SWS100

RELIABILITY DATA

DWG No. CA731-57-01			
QA APPD	APPD	CHK	DWG
王 03.5.29 国峰	23-May-03	Jackson 20-May-'03	Chris 20, May, '03

I N D E X

※ The above data is typical value. As all units have nearly the same characteristics, the data to be considered as ability value.

1. CALCULATED VALUES OF MTBF

MODEL : SWS100-5

(1) Calculating method

Calculated based on part count reliability projection of JEITA (RCR-9102).

Individual failure rates λ_G is given to each part and MTBF is calculated by the count of each part.

<Formula> :

$$MTBF = \frac{1}{\lambda_{equip}} = \frac{1}{\sum_{i=1}^{n} N_i(\lambda_G \pi_Q)_i} \times 10^6 \text{ (Hours)}$$

λ_{equip}	: Total Equipment Failure Rate (Failure/10^6 Hours)
λ_G	: Generic Failure Rate for The ith Generic Part (Failure/10^6 Hours)
N_i	: Quantity of ith Generic Part
n	: Number of Different Generic Part Categories
π_Q	: Generic Quality Factor for The ith Generic Part (π_Q =1)

(2) MTBF Values

G_F : (Ground , Fixed)

<u>MTBF ≒426,898(Hours)</u>

2. COMPONENT DERATING

MODEL : SWS100-5

(1) Calculating Method

(a) Measuring Conditions

Input	:	100/200VAC	• Ambient temperature	:	45°C
Output	:	5V 20A(100%)	• Mounting method	:	Standard Mounting

(b) Semiconductors

Compared with maximum junction temperature and actual one which is calculated based on case temperature, power dissipation and thermal impedance.

(c) IC, Resistors, Capacitors, etc.

Ambient temperature, operating condition, power dissipation and so on are within derating criteria.

(d) Calculating Method of Thermal Impedance

$$\theta_{j-c} = \frac{T_{j(max)} - T_c}{P_{c(max)}} \qquad \theta_{j-a} = \frac{T_{j(max)} - T_a}{P_{c(max)}} \qquad \theta_{j-l} = \frac{T_{j(max)} - T_l}{P_{c(max)}}$$

T_c	: Case Temperature at Start Point of Derating ; 25°C in General
T_a	: Ambient Temperature at Start Point of Derating ; 25°C in General
T_l	: Lead Temperature at Start Point of Derating ; 25°C in General
$P_{c(max)}$ ($P_{ch(max)}$)	: Maximum Collector(channel) Dissipation
$T_{j(max)}$ ($T_{ch(max)}$)	: Maximum Junction(channel) Temperature
θ_{j-c} (θ_{ch-c})	: Thermal Impedance between Junction(channel) and Case
θ_{j-a}	: Thermal Impedance between Junction and Air
θ_{j-l}	: Thermal Impedance between Junction and Lead

