



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

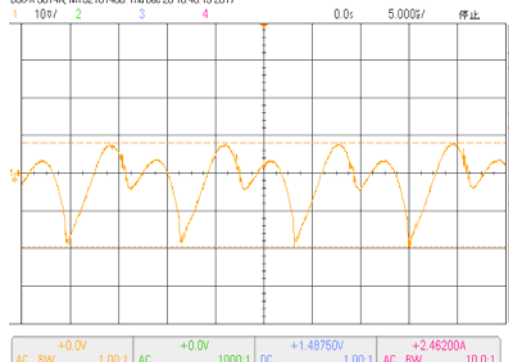
DESIGN VERIFY TEST

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

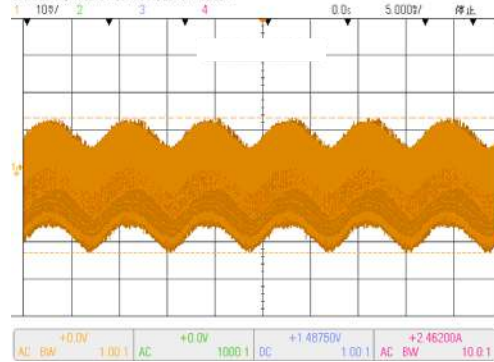
high frequency :

DSO-X 3014A, MV52161480 Thu Dec 28 10:48 19 2017



low frequency :

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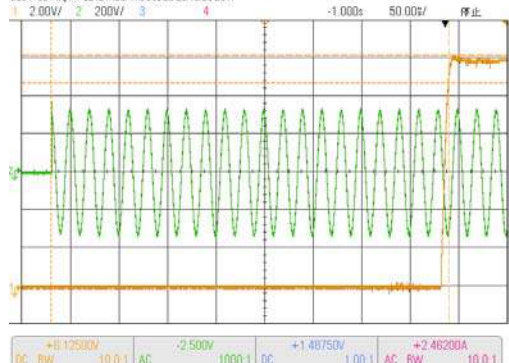


7	SET UP TIME(Max)	230VAC/1000ms 115VAC/2000ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25℃	230VAC/410ms 115VAC/472ms
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INPUT=230VAC/50HZ @ FULL LOAD

CH1 : Output Voltage CH2 : AC Input Voltage

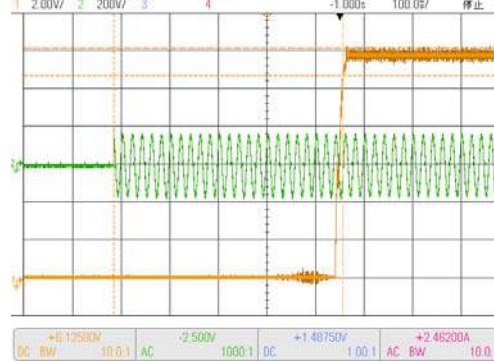
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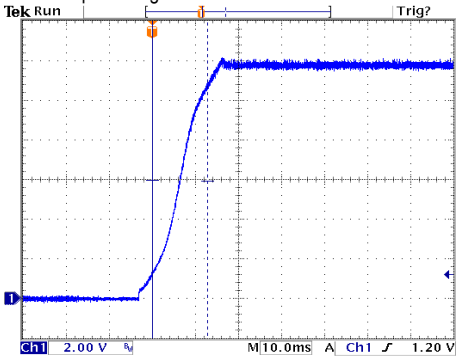
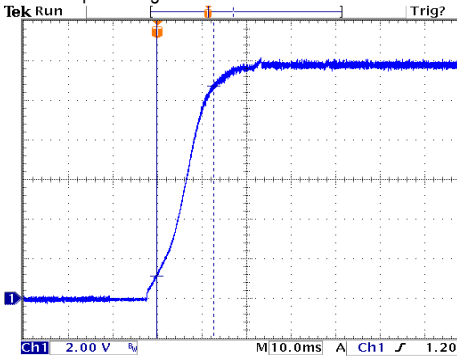
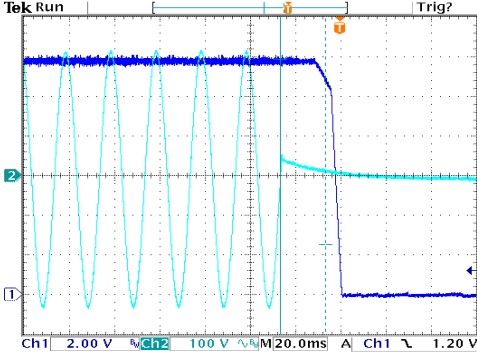
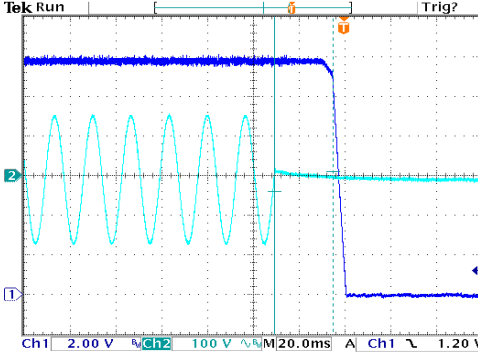
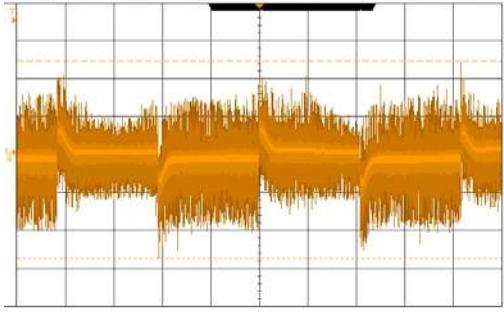
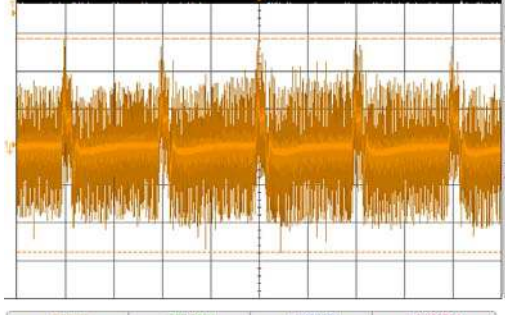


