

# CPX4 DC-PLC Evaluation Kit M01D1

R30AN0393EJ0101

RTK0EE0009D01001BJ SCH, BOM, PCB layout

Rev.1.01

Apr 1, 2024

## Introduction

This document describes the schematics, the bill of materials and the PCB layout of CPX4 DC-PLC Evaluation Kit M01D1.

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1. Schematics

1.1 DC-PLC board

1.1.1 PLC modem LSI (R9A06G061:CPX4)

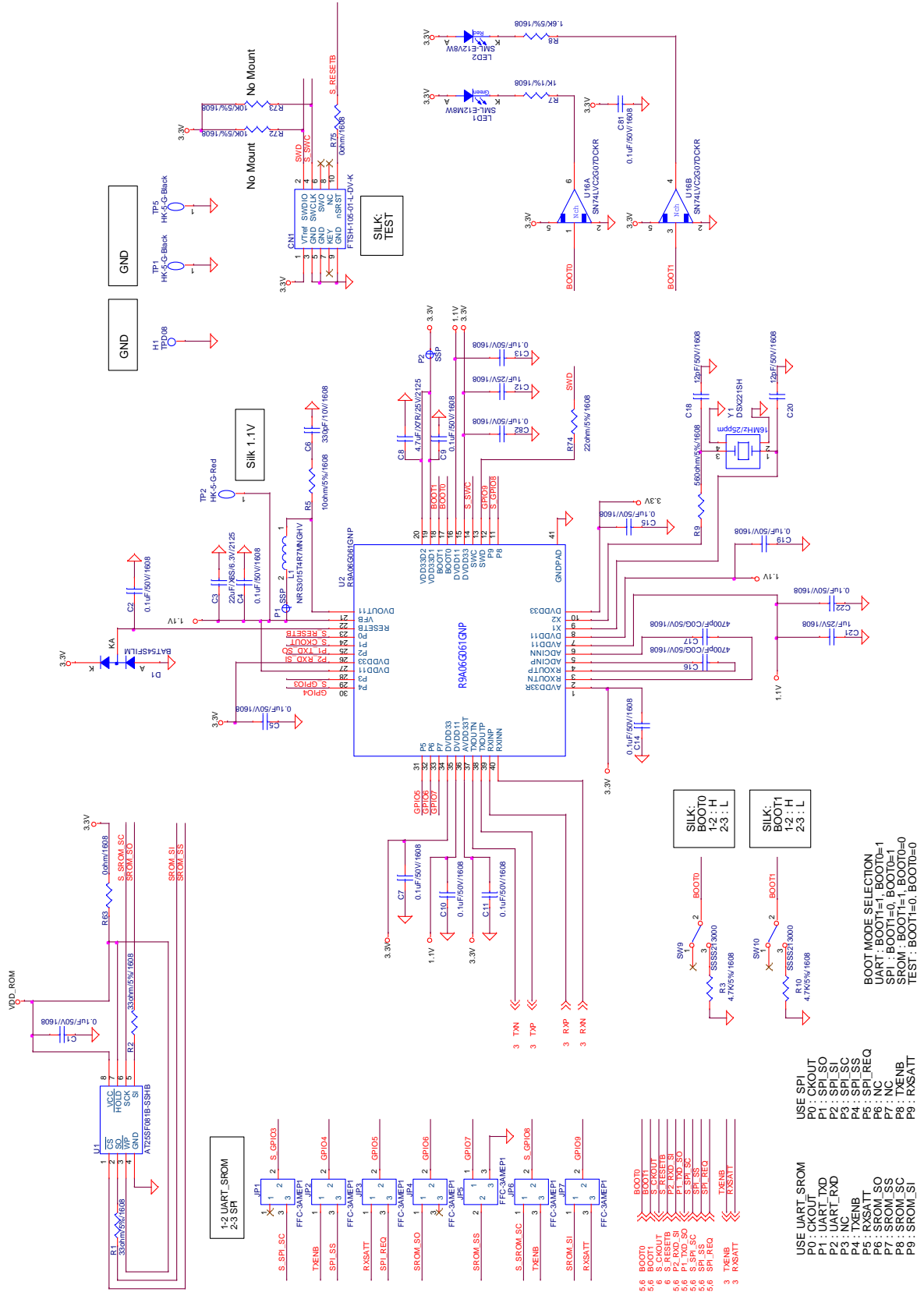


Figure 1-1 DC-PLC board (1/5)

1.1.2 PLC output stage and AFE circuit

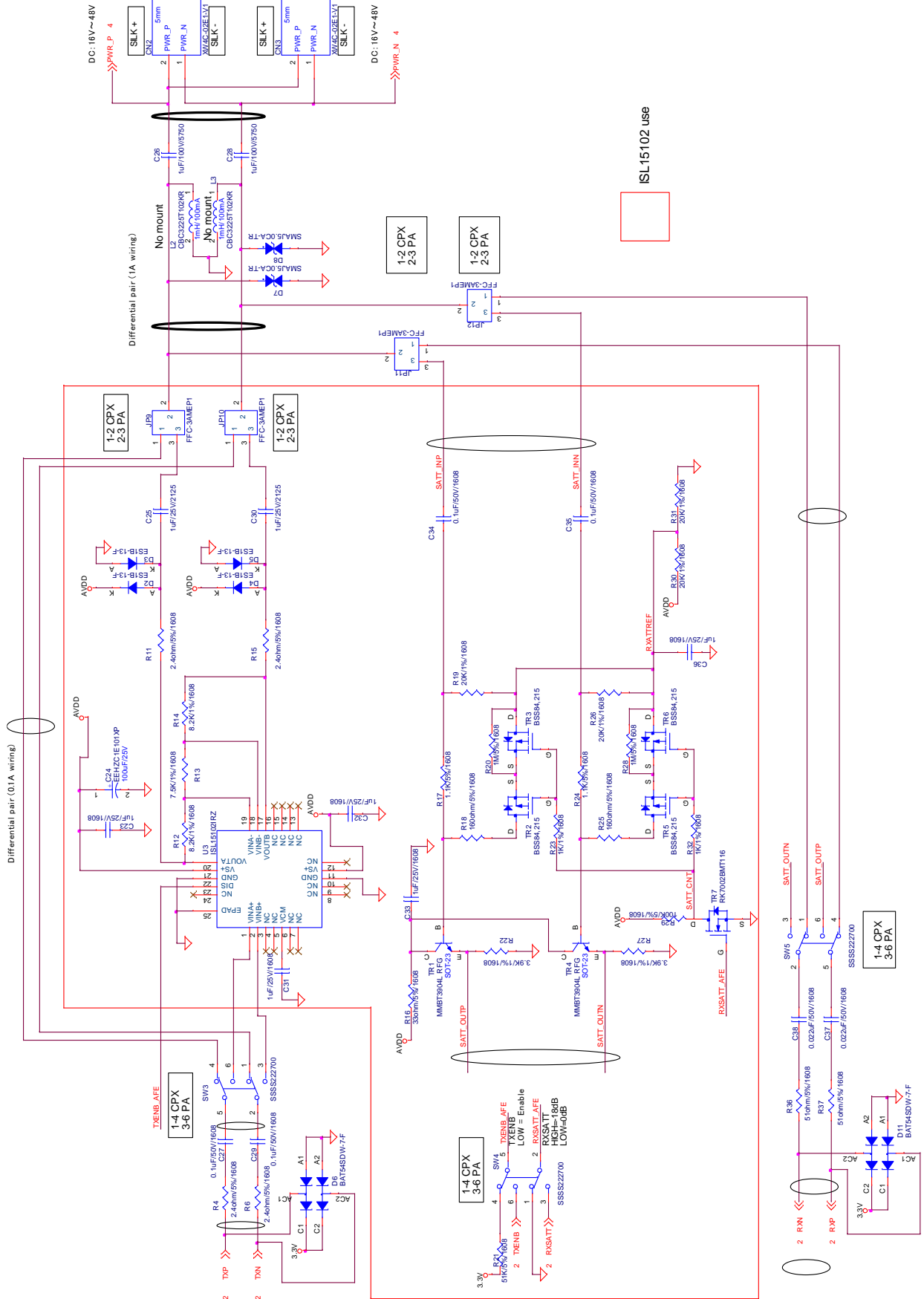


Figure 1-2 DC-PLC board (2/5)

