SWT65 -- *

RELIABILITY DATA

DWG. NO.: CA703-79-01				
QA APPROVAL	R&D			
NLJ	APPROVED	CHECKED	ENGR.	DRAWN
T. Murayama		Alex	LEONTORD	CHER
15. OCT. 96	4. OCT. 96	4. OCT. '96	OCT. 4. '96	Oct. 4. '96

NEMIC-LAMBDA

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

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M.T.B.F.

1. Method of calculation

Calculated based on part count reliability projection of MIL - HDBK - 217F.

Individual failure rates λ_G is given to each part and M.T.B.F. is calculated by the count of each part.

Formula :

$$M.T.B.F. = \frac{1}{\lambda_{equip}}$$

$$= \frac{1}{\sum_{i=1}^{n} Ni\,(\lambda_G \pi_Q)_i} \quad (HOURS)$$

Where :

λ equip = Total Equipment Failure Rate (Failures/10^6 Hours)

λ_G = Generic Failure Rate For The ith Generic Part (Failure/10^6 Hours)

Ni = 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. M.T.B.F. Values

G F. (GROUND , FIXED)

M.T.B.F. = 346,998 (HOURS)

COMPONENT DERATING

(At nominal Line and Rated Load , Ambient Temperature 50°C)

Method of calculation

A. Semiconductors

The derating factor is taken as the ratio of the actual operating junction temperature taking into consideration operating ambient temperature , power loss and thermal resistance to the maximum rated junction temperature specifications of the components.

B. IC, Resistors, Capacitors etc.

Operating ambient temperature, operating condition, power loss for each individual component are all designed to meet the requirements of Nemic - Lambda's design standard.

C. Thermal Resistance Calculation

$$Rth_{(j-c)} = \frac{Tj(max) - Tc}{Pd(max)} \quad , \quad Rth_{(j-a)} = \frac{Tj(max) - Ta}{Pd(max)}$$

Tc : Case Temperature (Normally 25°C)

Ta : Ambient Temperature (Normally 25°C)

Pd(max) : Maximum Power Loss

Tj(max) : Maximum Junction temperature

Rth(j-c) : Junction to Case Thermal Resistance

Rth(j-a) : Junction to Ambient Thermal Resistance

SEMICONDUCTOR DERATING

MODEL No. : SWT65 - 522

MOUNTING: A Vin = 100VAC LOAD = 100% Ta = 50°C

A1 STR83145 SANKEN	Tjmax = 125°C Rth(j-c) =1.8°C/W Pd(max) = --W Pd =0.62W dTc = 47.1°C Tc = 97.1°C Tj = 98.2°C D.F. = 78.6%
A2 PWR-TOP204YAI P.I.	Tjmax = 150°C Rth(j-c) = 2°C/W Pd(max) = --W Pd = 4.28W dTc = 58°C Tc = 108°C Tj = 116.56°C D.F. = 77.7%
A3 KA431Z SAMSUNG	Tjmax = 150°C Rth(j-c) = 156.25°C/W Pd(max) = 0.70W Pd =0.008W dTc = 25°C Tc = 75°C Tj = 76.25°C D.F. = 50.8%
A4 uPC7912 NEC	Tjmax = 150°C Rth(j-c) = 3°C/W Pd(max) = --W Pd =1.29W dTc = 61°C Tc = 111°C Tj = 114.87°C D.F. = 76.6%
A5 KA431Z SAMSUNG	Tjmax = 150°C Rth(j-c) = 156.25°C/W Pd(max) = --W Pd =0.008W dTc = 32.5°C Tc = 82.5°C Tj = 83.75°C D.F. = 55.8%
D1 D3SB60 SHINDENGEN	Tjmax = 150°C Rth(j-c) = 5.5°C/W Pd(max) = --W Pd =0.65W dTc = 45.6°C Tc = 95.6°C Tj = 99.2°C D.F. = 66.1%
D2 1NU41 TOSHIBA	Tjmax = 150°C Rth(j-l) = 50°C/W Pd(max) = --W Pd =0.02W dTl = 6°C Tl = 56°C Tj = 57°C D.F. = 38%
D3 1NU41 TOSHIBA	Tjmax = 150°C Rth(j-l) = 50°C/W Pd(max) = --W Pd =0.085W dTl = 64.9°C Tl = 114.9°C Tj = 119.15°C D.F. = 79.4%
D4 GI1003 G.I.	Tjmax = 175°C Rth(j-l) = 20.0°C/W Pd(max) = --W Pd = 0.0093W dTl = 30.8°C Tl = 80.8°C Tj = 81°C D.F. = 46.3%
D5 1NU41 TOSHIBA	Tjmax = 150°C Rth(j-l) = 50°C/W Pd(max) = --W Pd=0W dTl=27°C Tl=77°C Tj =77°C D.F. = 51.3%
D6 D10SC6M SHINDENGEN	Tjmax = 125°C Rth(j-c) = 3.3°C/W Pd(max) = --W Pd =1.38W dTc = 40°C Tc = 90°C Tj = 94.5°C D.F. = 75.6%

