



# Test Report: HEP-600-12

---

600W Single Output Switching Power Supply

## ■ 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	RIPPLE & NOISE	V1 : 150 mVp-p (Max)	I/P : 230VAC O/P : FULL LOAD Ta : 25°C	V1 : 70.4 mVp-p
2	OUTPUT VOLTAGE ADJUST RANGE	CH1 : 10.2V ~ 12.6 V	I/P : 230 VAC I/P : 115 VAC O/P : MIN LOAD Ta : 25°C	12.94 V ~ 9.794 V / 230 VAC 12.94 V ~ 9.794 V / 115 VAC
3	OUTPUT VOLTAGE TOLERANCE	V1 : -3 % ~ 3 % (Max)	I/P : 100 VAC / 305 VAC O/P : FULL / MIN LOAD Ta : 25°C	V1 : 0.05 % ~ -1.56 %
4	LINE REGULATION	V1 : -0.5 % ~ 0.5 % (Max)	I/P : 100VAC ~ 305 VAC O/P : FULL LOAD Ta : 25°C	V1 : 0.152 % ~ -0.05 %
5	LOAD REGULATION	V1 : -2 % ~ 2 % (Max)	I/P : 230 VAC O/P : FULL ~MIN LOAD Ta : 25°C	V1 : -0.68 % ~ 0.73 %
6	SET UP TIME	230VAC : 500 ms (Max) 115VAC : 500 ms(Max)	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/ 100.8 ms 115VAC/ 105.6 ms
7	RISE TIME	230VAC : 80 ms (Max) 115VAC : 80 ms (Max)	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/ 15.2 ms 115VAC/ 17.2 ms
8	HOLD UP TIME	230VAC : 15 ms (TYP) 115VAC : 15 ms (TYP)	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/ 22.8 ms 115VAC/ 24 ms
9	OVER/UNDERSHOOT TEST	< ±5%	I/P : 230 VAC O/P : FULL LOAD Ta : 25°C	TEST : 0.833 %
10	OUTPUT CURRENT ADJ RANGE	CH1 : 20 A ~ 40 A	I/P : 230 VAC I/P : 115 VAC O/P : MIN LOAD Ta : 25°C	11.96A ~ 45.46 A/230VAC 11.71A ~ 45.46 A/115VAC
11	DYNAMIC LOAD	V1 : 2040 mVp-p	I/P : 230 VAC (1).O/P : FULL /Min LOAD 90%DUTY/ 1KHZ (2).O/P : FULL /Min LOAD 90%DUTY/ 3KHZ (3).O/P : FULL /Min LOAD 90%DUTY/ 5KHZ (4).O/P : FULL /Min LOAD 50%DUTY/ 120HZ Ta : 25°C	(1)1610 mVp-p (2)1530 mVp-p (3)1320 mVp-p (4)1540 mVp-p

**INPUT FUNCTION TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	90VAC~305 VAC	I/P : TESTING O/P : FULL LOAD Ta : 25°C	69.6 V~264V
			I/P : LOW-LINE-3V=87 V (PLEASE CHECK DERATING CURVE) HIGH-LINE+10V=315 V O/P : FULL/MIN LOAD 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 ~ 305VAC O/P : FULL-MIN LOAD Ta : 25°C	TEST : OK
3	POWER FACTOR	0.95 / 230 VAC(TYP)	I/P : 230 VAC	PF= 0.963 / 230 VAC
		0.98 / 115 VAC(TYP)	I/P : 115 VAC	PF= 0.992 / 115 VAC
		0.93 / 277 VAC(TYP)	I/P : 277 VAC	PF= 0.946 / 277 VAC
			O/P : FULL LOAD Ta : 25°C	
4	EFFICIENCY	93% (TYP)	I/P : 230 VAC O/P : FULL LOAD Ta : 25°C	93.1 %
5	INPUT CURRENT	277V/ 2.9 A (TYP)	I/P : 277 VAC	I = 1.9432 A/ 277 VAC
		230V/ 3.3 A (TYP)	I/P : 230 VAC	I = 2.2997 A/ 230 VAC
		115V/ 7 A (TYP)	I/P : 115 VAC	I = 4.5351 A/ 115 VAC
			O/P : FULL LOAD Ta : 25°C	
6	INRUSH CURRENT	230V/ 70 A (TYP) (twidth=1000us measured at 50% Ipeak) COLD START	I/P : 230 VAC O/P : FULL LOAD Ta : 25°C	I = 54.4 A/ 230 VAC T50= 990 us
7	LEAKAGE CURRENT	< 0.75 mA / 277 VAC	I/P : 277 VAC O/P : Min LOAD Ta : 25°C	L-FG : 0.32 mA N-FG : 0.31 mA
8	NO LOAD CONSUMPTION	< 0.5 W	I/P : 115VAC	< 0.08 W
			I/P : 230VAC O/P : NO LOAD AT REMOTE OFF Ta : 25°C	< 0.35 W

