Test Report: RPB-1600-24

1600W Intelligent Single Output 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

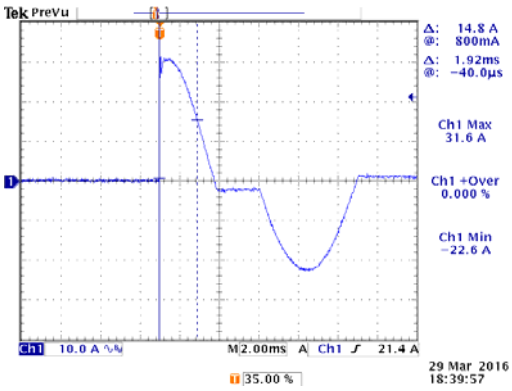
■ DESIGN VERIFY TEST

OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	BOOST CHARGE VOLTAGE(Vboost)(default)	Default, programmable 28.8V±0.24V	I/P: 230 VAC O/P: CV MODE Ta:25℃	28.859V
2	FLOAT CHARGE VOLTAGE	Default, programmable 27.6V±0.24V	I/P: 230 VAC O/P: CV MODE Ta:25℃	27.646V
3	OUTPUT CURRENT	55A±1.65A	I/P: 230 VAC O/P:CV MODE-2V Ta:25℃	55.5A
4	VOLTAGE ADJ. RANGE	23.5V~30V (D0、-V short)	I/P: 230 VAC O/P:NO LOAD Ta:25℃	22.6V~30.72V/230VAC 22.6V~30.72V/115VAC
5	LEAKAGE CURRENT FROM BATTERY (Typ.)	<45mA	I/P: AC OFF O/P:BATTERY Ta:25℃	42.6mA

INPUT FUNCTION TEST

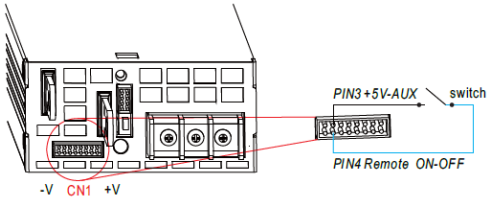
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	90VAC~264VAC	I/P:TESTING O/P: FULL LOAD O/P:60% LOAD Ta:25℃	150 V~ 264 V 87V~264V
			I/P: (1)LOW-LINE-3V=87 V HIGH-LINE+15%=300 V O/P:FULL/MIN LOAD (PLEASE CHECK DERATING CURVE) ON: 30 Sec OFF: 30 Sec 10MIN (2)230Vac ON: 0.5 Sec OFF: 0.5 Sec 20MIN (3)230Vac ON:3Sec OFF:3Sec 12HOURS (POWER ON/OFF NO DAMAGE)	TEST:OK
2	INPUT FREQUENCY RANGE	47HZ ~63 HZ NO DAMAGE	I/P:100 VAC ~264 VAC O/P:FULL~MIN LOAD Ta:25℃	TEST: OK
3	INPUT CURRENT (Typ.)	230V/ 8.5 A 115V/ 15 A	I/P： 230 VAC I/P： 115 VAC O/P：FULL LOAD (PLEASE CHECK DERATING CURVE) Ta：25℃	I =7.83A/ 230VAC I =12.77A/ 115VAC
4	LEAKAGE CURRENT	<2 mA / 240 VAC	I/P： 240 VAC O/P：Min LOAD Ta：25℃	L-FG：0.8 mA N-FG：0.8 mA
5	POWER FACTOR (Typ.)	0.97 / 230VAC	I/P： 230 VAC O/P：FULL LOAD Ta：25℃	PF=0.98/230VAC

6	EFFICIENCY(Typ.)	92.5%	I/P:230 VAC O/P: FULL LOAD Ta:25℃	92.6 %
7	INRUSH CURRENT(Typ.)	230V/35 A COLD START	I/P： 230 VAC O/P：FULL LOAD Ta：25℃	I =31.6A/ 230VAC T50= 1920 us/230V
	INPUT=230VAC/50HZ @ FULL LOAD CH1 : Input current 			

