HWS650G
Instruction Manual

INDEX

BEFORE USING THE POWER SUPPLY UNIT....3
1. Model name identification method....6
2. Terminal explanation....6
2.1. Connector pin Configuration and Function....7
2.1.1. CN601....7
2.1.2. CN602, CN603....7
2.1.3. CN901....8
3. Connecting method....9
3.1. Basic connection(Common connection when using analog function)....9
3.1.1. At time of shipment....9
3.1.2. Remote sensing connection....9
3.1.3. Parallel operation....10
3.1.4. Series operation....11
3.1.5. Auxiliary power supply....12
3.2. Connection method when using analog function....13
3.2.1. Remote ON/OFF control function....13
3.2.2. Output voltage external control function (Apply external power to CV-A terminal)....15
3.2.3. Output current external control function (Apply external power to CC-A terminal)....15
3.2.4. Output voltage monitor function....16
3.2.5. Output current monitor function....16
3.2.6. Constant voltage output mode voltage shortage alarm (VPF signal)....17
3.2.7. Constant current output mode current shortage alarm (CPF signal)....17
4. Notes on wiring....18
4.1. Input/output wiring....18
4.2. Signal wiring....18
5. Installation method and notes....19
5.1. Mounting direction....19

トップに戻る

6. Functional explanation and notes 20
6.1. Input voltage 20
6.2. Input inrush current 20
6.3. Variable output voltage (variable constant voltage output setting value) 20
6.3.1. Variable with built-in output voltage adjustment trimmer 20
6.3.2. Variable by external power (CV-A terminal external voltage applied) 21
6.4. Variable output current (variable constant current output setting value) 21
6.5. Over voltage protection (OVP) 22
6.6. Over current protection (OCP) 22
6.7. Output ripple & noise 23
6.8. Remote sensing (+S, -S terminal) 23
6.9. Parallel operation 24
6.9.1. Parallel operation to increase output current 24
6.9.2. N+1 redundant operation 26
6.9.3. Backup power source (1+1 redundant operation) 27
6.10. Series operation 28
6.10.1. Series operation for increasing output voltage 28
6.10.2. Series operation for plus/minus output 29
6.11. AUX output 29
6.12. Remote ON/OFF control 30
6.13. Output voltage monitor function 31
6.14. Output current monitor function 31
6.15. Constant voltage output mode voltage shortage alarm (VPF signal) 32
6.16. Constant current output mode current shortage alarm (CPF signal) 32
6.17. Isolation test 33
6.18. Withstand voltage 34
6.19. Output discharge 35
6.20. Output peak current 36
7. Block diagram 37
8. Sequence time chart 38
9. External fuse rating 39
10. Before concluding that the unit is at fault… 39
11. The life expectancy 40
12. Warranty period 40
13. CE MARKING / UKCA MARKING 40

トップに戻る

BEFORE USING THE POWER SUPPLY UNIT

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 unit or a fire hazard.

DANGER

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

INSTALLATION WARNING

1. 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.
2. Installation shall be done by Service personnel with necessary and appropriate technical training and experience. There is a risk of electric shock and fire.
3. 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

1. Do not touch this product or its internal components while circuit in operation, or shortly after shutdown. You may receive a burn.
2. While this product is operating, keep your hands and face away from it as you may be injured by an unexpected situation.
3. For products with no cover, do not touch them as there are high-voltage and high temperature parts inside. Touching them might cause injury such as electric shock or burn.
4. 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.
5. 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 dis-assembled.
6. 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.
7. Do not operate and store these products in environments where condensation occurs due to moisture and humidity.
   It might lead fire and electric shock.
8. 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

1. Confirm connections to input/output terminals are correct as indicated in the instruction manual before switching on.
2. Input voltage, Output current, Output power, ambient temperature and ambient humidity should be kept within specifications, otherwise the product will be damaged.
3. Input line, please use the wires as short and thick as possible.
4. 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.
5. Mount this product properly in accordance with the instruction manual, mounting direction and shall properly be ventilated.
6. Please shut down the input when connecting input and output of the product.
7. When installing in environment where conductive foreign, dust and liquid may be present, please consider penetration of above foreign material in the power supply by installing filter, to prevent trouble or malfunction.
8. Not for use in salt water-wet locations.
9. Suitable for mounting on concrete or other non-combustible surfaces only.
10. This open type PECS does not provide comprehensive mitigation for fire hazards. It is intended to be installed inside a supplementary enclosure or in a restricted access area which provides appropriate protection against access to hazardous live parts.
11. This open type PECS does not provide protective means for access to hazardous live parts. It is intended to be installed inside a supplementary enclosure or in a restricted access area which provides.
12. Intended to be used only in areas without combustible materials.
13. No touch of conductive surface of cooling fan due to hazard voltage may appear.

トップに戻る

CAUTION ON USE

1. Product individual notes are shown in the instruction manual. If there is any difference with common notes individual notes shall have priority.
2. 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.
3. 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.
4. If the built-in fuse is blown, do not use the product even after replacing the fuse, as there is risk of abnormality inside.
   Be sure to request repair to our company.
5. For products without built-in protection circuit (element, fuse, etc.), insert fuse at the input to prevent smoke, fire during abnormal operation.
   As for products with built-in protection circuit, depending on usage conditions, built-in protection circuit might not work.
   It is recommended to provide separate proper protection circuit.
6. For externally mounted fuse do not use other fuses aside from our specified and recommended fuse.
7. This product was made for general purpose electronic equipment use and is not designed for applications requiring high safety (such as extremely high reliability and safety requirements. Even though high reliability and safety are not required, this product should not be used directly for applications that have serious risk for life and physical safety.
   Take sufficient consideration in fail-safe design (such as providing protective circuit or protective device inside the system, providing redundant circuit to ensure no instability when single device failure occurs).
8. When used in environments with strong electromagnetic field, there is possibility of product damage due to malfunction.
9. 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.
10. When used in environments where there is conductive foreign matter or dust, there is possibility of product failure or malfunction.
11. Provide countermeasure for prevention of lightning surge voltage as there is risk of damage due to abnormal voltage.
12. Connect together the frame ground terminal of the product and the ground terminal of the equipment for safety and noise reduction. If these ground is not connected together, there is risk of electric shock.
13. Parts with lifetime specifications (built-in fan electrolytic capacitor) are required to be replaced periodically. Set the overhaul period depending on the environment of usage and perform maintenance.
    Also, note that there are cases when EOL products cannot be overhauled.
14. Take care not to apply external abnormal voltage to the output. Especially, applying reverse voltage or overvoltage more than the rated voltage to the output might cause failure, electric shock or fire.

NOTE

1. Take note that traces of sheet metal processing be left in our power supplies.
2. When disposing product, follow disposal laws of each municipality.
3. 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.
4. When exporting our products, apply for necessary permissions as required by rules and regulations of Foreign Exchange and foreign Trade Control Act.
5. Catalogue, contents of the instruction manual may be changed without a prior notice. Refer to latest catalogue or instruction manual.
6. Reproduction or reprinting the instruction manual or its portion is forbidden without our permission.

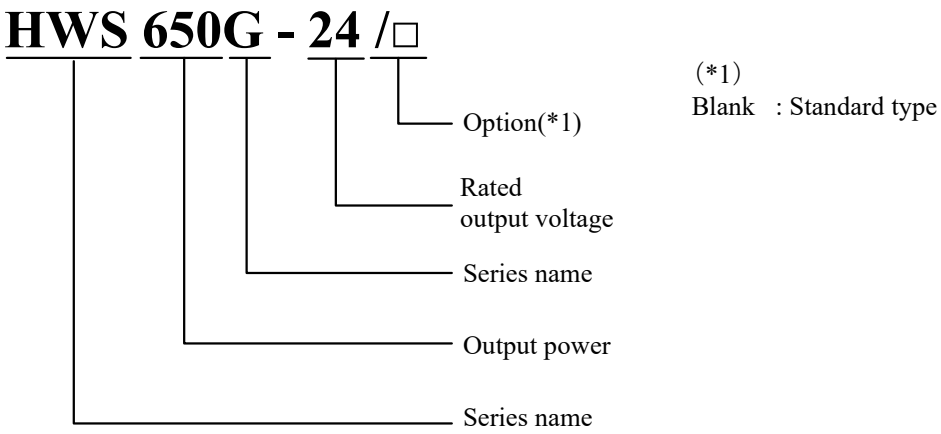
トップに戻る

LONG-TERM STORAGE METHOD AND PERIOD

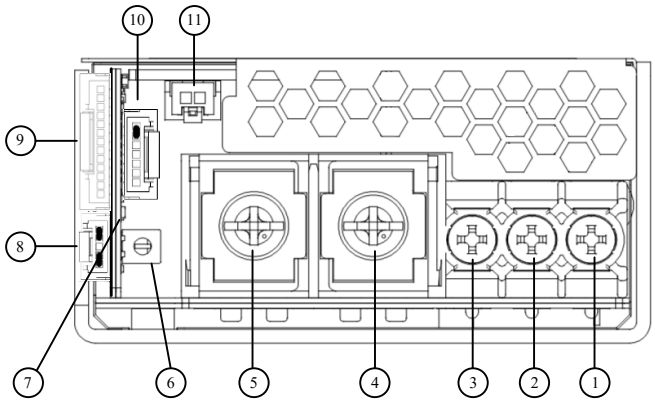
1. Please keep the product in carton box.
2. Please do not apply excessive vibration, shock or mechanical stress applied directly to the product.
3. Please keep away from direct sunlight.
4. For long-term storage temperature and humidity, the following conditions shall be used as a guideline :
   Temperature range : 5℃～30℃
   Humidity range : 40%～60%RH
   Please keep away from the places where temperature and humidity can change drastically.
   It can cause condensation on the product or deterioration.
5. For long-term storage period, we recommend to use within 2 years after receiving the product.
   < Soldering and PCB mounted products : On Board, Power Module and etc >
   For products that have been received for more than 1 year, please check lead oxidation and solderability.
   In addition, SMD type products may have MSL (Moisture Sensitivity Level) provision.
   Please be sure to read the instruction manual and delivery specifications.
   < Unit type or PCB type of products : the product is used an aluminum electrolytic capacitor >
   There is tendency that the leakage current of an aluminum electrolytic capacitor may increase when stored without using for a long time. This phenomenon can be improved by applying voltage to the aluminum electrolytic capacitor to reduce the increased leakage current through the self-recovery effect of the electrolyte. For reference, before using products that have been stored for a very long time, please warm-up first for 30 minutes or more without taking load.
   < Criterion of warm up voltage condition >
   (1)Implementation period : 1 year or above after the delivery
   (2)Electrical continuity condition
   Input voltage : Rating
   Load : 0A
   Ambient temperature : Normal temperature
   Time : 30 minutes or more

トップに戻る

1. Model name identification method



2. Terminal explanation



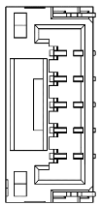
① N : Input terminal Neutral line (M3.5 screw) *Basic insulation between FG
② L : Input terminal Live line (Fuse in line) (M3.5 screw) *Basic insulation between FG
③ ⏚ : Earth terminal (FG) (M3.5 screw) *Connected to the power supply case inside the power supply
④ -V : -Output terminal (100A max. / terminal, M5 screw) *Basic insulation between FG
⑤ +V : +Output terminal (100A max. / terminal, M5 screw) *Basic insulation between FG
⑥ Output voltage adjustment trimmer
⑦ Output monitoring indicator (Green LED lights up when power is output)
⑧ Signal connector CN601 *Basic insulation between FG
⑨ Signal connector CN602 *Basic insulation between FG
⑩ Signal connector CN603 *Basic insulation between FG
⑪ Signal connector CN901 *Basic insulation between FG

トップに戻る

2.1. Connector pin Configuration and Function

2.1.1. CN601

Connector for remote sensing.
CN601 is connected to the output of the power supply.
Note: Products with 60 V output will have voltages above 60 V.

Configuration	No.	Pin name	Function
 CN601	1	+L	Local sensing terminal, internally connected to +output terminal. (+L terminal cannot supply load current.)
	2	+S	Remote sensing terminal for +output side. (For remote sensing function, which compensates for line drop between power supply terminals and load terminals. Connect to +L terminal when remote sensing function unnecessary.)
	3	NC	Do not connect.
	4	-S	Remote sensing terminal for -output side. (For remote sensing function, which compensates for line drop between power supply terminals and load terminals. Connect to -L terminal when remote sensing function unnecessary.)
	5	-L	Local sensing terminal, internally connected to -output terminal. (-L terminal cannot supply load current.)

*CN601 Connector（JST）

Connector	Housing	Terminal Pin
SM05B-GHS-TB	GHR-05V-S	SSHL-002T-P0.2 (AWG26)

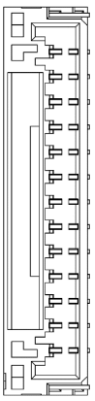
Use maker recommended crimping tool.
Hand Crimping Tool ：YRS-1590（SSHL-002T-P0.2）（JST）

These are connected by short pieces at time of shipment.
+S terminal (Pin No.2）to +L terminal (Pin No.1）
-S terminal (Pin No.4）to -L terminal (Pin No.5）

2.1.2. CN602, CN603

Terminals with the same name, CN602 and CN603, are connected inside the power supply.
If you short the terminals on the CN602 side, the terminals on the CN603 side will also short.

