PAH200S48-*

RELIABILITY DATA

POWER MODULE

DRAWING NO. : PA554-79-01			
DLJ QA	NLS R&D		
APPROVED	PREPARED	CHECKED	APPROVED
T Murayama	24/7/2000	24/7/00.	24/7/00
DATE : 4/Sep/00	DATE ISSUE : 24/7/00		

NEMIC-LAMBDA (S) PTE LTD

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Note :- Test result are typical data. Nevertheless the following result are consider to be actual capability data because all units have nearly the same charateristics.

1. Calculated Values Of M.T.B.F

MODEL :- PAH200S48-12

1 . Method of calculation

Calculated based on part count reliability projection of MIL-HDBK-217F.
Individual failure rate λ_G is given to each part, and MTBF is calculated by the count of each part.

Formula :

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

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

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)

M T B F = 409,695 Hours

2. Component Derating

MODEL : PAH200S48-12

(1) Calculating Method

(a) Measuring Conditions

Input Voltage	:	48VDC
Output Current	:	12V, 16.7A (100%)
Mounting Method	:	Standard Mounting Method (with Heatsink)
Ambient Temperature	:	25°C
Base-Plate Temperature	:	80°C

(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, etc are within derating criteria.

(d) Calculating Method of Thermal Impedance

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

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

$P_{(max)}$ = Maximum Power Dissipation

$T_{j(max)}$ = Maximum Junction Temperature

q_{j-c} = Thermal Impedance between Junction and Case

q_{j-a} = Thermal Impedance between Junction and Air

2. Temperature Derating

Model :- PAH200S48-12

Condition :- Vin = 48 VDC
Load = 100 %
Tp = 80°C

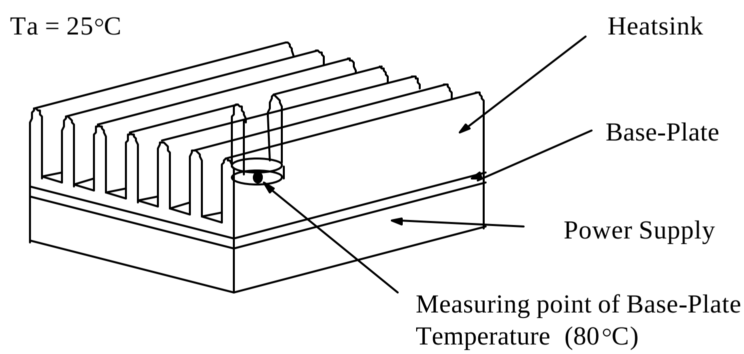
Symbol	Parts Name	Catalog No	Tj max (°C)	Actual Tj (°C)	Derating factor (%)
Q1	CHIP MOSFET	2SK1334BY-TL	150	98.05	65.36
Q2	CHIP TRANSISTOR	2SC2712Y-TE85L	125	84.1	67.28
Q3	CHIP TRANSISTOR	2SA1162Y-TE85L	150	75.9	50.6
A1	CHIP IC	NL21C001	150	100.2	66.8
A2	CHIP IC	HA17431UA-04-TL	150	71.6	47.73
A3	CHIP IC	IR2110S	150	111.14	74.09
A4	CHIP IC	TA75S393F-TE85L	125	81.5	65.2
A5	CHIP IC	OPA2244EA	125	72.1	57.68
A6	CHIP IC	LM4041CIM3-1.2	150	70	46.67
A7	CHIP IC	TA75S01F-TE85L	125	81.9	65.52
D1	CHIP DIODE, U-LLD	D1FL20U-4063	150	86.39	57.59
D2	CHIP DIODE	1SS184-TE85L	150	100.8	67.2
D3	CHIP DIODE, U-LLD	D1FL20U-4063	150	87.13	58.08
D4	CHIP DIODE	1SS184-TE85L	150	99.76	66.5
D5	CHIP DIODE	1SS181-TE85L	125	81.6	65.28
ZD1	CHIP ZENER	02CZ18Y-TE85L	150	89.8	59.86
ZD2	CHIP ZENER	02CZ3.6Z-TE85L	150	85.28	56.85
ZD3	CHIP ZENER	02CZ12Z-TE85L	150	82.1	54.73
ZD4	CHIP ZENER	02CZ2.2Z-TE85L	150	79.4	52.93
PC1	CHIP PHOTO COUPLER	TLP181GRH-TPL	150	75.34	50.22
PC2	CHIP PHOTO COUPLER	TLP181GRH-TPL	150	70.2	46.8
Q101	CHIP MOSFET	2SK2099-01S	150	93	62
Q102	CHIP MOSFET	2SK2226-01S	150	105.18	70.12
D101	CHIP S.B.D	DF20SC3ML	150	96.04	64.02
D102	CHIP S.B.D	DF20SC3ML	150	98.54	65.69
ZD101	CHIP ZENER	02CZ18Y-TE85L	150	82	54.66

