

## Certificate

### No. 0815 / FhG-ISE / 001

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**Manufacturer: phocos China Ltd.**  
**Charge regulator type: CMLmppt 10**

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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 (CMLmppt 10) that are laid down in the measurement protocol (test report) dated 10.08.2015 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 CMLmppt 10 charge controllers may require a repetition of some or all qualification tests to maintain type approval.

Freiburg,  
August 10<sup>th</sup>, 2015

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*This PDF-document  
is identical to the  
original document*



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## Test and Measurement Protocol - Charge Controllers -

Tests according to IEC 65 209:2010



Model/Type Phocos CMLmppt
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DuT	Serial Number	Reference number	Date	Update
1	150429 0015	CMLMP1-phc-2007	10.08.2015	
2	150429 0013	CMLMP2-phc-2007		



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## Overview Evaluation / Summary, page 1/2

**DuT:** Phocos CMLmppt  
**Ref. nr.:** CMLMP1-phc-2007

**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)		value / claim <sup>1)</sup>	tolerance	measured value / result	requirements fulfilled?	comments	
		IEC 62 509 requirements						
<b>Battery Lifetime Protection Tests</b>								
<input checked="" type="checkbox"/>	<input type="checkbox"/>	PV leakage current test	$\leq 0.1 \% I_N$	---	171 $\mu$ A	<input checked="" type="checkbox"/>	@ 12.6 V; $R_{PVLOOP} = 150 \text{ Ohm}$	
<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>	$\pm 1 \%$	14,36 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>14.8 V</b>	$\pm 1 \%$	14,78 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>13.8 V</b>	$\pm 1 \%$	13,50 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>11.0 V</b>	$\pm 2 \%$	11.04 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.	3,7 to 4,2 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.	7,3 mA	<input checked="" type="checkbox"/>	max. self consumption	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	charge efficiency	n. d.	n. d.	97,2 %	<input checked="" type="checkbox"/>	at max. current	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	discharge efficiency	n. d.	n. d.	99,2 %	<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	MPPT				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)		Value / claim	tolerance	measured value / result	requirements fulfilled?	comments
		IEC 62 509 requirements					
<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	---	o.k.	<input checked="" type="checkbox"/>	MPPT Power limitation
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Load overcurrent protection test	$1.25 \times I_N$ @ 25 °C	---	12,5 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	CMLmppt	
Serial / Batch Nr.	1	150429 0015
	2	150429 0013

### Mechanical data

Dimensions (l * w * h) [mm]	38*127*126
Weight [g]	260
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	<input type="checkbox"/>	12V	<input type="checkbox"/>	24V	<input checked="" type="checkbox"/>	12 & 24V
Automatic adjustment 12/24V	<input checked="" type="checkbox"/>	yes	<input type="checkbox"/>		<input type="checkbox"/>	no
Max. module power [W]	---					
Max. charge current [A]	10 @ 45 °C					
Max. discharge current [A]	10 @ 45 °C					
Type of controller	<input type="checkbox"/>	shunt	<input type="checkbox"/>	serial	<input checked="" type="checkbox"/>	other: MPPT
Technique of regulation	<input type="checkbox"/>	two point	<input type="checkbox"/>	PWM	<input checked="" type="checkbox"/>	other: MPPT
Self consumption [mA]	< 10 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	<input checked="" type="checkbox"/>	LED	<input type="checkbox"/>	LCD	<input type="checkbox"/>	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	<input type="checkbox"/>	yes	<input checked="" type="checkbox"/>	no		
DC/DC-Converter	<input type="checkbox"/>	yes	<input checked="" type="checkbox"/>	no		
MPPT	<input checked="" type="checkbox"/>	yes	<input type="checkbox"/>	no		
adjustable for different battery types	<input checked="" type="checkbox"/>	yes	<input type="checkbox"/>	no		
adjustable thresholds	<input type="checkbox"/>	yes	<input checked="" type="checkbox"/>	no		
end of charge [V]	<input type="checkbox"/>	min.	<input type="checkbox"/>	max.		
load disconnect [V]	<input type="checkbox"/>	min.	<input type="checkbox"/>	max.		
selectable priority at load disconnection	<input type="checkbox"/>	yes	<input checked="" type="checkbox"/>	no		
Protection against reversed battery polarity	<input checked="" type="checkbox"/>	yes <sup>1)</sup>	<input type="checkbox"/>	no	<input type="checkbox"/>	not specified
Protection against reversed PV polarity	<input checked="" type="checkbox"/>	yes <sup>1)</sup>	<input type="checkbox"/>	no	<input type="checkbox"/>	not specified
Others	USB-Charger					
	Jumpers for Alarm, LVD and Battery type					

