CCG Series
Instruction Manual

BEFORE USING THE POWER SUPPLY

Be sure to read this instruction manual thoroughly before using this product. Pay attention to all cautions and warnings before using this product. Incorrect usage could lead to an electrical shock, damage to the power supply or a fire hazard.

⚠DANGER

Never use this product in locations where flammable gas or ignitable substances are present.

⚠INSTALLATION WARNING

- When installing, ensure that work is done in accordance with the instruction manual. When installation is improper, there is risk of electric shock and fire.
- Installation shall be done by Service personnel with necessary and appropriate technical training and experience. There is a risk of electric shock and fire.
- Do not cover the product with cloth or paper etc. Do not place anything flammable around. This might cause damage, electric shock or fire.

⚠WARNING on USE

- Do not touch this product or its internal components while circuit in operation, or shortly after shutdown. You may receive a burn.
- While this product is operating, keep your hands and face away from it as you may be injured by an unexpected situation.
- There are cases where high voltage charge remains inside the product. Therefore, do not touch even if they are not in operation as you might get injured due to high voltage and high temperature. You might also get electric shock or burn.
- Do not make unauthorized changes to this product nor remove the cover as you might get an electric shock or might damage the product. We will not be held responsible after the product has been modified, changed or disassembled.
- Do not use this product under unusual condition such as emission of smoke or abnormal smell and sound etc. Please stop using it immediately and shut off the product. It might lead to fire and electric shock. In such cases, please contact us. Do not attempt repair by yourself, as it is dangerous for the user.
- Do not operate and store these products in environments where condensation occurs due to moisture and humidity. It might lead fire and electric shock.
- Do not drop or apply shock to this product. It might cause failure. Do not operate these products mechanical stress is applied.

⚠CAUTION on MOUNTING

- Confirm connections to input terminals, output terminals and signal terminals are correct as indicated in the instruction manual before switching on.
- Input voltage, Output current, Output power, ambient temperature and ambient humidity should be kept within specifications, otherwise the product will be damaged or malfunction.
- Input line and output line, please use the wires as short and thick as possible.
- Do not use this product in special environment with strong electromagnetic field, corrosive gas or conductive substances and direct sunlight, or places where product is exposed to water or rain.
- Mount this product properly in accordance with the instruction manual, mounting direction and shall be properly be ventilated.
- Please shut down the input when connecting input and output of the product.
- When mounted in environments where there is conductive foreign matter, dust or liquid, there is possibility of product failure or malfunction. Such as install filter, please consider that a conductive foreign matter, dust and liquid do not invade inside the power supply.

⚠CAUTION on USE

- ●Product individual notes are shown in the instruction manual. If there is any difference with common notes, individual notes shall have priority.
- ●Before using this product, be sure to read the catalog and instruction manual. There is risk of electric shock or damage to the product or fire due to improper use.
- ●Input voltage, Output current, Output power, ambient temperature and ambient humidity should be kept within specifications, otherwise the product will be damaged, or cause electric shock or fire.
- ●For products without built-in protection circuit (element, fuse, etc.), insert fuse at the input to prevent smoke, fire during abnormal operation.
- ●For externally mounted fuse do not use other fuses aside from our specified and recommended fuse.
- ●As our product is standard industrial use product that was manufactured by purpose that is used to an general electronics equipment etc., it is not products that to designed for High Safety uses (Uses extremely high reliability and safety are required, if reliability and safety has not been secured, with significant dangerousness for directly life or body) is expected. Please consider a fail safe (systems that was provided with protection circuit protective devices or systems that redundant circuit was mounted so that was not unstable in single failure) design enough.
- ●When used in environments with strong electromagnetic field, there is possibility of product damage due to malfunction.
- ●When used in environment with corrosive gas (hydrogen sulfide, sulfur dioxide, etc.), there is possibility that they might penetrate the product and lead to failure.
- ●When used in environments where there is conductive foreign matter, dust or liquid, there is possibility of product failure or malfunction.
- ●Provide countermeasure for prevention of lightning surge voltage as there is risk of damage due to abnormal voltage.
- ●Take care not to apply external abnormal voltage to the output terminals and signal terminals. Especially, applying reverse voltage or overvoltage more than the rated voltage to the output might cause failure, electric shock or fire.
- ●Do not use this product in special environment with strong electromagnetic field, corrosive gas or conductive substances and direct sunlight, or places where product is exposed to water or rain.
- ●Never operate the product under overcurrent or short circuit condition. Insulation failure, or other damages may occur.
- ●The application circuits and their parameters are for reference only. Be sure to verify effectiveness of these circuits and their parameters before finalizing the circuit design. Moreover, we will not be responsible on application patent or utility model.
- ●Excessive stress could cause damage. Therefore, please handle with care.
- ●Use recommended external fuse to each products to ensure safe operation and compliance with the Safety Standards to which it is approved.
- ●The input power source to this product must have reinforced or double insulation from the mains.

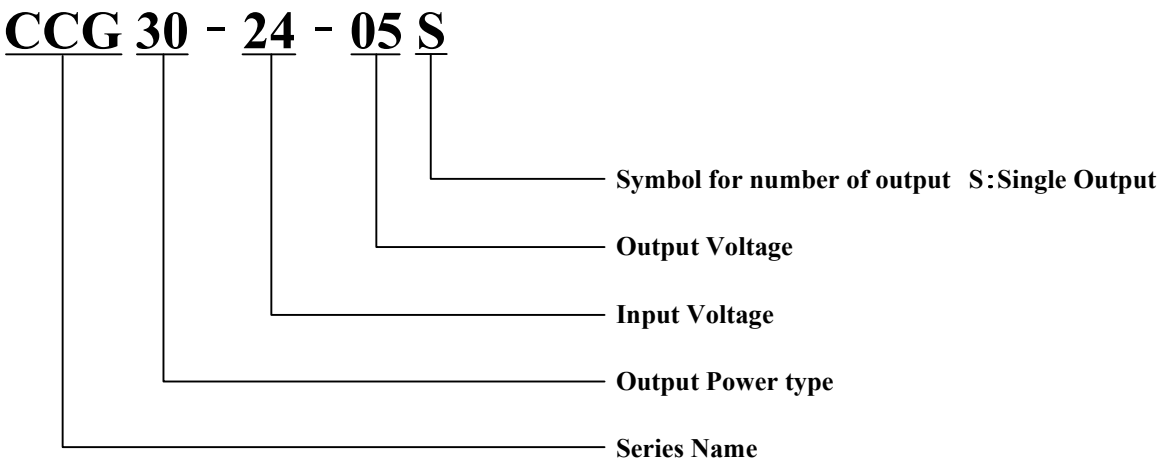
⚠Note

- ●Consider storage of the product at normal temperature and humidity avoiding direct exposure to sunlight at environment with minimal temperature and humidity changes. Storage of product at high temperature, high humidity and environments with severe changes in temperature and humidity might cause deterioration, and occurrence of condensation in the product.
- ●When disposing product, follow disposal laws of each municipality.
- ●Published EMI (CE, RE) or immunity is the result when measured in our standard measurement conditions and might not satisfy specification when mounted and wired inside end-user equipment.
- ●Use the product after sufficiently evaluating at actual end-user equipment.
- ●If products are exported, please register the export license application etc. by the Government of Japan according to Foreign Exchange and Foreign Trade Control Law.
- ●The information in the catalog or the instruction manual is subject to change without prior notice. Please refer to the latest version of the catalog or the instruction manual.
- ●No part of this document may be copied or reproduced in any form without prior written consent TDK-Lambda.

