

MAX. Power 5W Isolated On-Board Type AC-DC Converter

## TS5 Series Isolated On-Board Type AC-DC Converter



### Features

- Power Saving Mode Operation
- High Efficiency
- Isolated Input - Output
- 115kHz fixed frequency and Current mode Control
- Low output Ripple & Noise
- Built-in over current protection circuit
- Short Circuit Protection
- Universal Input Voltage(Free Voltage)
- Safety standard : CB, CE approved (CB : IEC60950-1, CE : EN60950-1)
- RoHS compatible design

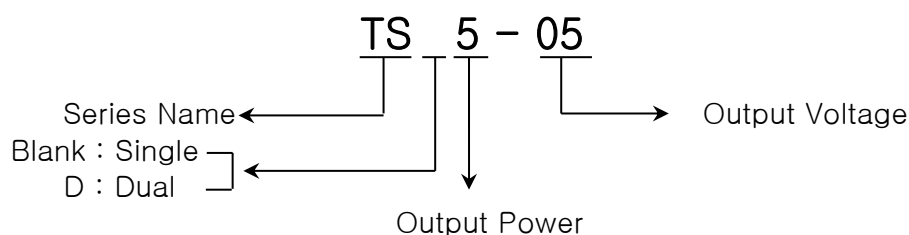
### Applications

- Data and telecommunication
- FA control
- Datacommunication electronic equipments

### Environment

- Operating Temperature : -40℃ ~ 70℃
- Operating Humidity : 20% ~ 90% RH (Non condensing)
- Storage Temperature : -40℃ ~ 85℃
- Cooling : Free-Air Convection
- MTBF : 5.0 x 10<sup>5</sup> hrs

