Market launch of Lithium batteries for electric vehicles at Nepal

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"old" Lead-acid battery

weight : 360 kg

energy : ~11 kWh

life : 1 year

cost : 3'360$

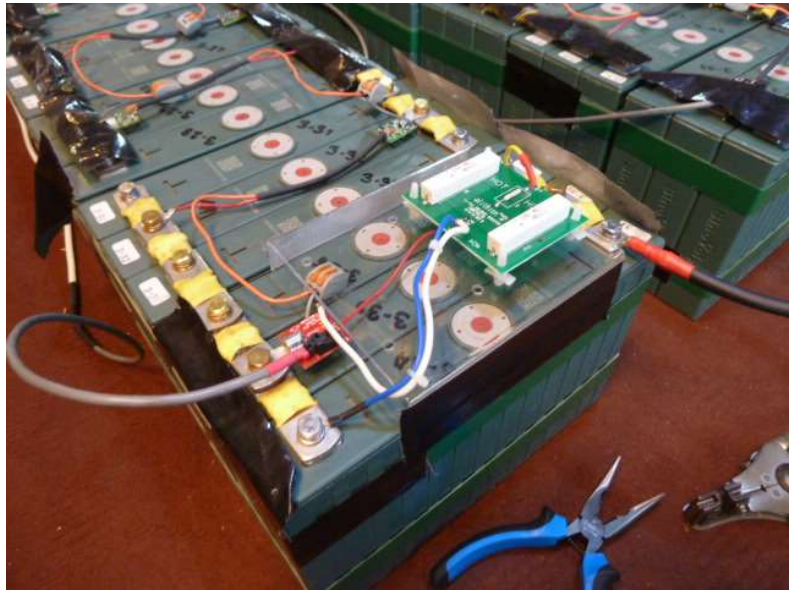
"new" LiFePo4 battery

weight : 223.2 kg

energy : ~18 kWh

life : 6-7 years

cost : 7'920$



Why we chose LiFePo4 cells ?

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LiFePo4 cells are:

- Safe in the vehicle because they do not catch fire even if they are mechanically damaged.
- Safe when loading, because they do not decompose exothermically even at higher temperatures.
- Easy to use because they do not need to be cooled.
- Energy efficient, because they have an Ah efficiency of nearly 100%.
- Heavy duty because they can be discharged with 3C (900A for a 300Ah pack).
- Very stable under load, because they have a very low internal resistance.
- Durable because they can reach at least 2000 cycles with 80% discharge and have a life of 6-7 years.
- Economical, because they are not very expensive and have a long live.

100 Ah Sinopoly LiFePo4 : 3 in parallel

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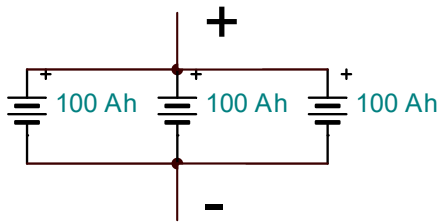

SP-LFP100AHA cell specification

Model name	SP-LFP100AHA	
Nominal voltage	3.2 V	Operating voltage under load is 3.0 V
Capacity	100 AH	+/- 5%
Internal impenetrableness	<0.7 mΩ	AC1kHz
Operating voltage	min 2.8V - max 3,65 V	At 80% DOD
Discharging cut-off voltage	2.65 V	The cells is damaged if voltage drops below this level
Charging cut-off voltage	3.7 V	The cells is damaged if voltage exceeds this level
Recommended charging - discharging Current	33 A	0.3 C
Maximum charging current	200 A	2 C
Maximum discharging current	300 A	3 C
Life cycles	≥ 2000Times	0.3C, 80% DOD
Operating thermal ambient - charging	0°C ~ 45°C	The battery temperature should not increase this level
Operating thermal ambient - discharging	-20°C ~ 55°C	The battery temperature should not increase this level
Storage thermal Ambient	-10°C ~ 45°C	The battery temperature should not increase this level
Shell Material	Plastic	flame retardants
Dimensions	142 x 61 x 221 mm	Millimeters (tolerance +/- 1 mm)
Weight	3,1 kg	Kilograms (tolerance +/- 100g)

