



Test Report: HVGC-650-U

650W Constant Power Mode 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

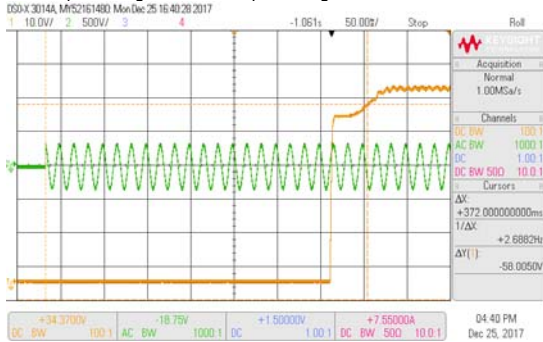
ENVIRONMENT TEST

■ **DESIGN VERIFY TEST**

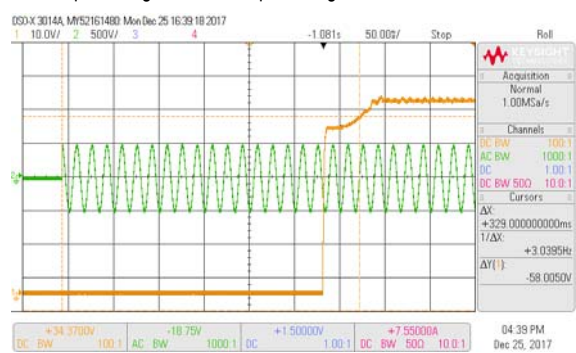
OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	CURRENT TOLERANCE	±5%	I/P: 347VAC I/P: 480VAC O/P: FULL LOAD CP: 11.2A & 14A Ta: 25°C	CP 11.2A: 11.189A/347VAC@LED MAX-1V 11.344A/347VAC@LED MIN 11.206A/480VAC@LED MAX-1V 11.36A/480VAC@LED MIN 1.42% CP 14A: 14.006A/347VAC@LED MAX-1V 14.136A/347VAC@LED MIN 13.979A/480VAC@LED MAX-1V 14.146A/480VAC@LED MIN 1.04%
2	FULL POWER CURRENT RANGE	11200~14000mA	I/P: 347VAC O/P: FULL LOAD CP: 11.2A & 14A Ta: 25°C	59.88V/11.2A/347VAC 48.91V/14A/347VAC
3	OPEN CIRCUIT VOLTAGE (max)	60V	I/P: 347VAC O/P: NO LOAD CP: OPEN Ta: 25°C	CP 11.2A: 59.88V
4	CONSTANT CURRENT REGION	CP 11.2A: CH1: 29V~ 58V CP 14A: CH2: 24V~ 46.4V	I/P: 347VAC O/P: FULL LOAD CP: 11.2A & 14A Ta: 25°C	CP 11.2A: 0.43V~58 V/347VAC CP 14A: 0.62V~ 46.4V/347VAC
5	CURRENT ADJ. RANGE	CH1: 5600mA~14000mA	I/P: 347VAC I/P: 480VAC O/P: LED MIN & LED MAX-1V Ta: 25°C	4922mA~14001mA/347VAC@LED MAX-1V 5120mA~14169mA /347VAC@LED MIN 4.943mA~14002mA/480VAC@LED MAX-1V 5186mA~14180mA /480VAC@LED MIN
6	CURRENT RIPPLE	5% max. @rated current	I/P: 347VAC O/P: FULL LOAD CP: 11.2A & 14A Ta: 25°C	CP 11.2A: 2.59% CP 14A: 1.75%
7	SET UP TIME	230VAC/ 500 ms (Max) 347VAC/ 500 ms (Max) 480VAC/ 500 ms (Max)	I/P: 230VAC I/P: 347VAC I/P: 480VAC O/P: FULL LOAD CP 11.2A Ta: 25°C	230VAC/372 ms 347VAC/329ms 480VAC/ 278ms

INPUT=230VAC/50HZ @ FULL LOAD@ CP 11.2A
CH1 : Output Voltage CH2 : AC Input Voltage



INPUT=347VAC/60HZ @ FULL LOAD@ CP 11.2A
CH1 : Output Voltage CH2 : AC Input Voltage

