



# Test Report: HVG-480-36

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480W 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

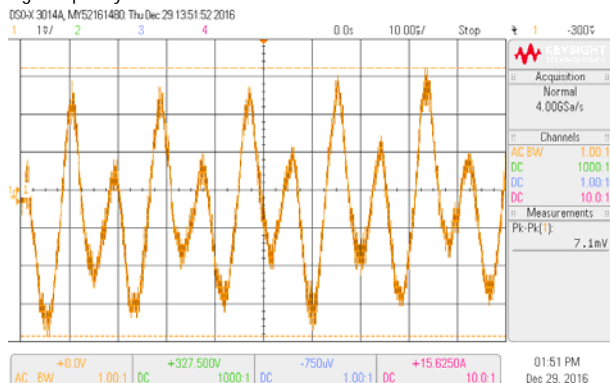
ENVIRONMENT TEST

DESIGN VERIFY TEST

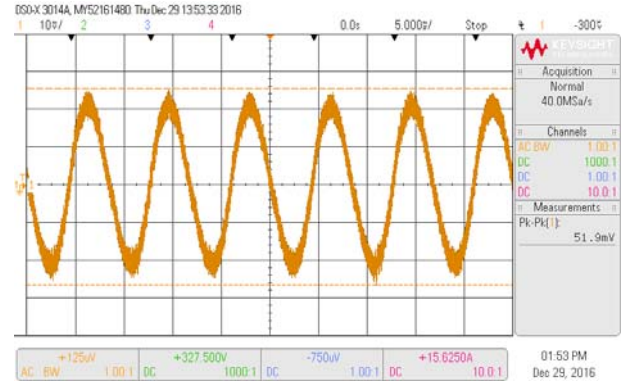
OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	CONSTANT CURRENT REGION	CH1: 18V~ 36V	I/P: 347 VAC O/P:FULL LOAD Ta:25°C	0.14V~35 V /347VAC
2	OUTPUT VOLTAGE ADJUST RANGE	CH1:30.6~37.8V	I/P: 347 VAC I/P:230VAC O/P:MIN LOAD Ta:25°C	28.366V~38.944V /347VAC 28.369V~ 38.944V/230VAC
3	CURRENT ADJ. RANGE	CH1:6.6A~ 13.3A	I/P: 347 VAC I/P:230VAC O/P:CV MIN & CV MAX-1V Ta:25°C	4.686A~14.102 A /347VAC@CV MAX-1V 4.703A~14.059A /347VAC@CV MIN 4.684A~14.11A/230VAC@CVMAX-1V 4.7A~14.057A/230VAC@CV MIN
4	OUTPUT VOLTAGE TOLERANCE (Max)	V1: 1 % ~ -1 %	I/P:180VAC /528AC O/P:FULL/ MIN LOAD Ta:25°C	V1: 0.286%~-0.058%
5	LINE REGULATION (Max)	V1: 0.5 % ~ -0.5 %	I/P:180VAC~528AC O/P:FULL LOAD Ta:25°C	V1: 0.008%~0%
6	LOAD REGULATION (Max)	V1: 0.5 % ~ -0.5 %	I/P: 347 VAC O/P:FULL ~MIN LOAD Ta:25°C	V1: 0.174%~-0.164%
7	OVER/UNDERSHOOT TEST	< ±5%	I/P: 347 VAC O/P:FULL LOAD Ta:25°C	TEST: < 5 %
8	RIPPLE & NOISE (Max)	V1: 250 mVp-p	I/P: 347 VAC O/P:FULL LOAD Ta:25°C	V1: 51.9mVp-p

