Test Report: HEP-1000-100

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

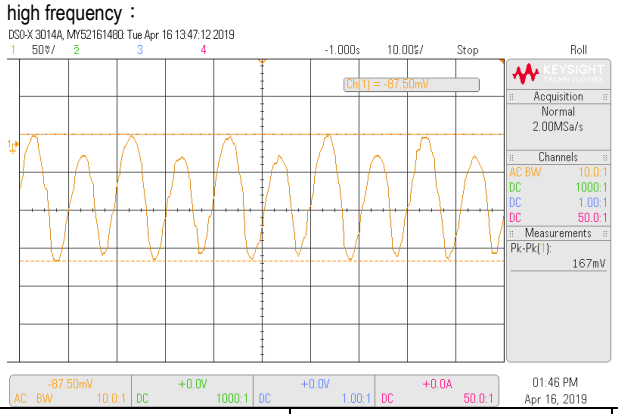
ENVIRONMENT TEST

■ DESIGN VERIFY TEST

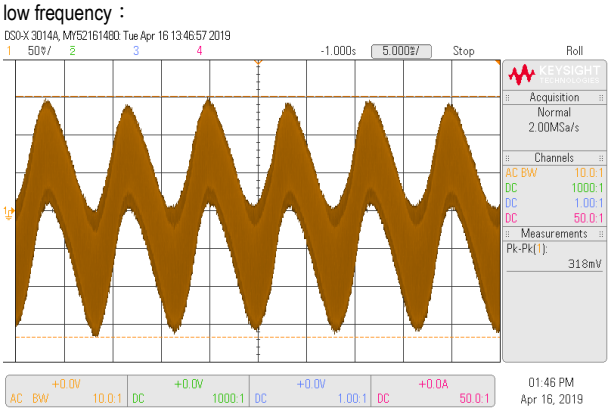
OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE ADJUST RANGE	CH1: 100V~ 125V	I/P ： 230 VAC I/P ： 115 VAC O/P ：MIN LOAD Ta ：25℃	97.65V~128.32V/230VAC 97.265V~128.31V/115VAC
2	OUTPUT VOLTAGE(Max) TOLERANCE	V1: -1%~ +1%	I/P: 90VAC /305VAC O/P:FULL/ MIN. LOAD Ta:25℃	V1: - 0.065%~0.065%
3	LINE REGULATION (Max)	V1: -0.5%~ +0.5%	I/P: 180VAC~ 305VAC O/P:FULL LOAD Ta:25℃	V1: 0%~0.019 %
4	LOAD REGULATION(Max)	V1: -0.5%~ +0.5%	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25℃	V1: -0.069%~ 0.049 %
5	OVER/UNDERSHOOT TEST	< ±5%	I/P: 230VAC O/P:FULL LOAD Ta:25℃	< 5 %
6	RIPPLE & NOISE(Max)	V1: 500mVp-p	I/P:230VAC O/P:FULL LOAD Ta:25℃	V1:318mVp-p

high frequency ：



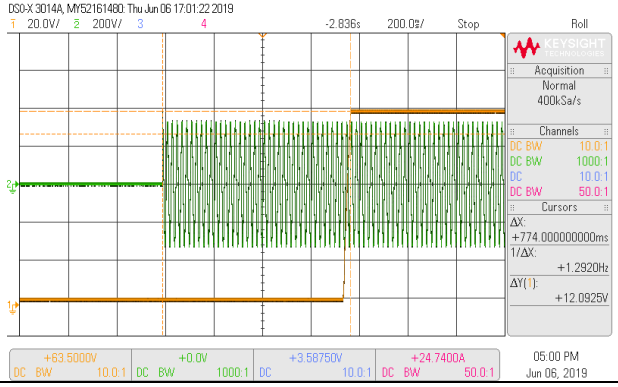
low frequency ：



NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
7	SET UP TIME(Max)	230VAC/1800ms 115VAC/1800ms	I/P ： 230 VAC O/P ：FULL LOAD I/P ： 115 VAC O/P ：71% LOAD Ta ：25℃	230VAC/ 774 ms 115VAC/ 822 ms

