



# Test Report: HRPG-1000-24

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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

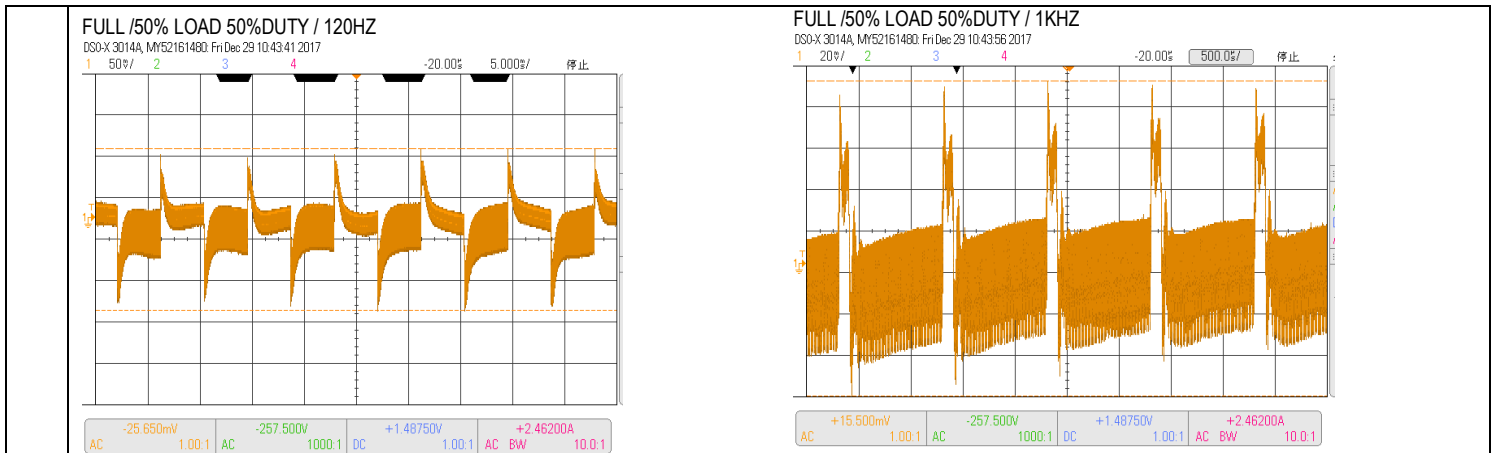
ENVIRONMENT TEST

■ DESIGN VERIFY TEST

**OUTPUT FUNCTION TEST**

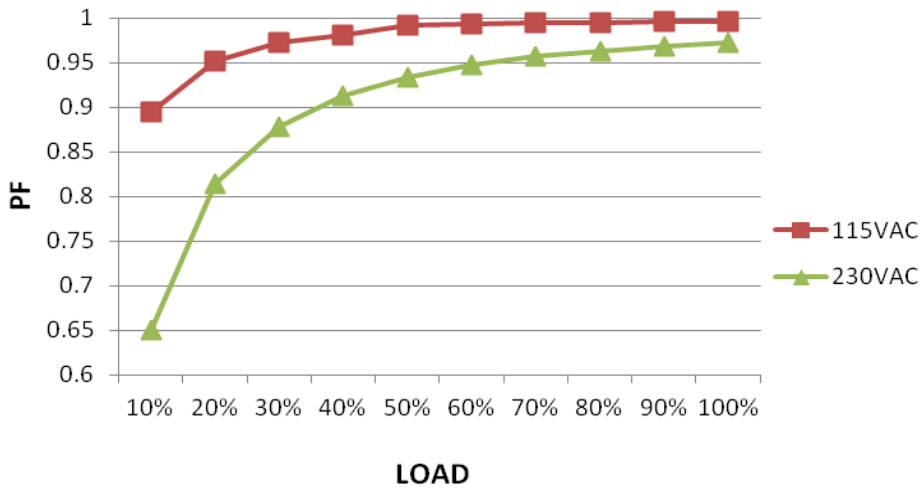
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE ADJUST RANGE	CH1: 22V~ 28 V	I/P : 230 VAC I/P : 115 VAC O/P : MIN LOAD Ta : 25°C	20.772V~28.96V/230VAC 20.779V~28.96V/115VAC
2	OUTPUT VOLTAGE(Max) TOLERANCE	V1: 1%~ -1%	I/P: 200VAC /264VAC O/P:FULL/ MIN. LOAD Ta:25°C	V1: 0.06%~ -0.06 %
3	LINE REGULATION (Max)	V1: 0.5%~ -0.5 %	I/P: 200VAC~264VAC O/P:FULL LOAD Ta:25°C	V1: 0.042%~ -0%
4	LOAD REGULATION(Max)	V1: 0.5%~ -0.5 %	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25°C	V1: 0.042%~ -0.042%
5	OVER/UNDERSHOOT TEST	< ±5%	I/P: 230VAC O/P:FULL LOAD Ta:25°C	<5%
6	RIPPLE & NOISE(Max)	V1: 200mVp-p	I/P:230VAC O/P:FULL LOAD Ta:25°C	V1: 68.3mVp-p
<div style="display: flex; justify-content: space-around;"> <div style="width: 45%;"> <p><b>high frequency :</b> DSO-X 3014A, M52161480, Fri Dec 29 10:42:22 2017</p> <p>AC -5.125mV 1.00:1 AC -257.500V 1000:1 DC +1.48750V 