

PAH75D24

RELIABILITY DATA



POWER MODULE

DRAWING NO. : PA565-79-01A			
DLJ QA	NLS R&D		
APPROVED	PREPARED	CHECKED	APPROVED
<i>T. Murayama</i> 201.9/01	<i>Fury</i> 4/9/01	<i>Tha</i> 4/9/01	<i>Jeff</i> 12/9/01
DATE :	DATE ISSUE : 12 Sept 01		

DENSEI-LAMBDA

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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.

2. Temperature Derating

Model :- PAH75D24-5033

Condition :-
Vin = 24 VDC
Load = Io1 (5A) Io2 (15A)
Tp = 100°C

Symbol	Parts Name	Catalog No	Tj max (°C)	Actual Tj (°C)	Derating factor (%)
A1	CHIP IC	NL21C001	150	124.8	83.20
A3	CHIP IC	IR2110STR	150	116.6	77.50
A4	CHIP IC	UCC2813DTR-3	150	116.6	77.71
Q101	CHIP MOSFET	2SK2099-01S	150	113.2	75.48
Q102	CHIP MOSFET	2SK3443	150	116.0	77.36
Q104	CHIP MOSFET	HAT2064R	150	132.3	88.20
D101	CHIP S.B.D	DF30SC3ML	150	121.1	80.72
D102	CHIP S.B.D	DE10S3L	150	117.2	78.13

Model :- PAH75D24-5033

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

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 :

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

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 ($\pi_Q = 1$)

2 . MTBF Values

- G F : (GROUND, FIXED)
- MTBF = 377,925 Hours**

2. Component Derating

(1) Calculating Method

(a) Measuring Conditions

Input Voltage	:	24VDC
Output Current	:	Io5 = 5A, Io3.3 = 15A
Mounting Method	:	Standard Mounting Method (with Heatsink)
Ambient Temperature	:	25°C
Base-Plate Temperature	:	100°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

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

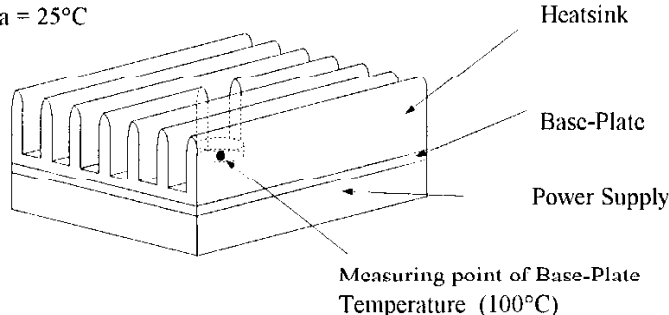
θ_{j-a} = Thermal Impedance between Junction and Air

3. Main Components Temperature Rise ΔT List

MODEL : PAH75D24-5033

Location	Parts Name	Catalog No.	ΔT_{C-P} (°C)
Q101	CHIP MOSFET	2SK2099-01S	5.7
Q102	CHIP MOSFET	2SK3443	9.6
Q104	CHIP MOSFET	HAT2064R	23.9
D101	CHIP S.B.D	DF30SC3ML-4072	11.0
D102	CHIP S.B.D	DE10S3L	7.2
L101	CHIP COIL	R-12T767DA	6.2
T101	COIL (SEC)		15.0
T102	COIL (SEC)		25.4