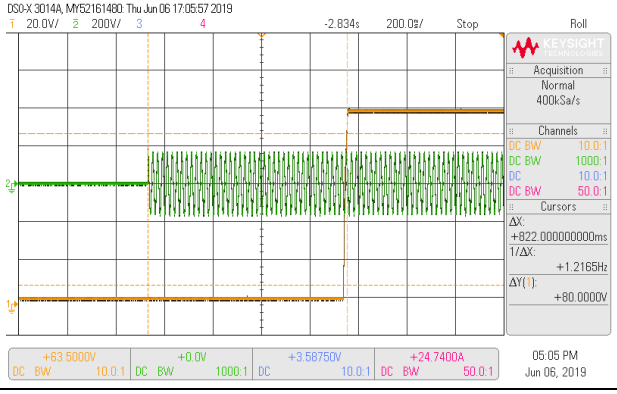
INPUT=230VAC/50HZ @ FULL LOAD

CH1 : Output Voltage CH2 : AC Input Voltage



INPUT=115VAC/60HZ @ 71% LOAD

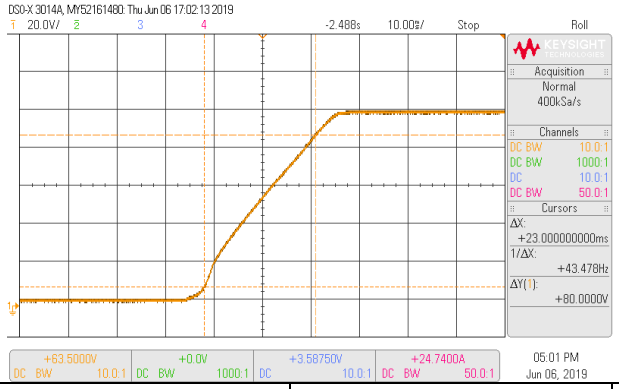
CH1 : Output Voltage CH2 : AC Input Voltage



8	RISE TIME (Max)	230VAC/80ms 115VAC/80ms	I/P： 230 VAC O/P：FULL LOAD I/P： 115 VAC O/P：71% LOAD Ta：25℃	230VAC/ 23 ms 115VAC/ 13.1 ms

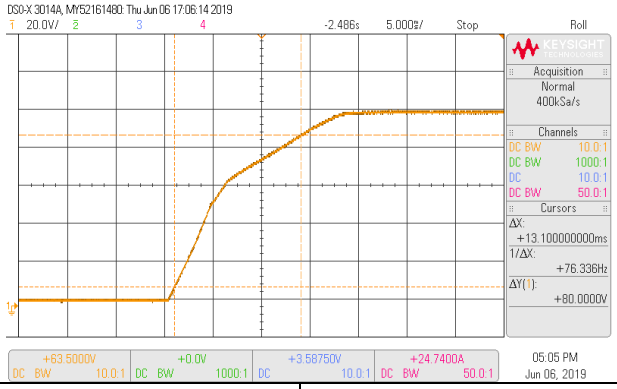
INPUT=230VAC/50HZ @ FULL LOAD

CH1 : Output Voltage



INPUT=115VAC/60HZ @ 71% LOAD

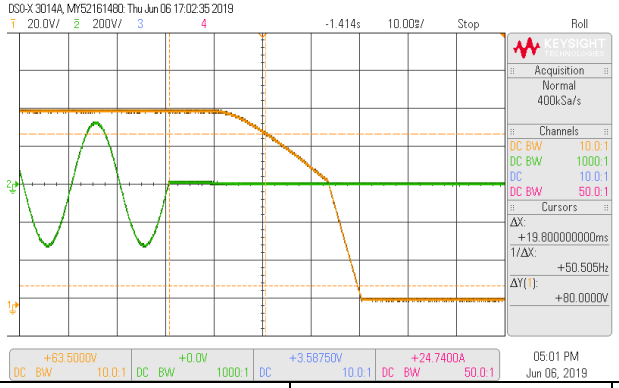
CH1 : Output Voltage



9	HOLD UP TIME (Typ.)	230VAC/12ms @FULL LOAD 230VAC/16ms @75%LOAD	I/P： 230 VAC O/P：FULL LOAD /75% LOAD Ta：25℃	230VAC/ 19.8 ms@ FULL LOAD 230VAC/ 31.2ms@75%LOAD

