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Manual

Phymex
Phybox PB1

English

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1 Phymex short introduction

Phymex is a convenient and intuitive useable data acquisition and experimentation software with Windows guidance for operation of the universal interface Phybox. Analog and digital display instruments, an eight channel recorder, a two point controlling system, a frequency counter, a function generator, a power pack, and a data table, tied together with mathematical combination and analysation opportunities, provide a wide range of measurement and experimental opportunities. In addition an integrated text editor module gives the convenient option to analyse and revise the experiment. In the information section, the user may save all necessary informations needed for the experiment. With a single mouse stroke on a specific index-card, located at the right side of the screen, any function may be selected.

1.1 Using the scales

The following functions are available on all Phymex scales:

Channel menu (manual determination of measuring range): Click on unit click-field

Range up by clicking at the upper end of the scale, e.g. 20V in this case

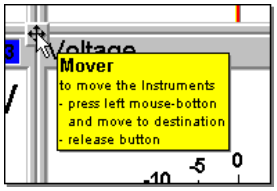
Automatical scale selection by mouse-click on the scale's center area, e.g. 0V as above

Shift the scale by dragging it

- press the left mouse button
- drag the mouse to the destination
- release mouse button

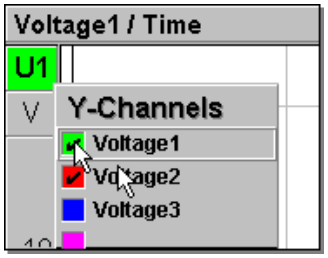
Range down by clicking at the lower end of the scale, e.g. -20V in this example

All Phymex scales run synchronously to each other. If you change the measurement range, e.g. on the recorder, all displays etc. become adjusted automatically.



Located on the index-card „display", a slide in the center of the four windows serves as a tool to change position, size and number (4,2,1) of the displays. If you prefer the analog displays to be shown without additional digital displays, simply switch them on/off by clicking on them. Due to deactivation of the analog scale (click at the area below the analog scale), a full-screen display can be generated.

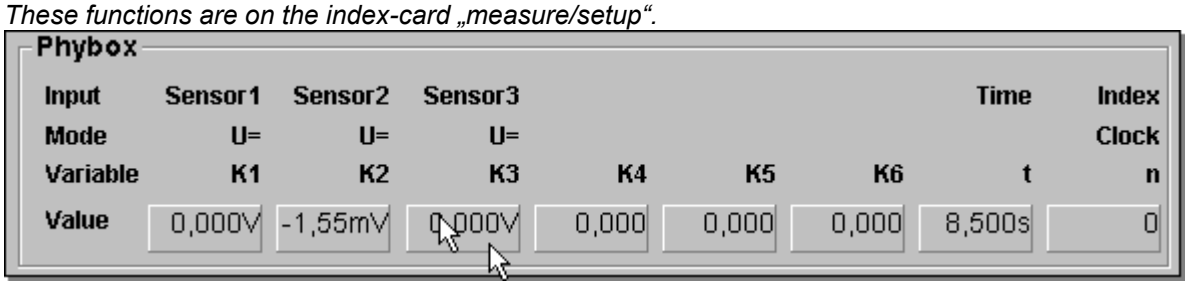
1.2 Selecting the displayed channel



If you click on the colored click-field at the scale's end (it shows a measurement unit), the channel menu appears. Click on the requested channel, and the menu becomes closed. The scale changes and adapts the channel selected.
The channel menu of the recorder's Y-axis (see left) gives enhanced options to select between channels, that may be additionally characterised on the eight-channel recorder, if you click on any of the colored click-fields (check mark = on). Selected channels may also be changed during or after recording. This gives the opportunity to e.g. assign the time base to the X-axis first, and to switch to XY-mode during recording.

1.3 Defining channels

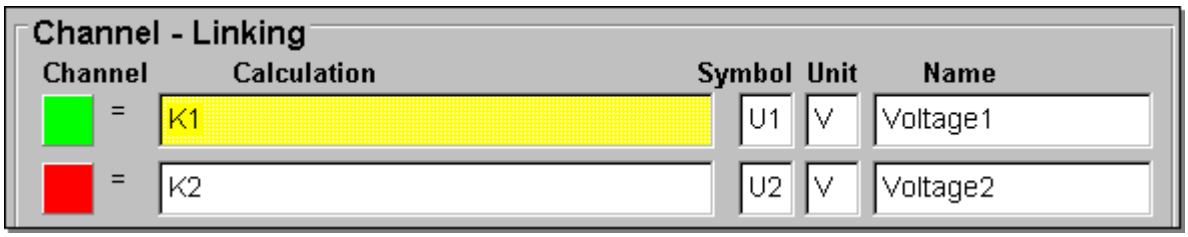
These functions are on the index-card „measure/setup“.



Phybox acquired data has to pass initial calibration, before it can be displayed at the Phybox display (data field) as illustrated above. To calibrate an input, click on the corresponding data field that matches the requested channel. A calibration window appears allowing two point callibration.

The current value is assigned to the variables K1.. K6^, t and Ind. At the *„calculation“* field, these variables may be linked freely and mathematically determined (e.g.logarithm, multiplication, etc.). In the following example, channel 1 is assigned to the variable K1, called Voltage 1. As a result, all Phymex instruments show the value of sensor 1 on the green channel.

Complex calculations, e.g. K1 * Log(K2 * 3.437) may be entered..



1.4 Measurement, report

These functions are located on the index-card „measurement/recorder“.

To start any record operation switch the recorder on by hitting the on-switch 1 (green) at the recorders toolbar (bar on the right). To stop recording press the off-switch 0 (red). During and after the measurement you may use the recorder tools to zoom, label curves, set tangents, or select a new base (X-axis) by clicking the colored tag of the X-axis, etc..

If curves and labels on the recorder are in compliance, activate the printer tool. This automatically inserts the finished recorded graph at a determined spot in your report. By selecting *„File/ Insert Bitmap“* on the menu bar, graphic files can be integrated into the report. Any graphic can be enlarged or be made smaller (click on the picture, move anchor point) as liked. On a text-sheet a graphic is treated like a letter, moving pictures is carried out by *„Edit/Cut“* and *„Edit/Insert“*.

Tables become inserted into the report by means of the recorder’s table-tool. Information as well as the report may be printed out on your Windows printer by selecting *„File/Print“*.

1.5 Saving experiments

After completing your experiment, lock (*„File/Lock“*) and save it (*„File/Save“*). The lock command write-protects the information data, and asks for a password to save the experiment file. On the experimentation file, the current status of Phymex, considering all settings, becomes saved. After loading up the file, the saved configuration becomes displayed on the screen again. With *„File/Add Icon“* you may insert an experiment-icon into the Phymex group of the program manager, which allows direct load-up of the experiment. If an icon named the same like the experiment (e.g. exp.ICO) does already exist, that one will be used.