Discharging diagram

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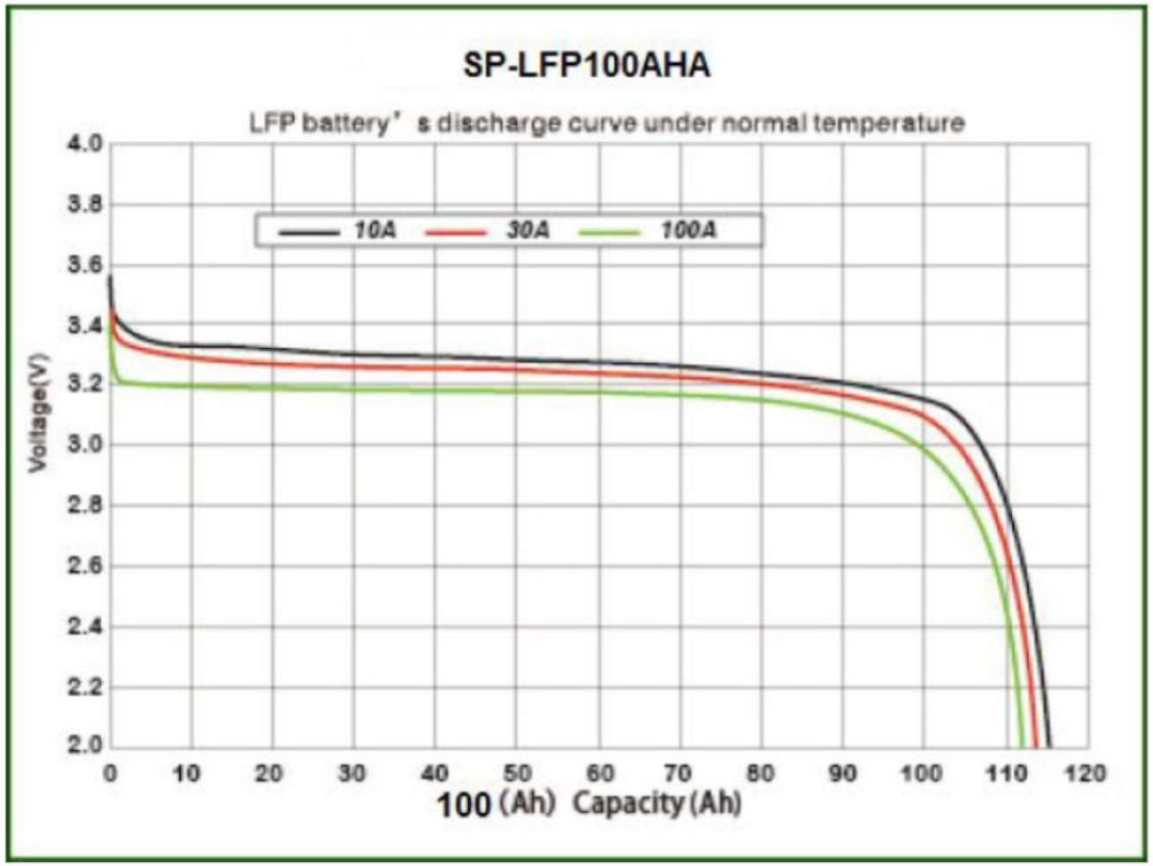
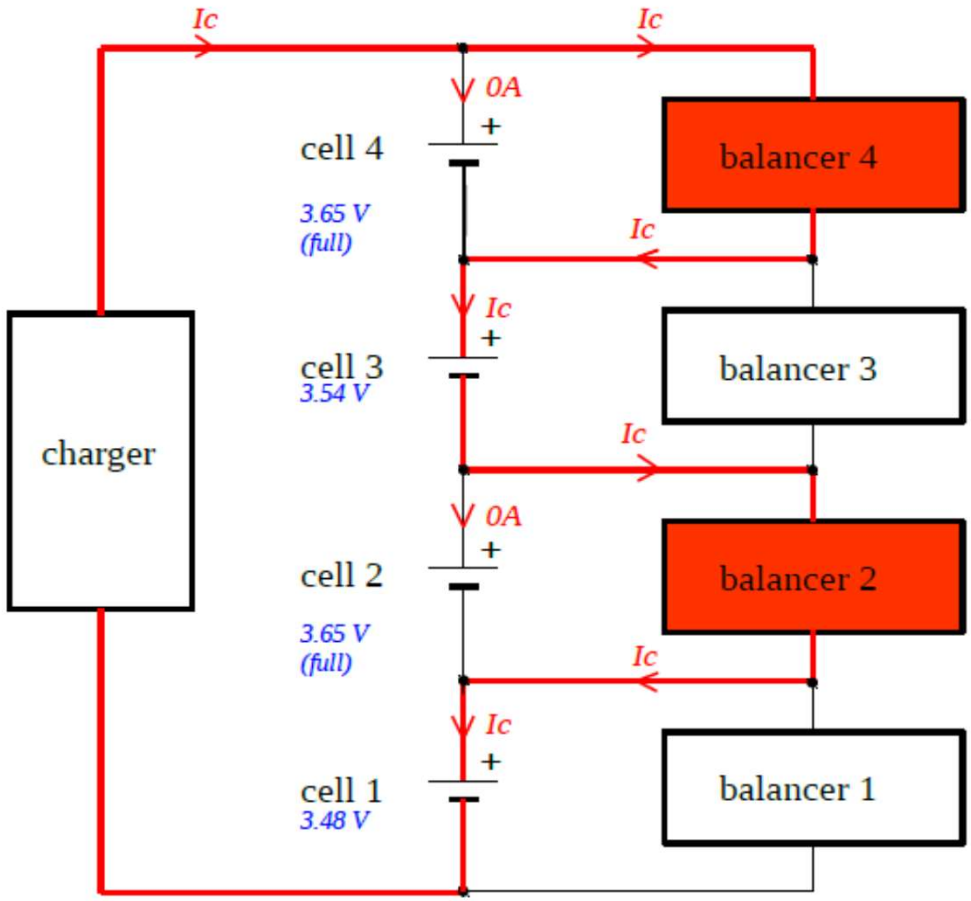