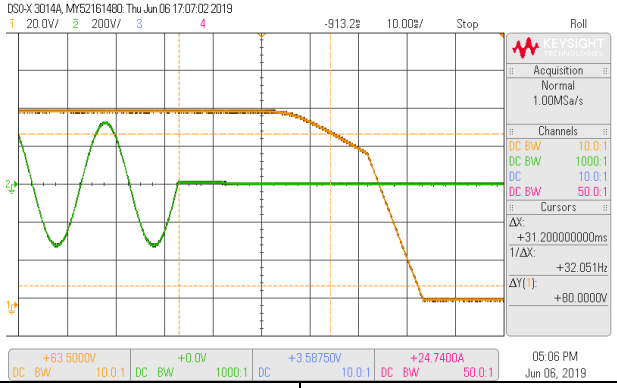
INPUT=230VAC/50HZ @ FULL LOAD

CH1 : Output Voltage CH2 : AC Input Voltage



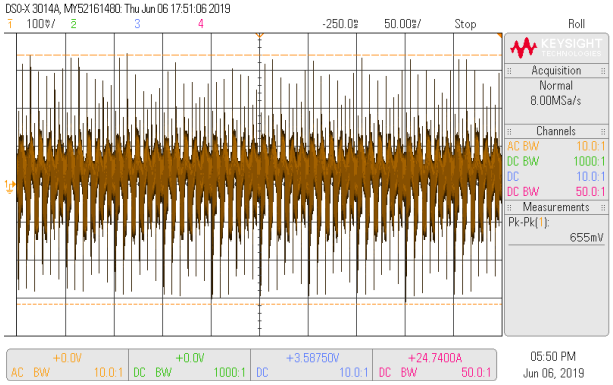
INPUT=230VAC/50HZ @ 75% LOAD

CH1 : Output Voltage CH2 : AC Input Voltage

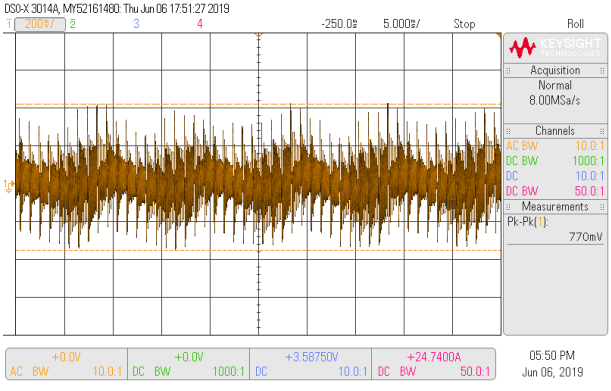


10	DYNAMIC LOAD	V1: 10000mVp-p	I/P: 230VAC O/P: (1)FULL /50% LOAD 50%DUTY / 120HZ (2)FULL /50% LOAD 50%DUTY / 1KHZ Ta:25℃	 655mVp-p 770mVp-p

