Test Report: LRS-450-12

450W Single Output Switching 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

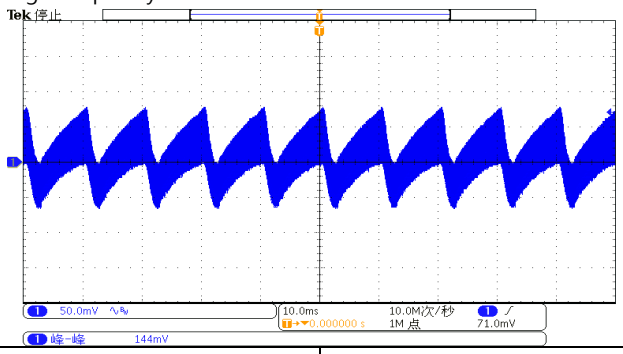
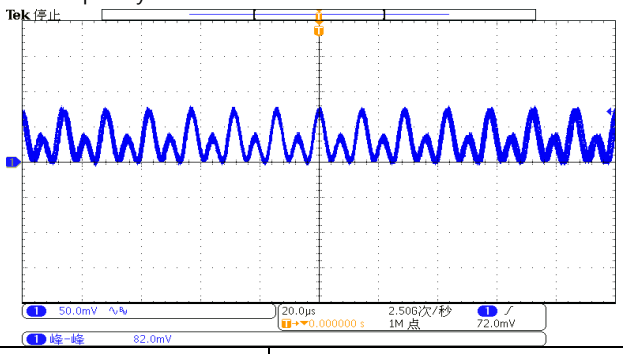
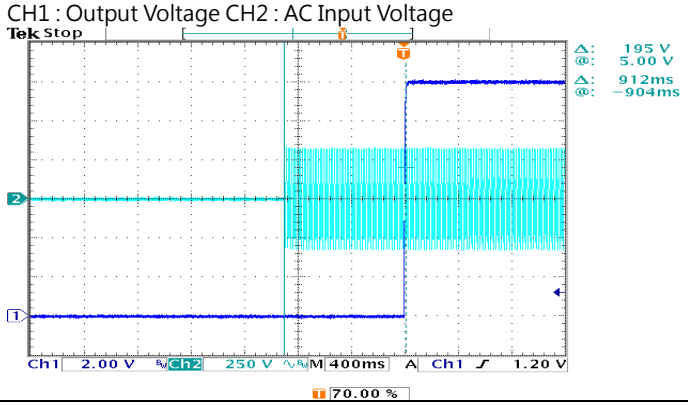
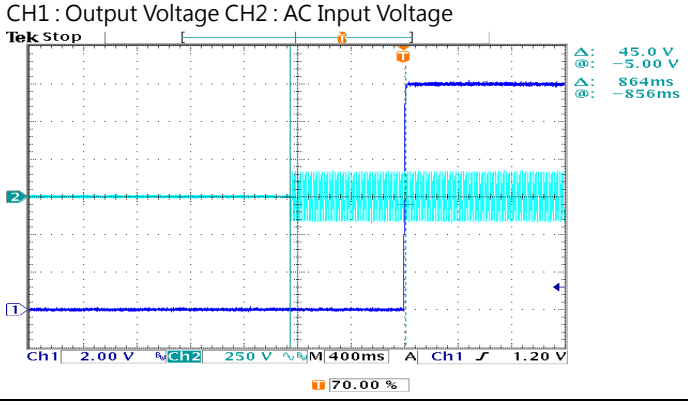
Safety Test
E.M.C. Test

