TEST REPORT

SGS-CSTC
Standards Technical Services
(Shanghai) Co., Ltd.
No.588 West Jindu Road,
Songjiang District,
Shanghai, China

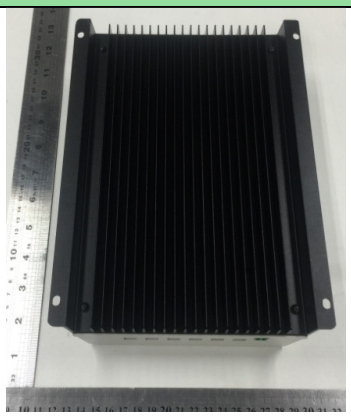
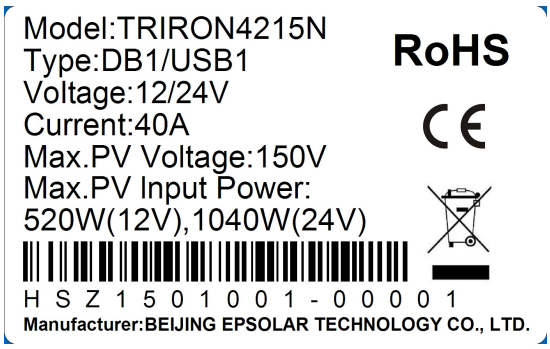
Report reference no. .....:	SHES180300220372
Date of issue.....:	July 25, 2018
Total number of pages .....:	30
Testing laboratory .....:	SGS-CSTC Standards Technical Services(Shanghai) Co., Ltd.
Address .....:	588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China
Applicant's name.....:	Beijing Epsolar Technology Co., Ltd.
Address .....:	No.228, Block A, 2nd Floor, Bldg 1, No.3 Street, Shangdi Xinxi Chanye Jidi, Haidian District, Beijing, China
Test specification .....:	IEC 62509:2010
Test item description .....:	Solar charge controller
Trade mark .....:	EPEVER
Manufacturer .....:	Same as applicant
Factory.....:	Beijing Epsolar Technology Co., Ltd. Shenzhen Branch Bldg A3, No.18, Fouth Industrial Park, Zhulongtian Road, Shuitian Community, Shiyan Street, Baoan District, Shenzhen, Guangdong, China, 518108
Model/Type reference .....:	TRIRON2206N/###/XXXX, TRIRON2210N/###/XXXX, TRIRON3210N/###/XXXX, TRIRON3215N/###/XXXX, TRIRON4210N/###/XXXX, TRIRON4215N/###/XXXX, ### stand for the display units: DB1, DS1, DS2 or DCV. XXXX stand for the communication units: UCS, RCM, RCS, USB1, CCV
Ratings .....:	Refer to page 3 to page 8

Signature

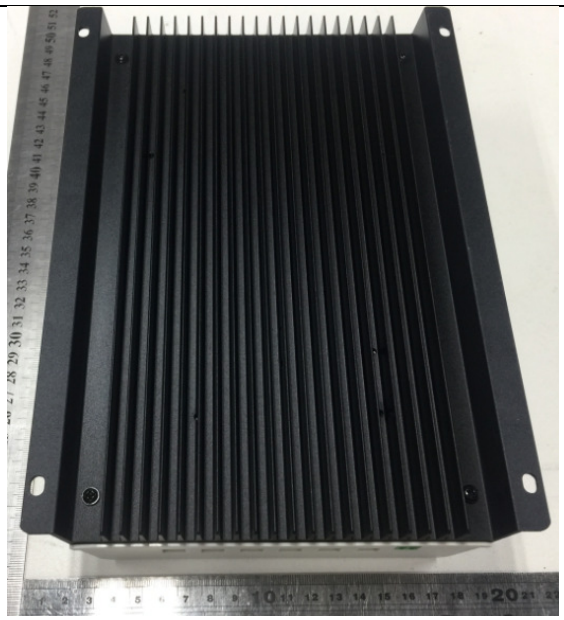
Tested by: Simon Shi

Signature

Approved by: Erin Lin

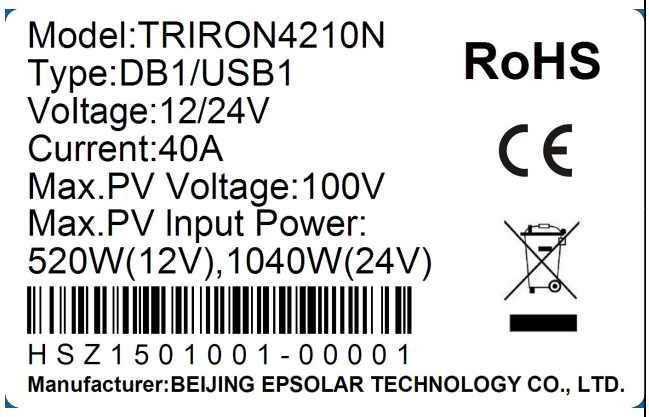
Summary of testing	
This report is based on the report (Report NO. SHES180300220371, issued on July 23, 2018.) TRIRON4215N/DB1/USB1 selected as representative samples are tested according to IEC 62509:2010 in this test report. And rating test items were repeated on other models. Communication units whose code is UCS, RCM, RCS, USB1 and CCV are not required in IEC 62509:2010, and not be evaluated in this report. All the samples have been tested and found to comply with the above-mentioned standards' requirements. Details of test result are shown in this test report.	
Tests performed (name of test and test clause):	**Testing location:**
Full test	Shenzhen Academy of Metrology and Quality Inspection NETC Building, No.4 Tongfa road, Xili, Nanshan, Shenzhen, China
Copy of marking plate / device under test:	
 Front view of TRIRON4215N/DB1/USB1	 Rear view of TRIRON4215N/DB1/USB1
 Terminal side of TRIRON4215N/DB1/USB1	 Nameplate of TRIRON4215N/DB1/USB1

