



# Test Report: MPM-65-5

---

65W 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

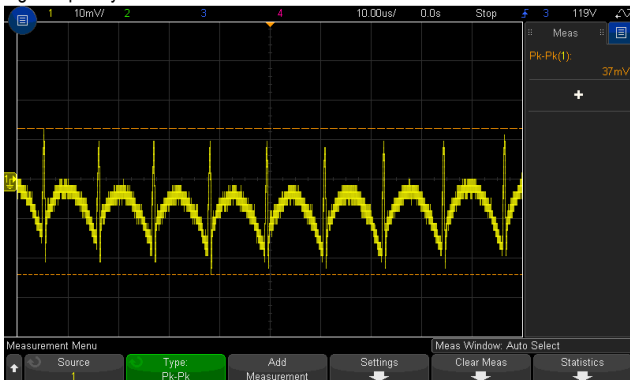
ENVIRONMENT TEST

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: -0.12%~0.18%
2	LINE REGULATION (Max)	V1: -0.5%~ +0.5 %	I/P: 80VAC~ 264VAC O/P:FULL LOAD Ta:25°C	V1: -0.04%~0.8%
3	LOAD REGULATION(Max)	V1: -1%~ +1%	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25°C	V1: -0.12%~0.18%
4	OVER/UNDERSHOOT TEST	< ± 10%	I/P: 230VAC O/P:FULL LOAD Ta:25°C	1.2%
5	PEAK LOAD TEST	≥ 10 Sec.	I/P: 230VAC O/P:PEAK LOAD Ta:25°C	OK
6	RIPPLE & NOISE(Max )	V1: 80mVp-p	I/P:230VAC O/P:FULL LOAD Ta:25°C	V1: 47mVp-p

high frequency :

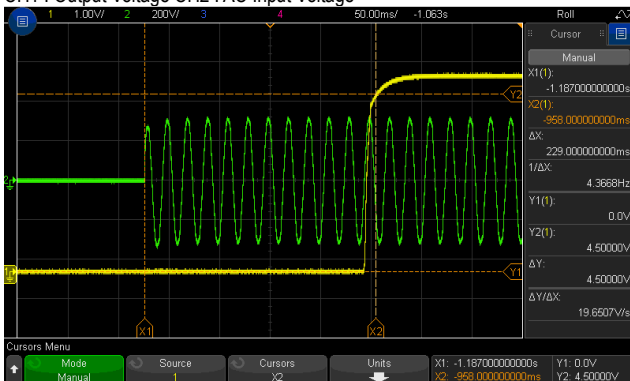


low frequency :