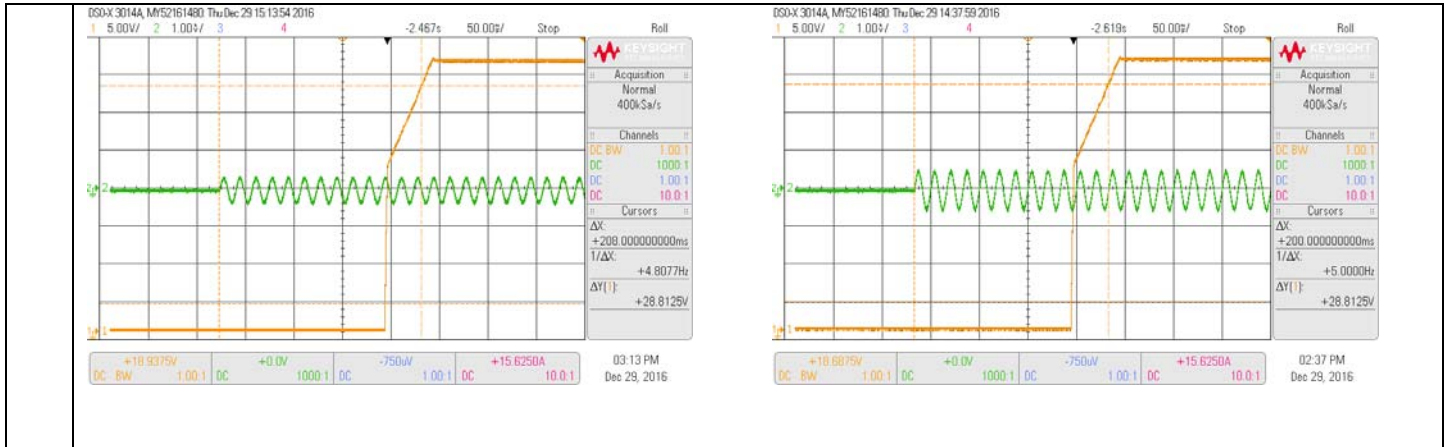
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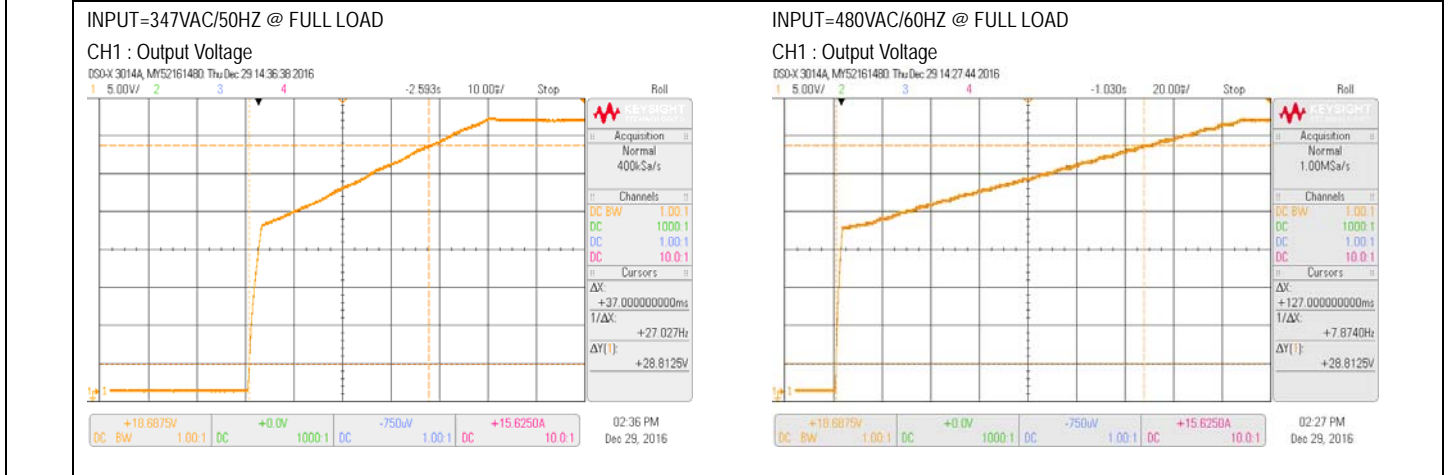
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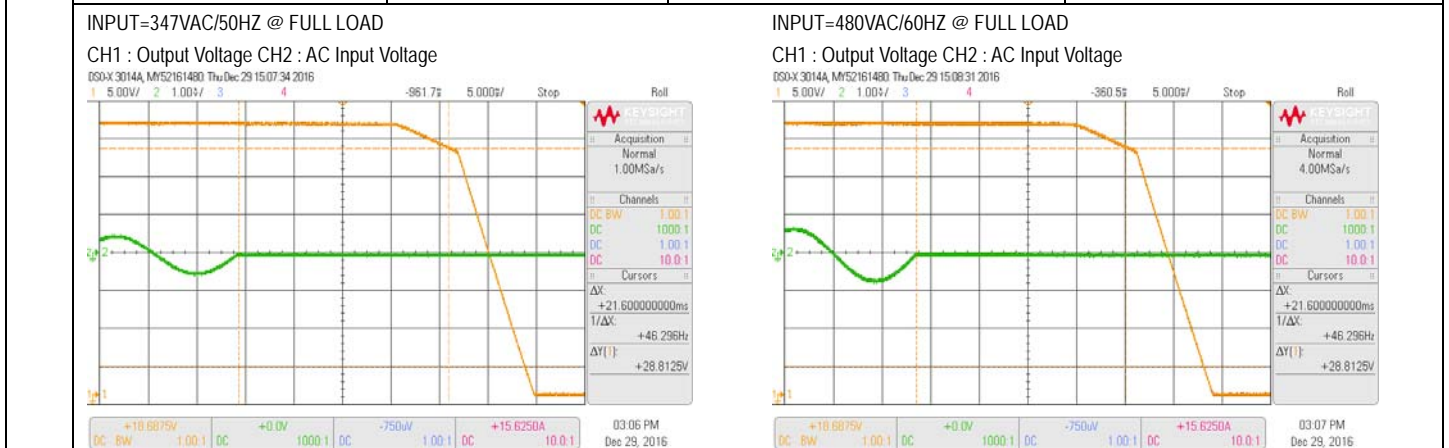
9	SET UP TIME	480VAC/ 500 ms (Max) 347VAC/ 500 ms (Max) 230VAC/ 500 ms (Max)	I/P: 480 VAC I/P: 347 VAC I/P: 230 VAC O/P:FULL LOAD Ta:25°C	480VAC/200ms 347VAC/208ms 230VAC/215ms
INPUT=347VAC/50HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage		INPUT=480VAC/60HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage		



