



# TEST REPORT: MFM-20-5

**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

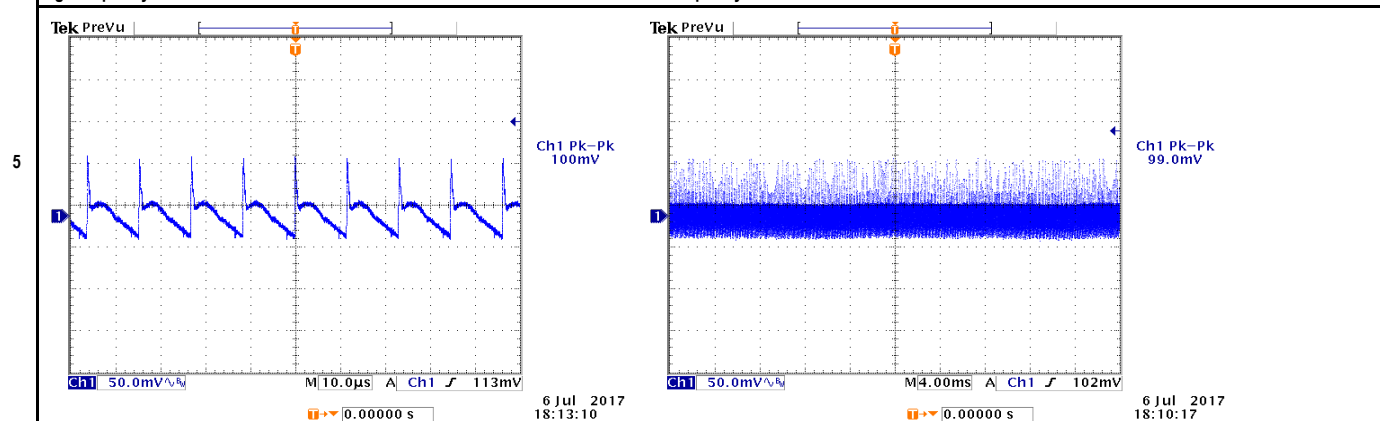
ENVIRONMENT TEST

# DESIGN VERIFY TEST OUTPUT FUNCTION

| NO | TEST ITEM                      | SPECIFICATION     | TEST CONDITION                                          | RESULT             |
|----|--------------------------------|-------------------|---------------------------------------------------------|--------------------|
| 1  | OUTPUT VOLTAGE TOLERANCE (Max) | V1 : 2.0% ~ -2.0% | I/P : 80VAC / 264VAC<br>O/P: FULL / MINLOAD<br>TA= 25°C | V1: 0.60% ~ 0.20%  |
| 2  | LINE REGULATION (MAX.)         | V1 : 0.5% ~ -0.5% | I/P : 80VAC / 264VAC<br>O/P: FULL LOAD<br>TA : 25°C     | V1: 0.00% ~ 0.00%  |
| 3  | LOAD REGULATION(MAX.)          | V1 : 0.5% ~ -0.5% | I/P : 230VAC<br>O/P: MIN LOAD ~ FULL LOAD<br>TA : 25°C  | V1: 0.20% ~ -0.20% |
| 4  | OVER/UNDERSHOOT TEST           | < ±10%            | I/P : 230VAC<br>O/P: FULL LOAD<br>TA : 25°C             | TEST< 4.0 %        |
|    | RIPPLE & NOISE(Max)            | V1 : 150 mVp-p    | I/P : 230VAC<br>O/P: FULL LOAD<br>TA : 25°C             | V1 : 100 mVp-p     |

high frequency:

low frequency:



SET UP TIME (MAX.)

