



# Test Report: HRPG-1000-48

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1000W 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

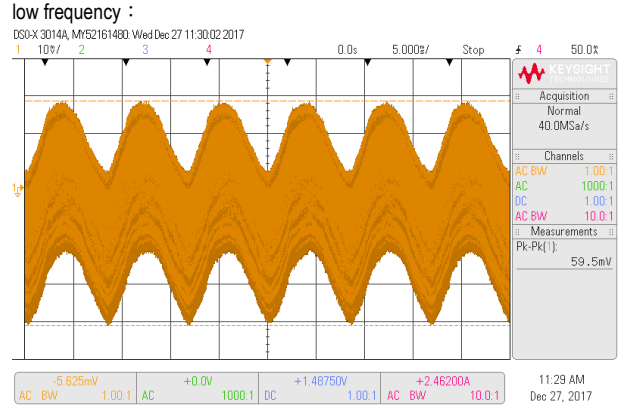
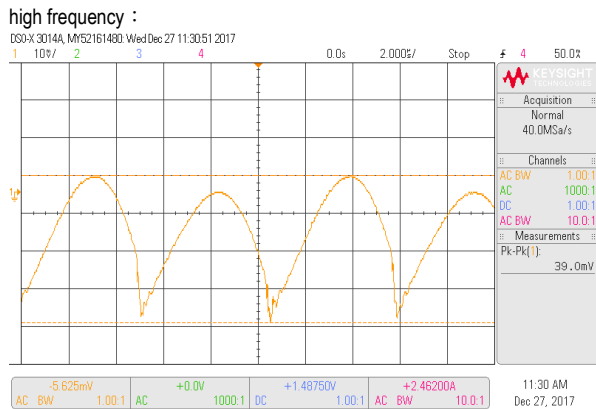
## ■ RELIABILITY TEST

ENVIRONMENT TEST

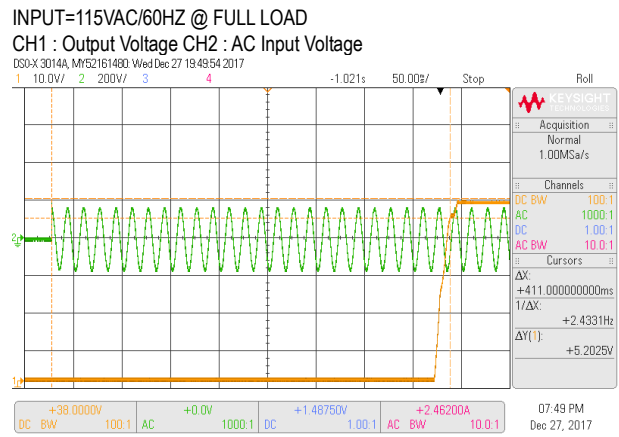
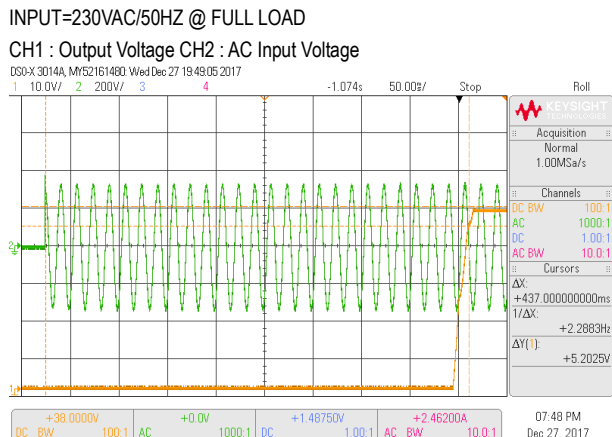
■ DESIGN VERIFY TEST

