
ECU series “ECU001-F14-12V”
Low voltage ECU evaluation kit
Users Manual

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1. Introduction

1.1. Introduction

This users' manual is for ECU001-F14-12V Low voltage F14 ECU training kit. These inverters are designed for PMSM motor and induction motor. When you use this inverter, please check your motor specifications like sensor, power, voltage range, current range and so on.

1.2. Suitable use

This inverter is suitable for research or development stage.

1.3. Precaution

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1.4. Warning



Danger

- There is a risk of fire.

If you find inverter firing, Fuming, abnormal sounding, or other abnormal conditions, stop the inverter immediately. After you stop the inverter, you should disconnect all wiring connected to the inverter.



Danger

- There is a risk of electrical shock.

There is a high voltage parts inside the inverter. Do not touch directly on working or after you stopped the inverter, while there is a charge in the capacitor. If you don't keep this warning, by electric shock, there is a risk of serious injury or death.



Danger

- There is a risk of blindness.

This inverter has an enclosure. If the inverter ruptured while opening the lid of the enclosure, there is a possibility the liquid contained in the internal capacitor, such as damaged parts enters the eyes, and it would make you blindness. Please do not open the lid of the enclosure after stopped the inverter immediately, even during the operation. If you open the lid, please be sure to wear goggles for protection such as in the photo below.



Caution

- There is a risk of burns

While driving or after stopped, this inverter gets hot such as more than 100 degree. If you touch the inverter, please pay attention to the temperature.

Caution

- Please do not block the air vents of the enclosure.

In this inverter there is a vent for cooling the inside. If you block the air vent, cooling capacity is reduced. And it may cause the inverter damage or fire.

Caution

- Please drive the FAN while driving the inverter.

In this inverter there is a FAN to cooling the inverter. If you do not drive the FAN while driving the inverter, the temperature of the inverter will rise, it may cause the inverter damage or fire.

Caution

- If you want to create a software, please create the protection routine first, such as over-current protection, over-heat protection and so on.

In this inverter, there is no mechanism to protect the inverter hardware alone. Please make the protection software first, or you may break the inverter.

Caution

- Do not drive the inverter when the ambient is very high or very high humidity.

This inverter is designed for experimental use. So this inverter won't work under below conditions. Do not use under the environment that is out of the operation environment of this manual.

- Environment where there is vibration and shock.
- Environment where there is saprophagous gas, combustible gas, humidity over 90%
- Very High or very low temperature environment

Caution

- This product handling high voltage. Please use a person who is aware of the danger of high voltage.

The wiring materials are enclosed in this inverter for reference. But they do not necessarily mean that they are appropriate for your application. Please use it before check the applications.



Caution

- Rating of this product is measured under certain conditions.

Maximum power capacity would be affected by input voltage output voltage, output current, load conditions, operations conditions and ambient temperature. To prevent the inverter broken, please watch the temperature, current, voltage, and external sensors for to protect inverter.

2. Inverter overview

2.1. Feature

This inverter unit is designed for a research or development of Car electronics use.

- * Non-isolated structure inverter based on an inexpensive circuit for a mass-production.
- * This inverter can be driven by RENESAS CPUs.
- * Unused CPU pin can be used freely by the user.
- * DC link voltage, three phase output current, three phase output voltage sensor is included.