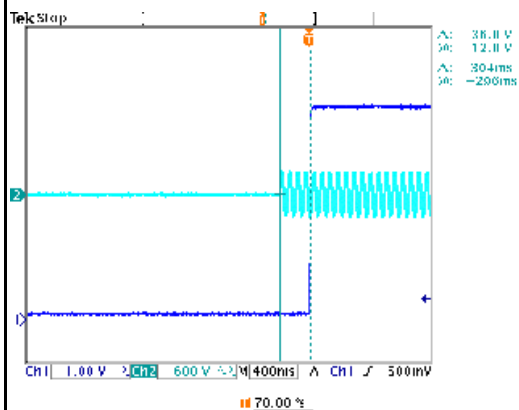
230VAC : 1500ms  
115VAC : 1500ms

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

230VAC : 304ms  
115VAC : 168ms

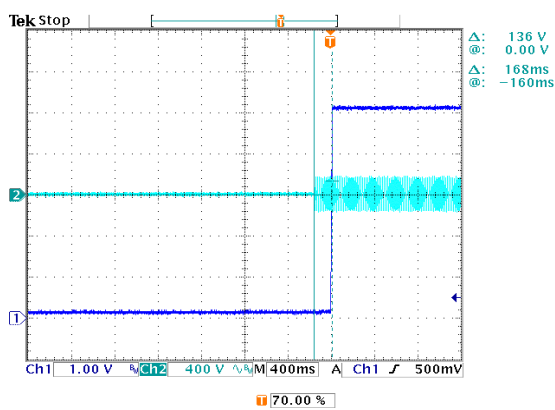
INPUT=230VAC/50HZ @ FULL LOAD

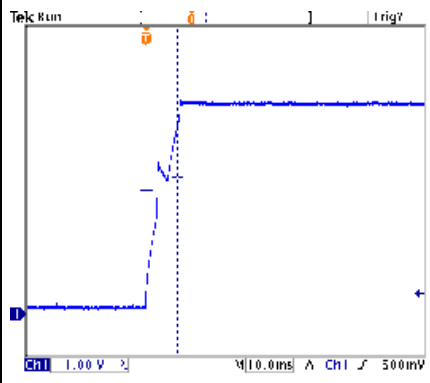
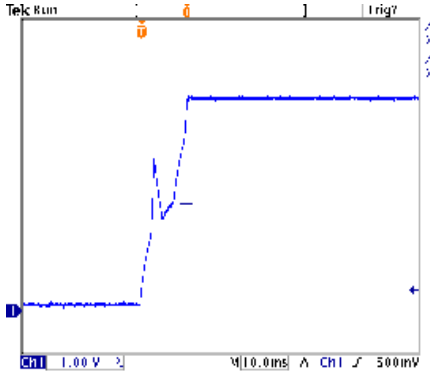
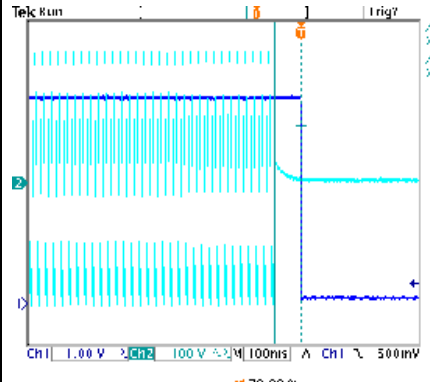
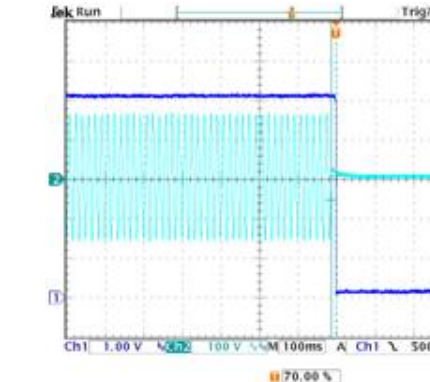
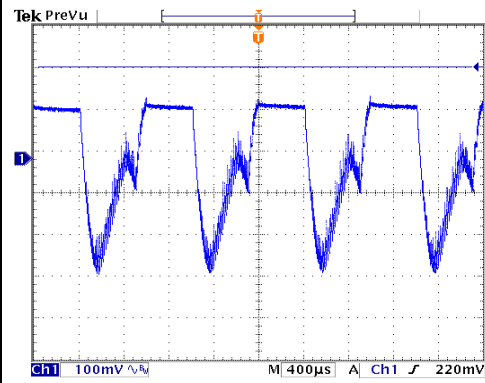
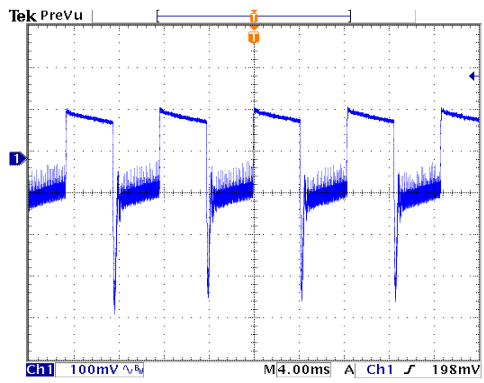
CH1 : Output Voltage CH2 : AC Input Voltage



