

DATASHEET & RELIABILITY DATA

HS30 SERIES(TB Type)

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Open Digital Power Corp.

Contents

- Introduction	-----	3~4 page
- Datasheet	-----	5~8 page
1. Internal Circuit Architecture		
2. Maximum Ratings		
3. Electrical Characteristics		
4. Isolation Characteristics		
5. General Characteristics		
6. Environment		
- Reliability Data	-----	9~20 page
1. MTBF		
2. Life Time		
3. Environmental Stress Test		
4. Main Components Δt Test		
5. Derating of semiconductor(Bridge Diode, FET, Rectifier diode)		
6. Abnormal Test		
- Application Sheet	-----	21~27 page
1. Basic Connection		
2. EMI(Electro Magnetic Interference) Connection		
3. Input Section		
4. Output Section		
5. Protection		
6. Operating Method		
7. Environment		
8. Isolation		
9. Outline Dimensions		

MAX. Power 30W Isolated Terminal Block Type AC-DC Converter

HS30 Series(TB Type) Isolated Terminal Block Type AC-DC Converter



Features

- Power Saving Mode Operation
- Small, High Efficiency
- Isolated Input – Output
- Quasi-resonant operation and Current mode Control
- Low output Ripple & Noise
- Built-in over current protection circuit
- Built-in over Voltage protection circuit
- Short Circuit Protection
- Universal Input Voltage(Free Voltage)
- Built in EMI Filter
- Safety standard (IEC, EN 60950-1)
AC-DC Converter : CB, CE approved
Mold Base : Meets CB, CE standard
- RoHS compatible design

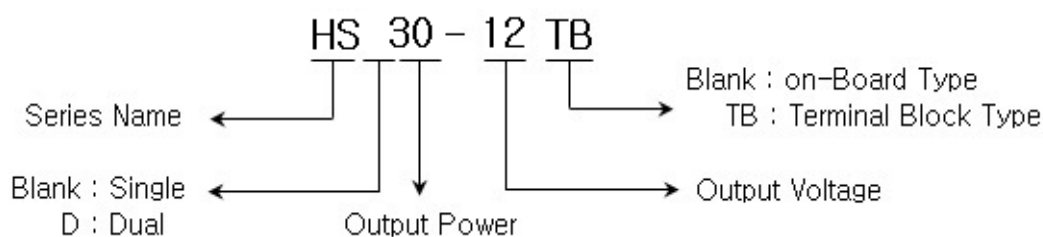
Applications

- Data and telecommunication
- FA control
- Datacommunication electronic equipments

Environment

- Operating Temperature : -10℃ ~ 70℃
- Operating Humidity : 20% ~ 90% RH (Non condensing)
- Storage Temperature : -20℃ ~ 75℃
- Cooling : Free-Air Convection
- MTBF : 3.1 x 10⁵ hrs

Model Name Structure



Pin assignments & Function



<Top View>

- Single Output Name & Function

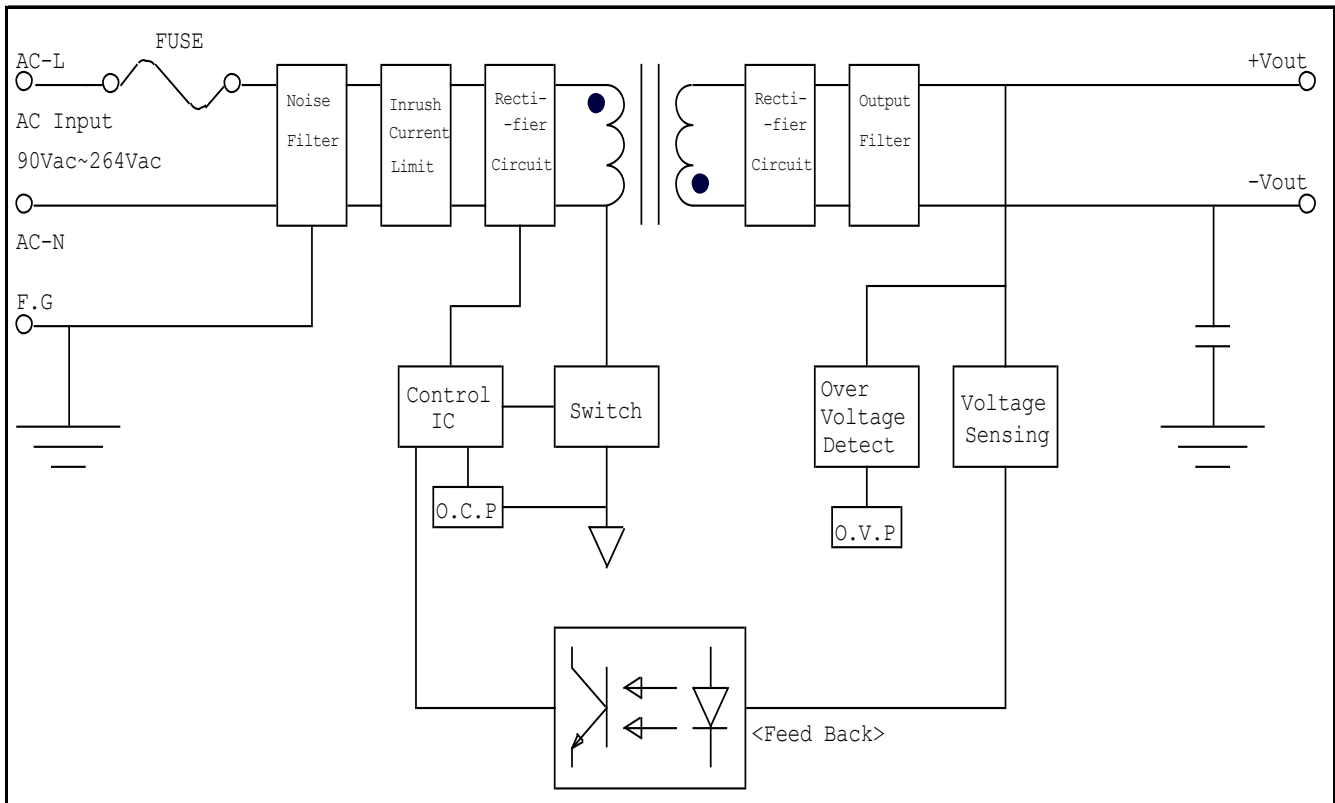
PIN No.	NAME	FUNCTION
1	AC input L	AC input N
2	AC input N	AC input L
3	FRG	Frame Ground
4	+Vout	Positive terminal for Vout
5	+Vout	Positive terminal for Vout
6	-Vout	Negative terminal for Vout
7	-Vout	Negative terminal for Vout

