# DATASHEET & RELIABILITY DATA

## SD3 SERIES

㈜오디피

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# Contents

MAX. Power 3.0W Isolated DC-DC Converter

# SDS3 Series Small Compact Size DC-DC Converter

## Features

- Small Compact Size
- High Efficiency
- Isolated Input - Output
- Wide operating temperature range (-40℃ to 85℃)
- Long Life Design (Employ only Ceramic Capacitor)
- Built-in over current protection circuit
- Wide 2 :1 input range
- Adjustable output voltage (single output)
- Safety standard : CE approved
- RoHS compatible design

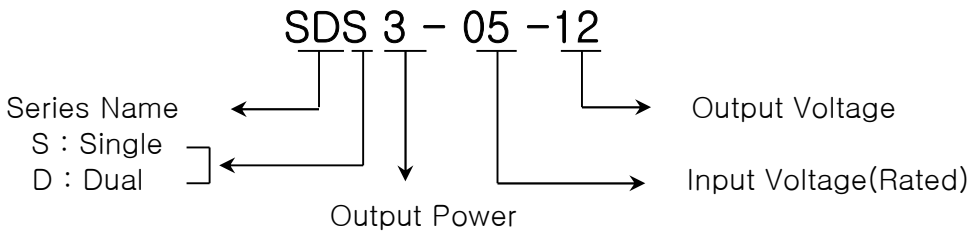
## Applications

- Data and telecommunication
- FA control
- Datacommunication electronic equipments

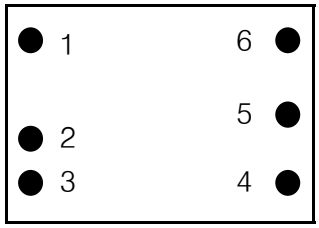
## Environment

- Operating Temperature : -40℃ ~ 85℃
- Operating Humidity : 5% ~ 95% RH (Non condensing)
- Storage Temperature : -40℃ ~ 105℃
- Cooling : Free-Air Convection
- MTBF : 8.0 x $10^5$ hrs

## Model Name Structure



# Pin assignments & Function




<Top View>

## - Single Output Name & Function

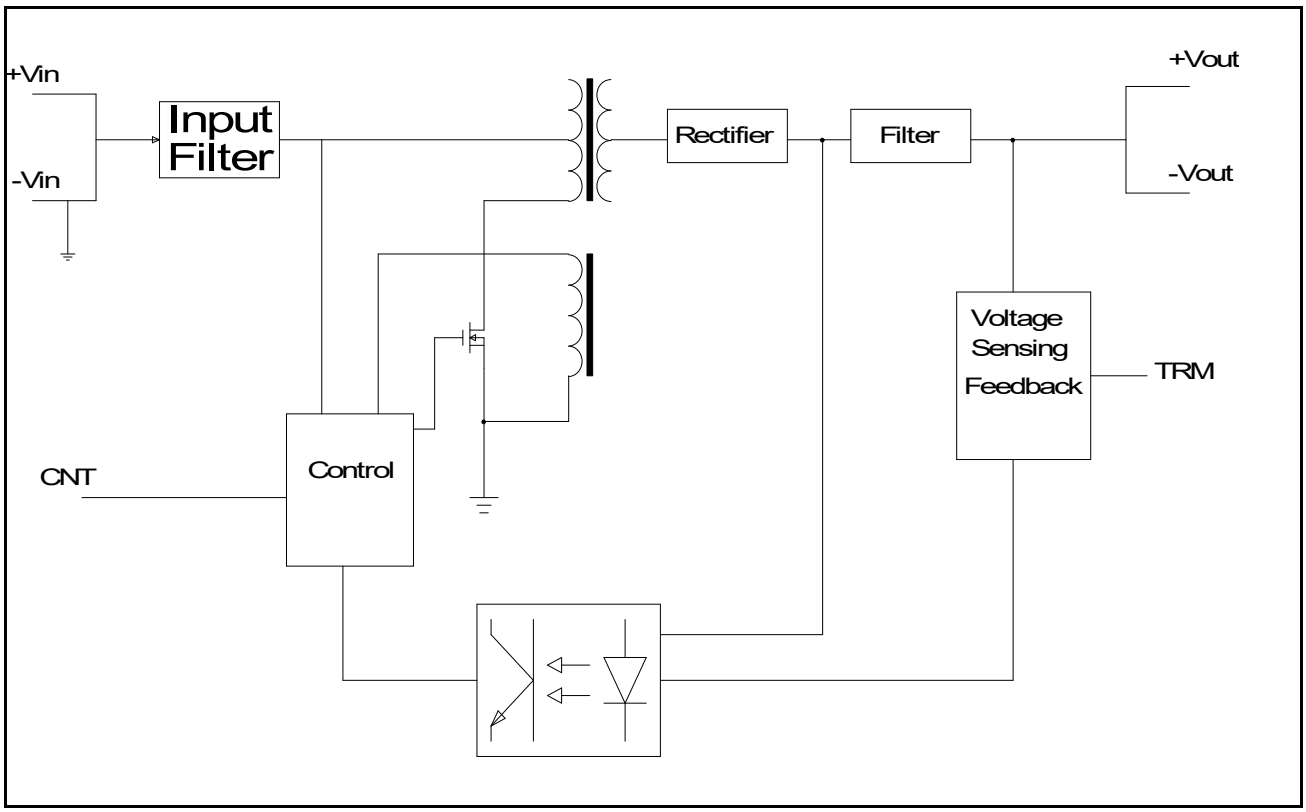
| PIN No. | NAME | FUNCTION |
|---|---|---|
| 1 | +Vin | Positive terminal for Vin |
| 2 | -Vin | Negative terminal for Vin |
| 3 | CNT | Remote on/off Control |
| 4 | TRM | Vout variation(±10%) by external parts |
| 5 | -Vout | Negative terminal for Vout |
| 6 | +Vout | Positive terminal for Vout |

## - Dual Output Name & Function

| PIN No. | NAME | FUNCTION |
|---|---|---|
| 1 | +Vin | Positive terminal for Vin |
| 2 | -Vin | Negative terminal for Vin |
| 3 | CNT | Remote on/off Control |
| 4 | -Vout | Negative terminal for Vout |
| 5 | Com | The common ground of Vout |
| 6 | +Vout | Positive terminal for Vout |

# - Datasheet

## 1. Internal Circuit Architecture




## 2. Maximum Ratings

| Characteristics | | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Input Voltage Continuis | SDS3 - 05 - XX | Vin | 4.5 | - | 9.0 | VDC |
| | SDS3 - 12 - XX | | 9.0 | - | 18.0 | |
| | SDS3 - 24 - XX | | 18.0 | - | 36.0 | |
| | SDS3 - 48 - XX | | 36.0 | - | 76.0 | |
| Operating Ambient Temperature | | Ta | -40 | - | 85 | ℃ |
| Storage Temperature | | Tstg | -40 | - | 105 | ℃ |
| Withstand Voltage | | | - | - | 500 | Vac |