CN602

Configuration	No.	Pin name	Function
 CN602	1	CV-M	CV voltage monitor terminal.
	2	AG	Ground for CV-M,CV-A,CC-A,CB (internally connected to -S terminal.)
	3	CV-A	Output voltage external control terminal.
	4	CC-A	Output current external control terminal.
	5	AG	Ground for CV-M,CV-A,CC-A,CB (internally connected to -S terminal.)
	6	CB	Current balance terminal. (For current balancing in parallel operation.)
	7	NC	Do not connect.
	8	CNT1	Remote ON/OFF control terminal
	9	CNT2	Remote ON/OFF control terminal
	10	TOG	Ground for CNT1,CNT2,CNT3,VPF,CPF (internally connected to GND terminal.)
	11	VPF	Constant voltage output mode voltage shortage alarm (Open collector output. Open when the output voltage drops.)
	12	CPF	Constant current output mode current shortage alarm (Open collector output. Open when output current decreases.)
	13	TOG	Ground for CNT1,CNT2,CNT3,VPF,CPF (internally connected to GND terminal.)

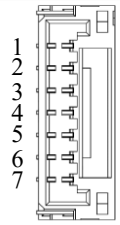
トップに戻る

*CN602 Connector（JST）

Connector	Housing	Terminal Pin
SM13B-GHS-TB	GHR-13V-S	SSHL-002T-P0.2 (AWG26)

Use maker recommended crimping tool.
Hand Crimping Tool ：YRS-1590（SSHL-002T-P0.2）（JST）

CN603

Configuration	No.	Pin name	Function
 CN603	1	TOG	Ground for CNT1,CNT2,CNT3,VPF,CPF (internally connected to GND terminal.)
	2	CNT3	Remote ON/OFF control terminal
	3	NC	Do not connect.
	4	CB	Current balance terminal. (For current balancing in parallel operation.)
	5	AG	Ground for CV-M,CV-A,CC-A,CB (internally connected to -S terminal.)
	6	CC-A	Output current external control terminal.
	7	CV-A	Output voltage external control terminal.

*CN603 Connector（JST）

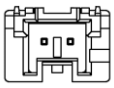
Connector	Housing	Terminal Pin
SM07B-GHS-TB	GHR-07V-S	SSHL-002T-P0.2 (AWG26)

Use maker recommended crimping tool.
Hand Crimping Tool ：YRS-1590（SSHL-002T-P0.2）（JST）

These are connected by short pieces at time of shipment.
CN603 : CNT3 terminal (Pin No.2) to TOG terminal (PinNo.1)

2.1.3. CN901

CN901 are isolated from the power input and output circuits.

Configuration	No.	Pin name	Function
 CN901	1	AUX	+ output terminal of auxiliary power output
	2	GND	- output terminal of auxiliary power output (internally connected to TOG terminal.)

*CN901 Connector（JST）

Connector	Housing	Terminal Pin
SM02B-PASS-TBT	PAP-02V-S	SPHD-001T-P0.5 (AWG22 ~ 26)

Use SPHD-001T-P0.5 (AWG22 ~ 26) for the AUX and GND terminals, and select a wire with a thickness according to the output current.

Use maker recommended crimping tool.
Hand Crimping Tool ：YRS-620(SPHD-002T-P0.5)(JST) or YC-610R(SPHD-001T-P0.5)(JST)

トップに戻る

3. Connecting method

Pay attention to the input wiring. If it is connected to wrong terminal, the power supply will be damaged.

- Input must be off when making connections.
- Must connect terminal to earth (frame ground of the equipment etc.) by thick wire for safety and improvement of Noise sensitivity.

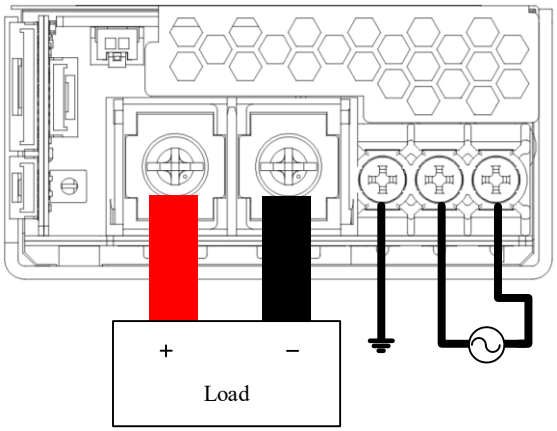
3.1. Basic connection(Common connection when using analog function)

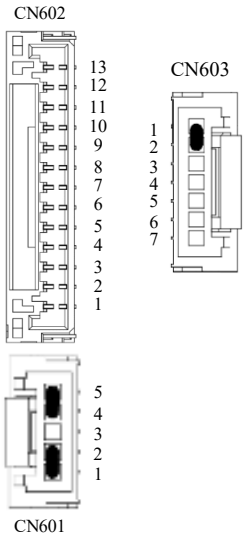
3.1.1. At time of shipment

Short pieces ① and ② are connected at the time of shipment from the factory.

① When not using the remote sensing function (local sensing), short-connect the +S terminal (Pin No.2) and +L terminal (Pin No.1), and short-connect the -S terminal (Pin No.4) and -L terminal (Pin No.5) of CN601.

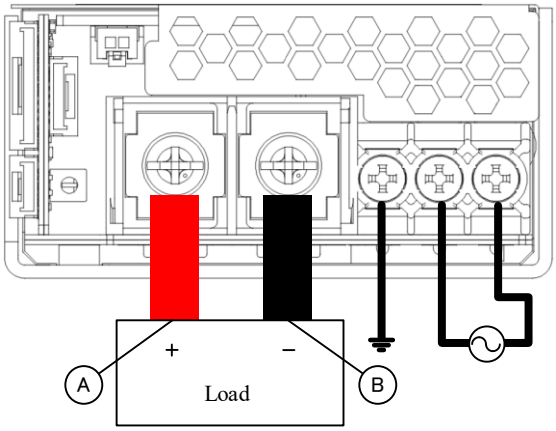
② When not using the remote ON/OFF control function, short-connect the CNT3 terminal (Pin No.2) and TOG terminal (Pin No.1) of CN603

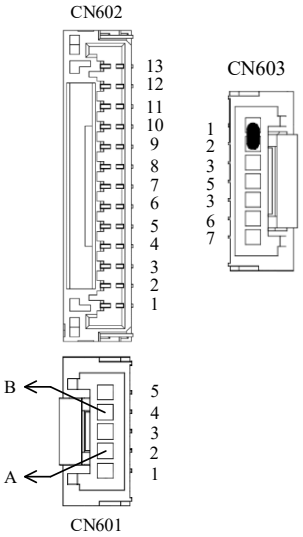




3.1.2. Remote sensing connection

Connect the sensing wire from the +S terminal (pin No. 2) of CN601 to the + side of the load terminal, and from the -S terminal (pin No. 4) of CN601 to the - side of the load terminal.
Use twisted or shielded sensing wires.
Be careful not to remove the load wire screws. Load current may flow through the sensing wires, causing power supply failure.



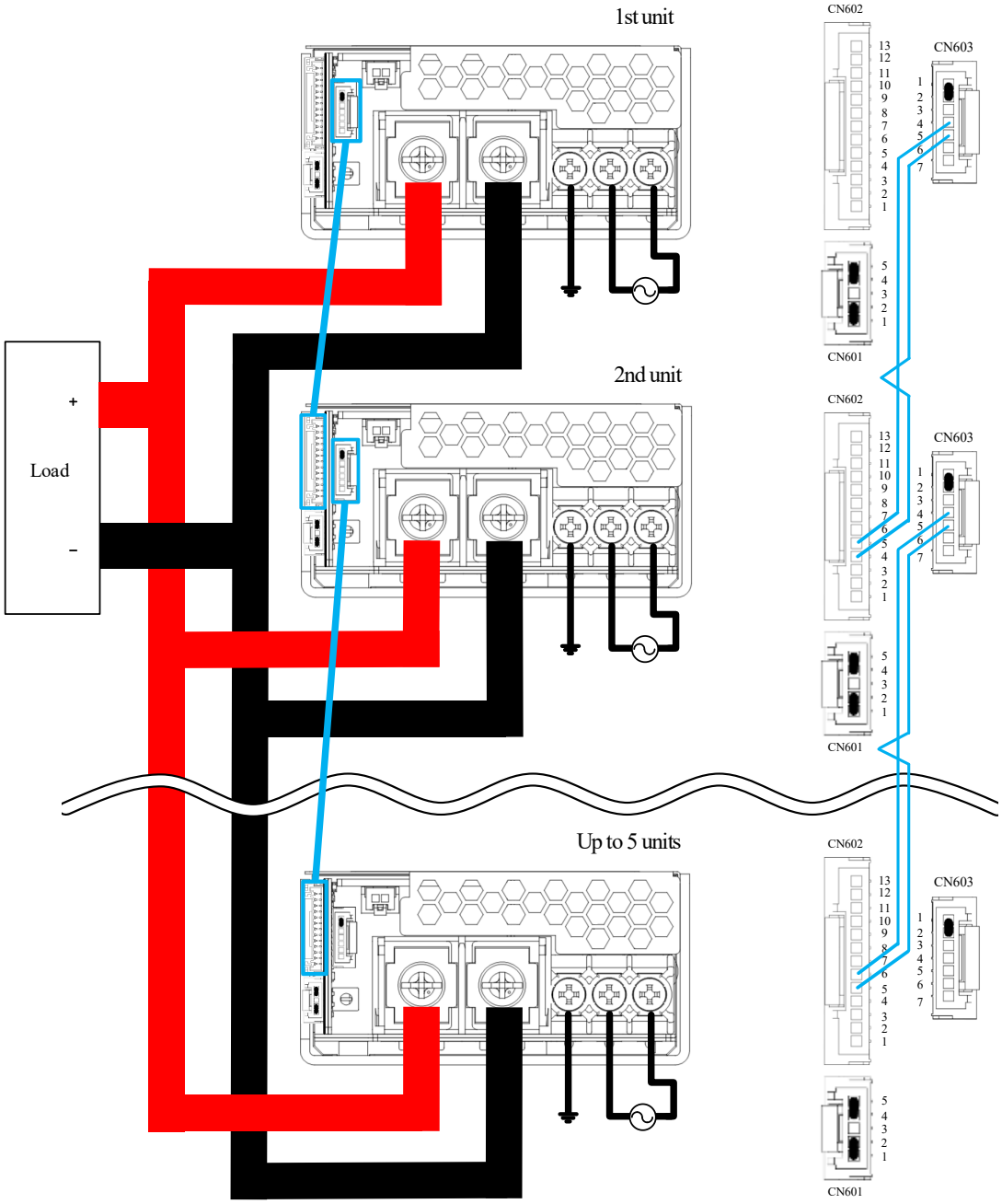


トップに戻る

3.1.3. Parallel operation:
For constant voltage output mode when using output current balance function

Parallel operation in constant voltage output mode is possible by using the output current balance function. Connect between the CB terminals (pin No. 6 of CN602 or pin No. 4 of CN603) and the AG terminals (pin No. 5 of CN602 or pin No. 5 or CN603) of all power supplies operating in parallel.

