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

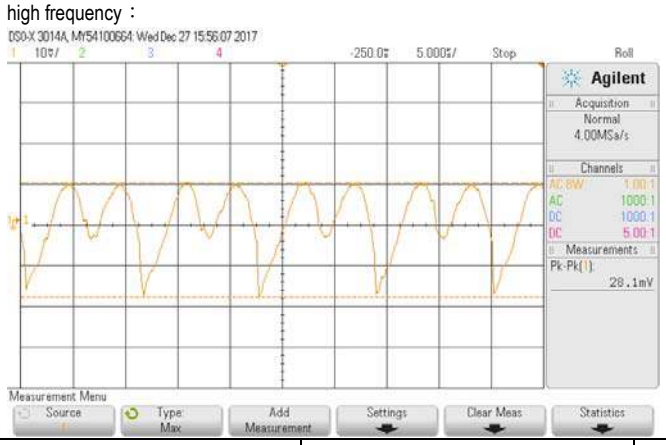
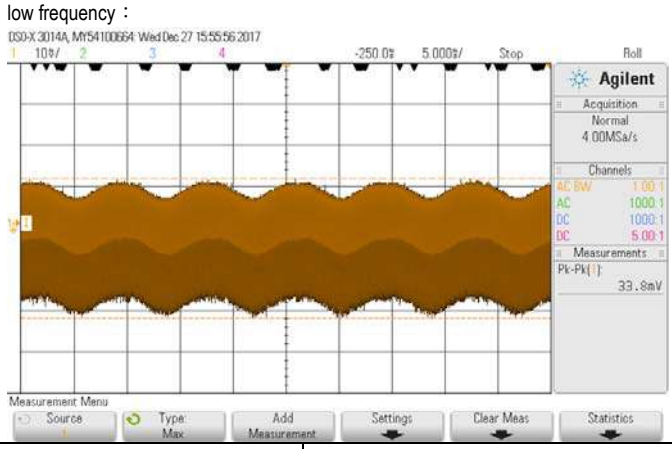
Safety Test
E.M.C. Test

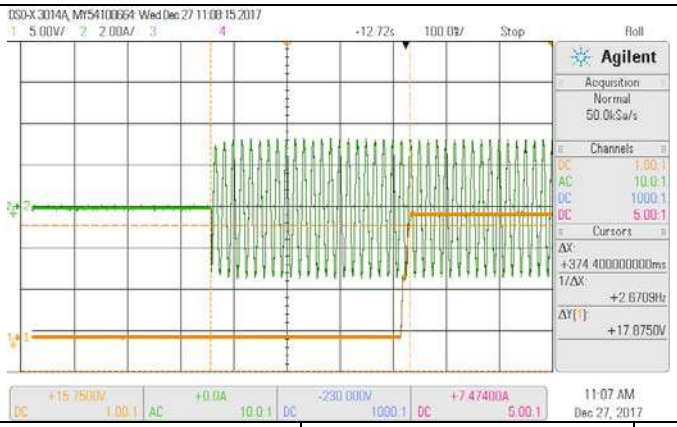
■ RELIABILITY TEST

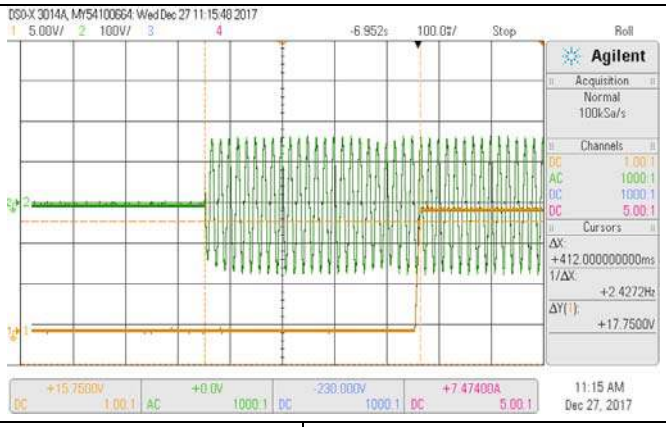
ENVIRONMENT TEST

■ 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℃	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℃	V1: 0.53 %~ -0.2 %
3	LINE REGULATION (Max)	V1: 0.5%~ -0.5 %	I/P: 200VAC~ 264VAC O/P:FULL LOAD Ta:25℃	V1: 0 %~ 0.19 %
4	LOAD REGULATION(Max)	V1: 1.5%~ -1.5 %	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25℃	V1: 0.13 %~ 0 %
5	OVER/UNDERSHOOT TEST	< ±5%	I/P: 230VAC O/P:FULL LOAD Ta:25℃	< ±5%
6	RIPPLE & NOISE(Max)	V1: 150mVp-p	I/P:230VAC O/P:FULL LOAD Ta:25℃	V1: 33.8 mVp-p
	high frequency：  low frequency： 			
7	SET UP TIME(Max)	230VAC/1000ms 115VAC/2000ms	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	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	

