Test Report: HRPG-1000-48

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

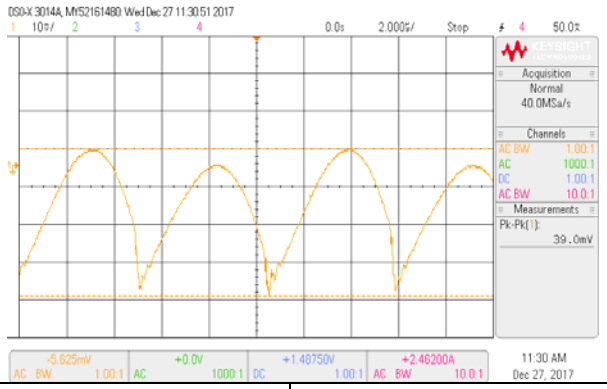
ENVIRONMENT TEST

■ DESIGN VERIFY TEST

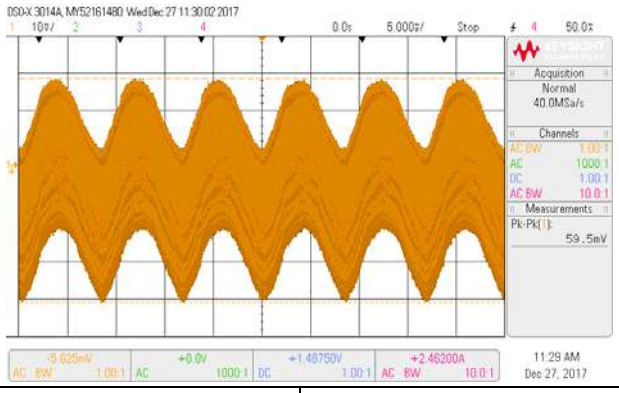
OUTPUT FUNCTION TEST

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℃	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℃	V1: 0.31 %~ 0 %
3	LINE REGULATION (Max)	V1: 0.5%~ -0.5 %	I/P: 200VAC~ 264VAC O/P:FULL LOAD Ta:25℃	V1: 0 %
4	LOAD REGULATION(Max)	V1: 0.5%~ -0.5 %	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25℃	V1: 0 %
5	OVER/UNDERSHOOT TEST	< ±5%	I/P: 230VAC O/P:FULL LOAD Ta:25℃	<5 %
6	RIPPLE & NOISE(Max)	V1: 250mVp-p	I/P:230VAC O/P:FULL LOAD Ta:25℃	V1: 39 mVp-p

