Test Report： HBG-160-36

160W 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

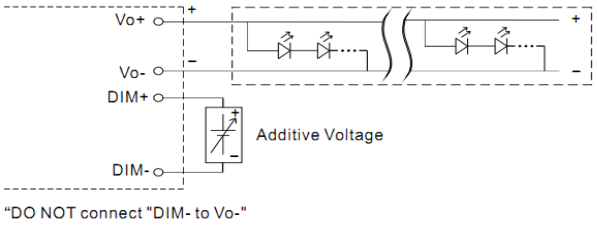
OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	CONSTANT CURRENT REGION	21.6 V~ 36 V	I/P： 230VAC O/P：LED MODE Ta：25℃	21.6V~ 36 V
2	OUTPUT CURRENT ADJUST RANGE (For A-Type)	2.6A~4.4A	I/P： 230VAC O/P：SETING Ta：25℃	2.273A~4.803A
3	OUTPUT VOLTAGE TOLERANCE	-2%~+2%	I/P： 90VAC / 305VAC O/P：FULL/80%/ NO LOAD Ta：25℃	-0.105%~ 0.850%
4	LINE REGULATION	-0.5%~+0.5%	I/P： 90VAC ~ 305VAC O/P：80% ~ FULL LOAD Ta：25℃	-0%~ 0.017 %
5	LOAD REGULATION	-1.0%~+1.0%	I/P： 230VAC O/P：FULL/ NO LOAD Ta：25℃	-0.051%~ 0.041%
6	OVER/UNDERSHOOT TEST	<±5 %	I/P： 230VAC O/P：FULL LOAD Ta：25℃	<5 %
7	RIPPLE & NOISE (Max)	300mVp-p	I/P： 230VAC O/P：FULL LOAD Ta：25℃	40 mVp-p
8	SET UP TIME(Max)	230VAC/ 500ms 115VAC/ 2500ms	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	230VAC/ 230 ms 115VAC/ 421 ms
9	RISE TIME (Max)	230VAC/ 200ms 115VAC/ 200ms	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	230VAC/ 31.7 ms 115VAC/ 31.4 ms
10	HOLD UP TIME(Typ)	230VAC/ 12ms 115VAC/ 12ms	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD Ta：25℃	230VAC/ 23.2 ms 115VAC/ 23.4 ms
11	DYNAMIC LOAD	V1： 3600 mVp-p	I/P： 230VAC O/P： (1) FULL/50% LOAD 50%DUTY / 120HZ (2) FULL /50% LOAD 50%DUTY / 1KHZ Ta：25℃	 (1) 468mVp-p (2) 716mVp-p

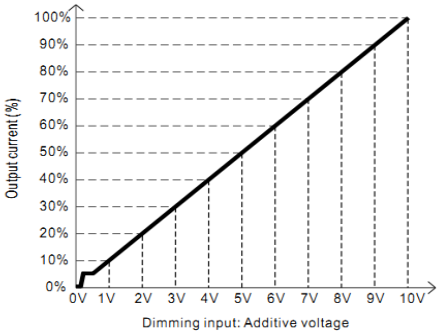
12 DIMMING OPERATION (for B-Type)

- 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:100uA(typ.)

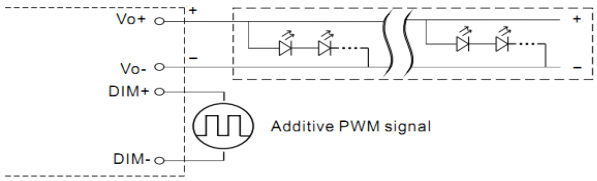
◎ Applying additive 0 ~ 10VDC



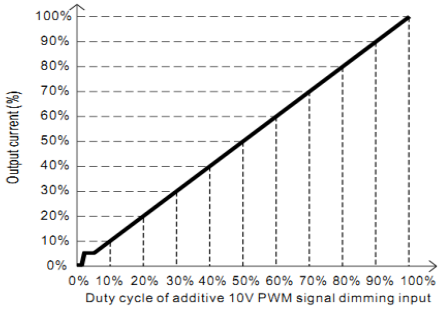
"DO NOT connect "DIM- to Vo-"



