



# Test Report: MSP-450-5

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## 450W 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	VERDICT
1	RIPPLE & NOISE	V1 : 80 mVp-p (Max)	I/P : 230VAC O/P : FULL LOAD Ta : 25°C	V1 : 51.2 mVp-p (Max)	P
2	OUTPUT VOLTAGE ADJUST RANGE	CH1 : 4.3 V ~ 5.8 V	I/P : 230 VAC I/P : 115 VAC O/P : MIN LOAD Ta : 25°C	4.072 V~ 5.935 V/ 230 VAC 4.068 V~ 5.948 V/ 115 VAC	P
3	OUTPUT VOLTAGE TOLERANCE	V1 : 2%~ -2% (Max)	I/P : 100 VAC / 264 VAC O/P : FULL/ MIN LOAD Ta : 25°C	V1 : 0.4 %~ -0.4 %	P
4	LINE REGULATION	V1 : 0.5%~ -0.5% (Max)	I/P : 100 VAC ~ 264 VAC O/P : FULL LOAD Ta : 25°C	V1 : 0.12 %~ -0.12 %	P
5	LOAD REGULATION	V1 : 1 %~ -1% (Max)	I/P : 230 VAC O/P : FULL ~MIN LOAD Ta : 25°C	V1 : 0.4 %~ -0.4 %	P
6	SET UP TIME	230VAC : 1000 ms (Max) 115VAC : 2500 ms(Max)	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/ 97 ms 115VAC/ 200 ms	P
7	RISE TIME	230VAC : 100 ms (Max) 115VAC : 100 ms (Max)	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/ 19 ms 115VAC/ 11 ms	P
8	HOLD UP TIME	230VAC : 16 ms (TYP) 115VAC : 16 ms (TYP)	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/ 21 ms 115VAC/ 16 ms	P
9	OVER/UNDERSHOOT TEST	< ±5%	I/P : 230 VAC O/P : FULL LOAD Ta : 25°C	TEST : < 5 %	P
10	DYNAMIC LOAD	V1 : 1000 mVp-p	I/P : 230 VAC (1).O/P : FULL /Min LOAD 90%DUTY/ 1KHZ (2).O/P : FULL /Min LOAD 50%DUTY/ 120HZ Ta : 25°C	(1)560 mVp-p (2)796 mVp-p	P

## INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	VERDICT
1	INPUT VOLTAGE RANGE	100VAC~264 VAC	I/P : TESTING O/P : FULL LOAD Ta : 25°C	73 V~264V	P
			I/P : LOW-LINE-3V= 97 V HIGH-LINE+15%=300 V O/P : FULL/MIN LOAD ON : 30 Sec . OFF : 30 Sec 10MIN ( AC POWER ON/OFF NO DAMAGE )	TEST : OK	
2	INPUT FREQUENCY RANGE	47HZ ~63 HZ NO DAMAGE OSC	I/P : 100 VAC ~ 264 VAC O/P : FULL-MIN LOAD Ta : 25°C	TEST : OK	P
3	POWER FACTOR	0.95 / 230 VAC(TYP)	I/P : 230 VAC	PF= 0.979 / 230 VAC	P
		0.99 / 115 VAC(TYP)	I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	PF= 0.997 / 115 VAC	
4	EFFICIENCY	83% (TYP)	I/P : 230 VAC O/P : FULL LOAD Ta : 25°C	83.89 %	P
5	INPUT CURRENT	230V/ 2.4 A (TYP)	I/P : 230 VAC	I = 2.39 A/ 230 VAC	P
		115V/ 5 A (TYP)	I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	I = 4.89 A/ 115 VAC	
6	INRUSH CURRENT	230V/ 70 A (TYP)	I/P : 230 VAC	I = 58 A/ 230 VAC	P
		115V/ 35 A (TYP) COLD START	I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	I = 29 A/ 115 VAC	
7	LEAKAGE CURRENT	< 300 uA/ for earth leakage current	I/P: 264 VAC O/P:Min LOAD Ta:25°C	L-FG 270 uA N-FG 270 uA	P
		< 100 uA/ for touch leakage current	I/P: 264 VAC O/P:Min LOAD Ta:25°C	L-V+ 75 uA L-V- 75 uA N-V+ 75 uA N-V- 75 uA	
8	No load power consumption	< 0.6 W	I/P : 230 VAC O/P : NO LOAD RC+&RC- SHORT Ta : 25°C	0.41 W	P

## PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	VERDICT
1	OVER LOAD PROTECTION	105% ~ 135 %	I/P : 230 VAC I/P : 115 VAC O/P : TESTING Ta : 25°C	120 %/ 230 VAC 120%/ 115 VAC Constant current limiting, recovers automatically after fault condition is removed	P
2	OVER VOLTAGE PROTECTION	CH1 : 6 V ~ 7 V	I/P : 230 VAC I/P : 115 VAC O/P : MIN LOAD Ta : 25°C	6.15 V/ 230 VAC 6.25 V/ 115 VAC Shut down Re- power ON	P
3	OVER TEMPERATURE PROTECTION	SPEC : TSW1 : 70 ± 5°C O.T.P. detect on heatsink of power transistor TSW2 : 90 ± 5°C O.T.P. detect on heatsink of power transistor NO DAMAGE	I/P : 230 VAC O/P : FULL LOAD	O.T.P. Active Shut down o/p voltage · recovers automatically after temperature goes down	P
4	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE	I/P : 264 VAC O/P : FULL LOAD Ta : 25°C	NO DAMAGE Constant current limiting, recovers automatically after fault condition is removed	P

## CONTROL FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	VERDICT
1	DC OK SIGNAL	PSU turn on : 3.3 ~ 5.6V ; PSU turn off : 0 ~ 1V	I/P : 230 VAC O/P : FULL LOAD Ta : 25°C	PSU turn on : 5.094 V PSU turn off : 0 V	P
2	REMOTE CONTROL	Rc+ / Rc- 4 ~ 10V or open = power on 0 ~ 0.8V or short = power off	I/P : 230 VAC O/P : FULL LOAD Ta : 25°C	3.5V ~ 10 V POWER ON 0V ~ 3.4 V POWER OFF	P
3	REMOTE SENSE	>0.5V	I/P : 230 VAC O/P : FULL LOAD Ta : 25°C	> 0.5 V	P
4	AUX POWER	4.75V~5.25V / 0.3A Ripple : 50mV	I/P : 230 VAC O/P : FULL LOAD Ta : 25°C	4.961V / 0.3A Ripple : 6mv	P
5	FAN ON/OFF control test(TYP)	1、FAN ON : 20%± 10%	I/P : 230 VAC O/P : TESTING Ta : 25°C	> 23.4 %LOAD FAN ON < 17.1 %LOAD FAN OFF	P
		2、RTH2≥ 50°C	I/P : 230 VAC O/P : FULL LOAD Ta : 25°C	>54.8 °C FAN ON	P

## COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	VERDICT
1	Power Transistor ( D to S) or (C to E) Peak Voltage	Q3 Rated : IRFP460A 20A/500V	I/P : High-Line +3V = 267 V O/P : (1)Full Load Turn on (2) Output Short (3)Full load continue Ta : 25°C	(1) 436 V (2) 428 V (3) 436 V	P
2	Diode Peak Voltage	Q 101 Rated : STP80NF03L-04 80A/30V  Q 103Rated : STP80NF03L-04 80A/30V	I/P : High-Line +3V = 267 V O/P : (1)Full Load Turn on (2)Output Short (3)Full load continue Ta : 25°C	(1) 19.5 V (2) 18.9 V (3) 18.9 V  (1) 29 V (2) 22.1 V (3) 22.1 V	P
3	Input Capacitor Voltage	C5 Rated : 330u/400V 105°C 30*30 HU	I/P : High-Line +3V = 267 V O/P : (1)Full Load Turn on /Off (2) Min load Turn on /Off (3)Full Load /Min load Change Ta : 25°C	(1) 373.3 V (2) 379.8 V (3) 379.7 V	P
4	Control IC Voltage Test	U1 Rated : FAN4801NY 9.3V~30V	I/P : High-Line +3V = 267 V O/P : (1)Full Load Turn on /Off (2) Min load Turn on /Off (3)Full Load /Min load Change Ta : 25°C	(1) 14.1 V (2) 15.1 V (3) 14.9 V	P
5	Power Transistor ( D to S) or (C to E) Peak Voltage	Q 1 Rated : IRFP460A 20A/500V	I/P : High-Line +3V = 267 V O/P : (1)Full Load Turn on (2) Output Short (3)Full load continue Ta : 25°C	(1) 488 V (2) 434 V (3) 436 V	P

## ■ SAFETY & E.M.C. TEST

### SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	VERDICT
1	WITHSTAND VOLTAGE	I/P-O/P : 4 KVAC/min I/P-FG : 2 KVAC/min O/P-FG : 0.5 KVAC/min	I/P-O/P : 4.2 KVAC/min I/P-FG : 2.4 KVAC/min O/P-FG : 0.6 KVAC/min Ta : 25°C	I/P-O/P : 6.49 mA I/P-FG : 5.48 mA O/P-FG : 3.92 mA NO DAMAGE	P
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/70% RH	I/P-O/P : 22 GΩ I/P-FG : 18.4 GΩ O/P-FG : 30 GΩ NO DAMAGE	P
3	GROUNDING CONTINUITY	FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40 A / 2min Ta : 25°C / 70% RH	9mΩ	P

### E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	VERDICT
1	HARMONIC	EN61000-3-2,-3 CLASS A CLASS D	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	PASS	P
2	CONDUCTION	EN55011 CLASS B	I/P : 230 VAC (50HZ) O/P : FULL/50% LOAD Ta : 25°C	PASS Test by certified Lab	P
3	RADIATION	EN55011 CLASS B	I/P : 230 VAC (50HZ) O/P : FULL LOAD Ta : 25°C	PASS Test by certified Lab	P
4	E.S.D	EN61000-4-2 INDUSTRY AIR : 8KV / Contact : 4KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA A	P
5	E.F.T	EN61000-4-4 INDUSTRY INPUT : 2KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA A	P
6	SURGE	IEC61000-4-5 INDUSTRY L-N : 2KV L,N-PE : 4KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA A	P
7	Test by certified Lab & Test Report Prepare				