high frequency：



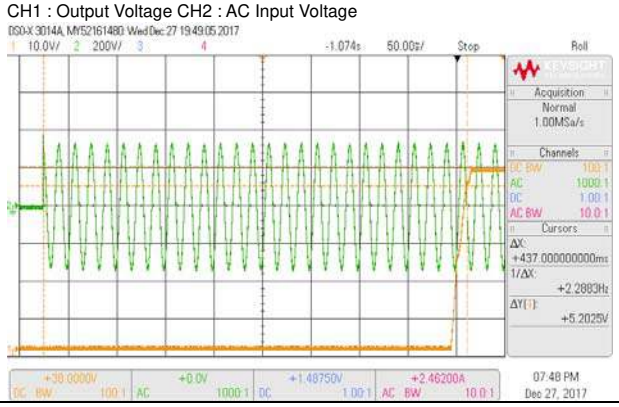
low frequency：



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

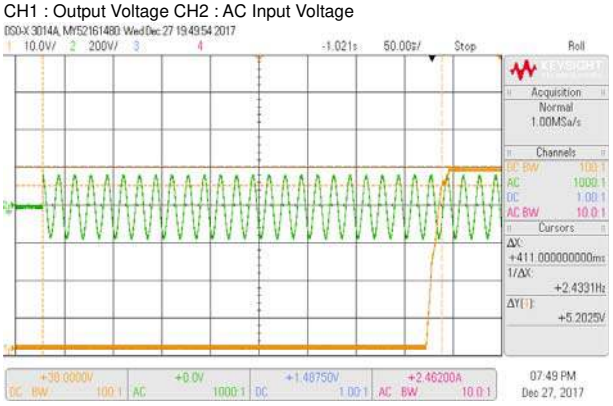
INPUT=230VAC/50HZ @ FULL LOAD

CH1 : Output Voltage CH2 : AC Input Voltage



INPUT=115VAC/60HZ @ FULL LOAD

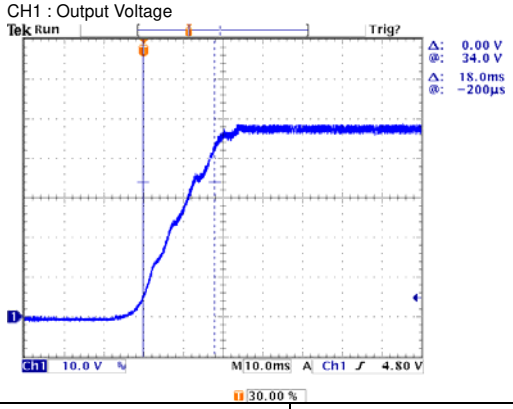
CH1 : Output Voltage CH2 : AC Input Voltage



8	RISE TIME (Max)	230VAC/50ms 115VAC/50ms	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	230VAC/18 ms 115VAC/ 16.6 ms

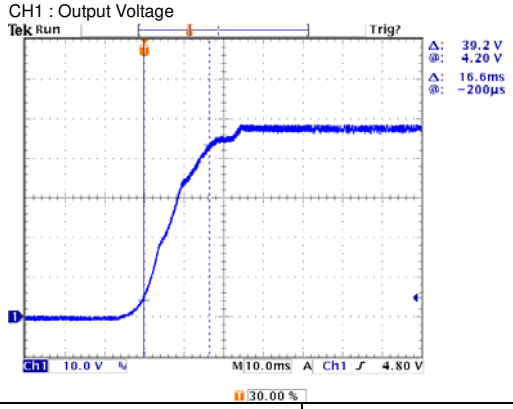
INPUT=230VAC/50HZ @ FULL LOAD

CH1 : Output Voltage



INPUT=115VAC/60HZ @ FULL LOAD

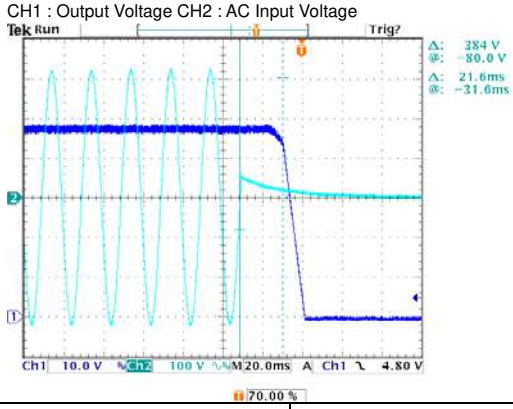
CH1 : Output Voltage



9	HOLD UP TIME (Typ.)	230VAC/16ms 115VAC/16ms	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	230VAC/21.6 ms 115VAC/25.6 ms

