



Test Report: HEP-480-24

480W 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

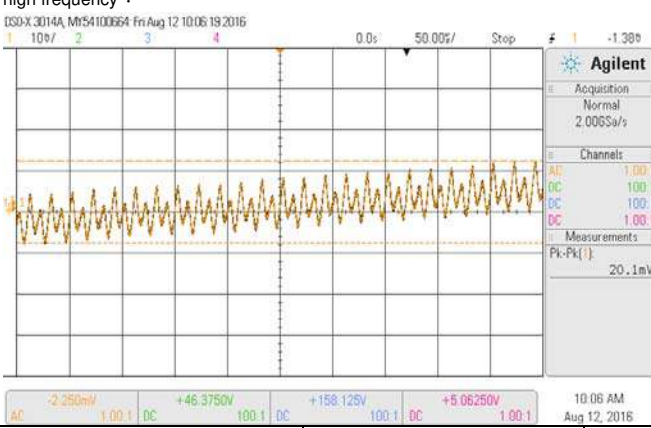
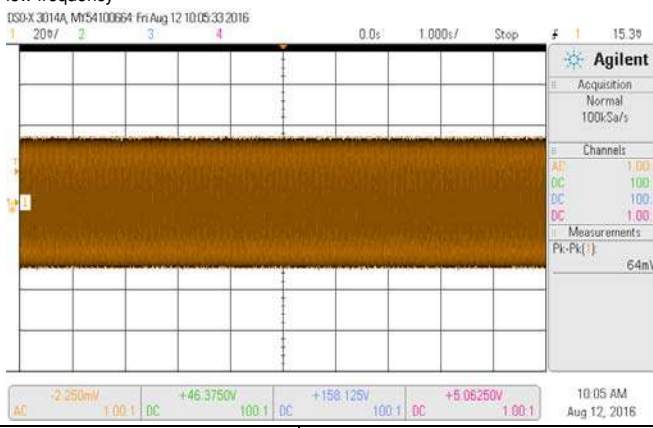
E.M.C. Test