# 3. Electrical Characteristics

## - Input Section

Ta : 25℃, Vin : Typical Input Voltage

| Characteristics | | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Operating Voltage Range | SDS3 - 05 - XX | Vin | 4.5 | 5.0 | 9.0 | VDC |
| | SDS3 - 12 - XX | | 9.0 | 12.0 | 18.0 | |
| | SDS3 - 24 - XX | | 18.0 | 24.0 | 36.0 | |
| | SDS3 - 48 - XX | | 36.0 | 48.0 | 76.0 | |
| Maximum Input Current (Vin : rated, Io : 100%) | SDS3 - 05 - XX | Iin | | 0.769 | | A |
| | SDS3 - 12 - XX | | | 0.305 | | |
| | SDS3 - 24 - XX | | | 0.152 | | |
| | SDS3 - 48 - XX | | | 0.078 | | |
| Maximum No Load Input Current (Vin : rated) | SDS3 - 05 - XX | | | 46 | | mA |
| | SDS3 - 12 - XX | | | 27 | | |
| | SDS3 - 24 - XX | | | 10 | | |
| | SDS3 - 48 - XX | | | 7 | | |

## - Output Section

Ta : 25℃, Vin : Minimum, Typical, Maximum Input Voltage

| Characteristics | | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Output Voltage Accuracy | | Vo | - | - | ±2 | % |
| Regulation | Line Regulation (From min. Vin to max. Vin, constant load) | | - | - | ±0.5 | % |
| | Load Regulation (From no load to maximum load) | | - | - | ±1 | % |
| Output Ripple and Noise (Vin : Rated, Io : Max., BW : 20MHz, use the external capacitor(1uF) between +Vo and -Vo) | | mVp-p | - | - | 1% of Vout | mV (peak to peak) |

| Characteristics | | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Output Current | SDS3 - XX - 3R3 | Io | - | - | 0.6 | A |
| | SDS3 - XX - 05 | | - | - | 0.6 | |
| | SDS3 - XX - 12 | | - | - | 0.25 | |
| | SDS3 - XX - 15 | | - | - | 0.2 | |
| Output Current Limit (OCP : Over Current Protection, recovers automatically) | | | 105 | - | - | % |
| Dynamic Load Response (Vin : rated, Io : from 50% to 100%, from100% to 50%, BW : 20MHz, Freq. : 100Hz, Duty : 0.5, Tr/Tf : 100us use the external capacitor(1uF) between +Vo and -Vo) | | | - | - | 3% of Vout | mV (peak to peak) |
| Start - Up Time | | Tstart | - | - | 10 | ms |
| Turn - on Overshoot | | | - | - | 5 | % |
| Efficiency (Vin : Rated, Io : Max.) | SDS3 - 05 - 3R3 | | - | 73 | - | % |
| | SDS3 - 05 - 05 | | - | 78 | - | |
| | SDS3 - 05 - 12 | | - | 81 | - | |
| | SDS3 - 05 - 15 | | - | 81 | - | |
| | SDS3 - 12 - 3R3 | | - | 77 | - | % |
| | SDS3 - 12 - 05 | | - | 82 | - | |
| | SDS3 - 12 - 12 | | - | 86 | - | |
| | SDS3 - 12 - 15 | | - | 87 | - | |
| | SDS3 - 24 - 3R3 | | - | 77 | - | % |
| | SDS3 - 24 - 05 | | - | 82 | - | |
| | SDS3 - 24 - 12 | | - | 86 | - | |
| | SDS3 - 24 - 15 | | - | 87 | - | |
| | SDS3 - 48 - 3R3 | | - | 73 | - | % |
| | SDS3 - 48 - 05 | | - | 80 | - | |
| | SDS3 - 48 - 12 | | - | 83 | - | |
| | SDS3 - 48 - 15 | | - | 83 | - | |

## 4. Isolation Characteristics

| Characteristics | | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Withstand Voltage (AC500V, 1minute) | Input - Output | | - | - | 500 | Vac |
| | Input - Case | | - | - | 500 | Vac |
| | Output - Case | | - | - | 500 | Vac |
| Isolation Resistance (DC500V at 25℃ and 70%RH) | Output - Case | Riso | 100 | - | - | 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 | -10 | - | +10 | % |
| Switching Frequency | | | | | kHz |
| MTBF (MIL-HDBK-217F) | | $8.0 \times 10^5$ | | | hrs |
| Dimension (W x H x L) | | 23.4 x 8.5 x 16.0 | | | mm |
| Weight | | - | 4.0 | - | grams |

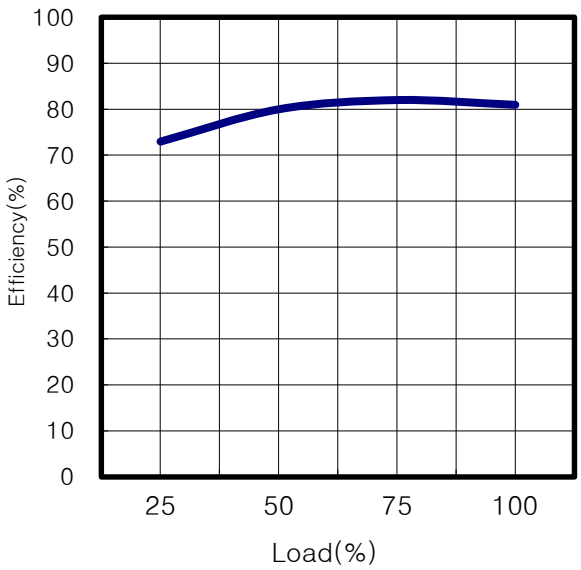
## 6. Environment

| Characteristics | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Operating Temperature Range | Ta | -40 | - | 85 | ℃ |
| Operating Humidity (non Condensing) | | 5 | - | 95 | %RH |
| Storage Temperature | Tstg | -40 | - | 105 | ℃ |