Note : CE MARKING

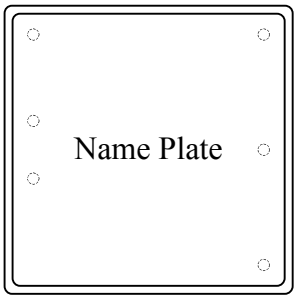
CE Marking indicated on the products which is covered by this handbook is applied to CCG30-24-xxS with RoHS compliance and to CCG30-48-xxS with low voltage directive and RoHS compliance.

1. Model name identification method

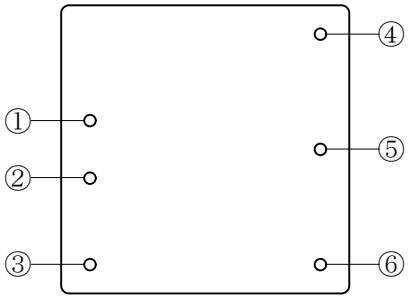


2. Terminal Explanation

Top view

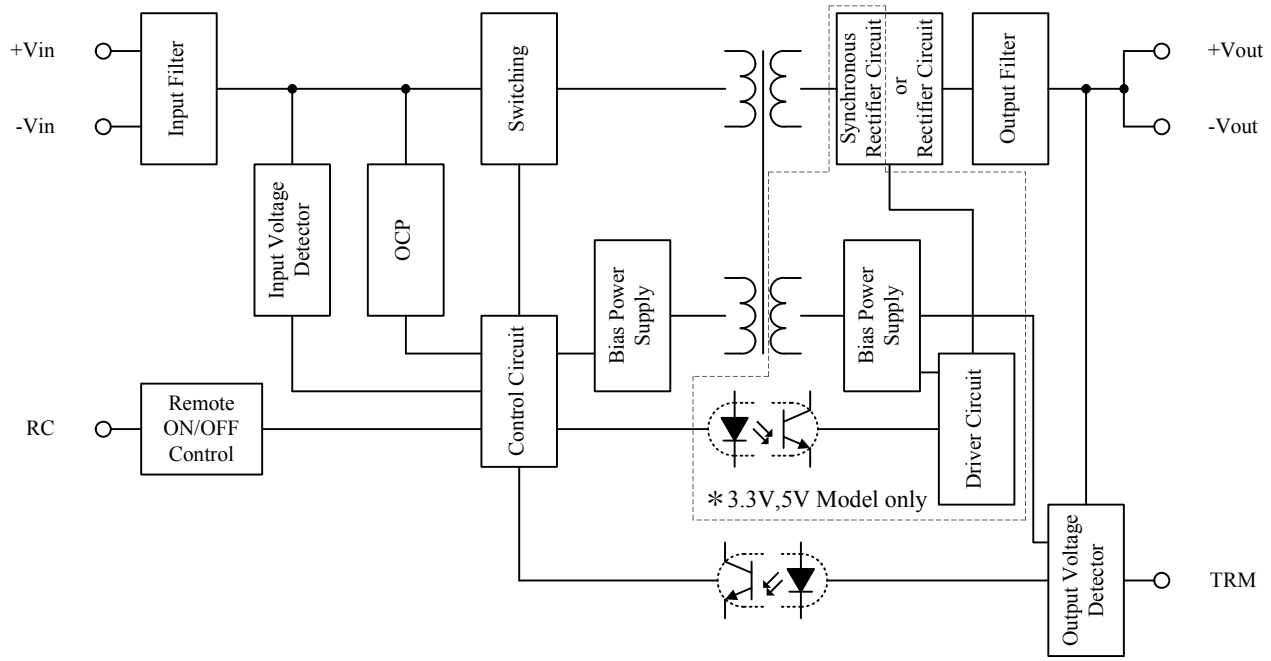


Bottom view



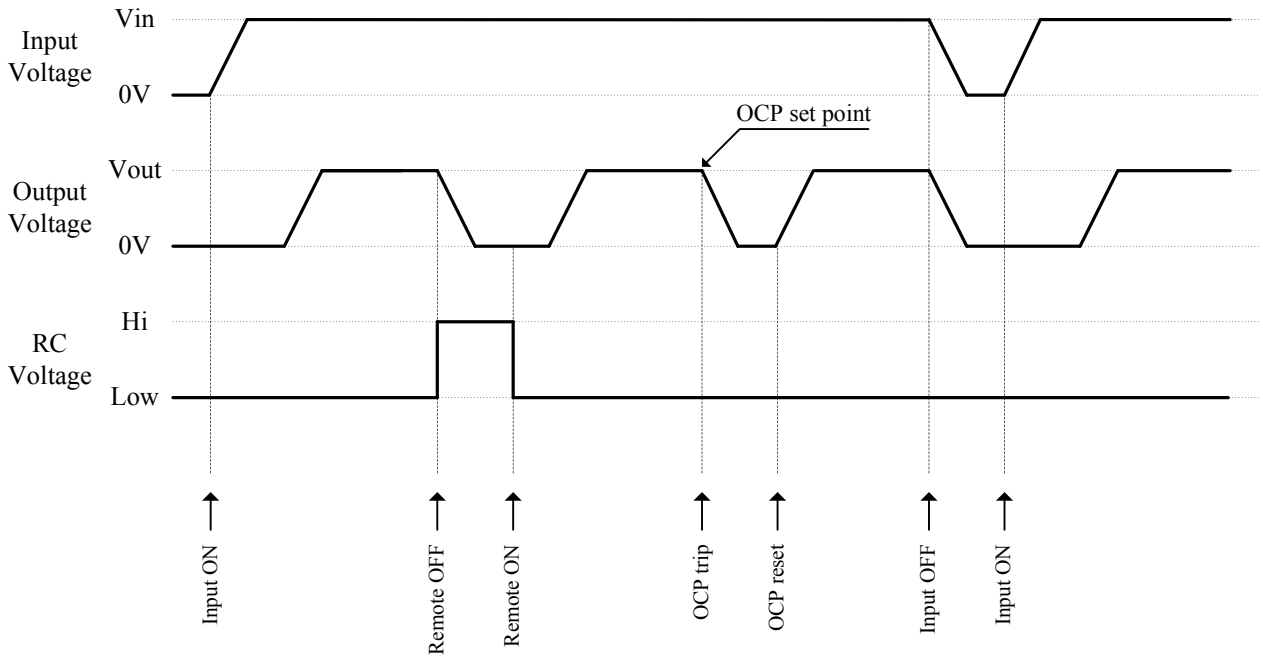
① +Vin : +Input Terminal
② -Vin : -Input Terminal
③ RC : Remote ON/OFF Control Terminal
④ +Vout : +Output Terminal
⑤ TRM : Output Voltage Trimming Terminal
⑥ -Vout : -Output Terminal

3. Block Diagram



Switching Frequency(fixed) 3.3V, 5V : 270kHz
12V, 15V : 360kHz

4. Sequence Time Chart



5. Terminal connecting method

In order to use the CCG series, this power supply must be connected with external components according to Fig.5-1.
If it is connected to wrong terminal, the power supply will be damaged. Pay attention to each wiring.