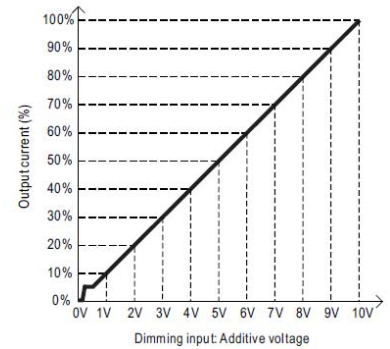
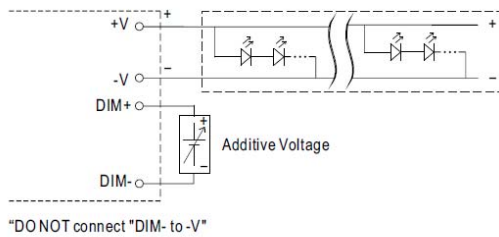


8 DIMMING OPERATION (for B-Type)

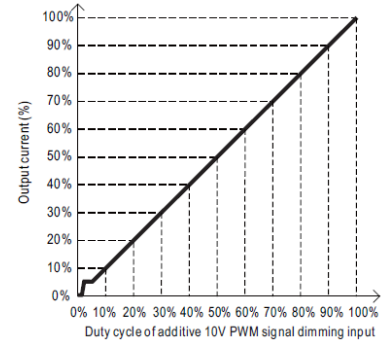
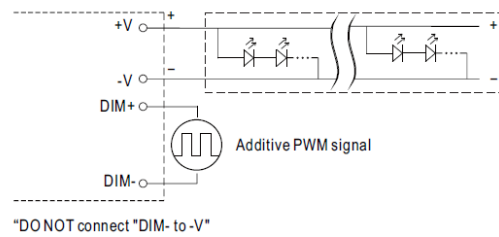
※3 in 1 dimming function

- ※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: 100μ A (typ.)

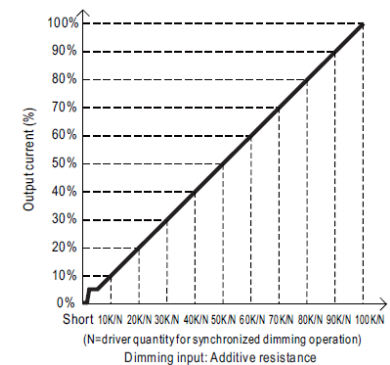
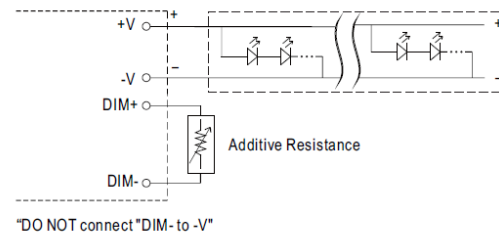
◎ Applying additive 0 ~ 10VDC



◎ Applying additive 10V PWM signal (frequency range 100Hz ~ 3KHz):



◎ Applying additive resistance:



- Note : 1. Min. dimming level is about 5% and the output current is not defined when 0% < i_{out} < 6%.
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 : 347VAC
O/P : DIMMING TEST

TA : 25°C

R	SHORT	10K	20K	30K	40K	50K	60K	70K	80K	90K	100K	OPEN
O/P CURRENT	0A	1.522A	2.637A	3.776A	4.870A	5.920A	7.000A	7.900A	8.900A	9.900A	11.100A	11.100A
%	0.00%	13.59%	23.54%	33.71%	43.48%	52.86%	62.50%	70.54%	79.46%	88.39%	99.11%	99.11%
V	0V	1V	2V	3V	4V	5V	6V	7V	8V	9V	10V	OPEN
O/P CURRENT	0A	1.267A	2.752A	3.893A	5.000A	6.129A	7.259A	8.263A	9.409A	10.412A	11.280A	11.200A
%	0.00%	11.31%	24.57%	34.76%	44.64%	54.72%	64.81%	73.78%	84.01%	92.96%	100.71%	100.00%
PWM (100HZ)	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	OPEN
O/P CURRENT	0A	1.587A	2.749A	3.837A	4.953A	6.123A	7.210A	8.224A	9.268A	10.353A	11.254A	11.200A
%	0.00%	14.17%	24.54%	34.26%	44.22%	54.67%	64.38%	73.43%	82.75%	92.44%	100.48%	100.00%

