



# Test Report: MPM-90-24

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90W AC-DC High Reliable PCB-Mount Green Medical Power  
Module

## ■ DESIGN VERIFY TEST

Output Function Test

Input Function Test

Protection Function Test

Component Stress Test

## ■ SAFETY & E.M.C. TEST

Safety Test

E.M.C. Test

## ■ RELIABILITY TEST

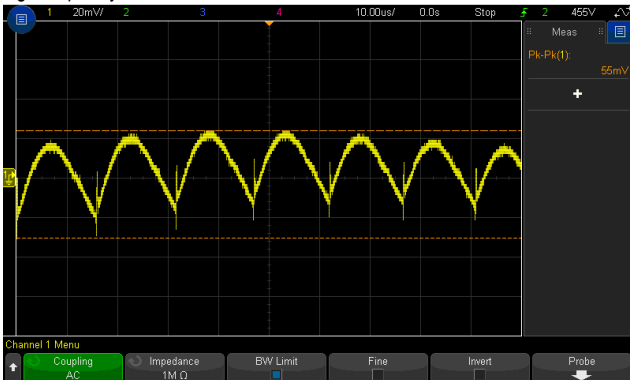
ENVIRONMENT TEST

DESIGN VERIFY TEST

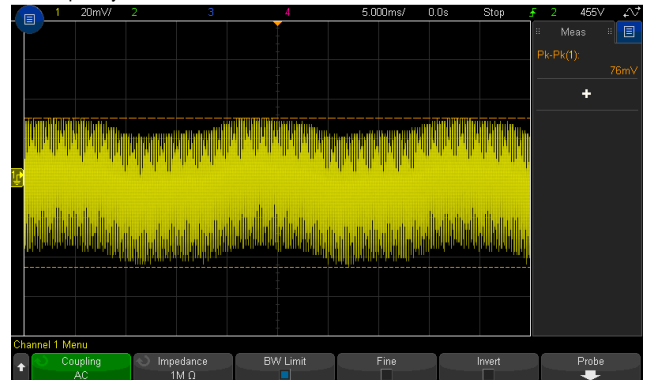
OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE(Max) TOLERANCE	V1: -2.0%~ +2.0 %	I/P: 80VAC /264VAC O/P:FULL/ MIN. LOAD Ta:25°C	V1: -0.06%~0.09%
2	LINE REGULATION (Max)	V1: -0.5%~ +0.5 %	I/P: 80VAC~ 264VAC O/P:FULL LOAD Ta:25°C	V1: -0.02%~0.09%
3	LOAD REGULATION(Max)	V1: -0.5%~ +0.5 %	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25°C	V1: -0.06%~0.09%
4	OVER/UNDERSHOOT TEST	< ±5%	I/P: 230VAC O/P:FULL LOAD Ta:25°C	1.3%
5	PEAK LOAD TEST	≥ 10 Sec.	I/P: 230VAC O/P:PEAK LOAD Ta:25°C	OK
6	RIPPLE & NOISE(Max)	V1: 200mVp-p	I/P:230VAC O/P:FULL LOAD Ta:25°C	V1: 76 mVp-p

high frequency :



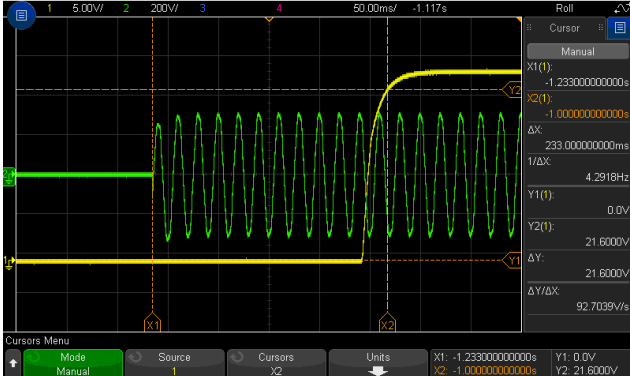
low frequency :



