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ISE

Certificate
No. 0817 / FhG-ISE / 001

Manufacturer: phocos China Ltd.
Charge regulator family: CXup

The above mentioned family of charge controllers have been subjected voluntarily to the qualification tests according to IEC 62 509 / 2010-12 Edition 1.0 "Battery Charge Controllers for Photovoltaic Systems – Performance and Functioning".

On the basis of the test results that are laid down in the measurement protocol (test report 17-08-04_Phocos_CXup_v5.pdf) dated 04.08.2017 herewith we confirm that the tested charge controller type fulfils or exceeds controller specifications required by IEC 62 509 / 2010-12 Edition 1.0.

Remarks

1. This certificate is only valid in combination with above mentioned test report.
2. Any change in the electronic design, materials, components or processing of the CXup charge controllers may require a repetition of some or all qualification tests to maintain type approval.

Freiburg,
August, 04th, 2017

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Fraunhofer ISE

Test and Measurement Protocol
- Charge Controllers -

Tests according to IEC 62 509:2010-12

Model/Type
Phocos CXup 20

DuT	Serial Number	Reference number	Date	Update
1	170310 0009	CXup_1-phc-0417	04.08.2017	
2	170310 0007	CXup_2-phc-0417		

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Overview Evaluation / Summary, page 1/2

DuT: Phocos CXup 20
Ref. nr.: CXup_1-phc-0417
CXup_2-phc-0417

Tests based on standard / requirements: **IEC 62 509 / 2010-12 Ed. 1.0**

General remarks, recommendations

The charge controller family CXup of phocos AG are professional manufactured charge controllers. The performance in all areas (efficiency, protection features, self-consumption etc.) is very high. The charge controllers are protected against short circuit and reversed polarity PV module, short circuited and reversed polarity battery using a reliable electronic fuse.

tested?		not tested (see commen	IEC 62 509 requirements	value / claim [1]	tolerance	measured value / result	requirements fulfilled?	comments
			Battery Lifetime Protection Tests					
✓			PV leakage current test	≤ 0.1 % I_N	---	0 µA	✓	@ 12.6 V; R_{PVLoop} = 30 Ohm
			BCC Mode (battery)					Vented battery
✓			end of charge voltage boost mode	**14.4 V[2,3]**	± 1 %	14.40 V	✓	
✓			end of charge voltage overcharge / equalization mode	**14.7 V to 15.3 V[2]** **14.7 V[3]**	± 1 %	14.82 V	✓	
✓			end of charge voltage floating mode	**14,1 V[2]** **13.8 V[3]**	± 1 %	13.80 V	✓	
✓			low voltage disconnect @ 0.1 x I_{10}	**11.7 V to 12.0 V**	± 2 %	11.50 V	✓	
✓			temperature compensation HVD	**- 5 mV/cell/°C**	n. d.	-4.1 to -4.7 mV/cell/°C	✓	From ISE perspective a range of -3 to -6 mV/cell/°C is o.k.!
			Energy Performance Tests					
✓			self-consumption (including lights / LCD)	0.1 % I_N	n. d.	3.5 mA	✓	
✓			charge efficiency	n. d.	n. d.	99.3 %	✓	at max. current
✓			discharge efficiency	n. d.	n. d.	99.2 %	✓	at max. discharge current
			charging technology	PWM/two point				For information only

1) Values in **bold** are recommended values according to IEC 62 509
2) Vented battery
3) Sealed/VRLA battery

