



# Test Report: HEP-1000-24

---

1000W Switching Power Supply for Harsh Environment

## ■ 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

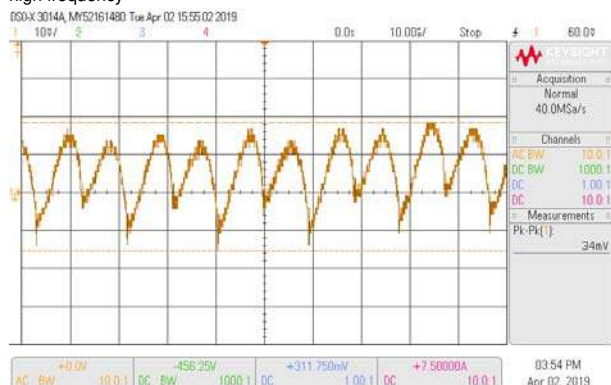
ENVIRONMENT TEST

## DESIGN VERIFY TEST

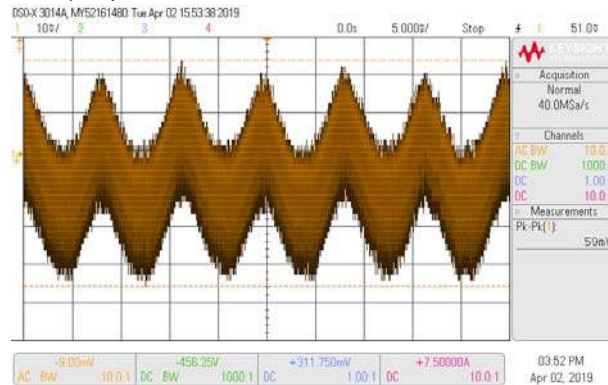
### OUTPUT FUNCTION TEST

| NO | TEST ITEM                        | SPECIFICATION    | TEST CONDITION                                                | RESULT                                           |
|----|----------------------------------|------------------|---------------------------------------------------------------|--------------------------------------------------|
| 1  | OUTPUT VOLTAGE<br>ADJUST RANGE   | CH1: 24 V~ 30V   | I/P : 230 VAC<br>I/P : 115 VAC<br>O/P : MIN LOAD<br>Ta : 25°C | 23.279V~30.679V/230VAC<br>23.279V~30.677V/115VAC |
| 2  | OUTPUT VOLTAGE(Max)<br>TOLERANCE | V1: -1%~ +1%     | I/P: 90VAC /305VAC<br>O/P:FULL/ MIN. LOAD<br>Ta:25°C          | V1: -0.229%~ 0.229 %                             |
| 3  | LINE REGULATION (Max)            | V1: -0.5%~ +0.5% | I/P: 180VAC~ 305VAC<br>O/P:FULL LOAD<br>Ta:25°C               | V1: -0.08%~ 0%                                   |
| 4  | LOAD REGULATION(Max)             | V1: -0.5%~ +0.5% | I/P: 230VAC<br>O/P:FULL ~MIN LOAD<br>Ta:25°C                  | V1: - 0.166%~0.208 %                             |
| 5  | OVER/UNDERSHOOT TEST             | < ±5%            | I/P: 230VAC<br>O/P:FULL LOAD<br>Ta:25°C                       | < 5%                                             |
| 6  | RIPPLE & NOISE(Max )             | V1: 200mVp-p     | I/P:230VAC<br>O/P:FULL LOAD<br>Ta:25°C                        | V1:59 mVp-p                                      |

high frequency :



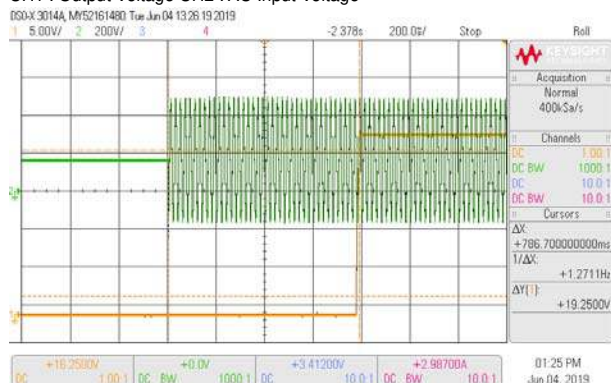
low frequency :



|   |                  |                                |                                                                                  |                                  |
|---|------------------|--------------------------------|----------------------------------------------------------------------------------|----------------------------------|
| 7 | SET UP TIME(Max) | 230VAC/1800ms<br>115VAC/1800ms | I/P : 230 VAC<br>O/P : FULL LOAD<br>I/P : 115 VAC<br>O/P : 71% LOAD<br>Ta : 25°C | 230VAC/ 786 ms<br>115VAC/ 866 ms |
|---|------------------|--------------------------------|----------------------------------------------------------------------------------|----------------------------------|