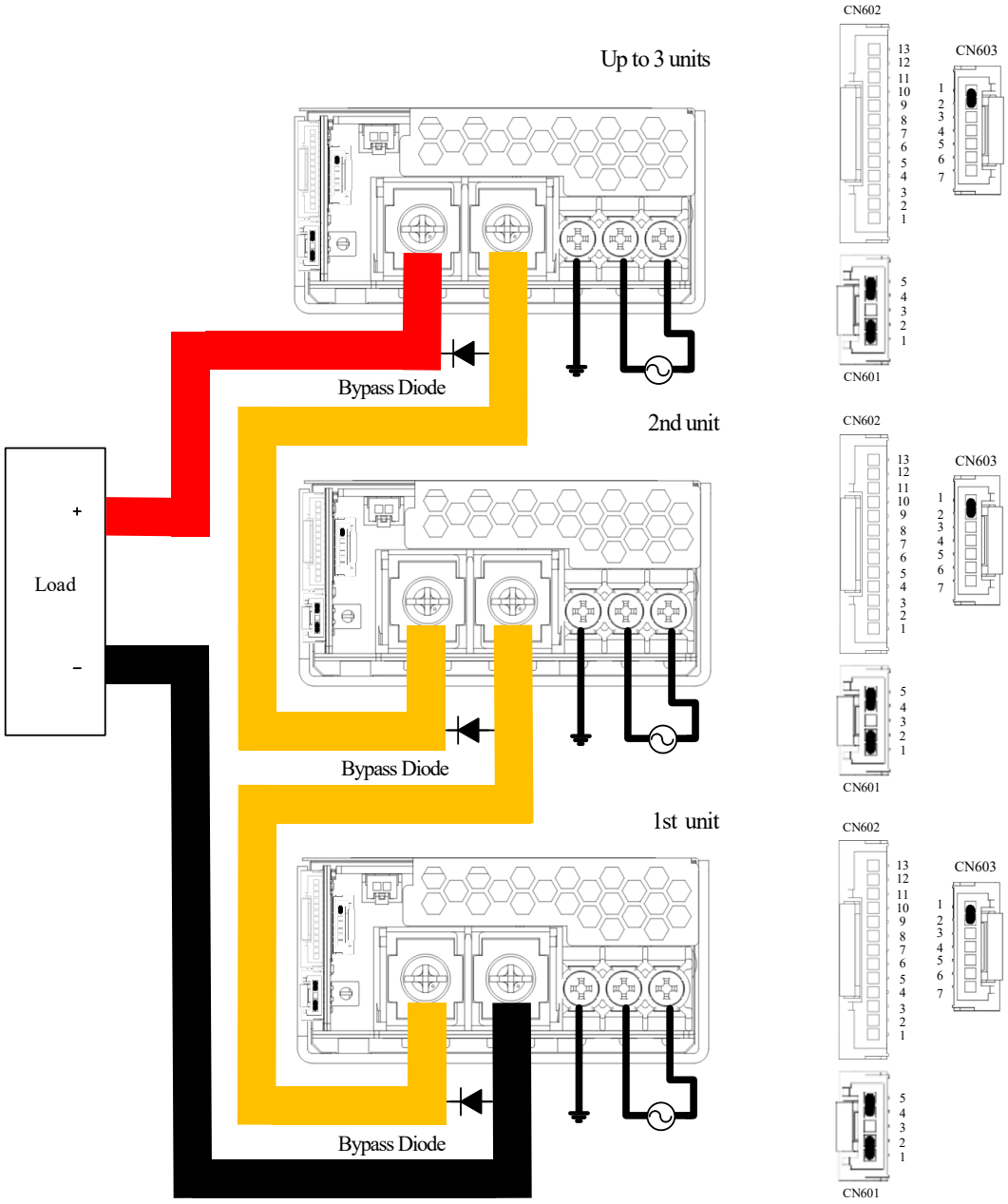
1) Adjust the output voltage of each power supply to be same value within 1% or 100mV whichever is smaller.
2) Parallel operation is possible up to 5 units.
3) Use same length and type of wires for all load lines.
4) The wires between CB terminals and AG terminals should be the same length and as short as possible, and twisted or shielded wires should be used.



トップに戻る

3.1.4. Series operation

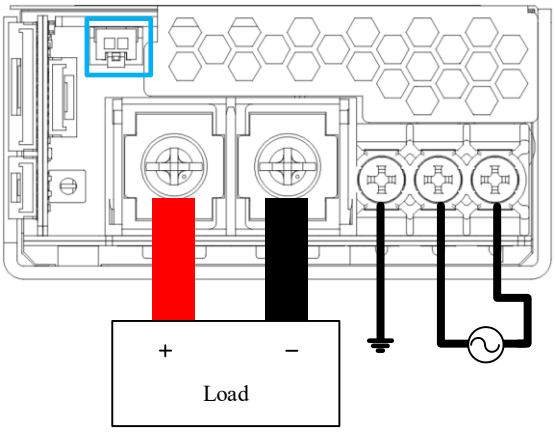
Ensure that all units must be in operation. (Never use in condition that one of the units is not operated.)
When connected the bypass diode, select a bypass diode with maximum forward current rating more than output load current. And maximum reveres voltage must withstand each power supply output voltage.
There might be a step in the output rise waveform during series operation.
Series operation is possible up to 3 units.

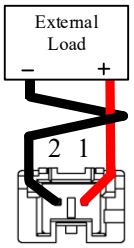


トップに戻る

3.1.5. Auxiliary power supply

Connect the AUX terminal (pin No. 1) and GND terminal (pin No. 2) of CN901 to the external load. Twist the load wires.





CN901

トップに戻る

3.2. Connection method when using analog function

3.2.1. Remote ON/OFF control function

Power output can be controlled ON/OFF using CNT1 terminal (pin No. 8), CNT2 terminal (pin No. 9) of CN602 or CNT3 terminal (pin No. 2) of CN603, and TOG terminal (pin No. 10 or pin No. 13) of CN602 or TOG terminal (pin No. 1) of CN603.
The following four types of ON/OFF control are possible.

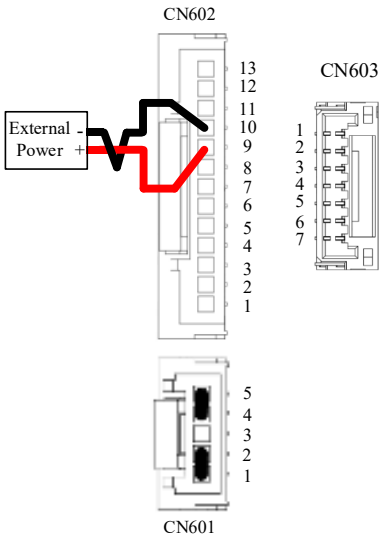
1) Power output by applying external voltage
Connect an external voltage source between CNT2 terminal (pin No. 9) and TOG terminal (pin No. 10 or pin No. 13).
(Use twisted or shielded wires for the ON/OFF control wires.)

2) Power output when short-circuited between terminals
Connect a switch between CNT1 terminal (pin No. 8) and TOG terminal (pin No. 10 or pin No. 13).
(Use twisted or shielded wires for the ON/OFF control wires.)

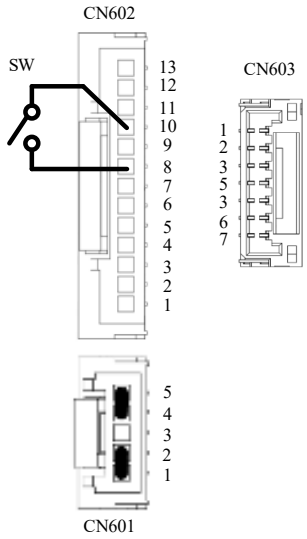
3) Power output when terminals are open
Short-connect between CNT1 terminal (pin No. 8) and TOG terminal (pin No. 10 or pin No. 13) of CN603, and connect a switch between CNT2 terminal (pin No. 9) and TOG terminal (pin No. 10 or pin No. 13) of CN602.
(Use twisted or shielded wires for the ON/OFF control wires.)

4) Linked ON/OFF control during parallel operation
When using Linked ON/OFF control during parallel operation, connect CNT3 terminal (pin No. 2) of CN603 to CNT1 terminal (pin No. 8) of CN602 of the other unit, and TOG terminal (pin No. 1) of CN603 to TOG terminal (pin No. 10 or pin No. 13) of CN602 of the other unit.
(Use twisted or shielded wires for the ON/OFF control wires.)

1) Power output by applying external voltage

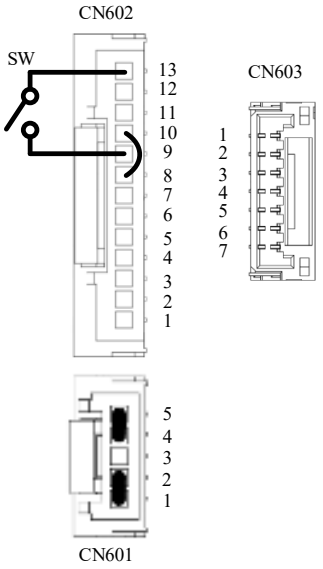


2) Power output when short-circuited between terminals

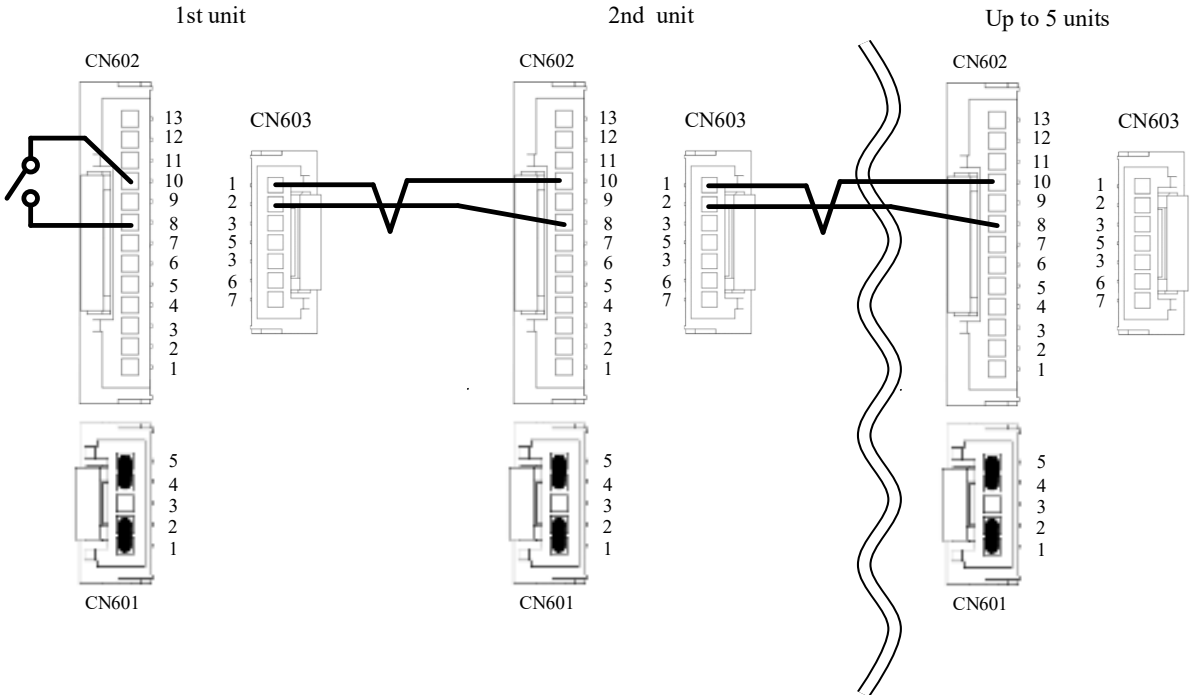


トップに戻る

3) Power output when terminals are open



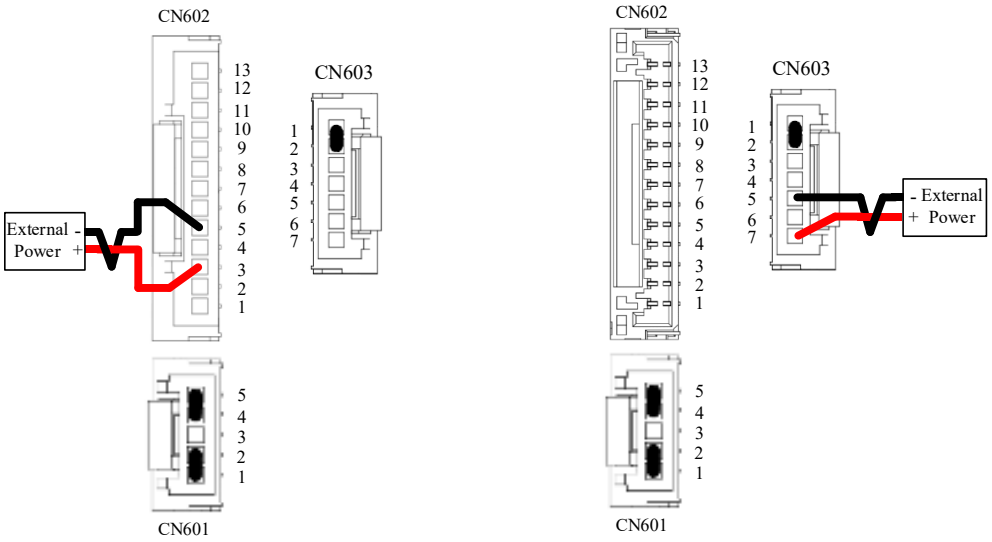
4) Linked ON/OFF control during parallel operation
(e.g. Power output when short-circuited between terminals)



トップに戻る

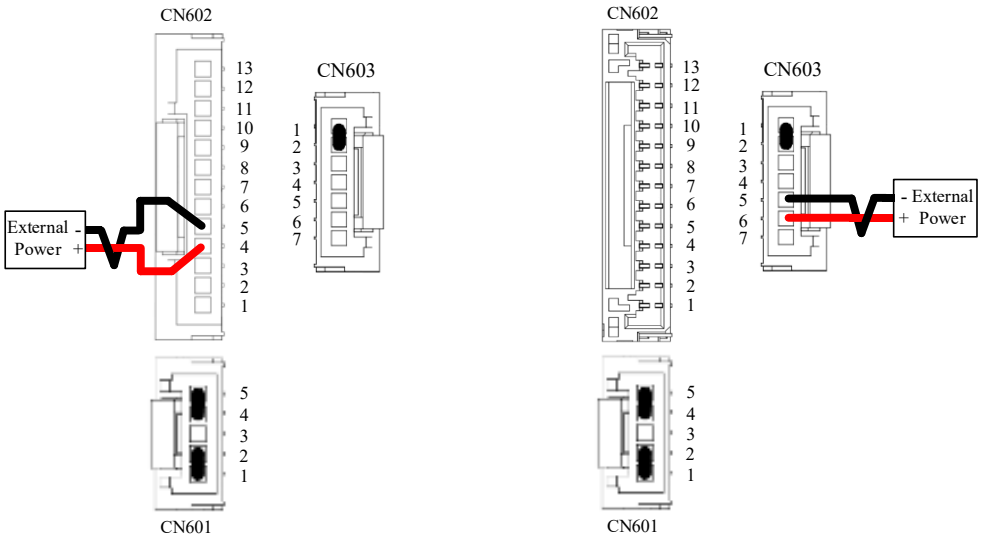
3.2.2. Output voltage external control function (Apply external power to CV-A terminal)

Connect the external power supply between the CV-A terminal (pin No. 3 of CN602) and the AG terminal (pin No. 2 or pin No. 5 of CN602) or CV-A terminal (pin No. 7 of CN603) and the AG terminal (pin No. 5 of CN603). Use twisted or shielded signal wires.