■ RELIABILITY TEST

ENVIRONMENT TEST

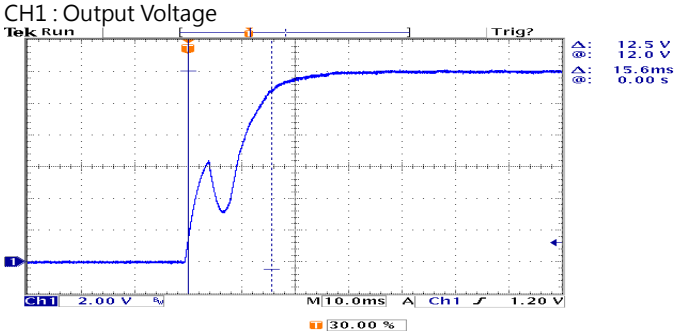
■ DESIGN VERIFY TEST

OUTPUT FUNCTION TEST

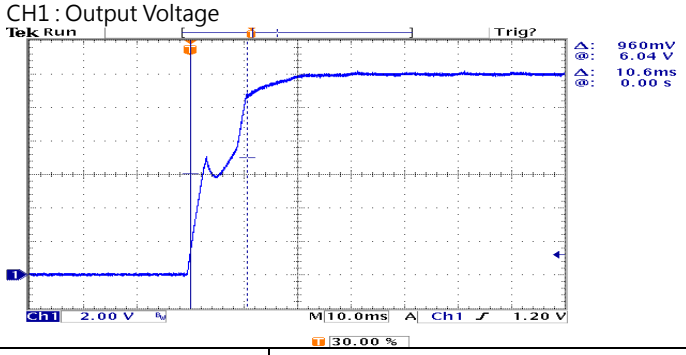
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE ADJUST RANGE	CH1: 11.4 V~13.2V	I/P： 230 VAC I/P： 115 VAC O/P：MIN LOAD Ta：25℃	11.03V~13.80V/230VAC 11.08V~13.78V/115VAC
2	OUTPUT VOLTAGE(Max) TOLERANCE	V1:-1.5%~+1.5%	I/P: 90VAC /264VAC O/P:FULL/ MIN. LOAD Ta:25℃	V1: -0.25 %~0.33%
3	LINE REGULATION (Max)	V1: -0.5%~+0.5%	I/P: 90VAC~ 264VAC O/P:FULL LOAD Ta:25℃	V1: -0.16%~0.25%
4	LOAD REGULATION(Max)	V1: -1%~+1%	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25℃	V1: -0.25%~ 0.25%
5	RIPPLE & NOISE(Max)	V1:200mVp-p	I/P:230VAC O/P:FULL LOAD Ta:25℃	V1: 144mVp-p
	high frequency：  		low frequency：  	
6	SET UP TIME(Max)	230VAC/1500ms 115VAC/1500ms	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	230VAC/912ms 115VAC/864ms
	INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage  		INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage  	

7	RISE TIME (Max)	230VAC/50ms 115VAC/50ms	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	230VAC/15.6ms 115VAC/10.6 ms

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

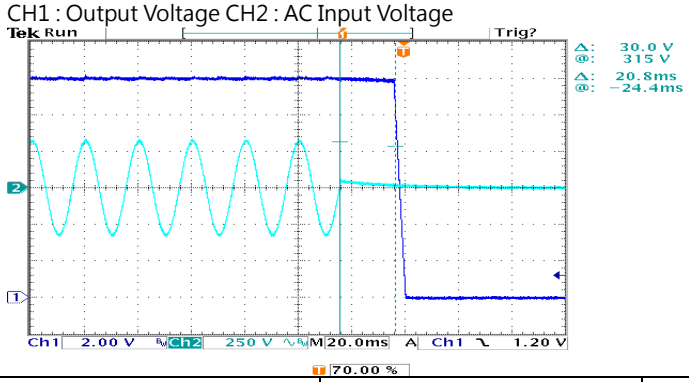


INPUT=115VAC/60HZ @ FULL LOAD
CH1 : Output Voltage

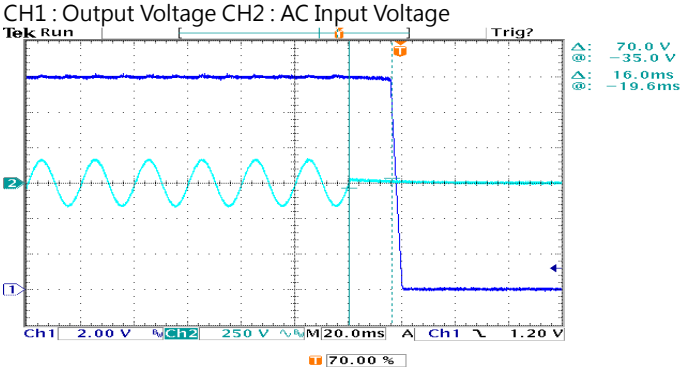


8	HOLD UP TIME (Typ.)	230VAC/16ms 115VAC/12ms	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	230VAC/20.8ms 115VAC/16ms

