



# Test Report: LOP-400-27

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400W 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: 25.6V~28.4V	I/P : 230 VAC I/P : 115 VAC O/P : MIN LOAD Ta : 25°C	24.693V~28.998V/230VAC 24.693V~28.999V/115VAC
2	OUTPUT VOLTAGE TOLERANCE	V1: -1% ~ +1%	I/P: 80VAC~ 264VAC O/P:FULL~ MIN. LOAD Ta:25°C	V1: -0.0296% ~0.0629%
3	LINE REGULATION	V1: -0.5% ~ +0.5%	I/P: 80VAC~ 264VAC O/P:FULL LOAD Ta:25°C	V1: 0% ~0.0185%
4	LOAD REGULATION	V1: -1% ~ +1%	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25°C	V1: -0.0296% ~0.0629%
5	OVER/UNDERSHOOT TEST	<±5%	I/P: 230VAC O/P:FULL LOAD / NO LOAD Ta:25°C	1.90%
6	RIPPLE & NOISE (Max)	V1: 200mVp-p	I/P:230VAC O/P: FULL LOAD Ta:25°C	V1: 56mVp-p / high frequency 71mVp-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/ 662.6ms 115VAC/ 597.8ms
		INPUT=230VAC/50HZ @ FULL LOAD CH2: Output Voltage CH3: AC Input Voltage	INPUT=115VAC/60HZ @ FULL LOAD CH2: Output Voltage CH3: AC Input Voltage	

	<p>8</p> <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/ 11.91ms 115VAC/ 10.73ms</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>16ms /400W load 30ms /250W load</p>	<p>I/P : 230 VAC O/P : TESTING Ta : 25°C</p>	<p>28.00ms /400W load 44.0ms /250W load</p>
<p>INPUT=230VAC/50HZ @ 400W load CH2: Output Voltage CH3: AC Input Voltage</p>		<p>INPUT=230VAC/50HZ @ 250W load CH2: Output Voltage CH3: AC Input Voltage</p>	
	<p>10</p> <p>DYNAMIC LOAD</p> <p>V1: 2700mVp-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>710mVp-p 520mVp-p</p>
<p>FULL /0% LOAD 50%DUTY / 120HZ</p>		<p>FULL /0% LOAD 50%DUTY / 1KHZ</p>	

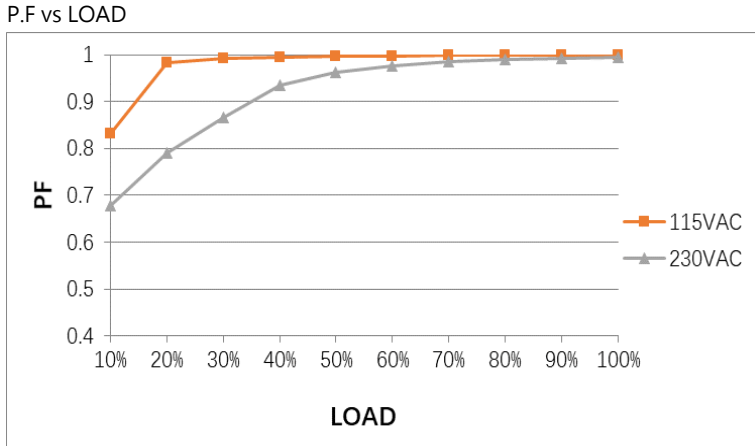
<p>11 TRANSIENT RECOVERY TIME</p>	<p>V1: 2700mVp-p &lt; 500us</p>	<p>I/P: 230VAC O/P:40% LOAD CHANGE 50%DUTY/120HZ 1.25A/us</p>	<p>326mVp-p 0us</p>
<p>12 PEAK LOAD</p>	<p>150% PEAK LOAD@3S</p>	<p>I/P: 264VAC I/P: 115VAC O/P: PEAK LOAD</p>	<p>TEST : OK</p>