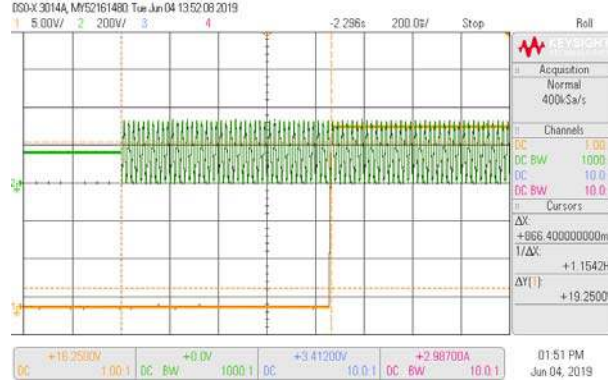
INPUT=230VAC/50HZ @ FULL LOAD

CH1 : Output Voltage CH2 : AC Input Voltage

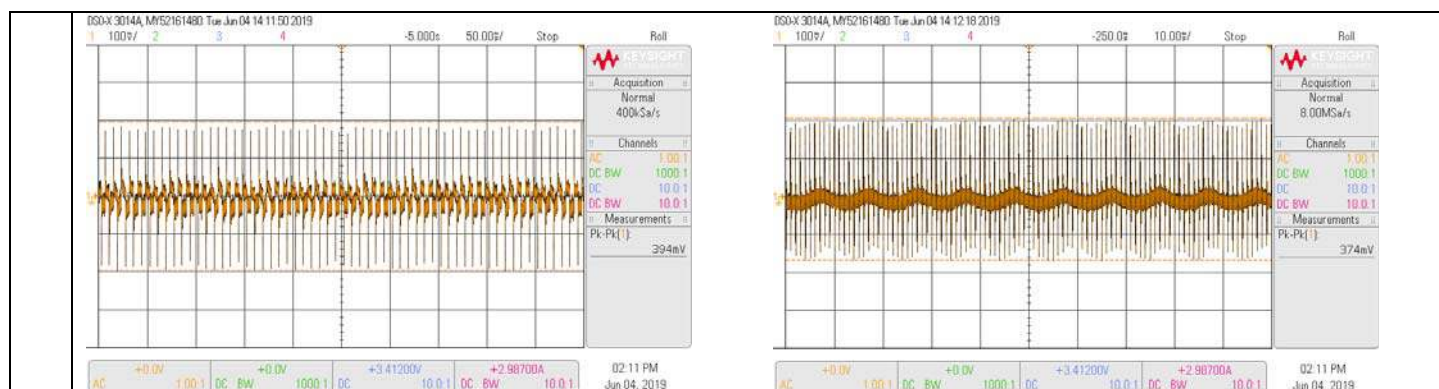


INPUT=115VAC/60HZ @ 71% LOAD

CH1 : Output Voltage CH2 : AC Input Voltage



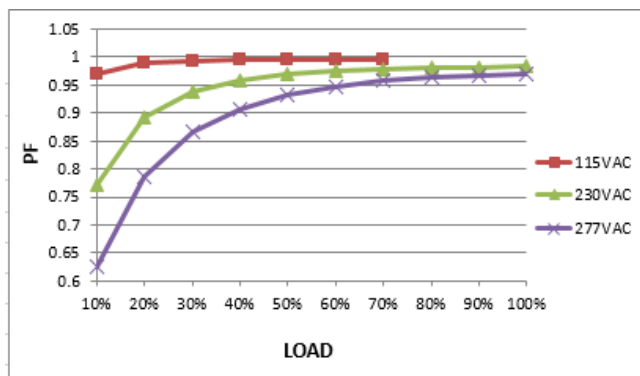
|                                                                              |                     |                                                                             |                                                                                                         |                                   |
|------------------------------------------------------------------------------|---------------------|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|-----------------------------------|
| 8                                                                            | RISE TIME (Max)     | 230VAC/80ms<br>115VAC/80ms                                                  | I/P : 230 VAC<br>O/P : FULL LOAD<br>I/P : 115 VAC<br>O/P : 71% LOAD<br>Ta : 25°C                        | 230VAC/ 10.4 ms<br>115VAC/ 8.9 ms |
| INPUT=230VAC/50HZ @ FULL LOAD<br>CH1 : Output Voltage                        |                     | INPUT=115VAC/60HZ @ 71% LOAD<br>CH1 : Output Voltage                        |                                                                                                         |                                   |
|                                                                              |                     |                                                                             |                                                                                                         |                                   |
| 9                                                                            | HOLD UP TIME (Typ.) | 230VAC/12ms<br>230VAC/16ms at 75% load                                      | I/P : 230 VAC<br>O/P : 100% LOAD<br>I/P : 230VAC<br>O/P : 75% LOAD<br>Ta : 25°C                         | 230VAC/ 29ms<br>230VAC/ 30.2 ms   |
| INPUT=230VAC/50HZ @ FULL LOAD<br>CH1 : Output Voltage CH2 : AC Input Voltage |                     | INPUT=115VAC/60HZ @ 71% LOAD<br>CH1 : Output Voltage CH2 : AC Input Voltage |                                                                                                         |                                   |
|                                                                              |                     |                                                                             |                                                                                                         |                                   |
| 10                                                                           | DYNAMIC LOAD        | V1: 2400mVp-p                                                               | I/P: 230VAC<br>O/P:<br>(1)FULL /50% LOAD 50%DUTY / 120HZ<br>(2)FULL /50% LOAD 50%DUTY / 1KHZ<br>Ta:25°C | 394mVp-p<br>374mVp-p              |
| FULL /50% LOAD 50%DUTY / 120HZ                                               |                     | FULL /50% LOAD 50%DUTY / 1KHZ                                               |                                                                                                         |                                   |

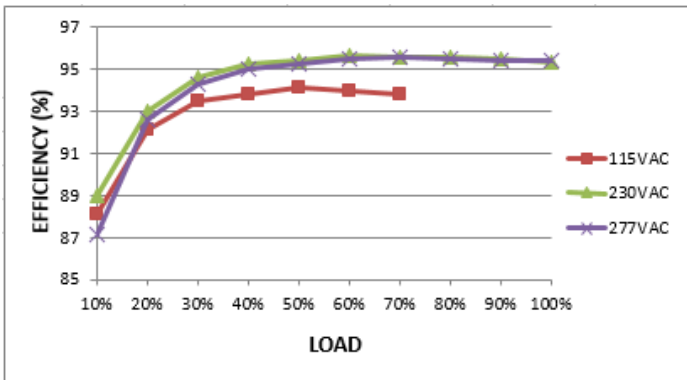
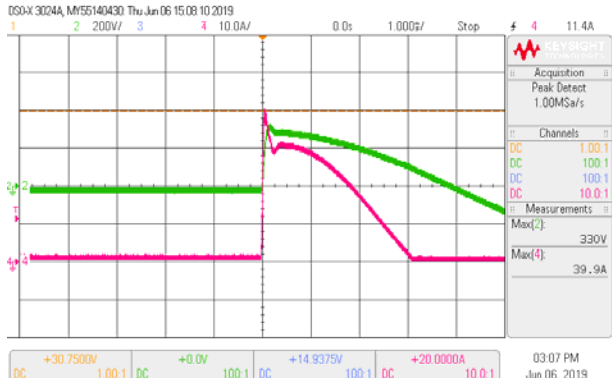