■ RELIABILITY TEST

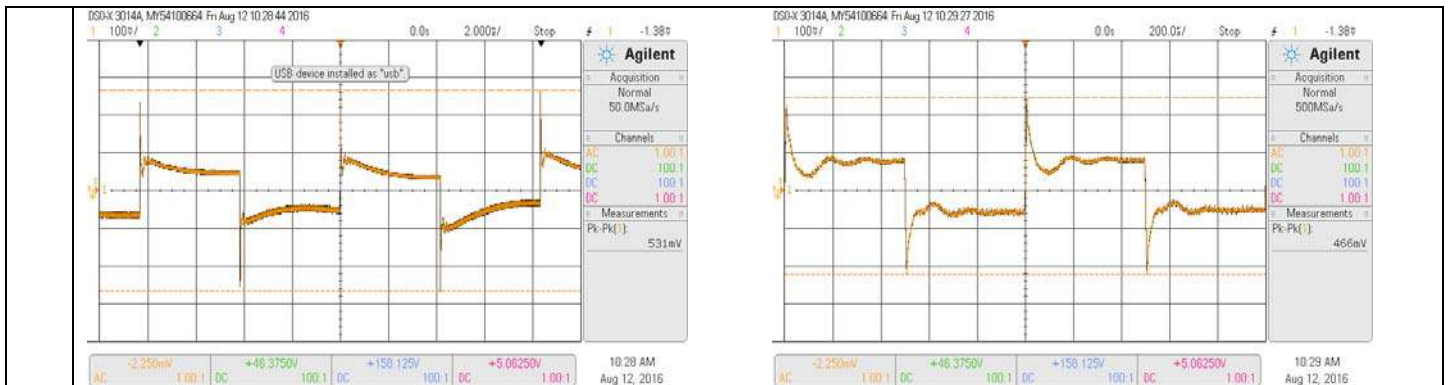
ENVIRONMENT TEST

DESIGN VERIFY TEST

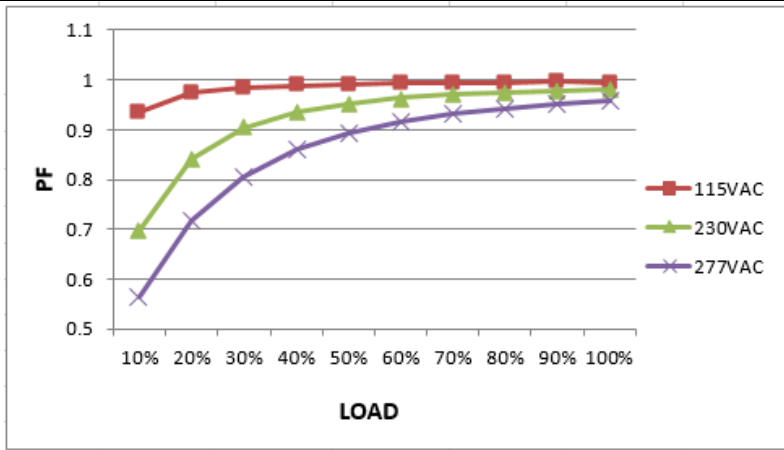
OUTPUT FUNCTION TEST

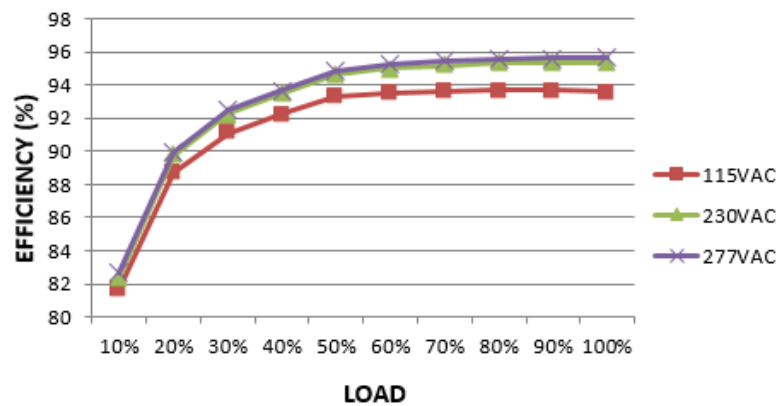
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	VOLTAGE ADJUST RANGE	CH1: 20.4 V ~ 25.2V	I/P: 230 VAC I/P: 115VAC O/P: MIN LOAD Ta: 25°C	18.51V ~ 25.76 V / 230VAC 18.52V ~ 25.76 V / 115VAC
2	CURRENT ADJ. RANGE	CH1: 10 A ~ 20 A	I/P: 230 VAC I/P: 115VAC O/P: CV MIN & CV MAX -1V Ta: 25°C	7.84A ~ 24.51A / 230VAC @ CV MAX -1V 7.84A ~ 24.51 A / 115VAC @ CV AX -1V
3	OUTPUT VOLTAGE TOLERANCE (Max)	V1: 1% ~ -1 %	I/P: 100VAC / 305AC O/P: FULL / MIN LOAD Ta: 25°C	V1: 0% ~ -0.62%
4	LINE REGULATION (Max)	V1: 0.5% ~ -0.5 %	I/P: 100VAC ~ 305AC O/P: FULL LOAD Ta: 25°C	V1: 0 % ~ 0 %
5	LOAD REGULATION (Max)	V1: 0.5 % ~ -0.5 %	I/P: 230 VAC O/P: FULL ~ MIN LOAD Ta: 25°C	V1: -0.33 % ~ 0.29 %
6	OVER/UNDERSHOOT TEST	< ±5%	I/P: 230 VAC O/P: FULL LOAD Ta: 25°C	TEST: 1.63 %
7	RIPPLE & NOISE (Max)	V1: 200 mVp-p	I/P: 230 VAC O/P: FULL LOAD Ta: 25°C	V1: 64 mVp-p
high frequency :  low frequency : 				
8	SET UP TIME (Max)	230VAC/ 500 ms 115VAC/ 500 ms	I/P: 230 VAC I/P: 115 VAC O/P: FULL LOAD Ta: 25°C	230VAC/ 168 ms 115 VAC/ 184 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	