SEMICONDUCTOR DERATING

MODEL No. : SWT65 - 522

MOUNTING: A Vin = 100VAC LOAD = 100% Ta = 50°C

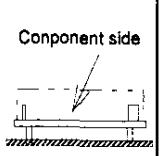
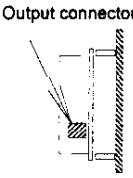
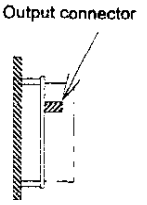
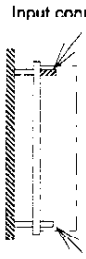
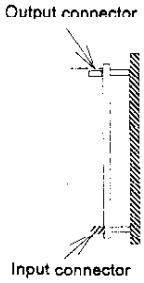
D7 CTB-34M SANKEN	Tjmax = 150°C	Rth(j-c) = 1.5°C/W	Pd(max) = --W
	Pd = 4.4W	dTc = 65.8°C	Tc = 115.8°C
	Tj = 122.4°C		
	D.F. = 81.6%		
D8 UF5402 G.I.	Tjmax = 150°C	Rth(j-c) = 8.5°C/W	Pd(max) = --W
	Pd = 0.4W	dTc = 51.6°C	Tc = 101.6°C
	Tj = 105°C		
	D.F. = 70%		
D9 1N4001 G.I.	Tjmax = 175°C	Rth(j-a) = 50°C/W	Pd(max) = --W
	Pd =0W	dTc = 20.6°C	Tc = 70.6°C
	Tj = 70.6°C		
	D.F. = 47%		
PC1(LED) 4N35TV MOTOROLA	Tjmax = 125°C	Rth(j-c) = --°C/W	Pd(max) = --W
	If= 0.97mA		
	Ifmax = 24mA	Ta =82.8°C	
	D.F. = 4%		
PC1(TR.) 4N35TV MOTOROLA	Tjmax = 125°C	Rth(j-c) = 568.2°C/W	Pd(max) = --W
	Pd =0.0052W	dTc = 32.8°C	Tc = 82.8°C
	Tj = 85.7°C		
	D.F. = 68.6%		
Q1 KSA1013-O SAMSUNG	Tjmax = 150°C	Rth(j-c) = 111.1°C/W	Pd(max) = 900mW
	Pd =0W	dTc = 18°C	Tc = 68°C
	Tj = 68°C		
	D.F. = 45.3%		
Q2 2SA1015-Y TOSHIBA	Tjmax = 125°C	Rth(j-c) = 250°C/W	Pd(max) = 0.4W
	Pd =0W	dTc = 42.9°C	Tc = 92.9°C
	Tj = 98.1°C		
	D.F. = 78.5%		
ZD1 P6KE220CA G.I.	Tjmax = 175°C	Rth(j-l) = 20.0°C/W	Pd(max) = --W
	Pd = 0.14W	dTl = 56.2°C	Tl = 106.2°C
	Tj = 109°C		
	D.F. = 62.3%		

TEMPERATURE RISE

Ta : 50°C

Symbol	Parts name	dT Temperature Rise (°C)				
		Mounting A	Mounting B	Mounting C	Mounting D	Mounting E
A1	AVS	47.1	45.5	51.6	49.8	44.5
A2	TOPSWITCH	58.0	45.8	44.8	54.0	49.5
A4	3T REGULATOR	61.0	53.5	55.4	53.2	59.9
C9	E.CAP	39.0	38.2	29.3	46.1	34.4
C21	E.CAP	45.1	42.8	36	36.2	45.1
D7	S.B.D.	65.8	57.1	58.1	56.5	62.8
T1	TRANS.PULSE	57.7	51.8	41.8	48.4	50.8

