

## Certificate

### No. 1015 / FhG-ISE / 001

---

**Manufacturer: phocos China Ltd.**  
**Charge regulator type: CIS MPPT 85/20**

---

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 (CIS MPPT 85/20) that are laid down in the measurement protocol (test report) dated 22.05.2014 herewith we confirm that the tested charge controller type fulfils or exceeds controller specifications required by IEC 62 509 / 2010-12 Edition 1.0.

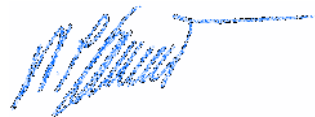
#### Remarks

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 CIS MPPT 85/20 charge controllers may require a repetition of some or all qualification tests to maintain type approval.

Freiburg,  
October 7<sup>th</sup>, 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

## Test and Measurement Protocol - Charge Controllers -

Tests according to IEC 65 209:2010



Model/Type Phocos CIS MPPT 85/20
-------------------------------------

DuT	Serial Number	Reference number	Date	Update
1	131121 0117	CIS201-phc-1405	22.05.2014	
2	131121 0118	CIS202-phc-1405		



## Table of Contents

Overview	page	3
Pretests	page	5
Battery Life Time Protection Tests	page	8
Energy Performance Tests	page	11
Protection and Fail-Safe Tests	page	15
User Interface Tests	page	19
Fraunhofer ISE ISO 9001 Certification	page	21

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

**DuT:** Phocos CIS-MPPT 85/20  
**Ref. nr.:** CIS201-phc-1405 / CIS202-phc-1405

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

General remarks, recommendations

The charge controller family CIS mppt 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. 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	$\leq 0.1 \% I_N$	---	252 $\mu$ 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>	$\pm 1 \%$	14.38 V	<input checked="" type="checkbox"/>	(start of PWM, at 24.4 °C); 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>	$\pm 1 \%$	14.79 V	<input checked="" type="checkbox"/>	(start of PWM, at 24.4 °C); 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>	$\pm 1 \%$	13.75 V	<input checked="" type="checkbox"/>	(start of PWM, at 24.4 °C); 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>	$\pm 2 \%$	10.86 V	<input checked="" type="checkbox"/>	$11.0 < V_{batt} < 12.0$ according to programming
<input checked="" type="checkbox"/>	<input type="checkbox"/>	temperature compensation HVD	<b>- 5 mV/cell/°C</b>	n. d.	-3.0 to -5.0 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.	12.8 mA	<input checked="" type="checkbox"/>	average self-consumption 10.2 – 12.6 V
<input checked="" type="checkbox"/>	<input type="checkbox"/>	charge efficiency	n. d.	n. d.	94.1 %	<input checked="" type="checkbox"/>	at max. battery current
<input checked="" type="checkbox"/>	<input type="checkbox"/>	discharge efficiency	n. d.	n. d.	97.8 %	<input checked="" type="checkbox"/>	at max. battery 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

➔ next page

**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	---	21.9 A	<input checked="" type="checkbox"/>	charge contr. limits current to 21.9 A
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Load overcurrent protection test	$1.25 \times I_N$ @ 25 °C	---	25 A	<input checked="" type="checkbox"/>	auto disconnect after 2 min.
<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. charging current at 60 °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"/>	Moving bar graph
<input checked="" type="checkbox"/>	<input type="checkbox"/>		batt. charged	n. d.	Not available	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>		discharg. batt.	n. d.	available	<input checked="" type="checkbox"/>	Signalled by LEDs
<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	Deutschland	
Model/Type	CIS-MPPT 85/20	
Serial / Batch Nr.	1	131121 0117
	2	131121 0118

### Mechanical data

Dimensions (l * w * h) [mm]	150 * 130 * 43 (l*h*w)
Weight [g]	1287
Case material	metall, black
Protection class (IP)	68
Case mounting	screws
Connection type	cable strand
Cable stress relief	n.a.
Cable diameter [mm <sup>2</sup> ]	n.a.
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"/> x	12 & 24V
Automatic adjustment 12/24V	<input checked="" type="checkbox"/> x	yes	<input type="checkbox"/>	no
Max. module power [W]	---			
Max. charge current [A]	20 @ 60 °C			
Max. discharge current [A]	20 @ 60 °C			
Type of controller	<input type="checkbox"/> shunt	<input checked="" type="checkbox"/> x	<input type="checkbox"/> serial	<input type="checkbox"/> other:
Technique of regulation	<input type="checkbox"/> two point	<input type="checkbox"/>	<input type="checkbox"/> PWM	<input checked="" type="checkbox"/> x other: MPPT
Self consumption [mA]	7 - 15			
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 - 12.0 / 22.0 - 24.0 programmable			
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 +60			
display	<input checked="" type="checkbox"/> x	LED	<input type="checkbox"/>	LCD
	<input type="checkbox"/>		<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 checked="" type="checkbox"/>	yes	<input 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 checked="" type="checkbox"/>	yes	software adjustable	
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
Protection against reversed PV polarity	<input checked="" type="checkbox"/>	yes <sup>1)</sup>	<input type="checkbox"/>	no
Others	Dimming function			
	optical interface for programing			
	external temperature sensor			
	night light function			