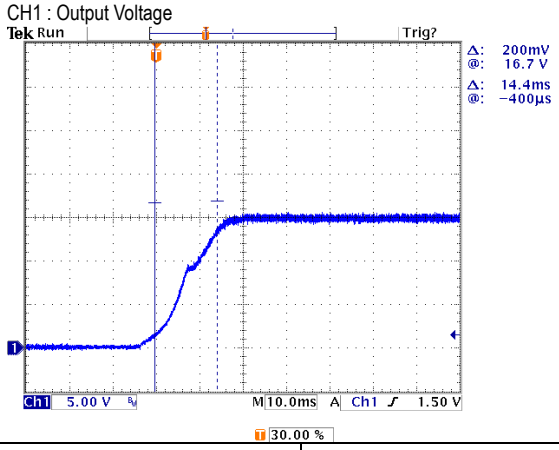




8	RISE TIME (Max)	230VAC/50ms 115VAC/50ms	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	230VAC/ 14.4 ms 115VAC/ 11.8 ms

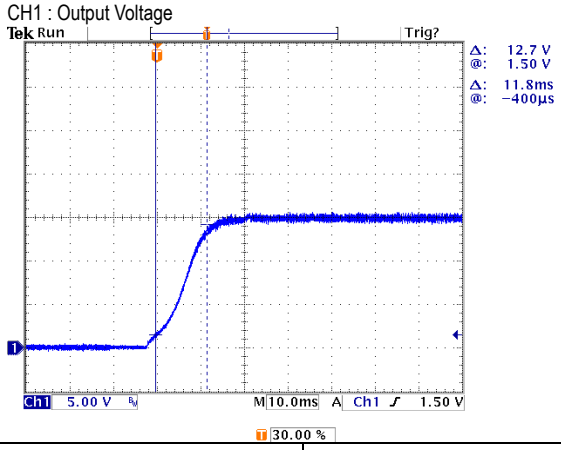
INPUT=230VAC/50HZ @ FULL LOAD

CH1 : Output Voltage



INPUT=115VAC/60HZ @ FULL LOAD

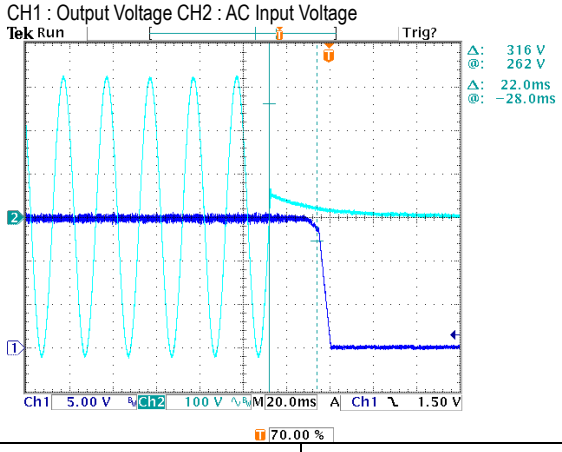
CH1 : Output Voltage



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