## INPUT FUNCTION TEST

| NO | TEST ITEM             | SPECIFICATION                               | TEST CONDITION                                                                                                                                                      | RESULT                                                |
|----|-----------------------|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| 1  | INPUT VOLTAGE RANGE   | 90VAC~305VAC                                | I/P:TESTING<br>O/P:FULL LOAD/ Derating Load<br>Ta:25°C                                                                                                              | 158V~305V / FULL LOAD<br>78V~305V/ Derating Load      |
|    |                       |                                             | I/P:<br>LOW-LINE-3V=87 V<br>HIGH-LINE+15%=315 V<br>O/P:FULL/MIN LOAD<br>(PLEASE CHECK DERATING CURVE)<br>ON: 30 Sec OFF: 30 Sec 10MIN<br>( POWER ON/OFF NO DAMAGE ) | TEST:OK                                               |
| 2  | INPUT FREQUENCY RANGE | 47HZ ~63 HZ<br>NO DAMAGE                    | I/P:90 VAC ~305 VAC<br>O/P:FULL~MIN LOAD<br>Ta:25°C                                                                                                                 | TEST: OK                                              |
| 3  | INPUT CURRENT (Typ.)  | 277V/ 4.5A<br>230V/ 5.3A<br>115V/ 10.1A     | I/P : 230 VAC<br>O/P : FULL LOAD<br>I/P : 115 VAC<br>O/P : 71% LOAD<br>Ta : 25°C                                                                                    | I=3.97A/ 277VAC<br>I=4.72A/ 230VAC<br>I=6.71A/ 115VAC |
| 4  | LEAKAGE CURRENT       | <0.75 mA / 240 VAC                          | I/P : 240 VAC<br>O/P : Min LOAD<br>Ta : 25°C                                                                                                                        | L-FG : 0.49 mA<br>N-FG : 0.5 mA                       |
| 5  | POWER FACTOR (Typ.)   | 0.93/ 277VAC<br>0.95/ 230VAC<br>0.99/115VAC | I/P : 230 VAC<br>O/P : FULL LOAD<br>I/P : 115 VAC<br>O/P : 71% LOAD<br>Ta : 25°C                                                                                    | PF=0.967/277VAC<br>PF=0.982/230VAC<br>PF=0.996/115VAC |

P.F vs LOAD



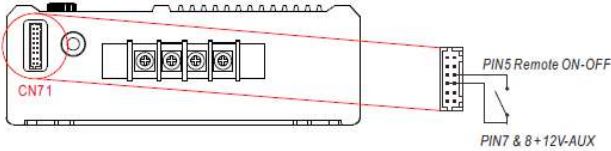
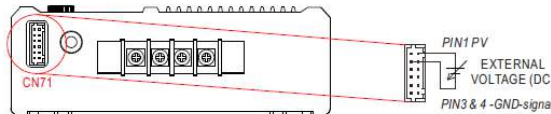
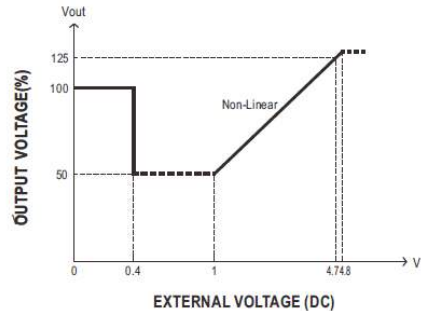
|                                                                                                                                                                   |                      |                        |                                               |                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------------------|-----------------------------------------------|---------------------------------------|
| 6                                                                                                                                                                 | EFFICIENCY(Typ.)     | 95%                    | I/P:230 VAC<br>O/P:FULL LOAD<br>Ta:25°C       | 95.33%                                |
| EFFICIENCY vs LOAD                                                              |                      |                        |                                               |                                       |
| 7                                                                                                                                                                 | INRUSH CURRENT(Typ.) | 230V/40A<br>COLD START | I/P : 230 VAC<br>O/P : FULL LOAD<br>Ta : 25°C | I =39.9A/ 230VAC<br>T50= 1760 us/230V |
| INPUT=230VAC/50HZ @ FULL LOAD<br>CH2 : AC Input Voltage CH4 : Input current<br> |                      |                        |                                               |                                       |

