



# Test Report : PWM-60-12

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60W PWM Output LED Power Supply

## ■ DESIGN VERIFY TEST

Output Function Test

Input Function Test

Protection 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	VERDICT
1	PWM FREQUENCY	1.47KHz	I/P: 230 VAC O/P:FULL LOAD Ta:25°C	1.483KHz	PASS
2	OUTPUT VOLTAGE TOLERANCE	V1: -4.0%~ +4.0% (Max)	I/P: 90 VAC / 305VAC O/P:FULL/ NO LOAD Ta:25°C	V1: -0.46% ~ 0.72%	PASS
3	SET UP TIME	230VAC : 500 ms (Max) 115VAC : 500 ms (Max)	I/P: 230 VAC I/P: 115 VAC O/P:95% LOAD Ta:25°C	230VAC/ 314 ms 115VAC/ 310 ms	PASS
4	RISE TIME	230VAC : 80 ms (Max) 115VAC : 80 ms (Max)	I/P: 230 VAC I/P: 115 VAC O/P:95% LOAD Ta:25°C	230VAC/ 0.10 ms 115VAC/ 0.40 ms	PASS
5	HOLD UP TIME	230VAC : 16 ms (Typ) 115VAC : 16 ms (Typ)	I/P: 230 VAC I/P: 115 VAC O/P:FULL LOAD Ta:25°C	230VAC/ 20 ms 115VAC/ 20 ms	PASS
6	OVER/UNDERSHOOT TEST	< ±5%	I/P: 230 VAC O/P:FULL LOAD Ta:25°C	TEST: <5 %	PASS

7	DIMMER TEST	<p>SPEC:</p> <p>*The duty of the PWM style output can be adjusted through output cable by connecting a 0~10Vdc or 10V PWM signal or resistance between DIM+ and DIM - .</p> <p>* Reference resistance value for output current adjustment (Typical)</p> <table border="1"> <tr> <td>Resistance value</td> <td>10K</td> <td>20K</td> <td>30K</td> <td>40K</td> <td>50K</td> <td>60K</td> <td>70K</td> <td>80K</td> <td>90K</td> <td>100K</td> </tr> <tr> <td>Output duty</td> <td>10%</td> <td>20%</td> <td>30%</td> <td>40%</td> <td>50%</td> <td>60%</td> <td>70%</td> <td>80%</td> <td>90%</td> <td>100%</td> </tr> </table> <p>*0 ~ 10V dimming function for output current adjustment (Typical)</p> <table border="1"> <tr> <td>Dimming value</td> <td>1V</td> <td>2V</td> <td>3V</td> <td>4V</td> <td>5V</td> <td>6V</td> <td>7V</td> <td>8V</td> <td>9V</td> <td>10V</td> </tr> <tr> <td>Output duty</td> <td>10%</td> <td>20%</td> <td>30%</td> <td>40%</td> <td>50%</td> <td>60%</td> <td>70%</td> <td>80%</td> <td>90%</td> <td>100%</td> </tr> </table> <p>*10V PWM signal for output current adjustment (Typical): Frequency range: 100Hz~3KHz</p> <table border="1"> <tr> <td>Duty value</td> <td>10%</td> <td>20%</td> <td>30%</td> <td>40%</td> <td>50%</td> <td>60%</td> <td>70%</td> <td>80%</td> <td>90%</td> <td>100%</td> </tr> <tr> <td>Output duty</td> <td>10%</td> <td>20%</td> <td>30%</td> <td>40%</td> <td>50%</td> <td>60%</td> <td>70%</td> <td>80%</td> <td>90%</td> <td>100%</td> </tr> </table>										Resistance value	10K	20K	30K	40K	50K	60K	70K	80K	90K	100K	Output duty	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Dimming value	1V	2V	3V	4V	5V	6V	7V	8V	9V	10V	Output duty	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Duty value	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Output duty	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
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		TEST RESULT: I/P : 230 VAC ;Ta : 25°C																																																																											
		1	Resistance value	10K	20K	30K	40K	50K	60K	70K	80K	90K	100K																																																																
			Output Current	0.525A	0.992A	1.485A	1.981A	2.457A	2.935A	3.393A	3.876A	4.338A	4.779A																																																																
%	10.50%		19.84%	29.70%	39.62%	49.14%	58.70%	67.86%	77.52%	86.76%	95.58%																																																																		
2	Dimming value	1V	2V	3V	4V	5V	6V	7V	8V	9V	10V																																																																		
	Output Current	0.674A	1.115A	1.589A	2.086A	2.584A	3.086A	3.587A	4.065A	4.567A	4.866A																																																																		
	%	13.48%	22.30%	31.78%	41.72%	51.68%	61.72%	71.74%	81.30%	91.34%	97.32%																																																																		
3	Duty value	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%																																																																		
	Output Current	0.610A	1.048A	1.516A	1.988A	2.486A	2.962A	3.466A	3.969A	4.448A	4.864A																																																																		
	%	12.20%	20.96%	30.32%	39.76%	49.72%	59.24%	69.32%	79.38%	88.96%	97.28%																																																																		