2 Starting the program

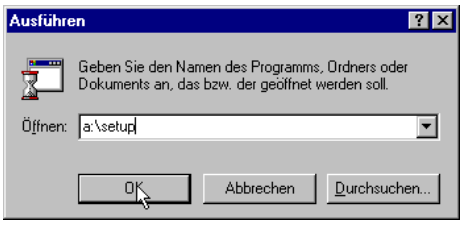
2.1 Minimum requirements:

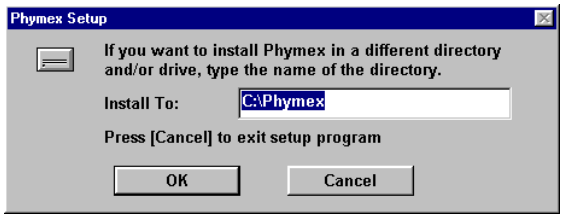
IBM compatible PC meeting the following requirements:

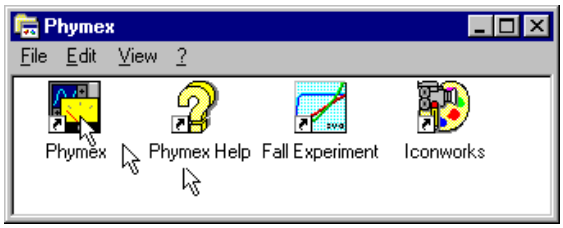
- 486DX 66 MHz
- 16 megabyte RAM memory
- 4 megabyte free storage space on the harddisk
- MS DOS 5.0 and Windows 3.1, or Windows 95
- a free buffered serial port, e.g. Typ 16550

For fast operation:
- Pentium 200MHz
- 32 MB RAM

2.2 Installation







Stick to the following steps at installation of Phymex:
- start Windows
- select *'File/Run'* in the program manager
- insert disc into 3.5" drive
- Enter drive + „setup", (e.g. „a:\setup")

This starts the Phymex installation program. If the program is loaded from disc, you will be asked in which language, and what drive and directory you want to install Phymex. Phymex becomes installed now. You will find a new group called „Phymex" in the program manager. If you open that group, you will see the Phymex symbol, Phymex help, an icon drawing-programm, as well as an example for experimentation.

The delivered serial cable provides the connection between Phybox and a serial port of your PC (Please connect Phybox first, then the PC).
Finally connect Chembox to a socket and switch it on. The bottom relay-light will illuminate.

Doubleclick the Phymex symbol in the program manager to activate Phymex, Phybox also starts operating now. The software detects the serial port Phybox is connected to (COM1 to COM4), and automatically sets the serial port parameters. You may start with your measurements now!

Caution: Windows 3.1 as well as Windows for Workgroups 3.11 are hampered with distributed bugs on serial port drivers. All users of **SMC-serial-chips** are affected. The corrected drivers are on the Phymex setup-disc in the WIN_BUG directory. To install the new drivers, exit Windows, go to the WIN_BUG directory, and enter SETUP. The new drivers become installed now.

2.3 Trouble shooting

This chapter deals with the most common problems, and gives clear instructions for removal.

Phybox Relay-LED does not illuminate

- Check if the mains-switch in the rear of Phybox is set on „1“ (ON).
- Make clear that the power-cable is good, and correctly plugged in.
- Check if the Phybox-fuse is still good.

Unsuccessful connection of the serial cable

- The cable has not been connected to the serial port of the PC, but to the parallel port. Simply plug it into the other socket (firstly connect the cable to Phybox, then to the PC).
- The only serial port on the PC is reserved for the mouse, a further one is not available. You can only get rid of this problem through the installation of an additional serial port (please use a buffered serial port, e.g. type 16550).

The setup program cannot be started

- Exit Windows and start it again.
- Try the following: Programm-manager → menu *‘File/Run’* → *scan* → drive: *a:* or *b:* → filename: *SETUP.EXE* → *OK* → *OK*

Phymex cannot be started

- Exit Windows, restart Windows and Phymex.
- Try to test the software on an other PC. If this attempt turns out to be successfully, check your Windows installation, maybe you need to do a new Windows installation.
- The program is loaded, the main window remains grey though, or sections of the screen do not get drawn right, or Phymex sends a message „Out of Memory“, etc.. In that case your systems resources are running short. The resources in Windows 3.1 are restricted to 64000 byte, a big issue for operation of graphic intensive software like Phymex. Windows 95 removes this problem, the other option is to close programs not needed. Close all open applications (except the program manager) and restart Phymex. It may also be helpful to delete autostart programs of the autostart group.

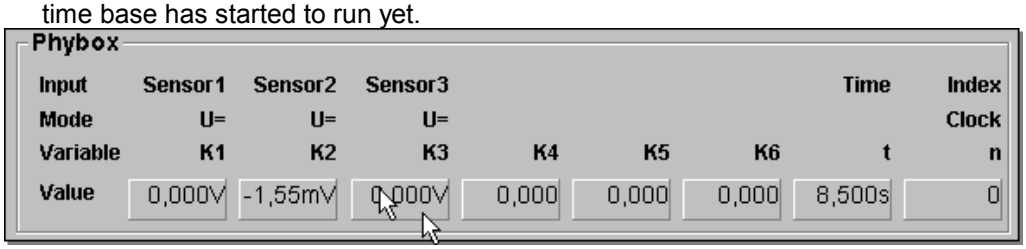
Phymex starts and sends a message „Phybox not active“

The reason for this is that Phymex is not able to communicate with Phybox. Phymex is checking all available serial ports of the computer to find Phybox, that sends ‘Phybox PB1....Phybox PB1....’ in neutral status at 19200Baud 8N1.

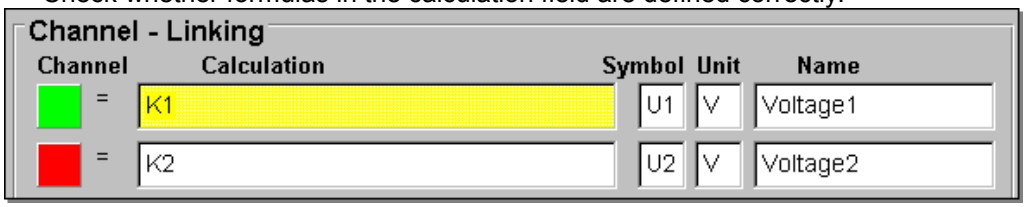
- Is the serial cable plugged in correctly?
- Does the serial cable meet the requirements, and is it good? You need a 25pole modem-cable, e.g. PIN 1 of the plug is connected with PIN 1 of the socket on the other side, PIN 2 with PIN 2, etc.. *Caution: Do not use a crossover cable.*
- Switch off Phybox, and switch it on again. Give it a new trial.
- Check if the serial port of the computer works. Therefore exit Windows, connect your mouse at the port to be tested, and restart Windows. If the mouse pointer can be moved as usuallay, you have got a good port.
- Using a terminal-program, check if Phybox sends the following messages at 19200 baud, non parity, 8 databit, 1 stopbit on the port: ‘Phybox PB1....Phybox PB1.....’.
  Switch Phybox off and on, and try again.
- Another message „Phybox with the serial number ... has not been registered“ appears: Install the setup disc with the matching serial number. The installation may be interrupted after a certain language became selected, since registration has already been carried out.

Phymex starts but does not show any measured data

- Check if at *'Option/Samplemode'* the sampling-clock has been set by pushbutton.
- At „Setup“, check whether the measured data (see „Value“ window) comes from Phybox, and if the time base has started to run yet.



- Check whether formulas in the calculation field are defined correctly.



- Check whether the recorder switch is set on „1“ (green). It has to be activated first, before recording can start.
- Check if the right measuring range became chosen. Press the „autorange“ key on the recorder.
- Check if all sensors are connected correctly. Watch the polarity while connecting the banana-jacks. At connection of the 7pole DIN socket you need to consider, that sensors of an other producer may have an different layout. Compare the layout with the input-positions described in this manual, and adjust the pin-positions if necessary. Never plug in a sensor deviating from this, because the sensor may become seriously damaged!

