

# *CUS150M1*

## *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.

#### DANGER

Never use this product in locations where flammable gas or ignitable substances are present. There are risks of igniting these substances and exploding by an arcing.

#### WARNING

- Do not touch this product or its internal components while circuit is live, or shortly after shut down. There may be high voltage or high temperature present and you may receive an electric shock or burn.
- When this product is operating, keep your hands and face away from it as you may be injured by an unexpected situation.
- Do not make unauthorized changes to this product, otherwise you may receive an electric shock and void your warranty.
- Do not drop or insert anything into this product. It might cause a failure, fire and electric shock.
- Do not use this product under unusual condition such as emission of smoke or abnormal smell and sound etc. It might lead to fire and electric shock. In such cases, please contact us. Do not attempt repair by oneself, as it is dangerous for the user.
- Do not operate these products in the presence of condensation. It might lead fire and electric shock.

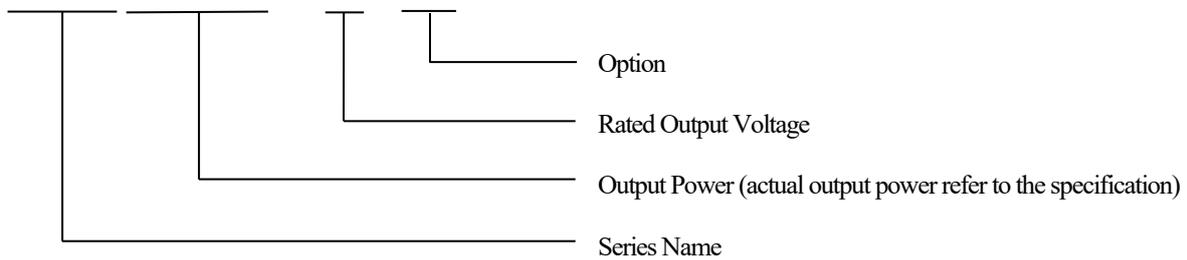
#### CAUTION

- This power supply is designed and manufactured for use within an end product such that it is accessible to SERVICE ENGINEERS only.
- Confirm connections to input/output terminals are correct as indicated in the instruction manual before switching on.
- Input voltage, Output current, Output power, ambient temperature and ambient humidity should be kept within specifications, otherwise the product will be damaged.
- Do not use this product in environment with a strong electromagnetic field, corrosive gas or conductive substances.
- For applications, which require very high reliability (Nuclear related equipment, medical equipment, traffic control equipment, etc.), it is necessary to provide a fail-safe mechanism in the end equipment.
- Do not inject abnormal voltages into the output of this product. The injection of reverse voltage or over voltage exceeding nominal output voltage into the output terminal might cause damage to internal components.
- Never operate the product under over current or short-circuit conditions for more than 30 seconds, or outside its specified Input Voltage Range. Insulation failure, smoking, burning or other damage may occur.
- PCB stress such as bending, twisting etc. could cause damage. Therefore, please handle with care.
- When handling this product, hold the board edge and take care not to touch the component side. When installing this product in apparatus or equipment, mount it on spacers.
- This power supply has possibility that hazardous voltage may occur in output terminal depending on failure mode. The output of these products must be protected in the end use equipment to maintain SELV.
- This product has used Power Thermistor to protect the circuit from Inrush Current. Frequent repetition of input might cause damage to internal components because of generating surge current.
- Breaking of internal fuse is considered internal failure. In such cases, please contact us.
- The information in this document is subject to change without prior notice. Please refer to the latest version of the data sheet, etc., for the most up-to date specifications of the product.
- Double pole / neutral fusing.  

- This product is for sale to business to business customers and can be obtained via distribution channels. It is not intended for sale to end users.
- This product is a component power supply and does not fall within the scope of the EMC directive. Compliance with the EMC directive must be considered in the final installation.
- No part of this document may be copied or reproduced in any form without prior written consent of TDK-Lambda.

