LS35

RELIABILITY DATA

DWG. No PA581-57-01		
APPD	CHK	DWG
5-Jan '09	5-Jan-09	5-Jan-09

TDK-Lambda

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 FOR MTBF

MODEL : LS35-5

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 :

$$MTBF = \frac{1}{\lambda_{equip}}$$

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

where :

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 = 706,464 (Hours)

2. Component derating

MODEL : LS35-5

(1) Calculating method

(a) Measuring Conditions

Input	:	115 , 230VAC	• Ambient temperature	:	50°C
Output	:	5V 10A(100%)	• Mounting method	:	Mounting A

(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_j : 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 = 115VAC Load = 100% Ta = 50°C	
Q3 STF6NK60ZFP ST MICROELECTRONICS	Tchmax = 150°C, θ ch-c = 4.2°C/W, Pch = 0.964W, Δ Tc = 42.6°C, Tch = Tc + ((θ ch-c) × Pch) = 96.65°C D.F. = 64.44%	Pch(max) = 30W Tc = 92.6°C
D7 STPS20L45CFP ST MICROELECTRONICS	Tjmax = 150°C, θj-c = 3.5°C/W, Pd = 3.16W, Δ Tc = 74.6°C, Tj = Tc + ((θ j-c) × Pd) = 135.67°C D.F. = 90.44%	Tc = 124.6°C
D1 RS405M RECTRON	Tjmax = 150°C, θ j-c = 6.0°C/W Pd = 1.32W, Δ Tc = 30.3°C Tj = Tc + ((θ j-c) × Pd) = 88.22°C D.F. = 58.82%	Tc = 80.3°C
D2 CRF02 TOSHIBA	Tjmax = 150°C, θ j-l = 20°C/W Pd = 0.06W, Δ Tl = 61.3°C Tj = Tl + ((θ j-l) × Pd) = 112.5°C D.F. = 75.0%	Tl = 111.3°C
D4 CRH01 TOSHIBA	Tjmax = 150°C, θ j-l = 20°C/W Pd = 2.0mW, Δ Tl = 29.71°C Tj = Tl + ((θ j-l) × Pd) = 79.75°C D.F. = 53.17%	Tl = 79.71°C
PC1 PS2561L2-E3(D)-A (TRANSISTOR) NEC	Tjmax = 125°C, θ j-c = 150°C/W, Pc = 3mW, Δ Tc = 31.7°C, Tj = Tc + ((θ j-c) × Pc) = 82.15°C D.F. = 65.72%	Pc(max) = 0.15W Tc = 81.7°C
PC1 PS2561L2-E3(D)-A (LED) NEC	Tjmax = 125°C, θ j-c = 150°C/W, Pc = 12mW, Δ Tc = 31.7°C, Tj = Tc + ((θ j-c) × Pc) = 83.5°C D.F. = 66.8%	Pc(max) = 0.15W Tc = 81.7°C
PC2 PS2561L2-E3(D)-A (TRANSISTOR) NEC	Tjmax = 125°C, θ j-c = 150°C/W, Pc = 0.0W, Δ Tc = 36.3.1°C, Tj = Tc + ((θ j-c) × Pc) = 86.3°C D.F. = 69.1%	Pc(max) = 0.15W Tc = 86.3°C
PC2 PS2561L2-E3(D)-A (LED) NEC	Tjmax = 125°C, θ j-c = 150°C/W, Pc = 0.0W, Δ Tc = 36.3.1°C, Tj = Tc + ((θ j-c) × Pc) = 86.3°C D.F. = 67.28%	Pc(max) = 0.15W Tc = 86.3°C
A1 FA13842N-D1-TE1 FUJI-ELEC.	Tjmax = 150°C, θ j-c = 72°C/W Pd = 0.108W, Δ Tc = 28.3°C Tj = Tc + ((θ j-c) × Pd) = 86.1°C D.F. = 57.39%	Tc = 78.3°C
A2 HA17L431AP-TZ-E RENESAS	Tjmax = 150°C, θ j-c = 100°C/W, Pd = 30.9mW, Δ Tc = 25.2°C, Tj = Tc + ((θ j-c) × Pd) = 78.3°C D.F. = 52.20%	Tc = 75.2°C
PD1 264-7GVD/S530-E2 EVERLIGHT	IF = 6.38mA, Δ Tc = 17.8°C Allowable IF(max)= 12mA(at Ta = 67.8°C) D.F. = 53.17%	Tc = 67.8°C