Overview Evaluation / Summary, page 2/2

tested?		not tested (see comment)	IEC 62 509 requirements	Value / claim	tolerance	measured value / result	requirements fulfilled?	comments
			Protection and Fail Safe Tests					
✓			protection against wrong polarity battery	compulsory	---	o.k.	✓	
✓			battery open circuit test	compulsory	---	o.k.	✓	
✓			protection against wrong polarity module	compulsory	---	o.k.	✓	
✓			protection against shorted load	compulsory	---	o.k.	✓	
✓			PV overcurrent protection test	1.25 x I_N @ 25 °C	---	25.1 A	✓	Remarks see 4.2.1
✓			Load overcurrent protection test	1.25 x I_N @ 25 °C	---	25.2 A	✓	Remarks see 4.2.2
✓			Thermal performance test	I_{PVmax} @T_{max} for 1 h	---	o.k.	✓	test with max. currents at 40 °C ambient temperature for 1 hour
			User Interface Tests					
✓			display (charging, batt. charged, discharged)	charging	n. d.			Signalled by LCD pictograms
✓				batt. charged	n. d.			Signalled by LCD pictograms
✓				discharg. batt.	n. d.			Signalled by LCD pictograms
✓			The following lettering / labelling should be available: manufacturer, model/type, serial no, rated voltage, max. charge current, max. load current, terminals, display, fuses	must be durable	---	o.k.	✓	The availability of lettering/Labelling is not postulated by IEC 62 509. From Fraunhofer ISE perspective a labelling should be available. Visual test
✓			Complete documentation should be available: data sheet, user manual, installation instructions, operation instructions, trouble shooting guide, calibration instructions (if on site calibration is possible) , safety instructions, warranty, information about spare parts	---	---	o.k.	✓	The availability of documentation is not postulated by IEC 62 509. From Fraunhofer ISE perspective a documentation should be available. Visual test.

n.d. = not defined
T_{max} = manufacturer's specified max. rated ambient operation temperature
I_N = nominal current
I_{PVmax} = manufacturer's specified max. PV current
$I_{Loadmax}$ = manufacturer's specified max. load current

1 Pretests

1.1 Information given by the manufacturer

Manufacturer	phocos AG
Country/Origin	Germany
Model/Type	CXup
Serial / Batch Nr.	(CXup_1-phc-0417)
	170310 0007 (CXup_2-phc-0417)

Mechanical data

Dimensions (l * w * h) [mm]	101*103*31
Weight [g]	205
Case material	plastic
Protection class (IP)	20
Case mounting	2 screws
Connection type (terminal)	screws
Cable stress relief	n.a.
Cable diameter [mm²]	16
Label	yes

Electrical data

At ambient temperature of [°C]	25 °C						
Rated voltage	x	12 V	x	24 V		48 V	
Automatic voltage adjustment	x	yes				no	
Max. module power [W]	n.a.						
Max. charge current [A]	10 to 40 depending on type						
Max. discharge current [A]	10 to 40 depending on type						
Type of controller		shunt	x	serial		other:	
Technique of regulation		two point	x	PWM		other:	
Self consumption [mA]	< 4 mA						
End of charge voltage [V]	13.8 / 27.6 (lead acid float voltage) 14.0 / 28.0 (LiFePO4)						
return switch-on voltage (two point regulation) [V]	---						
load disconnect warning on [% SOC]	n.s.						
load disconnect voltage [V]	11.5 / 23.0 / 46.0						
time delay at load sheding [s]	n.s.						
Reconnection voltage load [V]	12.8 / 25.6 (lead acid) 12.2 / 24.4 (LiFePO4)						
time delay at reconnection [s]	n.s.						
load reconnection manually [V]	n.s.						
operation temperature range [°C]	-30 up to +60°C						
display		LED	x	LCD		LED & LCD	

Information given by the manufacturer (continued)

Additional functions

boost/gassing function	x	yes					no
boost activation voltage [V]	< 12.3 / 24.6						
final boost voltage [V]	14.4 / 28.8 (25 °C), 2 h						
equalization activation voltage [V]	< 12.1 / 24.2						
final equalization (gassing) voltage [V]	14.8 / 29.6 (25 °C), 2h						
Temperature compensation	x	yes					no
temperature compensation [mV/K*cell]	-4.2						
Battery voltage sensor		yes			x		no
DC/DC-Converter (e.g. USB-Port)	x	yes 5.0 V, 1500 mA					no
adjustable for different battery types	x	yes					no
adjustable thresholds		yes			x		no
end of charge [V]	--	min.			--		max.
load disconnect [V]				min.			max.
selectable priority at load disconnection		yes			x		no
Protection against reversed battery polarity	x	yes[1)]		no			not specified
Protection against reversed PV polarity	x	yes[1)]		no			not specified
Others	Protection against Over-Current, Over-Voltage, Over-Temperature, short-circuit and wrong polarity. 2 years datalogger and serial communication interface User friendly LC-Display and touch buttons Programmable nightlight function. Ext. Temperatur sensor						

