



# Test Report: LOP-600-15

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600W 5"×3" Low Profile Open Frame Power Supply

## ■ 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: 14.3V~15.8V	I/P : 230 VAC I/P : 115 VAC O/P : MIN LOAD Ta : 25°C	13.817V~16.188V/230VAC 13.817V~16.188V/115VAC
2	OUTPUT VOLTAGE TOLERANCE	V1: -3% ~ +3%	I/P: 80VAC~ 264VAC O/P:FULL~ MIN. LOAD Ta:25°C	V1: -0.06% ~0.12%
3	LINE REGULATION	V1: -0.5% ~ +0.5%	I/P: 80VAC~ 264VAC O/P:FULL LOAD Ta:25°C	V1: -0 % ~0%
4	LOAD REGULATION	V1: -1% ~ +1%	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25°C	V1: -0.06% ~0.12%
5	OVER/UNDERSHOOT TEST	<±5%	I/P: 230VAC O/P:FULL LOAD / NO LOAD Ta:25°C	-2.74%
6	RIPPLE & NOISE (Max)	V1: 150mVp-p	I/P:230VAC O/P: FULL LOAD Ta:25°C	V1: 45mVp-p / high frequency 53mVp-p / low frequency
		high frequency :		
		low frequency :		
7	SET UP TIME(Max)	230VAC/1000ms 115VAC/1500ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/ 658ms 115VAC/ 542ms
		INPUT=230VAC/50HZ @ FULL LOAD CH1: Output Voltage CH2: AC Input Voltage	INPUT=115VAC/60HZ @ FULL LOAD CH1: Output Voltage CH2: AC Input Voltage	

<p>8</p> <p>RISE TIME (Max)</p>	<p>230VAC/50ms 115VAC/50ms</p>	<p>I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C</p>	<p>230VAC/ 15.66ms 115VAC/ 15.84ms</p>
<p>INPUT=230VAC/50HZ @ FULL LOAD CH1: Output Voltage</p>		<p>INPUT=115VAC/60HZ @ FULL LOAD CH1: Output Voltage</p>	
<p>9</p> <p>HOLD UP TIME (Typ.)</p>	<p>8ms /600W load 12ms /400W load</p>	<p>I/P : 230 VAC O/P : TESTING Ta : 25°C</p>	<p>16.6ms /600W load 24.8ms /400W load</p>
<p>INPUT=230VAC/50HZ @ 600W load CH1: Output Voltage CH2: AC Input Voltage</p>		<p>INPUT=230VAC/50HZ @ 400W load CH1: Output Voltage CH2: AC Input Voltage</p>	
<p>10</p> <p>DYNAMIC LOAD</p>	<p>V1: 1500mVp-p</p>	<p>I/P: 230VAC O/P: (1) FULL/0% LOAD 50%DUTY / 120HZ (2) FULL/0% LOAD 50%DUTY / 1KHZ Ta:25°C</p>	<p>695mVp-p 637mVp-p</p>
<p>FULL /0% LOAD 50%DUTY / 120HZ</p>		<p>FULL /0% LOAD 50%DUTY / 1KHZ</p>	

<p>11 TRANSIENT RECOVERY TIME</p>	<p>V1: 1500mVp-p &lt; 500us</p>	<p>I/P: 230VAC O/P:40% LOAD CHANGE 50%DUTY/120HZ 1.25A/us</p>	<p>280mVp-p 0us</p>
<p>12 PEAK LOAD</p>	<p>150% PEAK LOAD@3S</p>	<p>I/P: 264VAC I/P: 115VAC O/P: PEAK LOAD</p>	<p>TEST : OK</p>