INPUT=115VAC/60HZ @ FULL LOAD

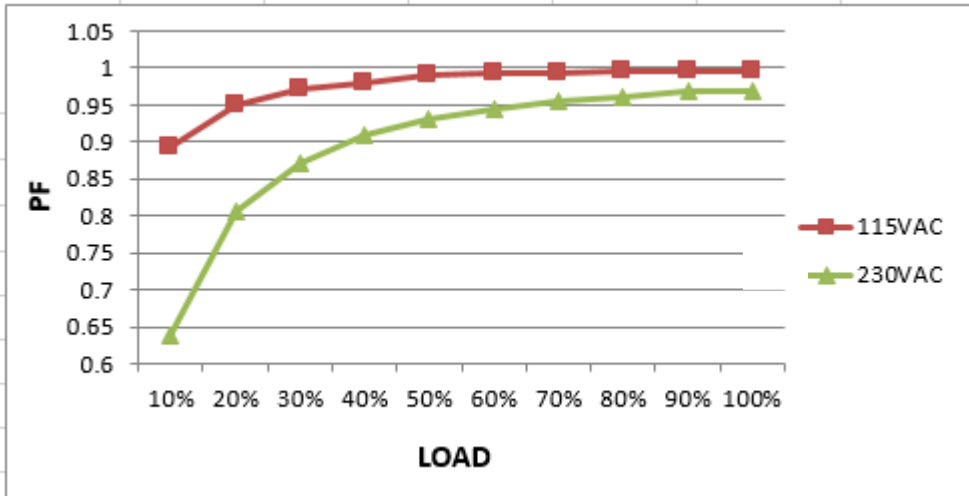
CH1 : Output Voltage CH2 : AC Input Voltage

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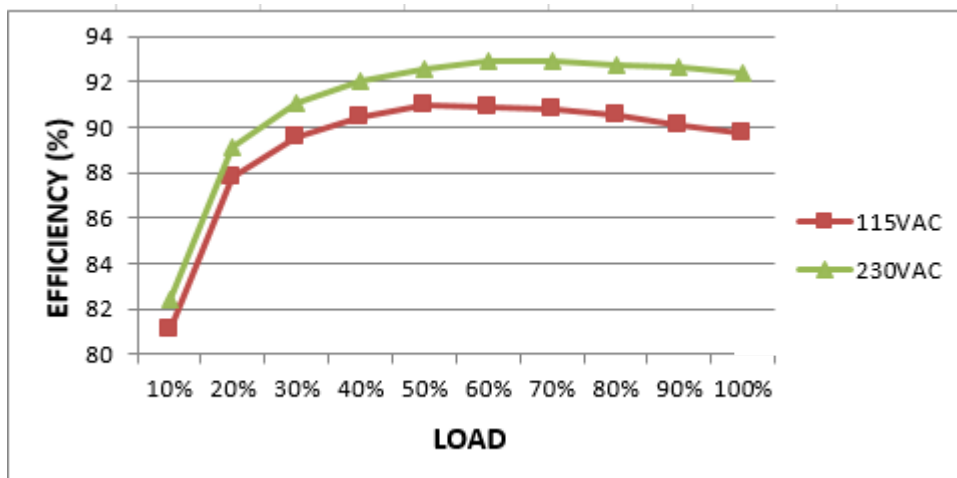


