Test Report: HVGC-650-L

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

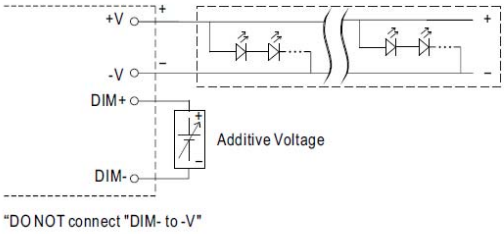
■ DESIGN VERIFY TEST

OUTPUT FUNCTION TEST

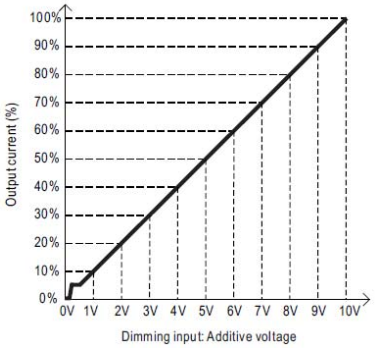
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	CURRENT TOLERANCE	±5%	I/P: 347VAC I/P:480VAC O/P:FULL LOAD CP: 2.8A & 3.5A Ta:25℃	CP2.8A: 2.799A/347VAC@LED MAX-1V 2.836A/347VAC@LED MIN 2.801A/480VAC@LED MAX-1V 2.843A/480VAC@LED MIN 1.57% CP 3.5A: 3.513A/347VAC@LED MAX-1V 3.539A/347VAC@LED MIN 3.514A/480VAC@LED MAX-1V 3.544A/480VAC@LED MIN 0.88%
2	FULL POWER CURRENT RANGE	2800~3500mA	I/P: 347VAC O/P:FULL LOAD CP: 2.8A & 3.5A Ta:25℃	234.2V/2.8A/347VAC 187.3V/3.5A/347VAC
3	OPEN CIRCUIT VOLTAGE (max)	240V	I/P: 347VAC O/P:NO LOAD CP: 1/2 Io min Ta:25℃	236V
4	CONSTANT CURRENT REGION	CP 2.8A: CH1:116V~ 232V CP 3.5A: CH1:92.8V~ 185.6V	I/P: 347VAC O/P:FULL LOAD CP: 2.8A & 3.5A Ta:25℃	CP 2.8A: 7.57V~ 232V/347VAC CP 3.5A: 9.31V~185.6 V/347VAC
5	CURRENT ADJ. RANGE	CH1: 1400mA~3500mA	I/P: 347VAC I/P:480VAC O/P:LED MIN & LED MAX-1V Ta:25℃	1156mA~3516mA/347VAC@LED MAX-1V 1168mA~3532mA /347VAC@LED MIN 1163mA~3514mA /480VAC@LED MAX-1V 1186m A~3536mA /480VAC@LED MIN
6	CURRENT RIPPLE	5% max. @rated current	I/P: 347VAC O/P:FULL LOAD CP: 2.8A & 3.5A Ta:25℃	CP 2.8A: 2.16% CP 3.5A: 2.49%
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 2.8A Ta:25℃	230VAC/390ms 347VAC/328 ms 480VAC/ 270ms
	INPUT=230VAC/50HZ @ FULL LOAD@ CP 2.8A CH1 : Output Voltage CH2 : AC Input Voltage		INPUT=347VAC/60HZ @ FULL LOAD@ CP 2.8A 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.)

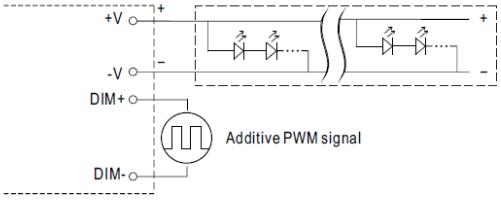
◎ Applying additive 0 ~ 10VDC



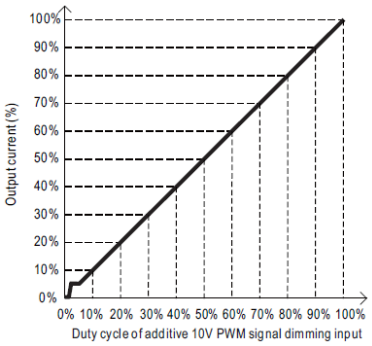
"DO NOT connect "DIM- to -V"



