



Test Report: MPM-45-12

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

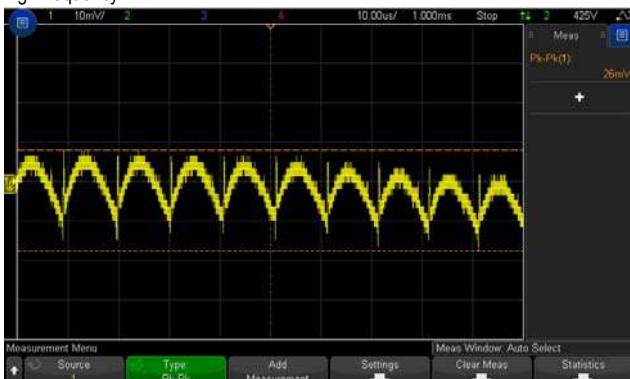
ENVIRONMENT TEST

DESIGN VERIFY TEST

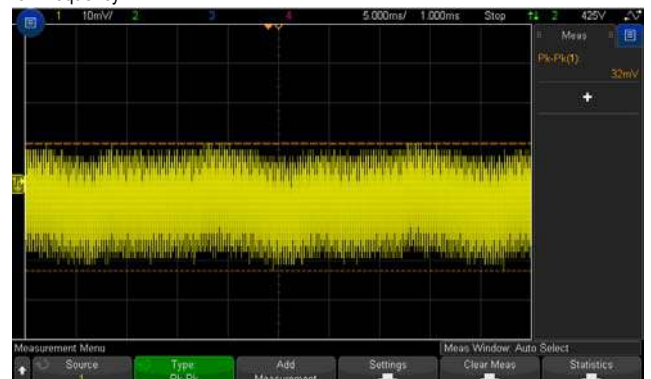
OUTPUT FUNCTION TEST

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℃	V1: -0.03%~0.05%
2	LINE REGULATION (Max)	V1: -0.5%~ +0.5 %	I/P: 80VAC~ 264VAC O/P:FULL LOAD Ta:25℃	V1: -0.01%~0.04%
3	LOAD REGULATION(Max)	V1: -1%~ +1 %	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25℃	V1: -0.03%~0.05%
4	OVER/UNDERSHOOT TEST	< ± 5%	I/P: 230VAC O/P:FULL LOAD Ta:25℃	2.5%
5	PEAK LOAD TEST	≥ 10 sec.	I/P: 230VAC O/P:PEAK LOAD Ta:25℃	OK
6	RIPPLE & NOISE(Max)	V1: 120mVp-p	I/P:230VAC O/P:FULL LOAD Ta:25℃	V1: 32mVp-p

high frequency :