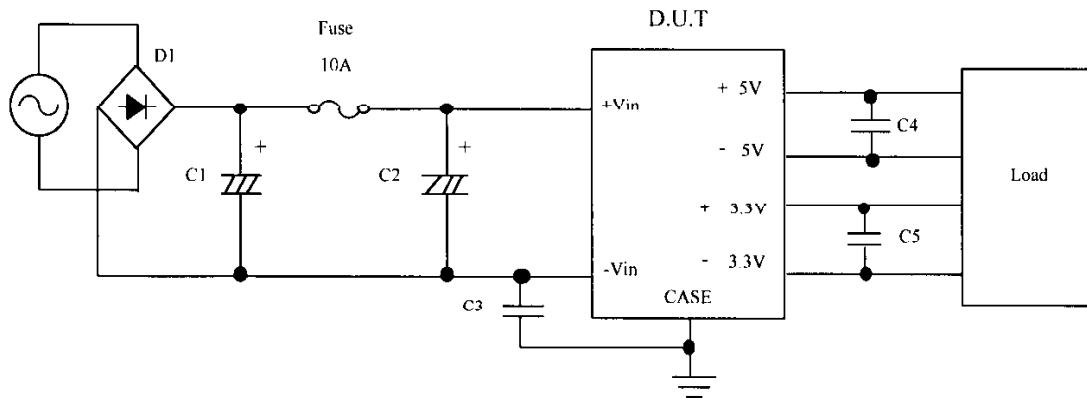
Measuring Conditions

Mounting Method	Standard Mounting Method (with Heatsink) $T_a = 25^\circ\text{C}$ 
Input Voltage	24VDC
Output Voltage	$V_{o1} = 5\text{ V}, V_{o2} = 3.3\text{ V}$
Output Current	$I_{o1} = 5\text{ A}, I_{o2} = 15\text{ A}$

ΔT_{C-P} : Differential temperature between component and base-plate; with power supply fitted with heatsink, baseplate temperature = 100°C and ambient temperature = 25°C .

4. Abnormal Test

MODEL : PAH75D24-5033



(1) Test Condition and Circuit

Input Voltage	36VDC	Output Current	$I_{o1} = 5A, I_{o2} = 15A$
Base-Plate Temperature	25°C	Fuse	10A
Bridge Rectifier (D1)	D10XB60H	Electrolytic Cap. (C1)	200V 1000uF x 10pcs
Electrolytic Cap. (C2)	100V 100uF	Ceramic Cap. (C3)	AC400V 4700pF
Ceramic Cap.(C4)	25V 33uF	Ceramic Cap. (C5)	25V 33uF

(2) Test Results

No.	Test Position		Test Mode		Test Results												NOTE
	LOC CATION	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 NON-OUTPUT	11 NON-CHANGE	12 OTHER	
1	Q1	D-G	●							●				●			Q1, R27, A1 Damage
2		D-S	●							●				●			R30, Q1, A1 Damage
3		G-S	●											●			
4		D		●										●			
5		S		●										●			
6		G		●										●			

No.	Test Position		Test Mode		Test Results												NOTE
	L O C A T I O N	T P E O S I T I O N	S H O R T	O P E N	1 F I R E	2 S M O K E	3 B U R S T	4 S M E L L	5 R E D H O T	6 D A M A G E	7 F U S E B L O W	8 O C P	9 O V P	10 N O O U T P U T	11 N O C H A N G E	12 O T H E R	
7	Q3	E-B	●												●		
8		E-C	●											●			
9		B-C	●											●			
10		B		●											●		
11		C		●											●		
12		E		●											●		
13	A4	1-2	●										●	●			
14		2-3	●													●	5V O/P remain. 3.3V O/P low
15		3-4	●										●	●			
16		5-6	●													●	5V O/P remain. 3.3V no O/P
17		6-7	●													●	5V O/P remain. 3.3V O/P low
18		7-8	●											●			
19		1		●												●	5V O/P remain. 3.3V O/P low
20		2		●												●	5V O/P remain. 3.3V O/P low
21		3		●												●	5V O/P remain. 3.3V O/P low
22		4		●												●	5V O/P remain. 3.3V no O/P
23		5		●										●			
24		6		●												●	5V O/P remain. 3.3V no O/P
25		7		●												●	5V O/P remain. 3.3V no O/P
26		8		●												●	5V O/P remain. 3.3V no O/P
27	D1		●							●	●			●			Q101, Q102 A2 Damage
28				●											●		Efficiency Low
29	D2		●												●		
30				●										●			
31	D3		●											●			
32				●										●			
33	D4		●												●		
34				●										●			
35	D5	1-2	●												●		
36		1-3	●												●		
37		2-3	●												●		
38		1		●											●		
39		2		●											●		
40	D6	3		●											●		
41			●												●		
42	D7			●											●		
43			●													●	5V O/P remain. 3.3V no O/P
44				●												●	5V O/P remain. 3.3V no O/P

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No.	Test Position		Test Mode		Test Results												NOTE
	L O C A T I O N	T P O S I T I O N	S H O R T	O P E N	1 F I R E	2 S M O K E	3 B U R S T	4 S M E L L	5 R E D H O T	6 D A M A G E	7 F U S E B L O W	8 O C C P .	9 O V P .	10 N O O U T P U T	11 N O C H A N G E	12 O T H E R	
45	ZD1		●												●		Efficiency Low
46				●											●		
47	ZD2		●													●	Output Low
48				●											●		
49	ZD3		●											●			
50				●											●		
51	PC1	1-3	●										●				
52		4-6	●											●			
53		1		●									●				
54		3		●									●				
55		4		●									●				
56		6		●									●				
57	PC2	1-3	●												●		
58		4-6	●											●			
59		1		●											●		
60		3		●											●		
61		4		●											●		
62		6		●											●		
63	C4		●													●	Output High
64				●									●	●			
65	C5		●												●		
66				●											●		
67	C9		●											●			
68				●										●			
69	C12		●											●			
70				●										●			
71	C26		●											●			
72				●											●		
73	C28		●											●			
74				●											●		
75	T1	1-3	●											●			
76		6-7	●											●			
77		1		●										●			
78		3		●										●			
79		6		●										●			
80		7		●										●			

