

Certificate

No. 0913 / FhG-ISE / 001

Manufacturer: phocos China Ltd.

Charge regulator types: CIS 05 / CIS-2L 05, CIS 10 / CIS-2L 10, CIS 20 / CIS-2L 20 as well as the CIS family with negative grounding: CIS-N 05 / CIS-N 05 2L, CIS-N 10 / CIS-N 10 2L, CIS-N 20 / CIS-N 20 2L

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 10) that are laid down in the measurement protocol (test report) dated 24.09.2013 herewith we confirm that the tested charge controller types 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 charge controllers may require a repetition of some or all qualification tests to maintain type approval.
 3. The period of validity of this certificate has been extended due to the affirmation of the manufacturer that the above mentioned products have not been changed in terms of electronic design, materials, components or processing of the products.
- All responsibility in terms of liability is born fully by the manufacturer phocos AG.

Freiburg,
August 4th, 2014

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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 CIS 10-1.1

DuT	Serial Number	Reference number	Date	Update
1	111115 0883	CIS0101-phc-1308	12.08.2013	
2	111115 0889	CIS0102-phc-1308		



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DuT: Phocos CIS 10 1.1
Ref. nr.: CIS0101-phc-1308 /
 CIS0102-phc-1308

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

General remarks,
recommendations

The charge controller family CIS 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 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 ¹⁾	tolerance	measured value / result	requirements fulfilled?	comments
		IEC 62 509 requirements					
Battery Lifetime Protection Tests							
<input checked="" type="checkbox"/>	<input type="checkbox"/>	PV leakage current test	$\leq 0.1 \% I_N$	---	169 μ 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	14.4 V	$\pm 1 \%$	14.36 V	<input checked="" type="checkbox"/>	(start of PWM, at 25.1 °C); values are within $\pm 1 \%$ of manufact. statement
<input checked="" type="checkbox"/>	<input type="checkbox"/>	end of charge voltage overcharge / equalization mode	14.7 V – 15.3 V	$\pm 1 \%$	14.73 V	<input checked="" type="checkbox"/>	(start of PWM, at 25.1 °C); values are within $\pm 1 \%$ of manufact. statement
<input checked="" type="checkbox"/>	<input type="checkbox"/>	end of charge voltage floating mode	14.1 V	$\pm 1 \%$	13.77 V	<input checked="" type="checkbox"/>	(start of PWM, at 25.1 °C); values are within $\pm 1 \%$ of manufact. statement
<input checked="" type="checkbox"/>	<input type="checkbox"/>	low voltage disconnect @ $0.1 \times I_{10}$	11.7 V – 12.0 V	$\pm 2 \%$	10.99 V	<input checked="" type="checkbox"/>	$11.0 < V_{batt} < 12.0$ according to programming
<input checked="" type="checkbox"/>	<input type="checkbox"/>	temperature compensation HVD	- 5 mV/cell/°C	n. d.	-2.7 to -3,2 mV/cell/°C	<input checked="" type="checkbox"/>	From ISE perspective a range of -3 to -6 mV/cell/°C is o.k.!
Energy Performance Tests							
<input checked="" type="checkbox"/>	<input type="checkbox"/>	self-consumption (including lights / LCD)	$0.1 \% I_N$	n. d.	7.1 mA	<input checked="" type="checkbox"/>	max. self consumption at 10.2 V
<input checked="" type="checkbox"/>	<input type="checkbox"/>	charge efficiency	n. d.	n. d.	97.6 %	<input checked="" type="checkbox"/>	at max. current
<input checked="" type="checkbox"/>	<input type="checkbox"/>	discharge efficiency	n. d.	n. d.	97.6 %	<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

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)		Value / claim	tolerance	measured value / result	requirements fulfilled?	comments
				IEC 62 509 requirements				
Protection and Fail Safe Tests								
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	protection against wrong polarity battery	compulsory	---	o.k.	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input 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"/>	<input type="checkbox"/>	protection against wrong polarity module	compulsory	---	o.k.	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	protection against shorted load	compulsory	---	o.k.	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PV overcurrent protection test	$1.25 \times I_N$ @ 25 °C	---	12,5 A	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input 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"/>	<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 60 °C ambient temperature for 1 hour
User Interface Tests								
<input checked="" type="checkbox"/>	<input 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"/>	<input type="checkbox"/>		batt. charged	n. d.	Not available	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		discharg. batt.	n. d.	available	<input checked="" type="checkbox"/>	Signalled by LEDs
<input checked="" type="checkbox"/>	<input 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"/>	<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 China Ltd.	
Country/Origin	China	
Model/Type	CIS 10-1.1	
Serial / Batch Nr.	1	111115 0883
	2	111115 0889