Front view of TRIRON4210N/DB1/USB1



Rear view of TRIRON4210N/DB1//USB1

Terminal side of TRIRON4210N/DB1/USB1



Nameplate of TRIRON4210N/DB1/USB1

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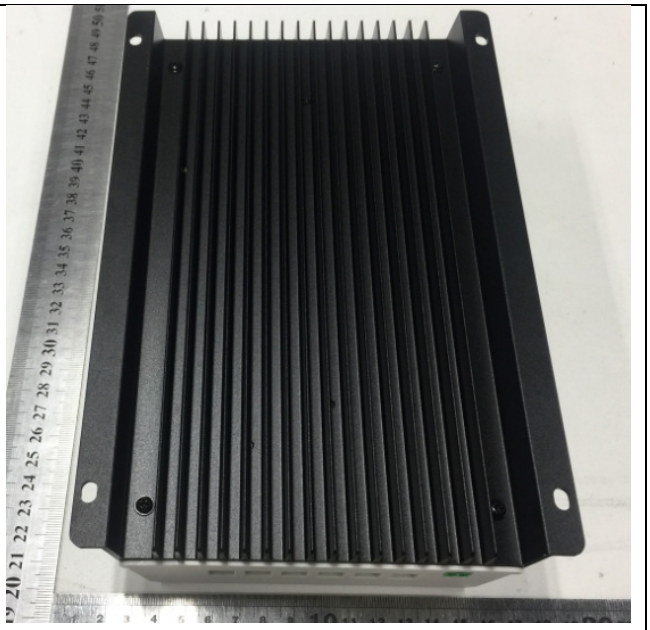
Front view of TRIRON3215N/DS1/RCS



Rear view of TRIRON3215N/DS1/RCS

Terminal side of TRIRON3215N/DS1/RCS

Model:TRIRON3215N
Type:DS1/RCS
Voltage:12/24V
Current:30A
Max.PV Voltage:150V
Max.PV Input Power:
390W(12V),780W(24V)

RoHS

HSZ1501001-00001

Manufacturer:BEIJING EPSOLAR TECHNOLOGY CO., LTD.

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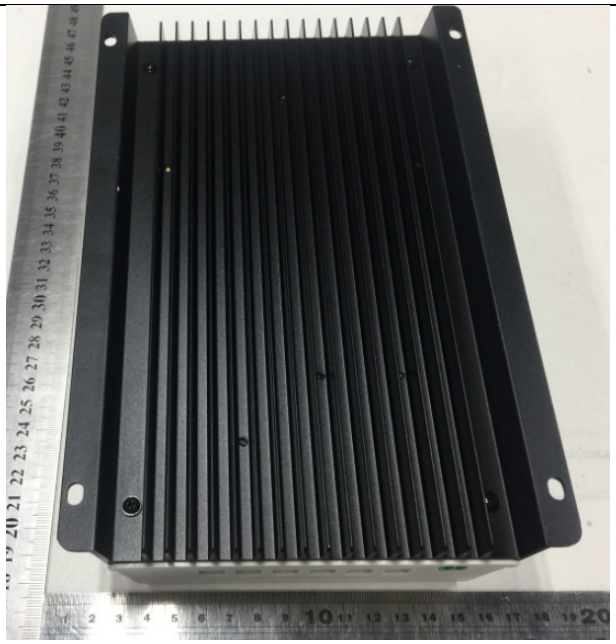
Front view of TRIRON3210N/DS1/RCS



Rear view of TRIRON3210N/DS1/RCS

Terminal side of TRIRON3210N/DS1/RCS

Model:TRIRON3210N
Type:DS1/RCS
Voltage:12/24V
Current:30A
Max.PV Voltage:100V
Max.PV Input Power:
390W(12V),780W(24V)

RoHS

HSZ1501001-00001

Manufacturer:BEIJING EPSOLAR TECHNOLOGY CO., LTD.

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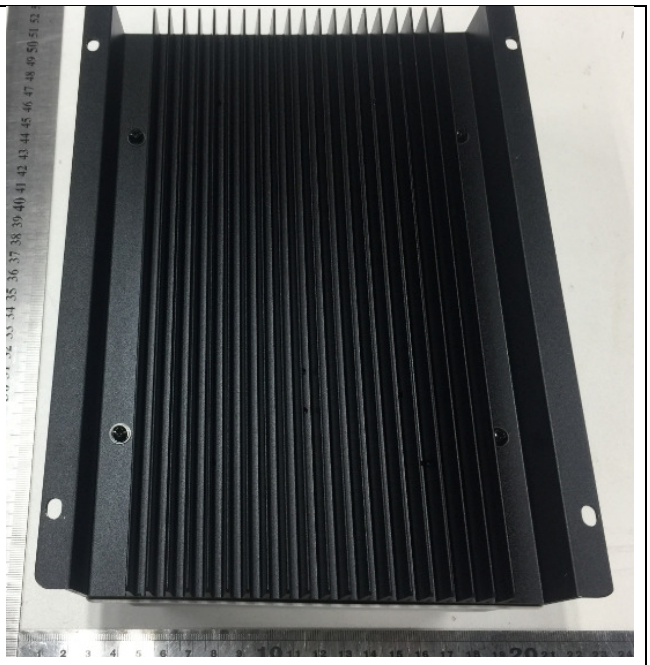
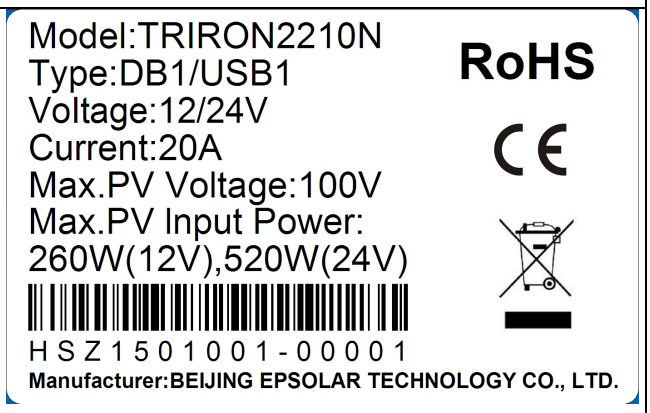
Front view of TRIRON2210N/DB1/USB1



