

DATASHEET & RELIABILITY DATA

HS10 SERIES

(주)오디피

Open Digital Power Corp.

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MAX. Power 10W Isolated On-Board Type AC-DC Converter

HS10 Series Isolated On-Board Type AC-DC Converter



Features

- Power Saving Mode Operation
- High Efficiency
- Isolated Input – Output
- 100kHz fixed frequency and Current mode Control
- Low output Ripple & Noise
- Built-in over current protection circuit
- Short Circuit Protection

Applications

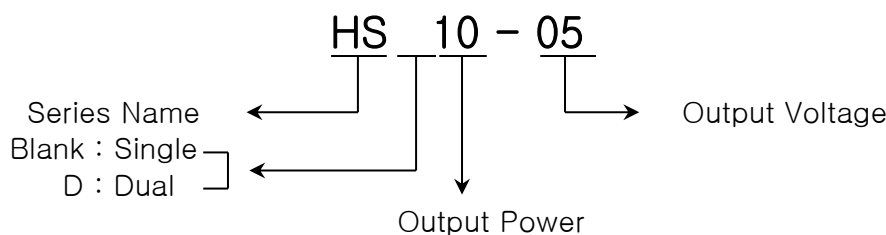
- Data and telecommunication
- FA control
- Datacommunication electronic equipments

- Universal Input Voltage(Free Voltage)
- Safety standard : CE approved
- RoHS compatible design

Environment

- Operating Temperature : -10℃ ~ 70℃
- Operating Humidity : 20% ~ 90% RH (Non condensing)
- Storage Temperature : -20℃ ~ 75℃
- Cooling : Free-Air Convection
- MTBF : 4.1 x 10⁵ hrs

Model Name Structure



Pin assignments & Function



<Top View>

- Single Output Name & Function

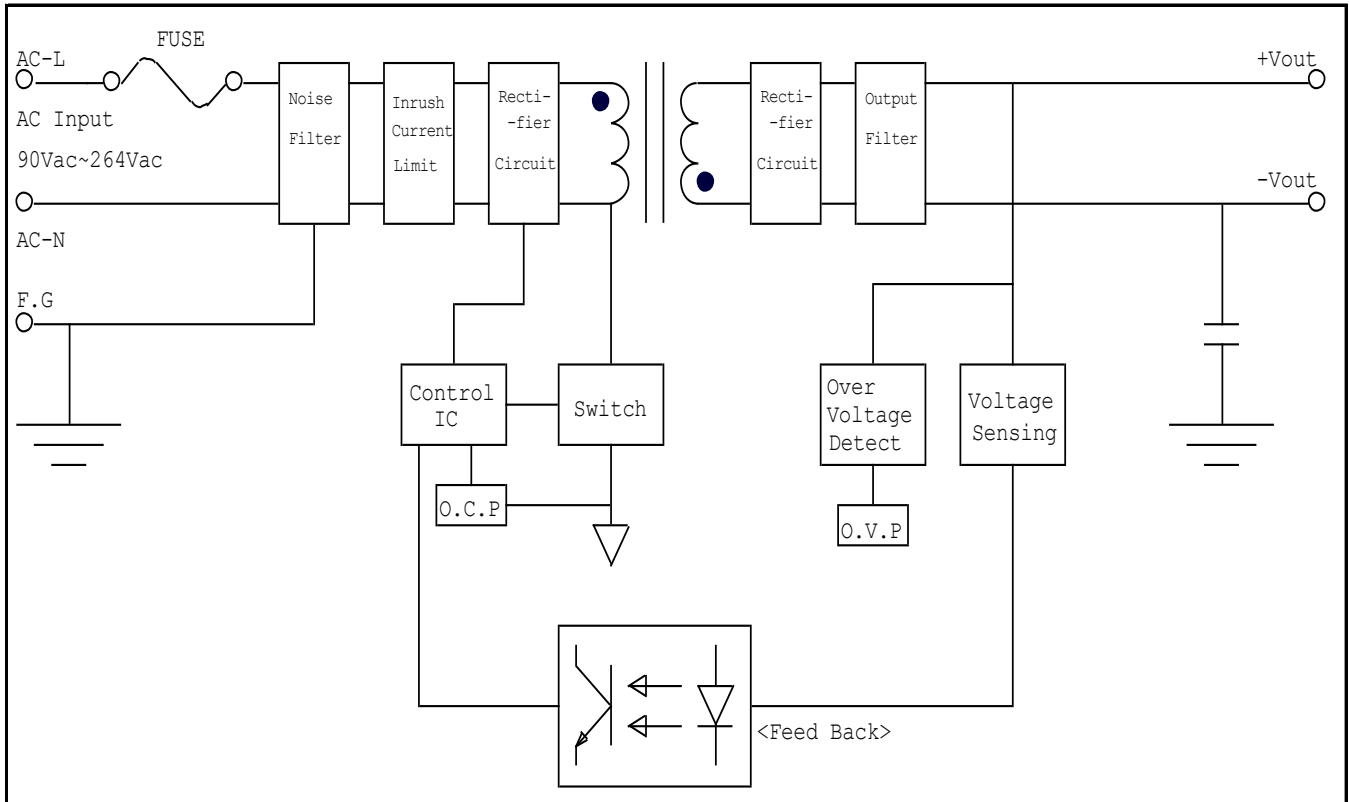
PIN No.	NAME	FUNCTION
1	FRG	Frame Ground
2	N	AC input N
3	L	AC input L
4	No Pin	
5	+Vout	Positive terminal for Vout
6	No Pin	
7	-Vout	Negative terminal for Vout
8	No Pin	

- Dual Output Name & Function

PIN No.	NAME	FUNCTION
1	FRG	Frame Ground
2	N	AC input N
3	L	AC input L
4	No Pin	
5	+Vout	Positive terminal for Vout
6	Com	The common ground of Vout
7	-Vout	Negative terminal for Vout
8	No Pin	

- Datasheet

1. Internal Circuit Architecture



2. Maximum Ratings

Characteristics		Symbol	Min.	Typ.	Max.	Unit
No-load Power Consumption	HS10 - XX				0.3	W
Frequency	HS10 - XX		44	-	440	Hz
Input Voltage Continuous	HS10 - 05	Vin	90	-	264	Vac
	HS10 - 12		90	-	264	
	HS10 - 15		90	-	264	
	HS10 - 24		90	-	264	
Input Voltage Continuous	HSD10 - 1212		90	-	264	Vac
	HSD10 - 1515		90	-	264	
Operating Ambient Temperature		Ta	-10	-	70	°C
Storage Temperature		Tstg	-20	-	75	°C
Withstand Voltage (Input - Output)			-	-	3000	Vac