The capacity of a cell depends on :

- the temperature of the cell
- the discharge current
- the age of the cell

Balancing LiFePo4 cells



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for good balancing of the lifepo4 cells, I(charge) must be same or less balancing current

«New» cells without balancing

cell number	c 1	c 2	c 3	c 4	
resistance	0.0007	0.001	0.0008	0.0013	ohms
start capacity	100	100	100	100	Ah
discharge	80	80	80	80	Ah
disch. lost	4.48	6.4	5.12	8.32	Wh
eff. capacity	18.6	18	18.4	17.4	Ah
charge	83	83	83	83	Ah
charge lost	4.82	6.89	5.51	8.96	Wh
eff. Capacity	100	99	100	98	Ah

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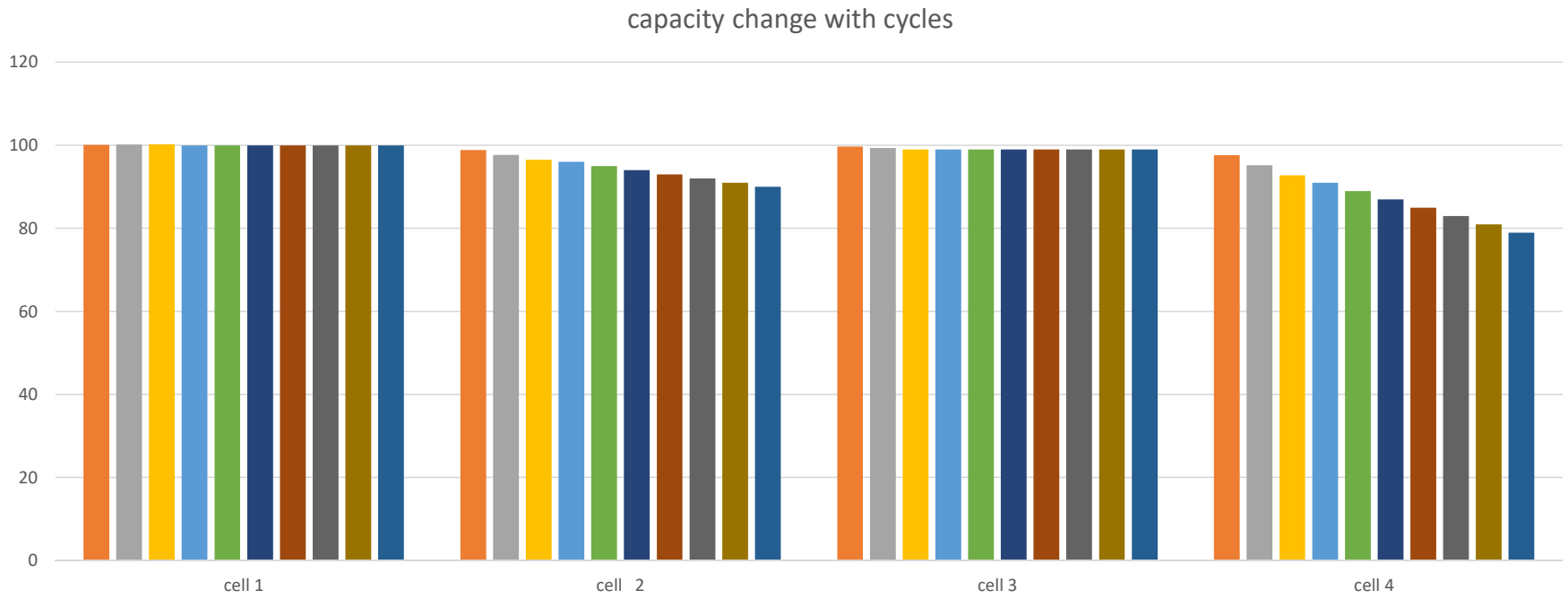

«New» cells with 1 hour / 2 A balancing

cell number	c 1	c 2	c 3	c 4	
resistance	0.0007	0.001	0.0008	0.0013	ohms
bal. time	1	1	1	1	h
bal. current	2	2	2	2	A
start capacity	100	100	100	100	Ah
discharge	80	80	80	80	Ah
disch. lost	4.48	6.4	5.12	8.32	Wh
eff. capacity	18.6	18	18.4	17.4	Ah
charge	83	83	83	83	Ah
charge lost	4.82	6.89	5.51	8.96	Wh
eff. capacity	100	100	100	100	Ah