## RELIABILITY TEST

### ENVIRONMENT TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	VERDICT																																																																																																																			
1	TEMPERATURE RISE TEST	MODEL : MSP-450-5 1. ROOM AMBIENT BURN-IN : 1 HRS I/P : 230VAC O/P : FULL LOAD Ta=27.1 °C 2. HIGH AMBIENT BURN-IN : 4.5 HRS I/P : 230VAC O/P : FULL LOAD Ta= 50 °C			P																																																																																																																			
		<table border="1"> <thead> <tr> <th>NO</th> <th>Position</th> <th>P/N</th> <th>ROOM AMBIENT Ta= 27.1 °C</th> <th>HIGH AMBIENT Ta= 50 °C</th> </tr> </thead> <tbody> <tr><td>1</td><td>LF2</td><td>TR548-R2</td><td>56.8°C</td><td>78.9°C</td></tr> <tr><td>2</td><td>U1</td><td>PWM FAN4801NY</td><td>51.1°C</td><td>71.5°C</td></tr> <tr><td>3</td><td>L3</td><td>TR934</td><td>66.6°C</td><td>89.2°C</td></tr> <tr><td>4</td><td>C5</td><td>330u/400V 105°C 30*30 HU</td><td>53.9°C</td><td>74.5°C</td></tr> <tr><td>5</td><td>D1</td><td>BYC10-600 10A/600V</td><td>58.2°C</td><td>78.4°C</td></tr> <tr><td>6</td><td>Q1</td><td>IRFP460A 20A/500V</td><td>58.8°C</td><td>80.1°C</td></tr> <tr><td>7</td><td>Q4</td><td>IRFP460A 20A/500V</td><td>48.6°C</td><td>70.3°C</td></tr> <tr><td>8</td><td>T1</td><td>TF2108</td><td>78.6°C</td><td>99.4°C</td></tr> <tr><td>9</td><td>BD1</td><td>10A/800V US10KB80R</td><td>60.4°C</td><td>81.6°C</td></tr> <tr><td>10</td><td>TSW1</td><td>ST-22W-R2 90°C 90mm</td><td>57.8°C</td><td>77.3°C</td></tr> <tr><td>11</td><td>C18</td><td>100u/35V L7Kh 8*11.5 YXF</td><td>52.9°C</td><td>73.9°C</td></tr> <tr><td>12</td><td>C61</td><td>330u/25V UL8Kh 8*11.5 ZLH</td><td>52.2°C</td><td>72.7°C</td></tr> <tr><td>13</td><td>C105</td><td>4700u/10V UL10Kh ZLH</td><td>53.2°C</td><td>72.7°C</td></tr> <tr><td>14</td><td>Q101</td><td>STP80NF03L-04 80A/30V</td><td>66.8°C</td><td>88.5°C</td></tr> <tr><td>15</td><td>Q104</td><td>STP80NF03L-04 80A/30V</td><td>61.7°C</td><td>83.6°C</td></tr> <tr><td>16</td><td>L100</td><td>TR936 CS270125E18</td><td>46.0°C</td><td>65.7°C</td></tr> <tr><td>17</td><td>TSW2</td><td>ST-22W-R1 90°C 100mm</td><td>55.6°C</td><td>76.4°C</td></tr> <tr><td>18</td><td>C19</td><td>47u/25V L5Kh 5*11 KY</td><td>58.0°C</td><td>79.4°C</td></tr> <tr><td>19</td><td>D900</td><td>TVS ST02D-200</td><td>45.7°C</td><td>65.5°C</td></tr> <tr><td>20</td><td>U900</td><td>PWM TNY275PN</td><td>42.3°C</td><td>62.2°C</td></tr> <tr><td>21</td><td>T900</td><td>TF1593-R2</td><td>39.8°C</td><td>58.8°C</td></tr> <tr><td>22</td><td>C955</td><td>220u/16V UL8Kh 6.3*11 ZLH</td><td>33.8°C</td><td>52.5°C</td></tr> </tbody> </table>	NO	Position		P/N	ROOM AMBIENT Ta= 27.1 °C	HIGH AMBIENT Ta= 50 °C	1	LF2	TR548-R2	56.8°C	78.9°C	2	U1	PWM FAN4801NY	51.1°C	71.5°C	3	L3	TR934	66.6°C	89.2°C	4	C5	330u/400V 105°C 30*30 HU	53.9°C	74.5°C	5	D1	BYC10-600 10A/600V	58.2°C	78.4°C	6	Q1	IRFP460A 20A/500V	58.8°C	80.1°C	7	Q4	IRFP460A 20A/500V	48.6°C	70.3°C	8	T1	TF2108	78.6°C	99.4°C	9	BD1	10A/800V US10KB80R	60.4°C	81.6°C	10	TSW1	ST-22W-R2 90°C 90mm	57.8°C	77.3°C	11	C18	100u/35V L7Kh 8*11.5 YXF	52.9°C	73.9°C	12	C61	330u/25V UL8Kh 8*11.5 ZLH	52.2°C	72.7°C	13	C105	4700u/10V UL10Kh ZLH	53.2°C	72.7°C	14	Q101	STP80NF03L-04 80A/30V	66.8°C	88.5°C	15	Q104	STP80NF03L-04 80A/30V	61.7°C	83.6°C	16	L100	TR936 CS270125E18	46.0°C	65.7°C	17	TSW2	ST-22W-R1 90°C 100mm	55.6°C	76.4°C	18	C19	47u/25V L5Kh 5*11 KY	58.0°C	79.4°C	19	D900	TVS ST02D-200	45.7°C	65.5°C	20	U900	PWM TNY275PN	42.3°C	62.2°C	21	T900	TF1593-R2	39.8°C	58.8°C	22	C955	220u/16V UL8Kh 6.3*11 ZLH	33.8°C	52.5°C		
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2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR ( MIN )	I/P : 230 VAC O/P : 123 % LOAD Ta : 25°C	TEST : OK	P																																																																																																																			
3	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 264VAC/100VAC O/P : 100 % LOAD Ta= -40 °C	TEST : OK	P																																																																																																																			
4	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 50 °C NO DAMAGE	I/P : 272 VAC O/P : FULL LOAD Ta= 50 °C HUMIDITY= 95 %R.H	TEST : OK	P																																																																																																																			
5	TEMPERATURE COEFFICIENT	± 0.03 % (0~50°C)	I/P : 230 VAC O/P : FULL LOAD	± 0.001 % (0~50°C)	P																																																																																																																			