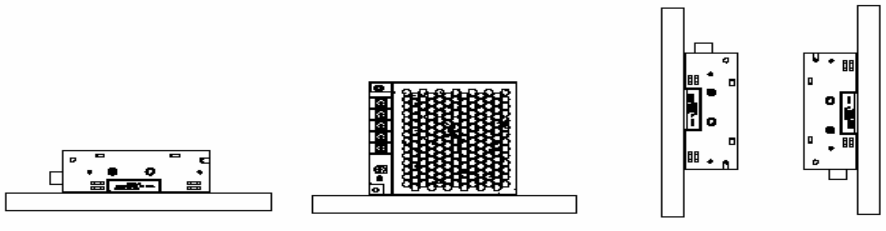
Component Derating List

Location No.	Vin = 230VAC Load = 100% Ta = 50°C		
Q3 STF6NK60ZFP ST MICROELECTRONICS	Tchmax = 150°C, Pch = 1.18W, Tch = Tc + ((θ ch-c) × Pch) = 98.76°C D.F. = 65.84%	θ ch-c = 4.2°C/W, Δ Tc = 43.8°C,	Pch(max) = 30W Tc = 93.8°C
D7 STPS20L45CFP ST MICROELECTRONICS	Tjmax = 150°C, Pd = 3.16W, Tj = Tc + ((θ j-c) × Pd) = 136.06°C D.F. = 90.71%	θj-c = 3.5°C/W, Δ Tc = 75.0°C,	Tc = 125.0°C
D1 RS405M RECTRON	Tjmax = 150°C, Pd = 0.67 W, Tj = Tc + ((θ j-c) × Pd) = 76.1°C D.F. = 50.68%	θ j-c = 6.0°C/W Δ Tc = 22.0°C	Tc = 72.0°C
D2 CRF02 TOSHIBA	Tjmax = 150°C, Pd = 0.06W, Tj = Tl + ((θ j-l) × Pd) = 105.6°C D.F. = 70.49%	θ j-l = 20°C/W Δ Tl = 54.4°C	Tl = 104.4°C
D4 CRH01 TOSHIBA	Tjmax = 150°C, Pd = 2.0mW, Tj = Tl + ((θ j-a) × Pd) = 79.65°C D.F. = 53.1%	θ j-l = 20°C/W Δ Tl = 29.61°C	Tl = 79.61°C
PC1 PS2561L2-E3(D)-A (TRANSISTOR) NEC	Tjmax = 125°C, Pc = 2.75mW, Tj = Tc + ((θ j-c) × Pc) = 83.82°C D.F. = 67.10%	θ j-c = 150°C/W, Δ Tc = 33.4°C,	Pc(max) = 0.15W Tc = 83.4°C
PC1 PS2561L2-E3(D)-A (LED) NEC	Tjmax = 125°C, Pc = 12mW, Tj = Tc + ((θ j-c) × Pc) = 85.2°C D.F. = 68.20%	θ j-c = 150°C/W, Δ Tc = 33.4°C,	Pc(max) = 0.15W Tc = 83.4°C
PC2 PS2561L2-E3(D)-A (TRANSISTOR) NEC	Tjmax = 125°C, Pc = 0.0W, Tj = Tc + ((θ j-c) × Pc) = 89.1°C D.F. = 71.28%	θ j-c = 150°C/W, Δ Tc = 39.1°C,	Pc(max) = 0.15W Tc = 89.1°C
PC2 PS2561L2-E3(D)-A (LED) NEC	Tjmax = 125°C, Pc = 0.0W, Tj = Tc + ((θ j-c) × Pc) = 89.1°C D.F. = 71.28%	θ j-c = 150°C/W, Δ Tc = 39.1°C,	Pc(max) = 0.0W Tc = 89.1°C
A1 FA13842N-D1-TE1 FUJI-ELEC.	Tjmax = 150°C, Pd = 0.103W, Tj = Tc + ((θ j-c) × Pd) = 86.2°C D.F. = 57.35%	θ j-c = 72°C/W Δ Tc = 28.6°C	Tc = 78.6°C
A2 HA17L431AP-TZ-E RENESAS	Tjmax = 150°C, Pd = 30.6mW, Tj = Tc + ((θ j-c) × Pd) = 79.26°C D.F. = 52.84%	θ j-c = 100°C/W, Δ Tc = 26.2°C,	Tc = 76.2°C
PD1 264-7GVD/S530-E2 EVERLIGHT	IF = 6.38mA, Allowable IF(max)= 12mA(at Ta = 68.4°C) D.F. = 53.17%	Δ Tc = 18.4°C	Tc = 68.4°C