Rear view of TRIRON2210N/DB1/USB1

Terminal side of TRIRON2210N/DB1/USB1



Nameplate of TRIRON2210N/DB1/USB1

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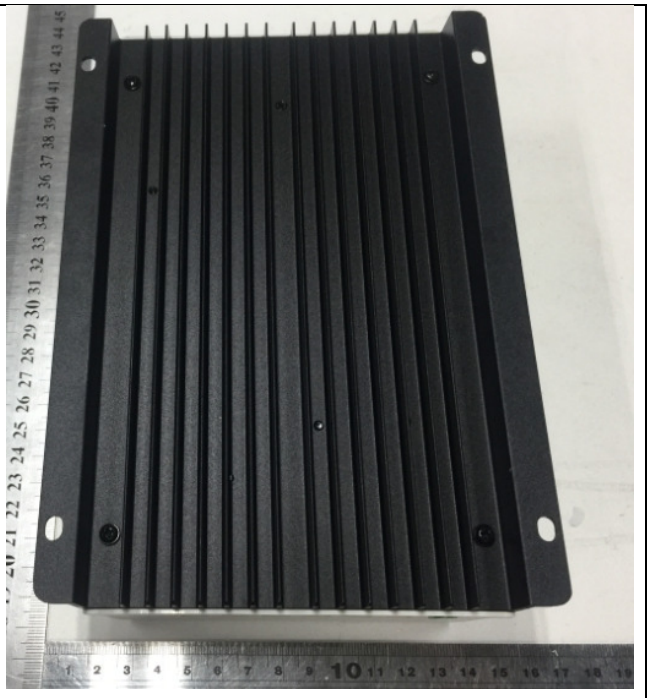
Front view of TRIRON2206N/DS1/RCS



Rear view of TRIRON2206N/DS1/RCS

Terminal side of TRIRON2206N/DS1/RCS

Model:TRIRON2206N
Type:DS1/RCS
Voltage:12/24V
Current:20A
Max.PV Voltage:60V
Max.PV Input Power:
260W(12V),520W(24V)

RoHS

HSZ150100 1-00001

Manufacturer:BEIJING EPSOLAR TECHNOLOGY CO., LTD.

Nameplate of TRIRON2206N/DS1/RCS

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Possible test case verdicts:	
- Test case does not apply to the test object	N/A
- Test object does meet the requirement	Pass (P)
- Test object does not meet the requirement	Fail (F)

General remarks:

The test results presented in this report relate only to the object tested.

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Throughout this report, a point is used as the decimal separator.

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Unless otherwise stated: (a) the results shown in this document refer only to the sample(s) tested and (b) such sample(s) are retained for 30 days. This document cannot be reproduced except in full, without prior approval of the company.

Contents:

1) The main report.
2) Attachment 1: User Manual (49 pages)
3) Attachment 2: Constructional Data Form (CDF) for Solar Charger Controller (11 pages)

General product information

1. The equipment under test is a solar charge controller. The working environment temperature is -25℃-55℃ for equipment with LCD and -30℃-55℃ for that without LCD. The equipment can work at full power under the temperature above.

   This report covers model TRIRON****N/###/XXXX

   **** stands for electrical parameter information, which can be 2206, 2210 ,3210, 3215, 4210, 4215.

   ### stand for the display units, which can be DB1, DS1, DS2 or DCV.
   XXXX stand for the communication units: UCS, RCM, RCS, USB1, CCV
2. The naming rules of the product are as follows.

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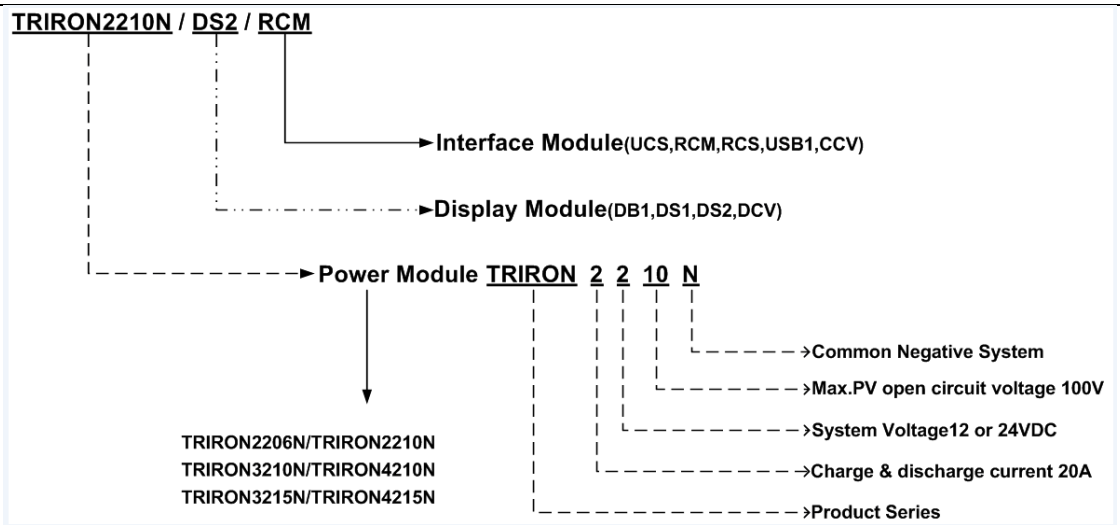

The different rating of each model is list in table below.

Model	Battery voltage （V）	Charging current （V）	Load current （A）	Max. PV input voltage （V）	PV input power （W）
TRIRON2206N/###/XXXX	12/24VDC	20A	20A	60V	260W/12V 520W/24V
TRIRON2210N/###/XXXX	12/24VDC	20A	20A	100V	260W/12V 520W/24V
TRIRON3210N/###/XXXX	12/24VDC	30A	30A	100V	390W/12V 780W/24V
TRIRON3215N/###/XXXX	12/24VDC	30A	30A	150V	390W/12V 780W/24V
TRIRON4210N/###/XXXX	12/24VDC	40A	40A	100V	520W/12V 1040W/24V
TRIRON4215N/###/XXXX	12/24VDC	40A	40A	150V	520W/12V 1040W/24V
Remarks	### stand for the display units, which can be DB1, DS1, DS2 or DCV. XXXX stand for the interface units: UCS, RCM, RCS, USB1, CCV.				