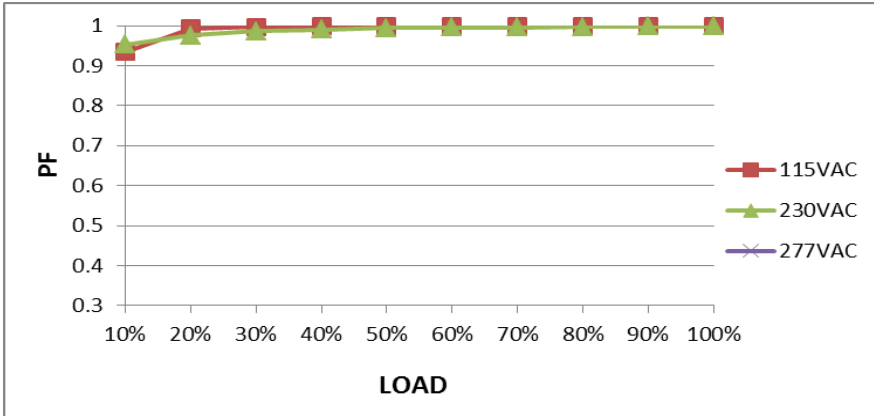
### INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	80VAC~264VAC 113VDC~ 370VDC 	(1) I/P: TESTING O/P: FULL / 70% LOAD (2) I/P: DC TESTING (L: + N: -) O/P: FULL / 70% LOAD (3) I/P: DC TESTING (L: - N: +) O/P: FULL / 70% LOAD Ta:25°C I/P: HIGH-LINE+15%=300V O/P:FULL/MIN LOAD (PLEASE CHECK DERATING CURVE) ON: 30 Sec OFF: 30 Sec 10MIN ( POWER ON/OFF NO DAMAGE )	(1) 70V~264V/ FULL LOAD 70V~264V/ 70% LOAD (2) 96.5Vdc~370Vdc/FULL LOAD 96.5Vdc~370Vdc/70% LOAD (3) 96.5Vdc~370Vdc/FULL LOAD 96.5Vdc~370Vdc/70% LOAD TEST : OK
2	INPUT FREQUENCY RANGE	47HZ ~63 HZ NO DAMAGE	I/P:80 VAC ~264 VAC O/P:FULL~MIN LOAD Ta:25°C	TEST : OK
3	INPUT CURRENT (Typ.)	230V/ 3.2A 115V/ 6.4A	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	I =2.786A/ 230VAC I =5.804A/ 115VAC
4	LEAKAGE CURRENT	Earth leakage current <500uA(rms) @ 264VAC touch current <70uA(rms) @ 264VAC	I/P : 264 VAC/60HZ O/P : Min LOAD Ta : 25°C	316.6 uA / 264 VAC@ For Earth 33.5uA / 264 VAC@For Touch
5	NO LOAD CONSUMPTION	<0.5W	I/P : 240VAC O/P : NO LOAD Ta : 25°C	0.3835W



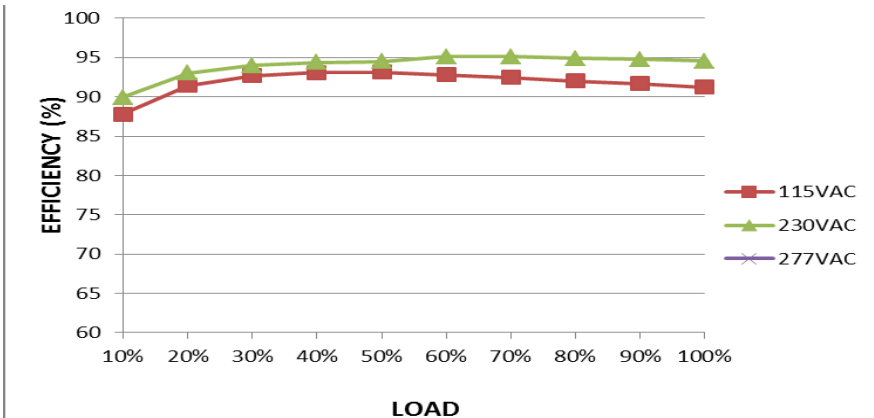
6	POWER FACTOR (Typ.)	0.94/ 230VAC 0.98/115VAC	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	PF=0.9972/230VAC PF=0.9988/115VAC
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P.F vs LOAD



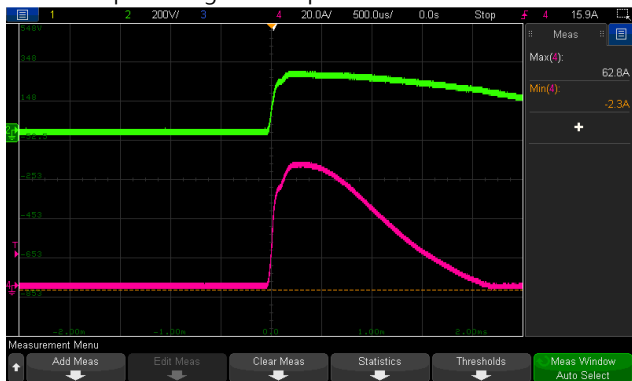
7	EFFICIENCY(Typ.)	93.5%	I/P:230 VAC O/P:FULL LOAD Ta:25°C	94.19%
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EFFICIENCY vs LOAD