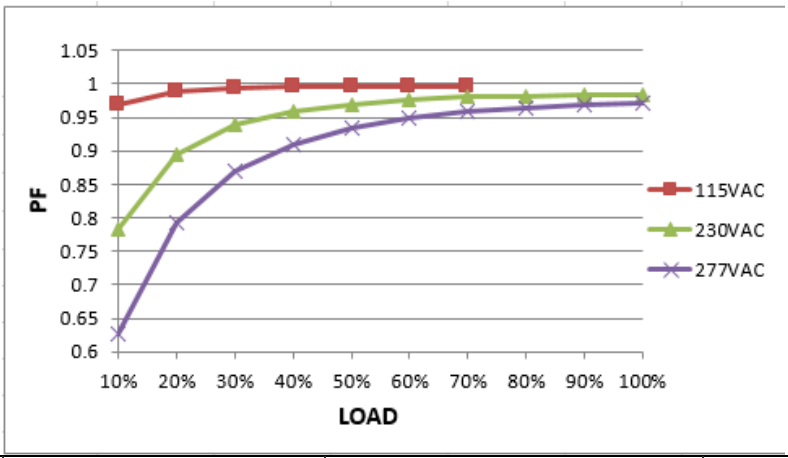
FULL /50% LOAD 50%DUTY / 120HZ

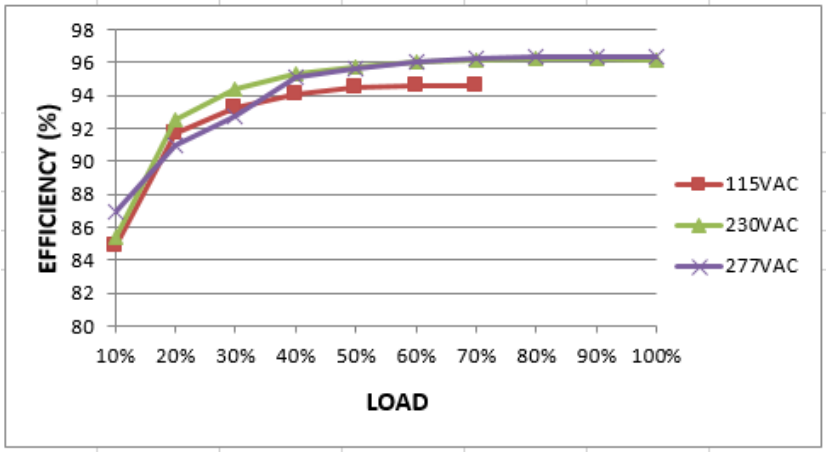


FULL /50% LOAD 50%DUTY / 1KHZ



INPUT FUNCTION TEST

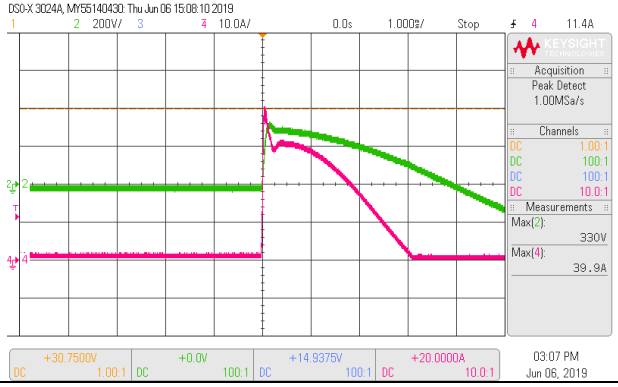
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	90VAC~305VAC	I/P:TESTING O/P:FULL LOAD/ Derating Load Ta:25℃	158V~305V/ Full Load 57V~305V/ Derating Load
			I/P: LOW-LINE-3V=87 V HIGH-LINE+15%=315 V O/P:FULL/MIN LOAD (PLEASE CHECK DERATING CURVE) ON: 30 Sec OFF: 30 Sec 10MIN (POWER ON/OFF NO DAMAGE)	TEST:OK
2	INPUT FREQUENCY RANGE	47HZ ~63 HZ NO DAMAGE	I/P:90 VAC ~305 VAC O/P:FULL~MIN LOAD Ta:25℃	TEST: OK
3	INPUT CURRENT (Typ.)	277V/ 4.5A 230V/ 5.3A 115V/ 10.1A	I/P： 277 VAC I/P： 230 VAC O/P：FULL LOAD I/P： 115 VAC O/P：71% LOAD Ta：25℃	I =3.92A/ 277VAC I =4.65A/ 230VAC I =6.56A/ 115VAC
4	LEAKAGE CURRENT	<0.75 mA / 240 VAC	I/P： 240 VAC O/P：Min LOAD Ta：25℃	L-FG：0.48 mA N-FG：0.52 mA
5	POWER FACTOR (Typ.)	0.93/ 277VAC 0.95/ 230VAC 0.99/115VAC	I/P： 277 VAC I/P： 230 VAC O/P：FULL LOAD I/P： 115 VAC O/P：71% LOAD Ta：25℃	PF=0.967/277VAC PF=0.983/230VAC PF=0.995/115VAC
	P.F vs LOAD			
6	EFFICIENCY(Typ.)	96%	I/P:230 VAC O/P:FULL LOAD Ta:25℃	96.2%
	EFFICIENCY vs LOAD			