Mechanical data

Dimensions (l * w * h) [mm]	82 * 58 * 20 (l*h*w)
Weight [g]	150
Case material	metall, black
Protection class (IP)	68
Case mounting	screws
Connection type	cable strand
Cable stress relief	n.a.
Cable diameter [mm²]	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"/>	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 @ 60 °C					
Max. discharge current [A]	10 @ 60 °C					
Type of controller	<input type="checkbox"/>	shunt	<input checked="" type="checkbox"/>	serial	<input type="checkbox"/>	other:
Technique of regulation	<input type="checkbox"/>	two point	<input checked="" type="checkbox"/>	PWM	<input type="checkbox"/>	other:
Self consumption [mA]	5 - 10					
End of charge voltage [V]	13.8 (float voltage)					
return switch-on voltage (two point regulation) [V]	---					
load disconnect warning on [% SOC]	--					
load disconnect voltage [V]	11.0 - 12.0 programmable (normally SOC controlled 11.0-12.02)					
time delay at load sheding [s]	no information					
Reconnection voltage load [V]	12.8					
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"/>	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			
final boost voltage [V]	14.4 (2 h)			
equalization activation voltage [V]	< 12.1			
final equalization (gassing) voltage [V]	14.8 (2 h)			
Temperature compensation	<input checked="" type="checkbox"/>	yes	<input type="checkbox"/>	no
temperature compensation [mV/K*cell]	-4.17			
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 type="checkbox"/>	yes	<input checked="" 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 ¹⁾	<input type="checkbox"/>	no
Protection against reversed PV polarity	<input checked="" type="checkbox"/>	yes ¹⁾	<input type="checkbox"/>	no
Others	Dimming function			
	optical interface for programing			
	external temperature sensor			
	night light function			

¹⁾ 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	<input type="checkbox"/>	plug	<input type="checkbox"/>	screw	<input checked="" type="checkbox"/>	other: cables
Cable stress relief	<input checked="" type="checkbox"/>	o.k.	<input type="checkbox"/>	not o.k.	<input type="checkbox"/>	not available
Cable diameter stranded [mm²]	<input type="checkbox"/>	2.5	<input type="checkbox"/>	4	<input type="checkbox"/>	6 <input type="checkbox"/> 16
Cable diameter solid [mm²]	<input type="checkbox"/>	2.5	<input type="checkbox"/>	4	<input type="checkbox"/>	6 <input type="checkbox"/> 16
Case quality	<input checked="" type="checkbox"/>	very good	<input type="checkbox"/>	good	<input type="checkbox"/>	bad
Connector quality	<input type="checkbox"/>	very good	<input 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. ¹⁾
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"/>	x	<input 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. ¹⁾
LED, displays	<input type="checkbox"/>	yes	<input checked="" 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 checked="" type="checkbox"/>	not available ¹⁾
Mounting parts	<input type="checkbox"/>	availabe	<input checked="" type="checkbox"/>	not available
Connectors	<input type="checkbox"/>	availabe	<input checked="" type="checkbox"/>	not available
Others				
Comment spare parts	---			

Support

Repair / Service address	<input type="checkbox"/>	availabe	<input checked="" type="checkbox"/>	not available
Warranty	<input type="checkbox"/>	availabe	<input checked="" type="checkbox"/>	not available
Others				
Comment support	a support address should be given			

¹⁾ 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
<div style="border: 1px solid black; height: 20px; width: 100%;"></div>			

2 Battery Lifetime Protection Tests

2.1 Leakage Current

Ambient temperature	27.0 °C
Rated voltage	12.0 V

DuT	1	2
Reference	CIS0101-phc-1308	
Inspector	fs	

Test	Behaviour / results		remarks	DuT
	1	p/f		
	Revers current [µA]			
Protection against night discharge of the battery (leakage current)	169	p	V _{batt} : 12.6 V PV loop resistor: 150 Ohm	

