

MAX. Power 60W Isolated Open Frame Type Small AC-DC Converter

NOF60 Series Isolated Open Frame Type Small AC-DC Converter



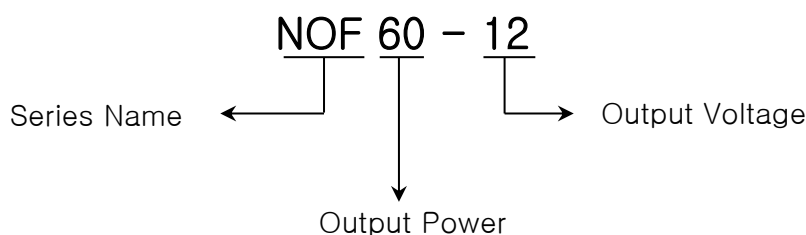
Features

- Power Saving Mode Operation
- Very Small, High Efficiency
- Isolated Input - Output
- 65kHz fixed frequency and Current mode Control
- Low output Ripple & Noise
- Built-in over current protection circuit
- Short Circuit Protection
- Universal Input Voltage(Free Voltage)
- Built in EMI Filter
- Safety standard : CB,CE(approvals pending)
(CB : IEC60950-1, CE : EN60950-1)
- RoHS compatible design

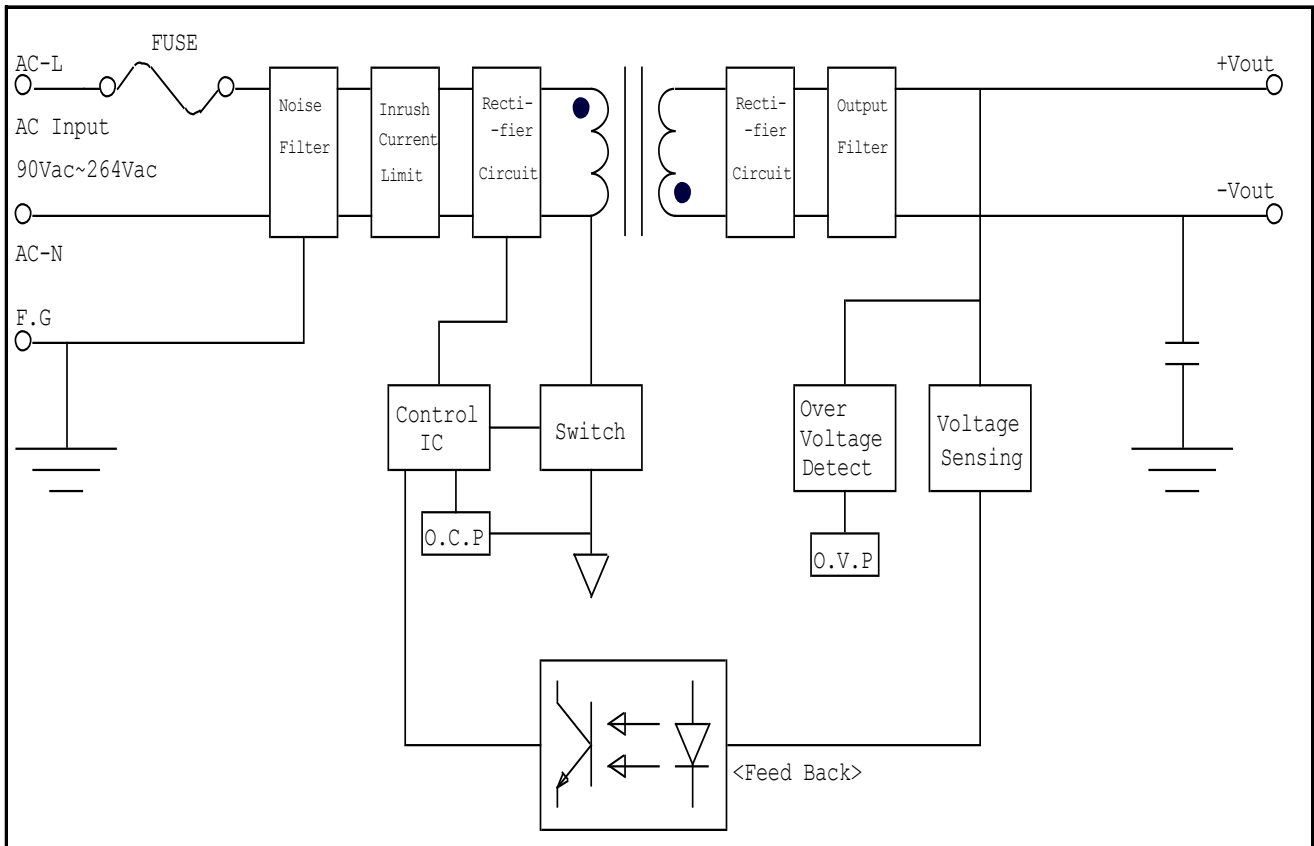
Environment

- Operating Temperature : -40°C ~ 70°C
- Operating Humidity : 20% ~ 90% RH (Non condensing)
- Storage Temperature : -40°C ~ 85°C
- Cooling : Free-Air Convection
- MTBF : 3.0 x 10⁵ hrs

Model Name Structure



Internal Circuit Architecture



Maximum Ratings

Characteristics	Symbol	Min.	Typ.	Max.	Unit
No-load Power Consumption	NOF60 - XX			0.3	W
Frequency	NOF60 - XX	44	-	440	Hz
Input Voltage Continuous	NOF60-12	90	-	264	Vac
	NOF60-15	90	-	264	
	NOF60-24	90	-	264	
	NOF60-48	90	-	264	
Operating Ambient Temperature	Ta	-40	-	70	°C
Storage Temperature	Tstg	-40	-	85	°C
Withstand Voltage (Input - Output)		-	-	3000	Vac

Electrical Characteristics

- Input Section

Ta : 25°C, Vin : Typical Input Voltage

Characteristics		Symbol	Min.	Typ.	Max.	Unit
No-load Power Consumption	NOF60 - XX				0.3	W
