

Application manual DCS1400B

DCS1400B SERIES



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Note: Information contained in this document is subject to change without notice for improvement.
 The materials are intended as a reference design, component values and circuit examples described in this document varies depending on operating conditions and component variations.
 Please select the components and design under consideration of usage condition etc.

1. Pin Assignment

1.1 Pin Assignment

Fig.1.1
Pin Assignment

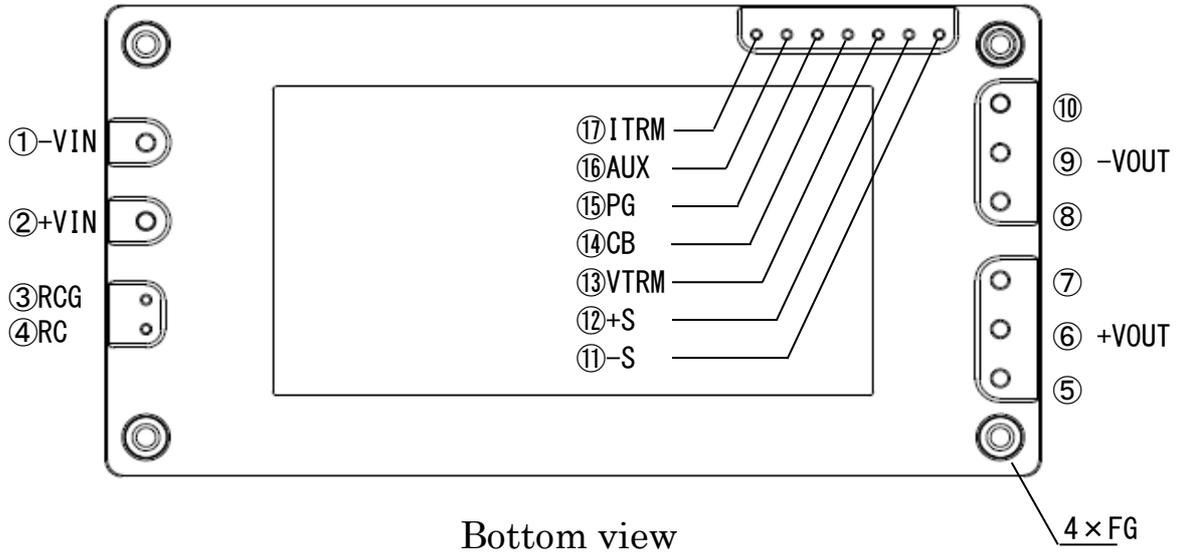


Table 1.1
Pin configuration
and function

No.	Pin Connection	Function
①	-VIN	-DC input
②	+VIN	+DC input
③	RCG	Remote ON/OFF(GND)
④	RC	Remote ON/OFF
⑤⑥⑦	+VOUT	+DC output
⑧⑨⑩	-VOUT	-DC output
⑪	-S	Remote sensing(-)
⑫	+S	Remote sensing(+)
⑬	VTRM	Adjustment of output voltage
⑭	CB	Current balance
⑮	PG	Power good output
⑯	AUX	Auxiliary output for PG
⑰	ITRM	Adjustment of constant current
—	FG	Mounting hole(FG)

2. Connection for Standard Use

2.1 Connection for standard use

- To use the DCS1400 series, external components should be connected as shown in Fig.2.1.
- The DCS1400 series should be conduction-cooled. Use a heatsink or fan to dissipate heat.

Fig.2.1
Connection for
standard use

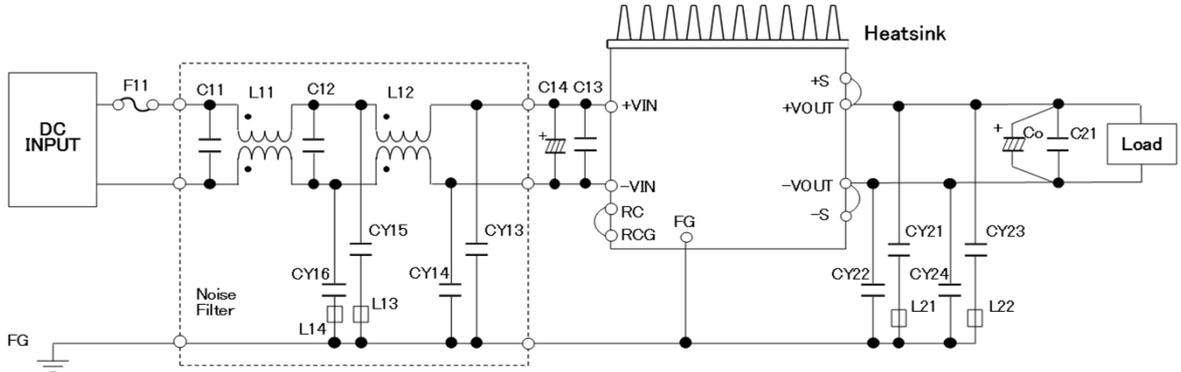


Table 2.1
Components list

No.	Symbol	Item	Vin = 200~435VDC		Note	
			Rating	Part name		
1	F11	Input fuse	500VDC/16A	0505016 (Littelfuse)		
2	L11 L12	AC Linefilter	2.5mH/15A	SCF25XV-150-1R6A010JH (KEMET)		
3	C11					X capacitor
4	C12	DC450V/2.2uF	AFS450V225K (OKAYA ELECTRIC INDUSTRIES)			
5	CY13 CY14	Y capacitor	AC400V/2200pF	CD45-E2GA222M (TDK)		
6	CY15 CY16					AC400V/1500pF
7	L13 L14	Ferrite Bead	-	K5B T 4x2x2 (King Core Electronics)		
8	C13	Input capacitor	DC450V/1.0uF	AFS450V105K (OKAYA ELECTRIC INDUSTRIES)		
9	C14					DC450V/82uF
10	Co	Output capacitor	B12	DC16V/2200uF	ELXZ160ELL222MK25S (Nippon Chemi-Con)	
11			B24	DC35V/2200uF	ELXZ350ELL222ML25S (Nippon Chemi-Con)	
12			B28	DC50V/1000uF	ELXZ500ELL102ML25S (Nippon Chemi-Con)	
13			B36	DC50V/1000uF	ELXZ500ELL102ML25S (Nippon Chemi-Con)	
14			B48	DC63V/680uF	ELXZ630ELL681ML25S (Nippon Chemi-Con)	
15			B65	DC100V/330uF	UPW2A331MHD (Nichicon)	
16			C21	Bypass capacitor	DC100V/1.0uF	GRM31CR72A105K (Murata Manufacturing)
17	CY21 CY22 CY23 CY24	Y capacitor	AC300V/0.01uF	CS45-F2GA103M (TDK)	For DCS1400B65 only	
18	L21 L22	Ferrite Bead	-	K5B T 4x2x2 (King Core Electronics)	For DCS1400B65 only	

• External parts should be changed according to the ambient temperature, and input and output conditions.

For details, refer to the selection method of individual parts.

2.2 Input fuse: F11

- Fuse is not built-in on input side. In order to protect the unit, install a fuse (as shown in Table 2.2)

Table 2.2
Recommended
fuse

Input voltage range	Rated Voltage	Rated current
200~435VDC	500VDC or more	16A

2.3 Input capacitors: C13,C14

- Install a film capacitor of 0.68 μ F or higher as input capacitor C13.
- When the input voltage rises quickly at start-up (less than 10 μ s), install a electrolytic capacitor C14 with more than 22 μ F between +VIN and -VIN pins.
- If C13 is not connected, it may cause failure of the power supply or external components.
- When selecting a capacitor, check the maximum allowable ripple current.
- Ripple current includes high frequency component (300kHz).
- Ripple current values flowing through C13 and C14 as listed in Table 2.1 are shown in the figure below.
- The ripple current changes with PCB patterns, external parts, ambient temperature, etc. Check the actual ripple current value flowing through capacitors.

Fig.2.2
Ripple current
values
C13

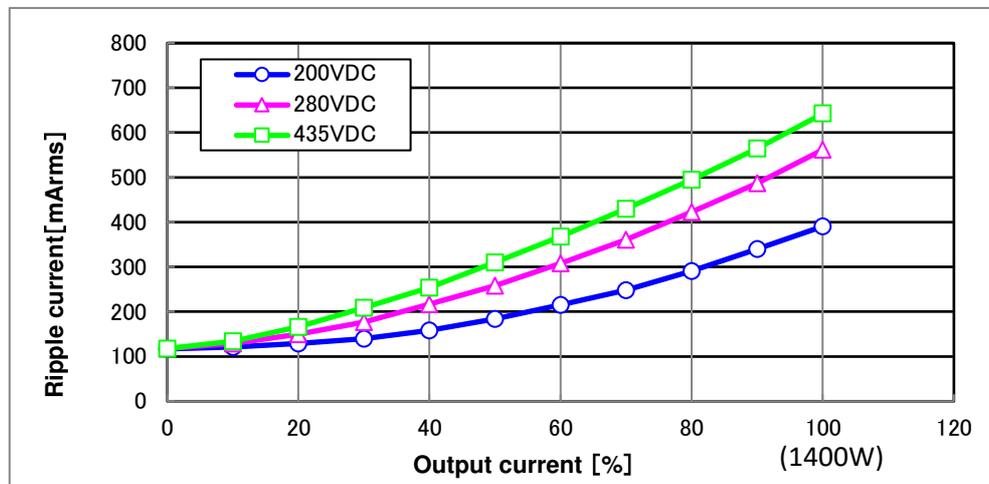
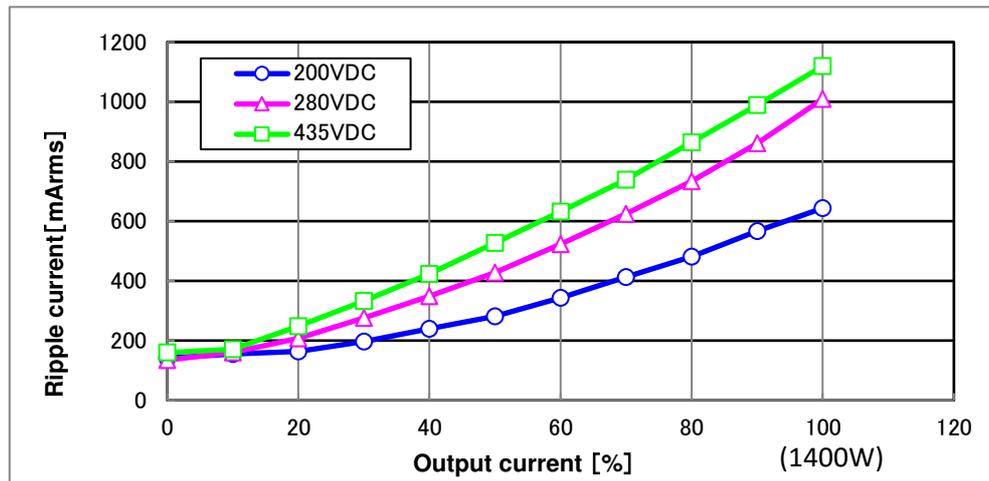


Fig.2.3
Ripple current
values
C14



2.4 Y Capacitors and noise filters: CY, CX, L11, L12

- The DCS1400B doesn't have noise filter internally.