Phymex shows false measured values

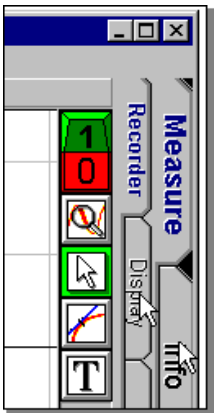
- Check the input formulas and calibration.
- The probes need to be calibrated considering corner values widely laying apart, and above the approximate measuring range used. Consider that Phymex is two-point calibrated (linear). That does not remove dislinearity, but it may be compensated linear through the right selection of the calibration point.
- Do you recognize greater spikes (peaks) of the signal measured from time to time? Most of the time the reason can be found in the serial port of the PC.Use a serial port with an integrated buffer (e.g. type 16550) if possible. Unbuffered serial ports tend to carry out wrong transmissions, the software can only prevent to a certain limit. If too many mistakes do occur, this is not possible anymore, leading to reproducable spikes.
- Strong electromagnetic fields fake the measured result of Phybox. Take care to keep enough distance between Phybox and strong high-frequency transmitters (interfering facilities) to avoid current noise levels.
- „60Hz-drones“ of transformers and mains lines, close to the measurement lines, may result in poor quality measurement of signals with current noise levels. Please provide enough distance!

If you still have problems with the operation of Phymex, do not hesitate to call our hotline service.

Note:

- The speed of the program basically depends on the memory (16megabyte = slow, 32MB = good, 128MB = best), and the processor type used (486DX=slow, Pentium133 =good, Pentium200 =best).

3 Operation of Phymex

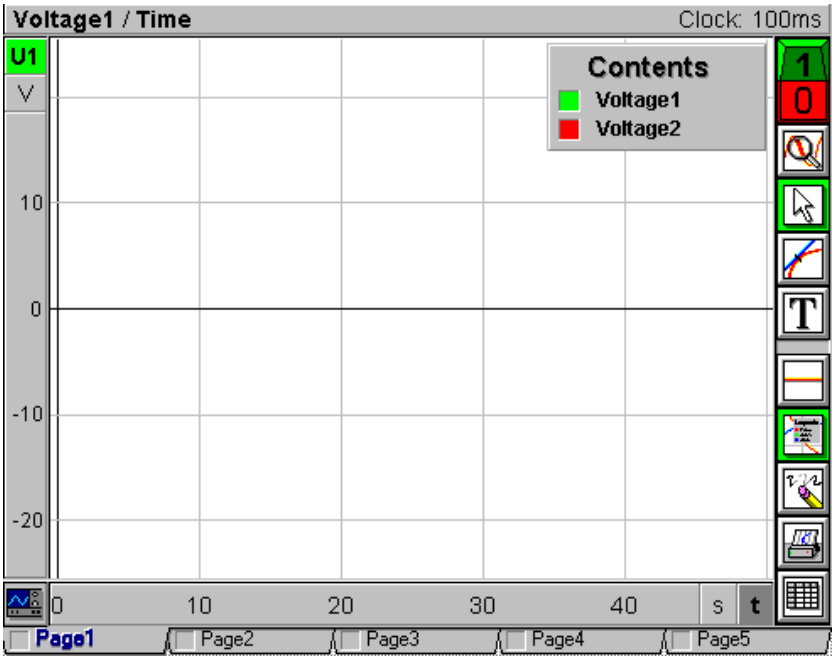


Chose the desired Chemex function on the index-cards at the right end of the screen. If you click on *"Display"*, the display index-card will be activated. If you hit *„Info"*, the information page is shown.

The following index-cards are available:

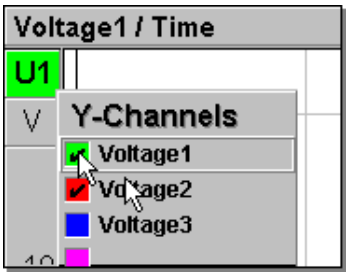
- Measurement
  1. Recorder (Eight channel recorder Y-t, Y-n, X/Y)
  2. Display (one to four analog/digital instruments)
  3. Setup (Calibration and calculation)
  4. Control (2-point controllers)
- Info (User information)
- Report (Experiment documentation - integrated text editor)

3.1 Recorder



The Phymex recorder is an universal 8 channel Y/t and X/Y-recorder. The titlebar of the recorder shows the current assignment to the axis, as well as the current mouse position. Using the listbox (right above), the dutycycle of Phybox may be adjusted.
On the right side of the screen you will find a toolbar, providing an ON/OFF switch and tools for revising, like zoom, tensions, lines, labeling, legend, etc..
You may assign any variables to the axes (X and Y), allowing vice-versa display of any variables.
The recorder allows up to five measurements to be recorded, overlied, and viewed in a row by means of index-cards located below the X-axis.

3.1.1 Selecting the displayed channels and bases



By clicking on the colored click-field of the Y-axis, the Y-channel-menu appears (see left). It lists all color-fields and names for each channel. If you click on any color-field, a check-mark appears, symbolizing the channel's active status on the recorder. According to the setting on the left, a green and a red curve will be drawn, representing Voltage1 and Voltage2. Data assigned to the Y-ruler is selected by clicking on the channel's name. In this case, the bar shows Voltage 1 (superior channel). The selection of the basis (X-axis) is done accordingly.

3.1.2 Recorder tools

ON/OFF switch

Click on 1 (green) to start recording,
click on 0 (red) to stop recording.

Zoom

Key for zoom ON/OFF; zooming:

- press zoom symbol
- move the cursor to the upper left area, subject to magnification
- press left mouse button
- define the area of interest by dragging a rectangle
- release mouse button

Switch off zoom function by clicking on the zoom-symbol.

Standard

Deactivate straight lines and text tools.
The standard, line, and text-tool can only be activated one at a time. These three tools take turns.

Line

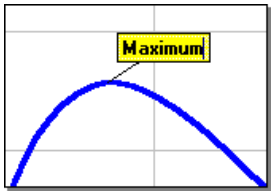
To position attendend and a best fitting curve, do the following:

- click on the line-symbol
- mark any critical point on the curve to identify the tensions position
- press left mouse button, and move to the end of the line
- release left mouse button

Text

To label curves on the recorder:

- click on the text-tool
- move mouse to any point to be labeled
- press left mouse button
- enter text



Eraser

To erase labels and lines.

Line-width

To adjust the curve's line-thickness.
Activation of this function changes the line's thickness to three points. If left in neutral position, thickness is one point.

Legend

Click on the legend-tool to turn the recorder's legend on/off.

