



Test Report: MSP-1000-48

1000W Single Output Medical Type

■ 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

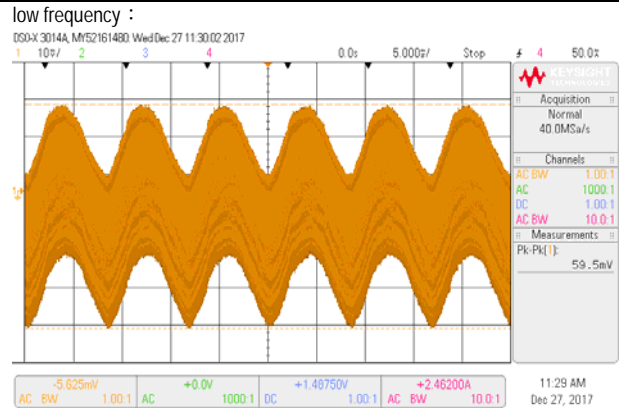
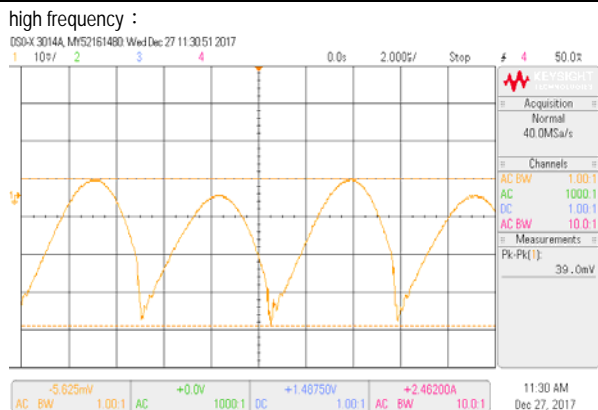
■ RELIABILITY TEST

ENVIRONMENT TEST

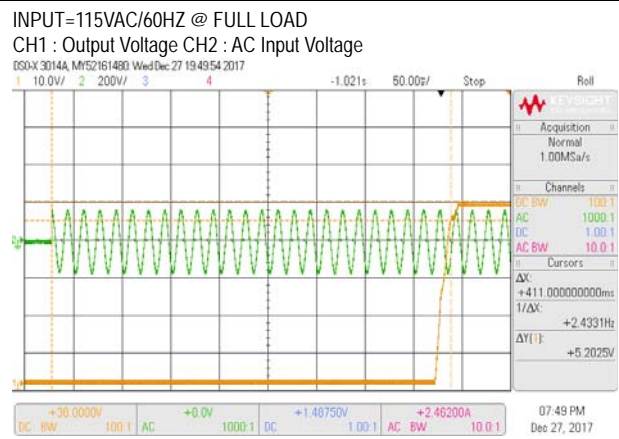
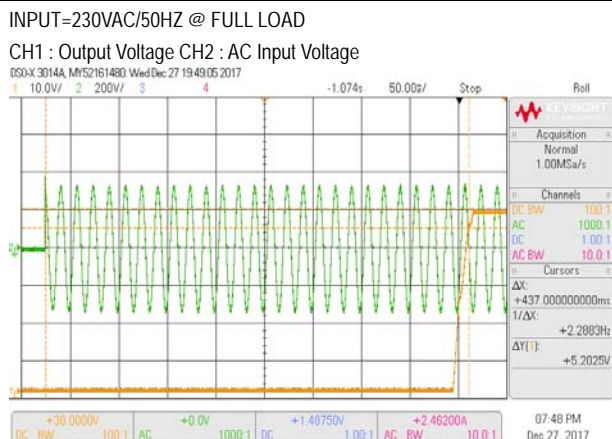
DESIGN VERIFY TEST