- Dual Output Name & Function

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

- Datasheet

1. Internal Circuit Architecture



2. Maximum Ratings

Characteristics		Symbol	Min.	Typ.	Max.	Unit
No-load Power Consumption	HS30-05,12,15,24 TB				0.3	W
	HS30-48TB				0.5	
Frequency	HS30 - XXTB		44	-	440	Hz
Input Voltage Continuous	HS30 - 05TB	Vin	90	-	264	Vac
	HS30 - 12TB		90	-	264	
	HS30 - 15TB		90	-	264	
	HS30 - 24TB		90	-	264	
	HS30 - 48TB		90	-	264	
Input Voltage Continuous	HSD30 - 1212TB		90	-	264	Vac
	HSD30 - 1515TB		90	-	264	
Operating Ambient Temperature		Ta	-10	-	70	℃
Storage Temperature		Tstg	-20	-	75	℃
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	HS30-05,12,15,24 TB				0.3	W
	HS30-48TB				0.5	
Operating Voltage Range	HS30 - XXTB	Vin	90	110, 220	264	Vac
Frequency	HS30 - XXTB		44	50, 60	440	Hz
Maximum Input Current (Vin : rated, Io : 100%)	HS30 - XXTB	Iin		0.54		A
Maximum No Load Input Current (Vin : rated)	HS30 - XXTB			30		mA
Inrush Current (In : 220Vac)	HS30 - XXTB				60	A
Leakage Current (In : 220Vac)	HS30 - XXTB				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		mVp-p	-	-	1% of Vout	mV (peak to peak)
(Vin : Rated, Io : Max., BW : 20MHz)						

HS30 Series(TB Type) AC-DC Converter

Characteristics		Symbol	Min.	Typ.	Max.	Unit
Output Current	HS30 - 05TB	I _o	-	-	6	A
	HS30 - 12TB		-	-	2.5	
	HS30 - 15TB		-	-	2	
	HS30 - 24TB		-	-	1.25	
	HS30 - 48TB		-	-	0.63	
	HSD30 - 1212TB	I _o	-	-	1.25	
	HSD30 - 1515TB		-	-	1	
Output Current Limit (OCP : Over Current Protection, recovers automatically)			105	-	-	%
Dynamic Load Response (V _{in} : rated, I _o : from 50% to 100%, from 100% to 50%, 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.)	HS30 - 05TB		-	81	-	%
	HS30 - 12TB		-	88	-	
	HS30 - 15TB		-	88	-	
	HS30 - 24TB		-	87	-	
	HS30 - 48TB		-	86	-	
	HSD30 - 1212TB		-	86	-	
	HSD30 - 1515TB		-	86	-	

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					kHz
MTBF (MIL-HDBK-217F)		3.1 x 10 ⁵			hrs
Dimension (L x W x H)		106.5 x 58.5 x 30.0			mm
Weight		-	-	225	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	2	0.015	0.0300000
2	FET	3	0.012	0.0360000
3	Voltage Regulaor	1	0.002	0.0020000
4	Diode (Zener)	4	0.002	0.0080000
5	Diode (FRD)	7	0.069	0.4830000
6	Diode (SBD)	0	0.027	-
7	Bridge Diode	0	0.066	-
8	LED	0	0.00023	-
9	Varistor	1	0.0013	0.0013000
10	Photo-coupler	1	0.07	0.0700000
11	Thyristor	0	0.0022	-
12	Elec. - Cap.	5	0.019	0.0950000
13	Ceramic Cap.	4	0.026	0.1040000
14	MLCC	8	0.053	0.4240000
15	Choke coil	1	0.00022	0.0002200
16	Switching transformer	1	0.0042	0.0042000
17	Line Filter	1	0.0044	0.0044000
18	Resistor	31	0.0024	0.0744000
19	Resistor Variable	0	0.0024	-
20	Thermister	1	0.0019	0.0019000
21	Connertor	8	0.052	0.4160000
22	Soldering Point	138	0.0078	1.0764000
23	PCB	1	0.37	0.3700000
24	Fuse	1	0.01	0.0100000
Total Equipment Failure Rate (λ_{equip})				3.2108200
MTBF = 10 ⁶ / λ_{equip} (F/T)				311,446.920
MTBF ≅ 310,000[Hours]				

HS30 Series(TB Type) AC-DC Converter

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. Temperature rating of capacitor
 T_{case} : Temperature of case

HS30-05TB <(5VDC, 6A(100% Load)>, [unit : hrs]

110Vac Input		220Vac Input	
$T_{amb.} : 25^{\circ}\text{C}$	$T_{amb.} : 50^{\circ}\text{C}$	$T_{amb.} : 25^{\circ}\text{C}$	$T_{amb.} : 50^{\circ}\text{C}$
57,000 hrs	10,000 hrs	73,500 hrs	13,000 hrs

HS30-12TB <(12VDC, 2.5A(100% Load)>, [unit : hrs]

110Vac Input		220Vac Input	
$T_{amb.} : 25^{\circ}\text{C}$	$T_{amb.} : 50^{\circ}\text{C}$	$T_{amb.} : 25^{\circ}\text{C}$	$T_{amb.} : 50^{\circ}\text{C}$
76,500 hrs	13,500 hrs	97,000 hrs	17,000 hrs

HS30-15TB <(15VDC, 2.0A(100% Load)>, [unit : hrs]

110Vac Input		220Vac Input	
$T_{amb.} : 25^{\circ}\text{C}$	$T_{amb.} : 50^{\circ}\text{C}$	$T_{amb.} : 25^{\circ}\text{C}$	$T_{amb.} : 50^{\circ}\text{C}$
90,000 hrs	16,000 hrs	> 100,000 hrs	18,500 hrs