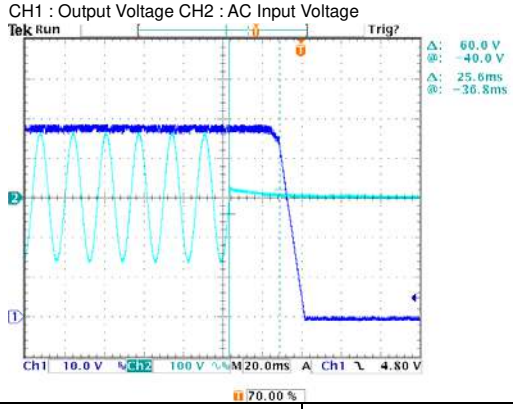
INPUT=230VAC/50HZ @ FULL LOAD

CH1 : Output Voltage CH2 : AC Input Voltage



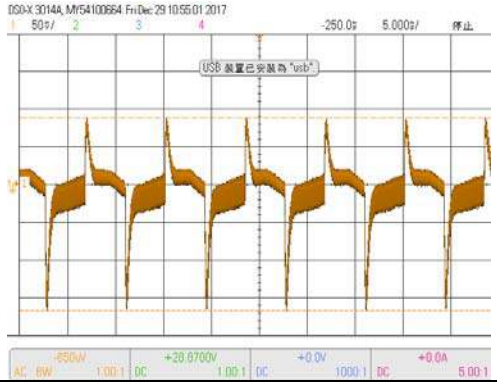
INPUT=115VAC/60HZ @ FULL LOAD

CH1 : Output Voltage CH2 : AC Input Voltage

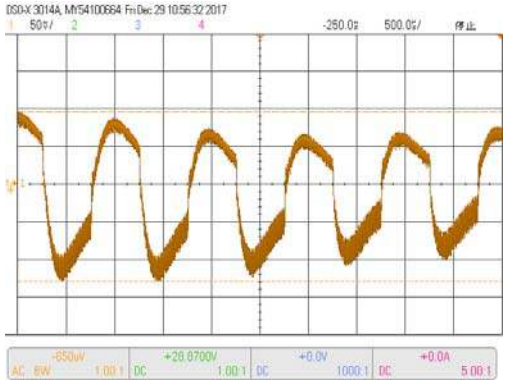


10	DYNAMIC LOAD	V1: 4800 mVp-p	I/P: 230VAC O/P: (1)FULL /50% LOAD 50%DUTY / 120HZ (2)FULL /50% LOAD 50%DUTY / 1KHZ Ta:25℃	 255mVp-p 225mVp-p

