



TEST REPORT: MFM-20-24

20W High Reliable Green Medical On Board Type

■ DESIGN VERIFY TEST

- Output Function Test
- Input Function Test
- Protection Function Test
- Control Function Test
- Component Stress Test

■ SAFETY & E.M.C. TEST

- Safety Test
- E.M.C. Test

■ RELIABILITY TEST

- ENVIRONMENT TEST

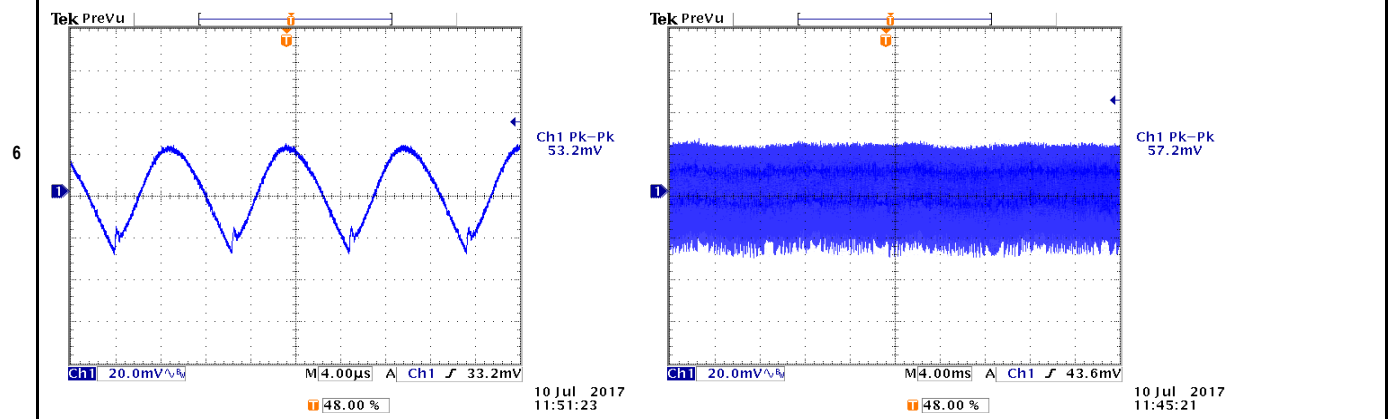


DESIGN VERIFY TEST
OUTPUT FUNCTION

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
2	OUTPUT VOLTAGE TOLERANCE (Max)	V1 : 2.0% ~ -2.0%	I/P : 100VAC / 264VAC O/P: FULL / MINLOAD TA= 25°C	V1: 0.79% ~ 0.71%
3	LINE REGULATION (MAX.)	V1 : 0.3% ~ -0.3%	I/P : 100VAC / 264VAC O/P: FULL LOAD TA : 25°C	V1: 0.00% ~ -0.04%
4	LOAD REGULATION(MAX.)	V1 : 0.5% ~ -0.5%	I/P : 230VAC O/P: MIN LOAD ~ FULL LOAD TA : 25°C	V1: 0.04% ~ -0.04%
5	OVER/UNDERSHOOT TEST	< ±5%	I/P : 230VAC O/P: FULL LOAD TA : 25°C	TEST< 4.2 %
	RIPPLE & NOISE(Max)	V1 : 180 mVp-p	I/P : 230VAC O/P: FULL LOAD TA : 25°C	V1 : 57.2 mVp-p

high frequency:

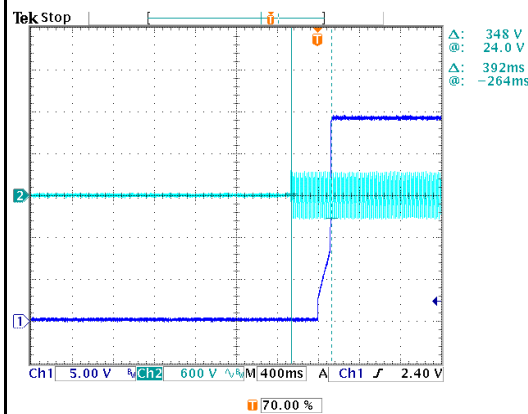
low frequency:



SET UP TIME (MAX.)	230VAC	: 1500ms	I/P : 230VAC	230VAC	: 392ms
	115VAC	: 1500ms	I/P : 115VAC	115VAC	: 168ms
			O/P: FULL LOAD		
			TA : 25°C		

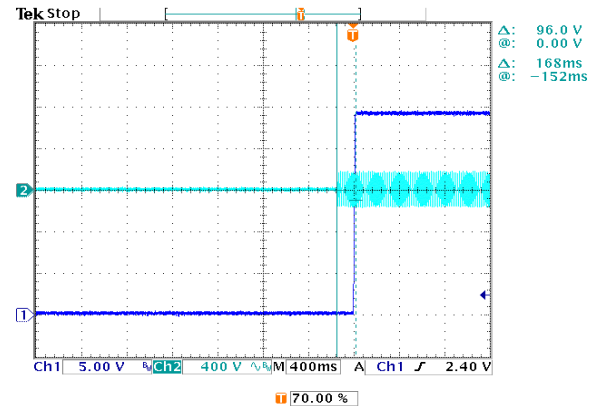
INPUT=230VAC/50HZ @ FULL LOAD

CH1 : Output Voltage CH2 : AC Input Voltage



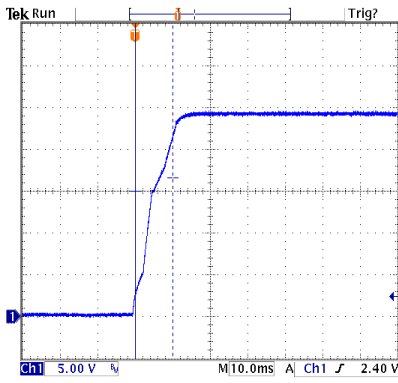
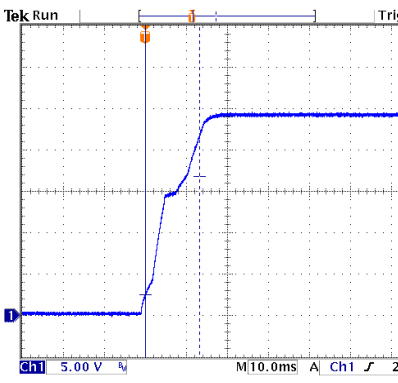
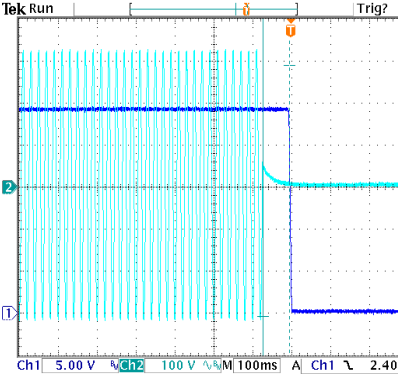
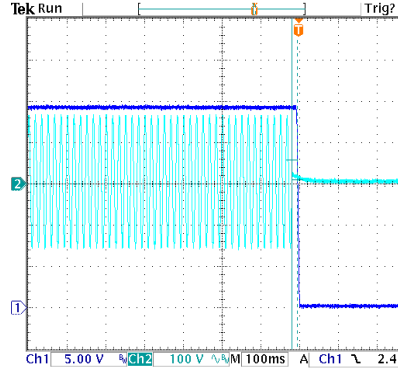
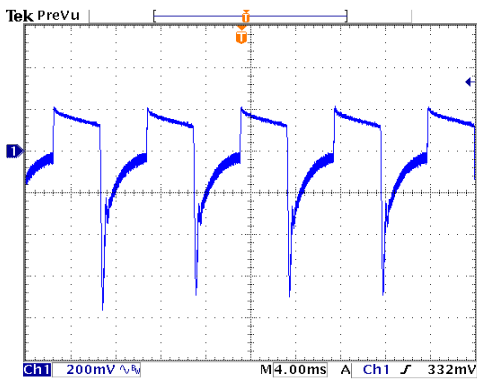
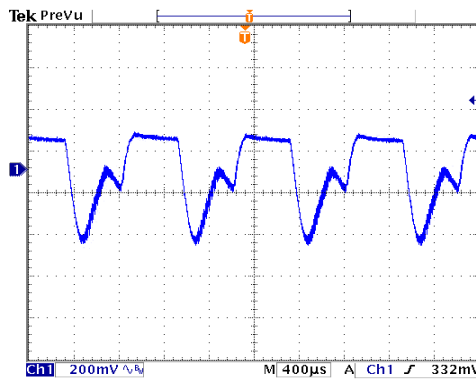
INPUT=115VAC/60HZ @ FULL LOAD