[1)] Electronic protection

Others

Interfaces	serial proprietary interface
Price	not available
Service	only manufacturer website
Warranty	no information

1 Pretests

1.2 Visual Inspection

Connection type		plug	x	screw		other:			
Cable stress relief		o.k.		not o.k.	x	not available			
Cable diameter stranded [mm²]		2,5		4		6	x	16	
Cable diameter solid [mm²]		2,5		4		6	x	16	
Case quality		very good	x	good		bad			
Connector quality	x	very good		good		bad			
Electronic quality	x	very good		good		bad			
Packing of charge controller	x	very good		good		bad			
Lettering of packing	x	very good		good		bad			
Fuse changing		very good		good		bad	x	n.a. [1]	
Mounting of charge contr.	x	very good		good		bad			
Others:									
Comment quality	very good quality								
Damages		yes			x	no			

Lettering of the charge controller

Manufacturer	x	yes		no		
Model / type	x	yes		no		
Serial / batch number	x	yes		no		
Nominal voltage	x	yes		no		
Connectors	x	yes		no		
Fuse		yes		no	x	n.a. [1]
LED, displays	x	yes		no		
Comment labeling:	o.k.					

Documentation

Data sheet	x	o.k.		not o.k.		not available
User manual						
Operating instructions	x	o.k.		not o.k.		not available
Troubleshooting guide	x	o.k.		not o.k.		not available
Safety instructions	x	o.k.		not o.k.		not available
Installation instructions	x	o.k.		not o.k.		not available
Calibration instructions		o.k.		not o.k.	x	not available
Others	user manuals in different languages (German, English, French, Spanish, Portugese, Chinese)					
Comment documentation	o.k.					

Spare parts

Fuse		availabe	x	not available [1]
Mounting parts		availabe	x	not available
Connectors		availabe	x	not available
Others				
Comment spare parts	---			

Support

Repair / Service address		availabe	x	not available
Warranty		availabe	x	not available
Others				
Comment support	a support address should be given			

[1] Electronic protection

Is it possible to test the charge controller?	x	yes		no
IEC 62 509 requirements fulfilled?	x	passed		failed
If failed, reason?	----------			

2 Battery Lifetime Protection Tests

2.1 Leakage Current

Ambient temperature	28,0	°C
Rated voltage	12,0	V

DuT	1	
Reference	CXup_1-phc-0417	
Inspector	NP	

Test	**Behaviour / results**			
	Revers current [µA]			
Protection against night discharge of the battery (leakage current)	0,0	p	leakage current was not measurable	

Used measurement equipment:	Vbat:	Zimmer LMG95
	Ibat:	---
	Vpv:	---
	Ipv:	Fluke 87
	Vload:	---
	Iload:	---
	Ta:	Maxim DS18S20

DuT = device under test
p/f = passed / failed

IEC 62 509 requirements?	x	passed		failed
If failed, reason?				