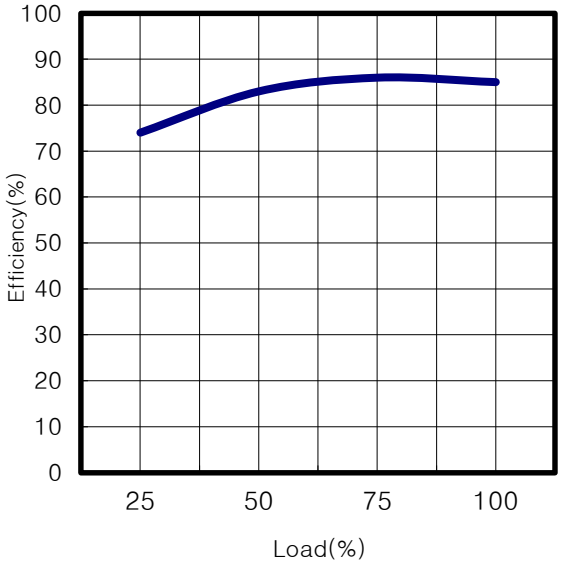
# 7. Characteristics Curves

## Efficiency Curves

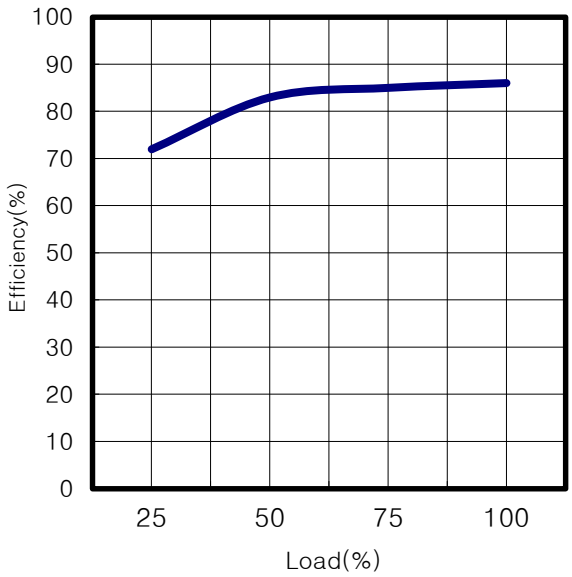
< SDS3 - 05 - 12 >



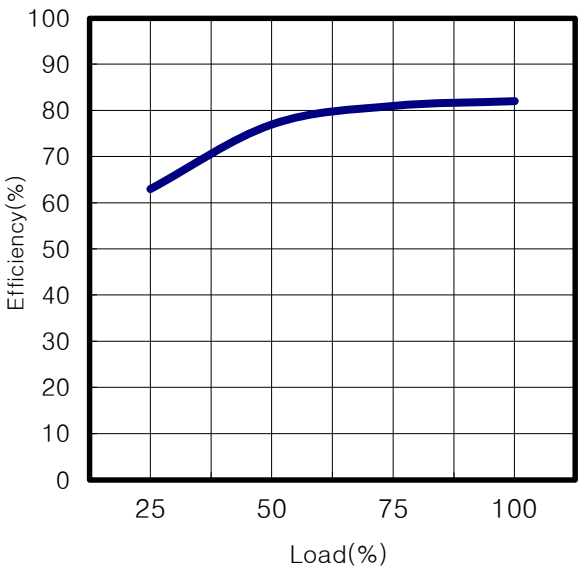

< SDS3 - 12 - 12 >




< SDS3 - 24 - 12 >




< SDS3 - 48 - 12 >



# - Reliability Data

## 1. MTBF

Calculating Reliable Values of MTBF

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

Method is :

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

For a given equipment environment where :

$\lambda\, equip$ = Total equipment failure rate (Failures / 10^6 Hours)

$\lambda g$ = Generic failure rate for the i th generic part (Failures / 10^6 Hours)

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

$Ni$ = Quanty of i th generic part

$n$ = Number of different generic part categories in the equipment

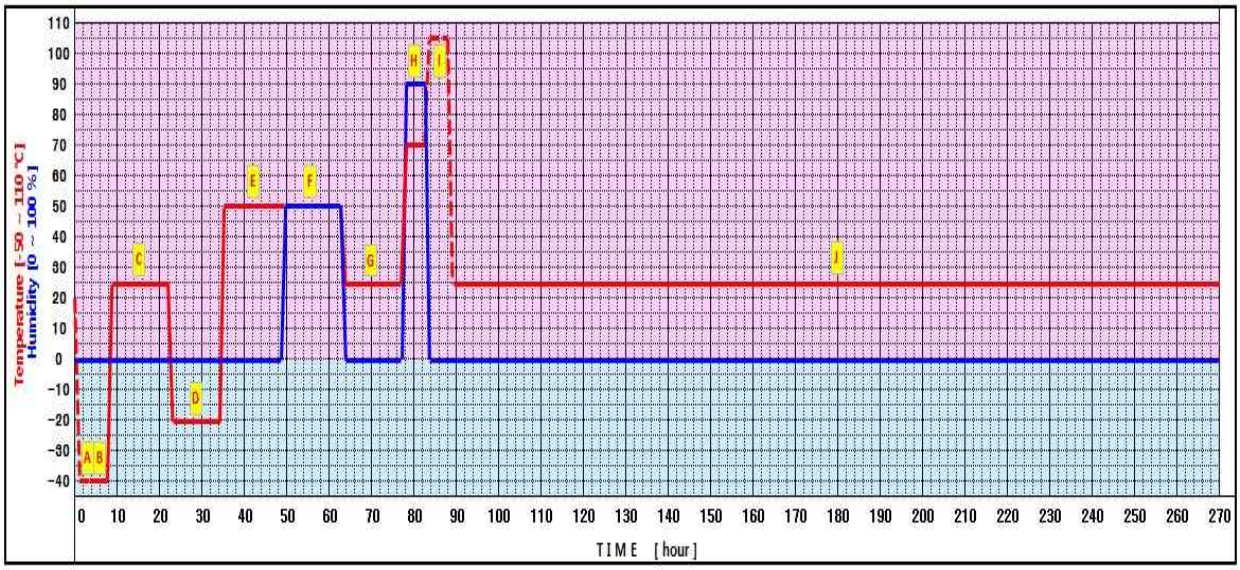
| | PART | Number | Failure Rate | Failure Rate |
|---|---|---|---|---|
| 1 | Logic IC | 0 | 0.015 | - |
| 2 | FET | 3 | 0.012 | 0.0360000 |
| 3 | Voltage Regulaor | 1 | 0.002 | 0.0020000 |
| 4 | Diode (Zener) | 1 | 0.002 | 0.0020000 |
| 5 | Diode (FRD) | 0 | 0.069 | - |
| 6 | Diode (SBD) | 3 | 0.027 | 0.0810000 |
| 7 | Bridge Diode | 0 | 0.066 | - |
| 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. | 0 | 0.019 | - |
| 13 | Ceramic Cap. | 7 | 0.026 | 0.1820000 |
| 14 | MLCC | 3 | 0.053 | 0.1590000 |
| 15 | Choke coil | 2 | 0.00022 | 0.0004400 |
| 16 | Switching transformer | 1 | 0.0042 | 0.0042000 |
| 17 | Line Filter | 0 | 0.0044 | - |
| 18 | Resistor | 15 | 0.0024 | 0.0360000 |
| 19 | Resistor Variable | 0 | 0.0024 | - |
| 20 | Thermister | 0 | 0.0019 | - |
| 21 | Connertor | 0 | 0.052 | - |
| 22 | Soldering Point | 38 | 0.0078 | 0.2964000 |
| 23 | PCB | 1 | 0.37 | 0.3700000 |
| 24 | Fuse | 1 | 0.01 | 0.0100000 |
| Total Equipment Failure Rate (λequip) | | | | 1.2490400 |
| MTBF = 10^6 / λequip(F/T) | | | | 800,614.872 |
| MTBF ≒ 800,000[Hours] | | | | |