Operating Voltage Range	NOF60 - XX	Vin	90	110, 220	264	Vac
Frequency	NOF60 - XX		44	50, 60	440	Hz
Max. Input Current (Vin : rated, Io : 100%)	NOF60 - XX	Iin			1.4	A
Max. No Load Input Current (Vin : rated)	NOF60 - XX				0.03	A
Inrush Current (In : 220Vac)	NOF60 - XX				60	A
Leakage Current (In : 220Vac)	NOF60 - XX				0.35	mA

- Output Section

Ta : 25°C, Vin : Minimum, Typical, Maximum Input Voltage

Characteristics		Symbol	Min.	Typ.	Max.	Unit
Output Voltage Accuracy	Single	Vo	-	-	±2	%
Regulation	Line Regulation (From min. Vin to max. Vin, constant load)		-	-	±1	%
	Load Regulation (From no load to maximum load)		-	-	±1	%(@Single)
Output Ripple and Noise (Vin : Rated, Io : Max., BW : 20MHz)		mVp-p	-	-	1% of Vout	mV (peak to peak)

Characteristics		Symbol	Min.	Typ.	Max.	Unit
Output Current	NOF60 - 12	I _o	-	-	5	A
	NOF60 - 15				4	
	NOF60 - 24				2.5	
	NOF60 - 48				1.25	
Output Current Limit (OCP : Over Current Protection, recovers automatically)			105	-	-	%
Over Voltage Protection			115	-	140	%
Output Voltage adj. Range			-10	0	+10	%
Dynamic Load Response (V _{in} : rated, I _o : from 50% to 100%, from 100% to 50%, BW : 20MHz, Freq. : 50Hz, Duty : 0.5, Tr/Tf : 100us)			-	-	3% of V _{out}	mV (peak to peak)
Start - Up Time		T _{start}			1.5	s
Turn - on Overshoot			-	-	5	%
Efficiency (V _{in} : Rated, I _o : Max.)	NOF60 - 12		-	86	-	%
	NOF60 - 15			87		
	NOF60 - 24			89		
	NOF60 - 48			88		