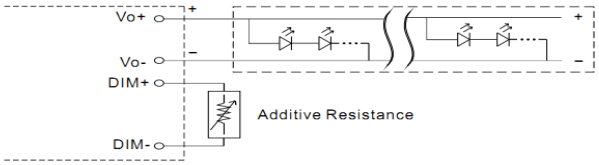
◎ Applying additive 10V PWM signal (frequency range 100Hz ~ 3KHz):



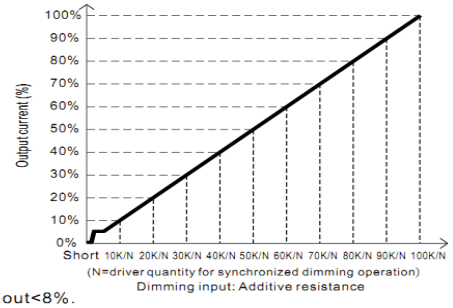
"DO NOT connect "DIM- to Vo-"



◎ Applying additive resistance:



"DO NOT connect "DIM- to Vo-"



Note : 1. Min. dimming level is about 8% and the output current is not defined when 0%< Iout<8%.
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： 230 VAC

O/P：DIMMING TEST

Ta：25℃

	DIMMING	Short	1V	2V	3V	4V	5V	6V	7V	8V	9V	10V
1	Output Current	0	0.489A	0.917A	1.349A	1.781A	2.208A	2.630A	3.504A	3.480A	3.901A	4.332A
	%	0%	11.11%	20.84%	30.66%	40.48%	50.18%	59.77%	79.64%	79.09%	88.66%	98.45%
2	PWM(100Hz)	0V	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	Output Current	0	0.527A	0.955A	1.386A	1.812A	2.241A	2.657A	3.077A	3.501A	3.921A	4.304A
	%	0%	11.91%	21.68%	31.50%	41.16%	50.89%	60.39%	69.91%	79.55%	89.14%	97.82%
3	R	0%	10K	20K	30K	40K	50K	60K	70K	80K	90K	100K
	Output Current	0	0.498A	0.929A	1.360A	1.790A	2.217A	2.636A	3.056A	3.477A	3.898A	4.319A
	%	0%	11.32%	21.11%	30.91%	40.68%	50.39%	59.91%	69.45%	79.02%	88.59%	98.16%

TEST RESULT：OK

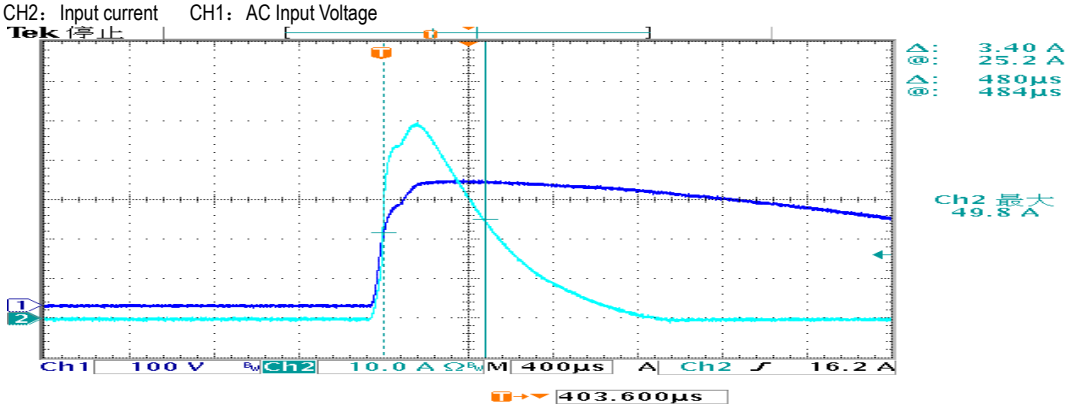
13	DALI DIMMING OPERATION (primary side；for DA-Type)	※DALI Interface ·Apply DALI signal between DA+ and DA-. ·DALI protocol comprises 16 groups and 64 addresses. ·Firse step is fixed at 8% of output. I/P： 230 VAC O/P：DIMMING TEST Ta：25℃ TEST RESULT：OK

INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	90VAC~305VAC	I/P：TESTING O/P：80% ~FULL LOAD Ta：25℃	87 V~ 305 V
			(1)I/P：LOW-LINE-3V=87 V HIGH-LINE+10V=315 V O/P：80% ~FULL LOAD ON：30 Sec OFF：30 Sec 10MIN (2)230VAC ON：0.5 Sec OFF：0.5 Sec 20MIN (POWER ON/OFF NO DAMAGE)	TEST： OK
2	INPUT FREQUENCY RANGE	47HZ ~63 HZ NO DAMAGE	I/P： 90 VAC ~305 VAC O/P：FULL ~NO LOAD Ta：25℃	TEST： OK
3	AC CURRENT	1.7A/115VAC 0.78A/230VAC 0.7A/277VAC	I/P： 115 VAC I/P： 230 VAC I/P： 277 VAC O/P：FULL LOAD Ta：25℃	I = 1.55 A/ 115VAC I = 0.78 A/ 230VAC I = 0.66 A/ 277VAC
4	LEAKAGE CURRENT	< 0.75mA / 277VAC	I/P： 277 VAC O/P：NO LOAD Ta：25℃	L-FG： 0.347 mA N-FG： 0.335 mA
5	INRUSH CURRENT(Typ)	230V/ 65A Twidth =550us measured at 50% Ipeak COLD START COLD START	I/P： 230 VAC O/P：FULL LOAD Ta：25℃	I = 49.8 A/ 230VAC Twidth =480 us

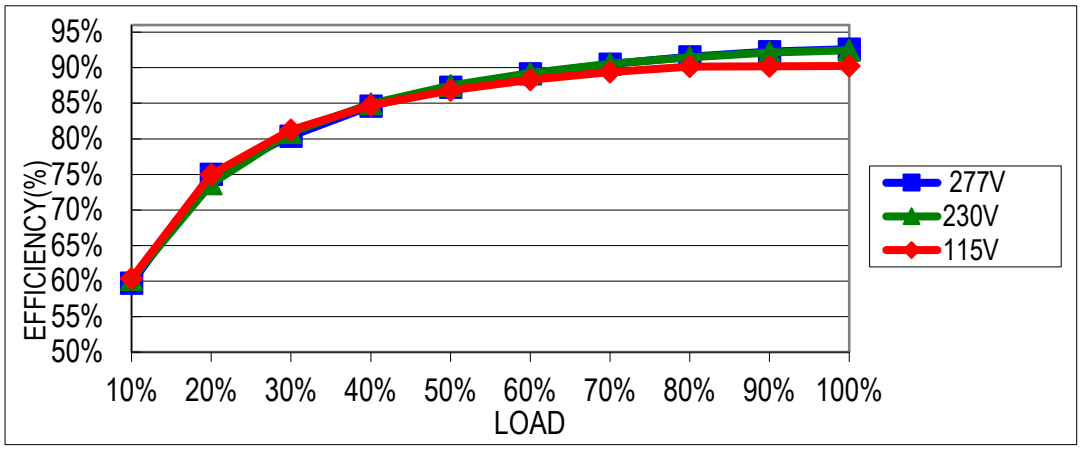
INPUT=230VAC/50HZ @ FULL LOAD

CH2：Input current CH1：AC Input Voltage



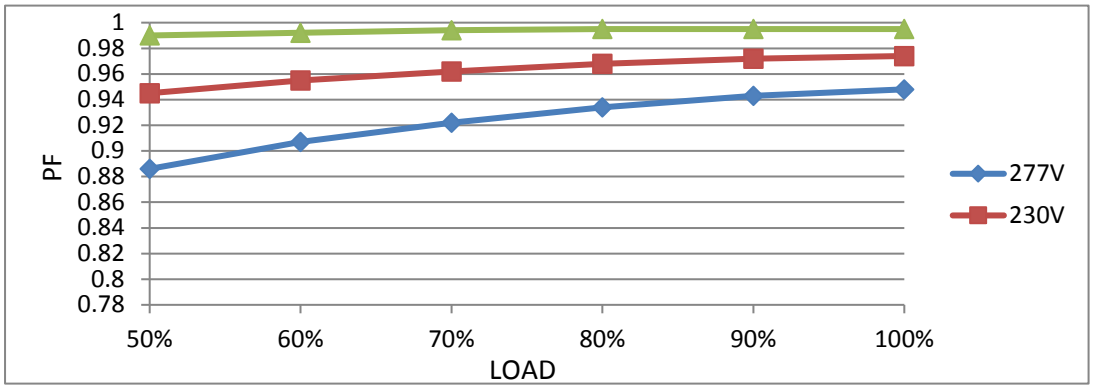
6	EFFICIENCY(Typ)	92%	I/P： 230VAC O/P：FULL LOAD Ta：25℃	93.08%

