



# Test Report: NPB-450-24

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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)	28.8V ± 0.48V	I/P: 230 VAC O/P:BAT. LOAD Ta:25°C	28.79V
2	FLOAT CHARGE VOLTAGE (default)	27.6V ± 0.24 V	I/P: 230 VAC O/P:BAT. LOAD Ta:25°C	27.689V
3	MAX. OUTPUT CURRENT	13.5A ± 0.135 A	I/P: 230 VAC O/P:C.V =27.8V Ta:25°C	13.482A
4	LEAKAGE CURRENT FROM BATTERY (TYP)	<1mA	I/P: AC OFF O/P:BAT. LOAD Ta:25°C	171uA
5	OUTPUT CURRENT RANGE	50%~100%Io	I/P: 230 VAC O/P:C.V =33.6V Ta:25°C	6.334~ 13.476A
6	MAX. POWER	453.6W	I/P: 230 VAC O/P:C.V =33.6V Ta:25°C	454.1W

### 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°C	(1) 86.3V~264V (2) 120Vdc~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°C	TEST: OK
3	LEAKAGE CURRENT	< 0.75mA / 240VAC	I/P: 240 VAC O/P:Min LOAD Ta:25°C	0.645 mA
4	INPUT CURRENT (TYP)	230 V/ 2.2 A 115 V/ 4.5A	I/P: 230 VAC I/P: 115 VAC	I =2.13A/ 230VAC I =4.35A/ 115VAC



			O/P:BAT. LOAD Ta:25°C	
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°C	PF= 0.989/ 230VAC PF=0.998 / 115VAC
6	EFFICIENCY (TYP)	93%	I/P: 230 VAC O/P:BAT. LOAD(C.V =33.6V) Ta:25°C	93.94%
7	INRUSH CURRENT (TYP)	230 V/ 50 A COLD START	I/P: 230 VAC O/P:BAT. LOAD Ta:25°C	I =43.7A/ 230VAC T50=1.126ms/230V
<p>INPUT=230VAC/50HZ @ FULL LOAD CH1 : AC Input Voltage CH4 : Input current (1V=1A)</p>				
8	GAIN-PHASE MARGIN TEST	GAIN MARGIN < -10dB PHASE MARGIN > =60 Gain Curve slope: <u>-10dB/dec~-40dB/dec</u>	(1) CC MODE(Vboost)/ 90% LOAD /264Vac (2) CC MODE(Vboost)/ 90% LOAD /90Vac Ta:25°C	(1) 77.2718°/ -20.123dB / -21.4 dB/dec (2) 76.9597°/-19.962dB/ -27.0 dB/dec

**PROTECTION FUNCTION TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER VOLTAGE PROTECTION	CH1:43V~52V 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°C	47.9V/ 264VAC 47.9V/ 90VAC PROTECTION 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 : <u>OK</u> Shut down o/p voltage, recover automatically after temperature goes on.
3	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE 12.15A~16.2A Constant current	I/P: 264 VAC O/P: BAT. LOAD Ta:25°C	NO DAMAGE <u>13.86 A</u> PROTECTION TYPE : Constant current



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		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°C	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°C	PROTECTION TYPE : Shut down o/p voltage, re-power on to recover