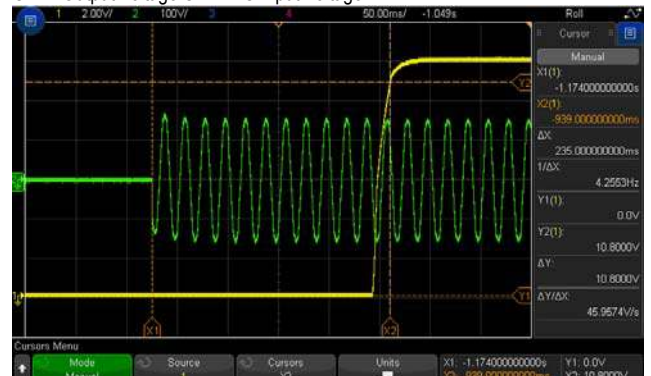


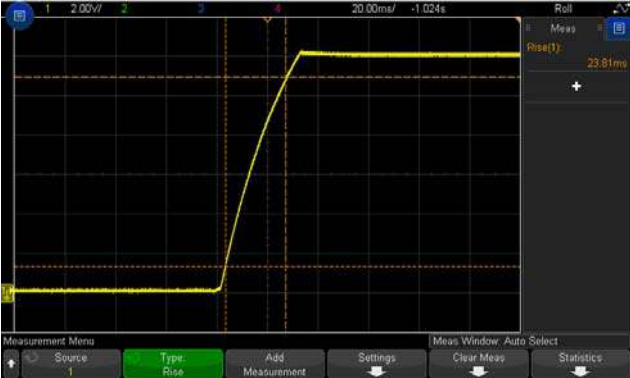
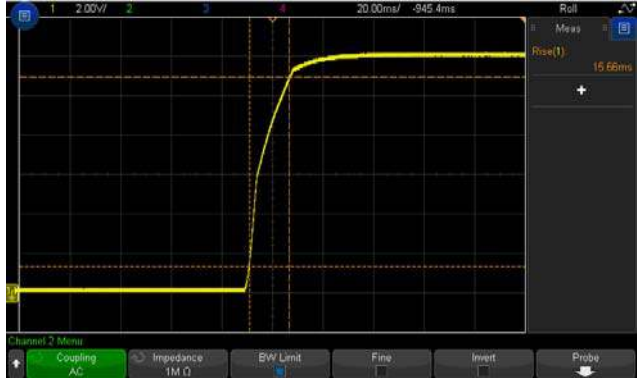
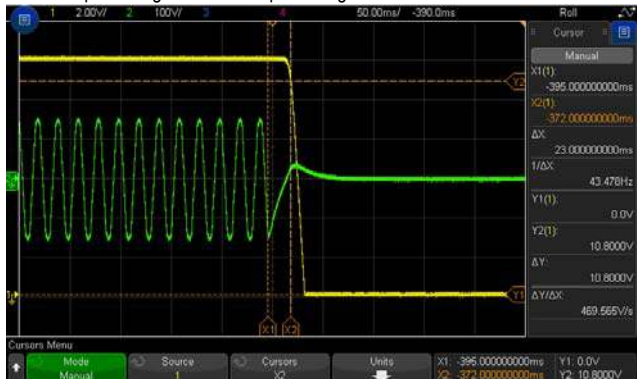
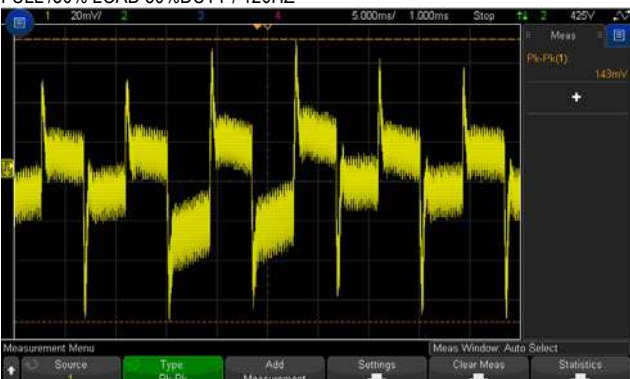
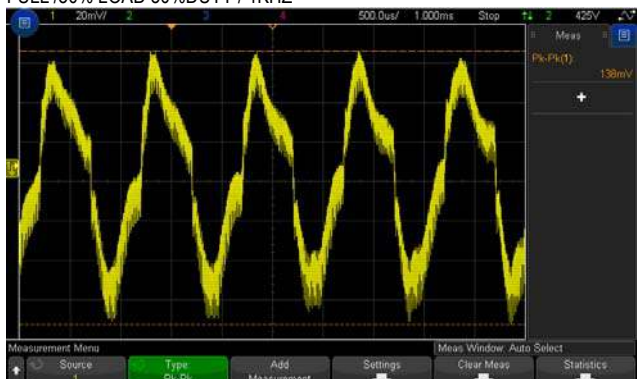
low frequency :



7	SET UP TIME(Max)	230VAC/1000ms 115VAC/1000ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25℃	230VAC/ 248ms 115VAC/ 235ms
---	------------------	--------------------------------	---	--------------------------------