1.00:1 AC BW +2.46200A 10.0:1</p> </div> <div style="width: 45%;"> <p><b>low frequency :</b> DSO-X 3014A, M52161480, Fri Dec 29 10:42:08 2017</p> <p>AC -5.125mV 1.00:1 AC -257.500V 1000:1 DC +1.48750V 1.00:1 AC BW +2.46200A 10.0:1</p> </div> </div>				
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/ 370 ms 115VAC/ 458 ms
		INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage	INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input	

<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/ 12.8 ms 115VAC/ 12.2 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: 2400 mVp-p	I/P: 230VAC O/P: (1)FULL /50% LOAD 50%DUTY / 120HZ (2)FULL /50% LOAD 50%DUTY / 1KHZ Ta:25°C	195mVp-p 152mVp-p



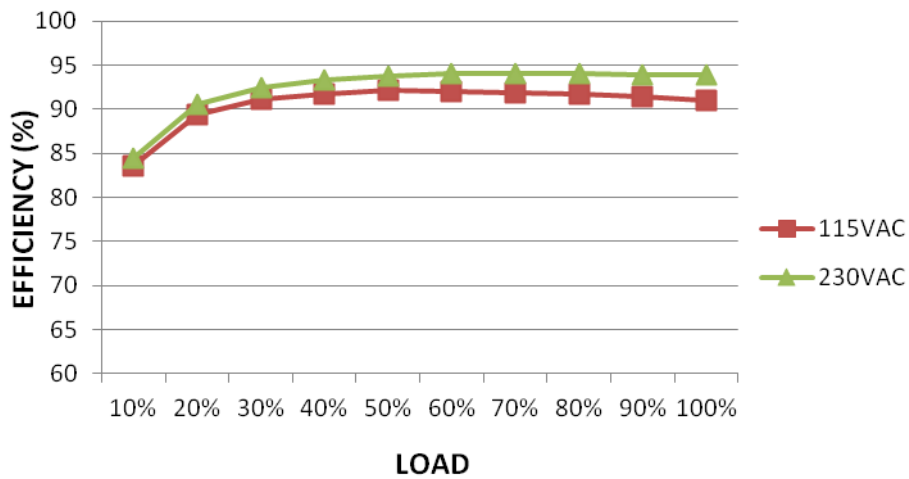
## INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	90VAC~264VAC	I/P: TESTING O/P: FULL LOAD Ta: 25°C	74V~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 = 4.83A/ 230VAC I = 8.255A/ 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	< 0.394 W < 0.642 W
6	POWER FACTOR (Typ.)	0.95/ 230VAC 0.98/115VAC	I/P : 230 VAC O/P : FULL LOAD I/P : 115 VAC Ta : 25°C	PF=0.973/230VAC PF= 0.996/115VAC
			P.F vs LOAD	