3. Main Components Temperature Rise ΔT List

MODEL : PAH200S48-12

Location	Parts Name	Catalog No.	ΔT_{C-P} (°C)
Q101	CHIP MOSFET	2SK2099-01S	4.6
Q102	CHIP MOSFET	2SK2226-01S	13.5
D101	CHIP S.B.D	DF20SC9M	5.0
D102	CHIP S.B.D	DF20SC9M	7.5
L101	CHIP COIL	HA-841R5X	21.9
T101	COIL (SEC)		54.7
T102	COIL (SEC)		44.3

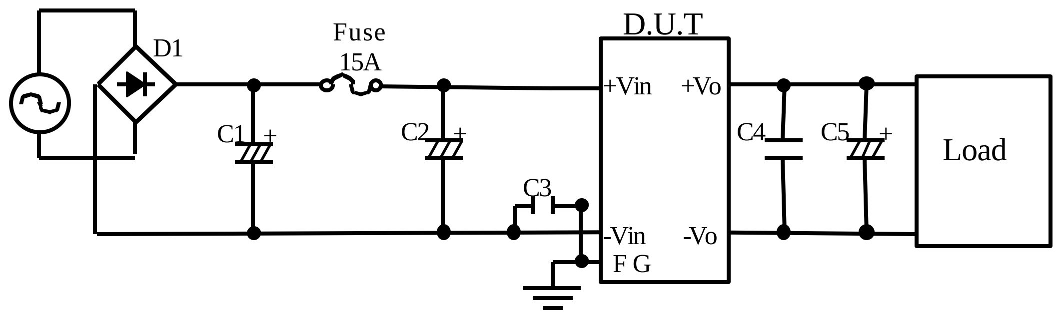
Measuring Conditions

Mounting Method	Standard Mounting Method (with Heatsink) 
Input Voltage	48VDC
Output Voltage	12VDC
Output Current	16.7A (100%)

ΔT_{C-P} : Differential temperature between component and base-plate; with power supply fitted with heatsink, baseplate temperature = 80°C and ambient temperature = 25°C.

4. Abnormal Test

Model :- PAH200S48-12



(1) Test Condition and Circuit

Input Voltage		76VDC	Output Current	16.7A(100%)
Base-Plate Temperature		25°C	Additional Fuse	15A
Bridge Rectifier	(D1)	D10XB60H	Electrolytic Cap. (C1)	200V 1000uF x 10pcs
Electrolytic Cap.	(C2)	100V 33uF	Ceramic Cap. (C3)	AC400V 4700pF
Ceramic Cap.	(C4)	50V 1uF	Electrolytic Cap. (C5)	25V 1000uF

(2) Test Results

No.	Test Position		Test Mode		Test Results												
	Loca-tion No.	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	Note
1	Q1	D-G	●							●				●			Q1, R27, A1 Damage
2		D-S	●							●				●			R30, Q1, A1 Damage
3		G-S	●											●			
4		D		●										●			
5		S		●										●			
6		G		●										●			
7	Q2	E-B	●												●		
8		E-C	●											●			
9		B-C	●											●			
10		B		●											●		
11		C		●											●		
12		E		●											●		

No.	Test Position: Location No.	Test Position: Test Point	Test Mode: SHORT	Test Mode: OPEN	Test Results: 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	Note
13	D1		●							●	●			●			Q101, Q102, A2 Damage
14				●											●		Efficiency Low
15	D2		●												●		
16				●										●			
17	D3		●											●			
18				●										●			
19	D4		●												●		
20				●										●			
21	D6		●												●		
22				●											●		
23	ZD1		●												●		Efficiency Low
24				●											●		
25	ZD2		●													●	Output Low
26				●											●		
27	ZD3		●											●			
28				●											●		
29	PC1	1-3	●										●				
30		4-6	●											●			
31		1		●									●				
32		3		●									●				
33		4		●									●				
34		6		●									●				
35	PC2	1-3	●												●		
36		4-6	●										●				
37		1		●											●		
38		3		●											●		
39		4		●											●		
40		6		●											●		
41	C4		●													●	Output High
42				●									●	●			
43	C5		●												●		
44				●											●		
45	C9		●											●			
46				●										●			
47	C12		●											●			
48				●										●			
49	C18		●											●			
50				●											●		

