Test Report: LOP-400-15

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

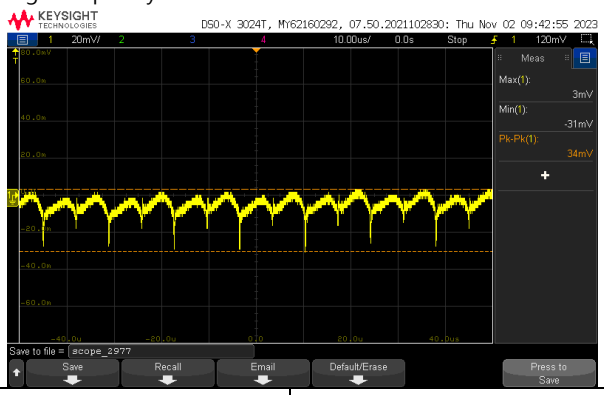
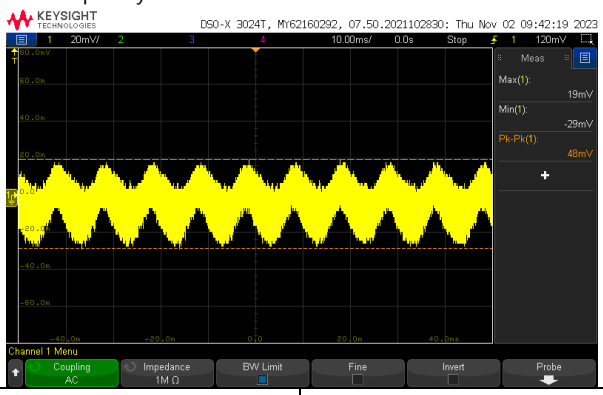
Safety Test
E.M.C. Test