INPUT=115VAC/60HZ @ FULL LOAD

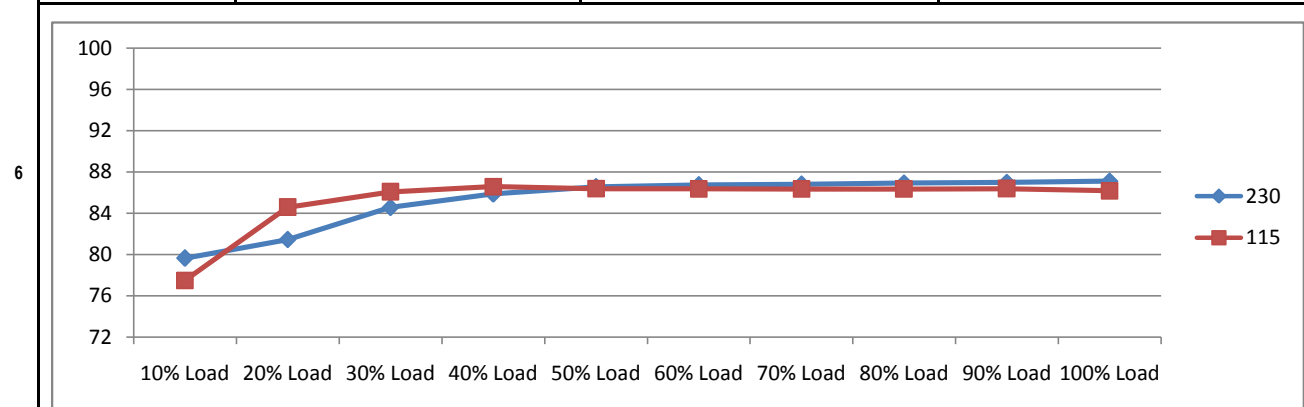
CH1 : Output Voltage CH2 : AC Input Voltage

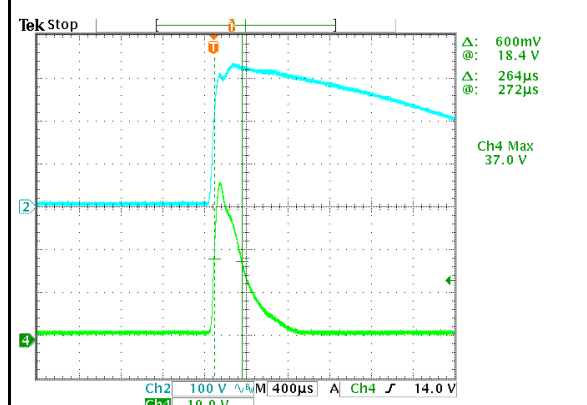
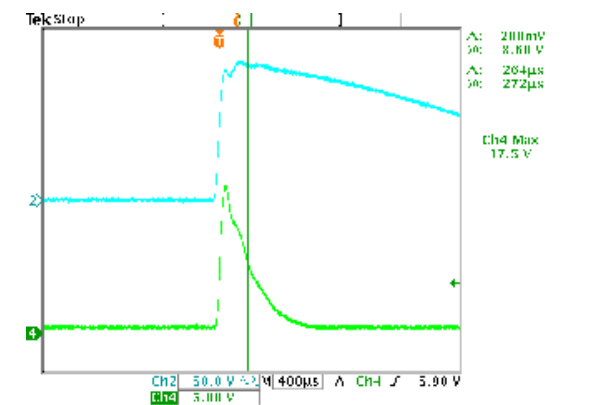