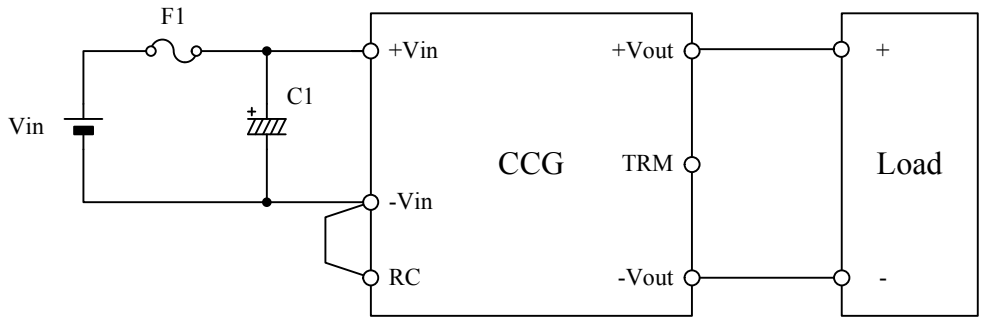


Fig.5-1 Basic connection

F1 : Input Fuse

This CCG series has no built-in fuse.
Use external fuse to comply various Safety Standards and to improve safety.
Moreover, use normal-blow type for every power supply.
Furthermore, fuse must be connected to +Vin side if -Vin side is used as ground, or fuse must be connected to -Vin side if +Vin side is used as ground.
Consider margin over the actual input voltage to be used when selecting fuse. Moreover, consider I^2t fuse rating for surge current (inrush current) during line throw-in.

Input Fuse Recommended Current Rating
CCG30-24-xxS : 10A or lower
CCG30-48-xxS : 6.3A or lower

C1 : External Input Capacitor

To prevent the effect of input line inductance to the power supply, connect electrolytic capacitor between +Vin and -Vin terminals.

Recommended Capacitance
CCG30-24-xxS : 120μF or more
CCG30-48-xxS : 47μF or more

Note) 1.Use low impedance electrolytic capacitor with excellent temperature characteristics.
(Nippon Chemi-Con KZE series or equivalent)
2.When input line inductance becomes excessively high due to insertion of choke coil, operation of the power supply could become unstable. For this case, increase capacitance of electrolytic capacitor more than recommended capacitance.

● Protection for Reversed Input Connection

Reverse input polarity would cause power supply damage. For cases where reverse connections are possible, connect a protective diode and fuse. Use protective diode with higher voltage rating than the input voltage, and with higher surge current rating than fuse current rating.

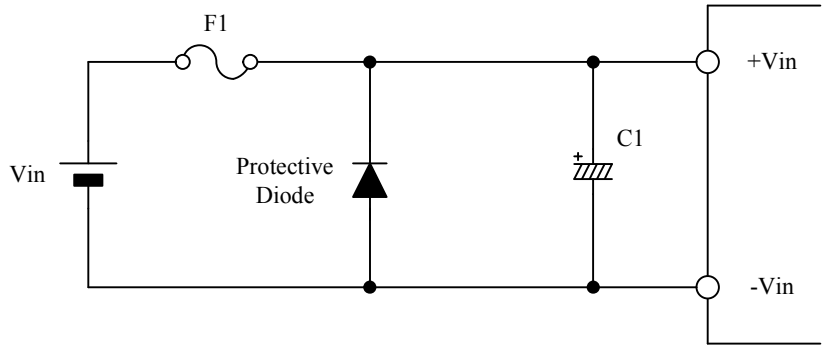


Fig.5-2 Protection for Reversed Input Connection

● External Output Capacitor

This power supply is capable of operating without external output capacitor.
For case of abrupt changes in load current or the line to the load is long, operation might become unstable. In this case, it is possible to stabilize the output voltage by attaching capacitor between +Vout and -Vout terminal.
Maximum capacitance of external output capacitor is shown in Table 5-1.

Table 5-1 Maximum Capacitance of External Output Capacitor

Output Voltage	Maximum Capacitance
3.3V	10,000μF
5V	7,200μF
12V	1,200μF
15V	1,000μF

Note) For 3.3V and 5V output models, output voltage might become unstable at input voltage dips or short interruption on connection output capacitor. In this case, it is possible to stabilize the output voltage by attaching input voltage retention diode and increase capacitance of C1 as shown in Fig.5-3. Use input voltage retention diode with higher current rating than fuse current rating. Moreover, choose a suitable capacitance of C1 in accordance with operating condition.

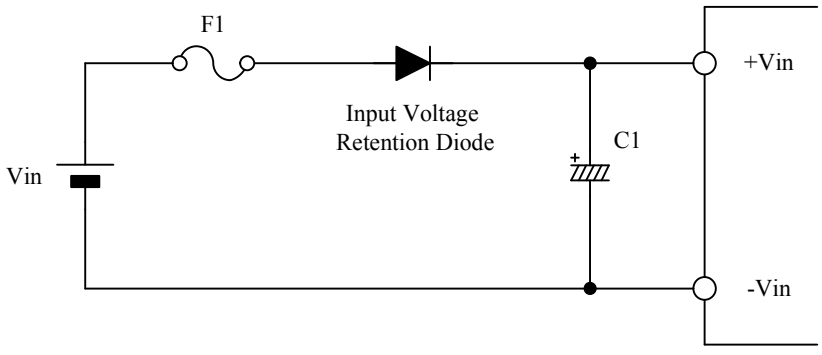


Fig.5-3 Caution about Connecting Output Capacitor

6. Explanation of Functions and Precautions

6-1. Input Voltage Range

Input voltage range for CCG series is indicated below.

Input Voltage Range
CCG30-24-xxS : 9 - 36VDC
CCG30-48-xxS : 18 - 76VDC

Take note that power supply might be damaged or not meet specification when applied input voltage which is out of specified range.

Ripple voltage(Vrpl) which results from rectification and filtering of commercial AC line is might be included within the input voltage as shown in Fig.6-1.
In this case, ripple voltage must be limited within the voltage described below.

Allowable Input Ripple Voltage : 2Vp-p

When input ripple voltage exceed above value, the output ripple voltage may become large.
Take note that sudden input voltage change might be cause variation of output voltage transitionally.
Moreover, maximum value and minimum value of input voltage waveform must not go beyond the limit of above input voltage range.

