

## Certificate No. 0615 / FhG-ISE / 001

**Manufacturer: phocos China Ltd.**

**Charge regulator type family: CMLup20 and CML10**

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 (CMLup 20) that are laid down in the measurement protocol (test report) dated 28.04.2015 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 CMLup 20 charge controllers may require a repetition of some or all qualification tests to maintain type approval.

Freiburg,  
June 30<sup>th</sup>, 2015

Fraunhofer-Institut für  
Solare Energiesysteme ISE  
Heidenhofstraße 2  
79110 Freiburg

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Confirmed



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



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

## **Test and Measurement Protocol - Charge Controllers -**

Tests according to IEC 65 209:2010



Model/Type Phocos CMLup20
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DuT	Serial Number	Reference number	Date	Update
1	140512 0599	CML201-phc-2704		
2	140512 0600	CML202-phc-2704	28.04.2015	



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**Overview Evaluation / Summary, page 1/2**

**DuT:** Phocos CMLup20  
**Ref. nr.:** CML201-phc-2704

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

**General remarks, recommendations**

The charge controller family CMLup of phocos AG are professional manufactured charge controllers. The performance in all areas (efficiency, protection features, self-consumption etc.) is very high. The voltage thresholds are well adjusted and the displayed information via LEDs is suitable for the user. The charge controllers are protected against short circuit and reversed polarity PV module, short circuited and overload and reversed polarity battery using a reliable electronic fuse.

tested?	not tested (see comment)	IEC 62 509 requirements	value / claim <sup>1)</sup>	tolerance	measured value / result	requirements fulfilled?	comments
<b>Battery Lifetime Protection Tests</b>							
<input checked="" type="checkbox"/>	<input type="checkbox"/>	PV leakage current test	$\leq 0.1 \% I_N$	---	168,6 $\mu\text{A}$	<input checked="" type="checkbox"/>	@ 12.6 V; $R_{\text{PVLoop}} = 75 \text{ Ohm}$
<input type="checkbox"/>	<input type="checkbox"/>						
<input type="checkbox"/>	<input type="checkbox"/>						
<input type="checkbox"/>	<input type="checkbox"/>						
<input type="checkbox"/>	<input type="checkbox"/>						
<input checked="" type="checkbox"/>	<input type="checkbox"/>	end of charge voltage boost mode	<b>14.4 V</b>	$\pm 1 \%$	14,47 V	<input checked="" type="checkbox"/>	values are within $\pm 1 \%$ of manufact. statement
<input checked="" type="checkbox"/>	<input type="checkbox"/>	end of charge voltage overcharge / equalization mode	<b>14.7 V – 15.3 V</b>	$\pm 1 \%$	14,86 V	<input checked="" type="checkbox"/>	values are within $\pm 1 \%$ of manufact. statement
<input checked="" type="checkbox"/>	<input type="checkbox"/>	end of charge voltage floating mode	<b>14.1 V</b>	$\pm 1 \%$	13,84 V	<input checked="" type="checkbox"/>	values are within $\pm 1 \%$ of manufact. statement
<input checked="" type="checkbox"/>	<input type="checkbox"/>	low voltage disconnect @ $0.1 \times I_{10}$	<b>11.7 V – 12.0 V</b>	$\pm 2 \%$	11,11 V	<input checked="" type="checkbox"/>	values are within $\pm 2 \%$ of manufact. statement
<input checked="" type="checkbox"/>	<input type="checkbox"/>	temperature compensation HVD	<b>- 5 mV/cell/°C</b>	n. d.	-3,3 to -4,5 mV/cell/°C	<input checked="" type="checkbox"/>	From ISE perspective a range of -3 to -6 mV/cell/°C is o.k.!
<b>Energy Performance Tests</b>							
<input checked="" type="checkbox"/>	<input type="checkbox"/>	self-consumption (including lights / LCD)	$0.1 \% I_N$	n. d.	3,36 mA	<input checked="" type="checkbox"/>	max. self consumption
<input checked="" type="checkbox"/>	<input type="checkbox"/>	charge efficiency	n. d.	n. d.	98,8 %	<input checked="" type="checkbox"/>	at max. current
<input checked="" type="checkbox"/>	<input type="checkbox"/>	discharge efficiency	n. d.	n. d.	98,5 %	<input checked="" type="checkbox"/>	at max. current
<input type="checkbox"/>	<input type="checkbox"/>						
<input type="checkbox"/>	<input type="checkbox"/>						
<input type="checkbox"/>	<input type="checkbox"/>						
<input type="checkbox"/>	<input type="checkbox"/>	charging technology	PWM				For information only