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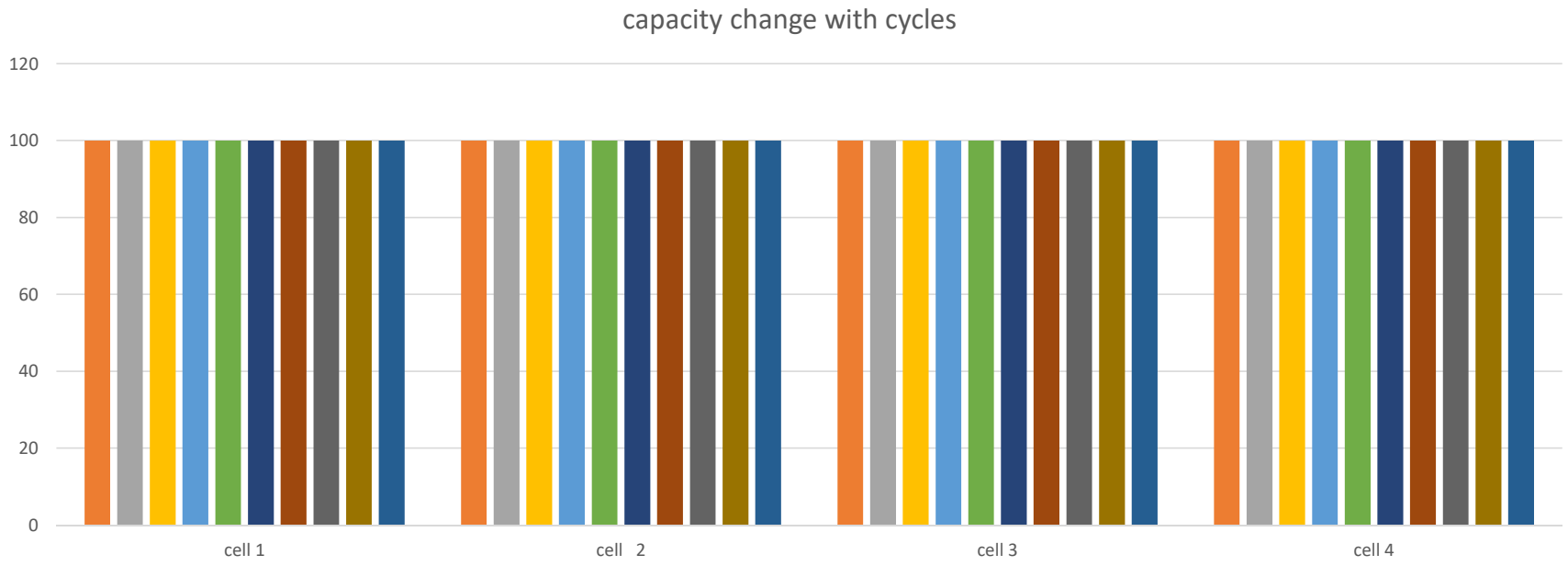

«Old» cells with 1 hour 2 A balancing

Cell number	c 1	c 2	c 3	c 4	
resistance	0.0009	0.0015	0.0012	0.002	ohms
bal. time	1	1	1	1	h
bal. current	2	2	2	2	A
start capacity	100	100	100	100	Ah
discharge	80	80	80	80	Ah
disch. lost	5.76	9.6	7.68	12.8	Wh
eff. capacity	18.2	17	17.6	16	Ah
charge	83	83	83	83	Ah
charge lost	6.20	10.33	8.27	13.78	Wh
eff. capacity	100	99	100	97	Ah

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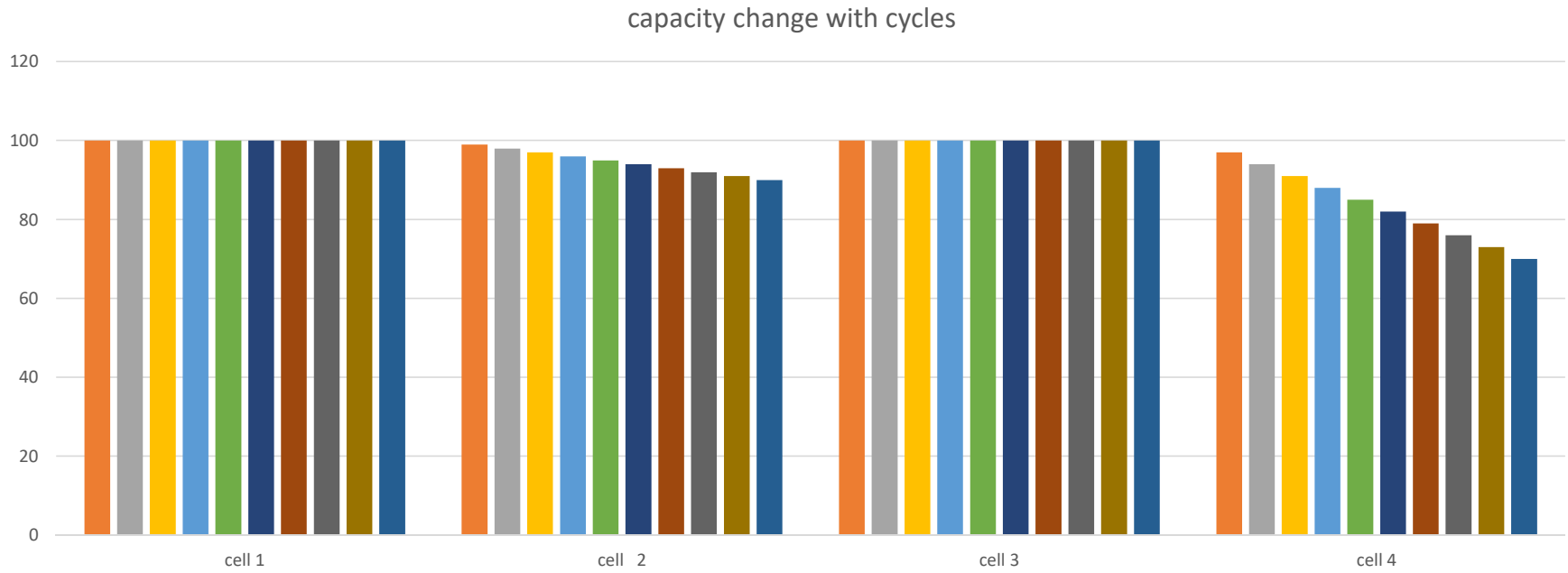