Conditions

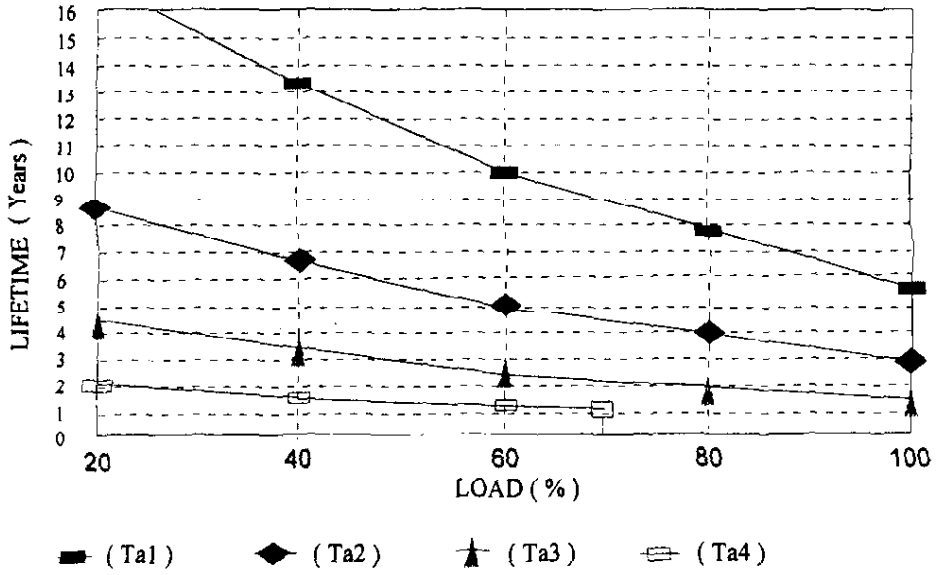
Mounting Method (Standard Mounting : A)	(A)	(B)	(C)	(D)	(E)
					
Input Voltage	100VAC	100VAC	100VAC	100VAC	100VAC
Output Voltage	Rated	Rated	Rated	Rated	Rated
Output Current	100%	80%	80%	80%	80%

E-CAP LIFETIME versus LOAD

Vin = 100VAC　　Mounting Position : A

8 hours per day,365 days operation

GRAPH OF ELECTROLYTIC CAPACITOR LIFETIME VERSUS LOAD



Load (%)	LIFETIME (Yrs.)			
	Ta1 = 30°C	Ta2 = 40°C	Ta3 = 50°C	Ta4 = 60°C
100	5.68	2.84	1.42	-
80	7.86	3.93	1.97	-
60	9.81	4.90	2.45	1.23
40	13.31	6.65	3.33	1.66
20	17.32	8.66	4.33	2.17

Formula :

1.For 105°C Elec. capacitor

$$L = Lo * 2^{(105-dT-Ta)/10} /(8 * 365) \text{ (Yrs.)}$$

2. For 85°C Elec. capacitor

$$L = Lo * 2^{(85-dT-Ta)/10} /(8 * 365) \text{ (Yrs)}$$

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

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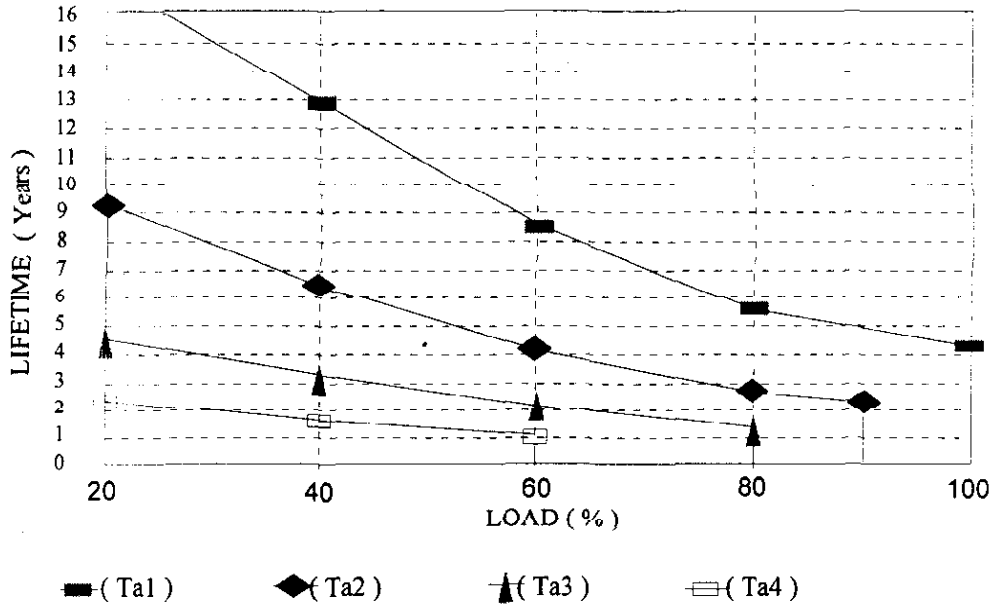
E - CAP LIFETIME versus LOAD

Vin = 100VAC　　Mounting Position : B

8 hours per day,365 days operation

GRAPH OF ELECTROLYTIC CAPACITOR LIFETIME VERSUS LOAD



Load (%)	LIFETIME (Yrs.)			
	Ta1 = 30°C	Ta2 = 40°C	Ta3 = 50°C	Ta4 = 60°C
100	4.20	-	-	-
80	5.48	2.74	1.37	-
60	8.54	4.27	2.14	1.07
40	12.86	6.43	3.22	1.61
20	18.56	9.28	4.64	2.32