3. Electrical Characteristics

- Input Section

Ta : 25°C, Vin : Typical Input Voltage

Characteristics		Symbol	Min.	Typ.	Max.	Unit
No-load Power Consumption	HS10 - XX				0.3	W
Operating Voltage Range	HS10 - XX	Vin	90	110, 220	264	Vac
Frequency	HS10 - XX		44	50, 60	440	Hz
Maximum Input Current (Vin : rated, Io : 100%)	HS10 - XX	Iin		0.21		A
Maximum No Load Input Current (Vin : rated)	HS10 - XX					mA
Inrush Current (In : 220Vac)	HS10 - XX				60	A
Leakage Current (In : 220Vac)	HS10 - 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	%
	Dual		-	-	±3	
Regulation	Line Regulation (From min. Vin to max. Vin, constant load)		-	-	±1	%
	Load Regulation (From no load to maximum load)		-	-	±1 ±2.5	%(@Single) %(@Dual)
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	HS10 - 05	I _o	-	-	2	A
	HS10 - 12		-	-	0.9	
	HS10 - 15		-	-	0.7	
	HS10 - 24		-	-	0.45	
	HSD10 - 1212	I _o	-	-	0.45	
	HSD10 - 1515		-	-	0.35	
Output Current Limit (OCP : Over Current Protection, recovers automatically)			105	-	-	%
Dynamic Load Response (V _{in} : rated, I _o : from 10% to 100%, from 100% to 10%, BW : 20MHz, Freq. : 100Hz, Duty : 0.5, Tr/Tf : 100us)			-	-	3% of V _{out}	mV (peak to peak)
Start - Up Time		T _{start}				ms
Turn - on Overshoot			-	-	5	%
Efficiency (V _{in} : Rated, I _o : Max.)	HS10 - 05		-	78	-	%
	HS10 - 12		-	82	-	
	HS10 - 15		-	82	-	
	HS10 - 24		-	82	-	
	HSD10 - 1212		-	80	-	
	HSD10 - 1515		-	81	-	

4. 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

5. 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				
External Trim Adj. Range (TRM Pin, Vout variation by external parts)	TRM				
Switching Frequency			100		kHz
MTBF (MIL-HDBK-217F)		4.1 x 10 ⁵			hrs
Dimension (L x W x H)		58.0 x 45.0 x 19.5			mm
Weight		-	-	90	grams

6. Environment

Characteristics	Symbol	Min.	Typ.	Max.	Unit
Operating Temperature Range	Ta	-10	-	70	°C
Operating Humidity (non Condensing)		20	-	90	%RH
Storage Temperature	Tstg	-20	-	75	°C

- Reliability Data

1. MTBF

Calculating Reliable Values of MTBF

Calculated based on part count reliability projection of MIL-HDBK-217F individual failure rates λ_g is given to each part and MTBF is calculated by the count of each part.

Method is :

$$MTBF = \frac{10^6}{\sum_{i=1}^n Ni(\lambda_g \cdot \pi Q)_i} = \frac{10^6}{\lambda_{equip}} \quad [\text{hours}]$$

For a given equipment environment where :

λ_{equip} = Total equipment failure rate (Failures / 10⁶ Hours)

λ_g = Generic failure rate for the i th generic part (Failures / 10⁶ Hours)

πQ = Quality factor for the i th generic part ($\pi Q = 1$)

Ni = Quantity of i th generic part

n = Number of different generic part categories in the equipment

	PART	Number	Failure Rate	Failure Rate
1	Logic IC	1	0.015	0.0150000
2	FET	0	0.012	-
3	Voltage Regulaor	1	0.002	0.0020000
4	Diode (Zener)	0	0.002	-
5	Diode (FRD)	2	0.069	0.1380000
6	Diode (SBD)	1	0.027	0.0270000
7	Bridge Diode	1	0.066	0.0660000
8	LED	0	0.00023	-
9	Varistor	0	0.0013	-
10	Photo-coupler	1	0.07	0.0700000
11	Thyristor	0	0.0022	-
12	Elec.- Cap.	4	0.019	0.0760000
13	Ceramic Cap.	7	0.026	0.1820000
14	MLCC	5	0.053	0.2650000
15	Choke coil	1	0.00022	0.0002200
16	Switching transformer	1	0.0042	0.0042000
17	Line Filter	0	0.0044	-
18	Resistor	19	0.0024	0.0456000
19	Resistor Variable	0	0.0024	-
20	Thermister	1	0.0019	0.0019000
21	Connertor	5	0.052	0.2600000
22	Soldering Point	115	0.0078	0.8970000
23	PCB	1	0.37	0.3700000
24	Fuse	1	0.01	0.0100000
Total Equipment Failure Rate (λ_{equip})				2.4299200
MTBF = 10 ⁶ / λ_{equip} (F/T)				411,536.182
MTBF ≅ 410,000[Hours]				

2. Lifetime

The shortest lifetime parts is an electrolytic capacitor. Thus, the lifetime of SMPS is lifetime of electrolytic capacitors.

Lifetime of electrolytic capacitor can be calculated by the following factors.

- T_0 : Load life rating
- T_{max} : Maximum temperature rating of capacitor
- T_{case} : Temperature of case

$$T[\text{hour}] = T_0 * 2^{\frac{T_{max} - T_{case}}{10}}$$

T : Life Time(Electrolytic Cap.)
 T_0 : Load Life Rating
 T_{max} : Max. Tepmerature rating of capacitor
 T_{case} : Temperature of case

HS10-05 <(5VDC, 2A(100% Load)>, [unit : hrs]			
110Vac Input		220Vac Input	
$T_{amb.} : 25^{\circ}\text{C}$	$T_{amb.} : 50^{\circ}\text{C}$	$T_{amb.} : 25^{\circ}\text{C}$	$T_{amb.} : 50^{\circ}\text{C}$
72,500 hrs	12,800 hrs	> 100,000 hrs	22,000 hrs

HS10-12<(12VDC, 0.9A(100% Load)>, [unit : hrs]			
110Vac Input		220Vac Input	
$T_{amb.} : 25^{\circ}\text{C}$	$T_{amb.} : 50^{\circ}\text{C}$	$T_{amb.} : 25^{\circ}\text{C}$	$T_{amb.} : 50^{\circ}\text{C}$
84,000 hrs	15,000 hrs	> 100,000 hrs	23,000 hrs

