



Test Report: MSP-1000-15

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

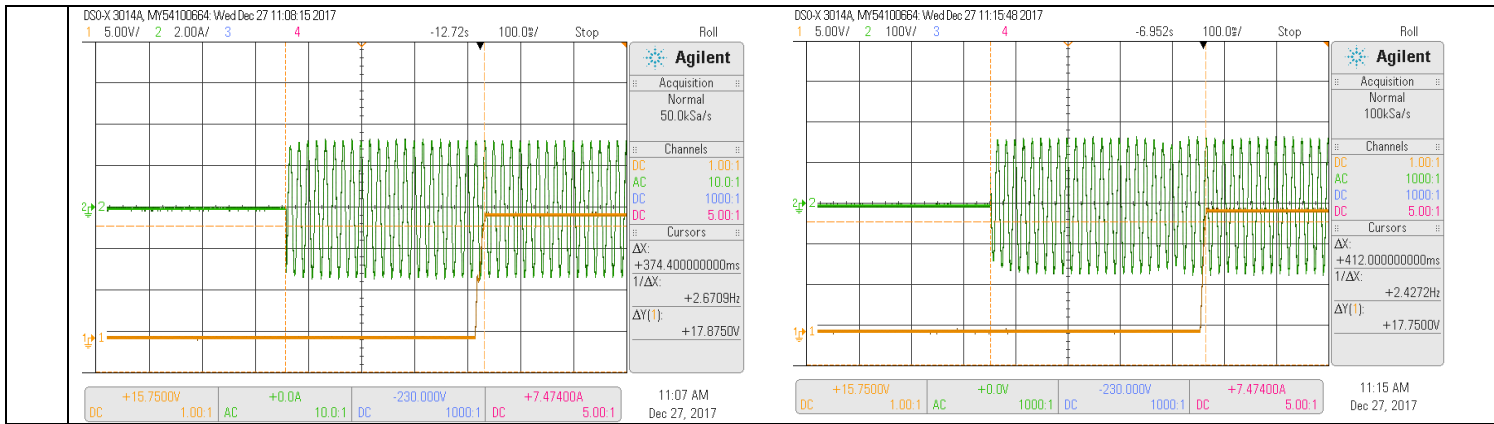
OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE ADJUST RANGE	CH1: 14V~ 17 V	I/P : 230 VAC I/P : 115 VAC O/P : MIN LOAD Ta : 25°C	13.4V~17.59V/230VAC 13.4V~17.59V/115VAC
2	OUTPUT VOLTAGE(Max) TOLERANCE	V1: 1.5%~ -1.5 %	I/P: 200VAC /264VAC O/P:FULL/ MIN. LOAD Ta:25°C	V1: 0.53 %~ -0.2 %
3	LINE REGULATION (Max)	V1: 0.5%~ -0.5 %	I/P: 200VAC~ 264VAC O/P:FULL LOAD Ta:25°C	V1: 0 %~ 0.19 %
4	LOAD REGULATION(Max)	V1: 1.5%~ -1.5 %	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25°C	V1: 0.13 %~ 0 %
5	OVER/UNDERSHOOT TEST	< ±5%	I/P: 230VAC O/P:FULL LOAD Ta:25°C	< ±5%
6	RIPPLE & NOISE(Max)	V1: 150mVp-p	I/P:230VAC O/P:FULL LOAD Ta:25°C	V1: 33.8 mVp-p
<div style="display: flex; justify-content: space-around;"> <div style="width: 45%;"> <p>high frequency : D50-X 3014A, MY54100664 Wed Dec 27 15:56:07 2017</p> </div> <div style="width: 45%;"> <p>low frequency : D50-X 3014A, MY54100664 Wed Dec 27 15:55:56 2017</p> </div> </div>				
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/ 374.4 ms 115VAC/ 412 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	