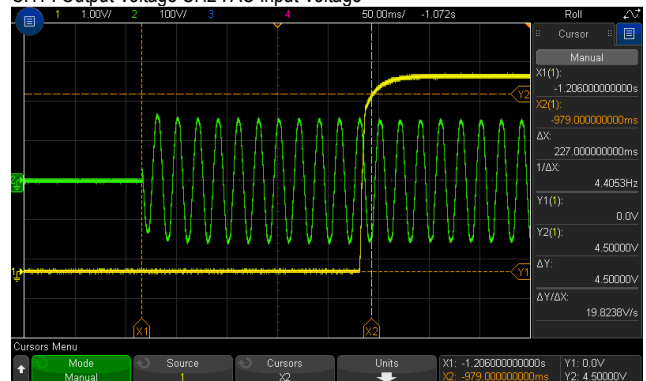


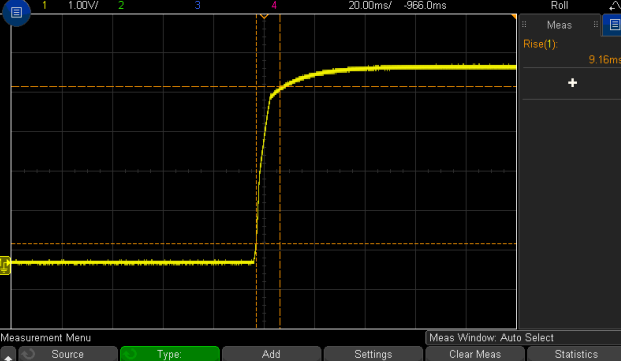
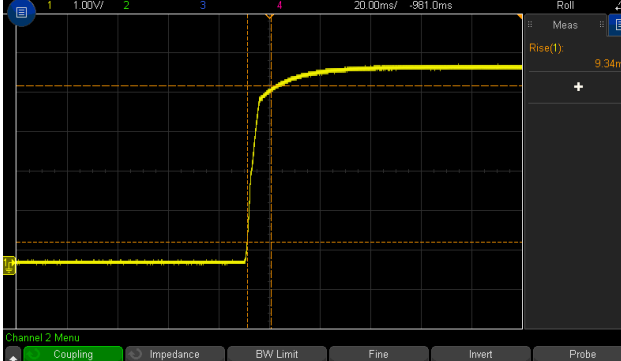
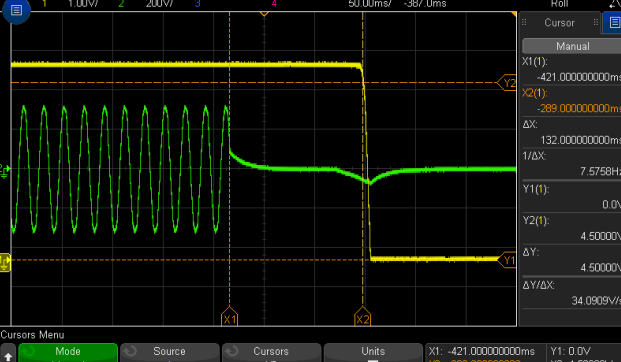
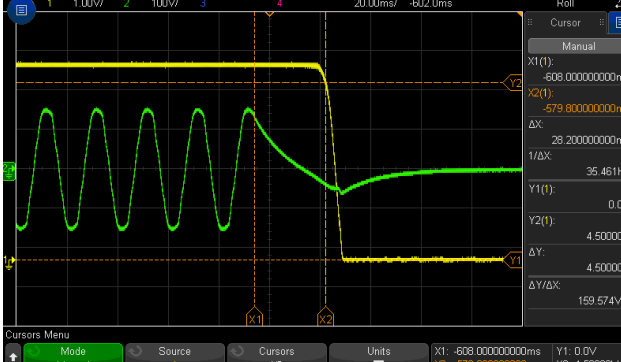
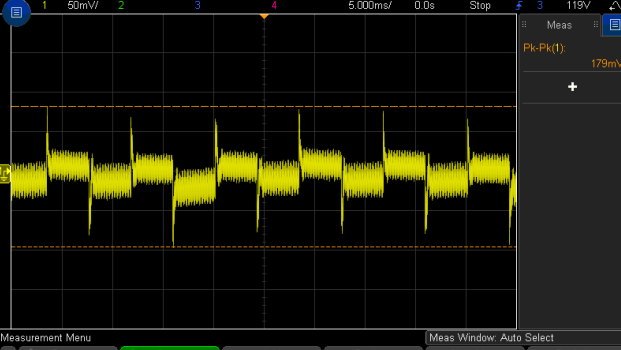
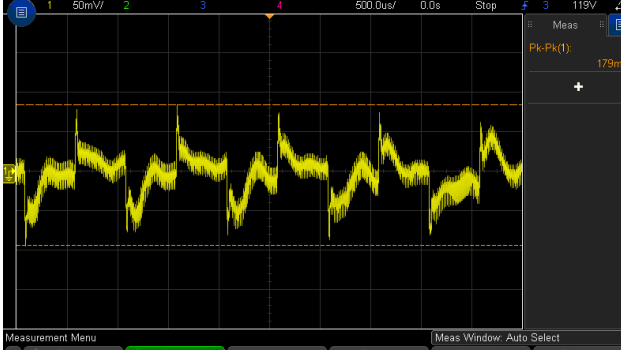
7	SET UP TIME(Max)	230VAC/1000ms 115VAC/1000ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/ 229ms 115VAC/ 227ms
---	------------------	--------------------------------	----------------------------------------------------------------	--------------------------------