<b>10</b> RISE TIME	480VAC/ 100 ms (Max) 347VAC/ 100 ms (Max) 230VAC/ 100 ms (Max)	I/P: 480 VAC I/P: 347 VAC I/P: 230 VAC O/P:FULL LOAD Ta:25°C	480VAC/ 37ms 347VAC/38.4ms 230VAC/37ms
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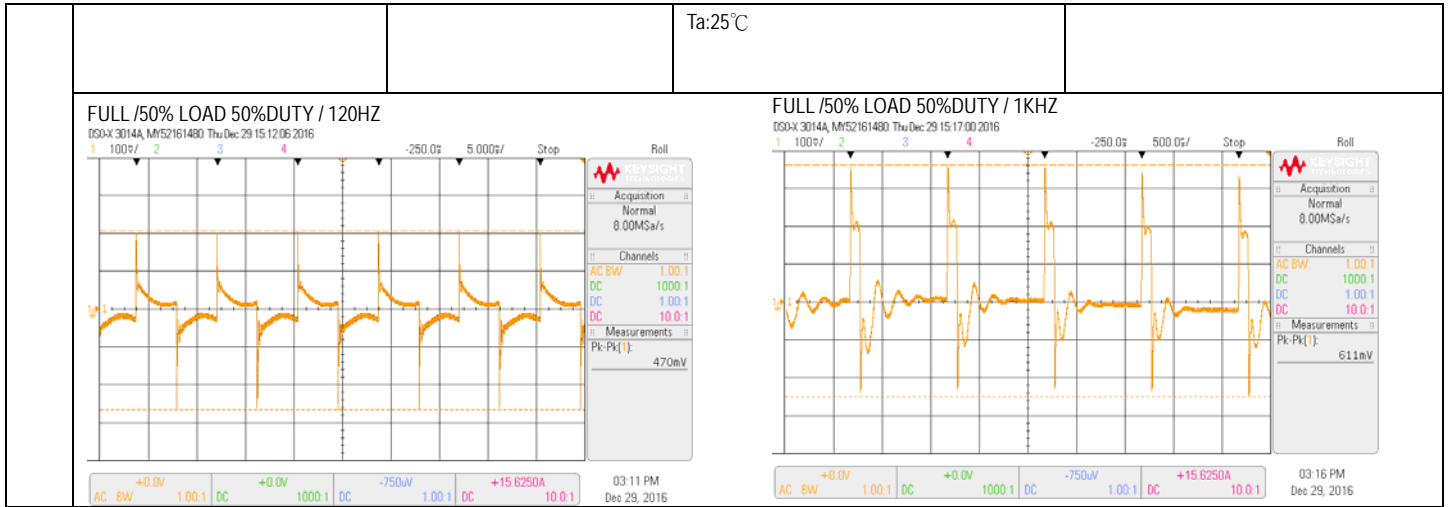