2.2. Inverter block diagram

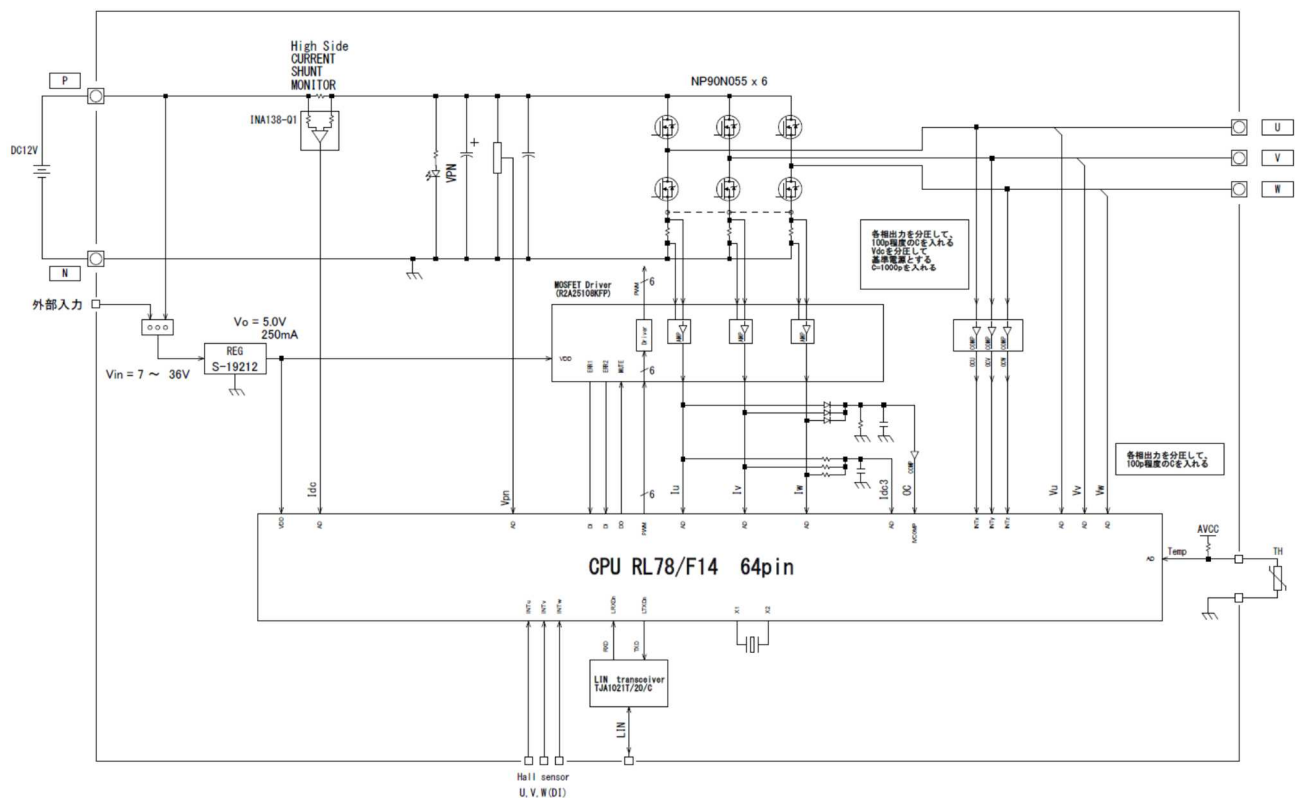


図 2.1. Inverter block diagram

2.3. Specification

Item	Specification	Remark
Operation temperature	0°C~40°C	
Operation humidity	Below 90% (No dew condensation)	
Size	146 x 100 x 35 mm	
Weight	355g	
Input voltage range	DC 0V~DC18V	
Maximum input power	300W at DC12V input	
Maximum output current	AC40A peak (28Arms)	At switching frequency 10kHz <Tc 100deg
Switching frequency	2kHz~20kHz	This data is example
Deadtime	1.5us	This data is example
Current detection	3 shunt	3 shunts is default. Can be changed to 1 shunt type
Shunt register	2mΩ	
PWM polarity	Positive logic	
Control power supply	Generated from DC link	Non-isolated
DC link – control circuit isolation	Non-isolated	
Cooling	None	

*Caution: Each maximum value, the rated value, may be changed by the type of load, input voltage, ambient environment, such as by air cooling conditions. Desk top laboratories Inc does not guarantee the condition of all the rated and maximum values of these specifications. Please install the protection way by the customer, depending experimental environment and the load environment.

3. Precaution for each circuit blocks

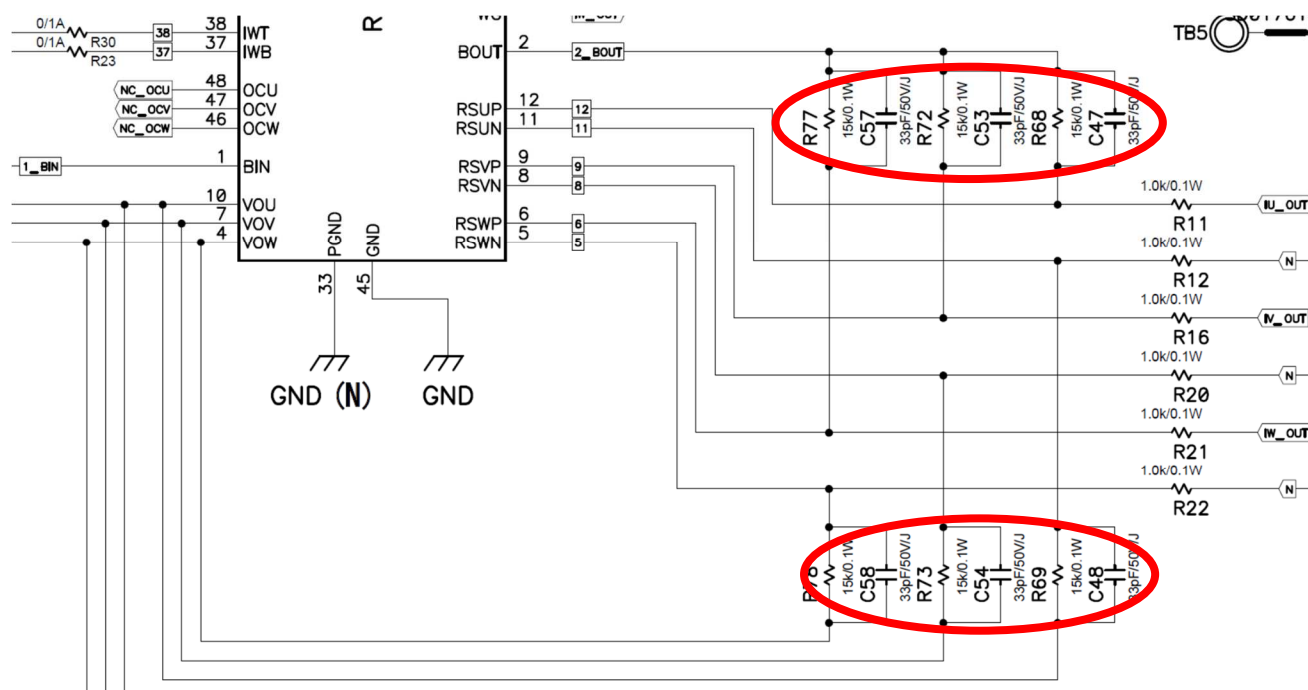
3.1. Choice of the current detection circuits