**OUTPUT FUNCTION TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE ADJUST RANGE	CH1: 46V~ 56 V	I/P : 230 VAC I/P : 115 VAC O/P : MIN LOAD Ta : 25°C	43.57V~57.76V/230VAC 43.68V~57.73V/115VAC
2	OUTPUT VOLTAGE(Max) TOLERANCE	V1: 1%~ -1%	I/P: 200VAC /264VAC O/P:FULL/ MIN. LOAD Ta:25°C	V1: 0.31%~ 0 %
3	LINE REGULATION (Max)	V1: 0.5%~ -0.5 %	I/P: 200VAC~ 264VAC O/P:FULL LOAD Ta:25°C	V1: 0 %
4	LOAD REGULATION(Max)	V1: 0.5%~ -0.5 %	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25°C	V1: 0 %
5	OVER/UNDERSHOOT TEST	< ±5%	I/P: 230VAC O/P:FULL LOAD Ta:25°C	< 5 %
6	RIPPLE & NOISE(Max)	V1: 250mVp-p	I/P:230VAC O/P:FULL LOAD Ta:25°C	V1: 39 mVp-p



7	SET UP TIME(Max)	230VAC/1000ms 115VAC/2000ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/ 437 ms 115VAC/ 411 ms
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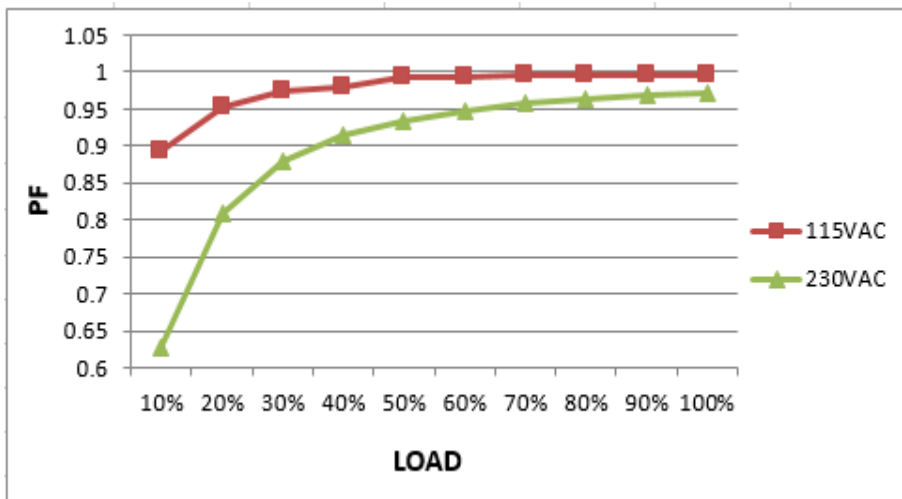


<b>8</b> RISE TIME (Max)	230VAC/50ms 115VAC/50ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/18 ms 115VAC/ 16.6 ms
INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage 		INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage 	
<b>9</b> HOLD UP TIME (Typ.)	230VAC/16ms 115VAC/16ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/21.6 ms 115VAC/25.6 ms
INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage 		INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage 	
<b>10</b> DYNAMIC LOAD	V1: 4800 mVp-p	I/P: 230VAC O/P: (1)FULL /50% LOAD 50%DUTY / 120HZ (2)FULL /50% LOAD 50%DUTY / 1KHZ Ta:25°C	255mVp-p 225mVp-p
FULL /50% LOAD 50%DUTY / 120HZ 		FULL /50% LOAD 50%DUTY / 1KHZ 	

