



Test Report: MPM-45-24

45W 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

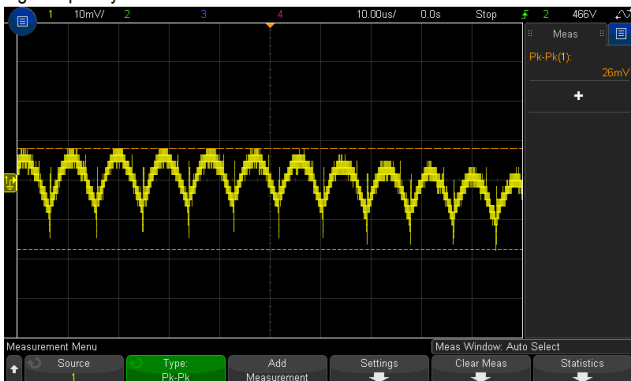
ENVIRONMENT TEST

DESIGN VERIFY TEST

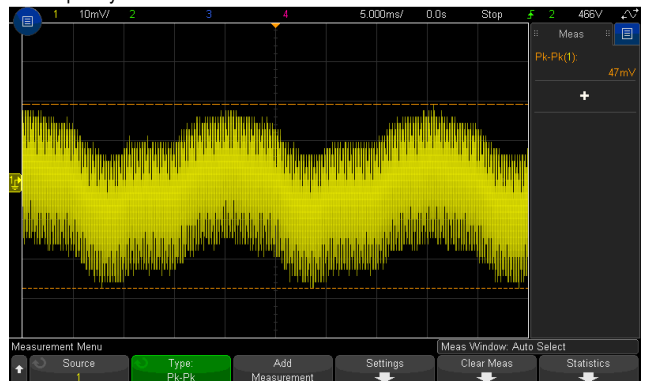
OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE(Max) TOLERANCE	V1: -2%~ +2 %	I/P: 80VAC /264VAC O/P:FULL/ MIN. LOAD Ta:25°C	V1: -0.08%~0.13%
2	LINE REGULATION (Max)	V1: -0.5%~ +0.5 %	I/P: 80VAC~ 264VAC O/P:FULL LOAD Ta:25°C	V1:-0.03%~0.13%
3	LOAD REGULATION(Max)	V1: -0.5%~ +0.5 %	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25°C	V1:-0.08%~0.10%
4	OVER/UNDERSHOOT TEST	< ± 5%	I/P: 230VAC O/P:FULL LOAD Ta:25°C	0.4%
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: 47mVp-p

high frequency :

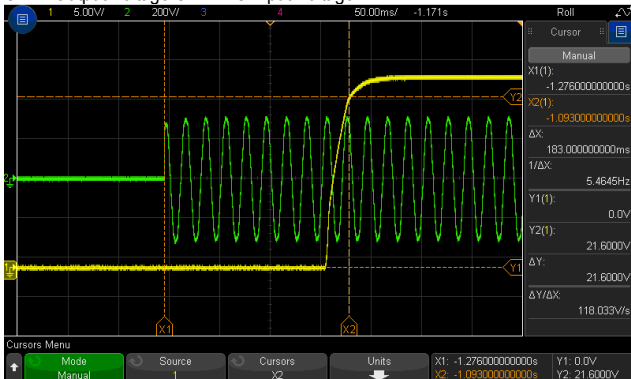


low frequency :