(2) Component Derating List

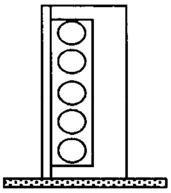
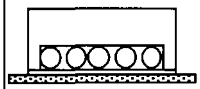
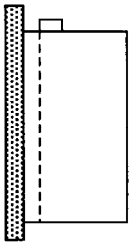
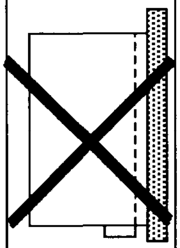
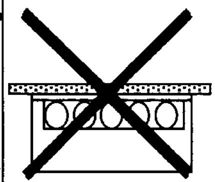
Location No.	Vin = 100VAC Load = 100% Ta = 45°C Convection cooling
Q1 2SK2601 TOSHIBA	Tchmax = 150 °C, θ ch-c = 1.00 °C/W, Pch(max) = 100 W, Pch = 4.80W, Δ Tc = 43.2 °C, Tc = 88.2°C Tch = Tc + ((θ ch-c) × Pch) = 93.0 °C D.F. = 62.0%
Q2 2SK2611 TOSHIBA	Tchmax = 150 °C, θ ch-c = 0.83 °C/W, Pch(max) = 150 W, Pch = 7.29W, Δ Tc =47.9 °C, Tc = 92.9 °C Tch = Tc + ((θ ch-c) × Pch) =99.0 °C D.F. = 66.0%
Q102 2SK2177-4061 SHINDENGEN	Tjmax = 150 °C, θ ch-c = 12.5 °C/W, Pch(max) = 10 W, Pch= 0.03 W, Δ Tc= 49.9 °C, Tc =94.9 °C Tch = Tc + ((θ ch-c) × Pch) = 95.3 °C D.F.= 63.5%
D1 D3SB60 SHINDENGEN	Tjmax = 150 °C, θ j-c = 5.5 °C/W, Pd = 2.30 W, Δ Tc = 83.7 °C, Tc= 128.7 °C Tj = Tc + ((θ j-c) × Pd) = 141.4 °C D.F. = 94.3%
D2 YG911S3R FUJI-ELE.	Tjmax = 150 °C, θ j-c = 3.50 °C/W, Pd = 0.72 W, Δ Tc = 46.9 °C, Tc= 91.9 °C Tj = Tc + ((θ j-c) × Pd) = 94.4°C D.F. = 62.9%
D51 S30SC4M SHINDENGEN	Tjmax = 150 °C, θ j-c = 1.00 °C/W, Pd = 11.0 W, Δ Tc =56.4 °C, Tc =101.4 °C Tj = Tc + ((θ j-c) × Pd) = 112.4 °C D.F. = 74.9%
A101 FA5502M-TE1 FUJI-ELE.	Tjmax = 150 °C, θ j-c = 50.00 °C/W, Pd = 0.09W, Δ Tc =48.5 °C, Tc= 93.5 °C Tj = Tc + ((θ j-c) × Pd) = 98 °C D.F. = 65.3 %
A102 M51995AFP-600C MITSUBISHI	Tjmax = 150 °C, θ j-c = 40.00 °C/W, Pd = 0.35W, Δ Tc =72.6 °C, Tc= 117.6 °C Tj = Tc + ((θ j-c) × Pd) =131.6 °C D.F. = 87.7 %
A201 UPC1093T-E1 NEC	Tjmax = 150 °C, θ j-a = 315 °C/W, Pd = 0.03W, Δ Ta =58.9 °C, Ta= 103.9 °C Tj = Ta + ((θ j-a) × Pd) =113.4 °C D.F. = 75.6 %
PC1 TLP721F (D4-GR,M) (LED) TOSHIBA	Tjmax = 150 °C, ΔI_f/°C = -0.7mA /°C I_f(max)=60mA I_f = 0 mA,, Δ Ta = 47.9 °C, Ta= 92.9 °C ALLOWABLE I_f(max) = 23mA (at Ta = 92.9°C) D.F. = 0 %
PC1 TLP721F (D4-GR,M) (Transistor) TOSHIBA	Tjmax = 150 °C, θ j-a = 667°C/W, Pc(max) = 150mW, Pd = 0 W, Δ Ta = 47.9 °C, Ta= 92.9 °C Tj = Ta + ((θ j-a) × Pd) =92.9 °C D.F. = 61.9 %
PC2 TLP721F (D4-GR,M) (LED) TOSHIBA	Tjmax = 150 °C, ΔI_f/°C = -0.7mA /°C I_f(max)=60mA I_f = 1.2 mA,, Δ Ta =46.7 °C, Ta= 91.7 °C ALLOWABLE I_f(max) = 24mA (at Ta = 91.7°C) D.F. = 5 %
PC2 TLP721F (D4-GR,M) (Transistor) TOSHIBA	Tjmax = 150 °C, θ j-a = 667°C/W, Pc(max) = 150mW, Pd = 25 mW, Δ Ta =46.7 °C, Ta= 91.7 °C Tj = Ta + ((θ j-a) × Pd) =108.4 °C D.F. = 72.3 %

