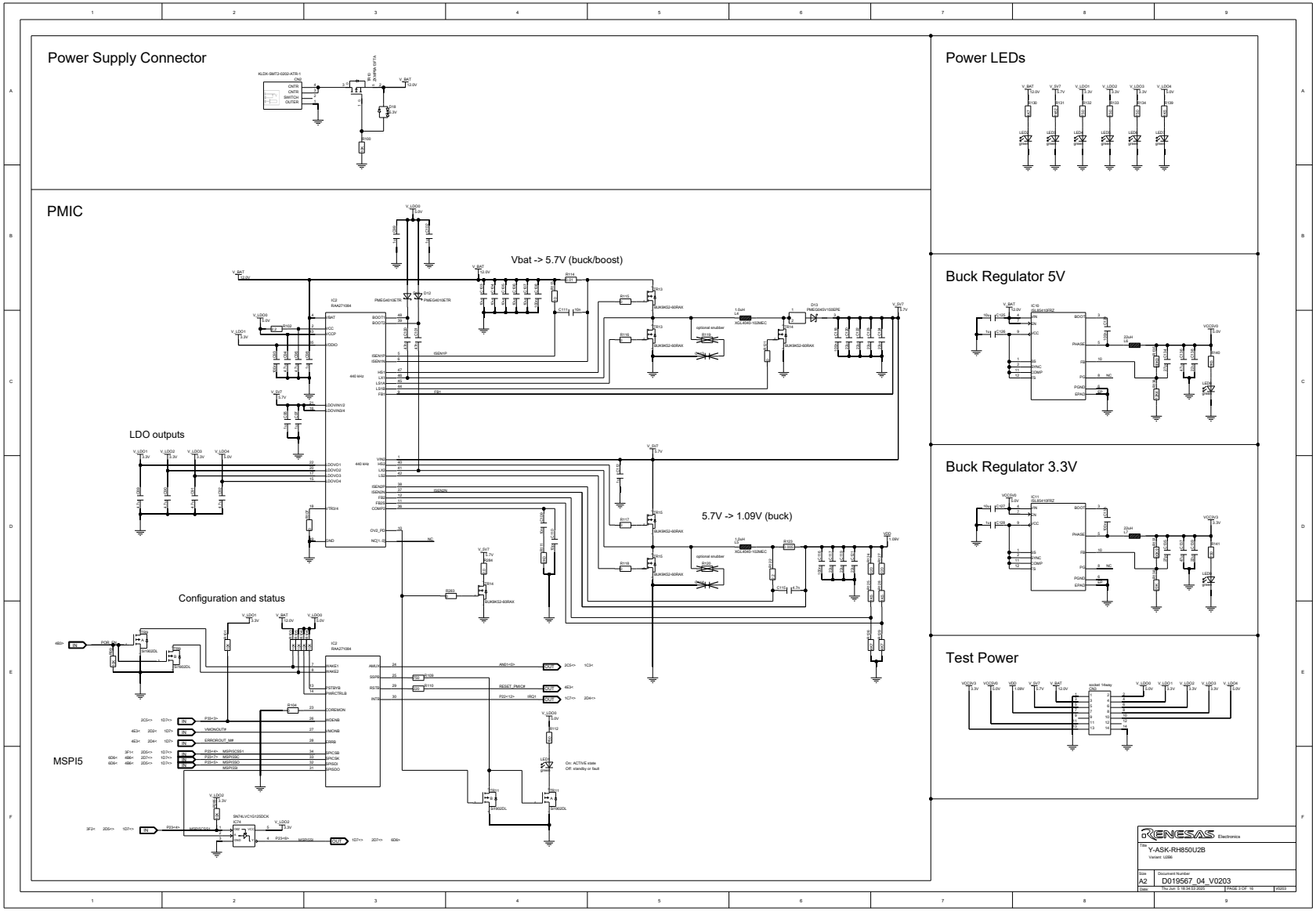
Y-ASK-RH850U2B

A2 D019567_04_V0203

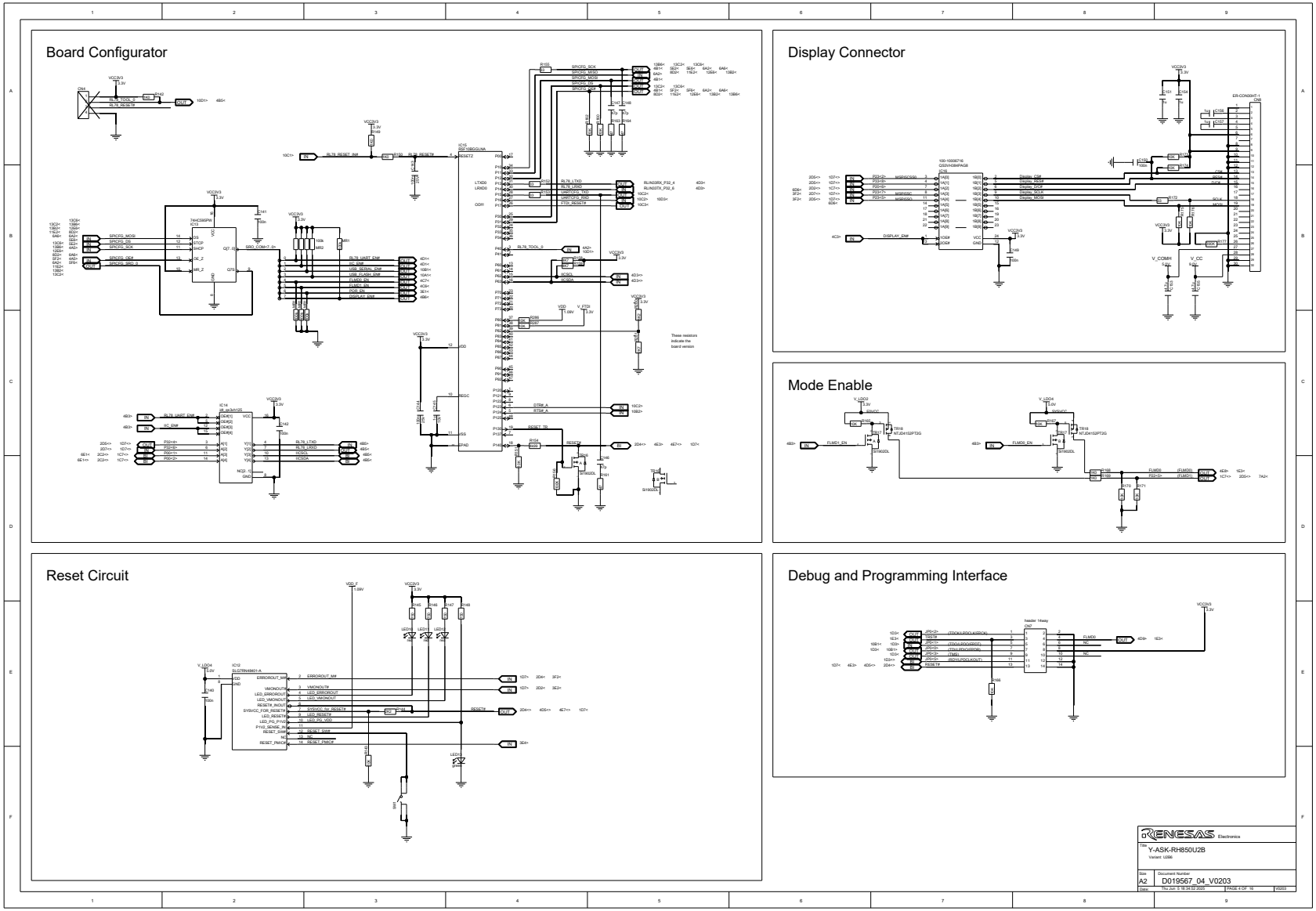
12.2.2 Breakout Connectors



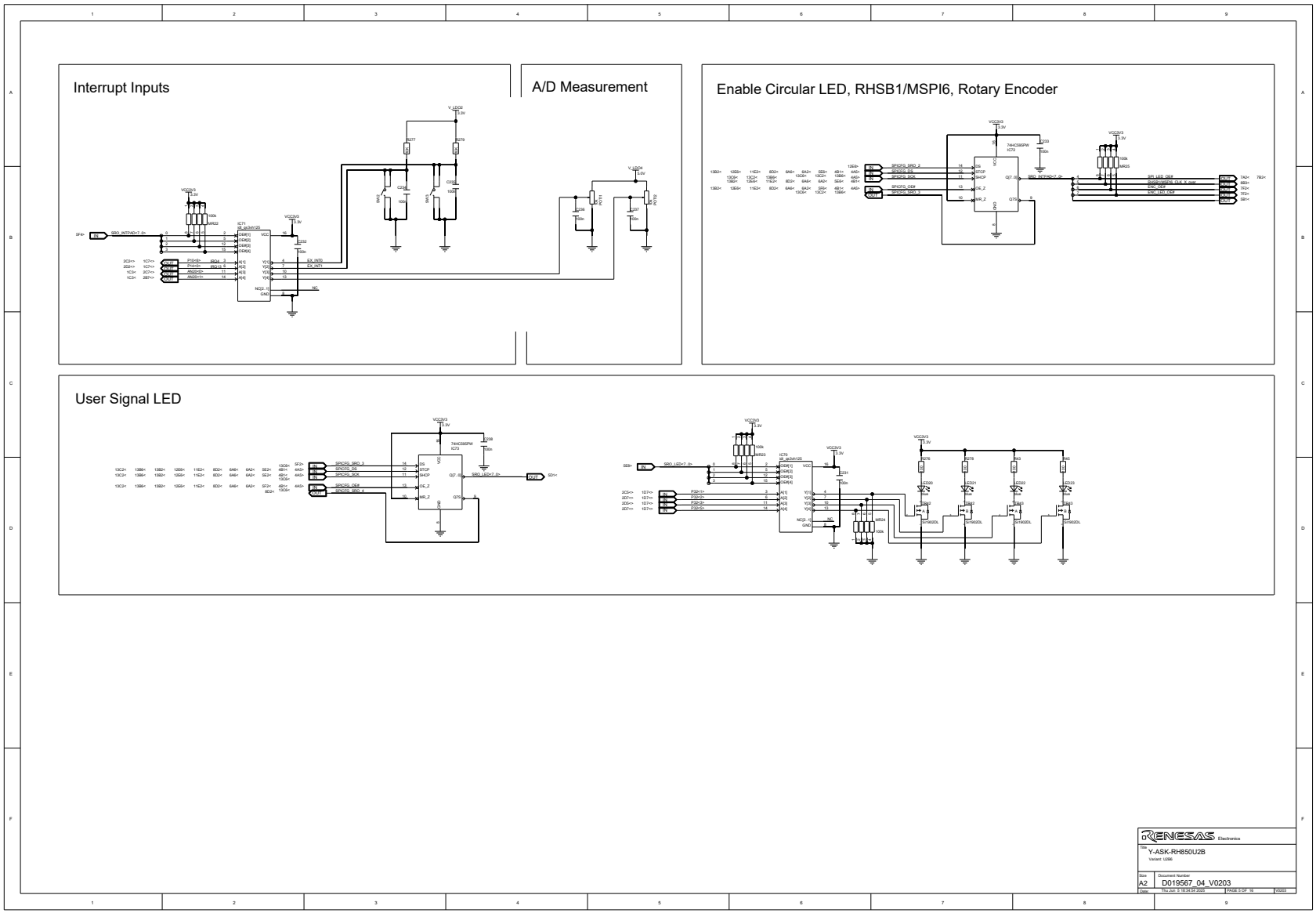
12.2.3 Power Supply



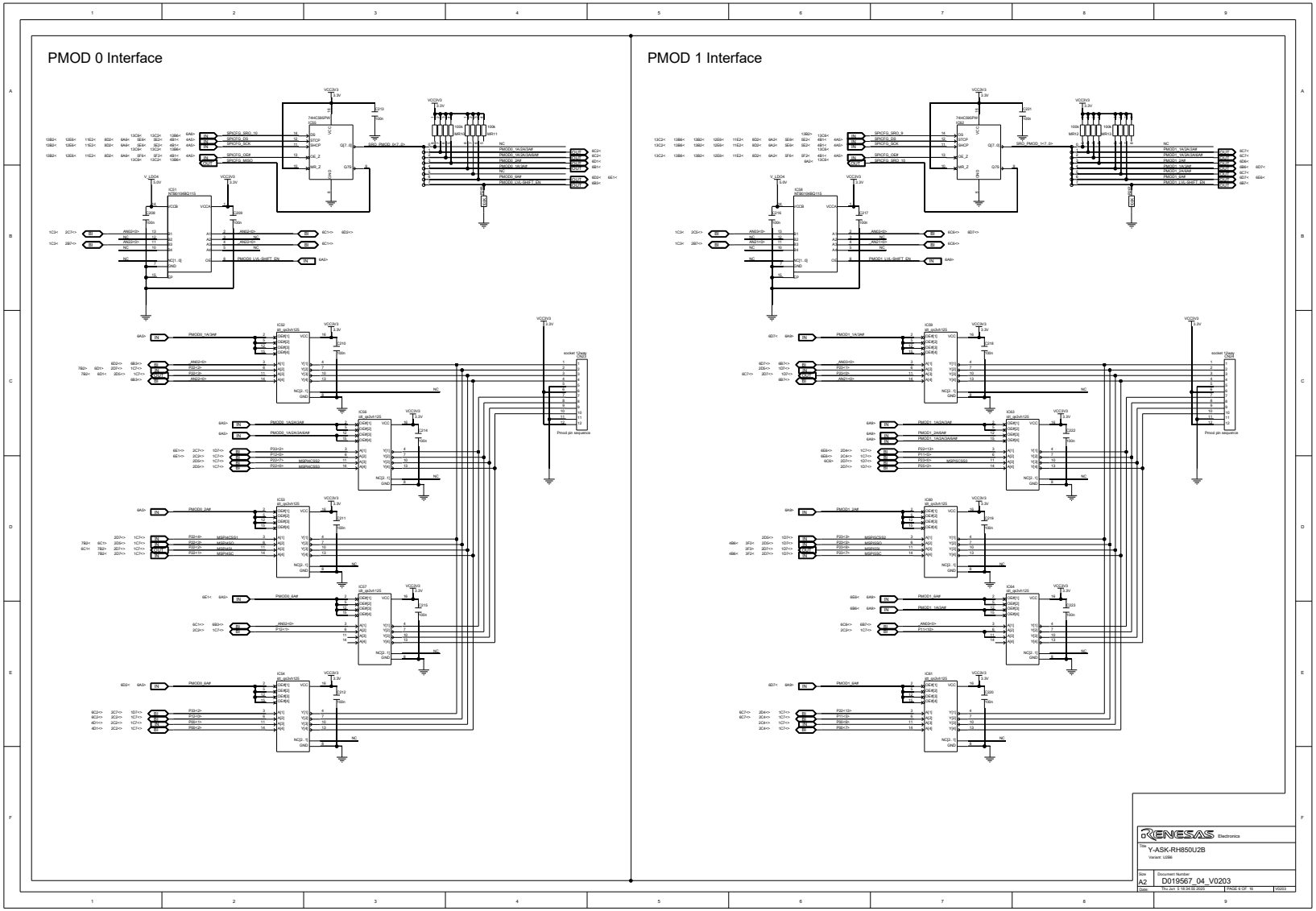
12.2.4 Board Control, Miscellaneous



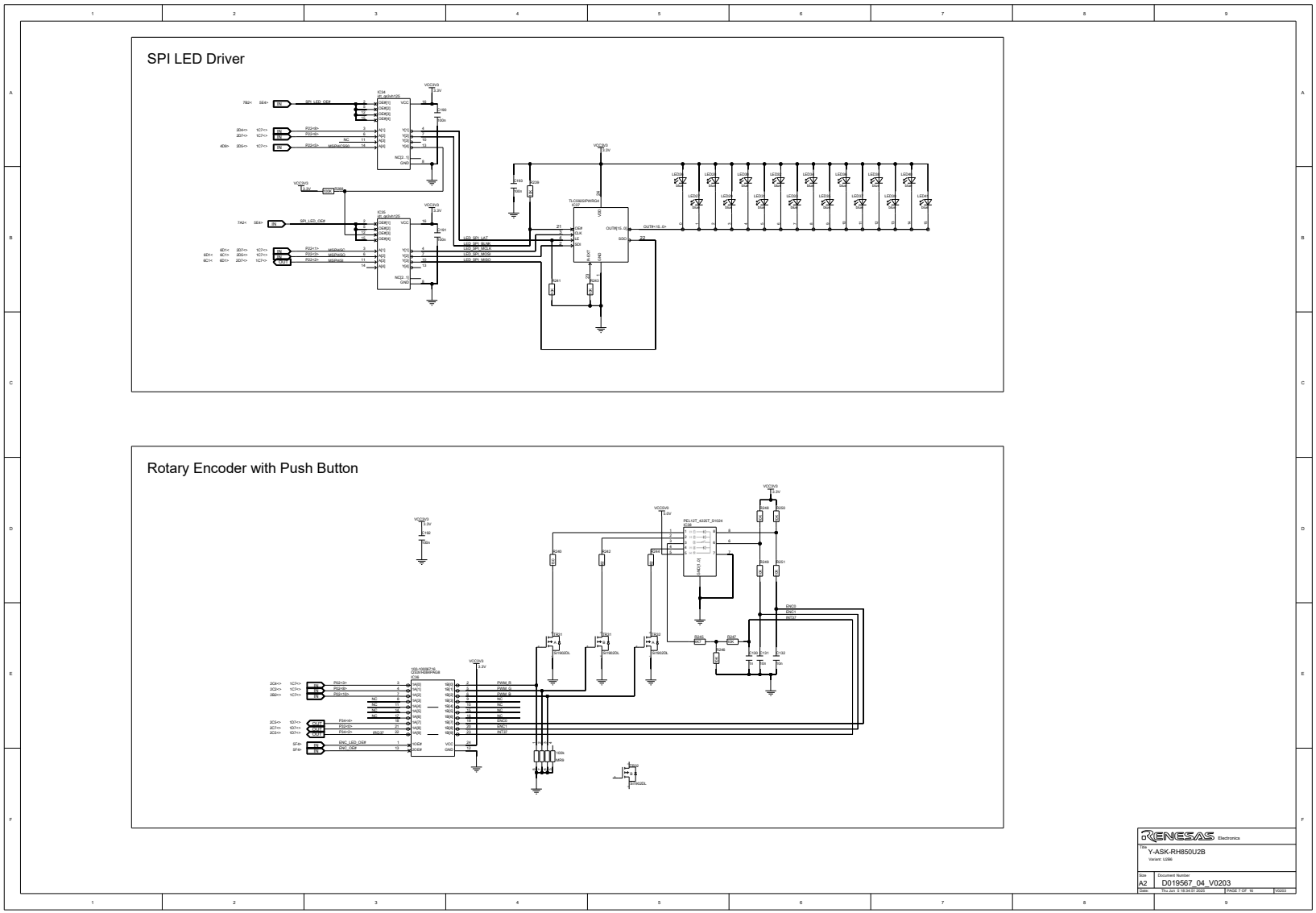
12.2.5 Interrupt Input, A/D Measurement, Signal LED