Print

To copy records to a report sheet:

- click on the printer-symbol
- set the text-cursor at the wanted insert point on the report sheet
- press OK

Table

To insert a table into your report, listing measured data of all active channels on the recorder:

- click on the table-tool
- enter the number of rows
- determine the insert point by setting the text-cursor anywhere on the report sheet
- press OK
- a table with measured data of active channels on the recorder appears

Activated tools have a green frame

3.1.3 Working with the recorder's scales

Lists channel menu by click on button

Range up by clicking on the upper end of the scale, e.g. 20 in this case

Shift scale by dragging it

- press left mouse button
- shift mouse to destination
- release mouse button

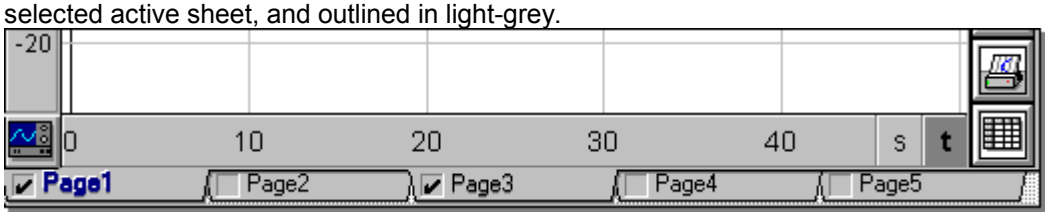
ange down, done by mouse-click at the lower scale end, e.g. 20 as on the left.

Auto scale adjusts to ideal scaling by mouse-click

All Phymex scales run synchronously to each other. Once the measurement range has been changed on the recorder, the change will automatically affect all displays.

3.1.4 Multiple measurement

The Phymex recorder allows up to five measurements to be carried out in a row. Simply click on one of the recorder sheets illustrated below (index-cards).
At a new measurement, acquired data becomes filed on the activated sheet (index-card with blue text).
By doubleclicking an index-card, it may be renamed (e.g. 'free fall 1' instead of 'measurement 1')
To view several measurements on the recorder at the same time, checkmark any other index-card (see graphic). This effects measurements, recorded on these index-cards, to become copied to the selected active sheet, and outlined in light-grey.

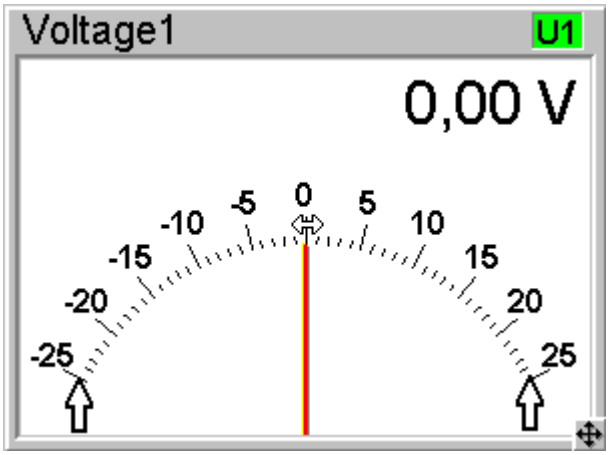


3.1.5 Recorder tutorial

- Set the measuring rate. Options are listed in the listbox on the recorder's titlebar.
- Chose the channels to be displayed, as well as their base and appropriate measuring range.
- Set the big ON/OFF switch on 1, recording has been started now.
- After completing your measurement, switch the recorder off (ON/OFF switch put on 0).
- You may magnify critical points of the curve. Chose the magnifying glass on the right side of the recorder. Drag a rectangle onto the area of the curve you want to take a closer look at.
- Add best fitting curves, or tensions if required.
- To copy a recorder graph into the report, use the print-tool of the recorder. To insert recorded data into table format, use the table-tool.
- Labels and lines on the recorder are deleted if you click the eraser, or change the axes or recorder-sheet.

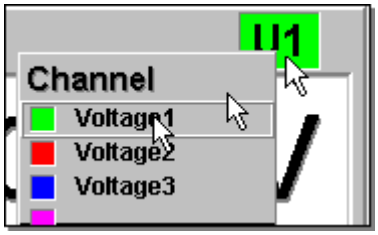
Hint: A single mouse-click on a specific curve assigns its unit to the Y-ruler (new superior channel).

3.2 Display



The display of Phymex features four analog instruments with inserted digital display. A slide, moveable with your mouse, determines the exact position and size of the instruments. This slide is shown at the lower right corner of the picture. Its location is the center-port of all four displays. A single stroke on it makes the displays to match in size, putting the slide in the very center of the displays.
If you click on the digital display, it will be turned on/off. Clicking at the area below the analog scale activates the digital full-screen display.

3.2.1 Selecting the displayed channel



To change any channel, click on the colored click-field in the right upper corner of the gauge.
The channel menu appears. Click on the required channel (signal), and the display adapts automatically.
The number of channels available depends on the number of parameters setup on the *„Setup“* index-card.

3.2.2 Determing the measuring range

Determing the measuring range can either be accomplished by means of the menu *„Options/Channels“*, or directly on the scale by mouse. A mouse click on the right end of the scale (e.g. 25V) increases the measurement range in 1-2-5 steps. A click on the left end (here: -25V) decreases the measurement range. If you click at the center of the scale (e.g. 0V), the scale will be determined automatically. The zero-position may be changed by dragging the scales:

- press left mouse button
- shift the mouse to any destination
- release mouse button

Note: If you change the measurement range on the display, settings in the recorder and control function will automatically be adjusted, and adapt to the change.

3.2.3 Printing

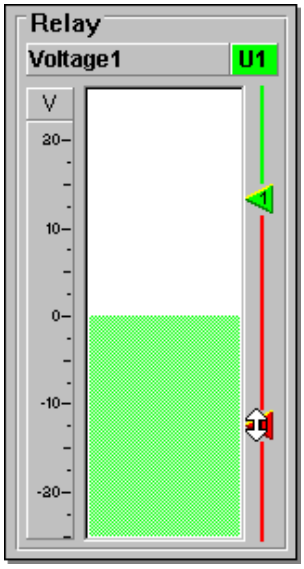
To print the display, insert it into the report:

- select *'Edit/Copy'* on the menu
- shift to the report
- set the text cursor at your displays insert place
- select *'Edit/Insert'* on the menu, and Phymex inserts the display-graph into the report

If you chose to shrink the graph:

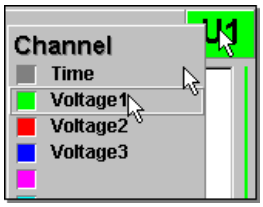
- click on the display-graph
- black anchor points appear at the corners
- pulling on these points reduces or enlarges the graph

3.3 Control



Phymex-control is devided in three control fields. One controls the Phybox-relay, an other one the mains-relay, and the third generates alarm messages on the screen.
The left graph shows the relay control field (connection on the frontpanel of Phybox). If the level indicator of the bargraph runs along the red area of the markers, the relay has gone down. If it moves along the green area, the relay goes up.
The tabs (1=green, and 0=red), located on the bar's right edge, illustrate cross over points, and may be shifted by mouse. These tabs define the switching points.

3.3.1 Selecting the control channel



To change the control channel of any control field, click on the colored click-field in the right upper corner of the control field. The channel menu appears. Click on the required channel, and the control field adapts to the change.
You may chose of any channels defined on the setup index-card.

3.3.2 Setting the switch points and the switch direction

The switch points become adjusted by the tabs on the right side of the control field. The ON-tab (1) is green, the OFF-tab (0) is red. The tabs can be shifted by mouse. Press the left mouse button, keep the button down, and move the mouse to its new destination. In order to change the switch direction, drag the OFF-tab above the ON-tab. Space between those tabs defines the hysteresis.

