Test Report: MSP-1000-12

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

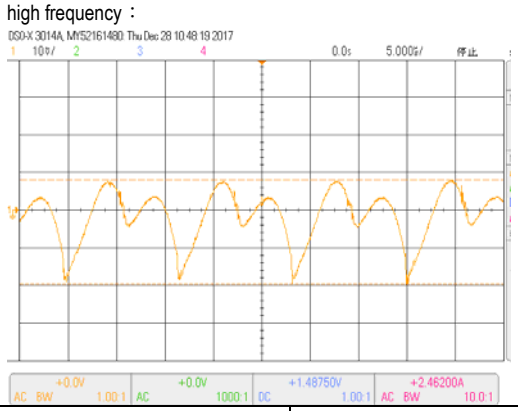
ENVIRONMENT TEST

■ DESIGN VERIFY TEST

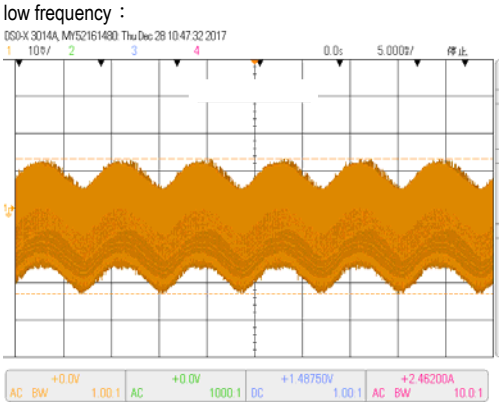
OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE ADJUST RANGE	CH1: 11V~ 14 V	I/P： 230 VAC I/P： 115 VAC O/P：MIN LOAD Ta：25℃	10.486V~14.415V/230VAC 10.47V~14.426V/115VAC
2	OUTPUT VOLTAGE(Max) TOLERANCE	V1: 2%~ -2 %	I/P: 200VAC /264VAC O/P:FULL/ MIN. LOAD Ta:25℃	V1:0.42%~ 0%
3	LINE REGULATION (Max)	V1: 0.5%~ -0.5 %	I/P: 200VAC~ 264VAC O/P:FULL LOAD Ta:25℃	V1:0%~0%
4	LOAD REGULATION(Max)	V1: 2%~ -2 %	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25℃	V1:0.08%~0.25%
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℃	V1:36.2mVp-p

high frequency：



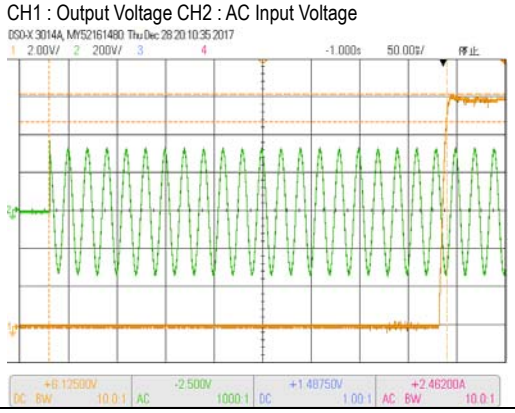
low frequency：



7	SET UP TIME(Max)	230VAC/1000ms 115VAC/2000ms	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	230VAC/410ms 115VAC/472ms