<sup>1)</sup> Electronic protection

listed values rated for

12V

24V

### Others

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

# 1 Pretests

## 1.2 Visual Inspection

Connection type	<input type="checkbox"/>	plug	<input checked="" type="checkbox"/>	screw	<input type="checkbox"/>	other:	
Cable stress relief	<input type="checkbox"/>	o.k.	<input type="checkbox"/>	not o.k.	<input checked="" type="checkbox"/>	not available	
Cable diameter stranded [mm <sup>2</sup> ]	<input type="checkbox"/>	2,5	<input type="checkbox"/>	4	<input type="checkbox"/>	6	<input checked="" type="checkbox"/> 16
Cable diameter solid [mm <sup>2</sup> ]	<input type="checkbox"/>	2,5	<input type="checkbox"/>	4	<input type="checkbox"/>	6	<input checked="" type="checkbox"/> 16
Case quality	<input type="checkbox"/>	very good	<input checked="" type="checkbox"/>	good	<input type="checkbox"/>	bad	
Connector quality	<input type="checkbox"/>	very good	<input checked="" type="checkbox"/>	good	<input type="checkbox"/>	bad	
Electronic quality	<input checked="" type="checkbox"/>	very good	<input type="checkbox"/>	good	<input type="checkbox"/>	bad	
Packing of charge controller	<input type="checkbox"/>	very good	<input checked="" type="checkbox"/>	good	<input type="checkbox"/>	bad	
Lettering of packing	<input checked="" type="checkbox"/>	very good	<input type="checkbox"/>	good	<input type="checkbox"/>	bad	
Fuse changing	<input type="checkbox"/>	very good	<input type="checkbox"/>	good	<input type="checkbox"/>	bad	<input checked="" type="checkbox"/> n.a. <sup>1)</sup>
Mounting of charge contr.	<input type="checkbox"/>	very good	<input checked="" type="checkbox"/>	good	<input type="checkbox"/>	bad	
Others:							
Comment quality	very good quality						
Damages	<input type="checkbox"/>	yes	<input type="checkbox"/>	no	<input checked="" type="checkbox"/>	no	

### Lettering of the charge controller

Manufacturer	<input checked="" type="checkbox"/>	yes	<input type="checkbox"/>	no			
Model / type	<input checked="" type="checkbox"/>	yes	<input type="checkbox"/>	no			
Serial / batch number	<input checked="" type="checkbox"/>	yes	<input type="checkbox"/>	no			
Nominal voltage	<input checked="" type="checkbox"/>	yes	<input type="checkbox"/>	no			
Connectors	<input checked="" type="checkbox"/>	yes	<input type="checkbox"/>	no			
Fuse	<input type="checkbox"/>	yes	<input type="checkbox"/>	no	<input checked="" type="checkbox"/>	n.a. <sup>1)</sup>	
LED, displays	<input checked="" type="checkbox"/>	yes	<input type="checkbox"/>	no			
Comment labeling:	o.k.						