## PROTECTION FUNCTION TEST

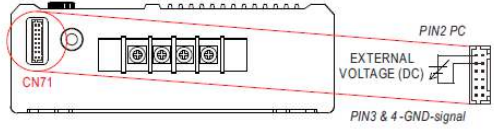
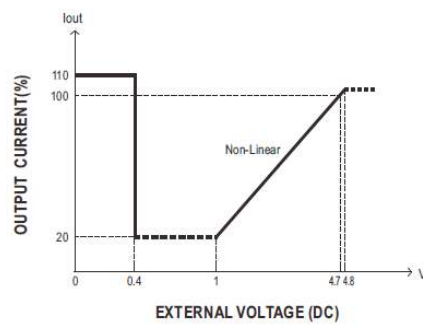
| NO | TEST ITEM                   | SPECIFICATION                                                                                                                          | TEST CONDITION                                                      | RESULT                                                                                                                                                       |
|----|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | OVER LOAD PROTECTION        | 105%~ 125%<br>PROTECTION TYPE :<br>Constant current limiting,unit will shutdown after 5 sec,re-power on to recover.                    | I/P: 305VAC<br>I/P: 230VAC<br>I/P: 180VAC<br>O/P:TESTING<br>Ta:25°C | 109.3%/ 305VAC<br>110.42%/ 230VAC<br>110.42%/180VAC<br>PROTECTION TYPE :<br>Constant current limiting,unit will shutdown after 5 sec,re-power on to recover. |
| 2  | OVER VOLTAGE PROTECTION     | 30V~35V<br>Protection type :<br>Shut down O/P voltage,re-power on to recover.                                                          | I/P: 305VAC<br>I/P: 230VAC<br>I/P: 90VAC<br>O/P:MIN LOAD<br>Ta:25°C | 32.14V/ 305VAC<br>32.198V/ 230VAC<br>31.996V/ 90VAC<br>PROTECTION TYPE : Shut down O/P voltage,re-power on to recover.                                       |
| 3  | OVER TEMPERATURE PROTECTION | Protection type :<br>Shut down O/P voltage,, recovers automatically after temperature goes down                                        | I/P: 305VAC<br>O/P:FULL LOAD<br>I/P: 90VAC<br>O/P:60% LOAD          | O.T.P. Active<br>Protection type :Shut down O/P voltage,, recovers automatically after temperature goes down                                                 |
| 4  | SHORT PROTECTION            | SHORT EVERY OUTPUT<br>1 HOUR NO DAMAGE<br>PROTECTION TYPE :<br>Constant current limiting,unit will shutdown after 5 sec,re-power on to | I/P: 305VAC<br>I/P: 90VAC<br>O/P: FULL LOAD<br>Ta:25°C              | NO DAMAGE<br>PROTECTION TYPE : Constant current limiting,unit will shutdown after 5 sec,re-power on to recover.                                              |

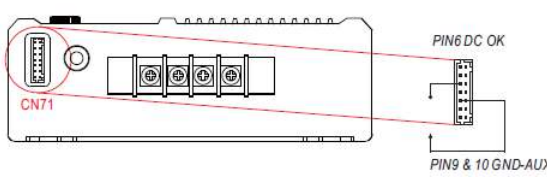
recover.

## CONTROL FUNCTION TEST

| NO                             | TEST ITEM                       | SPECIFICATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | TEST CONDITION   | RESULT    |                                |                     |               |             |              |             |                            |                     |          |           |         |        |        |        |        |
|--------------------------------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----------|--------------------------------|---------------------|---------------|-------------|--------------|-------------|----------------------------|---------------------|----------|-----------|---------|--------|--------|--------|--------|
| 1                              | AUXILIARY POWER (AUX)           | <div>I/P: 230 VAC</div> <div>O/P:FULL LOAD</div> <div>Ta:25°C</div> <div>Test Result :</div> <table><tr><td>AUX</td><td>TOLERANCE</td><td>RIPPLE</td><td>TEST RESULT</td></tr><tr><td>12V / 0.5A</td><td>10.8~13.2 V</td><td>150mVp-p</td><td>11.76V/32.7mvp-p</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                  |           | AUX                            | TOLERANCE           | RIPPLE        | TEST RESULT | 12V / 0.5A   | 10.8~13.2 V | 150mVp-p                   | 11.76V/32.7mvp-p    |          |           |         |        |        |        |        |
| AUX                            | TOLERANCE                       | RIPPLE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | TEST RESULT      |           |                                |                     |               |             |              |             |                            |                     |          |           |         |        |        |        |        |
| 12V / 0.5A                     | 10.8~13.2 V                     | 150mVp-p                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 11.76V/32.7mvp-p |           |                                |                     |               |             |              |             |                            |                     |          |           |         |        |        |        |        |
| 2                              | REMOTE ON/OFF CONTROL           | <div>The power supply can be turned ON/OFF individually or along with other units in parallel by using the "Remote ON-OFF" function.</div> <div></div> <div><table><tr><td>Remote ON-OFF</td><td>Power Supply Status</td></tr><tr><td>Short circuit</td><td>ON</td></tr><tr><td>Open circuit</td><td>OFF</td></tr></table></div> <div><div>I/P: 230 VAC</div><div>O/P:FULL LOAD</div><div>Ta:25°C</div><div>Test Result :</div><table><tr><td>Between ON/OFF and +5V-AUX</td><td>Power Supply Status</td></tr><tr><td>SW SHORT</td><td>ON</td></tr><tr><td>SW OPEN</td><td>OFF</td></tr></table></div>                                                   |                  |           | Remote ON-OFF                  | Power Supply Status | Short circuit | ON          | Open circuit | OFF         | Between ON/OFF and +5V-AUX | Power Supply Status | SW SHORT | ON        | SW OPEN | OFF    |        |        |        |
| Remote ON-OFF                  | Power Supply Status             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |           |                                |                     |               |             |              |             |                            |                     |          |           |         |        |        |        |        |
| Short circuit                  | ON                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |           |                                |                     |               |             |              |             |                            |                     |          |           |         |        |        |        |        |
| Open circuit                   | OFF                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |           |                                |                     |               |             |              |             |                            |                     |          |           |         |        |        |        |        |
| Between ON/OFF and +5V-AUX     | Power Supply Status             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |           |                                |                     |               |             |              |             |                            |                     |          |           |         |        |        |        |        |
| SW SHORT                       | ON                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |           |                                |                     |               |             |              |             |                            |                     |          |           |         |        |        |        |        |
| SW OPEN                        | OFF                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |           |                                |                     |               |             |              |             |                            |                     |          |           |         |        |        |        |        |
| 3                              | OUTPUT VOLTAGE PROGRAMMABLE(PV) | <div>※ In addition to the adjustment via the built-in potentiometer, the output voltage can be trimmed by applying EXTERNAL VOLTAGE.</div> <div></div> <div></div> <div><div>I/P: 230 VAC</div><div>O/P:FULL LOAD</div><div>Ta:25°C</div><div>TEST RESULT :</div><table><tr><td><div>PV</div><div>MODEL</div></td><td>&lt;0.4V</td><td>1V</td><td>4.7V</td><td>4.8V</td></tr><tr><td>SPEC</td><td>24V±5%</td><td>12V±5%</td><td>30V±5%</td><td>30.48V±5%</td></tr><tr><td>Vout</td><td>23.95V</td><td>11.88V</td><td>29.91V</td><td>30.45V</td></tr></table></div> |                  |           | <div>PV</div> <div>MODEL</div> | <0.4V               | 1V            | 4.7V        | 4.8V         | SPEC        | 24V±5%                     | 12V±5%              | 30V±5%   | 30.48V±5% | Vout    | 23.95V | 11.88V | 29.91V | 30.45V |
| <div>PV</div> <div>MODEL</div> | <0.4V                           | 1V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 4.7V             | 4.8V      |                                |                     |               |             |              |             |                            |                     |          |           |         |        |        |        |        |
| SPEC                           | 24V±5%                          | 12V±5%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 30V±5%           | 30.48V±5% |                                |                     |               |             |              |             |                            |                     |          |           |         |        |        |        |        |
| Vout                           | 23.95V                          | 11.88V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 29.91V           | 30.45V    |                                |                     |               |             |              |             |                            |                     |          |           |         |        |        |        |        |