HS30-24TB <(24VDC, 1.25A(100% Load)>, [unit : hrs]

110Vac Input		220Vac Input	
$T_{amb.} : 25^{\circ}\text{C}$	$T_{amb.} : 50^{\circ}\text{C}$	$T_{amb.} : 25^{\circ}\text{C}$	$T_{amb.} : 50^{\circ}\text{C}$
73,000 hrs	13,000 hrs	95,000 hrs	16,500 hrs

HS30-48TB <(24VDC, 0.63A(100% Load)>, [unit : hrs]

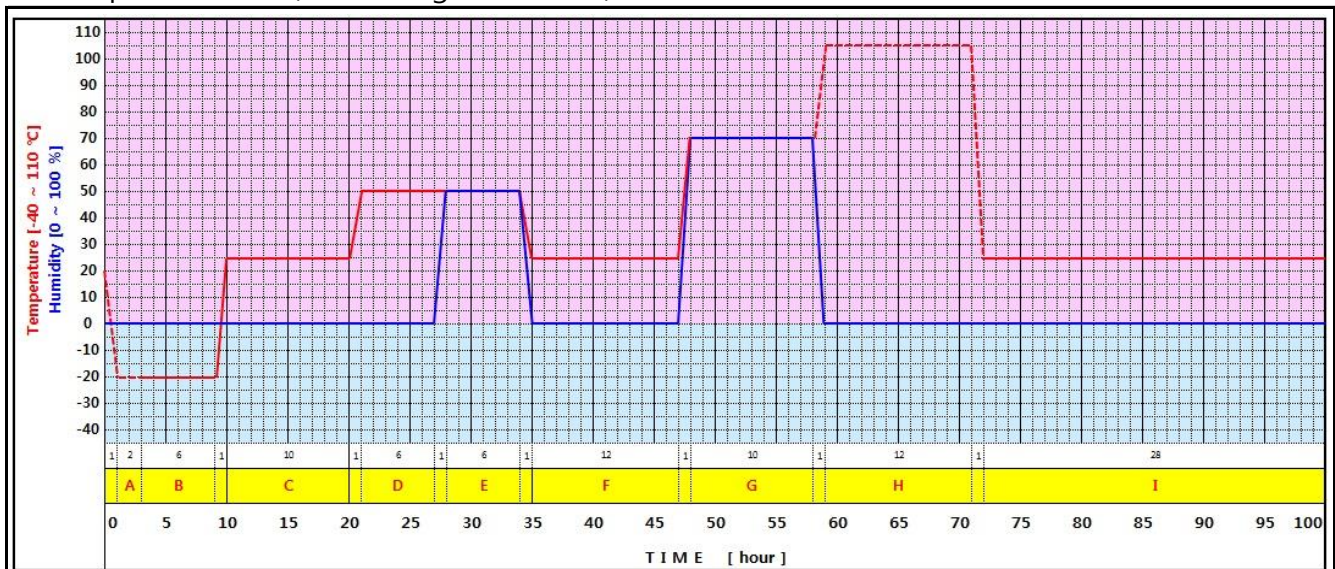
110Vac Input		220Vac Input	
$T_{amb.} : 25^{\circ}\text{C}$	$T_{amb.} : 50^{\circ}\text{C}$	$T_{amb.} : 25^{\circ}\text{C}$	$T_{amb.} : 50^{\circ}\text{C}$
85,000 hrs	15,000 hrs	91,500 hrs	16,000 hrs

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)



< Fig.1 : Test Cycle >

Segment	Time	Temp.	Humidity	Description	Input 'SW'
A	2 hours	-20°C	0%	Low temperature storage	off
B	6 hours	-20°C	0%	Low temperature operation	on
C	10 hours	25°C	0%	Room temperature operation	on
D	6 hours	50°C	0%	High temperature operation	on
E	6 hours	50°C	50%	High-temperature & humidity operation	on
F	12 hours	25°C	0%	Room temperature operation	on
G	10 hours	70°C	70%	High-temperature & humidity operation	on
H	12 hours	105°C	0%	High temperature storage	off
I	28 hours	25°C	0%	Room temperature operation	on