Install an external noise filter and capacitor (CY) to reduce conducted noise and stabilize the operation of the power supply.

- Noise filters should be properly designed when the unit must conform to the EMI/EMS standards or when surge voltage may be applied to the unit.
- The primary Y capacitor (CY1) must have a capacitance of 470 pF or more.
- When the total capacitance of CY1s exceeds 18,800 pF, input-output withstanding voltage may be dropped. In this case, either reduce the capacitance of CY1s capacitors or install a grounding capacitor (CY2) between output and FG.

For the DCS1400B65, CY2 should be connected regardless of the capacity of CY1. In addition, the capacitance of CY2 is 2,200pF or more.

Calculate CY2 from the following formula.

$$\text{DCS1400B12/24/28/36/48} \quad \text{CY2} > (\text{Total capacitance of CY1} - 18,800\text{pF}) \times 5$$

$$\text{DCS1400B65} \quad \text{CY2} > (\text{Total capacitance of CY1}) \times 3$$

- Use capacitors that comply with safety standards as CY.

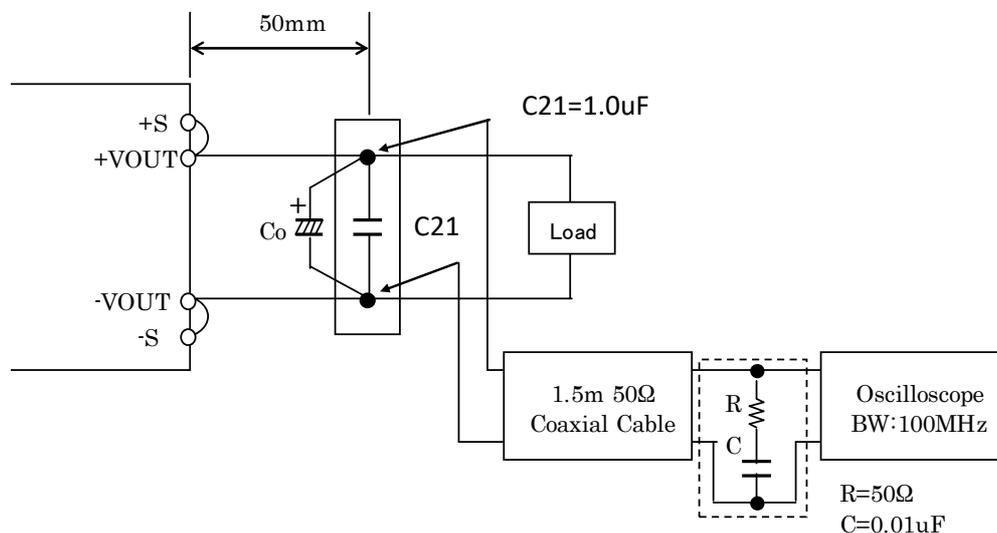
2.5 Output capacitors: Co, C21

- Install an external capacitor, Co, between +VOUT and -VOUT pins for stable operation of the power supply. Recommended capacitance of Co is shown in Table 2.3.
- Use low impedance electrolytic capacitors with excellent temperature characteristics.
- When using at ambient temperatures below -10 °C, the output ripple voltage increases due to the characteristics of equivalent series resistor (ESR). In this case, connect three capacitors, Co, of recommended capacitance in parallel connection.
- Specifications, output ripple and ripple noise as evaluation data values are measured according to Fig.2.3.

Table 2.3
Recommended
capacitance
Co

Output Voltage	Tc = -10~100°C	Tc = -40~100°C
12V	2,200uF	2,200uF×3parallel
24V	2,200uF	2,200uF×3parallel
28V	1,000uF	1,000uF×3parallel
36V	1,000uF	1,000uF×3parallel
48V	680uF	680uF×3parallel
65V	330uF	330uF×3parallel

Fig.2.4
Measuring
environment



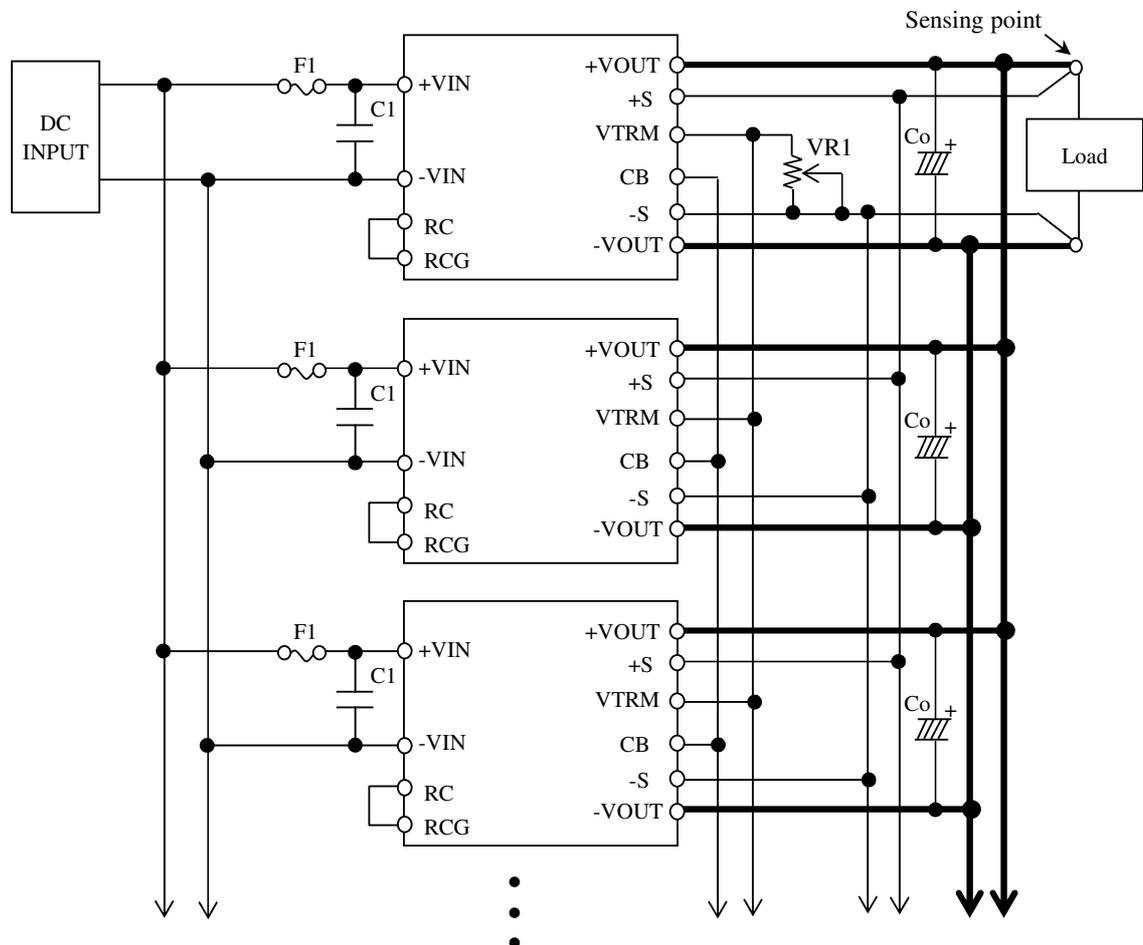
3. Parallel operation

3.1 Wiring for parallel operation

- Parallel operation is available by connecting the units as shown in Fig 3.1.
- Total current should not exceed the value calculated by the following equation, and total number of unit should be no more than 12 pieces.

$$(\text{Output current at parallel operation}) = (\text{the rated current per unit}) \times (\text{number of unit}) \times 0.95$$
- Connect the sensing line and the power line by one point after connecting each power supply's sensing pin(+S,-S). Please do not connect the sensing from the individual power supply as it may cause unstable operation.
- Please make sure that the wiring impedance of a load from each power supply become even.
- Output voltage and constant current can be adjusted in parallel operation.
 (Refer to item 3.2, 3.3)
- If the output current is less than 2% of the rated current, the output voltage ripple will be large. Therefore, it is recommended to use it with 2% load or more.

Fig3.1
Wiring for
parallel
operation



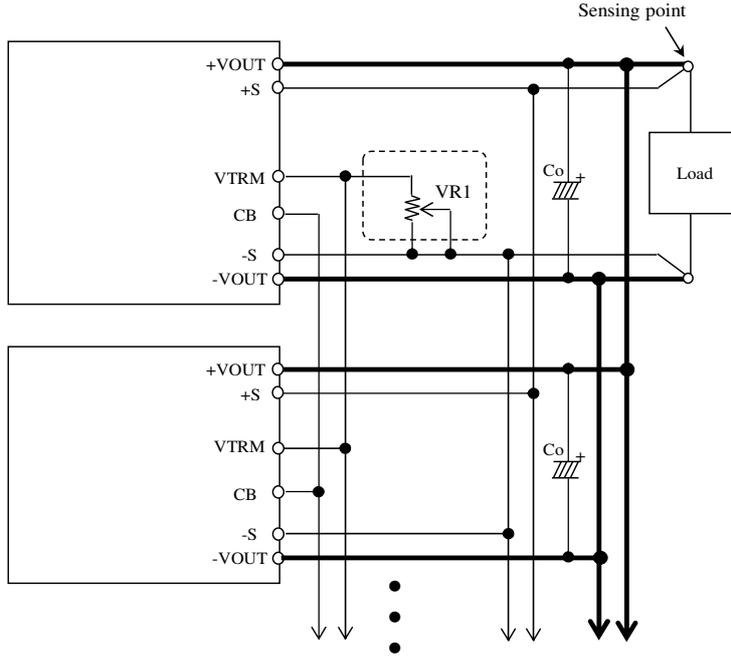
3.2 Output voltage adjustment in parallel operation(CV)