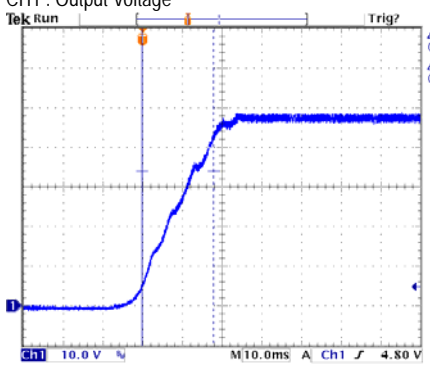
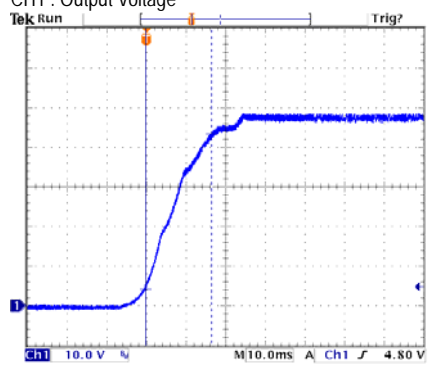
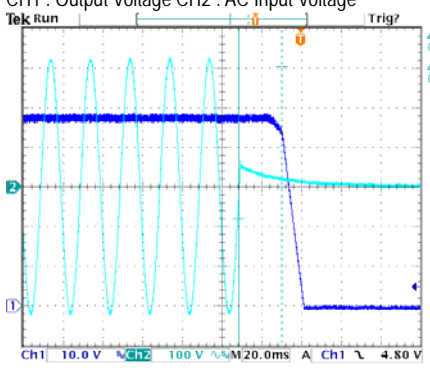
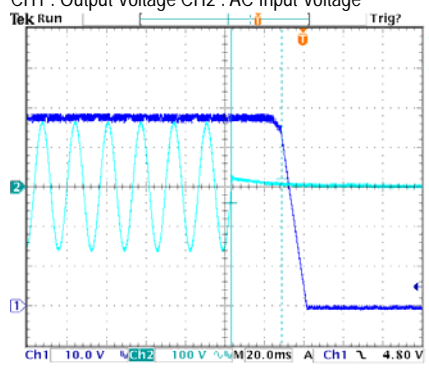
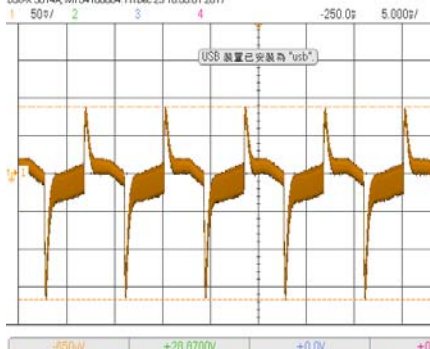
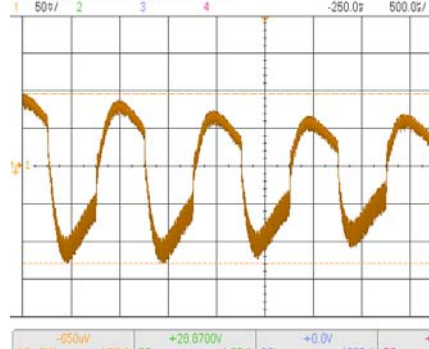
OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE ADJUST RANGE	CH1: 46V~ 56 V	I/P : 230 VAC I/P : 115 VAC O/P : MIN LOAD Ta : 25°C	43.57V~57.76V/230VAC 43.68V~57.73V/115VAC
2	OUTPUT VOLTAGE(Max) TOLERANCE	V1: 1%~ -1%	I/P: 200VAC /264VAC O/P:FULL/ MIN. LOAD Ta:25°C	V1: 0.31%~ 0%
3	LINE REGULATION (Max)	V1: 0.5%~ -0.5 %	I/P: 200VAC~ 264VAC O/P:FULL LOAD Ta:25°C	V1: 0 %
4	LOAD REGULATION(Max)	V1: 0.5%~ -0.5 %	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25°C	V1: 0 %
5	OVER/UNDERSHOOT TEST	< ±5%	I/P: 230VAC O/P:FULL LOAD Ta:25°C	< 5 %
6	RIPPLE & NOISE(Max)	V1: 250mVp-p	I/P:230VAC O/P:FULL LOAD Ta:25°C	V1: 39 mVp-p