No.	Test Position		Test Mode		Test Results												
	Loca-tion No.	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	Note
51	T1	1-3	●											●			
52		6-7	●											●			
53		1		●										●			
54		3		●										●			
55		6		●										●			
56		7		●										●			
57	Q101	D-G	●									●					
58		D-S	●									●					
59		G-S	●												●		Efficiency Low
60		D		●											●		Efficiency Low
61		S		●											●		Efficiency Low
62		G		●											●		Efficiency Low
63	Q102	D-G	●							●	●			●			Q102 Damage
64		D-S	●								●			●			
65		G-S	●											●			
66		D		●										●			
67		S		●										●			
68		G		●										●			
69	D101		●													●	Output Low
70				●												●	Output Low
71	D102		●													●	Output Low
72				●												●	Output Low
73	ZD101		●											●			
74				●											●		
75	C102		●								●			●			
76				●												●	Output Drop To Zero
77	C103		●											●			Efficiency Low
78				●											●		Efficiency Low
79	C105		●							●				●			R103, R104, R107 Damage
80				●											●		

No.	Test Position		Test Mode		Test Results												
	Loca-tion No.	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	Note
81	T101	1-2	●													●	Output Low
82		3-4	●													●	Output Low
83		1		●												●	Output Low
84		2		●												●	Output Low
85		3		●												●	Output Low
86		4		●												●	Output Low
87	T102	1-2	●												●		Output Low
88		3-4	●												●		Output Low
89		1	●													●	Output Low
90		2		●												●	Output Low
91		3		●												●	Output Low
92		4		●												●	Output Low
93	Reverse Input Voltage											●		●			

5. Vibration Test

MODEL : PAH200S48-12

(1) Vibration Test Class

Frequency Variable Endurance Test

(2) Equipment Used

Controller : F-400-BM-DCS-7800 (EMIC CORP.)

Vibrator : 905-FN (EMIC CORP.)

(3) Test Conditions

Sweep Frequency : 10-55Hz

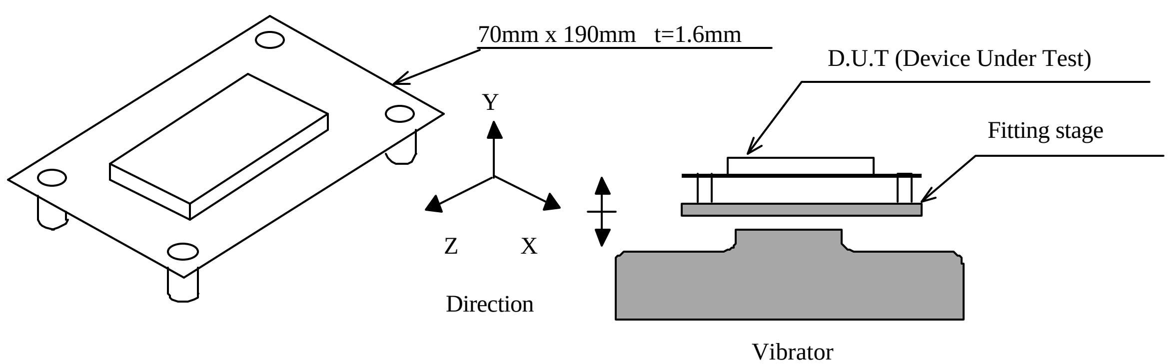
Sweep Time : 1 min.

Amplitude : (0.825mm) const.

Direction : X, Y, Z

Test Time : 1 hour each

(5) Test Method



Put the D.U.T. on the universal circuit board (soldering Input Output signal terminals and fixing by four M3-tapped-holes) and fit it on the fitting-stage.

(6) Test Results

Check Item		Output Voltage (V)	Ripple Voltage (mVp-p)	D.U.T. State
Before Test		12.007	15.6	OK
After Test	X	12.005	15.4	OK
	Y	12.004	15.6	OK
	Z	12.004	15.8	OK