1.1.3 Peripheral circuit (RESET and USB)

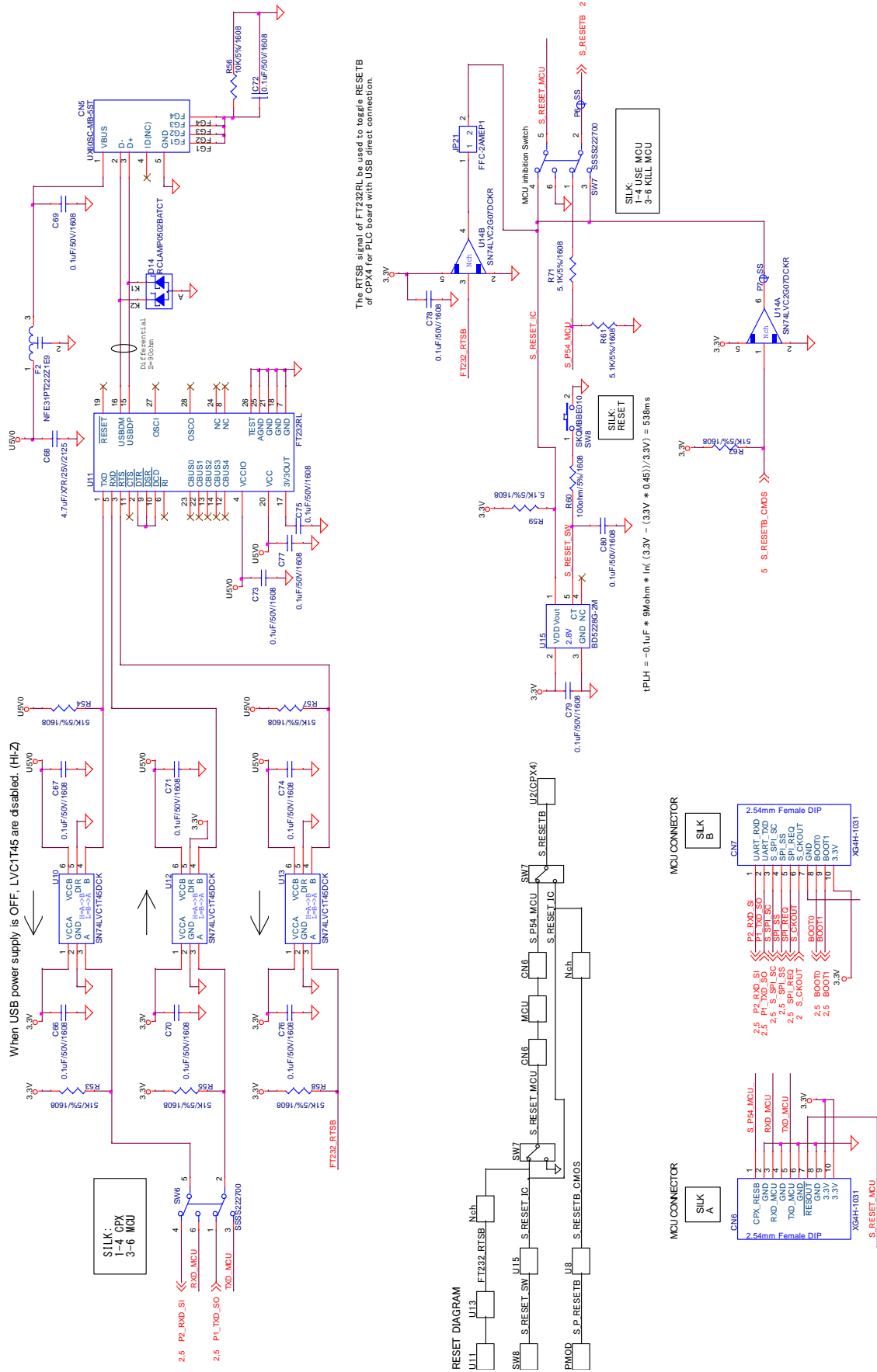


Figure 1-3 DC-PLC board (3/5)

1.1.4 Power supply circuit

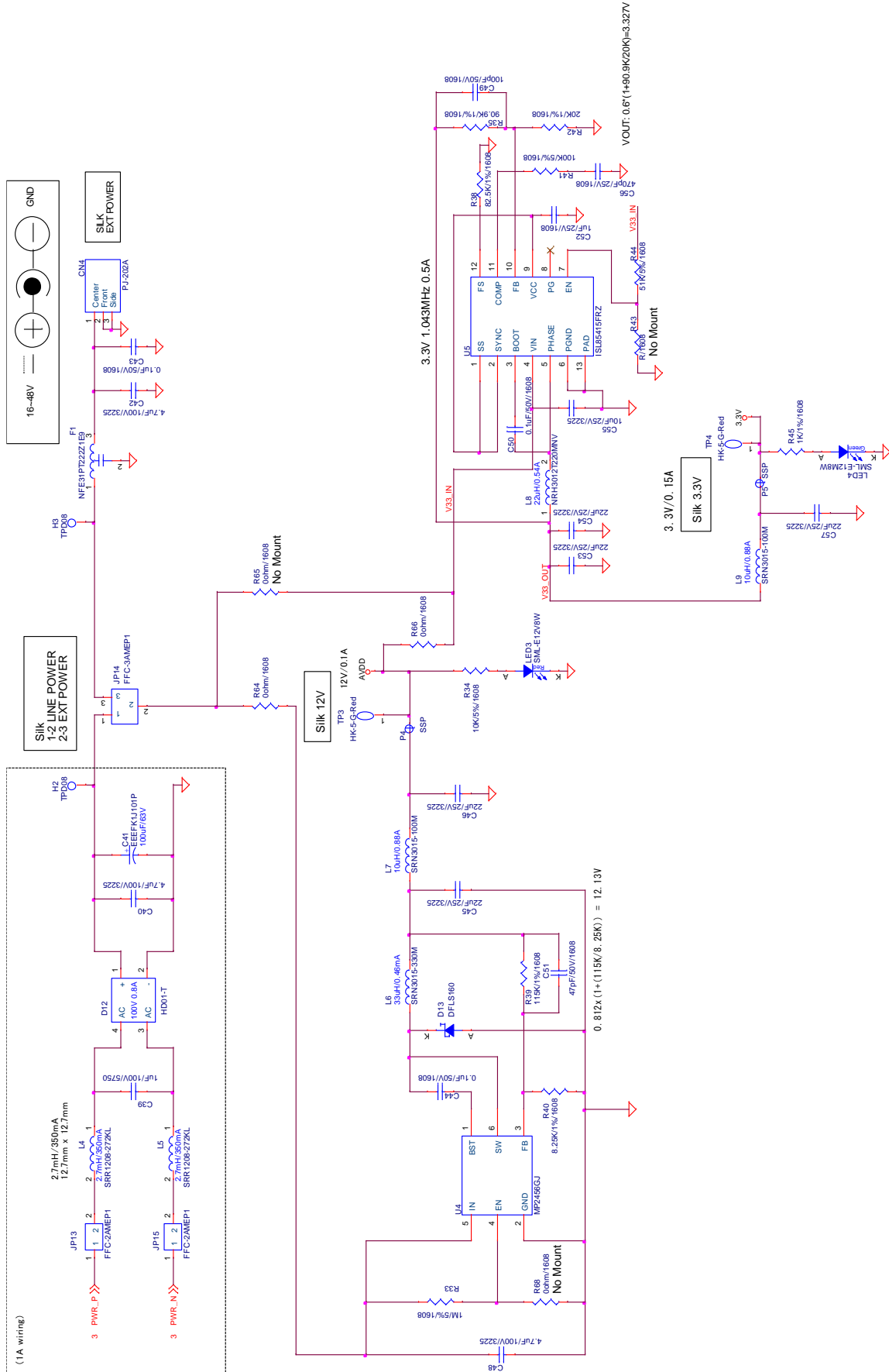


Figure 1-4 DC-PLC board (4/5)

1.1.5 PMOD interface

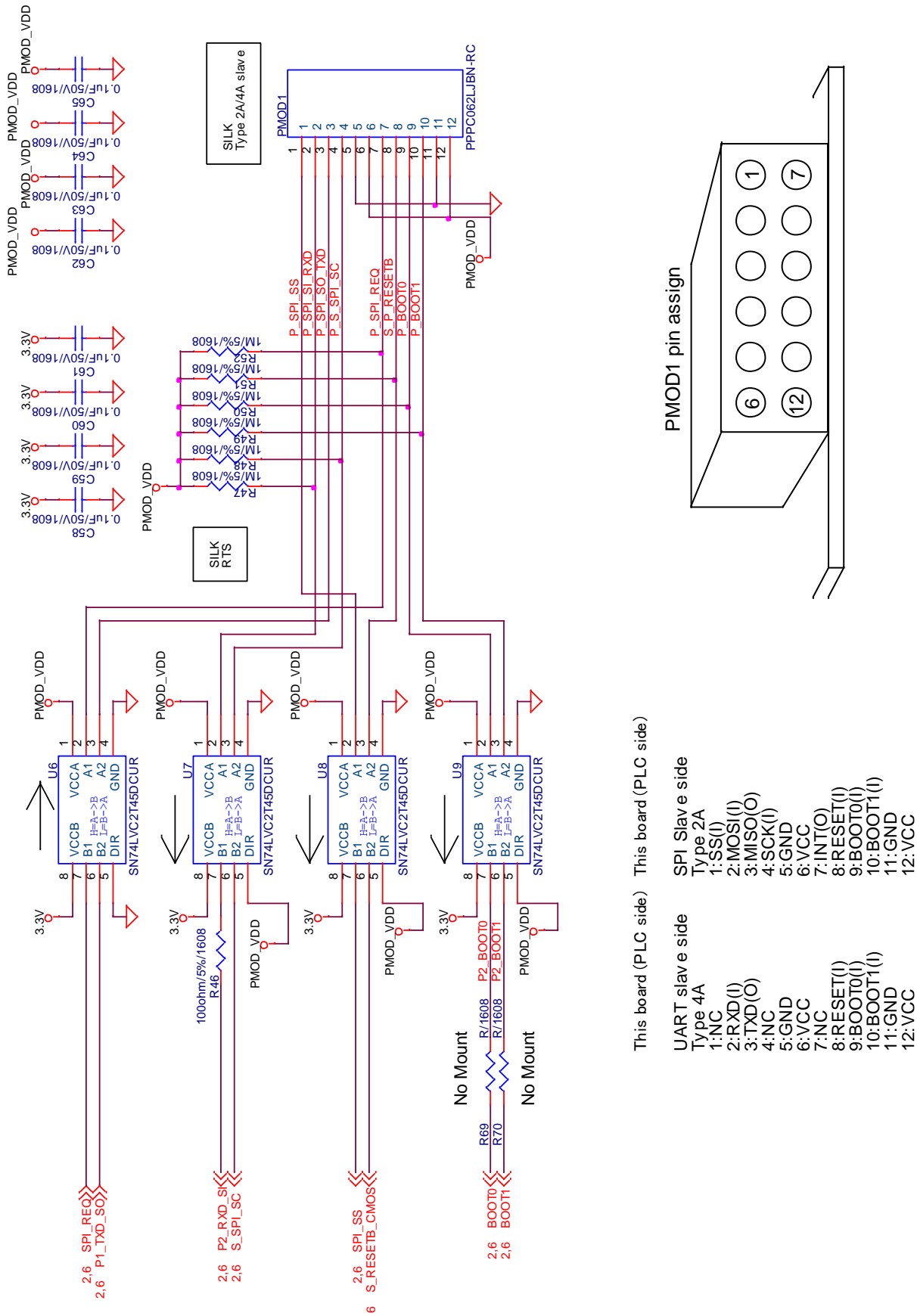


Figure 1-5 DC-PLC board (5/5)