«Old» cells with 1 hour 6 A balancing

Cell number	c 1	c 2	c 3	c 4	
resistance	0.0009	0.0015	0.0012	0.002	ohms
bal. time	1	1	1	1	h
bal. current	6	6	6	6	A
start capacity	100	100	100	100	Ah
discharge	80	80	80	80	Ah
disch. lost	5.76	9.6	7.68	12.8	Wh
eff. capacity	18.2	17	17.6	16	Ah
charge	83	83	83	83	Ah
charge lost	6.20	10.33	8.27	13.78	Wh
eff. capacity	100	100	100	100	Ah

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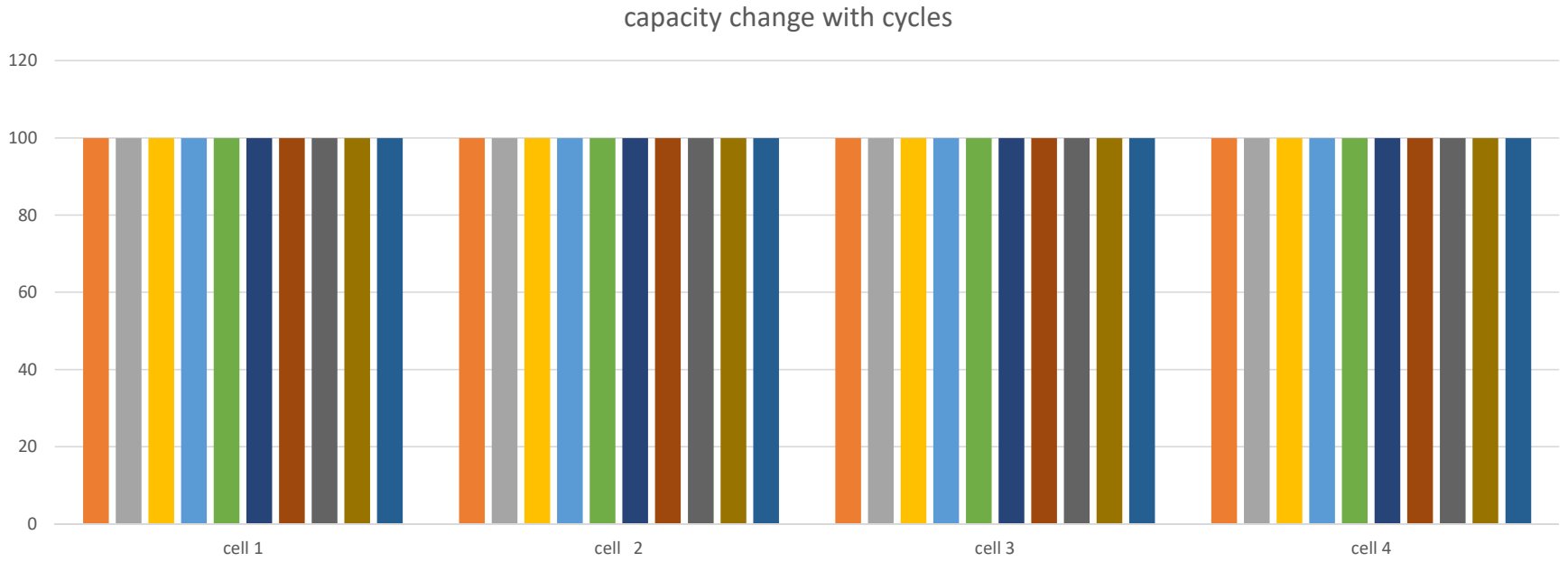
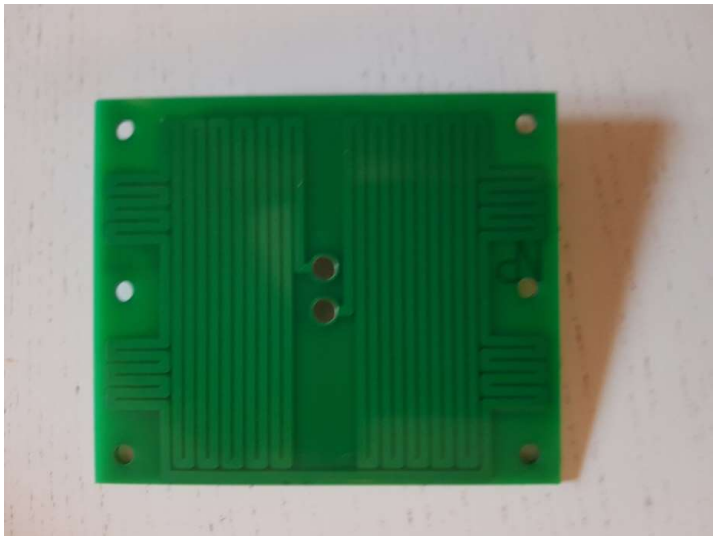
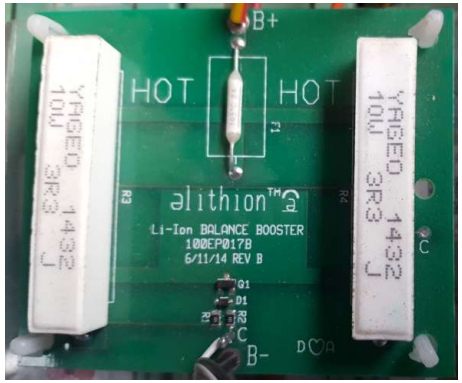