3.3.3 Determing the measurement range

To determine the measurement range, either chose the menu *„Options/Channels“*, or go the direct way on the scale using the mouse. A click on the upper end of the scale (here: 20V) scales the range in 1-2-5 steps up, a click on the lower end (e.g. -20V) scales the bar down, and a click in the center area of the scale activates automatical scale selection. The null point may be delocated by dragging the scale. Move the mouse to any point on the scale, press the left mouse button, and drag it the button kept pressed down to a new location. Release the mouse button.
Hint: A click on the unit-field at the scale bar (here: Volt [V]) opens *'Options/Channels'* in the menu directly.

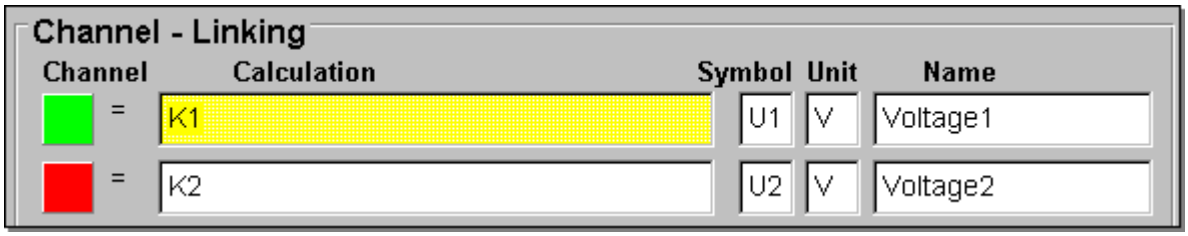
3.3.4 Printing

An option to Insert the current status of Phymex-control into your report. Select *'Edit/Copy'* in the menu to copy the control index-card to the clipboard. Now shift to your report, position the text cursor at the graph's insert point, and select *'Edit/Insert'*. Phymex inserts the graph into the document. If you want to shrink the graph, click on the picture, and drag the anchor points towards the center.

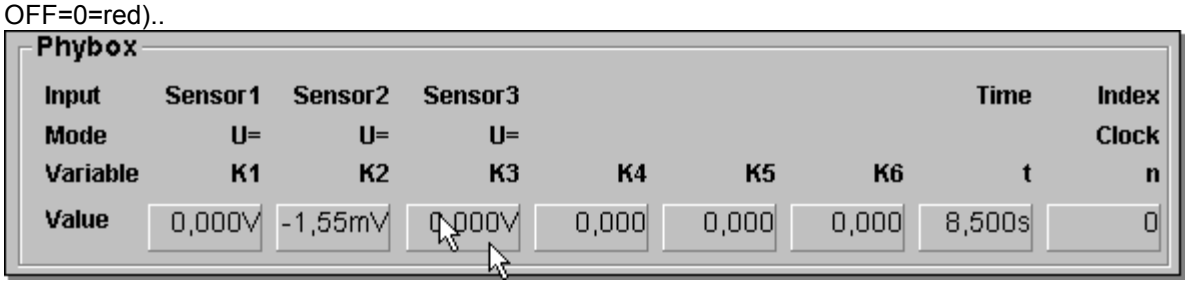
3.4 Defining channels

The index-card *„Setup“* is the communication port of Phymex and Phybox. In this function, all channels displayed by Phymex are defined. Each channel (colored-field) is assigned to a calculation syntax, a

symbol, an unit, and a name representing it. Assignments may be customized, e.g. channel1(light-green)=K1, symbol=U1, unit=V, name=voltage1.



To link any Phymex channel to Phybox, enter the corresponding variables in the calculation field. All Phybox variables and their current value are displayed in the Phybox field (also see next graph). You may also relate variables in mathematical terms if required. Please change calculations only if the experiment has been stopped, the ON/OFF switch on the recorder ought to be turned off(OFF=0=red)..



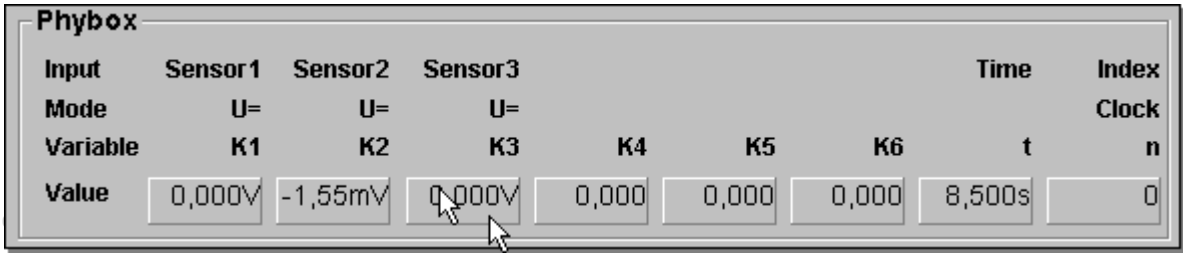
The entered symbol, unit, and name may be user defined. Phymex itself adds a prefix to the unit, depending on the measurement range, e.g. k for 10^3

Permitted operations:

Arithmetic operations:	+	addition
	-	subtraction
	*	multiplication
	/	division
	^	power
Brackets:	( )	down to the depth 16
Variables:	K1-K6, t, Idx	(Capitol and small letters are equal, e.g. k1 instead of K1)
Numbers:		0,003348 or 0.003348 or 3,348E-3 (. equals ,)
Functions:	Ln( )	neutral logarithm, basis e
	Log( )	logarithm, basis 10
	Sqr( )	square root
	Exp( )	eponential function (zur Basis e)
	Sin( )	sine
	Cos( )	cosinus
	Tan( )	tangens
	ASin( )	arcus sine
	ACos( )	arcus Cosinus
	ATan( )	arcus Tangens
	Abs( )	absolute/ total value

Examples:

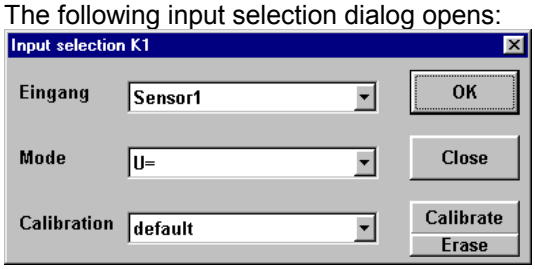
K1	voltage of sensor1 [V] is used directly
10*K1 - 2	voltage of sensor1 [V] is multiplied by ten first, a two gets finally subtracted
10*(k1+2)	to the voltage of sensor1 [V] 2 is added, the result being multiplied by ten
sqr(k2*2)	voltage of sensor2 [V] is multiplied by 2, then the square root is taken
log(K1 * 10,54E-5) ^ K3	



3.5 Input selection, calibration

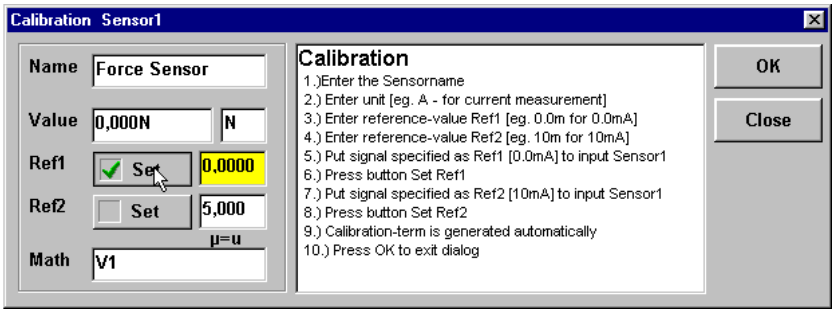
To assign an other input to an input variable, click at the area holding data to be reassigned.