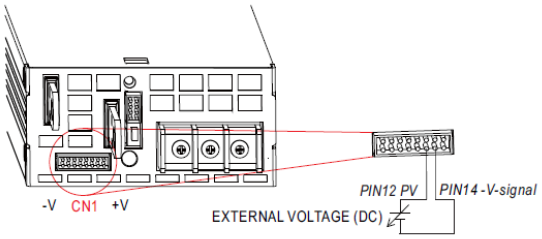
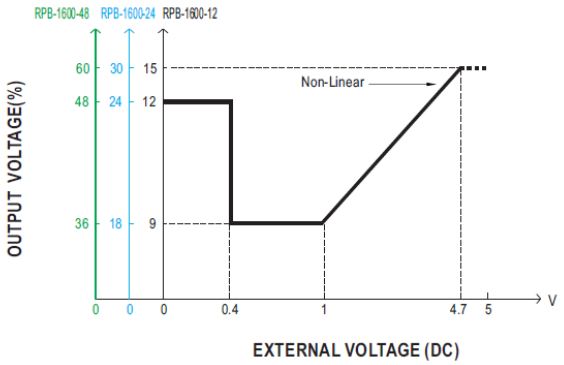
PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER VOLTAGE PROTECTION	31.5 V~ 37.5 V PROTECTION TYPE： Shut down o/p voltage, re-power on to recover	I/P: 264VAC I/P: 230VAC I/P: 90VAC O/P:MIN LOAD Ta:25℃	34.5V/ 264VAC 34.5V/ 230VAC 34.5V/ 90VAC PROTECTION TYPE： Shut down o/p voltage, re-power on to recover
2	OVER TEMPERATURE PROTECTION	NO DAMAGE PROTECTION TYPE： Shut down o/p voltage, recovers automatically after temperature goes down	I/P: 264VAC I/P: 90VAC O/P:FULL LOAD	O.T.P. Active PROTECTION TYPE： Shut down o/p voltage, recovers automatically after temperature goes down

CONTROL FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	AUXILIARY POWER (AUX)	1. 5V±10%@0.3A ripple:150mVp-p 2. 12V±10%@0.8A ripple:250mVp-p	I/P: 230 VAC O/P:FULL LOAD Ta:25℃	4.741V/0.3A ；ripple:14mVp-p 11.36V/0.8A ；ripple: 156 mVp-p
2	REMOTE ON/OFF CONTROL	The power supply can be turned ON/OFF individually or along with other units in parallel by using the "Remote ON-OFF" function.  I/P: 230 VAC O/P:FULL LOAD Ta:25℃ Test Result：		

Between Remote ON-OFF and +5V-AUX	Power Supply Status
Switch Short	ON
Switch Open	OFF

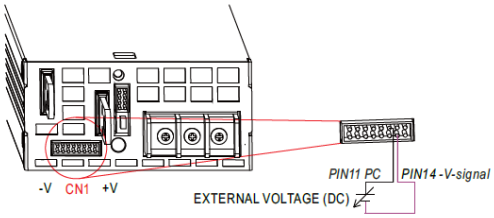
		Between ON/OFF and +5V-AUX / OUTPUT SW SHORT / ON SW OPEN / OFF
3	ALARM SIGNAL	1. DC OK SIGNAL High (4.5 ~ 5.5V) : When the Vout≦8V/16V/32V ±1V. Low (0 ~ 0.5V) : When Vout≧8V/16V/32V ±1V. The maximum sourcing current is 10mA and only for output. DC OK is associated with battery low protection. I/P: 230 VAC O/P:FULL LOAD Ta:25℃ Test Result： Vout / DC OK SIGNAL Vout≦ 75% / 5V Vout≧ 85% / -0.09V 2. T-ALARM P.S.U STATUS / Vo / T-ALARM NORMAL / 100%±2% / -0.1 ~0.5V OTP OR FAN LOCK / 0V / 4.5~5.5V I/P: 230 VAC O/P:FULL LOAD Ta:25℃ Test Result： P.S.U STATUS / T-ALARM NORMAL / -0.09 V OTP OR FAN LOCK / 4.936V
6	OUTPUT VOLTAGE PROGRAMMABLE(PV)	(D0、-V short) ※ In addition to the adjustment via the built-in potentiometer, the output voltage can be trimmed by applying EXTERNAL VOLTAGE.   I/P: 230 VAC O/P:FULL LOAD Ta:25℃ Test Result：