<b>11</b> HOLD UP TIME	480VAC/ 16ms (Max) 347VAC/ 16 ms (Max)	I/P: 480 VAC I/P: 347 VAC O/P:FULL LOAD Ta:25°C	480VAC/21.6ms 347VAC/21.6ms
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<b>12</b> DYNAMIC LOAD	V1: 3600 mVp-p	I/P: 347VAC O/P: (1)FULL /50% LOAD 50%DUTY / 120HZ (2)FULL /50% LOAD 50%DUTY / 1KHZ	470mVp-p 611mVp-p
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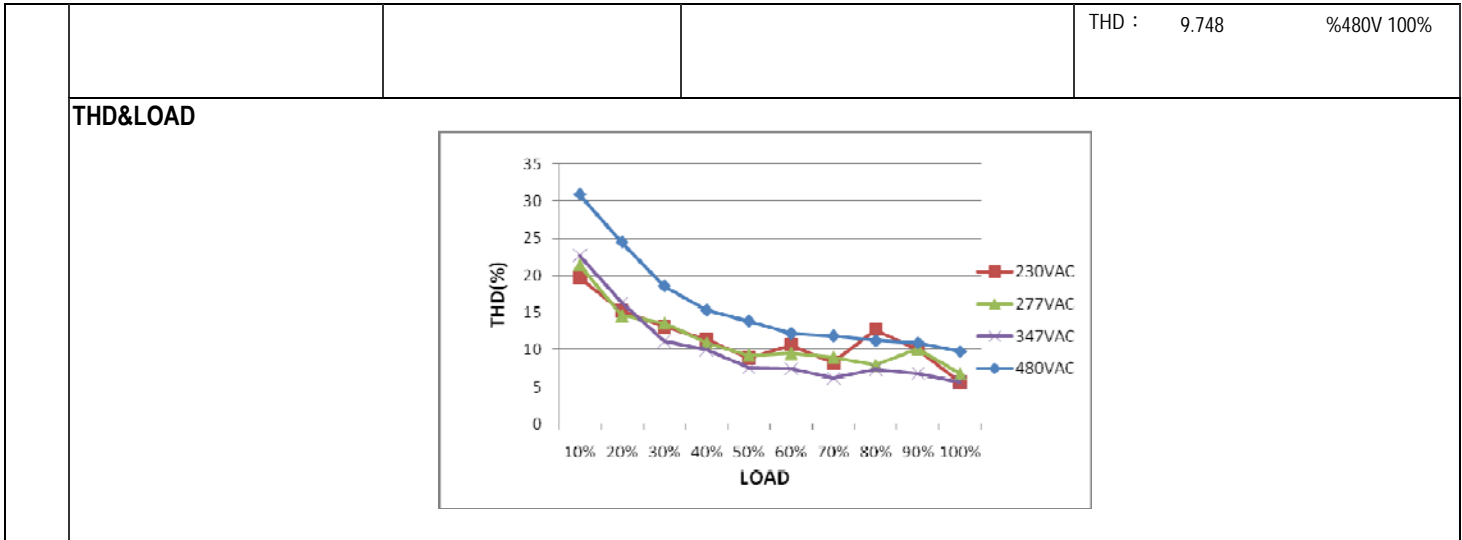
Ta:25°C