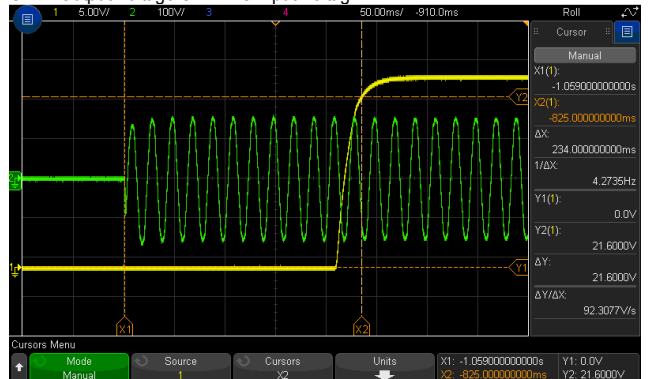


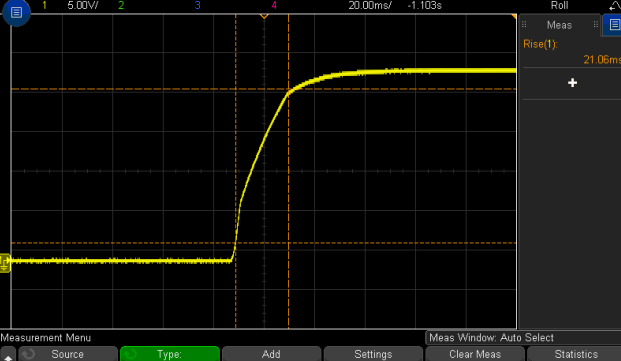
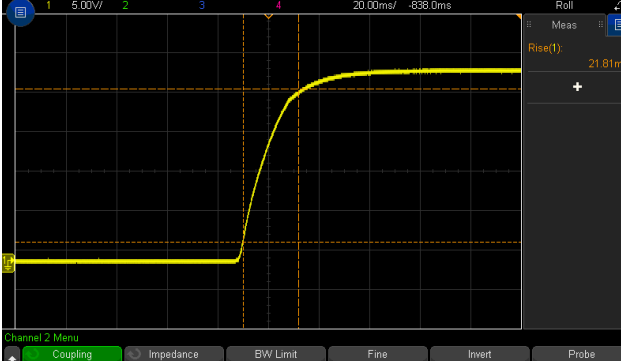
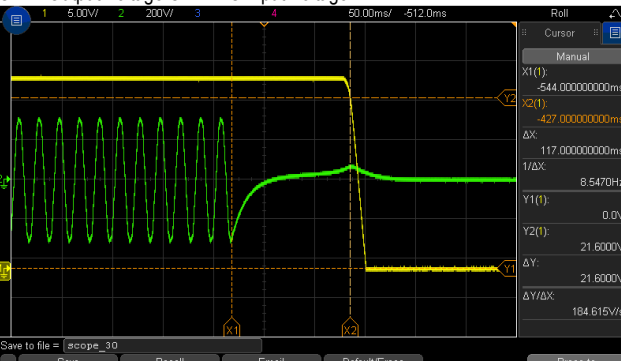
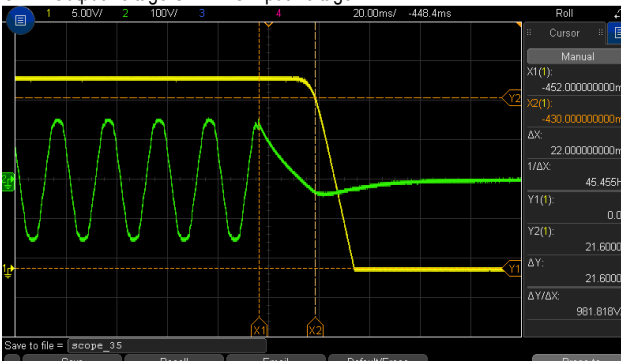
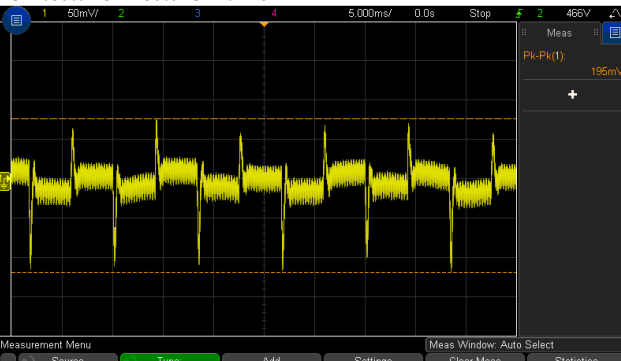
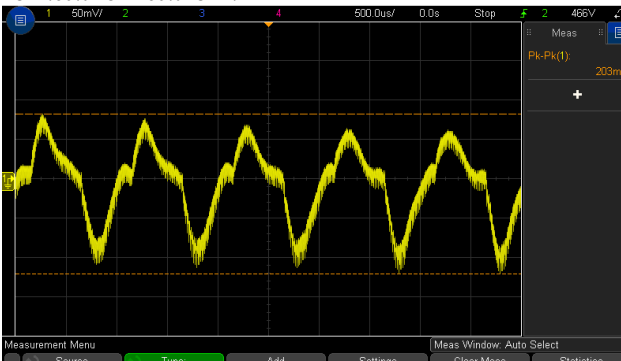
7	SET UP TIME(Max)	230VAC/1000ms 115VAC/1000ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25 °C	230VAC/ 183ms 115VAC/ 234ms
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INPUT=230VAC/50HZ @ FULL LOAD
CH1 : Output Voltage CH2 : AC Input Voltage