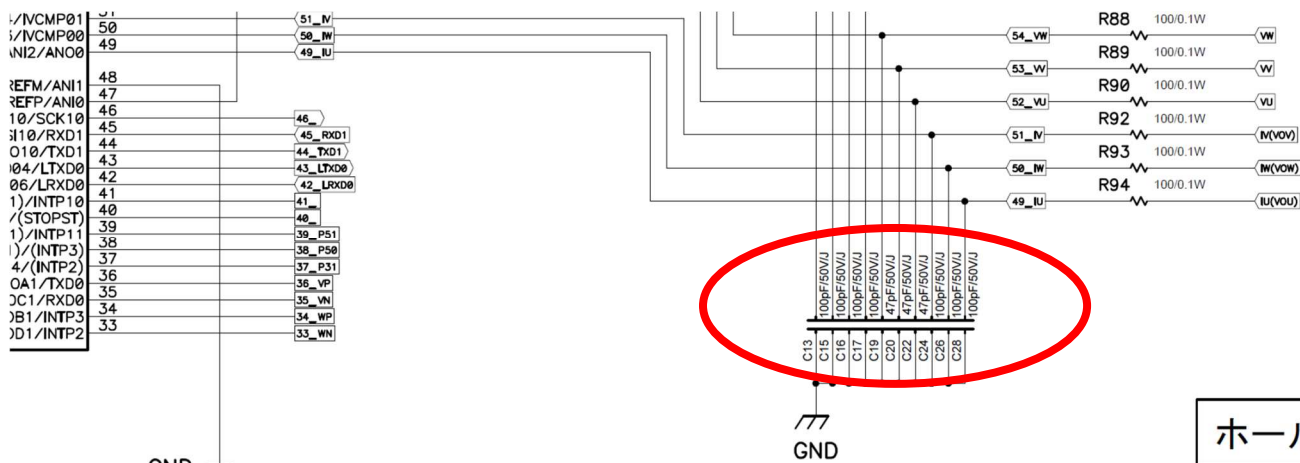
Current detection circuits gain is fixed at 15times.

Outupt	Equations
Iu OPAMP output	$V_{out} = 15 * R * I_{in} + AV_{cc} / 2$ $R = 2m \Omega$
Iv OPAMP output	
Iw OPAMP output	$I_{in}=83.333A \Rightarrow V_{out}=5V$ $I_{in}=0A \Rightarrow V_{out}=2.5V$ $I_{in}=-83.333A \Rightarrow V_{out}=0V$
Idc AMP	$I_{dc}=52A \Rightarrow V_{out} = 5V$ $I_{dc}=0A \Rightarrow V_{out} = 0V$

3.2. The filter circuits for the current detection

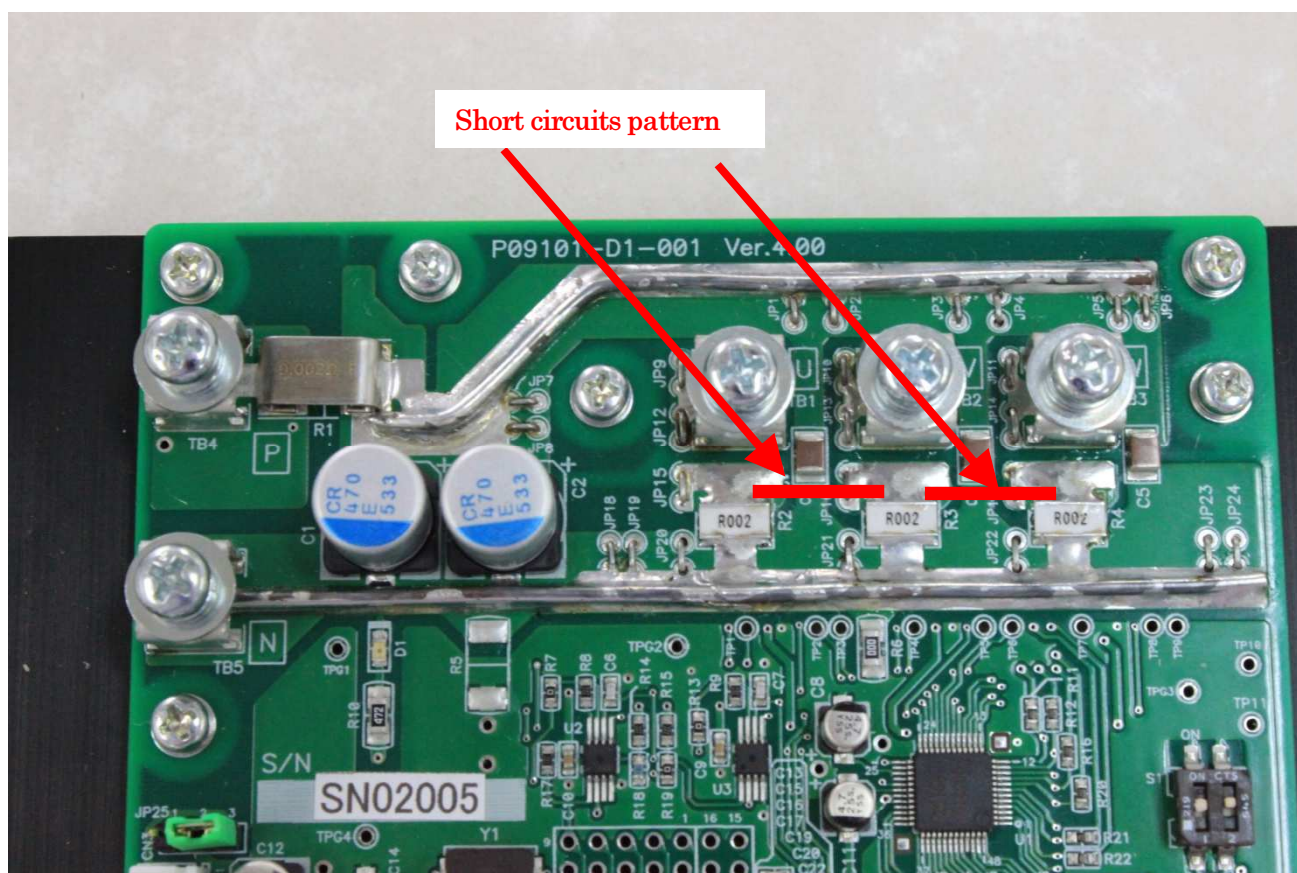
The filter parameters for the current detection circuits need be changed by the application, noise environment, switching frequency, control algorithm and so on. As shown below, this inverter provides the pattern of the filter capacitor.

