# TEST REPORT: EPP-400-24

## 400W Single Output With PFC Function

■ 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

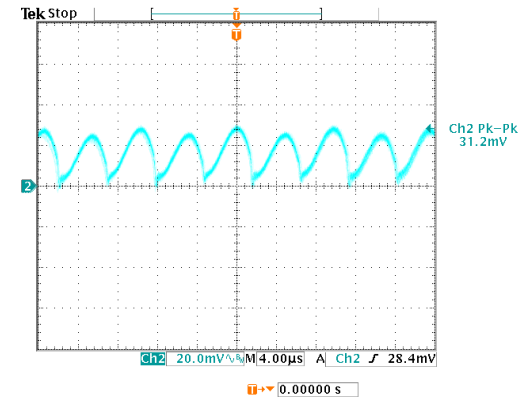
■ RELIABILITY TEST

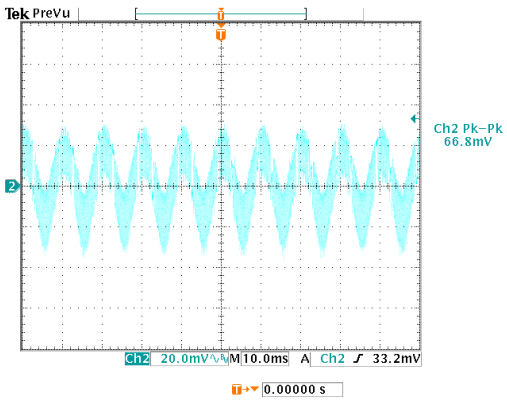
- ENVIRONMENT TEST

■ DESIGN VERIFY TEST

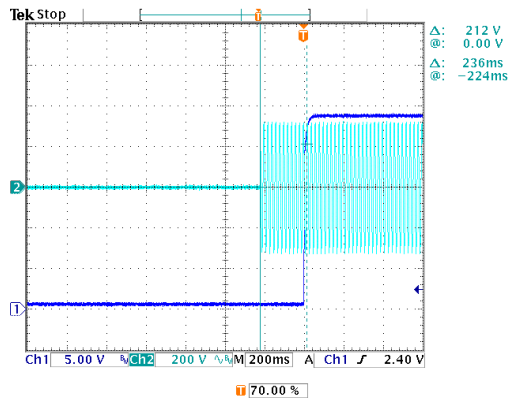
OUTPUT FUNCTION

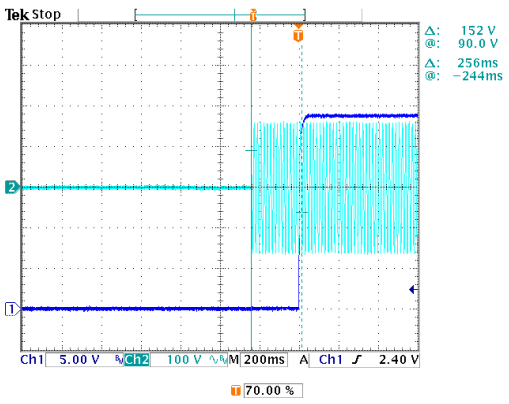
| NO | TEST ITEM | SPECIFICATION | TEST CONDITION | RESULT |
|---|---|---|---|---|
| 1 | OUTPUT VOLTAGE ADJUST RANGE | CH1: 22.80V ~ 25.20V | I/P : 230VAC<br>O/P: MIN LOAD<br>TA : 25℃ | CH1: 22.13V ~ 26.13V |
| 2 | OUTPUT VOLTAGE TOLERANCE (Max) | V1 : 2.0% ~ -2.0% | I/P : 115VAC / 264VAC<br>O/P: FULL / MINLOAD<br>TA= 25℃ | V1: 0.58% ~ -0.50% |
| 3 | LINE REGULATION (MAX.) | V1 : 0.5% ~ -0.5% | I/P : 115VAC / 264VAC<br>O/P: FULL LOAD<br>TA : 25℃ | V1: 0.00% ~ 0.00% |
| 4 | LOAD REGULATION (MAX.) | V1 : 1.0% ~ -1.0% | I/P : 230VAC<br>O/P: MIN LOAD ~ FULL LOAD<br>TA : 25℃ | V1: 0.58% ~ -0.50% |
| 5 | OVER/UNDERSHOOT TEST | < ±10% | I/P : 230VAC<br>O/P: FULL LOAD<br>TA : 25℃ | TEST< 1.2 % |
| 6 | RIPPLE & NOISE(Max) | V1 : 150 mVp-p | I/P : 230VAC<br>O/P: FULL LOAD<br>TA : 25℃ | V1 : 66.8 mVp-p |
| | high frequency: | | low frequency: | |




