Test Report: NPB-450-12

450W High Reliable Ultra Wide Output Range
Intelligent Battery Charger

■ DESIGN VERIFY TEST

Output Function Test
Input Function Test
Protection Function Test
Control Function Test
Component Stress Test

■ SAFETY & E.M.C. TEST

Safety Test
E.M.C. Test

■ RELIABILITY TEST

ENVIRONMENT TEST

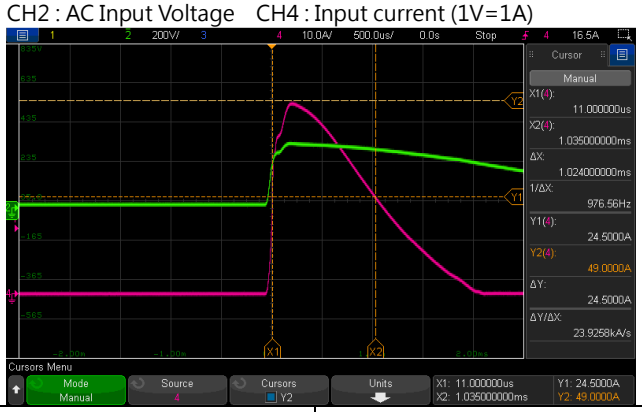
■ DESIGN VERIFY TEST

OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	BOOST CHARGE VOLTAGE (default)	14.4V± 0.24 V	I/P: 230 VAC O/P:BAT. LOAD Ta:25℃	14.4 1 V
2	FLOAT CHARGE VOLTAGE **(default)**	13.8V± 0.12 V	I/P: 230 VAC O/P:BAT. LOAD Ta:25℃	13.82V
3	MAX. OUTPUT CURRENT	25A± 0.25 A	I/P: 230 VAC O/P:C.V =13.4V Ta:25℃	24.97A
4	MAX. POWER	420W	I/P: 230 VAC O/P:C.V =16.8V Ta:25℃	420.9W
5	LEAKAGE CURRENT FROM BATTERY (TYP)	<1mA	I/P: AC OFF O/P:BAT. LOAD Ta:25℃	77.uA
6	OUTPUT CURRENT RANGE	50%~100%Io	I/P: 230 VAC O/P:C.V =16.8V Ta:25℃	11.72~24.81A

INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	90VAC~264VAC 127VDC~370VDC	(1) I/P:TESTING O/P:FULL LOAD (2) I/P:DC TESTING(L:+ N:-) O/P: FULL LOAD (3) I/P:DC TESTING(L:- N:+) O/P: FULL LOAD Ta:25℃	(1) 86.6V~264V (2)120 Vdc~370Vdc/FULL LOAD (3) 120Vdc~370Vdc/FULL LOAD
			I/P: LOW-LINE-3V=87 V HIGH-LINE+15%= 300 V O/P:BAT. LOAD (PLEASE CHECK DERATING CURVE) 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: 90 VAC ~264 VAC O/P:FULL~MIN LOAD Ta:25℃	TEST: **OK**
3	LEAKAGE CURRENT	< 0.75 mA / 240VAC	I/P: 240 VAC O/P:Min LOAD Ta:25℃	0.47 mA
4	INPUT CURRENT (TYP)	230 V/ 2.2 A 115 V/ 4.5A	I/P: 230 VAC I/P: 115 VAC	I =2.00A/ 230VAC I =4.09A/ 115VAC