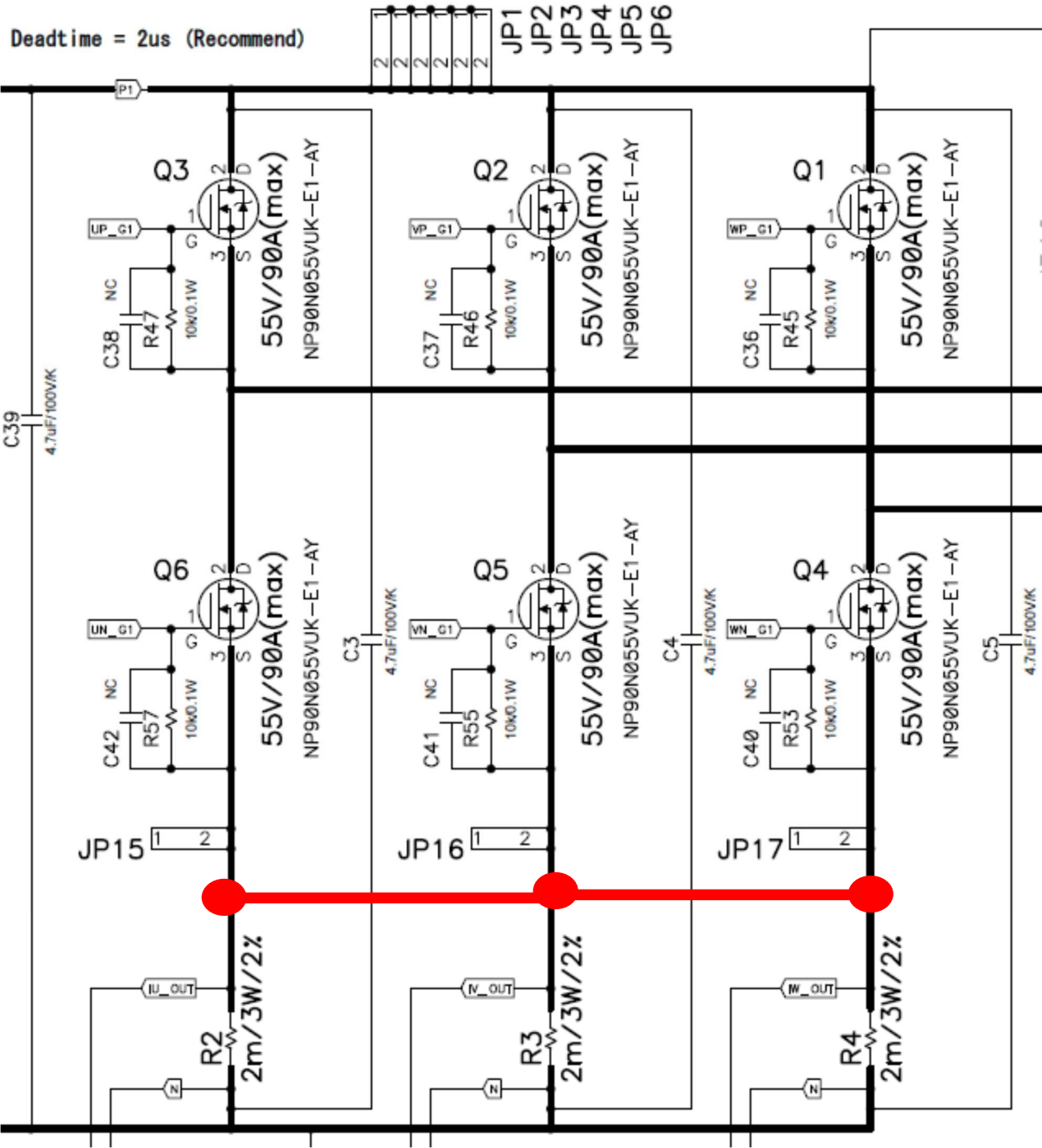




3.3. Alterations for one shunt current detection method

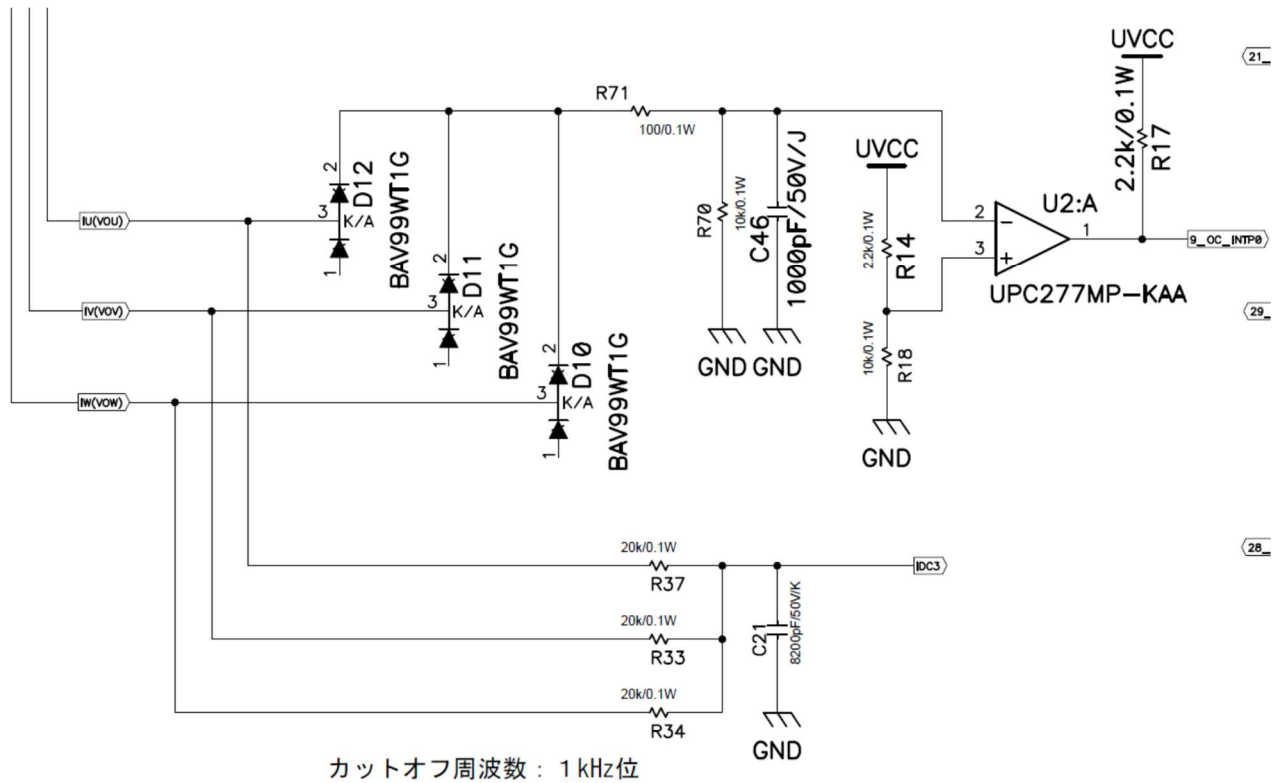
This inverter is based on three shunt current detection. But this inverter can be converted to the one shunt current detection. If you want to use one shunt current detection method, please connect MOSFET side of the R2, R3 and R4. In case of this alteration, resistor value will be 1/3. You need to change the resistor value or remove resistors depending on your requirement.





3.4. Over current detection circuits

The over current detection circuits of this inverter use the comparators. The outputs of the comparators are connected to the /INTP0 pin of CPU. So user need to install the gate-block routine to your application.

