Test Report: HEP-1000-48

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

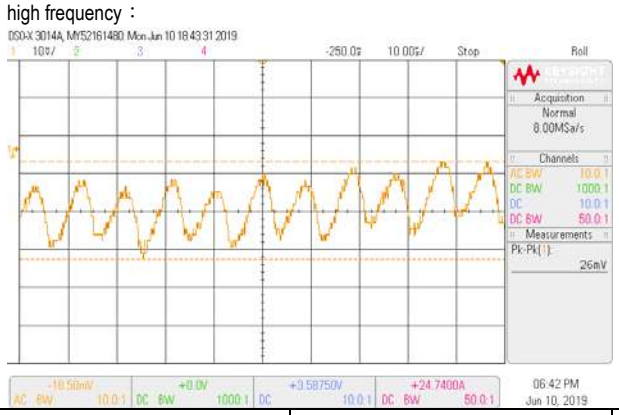
ENVIRONMENT TEST

■ DESIGN VERIFY TEST

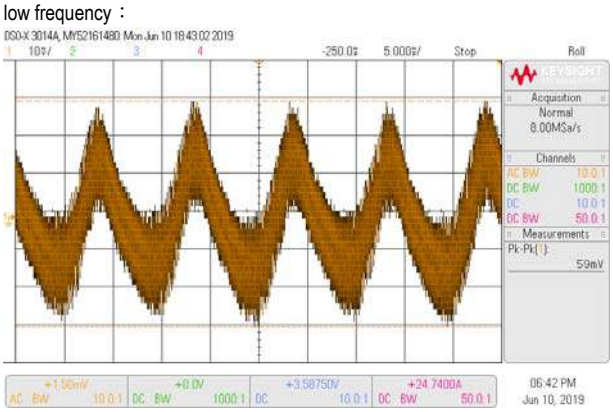
OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE ADJUST RANGE	CH1: 48V ~ 60V	I/P： 230 VAC I/P： 115 VAC O/P：MIN LOAD Ta：25℃	46.567V~61.155V/230VAC 46.565V~61.14V/115VAC
2	OUTPUT VOLTAGE(Max) TOLERANCE	V1: -1%~ +1%	I/P: 90VAC /305VAC O/P:FULL/ MIN. LOAD Ta:25℃	V1: -0.073%~ 0.073 %
3	LINE REGULATION (Max)	V1: -0.5%~ +0.5%	I/P: 180VAC~ 305VAC O/P:FULL LOAD Ta:25℃	V1: -0.041%~ 0 %
4	LOAD REGULATION(Max)	V1: -0.5%~ +0.5%	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25℃	V1: -0.062%~ 0.042 %
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: 59mVp-p

