SWS75

RELIABILITY DATA

DWG No. CA730-57-01			
QA APPD	APPD	CHK	DWG
王 03.5.29 国林	23.May.03	22.May'03	22.May'03

I N D E X

		PAGE
1.	Calculated Values of MTBF	R-1
2.	Component Derating	R-2
3.	Main Components Temperature Rise ΔT List	R-5
4.	Electrolytic Capacitor Life	R-7
5.	Vibration Test	R-11
6.	Noise Simulate Test	R-12

※ 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 : SWS75-5

(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> :

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

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)

MTBF ≒618,054 (Hours)

2. COMPONENT DERATING

MODEL : SWS75-5

(1) Calculating Method

(a) Measuring Conditions

Input	:	100/200 VAC	• Ambient temperature	:	40°C
Output	:	5V 15A(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 = 40°C, Convection cooling		
Q1 2SK2866 TOSHIBA	Tchmax = 150 °C, Pd = 3.275W, Tch = Tc + ((θ ch-c) × Pd) = 81.4 °C D.F. =54.3%	θ ch-c = 1.00 °C/W, Δ Tc = 38.1 °C,	Pch(max) = 125 W, Tc = 78.1°C
Q2 2SC4793 TOSHIBA	Tjmax = 150 °C, Pd = 1.37W, Tj = Tc + ((θ j-c) × Pd) =79.2 °C D.F. =52.8%	θ j-c = 6.25 °C/W, Δ Tc =30.6 °C,	Pc(max) = 2.0 W, Tc = 70.6 °C
D1 D3SB60 SHINDENGEN	Tjmax = 150 °C, Pd = 1.500 W, Tj = Tl + ((θ j-l) × Pd) = 120.7 °C D.F. =80.5%	θ j-l = 6.00 °C/W, Δ Tl = 71.7 °C,	Tl= 111.7 °C
D104 D1FL20U-4063 SHINDENGEN	Tjmax = 150 °C, Pd= 0.060 W, Tj = Tl + ((θ j-l) × Pd) =83.5 °C D.F.= 55.7%	θ j-l = 23.00 °C/W, Δ Tl =42.1 °C,	Tl =82.1 °C
D51 S25SC6M SHINDENGEN	Tjmax = 150 °C, Pd = 10.0 W, Tj = Tc + ((θ j-c) × Pd) = 122.1 °C D.F. = 81.4%	θ j-c = 1.00 °C/W, Δ Tc =72.1 °C,	Tc =112.1 °C
A101 M51995AFP-600C MITSUBISHI	Tjmax = 150 °C, Pd = 0.380W, Tj = Tc + ((θ j-c) × Pd) =107.2°C D.F. =71.5 %	θ j-c = 40.00 °C/W, Δ Tc =52.0 °C,	Tc= 92.0°C
A201 UPC1093T-E1 NEC	Tjmax = 150 °C, Pd = 12 mW, Tj = Ta + ((θ j-a) × Pd) = 87.0 °C D.F. = 58.0%	θ j-a = 315.0 °C/W, Δ Ta = 43.2°C,	Ta = 83.2 °C
PC1 LED TLP721F(D4-GR,M) TOSHIBA	Tjmax = 125 °C, If = 2mA, ALLOWBLE If(max) = 27.4mA (at Ta=85.6 °C) D.F. = 7.3%	ΔIf/°C= - 0.7 mA/°C Δ Ta = 45.6 °C,	If(max)=60mA Ta = 85.6 °C
PC1 TRANSISTOR TLP721F(D4-GR,M) TOSHIBA	Tjmax = 125 °C, Pd = 13 mW, Tj = Ta + ((θj-a) × Pd) = 94.3 °C D.F. = 75.4%	θ j-a = 667 °C/W, Δ Ta = 45.6 °C,	Pc(max) = 150 mW, Ta = 85.6 °C
PC2 LED TLP721F(D4-GR,M) TOSHIBA	Tjmax = 125 °C, If = 0mA, ALLOWBLE If(max) = 33.5 mA (at Ta=76.9 °C) D.F. = 0%	ΔIf/°C= - 0.7 mA/°C Δ Ta = 36.9 °C,	If(max)=60mA Ta = 76.9 °C
PC2 TRANSISTOR TLP721F(D4-GR,M) TOSHIBA	Tjmax = 125 °C, Pd = 0 W, Tj = Ta + ((θj-a) × Pd) = 76.9 °C D.F. = 61.5%	θ j-a = 667 °C/W, Δ Ta = 36.9 °C,	Pc(max) = 150 mW, Ta = 76.9 °C