| NO | TEST ITEM | SPECIFICATION | TEST CONDITION | RESULT |
|---|---|---|---|---|
| 7 | SET UP TIME (MAX.) | 230VAC : 1000ms<br>115VAC : 1500ms | I/P : 230VAC<br>I/P : 115VAC<br>O/P: FULL LOAD<br>TA : 25℃ | 230VAC : 236ms<br>115VAC : 256ms |
| | INPUT=230VAC/50HZ @ FULL LOAD<br>CH1 : Output Voltage CH2 : AC Input Voltage | | INPUT=115VAC/60HZ @ FULL LOAD<br>CH1 : Output Voltage CH2 : AC Input Voltage | |



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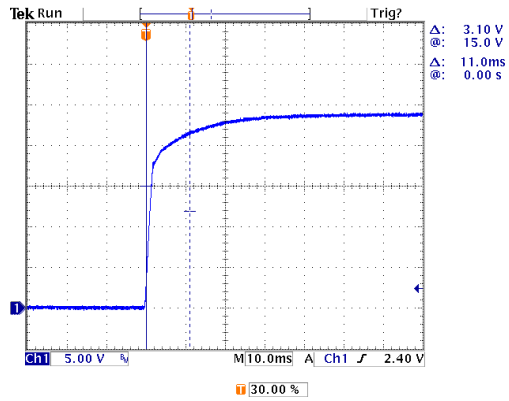
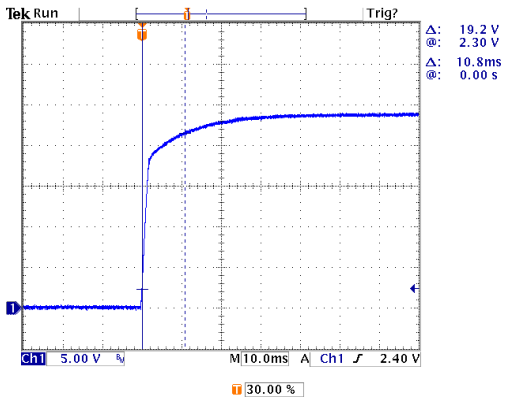
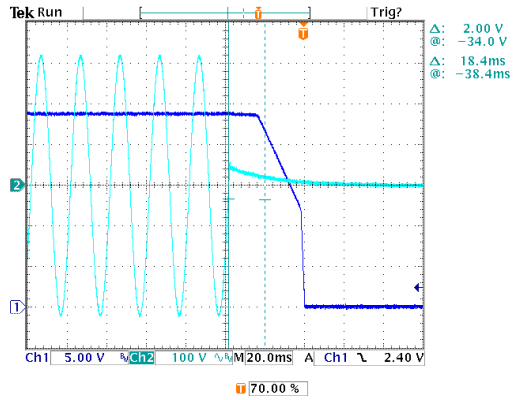
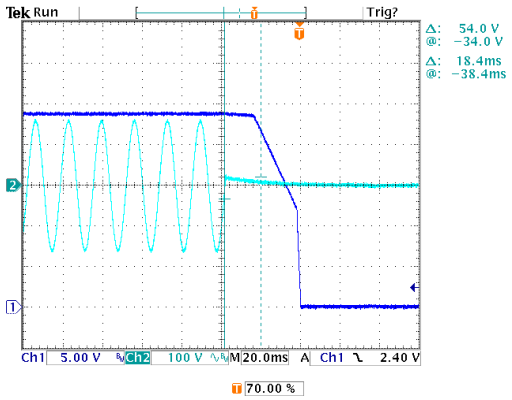
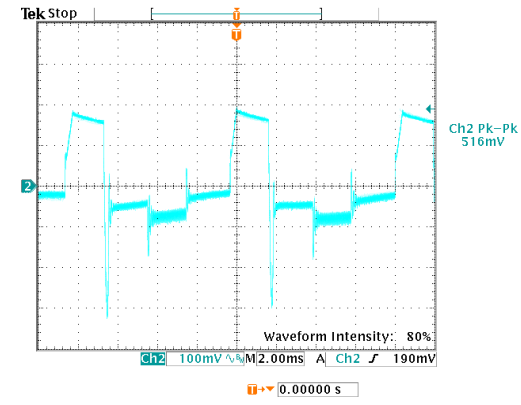
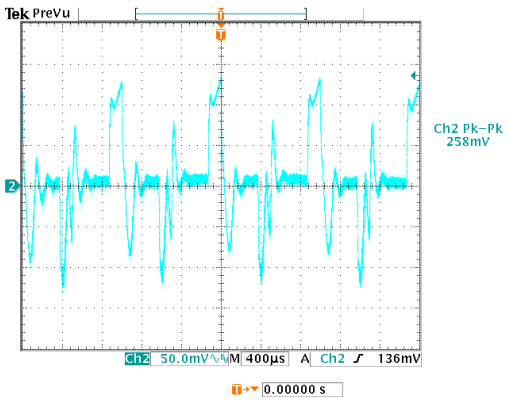
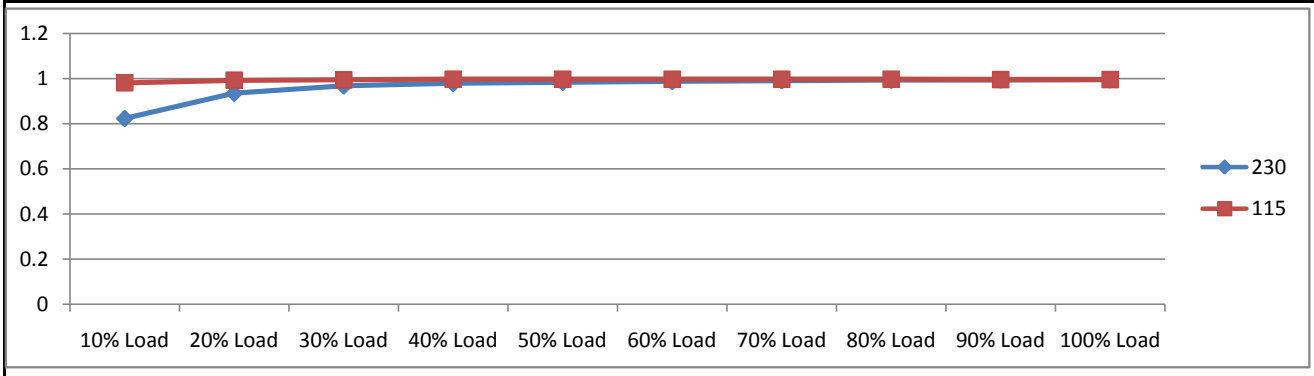
|---|---|---|---|---|---|---|