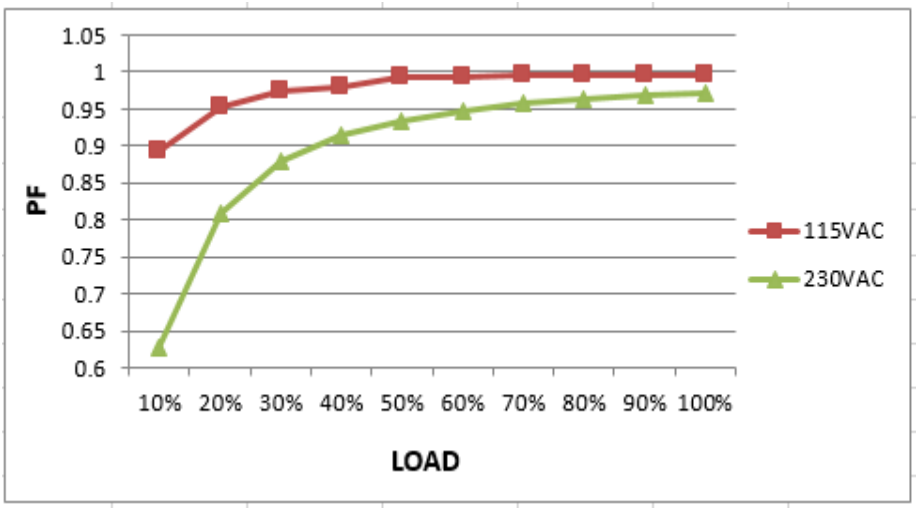
FULL /50% LOAD 50%DUTY / 120HZ

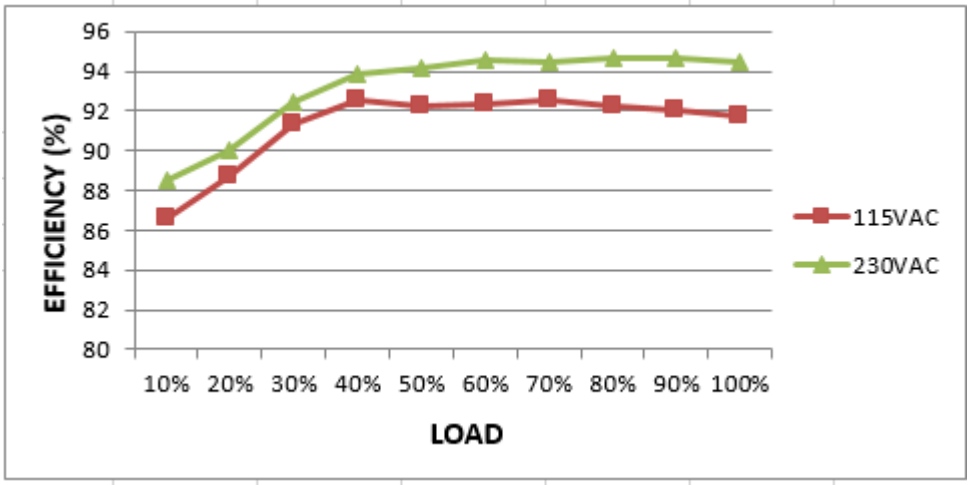


FULL /50% LOAD 50%DUTY / 1KHZ



INPUT FUNCTION TEST

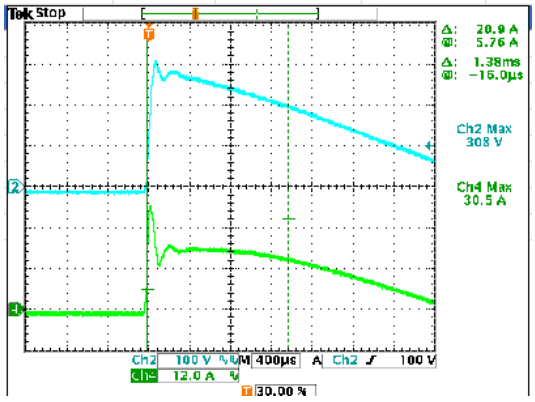
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	90VAC~264VAC	I/P:TESTING O/P:FULL LOAD Ta:25℃	73V~264V
			I/P: LOW-LINE-3V=87 V HIGH-LINE+15%=300 V O/P:FULL/MIN LOAD (PLEASE CHECK DERATING CURVE) ON: 30 Sec OFF: 30 Sec 10MIN (POWER ON/OFF NO DAMAGE)	TEST:OK
2	INPUT FREQUENCY RANGE	47HZ ~63 HZ NO DAMAGE	I/P:100 VAC ~264 VAC O/P:FULL~MIN LOAD Ta:25℃	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℃	I =4.8A/ 230VAC I =8.21A/ 115VAC
4	LEAKAGE CURRENT	< 1.2mA/240VAC	I/P： 240 VAC O/P：Min LOAD Ta：25℃	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℃	< 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℃	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℃	94.2 %
	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℃	I =30.5A/ 230VAC I =17A/ 115VAC T50= 1380 us/230V