3.2.3. Output current external control function (Apply external power to CC-A terminal)

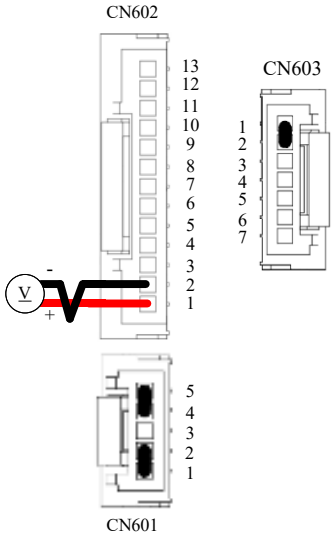
Connect the external power supply between the CC-A terminal (pin No. 4 of CN602) and the AG terminal (pin No. 2 or pin No. 5 of CN602) or the CC-A terminal (pin No. 6 of CN603) and the AG terminal (pin No. 5 of CN603). Use twisted or shielded signal wires.



トップに戻る

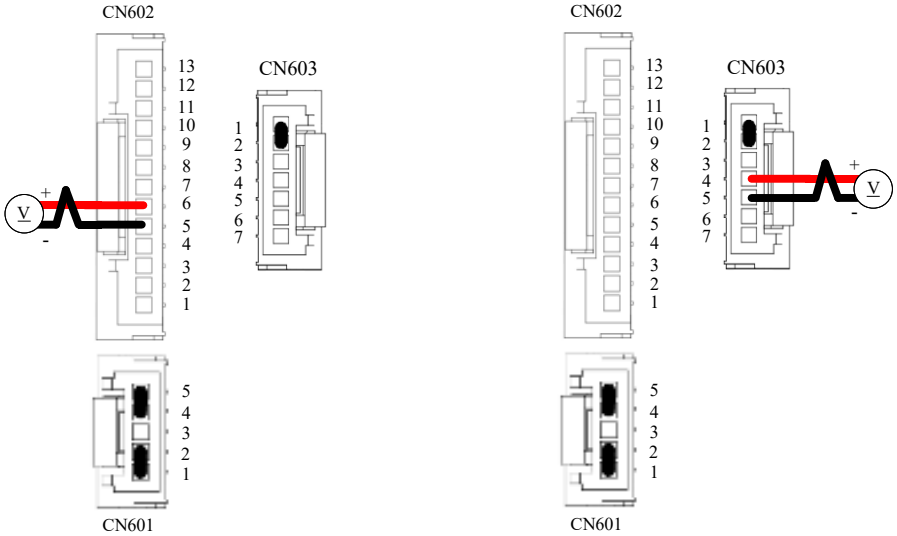
3.2.4. Output voltage monitor function

Measure the voltage between the CV-M terminal (pin No. 1 of CN602) and the AG terminal (pin No. 2 or pin No. 5 of CN602).
Use twisted or shielded signal wires.
Use a measuring device with an input impedance of 500kΩ or more.



3.2.5. Output current monitor function

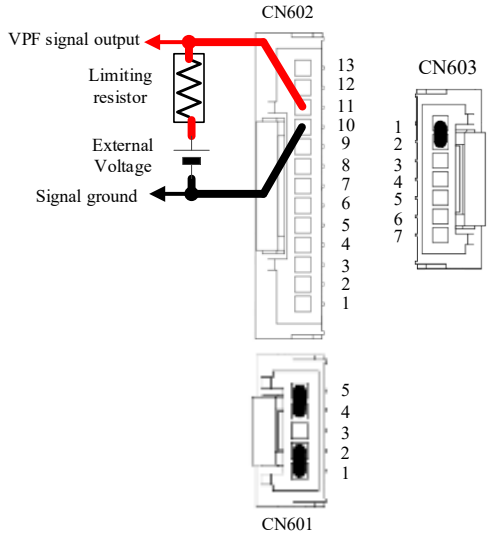
Measure the voltage between the CB terminal (pin No. 6 of CN602) and the AG terminal (pin No. 2 or pin No. 5 of CN602) or the CB terminal (pin No. 4 of CN603) and the AG terminal (pin No. 5 of CN603).
Use twisted or shielded signal wires.
Use a measuring device with an input impedance of 500kΩ or more.



トップに戻る

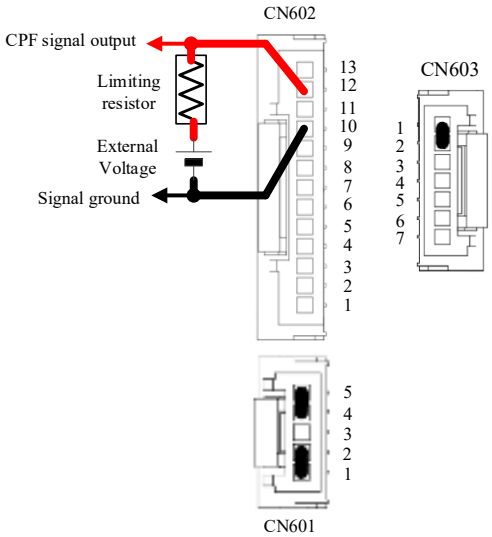
3.2.6. Constant voltage output mode voltage shortage alarm (VPF signal)

Open collector output. Connect the external voltage between the VPF terminal (pin No. 11 of CN602) and the TOG terminal (pin No. 10 or pin No. 13 of CN602).
Use twisted or shielded signal wires.



3.2.7. Constant current output mode current shortage alarm (CPF signal)

Open collector output. Connect the external voltage between the CPF terminal (pin No. 12 of CN602) and the TOG terminal (pin No. 10 or pin No. 13 of CN602).
Use twisted or shielded signal wires.



トップに戻る

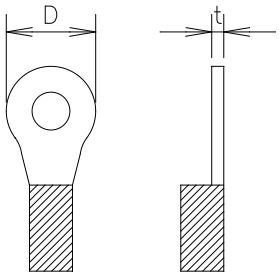
4. Notes on wiring

4.1. Input/output wiring

(1) The output load line and input line shall be separated, and use all lines as thick and short as possible to make lower impedance. The output load line and input line shall be twisted or use shielded wire to improve noise sensitivity.
The recommended wire type, torque and crimp-type terminal :

	Recommended Wire	Recommended torque	Recommended crimp-type terminal		
			D (MAX)	t (MAX)	Mounting pieces (MAX)
Input terminal	AWG12-22	M3.5 Screws 1.0N·m (12.2kgf·cm) ~ 1.6N·m (16.3kgf·cm)	7.4mm	1.0mm	1piece
				0.8mm	2pieces
Output terminal	AWG6-14	M5 Screws 2.0N·m (20.4kgf·cm) ~ 2.4N·m (24.4kgf·cm)	15.6mm	1.8mm	1piece
				1.5mm	2pieces

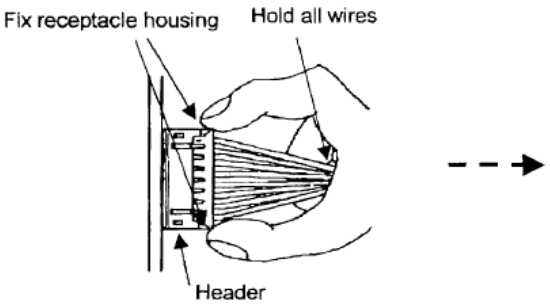
Note1: Recommended wire type and crimp-type terminal vary depending on use conditions. Choice most appropriate wire type and crimp-type terminal after referring to wire maker recommended allowable current and voltage drop.
Thick diameter wire is recommended.
Note2: Use minimum 60°C wire and copper conductor only.
In addition, choice must consideration of the ambient temperature and self-heating.



(2) Noise can be reduced by attaching a capacitor to the load terminals.

4.2. Signal wiring

(1) Be sure to twist the signal wire and separate it from the input and output wires.
(2) Hold the socket housing firmly and insert it straight into the post until it clicks into place.
(3) To pull out the connector, hold the wires together, secure the socket housing with your fingers so as not to pry it, and pull it out while mating.
(4) Products with 60V outputs generate voltages exceeding 60V on the remote sensing wires. Pay attention to the withstand voltage of the wire materials used.



トップに戻る

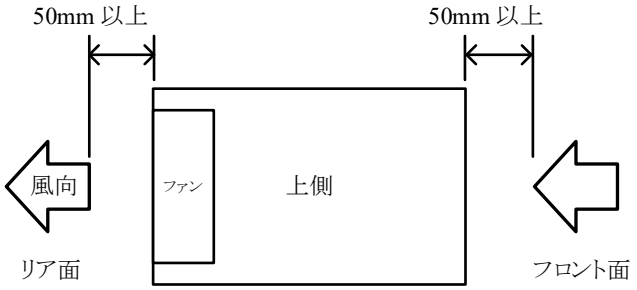
5. Installation method and notes

(1) Forced air cooling power supply with built-in fan. There are cooling air intake and exhaust ports on the front and rear sides. Leave a space of at least 50mm from the intake and exhaust surfaces.
In addition, in a dusty environment, if ventilation becomes poor due to clogged intake/exhaust ports, or if conductive foreign matter, dust, or liquid enters the power supply, there is a risk of failure or malfunction.

(2) The maximum allowable penetration of mounting screws is 5mm.
Incomplete threads must not enter inside the power supply.

(3) Recommended torque for mounting screw.
M3 screw : 0.51 N･m (5.2kgf･cm)

(4) The power supply is considered a component which will be installed into a final equipment. Depending on the environment in which the power supply is installed, it may not meet EMC, vibration resistance, and shock resistance specifications.
The final equipment should be re-evaluated that it meets EMC, vibration and shock requirement.

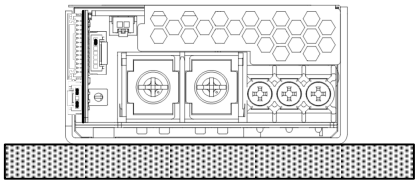


5.1. Mounting direction

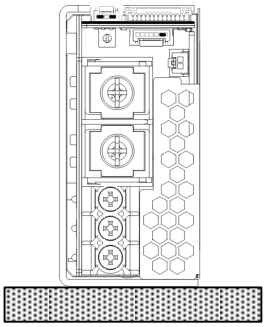
The mounting direction is shown in the figure below. The standard mounting direction is (A).
For output derating, refer to specifications (A296-01-02_).

･The power supply is considered a component which will be installed into a final equipment. Depending on the environment in which the power supply is installed, it may not meet EMC, vibration resistance, and shock resistance specifications.
The final equipment should be re-evaluated that it meets EMC, vibration and shock requirement.

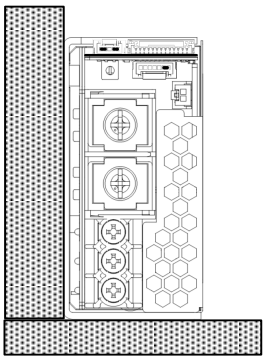
■Mounting direction A
Standard mounting



■Mounting direction B



■In case of strong vibration or shock
Fix the bottom and sides together.



トップに戻る

6. Functional explanation and notes

6.1. Input voltage

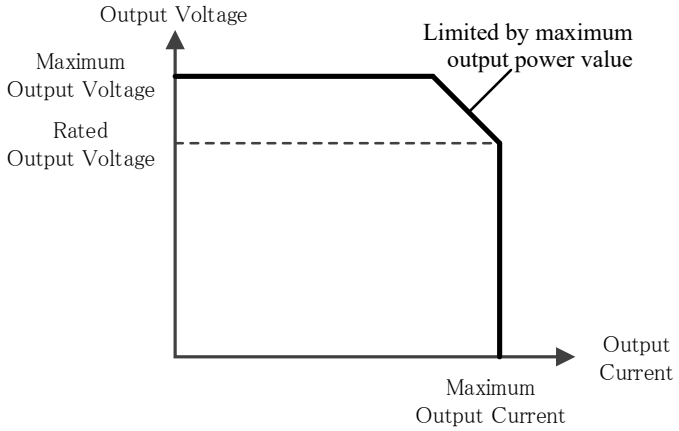
Input voltage range is single-phase 85 - 265VAC (47 - 63Hz).
Applying input voltage outside of specifications may damage the power supply.
The safety standard certified input voltage range is 100 - 240VAC (50 - 60Hz).