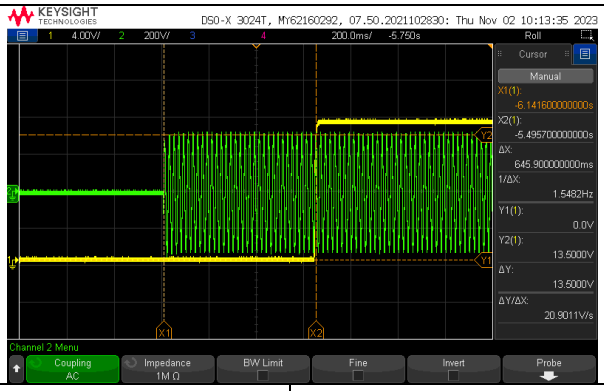
■ RELIABILITY TEST

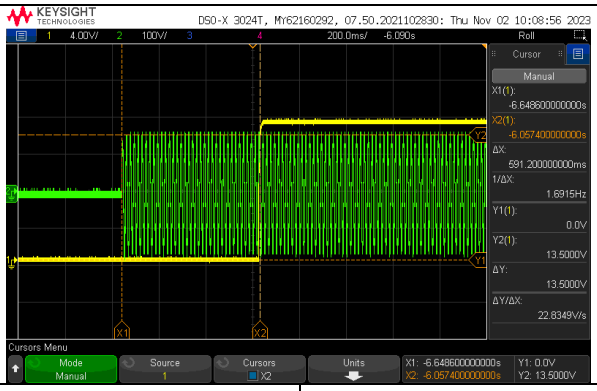
ENVIRONMENT TEST

■ DESIGN VERIFY TEST

OUTPUT FUNCTION TEST

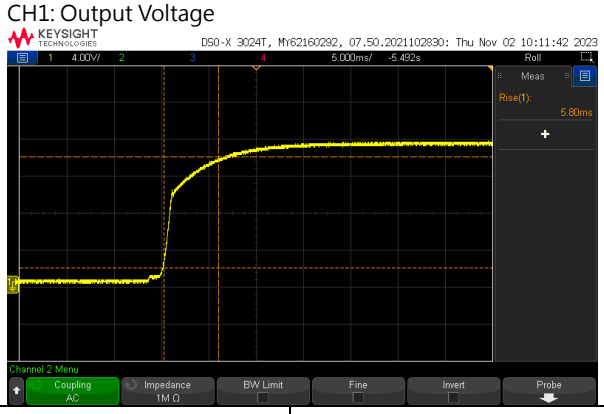
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE ADJUST RANGE	CH1: 14.3V~15.8V	I/P： 230 VAC I/P： 115 VAC O/P：MIN LOAD Ta：25℃	13.764V~16.165V/230VAC 13.764V~16.165V/115VAC
2	OUTPUT VOLTAGE TOLERANCE	V1: -3% ~ +3%	I/P: 80VAC~ 264VAC O/P:FULL~ MIN. LOAD Ta:25℃	V1: -0.04% ~ 0.1266%
3	LINE REGULATION	V1: -0.5% ~ +0.5%	I/P: 80VAC~ 264VAC O/P:FULL LOAD Ta:25℃	V1: -0.0067% ~ 0.02%
4	LOAD REGULATION	V1: -1% ~ +1%	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25℃	V1: -0.04% ~ 0.1266%
5	OVER/UNDERSHOOT TEST	<±5%	I/P: 230VAC O/P:FULL LOAD/NO LOAD Ta:25℃	3.4%
6	RIPPLE & NOISE (Max)	V1: 150mVp-p	I/P:230VAC O/P: FULL LOAD Ta:25℃	V1: 34mVp-p / high frequency 48mVp-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/ 645.9ms 115VAC/ 591.2ms
	INPUT=230VAC/50HZ @ FULL LOAD CH1: Output Voltage CH2: AC Input Voltage		INPUT=115VAC/60HZ @ FULL LOAD CH1: Output Voltage CH2: AC Input Voltage	



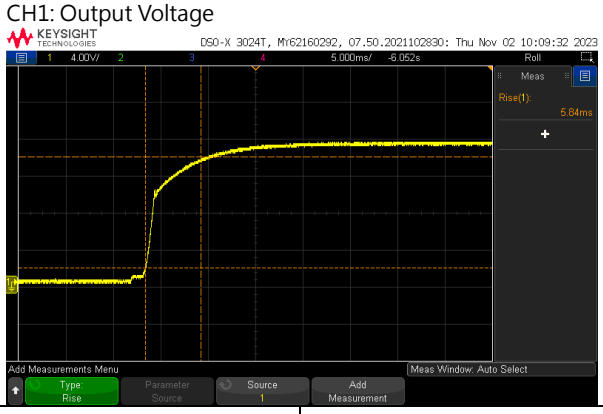


8	RISE TIME (Max)	230VAC/30ms 115VAC/30ms	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	230VAC/ 5.80ms 115VAC/ 5.84ms