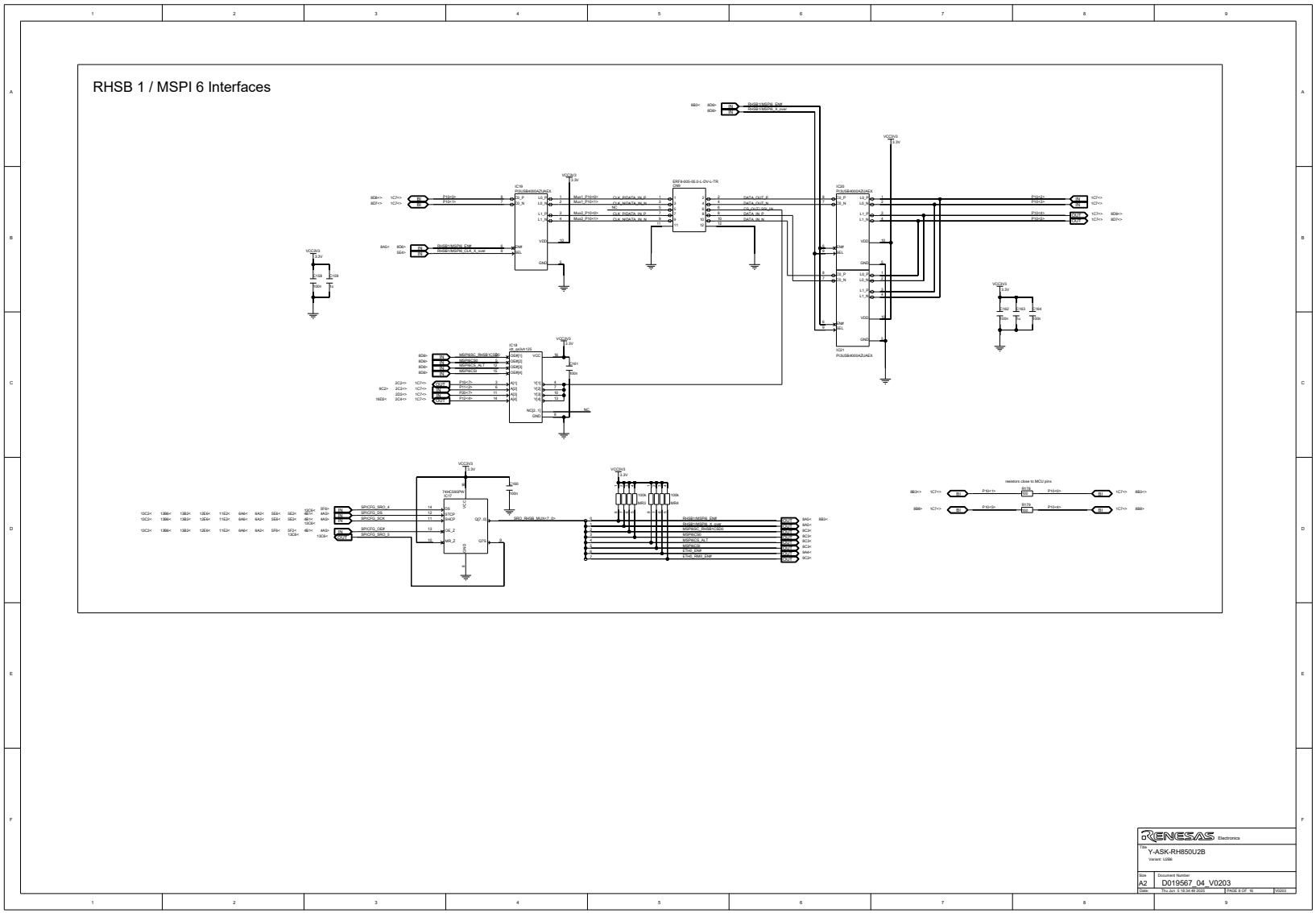
12.2.6 PMOD 0/1 Interfaces



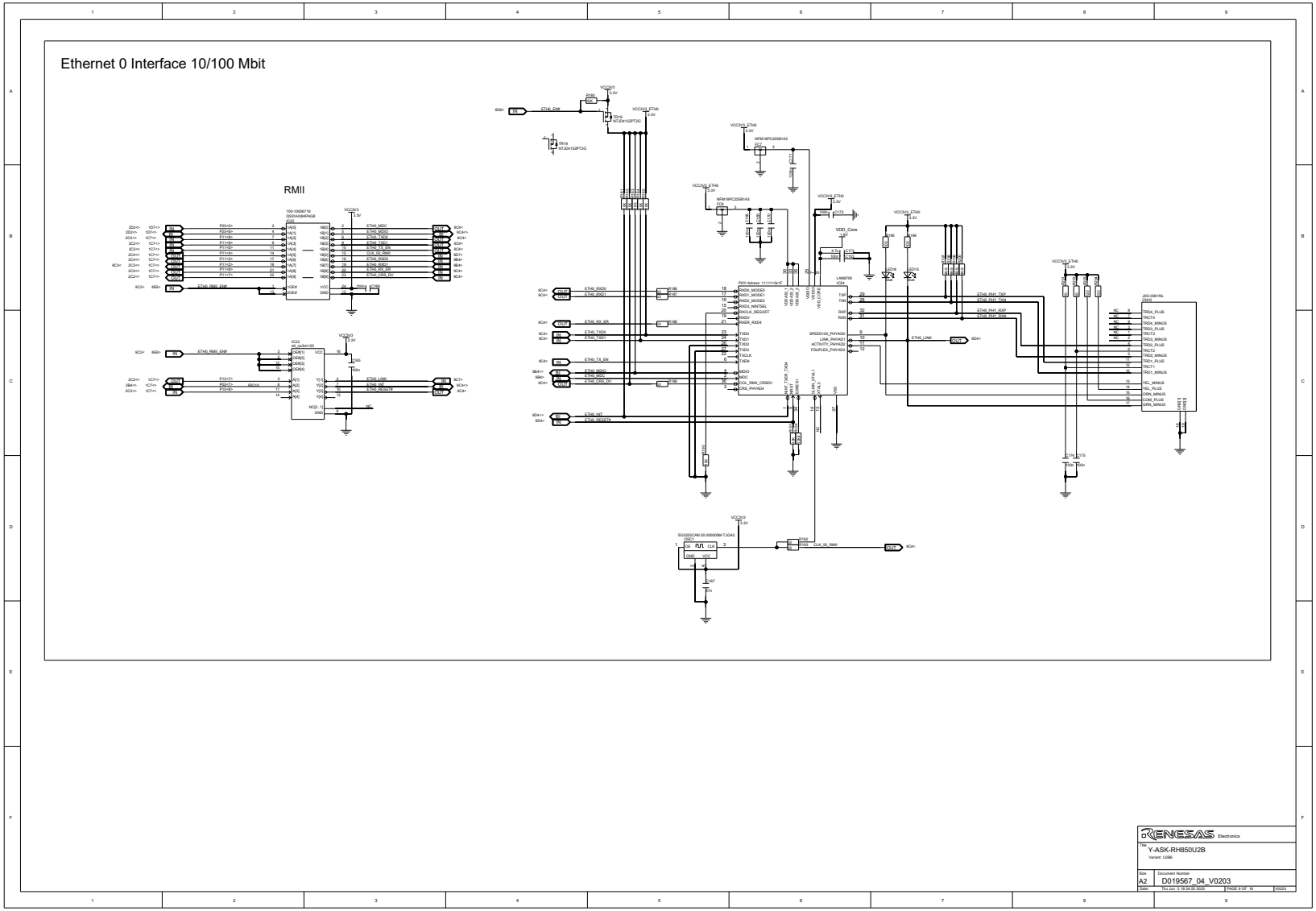
12.2.7 SPI LED & Rotary Encoder



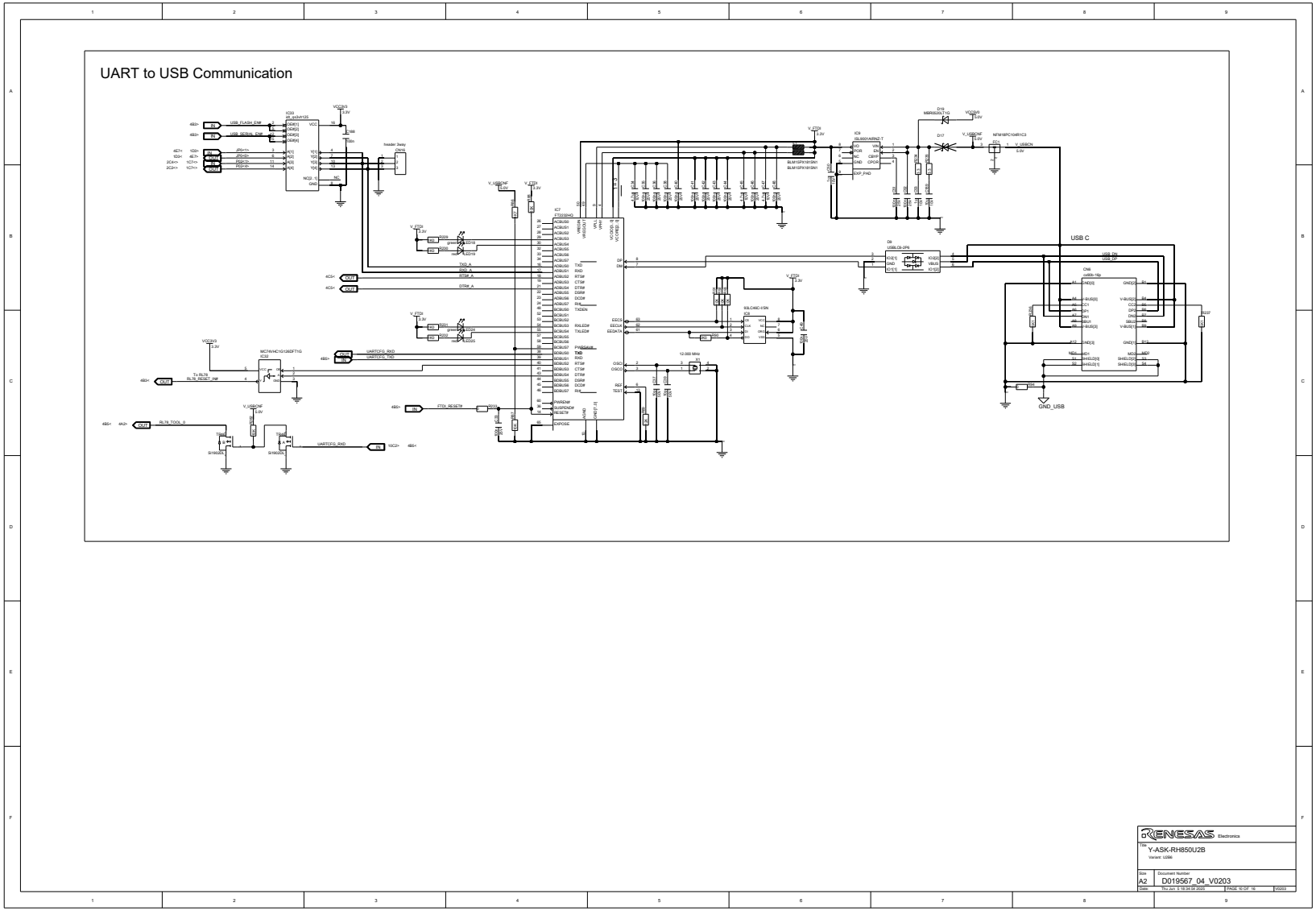
12.2.8 RHSB1 / MSPI6 Interfaces



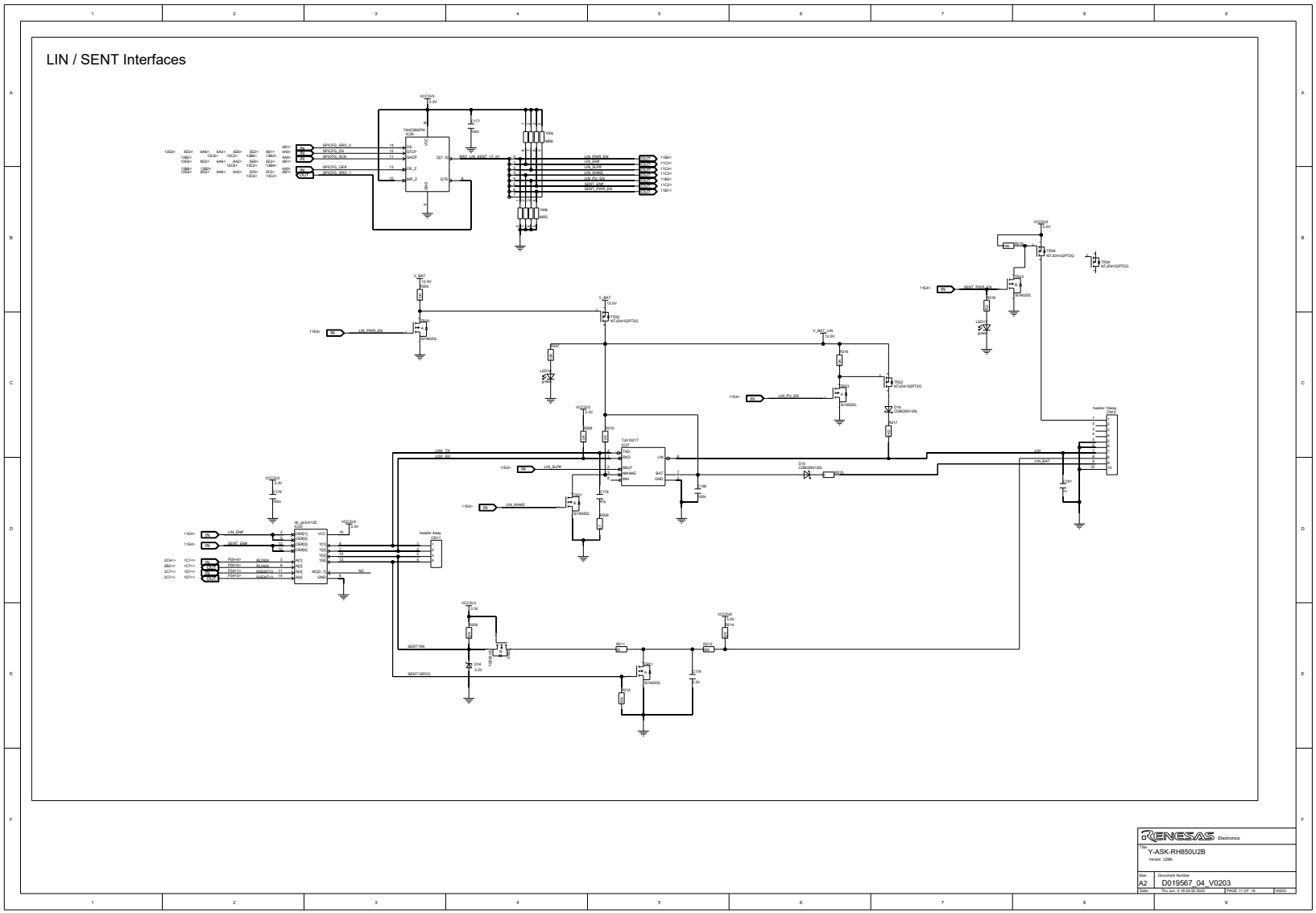
12.2.9 Ethernet Interface



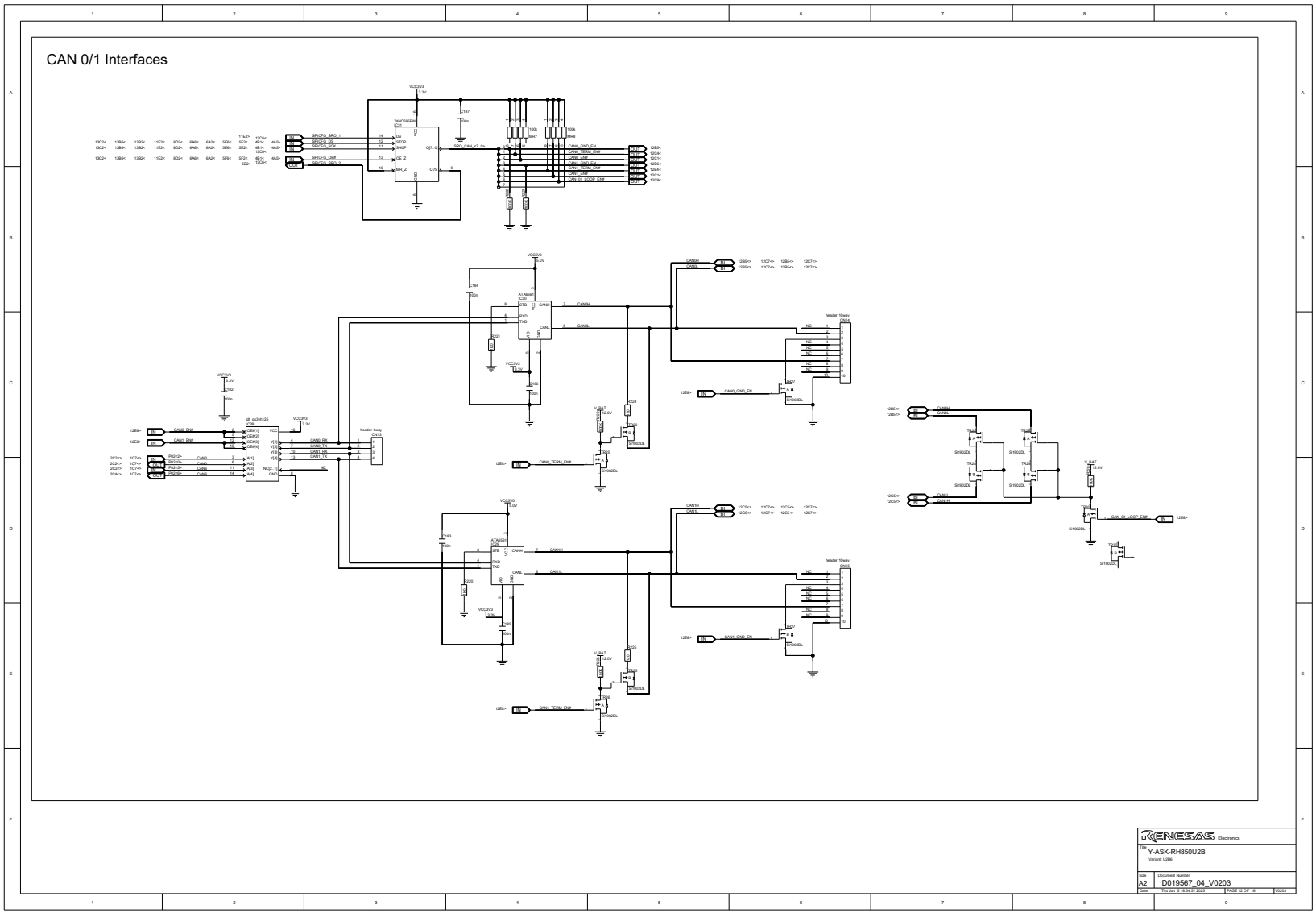
12.2.10 UART Interface



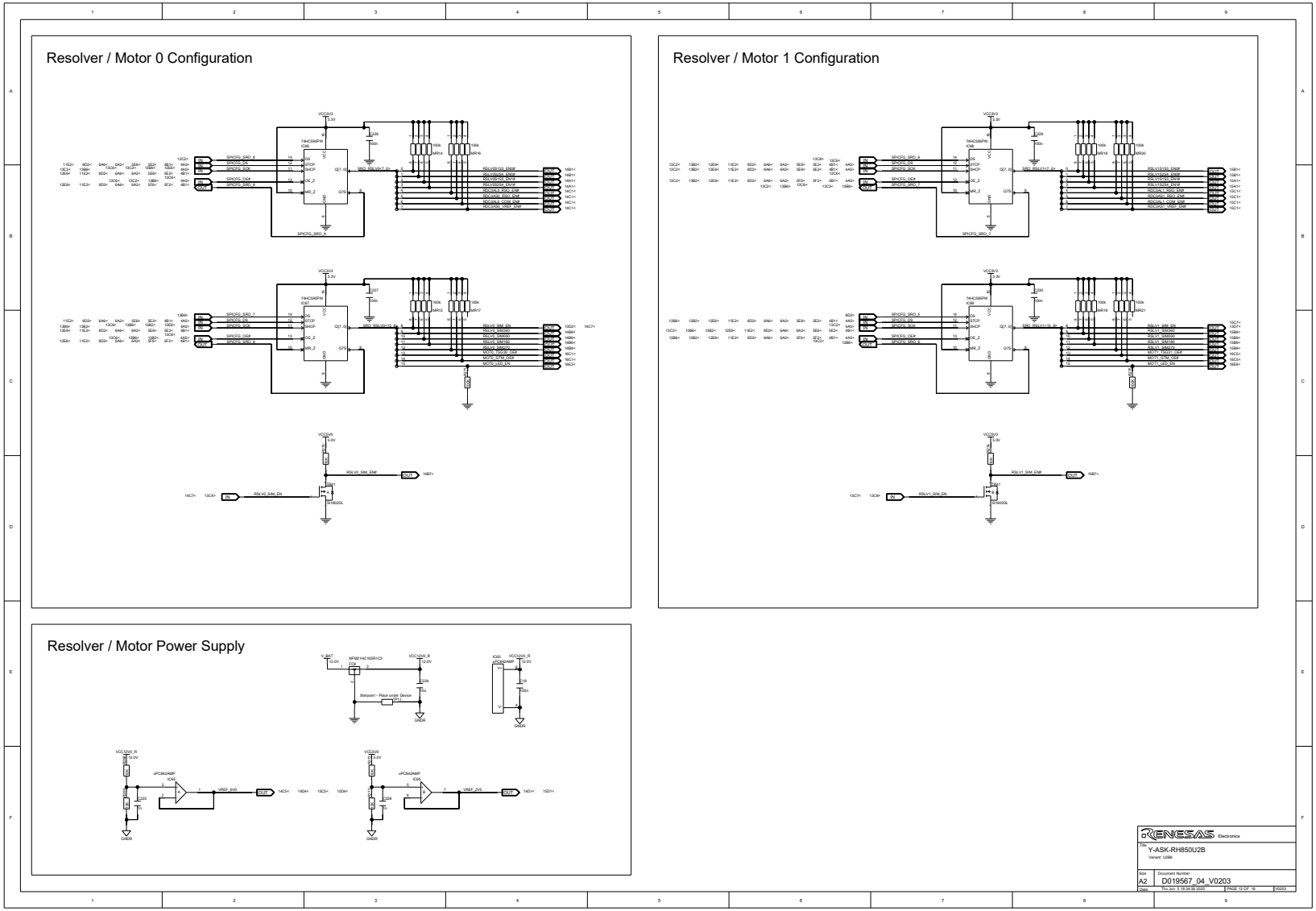
12.2.11 LIN / SENT Interfaces



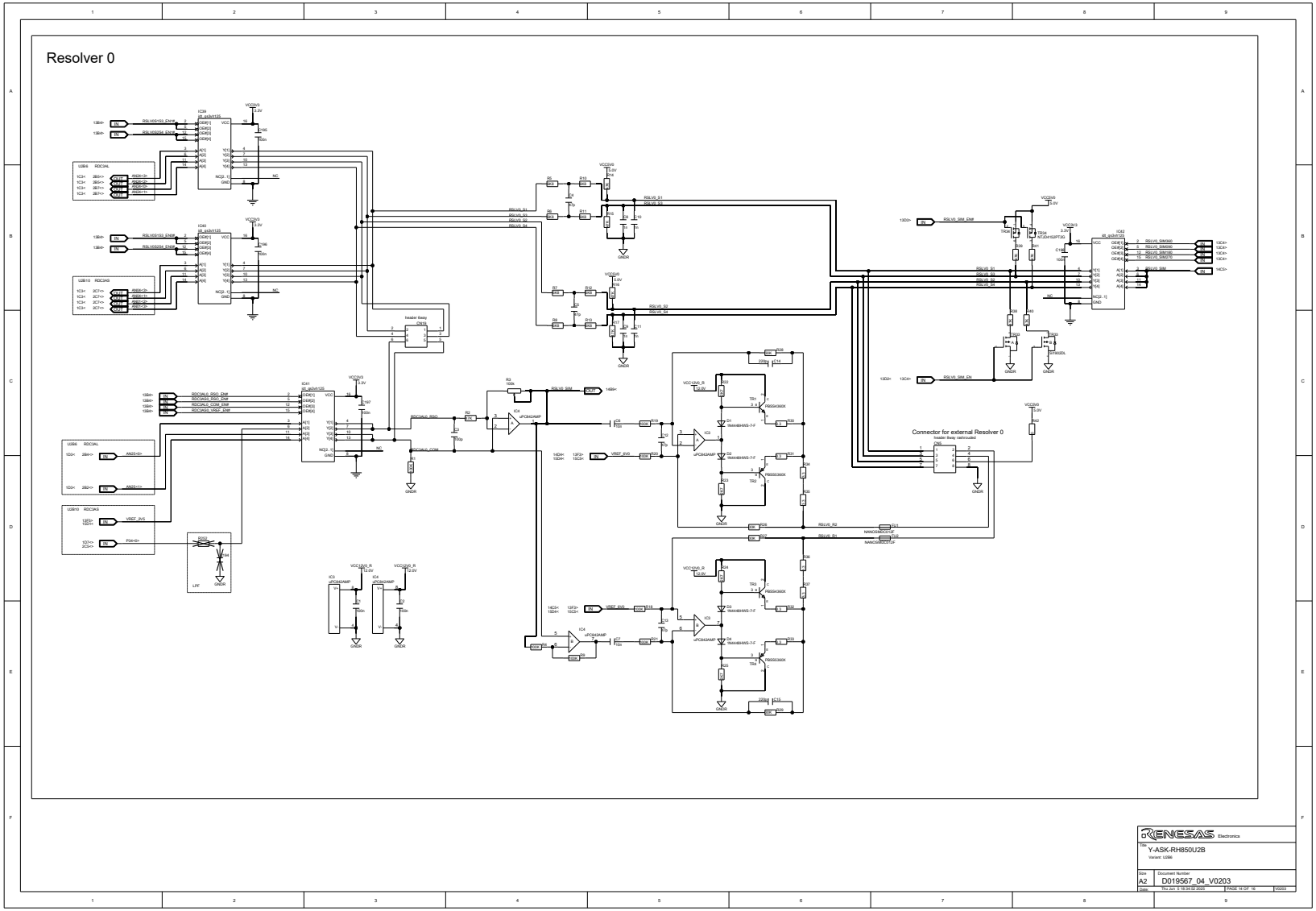
12.2.12 CAN 0/1 Interfaces



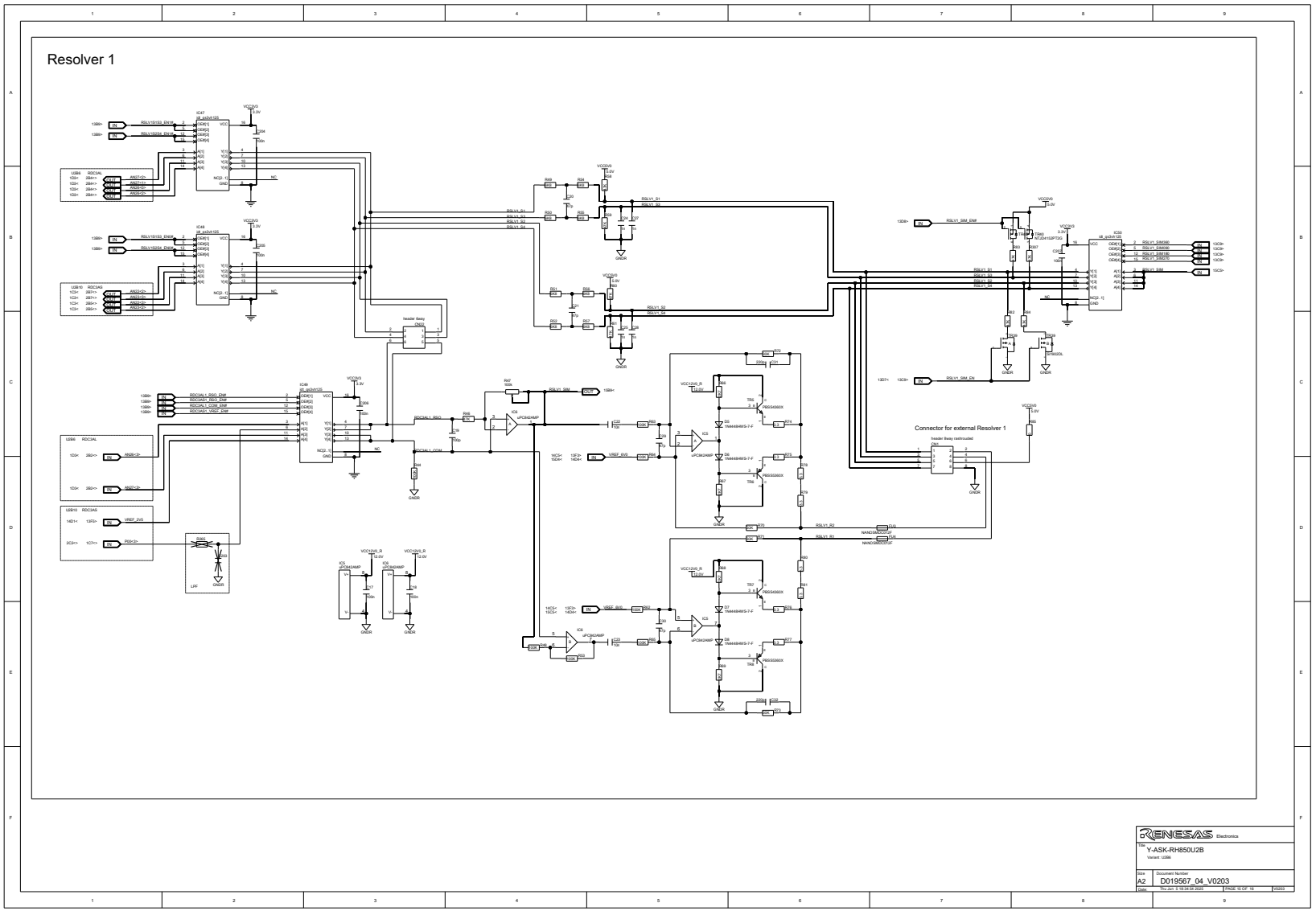
12.2.13 Resolver and Motor Control