2 Battery Lifetime Protection Tests

2.2 Set-points

Ambient temperature	27,5 °C
Rated voltage	12,0 V

DuT	1	
Reference	CXup_1-phc-0417	
Inspector	NP	

Voltage thresholds	Specification (manufacturer) [V]	Measured [V] DuT 1		DuT 2		p / f	Remarks
		reg. start	Cut-off				
End of charge voltage (floating)	13,8	13,76	13,80			p	
final voltage equalisation (gassing)	14,8	14,79	14,82			p	Only if vented battery is selected.
final voltage boost	14,4	14,35	14,40			p	
		LVD					
Deep discharging cut-off voltage		11,50				p	CC set to 11,5 V; mode = voltage
Reconnect voltage load		12,78				p	

Time delay load disconnect [s]	appr. 1min.			
Time delay load reconnect [s]	0			
Type of controller	serial / PWM			
equal to manufacturer data	x	yes		no

Used measurement equipment:	Vbat:	Zimmer LMG 95
	Ibat:	Zimmer LMG 95
	Vpv:	Oscilloscope Agilent DSO-X-3014A
	Ipv:	Zimmer LMG 95
	Vload:	Zimmer LMG 95
	Iload:	Zimmer LMG 95
	Ta:	Maxim DS18S20

DuT = device under test
p/f = passed / failed

IEC 62 509 requirements / recommendations?

x	passed		failed

If failed, reason?

2 Battery Lifetime Protection Tests

2.3 Temperature Compensation of the Set-points

Ambient temperature	see below	°C
Rated voltage	12,0	V

DuT	1	
Reference	CXup_1-phc-0417	
Inspector	NP	

Voltage thresholds	ambient temperature [°C]				temp. comp [mV/K] / cell	DuT
	@ 25,0 °C		@ Temp. °C			
End of charge voltage (float) [V] 1)2)	13,76		40,5	13,38	4,1	1
	13,80		40,5	13,36	4,7	1
Equalization voltage [V] 1)2)						
Boost voltage [V] 1)2)						
Deep discharging cut-off voltage [V]	11,50			11,52		1
Reconnect voltage [V]	12,78			12,70		1

1) PWM start
2) cut off

Remarks		
Used measurement equipment:	Vbat:	Zimmer LMG 95
	Ibat:	Zimmer LMG 95
	Vpv:	Oscilloscope Agilent DSO-X-3014A
	Ipv:	Zimmer LMG 95
	Vload:	Zimmer LMG 95
	Iload:	Zimmer LMG 95
	Ta:	Maxim DS18S20

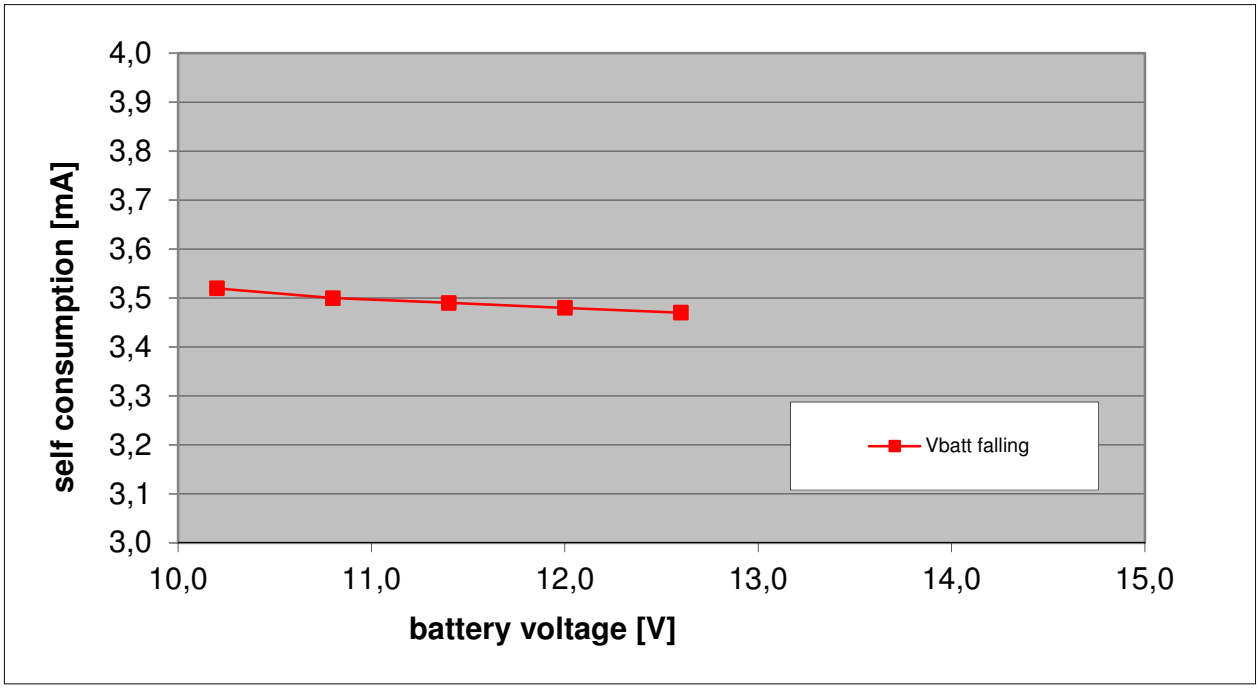
IEC 62 509 requirements?	x	passed		failed
If failed, reason?				