1000W Single Output Medical Type

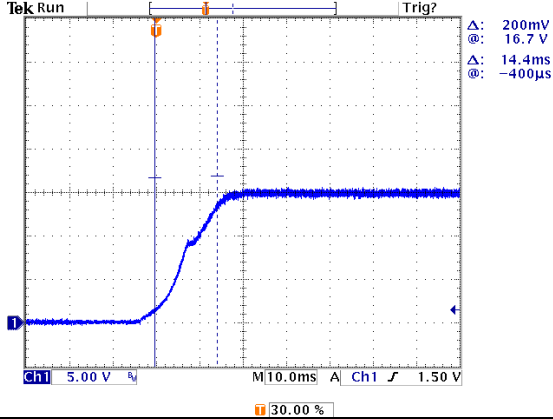
MSP-1000series



8	RISE TIME (Max)	230VAC/50ms	I/P : 230 VAC	230VAC/ 14.4 ms
		115VAC/50ms	I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	115VAC/ 11.8 ms

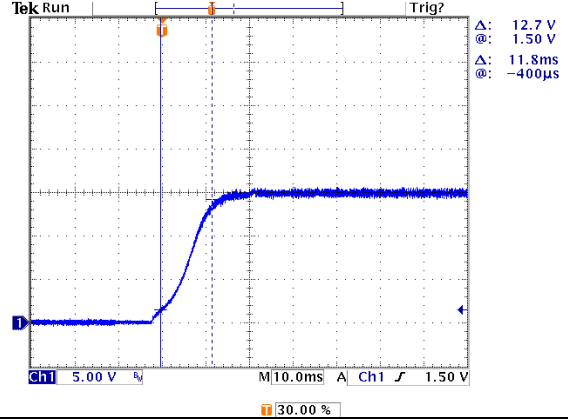
INPUT=230VAC/50HZ @ FULL LOAD

CH1 : Output Voltage



INPUT=115VAC/60HZ @ FULL LOAD

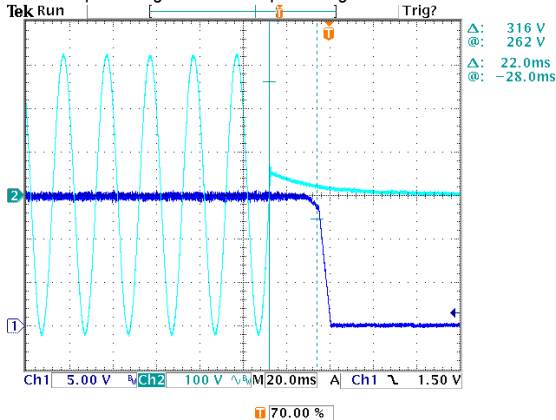
CH1 : Output Voltage



9	HOLD UP TIME (Typ.)	230VAC/16ms	I/P : 230 VAC	230VAC/ 22 ms
		115VAC/16ms	I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	115VAC/ 27.2 ms

