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ISE

Certificate
No. 0515 / FhG-ISE / 001

Manufacturer: phocos China Ltd.
Charge regulator type: CMLsolid 30

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 (CMLsolid 30) that are laid down in the measurement protocol (test report) dated 02.04.2015 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 CMLsolid 30 charge controllers may require a repetition of some or all qualification tests to maintain type approval.

Freiburg,
May 27th, 2015

Fraunhofer-Institut für
Solare Energiesysteme ISE
Heidenhofstraße 2
79110 Freiburg
this PDF-Document
is identical to the
original document

Dipl. Ing. (FH) Norbert Pfanner
Head of Laboratory

Confirmed

Dipl. Ing. (FH) Friedemar Schreiber
Head of Testing Team

Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V., München
Vorstand
Prof. Dr.-Ing. habil. Prof. E.h. Dr.-Ing. E.h. mult. Dr. h.c. Reimund Neugebauer, Präsident
Prof. Dr. rer. nat. Ulrich Buller
Prof. (Univ. Stellenbosch) Dr. rer. pol. Alfred Gossner
Dr. rer. publ. Alexander Kurz

Fraunhofer ISE

Test and Measurement Protocol
- Charge Controllers -

Tests according to IEC 65 209:2010

Model/Type
Phocos CMLsolid30

DuT	Serial Number	Reference number	Date	Update
1	140225 0331	CML301-phc-1503	02.04.2015	
2	140225 0334	CML302-phc-1503		

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Overview Evaluation / Summary, page 1/2

DuT: Phocos CMLsolid30
Ref. nr.: CML301-phc-1503

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

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	---	167,7 µA	✓	@ 12.6 V; R_{PVLoop} = 48 Ohm
✓			end of charge voltage boost mode	**14.4 V**	± 1 %	14,42 V	✓	values are within ± 1 % of manufact. statement
✓			end of charge voltage overcharge / equalization mode	**14.7 V – 15.3 V**	± 1 %	14,84 V	✓	values are within ± 1 % of manufact. statement
✓			end of charge voltage floating mode	**14.1 V**	± 1 %	13,86 V	✓	values are within ± 1 % of manufact. statement
✓			low voltage disconnect @ 0.1 x I_{10}	**11.7 V – 12.0 V**	± 2 %	11,00 V	✓	values are within ± 2 % of manufact. statement
✓			temperature compensation HVD	**- 5 mV/cell/°C**	n. d.	-3,8 to -4,3 mV/cll/°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.	4,5 mA	✓	max. self consumption
✓			charge efficiency	n. d.	n. d.	98,1 %	✓	at max. current
✓			discharge efficiency	n. d.	n. d.	98,1 %	✓	at max. current
			charging technology	PWM				For information only

[1] Values in **bold** are recommended values according to IEC 62 509

➔ next page

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.	✓	Load voltage 0 V @ removed battery
✓			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	---	37,5 A	✓	
✓			Load overcurrent protection test	1.25 x I_N @ 25 °C	---	37.5 A	✓	
✓			Thermal performance test	I_{PVmax} and $I_{Loadmax}$ @T_{max} for 1 h	---	o.k.	✓	test with max. currents at 50 °C ambient temperature for 1 hour
			User Interface Tests					
✓			display (charging, batt. charged, discharged)	charging	n. d.	available	✓	Signalled by LED
✓				batt. charged	n. d.	available	✓	Signalled by LEDs
✓				discharg. batt.	n. d.	available	✓	Signalled by LED
✓			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	CMLsolid30	
Serial / Batch Nr.	1	140225 0331
	2	140225 0334

Mechanical data

Dimensions (l * w * h) [mm]	40*140*90
Weight [g]	420
Case material	metall
Protection class (IP)	20
Case mounting	screws
Connection type	screws
Cable stress relief	n.a.
Cable diameter [mm²]	16
Label	yes