3. Main components temperature rise ΔT list

MODEL : LS35-5

Condition:

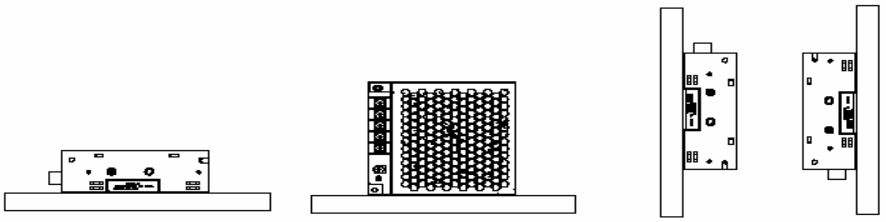
Standard Mounting (Mounting Method (A)	(A)  Mounting A Mounting B Mounting C Mounting D
Input Voltage (VAC)	115
Output Voltage (VDC)	5
Output Current (A)	7

			ΔT Temperature rise (°C)		
Output Derating Ta = 50°C		Io=100%	Io=100%	Io=100%	Io=100%
Location No	Parts Name	Mounting (A)	Mounting (B)	Mounting (C)	Mounting (D)
Q3	MOSFET	42.6	42.3	38.9	57.0
D1	BRIDGE DIODE	30.3	46.7	30.6	36.5
D7	F.R. DIODE	74.6	72.8	72.5	68.7
A1	CHIP IC	28.3	29.4	25.7	41.1
A2	SHUNT REGULATOR	25.2	30.3	44.4	22.0
PC1	PHOTOCOUPLER	31.7	34.7	31.6	42.4
PC2	PHOTOCOUPLER	36.3	38.8	36.3	44.6
F1	FUSE	18.6	26.8	27.9	17.0
L1	BALUN COIL	36.4	41.6	37.2	33.5
L2	CHOKE COIL	41.3	45.8	50.5	35.6
C3	CAP. FILM	31.5	36.0	35.0	28.1
C8	CAP. ELECT.	23.3	33.1	21.3	30.2
C25	CAP. ELECT.	28.7	29.1	26.5	43.6
C26	CAP. ELECT.	23.5	25.8	21.8	40.7
C29	CAP. ELECT.	50.1	46.4	46.4	41.5
C30	CAP. ELECT.	42.2	42.2	43.4	35.5
C31	CAP. ELECT.	43.3	43.1	45.2	35.6
C32	CAP. ELECT.	33.8	38.0	41.2	28.3

3. Main components temperature rise ΔT list

MODEL : LS35-5

Condition:

Standard Mounting (Mounting Method (A)	(A)  Mounting A Mounting B Mounting C Mounting D
Input Voltage (VAC)	230
Output Voltage (VDC)	5
Output Current (A)	7