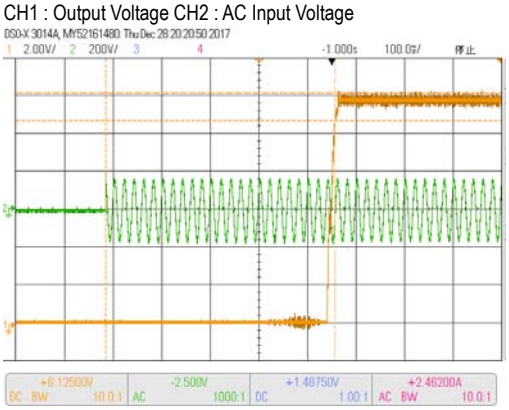
INPUT=230VAC/50HZ @ FULL LOAD

CH1 : Output Voltage CH2 : AC Input Voltage



INPUT=115VAC/60HZ@ FULL LOAD

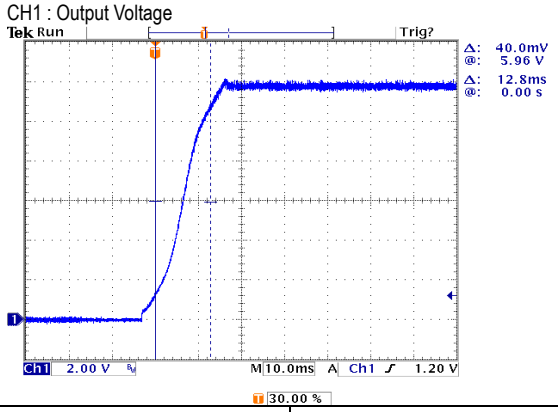
CH1 : Output Voltage CH2 : AC Input Voltage



8	RISE TIME (Max)	230VAC/50ms 115VAC/50ms	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	230VAC/12.8ms 115VAC/12.8ms

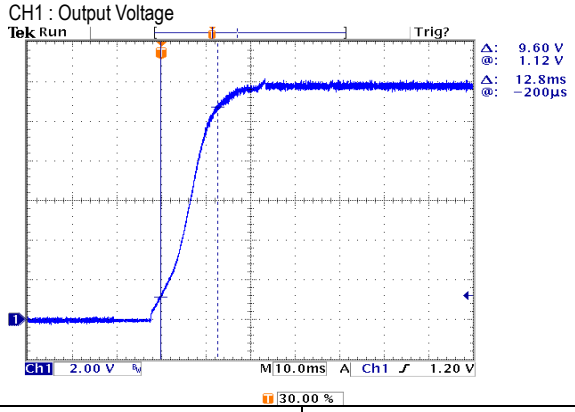
INPUT=230VAC/50HZ @ FULL LOAD

CH1 : Output Voltage



INPUT=115VAC/60HZ @ FULL LOAD

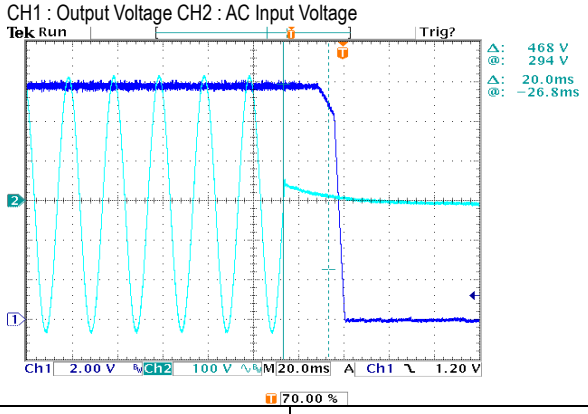
CH1 : Output Voltage



9	HOLD UP TIME (Typ.)	230VAC/16ms 115VAC/16ms	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	230VAC/20.0ms 115VAC/25.6ms

