Test Report: RCB-1600-48

1600W Rack Mountable Front End 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

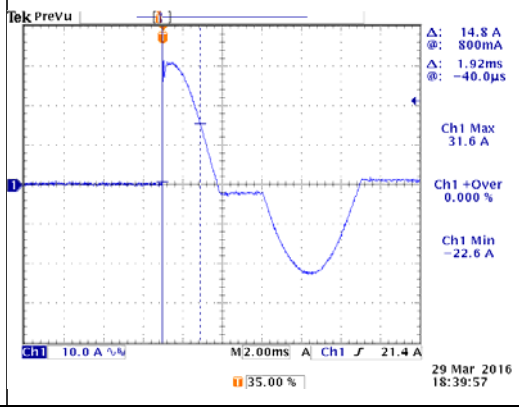
■ DESIGN VERIFY TEST

OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	BOOST CHARGE VOLTAGE(Vboost)(default)	Default, programmable 57.6V±0.48V	I/P: 230 VAC O/P: CV MODE Ta:25℃	57.609V
2	FLOAT CHARGE VOLTAGE	Default, programmable 55.2V±0.48V	I/P: 230 VAC O/P: CV MODE Ta:25℃	55.212V
3	OUTPUT CURRENT	27.5A±0.825A	I/P: 230 VAC O/P:CV MODE-2V Ta:25℃	27.253A
4	VOLTAGE ADJ. RANGE	47.5V~58.8V DIP switch position 4 : OFF	I/P: 230 VAC O/P:NO LOAD Ta:25℃	45.62V~60.1V/230VAC 45.62V~60.1V/115VAC
5	LEAKAGE CURRENT FROM BATTERY (Typ.)	<1mA	I/P: AC OFF O/P:BATTERY Ta:25℃	3uA

INPUT FUNCTION TEST

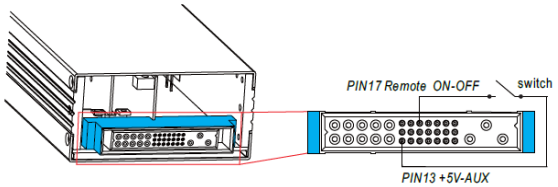
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	90VAC~264VAC	I/P:TESTING O/P:FULL LOAD Ta:25℃	150 V~264V
			I/P: (1)LOW-LINE-3V=87 V HIGH-LINE+15%=300 V O/P:FULL/MIN LOAD (PLEASE CHECK DERATING CURVE) ON: 30 Sec OFF: 30 Sec 10MIN (2)230Vac ON: 0.5 Sec OFF: 0.5 Sec 20MIN (3)230Vac 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 =7.72A/ 230VAC I =12.7A/ 115VAC
4	LEAKAGE CURRENT	<1.5mA / 230 VAC	I/P ： 230 VAC O/P ：Min LOAD Ta ：25℃	L-FG ：0.84 mA N-FG ：0.84 mA
5	POWER FACTOR (Typ.)	0.97 / 230VAC	I/P ： 230 VAC O/P ：FULL LOAD Ta ：25℃	PF=0.978/230VAC

6	EFFICIENCY(Typ.)	93%	I/P:230 VAC O/P:FULL LOAD Ta:25℃	93.15%
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 			

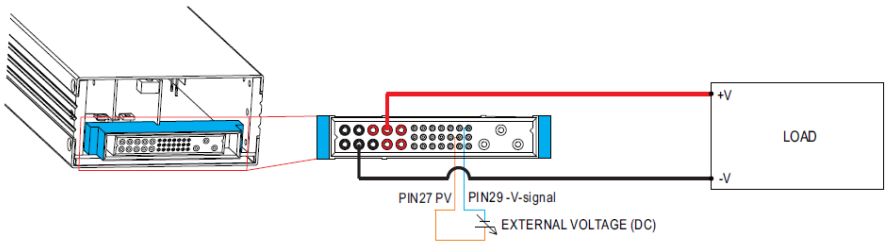
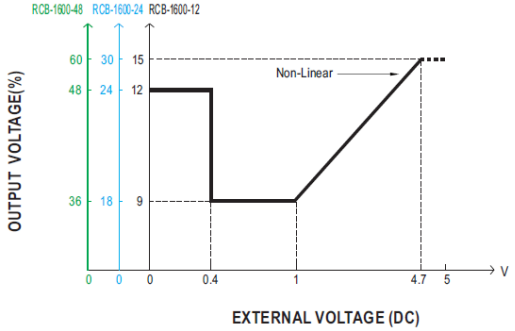
PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER VOLTAGE PROTECTION	63 V~ 75 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℃	69V/ 264VAC 69V/ 230VAC 69V/ 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℃	4.78 V 0.3A ；ripple: 15.9mVp-p 11.16V 0.8 A；ripple: 100 mVp-p
2	REMOTE ON/OFF CONTROL	The charger 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	Charger 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% / 5.037 V 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 / -0.09V OTP OR FAN LOCK / 4.998V **3.** AC- OK AC IN / Vo / AC OK AC I/P≧87Vrms / 100%±2% / 4.5~5.5V AC I/P≦75Vrms / 0V / 0~0.5V I/P: TEST O/P:60%LOAD Test Result： AC IN / Vo / AC OK AC I/P≧87V / 100.4% / 5.39V AC I/P≦75V / 0.002V / 0.002
4	OUTPUT VOLTAGE PROGRAMMABLE(PV)	DIP switch position 4 : OFF ※ In addition to the adjustment via the built-in potentiometer, the output voltage can be trimmed to 75~125% of the nominal voltage by applying EXTERNAL VOLTAGE.   I/P: 230 VAC O/P:FULL LOAD

