



# Test Report: LOP-400-24

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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: 22.8V~25.2V	I/P : 230 VAC I/P : 115 VAC O/P : MIN LOAD Ta : 25°C	22.081V~26.047V/230VAC 22.081V~26.047V/115VAC
2	OUTPUT VOLTAGE TOLERANCE	V1: -2% ~ +2%	I/P: 80VAC~ 264VAC O/P:FULL~ MIN. LOAD Ta:25°C	V1: -0.025% ~0.067%
3	LINE REGULATION	V1: -0.5% ~ +0.5%	I/P: 80VAC~ 264VAC O/P:FULL LOAD Ta:25°C	V1: 0% ~0.017%
4	LOAD REGULATION	V1: -1% ~ +1%	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25°C	V1: -0.025% ~0.067%
5	OVER/UNDERSHOOT TEST	<±5%	I/P: 230VAC O/P:FULL LOAD / NO LOAD Ta:25°C	2.1%
6	RIPPLE & NOISE (Max)	V1: 200mVp-p	I/P:230VAC O/P: FULL LOAD Ta:25°C	V1: 72mVp-p / high frequency 85mVp-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/ 646.2ms 115VAC/596.2ms
		INPUT=230VAC/50HZ @ FULL LOAD CH1: Output Voltage CH2: AC Input Voltage	INPUT=115VAC/60HZ @ FULL LOAD CH1: Output Voltage CH2: AC Input Voltage	

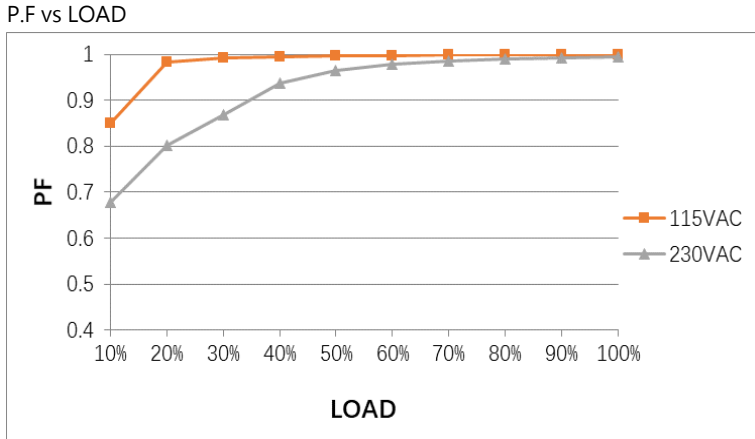
<p>8</p> <p>RISE TIME (Max)</p>	<p>230VAC/30ms 115VAC/30ms</p>	<p>I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C</p>	<p>230VAC/ 10.41ms 115VAC/ 10.94ms</p>
<p>INPUT=230VAC/50HZ @ FULL LOAD CH1: Output Voltage</p>		<p>INPUT=115VAC/60HZ @ FULL LOAD CH1: Output Voltage</p>	
<p>9</p> <p>HOLD UP TIME (Typ.)</p>	<p>16ms /400W load 30ms /250W load</p>	<p>I/P : 230 VAC O/P : TESTING Ta : 25°C</p>	<p>29.0ms /400W load 41.2ms /250W load</p>
<p>INPUT=230VAC/50HZ @ 400W load CH1: Output Voltage CH2: AC Input Voltage</p>		<p>INPUT=230VAC/50HZ @ 250W load CH1: Output Voltage CH2: AC Input Voltage</p>	
<p>10</p> <p>DYNAMIC LOAD</p>	<p>V1: 2400mVp-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>720mVp-p 760mVp-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: 240mVp-p &lt; 500us</p>	<p>I/P: 230VAC O/P:40% LOAD CHANGE 50%DUTY/120HZ 1.25A/us</p>	<p>322mVp-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>