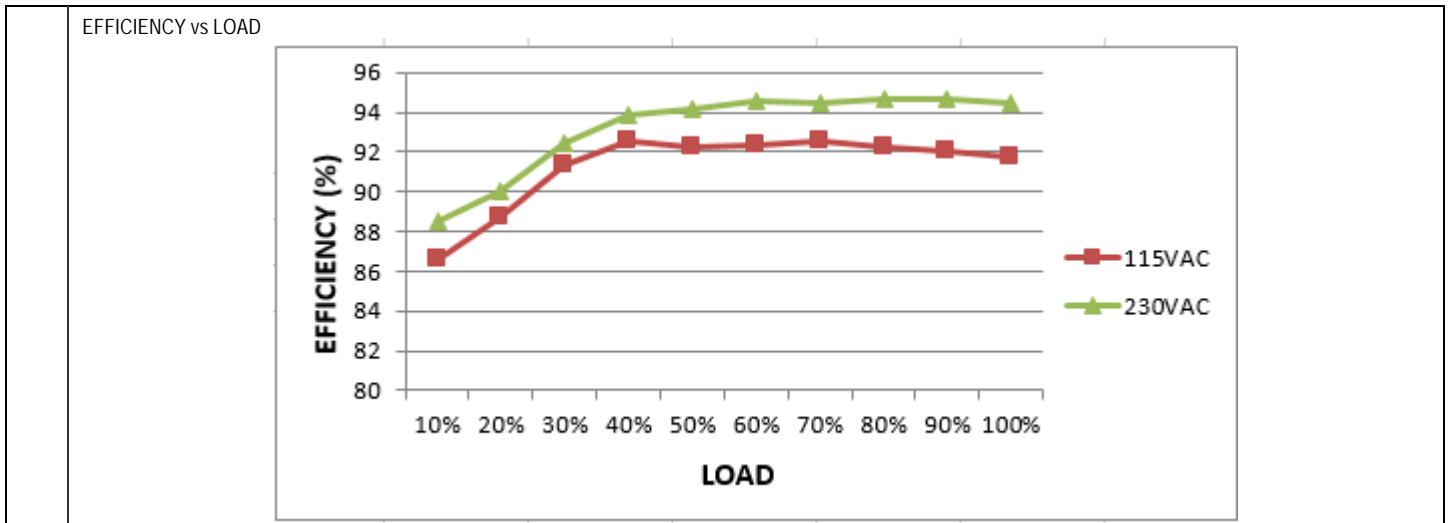
7	SET UP TIME(Max)	230VAC/1000ms 115VAC/2000ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/ 437 ms 115VAC/ 411 ms
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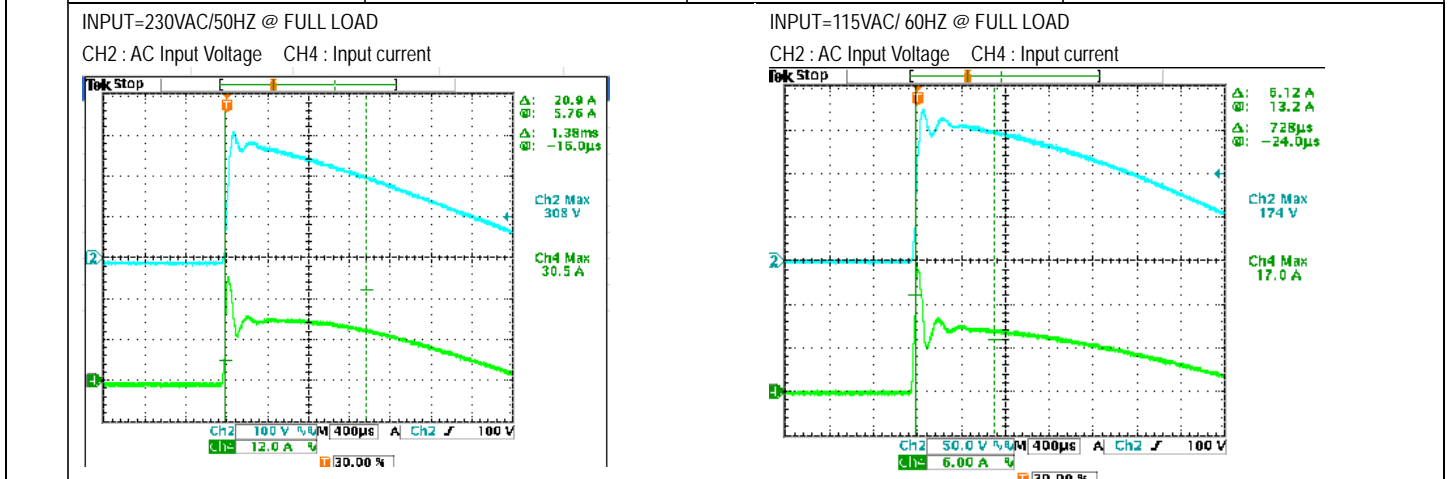
8 RISE TIME (Max)	230VAC/50ms 115VAC/50ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/18 ms 115VAC/ 16.6 ms
INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage 		INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage 	
9 HOLD UP TIME (Typ.)	230VAC/16ms 115VAC/16ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/21.6 ms 115VAC/25.6 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 	
10 DYNAMIC LOAD	V1: 4800 mVp-p	I/P: 230VAC O/P: (1)FULL /50% LOAD 50%DUTY / 120HZ (2)FULL /50% LOAD 50%DUTY / 1KHZ Ta:25°C	255mVp-p 225mVp-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~264VAC	I/P:TESTING O/P:FULL LOAD Ta:25°C	73V~264V																																	
			I/P: LOW-LINE-3V=87 V HIGH-LINE+15%=300 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 ~264 VAC O/P:FULL-MIN LOAD Ta:25°C	TEST: OK																																	
3	INPUT CURRENT (Typ.)	230V/ 5A 115V/ 8.5A	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	I=4.8A/ 230VAC I=8.21A/ 115VAC																																	
4	LEAKAGE CURRENT	Earth leakage current < 360 uA/264VAC	I/P : 264 VAC O/P : Min LOAD Ta : 25°C	L-FG : 300uA N-FG : 298uA																																	
		Touch leakage current < 100 uA/264VAC	I/P : 264 VAC O/P : Min LOAD Ta : 25°C	L-V+ : 84.6uA L-V-: 84.7uA N-V+: 84.5uA N-V-: 84.6uA																																	
5	NO LOAD CONSUMPTION	< 0.75W	I/P : 115VAC I/P : 230VAC O/P : NO LOAD Ta : 25°C	< 0.412 W < 0.671 W																																	
6	POWER FACTOR (Typ.)	0.95/ 230VAC 0.98/115VAC	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	PF=0.973/230VAC PF=0.996/115VAC																																	
<p>P.F vs LOAD</p> <table border="1"> <caption>Approximate data from P.F vs LOAD graph</caption> <thead> <tr> <th>LOAD (%)</th> <th>115VAC PF</th> <th>230VAC PF</th> </tr> </thead> <tbody> <tr><td>10%</td><td>0.90</td><td>0.65</td></tr> <tr><td>20%</td><td>0.95</td><td>0.82</td></tr> <tr><td>30%</td><td>0.97</td><td>0.88</td></tr> <tr><td>40%</td><td>0.98</td><td>0.92</td></tr> <tr><td>50%</td><td>0.99</td><td>0.94</td></tr> <tr><td>60%</td><td>0.99</td><td>0.95</td></tr> <tr><td>70%</td><td>0.99</td><td>0.96</td></tr> <tr><td>80%</td><td>0.99</td><td>0.97</td></tr> <tr><td>90%</td><td>0.99</td><td>0.97</td></tr> <tr><td>100%</td><td>0.99</td><td>0.98</td></tr> </tbody> </table>					LOAD (%)	115VAC PF	230VAC PF	10%	0.90	0.65	20%	0.95	0.82	30%	0.97	0.88	40%	0.98	0.92	50%	0.99	0.94	60%	0.99	0.95	70%	0.99	0.96	80%	0.99	0.97	90%	0.99	0.97	100%	0.99	0.98
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7	EFFICIENCY(Typ.)	94%	I/P:230 VAC O/P:FULL LOAD Ta:25°C	94.2 %																																	