INPUT=115VAC/60HZ @ FULL LOAD
CH1 : Output Voltage CH2 : AC Input Voltage

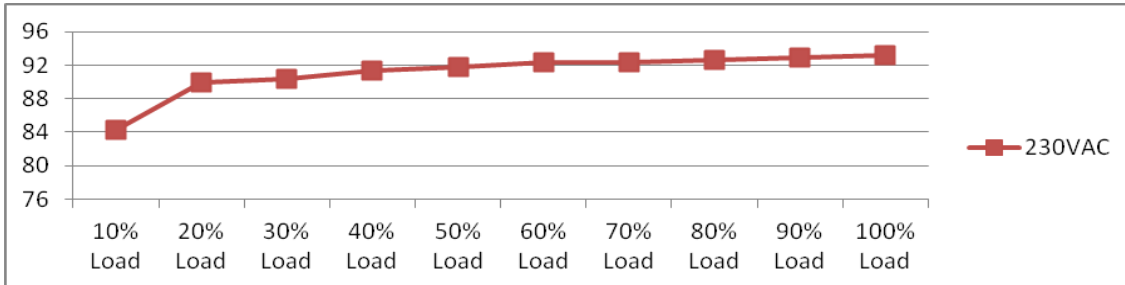


<p>8 RISE TIME (Max)</p>	<p>230VAC/30ms 115VAC/30ms</p>	<p>I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C</p>	<p>230VAC/ 21.06ms 115VAC/ 21.81ms</p>
<p>INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage</p> 		<p>INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage</p> 	
<p>9 HOLD UP TIME (Typ.)</p>	<p>230VAC/50ms 115VAC/12ms</p>	<p>I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C</p>	<p>230VAC/ 117ms 115VAC/ 22ms</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 DYNAMIC LOAD</p>	<p>V1: 2400 mVp-p</p>	<p>I/P: 230VAC O/P: (1)FULL /MIN LOAD 50%DUTY / 120HZ (2)FULL /MIN LOAD 50%DUTY / 1KHZ Ta:25°C</p>	<p>195mVp-p 203mVp-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	68V~264V 96VDC~370VDC
			I/P: LOW-LINE-3V=77 V HIGH-LINE+10V=300 V 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/ 0.6 A 115V/ 1.2 A	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	I=0.39A/ 230VAC I=0.62A/ 115VAC
4	LEAKAGE CURRENT	< 100uA / 264VAC	I/P : 264VAC O/P : Min LOAD Ta : 25°C	Touch current : 80.7 uA
5	NO LOAD CONSUMPTION	<0.1 W	I/P : 115VAC/230VAC O/P : NO LOAD Ta : 25°C	0.051W/115VAC 0.077W/230VAC
7	EFFICIENCY(Typ.)	92.5%	I/P:230 VAC O/P:FULL LOAD Ta:25°C	93.2%