(2) Component Derating List

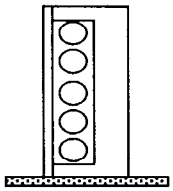
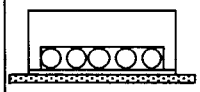
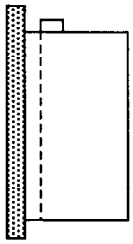
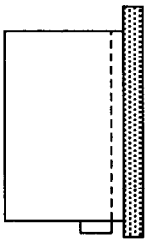
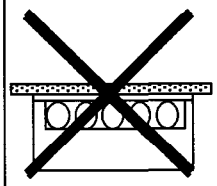
Location No.	Vin = 200VAC Load = 100% Ta = 40°C, Convection cooling		
Q1 2SK2866 TOSHIBA	Tchmax = 150 °C, Pd = 5.975W, Tch = Tc + ((θ ch-c) × Pd) = 84.1 °C D.F. =66.9%	θ ch-c = 1.00 °C/W, Δ Tc = 54.4 °C,	Pch(max) = 125 W, Tc = 94.4°C
Q2 2SC4793 TOSHIBA	Tjmax = 150 °C, Pd = 3.57W, Tj = Tc + ((θ j-c) × Pd) =106.4 °C D.F. =70.9%	θ j-c = 6.25 °C/W, Δ Tc =44.1 °C,	Pc(max) = 2.0 W, Tc = 84.1 °C
D1 D3SB60 SHINDENGEN	Tjmax = 150 °C, Pd = 0.78 W, Tj = Tl + ((θ j-l) × Pd) = 93.1 °C D.F. =63.9%	θ j-l = 6.00 °C/W, Δ Tl = 51.1°C,	Tl= 91.1 °C
D104 D1FL20U-4063 SHINDENGEN	Tjmax = 150 °C, Pd= 0.086 W, Tj = Tl + ((θ j-l) × Pd) =82.4 °C D.F.= 62.1%	θ j-l = 23.00 °C/W, Δ Tl =53.0 °C,	Tl =93.0 °C
D51 S25SC6M SHINDENGEN	Tjmax = 150 °C, Pd = 10.0 W, Tj = Tc + ((θ j-c) × Pd) = 122.9 °C D.F. = 81.9%	θ j-c = 1.00 °C/W, Δ Tc =72.9 °C,	Tc =112.9 °C
A101 M51995AFP-600C MITSUBISHI	Tjmax = 150 °C, Pd = 0.380W, Tj = Tc + ((θ j-c) × Pd) =107.2°C D.F. =77.9 %	θ j-c = 40.00 °C/W, Δ Tc =61.7 °C,	Tc =101.7°C
A201 UPC1093T-E1 NEC	Tjmax = 150 °C, Pd = 12 mW, Tj = Ta + ((θ j-a) × Pd) = 86.8 °C D.F. = 57.9%	θ j-a = 315.0 °C/W, Δ Ta = 43.0°C,	Ta = 83.0 °C
PC1 LED TLP721F(D4-GR,M) TOSHIBA	Tjmax = 125 °C, If = 2.2mA, ALLOWBLE If(max) = 28.2 mA (at Ta=84.4°C) D.F. = 7.8%	ΔIf/°C= - 0.7 mA/°C Δ Ta = 44.4 °C,	If(max)=60mA Ta = 84.4 °C
PC1 TRANSISTOR TLP721F(D4-GR,M) TOSHIBA	Tjmax = 125 °C, Pd = 15.6 mW, Tj = Ta + ((θj-a) × Pd) = 94.8 °C D.F. = 75.8%	θ j-a = 667 °C/W, Δ Ta = 44.4 °C,	Pc(max) = 150 mW, Ta = 84.4 °C
PC2 LED TLP721F(D4-GR,M) TOSHIBA	Tjmax = 125 °C, If = 0mA, ALLOWBLE If(max) = 34.7mA (at Ta=75.2 °C) D.F. = 0%	ΔIf/°C= - 0.7 mA/°C Δ Ta = 35.2 °C,	If(max)=60mA Ta = 75.2 °C
PC2 TRANSISTOR TLP721F(D4-GR,M) TOSHIBA	Tjmax = 125 °C, Pd = 0 W, Tj = Ta + ((θj-a) × Pd) = 75.2 °C D.F. = 60.2%	θ j-a = 667 °C/W, Δ Ta = 35.2 °C,	Pc(max) = 150 mW, Ta = 75.2 °C