			O/P:BAT. LOAD Ta:25℃	
5	POWER FACTOR (TYP)	0.95/ 230 VAC 0.98/ 115 VAC	I/P: 230 VAC I/P: 115 VAC O/P:BAT. LOAD Ta:25℃	PF= 0.989/ 230VAC PF= 0.997/ 115VAC
6	EFFICIENCY (TYP)	92%	I/P: 230 VAC O/P:BAT. LOAD(C.V =16.8V) Ta:25℃	92.1%
7	INRUSH CURRENT (TYP)	230 V/ 50 A COLD START	I/P: 230 VAC O/P:BAT. LOAD Ta:25℃	I =49A/ 230VAC T50= 1.024ms/230V
	INPUT=230VAC/50HZ @ FULL LOAD CH2 : AC Input Voltage CH4 : Input current (1V=1A) 			
8	GAIN-PHASE MARGIN TEST	GAIN MARGIN < -10dB PHASE MARGIN>=60 Gain Curve slope: -10dB/dec~-40dB/dec	(1) CC MODE(Vboost)/ 90% LOAD /264Vac (2) CC MODE(Vboost)/ 90% LOAD /90Vac Ta:25℃	(1) 69.2439 °/ -21.276 dB / -27.8 dB/dec (2) 70.4614 °/ -21.326 dB / -32.7 dB/dec

PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER VOLTAGE PROTECTION	CH1:21.5V~26V PROTECTION RESULT Shut down and latch off o/p voltage, re-power on to recover.	I/P: 264 VAC I/P: 90 VAC O/P:TESTING Ta:25℃	25.4V/ 264VAC 25.4V/ 90VAC ROTECTION TYPE : Shut down and latch off o/p voltage, re-power on to recover.
2	OVER TEMPERATURE PROTECTION	SPEC: NO DAMAGE Shut down o/p voltage, recover automatically after temperature goes on.	I/P: 264 VAC I/P: 90 VAC O/P:BAT. LOAD	O.T.P. Active PROTECTION TYPE : OK Shut down o/p voltage, recover automatically after temperature goes on.
3	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE 22.5A~30A Constant current	I/P: 264 VAC O/P: BAT. LOAD Ta:25℃	NO DAMAGE 25.02 A PRO TECTION TYPE : Constant current

		limiting ,charger will shut down after 5 sec, re-power on to recover.		limiting ,charger will shut down after 5 sec, re-power on to recover.
4	BATTERY REVERSE POLARITY	Protected internal reverse detection, No damage, re-power on to recover after conduction is removed.	I/P: 230 VAC O/P:BAT. LOAD Ta:25℃	Protected internal reverse detection, No damage, re-power on to recover after conduction is removed
5	ERROR INPUT HIGH VOLTAGE BATTERY	Shut down o/p voltage, re-power on to recover	I/P: 230 VAC O/P:BAT. LOAD Ta:25℃	PROTECTION TYPE： Shut down o/p voltage, re-power on to recover

CONTROL FUNCTION 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>FAN SPEED CONTROL</td><td>FAN control mosfet duty：
30%（-1%）@RTH5＜45℃
FAN control mosfet duty：
100%（-1%）@RTH5＞60℃</td><td>I/P: 230 VAC
O/P:BAT. LOAD
Ta:25℃</td><td>29.6% @RTH5＜45℃
99.6% @RTH5＞60℃</td></tr>
<tr><td>2</td><td>REMOTE CONTROL</td><td>Rc+ / Rc-
OPEN/(-0.5~0.5V):
Charger stop charging
SHORT/(10.8~13.2V) :
Charger normal work</td><td>I/P: 230 VAC
O/P:BAT. LOAD
Ta:25℃</td><td>TEST:
OPEN/-0.5~2.5 V
SHORT/ 2.7~ 13.2V
(1) Remote off Pin=4.08W
(2) Remote off Vo= 0.04V</td></tr>
<tr><td>3</td><td>AUX POWER</td><td>OUTPUT VOLTAGE RANGE：
10.8~13.2V
OUTPUT RIPPLE&NOISE：
150mVp-p</td><td>I/P: 230 VAC
O/P:BAT. LOAD
Ta:25℃</td><td>TEST: 12.04 V
33 mVp-p</td></tr>
<tr><td>4</td><td>LED INDICATOR</td><td><table><tr><th>LED</th><th>Description</th></tr><tr><td>Green</td><td>Float(stage 3) or Battery full</td></tr><tr><td>Orange</td><td>Charging (stage 1 or stage 2)</td></tr><tr><td>Orange (Flashing)</td><td>Auto sensing for charging</td></tr><tr><td>Red</td><td>Abnormal status (OTP,OVP, Short, Reverse polarity, Charging timeout.)</td></tr><tr><td>Red (Flashing)</td><td>The LED will flash with the red light when the internal temperature reaches 95℃; under this condition, the unit still operates normally without entering OTP.</td></tr></table>I/P: TESTING VAC
O/P:TESTING LOAD
Ta:25℃</td><td>TEST： OK</td></tr>
</table>