### 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°C	127V~528 V
			I/P: LOW-LINE-3V=177 V HIGH-LINE+10V=538 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: 180 VAC ~528VAC O/P:FULL~MIN LOAD Ta:25°C	OK
3	INPUT CURRENT (TYP)	480VAC/ 1.15 A 347 VAC/ 1.52A	I/P: 480VAC/347 VAC O/P:FULL LOAD Ta:25°C	I= 1.086A/480VAC I=1.476A/ 347VAC
4	LEAKAGE CURRENT	< 0.75 mA / 480VAC	I/P : 480 VAC O/P : Min LOAD Ta : 25°C	L-FG:0.3 mA N-FG: 0.3mA
5	POWER FACTOR(TYP)	0.95/480 VAC FULL LOAD 0.97/347 VAC FULL LOAD 0.98/277 VAC FULL LOAD 0.98/230 VAC FULL LOAD	I/P: 480VAC/347VAC/230VAC/277VAC O/P:FULL LOAD Ta:25°C	PF=0.9585/480V/100%LOAD PF=0.9873/347V/100%LOAD PF=0.992/277V/100%LOAD PF=0.996/230V/100%LOAD
				P.F vs LOAD

6	EFFICIENCY (TYP)	94.5%	I/P: 347 VAC O/P: FULL LOAD Ta: 25°C	94.626 %
<p>EFFICIENCY vs LOAD</p>				
7	INRUSH CURRENT (TYP)	480 V/ 40 A COLD START  (twidth=1100 us measured at 50% Ipeak) COLD START	I/P: 480VAC O/P: FULL LOAD Ta: 25°C	I = 33.8A/ 480VAC  T50= 1090 μs
<p>INPUT=480VAC/60HZ @ FULL LOAD</p> <p>CH2 : AC Input Voltage CH4 : Input current (1V=1A)</p>				
8	TOTAL HARMONIC DISTORTION	Total harmonic distortion will be lower than 20% when output loading is 50% or higher at 230V/277V/347V/480V	I/P : 230V/277V/347V/480V O/P : 100% LOAD 50% LOAD Ta : 25°C	THD : 8.87 %/230V 50% THD : 5.64 %/230V 100% THD : 9.24 %/277V 50% THD : 6.75 %/277V 100% THD : 7.552 %/347V 50% THD : 5.5962 %/347V 100% THD : 13.835 %/480V 50%



### PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER LOAD PROTECTION	95 %- 108 % PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed	I/P: 528VAC I/P: 347VAC I/P: 180VAC O/P: TESTING Ta:25°C	103.44%/ 528VAC 103.44%/ 347VAC 103.43%/180VAC PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed
2	OVER VOLTAGE PROTECTION	V1:39.5 V-45V PROTECTION TYPE : Shut down o/p voltage re-power on to recovery	I/P: 528VAC I/P: 347VAC I/P: 180VAC O/P: MIN LOAD Ta:25°C	41.722V/ 528VAC 41.719V/ 347VAC 41.49V/ 180VAC PROTECTION TYPE : Shut down o/p voltage re-power on to recovery
3	OVER TEMPERATURE PROTECTION	PROTECTION TYPE : Shut down o/p voltage, re-power on to recover	I/P: 528 VAC I/P: 180 VAC O/P: FULL LOAD	O.T.P.Active PROTECTION TYPE : Shut down o/p voltage, re-power on to recover
4	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed	I/P: 528VAC I/P: 180 VAC O/P: FULL LOAD Ta:25°C	NO DAMAGE PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed

### COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PFC Transistor ( D to S) or (C to E) <b>Peak Voltage</b>	Q1 Rated 9A/950V	I/P: High-Line +3V =531V AC ON/OFF VDS: O/P: (1) Full Load (2) Output Short (3) Dynamic Load Full Load/	VDS: (1) 897V (2) 849V (3) 897V