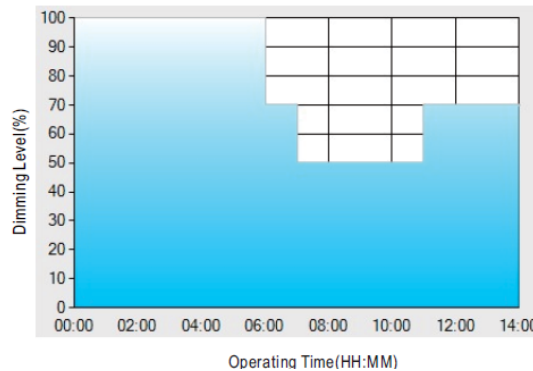
TEST RESULT : OK

9 DIMMING OPERATION (for Dxx-Type by User definition)

※Smart timer dimming function (for Dxx-Type by User definition)

MEAN WELL Smart timer dimming primarily provides the adaptive proportion dimming profile for the output constant current level to perform up to 14 consecutive hours. 3 dimming profiles hereunder are defined accounting for the most frequently seen applications. If other options may be needed, please contact MEAN WELL for details.

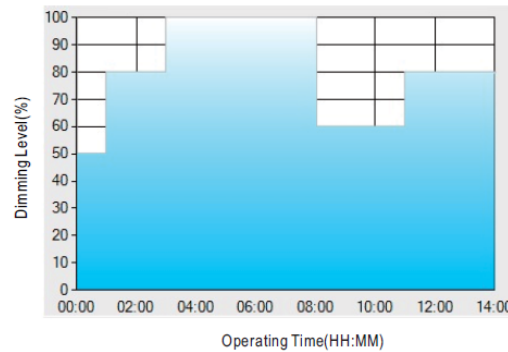
Ex : Ⓒ D01-Type: the profile recommended for residential lighting



Set up for D01-Type in Smart timer dimming software program:

	T1	T2	T3	T4
TIME**	06:00	07:00	11:00	--
LEVEL**	100%	70%	50%	70%

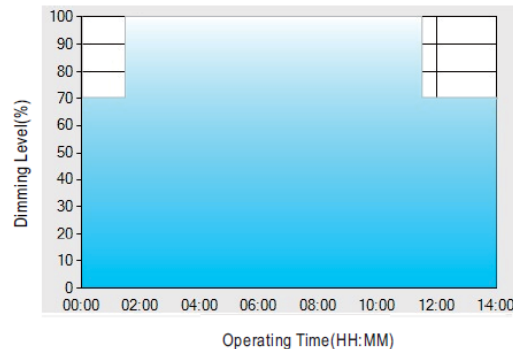
Ex : Ⓒ D02-Type: the profile recommended for street lighting



Set up for D02-Type in Smart timer dimming software program:

	T1	T2	T3	T4	T5
TIME**	01:00	03:00	8:00	11:00	--
LEVEL**	50%	80%	100%	60%	80%

Ex : Ⓒ D03-Type: the profile recommended for tunnel lighting



Set up for D03-Type in Smart timer dimming software program:

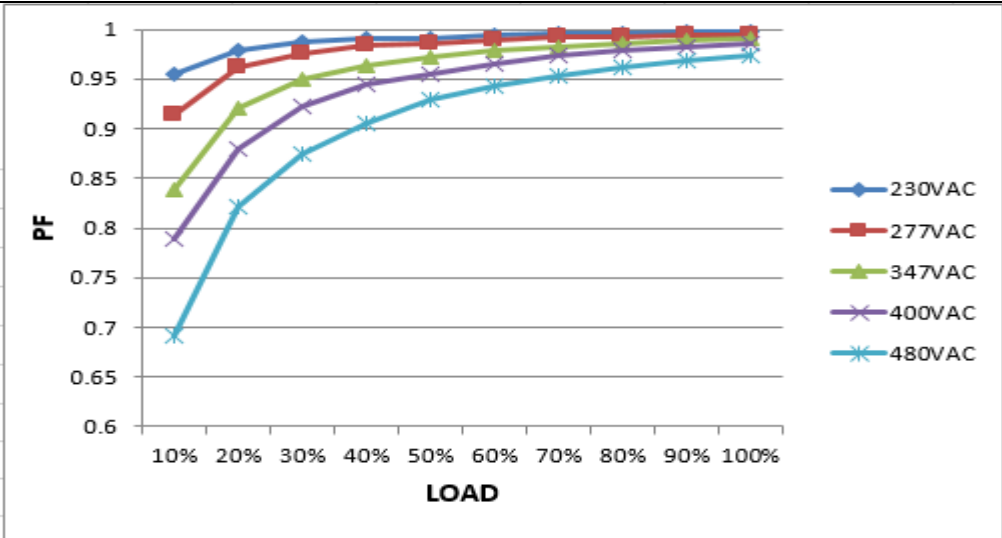
	T1	T2	T3
TIME**	01:30	11:00	--
LEVEL**	70%	100%	70%

I/P : 347VAC

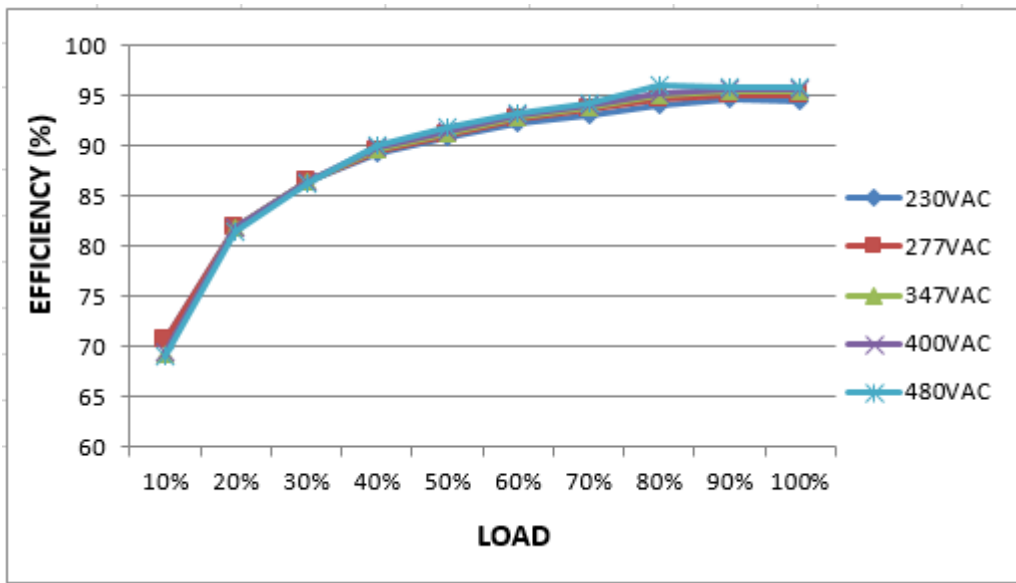
		O/P : DIMMING TEST TA : 25°C TEST RESULT : OK
10	DALI interface(primary side)	DALI protocol including 16 groups and 64 addresses. First step is fixed at 6% of output. I/P : 347VAC O/P : DALI TEST TA : 25°C TEST RESULT : OK