### Documentation

Data sheet	<input checked="" type="checkbox"/>	o.k.	<input type="checkbox"/>	not o.k.	<input type="checkbox"/>	not available	
User manual	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		
Operating instructions	<input checked="" type="checkbox"/>	o.k.	<input type="checkbox"/>	not o.k.	<input type="checkbox"/>	not available	
Troubleshooting guide	<input checked="" type="checkbox"/>	o.k.	<input type="checkbox"/>	not o.k.	<input type="checkbox"/>	not available	
Safety instructions	<input checked="" type="checkbox"/>	o.k.	<input type="checkbox"/>	not o.k.	<input type="checkbox"/>	not available	
Installation instructions	<input checked="" type="checkbox"/>	o.k.	<input type="checkbox"/>	not o.k.	<input type="checkbox"/>	not available	
Calibration instructions	<input type="checkbox"/>	o.k.	<input type="checkbox"/>	not o.k.	<input checked="" type="checkbox"/>	not available	
Others	user manuals in different languages (german, english, french, spanish, portugese, chinese)						
Comment documentation	o.k.						

### Spare parts

Fuse	<input type="checkbox"/>	availabe	<input type="checkbox"/>	not available <sup>1)</sup>	<input checked="" type="checkbox"/>		
Mounting parts	<input type="checkbox"/>	availabe	<input type="checkbox"/>	not available	<input checked="" type="checkbox"/>		
Connectors	<input type="checkbox"/>	availabe	<input type="checkbox"/>	not available	<input checked="" type="checkbox"/>		
Others							
Comment spare parts	---						

### Support

Repair / Service address	<input type="checkbox"/>	availabe	<input type="checkbox"/>	not available	<input checked="" type="checkbox"/>		
Warranty	<input type="checkbox"/>	availabe	<input type="checkbox"/>	not available	<input checked="" type="checkbox"/>		
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?

<input checked="" type="checkbox"/>	yes	<input type="checkbox"/>	no
<input checked="" type="checkbox"/>	passed	<input type="checkbox"/>	failed
-----			



## 2 Battery Lifetime Protection Tests

### 2.1 Leakage Current

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

DuT	1	
Reference	CMLMP1-phc-2007	
Inspector	bg	

<

Test	Behaviour / results		
	Revers current [µA]		
Protection against night discharge of the battery (leakage current)	171,2	p	V <sub>batt</sub> : 12.6 V PV loop resistor: 150 Ohm

Used measurement equipment:	V <sub>bat</sub> :	Zimmer LMG95
	I <sub>bat</sub> :	---
	V <sub>pv</sub> :	---
	I <sub>pv</sub> :	Fluke 87
	V <sub>load</sub> :	---
	I <sub>load</sub> :	---
	T <sub>a</sub> :	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	25,5 °C
Rated voltage	12,0 V

DuT	1	
Reference	CMLMP1-phc-2007	
Inspector	bg	

Voltage thresholds	Specification (manufacturer) [V]	Measured [V]				p / f	Remarks
		DuT 1		DuT 2			
		Regulation start	Cut-off				
End of charge voltage (floating)	13,8	13,74	13,76			p	
final voltage equalisation (gassing)	14,8	14,76	14,79			p	Only if flooded battery is selected.
final voltage boost	14,4	14,35	14,37			p	
		LVD	LVR				
Deep discharging cut-off voltage	11,0	11,04				p	Alarm before Cut-Off
Reconnect voltage load	12,8		12,76			p	

Time delay load disconnect [s]	appr. 1min.	
Time delay load reconnect [s]	0	
Type of controller	MPPT	
equal to manufacturer data	<input checked="" type="checkbox"/> yes	<input type="checkbox"/> 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?

<input checked="" type="checkbox"/>	passed	<input type="checkbox"/>	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	CMLMP1-phc-2007	
Inspector	bg	

Voltage thresholds	ambient temperature [°C]				temp. comp [mV/K] / cell	DuT
	@ 25,5 °C		@ Temp. °C			
End of charge voltage (float) [V] <sup>1)2)</sup>	13,74	13,42	39,0		-3,8	1
	13,76	13,45	39,0		-3,7	1
Equalization voltage [V] <sup>1)2)</sup>	14,76	14,42	39,0		-4,0	1
	14,79	14,44	39,0		-4,2	1
Boost voltage [V] <sup>1)2)</sup>	14,35	14,01	39,0		-4,0	1
	14,37	14,02	39,0		-4,2	1
Deep discharging cut-off voltage [V]	11,04	11,04	39,0	stable		1
Reconnect voltage load [V]	12,76	12,76	39,0	stable		1

<sup>1)</sup> regulation 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?

x  passed  failed

If failed, reason?