The following input selection dialog opens:



Determine

- the required Phybox input
- the operation mode
- calibration
- press *„OK“*



If you want to recalibrate any input, press *„Calibration“*. A calibration dialog opens, listing comprehensive calibration instructions.

Preparation:

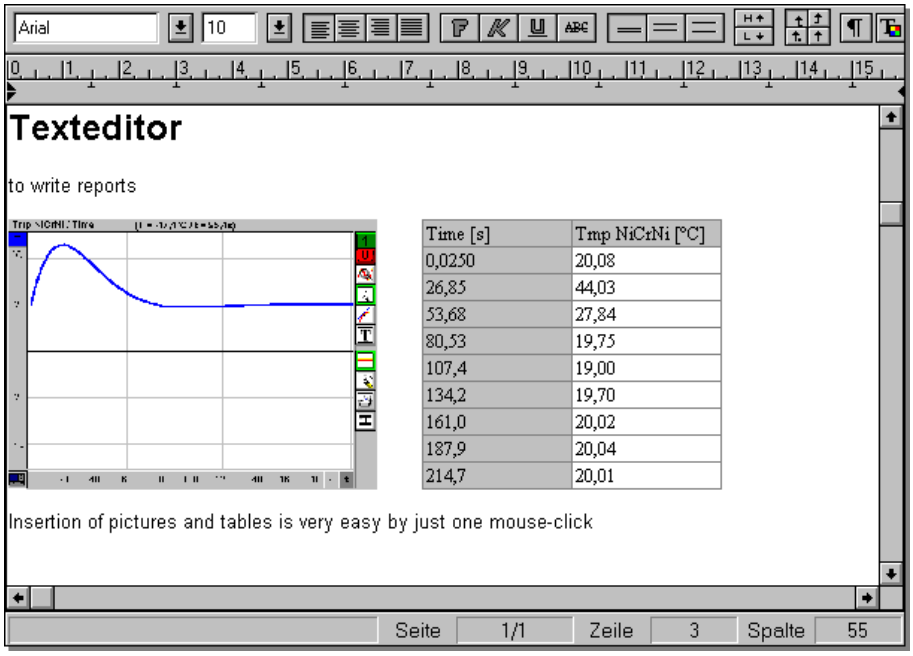
Fill in the sensor name and the unit (e.g. „force sensor“ „N“) first, followed by the reference point, at which you want to calibrate the sensor (in this example: 0,0 und 5,0).

Calibration process:

- **First calibration point:** Load the force sensor with 0N. Wait for the displayed value to become stable, and then click on *„SetRef1“*. The current value should now match 0,00N. At only one calibration point, the formula for the offset process becomes generated automatically.
- **Second calibration point:** Load the hardware with 5,0N (2. Refpoint), wait for the displayed value to become stable, and click on *„SetRef2“*. The calibration formula becomes generated, and is structured in offset and gain factor. This completes the calibration process.
- If a calibration point is not met best, click on the corresponding SetRef button. The pressed button regains an unpressed status, the calibration point becomes rejected, and the reference point may be recorded again.
- Calibration data becomes registered at a calibration databank after you hit *„OK“*, and may be selected at the input selection dialog later. If you want to save your calibration data long-term in an experimentation file, please select *„File/Save“* in the menu.

3.6 Information and report

The index-cards *„Info“* and *„Report“* provide access to an integrated text editor. The info-card is intended to assist you in any experimentation work. With *„File/Lock“* kept activated, Info-text stays write-protected. The user may read and print the text though, a change to it is not possible. On the report page, you may carry out the experiments analysation. Required recorder and display graphs, or tables will be insert into text (see sections: Recorder, Display).



3.6.1 Text insertion

The Phymex editor holds four elements, called format strip, tabulator ruler, text input window, and status strip. The text's outlay (subject to format) depends on the settings on the format strip. Elements on the format strip affect the following changes:

Select font **

Select font size **

Text formatting: Left justification, center justification, right justification, block

Font style: Bolt, italic, underlined, crossed out **

Line spacing: 1, 1½ or 2 **

Typeface: Superscript/subscript **

Tabs: left/right justification, comma justification, center justification

Paragraph, tabs, spaces (visible/invisible)

Font color **

**The corresponding text has to be marked first (drag the mouse with the left button kept pressed).

3.6.2 Graph insertion

You may either insert bitmaps, saved on harddisk, or graphs sourced from clipboard.

Inserting graph data

Select *„File/Insert Bitmap“* from the menu. Select the format, in which the file is saved. Available are:

- BMP Windows Bitmap Format
- PCX ZSoft Paintbrush Format
- TIFF Tag Image File Format of Scanners, etc.
- GIF compressed Compuserve Format
- TGA Targa Format
- WMF Windows Meta File

From the file list, select the file to be insert into text and hit *„OK“.* The graph will be insert at the current location of the text cursor.

Insert text from the clipboard

Select *„Edit/Paste“* from the menu.
To insert e.g. the display-graph into the report, shift to the *„Measurement/Display“* index-card, and select *‘Edit/Copy* from the menu. Return to text input, and select *‘Edit/Paste’* from the menu. Now the graph of the display appears at the current position of the text cursor.

3.6.3 Changing the graph size

- Click on the graph, whose size needs to be changed.
- On the corners of the picture, little black anchor points will appear, at which you may grab the graph. By means of this anchor points, you may change the graphs size by dragging with your mouse.
- Move your mouse onto any anchor point and press the left mouse button.
- Drag the mouse e.g. towards the center of the picture and release the button. The graph will be made smaller. Dragging towards the center reduces, and dragging away from the center increases the graph size.

If you want to move the graph to a different position in the text, click on it, and chose *‘Edit/Cut’* from the menu. Insert it at any location by selecting *‘Edit/Insert’* in the menu.

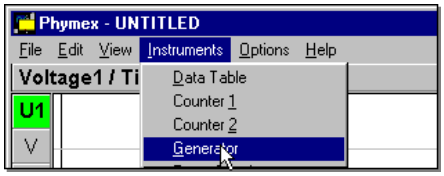
Comment: Using the text editor, graphs are inserted in the same way as letters in text.

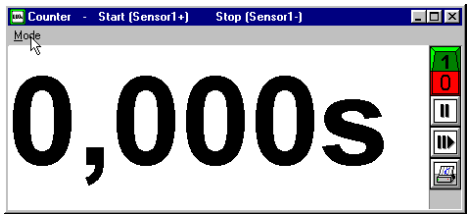
Hint: Graphs inserted in text take a lot of storage capacity, slowing down the editor. Therefore you ought to write the text before the graph becomes insert.