Isolation Characteristics

Characteristics		Symbol	Min.	Typ.	Max.	Unit
Withstand Voltage	Input - Output		-	-	3000	Vac
	Input - FRG				2000	Vac
	Output - FRG				500	Vac
Isolation Resistance (DC500V at 25°C and 70%RH)	Output - FRG	R _{iso}	70	-	-	MΩ

General Characteristics

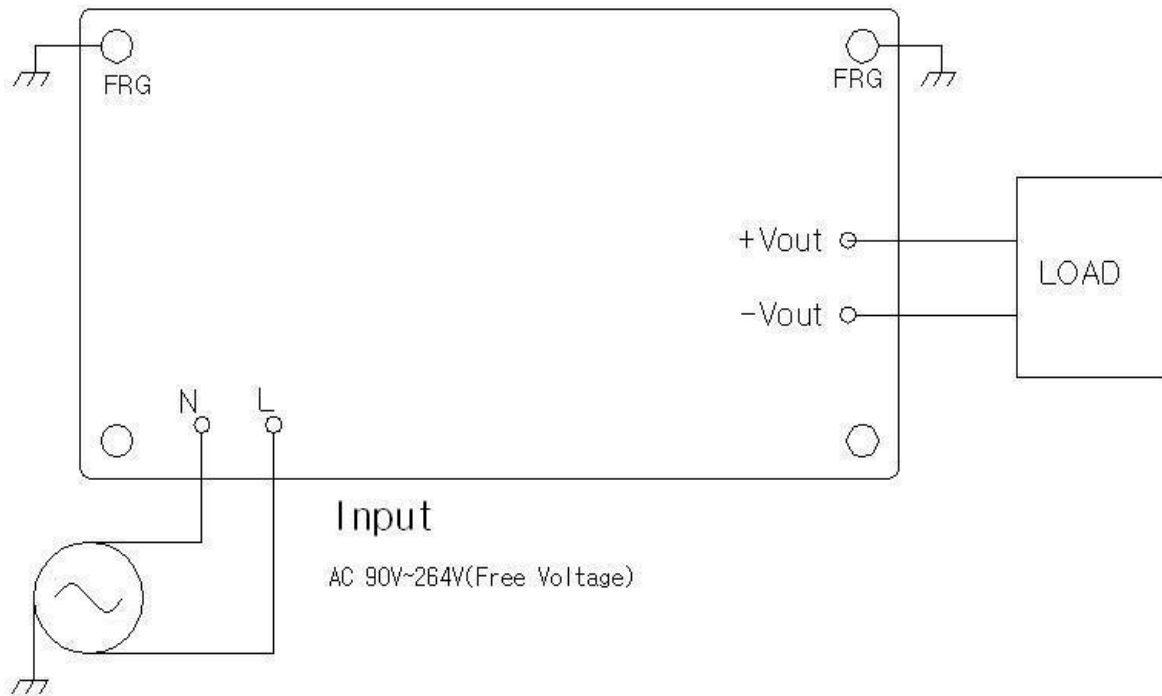
Characteristics	Symbol	Min.	Typ.	Max.	Unit
Remote on / off control (CNT Pin, Negative Logic Module on : Logic Low or Short to -Vin Module off : Logic High or open)	CNT				
Internal Trim Adj. Range (by VR1)		-10	0	+10	%
Switching Frequency			65		kHz
MTBF (MIL-HDBK-217F)		3.0 x 10 ⁵			hrs
Dimension (W x H x L)		110 x 28.0 x 50			mm
Weight				170	grams

Environment

Characteristics	Symbol	Min.	Typ.	Max.	Unit
Operating Temperature Range	Ta	-40	-	70	°C
Operating Humidity (non Condensing)		20	-	90	%RH
Storage Temperature	Tstg	-40	-	85	°C

Application Sheet

Basic Connection



- ※ For safety and improved noise, ensure secure connection of the FRG terminal to the ground terminal of the equipment.
- ※ To avoid excessive voltage drop and improved noise, short and thick wire should be used to connect the load.

Input Section

Input Fuse

Generally, ac-dc converter(NOF Series) has internal fuse. Refer to Fuse Rating table. Avoid using fast-blow fuse.