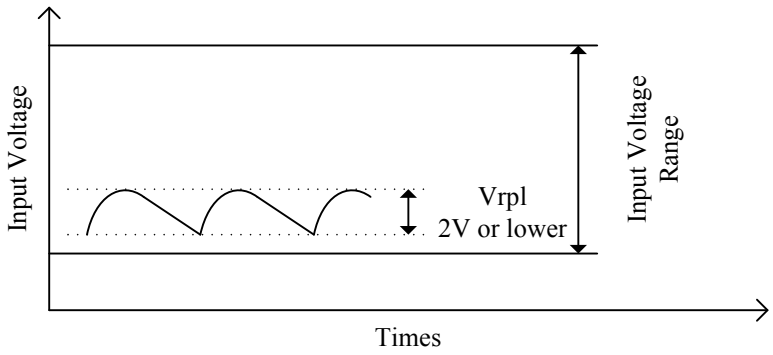


Fig.6-1 Input Ripple Voltage

6-2. Output Voltage Adjustment Range

Output voltage could be adjusted within the range described below by external resistor or variable resistor.
However, take note that power supply might be damaged at increased output voltage which is out the range described below.

When increasing the output voltage, reduce the output current accordingly so as not to exceed the maximum output power.
Take note that when output voltage is decreased, maximum output current is still rated maximum output current of specification.

Output Voltage Adjustment Range : ±10% of Nominal Output Voltage

● Output Voltage Adjustment by External Resistor or Variable Resistor

(1) In case of adjusting output voltage lower

(1-1) Maximum output current

In case of adjusting output voltage lower, maximum output current is until rated maximum output current of specification.

ex)When setting 12V Model to 10.8V output, maximum output power = 10.8V×2.5A = 27W.

(1-2) External resister connecting method

Connect an external resistor or variable resister Ra between TRM and +Vout terminal.
To prevent the effect of noise or other, connect as short as possible because TRM terminal is relatively high impedance.
Please refer to Table 6-1 when adjusting output voltage.

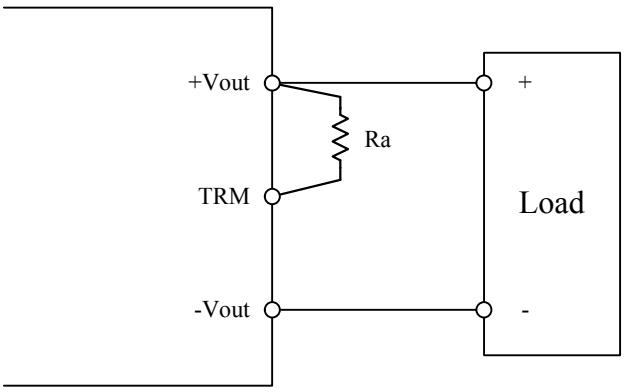


Fig.6-2 Basic Connection for Output Voltage Trim Down

Table 6-1 Equation of External Resistor and Output Voltage

Model	Equation of External Resistor and Output Voltage	
CCG30-xx-03S	$Vout = 3.3 - \frac{16.05}{22.8+Ra}$	$Ra = \frac{16.05}{3.3-Vout} - 22.8$
CCG30-xx-05S	$Vout = 5.01 - \frac{53.95}{32.3+Ra}$	$Ra = \frac{53.95}{5.01-Vout} - 32.3$
CCG30-xx-12S	$Vout = 12.01 - \frac{450.01}{63.3+Ra}$	$Ra = \frac{450.01}{12.01-Vout} - 63.3$
CCG30-xx-15S	$Vout = 15 - \frac{738.3}{74.9+Ra}$	$Ra = \frac{738.3}{15-Vout} - 74.9$

Output Voltage：Vout(V), External Resistor Value：Ra(kΩ)
Output voltage could be adjusted within the -10% of nominal output voltage by external resistor Ra.

(2) In case of adjusting output voltage higher

(2-1) Maximum output current

When increasing the output voltage, reduce the output current accordingly so as not to exceed the maximum output power.

ex)When setting 12V Model to 13.2V output, maximum output current = 30W÷13.2V = 2.272A.

(2-2) External resister connecting method

Connect an external resistor or variable resister Rb between TRM and -Vout terminal.
To prevent the effect of noise or other, connect as short as possible because TRM terminal is relatively high impedance.
Please refer to Table 6-2 when adjusting output voltage.

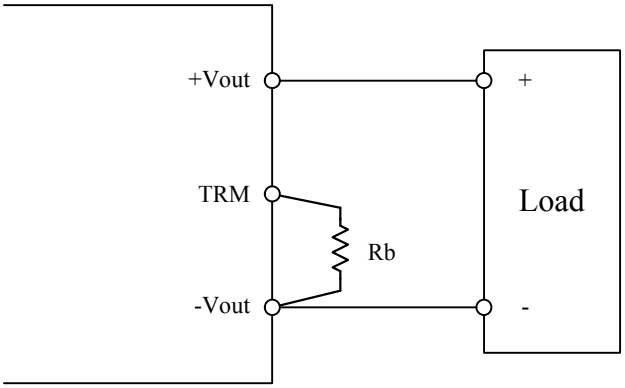


Fig.6-3 Basic Connection for Output Voltage Trim Up

Table 6-2 Equation of External Resistor and Output Voltage

Model	Equation of External Resistor and Output Voltage	
CCG30-xx-03S	$Vout = 3.3 + \frac{9.67}{15+Rb}$	$Rb = \frac{9.67}{Vout-3.3} - 15$
CCG30-xx-05S	$Vout = 5.01 + \frac{17.73}{18+Rb}$	$Rb = \frac{17.73}{Vout-5.01} - 18$
CCG30-xx-12S	$Vout = 12.01 + \frac{51.21}{22+Rb}$	$Rb = \frac{51.21}{Vout-12.01} - 22$
CCG30-xx-15S	$Vout = 15 + \frac{65.6}{22+Rb}$	$Rb = \frac{65.6}{Vout-15} - 22$

Output Voltage：Vout(V), External Resistor Value：Rb(kΩ)
Output voltage could be adjusted within the +10% of nominal output voltage by external resistor Rb.

6-3. Maximum Output Ripple and Noise

This output ripple and noise voltage is measured at connection as shown in Fig.6-4.
Connect ceramic capacitor (C2 : 22μF) Note1) at 50mm distance from the output terminal.
Measure at C2 terminals as shown in Fig.6-4 using coaxial cable with JEITA attachment.
Use oscilloscope with 20MHz frequency bandwidth or equivalent.