7	SET UP TIME(Max)	230VAC/1000ms 115VAC/1000ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/ 233 ms 115VAC/ 250 ms
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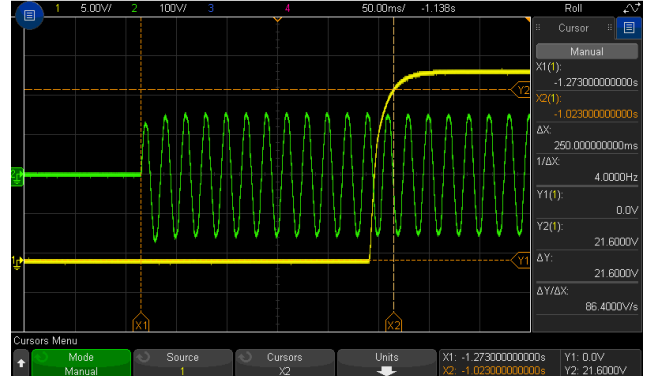
INPUT=230VAC/50HZ @ FULL LOAD

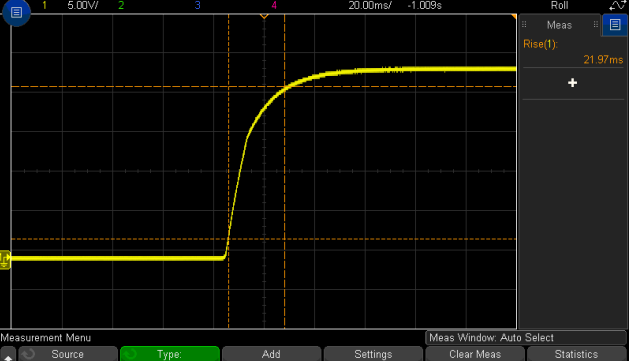
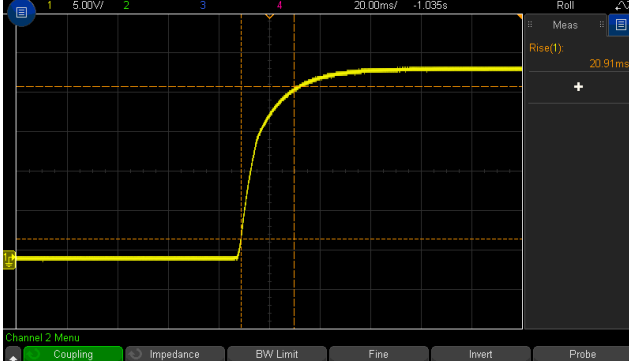
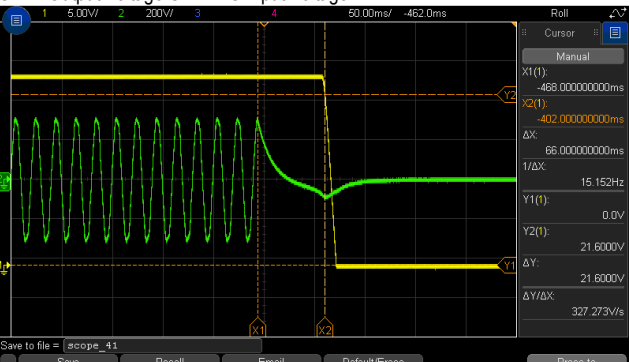
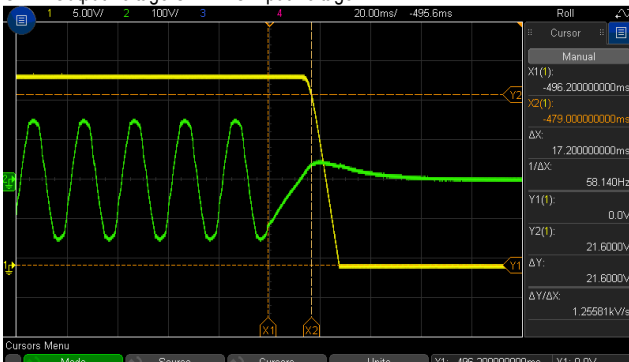
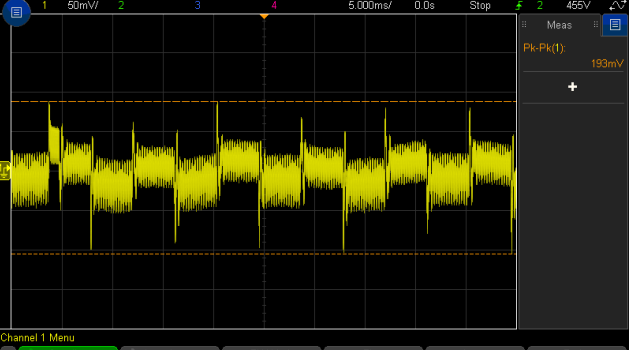
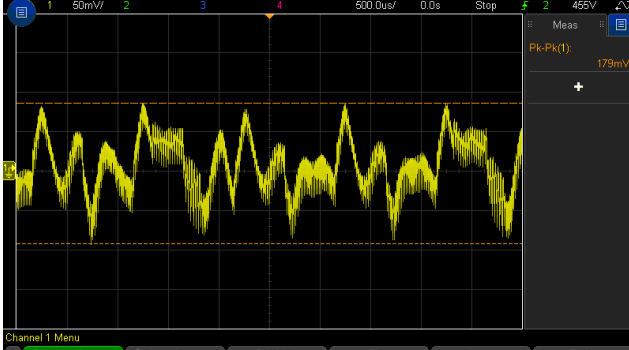
CH1 : Output Voltage CH2 : AC Input Voltage