<sup>1)</sup> Electronic protection

listed values rated for

12V

24V

**Others**

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

# 1 Pretests

## 1.2 Visual Inspection

Connection type		plug		screw	x	other: cables
Cable stress relief	x	o.k.		not o.k.		not available
Cable diameter stranded [mm <sup>2</sup> ]	x	2,5		4		6 16
Cable diameter solid [mm <sup>2</sup> ]		2,5		4		6 16
Case quality	x	very good		good		bad
Connector quality		very good		good		bad
Electronic quality		very good		good		bad not visible
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, chinese)					
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?

<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	27,0 °C
Rated voltage	12,0 V

DuT	1	2
Reference	CIS201-phc-1405	
Inspector	fs	

Test	Behaviour / results		remarks	DuT
	1	p/f		
	Revers current [µA]			
Protection against night discharge of the battery (leakage current)	252	p	Vbatt: 12.6 V PV loop resistor: 72 Ohm	

Used measurement equipment	Vbat:	Zimmer LMG95
	Ibat:	---
	Vpv:	---
	Ipv:	HP 34401A
	Vload:	---
	Iload:	---
	Ta:	Tinsley 5885A

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	24,4 °C
Rated voltage	12,0 V

DuT	1	2
Reference	CIS201-phc-1405	
Inspector	fs	

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	13,75	13,80			p	
final voltage equalisation (gassing)	14,8		14,79			p	DUT 3
final voltage boost	14,4	14,38	14,40			p	
Load disconnect warning on							
Deep discharging cut-off voltage	11.00 - 12.02	10,86				p	default setting is 10,984V (Base Voltage LVD)
Reconnect voltage load	12,8	12,80				p	

Time delay load disconnect [s]	appr. 1 min.	
Time delay load reconnect [s]	0	
Type of controller	serial / PWM	
equal to manufacturer data	<input checked="" type="checkbox"/> x	<input type="checkbox"/> yes <input type="checkbox"/> no

Used measurement equipment	Vbat:	Zimmer LMG 95
	Ibat:	Zimmer LMG 95
	Vpv:	Oscilloscope Agilent DSO-X-3032A
	Ipv:	Zimmer LMG 95
	Vload:	---
	Iload:	Zimmer LMG 95
	Ta:	Tinsley 5885A

DuT = device under test

p/f = passed / failed

IEC 62 509 requirements / recommendations?

If failed, reason?

<input checked="" type="checkbox"/> x	<input checked="" type="checkbox"/> passed	<input type="checkbox"/>	<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	V

DuT	1	2
Reference	SIS201-phc-1405	
Inspector	fs	

Voltage thresholds	ambient temperature [°C]				temp. comp [mV/ K*cell]	DuT
	@ 24,4 °C		@ Temp. °C			
End of charge voltage (float) [V] <sup>1)2)</sup>	13,75	13,47	40,9		-3,0	1
	13,80	13,53	39,1			1
Equalization voltage [V] <sup>1)2)</sup>	0,00		40,9		0,0	1
	14,79	14,42	40,0		-4,1	3
Boost voltage [V] <sup>1)2)</sup>	14,31	13,85	40,4		-5,0	1
	14,44	13,98	40,4			1
Deep discharging cut-off voltage [V]	10,86	10,99	39,8		1,5	1
						1
Reconnect voltage load [V]	12,80	12,80	39,8	stable	0,0	1

<sup>1)</sup> PWM start

<sup>2)</sup> cut off

Remarks	Boost voltage should also be compensated	
Used measurement equipment	Vbat:	Zimmer LMG 95
	Ibat:	Zimmer LMG 95
	Vpv:	Oscilloscope for controlling PWM behaviour
	Ipv:	Zimmer LMG 95
	Vload:	Zimmer LMG 95
	Iload:	Zimmer LMG 95
	Ta:	Tinsley 5885A

IEC 62 509 requirements?

