GUS1000
Instruction Manual

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.
- Product individual notes are shown in the instruction manual. If there is any difference with common notes individual notes shall have priority.

⚠DANGER

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

⚠INSTALLATION WARNING

There is a risk of electric shock, fire or damage, if you do not follow the instructions below.

- When installing this product, ensure that work is done in accordance with the instruction manual. Installation shall be done by service personnel with necessary and appropriate technical training and experience.
- Do not cover the product with cloth, paper and etc. Do not place anything flammable object around the product.
- Do not operate and store these products in environments where condensation occurs due to moisture and humidity.

⚠WARNING ON USE

There is a risk of electric shock, fire, burn or damage, if you do not follow the instructions below.

- Do not touch this product or its internal components while product is in operation, or shortly after shutdown.
- Prepare for the unexpected, keep your face and hands away from the product while it is in operation.
- Do not make unauthorized change to this product or remove the cover. We will not be held responsible if the product was modified, changed or disassembled.
- Do not use this product under unusual conditions such as emission of smoke or abnormal smell and sound etc. Please stop using it immediately and shut off the product. In such cases, please contact us.
- Do not attempt any repair by yourself, as it is dangerous for the user.
  This product will be repaired by our company or an authorized agent designated by our company.
- Please do not use products that have been dropped or subjected to impact.
- Please use within specifications standards for input voltage, output current, output power, ambient temperature, humidity, etc.
- 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).
- It is important that this product must not be used in hazardous environments or facilities such as nuclear power control system or life support equipment without our written consent.
- Connect together ⏚ Earth terminal of the product and the ground terminal of the equipment for safety and noise reduction.

⚠CAUTION ON MOUNTING

- Ensure connections to input/output terminals are correct as indicated in the instruction manual before switching on.
- Please use the wires as short and thick as possible.
- Do not use this product in special environment with strong electromagnetic field, corrosive gas (hydrogen sulfide, sulfur dioxide, etc.) 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 properly be ventilated.
- Please shut down the input when connecting input and output of the product.
- When installing in environment where conductive foreign, dust and liquid may be present, please take care to avoid penetration of these foreign material in the power supply by installing filter, to prevent trouble or malfunction.
- This product have a built-in fan. Please do not block the intake and exhaust fun of the power supply.

⚠CAUTION ON USE

- 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.
- Please note that the built-in fuse may not operate depending on the input wiring and input line conditions.
- Please insert a fuse at the input, taking into account inrush current values, to prevent smoke, fire during abnormal operation, or to comply with various safety standards, for products without built-in protection circuits (protection elements, fuses, etc.). Please refer to the instruction manual when selecting a fuse.
- Provide countermeasure for prevention of lightning surge voltage as there is risk of damage due to abnormal voltage.
- Parts with lifetime specifications (built-in fan, electrolytic capacitor, etc.) are required to be replaced periodically. Set the overhaul period depending on the environment of usage and request a component replacement to our company. Also, note that there are cases when EOL products cannot change component.
- Take care not to apply abnormal voltage to the output. It might cause failure, smoke or fire.

⚠OTHER NOTES OF CAUTION

- If your fingers come into direct contact with the metal edges, there is a risk of injury. When handling, please take sufficient care, such as wearing protective gloves, and work carefully.
- When disposing product, follow disposal laws of each municipality.
- Published EMI (CE, RE) or immunity is the result of measuring the power supply unit under 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.
- When exporting our products, apply for necessary permissions as required by rules and regulations of Foreign Exchange and Foreign Trade Control Act.
- Take note that traces of sheet metal processing be left in our power supplies. Also, partial discoloration or oxidation may be observed on the sheet metal surface of the product depending on storage conditions, such as in warehouses, but this does not affect the characteristics or reliability of the product.
- Catalogue or contents of the instruction manual may be changed without a prior notice. Refer to latest catalogue or instruction manual.
- Reproduction or reprinting the instruction manual or its portion is forbidden without our permission unless with TDK-Lambda authorization.

STORAGE METHOD AND STORAGE PERIOD BFFORE IMPLEMENTATION.

- Please keep the product in carton box.
- Please do not apply excessive vibration, shock or mechanical stress to the product.
- Please keep away from direct sunlight.
- For storage temperature and humidity, the following conditions shall be used as a guideline :

  Temperature range : 5℃～30℃

  Humidity range : 40%～60%RH

  Avoid places where its temperature and humidity can change drastically.

  It might cause product degradation or condensation on the product.
- < Soldering and PCB mounted products >

  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 approval specifications.

  < The product is used an aluminium electrolytic capacitor >

  There is tendency that the leakage current of an aluminum electrolytic capacitor may increase when not use for a long time. This phenomenon can be improved by applying voltage to the aluminum electrolytic capacitor to reduce the leakage current through the self-recovery effect of the electrolyte.

  As a guide if the products have been stored for longer than one year, it is recommended to turn on the product for at least 30 min at no load condition.

  < Criterion of warm up voltage condition >

  (1) Implementation period : 1 year or above after the delivery

  (2) Electrical condition

  Input voltage : Nominal

  Load : 0A

  Ambient temperature : Normal temperature

  Time : 30 minutes or more

1. Model name identification method

GUS 1000 – 12 / □

Option (*1)
Rated Output Voltage
Output Power type (actual output power refer to the specification)
Series Name.