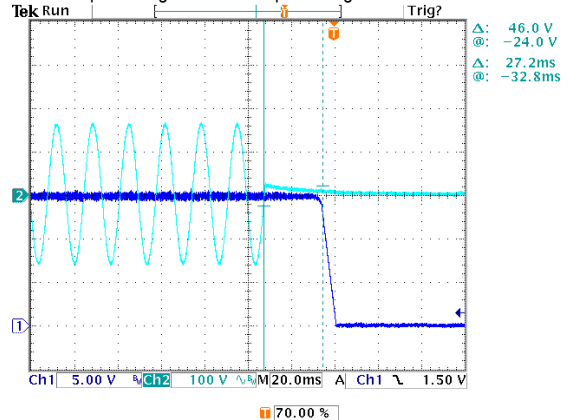
INPUT=230VAC/50HZ @ FULL LOAD

CH1 : Output Voltage CH2 : AC Input Voltage

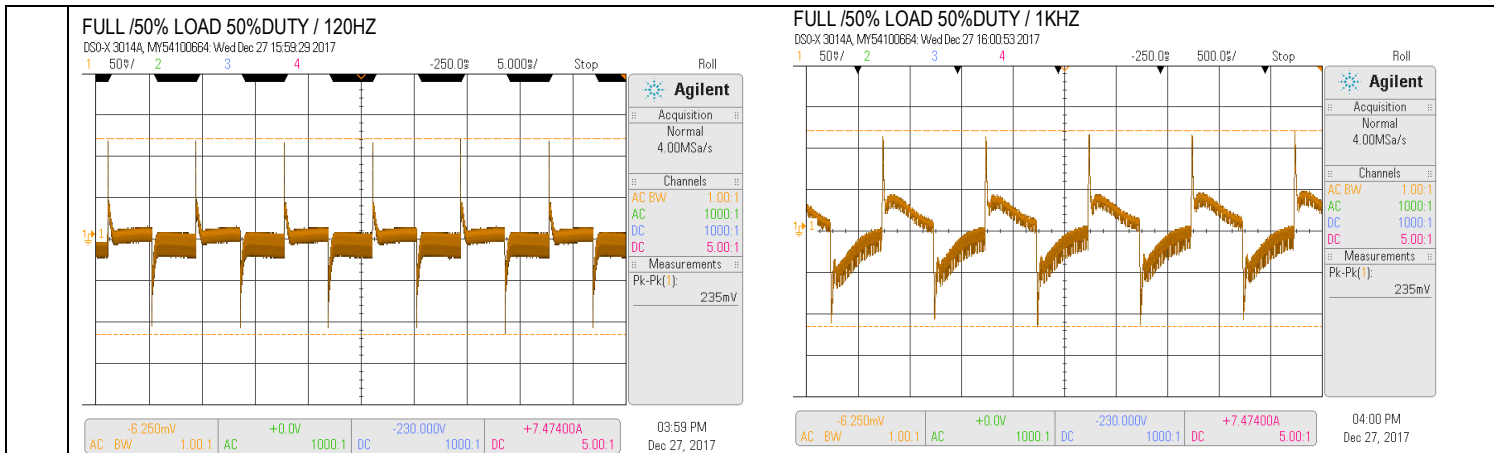


INPUT=115VAC/60HZ @ FULL LOAD

CH1 : Output Voltage CH2 : AC Input Voltage

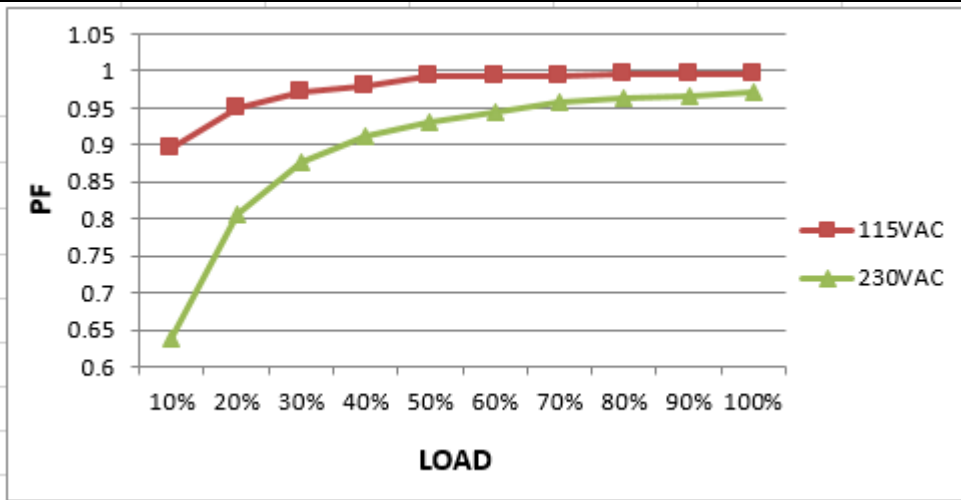


10	DYNAMIC LOAD	V1: 1500 mVp-p	I/P: 230VAC	235mVp-p 235mVp-p
			O/P: (1)FULL /50% LOAD 50%DUTY / 120HZ (2)FULL /50% LOAD 50%DUTY / 1KHZ Ta:25°C	