|                  |                                                                                                                                                                                                                             |                                                                                                         |                                      |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|--------------------------------------|
| RISE TIME (MAX.) | 230VAC : 30ms<br>115VAC : 30ms                                                                                                                                                                                              | I/P : 230VAC<br>I/P : 115VAC<br>O/P: FULL LOAD<br>TA: 25°C                                              | 230VAC : 7.8ms<br>115VAC : 11.2ms    |
| 7                | INPUT=230VAC/50HZ @ FULL LOAD<br>CH1 : Output Voltage<br>                                                                                  |                                                                                                         |                                      |
|                  | INPUT=115VAC/60HZ @ FULL LOAD<br>CH1 : Output Voltage<br>                                                                                 |                                                                                                         |                                      |
| 8                | HOLD UP TIME (TYP.)<br>230VAC : 40ms<br>115VAC : 10ms<br>INPUT=230VAC/50HZ @ FULL LOAD<br>CH1 : Output Voltage CH2 : AC Input Voltage<br> |                                                                                                         |                                      |
|                  | 230VAC : 68.0ms<br>115VAC : 11.4ms<br>INPUT=115VAC/60HZ @ FULL LOAD<br>CH1 : Output Voltage CH2 : AC Input Voltage<br>                   |                                                                                                         |                                      |
| DYNAMIC LOAD     | V1 : 1000 mVp-p                                                                                                                                                                                                             | I/P : 230VAC<br>O/P:<br>(1) Full/Min load 50% duty/120HZ<br>(2) Full/Min load 50% duty/1KHZ<br>TA: 25°C | V1: (1). 498mv (2). 428mv unit:mVp-p |
| 9                | FULL / MIN LOAD 50% DUTY / 120HZ<br>                                                                                                     |                                                                                                         |                                      |
|                  | FULL / MIN LOAD 50% DUTY / 1KHZ<br>                                                                                                     |                                                                                                         |                                      |

## INPUT FUNCTION TEST

| NO | TEST ITEM                 | SPECIFICATION                 | TEST CONDITION                                                                                                                     | RESULT                                 |
|----|---------------------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| 1  | INPUT VOLTAGE RANGE       | 80VAC ~ 264VAC                | I/P : TESTING<br>O/P : FULL LOAD<br>Ta : 25°C                                                                                      | 78.0VAC ~ 264VAC                       |
|    |                           |                               | I/P :<br>LOW-LINE = 97VAC<br>HIGH-LINE = 300VAC<br>O/P : FULL/MIN LOAD<br>ON:30 Sec ; OFF:30 Sec 10MIN<br>(POWER ON/OFF NO DAMAGE) | TEST : OK                              |
| 2  | INPUT FREQUENCY RANGE     | 47HZ ~ 440HZ<br>NO DAMAGE     | I/P : 80VAC ~ 264VAC<br>O/P : FULL~MIN LOAD<br>Ta : 25°C                                                                           | TEST : OK                              |
| 3  | INPUT CURRENT (TYP.)      | 0.5 / 230VAC<br>0.75 / 115VAC | I/P : 230VAC<br>I/P : 115VAC<br>O/P : FULL LOAD<br>TA : 25°C                                                                       | I= 0.176 / 230VAC<br>I= 0.326 / 115VAC |
| 4  | LEAKAGE CURRENT           | < 80.00μA                     | I/P : 264VAC<br>O/P : MIN LOAD<br>TA : 25°C                                                                                        | Touch current<br>48.6 μA               |
| 5  | NO LOAD POWER CONSUMPTION | < 0.1W                        | I/P : 230VAC<br>O/P : MIN LOAD<br>TA : 25°C                                                                                        | < 0.066 W                              |
|    | EFFICIENCY (TYP.)         | 85.0%                         | I/P : 230VAC<br>O/P : FULL LOAD<br>TA : 25°C                                                                                       | 85.39 %                                |