**CONTROL FUNCTION TEST**

N O	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT												
1	FAN SPEED CONTROL	FAN control mosfet duty : 30%@RTH5<45°C FAN control mosfet duty : 100%@RTH5>60°C	I/P: 230 VAC O/P:BAT. LOAD Ta:25°C	<u>30%</u> @RTH5<45°C <u>100%</u> @RTH5>60°C												
2	REMOTE CONTROL	Rc+ / Rc- OPEN/(-0.5~0.5V): Charger stop charging SHORT/(10.8~13.2V) : Charger normal work	I/P: 230 VAC O/P:BAT. LOAD Ta:25°C	TEST: <u>OPEN/-0.5~2.50 V</u> <u>SHORT/2.70~13.2 V</u> (1) Remote off Pin= <u>5.61W</u> (2) Remote off Vo= <u>0.06V</u>												
3	AUX POWER	OUTPUT VOLTAGE RANGE : 10.8~13.2V OUTPUT RIPPLE&NOISE: 150mVp-p	I/P: 230 VAC O/P:BAT. LOAD Ta:25°C	TEST: <u>12.04</u> V <u>39</u> mVp-p												
4	LED INDICATOR	<table border="1"> <thead> <tr> <th>LED</th> <th>Description</th> </tr> </thead> <tbody> <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 ranging 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°C; under this condition, the unit still operates normally without entering OTP.</td> </tr> </tbody> </table>	LED	Description	Green	Float(stage 3) or Battery full	Orange	Charging (stage 1 or stage 2)	Orange (Flashing)	Auto ranging for charging	Red	Abnormal status (OTP,OVP, Short, Reverse polarity, Charging timeout.)	Red (Flashing)	The LED will flash with the red light when the internal temperature reaches 95°C; under this condition, the unit still operates normally without entering OTP.	I/P: TESTING VAC O/P:TESTING LOAD Ta:25°C	TEST : <u>OK</u>
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5	TEMPERATURE COMPENSATION	I/P: 230 VAC O/P:BAT. LOAD Ta:25°C			
		Constant Voltage			
		SPEC:	Ta=0°C ( 17K Ω )	Ta=25°C ( 5K Ω )	Ta=50°C ( 1.7K Ω )
		TEST RESULT:	29.7±0.48V	28.8±0.48V	28.26±0.48V
6	CHARGE OK	The TTL signal out, Charger OK = 4.5 ~ 5.5V; Charger failure or protection = -0.5 ~ 0.5V	I/P: 230 VAC O/P:BAT. LOAD Ta:25°C	TEST: Charger OK = <u>5.187</u> V; Charger failure = <u>36m</u> V; Charger protection= <u>37m</u> V	
7	BATTERY FULL SIGNAL	The TTL signal out, Battery full = 4.5 ~ 5.5V ; Charging = -0.5 ~ 0.5V	I/P: 230 VAC O/P:BAT. LOAD Ta:25°C	TEST: Battery full = <u>5.2</u> V Charging = <u>33</u> mV	

**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) =41V (2) CV(min) =21V (3)no load (4)OUTPUT SHORT Ta:25°C	Q5 VDS : (1) 505V (2) 509V (3) 485V (4) 492V Q6 VDS : (1) 486V (2) 453V (3) 453V (4) 497V
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) =41V (2) CV(min) =21V (3)no load (4)OUTPUT SHORT Ta:25°C	VDS : (1) 521V (2) 477V (3) 513V (4) 501V
3	AUX MOS	U600 Rate: 725V/ 0.88A	AC ON/OFF I/P:High-Line +3V = 267 V VDS : O/P: (1)CV(max) =41V (2) CV(min) =21V (3)no load (4)OUTPUT SHORT Ta:25°C	VDS : (1) 634V (2) 586V (3) 593V (4) 590V
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) =41V (2) CV(min) =21V (3)no load (4)OUTPUT SHORT Ta:25°C	(1) 469V (2) 445V (3) 469V (4) 457V



5	Diode Peak Voltage	Q211/ Q213 Rated :120V/ 100A	AC ON/OFF I/P:High-Line +3V = 267 V VDS : O/P: (1)CV(max) =41V (2) CV(min) =21V (3)no load (4)OUTPUT SHORT Ta:25°C	Q211 VDS : (1) 94.4V (2) 63.0V (3) 92.8V (4) 93.6V	Q213 VDS : (1) 97.6V (2) 63.8V (3) 95.2V (4) 95.2V
6	Input Capacitor Voltage	C 5 Rated : 220u / 450 V °C/ Series	AC ON/OFF I/P:High-Line +3V = 267 V VDS : O/P: (1)CV(max) =41V (2) CV(min) =21V (3)no load (4)OUTPUT SHORT Ta:25°C	(1) 441V (2)435V (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) =41V (2) CV(min) =21V (3)no load (4)OUTPUT SHORT Ta:25°C	U3 (1) 13.7V (2) 13.7V (3) 13.9V (4) 13.7V  U2 (1) 14.3V (2) 14.1V (3) 14.6V (4) 14.3V  U801 (1) 10.7V (2) 10.7V (3) 10.7V (4) 10.7V	U100 (1) 12.7V (2) 12.7V (3) 12.5V (4) 14.6V  U701 (1) 3.35V (2) 3.31V (3) 3.35V (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°C	I/P-O/P: 2.468 mA I/P-FG: 3.289 mA O/P-FG: 0.784 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°C	I/P-O/P: 9999MΩ I/P-FG: 5720MΩ O/P-FG: 9999MΩ NO DAMAGE
3	GROUNDING CONTINUITY	FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40A / 2min Ta:25°C	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°C	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°C	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°C	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°C	CRITERIA A
5	E.F.T	BS EN/EN61000-4-4 INPUT: 1KV	I/P:230VAC/50HZ O/P:FULL LOAD Ta:25°C	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°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 : NPB-450-24 1. ROOM AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta= 23.8 °C 2. HIGH AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta= 50.8 °C		