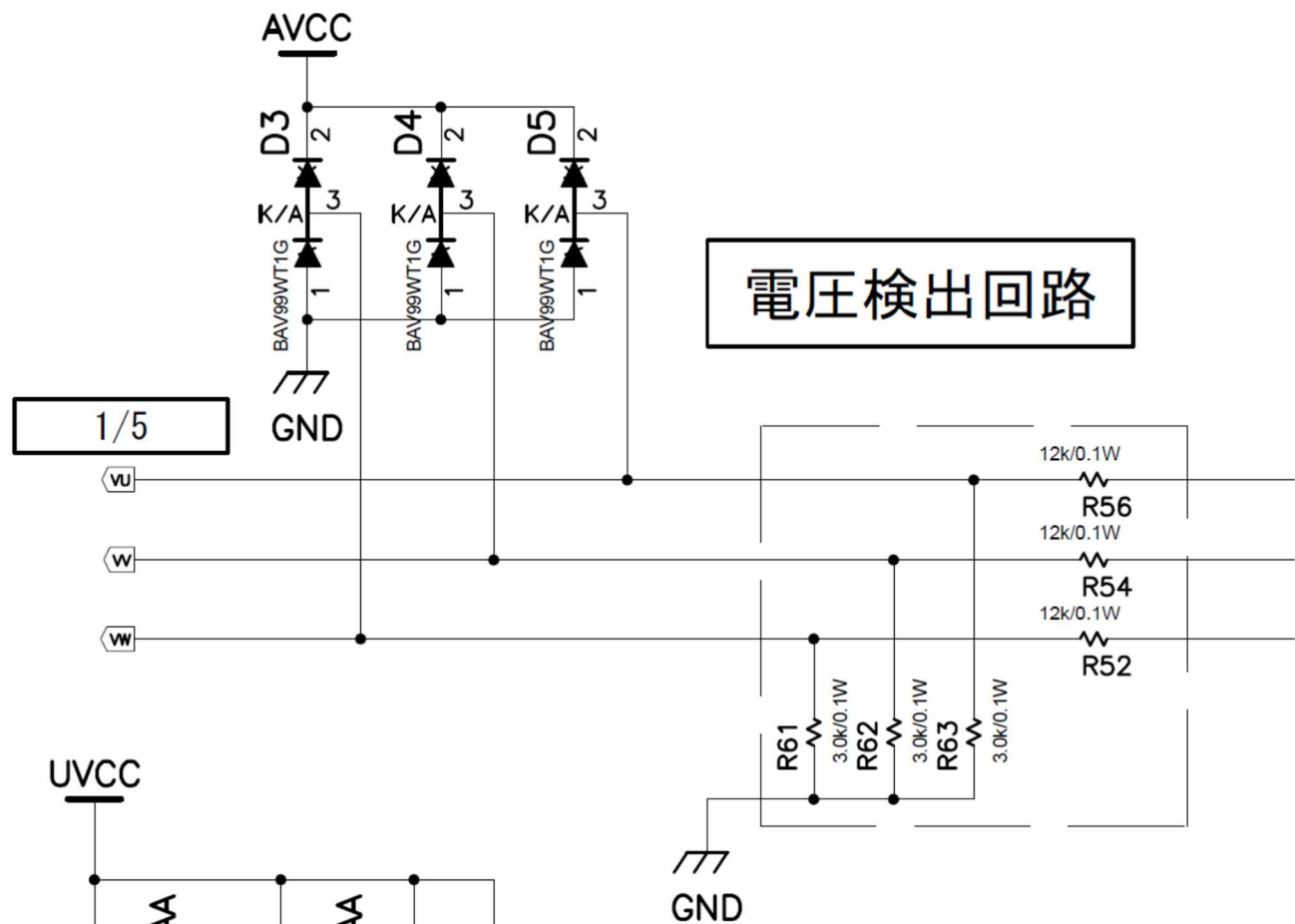


3.5. Output Voltage detection circuits

This inverter has four voltage detection circuits.

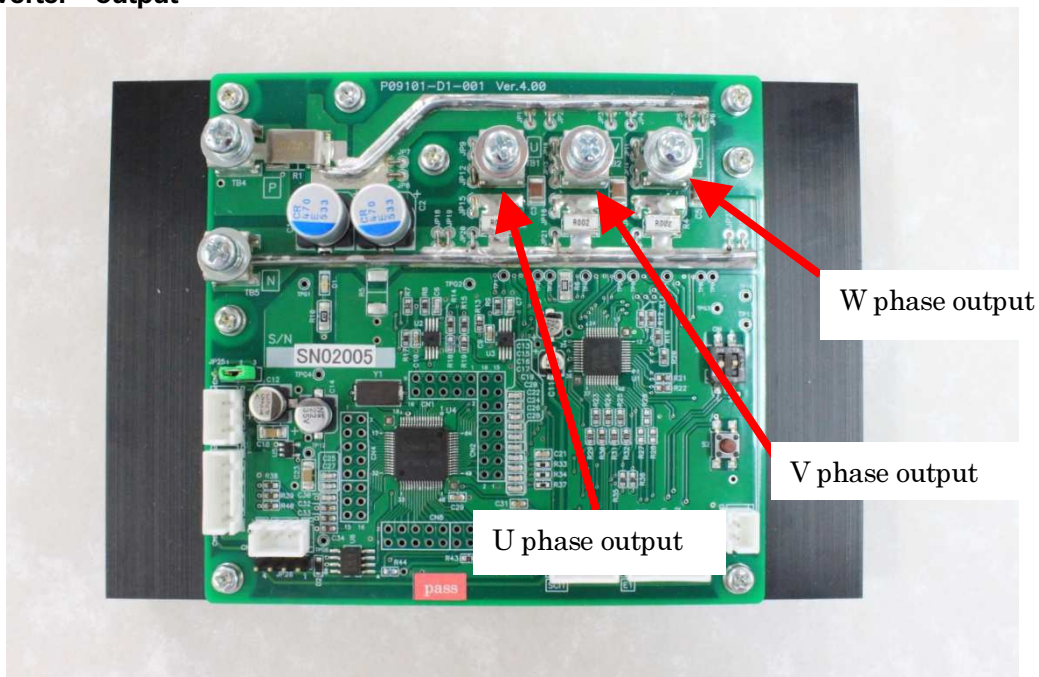
At AVcc = 5V

Voltage	Equation
DC link	$V_{out} = \frac{3.0}{12 + 3} \times V_{in}$
U phase	
V phase	$V_{in}=15V \rightarrow V_{out}=3V$
W phase	$V_{in}=0V \rightarrow V_{out}=0V$



