Test Report: HVG-65-24

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

■ DESIGN VERIFY TEST

OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	RIPPLE & NOISE	V1：150 mVp-p (Max)	I/P： 347VAC O/P：FULL LOAD Ta：25℃	V1： 39 mVp-p (Max)
2	OUTPUT VOLTAGE ADJUST RANGE	CH1：22V ~ 27 V	I/P： 480 VAC I/P： 347 VAC O/P：MIN LOAD Ta：25℃	21.399 V ~ 28.172 V/ 480 VAC 21.395 V ~ 28.172 V/ 347 VAC
3	OUTPUT CURRENT ADJUST RANGE	CH1 ：1.62A~2.71 A	I/P： 480 VAC I/P： 347 VAC O/P：CV MODE Ta：25℃	1.161 A~ 2.921 A/ 480 VAC 1.156 A~ 2.916 A/ 347 VAC
4	OUTPUT VOLTAGE TOLERANCE	V1： 1%~ -1 % (Max)	I/P：180 VAC / 480 VAC O/P：FULL/ MIN LOAD Ta：25℃	V1： 0.23 %~ 0.23 %
5	LINE REGULATION	V1：0.5 %~ -0.5% (Max)	I/P：180 VAC ~ 480 VAC O/P：FULL LOAD Ta：25℃	V1： 0.025 %~ 0 %
6	LOAD REGULATION	V1：0.5 %~-0.5% (Max)	I/P： 347 VAC O/P：FULL ~MIN LOAD Ta：25℃	V1： 0.13 %~ 0.32 %
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/ 10.2 ms 347VAC/ 11 ms 230VAC/ 11 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/ 42 ms 347VAC/ 20 ms
10	OVER/UNDERSHOOT TEST	< ±5%	I/P： 347 VAC O/P：FULL LOAD Ta：25℃	TEST： <5 %

11	DYNAMIC LOAD	V1： 2400 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)277 mVp-p (2)185 mVp-p (3)187 mVp-p (4)671 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	0.301A	0.572A	0.845A	1.120A	1.393A	1.669A	1.951A	2.224A	2.506A	2.769A	2.808A
	%	0.00%	11.11%	21.11%	31.18%	41.33%	51.40%	61.59%	71.99%	82.07%	92.47%	102.18%	103.62%
2	Dimming value	SHORT	1V	2V	3V	4V	5V	6V	7V	8V	9V	10V	OPEN
	Output current	0.000A	0.321A	0.581A	0.841A	1.110A	1.390A	1.661A	1.922A	2.178A	2.458A	2.719A	2.808A
	%	0.00%	11.85%	21.44%	31.03%	40.96%	51.29%	61.29%	70.92%	80.37%	90.70%	100.33%	103.62%
3	Duty value	SHORT	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	OPEN
	Output current	0.000A	0.354A	0.593A	0.860A	1.127A	1.395A	1.662A	1.930A	2.198A	2.466A	2.735A	2.808A
	%	0.00%	13.06%	21.88%	31.73%	41.59%	51.48%	61.33%	71.22%	81.11%	91.00%	100.92%	103.62%

13	CONSTANT CURRENT REGION	14.4V ~ 24V	I/P： 347 VAC O/P：FULL LOAD Ta：25℃	O/P=14.4V ：2.798 A O/P=23 V ：2.798 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℃	160V~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= 0.9914 / 230 VAC PF= 0.9882 / 277 VAC PF= 0.9767 / 347VAC PF= 0.9765 / 480VAC
4	EFFICIENCY	89 % (TYP)	I/P： 347 VAC O/P：FULL LOAD Ta：25℃	89.8 %
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 = 0.202 A/ 347 VAC I = 0.148 A/ 480 VAC
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= 396 us
7	LEAKAGE CURRENT	< 0.75 mA / 480 VAC	I/P： 480 VAC O/P：Min LOAD Ta：25℃	L-FG： 0.26 mA N-FG： 0.24 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： 11.84 % THD： 14.28 % THD： 14.04 %
		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： 14.4 %

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℃	102.1%/ 480 VAC 102.06%/ 347 VAC Constant current limiting, recovers automatically after fault condition is removed
2	OVER VOLTAGE PROTECTION	CH1：28V ~ 34 V	I/P： 480 VAC I/P： 347 VAC O/P：MIN LOAD Ta：25℃	43.06V/ 480VAC 38.51V/ 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	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： 5 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) 706 V (3) 521 V
2	Diode Peak Voltage	D101 Rated： 30A/100V	I/P：High-Line +3V = 531 V O/P： (1)Full Load Turn on (2)Output Short (3)Full load continue Ta：25℃	(1) 80 V (2) 65.6 V (3) 79.2 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) 412 V (2) 400 V (3) 400 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) 19.2 V (2) 19.4 V (3) 19.0 V (4) 17.0 V (5) 17.6 V (6) 16.2 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) 841 V (2) 768 V (3) 752 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： 1.5KVAC/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： 3.38 mA I/P-FG： 2.945 mA O/P-FG： 2.078 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： 1.74 GΩ I/P-FG： 1.51 GΩ O/P-FG： 5.96 GΩ NO DAMAGE
3	GROUNDING CONTINUITY	FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40 A / 2min Ta：25℃ / 70%RH	19 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-65-24
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>52.5℃</td><td>82.2℃</td></tr>
<tr><td>2</td><td>L2</td><td>55.3℃</td><td>84.7℃</td></tr>
<tr><td>3</td><td>Q1</td><td>57.8℃</td><td>86.9℃</td></tr>
<tr><td>4</td><td>U1</td><td>55.3℃</td><td>85.1℃</td></tr>
<tr><td>5</td><td>Q3</td><td>60.1℃</td><td>88.9℃</td></tr>
<tr><td>6</td><td>C5</td><td>56.6℃</td><td>85.4℃</td></tr>
<tr><td>7</td><td>RTH2</td><td>54.1℃</td><td>83.5℃</td></tr>
<tr><td>8</td><td>T1</td><td>65.0℃</td><td>93.4℃</td></tr>
<tr><td>9</td><td>C62</td><td>56.7℃</td><td>85.6℃</td></tr>
<tr><td>10</td><td>C46</td><td>51.7℃</td><td>81.8℃</td></tr>
<tr><td>11</td><td>D101</td><td>65.5℃</td><td>95.1℃</td></tr>
<tr><td>12</td><td>C102</td><td>60.3℃</td><td>89.5℃</td></tr>
<tr><td>13</td><td>C203</td><td>58.9℃</td><td>87.8℃</td></tr>
<tr><td>14</td><td>LF100</td><td>55.1℃</td><td>84.7℃</td></tr>
<tr><td>15</td><td>C104</td><td>55.7℃</td><td>85.3℃</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) 56870 HRS (2) 63621 HRS (3) 76129 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