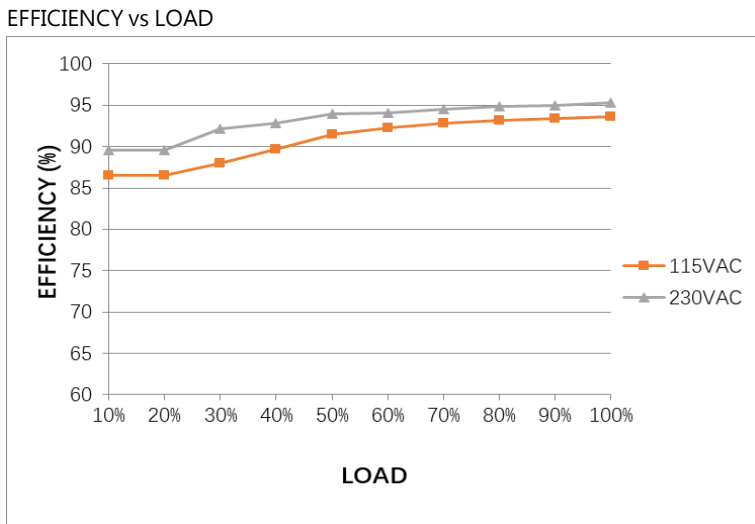
### INPUT FUNCTION TEST

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) 73.9V~264V/ FULL LOAD 73.8V~264V/ 70% LOAD (2) 107.2Vdc~370Vdc/FULL LOAD 107.2Vdc~370Vdc/70% LOAD (3) 107.2Vdc~370Vdc/FULL LOAD 107.2Vdc~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 =1.8292A/ 230VAC I =3.7815A/ 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: 298uA / 264VAC Touch:37uA / 264VAC
5	NO LOAD CONSUMPTION	<0.5W	I/P : 240VAC O/P : NO LOAD Ta : 25°C	0.296W

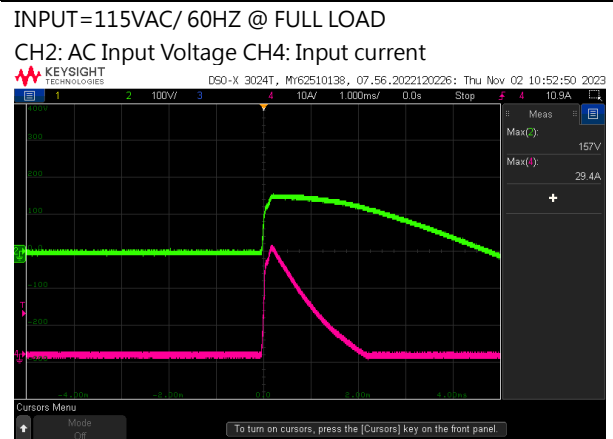
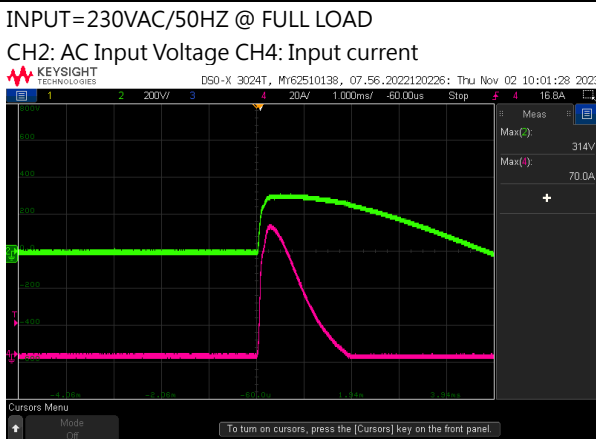
6	POWER FACTOR (Typ.)	0.95/ 230VAC 0.98/115VAC	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	PF=0.9994/230VAC PF=0.9982/115VAC
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7	EFFICIENCY(Typ.)	94.5%	I/P:230 VAC O/P:FULL LOAD Ta:25°C	95.46%
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8	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 =70.0A/ 230VAC I =29.4A/ 115VAC T50= 880us/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	122.40%/ 264VAC 122.32%/ 230VAC 122.20%/ 115VAC PROTECTION TYPE : Hiccup after 3 sec, recovers automatically after fault condition is removed
2	OVER VOLTAGE PROTECTION	26.4V~31.2V 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	28.50V/ 264VAC 28.50V/ 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>-0.484% ~ 0.284%</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:                      Q3: VDS:                      VDS: (1) 465V                      (1) 469V (2) 481V                      (2) 485V (3) 469V                      (3) 469V (4) 469V                      (4) 469V (5) 465V                      (5) 473V (6) 465V                      (6) 465V (7) 489V                      (7) 501V (8) 465V                      (8) 477V
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) 513V (2) 461V (3) 477V (4) 489V (5) 485V (6) 517V (7) 513V (8) 501V
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) 432V (2) 420V (3) 420V (4) 416V (5) 420V
4	Diode Peak Voltage	Q101/Q103 Rated:	AC ON/OFF I/P: High-Line +3V =267 V	Q101:                      Q103: Vo=Vmax                      Vo=Vmax