Location No.	Vin = 200VAC Load = 100% Ta = 45°C Convection cooling
Q1 2SK2601 TOSHIBA	Tchmax = 150 °C, θ ch-c = 1.00 °C/W, Pch(max) = 100 W, Pch = 1.83W, Δ Tc = 34.6 °C, Tc = 79.6°C Tch = Tc + ((θ ch-c) × Pch) = 81.4 °C D.F. = 54.3%
Q2 2SK2611 TOSHIBA	Tchmax = 150 °C, θ ch-c = 0.83 °C/W, Pch(max) = 150 W, Pch = 7.29W, Δ Tc =44.3 °C, Tc = 89.3 °C Tch = Tc + ((θ ch-c) × Pch) =95.4 °C D.F. = 63.6%
Q102 2SK2177-4061 SHINDENGEN	Tjmax = 150 °C, θ ch-c = 12.5 °C/W, Pch(max) = 10 W, Pch= 0.03 W, Δ Tc= 40.4 °C, Tc = 85.4 °C Tch = Tc + ((θ ch-c) × Pch) = 85.8 °C D.F.= 57.2%
D1 D3SB60 SHINDENGEN	Tjmax = 150 °C, θ j-c = 5.5 °C/W, Pd = 0.60 W, Δ Tc = 54.1 °C, Tc= 99.1 °C Tj = Tc + ((θ j-c) × Pd) = 102.4 °C D.F. = 68.3%
D2 YG911S3R FUJI-ELE.	Tjmax = 150 °C, θ j-c = 3.50 °C/W, Pd = 0.72 W, Δ Tc = 37.5 °C, Tc= 82.5 °C Tj = Tc + ((θ j-c) × Pd) = 85.0°C D.F. = 56.7%
D51 S30SC4M SHINDENGEN	Tjmax = 150 °C, θ j-c = 1.00 °C/W, Pd = 11.0 W, Δ Tc =54.5 °C, Tc = 95.5 °C Tj = Tc + ((θ j-c) × Pd) = 106.5 °C D.F. = 71%
A101 FA5502M-TE1 FUJI-ELE.	Tjmax = 150 °C, θ j-c = 50.00 °C/W, Pd = 0.09W, Δ Tc =45.5 °C, Tc= 90.5 °C Tj = Tc + ((θ j-c) × Pd) = 95 °C D.F. = 63.3 %
A102 M51995AFP-600C MITSUBISHI	Tjmax = 150 °C, θ j-c = 40.00 °C/W, Pd = 0.35W, Δ Tc =70.5 °C, Tc= 115.5 °C Tj = Tc + ((θ j-c) × Pd) =129.5 °C D.F. = 86.3 %
A201 UPC1093T-E1 NEC	Tjmax = 150 °C, θ j-a = 315 °C/W, Pd = 0.03W, Δ Ta =58.3 °C, Ta= 103.3 °C Tj = Ta + ((θ j-a) × Pd) =112.8 °C D.F. = 75.2 %
PC1 TLP721F (D4-GR,M) (LED) TOSHIBA	Tjmax = 150 °C, ΔI_f/°C = -0.7mA /°C I_f(max)=60mA I_f = 0 mA,, Δ Ta = 41.7 °C, Ta= 86.7 °C ALLOWABLE I_f(max) = 28mA (at Ta = 86.7°C) D.F. = 0 %
PC1 TLP721F (D4-GR,M) (Transistor) TOSHIBA	Tjmax = 150 °C, θ j-a = 667°C/W, Pc(max) = 150mW, Pd = 0 W, Δ Ta = 41.7 °C, Ta= 86.7 °C Tj = Ta + ((θ j-a) × Pd) = 86.7 °C D.F. = 57.8 %
PC2 TLP721F (D4-GR,M) (LED) TOSHIBA	Tjmax = 150 °C, ΔI_f/°C = -0.7mA /°C I_f(max)=60mA I_f = 1.4 mA,, Δ Ta =41.5 °C, Ta= 86.5 °C ALLOWABLE I_f(max) = 28mA (at Ta = 91.7°C) D.F. = 5.0 %
PC2 TLP721F (D4-GR,M) (Transistor) TOSHIBA	Tjmax = 150 °C, θ j-a = 667°C/W, Pc(max) = 150mW, Pd = 25 mW, Δ Ta =41.5 °C, Ta= 86.5 °C Tj = Ta + ((θ j-a) × Pd) =103.2 °C D.F. = 68.8 %