< Fuse Rating table > Type : SS-5C, Time-Delay

	NOF5,10	NOF20	NOF40	NOF60	NOF75	NOF100	OFS150
Fuse	1.0A	1.6A	2.0A	2.5A	3.15A	4.0A	5.0A

UL/CSA or IEC approved type should be used to meet safety requirements.

Output Section

Output Ripple and Noise Measurement Method

The measurement for output ripple and noise are based on normal probe with 20MHz bandwidth scope. Upon measurement of the ripple voltage, make sure that the scope probe leads are not too long. If a precise measurement can be made, the noise occurs from circumference must be reduced.

Regulation

Line Regulation

The line regulation means to the change in output voltage when the input voltage is varied within the input voltage range, at constant load and constant ambient temperature. The measurement point for the output voltage are $\pm V_{out}$ pins respectively.

Load Regulation

The load regulation means to the change in output voltage when the load is changed from minimum load to maximum load, at constant input voltage and constant ambient temperature. The measurement point for the output voltage are $\pm V_{out}$ pins respectively.

Output Voltage adjustment

The output voltage can be varied within $\pm 10\%$ of the standard output voltage. (By the VR1) When turn VR1 counterclockwise, the output voltage increase. If the output voltage is increased excessively, the OVP (Over Voltage Protection) will trigger.

Protection

Over Voltage Protection

The NOF series is built into an OVP (Over Voltage Protection) circuit. When the OVP triggers, the output voltage is clamped 70%~90% of output voltage. The input must be taken out (for at least five seconds), and then reinputted manually. Otherwise, the module will maintain the clamped voltage.

Over Current Protection

The NOF series is built into an OCP (Over Current Protection) circuit. When the OCP triggers, the output voltage will fall. If overload condition is removed, the output will automatically recover.

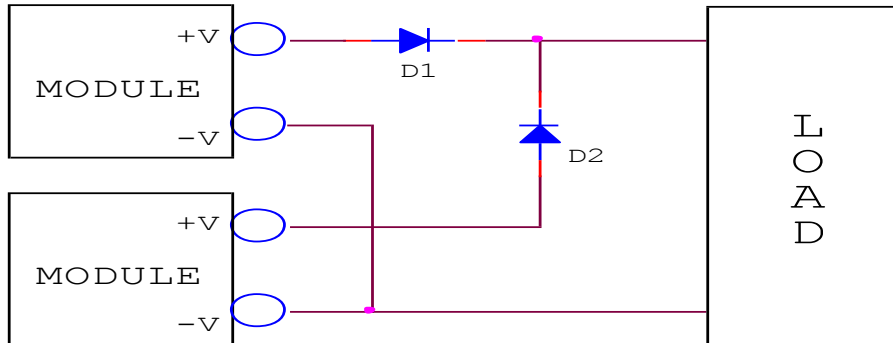
Short Circuit Protection

The NOF series is built into an short circuit protection circuit. It is similar to OCP circuit. When output is short condition, the output voltage will fall. If short condition is removed, the output will automatically recover. However, if the short condition continues damage to the module could occur.

Operation Method

Parallel Operation

The module can be operated parallel connection. Refer to diagram as shown below.



Please, you must consider both reverse voltage and forward current of diode, when you choose a diode.

Maximum reverse voltage(V_{rm}) : $V_{rm} > 1.5 \times V_o$

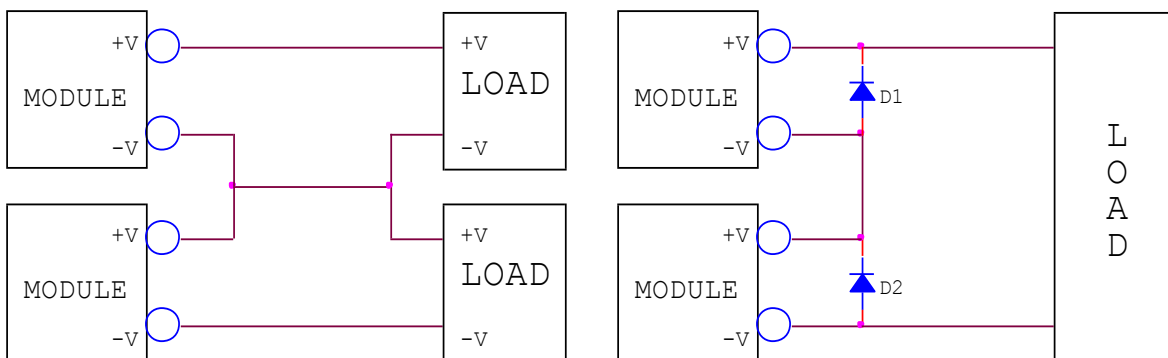
Forward current(I_f) : $I_f > 3 \times I_o$