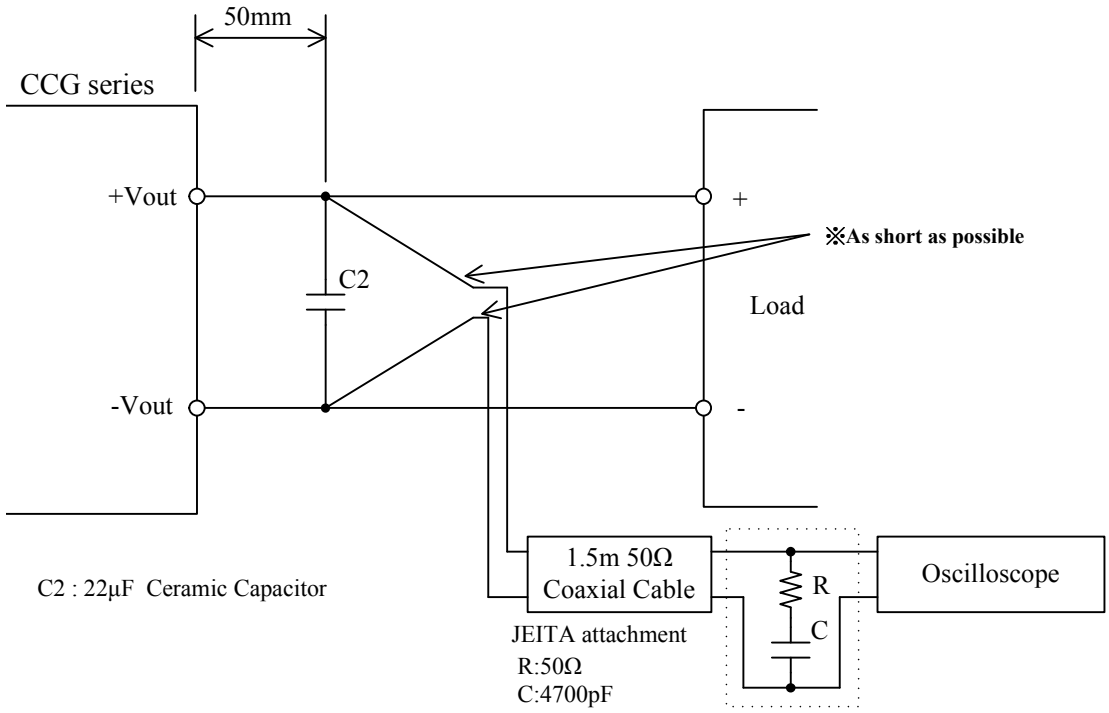


Fig.6-4 Measurement of Maximum Output Ripple and Noise

Take note that, PCB wiring design might influence output ripple voltage and spike noise voltage.
Generally, increasing capacitance value of external capacitor can reduce output ripple voltage.
Moreover, connecting ceramic capacitor can reduce output spike noise voltage.

Note1) For 3.3V and 5V output models, use two ceramic capacitors in parallel when ambient temperature becomes lower than -20ºC to reduce ESR.

6-4. Maximum Line Regulation

Maximum value of output voltage change when input voltage is gradually varied (steady state) within specified input voltage range.

6-5. Maximum Load Regulation

Maximum value of output voltage change when output current is gradually varied (steady state) within specified output current range.
When using at dynamic load mode, output voltage fluctuation might increase.
A thorough pre-evaluation must be performed before using this power supply.

6-6. Over Current Protection (OCP)

This power supply has built-in OCP function.
When short circuit or output current is in overload condition, it becomes intermittent operation.
Output will recover when short circuit or overload conditions are released.
Take note that power supply might be damaged at continuous overload conditions depending on thermal conditions.

6-7. Remote ON/OFF Control (RC terminal)

Without turning the input supply on and off, the output can be enabled and disabled using this function.
Standard type is negative logic.
In order to use remote ON/OFF control function, attach transistor, relay or equivalent between RC and -Vin terminal as shown Fig.6-5.
For secondary control, isolation can be achieved through the use of a photo-coupler or equivalent as shown in Fig.6-6.

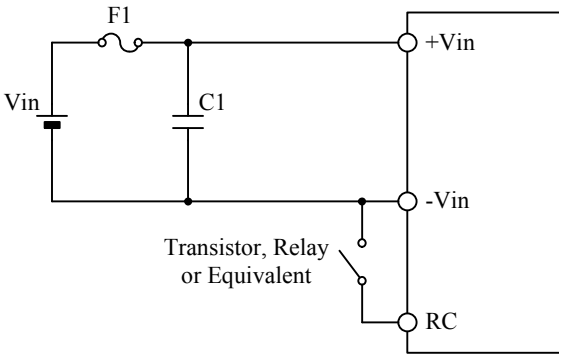


Fig.6-5 RC Connection (1)

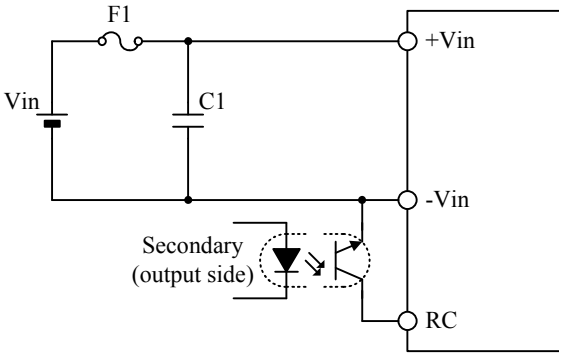


Fig.6-6 RC Connection (2)

Table 6-3 RC Connection

Logic	Switch	Output Status
Negative Logic	Short ($0V \leqq V_{RC} \leqq 0.5V$)	ON
	Open ($4V \leqq V_{RC} \leqq 18V$)	OFF

Note) 1. When remote ON/OFF control function is not used, RC terminal should be shorted to -Vin terminal.
2. Source current from RC terminal to -Vin terminal is 1mA or lower.
3. The maximum RC terminal voltage is 18V.
4. When using long wiring, for prevention of noise, attach capacitor between RC and -Vin terminal. The maximum capacitance between RC and -Vin terminal is 1μF.

6-8. Redundant Operation

Redundant operation is possible for loads that are within the maximum output power of one power supply. When one power supply is shut-down by the power failure etc., another one can continue to provide power.

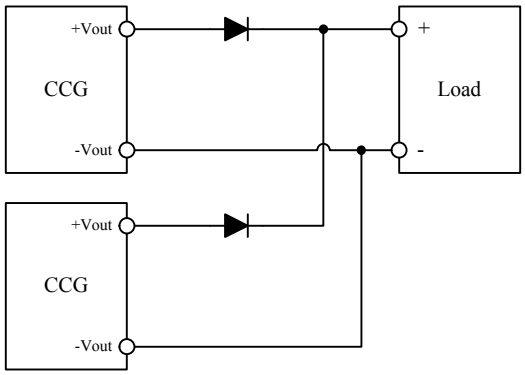


Fig.6-7 Redundant Operation Connection

6-9. Parallel Operation

Parallel operation cannot be used.

6-10. Series Operation

Series operation is possible for CCG series.
Connections shown in Fig.6-8 and Fig.6-9 are possible.

