

How to do cell grading with the BaSyTec Test System?

Or: How to use the digital IO in the BaSyTec test system?

Introduction

An important task within battery packs manufacturing is the matching of the cells within a battery pack. Depending on the cell manufacturing quality, variations of about $\pm 5\%$ of the typical cell capacity are normal. In some cases the variation can be higher.

To avoid premature performance loss of battery packs it is important to use selected cells within one battery pack. Therefore a cell grading test should be carried out, to make different cell capacity classes. The following figure shows the principle.

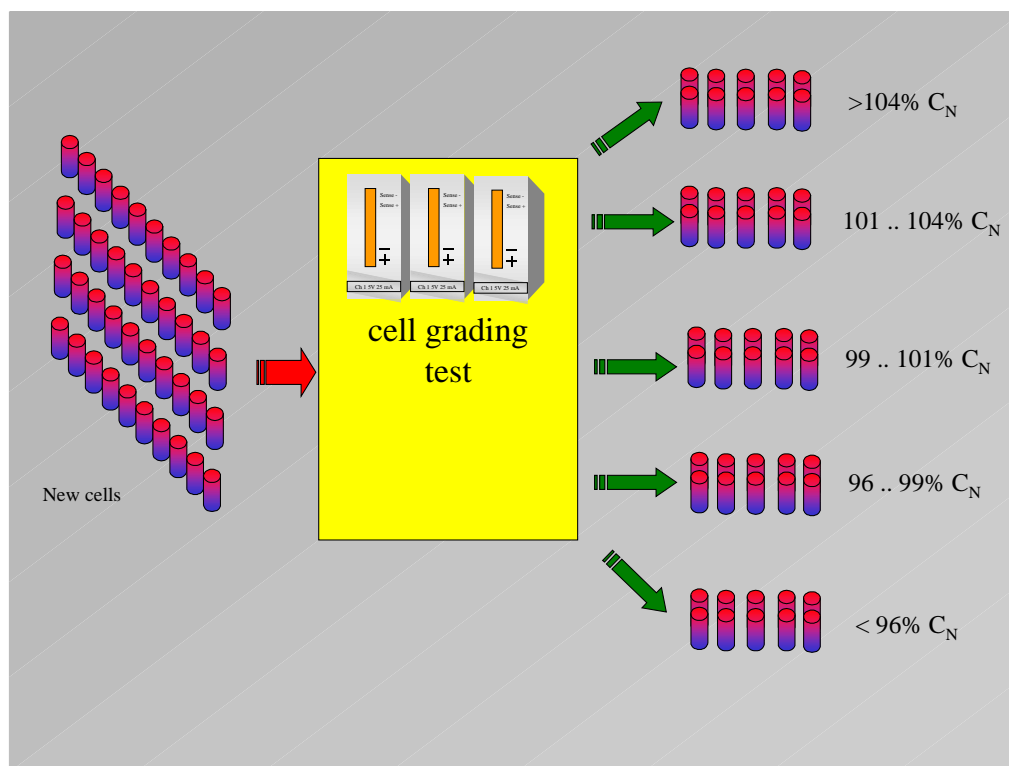


Figure 1: Principle of cell grading

The range of the classes depends on the battery type and the necessary battery pack quality. A good number of classes is between 5 and 10. Typical parameters for cell selection are cell capacity and internal resistance. All other parameters that are relevant for the performance of the target application are also possible.

However in most cases the battery capacity is a good parameter for cell selection.

System Set-up

The following figure shows a system set-up for cell grading where no separate computer is necessary. A computer is only necessary to start the program once. A cell test is started with a separate button (Start) and the result is displayed by some led. The led, the start button and the battery holder should be located close together. The number of channels running in such a cell grading mode is not limited.

The following things are important:

- It must be taken into account that the digital outputs can drive only negative currents (sink). Positive currents are limited to about 0.2 mA. Therefore the led must be operated with a common anode. This common anode must be connected to D0 and D0 must be set to +5V (by a simple hardware change: Please call BaSyTec)
- The digital output D7 is always (factory setting) digital ground (0V).
- A digital input must be set to high (1) and it is 1 in case of open circuit operation.