**INPUT FUNCTION TEST**

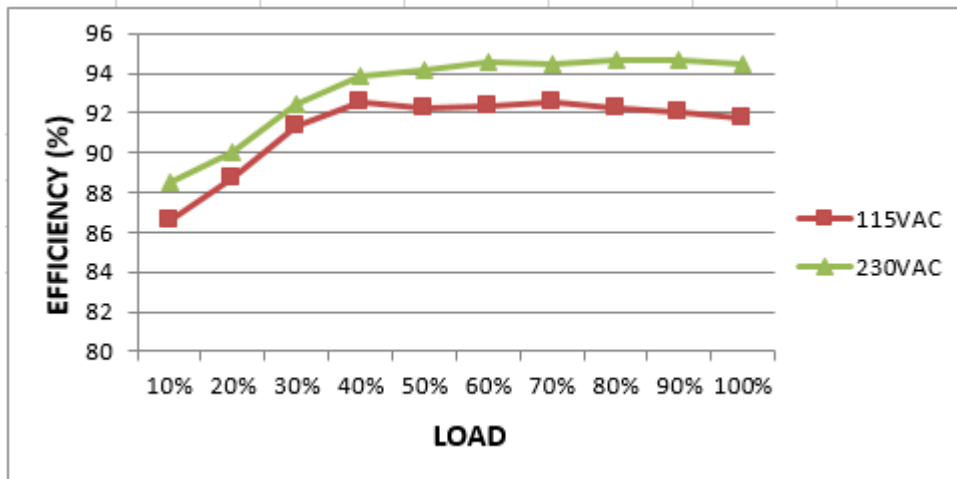
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	90VAC~264VAC	I/P:TESTING O/P:FULL LOAD Ta:25°C	73V~264V
			I/P: LOW-LINE-3V=87 V HIGH-LINE+15%=300 V O/P:FULL/MIN LOAD (PLEASE CHECK DERATING CURVE) ON: 30 Sec OFF: 30 Sec 10MIN (POWER ON/OFF NO DAMAGE)	TEST:OK
2	INPUT FREQUENCY RANGE	47HZ ~63 HZ NO DAMAGE	I/P:100 VAC ~264 VAC O/P:FULL~MIN LOAD Ta:25°C	TEST: OK
3	INPUT CURRENT (Typ.)	230V/ 5A 115V/ 8.5A	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	I=4.8A/ 230VAC I=8.21A/ 115VAC
4	LEAKAGE CURRENT	< 1.2mA/240VAC	I/P : 240 VAC O/P : Min LOAD Ta : 25°C	L-FG : 0.3mA N-FG : 0.3mA
5	NO LOAD CONSUMPTION	< 0.75W	I/P : 115VAC I/P : 230VAC O/P : NO LOAD Ta : 25°C	< 0.412 W < 0.671 W
6	POWER FACTOR (Typ.)	0.95/ 230VAC 0.98/115VAC	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	PF=0.973/230VAC PF=0.996/115VAC

P.F vs LOAD

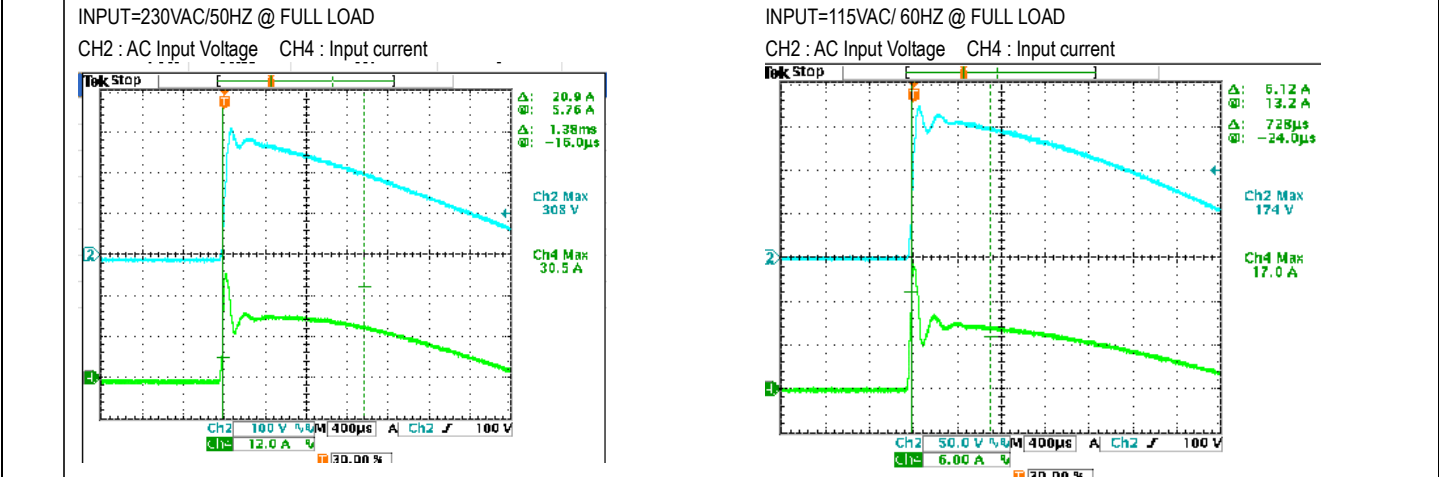


7	EFFICIENCY(Typ.)	94%	I/P:230 VAC O/P:FULL LOAD Ta:25°C	94.2 %
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EFFICIENCY vs LOAD