Formula :

1.For 105°C Elec. capacitor

$$L = Lo * 2^{(105-dT-Ta)/10} /(8 * 365) \text{ (Yrs.)}$$

2. For 85°C Elec. capacitor

$$L = Lo * 2^{(85-dT-Ta)/10} /(8 * 365) \text{ (Yrs)}$$

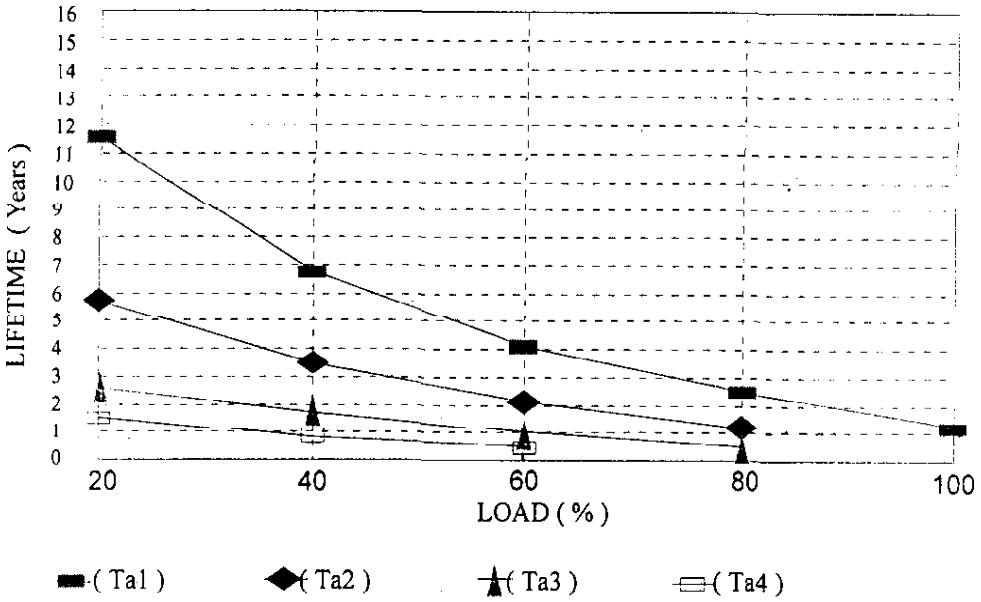
Where :
- L —Elec. capacitor computed life (8 hours per day , 365 days operation)
- Lo—Guarantee life for Elec. capacitor
- Ta—Ambient temperature
- dT—Temperature rise of Elec. capacitor

E - CAP LIFETIME versus LOAD

Vin = 100VAC
8 hours per day,365 days operation

Mounting Position : C

GRAPH OF ELECTROLYTIC CAPACITOR LIFETIME VERSUS LOAD



Load (%)	LIFETIME (Yrs.)			
	Ta1 = 30°C	Ta2 = 40°C	Ta3 = 50°C	Ta4 = 60°C
100	1.21	-	-	-
80	2.56	1.28	0.64	-
60	4.18	2.09	1.05	0.53
40	6.84	3.42	1.71	0.86
20	11.58	5.79	2.89	1.45

Formula :

1.For 105°C Elec. capacitor

$$L = Lo * 2^{(105-dT-Ta)/10} /(8 * 365) \text{ (Yrs.)}$$

2. For 85°C Elec. capacitor

$$L = Lo * 2^{(85-dT-Ta)/10} /(8 * 365) \text{ (Yrs)}$$

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

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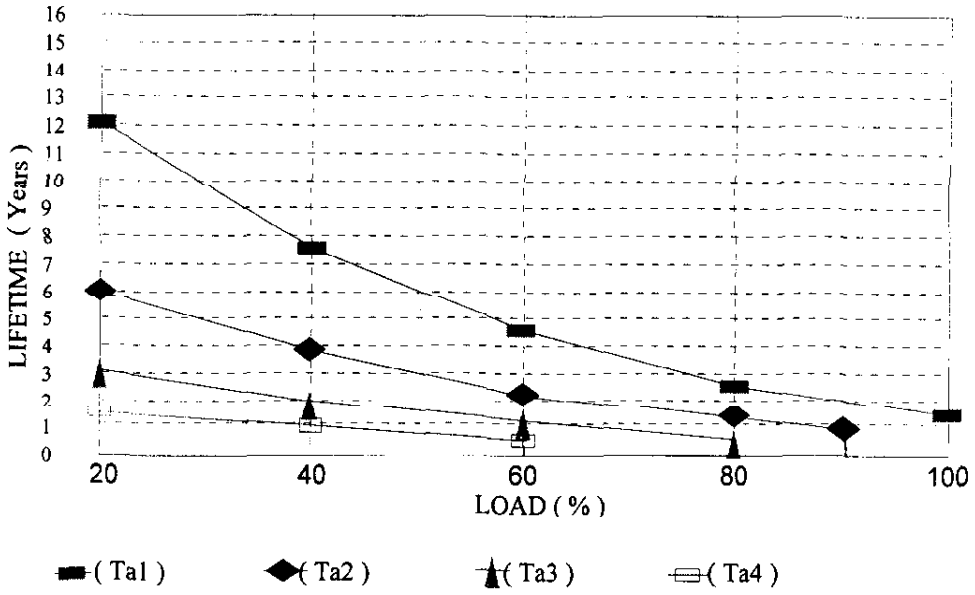
E - CAP LIFETIME versus LOAD

