Test Report: LOP-600-36

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

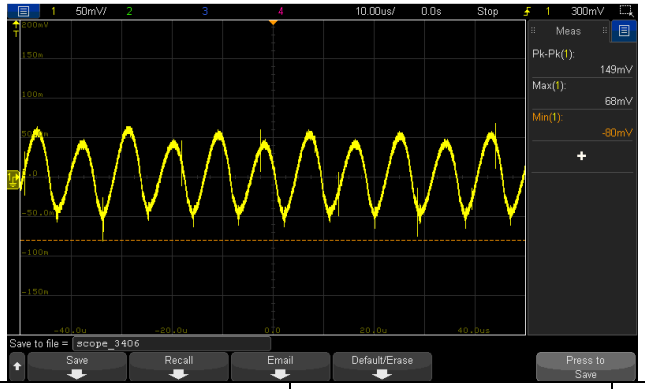
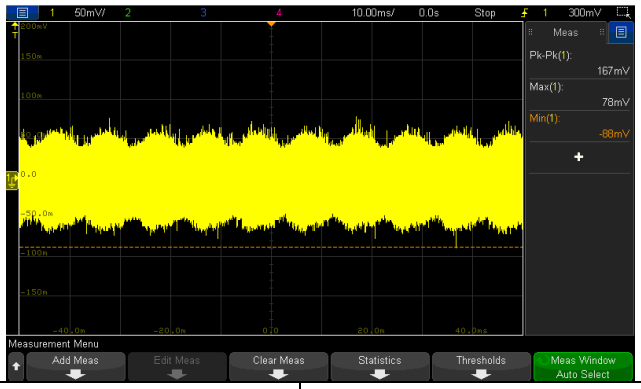
Safety Test
E.M.C. Test