- When adjusting the output voltage in parallel operation, connect the VTRM terminals together and adjust them together.
- By connecting the external potentiometer (VR1) as shown in Fig.3.2.,output voltage becomes adjustable. See formula①

$$\text{Output voltage[V]} = \frac{5 \times \text{VR1 [k}\Omega\text{]}}{(\text{VR1} + 4.7 / \text{N}) \text{ [k}\Omega\text{]}} \times \text{Rated output voltage [V]} \dots \text{①}$$

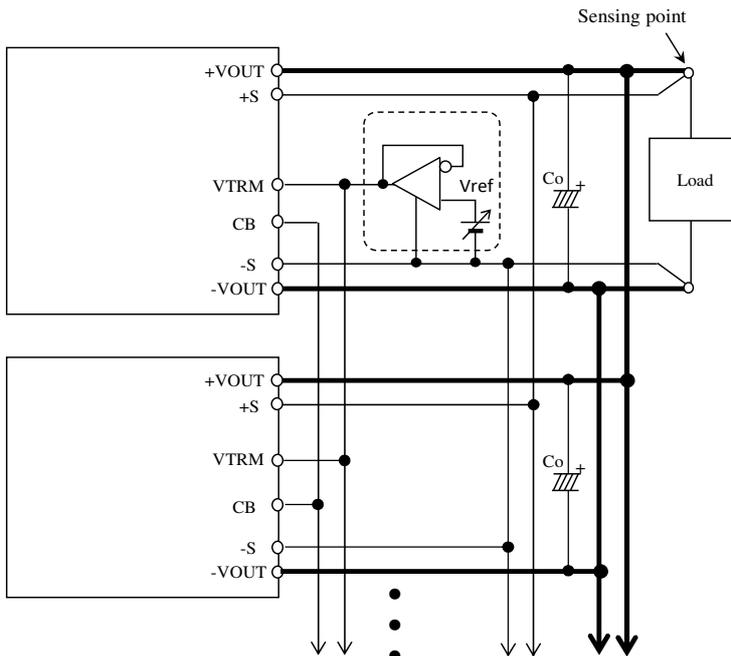
※ N: Parallel number of unit

Fig.3.2
Output voltage
adjustment by
external
resistor



- By connecting the external power supply as shown in Fig.3.3.,output voltage becomes adjustable.

Fig.3.3
Output voltage
adjustment by
external
power supply

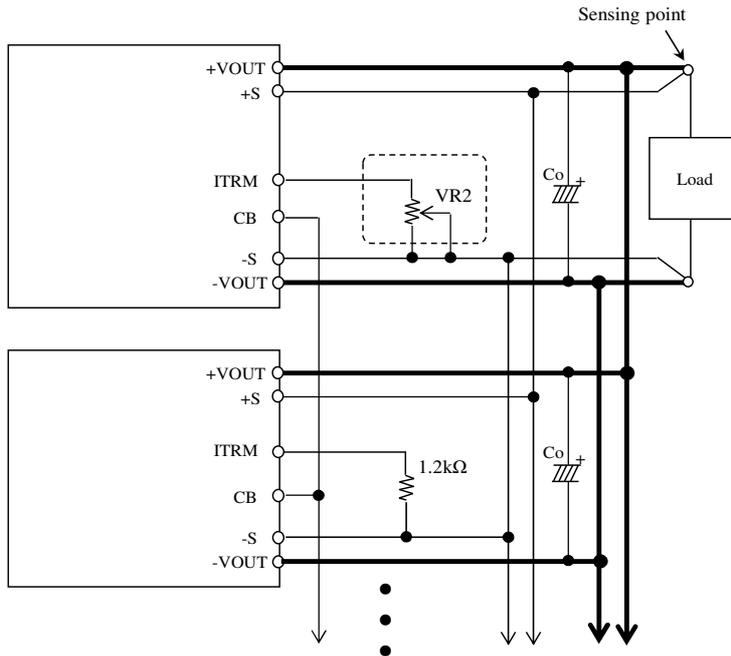


3.3 Constant current adjustment in parallel operation(CC)

- By adjusting the voltage of one ITRM, it is possible to adjust the constant current of all power supplies connected in parallel. It is not necessary to connect all ITRM terminals.
- By connecting the external potentiometer (VR2) as shown in Fig.3.4.,constant current becomes adjustable. See formula②

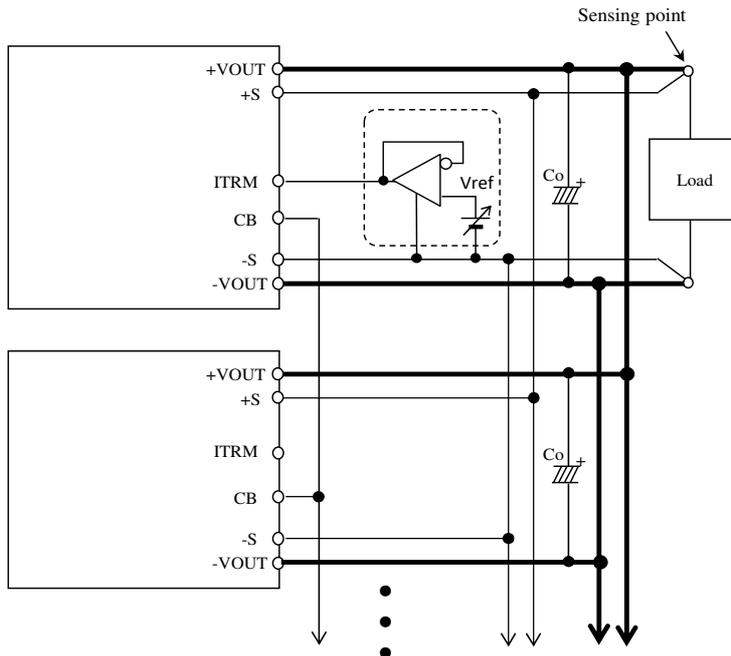
$$\text{Output current[A]} = \frac{5 \times \text{VR2 [k}\Omega]}{(\text{VR2} + 4.7) \text{ [k}\Omega]} \times \text{Rated output current [A]} \dots \text{②}$$

Fig.3.4
Constant current
adjustment by
external
resistor



- By connecting the external power supply as shown in Fig.3.5.,constant current becomes adjustable.

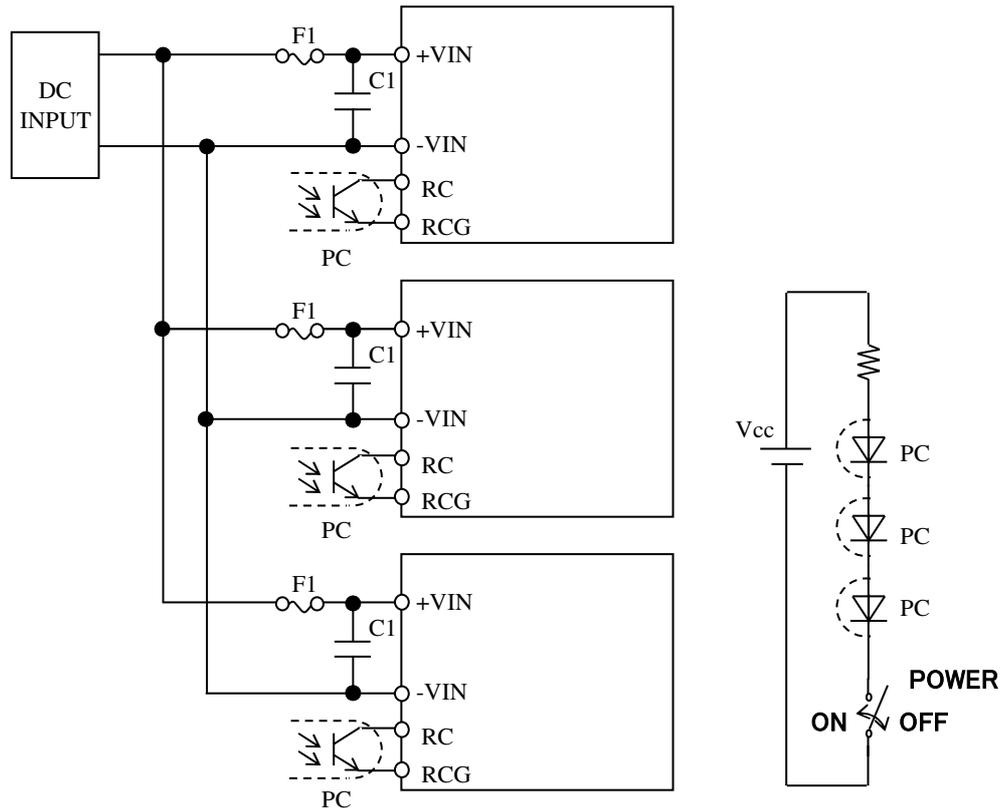
Fig.3.5
Constant current
adjustment by
external
power supply



3.4 Remote control

- When using remote control in parallel operation, control the remote control terminals of the power supplies in parallel at the same time, as shown in Fig.3.6.
- Do not connect RCG terminals to each other. The RCG is connected to -Vin terminal inside the power supply, and connecting them to each other can form a loop circuit, potentially causing the power supply to malfunction.