Vin = 100VAC　　Mounting Position : **D**

8 hours per day,365 days operation

GRAPH OF ELECTROLYTIC CAPACITOR LIFETIME VERSUS LOAD



Load (%)	LIFETIME (Yrs.)			
	Ta1 = 30°C	Ta2 = 40°C	Ta3 = 50°C	Ta4 = 60°C
100	1.30	-	-	-
80	2.61	1.30	0.65	-
60	4.48	2.24	1.12	0.56
40	7.64	3.82	1.91	0.96
20	12.00	6.00	3.01	1.50

Formula :

1.For 105°C Elec. capacitor

$$L = Lo * 2^{(105-dT-Ta)/10} /(8 * 365) \text{ (Yrs.)}$$

2. For 85°C Elec. capacitor

$$L = Lo * 2^{(85-dT-Ta)/10} /(8 * 365) \text{ (Yrs)}$$

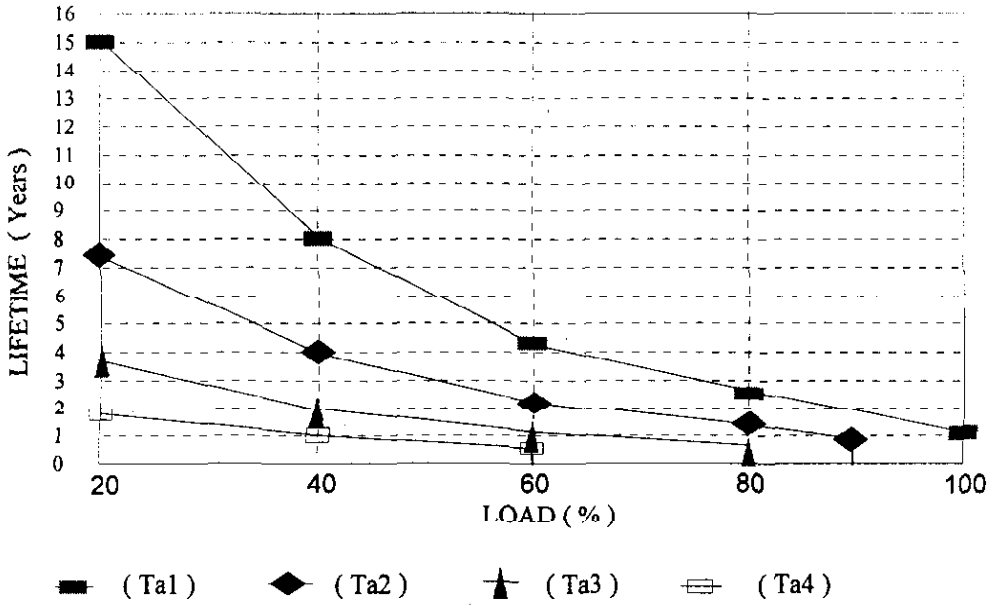
Where : L ----Elec. capacitor computed life
(8 hours per day , 365 days operation)
Lo—Guarantee life for Elec. capacitor
Ta---Ambient temperature
dT—Temperature rise of Elec. capacitor

E - CAP LIFETIME versus LOAD

Vin = 100VAC
8 hours per day,365 days operation

Mounting Position : E

GRAPH OF ELECTROLYTIC CAPACITOR LIFETIME VERSUS LOAD



Load (%)	LIFETIME (Yrs.)			
	Ta1 = 30°C	Ta2 = 40°C	Ta3 = 50°C	Ta4 = 60°C
100	1.08	-	-	-
80	2.65	1.32	0.66	-
60	4.36	2.18	1.09	0.55
40	7.97	3.98	1.99	0.99
20	14.97	7.48	3.74	1.87

Formula :

1.For 105°C Elec. capacitor

$$L = Lo * 2^{(105-dT-Ta)/10} /(8 * 365) \text{ (Yrs.)}$$

2. For 85°C Elec. capacitor

$$L = Lo * 2^{(85-dT-Ta)/10} /(8 * 365) \text{ (Yrs)}$$

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 : SWT65 -522	ABNORMAL TEST	TEST CONDITIONS	APPROVED	TESTED
		LOAD = 100%	Vin = AC200V Ta = 25	2 Nov 95