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

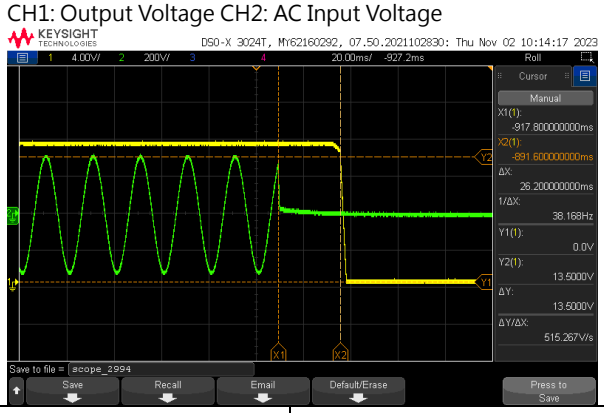


INPUT=115VAC/60HZ @ FULL LOAD
CH1: Output Voltage

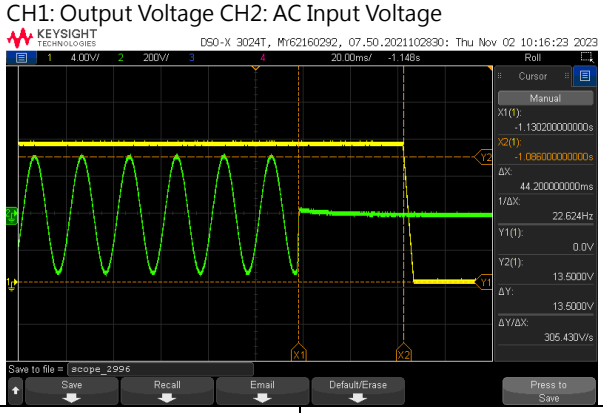


9	HOLD UP TIME (Typ.)	16ms /400W load 30ms /250W load	I/P： 230 VAC O/P：TESTING Ta：25℃	26.2ms /400W load 44.2ms /250W load

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



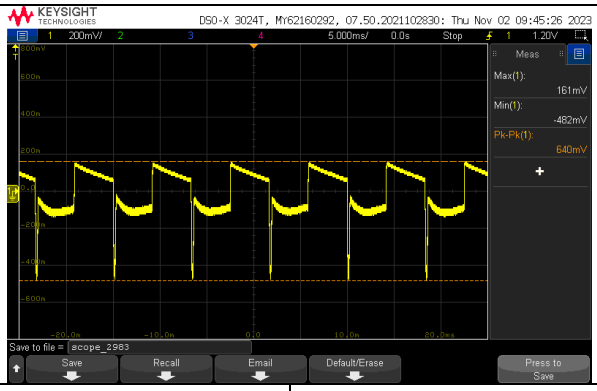
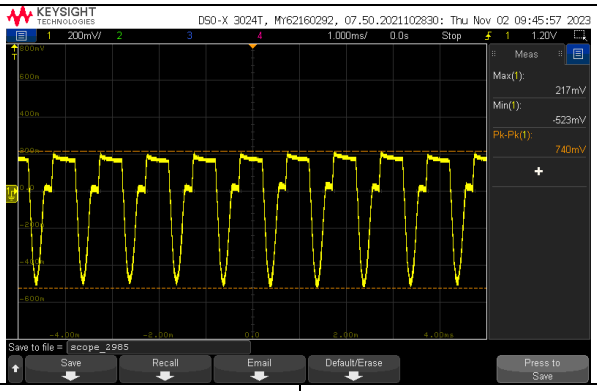
INPUT=230VAC/50HZ @ 250W load
CH1: Output Voltage CH2: AC Input Voltage



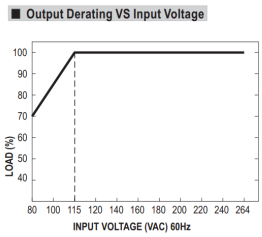
10	DYNAMIC LOAD	V1: 1500mVp-p	I/P: 230VAC O/P: (1) FULL/0% LOAD 50%DUTY / 120HZ (2) FULL/0% LOAD 50%DUTY / 1KHZ Ta:25℃	640mVp-p 740mVp-p