## 2. 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 270 hours). Test results of all segments must meet the specifications. (refer to Fig.1 & Table1)




**< Fig.1 : Test Cycle >**

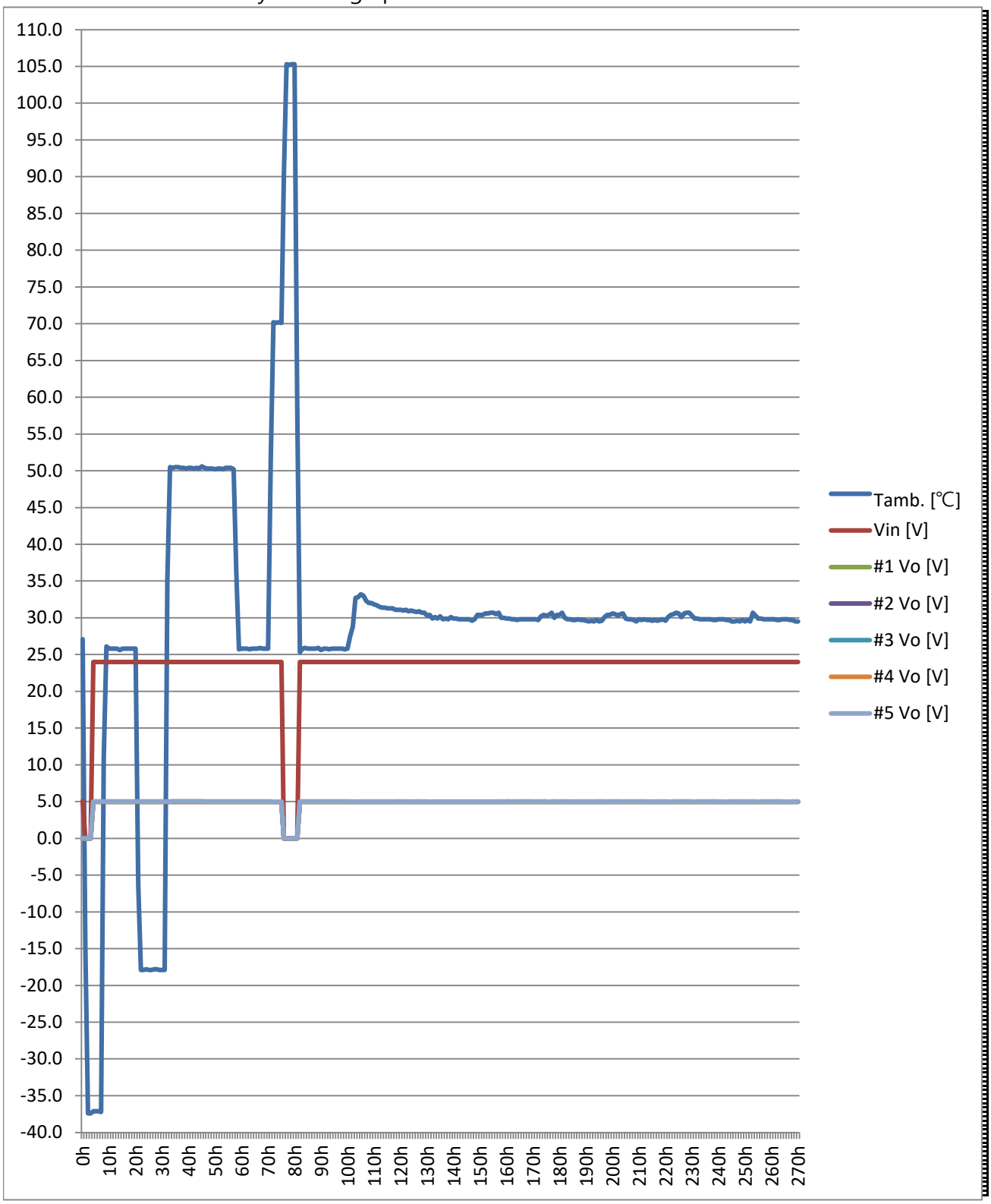
| Segment | Time | Temp. | Humidity | Description | Input 'SW' |
|---|---|---|---|---|---|
| **A** | 2 hours | -40℃ | 0% | Low temperature storage | off |
| **B** | 4 hours | -40℃ | 0% | Low temperature operation | on |
| **C** | 12 hours | 25℃ | 0% | Room temperature operation | on |
| **D** | 10 hours | -20℃ | 0% | Low temperature operation | on |
| **E** | 12 hours | 50℃ | 0% | High temperature operation | on |
| **F** | 12 hours | 50℃ | 50% | High-temperature & humidity operation | on |
| **G** | 12 hours | 25℃ | 0% | Room temperature operation | on |
| **H** | 4 hours | 70℃ | 90% | High-temperature & humidity operation | on |
| **I** | 4 hours | 105℃ | 0% | High temperature storage | off |
| **J** | 189 hours | 25℃ | 0% | Room temperature operation | on |

**< Table1 : Segment Description >**

## 2.1. Environmental Stress Test Results

a. Test Sample : SDS3-24-05

b. 270 hours in one cycle test graph



c. Characteristics test results (@ Input Voltage : 24VDC, Output Load : 0.49A(81.7% of Full load))