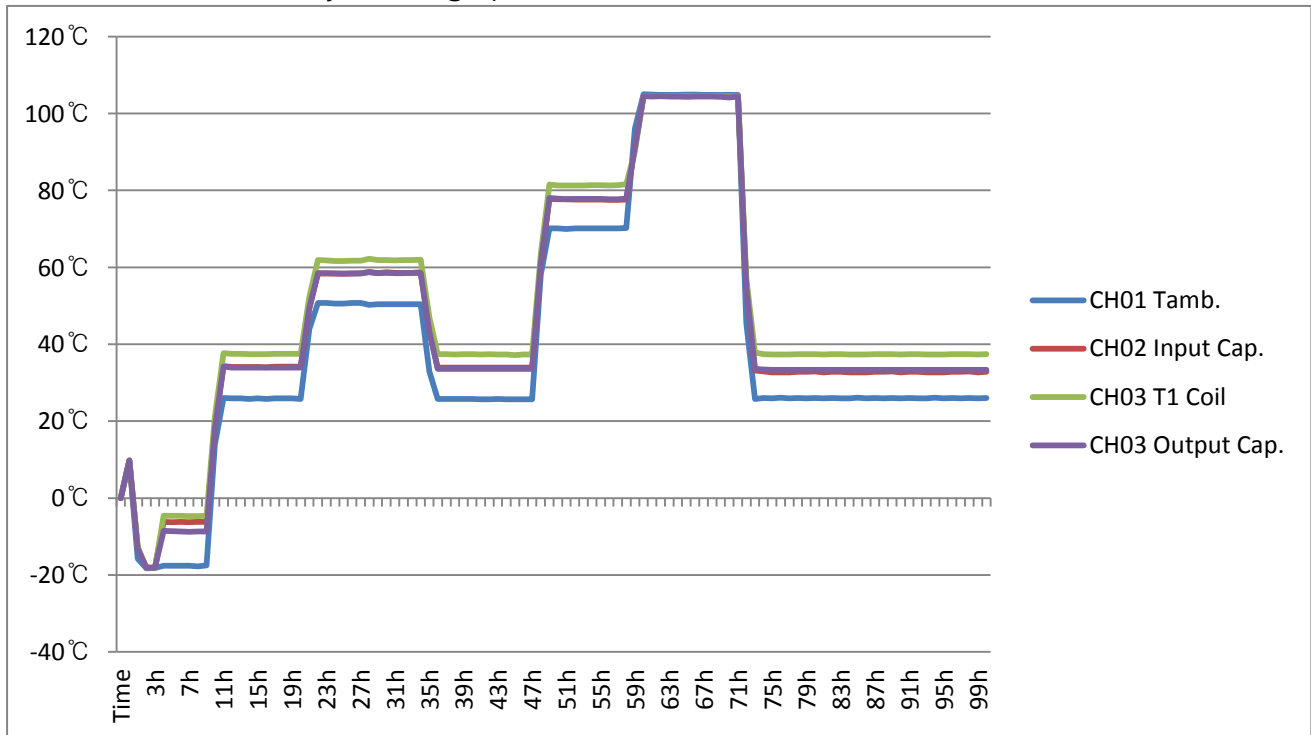
< Table1 : Segment Description >

HS30 Series(TB Type) AC-DC Converter

3.1. Environmental Stress Test Results

a. Test Sample : HS30-12

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%		OK		50% Load
B	7h	-20°C / 0%		OK		50% Load
C	10h	25°C / 0%		OK		100% Load
D	24h	50°C / 0%		OK		100% Load
E	33h	50°C / 50%		OK		100% Load
F	48h	25°C / 0%		OK		100% Load
G	57h	70°C / 70%		OK		100% Load
H	72h	25°C / 0%		OK		100% Load
I	81h	25°C / 0%		OK		100% Load
Test Result				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. HS30-05TB (@ 100% Load)

Test Point \ Test Condition	Vin : 110Vac, 60Hz		Vin : 220Vac, 60Hz	
	T _{amb.}	24.7°C	T _{amb.}	21.7°C
	T _c	Δt	T _c	Δt
Input Cap.	56.4°C	31.7°C	49.7°C	28.0°C
Input FET	74.7°C	50.0°C	58.1°C	36.4°C
Trans Coil	78.8°C	54.1°C	63.9°C	42.2°C
Trans Core	79.1°C	54.4°C	65.6°C	43.9°C
Output FET	102.3°C	77.6°C	75.1°C	53.4°C
Output Cap.	78.7°C	54.0°C	63.2°C	41.5°C

4.2. HS30-12TB (@ 100% Load)

Test Point \ Test Condition	Vin : 110Vac, 60Hz		Vin : 220Vac, 60Hz	
	T _{amb.}	35.2°C	T _{amb.}	34.8°C
	T _c	Δt	T _c	Δt
Input Cap.	62.6°C	27.4°C	58.8°C	24.0°C
Input FET	66.1°C	30.9°C	61.6°C	26.8°C
Trans Coil	61.6°C	26.4°C	61.7°C	26.9°C
Trans Core	61.6°C	26.4°C	62.6°C	27.8°C
Output FET	61.9°C	26.7°C	62.8°C	28.0°C
Output Cap.	57.1°C	21.9°C	57.8°C	23.0°C

4.3. HS30-15TB (@ 100% Load)

Test Point \ Test Condition	Vin : 110Vac, 60Hz		Vin : 220Vac, 60Hz	
	T _{amb.}	31.7°C	T _{amb.}	33.0°C
	T _c	Δt	T _c	Δt
Input Cap.	56.8°C	25.1°C	55.9°C	22.9°C
Input FET	75.0°C	43.3°C	68.6°C	35.6°C
Trans Coil	55.8°C	24.1°C	58.7°C	25.7°C
Trans Core	56.8°C	25.1°C	60.1°C	27.1°C
Output FET	55.0°C	23.3°C	59.6°C	26.6°C
Output Cap.	50.7°C	19.0°C	54.4°C	21.4°C

4.4. HS30-24TB (@ 100% Load)

Test Point \ Test Condition	Vin : 110Vac, 60Hz		Vin : 220Vac, 60Hz	
	T _{amb.}	25.2°C	T _{amb.}	26.8°C
	T _c	Δt	T _c	Δt
Input Cap.	53.3°C	28.1°C	51.1°C	24.3°C
Input FET	58.3°C	33.1°C	54.9°C	28.1°C
Trans Coil	54.2°C	29.0°C	56.1°C	29.3°C
Trans Core	55.3°C	30.1°C	57.2°C	30.4°C
Diode	55.3°C	30.1°C	59.3°C	32.5°C
Output Cap.	49.1°C	23.9°C	51.9°C	25.1°C

4.5. HS30-48TB (@ 100% Load)

Test Point \ Test Condition	Vin : 110Vac, 60Hz		Vin : 220Vac, 60Hz	
	T _{amb.}	30.4°C	T _{amb.}	32.9°C
	T _c	Δt	T _c	Δt
Input Cap.	56.3°C	25.9°C	57.7°C	24.8°C
Input FET	59.8°C	29.4°C	60.9°C	28.0°C
Trans Coil	55.8°C	25.4°C	63.7°C	30.8°C
Trans Core	55.6°C	25.2°C	63.4°C	30.5°C
Diode	55.1°C	24.7°C	68.5°C	35.6°C
Output Cap.	49.2°C	18.8°C	58.9°C	26.0°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. HS30-05TB

Condition		Vin : 110Vac, 60Hz		Load : 100%	T _{amb.} : 50°C
Components					
Input FET	$T_{j(max)}$: 150 °C	P_d : 3.61 W		$T_j = 115.0$ °C	Derating Ratio = 76.7%
	$R_{\theta(j-c)}$: 4.16 °C/W				
	T_c : 100.0°C				
Output FET	$T_{j(max)}$: 175 °C	P_d : 1.37 W		$T_j = 135.5$ °C	Derating Ratio = 77.5%
	$R_{\theta(j-c)}$: 5.8 °C/W				
	T_c : 127.6°C				
Condition		Vin : 220Vac, 60Hz		Load : 100%	T _{amb.} : 50°C
Components					
Input FET	$T_{j(max)}$: 150 °C	P_d : 0.63 W		$T_j = 89.0$ °C	Derating Ratio = 59.3%
	$R_{\theta(j-c)}$: 4.16 °C/W				
	T_c : 86.4°C				
Output FET	$T_{j(max)}$: 175 °C	P_d : 1.37 W		$T_j = 111.3$ °C	Derating Ratio = 63.6%
	$R_{\theta(j-c)}$: 5.8 °C/W				
	T_c : 103.4°C				