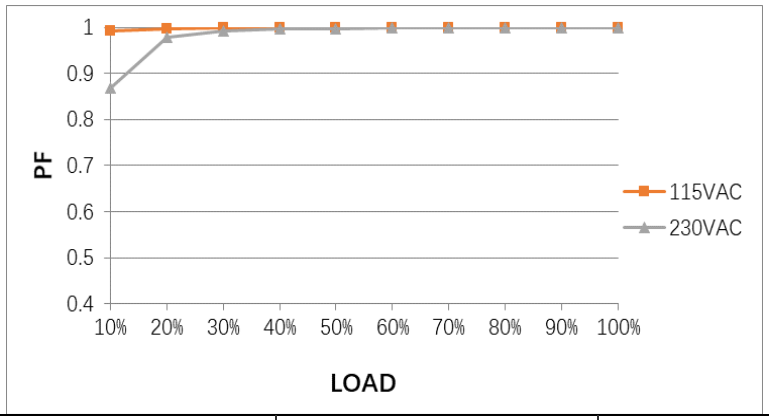
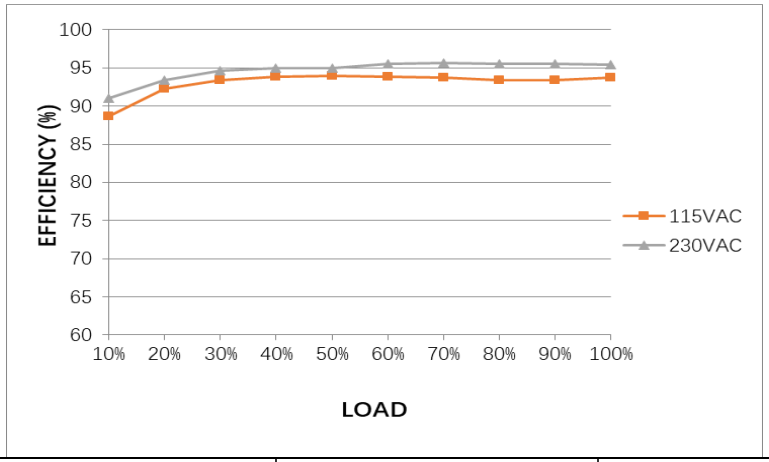
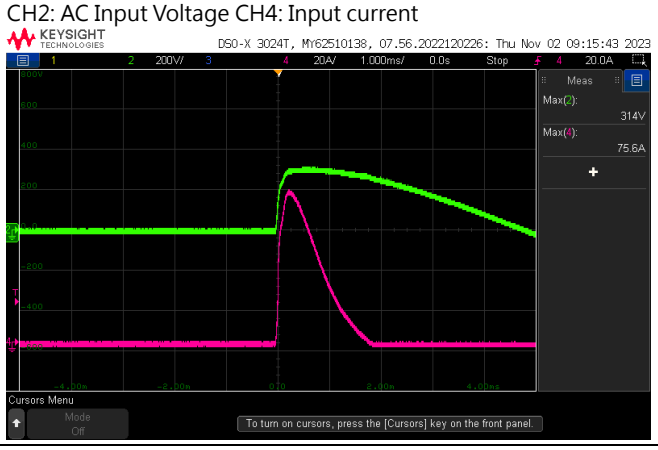
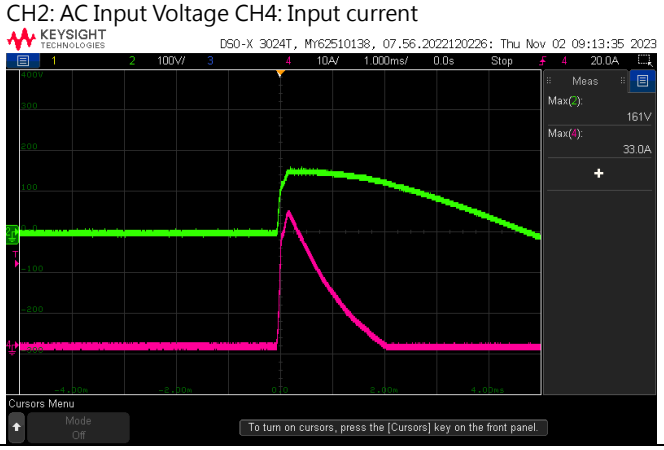
FULL /0% LOAD 50%DUTY / 120HZ