EFFICIENCY vs LOAD



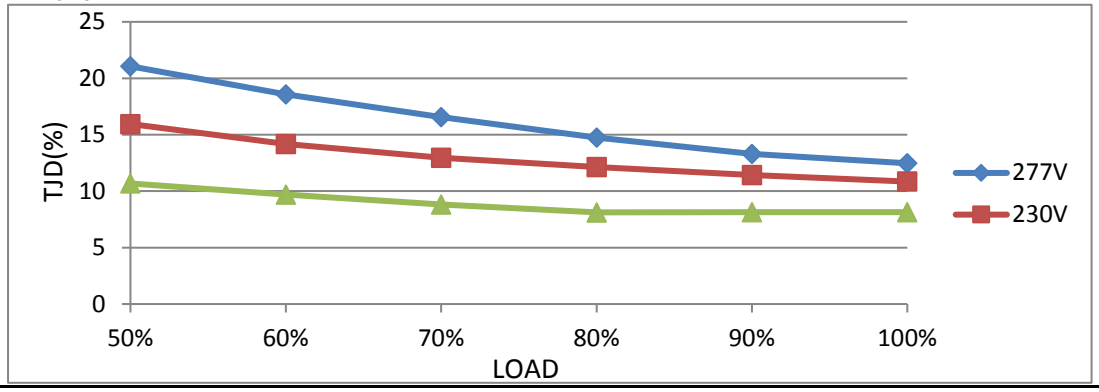
7	POWER FACTOR	0.98/ 115VAC 0.95/ 230VAC 0.92/ 277VAC	I/P： 115 VAC I/P： 230 VAC I/P： 277 VAC O/P：FULL LOAD Ta：25℃	PF= 0.995 / 115VAC PF= 0.974 / 230VAC PF= 0.948 / 277VAC

P.F vs LOAD



8	TOTAL HARMONIC DISTORTION	THD＜20% （@load≥60%/115VAC，230VAC； @load≥75%/277VAC）	I/P：115 VAC/60% LOAD I/P：230 VAC/60% LOAD I/P：277 VAC/75% LOAD Ta：25℃	THD=9.71% @60% load /115VAC THD=14.17% @60% load /230VAC THD=15.63% @75% load /277VAC

THD vs LOAD



PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER CURRENT PROTECTION	95%~108%	I/P： 90VAC I/P： 230VAC I/P： 305VAC O/P：TESTING Ta：25℃	100.66 %/ 90VAC 100.68 %/ 230VAC 100.70%/ 305VAC Constant Current Limiting，recovers automatically after fault condition is removed
2	OVER VOLTAGE PROTECTION	41V~47V	I/P： 90VAC I/P： 230VAC I/P： 305VAC O/P：NO LOAD Ta：25℃	43.5 V/ 90VAC 43.5 V/ 230VAC 43.5V/ 305VAC Shut down o/p voltage with auto-recovery or re-power on to recovery
3	OVER TEMPERATURE PROTECTION	NO DAMAGE	I/P： 230VAC O/P：FULL LOAD	Shut down o/p voltage, recovers automatically after temperature goes down
4	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE	I/P： 305VAC O/P：FULL LOAD Ta：25℃	NO DAMAGE Hiccup mode, recovers automatically after fault condition is removed

COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Power Transistor	Q6 Rated 600V/11A	I/P：High-Line +3V =308V O/P： (1) FULL LOAD Turn on (2) Output Short (3) FULL LOAD continue Ta：25℃	(1) 480 V (2) 434 V (3) 440 V
2	O/P Diode (MOSFET)	D100 Rated 100V/40A	I/P：High-Line +3V =308V O/P： (1) FULL LOAD Turn on (2) Output Short (3) FULL LOAD continue Ta：25℃	(1)81.6 V (2)12.7 V (3)81.2 V
3	Input Capacitor	C5 Rated 82u/450V	I/P：High-Line +3V =308 V O/P：(1) FULL LOAD input on/off (2) NO LOAD input on /Off (3) FULL LOAD /NO LOAD Change Ta：25℃	(1) 448 V (2) 440 V (3) 442 V
4	Control IC	U2 Rated 16V (MAX.)	I/P：High-Line +3V =308 V O/P：((1) FULL LOAD (2) NO LOAD input on /Off (3) FULL LOAD /NO LOAD Change Ta：25℃	(1) 14.0 V (2) 14.3 V (3) 14.0 V
5	PFC Power Transistor	Q 1 Rated 600V/16A	I/P：High-Line +3V =308V O/P： (1) FULL LOAD Turn on (2) Output Short (3) FULL LOAD continue Ta：25℃	(1) 480 V (2) 458 V (3) 452 V

SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	I/P-O/P：3.75KVAC/min I/P-FG： 2.0KVAC/min O/P-FG：0.5KVAC/min	I/P-O/P：4.2KVAC/min I/P-FG： 2.4 KVAC/min O/P-FG：0.6 KVAC/min Ta：25℃	I/P-O/P：2.985 mA I/P-FG： 2.596 mA O/P-FG：3.598 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℃	I/P-O/P：>9999 MΩ I/P-FG： >9999 MΩ O/P-FG：>9999 MΩ
3	GROUNDING CONTINUITY	FG(PE) TO CHASSIS OR TRACE < 50 mΩ EN 60950-1	40 A / 2min Ta：25℃ / 70%RH	18 MΩ

E.M.C TEST

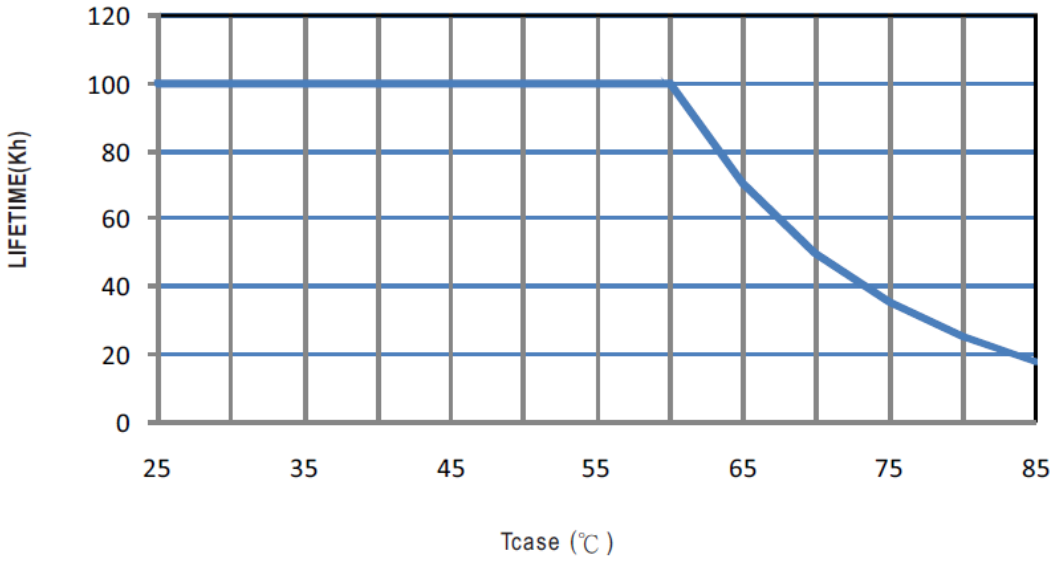
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	HARMONIC	EN61000-3-2 Class C	I/P：230VAC/50HZ O/P：FULL/60% LOAD Ta：25℃	PASS
2	CONDUCTION	EN55015	I/P：230 VAC (50HZ) O/P：FULL LOAD Ta：25℃	PASS Test by certified Lab
3	RADIATION	EN55015	I/P：230 VAC (50HZ) O/P：FULL LOAD Ta：25℃	PASS Test by certified Lab
4	E.S.D	EN61000-4-2 LIGHT INDUSTRY AIR：8KV Contact：4KV	I/P：230 VAC/50HZ O/P：FULL LOAD Ta：25℃	PASS
5	E.F.T	EN61000-4-4 LIGHT INDUSTRY INPUT：1KV	I/P： 230VAC/50HZ O/P：FULL LOAD Ta：25℃	PASS
6	SURGE	EN61000-4-5 INDUSTRY L-N：2KV L,N-PE：4KV	I/P： 230VAC/50HZ O/P：FULL LOAD Ta：25℃	PASS
7	Test by certified Lab ＆ Test Report Prepare			