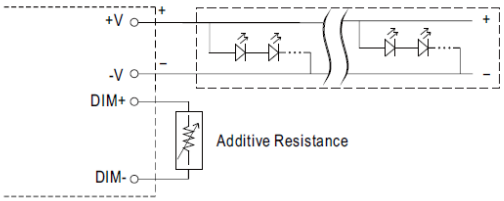
◎ Applying additive 10V PWM signal (frequency range 100Hz ~ 3KHz):



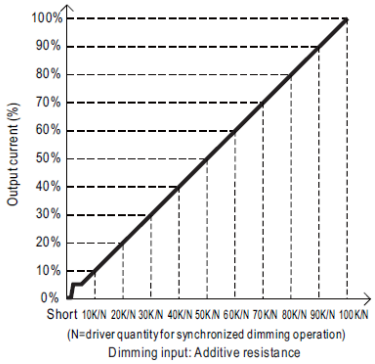
"DO NOT connect "DIM- to -V"



◎ Applying additive resistance:



"DO NOT connect "DIM- to -V"



Note : 1. Min. dimming level is about 5% and the output current is not defined when 0%< Iout<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℃

R	SHORT	10K	20K	30K	40K	50K	60K	70K	80K	90K	100K	OPEN
O/P CURRENT	0A	0.328A	0.575A	0.850A	1.110A	1.360A	1.680A	1.980A	2.250A	2.520A	2.810A	2.830A
%	0.00%	11.71%	20.54%	30.36%	39.64%	48.57%	60.00%	70.71%	80.36%	90.00%	100.36%	101.07%

V	0V	1V	2V	3V	4V	5V	6V	7V	8V	9V	10V	OPEN
O/P CURRENT	0A	0.360A	0.596A	0.880A	1.170A	1.450A	1.720A	1.970A	2.260A	2.510A	2.770A	2.760A
%	0.00%	12.86%	21.29%	31.43%	41.79%	51.79%	61.43%	70.36%	80.71%	89.64%	98.93%	98.57%

PWM (100HZ)	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	OPEN
O/P CURRENT	0A	0.311A	0.594A	0.870A	1.150A	1.420A	1.700A	1.980A	2.260A	2.540A	2.780A	2.760A
%	0.00%	11.11%	21.21%	31.07%	41.07%	50.71%	60.71%	70.71%	80.71%	90.71%	99.29%	98.57%

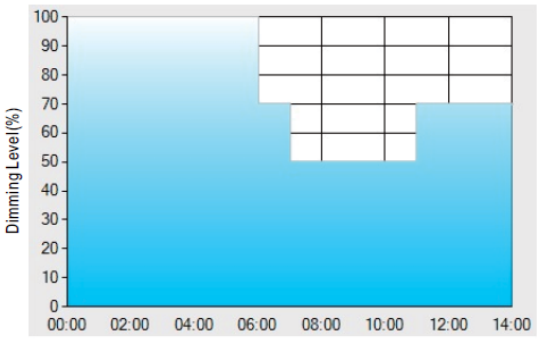
TEST RESULT：OK

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.

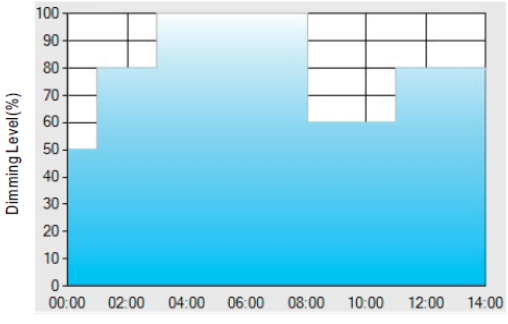
Ex : ◎ D01-Type: the profile recommended for residential lighting