HS10-15 <(15VDC, 0.7A(100% Load)>, [unit : hrs]			
110Vac Input		220Vac Input	
$T_{amb.} : 25^{\circ}\text{C}$	$T_{amb.} : 50^{\circ}\text{C}$	$T_{amb.} : 25^{\circ}\text{C}$	$T_{amb.} : 50^{\circ}\text{C}$
87,000 hrs	15,000 hrs	> 100,000 hrs	23,000 hrs

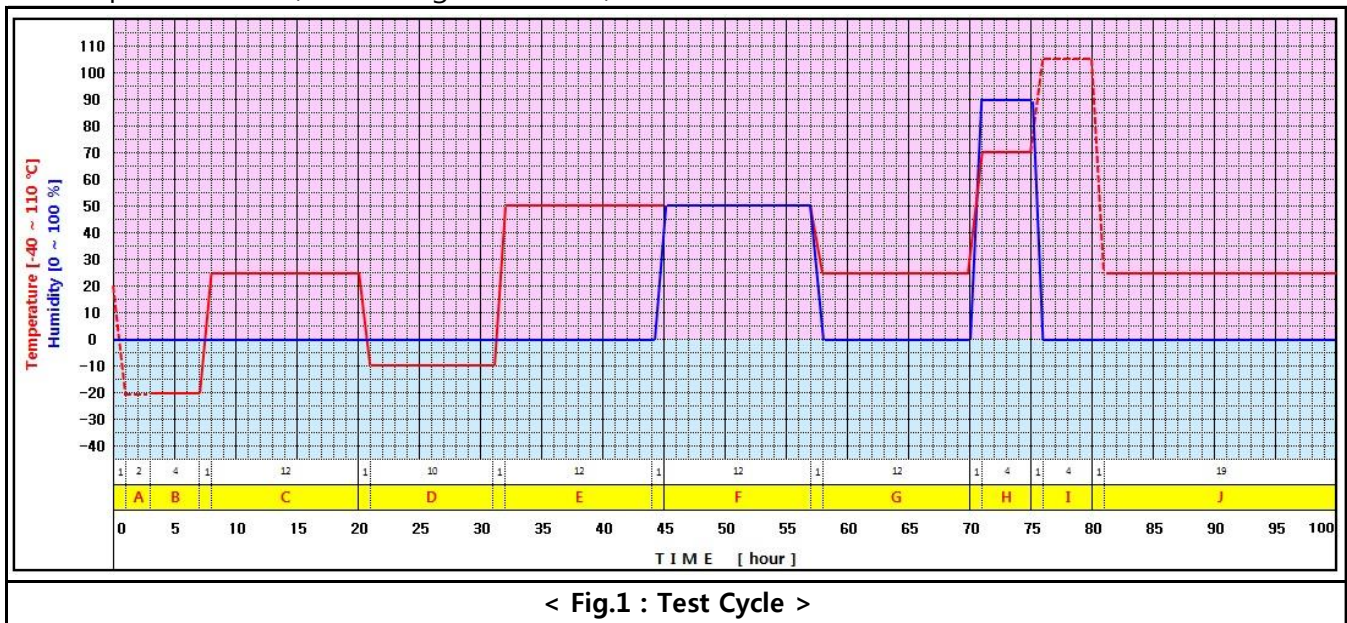
HS10-24 <(24VDC, 0.45A(100% Load)>, [unit : hrs]			
110Vac Input		220Vac Input	
$T_{amb.} : 25^{\circ}\text{C}$	$T_{amb.} : 50^{\circ}\text{C}$	$T_{amb.} : 25^{\circ}\text{C}$	$T_{amb.} : 50^{\circ}\text{C}$
90,500 hrs	16,000 hrs	> 100,000 hrs	24,000 hrs

3. Environmental Stress Test(EST)

The purpose of the environment stress test is to ensure reliability by setting in advance the following environment and verified.

- transport process and conservation status
- environmental change conditions that can be applied to the product from the process of the end-user

Test cycle consists of 10 segments(total 100 hours). Test results of all segments must meet the specifications. (refer to Fig.1 & Table1)



Segment	Time	Temp.	Humidity	Description	Input 'SW'
A	2 hours	-20°C	0%	Low temperature storage	off
B	4 hours	-20°C	0%	Low temperature operation	on
C	12 hours	25°C	0%	Room temperature operation	on
D	10 hours	-10°C	0%	Low temperature operation	on
E	12 hours	50°C	0%	High temperature operation	on
F	12 hours	50°C	50%	High-temperature & humidity operation	on
G	12 hours	25°C	0%	Room temperature operation	on
H	4 hours	70°C	90%	High-temperature & humidity operation	on
I	4 hours	105°C	0%	High temperature storage	off
J	19 hours	25°C	0%	Room temperature operation	on

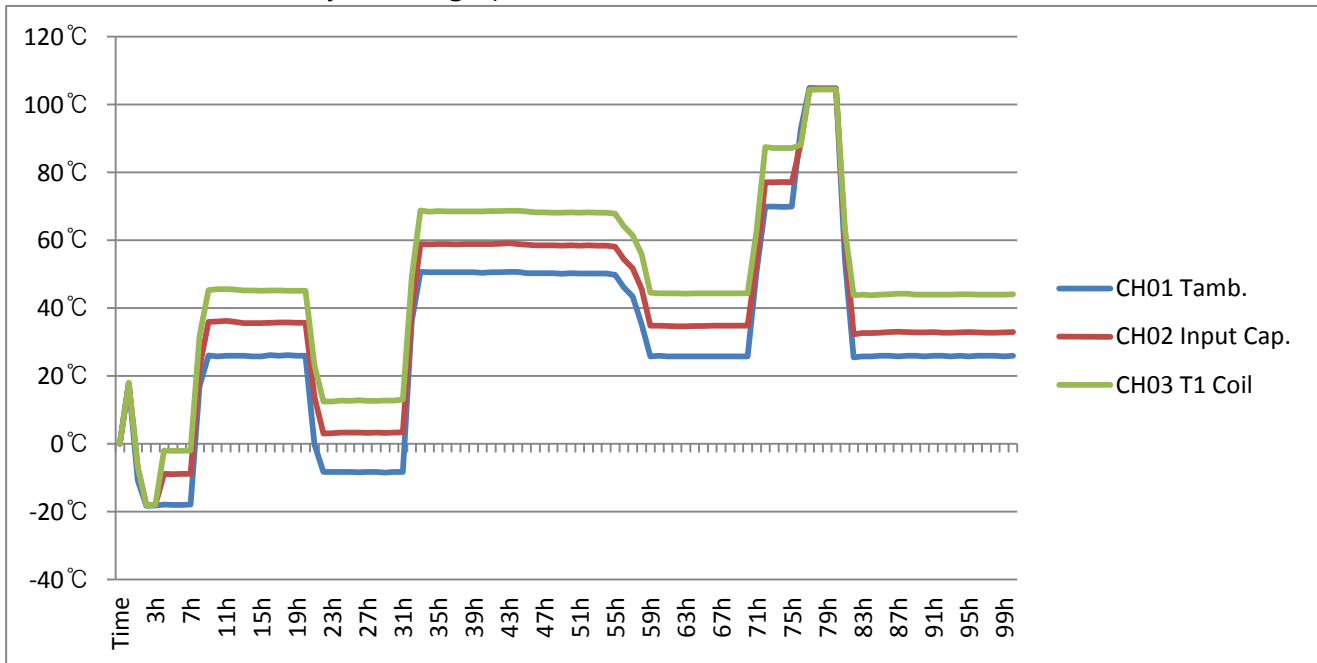
< Table1 : Segment Description >

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3.1. Environmental Stress Test Results