Fig.3.6
Remote control
wiring example

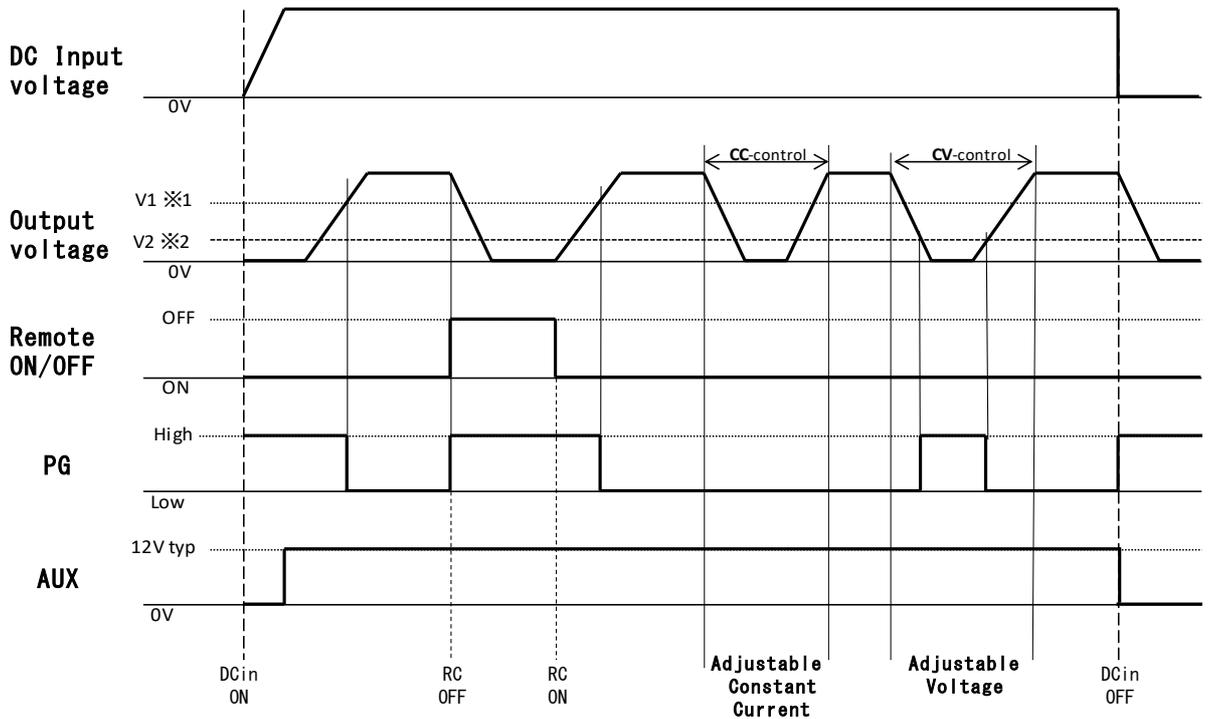


4. Other functions

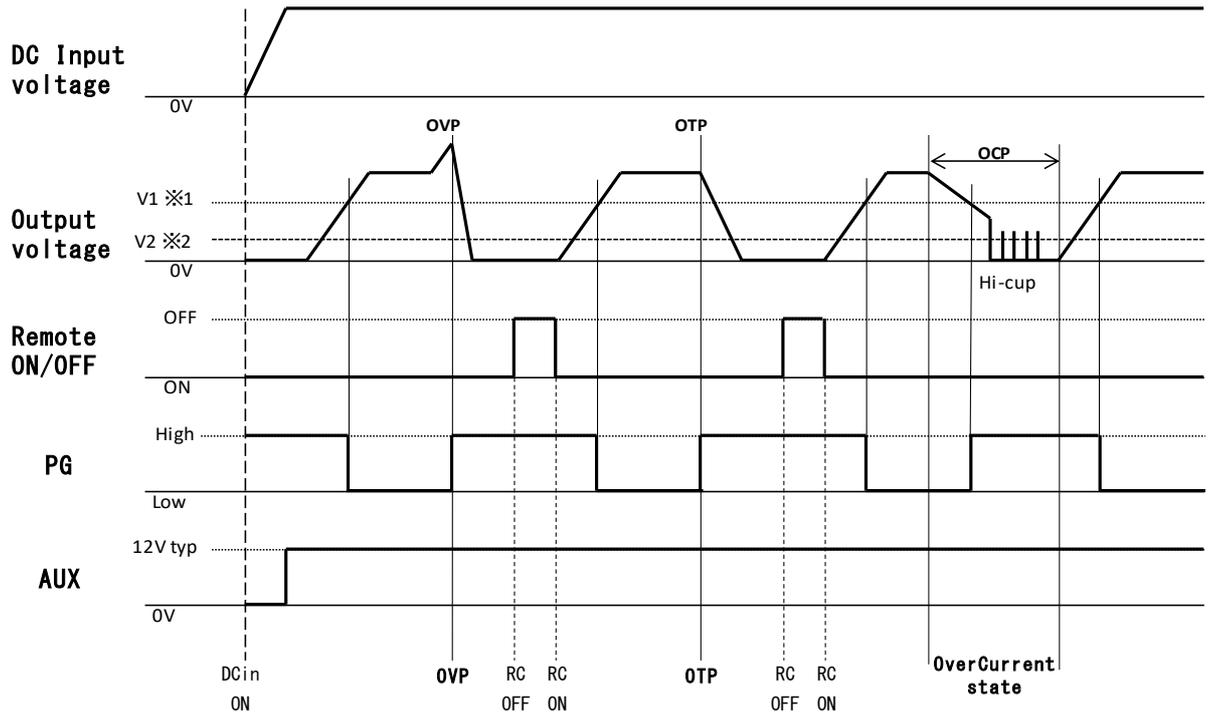
4.1 Power Good

- By using PG, it is possible to monitor power supply whether normal operation or abnormal operation. The PG signal is "Low" when the power supply operates correctly. The signal turns to "High" when the power supply stops.
- The PG signal sequence is shown in Fig4.1.

Fig4.1
PG signal
sequence



※1 V1 : 60% of the set output voltage
 ※2 V2 : 20% of the rated output voltage



※1 V1 : 60% of the set output voltage
 ※2 V2 : 20% of the rated output voltage

4.2 Output Current Monitor

- The output current can be monitored by voltage between the CB and -S.
- Fig.4.2 shows the relationship between the voltage of CB terminal and the output current. The output current shown in Fig.4.2 is for reference only.
- Output current monitor circuit example is shown in Fig.4.3.

Fig4.2
Load factor -
CB voltage

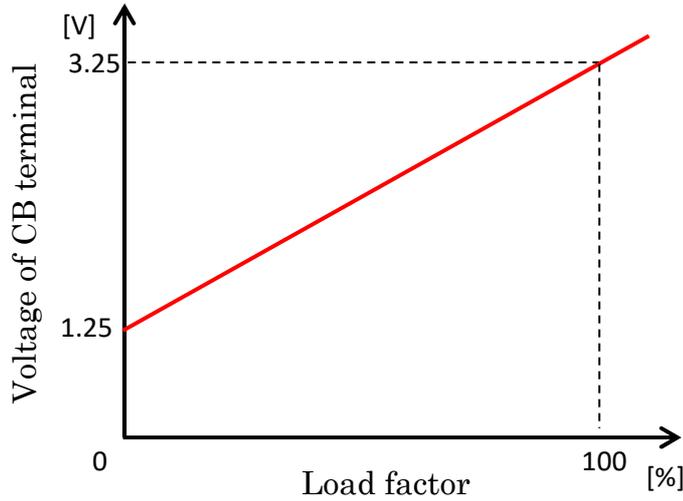
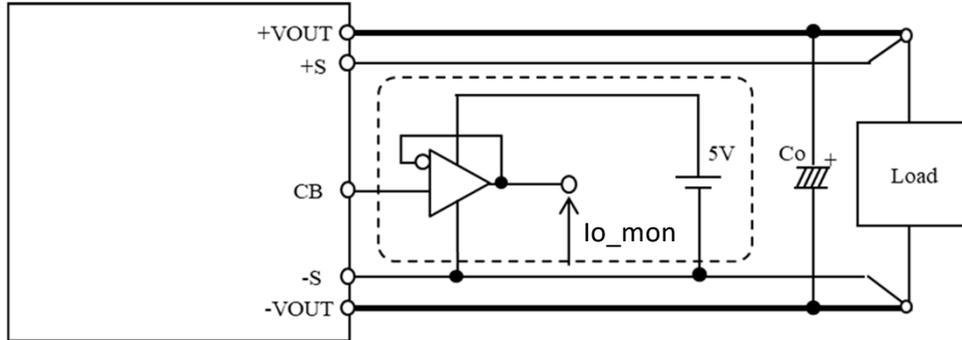


Fig.4.3
Output current
monitor Circuit
example



Please note the following when using the output current monitor.

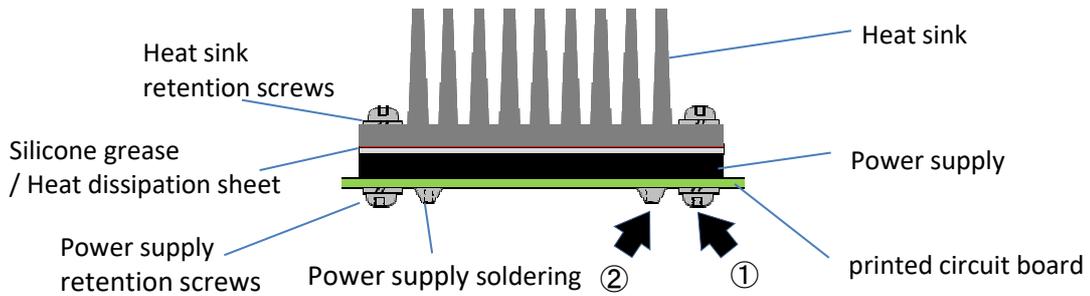
- Use a measuring instrument whose input impedance is 500k Ω or more.
- Do not connect more than 0.01 μ F to CB terminal to prevent output voltage malfunction.
- Wire carefully to avoid malfunction caused by noise.
- The pulse load cannot be monitored.

5. Mounting method

5.1 Mounting method

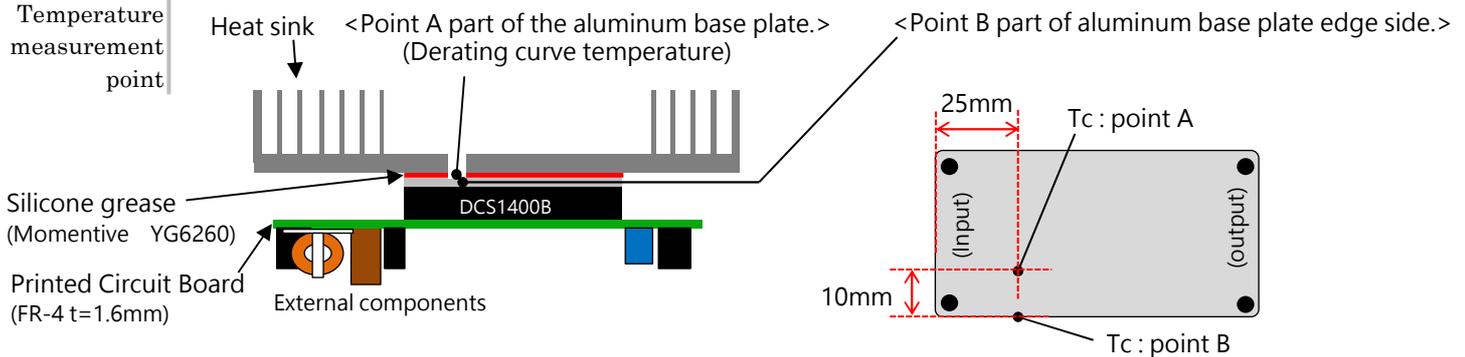
- When implementing the power supply to the printed circuit board, please fix the power supply to the printed circuit board by screw before the soldering.
If it is screwed to the substrate after soldering, there is a possibility of failure by adding mechanical stress to the soldering point and the internal connections of power supply.