3. MAIN COMPONENTS TEMPERATURE RISE ΔT LIST

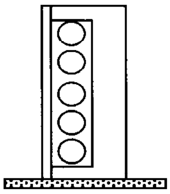
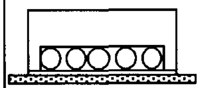
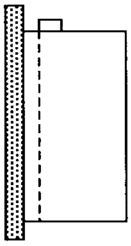
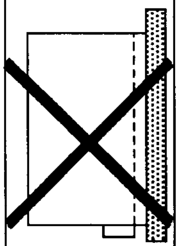
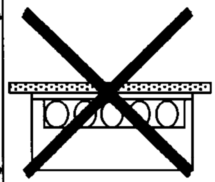
MODEL : SWS100-5

Measuring Conditions (Convection cooling)

	(A)	(B)	(C)	DON'T USE	DON'T USE
Mounting Method (Standard Mounting Method:(A))					
Input Voltage (VAC)	100			Not Recommended	
Output Voltage (VDC)	5				
Output Current (A)	20				

		ΔT Temperature rise (°C)		
Ambient Temperature		Ta =45°C	Ta =35°C	Ta =35°C
Location No.	Parts Name	Mounting A	Mounting B	Mounting C
L2	BALUN COIL	48.3	70.0	65.4
T1	TRANS PULSE	65.2	75.7	62.8
A101	CHIP IC	48.5	60.9	49.8
A102	CHIP IC	72.6	80.8	70.9
A201	CHIP IC	58.9	54.8	71.3
D1	BRIDGE DIODE	83.7	93.6	94.4
Q1	MOS-FET	43.2	51.1	45.2
Q2	MOS-FET	47.9	54.4	49.2
D51	OUTPUT DIODE	56.4	60.2	58.3
C6	E.CAP.	31.3	43.2	32.8
C9	E. CAP.	30.9	43.2	30.4
C10	E. CAP.	36.3	44.1	34.3
C51	E. CAP.	32.6	42.3	50.3

Measuring Conditions (Convection cooling)

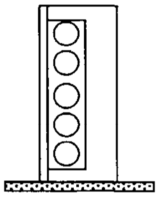
	(A)	(B)	(C)	DON'T USE	DON'T USE
Mounting Method (Standard Mounting Method:(A))					
Input Voltage (VAC)	200			Not Recommended	
Output Voltage (VDC)	5				
Output Current (A)	20				

		ΔT Temperature rise (°C)		
Ambient Temperature		Ta =45°C	Ta =35°C	Ta =35°C
Location No.	Parts Name	Mounting A	Mounting B	Mounting C
L2	BALUN COIL	32.6	50.6	43.9
T1	TRANS PULSE	61.7	74.5	60.3
A101	CHIP IC	45.5	58.9	47.5
A102	CHIP IC	70.5	80.6	70.8
A201	CHIP IC	58.3	53.4	68.9
D1	BRIDGE DIODE	54.1	66.5	62.6
Q1	MOS-FET	34.6	40.6	35.8
Q2	MOS-FET	44.3	49.7	45.0
D51	OUTPUT DIODE	54.5	58.0	55.5
C6	E.CAP.	28.2	37.2	27.4
C9	E. CAP.	34.5	40.6	27.7
C10	E. CAP.	67.5	42.6	33.2
C51	E. CAP.	31.6	41.7	45.9