INPUT=230VAC/50HZ @ FULL LOAD
CH1 : Output Voltage CH2 : AC Input Voltage

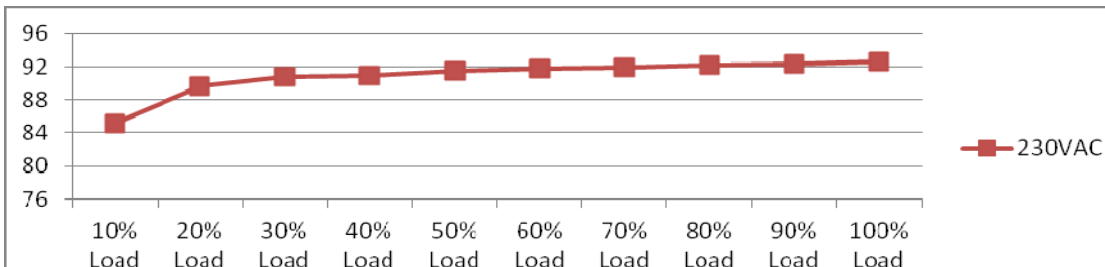
INPUT=115VAC/60HZ @ FULL LOAD
CH1 : Output Voltage CH2 : AC Input Voltage


8	RISE TIME (Max)	230VAC/30ms 115VAC/30ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/ 23.81ms 115VAC/ 15.66ms
INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage				
INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage				
9	HOLD UP TIME (Typ.)	230VAC/50ms 115VAC/12ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/ 121ms 115VAC/ 23ms
INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage				
INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage				
10	DYNAMIC LOAD	V1: 1200 mVp-p	I/P: 230VAC O/P: (1)FULL /MIN LOAD 50%DUTY / 120HZ (2)FULL /MIN LOAD 50%DUTY / 1KHZ Ta:25°C	143mVp-p 138mVp-p
FULL /50% LOAD 50%DUTY / 120HZ				
FULL /50% LOAD 50%DUTY / 1KHZ				

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+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=0.38A/ 230VAC I=0.64A/ 115VAC
4	LEAKAGE CURRENT	< 100uA / 264VAC	I/P : 264VAC O/P : Min LOAD Ta : 25°C	Touch current : 82.1 uA
5	NO LOAD CONSUMPTION	<0.1 W	I/P : 115VAC/230VAC O/P : NO LOAD Ta : 25°C	0.036W/115VAC 0.068W/230VAC
7	EFFICIENCY(Typ.)	91.5%	I/P: 230 VAC O/P: FULL LOAD Ta: 25°C	92.6%

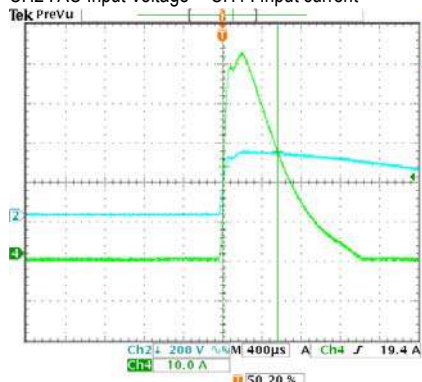
EFFICIENCY vs LOAD



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=51.2A/ 230VAC I=28.7A/ 115VAC
---	----------------------	------------------------------------	--	------------------------------------

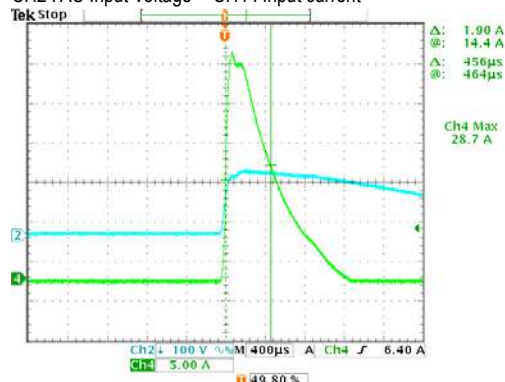
INPUT=230VAC/50HZ @ FULL LOAD

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	121.3%/ 264VAC 127.4%/ 230VAC 122.4%/100VAC PROTECTION TYPE : Hiccup mode ,recovers automatically after fault condition is removed .
2	OVER VOLTAGE PROTECTION	12.6V~16.2V	I/P: 264VAC I/P: 230VAC I/P: 80VAC O/P: MIN LOAD Ta:25°C	14.3V/ 264VAC 14.3V/ 230VAC 14.3V/ 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: 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) 522V (2) 438V (3) 522V (4) 522V (5) 522V (6) 522V (7) 514V
4	Diode Peak Voltage	Q100 Rated: 140A/85V	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) 67.4V (2) 55.4V (3) 67.4V (4) 66.6V (5) 67.4V (6) 67.4V (7) 67.4V (8) 67.4V