| 8 | RISE TIME (MAX.) | 230VAC : 30ms<br>115VAC : 30ms | | I/P : 230VAC<br>I/P : 115VAC<br>O/P: FULL LOAD<br>TA : 25℃ | 230VAC : 11.0ms<br>115VAC : 10.8ms | |
| | INPUT=230VAC/50HZ @ FULL LOAD<br>CH1 : Output Voltage | | | INPUT=115VAC/60HZ @ FULL LOAD<br>CH1 : Output Voltage | | |
| |  | | |  | | |
| 9 | HOLD UP TIME (TYP.) | 230VAC : 16ms<br>115VAC : 12ms | | I/P : 230VAC<br>I/P : 115VAC<br>O/P: FULL LOAD<br>TA : 25℃ | 230VAC : 18.4ms<br>115VAC : 18.4ms | |
| | INPUT=230VAC/50HZ @ FULL LOAD<br>CH1 : Output Voltage CH2 : AC Input Voltage | | | INPUT=115VAC/60HZ @ FULL LOAD<br>CH1 : Output Voltage CH2 : AC Input Voltage | | |
| |  | | |  | | |
| 10 | DYNAMIC LOAD | V1 : 2400 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℃ | (1). (2). unit:mVp-p<br>V1: 516mv 258mv | |
| | FULL /MIN LOAD 50%DUTY / 120HZ | | | FULL /MIN% LOAD 50%DUTY / 1KHZ | | |
| |  | | |  | | |