high frequency：



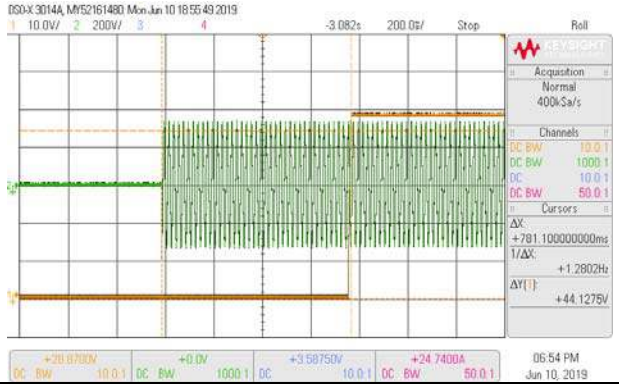
low frequency：



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/ 781.1 ms 115VAC/ 702 ms

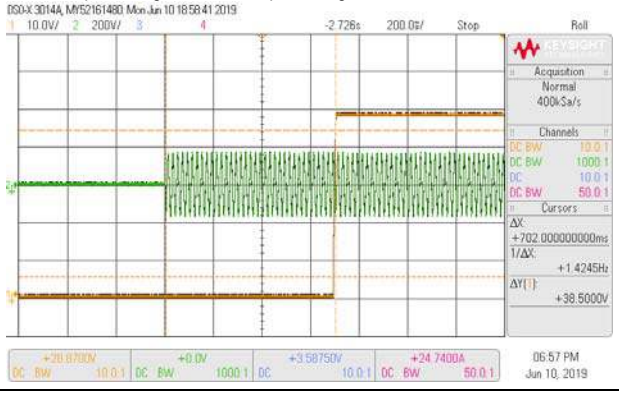
INPUT=230VAC/50HZ @ FULL LOAD

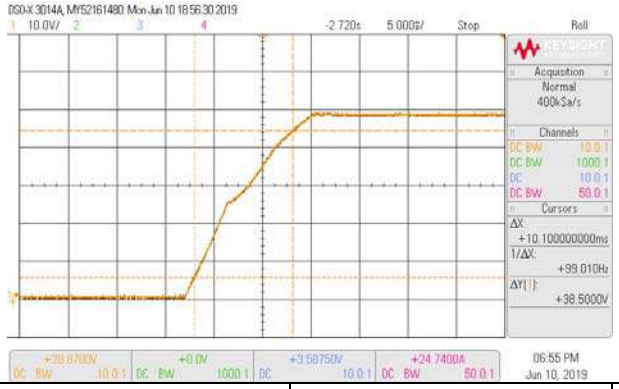
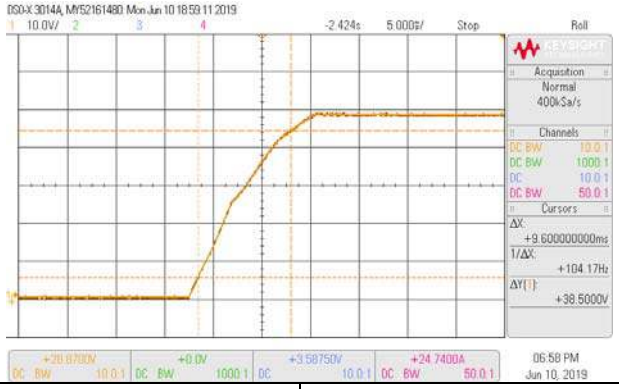
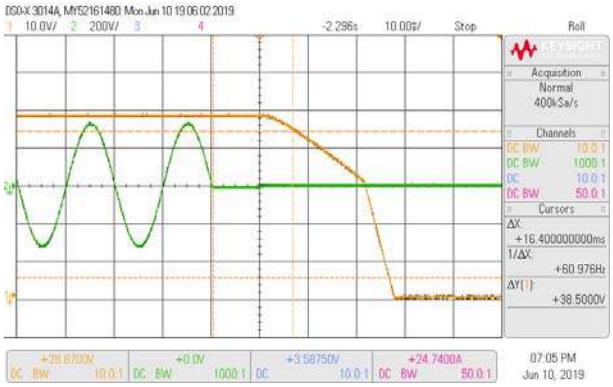
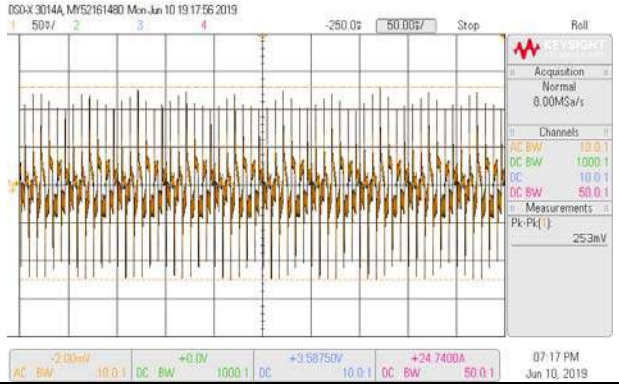
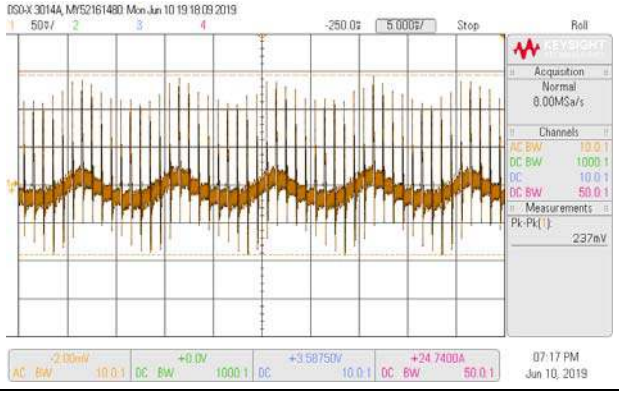
CH1 : Output Voltage CH2 : AC Input Voltage