### Model Name Structure



## Pin assignments & Function

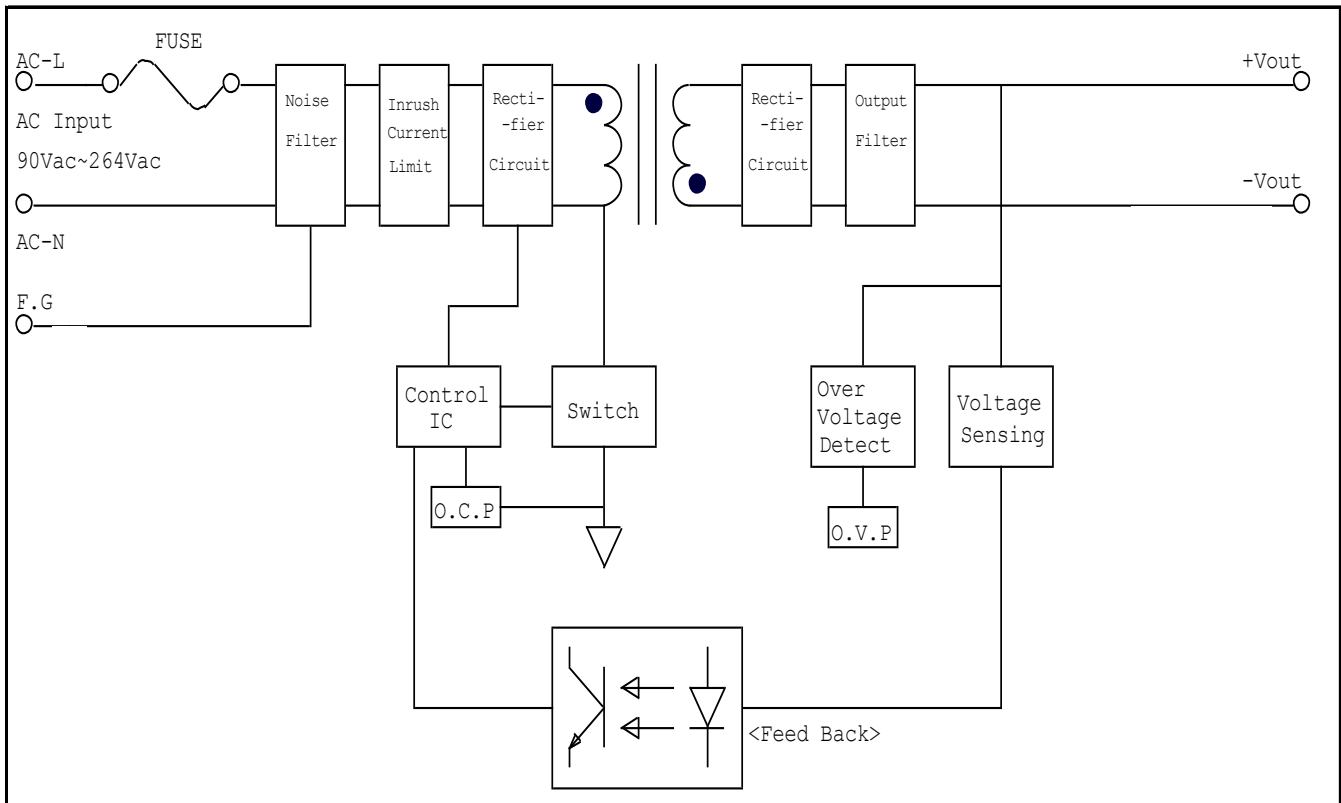


<Top View>

### - Single Output Name & Function

PIN No.	Single
1	AC input N
2	AC input L
3	+ Vout
4	- Vout

## Internal Circuit Architecture



## Maximum Ratings

Characteristics		Symbol	Min.	Typ.	Max.	Unit
No-load Power Consumption	TS5 - XX				0.1	W
Frequency	TS5 - XX		44	-	440	Hz
Input Voltage Continuous	TS5 - 05	Vin	90	-	264	Vac
	TS5 - 12		90	-	264	
	TS5 - 15		90	-	264	
	TS5 - 24		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	TS5 - XX				0.1	W
Operating Voltage Range	TS5 - XX	Vin	90	110, 220	264	Vac
Frequency	TS5 - XX		44	50, 60	440	Hz
Max. Input Current (Vin : rated, Io : 100%)	TS5 - XX	Iin		0.13		A
Max. No Load Input Current (Vin : min.)	TS5 - XX				2.5	mA
Inrush Current (In : 220Vac)	TS5 - XX				30	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	%
			-	-		
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	TS5 - 05	I <sub>o</sub>	-	-	1.0	A
	TS5 - 12		-	-	0.42	
	TS5 - 15		-	-	0.34	
	TS5 - 24		-	-	0.21	
Output Current Limit (OCP : Over Current Protection, recovers automatically)			105	-	-	%
Dynamic Load Response (V <sub>in</sub> : rated, I <sub>o</sub> : from 10% to 100%, from 100% to 10%, BW : 20MHz, Freq. : 100Hz, Duty : 0.5, Tr/Tf : 100us)			-	-	3% of V <sub>out</sub>	mV (peak to peak)
Start - Up Time		T <sub>start</sub>			100	ms
Turn - on Overshoot			-	-	5	%
Efficiency (V <sub>in</sub> : Rated, I <sub>o</sub> : Max.)	TS5 - 05		-	75	-	%
	TS5 - 12		-	77	-	
	TS5 - 15		-	78	-	
	TS5 - 24		-	80	-	

## Isolation Characteristics

Characteristics		Symbol	Min.	Typ.	Max.	Unit
Withstand Voltage	Input - Output		-	-	3000	V <sub>ac</sub>
Isolation Resistance (DC500V at 25°C and 70%RH)	Input - Output	R <sub>iso</sub>	100	-	-	MΩ

## General Characteristics

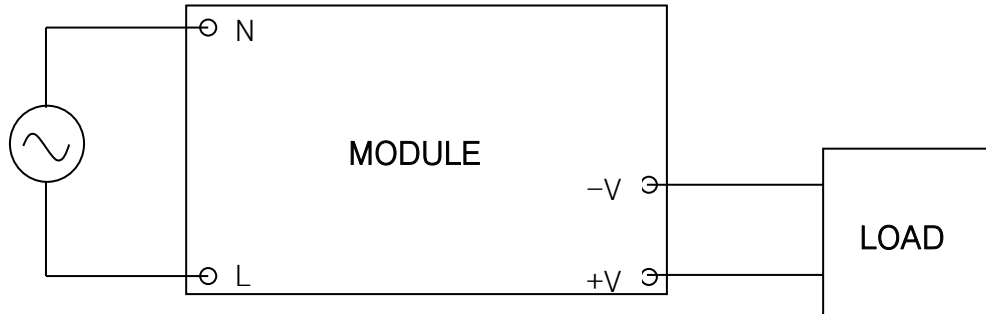
Characteristics	Symbol	Min.	Typ.	Max.	Unit
Remote on / off control (CNT Pin, Negative Logic Module on : Logic Low or Short to -Vin Module off : Logic High or open)	CNT				
External Trim Adj. Range (TRM Pin, Vout variation by external parts)	TRM				
Switching Frequency			115		kHz
MTBF (MIL-HDBK-217F)		5.0 x 10 <sup>5</sup>			hrs
Dimension (W x H x L)		58.0 x 30.0 x 19.0			mm
Weight		-	-	50	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



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

- ※ To avoid excessive voltage drop and improved noise, short and thick wire should be used to connect the load.

## 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.

## Protection

### Over Current Protection

The TS 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

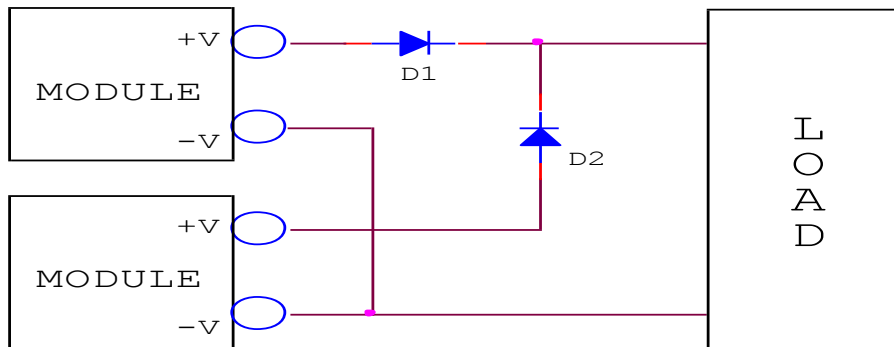
The TS series is built into an short circuit protection circuit. It is similar to OCP circuit. When output is short condition, the output voltage will fall. If short condition is removed, the output will automatically recover. However, if the short condition continues damage to the module could occur.