INPUT=115VAC/60HZ @ FULL LOAD

CH1 : Output Voltage CH2 : AC Input Voltage

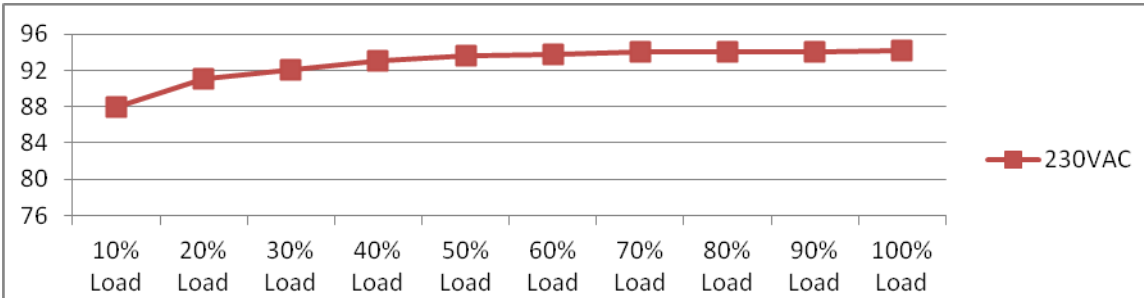


<p>8</p> <p>RISE TIME (Max)</p>	<p>230VAC/30ms 115VAC/30ms</p>	<p>I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C</p>	<p>230VAC/ 21.97 ms 115VAC/ 20.91 ms</p>
<p>INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage</p> 		<p>INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage</p> 	
<p>9</p> <p>HOLD UP TIME (Typ.)</p>	<p>230VAC/30ms 115VAC/10ms</p>	<p>I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C</p>	<p>230VAC/ 66 ms 115VAC/ 17.2 ms</p>
<p>INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage</p> 		<p>INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage</p> 	
<p>10</p> <p>DYNAMIC LOAD</p>	<p>V1: 2400 mVp-p</p>	<p>I/P: 230VAC O/P: (1)FULL /HALF LOAD 50%DUTY / 120HZ (2)FULL /HALF LOAD 50%DUTY / 1KHZ Ta:25°C</p>	<p>193 mVp-p 179 mVp-p</p>
<p>FULL /50% LOAD 50%DUTY / 120HZ</p> 		<p>FULL /50% LOAD 50%DUTY / 1KHZ</p> 	

### INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	80VAC~264VAC 113VDC~370VDC	I/P:TESTING O/P:FULL LOAD Ta:25°C	69VAC~264VAC 99VDC~370VDC
			I/P: LOW-LINE-3V=77 V HIGH-LINE+15%=300V O/P:FULL/MIN LOAD (PLEASE CHECK DERATING CURVE) ON: 30 Sec OFF: 30 Sec 10MIN (POWER ON/OFF NO DAMAGE )	TEST: OK
2	INPUT FREQUENCY RANGE	47HZ ~63 HZ NO DAMAGE	I/P:80 VAC ~264 VAC O/P:FULL~MIN LOAD Ta:25°C	TEST: OK
3	INPUT CURRENT (Typ.)	230V/ 1.1A 115V/ 1.9 A	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	I=0.66A/ 230VAC I=1.20A/ 115VAC
4	LEAKAGE CURRENT	< 100uA / 264VAC	I/P : 264VAC O/P : Min LOAD Ta : 25°C	Touch current : 84uA
5	NO LOAD CONSUMPTION	<0.1 W	I/P : 115VAC/230VAC O/P : NO LOAD Ta : 25°C	0.048W/115VAC 0.074W/230VAC
6	EFFICIENCY(Typ.)	93%	I/P:230 VAC O/P:FULL LOAD Ta:25°C	94.2%

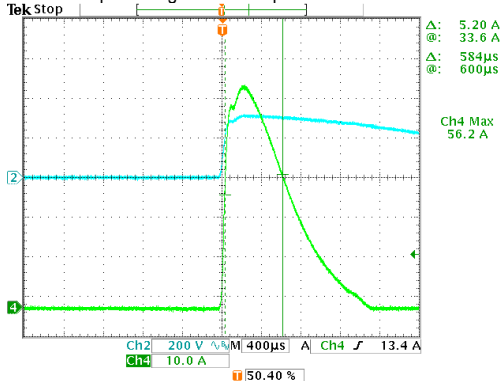
EFFICIENCY vs LOAD



7	INRUSH CURRENT(Typ.)	230V/65A 115V/30A COLD START	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	I=56.2A/ 230VAC I=27A/ 115VAC
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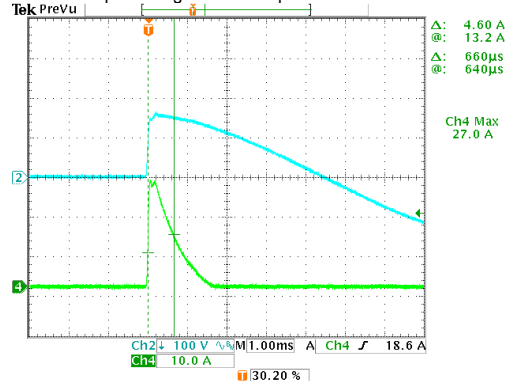
INPUT=230VAC/50HZ @ FULL LOAD

CH2 : AC Input Voltage CH4 : Input current



INPUT=115VAC/60HZ @ FULL LOAD

CH2 : AC Input Voltage CH4 : Input current



### PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER LOAD PROTECTION	115%~ 160%	I/P: 264VAC I/P: 230VAC I/P: 100VAC O/P: TESTING Ta:25°C	141.1%/ 264VAC 146.6%/ 230VAC 133.1%/100VAC PROTECTION TYPE : Hiccup mode ,recovers automatically after fault condition is removed .
2	OVER VOLTAGE PROTECTION	25.2V~32.4V	I/P: 264VAC I/P: 230VAC I/P: 80VAC O/P: MIN LOAD Ta:25°C	28.4V/ 264VAC 28.4V/ 230VAC 28.4V/ 80VAC PROTECTION TYPE : Shut down O/P voltage ,re-power on to recover.
3	OVER TEMPERATURE PROTECTION	Protection type : Shut down O/P voltage, re-power on to recover.	I/P: 264VAC I/P: 80VAC O/P: FULL LOAD	O.T.P. Active Protection type : Shut down O/P voltage ,re-power on to recover.
4	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE	I/P: 264VAC I/P: 80VAC O/P: FULL LOAD Ta:25°C	NO DAMAGE PROTECTION TYPE : Hiccup mode ,recovers automatically after fault condition is removed .

### COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Transistor ( D to S) or (C to E) Peak Voltage	Q1 Rated: 17A/ 680 V	AC ON/OFF I/P: High-Line +3V =267V VDS: O/P: (1) Full Load (2) Output Short (3) Dynamic Load Full Load/ Min. Load 90%Duty/1KHz (4) Dynamic Load Full Load/ Min. Load 90%Duty/3KHz (5) Dynamic Load Full Load/ Min. Load 90%Duty/5KHz (6) Dynamic Load 100% Load/ Min. Load 50%Duty/120Hz (7) 0%→400% Load. Ta:25°C	VDS: (1) 571V (2) 571V (3) 579V (4) 575V (5) 575V (6) 575V (7) 575V
4	Diode Peak Voltage	Q100 Rated: 50A/ 150V	AC ON/OFF I/P: High-Line +3V =267V O/P: (1) Full Load (2) Output Short (3) Dynamic Load Full Load/ Min. Load 90%Duty/1KHz (4) Dynamic Load Full Load/ Min. Load 90%Duty/3KHz (5) Dynamic Load Full Load/ Min. Load 90%Duty/5KHz (6) Dynamic Load 100% Load/ Min. Load 50%Duty/120Hz (7) 0%→400% Load. (8). NO LOAD Ta:25°C	Q101: VDS: (1) 110.2V (2) 109.4V (3) 109.4V (4) 109.4V (5) 109.4V (6) 109.4V (7) 109.4V (8) 109.4V

5	Input Capacitor Voltage	C5 Rated: 150 $\mu$ / 450 V	I/P:High-Line +3V =267V O/P: (1)Full Load input on/off (2) Min load input on /Off (3)Full Load /Min load Change (4)Full load continue Ta:25°C	(1) 370V (2) 370V (3) 370V (4) 370V
6	Control IC Voltage Test	PWM IC U2 Rated: -0.3 V~ 30 V  O/P IC U100 Rated: -0.3V~ 38 V	AC ON/OFF I/P:High-Line +3V =267V O/P(1)FULL LOAD (2) Output Short (3)O.L.P (4)O.V.P. (5)NO LOAD (LOW LINE) Ta:25°C	U2 (1)17.2V (2)17.2V (3)17.0V (4)18.0V (5)17.0V  U100 (1)15.0V (2)15.0V (3)15.0V (4)19.2V (5)15.0V
9	Clamp Diode Peak Voltage	D1 Rated : 650 V/ 1 A	AC ON/OFF I/P : High-Line +3V = 267 V O/P : (1) Dynamic Load 90%Duty/1KHz (2)Full load continue Ta:25°C	(1) 494 V (2) 490 V

### SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	I/P-O/P: 4KVAC/min	I/P-O/P:4.4 KVAC/min Ta:25°C	I/P-O/P:1.854 mA NO DAMAGE
2	ISOLATION RESISTANCE	I/P-O/P:500VDC>100M $\Omega$	I/P-O/P: 600 VDC Ta:25°C	I/P-O/P:9999M $\Omega$ NO DAMAGE