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



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

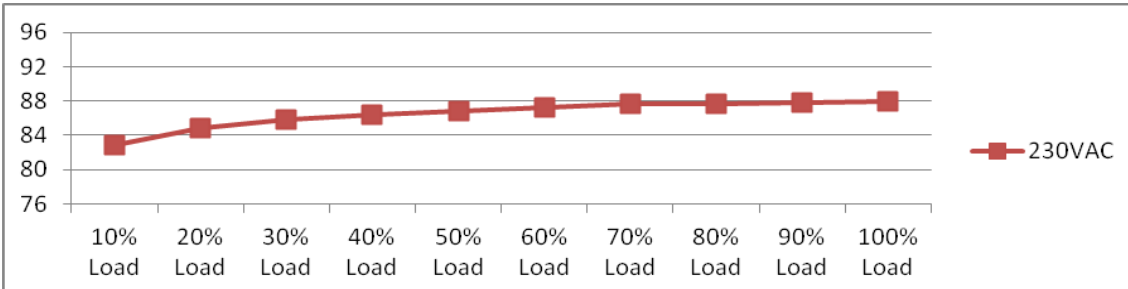


<p>8</p> <p>RISE TIME (Max)</p>	<p>230VAC/30ms 115VAC/30ms</p>	<p>I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C</p>	<p>230VAC/ 9.16ms 115VAC/ 9.34ms</p>
<p>INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage</p> 		<p>INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage</p> 	
<p>9</p> <p>HOLD UP TIME (Typ.)</p>	<p>230VAC/50ms 115VAC/12ms</p>	<p>I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C</p>	<p>230VAC/ 132ms 115VAC/ 28.2ms</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: 1000 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>179mVp-p 179mVp-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	69V~264V 98VDC~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/ 1 A 115V/ 1.5A	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	I=0.43A/ 230VAC I=0.73A/ 115VAC
4	LEAKAGE CURRENT	< 100uA / 264VAC	I/P : 264VAC O/P : Min LOAD Ta : 25°C	Touch current : 78.1 uA
5	NO LOAD CONSUMPTION	<0.1 W	I/P : 115VAC/230VAC O/P : NO LOAD Ta : 25°C	0.055W/115VAC 0.089W/230VAC
7	EFFICIENCY(Typ.)	86.5%	I/P:230 VAC O/P:FULL LOAD Ta:25°C	87.9%

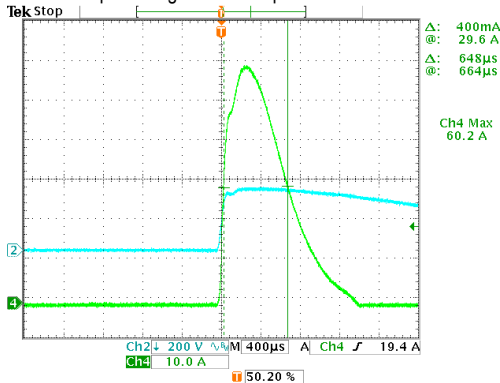
EFFICIENCY vs LOAD



8	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=60.2A/ 230VAC I=23.9A/ 115VAC
---	----------------------	------------------------------------	----------------------------------------------------------------	------------------------------------

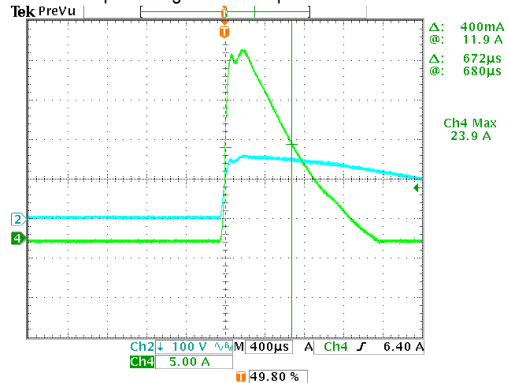
INPUT=230VAC/50HZ @ FULL LOAD

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	123.4% 264VAC 129.5%/ 230VAC 126.7%100VAC PROTECTION TYPE : Hiccup mode ,recovers automatically after fault condition is removed .
2	OVER VOLTAGE PROTECTION	5.3V~7.2V	I/P: 264VAC I/P: 230VAC I/P: 80VAC O/P: MIN LOAD Ta:25°C	6.25VAC 6.25VAC 6.25VAC 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: 10A/650V	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) 545V (2) 541V (3) 545V (4) 545V (5) 545V (6) 549V (7) 537V
4	Diode Peak Voltage	Q100 Rated: 60A/60V	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) 35.6V (2) 35.6V (3) 35.6V (4) 35.6V (5) 35.2V (6) 35.2V (7) 36.8V (8) 31.9V