1.2 RX651 MCU board

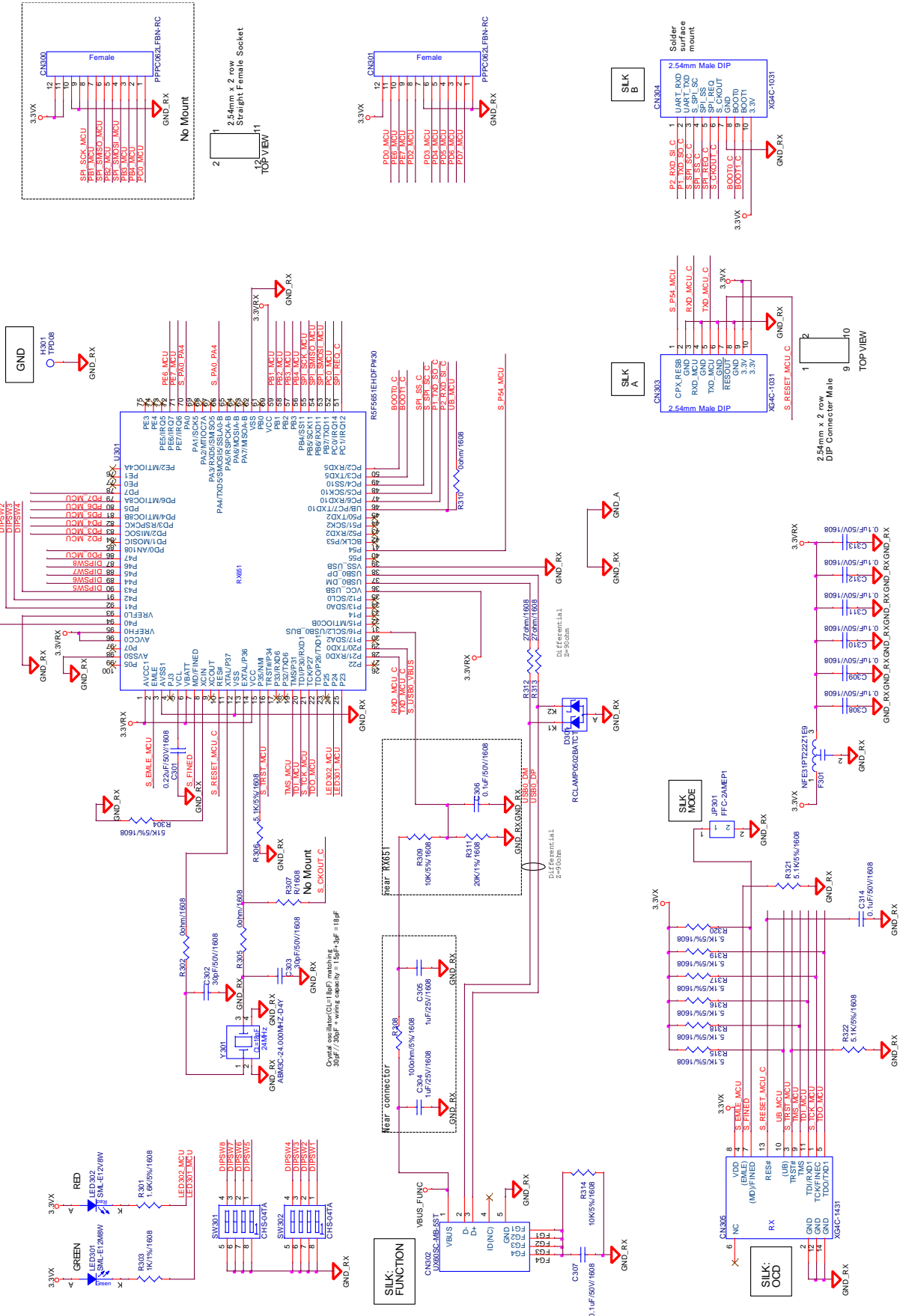


Figure 1-6 RX651 MCU board

### 1.3 POWER Filter board

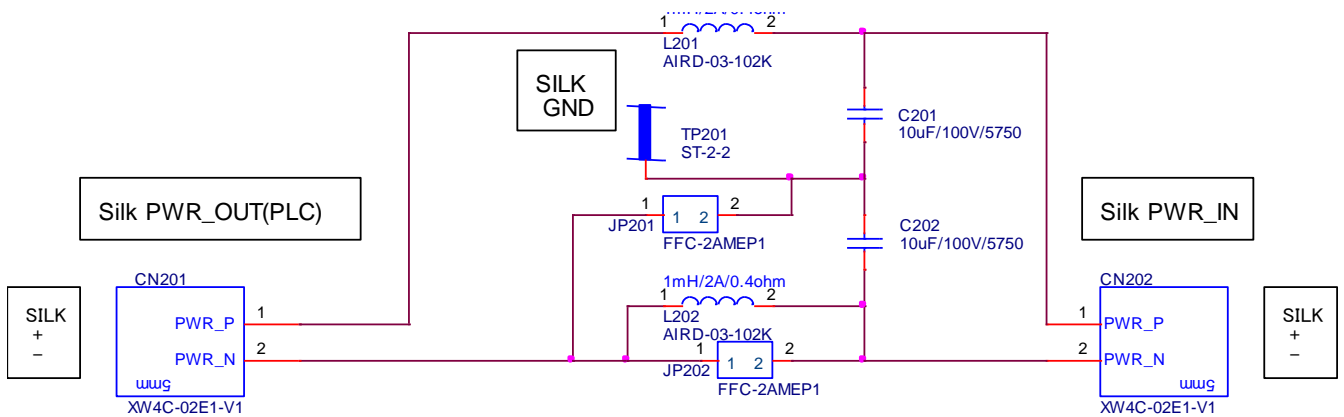
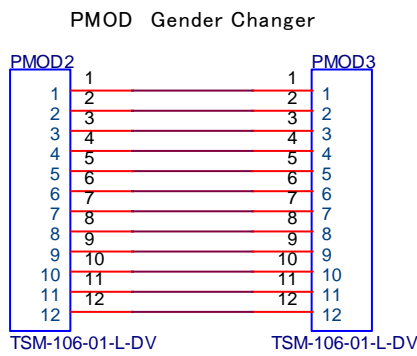


Figure 1-7 Power Filter board

### 1.4 PMOD conversion board



Circled 2 pins on both component side and solder side (pin number silk not required)

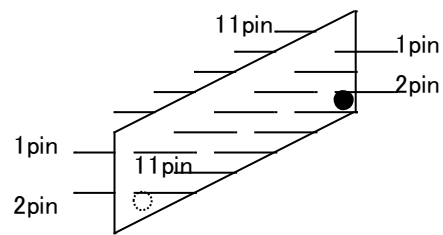


Figure 1-8 PMOD conversion board

## 2. Bill of materials

### 2.1 DC-PLC board

**Table 2.1 DC-PLC board (1/3)**

Quantity	Reference	KIND	Parts Name	Manufacturer	Remark
1	CN1	CONNECTOR	FTSH-105-01-L-DV-K	SAMTEC	
2	CN2,CN3	CONNECTOR	XW4C-02E1-V1	OMRON	(2*) SPT2.5/2-V-5,0 (Phoenix Contact)
1	CN4	CONNECTOR	PJ-202A	CUI	
1	CN5	CONNECTOR	UX60SC-MB-5ST	HIROSE	
2	CN6,CN7	CONNECTOR	XG4H-1031	OMRON	
44	C1,C2,C4,C5,C7,C9,C10,C11,C13,C14,C15,C19,C22,C27,C29,C34,C35,C43,C44,C50,C58,C59,C60,C61,C62,C63,C64,C65,C66,C67,C69,C70,C71,C72,C73,C74,C75,C76,C77,C78,C79,C80,C81,C82	CERAMIC CAPACITOR	CC0603KRX7R9BB104	Yageo	(1*) 0.1uF/X7R/50V/1608
1	C3	CERAMIC CAPACITOR	C2012X6S0J226M085AC	TDK	(1*) 22uF/X6S/6.3V/2125
1	C6	CERAMIC CAPACITOR	C0603C331J3GACTU	KEMET	(1*) 330pF/C0G/10V/1608
2	C8,C68	CERAMIC CAPACITOR	TMK325B7226KMHP	Taiyo Yuden	(1*) 4.7uF/X7R/25V/2125
8	C12,C21,C23,C31,C32,C33,C36,C52	CERAMIC CAPACITOR	CGA3E1X7R1E105K080AC	TDK	(1*) 1uF/X7R/25V/1608
2	C16,C17	CERAMIC CAPACITOR	CGA3E2C0G1H472J	TDK	(1*) 4700pF/C0G/50V/1608
2	C18,C20	CERAMIC CAPACITOR	CGA3E2C0G1H120J080AA	TDK	(1*) 12pF/C0G/50V/1608
1	C24	ALUM CAP	EEHZC1E101XP	Panasonic	
2	C25,C30	CERAMIC CAPACITOR	CGA4J3X7R1E105M125AB	TDK	(1*) 1uF/X7R/25V/2125
3	C26,C28,C39	CERAMIC CAPACITOR	22201C105KAT2A	AVX	(1*) 1uF/X7R/100V/5750
2	C37,C38	CERAMIC CAPACITOR	C1608X7R1H223K	TDK	(1*) 0.022uF/X7R/50V/1608
3	C40,C42,C48	CERAMIC CAPACITOR	HMK325B7475MN-TE	Taiyo Yuden	(1*) 4.7uF/X5R/100V/3225
1	C41	ALUM CAP	EEEFK1J101P	Panasonic	
5	C45,C46,C53,C54,C57	CERAMIC CAPACITOR	TMK325B7226KMHT	Taiyo Yuden	(1*) 22uF/X7R,X5R/25V/3225
1	C49	CERAMIC CAPACITOR	C1608C0G1H101J080AA	TDK	(1*) 100pF/C0G/50V/1608
1	C51	CERAMIC CAPACITOR	CGA3E2C0G1H470J080AA	TDK	(1*) 47pF/C0G/50V/1608
1	C55	CERAMIC CAPACITOR	GRM32DR71E106KA12L	MURATA	(1*) 10uF/X7R,X5R/25V/3225
1	C56	CERAMIC CAPACITOR	C0603C471J3GACAUTO	KEMET	(1*) 470pF/C0G/25V/1608
1	D1	DIODE	BAT54SFILM	STMicroelectronics	
4	D2,D3,D4,D5	DIODE	ES1B-13-F	Diodes Inc	
2	D6,D11	DIODE	BAT54SDW-7-F	Diodes Inc	(2*) BAT54SDWQ-7-F
2	D7,D8	DIODE	SMAJ5.0CA-TR	STMicroelectronics	Recommended by STMicroelectronics
1	D12	BRIDGE DIODE	HD01-T	Diodes Inc	
1	D13	DIODE	DFLS160	Diodes Inc	
1	D14	DIODE	RCLAMP0502BATCT	Semtech	
2	F1,F2	FILTER	NFE31PT222Z1E9	Murata	
12	JP1,JP2,JP3,JP4,JP5,JP6,JP7,JP9,JP10,JP11,JP12,JP14	CONNECTOR	FFC-3AMEP1	HONDA	(1*)
3	JP13,JP15,JP21	CONNECTOR	FFC-2AMEP1	HONDA	(1*)
2	LED1,LED4	LED	SML-E12M8W	Rohm	
2	LED2,LED3	LED	SML-E12V8W	Rohm	
1	L1	INDUCTOR	NRS3015T4R7MNGHV	Taiyo Yuden	(2*) VLS3015CX-4R7M(TDK)
2	L4,L5	INDUCTOR	SRR1208-272KL	Bourns Inc	
1	L6	INDUCTOR	SRN3015-330M	Bourns	(2*) VLS3015CX-330M (TDK)