| Segment | Test Time | $T_{amb}$/Humi. | Output Voltage | Start up | Ripple / Noise [ mVp-p ] | Sapmle No. |
|---|---|---|---|---|---|---|
| A | 3h | -40℃ / 0% | 5.01V | OK | 18 / 36 | # 1 |
| | | | 4.99V | OK | 18 / 36 | # 2 |
| | | | 4.99V | OK | 18 / 38 | # 3 |
| | | | 4.99V | OK | 18 / 36 | # 4 |
| | | | 5.01V | OK | 18 / 34 | # 5 |
| B | 7h | -40℃ / 0% | 5.01V | OK | 16 / 34 | # 1 |
| | | | 4.99V | OK | 16 / 32 | # 2 |
| | | | 4.99V | OK | 16 / 34 | # 3 |
| | | | 4.99V | OK | 16 / 36 | # 4 |
| | | | 5.01V | OK | 16 / 33 | # 5 |
| C | 10h | 25℃ / 0% | 5.01V | OK | 13 / 20 | # 1 |
| | | | 4.99V | OK | 13 / 20 | # 2 |
| | | | 4.99V | OK | 11 / 23 | # 3 |
| | | | 4.99V | OK | 13 / 19 | # 4 |
| | | | 5.00V | OK | 11 / 21 | # 5 |
| D | 24h | -20℃ / 0% | 5.01V | OK | 14 / 28 | # 1 |
| | | | 5.00V | OK | 15 / 28 | # 2 |
| | | | 4.99V | OK | 15 / 27 | # 3 |
| | | | 4.99V | OK | 15 / 24 | # 4 |
| | | | 5.01V | OK | 15 / 27 | # 5 |
| E | 33h | 50℃ / 0% | 5.00V | OK | 13 / 22 | # 1 |
| | | | 4.98V | OK | 13 / 23 | # 2 |
| | | | 4.98V | OK | 12 / 26 | # 3 |
| | | | 4.98V | OK | 11 / 28 | # 4 |
| | | | 5.00V | OK | 12 / 24 | # 5 |
| F | 48h | 50℃ / 50% | 5.01V | OK | 13 / 26 | # 1 |
| | | | 4.98V | OK | 13 / 28 | # 2 |
| | | | 4.99V | OK | 12 / 28 | # 3 |
| | | | 4.98V | OK | 11 / 33 | # 4 |
| | | | 5.00V | OK | 12 / 28 | # 5 |
| G | 57h | 25℃ / 0% | 5.00V | OK | 13 / 24 | # 1 |
| | | | 4.98V | OK | 13 / 24 | # 2 |
| | | | 4.99V | OK | 13 / 26 | # 3 |
| | | | 4.98V | OK | 13 / 27 | # 4 |
| | | | 5.00V | OK | 13 / 28 | # 5 |
| H | 72h | 70℃ / 90% | 4.99V | OK | 14 / 28 | # 1 |
| | | | 4.97V | OK | 15 / 32 | # 2 |
| | | | 4.98V | OK | 15 / 33 | # 3 |
| | | | 4.98V | OK | 14 / 29 | # 4 |
| | | | 4.99V | OK | 14 / 33 | # 5 |
| I | 81h | 25℃ / 0% | 5.01V | OK | 13 / 26 | # 1 |
| | | | 4.99V | OK | 13 / 24 | # 2 |
| | | | 4.99V | OK | 13 / 28 | # 3 |
| | | | 4.98V | OK | 13 / 28 | # 4 |
| | | | 5.00V | OK | 13 / 28 | # 5 |
| J | 270h | 25℃ / 0% | 5.00V | OK | 13 / 24 | # 1 |
| | | | 4.98V | OK | 13 / 25 | # 2 |
| | | | 4.98V | OK | 13 / 28 | # 3 |
| | | | 4.98V | OK | 13 / 28 | # 4 |
| | | | 5.00V | OK | 13 / 26 | # 5 |
| Test Result | | | Pass | Pass | Pass | |

# 3. 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.

### 3.1. SDS3-24-12 (@ 100% Load)

| Test Condition / Test Point | Vin : 18VDC | | Vin : 24VDC | |
|---|---|---|---|---|
| | $T_{amb.}$ | 24.1℃ | $T_{amb.}$ | 24.0℃ |
| | Tc | Δt | Tc | Δt |
| FET | 51.3℃ | **27.2℃** | 50.4℃ | **26.4℃** |
| Trans Coil | 49.4℃ | **25.3℃** | 48.6℃ | **24.6℃** |
| Trans Core | 49.8℃ | **25.7℃** | 50.0℃ | **26.0℃** |
| Output Diode | 50.6℃ | **26.5℃** | 50.8℃ | **26.8℃** |

# 4. Derating of Semiconductor

Compare Tjmax(maximum junction temperature) and TJ and is expressed as a percentage. Tj is the value calculated by the temperature of the case and the power dissipation and the thermal impedance.

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

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

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

$T_c$ : Case Temperature

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

$P_d$ : Power dissipation

### 4.1. SDS3-24-12

| Components / Condition | Vin : 18VDC | Load : 100% | $T_{amb.}$ : 50℃ |
|---|---|---|---|
| Q1 (FET) | $T_{j(max)}$ : 150 ℃ | $P_d$ : 0.24 W | **Derating Ratio = 56.3%** |
| | $R_{\Theta(J\text{-}C)}$ : 30 ℃/W | $T_j$ = 84.4 ℃ | |
| | $T_c$ : 77.2℃ | | |
| D4 (Rectifier Diode) | $T_{j(max)}$ : 150 ℃ | $P_d$ : 0.16 W | **Derating Ratio = 58.5%** |
| | $R_{\Theta(J\text{-}C)}$ : 70 ℃/W | $T_j$ = 87.7 ℃ | |
| | $T_C$ : 76.5℃ | | |

# 5. Abnormal Test



Product Service

| Clause | Requirement – Test | Result – Remark | Verdict |
|---|---|---|---|
| 5.3 | TABLE: fault condition tests | | P |
| | ambient temperature (°C) ..... : | 22 °C | — |
| | model/type of power supply ..... : | SDS1R5, SDS3 | — |
| | manufacturer of power supply ..... : | Open Digital Power | — |
| | rated markings of power supply ..... : | 5 – 48Vd.c. | — |

| component No. | fault | test voltage (V) | test time | fuse No. | fuse current (A) | result |
|---|---|---|---|---|---|---|
| Reverse input | - | 5/12/ 24/48 | 10 min | F1 | 3 - 1A | Immediately fuse(F1) opened. No hazard. |
| C1 | s/c | 5/12/ 24/48 | 1 sec | F1 | 3 - 1A | Immediately fuse(F1) opened. No hazard. |
| PC1 #3-4 | s/c | 5/12/ 24/48 | 10 min | F1 | 3 - 1A | Immediately output shutdown. No hazard. |
| PC1 #-12 | s/c | 5/12/ 24/48 | 1 sec | F1 | 3 - 1A | Immediately fuse(F1) opened. No hazard. |
| Output | s/c | 5/12/ 24/48 | 30 min | F1 | 3 - 1A | Immediately output shutdown. No hazard. |
| Q1 # 1-2 | s/c | 5/12/ 24/48 | 1 sec | F1 | 3 - 1A | Immediately fuse(F1) opened. No hazard. |
| T1 # 1-5 | s/c | 5/12/ 24/48 | 30 min | F1 | 3 - 1A | Normal operation. No hazard. |
| T1 # 3-5 | s/c | 5/12/ 24/48 | 30 min | F1 | 3 - 1A | Normal operation. No hazard. |
| T1 # 1-7 | s/c | 5/12/ 24/48 | 30 min | F1 | 3 - 1A | Normal operation. No hazard. |
| supplementary information | | | | | | |
| s/c: short circuit, #: pin No., | | | | | | |