INPUT FUNCTION TEST

| NO | TEST ITEM | SPECIFICATION | TEST CONDITION | RESULT |
|---|---|---|---|---|
| 1 | INPUT VOLTAGE RANGE | 80VAC ~ 264VAC<br>113VDC ~ 370VDC | I/P : TESTING<br>O/P : FULL LOAD<br>Ta : 25℃ | 65.0VAC ~ 264VAC<br>97VDC ~ 370VDC |
| | | | I/P :<br>LOW-LINE = 112VAC<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 ~ 63HZ<br>NO DAMAGE | I/P : 115VAC ~ 264VAC<br>O/P : FULL~MIN LOAD<br>Ta : 25℃ | TEST : OK |
| 3 | INPUT CURRENT (TYP.) | 2.10A / 230VAC<br>4.20A / 115VAC | I/P : 230VAC<br>I/P : 115VAC<br>O/P: FULL LOAD<br>TA : 25℃ | I= 1.87A / 230VAC<br>I= 3.88A / 115VAC |
| 4 | LEAKAGE CURRENT | < 0.75mA | I/P : 264VAC<br>O/P: MIN LOAD<br>TA : 25℃ | L-FG 0.19 mA<br>N-FG 0.22 mA |
| 5 | NO LOAD POWER CONSUMPTION | < 0.50W | I/P : 230VAC<br>O/P: MIN LOAD<br>TA : 25℃ | < 0.4048 W |
| 6 | POWER FACTOR (TYP.) | 0.94 / 230VAC<br>0.98 / 115VAC | I/P : 230VAC<br>I/P : 115VAC<br>O/P: FULL LOAD<br>TA : 25℃ | PF= 0.994 / 230VAC<br>PF= 0.996 / 115VAC |

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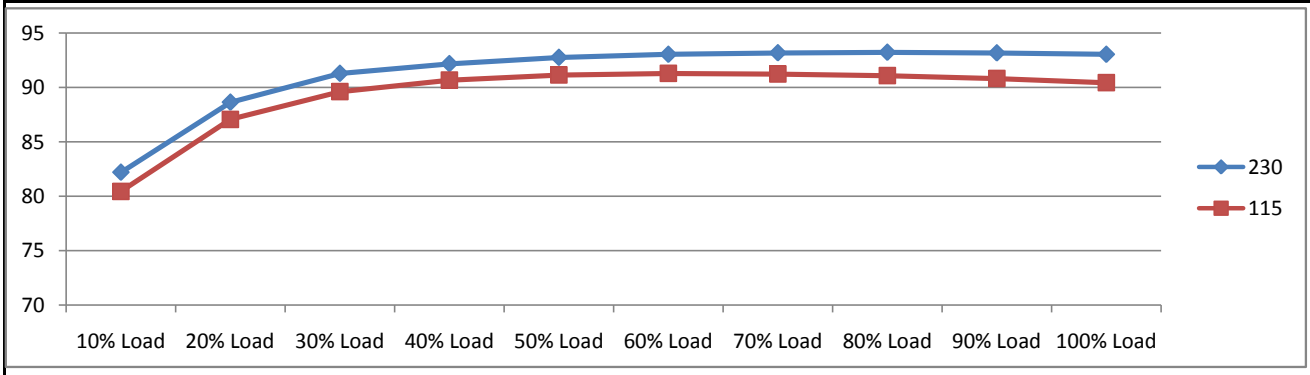
|---|---|---|---|---|
| 7 | EFFICIENCY (TYP.) | 93.0% | I/P : 230VAC<br>O/P: FULL LOAD<br>TA : 25℃ | 93.04 % |