|   |                                                                                                                                                                                                               |                                                                                                 |                                                                              |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
|   | <div>INRUSH CURRENT (TYP.)</div> <div>45A / 230VAC<br/>20A / 115VAC<br/>twidth= 555 us measured at 50% Ipeak<br/>COLD START</div>                                                                             | <div>I/P : 230VAC<br/>I/P : 115VAC<br/>O/P : FULL LOAD<br/>TA : 25°C</div>                      | <div>I= 37.0A / 230VAC<br/>I= 17.5A / 115VAC<br/>T50= 264.0us / 230VAC</div> |
|   | <div>INPUT=230VAC/50HZ @ FULL LOAD</div> <div>INPUT=115VAC/50HZ @ FULL LOAD</div> <div>CH2 : AC Input Voltage CH4 : Input current (1V=1A)</div> <div>CH2 : AC Input Voltage CH4 : Input current (1V=1A)</div> |                                                                                                 |                                                                              |
| 7 | <div></div>                                                                                                                | <div></div> |                                                                              |



#### PROTECTION FUNCTION TEST

| NO | TEST ITEM                   | SPECIFICATION                                                             | TEST CONDITION                                                        | RESULT                                                                                     |
|----|-----------------------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| 1  | OVER LOAD PROTECTION        | 110% ~ 150%                                                               | I/P: 264VAC<br>I/P: 230VAC<br>I/P: 100VAC<br>O/P: TESTING<br>Ta: 25°C | 131.00% 264VAC<br>127.25% 230VAC<br>117.25% 100VAC<br>Hiccup Mode                          |
| 2  | OVER VOLTAGE PROTECTION     | 5.80V ~ 6.80V                                                             | I/P: 80VAC/230VAC/264VAC<br>O/P: MIN LOAD<br>Ta: 25°C                 | 6.30V 264VAC<br>6.30V 230VAC<br>6.30V 80VAC<br>Shut off o/p voltage                        |
| 3  | OVER TEMPERATURE PROTECTION | Shut down o/p voltage, recovers automatically after temperature goes down | I/P: 264VAC<br>I/P: 80VAC<br>O/P: FULL LOAD                           | O.T.P. Active<br>Shut down o/p voltage, recovers automatically after temperature goes down |
| 4  | SHORT PROTECTION            | SHORT EVERY OUTPUT<br>1 HOUR NO DAMAGE                                    | I/P: 264VAC<br>I/P: 80VAC<br>O/P: FULL LOAD<br>Ta: 25°C               | NO DAMAGE<br>Hiccup Mode                                                                   |

#### COMPONENT STRESS TEST

| NO | TEST ITEM            | SPECIFICATION                      | TEST CONDITION                                                                                                                                     | RESULT                                                                                         |
|----|----------------------|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| 1  | PWM Power Transistor | U1 Rated : 800V 11.5A              | I/P : 267VAC<br>VDS :<br>O/P : (1)Full Load Turn on<br>(2) Output Short<br>(3)Full load continue<br>Ta : 25°C                                      | VIN: 267VAC<br>VDS:<br>(1). 534.00V<br>(2). 494.00V<br>(3). 540.00V                            |
| 2  | O/P MOSFET           | Q100 Rated : 60V 84.0A             | I/P : 267VAC<br>VDS :<br>O/P : (1)Full Load Turn on<br>(2) Output Short<br>(3)Full load continue<br>Ta : 25°C                                      | Q100<br>VDS :<br>(1). 36.00V<br>(2). 46.80V<br>(3). 36.40V                                     |
| 3  | Input Capacitor      | C5 Rated : 33uf 400V               | I/P : 267VAC<br>O/P : (1)Full Load Turn on /Off<br>(2)Min load Turn on /Off<br>(3)Full Load /Min load Change<br>(4)Full Load Continue<br>Ta : 25°C | (1). 380.00V<br>(2). 384.00V<br>(3). 30.00V<br>(4). 376.00V                                    |
| 4  | Control IC           | U1 Rated : 27V (max)<br>-0.3 (min) | I/P : 267VAC<br>O/P : (1)Full Load<br>(2)Output Short<br>(3)O.L.P<br>(4)Low Line No Load Vo(min)<br>Ta : 25°C                                      | U1 U100<br>(1). 23.00V 13.30V<br>(2). 16.40V 5.80V<br>(3). 23.40V 13.90V<br>(4). 16.40V 10.50V |
| 9  | Clamp Diode          | D1 Rated : 1000V 1.0A              | I/P : 267VAC<br>O/P : (1)Dynamic Load Full/Min Load<br>(2)Full load continue<br>Ta : 25°C                                                          | (1). 450.00V<br>(2). 444.00V                                                                   |