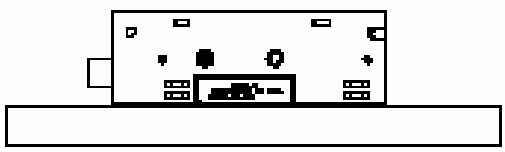
			ΔT Temperature rise (°C)		
Output Derating Ta = 50°C		Io=100%	Io=100%	Io=100%	Io=100%
Location No	Parts Name	Mounting (A)	Mounting (B)	Mounting (C)	Mounting (D)
Q3	MOSFET	43.8	44.4	40.7	58.3
D1	BRIDGE DIODE	22.0	40.3	22.6	36.5
D7	F.R. DIODE	75.0	73.4	73.0	68.7
A1	CHIP IC	28.6	30.0	25.7	42.0
A2	SHUNT REGULATOR	26.2	31.7	47.1	22.7
PC1	PHOTOCOUPLER	33.4	36.3	33.9	44.5
PC2	PHOTOCOUPLER	39.1	41.7	39.8	47.7
F1	FUSE	15.5	25.3	23.6	14.2
L1	BALUN COIL	24.3	33.6	25.9	22.7
L2	CHOKE COIL	43.4	49.3	52.8	37.4
C3	CAP. FILM	23.4	31.2	26.7	21.2
C8	CAP. ELECT.	18.8	30.8	17.3	24.9
C25	CAP. ELECT.	29.2	30.0	27.3	44.6
C26	CAP. ELECT.	23.7	26.3	22.3	41.5
C29	CAP. ELECT.	50.1	47.9	47.5	42.1
C30	CAP. ELECT.	42.1	43.6	44.0	35.7
C31	CAP. ELECT.	43.7	44.6	45.8	35.9
C32	CAP. ELECT.	33.9	39.8	41.6	28.5

4. Electrolytic capacitor lifetime

MODEL : LS35-5

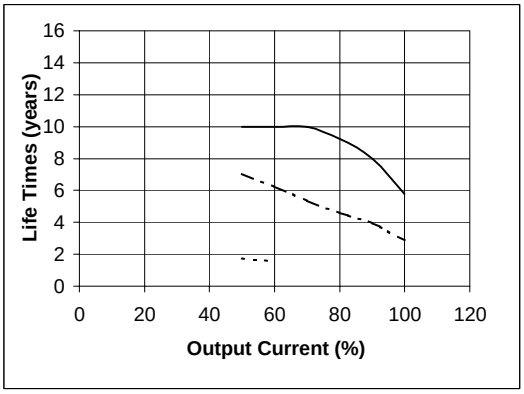
Ta = 40°C ——
= 50°C —·—·—
= 70°C - - - - - -

Mounting A



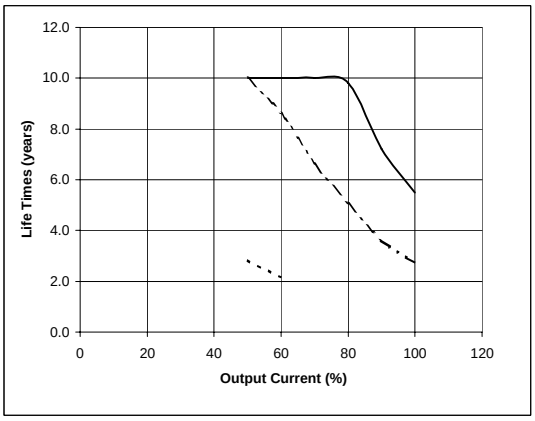
Vin = 115VAC

Load (%)	Life Time (years)		
	Ta = 40°C	Ta = 50°C	Ta = 70°C
50	10.0	7.1	1.8
60	10.0	6.2	1.6
70	10.0	5.4	—
80	9.2	4.6	—
90	8.0	4.0	—
100	5.8	2.9	—



Vin = 230VAC

Load (%)	Life Time (years)		
	Ta = 40°C	Ta = 50°C	Ta = 70°C
50	10.0	10.0	2.8
60	10.0	8.6	2.2
70	10.0	6.6	—
80	9.8	5.1	—
90	7.2	3.6	—
100	5.5	2.7	—

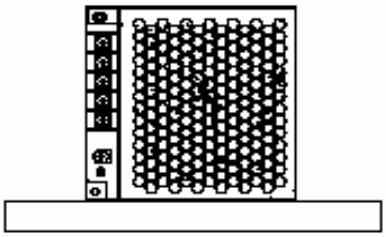


Note : E-cap life calculation is based on 8hrs/day operation.