<table>
<tr><td>5</td><td>TEMPERATURE COMPENSATION</td><td colspan="3">I/P: 230 VAC
O/P:BAT. LOAD
Ta:25℃
<table><tr><td colspan="4">Constant Voltage</td></tr><tr><td rowspan="2">SPEC:</td><td>Ta=0℃ (17KΩ)</td><td>Ta=25℃ (5KΩ)</td><td>Ta=50℃ (1.7KΩ)</td></tr><tr><td>14.85±0.24V</td><td>14.4±0.24V</td><td>14.13±0.24V</td></tr><tr><td>TEST RESULT:</td><td>14.66V</td><td>14.22V</td><td>13.97V</td></tr></table></td></tr>
<tr><td>6</td><td>CHARGE OK</td><td>The TTL signal out, Charger OK = 4.5 ~ 5.5V;
Charger failure or protection = -0.5 ~ 0.5V</td><td>I/P: 230 VAC
O/P:BAT. LOAD
Ta:25℃</td><td>TEST：
Charger OK = 5.18 V;
Charger failure= 34 mV;
Charger protection= 34m V</td></tr>
<tr><td>7</td><td>BATTERY FULL SIGNAL</td><td>The TTL signal out, Battery full = 4.5 ~ 5.5V ;
Charging = -0.5 ~ 0.5V</td><td>I/P: 230 VAC
O/P:BAT. LOAD
Ta:25℃</td><td>TEST：
Battery full = 5.1 V
Charging = 33mV</td></tr>
</table>

COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	Power Transistor (D to S) or (C to E) Peak Voltage	Q 5/Q6 Rated : 600V/25 A	AC ON/OFF I/P:High-Line +3V = 267 V VDS : O/P: (1)CV(max) =20V (2) CV(min) =10.5V (3)no load (4)OUTPUT SHORT Ta:25℃	Q5 VDS : (1) 492V (2) 472V (3) 480V (4) 480V Q6 VDS : (1) 476V (2) 444V (3) 456V (4) 484V
2	P.F.C Transistor (D to S) or (C to E) Peak Voltage	Q 1 Rate: 600V /18 A	AC ON/OFF I/P:High-Line +3V = 267 V VDS : O/P: (1)CV(max) =20V (2) CV(min) =10.5V (3)no load (4)OUTPUT SHORT Ta:25℃	VDS : (1) 508V (2) 464V (3) 496V (4) 452V
3	AUX MOS	U600 Rate: 725V/ 0.88A	AC ON/OFF I/P:High-Line +3V = 267 V VDS : O/P: (1)CV(max) =20V (2) CV(min) =10.5V (3)no load (4)OUTPUT SHORT Ta:25℃	VDS : (1) 621V (2) 577V (3) 613V (4) 585V
4	P.F.C DIODE	D19 Rated : 650 V/ 6 A	AC ON/OFF I/P:High-Line +3V = 267 V O/P: (1)CV(max) =20V (2) CV(min) =10.5V (3)no load (4)OUTPUT SHORT Ta:25℃	(1) 464V (2) 416V (3) 460V (4) 464V