All models above are the similar in electrical principle, and use the same critical safety components. All tests were conducted on model TRIRON4215N/DB1/USB1 to represent the others. And rating test was repeated on other models.

1. Test specification and test result

Clause	Requirement + Test	Result - Remark	Verdict
4.3	**Battery lifetime protection requirements**		P
4.3.1	Prevent leakage current from battery to PV generator		P
	The allowable reverse current on the PV side shall be ≤0.1% of the BCC rated input current when the battery voltage is equal to the rated voltage.	Rated input current:40 A max Allowable reverse current: 40 mA	P
	Compliance shall be verified by the test according to 5.2.1.	Adjust the Battery voltage to 2.1 V/cell (recommended by the manufacturer), thus the battery pack voltage is 25.2 V. Negligible current (0.03 mA) is measured in the RPV loop.	P
4.3.2	Basic battery charging functions		
4.3.2.1	General		P
	The BCC shall provide appropriate charging set-point and load disconnect set-points for the specific battery technology or technologies it is intended to be used for.	MPPT controller provides appropriate charging set-point and load disconnect set-point for different batteries.	P
4.3.2.2	Protect battery from over-charge		P
	The BBC shall cut out or regulate the charging current to avoid over-charging of the battery according to battery manufacture recommended end of charge set-point.	The controller cut out the charging current to avoid over-charging of the battery. Refer to below.	P
	Compliance shall be determined by test according to 5.2.2.	The end of charge voltage is 28.7 V. Refer to the table for detail.	P
4.3.2.3	Protect battery from over-discharge		P
	The BCC shall have a provision to prevent the battery from over-discharging.	The load disconnect voltage is 22.1 V. Refer to the table for detail.	P
	If battery over-discharge protection is achieved by means of audible or visible alarms that prompt the system user to distance all or non-essential load, this shall be clearly stated in the operation manual.	The indicator or display light on and the output terminals open circuit.	P

	If over-discharge protection is reliant on the installation of an external device that provides over-discharge protection, this fact shall be clearly stated in the installation manual.		N/A
	Battery over-discharge protection can be triggered by a battery voltage measurement, a state of charge calculation, a combination of both or other algorithms.	The over-discharge protection is triggered by a battery voltage measurement	P
	The BBC documentation and/or interface shall clearly specify the algorithms and criteria used to establish the load disconnect and reconnect set-points		P
	Compliance shall be determined by test according to 5.2.3	Load disconnected voltage: 22.1 V Load reconnected voltage: 25.2 V Refer to the table for detail.	P
4.3.2.4	Set-point accuracy		P
	The BBC measurement accuracy for voltage set-points for charge control shall be ±1% or better. For load disconnect it shall be ±2% or better.	＜±1%	P
	Compliance shall be determined by test according to 5.2.2 and 5.2.3.	The set-point of the end charging is 28.8 V, the measured point is 28.7 V. The set-point of the disconnect point is 22.2 V, the measured point is 22.1 V.	P
4.3.3	Charging regime		P
4.3.3.1	General		P
	The BBC shall be matched to the specific battery technology for its intended use to ensure that correct charging set-points are implemented.		P
4.3.3.2	Required charging stages		P
	As a minimum, PV battery charge controllers shall have bulk and float charging stages.	The BCC has bulk and float charging stages	P
4.3.3.3	Recommended charging stages		P
	In addition to 4.3.3.2, battery charge controllers should provide equalise charge periodically to the battery. The periodicity of equalise charge should be more than 7 days.		P
4.3.3.4	Adjustable charging set-points		P

	Charging set-points should be adjustable or automatically selected either by means of individual set-point adjustment, or by battery type selection or self-detection of type of battery.		P
	The specific charging regime used depends on the battery technology specified.		P
	Self-adaptive set-points based on advanced algorithms shall be able to be verified using information provided by the user interface and the BCC documentation.		N/A
4.3.3.5	Temperature compensated charging set-points		P
	Bulk, float, and other high voltage or end of charge set-points should be temperature compensated.		P
	Temperature compensation if provided should be in accordance with battery manufacturer recommendations for the particular type of battery.		P
	Temperature compensated set-points shall be identifiable from the charge controller documentation.	Refer to the table for detail.	P
4.3.3.6	Voltage drop compensation for set-point measurement	No voltage drop function is provided.	N/A
	The BCC should provide a means to compensate for voltage drop in battery cables, or provide installation instructions to minimize voltage drop.		N/A
	If the battery charge controller has the provision for battery sense cables, it shall be able to operate with or without these. This requirement is tested according to 5.2.2 and 5.2.3		N/A
4.3.4	Set-point security	Charge controller with fixed set-points	N/A
	Charging set-points shall be secured against change other than by a deliberate and qualified action		N/A
	Compliance shall be determined by inspection of the unit and accompanying operating instructions.		N/A
4.3.5	Load disconnect capability		P
	Where over-discharge protection is provided by means of load disconnect functionality the load disconnect and reconnect set-points shall be verified by testing according 5.2.3	Refer to the table 5.2.3 for detail.	P

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	The load could be either a load directly switched or a load controlled by the BBC by other means.	Directly switched	P
	In case of a BBC directly switching the load, this should be provided by means of an integrated load breaking switching device.	The load is automatically switched by the BCC.	P
4.4	**Energy performance requirements**		P
4.4.1	Stand by self-consumption	For TRIRON4215N	P
	With no PV input or load the self-consumption of a PV BCC shall be as detailed in table 1, when the battery voltage is equivalent to 2.1V/Cell ±2%, and the ambient temperature is 25℃±2℃	Nominal charging current: 40 A (For TRIRON4215N) Maximum self-consumption: 25.53 mA. Note: The Battery voltage is adjusted to 2.1 V/cell (recommended by the manufacturer), thus the battery pack voltage is 25.2 V	P
	Compliance shall be determined by test according to 5.3.1	Refer to the table 5.3.1 for detail. (For TRIRON4215N)	P
4.4.2	BBC efficiency		P
	Power efficiency of the BBC shall be evaluated from 10% to 100% of the rated charging current, at a battery voltage equivalent to 2.2V/cell±2% and at ambient temperature of 25℃±2℃	Refer to the table 5.3.2 for detail.	P
	The efficiency shall be determined by test according to 5.3.2	Refer to the table 5.3.2 for detail.	P
4.5	**Protection and fail safe requirements**		
4.5.1	Thermal performance		P
	The BBC shall be capable of handling rated input current/power from the generator and, simultaneously, rated load current to load terminals (if provided) for at least 1h at the manufacture’s specified maximum rated ambient operating temperature ±2℃. Battery voltage shall be 2.2V/cell±2%	the manufacture’s specified maximum rated ambient operating temperature: 55.0℃ Battery voltage: 28.4 V Charging current: 40.0 A Operating time: 1 h	P
	Compliance shall be determined by test according to 5.4.1	The BCC operates for 1h normally. Refer to the table 5.4.1 for detail.	P