Electrical data

At ambient temperature of [°C]	25 °C						
Rated voltage		12V		24V	x	12 & 24V	
Automatic adjustment 12/24V	x	yes				no	
Max. module power [W]	---						
Max. charge current [A]	30 @ 45 °C						
Max. discharge current [A]	30 @ 45 °C						
Type of controller		shunt	x	serial		other:	
Technique of regulation		two point	x	PWM		other:	
Self consumption [mA]	10						
End of charge voltage [V]	13.8 / 27,6 (float voltage)						
return switch-on voltage (two point regulation) [V]	--						
load disconnect warning on [% SOC]	--						
load disconnect voltage [V]	11.0 / 22.0						
time delay at load sheding [s]	no information						
Reconnection voltage load [V]	12.8 / 25.6						
time delay at reconnection [s]	no information						
load reconnection manually [V]	no						
operation temperature range [°C]	-40 up to +50						
display	x	LED		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) 2 h				
Temperature compensation	x	yes			no
temperature compensation [mV/K*cell]	4,2				
Battery voltage sensor		yes		x	no
DC/DC-Converter		yes		x	no
MPPT		yes		x	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	USB-Charger				
	Remote Terminal for inverter				
	DIP switches for Alarm, LVD and Battery type				

[1)] Electronic protection

listed values rated for x 12V x 24V

Others

Interfaces	yes
Price	not available
Service	only manufacturer website
Warranty	no information

1 Pretests

1.2 Visual Inspection

Connection type		plug	x	screw		other: cables			
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	x	very good		good		bad			
Connector quality		very good	x	good		bad			
Electronic quality	x	very good		good		bad			
Packing of charge controller		very good	x	good		bad			
Lettering of packing	x	very good		good		bad			
Fuse changing		very good		good		bad	x	n.a. [1]	
Mounting of charge contr.		very good	x	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, spainish, portugese, chineese)					
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	25,5 °C
Rated voltage	12,0 V

DuT	1	
Reference	CML301-phc-1503	
Inspector	bg	

Test	**Behaviour / results** p/f	remarks	DuT 1	
	Revers current [µA]			
Protection against night discharge of the battery (leakage current)	167,7	p	Vbatt: 12.6 V PV loop resistor: 48 Ohm	

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	25,0 °C
Rated voltage	12,0 V

DuT	1	
Reference	CML301-phc-1503	
Inspector	bg	

Voltage thresholds	Specification (manufacturer) [V]	Measured [V] DuT 1		DuT 2		p / f	Remarks
		PWM start	Cut-off				
End of charge voltage (floating)	13,8	13,71	13,86			p	
final voltage equalisation (gassing)	14,8	14,71	14,84			p	Only if flooded battery is selected.
final voltage boost	14,4	14,31	14,42			p	
Load disconnect warning on							
Deep discharging cut-off voltage	11,0		11,00			p	Alarm before Cut-Off
Reconnect voltage load	12,8		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	V

DuT	1	
Reference	CML301-phc-1503	
Inspector	bg	

Voltage thresholds	ambient temperature [°C]				temp. comp [mV/K] / cell	DuT
	@ 25,0 °C		@ Temp. °C			1
End of charge voltage (float) [V] 1)2)	13,71	13,36	39,5		-4,0	1
	13,86	13,50	39,5		-4,1	1
Equalization voltage [V] 1)2)	14,71	14,36	39,5		-4,0	1
	14,84	14,51	39,5		-3,8	1
Boost voltage [V] 1)2)	14,31	13,94	39,5		-4,3	1
	14,42	14,07	39,5		-4,0	1
Deep discharging cut-off voltage [V]	11,10	11,06	39,5	stable		1
						1
Reconnect voltage load [V]	12,78	12,72	39,5	stable		1

1) PWM start
2) cut off

Remarks	Equalization charge only in flooded battery mode.	
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

