



Test Report: LOP-600-54

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

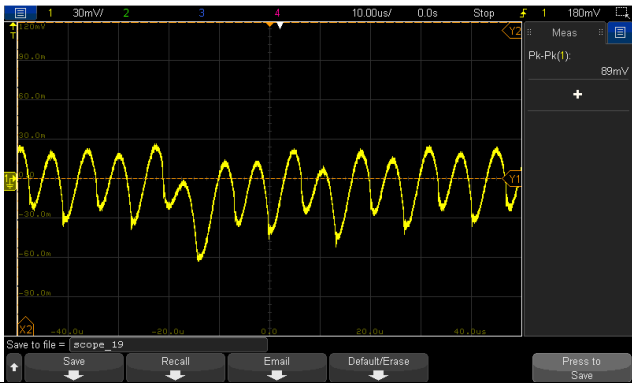
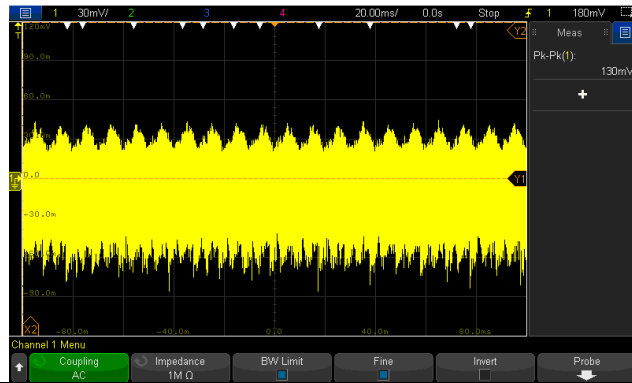
E.M.C. Test

■ RELIABILITY TEST

ENVIRONMENT TEST

■ DESIGN VERIFY TEST

OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE ADJUST RANGE	CH1: 52V~58V	I/P : 230 VAC I/P : 115 VAC O/P : MIN LOAD Ta : 25°C	49.75V~59.35V/230VAC 49.75V~59.35V/115VAC
2	OUTPUT VOLTAGE TOLERANCE	V1: -1% ~ +1%	I/P: 80VAC~ 264VAC O/P:FULL~ MIN. LOAD Ta:25°C	V1: -0.04% ~0.04%
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: -0.04% ~0.04%
5	OVER/UNDERSHOOT TEST	<±5%	I/P: 230VAC O/P:FULL LOAD / NO LOAD Ta:25°C	0.74%
6	RIPPLE & NOISE (Max)	V1: 250mVp-p	I/P:230VAC O/P: FULL LOAD Ta:25°C	V1: 89mVp-p / high frequency 130mVp-p / low frequency
		<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>high frequency :</p>  </div> <div style="text-align: center;"> <p>low frequency :</p>  </div> </div>		
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/ 706ms 115VAC/ 558ms
		<div style="display: flex; justify-content: space-around;"> <div style="width: 45%;"> <p>INPUT=230VAC/50HZ @ FULL LOAD CH1: Output Voltage CH2: AC Input Voltage</p> </div> <div style="width: 45%;"> <p>INPUT=115VAC/60HZ @ FULL LOAD CH1: Output Voltage CH2: AC Input Voltage</p> </div> </div>		

8	<p>RISE TIME (Max)</p>	<p>230VAC/30ms 115VAC/30ms</p>	<p>I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C</p>	<p>230VAC/ 3.91ms 115VAC/ 3.94ms</p>
<p>INPUT=230VAC/50HZ @ FULL LOAD CH1: Output Voltage</p>		<p>INPUT=115VAC/60HZ @ FULL LOAD CH1: Output Voltage</p>		
9	<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>15.8ms /600W load 26.0ms /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>		
10	<p>DYNAMIC LOAD</p>	<p>V1: 5400mVp-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>800mVp-p 754mVp-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: 540mVp-p < 500us</p>	<p>I/P: 230VAC O/P:40% LOAD CHANGE 50%DUTY/120HZ 1.25A/us</p>	<p>362mVp-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>