a. Test Sample : HS10-24

b. 100 hours in one cycle test graph



c. Characteristics test results (@ Input Voltage : 220Vac)

Segment	Test Time	T _{amb./Humi.}	Output Voltage	Start up	Ripple / Noise	Output Load Condition
A	3h	-20°C / 0%	23.75V	OK	132 / 184 [mVp-p]	50% Load
B	7h	-20°C / 0%	23.85V	OK	48 / 124 [mVp-p]	50% Load
C	10h	25°C / 0%	23.87V	OK	24 / 49 [mVp-p]	100% Load
D	24h	-10°C / 0%	23.81V	OK	44 / 86 [mVp-p]	100% Load
E	33h	50°C / 0%	23.87V	OK	18 / 46 [mVp-p]	100% Load
F	48h	50°C / 50%	23.87V	OK	22 / 46 [mVp-p]	100% Load
G	57h	25°C / 0%	23.88V	OK	20 / 45 [mVp-p]	100% Load
H	72h	70°C / 90%	23.83V	OK	22 / 48 [mVp-p]	100% Load
I	81h	25°C / 0%	23.88V	OK	22 / 47 [mVp-p]	100% Load
J	100h	25°C / 0%	23.87V	OK	24 / 42 [mVp-p]	100% Load
Test Result			Pass	Pass	Pass	

4. Main Components Δt Test

The purpose of the test is to ensure the reliability and margin by measuring the heating value of the main components.

4.1. HS10-05 (@ 100% Load)

Test Point \ Test Condition	Vin : 110Vac, 60Hz		Vin : 220Vac, 60Hz	
	T _{amb.}	27.4°C	T _{amb.}	27.6°C
	T _c	Δt	T _c	Δt
Bridge Diode	56.3°C	28.9°C	42.6°C	15.0°C
Input Cap.	55.6°C	28.2°C	48.0°C	20.4°C
PWM IC	65.5°C	38.1°C	55.4°C	27.8°C
Trans Coil	68.3°C	40.9°C	58.3°C	30.7°C
Trans Core	68.7°C	41.3°C	68.8°C	41.2°C
Output Diode	77.0°C	49.6°C	78.0°C	50.4°C
Output Cap.	48.8°C	21.4°C	49.0°C	21.4°C

4.2. HS10-12 (@ 100% Load)

Test Point \ Test Condition	Vin : 110Vac, 60Hz		Vin : 220Vac, 60Hz	
	T _{amb.}	29.0°C	T _{amb.}	28.6°C
	T _c	Δt	T _c	Δt
Bridge Diode	50.5°C	21.5°C	38.8°C	10.2°C
Input Cap.	55.0°C	26.0°C	48.2°C	19.6°C
PWM IC	63.1°C	34.1°C	56.0°C	27.4°C
Trans Coil	65.3°C	36.3°C	57.3°C	28.7°C
Trans Core	63.5°C	34.5°C	64.0°C	35.4°C
Output Diode	66.5°C	37.5°C	67.0°C	38.4°C
Output Cap.	43.5°C	14.5°C	43.5°C	14.9°C

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4.3. HS10-15 (@ 100% Load)

Test Point \ Test Condition	Vin : 110Vac, 60Hz		Vin : 220Vac, 60Hz	
	T _{amb.}	27.4°C	T _{amb.}	28.8°C
	T _c	Δt	T _c	Δt
Bridge Diode	51.4°C	24.0°C	39.7°C	10.9°C
Input Cap.	53.0°C	25.6°C	48.4°C	19.6°C
PWM IC	62.1°C	34.7°C	55.0°C	26.2°C
Trans Coil	65.0°C	37.6°C	57.0°C	28.2°C
Trans Core	63.7°C	36.3°C	63.7°C	34.9°C
Output Diode	61.7°C	34.3°C	64.5°C	35.7°C
Output Cap.	41.8°C	14.4°C	42.2°C	13.4°C

4.4. HS10-24 (@ 100% Load)

Test Point \ Test Condition	Vin : 110Vac, 60Hz		Vin : 220Vac, 60Hz	
	T _{amb.}	26.1°C	T _{amb.}	27.3°C
	T _c	Δt	T _c	Δt
Bridge Diode	51.0°C	24.9°C	37.6°C	10.3°C
Input Cap.	51.1°C	25.0°C	46.6°C	19.3°C
PWM IC	55.9°C	29.8°C	45.8°C	18.5°C
Trans Coil	61.5°C	35.4°C	57.3°C	30.0°C
Trans Core	58.3°C	32.2°C	59.8°C	32.5°C
Output Diode	58.1°C	32.0°C	61.5°C	34.2°C
Output Cap.	38.2°C	12.1°C	40.3°C	13.0°C

5. Derating of Semiconductor

Compare T_{jmax} (maximum junction temperature) and T_j and is expressed as a percentage. T_j is the value calculated by the temperature of the case and the power dissipation and the thermal impedance.