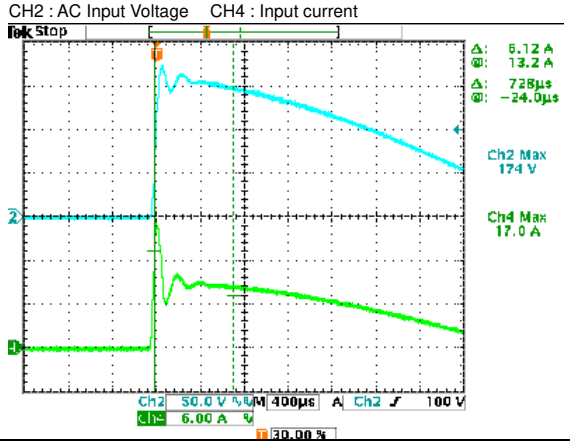
INPUT=230VAC/50HZ @ FULL LOAD

CH2 : AC Input Voltage CH4 : Input current



INPUT=115VAC/ 60HZ @ FULL LOAD

CH2 : AC Input Voltage CH4 : Input current

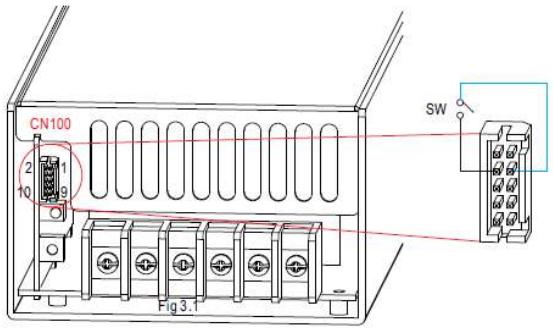


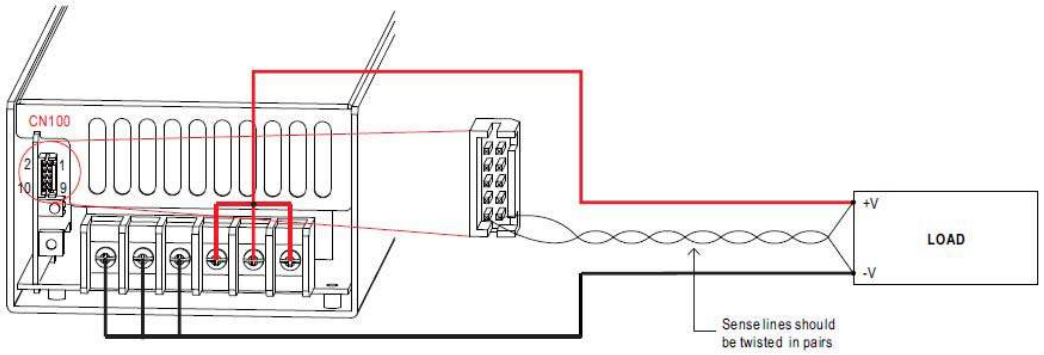
PROTECTION FUNCTION TEST

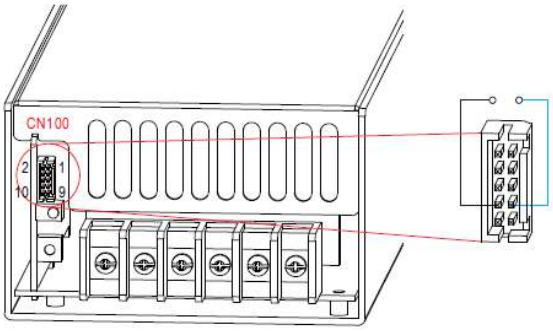
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER LOAD PROTECTION	105%~ 135 % Protection type : Constant current limiting, recovers automatically after fault condition is removed	I/P: 264VAC I/P: 230VAC I/P: 200AC O/P:TESTING Ta:25℃	115.03%/ 264VAC 115.03%/ 230VAC 115.04%/200VAC PROTECTION TYPE： 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℃	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℃	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℃	O/P：90% PSU1： 19.4A PSU2： 19.3 A PSU3： 19.4A PSU4： 20.3A O/P：50% PSU1： 10.9 A PSU2： 10.2 A PSU3： 10.3A PSU4： 11.8A
2	REMOTE ON/OFF CONTROL	The PSU can be turned ON/OFF by using the "Remote Control" function. Between RC+(pin3) and RC-(pin4) / Output Status SW ON (Short) / ON SW OFF (Open) / OFF  I/P: 230 VAC O/P: FULL LOAD Ta:25℃ TEST RESULT : OK		
3	REMOTE SENSE	S+ / S- >0.5V		

<table>
<tr><td></td><td></td><td colspan="3"> 

I/P: 230 VAC
O/P:FULL LOAD
Ta:25℃
TEST RESULT:> 0.5 V</td></tr>
<tr><td>4</td><td>DC OK SIGNAL</td><td colspan="3">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.
<table><tr><th>Between DC-OK(pin7) and GND(pin6,8)</th><th>Output Status</th></tr><tr><td>3.3 ~ 5.6V</td><td>ON</td></tr><tr><td>0 ~ 1V</td><td>OFF</td></tr></table> 