#### 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<br>Ta : 25°C | I/P-O/P: 0.78mA<br>NO DAMAGE   |
| 2  | ISOLATION RESISTANCE | I/P-O/P : 500VDC>100MΩ   | I/P-O/P: 500VDC<br>Ta : 25°C/70%RH   | I/P-O/P: 9999.0MΩ<br>NO DAMAGE |

##### E.M.C. TEST

| NO | TEST ITEM | SPECIFICATION          | TEST CONDITION                                     | RESULT |
|----|-----------|------------------------|----------------------------------------------------|--------|
| 1  | HARMONIC  | EN61000-3-2<br>CLASS A | I/P : 230VAC /50HZ<br>O/P : FULL LOAD<br>Ta : 25°C | PASS   |



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|   |            |                                                 |                                                               |                               |
|---|------------|-------------------------------------------------|---------------------------------------------------------------|-------------------------------|
| 2 | CONDUCTION | EN55011<br>CLASS B                              | I/P : 230VAC /50HZ<br>O/P : FULL LOAD / 50% LOAD<br>Ta : 25°C | PASS<br>Test by certified Lab |
| 3 | RADIATION  | EN55011<br>CLASS B                              | I/P : 230VAC /50HZ<br>O/P : FULL LOAD<br>Ta : 25°C            | PASS<br>Test by certified Lab |
| 4 | E.S.D      | EN61000-4-2<br>MEDICAL AIR: 15KV / Contact: 8KV | I/P : 230VAC /50HZ<br>O/P : FULL LOAD<br>Ta : 25°C            | CRITERIA A                    |
| 5 | E.F.T      | EN61000-4-4<br>MEDICAL INPUT: 2KV               | I/P : 230VAC /50HZ<br>O/P : FULL LOAD<br>Ta : 25°C            | CRITERIA A                    |
| 6 | SURGE      | EN61000-4-5<br>MEDICAL L-N:1KV                  | I/P : 230VAC /50HZ<br>O/P : FULL LOAD<br>Ta : 25°C            | CRITERIA A                    |