HS30 Series(TB Type) AC-DC Converter

5.2. HS30-12TB

Condition		Vin : 110Vac, 60Hz		Load : 100%	T _{amb.} : 50°C
Components					
Input FET	T _{j(max)} : 150 °C	P _d : 2.23 W		T _j = 90.2 °C	Derating Ratio = 60.1%
	R _{θ(j-c)} : 4.16 °C/W				
	T _c : 80.9°C				
Output FET	T _{j(max)} : 150 °C	P _d : 0.24 W		T _j = 77.6 °C	Derating Ratio = 51.7%
	R _{θ(j-c)} : 3.7 °C/W				
	T _c : 76.7°C				
Condition		Vin : 220Vac, 60Hz		Load : 100%	T _{amb.} : 50°C
Components					
Input FET	T _{j(max)} : 150 °C	P _d : 0.31 W		T _j = 78.1 °C	Derating Ratio = 52.1%
	R _{θ(j-c)} : 4.16 °C/W				
	T _c : 76.8°C				
Output FET	T _{j(max)} : 150 °C	P _d : 0.24 W		T _j = 78.9 °C	Derating Ratio = 52.6%
	R _{θ(j-c)} : 3.7 °C/W				
	T _c : 78.0°C				

5.3. HS30-15TB

Condition		Vin : 110Vac, 60Hz		Load : 100%	T _{amb.} : 50°C
Components					
Input FET	T _{j(max)} : 150 °C	P _d : 2.07 W		T _j = 101.9 °C	Derating Ratio = 67.9%
	R _{θ(j-c)} : 4.16 °C/W				
	T _c : 93.3°C				
Output FET	T _{j(max)} : 150 °C	P _d : 0.15 W		T _j = 73.9 °C	Derating Ratio = 49.2%
	R _{θ(j-c)} : 3.7 °C/W				
	T _c : 73.3°C				
Condition		Vin : 220Vac, 60Hz		Load : 100%	T _{amb.} : 50°C
Components					
Input FET	T _{j(max)} : 150 °C	P _d : 0.31 W		T _j = 86.9 °C	Derating Ratio = 57.9%
	R _{θ(j-c)} : 4.16 °C/W				
	T _c : 85.6°C				
Output FET	T _{j(max)} : 150 °C	P _d : 0.15 W		T _j = 77.2 °C	Derating Ratio = 51.4%
	R _{θ(j-c)} : 3.7 °C/W				
	T _c : 76.6°C				

HS30 Series(TB Type) AC-DC Converter

5.4. HS30-24TB

Condition		Vin : 110Vac, 60Hz		Load : 100%	T _{amb.} : 50°C
Components					
Input FET	T _{j(max)} : 150 °C	P _d : 2.18 W		T _j = 92.2 °C	Derating Ratio = 61.4%
	R _{θ(j-c)} : 4.16 °C/W				
	T _c : 83.1°C				
Output Diode	T _{j(max)} : 150 °C	P _d : 1.23 W		T _j = 83.8 °C	Derating Ratio = 55.9%
	R _{θ(j-c)} : 3 °C/W				
	T _c : 80.1°C				
Condition		Vin : 220Vac, 60Hz		Load : 100%	T _{amb.} : 50°C
Components					
Input FET	T _{j(max)} : 150 °C	P _d : 0.33 W		T _j = 79.5 °C	Derating Ratio = 53.0%
	R _{θ(j-c)} : 4.16 °C/W				
	T _c : 78.1°C				
Output Diode	T _{j(max)} : 150 °C	P _d : 1.23 W		T _j = 86.2 °C	Derating Ratio = 57.5%
	R _{θ(j-c)} : 3 °C/W				
	T _c : 82.5°C				

5.5. HS30-48TB

Condition		Vin : 110Vac, 60Hz		Load : 100%	T _{amb.} : 50°C
Components					
Input FET	T _{j(max)} : 150 °C	P _d : 2.18 W		T _j = 88.5 °C	Derating Ratio = 59.0%
	R _{θ(j-c)} : 4.16 °C/W				
	T _c : 79.4°C				
Output Diode	T _{j(max)} : 150 °C	P _d : 0.79 W		T _j = 77.1 °C	Derating Ratio = 51.4%
	R _{θ(j-c)} : 3 °C/W				
	T _c : 74.7°C				
Condition		Vin : 220Vac, 60Hz		Load : 100%	T _{amb.} : 50°C
Components					
Input FET	T _{j(max)} : 150 °C	P _d : 0.31 W		T _j = 79.3 °C	Derating Ratio = 52.9%
	R _{θ(j-c)} : 4.16 °C/W				
	T _c : 78.0°C				
Output Diode	T _{j(max)} : 150 °C	P _d : 0.79 W		T _j = 88.0 °C	Derating Ratio = 58.6%
	R _{θ(j-c)} : 3 °C/W				
	T _c : 85.6°C				