5	Input Capacitor Voltage	C5 Rated: 150 $\mu$ / 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) 372V (2) 376V (3) 372V (4) 368V
6	Control IC Voltage Test	PWM IC U2 Rated: -0.3V~ 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)20.2V (2)17.2V (3)20.0V (4)17.2V (5)17.2V  U100: (1)27.8V (2)23.4V (3)27.6V (4)28.0V (5)26.0V
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) 455V (2) 451V

### 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:2.314mA 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 <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-65-5 1. ROOM AMBIENT BURN-IN : 2HRS I/P : 230VAC O/P : FULL LOAD Ta=26 °C 2. HIGH AMBIENT BURN-IN : 2HRS I/P : 230VAC O/P : FULL LOAD Ta=56 °C																																																																																																																						
				<table border="1"> <thead> <tr> <th>NO</th> <th>Position</th> <th>ROOM AMBIENT Ta= 26°C</th> <th>HIGH AMBIENT Ta=56°C</th> </tr> </thead> <tbody> <tr><td>1</td><td>RTH1</td><td>57.8°C</td><td>82.6°C</td></tr> <tr><td>2</td><td>LF1</td><td>58.8°C</td><td>85.6°C</td></tr> <tr><td>3</td><td>LF2</td><td>59.2°C</td><td>86.9°C</td></tr> <tr><td>4</td><td>C1</td><td>60.9°C</td><td>88.3°C</td></tr> <tr><td>5</td><td>BD1</td><td>62.1°C</td><td>89.4°C</td></tr> <tr><td>6</td><td>C5</td><td>65.5°C</td><td>93.2°C</td></tr> <tr><td>7</td><td>Q1</td><td>67.9°C</td><td>95.9°C</td></tr> <tr><td>8</td><td>C11</td><td>63.6°C</td><td>91.5°C</td></tr> <tr><td>9</td><td>RTH2</td><td>67.9°C</td><td>95.6°C</td></tr> <tr><td>10</td><td>T1 coil</td><td>71.7°C</td><td>99.3°C</td></tr> <tr><td>11</td><td>T1 core</td><td>69.1°C</td><td>97.5°C</td></tr> <tr><td>12</td><td>Q100</td><td>79.5°C</td><td>107.3°C</td></tr> <tr><td>13</td><td>C105</td><td>79°C</td><td>106.4°C</td></tr> <tr><td>14</td><td>C106</td><td>76.1°C</td><td>103°C</td></tr> <tr><td>15</td><td>L100</td><td>67.6°C</td><td>94.4°C</td></tr> <tr><td>16</td><td>D1</td><td>91.7°C</td><td>116.4°C</td></tr> <tr><td>17</td><td>U2</td><td>68.2°C</td><td>95.4°C</td></tr> <tr><td>18</td><td>U1</td><td>55.1°C</td><td>83°C</td></tr> <tr><td>19</td><td>R5</td><td>84.4°C</td><td>110°C</td></tr> <tr><td>20</td><td>C8</td><td>78.2°C</td><td>101.9°C</td></tr> <tr><td>21</td><td>R22</td><td>65.2°C</td><td>92.5°C</td></tr> <tr><td>22</td><td>R21</td><td>65.1°C</td><td>92.5°C</td></tr> <tr><td>23</td><td>U3</td><td>70.7°C</td><td>99.2°C</td></tr> <tr><td>24</td><td>D2</td><td>81.6°C</td><td>108.4°C</td></tr> <tr><td>25</td><td>R11</td><td>72.7°C</td><td>100.7°C</td></tr> <tr><td>26</td><td>Q2</td><td>69.2°C</td><td>97.2°C</td></tr> <tr><td>27</td><td>U100</td><td>86.1°C</td><td>113.3°C</td></tr> <tr><td>28</td><td>PCB</td><td>85.3°C</td><td>110.7°C</td></tr> </tbody> </table>	NO	Position	ROOM AMBIENT Ta= 26°C	HIGH AMBIENT Ta=56°C	1	RTH1	57.8°C	82.6°C	2	LF1	58.8°C	85.6°C	3	LF2	59.2°C	86.9°C	4	C1	60.9°C	88.3°C	5	BD1	62.1°C	89.4°C	6	C5	65.5°C	93.2°C	7	Q1	67.9°C	95.9°C	8	C11	63.6°C	91.5°C	9	RTH2	67.9°C	95.6°C	10	T1 coil	71.7°C	99.3°C	11	T1 core	69.1°C	97.5°C	12	Q100	79.5°C	107.3°C	13	C105	79°C	106.4°C	14	C106	76.1°C	103°C	15	L100	67.6°C	94.4°C	16	D1	91.7°C	116.4°C	17	U2	68.2°C	95.4°C	18	U1	55.1°C	83°C	19	R5	84.4°C	110°C	20	C8	78.2°C	101.9°C	21	R22	65.2°C	92.5°C	22	R21	65.1°C	92.5°C	23	U3	70.7°C	99.2°C	24	D2	81.6°C	108.4°C	25	R11	72.7°C	100.7°C	26	Q2	69.2°C	97.2°C	27	U100	86.1°C	113.3°C	28	PCB	85.3°C	110.7°C
NO	Position	ROOM AMBIENT Ta= 26°C	HIGH AMBIENT Ta=56°C																																																																																																																					
1	RTH1	57.8°C	82.6°C																																																																																																																					
2	LF1	58.8°C	85.6°C																																																																																																																					
3	LF2	59.2°C	86.9°C																																																																																																																					
4	C1	60.9°C	88.3°C																																																																																																																					