3. MAIN COMPONENTS TEMPERATURE RISE ΔT LIST

MODEL : SWS75-5

Measuring Conditions

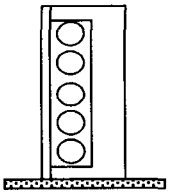
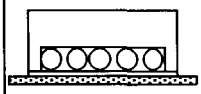
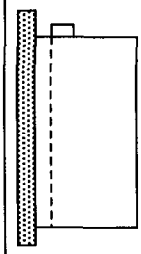
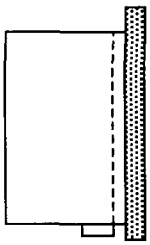
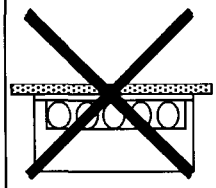
※ Convection cooling

	(A)	(B)	(C)	(D)	DON'T USE
Mounting Method (Standard Mounting Method:(A))					
Input Voltage (VAC)	100				NOT RECOMMENDED
Output Voltage (VDC)	5				
Output Current (A)	15				

		ΔT Temperature rise (°C)			
Ta		40°C	35°C	35°C	35°C
Location No.	Parts Name	Mounting A	Mounting B	Mounting C	Mounting D
L1	BALUN COIL	56.1	64.8	72.3	59.3
L51	CHOKE COIL	68.9	71.8	65.8	64.4
T1	TRANS PULSE	65.2	71.8	59.4	67.9
A101	CHIP IC	52.0	56.8	45.0	66.6
A201	CHIP IC	43.2	32.4	56.5	23.5
D1	BRIDGE DIODE	71.7	79.9	76.1	75.9
Q1	MOS-FET	38.1	40.8	34.8	49.0
Q2	MOS-FET	30.6	32.9	26.7	41.5
D51	OUTPUT DIODE	72.1	69.7	65.1	68.6
C5	E.CAP.	28.7	38.6	27.8	44.6
C6	E. CAP.	23.1	30.1	22.1	41.5
C8	E. CAP.	29.8	33.7	25.2	44.8
C53	E. CAP.	55.3	57.7	64.1	48.5
C55	E. CAP.	42.4	24.0	45.8	19.9

Measuring Conditions

※ Convection cooling

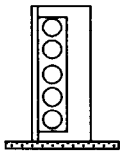
	(A)	(B)	(C)	(D)	DON'T USE
Mounting Method (Standard Mounting Method:(A))					
Input Voltage (VAC)	200				NOT RECOMMENDED
Output Voltage (VDC)	5				
Output Current (A)	15				

		ΔT Temperature rise (°C)			
Ta		40°C	35°C	35°C	35°C
Location No.	Parts Name	Mounting A	Mounting B	Mounting C	Mounting D
L1	BALUN COIL	36.6	45.7	47.7	34.6
L51	CHOKE COIL	68.3	76.0	68.8	65.3
T1	TRANS PULSE	63.9	74.2	62.4	66.0
A101	CHIP IC	61.7	65.9	53.7	73.2
A201	CHIP IC	43.0	32.9	58.2	23.6
D1	BRIDGE DIODE	51.1	60.2	55.7	51.6
Q1	MOS-FET	54.4	58.0	51.2	64.6
Q2	MOS-FET	44.1	47.3	40.2	54.0
D51	OUTPUT DIODE	72.9	71.9	67.0	69.1
C5	E.CAP.	26.9	38.1	27.7	36.8
C6	E. CAP.	24.6	33.5	24.4	39.6
C8	E. CAP.	35.5	40.8	33.3	48.3
C53	E. CAP.	54.8	58.5	65.1	48.3
C55	E. CAP.	42.1	24.5	47.6	20.1