6. Abnormal Test

IEC 60950-1						
Clause	Requirement + Test				Result - Remark	Verdict
5.3	TABLE: Fault condition tests					P
	Ambient temperature (°C)				20 - 30	—
	Power source for EUT: Manufacturer, model/type, output rating				-	—
Component No.	Fault	Supply voltage (V)	Test time	Fuse #	Fuse current (A)	Observation
1.BD1* (+, ~)	Short	264 Vac	1 s	F1	2.0	Immediately fuse(F1) opened, RD2, RD3 damaged, NC, NT, NB, NH. FI:0 A
1-1.BD1* (+, ~)	Short	90 Vac	1 s	F1	2.0	Immediately fuse(F1) opened, RD2, RD3 damaged, NC, NT, NB, NH. FI:0 A
2.C6*	Short	264 Vac	1 s	F1	2.0	Immediately fuse(F1) opened, RD2, RD3 damaged, NC, NT, NB, NH. FI:0 A
2-1.C6*	Short	90 Vac	1 s	F1	2.0	Immediately fuse(F1) opened, RD2, RD3 damaged, NC, NT, NB, NH. FI:0 A
3.D1	Short	264 Vac	10 min	F1	2.0	Immediately input current increased, NCD, NC, NT, NB, NH. FI: 0.35 A
4.Q1* (1, 2)	Short	264 Vac	1 s	F1	2.0	Immediately fuse(F1) opened, Q1 damaged, NC, NT, NB, NH. FI:0 A
4-1.Q1* (1, 2)	Short	90 Vac	1 s	F1	2.0	Immediately fuse(F1) opened, Q1 damaged, NC, NT, NB, NH. FI:0 A
5.Q1* (2, 3)	Short	264 Vac	1 s	F1	2.0	Immediately fuse(F1) opened, Q1 damaged, NC, NT, NB, NH. FI:0 A
5-1.Q1* (2, 3)	Short	90 Vac	1 s	F1	2.0	Immediately fuse(F1) opened, Q1 damaged, NC, NT, NB, NH. FI:0 A
6.U1 (2, 5)	Short	264 Vac	10 min	F1	2.0	Immediately output IP, NCD, NC, NT, NH. FI:0.03 A
7.U1 (2, 8)	Short	264 Vac	10 min	F1	2.0	Normal operated, NCD, NC, NT, NH. FI:0.33 A



IEC 60950-1						
Clause	Requirement + Test				Result - Remark	Verdict
8.D6	Short	264 Vac	10 min	F1	2.0	Immediately output IP, NCD, NC, NT, NH. FI:0.03 A
9.C13	Short	264 Vac	10 min	F1	2.0	Immediately output IP, NCD, NC, NT, NH. FI:0.03 A
10.C14	Short	264 Vac	10 min	F1	2.0	Immediately output IP, NCD, NC, NT, NH. FI:0.03 A
11.C18	Short	264 Vac	10 min	F1	2.0	Immediately output IP, NCD, NC, NT, NH. FI:0.03 A
12.Q2 (1, 2)	Short	264 Vac	10 min	F1	2.0	Normal operated, NCD, NC, NT, NH. FI:0.33 A
13.Q2 (1, 3)	Short	264 Vac	10 min	F1	2.0	Normal operated, NCD, NC, NT, NH. FI:0.33 A
14.Q3 (1, 3)	Short	264 Vac	10 min	F1	2.0	Normal operated, NCD, NC, NT, NH. FI:0.33 A
15.Q3 (2, 3)	Short	264 Vac	10 min	F1	2.0	Normal operated, NCD, NC, NT, NH. FI:0.33 A
16.PC1 (1, 2)	Short	264 Vac	10 min	F1	2.0	Immediately output IP, NCD, NC, NT, NH. FI:0.03 A
17.PC1 (3, 4)	Short	264 Vac	10 min	F1	2.0	Immediately output IP, NCD, NC, NT, NH. FI:0.03 A
18.D2	Short	264 Vac	10 min	F1	2.0	Immediately output IP, NCD, NC, NT, NH. FI:0.03 A
19.C9	Short	264 Vac	10 min	F1	2.0	Immediately output IP, NCD, NC, NT, NH. FI:0.03 A
20. HS30-05 Output, T1	Overload	264 Vac	3 hr 30 min	F1	2.0	Load: 6.7 A FI:0.37 A - Temperature Stabilized, <Measured temperature, °C> T1 Coil: 71.3, T1 Core: 71.5 Ambient: 21.9 Load: 7.0 A - Unit IP, NCD, NC, NT, NB, NH - FI: 0.03 to 0.15 A