3 Energy Performance Tests

3.1 Self Consumption Tests

Ambient temperature	24,5	°C
Rated voltage	12,0	V

DuT	1	
Reference	CXup_1-phc-0417	
Inspector	NP	



				DuT
max. selfconsumption	3,52	mA @	10,2 V	1
average selfconsumption	3,49	mA		1

Comment		
Used measurement equipment:	Ibat:	Fluke 87
	Ubat:	Zimmer LMG 95
	Ta:	Maxim DS18S20

IEC 62 509 requirements?	x	passed		failed
If failed, reason?				

Measured data

Nr.	Batt. Volt. [V]	Self consumpt. [mA]	Self consumpt. [mW]	DuT	Comment
1	12,6	3,47	43,7	1	
2	12,0	3,48	41,8	1	
3	11,4	3,49	39,8	1	Deep discharge warning
4	10,8	3,50	37,8	1	
5	10,2	3,52	35,9	1	

3 Energy Performance Tests

3.2 Efficiency Tests

Ambient temperature:	28,5	°C
Rated voltage:	12,0	V
Rated max. charge current:	20,0	A
Rated max. discharge current:	20,0	A

DuT	1	2
Reference	CXup_1-phc-0417	
Inspector:	NP	

3.2.1 Charging efficiency @ 10 % to 100 % rated charging current

PV-Module			Battery			efficiency	Vpv-Vbat	DuT
[V]	[A]	[W]	[V]	[A]	[W]	[%]	[V]	
13,239	1,95	25,8	13,207	1,95	25,8	99,8	0,032	1
13,305	4,04	53,8	13,259	4,04	53,6	99,7	0,046	1
13,323	6,53	87,0	13,259	6,53	86,6	99,5	0,064	1
13,370	8,02	107,2	13,295	8,02	106,6	99,4	0,075	1
13,333	10,61	141,5	13,239	10,61	140,5	99,3	0,094	1
13,380	12,10	161,9	13,276	12,10	160,6	99,2	0,104	1
13,440	13,99	188,0	13,322	13,99	186,4	99,1	0,118	1
13,510	16,19	218,7	13,376	16,19	216,6	99,0	0,134	1
13,575	18,20	247,1	13,425	18,20	244,3	98,9	0,150	1
13,647	20,39	278,3	13,479	20,39	274,8	98,8	0,168	1
						99,3		

3.2.2 Discharging efficiency @ 100 % rated load current

Battery			Load			efficiency	Vbat-Vload	DuT
[V]	[A]	[W]	[V]	[A]	[W]	[%]	[V]	
13,222	20,08	265,5	13,118	20,08	263,41	99,2	0,104	1