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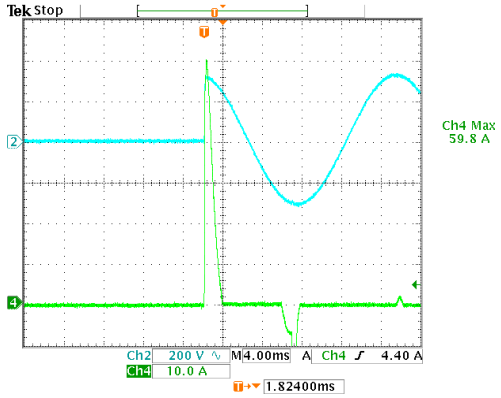
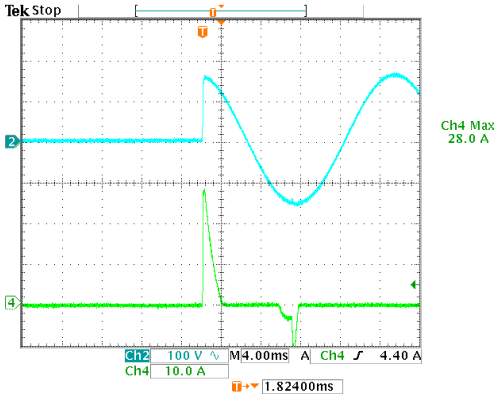
|---|---|---|---|---|---|---|---|---|
| 8 | INRUSH CURRENT (TYP.) | 80A / 230VAC<br>40A / 115VAC<br>COLD START | | I/P : 230VAC<br>I/P : 115VAC<br>TA : 25℃ | | I= 59.8A / 230VAC<br>I= 28.0A / 115VAC | | |
| | INPUT=230VAC/50HZ @ FULL LOAD<br>CH2 : AC Input Voltage CH4 : Input current (1V=1A) | | | INPUT=115VAC/50HZ @ FULL LOAD<br>CH2 : AC Input Voltage CH4 : Input current (1V=1A) | | | | |




## PROTECTION FUNCTION TEST

| NO | TEST ITEM | SPECIFICATION | TEST CONDITION | RESULT |
|---|---|---|---|---|
| 1 | OVER LOAD PROTECTION | 105% ~ 135% | I/P: 264VAC<br>I/P: 230VAC<br>I/P: 115VAC<br>O/P: TESTING<br>TA : 25℃ | 117.50% 264VAC<br>117.50% 230VAC<br>117.50% 115VAC<br>Hiccup Mode, recovers automatically after fault condition is removed |
| 2 | OVER VOLTAGE PROTECTION | 26.40V ~ 31.20V | I/P: 264VAC<br>I/P: 230VAC<br>I/P: 80VAC<br>O/P: MIN LOAD<br>TA : 25℃ | 27.80V 264VAC<br>27.80V 230VAC<br>27.80V 80VAC<br>Shut down Re- power ON |
| 3 | OVER TEMPERATURE PROTECTION | Shut down Re- power ON | 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℃ | NO DAMAGE<br>Hiccup Mode, recovers automatically after fault condition is removed |

## CONTROL FUNCTION TEST

| NO | TEST ITEM | SPECIFICATION | TEST CONDITION | RESULT |
|---|---|---|---|---|
| 1 | PS-ON INPUT SIGNAL | Power on: PS-ON = "Hi" or " > 2 ~ 5V" ;<br>Power off: PS-ON = "Low" or " < 0 ~ 0.5V" | I/P: 230VAC<br>O/P: FULL LOAD<br>TA : 25℃ | OK |
| 2 | 5V STANDBY | 5V / 1.0A<br>ripple & noise: 120 mv<br>Tolerance: ±2% | I/P: 230VAC<br>O/P: FULL LOAD<br>TA : 25℃ | 4.9425 V/ 0.9919 A<br>ripple & noise: 28.8 mv<br>Tolerance: ±1.15 % |
| 3 | FAN SUPPLY | 12V / 0.5A<br>Tolerance: ±10% | I/P: 230VAC<br>O/P: FULL LOAD<br>TA : 25℃ | 11.895 V/ 0.4934 A<br>Tolerance: ±0.875 % |
| 4 | POWER GOOD/ POWER FAIL | > 1ms<br>10ms< PG < 500ms | I/P: 230VAC<br>I/P: 115VAC<br>O/P: FULL LOAD<br>TA : 25℃ | 90.8ms 9.2ms /230VAC<br>90.8ms 6.4ms /115VAC |