7	EFFICIENCY(Typ.)	93%	I/P:230 VAC O/P:FULL LOAD Ta:25°C	93.37%
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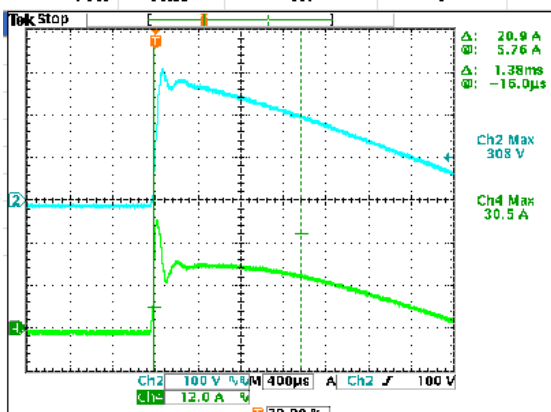
EFFICIENCY vs LOAD



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= 1380us/230V
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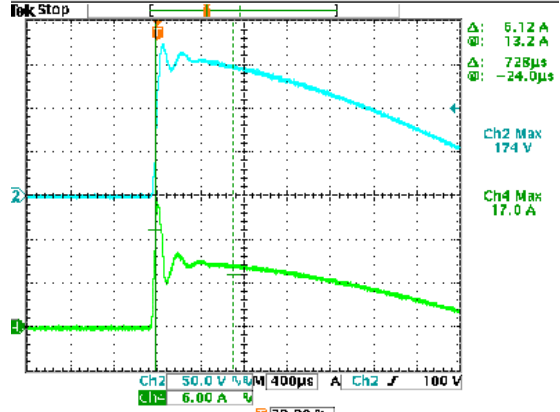
INPUT=230VAC/50HZ @ FULL LOAD

CH2 : AC Input Voltage CH4 : Input current



INPUT=115VAC/ 60HZ @ FULL LOAD

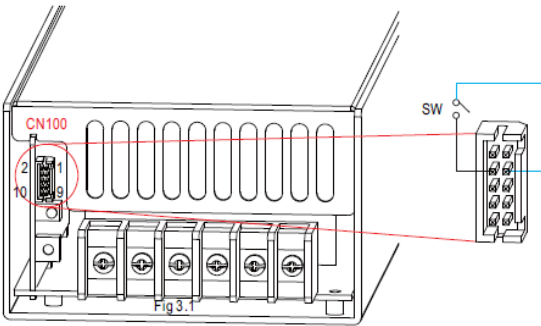
CH2 : AC Input Voltage CH4 : Input current

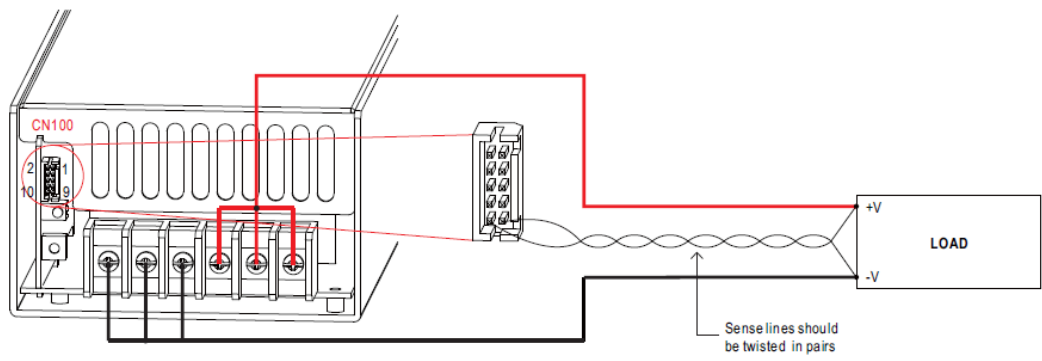
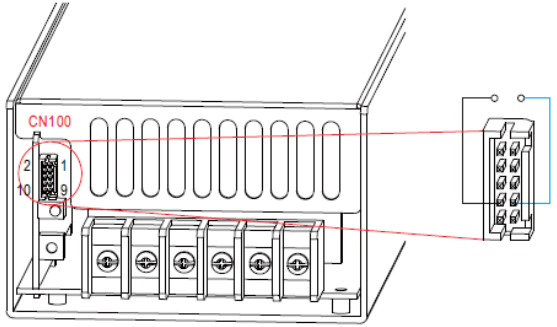