3.6.4 Other editor features

- Multiple undo-function by menu *„Edit/Undo“* or Alt + BackSpace
- Page preview by menu *„File/Page Preview“*
- Editable table cells
- Modifyable table columns:
  - select table (click on the table)
  - move the mouse cursor to the right upper corner of a column (next to the neighboring column)
  - the cursor turns into a small triangle
  - press the left mouse button, and drag the mouse to any destination, then release the mouse button
- Delete tables
  - position the text cursor in front of the table
  - on the keyboard, press *„Shift“* and *„Cursor to the right“* key
  - press delete key on the keyboard
- Output prints on all Windows-printers by menu *‘File/Print’*

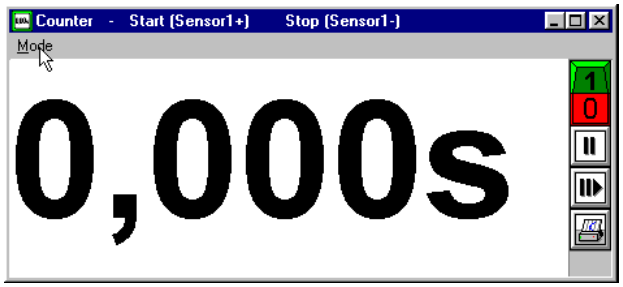
3.7 Instruments

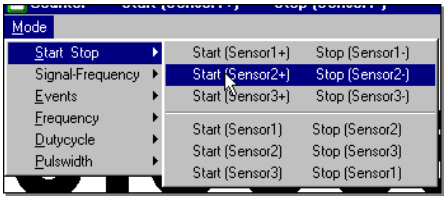




The menu *„Instruments“* lists all available Phymex instruments. To select an option, click on the listed instrument.
The selected instrument, e.g. the counter, will be displayed in Windows standard as a window. Any instrument may be enlarged and reduced by pulling at the window's edge, and also be moved freely. If an instrument becomes reduced, it is symbolised at the lower edge of Phymex on the instrument bar.
If you click on the symbol, the instruments on/off switch is operated. The current status can be recognized by colored lines, framing the symbol: red = off, green = on. Further, the most important operation parameters of the instrument stay visible beside the symbol. A click at this area reactivates the symbol.

3.7.1 Counter





The counter instrument is a display, showing all Phybox counter data. To change it's operation mode, select operation mode and counter input on the menu *„Operation Mode“*.
Provided are On/Off, signal frequency (frequency of an analog signal), event, frequency, dutycycle, as well as impulse length for sensor1, 2 and 3. The operation modes working method may be read in chapter 4.1.2 „Digital Measurement“.

On/Off switch

- Switches the counter on/off
- Automatically set on off, if the measurement is finished

Pause

- Sets the counter on pause status, the display stays visible, the counter continues operating in the background
- To stop pausing, click on the Pause symbol for another time

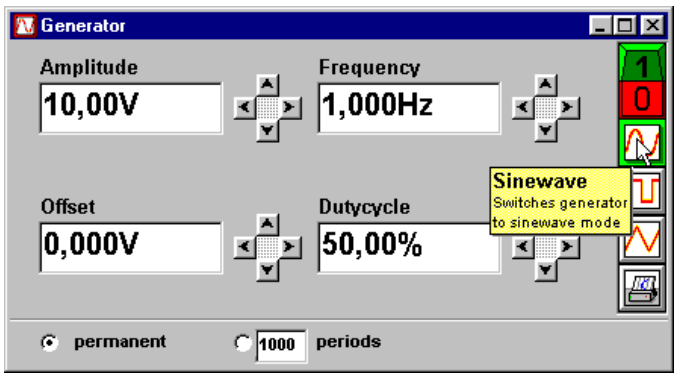
Single step

- Views the counter's next value by mouse-click
- Reactivates Pause

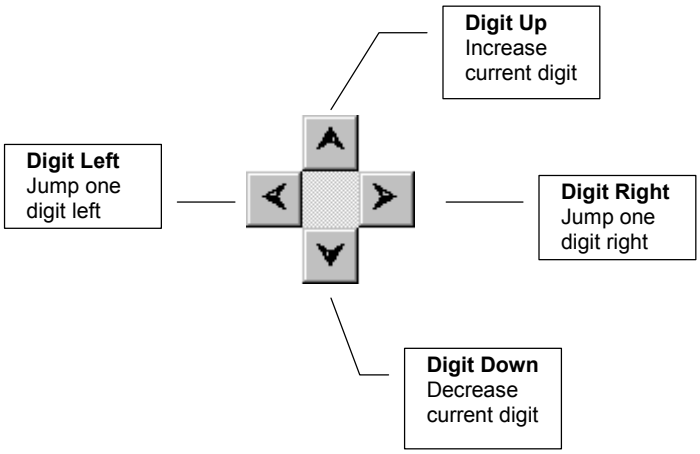
Printing

To copy the counter into report:
- Click on the symbol
- Place the cursor on any location of the report
- Press OK

3.7.2 Function generator



The generator is used as an operation field for the Phybox generator output. Signal form (sine, rectangle, triangle), amplitude, frequency, offset, as well as the dutycycle of the signal may be selected.
Further, you may adjust, whether the signal is output continuously, only at recording by the recorder, or in periods to be pre-set. Output starts with activation of the On/Off switch (right above).



Single parameter of the generator may either be adjusted or input by means of the keys explained on the left, or through manual input in the corresponding field. At the same time, an used prefix becomes utilized, making the input of a frequency of 17,5kHz, 17500 or 17,5k to equalize 17,5kHz.

On/Off switch

Switches the generator on/off.
Note: With the generator turned off, the Phybox generator output becomes highly Ohm!

Sine

Switches the Phybox generator output into sine mode.

Rectangle

Switches the generator output into rectangle mode.

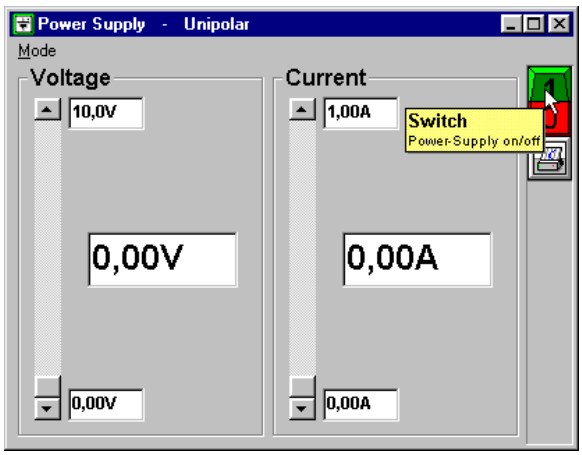
Triangle

Switches the generator into triangle mode.

Printing

Copies the generator into report.

3.7.3 Power pack



The instrument's function is to control the Phybox voltage output, and to remote control external power supplies. Determine the operation mode on the menu *„Operation Mode“*. At operation with external facilities, a dialog (as illustrated on the left) is opened, allowing adjustment of current and voltage of the external facility by pulling on a slide. The current value is displayed in the center field (21,1V / 2,43A). Another two fields are given, holding minimum and maximum value of each slide. These two values allow Phybox to recalculate the control's voltage (0 - 10V) into the power pack's output voltage.

Driving external facilities with integrated 0 ... 10V serial port:

- Connect the external power supply to the corresponding Phybox output (7pole)
- Fill the external facility's nominal value of voltage and current in the fields next to the slide.
- Set the slides on 0.
- Turn on the power pack switch (1 = green) by mouse click.
- Adjusting the slides sets voltage and current of the external facility.

Note: Study the handbook of the external facility thoroughly!

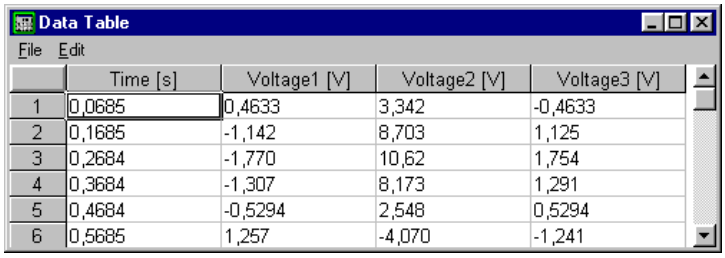
On/Off switch

Turns the power pack on/off.
The Phybox voltage output becomes set on 0V, external power supplies on standby if necessary.