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

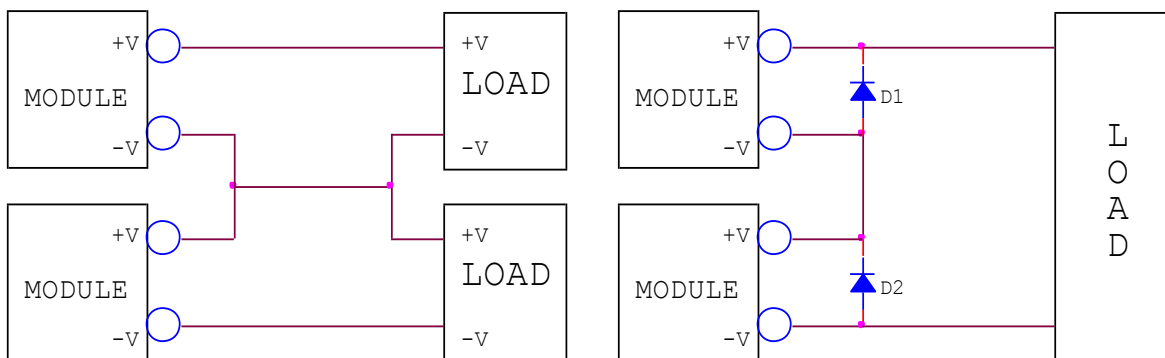
Forward current( $I_f$ ) :  $I_f > 3 \times I_o$

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.

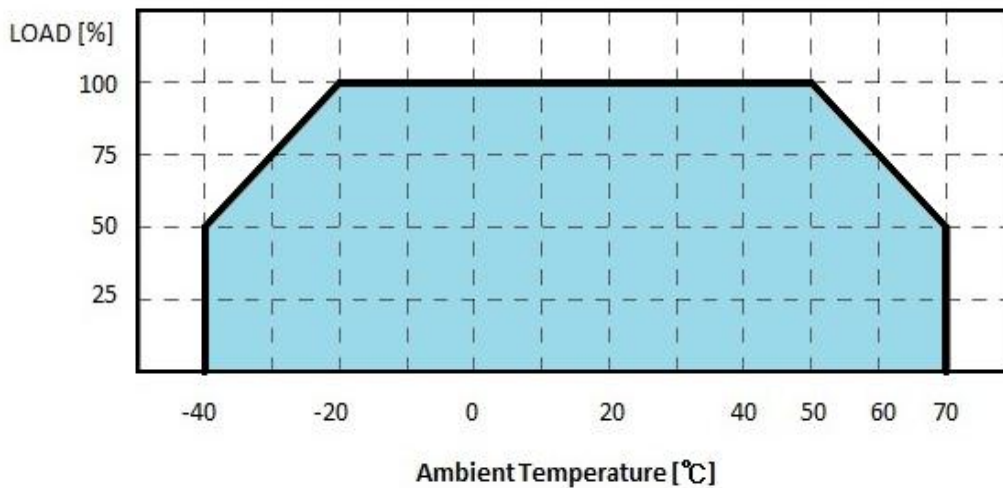
Power loss =  $V_f(\text{forward voltage}) \times I_o(\text{output current})$

## 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.

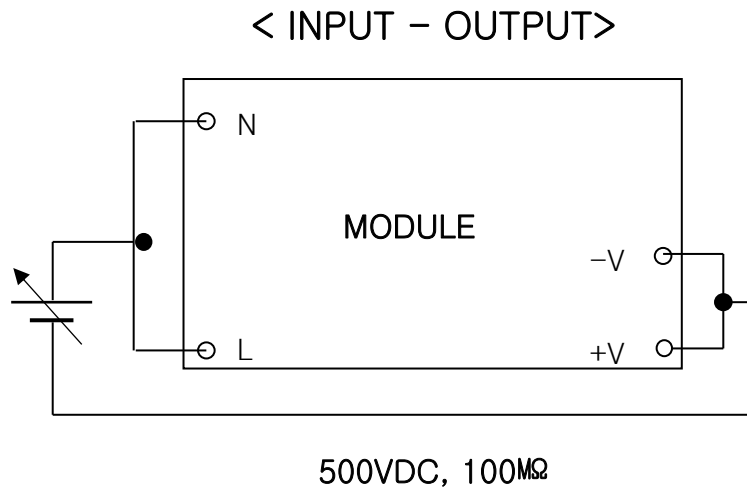
#### Storage Humidity

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.



### 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.