**PROTECTION FUNCTION TEST**

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: 115VAC O/P: TESTING Ta:25°C	118.41%/ 264VAC 118.44%/ 230VAC 118.41%/200VAC PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed
2	OVER VOLTAGE PROTECTION	29V~33V 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	30.741V/ 264VAC 30.797V/ 230VAC 30.737V/ 90VAC PROTECTION TYPE : 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	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 : 40.6A PSU2 : 38.9A PSU3 : 38.5A PSU4 : 38.8A O/P : 50% PSU1 : 22.9 A PSU2 : 22.2 A PSU3 : 22.5A PSU4 : 19.6A						
2	REMOTE ON/OFF CONTROL	The PSU can be turned ON/OFF by using the "Remote Control" function. <table border="1" style="margin-left: 20px;"> <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>  I/P: 230 VAC O/P: FULL LOAD Ta:25°C TEST RESULT : OK	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	<p>S+ / S- &gt;0.5V</p>  <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="459 994 820 1099"> <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 = 5.278V ; PSU turn off = 0.0048V.</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	<p>5VSB : 5V@0.3A ; tolerance± 5%, ripple : 50mVp-p(max.)</p>	<p>I/P: 230 VAC O/P:FULL LOAD Ta:25°C</p>	<p>TEST RESULT : 4.93V / 0.304A Ripple : 4.2mVp-p</p>									
6	FAN CONTROL	<p>FAN ON/OFF BY BY NTC (RT50) OR LOAD</p>	<p>I/P: 230 VAC O/P:TESTING</p>	<p>TEST RESULT :</p> <table border="1" data-bbox="1150 1682 1501 1787"> <thead> <tr> <th></th> <th>TEMP.</th> <th>LOAD</th> </tr> </thead> <tbody> <tr> <td>FAN ON</td> <td>55°C</td> <td>&gt;17.8%</td> </tr> <tr> <td>FAN OFF</td> <td>36°C</td> <td>&lt;17.1%</td> </tr> </tbody> </table>		TEMP.	LOAD	FAN ON	55°C	>17.8%	FAN OFF	36°C	<17.1%
	TEMP.	LOAD											
FAN ON	55°C	>17.8%											
FAN OFF	36°C	<17.1%											

**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 VGS : ±25V	I/P:High-Line +3V =303V AC ON/OFF VDS: 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°C	VDS: (1) 472V (2) 533V (3) 525V (4) 525V (5) 529V (6) 521V (7) 525V
2	P.F.C Transistor ( D to S) or (C to E) <b>Peak Voltage</b>	Q1 Rated :34A / 600V VGS:±25V	I/P:High-Line +3V =303V 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°C	VDS: (1)480 V (2)484V (3)496V (4)492V (5) 488V (6) 492V (7) 436V
3	P.F.C DIODE	D6 Rated : 10A / 600V	I/P:High-Line +3V =303V 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°C	(1)393 V (2) 389V (3) 393V (4) 401V
4	SR MOSFET <b>Peak Voltage</b>	Q508 Rated: 100A / 80V Q506 Rated: 100A / 80V	I/P:High-Line +3V =303V 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	Q508: VDS: (1) 67.4V (2)13.6 V (3) 65.8V (4) 66.6V (5) 66.6V (6) 65.8V (7) 68.2V (8)61.8V (9) 64.2V  Q506: VDS: (1) 65V (2) 16V (3) 65.8V (4) 64.2V (5) 65V (6) 62.6V (7) 60.2V (9) 62.6V



