



TEST REPORT: MFM-15-24

15W 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

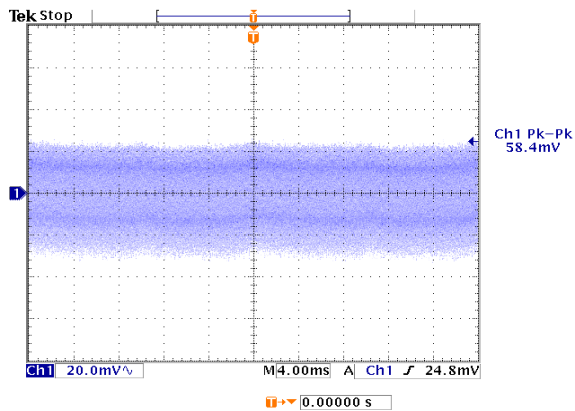
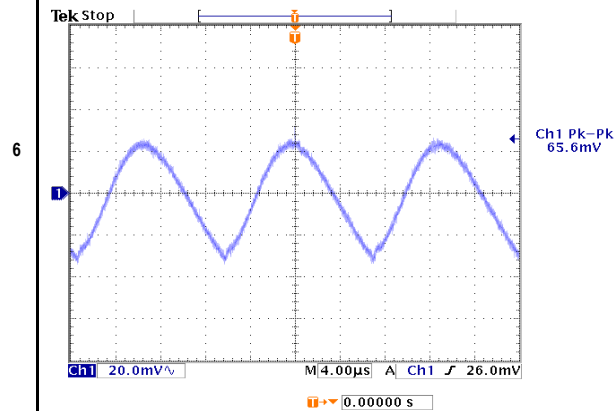
- ENVIRONMENT TEST

DESIGN VERIFY TEST
OUTPUT FUNCTION

| NO | TEST ITEM | SPECIFICATION | TEST CONDITION | RESULT |
|----|--------------------------------|-------------------|---|--------------------|
| 2 | OUTPUT VOLTAGE TOLERANCE (Max) | V1 : 2.0% ~ -2.0% | I/P : 80VAC / 264VAC O/P: FULL / MINLOAD TA= 25°C | V1: 0.62% ~ -0.50% |
| 3 | LINE REGULATION (MAX.) | V1 : 0.3% ~ -0.3% | I/P : 80VAC / 264VAC O/P: FULL LOAD TA : 25°C | V1: 0.04% ~ -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< 2.1 % |
| | RIPPLE & NOISE(Max) | V1 : 180 mVp-p | I/P : 230VAC O/P: FULL LOAD TA : 25°C | V1 : 65.6 mVp-p |

high frequency:

low frequency:



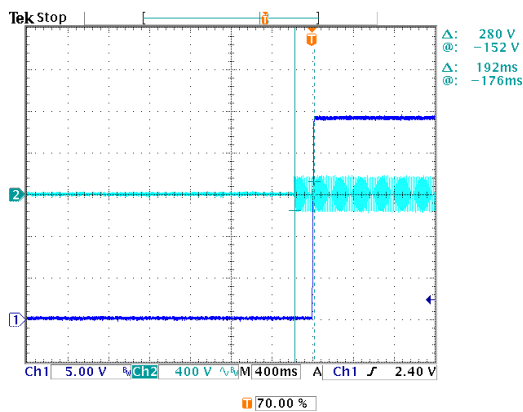
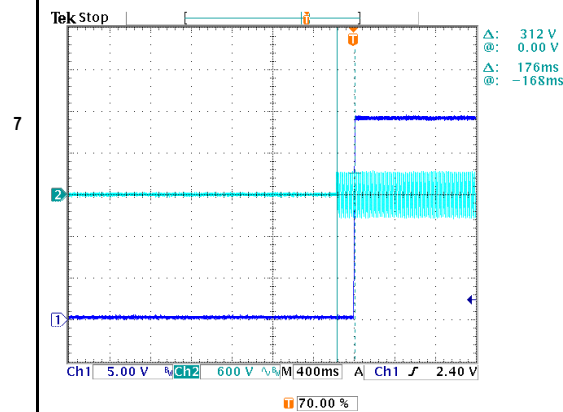
| | | |
|--------------------|--------|----------|
| SET UP TIME (MAX.) | 230VAC | : 1500ms |
| | 115VAC | : 1500ms |