Note (*1) Blank : Standard model.
/R : Sub-model with remote ON/OFF control
/CO : Sub-model with coating on solder side of PCB
/CO2 : Sub-model with coating on both sides of PCB

For "/CO" and "/CO2" models, to improve resistance against humidity and dust environment, solder side or both sides of assembled PCB are coated. However, complete effect is not guaranteed because some areas on the board are not coated.

2. Terminal Explanation

GUS1000

① L : Live line of input terminal (Fuse in line) (M3 screw).
② N : Neutral line of input terminal (M3 screw).
③ ⏚ : Earth terminal (M3 screw).
④ +V : Positive terminal of output voltage (M4 screw).
⑤ -V : Negative terminal of output voltage (M4 screw).
⑥ LED : Output monitoring indicator (Green LED).
⑦ VR51 : Output voltage adjustment trimmer.
The output voltage rises when the trimmer is turned clockwise.

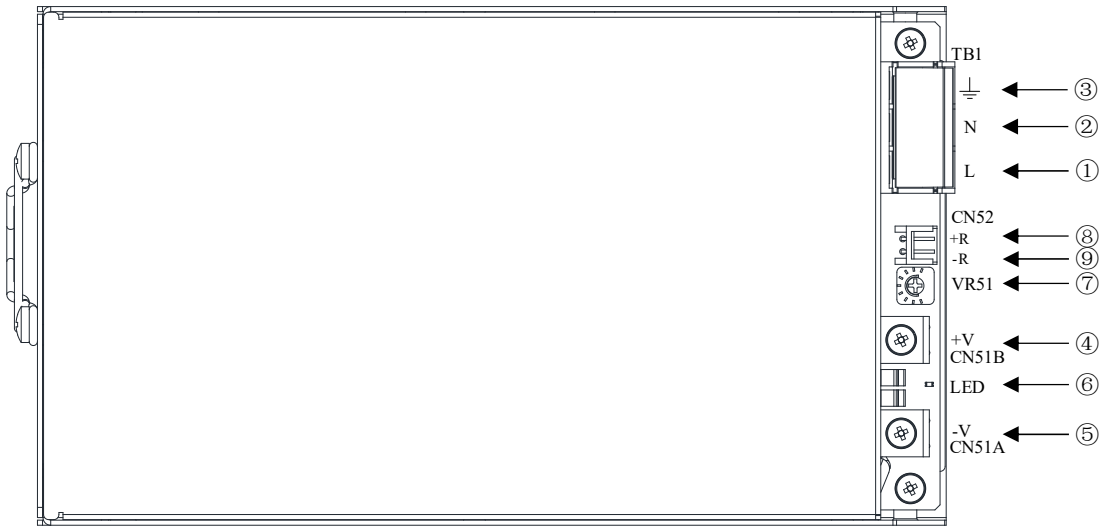
GUS1000/R

⑧ +R : Positive terminal of remote ON/OFF control.
⑨ -R : Negative terminal of remote ON/OFF control.

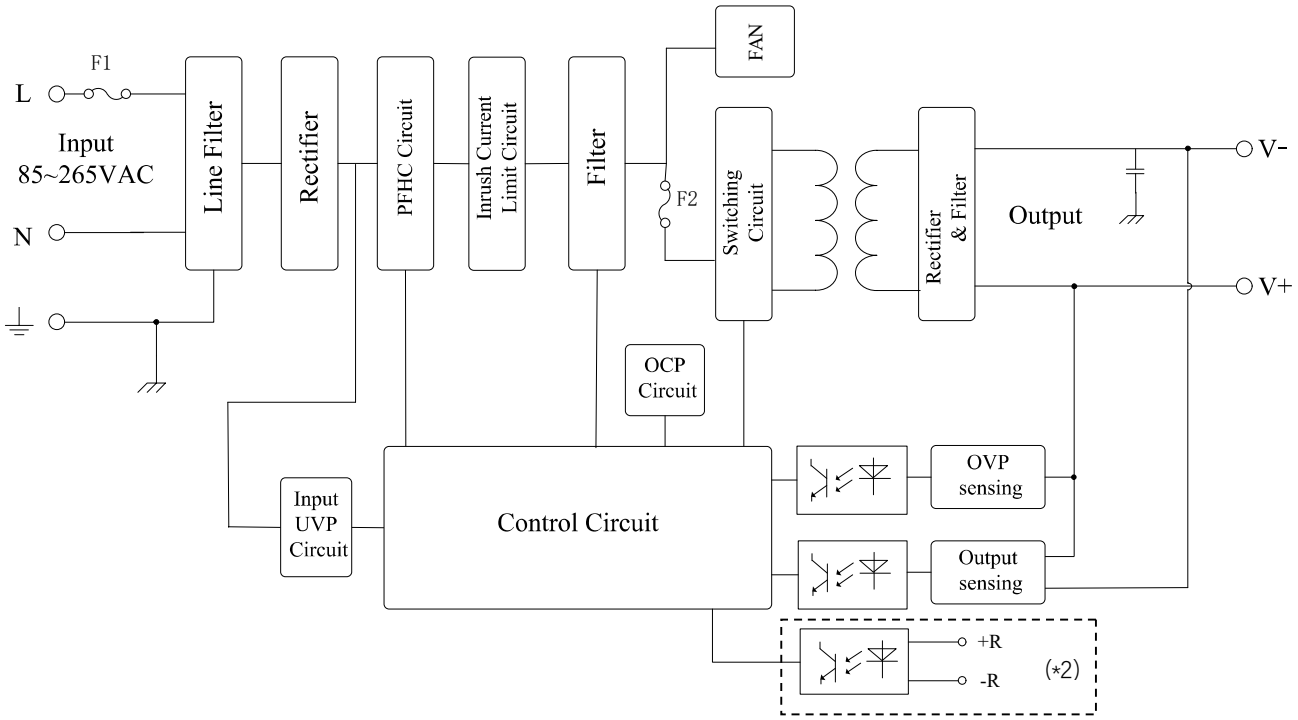
*Remote ON/OFF control Connector (JST)

Connector	Housing	Terminal Pin
S2B-EH(LF)(SN)	EHR-2	SEH-001T-P0.6

Hand Crimping Tool : YRS-260(JST) or YC-260R(JST).
Use maker recommended crimping tool.
Matching housings and pins are not included in product.