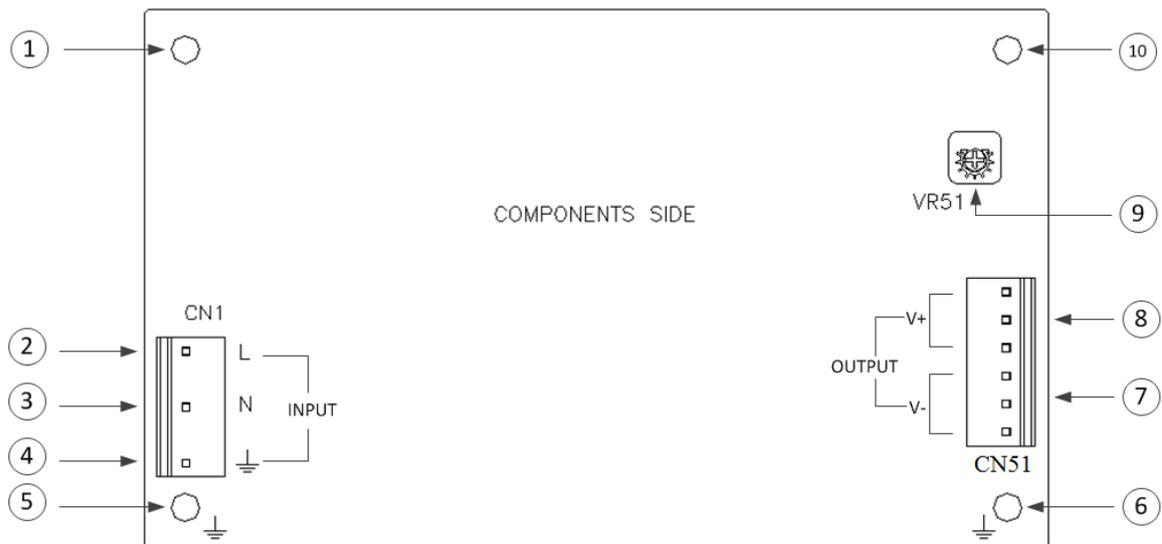
1. Model name identification method

**CUS 150M1 – 12 □**



Option	Description
blank	Standard model.
/L	With chassis model.
/A	With chassis and cover model.

2. Terminal Explanation



- ① Mounting hole (hole diameter :  $\phi 3.5\text{mm}$ ), This hole is not connected to Protective Earth of CN1.
- ② L : AC Input terminal Live line (Fuse in line.).
- ③ N : AC Input terminal Neutral line (Fuse in line.).
- ④  $\perp$  : Earth terminal.
- ⑤ Mounting hole (hole diameter :  $\phi 3.5\text{mm}$ ), This hole is connected to Protective Earth of CN1. The mounting surface of the spacer should be within Max  $\phi 7\text{mm}$ .
- ⑥ Same as mounting hole ⑤.
- ⑦ V-: Output Terminal -.
- ⑧ V+: Output Terminal +.
- ⑨ V.ADJ : Output voltage adjust trimmer. The output voltage rises when the trimmer is turned clockwise.
- ⑩ Same as mounting hole ①.

### 3. Terminal Connection Method

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

- Input must be off when making connections.
- Connect  $\perp$  terminal of mounting hole to protective earth of the equipment.
- The output load line and input line shall be separated to improve noise sensitivity.
- Do not apply stress to PCB, when connecting or removing connectors.
- Do not apply stress to the components ( especially VR51 ) when connecting or removing connectors.
- Use input/output connector (housing) specified by the table below.
- Housing, Terminal Pin and Tool are not included with this product. (Refer to the following)

Input/Output/Standby Connector & Housing & Terminal Pin

	Model	Connector	Housing	Terminal Pin	Maker
Input (CN1)	CUS150M1	B3P5-VH(LF)(SN)	VHR-5N	SVH-21T-P1.1	J.S.T.
Output (CN51)	CUS150M1	B6P-VH(LF)(SN)	VHR-6N	SVH-41T-P1.1	

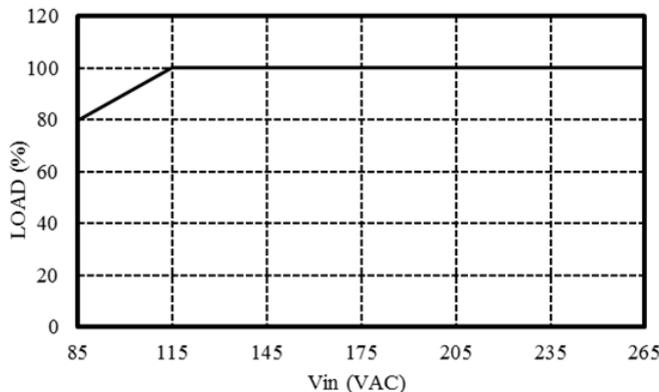
Hand Crimping Tool : YC160R, YC-930R, YC-610R (J.S.T.)

### 4. Explanation of Function and Precautions

#### 4-1. Input Voltage Range

Input voltage range is single phase 85-265VAC(47-63Hz). Input voltage, which is out of specification, might lead unit damage. For cases where conformance to various safeties required, described as 100-240VAC (50-60Hz). If input voltage is less than 115VAC, output power need to be derated.