Ch2 Coupling & Impedance: DC, AC, GND. Ch1: 5.00 V, 200 V, 100ms, 2.40 V. 70.00%.					Ch2 Coupling & Impedance: DC, AC, GND. Ch1: 5.00 V, 400 V, 100ms, 2.40 V. 70.00%.				
9	RISE TIME (Max)	230VAC/ 80 ms 115VAC/ 80 ms	I/P: 230 VAC I/P: 115 VAC O/P:FULL LOAD Ta:25°C	230VAC/ 34 ms 115 VAC/34.4 ms					
INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage Ch1 Probe Setup: Voltage, Current, Voltage Probe 10X. Des skew 0.00 s. Set to 0 s.					INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage Ch1 Probe Setup: Voltage, Current, Voltage Probe 10X. Des skew 0.00 s. Set to 0 s.				
10	HOLD UP TIME (Typ.)	230VAC/ 16 ms 115VAC/ 16 ms	I/P: 230 VAC I/P: 115 VAC O/P:FULL LOAD Ta:25°C	230VAC/ 26.8 ms 115 VAC/27.2 ms					
INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage Ch2 Coupling & Impedance: DC, AC, GND. Ch1: 5.00 V, 100 V, 100ms, 2.40 V. 70.00%.					INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage Ch2 Coupling & Impedance: DC, AC, GND. Ch1: 5.00 V, 100 V, 100ms, 2.40 V. 70.00%.				
11	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	531mVp-p 466mVp-p					
FULL /50% LOAD 50%DUTY / 120HZ					FULL /50% LOAD 50%DUTY / 1KHZ				



INPUT FUNCTION TEST

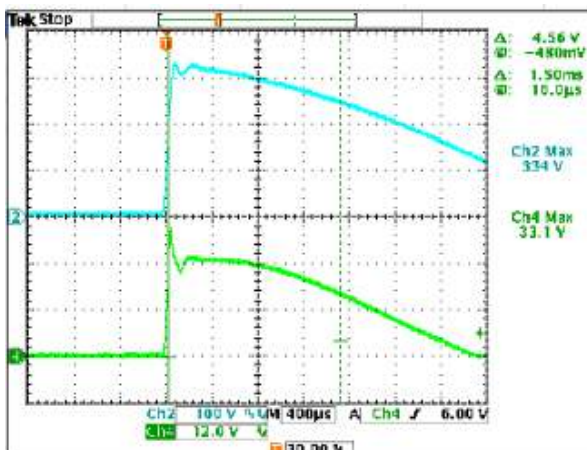
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	90VAC~305 VAC	I/P:TESTING O/P:FULL LOAD Ta:25°C	76V~305 V
			I/P: LOW-LINE-3V=87 V HIGH-LINE+10V=315 V O/P:FULL/MIN LOAD (PLEASE CHECK DERATING CURVE) ON: 30 Sec OFF: 30 Sec 10MIN (POWER ON/OFF NO DAMAGE)	TEST:OK
2	INPUT FREQUENCY RANGE	47HZ ~63 HZ NO DAMAGE	I/P: 100 VAC ~305VAC O/P:FULL~MIN LOAD Ta:25°C	OK
3	INPUT CURRENT (TYP)	277VAC/ 2 A 230 VAC/ 2.45 A 115 VAC/ 5 A	I/P: 277VAC/230 VAC/115 VAC O/P:FULL LOAD Ta:25°C	I=1.80A/ 277VAC I =2.13A/ 230VAC I =4.31 A/ 115VAC
4	LEAKAGE CURRENT	< 0.75 mA / 277VAC	I/P : 277 VAC O/P : Min LOAD Ta : 25°C	L-FG:0.32mA N-FG:0.32 mA
5	POWER FACTOR(TYP)	0.97/230 VAC FULL LOAD 0.98/115 VAC FULL LOAD 0.95/277 VAC FULL LOAD	I/P: 230 VAC/115VAC/277VAC O/P:FULL LOAD Ta:25°C	PF=0.982 /230V/100%LOAD PF=0.994/115V/100%LOAD PF=0.958 /277V/100%LOAD
 Graph of Power Factor (PF) vs Load for 115VAC, 230VAC, and 277VAC. The graph shows that PF increases with load and is highest for 115VAC.				
6	EFFICIENCY (TYP)	94 %	I/P: 230 VAC O/P:FULL LOAD Ta:25°C	94.37% /230V