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NO	Position	ROOM AMBIENT Ta= 23.8 °C	HIGH AMBIENT Ta=50.8°C
1	ZNR1	35.2°C	55.7°C
2	U3	40.0°C	60.0°C
3	LF1	38.4°C	58.0°C
4	RY1	39.3°C	59.2°C
5	RTH2	37.1°C	57.0°C
6	LF3	48.5°C	64.9°C
7	BD1	53.4°C	71.5°C
8	C8	46.4°C	64.0°C
9	Q1	47.7°C	67.6°C
10	TSW1	34.9°C	56.0°C
11	L1	62.3°C	75.3°C
12	C5	48.9°C	64.2°C
13	R18	51.5°C	67.3°C
14	C24	46.7°C	63.5°C
15	Q6	45.3°C	63.3°C
16	C60	57.7°C	68.8°C
17	T1	73.2°C	82.8°C
18	T600	37.7°C	58.9°C
19	Q211	35.8°C	57.5°C
20	Q213	42.2°C	62.0°C
21	C111	36.2°C	56.9°C
22	C115	33.2°C	55.5°C
23	Q352	32.6°C	55.5°C
24	U701	31.8°C	55.3°C
25	LF100	34.0°C	56.9°C
26	U503	34.1°C	56.4°C
27	U150	33.7°C	56.3°C
28	RG5	48.5°C	61.3°C
29	J102	43.7°C	63.0°C
30	R228	45.5°C	59.4°C
31	D19	53.0°C	72.2°C
32	U2	53.4°C	69.1°C
33	PCB	53.7°C	68.8°C
34	D651	43.0°C	63.8°C
35	RG6	35.1°C	56.5°C
36	Q500	40.8°C	61.4°C
37	U100	50.6°C	66.5°C
38	RTH5	51.3°C	66.2°C
39	TC	37.7°C	58.8°C
40	U600	51.5°C	60.3°C
41	C114	38.7°C	57.9°C

2	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 230VAC/100VAC O/P : 100 %LOAD Ta= -35°C	TEST : OK
3	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 50 °C NO DAMAGE	I/P : 272 VAC O/P : FULL LOAD Ta= 50.9 °C HUMIDITY= 95 %R.H	TEST : OK
4	TEMPERATURE COEFFICIENT	± 0.05%/ (0°C~50°C)	I/P : 230 VAC O/P : FULL LOAD	0.0081 %/°C(0~50°C)
5	STORAGE TEMPERATURE TEST	-40~85°C	1. Thermal shock Temperature : -45°C~ +90°C 2. Temperature change rate : 25°C / MIN 3. Dwell time low and high temperature : 30 MIN/EACH 4. Total test cycle : 10CYCLE 5. Input/Output condition : STATIC	





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6	THERMAL SHOCK TEST	-30~50°C	1. Thermal shock Temperature : -35°C~ +55°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: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°C
8	CAPACITOR LIFE CYCLE	SUPPOSE C114 IS THE MOST CRITICAL COMPONENT (1) I/P : 230VAC O/P : FULL LOAD Ta= 25 °C LIFE TIME (2) I/P : 230VAC O/P : FULL LOAD Ta= 50 °C LIFE TIME (3) I/P : 230VAC O/P : 75% LOAD Ta= 50 °C LIFE TIME (4) I/P : 230VAC O/P : 50% LOAD Ta= 50 °C LIFE TIME	(1) 1200090.2HRS (2) 364285.8HRS (3) 447852.6HRS (4) 515848.1HRS
9	MTBF	Conducted by Parts Stress Analysis Prediction 273.7K hrs min. Telcordia SR-332 (Bellcore) ; 83.4K 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 : 30,000 hours	

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	LIUTT		Wangdz

2020.10.1 TAG-QA-009