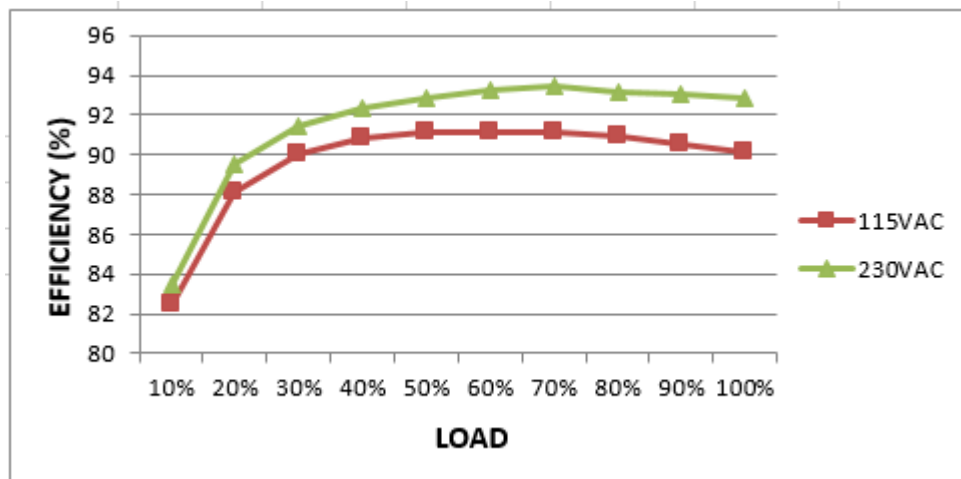
INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	90VAC~264VAC	I/P:TESTING O/P:FULL LOAD Ta:25°C	74V~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 =4.666A/ 230VAC I =7.885A/ 115VAC
4	LEAKAGE CURRENT	Earth leakage current < 360uA/264VAC	I/P : 264 VAC O/P : Min LOAD Ta : 25°C	L-FG : 282uA N-FG : 285.3uA
		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	< 0.4399 W < 0.6658 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=0.967/230VAC PF=0.996/115VAC
	P.F vs LOAD			



7	EFFICIENCY(Typ.)	92%	I/P:230 VAC O/P:FULL LOAD Ta:25°C	92.77%
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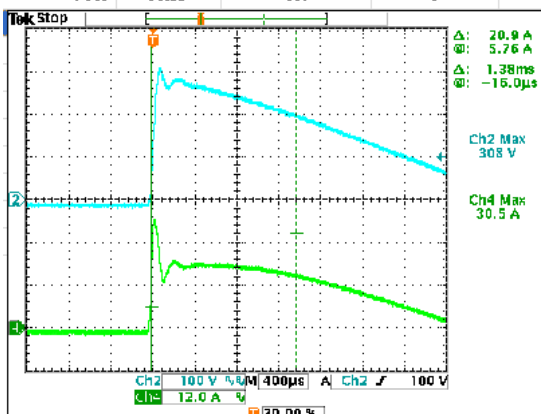
EFFICIENCY vs LOAD



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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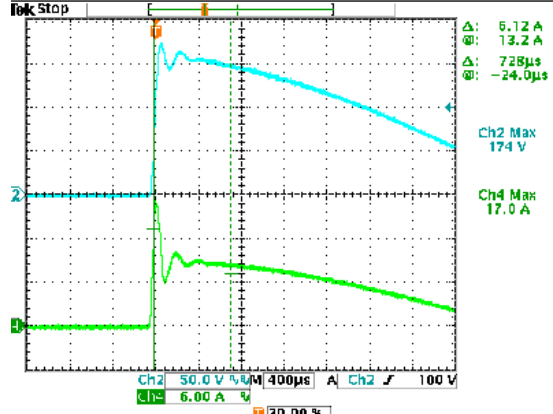
INPUT=230VAC/50HZ @ FULL LOAD