7	INRUSH CURRENT (TYP)	230 V/35A COLD START	I/P: 230 VAC O/P: FULL LOAD Ta: 25°C	I = 33.1 A / 230VAC
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INPUT=230VAC/50HZ @ FULL LOAD

CH2 : AC Input Voltage CH1 : Input current (1V=1A)



PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER CURRENT PROTECTION	105%~ 125 % PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed	I/P: 305VAC I/P: 230VAC I/P: 100VAC O/P: TESTING Ta: 25°C	110%/ 305VAC 110%/ 230VAC 110%/100VAC PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed
2	OVER VOLTAGE PROTECTION	V1: 27 V~ 33 V PROTECTION TYPE : Shut down output voltage, re-power on to recovery	I/P: 305VAC I/P: 230VAC I/P: 90VAC O/P: MIN LOAD Ta: 25°C	28.26V/ 305VAC 28.27V/ 230VAC 28.26V/ 90VAC PROTECTION TYPE : Shut down output voltage, re-power on to recovery

3	OVER TEMPERATURE PROTECTION	PROTECTION TYPE : Shut down output voltage, re-power on to recovery	I/P: 305 VAC I/P: 90 VAC O/P: FULL LOAD	O.T.P Active PROTECTION TYPE : Shut down output voltage, re-power on to recovery
4	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed	I/P: 305VAC I/P: 90 VAC O/P: FULL LOAD Ta:25°C	NO DAMAGE PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed

COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Transistor (D to S) or (C to E) Peak Voltage	Q 10 Rated 13 A/ 600 V Q 13 Rated 13 A/ 600V	I/P:High-Line +3V =308V 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	Q10 Q13 VDS: VDS: (1)504V (1)508V (2)500V (2)500V (3)440V (3)440V (4)428V (4)432V (5)432V (5)440V (6)432V (6)432V (7)488V (7)500V
2	P.F.C Transistor (D to S) or (C to E) Peak Voltage	Q 1Rated 13 A/ 600 V	I/P:High-Line +3V =308 V 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)499V (2) 459V (3)479V (4)483V (5)491V (6)483V (7)471V
3	P.F.C DIODE	D8 Rated 15A/ 600V	I/P:High-Line +3V =308 V 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)424V (2)448V (3)428V (4)440V
4	Diode Peak Voltage	Q100 Rated 100 A/ 80V Q101 Rated	I/P:High-Line +3V =308 V AC ON/OFF O/P: (1)Full Load (2)Output Short (3)Dynamic Load Full Load/	Q100: Q101 VDS: VDS: (1)56.3V (1)57.1V (2)17.7V (2)4.1V (3)53.9V (3)57.1V

		100 A/ 80V	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℃	(4)57.9V (5)55.5V (6)53.9V (7)12.9V (8)51.5V	(4)59.5V (5)58.7V (6)61.2V (7)8.9V (8)24.2V
5	Input Capacitor Voltage	C5 Rated: 150 μ / 450V	I/P:High-Line +3V =308V 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℃	(1)433V (2)437V (3)449V (4)433V	
6	Control IC Voltage Test	PWM IC U2 Rated 16V~ 8.85V(MIN.) PFC IC U1 Rated 20V~10.5V(MIN.)	I/P:High-Line +3V =308 V AC ON/OFF O/P(1)FULL LOAD (2) Output Short (3)O.L.P (4)O.V.P. Ta:25℃	U1: (1) 13.68V (2) 13.25V (3) 13.31V (4) 13.31V U2: (1)12.375V (2)12.375V (3)12.25V (4)12.81V	