4.5.2	Overcurrent operation		P
4.5.2.1	PV side	(For TRIRON4215N)	P
	The BCC shall not be damaged by excessive current from the PV generator up to 125% of the full rated current. The BBC shall continue to operate normally after such an event and shall not require manual resetting	Rated current: 40 A The maximum sustained test charging current is 40 A, the power will be decrease if the current is more than 40 A. Operating time: 1 h	P
	Compliance shall be determined by test according to 5.4.2	After 1h, the BCC is not damaged. The BCC continues to operate normally after such an event and does not require manual resetting. Refer to the table 5.4.2 for detail.	P
4.5.2.2	Load side		P
	If the BBC has a load terminal, this terminal shall be current protected to prevent over loads from causing damage to the operation of the essential PV BCC functions.	The output terminal is current protected to prevent over load. The BCC will shut down if the load current is more than 40 A.	P
	Compliance shall be determined by test according to 5.4.3	After 1h, the BCC is not damaged. The BCC operates normally under normal condition. Refer to the table 5.4.3 for detail.	P
4.5.3	PV generator and battery reverse polarity		P
	The BBC shall be protected from reverse polarity connection of the PV generator or the battery by hardware or by documented procedure and markings.	The PV generator reverse polarity won't cause any damage.	P
	Compliance shall be determined by test according to 5.4.4 and 5.4.5	After 5 min, the BCC is not damaged. The BCC operates normally under normal condition. Refer to the table 5.4.4 and 5.4.5 for detail.	P

4.5.4	Open circuit on battery terminals (no battery connection)		P
	BCC with load terminals shall be protected from damage to itself and protect the load from the open circuit voltage of the PV generator in case of battery disconnection	The load will be powered by PV input when the battery terminal is open circuit.	P
	Compliance shall be determined by test according to 5.4.6	The BCC is not damaged and operates normally under normal condition.	P
4.6	**User interface requirements**		P
4.6.1	General		P
	The type of the user interface	LED indicators/display	P
	The user interface shall provide the user with valuable information about the system operation if implemented properly	There are descriptions for the LED indicators/display and explanation in the user's manual.	P
	The user interface may be integrated into another system component separate from the BCC.		P
4.6.2	Operational information		P
4.6.2.1	General		P
	The level of information provided to the user is determined by the intended application and its specific requirements		P
4.6.2.2	Recommended operation information		P
	An indication of charging status	Battery status green LED, flash for charging, always on for full, off for no charging	P
	An indication of load-disconnect state		P
	An indication of the state-of-charge of the connected battery	Four battery status LEDs (<25%, >25%, >50% and > 75%)	P
	Other additional operational information displayed by the unit may include but is not limited to: Charging set-point Battery voltage Charging current Energy input/output	 28.8 V 24 V 40 A max 1040 W	P

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4.6.3	User adjustable set-points and parameters	The set-points cannot be adjusted by the user.	P
	If user-adjustable set-points or parameters are provided, the user interface shall provide a facility to modify and display those adjustments as specified in 4.3.3.4		P
	Compliance shall be determined by inspection of the unit and accompanying user/installation manual		P
4.6.4	Alarms		P
	The following condition should be signed by the user interface:		P
	Low battery state of charge/ low battery voltage/ low availability	Red LED on	P
	Load disconnect		P
	BCC trip	Red LED flash	P
	Visible and/or audible alarms, clearly identifiable by the system user, shall be triggered within the unit in case of any of the above conditions occurring. Audible alarms shall be time limited and revert to a visible alarm or be pulsed.	Visual alarm provided	P
	Compliance shall be determined by test according to 5.2.2 and 5.2.3		

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5.2.2	Charging cycle test (TRIRON4215N, 24V, 10 % of the rated charging current)				
Chamber temperature [℃]	Charging stages	PV voltage [V]	PV current [A]	Battery voltage [V]	Battery current [A]
25.0	Bulk charge	35.81	4.01	25.57	5.51
	End of bulk charge	36.44	2.83	28.68	3.52
	HVD	36.51	1.17	28.68	1.43
	Equalise charge	36.56	0.162	29.01	0.159
	Float charge	36.57	0.048	28.81	0.008
40.0	Bulk charge	36.24	4.01	25.82	5.52
	End of bulk charge	36.32	3.28	28.22	4.17
	HVD	36.36	1.71	28.25	2.66
	Equalise charge	36.45	0.05	28.52	0.02
	Float charge	36.45	0.05	28.14	0.016

5.2.2	Charging cycle test (TRIRON4215N, 12V, 10 % of the rated charging current)				
Chamber temperature [℃]	Charging stages	PV voltage [V]	PV current [A]	Battery voltage [V]	Battery current [A]
25.0	Bulk charge	17.21	4.01	12.48	5.38
	End of bulk charge	18.43	4.01	14.46	4.89
	HVD	18.46	2.31	14.42	2.05
	Equalise charge	18.56	0.09	14.51	0.07
	Float charge	18.56	0.07	14.25	0.007
40.0	Bulk charge	17.94	4.01	13.29	5.26
	End of bulk charge	17.99	3.85	14.11	4.97
	HVD	18.12	0.98	14.17	1.27
	Equalise charge	18.16	0.09	14.31	0.04
	Float charge	18.16	0.06	14.23	0.004

