Test Report: HVG-65-12

65W Constant Voltage + Constant Current LED Driver

■ 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

■ ESIGN VERIFY TEST

OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	RIPPLE & NOISE	V1：120 mVp-p (Max)	I/P： 347VAC O/P：FULL LOAD Ta：25℃	V1： 24 mVp-p (Max)
2	OUTPUT VOLTAGE ADJUST RANGE	CH1： 10.8V ~ 13.5 V	I/P： 480 VAC I/P： 347 VAC O/P：MIN LOAD Ta：25℃	10.462 V ~ 13.855 V/ 480 VAC 10.455 V ~ 13.855 V/ 347 VAC
3	OUTPUT CURRENT ADJUST RANGE	CH1 ：3 A~5 A	I/P： 480 VAC I/P： 347 VAC O/P：CV MODE Ta：25℃	2.266 A~ 5.525 A/ 480 VAC 2.267 A~ 5.525 A/ 347 VAC
4	OUTPUT VOLTAGE TOLERANCE	V1： 2%~ -2 % (Max)	I/P：180 VAC / 480 VAC O/P：FULL/ MIN LOAD Ta：25℃	V1： 0.9 %~ -0.9 %
5	LINE REGULATION	V1：0.5 %~ -0.5% (Max)	I/P：180 VAC ~ 480 VAC O/P：FULL LOAD Ta：25℃	V1： 0 %~ 0 %
6	LOAD REGULATION	V1：1.5 %~-1.5% (Max)	I/P： 347 VAC O/P：FULL ~MIN LOAD Ta：25℃	V1： 0.037 %~ -0.79 %
7	SET UP TIME	480 VAC： 400 ms (Max) 347VAC： 400 ms(Max) 230VAC： 500 ms(Max)	I/P： 480 VAC I/P： 347 VAC I/P： 230 VAC O/P：FULL LOAD Ta：25℃	480 VAC/ 169 ms 347VAC/ 268 ms 230VAC/ 329 ms
8	RISE TIME	480 VAC： 80 ms (Max) 347VAC： 80 ms (Max) 230VAC： 80 ms (Max)	I/P： 480 VAC I/P： 347 VAC I/P： 230 VAC O/P：FULL LOAD Ta：25℃	480 VAC/ 16.2 ms 347VAC/ 19.1 ms 230VAC/ 19.1 mS
9	HOLD UP TIME	480 VAC： 30 ms (TYP) 347VAC： 16 ms (TYP)	I/P： 480 VAC I/P： 347 VAC O/P：FULL LOAD Ta：25℃	480 VAC/ 43.8 ms 347VAC/ 19.4 ms
10	OVER/UNDERSHOOT TEST	< ±5%	I/P： 347 VAC O/P：FULL LOAD Ta：25℃	TEST： <5 %

11	DYNAMIC LOAD	V1： 1200 mVp-p	I/P： 347VAC (1).O/P：FULL /Min LOAD 90%DUTY/ 1KHZ (2).O/P：FULL /Min LOAD 90%DUTY/ 3KHZ (3).O/P：FULL /Min LOAD 90%DUTY/ 5KHZ (4).O/P：FULL /Min LOAD 50%DUTY/ 120HZ Ta：25℃	(1)261 mVp-p (2)217 mVp-p (3)213 mVp-p (4)442 mVp-p

12 DIMMER TEST
(B Type only)
SPEC:
※Built-in 3 in 1 dimming function, IP67 rated. Output constant current level can be adjusted through output cable by connecting a resistance or
0 ~ 10Vdc or 10V PWM signal between DIM+ and DIM-.
※Please DO NOT connect "DIM-" to "-V".
※Reference resistance value for output current adjustment (Typical)

Resistance value	Short	10K	20K	30K	40K	50K	60K	70K	80K	90K	100K	OPEN
Output current	**0%**	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**	95%~ 108%

*1 ~ 10V dimming function for output current adjustment (Typical)

Dimming value	Short	1V	2V	3V	4V	5V	6V	7V	8V	9V	10V	OPEN
Output current	**0%**	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**	95%~ 108%

*10V PWM signal for output current adjustment (Typical) : Frequency range :100Hz ~ 3KHz

Duty value	Short	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	OPEN
Output current	**0%**	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**	95%~ 108%

