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Application report

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How to use climate chambers with the BaSyTec Test System

Introduction

Battery performance and battery lifetime strongly depends on the temperature. Therefore it is recommended to make battery tests within a well defined temperature range (for example 23°C +-2°C). It is also necessary to make some tests at higher temperature (for example 40 and 60°C) and at temperatures below the room temperature. For these tests it is necessary to control the temperature active. Depending on the battery type and the required temperatures, there are several methods possible:

Water bath:
A water bath is the simplest method if the test temperature is approximately not more than 20°C below or above the room temperature. A water bath can only be used if the battery terminals are on the top of the battery and the battery housing is water resistant. Normally lead acid batteries or stationary NiCd batteries fulfill this requirements. A heater inside the bath is used for heating. This heater is controlled by a temperature controller. It is also possible to use a cooler if temperatures below room temperatures are required. If a cooler is used it is recommended to circulate the water in the bath to avoid temperature stratification. As Water ha a high heat capacity the speed for temperature changes is limited.

Climate chambers and temperature chambers
Climate chambers and temperature chambers are more expensive than water baths. On the other side there are some important advantages, as water-free, faster temperature change and maintenance free operation. A climate/temperature chamber has an integrated temperature controller and available with (climate) or without (temperature chamber) humidity control. There are several manufacturers of climate chambers. A list is given at the end of this paper.

Control of climate chambers

The control of the climate chamber strongly depends on the type of the test. At tests where for a long time a constant temperature is required (cycle life test storage test) the temperature will be set by the operator at the beginning of the test and will then not be changed for several weeks or months. In this cases it is not necessary that the battery test system will control the temperature of the battery. A simple temperature monitoring will fulfill the requirements. However if there are tests where the temperature must be changed several times, for example if the discharge capacity as a function of the temperature is measured something like the following will be done:

1. Set temperature to RT
2. charge the battery to full state of charge
3. Set the temperature to 10°C
4. discharge the battery
5. Set temperature to RT

6. Charge the battery to full state of charge
7. Set the temperature to 0°C
8. discharge the battery

…..and so on

In this case the temperature has to be changed every few hours. A manual change is not effective, as night hours and the weekend cannot be used for testing.

For this type of tests we have added a interface and a control command in the basytec battery test software.

Key Features of the control within the Basytec Software

The organization and control of climate chambers is as follows:

- All installed climate chambers are defined in a database. Each climate chamber has an identifier (Id).
- Climate chambers use a dynamic link library (dll) as driver. This driver must be located in the basytec directory. There are several drivers available today. Se below.
- Within the test plan the command 'set-temp' is used to set the control parameters of a connected climate chamber. The test program then waits until the requested temperature is reached.
- When a new test is started it is possible to connect a climate chamber to the test channel.
- During runtime the actual parameters and the control parameters of the climate chambers can be displayed in a status window.
- Different test channels using the same climate chambers are synchronized.

Up to now climate chambers must use a **RS232 interface** (or other serial interface with an RS232 adapter) or an **ethernet interface (TCP/IP)** for control. Other interfaces are not supported at the moment.

How does the synchronization work?

If more than one channel is connected to a climate chamber the tests are synchronized as follows:

- The next setting of control parameters is carried out with the parameters of that test channel that first reached the 'set-temp' command.
- The control parameters of a climate chamber are only changed if all test channels that are connected with the climate chamber are waiting in the program step with the command 'Set-temp'.
- If the climate chamber has reached the control values then all test channels that have the same control parameters in the command 'Set-temp' will go on. All other test channels that are connected to the climate chamber will wait.

To guarantee that the battery will have the control temperature too, please insert a pause step after the set-temp step to acclimatize the battery.

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Supported climate chambers and their interface settings

The following table gives a list of the supported climate and temperature chambers:

Manufacturer	Model	Name of driver	Used Protocol	Baud rate	bit	parity	Stop bits	Hand-shake
Driver for RS232 Interface								
Angelantoni (only temp control)	microPLC	Temp_microPLC.dll	Adr = 17	19200	8	no	1	no
BaSyTec	MiniChamber	Basytec_Temp.dll	ASCII	9600	8	no	1	no
Binder	MK-DIC1000	Temp_binder_MK.dll	Modbus	9600	8	no	1	no
	MB1	Temp_Binder_MB1	Modbus	9600	8	no	1	no
	RD2 (no read of actual values)	Temp_Binder_RD2	ASCII	9600	8	no	1	no
	RD3	Temp_Binder_RD3	Modbus	9600	8	no	1	no
CTS	NN	Temp_CTS.dll	ASC 1	19200	8	odd	1	no
ESPEC	SU-221, 241, 261, 641, 661; SH-221, 241, 261, 641, 661; MC-711T, 811T; LH-113, LHL-113; LHU-113, LU-113; LC-113, 123, 223; LG-113, 123; LCV-233, 233P, 243, 243P	Temp_Espec.dll	CR as termination	9600	8	no	1	no
Haake	DC30	Temp_Haake_DC30.dll		4800	8	no	1	no
Huber	CC3	Temp_Huber_CCC3.dll		9600	8	no	1	no
Lauda	Proline RP845, RP855, RP870, RP890, RP1290, RP1840, RP1845, RP3530	Temp_Lauda.dll	CR+LF terminated	9600	8	no	1	no
Nema	CP340	Temp_Nema.dll	stx --- etx	9600	8	no	1	no
RuMed	CONTROL2000	Temp_RuMed.dll	stx --- etx	9600	8	no	1	no
SamwonTech	Temp 850, Temp 880	temp_dll_SamwonTech	CR+LF terminated					
Vötsch	HT 4002 (16dio,5ai)	Temp_voetsch_HT4002.dll	ASCII-2	9600	8	no	1	no
	VT4010/4020 (16dio,6ai)	Temp_voetsch.dll	ASCII-2	9600	8	no	1	no
	VTM4004/VT4002 (32dio,7ai)	Temp_voetsch_VTM4004.dll	ASCII-2	19200				
	HC2020 (24dio,7ai)	Temp_voetsch_HC2020.dll	ASCII-2	19200	8	no	1	no
	VCL6010 (32dio,7ai)	Temp_voetsch_VCL6010.dll	ASCII 2	9600	8	no	1	no
	All others with ascii-2; dio and ai are defined in an inifile	Temp_voetsch_Uni.dll + Temp_voetsch_Uni.ini	ASCII 2	4800, 9600 or 19200	8	no	1	no
Weiss	SB xxx *	Temp_weiss_simcon.dll	ASCII-1	9600	8	no	1	no
Universal	using a postbox file	Temp_Open_Interface.dll	ASCII File climate.pst	--	--	--	--	--