8	INRUSH CURRENT(Typ.)	230V/40A 115V/20A COLD START	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	I=30.5A/ 230VAC I=17A/ 115VAC T50= 1380 us/230V
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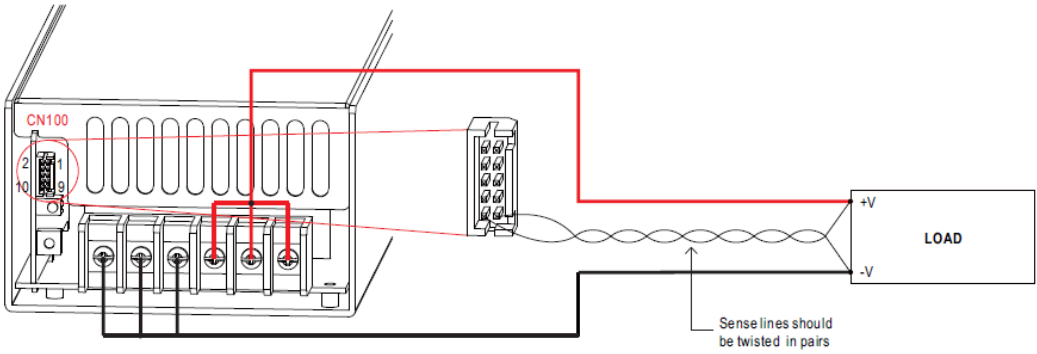
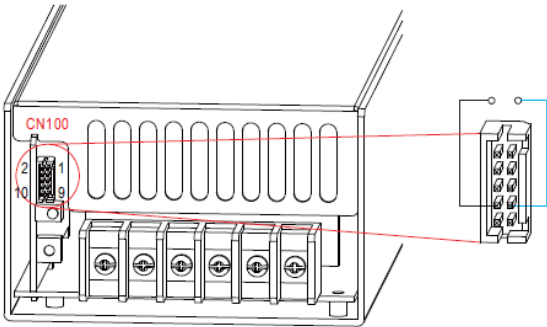
**PROTECTION FUNCTION TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER LOAD PROTECTION	105%~ 135 % Protection type : Constant current limiting, recovers automatically after fault condition is removed	I/P: 264VAC I/P: 230VAC I/P: 200AC O/P:TESTING Ta:25°C	115.03%/ 264VAC 115.03%/ 230VAC 115.04%/200VAC PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed

2	OVER VOLTAGE PROTECTION	58V~65V Protection type : Shut down o/p voltage, re-power on to recover	I/P: 264VAC I/P: 230VAC I/P: 90VAC O/P: MIN LOAD Ta:25°C	60.97V/ 264VAC 60.97V/ 230VAC 60.98V/ 90VAC PROTECTION TYPE : Shut down o/p voltage, re-power on to recover
3	OVER TEMPERATURE PROTECTION	Protection type : Shut down o/p voltage, recovers automatically after temperature goes down	I/P: 264VAC I/P: 90VAC O/P: FULL LOAD	O.T.P. Active Protection type : Shut down o/p voltage, recovers automatically after temperature goes down
4	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE PROTECTION TYPE :	I/P: 264VAC I/P: 90VAC O/P: FULL LOAD Ta:25°C	NO DAMAGE PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed

**CONTROL FUNCTION TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT						
1	CURRENT SHARING	< 10%	I/P : 230 VAC O/P : FULL/50% LOAD Ta : 25°C	O/P : 90% PSU1 : 19.4A PSU2 : 19.3A PSU3 : 19.4A PSU4 : 20.3A O/P : 50% PSU1 : 10.9A PSU2 : 10.2A PSU3 : 10.3A PSU4 : 11.8A						
2	REMOTE ON/OFF CONTROL	<p>The PSU can be turned ON/OFF by using the "Remote Control" function.</p> <table border="1"> <tr> <td>Between RC+(pin3) and RC-(pin4)</td> <td>Output Status</td> </tr> <tr> <td>SW ON (Short)</td> <td>ON</td> </tr> <tr> <td>SW OFF (Open)</td> <td>OFF</td> </tr> </table> <p>I/P: 230 VAC O/P: FULL LOAD Ta:25°C TEST RESULT : OK</p>	Between RC+(pin3) and RC-(pin4)	Output Status	SW ON (Short)	ON	SW OFF (Open)	OFF		
Between RC+(pin3) and RC-(pin4)	Output Status									
SW ON (Short)	ON									
SW OFF (Open)	OFF									
3	REMOTE SENSE	S+ / S- >0.5V								

		 <p>I/P: 230 VAC O/P:FULL LOAD Ta:25°C TEST RESULT:&gt; 0.5 V</p>											
4	DC OK SIGNAL	<p>The TTL signal out, PSU turn on = 3.3 ~ 5.6V ; PSU turn off = 0 ~ 1V DC-OK signal is a TTL level signal. High when PSU turns on.</p> <table border="1" data-bbox="459 929 817 1032"> <thead> <tr> <th>Between DC-OK(pin7) and GND(pin6,8)</th> <th>Output Status</th> </tr> </thead> <tbody> <tr> <td>3.3 ~ 5.6V</td> <td>ON</td> </tr> <tr> <td>0 ~ 1V</td> <td>OFF</td> </tr> </tbody> </table>  <p>I/P:230VAC O/P:FULL LOAD Ta:25°C TEST RESULT: PSU turn on = 5.27V PSU turn off = 0.005V</p>	Between DC-OK(pin7) and GND(pin6,8)	Output Status	3.3 ~ 5.6V	ON	0 ~ 1V	OFF					
Between DC-OK(pin7) and GND(pin6,8)	Output Status												
3.3 ~ 5.6V	ON												
0 ~ 1V	OFF												
5	5V STANDBY	5VSB : 5V@0.3A ; tolerance± 5%, ripple : 50mVp-p(max.)	I/P: 230 VAC O/P:FULL LOAD Ta:25°C	TEST RESULT : 5.035V /0.3A Ripple : 3.2 mVp-p									
6	FAN CONTROL	FAN ON/OFF BY BY NTC (RT50) OR LOAD	I/P: 230 VAC O/P:TESTING	<table border="1" data-bbox="1150 1608 1501 1709"> <thead> <tr> <th></th> <th>TEMP.</th> <th>LOAD</th> </tr> </thead> <tbody> <tr> <td>FAN ON</td> <td>55°C</td> <td>&gt;10.4%</td> </tr> <tr> <td>FAN OFF</td> <td>36°C</td> <td>&lt;10%</td> </tr> </tbody> </table>		TEMP.	LOAD	FAN ON	55°C	>10.4%	FAN OFF	36°C	<10%
	TEMP.	LOAD											
FAN ON	55°C	>10.4%											
FAN OFF	36°C	<10%											

**COMPONENT STRESS TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Transistor ( D to S) or (C to E) <b>Peak Voltage</b>	Q911 Rated: 26A / 600V	I/P:High-Line +3V =303V AC ON/OFF VDS: O/P: (1)Full Load (2)Output Short	VDS: (1)506V (2)490V