**PROTECTION FUNCTION TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER LOAD PROTECTION	105% ~125 %	I/P : 230 VAC I/P : 115 VAC O/P : TESTING Ta : 25°C	112.5%/ 230 VAC 112.5%/ 115 VAC Constant current limiting, recovers automatically after fault condition is removed
2	OVER VOLTAGE PROTECTION	CH1 : 13 V ~ 16V	I/P : 230 VAC I/P : 115 VAC O/P : MIN LOAD Ta : 25°C	13.96-V/ 230 VAC 13.96 V/ 115 VAC Shut down o/p voltage, re-power on to recover
3	OVER TEMPERATURE PROTECTION	NO DAMAGE	I/P : 230 VAC O/P : FULL LOAD	O.T.P. Active Shut down o/p voltage, re-power on to recover
4	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE	I/P : 305 VAC O/P : FULL LOAD Ta : 25°C	NO DAMAGE Constant current limiting, recovers automatically after fault condition is removed

**CONTROL FUNCTION TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	REMOTE CONTROL	Power on : "Hi" (Open circuit) or ">2 ~ 5V" Power off : "Low" (Short circuit) or "<0 ~ 0.5V"	I/P : 230 VAC O/P : FULL LOAD Ta : 25°C	1.45 V~5 V POWER ON 0 V~1.3 V POWER OFF
2	5V STANDBY	5V@0.5A TOLERANCE ± 5% RIPPLE 100mVp-p	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	4.958V 26mVp-p/230 VAC 4.958V 26mVp-p/115 VAC

**COMPONENT STRESS TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	Power Transistor ( D to S) or (C to E) Peak Voltage	Q 12 Rated 600 V/ 20 A	I/P : High-Line +3V = 308 V O/P : (1)Full Load Turn on (2) Output Short (3)Full load continue Ta : 25°C	(1) 450 V (2) 450 V (3) 450 V
2	Diode Peak Voltage	Q100 Rated 40 V /120 A	I/P : High-Line +3V = 308 V O/P : (1)Full Load Turn on (2)Output Short (3)Full load continue Ta : 25°C	(1) 29.5 V (2) 22.1 V (3) 28.7 V
3	Input Capacitor Voltage	C5 Rated 220 u / 450V SURGE VOLTAGE 495V	I/P : High-Line +3V = 308 V O/P : (1)Full Load Turn on /Off (2) Min load Turn on /Off (3)Full Load /Min load Change Ta : 25°C	(1) 444 V (2) 442 V (3) 452 V
4	Control IC Voltage Test	U 2 Rated MAX 16 V MIN 8.85V	I/P : High-Line +3V = 308 V O/P : (1)Full Load Turn on /Off (2) Min load Turn on /Off (3)Full Load /Min load Change Ta : 25°C	(1) 13.8 V (2) 14 V (3) 14 V

5	Power Transistor (D to S) or (C to E) Peak Voltage	Q 1 Rated 600 V/ 20.2 A	I/P : High-Line +3V = 308 V O/P : (1) Full Load Turn on (2) Output Short (3) Full load continue Ta : 25°C	(1)	468	V
				(2)	454	V
				(3)	470	V

## ■ SAFETY & E.M.C. TEST

### SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	I/P-O/P : 3.75KVAC/min I/P-FG : 2 KVAC/min O/P-FG : 1.5 KVAC/min	I/P-O/P : 4KVAC/min I/P-FG : 2.4 KVAC/min O/P-FG : 1.8 KVAC/min Ta : 25°C	I/P-O/P : 3.33 mA I/P-FG : 2.67 mA O/P-FG : 3.54 mA 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/70%RH	I/P-O/P : 30 GΩ I/P-FG : 25.4 GΩ O/P-FG : 30 GΩ NO DAMAGE
3	GROUNDING CONTINUITY	FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40 A / 2min Ta : 25°C / 70%RH	21 mΩ