				TEST MODE		TEST RESULTS																
	PARTS NANE	PART NO.	TEST POINT	SHORT	OPEN	FIRE	SMOKE A	SMOKE B	BURST	SMELL	RED HOT	DAMAGE	FUSE BLOWN	O.C.P.	O.V.P.	NO OUTPUT	NO CHANGE	OTHERS	NOTE	OK	RETEST	NO GOOD
1	TOPSWITCH	A2	C-D	Y									Y			Y			ZD3 SHORT;TOPSWITCH SPOILT	Y		
2	PWR-TOP204YAI		S-D	Y									Y			Y				Y		
3			C-S	Y												Y				Y		
4			C		Y											Y			TOPSWITCH SPOILT	Y		
5			D		Y											Y				Y		
6			S		Y											Y				Y		
7	3-T REG	A4	1-2	Y										Y					HICCUP	Y		
8			2-3	Y														Y	CH3 O/P HIGH	Y		
9			3-1	Y														Y	CH3 NO O/P	Y		
10			1		Y													Y	CH3 O/P HIGH	Y		
11			2		Y													Y	CH3 NO O/P	Y		
12			3		Y													Y	CH3 NO O/P	Y		
13	SHUNT REG	A5	R-A	Y										Y					HICCUP	Y		
14	KA431Z		K-R	Y														Y	ALL O/P LOW	Y		
15			R-A	Y														Y	ALL O/P LOW	Y		
16			K		Y									Y					HICCUP	Y		
17			A		Y									Y					HICCUP	Y		
18			R		Y									Y					HICCUP	Y		
19	CAP.,FILM	C1		Y									Y			Y				Y		
20					Y												Y			Y		
21	CAP.,CERANIC	C2		Y													Y			Y		
22	CD16E2GA332MYAS				Y												Y			Y		
23	CAP.,FILM	C12		Y										Y						Y		
24	MMH104K63A				Y													Y	ALL O/P LOW	Y		
25																						

*** A : SLIGHT B : PROLONGED

MODEL : SWT65 -522	ABNORMAL TEST	TEST CONDITIONS		APPROVED	TESTED
		LCAD = 100%	Vin = AC200V Ta = 25		

	PARTS NAME	PART NO.	TEST POINT	TEST MODE		TEST RESULTS																
				SHORT	OPEN	FIRE	SMCKEA	SMOKEB	BURST	SMELL	RED HOT	DAMAGE	FUSE BLOWN	O.C.P.	O.V.P.	NO OUTPUT	NO CHANGE	OTHERS		OK	RETEST	NO GOOD
1	CAP.,ELECT	C13		Y												Y				Y		
2	RSH-25V560MA22-F				Y												Y			Y		
3	CAP.,ELECT	C17		Y										Y					HICCUP	Y		
4	RSH-25V222MA66				Y													Y	CH2 O/P LOW	Y		
5	CAP.,ELECT	C20		Y										Y					HICCUP	Y		
6	RSH-10V392MA66				Y												Y			Y		
7	CAP.,ELECT	C26		Y										Y					HICCUP	Y		
8	RSH-50V12 MA43				Y														CH3 O/P LOW	Y		
9	REC.BRIDGE	D1	ONEDIODE	Y									Y			Y				Y		
10	D3SB60		ONELEAD		Y											Y				Y		
11	DIODE,F.R.D	D3		Y												Y			SHUTDOWN	Y		
12	1NU4				Y												Y			Y		
13	DIODE,F.R.D	D4		Y												Y			SHUTDOWN	Y		
14	GI1003				Y									Y					HICUUP	Y		
15	DIODE,S.B.D	D6		Y										Y					HICCUP	Y		
16	D10SC6M				Y													Y	CH2 NO O/P	Y		
17	DIODE,S.B.D	D7		Y										Y					HICCUP	Y		
18	SBL2040PT				Y									Y					HICUUP	Y		
19	DIODE,F.R.D	D8		Y										Y					HICCUP	Y		
20	UF5402				Y													Y	CH3 NO O/P	Y		
21	TRANSIENT	ZD1		Y										Y					HICCUP	Y		
22	P6KE220CA				Y												Y			Y		
23	ZENER DIODE	ZD3		Y												Y				Y		
24	AW01-07				Y												Y			Y		
25																						