4. Electrolytic capacitor lifetime

MODEL : LS35-5

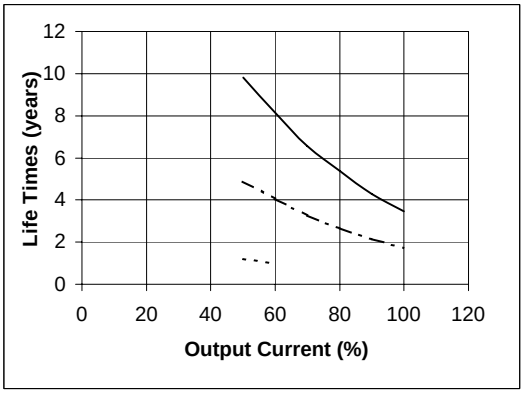
Mounting B



Ta = 40°C
= 50°C
= 70°C

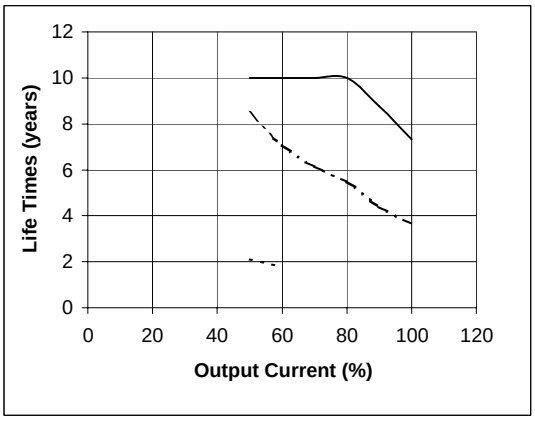
Vin = 115VAC

Load (%)	Life Time (years)		
	Ta = 40°C	Ta = 50°C	Ta = 70°C
50	9.8	4.9	1.2
60	8.1	4.1	1.0
70	6.6	3.3	—
80	5.4	2.7	—
90	4.3	2.1	—
100	3.5	1.7	—



Vin = 230VAC

Load (%)	Life Time (years)		
	Ta = 40°C	Ta = 50°C	Ta = 70°C
50	10.0	8.5	2.1
60	10.0	7.1	1.8
70	10.0	6.2	—
80	10.0	5.5	—
90	8.8	4.4	—
100	7.3	3.7	—

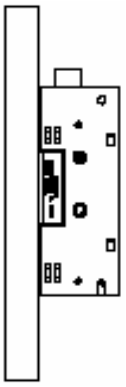


Note : E-cap life calculation is based on 8hrs/day operation.

4. Electrolytic capacitor lifetime

MODEL : LS35-5

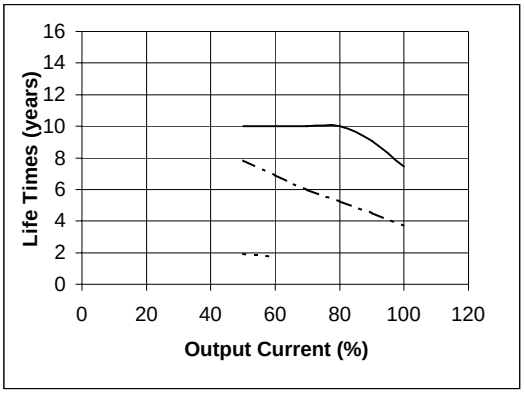
Mounting C



Ta = 40°C
= 50°C
= 70°C

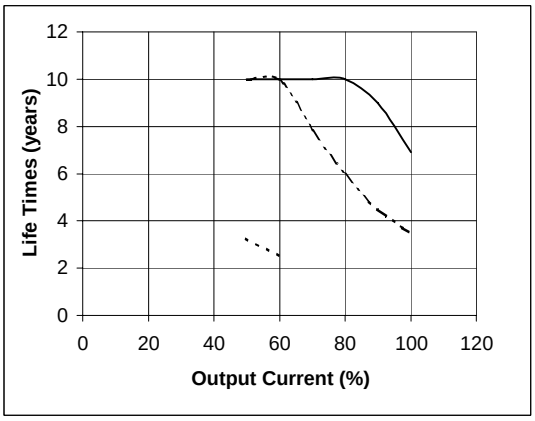
Vin = 115VAC

Load (%)	Life Time (years)		
	Ta = 40°C	Ta = 50°C	Ta = 70°C
50	10.0	7.9	2.0
60	10.0	6.9	1.7
70	10.0	6.0	—
80	10.0	5.3	—
90	9.1	4.5	—
100	7.5	3.7	—