COMPONENT STRESS TEST

| NO | TEST ITEM | SPECIFICATION | TEST CONDITION | RESULT |
|---|---|---|---|---|
| 1 | PWM Power Transistor | Q5 Rated： 600V 30.0A | I/P： 267VAC<br>VDS：<br>O/P： (1)Full Load Turn on<br>(2) Output Short<br>(3)Fulll load continue<br>Ta： 25℃ | VIN: 267VAC<br>VDS:<br>(1). 398.00V<br>(2). 458.00V<br>(3). 396.00V |
| 2 | PWM Power Transistor | Q6 Rated： 600V 30.0A | I/P： 267VAC<br>VDS：<br>O/P： (1)Full Load Turn on<br>(2) Output Short<br>(3)Fulll load continue<br>Ta： 25℃ | VIN: 267VAC<br>VDS:<br>(1). 422.00V<br>(2). 426.00V<br>(3). 394.00V |
| 3 | PWM Power Transistor | U900 Rated： 725V 0.7A | I/P： 267VAC<br>VDS：<br>O/P： (1)Full Load Turn on<br>(2) Output Short<br>(3)Fulll load continue<br>Ta： 25℃ | VIN: 267VAC<br>VDS:<br>(1). 492.00V<br>(2). 486.00V<br>(3). 486.00V |
| 4 | O/P MOSFET | Q101 Rated： 80V 120.0A<br>Q102 Rated： 80V 120.0A | I/P： 267VAC<br>VDS：<br>O/P： (1)Full Load Turn on<br>(2) Output Short<br>(3)Fulll load continue<br>Ta： 25℃ | Q101 Q102<br>VDS： VDS：<br>(1). 62.40V 62.20V<br>(2). 8.24V 8.36V<br>(3). 62.40V 62.20V |
| 5 | Input Capacitor | C5 Rated： 270uf 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>Ta： 25℃ | (1). 386.00V<br>(2). 384.00V<br>(3). 398.00V |
| 6 | Control IC | U2 Rated： 26V (max)<br>-0.3V (min)<br>U1 Rated： 16V (max)<br>-0.3V (min) | I/P： 267VAC<br>O/P： (1)Full Load<br>(2)Output Short<br>(3)O.L.P<br>(4)O.V.P<br>(5)Low Line No Load Vo(min)<br>Ta： 25℃ | U2 U1<br>(1). 16.20V 13.90V<br>(2). 15.60V 13.80V<br>(3). 15.30V 13.80V<br>(4). 15.30V 13.70V<br>(5). 15.90V 13.70V |
| 7 | Control IC | U101 Rated： 24V (max)<br>-0.3V (min) | I/P： 267VAC<br>O/P： (1)Full Load<br>(2)Output Short<br>(3)O.L.P<br>(4)O.V.P<br>(5)Low Line No Load Vo(min)<br>Ta： 25℃ | U101<br>(1). 11.40V<br>(2). 2.80V<br>(3). 11.50V<br>(4). 11.50V<br>(5). 11.50V |
| 8 | PFC Power Transistor | Q1 Rated： 600V 35.0A | I/P： 267VAC<br>VDS：<br>O/P： (1)Full Load Turn on<br>(2) Output Short<br>(3)Fulll load continue<br>Ta： 25℃ | VIN: 267VAC<br>VDS:<br>(1). 468.00V<br>(2). 532.00V<br>(3). 462.00V |
| 9 | PFC Diode | D10 Rated： 600V 6.0A | I/P： 267VAC<br>O/P： (1)Full Load Turn on<br>(2) Output Short<br>(3)Dynamic Load Full/Min Load 90%Duty/5KHz<br>(4)Dynamic Load Full/Min Load 50%Duty/120Hz<br>Ta： 25℃ | 267VAC<br>(1). 412.00V<br>(2). 408.00V<br>(3). 394.00V<br>(4). 396.00V |