Derating curve for standard CUS150M1



INPUT VOLTAGE (VAC)	MOUNTING A,B,C,D,E
	LOAD (%)
85	80
115~265	100

#### 4-2. Output Voltage Range

Output voltage is set the rated value at shipment. V.ADJ trimmer (VR51) can adjust the output voltage within the range. Output voltage range refers to the specification. To turn the trimmer clockwise, the output voltage will be increased. Take note when the output voltage is increased excessively, over voltage protection (OVP) function may be triggered and voltage will be shut down. Furthermore, when increasing the output voltage reduce the output current so as not to exceed the maximum output power.

#### 4-3. Inrush Current

These products equipped Power thermistor to limit the inrush Current. Higher current will flow at higher ambient temperature or re-input condition. Please select input switch and fuse carefully with the high temperature and re-input the power condition. The Inrush Current value is under cold start at 25°C in the specification.

#### 4-4. Over Voltage Protection (OVP)

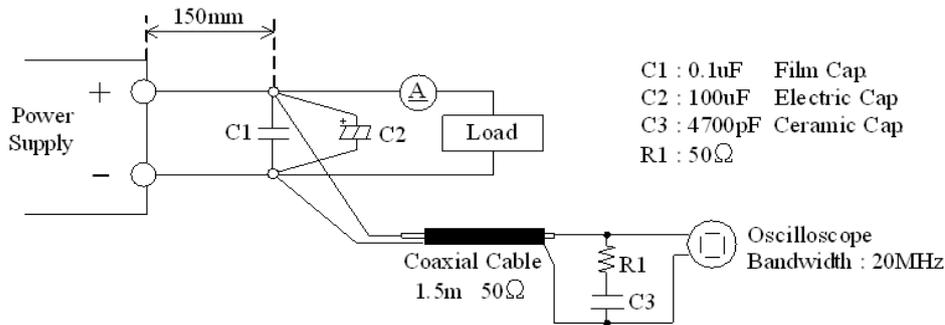
The OVP function (Inverter shut down method, manual reset type) is provided. Please refer to its specification for OVP range. When OVP triggers, the output will be shut down. In addition, the setting value of OVP is fixed and not adjustable. Pay attention not to apply higher voltage externally to the output terminal to avoid unit failure. In case of inductive load, put protective diode in series to the output power line. To recovery from OVP, we need to turn off the input of power supply for a few minutes, and then re-input.

#### 4-5. Over Current Protection (OCP)

These products provide the 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, however the outputs may be latched off when shorted condition happens. Never operate the unit under over current or shorted conditions for more than 30seconds, which may leads damage or insulation failure. OCP setting is fixed and not to be adjusted externally.

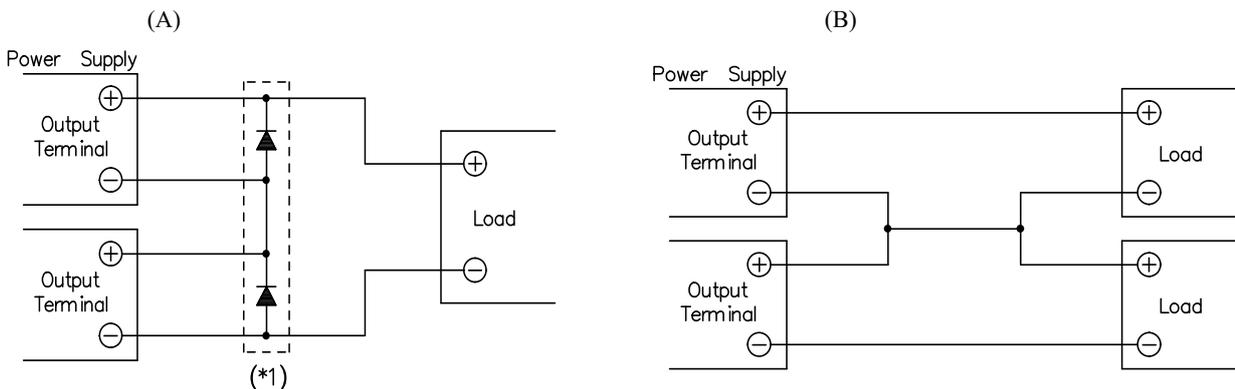
#### 4-6. Output Ripple & Noise

The standard specification for maximum ripple value is measured according to measurement circuit specified as below. When load lines are longer, ripple will becomes larger. In this case, electrolytic capacitor, film capacitor, etc. might be necessary to use across the load terminal. The output ripple cannot be measured accurately if the probe ground lead of oscilloscope is too long.