6	STORAGE TEMPERATURE TEST	<ol style="list-style-type: none"> <li>1. Thermal shock Temperature : -45°C~ +90°C</li> <li>2. Temperature change rate : 25°C / MIN</li> <li>3. Dwell time low and high temperature : 30 MIN/EACH</li> <li>4. Total test cycle : 5 CYCLE</li> <li>5. Input/Output condition : STATIC</li> </ol>	OK	P
7	THERMAL SHOCK TEST	<ol style="list-style-type: none"> <li>1. Thermal shock Temperature : -40°C~ +55°C</li> <li>2. Temperature change rate : 25°C / MIN</li> <li>3. Dwell time low and high temperature : 30 MIN/EACH</li> <li>4. Total test cycle : 10 CYCLE</li> <li>5. Input/Output condition : 230VAC/Full Load AC ON/OFF TEST turn on 58sec ; turn off 2sec</li> </ol>	OK	P
8	VIBRATION TEST	1 Carton & 1 Set <ol style="list-style-type: none"> <li>(1) Waveform : Sine Wave</li> <li>(2) Frequency : 10~500Hz</li> <li>(3) Sweep Time : 10min/sweep cycle</li> <li>(4) Acceleration : 5G</li> <li>(5) Test Time : 60min in each axis (X.Y.Z)</li> <li>(6) Ta : 25°C</li> </ol>	TEST : OK	P
9	CAPACITOR LIFE CYCLE	MSP-450-5:SUPPOSE C105 IS THE MOST CRITICAL COMPONENT <ol style="list-style-type: none"> <li>(1) I/P : 230VAC O/P : FULL LOAD Ta= 25 °C LIFE TIME</li> <li>(2) I/P : 230VAC O/P : FULL LOAD Ta= 50 °C LIFE TIME</li> <li>(3) I/P : 230VAC O/P : 75% LOAD Ta= 50 °C LIFE TIME</li> </ol>	<ol style="list-style-type: none"> <li>(1) 487645.9HRS</li> <li>(2) 109089.4HRS</li> <li>(3) 229111HRS</li> </ol>	P
10	MTBF	Conducted by Parts Stress Analysis Prediction 1171.9Khrs. Telcordia SR-332 (Bellcore) ; 159.4K hrs min. MIL-HDBK-217F (25°C)		P

SAMPLE	TEST RESULT	TESTER	APPROVAL
RD SAMPLE	PASS	SANFORD SU	VINCENT TSENG
PRODUCT SAMPLE	PASS	SANFORD SU	VINCENT TSENG

2009/08/04 A50-F023