### INPUT FUNCTION TEST

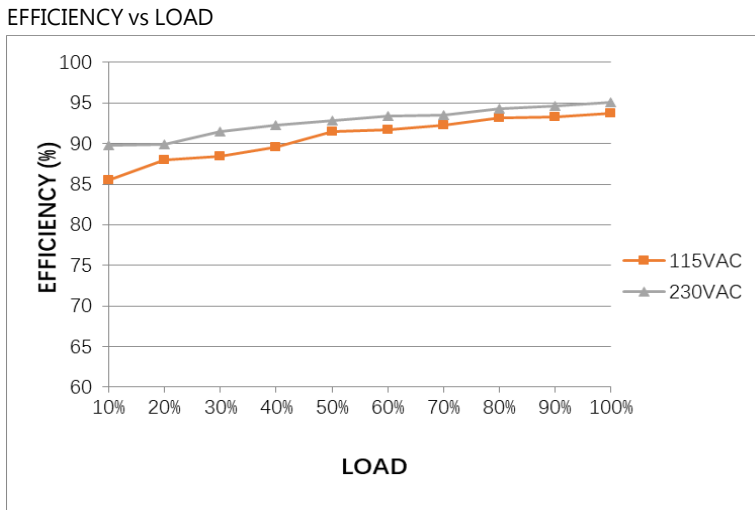
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	80VAC~264VAC 113VDC~ 370VDC 	(1) I/P: TESTING O/P: FULL / 70% LOAD (2) I/P: DC TESTING (L: + N: -) O/P: FULL / 70% LOAD (3) I/P: DC TESTING (L: - N: +) O/P: FULL / 70% LOAD Ta:25°C  I/P: HIGH-LINE+15%=300V O/P:FULL/MIN LOAD (PLEASE CHECK DERATING CURVE) ON: 30 Sec OFF: 30 Sec 10MIN ( POWER ON/OFF NO DAMAGE )	(1) 74.6V~264V/ FULL LOAD 74.6V~264V/ 70% LOAD (2) 106.4Vdc~370Vdc/FULL LOAD 106.4Vdc~370Vdc/70% LOAD (3) 106.4Vdc~370Vdc/FULL LOAD 106.4Vdc~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/ 2.1A 115V/ 4.2A	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	I =1.8291A/ 230VAC I =3.7833A/ 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	Earth: 329uA / 264VAC Touch:37uA / 264VAC
5	NO LOAD CONSUMPTION	<0.5W	I/P : 240VAC O/P : NO LOAD Ta : 25°C	0.308W



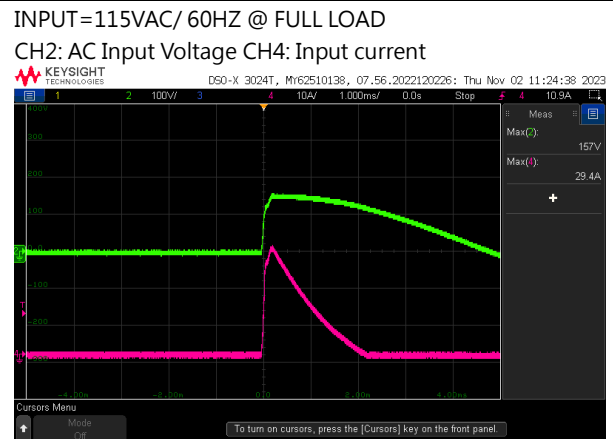
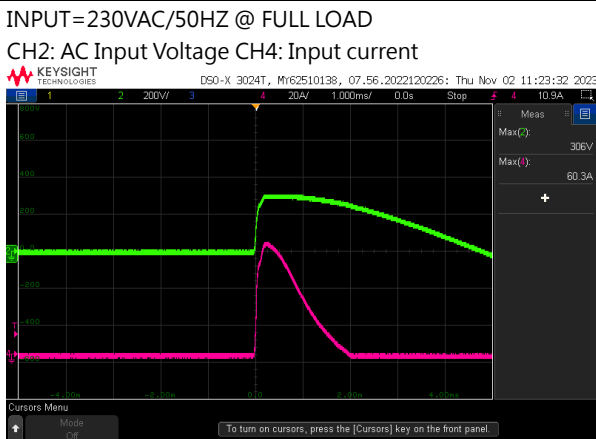
6	POWER FACTOR (Typ.)	0.95/ 230VAC 0.98/115VAC	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	PF=0.9993/230VAC PF=0.9979/115VAC
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7	EFFICIENCY(Typ.)	95%	I/P:230 VAC O/P:FULL LOAD Ta:25°C	95.60%
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8	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 =60.3A/ 230VAC I =29.4A/ 115VAC T50= 980us/230V
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### PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER LOAD PROTECTION	105 ~ 150% rated output power 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	133.34%/ 264VAC 133.39%/ 230VAC 133.24%/ 115VAC PROTECTION TYPE : Hiccup after 3 sec, recovers automatically after fault condition is removed
2	OVER VOLTAGE PROTECTION	29.7V~35.1V 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	32.1V/ 264VAC 32.2V/ 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 or re-power on to recover	I/P: 264VAC I/P: 80VAC O/P:FULL LOAD	O.T.P Active Protection type : Shut down o/p voltage, recovers automatically after temperature goes down or re-power on to recover
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 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>-0.7% ~ -0.313%</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: OK

