



# Test Report: HEP-320-48

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320W Single Output Switching Power Supply

## ■ DESIGN VERIFY TEST

Output Function Test

Input Function Test

Protection 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 : 250 mVp-p (Max)	I/P : 230VAC O/P : FULL LOAD Ta : 25°C	V1 : 73.2 mVp-p (Max)
2	OUTPUT VOLTAGE ADJUST RANGE	CH1 : 43 V ~ 52 V	I/P : 230 VAC I/P : 115 VAC O/P : MIN LOAD Ta : 25°C	42.01 V ~ 53.48 V / 230 VAC 42.01 V ~ 53.48 V / 115 VAC
3	OUTPUT CURRENT ADJUST RANGE	CH1 : 3.35A ~ 6.7A	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	2.668 A ~ 7.657 A / 230 VAC 2.806 A ~ 7.657 A / 115 VAC
4	OUTPUT VOLTAGE TOLERANCE	V1 : 1 % ~ -1 % (Max)	I/P : 100 VAC / 305 VAC O/P : FULL / MIN LOAD Ta : 25°C	V1 : 0.09 % ~ -0.09 %
5	LINE REGULATION	V1 : 0.5 % ~ -0.5 % (Max)	I/P : 100 VAC ~ 305 VAC O/P : FULL LOAD Ta : 25°C	V1 : 0 % ~ 0 %
6	LOAD REGULATION	V1 : 0.5 % ~ -0.5 % (Max)	I/P : 230 VAC O/P : FULL ~ MIN LOAD Ta : 25°C	V1 : 0.09 % ~ -0.09 %
7	SET UP TIME	230VAC : 500 ms (Max) 115VAC : 2500 ms(Max)	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/ 384 ms 115VAC/ 780 ms
8	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/ 21 ms 115VAC/ 22 ms
9	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/ 25 ms 115VAC/ 25 ms
10	OVER/UNDERSHOOT TEST	< ±5%	I/P : 230 VAC O/P : FULL LOAD Ta : 25°C	TEST : <5 %
11	DYNAMIC LOAD	V1 : 4800 mVp-p	I/P : 230 VAC (1).O/P : FULL /Min LOAD 90%DUTY/ 1KHZ (2).O/P : FULL /Min LOAD 50%DUTY/ 120HZ Ta : 25°C	(1)313 mVp-p (2)1248 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	61 V~305V
			I/P : LOW-LINE-3V= 87 V HIGH-LINE+10V=315V O/P : FULL/MIN LOAD ON : 30 Sec. OFF : 30 Sec 10MIN ( AC POWER ON/OFF NO DAMAGE )	TEST : OK
2	INPUT FREQUENCY RANGE	47HZ ~63 HZ NO DAMAGE	I/P : 100VAC ~ 305 VAC O/P : FULL -MIN LOAD Ta : 25°C	TEST : OK
3	POWER FACTOR	0.95/ 230 VAC FULL LOAD (TYP) 0.98/ 115 VAC FULL LOAD (TYP) 0.94/ 277 VAC FULL LOAD (TYP)	I/P : 230 VAC I/P : 115 VAC I/P : 277 VAC O/P : FULL LOAD Ta : 25°C	PF=0.975 /230V/100%LOAD PF=0.998 /115V/100%LOAD PF=0.95 / 277V/100%LOAD
4	EFFICIENCY	94.5 % (TYP)	I/P : 230 VAC O/P : FULL LOAD Ta : 25°C	95 %
5	INPUT CURRENT	277V/ 1.45 A (TYP) 230V/ 1.6 A (TYP) 115V/ 3.5 A (TYP)	I/P : 277 VAC I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	I = 1.5471 A/ 277VAC I = 1.6241 A/ 230 VAC I = 3.156 A/ 115 VAC
6	INRUSH CURRENT	230V/ 70 A (TYP)	I/P : 230 VAC O/P : FULL LOAD Ta : 25°C	I = 67 A/ 230 VAC
7	LEAKAGE CURRENT	< 0.75 mA/ 277VAC	I/P : 305 VAC O/P : Min LOAD Ta : 25°C	L-FG : 0.2 mA N-FG : 0.2 mA

**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	115 %/ 230 VAC 115 %/ 115 VAC Hiccup Mode
2	OVER VOLTAGE PROTECTION	CH1 : 53.5V ~ 60 V	I/P : 230 VAC I/P : 115 VAC O/P : MIN LOAD Ta : 25°C	55.28 V/ 230 VAC 55.23 V/ 115 VAC Shut down and latch off 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 and latch off 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 Hiccup Mode

## COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	Power Transistor (D to S) or (C to E) Peak Voltage	Q5 Rated : 20A/600V	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) 476 V (2) 460 V (3) 468 V
2	Diode Peak Voltage	Q101 Rated : 50A/150V    Q102 Rated : 50A/150V	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) 118 V (2) 38.4 V (3) 111 V (1) 118 V (2) 42 V (3) 115 V
3	Input Capacitor Voltage	C5 Rated : 220u/450V	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) 424.25 V (2) 431.56 V (3) 432.21 V
4	Control IC Voltage Test	U900 Rated : 8.85V~16V	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) 13.758 V (2) 13.725 V (3) 13.748 V
5	P.F.C Transistor (D to S) or (C to E) Peak Voltage	Q 1 Rated : 20A/600V	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) 588 V (2) 484 V (3) 570 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 : 2KVAC/min<4.5mA O/P-FG : 1.5KVAC/min	I/P-O/P : 4 KVAC/min I/P-FG : 2.4 KVAC/min O/P-FG : 1.8KVAC/min Ta : 25°C	I/P-O/P : 2.469 mA I/P-FG : 1.997 mA O/P-FG : 1.648 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 : 30 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	20 mΩ