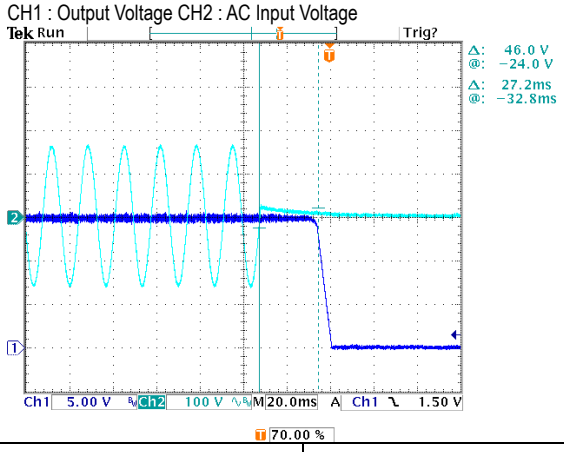
INPUT=230VAC/50HZ @ FULL LOAD

CH1 : Output Voltage CH2 : AC Input Voltage



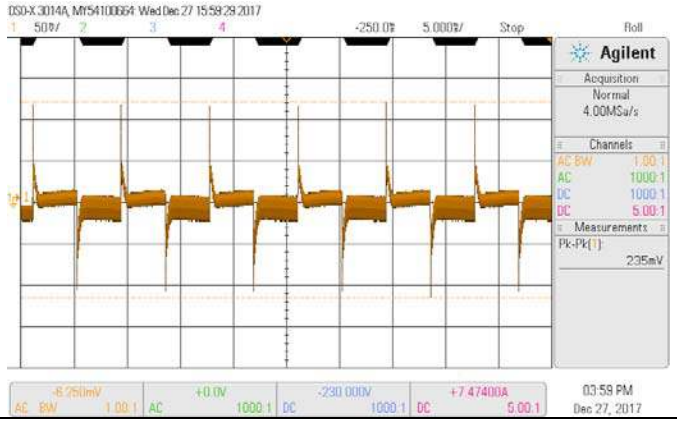
INPUT=115VAC/60HZ @ FULL LOAD

CH1 : Output Voltage CH2 : AC Input Voltage

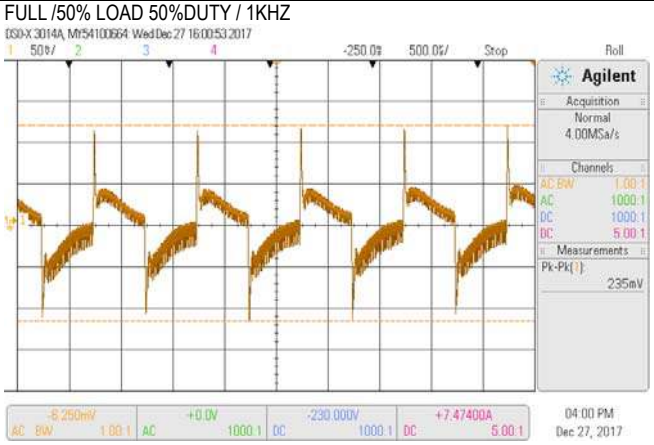


10	DYNAMIC LOAD	V1: 1500 mVp-p	I/P: 230VAC O/P: (1)FULL /50% LOAD 50%DUTY / 120HZ (2)FULL /50% LOAD 50%DUTY / 1KHZ Ta:25℃	 235mVp-p 235mVp-p