INPUT=230VAC/50HZ @ FULL LOAD
CH1 : Output Voltage CH2 : AC Input Voltage

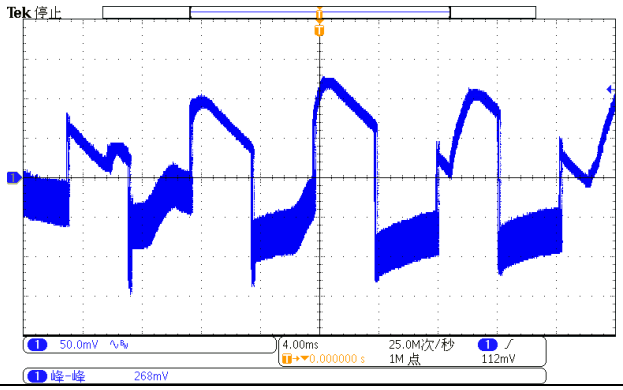


INPUT=115VAC/60HZ @ FULL LOAD
CH1 : Output Voltage CH2 : AC Input Voltage

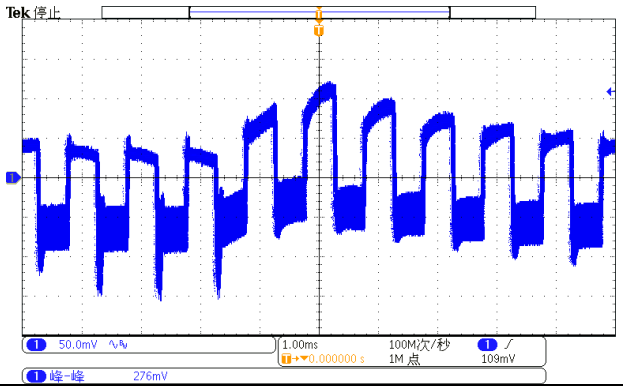


9	DYNAMIC LOAD	V1: 1200mVp-p	I/P: 230VAC O/P: (1)FULL /50% LOAD 50%DUTY / 120HZ (2)FULL /50% LOAD 50%DUTY / 1KHZ Ta:25℃	 268mVp-p 276mVp-p