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5.2.2	Charging cycle test (TRIRON3215N, 24V, 10 % of the rated charging current)				
Chamber temperature [℃]	Charging stages	PV voltage [V]	PV current [A]	Battery voltage [V]	Battery current [A]
25.0	Bulk charge	36.30	3.01	24.51	4.34
	End of bulk charge	34.41	3.01	28.8	3.48
	HVD	36.38	1.46	28.9	1.79
	Equalise charge	36.44	0.21	28.81	0.22
	Float charge	36.45	0.04	28.72	0.014
40.0	Bulk charge	36.26	3.01	25.75	4.2
	End of bulk charge	36.36	2.45	28.29	3.08
	HVD	36.46	0.22	28.33	0.25
	Equalise charge	36.46	0.17	28.53	0.18
	Float charge	36.47	0.04	28.35	0.02

5.2.2	Charging cycle test (TRIRON4210N, 24V, 10 % of the rated charging current)				
Chamber temperature [℃]	Charging stages	PV voltage [V]	PV current [A]	Battery voltage [V]	Battery current [A]
25.0	Bulk charge	36.22	4.01	26.01	5.33
	End of bulk charge	36.17	4.01	28.62	4.93
	HVD	36.44	0.259	28.71	0.23
	Equalise charge	36.45	0.07	28.31	0.03
	Float charge	36.45	0.08	28.7	0.01
40.0	Bulk charge	36.27	4.01	25.54	5.45
	End of bulk charge	35.09	4.01	28.09	5.04
	HVD	36.42	1.05	28.18	1.26
	Equalise charge	36.46	0.21	28.32	0.21
	Float charge	36.46	0.09	28.41	0.01

5.2.2	Charging cycle test (TRIRON3210N, 24V, 10 % of the rated charging current)				
Chamber temperature [℃]	Charging stages	PV voltage [V]	PV current [A]	Battery voltage [V]	Battery current [A]
25.0	Bulk charge	36.25	3.01	25.5	4.14

	End of bulk charge	35.93	3.01	28.6	3.69
	HVD	36.25	3.01	28.8	2.79
	Equalise charge	36.44	0.191	29.01	0.171
	Float charge	36.45	0.066	28.78	0.013
40.0	Bulk charge	35.75	3.01	25.74	4.03
	End of bulk charge	35.69	3.01	28.22	3.7
	HVD	36.38	1.94	28.24	2.41
	Equalise charge	36.46	0.067	28.52	0.026
	Float charge	36.46	0.066	28.24	0.018

5.2.2	Charging cycle test (TRIRON2210N, 24V, 10 % of the rated charging current)				
Chamber temperature [℃]	Charging stages	PV voltage [V]	PV current [A]	Battery voltage [V]	Battery current [A]
25.0	Bulk charge	36.34	2.01	25.52	2.74
	End of bulk charge	36.29	2.01	28.72	2.42
	HVD	36.44	0.245	28.71	0.232
	Equalise charge	36.45	0.07	28.91	0.017
	Float charge	36.45	0.07	28.68	0.016
40.0	Bulk charge	35.81	2.01	25.64	2.73
	End of bulk charge	35.58	2.01	28.14	2.45
	HVD	36.39	1.55	28.21	1.91
	Equalise charge	36.45	0.22	28.42	0.22
	Float charge	36.45	0.06	28.06	0.02

5.2.2	Charging cycle test (TRIRON2206N, 24V, 10 % of the rated charging current)				
Chamber temperature [℃]	Charging stages	PV voltage [V]	PV current [A]	Battery voltage [V]	Battery current [A]
25.0	Bulk charge	36.30	2.01	25.5	2.76
	End of bulk charge	35.36	2.01	28.7	2.39
	HVD	36.42	0.758	28.8	0.892
	Equalise charge	36.45	0.054	28.62	0.017
	Float charge	36.45	0.055	28.68	0.014

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40.0	Bulk charge	36.29	2.01	26.16	2.68
	End of bulk charge	36.35	2.01	28.24	2.49
	HVD	36.42	0.77	28.26	0.91
	Equalise charge	36.45	0.28	28.42	0.29
	Float charge	36.46	0.06	28.18	0.015

5.2.3	Load disconnect/load reconnect test	
TRINON4215N, 24 V		
Champer temperature (℃)	Disconnect voltage [V]	Reconnect voltage [V]
25	22.1	25.2
40	22.4	25.5
TRINON4215N, 12 V		
Champer temperature (℃)	Disconnect voltage [V]	Reconnect voltage [V]
25	11.1	12.6
40	11.2	12.8
TRINON3215N, 24 V		
Champer temperature (℃)	Disconnect voltage [V]	Reconnect voltage [V]
25	22.1	25.3
40	22.4	25.5
TRINON4210N, 24 V		
Champer temperature (℃)	Disconnect voltage [V]	Reconnect voltage [V]
25	22.0	25.1
40	22.3	25.4
TRINON3210N, 24 V		
Champer temperature (℃)	Disconnect voltage [V]	Reconnect voltage [V]
25	22.1	25.2
40	22.3	25.5
TRINON2210N, 24 V		
Champer temperature (℃)	Disconnect voltage [V]	Reconnect voltage [V]
25	22.1	25.2

40	22.3	25.4
TRINON2206N, 24 V		
Champer temperature (℃)	Disconnect voltage [V]	Reconnect voltage [V]
25	22.1	25.2
40	22.3	25.4
Note：The BCC is not provided with the temperature compenstion function		

5.3.1	**Standby self-consumption test**	
Chamber temperature [℃]	25.0	
TRINON4215N, 24 V		
Battery voltage [V/Cell]	Battery voltage [V]	Battery current [mA]
2.1	25.2	24.68
2.0	24.01	25.03
1.9	22.80	25.53
1.8	21.6	10.65
1.7	20.4	10.63
TRINON4215N, 12 V		
Battery voltage [V/Cell]	Battery voltage [V]	Battery current [mA]
2.1	12.59	34.43
2.0	12.00	35.23
1.9	11.4	36.70
1.8	10.8	17.45
1.7	10.2	18.3
TRINON3215N, 24 V		
Battery voltage [V/Cell]	Battery voltage [V]	Battery current [mA]
2.1	25.2	22.57
2.0	24.0	23.02
1.9	22.8	23.5
1.8	21.6	17.66
1.7	20.4	18.07
TRINON4210N, 24 V		