### E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	HARMONIC	EN61000-3-2 CLASS A	I/P:230VAC/50HZ O/P:FULL LOAD Ta:25°C	PASS
2	CONDUCTION	EN55011 CLASS B	I/P : 230 VAC (50HZ) O/P : FULL/50% LOAD Ta : 25°C	PASS Test by certified Lab
3	RADIATION	EN55011 CLASS B	I/P : 230 VAC (50HZ) O/P : FULL LOAD Ta : 25°C	PASS Test by certified Lab
4	E.S.D	EN61000-4-2 MEDICAL AIR: 15KV / Contact: 8KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	<input checked="" type="checkbox"/> CRITERIA A <input type="checkbox"/> CRITERIA B
5	E.F.T	EN61000-4-4 MEDICAL INPUT : 2KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	<input checked="" type="checkbox"/> CRITERIA A <input type="checkbox"/> CRITERIA B
6	SURGE	IEC61000-4-5 MEDICAL L-N : 1KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	<input checked="" type="checkbox"/> CRITERIA A <input type="checkbox"/> CRITERIA B
7	Test by certified Lab & Test Report Prepare Any contradictions of the test results, please refer to the latest EMC test report			

■ RELIABILITY TEST

ENVIRONMENT TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT																																																																																																
1	TEMPERATURE RISE TEST	MODEL : MPM-90-48 1. ROOM AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta= 26.2 °C 2. HIGH AMBIENT BURN-IN : HRS I/P : 230VAC O/P : FULL LOAD Ta= 51.9 °C																																																																																																		
				<table border="1"> <thead> <tr> <th>NO</th> <th>Position</th> <th>ROOM AMBIENT Ta= 26.2 °C</th> <th>HIGH AMBIENT Ta= 51.9 °C</th> </tr> </thead> <tbody> <tr><td>1</td><td>RTH1</td><td>68.2°C</td><td>88.6°C</td></tr> <tr><td>2</td><td>LF1</td><td>64.2°C</td><td>85.7°C</td></tr> <tr><td>3</td><td>LF2</td><td>63.5°C</td><td>86.5°C</td></tr> <tr><td>4</td><td>C1</td><td>62.6°C</td><td>85.4°C</td></tr> <tr><td>5</td><td>BD1</td><td>63.8°C</td><td>86.6°C</td></tr> <tr><td>6</td><td>R22</td><td>65.1°C</td><td>88°C</td></tr> <tr><td>7</td><td>C5</td><td>65.7°C</td><td>88.5°C</td></tr> <tr><td>8</td><td>Q1</td><td>66.3°C</td><td>89.3°C</td></tr> <tr><td>9</td><td>C11</td><td>64.7°C</td><td>87.7°C</td></tr> <tr><td>10</td><td>RTH2</td><td>67.6°C</td><td>90.7°C</td></tr> <tr><td>11</td><td>T1 coil</td><td>69.2°C</td><td>92.4°C</td></tr> <tr><td>12</td><td>T1 core</td><td>68.6°C</td><td>91.6°C</td></tr> <tr><td>13</td><td>Q100</td><td>78°C</td><td>100.4°C</td></tr> <tr><td>14</td><td>C107</td><td>54.6°C</td><td>77°C</td></tr> <tr><td>15</td><td>C106</td><td>61.9°C</td><td>84.3°C</td></tr> <tr><td>16</td><td>C105</td><td>71.2°C</td><td>93.2°C</td></tr> <tr><td>17</td><td>L100</td><td>56.9°C</td><td>79.3°C</td></tr> <tr><td>18</td><td>D1</td><td>68.3°C</td><td>91.4°C</td></tr> <tr><td>19</td><td>U2</td><td>65.1°C</td><td>87.9°C</td></tr> <tr><td>20</td><td>BC1</td><td>67.7°C</td><td>90.7°C</td></tr> <tr><td>21</td><td>U3</td><td>63.2°C</td><td>86.8°C</td></tr> <tr><td>22</td><td>U4</td><td>61.7°C</td><td>85°C</td></tr> <tr><td>23</td><td>PCB</td><td>71.9°C</td><td>94.4°C</td></tr> </tbody> </table>	NO	Position	ROOM AMBIENT Ta= 26.2 °C	HIGH AMBIENT Ta= 51.9 °C	1	RTH1	68.2°C	88.6°C	2	LF1	64.2°C	85.7°C	3	LF2	63.5°C	86.5°C	4	C1	62.6°C	85.4°C	5	BD1	63.8°C	86.6°C	6	R22	65.1°C	88°C	7	C5	65.7°C	88.5°C	8	Q1	66.3°C	89.3°C	9	C11	64.7°C	87.7°C	10	RTH2	67.6°C	90.7°C	11	T1 coil	69.2°C	92.4°C	12	T1 core	68.6°C	91.6°C	13	Q100	78°C	100.4°C	14	C107	54.6°C	77°C	15	C106	61.9°C	84.3°C	16	C105	71.2°C	93.2°C	17	L100	56.9°C	79.3°C	18	D1	68.3°C	91.4°C	19	U2	65.1°C	87.9°C	20	BC1	67.7°C	90.7°C	21	U3	63.2°C	86.8°C	22	U4	61.7°C	85°C	23	PCB	71.9°C	94.4°C
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23	PCB	71.9°C	94.4°C																																																																																																	
2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR ( MIN )	I/P : 230 VAC O/P : 148 % LOAD Ta : 25°C	TEST : OK																																																																																																
3	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 264VAC/100VAC O/P : 100 % LOAD Ta= -35 °C	TEST : OK																																																																																																
4	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 55 °C /95 %R.H NO DAMAGE	I/P : 272 VAC O/P : FULL LOAD Ta= 55 °C HUMIDITY= 95 %R.H	TEST : OK																																																																																																
5	TEMPERATURE COEFFICIENT	± 0.03 %/°C (0~50°C)	I/P : 230 VAC O/P : FULL LOAD	± 0.0263 %/°C (0~50°C)																																																																																																