INPUT FUNCTION TEST

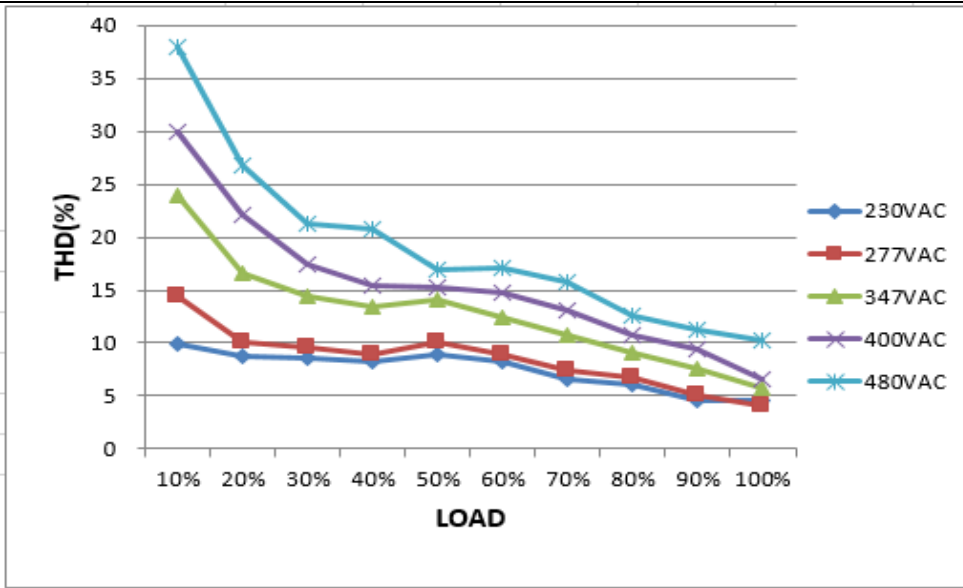
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	180VAC~528 VAC	I/P:TESTING O/P:FULL LOAD CP 11.2A Ta:25°C	147V~528V
			I/P: LOW-LINE-3V=177 V HIGH-LINE+10V=538 V O/P:FULL/MIN LOAD CP 11.2A (PLEASE CHECK DERATING CURVE) ON: 30 Sec OFF: 30 Sec 10MIN (POWER ON/OFF NO DAMAGE)	(1).TEST:OK (2).TEST :OK
2	INPUT FREQUENCY RANGE	47HZ ~63 HZ NO DAMAGE	I/P: 180 VAC ~528VAC O/P:FULL~MIN LOAD CP 11.2A Ta:25°C	TEST:OK
3	INPUT CURRENT (TYP)	347VAC/ 2.1 A 480VAC/ 1.5A	I/P: 347VAC/480VAC O/P:FULL LOAD CP 11.2A Ta:25°C	I =2.018A/ 347VAC I =1.476A/480VAC
4	LEAKAGE CURRENT	IEC60950-1 < 0.75mA / 480VAC	I/P: 480 VAC O/P:Min LOAD Ta:25°C	L-FG:0.3mA N-FG:0.3mA
5	POWER FACTOR(TYP)	0.95/480VAC FULL LOAD 0.96/400VAC FULL LOAD 0.97/347VAC FULL LOAD 0.98/277 VAC FULL LOAD 0.98/230 VAC FULL LOAD	I/P: 480VAC/400VAC/347VAC/277VAC/230VAC O/P:FULL LOAD CP 2.8A Ta:25°C	PF= 0.973/480V/100%LOAD PF= 0.986/400V/100%LOAD PF= 0.991/347V/100%LOAD PF=0.995/277V/100%LOAD PF=0.997 /230V/100%LOAD
	P.F vs LOAD			



6	EFFICIENCY (TYP)	95.5%	I/P: 347VAC O/P: FULL LOAD. CP 11.2A Ta: 25°C	95.56%
	EFFICIENCY vs LOAD			



7	TOTAL HARMONIC DISTORTION	THD < 20% output load ≥ 50% at 230VAC/277VAC/347VAC /480VAC input	I/P : 230V/277V/347V/480V/400VAC O/P : 100% LOAD 50% LOAD CP 11.2A Ta : 25°C	THD : 8.99 %/230V 50% THD : 4.65 %/230V 100% THD : 10.09 %/277V 50% THD : 4.07 %/277V 100% THD : 14.17 %/347V 50% THD : 5.77 %/347V 100% THD : 17 %/480V 50% THD : 10.32 %/480V 100% THD : 15.2 %/400V 50% THD : 6.57 %/400V 100%
	THD vs LOAD			