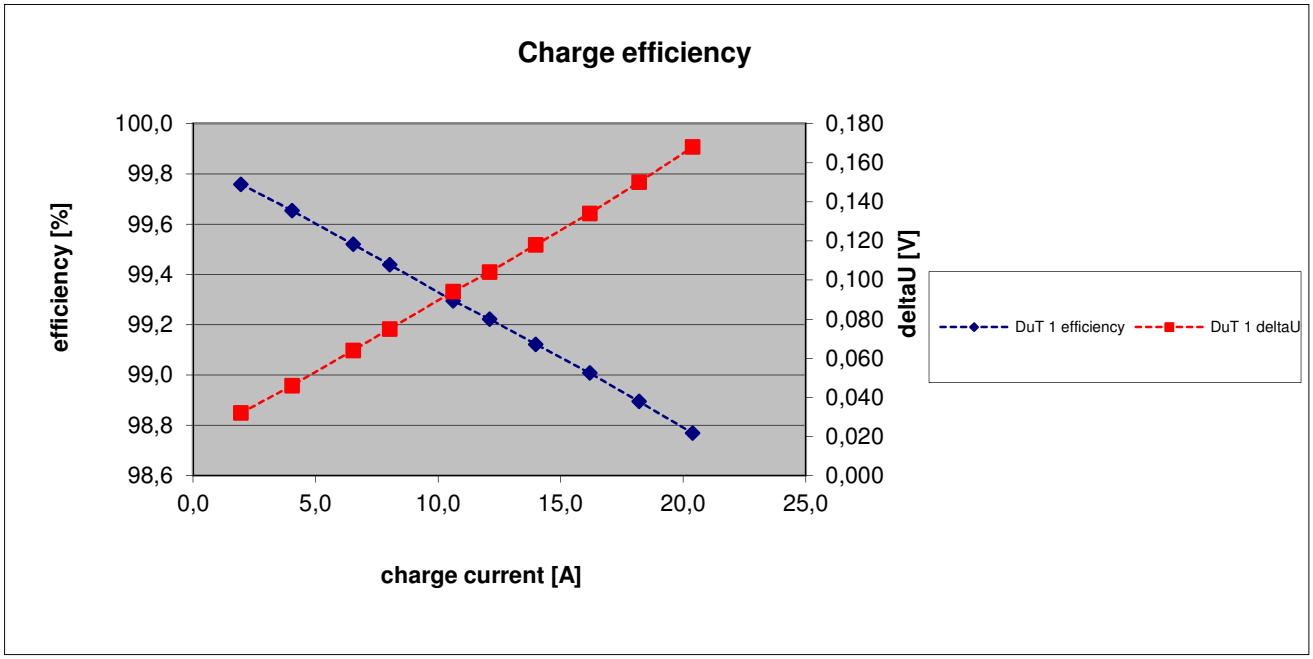
min. discharge efficiency [%]:

Remarks:

Used measurement equipment:	Vbat:	Zimmer LMG 95
	Ibat:	Zimmer LMG 95
	Vpv:	Zimmer LMG 95
	Ipv:	Zimmer LMG 95
	Vload:	Zimmer LMG 95
	Iload:	Zimmer LMG 95
	Ta:	Maxim DS18S20

IEC 62 509 requirements?	x	p	f
If failed, reason?			

Charge and discharge efficiencies



4 Protection and Fail-Safe Tests

4.1 Thermal Performance Tests

Ambient temperature:	see below
Rated voltage:	12 V
Rated max. charge current:	20 A
Rated max. discharge current:	20 A