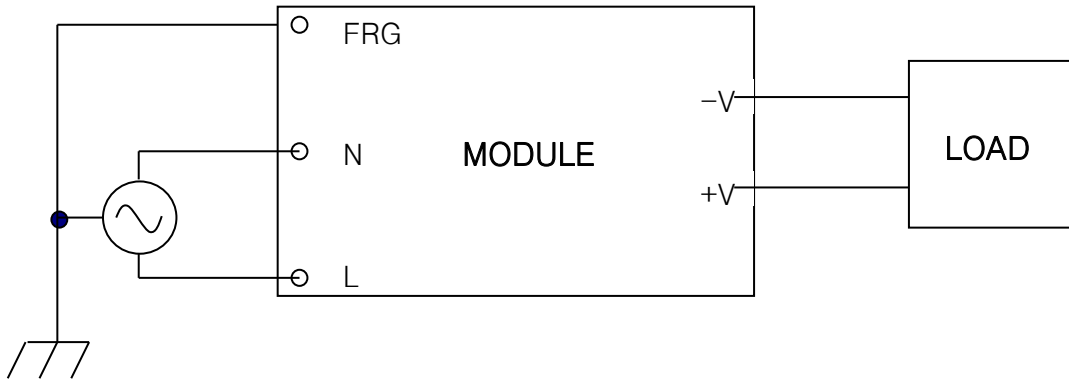
TRF No. IEC60950_1F



IEC 60950-1						
Clause	Requirement + Test				Result - Remark	Verdict
21. HS30-12 Output, T1	Overload	264 Vac	3 hr 30 min	F1	2.0	Load: 3.1 A FI:0.38 A - Temperature Stabilized, <Measured temperature, °C> T1 Coil: 54.4, T1 Core: 55.1 Ambient: 25.2 Load: 3.3 A - Unit IP, NCD, NC, NT, NB, NH - FI: 0.03 to 0.15 A
22. HS30-15 Output, T1	Overload	264 Vac	3 hr 48 min	F1	2.0	Load: 2.8 A FI:0.41 A - Temperature Stabilized, <Measured temperature, °C> T1 Coil: 59.6, T1 Core: 58.1 Ambient: 27.5 Load: 3.1 A - Unit IP, NCD, NC, NT, NB, NH - FI: 0.03 to 0.18 A
23. HS30-24 Output, T1	Overload	264 Vac	2 hr 44 min	F1	2.0	Load: 1.5 A FI:0.38 A - Temperature Stabilized, <Measured temperature, °C> T1 Coil: 57.2, T1 Core: 56.4 Ambient: 25.1 Load: 1.6 A - Unit IP, NCD, NC, NT, NB, NH - FI: 0.02 to 0.18 A
24. HS30-48 Output, T1	Overload	264 Vac	2 hr 45 min	F1	2.0	Load: 0.7 A FI:0.35 A - Temperature Stabilized, <Measured temperature, °C> T1 Coil: 57.1, T1 Core: 56.4 Ambient: 25.8 Load: 0.8 A - Unit IP, NCD, NC, NT, NB, NH - FI: 0.02
supplementary information:						
IP – Internal Protection occurred, NT - Tissue paper remained intact NC - Cheesecloth remained intact, NB - No indication of dielectric breakdown, NCD – No component damaged, FI – Final Input Current *** means test were repeated three times and same results were obtained. F1: (Cooper Bussmann LLC, Type SS-5, ORISEL CO., LTD, Type: OS5, Littelfuse, Inc, Type: 392, Smart Electronics Inc., Type: Series SPT						

- Application Sheet

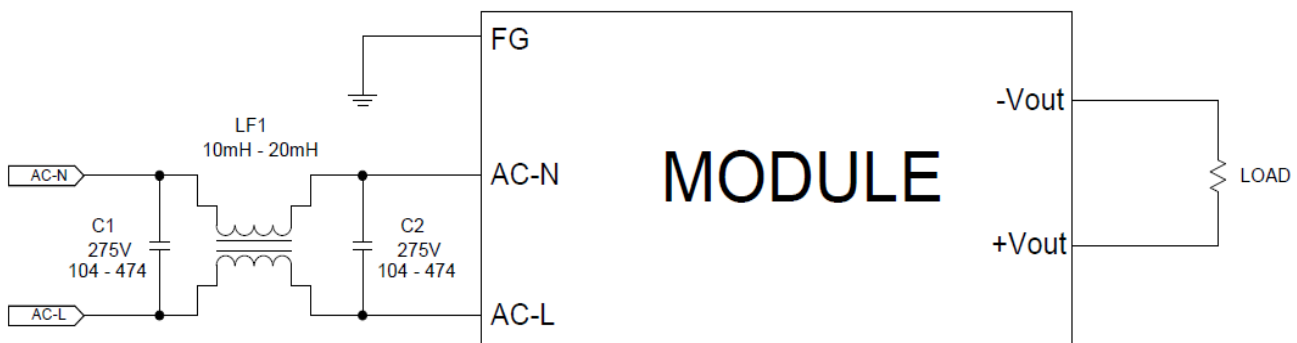
1. Basic Connection



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

	HS30TB	HS60TB
Fuse	2.0A	2.5A

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 HS30 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 HS30 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.

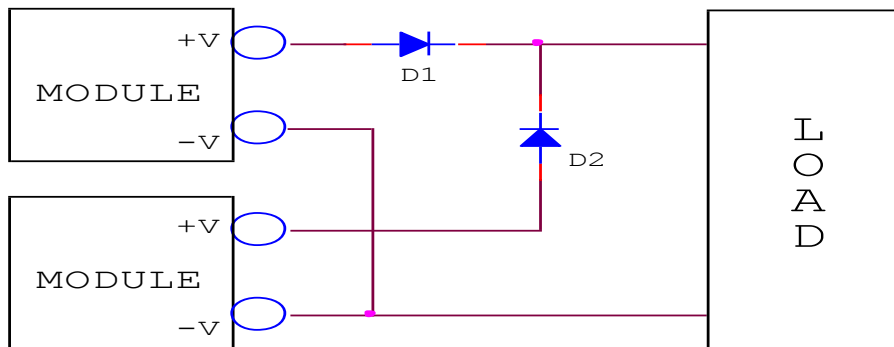
Over Voltage Protection

The HS30 series is built into an OVP(Over Voltage Protection) circuit. When the OVP triggers, the output voltage is clamped 60%~80% of output voltage. The input must be taken out (for at least five seconds), and than reinpitted manually. Otherwise, the module will maintain the clamped voltage.

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

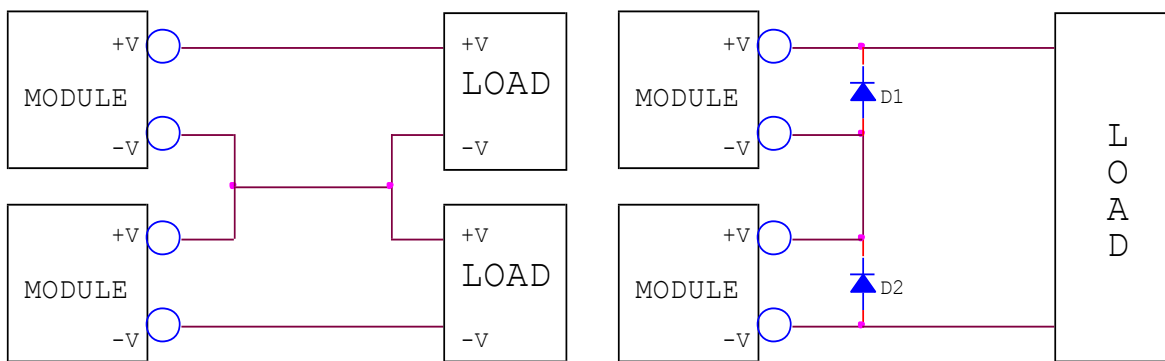
Forward current(I_f) : $I_f > 3 \times I_o$

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.