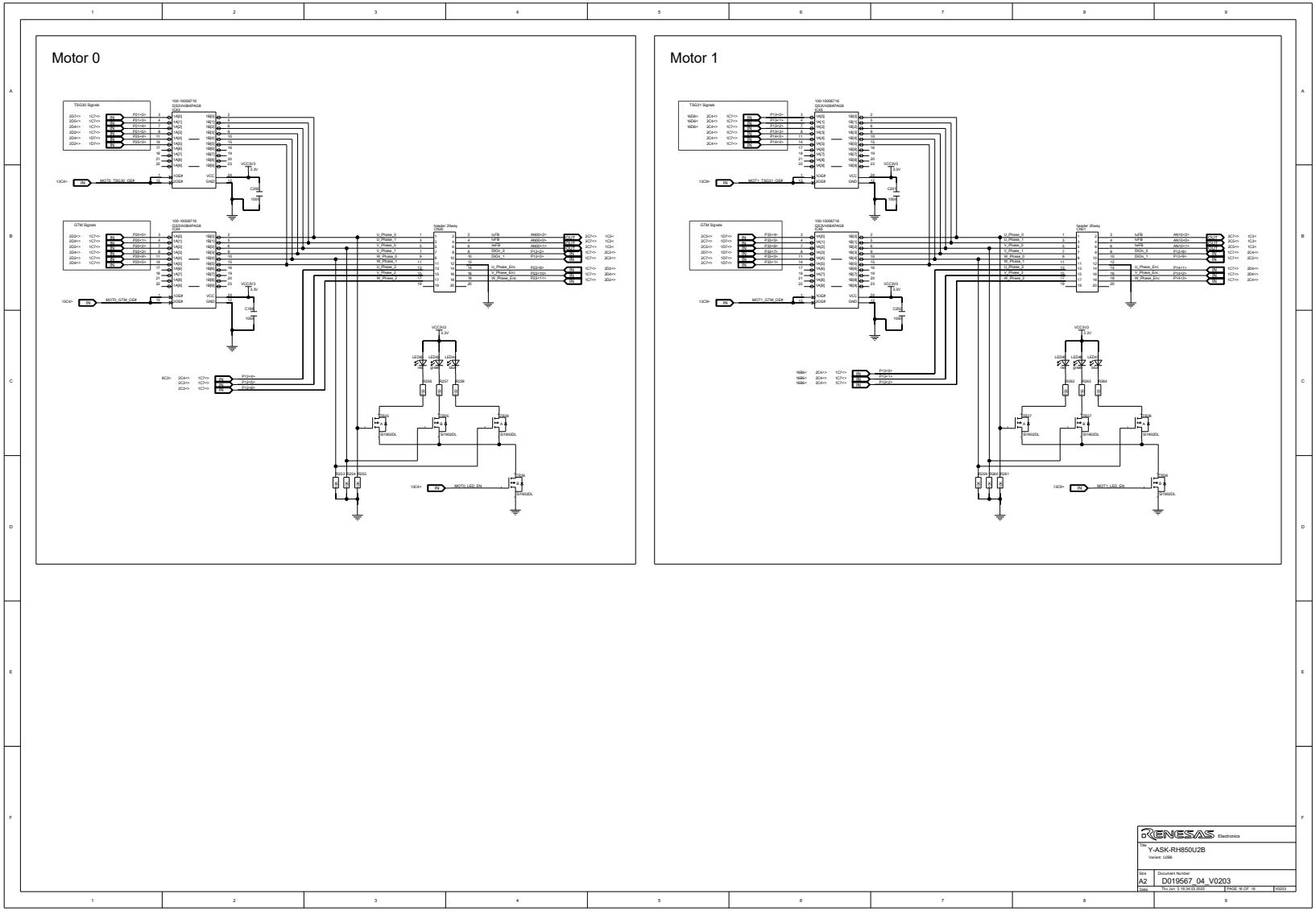
12.2.14 Resolver Circuit 0



12.2.15 Resolver Circuit 1

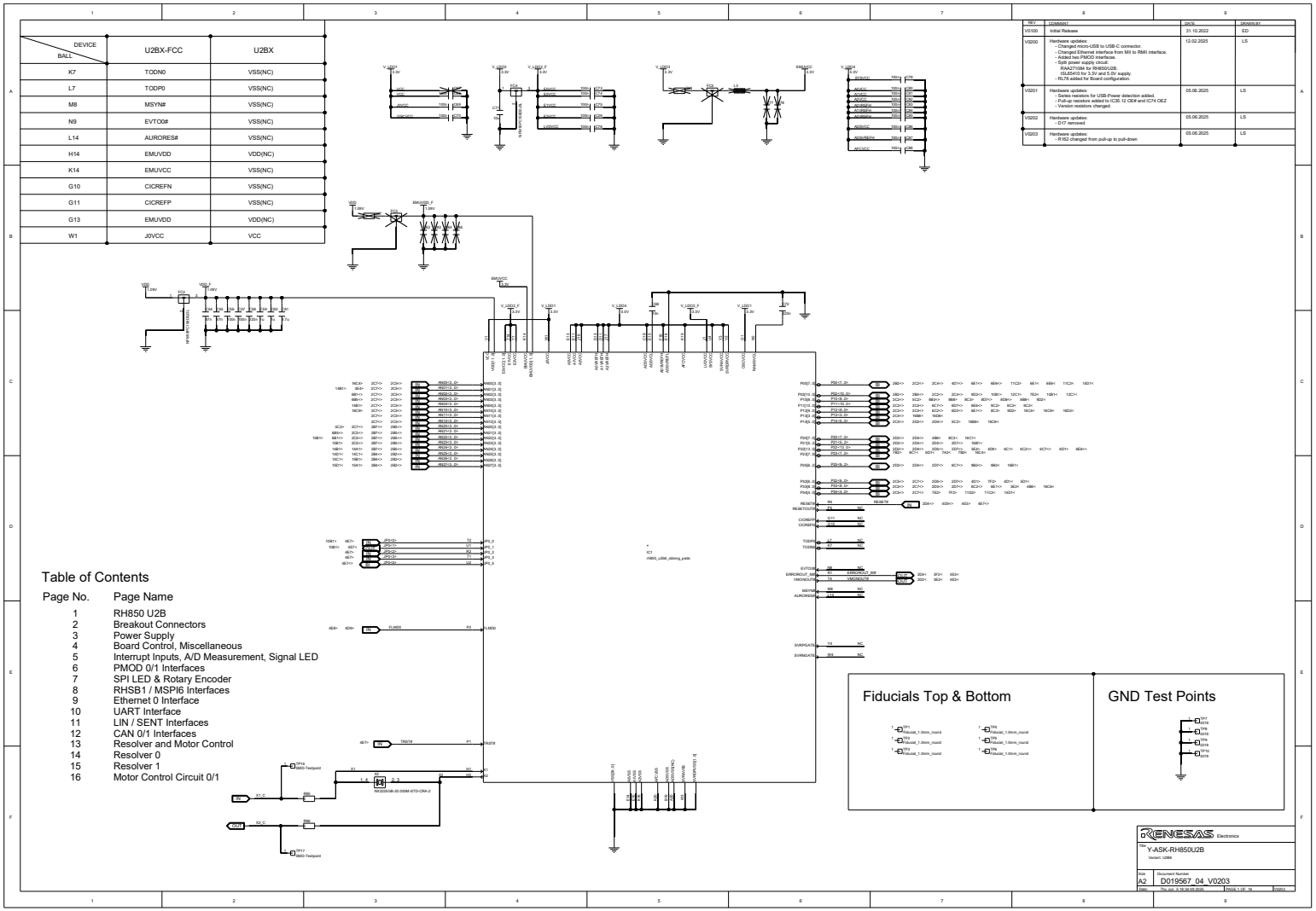


12.2.16 Motor Control Circuit 0/1



12.3 Y-ASK-RH850U2B10 (D019567_06_V0300)

12.3.1 RH850 U2B



DEVICE / BALL	U2BX-FCC	U2BX
K7	TODN0	VSS(NC)
L7	TODP0	VSS(NC)
M8	MSYN#	VSS(NC)
N9	EVTO0#	VSS(NC)
L14	AURORES#	VSS(NC)
H14	EMUVDD	VDD(NC)
K14	EMUVCC	VSS(NC)
G10	CICREFN	VSS(NC)
G11	CICREFP	VSS(NC)
G13	EMUVDD	VDD(NC)
W1	J0VCC	VCC

REV	COMMENT	DATE	DRAWN BY
V0100	Initial Release	31.10.2022	ED
V0200	Hardware updates: - Changed micro-USB to USB-C connector. - Added Ethernet interface from MII to RMII interface. - Added two PMOD interfaces. - Split power supply circuit: RAA271094 for RH850/U2B, ISL85410 for 3.3V and 5.0V supply. - RL78 added for Board configuration.	12.02.2025	LS
V0201	Hardware updates: - Series resistors for USB-Power detection added. - Pull-up resistors added to IC35, 12 OE# and IC74 OE2 - Version resistors changed.	05.06.2025	LS
V0202	Hardware updates: - D17 removed.	05.06.2025	LS
V0203	Hardware updates: - R162 changed from pull-up to pull-down	05.06.2025	LS