CH2 : AC Input Voltage CH4 : Input current



INPUT=115VAC/ 60HZ @ FULL LOAD

CH2 : AC Input Voltage CH4 : Input current

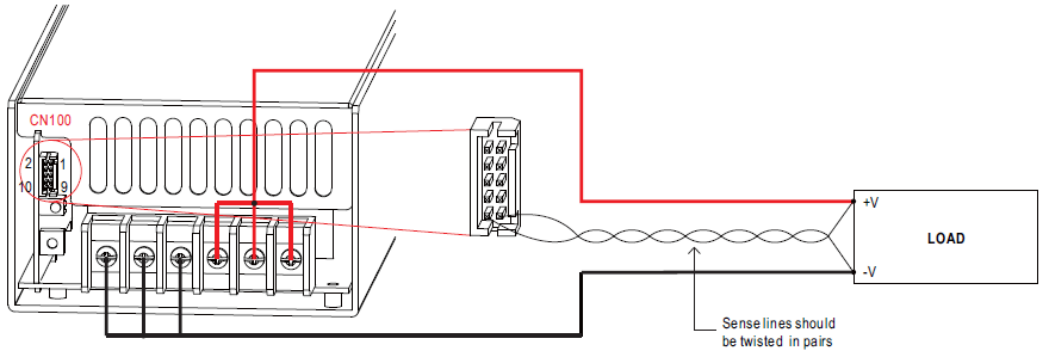
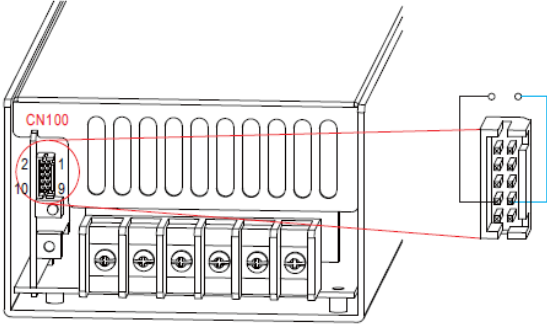


PROTECTION FUNCTION TEST

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: 115VAC O/P: TESTING Ta: 25°C	118.68%/ 264VAC 118.56%/ 230VAC 118.53%/115VAC PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed
2	OVER VOLTAGE PROTECTION	18.2V~20.6V 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	19.4V/ 264VAC 19.4V/ 230VAC 19.4V/ 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	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 : 58.2A PSU2 : 59 A PSU3 : 60.3A PSU4 : 60.5A O/P : 50% PSU1 : 32.3 A PSU2 : 32.4 A PSU3 : 34.4A PSU4 : 32.6A						
2	REMOTE ON/OFF CONTROL	<p>The PSU can be turned ON/OFF by using the "Remote Control" function.</p> <table border="1"> <thead> <tr> <th>Between RC+ (pin3) and RC- (pin4)</th> <th>Output Status</th> </tr> </thead> <tbody> <tr> <td>SW ON (Short)</td> <td>ON</td> </tr> <tr> <td>SW OFF (Open)</td> <td>OFF</td> </tr> </tbody> </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="459 965 818 1066"> <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 = 5.292V ; PSU turn off = 0V</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 : 5V /0.3A Ripple : 9.8mVp-p									
6	FAN CONTROL	FAN ON/OFF BY BY NTC (RT50) OR LOAD	I/P: 230 VAC O/P: TESTING	TEST RESULT : <table border="1" data-bbox="1150 1630 1501 1736"> <thead> <tr> <th></th> <th>TEMP.</th> <th>LOAD</th> </tr> </thead> <tbody> <tr> <td>FAN ON</td> <td>50°C</td> <td>>26.2%</td> </tr> <tr> <td>FAN OFF</td> <td>42°C</td> <td><25.1%</td> </tr> </tbody> </table>		TEMP.	LOAD	FAN ON	50°C	>26.2%	FAN OFF	42°C	<25.1%
	TEMP.	LOAD											
FAN ON	50°C	>26.2%											
FAN OFF	42°C	<25.1%											

COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Transistor (D to S) or (C to E) Peak Voltage	Q911 Rated 600 V	I/P: High-Line +3V = 303V AC ON/OFF VDS: O/P: (1) Full Load (2) Output Short (3) Dynamic Load Full Load/	VDS: (1) 528V (2) 480V (3) 516V