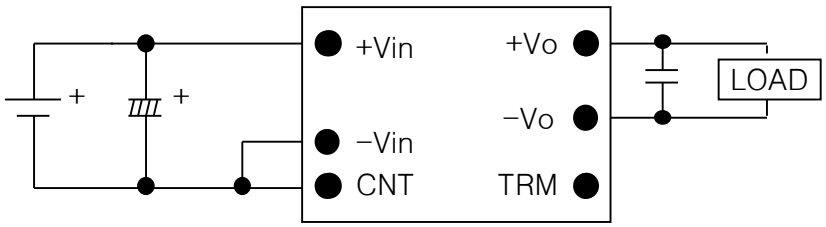
**Note Before placing the products in the different countries the manufacturer has to guarantee that:**

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




## 2. Input Section

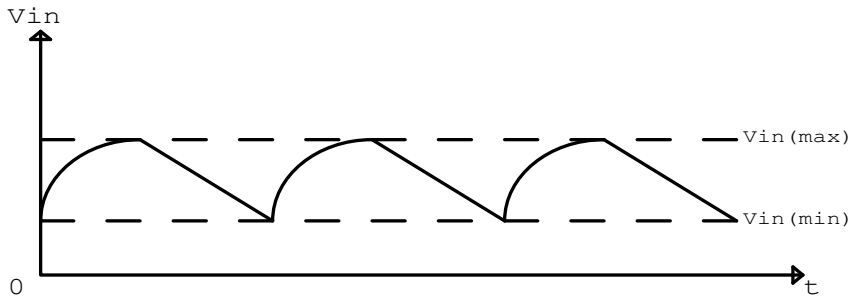
### - Input fuse

In order to comply with safety requirements, SDS series has a fuse(Slow Blow Type) built in.

| | SDS1R5 Series | SDS3 Series | SDS6 Series | SDS10 Series |
|---|---|---|---|---|
| 5V | 2A | 3A | 5A | 6A |
| 12V | 1A | 2.5A | 2.5A | 4A |
| 24V | 1A | 1A | 2A | 2.5A |
| 48V | 1A | 1A | 1.5A | 2A |

### - Unstable Input

Input voltage is comprised of both the DC voltage(average rectified voltage)and the peak to peak ripple voltage. Peak to peak ripple voltage should be minimized so that the input voltage is within the standard input voltage range as follows.



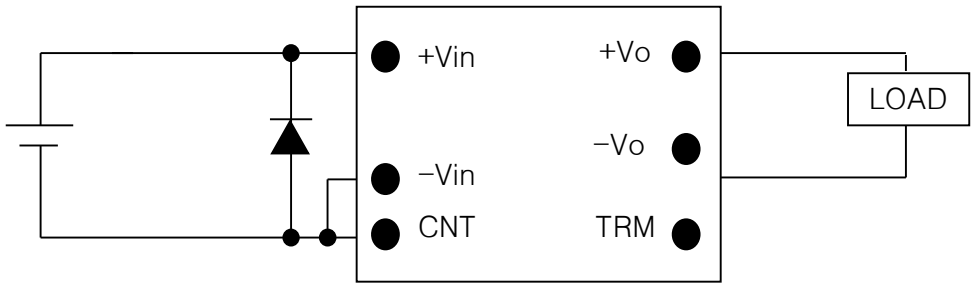

< Unstable Input >

### - Battery Input

When using a battery as the input power supply, make sure that the maximum and minimum input voltage do not away out of the standard input voltage range.

### - Input Reverse-polarity voltage protection

Accidentlly reversing the input connections could damage the module. Thus. If the connections may be accidentally reversed. Use a protective diode and an input fuse as shown below.




### - Remote On/Off Control(CNT) (Except SDS1R5 Series)

Without switching the input on/off, the output can be enabled and disabled using this function. This function is useful for sequence control when building multiple output power supplies. This control circuit is on the input side using the CNT pin. Ground of CNT pin is the input -V terminal. When not using this function, short CNT to input -V terminal.

| CNT level for -Vin | | OUTPUT |
|---|---|---|
| Low level | Short to -Vin | ON |
| High level | Open | OFF |

< Negative Logic on/off Control >

## 3. Output Section

### - Output Ripple and Noise Measurement Method

The measurement for output ripple and noise are based on normal probe with 20㎒ 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.

## - 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 input and output voltage are ±Vin pins, ±Vout 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 input and output voltage are ±Vin pins, ±Vout pins respectively.

## - Output Voltage adjustment (TRM)

The output voltage can be varied within ±10% of the standard output voltage when use the external parts-resistors and variable resistor.

External Resistors :

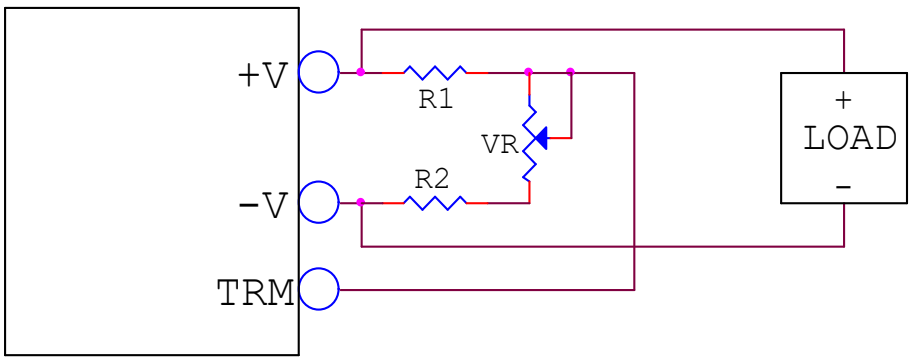
Resistance tolerance ±5%

Variable Resistor(VR) :

Total resistance toloatace ±20%

Remaining Resistance : Value less than 1%

| Vo | R1 | R2 | VR |
|---|---|---|---|
| 3.3V | 1.5kΩ | 680Ω | 1kΩ |
| 5V | 1kΩ | 680Ω | 1kΩ |
| 12V | 3.9kΩ | 680Ω | 1kΩ |
| 15V | 5.6kΩ | 750Ω | 1kΩ |
| ±12(24V) | 12kΩ | 1kΩ | 1kΩ |
| ±15(30V) | 15kΩ | 1kΩ | 1kΩ |




