Test Report: XLC-60-12

60W Constant Voltage LED Driver

■ 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

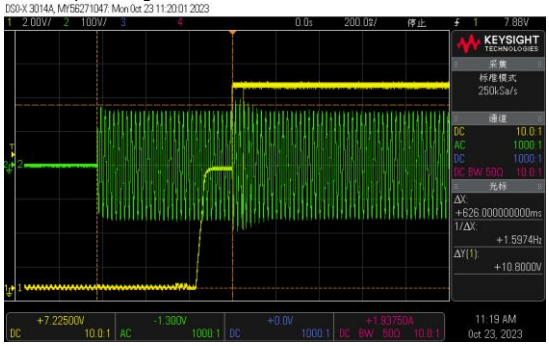
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE(Max) TOLERANCE	V1: -5% ~ +5% (Max)	I/P: 230VAC O/P:100%load Ta:25℃	V1: 0.93%~ 1.0%
2	OVER/UNDERSHOOT TEST	< ±5%	I/P: 230VAC O/P:100% /0% Ta:25℃	1.75%
3	SET UP TIME(Max)	230VAC/ 800ms (Max) 115VAC/ 1000ms (Max)	I/P: 230 VAC I/P: 115 VAC O/P: FULL LOAD Ta:25℃	230VAC/ 420ms 115VAC/626ms

INPUT=230VAC/50HZ @ FULL LOAD

CH1 : Output Voltage CH2 : AC Input Voltage

INPUT=115VAC/60HZ @ FULL LOAD

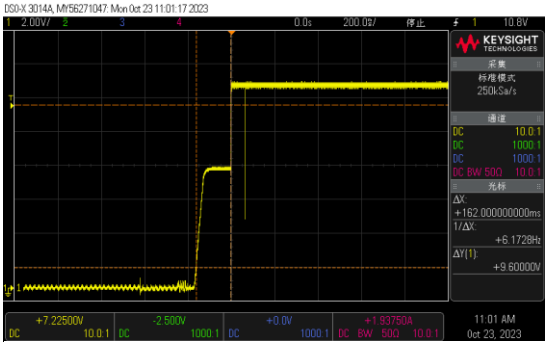
CH1 : Output Voltage



4	RISE TIME (Max)	230VAC/ 180ms (Max) 115VAC/ 180ms (Max)	I/P: 230 VAC I/P: 115 VAC O/P: FULL LOAD Ta:25℃	230VAC/162ms 115VAC/162 ms