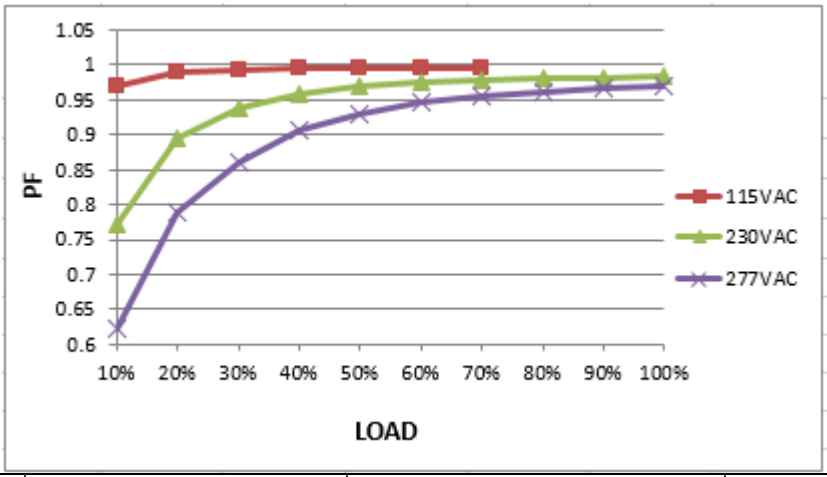
INPUT=115VAC/60HZ @ 71% LOAD

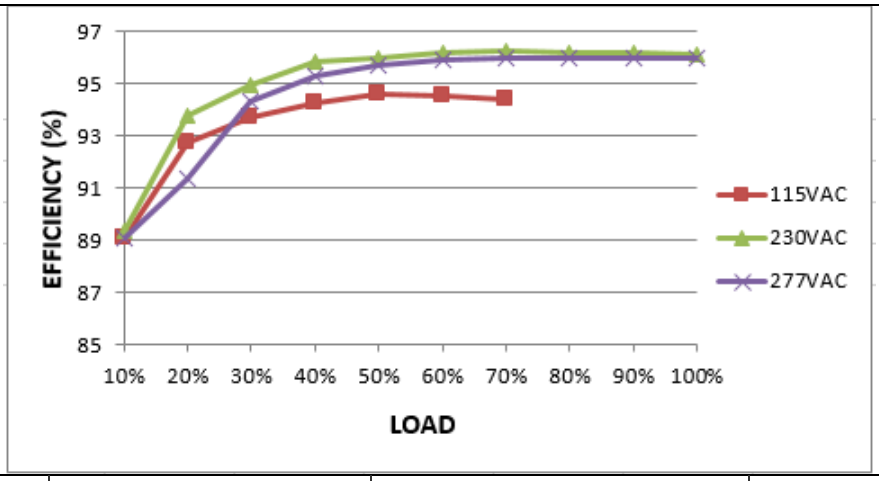
CH1 : Output Voltage CH2 : AC Input Voltage



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/ 10.1 ms 115VAC/ 9.6 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/ 16.4 ms@ FULL LOAD 230VAC/ 28.4 ms@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: 4800mVp-p	I/P: 230VAC O/P: (1)FULL /50% LOAD 50%DUTY / 120HZ (2)FULL /50% LOAD 50%DUTY / 1KHZ Ta:25℃	 253mVp-p 237mVp-p
	FULL /50% LOAD 50%DUTY / 120HZ 		FULL /50% LOAD 50%DUTY / 1KHZ 	

INPUT FUNCTION TEST

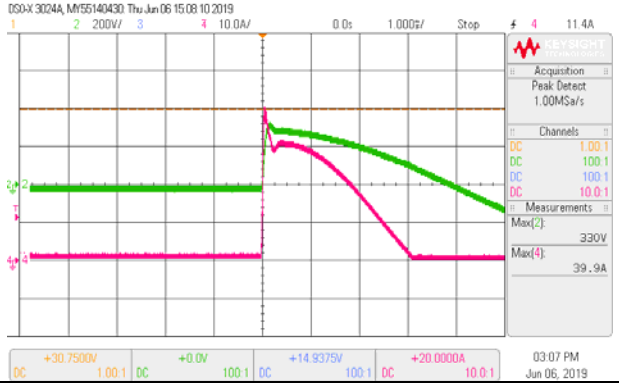
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	90VAC~305VAC	I/P:TESTING O/P: Full Load /Derating Load Ta:25℃	153V~305V/Full Load 78V~305V/ Derating Load
			I/P: LOW-LINE-3V=87 V HIGH-LINE+15%=315 V O/P:FULL/MIN LOAD (PLEASE CHECK DERATING CURVE) ON: 30 Sec OFF: 30 Sec 10MIN (POWER 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： 230 VAC O/P：FULL LOAD I/P： 115 VAC O/P：71% LOAD Ta：25℃	I =3.95A/ 277VAC I =4.69A/ 230VAC I =6.63A/ 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： 0.5 mA
5	POWER FACTOR (Typ.)	0.93/ 277VAC 0.95/ 230VAC 0.99/115VAC	I/P： 230 VAC O/P：FULL LOAD I/P： 115 VAC O/P：71% LOAD Ta：25℃	PF=0.969/277VAC PF=0.982/230VAC PF=0.996/115VAC
	P.F vs LOAD			
6	EFFICIENCY(Typ.)	96%	I/P:230 VAC O/P:FULL LOAD Ta:25℃	96.26%
	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℃	111.52%/ 305VAC 111.52%/ 230VAC 111.52%/100VAC PROTECTION TYPE： Constant current limiting,unit will shutdown after 5 sec,re-power on to recover.
2	OVER VOLTAGE PROTECTION	60V~70V 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℃	64.45V/ 305VAC 64.21V/ 230VAC 64.6V/ 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:65% 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	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.