5	Diode Peak Voltage	Q211/ Q213 Rated :60V/ 120A _	AC ON/OFF I/P:High-Line +3V = 267 V VDS : O/P: (1)CV(max) =20.5V (2) CV(min) =10.5V (3)no load (4)OUTPUT SHORT Ta:25℃	Q211 VDS : (1) 48.5V (2) 36.1V (3) 46.5V (4) 48.9V	Q213 VDS : (1) 49.3V (2) 42.9V (3) 48.5V (4) 49.3V
6	Input Capacitor Voltage	C 5 Rated : 220u / 450 V	AC ON/OFF I/P:High-Line +3V = 267 V VDS : O/P: (1)CV(max) =20V (2) CV(min) =10.5V (3)no load (4)OUTPUT SHORT Ta:25℃	(1) 447V (2) 437V (3) 445V (4) 447V	
7	Control IC Voltage Test	PWM IC U3Rated 8.9V~15.5V PFC IC U2Rated 11V~26V O/P IC U801 Rated 4.5V~36V U100 Rated 6.5V~35V MCU IC U701 Rated 2.4V~ 3.6 V	AC ON/OFF I/P:High-Line +3V = 267 V VDS : O/P: (1)CV(max) =20V (2) CV(min) =10.5V (3)no load (4)OUTPUT SHORT Ta:25℃	U3 (1) 14.0V (2) 14.0V (3) 14.2V (4) 13.6V U2 (1) 14.6V (2) 14.4V (3) 14.6V (4) 14.0V U801 (1) 10.67V (2) 10.67V (3) 10.67V (4) 10.67V	U100 (1) 12.60V (2) 12.60V (3) 12.68V (4) 13.08V U701 (1) 3.32V (2) 3.32V (3) 3.32V (4) 3.32V

■ SAFETY & E.M.C. TEST

SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	I/P-O/P: 3 KVAC/min I/P-FG:2 KVAC/min O/P-FG:0.5KVAC/min	I/P-O/P: 3.6 KVAC/min I/P-FG: 2.4 KVAC/min O/P-FG: 0.6 KVAC/min Ta:25℃	I/P-O/P: 2.468 mA I/P-FG: 3.297 mA O/P-FG: 0.971 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: 600 VDC I/P-FG: 600 VDC O/P-FG: 600 VDC Ta:25℃	I/P-O/P: 9999M Ω I/P-FG: 7698MΩ O/P-FG :9999MΩ NO DAMAGE
3	GROUNDING CONTINUITY	FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40A / 2min Ta:25℃	17mΩ

E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	HARMONIC	BS EN/EN61000-3-2 CLASS A	I/P:230VAC/50HZ O/P:FULL LOAD Ta:25℃	PASS
2	CONDUCTION	BS EN/EN 55032 (CISPR32), BS EN / EN55014-1 CLASS B	I/P: 230 VAC (50HZ) O/P:FULL/50% LOAD Ta:25℃	PASS Test by certified Lab
3	RADIATION	BS EN/EN 55032 (CISPR32), BS EN / EN55014-1 CLASS B	I/P:230VAC/50HZ O/P:FULL /50%LOAD Ta:25℃	PASS Test by certified Lab
4	E.S.D	BS EN/EN61000-4-2 AIR：8KV / Contact：4KV	I/P:230VAC/50HZ O/P:FULL LOAD Ta:25℃	CRITERIA A
5	E.F.T	BS EN/EN61000-4-4 INPUT: 1KV	I/P:230VAC/50HZ O/P:FULL LOAD Ta:25℃	CRITERIA A
6	SURGE	BS EN/EN 61000-4-5 L-N :1KV L,N-PE:2KV	I/P:230VAC/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：NPB-450-12 1. ROOM AMBIENT BURN-IN：2 HRS I/P： 230VAC O/P： FULL LOAD Ta= 27.6 ℃ 2. HIGH AMBIENT BURN-IN： 2 HRS I/P： 230VAC O/P： FULL LOAD Ta= 53.8 ℃		