Also, design a heatsink according to power loss at diode. If you want to reduce power loss, use a schottky barrier diode.

Power loss = $V_f(\text{forward voltage}) \times I_o(\text{output current})$

Series Operation

Series operation is available by connecting the outputs of two or more module as shown below.



< A. General Series Operation >

< B. Complemental Series Operation >

Please, you must consider both reverse voltage and forward current of diode, when you choose a diode.

Maximum reverse voltage(V_{rm}) : $V_{rm} > 1.5 \times V_o$

Forward current(I_f) : $I_f > 3 \times I_o$

Also, design a heatsink according to power loss at diode. If you want to reduce power loss, use a schottky barrier diode.

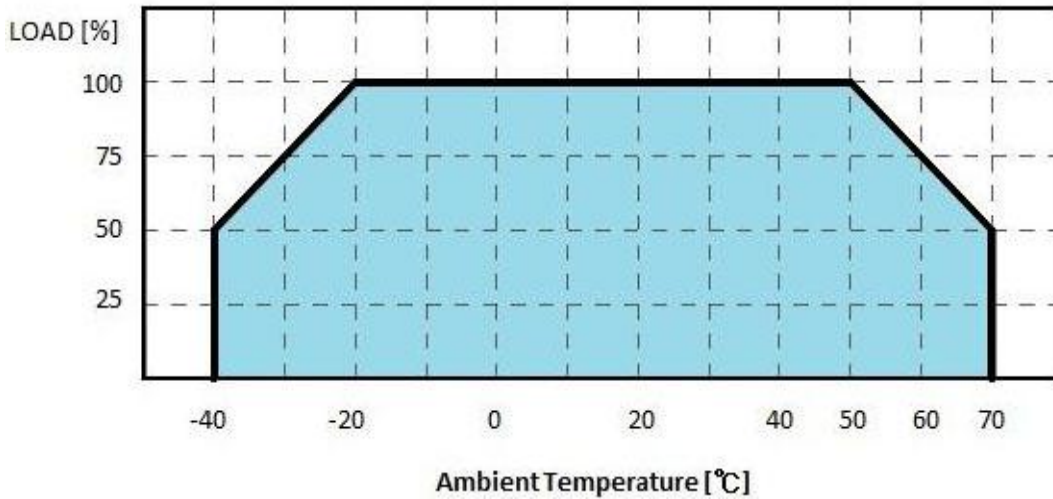
Power loss = $V_f(\text{forward voltage}) \times I_o(\text{output current})$

Environment

Temperature

Operation Temperature

The range of ambient temperature in °C over which a module can be operated safely at either rated or derated output power. Refer to derating curve as shown below.



※ Operating Temperature Range : From -40°C to 70°C

< Derating Curve >

Storage Temperature

The range of ambient temperature in °C over which a module may be stored long term without damage. The storage temperature range is from -40°C to 85°C.

Humidity

Operation Humidity

The range of ambient humidity in % over which a module can be operated safely at either rated or derated output power. Refer to derating curve as shown below.

The operating humidity range is from 20% to 90%RH.