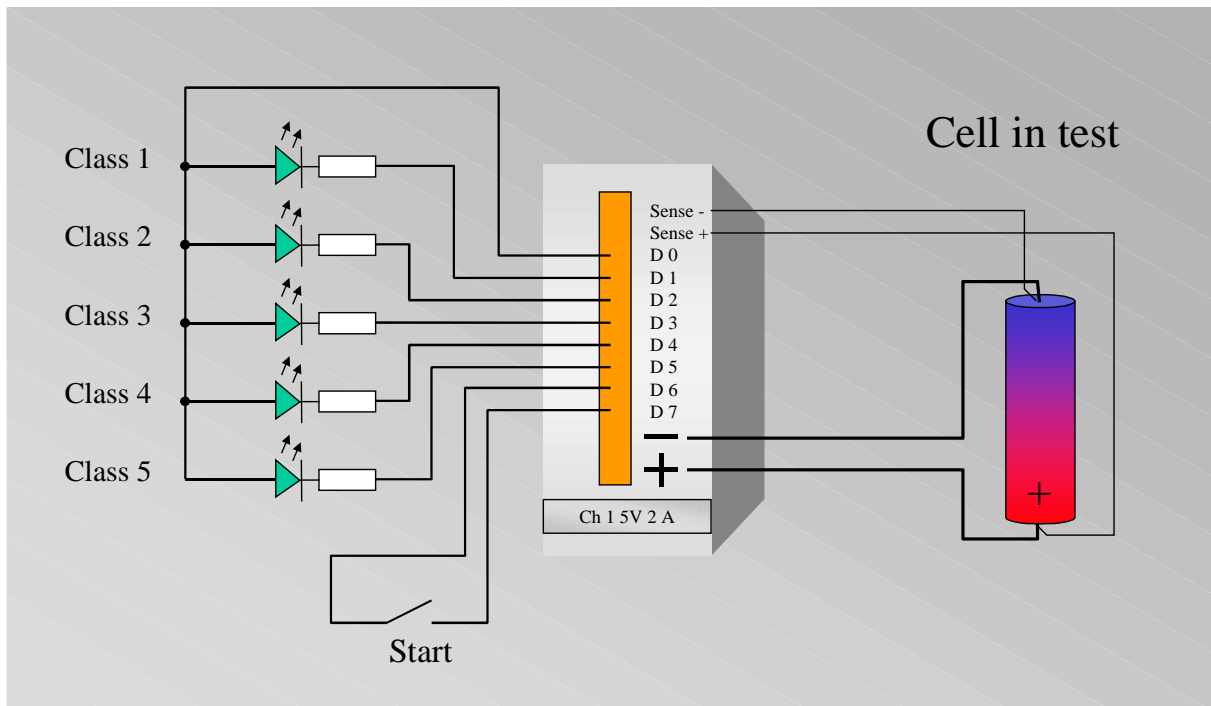


Figure 2: System set-up for operation without PC

Test-plan

The following table shows a testplan for a cell grading test.

The selection test is within a endless loop between line 3 and 23. At line 4 the test system waits until the user has pressed the start button (open 1, pressed 0). For defined start conditions the cell is first discharged (line 6) and then fully charged (line 7 and 8). Between line 12 and 22 the cell is step by step discharged. Depending on the discharged capacity the corresponding led is turned on with the set command.

	Label	command	parameter	Termination	Action	registration	comment
1		Start					
2		Set	DOut=255				All Outputs High
3		Cycle-start					
4		Pause		DIn6<0.5			Wait for start button Will go from 1 to 0 if start is pressed
5		Set	DOut=255				All Outputs High Turn all led off
6		Discharge	I=1CA	U<1V			First discharge the cells
7		Charge	I=1CA	t>2min			Start recharging Do not stop on -deltaV within the first 2 minutes
8		Charge	I=1CA	UMax-U>5mV			Charge the cells to full state of charge
9		Pause		t>2min			Wait 2 minutes (optional)
10	CLASS1	Discharge	I=1CA	U<1V Ah>0.96CN	Goto CLASS2		Discharge first 96%
11		Set	DOut2=0				turn led for class 1 on
12		Pause		t>1s	Goto END		
13	CLASS2	Discharge	I=1CA	U<1V Ah>0.03CN	Goto CLASS3		Discharge down to 99%
14		Set	DOut3=0				turn led for class 2 on capacity between 96 -99%
15		Pause		t>1s	Goto END		
16	CLASS3	Discharge	I=1CA	U<1V Ah>0.02CN			Discharge down to 101%
17		Set	DOut4=0				turn led for class 3 on capacity between 99 - 101%
18		Pause		t>1s	Goto END		
19	CLASS4	Discharge	I=1CA	U<1V Ah>0.03CN	Goto Class5		Discharge first 104%
20		Set	DOut5=0				turn led for class 4 on capacity between 101 -104 %
21		Pause		t>1s	Goto END		
22	CLASS5	Set	DOut6=0				turn led for class 5 on capacity is above 104%
23	END	Cycle-end	Count=99999				repeat 'endless'
24		Stop					

The above testplan do not register any data. Therefore it is possible to disconnect the PC from the test system after the program was started.

If data registration is of interest the following line should be added between line 22 and 23 and the End label should be changed to this line.

23	END	Pause		t>1s		T=1s	Store data
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Tips and Tricks

The following should be taken into account for use of digital IO:

- The digital port should always be initialized at the beginning of the testplan (See line 2 of the example).
- Do not short circuit the digital outputs.
- The digital IOs operate with TTL like levels. The maximum output current as source is about 0.2mA and as sink it is -20 mA. 0V is logical low and +5V is logical high.
- Normally the +5V line is not available on the connector. If the +5V is needed (for example to operate direct led, please contact BaSyTec.
- The IOs are connected with the internal power supply of the test channels. Therefore they are not potential free. Do not connect digital IOs of different channels. This will cause measurement failures.
- If isolated outputs are needed, a 8 channel isolated output card is available. Please contact BaSyTec for further options.