## ■SAFETY & E.M.C. TEST

### SAFETY TEST

| NO | TEST ITEM | SPECIFICATION | TEST CONDITION | RESULT |
|---|---|---|---|---|
| 1 | WITHSTAND VOLTAGE | I/P-O/P : 3.000KVAC /min<br>I/P-FG : 2.000KVAC /min<br>O/P-FG : 0.500KVAC /min | I/P-O/P: 3.600KVAC /min<br>I/P-FG: 2.400KVAC /min<br>O/P-FG: 0.600KVAC /min<br>Ta : 25℃ | I/P-O/P: 1.47mA<br>I/P-FG: 1.66mA<br>O/P-FG: 0.54mA<br>NO DAMAGE |
| 2 | ISOLATION RESISTANCE | I/P-O/P : 500VDC>100MΩ<br>I/P-FG : 500VDC>100MΩ<br>O/P-FG : 500VDC>100MΩ | I/P-O/P: 500VDC<br>I/P-FG: 500VDC<br>O/P-FG: 500VDC<br>Ta : 25℃/70%RH | I/P-O/P: 9999MΩ<br>I/P-FG: 9999MΩ<br>O/P-FG: 9999MΩ<br>NO DAMAGE |

### E.M.C. TEST

| NO | TEST ITEM | SPECIFICATION | TEST CONDITION | RESULT |
|---|---|---|---|---|
| 1 | HARMONIC | EN61000-3-2<br>CLASS A<br>Shut down Re- power ON | I/P : 230VAC /50HZ<br>O/P : FULL LOAD<br>Ta : 25℃ | PASS |
| 2 | CONDUCTION | EN55022<br>CLASS B | I/P : 230VAC /50HZ<br>O/P : FULL LOAD / 50% LOAD<br>Ta : 25℃ | PASS<br>Test by certified Lab |
| 3 | RADIATION | EN55022<br>CLASS B | I/P : 230VAC /50HZ<br>O/P : FULL LOAD<br>Ta : 25℃ | 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℃ | CRITERIA A |
| 5 | E.F.T | EN61000-4-4<br>INDUSTRY INPUT： 2KV | I/P : 230VAC /50HZ<br>O/P : FULL LOAD<br>Ta : 25℃ | CRITERIA A |
| 6 | SURGE | IEC61000-4-5<br>INDUSTRY L-N：2KV;L/N-PE：4KV | I/P : 230VAC /50HZ<br>O/P : FULL LOAD<br>Ta : 25℃ | CRITERIA A |

## ■RELIABILITY TEST

| NO | TEST ITEM | SPECIFICATION | TEST CONDITION | RESULT |
|---|---|---|---|---|
| 1 | TEMPERATURE RISE TEST | MODEL : EPP-400-24<br>1. ROOM AMBIENT BURN-IN : 1.0hrs<br>IP: 230VAC O/P: 250W TA= 25.5℃<br>2. HIGH AMBIENT BURN-IN : 1.0hrs<br>IP: 230VAC O/P: 250W TA= 42.1℃ | | |

| NO. | Position | ROOM AMBIENT 25.5℃ | HIGH AMBIENT Ta： 42.1℃ |
|---|---|---|---|
| 1 | BD1 | 62.0℃ | 78.6℃ |
| 2 | LF1 | 41.7℃ | 58.8℃ |
| 3 | LF2 | 43.0℃ | 59.4℃ |
| 4 | Q5 | 75.3℃ | 91.8℃ |
| 5 | Q6 | 71.0℃ | 86.7℃ |
| 6 | L1 | 81.2℃ | 97.8℃ |
| 7 | D10 | 70.7℃ | 86.2℃ |
| 8 | Q1 | 74.1℃ | 89.2℃ |
| 9 | C33 | 58.1℃ | 76.3℃ |
| 10 | C5 | 69.0℃ | 82.7℃ |
| 11 | T1COIL | 69.3℃ | 83.1℃ |
| 12 | T1COIL | 65.8℃ | 81.1℃ |
| 13 | L2 | 74.6℃ | 87.7℃ |
| 14 | Q101 | 53.5℃ | 70.0℃ |
| 15 | Q102 | 59.5℃ | 74.8℃ |
| 16 | TSW1 | 66.5℃ | 81.4℃ |
| 17 | C106 | 48.1℃ | 64.1℃ |
| 18 | C105 | 51.3℃ | 66.6℃ |
| 19 | U900 | 74.7℃ | 89.3℃ |
| 20 | U1 | 69.8℃ | 84.4℃ |
| 21 | U2 | 73.7℃ | 90.1℃ |
| 22 | T900 | 62.5℃ | 78.5℃ |
| 23 | LF3 | 37.8℃ | 55.1℃ |
| 24 | C1 | 37.3℃ | 54.3℃ |
| 25 | C2 | 39.1℃ | 55.7℃ |
| 26 | D911 | 69.1℃ | 84.0℃ |