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) 373V (2) 373V (3) 373V (4) 369V
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 =267 V 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)17.1V (2)17.1V (3)17.3V (4)14.7V (5)17.1V U100 (1)12.5V (2)12.5V (3)11.1V (4)14.5V (5)12.3V
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) 462V (2) 458V

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:2.295mA 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	☒ CRITERIA A ☐ CRITERIA B
5	E.F.T	EN61000-4-4 MEDICAL INPUT : 2KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	☒ CRITERIA A ☐ CRITERIA B
6	SURGE	IEC61000-4-5 MEDICAL L-N : 1KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	☒ CRITERIA A ☐ 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-45-5 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><tr><th>NO</th><th>Position</th><th>ROOM AMBIENT Ta= 28 °C</th><th>HIGH AMBIENT Ta= 60.6 °C</th></tr><tr><td>1</td><td>RTH1</td><td>53.9°C</td><td>80.4°C</td></tr><tr><td>2</td><td>LF1</td><td>53.9°C</td><td>82.8°C</td></tr><tr><td>3</td><td>LF2</td><td>54.4°C</td><td>83.9°C</td></tr><tr><td>4</td><td>C1</td><td>55.3°C</td><td>84.2°C</td></tr><tr><td>5</td><td>BD1</td><td>60.0°C</td><td>90.0°C</td></tr><tr><td>6</td><td>C5</td><td>59.9°C</td><td>89.5°C</td></tr><tr><td>7</td><td>Q1</td><td>62.8°C</td><td>93.5°C</td></tr><tr><td>8</td><td>C11</td><td>58.8°C</td><td>88.9°C</td></tr><tr><td>9</td><td>RTH2</td><td>62.3°C</td><td>92.6°C</td></tr><tr><td>10</td><td>T1 coil</td><td>65.0°C</td><td>95.3°C</td></tr><tr><td>11</td><td>T1 core</td><td>64.9°C</td><td>95.4°C</td></tr><tr><td>12</td><td>Q100</td><td>67.9°C</td><td>99.3°C</td></tr><tr><td>13</td><td>C105</td><td>68.3°C</td><td>100.1°C</td></tr><tr><td>14</td><td>C106</td><td>66.5°C</td><td>98.2°C</td></tr><tr><td>15</td><td>C107</td><td>58.0°C</td><td>89.4°C</td></tr><tr><td>16</td><td>L100</td><td>62.9°C</td><td>94.7°C</td></tr><tr><td>17</td><td>D1</td><td>74.1°C</td><td>105.7°C</td></tr><tr><td>18</td><td>U2</td><td>62.3°C</td><td>93.1°C</td></tr><tr><td>19</td><td>D102</td><td>74.8°C</td><td>111.3°C</td></tr><tr><td>20</td><td>R22</td><td>61.7°C</td><td>91.7°C</td></tr><tr><td>21</td><td>U3</td><td>62.6°C</td><td>94.3°C</td></tr><tr><td>22</td><td>U100</td><td>73.2°C</td><td>106.0°C</td></tr><tr><td>23</td><td>U1</td><td>40.9°C</td><td>72.6°C</td></tr><tr><td>24</td><td>R5</td><td>71.2°C</td><td>101.3°C</td></tr><tr><td>25</td><td>C8</td><td>69.0°C</td><td>99.1°C</td></tr><tr><td>26</td><td>R21</td><td>61.0°C</td><td>91.3°C</td></tr><tr><td>27</td><td>D2</td><td>70.7°C</td><td>101.2°C</td></tr><tr><td>28</td><td>R11</td><td>63.6°C</td><td>93.9°C</td></tr><tr><td>29</td><td>Q2</td><td>59.6°C</td><td>91.3°C</td></tr><tr><td>30</td><td>PCB</td><td>73.3°C</td><td>105.4°C</td></tr></table>			NO	Position	ROOM AMBIENT Ta= 28 °C	HIGH AMBIENT Ta= 60.6 °C	1	RTH1	53.9°C	80.4°C	2	LF1	53.9°C	82.8°C	3	LF2	54.4°C	83.9°C	4	C1	55.3°C	84.2°C	5	BD1	60.0°C	90.0°C	6	C5	59.9°C	89.5°C	7	Q1	62.8°C	93.5°C	8	C11	58.8°C	88.9°C	9	RTH2	62.3°C	92.6°C	10	T1 coil	65.0°C	95.3°C	11	T1 core	64.9°C	95.4°C	12	Q100	67.9°C	99.3°C	13	C105	68.3°C	100.1°C	14	C106	66.5°C	98.2°C	15	C107	58.0°C	89.4°C	16	L100	62.9°C	94.7°C	17	D1	74.1°C	105.7°C	18	U2	62.3°C	93.1°C	19	D102	74.8°C	111.3°C	20	R22	61.7°C	91.7°C	21	U3	62.6°C	94.3°C	22	U100	73.2°C	106.0°C	23	U1	40.9°C	72.6°C	24	R5	71.2°C	101.3°C	25	C8	69.0°C	99.1°C	26	R21	61.0°C	91.3°C	27	D2	70.7°C	101.2°C	28	R11	63.6°C	93.9°C	29	Q2	59.6°C	91.3°C	30	PCB	73.3°C	105.4°C
NO	Position	ROOM AMBIENT Ta= 28 °C	HIGH AMBIENT Ta= 60.6 °C																																																																																																																													
1	RTH1	53.9°C	80.4°C																																																																																																																													
2	LF1	53.9°C	82.8°C																																																																																																																													
3	LF2	54.4°C	83.9°C																																																																																																																													
4	C1	55.3°C	84.2°C																																																																																																																													