3. Block Diagram

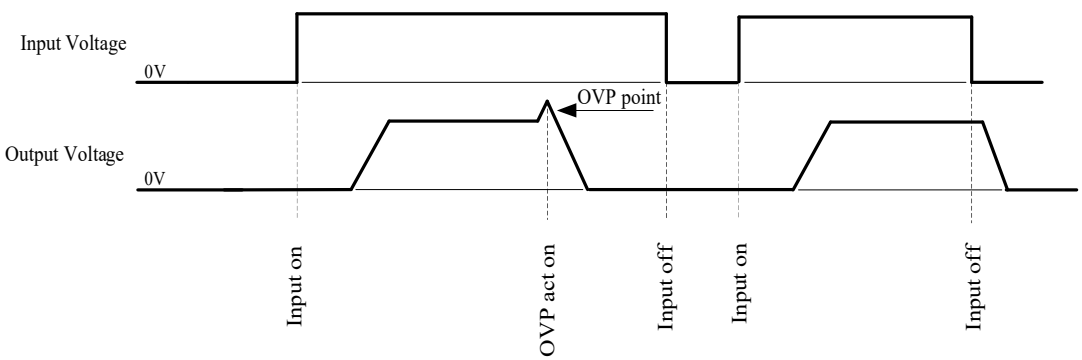


- Fuse rating
  F1 : AC250V, F16AH
  F2 : DC500V, 8A
- Circuit topology, switch frequency
  PFHC circuit: active filter 65kHz (Typ).
  Output circuit: LLC resonant 50k~300kHz.

Note (*2): Block in dash box is with /R model, standard model doesn't have this block.

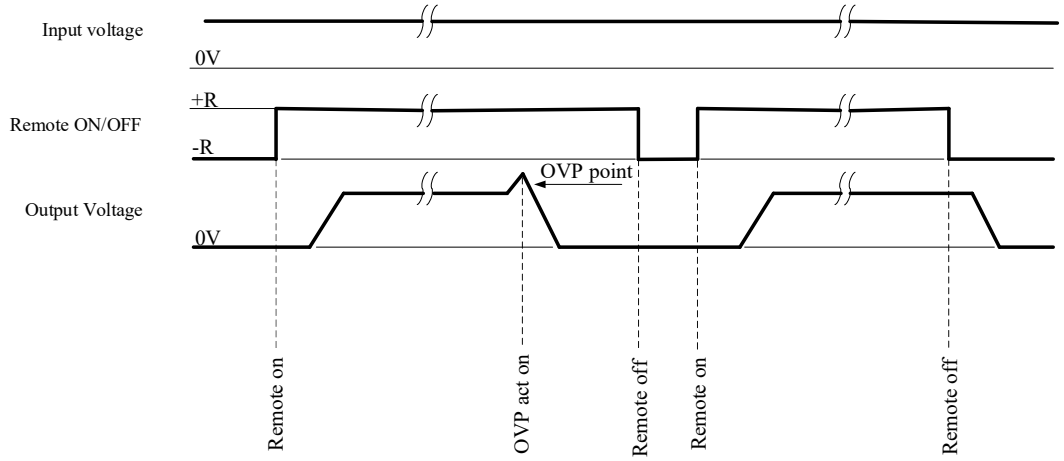
4. Sequence time chart

Input voltage ON/OFF and output OVP recovery sequence time chart



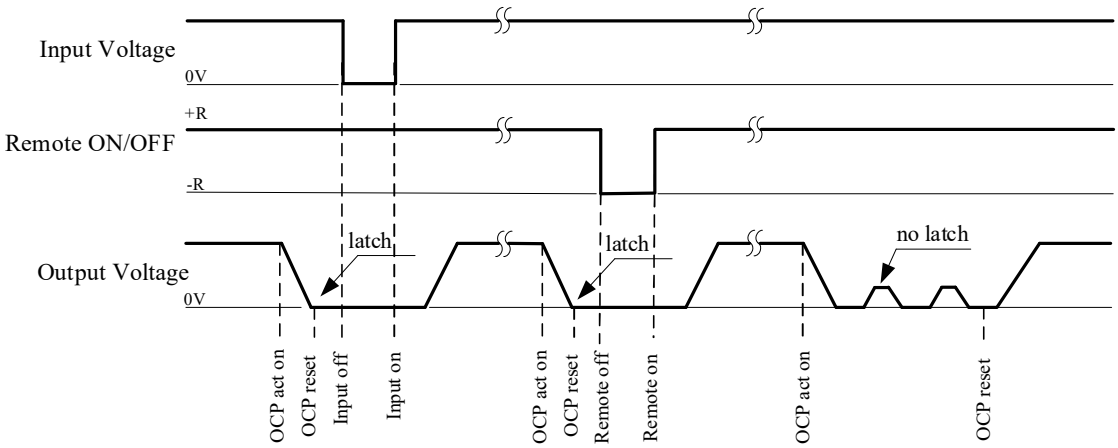
Remote ON/OFF and output OVP recovery sequence time chart

Note: Remote ON/OFF function is with /R model, and external driving voltage is needed.