Fig.5.1
Mounting method



- Please measure the temperature at point B on the aluminum base plate edge side when you cannot measure the aluminum base plate temperature at measurement point A. In this case, please take 5deg temperature margin from the derating characteristics.

Fig.5.2
Temperature measurement point



- Use a heat sink that larger than the power supply and has a large thickness so that the aluminum base plate can be cooled uniformly.

6. Board layout

6.1 Consideration for board layout

■ The potential voltage of each terminal is given below. External components that are connected to these terminals should be at same potential voltage.

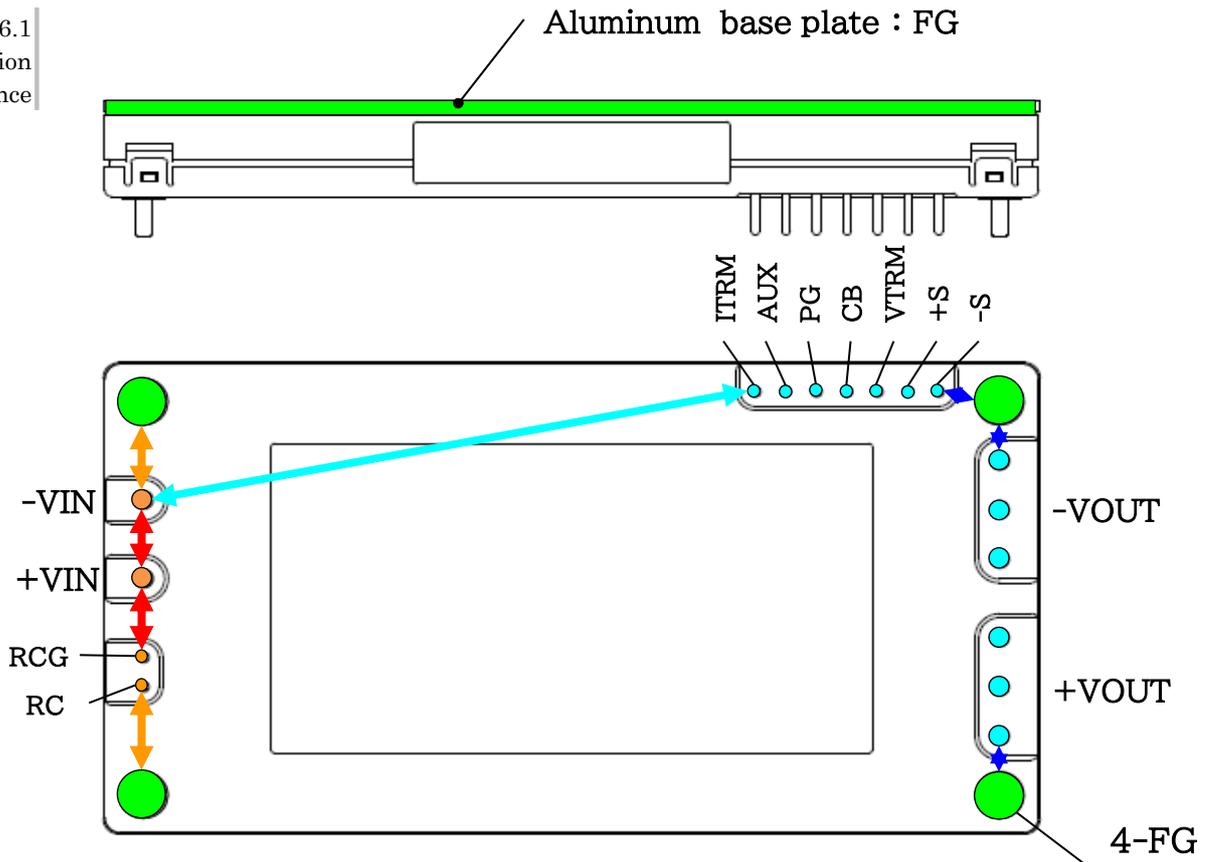
- | | | |
|------------------------------|---|--|
| Primary side (Input line) | ● | : VIN, RC, RCG pin |
| Secondary side (Output line) | ● | : VOUT, S, VTRM, ITRM, CB, AUX, PG pin |
| FG (Aluminum base plate) | ● | : Nut (4 places), Aluminum base plate, Heat sink |

■ In order to meet the breakdown voltage specification of products, insulation distance components and between patterns is recommended to ensure the following.

- | | | |
|-------------------------------------|---|-----------------|
| Primary circuit - Secondary circuit | ↔ | : 8mm or more |
| Primary circuit - FG | ↔ | : 5mm or more |
| Secondary circuit - FG | ↔ | : 1.6mm or more |
| Primary circuit - Primary circuit | ↔ | : 3mm or more |

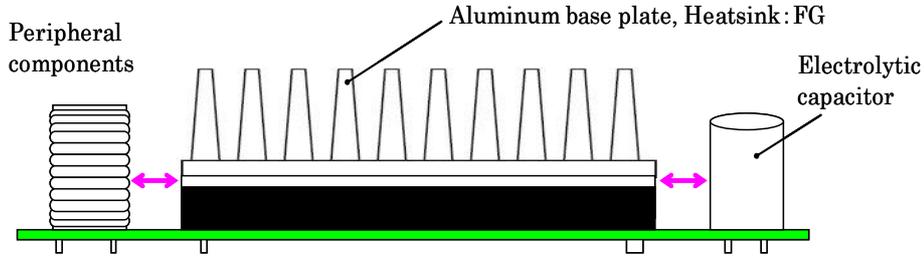
■ Clearance and creepage requirements vary based on different safety standards and conditions of usage. Please place the components and wiring pattern according to those safety standards.

Fig.6.1
Insulation
distance



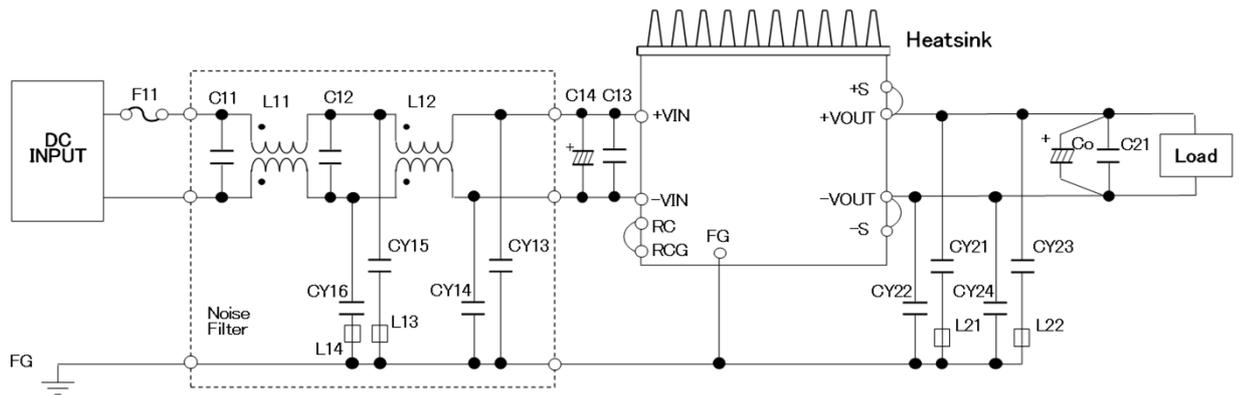
- When installing the electrolytic capacitor and the power supply on the same surface of the printed circuit board, please pay attention to the distance between the base plate and electrolytic capacitor. Exterior of the electrolytic capacitor is assumed to be the same potential as the negative electrode.
- High-frequency noise radiates directly from the unit to the atmosphere. Therefore, design the shield pattern on the printed circuit board and connect to FG. The shield pattern prevents noise radiation.

Fig.6.2
Same Surface Mount



- There are notes for printed circuit board design at recommended circuit in this applications manual. Please see below.

Fig.6.3
Recommended external circuit



- ① Input fuse : F11
- ② Noise filters

}	Line filter : L11, L12
}	Interphase capacitor : C11, C12
}	Y capacitor : CY13, CY14, CY15, CY16
}	Ferrite Bead : L13, L14
- ③ Input capacitors

}	Film capacitor : C13
}	Electrolytic capacitor : C14
- ④ Output capacitors

}	Electrolytic capacitor : Co
}	Ceramic capacitor : C21
- ⑤ Secondary grounding capacitors

}	Y capacitor : CY21, CY22, CY23, CY24
}	Ferrite Bead : L21, L22

※ Only required for DCS1400B65
- ⑥ FG terminals

① Input fuse : F11

When the fuse is blown out, input voltage would be applied between the terminals of the fuse F11.

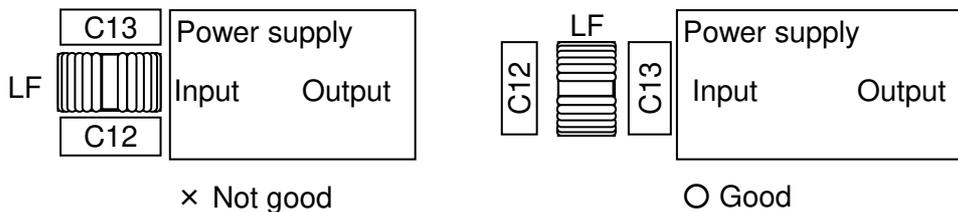
Please keep the distance of the pattern between the terminals of the fuse more than 3mm for safety.

② Noise filters

Noise filter is build by Line filters (L11, L12), X capacitor (C11, C12), Y capacitor(CY13,CY14,CY15,CY16) and Ferrite Bead (L13,L14). And the Noise filter is used to reduce conduction noise from power supply. Off-the-shelf Noise filter is also available.

If the Line filter is placed near the components which is switching at high frequency, the conduction noise may be increased because the noise goes into the Line filter.

Therefore, the Line filter should be shielded or keep the distance from the source of noise.



The effect of noise reduction by Y capacitor depends on the place of the FG connection. Recommend connecting Y capacitor to the FG terminal of the power supply as close as possible. Please evaluate before use.