balance boosters :

Prototype of **6A** Balance booster,
developed at ZBW (St.Gallen)

With security function :
Booster begins auto balancing at **3.7V** and ends at **3.5V.**





2A booster from **elithion**

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Cell boards pos, mid and neg

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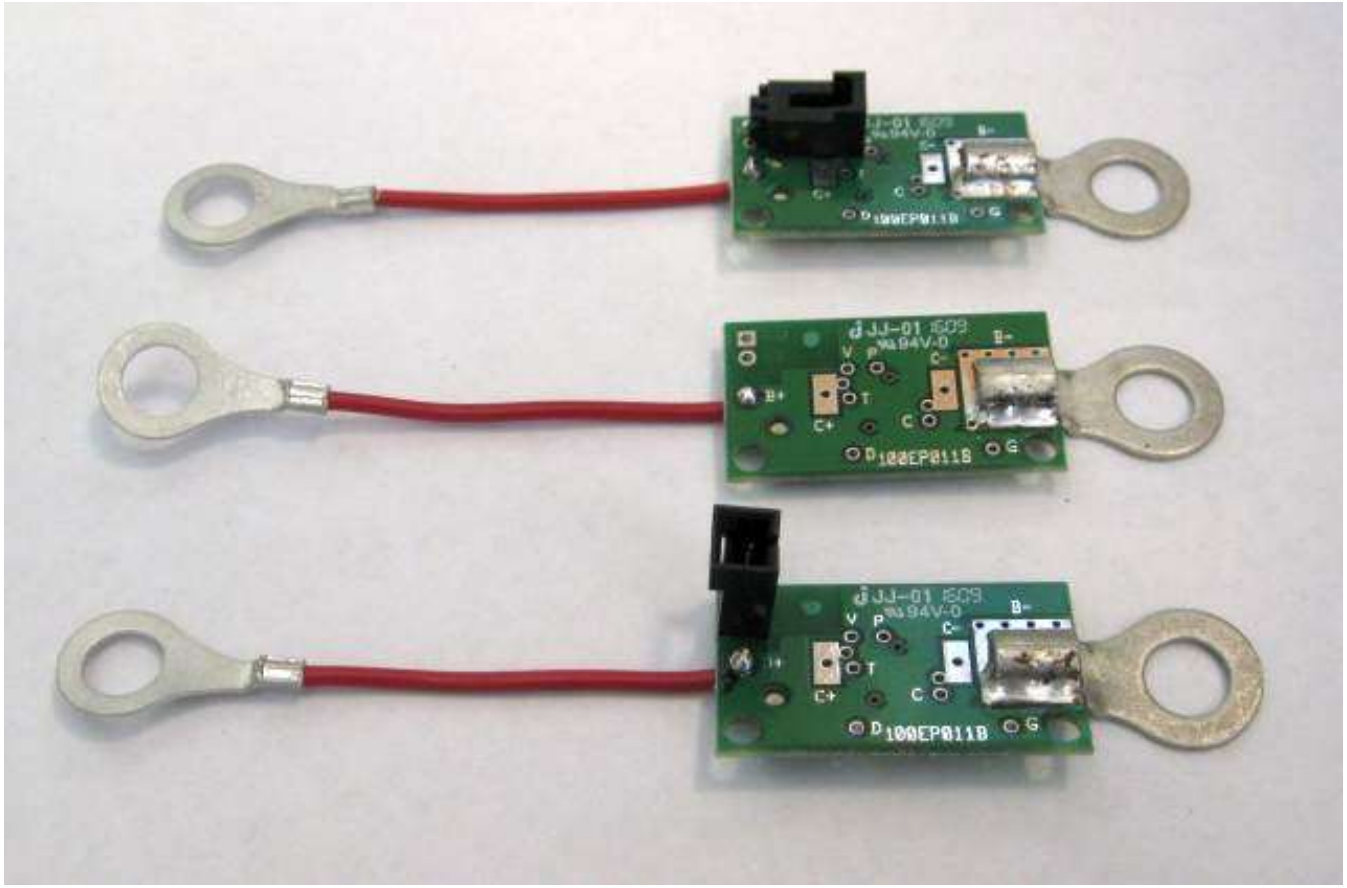