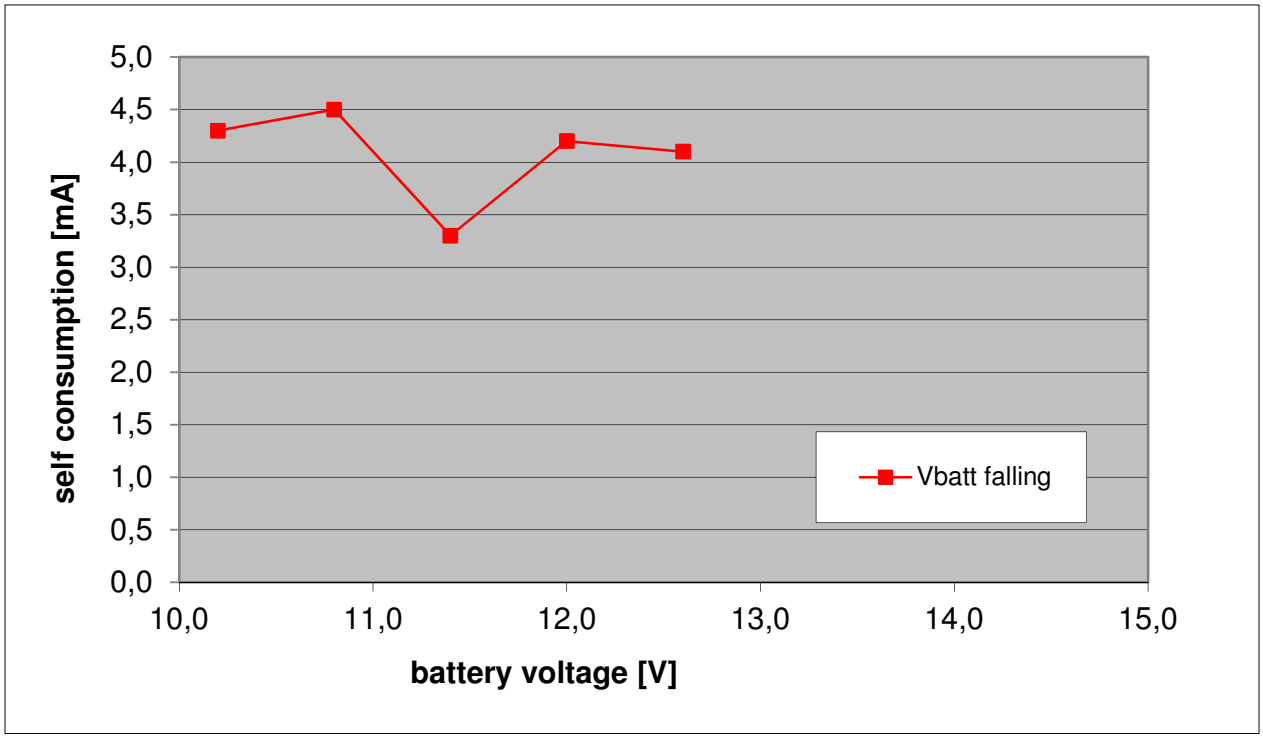
IEC 62 509 requirements?	x	passed		failed
If failed, reason?				

3 Energy Performance

3.1 Self Consumption Tests

Ambient temperature	25,5	°C
Rated voltage	12,0	V

DuT	1	
Reference	CML301-phc-1503	
Inspector	bg	



					DuT
max. selfconsumption	4,5	mA @	10,8	V	1
average selfconsumption	4,1	mA @	12.6 - 10.2	V	1

Comment		
Used measurement equipment	Ibat:	HP 34401A
	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	4,1	51,7	1	3 State of charge Leds On
2	12,0	4,2	50,4	1	1 State of charge Led On
3	11,4	3,3	37,6	1	1 State of charge Led flashing
4	10,8	4,5	48,6	1	Load status Led On
5	10,2	4,3	43,9	1	Load status Led On
6					

3 Energy Performance

3.2 Efficiency Tests

Ambient temperature:	27,0	°C
Rated voltage:	12,0	V
Rated max. charge current:	30,0	A
Rated max. discharge current:	30,0	A