### E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	HARMONIC	EN61000-3-2 CLASS A	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	PASS
2	CONDUCTION	EN55022 CLASS B	I/P : 230 VAC (50HZ) O/P : FULL/50% LOAD Ta : 25°C	PASS Test by certified Lab
3	RADIATION	EN55022 CLASS B	I/P : 230 VAC (50HZ) O/P : FULL LOAD Ta : 25°C	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°C	CRITERIA A
5	E.F.T	EN61000-4-4 INDUSTRY INPUT : 2KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA A
6	SURGE	IEC61000-4-5 INDUSTRY L-N : 2KV L,N-PE : 4KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA A

■ RELIABILITY TEST

ENVIRONMENT TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT																																																																																																				
1	TEMPERATURE RISE TEST	MODEL : HEP-600-12 1. ROOM AMBIENT BURN-IN : 2.5 HRS I/P : 230VAC O/P : FULL LOAD Ta= 29 °C 2. HIGH AMBIENT BURN-IN : 14.5 HRS I/P : 230VAC O/P : FULL LOAD Ta= 61.7 °C	<table border="1"> <thead> <tr> <th>NO</th> <th>Position</th> <th>ROOM AMBIENT Ta= 29 °C</th> <th>HIGH AMBIENT Ta= 61.7 °C</th> </tr> </thead> <tbody> <tr><td>1</td><td>BD1</td><td>66.5°C</td><td>95.0°C</td></tr> <tr><td>2</td><td>C10</td><td>64.3°C</td><td>93.0°C</td></tr> <tr><td>3</td><td>ZNR3</td><td>63.5°C</td><td>92.2°C</td></tr> <tr><td>4</td><td>C2</td><td>60.3°C</td><td>88.8°C</td></tr> <tr><td>5</td><td>LF3</td><td>61.9°C</td><td>90.3°C</td></tr> <tr><td>6</td><td>Q1</td><td>63.9°C</td><td>92.7°C</td></tr> <tr><td>7</td><td>L2</td><td>65.8°C</td><td>94.6°C</td></tr> <tr><td>8</td><td>L3</td><td>66.1°C</td><td>95.1°C</td></tr> <tr><td>9</td><td>T1</td><td>71.4°C</td><td>100.3°C</td></tr> <tr><td>10</td><td>T2</td><td>75.0°C</td><td>104.6°C</td></tr> <tr><td>11</td><td>C5</td><td>61.6°C</td><td>90.2°C</td></tr> <tr><td>12</td><td>RTH2</td><td>63.2°C</td><td>92.1°C</td></tr> <tr><td>13</td><td>D9</td><td>66.3°C</td><td>95.5°C</td></tr> <tr><td>14</td><td>Q13</td><td>65.8°C</td><td>95.3°C</td></tr> <tr><td>15</td><td>C115</td><td>69.7°C</td><td>98.7°C</td></tr> <tr><td>16</td><td>C124</td><td>72.0°C</td><td>102.0°C</td></tr> <tr><td>17</td><td>C140</td><td>66.3°C</td><td>95.6°C</td></tr> <tr><td>18</td><td>LF100</td><td>71.8°C</td><td>102.2°C</td></tr> <tr><td>19</td><td>U1</td><td>60.7°C</td><td>89.1°C</td></tr> <tr><td>20</td><td>U2</td><td>61.4°C</td><td>89.9°C</td></tr> <tr><td>21</td><td>C560</td><td>64.3°C</td><td>93.0°C</td></tr> <tr><td>22</td><td>C562</td><td>66.2°C</td><td>94.9°C</td></tr> <tr><td>23</td><td>C510</td><td>63.5°C</td><td>91.8°C</td></tr> <tr><td>24</td><td>C523</td><td>64.0°C</td><td>92.2°C</td></tr> </tbody> </table>	NO	Position	ROOM AMBIENT Ta= 29 °C	HIGH AMBIENT Ta= 61.7 °C	1	BD1	66.5°C	95.0°C	2	C10	64.3°C	93.0°C	3	ZNR3	63.5°C	92.2°C	4	C2	60.3°C	88.8°C	5	LF3	61.9°C	90.3°C	6	Q1	63.9°C	92.7°C	7	L2	65.8°C	94.6°C	8	L3	66.1°C	95.1°C	9	T1	71.4°C	100.3°C	10	T2	75.0°C	104.6°C	11	C5	61.6°C	90.2°C	12	RTH2	63.2°C	92.1°C	13	D9	66.3°C	95.5°C	14	Q13	65.8°C	95.3°C	15	C115	69.7°C	98.7°C	16	C124	72.0°C	102.0°C	17	C140	66.3°C	95.6°C	18	LF100	71.8°C	102.2°C	19	U1	60.7°C	89.1°C	20	U2	61.4°C	89.9°C	21	C560	64.3°C	93.0°C	22	C562	66.2°C	94.9°C	23	C510	63.5°C	91.8°C	24	C523	64.0°C	92.2°C	
NO	Position	ROOM AMBIENT Ta= 29 °C	HIGH AMBIENT Ta= 61.7 °C																																																																																																					
1	BD1	66.5°C	95.0°C																																																																																																					
2	C10	64.3°C	93.0°C																																																																																																					
3	ZNR3	63.5°C	92.2°C																																																																																																					
4	C2	60.3°C	88.8°C																																																																																																					
5	LF3	61.9°C	90.3°C																																																																																																					
6	Q1	63.9°C	92.7°C																																																																																																					