DuT	1	
Reference	CXup_1-phc-0417	
Inspector:	NP	

Test at extented ambient temperature

time	PV-module		Battery		Load		$T_{heatsink}$	$T_{ambient}$	DuT	Comment
[min]	[V]	[A]	[V]	[A]	[V]	[A]	[°C]	[°C]		
1	13,3	20,5	13,2	0,1	13,1	20,4	45,2	45,0	1	
5	13,3	20,5	13,2	0,2	13,1	20,3	45,3	45,1	1	
10	13,2	20,6	13,1	0,1	13,1	20,5	45,5	45,2	1	
15	13,3	20,6	13,2	0,1	13,0	20,5	45,5	45,1	1	
20	13,3	20,4	13,2	0,1	13,1	20,3	45,5	45,0	1	
25	13,2	20,5	13,1	0,0	13,0	20,5	45,6	45,2	1	
30	13,3	20,6	13,2	0,1	13,1	20,5	45,4	45,1	1	
35	13,3	20,3	13,2	0,1	13,1	20,2	45,6	45,2	1	
40	13,2	20,5	13,1	0,1	13,0	20,4	45,6	45,1	1	
45	13,3	20,5	13,2	0,2	13,1	20,3	45,5	45,3	1	
50	13,3	20,5	13,2	0,1	13,0	20,4	45,6	45,2	1	
55	13,2	20,5	13,2	0,1	13,1	20,4	45,6	45,3	1	
60	13,2	20,5	13,1	0,1	13,0	20,4	45,7	45,3	1	

Remarks: According manual:max.ambient temperature @rated currents is 45 °C
No problems occured during test.

Used measurement equipment:	Vbat:	Zimmer LMG95
	Ibat:	Zimmer LMG95
	Vpv:	Zimmer LMG95
	Ipv:	Zimmer LMG95
	Vload:	Zimmer LMG95
	Iload:	Zimmer LMG95
	Ta:	Maxim DS18S20
	Tc:	Maxim DS18S20

IEC 62 509 requirements?	x	p		f
If failed, reason?				

4 Protection and Fail-Safe Tests

4.2 Overcurrent protection tests

Ambient temperature:	see below °C
Rated voltage:	12,0 V
Rated max. charge current:	20,0 A
Rated max. discharge current	20,0 A

DuT	1	
Reference	CXup_1-phc-0417	
Inspector:	NP	

4.2.1 PV overcurrent protection test

time	PV-module		Battery		Remark	$T_{heatsink}$	$T_{ambient}$	DuT
[min]	[V]	[A]	[V]	[A]		[°C]	[°C]	
1	14,03	25,0	13,20	25,0		27,0	25,5	1
15	14,04	25,0	13,21	25,0		30,0	26,0	1
30	14,05	25,1	13,21	25,1	---	31,0	26,5	1
45	14,05	25,1	13,20	25,1		32,0	27,5	1
60	14,05	25,1	13,20	25,1		32,0	27,5	1

4.2.2 Load overcurrent protection test

time	Remark	Battery		Load		$T_{heatsink}$	$T_{ambient}$	DuT
[min]		[V]	[A]	[V]	[A]	[°C]	[°C]	
1		12,05	25,2	11,91	25,2	28,0	27,5	1
5		12,04	25,2	11,90	25,2	29,0	27,5	1
15		12,03	25,2	11,91	25,2	30,5	28,0	1
30		12,02	25,3	11,91	25,3	31,0	28,5	1
45		12,02	25,3	11,91	25,3	32,0	29,0	1
60		12,0	25,3	11,91	25,3	33,0	30,0	1

No problems at all

Used measurement equipment:	Vbat:	Zimmer LMG95
	Ibat:	Zimmer LMG95
	Vpv:	Zimmer LMG95
	Ipv:	Zimmer LMG95
	Vload:	Zimmer LMG95
	Iload:	Zimmer LMG95
	Ta:	Maxim DS18S20
	Tc:	Maxim DS18S20

IEC 62 509 requirements?	x	passed		failed
If failed, reason?				

4 Protection and Fail-Safe Tests

4.3 Protection Against Reversed Polarity and Short Circuits

Ambient temperature	26,0	°C
Rated voltage	12,0	V

DuT	1	
Reference	CXup_1-phc-0417	
Inspector	NP	

Test	Behaviour / results DuT 1	p/f	remarks	
Protection against short circuited PV[1)]	Vpv = 12,03 V Ipv = 2,2 A	p	DuT didn't suffer any damage.	
Protection against reversed polarity PV Module	Vpv = 22 V	p	DuT didn't suffer any damage. DuT didn't fed the reverse voltage to the load.	
Protection against short circuited load[1)]	Vload = 12,10 V Iload = 2,1 A	p	DuT didn't suffer any damage.	
Operation with reversed polarity battery		p	DuT didn't suffer any damage. Buzzer alarm	