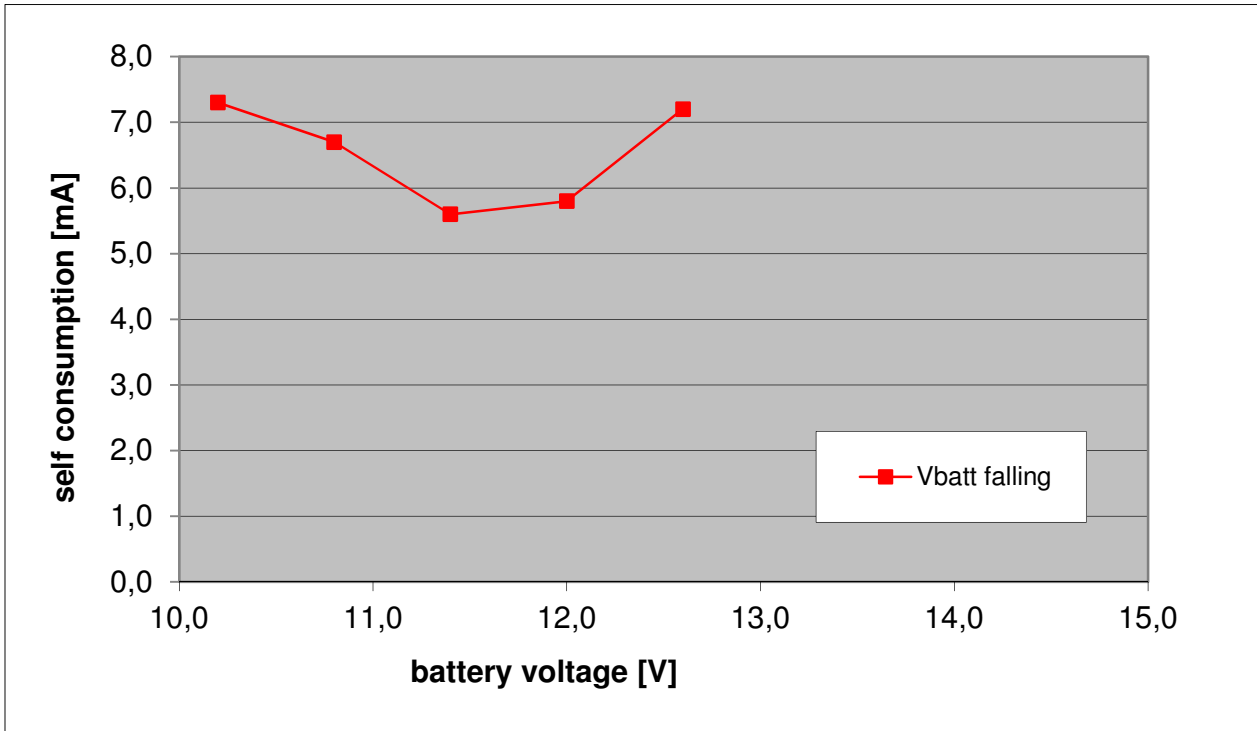
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### 3 Energy Performance Tests

#### 3.1 Self Consumption Tests

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

DuT	1	
Reference	CMLMP1-phc-2007	
Inspector	bg	



	DuT		
max. selfconsumption	7,3	mA @	10,2 V
average selfconsumption	6,5	mA @	12.6 - 10.2 V
			1