|       |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |         |    |      |      |      |         |        |         |         |      |         |        |        |         |
|-------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|---------|----|------|------|------|---------|--------|---------|---------|------|---------|--------|--------|---------|
| 4     | OUTPUT CURRENT PROGRAMMABLE (PC) | <p>※ The output current can be trimmed to 20~100% of the rated current by applying EXTERNAL VOLTAGE.</p>   <p>I/P: 230 VAC<br/>O/P: TESTING<br/>Ta: 25°C</p> <table> <tr> <td>ADJ V</td><td>&lt;0.4V</td><td>1V</td><td>4.7V</td><td>4.8V</td></tr> <tr> <td>SPEC</td><td>110%±5%</td><td>20%±5%</td><td>100%±5%</td><td>100%±5%</td></tr> <tr> <td>TEST</td><td>107.83%</td><td>19.69%</td><td>97.95%</td><td>100.31%</td></tr> </table> | ADJ V   | <0.4V   | 1V | 4.7V | 4.8V | SPEC | 110%±5% | 20%±5% | 100%±5% | 100%±5% | TEST | 107.83% | 19.69% | 97.95% | 100.31% |
| ADJ V | <0.4V                            | 1V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 4.7V    | 4.8V    |    |      |      |      |         |        |         |         |      |         |        |        |         |
| SPEC  | 110%±5%                          | 20%±5%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 100%±5% | 100%±5% |    |      |      |      |         |        |         |         |      |         |        |        |         |
| TEST  | 107.83%                          | 19.69%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 97.95%  | 100.31% |    |      |      |      |         |        |         |         |      |         |        |        |         |

| 5                | DC-OK SIGNAL        | <p>DC-OK signal is a TTL level signal. The maximum source current is 10mA and the maximum external voltage is 5.5V.</p>  <table> <tr> <th>DC-OK signal</th><th>Power Supply Status</th></tr> <tr> <td>"High" &gt;4.4~5.5V</td><td>ON</td></tr> <tr> <td>"Low" &lt;-0.5~0.5V</td><td>OFF</td></tr> </table> <p>I/P: 230VAC<br/>O/P: FULL LOAD<br/>Ta: 25°C</p> <table> <tr> <th>DC-OK signal</th><th>Power Supply Status</th></tr> <tr> <td>"High" &gt;4.5~5.5V</td><td>ON(5.05v)</td></tr> <tr> <td>"Low" &lt;-0.5~0.5V</td><td>OFF(-0.142V)</td></tr> </table> | DC-OK signal | Power Supply Status | "High" >4.4~5.5V | ON | "Low" <-0.5~0.5V | OFF | DC-OK signal | Power Supply Status | "High" >4.5~5.5V | ON(5.05v) | "Low" <-0.5~0.5V | OFF(-0.142V) |
|------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------------|------------------|----|------------------|-----|--------------|---------------------|------------------|-----------|------------------|--------------|
| DC-OK signal     | Power Supply Status |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |                     |                  |    |                  |     |              |                     |                  |           |                  |              |
| "High" >4.4~5.5V | ON                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |                     |                  |    |                  |     |              |                     |                  |           |                  |              |
| "Low" <-0.5~0.5V | OFF                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |                     |                  |    |                  |     |              |                     |                  |           |                  |              |
| DC-OK signal     | Power Supply Status |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |                     |                  |    |                  |     |              |                     |                  |           |                  |              |
| "High" >4.5~5.5V | ON(5.05v)           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |                     |                  |    |                  |     |              |                     |                  |           |                  |              |
| "Low" <-0.5~0.5V | OFF(-0.142V)        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |                     |                  |    |                  |     |              |                     |                  |           |                  |              |

## CHARGER MODE

### OUTPUT FUNCTION TEST

| NO | TEST ITEM            | SPECIFICATION   | TEST CONDITION                             | RESULT |
|----|----------------------|-----------------|--------------------------------------------|--------|
| 1  | BOOST CHARGE VOLTAGE | 28.8V ± 0.24 V  | I/P: 230 VAC<br>O/P: BAT. LOAD<br>Ta: 25°C | 28.76V |
| 2  | FLOAT CHARGE VOLTAGE | 27.6 V ± 0.24 V | I/P: 230 VAC<br>O/P: BAT. LOAD<br>Ta: 25°C | 27.62V |
| 3  | OUTPUT CURRENT       | 35A ± 0.88 A    | I/P: 230 VAC<br>O/P: BAT. LOAD<br>Ta: 25°C | 34.46A |