Vin = 230VAC

Load (%)	Life Time (years)		
	Ta = 40°C	Ta = 50°C	Ta = 70°C
50	10.0	10.0	3.2
60	10.0	10.0	2.5
70	10.0	7.8	—
80	10.0	6.0	—
90	9.0	4.5	—
100	6.9	3.5	—

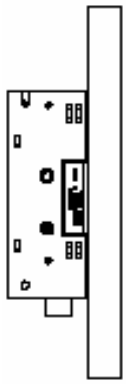


Note : E-cap life calculation is based on 8hrs/day operation.

4. Electrolytic capacitor lifetime

MODEL : LS35-5

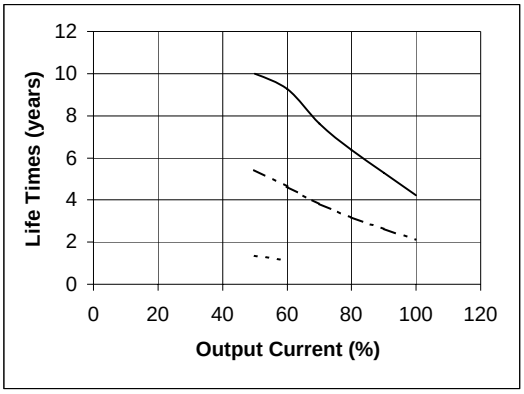
Mounting D



Ta = 40°C
= 50°C
= 70°C

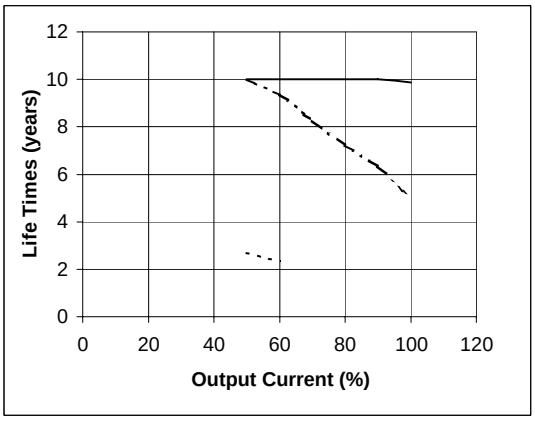
Vin = 115VAC

Load (%)	Life Time (years)		
	Ta = 40°C	Ta = 50°C	Ta = 70°C
50	10.0	5.4	1.4
60	9.3	4.6	1.2
70	7.6	3.8	—
80	6.4	3.2	—
90	5.3	2.6	—
100	4.2	2.1	—



Vin = 230VAC

Load (%)	Life Time (years)		
	Ta = 40°C	Ta = 50°C	Ta = 70°C
50	10.0	10.0	2.7
60	10.0	9.3	2.3
70	10.0	8.2	—
80	10.0	7.2	—
90	10.0	6.3	—
100	9.9	4.9	—



Note : E-cap life calculation is based on 8hrs/day operation.

5. Vibration Test

MODEL : LS35-5

(1) Vibration Test Class

Frequency Variable Endurance Test

(2) Equipment Used

Controller	:	F-400-BM-E47 (EMIC CORP.)
Vibrator	:	905-FN (EMIC CORP.)
Serial no.	:	22965

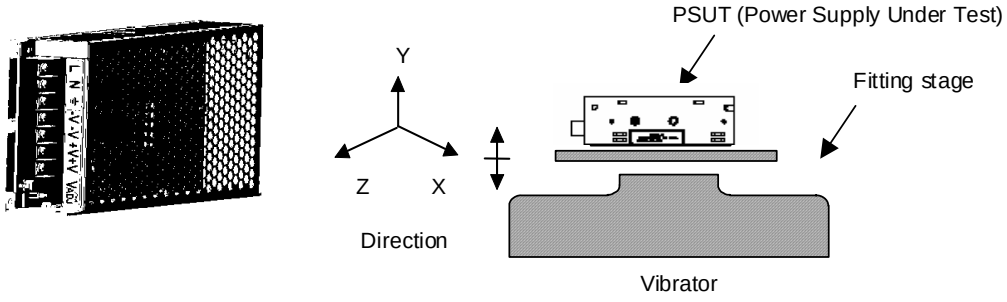
(3) The Number Of D.U.T. (Device Under Test)