8	INRUSH CURRENT (TYP)	480V/ 40A COLD START (twidth=1100 us measured at 50% Ipeak) COLD START	I/P: 480VAC O/P: FULL LOAD CP 11.2A Ta:25°C	I=32.5A/480VAC T50= 1080 us
	<p>INPUT=480VAC/ 60HZ @ FULL LOAD</p> <p>CH2 : AC Input Voltage CH1 : Input current</p>			

ROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER VOLTAGE PROTECTION	V1: 62V~70V PROTECTION TYPE : Shut down output voltage, re-power on to recovery	I/P: 528VAC I/P: 347VAC I/P: 180VAC CP 11.2A O/P: MIN LOAD Ta:25°C	65.6V/ 528VAC 65.6V/ 347VAC 65.6V/ 180VAC PROTECTION TYPE : Shut down output voltage, re-power on to recovery
2	OVER TEMPERATURE PROTECTION	PROTECTION TYPE : Shut down output voltage, re-power on to recovery	I/P: 528 VAC I/P: 180 VAC O/P: FULL LOAD CP 11.2A Ta:25°C	O.T.P. Active PROTECTION TYPE : Shut down output voltage, re-power on to recovery

3	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE PROTECTION TYPE :	I/P: 528VAC I/P: 180 VAC O/P: FULL LOAD CP: 11.2A &14A Ta:25°C	CP: 11.2A NO DAMAGE PROTECTION TYPE : Constant current, recovers automatically after fault condition is removed CP: 14A NO DAMAGE PROTECTION TYPE : Constant current, recovers automatically after fault condition is removed
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COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT																																																
1	PWM Transistor (D to S) or (C to E) Peak Voltage	Q11 Rated : 12A / 950V Q13 Rated : 12A / 950V	I/P:High-Line +3V =531v CP: 11.2A&14A VDS: O/P: (1)Full Load (2)Output Short (3) Full Load continue I/P:Low-Line -3V = 177V O/P: (1)Full Load (2)Output Short (3) Full Load continue Ta:25°C	<table border="0"> <tr> <td>CP: 11.2A</td> <td>CP: 14A</td> </tr> <tr> <td>Q11 VDS:</td> <td>Q11</td> </tr> <tr> <td>Vi= 531V</td> <td>Vi=531</td> </tr> <tr> <td>VDS:</td> <td>VDS:</td> </tr> <tr> <td>(1) 861V</td> <td>(1) 861V</td> </tr> <tr> <td>(2) 861V</td> <td>(2) 861V</td> </tr> <tr> <td>(3) 796V</td> <td>(3) 804V</td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td>Vi=177V</td> <td>Vi=177V</td> </tr> <tr> <td>VDS:</td> <td>VDS:</td> </tr> <tr> <td>(1)861 V</td> <td>(1) 853V</td> </tr> <tr> <td>(2)820V</td> <td>(2) 828V</td> </tr> <tr> <td>(3) 836V</td> <td>(3) 836V</td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td>Q13</td> <td>Q13</td> </tr> <tr> <td>VDS:Vi=531</td> <td>VDS: Vi=531</td> </tr> <tr> <td>(1) 861V</td> <td>(1) 853V</td> </tr> <tr> <td>(2) 853V</td> <td>(2) 853V</td> </tr> <tr> <td>(3) 804V</td> <td>(3) 804V</td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td>VDS: Vi=177</td> <td>VDS: Vi=177</td> </tr> <tr> <td>(1) 853V</td> <td>(1) 853V</td> </tr> <tr> <td>(2) 812V</td> <td>(2) 828V</td> </tr> <tr> <td>(3) 780V</td> <td>(3) 836V</td> </tr> </table>	CP: 11.2A	CP: 14A	Q11 VDS:	Q11	Vi= 531V	Vi=531	VDS:	VDS:	(1) 861V	(1) 861V	(2) 861V	(2) 861V	(3) 796V	(3) 804V	 	 	Vi=177V	Vi=177V	VDS:	VDS:	(1)861 V	(1) 853V	(2)820V	(2) 828V	(3) 836V	(3) 836V	 	 	Q13	Q13	VDS:Vi=531	VDS: Vi=531	(1) 861V	(1) 853V	(2) 853V	(2) 853V	(3) 804V	(3) 804V	 	 	VDS: Vi=177	VDS: Vi=177	(1) 853V	(1) 853V	(2) 812V	(2) 828V	(3) 780V	(3) 836V