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

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

## Measured data

Nr.	Batt. Volt. [V]	Self consumpt. [mA]	Self consumpt. [mW]	DuT	Comment
1	12,6	7,2	90,7	1	3 State of charge Leds On
2	12,0	5,8	69,6	1	1 State of charge Led On
3	11,4	5,6	63,8	1	1 State of charge Led flashing
4	10,8	6,7	72,4	1	Load status Led On
5	10,2	7,3	74,5	1	Load status Led On

### 3 Energy Performance Tests

#### 3.2 Efficiency Tests

Ambient temperature:	25,1	°C
Rated voltage:	12,0	V
Rated max. charge current:	10,0	A
Rated max. discharge current:	10,0	A

DuT	1	
Reference	CMLMP1-phc-2007	
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]	
17,24	0,60	10,34	13,22	0,78	10,31	99,7	4,02	1
18,49	1,11	20,52	13,21	1,53	20,21	98,5	5,28	1
18,73	2,13	39,89	13,21	2,93	38,71	97,0	5,52	1
18,50	5,13	94,91	13,21	7,05	93,13	98,1	5,29	1
18,72	7,66	143,40	13,21	10,55	139,37	97,2	5,51	1
21,92	6,45	141,38	13,20	10,20	134,64	95,2	8,72	1

##### 3.2.2 Discharging efficiency @ 100 % rated load current

Battery			Load			efficiency	Vbat-Vload	DuT
[V]	[A]	[W]	[V]	[A]	[W]	[%]	[V]	
13,21	10,47	138,31	13,11	10,47	137,26	99,2	0,10	1

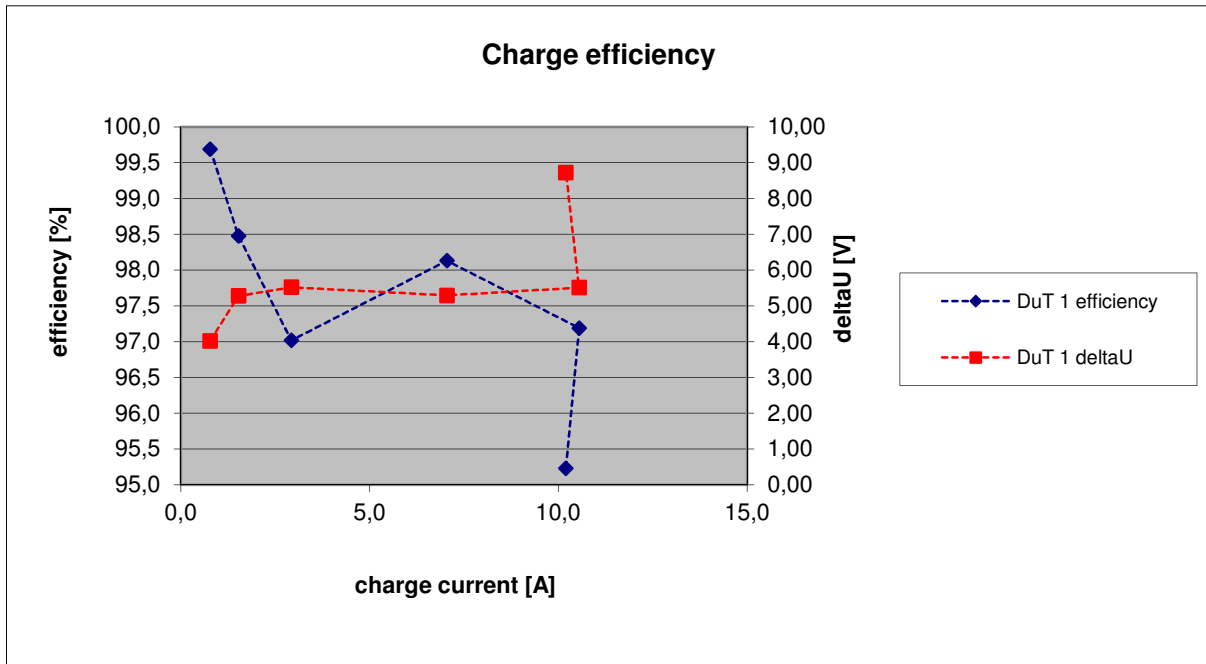
min. discharge efficiency [%]: 99,2

Remarks: Because of the DC/DC converter PV and battery currents and voltages are different 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 efficiencies