8	INRUSH CURRENT(Typ.)	230V/40A 115V/20A COLD START	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	I =30.5A/ 230VAC I =17A/ 115VAC T50= 1380 us/230V
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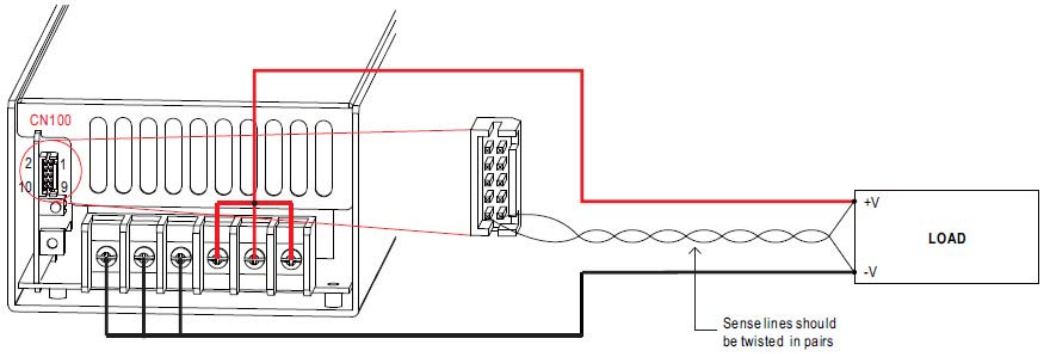
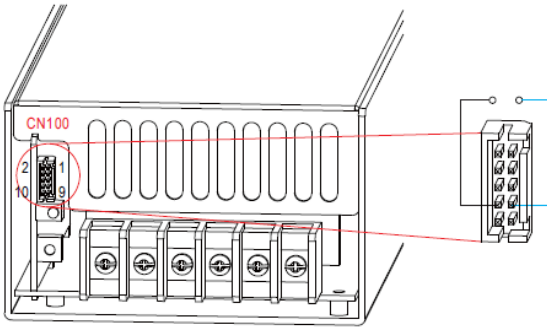
PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER LOAD PROTECTION	105%~ 135 % Protection type : Constant current limiting, recovers automatically after fault condition is removed	I/P: 264VAC I/P: 230VAC I/P: 200AC O/P:TESTING Ta:25°C	115.03%/ 264VAC 115.03%/ 230VAC 115.04%/200VAC PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed

2	OVER VOLTAGE PROTECTION	58V-65V Protection type : Shut down o/p voltage, re-power on to recover	I/P: 264VAC I/P: 230VAC I/P: 90VAC O/P:MIN LOAD Ta:25°C	60.97V/ 264VAC 60.97V/ 230VAC 60.98V/ 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: 264VAC I/P: 90VAC O/P:FULL 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 :	I/P: 264VAC I/P: 90VAC O/P: FULL LOAD Ta:25°C	NO DAMAGE PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed

CONTROL FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT						
1	CURRENT SHARING	< 10%	I/P : 230 VAC O/P : FULL/50% LOAD Ta : 25°C	O/P : 90% PSU1 : 19.4A PSU2 : 19.3A PSU3 : 19.4A PSU4 : 20.3A O/P : 50% PSU1 : 10.9A PSU2 : 10.2A PSU3 : 10.3A PSU4 : 11.8A						
2	REMOTE ON/OFF CONTROL	<p>The PSU can be turned ON/OFF by using the "Remote Control" function.</p> <table border="1"> <tr> <td>Between RC+(pin3) and RC-(pin4)</td> <td>Output Status</td> </tr> <tr> <td>SW ON (Short)</td> <td>ON</td> </tr> <tr> <td>SW OFF (Open)</td> <td>OFF</td> </tr> </table> <p>I/P: 230 VAC O/P: FULL LOAD Ta:25°C TEST RESULT : OK</p>	Between RC+(pin3) and RC-(pin4)	Output Status	SW ON (Short)	ON	SW OFF (Open)	OFF		
Between RC+(pin3) and RC-(pin4)	Output Status									
SW ON (Short)	ON									
SW OFF (Open)	OFF									
3	REMOTE SENSE	S+ / S- >0.5V								