Output OCP (latch and not latched) recovery sequence time chart

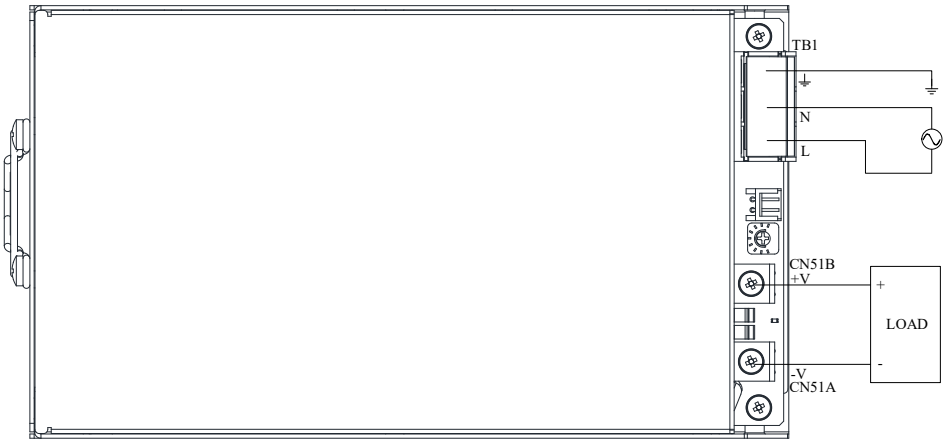
Note: Remote ON/OFF function is with /R model, and external driving voltage is needed.



5. Connection 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.
- Connect ⏚ terminal and mounting holes to earth (frame ground of the equipment etc.) by thick wire for safety and improvement of noise sensitivity.



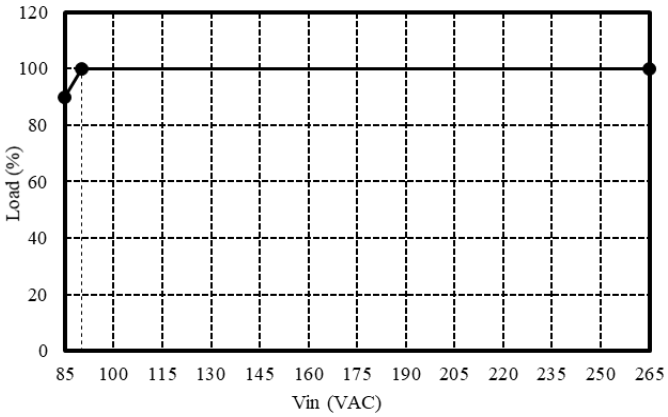
Recommended torque for M3 screws of TB1 : 0.5N·M ~ 1N·M (5.1kgf·cm ~ 10.2kgf·cm).
Recommended torque for M4 screws of CN51A and CN51B : 1.18N·M(12kgf·cm) MAX.

6. Explanation of Function and Precautions

6-1. Input Voltage Range

Input voltage range is single phase 85-265VAC(47-63Hz). Never operate the unit out of the specified input voltage range to avoid unit failure. For cases where conformance to various safeties required, input voltage range will be 100-240VAC (50-60Hz). If input voltage is less than 90VAC, output power need to be derated.

Derating curve of the input voltage



INPUT VOLTAGE (VAC)	LOAD (%)
85	90
90~265	100

6-2. Output Voltage Range

Output voltage is set at the nominal value at shipment.
Output voltage can be adjusted by the V.ADJ trimmer (VR51), the output voltage setting should be within the range in the specifications. Turning the trimmer clockwise, the output voltage will be increased. Please note if the output voltage is increased excessively, over voltage protection (OVP) function may be triggered and output will be shut down. Furthermore, when increasing the output voltage, output current should be reduced so that the output power does not exceed the maximum output power in the specifications.

6-3. Inrush Current

Power thermistor is used for limiting the inrush current. Higher current will flow at higher ambient temperature or input re-power on. Please select input switch or external fuse carefully. The inrush current value specified in the specification is under cold start condition (at 25℃).

6-4. Over Voltage Protection (OVP)

The OVP function (Inverter shut down method, manual reset type) is provided. Please refer to the specification for OVP trip level. When OVP is triggered, the output will be shut down.
Two methods to recovery from OVP, one is to turn off the input of power supply for a few minutes, and then re-power on, the other is to remote off, and then remote on again (Remote on/off function is with /R model, standard model doesn't have remote on/off function).
The OVP setting is fixed and can not be adjusted externally. Pay attention not to 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.

6-5. Over Current Protection (OCP)

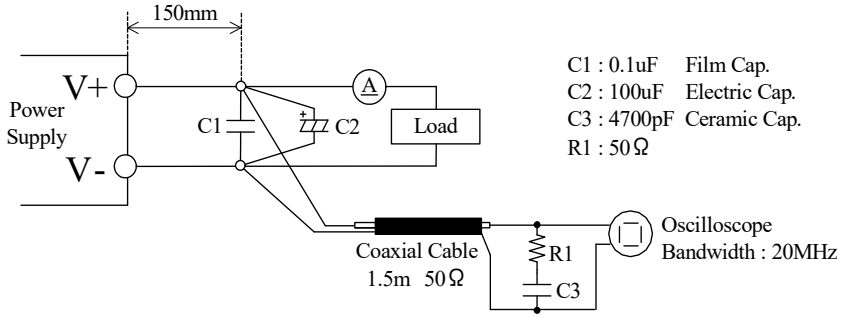
The OCP is hiccup mode with automatic recovery.
The outputs will be automatically recovered when the overload condition is removed, however the outputs may be latched off when shorted condition happens. Please refer to the specification for OCP trip level. Never operate the unit under over current or shorted conditions, which may cause the unit damage. OCP setting is fixed and cannot be adjusted externally.