PASS

INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	VERDICT
1	INPUT VOLTAGE RANGE	90 VAC~305 VAC	I/P : TESTING O/P : FULL LOAD Ta : 25°C	87 V~305 V	PASS
			I/P : (1)LOW-LINE-3V=87 V HIGH-LINE+10V=315 V O/P : FULL/NO LOAD ON : 30 Sec OFF : 30 Sec 10MIN (2)230VAC ON : 0.5 Sec OFF : 0.5 Sec 20MIN (3)230VAC ON : 3Sec OFF : 3Sec 12HOURS ( POWER ON/OFF NO DAMAGE )	TEST : (1) OK (2) OK (3) OK	
2	INPUT FREQUENCY RANGE	47HZ ~63 HZ NO DAMAGE OSC	I/P : 90 VAC ~ 305 VAC O/P : FULL ~NO LOAD Ta : 25°C	TEST : OK	PASS
3	POWER FACTOR	115V/ 0.97 (TYP) 230V/ 0.95 (TYP) 277V/ 0.92 (TYP)	I/P : 115 VAC I/P : 230 VAC I/P : 277 VAC O/P : FULL LOAD Ta : 25°C	PF= 0.997 / 115 VAC PF= 0.982 / 230 VAC PF= 0.955 / 277 VAC	PASS
4	EFFICIENCY	86% (TYP)	I/P : 230 VAC O/P : FULL LOAD Ta : 25°C	88.05%	PASS
5	INPUT CURRENT	115V/ 0.8 A (TYP) 230V/ 0.4 A (TYP) 277V/ 0.32 A (TYP)	I/P : 115 VAC I/P : 230 VAC I/P : 277 VAC O/P : FULL LOAD Ta : 25°C	I = 0.586 A / 115 VAC I = 0.291 A / 230 VAC I = 0.246 A / 277 VAC	PASS
6	INRUSH CURRENT	230V/ 50 A (TYP) Twidth =270 us measured at 50% Ipeak COLD START	I/P : 230 VAC O/P : FULL LOAD Ta : 25°C	I = 47.2 A Twidth = 252 us	PASS
7	LEAKAGE CURRENT	< 0.25 mA / 277 VAC	I/P : 305 VAC O/P : NO LOAD Ta : 25°C	L-CASE : 0.003 mA N-CASE : 0.003 mA	PASS
8	NO LOAD CONSUMPTION	< 0.5 W	I/P : 230VAC O/P : NO LOAD Ta : 25°C	0.32 W	PASS
9	TOTAL HARMONIC DISTORTION	Total harmonic distortion will be lower than 20% when output loading is 60% or higher at 230V/115VAC Total harmonic distortion will be lower than 20% when output loading is 75% or higher at 277VAC	I/P : 115 VAC I/P : 230 VAC O/P : 60% LOAD I/P : 277 VAC O/P : 75%LOAD Ta : 25°C	THD : 5.85% /115VAC THD : 14.31% /230VAC THD : 14.73% /277VAC	PASS

**PROTECTION FUNCTION TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	VERDICT
1	OVER LOAD PROTECTION	108% ~ 120 %	I/P : 100 VAC I/P : 230 VAC I/P : 305 VAC O/P : TESTING Ta : 25°C	115.2 %/ 100 VAC 115.1 %/ 230 VAC 115.1 %/ 305 VAC Hiccup Mode , recovers automatically after fault condition is removed	PASS
2	OVER VOLTAGE PROTECTION	CH1 : 15 V ~ 17 V	I/P : 90 VAC I/P : 230 VAC I/P : 305 VAC O/P : NO LOAD Ta : 25°C	16.07 V/ 90 VAC 16.04 V/ 230 VAC 16.02 V/ 305 VAC Shut down o/p voltage , re-power on to recover	PASS
3	OVER TEMPERATURE PROTECTION	SPEC : O.T.P. NO DAMAGE	I/P : 230 VAC O/P : FULL LOAD	O.T.P. Active Shut down o/p voltage , re-power on to recover	PASS
4	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE	I/P : 305 VAC O/P : FULL LOAD Ta : 25°C	NO DAMAGE Hiccup mode , recovers automatically after fault condition is removed	PASS