| | | |
|-------|-----------|--|
| I/P : | 230VAC | |
| I/P : | 115VAC | |
| O/P: | FULL LOAD | |
| TA: | 25°C | |

| | |
|--------|---------|
| 230VAC | : 176ms |
| 115VAC | : 192ms |

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

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

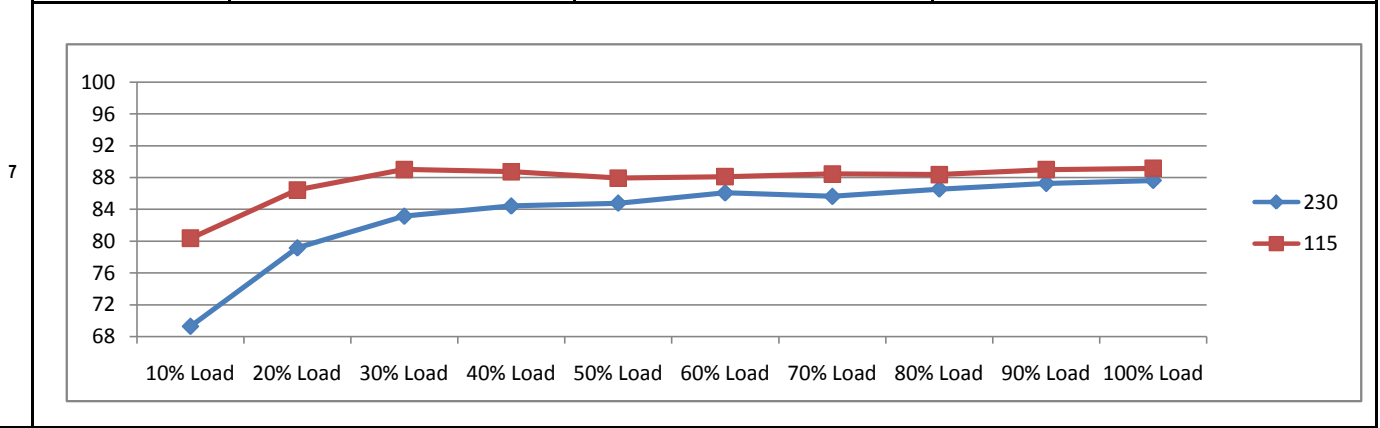


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|---|--|--|---|
| <p>RISE TIME (MAX.)</p> | <p>230VAC : 30ms 115VAC : 30ms</p> | <p>I/P : 230VAC I/P : 115VAC O/P: FULL LOAD TA: 25°C</p> | <p>230VAC : 11.4ms 115VAC : 14.4ms</p> |
| <p>8</p> <p>INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage</p> | <p>INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage</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 : 100.0ms 115VAC : 22.0ms</p> |
| <p>9</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>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). 512mv (2). 442mv unit:mVp-p</p> |
| <p>10</p> <p>FULL / MIN LOAD 50%DUTY / 120HZ</p> | <p>FULL / MIN% LOAD 50%DUTY / 1KHZ</p> | | |