#### 4-7. Series Operation

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

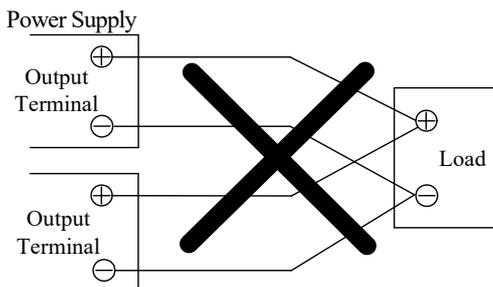


(\*1) Please select a bypass diode with maximum forward current rating more than output load current. And maximum reverse voltage must withstand each power supply output voltage.

#### 4-8. Parallel Operation

For parallel operation, method (B) is possible

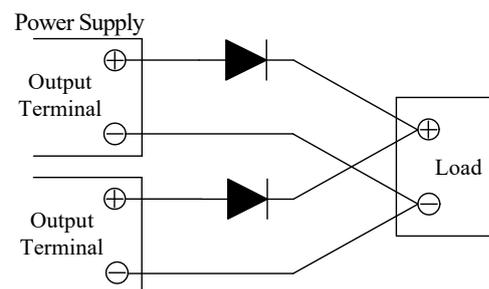
(A) To increase the output current is not possible.



(B) To use as Back-up Power Supply

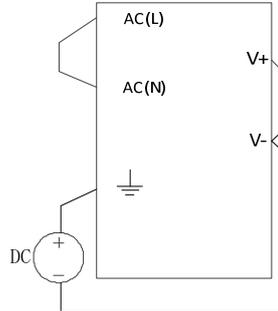
1. Adjust the output voltage of each power supply to be the same.
2. Set power supply output voltage higher by the forward voltage drop ( $V_f$ ) of diode.

Use within the specification for output voltage and output power.



#### 4-9. Isolation Test

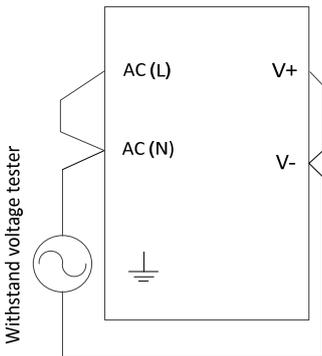
Isolation resistance between Output and  $\perp$  is more than  $100M\Omega$  at 500VDC. For safety operation, voltage setting of DC isolation tester must be done before the test. Ensure that the unit is fully discharged after the test.



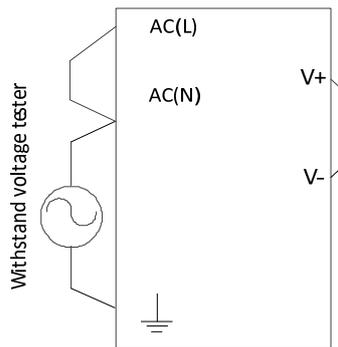
#### 4-10. Withstand Voltage Test

These products are designed to withstand 4kVAC between input and output, 2kVAC between input and  $\perp$  and 1.5kVAC between output and  $\perp$  for 1 minute. When testing withstand voltage, set current limit of the withstand voltage test equipment to 20mA. 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 timer switch on and off. Connect input and output as follows.

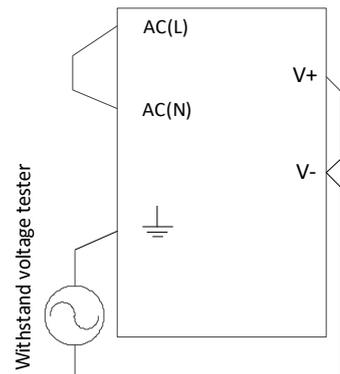
Input – Output: 4kVAC,  
1 minute (20mA)



Input –  $\perp$ : 2kVAC,  
1 minute (20mA)



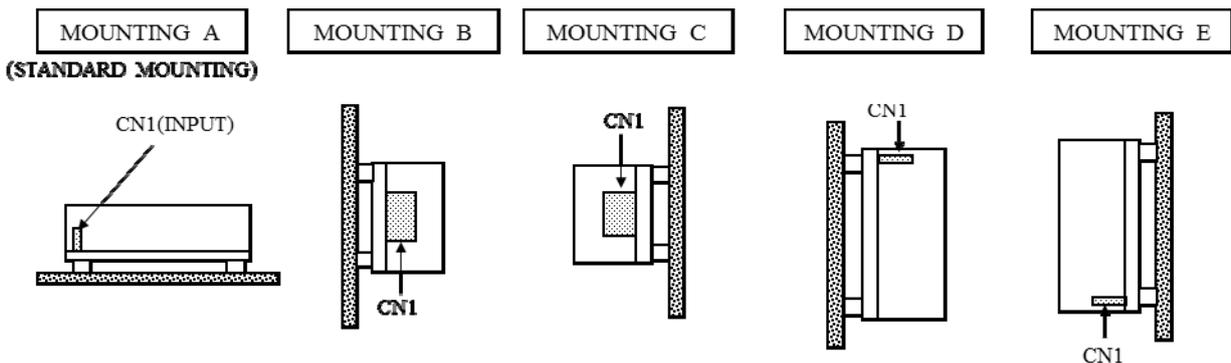
Output –  $\perp$ : 1.5kVAC,  
1 minute (20mA)