Cell boards are measuring temperature and voltage of a cell.

They have a small microcontroller with a isolated 1-wire communication line and a small capacity for balancing (200mA).

Each cell board has a control output line for one or more balance boosters.

They are very sensitiv on electrostatic discharge !

Battery management system (BMS)

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Collects data from cell boards

Controls charger over CAN

Balances the battery pack

Calculates state of charge (SOC)

Generates battery protection (DCL)

Enables data monitoring via USB

Why we chose «elithion» system ?

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- Flexibility : numbers of cells, cell chemistry type, safety is programmable
- Roughness : fully closed housing, industry type connectors
- Installation : easy for installation, because it’s a distributed system
- Cost : middle price segment, good price-performance ratio
- Support : flexible and fast response over phone and mail, if they know a answer

GUI : Graphical User Interface

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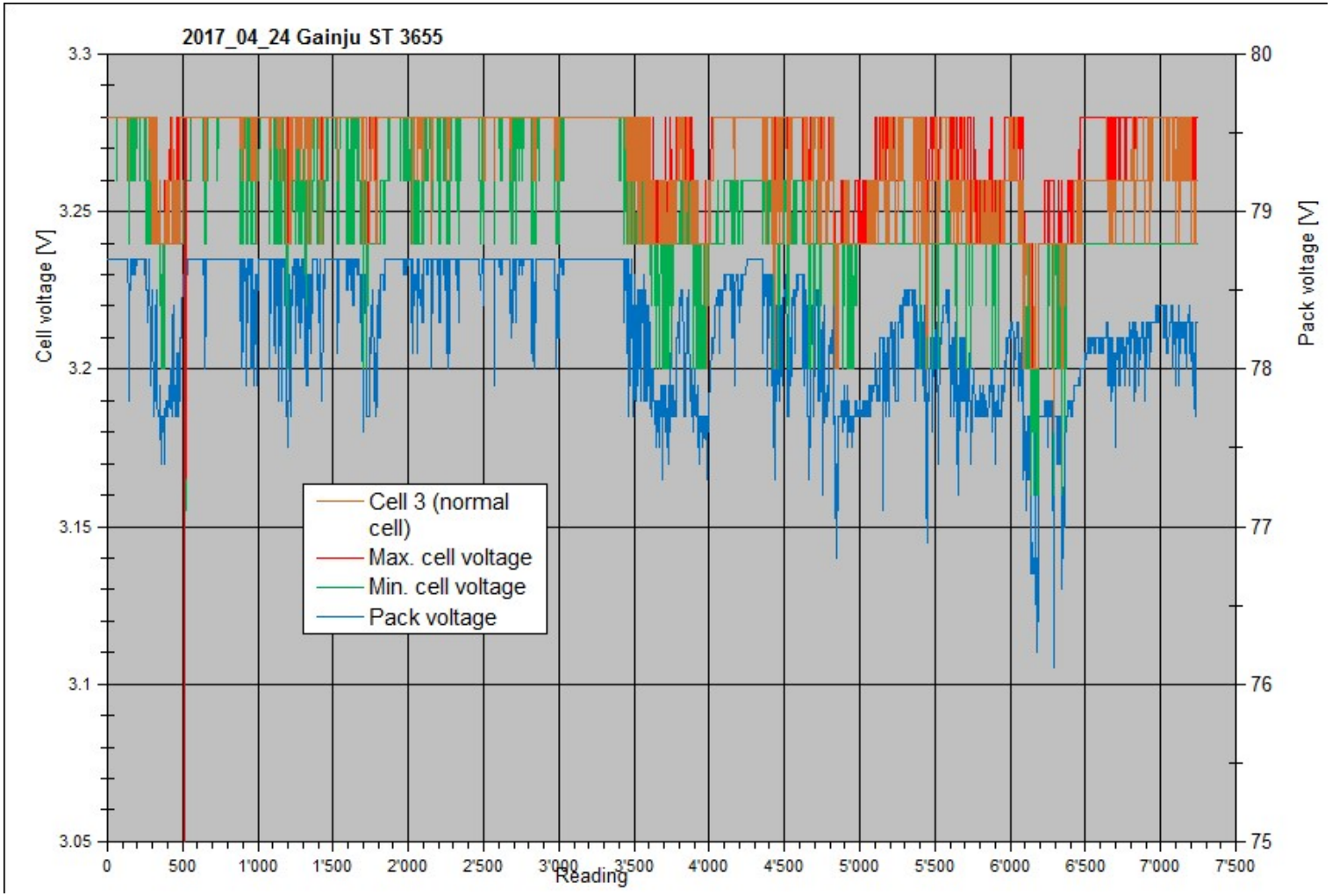
The GUI (on any laptop or pc) can collect data from BMS via USB.