		 <p>I/P: 230 VAC O/P: FULL LOAD Ta: 25°C TEST RESULT: > 0.5 V</p>											
4	DC OK SIGNAL	<p>The TTL signal out, PSU turn on = 3.3 ~ 5.6V ; PSU turn off = 0 ~ 1V DC-OK signal is a TTL level signal. High when PSU turns on.</p> <table border="1" data-bbox="459 929 817 1032"> <thead> <tr> <th>Between DC-OK(pin7) and GND(pin6,8)</th> <th>Output Status</th> </tr> </thead> <tbody> <tr> <td>3.3 ~ 5.6V</td> <td>ON</td> </tr> <tr> <td>0 ~ 1V</td> <td>OFF</td> </tr> </tbody> </table>  <p>I/P: 230VAC O/P: FULL LOAD Ta: 25°C TEST RESULT: PSU turn on = 5.27V PSU turn off = 0.005V</p>	Between DC-OK(pin7) and GND(pin6,8)	Output Status	3.3 ~ 5.6V	ON	0 ~ 1V	OFF					
Between DC-OK(pin7) and GND(pin6,8)	Output Status												
3.3 ~ 5.6V	ON												
0 ~ 1V	OFF												
5	5V STANDBY	5VSB : 5V@0.3A ; tolerance ± 5%, ripple : 50mVp-p(max.)	I/P: 230 VAC O/P: FULL LOAD Ta: 25°C	TEST RESULT : 5.035V /0.3A Ripple : 3.2 mVp-p									
6	FAN CONTROL	FAN ON/OFF BY BY NTC (RT50) OR LOAD	I/P: 230 VAC O/P: TESTING	<table border="1" data-bbox="1150 1608 1501 1709"> <thead> <tr> <th></th> <th>TEMP.</th> <th>LOAD</th> </tr> </thead> <tbody> <tr> <td>FAN ON</td> <td>55°C</td> <td>>10.4%</td> </tr> <tr> <td>FAN OFF</td> <td>36°C</td> <td><10%</td> </tr> </tbody> </table>		TEMP.	LOAD	FAN ON	55°C	>10.4%	FAN OFF	36°C	<10%
	TEMP.	LOAD											
FAN ON	55°C	>10.4%											
FAN OFF	36°C	<10%											

COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Transistor (D to S) or (C to E) Peak Voltage	Q911 Rated: 26A / 600V	I/P: High-Line +3V = 303V AC ON/OFF VDS: O/P: (1) Full Load (2) Output Short	VDS: (1) 506V (2) 490V

			(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	(3)510V (4)510V (5)506V (6)510V (7)490V
2	P.F.C Transistor (D to S) or (C to E) Peak Voltage	Q1 Rated: 34A / 600V	I/P:High-Line +3V =303V 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) 490V (2) 510V (3) 502V (4) 506V (5) 510V (6) 506V (7) 494V
3	P.F.C DIODE	D6 Rated: 10A / 600V	I/P:High-Line +3V =303V 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) 405V (2) 413V (3) 389V (4) 397V
4	SR MOSFET Peak Voltage	Q508 Rated: 76A / 150V Q506 Rated: 76A / 150V	I/P:High-Line +3V =303V 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. (8).NO LOAD (9) burst mode Ta:25°C	Q508: VDS: (1)118.2V (2)6.0V (3)118.6V (4)117.8V (5)116.2V (6)117.8V (7)113.8V (8)48.4V (9)116.2V Q506: VDS: (1)119.4V (2)13.3V (3)118.6V (4)120.2V (5)118.6V (6)118.6V (7)114.6V (8)113.8V (9)117.8V
5	Input Capacitor Voltage	C5 220μF / 400V	I/P:High-Line +3V =303VV 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°C	(1)399V (2)399V (3)398V (4) 398V