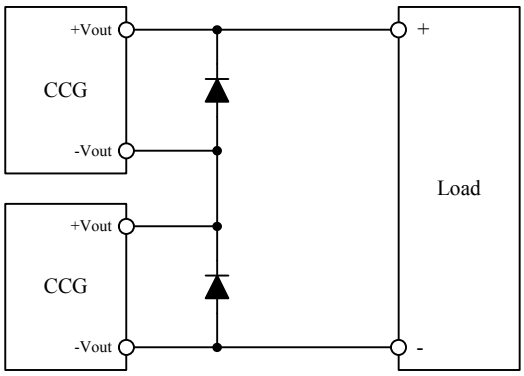


Fig.6-8 Series Operation for High Output Voltage

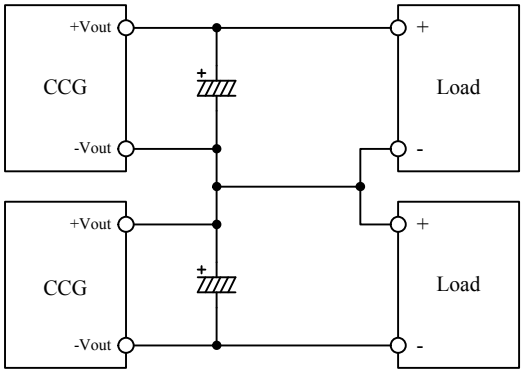


Fig.6-9 ±Output Series Operation

6-11. Operating Ambient Temperature

This is the allowable operating range.
Output load needs to be derated depending on the ambient temperature. There is no restriction on mounting direction but there should be enough consideration for airflow so that heat does not accumulate around the power supply vicinity. Determine external components configuration and mounting direction on PCB such that air could flow around the power supply at forced cooling and convection cooling. For better improvement of power supply reliability, derating of ambient temperature is recommended. For details, refer to "7.Output Derating" section.

6-12. Operating Ambient Humidity

Take note that condensation could lead to power supply abnormal operation or damage.

6-13. Storage Ambient Temperature

Take note that sudden temperature change can cause dew condensation, and it may affect solderability of terminals.

6-14. Storage Ambient Humidity

Take enough care when storing the power supply because rust which causes poor solderability would occurred on terminals when stored in high temperature, high humidity environment.

6-15. Withstand Voltage

This power supply is designed to have a withstand voltage of 1.5kVDC between input and output, 1.0kVDC between input and case and 1.0kVDC between output and case for 1 minute. When conducting withstand voltage test during incoming inspection, set the current limit value of the withstand voltage testing equipment to 10mA. Furthermore, avoid throw in or shut off of the testing equipment when applying or when shutting down the test voltage. Instead, gradually increase or decrease the applied voltage. Take note especially when using the timer of the test equipment because when the timer switches the applied voltage off, impulse voltage which has several times the magnitude of the applied voltage is generated causing damage to the power supply. Connect the terminals as shown in the diagram below.

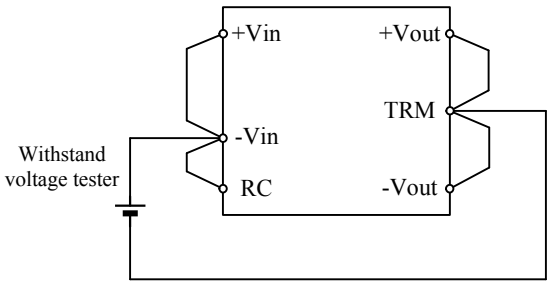


Fig.6-10 Withstand Voltage Test for Input - Output

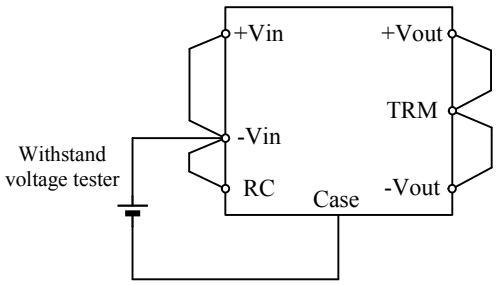


Fig.6-11 Withstand Voltage Test for Input - Case

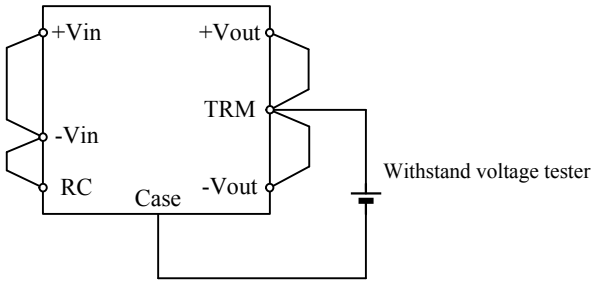


Fig.6-12 Withstand Voltage Test for Output - Case

6-16. Isolation Resistance

Isolation resistance value is 100MΩ and above at 500VDC applied voltage.
Use DC isolation tester (MAX 500V) between output and case.
Make sure that during testing, the isolation testers do not generate a high pulse when the applied voltage is varied. Ensure that the tester is fully discharged after the test.

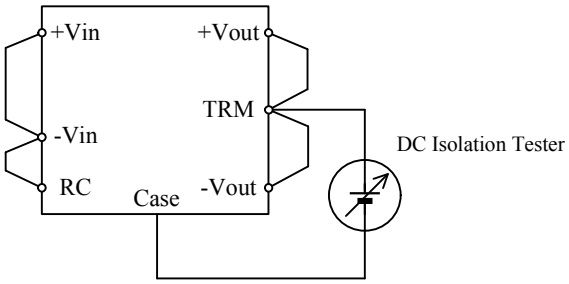


Fig.6-13 Isolation Resistance Test

6-17. Vibration

Vibration of power supply is defined when mounted on PCB.

6-18. Shock

Withstand shock value is define to be the value at TDK-Lambda shipment and packaging conditions, or when mounted on PCB.

7. Output Derating

7-1. Output Derating Measurement Method

There is no restriction on mounting direction but there should be enough consideration for airflow so that heat dose not accumulate around the power supply vicinity. Determine external components configuration and mounting direction on PCB such that air could flow around the power supply at forced cooling and conventional cooling. The derating of the output current is necessary when the ambient temperature is high. (See Output current VS Ambient Temperature.) Output current VS Ambient Temperature is measured according to Fig.7-1 and Fig.7-2. When mounting on actual device, do actual measurement based on measurement points shown in Fig.7-1 and Fig.7-2.
For this measurement, in order not to exceed the Rating temperature of the critical component, refer to the case temperature measurement point shown on Fig.7-3.