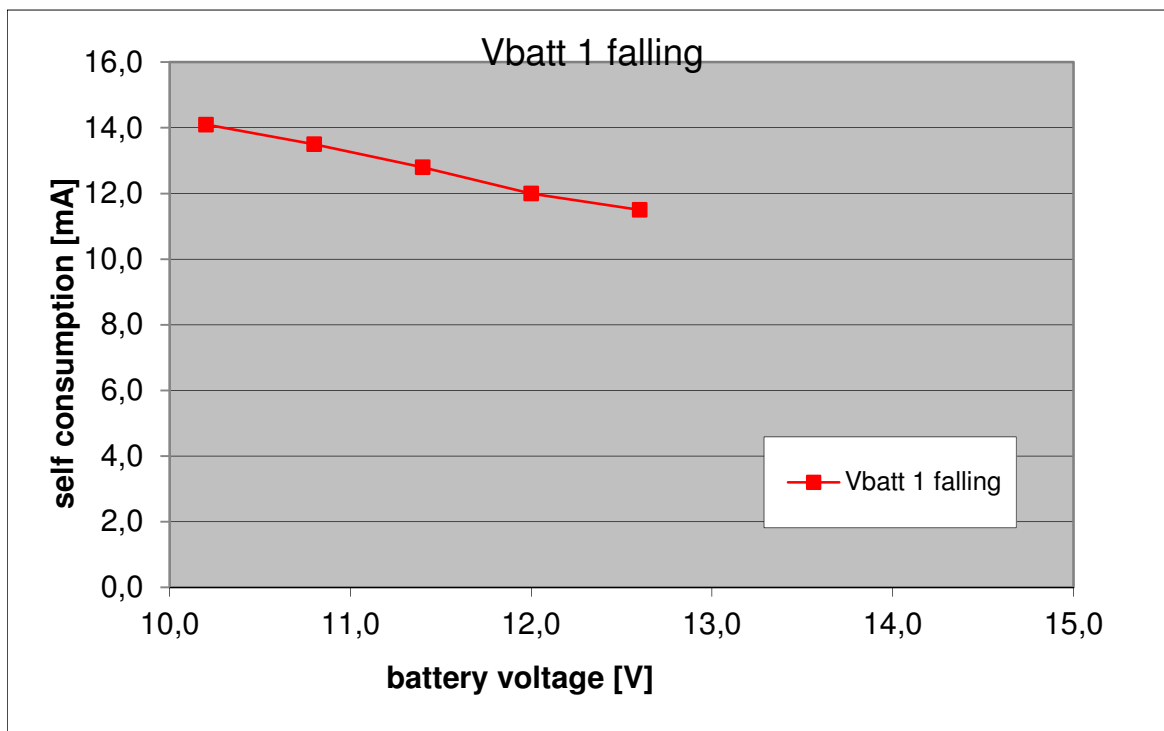
x	passed		failed
Model/Type			

### 3 Energy Performance

#### 3.1 Self Consumption Tests

Ambient temperature	24,9	°C
Rated voltage	12,0	V

DuT	1	2
Reference	CIS201-phc-1405	
Inspector	fs	



		DuT
max. selfconsumption	14,1 mA @ 10,2 V	1
average selfconsumption	12,8 mA @ 12,6 - 10,2 V	1

Comment			
Used measurement equipment	Ibat:	HP 34401A	
	Ubat:	Zimmer LMG 95	
	Ta:	Tinsley 5885A	

IEC 62 509 requirements?	<input checked="" type="checkbox"/>	passed	<input type="checkbox"/>	failed
If failed, reason?				

**Measured data**

Nr.	Batt. Volt. [V] ↑ ↓	Self consumpt. [mA] ↓	Self consumpt. [mW] ↓	DuT
1	12,6	11,5	144,9	1
2	12,0	12,0	144,0	1
3	11,4	12,8	145,9	1
4	10,8	13,5	145,8	1
5	10,2	14,1	143,8	1
6				

### 3 Energy Performance

#### 3.2 Efficiency Tests

Ambient temperature:	25,3	°C
Rated voltage:	12,0	V
Rated max. charge current:	20,0	A
Rated max. discharge current:	20,0	A