### 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: 18A/ 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/ 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	Q2: VDS: (1) 489V (2) 481V (3) 465V (4) 465V (5) 469V (6) 461V (7) 502V (8) 477V Q3: VDS: (1) 469V (2) 477V (3) 469V (4) 469V (5) 469V (6) 461V (7) 502V (8) 473V
2	P.F.C Transistor ( D to S) or (C to E) Peak Voltage	Q1 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/ 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	VDS: (1) 481V (2) 473V (3) 506V (4) 485V (5) 494V (6) 485V (7) 518V (8) 510V
3	P.F.C DIODE	D2 Rated: 6A/ 650V	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	(1) 421V (2) 421V (3) 417V (4) 413V (5) 429V
4	Diode Peak Voltage	Q101/Q103 Rated:	AC ON/OFF I/P: High-Line +3V =267 V	Q101: Vo=Vmax Q103: Vo=Vmax

		120A/ 80V	<p>Vo=Vmax</p> <p>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 (10) Peak Load</p> <p>Vo=Vnormal</p> <p>O/P: (1) Full Load Ta:25°C</p>	<p>VDS:</p> <p>(1) 70.5V (2) 70.5V (3) 70.5V (4) 70.5V (5) 70.9V (6) 71.7V (7) 71.3V (8) 67.5V (9) 67.5V (10) 71.3V</p> <p>Vo=Vnormal</p> <p>(1) 69.9V</p>	<p>VDS:</p> <p>(1) 70.8V (2) 70.8V (3) 71.2V (4) 71.2V (5) 71.2V (6) 71.4V (7) 70.9V (8) 66.1V (9) 69.2V (10) 71.4V</p> <p>Vo=Vnormal</p> <p>(1) 70.5V</p>
5	Input Capacitor Voltage	C5 Rated: 270μ / 420V	<p>I/P: High-Line +3V =267V</p> <p>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</p>	(1) 411V (2) 407V (3) 409V (4) 401V	
6	Control IC Voltage Test	<p>PFC /PWM IC U1: Rated : 10.4V~28.7 V</p> <p>O/P IC U101 Rated : 4.75V~38V</p>	<p>AC ON/OFF</p> <p>I/P: High-Line +3V =267 V</p> <p>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</p>	<p>U1</p> <p>(1) 19.2V (2) 19.2V (3) 19.2V (4) 19.2V (5) 19.2V</p>	<p>U101</p> <p>(1) 11.80V (2) 11.60V (3) 11.70V (4) 11.80V (5) 11.70V</p>