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%

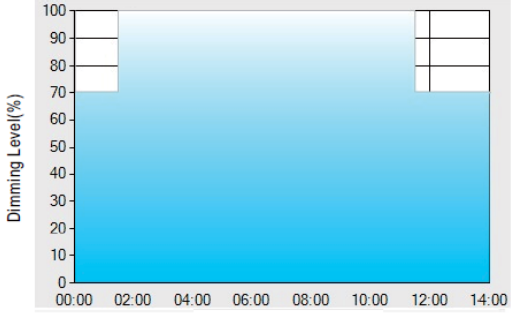
Ex: ◎ D02-Type: the profile recommended for street lighting



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%

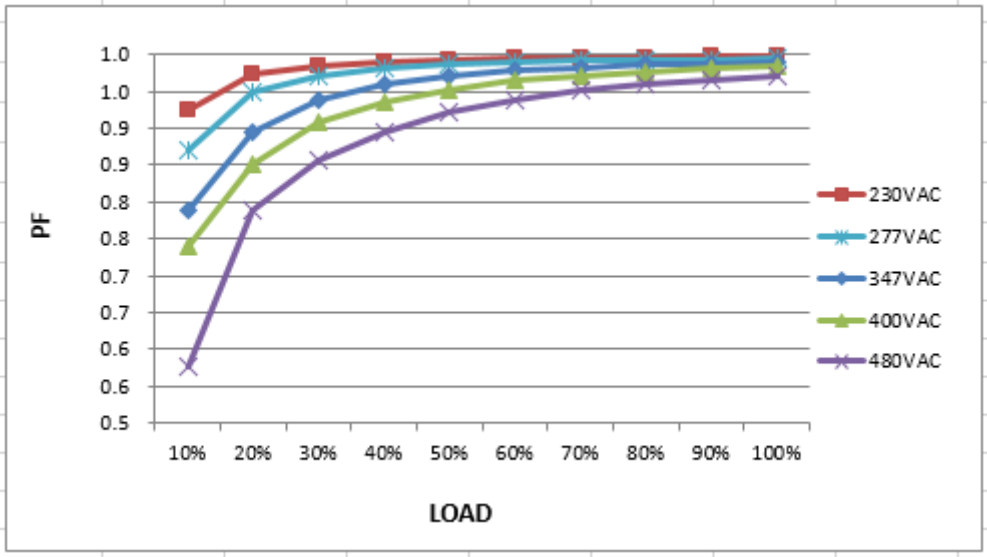
I/P：347VAC

O/P：DIMMING TEST

		TA：25℃ 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℃ TEST RESULT：OK

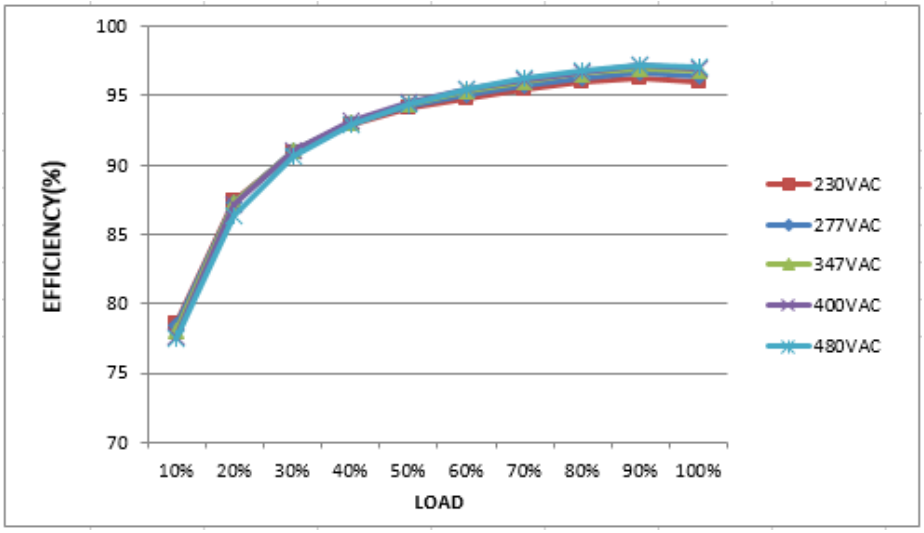
INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	180VAC~528 VAC	I/P:TESTING O/P:FULL LOAD CP 2.8A Ta:25℃	149V~528 V
			I/P: LOW-LINE-3V=177 V HIGH-LINE+10V=538 V O/P:FULL/MIN LOAD CP 2.8A (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 2.8A Ta:25℃	TEST: OK
3	INPUT CURRENT (TYP)	347VAC/ 2.1 A 480VAC/ 1.5A	I/P: 347VAC/480VAC O/P:FULL LOAD CP 2.8A Ta:25℃	I =1.938A/ 347VAC I =1.428A/480VAC
4	LEAKAGE CURRENT	IEC60950-1 < 0.75mA / 480VAC	I/P: 480 VAC O/P:Min LOAD Ta:25℃	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℃	PF= 0.971/480V/100%LOAD PF=0.984/400V/100%LOAD PF= 0.99/347V/100%LOAD PF=0.995/277V/100%LOAD PF=0.997/230V/100%LOAD
	P.F vs LOAD			