			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	(4)516V (5)520V (6)520V (7)500V
2	P.F.C Transistor (D to S) or (C to E) Peak Voltage	Q1 Rated 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) 480V (2) 496V (3) 488V (4) 484V (5) 488V (6) 488V (7) 488V
3	P.F.C DIODE	D6 Rated 600 V	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) 387V (2) 396V (3) 387V (4) 379V
4	SR MOSFET Peak Voltage	Q506 Rated: 80 V Q508 Rated: 80 V	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	Q506: VDS: (1)46.4V (2)16.2V (3)45.7V (4)46.1V (5)46.5V (6)49.3V (7)49.3V (8)41.5V (9)42.1V Q508: VDS: (1)42.9V (2)12.35V (3)43.3V (4)43.3V (5)43.7V (6)45.3V (7)45.3V (8)39.7V (9)39.2V
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)398V (3)399V (4) 389V
6	Control IC Voltage Test	PWM IC U900 Rated Absolute Rating: Self-limited Operating Range: 8.85 V ~ 16 V	I/P:High-Line +3V =303V V AC ON/OFF O/P:(1)FULL LOAD	PWM IC (1) 15V PFC IC (1) 20.8V

		PFC IC U1 Rated Absolute Rating: -0.3 V ~ 26 V Operating Range: 12.9 V ~ 25 V	(2) Output Short (3)O.L.P (4)O.V.P. (5)NO LOAD VR MIN .LOW LINE Ta:25°C	(2) 14.6V (3) 14.2V (4) 14V (5) 14.2V	(2) 21V (3) 19.8V (4) 20.4V (5) 21.4V
7	TOP SWITCHING STAND BY POWER	U971 Rated : 700 V	I/P:High-Line +3V =303V V AC ON/OFF O/P: (1)Full Load (2)Remote On/Off Ta:25°C	(1) 553V (2) 564V	

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:1.8 KVAC/min Ta:25°C	I/P-O/P:5.67mA I/P-FG:4.84mA O/P-FG:5.15m 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°C	I/P-O/P: 7.45GΩ I/P-FG: 8.12GΩ O/P-FG:11.4 GΩ NO DAMAGE
3	GROUNDING CONTINUITY	FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40A / 2min Ta:25°C	13mΩ

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	Test by certified Lab
3	RADIATION	EN55032 /EN55011 CLASS B	I/P : 230 VAC (50HZ) O/P : FULL LOAD Ta : 25°C	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			

■ RELIABILITY TEST

ENVIRONMENT TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT																																																																																																																																																					
1	TEMPERATURE RISE TEST	MODEL : MSP-1000-15																																																																																																																																																							
		1. ROOM AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta= 25 °C																																																																																																																																																							
		2. HIGH AMBIENT BURN-IN : 1.5 HRS I/P : 230VAC O/P : FULL LOAD Ta= 50 °C																																																																																																																																																							
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2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR (MIN)	I/P : 230 VAC O/P : 127 % 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 50 °C HUMIDITY= 90 %R.H NO DAMAGE	I/P : 272 VAC O/P : FULL LOAD Ta= 50°C HUMIDITY= 95 %R.H	TEST : OK
5	TEMPERATURE COEFFICIENT	± 0.03 %/°C(0~50°C)	I/P : 230 VAC O/P : FULL LOAD	± 0.009 %/°C(0~50°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	-40~50°C	1. Thermal shock Temperature : -45°C~ +55°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= 50°C LIFE TIME (3) I/P : 230VAC O/P : 75% LOAD Ta= 50°C LIFE TIME (4) I/P : 230VAC O/P : 50% LOAD Ta= 50°C LIFE TIME		(1) 1485023HRS (2) 128548HRS (3) 198531HRS (4) 262922HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 850.5K hrs min. Telcordia SR-332 (Bellcore) ; 105.8K hrs min. MIL-HDBK-217F (25)		
11	DMTBF/Accelerated Life Test	Demonstration Mean Time Between Failure (Expected Life): Above 50,000 hours @ TA 50°C		

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

12.10.30 A50-F031