TEST RESULT: I/P： 230 VAC ;Ta：25℃

1	Resistance value	SHORT	10K	20K	30K	40K	50K	60K	70K	80K	90K	100K	OPEN
	Output current	0.000A	0.530A	1.017A	1.497A	1.976A	2.447A	2.914A	3.387A	3.839A	4.301A	4.802A	5.201A
	%	0.00%	10.60%	20.34%	29.94%	39.52%	48.94%	58.28%	67.74%	76.78%	86.02%	96.04%	104.02%
2	Dimming value	SHORT	1V	2V	3V	4V	5V	6V	7V	8V	9V	10V	OPEN
	Output current	0.000A	0.547A	1.062A	1.566A	2.047A	2.550A	3.043A	3.545A	4.023A	4.512A	5.031A	5.201A
	%	0.00%	10.94%	21.24%	31.32%	40.94%	51.00%	60.86%	70.90%	80.46%	90.24%	100.62%	104.02%
3	Duty value	SHORT	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	OPEN
	Output current	0.000A	0.640A	1.084A	1.578A	2.072A	2.567A	3.062A	3.558A	4.054A	4.551A	5.048A	5.201A
	%	0.00%	12.80%	21.68%	31.56%	41.44%	51.34%	61.24%	71.16%	81.08%	91.02%	100.96%	104.02%

13	CONSTANT CURRENT REGION	7.2V ~ 12V	I/P： 347 VAC O/P：FULL LOAD Ta：25℃	O/P=7.2V ：5.01 A O/P=11V ：5.01 A

INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT

1	INPUT VOLTAGE RANGE	180VAC~528 VAC	I/P：TESTING O/P：FULL LOAD Ta：25℃	159 V~480V
			I/P： LOW-LINE-3V=177V HIGH-LINE+3V=531 V O/P：FULL/MIN LOAD ON： 30 Sec . OFF： 30 Sec 10MIN (AC POWER ON/OFF NO DAMAGE)	TEST： OK
2	INPUT FREQUENCY RANGE	47HZ ~63 HZ NO DAMAGE	I/P：180VAC ~ 528 VAC O/P：FULL~MIN LOAD Ta：25℃	TEST： OK
3	POWER FACTOR	0.98 / 230 VAC(TYP) 0.97 / 277VAC(TYP) 0.97 /347 VAC(TYP) 0.93 / 480 VAC(TYP)	I/P： 230VAC I/P： 277VAC I/P： 347VAC I/P： 480VAC O/P：FULL LOAD Ta：25℃	PF= 0.9922 / 230 VAC PF= 0.9886 / 277 VAC PF= 0.9770 / 347VAC PF= 0.9503 / 480VAC
4	EFFICIENCY	86.5 % (TYP)	I/P： 347 VAC O/P：FULL LOAD Ta：25℃	87.3 %
5	INPUT CURRENT	347V/ 0.22 A (TYP) 480V/ 0.18 A (TYP)	I/P： 347 VAC I/P： 480 VAC O/P：FULL LOAD Ta：25℃	I = 0.1924 A/347 VAC I = 0.1425 A/ 480VAC
6	INRUSH CURRENT	480V/ 25 A (TYP) (twidth=420us measured at 50% Ipeak) COLD START	I/P： 480VAC O/P：FULL LOAD Ta：25℃	I = 19.4 A/ 480VAC T50= 376 us
7	LEAKAGE CURRENT	< 0.75 mA / 480 VAC	I/P： 480 VAC O/P：Min LOAD Ta：25℃	L-FG： 0.34 mA N-FG： 0.38 mA
8	TOTAL HARMONIC DISTORTION	Total harmonic distortion will be lower than 20% when output loading is 60% or higher at 230VAC / 277VAC / 347VAC	I/P： 230VAC I/P： 277VAC I/P： 347VAC O/P：60% LOAD Ta：25℃	THD： 14.26 % THD： 15.3 % THD： 13.2 %
		Total harmonic distortion will be lower than 20% when output loading is 75% or higher at 480VAC	I/P： 480VAC O/P：75% LOAD Ta：25℃	THD： 14.27 %

PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER CURRENT	95% ~ 108%	I/P： 480 VAC I/P： 347 VAC O/P：TESTING Ta：25℃	102.78 %/ 480 VAC 102.78 %/ 347 VAC Constant current limiting, recovers automatically after fault condition is removed
2	OVER VOLTAGE PROTECTION	CH1：14.4V ~ 16.8 V	I/P： 480 VAC I/P： 347 VAC O/P：MIN LOAD Ta：25℃	15.65V/ 480VAC 15.61V/ 347 VAC Shut down o/p voltage with auto-recovery or re-power on to recovery
3	OVER TEMPERATURE PROTECTION	SPEC： NO DAMAGE	I/P： 347 VAC O/P：FULL LOAD	O.T.P. Active Shut down o/p voltage, recovers automatically after temperature goes down
4	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE	I/P： 528VAC O/P：FULL LOAD Ta：25℃	NO DAMAGE Constant current limiting, recovers automatically after fault condition is removed

COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	Power Transistor (D to S) or (C to E) Peak Voltage	Q3 Rated：9A/950V	I/P：High-Line +3V = 531 V O/P： (1)Full Load Turn on (2) Output Short (3)Full load continue Ta：25℃	(1) 762 V (2) 665 V (3) 585 V
2	Diode Peak Voltage	D101 Rated： 30A/65V	I/P：High-Line +3V = 531 V O/P： (1)Full Load Turn on (2)Output Short (3)Full load continue Ta：25℃	(1) 53.2 V (2) 62.9 V (3) 45.2 V
3	Input Capacitor Voltage	C5 Rated： 22u/450V	I/P：High-Line +3V = 531 V O/P： (1)Full Load Turn on /Off (2) Min load Turn on /Off (3)Full Load /Min load Change Ta：25℃	(1) 483 V (2) 412 V (3) 445 V
4	Control IC Voltage Test	U1 Rated： 10.3V~22.5V U2 Rated： 11V~28V	I/P：High-Line +3V = 531 V O/P： (1)Full Load Turn on /Off (2) Min load Turn on /Off (3)Full Load /Min load Change (1)Full Load Turn on /Off (2) Min load Turn on /Off (3)Full Load /Min load Ta：25℃	(1) 21.8 V (2) 20.2 V (3) 19.4 V (4) 19.4 V (5) 19.6 V (6) 17.7 V

5	Power Transistor (D to S) or (C to E) Peak Voltage	Q1 Rated： 9A/950V	I/P：High-Line +3V = 531 V O/P： (1)Full Load Turn on (2) Output Short (3)Full load continue Ta：25℃	(1) 927 V (2) 879 V (3) 855 V

■ SAFETY & E.M.C. TEST

SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	I/P-O/P： 3.75 KVAC/min I/P-FG： 2 KVAC/min O/P-FG： 1.5 KVAC/min	I/P-O/P： 4 KVAC/min I/P-FG： 2.4 KVAC/min O/P-FG： 1.8 KVAC/min Ta：25℃	I/P-O/P： 3.28 mA I/P-FG： 2.985 mA O/P-FG： 1.969 mA 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℃/70%RH	I/P-O/P： 4.78 GΩ I/P-FG： 4.41 GΩ O/P-FG： 27.4 GΩ NO DAMAGE
3	GROUNDING CONTINUITY	FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40 A / 2min Ta：25℃ / 70%RH	22 mΩ