Battery voltage [V/Cell]	Battery voltage [V]	Battery current [mA]
2.1	25.2	21.90
2.0	24.01	21.66
1.9	22.8	19.47
1.8	21.6	19.09
1.7	20.4	19.0
TRINON3210N, 24 V		
Battery voltage [V/Cell]	Battery voltage [V]	Battery current [mA]
2.1	25.2	25.21
2.0	24.0	25.1
1.9	22.8	22.3
1.8	21.6	22.3
1.7	20.4	22.3
TRINON2210N, 24 V		
Battery voltage [V/Cell]	Battery voltage [V]	Battery current [mA]
2.1	25.19	19.31
2.0	24.0	19.18
1.9	22.8	19.35
1.8	21.6	19.04
1.7	20.4	18.93
TRINON2206N, 24 V		
Battery voltage [V/Cell]	Battery voltage [V]	Battery current [mA]
2.1	25.19	18.69
2.0	24.01	18.35
1.9	22.81	18.23
1.8	21.16	18.18
1.7	20.4	18.18

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5.3.2	Efficiency test (TRIRON4215N, 24 V,)

Chamber temperature [℃]	25.0

Charging

PV input current [%]	PV voltage [V]	PV current [A]	PV power [W]	Battery voltage [V]	Battery current [A]	Battery power [W]	Charging efficiency [%]
10	36.3	3.24	118	28.81	4.04	116	99.0
20	36.23	6.43	233	28.79	8.03	231	99.2
30	36.16	9.67	350	28.76	12.07	347	99.3
40	36.09	12.92	466	28.71	16.11	463	99.2
50	36.02	16.24	585	28.75	20.15	579	99.0
60	35.96	19.66	707	28.51	24.19	690	97.6
70	35.88	22.94	823	28.53	28.24	806	97.9
80	35.81	26.34	943	28.52	32.25	920	97.5
90	35.74	29.78	1064	28.68	36.33	1042	97.9
100	35.67	33.18	1184	28.36	40.34	1144	96.7

Discharging

Battery voltage [V]	Battery current [A]	Battery power [W]	Load voltage [V]	Load current [A]	Load power [W]	Voltage drop [V]	Discharging efficiency [%]
23.16	40.39	935.4	22.95	40.65	932.9	0.21	99.7

5.3.2	Efficiency test (TRIRON4215N, 12 V)

Chamber temperature [℃]	25.0

Charging

PV input current [%]	PV voltage [V]	PV current [A]	PV power [W]	Battery voltage [V]	Battery current [A]	Battery power [W]	Charging efficiency [%]
10	18.38	3.27	60	14.32	4.08	59	97.7
20	18.28	6.46	119	14.33	8.08	116	97.8
30	18.18	9.78	178	14.39	12.08	174	97.9
40	18.07	13.08	236	14.33	16.08	230	97.4
50	17.96	16.54	297	14.3	20.08	288	97.0
60	17.85	20.04	357	14.35	24.08	343	96.1
70	17.73	23.56	419	14.27	28.16	402	96.0
80	17.62	26.67	470	14.01	32.16	451	95.9
90	17.49	31.02	543	14.3	36.21	518	95.4
100	17.37	34.75	604	14.2	39.9	567	93.9

Discharging

Battery voltage [V]	Battery current [A]	Battery power [W]	Load voltage [V]	Load current [A]	Load power [W]	Voltage drop [V]	Discharging efficiency [%]
12.14	39.09	474.6	11.97	39.14	468.5	0.17	98.7

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5.3.2	Efficiency test (TRIRON3215N, 24 V)

Chamber temperature [℃]	25.0

Charging

PV input current [%]	PV voltage [V]	PV current [A]	PV power [W]	Battery voltage [V]	Battery current [A]	Battery power [W]	Charging efficiency [%]
10	36.38	2.5	91	28.83	3.09	89	97.9
20	36.31	4.89	178	28.76	6.09	175	98.6
30	36.23	7.32	265	28.72	9.09	261	98.4
40	36.14	9.78	353	28.71	12.08	347	98.1
50	36.06	12.23	441	28.69	15.08	433	98.1
60	35.97	14.76	531	28.72	18.08	519	97.8
70	35.89	17.32	622	28.81	21.08	607	97.7
80	35.81	19.89	712	28.77	24.08	693	97.3
90	35.73	22.47	803	28.75	27.08	779	97.0
100	35.65	25.01	892	28.67	30.07	862	96.7

Discharging

Battery voltage [V]	Battery current [A]	Battery power [W]	Load voltage [V]	Load current [A]	Load power [W]	Voltage drop [V]	Discharging efficiency [%]
23.38	30.32	708.9	23.15	30.08	696.4	0.23	98.2

5.3.2	Efficiency test (TRIRON4210N, 24 V)

Chamber temperature [℃]	25.0

Charging

PV input current [%]	PV voltage [V]	PV current [A]	PV power [W]	Battery voltage [V]	Battery current [A]	Battery power [W]	Charging efficiency [%]
10	36.29	3.32	120	28.7	4.09	117	97.4
20	36.19	6.5	235	28.63	8.09	232	98.5
30	36.1	9.72	351	28.65	12.08	346	98.6
40	36	12.95	466	28.59	16.09	460	98.7
50	35.9	16.21	582	28.61	20.08	574	98.7
60	35.8	19.53	699	28.54	24.08	687	98.3

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70	35.7	22.89	817	28.55	28.04	801	98.0
80	35.59	26.28	935	28.52	31.79	907	96.9
90	35.49	29.68	1053	28.49	36.14	1030	97.7
100	35.45	30.37	1077	26.19	40.03	1048	97.4

Discharging							
Battery voltage [V]	Battery current [A]	Battery power [W]	Load voltage [V]	Load current [A]	Load power [W]	Voltage drop [V]	Discharging efficiency [%]
23.05	40.48	941.2	22.96	40.13	921.4	0.09	97.9