6-6. Over Temperature Protection (OTP)

Over temperature protection function is provided.
When ambient or internal temperature rises abnormally, over temperature protection function operates and output will be shut down. After protection, remove the input and cool it down to reset over temperature protection, and then re-input.
Over temperature protection function operates at out of the specification area.
This function may not activate or cannot avoid power supply damage depending on the situation.

6-7. Output Ripple & Noise

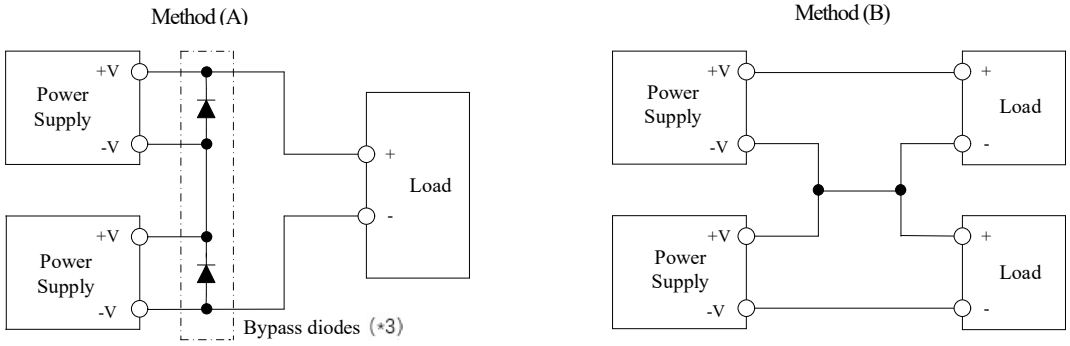
The measurement circuit of the output ripple and noise in the specifications is shown below. If the load wires are longer, the ripple and noise will be higher. In this case, electrolytic capacitor, film capacitor, etc. might be necessary to be used across the load terminal. The ground lead of probe should be short to avoid the noise interference.



C1 : 0.1uF Film Cap.
C2 : 100uF Electric Cap.
C3 : 4700pF Ceramic Cap.
R1 : 50Ω

6-8. Series Operation

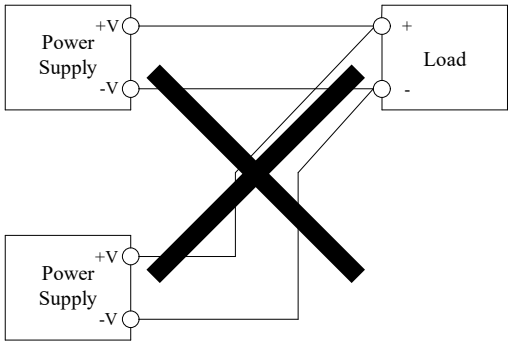
For series operation, either method (A) or (B) is possible.



Note: In case of method (A), it is recommended to connect the bypass diodes (*3), power supply might be damaged without bypass diodes.
Please select a bypass diode with maximum forward current rating more than output load current. And maximum reveres voltage must withstand output voltage of each power supply.
Series operation is possible without bypass diode, but make sure all units must be in operation.
(Never use in condition that one of the units is not operated.)

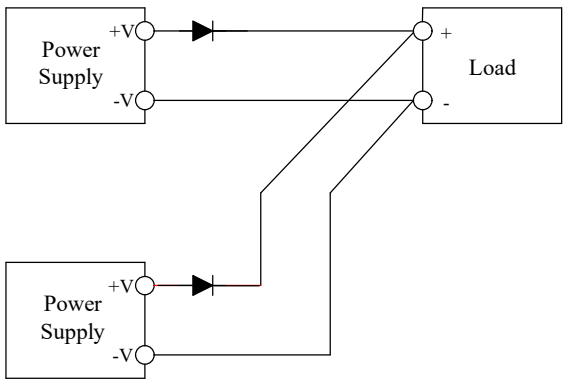
6-9. Parallel Operation

(A) To increase the Output Current is not possible.



(B) Operation as a Backup System is possible.

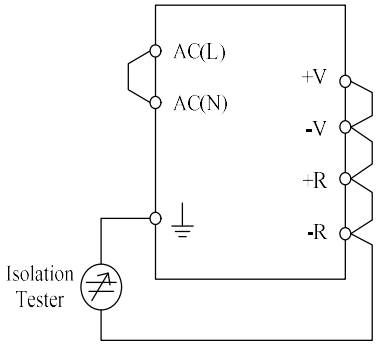
1. Adjust the output voltage higher to compensate the forward voltage drop (VF) of the diode.
2. Adjust each power supply output to same voltage.
3. Output voltage and output power should be used with specifications.
4. Use blocking diode to prevent reverse current. Diode current rating must be more than output load current.



6-10. Isolation Test

Isolation resistance between Output and ⏚ 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.