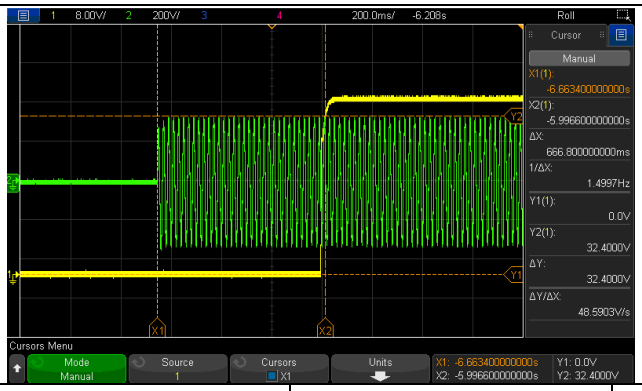
■ RELIABILITY TEST

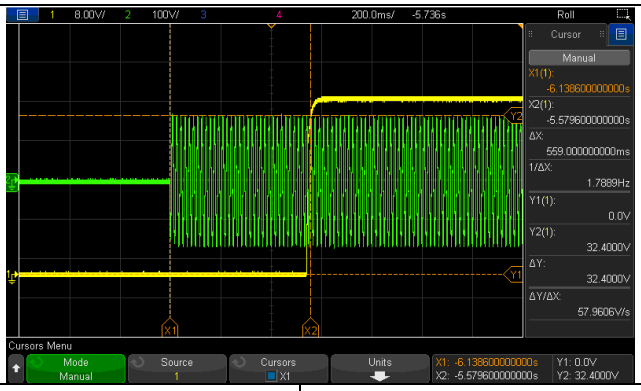
ENVIRONMENT TEST

■ DESIGN VERIFY TEST

OUTPUT FUNCTION TEST

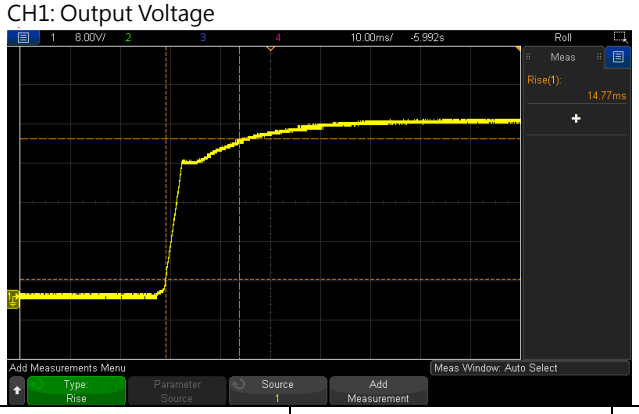
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE ADJUST RANGE	CH1: 34.2V~37.8V	I/P： 230 VAC I/P： 115 VAC O/P：MIN LOAD Ta：25℃	33.043V~38.902V/230VAC 33.043V~38.902V/115VAC 33.043~38.902
2	OUTPUT VOLTAGE TOLERANCE	V1: -1% ~ +1%	I/P: 80VAC~ 264VAC O/P:FULL~ MIN. LOAD Ta:25℃	V1: -0.776% ~0.0556%
3	LINE REGULATION	V1: -0.5% ~ +0.5%	I/P: 80VAC~ 264VAC O/P:FULL LOAD Ta:25℃	V1: -0.0056% ~0.0084%
4	LOAD REGULATION	V1: -1% ~ +1%	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25℃	V1: -0.776% ~0.0556%
5	OVER/UNDERSHOOT TEST	<±5%	I/P: 230VAC O/P:FULL LOAD / NO LOAD Ta:25℃	2.2%
6	RIPPLE & NOISE (Max)	V1: 250mVp-p	I/P:230VAC O/P: FULL LOAD Ta:25℃	V1: 149mVp-p / high frequency 167mVp-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℃	230VAC/ 666.8ms 115VAC/ 559.0ms
	INPUT=230VAC/50HZ @ FULL LOAD CH1: Output Voltage CH2: AC Input Voltage		INPUT=115VAC/60HZ @ FULL LOAD CH1: Output Voltage CH2: AC Input Voltage	



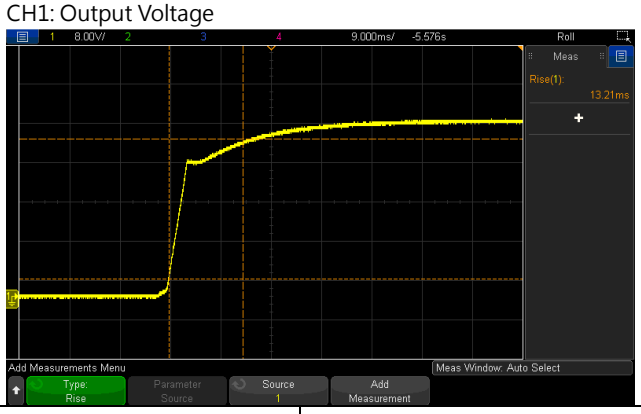


8	RISE TIME (Max)	230VAC/50ms 115VAC/50ms	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	230VAC/ 14.77ms 115VAC/ 13.21ms