4. ELECTROLYTIC CAPACITOR LIFETIME

MODEL: SWS100-5

Mounting A

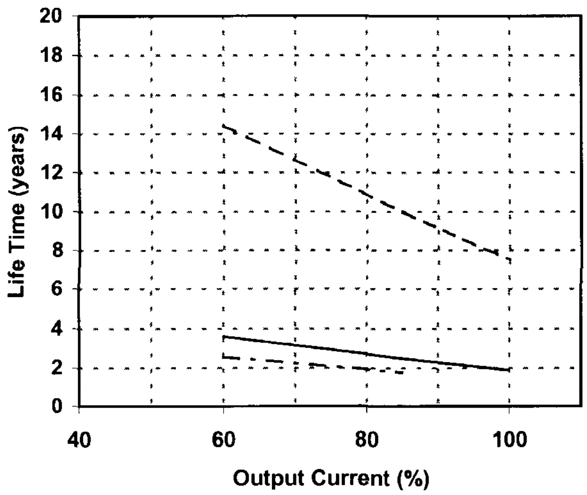


Ta = 25°C - - - - -
Ta = 45°C ———
Ta = 50°C —·—·—·—

Vin = 100VAC

※ Convection Cooling

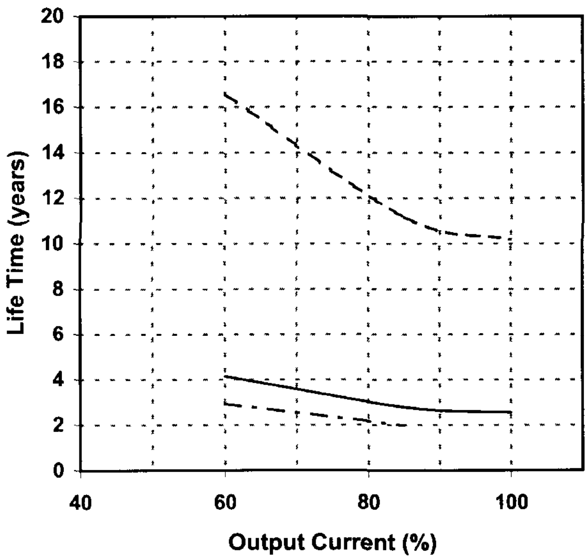
Load (%)	Life Time (years)			
	Ta = 25°C	Ta = 45°C	Ta = 50°C	Ta = 60°C
60	14.4	3.6	2.5	1.3
85	10.0	2.5	1.8	---
100	7.5	1.9	---	---



Vin = 200VAC

※ Convection Cooling

Load (%)	Life Time (years)			
	Ta = 25°C	Ta = 45°C	Ta = 50°C	Ta = 60°C
60	16.6	4.1	2.9	1.5
85	11.2	2.8	2.0	---
100	10.2	2.5	---	---



Formula:

1. For 105°C Elect. capacitor

   $L = Lo * 2^{(105-\Delta T-Ta)/10} / (8 * 365)$ (years)

2. For 85°C Elect. capacitor

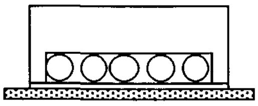
   $L = Lo * 2^{(85-\Delta T-Ta)/10} / (8 * 365)$ (years)

Where:
- L —— Elec. Capacitor computed life (8 hours per day , 365 days operation)
- Lo —— Guarantee life for Elec. capacitor
- Ta —— Ambient temperature
- ΔT —— Temperature rise of Elec. capacitor