## RELIABILITY TEST

| NO |                                                        | TEST ITEM                                                                                                                                                                                                                                                                                                                                      | SPECIFICATION                        | TEST CONDITION       | RESULT                  |
|----|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|----------------------|-------------------------|
| 1  | TEMPERATURE RISE TEST                                  |                                                                                                                                                                                                                                                                                                                                                | MODEL : MFM-20-5                     |                      |                         |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                | 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= 50.6°C |                      |                         |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                | NO. Positio                          | ROOM AMBIENT 23.1°C  | HIGH AMBIENT Ta: 50.6°C |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                | 1 LF1                                | 54.1°C               | 80.4°C                  |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                | 2 C6                                 | 65.5°C               | 81.8°C                  |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                | 3 C5                                 | 62.8°C               | 85.5°C                  |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                | 4 U1                                 | 99.5°C               | 120.6°C                 |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                | 5 T1                                 | 77.8°C               | 102.2°C                 |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                | 6 C105                               | 55.9°C               | 79.5°C                  |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                | 7 Q100                               | 75.0°C               | 107.2°C                 |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                | 8 BD1                                | 64.6°C               | 107.2°C                 |
| 2  | OVER LOAD BURN-IN TEST                                 | NO DAMAGE<br>1 HOUR ( MIN )                                                                                                                                                                                                                                                                                                                    | I/P : 230VAC                         | TEST : OK            |                         |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                | O/P : 130.00% LOAD                   |                      |                         |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                | Ta : 25°C                            |                      |                         |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                |                                      |                      |                         |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                |                                      |                      |                         |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                |                                      |                      |                         |
| 3  | LOW TEMPERATURE TURN ON TEST                           | NO DAMAGE<br>1 HOUR ( MIN )                                                                                                                                                                                                                                                                                                                    | I/P : 264VAC / 100VAC                | TEST : OK            |                         |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                | O/P : FULL LOAD                      |                      |                         |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                | Ta : -35.0°C                         |                      |                         |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                |                                      |                      |                         |
| 4  | HIGH HUMIDITY<br>HIGH TEMPERATURE<br>HIGH VOLTAGE TEST | AFTER 12 HOURS<br>IN CHAMBER ON<br>CONTROL 45°C<br>NO DAMAGE                                                                                                                                                                                                                                                                                   | I/P : 272VAC                         | TEST : OK            |                         |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                | O/P : FULL LOAD                      |                      |                         |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                | Ta : 45°C                            |                      |                         |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                | HUMIDITY= 95.0% RH                   |                      |                         |
| 5  | TEMPERATURE COEFFICIENT                                | ±0.03% /(0°C~50°C)                                                                                                                                                                                                                                                                                                                             | I/P : 230VAC                         | ±0.0072% /(0°C~50°C) |                         |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                | O/P : FULL LOAD                      |                      |                         |
| 6  | STORAGE TEMPERATURE TEST                               | 1. Thermal shock Temperature : -45°C ~ +90°C<br>2. Temperature change rate : 25°C / MIN<br>3. Dwell time low and high temperature : 30 MIN/EACH<br>4. Total test cycle : 10 CYCLE<br>5. Input/Output condition : STATIC                                                                                                                        |                                      | TEST : OK            |                         |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                |                                      |                      |                         |
| 7  | THERMAL SHOCK TEST                                     | 1. Thermal shock Temperature : -40°C ~ +50°C<br>2. Temperature change rate : 25°C / MIN<br>3. Dwell time low and high temperature : 30 MIN/EACH<br>4. Total test cycle : 16 CYCLE<br>5. Input/Output condition :<br>230VAC Full Load AC ON/OFF test turn on 3sec ; turn off 1sec @ 15CYCLE<br>230VAC Full Load AC ON turn on continue @ 1CYCLE |                                      | TEST : OK            |                         |
|    |                                                        |                                                                                                                                                                                                                                                                                                                                                |                                      |                      |                         |



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|    |                              |                                                                                                                                                                                                                                                                                         |                                                                                 |
|----|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| 8  | VIBRATION TEST               | 1 Carton & 1 Set<br>(1) Waveform : Sine Wave<br>(2) Frequency : 10~500Hz<br>(4) Acceleration : 5G<br>(5) Test Time : 60 min in each axis (X.Y.Z)<br>(6) Ta : 25°C                                                                                                                       | TEST : OK                                                                       |
| 9  | CAPACITOR LIFE CYCLE         | MFM-20-5 :SUPPOSE C105 IS THE MOST CRITICAL COMPONENT<br>(1) I/P : 230VAC O/P : FULL LOAD Ta= 25.0°C LIFE TIME<br>(2) I/P : 230VAC O/P : FULL LOAD Ta= 45.0°C LIFE TIME<br>(3) I/P : 230VAC O/P : 75% LOAD Ta= 45.0°C LIFE TIME<br>(4) I/P : 230VAC O/P : 50% LOAD Ta= 45.0°C LIFE TIME | (1). 295541.6 HRS<br>(2). 96794.1 HRS<br>(3). 171874.2 HRS<br>(4). 268856.8 HRS |
| 10 | MTBF                         | Conducted by Parts Stress Analysis Prediction<br>1210K hrs min. MIL-HDBK-217F (25°C)                                                                                                                                                                                                    |                                                                                 |
| 11 | DMTBF /Accelerated Life test | Demonstration Mean Time Between Failure (Expected Life): Above 30000HRS @ TA 45°C                                                                                                                                                                                                       |                                                                                 |

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