8	RISE TIME (Max) 230VAC/50ms 115VAC/50ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/12.8ms 115VAC/12.8ms
INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage 		INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage 	
9	HOLD UP TIME (Typ.) 230VAC/16ms 115VAC/16ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	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°C	(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°C	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°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=4.7A/ 230VAC I=8.005A/ 115VAC
4	LEAKAGE CURRENT	Earth leakage current < 360 μ A/264VAC	I/P : 264 VAC O/P : Min LOAD Ta : 25°C	L-FG : 287.4 μ A N-FG : 290.5 μ A
		Touch leakage current < 100 μ A/264VAC	I/P : 264 VAC O/P : Min LOAD Ta : 25°C	L-V+ : 86.4 μ A L-V-: 86.9 μ A N-V+: 86.2 μ A N-V-: 86.7 μ A
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°C	< 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°C	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°C	92.07%

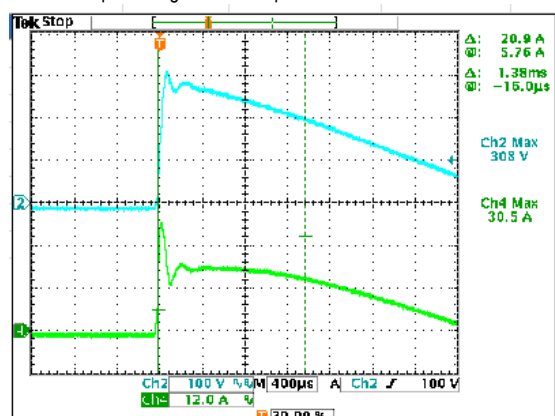
EFFICIENCY vs LOAD



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

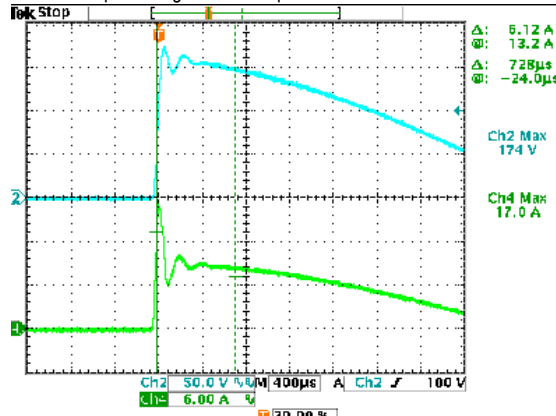
INPUT=230VAC/50HZ @ FULL LOAD

CH2 : AC Input Voltage CH4 : Input current



INPUT=115VAC/ 60HZ @ FULL LOAD

CH2 : AC Input Voltage CH4 : Input current

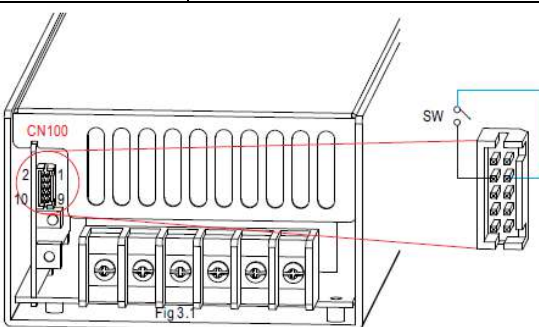
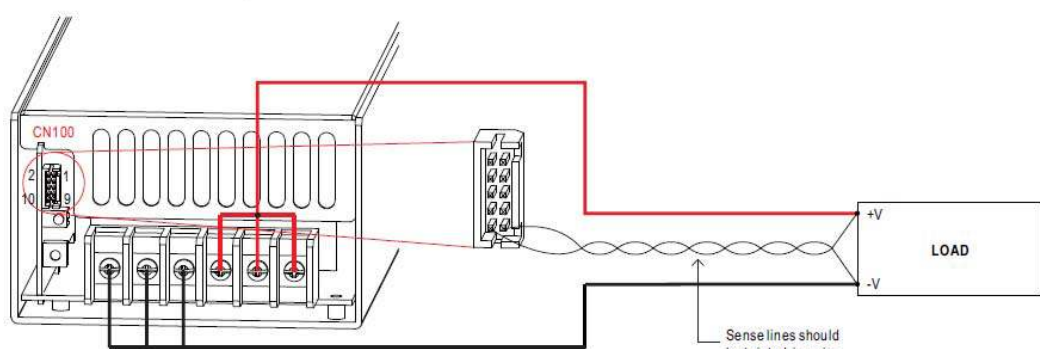