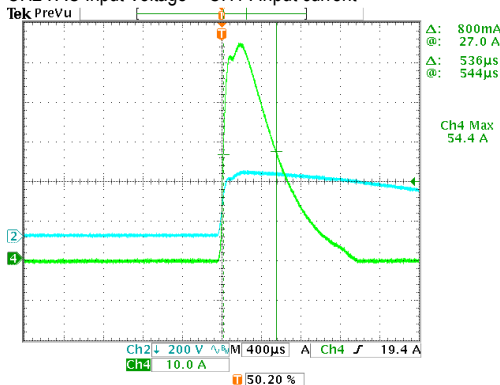
EFFICIENCY vs LOAD



8	INRUSH CURRENT(Typ.)	230V/60A 115V/30A COLD START	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	I=54.4A/ 230VAC I=22.8A/ 115VAC
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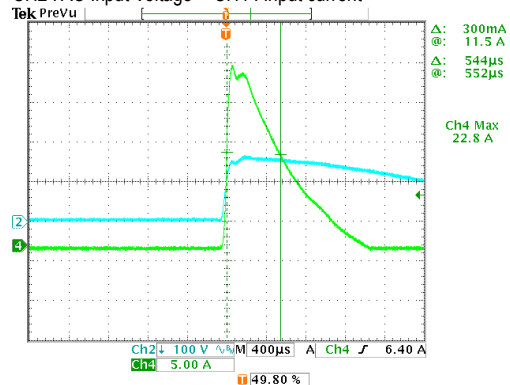
INPUT=230VAC/50HZ @ FULL LOAD

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%~ 135 %	I/P: 264VAC I/P: 230VAC I/P: 100VAC O/P: TESTING Ta:25°C	124.4% 264VAC 130.8%/ 230VAC 122.3%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	27.4VAC 27.4VAC 27.4VAC 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: 7A/600V	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) 535V (2) 434V (3) 535V (4) 535V (5) 535V (6) 535V (7) 535V
4	Diode Peak Voltage	Q100 Rated: 27.4A/150V	AC ON/OFF I/P: High-Line +3V =267 V 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	Q100: VDS: (1) 122.7V (2) 129.1V (3) 122.7V (4) 128.3V (5) 122.7V (6) 124.3V (7) 132.0V (8) 124.3V

5	Input Capacitor Voltage	C5 Rated: 120 μ / 400 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) 368V (2) 368V (3) 368V (4) 364V
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)17.3V (2)17.3V (3)17.3V (4)14.7V (5)17.3V U100 (1)15.1V (2)15.1V (3)13.5V (4)18.1V (5)15.3V
9	Clamp Diode Peak Voltage	D1 Rated : 650 V/ 1 A	AC ON/OFF I/P : High-Line +3V = 267V O/P : (1) Dynamic Load 90%Duty/1KHz (2)Full load continue Ta : 25°C	(1) 465V (2) 461V