### 5. Mounting Directions

#### 5-1. Output Derating according to the Mounting Direction

Recommended standard mounting direction is (A). Mounting direction (B)-(E) are also possible. Refer to the output derating at 5-2. Load (%) of derating curve indicates output power.



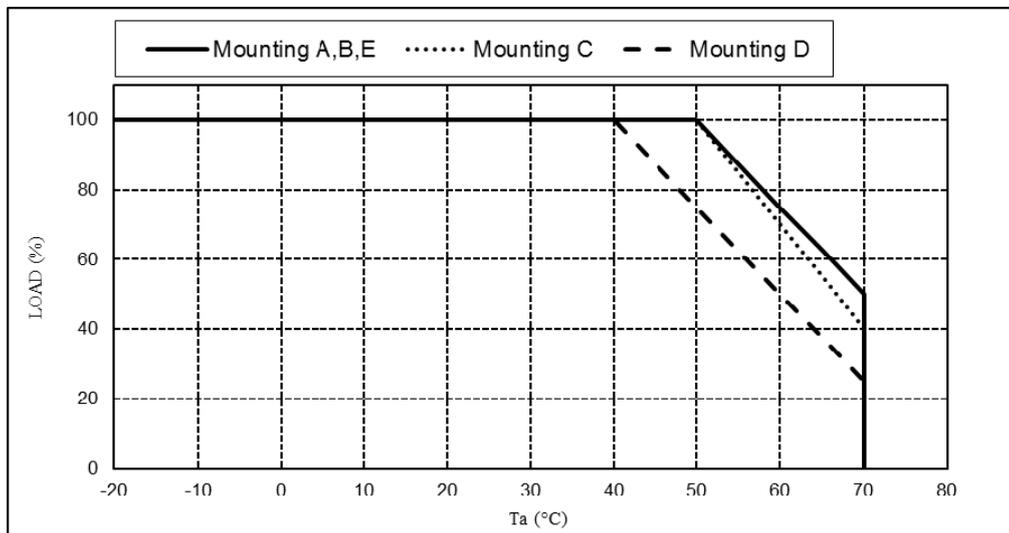
### 5-2. Output Derating

Make sure that the specified temperature range is maintained.

#### Convection cooling

MODEL: CUS150M1-12, CUS150M1-18, CUS150M1-24, CUS150M1-36, CUS150M1-48

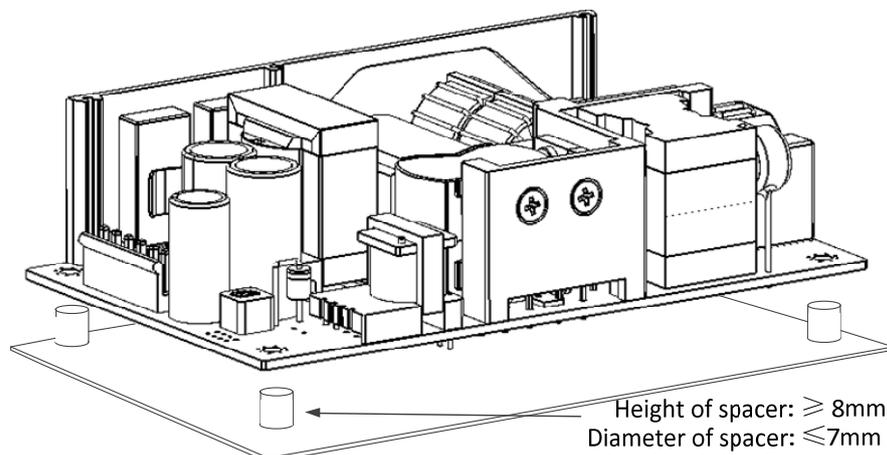
Ta (°C)	MOUNTING A,B,E	MOUNTING C	MOUNTING D
	LOAD (%)	LOAD (%)	LOAD (%)
-20 - +40	100	100	100
50	100	100	75
60	75	70	50
65	63	55	38
70	50	40	25