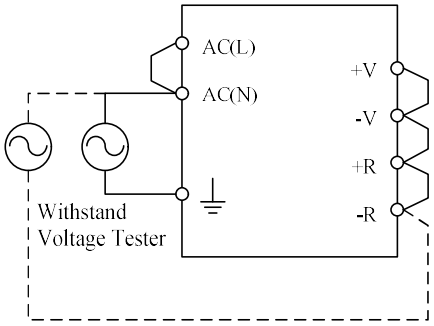
■ Output - ⏚ terminal : 500VDC More than 100MΩ



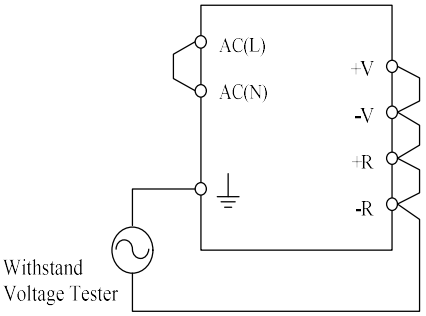
6-11. Withstand Voltage Test

GUS1000 is designed to withstand 3.0kVAC between input and output, 2.0kVAC between input and ⏚ terminal and 500VAC between output and ⏚ terminal each for 1 minute. When testing withstand voltage, set current limit of the withstand voltage test equipment at 20mA (Output – ⏚:100mA). The applied voltage must be gradually increased from zero to the testing value and then gradually decreased for shut down. When timer is used, the power supply may be damaged by high impulse voltage at switch on and off timing. Connect input and output as follows.

Input – Output (Dashed line): 3kVAC, 1 minute (20mA)
Input – ⏚(Solid line) : 2kVAC, 1 minute (20mA)

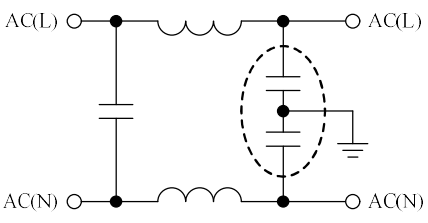


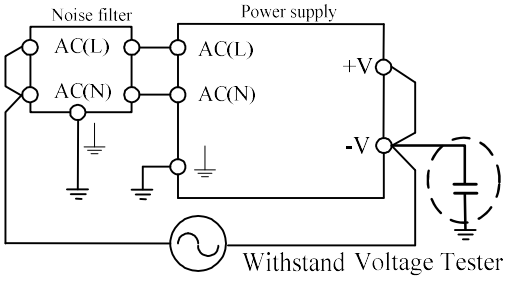
Output – ⏚:500VAC, 1 minute (100mA)



Instructions for using the power supply in customer's system

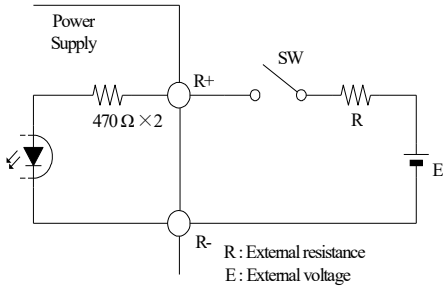
1. If the output of power supply is connected to ⏚ in the application, there is no need to check the withstand voltage between output and ⏚.
2. In case of using external noise filter, capacitance between input and ⏚ might be increased. When testing withstand voltage between input and output, there is a possibility exceeding withstand voltage between output and ⏚ (500VAC). Please check the voltage between output and ⏚. If the voltage exceeding withstand voltage, please add external capacitor between output and ⏚. It can decrease the voltage.





6-12. Remote ON/OFF Control

Remote ON/OFF control function is provided on option model /R.
Using this function allows the user to turn the output on and off without having to turn the AC input off and on. It is controlled by the external voltage applied to +R and -R. This circuit is in the secondary side of the power supply unit and is isolated from the output of power supply unit.
Never connect to primary side.



The control mode is shown below

+R & -R terminal condition	Ouput condition
SW OFF (Lower than 0.5V)	OFF
SW ON (Higher than 4.5V)	ON

External voltage : E	External resistance : R
4.5~9VDC	No required
9~20VDC	1.5kΩ
20~30VDC	4.7kΩ

7. Mounting Method

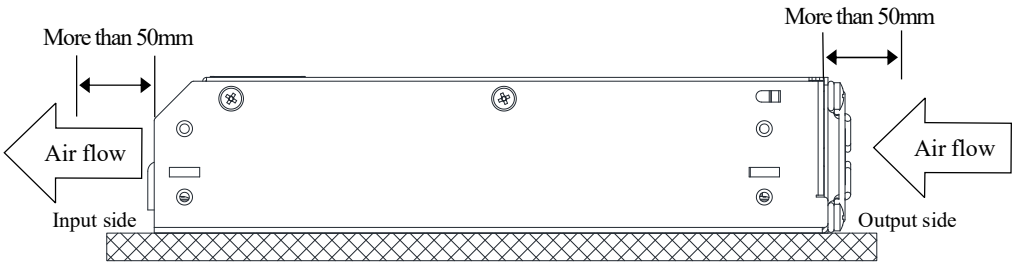
7-1. Mounting Method

(1) These models are forced air cooling type power supply.
This power supply has ventilating holes. Keep a space more than 50mm between front side and back side of the power supply from the peripheral parts.

(2) The maximum allowable penetration of mounting screws is 4.0mm.
Incomplete thread of mounting screw should not be penetrated.