			<p>(3)Dynamic Load Full Load/ Min. Load 90%Duty/1KHz</p> <p>(4)Dynamic Load Full Load/ Min. Load 90%Duty/3KHz</p> <p>(5)Dynamic Load Full Load/ Min. Load 90%Duty/5KHz</p> <p>(6)Dynamic Load 100% Load/ Min. Load 50%Duty/120Hz</p> <p>(7)0%→400% Load. Ta:25°C</p>	<p>(3)510V</p> <p>(4)510V</p> <p>(5)506V</p> <p>(6)510V</p> <p>(7)490V</p>
2	P.F.C Transistor ( D to S) or (C to E) <b>Peak Voltage</b>	Q1 Rated: 34A / 600V	<p>I/P:High-Line +3V =303V V</p> <p>AC ON/OFF</p> <p>O/P: (1)Full Load</p> <p>(2)Output Short</p> <p>(3)Dynamic Load Full Load/ Min. Load 90%Duty/1KHz</p> <p>(4)Dynamic Load Full Load/ Min. Load 90%Duty/3KHz</p> <p>(5)Dynamic Load Full Load/ Min. Load 90%Duty/5KHz</p> <p>(6)Dynamic Load 100% Load/ Min. Load 50%Duty/120Hz</p> <p>(7)0%→400% Load. Ta:25°C</p>	<p>VDS:</p> <p>(1) 490V</p> <p>(2) 510V</p> <p>(3) 502V</p> <p>(4) 506V</p> <p>(5) 510V</p> <p>(6) 506V</p> <p>(7) 494V</p>
3	P.F.C DIODE	D6 Rated: 10A / 600V	<p>I/P:High-Line +3V =303V V</p> <p>AC ON/OFF</p> <p>O/P: (1)Full Load</p> <p>(2)Output Short</p> <p>(3)Dynamic Load Full Load/ Min. Load 90%Duty/5KHz</p> <p>(4)Dynamic Load 100% Load/ Min. Load 50%Duty/120Hz</p> <p>Ta:25°C</p>	<p>(1) 405V</p> <p>(2) 413V</p> <p>(3) 389V</p> <p>(4) 397V</p>
4	SR MOSFET <b>Peak Voltage</b>	Q508 Rated: 76A / 150V Q506 Rated: 76A / 150V	<p>I/P:High-Line +3V =303V V</p> <p>AC ON/OFF</p> <p>O/P: (1)Full Load</p> <p>(2)Output Short</p> <p>(3)Dynamic Load Full Load/ Min. Load 90%Duty/1KHz</p> <p>(4)Dynamic Load Full Load/ Min. Load 90%Duty/3KHz</p> <p>(5)Dynamic Load Full Load/ Min. Load 90%Duty/5KHz</p> <p>(6)Dynamic Load 100% Load/ Min. Load 50%Duty/120Hz</p> <p>(7)0%→400% Load.</p> <p>(8).NO LOAD</p> <p>(9) burst mode</p> <p>Ta:25°C</p>	<p>Q508: VDS:</p> <p>(1)118.2V</p> <p>(2)6.0V</p> <p>(3)118.6V</p> <p>(4)117.8V</p> <p>(5)116.2V</p> <p>(6)117.8V</p> <p>(7)113.8V</p> <p>(8)48.4V</p> <p>(9)116.2V</p> <p>Q506: VDS:</p> <p>(1)119.4V</p> <p>(2)13.3V</p> <p>(3)118.6V</p> <p>(4)120.2V</p> <p>(5)118.6V</p> <p>(6)118.6V</p> <p>(7)114.6V</p> <p>(8)113.8V</p> <p>(9)117.8V</p>
5	<b>Input Capacitor Voltage</b>	C5 220μF / 400V	<p>I/P:High-Line +3V =303VV</p> <p>O/P: (1)Full Load input on/off</p> <p>(2) Min load input on /Off</p> <p>(3)Full Load /Min load Change</p> <p>(4)Full load continue</p> <p>Ta:25°C</p>	<p>(1)399V</p> <p>(2)399V</p> <p>(3)398V</p> <p>(4) 398V</p>