In Configure mode, all parameters can be set.

In Test mode, outputs can be set manually for calibration process.

The GUI enables analysis of the health of the battery pack.

Data analysis from GUI-data's



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This excel-diagram shows voltage of cells and voltage of the battery pack while driving the Safa-Tempo.

Display in Safa-Tempo : BMV

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- Shows voltage, current, capacity of battery pack
- Makes a history of the charging cycles
- Protects the battery from deep discharge
- Is programmable for different battery types
- Has a model of LiFePo4 battery inside

At the end

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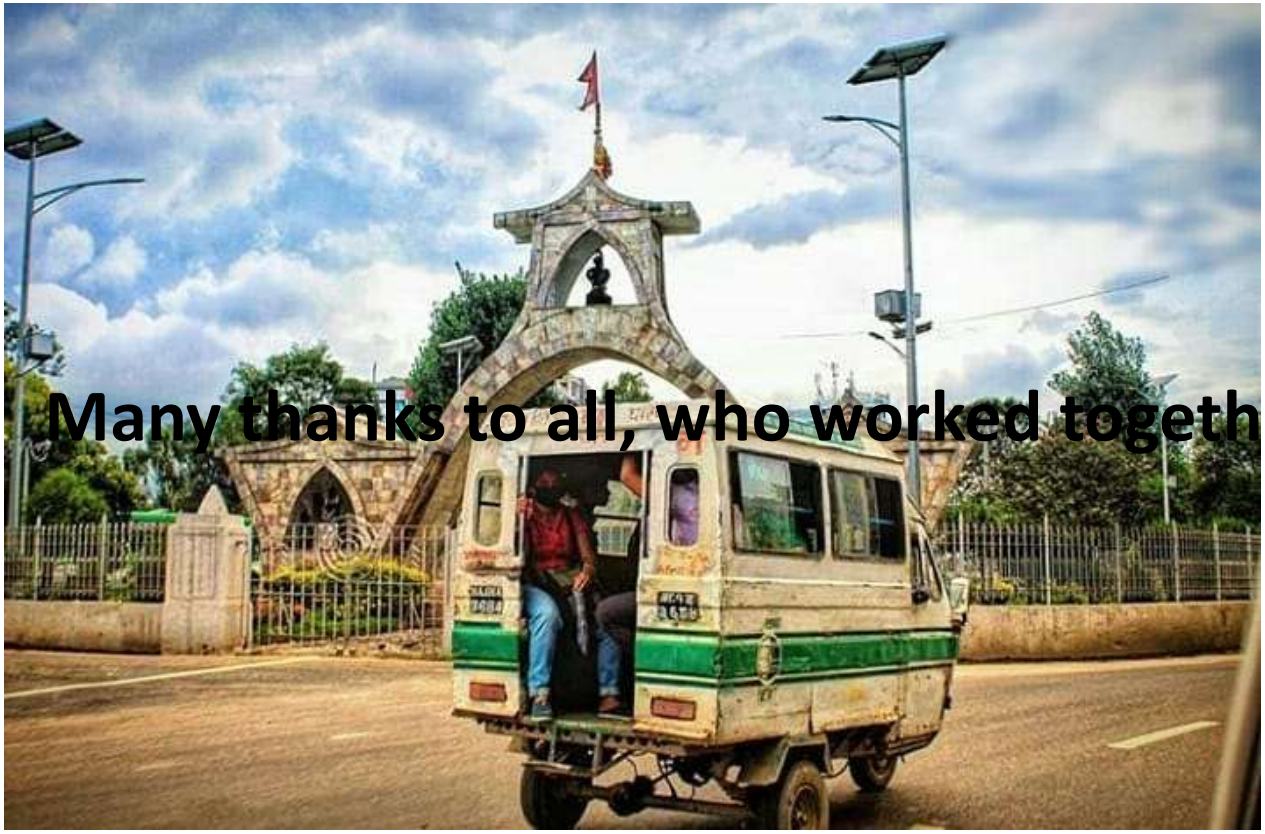

Many thanks to all, who worked together with us !

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