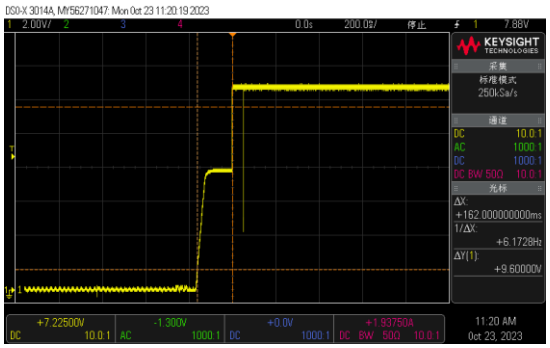
INPUT=230VAC/50HZ @ FULL LOAD

CH1: Output Voltage

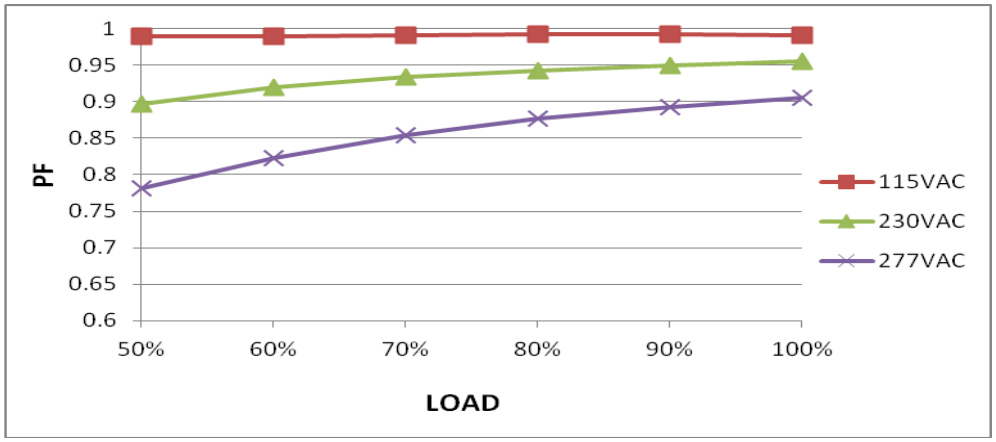


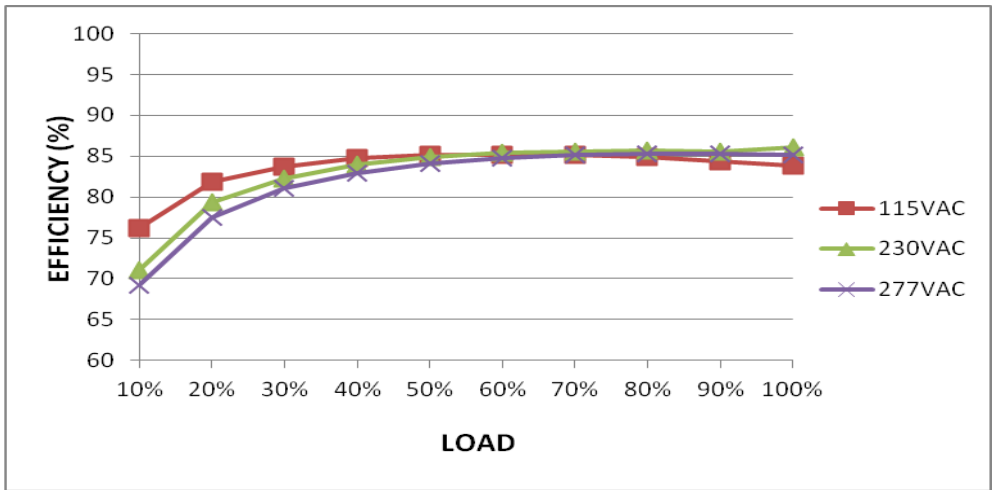
INPUT=115VAC/60HZ @ FULL LOAD

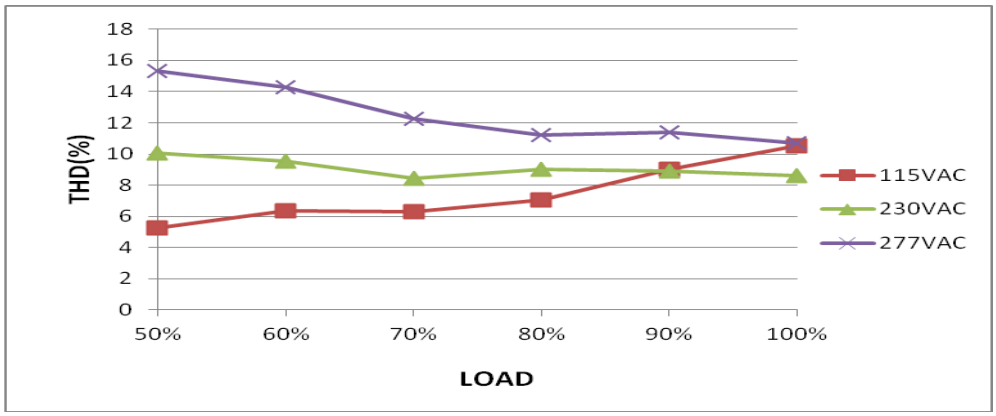
CH1: Output Voltage



INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	110VAC~305 VAC 155VDC~400VDC	(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 (4) I/P: LOW-LINE=141VDC HIGH-LINE=431VDC O/P: Dimming on/off 【for Dimming type】 Ta:25℃	(1) 100V~305V (2) 141Vdc~400Vdc/FULL LOAD 141Vdc~400Vdc/50% LOAD (3) 141Vdc~400Vdc/FULL LOAD 141Vdc~400Vdc/50% LOAD (4)OK
			I/P: LOW-LINE-3V=107 V HIGH-LINE+10V=315 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 ~305VAC O/P:FULL~MIN LOAD Ta:25℃	OK
3	INPUT CURRENT (TYP)	277VAC/ 0.30 A 230 VAC/ 0.35 A 115 VAC/ 0.75 A	I/P: 277VAC/230 VAC/115 VAC O/P:FULL LOAD Ta:25℃ **LEDH MODE TEST**	I= 0.274 A/277VAC I = 0.316 A/ 230VAC I = 0.628 A/ 115VAC
4	POWER FACTOR(TYP)	0.95/230 VAC FULL LOAD 0.95/115 VAC FULL LOAD 0.9/277 VAC FULL LOAD	I/P: 230 VAC/115VAC/277VAC O/P:FULL LOAD Ta:25℃ **LEDH MODE TEST**	PF= 0.955 /230V/100%LOAD PF= 0.991 /115V/100%LOAD PF= 0.905 /277V/100%LOAD
	P.F vs LOAD 			