INPUT=230VAC/50HZ @ FULL LOAD
CH1: Output Voltage

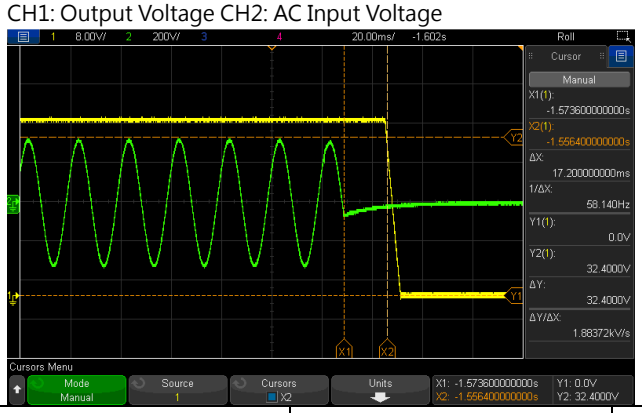


INPUT=115VAC/60HZ @ FULL LOAD
CH1: Output Voltage

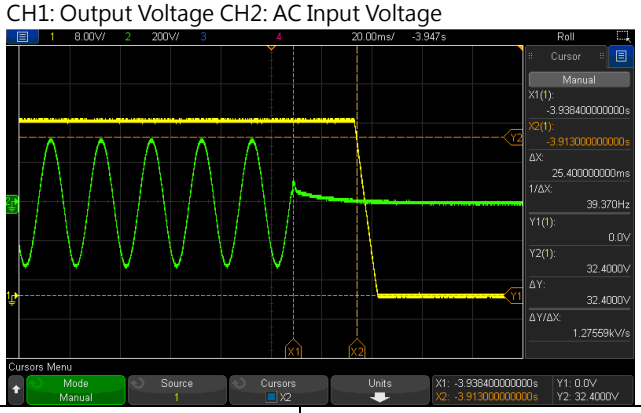


9	HOLD UP TIME (Typ.)	8ms /600W load 12ms /400W load	I/P： 230 VAC O/P：TESTING Ta：25℃	17.20ms /600W load 25.40ms /400W load

INPUT=230VAC/50HZ @ 600W load
CH1: Output Voltage CH2: AC Input Voltage



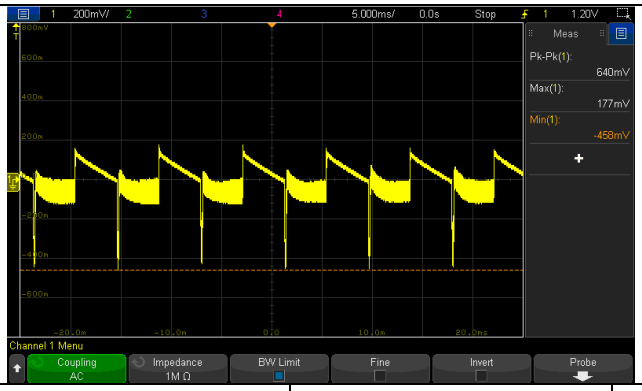
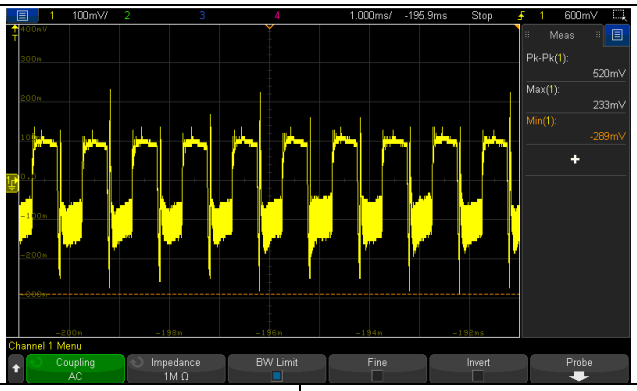
INPUT=230VAC/50HZ @ 400W load
CH1: Output Voltage CH2: AC Input Voltage



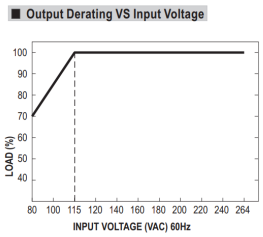
10	DYNAMIC LOAD	V1: 3600mVp-p	I/P: 230VAC O/P: (1) FULL/0% LOAD 50%DUTY / 120HZ (2) FULL/0% LOAD 50%DUTY / 1KHZ Ta:25℃	640mVp-p 520mVp-p