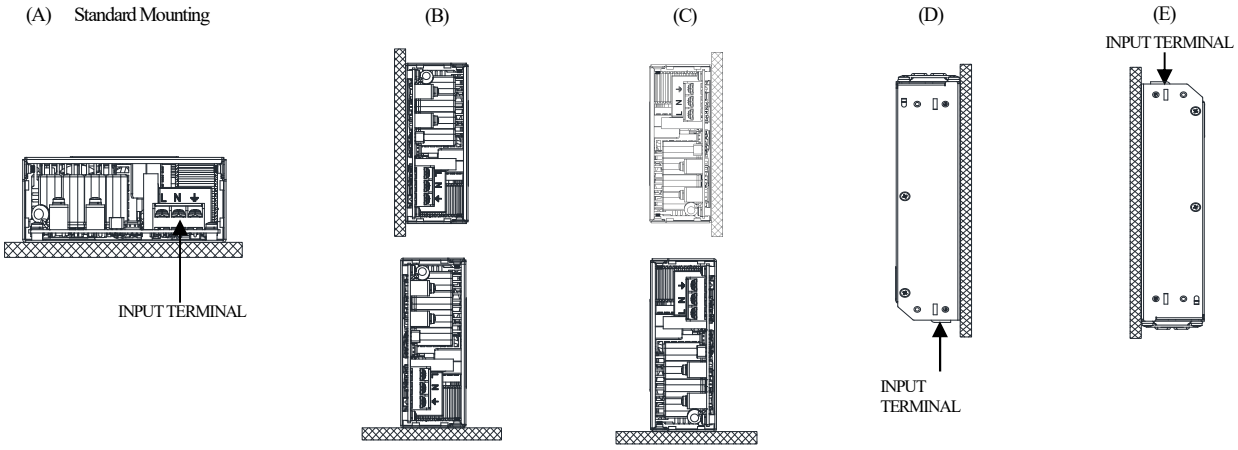
(3) Rear mounting from bottom side with 4*M3 screws is recommented to comply the vibration and shock specification.
Recommended torque for mounting screw: M3 screws : 0.49N·m (5.0kgf·cm)

(4) Recommend to connect mounting hole to protective ground of system.

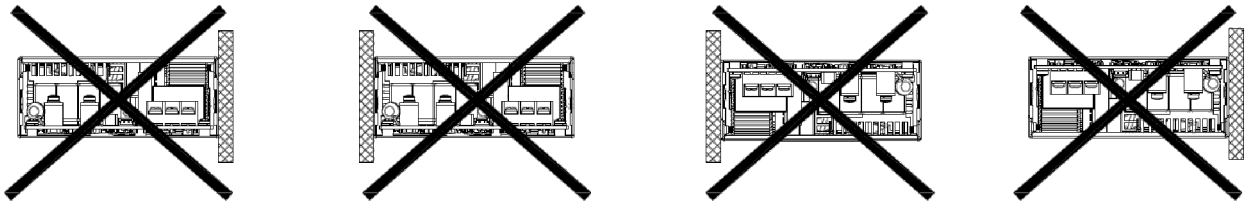


7-2. Mounting

The standard mounting is direction (A). Direction (B), (C), (D) and (E) are also possible. Please contact us for other directions.



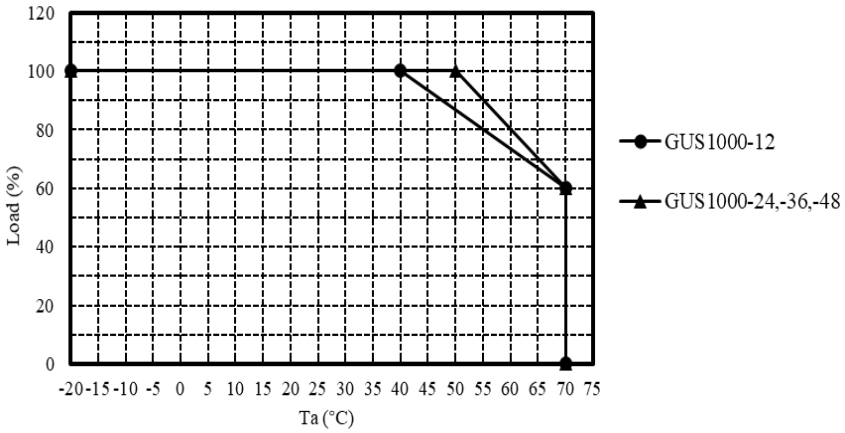
Never use as mounting direction shown below :



7-3. Output Derating

Make sure that the specified temperature range is maintained. Refer to the output derating below. Load (%) of derating curve indicates output power.
Note: Output derating versus input voltage should be considered.
Please refer to the output derating versus input voltage curve 6-1 for detail.

Output Derating versus Operating Ambient Temperature (Ta)



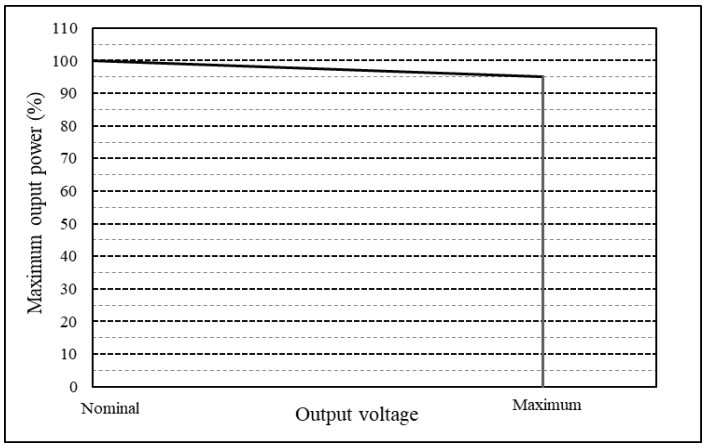
GUS1000-12

Ta (°C)	Load (%)
-20 ~ +40	100
70	60

GUS1000-24, -36, -48

Ta (°C)	Load (%)
-20 ~ +50	100
70	60

Output Power Derating versus High Output Voltage



Output voltage	Maximium Output Power(%)
Nominal output voltage	100
Maximum output voltage	95

Note： The maximum output voltage of each models.