<sup>1)</sup> Values in **bold** are recommended values according to IEC 62 509

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**Overview Evaluation / Summary, page 2/2**

tested?	not tested (see comment)	IEC 62 509 requirements	Value / claim	tolerance	measured value / result	requirements fulfilled?	comments
<b>Protection and Fail Safe Tests</b>							
<input checked="" type="checkbox"/>	<input type="checkbox"/>	protection against wrong polarity battery	compulsory	---	o.k.	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	battery open circuit test	compulsory	---	o.k.	<input checked="" type="checkbox"/>	Load voltage 0 V @ removed battery
<input checked="" type="checkbox"/>	<input type="checkbox"/>	protection against wrong polarity module	compulsory	---	o.k.	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	protection against shorted load	compulsory	---	o.k.	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	PV overcurrent protection test	$1.25 \times I_N$ @ 25 °C	---	25 A	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Load overcurrent protection test	$1.25 \times I_N$ @ 25 °C	---	25 A	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Thermal performance test	$I_{PVmax}$ and $I_{Loadmax} @ T_{max}$ for 1 h	---	o.k.	<input checked="" type="checkbox"/>	test with max. currents at 45 °C ambient temperature for 1 hour
<b>User Interface Tests</b>							
<input checked="" type="checkbox"/>	<input type="checkbox"/>	display (charging, batt. charged, discharged)	charging	n. d.	available	<input checked="" type="checkbox"/>	Signalled by LED
<input checked="" type="checkbox"/>	<input type="checkbox"/>		batt. charged	n. d.	available	<input checked="" type="checkbox"/>	Signalled by LEDs
<input checked="" type="checkbox"/>	<input type="checkbox"/>		discharg. batt.	n. d.	available	<input checked="" type="checkbox"/>	Signalled by LED
<input checked="" type="checkbox"/>	<input type="checkbox"/>	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.	<input checked="" type="checkbox"/>	The availability of lettering/Labelling is not postulated by IEC 62 509. From Fraunhofer ISE perspective a labelling should be available. Visual test
<input checked="" type="checkbox"/>	<input type="checkbox"/>	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.	<input checked="" type="checkbox"/>	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	CMLup20		
Serial / Batch Nr.	1	140512 0599	
	2	140512 0600	

#### Mechanical data

Dimensions (l * w * h) [mm]	28*100*100		
Weight [g]	420		
Case material	plastic		
Protection class (IP)	20		
Case mounting	screws		
Connection type	screws		
Cable stress relief	n.a.		
Cable diameter [mm <sup>2</sup> ]	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]	20 @ 45 °C		
Max. discharge current [A]	20 @ 45 °C		
Type of controller	shunt	x serial	other:
Technique of regulation	two point	x PWM	other:
Self consumption [mA]	< 5 mA		
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 shedding [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	<input checked="" type="checkbox"/>	yes	<input type="checkbox"/>	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	<input checked="" type="checkbox"/>	yes	<input type="checkbox"/>	no
temperature compensation [mV/K*cell]	4,2			
Battery voltage sensor		yes	<input checked="" type="checkbox"/>	no
DC/DC-Converter		yes	<input checked="" type="checkbox"/>	no
MPPT		yes	<input checked="" type="checkbox"/>	no
adjustable for different battery types	<input checked="" type="checkbox"/>	yes		no
adjustable thresholds		yes	<input checked="" type="checkbox"/>	no
end of charge [V]		min.		max.
load disconnect [V]		min.		max.
selectable priority at load disconnection		yes	<input checked="" type="checkbox"/>	no
Protection against reversed battery polarity	<input checked="" type="checkbox"/>	yes <sup>1)</sup>	<input type="checkbox"/>	no
Protection against reversed PV polarity	<input checked="" type="checkbox"/>	yes <sup>1)</sup>	<input type="checkbox"/>	no
Others	USB-Charger			
	Jumpers for Alarm, LVD and Battery type			