*** A : SLIGHT B : PROLONGED

SHANGHAI NEMIC - LAMBDA

MODEL : SWT65 -522	ABNORMAL TEST	TEST CONDITIONS		APPROVED	TESTED
		LOAD = 100%	Vin = AC200V Ta =25	2NOV95	

				TEST MODE		TEST RESULTS																
	PARTS NAME	PART NO.	TEST POINT	SHORT	OPEN	FIRE	SMOKE A	SMOKE B	BURST	SMELL	RED HOT	DAMAGE	FUSE BROWN	O.C.P.	O.V.P.	NO OUTPUT	NO CHANGE	OTHERS		CK	RETEST	NO GOOD
1	PHOTO COUPLER	PC1	1-2	Y										Y					HICCUP	Y		
2	4N35TV		4-5	Y												Y			SHUTDOWN	Y		
3			1		Y									Y					HICCUP	Y		
4			2		Y									Y					HICCUP	Y		
5			4		Y									Y					HICCUP	Y		
6			5		Y									Y					HICCUP	Y		
7																						
8																						
9																						
10																						
11																						
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25																						

*** A : SLIGHT B : PROLONGED

SHANGHAI NEMIC - LAMBDA

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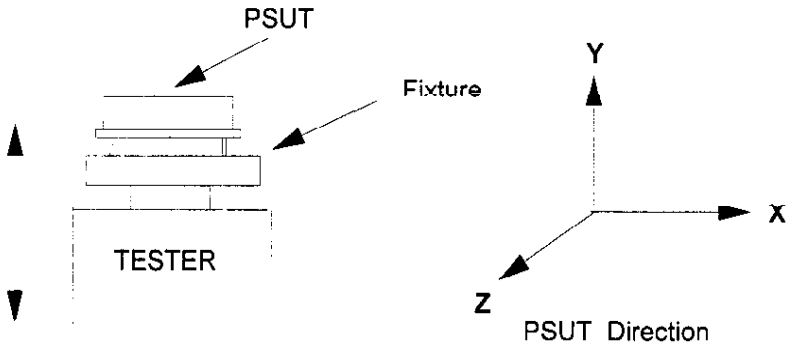
VIBRATION TEST

Type of vibration test : A) Oscillator frequency sweep

Equipment used : Vibration test system F - 400 - BM - E47 (EMIC CORP.)
Vibration generator 905 - FN(EMIC CORP.)

Proceduce :



A) Vibration test with frequency sweep

Sweep frequency	:	10 - 55Hz
Sweep time	:	1min
Acceleration	:	Fixed 2G
Direction	:	X,Y,Z.
Duration	:	1hour for each direction.

Test point :

1) Output voltage (Apply some shock when checking the output voltage, and observe any abnormalities.)
2) Ripple voltage (At nominal input and output.)
3) Mechanical condition (No breakage.)

Test result :

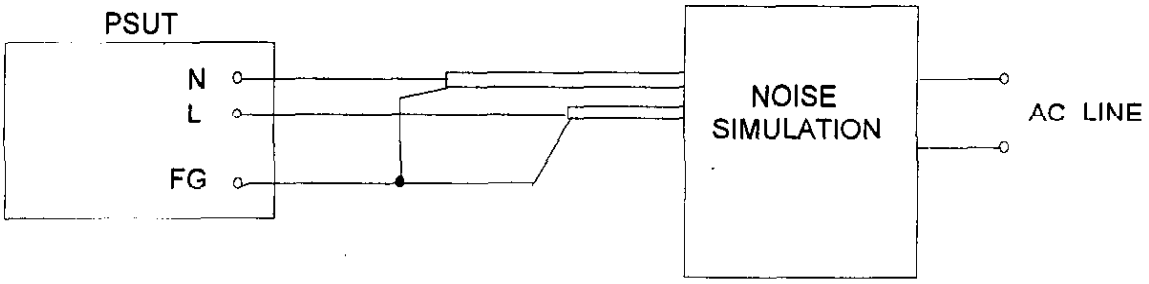
Test Point		Output voltage (V)			Ripple voltage (mV)			Mechanical Condition	Note
		CH1	CH2	CH3	CH1	CH2	CH3		
Before test		5.009	12.185	-5.001	40	70	5	O.K	
After test	Direction								
	X	5.110	12.189	-4.998	40	70	5	O.K	
	Y	5.159	12.222	-5.001	40	62	5	O.K.	
	Z	5.154	12.219	-5.000	40	65	5	O.K.	

Evaluation result : (PASS) / FAIL

Visual inpection result : (PASS) / FAIL

NOISE SIMULATION TEST

Circuit for measurement and equipmet used :



MODEL : ENS - 24X (SANKI)

Test condition :

Input voltage	:	100VAC
Output voltage	:	Rated
Output current	:	Min . 100%
Ambient temp.	:	25°C

Settings :

MODE	:	Normal , Common
TRIG SELECT	:	Line
PULSE WIDTH	:	50 , 200 , 800 , 1000ns
PHASE SHIFT	:	0° ~ 360°
POLARITY	:	+ , -
NOISE LEVEL	:	0 ~ 2KV

Acceptance criteria :

1) No damage of PSUT.
2) No output failure.
3) Check any abnormalities. (e.g. noise)