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Driver for tcp/IP Interface (ethernet)								
Vötsch/Weiss	All chambers that support ASCII 2 protocol	Temp_voetsch_TCPIP.dll + Temp_voetsch_TCPIP.ini	ASCII-2	IP address and tcp-port are setable at chamber and at the basytec software				

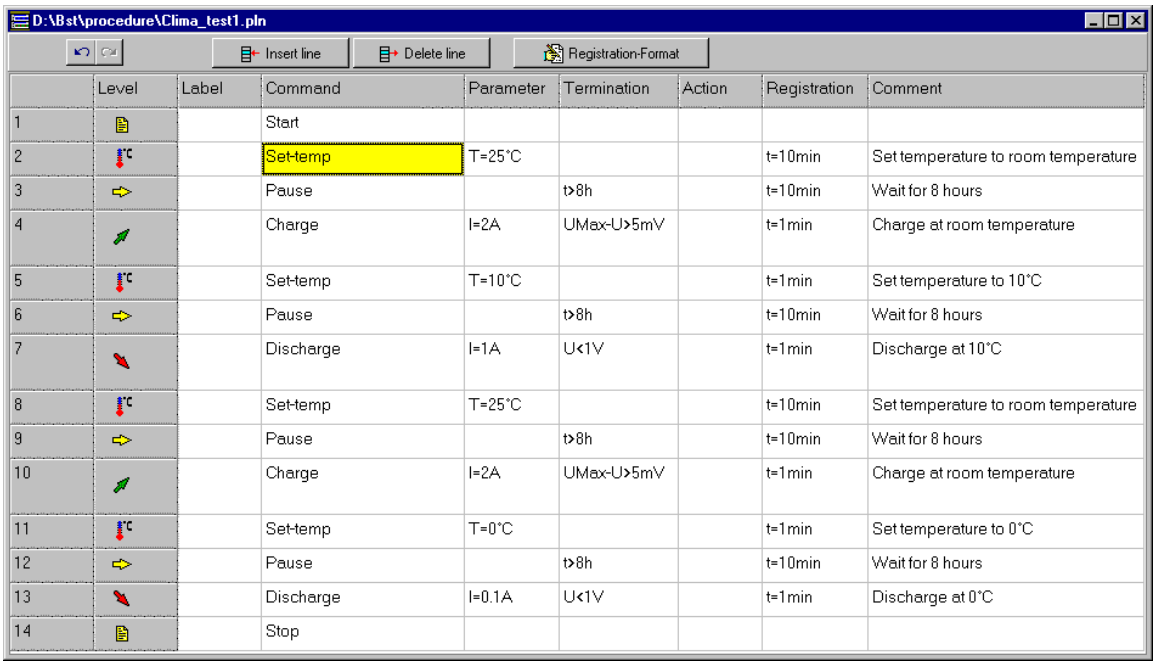
*: should also work with DU11, SBK, DU22, TS130, SBK, WK111, VC0, Sonder and all chambers with a SimCon32 control.

If a driver for another climate chamber or temperature chamber is required, please contact BaSyTec (Software@Basytec.de).

By use of the tool TempCha it is very simple to test if the communication between the Climate chamber and the PC works. Both, the Tool and the drivers are free for Basytec customers and can be downloaded from the update area of the Basytec homepage.

Example

The following figure shows an example for a test plan where the temperature control is used:



	Level	Label	Command	Parameter	Termination	Action	Registration	Comment
1			Start					
2			Set-temp	T=25°C			t=10min	Set temperature to room temperature
3			Pause		t>8h		t=10min	Wait for 8 hours
4			Charge	I=2A	UMax-U>5mV		t=1min	Charge at room temperature
5			Set-temp	T=10°C			t=1min	Set temperature to 10°C
6			Pause		t>8h		t=10min	Wait for 8 hours
7			Discharge	I=1A	U<1V		t=1min	Discharge at 10°C
8			Set-temp	T=25°C			t=10min	Set temperature to room temperature
9			Pause		t>8h		t=10min	Wait for 8 hours
10			Charge	I=2A	UMax-U>5mV		t=1min	Charge at room temperature
11			Set-temp	T=0°C			t=1min	Set temperature to 0°C
12			Pause		t>8h		t=10min	Wait for 8 hours
13			Discharge	I=0.1A	U<1V		t=1min	Discharge at 0°C
14			Stop					