4. External connection

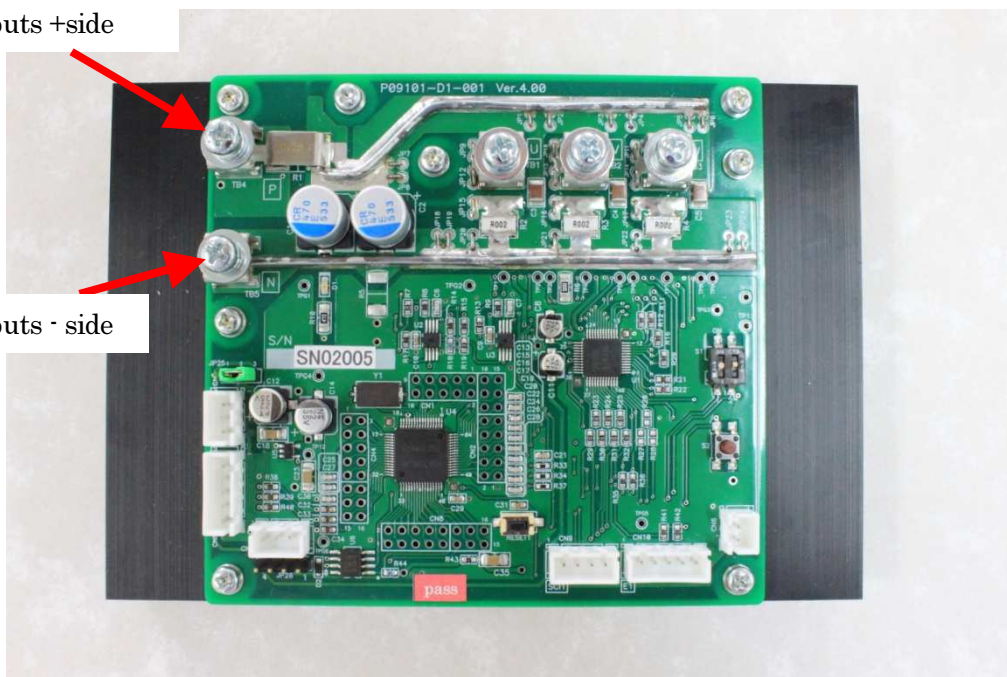
4.1. Inverter output



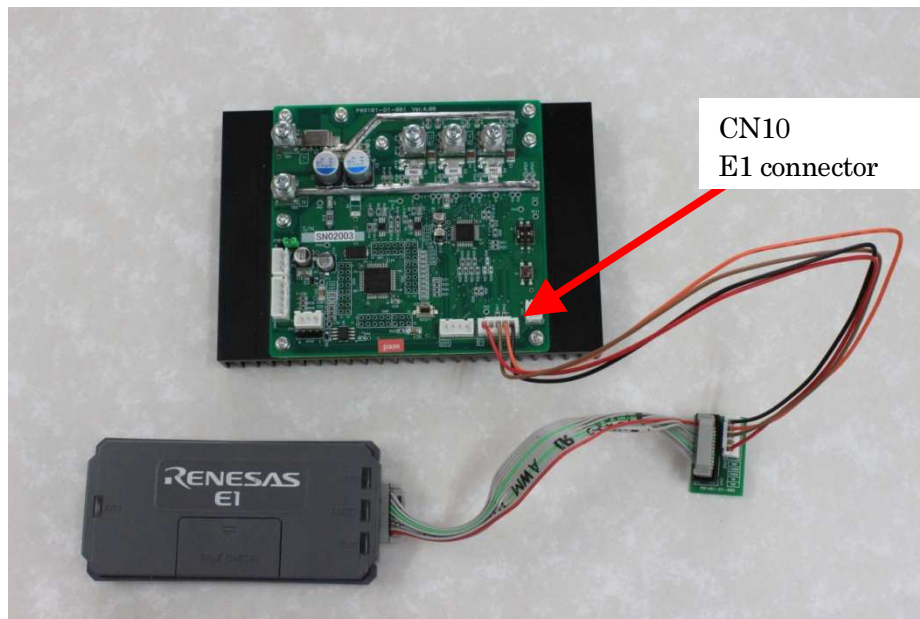
4.2. Inverter DC power input

DC inputs +side

DC inputs - side

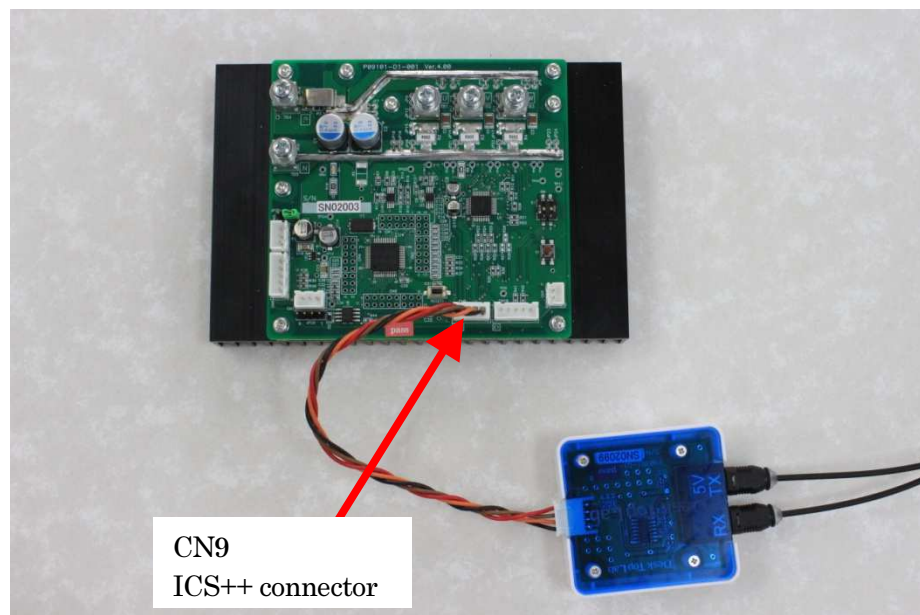


4.3. E1 connector (CN10)



4.4. ICS++ connector (CN9)

If you use ICS++, please connect ICS unit via CN9



5. Accessories

5.1. Accessories

- ECU001-F14-12V inverter 1 pcs
- Input cable 3.5SQ x 2 (Rated 23Arms) 1pcs
- Output cable 3.5SQ x 3 (Rated 23Arms) 1pcs
- E1 conversion cable (with conversion board) 1 pcs
- Option shunt resistor (5m ohm x 3, 15m ohm x 3) 1 set
- PM Motor (BLY171S-15V-8000 Anaheim automation) 1 pcs
- Transparent cover 1 pcs