<sup>1)</sup> Electronic protection

listed values rated for

12V

24V

### Others

Interfaces	<input type="checkbox"/>	no
Price	<input type="checkbox"/>	not available
Service	<input type="checkbox"/>	only manufacturer website
Warranty	<input type="checkbox"/>	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 [mm <sup>2</sup> ]	2,5		4		6	x	16
Cable diameter solid [mm <sup>2</sup> ]	2,5		4		6	x	16
Case quality	very good	x	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. <sup>1)</sup>
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. <sup>1)</sup>
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, chineese)					
Comment documentation				o.k.			

#### Spare parts

Fuse		availabe	x	not available <sup>1)</sup>		
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				

<sup>1)</sup> Electronic protection

Is it possible to test the charge controller?

IEC 62 509 requirements fulfilled?

If failed, reason?

x	yes		no
x	passed		failed
-----			

## 2 Battery Lifetime Protection Tests

### 2.1 Leakage Current

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

DuT	1	
Reference	CML201-phc-2704	
Inspector	bg	

Test	Behaviour / results			
	Revers current [µA]			
Protection against night discharge of the battery (leakage current)	168,6	p	Vbatt: 12.6 V PV loop resistor: 75 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?

If failed, reason?

x	passed		failed

## 2 Battery Lifetime Protection Tests

### 2.2 Set-points

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

DuT	1	
Reference	CML201-phc-2704	
Inspector	bg	

Voltage thresholds	Specification (manufacturer) [V]	Measured [V]		p / f	Remarks
		DuT 1	DuT 2		
		PWM start	Cut-off		
End of charge voltage (floating)	13,8	13,72	13,84	p	
final voltage equalisation (gassing)	14,8	14,72	14,86	p	Only if flooded battery is selected.
final voltage boost	14,4	14,37	14,47	p	
		LVD	LVR		
Deep discharging cut-off voltage	11,0	11,11		p	Alarm before Cut-Off
Reconnect voltage load	12,8		12,83	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?

If failed, reason?

x	passed		failed

## 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	CML201-phc-2704	
Inspector	bg	

Voltage thresholds	ambient temperature [°C]			temp. comp [mV/K] / cell	DuT
	@ 25,0 °C		@ Temp. °C		
End of charge voltage (float) [V] <sup>1)</sup> <sup>2)</sup>	13,72	13,37	39,5	-4,0	1
	13,84	13,53	39,5	-3,6	1
Equalization voltage [V] <sup>1)</sup> <sup>2)</sup>	14,72	14,43	39,5	-3,3	1
	14,86	14,54	39,5	-3,7	1
Boost voltage [V] <sup>1)</sup> <sup>2)</sup>	14,37	13,98	39,5	-4,5	1
	14,47	14,08	39,5	-4,5	1
Deep discharging cut-off voltage [V]	11,11	11,11	39,5	stable	1
Reconnect voltage load [V]	12,83	12,82	39,5	stable	1

<sup>1)</sup> PWM start<sup>2)</sup> 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