- Measuring Components : Bridge Diode, FET, Rectifier diode
- Calculating method of derating ratio

$$\text{Derating Ratio} = \frac{T_j}{T_{j(max)}} \times 100 \text{ [%]}$$

$$T_j = T_c + (R_{\theta(J-C)} \times P_d)$$

T_c : Case Temperature

$R_{\theta(J-C)}$: Thermal impedance between junction and case

P_d : Power dissipation

5.1. HS10-05

Condition		Vin : 110Vac, 60Hz		Load : 100%	T _{amb.} : 50°C
Components					
BD1 (Bridge Diode)	T _{j(max)} : 150 °C	P _d : 0.31 W		T _j = 86.7 °C	Derating Ratio = 57.8%
	R _{θ(J-A)} : 25 °C/W				
	T _c : 78.9°C				
IC1 (IC + FET)	T _{j(max)} : 130 °C	P _d : 0.18 W		T _j = 104.3 °C	Derating Ratio = 80.2%
	R _{θ(J-A)} : 90 °C/W				
	T _c : 88.1°C				
D4 (Rectifier Diode)	T _{j(max)} : 150 °C	P _d : 1.1 W		T _j = 127.1 °C	Derating Ratio = 84.7%
	R _{θ(J-A)} : 25 °C/W				
	T _c : 99.6°C				
Condition		Vin : 220Vac, 60Hz		Load : 100%	T _{amb.} : 50°C
Components					
BD1 (Bridge Diode)	T _{j(max)} : 150 °C	P _d : 0.18 W		T _j = 69.5 °C	Derating Ratio = 46.3%
	R _{θ(J-A)} : 25 °C/W				
	T _c : 65°C				
IC1 (IC + FET)	T _{j(max)} : 130 °C	P _d : 0.05 W		T _j = 82.3 °C	Derating Ratio = 63.3%
	R _{θ(J-A)} : 90 °C/W				
	T _c : 77.8°C				
D4 (Rectifier Diode)	T _{j(max)} : 150 °C	P _d : 1.1 W		T _j = 127.9 °C	Derating Ratio = 85.3%
	R _{θ(J-A)} : 25 °C/W				
	T _c : 100.4°C				

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5.2. HS10-12

Condition		Vin : 110Vac, 60Hz		Load : 100%	T _{amb.} : 50°C
Components					
BD1 (Bridge Diode)	T _{j(max)} : 150 °C	P _d : 0.34 W		T _j = 80.0 °C	Derating Ratio = 53.3%
	R _{Θ(J-A)} : 25 °C/W				
	T _C : 71.5°C				
IC1 (IC + FET)	T _{j(max)} : 130 °C	P _d : 0.20 W		T _j = 102.1 °C	Derating Ratio = 78.5%
	R _{Θ(J-A)} : 90 °C/W				
	T _C : 84.1°C				
D4 (Rectifier Diode)	T _{j(max)} : 150 °C	P _d : 0.72 W		T _j = 94.7 °C	Derating Ratio = 63.1%
	R _{Θ(J-A)} : 10 °C/W				
	T _C : 87.5°C				
Condition		Vin : 220Vac, 60Hz		Load : 100%	T _{amb.} : 50°C
Components					
BD1 (Bridge Diode)	T _{j(max)} : 150 °C	P _d : 0.19 W		T _j = 65.0 °C	Derating Ratio = 43.3%
	R _{Θ(J-A)} : 25 °C/W				
	T _C : 60.2°C				
IC1 (IC + FET)	T _{j(max)} : 130 °C	P _d : 0.05 W		T _j = 81.9 °C	Derating Ratio = 63.0%
	R _{Θ(J-A)} : 90 °C/W				
	T _C : 77.4°C				
D4 (Rectifier Diode)	T _{j(max)} : 150 °C	P _d : 0.72 W		T _j = 95.6 °C	Derating Ratio = 63.7%
	R _{Θ(J-A)} : 10 °C/W				
	T _C : 88.4°C				

5.3. HS10-15

Condition		Vin : 110Vac, 60Hz		Load : 100%	T _{amb.} : 50°C
Components					
BD1 (Bridge Diode)	T _{j(max)} : 150 °C	P _d : 0.31 W		T _j = 81.8 °C	Derating Ratio = 54.5%
	R _{Θ(J-A)} : 25 °C/W				
	T _C : 74.0°C				
IC1 (IC + FET)	T _{j(max)} : 130 °C	P _d : 0.18 W		T _j = 100.9 °C	Derating Ratio = 77.6%
	R _{Θ(J-A)} : 90 °C/W				
	T _C : 84.7°C				
D4 (Rectifier Diode)	T _{j(max)} : 150 °C	P _d : 0.56 W		T _j = 89.9 °C	Derating Ratio = 59.9%
	R _{Θ(J-A)} : 10 °C/W				
	T _C : 84.3°C				
Condition		Vin : 220Vac, 60Hz		Load : 100%	T _{amb.} : 50°C
Components					
BD1 (Bridge Diode)	T _{j(max)} : 150 °C	P _d : 0.18 W		T _j = 65.4 °C	Derating Ratio = 43.6%
	R _{Θ(J-A)} : 25 °C/W				
	T _C : 60.9°C				
IC1 (IC + FET)	T _{j(max)} : 130 °C	P _d : 0.05 W		T _j = 80.7 °C	Derating Ratio = 62.1%
	R _{Θ(J-A)} : 90 °C/W				
	T _C : 76.2°C				
D4 (Rectifier Diode)	T _{j(max)} : 150 °C	P _d : 0.56 W		T _j = 91.3 °C	Derating Ratio = 60.9%
	R _{Θ(J-A)} : 10 °C/W				
	T _C : 85.7°C				

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5.4. HS10-24

Condition		Vin : 110Vac, 60Hz		Load : 100%	T _{amb.} : 50°C
Components					
BD1 (Bridge Diode)	T _{j(max)} : 150 °C	P _d : 0.32 W		T _j = 82.9 °C	Derating Ratio = 55.3%
	R _{Θ(J-A)} : 25 °C/W				
	T _C : 74.9°C				
IC1 (IC + FET)	T _{j(max)} : 130 °C	P _d : 0.19 W		T _j = 96.9 °C	Derating Ratio = 74.5%
	R _{Θ(J-A)} : 90 °C/W				
	T _C : 79.8°C				
D4 (Rectifier Diode)	T _{j(max)} : 150 °C	P _d : 0.45 W		T _j = 97.8 °C	Derating Ratio = 65.2%
	R _{Θ(J-A)} : 35 °C/W				
	T _C : 82.0°C				
Condition		Vin : 220Vac, 60Hz		Load : 100%	T _{amb.} : 50°C
Components					
BD1 (Bridge Diode)	T _{j(max)} : 150 °C	P _d : 0.19 W		T _j = 65.1 °C	Derating Ratio = 43.4%
	R _{Θ(J-A)} : 25 °C/W				
	T _C : 60.3°C				
IC1 (IC + FET)	T _{j(max)} : 130 °C	P _d : 0.05 W		T _j = 73.0 °C	Derating Ratio = 56.2%
	R _{Θ(J-A)} : 90 °C/W				
	T _C : 68.5°C				
D4 (Rectifier Diode)	T _{j(max)} : 150 °C	P _d : 0.45 W		T _j = 100.0 °C	Derating Ratio = 66.7%
	R _{Θ(J-A)} : 35 °C/W				
	T _C : 84.2°C				