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2	P.F.C Transistor (D to S) or (C to E) Peak Voltage	Q4 Rated : 6A / 1050V	I/P:High-Line +3V =531V CP: 11.2A VDS: O/P: (1)Full Load (2)Output Short (3) Full Load continue I/P:Low-Line -3V = 177V O/P: (1)Full Load (2)Output Short (3) Full Load continue Ta:25°C	<table border="0"> <tr> <td>CP: 11.2A</td> </tr> <tr> <td>Q4</td> </tr> <tr> <td>VDS: Vi=531V</td> </tr> <tr> <td>(1) 943V</td> </tr> <tr> <td>(2) 798V</td> </tr> <tr> <td>(3) 839V</td> </tr> <tr> <td> </td> </tr> <tr> <td>VDS: Vi=177</td> </tr> <tr> <td>(1) 999V</td> </tr> <tr> <td>(2) 790V</td> </tr> <tr> <td>(3) 967V</td> </tr> </table>	CP: 11.2A	Q4	VDS: Vi=531V	(1) 943V	(2) 798V	(3) 839V	 	VDS: Vi=177	(1) 999V	(2) 790V	(3) 967V																																					
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3	P.F.C DIODE	D8 Rated : 8A/ 1200V	I/P:High-Line +3V =531 V CP: 11.2A O/P: (1)Full Load (2)Output Short (3) Full Load continue I/P:Low-Line -3V = 177V O/P: (1)Full Load (2)Output Short (3) Full Load continue Ta:25°C	CP: 11.2A Vi=531V (1) 879V (2) 806V (3) 798V (1) 927V (2) 790V (3) 871V	
4	Diode Peak Voltage	Q100 Rated : 100A/150 V Q101 Rated :100A/150 V Q130 Rated : 100A/150 V Q131 Rated : 100A/150 V D561 Rated : 1A/200 V	I/P:High-Line +3V =531 V D104 : CP: 11.2A& 14A O/P: (1)Full Load (2)Output Short (3) Full Load continue D112 : O/P: (1) Full Load (2)Output Short (3) Full Load continue Ta:25°C	CP: 11.2A Q100 VDS: (1)130.4 V (2) 18.6 V (3) 123.1V Q101 VDS: (1) 127.9V (2) 21.8V (3) 125.5V Q130 VDS: (1) 130.4V (2) 16.2V (3) 127.9V Q131 VDS: (1) 127.1V (2) 15.4V (3) 123.9V D561 (1) 141V (2) 151V (3) 133V	CP:14A Q100 VDS: (1)107 V (2) 17.8V (3) 104.6V Q101 VDS: (1) 105.4V (2) 12.2V (3) 103.8V Q130 VDS: (1) 107V (2) 17.8V (3) 104.6V Q131 VDS: (1)104.6V (2)10.6 V (3) 102.2V D561 (1) 151V (2) 145V (3)135V
5	Input Capacitor Voltage	C5 Rated: : 220μ/ 450V	I/P:High-Line +3V =531V CP 11.2A 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	CP: 11.2A (1)414 V (2) 398V (3) 410V (4)386V	
6	Control IC Voltage Test	PFC IC U1 Rated 21V~11.5V(MIN.) PWM IC U2 Rated 16V~ 8.85V(MIN.)	I/P:High-Line +3V =531 V CP: 11.2A O/P(1)FULL LOAD (2) Output Short (3)O.L.P (4)O.V.P. (5)NO LOAD VRmin.LOW LINE Ta:25°C	U1 (1) 14.63V (2) 14.6V (3) 16.8V (4) 15.9V (5) 14.9V	U2 (1) 14.07V (2) 13.83V (3) 14.79V (4) 14.47V (5) 11.58V