Table of Contents

Page No.	Page Name
1	RH850 U2B
2	Breakout Connectors
3	Power Supply
4	Board Control, Miscellaneous
5	Interrupt Inputs, A/D Measurement, Signal LED
6	PMOD 0/1 Interfaces
7	SPI LED & Rotary Encoder
8	RHSB1 / MSPI6 Interfaces
9	Ethernet 0 Interface
10	UART Interface
11	LIN / SENT Interfaces
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13	Resolver and Motor Control
14	Resolver 0
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Fiducials Top & Bottom

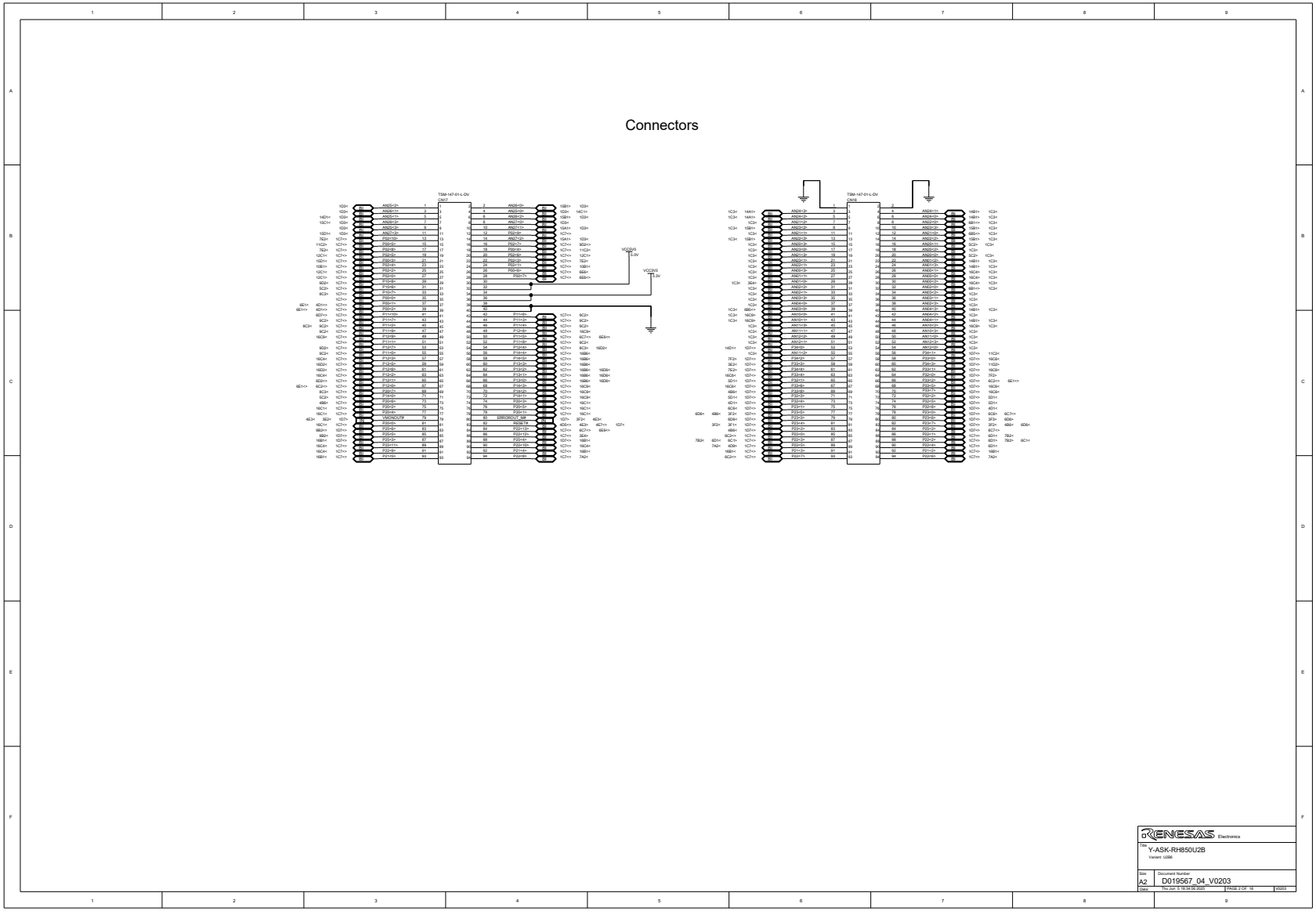
GND Test Points

RENESAS Electronics

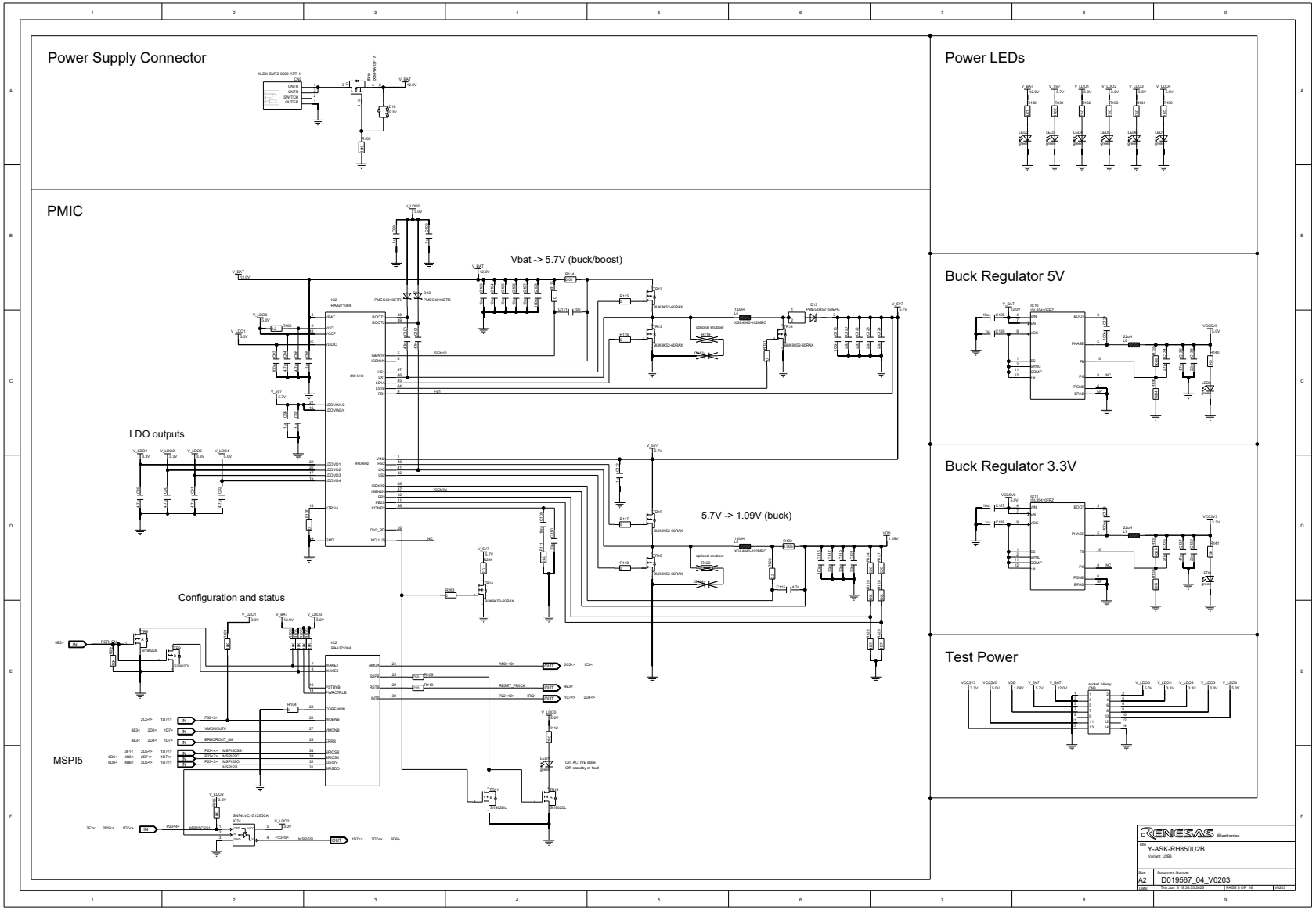
Y-ASK-RH850U2B

A2 D019567_04_V0203

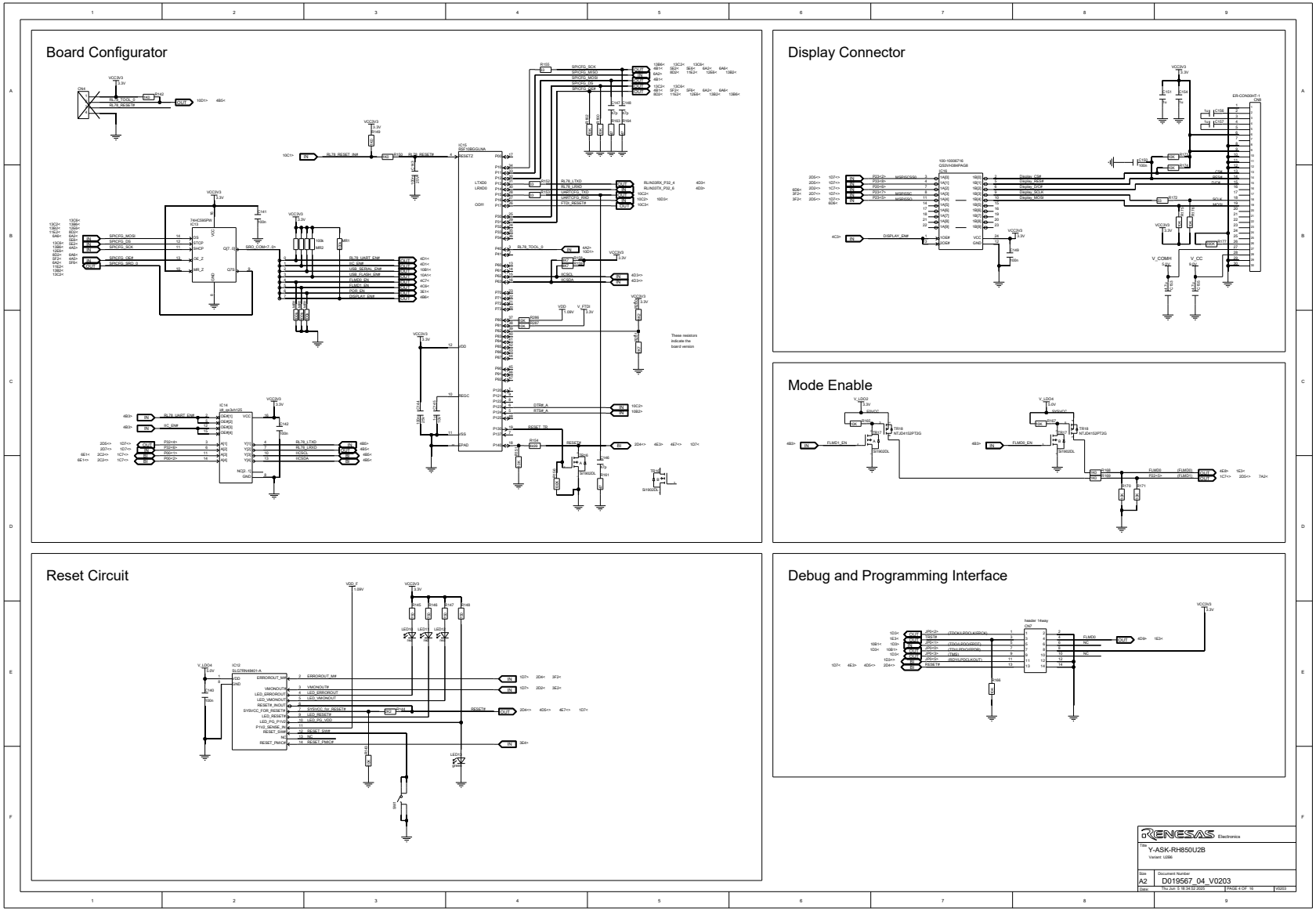
12.3.2 Breakout Connectors



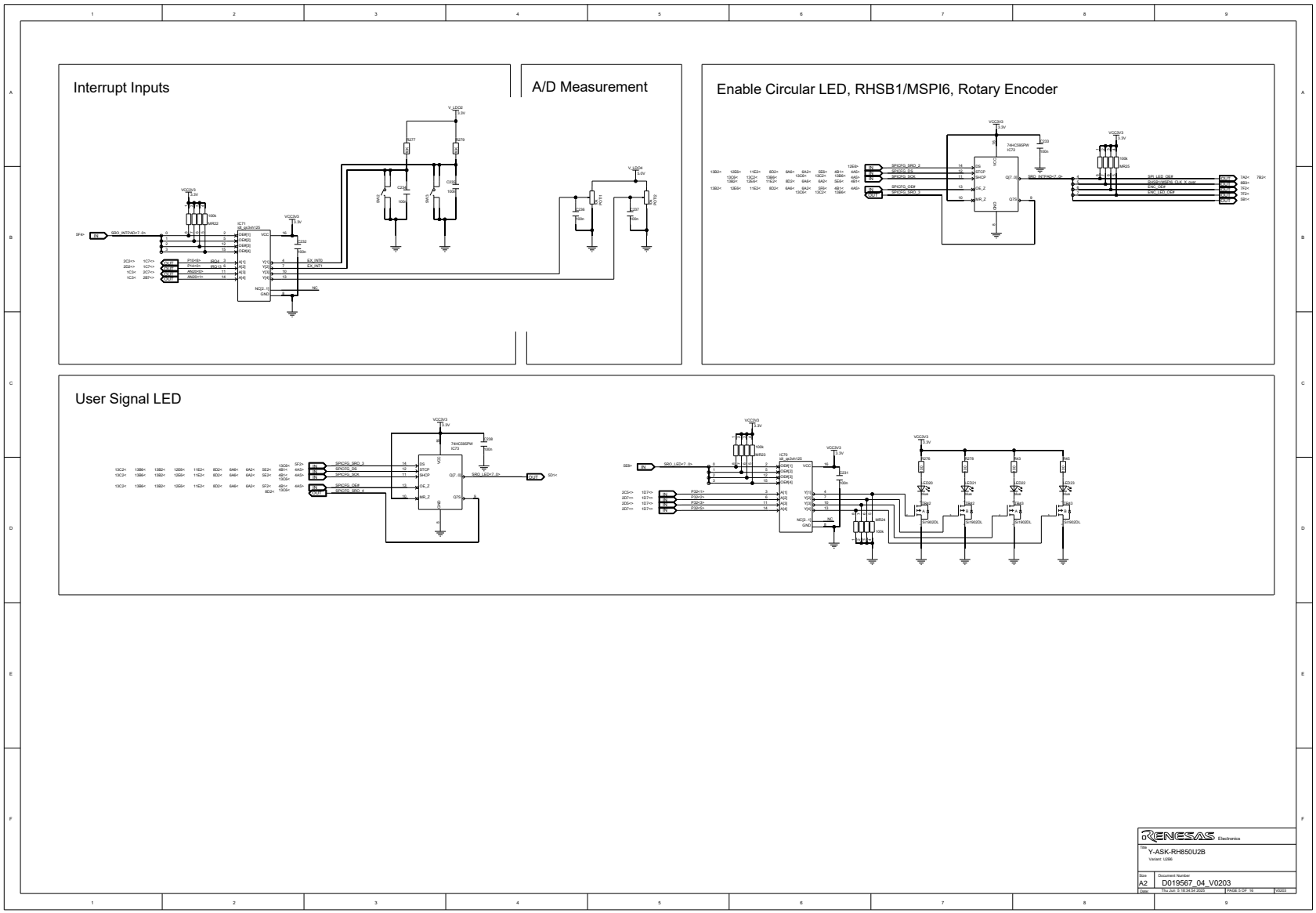
12.3.3 Power Supply



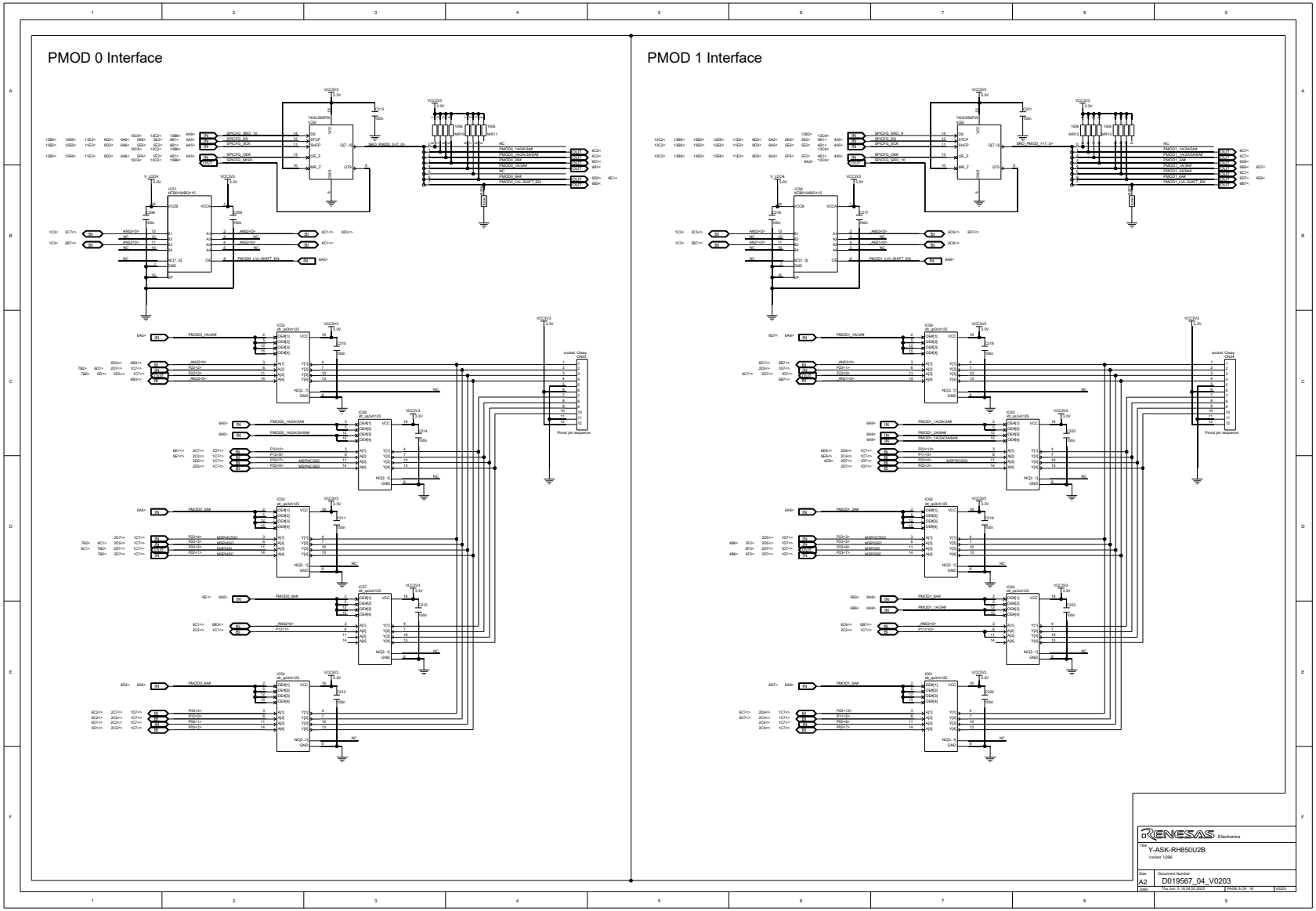
12.3.4 Board Control, Miscellaneous



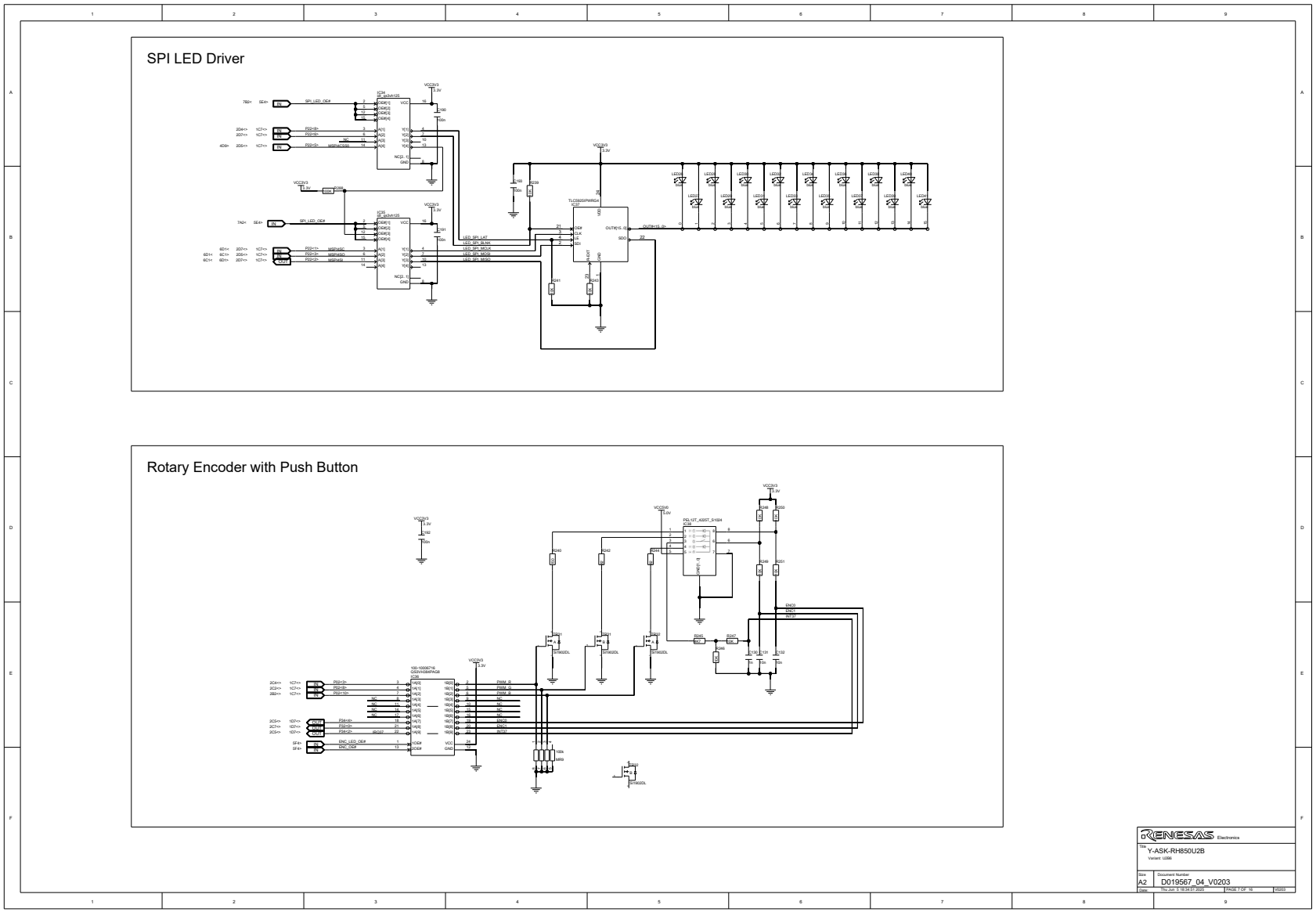
12.3.5 Interrupt Input, A/D Measurement, Signal LED