6. Abnormal Test

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Report Reference No.: 077-213647-000



Clause	Requirement – Test	Result – Remark	Verdict
5.2	TABLE: electric strength tests, impulse tests and voltage surge tests		P
	test voltage applied between:	test voltage (V) a.c. / d.c.	breakdown Yes / No
	Primary to secondary of unit	3000Vac	No
	Primary to body	3000Vac	No
	Primary to Ground	1772Vac	No
	Primary to Secondary of Transformer(T1)	3000Vac	No
	supplementary information		

5.3	TABLE: fault condition tests					P
	ambient temperature (°C)	22 °C				—
	model/type of power supply	HS10-12, HS10-05				—
	manufacturer of power supply	Open Digital Power				—
	rated markings of power supply	100-240V~				—
component No.	fault	test voltage (V)	test time	fuse No.	fuse current (A)	result
1. BD1 (L) – (+)	s/c	254	1 sec	F1	1,6	Immediately fuse(F1) opened. No hazard.
2. BD1 (N) – (-)	s/c	254	1 sec	F1	1,6	Immediately fuse(F1) opened. No hazard.
3. C5	s/c	254	1 sec	F1	1,6	Immediately fuse(F1) opened. No hazard.
4. D1	s/c	254	30 min	F1	1,6	Immediately Unit shut down. No hazard.
5. IC01 #7-8	s/c	254	10 min	F1	1,6	Immediately Unit shut down. No hazard.
6. IC01 #2-7	s/c	254	10 min	F1	1,6	Immediately Unit shut down. No hazard.
7. IC01 #2-4	s/c	254	1 sec	F1	1,6	Immediately fuse(F1)open. IC01, ZD1 damage. No hazard.
8. PC1 #3-4	s/c	254	30 min	F1	1,6	Immediately Unit shut down. No hazard.
9. PC1 #1-2	s/c	254	30 min	F1	1,6	Immediately Unit shut down. No hazard.
10. D3	s/c	254	10 min	F1	1,6	Immediately Unit shut down. No hazard.

Test Report EN/IEC 60950-1b Rev. 00 / 2003-04

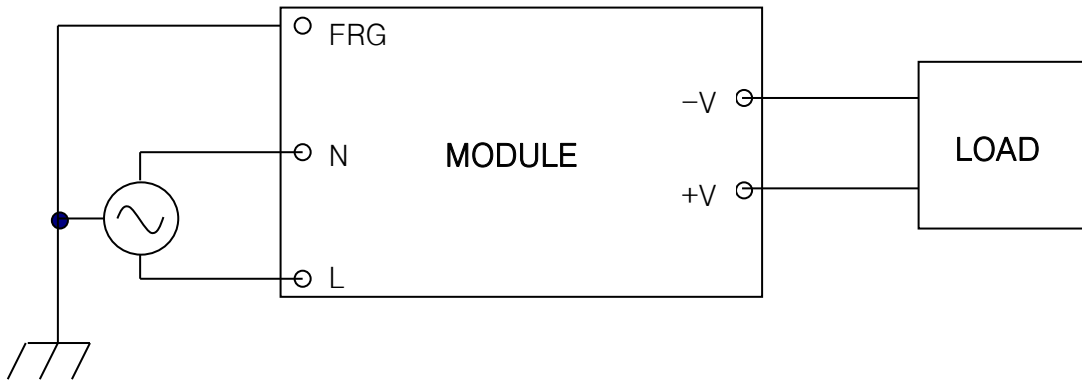
Clause	Requirement – Test					Result – Remark	Verdict
component No.	fault	test voltage (V)	test time	fuse No.	fuse current (A)	result	
11. DC Output	s/c	254	30 min	F1	1,6	Immediately Unit shut down. No hazard.	
12. T1 #S-W (for model HS10-12)	Over load	254	1 hour	F1	-	Max. 1,2A T1 coil: 84,3 °C Ambient: 21,6 °C	
13. T101 #S-W (for model HS10-05)	Over load	254	1 hour	F1	-	Max. 2,5A T1 coil: 94,3 °C Ambient: 21,6 °C	
14. BD1 (L) – (+)	s/c	90	1 sec	F1	1,6	Immediately fuse(F1) opened. No hazard.	
15. BD1 (N) – (-)	s/c	90	1 sec	F1	1,6	Immediately fuse(F1) opened. No hazard.	
16. C5	s/c	90	1 sec	F1	1,6	Immediately fuse(F1) opened. No hazard.	
17. IC01 #2-4	s/c	90	1 sec	F1	1,6	Immediately fuse(F1)open. IC01, ZD1 damage. No hazard.	
supplementary information							
s/c: short circuit, #: pin No.,							

Note Before placing the products in the different countries the manufacturer has to guarantee that:

1. Operating instructions and warnings are written in an accepted language of the certain country.
2. The equipment is in compliance with the national standards of the certain country.

- Application Sheet

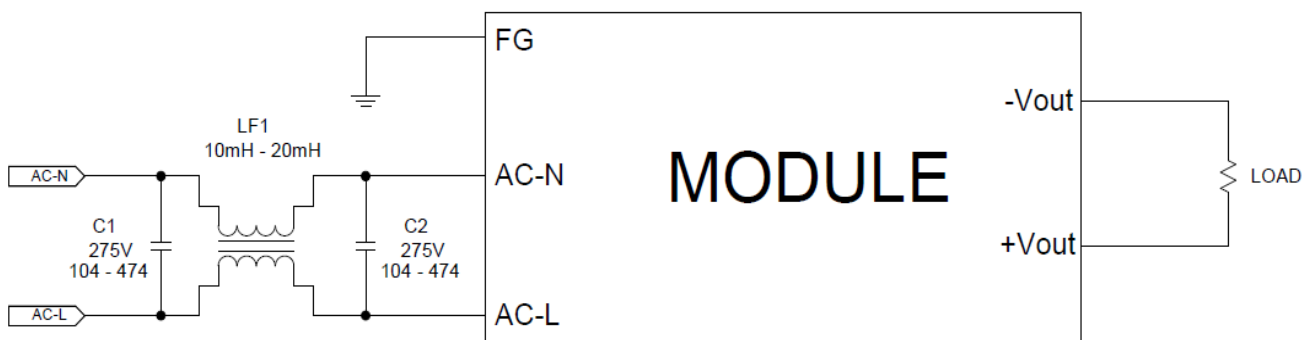
1. Basic Connection



AC INPUT : 90Vac ~ 264Vac (Free Voltage)

- ※ For safety and improved noise, ensure secure connection of the FRG Pin 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.