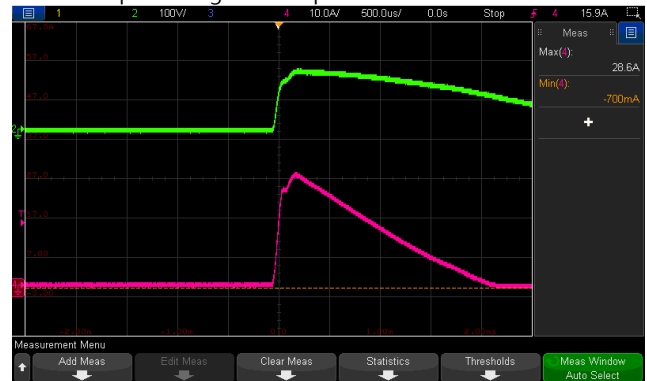


8	INRUSH CURRENT(Typ.)	230V/80A 115V/40A COLD START	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	I =62.8A/ 230VAC I =27.8A/ 115VAC T50=1152us/230V
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INPUT=230VAC/50HZ @ FULL LOAD  
CH2: AC Input Voltage CH4: Input current



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%~ 150% PROTECTION TYPE : Hiccup after 3 sec, recovers automatically after fault condition is removed	I/P: 264VAC I/P: 230VAC I/P: 115VAC O/P:TESTING Ta:25°C	140.5%/ 264VAC 140.5%/ 230VAC 140.5%/ 115VAC PROTECTION TYPE : Hiccup after 3 sec, recovers automatically after fault condition is removed
2	OVER VOLTAGE PROTECTION	16.5V~19.5V Protection type: Shut down o/p voltage, re-power on to recover	I/P: 264VAC I/P: 80VAC O/P:MIN LOAD Ta:25°C	17.4V/ 264VAC 17.4V/ 80VAC 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 (Vin=115Vac); Shut down o/p voltage, re-power on to recover ( Vin=230Vac or FAN LOCK)	I/P: 264VAC I/P: 80VAC O/P:FULL LOAD	O.T.P Active OK Protection type : Shut down o/p voltage, recovers automatically after temperature goes down (Vin=115Vac); Shut down o/p voltage, re-power on to recover (Vin=230Vac or FAN LOCK)
4	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE Protection type: Hiccup mode, recovers automatically after fault condition is removed	I/P: 264VAC I/P: 80VAC O/P: FULL LOAD Ta:25°C	NO DAMAGE OK PROTECTION TYPE : Hiccup mode, recovers automatically after fault condition is removed

**CONTROL FUNCTION TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	EXTERNAL FAN SUPPLY	12V@0.5A for driving a fan ; tolerance -15% ~ +15% at main output 20% rated current (23CFM)	I/P: 230 VAC O/P: TESTING Ta:25°C	TEST : <u>-0.78% ~0%</u>
2	REMOTE SENSE	S+ / S- The remote sensing compensates voltage drop on the load wiring up to 0.5V	I/P: 230 VAC O/P:FULL LOAD Ta:25°C	TEST : <u>OK</u>

**COMPONENT STRESS TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Transistor ( D to S) or (C to E) Peak Voltage	Q2/ Q3 Rated: 26A/600V	AC ON/OFF I/P: High-Line +3V =267V VDS: O/P: (1)Full Load (2)Output Short (3) Dynamic Load Full Load/ Min. Load 90%Duty/1KHz (4) Dynamic Load Full Load/	Q2: Q3: VDS: VDS: (1) 433V (1) 413V (2) 433V (2) 417V (3) 433V (3) 425V (4) 429V (4) 413V (5) 433V (5) 417V (6) 433V (6) 413V