4. ELECTROLYTIC CAPACITOR LIFETIME

MODEL: SWS75-5

Mounting A

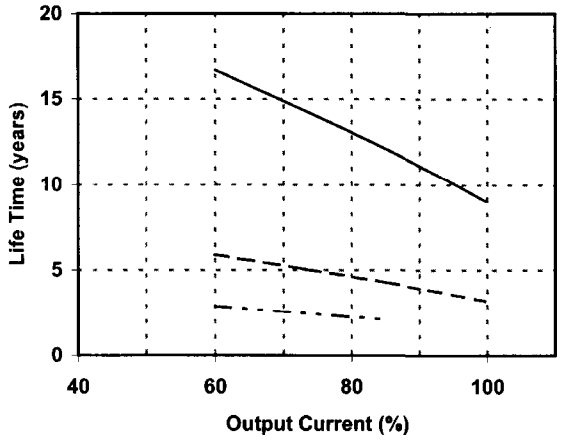


Ta = 25°C ———
Ta = 40°C – – – –
Ta = 50°C —·—·—

Vin = 100VAC

※ Convection cooling

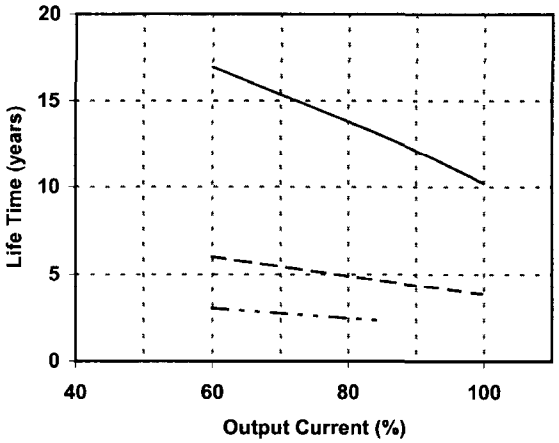
Load (%)	Life Time (years)			
	Ta = 25°C	Ta = 40°C	Ta = 50°C	Ta = 60°C
60	16.7	5.9	2.9	1.5
85	12.1	4.3	2.1	—
100	9.0	3.2	—	—



Vin = 200VAC

※ Convection cooling

Load (%)	Life Time (years)			
	Ta = 25°C	Ta = 40°C	Ta = 50°C	Ta = 60°C
60	16.9	6.0	3.0	1.5
85	13.0	4.6	2.3	—
100	10.2	3.8	—	—



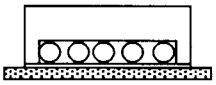
Formula:

1.For 105 °C Elec. Capacitor, $L = Lo * 2^{(105-dT-Ta)/10}/(8*365)$ (Yrs.)
2.For 85 °C Elec. Capacitor, $L = Lo * 2^{(85-dT-Ta)/10}/(8*365)$ (Yrs.)

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

MODEL: **SWS75-5**

Mounting B

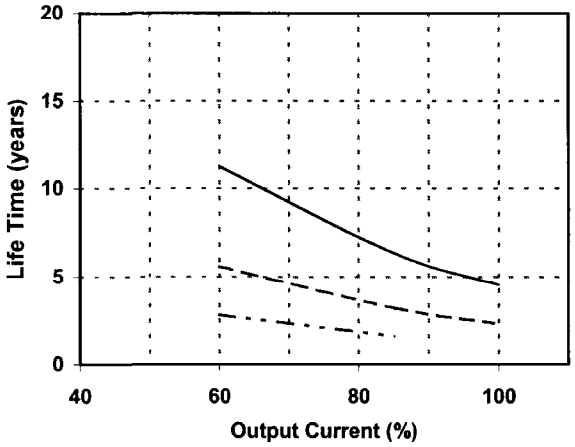


Ta = 25°C ———
Ta = 35°C – – – –
Ta = 45°C —·—·—

Vin = 100VAC

※ Convection cooling

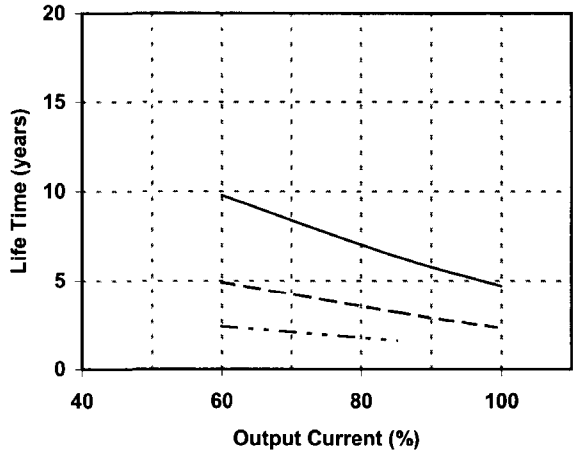
Load (%)	Life Time (years)			
	Ta = 25°C	Ta = 35°C	Ta = 45°C	Ta = 55°C
60	11.2	5.6	2.8	1.4
85	6.4	3.2	1.6	—
100	4.5	2.3	—	—