(1\*)Equivalent product can be changed

(2\*)Alternative product

Table 2.2 DC-PLC board (2/3)

Quantity	Reference	KIND	Parts Name	Manufacturer	Remark
2	L7,L9	INDUCTOR	SRN3015-100M	Bourns	(2*) VLS3015CX-100M (TDK)
1	L8	INDUCTOR	NRH3012T220MNV	Taiyo Yuden	(2*) LQH3NPN220MMEL (Murata)
1	PMOD1	CONNECTOR	PPPC062LJBN-RC	Sullins	
2	PMOD2,PMOD3	CONNECTOR	TSM-106-01-L-DV	SAMTEC	
3	R1,R2,R16	RESISTOR	RK73B1JTTD330J	KOA	(1*) 33ohm/5%/1608
2	R3,R10	RESISTOR	RK73B1JTTD472J	KOA	(1*) 4.7K/5%/1608
4	R4,R6,R11,R15	RESISTOR	RK73B1JTTD2R4J	KOA	(1*) 2.4ohm/5%/1608
1	R5	RESISTOR	RK73B1JTTD100J	KOA	(1*) 10ohm/5%/1608
4	R7,R23,R32,R45	RESISTOR	RK73H1JTTD1001F	KOA	(1*) 1K/1%/1608
1	R8	RESISTOR	RK73B1JTTD162J	KOA	(1*) 1.6K/5%/1608
1	R301	RESISTOR	RK73B1JTTD162J	KOA	(1*) 1.6K/5%/1608
1	R9	RESISTOR	RK73B1JTTD561J	KOA	(1*) 560ohm/5%/1608
2	R12,R14	RESISTOR	RK73H1JTTD8201F	KOA	(1*) 8.2K/1%/1608
1	R13	RESISTOR	RK73H1JTTD7501F	KOA	(1*) 7.5K/1%/1608
2	R17,R24	RESISTOR	RK73B1JTTD112J	KOA	(1*) 1.1K/5%/1608
2	R18,R25	RESISTOR	RK73B1JTTD161J	KOA	(1*) 160ohm/5%/1608
5	R19,R26,R30,R31,R42	RESISTOR	RK73H1JTTD2002F	KOA	(1*) 20K/1%/1608
1	R311	RESISTOR	RK73H1JTTD2002F	KOA	(1*) 20K/1%/1608
9	R20,R28,R33,R47,R48,R49,R50,R51,R52	RESISTOR	RK73B1JTTD105J	KOA	(1*) 1M/5%/1608
8	R21,R44,R53,R54,R55,R57,R58,R62	RESISTOR	RK73B1JTTD513J	KOA	(1*) 51K/5%/1608
2	R22,R27	RESISTOR	RK73H1JTTD3901F	KOA	(1*) 3.9K/1%/1608
2	R41,R29	RESISTOR	RK73B1JTTD104J	KOA	(1*) 100K/5%/1608
2	R34,R56	RESISTOR	RK73B1JTTD103J	KOA	(1*) 10K/5%/1608
1	R35	RESISTOR	RK73H1JTTD9092F	KOA	(1*) 90.9K/1%/1608
2	R36,R37	RESISTOR	RK73B1JTTD510J	KOA	(1*) 51ohm/5%/1608
1	R38	RESISTOR	RK73H1JTTD8252F	KOA	(1*) 82.5K/1%/1608
1	R39	RESISTOR	RK73H1JTTD1153F	KOA	(1*) 115K/1%/1608
1	R40	RESISTOR	RK73H1JTTD8251F	KOA	(1*) 8.25K/1%/1608
2	R46,R60	RESISTOR	RK73B1JTTD101J	KOA	(1*) 100ohm/5%/1608
1	R308	RESISTOR	RK73B1JTTD101J	KOA	(1*) 100ohm/5%/1608
3	R59,R61,R71	RESISTOR	RK73B1JTTD512J	KOA	(1*) 5.1K/5%/1608
4	R63,R64,R66,R75,	RESISTOR	RK73Z1JTTD	KOA	(1*) 0ohm/1608
1	R74	RESISTOR	RK73B1JTTD220J	KOA	(1*) 22ohm/5%/1608
5	SW3,SW4,SW5,SW6,SW7	SWITCH	SSSS222700	ALPS	
1	SW8	SWITCH	SKQMBBE010	ALPS	
2	SW9,SW10	SWITCH	SSSS213000	ALPS	
2	TP1,TP5	TEST PIN	HK-5-G-Black	MAC8	
3	TP2,TP3,TP4	TEST PIN	HK-5-G-Red	MAC8	
2	TR1,TR4	TRANSISTOR	MMBT3904L RFG	Taiwan Semiconductor	
4	TR2,TR3,TR5,TR6	TRANSISTOR	BSS84,215	Nexperia	
1	TR7	TRANSISTOR	RK7002BMT116	Rohm	
1	U1	IC	AT25SF081B-SSHB	Adesto	(2*) W25Q80DVSNIG(Winbond)
1	U2	IC	R9A06G061GNP	Renesas	
1	U3	IC	ISL15102IRZ	INTERSIL	

(1\*)Equivalent product can be changed

(2\*)Alternative product

**Table 2.3 DC-PLC board (3/3)**

Quantity	Reference	Kind	Part name	Manufacturer	Remark
4	U6,U7,U8,U9	IC	SN74LVC2T45DCUR	TI	
3	U10,U12,U13	IC	SN74LVC1T45DCK	TI	
1	U11	IC	FT232RL	FTDI	
2	U14,U16	IC	SN74LVC2G07DCKR	TI	
1	U15	IC	BD5228G-TR	Rohm	(2*) BD5228G-2MTR(Rohm)
1	Y1	CRYSTAL	DSX221SH	Daishinku	Specify the specifications (16MHz,CL:8pF, Frequency tolerance:±10ppm, Frequency characteristics over temperature:±15ppm) (2*)(3*)NX2520SA-16M-CHP-CSW- 19(NDK) (4*)

(2\*)Alternative product

(3\*) For NX2520SA-16M-CHP-CSW-19, it is necessary to change the constants of the external circuit (R9=2.2kΩ, C20=12pF, C18=15pF).

(4\*) CX2520DB16000D0FLJCC (Kyocera) has been discontinued.

## 2.2 RX651 MCU board

**Table 2.4 RX651 MCU board**

Quantity	Reference	KIND	Parts Name	Manufacturer	Remark
1	CN301	CONNECTOR	PPPC062LFBN-RC	SULLINS	
1	CN302	CONNECTOR	UX60SC-MB-5ST(82)	HIROSE	
2	CN303,CN304	CONNECTOR	XG4C-1031	OMRON	
1	CN305	CONNECTOR	XG4C-1431	OMRON	
1	C301	CERAMIC CAPACITOR	GCM188R71H224KA64	MURATA	(1*) 0.22uF/X7R/50V/1608
2	C302,C303	CERAMIC CAPACITOR	C0603C300J5GACTU	KEMET	(1*) 30pF/C0G/50V/1608
2	C304,C305	CERAMIC CAPACITOR	CGA3E1X7R1E105K080AC	TDK	(1*) 1uF/X7R/25V/1608
9	C306,C307,C308,C309,C310,C311,C312,C313,C314	CERAMIC CAPACITOR	CC0603KRX7R9BB104	Yageo	(1*) 0.1uF/X7R/50V/1608
1	D301	DIODE	RCLAMP0502BATCT	Semtech	
1	F301	FILTER	NFE31PT222Z1E9	Murata	
1	JP301	CONNECTOR	FFC-2AMEP1	HONDA	(1*)
1	LED301	LED	SML-E12M8W	Rohm	
1	LED302	LED	SML-E12V8W	Rohm	
3	R302,R305,R310	RESISTOR	RK73Z1JTTD	KOA	(1*) 0ohm/1608
1	R303	RESISTOR	RK73H1JTTD1001F	KOA	(1*) 1K/1%/1608
1	R304	RESISTOR	RK73B1JTTD513J	KOA	(1*) 51K/5%/1608
9	R306,R315,R316,R317,R318,R319,R320,R321,R322	RESISTOR	RK73B1JTTD512J	KOA	(1*) 5.1K/5%/1608
2	R309,R314	RESISTOR	RK73B1JTTD103J	KOA	(1*) 10K/5%/1608
2	R312,R313	RESISTOR	RK73B1JTTD270J	KOA	(1*) 27ohm/5%/1608
2	SW301,SW302	SWITCH	CHS-04TA	COPAL	
1	U301	IC	R5F5651EHDFP#30	Renesas	
1	Y301	CRYSTAL	ABM3C-24.000MHZ-D4Y	Abracon	

(1\*)Equivalent product can be changed

## 2.3 POWER Filter board

**Table 2.5 POWER Filter board**

Quantity	Reference	KIND	Parts Name	Manufacturer	Remark
2	CN201,CN202	CONNECTOR	XW4C-02E1-V1	OMRON	(2*) SPT2.5/2-V-5,0 (Phoenix Contact)
2	C201,C202	CERAMIC CAPACITOR	22201C106MAT2A	AVX	(1*) 10uF/X7R,X5R/100V/5750
2	JP201,JP202	CONNECTOR	FFC-2AMEP1	HONDA	(1*)
2	L201,L202	INDUCTOR	AIRD-03-102K	Abracon	
1	TP201	TEST PIN	ST-2-2	MAC8	

(1\*)Equivalent product can be changed

(2\*)Alternative product

## 2.4 PMOD conversion board

**Table 2.6 PMOD conversion board**

Quantity	Reference	KIND	Parts Name	Manufacturer	Remark
2	PMOD2,PMOD3	CONNECTOR	TSM-106-01-L-DV	SAMTEC	