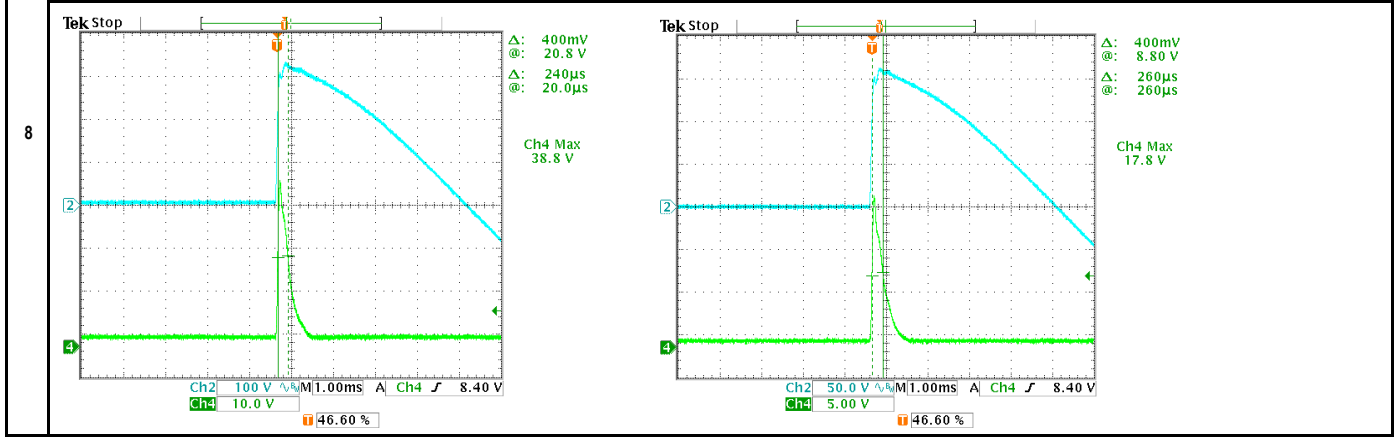
INPUT FUNCTION TEST

| NO | TEST ITEM | SPECIFICATION | TEST CONDITION | RESULT |
|----|---------------------------|------------------------------|--|------------------------|
| 1 | INPUT VOLTAGE RANGE | 80VAC ~ 264VAC | I/P : TESTING O/P : FULL LOAD Ta : 25°C | 74.0VAC ~ 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 : 80VAC ~ 264VAC O/P : FULL-MIN LOAD Ta : 25°C | TEST : OK |
| 3 | INPUT CURRENT (TYP.) | 0.3 / 230VAC 0.6 / 115VAC | I/P : 230VAC | I= 0.1712 / 230VAC |
| | | | I/P : 115VAC O/P : FULL LOAD TA : 25°C | I= 0.2671 / 115VAC |
| 4 | LEAKAGE CURRENT | < 80.00µA | I/P : 264VAC O/P : MIN LOAD TA : 25°C | Touch current 48 µA |
| 5 | NO LOAD POWER CONSUMPTION | < 0.1W | I/P : 230VAC O/P : MIN LOAD TA : 25°C | < 0.0568 W |
| | EFFICIENCY (TYP.) | 86.5% | I/P : 230VAC O/P : FULL LOAD TA : 25°C | 87.63 % |



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|---|-----------------------|---|--|---|
| 8 | INRUSH CURRENT (TYP.) | 45A / 230VAC 20A / 115VAC twidh= 555 us measured at 50% Ipeak COLD START | I/P : 230VAC I/P : 115VAC O/P : FULL LOAD TA : 25°C | I= 38.8A / 230VAC I= 17.8A / 115VAC T50= 240.0us / 230VAC |
| | | 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 | 139.73% 264VAC 134.02% 230VAC 125.81% 100VAC Hiccup Mode |
| 2 | OVER VOLTAGE PROTECTION | 27.60V ~ 32.40V | I/P: 264VAC I/P: 230VAC I/P: 80VAC O/P: MIN LOAD TA: 25°C | 29.00V 264VAC 29.00V 230VAC 29.00V 80VAC Shut off o/p voltage, clamping by zener diode |
| 3 | OVER TEMPERATURE PROTECTION | Shut down o/p voltage, recovers automatically after fault condition is removed | I/P: 264VAC I/P: 80VAC O/P: FULL LOAD | O.T.P. Active Shut down o/p voltage, recovers automatically after fault condition is removed |
| 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). 510.00V (2). 434.00V (3). 508.00V |
| 2 | O/P MOSFET | Q100 Rated : 200V 5.0A | I/P : 267VAC VDS : O/P : (1) Full Load Turn on (2) Output Short (3) Full load continue Ta : 25°C | Q100 VDS : (1). 122.00V (2). 117.00V (3). 122.00V |
| 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). 374.00V (2). 374.00V (3). 374.00V (4). 372.00V |
| 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). 17.50V (2). 16.00V (3). 16.50V (4). 16.30V |
| 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). 464.00V (2). 464.00V |