Vin = 200VAC

※ Convection cooling

Load (%)	Life Time (years)			
	Ta = 25°C	Ta = 35°C	Ta = 45°C	Ta = 55°C
60	9.8	4.9	2.4	1.2
85	6.4	3.2	1.6	—
100	4.7	2.3	—	—



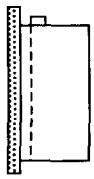
Formula:

1.For 105 °C Elec. Capacitor, $L = Lo * 2^{(105-dT-Ta)/10}/(8*365)$ (Yrs.)
2.For 85 °C Elec. Capacitor, $L = Lo * 2^{(85-dT-Ta)/10}/(8*365)$ (Yrs.)

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

MODEL: **SWS75-5**

Mounting C

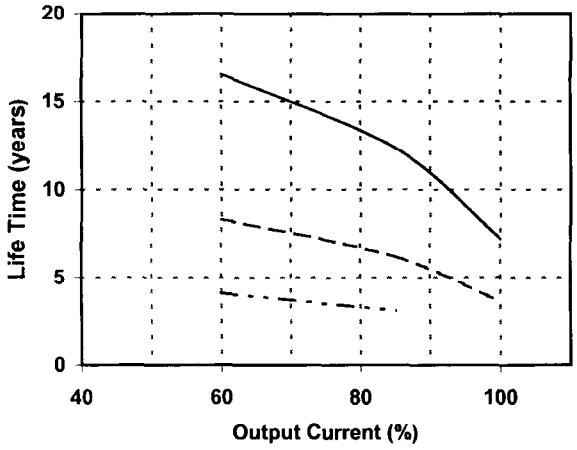


Ta = 25°C ———
Ta = 35°C – – – –
Ta = 45°C —·—·—

Vin = 100VAC

※ Convection cooling

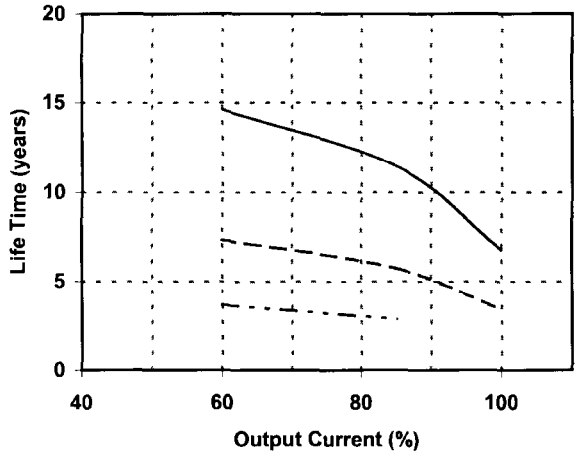
Load (%)	Life Time (years)			
	Ta = 25°C	Ta = 35°C	Ta = 45°C	Ta = 55°C
60	16.6	8.3	4.1	2.1
85	12.4	6.2	3.1	—
100	7.2	3.6	—	—



Vin = 200VAC

※ Convection cooling

Load (%)	Life Time (years)			
	Ta = 25°C	Ta = 35°C	Ta = 45°C	Ta = 55°C
60	14.6	7.3	3.7	1.8
85	11.5	5.7	2.9	—
100	6.7	3.4	—	—



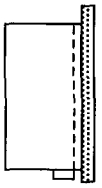
Formula:

1.For 105 °C Elec. Capacitor, $L = Lo * 2^{(105-dT-Ta)/10}/(8*365)$ (Yrs.)
2.For 85 °C Elec. Capacitor, $L = Lo * 2^{(85-dT-Ta)/10}/(8*365)$ (Yrs.)