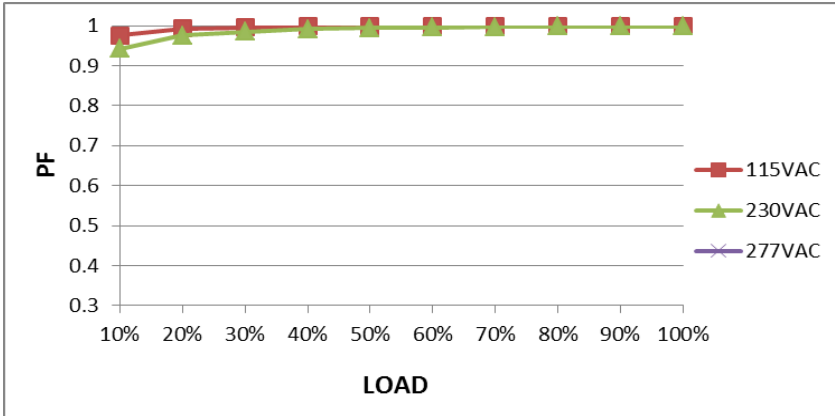
INPUT FUNCTION TEST

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) 96.8Vdc~370Vdc/FULL LOAD 96.8Vdc~370Vdc/70% LOAD (3) 96.8Vdc~370Vdc/FULL LOAD 96.8Vdc~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 =2.7932A/ 230VAC I =5.8324A/ 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	256.3 uA / 264 VAC@ For Earth 33.7uA / 264 VAC@For Touch
5	NO LOAD CONSUMPTION	<0.5W	I/P : 240VAC O/P : NO LOAD Ta : 25°C	0.38W



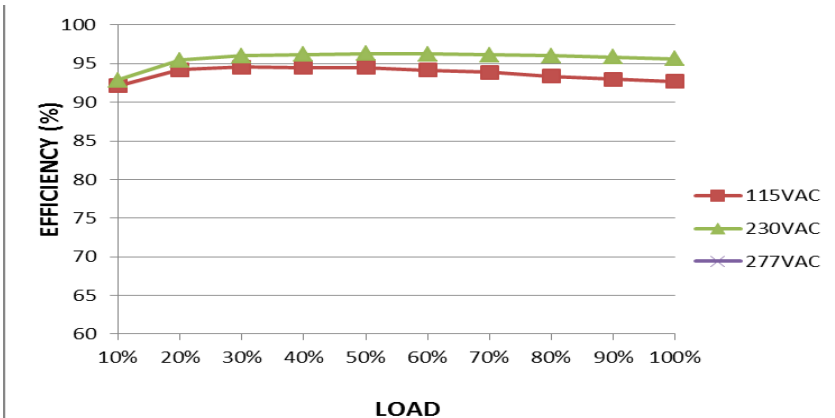
6	POWER FACTOR (Typ.)	0.94/ 230VAC 0.98/115VAC	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	PF=0.9977/230VAC PF=0.9986/115VAC
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P.F vs LOAD



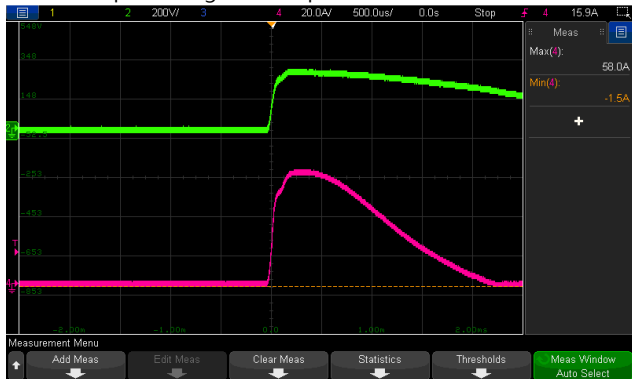
7	EFFICIENCY(Typ.)	95%	I/P:230 VAC O/P:FULL LOAD Ta:25°C	95.18%
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EFFICIENCY vs LOAD



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 =58.0A/ 230VAC I =29.8A/ 115VAC T50= 1214us/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	140.17%/ 264VAC 140.17%/ 230VAC 140.17%/ 115VAC PROTECTION TYPE : Hiccup after 3 sec, recovers automatically after fault condition is removed
2	OVER VOLTAGE PROTECTION	59.4V~67.5V 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	62.1V/ 264VAC 62.1V/ 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>-0.46% ~0.24%</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) 425V (3) 429V (3) 417V (4) 425V (4) 413V (5) 421V (5) 413V (6) 433V (6) 417V



			<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>	(7) 433V (8) 429V	(7) 417V (8) 417V
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>	VDS: (1) 437V (2) 425V (3) 429V (4) 437V (5) 437V (6) 429V (7) 457V (8) 453V	
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>	(1) 399V (2) 399V (3) 395V (4) 395V (5) 416V	
4	Diode Peak Voltage	Q101/Q103 Rated: 19A/ 200V	<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) 142V (2) 140V (3) 142V (4) 142V (5) 143V (6) 148V (7) 146V (8) 146V (9) 136V (10) 145V <u>Vo=Vnormal</u> (1) 140V</p>	<p>Q103: <u>Vo=Vmax</u> VDS: (1) 151V (2) 151V (3) 157V (4) 150V (5) 150V (6) 157V (7) 159V (8) 140V (9) 162V (10) 158V <u>Vo=Vnormal</u> (1) 143V</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 μ / 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) 389V (3) 393V (4) 393V
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) 18.8V (1) 11.29V (2) 18.8V (2) 11.29V (3) 18.8V (3) 11.29V (4) 18.8V (4) 11.37V (5) 12.6V (5) 9.69V