DuT	3	
Reference	CIS203-phc-1405	
Inspector:	fs	

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

PV-Module			Battery			efficiency	V <sub>pv</sub> -V <sub>bat</sub>	DuT
[V]	[A]	[W]	[V]	[A]	[W]	[%]	[V]	
41,08	0,70	28,59	13,20	2,00	26,40	92,3	27,88	3
40,63	1,39	56,48	13,20	4,06	53,59	94,9	27,43	3
40,06	2,10	84,09	13,23	6,02	79,62	94,7	26,83	3
39,56	2,81	111,16	13,25	8,00	106,00	95,4	26,31	3
38,95	3,54	137,88	13,20	10,00	132,00	95,7	25,75	3
38,90	4,29	166,88	13,21	12,00	158,52	95,0	25,69	3
38,80	5,00	194,00	13,21	14,08	185,95	95,9	25,59	3
38,64	5,81	224,50	13,18	16,09	212,07	94,5	25,46	3
38,40	6,56	251,90	13,19	18,00	237,42	94,3	25,21	3
38,44	7,30	280,61	13,19	20,02	264,06	94,1	25,25	3

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

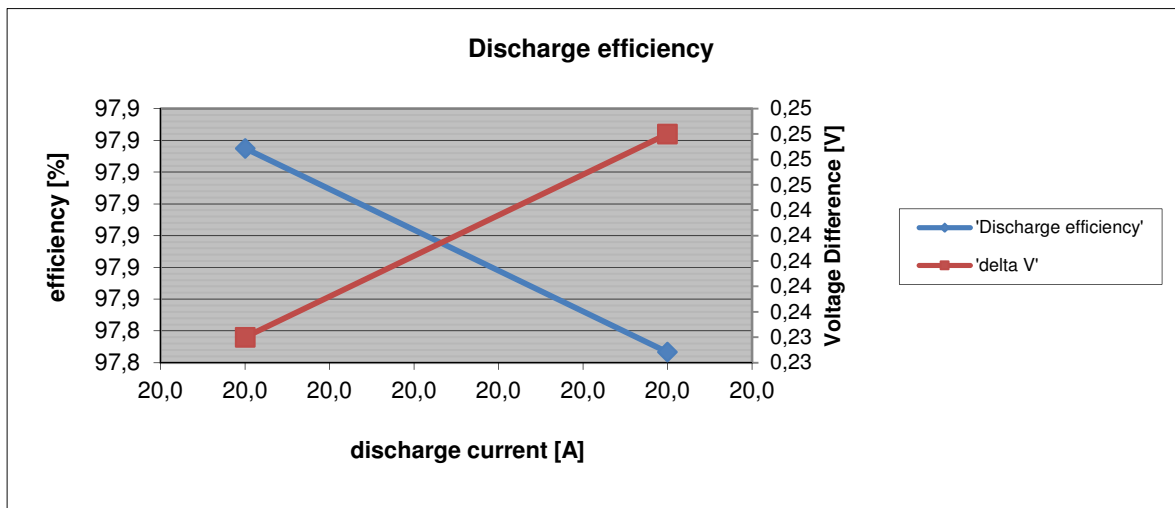
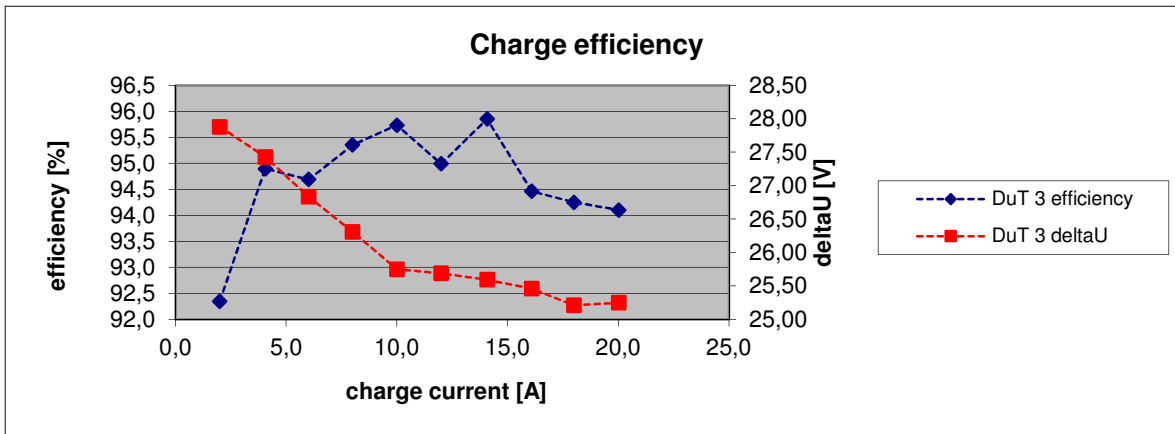
Battery			Load			efficiency	V <sub>bat</sub> -V <sub>load</sub>	DuT
[V]	[A]	[W]	[V]	[A]	[W]	[%]	[V]	
12,60	20,00	252,00	12,37	19,95	246,70	97,9	0,23	3
13,01	20,01	260,33	12,76	19,96	254,69	97,8	0,25	3