5	EFFICIENCY (TYP)	86 %	I/P: 230 VAC O/P:FULL LOAD Ta:25℃ **LEDH MODE TEST**	86.05%
	EFFICIENCY vs LOAD 			
6	INRUSH CURRENT (TYP)	230 V/ 15 A COLD START (twidth=310us measured at 50% Ipeak) COLD START	I/P: 230 VAC O/P:FULL LOAD Ta:25℃ **LEDH MODE TEST**	I = 12.28A/ 230VAC T50=12 us
	INPUT=230VAC/50HZ @ FULL LOAD CH2 : AC Input Voltage CH4 : Input current (1V=1A) 			
7	LEAKAGE CURRENT	< 0.75mA / 277VAC	I/P: 277 VAC O/P:Min LOAD Ta:25℃	L-FG： 0.018mA N-FG：0.017 mA
8	TOTAL HARMONIC DISTORTION	THD< 20%(@load ≥ 60%/230VAC; @load ≥ 75%/277VAC); THD<10%@load 100%/230VAC	I/P： 230VAC/277VAC O/P：60% /75% /100% LOAD Ta：25℃	THD：9.56% 230VAC 60% THD：11.54% 277VAC 75% THD：8.62% 230VAC 100%

	THD vs LOAD 			
9	STANDBY POWER CONSUMPTION	Standby power consumption<0.5W (Dimming OFF, only for standard version B/DA2-type)	I/P：230VAC O/P：TESTING Ta：25℃	0.2626W for B-type 0.314W for DA2-type

PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER LOAD PROTECTION	105%~ 200 %	I/P: 305VAC I/P: 230VAC I/P: 110VAC O/P:TESTING Ta:25℃	141.2%/ 305VAC 140.4%/ 230VAC 125.6%/110VAC PROTECTION TYPE： Hiccup mode, recovers automatically after fault condition is removed.
2	OVER VOLTAGE PROTECTION	14 V~ 17V	I/P: 305VAC I/P: 230VAC I/P: 110VAC O/P:MIN LOAD Ta:25℃	15.3V/ 305VAC 15.3V/ 230VAC 15.3V/ 110VAC PROTECTION TYPE：Shut down output voltage，re-power on to recover
3	OVER TEMPERATURE PROTECTION	NO DAMAGE	I/P: 305 VAC I/P: 110 VAC O/P:FULL LOAD	O.T.P. Active PROTECTION TYPE： Shut down output voltage, recovers automatically after fault condition is removed
4	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE	I/P: 305VAC I/P: 110 VAC O/P: FULL LOAD Ta:25℃	NO DAMAGE PROTECTION TYPE： Hiccup mode, recovers automatically after fault condition is removed.

CONTROL FUNCTION TEST

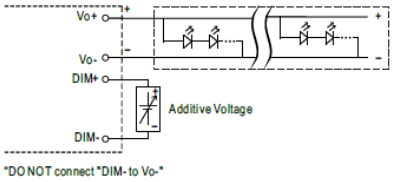
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	DIMMING OPERATION(B-Type)			

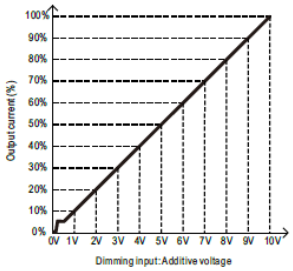
◎ B type

※ 3 in 1 dimming function

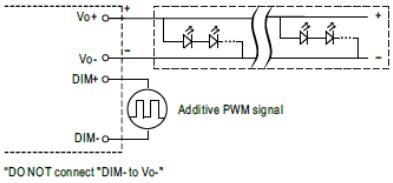
- Output constant current level can be adjusted by applying one of the three methodologies between DIM+ and DIM-: 0 ~ 10VDC, or 10V PWM signal or resistance.
- Direct connecting to LEDs is suggested. It is not suitable to be used with additional drivers.
- Dimming source current from power supply: 100 μA (typ.)