E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	HARMONIC	EN61000-3-2 CLASS C	I/P:230VAC/380VAC/50HZ/60HZ O/P:100/60%ELECTRONIC LOAD O/P:100%LED LOAD Ta:25℃	PASS
2	CONDUCTION	EN55015 CLASS B FCC Part 15 Subpart B	I/P: 230VAC/380VAC/50HZ/60HZ O/P:FULL/50% LOAD Ta:25℃	PASS Test by certified Lab
3	RADIATION	EN55015 CLASS B FCC Part 15 Subpart B	I/P: 230VAC/380VAC/50HZ/60HZ O/P:FULL LOAD Ta:25℃	PASS Test by certified Lab
4	E.S.D	EN61000-4-2 LIGHT INDUSTRY AIR:8KV / Contact:4KV	I/P: 230VAC/380VAC/50HZ/60HZ O/P:FULL LOAD Ta:25℃	CRITERIA A
5	E.F.T	EN61000-4-4 LIGHT INDUSTRY INPUT： 1KV	I/P: 230VAC/380VAC/50HZ/60HZ O/P:FULL LOAD Ta:25℃	CRITERIA A
6	SURGE	IEC61000-4-5 INDUSTRY L-N :2KV L,N-PE:4KV	I/P: 230VAC/380VAC/50HZ/60HZ 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：HVG-65-12
1. ROOM AMBIENT BURN-IN：4.5 HRS
I/P： 347VAC O/P： FULL LOAD Ta=33.2 ℃
2. HIGH AMBIENT BURN-IN： 1 HRS
I/P： 347VAC O/P： FULL LOAD Ta=65.5 ℃
<table>
<tr><th>NO</th><th>Position</th><th>ROOM AMBIENT Ta= 33.2 ℃</th><th>HIGH AMBIENT Ta= 65.5 ℃</th></tr>
<tr><td>1</td><td>BD1</td><td>55.8℃</td><td>85.2℃</td></tr>
<tr><td>2</td><td>L2</td><td>56.4℃</td><td>85.9℃</td></tr>
<tr><td>3</td><td>Q1</td><td>60.6℃</td><td>89.5℃</td></tr>
<tr><td>4</td><td>U1</td><td>57.6℃</td><td>86.8℃</td></tr>
<tr><td>5</td><td>Q3</td><td>61.6℃</td><td>90.6℃</td></tr>
<tr><td>6</td><td>C5</td><td>58.7℃</td><td>87.4℃</td></tr>
<tr><td>7</td><td>RTH2</td><td>57.3℃</td><td>86.4℃</td></tr>
<tr><td>8</td><td>T1</td><td>67.0℃</td><td>96.3℃</td></tr>
<tr><td>9</td><td>C62</td><td>59.2℃</td><td>88.2℃</td></tr>
<tr><td>10</td><td>C46</td><td>54.1℃</td><td>83.3℃</td></tr>
<tr><td>11</td><td>D101</td><td>67.1℃</td><td>97.1℃</td></tr>
<tr><td>12</td><td>C102</td><td>64.2℃</td><td>94.0℃</td></tr>
<tr><td>13</td><td>C203</td><td>61.8℃</td><td>91.3℃</td></tr>
<tr><td>14</td><td>LF100</td><td>59.2℃</td><td>89.5℃</td></tr>
<tr><td>15</td><td>C104</td><td>60.1℃</td><td>89.9℃</td></tr>
</table></td></tr>
<tr><td>2</td><td>LOW TEMPERATURE
TURN ON TEST</td><td>TURN ON AFTER 2 HOUR</td><td>I/P： 528VAC/180VAC
O/P： 100 % LOAD
Ta= -40 ℃</td><td>TEST：OK</td></tr>
<tr><td>3</td><td>HIGH HUMIDITY
HIGH TEMPERATURE
HIGH VOLTAGE
TURN ON TEST</td><td>AFTER 12 HOURS
IN CHAMBER ON
CONTROL 60℃
NO DAMAGE</td><td>I/P： 528 VAC
O/P：FULL LOAD
Ta= 60 ℃
HUMIDITY= 95 %R.H</td><td>TEST：OK</td></tr>
<tr><td>4</td><td>TEMPERATURE
COEFFICIENT</td><td>± 0.03%(0~60℃)</td><td>I/P： 347 VAC
O/P：FULL LOAD</td><td>± 0.011 %(0~60℃)</td></tr>
<tr><td>5</td><td>STORAGE TEMPERATURE TEST</td><td>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：5 CYCLE
5. Input/Output condition： STATIC</td><td colspan="2">OK</td></tr>
<tr><td>6</td><td>THERMAL SHOCK TEST</td><td>1. Thermal shock Temperature： -45℃~ +65℃
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： 347VAC/Full Load AC ON/OFF TEST
turn on 58sec；turn off 2sec</td><td colspan="2">OK</td></tr>
</table>

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：72min in each axis (X.Y.Z) (6) Ta：25℃	TEST：OK
8	CAPACITOR LIFE CYCLE	SUPPOSE C102 IS THE MOST CRITICAL COMPONENT (1) I/P： 347VAC O/P：FULL LOAD Tc=75 ℃ LIFE TIME (2) I/P： 347VAC O/P：75% LOAD Tc=75 ℃ LIFE TIME (3) I/P： 347VAC O/P：50% LOAD Tc=75 ℃ LIFE TIME	 (1) 47064 HRS (2) 56057 HRS (3) 72568 HRS
9	MTBF	Conducted by Parts Stress Analysis Prediction 612.6K hrs min. Telcordia SR-332 (Bellcore) ; 208K hrs min. MIL-HDBK-217F (25℃)	
10	Ongoing Reliability Test	I/P：230VAC O/P：FULL LOAD TA=50℃ Demonstration Mean Time Between Failure : 50,000 hours	

RESULT	TESTER	REVIEW	APPROVAL
PASS	DANIEL GAO	SANFORD SU	VINCENT TSENG

■ 12.10.30 A50-F031