MODEL: **SWS100-5**

Ta = 25°C ------
Ta = 35°C ———
Ta = 40°C —·—·—

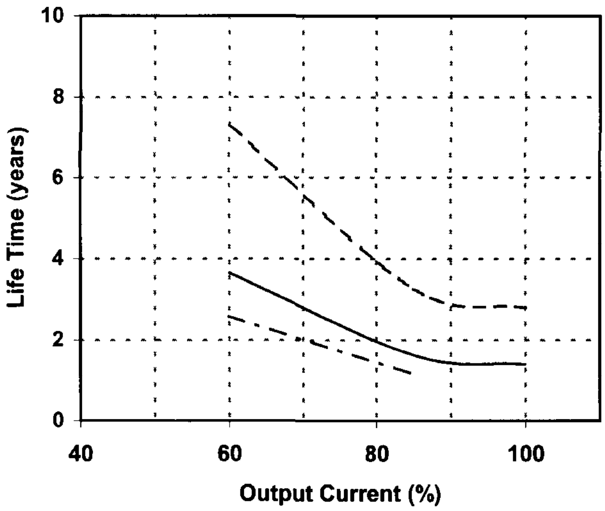
Mounting B



Vin = 100VAC

※ Convection Cooling

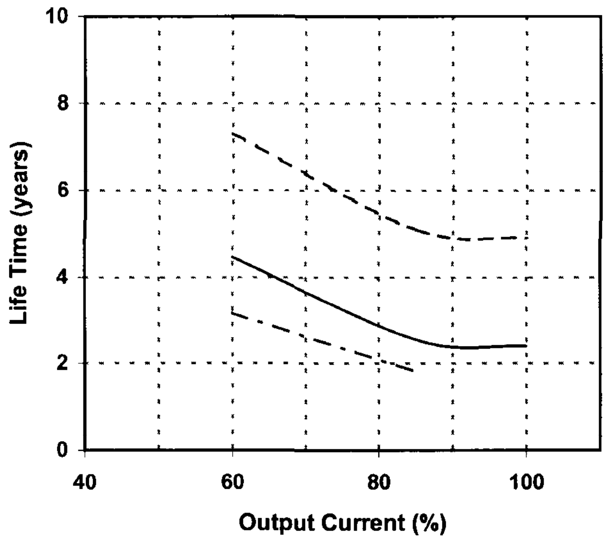
Load (%)	Life Time (years)			
	Ta = 25°C	Ta = 35°C	Ta = 40°C	Ta = 50°C
60	7.3	3.7	2.6	1.3
85	3.3	1.6	1.2	---
100	2.8	1.4	---	---



Vin = 200VAC

※ Convection Cooling

Load (%)	Life Time (years)			
	Ta = 25°C	Ta = 35°C	Ta = 40°C	Ta = 50°C
60	7.3	4.5	3.2	1.6
85	5.1	2.5	1.8	---
100	4.9	2.4	---	---



Formula:

1. For 105°C Elect. capacitor

   $L = Lo * 2^{(105-\Delta T-Ta)/10} /(8 *365)$ (years)

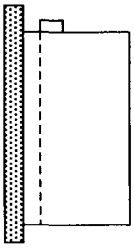
2. For 85°C Elect. capacitor

   $L = Lo * 2^{(85-\Delta T-Ta)/10} /(8 *365)$ (years)

Where:
L —— Elec. Capacitor computed life (8 hours per day , 365 days operation)
Lo —— Guarantee life for Elec. capacitor
Ta —— Ambient temperature
ΔT —— Temperature rise of Elec. capacitor

MODEL: SWS100-5

Mounting C

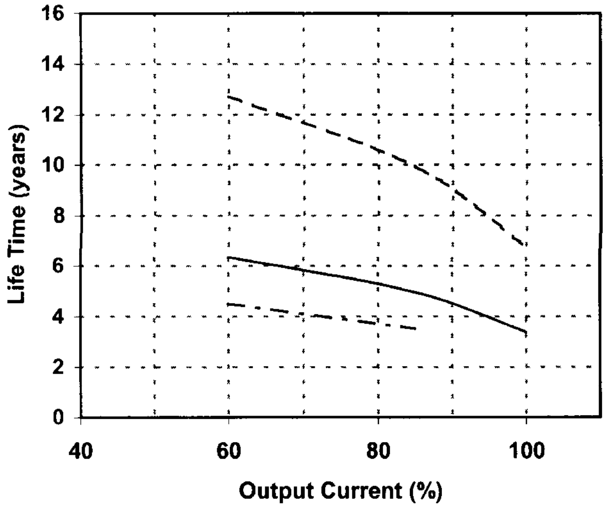


Ta = 25°C ------
Ta = 35°C ———
Ta = 40°C -·-·-·-

Vin = 100VAC

※ Convection Cooling

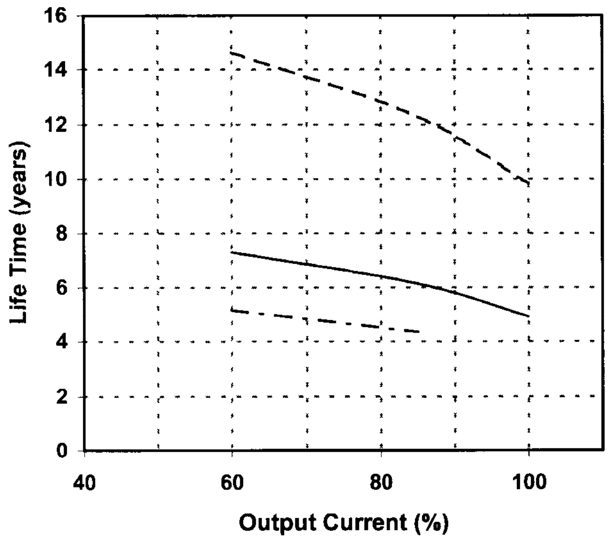
Load (%)	Life Time (years)			
	Ta = 25°C	Ta = 35°C	Ta = 40°C	Ta = 50°C
60	12.7	6.4	4.5	2.2
85	9.9	5.0	3.5	---
100	6.8	3.4	---	---