**COMPONENT STRESS TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	VERDICT
1	Power Transistor ( D to S) or (C to E) Peak Voltage	Q2 Rated 800 V 9 A	I/P : High-Line +3V = 308 V O/P : (1) FULL LOAD Turn on (2) Output Short (3) FULL LOAD continue Ta : 25°C	(1) 672 V (2) 648 V (3) 664 V	PASS
2	Diode Peak Voltage	D100 Rated 60 V 40 A  Q105 60 V 79 A	I/P : High-Line +3V = 308 V O/P : (1) FULL LOAD Turn on (2) Output Short (3) FULL LOAD continue Ta : 25°C	D100 (1) 50.6 V (2) 50.6 V (3) 49.6 V Q105 (1) 10.6 V (2) 12.5 V (3) 0 V	PASS
3	Input Capacitor Voltage	C5 Rated 47uF / 450 V	I/P : High-Line +3V = 308 V O/P : (1) FULL LOAD Turn on /Off (2) NO LOAD Turn on /Off (3) FULL LOAD / NO LOAD Change Ta : 25°C	(1) 444 V (2) 443 V (3) 446 V	PASS
4	Control IC Voltage Test	U1 Rated 28V	I/P : High-Line +3V = 308 V O/P : (1) FULL LOAD Turn on /Off (2) NO LOAD Turn on /Off (3) FULL LOAD / NO LOAD Change Ta : 25°C	(1) 17.4 V (2) 17.5 V (3) 17.3 V	PASS
5	PFC Transistor ( D to S) or (C to E) Peak Voltage	Q1 Rated 600 V 10 A	I/P : High-Line +3V = 308 V O/P : (1) FULL LOAD Turn on (2) Output Short (3) FULL LOAD continue Ta : 25°C	(1) 470 V (2) 460 V (3) 456 V	PASS

**SAFETY & E.M.C. TEST**

**SAFETY TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	VERDICT
1	WITHSTAND VOLTAGE	I/P-O/P : 3.75 KVAC/min	I/P-O/P : 4.2 KVAC/min Ta : 25°C	I/P-O/P : 2.640 mA NO DAMAGE	PASS
2	ISOLATION RESISTANCE	I/P-O/P : 500VDC>100MΩ	I/P-O/P : 500 VDC Ta : 25°C/70%RH	I/P-O/P : >9999 MΩ NO DAMAGE	PASS

**E.M.C TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	VERDICT
1	HARMONIC	EN61000-3-2 CLASS C	I/P : 115VAC/230VAC/50HZ O/P : 60%/FULL LOAD I/P : 277VAC/50HZ O/P : 75%/FULL LOAD Ta:25°C	OK	PASS
2	CONDUCTION	EN55015 CLASS B	I/P : 230 VAC/50HZ O/P:FULL LOAD Ta:25°C	OK Test by certified Lab	PASS
3	RADIATION	EN55015 CLASS B	I/P : 230 VAC/50HZ O/P:FULL LOAD Ta:25°C	OK Test by certified Lab	PASS
4	E.S.D	EN61000-4-2 LIGHT INDUSTRY AIR:8KV / Contact:4KV	I/P : 230 VAC/50HZ O/P:FULL LOAD Ta:25°C	CRITERIA A	PASS
5	E.F.T	EN61000-4-4 LIGHT INDUSTRY INPUT : 1KV	I/P : 230 VAC/50HZ O/P:FULL LOAD Ta:25°C	CRITERIA A	PASS
6	SURGE	IEC61000-4-5 INDUSTRY L-N :2KV	I/P : 230 VAC/50HZ O/P:FULL LOAD Ta:25°C	CRITERIA A	PASS
7	Test by certified Lab & Test Report Prepare				