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

MODEL: **SWS75-5**

Mounting D

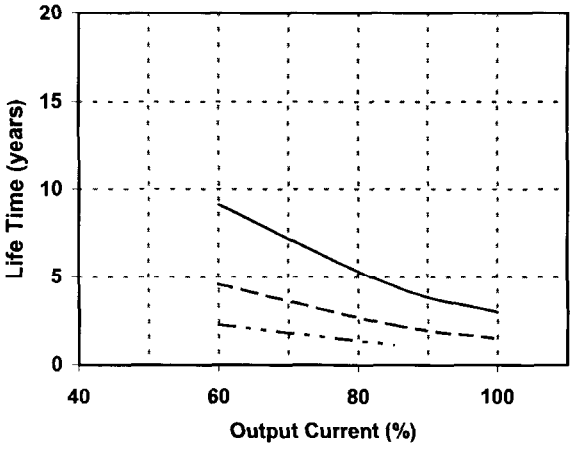


Ta = 25°C ———
Ta = 35°C – – – –
Ta = 45°C —·—·—

Vin = 100VAC

※ Convection cooling

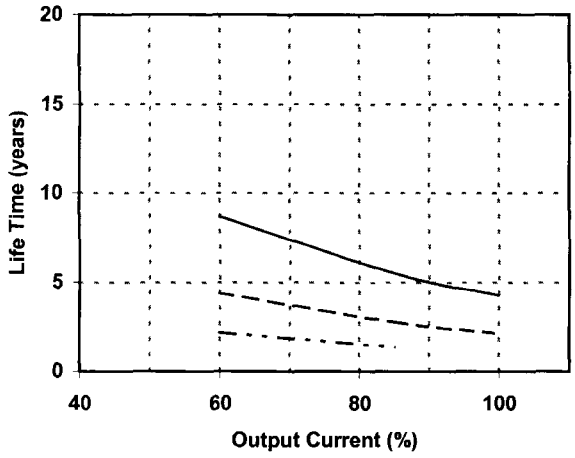
Load (%)	Life Time (years)			
	Ta = 25°C	Ta = 35°C	Ta = 45°C	Ta = 55°C
60	9.1	4.6	2.3	1.1
85	4.5	2.2	1.1	—
100	3.0	1.5	—	—



Vin = 200VAC

※ Convection cooling

Load (%)	Life Time (years)			
	Ta = 25°C	Ta = 35°C	Ta = 45°C	Ta = 55°C
60	8.7	4.3	2.2	1.1
85	5.5	2.7	1.4	—
100	4.2	2.1	—	—



Formula:

1.For 105 °C Elec. Capacitor, $L = Lo * 2^{(105-dT-Ta)/10}/(8*365)$ (Yrs.)
2.For 85 °C Elec. Capacitor, $L = Lo * 2^{(85-dT-Ta)/10}/(8*365)$ (Yrs.)

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

5. VIBRATION TEST

MODEL : SWS75-12

(1) Vibration Test Class

Frequency Variable Endurance Test

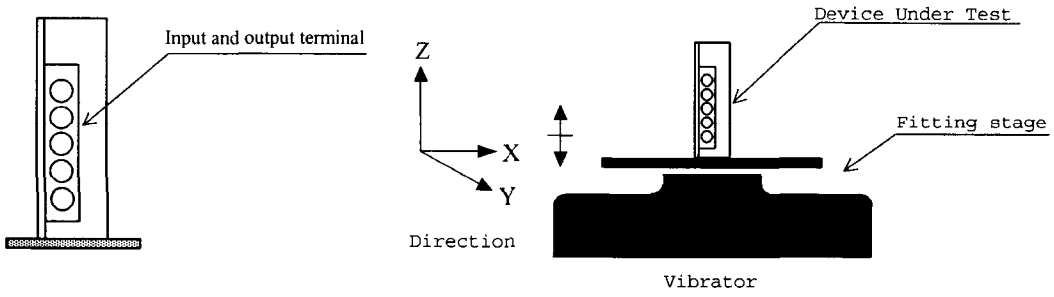
(2) Equipment Used

- 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 : 230VAC

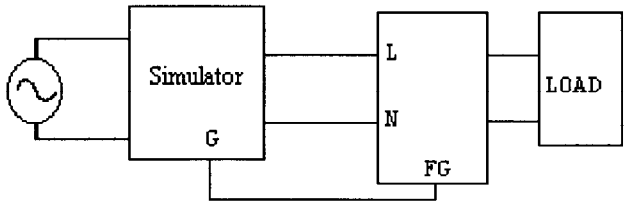
Iout : 100%

Check item		Output Voltage (V)	Ripple Voltage (mVp-p)	D.U.T.State
Before Test		12.001	60	———
After Test	X	12.002	65	O.K.
	Y	12.003	70	O.K.
	Z	12.005	75	O.K.

6. NOISE SIMULATE TEST

MODEL : SWS75-5, 24

(1) Test Circuit And Equipment



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

(2) Test Conditions

• Input Voltage	:	115, 230VAC	• 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