5.3.2 Efficiency test (TRIRON3210N, 24 V)

Chamber temperature [℃]	25.0

Charging							
PV input current [%]	PV voltage [V]	PV current [A]	PV power [W]	Battery voltage [V]	Battery current [A]	Battery power [W]	Charging efficiency [%]
10	36.32	2.52	92	28.84	3.09	89	97.4
20	36.25	4.9	178	28.76	6.09	175	98.6
30	36.18	7.31	264	28.71	9.08	261	98.6
40	36.1	9.73	351	28.69	12.08	347	98.7
50	36.02	12.19	439	28.68	15.09	433	98.6
60	35.95	14.66	527	28.66	18.09	518	98.4
70	35.88	17.16	616	28.7	21.09	605	98.3
80	35.8	19.68	705	28.7	24.09	691	98.1
90	35.73	22.25	795	28.69	27.09	777	97.8
100	35.71	22.92	818	26.53	30.22	802	98.0

Discharging							
Battery voltage [V]	Battery current [A]	Battery power [W]	Load voltage [V]	Load current [A]	Load power [W]	Voltage drop [V]	Discharging efficiency [%]
23.23	30.34	704.8	23.15	30.41	703.9	0.08	99.9

5.3.2	Efficiency test (TRIRON2210N, 24 V)						
Chamber temperature [℃]	25.0						
Charging							
PV input current [%]	PV voltage [V]	PV current [A]	PV power [W]	Battery voltage [V]	Battery current [A]	Battery power [W]	Charging efficiency [%]
10	36.36	1.73	63	28.79	2.09	60	95.7
20	36.31	3.31	120	28.65	4.08	117	97.3
30	36.25	4.91	178	28.69	6.09	175	98.2
40	36.21	6.51	236	28.67	8.08	232	98.3
50	36.16	8.12	294	28.64	10.08	289	98.3
60	36.11	9.74	352	28.6	12.08	345	98.2
70	36.06	11.38	410	28.62	14.08	403	98.2
80	36.01	13.03	469	28.62	16.08	460	98.1
90	35.96	14.69	528	28.61	18.08	517	97.9
100	35.95	14.99	538.9	26.25	20.08	527	97.8
Discharging							
Battery voltage [V]	Battery current [A]	Battery power [W]	Load voltage [V]	Load current [A]	Load power [W]	Voltage drop [V]	Discharging efficiency [%]
23.05	20.36	469.3	23.0	20.25	465.8	0.05	99.2

5.3.2	Efficiency test (TRIRON2206N, 24 V)						
Chamber temperature [℃]	25.0						
Charging							
PV input current [%]	PV voltage [V]	PV current [A]	PV power [W]	Battery voltage [V]	Battery current [A]	Battery power [W]	Charging efficiency [%]
10	36.33	1.72	62	28.82	2.09	60	96.4
20	36.28	3.3	120	28.65	4.08	117	97.6
30	36.23	4.9	178	28.67	6.09	175	98.4
40	36.18	6.51	236	28.68	8.08	232	98.4
50	36.13	8.12	293	28.62	10.08	288	98.3
60	36.07	9.78	353	28.62	12.08	346	98.0

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70	36.02	11.4	411	28.7	14.08	404	98.4
80	35.98	13.06	470	28.6	16.08	460	97.9
90	35.93	14.73	529	28.6	18.09	517	97.8
100	35.91	15.1	542	26.26	20.08	527	97.2

Discharging							
Battery voltage [V]	Battery current [A]	Battery power [W]	Load voltage [V]	Load current [A]	Load power [W]	Voltage drop [V]	Discharging efficiency [%]
23.18	20.35	471.7	23.06	20.25	466.9	0.12	98.9

5.4.1	Thermal performance test (TRIRON4215N)							
Operating time				1h				
Chamber temp. [℃]				55				
Heat-sink max. temp. [℃]				81.0				
PV voltage [V]	PV current [A]	PV power [W]	Battery voltage [V]	Battery current [A]	Battery power [W]	Load voltage [V]	Load current [A]	Load power [W]
35.7	33.2	1184	28.4	40.3	1144	--	--	--
Note: The BCC has a heatsink attached with the enclosure, the temperature was measured at the middle of the heatsink.								

5.4.2	PV over current protection test (TRIRON4215N)						
Operating time			1 h				
Chamber temp. [℃]	Heat-sink maximum temp. [℃]	PV voltage [V]	PV current [A]	PV power [W]	Battery voltage [V]	Battery current [A]	Battery power [W]
25	55	35.4	32.9	1165	28.33	40	1133
Note: 1) Rated current: 40 A. The test charging current is 40 A. 2) The BCC has a PV input over current protection, when the current is more than 40 A, the input power will decrease.							

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5.4.3	Load over current protection test (TRIRON4215N)						
Operating time			1 h				
Chamber temp. [℃]	Heat-sink maximum temp. [℃]	Battery voltage [V]	Battery current [A]	Battery power [W]	Load voltage avg.[V]	Load current [A]	Load power [W]
25.0	53.7	24.36	40.08	976	24.20	40.04	968
Note: When the output current is more than 40 A, the BCC will shut off the output terminal.							

2. List of measurement equipment

Identification #	Description	Calibration expire date
SB9146	Oscilloscope	03/27/2019
SB9148	Current sensor	02/25/2019
SB7661	High-voltage probe	12/28/2018
SB11208	Multimeter	02/26/2019
SB9807	Temperature recorder	12/14/2018
SB8556	Sound level meter	08/06/2018
SB9150/20	Test finger	04/10/2020
SB8900	Power analyzer	08/13/2018
SB9618/05	Current transformer	10/26/2018
SB9618/06	Current transformer	10/26/2018
SB11485	Contact current tester	07/30/2018
SB9814	Contact resistance tester	08/21/2018
SB9815	Withstand voltage tester	02/26/2019
SB9808	Impulse voltage generator	12/17/2018
SB8556	High-low temperature test chamber	08/06/2018
SB8081	Water Proof tester	03/11/2019
SB150/08	Finger	01/10/2020

3. Statement of the estimated uncertainty of the test results

The estimated uncertainty fulfils the requirements from the CTL decision sheet DSH 251B / 2009.

----- *End of Test Report* -----