			<p>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.</p> <p>I/P:Low-Line -3V = 177V 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°C</p>	<p>(4) 905V (5) 881V (6) 865V (7) 825V</p> <p>VDS: (1)897V (2)841V (3)897V (4)913V (5)921V (6)905V (7)881V</p>																																						
2	PWM Transistor ( D to S) or (C to E) <b>Peak Voltage</b>	<p>Q10 Rated 9A/950V</p> <p>Q12 Rated 9A/950V</p>	<p>I/P:High-Line +3V =531 V AC ON/OFF 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.</p> <p>I/P:Low-Line -3V = 177V AC ON/OFF 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°C</p>	<table border="0"> <tr> <td>Q10</td> <td>Q12</td> </tr> <tr> <td>531V:</td> <td>531V:</td> </tr> <tr> <td>VDS:</td> <td>VDS:</td> </tr> <tr> <td>(1)879V</td> <td>(1)869V</td> </tr> <tr> <td>(2) 871V</td> <td>(2)885V</td> </tr> <tr> <td>(3) 879V</td> <td>(3)812V</td> </tr> <tr> <td>(4) 878V</td> <td>(4) 821V</td> </tr> <tr> <td>(5) 879V</td> <td>(5) 861V</td> </tr> <tr> <td>(6) 876V</td> <td>(6)853 V</td> </tr> <tr> <td>(7) 863V</td> <td>(7)880V</td> </tr> <tr> <td>177V:</td> <td>177V:</td> </tr> <tr> <td>VDS:</td> <td>VDS:</td> </tr> <tr> <td>(1) 815V</td> <td>(1) 872V</td> </tr> <tr> <td>(2)823 V</td> <td>(2) 880V</td> </tr> <tr> <td>(3) 823V</td> <td>(3)863 V</td> </tr> <tr> <td>(4) 831V</td> <td>(4) 880V</td> </tr> <tr> <td>(5) 823V</td> <td>(5) 880V</td> </tr> <tr> <td>(6) 807V</td> <td>(6) 880V</td> </tr> <tr> <td>(7) 807V</td> <td>(7) 880V</td> </tr> </table>	Q10	Q12	531V:	531V:	VDS:	VDS:	(1)879V	(1)869V	(2) 871V	(2)885V	(3) 879V	(3)812V	(4) 878V	(4) 821V	(5) 879V	(5) 861V	(6) 876V	(6)853 V	(7) 863V	(7)880V	177V:	177V:	VDS:	VDS:	(1) 815V	(1) 872V	(2)823 V	(2) 880V	(3) 823V	(3)863 V	(4) 831V	(4) 880V	(5) 823V	(5) 880V	(6) 807V	(6) 880V	(7) 807V	(7) 880V
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3	P.F.C DIODE	D9 Rated 8A/1200V	<p>I/P:High-Line +3V =531 V AC ON/OFF O/P: (1)Full Load (2)Output Short (3)Dynamic Load Full Load/ Min. Load 90%Duty/5KHz (4)Dynamic Load 100% Load/ Min. Load 50%Duty/120Hz</p>	<p>(1)811V (2)836V (3)803V (4)811V</p> <p>(1)828V (2)844V (3)836V</p>																																						

			<p>I/P:Low-Line -3V = 177V  AC ON/OFF  O/P: (1)Full Load  (2)Output Short  (3)Dynamic Load Full Load/  Min. Load 90%Duty/5KHz  (4)Dynamic Load 100% Load/  Min. Load 50%Duty/120Hz  Ta:25°C</p>	(4)844V
4	Diode Peak Voltage	<p>Q101 Rated 70 A/ 100 V</p> <p>Q120 Rated 70 A/ 100 V</p>	<p>I/P:High-Line +3V =531 V  AC ON/OFF  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</p>	<p>Q101: VDS: (1)76.7 V (2)9.9 V (3)79.1V (4)77.5V (5)77.5V (6)79.1V (7)81.5V (8)76.7V</p> <p>Q120: VDS: (1)83.1V (2) 17.2V (3)84.7V (4)83.1V (5)83.9V (6)87.1V (7)85.5V (8)77.5V</p>
5	Input Capacitor Voltage	C5 Rated: 150 $\mu$ /450 V	<p>I/P:High-Line +3V =531V  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°C</p>	<p>(1) 387V  (2) 387V  (3) 391V  (4) 383V</p>
6	Control IC Voltage Test	<p>PWM IC U2 Rated 8.85V~16V</p> <p>PFC IC U1 Rated 10.5V~20V</p>	<p>I/P:High-Line +3V =531 V  AC ON/OFF  O/P:(1)FULL LOAD  (2) Output Short  (3)O.L.P  (4)O.V.P.  (5)NO LOAD VR MIN (LOW LINE)  Ta:25°C</p>	<p>(1) 14.1V  (2) 14.1V  (3) 14.1V  (4) 14.3V  (5) 14.3V</p> <p>(1) 13.7V  (2) 13.7V  (3) 13.5V  (4) 14.1V  (5) 13.7V</p>