min. discharge efficiency [%]: 97,9 +/- 0,4

Remarks:	very high efficiencies	
Used measurement equipment:	V <sub>bat</sub> :	Zimmer LMG 95
	I <sub>bat</sub> :	Zimmer LMG 95
	V <sub>pv</sub> :	Zimmer LMG 95
	I <sub>pv</sub> :	Zimmer LMG 95
	V <sub>load</sub> :	Zimmer LMG 95
	I <sub>load</sub> :	Zimmer LMG 95
	T <sub>a</sub> :	Tinsley 5885A

IEC 62 509 requirements?	x	passed	failed
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:	20A
Rated max. discharge current:	20A

DuT	3	2
Reference	CIS203-phc-1405	
Inspector:	fs	

#### Test at extended ambient temperature

time [min]	PV-module		Battery		load		T <sub>case</sub>	T <sub>ambient</sub>	DuT	Comment
	[V]	[A]	[V]	[A]	[V]	[A]	[°C]	[°C]		
0	38,2	7,2	12,8	20,0	12,9	0,0	60,2	60,0	3	
15	38,3	7,2	12,8	20,0	12,8	0,0	62,7	60,5	3	
30	38,3	7,2	12,8	20,0	12,8	0,0	64,2	60,7	3	
45	38,3	7,2	12,8	20,0	12,8	0,0	64,8	60,4	3	
60	38,3	7,2	12,8	20,0	12,8	0,0	65,7	60,5	3	

Remarks: As per manual, at 60°C CIS-MPPT 85/20 can only have full current on panel or load, not simultaneously. Therefore only the PV input was set to max. power which results in a battery current of 20A

Used measurement eq	V <sub>bat</sub> :	Zimmer LMG95
	I <sub>bat</sub> :	Zimmer LMG95
	V <sub>pv</sub> :	Zimmer LMG95
	I <sub>pv</sub> :	Zimmer LMG95
	V <sub>load</sub> :	Zimmer LMG95
	I <sub>load</sub> :	Zimmer LMG95
	T <sub>a</sub> :	Tinsley 5885A
	T <sub>c</sub> :	Tinsley 5885A

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	3	
Reference	CIS203-phc-1405	
Inspector:	fs	

#### 4.2.1 PV Overcurrent Protection Test <sup>1)</sup>

time	PV-module		Battery		Remark	T <sub>heatsint</sub>	T <sub>ambien</sub>	DuT
[min]	[V]	[A]	[V]	[A]		[°C]	[°C]	
0	37,6	8,2	13,2	21,9	charging current is limited to 21,9A	27,0	26,6	3
15	37,8	8,2	13,2	21,9		34,0	27,7	3
30	37,9	8,2	13,2	21,8		39,1	27,9	3
45	37,9	8,1	13,2	21,8		43,2	28,1	3
60	37,9	8,2	13,2	21,8		46,0	27,5	3

#### 4.2.2 Load Overcurrent Protection Test <sup>1)</sup>

time	Remark	Battery		load <sup>2)</sup>		T <sub>heatsint</sub>	T <sub>ambien</sub>	DuT
[min]		[V]	[A]	[V]	[A]	[°C]	[°C]	
0	after 2 minutes the current gets limited by PWM. After another minute the the load is reconnected for 2 minutes again. This cycle continues, it was stopped after 30 minutes by FS	11,0	25,0	10,7	25,0	28,2	28,5	3
2		16,2	10,3	2,3	5,2	28,2	28,8	3
3		11,0	25,0	10,7	25,0	28,9	29,0	3

Used measurement equipment		
Vbat:	Zimmer LMG95	
Ibat:	Zimmer LMG95	
Vpv:	Zimmer LMG95	
Ipv:	Zimmer LMG95	
Vload:	Zimmer LMG95	
Iload:	Zimmer LMG95	
Ta:	Tinsley 5885A	
Tc:	Tinsley 5885A	