SAFETY & EMC TEST

SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	IEC60950-1 I/P-O/P: 4.2KVAC/min I/P-FG: 2.1KVAC/min<4.5mA O/P-FG:1.5KVAC/min	I/P-O/P: 4.62 KVAC/min I/P-FG: 2.52KVAC/min O/P-FG: 1.8 KVAC/min Ta:25°C	I/P-O/P:3.7 mA I/P-FG:2.39 mA O/P-FG: 6.51mA 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: 15.4GΩ I/P-FG:13.1 G Ω O/P-FG: 18G Ω NO DAMAGE
3	GROUNDING CONTINUITY	IEC60950-1 FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40A / 2min Ta:25°C	24 mΩ

E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	HARMONIC	EN61000-3-2 CLASS A	I/P:230VAC/50HZ O/P:FULL LOAD Ta:25°C	PASS
2	CONDUCTION	FCC PART 15 CLASS B EN55015	I/P:230V/400V/480VAC (50HZ/60HZ) O/P:FULL/40% LOAD Ta:25°C	PASS Test by certified Lab
3	RADIATION	FCC PART 15 CLASS B EN55015	I/P:230V/400V/480VAC (50HZ/60HZ) O/P:FULL/40% LOAD Ta:25°C	PASS Test by certified Lab
4	E.S.D	EN61000-4-2 LIGHT INDUSTRY AIR:8KV / Contact:4KV	I/P: 230/400VAC (50HZ) O/P:FULL LOAD Ta:25°C	CRITERIA A
5	E.F.T	EN61000-4-4 LIGHT INDUSTRY INPUT: 1KV	I/P: 230/400VAC (50HZ) O/P:FULL LOAD Ta:25°C	CRITERIA A
6	SURGE	IEC61000-4-5 INDUSTRY L-N :4KV L,N-PE:8KV	I/P: 230/400VAC (50HZ) O/P:FULL LOAD Ta:25°C	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

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT																																																																																																																																																
1	TEMPERATURE RISE TEST	MODEL : HVGC-650-U 1. ROOM AMBIENT BURN-IN : 1.5 HRS I/P : 347VAC O/P : FULL LOAD 2. HIGH AMBIENT BURN-IN : 3 HRS I/P : 347VAC O/P : FULL LOAD																																																																																																																																																		
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2	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR TEMPERATURE : -40°C	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 55 °C 95 %R.H NO DAMAGE	I/P : 538VAC O/P : FULL LOAD Ta= 55 °C HUMIDITY= 95 %R.H	TEST : OK																																																																																																																																																
4	TEMPERATURE COEFFICIENT	± 0.03%/°C (0~55°C)	I/P : 347 VAC O/P : FULL LOAD	± 0.024 %/°C (0~55°C)																																																																																																																																																

5	STORAGE TEMPERATURE TEST	-40°C~+80°C	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 : 200 CYCLE 5. Input/Output condition : STATIC
6	THERMAL SHOCK TEST	-40°C~+55°C (PLEASE CHECK DERATING CURVE)	1. Thermal shock Temperature : -45°C~ +60°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
7	VIBRATION TEST	10 ~ 500Hz, 5G 12min./1cycle, period for 72min. each along X, Y, Z axes	1 Carton & 1 Set (1) Waveform : Sine Wave (2) Frequency : 10~500Hz (3) Sweep Time : 12min/sweep cycle (4) Acceleration : 6G (5) Test Time : 180min in each axis (X.Y.Z) (6) Ta : 25°C
8	CAPACITOR LIFE CYCLE	SUPPOSE C105 IS THE MOST CRITICAL COMPONENT (1) I/P : 347VAC O/P : FULL LOAD Tc= 80 °C LIFE TIME (2) I/P : 347VAC O/P : FULL LOAD Tc= 80 °C LIFE TIME (3) I/P : 347VAC O/P : 75% LOAD Tc= 80 °C LIFE TIME	(1) 49862 HRS (2) 46224 HRS (3) 44515HRS
9	MTBF	Conducted by Parts Stress Analysis Prediction 218.8K hrs min. Telcordia SR-332(Bellcore) ; 60.2K hrs min. MIL-HDBK-217F (25°C)	
10	Ongoing Reliability Test	I/P : 230VAC O/P : FULL LOAD TA=50°C Demonstration Mean Time Between Failure : 50,000 hours	

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

12.10.30 A50-F031