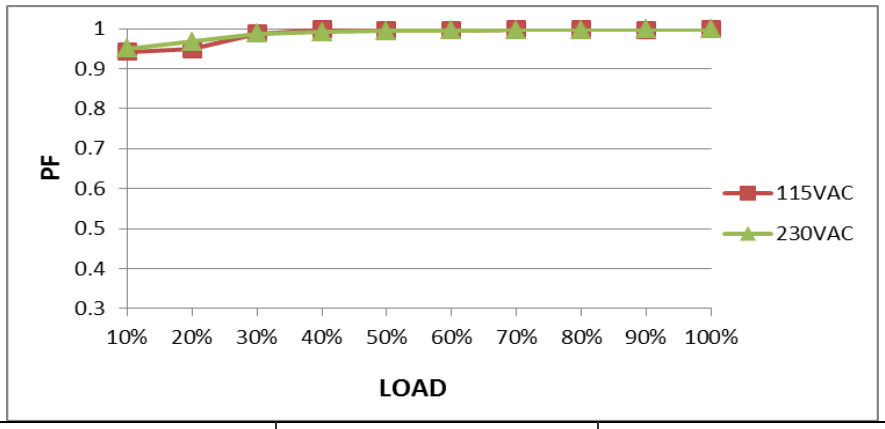
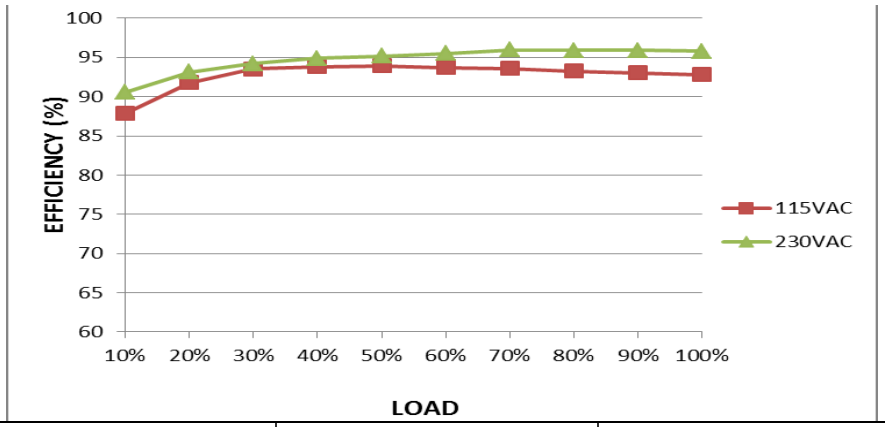
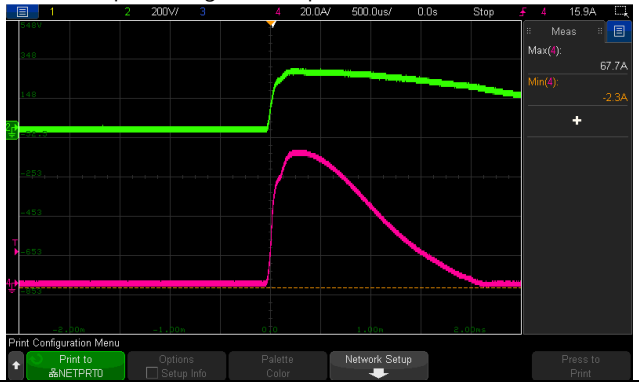
FULL /0% LOAD 50%DUTY / 120HZ

FULL /0% LOAD 50%DUTY / 1KHZ

				
11	TRANSIENT RECOVERY TIME	V1: 3600mVp-p < 500us	I/P: 230VAC O/P:40% LOAD CHANGE 50%DUTY/120HZ 1.25A/us	259mVp-p 0us
12	PEAK LOAD	150% PEAK LOAD@3S	I/P: 264VAC I/P: 115VAC O/P: PEAK LOAD	TEST：OK