### INPUT FUNCTION TEST

| NO | TEST ITEM           | SPECIFICATION                                 | TEST CONDITION                               | RESULT                                                      |
|----|---------------------|-----------------------------------------------|----------------------------------------------|-------------------------------------------------------------|
| 1  | INPUT CURRENT (TYP) | 277 V/ 4.5 A<br>230 V/ 5.3 A<br>115 V/ 10.1 A | I/P: 277 VAC<br>I/P: 230 VAC<br>I/P: 115 VAC | I = 3.14A/ 277VAC<br>I = 3.68A/ 230VAC<br>I = 7.32A/ 115VAC |

|   |                    |                                                 |                                                                            |                                                         |
|---|--------------------|-------------------------------------------------|----------------------------------------------------------------------------|---------------------------------------------------------|
|   |                    |                                                 | O/P: C.V MODE-1V<br>Ta:25°C                                                |                                                         |
| 2 | POWER FACTOR (TYP) | 0.93/ 277 VAC<br>0.95/ 230 VAC<br>0.99/ 115 VAC | I/P: 277VAC<br>I/P: 230 VAC<br>I/P: 115 VAC<br>O/P: C.V MODE-1V<br>Ta:25°C | PF=0.96/ 277VAC<br>PF=0.992/ 230VAC<br>PF=0.999/ 115VAC |
| 3 | EFFICIENCY (TYP)   | 95%                                             | I/P: 230 VAC<br>O/P: C.V MODE-1V<br>Ta:25°C                                | 95.84%                                                  |

## COMPONENT STRESS TEST

| NO | TEST ITEM                                              | SPECIFICATION                            | TEST CONDITION                                                                                                                                                                                                                                                                                                                                           | RESULT                                                                                   |
|----|--------------------------------------------------------|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| 1  | PWM Transistor<br>( D to S) or (C to E) Peak Voltage   | Q903 Rated<br>16A/ 650V<br>VGS $\pm$ 30V | AC ON/OFF<br><br>I/P:High-Line +3V =308V<br>VDS:<br>O/P: (1)Full Load<br>(2)Output Short<br>(3)Dynamic Load Full Load/<br>Min. Load 90%Duty/1KHz<br>(4)Dynamic Load Full Load/<br>Min. Load 90%Duty/3KHz<br>(5)Dynamic Load Full Load/<br>Min. Load 90%Duty/5KHz<br>(6)Dynamic Load 100% Load/<br>Min. Load 50%Duty/120Hz<br>(7)0%→400% Load.<br>Ta:25°C | VDS:<br>(1) 514V<br>(2) 522V<br>(3) 518V<br>(4) 518V<br>(5) 518V<br>(6) 522V<br>(7) 522V |
| 2  | P.F.C Transistor<br>( D to S) or (C to E) Peak Voltage | Q51 Rated<br>16A/ 650V                   | I/P:High-Line +3V =308V<br>AC ON/OFF<br>O/P: (1)Full Load<br>(2)Output Short<br>(3)Dynamic Load Full Load/<br>Min. Load 90%Duty/1KHz<br>(4)Dynamic Load Full Load/<br>Min. Load 90%Duty/3KHz<br>(5)Dynamic Load Full Load/<br>Min. Load 90%Duty/5KHz<br>(6)Dynamic Load 100% Load/<br>Min. Load 50%Duty/120Hz<br>(7)0%→400% Load.<br>Ta:25°C             | VDS:<br>(1) 446V<br>(2) 450V<br>(3) 446V<br>(4) 454V<br>(5) 450V<br>(6) 437V<br>(7) 454V |
| 3  | P.F.C DIODE                                            | D14 Rated<br>8A/ 650V                    | I/P:High-Line +3V =308V<br>AC ON/OFF<br>O/P: (1)Full Load<br>(2)Output Short<br>(3)Dynamic Load Full Load/<br>Min. Load 90%Duty/5KHz<br>(4)Dynamic Load 100% Load/<br>Min. Load 50%Duty/120Hz<br>Ta:25°C                                                                                                                                                 | (1) 397V<br>(2) 397V<br>(3) 385V<br>(4) 397V                                             |
| 4  | Diode Peak Voltage                                     | Q101 Rated<br>111 A/ 80V                 | AC ON/OFF<br>I/P:High-Line +3V =308V<br>O/P: (1)Full Load                                                                                                                                                                                                                                                                                                | Q101:<br>VDS:<br>(1) 57V                                                                 |