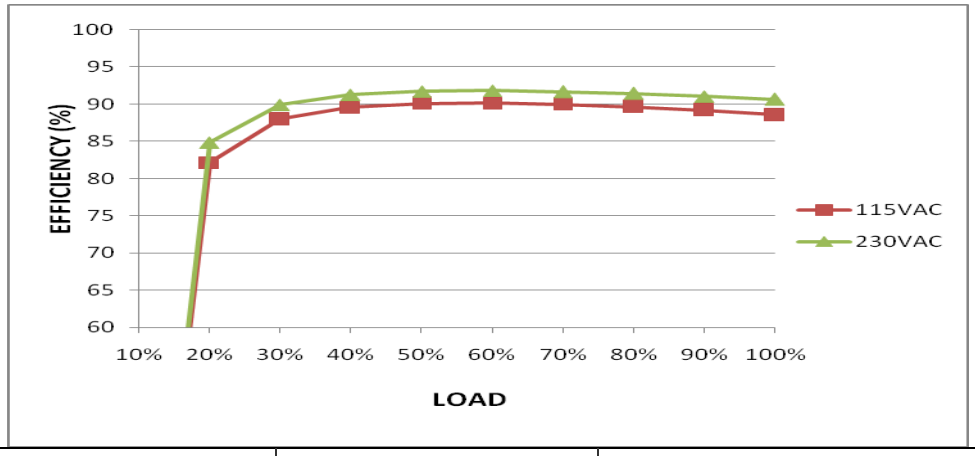
FULL /50% LOAD 50%DUTY / 120HZ



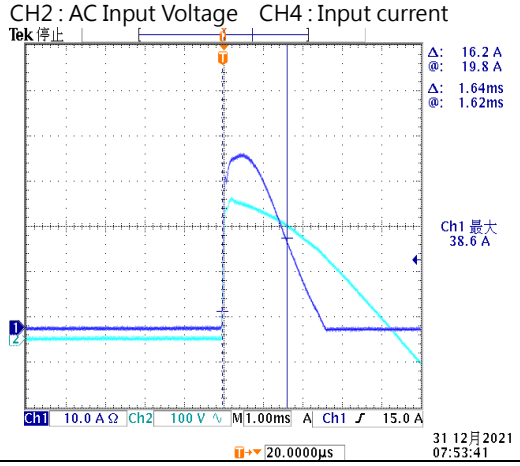
FULL /50% LOAD 50%DUTY / 1KHZ



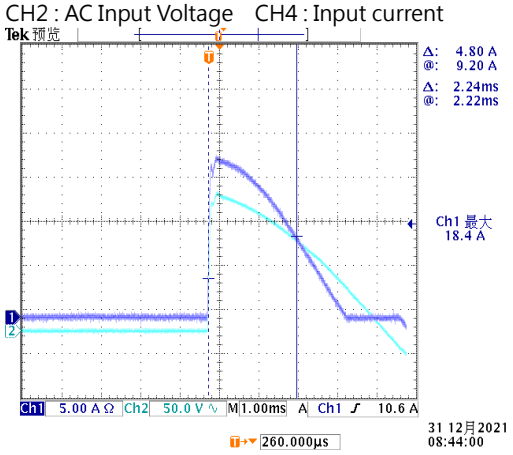
INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	90 ~ 132VAC / 180 ~ 264VAC by switch 250VDC~ 370VDC (switch on 230VAC)	(1) I/P:TESTING O/P:FULL LOAD (2) I/P:DC TESTING(L:+ N:-) O/P: FULL / 50% LOAD (3) I/P:DC TESTING(L:- N:+) O/P: FULL / 50% LOAD Ta:25℃	(1) 85 VAC~ 267VAC (2)250Vdc~370Vdc/FULL LOAD 250Vdc~370Vdc/50% LOAD (3) 250Vdc~370Vdc/FULL LOAD 250Vdc~370Vdc/50% LOAD
			I/P: LOW-LINE-3V=87 V HIGH-LINE+15%=300 V 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:90 VAC ~264 VAC O/P:FULL~MIN LOAD Ta:25℃	TEST: OK
3	INPUT CURRENT (Typ.)	230V/6A 115V/10A	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	I =4.35A/ 230VAC I =7.83A/ 115VAC
4	LEAKAGE CURRENT	< 2mA / 240 VAC	I/P： 240 VAC O/P：Min LOAD Ta：25℃	L-FG：0.9182mA N-FG：0.9217mA
5	EFFICIENCY(Typ.)	90%	I/P:230 VAC O/P:FULL LOAD Ta:25℃	90.23%
	EFFICIENCY vs LOAD 			
6	INRUSH CURRENT(Typ.)	230V/60A 115V/35A COLD START	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	I =38.6A/ 230VAC I =18.4A/ 115VAC T50=1640us/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%~ 140%	I/P: 264VAC I/P: 230VAC I/P: 100VAC O/P:TESTING Ta:25℃	108%/ 264VAC 108.2%/ 230VAC 108.8%/100VAC PROTECTION TYPE : Constant current limiting, unit will shut down after 3 sec. re-power on to recover
2	OVER VOLTAGE PROTECTION	13.8V~16.2V	I/P: 264VAC I/P: 230VAC I/P: 90VAC O/P:MIN LOAD Ta:25℃	14.66V/ 264VAC 14.52V/ 230VAC 14.22V/ 90VAC PROTECTION TYPE : Shut down o/p voltage, re-power on to recover
3	OVER TEMPERATURE PROTECTION	NO DAMAGE	I/P: 264VAC I/P: 90VAC O/P:FULL LOAD	O.T.P. Active OK PROTECTION TYPE : Shut down o/p voltage, re-power on to recover