## ■ SAFETY& E.M.C. TEST

### SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	<p>I/P-O/P: 4KVAC/min</p> <p>I/P-FG :2KVAC/min</p> <p>O/P-FG:1.5KVAC/min</p>	<p>I/P-O/P: 4.4 KVAC/min</p> <p>I/P-FG: 2.4 KVAC/min</p> <p>O/P-FG:1.8 KVAC/min</p> <p>Ta:25°C</p>	<p>I/P-O/P: 2.56mA</p> <p>I/P-FG: 3.14mA</p> <p>O/P-FG: 1.476mA</p> <p>NO DAMAGE</p>
2	ISOLATION RESISTANCE	<p>I/P-O/P:500VDC&gt;100MΩ</p> <p>I/P-FG: 500VDC&gt;100MΩ</p> <p>O/P-FG:500VDC&gt;100MΩ</p>	<p>I/P-O/P: 600 VDC</p> <p>I/P-FG: 600 VDC</p> <p>O/P-FG: 600 VDC</p> <p>Ta:25°C</p>	<p>I/P-O/P: 50GΩ</p> <p>I/P-FG: 50GΩ</p> <p>O/P-FG: 50GΩ</p> <p>NO DAMAGE</p>



### 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) BS EN/EN55011(CISPR11) 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) BS EN/EN55011(CISPR11) 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	BS EN/EN61000-4-5 ■ 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-400-27 1. ROOM AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta= 23.6 °C 2. HIGH AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta= 50.3 °C		



		NO	Position	ROOM AMBIENT Ta= 23.6°C	HIGH AMBIENT Ta= 50.3 °C
		1	ZNR1	25.6°C	52.0°C
		2	C2	25.5°C	51.9°C
		3	LF1	25.9°C	52.6°C
		4	RTH1	28.2°C	55.2°C
		5	LF2	29.0°C	55.9°C
		6	BD1	43.5°C	70.7°C
		7	C8	32.5°C	59.2°C
		8	L1	44.7°C	71.6°C
		9	RY1	33.1°C	60.4°C
		10	Q1	47.0°C	74.7°C
		11	D2	47.2°C	74.7°C
		12	RTH3	43.3°C	70.4°C
		13	Q3	43.7°C	71.2°C
		14	Q2	44.5°C	72.4°C
		15	RTH2	33.7°C	60.0°C
		16	U1	38.1°C	64.1°C
		17	C5	39.3°C	65.7°C
		18	D103	37.0°C	63.6°C
		19	C125	35.6°C	62.3°C
		20	TSW1	38.8°C	65.9°C
		21	T1 coil	56.8°C	83.2°C
		22	T1 core	44.2°C	70.9°C
		23	C60	24.9°C	51.2°C
		24	Q103	42.1°C	68.8°C
		25	Q101	42.7°C	69.5°C
		26	C103	35.1°C	61.5°C
		27	C102	35.2°C	61.7°C
		28	L100	32.7°C	58.7°C
		29	D1	31.3°C	57.9°C
		30	R3	33.5°C	60.3°C
		31	Q7	28.2°C	54.2°C
		32	U101	32.3°C	58.5°C
		33	R105	43.4°C	69.2°C
		34	R101	52.5°C	77.5°C
		35	Q108	32.8°C	58.9°C
		36	RG100	41.1°C	66.9°C
		37	R122	36.2°C	62.3°C
		38	D105	32.2°C	58.1°C
		39	U4	29.6°C	55.7°C
		40	C38	34.9°C	62.5°C
2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR ( MIN )		I/P : 230 VAC O/P : 133.39 % LOAD Ta : 25°C	TEST : OK
3	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR		I/P : 264VAC/100VAC 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	± 0.01 %/°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 C103 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) 1506586.2 HRS (2) 271925.5 HRS (3) 362155.3 HRS (4) 451326.6 HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 1696.4K hrs min. Telcordia SR-332 (Bellcore) ; 231.2K 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