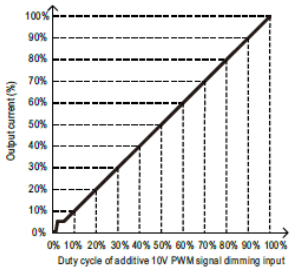
◎ Applying additive 0 ~ 10VDC



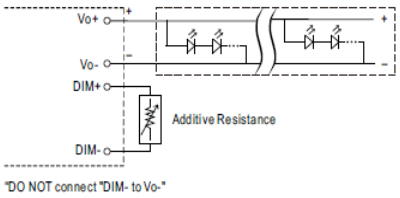


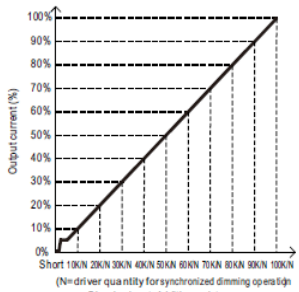
◎ Applying additive 10V PWM signal (frequency range 300Hz~3KHz):





◎ Applying additive resistance: 0~100k Ω

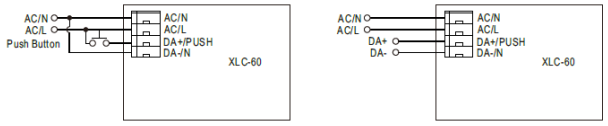
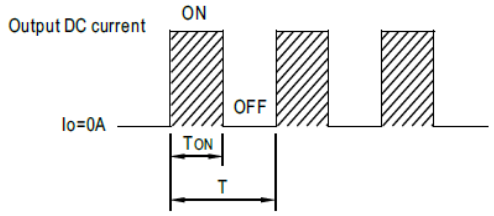




Note : 1. Min. dimming level is about 8% and the output current is not defined when 0% < Iout < 8%.
2. The output current could drop down to 0% when dimming input is about 0kΩ or 0Vdc, or 10V PWM signal with 0% duty cycle.

I/P : 230 VAC ; O/P : DIMMING TEST ;Ta : 25℃

1	Resistance value	Short	10K	20K	30K	40K	50K	60K	70K	80K	90K	100K	OPEN
	Output Current	0	0.640A	1.110A	1.630A	2.090A	2.620A	3.130A	3.660A	4.180A	4.730A	4.950A	4.950A
	Output Current duty	0%	12.80%	22.20%	32.60%	41.80%	52.40%	62.60%	73.20%	83.60%	94.60%	99.00%	99.00%
2	Dimming value	0V	1V	2V	3V	4V	5V	6V	7V	8V	9V	10V	OPEN
	Output Current	0	0.558A	1.010A	1.530A	1.999A	2.530A	3.022A	3.560A	4.100A	4.620A	4.960A	4.960A
	Output Current duty	0%	11.16%	20.20%	30.60%	39.98%	50.60%	60.44%	71.20%	82.00%	92.40%	99.20%	99.20%
3	Duty value	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	OPEN
	Output Current	0	0.550A	1.010A	1.530A	1.990A	2.520A	3.020A	3.540A	4.060A	4.590A	4.950A	4.960A
	Output Current duty	0%	11.00%	20.20%	30.60%	39.80%	50.40%	60.40%	70.80%	81.20%	91.80%	99.00%	99.20%

2	DA2 type (DALI-2 digital dimming function)	◎ DA2 type (DALI-2 digital dimming function) ※ Input wiring diagram  ※PUSH dimming (primary side) • The factory default dimming level is at 100%. • If the push action lasts less than 0.05 sec., it will not lead to a change for the status of the driver. • Up to 10 drivers can perform the PUSH dimming at the same time when utilizing one common push button. • The maximum length of the cable from the push button to the last driver is 20 meters. Action / Action duration / Function Short Push / 0.1~1s / Turn ON-OFF the driver Double Click / Click twice in 1.5s / Set up the dimming level to 100% Long Push / 1.5~10s / Every Long Push changes the dimming direction, dimming up or down I/P： 230 VAC O/P：DIMMING TEST Ta：25℃ TEST RESULT：OK
3	PWM OUTPUT DIMMING PRINCIPLE	※ For 12V/24V/48V PWM style output dimming • Dimming is achieved by varying the duty cycle of the output current.  $\text{Duty cycle}(\%) = \frac{T_{ON}}{T} \times 100\%$ Output PWM frequency : 4kHz for B-Type fixed (Typ.) 3.2kHz for DA2-Type fixed (Typ.) I/P： 230 VAC O/P：FULL LOAD Ta：25℃ TEST RESULT：OK

COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Transistor (D to S) or (C to E) **Peak Voltage**	Q 1 Rated 800 V/11 A	AC ON/OFF I/P: High-Line +3V =308V 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 = 107V 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) 779V (2) 799V (3) 690V (4) 682V (5) 678V (6) 706V (7) 798V VDS: (1) 475V (2) 475V (3) 471V (4) 467V (5) 475V (6) 463V (7) 418V
2	Diode Peak **Voltage**	Q100 Rated 93A/150V	AC ON/OFF I/P: High-Line +3V =308 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℃	Q100: VDS: (1) 148V (2) 149V (3) 149V (4) 148V (5) 147V (6) 149V (7) 148V (8) 147V

<table>
<tr>
<td>3</td>
<td>Control IC Voltage Test</td>
<td>U1 Rated
7V~18V

U100 Rated
6V~ 75V

U451 Rated
1.7V-3.6V</td>
<td>AC ON/OFF
I/P: High-Line +3V =308 V
FOR C.V MODE TYPE
O/P (1) FULL LOAD
(2) Output Short
(3) O.L.P
(4) O.V.P.
(5) NO LOAD VRmin.LOW LINE
(6) Dim off
Ta:25℃</td>
<td>U1
(1) 14.7V
(2) 14.7V
(3) 14.7V
(4) 14.7V
(5) 11.0V
(6) 11.0V
U100
(1) 18.6V
(2) 19.6V
(3) 18.8V
(4)19.0V
(5) 17.6V
(6) 17.2V

U451
<table>
<tr><th>FOR C.V MODE TYPE</th><th>Level</th><th>Ripple</th><th>Spike</th></tr>
<tr><td>FULL LOAD</td><td>3.288</td><td>0.59%</td><td>2.91%</td></tr>
<tr><td>Output Short</td><td>3.288</td><td>0.57%</td><td>3.55%</td></tr>
<tr><td>O.L.P</td><td>3.288</td><td>0.49%</td><td>3.55%</td></tr>
<tr><td>O.V.P</td><td>3.284</td><td>0.26%</td><td>0.94%</td></tr>
<tr><td>NO LOAD VRmin.LOW LINE</td><td>3.283</td><td>0.28%</td><td>0.64%</td></tr>
<tr><td>DIM OFF</td><td>3.283</td><td>0.24%</td><td>0.88%</td></tr>
</table>
</td>
</tr>
<tr>
<td>4</td>
<td>Clamp Diode Peak Voltage</td>
<td>D10 Rated：
1000V/1A</td>
<td>AC ON/OFF
I/P：High-Line +3V = 308 V
O/P： (1) Dynamic Load 90%Duty/1KHz
(2) Full load continue
Ta：25℃</td>
<td>(1)629V

(2)637V</td>
</tr>
<tr>
<td>5</td>
<td>Buck Diode Peak Voltage
MOS</td>
<td>Q110 Rated：
90A/40V

Q111 Rated：
90A/40V</td>
<td>AC ON/OFF
I/P：High-Line +3V = 308 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.
Ta:25℃</td>
<td>Q110 Q111

(1) 34.8V (1) 28.8V
(2) 31.2V (2) 28.4V
(3) 31.6V (3) 28.4V

(4) 30.4V (4) 28.4V

(5)32.8V (5) 28.8V

(6)34.0V (6) 28.4V

(7) 34.0V (7) 27.2V</td>
</tr>
</table>

6	Dimming MOS Only B or DA2-type	Q200 Rated： 80A/60V	AC ON/OFF I/P：High-Line +3V = 308 V O/P: (1) FULL Load (2) FULL Load continue (3) Output Short (4) DIM OFF Ta:25℃	 (1) 80.4A (2) 5.22A (3) 79A (4) 0A

■ SAFETY & EMC TEST

SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	I/P-O/P: 3.75KVAC/min	I/P-O/P: 4.125 KVAC/min Ta:25℃	I/P-O/P: 0.85 mA NO DAMAGE
2	ISOLATION RESISTANCE	I/P-O/P:500VDC>100MΩ	I/P-O/P: 500 VDC Ta:25℃	I/P-O/P: >99999MΩ NO DAMAGE