6.2. Input inrush current

The switch method is used for limiting the inrush current.
Higher current might flow when input turn on interval is short.
First inrush current and second inrush current flow. Select input switch and external fuse carefully.

6.3. Variable output voltage (variable constant voltage output setting value)

In the initial state, the output voltage of the power supply is set to the nominal output voltage value.
The output voltage can be set using the built-in output voltage adjustment trimmer or external signals (CV-A terminal external voltage application).
When using the product at a voltage exceeding the rated voltage, it is necessary to derate the output current so as not to exceed the maximum output power.



6.3.1. Variable with built-in output voltage adjustment trimmer

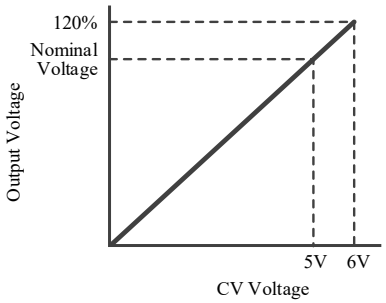
The built-in output voltage adjustment trimmer allows you to change the constant voltage output value setting.
Turning the output voltage adjustment trimmer clockwise, the output voltage will be increased.
For the output voltage variable range refer to specifications (A296-01-01_).

トップに戻る

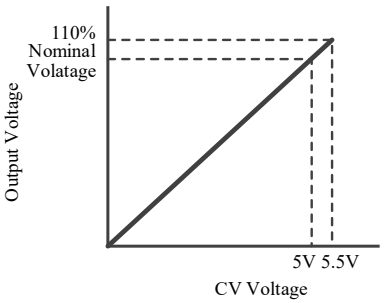
6.3.2. Variable by external power (CV-A terminal external voltage applied)

The constant voltage output value setting can be changed by applying an external voltage in the range of 0-6V or 0-5.5V between the CV-A and AG terminals.
When an external voltage is applied to the CV-A terminal, the output voltage adjustment trimmer setting value will be invalid.
Note that if the output voltage is low, the output ripple may increase, potentially causing the unit to fail to meet the specifications for load regulation.
This phenomenon is influenced by factors such as voltage drop due to wiring length and the load.
Please verify the behavior of this product using the end-use equipment.

◆5V - 48V

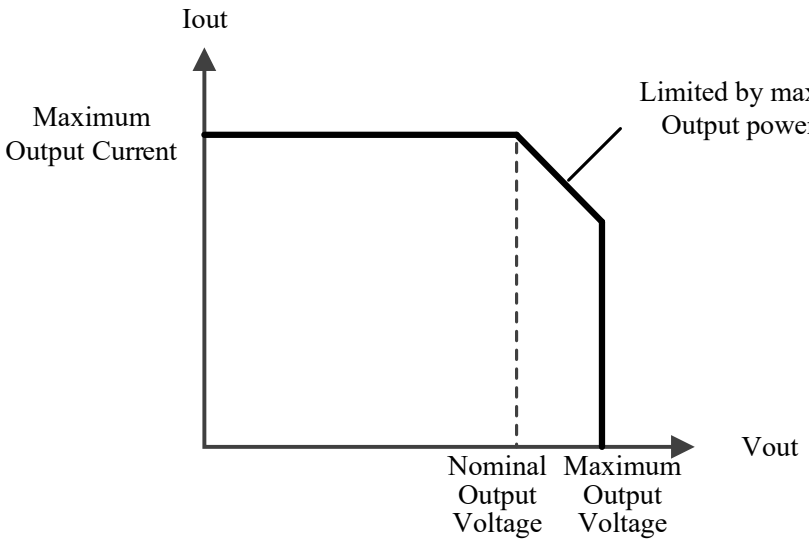


◆60V



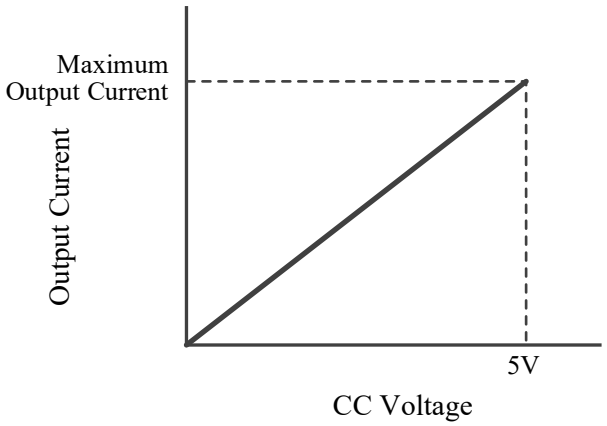
6.4. Variable output current (variable constant current output setting value)

Output current can be set using an external signal (CC-A terminal external voltage application).
In constant current operation, when the output voltage reaches the value set by the built-in volume or external signal (CV-A terminal external voltage application), it switches to constant voltage operation.
When using the product at a voltage exceeding the rated voltage, it is necessary to derate the output current so as not to exceed the maximum output power.



トップに戻る

The constant current output value setting can be changed by applying an external voltage in the range of 0-5V between the CC-A and AG terminals.
Note that if the output current is set to a low value, or if the output voltage drops during constant current operation, the output ripple may increase, potentially causing the unit to fail to meet the specifications for load regulation.
This phenomenon is influenced by factors such as voltage drop due to wiring length and the load.
Please verify the behavior of this product using the end-use equipment.



6.5. Over voltage protection (OVP)

OVP function is output shutdown method and manual reset type.
When OVP is activated, shut off the input, correct the cause of the overvoltage, and then turn it back on after a few minutes.
Or, turn off the remote ON/OFF control signal, correct the cause of the overvoltage, and then turn it back on.
Never apply voltage externally to the output terminal to avoid unit failure.
In case of inductive load, put protective diode in series to the output power line.

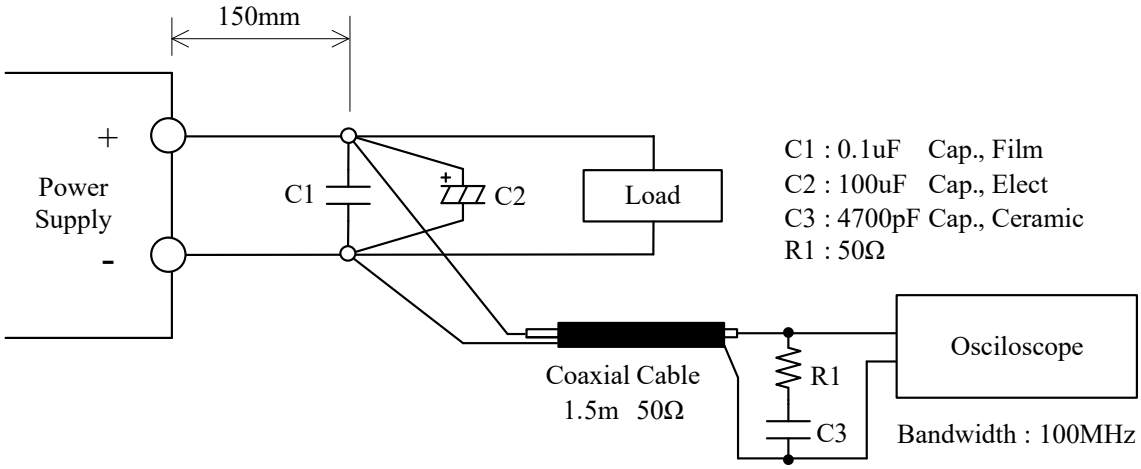
6.6. Over current protection (OCP)

Constant current limit with automatic recovery.
The output will automatically return to normal when the overcurrent condition is resolved.
The 5V and 24V product support delay shutdown function.
If the output current exceeds the rated value for 10 seconds or more, the output will latch and stop.
When the latch stops, shut off the input, correct the cause of the overcurrent, and then turn it back on after a few minutes.
Or, turn off the remote ON/OFF control signal, correct the cause of the overcurrent, and then turn it back on.
Never operate the unit under over current or shorted conditions, which may lead unit damage.

トップに戻る

6.7. Output ripple & noise

The maximum ripple noise voltage value in the specifications is the value measured using the measurement circuit below.
The output ripple cannot be measured accurately if the probe ground lead of oscilloscope is too long.
When load lines are longer, ripple will become larger. In this case, electrolytic capacitor, film capacitor, etc. might be necessary to use across the load terminal.

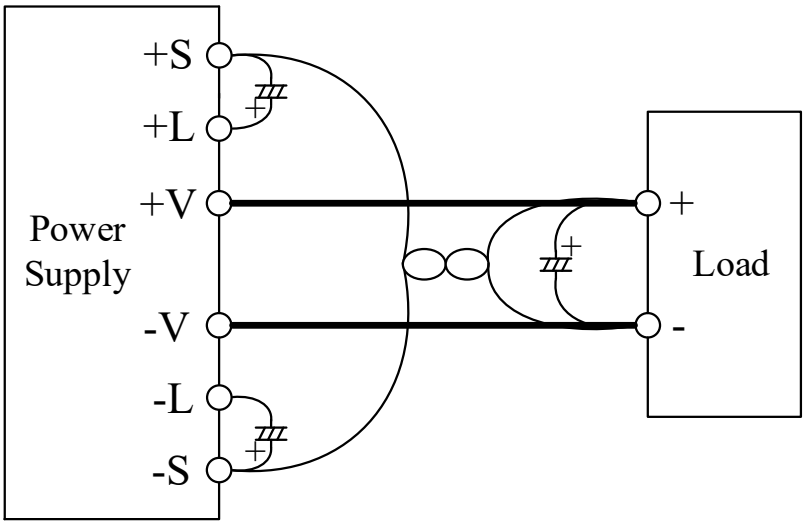


6.8. Remote sensing (+S, -S terminal)

This function compensates voltage drop of wiring from output terminals to load terminals.
Connect "+S" terminal to "+" terminal of load and "-S" terminal to "-" terminal of load with sensing wires.
The total line voltage drop (+ side line and - side line) shall be less than 0.3V.
【Note】The output voltage specification applies to power supply output terminals, not the load terminals.
In case that sensing line is too long, we recommend connecting electrolytic capacitors at the following locations:

1) Across the load terminals,
2) Between “+S” terminal and “+L” terminal,
3) Between "-S" terminal and "-L" terminal.

When not using the remote sensing function, short-connect the "+S" and "+L" terminal, and the "-S" and "-L" terminal.



トップに戻る

6.9. Parallel operation

Three types of parallel connection are possible: parallel operation to increase output current, N+1 redundant operation, connection as a backup power source (1+1 redundant operation).

6.9.1. Parallel operation to increase output current

(A) When using in constant voltage output mode
Connecting CB to CB terminal and AG to AG terminal, the current balancing function activates and output current of each power supply is equivalently supplied to load.
The CB and AG terminals are isolated from the power input circuits.
Wire to CB terminal, AG terminals shall be as short as possible and same length with twist.

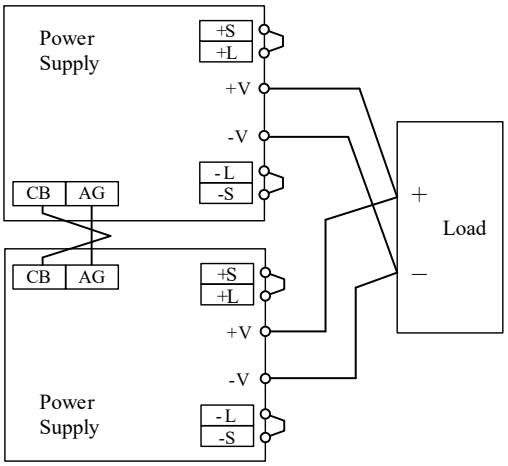
(B) When using in constant voltage output mode
Connecting CV-A to CV-A terminal and AG to AG terminal, the current balancing function activates and output current of each power supply is equivalently supplied to load.
Connecting CB to CB terminal and AG to AG terminal, the current balancing function activates and output current of each power supply is equivalently supplied to load.
The CV-A and CB and AG terminals are isolated from the power input circuits.
Wire to CV-A and CB terminal, AG terminals shall be as short as possible and same length with twist.

(C) When using in constant current output mode
Connecting CB to CB terminal and AG to AG terminal, the current balancing function activates and output current of each power supply is equivalently supplied to load.
The CB and AG terminals are isolated from the power input circuits.
Wire to CB terminal, AG terminals shall be as short as possible and same length with twist.