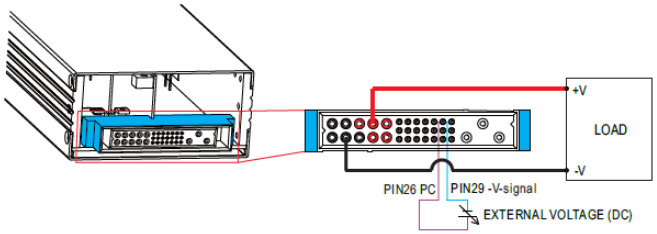
Ta:25℃
Test Result：

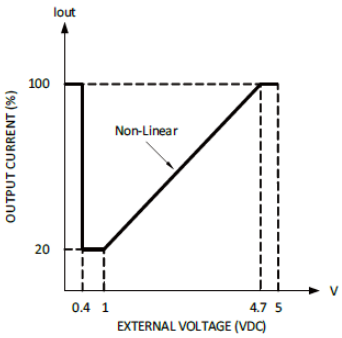
MODEL \ PV	<0.4V	1V	4.7V	5V
SPEC	48V±5%	36V±5%	60V±5%	60V±5%
Vout	48.1V	36.06V	59.7V	61.01V

5 OUTPUT CURRENT PROGRAMMABLE (PC)

DIP switch position 4 : OFF

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



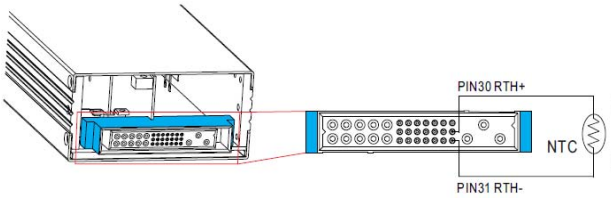


I/P: 230 VAC
O/P:TESTING
Ta:25℃
Test Result：

ADJ V	<0.4V	1V	4.7V	5V
SPEC	100%±10%	20%±10%	100%±10%	100%±10%
Iout	101.45%	20.58%	101.45%	102.18%

6 TEMPERATURE COMPENSATION

Temperature sense associated with the temperature compensation function.



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

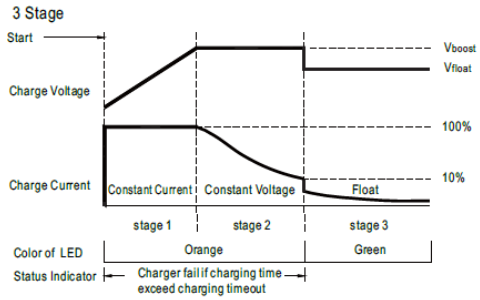
I/P: 230 VAC
O/P:FULL LOAD
Test Result：

TEMP	Voltage compensation	Temperature compensation	
		BEFORE	AFTER
(Ta=0℃)	57.6V = +1.80V ±0.48V	57.51	59.21
(Ta=25℃)	57.6V = 0V	57.54	57.54
(Ta=50℃)	57.6V = -1.80V ±0.48V	57.55	55.86

7 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
Test Result：

MODEL	Constant voltage(V_{boost})	Float (V_{float})	Turn state current
48V	57.6V± 0.48V	55.2V± 0.48V	2.75A± 0.825A
	57.609V	55.212V	2.845A

8 LED Status Indicators

※ **LED Status Indicators**

LED	Description
Green	Float (stage 3)
Orange	Charging (stage 1 or stage 2)
Red	The LED will present a constant red light when the abnormal status (OTP, OLP, fan fail and charging timeout) arises.
Red (Flashing)	The LED will flash with the red light when the internal temperature reaches 60℃; under this condition, the unit still operates normally without entering OTP. (In the meantime, an alarm signal will be sent out through the PMBus interface.)

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)566V
2	P.F.C Transistor (D to S) or (C to E) **Peak Voltage**	Q52 Rated 33A/600V	I/P:High-Line +3V =267 V AC ON/OFF O/P: (1)Full Load Ta:25℃	VDS: (1)480V
3	Diode Peak **Voltage**	Q101 Rated 65A/200 V Q104 Rated 65A/200 V	I/P:High-Line +3V =267 V AC ON/OFF O/P: (1)Full Load Ta:25℃	Q101: Q104: VDS: VDS: (1)187V (1)189V
4	Input Capacitor Voltage	C5 Rated: 680 μ /400V SURGE VOLTAGE:450V	I/P:High-Line +3V =267 V O/P: (1)Full Load input on/off Ta:25℃	(1)398V
5	Control IC Voltage Test	PFC IC U51 Rated 6V~1 6V PWM IC U901 Rated	I/P:High-Line +3V =267 V AC ON/OFF O/P(1)FULL LOAD Ta:25℃	U51 (1) 11.68V U901 (1)12.56V

		5.5V~ 24V		
6	Transistor	Q154 Rated： 100A/40V	I/P:High-Line +3V =267 V (HOT SWAP TEST) O/P: (1)Full Load	(1)400mV
7	Transistor	Q163 Rated： 2.4A/100V	I/P:High-Line +3V =267 V (HOT SWAP TEST) O/P: (1)Full Load	(1)600mV

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:6.9mA I/P-FG:8.04mA O/P-FG:6.28m 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: 8.16GΩ I/P-FG: 9.35GΩ O/P-FG: 9.4GΩ 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： RCB-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 160.9K hrs min. Telcordia SR-332 (Bellcore) ; 42.1K 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