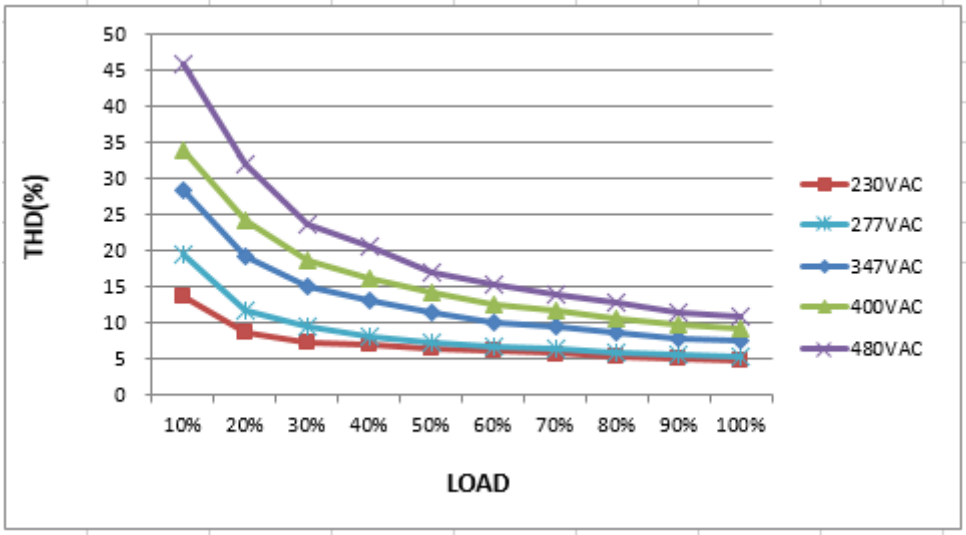
6	EFFICIENCY (TYP)	95%	I/P: 347VAC O/P:FULL LOAD. CP 2.8A Ta:25℃	95.54%

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 2.8A Ta：25℃	THD： 6.55 %/230V 50% THD： 4.71 %/230V 100% THD： 7.28 %/277V 50% THD： 5.32 %/277V 100% THD： 11.36 %/347V 50% THD： 7.47 %/347V 100% THD： 16.96 %480V 50% THD： 10.88 %480V 100% THD： 14.3 %400V 50% THD： 9.17 %400V100%

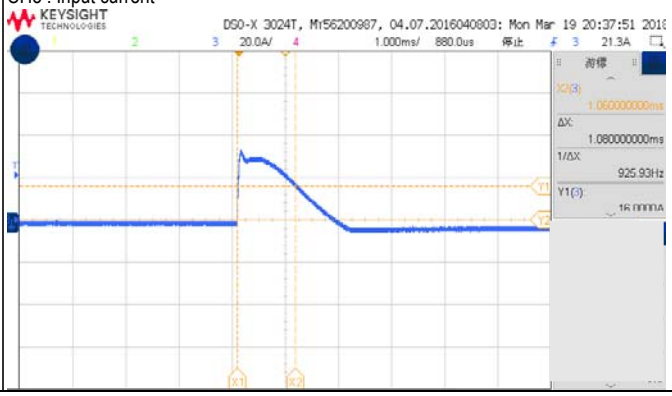
THD vs LOAD



8	INRUSH CURRENT (TYP)	480V/ 40A COLD START (twidth= 1100us measured at 50% Ipeak) COLD START	I/P: 480VAC O/P:FULL LOAD CP 2.8A Ta:25℃	I =32.5A /480VAC T50= 1080 μS