I/P:230VAC
O/P:FULL LOAD
Ta:25℃
TEST RESULT:
PSU turn on = 5.27V
PSU turn off = 0.005V</td></tr>
<tr><td>5</td><td>5V STANDBY</td><td>5VSB ： 5V@0.3A ； tolerance± 5%, ripple : 50mVp-p(max.)</td><td>I/P: 230 VAC
O/P:FULL LOAD
Ta:25℃</td><td>TEST RESULT：
5.035V /0.3A
Ripple：3.2 mVp-p</td></tr>
<tr><td>6</td><td>FAN CONTROL</td><td>FAN ON/OFF BY BY NTC (RT50) OR LOAD</td><td>I/P: 230 VAC
O/P:TESTING</td><td><table><tr><th></th><th>TEMP.</th><th>LOAD</th></tr><tr><td>FAN ON</td><td>55℃</td><td>>10.4%</td></tr><tr><td>FAN OFF</td><td>36℃</td><td><10%</td></tr></table></td></tr>
</table>

COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Transistor (D to S) or (C to E) **Peak Voltage**	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

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

6	**Control IC Voltage Test**	PFC IC U1 Absolute Rating: -0.3 V ~ 26 V Operating Range: 12.9 V ~ 25 V PWM IC U900 Absolute Rating: Self-limited Operating Range: 8.85 V ~ 16 V	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℃	(1) 21.5V (2) 21.9V (3) 21.3V (4) 19.5V (5) 15.2V (1) 14.63V (2) 14.87V (3) 15.03V (4) 14.07V (5) 13.51V
7	TOP SWITCHING STAND BY POWER	U971 Rated : 1.8 A / 700V	I/P:High-Line +3V =303V V AC ON/OFF O/P: (1)Full Load (2)Remote On/Off Ta:25℃	 (1) 535V (2) 543V

SAFETY TEST

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

E.M.C TEST

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

7	Test by certified Lab & Test Report Prepare

■ 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 ℃ 2. HIGH AMBIENT BURN-IN： 1 HRS I/P： 230VAC O/P： FULL LOAD Ta= 60 ℃		

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

2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR (MIN)	I/P： 230 VAC O/P： 115 % LOAD Ta：25℃	TEST：OK
3	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P： 230VAC/90VAC O/P： 100% /80% LOAD Ta= -45℃	TEST：OK
4	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 60 ℃ HUMIDITY= 90 %R.H NO DAMAGE	I/P： 272 VAC O/P：FULL LOAD Ta= 60℃ HUMIDITY= 95 %R.H	TEST：OK
5	TEMPERATURE COEFFICIENT	± 0.03 %/℃(0~60℃)	I/P： 230 VAC O/P：FULL LOAD	± 0.009 %/℃(0~60℃)
6	STORAGE TEMPERATURE TEST	-40~85℃	1. Thermal shock Temperature： -45℃~ +90℃ 2. Temperature change rate ：25℃ / 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℃	1. Thermal shock Temperature： -45℃~ +65℃ 2. Temperature change rate ：25℃ / 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℃	
9	CAPACITOR LIFE CYCLE	SUPPOSE C105 IS THE MOST CRITICAL COMPONENT (1) I/P： 230VAC O/P：FULL LOAD Ta= 25℃ LIFE TIME (2) I/P： 230VAC O/P：FULL LOAD Ta= 60℃ LIFE TIME (3) I/P： 230VAC O/P：75% LOAD Ta= 60℃ LIFE TIME (4) I/P： 230VAC O/P：50% LOAD Ta= 60℃ LIFE TIME		(1) 2272135HRS (2) 183566HRS (3) 236909HRS (4) 268024HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 286.6K hrs min. Telcordia SR-332 (Bellcore) ; 105.8K hrs min. MIL-HDBK-217F (25℃)		
11	DMTBF/Accelerated Life Test	Demonstration Mean Time Between Failure (Expected Life): Above 50,000 hours @ TA 60℃		

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

12.10.30 A50-F031