### 5-3. Mounting Method

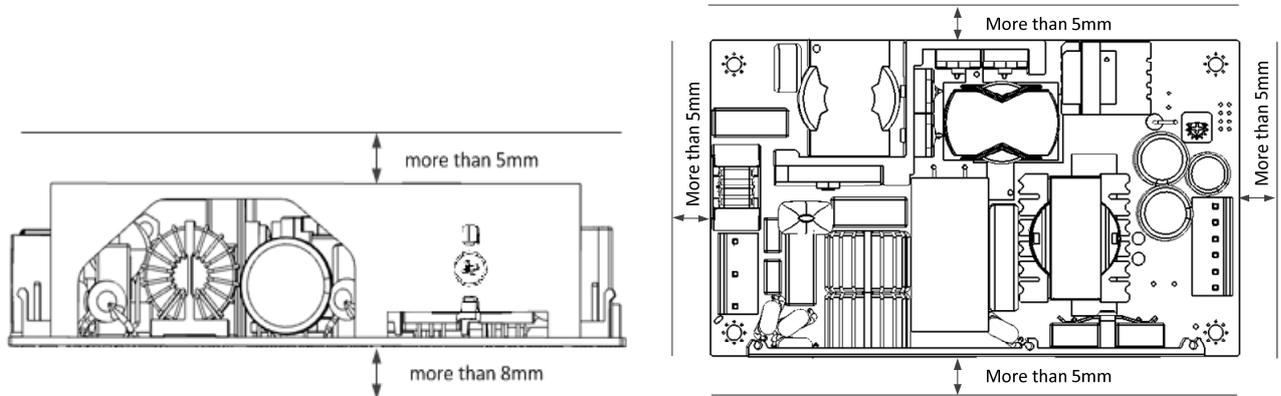
Insert the spacer (Max  $\phi$  7mm) of height more than 8mm to lift the unit. And use all mounting holes for the unit installation. The vibration spec is specified under this mounting condition. Keep enough space in the power supply surroundings and the upper area of components for convection cooling

- (1) Mounting Holes size: 4 holes  $\phi$  3.5mm.

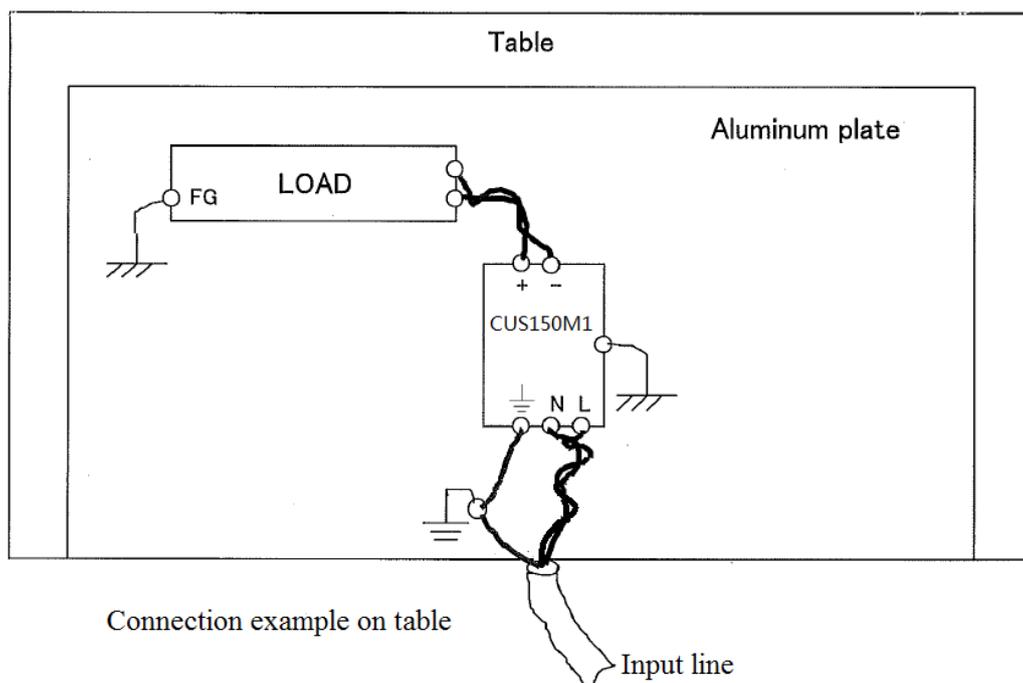


- (2) Conditions to meet Isolation and Withstanding Voltage standard.