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℃	(1) 67.8V~264V/ FULL LOAD 67.8V~264V/ 70% LOAD (2) 96.7Vdc~370Vdc/FULL LOAD 96.7Vdc~370Vdc/70% LOAD (3) 96.7Vdc~370Vdc/FULL LOAD 96.7Vdc~370Vdc/70% LOAD
			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)	TEST：OK
2	INPUT FREQUENCY RANGE	47HZ ~63 HZ NO DAMAGE	I/P:80 VAC ~264 VAC O/P:FULL~MIN LOAD Ta:25℃	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℃	I =2.7386A/ 230VAC I =5.7178A/ 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℃	266.2 uA / 264 VAC@ For Earth 33.8uA / 264 VAC@For Touch
5	NO LOAD CONSUMPTION	<0.5W	I/P：240VAC O/P：NO LOAD Ta：25℃	0.3851W

6	POWER FACTOR (Typ.)	0.95/ 230VAC 0.98/115VAC	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	PF=0.9981/230VAC PF=0.9982/115VAC
	P.F vs LOAD 			
7	EFFICIENCY(Typ.)	95%	I/P:230 VAC O/P:FULL LOAD Ta:25℃	95.57%
	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℃	I =67.7A/ 230VAC I =28.6A/ 115VAC T50=1069us/230V
	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℃	136.82%/ 264VAC 137.01%/ 230VAC 138.92%/ 115VAC PROTECTION TYPE : Hiccup after 3 sec, recovers automatically after fault condition is removed
2	OVER VOLTAGE PROTECTION	39.6V~46.8V Protection type: Shut down o/p voltage, re-power on to recover	I/P: 264VAC I/P: 80VAC O/P:MIN LOAD Ta:25℃	42.1V/ 264VAC 42.3V/ 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℃	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℃	TEST : -0.116% ~ 0.0746%
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℃	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: 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	Q2: VDS: (1) 458V (2) 470V (3) 458V (4) 466V (5) 462V	Q3: VDS: (1) 450V (2) 454V (3) 454V (4) 450V (5) 446V

			(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℃	(6) 466V (7) 466V (8) 462V	(6) 450V (7) 450V (8) 446V
2	P.F.C Transistor (D to S) or (C to E) Peak Voltage	Q1 Rated: 52A/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℃	VDS: (1) 446V (2) 446V (3) 450V (4) 442V (5) 446V (6) 450V (7) 438V (8) 470V	
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℃	(1) 402V (2) 406V (3) 402V (4) 398V (5) 406V	
4	Diode Peak Voltage	Q101/Q103 Rated: 90A/ 100V	AC ON/OFF I/P: High-Line +3V =267 V 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.	Q101: VO=Vmax VDS: (1) 87.5V (2) 87.5V (3) 87.5V (4) 87.5V (5) 87.5V (6) 88.3V (7) 86.7V (8) 86.7V (9) 87.1V (10) 89.1V VO=Vnormal	Q103: VO=Vmax VDS: (1) 88.5V (2) 88.5V (3) 88.5V (4) 88.5V (5) 87.7V (6) 89.3V (7) 84.5V (8) 84.5V (9) 85.3V (10) 89.3V VO=Vnormal

			(8).NO LOAD (9) burst Mode (10) Peak Load VO=Vnormal O/P: (1) Full Load Ta:25℃	(1) 84.3V (1) 84.5V
5	Input Capacitor Voltage	C5 Rated: 330μ / 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℃	(1) 398V (2) 396V (3) 398V (4) 398V
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℃	U1 U101 (1) 19.1V (1) 11.7V (2) 19.1V (2) 11.6V (3) 19.1V (3) 11.7V (4) 19.1V (4) 11.7V (5) 18.9V (5) 11.7V

■ 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℃	I/P-O/P: 1.763mA I/P-FG: 2.37mA O/P-FG:0.808mA NO DAMAGE
2	ISOLATION RESISTANCE	I/P-O/P:500VDC>100MΩ I/P-FG: 500VDC>100MΩ O/P-FG:500VDC>100MΩ	I/P-O/P: 600 VDC I/P-FG: 600 VDC O/P-FG: 600 VDC Ta:25℃	I/P-O/P:50GΩ I/P-FG:50GΩ O/P-FG:50GΩ 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℃	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℃	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℃	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℃	■ 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℃	■ 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℃	■ 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 ℃ 2. HIGH AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta= 50.7 ℃		