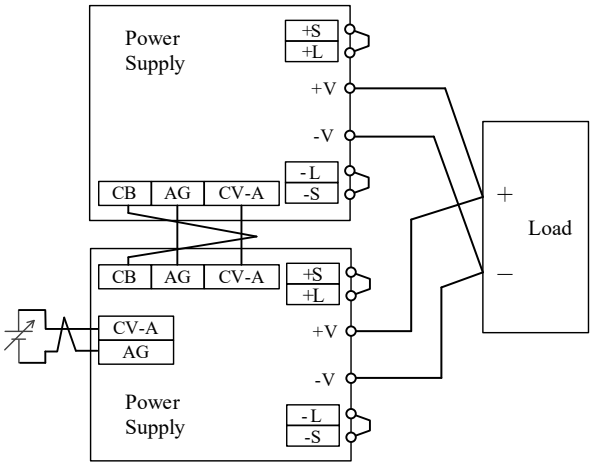
・Adjust the output voltage of each power supply to be same value within 1% or 100mV whichever is smaller.
・Use same length and type of wires for all load lines.
・Parallel operation is possible up to 5 units. Maximum value of output current in parallel is up to 90% of all paralleled models.
・There is a possibility that output voltage dips at dynamic load change.

トップに戻る

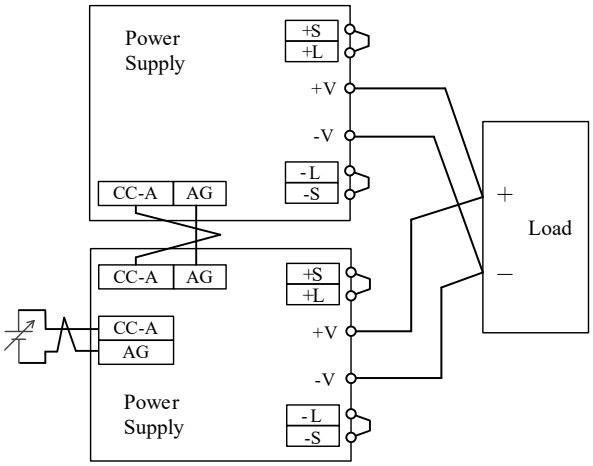
(A) When using in constant voltage output mode



(B) When using in constant voltage output mode(CV-A terminal external voltage applied)



(C) When using in constant current output mode



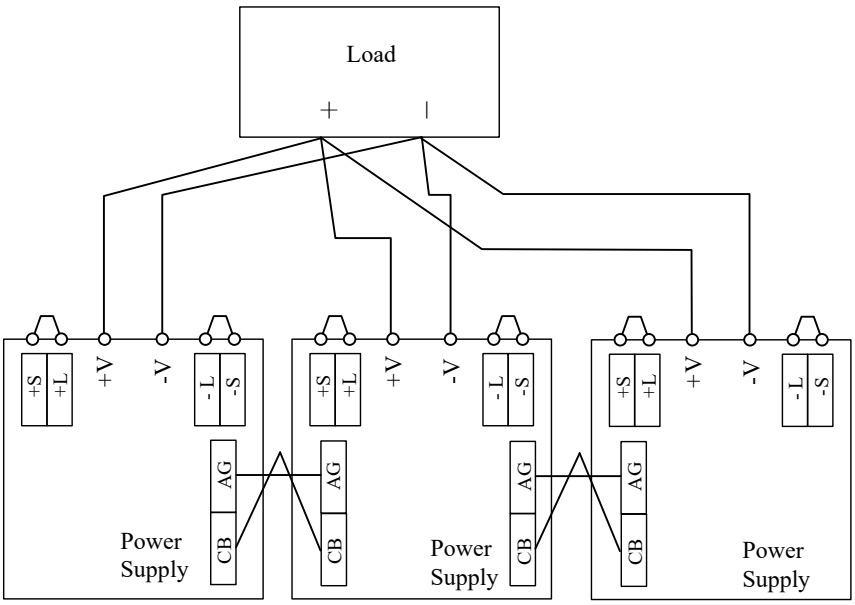
トップに戻る

6.9.2. N+1 redundant operation

In power supply systems that require higher reliability, it is possible to increase system reliability by using N+1 units for a load of N units.
When N+1 units are operating in parallel, even if one unit stops, the load current is automatically shared with the other power supplies to maintain system functionality.

Connecting CB to CB terminal and AG to AG terminal, the current balancing function activates and output current of each power supply is equivalently supplied to load.
This product has a function to disconnect the CB terminal when the power is stopped, which suppresses fluctuations in the output voltage when one unit is stopped.

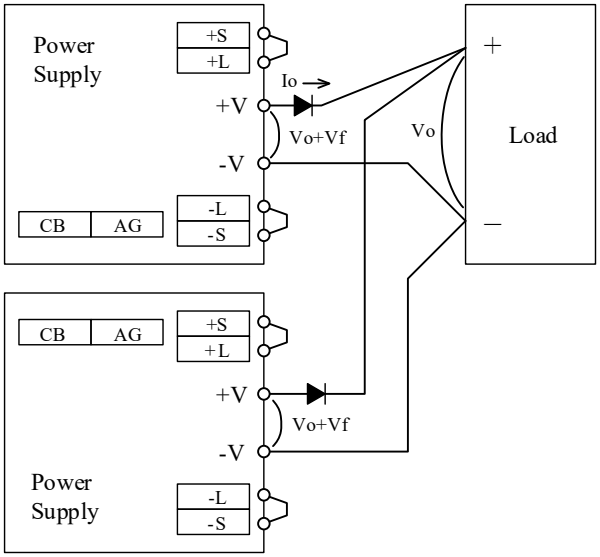
- Wire to CB terminal, AG terminals shall be as short as possible and same length with twist.
- Adjust the output voltage of each power supply to be same value within 1% or 100mV whichever is smaller.
- Use same length and type of wires for all load lines.
- Parallel operation is possible up to 5 units. Maximum value of output current in parallel is up to 90% of all paralleled models.
- There is a possibility that output voltage dips at dynamic load change.
- Even if one unit stops, check that the output current satisfies the formula below using only a normally operating power supply.
  Maximum output current ≦ Rated current per power supply × Number of power supplies operating normally × 0.9
- Redundant operation is not possible with other products.
- When two or more power supplies fail and cannot supply output current, the output voltage may drop and the system may stop.
  If even one power supply is found to be faulty, immediately replace the faulty power supply.
- Disconnect the input voltage before removing or replacing a failed power supply.
- Depending on the failure mode of the power supply, redundant operation may not be possible.
  If you want to perform complete redundant operation, please build a redundant function by adding a diode to the output of the power supply.



トップに戻る

6.9.3. Backup power source (1+1 redundant operation)

・Adjust the output voltage higher by the value of forward voltage drop (VF) of the diode.
*Output voltage and output power should be used within specifications.
・Use blocking diode to prevent reverse current. Diode current rating must be more than output load current.



トップに戻る

6.10. Series operation

Three types of series connection are possible: series operation for increasing output voltage and series operation for plus/minus output.

Note : Ensure that all units must be in operation. (Never use in condition that one of the units is not operated.)
When connected the bypass diode, select a bypass diode with maximum forward current rating more than output load current. And maximum reveres voltage must withstand each power supply output voltage.
There might be a step in the output rise waveform during series operation.

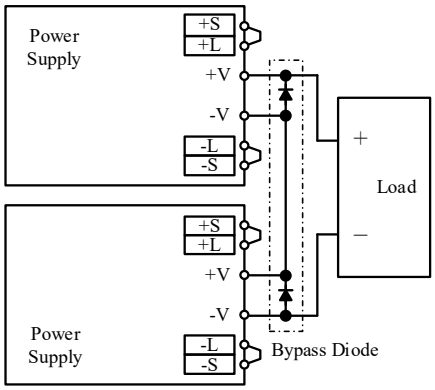
6.10.1. Series operation for increasing output voltage

（A） When using with variable volage via the built-in output voltage adjustment trimmer.
The constant voltage output value can be adjusted using the built-in output voltage adjustment trimmer.
Adjust the output voltage of each power supply to be same value within 1%.

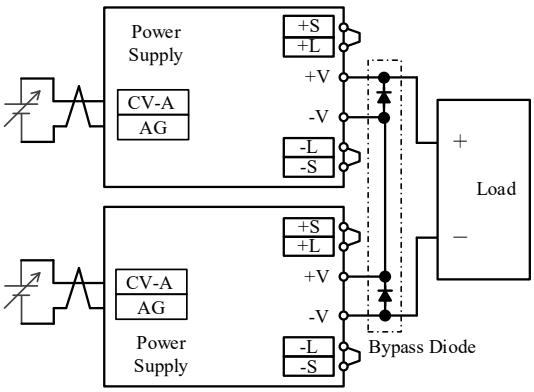
（B） When using with variable voltage via external signal (Apply external power to CV-A terminal)
Apply the external voltage between the CV-A and AG terminals of each power in series operation.
The CV-A and AG terminals are not isolated from the power supply output circuit.
Therefore, CV-A terminals cannot be connected to each other, nor can AG terminals be connected to each other..
Wire to CV-A terminal, AG terminal shall be as short as possible and same length with twist.
When changing the constant voltage output value using the built-in output voltage adjustment trimmer : Connection between CV-A and AG terminals is not required.
When using the product at a voltage exceeding the rated voltage, be careful not to exceed the maximum output power.

・Series operation is possible up to 3 units.

（A）When using with built-in
Output adjustment trimmer



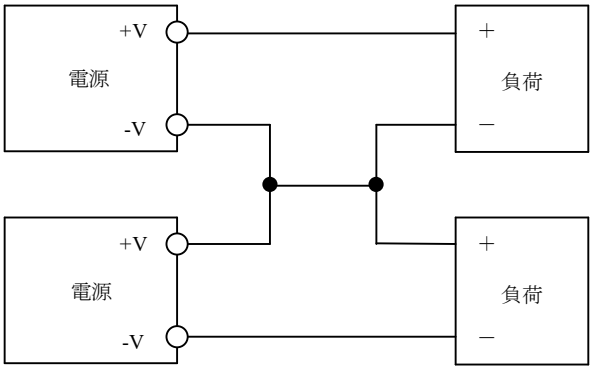
（B）When using with an
external voltage applied



トップに戻る

6.10.2. Series operation for plus/minus output

Series operation is possible for plus/minus output.



6.11. AUX output

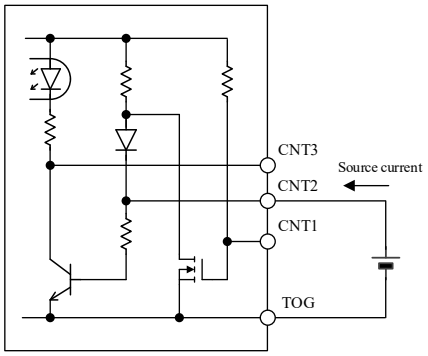
The AUX output voltage is 5V Typ. (4.8 to 5.2V), and the maximum output current is 2A.
The AUX output does not depend on the state of the main output.
AUX output is output even when the main output is in the control OFF state.
Even if the main output is stopped due to a protection function, the AUX will continue to output.
Over Current Protection (OCP) is fold back limit and hiccup mode with automatic recovery.
OCP function operates when the output current exceeds 105% of maximum DC output current of specification.
The outputs will be automatically recovered when the overload condition is canceled.
The OCP setting is fixed and cannot be changed.
If the OCP function is triggered, the main output may shut down.
Never operate the unit under over current or shorted conditions, which may leads damage or insulation failure.
Never apply higher voltage externally to the output terminal to avoid unit failure.
In case of inductive load, put protective diode in series to the output power line.

トップに戻る

6.12. Remote ON/OFF control

Output ON/OFF can be controlled while maintaining the input application state.
Remote ON/OFF control can be controlled in three ways output by applying external voltage, output by shorting between terminals, output by opening between terminals.
If you do not use this function, short the CNT1 or CNT3 terminal and TOG terminal.