(1) Output Current VS Ambient Temperature Measurement Method (for convection cooling)

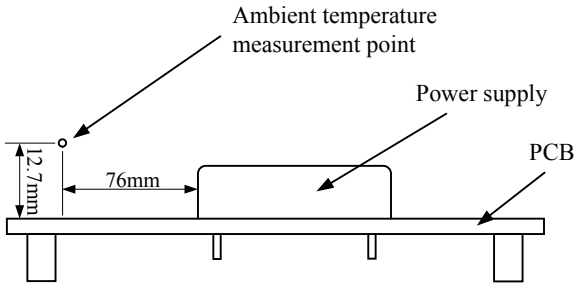


Fig.7-1 Output Current VS Ambient Temperature Measurement Method (for convection cooling)

(2) Output Current VS Ambient Temperature Measurement Method (for forced cooling)

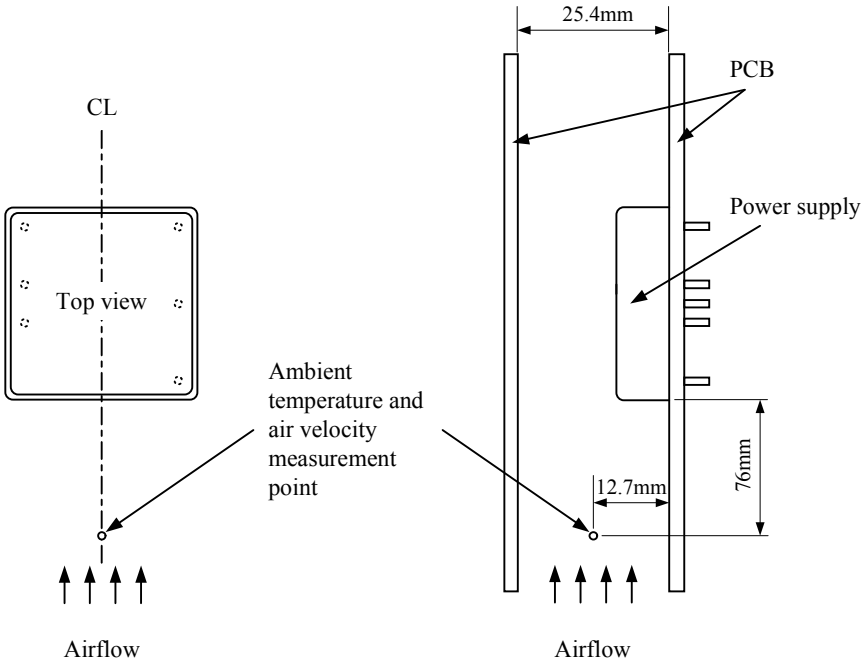


Fig.7-2 Output Current VS Ambient Temperature Measurement Method (for forced cooling)

(3) Temperature Measurement Point on The Case

Confirm the temperature measurement point on the case of Fig.7-3 is below 110ºC.
Moreover, clear the hole at the center of the label, and measure the metal part when you measure the case temperature.

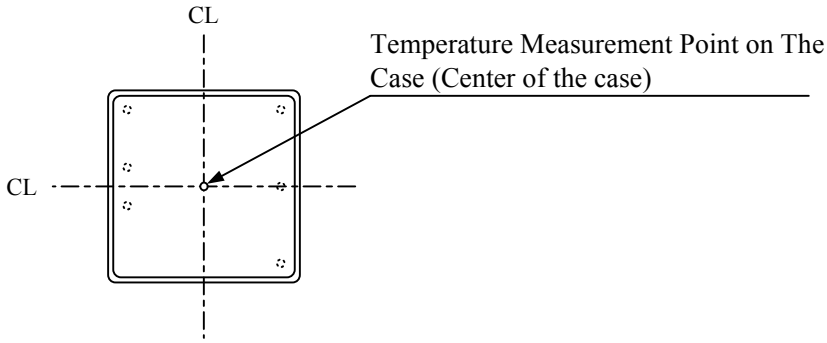


Fig.7-3 Temperature Measurement Point on The Case

7-2. Output Derating Curve

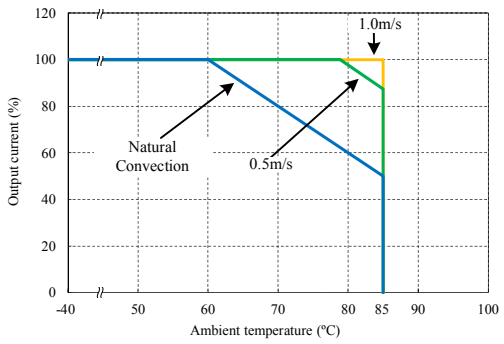
The following Output Current VS Ambient Temperature is a measurement data when mounting on our evaluation PCB. The output derating curve is affected by the mounting board, the external components, and the ambient conditions. Therefore, use it after confirming the case temperature when the power supply operates with actual device does not exceed 110ºC (Temperature Measurement Point On The Case). Moreover, use below 85ºC ambient temperature.

＊Evaluation PCB Specification

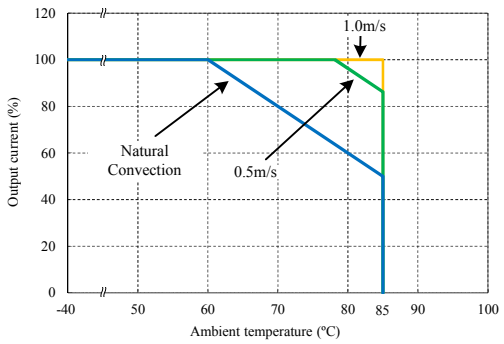
Size	150mm×70mm t = 1.6mm
Material	FR-4 （Double sided）
Copper	35μm

(1) Output Current VS Ambient Temperature (Reference data : Vin=Typ.)