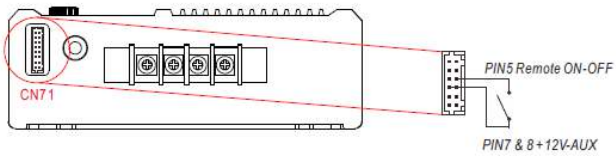
		shutdown after 5 sec,re-power on to recover.		

CONTROL FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	AUXILIARY POWER (AUX)	I/P: 230 VAC O/P:FULL LOAD Ta:25℃ Test Result：		

AUX	TOLERANCE	RIPPLE	TEST RESULT
12V / 0.5A	10.8~13.2 V	150mVp-p	11.79V/33mvp-p

NO	TEST ITEM	SPECIFICATION
2	REMOTE ON/OFF CONTROL	The power supply can be turned ON/OFF individually or along with other units in parallel by using the "Remote ON-OFF" function.



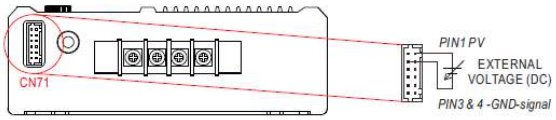
Remote ON-OFF	Power Supply Status
Short circuit	ON
Open circuit	OFF

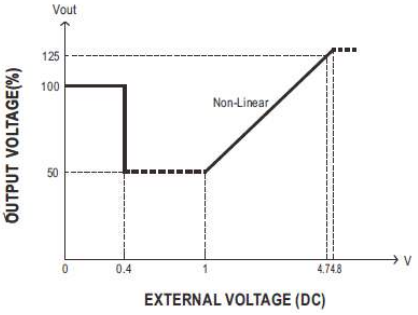
I/P: 230 VAC
O/P:FULL LOAD
Ta:25℃
Test Result：

Between ON/OFF and +5V-AUX	Power Supply Status
SW SHORT	ON
SW OPEN	OFF

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.



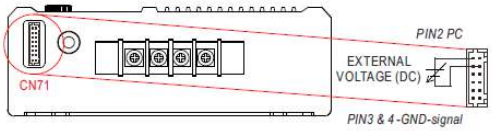


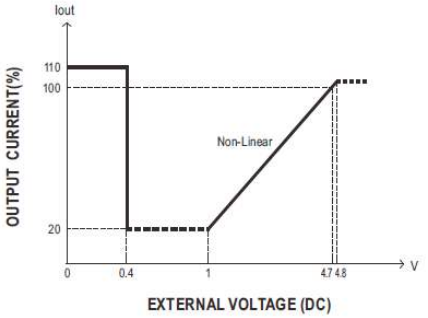
I/P: 230 VAC
O/P:FULL LOAD
Ta:25℃
TEST RESULT：

PV / MODEL	<0.4V	1V	4.7V	5V
SPEC	48V±5%	24V±5%	60V±5%	60.96V±5%
Vout	47.94V	23.82V	59.83V	60.94V

4 OUTPUT CURRENT PROGRAMMABLE (PC)

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



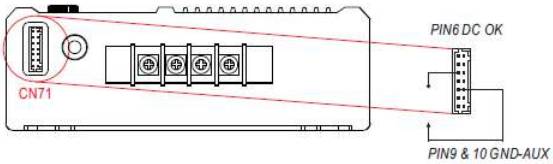


I/P: 230 VAC
O/P:TESTING
Ta:25℃

ADJ V	<0.4V	1V	4.7V	5V
SPEC	110%±5%	20%±5%	100%±5%	100%±5%
TEST	110.38%	19.95%	99.76%	102.67%

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(5.05v)
"Low" <-0.5~0.5V	OFF(-0.142V)