*Caution

Please download circuits, BOM list and manuals from

<http://www.desktoplab.co.jp/download.html>

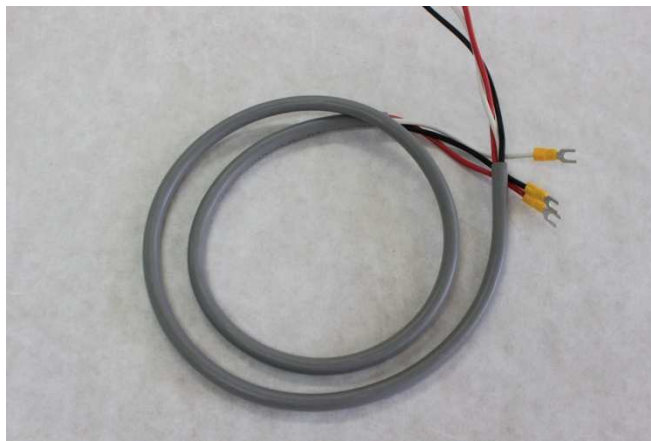
5.2. ECU001 inverter



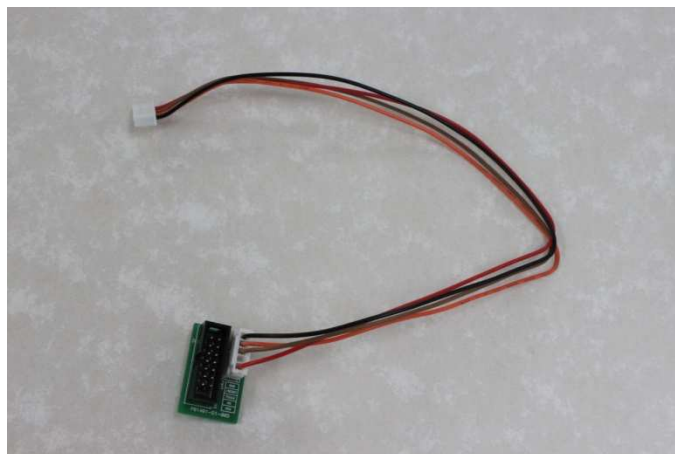
5.3. Input cable 3.5SQ x 2



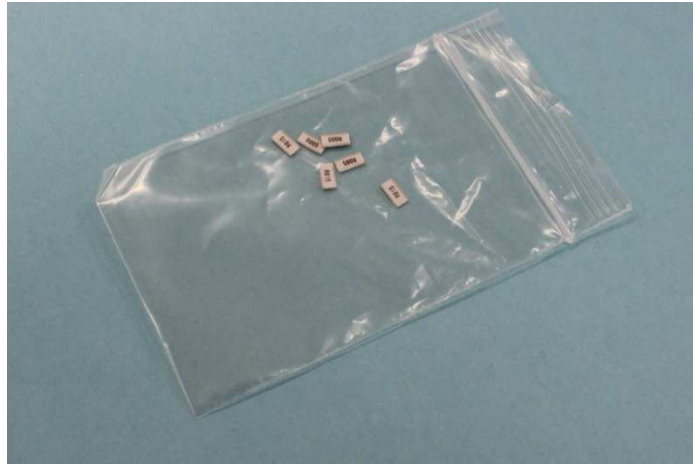
5.4. Output cable 3.5SQ x 3



5.5. E1 conversion cable with conversion PCB



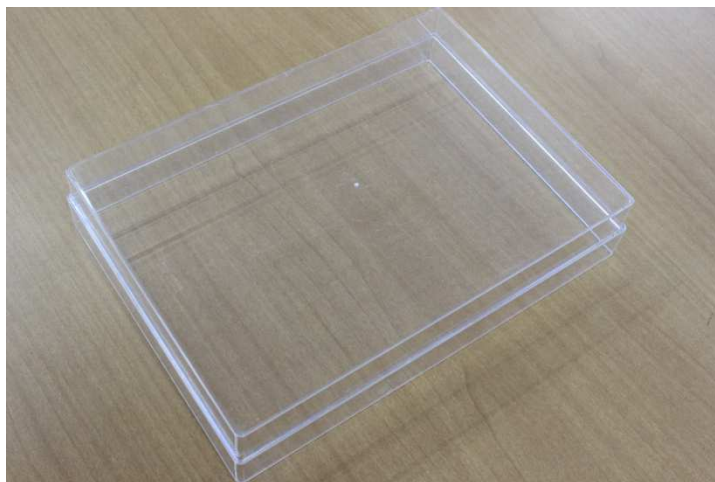
5.6. Option shunt resistors (5m ohm x 3, 15m ohm x 3)



5.7. PM motor (BLY171S-15V-8000 Anaheim automation)



5.8. Transparent cover



6. Ordering information

6.1. Ordering number

Order number	FAN	Case
ECU001-F14-12V	NA	none

OPTION

OPTION	内容
None	

7. Revision history

7.1. Revision history

Version	日付	Contents
V1.00	2020-06-26	・ First release in English

ECU series ECU001-F14-12V Low voltage ECU Unit Users Manual

Issue date: June/26/2020 Ver.1.00 EN

Issue: Desk Top Laboratories Inc.
101, 35-7, MATSUGI, HACHIOUJI-SHI, TOKYO, Japan, 192-0362