			Ta:25°C	
5	Input Capacitor Voltage	C5 220μF / 400V	I/P:High-Line +3V =303V 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°C	(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 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	PFC IC (1) 22.2V (2) 20.2V (3) 20.6V (4) 20.4V (5) 19.4V PWM IC (1) 14.67V (2) 15.8V (3) 14.59V (4) 14.19V (5) 13.55V
7	TOP SWITCHING STAND BY POWER	U971 Rated: 1.8 A / 700V	I/P:High-Line +3V =303V AC ON/OFF O/P: (1)Full Load (2)Remote On/Off Ta:25°C	(1)548 V (2) 556V (1) 520V (2) 512V
8	STAND BY Rectifier	D431 80V/5A (Ifsm 120A)	I/P:High-Line +3V =303 V AC ON/OFF O/P: (1)Full Load (2)Remote On/Off	(1) 79.1 V (2)80V

**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°C	I/P-O/P:6.04 mA I/P-FG: 5.1mA O/P-FG: 2.88mA 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°C	I/P-O/P: 13.7GΩ I/P-FG: 30GΩ O/P-FG:21.2 GΩ NO DAMAGE
3	GROUNDING CONTINUITY	FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40A / 2min Ta:25°C	13mΩ

**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°C	PASS
2	CONDUCTION	EN55032 /EN55011 CLASS B	I/P : 230 VAC (50HZ) O/P : FULL/50% LOAD Ta : 25°C	Test by certified Lab
3	RADIATION	EN55032 /EN55011 CLASS B	I/P : 230 VAC (50HZ) O/P : FULL LOAD Ta : 25°C	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°C	CRITERIA A
5	E.F.T	EN61000-4-4 MEDICAL INDUSTRY INPUT : 2KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	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°C	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-1000-24 1. ROOM AMBIENT BURN-IN : 1.5 HRS I/P : 230VAC O/P : FULL LOAD Ta= 25 °C 2. HIGH AMBIENT BURN-IN : 1.5 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	44.4°C	78.3°C
		2	R6	48.0°C	81.7°C
		3	Q1	42.3°C	76.3°C
		4	U1	39.5°C	72.8°C
		5	D5	41.6°C	76.3°C
		6	D6	46.8°C	80.5°C
		7	C6	37.6°C	71.1°C
		8	D981	47.8°C	76.9°C
		9	RY1	47.1°C	79.6°C
		10	RG2	35.0°C	70.0°C
		11	D431	43.2°C	76.9°C
		12	C406	28.9°C	62.8°C
		13	TSW4	36.1°C	70.0°C
		14	L1	38.8°C	71.9°C
		15	T951	35.9°C	70.0°C
		16	C2	46.8°C	79.3°C
		17	LF3	44.5°C	79.7°C
		18	T1-1	57.6°C	92.0°C
		19	T1-2	55.3°C	89.6°C
		20	T2-1	50.6°C	83.5°C
		21	T2-2	47.2°C	81.3°C
		22	L900	30.5°C	65.0°C
		23	Q910	54.5°C	94.4°C
		24	C933	32.2°C	67.1°C
		25	Q911	54.4°C	92.6°C
		26	U900	42.7°C	78.0°C
		27	C906	30.2°C	65.9°C
		28	C106	33.1°C	68.4°C
		29	C109	27.1°C	62.5°C
		30	U501	41.6°C	78.3°C
		31	Q502	47.4°C	85.6°C
		32	Q504	49.2°C	87.7°C
		33	U504	42.3°C	79.8°C
		34	Q506	53.5°C	93.6°C
		35	Q508	50.0°C	90.8°C
		36	TSW3	31.8°C	67.7°C
2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR ( MIN )		I/P : 230 VAC O/P : 127 % 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	± 0.005 %/°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) 1485023HRS (2) 128548HRS (3) 198531HRS (4) 262922HRS
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