③ Input film capacitor : C13

Huge ripple current flows into the capacitor C13.

Place the capacitor C13 near the power supply as close as possible.

④ Output capacitors : Co, C21

Connecting the output capacitor (Co,C21) to the power module as close as possible for stable operation and radiation noise reduction.

The output line impedance could cause unstable output voltage, which can be reduced by adding the output capacitor close to the load.

When the output ripple and ripple noise must be reduced, ceramic capacitor C21 which has good characteristics at high frequency should be used.

If through-hole type ceramic capacitor is used, the effect of the noise reduction would be reduced by the impedance of the lead frame of the components.

Please evaluate before using.

⑤ Secondary Y capacitors : CY21,CY22,CY23,CY24

Since the output voltage of DCS1400B65 exceeds the safe voltage (60V), basic insulation is required between the secondary and FG. Y capacitors CY21, CY22, CY23, CY24 must be Y2 class safety standard certified.

CY21, CY22, CY23, CY24 should be connected to the FG terminal of the power supply as close as possible.

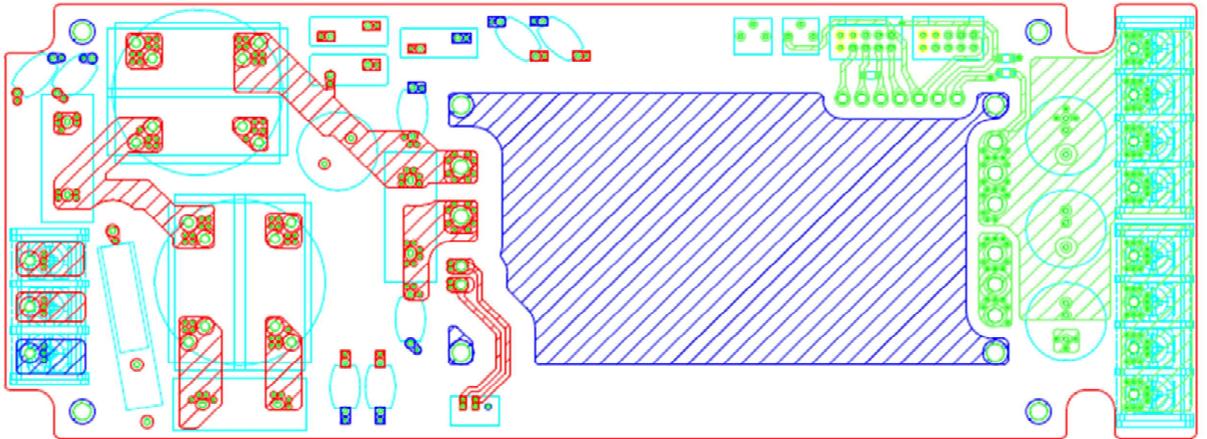
⑥ FG terminals of the power supply

Connect the FG terminal of the power supply to the PWB by screw. If the FG terminals of the power supply is not connected properly, malfunction or failure could happen.

Expose the solder mask around the hole of the FG connection on the PWB to connect FG terminals by screws.

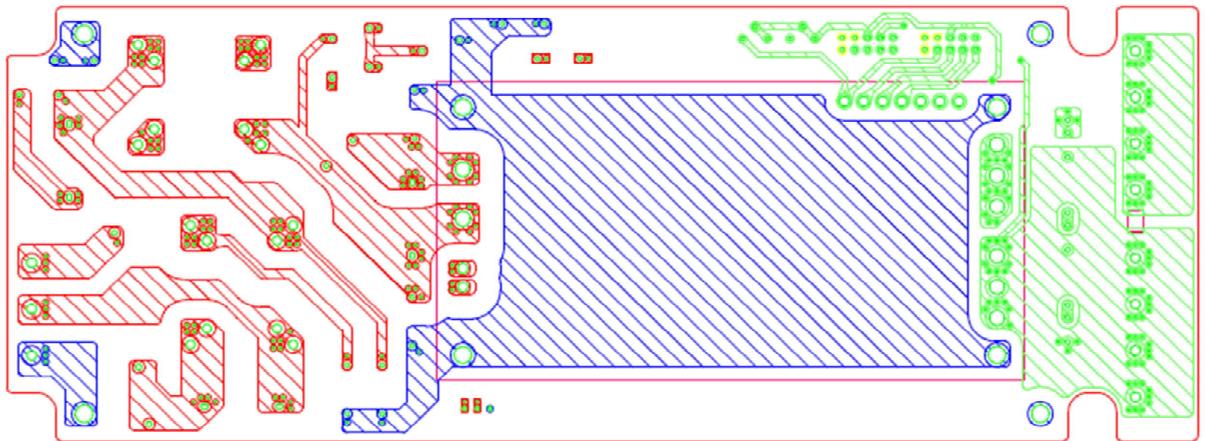
6.2 Reference PCB layout

Fig.6.4
Example of
the pattern
layout
(Top view)



PCB size: 89 x 238mm
PCB thickness: 1.6mm
copper thickness: 35um

(a) Example of the pattern and components layout (Top layer)



(b) Example of the pattern and components layout (Bottom layer)



Primary circuit



FG



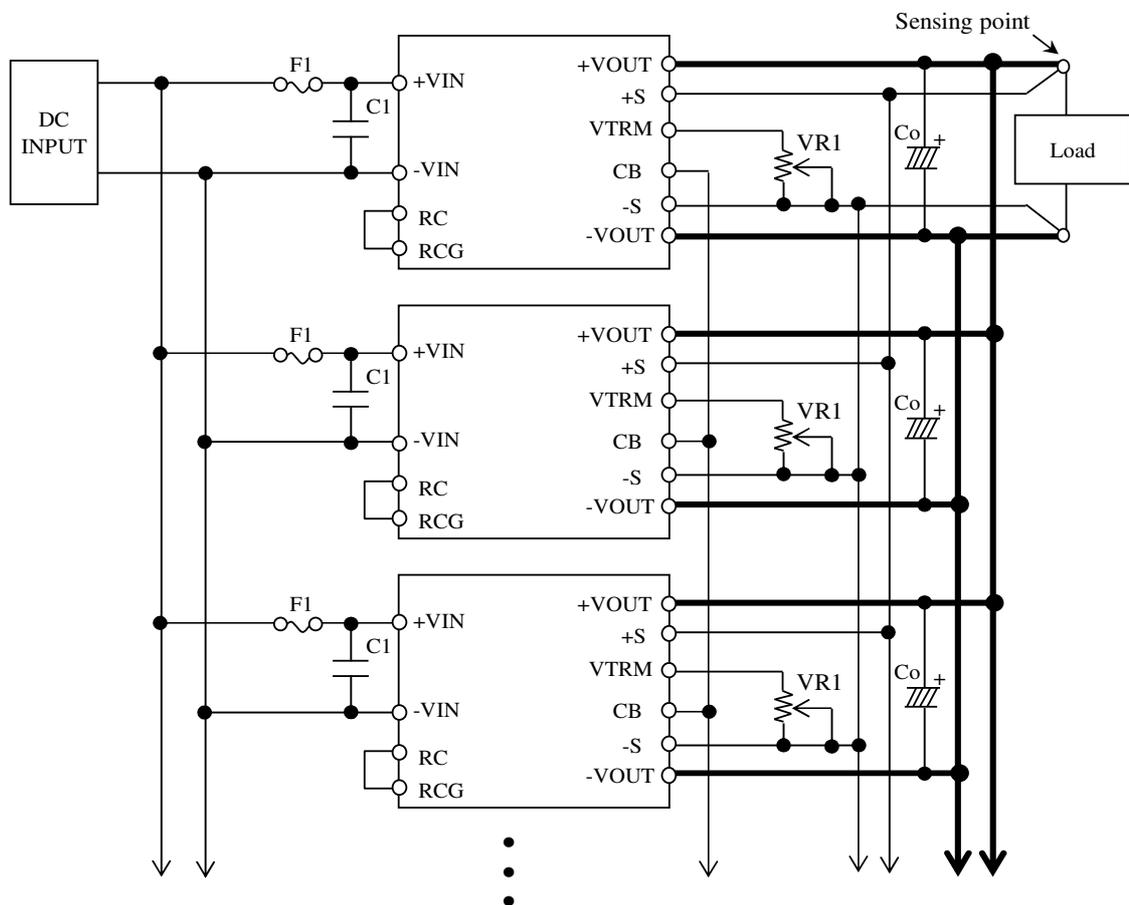
Secondary circuit

7. N+1 redundant operation (-P2 option)

7.1 N+1 redundant operation

- The -P2 option features a built-in ORing FET, enabling N+1 redundant operation without the need for an external ORing device. The connection diagram is shown in Figure 7.1.
- If you add one extra power supply in parallel operation, even if one of the power supplies in your system fails, the remaining power supplies continue to function.
- Use the load current with N power supplies, and keep the current per unit below the rated current $\times 0.95$ or less.
- Constant current control cannot be used in N+1 redundant operation.
- If the output current is less than 2% of the rated current, the PG output may become unstable.
- The specifications of the -P2 option differ from the standard product in the following
 - (a) Output voltage adjustment
The output voltage cannot be adjusted to 6.0V or less.
 - (b) Low voltage protection
If the output voltage drops to 5V or less, the low voltage protection circuit will operate and the output will latch stop. The latched stop operation can be released by reducing the DC input to 100V or less and resuming operation after 5 seconds. Alternatively, it can also be reset using the remote ON/OFF control function.
 - (c) Ripple, Ripple noise
If the output current is less than 2% of the rated current, the output voltage ripple may become large. Please refer to the product specifications for ripple voltage specifications under light load.