| | | | | |
|---|---|---|---|---|
| 2 | OVER LOAD BURN-IN TEST | NO DAMAGE<br>1 HOUR ( MIN ) | I/P : 230VAC<br>O/P : 123.00% LOAD<br>Ta : 25℃ | TEST : OK |
| 3 | LOW TEMPERATURE TURN ON TEST | NO DAMAGE<br>1 HOUR ( MIN ) | I/P : 264VAC / 115VAC<br>O/P : FULL LOAD<br>Ta : -30.0℃ | TEST : OK |
| 4 | HIGH HUMIDITY<br>HIGH TEMPERATURE<br>HIGH VOLTAGE TEST | AFTER 12 HOURS<br>IN CHAMBER ON<br>CONTROL 45℃<br>NO DAMAGE | I/P : 272VAC<br>O/P : FULL LOAD<br>Ta : 45℃<br>HUMIDITY= 95.0% RH | TEST : OK |
| 5 | TEMPERATURE COEFFICIENT | ±0.03% /(0℃~50℃) | I/P : 230VAC<br>O/P : FULL LOAD | ±0.005% /(0℃~50℃) |
| 6 | STORAGE TEMPERATURE TEST | 1. Thermal shock Temperature : -40℃ ~ +85℃<br>2. Temperature change rate : 25℃ / MIN<br>3. Dwell time low and high temperature : 30 MIN/EACH<br>4. Total test cycle : 5 CYCLE<br>5. Input/Output condition : STATIC | | TEST : OK |
| 7 | THERMAL SHOCK TEST | 1. Thermal shock Temperature : -35℃ ~ +50℃<br>2. Temperature change rate : 25℃ / MIN<br>3. Dwell time low and high temperature : 30 MIN/EACH<br>4. Total test cycle : 10 CYCLE<br>5. Input/Output condition :<br>230VAC Full Load AC ON/OFF test turn on 58sec ; turn off 2sec | | TEST : OK |
| 8 | VIBRATION TEST | 1 Carton & 1 Set<br>(1) Waveform : Sine Wave<br>(2) Frequency : 10~500Hz<br>(4) Acceleration : 2G<br>(5) Test Time : 60 min in each axis (X.Y.Z)<br>(6) Ta : 25℃ | | TEST : OK |
| 9 | CAPACITOR LIFE CYCLE | :SUPPOSE C106 IS THE MOST CRITICAL COMPONENT<br>(1) I/P : 230VAC O/P : FULL LOAD Ta= 25.0℃ LIFE TIME<br>(2) I/P : 230VAC O/P : FULL LOAD Ta= 45.0℃ LIFE TIME<br>(3) I/P : 230VAC O/P : 75% LOAD Ta= 45.0℃ LIFE TIME<br>(4) I/P : 230VAC O/P : 50% LOAD Ta= 45.0℃ LIFE TIME | | (1). 505637 HRS<br>(2). 131777.8 HRS<br>(3). 219984.4 HRS<br>(4). 321245.6 HRS |
| 10 | MTBF | Conducted by Parts Stress Analysis Prediction<br>194.1K hrs min. MIL-HDBK-217F (25℃) | | |
| 11 | DMTBF /Accelerated Life test | Demonstration Mean Time Between Failure (Expected Life): Above 30000HRS @ TA 45℃ | | |

| TEST RESULT | TESTER | REVIEW | APPROVAL |
|---|---|---|---|
| PASS | frank | GESG | WANGDZ |

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