E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	HARMONIC	EN61000-3-2 CLASS C	I/P: 230VAC/50HZ O/P:FULL LOAD Ta:25℃	PASS
2	CONDUCTION	EN55015	I/P: 230 VAC (50HZ) O/P:FULL/50% LOAD Ta:25℃	PASS Test by certified Lab
3	RADIATION	EN55015	I/P: 230 VAC (50HZ) O/P:FULL LOAD Ta:25℃	PASS Test by certified Lab
4	E.S.D	EN61000-4-2 AIR：8KV / Contact：4KV	I/P: 230 VAC/50HZ O/P:FULL LOAD Ta:25℃	CRITERIA A
5	E.F.T	EN61000-4-4 INPUT: 1KV	I/P: 230 VAC/50HZ O/P:FULL LOAD Ta:25℃	CRITERIA A
6	SURGE	IEC61000-4-5 L-N :1KV	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

<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： XLC-60-12DA2
1. ROOM AMBIENT BURN-IN：2 HRS
I/P： 230VAC O/P： FULL LOAD Ta=32.4 ℃
2. HIGH AMBIENT BURN-IN：2 HRS
I/P： 230VAC O/P： FULL LOAD Ta=44.5 ℃
<table><tr><th>NO</th><th>Position</th><th>ROOM AMBIENT Ta=32.4 ℃</th><th>HIGH AMBIENT Ta=44.5℃</th></tr><tr><td>1</td><td>R37</td><td>90.6℃</td><td>102.8℃</td></tr><tr><td>2</td><td>C20</td><td>87.0℃</td><td>99.1℃</td></tr><tr><td>3</td><td>D10</td><td>102.5℃</td><td>114.4℃</td></tr><tr><td>4</td><td>U1</td><td>87.0℃</td><td>99.3℃</td></tr><tr><td>5</td><td>Q1</td><td>92.1℃</td><td>104.4℃</td></tr><tr><td>6</td><td>T1</td><td>91.2℃</td><td>104.0℃</td></tr><tr><td>7</td><td>Q100</td><td>93.3℃</td><td>106.4℃</td></tr><tr><td>8</td><td>C101</td><td>92.0℃</td><td>105.1℃</td></tr><tr><td>9</td><td>Q110</td><td>98.5℃</td><td>111.8℃</td></tr><tr><td>10</td><td>Q111</td><td>97.5℃</td><td>110.2℃</td></tr><tr><td>11</td><td>Q200</td><td>91.1℃</td><td>104.3℃</td></tr><tr><td>12</td><td>R200</td><td>90.9℃</td><td>101.7℃</td></tr><tr><td>13</td><td>L100</td><td>96.2℃</td><td>109.3℃</td></tr><tr><td>14</td><td>U100</td><td>97.2℃</td><td>109.8℃</td></tr><tr><td>15</td><td>RT1</td><td>78.6℃</td><td>90.7℃</td></tr><tr><td>16</td><td>U103</td><td>93.0℃</td><td>106.4℃</td></tr><tr><td>17</td><td>TC</td><td>78.7℃</td><td>92.3℃</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：160 % 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： 305VAC/110VAC
O/P： 100 % LOAD
Ta=-30 ℃</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 45 ℃
NO DAMAGE</td><td>I/P： 305 VAC
O/P：FULL LOAD
Ta=45 ℃
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>± 0.014 %/℃(0~50℃)</td></tr>
</table>

6	STORAGE TEMPERATURE TEST	-40~80℃	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：10CYCLE 5. Input/output condition： STATIC TEST：OK
7	THERMAL SHOCK TEST	-25~45℃	1. Thermal shock Temperature： -30℃~ +50℃ 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, period for 60min. each along X, Y, Z axes	1 Carton & 1 Set (1) Waveform： Sine Wave (2) Frequency：10~500Hz (3) Sweep Time：10min/sweep cycle (4) Acceleration：3G (5) Test Time：180min in each axis (X.Y.Z) (6) Ta：25℃
9	CAPACITOR LIFE CYCLE	SUPPOSE C101 IS THE MOST CRITICAL COMPONENT (1) I/P： 230VAC O/P：FULL LOAD Tc=75 ℃ LIFE TIME (2) I/P： 230VAC O/P：75% LOAD Tc=75 ℃ LIFE TIME (3) I/P： 230VAC O/P：50% LOAD Tc=75 ℃ LIFE TIME	(1) 28040HRS (2) 85387HRS (3) 167843HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 4130.5K hrs min. Telcordia SR-332 (Bellcore) ; 317.7K hrs min. MIL-HDBK-217F (25℃)	
11	Ongoing Reliability Test	I/P：230VAC O/P：FULL LOAD TA=50℃ Demonstration Mean Time Between Failure : 50,000 hours	

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	WUWQ/HUANGMK	WENF	LINKX

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