6	STORAGE TEMPERATURE TEST	-40~85°C	1. Thermal shock Temperature : -45°C~ +90°C 2. Temperature change rate : 25°C / MIN 3. Dwell time low and high temperature : 30 MIN/EACH 4. Total test cycle : 10 CYCLE 5. Input/Output condition : STATIC
7	THERMAL SHOCK TEST	-30~55°C	1. Thermal shock Temperature : -35°C~ +60°C 2. Temperature change rate : 25°C / MIN 3. Dwell time low and high temperature : 30 MIN/EACH 4. Total test cycle : 16 CYCLE 5. Input/Output condition : 15cycle:230V/ FULL LOAD AC ON 3sec/AC OFF 1sec TEST 1cycle:230V/ FULL LOAD Burn In Test
8	VIBRATION TEST	10 ~ 500Hz, 2G (Blank) /5G (ST) 10min./1cycle, 60min. each along X, Y, Z axes	1 Carton & 1 Set (1) Waveform : Sine Wave (2) Frequency : 10~500Hz (3) Sweep Time : 10min/sweep cycle (4) Acceleration : 2G (Blank) /5G (ST) (5) Test Time : 180min in each axis (X.Y.Z) (6) Ta : 25°C
9	CAPACITOR LIFE CYCLE	SUPPOSE C105 IS THE MOST CRITICAL COMPONENT (1) I/P : 230VAC O/P : FULL LOAD Ta= 25 °C LIFE TIME (2) I/P : 230VAC O/P : FULL LOAD Ta= 55 °C LIFE TIME (3) I/P : 230VAC O/P : 75% LOAD Ta= 55 °C LIFE TIME (4) I/P : 230VAC O/P : 50% LOAD Ta= 55 °C LIFE TIME	(1) 106346 HRS (2) 17169 HRS (3) 30222 HRS (4) 61057 HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 4548.9K hrs min. Telcordia SR-332 (Bellcore) ; 570.5K hrs min. MIL-HDBK-217F (25°C)	
11	Ongoing Reliability Test	I/P : 230VAC O/P : FULL LOAD TA=50°C Demonstration Mean Time Between Failure : 30,000 hours	

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	LIUTT		Wangdz

2018.4.30 GP-A50-F010