			<p>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) Peak Load            Ta:25°C</p>	<p>(7) 433V            (8) 429V</p>	<p>(7) 445V            (8) 413V</p>
2	P.F.C Transistor ( D to S) or (C to E) Peak Voltage	Q1 Rated: 52A/600V	<p>AC ON/OFF            I/P: High-Line +3V =267V            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            (8) Peak Load            Ta:25°C</p>	<p>VDS:            (1) 433V            (2) 429V            (3) 433V            (4) 437V            (5) 437V            (6) 441V            (7) 453V            (8) 445V</p>	
3	P.F.C DIODE	D2 Rated: 6A/ 650V	<p>I/P: High-Line +3V =267 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            (5) Peak Load            Ta:25°C</p>	<p>(1) 409V            (2) 401V            (3) 405V            (4) 397V            (5) 417V</p>	
4	Diode Peak Voltage	Q101/Q103 Rated: 140A/ 60V	<p>AC ON/OFF            I/P: High-Line +3V =267 V  <u>Vo=Vmax</u>            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</p>	<p>Q101:  <u>Vo=Vmax</u>            VDS:            (1) 38.0V            (2) 37.4V            (3) 38.5V            (4) 39.4V            (5) 38.0V            (6) 38.5V            (7) 39.1V            (8) 38.0V            (9) 38.2V            (10) 38.5V  <u>Vo=Vnormal</u>            (1) 38.2V</p>	<p>Q103:  <u>Vo=Vmax</u>            VDS:            (1) 39.9V            (2) 38.5V            (3) 40.2V            (4) 40.5V            (5) 39.6V            (6) 40.2V            (7) 39.4V            (8) 38.0V            (9) 38.0V            (10) 40.5V  <u>Vo=Vnormal</u>            (1) 38.2V</p>

			(9) burst Mode (10) Peak Load $V_o = V_{normal}$ O/P: (1) Full Load Ta:25°C	
5	Input Capacitor Voltage	C5 Rated: 330 $\mu$ / 400V	I/P: High-Line +3V =267V 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) 393V (2) 385V (3) 397V (4) 389V
6	Control IC Voltage Test	PFC /PWM IC U1: Rated : 10.4V~28.7 V  O/P IC U101 Rated : 4.75V~38V	AC ON/OFF I/P: High-Line +3V =267 V O/P: (1) FULL LOAD (2) Output Short (3) O.L.P (4) O.V.P. (5) NO LOAD VRmin (LOW LINE) Ta:25°C	U1                      U101 (1) 18.9V              (1) 11.49V (2) 18.9V              (2) 11.49V (3) 18.9V              (3) 11.66V (4) 18.9V              (4) 11.49V (5) 18.9V              (5) 11.65V

■ SAFETY& E.M.C. TEST

SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	I/P-O/P: 4KVAC/min I/P-FG :2KVAC/min O/P-FG:1.5KVAC/min	I/P-O/P: 4.4 KVAC/min I/P-FG: 2.4 KVAC/min O/P-FG:1.8 KVAC/min Ta:25°C	I/P-O/P: 1.746mA I/P-FG: 2.37mA O/P-FG:0.805mA NO DAMAGE
2	ISOLATION RESISTANCE	I/P-O/P:500VDC>100M $\Omega$ I/P-FG: 500VDC>100M $\Omega$ O/P-FG:500VDC>100M $\Omega$	I/P-O/P: 600 VDC I/P-FG: 600 VDC O/P-FG: 600 VDC Ta:25°C	I/P-O/P:50G $\Omega$ I/P-FG:50G $\Omega$ O/P-FG:50G $\Omega$ NO DAMAGE

E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	HARMONIC	BS EN/EN61000-3-2 CLASS A	I/P:230VAC/50HZ O/P:FULL LOAD Ta:25°C	PASS
2	CONDUCTION	BS EN/EN55032(CISPR32) Class I: Class B , Class II: Class A BS EN/EN55014(CISPR32) Class I: Class B	I/P : 230 VAC (50HZ) O/P : FULL/50% LOAD Ta : 25°C	PASS Test by certified Lab



3	RADIATION	BS EN/EN55032(CISPR32) Class I: Class B, Class II: Class A BS EN/EN55014(CISPR32) Class I: Class B	I/P : 230 VAC (50HZ) O/P : FULL LOAD Ta : 25°C	PASS Test by certified Lab
4	E.S.D	BS EN/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	BS EN/EN61000-4-4 ■ INDUSTRY INPUT : 2KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	■ CRITERIA A
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
7	Test by certified Lab & Test Report Prepare Any contradictions of the test results, please refer to the latest EMC test report			