		120A/ 80V	<p>Vo=Vmax 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=Vmax O/P: (1) Full Load Ta:25°C</p>	<p>VDS: (1) 70.9V (2) 70.9V (3) 70.9V (4) 70.9V (5) 70.4V (6) 70.8V (7) 70.3V (8) 65.6V (9) 65.6V (10) 70.8V</p> <p>Vo=Vmax (1) 69.9V</p>	<p>VDS: (1) 71.3V (2) 71.3V (3) 71.3V (4) 71.9V (5) 71.9V (6) 71.3V (7) 71.2V (8) 61.7V (9) 65.6V (10) 71.7V</p> <p>Vo=Vmax (1) 71.4V</p>
	Input Capacitor Voltage	C5 Rated: 270μ / 420V	<p>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</p>	(1) 405V (2) 404V (3) 408V (4) 408V	
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 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</p>	<p>U1 (1) 19.2V (2) 19.2V (3) 19.2V (4) 19.2V (5) 19.1V</p>	<p>U101 (1) 11.60V (2) 11.20V (3) 11.30V (4) 11.80V (5) 10.6V</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 I/P-FG :2KVAC/min O/P-FG:1.5KVAC/min</p>	<p>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</p>	<p>I/P-O/P: 2.73mA I/P-FG: 3.22mA O/P-FG: 1.514mA NO DAMAGE</p>
2	ISOLATION RESISTANCE	<p>I/P-O/P:500VDC&gt;100MΩ I/P-FG: 500VDC&gt;100MΩ O/P-FG:500VDC&gt;100MΩ</p>	<p>I/P-O/P: 600 VDC I/P-FG: 600 VDC O/P-FG: 600 VDC Ta:25°C</p>	<p>I/P-O/P: 50GΩ I/P-FG: 50GΩ O/P-FG: 50GΩ 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-400-24 1. ROOM AMBIENT BURN-IN : 2HRS I/P : 230VAC O/P : FULL LOAD Ta=26.6 °C 2. HIGH AMBIENT BURN-IN : 2HRS I/P : 230VAC O/P : FULL LOAD Ta= 51.7 °C		



		NO	Position	ROOM AMBIENT Ta= 26.6°C	HIGH AMBIENT Ta=51.7°C
		1	ZNR1	29.0°C	54.5°C
		2	LF2	37.1°C	62.7°C
		3	BD1	42.6°C	67.6°C
		4	LF1	30.6°C	56.3°C
		5	C2	31.8°C	57.5°C
		6	RTH1	32.8°C	59.1°C
		7	RY1	37.3°C	64.1°C
		8	RTH3	40.7°C	67.8°C
		9	C8	35.3°C	60.9°C
		10	L1	41.6°C	67.3°C
		11	C60	28.1°C	53.8°C
		12	T1 coil	36.6°C	62.9°C
		13	T1 core	36.0°C	62.0°C
		14	C5	35.1°C	60.5°C
		15	Q1	52.1°C	78.9°C
		16	Q3	50.1°C	77.0°C
		17	Q2	51.5°C	78.5°C
		18	U1	40.5°C	65.9°C
		19	D2	50.3°C	77.1°C
		20	C55	41.3°C	68.5°C
		21	D103	40.7°C	68.1°C
		22	C120	39.1°C	65.4°C
		23	C104	37.3°C	63.6°C
		24	Q101	45.7°C	74.0°C
		25	Q103	45.7°C	73.8°C
		26	C103	33.4°C	59.6°C
		27	C102	33.7°C	59.8°C
		28	L100	35.1°C	61.2°C
		29	R122	40.0°C	65.4°C
		30	D1	34.0°C	59.6°C
		31	U103	33.7°C	59.6°C
		32	U101	33.2°C	59.4°C
		33	RG100	40.5°C	66.0°C
		34	U3	34.6°C	60.3°C
		35	D105	37.9°C	63.1°C
		36	D20	28.7°C	54.6°C
		37	R100	37.8°C	64.8°C
		38	R3	39.7°C	65.7°C
2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR ( MIN )		I/P : 230 VAC O/P : 131.85% 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	± 0.009 %/°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 C104 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) 982687.1 HRS (2) 159851.5 HRS (3) 284107.5 HRS (4) 402726.2 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