SAFETY & EMC TEST REPORT

SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	IEC60950-1 I/P-O/P: 3.75KVAC/min I/P-FG:2 KVAC/min O/P-FG:1.5KVAC/min	I/P-O/P: 4.125 KVAC/min I/P-FG: 2.4KVAC/min O/P-FG: 1.8 KVAC/min Ta:25℃	I/P-O/P:5.59mA I/P-FG: 4.8mA O/P-FG:6.08 mA NO DAMAGE
2	ISOLATION RESISTANCE	I/P-O/P:500VDC>100M Ω I/P-FG: 500VDC>100M Ω O/P-FG:500VDC>100M Ω	I/P-O/P: 500 VDC I/P-FG: 500 VDC O/P-FG: 500 VDC Ta:25℃	I/P-O/P: 25.1G Ω I/P-FG: 15G Ω O/P-FG:30 G Ω NO DAMAGE
3	GROUNDING CONTINUITY	IEC60950-1 FG(PE) TO CHASSIS OR TRACE < 100 m Ω	40A / 2min Ta:25℃	25m Ω

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℃	PASS
2	CONDUCTION	EN55022 CLASS B	I/P: 230 VAC /50HZ O/P:FULL/50% LOAD Ta:25℃	PASS Test by certified Lab
3	RADIATION	EN55022 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 LIGHT INDUSTRY	I/P: 230 VAC/50HZ O/P:FULL LOAD	CRITERIA A