### 3. PCB layout

#### 3.1 DC-PLC board

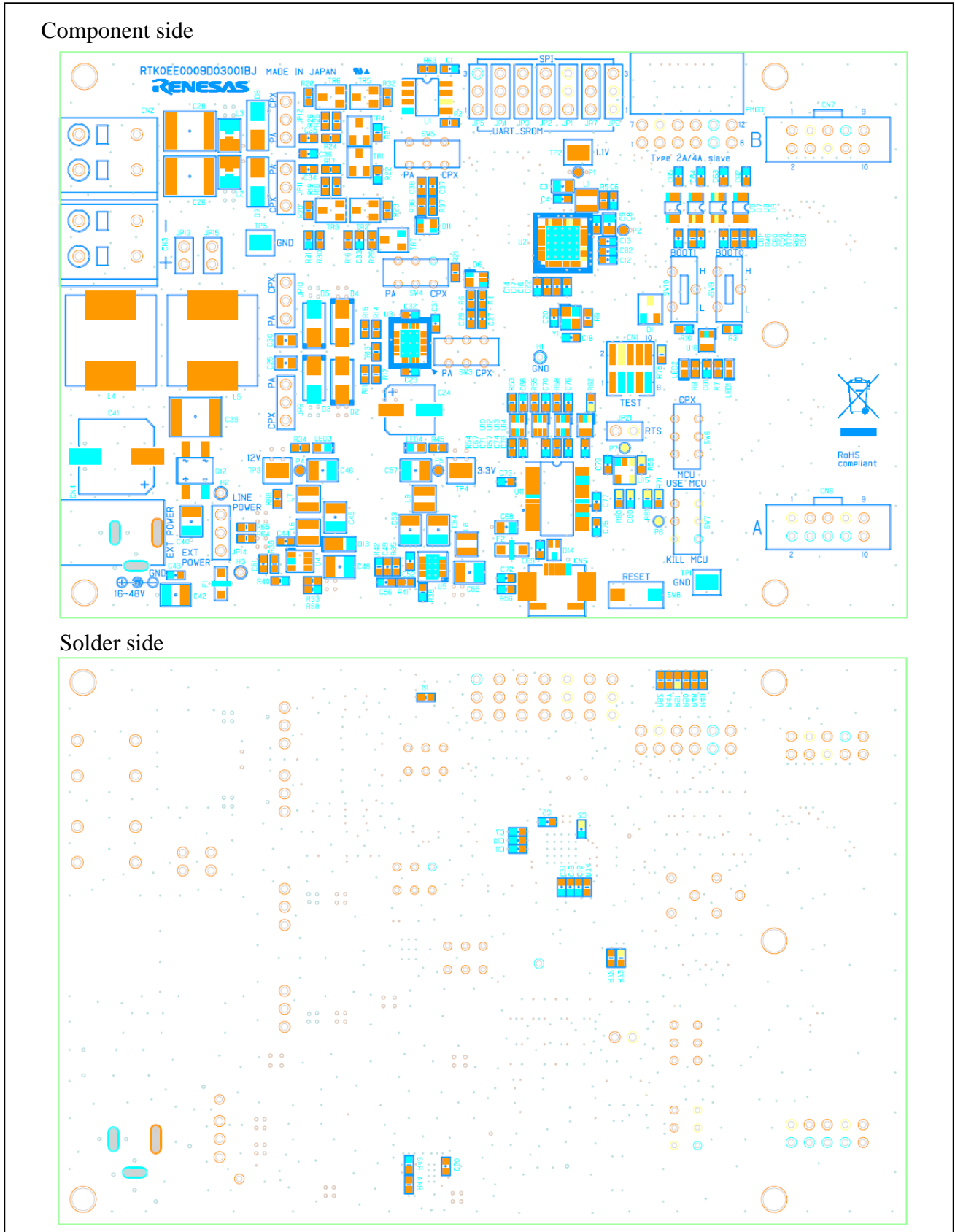


Figure 3-1 DC-PLC board parts layout and silkscreen

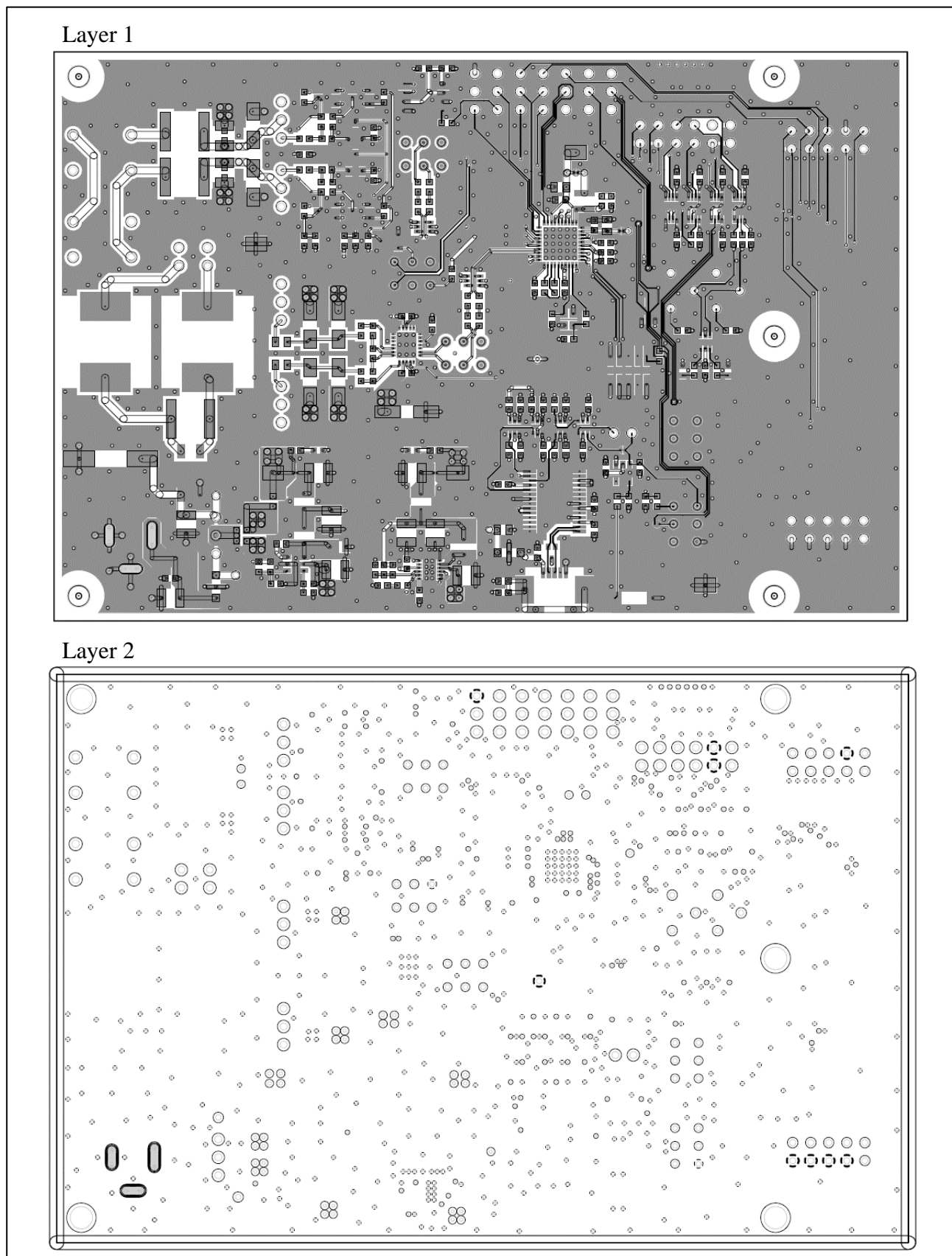


Figure 3-2 PCB layout of DC-PLC board Layer1, Layer2

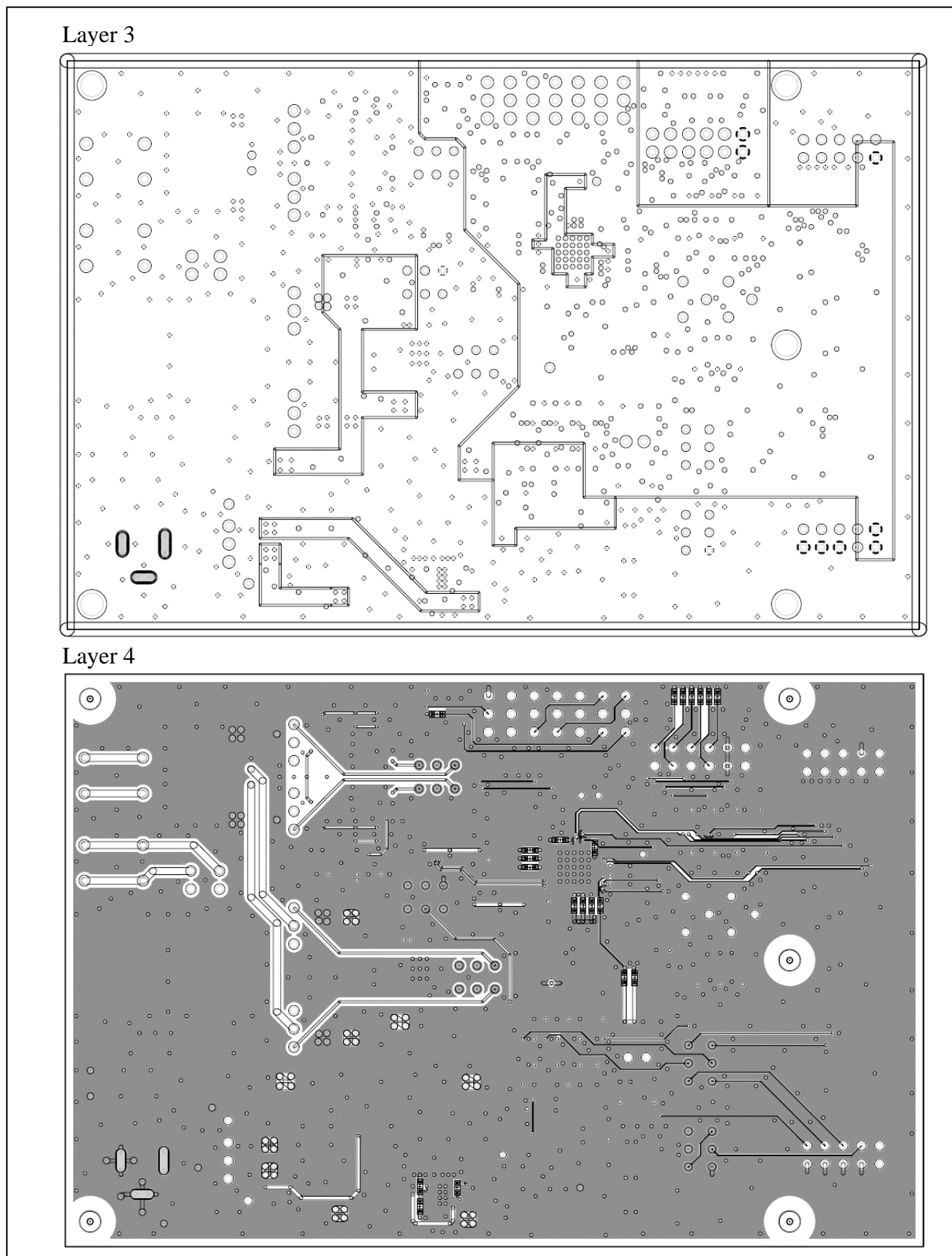


Figure 3-3 PCB layout of DC-PLC board Layer3, Layer4

### 3.2 RX651 MCU board

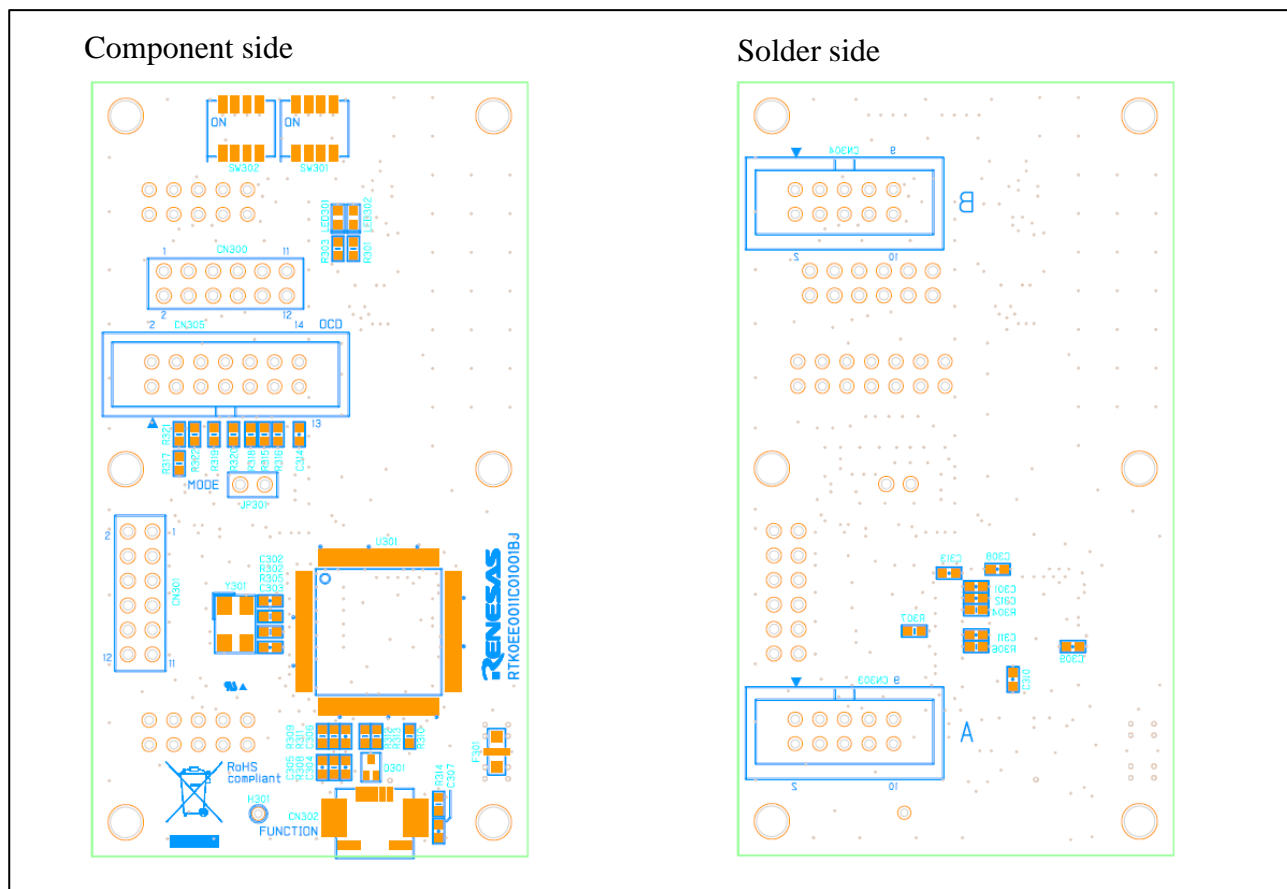


Figure 3-4 RX651 MCU board parts layout and silkscreen

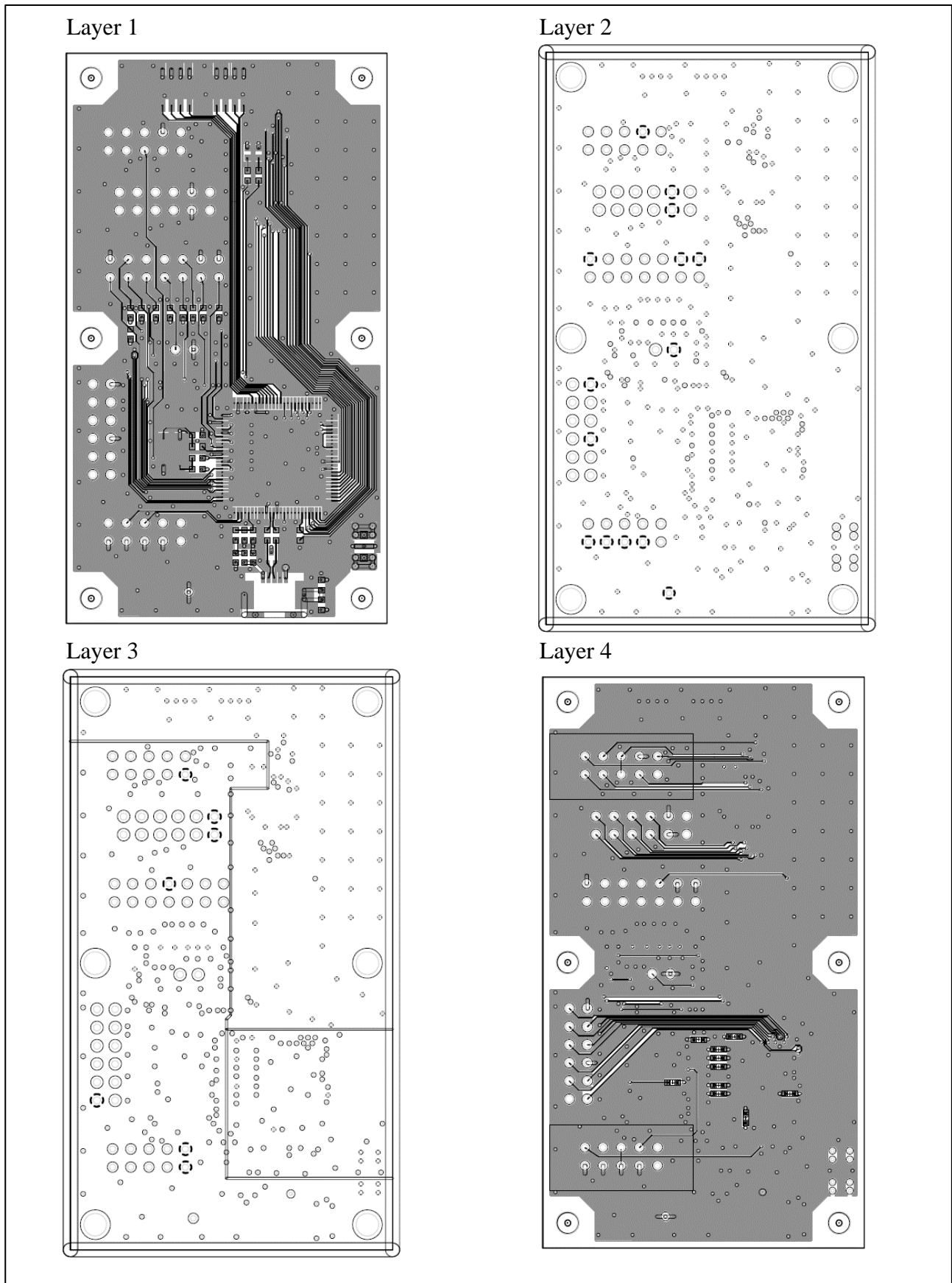


Figure 3-5 PCB layout of RX651 MCU board Layer1, Layer2, Layer3, Layer4

### 3.3 Power Filter board

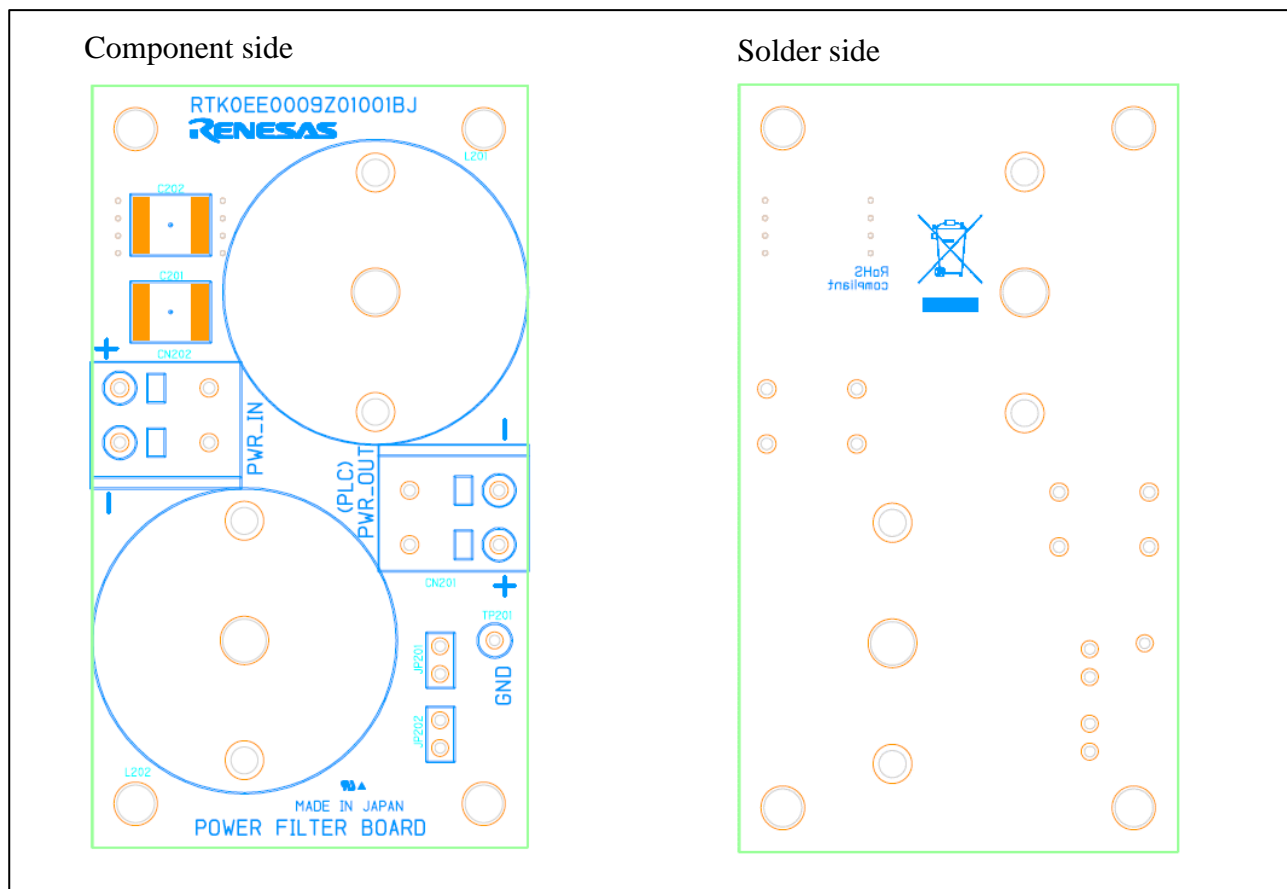