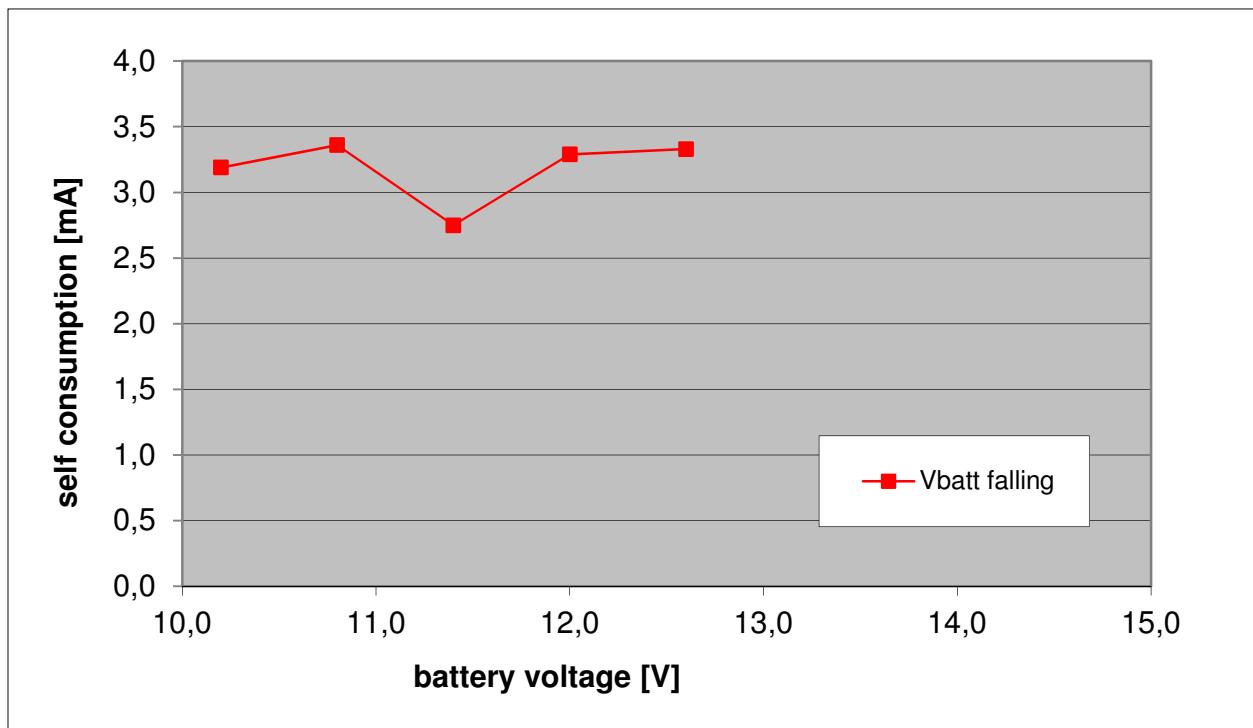
IEC 62 509 requirements?  passed  failed  
 If failed, reason?

### 3 Energy Performance Tests

#### 3.1 Self Consumption Tests

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

DuT	1	
Reference	CML201-phc-2704	
Inspector	bg	



	DuT		
max. selfconsumption	3,36	mA @	10,8 V
average selfconsumption	3,18	mA @	12,6 - 10,2 V

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	3,33	42,0	1	3 State of charge Leds On
2	12,0	3,29	39,5	1	1 State of charge Led On
3	11,4	2,75	31,4	1	1 State of charge Led flashing
4	10,8	3,36	36,3	1	Load status Led On
5	10,2	3,19	32,5	1	Load status Led On

### 3 Energy Performance Tests

#### 3.2 Efficiency Tests

Ambient temperature:	25,5	°C
Rated voltage:	12,0	V
Rated max. charge current:	20,0	A
Rated max. discharge current:	20,0	A

