

TEST REPORT

Report no.:
236-EL-LAB-00XX-EN



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Page 1 of 7
Init.: BAH/#Co reading
Order no.: #
No. of appendices: #

Requested by:

Company: DTI
Address: #
Postcode/town: #
Country: #
Email: #
Telephone: # +45

Product: Battery or hybrid solar/battery system Type: #type

Sample: Receipt at DTI, Aarhus: #.#.2018, sampled by #company

Test period: Date of testing: #.#.2018 - #.#.2018

Procedure Test and assessment of Example - battery system in accordance with test and assessment procedure developed in the ELFORSK project "Benchmark of battery systems".

Issued: Date 26.09.2018, Danish Technological Institute, Aarhus, Electrical Laboratory.

Signature: Bjarne Johnsen #Co reading
#Title Quality Assurance



1. Documentation material

Se section 8.3.

2. Remarks

NOTE that this report is a constructed example.

3. The basis of the test

The results presented in this test report is obtained on the basis of the method described in the report "Metode til afprøvning af batterianlæg", where some results are provided by the supplier, some are obtained by tests and some are obtained by an assessment carried out by DTI. Note that this is an example only and the results is not based on a real test.

4. Product description

4.1. Test specimen

The battery system consist of:

Battery system part	Model no.	Serial no.
Inverter	Example	0000
Battery	Example	0000

Accessories:

- Assembly manual and user's instructions
- Specification sheet
- CE conformance declaration

5. Arrangement and premises for test

The battery system was installed in accordance with the report "Metode til afprøvning af batterianlæg", and the solar panels was simulated by using a DC source.

The test was carried out according to the test method developed in the ELFORSK project Benchmark of Battery systems.

Test of nominal output in accordance with the Benchmark test method was carried out connected to a nominal 230 VAC, 50 Hz connection.



6. Parameters provided by the supplier

Parameter	Value
Chemistry of battery cells:	Lithium Manganese Oxid (LMO)
Weight of battery:	85Kg
Height x width x depth:	715 mm x 570 mm x 510 mm
Nominal voltage of battery:	N/A
Voltage range of battery:	100V-140V
Nominal battery capacity:	N/A
Nominal battery energy:	N/A
Available battery capacity:	N/A
Available battery energy:	5.6 kWh
Noise emission:	58.9 dBA (1pW)
Expected cycle life:	6500 cycles

7. Test results

7.1. Static test

Parameter	Value	Unit	Remarks
Voltage range of battery at 50% load	102.6 - 139.2	Volt	
Voltage range of battery at 100% load	102.3 - 139.4	Volt	
Available battery capacity at 50% load	20.5	Ah	
Available battery capacity at 100% load	20.0	Ah	
Available battery energy at 50% load	5.1	kWh	
Available battery energy at 100% load	5.0	kWh	
Efficiency PV-Battery-load at 50% load	79.6	%	Note 1
Efficiency PV-Battery-load at 100% load	78.7	%	Note 1
Stand-by power consumption	18	W	
Deep sleep power consumption	12	W	

Notes:

- 1) This efficiency express the losses in the inverter when charging the battery from the solar cell and when applying the battery energy in the household plus the losses in the battery.

7.2. Dynamic test

Battery system efficiency during 24 hour dynamic test: 85.2%
 Battery package efficiency during 24 hour dynamic test: 80.1%

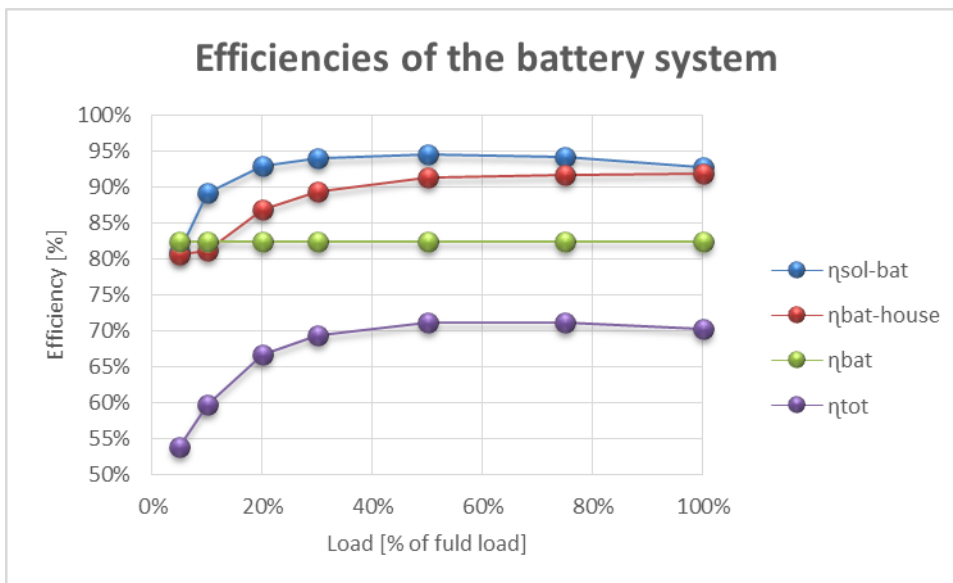


7.3. Test of high power electronics.

Battery system efficiencies for different loads

Efficiency solar cells to battery, $\eta_{sol-bat}$
 Efficiency battery to house net, $\eta_{bat-house}$
 Internal battery efficiency, η_{bat}
 Total battery system efficiency, η_{tot}