CONTROL FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	FAN ON/OFF CONTROL (Typ)	RTH3≧50℃ FAN ON RTH3≦40℃ FAN OFF	I/P:230 VAC O/P:FULL LOAD	RTH3 >50℃ FAN ON RTH3 <40℃ FAN OFF

COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Transistor (D to S) or (C to E) Peak Voltage	Q2 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. I/P:Low-Line -3V = 97V 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. Ta:25℃	 VDS: (1) 489V (2) 465V (3) 482V (4) 486V (5) 491V (6) 488V (7) 472V VDS: (1) 337V (2) 382V/ (3) 371V (4) 356V (5) 382V (6) 377V (7) 392V
2	Diode Peak Voltage	Q101 Rated 80 A/ 60 V Q104 Rated : 80 A/60V	AC ON/OFF I/P:High-Line +3V =267 V 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 Ta:25℃	Q101: VDS: (1) 35.4V (2) 13.4V (3) 39V (4) 38.6V (5) 38.6V (6) 38.2V (7) 13.4V (8) 36.6V Q104: VDS: (1) 33.8V (2) 12.2V (3) 34.8V (4) 35.4V (5) 35V (6) 34.6V (7) 13.6V (8) 33.8V

3	Input Capacitor Voltage	C5 Rated: 680μ / 200 V	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)199V (2)191V (3)198V (4) 197V
4	Control IC Voltage Test	PWM IC U2 Rated 8.9V~ 15.5V	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) (6)NO LOAD(AC continue) Ta:25℃	 (1) 15.4V (2) 13.9V (3) 14V (4) 14.1V (5) 14.2V (6) 14.2V
5	VCC Diode Peak Voltage	D30 Rated : 400V 2A D34 Rated : 400 V 2 A D200 Rated : 400V 2A	AC ON/OFF I/P：High-Line +3V = 267 V O/P： (1) Full load (2) Full load continue (3) Dynamic Load 90%Duty/1KHz Ta：25℃	 D30 (1)98.2 V (2) 88.3V (3)92.5V D34 (1)92.4V (2)61.5 V (3)88.6 V D200 (1)97.5V (2)68.7 V (3)93.7V

■ SAFETY& E.M.C. TEST

SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	I/P-O/P: 3KVAC/min I/P-FG :2KVAC/min O/P-FG:0.5KVAC/min	I/P-O/P: 3.6 KVAC/min I/P-FG: 2.4 KVAC/min O/P-FG:0.6 KVAC/min Ta:25℃	I/P-O/P:2.78mA I/P-FG:2.28mA O/P-FG:1.95m A 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: 500 VDC I/P-FG: 500 VDC O/P-FG: 500 VDC Ta:25℃	I/P-O/P: 9999MΩ I/P-FG: 9999MΩ O/P-FG: 9999MΩ NO DAMAGE
3	GROUNDING CONTINUITY	FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40A / 2min Ta:25℃	10mΩ

E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	CONDUCTION	EN55032 CLASS A	I/P : 230 VAC (50HZ) O/P : FULL/50% LOAD Ta : 25℃	PASS Test by certified Lab
2	RADIATION	EN55032 CLASS A	I/P : 230 VAC (50HZ) O/P : FULL/50% LOAD Ta : 25℃	PASS Test by certified Lab
3	E.S.D	EN61000-4-2 INDUSTRY AIR : 8KV / Contact : 4KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25℃	CRITERIA A
4	E.F.T	EN61000-4-4 INDUSTRY INPUT : 2KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25℃	CRITERIA A
5	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
6	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