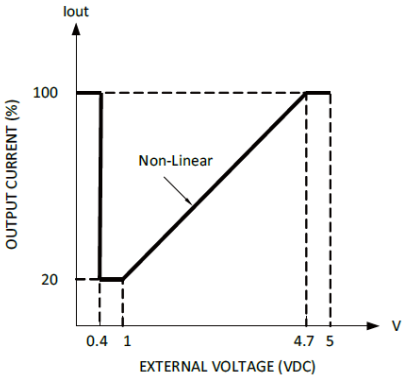
PV / MODEL	<0.4V	1V	4.7V	5V
SPEC	24V±5%	18V±5%	30V±5%	30V±5%
Vout	24.11V	18.03V	30.2V	30.3V

7 OUTPUT CURRENT PROGRAMMABLE (PC)

(D0、-V short)

※ The output current can be trimmed to 20~100% of the rated current by applying EXTERNAL VOLTAGE.



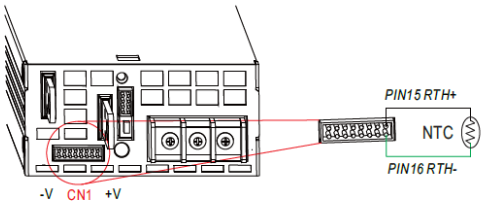


I/P: 230 VAC
O/P:TESTING
Ta:25℃
Test Result：

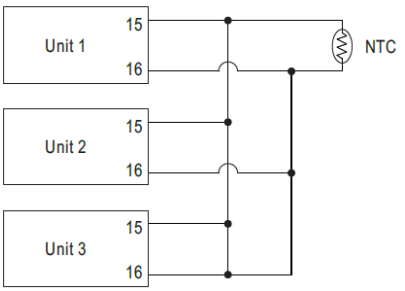
ADJ V	<0.4V	1V	4.7V	5V
SPEC	100%±10%	20%±10%	100%±10%	100%±10%
Iout	101.09%	22.25%	100.7%	101.2%

9 Temperature Compensation

Temperature sense associated with the temperature compensation function.



◎ To exploit the temperature compensation function, please attach the temperature sensor, NTC, which is enclosed with the charger, to the battery or the battery's vicinity.
◎ The charger is able to work normally without the NTC.



When multiple chargers are connected in parallel, please configure with the NTC as exhibited in the diagram .
If the temperature compensation is not required, RTH+ (PIN15) and RTH- (PIN16) from each unit still need to be connected.

I/P: 230 VAC
O/P:FULL LOAD
Ta:25℃
Test Result：

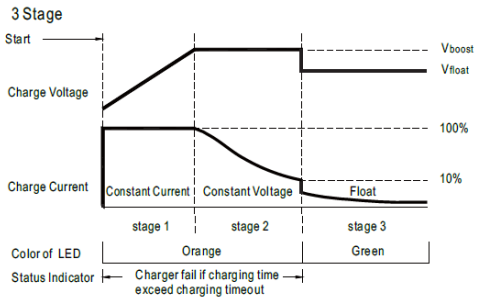
TEMP	Voltage compensation	Temperature compensation	
		BEFORE	AFTER
(Ta=0℃)	28.8V = +0.90V ±0.24V	29.082	29.946

		(Ta=25℃)	28.8V = 0V	29.082	29.082
		(Ta=50℃)	28.8V = -0.90V ±0.24V	29.084	28.271

10 Charging Curve

※ By factory default, this charger performs the default curve which can be programmed via PMBus.
※ To disable / enable the charging curve, change to a 2 stage curve, a different curve frequently used for certain types of batteries in the industry, and so on, please refer to the Installation Manual.