INPUT=480VAC/ 60HZ @ FULL LOAD

CH3 : Input current



ROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER VOLTAGE PROTECTION	V1: 240V~259V PROTECTION TYPE： Shut down output voltage, re-power on to recovery	I/P: 528VAC I/P: 347VAC I/P: 180VAC CP 2.8A O/P:MIN LOAD Ta:25℃	243.91V / 528VAC 244.49V/ 347VAC 243.1V/ 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 2.8A Ta:25℃	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： Constant current, recovers automatically after fault	I/P: 528VAC I/P: 180 VAC O/P: FULL LOAD CP: 2.8A &3.5A Ta:25℃	CP: 2.8A/3.5A NO DAMAGE PROTECTION TYPE： Constant current, recovers automatically after fault condition is

		condition is removed		removed

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: 2.8A&3.5A** VDS: O/P: (1)Full Load (2)Output Short (3) Full Load continue Ta:25℃	**CP: 2.8A** Q11 VDS: (1) 831V (2) 807V (3) 799V VDS: (1) 839V (2) 791V (3) 815V Q13 VDS: (1) 831V (2) 807V (3) 807V VDS: (1) 847V (2) 791V (3) 823V	**CP: 3.5A** Q11 VDS: (1) 862V (2) 870V (3) 805V VDS: (1) 862V (2) 781V (3) 829V Q13 VDS: (1) 854V (2) 854V (3) 805V VDS: (1) 862V (2) 789V (3) 846V
2	P.F.C Transistor (D to S) or (C to E) **Peak Voltage**	Q4 Rated 6 A/1050V	I/P:High-Line +3V =531V **CP: 2.8A** VDS: O/P: (1)Full Load (2)Output Short (3) Full Load continue Ta:25℃	**CP: 2.8A** Q4 VDS: (1) 888V (2) 815V (3) 807V	
3	P.F.C DIODE	D8 Rated 8A/1200V	I/P:High-Line +3V =531 V **CP: 2.8A** O/P: (1)Full Load (2)Output Short (3) Full Load continue Ta:25℃	**CP: 2.8A** (1) 847V (2) 791V (3) 799V	
4	Diode Peak **Voltage**	Q100 Rated 22A/600V Q101 Rated 22A/600V Q130 Rated 22A/600V Q131 Rated 22A/600V D561 Rated 1A/200V	I/P:High-Line +3V =531 V VDS： **CP: 2.8A& 3.5A** O/P: (1)Full Load (2)Output Short (3) Full Load continue Ta:25℃	**CP: 2.8A** **Q100** VDS: (1) 476V (2) 30V (3) 476V **Q101** VDS: (1) 476V (2) 50V (3) 472V	**CP:3.5A** **Q100** VDS: (1) 388V (2) 22V (3) 388V **Q101** VDS: (1) 392V (2) 50V (3) 392V

				Q130 VDS: (1) 476V (2) 26V (3) 472V **Q131** VDS: (1) 472V (2) 66V (3) 472V **D561** (1) 130.6V (2) 124.1V (3) 126.5V	**Q130** VDS: (1) 388V (2) 18V (3) 384V **Q131** VDS: (1) 392V (2)62 V (3) 388V **D561** (1) 129.6V (2) 122.1V (3) 123.5V
5	**Input Capacitor Voltage**	C5 Rated: : 220μ/ 450V	I/P:High-Line +3V =531V CP 2.8A 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℃	**CP: 2.8A** (1) 416V (2) 392V (3) 420V (4)392V	
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: 2.8A** 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℃	**CP: 2.8A** U1 (1) 14.69V (2) 14.05V (3) 14.05V (4) 13.91V (5) 12.76V	**CP: 2.8A** U2 (1) 15V (2) 14.52V (3) 14.52V (4) 14.52V (5) 12.12V