7	INRUSH CURRENT(Typ.)	230V/40A COLD START	I/P： 230 VAC O/P：FULL LOAD Ta：25℃	I =39.9A/ 230VAC T50= 1760 us/230V

INPUT=230VAC/50HZ @ FULL LOAD

CH2 : AC Input Voltage CH4 : Input current

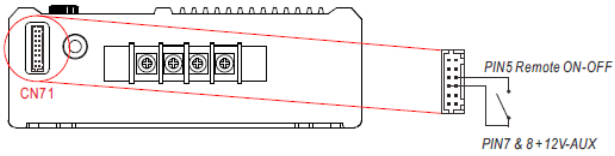


PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER LOAD PROTECTION	105%~ 125% PROTECTION TYPE： Constant current limiting,unit will shutdown after 5 sec,re-power on to recover.	I/P: 305VAC I/P: 230VAC I/P: 180VAC O/P:TESTING Ta:25℃	112.6%/ 305VAC 112.6%/ 230VAC 112.6%/180VAC PROTECTION TYPE： Constant current limiting,unit will shutdown after 5 sec,re-power on to recover.
2	OVER VOLTAGE PROTECTION	125V~145V Protection type : Shut down O/P voltage,re-power on to recover.	I/P: 305VAC I/P: 230VAC I/P: 90VAC O/P:MIN LOAD Ta:25℃	134.5V/ 305VAC 134.19V/ 230VAC 134.43V/ 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: 305VAC O/P:FULL LOAD I/P: 90VAC O/P:70% 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： Constant current limiting,unit will shutdown after 5 sec,re-power on to recover.	I/P: 305VAC I/P: 90VAC O/P: FULL LOAD Ta:25℃	NO DAMAGE PROTECTION TYPE： Constant current limiting,unit will shutdown after 5 sec,re-power on to recover.

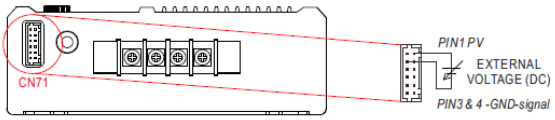
CONTROL FUNCTION TEST

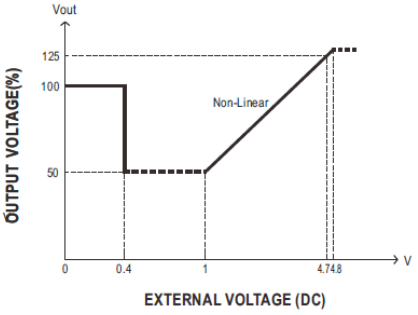
<table>
<tr><th>NO</th><th>TEST ITEM</th><th>SPECIFICATION</th><th>TEST CONDITION</th><th>RESULT</th></tr>
<tr><td>1</td><td>AUXILIARY POWER (AUX)</td><td colspan="3">I/P: 230 VAC
O/P:FULL LOAD
Ta:25℃
Test Result：
<table>
<tr><th>AUX</th><th>TOLERANCE</th><th>RIPPLE</th><th>TEST RESULT</th></tr>
<tr><td>12V / 0.5A</td><td>10.8~13.2 V</td><td>150mVp-p</td><td>11.7V/21mvp-p</td></tr>
</table></td></tr>
<tr><td>2</td><td>REMOTE ON/OFF CONTROL</td><td colspan="3">The power supply can be turned ON/OFF individually or along with other units in parallel by using the "Remote ON-OFF" function.
 

<table>
<tr><th>Remote ON-OFF</th><th>Power Supply Status</th></tr>
<tr><td>Short circuit</td><td>ON</td></tr>
<tr><td>Open circuit</td><td>OFF</td></tr>
</table>
I/P: 230 VAC
O/P:FULL LOAD
Ta:25℃
Test Result：
<table>
<tr><th>Between ON/OFF and +5V-AUX</th><th>Power Supply Status</th></tr>
<tr><td>SW SHORT</td><td>ON</td></tr>
<tr><td>SW OPEN</td><td>OFF</td></tr>
</table></td></tr>
</table>

3 OUTPUT VOLTAGE PROGRAMMABLE(PV)

※ In addition to the adjustment via the built-in potentiometer, the output voltage can be trimmed by applying EXTERNAL VOLTAGE.



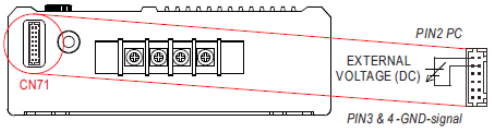


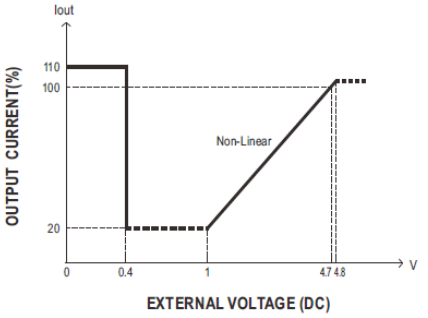
I/P: 230 VAC
O/P:FULL LOAD
Ta:25℃
TEST RESULT：

PV / MODEL	<0.4V	1V	4.7V	4.8V
SPEC	100V±5%	50V±5%	125V±5%	127V±5%
Vout	100.01V	49.83V	124.97V	127.26V

4 OUTPUT CURRENT PROGRAMMABLE (PC)

※ The output current can be trimmed to 20~100% of the rated current by applying EXTERNAL VOLTAGE.