FULL /50% LOAD 50%DUTY / 120HZ

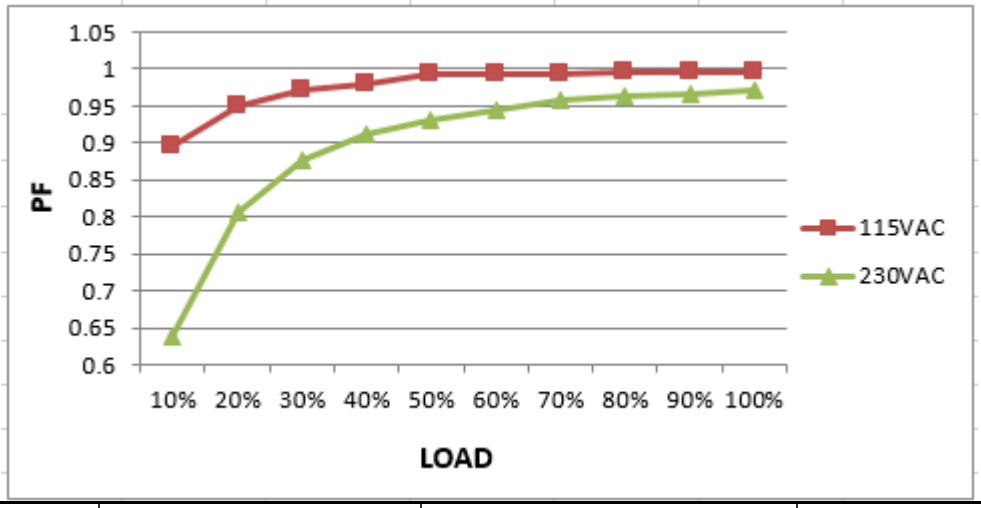


FULL /50% LOAD 50%DUTY / 1KHZ



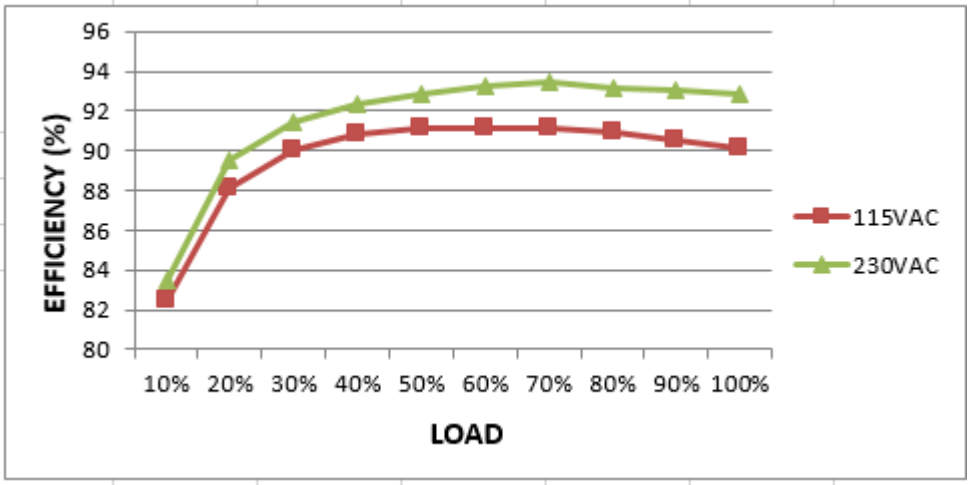
INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	90VAC~264VAC	I/P:TESTING O/P:FULL LOAD Ta:25℃	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℃	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℃	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℃	L-FG： 282uA N-FG： 285.3uA
		Touch leakage current < 100 uA/264VAC	I/P： 264 VAC O/P：Min LOAD Ta：25℃	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℃	< 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℃	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℃	92.77%

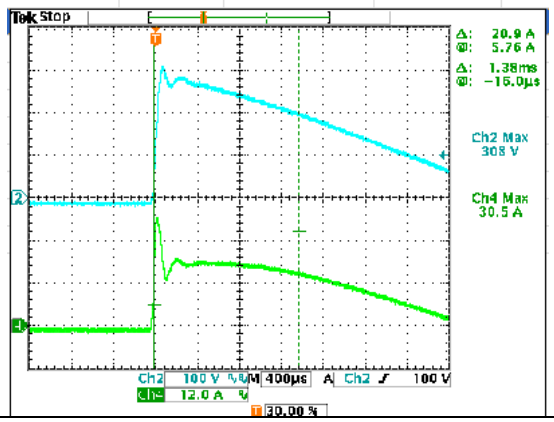
EFFICIENCY vs LOAD



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

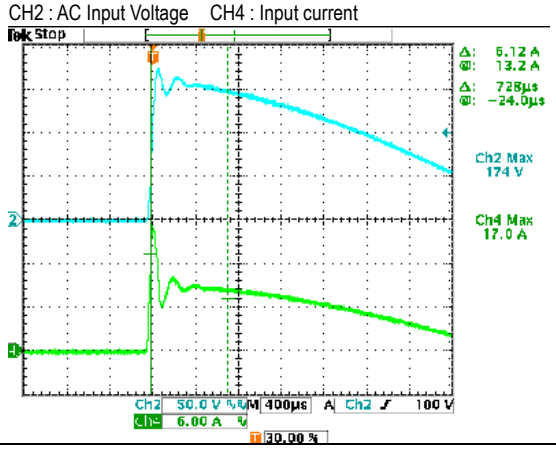
INPUT=230VAC/50HZ @ FULL LOAD

CH2 : AC Input Voltage CH4 : Input current



INPUT=115VAC/ 60HZ @ FULL LOAD

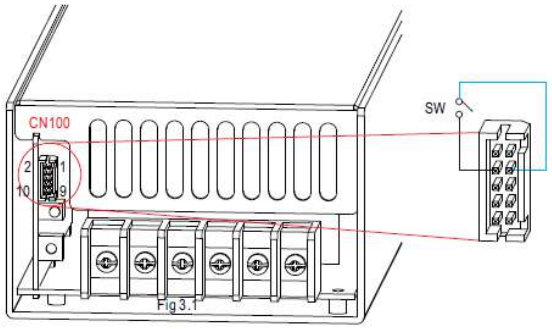
CH2 : AC Input Voltage CH4 : Input current