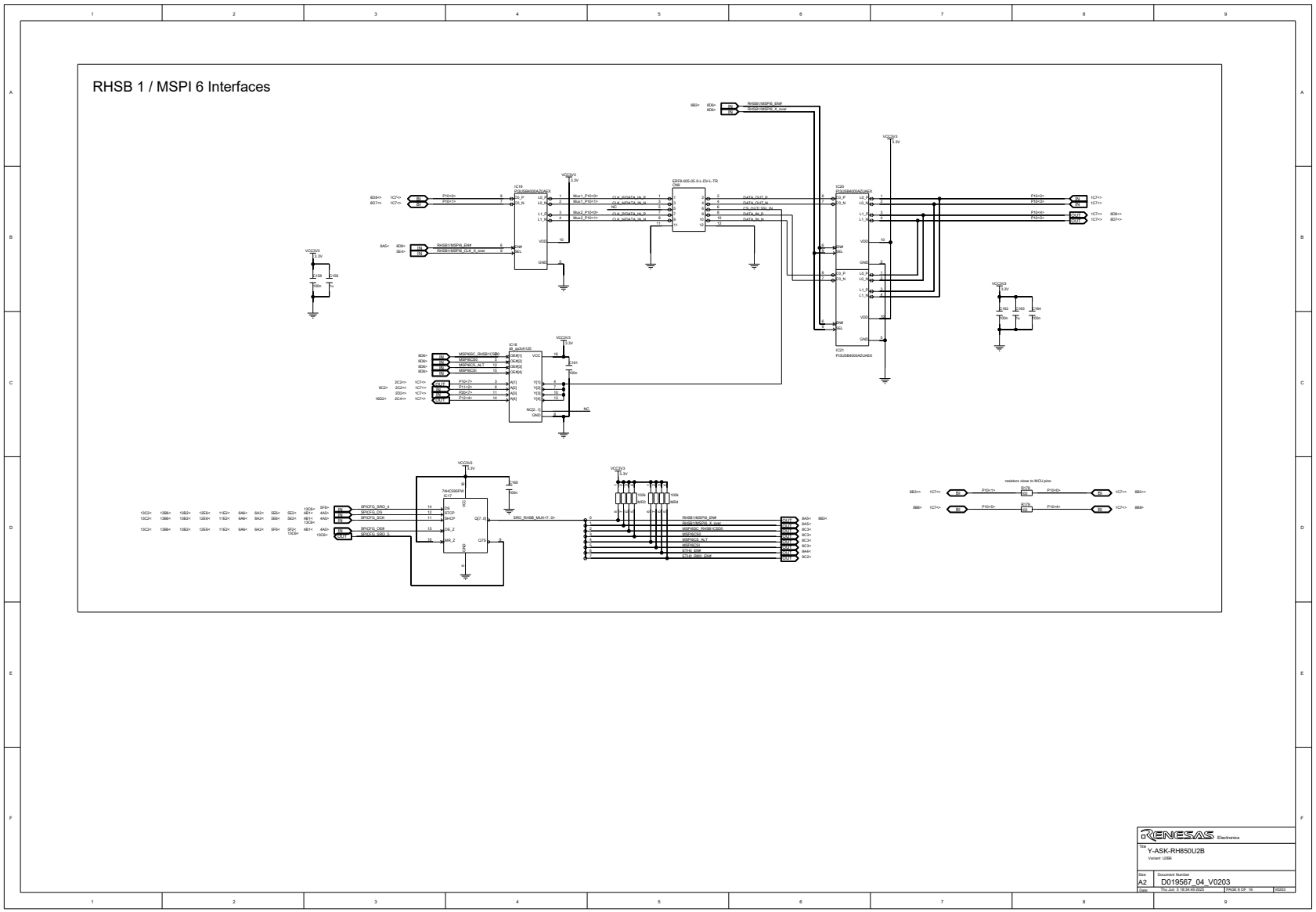
12.3.6 PMOD 0/1 Interfaces



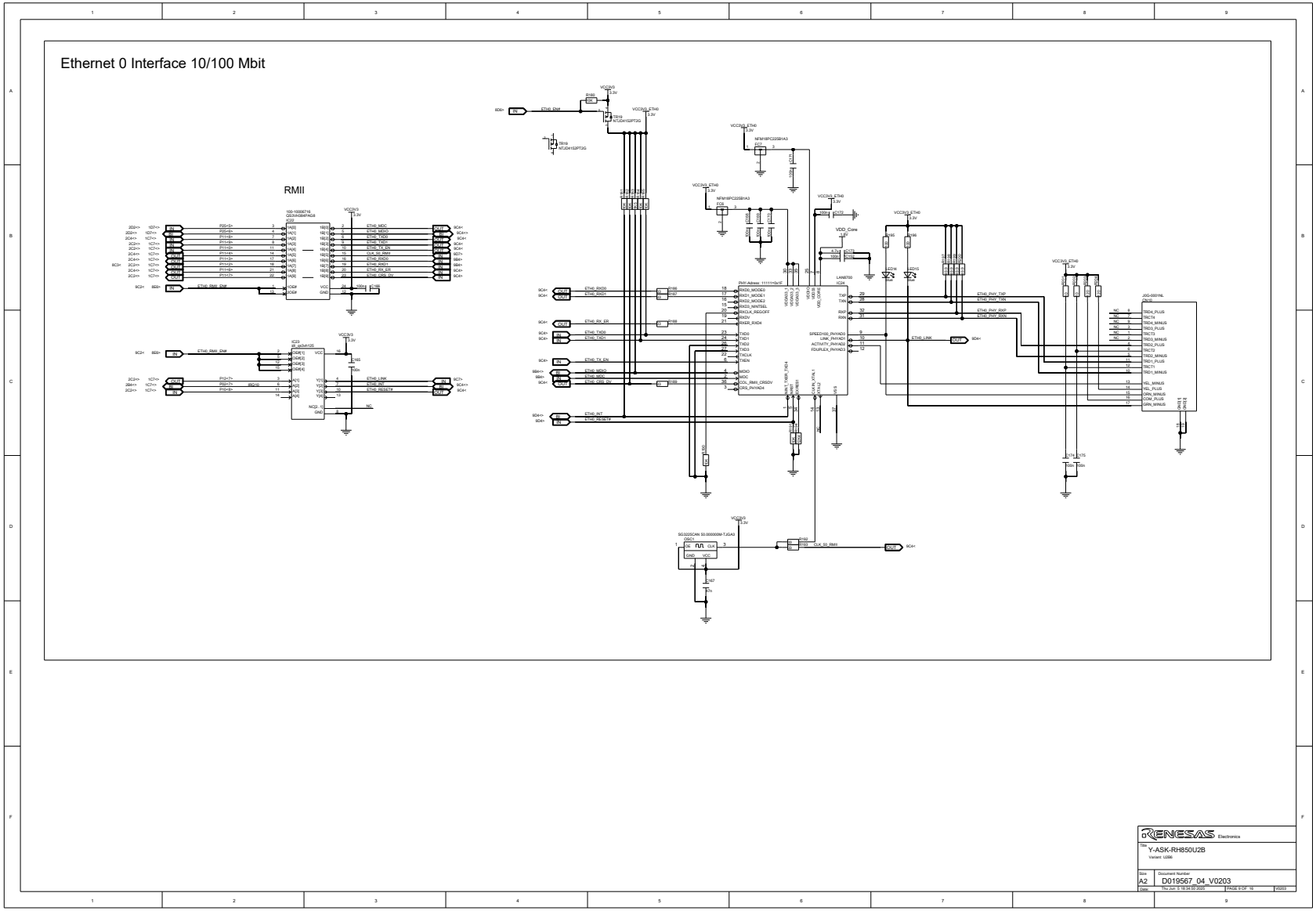
12.3.7 SPI LED & Rotary Encoder



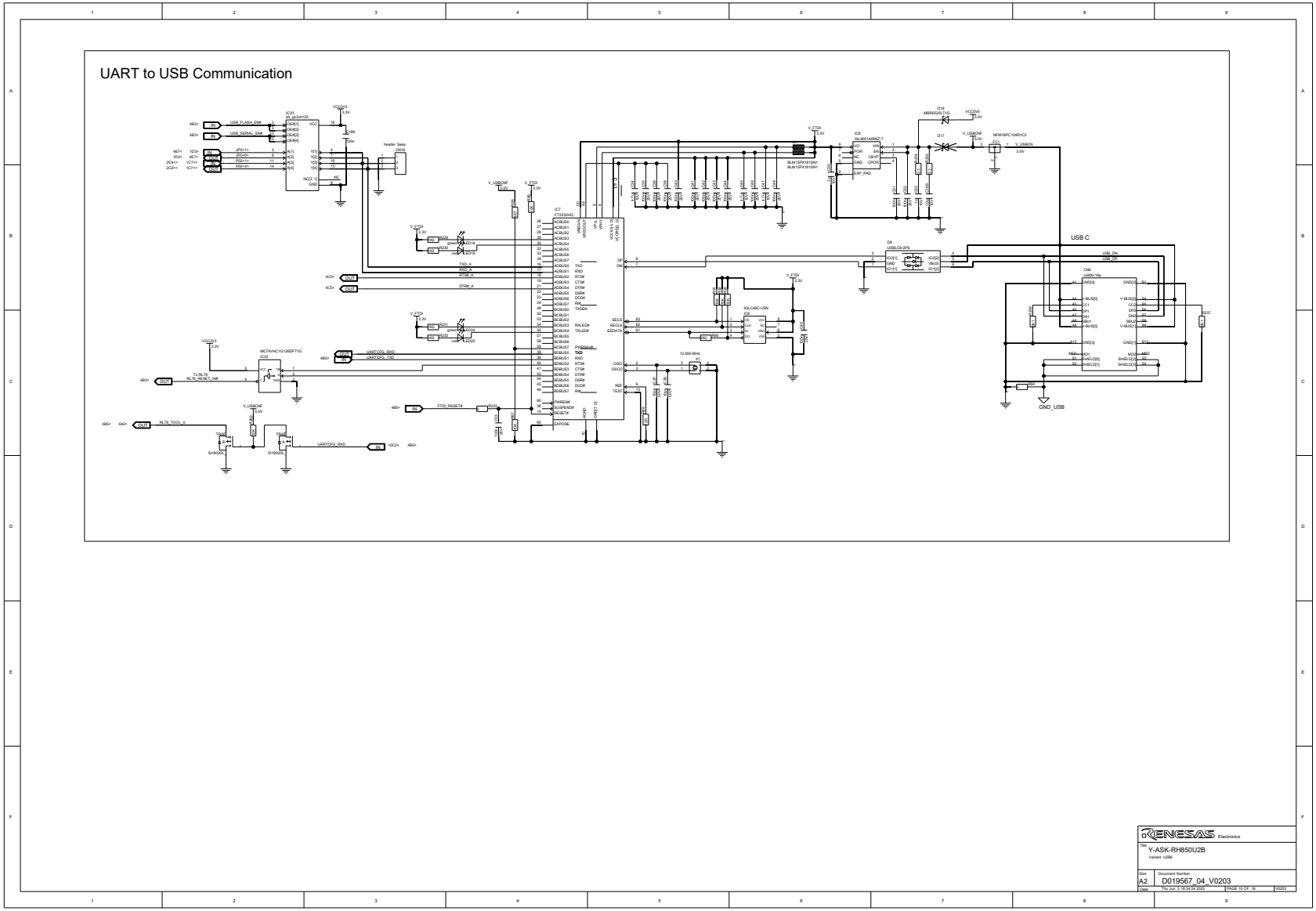
12.3.8 RHSB1 / MSPI6 Interfaces



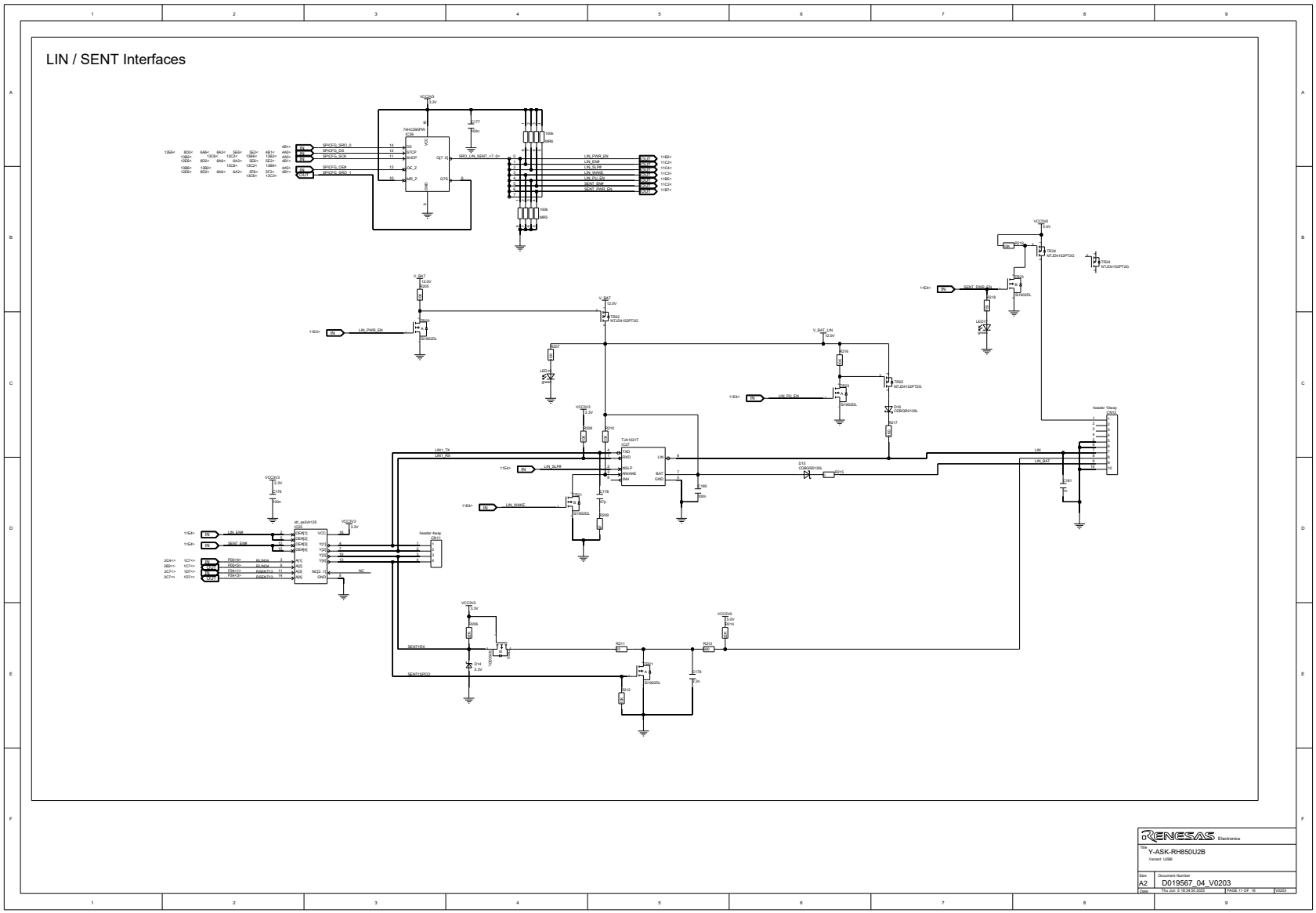
12.3.9 Ethernet Interface



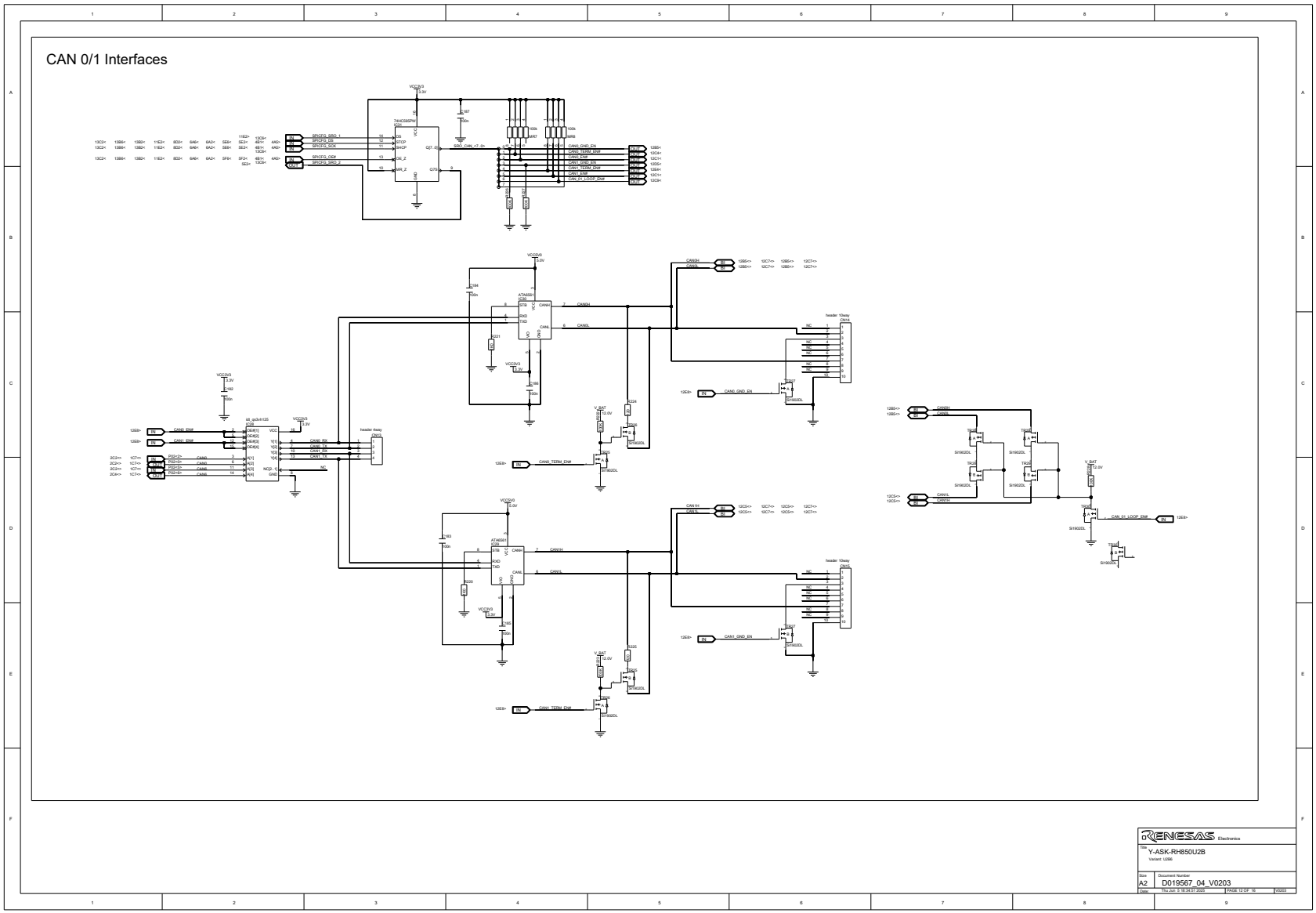
12.3.10 UART Interface



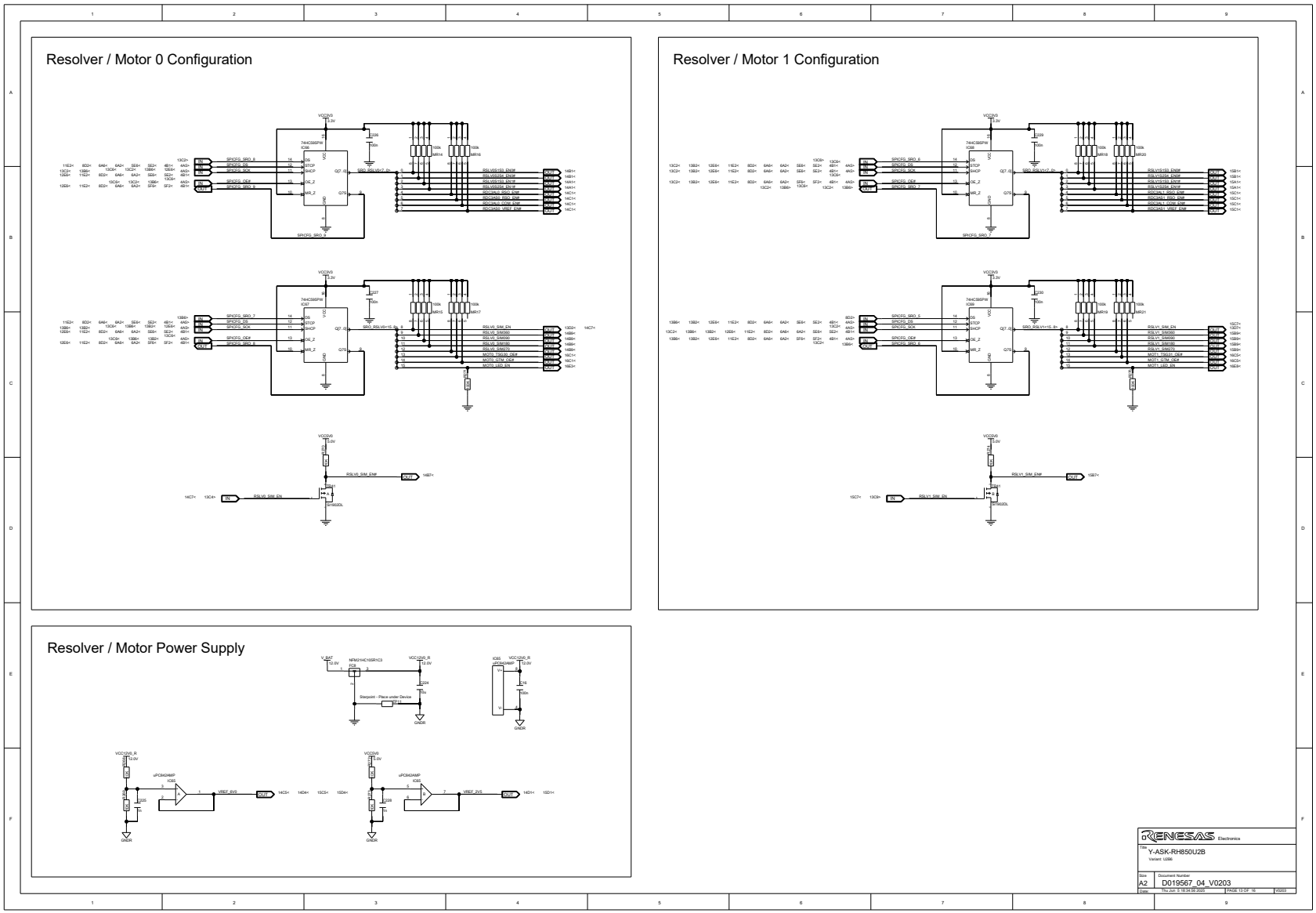
12.3.11 LIN / SENT Interfaces



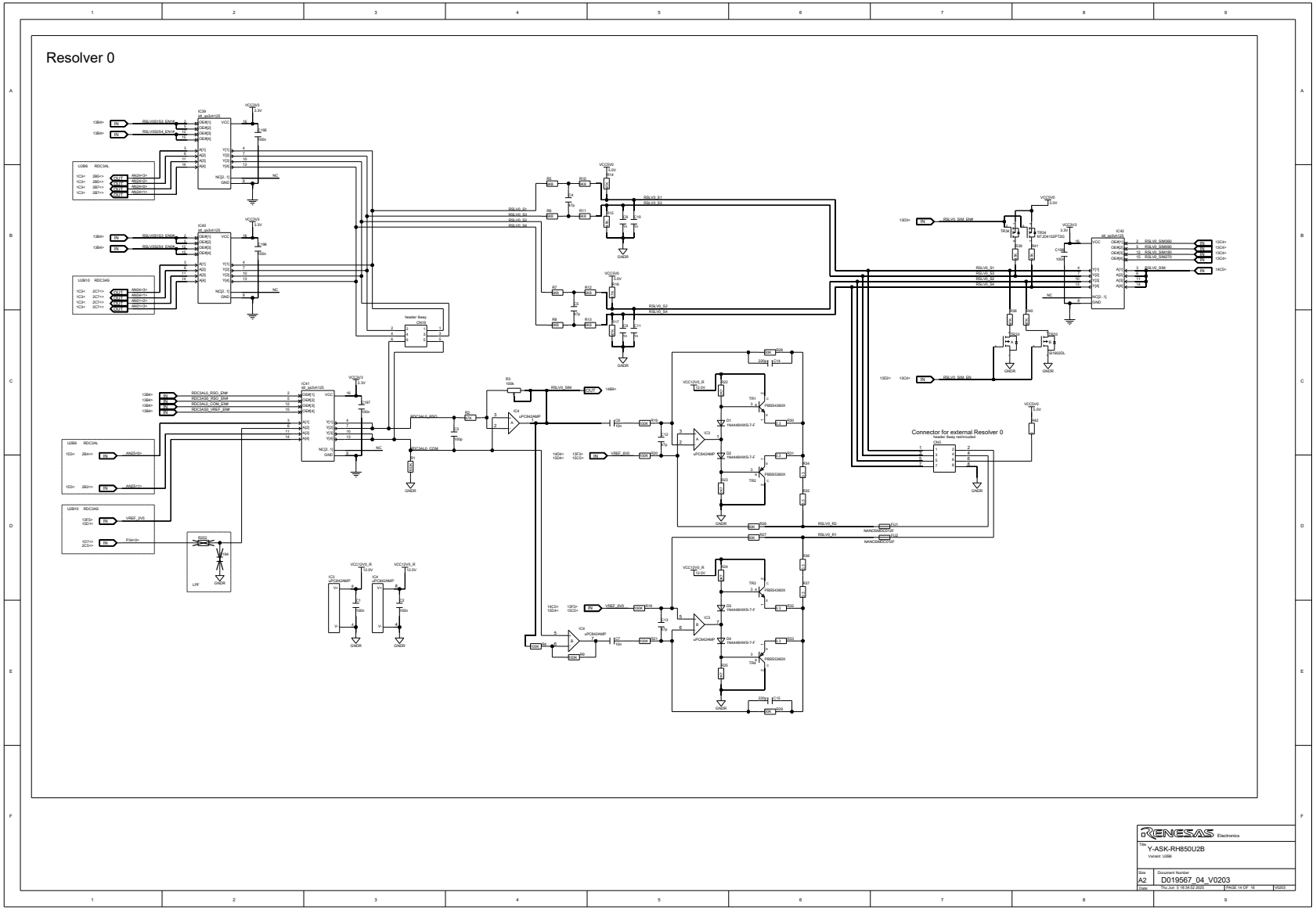
12.3.12 CAN 0/1 Interfaces



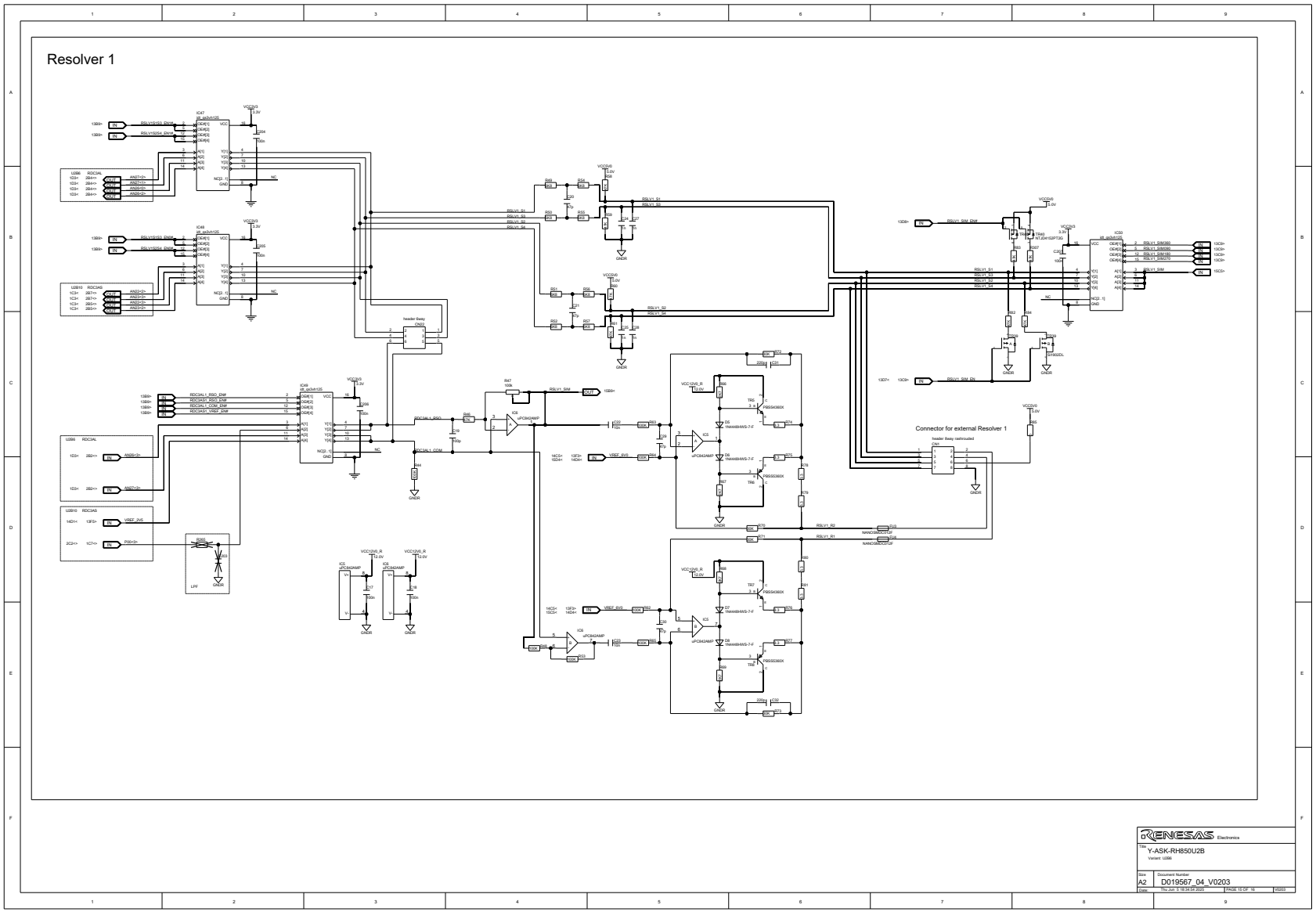
12.3.13 Resolver and Motor Control



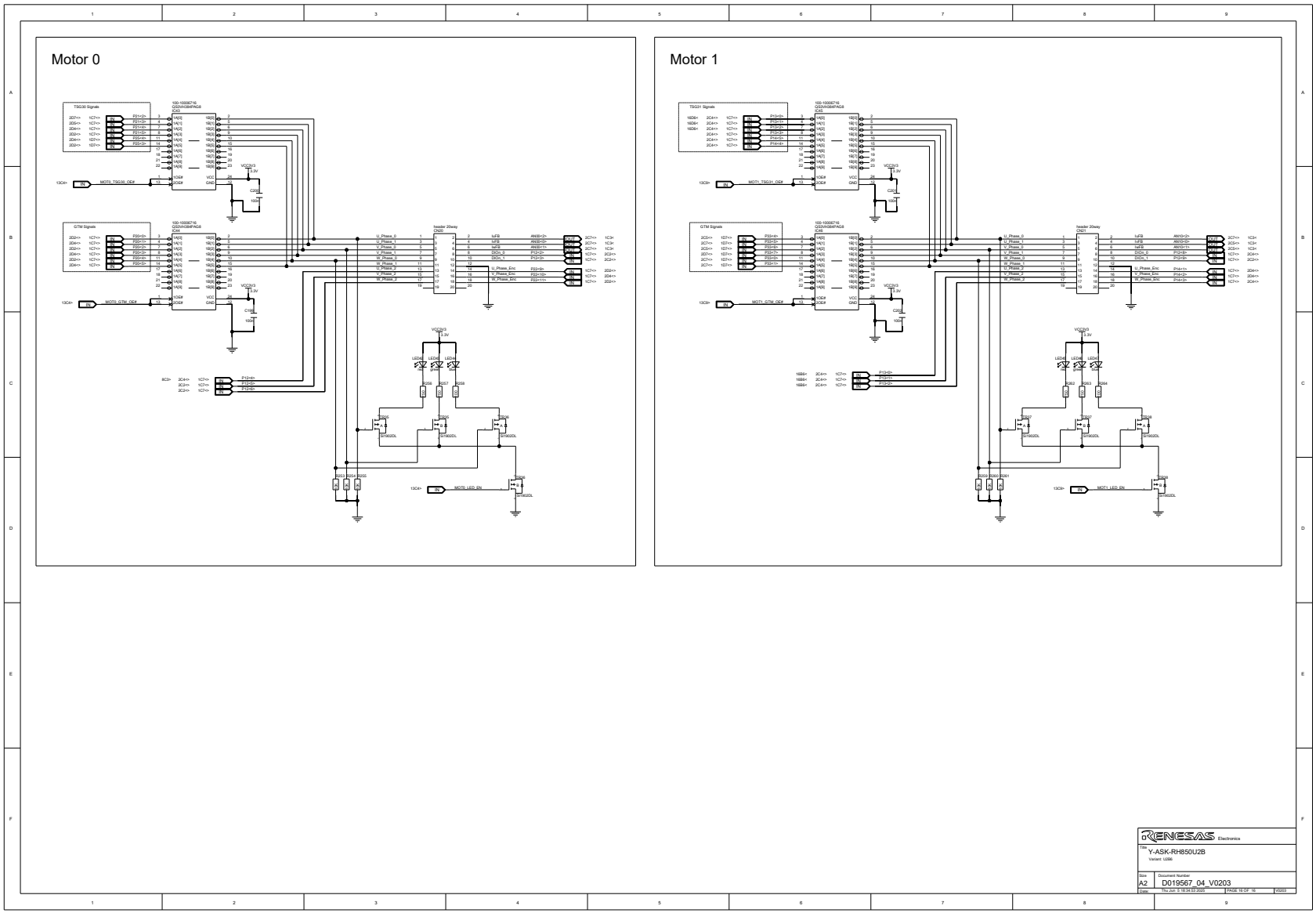
12.3.14 Resolver Circuit 0



12.3.15 Resolver Circuit 1



12.3.16 Motor Control Circuit 0/1



Revision History

		Description	
Rev.	**Date**	**Page**	**Summary**
V1.00	2025-09-01	–	Initial release

RH850/U2B Starter Kit User's Manual: Hardware

Publication Date: Rev.1.00 September 01, 2025

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Renesas Electronics Corporation
TOYOSU FORESIA, 3-2-24 Toyosu, Koto-ku, Tokyo 135-0061, Japan

Renesas Electronics America Inc.
1001 Murphy Ranch Road, Milpitas, CA 95035, U.S.A.
Tel: +1-408-432-8888, Fax: +1-408-434-5351

Renesas Electronics Canada Limited
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 101-T01, Floor 1, Building 7, Yard No. 7, 8th Street, Shangdi, Haidian District, Beijing 100085, China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai 200333, China
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852 2886-9022

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit No 3A-1 Level 3A Tower 8 UOA Business Park, No 1 Jalan Pengaturcara U1/51A, Seksyen U1, 40150 Shah Alam, Selangor, Malaysia
Tel: +60-3-5022-1288, Fax: +60-3-5022-1290

Renesas Electronics India Pvt. Ltd.
No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India
Tel: +91-80-67208700

Renesas Electronics Korea Co., Ltd.
17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5338

Colophon 6.0

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