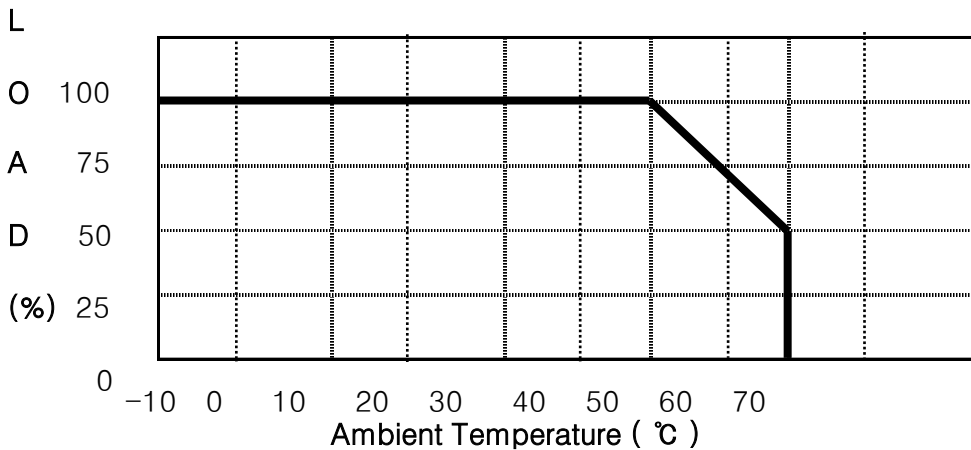
Power loss = $V_f(\text{forward voltage}) \times I_o(\text{output current})$

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

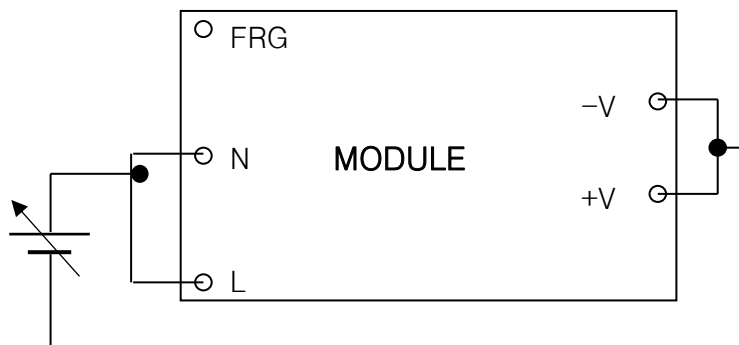
The range of ambient humidity in % over which a module may be stored long term without damage. The storage humidity range is from 20% to 90%RH.

8. Isolation

Isolation Resistance

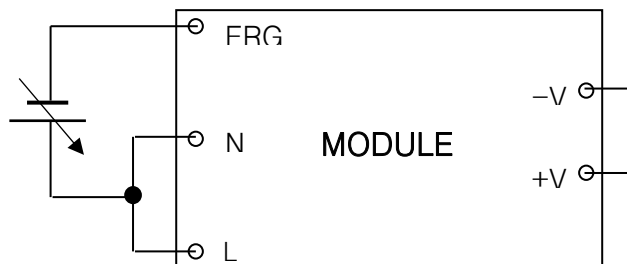
The electrical separation between input and output of a module by means of the power transformer. The isolation resistance is a function of materials and spacings employed throughout the module. Please don't test with a voltage above standard voltage for the Isolation Resistance Test.

< INPUT - OUTPUT >



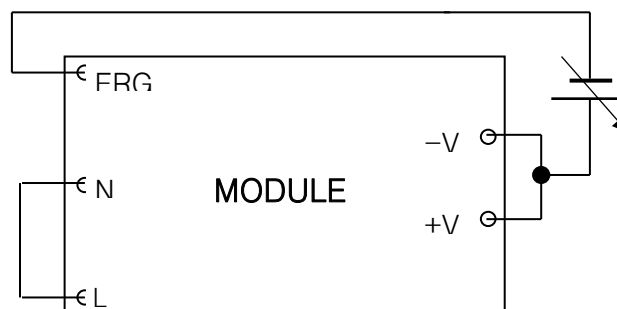
500VDC, 100MΩ

< INPUT - FRG >



500VDC, 100MΩ

< OUTPUT - FRG >

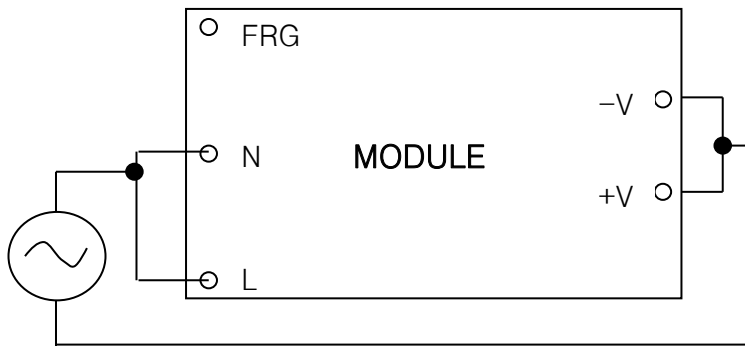


500VDC, 70MΩ

Withstand Voltage

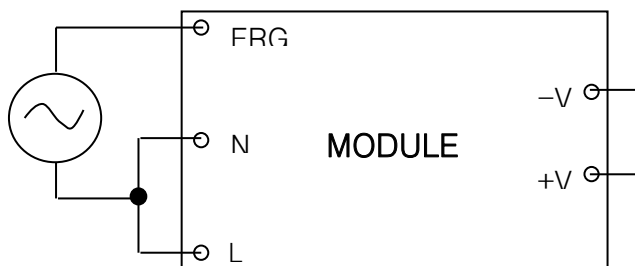
For the withstand voltage test, the applied voltage must be increased gradually from zero to the testing value, and then decreased gradually at shut down. Especially stay away from use of a timer. Where a pulse of several times the applied voltage can be generated.

< INPUT - OUTPUT >



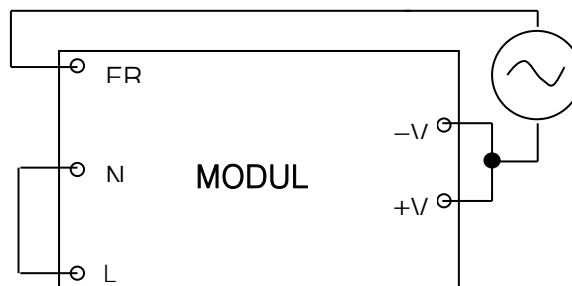
3kVAC (10mA) 1minute

< INPUT - FRG >



2kVAC (10mA) 1minute

< OUTPUT - FRG >



0.5kVAC (10mA) 1minute

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