6	Control IC Voltage Test	<p>PFC IC U1 Absolute Rating: -0.3 V ~ 26 V Operating Range: 12.9 V ~ 25 V</p> <p>PWM IC U900 Absolute Rating: Self-limited Operating Range: 8.85 V ~ 16 V</p>	<p>I/P:High-Line +3V =303V V AC ON/OFF O/P(1)FULL LOAD (2) Output Short (3)O.L.P (4)O.V.P. (5)NO LOAD VRmin .LOW LINE Ta:25°C</p>	<p>(1) 21.5V (2) 21.9V (3) 21.3V (4) 19.5V (5) 15.2V</p> <p>(1) 14.63V (2) 14.87V (3) 15.03V (4) 14.07V (5) 13.51V</p>
7	TOP SWITCHING STAND BY POWER	U971 Rated : 1.8 A / 700V	<p>I/P:High-Line +3V =303V V AC ON/OFF O/P: (1)Full Load (2)Remote On/Off Ta:25°C</p>	<p>(1) 535V (2) 543V</p>

**SAFETY TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	<p>I/P-O/P: 3KVAC/min I/P-FG :2KVAC/min O/P-FG:0.5KVAC/min</p>	<p>I/P-O/P: 3.6 KVAC/min I/P-FG: 2.4 KVAC/min O/P-FG:0.6 KVAC/min Ta:25°C</p>	<p>I/P-O/P:6.02mA I/P-FG:5.44mA O/P-FG:2.82mA NO DAMAGE</p>
2	ISOLATION RESISTANCE	<p>I/P-O/P:500VDC&gt;100MΩ I/P-FG: 500VDC&gt;100MΩ O/P-FG:500VDC&gt;100MΩ</p>	<p>I/P-O/P: 500 VDC I/P-FG: 500 VDC O/P-FG: 500 VDC Ta:25°C</p>	<p>I/P-O/P: 23.8GΩ I/P-FG:23.2 GΩ O/P-FG:30 GΩ NO DAMAGE</p>
3	GROUNDING CONTINUITY	<p>FG(PE) TO CHASSIS OR TRACE &lt; 100 mΩ</p>	<p>40A / 2min Ta:25°C</p>	<p>13 mΩ</p>

**E.M.C TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	HARMONIC	<p>EN61000-3-2 CLASS A</p>	<p>I/P:230VAC/50HZ O/P:FULL LOAD Ta:25°C</p>	<p>PASS</p>
2	CONDUCTION	<p>EN55032 /EN55011 CLASS B</p>	<p>I/P : 230 VAC (50HZ) O/P : FULL/50% LOAD Ta : 25°C</p>	<p>PASS Test by certified Lab</p>
3	RADIATION	<p>EN55032 /EN55011 CLASS B</p>	<p>I/P : 230 VAC (50HZ) O/P : FULL LOAD Ta : 25°C</p>	<p>PASS Test by certified Lab</p>
4	E.S.D	<p>EN61000-4-2 MEDICAL AIR: 8KV / Contact: 4KV</p>	<p>I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C</p>	<p>CRITERIA A</p>
5	E.F.T	<p>EN61000-4-4 MEDICAL INDUSTRY INPUT : 2KV</p>	<p>I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C</p>	<p>CRITERIA A</p>
6	SURGE	<p>IEC61000-4-5 MEDICAL INDUSTRY L-N : 2KV L,N-PE : 4KV</p>	<p>I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C</p>	<p>CRITERIA A</p>