NO	Position	ROOM AMBIENT Ta= 28.3 ℃	HIGH AMBIENT Ta= 50.7 ℃
1	ZNR1	33.0℃	56.4℃
2	LF1	33.0℃	55.6℃
3	C2	32.0℃	55.2℃
4	RTH1	35.1℃	58.4℃
5	LF2	36.7℃	60.0℃
6	BD1	49.3℃	72.6℃
7	L1	51.3℃	74.0℃
8	C8	42.0℃	65.2℃
9	Q1	51.3℃	74.5℃
10	D2	51.0℃	74.2℃
11	RY1	39.0℃	61.1℃
12	RTH3	47.4℃	71.1℃

NO	Position	ROOM AMBIENT Ta= 28.3 ℃	HIGH AMBIENT Ta= 50.7℃
13	Q3	50.4℃	74.1℃
14	Q2	49.7℃	73.3℃
15	C5	44.4℃	66.7℃
16	T1coil	70.2℃	93.9℃
17	T1core	41.7℃	65.1℃
18	TSW1	38.1℃	62.3℃
19	Q102	46.5℃	71.2℃
20	Q103	47.7℃	72.7℃
21	C103	34.8℃	58.8℃
22	C104	38.7℃	62.4℃
23	C102	37.4℃	61.2℃
24	C120	39.6℃	63.1℃
25	L100	37.0℃	60.7℃
26	C125	39.9℃	63.7℃
27	D103	40.5℃	64.6℃
28	C37	43.2℃	66.6℃
29	U1	43.0℃	65.9℃
30	Q8	29.3℃	52.0℃
31	U103	35.9℃	58.6℃
32	RG100	41.9℃	65.4℃
33	U4	35.9℃	59.3℃
34	R122	39.9℃	62.9℃
35	D105	37.3℃	59.9℃
36	R3	41.9℃	65.0℃
37	D1	35.9℃	58.3℃
38	Q108	34.7℃	58.1℃
39	U101	34.5℃	57.4℃
40	R101	40.2℃	65.3℃
41	R105	39.4℃	63.6℃
42	D20	31.8℃	55.7℃
43	Q7	31.6℃	54.5℃
44	C60	29.5℃	52.2℃

2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR (MIN)	I/P： 230 VAC O/P：129.4%LOAD Ta：25℃	TEST：OK
3	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P： 264VAC/115VAC O/P： 100%LOAD Ta= -45℃	TEST：OK
4	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 50 ℃/95 %R.H NO DAMAGE	I/P： 272 VAC O/P：FULL LOAD Ta= 50 ℃ HUMIDITY= 95 %R.H	TEST：OK
5	TEMPERATURE COEFFICIENT	± 0.03%/℃(0~50℃)	I/P： 230 VAC O/P：FULL LOAD	±0.006%/℃(0~50℃)

6	STORAGE TEMPERATURE TEST	-40~85℃	1. Thermal shock Temperature： -45℃~ +90℃ 2. Temperature change rate ：25℃ / 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℃	1. Thermal shock Temperature： -45℃~ +55℃ 2. Temperature change rate ：25℃ / 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℃
9	CAPACITOR LIFE CYCLE	SUPPOSE C102 IS THE MOST CRITICAL COMPONENT (1) I/P： 230VAC O/P：FULL LOAD Ta= 25 ℃ LIFE TIME (2) I/P： 230VAC O/P：FULL LOAD Ta= 50 ℃ LIFE TIME (3) I/P： 230VAC O/P：75% LOAD Ta= 50 ℃ LIFE TIME (4) I/P： 230VAC O/P：50% LOAD Ta= 50 ℃ 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℃)	
11	Ongoing Reliability Test	I/P：230VAC O/P：FULL LOAD TA=50℃ Demonstration Mean Time Between Failure : 30,000 hours	

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	Yuwei	Liutt	Wangdz

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