Load power	$\eta_{sol-bat}$	$\eta_{bat-house}$	η_{bat}	η_{tot}
5%	81%	81%	82%	54%
10%	89%	81%	82%	60%
20%	93%	87%	82%	67%
30%	94%	89%	82%	69%
50%	95%	91%	82%	71%
75%	94%	92%	82%	71%
100%	93%	92%	82%	70%

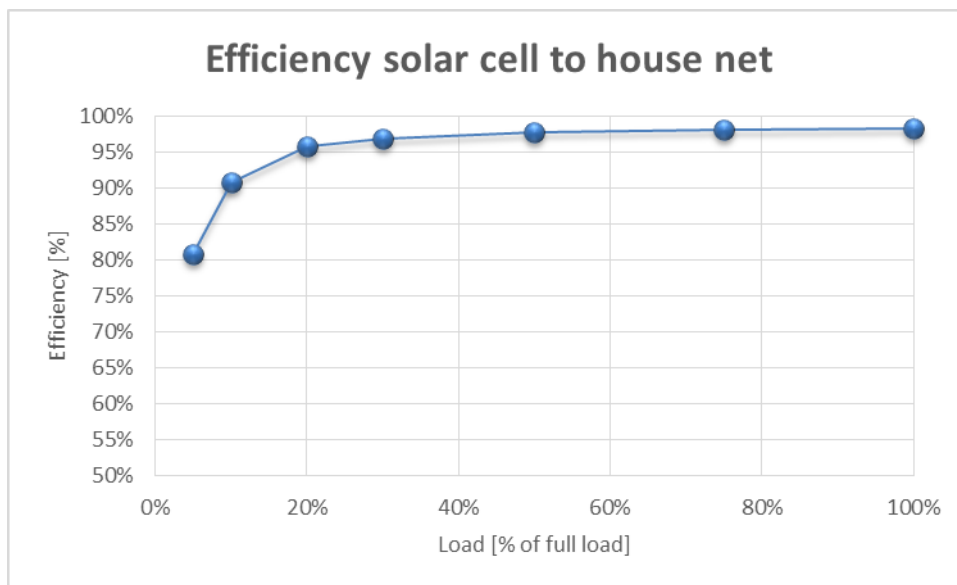


Yearly battery system efficiency according to EU norm: 76.9%



Efficiencies from solar cells directly to house net for different loads

Load power	$\eta_{\text{sol-house}}$
5%	81%
10%	91%
20%	96%
30%	97%
50%	98%
75%	98%
100%	98%



Yearly solar cells to house net efficiency according to EU norm: 96.6%

7.4. Weighted total efficiency

	Test pattern	η	Weight
1	Efficiency at 50% load	79.6%	20%
2	Efficiency at 100% load	78.7%	10%
3	Efficiency at dynamic simple operation	85.2%	40%
4	EU efficiency Solar-Bat-Housenet	76.9%	15%
5	EU efficiency Solar-Housenet	96.6%	15%
	Total	83.9%	100%



8. Assessment results

8.1. Lifetime calculation

Note that the lifetime data in the following is based on a coarse estimate.

Remaining energy content after a number of years at different temperatures.

Battery energy content after one to twenty years of operation [% of nominal energy content]					
Temperatur	1 år	5 år	10 år	15 år	20 år
5°C	91%	54%	12%		
25°C	96%	84%	68%	51%	31%
40°C	83%	30%			

Maximum battery lifetime

Temperature	Maximum battery lifetime	
5°C	5 Years	1450 Cycles
25°C	17 Years	6300 Cycles
40°C	3 Years	900 Cycles

At maximum battery lifetime the energy content is reduced to 40% of the original energy content.

8.2. Legal and safety requirements

Legal requirements

Requirement	Result
CE-mark location	Yes, on battery pack and on inverter
CE-mark according to Low voltage directive	Yes, according to certificate
CE-mark according to EMC directive	Yes, according to certificate
CE-mark according to ROHS directive	Yes, according to certificate
Prototype Test according to UN38.3	Yes, stated in user manual
Marking according to Battery and WEEE directive	Yes, on battery pack and on inverter

Safety assessment of lithium-ion batteries

Safety parameter	Result
Charge stopped before upper voltage limit	Stopped by inverter
Discharge stopped before lower voltage limit	Stopped by inverter