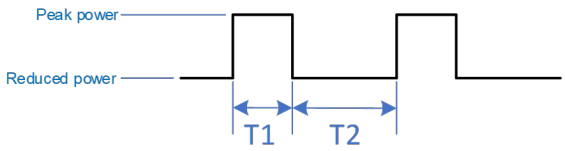
Model	Maximum Output Voltage
GUS1000-12	12.6V
GUS1000-24	25.9V
GUS1000-36	38.8V
GUS1000-48	51.8V

Peak Output Power

Peak output power is available.
For peak output power using, the RMS power should not be higher than the Maximum Output Power (load derating versus Input voltage, Operating temperature and high output voltage should be considered), and the maximum duty of peak power (40%) and maximum peak load time (4 seconds) should be limited too.

Below is typical application:

1. RMS power is calculated using the following formula:
   RMS power = ((peakpower^2 x T1 + reducedpower^2 x T2)/(T1 + T2))^1/2
   Where T1 = peak power time on in seconds.
   T2 = reduced power time on in seconds.
2. Peak output power up to 4 seconds is allowed.
   T1 ≦ 4 s.
3. Maximum duty of peak power should be less than 40%.
   T1/(T1+T2) ≦ 40%

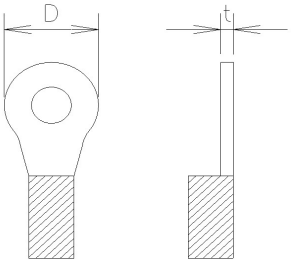


8. EMC and Wiring Method

This power supply is primarily designed and manufactured to be used and enclosed in other equipment. The installation, wiring, grounding and end application of the switching power supply in the equipment system may influence its EMC characteristics. Therefore, the EMC performance has to be tested on end system level.
Additional filtering may be required depends on application and installation methods.
(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.
(2) Remote ON/OFF control lines shall be twisted or shielded, and separated from the output lines.
(3) Noise can be eliminated by attaching a capacitor to the load terminals.
(4) The recommended wire type, torque and crimp-type terminal :

Recommended torque	Recommended crimp-type terminal		
	D (MAX)	t (MAX)	Mounting pieces (MAX)
Input terminal M3 Screws 0.50N·m (5.1kgf·cm) ~ 1N·m (10.2kgf·cm)	6.5mm	1.0mm	1 piece
		0.8mm	2 pieces
Output terminal M4 Screws 1.18N·m (12.0kgf·cm) Max.	——		

Note: For recommended wire type, refer to wire maker recommended allowable current and voltage drop.
Especially for 12V models, output current is large, thick diameter wire is recommended.
Recommended wire type and crimp-type terminal for GUS1000 vary depending on use conditions. Choice most appropriate wire type and crimp-type terminal by refer to wire maker recommended allowable current and voltage drop.



9. The life expectancy

The life of the power supply depends on the life of the built-in aluminum electrolytic capacitor being used and fan mounted products will depend on fan life. Each life is described in reliability data.
The life of the aluminum electrolytic capacitor varies depending on the load current of the power supply, and the ambient temperature. Please refer to “Electrolytic Capacitor Lifetime”.
The life of the fan depends on the fan blow 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 shut down and specifications may not be satisfied.
Please contact us for maintenance or exchange the product which passed over the life expectancy.

10. External Fuse Rating

Refer to the following fuse rating when selecting the external input fuse.
Surge current flows when input turn on. Have to use fast-blow and high breaking capacity fuse.
Fuse rating is specified by inrush current value at input turn on.
Do not select the fuse according to actual input current (rms.) values.

GUS1000 series: F16AH

11. 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 is properly adjusted.
(5) Check if the Remote ON/OFF control connector is not opened, when use Remote ON/OFF control function.
(6) Check if the output current and output power does not over specifications.
(7) Audible noise can be heard when input voltage waveform is not sinusoidal wave.
(8) Audible noise can be heard during Dynamic-Load operation.
(9) The built-in fan is stopped in remote off state.
(10) Ensure that large capacitor is not connected on the output side.

Please use within maximum external capacitance shown in below table.
If connecting more than the maximum capacitance value is required, please contact us for details.

Model	GUS1000-12	GUS1000-24	GUS1000-36	GUS1000-48
Maximum external capacitance	10000uF	10000uF	10000uF	5000uF

12. Altitude

GUS1000 is safety approved for operation up to 5000m by IEC62368-1 clearance requirement.
Thermal evaluation should be considered for products operating at elevated altitudes above 2000m.

13. Warranty Period

The warranty period applies for below conditions.
Ta≦40ºC
Output current≦80%

For damages occurring at normal operation within this warranty period, repair is free of charge.
For other ambient temperature and output current inquire to TDK-Lambda.

Following cases are not covered by warranty

(1) Improper usage like dropping products, applying shock and defects from operation exceeding specification of the unit.
(2) Defects resulting from natural disaster (fire, flood etc.)
(3) Unauthorized modifications or repair.
(4) Condition of continuously dynamic load or AC power on/off.

14. 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.