Used measurement equipment	V _{bat} :	Zimmer LMG95
	I _{bat} :	---
	V _{pv} :	---
	I _{pv} :	HP 34401A
	V _{load} :	---
	I _{load} :	---
	T _a :	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	25.8 °C
Rated voltage	12.0 V

DuT	1	2
Reference	CIS0101-phc-1308	
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	13.77	13.85			p	
final voltage equalisation (gassing)	14.8	14.73	14.81			p	
final voltage boost	14.4	14.36	14.44			p	
Load disconnect warning on							
Deep discharging cut- off voltage	11.00 - 12.02	10.99				p	when voltage controlled @ lload ~ 1 A
Reconnect voltage load	12.8	12.76				p	

Time delay load disconnect [s]	appr. 1 min.	
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:	---
	Iload:	Zimmer LMG 95
	Ta:	Tinsley 5885A

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	V

DuT	1	2
Reference	IS0101-phc-1308	
Inspector	fs	

Voltage thresholds	ambient temperature [°C]				temp. comp [mV/ K*cell]	DuT
	@ 25.8 °C		@ Temp. °C			
End of charge voltage (float) [V] ¹⁾²⁾	13.77	13.47	40.9		-3.2	1
	13.85	13.53	39.1			1
Equalization voltage [V] ¹⁾²⁾	14.73	14.45	40.9		-3.0	1
	14.81	14.49	40.9			1
Boost voltage [V] ¹⁾²⁾	14.31	14.05	40.9		-2.7	1
	14.44	14.11	40.8			1
Deep discharging cut-off voltage [V]	10.99	10.97	40.7	stable	-0.2	1
						1
Reconnect voltage load [V]	12.76	12.74	40.7	stable	-0.2	1

¹⁾ PWM start

²⁾ 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?