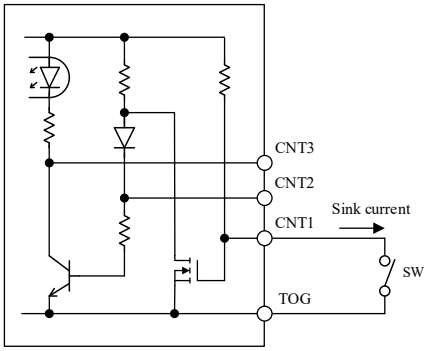
1) Output by applying external voltage

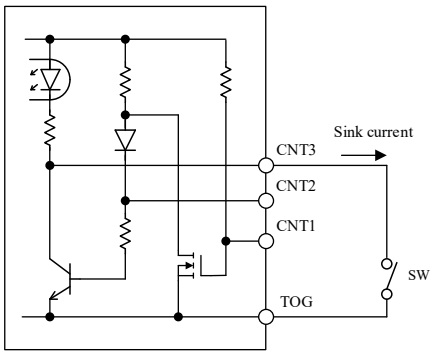


External voltage	Output status
2.4 ~ 12VDC	ON
0 ~ 0.6VDC	OFF

2)Output by shorting between terminals

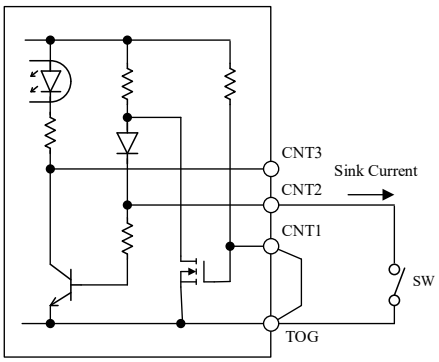
SW	Output status
ON	ON
OFF	OFF





3)Output by opening between terminals

SW	Output status
OFF	ON
ON	OFF



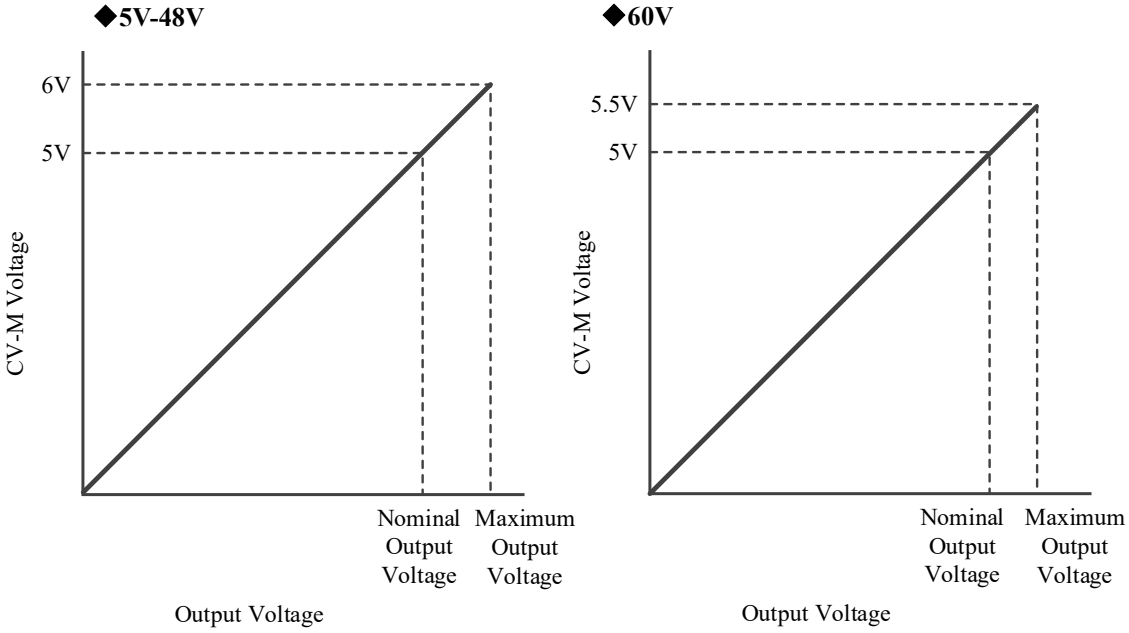
トップに戻る

6.13. Output voltage monitor function

The output voltage can be monitored by measuring the voltage between the CV-M and AG terminals.

- Use a measuring device with an input impedance of 500kΩ or more
- Do not short-circuit between the CV-M terminal and TOG terminal. It will be the cause of the failure.

The relationship between CV-M terminal voltage and output voltage is as follows.

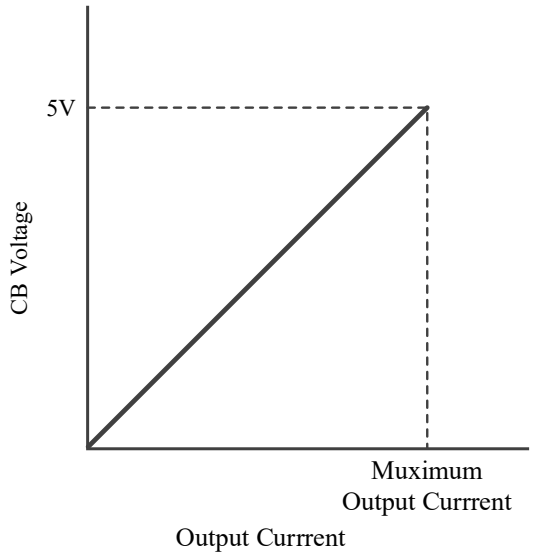


6.14. Output current monitor function

The output current can be monitored by measuring the voltage between the CB and AG terminals.

- Use a measuring device with an input impedance of 500kΩ or more
- Do not short-circuit between the CB terminal and AG terminal. It will be the cause of the failure.

The relationship between CB terminal voltage and output current is as follows.



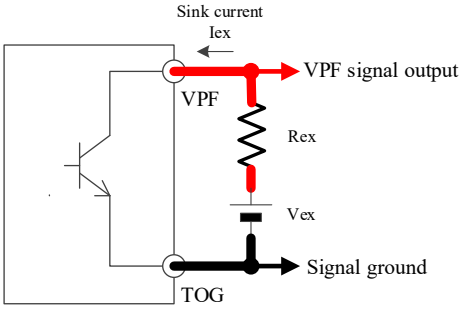
トップに戻る

6.15. Constant voltage output mode voltage shortage alarm (VPF signal)

Detects output voltage drops. At this time, the VPF signal goes high.
Conditions for output voltage drops: when the input voltage drops, during a momentary power outage, the output drops or stops due to overcurrent protection, overvoltage protection, overheating protection, etc., or when the remote control is turned off.
The VPF signal is an open collector output, and the emitter is connected to the TOG terminal.

Note: VPF signal may also be output in the following cases

- When the output voltage is suddenly increased by using the variable output voltage function.
- When the rotation speed of the FAN becomes abnormal or when it stops
- When the output voltage drops due to constant-current output mode operation



Requires a limit on sink current Iex.
Select Vex and Rex so that Iex is within the range of 0.1 to 20mA using the formula below.
Vex is 1V or more and 30V or less.

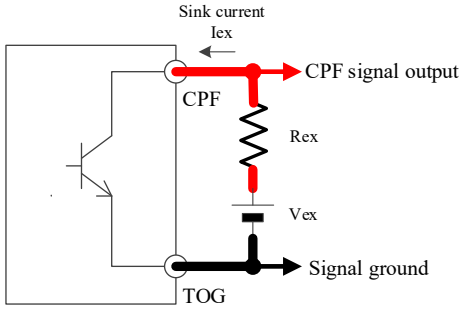
$$Iex = (Vex - 0.3) / (Rex)$$

6.16. Constant current output mode current shortage alarm (CPF signal)

Detects converter oscillation stop. At this time, the CPF signal goes high.
Conditions for output voltage drops: when the input voltage drops, during a momentary power outage, the output drops or stops due to overcurrent protection, overvoltage protection, overheating protection, etc., or when the remote control is turned off.
The CPF signal is an open collector output, and the emitter is connected to the TOG terminal.

Note: CPF signal may also be output in the following cases

- When the output is light load in parallel operation or N+1 redundant operation
- When the output is light load by using the variable output voltage function
- When the output current is suddenly increased by using the variable output current function
- When the rotation speed of the FAN becomes abnormal or when it stops



Requires a limit on sink current Iex.
Select Vex and Rex so that Iex is within the range of 0.1 to 20mA using the formula below.
Vex is 1V or more and 30V or less.

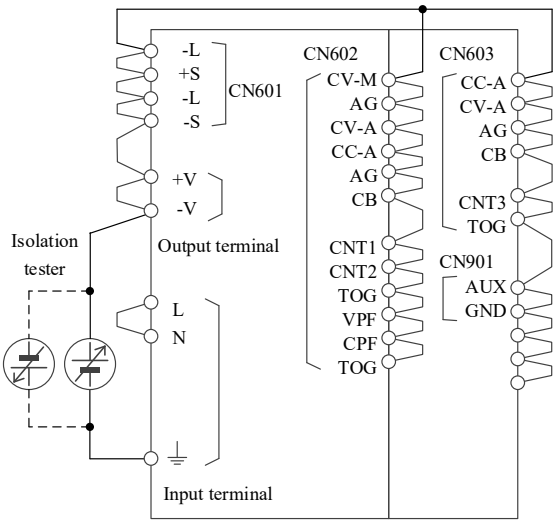
$$Iex = (Vex - 0.3) / (Rex)$$

トップに戻る

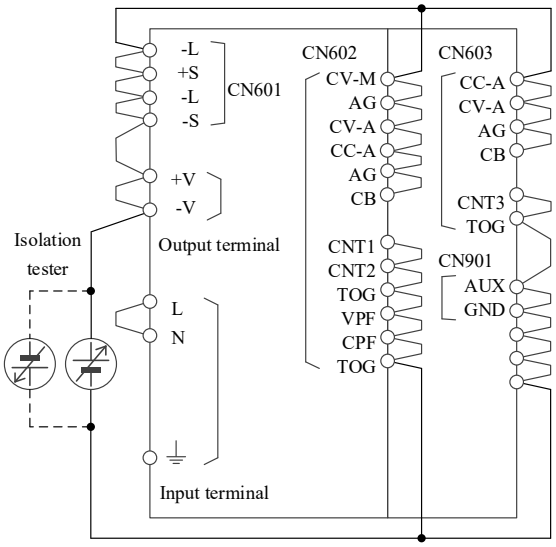
6.17. Isolation test

Isolation resistance between Output - ⏚ terminal is more than 100MΩ at 500VDC.
For safety operation, voltage setting of DC isolation tester must be done before the test.
Ensure that the unit is fully discharged after the test.

■ Output - ⏚ terminal : 500VDC More than 100MΩ



■ Output - AUX/CNT・VPF・CPF terminal : 500VDC More than 100MΩ

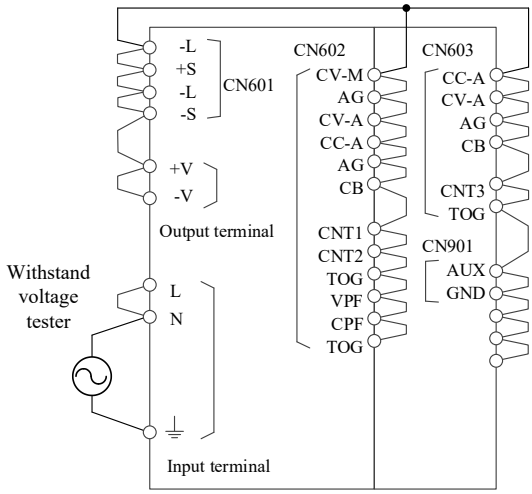


トップに戻る

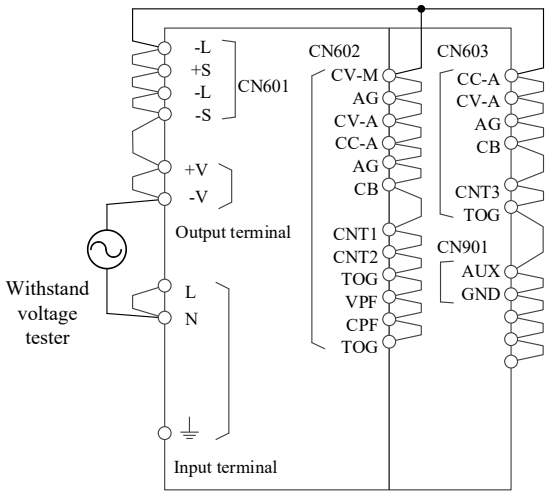
6.18. Withstand voltage

This series is designed to withstand 2.5kVAC between input and ⏚ terminal (FG), 3.0kVAC between input and output, 3.0kVAC between input and signal/AUX/CNT・VPF・CPF terminal, 500VAC between output and AUX terminal, 1.8kVAC between output and ⏚ terminal (FG) and each for 1 minute.
In the withstand voltage tester, set current limit of the withstand voltage tester as follows .
The applied voltage must be gradually increased from zero to test value and then gradually decreased for shut down.
When timer is used, the power supply might be damaged by high impulse voltage at switch on and off timing. Connection as follows.

■ Input - ⏚ terminal :2.5kVAC 1min (20mA)

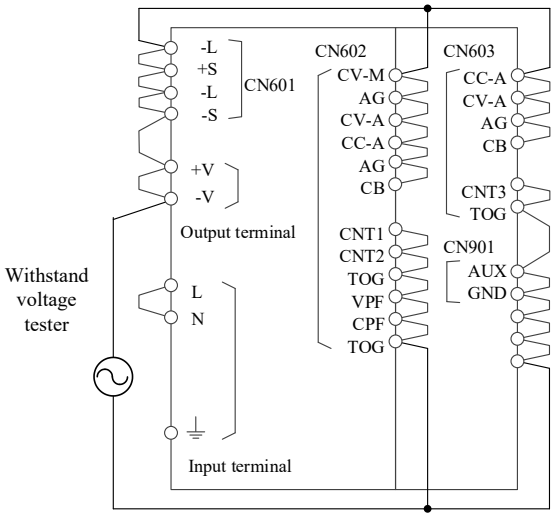


■ Input - Output :3.0kVAC 1min (20mA)
Input - Signal/ AUX/CNT・VPF・CPF terminal :3.0kVAC 1min (20mA)

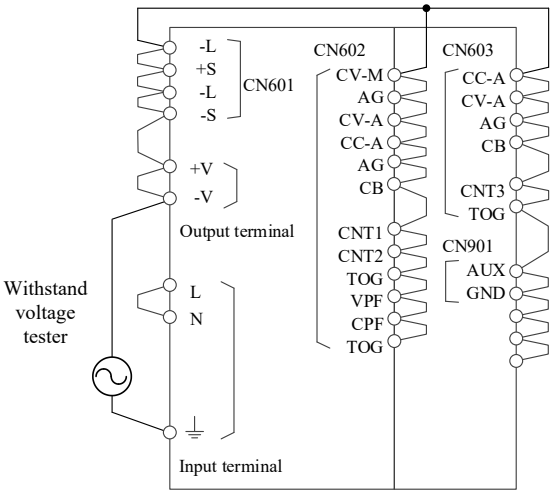


トップに戻る

■ Output - AUX/CNT・VPF・CPF terminal : 500VAC 1min (100mA)



■ Output - ⏚ terminal: 1.8kVAC 1min (100mA)



6.19. Output discharge

Note that because this product has a built-in capacitor, if the input is interrupted in a product with a rated output voltage of 60 V, the output terminals and CN601 will hold the hazardous voltage for a maximum of the following time.
To avoid risk of electric shock, wait the following time.