|   |                              |                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                        |                                                                                                                                                    |
|---|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
|   |                              |                                                                                                                                                                                         | (2)Output Short<br>(3)Dynamic Load Full Load/<br>Min. Load 90%Duty/1KHz<br>(4)Dynamic Load Full Load/<br>Min. Load 90%Duty/3KHz<br>(5)Dynamic Load Full Load/<br>Min. Load 90%Duty/5KHz<br>(6)Dynamic Load 100% Load/<br>Min. Load 50%Duty/120Hz<br>(7)0%→400% Load.<br>(8).NO LOAD<br>Ta:25℃ | (2) 58.2V<br>(3) 57.4V<br>(4) 58.2V<br>(5) 58.6V<br>(6) 58.2V<br>(7) 58.2V<br>(8)57.8V                                                                                                                                                 |                                                                                                                                                    |
| 5 | Input Capacitor Voltage      | C5 Rated:<br>: 220 $\mu$ / 450 V<br>105 °C / TXW Series                                                                                                                                 | I/P:High-Line +3V =308V<br>O/P: (1) Min load continue<br>(2)Full load continue<br>Ta:25℃                                                                                                                                                                                                      | (1)429V<br>(2)441V                                                                                                                                                                                                                     |                                                                                                                                                    |
| 6 | Control IC Voltage Test      | PWM IC U800 Rated<br>8.85 V~ 16V<br><br>PFC IC U401 Rated<br>10.6V~ 21 V<br><br>O/P IC U101Rated<br>8V ~24 V<br><br>MCU IC U701 Rated<br>2V~ 3.6V<br><br>AUX IC U601 Rated<br>10.5V~25V | AC ON/OFF<br><br>I/P:High-Line +3V =308V<br>O/P(1)FULL LOAD<br>(2) Output Short<br>(3)O.L.P<br>(4)O.V.P.<br>(5)NO LOAD VRmin(LOW LINE)<br>Ta:25℃                                                                                                                                              | U800<br>(1) 14.96V<br>(2) 13.71V<br>(3) 14.27V<br>(4) 12.58V<br>(5) 12.42V<br>U401<br>(1) 13.55V<br>(2) 13.31V<br>(3) 13.47V<br>(4) 12.58V<br>(5) 12.26V<br>U101<br>(1) 13.95V<br>(2) 13.39V<br>(3) 13.79V<br>(4) 12.18V<br>(5) 11.94V | U701<br>(1) 3.33V<br>(2) 3.35V<br>(3) 3.35V<br>(4) 3.33V<br>(5) 3.17V<br>U601<br>(1) 16.72V<br>(2) 13.66V<br>(3) 13.58V<br>(4) 13.34V<br>(5) 13.1V |
| 8 | TOP SWITCHING STAND BY POWER | U601 Rated<br>3.5 A/ 800 V                                                                                                                                                              | AC ON/OFF<br><br>I/P:High-Line +3V =308V<br>O/P: (1)Full Load<br>(2)Remote On/Off<br>I/P:Low-Line -3V =177V<br>O/P: (1)Full Load<br>(2)Remote On/Off<br>Ta:25℃                                                                                                                                | U601<br>(1) 568V<br>(2) 572V<br><br>(1) 512V<br>(2) 536V                                                                                                                                                                               |                                                                                                                                                    |

## SAFETY TEST

| NO | TEST ITEM            | SPECIFICATION                                                                               | TEST CONDITION                                                                 | RESULT                                                                                   |
|----|----------------------|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| 1  | WITHSTAND VOLTAGE    | I/P-O/P: 3KVAC/min<br>I/P-FG :2KVAC/min<br>O/P-FG:1.25KVAC/min                              | I/P-O/P: 3.6 KVAC/min<br>I/P-FG: 2.4 KVAC/min<br>O/P-FG:1.5 KVAC/min<br>Ta:25℃ | I/P-O/P: 7.74mA<br>I/P-FG: 7.97mA<br>O/P-FG: 6.49m A<br>NO DAMAGE                        |
| 2  | ISOLATION RESISTANCE | I/P-O/P:500VDC>100M $\Omega$<br>I/P-FG: 500VDC>100M $\Omega$<br>O/P-FG:500VDC>100M $\Omega$ | I/P-O/P: 500 VDC<br>I/P-FG: 500 VDC<br>O/P-FG: 500 VDC<br>Ta:25℃               | I/P-O/P: 14.8G $\Omega$<br>I/P-FG: 6.59G $\Omega$<br>O/P-FG: 6.52G $\Omega$<br>NO DAMAGE |
| 3  | GROUNDING CONTINUITY | FG(PE) TO CHASSIS<br>OR TRACE < 100 m $\Omega$                                              | 40A / 2min<br>Ta:25℃                                                           | 22 m $\Omega$                                                                            |

## 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                          |
| 2  | CONDUCTION                                                                                                                       | EN55032<br>CLASS B                                    | I/P : 230 VAC (50HZ)<br>O/P : FULL/50% LOAD<br>Ta : 25°C | PASS<br>Test by certified Lab |
| 3  | RADIATION                                                                                                                        | EN55032<br>CLASS B                                    | I/P : 230 VAC (50HZ)<br>O/P : FULL LOAD<br>Ta : 25°C     | PASS<br>Test by certified Lab |
| 4  | E.S.D                                                                                                                            | EN61000-4-2<br>INDUSTRY<br>AIR: 8KV / Contact: 4KV    | I/P : 230 VAC/50HZ<br>O/P : FULL LOAD<br>Ta : 25°C       | CRITERIA A                    |
| 5  | E.F.T                                                                                                                            | EN61000-4-4<br>INDUSTRY<br>INPUT : 2KV                | I/P : 230 VAC/50HZ<br>O/P : FULL LOAD<br>Ta : 25°C       | CRITERIA A                    |
| 6  | SURGE                                                                                                                            | IEC61000-6-2<br>INDUSTRY<br>L-N : 2KV<br>L,N-PE : 4KV | I/P : 230 VAC/50HZ<br>O/P : FULL LOAD<br>Ta : 25°C       | CRITERIA A                    |
| 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 : HEP-1000-24<br>1. ROOM AMBIENT BURN-IN : 1.5 HRS<br>I/P : 230VAC O/P : FULL LOAD Ta= 25 °C<br>2. HIGH AMBIENT BURN-IN : 3 HRS<br>I/P : 230VAC O/P : FULL LOAD Ta= 50 °C |                |        |