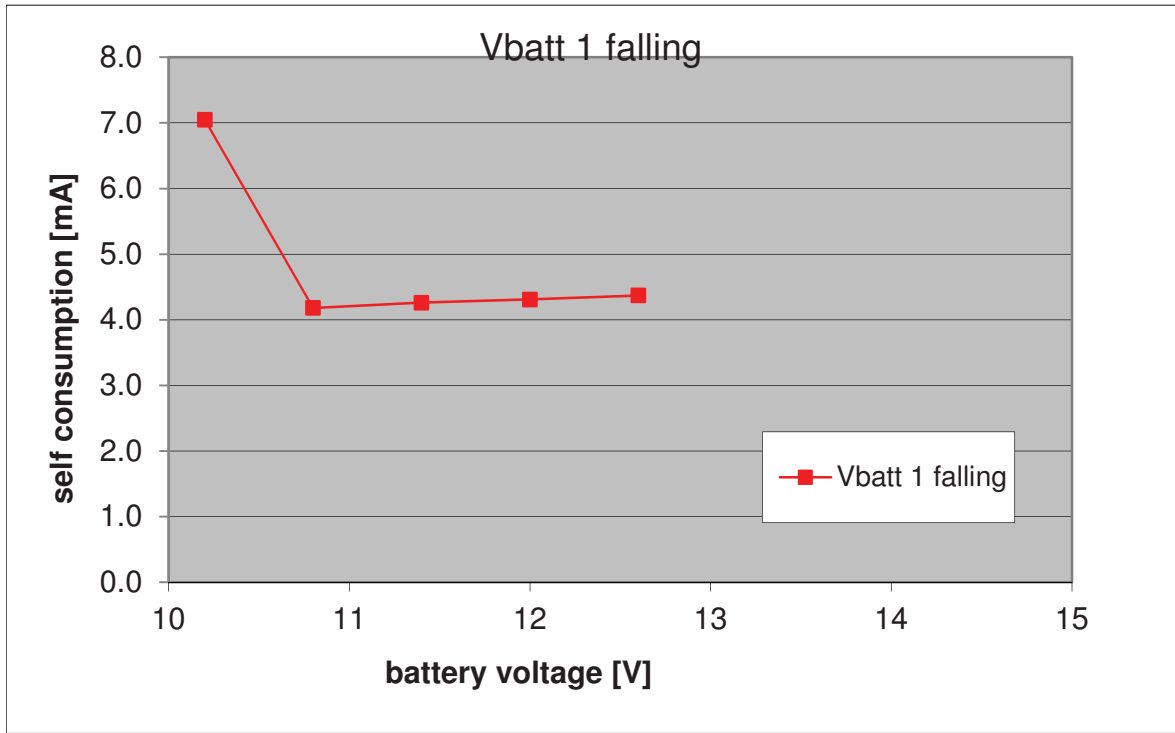
x	passed		failed
Model/Type			

3 Energy Performance

3.1 Self Consumption Tests

Ambient temperature	26.8	°C
Rated voltage	12.0	V

DuT	1	2
Reference	DIS0101-phc-130	
Inspector	fs	



			DuT
max. selfconsumption	7.1	mA @ 10.2 V	1
average selfconsumption	4.8	mA @ 12.6 - 10.2 V	1

Comment			
Used measurement equipment	lbat:	Fluke 87	
	Ubat:	Zimmer LMG 95	
	Ta:	Tinsley 5885A	

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

Measured data

Nr.	Batt. Volt. [V] ↑ ↓	Self consumpt. [mA] ↓	Self consumpt. [mW] ↓	DuT
1	12.6	4.4	55.1	1
2	12.0	4.3	51.7	1
3	11.4	4.3	48.6	1
4	10.8	4.2	45.1	1
5	10.2	7.1	71.9	1
6				

3 Energy Performance

3.2 Efficiency Tests

Ambient temperature:	25.3	°C
Rated voltage:	12.0	V
Rated max. charge current:	10.0	A
Rated max. discharge current:	10.0	A

DuT	1	2
Reference	CIS0101-phc-1308	
Inspector:	fs	

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

PV-Module			Battery			efficiency	V _{pv} -V _{bat}	DuT
[V]	[A]	[W]	[V]	[A]	[W]	[%]	[V]	
13.22	1.00	13.24	13.20	0.99	13.11	99.0	0.02	1
13.24	2.00	26.49	13.20	1.99	26.27	99.2	0.04	1
13.26	3.00	39.79	13.20	2.99	39.47	99.2	0.06	1
13.29	4.00	53.16	13.21	3.99	52.69	99.1	0.09	1
13.31	5.00	66.54	13.20	4.99	65.89	99.0	0.11	1
13.34	6.00	79.96	13.21	5.98	78.95	98.7	0.13	1
13.36	6.99	93.39	13.20	6.98	92.10	98.6	0.16	1
13.37	7.00	93.58	13.21	6.98	92.22	98.5	0.16	1
13.39	8.00	107.11	13.20	7.98	105.37	98.4	0.19	1
13.42	9.00	120.75	13.17	8.98	118.29	98.0	0.25	1
13.47	10.00	134.65	13.17	9.98	131.42	97.6	0.30	1

3.2.2 Discharging efficiency @ 100 % rated load current

Battery			Load			efficiency	V _{bat} -V _{load}	DuT
[V]	[A]	[W]	[V]	[A]	[W]	[%]	[V]	
13.19	10.08	132.94	12.93	10.03	129.70	97.6	0.27	1