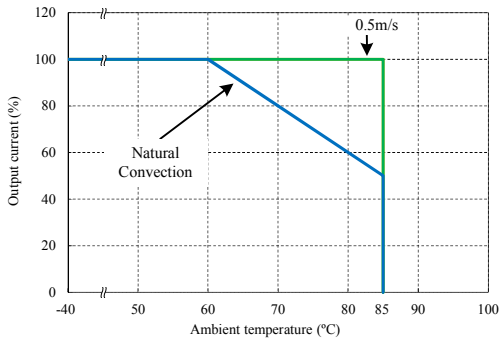
CCG30-24-03S



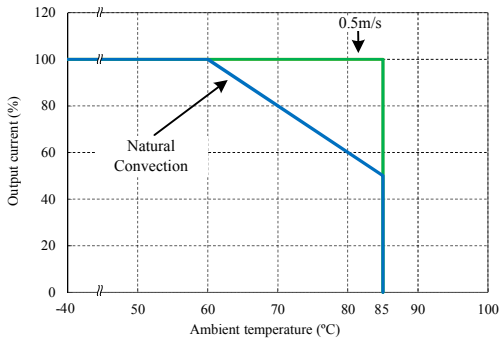
CCG30-24-05S



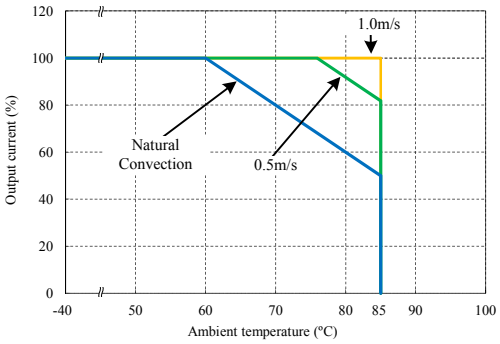
CCG30-24-12S



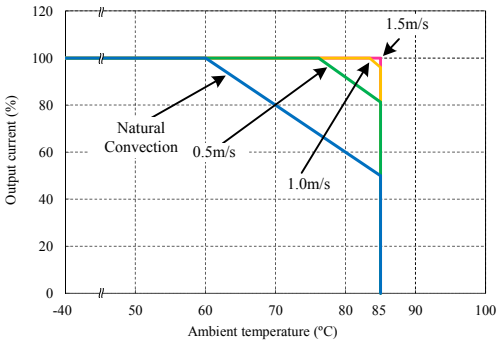
CCG30-24-15S



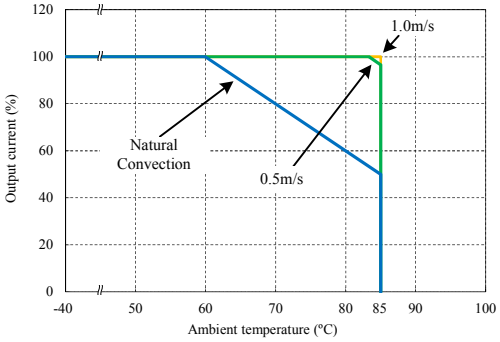
CCG30-48-03S



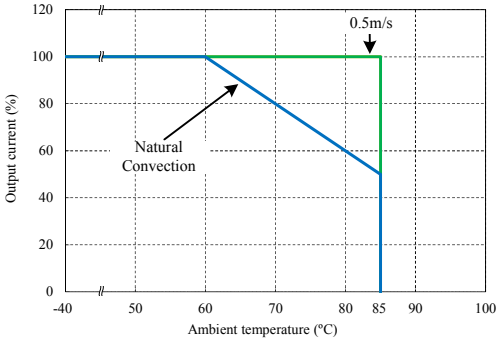
CCG30-48-05S



CCG30-48-12S

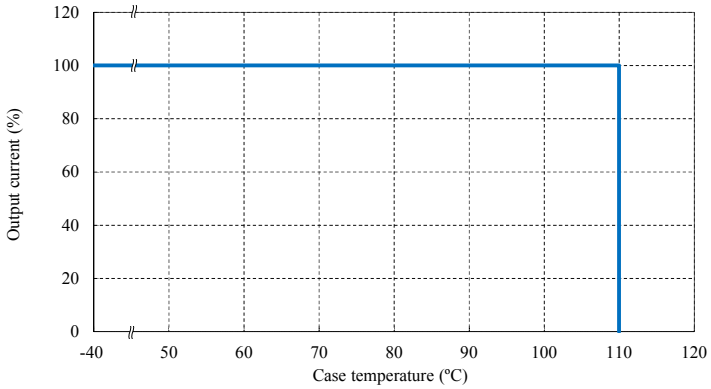


CCG30-48-15S



＊Please see reliability data for Output Current VS Ambient Temperature.

(2) Output current VS Case Temperature



8. Mounting Method, Soldering and Cleaning Condition

8-1. Mounting Method

(1) Mounting Holes on PCB

There is the recommended diameter of hole and pad of PCB in Table 8-1.
The mounting hole position is in Fig.8-1.
Also, see outline drawing for outline of the power supply.

Table 8-1 Recommended diameter of Hole and Pad of PCB

	Input / Output terminals
Pin diameter	ϕ1.0mm
Hole diameter	ϕ1.5mm
Pad diameter	ϕ2.8mm

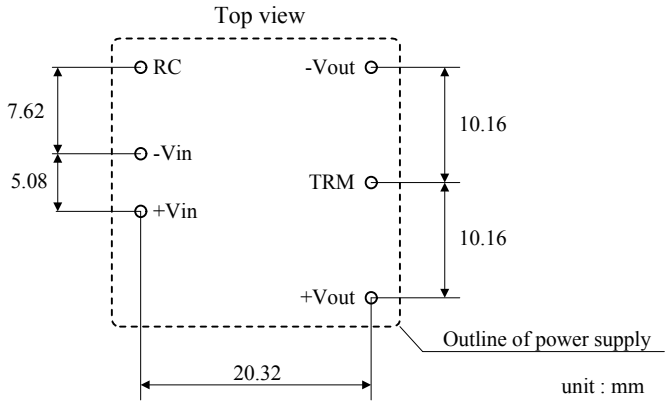


Fig.8-1 Dimension of Mounting Hole Position

(2) Recommended Material of PCB

Recommended materials of the printed circuit board is double sided glass epoxy with through holes.
(thickness : 1.6mm, copper : 35µm)

(3) Input / Output Pattern Width

Large current flows through input and output pattern. If pattern width is too narrow, heat on pattern will increase because of voltage drop of pattern. Relationship between allowable current and pattern width varies depending on materials of printed circuit board, thickness of conductor. It is definitely necessary to confirm on manufactures of printed circuit board for designing pattern.

(4) Method of Connecting Terminals

Connect +Vin, -Vin, +Vout, -Vout with consideration of contact resistance.

8-2. Recommended Soldering Condition

Recommended soldering conditions are as follows.

(1) Soldering Dip

Dip condition：260ºC within 10 seconds

Pre-heat condition : 110ºC for 30 - 40 seconds

(2) Soldering Iron

350ºC within 3 seconds

Note) Soldering time changes according to heat capacity of soldering iron, pattern on printed circuit board etc. Please confirm actual performance.

8-3. Recommended Cleaning Condition

Recommended cleaning condition after soldering is as follows.

(1) Cleaning Solvent

IPA (isopropyl alcohol)

(2) Cleaning Procedure

Use brush and dry the solvent completely before use.

9. Before Concluding Power Module Damage

Verify following items before concluding power supply damage.

(1) No output voltage
- Is specified input voltage applied?
- Are the remote ON/OFF control terminal (RC), output voltage trimming terminal (TRM) correctly connected?
- For case where output voltage adjustment is used, is resistor or variable resister setting, connections correctly done?
- Are there no abnormalities in the output load used?
- Is the case temperature within the specified temperature range?
- Is the ambient temperature within the specified temperature range?

(2) Output voltage is high
- For case where output voltage adjustment is used, is resistor or variable resister setting, connections correctly done?
- Is the ambient temperature within the specified temperature range?

(3) Output voltage is low
- Is specified input voltage applied?
- For cases where output voltage adjustment is used, is resistor or variable resistor setting, connections correctly done?
- Are there no abnormalities in the output load used?

(4) Load regulation or line regulation is large
- Is specified input voltage applied?
- Are the input terminals and the output terminals firmly connected?
- Is the input or output wire too thin?
- Is the input or output wire too long?

(5) Output ripple voltage is large
- Is the measurement done according to methods described in the Instruction Manual or is it an equivalent method?
- Is the input ripple voltage value within the specified value?

10. Warranty Period

Warranty period is 5 years.
For damages occurring at normal operation within this warranty period, repair is free of charge.

Following cases are not covered by warranty
(1) Improper usage like dropping products, applying shock and defects from operation exceeding specification of the power supply.
(2) Defects resulting from natural disaster (fire, flood etc.).
(3) Unauthorized modifications or repair by the buyer's defects not cause by our company.