		AIR:8KV / Contact:4KV	Ta:25℃	
5	E.F.T	EN61000-4-4 LIGHT INDUSTRY INPUT: 1KV	I/P: 230 VAC/50HZ O/P:FULL LOAD Ta:25℃	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℃	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 : HEP-480-24 1. ROOM AMBIENT BURN-IN : 2.5 HRS I/P : 230VAC O/P : FULL LOAD Ta= 29.4 °C 2. HIGH AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta= 63.8 °C																																																																																																																		
		<table><tr><th>NO</th><th>Position</th><th>ROOM AMBIENT Ta= 29.4 °C</th><th>HIGH AMBIENT Ta= 63.8 °C</th></tr><tr><td>1</td><td>BD2</td><td>89.8°C</td><td>98.1°C</td></tr><tr><td>2</td><td>C10</td><td>86.5°C</td><td>94.8°C</td></tr><tr><td>3</td><td>Q1</td><td>86.4°C</td><td>97.8°C</td></tr><tr><td>4</td><td>D8</td><td>90.1°C</td><td>99.1°C</td></tr><tr><td>5</td><td>Q10</td><td>88.8°C</td><td>94.8°C</td></tr><tr><td>6</td><td>Q12</td><td>89.7°C</td><td>98.7°C</td></tr><tr><td>7</td><td>RY1</td><td>87.6°C</td><td>96.1°C</td></tr><tr><td>8</td><td>LF2</td><td>83.3°C</td><td>90.7°C</td></tr><tr><td>9</td><td>ZNR2</td><td>83.2°C</td><td>90.3°C</td></tr><tr><td>10</td><td>C1</td><td>82.2°C</td><td>89.4°C</td></tr><tr><td>11</td><td>C5</td><td>83.3°C</td><td>90.5°C</td></tr><tr><td>12</td><td>L3</td><td>87.9°C</td><td>97.2°C</td></tr><tr><td>13</td><td>U1</td><td>83.6°C</td><td>90.2°C</td></tr><tr><td>14</td><td>U2</td><td>83.4°C</td><td>90.9°C</td></tr><tr><td>15</td><td>T1 Primary side</td><td>89.7°C</td><td>100.7°C</td></tr><tr><td>16</td><td>T2 Primary side</td><td>91.8°C</td><td>101.6°C</td></tr><tr><td>17</td><td>Q100</td><td>84.9°C</td><td>95.7°C</td></tr><tr><td>18</td><td>Q121</td><td>84.4°C</td><td>95.4°C</td></tr><tr><td>19</td><td>C115</td><td>81.2°C</td><td>91.6°C</td></tr><tr><td>20</td><td>C117</td><td>80.9°C</td><td>99.5°C</td></tr><tr><td>21</td><td>LF100</td><td>80.1°C</td><td>91.8°C</td></tr><tr><td>22</td><td>T500</td><td>83.1°C</td><td>91.6°C</td></tr><tr><td>23</td><td>C511</td><td>84.3°C</td><td>92.7°C</td></tr><tr><td>24</td><td>U501</td><td>83.4°C</td><td>90.9°C</td></tr><tr><td>25</td><td>J101</td><td>86.3°C</td><td>97.5°C</td></tr><tr><td>26</td><td>RTH2</td><td>84.4°C</td><td>92.6°C</td></tr><tr><td>27</td><td>C93</td><td>86.1°C</td><td>98.7°C</td></tr></table>			NO	Position	ROOM AMBIENT Ta= 29.4 °C	HIGH AMBIENT Ta= 63.8 °C	1	BD2	89.8°C	98.1°C	2	C10	86.5°C	94.8°C	3	Q1	86.4°C	97.8°C	4	D8	90.1°C	99.1°C	5	Q10	88.8°C	94.8°C	6	Q12	89.7°C	98.7°C	7	RY1	87.6°C	96.1°C	8	LF2	83.3°C	90.7°C	9	ZNR2	83.2°C	90.3°C	10	C1	82.2°C	89.4°C	11	C5	83.3°C	90.5°C	12	L3	87.9°C	97.2°C	13	U1	83.6°C	90.2°C	14	U2	83.4°C	90.9°C	15	T1 Primary side	89.7°C	100.7°C	16	T2 Primary side	91.8°C	101.6°C	17	Q100	84.9°C	95.7°C	18	Q121	84.4°C	95.4°C	19	C115	81.2°C	91.6°C	20	C117	80.9°C	99.5°C	21	LF100	80.1°C	91.8°C	22	T500	83.1°C	91.6°C	23	C511	84.3°C	92.7°C	24	U501	83.4°C	90.9°C	25	J101	86.3°C	97.5°C	26	RTH2	84.4°C	92.6°C	27	C93	86.1°C	98.7°C
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17	Q100	84.9°C	95.7°C																																																																																																																	
18	Q121	84.4°C	95.4°C																																																																																																																	
19	C115	81.2°C	91.6°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= -60 °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 : 315 VAC O/P : FULL LOAD Ta= 60°C HUMIDITY= 95 %R.H	TEST : OK
4	TEMPERATURE COEFFICIENT	± 0.02 %/°C(0~60°C)	I/P : 230 VAC O/P : FULL LOAD	± 0.006 %/°C (0~60°C)
5	STORAGE TEMPERATURE TEST	1. Thermal shock Temperature : -50°C~ +125°C 2. Temperature change rate : 25°C / MIN 3. Dwell time low and high temperature : 30 MIN/EACH 4. Total test cycle : 100 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 : 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
7	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°C		TEST : OK
8	CAPACITOR LIFE CYCLE	SUPPOSE C117 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) 95027HRS (2) 19111HRS (3) 52542HRS (4) 86291HRS
9	MTBF	Conducted by Parts Stress Analysis Prediction 89.8K hrs min. MIL-HDBK-217F (25°C)		
10	DMTBF/Accelerated Life Test	Demonstration Mean Time Between Failure(Expected Life) : Above 55,000 hours @ TA 60°C		

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

12.10.30 A50-F031