FULL /0% LOAD 50%DUTY / 1KHZ

				
11	TRANSIENT RECOVERY TIME	V1: 1500mVp-p < 500us	I/P: 230VAC O/P:40% LOAD CHANGE 50%DUTY/120HZ 1.25A/us	257mVp-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) 74.2V~264V/ FULL LOAD 74.2V~264V/ 70% LOAD (2) 104.8Vdc~370Vdc/FULL LOAD 104.8Vdc~370Vdc/70% LOAD (3) 104.8Vdc~370Vdc/FULL LOAD 104.8Vdc~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/ 2.1A 115V/ 4.2A	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	I =1.8232A/ 230VAC I =3.7697A/ 115VAC
4	LEAKAGE CURRENT	Earth leakage current < 500uA(rms) @ 264VAC Touch current < 70uA(rms) @ 264VAC	I/P： 264 VAC /60 HZ O/P：Min LOAD Ta：25℃	Earth: 332uA / 264VAC Touch:38.28uA / 264VAC
5	NO LOAD CONSUMPTION	<0.5W	I/P：240VAC O/P：NO LOAD Ta：25℃	0.2738W

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=0.9993/230VAC PF=0.9981/115VAC
	P.F vs LOAD 			
7	EFFICIENCY(Typ.)	94.5%	I/P:230 VAC O/P:FULL LOAD Ta:25℃	95.41%
	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 =75.6A/ 230VAC I =33.0A/ 115VAC T50= 840us/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% 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℃	132.304%/ 264VAC 132.05%/ 230VAC 131.66%/ 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℃	17.67V/ 264VAC 17.71V/ 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℃	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 : -0.517% ~ 0.0166%
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: 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℃	Q2: VDS: (1) 466V (2) 479V (3) 470V (4) 462V (5) 462V (6) 458V (7) 503V (8) 474V Q3: VDS: (1) 458V (2) 479V (3) 458V (4) 458V (5) 454V (6) 454V (7) 495V (8) 474V
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℃	VDS: (1) 495V (2) 470V (3) 491V (4) 495V (5) 495V (6) 491V (7) 519V (8) 507V
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) 422V (2) 426V (3) 422V (4) 414V (5) 434V
4	Diode Peak Voltage	Q101/Q103 Rated:	AC ON/OFF I/P: High-Line +3V =267 V	Q101: Vo=Vmax Q103: Vo=Vmax

		140A/ 60V	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 Vo=Vnormal O/P: (1) Full Load Ta:25℃	VDS: (1) 42.6V (2) 40.6V (3) 43.4V (4) 42.6V (5) 42.6V (6) 42.3V (7) 42.6V (8) 41.0V (9) 41.0V (10) 43.4V Vo=Vnormal (1) 41.0V	VDS: (1) 42.6V (2) 41.8V (3) 43.0V (4) 42.2V (5) 42.2V (6) 42.6V (7) 40.6V (8) 40.1V (9) 39.7V (10) 43.0V Vo=Vnormal (1) 40.6V
5	Input Capacitor Voltage	C5 Rated: 270μ / 420V	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) 412V (2) 408V (3) 412V (4) 408V	
6	Control IC Voltage Test	PFC /PWM IC U1: Rated : 10.4V~28.7 V O/P IC U101/U102 Rated : 4.75V~38 V	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 (1) 19.3V (2) 19.3V (3) 19.3V (4) 19.5V (5) 19.3V	U101/U102 (1) 11.7V (2) 11.7V (3) 11.6V (4) 11.7V (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: 2.38mA I/P-FG: 3.22mA O/P-FG: 1.475mA 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) 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℃	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℃	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	BS EN/EN61000-4-5 ■ 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-400-24 1. ROOM AMBIENT BURN-IN： 2HRS I/P： 230VAC O/P： FULL LOAD Ta=26.6 ℃ 2. HIGH AMBIENT BURN-IN： 2HRS I/P： 230VAC O/P： FULL LOAD Ta= 51.7 ℃		

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

2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR (MIN)	I/P : 230 VAC O/P : 131.85% LOAD Ta : 25℃	TEST : OK
3	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 264VAC/100VAC 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	± 0.009 %/℃(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 C104 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) 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℃)		
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

2020.10.1 TAG-QA-009