min. discharge efficiency [%]: 97.6 +/- 0.4

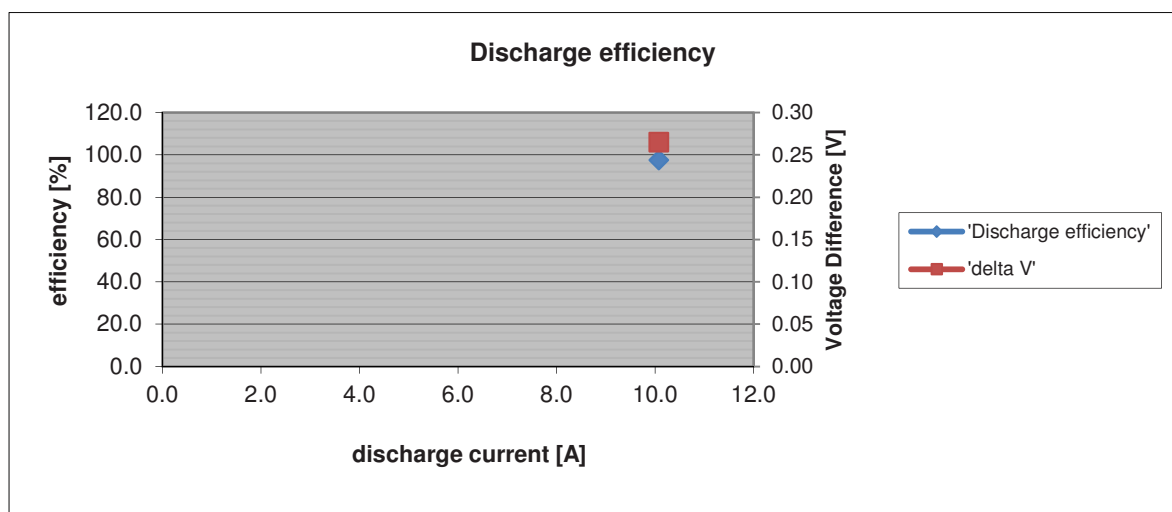
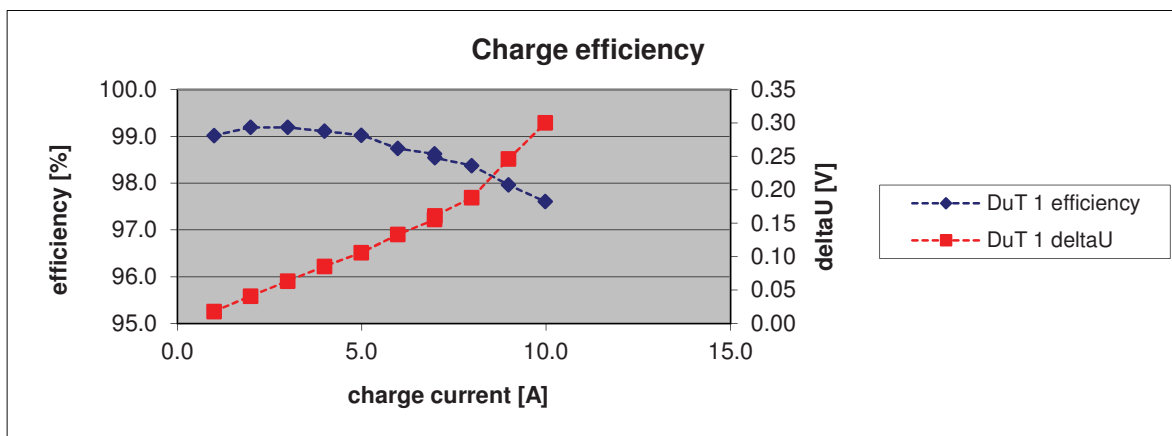
Remarks:	very high efficiencies	
Used measurement equipment:	V _{bat} :	Zimmer LMG 95
	I _{bat} :	Zimmer LMG 95
	V _{pv} :	Zimmer LMG 95
	I _{pv} :	Zimmer LMG 95
	V _{load} :	Zimmer LMG 95
	I _{load} :	Zimmer LMG 95
	T _a :	Tinsley 5885A

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:	10A
Rated max. discharge current:	10A

DuT	1	2
Reference	DIS0101-phc-1304	
Inspector:	fs	

Test at extended ambient temperature

time	PV-module		Battery		load		T _{case}	T _{ambient}	DuT	Comment
[min]	[V]	[A]	[V]	[mA]	[V]	[A]	[°C]	[°C]		
0	13.1	10.0	12.9	48.0	12.8	10.0	60.3	60.3	1	
15	13.2	10.0	12.9	42.0	12.8	10.0	62.0	60.4	1	
30	13.2	10.0	12.9	124.0	12.8	10.1	62.4	60.5	1	
45	13.2	10.0	12.9	135.0	12.8	10.1	62.5	60.6	1	
60	13.2	10.0	12.9	148.0	12.8	10.1	62.4	60.4	1	

Remarks: load was increasing and readjusted after 15 minutes.