7	L2	65.8°C	94.6°C																																																																																																					
8	L3	66.1°C	95.1°C																																																																																																					
9	T1	71.4°C	100.3°C																																																																																																					
10	T2	75.0°C	104.6°C																																																																																																					
11	C5	61.6°C	90.2°C																																																																																																					
12	RTH2	63.2°C	92.1°C																																																																																																					
13	D9	66.3°C	95.5°C																																																																																																					
14	Q13	65.8°C	95.3°C																																																																																																					
15	C115	69.7°C	98.7°C																																																																																																					
16	C124	72.0°C	102.0°C																																																																																																					
17	C140	66.3°C	95.6°C																																																																																																					
18	LF100	71.8°C	102.2°C																																																																																																					
19	U1	60.7°C	89.1°C																																																																																																					
20	U2	61.4°C	89.9°C																																																																																																					
21	C560	64.3°C	93.0°C																																																																																																					
22	C562	66.2°C	94.9°C																																																																																																					
23	C510	63.5°C	91.8°C																																																																																																					
24	C523	64.0°C	92.2°C																																																																																																					
2	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 230VAC/115VAC O/P : 100 % LOAD Ta= -45°C	TEST : OK																																																																																																				
3	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 55 °C NO DAMAGE	I/P : 305 VAC O/P : FULL LOAD Ta= 55 °C HUMIDITY= 95 %R.H	TEST : OK																																																																																																				
4	TEMPERATURE COEFFICIENT	± 0.03 %/°C (0~55°C)	I/P : 230 VAC O/P : FULL LOAD	± 0.003 %/°C (0~55°C)																																																																																																				
5	STORAGE TEMPERATURE TEST	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 : 5 CYCLE 5. Input/Output condition : STATIC		OK																																																																																																				

6	THERMAL SHOCK TEST	1. Thermal shock Temperature : -45°C~ +60°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 : 230VAC/Full Load AC ON/OFF TEST turn on 58sec ; turn off 2sec	OK
7	VIBRATION TEST	1 Carton & 1 Set (1) Waveform : Sine Wave (2) Frequency : 20~500Hz (3) Sweep Time : 12min/sweep cycle (4) Acceleration : 10G (5) Test Time : 72min in each axis (X.Y.Z) (6) Ta : 25°C	TEST : OK
8	CAPACITOR LIFE CYCLE	HEP-600-12 : SUPPOSE C115 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= 55 °C LIFE TIME (3) I/P : 230VAC O/P : 75% LOAD Ta= 55°C LIFE TIME (4) I/P : 230VAC O/P : 50% LOAD Ta= 55°C LIFE TIME	(1) 224613 HRS (2) 36803HRS (3) 61891HRS (4) 112288HRS
9	MTBF	MIL-HDBK-217F TOTAL FAILURE RATE : 76.9 KHRS	
10	DMTBF/Accelerated Life Test	Demonstration Mean Time Between Failure(Expected Life) : 55,000 hours @ Tcase75°C	

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

12.10.30 A50-F031