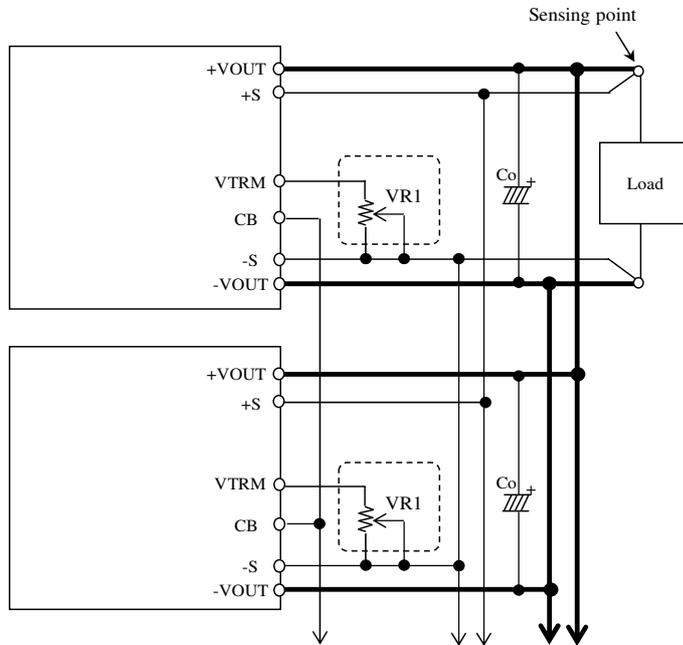
Fig7.1
Wiring for N+1
redundant
operation



7.2 Output voltage adjustment in N+1 redundant operation (CV)

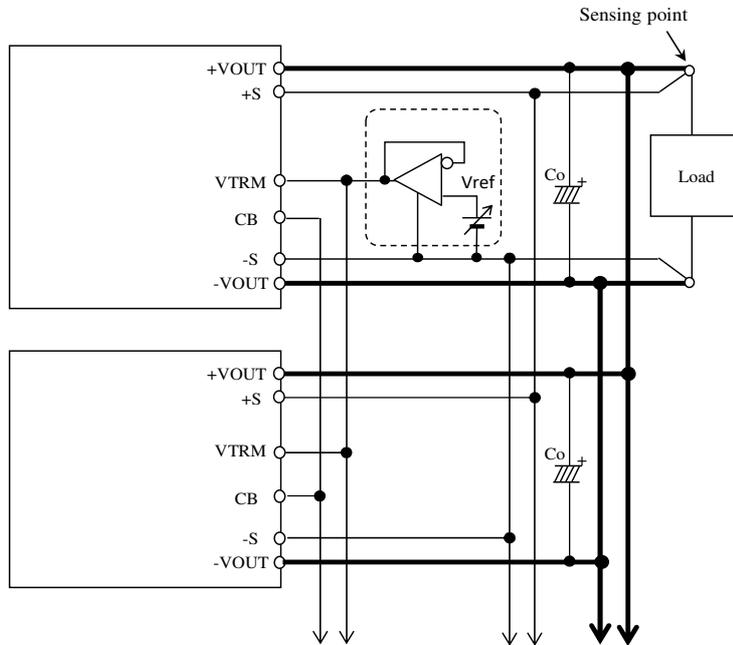
■ When the output voltage is adjusted by the volume in N+1 redundant operation, connect the volume to each power supply as shown in Fig.7.2.

Fig.7.2
Output voltage adjustment by external resistor



■ By connecting the external power supply as shown in Fig.7.3, output voltage becomes adjustable.

Fig.7.3
Output voltage adjustment by external power supply



8. Thermal Design

8.1 Thermal Design

■ Please refer to the applications manual “9.Thermal Considerations” on our website.

Home> Technical Data> Application Guide

◆ Power Module Type

9.Thermal Considerations

https://en.cosel.co.jp/technical/app_guide/module_type/pdf/thermal_considerations.pdf

8.2 Examples of Convection cooling

■ Here is an example of convection cooling with heatsink.

■ Please consider this example as a design guideline because it changes by the heat dissipation environment. Please measure the temperature of the actual equipment eventually.

Fig.8.1
Convection cooling
Heatsink example

280 × 150 × 80mm
Thermal resistance : 0.37°C/W

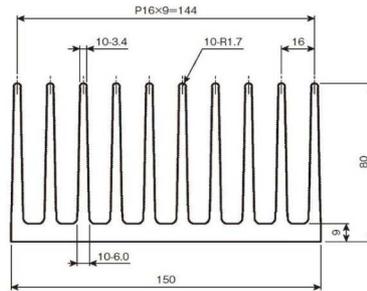


Fig.8.2
Environment

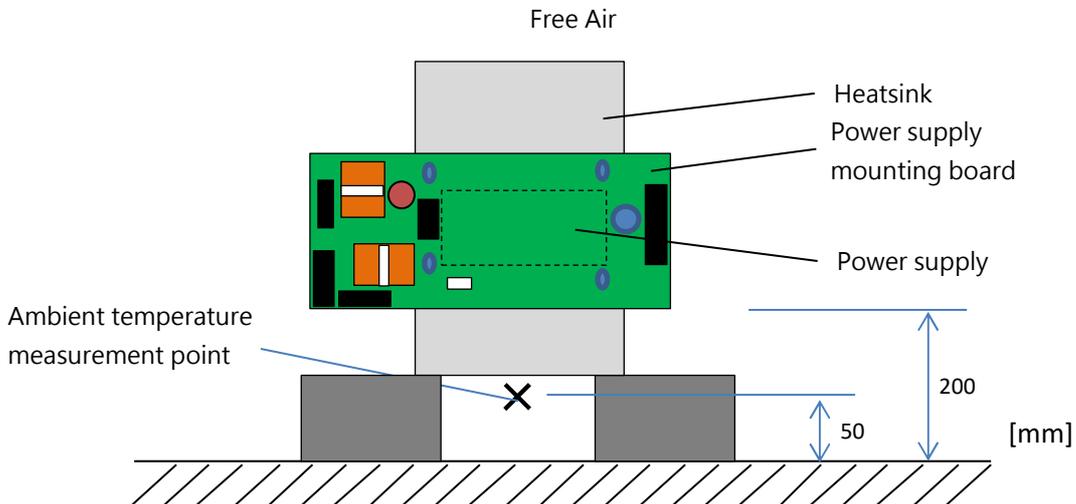
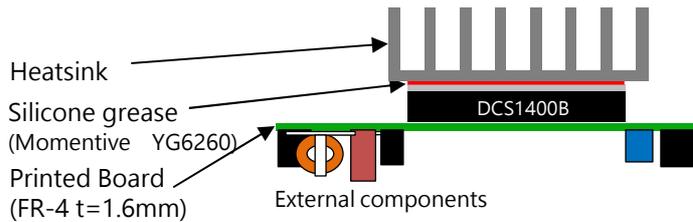
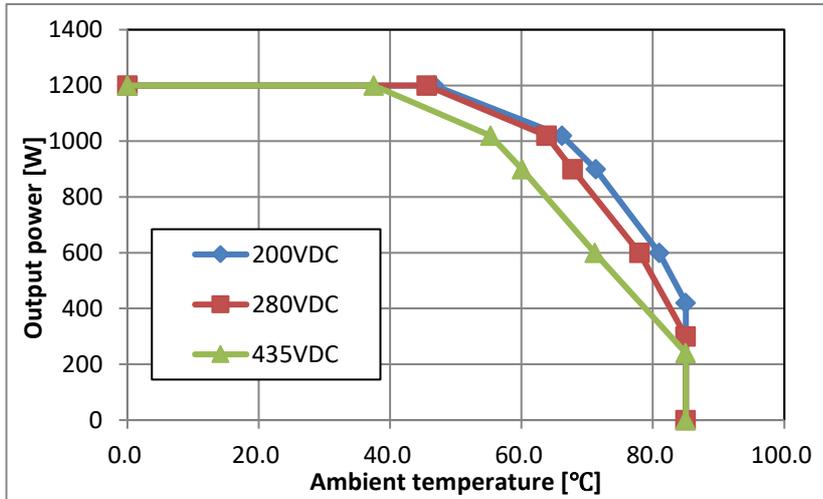
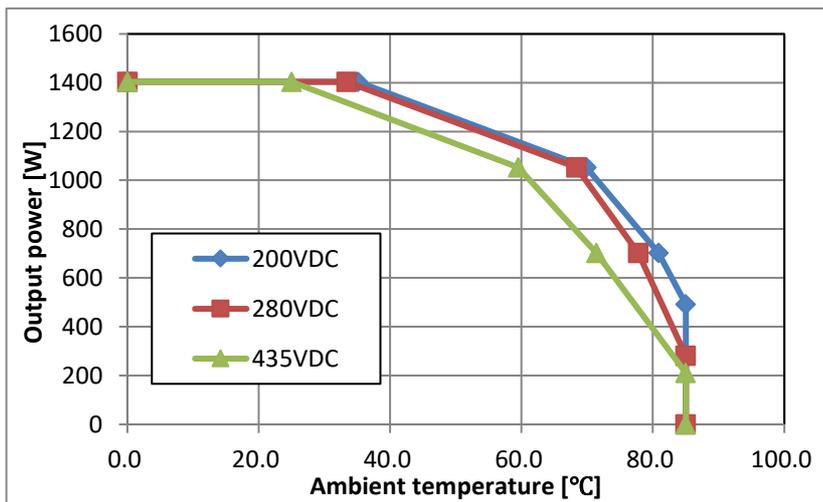


Fig.8.3
Convection cooling
measurement
result



※Measurement results with DCS1400B12



※Measurement results with DCS1400B24

8.3 Examples of Forced air cooling

- Here is an example of forced air cooling with heatsink.
- Please consider this example as a design guideline because it changes by the heat dissipation environment. Please measure the temperature of the actual equipment eventually.
- If it is difficult to measure the back side surface of the baseplate, please measure the leeward side of the baseplate edge.