◎ Default 3 stage charging curve



◎ Embedded 3 stage charging curve

MODEL	Description	Vboost	Vfloat
12V	Default, programmable	14.4	13.8
	Pre-defined, gel batter	14	13.6
	Pre-defined, flooded battery	14.2	13.4
	Pre-defined, AGM battery	14.5	13.5
24V	Default, programmable	28.8	27.6
	Pre-defined, gel batter	28	27.2
	Pre-defined, flooded battery	28.4	26.8
	Pre-defined, AGM battery	29	27
48V	Default, programmable	57.6	55.2
	Pre-defined, gel batter	56	54.4
	Pre-defined, flooded battery	56.8	53.6
	Pre-defined, AGM battery	58	54

◎ Suitable for lead-acid batteries (flooded, Gel and AGM) and Li-ion batteries (lithium iron and lithium manganese).

I/P: 230 VAC
O/P:FULL LOAD
Ta:25℃
Test Result：

MODEL	Constant voltage(V_{boost})	Float (V_{float})	Turn state current
24V	28.8V± 0.24V	27.6V± 0.24V	5.5A± 1.65A
	28.859V	27.646V	5.6A

8 LED Status Indicators

LED	Description
Green	Float (stage 3)
Orange	Charging (stage 1 or stage 2)
Red	Abnormal status (OTP, OLP, Fan Fail, Charging timeout.)

TEST：OK

COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Transistor (D to S) or (C to E) **Peak Voltage**	Q901 Rated 37A/600V	I/P:High-Line +3V =267V AC ON/OFF VDS: O/P: (1)Full Load Ta:25℃	VDS: (1)469V
2	P.F.C Transistor (D to S) or (C to E) **Peak Voltage**	Q52 Rated 52 A/600 V	I/P:High-Line +3V =267 V AC ON/OFF O/P: (1)Full Load Ta:25℃	VDS: (1)464V
3	Diode Peak **Voltage**	Q101 Rated 104 A/150 V Q104 Rated 104 A/150 V	I/P:High-Line +3V =267 V AC ON/OFF O/P: (1)Full Load Ta:25℃	Q101: Q104: VDS: VDS: (1)101.2V (1)100.4V
4	Input Capacitor Voltage	C5 Rated: 680μ/400V SURGE VOLTAGE:450V	I/P:High-Line +3V =267 V O/P: (1)Full Load	(1)398V

			Ta:25℃	
5	Control IC Voltage Test	PWM IC U901 Rated 6.5V ~24 V PFC IC U51 Rated 6V ~ 16V	I/P:High-Line +3V =267 V AC ON/OFF O/P(1)FULL LOAD Ta:25℃	U51 (1) 13.8V U901 (1)12.8 V

SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	I/P-O/P: 3KVAC/min I/P-FG :2KVAC/min O/P-FG:1.5KVAC/min	I/P-O/P: 3.6 KVAC/min I/P-FG: 2.4 KVAC/min O/P-FG:1.8 KVAC/min Ta:25℃	I/P-O/P:6.77mA I/P-FG:7.63mA O/P-FG:5.84m A 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: 30GΩ I/P-FG: 30GΩ O/P-FG: 30GΩ NO DAMAGE
3	GROUNDING CONTINUITY	FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40A / 2min Ta:25℃	17 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:100% LOAD Ta:25℃	PASS
2	CONDUCTION	EN55022 CLASS B	I/P： 230 VAC (50HZ) O/P：FULL/50% LOAD Ta：25℃	PASS Test by certified Lab
3	RADIATION	EN55022 CLASS A	I/P： 230 VAC (50HZ) O/P：FULL LOAD Ta：25℃	PASS Test by certified Lab
4	E.S.D	EN61000-4-2 INDUSTRY AIR：8KV / Contact：4KV	I/P： 230 VAC/50HZ O/P：FULL LOAD Ta：25℃	CRITERIA A
5	E.F.T	EN61000-4-4 INDUSTRY INPUT： 2KV	I/P： 230 VAC/50HZ O/P：FULL LOAD Ta：25℃	CRITERIA A
6	SURGE	IEC61000-4-5 INDUSTRY L-N ：2KV L,N-PE：4KV	I/P： 230 VAC/50HZ O/P：FULL LOAD Ta：25℃	CRITERIA A
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： RPB-1600-24
1. ROOM AMBIENT BURN-IN：1 HRS
I/P： 230VAC O/P： FULL LOAD Ta= 28.3 ℃
2. HIGH AMBIENT BURN-IN： 3 HRS
I/P： 230VAC O/P： FULL LOAD Ta= 52.5 ℃</td></tr>
<tr><td>2</td><td>LOW TEMPERATURE
TURN ON TEST</td><td>TURN ON AFTER 2 HOUR</td><td>I/P： 230VAC/180VAC
O/P： 100 % LOAD
Ta= -35℃ / -30℃</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： 272 VAC
O/P：FULL LOAD
Ta= 50 ℃
HUMIDITY= 95 %R.H</td><td>TEST：OK</td></tr>
</table>