1 Unit

(4) Test Conditions

Sweep Frequency	:	10 - 55Hz	Direction	:	X, Y, Z
Sweep Time	:	1 minute	Test Time	:	1 hour each axis
Acceleration	:	2G	Non-operation		
Mounting	:	A and B			

(5) Test Method



Fix the PSUT on the universal plate via two M3 tapped holes on the chassis of the power supply.
Standard mounting position as per test specification.

(6) Test results - OK

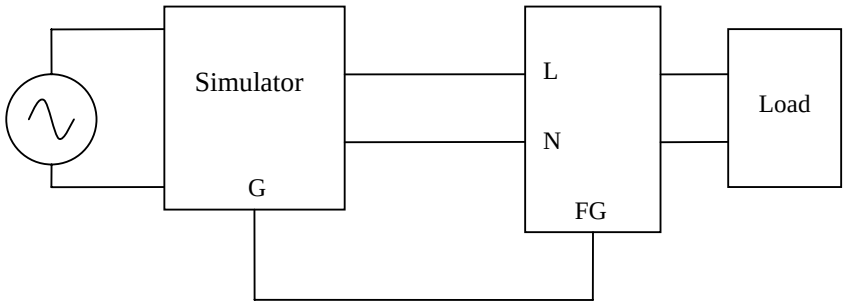
Test Conditions : Vin = 230 Vac Load Condition :
Ambient Temp. = +25 °C Full Load

Check Item		Output Voltage (V)	PSUT State
Before Test		Vo1	
		5.046	
After test	X	5.046	OK
	Y	5.046	OK
	Z	5.046	OK

6. Noise simulate test

MODEL : LS35-5

(1) Test circuit and equipment



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

(2) Test conditions

• Input voltage	: 115, 230VAC	• Noise level	: 0V~2.4kV
• Output voltage	: Rated	• Phase shift	: 0° ~ 360°
• Output current	: 0%, 100%	• Polarity	: +, -
• Ambient temperature	: 25°C	• Mode	: Normal Common
• Pulse Width	: 0ns ~ 1000ns	• Trigger select	: Line

(3) Acceptable conditions

1. Not to be broken.
2. No output shutdown.
3. No other out of order.

(4) Test result O K

7. Abnormal test

MODEL : LS35-5

(1) Test Condition

Input Voltage : 230VAC Output Current : 100% Ta : 25°C, 70% RH

(2) Test Results

(Da: Damaged)

No.	Test Position		Test Mode		Test Results												NOTE
	LOCATION	TEST POINT	SHORT	OPEN	1 FIRE	2 SMOKE	3 BURST	4 SMELL	5 RED HOT	6 DAMAGE	7 FUSE BLOW	8 O.C.P.	9 O.V.P.	10 NO OUTPUT	11 NO CHANGE	12 OTHER	
1	D1	(+) - (-)	•							•	•			•			Da : F1
2	D2		•							•				•			Da : Q3, Z1, Z2
				•											•		
3	D3		•											•			
				•											•		
4	D4		•												•		
				•										•			
5	D5		•												•		
				•											•		
6	D6		•							•						•	Hiccup, Da : R31,R30
				•										•			
7	D7		•											•			No Damage
				•						•				•			Da : A1,Q3,Z1,Z2
8	Q1	3 - 4	•											•		•	Latch
				•											•		
		1 - 6	•											•		•	Latch
				•											•		
		3 - 5	•											•		•	Latch
				•											•		
		6 - 2	•											•		•	Latch
				•											•		
9	Q2	C - E	•												•		
		B - E	•													•	Hiccup
		C - B	•													•	Hiccup
10	Q3	G - S	•											•			
		D - G	•							•	•			•			Da : Z1,F1
		D - S	•							•	•			•			Da : F1,Q3,Z2
11	C8	(+)Bulk - (-)Bulk	•							•	•			•			Da : F1
12	C20		•											•			
				•						•	•			•			Da : Q3,F1,Z2
13	C21/R22	C21/R22	•							•				•			Da : Q3,Z2
		C21		•											•		
		R22		•											•		
14	C37 OR C38		•												•		
				•												•	Hissing sound
15	PC1	1 - 2	•										•	•		•	Latch
		3 - 4	•											•			
		1 - 2		•									•	•		•	Latch
		3 - 4		•									•	•		•	Latch
16	PC2	3 - 4	•										•	•		•	Latch
				•											•		
		1 - 2	•												•		
				•											•		