Used measurement eq	V _{bat} :	Zimmer LMG95
	I _{bat} :	Zimmer LMG95
	V _{pv} :	Zimmer LMG95
	I _{pv} :	Zimmer LMG95
	V _{load} :	Zimmer LMG95
	I _{load} :	Zimmer LMG95
	T _a :	Tinsley 5885A
	T _c :	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:	10.0 A
Rated max. discharge current:	10.0 A

DuT	1	2
Reference	CIS0101-phc-130	CIS0102-phc-130
Inspector:	fs	fs

4.2.1 PV Overcurrent Protection Test ¹⁾

time	PV-module		Battery		Remark	T _{heatsink}	T _{ambient}	DuT
[min]	[V]	[A]	[V]	[A]		[°C]	[°C]	
0	13.2	12.5	12.9	12.4		26.9	26.2	2
15	13.2	12.5	12.9	12.4		33.0	26.1	2
30	13.2	12.5	12.8	12.4		36.1	26.9	2
45	13.2	12.5	12.8	12.4		38.1	27.9	2
60	13.2	12.5	12.8	12.4		39.1	28.1	2

4.2.2 Load Overcurrent Protection Test ¹⁾

time	Remark	Battery		load ²⁾		T _{heatsink}	T _{ambient}	DuT
[min]		[V]	[A]	[V]	[A]	[°C]	[°C]	
0	Load won't be disconnected. But overcurrent doesn't cause any damage to the charge controller	12.0	12.6	11.7	12.5	34.2	27.6	2
15		12.1	12.6	11.8	12.5	35.1	27.4	2
30		12.1	12.6	11.8	12.5	35.2	27.8	2
45		12.1	12.6	11.8	12.5	35.7	27.8	2
60		12.1	12.5	11.8	12.4	34.9	27.7	2

Remarks: ¹⁾ the nominal charging / discharging currents are defined for an ambient temperature of 25 °C (datasheet). The use at higher temperatures is possible at reduced currents.
The charge controller automatically limits the current respect. cut-off the load in order to protect itself

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	1	2
Reference		CIS0102-phc-130
Inspector		fs

Test	Behaviour / results		
	DuT 2	p/f	remarks
Protection against short circuited PV ¹⁾	test ok	p	
Protection against reversed polarity PV Module	test ok	p	
Protection against transient overvoltage (diodes, varistors) ¹⁾			protection via varistor according to manufacturer
Protection against short circuited load ¹⁾	test ok	p	
Operation with reversed polarity battery	test ok	p	

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:	Tinsley 5885A	

IEC 62 509 requirements?

x	passed		failed
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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	2
Reference		CIS0102-phc-130
Inspector		fs

Test	Behaviour / results			DuT
operating with disconnected battery	Load will be switched off;			2
	V load =	0.0 V	p Passed/failed	
removing battery during normal operation	Load will be switched off; all 3 LEDs on			2
	V load =	0.0 V	p Passed/failed	

Remarks	test with connected PV voltage (VOC = 22 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		CIS0102-phc-1308
Inspector		fs

Charge Controller is equipped with a LC-Display

		DuT
charging indication	yes, blinking LED	2
battery charged indication (charge status)	no	2
load cut off warning	no	2
battery discharged indication (load disconnection)	yes, 2 red LEDs on	2

Remarks:	Load disconnect warning via acoustic signal (beeper) All information are signalled via a LC-display	
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)

device	type	measured dimensions	reference number following DIN EN ISO 9001:2000
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

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Heidenhofstraße 2
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For the following activities

**Research, development and service in the fields of
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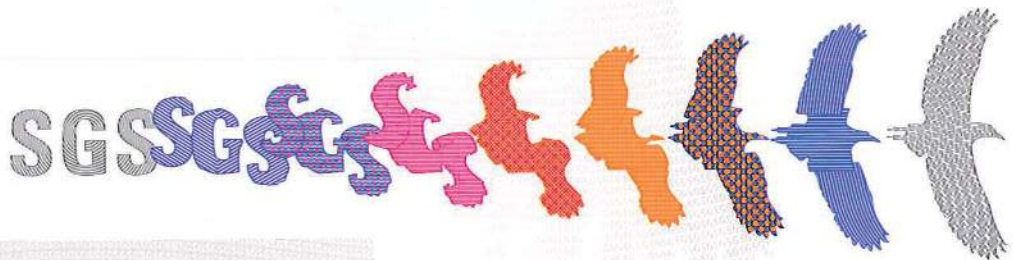
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