■ 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： HBG-160-24
1. ROOM AMBIENT BURN-IN：2 HRS
I/P： 230VAC O/P： 95% LOAD Ta=28.7 ℃
2. HIGH AMBIENT BURN-IN： 2 HRS
I/P： 230VAC O/P： 95% LOAD Ta=60.7 ℃
<table>
<tr><th>NO</th><th>Position</th><th>ROOM AMBIENT Ta=28.7 ℃</th><th>HIGH AMBIENT Ta=60.7 ℃</th></tr>
<tr><td>1</td><td>Q1</td><td>58.4℃</td><td>90.6℃</td></tr>
<tr><td>2</td><td>D5</td><td>58.6℃</td><td>89.8℃</td></tr>
<tr><td>3</td><td>C5</td><td>51.6℃</td><td>82.8℃</td></tr>
<tr><td>4</td><td>U2</td><td>54.1℃</td><td>86.3℃</td></tr>
<tr><td>5</td><td>Q6</td><td>48.8℃</td><td>79.5℃</td></tr>
<tr><td>6</td><td>T1</td><td>51.0℃</td><td>82.1℃</td></tr>
<tr><td>7</td><td>D100</td><td>71.2℃</td><td>103.4℃</td></tr>
<tr><td>8</td><td>C102</td><td>60.7℃</td><td>92.4℃</td></tr>
<tr><td>9</td><td>RTH2</td><td>54.5℃</td><td>80.0℃</td></tr>
<tr><td>10</td><td>TC</td><td>48.2℃</td><td>78.6℃</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： 305VAC/90VAC
O/P：FULL/80% LOAD
Ta= -45℃/-35℃</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 50℃
NO DAMAGE</td><td>I/P： 305VAC
O/P：FULL LOAD
Ta=50℃
HUMIDITY= 95 %R.H</td><td>TEST：OK</td></tr>
<tr><td>4</td><td>TEMPERATURE COEFFICIENT</td><td>±0.03 %/℃(0~50℃)</td><td>I/P： 230 VAC
O/P：FULL LOAD</td><td>±0.004 %/℃(0~50℃)</td></tr>
<tr><td>5</td><td>STORAGE TEMPERATURE TEST</td><td colspan="2">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>TEST：OK</td></tr>
<tr><td>6</td><td>THERMAL SHOCK TEST</td><td colspan="2">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： 230VAC/95% LOAD AC ON/OFF TEST
AC on 3 sec/AC off 1 sec TEST</td><td>TEST：OK</td></tr>
<tr><td>7</td><td>VIBRATION TEST</td><td colspan="2">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℃</td><td>TEST：OK</td></tr>
</table>

8	CAPACITOR LIFE CYCLE	HBG-160-24：SUPPOSE C102 IS THE MOST CRITICAL COMPONENT (1) I/P： 230VAC O/P：FULL LOAD Ta= 25 ℃ LIFE TIME (2) I/P： 230VAC O/P：FULL LOAD Ta= 60 ℃ LIFE TIME (3) I/P： 230VAC O/P：75% LOAD Ta= 60 ℃ LIFE TIME (4) I/P： 230VAC O/P：50% LOAD Ta= 60 ℃ LIFE TIME	(1) 413163 HRS (2) 37223 HRS (3) 58469 HRS (4) 90733 HRS
9	MTBF	Conducted by Parts Stress Analysis Prediction 2047.8K hrs min. Telcordia SR-332 (Bellcore) ; 194.1K hrs min. MIL-HDBK-217F (25℃)	
10	DMTBF/Accelerated Life Test	Demonstration Mean Time Between Failure(Expected Life) ： 50,000 hours @ Tcase 70℃	



TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	SHENJW/ZHUOKB	SKY	LIUWY