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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	
81	Q101	D-G	●									●					
82		D-S	●									●					
83		G-S	●												●		Efficiency Low
84		D		●											●		Efficiency Low
85		S		●											●		Efficiency Low
86		G		●											●		Efficiency Low
87	Q102	D-G	●							●	●			●			Q102 Damage
88		D-S	●							●	●			●			
89		G-S	●											●			
90		D		●										●			
91		S		●										●			
92		G		●										●			
93	Q103	D-G	●							●				●			Q103, R106, A4 Damage
94		D-S	●							●				●			Q103, R106, A4 Damage
95		G-S	●													●	5V O/P remain. 3.3V no O/P
96		D		●										●			5V O/P remain. 3.3V no O/P
97		S		●										●			5V O/P remain. 3.3V no O/P
98		G		●										●			5V O/P remain. 3.3V no O/P
99	Q104	D-G	●							●							Q104, R107, A4 Damage
100		D-S	●							●							Q104, R107, A4 Damage
101		G-S	●													●	5V O/P remain. 3.3V no O/P
102		D		●										●			5V O/P remain. 3.3V no O/P
103		S		●										●			5V O/P remain. 3.3V no O/P
104		G		●										●			5V O/P remain. 3.3V no O/P
105	D101	T101	●											●			
106			●													●	5V & 3.3V Output Low
107		T102	●											●			
108			●													●	5V & 3.3V Output Low
109	D102		●											●			
110			●													●	5V O/P remain. 3.3V O/P low
111	ZD101		●											●			
112			●												●		
113	C102		●											●			
114			●													●	Output drop to zero
115	C103		●											●			Efficiency Low
116			●												●		Efficiency Low
117	C105		●							●				●			R103, R104, R107 Damage
118			●												●		
119	L102		●											●			
120			●													●	5V O/P remain. 3.3V O/P low

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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	
121	T101	1-2	●													●	Output Low
122		3-4	●													●	Output Low
123		1		●												●	Output Low
124		2		●												●	Output Low
125		3		●												●	Output Low
126		4		●												●	Output Low
127	T102	1-2	●													●	Output Low
128		3-4	●													●	Output Low
129		1		●												●	Output Low
130		2		●												●	Output Low
131		3		●												●	Output Low
132		4		●												●	Output Low
133	Reverse Input Voltage										●			●			

5. Vibration Test

Model :- PAH75D24-5033

(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

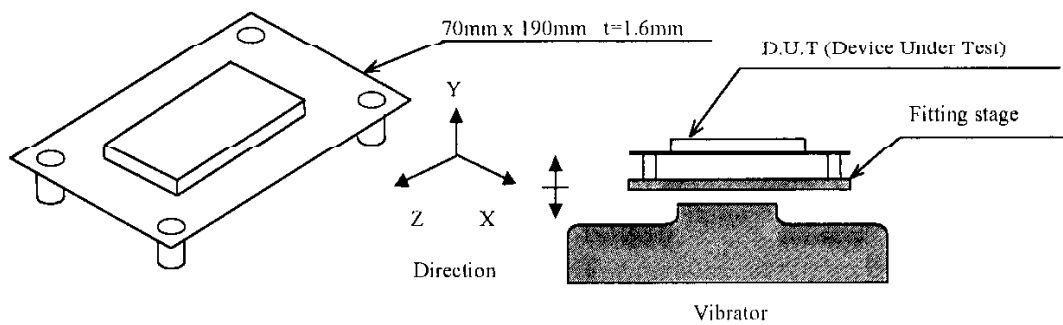
Sweep Time : 1 min.

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
		Vo1(5V)	Vo2(3.3V)	Vo1(5V)	Vo2(3.3V)	
Before Test		5.004	3.328	31.1	24.3	OK
After Test	X	5.003	3.274	30.7	25.5	OK
	Y	5.003	3.274	30.9	23.2	OK
	Z	5.003	3.274	30.9	23.2	OK