■ RELIABILITY TEST

ENVIRONMENT TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	VERDICT																																																																												
1	TEMPERATURE RISE TEST	MODEL : PWM-60-12 1. ROOM AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta=34.8 °C 2. HIGH AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta=54.1 °C			PASS																																																																												
		<table border="1"> <thead> <tr> <th>NO</th> <th>Position</th> <th>ROOM AMBIENT Ta= 34.8 °C</th> <th>HIGH AMBIENT Ta= 54.1 °C</th> </tr> </thead> <tbody> <tr><td>1</td><td>C11</td><td>65.3°C</td><td>83.0°C</td></tr> <tr><td>2</td><td>L3</td><td>56.6°C</td><td>74.2°C</td></tr> <tr><td>3</td><td>D6</td><td>66.1°C</td><td>84.0°C</td></tr> <tr><td>4</td><td>Q1</td><td>67.6°C</td><td>85.5°C</td></tr> <tr><td>5</td><td>Q2</td><td>70.2°C</td><td>88.4°C</td></tr> <tr><td>6</td><td>C5</td><td>63.6°C</td><td>81.5°C</td></tr> <tr><td>7</td><td>T1</td><td>71.8°C</td><td>89.2°C</td></tr> <tr><td>8</td><td>C45</td><td>66.1°C</td><td>84.0°C</td></tr> <tr><td>9</td><td>U1</td><td>64.2°C</td><td>82.2°C</td></tr> <tr><td>10</td><td>C105</td><td>74.2°C</td><td>92.5°C</td></tr> <tr><td>11</td><td>D100</td><td>79.0°C</td><td>97.4°C</td></tr> <tr><td>12</td><td>Q105</td><td>74.0°C</td><td>92.4°C</td></tr> <tr><td>13</td><td>U100</td><td>65.6°C</td><td>83.5°C</td></tr> <tr><td>14</td><td>LF100</td><td>72.0°C</td><td>90.5°C</td></tr> <tr><td>15</td><td>C112</td><td>67.1°C</td><td>85.4°C</td></tr> <tr><td>16</td><td>U2</td><td>59.2°C</td><td>77.0°C</td></tr> <tr><td>17</td><td>RTH2</td><td>63.5°C</td><td>81.4°C</td></tr> <tr><td>18</td><td>TC</td><td>58.3°C</td><td>75.4°C</td></tr> </tbody> </table>	NO	Position		ROOM AMBIENT Ta= 34.8 °C	HIGH AMBIENT Ta= 54.1 °C	1	C11	65.3°C	83.0°C	2	L3	56.6°C	74.2°C	3	D6	66.1°C	84.0°C	4	Q1	67.6°C	85.5°C	5	Q2	70.2°C	88.4°C	6	C5	63.6°C	81.5°C	7	T1	71.8°C	89.2°C	8	C45	66.1°C	84.0°C	9	U1	64.2°C	82.2°C	10	C105	74.2°C	92.5°C	11	D100	79.0°C	97.4°C	12	Q105	74.0°C	92.4°C	13	U100	65.6°C	83.5°C	14	LF100	72.0°C	90.5°C	15	C112	67.1°C	85.4°C	16	U2	59.2°C	77.0°C	17	RTH2	63.5°C	81.4°C	18	TC	58.3°C	75.4°C		
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14	LF100	72.0°C	90.5°C																																																																														
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16	U2	59.2°C	77.0°C																																																																														
17	RTH2	63.5°C	81.4°C																																																																														
18	TC	58.3°C	75.4°C																																																																														
2	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 305VAC/100VAC O/P : FULL LOAD Ta= -45°C/-30°C	TEST : OK	PASS																																																																												
3	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 50°C NO DAMAGE	I/P : 315 VAC O/P : FULL LOAD Ta= 50°C HUMIDITY= 95% R.H	TEST : OK	PASS																																																																												
4	TEMPERATURE COEFFICIENT	±0.03 %(0~50°C)	I/P : 230 VAC O/P : FULL LOAD	±0.008 %(0~50°C)	PASS																																																																												
5	STORAGE TEMPERATURE TEST	1. Thermal shock Temperature : -45°C ~ +85°C 2. Temperature change rate : 25°C / MIN 3. Dwell time low and high temperature : 30 MIN/EACH 4. Total test cycle : 5 CYCLE 5. Input/Output condition : STATIC		OK	PASS																																																																												
6	THERMAL SHOCK TEST	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 : 10 CYCLE 5. Input/Output condition : 230VAC/FULL LOAD AC ON/OFF TEST turn on 58sec : turn off 2sec		OK	PASS																																																																												



7	VIBRATION TEST	1 Carton & 1 Set (1) Waveform : Sine Wave (2) Frequency : 10~500Hz (3) Sweep Time : 12min/sweep cycle (4) Acceleration : 5G (5) Test Time : 90min in each axis (X.Y.Z) (6) Ta : 25°C	TEST : OK	PASS
8	CAPACITOR LIFE CYCLE	PWM-60-12 : SUPPOSE C105 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) 190819 HRS (2) 36150 HRS (3) 63377 HRS (4) 97354 HRS	PASS
9	MTBF	MIL-HDBK-217F NOTICES2 PARTS COUNT TOTAL FAILURE RATE : 271.03 KHRS		PASS
10	DMTBF/Accelerated Life Test	Demonstration Mean Time Between Failure(Expected Life) : 50000 hours @ Tcase 70°C		PASS

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	ZHANGZJ/ Cary Chen	SKY	LIUWY

2009/08/04 A50-G058