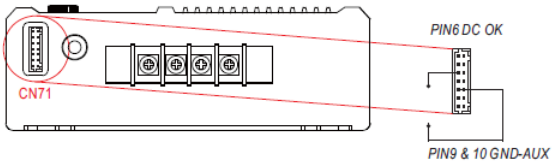


I/P: 230 VAC
O/P:TESTING
Ta:25℃

ADJ V	<0.4V	1V	4.7V	4.8V
SPEC	110%±5%	20%±5%	100%±5%	100%±5%
TEST	111.10%	21.10%	101.20%	103.80%

5 DC-OK SIGNAL

DC-OK signal is a TTL level signal. The maximum source current is 10mA and the maximum external voltage is 5.5V.



DC-OK signal	Power Supply Status
"High" >4.4~5.5V	ON
"Low" <-0.5~0.5V	OFF

I/P:230VAC
O/P:FULL LOAD
Ta:25℃

DC-OK signal	Power Supply Status
"High" >4.5~5.5V	ON(5.15v)
"Low" <-0.5~0.5V	OFF(-0.04V)

CHARGER MODE

OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	BOOST CHARGE VOLTAGE	115.2V±1V	I/P: 230 VAC O/P: C.V MODE-1V Ta:25℃	115.18 V
2	FLOAT CHARGE VOLTAGE	110.4V±1V	I/P: 230 VAC O/P: C.V MODE-1V Ta:25℃	110.44V
3	OUTPUT CURRENT	8.7A±0.22A	I/P: 230 VAC O/P: C.V MODE-1V Ta:25℃	8.8A

INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT CURRENT (TYP)	230 V/ 4.5A 230 V/ 5.3 A 115 V/ 10.1 A	I/P: 277VAC I/P: 230 VAC I/P: 115 VAC O/P: C.V MODE-1V Ta:25℃	I =3.91A/ 277VAC I =4.61A/ 230VAC I =6.92A/ 115VAC
2	POWER FACTOR (TYP)	0.93/ 277 VAC 0.95/ 230 VAC 0.99/ 115 VAC	I/P: 277VAC I/P: 230 VAC I/P: 115 VAC O/P: C.V MODE-1V Ta:25℃	PF= 0.97/ 277VAC PF= 0.99/ 230VAC PF=0.99/ 115VAC
3	EFFICIENCY (TYP)	96%	I/P: 230 VAC O/P: C.V MODE-1V Ta:25℃	96.2%

COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Transistor (D to S) or (C to E) Peak Voltage	Q902 Rated 16A/ 650V	AC ON/OFF I/P:High-Line +3V =308V 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℃	 VDS (1) 435V (2) 439V (3) 439V (4) 435V (5) 439V (6) 439V (7447V
2	P.F.C Transistor (D to S) or (C to E) Peak Voltage	Q66 Rated 16A/ 650V	I/P:High-Line +3V =308V AC ON/OFF O/P: (1)Full Load	 VDS (1) 451V

			(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℃	(2) 451V (3) 451V (4) 451V (5) 447V (6) 443V (7) 451V
3	P.F.C DIODE	D14 Rated 8A/ 650V	I/P:High-Line +3V =308V AC ON/OFF O/P: (1)Full Load (2)Output Short Ta:25℃	(1) 391V (2) 399V
4	Diode Peak Voltage	Q101 Rated 38A/ 300V	AC ON/OFF I/P:High-Line +3V =308V 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 Ta:25℃	Q101: VDS: (1)194V (2)194V (3)206V (4)206V (5)210V (6)206V (7)210V (8)214V
5	Input Capacitor Voltage	C5 Rated: : 220μ/ 450 V 105 ℃/ TXW Series	I/P:High-Line +3V =308V O/P: (1) Min load continue (2)Full load continue Ta:25℃	(1) 447V (2) 443V