■ 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℃	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℃	I/P-O/P:18.7 GΩ I/P-FG: 21.5G Ω O/P-FG:23.4GΩ **NO DAMAGE**
3	GROUNDING CONTINUITY	IEC60950-1 FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40A / 2min Ta:25℃	24mΩ

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℃	PASS
2	CONDUCTION	FCC PART 15 CLASS B EN55015	I/P:230V/400V/480VAC (50HZ/60HZ) O/P:FULL/40% LOAD Ta:25℃	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℃	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℃	CRITERIA A
5	E.F.T	EN61000-4-4 LIGHT INDUSTRY INPUT: 1KV	I/P: 230/400VAC (50HZ) O/P:FULL LOAD Ta:25℃	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℃	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-L 1. ROOM AMBIENT BURN-IN： 1 HRS I/P： 347VAC O/P： FULL LOAD 2. HIGH AMBIENT BURN-IN： 3 HRS I/P： 347VAC O/P： FULL LOAD		

CH.	Position	ROOM AMBIENT Ta= 25 ℃	HIGH AMBIENT Ta= 55 ℃
1	BD1	65.1℃	96.5℃
2	ZNR4	60.5℃	92.1℃
3	RTH4	74.3℃	100.5℃
4	C10	58.7℃	91.0℃
5	Q1	58.9℃	91.5℃
6	Q3	58.9℃	92.2℃
7	D5	57.0℃	89.3℃
8	D8	65.4℃	104.4℃
9	L3	62.6℃	98.1℃
10	LF3	59.0℃	91.1℃
11	C7	57.3℃	88.6℃
12	Q10	62.7℃	99.0℃
13	T3	60.9℃	94.7℃
14	C93	60.1℃	93.4℃
15	C5	56.8℃	89.0℃
16	RY1	62.8℃	96.8℃
17	T1-1	63.3℃	96.5℃
18	T1-2	64.1℃	96.7℃
19	T2-1	56.3℃	87.8℃
20	T2-2	65.0℃	97.6℃
21	C925	58.6℃	90.7℃
22	Q101	57.9℃	90.3℃
23	Q130	57.8℃	90.4℃
24	Q102	59.5℃	91.5℃
25	C105	56.4℃	88.0℃
26	C109	52.9℃	83.8℃
27	LF100	50.7℃	81.5℃
28	RTH2	59.1℃	91.0℃
29	U501	64.4℃	96.2℃
30	T500	58.8℃	90.5℃
31	Q511	64.6℃	96.6℃
32	D500	60.6℃	92.7℃
33	D501	58.5℃	90.8℃
34	U600	53.0℃	84.1℃
35	LF61	51.4℃	82.1℃

2	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR TEMPERATURE :-40℃	I/P： 528VAC/180VAC O/P： 100 % LOAD Ta= -45℃	TEST：OK
3	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 55 ℃ / 95 %R.H NO DAMAGE	I/P： 538VAC O/P：FULL LOAD Ta= 55 ℃ HUMIDITY= 95 %R.H	TEST：OK
4	TEMPERATURE COEFFICIENT	± 0.03%/℃(0~60℃)	I/P：347 VAC O/P：FULL LOAD	± 0 %/℃(0~60℃)
5	STORAGE TEMPERATURE TEST	-40℃~+80℃	1. Thermal shock Temperature： -50℃~ +125℃ 2. Temperature change rate ：25℃ / 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℃~+55℃ (PLEASE CHECK DERATING CURVE)	1. Thermal shock Temperature： -45℃~ +60℃ 2. Temperature change rate ：25℃ / 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℃	
8	CAPACITOR LIFE CYCLE	SUPPOSE C105 IS THE MOST CRITICAL COMPONENT (1) I/P： 347VAC O/P：FULL LOAD Tc= 80 ℃ LIFE TIME (2) I/P： 347VAC O/P：FULL LOAD Tc= 80 ℃ LIFE TIME (3) I/P： 347VAC O/P：75% LOAD Tc= 80 ℃ LIFE TIME		(1) 67461 HRS (2) 65578 HRS (3) 64113HRS
9	MTBF	Conducted by Parts Stress Analysis Prediction 218.8K hrs min. Telcordia SR-332(Bellcore) ; 60.2K 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		

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

12.10.30 A50-F031