DuT	1	
Reference	CML301-phc-1503	
Inspector:	bg	

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]	
13,23	3,15	41,67	13,20	3,06	40,39	96,9	0,03	1
13,25	6,17	81,75	13,20	6,09	80,39	98,3	0,05	1
13,27	9,19	121,95	13,20	9,11	120,25	98,6	0,07	1
13,29	12,23	162,54	13,20	12,15	160,38	98,7	0,09	1
13,32	15,25	203,13	13,20	15,19	200,51	98,7	0,12	1
13,34	18,28	243,86	13,20	18,23	240,64	98,7	0,14	1
13,36	21,31	284,70	13,20	21,26	280,63	98,6	0,16	1
13,39	24,34	325,91	13,20	24,30	320,76	98,4	0,19	1
13,42	27,36	367,17	13,20	27,33	360,76	98,3	0,22	1
13,44	30,38	408,31	13,20	30,36	400,75	98,1	0,24	1

3.2.2 Discharging efficiency @ 100 % rated load current

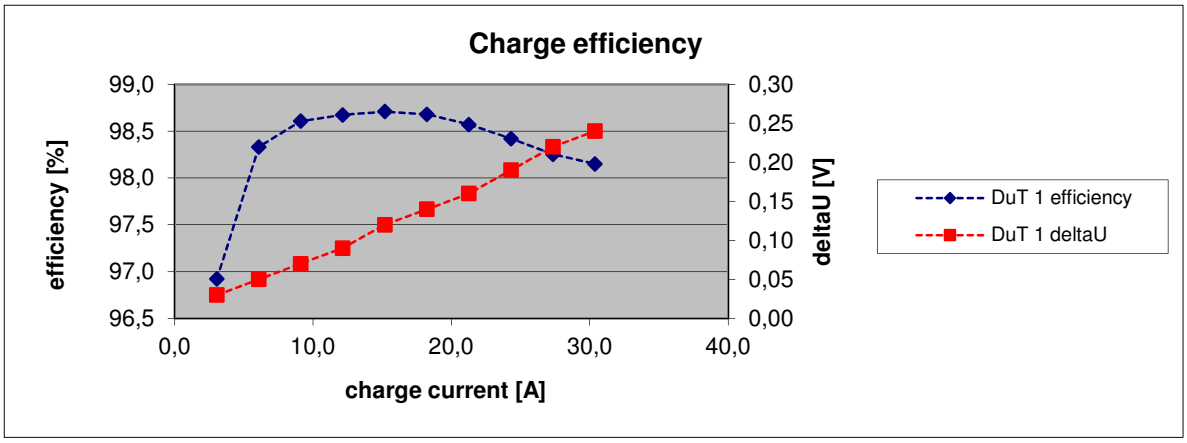
Battery			Load			efficiency	Vbat-Vload	DuT
[V]	[A]	[W]	[V]	[A]	[W]	[%]	[V]	
12,60	30,23	380,90	12,45	30,00	373,50	98,1	0,15	1
13,20	30,16	398,11	13,05	29,95	390,85	98,2	0,15	1

min. discharge efficiency [%]: 98,1

Remarks:	very high efficiencies	
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:	30 A
Rated max. discharge current:	30 A