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:1.25KVAC/min	I/P-O/P: 3.6 KVAC/min I/P-FG: 2.4 KVAC/min O/P-FG:1.5 KVAC/min Ta:25℃	I/P-O/P: 6.7mA I/P-FG: 6.43mA O/P-FG: 6.28m 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: 7.88GΩ I/P-FG: 7.53GΩ O/P-FG: 4.42GΩ NO DAMAGE
3	GROUNDING CONTINUITY	FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40A / 2min Ta:25℃	22mΩ

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 FAIL
2	CONDUCTION	EN55032 CLASS B	I/P： 230 VAC (50HZ) O/P：FULL/50% LOAD Ta：25℃	PASS Test by certified Lab
3	RADIATION	EN55032 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 INDUSTRY AIR：8KV / Contact：4KV	I/P： 230 VAC/50HZ O/P：FULL LOAD Ta：25℃	CRITERIA A
5	E.F.T	EN61000-4-4 INDUSTRY INPUT： 2KV	I/P： 230 VAC/50HZ O/P：FULL LOAD Ta：25℃	CRITERIA A
6	SURGE	IEC61000-6-2 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. 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-1000-100 1. ROOM AMBIENT BURN-IN：1.5 HRS I/P： 230VAC O/P： FULL LOAD Ta= 25 ℃ 2. HIGH AMBIENT BURN-IN： 3 HRS I/P： 230VAC O/P： FULL LOAD Ta= 50 ℃		

NO	Position	ROOM AMBIENT Ta= 25 ℃	HIGH AMBIENT Ta= 50℃
1	BD1	71.4℃	98.7℃
2	ZNR2	61.8℃	89.9℃
3	C2	59.6℃	87.5℃
4	D10	72.0℃	100.0℃
5	Q51	64.5℃	91.9℃
6	Q65	65.7℃	93.4℃
7	T51	64.7℃	92.8℃
8	C417	61.3℃	89.8℃
9	C8	61.9℃	90.3℃
10	L2	66.2℃	94.8℃
11	L3	70.3℃	100.7℃
12	Q903	66.9℃	96.4℃
13	T1	70.3℃	101.2℃
14	T2	67.8℃	97.9℃
15	Q113	63.7℃	92.9℃
16	C114	60.3℃	89.3℃
17	C118	59.9℃	89.2℃
18	U601	73.0℃	100.4℃
19	U702	59.6℃	88.9℃
20	U100	62.7℃	91.5℃
21	RT21	61.8℃	89.8℃
22	RTH4	61.3℃	88.8℃
23	RTH5	60.7℃	89.0℃
24	RG61	67.4℃	96.7℃
25	T601	79.5℃	104.8℃
26	C652	68.1℃	96.8℃

2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR (MIN)	I/P： 230 VAC O/P： 107 % LOAD Ta：25℃	TEST：OK
3	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P： 264VAC/180VAC/90VAC O/P： 100 % / 65% LOAD Ta= -45 ℃	TEST：OK
4	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 50℃ NO DAMAGE	I/P： 272 VAC O/P：FULL LOAD Ta= 50℃ HUMIDITY= 95 %R.H	TEST：OK
5	TEMPERATURE COEFFICIENT	± 0.03 %/℃(0~50℃)	I/P： 230 VAC O/P：FULL LOAD	± 0 %/℃(0~50℃)
6	STORAGE TEMPERATURE TEST	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		OK
7	THERMAL SHOCK TEST	1. Thermal shock Temperature： -45℃~ +55℃ 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		OK

8	VIBRATION TEST	1 Carton & 1 Set (1) Waveform： Sine Wave (2) Frequency：10~500Hz (3) Sweep Time：12min/sweep cycle (4) Acceleration：10G (5) Test Time：72min in each axis (X.Y.Z) (6) Ta：25℃	TEST：OK
9	CAPACITOR LIFE CYCLE	SUPPOSE C120 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= 50℃ LIFE TIME (3) I/P： 230VAC O/P：75% LOAD Ta= 50℃ LIFE TIME (4) I/P： 230VAC O/P：50% LOAD Ta= 50℃ LIFE TIME	(1) 302449 HRS (2) 40519HRS (3) 85924HRS (4) 136524HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 583.7K hrs min. Telcordia SR-332 (Bellcore) ; 52.3K hrs min. MIL-HDBK-217F (25℃)	
11	Ongoing reliability test	I/P：230VAC O/P：FULL LOAD TA=50 ℃ 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