5	BD1	62.1°C	89.4°C																																																																																																																					
6	C5	65.5°C	93.2°C																																																																																																																					
7	Q1	67.9°C	95.9°C																																																																																																																					
8	C11	63.6°C	91.5°C																																																																																																																					
9	RTH2	67.9°C	95.6°C																																																																																																																					
10	T1 coil	71.7°C	99.3°C																																																																																																																					
11	T1 core	69.1°C	97.5°C																																																																																																																					
12	Q100	79.5°C	107.3°C																																																																																																																					
13	C105	79°C	106.4°C																																																																																																																					
14	C106	76.1°C	103°C																																																																																																																					
15	L100	67.6°C	94.4°C																																																																																																																					
16	D1	91.7°C	116.4°C																																																																																																																					
17	U2	68.2°C	95.4°C																																																																																																																					
18	U1	55.1°C	83°C																																																																																																																					
19	R5	84.4°C	110°C																																																																																																																					
20	C8	78.2°C	101.9°C																																																																																																																					
21	R22	65.2°C	92.5°C																																																																																																																					
22	R21	65.1°C	92.5°C																																																																																																																					
23	U3	70.7°C	99.2°C																																																																																																																					
24	D2	81.6°C	108.4°C																																																																																																																					
25	R11	72.7°C	100.7°C																																																																																																																					
26	Q2	69.2°C	97.2°C																																																																																																																					
27	U100	86.1°C	113.3°C																																																																																																																					
28	PCB	85.3°C	110.7°C																																																																																																																					
2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR ( MIN )	I/P : 230 VAC O/P : 129%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 50 °C /95 %R.H NO DAMAGE	I/P : 272 VAC O/P : FULL LOAD Ta=50 °C HUMIDITY= 95 %R.H	TEST : OK																																																																																																																				
5	TEMPERATURE COEFFICIENT	± 0.03 %/°C (0~50°C)	I/P : 230 VAC O/P : FULL LOAD	± 0.017 %/°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	-30~50°C	1. Thermal shock Temperature : -35°C~ +55°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= 50 °C LIFE TIME (3) I/P : 230VAC O/P : 75% LOAD Ta= 50 °C LIFE TIME (4) I/P : 230VAC O/P : 50% LOAD Ta= 50 °C LIFE TIME	(1) 447723 HRS (2) 33988 HRS (3) 120537 HRS (4) 458148 HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 5087.8K 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