Keep 5mm space from the surfaces and sides of PCB. Especially, 8mm space is necessary from the solder surface. If the space is not enough, the specification of isolation or withstanding voltage will not be satisfied.



- (3)  $\perp$  (Protective Earth) should be connected to the earth terminal of the equipment. Also the mounting hole are should be connected to the Chassis by metal spacer. If not, the conducted noise, radiation noise and output noise may increase. Please refer to below setup.



## 6. Wiring Method

- (1) The output load line and input line shall be separated each other and twisted individually to improve noise.
- (2) Use all lines as thick and short as possible to made lower impedance.
- (3) Noise can be reduced by attaching a capacitor to the load terminals.
- (4) For safety and EMI considerations, connect  $\perp$  with the terminal of protective earth of equipment firmly.

## 7. External Fuse Rating

Refer to the following fuse rating when selecting the external fuses that are to be used on input line. Surge current flows when line turns on. Have to use slow-blow or time-lag type fuse, not fast-blow fuse. Fuse rating is considered by in-rush current value at line turn-on. Do not select the fuse according to input current (RMS.) values under the actual load condition.

CUS150M1 series: 5A

## 8. Before concluding that the unit is at fault

- (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 thickness is enough.
- (4) Check if the output current and output wattage dose not over specification.
- (5) Check if the output voltage adjust trimmer (V.ADJ) is properly adjusted. OVP might be triggered and output is shut down.
- (6) Audible noise can be heard when input voltage waveform is not sinusoidal wave.
- (7) Audible noise can be heard during Dynamic-Load operation.
- (8) Ensure that a large capacitor is not connected across the output terminals. Please use within maximum capacitance shown below.

Model	CUS150M1-12	CUS150M1-18	CUS150M1-24	CUS150M1-36	CUS150M1-48
Maximum external capacitance	10000uF	6000uF	3000uF	1000uF	400uF

## 9. Altitude

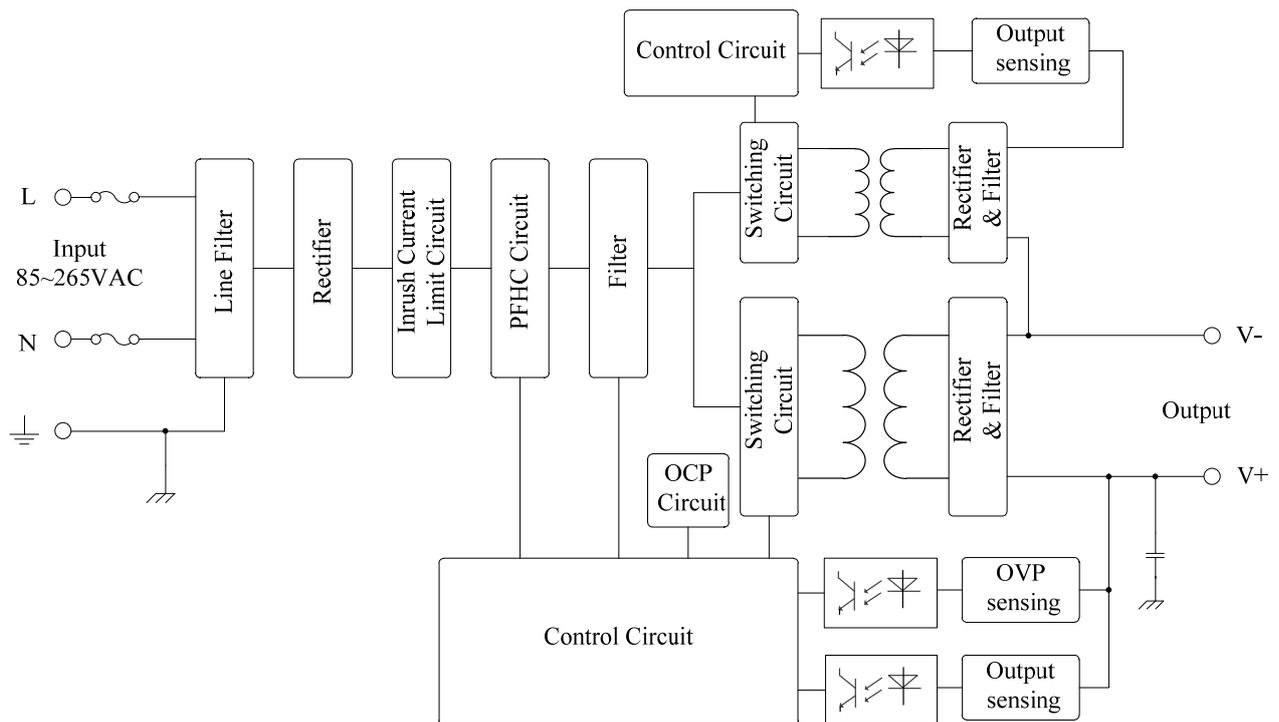
CUS150M1 is safety approved for operation at below altitude.