CHARGER MODE

OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	BOOST CHARGE VOLTAGE	57.6V±0.48V	I/P: 230 VAC O/P:BAT. LOAD Ta:25℃	57.58V
2	FLOAT CHARGE VOLTAGE	55.2V±0.48V	I/P: 230 VAC O/P:BAT. LOAD Ta:25℃	55.21V
3	OUTPUT CURRENT	17.5A±0.44A	I/P: 230 VAC O/P:BAT.LOAD Ta:25℃	17.55A

INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT CURRENT (TYP)	277 V/ 4.5 A 230 V/ 5.3 A 115 V/ 10.1 A	I/P: 230 VAC I/P: 115 VAC O/P:BAT. LOAD Ta:25℃	I =4.56A/ 230VAC I =6.82A/ 115VAC
2	POWER FACTOR (TYP)	0.95/ 230 VAC 0.99/ 115 VAC	I/P: 230 VAC I/P: 115 VAC O/P:BAT. LOAD Ta:25℃	PF= 0.99/ 230VAC PF= 0.99/ 115VAC
3	EFFICIENCY (TYP)	96%	I/P: 230 VAC O/P: C.V MODE-1V Ta:25℃	96.27%

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COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Transistor (D to S) or (C to E) Peak Voltage	Q903 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.	 VDS (1)458 V (2) 458V (3) 450V (4) 450V (5) 454V (6) 450V (7) 454V
2	P.F.C Transistor (D to S) or (C to E) Peak Voltage	Q51 Rated 16A/ 650V	I/P:High-Line +3V =308V AC ON/OFF O/P: (1)Full Load (2)Output Short (3)Dynamic Load Full Load/	 VDS (1) 450V (2) 442V (3) 450V

			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℃	(4) 446V (5) 450V (6) 450V (7) 450V
3	P.F.C DIODE	D56 Rated 8A/ 650V	I/P:High-Line +3V =308V AC ON/OFF O/P: (1)Full Load (2)Output Short Ta:25℃	(1) 390V (2) 410V
4	Diode Peak Voltage	Q101 Rated 100 A/ 150V	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)103.7 V (2)104.6V (3) 104.6V (4) 106.6V (5) 104.6V (6) 104.6V (7) 105.4V (8) 105.4V
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)430 V (2) 442V

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: 7.51mA I/P-FG: 7.43mA O/P-FG: 5.82m 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: 10.9GΩ I/P-FG: 10.6GΩ O/P-FG: 6.53GΩ NO DAMAGE
3	GROUNDING CONTINUITY	FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40A / 2min Ta:25℃	22 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 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-1000-24 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	BD2	75.3℃	98.5℃
2	BD1	76.0℃	99.1℃
3	LF3	68.8℃	92.4℃
4	ZNR2	66.1℃	89.6℃
5	C13	70.0℃	93.4℃
6	C2	65.1℃	88.6℃
7	D10	76.2℃	100.1℃
8	Q51	70.7℃	94.1℃
9	Q65	72.5℃	95.7℃
10	T51	71.3℃	95.0℃
11	T52	70.3℃	94.0℃
12	C417	63.8℃	89.9℃
13	C8	67.7℃	91.6℃
14	C964	70.1℃	93.9℃
15	L2	70.7℃	94.8℃
16	L3	76.4℃	102.2℃
17	Q901	72.5℃	97.0℃
18	Q903	71.9℃	96.6℃
19	T1	74.5℃	99.9℃
20	T1core	72.5℃	97.7℃
21	T2	73.0℃	98.0℃
22	T2core	71.7℃	96.5℃
23	Q103	74.8℃	100.0℃
24	Q113	75.5℃	100.7℃
25	C114	74.3℃	99.3℃
26	C118	73.2℃	98.2℃
27	LF10	75.7℃	101.0℃
28	U601	78.5℃	99.3℃
29	U100	71.8℃	96.2℃
30	RT21	67.3℃	90.3℃
31	RTH4	69.6℃	93.5℃
32	RTH5	70.1℃	93.9℃
33	RG61	78.8℃	103.8℃
34	T601	79.9℃	104.3℃
35	C652	74.5℃	98.6℃

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	±0.001%/℃(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) 100217HRS (2) 17716HRS (3) 54180HRS (4) 114992HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 197.9K hrs min. Telcordia SR-332 (Bellcore) ; 52.32K 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