Vin = 200VAC

※ Convection Cooling

Load (%)	Life Time (years)			
	Ta = 25°C	Ta = 35°C	Ta = 40°C	Ta = 50°C
60	14.6	7.3	5.2	2.6
85	12.3	6.1	4.3	---
100	9.8	4.9	---	---



Formula:

1. For 105°C Elect. capacitor

$L = Lo * 2^{(105-\Delta T-Ta)/10} / (8 * 365)$ (years)

2. For 85°C Elect. capacitor

$L = Lo * 2^{(85-\Delta T-Ta)/10} / (8 * 365)$ (years)

Where:
L —— Elec. Capacitor computed life (8 hours per day , 365 days operation)
Lo —— Guarantee life for Elec. capacitor
Ta —— Ambient temperature
ΔT —— Temperature rise of Elec. capacitor

5. VIBRATION TEST

MODEL : SWS100-12

(1) Vibration Test Class

Frequency Variable Endurance Test

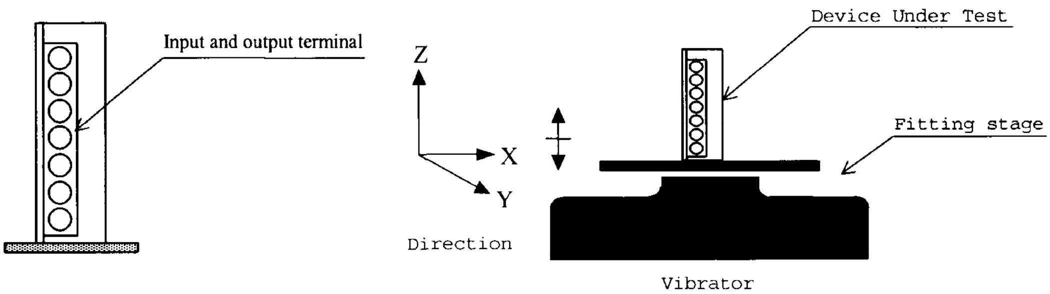
(2) Equipment Used

- Controller : DP550 (DP CORP. USA)
- Vibrator : V870 (LDS CORP. UK)

(3) Test Conditions

- Sweep frequency: 10 ~ 55Hz
- Sweep time: 1.0 min.
- Acceleration: Constant 19.6m/s^2 (2G)
- Direction: X, Y, Z.
- Test time: 1 hour each

(4) Test Method



(5) Test Results

O K

Vin : 200VAC

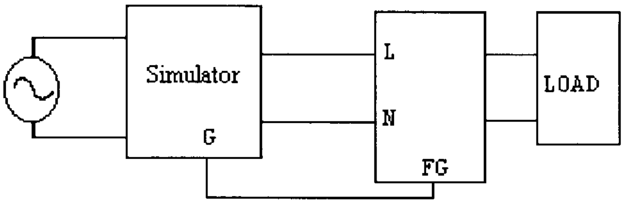
Iout : 100%

Check item		Output Voltage (V)	Ripple Voltage (mVp-p)	D.U.T.State
Before Test		12.003	25	————
After Test	X	12.004	30	O.K.
	Y	12.006	35	O.K.
	Z	12.007	40	O.K.

6. NOISE SIMULATE TEST

MODEL : SWS100-5, 24

(1) Test Circuit And Equipment



Simulator : INS-400L Noise Laboratory Co.,LTD

(2) Test Conditions

• Input Voltage	:	100, 200VAC	• Noise Level	:	0V~2kV
• Output Voltage	:	Rated	• Phase Shift	:	0° ~ 360°
• Output Current	:	0%, 100%	• Polarity	:	+ , −
• Ambient Temperature	:	25°C	• Mode	:	Normal Common
• Pulse Width	:	50ns ~ 1000ns	• Trigger Select	:	Line

(3) Acceptable Conditions

1. Not to be broken.
2. Not to be shut down output.
3. No other out of orders.

(4) Test Result

O K