## ■ RELIABILITY TEST

### ENVIRONMENT TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT																																																				
1	TEMPERATURE RISE TEST	MODEL : LOP-600-12 1. ROOM AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta= 25.0 °C 2. HIGH AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta= 50.8 °C																																																						
				<table border="1"> <thead> <tr> <th>NO</th> <th>Position</th> <th>ROOM AMBIENT Ta= 25.0 °C</th> <th>HIGH AMBIENT Ta= 50.8 °C</th> </tr> </thead> <tbody> <tr><td>1</td><td>RTH1</td><td>31.7°C</td><td>57.5°C</td></tr> <tr><td>2</td><td>LF2</td><td>38.2°C</td><td>62.5°C</td></tr> <tr><td>3</td><td>C2</td><td>28.7°C</td><td>54.8°C</td></tr> <tr><td>4</td><td>ZNR1</td><td>29.8°C</td><td>55.3°C</td></tr> <tr><td>5</td><td>RY1</td><td>29.5°C</td><td>55.2°C</td></tr> <tr><td>6</td><td>BD1</td><td>46.2°C</td><td>71.4°C</td></tr> <tr><td>7</td><td>C8</td><td>39.1°C</td><td>63.5°C</td></tr> <tr><td>8</td><td>L1</td><td>50.8°C</td><td>76.2°C</td></tr> <tr><td>9</td><td>Q1</td><td>50.4°C</td><td>76.3°C</td></tr> <tr><td>10</td><td>D2</td><td>50.1°C</td><td>76.9°C</td></tr> <tr><td>11</td><td>Q8</td><td>39.0°C</td><td>69.6°C</td></tr> <tr><td>12</td><td>C40</td><td>45.9°C</td><td>70.1°C</td></tr> </tbody> </table>	NO	Position	ROOM AMBIENT Ta= 25.0 °C	HIGH AMBIENT Ta= 50.8 °C	1	RTH1	31.7°C	57.5°C	2	LF2	38.2°C	62.5°C	3	C2	28.7°C	54.8°C	4	ZNR1	29.8°C	55.3°C	5	RY1	29.5°C	55.2°C	6	BD1	46.2°C	71.4°C	7	C8	39.1°C	63.5°C	8	L1	50.8°C	76.2°C	9	Q1	50.4°C	76.3°C	10	D2	50.1°C	76.9°C	11	Q8	39.0°C	69.6°C	12	C40	45.9°C	70.1°C
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9	Q1	50.4°C	76.3°C																																																					
10	D2	50.1°C	76.9°C																																																					
11	Q8	39.0°C	69.6°C																																																					
12	C40	45.9°C	70.1°C																																																					

		NO	Position	ROOM AMBIENT Ta= 25.0 °C	HIGH AMBIENT Ta= 50.8°C
		13	RTH3	47.3°C	71.3°C
		14	U1	45.3°C	69.2°C
		15	C5	42.3°C	64.8°C
		16	LF1	29.1°C	55.1°C
		17	C60	26.8°C	52.6°C
		18	T1coil	77.8°C	92.2°C
		19	T1core	62.7°C	66.8°C
		20	Q103	70.8°C	87.0°C
		21	Q102	80.2°C	85.9°C
		22	C101	61.1°C	75.0°C
		23	C102	73.4°C	84.5°C
		24	Q3	50.8°C	76.4°C
		25	Q2	51.6°C	76.7°C
		26	D103	54.4°C	72.3°C
		27	C120	54.8°C	75.6°C
		28	L100	81.7°C	88.5°C
		29	RG100	58.6°C	74.5°C
		30	U103	42.7°C	65.6°C
		31	R3	39.9°C	65.4°C
		32	D105	47.1°C	69.9°C
		33	R122	51.2°C	71.0°C
		34	U101	44.5°C	56.6°C
		35	R105	50.3°C	69.8°C
		36	R101	42.6°C	63.4°C
		37	U4	42.9°C	63.2°C
		38	Q7	32.0°C	56.4°C
		39	D1	34.7°C	60.3°C
		40	D20	32.6°C	56.5°C
		41	C112	54.6°C	71.0°C
2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR ( MIN )		I/P : 230 VAC O/P : 123%LOAD Ta : 25°C	TEST : OK
3	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR		I/P : 264VAC/115VAC O/P : 100%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/95 %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	±0.008%/°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, 2G 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 : 3G (5) Test Time : 180min in each axis (X.Y.Z) (6) Ta : 25°C
9	CAPACITOR LIFE CYCLE	SUPPOSE C102 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) 190095HRS (2) 58072HRS (3) 294422HRS (4) 500000HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 1963.2K hrs min. Telcordia SR-332 (Bellcore); 310.9K hrs min. MIL-HDBK-217F (25°C)	
11	Ongoing Reliability Test	I/P : 230VAC O/P : FULL LOAD TA=50°C Demonstration Mean Time Between Failure : 30,000 hours	

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	Yuwei	Liutt	Wangdz

2020.10.1 TAG-QA-009