NO	Position	ROOM AMBIENT Ta= 28.3 ℃	HIGH AMBIENT Ta= 52.5 ℃
1	Q901	48.6℃	72.3℃
2	Q904	75.5℃	81.5℃
3	Q52	63.2℃	87.8℃
4	D50	68.9℃	99.6℃
5	BD1	58.1℃	85.6℃
6	L900	45.9℃	68.6℃
7	T3	37.6℃	61.7℃
8	RG301	53.9℃	81.7℃
9	RG302	51.7℃	76.2℃
10	C302	30.3℃	55.3℃
11	C355	38.1℃	59.4℃
12	T1	30.2℃	76.1℃
13	Q101	47.8℃	76.0℃
14	Q104	48.7℃	77.2℃
15	U921	41.9℃	70.4℃
16	C5	38.4℃	64.2℃
17	L100	65.7℃	97.8℃
18	C980	33.4℃	63.9℃
19	C11	42.8℃	69.2℃
20	ZNR1	46.0℃	70.9℃
21	ZNR2	42.3℃	75.6℃
22	LF1	43.8℃	69.7℃
23	C2	43.0℃	69.7℃
24	D2	42.9℃	65.1℃
25	L1	49.1℃	77.9℃
26	L2	51.0℃	79.1℃
27	RY1	45.3℃	71.4℃
28	C101	47.0℃	73.6℃
29	T52	37.9℃	65.3℃
30	RTH21	54.0℃	76.4℃
31	RTH9	45.3℃	72.3℃
32	U671	43.8℃	70.0℃

4	TEMPERATURE COEFFICIENT	± 0.03 %/℃(0~50℃)	I/P： 230 VAC O/P：FULL LOAD	± 0.005 %/℃(0~50℃)
5	STORAGE TEMPERATURE TEST	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		OK
6	THERMAL SHOCK TEST	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：10 CYCLE 5. Input/Output condition： 15cycle:230V/ FULL LOAD AC ON 3sec/AC OFF 1sec TEST(13500 TIMES) 1cycle:230V/ FULL LOAD Burn In Test		OK
7	VIBRATION TEST	1 Carton & 1 Set (1) Waveform： Sine Wave (2) Frequency：10~500Hz (3) Sweep Time：12min/sweep cycle (4) Acceleration：2G (5) Test Time：60min in each axis (X.Y.Z) (6) Ta：25℃		TEST：OK
8	CAPACITOR LIFE CYCLE	SUPPOSE C101 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) 781466HRS (2) 119480HRS (3) 179758HRS (4) 222934HRS
9	MTBF	Conducted by Parts Stress Analysis Prediction 154K hrs min. Telcordia SR-332 (Bellcore) ; 100.3K hrs min. MIL-HDBK-217F (25℃)		
10	DMTBF/Accelerated Life Test	Demonstration Mean Time Between Failure (Expected Life): Above 50,000 hours @ TA 50℃		

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

12.10.30 A50-F031