- Up to 5000m by IEC62368-1 clearance requirement.

- Up to 4000m by IEC60601-1 clearance requirement.

Thermal evaluation should be considered for products operating at elevated altitudes above 2000m.

## 10. Block Diagram

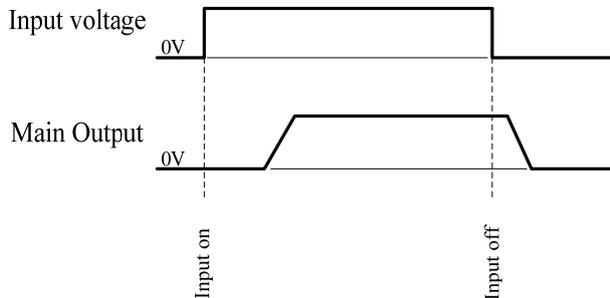


- Fuse rating : 5A

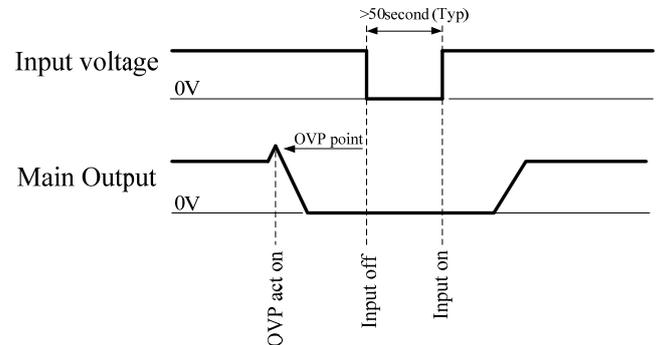
- Circuit topology, switch frequency  
 PFHC circuit: active filter (boundary current mode) 50k~800kHz.  
 Main output circuit: LLC resonant 45k~280kHz.  
 Auxiliary power circuit: Flyback 5k~25kHz.

## 11. Sequence time chart

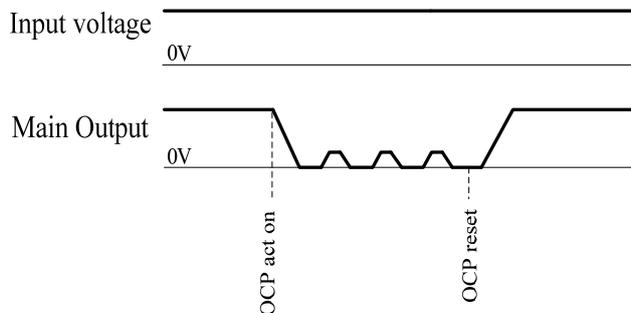
Input voltage ON/OFF sequence time chart



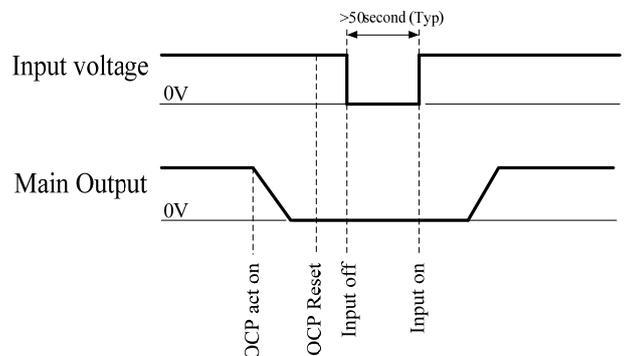
OVP recovery sequence time chart



Output OCP (not latched) recovery sequence time chart



Output OCP (latch) recovery sequence time chart



## 12. The life expectancy

The life of the power supply depends on the life of the built-in aluminum electrolytic capacitor. The life is described in reliability data. The life of the aluminum electrolytic capacitor varies depending on the method of mounting the power supply, the load current, and the ambient temperature. Please refer to "Electrolytic Capacitor Lifetime".

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.

## 13. Warranty Period

This product is warranted for a period of 3 years from the date of shipment. For damages occurring at normal operation within this warranty period, repair is free of charge. Please read the General Safety Instruction before using the products.

Warranty Period applies 3 years for below conditions.

$T_a \leq 40^\circ\text{C}$ ,

Output current  $\leq 100\%$

Mounting direction:(A),

Cooling: convection cooling

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

For other mounting directions 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.