< Trim Method >

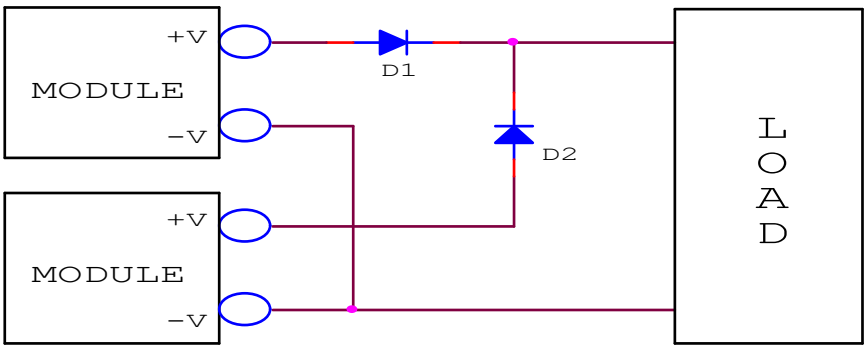
## - Over Current Protection

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

# 4. Operation Method

## Parallel Operation

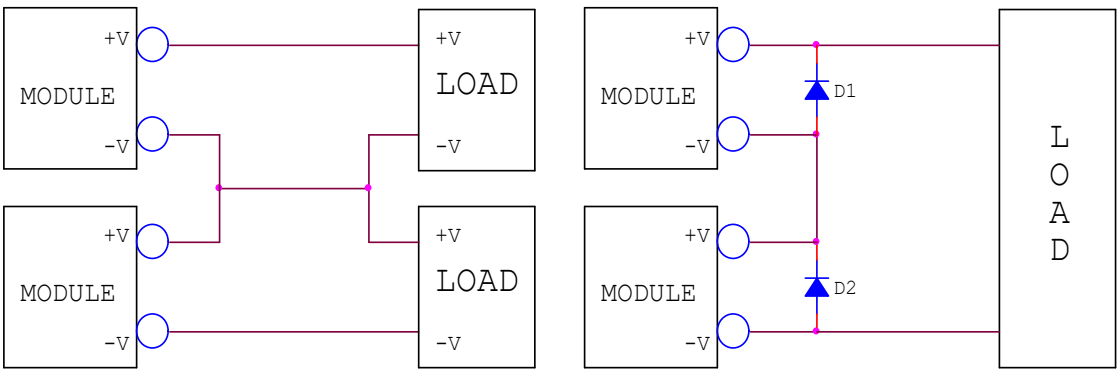
The module can be operated parallel connection. Refer to diagram as shown below.




Please, you must consider both revers voltage and forward current of diode, when you choose a diode.
Maximum reverse voltage(Vrm) : Vrm > 1.5 X Vo
Forward current(If) : If > 3 X Io
Also, design a heatsink according to power loss at diode. If you want to reduce power loss, use a schottky barrer diode.
Power loss = Vf(forward voltage) X Io(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 >

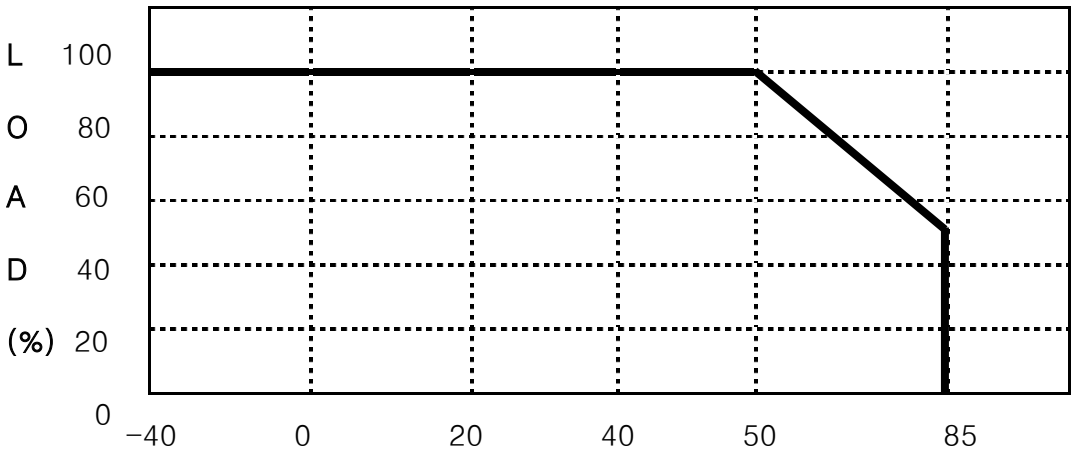
Please, you must consider both revers voltage and forward current of diode, when you choose a diode.
Maximum reverse voltage(Vrm) : Vrm > 1.5 X Vo
Forward current(If) : If > 3 X Io
Also, design a heatsink according to power loss at diode. If you want to reduce power loss, use a schottky barrer diode.
Power loss = Vf(forward voltage) X Io(output current)

# 5. Environment

## - Temperature

### Operation Temperature

The range of ambient temperature in ℃ 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℃ to 85℃

< Derating Curve>

### Storage Temperature

The range of ambient temperature in ℃ over which a module may be stored long term without damage. The storage temperature range is from -40℃ to 105℃.

## - 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 5% to 95%RH.

### Storage Humidity

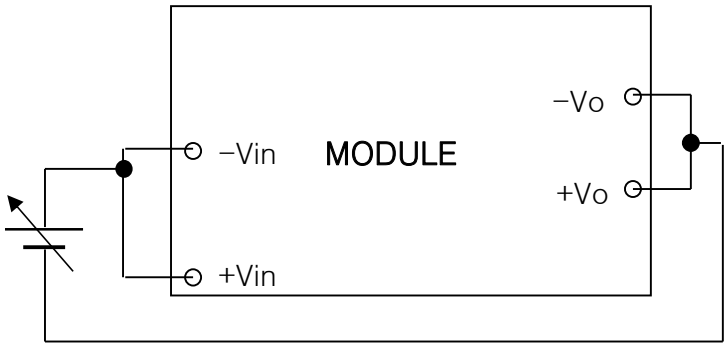
The range of ambient humidity in % over which a module may be stored long term without damage. The storage humidity range is from 5% to 95%RH.

# 6. Isolation

### Isolation Resistance

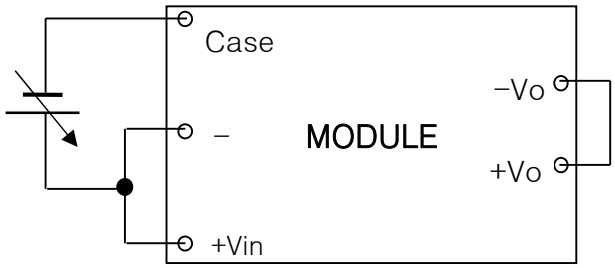
The electrical separation between input and output of a module by means of the power transformer. The isolation resistance is a function of materials and spacings employed throughout the module. Please don't test with a voltage above standard voltage for the Isolation Resistance Test.