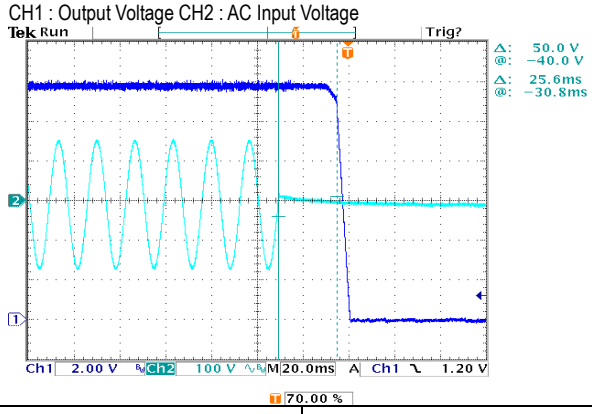
INPUT=230VAC/50HZ @ FULL LOAD

CH1 : Output Voltage CH2 : AC Input Voltage



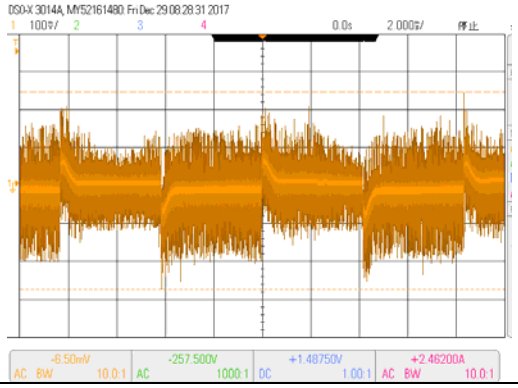
INPUT=115VAC/60HZ @ FULL LOAD

CH1 : Output Voltage CH2 : AC Input Voltage

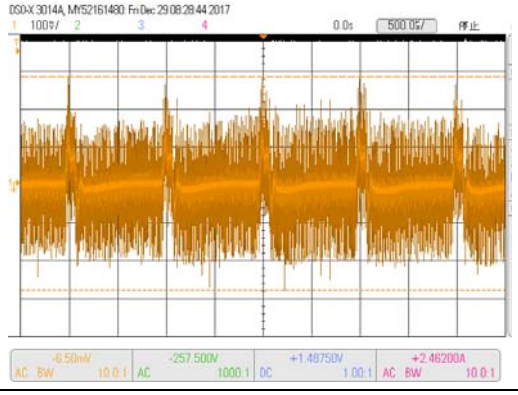


10	DYNAMIC LOAD	V1: 1200 mVp-p	I/P: 230VAC O/P: (1)FULL /50% LOAD 50%DUTY / 120HZ (2)FULL /50% LOAD 50%DUTY / 1KHZ Ta:25℃	 (1)519mVp-p (2)563mVp-p