DuT	1	
Reference	CML201-phc-2704	
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]	
13,21	2,1	27,2	13,20	2,0	26,4	97,0	0,01	1
13,22	4,1	53,8	13,20	4,0	52,9	98,4	0,02	1
13,24	6,1	80,6	13,20	6,0	79,7	98,9	0,04	1
13,25	8,1	107,2	13,20	8,1	106,3	99,1	0,05	1
13,27	10,1	134,2	13,20	10,1	132,9	99,1	0,07	1
13,28	12,0	159,8	13,20	12,0	158,3	99,1	0,08	1
13,30	14,1	186,9	13,20	14,0	185,1	99,0	0,10	1
13,32	16,1	214,2	13,20	16,1	211,9	98,9	0,12	1
13,33	18,1	241,1	13,20	18,1	238,5	98,9	0,13	1
13,35	20,1	268,6	13,20	20,1	265,3	98,8	0,15	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	20,2	254,0	12,48	20,0	250,0	98,4	0,12	1
13,20	20,1	265,8	13,09	20,0	261,9	98,5	0,11	1

min. discharge efficiency [%]: 98,4

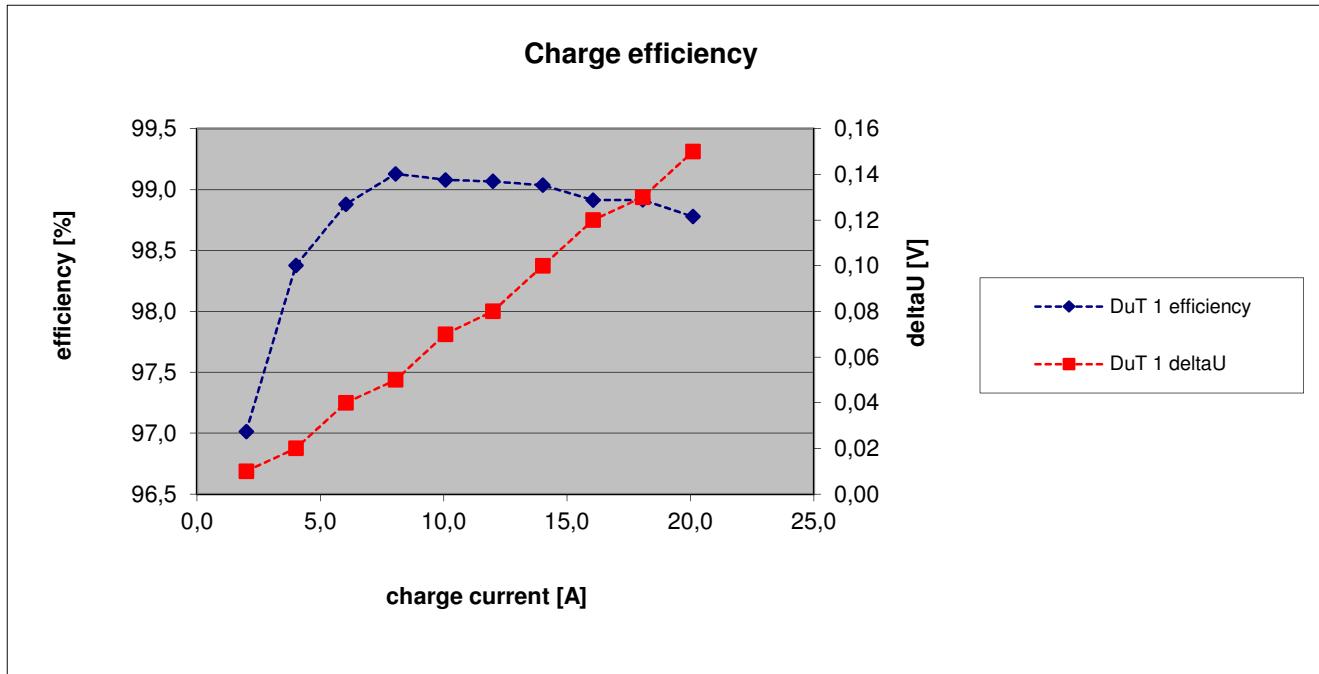
Remarks:	very high efficiencies
Used measurement equipment:	Vbat: Zimmer LMG 95
	Ibat: Zimmer LMG 95
	Vpv: Zimmer LMG 95
	Ipv: Zimmer LMG 95
	Vload: Zimmer LMG 95
	Iload: Zimmer LMG 95
	Ta: Maxim DS18S20

IEC 62 509 requirements?