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	25,2 °C
Rated voltage	12,0 V

DuT	3
Reference	CIS203-phc-1405
Inspector	fs

Test	Behaviour / results		remarks
	DuT 2	p/f	
Protection against short circuited PV <sup>1)</sup>	test ok	p	
Protection against reversed polarity PV Module	test ok	p	
Protection against transient overvoltage (diodes, varistors) <sup>1)</sup>			protection via varistor according to manufacturer
Protection against short circuited load <sup>1)</sup>	test ok	p	
Operation with reversed polarity battery	test not ok	p <sup>2)</sup>	the reverse voltage was fed to the load. The charge controller didn't suffer any damage.

p/f: passed/failed

<sup>1)</sup> Not mandatory according to IEC 62 509

<sup>2)</sup> Manual clearly warns that load can be destroyed under those operating conditions --> pass

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:	Tinsley 5885A	

IEC 62 509 requirements?	<input checked="" type="checkbox"/>	passed	<input type="checkbox"/>	failed
If failed, reason?				

## 4 Protection and Fail-Safe Tests

### 4.4 Battery Open Circuit Test

Ambient temperature	25,6 °C
Rated voltage	12,0 V

DuT	1	
Reference	CIS203-phc-1405	
Inspector	fs	

Test	Behaviour / results			DuT
operating with disconnected battery	Load will be switched off;			3
	V load =	0,0 V	p Passed/failed	
removing battery during normal operation	Load will be switched off;			3
	V load =	0,0 V	p Passed/failed	

Remarks	test with connected PV voltage (VOC = 42,5 V)		
Used measurement equipment	Vbat:	Zimmer LMG95	
	Ibat:	Zimmer LMG95	
	Vpv:	Zimmer LMG95	
	Ipv:	Zimmer LMG95	
	Vload:	Zimmer LMG95	
	Iload:	Zimmer LMG95	
	Ta:	Tinsley 5885A	

I/Typ	IEC 62 509 requirements?	x	passed		failed
	If failed, reason?				

## 5 User Interface Tests

### 5.1 Display

Ambient temperature	25,7 °C
Rated voltage	12,0 V

DuT	1	2
Reference		CIS203-phc-1405
Inspector		fs

Charge Controller is equipped with a LC-Display

		DuT
charging indication	yes, blinking LED	3
battery charged indication (charge status)	no	3
load cut off warning	no	3
battery discharged indication (load disconnection)	yes, 1 red LED on	3

Remarks:		
Used measurement equipment:	Vbat:	Zimmer LMG95
	Ibat:	Zimmer LMG95
	Vpv:	Zimmer LMG95
	Ipv:	Zimmer LMG95
	Vload:	Zimmer LMG95
	Iload:	Zimmer LMG95
	Ta:	Tinsley 5885A

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

**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>
Agilent 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 20 A, power	421-DC-16 421-DC-25 421-LI-5
Tinsley 5885A	multi channel temperature measurement device	temperatures	421-DC-24
Temperature sensors	Pt 100	temperatures in conjunction with Tinsley 5885A	421-DC-24.1 421-DC-24.2
Agilent DSO-X 3014A	4-channel-digital oscilloscope	control of PWM behaviour	
Fluke 87	multimeter	voltage, current, resistor	421-DC-17 / 421-DC-18



Certificate DE07/3874

The management system of

# Fraunhofer-Institut für Solare Energiesysteme ISE

Heidenhofstraße 2  
DE-79110 Freiburg



has been assessed and certified as meeting the requirements of

## ISO 9001:2008

For the following activities

**Research, development and service in the fields of thermal and electrical solar energy application, building services and hydrogen technology**

Further clarifications regarding the scope of this certificate and the applicability of ISO 9001:2008 requirements may be obtained by consulting the organization

This certificate is valid from 30/04/2013 until 29/04/2016  
Issue 5. Certified since March 2001

Mark Piekerell  
Managing Director

Christian Rathje  
Head Of Certification Body



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

Page 1 of 1



This document is issued by the Company subject to its General Conditions of Certification Services accessible at [www.sgs.com/terms\\_and\\_conditions.htm](http://www.sgs.com/terms_and_conditions.htm). Attention is drawn to the limitations of liability, indemnification and jurisdictional issues established therein. The authenticity of this document may be verified at <http://www.sgs.com/en/Our-Company/Certified-Client-Directories/Certified-Client-Directories.aspx>. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.