7. Abnormal test

MODEL : LS35-5

(1) Test Condition

Input Voltage : 230VAC Output Current : 100% Ta : 25°C, 70% RH

(2) Test Results

(Da: Damaged)

No.	Test Position		Test Mode		Test Results												NOTE
	LOCATION	TEST POINT	SHORT	OPEN	1 FIRE	2 SMOKE	3 BURST	4 SMELL	5 RED HOT	6 DAMAGE	7 FUSE BLOW	8 O.C.P.	9 O.V.P.	10 NO OUTPUT	11 NO CHANGE	12 OTHER	
17	A1	Vcc - GND	•											•			
		Vref - GND	•											•			
		Isense - GND	•							•				•			Da : Q3,Z2
		RtCt - GND	•											•			
		FB - GND	•												•		
		Comp - GND	•											•			
		Out - GND	•											•			
18	A2	A - K	•													•	Hiccup
		R - K	•													•	Vo = 4.39V
		R - A	•											•		•	Latch
19	T1	Np	•													•	Hiccup
		Nbias	•													•	Hiccup
		Ns	•													•	Hiccup
20	PD1		•												•		
				•											•		
21	Z1		•											•			
				•											•		
22	Z2		•													•	Hissing sound
				•											•		
23	Z4		•												•		
				•											•		
24	R9/C10	R9/C10	•											•			
		R9		•											•		
		C10		•											•		
25	R27		•												•		
				•						•	•			•			Da : Z1,F1,Q3
27	R29		•									•		•			
				•						•				•			Da : Q3,Z1
28	R32		•													•	Hissing sound
				•												•	Hiccup
29	R46		•										•	•		•	Latch
				•									•	•		•	Latch
30	VR1		•													•	Vo = 5.8
				•												•	Vo = 2.9

8. Thermal shock test

MODEL : LS35

(1) Equipment used

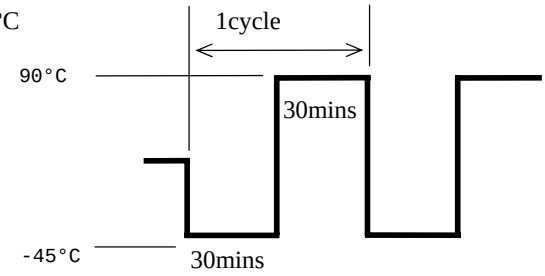
THERMAL SHOCK CHAMBER TSA-101S-W (ESPEC CORP.)

(2) The number of D.U.T.(Device Under Test)

1 unit

(3) Test Conditions

- Ambient temperature : -45°C ⟷ 90°C
- Test time : 30 mins each temp.
- Test cycle : 100 cycles
- Not operating



(4) Test Method

Before testing, check if there is no abnormal output, then put the D.U.T. in testing chamber, and test it according to the above cycle. 100 cycles later, leave it for 1 hour at the room temperature, then check if there is no abnormal output.

(5) Test Results OK

Vin : 230VAC Io : 100%			5V			
			From		To	
Ripple&Spike noise		mV	17		31	
Line regulation	Full load	mV	1		1	
Load regulation	Vin:115V	mV	8		8	
Efficiency	Pin	W	43.95	79.3%	43.77	79.8%
	Vout	V	4.98		4.99	
	Iout	A	7		7	
Solder condition • etc.			————		OK	