**SAFETY & EMC TEST REPORT**

**SAFETY TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	IEC60950-1 I/P-O/P: 3.75KVAC/min I/P-FG:2 KVAC/min<4.5mA O/P-FG:1.5KVAC/min	I/P-O/P: 4.125 KVAC/min I/P-FG: 2.4KVAC/min O/P-FG: 1.8 KVAC/min Ta:25°C	I/P-O/P:2.849 mA I/P-FG:1.925mA O/P-FG:6.21 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°C	I/P-O/P:11.4 GΩ I/P-FG:6.41 G Ω O/P-FG: 30G Ω NO DAMAGE
3.	GROUNDING CONTINUITY	IEC60950-1 FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40A / 2min Ta:25°C	25mΩ

**E.M.C TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	CONDUCTION	FCC Part 15 Subpart B	I/P: 440VAC /60HZ O/P:FULL LOAD/40% LOAD Ta:25°C	PASS Test by certified Lab
2	RADIATION	FCC Part 15 Subpart B	I/P: 480VAC /60HZ O/P:FULL LOAD/30% LOAD Ta:25°C	PASS Test by certified Lab
3	SURGE	IEC61000-4-5 INDUSTRY L-N :2KV L,N-PE:4KV	I/P: 230VAC/50HZ O/P:FULL LOAD Ta:25°C	CRITERIA A

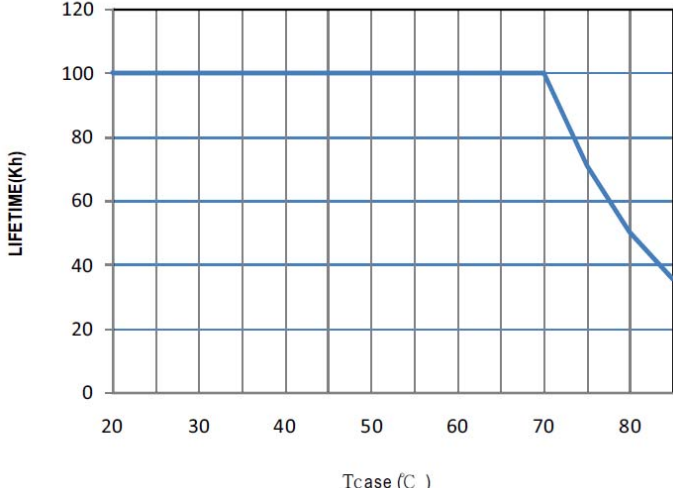
**RELIABILITY TEST**

**ENVIRONMENT TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	TEMPERATURE RISE TEST	MODEL : HVG-480-24 1. ROOM AMBIENT BURN-IN : 3 HRS I/P : 347VAC O/P : FULL LOAD Ta=25 °C 2. HIGH AMBIENT BURN-IN : 14 HRS I/P : 347VAC O/P : FULL LOAD Ta= 60 °C		