2. EMI(Electro Magnetic Interference) Connection



C1, C2	Y-Cap. AC 250V ~ 400V / 1000pF ~ 2200pF
LF1	Common mode line filter 10mH ~ 20mH

3. Input Section

Input Fuse

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

< Fuse Rating table > Type : SS5, Time-Lag

	HS10	HS15
Fuse	1.6A	1.6A

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

4. 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.

5. Protection

Over Current Protection

The HS 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.

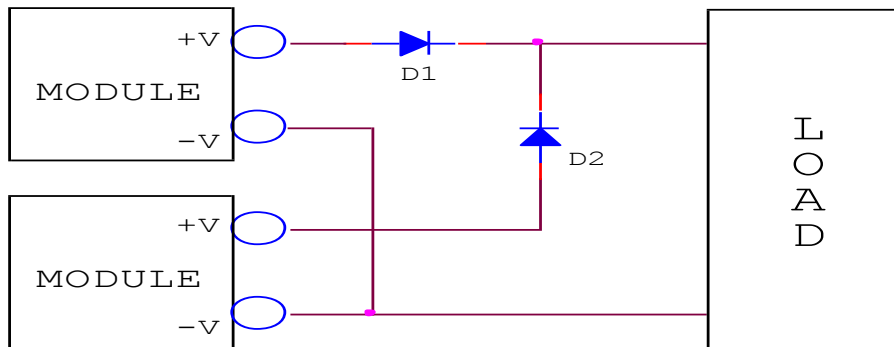
Short Circuit Protection

The HS 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.

6. 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}) : $V_{rm} > 1.5 \times V_o$

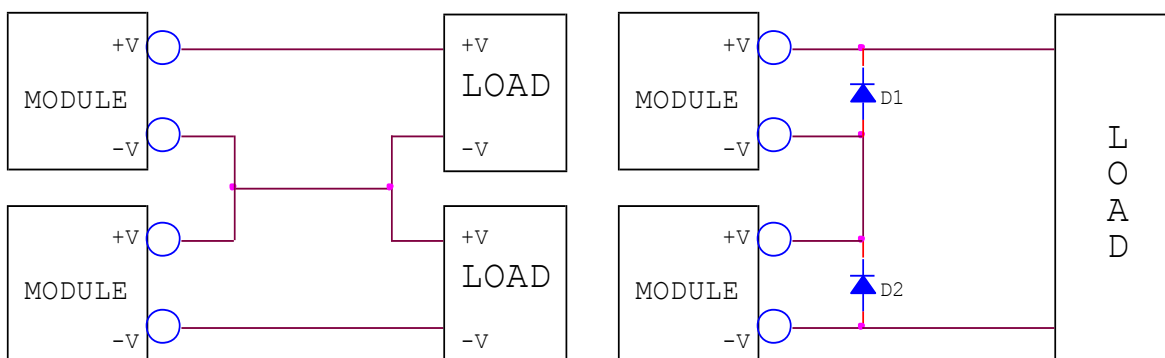
Forward current(I_f) : $I_f > 3 \times I_o$

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.

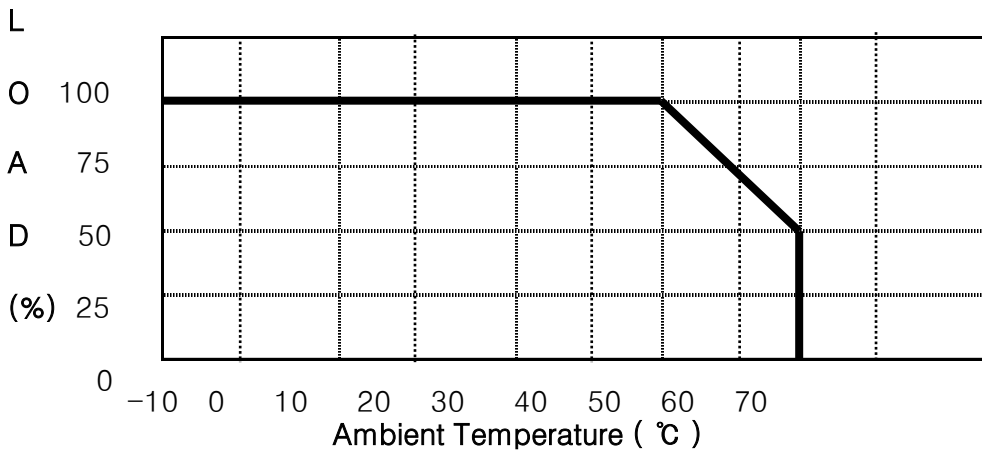
Power loss = $V_f(\text{forward voltage}) \times I_o(\text{output current})$

7. 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 -10°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 -20°C to 75°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

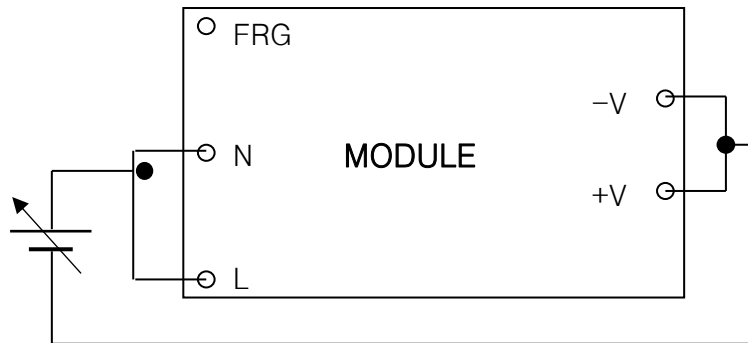
The range of ambient humidity in % over which a module may be stored long term without damage. The storage humidity range is from 20% to 90%RH.

8. Isolation

Isolation Resistance

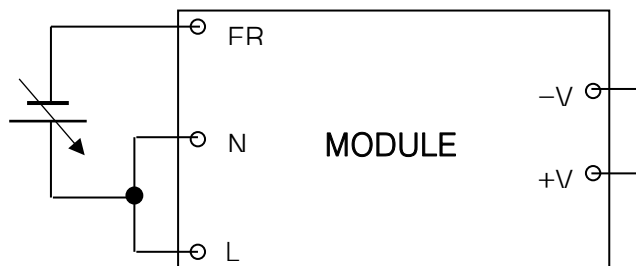
The electrical separation between input and output of a module by means of the power transformer. The isolation resistance is a function of materials and spacings employed throughout the module. Please don't test with a voltage above standard voltage for the Isolation Resistance Test.