5	BD1	60.0°C	90.0°C																																																																																																																													
6	C5	59.9°C	89.5°C																																																																																																																													
7	Q1	62.8°C	93.5°C																																																																																																																													
8	C11	58.8°C	88.9°C																																																																																																																													
9	RTH2	62.3°C	92.6°C																																																																																																																													
10	T1 coil	65.0°C	95.3°C																																																																																																																													
11	T1 core	64.9°C	95.4°C																																																																																																																													
12	Q100	67.9°C	99.3°C																																																																																																																													
13	C105	68.3°C	100.1°C																																																																																																																													
14	C106	66.5°C	98.2°C																																																																																																																													
15	C107	58.0°C	89.4°C																																																																																																																													
16	L100	62.9°C	94.7°C																																																																																																																													
17	D1	74.1°C	105.7°C																																																																																																																													
18	U2	62.3°C	93.1°C																																																																																																																													
19	D102	74.8°C	111.3°C																																																																																																																													
20	R22	61.7°C	91.7°C																																																																																																																													
21	U3	62.6°C	94.3°C																																																																																																																													
22	U100	73.2°C	106.0°C																																																																																																																													
23	U1	40.9°C	72.6°C																																																																																																																													
24	R5	71.2°C	101.3°C																																																																																																																													
25	C8	69.0°C	99.1°C																																																																																																																													
26	R21	61.0°C	91.3°C																																																																																																																													
27	D2	70.7°C	101.2°C																																																																																																																													
28	R11	63.6°C	93.9°C																																																																																																																													
29	Q2	59.6°C	91.3°C																																																																																																																													
30	PCB	73.3°C	105.4°C																																																																																																																													
2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR (MIN)	I/P : 230 VAC O/P : 121% 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 (0~60°C)	I/P : 230 VAC O/P : FULL LOAD	± 0.0252 %/°C (0~60°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 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 : 3G (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) 1932105 HRS (2) 67014 HRS (3) 166352 HRS (4) 408391 HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 563.44K hrs min. MIL-HDBK-217F (25°C); 1530.14 K hrs min.Telcordia TR/SR-332 (Bellcore) (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