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:2.249mA NO DAMAGE
2	ISOLATION RESISTANCE	I/P-O/P:500VDC>100M Ω	I/P-O/P: 600 VDC Ta:25°C	I/P-O/P: 9999M Ω 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 <u>MEDICAL</u> 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-45-48 1. ROOM AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta= 28 °C 2. HIGH AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta= 60.6 °C																																																																																																																		
				<table border="1"> <thead> <tr> <th>NO</th> <th>Position</th> <th>ROOM AMBIENT Ta= 28 °C</th> <th>HIGH AMBIENT Ta=60.6 °C</th> </tr> </thead> <tbody> <tr><td>1</td><td>RTH1</td><td>51.2°C</td><td>76.8°C</td></tr> <tr><td>2</td><td>LF1</td><td>50°C</td><td>77.8°C</td></tr> <tr><td>3</td><td>LF2</td><td>51.4°C</td><td>79.8°C</td></tr> <tr><td>4</td><td>C1</td><td>49.9°C</td><td>78°C</td></tr> <tr><td>5</td><td>BD1</td><td>53°C</td><td>81.5°C</td></tr> <tr><td>6</td><td>C5</td><td>51.9°C</td><td>80.7°C</td></tr> <tr><td>7</td><td>Q1</td><td>55.8°C</td><td>84.8°C</td></tr> <tr><td>8</td><td>C11</td><td>55.1°C</td><td>80.4°C</td></tr> <tr><td>9</td><td>RTH2</td><td>52.4°C</td><td>81.6°C</td></tr> <tr><td>10</td><td>T1 coil</td><td>54.9°C</td><td>83.9°C</td></tr> <tr><td>11</td><td>T1 core</td><td>54.1°C</td><td>83.1°C</td></tr> <tr><td>12</td><td>Q100</td><td>55.6°C</td><td>84.7°C</td></tr> <tr><td>13</td><td>C105</td><td>52.7°C</td><td>82°C</td></tr> <tr><td>14</td><td>C106</td><td>47.8°C</td><td>77.3°C</td></tr> <tr><td>15</td><td>C107</td><td>47.6°C</td><td>73.8°C</td></tr> <tr><td>16</td><td>L100</td><td>46°C</td><td>75.8°C</td></tr> <tr><td>17</td><td>R22</td><td>54°C</td><td>82.6°C</td></tr> <tr><td>18</td><td>D1</td><td>52.8°C</td><td>82.8°C</td></tr> <tr><td>19</td><td>U2</td><td>53.8°C</td><td>83°C</td></tr> <tr><td>20</td><td>U3</td><td>49.5°C</td><td>79.8°C</td></tr> <tr><td>21</td><td>R5</td><td>56.2°C</td><td>85.6°C</td></tr> <tr><td>22</td><td>C8</td><td>54.5°C</td><td>83.9°C</td></tr> <tr><td>23</td><td>R21</td><td>53.6°C</td><td>82.8°C</td></tr> <tr><td>24</td><td>D2</td><td>54.4°C</td><td>84.5°C</td></tr> <tr><td>25</td><td>R11</td><td>53.2°C</td><td>82.7°C</td></tr> <tr><td>26</td><td>Q2</td><td>51.3°C</td><td>81°C</td></tr> <tr><td>27</td><td>PCB</td><td>51.1°C</td><td>80.7°C</td></tr> </tbody> </table>	NO	Position	ROOM AMBIENT Ta= 28 °C	HIGH AMBIENT Ta=60.6 °C	1	RTH1	51.2°C	76.8°C	2	LF1	50°C	77.8°C	3	LF2	51.4°C	79.8°C	4	C1	49.9°C	78°C	5	BD1	53°C	81.5°C	6	C5	51.9°C	80.7°C	7	Q1	55.8°C	84.8°C	8	C11	55.1°C	80.4°C	9	RTH2	52.4°C	81.6°C	10	T1 coil	54.9°C	83.9°C	11	T1 core	54.1°C	83.1°C	12	Q100	55.6°C	84.7°C	13	C105	52.7°C	82°C	14	C106	47.8°C	77.3°C	15	C107	47.6°C	73.8°C	16	L100	46°C	75.8°C	17	R22	54°C	82.6°C	18	D1	52.8°C	82.8°C	19	U2	53.8°C	83°C	20	U3	49.5°C	79.8°C	21	R5	56.2°C	85.6°C	22	C8	54.5°C	83.9°C	23	R21	53.6°C	82.8°C	24	D2	54.4°C	84.5°C	25	R11	53.2°C	82.7°C	26	Q2	51.3°C	81°C	27	PCB	51.1°C	80.7°C
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2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR (MIN)	I/P : 230 VAC O/P : 134 % 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 60 °C /95 %R.H NO DAMAGE	I/P : 272 VAC O/P : FULL LOAD Ta= 60 °C HUMIDITY= 95 %R.H	TEST : OK																																																																																																																
5	TEMPERATURE COEFFICIENT	± 0.03 %/°C (0-50°C)	I/P : 230 VAC O/P : FULL LOAD	± 0.0116 %/°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	-30~60°C	1. Thermal shock Temperature : -35°C~ +65°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= 60 °C LIFE TIME (3) I/P : 230VAC O/P : 75% LOAD Ta= 60 °C LIFE TIME (4) I/P : 230VAC O/P : 50% LOAD Ta= 60 °C LIFE TIME	(1) 463228 HRS (2) 51508 HRS (3) 68503 HRS (4) 94082 HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 4590.4K hrs min. Telcordia SR-332 (Bellcore) ; 563.4K 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