7	Test by certified Lab & Test Report Prepare
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**RELIABILITY TEST**

**ENVIRONMENT TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	
1	TEMPERATURE RISE TEST	MODEL : HRPG-1000-48 1. ROOM AMBIENT BURN-IN : 1.5 HRS I/P : 230VAC O/P : FULL LOAD Ta= 25 °C 2. HIGH AMBIENT BURN-IN : 1 HRS I/P : 230VAC O/P : FULL LOAD Ta= 60 °C			
		NO	Position	ROOM AMBIENT Ta= 25 °C	HIGH AMBIENT Ta= 60 °C
		1	BD1	47.0°C	83.0°C
		2	R6	48.5°C	85.1°C
		3	Q1	40.5°C	77.3°C
		4	U1	39.9°C	76.1°C
		5	D5	35.5°C	71.9°C
		6	D6	45.3°C	83.1°C
		7	C6	33.0°C	68.5°C
		8	D981	40.0°C	76.3°C
		9	RY1	36.3°C	73.0°C
		10	RG2	45.3°C	82.2°C
		11	D431	46.3°C	81.4°C
		12	C406	26.6°C	62.7°C
		13	TSW4	34.2°C	70.6°C
		14	L1	47.5°C	82.2°C
		15	T951	39.7°C	75.8°C
		16	C2	33.0°C	69.6°C
		17	LF3	36.5°C	73.5°C
		18	T1-1	51.5°C	87.4°C
		19	T1-2	48.4°C	84.4°C
		20	T2-1	49.9°C	85.6°C
		21	T2-2	42.7°C	79.1°C
		22	L900	43.3°C	80.2°C
		23	Q910	50.1°C	90.1°C
		24	C933	31.2°C	67.4°C
		25	Q911	47.4°C	87.0°C
		26	U900	30.4°C	66.6°C
		27	C906	26.7°C	62.9°C
		28	C106	30.9°C	67.2°C
		29	C109	28.0°C	64.0°C
		30	U501	33.0°C	69.7°C
		31	Q502	44.3°C	81.2°C
		32	Q504	43.1°C	79.6°C
		33	U504	37.2°C	73.8°C
		34	Q506	51.5°C	88.7°C
		35	Q508	43.4°C	80.3°C
36	TSW3	27.6°C	63.7°C		



2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR ( MIN )	I/P : 230 VAC O/P : 115 % LOAD Ta : 25°C	TEST : OK
3	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 230VAC/90VAC O/P : 100% /80% LOAD Ta= -45°C	TEST : OK
4	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 60 °C HUMIDITY= 90 %R.H NO DAMAGE	I/P : 272 VAC O/P : FULL LOAD Ta= 60°C HUMIDITY= 95 %R.H	TEST : OK
5	TEMPERATURE COEFFICIENT	± 0.03 %/°C (0-60°C)	I/P : 230 VAC O/P : FULL LOAD	± 0.009 %/°C (0-60°C)
6	STORAGE TEMPERATURE TEST	-40~85°C	1. Thermal shock Temperature : -45°C~ +90°C 2. Temperature change rate : 25°C / MIN 3. Dwell time low and high temperature : 30 MIN/EACH 4. Total test cycle : 10 CYCLE 5. Input/Output condition : STATIC	
7	THERMAL SHOCK TEST	-40~60°C	1. Thermal shock Temperature : -45°C~ +65°C 2. Temperature change rate : 25°C / MIN 3. Dwell time low and high temperature : 30 MIN/EACH 4. Total test cycle : 16 CYCLE 5. Input/Output condition : 15cycle:230V/ FULL LOAD AC ON 3sec/AC OFF 1sec TEST 1cycle:230V/ FULL LOAD Burn In Test	
8	VIBRATION TEST	10 ~ 500Hz, 5G 10min./1cycle, 60min. each along X, Y, Z axes	1 Carton & 1 Set (1) Waveform : Sine Wave (2) Frequency : 10~500Hz (3) Sweep Time : 12min/sweep cycle (4) Acceleration : 6G (5) Test Time : 180min in each axis (X.Y.Z) (6) Ta : 25°C	
9	CAPACITOR LIFE CYCLE	SUPPOSE C105 IS THE MOST CRITICAL COMPONENT (1) I/P : 230VAC O/P : FULL LOAD Ta= 25°C LIFE TIME (2) I/P : 230VAC O/P : FULL LOAD Ta= 60°C LIFE TIME (3) I/P : 230VAC O/P : 75% LOAD Ta= 60°C LIFE TIME (4) I/P : 230VAC O/P : 50% LOAD Ta= 60°C LIFE TIME		(1) 2272135HRS (2) 183566HRS (3) 236909HRS (4) 268024HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 862.1K hrs min. Telcordia SR-332 (Bellcore) ; 105.9K hrs min. MIL-HDBK-217F (25°C)		
11	DMTBF/Accelerated Life Test	Demonstration Mean Time Between Failure (Expected Life): Above 50,000 hours @ TA 60°C		

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

12.10.30 A50-F031