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: 0.84mA 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 | EN61000-4-5 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-15-24 1. ROOM AMBIENT BURN-IN : 1.0hrs IP: 230VAC O/P: 100% LOAD TA= 24.5°C 2. HIGH AMBIENT BURN-IN : 1.0hrs IP: 230VAC O/P: 100% LOAD TA= 45.8°C | <table border="1"> <thead> <tr> <th>NO.</th> <th>Positio</th> <th>ROOM AMBIENT 24.5°C</th> <th>HIGH AMBIENT Ta: 45.8°C</th> </tr> </thead> <tbody> <tr><td>1</td><td>LF1</td><td>50.8°C</td><td>71.7°C</td></tr> <tr><td>2</td><td>C6</td><td>53.2°C</td><td>75.1°C</td></tr> <tr><td>3</td><td>C5</td><td>55.5°C</td><td>76.4°C</td></tr> <tr><td>4</td><td>U1</td><td>71.6°C</td><td>88.2°C</td></tr> <tr><td>5</td><td>T1</td><td>64.9°C</td><td>78.0°C</td></tr> <tr><td>6</td><td>C105</td><td>43.7°C</td><td>65.4°C</td></tr> <tr><td>7</td><td>Q100</td><td>74.7°C</td><td>92.3°C</td></tr> <tr><td>8</td><td>BD1</td><td>54.8°C</td><td>76.7°C</td></tr> <tr><td>9</td><td>C1</td><td>43.8°C</td><td>64.5°C</td></tr> <tr><td>10</td><td>L100</td><td>56.9°C</td><td>77.8°C</td></tr> <tr><td>60</td><td>TA</td><td>24.5°C</td><td>45.8°C</td></tr> </tbody> </table> | NO. | Positio | ROOM AMBIENT 24.5°C | HIGH AMBIENT Ta: 45.8°C | 1 | LF1 | 50.8°C | 71.7°C | 2 | C6 | 53.2°C | 75.1°C | 3 | C5 | 55.5°C | 76.4°C | 4 | U1 | 71.6°C | 88.2°C | 5 | T1 | 64.9°C | 78.0°C | 6 | C105 | 43.7°C | 65.4°C | 7 | Q100 | 74.7°C | 92.3°C | 8 | BD1 | 54.8°C | 76.7°C | 9 | C1 | 43.8°C | 64.5°C | 10 | L100 | 56.9°C | 77.8°C | 60 | TA | 24.5°C | 45.8°C | |
| NO. | Positio | ROOM AMBIENT 24.5°C | HIGH AMBIENT Ta: 45.8°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | LF1 | 50.8°C | 71.7°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | C6 | 53.2°C | 75.1°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | C5 | 55.5°C | 76.4°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | U1 | 71.6°C | 88.2°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | T1 | 64.9°C | 78.0°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | C105 | 43.7°C | 65.4°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | Q100 | 74.7°C | 92.3°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | BD1 | 54.8°C | 76.7°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | C1 | 43.8°C | 64.5°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | L100 | 56.9°C | 77.8°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 60 | TA | 24.5°C | 45.8°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | OVER LOAD BURN-IN TEST | NO DAMAGE 1 HOUR (MIN) | I/P : 230VAC O/P : 131.00% 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 55°C NO DAMAGE | I/P : 272VAC O/P : FULL LOAD Ta : 55°C HUMIDITY= 95.0% RH | TEST : OK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | TEMPERATURE COEFFICIENT | ±0.03% /(0°C~55°C) | I/P : 230VAC O/P : FULL LOAD | ±0.0078% /(0°C~55°C) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | STORAGE TEMPERATURE TEST | 1. Thermal shock Temperature : -40°C ~ +95°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 ~ +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 : 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 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



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|----|------------------------------|--|---|
| 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 | :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= 55.0°C LIFE TIME (3) I/P : 230VAC O/P : 75% LOAD Ta= 55.0°C LIFE TIME (4) I/P : 230VAC O/P : 50% LOAD Ta= 55.0°C LIFE TIME | (1). 568260 HRS (2). 69048 HRS (3). 65699.6 HRS (4). 86522.4 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 55°C | |

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| TEST RESULT | TESTER | REVIEW | APPROVAL |
| PASS | LIUTT | | WANGDZ |