|   |                                                                   |                                                                                                                                                                                                                        |                                                                   |                      |                        |                       |
|---|-------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|----------------------|------------------------|-----------------------|
|   |                                                                   |                                                                                                                                                                                                                        | NO                                                                | Position             | ROOM AMBIENT Ta= 25 °C | HIGH AMBIENT Ta= 50°C |
|   |                                                                   |                                                                                                                                                                                                                        | 1                                                                 | BD2                  | 75.3°C                 | 98.5°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 2                                                                 | BD1                  | 76.0°C                 | 99.1°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 3                                                                 | LF3                  | 68.8°C                 | 92.4°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 4                                                                 | ZNR2                 | 66.1°C                 | 89.6°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 5                                                                 | C13                  | 70.0°C                 | 93.4°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 6                                                                 | C2                   | 65.1°C                 | 88.6°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 7                                                                 | D10                  | 76.2°C                 | 100.1°C               |
|   |                                                                   |                                                                                                                                                                                                                        | 8                                                                 | Q51                  | 70.7°C                 | 94.1°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 9                                                                 | Q65                  | 72.5°C                 | 95.7°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 10                                                                | T51                  | 71.3°C                 | 95.0°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 11                                                                | T52                  | 70.3°C                 | 94.0°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 12                                                                | C417                 | 63.8°C                 | 89.9°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 13                                                                | C8                   | 67.7°C                 | 91.6°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 14                                                                | C964                 | 70.1°C                 | 93.9°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 15                                                                | L2                   | 70.7°C                 | 94.8°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 16                                                                | L3                   | 76.4°C                 | 102.2°C               |
|   |                                                                   |                                                                                                                                                                                                                        | 17                                                                | Q901                 | 72.5°C                 | 97.0°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 18                                                                | Q903                 | 71.9°C                 | 96.6°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 19                                                                | T1                   | 74.5°C                 | 99.9°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 20                                                                | T1core               | 72.5°C                 | 97.7°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 21                                                                | T2                   | 73.0°C                 | 98.0°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 22                                                                | T2core               | 71.7°C                 | 96.5°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 23                                                                | Q103                 | 74.8°C                 | 100.0°C               |
|   |                                                                   |                                                                                                                                                                                                                        | 24                                                                | Q113                 | 75.5°C                 | 100.7°C               |
|   |                                                                   |                                                                                                                                                                                                                        | 25                                                                | C114                 | 74.3°C                 | 99.3°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 26                                                                | C118                 | 73.2°C                 | 98.2°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 27                                                                | LF10                 | 75.7°C                 | 101.0°C               |
|   |                                                                   |                                                                                                                                                                                                                        | 28                                                                | U601                 | 78.5°C                 | 99.3°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 29                                                                | U100                 | 71.8°C                 | 96.2°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 30                                                                | RT21                 | 67.3°C                 | 90.3°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 31                                                                | RTH4                 | 69.6°C                 | 93.5°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 32                                                                | RTH5                 | 70.1°C                 | 93.9°C                |
|   |                                                                   |                                                                                                                                                                                                                        | 33                                                                | RG61                 | 78.8°C                 | 103.8°C               |
|   |                                                                   |                                                                                                                                                                                                                        | 34                                                                | T601                 | 79.9°C                 | 104.3°C               |
|   |                                                                   |                                                                                                                                                                                                                        | 35                                                                | C652                 | 74.5°C                 | 98.6°C                |
| 2 | OVER LOAD BURN-IN TEST                                            | NO DAMAGE<br>1 HOUR ( MIN )                                                                                                                                                                                            | I/P : 230 VAC<br>O/P : 107 % LOAD<br>Ta : 25°C                    | TEST : OK            |                        |                       |
| 3 | LOW TEMPERATURE<br>TURN ON TEST                                   | TURN ON AFTER 2 HOUR                                                                                                                                                                                                   | I/P : 264VAC/180VAC/90VAC<br>O/P : 100 % / 65% LOAD<br>Ta= -45 °C | TEST : OK            |                        |                       |
| 4 | HIGH HUMIDITY<br>HIGH TEMPERATURE<br>HIGH VOLTAGE<br>TURN ON TEST | AFTER 12 HOURS<br>IN CHAMBER ON<br>CONTROL 50°C<br>NO DAMAGE                                                                                                                                                           | I/P : 272 VAC<br>O/P : FULL LOAD<br>Ta= 50°C<br>HUMIDITY= 95 %R.H | TEST : OK            |                        |                       |
| 5 | TEMPERATURE<br>COEFFICIENT                                        | ± 0.03 %/°C (0~50°C)                                                                                                                                                                                                   | I/P : 230 VAC<br>O/P : FULL LOAD                                  | ± 0.001%/°C (0~50°C) |                        |                       |
| 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 |                                                                   |                      | OK                     |                       |

|    |                          |                                                                                                                                                                                                                                                                                                               |                                                                |
|----|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| 7  | THERMAL SHOCK TEST       | 1. Thermal shock Temperature : -45°C~ +55°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>15cycle:230V/ FULL LOAD AC ON 3sec/AC OFF 1sec TEST<br>1cycle:230V/ FULL LOAD Burn In Test | OK                                                             |
| 8  | VIBRATION TEST           | 1 Carton & 1 Set<br>(1) Waveform : Sine Wave<br>(2) Frequency : 10~500Hz<br>(3) Sweep Time : 12min/sweep cycle<br>(4) Acceleration : 10G<br>(5) Test Time : 72min in each axis (X.Y.Z)<br>(6) Ta : 25°C                                                                                                       | TEST : OK                                                      |
| 9  | CAPACITOR LIFE CYCLE     | SUPPOSE C120 IS THE MOST CRITICAL COMPONENT<br>(1) I/P : 230VAC O/P : FULL LOAD Ta= 25°C LIFE TIME<br>(2) I/P : 230VAC O/P : FULL LOAD Ta= 50°C LIFE TIME<br>(3) I/P : 230VAC O/P : 75% LOAD Ta= 50°C LIFE TIME<br>(4) I/P : 230VAC O/P : 50% LOAD Ta= 50°C LIFE TIME                                         | (1) 100217HRS<br>(2) 17716HRS<br>(3) 54180HRS<br>(4) 114992HRS |
| 10 | MTBF                     | Conducted by Parts Stress Analysis Prediction<br>197.9K hrs min. Telcordia SR-332 (Bellcore) ; 52.32K hrs min. MIL-HDBK-217F (25°C)                                                                                                                                                                           |                                                                |
| 11 | Ongoing reliability test | I/P : 230VAC O/P : FULL LOAD TA=50 °C<br>Demonstration Mean Time Between Failure : 55000 hours                                                                                                                                                                                                                |                                                                |

| TEST RESULT | TESTER     | REVIEW     | APPROVAL      |
|-------------|------------|------------|---------------|
| PASS        | DANIEL GAO | SANFORD SU | VINCENT TSENG |

2018.4.30 GP-A50-F010