CH1 : Output Voltage CH2 : AC Input Voltage



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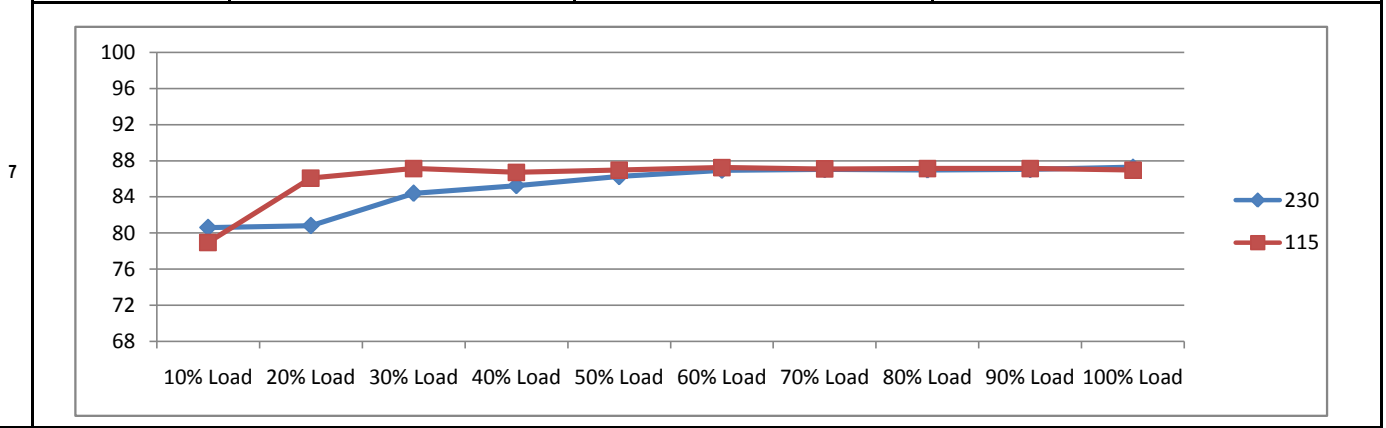


<p>RISE TIME (MAX.)</p>	<p>230VAC : 30ms 115VAC : 30ms</p>	<p>I/P : 230VAC I/P : 115VAC O/P: FULL LOAD TA: 25°C</p>	<p>230VAC : 10.0ms 115VAC : 13.2ms</p>
<p>8</p>	<p>INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage</p>  <p>Δ: 1.60 V @: 15.0 V Δ: 10.0ms @: 0.00 s</p>		<p>INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage</p>  <p>Δ: 14.3 V @: 2.50 V Δ: 13.2ms @: 0.00 s</p>
<p>9</p>	<p>HOLD UP TIME (TYP.)</p> <p>230VAC : 40ms 115VAC : 10ms</p>	<p>I/P : 230VAC I/P : 115VAC O/P: FULL LOAD TA: 25°C</p>	<p>230VAC : 68.0ms 115VAC : 14.0ms</p>
<p>10</p>	<p>INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage</p>  <p>Δ: 59.8 V @: -30.8 V Δ: 68.0ms @: -74.0ms</p>		<p>INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage</p>  <p>Δ: 48.0 V @: 58.0 V Δ: 14.0ms @: -20.0ms</p>
<p>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>V1: (1). 980mv (2). 544mv unit:mVp-p</p>
<p>FULL / MIN LOAD 50%DUTY / 120HZ</p>  <p>Ch1 Pk-Pk 980mV</p>	<p>FULL / MIN% LOAD 50%DUTY / 1KHZ</p>  <p>Ch1 Pk-Pk 544mV</p>		<p>10 Jul 2017 11:52:38 10 Jul 2017 11:53:49</p>



INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	80VAC ~ 264VAC	I/P : TESTING O/P : FULL LOAD Ta : 25°C	72.2VAC ~ 264VAC
			I/P : LOW-LINE = 97VAC HIGH-LINE = 300VAC O/P : FULL/MIN LOAD ON:30 Sec ; OFF:30 Sec 10MIN (POWER ON/OFF NO DAMAGE)	TEST : OK
2	INPUT FREQUENCY RANGE	47HZ ~ 440HZ NO DAMAGE	I/P : 100VAC ~ 264VAC O/P : FULL-MIN LOAD Ta : 25°C	TEST : OK
3	INPUT CURRENT (TYP.)	0.5 / 230VAC 0.75 / 115VAC	I/P : 230VAC I/P : 115VAC O/P : FULL LOAD TA : 25°C	I= 0.188 / 230VAC I= 0.333 / 115VAC
4	LEAKAGE CURRENT	< 80.00µA	I/P : 264VAC O/P : MIN LOAD TA : 25°C	Touch current 46.5 µA
5	NO LOAD POWER CONSUMPTION	< 0.100W	I/P : 230VAC O/P : MIN LOAD TA : 25°C	< 0.059 W
	EFFICIENCY (TYP.)	87.0%	I/P : 230VAC O/P : FULL LOAD TA : 25°C	88.08 %



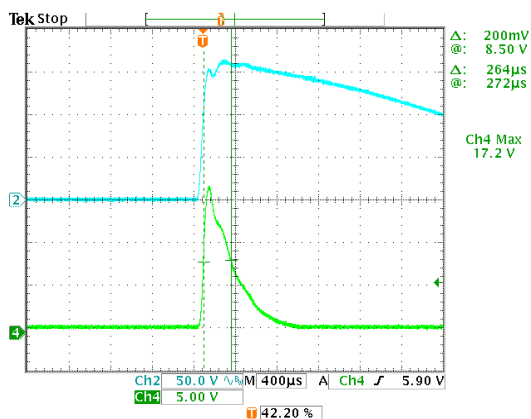
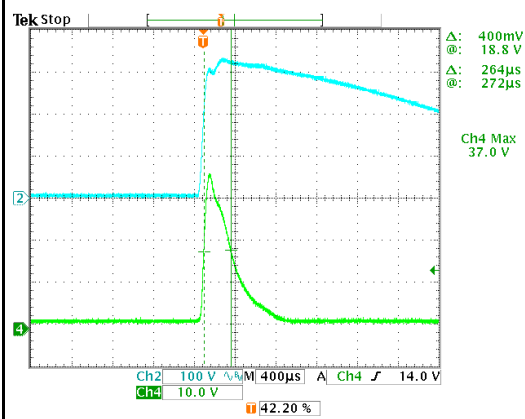
8	INRUSH CURRENT (TYP.) *	45A / 230VAC 20A / 115VAC	I/P : 230VAC I/P : 115VAC O/P : FULL LOAD TA : 25°C	I= 37.0A / 230VAC I= 17.2A / 115VAC T50= 264.0us / 230VAC
		COLD START		

INPUT=230VAC/50HZ @ FULL LOAD

INPUT=115VAC/50HZ @ FULL LOAD

CH2 : AC Input Voltage CH4 : Input current (1V=1A)

CH2 : AC Input Voltage CH4 : Input current (1V=1A)





PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER LOAD PROTECTION	110% ~ 150%	I/P: 264VAC I/P: 230VAC I/P: 100VAC O/P: TESTING TA: 25°C	141.44% 264VAC 138.11% 230VAC 124.88% 100VAC Hiccup Mode
2	OVER VOLTAGE PROTECTION	27.60V ~ 32.40V	I/P: 230VAC O/P: MIN LOAD TA: 25°C	29.10V 264VAC 29.10V 230VAC 29.10V 80VAC Shut off o/p voltage, clamping by zener diode
3	OVER TEMPERATURE PROTECTION	Shut down o/p voltage, recovers automatically after temperature goes down	I/P: 264VAC I/P: 80VAC O/P: FULL LOAD	O.T.P. Active Shut down o/p voltage, recovers automatically after temperature goes down
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 Hiccup Mode

COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Power Transistor	U1 Rated : 800V 11.5A	I/P : 267VAC VDS : O/P : (1)Full Load Turn on (2) Output Short (3)Full load continue Ta : 25°C	VIN: 267VAC VDS: (1). 470.00V (2). 436.00V (3). 474.00V
2	O/P MOSFET	Q100 Rated : 200V 5.0A 0 Rated : 0V 0.0A	I/P : 267VAC VDS : O/P : (1)Full Load Turn on (2) Output Short (3)Full load continue Ta : 25°C	Q100 VDS : (1). 118.00V (2). 118.00V (3). 115.00V
3	Input Capacitor	C5 Rated : 33uf 400V	I/P : 267VAC O/P : (1)Full Load Turn on /Off (2)Min load Turn on /Off (3)Full Load /Min load Change (4)Full Load Continue Ta : 25°C	(1). 360.00V (2). 360.00V (3). 358.00V (4). 35.00V
4	Control IC	U1 Rated : 27V (max) -0.3 (min)	I/P : 267VAC O/P : (1)Full Load (2)Output Short (3)O.L.P (4)Low Line No Load Vo(min) Ta : 25°C	U1 (1). 17.60V (2). 16.10V (3). 17.70V (4). 16.00V
9	Clamp Diode	D1 Rated : 1000V 1.0A	I/P : 267VAC O/P : (1)Dynamic Load Full/Min Load (2)Full load continue Ta : 25°C	(1). 434.00V (2). 436.00V

SAFETY & E.M.C. TEST

SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	I/P-O/P : 4.000KVAC /min	I/P-O/P: 4.400KVAC /min Ta : 25°C	I/P-O/P: 0.81mA NO DAMAGE
2	ISOLATION RESISTANCE	I/P-O/P : 500VDC>100MΩ	I/P-O/P: 500VDC Ta : 25°C/70%RH	I/P-O/P: 9999.0MΩ 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 : 230VAC /50HZ O/P : FULL LOAD / 50% LOAD Ta : 25°C	PASS Test by certified Lab
3	RADIATION	EN55011 CLASS B	I/P : 230VAC /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 : 230VAC /50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA A
5	E.F.T	EN61000-4-4 MEDICAL INPUT: 2KV	I/P : 230VAC /50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA A
6	SURGE	IEC61000-4-5 MEDICAL L-N:1KV	I/P : 230VAC /50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA A