Evaluation result : (PASS) / FAIL

ELECTROSTATIC DISCHARGE TEST

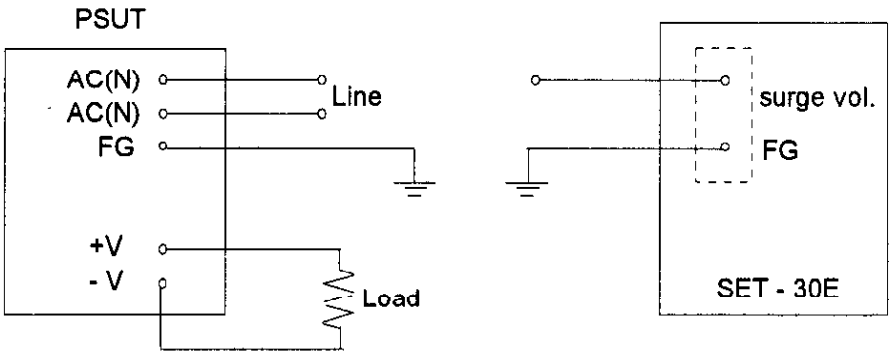
Equipment used : SET - 30E (SANKI ELECTRONIC)
Discharge resistor : 250 Ω
Capacitor unit : 200 pF

Test conditions : Input voltage : Nominal Line (100VAC)
Output voltage : Rated
Output current : 100%
Ambient temperature : 25°C
Applied voltage : ±3KV, ±5KV, ±10KV, ±15KV

Procedure : The PSUT should be in a good working condition.
Discharge the applied voltage to the touchable parts of the PSUT (Chassis, Input Terminals, Output Terminals, FG Terminal) and check any abnormalities.

Each point to be tested 3 times with different polarity.
Voltage should be applied from 3KV to 15KV.

Test circuit :

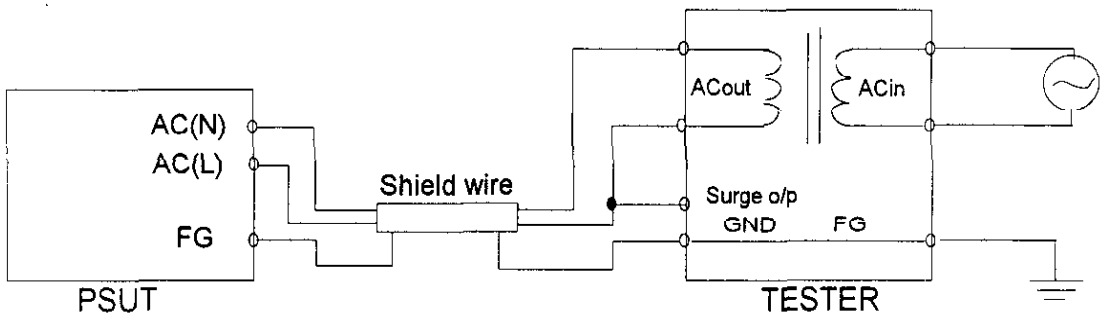


Acceptance criteria : 1) No damage of PSUT.
2) No output failure.
3) No abnormalities.

Evaluation result : (PASS) / FAIL

LIGHTNING SURGE TEST

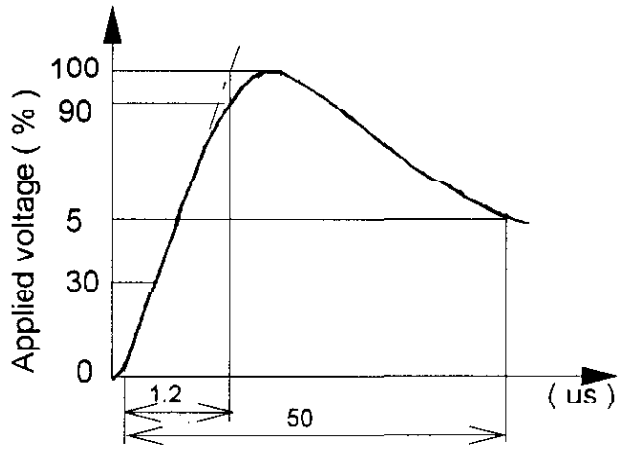
Test circuit, Test equipment



MODEL : LSG - 12K - E (SANKI)

Test conditions :	Input voltage	:	100VAC
	Output voltage	:	Rated
	Output current	:	Rated
	Ambient temp.	:	25°C
	Applied voltage	:	From 3KV in steps of 0.5KV Check the max. withstand voltage
	Applied point	:	Between FG - AC
	Number of test	:	Each voltage 3 times
	Polarity	:	+ , -

Applied voltage waveform :



Acceptance criteria
1) No damage of PSUT.
2) No output failure.
3) No abnormalities.

Evaluation result : 4.0KV (PASS) / FAIL