## 4 Protection and Fail-Safe Tests

### 4.1 Thermal Performance Tests

Ambient temperature:	see below
Rated voltage:	12 V
Rated max. charge current:	10 A
Rated max. discharge current:	10 A

DuT	1	
Reference	CMLMP1-phc-2007	
Inspector:	bg	

#### Test at extended ambient temperature

time	PV-module		Battery		Load		T <sub>heatsink</sub>	T <sub>ambient</sub>	DuT	Comment
[min]	[V]	[A]	[V]	[A]	[V]	[A]	[°C]	[°C]		
0	20,95	6,9	13,21	0,7	13,11	10,1	45,5	44,0	1	
5	20,95	7,0	13,21	0,6	13,12	10,1	47,0	45,0	1	
10	20,95	7,0	13,21	0,7	13,11	10,1	47,0	44,5	1	
15	20,95	6,9	13,21	0,8	13,11	10,1	47,0	44,5	1	
20	20,95	6,9	13,21	0,7	13,11	10,1	48,0	45,0	1	
25	20,95	7,0	13,21	0,7	13,12	10,1	48,0	45,0	1	
30	20,95	7,0	13,21	0,7	13,12	10,1	48,0	45,0	1	
35	20,95	7,0	13,20	0,6	13,11	10,1	47,5	45,0	1	
40	20,96	7,0	13,21	0,7	13,11	10,1	48,0	45,0	1	
45	20,96	7,1	13,21	0,6	13,12	10,1	47,5	45,0	1	
50	20,96	7,1	13,21	0,7	13,11	10,1	48,0	45,0	1	
55	20,96	7,0	13,21	0,7	13,11	10,1	47,5	45,0	1	
60	20,96	7,0	13,21	0,7	13,11	10,1	48,0	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:	10,0 A
Rated max. discharge current:	10,0 A

DuT	1	
Reference	CMLMP1-phc-2007	
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	20,94	7,6	13,45	11,0	The PV Power is limited by the BCC to Pmax = 150 W	31,0	29,5	1
15	20,95	7,2	13,44	10,7		30,5	28,5	1
30	20,95	7,3	13,44	10,7		30,5	28,0	1
45	20,95	7,2	13,44	10,7		30,5	28,0	1
60	20,95	7,2	13,44	10,7		30,5	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	12,6	11,88	12,5	28,5	27,0	1
15		12,00	12,6	11,88	12,6	28,5	27,0	1
30		12,00	12,7	11,88	12,6	28,5	27,5	1
45		12,00	12,6	11,88	12,6	29,0	27,5	1
60		12,00	12,6	11,88	12,6	29,0	28,0	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	CMLMP1-phc-2007	
Inspector	bg	

Test	Behaviour / results		
	DuT 1	p/f	remarks
Protection against short circuited PV <sup>1)</sup>		p	Voc = 21 V Ipv = 1 A
Protection against reversed polarity PV Module		p	
Protection against short circuited load <sup>1)</sup>		p	Iload = 1 A
Operation with reversed polarity battery		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
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If failed, reason?

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## 4 Protection and Fail-Safe Tests

### 4.4 Battery Open Circuit Test

Ambient temperature	25,1 °C
Rated voltage	12,0 V

DuT	1	
Reference	CMLMP1-phc-2007	
Inspector	NP	

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	Load will be switched off.	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	CMLMP1-phc-2007	
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?

If failed, reason?

x	p		f

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

<b>device</b>	<b>type</b>	<b>measured dimensions</b>	<b>reference number following DIN EN ISO 9001:2000</b>
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



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