		NO	Position	ROOM AMBIENT	HIGH AMBIENT
				Ta= 25 °C	Ta= 60 °C
		1	BD1	62.1°C	95.6°C
		2	C10	60.9°C	94.8°C
		3	Q1	61.7°C	96.0°C
		4	D8	65.6°C	102.8°C
		5	Q10	64.1°C	100.5°C
		6	RY1	63.3°C	98.4°C
		7	LF2	60.4°C	93.9°C
		8	C1	58.2°C	91.9°C
		9	C5	61.0°C	95.3°C
		10	L3	64.3°C	100.6°C
		11	U1	58.2°C	92.1°C
		12	U107	57.9°C	92.5°C
		13	T1-1	66.0°C	101.2°C
		14	T2-2	70.9°C	106.9°C
		15	Q100	62.3°C	97.6°C
		16	C115	58.6°C	92.8°C
		17	LF100	59.9°C	94.5°C
		18	C511	64.2°C	98.8°C
		19	RTH2	65.6°C	101.1°C
		20	T3	63.2°C	98.6°C
2	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR		I/P : 528VAC/180VAC O/P : 100 % LOAD Ta= -45 °C	TEST : OK
3	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 60 °C NO DAMAGE		I/P : 538 VAC O/P : FULL LOAD Ta= 60°C HUMIDITY= 95 %R.H	TEST : OK
4	TEMPERATURE COEFFICIENT	± 0.03 %/°C (0-60°C)		I/P : 347 VAC O/P : FULL LOAD	± 0 %/°C (0-60°C)
5	STORAGE TEMPERATURE TEST	1. Thermal shock Temperature : -50°C~ +125°C 2. Temperature change rate : 25°C / MIN 3. Dwell time low and high temperature : 30 MIN/EACH 4. Total test cycle : 100 CYCLE 5. Input/Output condition : STATIC			OK
6	THERMAL SHOCK TEST	1. Thermal shock Temperature : -45°C~ +65°C 2. Temperature change rate : 25°C / MIN 3. Dwell time low and high temperature : 30 MIN/EACH 4. Total test cycle : 16 CYCLE 5. Input/Output condition : 15cycle:347V/ FULL LOAD AC ON 3sec/AC OFF 1sec TEST 1cycle: 347V/ FULL LOAD Burn In Test			OK
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°C			TEST : OK



8	CAPACITOR LIFE CYCLE	<p>SUPPOSE C115 IS THE MOST CRITICAL COMPONENT</p> <p>(1) I/P : 347VAC O/P : FULL LOAD Ta= 25 °C LIFE TIME</p> <p>(2) I/P : 347VAC O/P : FULL LOAD Ta= 60 °C LIFE TIME</p> <p>(3) I/P : 347VAC O/P : 75% LOAD Ta= 60 °C LIFE TIME</p> <p>(4) I/P : 347VAC O/P : 50% LOAD Ta= 60 °C LIFE TIME</p>	<p>(1) 313619HRS</p> <p>(2) 29311HRS</p> <p>(3) 45290HRS</p> <p>(4) 59976HRS</p>																		
9	MTBF	318.9K hrs min. Telcordia SR-332(Bellcore) ; 84.5K hrs min. MIL-HDBK-217F (25°C)																			
10	DMTBF/Accelerated Life Test	<p>Demonstration Mean Time Between Failure(Expected Life) : 50,000 hours @ Tcase 80°C</p>  <table border="1"> <caption>Graph Data Points (Approximate)</caption> <thead> <tr> <th>Tcase (°C)</th> <th>Lifetime (kh)</th> </tr> </thead> <tbody> <tr><td>20</td><td>100</td></tr> <tr><td>30</td><td>100</td></tr> <tr><td>40</td><td>100</td></tr> <tr><td>50</td><td>100</td></tr> <tr><td>60</td><td>100</td></tr> <tr><td>70</td><td>100</td></tr> <tr><td>75</td><td>70</td></tr> <tr><td>80</td><td>35</td></tr> </tbody> </table>		Tcase (°C)	Lifetime (kh)	20	100	30	100	40	100	50	100	60	100	70	100	75	70	80	35
Tcase (°C)	Lifetime (kh)																				
20	100																				
30	100																				
40	100																				
50	100																				
60	100																				
70	100																				
75	70																				
80	35																				

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	DANIEL GAO	SANFORD SU	VINCENT ZENG

12.10.30 A50-F031