■ 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: 1.673mA I/P-FG: 2.36mA O/P-FG:0.805mA NO DAMAGE
2	ISOLATION RESISTANCE	I/P-O/P:500VDC>100M Ω I/P-FG: 500VDC>100M Ω O/P-FG:500VDC>100M Ω	I/P-O/P: 600 VDC I/P-FG: 600 VDC O/P-FG: 600 VDC Ta:25°C	I/P-O/P:50G Ω I/P-FG:50G Ω O/P-FG:50G Ω 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-600-54 1. ROOM AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta= 28.3 °C 2. HIGH AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta= 50.7 °C																																																						
		<table border="1"> <thead> <tr> <th>NO</th> <th>Position</th> <th>ROOM AMBIENT Ta= 28.3 °C</th> <th>HIGH AMBIENT Ta= 50.7 °C</th> </tr> </thead> <tbody> <tr><td>1</td><td>ZNR1</td><td>33.0°C</td><td>56.4°C</td></tr> <tr><td>2</td><td>LF1</td><td>33.0°C</td><td>55.6°C</td></tr> <tr><td>3</td><td>C2</td><td>32.0°C</td><td>55.2°C</td></tr> <tr><td>4</td><td>RTH1</td><td>35.1°C</td><td>58.4°C</td></tr> <tr><td>5</td><td>LF2</td><td>36.7°C</td><td>60.0°C</td></tr> <tr><td>6</td><td>BD1</td><td>49.3°C</td><td>72.6°C</td></tr> <tr><td>7</td><td>L1</td><td>51.3°C</td><td>74.0°C</td></tr> <tr><td>8</td><td>C8</td><td>42.0°C</td><td>65.2°C</td></tr> <tr><td>9</td><td>Q1</td><td>51.3°C</td><td>74.5°C</td></tr> <tr><td>10</td><td>D2</td><td>51.0°C</td><td>74.2°C</td></tr> <tr><td>11</td><td>RY1</td><td>39.0°C</td><td>61.1°C</td></tr> <tr><td>12</td><td>RTH3</td><td>47.4°C</td><td>71.1°C</td></tr> </tbody> </table>			NO	Position	ROOM AMBIENT Ta= 28.3 °C	HIGH AMBIENT Ta= 50.7 °C	1	ZNR1	33.0°C	56.4°C	2	LF1	33.0°C	55.6°C	3	C2	32.0°C	55.2°C	4	RTH1	35.1°C	58.4°C	5	LF2	36.7°C	60.0°C	6	BD1	49.3°C	72.6°C	7	L1	51.3°C	74.0°C	8	C8	42.0°C	65.2°C	9	Q1	51.3°C	74.5°C	10	D2	51.0°C	74.2°C	11	RY1	39.0°C	61.1°C	12	RTH3	47.4°C	71.1°C
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		NO	Position	ROOM AMBIENT Ta= 28.3 °C	HIGH AMBIENT Ta= 50.7°C
		13	Q3	50.4°C	74.1°C
		14	Q2	49.7°C	73.3°C
		15	C5	44.4°C	66.7°C
		16	T1coil	70.2°C	93.9°C
		17	T1core	41.7°C	65.1°C
		18	TSW1	38.1°C	62.3°C
		19	Q102	46.5°C	71.2°C
		20	Q103	47.7°C	72.7°C
		21	C103	34.8°C	58.8°C
		22	C104	38.7°C	62.4°C
		23	C102	37.4°C	61.2°C
		24	C120	39.6°C	63.1°C
		25	L100	37.0°C	60.7°C
		26	C125	39.9°C	63.7°C
		27	D103	40.5°C	64.6°C
		28	C37	43.2°C	66.6°C
		29	U1	43.0°C	65.9°C
		30	Q8	29.3°C	52.0°C
		31	U103	35.9°C	58.6°C
		32	RG100	41.9°C	65.4°C
		33	U4	35.9°C	59.3°C
		34	R122	39.9°C	62.9°C
		35	D105	37.3°C	59.9°C
		36	R3	41.9°C	65.0°C
		37	D1	35.9°C	58.3°C
		38	Q108	34.7°C	58.1°C
		39	U101	34.5°C	57.4°C
		40	R101	40.2°C	65.3°C
		41	R105	39.4°C	63.6°C
		42	D20	31.8°C	55.7°C
		43	Q7	31.6°C	54.5°C
		44	C60	29.5°C	52.2°C
2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR (MIN)		I/P : 230 VAC O/P : 129.4%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	±0.006%/°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) 1550753.7HRS (2) 250515.1HRS (3) 360491.8HRS (4) 452657.3HRS
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