<table>
<tr><th>NO</th><th>TEST ITEM</th><th>SPECIFICATION</th><th>TEST CONDITION</th><th>RESULT</th></tr>
<tr><td>1</td><td>TEMPERATURE RISE TEST</td><td colspan="3">MODEL : LRS-450-12
1. ROOM AMBIENT BURN-IN : 2 HRS
I/P : 230VAC O/P : FULL LOAD Ta=30.2 ℃
2. HIGH AMBIENT BURN-IN : 2 HRS
I/P : 230VAC O/P : FULL LOAD Ta=55.8 ℃
<table>
<tr><th>NO</th><th>Position</th><th>ROOM AMBIENT Ta=30.2 ℃</th><th>HIGH AMBIENT Ta=55.8 ℃</th></tr>
<tr><td>1</td><td>BD1</td><td>48.2℃</td><td>76.3℃</td></tr>
<tr><td>2</td><td>C5</td><td>48.1℃</td><td>69.6℃</td></tr>
<tr><td>3</td><td>C6</td><td>47.9℃</td><td>75.2℃</td></tr>
<tr><td>4</td><td>Q1</td><td>67.0℃</td><td>89.7℃</td></tr>
<tr><td>5</td><td>Q2</td><td>65.1℃</td><td>91.4℃</td></tr>
<tr><td>6</td><td>C36</td><td>44.2℃</td><td>71.4℃</td></tr>
<tr><td>7</td><td>T1</td><td>57.3℃</td><td>85.9℃</td></tr>
<tr><td>8</td><td>RG201</td><td>56.0℃</td><td>82.8℃</td></tr>
<tr><td>9</td><td>C205</td><td>46.1℃</td><td>75.5℃</td></tr>
<tr><td>10</td><td>Q100</td><td>51.9℃</td><td>80.0℃</td></tr>
<tr><td>11</td><td>Q101</td><td>49.3℃</td><td>77.3℃</td></tr>
<tr><td>12</td><td>Q103</td><td>62.7℃</td><td>90.6℃</td></tr>
<tr><td>13</td><td>Q104</td><td>66.4℃</td><td>94.0℃</td></tr>
<tr><td>14</td><td>C105</td><td>48.0℃</td><td>75.7℃</td></tr>
<tr><td>15</td><td>C106</td><td>49.0℃</td><td>76.3℃</td></tr>
<tr><td>16</td><td>J111</td><td>60.4℃</td><td>90.2℃</td></tr>
<tr><td>17</td><td>RTH3</td><td>56.0℃</td><td>83.1℃</td></tr>
</table></td></tr>
<tr><td>2</td><td>OVER LOAD BURN-IN TEST</td><td>NO DAMAGE
1 HOUR (MIN)</td><td>I/P : 230 VAC
O/P : 117.1 % LOAD
Ta : 25℃</td><td>TEST : OK</td></tr>
<tr><td>3</td><td>LOW TEMPERATURE
TURN ON TEST</td><td>TURN ON AFTER 2 HOUR</td><td>I/P : 264VAC/100VAC
O/P : 100 % LOAD
Ta= -25 ℃</td><td>TEST : OK</td></tr>
<tr><td>4</td><td>HIGH HUMIDITY
HIGH TEMPERATURE
HIGH VOLTAGE
TURN ON TEST</td><td>AFTER 12 HOURS
IN CHAMBER ON
CONTROL 50 ℃/95 %R.H
NO DAMAGE</td><td>I/P : 272 VAC
O/P : FULL LOAD
Ta=50 ℃
HUMIDITY= 95 %R.H</td><td>TEST : OK</td></tr>
<tr><td>5</td><td>TEMPERATURE
COEFFICIENT</td><td>± 0.03 %/℃(0~50℃)</td><td>I/P : 230 VAC
O/P : FULL LOAD</td><td>± 0.0029 %/℃(0~50℃)</td></tr>
</table>

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	-20~50℃	1. Thermal shock Temperature： -25℃~ +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, 5G 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：6G (5) Test Time：180min in each axis (X.Y.Z) (6) Ta：25℃
9	CAPACITOR LIFE CYCLE	SUPPOSE C106 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) 837767HRS (2) 106182HRS (3) 262870HRS (4) 407698HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 1508.9K hrs min. Telcordia SR-332 (Bellcore) ; 252.2K 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	WUWQ/HUANGMK	WENF	LINKX

2020.10.1 TAG-QA-009