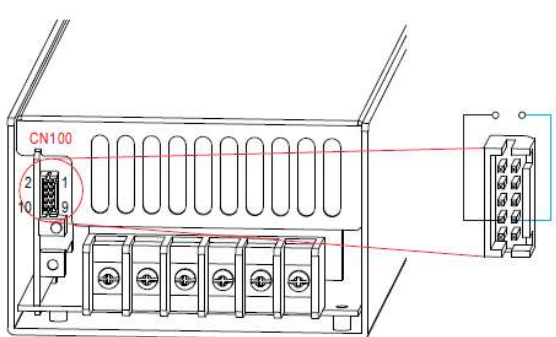
PROTECTION FUNCTION TEST

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°C	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°C	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°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 : 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. <table><tr><th>Between RC+(pin3) and RC-(pin4)</th><th>Output Status</th></tr><tr><td>SW ON (Short)</td><td>ON</td></tr><tr><td>SW OFF (Open)</td><td>OFF</td></tr></table> I/P: 230 VAC O/P: FULL LOAD Ta:25°C TEST RESULT : OK	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  Sense lines should be twisted in pairs I/P: 230 VAC O/P:FULL LOAD Ta:25°C 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. <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°C TEST RESULT: PSU turn on = 5.27V PSU turn off = 0.005V	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 : 4.94 V /0.303A Ripple : 5.1 mVp-p											
6	FAN CONTROL	FAN ON/OFF BY BY NTC (RT50) OR LOAD	I/P: 230 VAC O/P:TESTING	<table><tr><td></td><td>TEMP.</td><td>LOAD</td></tr><tr><td>FAN ON</td><td>55°C</td><td>>15.2%</td></tr><tr><td>FAN OFF</td><td>36°C</td><td><14.8%</td></tr></table>				TEMP.	LOAD	FAN ON	55°C	>15.2%	FAN OFF	36°C	<14.8%
	TEMP.	LOAD													
FAN ON	55°C	>15.2%													
FAN OFF	36°C	<14.8%													

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°C	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 PWM IC (1) 22.4V (1) 14.4V (2) 22V (2) 14.4V (3) 21.8V (3) 14.4V (4) 19.4V (4) 14.2V (5) 18V (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 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

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 °C	HIGH AMBIENT Ta= 50 °C
				1	BD1	60.1°C	82.9°C
				2	R6	63.2°C	74.1°C
				3	Q1	50.3°C	66.8°C
				4	U1	56.1°C	76.0°C
				5	D5	57.7°C	72.4°C
				6	D6	56.5°C	76.1°C
				7	C6	43.7°C	65.6°C
				8	U971	47.3°C	71.0°C
				9	D981	46.5°C	68.6°C
				10	RY1	49.8°C	67.4°C
				11	RG2	35.2°C	78.5°C
				12	D431	48.2°C	86.7°C
				13	C406	28.9°C	54.7°C
				14	TSW4	37.8°C	61.9°C
				15	L1	42.7°C	78.1°C
				16	T951	34.9°C	69.5°C
				17	C2	48.1°C	61.5°C
				18	LF3	54.1°C	66.9°C
				19	T1-1	63.5°C	89.0°C
				20	T2-1	62.0°C	91.3°C
				21	T2-2	60.4°C	86.3°C
				22	L900	46.7°C	70.9°C
				23	Q910	72.2°C	97.5°C
				24	C933	43.0°C	64.8°C
				25	Q911	61.6°C	86.3°C
				26	U900	36.0°C	62.5°C
				27	C105	31.1°C	73.6°C
				28	C108	42.5°C	79.3°C
				29	U501	44.9°C	86.0°C
				30	Q501	75.9°C	94.4°C
				31	Q506	78.3°C	111.7°C
				32	U504	68.8°C	94.2°C
				33	Q504	85.3°C	106.3°C
				34	Q508	82.1°C	112.6°C
				35	TSW3	37.4°C	62.0°C
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	± 0.015 %/°C (0~50°C)			

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