< INPUT - OUTPUT>



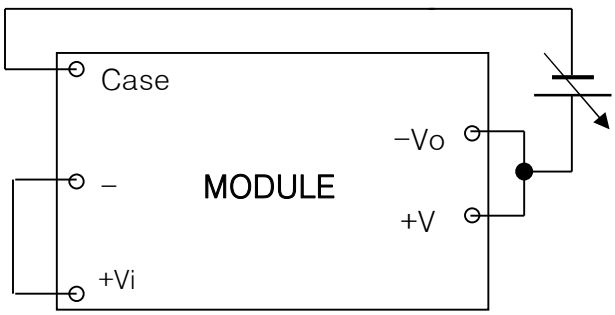

500VDC, 100㏁

<INPUT - Case>




500VDC, 100㏁

< OUTPUT - FRG>

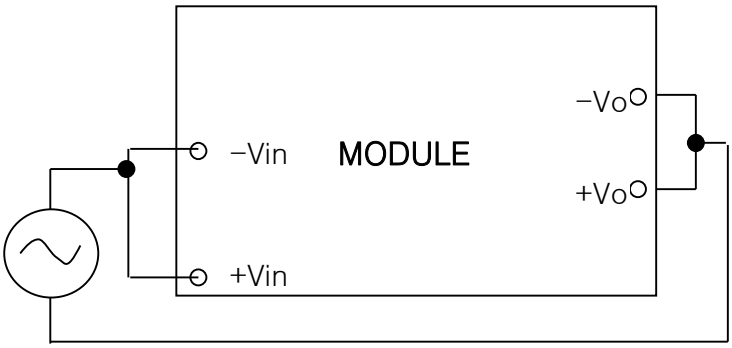



500VDC, 70㏁

Withstand Voltage

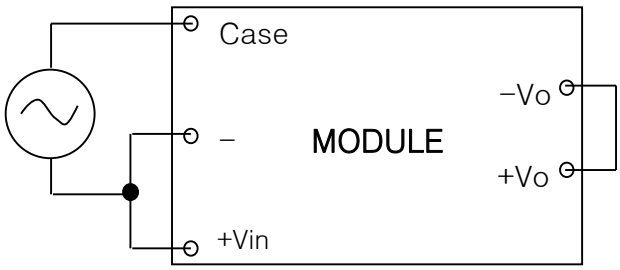
For the withstand voltage test, the applied voltage must be increased gradually from zero to the testing value, and then decreased gradually at shut down. Especially stay away from use of a timer. Where a pulse of several times the applied voltage can be generated.

< INPUT - OUTPUT>



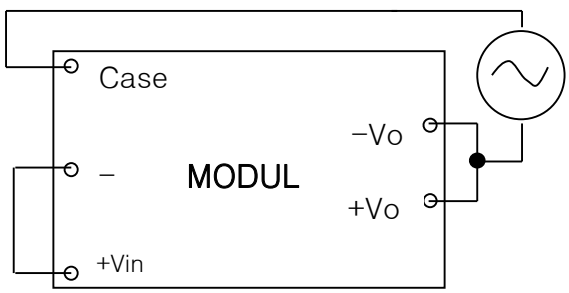

500VAC (10mA) 1minute

<INPUT - FRG>



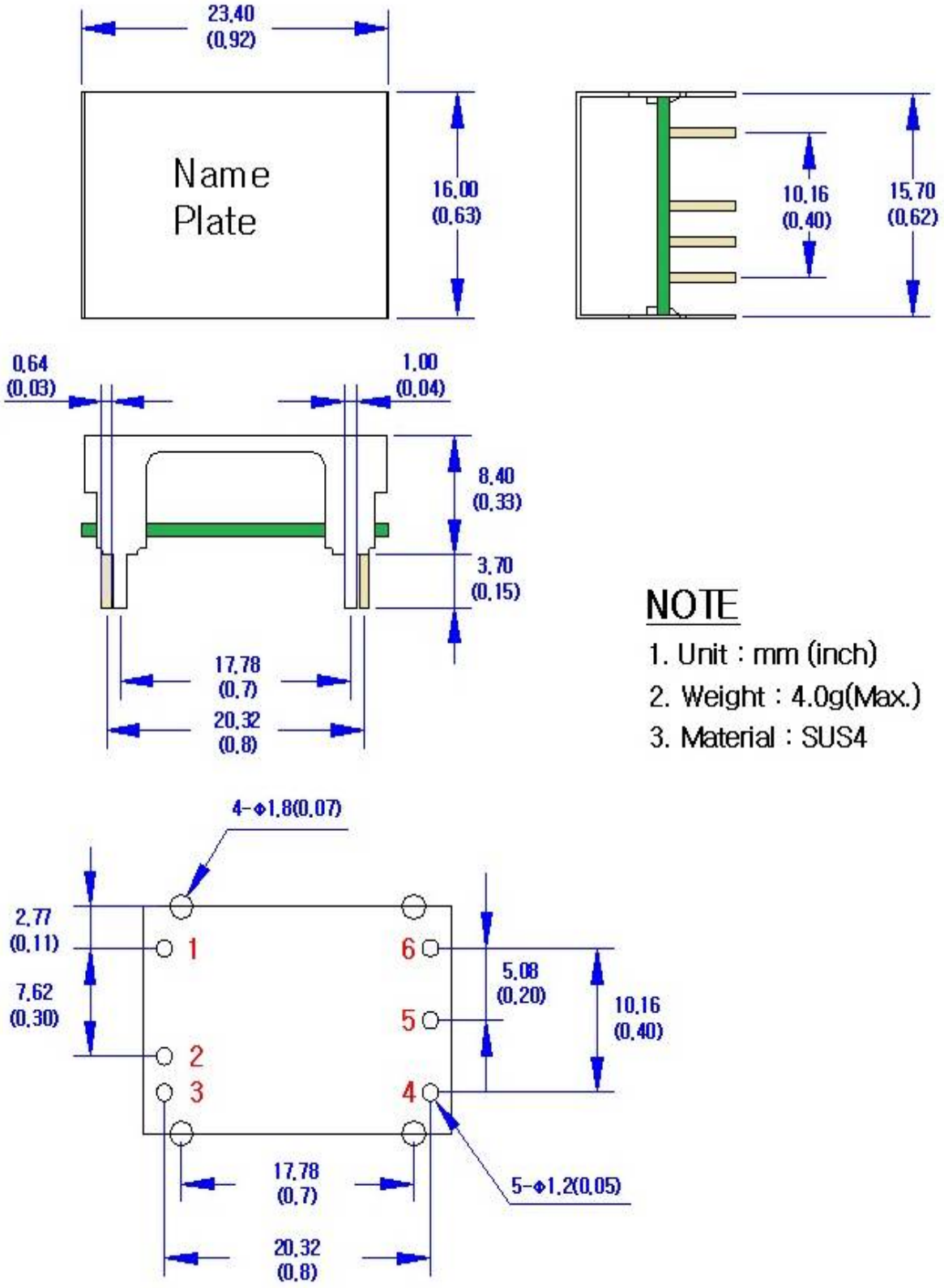

500VAC (10mA) 1minute

< OUTPUT - FRG>




500VAC (10mA) 1minute

## 7. Outline Dimensions <Unit : mm (inch)>




**NOTE**

1. Unit : mm (inch)
2. Weight : 4.0g(Max.)
3. Material : SUS4