Figure 3-6 Power Filter board parts layout and silkscreen

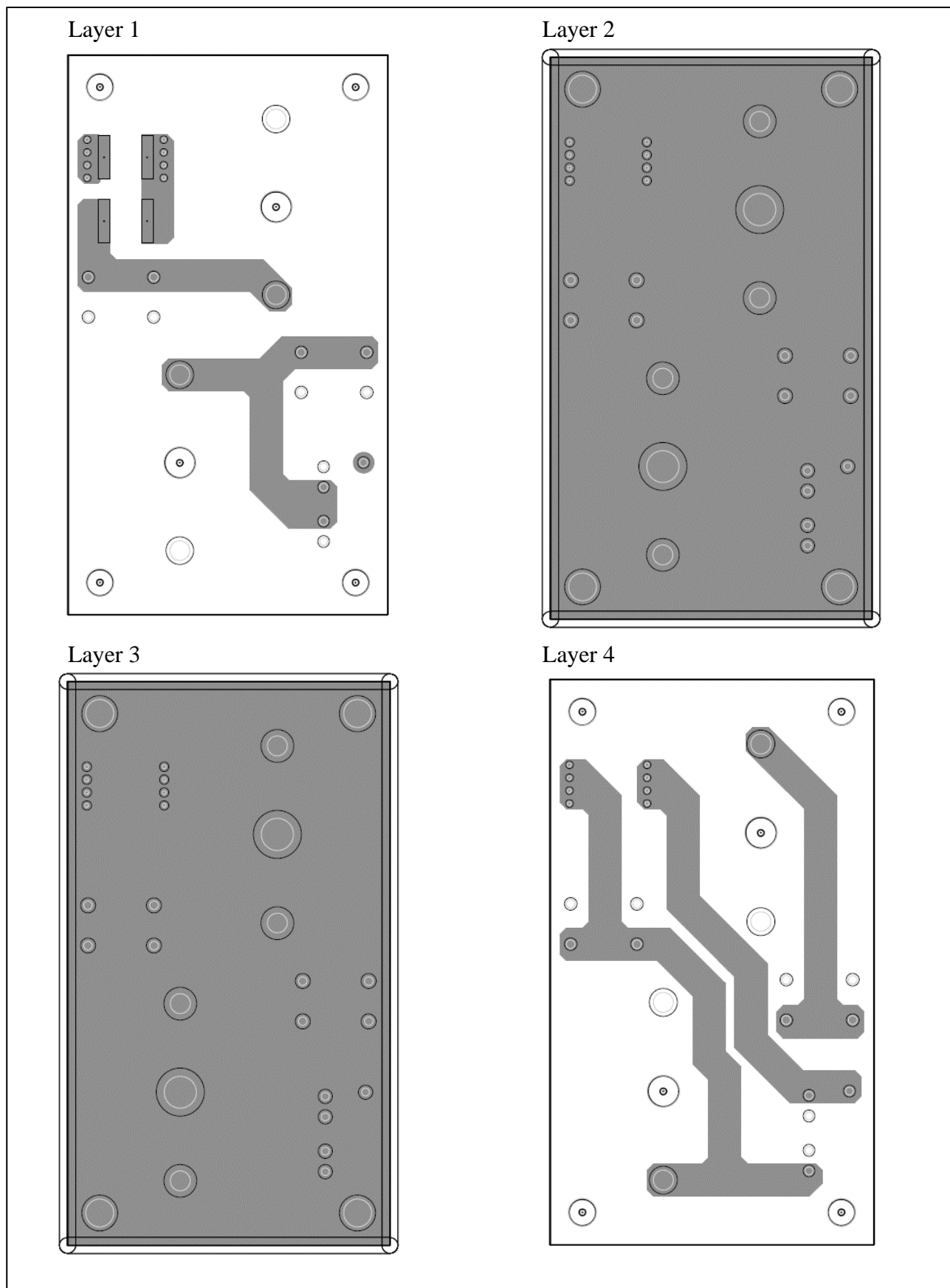


Figure 3-7 PCB layout of Power Filter board Layer1, Layer2, Layer3, Layer4

### 3.4 PMOD conversion board

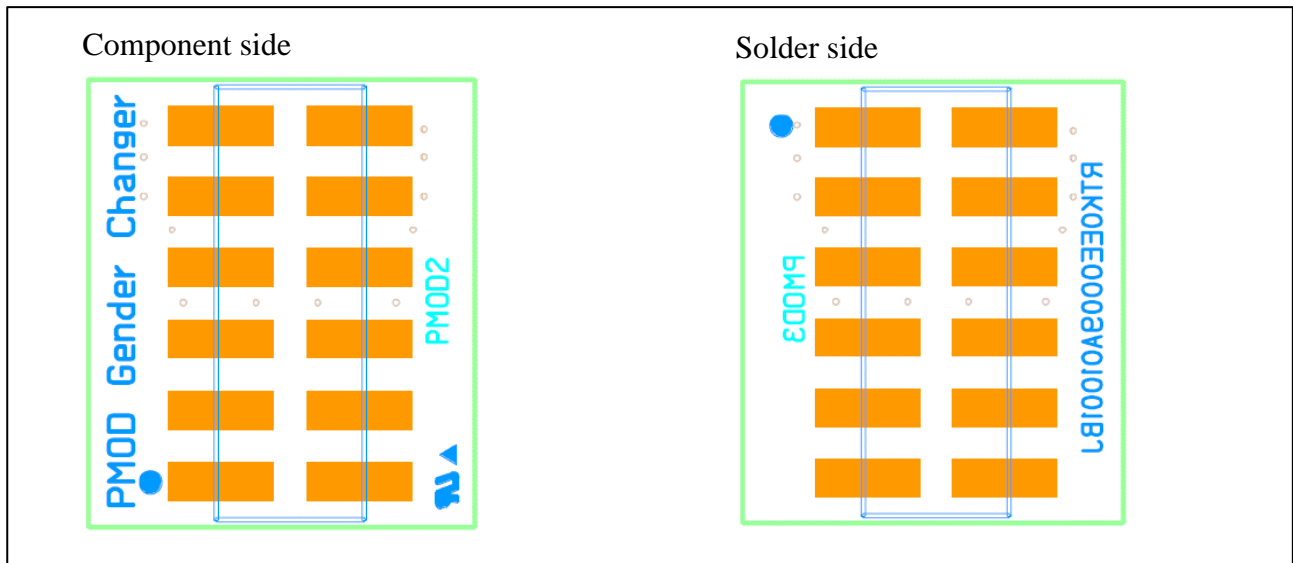


Figure 3-8 PMOD conversion board silkscreen

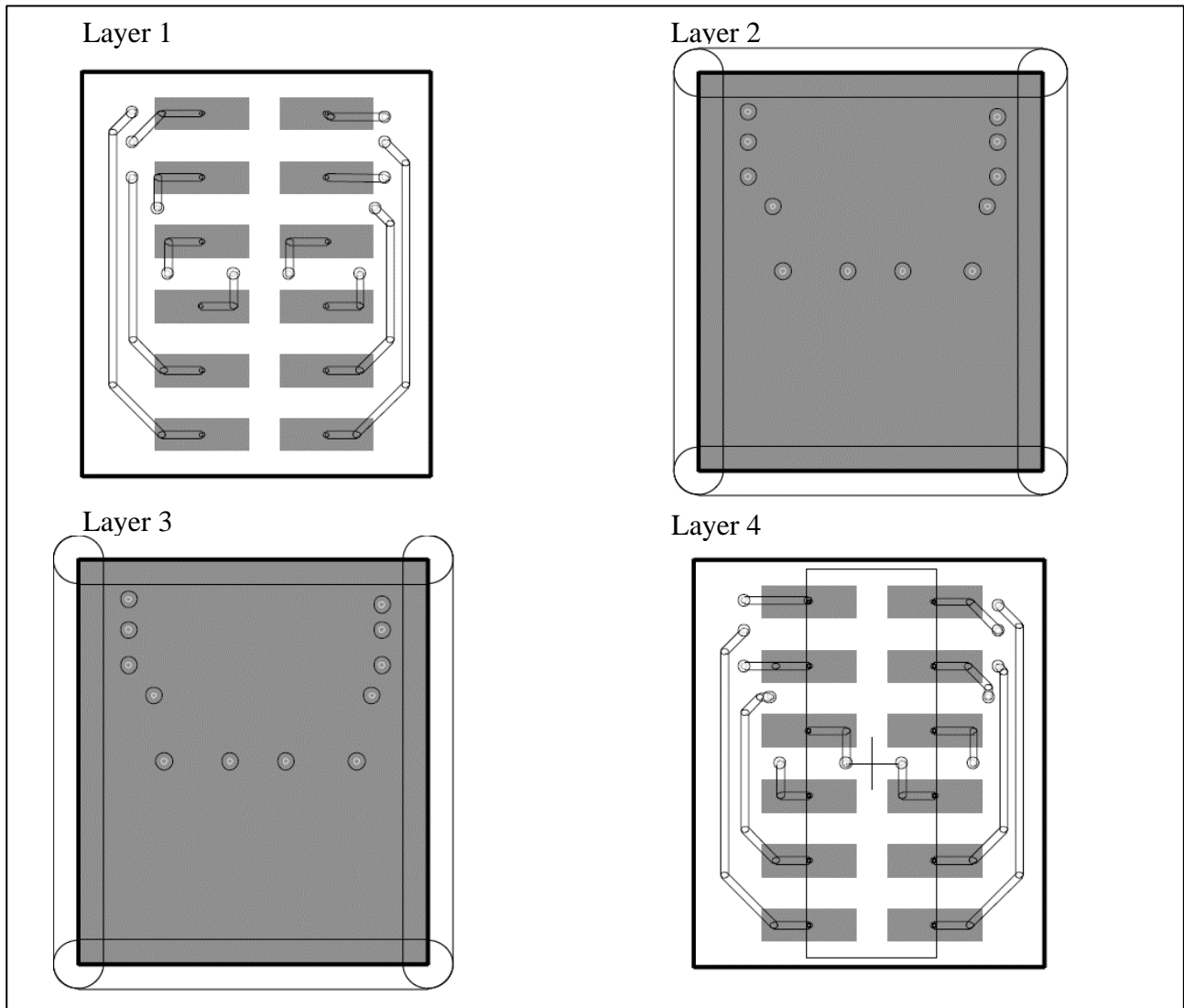
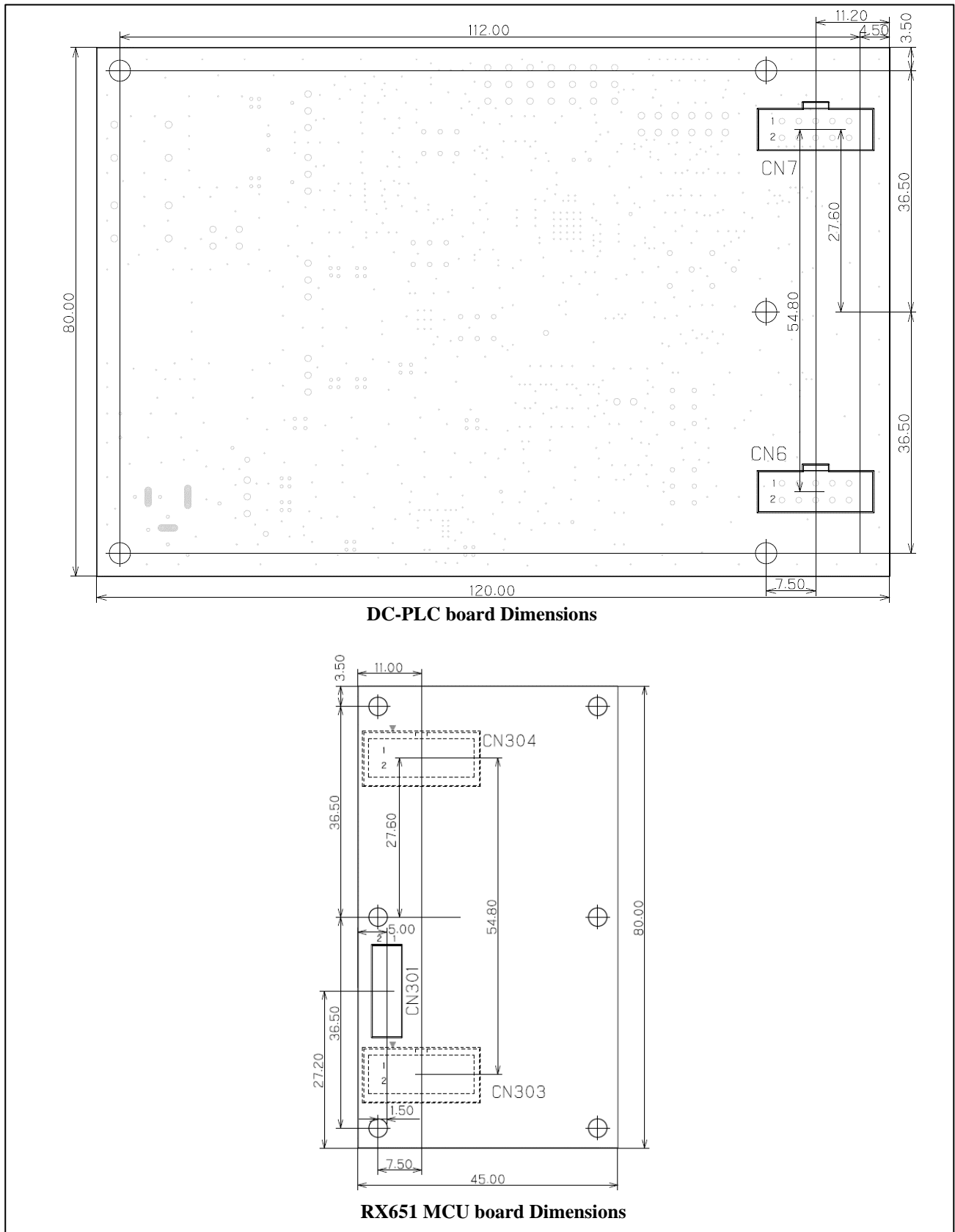


Figure 3-9 PCB layout of PMOD conversion board Layer1, Layer2, Layer3, Layer4

**4. Dimensions**



**Figure 4-1 DC-PLC board and RX651 MCU board external dimensions**

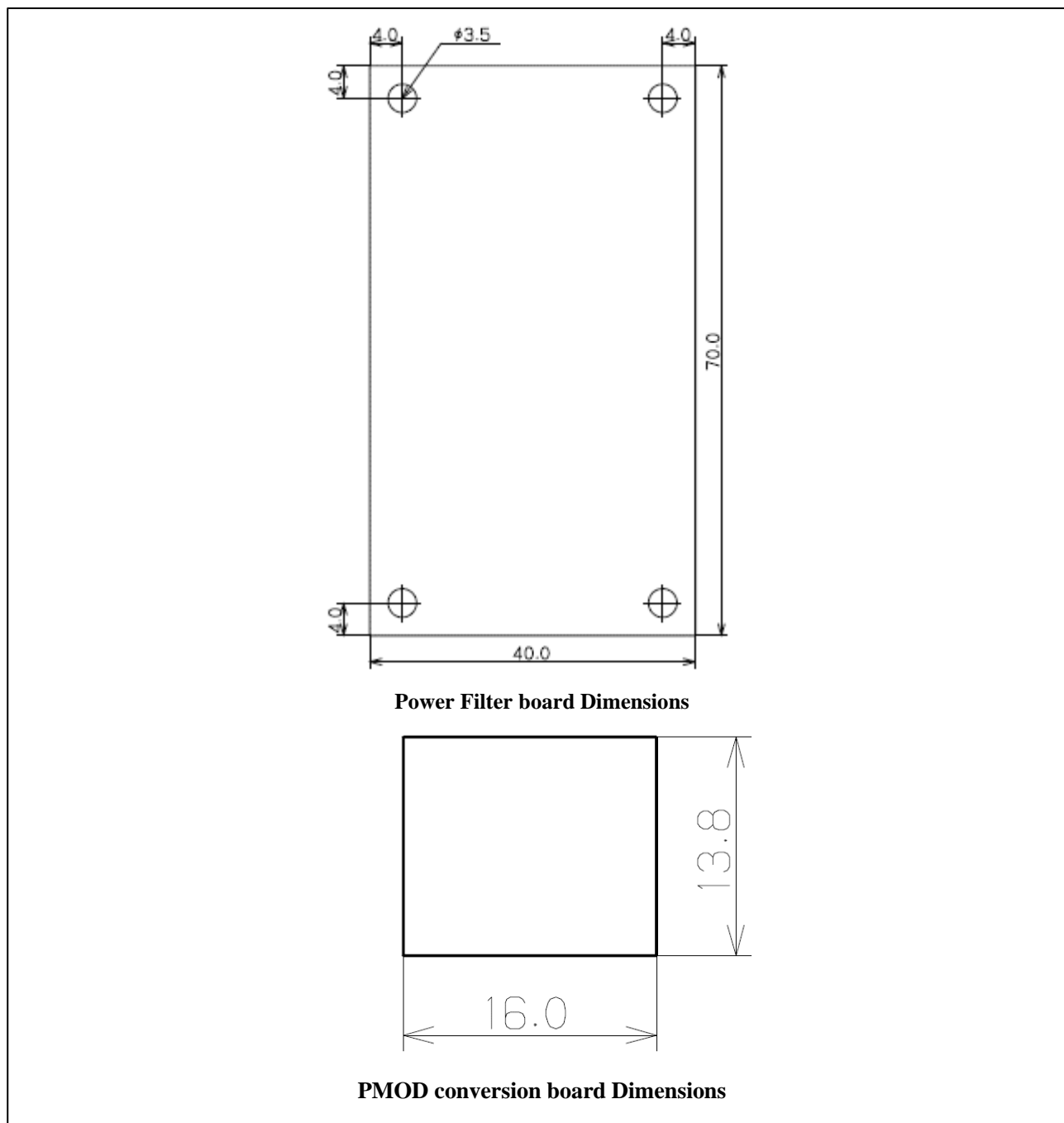


Figure 4-2 Power Filter board and PMOD conversion board external dimensions

### Revision History

Rev.	Date	Description	
		Page	Summary
1.00	OCT 01, 2021		First Edition issued
1.01	APR 01, 2024	11	Added alternative product for Y1

# General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

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

## 1. Precaution against Electrostatic Discharge (ESD)

A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.

## 2. Processing at power-on

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

## 3. Input of signal during power-off state

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

## 4. Handling of unused pins

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

## 5. Clock signals

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

## 6. Voltage application waveform at input pin

Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between  $V_{IL}$  (Max.) and  $V_{IH}$  (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between  $V_{IL}$  (Max.) and  $V_{IH}$  (Min.).

## 7. Prohibition of access to reserved addresses

Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.

## 8. Differences between products

Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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