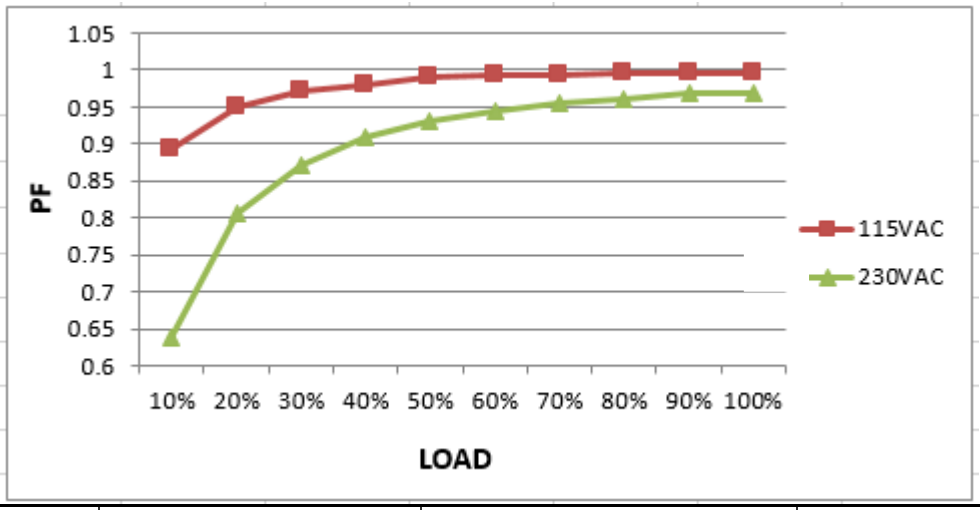
FULL /50% LOAD 50%DUTY / 120HZ

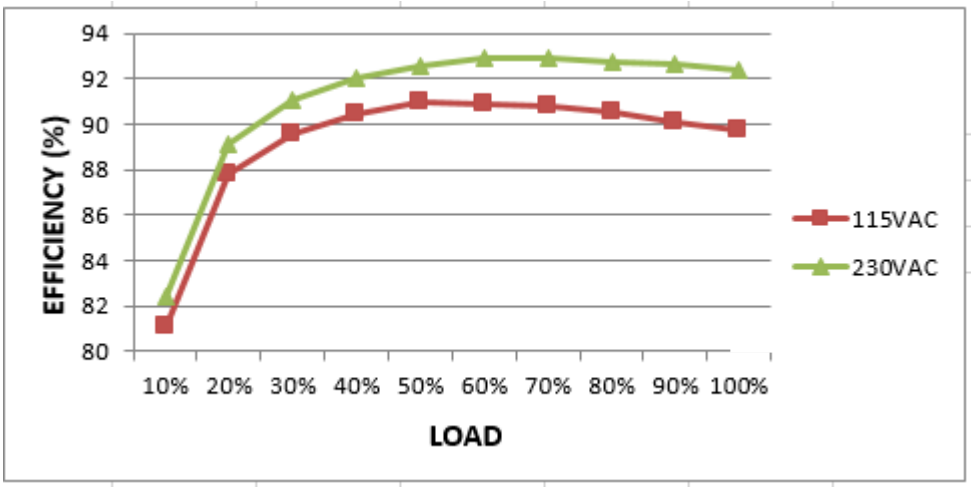
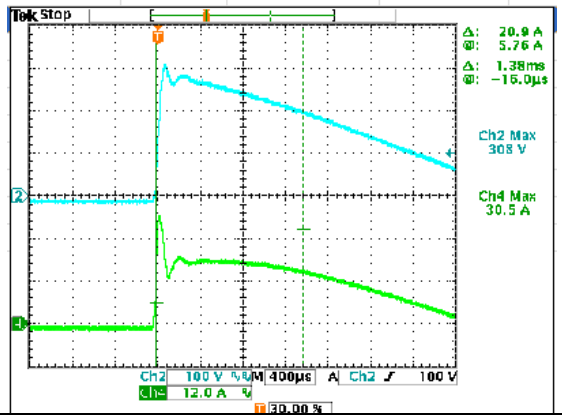
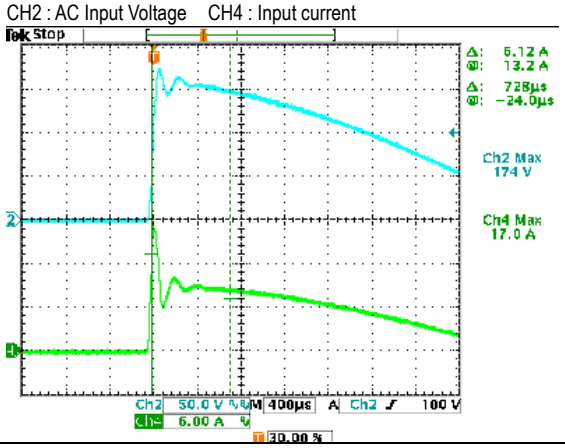


FULL /50% LOAD 50%DUTY / 1KHZ



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℃	78V~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 =4.7A/ 230VAC I =8.005A/ 115VAC
4	LEAKAGE CURRENT	Earth leakage current < 360 uA/264VAC	I/P： 264 VAC O/P：Min LOAD Ta：25℃	L-FG：287.4uA N-FG：290.5uA
		Touch leakage current < 100 uA/264VAC	I/P： 264 VAC O/P：Min LOAD Ta：25℃	L-V+ : 86.4uA L-V-: 86.9uA N-V+: 86.2uA N-V-: 86.7uA
5	NO LOAD CONSUMPTION	< 0.75W No load power consumption<0.75W when RC+&RC- open	I/P：115VAC I/P：230VAC O/P：NO LOAD Ta：25℃	< 0.403 W < 0.667 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=0.972/230VAC PF=0.995/115VAC
	P.F vs LOAD			
7	EFFICIENCY(Typ.)	91.5%	I/P:230 VAC O/P:FULL LOAD Ta:25℃	92.07%