6	Control IC Voltage Test	<p>PFC IC U1 Absolute Rating: -0.3 V ~ 26 V Operating Range: 12.9 V ~ 25 V</p> <p>PWM IC U900 Absolute Rating: Self-limited Operating Range: 8.85 V ~ 16 V</p>	<p>I/P:High-Line +3V =303V V AC ON/OFF O/P(1)FULL LOAD (2) Output Short (3)O.L.P (4)O.V.P. (5)NO LOAD VRmin .LOW LINE Ta:25°C</p>	<p>(1) 21.5V (2) 21.9V (3) 21.3V (4) 19.5V (5) 15.2V</p> <p>(1) 14.63V (2) 14.87V (3) 15.03V (4) 14.07V (5) 13.51V</p>
7	TOP SWITCHING STAND BY POWER	U971 Rated : 1.8 A / 700V	<p>I/P:High-Line +3V =303V V AC ON/OFF O/P: (1)Full Load (2)Remote On/Off Ta:25°C</p>	<p>(1) 535V (2) 543V</p>

SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	I/P-O/P: 4.5KVAC/min I/P-FG :2KVAC/min O/P-FG:1.5KVAC/min	I/P-O/P: 4.6 KVAC/min I/P-FG: 2.4 KVAC/min O/P-FG:1.8KVAC/min Ta:25°C	I/P-O/P:6.7mA I/P-FG:5.44mA O/P-FG:5.2mA 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	I/P-O/P: 23.8GΩ I/P-FG:23.2 GΩ O/P-FG:30 GΩ NO DAMAGE
3	GROUNDING CONTINUITY	FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40A / 2min Ta:25°C	13 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°C	PASS
2	CONDUCTION	EN55032 /EN55011 CLASS B	I/P : 230 VAC (50HZ) O/P : FULL/50% LOAD Ta : 25°C	PASS Test by certified Lab
3	RADIATION	EN55032 /EN55011 CLASS A	I/P : 230 VAC (50HZ) O/P : FULL LOAD Ta : 25°C	PASS Test by certified Lab
4	E.S.D	EN61000-4-2 MEDICAL AIR: 15KV / Contact: 8KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA A
5	E.F.T	EN61000-4-4 MEDICAL INDUSTRY INPUT : 2KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA A
6	SURGE	IEC61000-4-5 MEDICAL INDUSTRY L-N : 2KV L,N-PE : 4KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA A

7	Test by certified Lab & Test Report Prepare
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■ **RELIABILITY TEST**

ENVIRONMENT TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT																																																																																																																																																				
1	TEMPERATURE RISE TEST	MODEL : MSP-1000-48 1. ROOM AMBIENT BURN-IN : 1.5 HRS I/P : 230VAC O/P : FULL LOAD Ta= 25 °C 2. HIGH AMBIENT BURN-IN : 1 HRS I/P : 230VAC O/P : FULL LOAD Ta= 60 °C																																																																																																																																																						
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2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR (MIN)	I/P : 230 VAC O/P : 115 % LOAD Ta : 25°C	TEST : OK
3	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 230VAC/90VAC O/P : 100% /80% LOAD Ta= -45°C	TEST : OK
4	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 60 °C HUMIDITY= 90 %R.H NO DAMAGE	I/P : 272 VAC O/P : FULL LOAD Ta= 60°C HUMIDITY= 95 %R.H	TEST : OK
5	TEMPERATURE COEFFICIENT	± 0.03 %/°C (0-60°C)	I/P : 230 VAC O/P : FULL LOAD	± 0.009 %/°C (0-60°C)
6	STORAGE TEMPERATURE TEST	-40-85°C	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 : 10 CYCLE 5. Input/Output condition : STATIC	
7	THERMAL SHOCK TEST	-40-60°C	1. Thermal shock Temperature : -45°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	
8	VIBRATION TEST	10 - 500Hz, 5G 10min./1cycle, 60min. each along X, Y, Z axes	1 Carton & 1 Set (1) Waveform : Sine Wave (2) Frequency : 10-500Hz (3) Sweep Time : 12min/sweep cycle (4) Acceleration : 6G (5) Test Time : 180min in each axis (X.Y.Z) (6) Ta : 25°C	
9	CAPACITOR LIFE CYCLE	SUPPOSE C105 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) 2272135HRS (2) 183566HRS (3) 236909HRS (4) 268024HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 286.3K hrs min. Telcordia SR-332 (Bellcore) ; 105.7K hrs min. MIL-HDBK-217F (25°C)		
11	DMTBF/Accelerated Life Test	Demonstration Mean Time Between Failure (Expected Life): Above 50,000 hours @ TA 60°C		

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

12.10.30 A50-F031