NO	Position	ROOM AMBIENT Ta= 27.6 ℃	HIGH AMBIENT Ta=53.8℃
1	ZNR1	36.1℃	62.8℃
2	U3	43.0℃	70.3℃
3	LF1	38.5℃	65.5℃
4	RY1	40.3℃	67.2℃
5	RTH2	40.4℃	67.6℃
6	LF3	49.9℃	76.4℃
7	BD1	48.5℃	74.2℃
8	C8	49.6℃	76.3℃
9	Q1	50.3℃	76.9℃
10	TSW1	42.2℃	68.5℃
11	L1	68.4℃	96.0℃
12	C5	46.9℃	73.0℃
13	R18	56.8℃	83.7℃
14	C24	45.0℃	71.6℃
15	Q6	45.3℃	71.9℃
16	C60	52.3℃	76.8℃
17	T1	66.9℃	90.9℃
18	T600	47.0℃	74.5℃
19	Q211	56.2℃	81.9℃
20	Q213	46.6℃	76.1℃
21	C112	51.8℃	77.4℃
22	C115	32.6℃	60.1℃
23	Q354	45.7℃	80.1℃
24	U701	31.2℃	60.5℃
25	LF100	37.8℃	67.2℃
26	U503	41.4℃	59.6℃
27	U150	39.4℃	67.7℃
28	RG5	34.9℃	62.8℃
29	J102	49.8℃	80.5℃
30	R228	54.0℃	83.2℃
31	D19	57.1℃	82.9℃
32	U2	49.8℃	75.9℃
33	D651	49.2℃	76.0℃
34	RG6	38.8℃	67.2℃
35	Q500	47.0℃	74.9℃
36	U100	51.2℃	78.4℃
37	RTH5	52.3℃	78.8℃

2	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P： 230VAC/100VAC O/P： 100 %LOAD Ta= -35℃	TEST：OK
3	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 50 ℃ NO DAMAGE	I/P： 272 VAC O/P：FULL LOAD Ta= 49 ℃ HUMIDITY= 95 %R.H	TEST：OK
4	TEMPERATURE COEFFICIENT	± 0.05%/ (0℃~50℃)	I/P： 230 VAC O/P：FULL LOAD	0.0061 %/℃(0~50℃)

5	STORAGE TEMPERATURE TEST	-40~85℃	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：10CYCLE 5. Input/Output condition： STATIC	
6	THERMAL SHOCK TEST	-30~50℃	1. Thermal shock Temperature： -35℃~ +55℃ 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:230V/ FULL LOAD AC ON 3sec/AC OFF 1sec TEST 1cycle:230V/ FULL LOAD Burn In Test	
7	VIBRATION TEST	10 ~ 500Hz, 2G 10min./1cycle, 60min. each along X, Y, Z axes	1 Carton & 1 Set (1) Waveform： Sine Wave (2) Frequency：10~500Hz (3) Sweep Time：10min/sweep cycle (4) Acceleration：3G (5) Test Time：180min in each axis (X.Y.Z) (6) Ta：25℃	
8	CAPACITOR LIFE CYCLE	SUPPOSE C112 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= 50 ℃ LIFE TIME (3) I/P： 230VAC O/P：75% LOAD Ta= 50 ℃ LIFE TIME (4) I/P： 230VAC O/P：50% LOAD Ta= 50 ℃ LIFE TIME		(1) 745973.3HRS (2) 137470.7HRS (3) 276216.1HRS (4) 451756.4HRS
9	MTBF	Conducted by Parts Stress Analysis Prediction 273.7K hrs min. Telcordia SR-332 (Bellcore) ; 83.4K hrs min. MIL-HDBK-217F (25℃)		
10	Ongoing Reliability Test	I/P：230VAC O/P：FULL LOAD TA=50℃ Demonstration Mean Time Between Failure : 30,000 hours		

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	LIUTT		Wangdz

2020.10.1 TAG-QA-009