Model	Capacitor discharge time
HWS650G-60	2 sec

トップに戻る

6.20. Output peak current

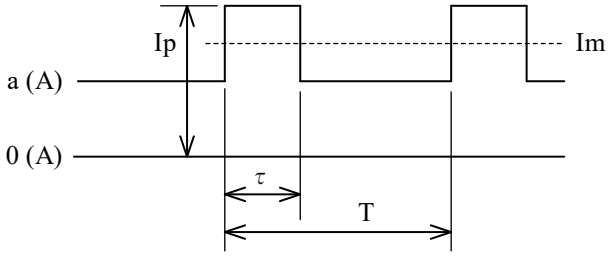
For 24V output products, please meet the following conditions.
Reduce average output current value according to output derating below.

Input voltage range	: AC170V～265V
Continuous peak output time(τ)	: Within 10 seconds
Peak output current(Ip)	: Within specification value
Average output current(Im)	: Within maximum output current (Iav)

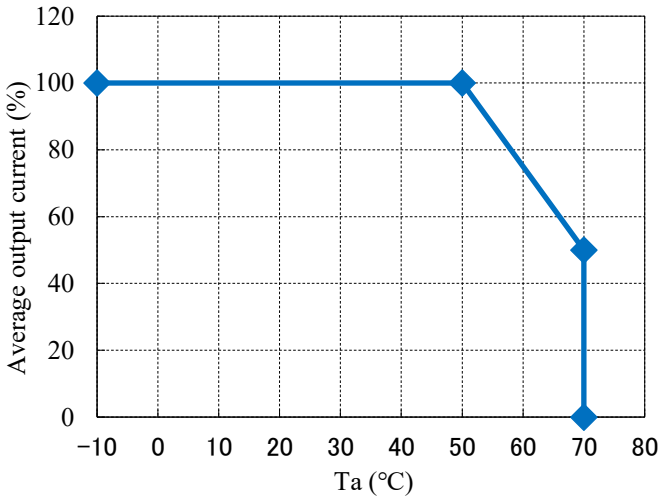
$$Im = \frac{(Ip - a) \times \tau}{T} + a \leqq Iav$$

$$Duty = \frac{\tau}{T} \times 100\ (\%)$$

Duty : up to 35%

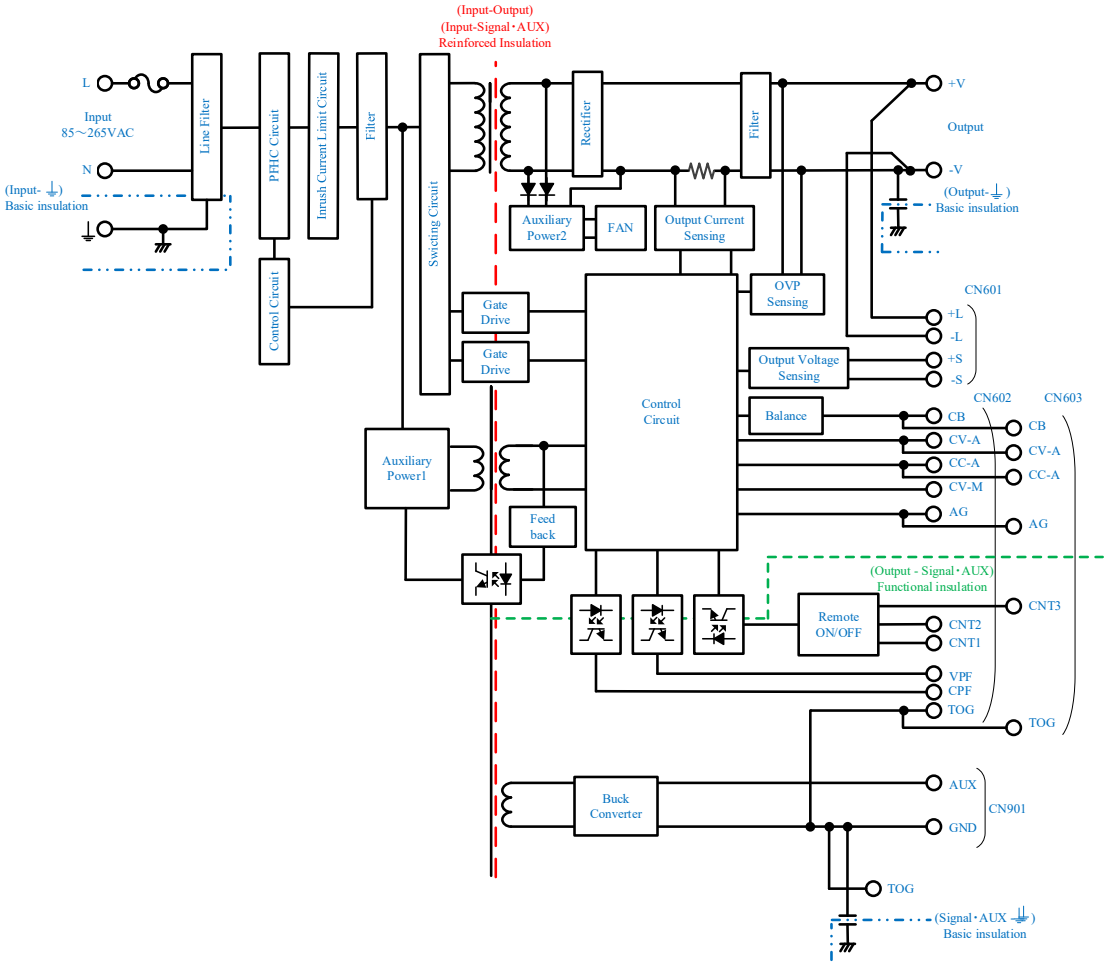


Ip : Peak output current(A)
Iav : Maximum output current(A)
Im : Average output current(A)
τ : Peak current pulse width(sec)
T : Period(sec)



トップに戻る

7. Block diagram

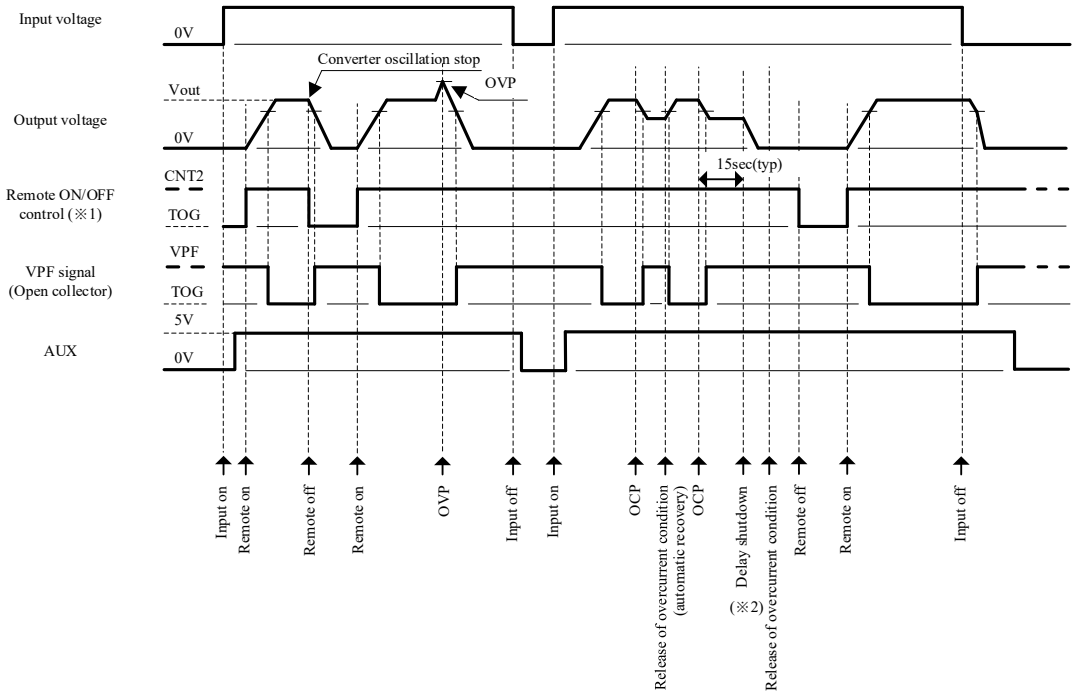


・Circuit topology, switching frequency
PFHC circuit : Active filter 84kHz
Switching Circuit : Full-Bridge converter 67kHz (Primary circuit), 134kHz (Secondary circuit)
Auxiliary power1: Flybuck converter 125kHz
Auxiliary power2: Flybuck converter 400kHz
Buck converter (AUX): Buck converter 500kHz

・Fuse rating : 16A
Parts name : 0216016
Manufacturer name : Littel fuse

トップに戻る

8. Sequence time chart



(*1) Sequence for remote ON/OFF control by applying external voltag
CNT2 to TOG terminal voltage
2.4 ~ 12VDC : Output ON
0.6V or less : Output OFF

(*2) OCP delay shutdown (5V and 24V products)
When the overload persists for more than 10 seconds, the output will latch and stop.

トップに戻る

9. External fuse rating

Refer to the following fuse rating when selecting the external input fuse.
Surge current flows when input turn on. Use slow-blow fuse or time-lag fuse.
Fast-blow fuse can not be used.
Fuse rating is specified by inrush current value at input turn on.
Do not select the fuse according to actual input current (rms.) values.

External fuse rating ： 16A

10. Before concluding that the unit is at fault…

Before concluding that the unit is at fault, make the following checks.

(1) Check if the rated input voltage is connected.
(2) Check if the wiring of input and output is correct.
(3) Check if the wire size is not too thin.
(4) Check if the output voltage control (V.ADJ) is properly adjusted.
(5) Check if the Remote sensing terminal is not opened.
In an open state, the output stability and accuracy will deteriorate.
(6) Check if the output current and output power are not over specifications.
(7) Audible noise can be heard when input voltage waveform is not sinusoidal wave.
(8) Audible noise may be generated from the power supply depending on the frequency at which the load fluctuates.
(9) Check that the remote ON/OFF control terminal is connected as specified.
(10) Check if the built-in fan has stopped.
Check that the fan is not stopped due to foreign matter, dust, etc.
When the fan is stopped, the protection function cuts off the output.
(11) Power supply has ventilating holes on the front and back panels.
Check for ventilation problems due to foreign matter or dust.
(12) When using in constant voltage output mode:
Check that there is no external voltage applied to the CC-A terminal.
It may be operating in constant current output mode.
(13) When using constant current output mode:
Check that there is no external voltage applied to the CV-A terminal.
It may be operating in constant voltage output mode.
(14) Check that the wiring to the signal connector is connected correctly.

トップに戻る

11. The life expectancy

The life of the power supply depends on the life of the built-in aluminum electrolytic capacitor being used and mounted fan. Each life is described in reliability data.
The life of the aluminum electrolytic capacitor varies depending on the method of the load current, and the ambient temperature. Please refer to "Electrolytic Capacitor Lifetime".
The life of the fan depends on the fan intake or exhaust temperature.
Please refer to "Fan Life Expectancy".
Please do not use the product which passed over the life expectancy.
There is a risk of unexpected output shutdown and specifications may not be satisfied.
Please contact us for maintenance or exchange the product which passed over the life expectancy.

12. Warranty period

This product is warranted for a period of 5 years from the date of shipment.
For damages occurring at normal operation within this warranty period, repair is free of charge.

13. CE MARKING / UKCA MARKING

CE MARKING

CE Marking, when applied to a product or packing material for a product covered by this handbook, Indicates compliance with the Low Voltage Directive, EMC Directive and RoHS Directive.

UKCA MARKING

UKCA Marking, when applied to a product or packing material for a product covered by this handbook, indicates compliance with the Electrical Equipment (Safety) Regulations, Electromagnetic Compatibility Regulations and Restriction of the Use of Certain Hazardous Substances in Electrical & Electronic Equipment Regulations.