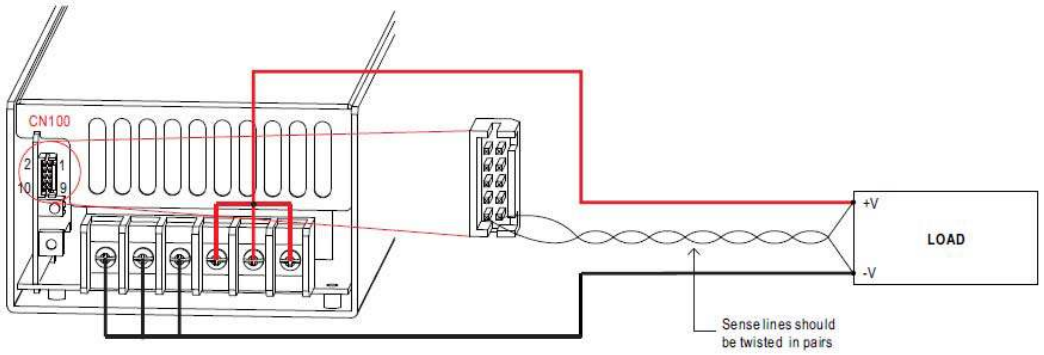
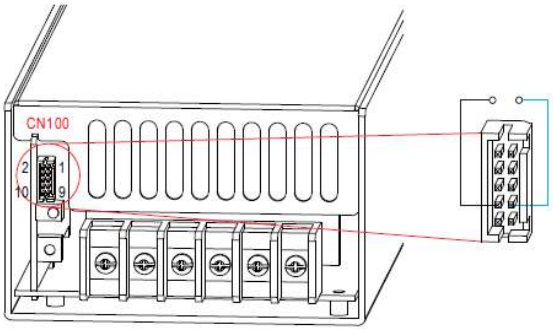


PROTECTION FUNCTION TEST

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℃	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℃	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℃	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℃	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	The PSU can be turned ON/OFF by using the "Remote Control" function. Between RC+(pin3) and RC-(pin4) / Output Status SW ON (Short) / ON SW OFF (Open) / OFF I/P: 230 VAC O/P: FULL LOAD Ta:25℃ TEST RESULT : OK		
3	REMOTE SENSE	S+ / S- >0.5V		

		 I/P: 230 VAC O/P:FULL LOAD Ta:25℃ TEST RESULT : > 0.5 V		
4	DC OK SIGNAL	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. Between DC-OK(pin7) and GND(pin6,8) / Output Status 3.3 ~ 5.6V / ON 0 ~ 1V / OFF  I/P:230VAC O/P:FULL LOAD Ta:25℃ TEST RESULT: PSU turn on =5.292V ; PSU turn off = 0V		
5	5V STANDBY	5VSB : 5V@0.3A ; tolerance± 5%, ripple : 50mVp-p(max.)	I/P: 230 VAC O/P:FULL LOAD Ta:25℃	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 : TEMP. / LOAD FAN ON / 50℃ / >26.2% FAN OFF / 42℃ / <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℃	(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℃	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℃	(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℃	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℃	(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℃	(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℃	(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℃	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℃	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℃	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℃	PASS
2	CONDUCTION	EN55032 /EN55011 CLASS B	I/P： 230 VAC (50HZ) O/P：FULL/50% LOAD Ta：25℃	Test by certified Lab
3	RADIATION	EN55032 /EN55011 CLASS B	I/P： 230 VAC (50HZ) O/P：FULL LOAD Ta：25℃	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℃	CRITERIA A
5	E.F.T	EN61000-4-4 MEDICAL INDUSTRY INPUT： 2KV	I/P： 230 VAC/50HZ O/P：FULL LOAD Ta：25℃	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℃	CRITERIA A
7	Test by certified Lab & Test Report Prepare			