If failed, reason?

x	p		f

## 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	CML201-phc-2704	
Inspector:	bg	

#### Test at extented ambient temperature

time [min]	PV-module		Battery		Load		T <sub>heatsink</sub>	T <sub>ambient</sub>	DuT	Comment
	[V]	[A]	[V]	[A]	[V]	[A]	[°C]	[°C]		
0	12,88	20,0	12,75	0,0	12,65	20,0	45,0	44,5	1	
5	12,89	20,1	12,75	0,0	12,66	20,0	46,0	44,5	1	
10	12,90	20,2	12,76	0,0	12,66	20,0	46,0	44,0	1	
15	12,90	20,2	12,76	0,0	12,66	20,0	46,5	44,5	1	
20	12,90	20,2	12,76	0,0	12,66	20,0	47,0	45,0	1	
25	12,90	20,2	12,76	0,0	12,66	20,0	46,5	44,5	1	
30	12,90	20,2	12,76	0,0	12,66	20,0	47,5	45,5	1	
35	12,90	20,2	12,76	0,0	12,66	20,0	47,0	45,0	1	
40	12,90	20,2	12,76	0,0	12,66	20,0	47,5	45,5	1	
45	12,90	20,2	12,76	0,0	12,66	20,0	47,0	45,0	1	
50	12,90	20,2	12,76	0,0	12,66	20,0	47,0	45,0	1	
55	12,90	20,2	12,76	0,0	12,66	20,0	47,0	45,0	1	
60	12,90	20,2	12,76	0,0	12,66	20,0	47,0	45,0	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?

If failed, reason?

x	p		f

## 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	CML201-phc-2704	
Inspector:	bg	

#### 4.2.1 PV overcurrent protection test

time	PV-module		Battery		Remark		T <sub>heatsink</sub>	T <sub>ambient</sub>	DuT
[min]	[V]	[A]	[V]	[A]			[°C]	[°C]	
0	13,40	25,1	13,20	25,1			28,0	28,0	1
15	13,41	25,0	13,20	25,0			29,0	26,5	1
30	13,41	25,1	13,20	25,0			33,5	27,0	1
45	13,41	25,1	13,20	25,0			34,0	27,0	1
60	13,41	25,0	13,20	25,0			34,5	28,0	1

#### 4.2.2 Load overcurrent protection test

time	Remark		Battery		Load		T <sub>heatsink</sub>	T <sub>ambient</sub>	DuT
[min]			[V]	[A]	[V]	[A]	[°C]	[°C]	
0			12,00	25,2	11,86	25,2	25,5	25,0	1
15			12,00	25,2	11,85	25,2	27,0	26,0	1
30			12,00	25,2	11,85	25,1	28,0	27,0	1
45			12,00	25,2	11,85	25,1	28,5	27,5	1
60			12,00	25,2	11,85	25,1	29,5	28,5	1

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?

If failed, reason?

x	passed	failed

## 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	CML201-phc-2704	
Inspector	bg	

Test	Behaviour / results		
	DuT 1	p/f	remarks
Protection against short circuited PV <sup>1)</sup>	test ok	p	Voc = 17 V Ipv = 2 A
Protection against reversed polarity PV Module	test ok	p	
Protection against short circuited load <sup>1)</sup>	test ok	p	Iload = 2 A
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

<sup>1)</sup> 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 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	27,0	°C
Rated voltage	12,0	V

DuT	1	
Reference	CML201-phc-2704	
Inspector	bg	

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

## 5 User Interface Tests

### 5.1 Display

Ambient temperature	
Rated voltage	

DuT	1	
Reference	CML201-phc-2704	
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	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

**SGS**

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

Mark Piekerit  
Geschäftsführer

Freigegeben durch  
Christian Rathje  
Leiter der Zertifizierungsstelle

Deutscher  
Akreditierungs  
Rat  
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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**SGSSGSGS** A decorative graphic consisting of several stylized birds in flight, rendered in various colors like blue, red, orange, and grey.

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