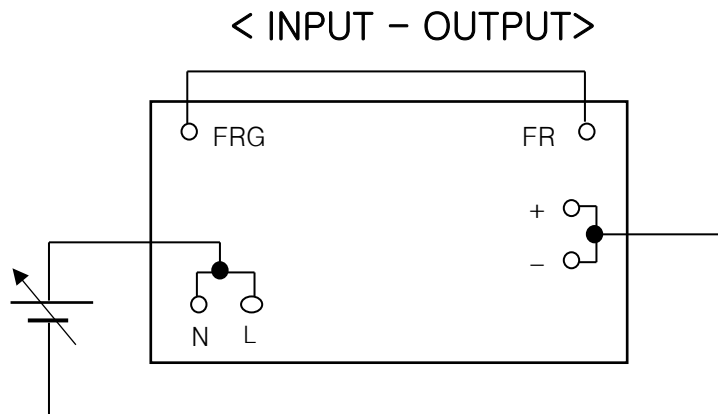
Storage Humidity

The range of ambient humidity in % over which a module may be stored long term without damage. The storage humidity range is from 20% to 90%RH.

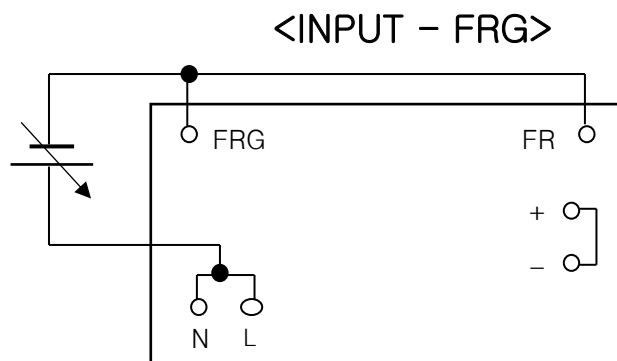
Isolation

Isolation Resistance

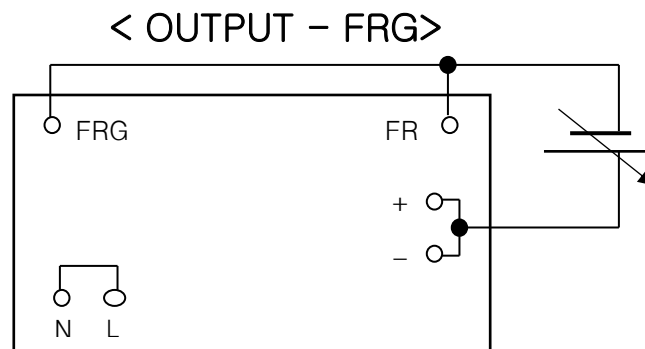
The electrical separation between input and output of a module by means of the power transformer. The isolation resistance is a function of materials and spacings employed throughout the module. Please don't test with a voltage above standard voltage for the Isolation Resistance Test.



500VDC, 100MΩ



500VDC, 100MΩ

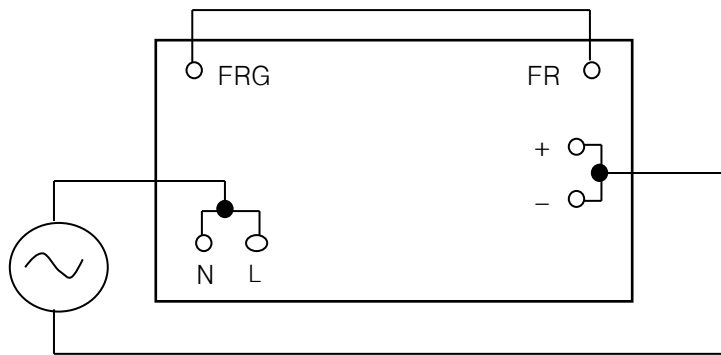


500VDC, 70MΩ

Withstand Voltage

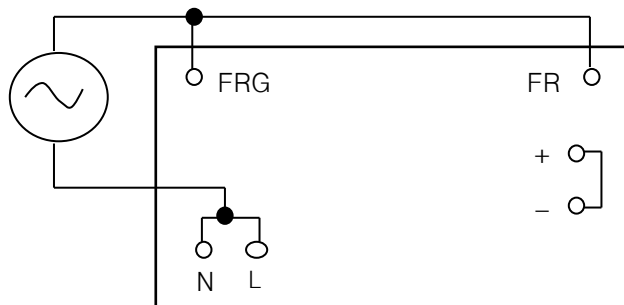
For the withstand voltage test, the applied voltage must be increased gradually from zero to the testing value, and then decreased gradually at shut down. Especially stay away from use of a timer. Where a pulse of several times the applied voltage can be generated.