**E.M.C TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	HARMONIC	EN61000-3-2 CLASS A	I/P:230 / 50HZ O/P:100% 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 : 3KV L,N-PE : 6KV	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-320-24 1. ROOM AMBIENT BURN-IN : 13 HRS I/P : 230VAC O/P : FULL LOAD Ta=30.6 °C 2. HIGH AMBIENT BURN-IN : 16.5 HRS I/P : 230VAC O/P : FULL LOAD Ta=67.8 °C	<table border="1"> <thead> <tr> <th>NO</th> <th>Position</th> <th>ROOM AMBIENT Ta= 30.6 °C</th> <th>HIGH AMBIENT Ta=67.8 °C</th> </tr> </thead> <tbody> <tr><td>1</td><td>LF1</td><td>60.3°C</td><td>91.5°C</td></tr> <tr><td>2</td><td>L2</td><td>64.9°C</td><td>95.7°C</td></tr> <tr><td>3</td><td>C11</td><td>66.8°C</td><td>97.7°C</td></tr> <tr><td>4</td><td>BD1</td><td>67.0°C</td><td>97.9°C</td></tr> <tr><td>5</td><td>Q1</td><td>66.7°C</td><td>97.3°C</td></tr> <tr><td>6</td><td>C5</td><td>66.1°C</td><td>96.5°C</td></tr> <tr><td>7</td><td>L1</td><td>68.5°C</td><td>98.5°C</td></tr> <tr><td>8</td><td>D2</td><td>67.7°C</td><td>98.5°C</td></tr> <tr><td>9</td><td>C13</td><td>65.9°C</td><td>96.7°C</td></tr> <tr><td>10</td><td>C902</td><td>65.5°C</td><td>96.4°C</td></tr> <tr><td>11</td><td>C40</td><td>67.0°C</td><td>97.6°C</td></tr> <tr><td>12</td><td>D3</td><td>70.7°C</td><td>100.9°C</td></tr> <tr><td>13</td><td>D41</td><td>65.4°C</td><td>95.8°C</td></tr> <tr><td>14</td><td>C906</td><td>63.6°C</td><td>94.7°C</td></tr> <tr><td>15</td><td>C205</td><td>64.7°C</td><td>96.2°C</td></tr> <tr><td>16</td><td>T1</td><td>68.8°C</td><td>100.7°C</td></tr> <tr><td>17</td><td>C102</td><td>62.3°C</td><td>94.1°C</td></tr> <tr><td>18</td><td>C106</td><td>62.6°C</td><td>94.5°C</td></tr> <tr><td>19</td><td>Q101</td><td>65.2°C</td><td>96.5°C</td></tr> <tr><td>20</td><td>C104</td><td>61.6°C</td><td>93.2°C</td></tr> <tr><td>21</td><td>U900</td><td>62.7°C</td><td>93.8°C</td></tr> <tr><td>22</td><td>RTH2</td><td>62.4°C</td><td>93.8°C</td></tr> <tr><td>23</td><td>LF100</td><td>62.5°C</td><td>94.8°C</td></tr> </tbody> </table>	NO	Position	ROOM AMBIENT Ta= 30.6 °C	HIGH AMBIENT Ta=67.8 °C	1	LF1	60.3°C	91.5°C	2	L2	64.9°C	95.7°C	3	C11	66.8°C	97.7°C	4	BD1	67.0°C	97.9°C	5	Q1	66.7°C	97.3°C	6	C5	66.1°C	96.5°C	7	L1	68.5°C	98.5°C	8	D2	67.7°C	98.5°C	9	C13	65.9°C	96.7°C	10	C902	65.5°C	96.4°C	11	C40	67.0°C	97.6°C	12	D3	70.7°C	100.9°C	13	D41	65.4°C	95.8°C	14	C906	63.6°C	94.7°C	15	C205	64.7°C	96.2°C	16	T1	68.8°C	100.7°C	17	C102	62.3°C	94.1°C	18	C106	62.6°C	94.5°C	19	Q101	65.2°C	96.5°C	20	C104	61.6°C	93.2°C	21	U900	62.7°C	93.8°C	22	RTH2	62.4°C	93.8°C	23	LF100	62.5°C	94.8°C	
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2	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 305VAC/100VAC O/P : 100 % LOAD Ta= -55 °C	TEST : OK																																																																																																
3	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 60 °C NO DAMAGE	I/P : 305 VAC O/P : FULL LOAD Ta= 60 °C HUMIDITY= 95 %R.H	TEST : OK																																																																																																
4	TEMPERATURE COEFFICIENT	±0.03 %(0-50°C)	I/P : 230 VAC O/P : FULL LOAD	± 0.003 %(0-50°C)																																																																																																
5	STORAGE TEMPERATURE TEST	1. Thermal shock Temperature : -60°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 : -60°C~ +65°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-320-24:SUPPOSE C106 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) 410656HRS (2) 52474HRS (3) 84303HRS (4) 117008HRS
9	MTBF	Conducted by Parts Stress Analysis Prediction 154.2K hrs min. MIL-HDBK-217F (25°C)	
10	DMTBF/Accelerated Life Test	Demonstration Mean Time Between Failure(Expected Life) : 55,000 hours @ Tcase 75°C	

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

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