< INPUT - OUTPUT >



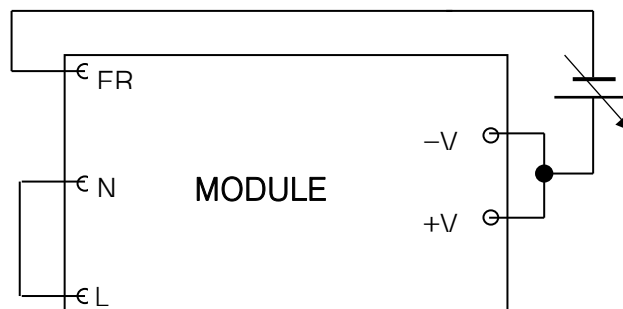
500VDC, 100MΩ

< INPUT - FRG >



500VDC, 100MΩ

< OUTPUT - FRG >



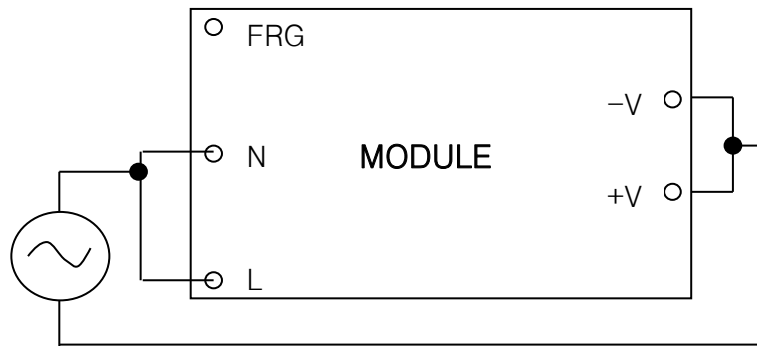
500VDC, 70MΩ

HS10 Series AC-DC Converter

Withstand Voltage

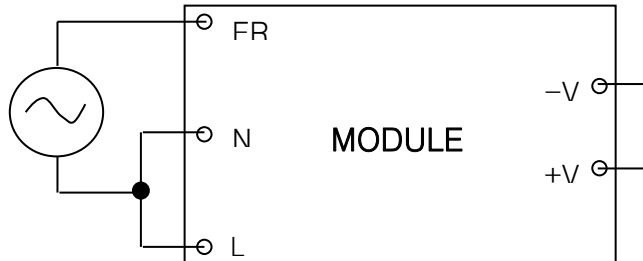
For the withstand voltage test, the applied voltage must be increased gradually from zero to the testing value, and then decreased gradually at shut down. Especially stay away from use of a timer. Where a pulse of several times the applied voltage can be generated.

< INPUT - OUTPUT >



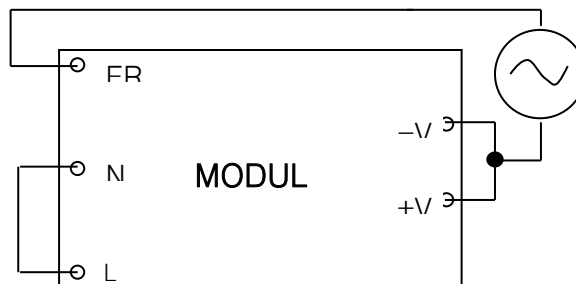
3kVAC (10mA) 1minute

< INPUT - FRG >



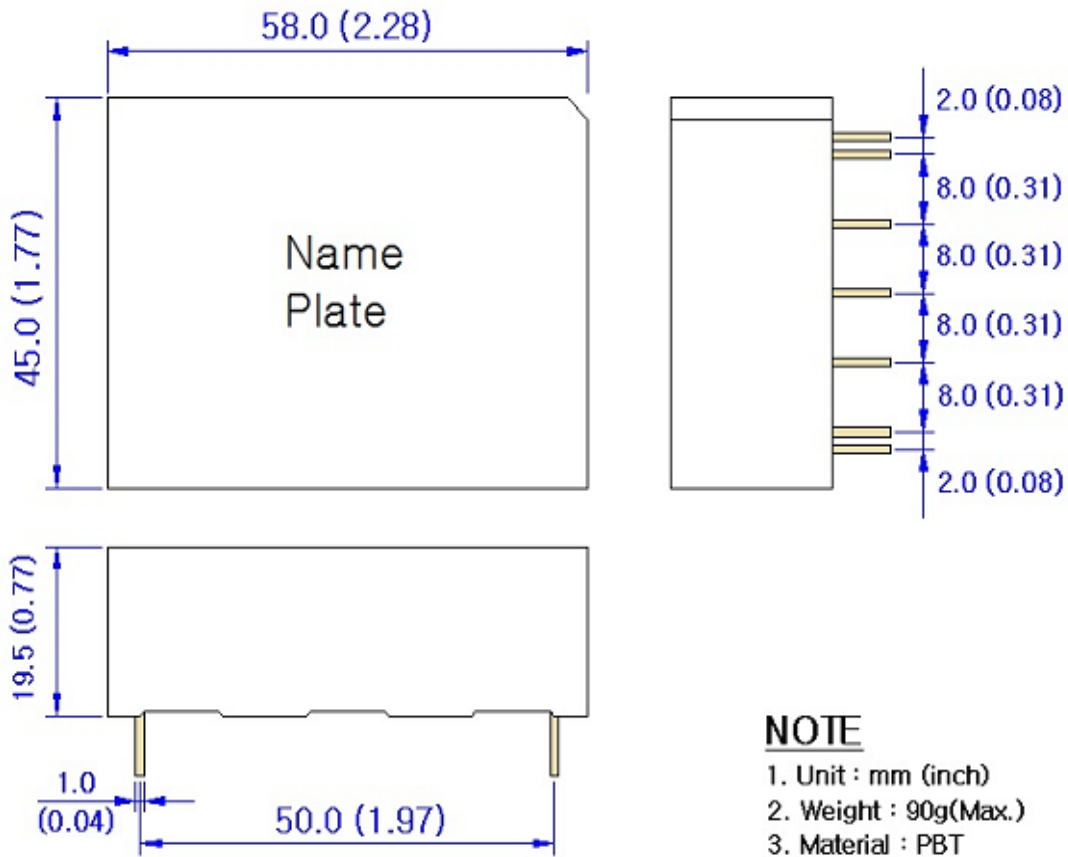
2kVAC (10mA) 1minute

< OUTPUT - FRG >



0.5kVAC (10mA) 1minute

9. Outline Dimensions <Unit : mm (inch)>



Mounting Hole <Top View>