DuT	1	
Reference	CML301-phc-1503	
Inspector:	bg	

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]		
0	12,77	30,00	12,53	0,00	12,39	30,00	52,0	50,0	1	
5	12,78	30,00	12,54	0,00	12,39	30,00	55,5	50,0	1	
10	12,78	30,00	12,54	0,00	12,39	30,00	56,0	50,0	1	
15	12,78	30,00	12,54	0,00	12,39	30,00	56,0	50,0	1	
20	12,78	30,00	12,54	0,00	12,39	30,00	56,0	50,0	1	
25	12,78	30,00	12,54	0,00	12,39	30,00	56,0	49,5	1	
30	12,78	30,00	12,54	0,00	12,39	30,00	56,0	50,0	1	
35	12,78	30,00	12,54	0,00	12,39	30,00	56,0	49,5	1	
40	12,78	30,00	12,54	0,00	12,39	30,00	56,0	49,5	1	
45	12,78	30,00	12,54	0,00	12,39	30,00	56,0	49,5	1	
50	12,78	30,00	12,54	0,00	12,39	30,00	56,0	50,0	1	
55	12,78	30,00	12,54	0,00	12,39	30,00	56,0	49,5	1	
60	12,78	30,00	12,54	0,00	12,39	30,00	56,0	50,0	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
	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	30,0 A
Rated max. discharge curre	30,0 A

DuT	1	
Reference	CML301-phc-1503	
Inspector:	bg	

4.2.1 PV overcurrent protection test

time	PV-module		Battery		Remark	$T_{heatsink}$	$T_{ambient}$	DuT
[min]	[V]	[A]	[V]	[A]		[°C]	[°C]	
0	13,50	37,65	13,20	37,58		27,5	26,0	1
15	13,51	37,62	13,20	37,57		33,5	27,0	1
30	13,52	37,63	13,21	37,57		34,0	28,0	1
45	13,52	37,63	13,21	37,56		34,5	28,0	1
60	13,52	37,64	13,21	37,56		34,5	28,0	1

4.2.2 Load overcurrent protection test

time	Remark	Battery		Load		$T_{heatsink}$	$T_{ambient}$	DuT
[min]		[V]	[A]	[V]	[A]	[°C]	[°C]	
0		12,00	37,76	11,81	37,51	28,0	27,0	1
15		12,01	37,75	11,81	37,50	31,5	29,5	1
30		12,00	37,76	11,81	37,50	32,5	29,5	1
45		12,00	37,76	11,80	37,50	38,0	30,0	1
60		12,00	37,76	11,80	37,50	41,0	31,0	1

Used measurement equipm	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	25,5	°C
Rated voltage	12,0	V

DuT	1	
Reference	CML301-phc-1503	
Inspector	bg	

Test	**Behaviour / results** DuT 1	p/f	remarks	
Protection against short circuited PV[1)]	test ok	p		
Protection against reversed polarity PV Module	test ok	p		
Protection against short circuited load[1)]	test ok	p		
Operation with reversed polarity battery	test ok	p	Load status Led indicates the reverse battery voltage.The reverse voltage was fed to the load. The charge controller didn't suffer any damage. According to the manual there is a warning to reverse the polarity.	

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, short circuited load, overload and reversed	
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	27,0	°C
Rated voltage	12,0	V

DuT	1	
Reference	CML301-phc-1503	
Inspector	bg	

Test	**Behaviour / results**			DuT
operating with disconnected battery	Load will be switched off;			1
	V load = 0,0 V	p	Passed/failed	
removing battery during normal operation				1
	V load = 0,0 V	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	
Rated voltage	

DuT	1	
Reference	CML301-phc-1503	
Inspector	bg	

		DuT
charging indication	yes, 1 green LED	1
battery charged indication (charge status)	yes, 3 Leds	1
load cut off warning	yes, acoustic signal	1
battery discharged indication (load disconnection)	yes, 1 red LED on	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	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
DE-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

Weitere Einzelheiten zum Geltungsbereich dieses Zertifikats und der Anwendbarkeit der Anforderungen der Norm ISO 9001:2008 können bei der Organisation erfragt werden

Dieses Zertifikat ist gültig vom 30/04/2013 bis 29/04/2016
Ausgabe 5. Zertifiziert seit März 2001

Freigegeben durch

Mark Piekereit
Geschäftsführer

Christian Rathje
Leiter der Zertifizierungsstelle

TGA-ZM-17-93-00

SGS-International Certification Services GmbH
Rödingsmarkt 16 D-20459 Hamburg (Germany)
t +49 (0)40 30.101.361 f +49 (0)40 33.04.08 www.de.sgs.com

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