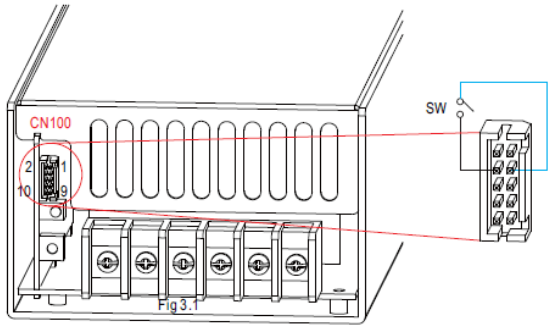
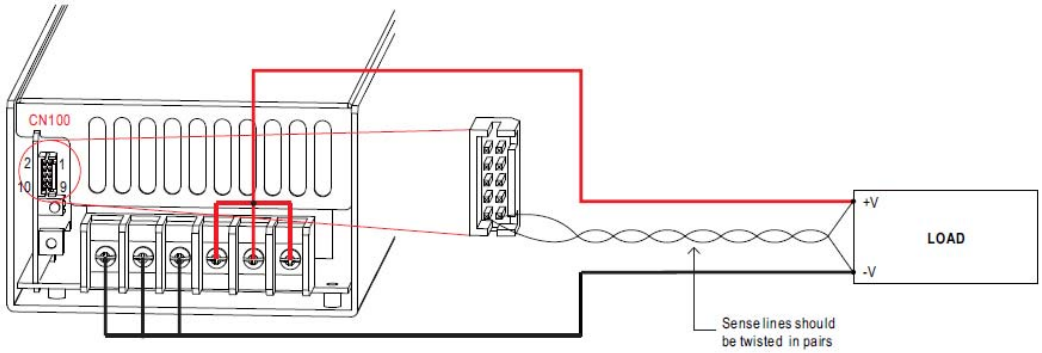
	EFFICIENCY vs LOAD 			
8	INRUSH CURRENT(Typ.)	230V/40A 115V/20A COLD START	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	I =30.5A/ 230VAC I =17A/ 115VAC T50= 1380us/230V
	INPUT=230VAC/50HZ @ FULL LOAD CH2 : AC Input Voltage CH4 : Input current 		INPUT=115VAC/ 60HZ @ FULL LOAD CH2 : AC Input Voltage CH4 : Input current 	

PROTECTION FUNCTION TEST

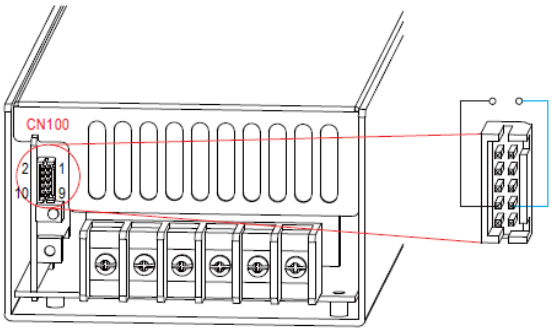
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER LOAD PROTECTION	105%~ 135 % Protection type : Constant current limiting, recovers automatically after fault condition is removed	I/P: 264VAC I/P: 230VAC I/P: 115VAC O/P:TESTING Ta:25℃	118.64%/ 264VAC 118.66%/ 230VAC 118.61%/115VAC PROTECTION TYPE： Constant current limiting, recovers automatically after fault condition is removed
2	OVER VOLTAGE PROTECTION	14.5V~16.5V 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℃	15.407V/ 264VAC 15.407V/ 230VAC 15.407V/ 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： 76.9A PSU2： 73.7 A PSU3： 74.2A PSU4： 73.3A O/P：50% PSU1： 44.5 A PSU2： 39.6 A PSU3： 41.8A PSU4： 39.8A
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		

<table>
<tr><td>4</td><td>DC OK SIGNAL</td><td colspan="3">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.

<table><tr><td>Between DC-OK(pin7) and GND(pin6,8)</td><td>Output Status</td></tr><tr><td>3.3 ~ 5.6V</td><td>ON</td></tr><tr><td>0 ~ 1V</td><td>OFF</td></tr></table>
 

I/P:230VAC
O/P:FULL LOAD
Ta:25℃
TEST RESULT:
PSU turn on = 5.27V
PSU turn off = 0.005V</td></tr>
<tr><td>5</td><td>5V STANDBY</td><td>5VSB ： 5V@0.3A ； tolerance± 5%, ripple : 50mVp-p(max.)</td><td>I/P: 230 VAC
O/P:FULL LOAD
Ta:25℃</td><td>TEST RESULT：
4.94 V /0.303A
Ripple ： 5.1 mVp-p</td></tr>
<tr><td>6</td><td>FAN CONTROL</td><td>FAN ON/OFF BY BY NTC (RT50) OR LOAD</td><td>I/P: 230 VAC
O/P:TESTING</td><td><table><tr><td></td><td>TEMP.</td><td>LOAD</td></tr><tr><td>FAN ON</td><td>55℃</td><td>>15.2%</td></tr><tr><td>FAN OFF</td><td>36℃</td><td><14.8%</td></tr></table></td></tr>
</table>

COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Transistor (D to S) or (C to E) **Peak Voltage**	Q911 Rated 26 A/ 600V	I/P:High-Line +3V =303V 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℃	VDS: (1)547V (2)547V (3)555V (4)559V (5)547V (6)543V (7)551V
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	VDS: (1) 515 V (2) 519V (3) 511V (4) 519V (5) 515V (6) 519V (7) 458V

			(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℃	
3	P.F.C DIODE	D6 Rated 6A/ 600V	I/P:High-Line +3V =303V 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) 381V (2) 393V (3) 385V (4) 377V
4	SR MOSFET Peak Voltage	Q508 Rated 100A/ 80V Q506 Rated 100A/ 80V	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℃	Q508: VDS: (1)35.6V (2)12.7V (3)35.2V (4)35.6V (5)35.6V (6)35.2V (7)32.8V (8)32.8V (9)32.8V Q506: VDS: (1)36.4V (2)13.5V (3)35.6V (4)36V (5)36V (6)36V (7)33.2V (8)31.6V (9)32.4V
5	Input Capacitor Voltage	C5 Rated: 220μ/ 400V	I/P:High-Line +3V =303V 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)453V (2)465V (3)441V (4)437V
6	Control IC Voltage Test	PFC IC U1: Absolute Rating: -0.3 V ~ 26 V Operating Range: 12.9 V ~ 25 V PWM IC U900: 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 (2) Output Short (3)O.L.P (4)O.V.P. (5)NO LOAD VR MIN.LOW LINE Ta:25℃	PFC IC (1) 22.4V (2) 22V (3) 21.8V (4) 19.4V (5) 18V PWM IC (1) 14.4V (2) 14.4V (3) 14.4V (4) 14.2V (5) 13V
7	TOP SWITCHING STAND BY POWER	U971 Rated 1.8 A/ 700 V	I/P:High-Line +3V =303V V AC ON/OFF O/P: (1)Full Load (2)Remote On/Off Ta:25℃	(1) 561V (2) 553V

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℃	I/P-O/P:5.72mA I/P-FG:4.46mA O/P-FG:5.2m 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: 30GΩ I/P-FG: 30GΩ O/P-FG:5.51 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 A	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

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	TEMPERATURE RISE TEST	MODEL： MSP-1000-12 1. ROOM AMBIENT BURN-IN： 1 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 ℃		

NO	Position	ROOM AMBIENT Ta= 25 ℃	HIGH AMBIENT Ta= 50 ℃
1	BD1	60.1℃	82.9℃
2	R6	63.2℃	74.1℃
3	Q1	50.3℃	66.8℃
4	U1	56.1℃	76.0℃
5	D5	57.7℃	72.4℃
6	D6	56.5℃	76.1℃
7	C6	43.7℃	65.6℃
8	U971	47.3℃	71.0℃
9	D981	46.5℃	68.6℃
10	RY1	49.8℃	67.4℃
11	RG2	35.2℃	78.5℃
12	D431	48.2℃	86.7℃
13	C406	28.9℃	54.7℃
14	TSW4	37.8℃	61.9℃
15	L1	42.7℃	78.1℃
16	T951	34.9℃	69.5℃
17	C2	48.1℃	61.5℃
18	LF3	54.1℃	66.9℃
19	T1-1	63.5℃	89.0℃
20	T2-1	62.0℃	91.3℃
21	T2-2	60.4℃	86.3℃
22	L900	46.7℃	70.9℃
23	Q910	72.2℃	97.5℃
24	C933	43.0℃	64.8℃
25	Q911	61.6℃	86.3℃
26	U900	36.0℃	62.5℃
27	C105	31.1℃	73.6℃
28	C108	42.5℃	79.3℃
29	U501	44.9℃	86.0℃
30	Q501	75.9℃	94.4℃
31	Q506	78.3℃	111.7℃
32	U504	68.8℃	94.2℃
33	Q504	85.3℃	106.3℃
34	Q508	82.1℃	112.6℃
35	TSW3	37.4℃	62.0℃

2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR (MIN)	I/P： 230 VAC O/P： 127 % LOAD Ta：25℃	TEST：OK
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	± 0.015 %/℃(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) 580719HRS (2) 93162HRS (3) 249582HRS (4) 421443HRS
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