p/f: passed/failed

[1)] Not mandatory according to IEC 62 509

Remarks	The charge controller is protected against short circuited PV, reversed polarity PV module, overload and reversed polarity battery.	
Used measurement equipment:	Vbat:	Zimmer LMG95
	Ibat:	Zimmer LMG95
	Vpv:	Zimmer LMG95
	Ipv:	Zimmer LMG95
	Vload:	Zimmer LMG95
	Iload:	Zimmer LMG95
	Ta:	Maxim DS18S20

IEC 62 509 requirements?	x	passed		failed
If failed, reason?				

4 Protection and Fail-Safe Tests

4.4 Battery Open Circuit Test

Ambient temperature	25,3	°C
Rated voltage	12,0	V

DuT	1	
Reference	CXup_1-phc-0417	
Inspector	NP	

Test	**Behaviour / results**			DuT
operating with disconnected battery	DuT didn't suffer any damage			1
	V load = 0,08 V	p	Passed/failed	
removing battery during normal operation	DuT didn't suffer any damage			1
		p	Passed/failed	

Remarks		
Used measurement equipment:	Vbat:	Zimmer LMG95
	Ibat:	Zimmer LMG95
	Vpv:	Zimmer LMG95
	Ipv:	Zimmer LMG95
	Vload:	Zimmer LMG95
	Iload:	Zimmer LMG95
	Ta:	Maxim DS18S20

IEC 62 509 requirements?	x	p		f
If failed, reason?				

5 User Interface Tests

5.1 Display

Ambient temperature	25,3
Rated voltage	12 V

DuT	1	
Reference	CXup_1-phc-0417	
Inspector	NP	

		DuT
charging indication	yes	1
battery charged indication (charge status)	yes	1
load cut off warning	yes /Buzzer	1
battery discharged indication (load disconnection)	yes / pictogram	1

Remarks:		
Used measurement equipment:	Vbat:	Zimmer LMG95
	Ibat:	Zimmer LMG95
	Vpv:	Zimmer LMG95
	Ipv:	Zimmer LMG95
	Vload:	Zimmer LMG95
	Iload:	Zimmer LMG95
	Ta:	Maxim DS18S20

IEC 62 509 requirements?	x	p		f
If failed, reason?				

Overview of measurement equipment used (following DIN ISO 9001:2000)

device	type	measured dimensions	reference number following DIN EN ISO 9001:2000
HP 34401A	Precision system-multimeter	voltages, currents up to 3 A	421-DC-10 421-DC- 11
Zimmer LMG 95	Precision-wattmeter	voltages, currents up to 40 A, power	421-DC-16 421-DC-25 421-LI-5
Temperature sensors	Maxim DS18S20 in combination with Arduino Mega datalogging	temperatures	
Agilent DSO-X 3014A	4-channel-digital oszilloscope	control of PWM behaviour	
Fluke 87	multimeter	voltage, current, resistor	421-DC-17 / 421-DC-18

Zertifikat DE07/3874

Das Management-System vom

Fraunhofer-Institut für Solare Energiesysteme ISE

Heidenhofstraße 2
D-79110 Freiburg

wurde auditiert und hat den Nachweis erbracht, dass die Anforderungen folgender Norm erfüllt werden

ISO 9001:2008

Die Zertifizierung umfasst

Forschung, Entwicklung und Dienstleistungen auf den Gebieten thermische und elektrische Solarenergienutzung, Gebäudetechnik und Wasserstofftechnologie

Dieses Zertifikat ist gültig vom 30/04/2016 bis 14/09/2018
Ausgabe 6. Zertifiziert seit März 2001

Freigegeben durch

Jan Meemken
Geschäftsführer

Christian Rathje
Leiter der Zertifizierungsstelle

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