< INPUT - OUTPUT >



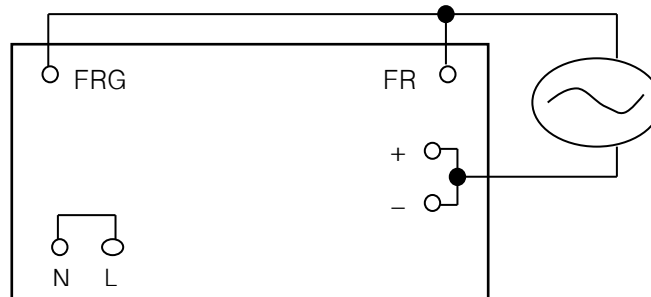
3kVAC (10mA) 1minute

< INPUT - FRG >



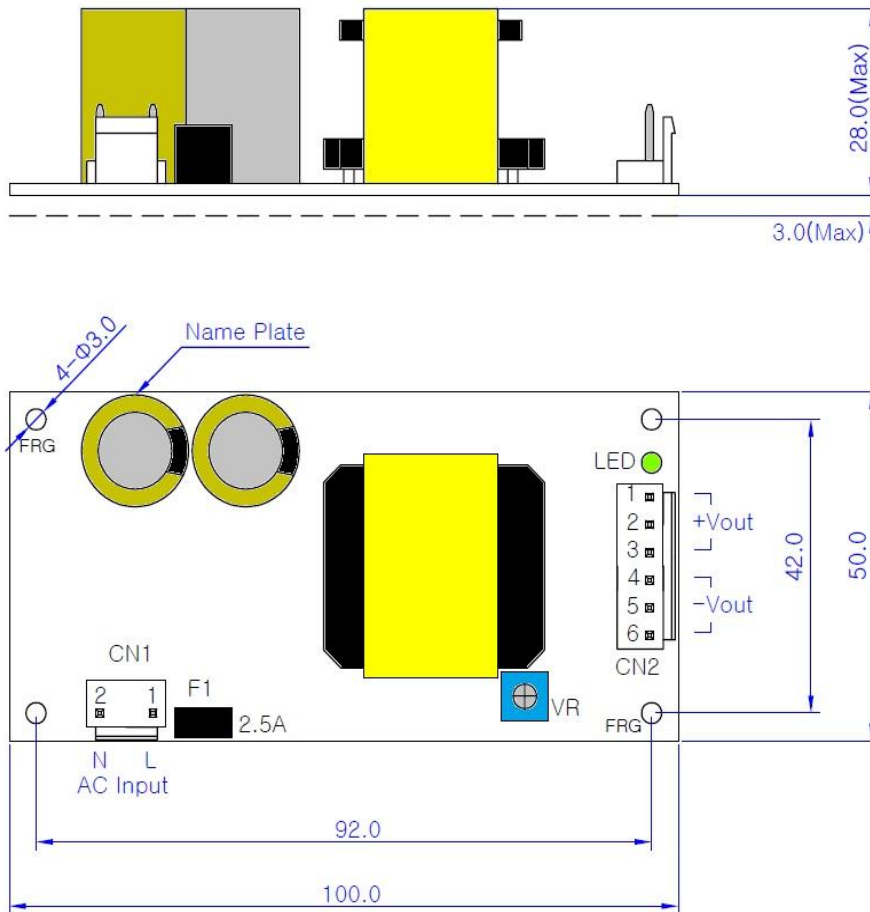
2kVAC (10mA) 1minute

< OUTPUT - FRG >



0.5kVAC (10mA) 1minute

Outline Dimensions (Unit : [mm])



Matching Crimp Housing & Terminals Pin assignments

	Crimp Housings	Terminals
CN1	Yeonho YH396-03V or equivalent	Yeonho YT396 or equivalent
CN2	Yeonho YH396-06V or equivalent	

Pin assignments

	Pin No.	Function
CN1	1	AC Input L
	2	AC input N
CN2	1, 2, 3	DC Output +V
	4, 5, 6	DC Output -V(GND)