■ RELIABILITY TEST

ENVIRONMENT TEST

<table>
<tr><th>NO</th><th>TEST ITEM</th><th>SPECIFICATION</th><th>TEST CONDITION</th><th>RESULT</th></tr>
<tr><td>1</td><td>TEMPERATURE RISE TEST</td><td colspan="3">MODEL： MSP-1000-15
1. ROOM AMBIENT BURN-IN： 2 HRS
I/P： 230VAC O/P： FULL LOAD Ta= 25 ℃
2. HIGH AMBIENT BURN-IN： 1.5 HRS
I/P： 230VAC O/P： FULL LOAD Ta= 50 ℃</td></tr>
<tr><td>2</td><td>OVER LOAD BURN-IN TEST</td><td>NO DAMAGE
1 HOUR (MIN)</td><td>I/P： 230 VAC
O/P： 127 % LOAD
Ta：25℃</td><td>TEST：OK</td></tr>
</table>

NO	Position	ROOM AMBIENT Ta= 25 ℃	HIGH AMBIENT Ta= 50 ℃
1	BD1	51.9℃	76.6℃
2	R6	52.8℃	77.5℃
3	Q1	43.7℃	69.2℃
4	U1	42.5℃	68.1℃
5	D5	41.3℃	66.8℃
6	D6	60.3℃	87.1℃
7	C6	37.6℃	62.8℃
8	D981	42.1℃	67.5℃
9	RY1	40.2℃	66.0℃
10	RG2	43.3℃	69.9℃
11	D431	49.0℃	74.4℃
12	C406	27.6℃	53.4℃
13	TSW4	35.4℃	61.1℃
14	L1	51.5℃	67.0℃
15	T951	39.8℃	63.9℃
16	C2	35.3℃	60.4℃
17	LF3	38.6℃	64.1℃
18	T1-1	50.4℃	75.9℃
19	T1-2	46.9℃	72.6℃
20	T2-1	61.1℃	87.7℃
21	T2-2	55.4℃	81.4℃
22	L900	44.7℃	69.8℃
23	Q910	61.4℃	91.1℃
24	C933	37.7℃	63.0℃
25	Q911	57.0℃	85.5℃
26	U900	32.3℃	57.9℃
27	C906	27.7℃	52.9℃
28	C106	40.5℃	66.6℃
29	C109	35.6℃	61.4℃
30	U501	57.6℃	83.7℃
31	Q502	63.6℃	90.7℃
32	Q504	52.2℃	78.5℃
33	U504	46.6℃	73.1℃
34	Q506	66.5℃	93.6℃
35	Q508	65.2℃	92.7℃
36	TSW3	32.1℃	57.9℃

3	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P： 230VAC/90VAC O/P： 100% /80% LOAD Ta= -45℃	TEST：OK
4	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 50 ℃ HUMIDITY= 90 %R.H NO DAMAGE	I/P： 272 VAC O/P：FULL LOAD Ta= 50℃ HUMIDITY= 95 %R.H	TEST：OK
5	TEMPERATURE COEFFICIENT	± 0.03 %/℃(0~50℃)	I/P： 230 VAC O/P：FULL LOAD	± 0.009 %/℃(0~50℃)
6	STORAGE TEMPERATURE TEST	-40~85℃	1. Thermal shock Temperature： -45℃~ +90℃ 2. Temperature change rate ：25℃ / 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℃	1. Thermal shock Temperature： -45℃~ +55℃ 2. Temperature change rate ：25℃ / 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℃	
9	CAPACITOR LIFE CYCLE	SUPPOSE C105 IS THE MOST CRITICAL COMPONENT (1) I/P： 230VAC O/P：FULL LOAD Ta= 25℃ LIFE TIME (2) I/P： 230VAC O/P：FULL LOAD Ta= 50℃ LIFE TIME (3) I/P： 230VAC O/P：75% LOAD Ta= 50℃ LIFE TIME (4) I/P： 230VAC O/P：50% LOAD Ta= 50℃ LIFE TIME		(1) 1485023HRS (2) 128548HRS (3) 198531HRS (4) 262922HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 286.3K hrs min. Telcordia SR-332 (Bellcore) ; 105.7K hrs min. MIL-HDBK-217F (25℃)		
11	DMTBF/Accelerated Life Test	Demonstration Mean Time Between Failure (Expected Life): Above 50,000 hours @ TA 50℃		

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

12.10.30 A50-F031