RELIABILITY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT																																																
1	TEMPERATURE RISE TEST	MODEL : MFM-20-24 1. ROOM AMBIENT BURN-IN : 1.0hrs IP: 230VAC O/P: 100% LOAD TA= 23.1°C 2. HIGH AMBIENT BURN-IN : 1.0hrs IP: 230VAC O/P: 100% LOAD TA= 50.0°C	<table border="1"> <thead> <tr> <th>NO.</th> <th>Positio</th> <th>ROOM AMBIENT 23.1°C</th> <th>HIGH AMBIENT Ta: 50.0°C</th> </tr> </thead> <tbody> <tr><td>1</td><td>LF1</td><td>56.6°C</td><td>80.1°C</td></tr> <tr><td>2</td><td>C6</td><td>69.6°C</td><td>91.8°C</td></tr> <tr><td>3</td><td>C5</td><td>65.4°C</td><td>100.5°C</td></tr> <tr><td>4</td><td>U1</td><td>99.3°C</td><td>115.5°C</td></tr> <tr><td>5</td><td>T1</td><td>78.3°C</td><td>106.6°C</td></tr> <tr><td>6</td><td>C105</td><td>48.3°C</td><td>89.4°C</td></tr> <tr><td>7</td><td>Q100</td><td>84.9°C</td><td>117.5°C</td></tr> <tr><td>8</td><td>BD1</td><td>29.6°C</td><td>98.7°C</td></tr> <tr><td>9</td><td>C1</td><td>41.5°C</td><td>73.0°C</td></tr> <tr><td>10</td><td>L100</td><td>63.9°C</td><td>88.0°C</td></tr> <tr><td>60</td><td>TA</td><td>23.1°C</td><td>50.0°C</td></tr> </tbody> </table>	NO.	Positio	ROOM AMBIENT 23.1°C	HIGH AMBIENT Ta: 50.0°C	1	LF1	56.6°C	80.1°C	2	C6	69.6°C	91.8°C	3	C5	65.4°C	100.5°C	4	U1	99.3°C	115.5°C	5	T1	78.3°C	106.6°C	6	C105	48.3°C	89.4°C	7	Q100	84.9°C	117.5°C	8	BD1	29.6°C	98.7°C	9	C1	41.5°C	73.0°C	10	L100	63.9°C	88.0°C	60	TA	23.1°C	50.0°C	
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60	TA	23.1°C	50.0°C																																																	
2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR (MIN)	I/P : 230VAC O/P : 130.00% LOAD Ta : 25°C	TEST : OK																																																
3	LOW TEMPERATURE TURN ON TEST	NO DAMAGE 1 HOUR (MIN)	I/P : 264VAC / 100VAC O/P : FULL LOAD Ta : -35.0°C	TEST : OK																																																
4	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 50°C NO DAMAGE	I/P : 272VAC O/P : FULL LOAD Ta : 50°C HUMIDITY= 95.0% RH	TEST : OK																																																
5	TEMPERATURE COEFFICIENT	±0.03% /(0°C~50°C)	I/P : 230VAC O/P : FULL LOAD	±0.0091% /(0°C~50°C)																																																
6	STORAGE TEMPERATURE TEST	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		TEST : OK																																																
7	THERMAL SHOCK TEST	1. Thermal shock Temperature : -40°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 :	230VAC Full Load AC ON/OFF test turn on 3sec ; turn off 1sec @ 15CYCLE 230VAC Full Load AC ON turn on continue @ 1CYCLE	TEST : OK																																																



8	VIBRATION TEST	1 Carton & 1 Set (1) Waveform : Sine Wave (2) Frequency : 10~500Hz (4) Acceleration : 5G (5) Test Time : 60 min in each axis (X.Y.Z) (6) Ta : 25°C	TEST : OK
9	CAPACITOR LIFE CYCLE	MFM-20-24 :SUPPOSE C105 IS THE MOST CRITICAL COMPONENT (1) I/P : 230VAC O/P : FULL LOAD Ta= 25.0°C LIFE TIME (2) I/P : 230VAC O/P : FULL LOAD Ta= 50.0°C LIFE TIME (3) I/P : 230VAC O/P : 75% LOAD Ta= 50.0°C LIFE TIME (4) I/P : 230VAC O/P : 50% LOAD Ta= 50.0°C LIFE TIME	(1). 357486.3 HRS (2). 33401.7 HRS (3). 57708 HRS (4). 70981 HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 7319.8K hrs min. Telcordia SR-332 (Bellcore) ; 1210.1K hrs min. MIL-HDBK-217F (25°C)	
11	DMTBF /Accelerated Life test	Demonstration Mean Time Between Failure (Expected Life): Above 30000HRS @ TA 50°C	

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	LIUTT		WANGDZ