Fig.8.4
Forced air cooling
Heat sink example

150 × 95 × 50mm
(EK95 L150 MIZUTANI ELECTRIC IND.CO.,LTD)
Thermal resistance: 1.1°C/W (at Convection cooling)

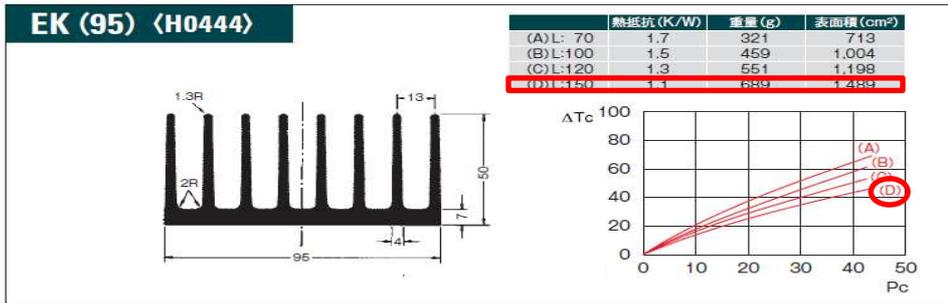


Fig.8.5
Environment

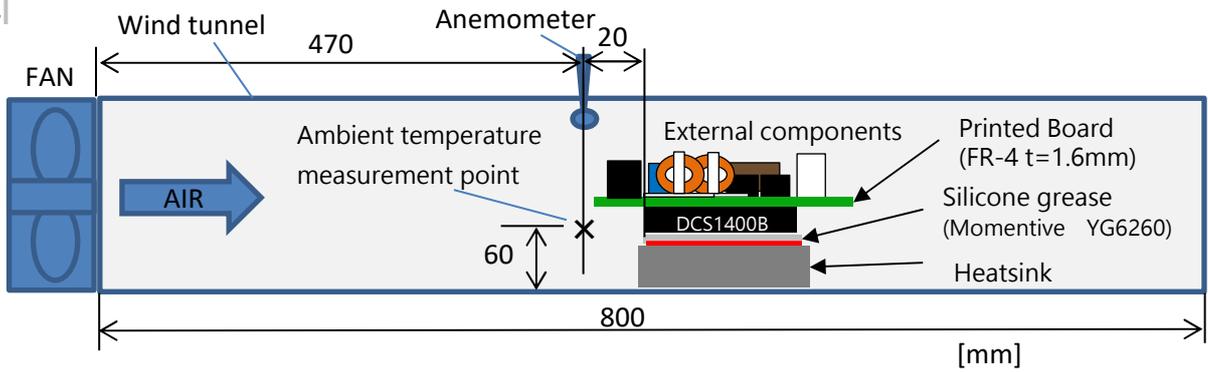
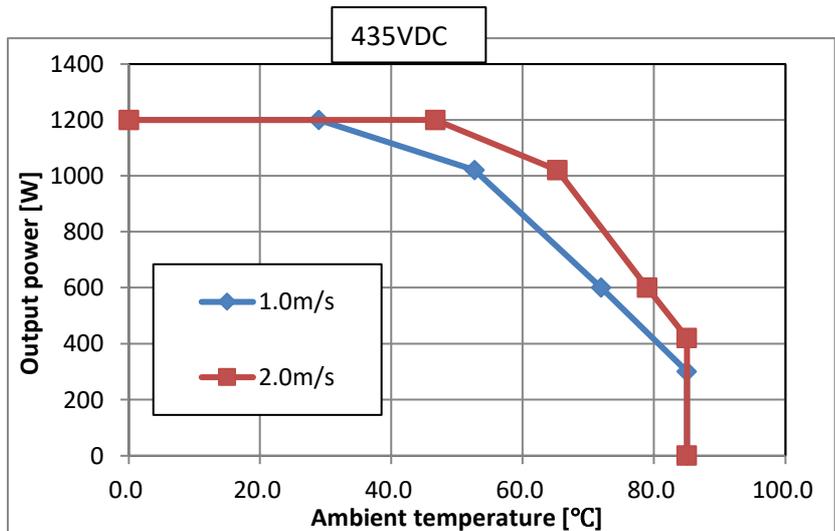
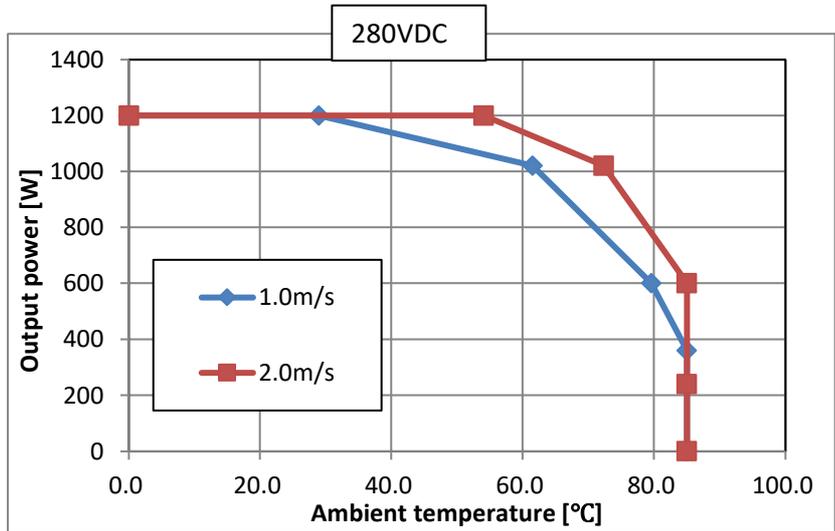
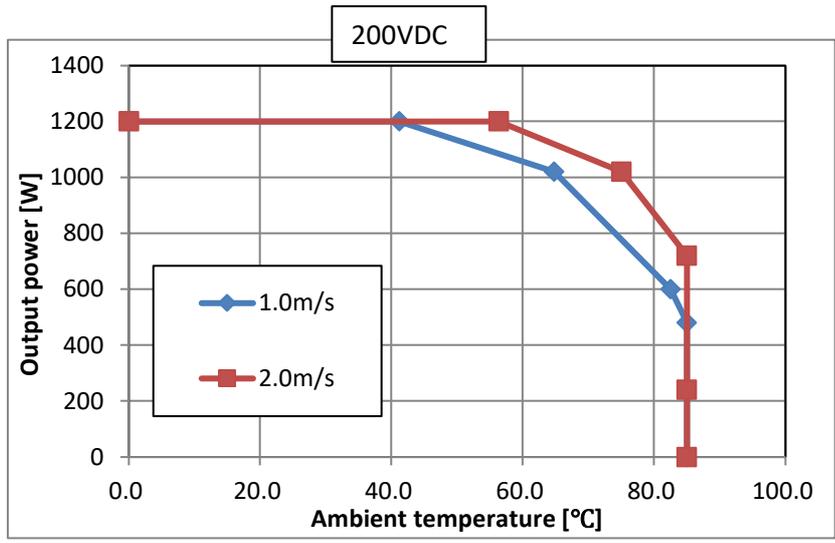
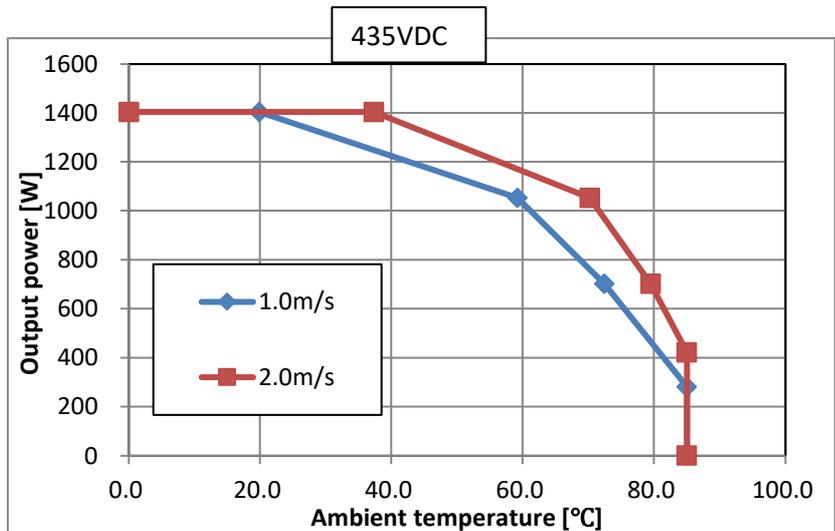
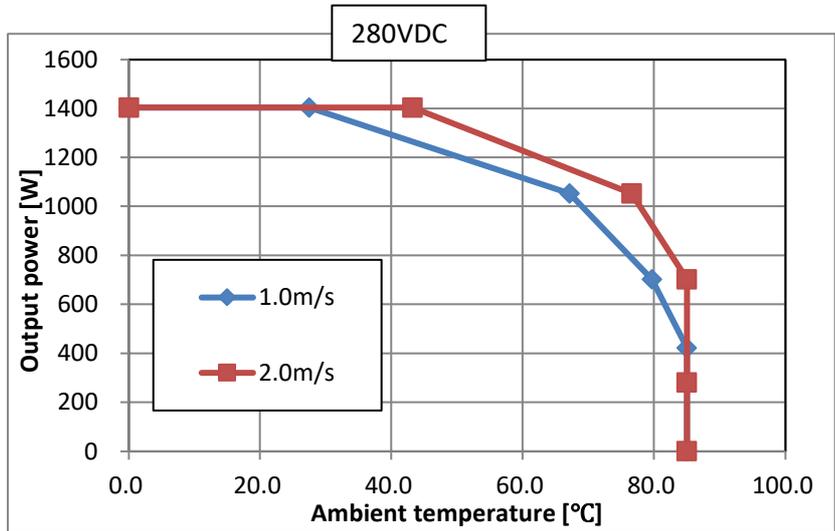
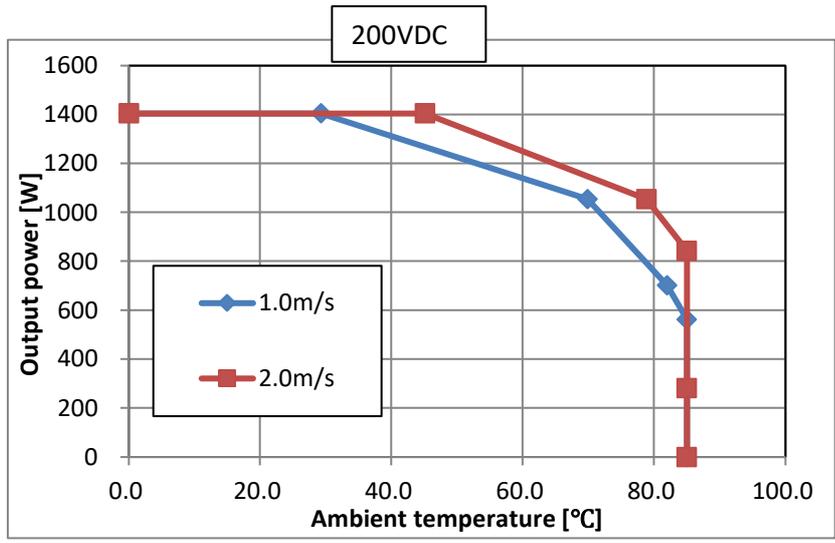


Fig.8.6
 Forced air cooling
 measurement
 result
 DCS1400B12



※Measurement results with DCS1400B12

Fig.8.7
 Forced air cooling
 measurement
 result
 DCS1400B24



※Measurement results with DCS1400B24

Revision history

No.	date	Rev.	page	content
1	2025.5.16	1.0E	A-1 ~ A-15	First Edition
2	2025.7.18	1.1E	A-16 ~ A-17	「7 N+1 redundant operation」 Addition
3	2025.7.18	1.1E	A-18 ~ A-22	「8 Thermal Design」 Addition
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