Printing

To copy the power pack into report.

3.7.4 Data table



Data Table

File Edit

	Time [s]	Voltage1 [V]	Voltage2 [V]	Voltage3 [V]
1	0,0685	0,4633	3,342	-0,4633
2	0,1685	-1,142	8,703	1,125
3	0,2684	-1,770	10,62	1,754
4	0,3684	-1,307	8,173	1,291
5	0,4684	-0,5294	2,548	0,5294
6	0,5685	1,257	-4,070	-1,241

This table holds all measured data, made available for Phymex use (e.g. all values that are output on the recorder). A change of a value in the table affects the Phymex databank, meaning that this change does leave the same track on the recorder.

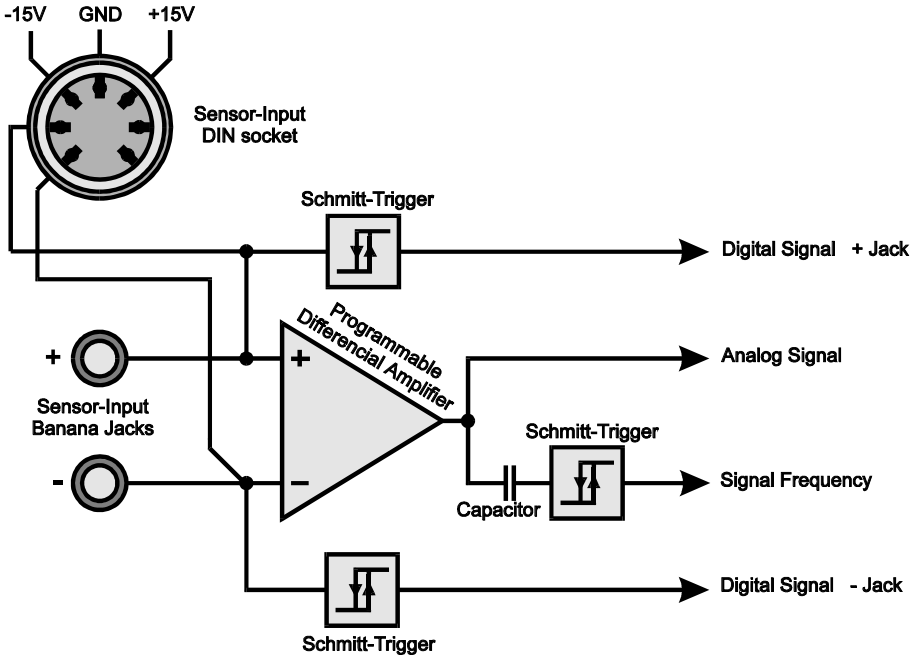
If the table is ought to be transferred into other programs, save the data by selecting *„File/ Export Table“* on the menu. Open this file, e.g. in a table calculation program, or copy the table by using the clipboard in *„Edit/Copy“* on the menu.

- If no cell is marked, and the cursor keeps flashing in a cell, the whole table becomes transferred
- If a part of the table is marked, only that area defined becomes transferred.

4 Phybox PB1

4.1 Sensor-inputs

The sensor-inputs sensor1, 2 and 3 are independent of each other, but absolutely identical in their function. Each one is equiped with a 7-pole DIN-jack and 2 banana-jacks to provide sensor connection. These sensor-inputs are a combination of analog and digital input. Thus digital sensors (like photogate or position sensor) and analog sensors(e.g. force sensor and pressure sensor) can be connected alternatively at the same input. In addition it is possible to carry out analog measurements followed by digital analysis.



Real measurements of effective values, and dynamic oversampling for measurement of signals even with a high current noise level may be carried out, as well as start/stop measurement, on/off times, event counting, length of period measurement, etc.. You may connect up to six air track light barriers to these three sensor-inputs.

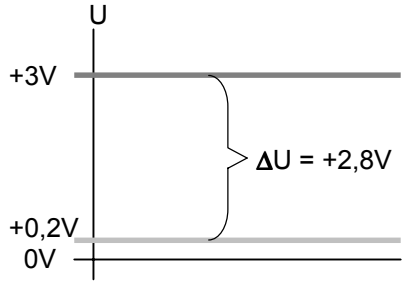
Caution: All Phybox inputs are high-voltage protected by means of 340V surpressor-diods. Surpressor-diods are very fast bipolar Zener-diods, which are high-Ohm at voltages of up to ±340V, and low-Ohm at exceeding values. They can stand loads reaching short voltage-peaks with an energy of max. 0,4Ws (e.g. arcs). Bigger energies may lead to the destruction of the input. Voltages lower than ±250V lead to the override of the input, but do not result in damage of the input.

Caution: The sensor's-voltage source (7pole DIN-jack) is protected against overloading and short-circuits. It is not back-voltage protected, therefore the voltage source may never be forced to reach voltages exceeding ±15V when using external voltage sources. This would result in the destruction of all connected sensors, and the analog instrument of Phybox also.

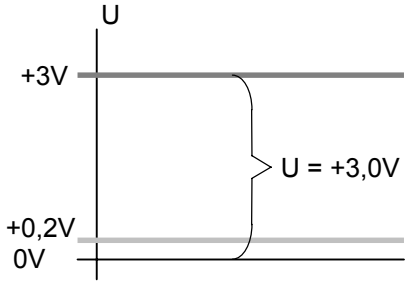
4.1.1 Analog measurement

Voltages ranging from -32Volt to +32Volt may be measured directly with Phybox. Simply connect the positive pole of the voltage to be measured to the red banana-jack (+), and the minus pole to blue (-). Voltage measurement will be carried out differential, thus voltage difference becomes measured between the two banana-jacks, with no relation to mass potential.

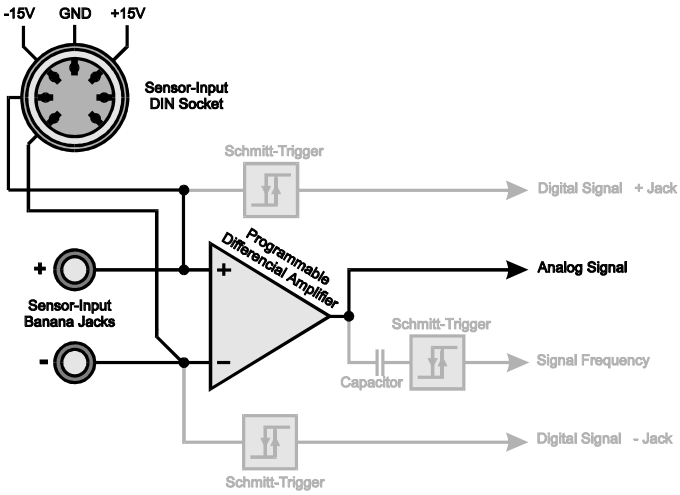
Potential free measuring:



Potential related measuring:



The sensor inputs show a common mode rejection, allowing correct measurement of the difference in voltage at synchonised input driving.



The 7-pole DIN-socket is switched in parall to the two banana-jacks, though this connection supplies additonal voltage for the sensor connected.

***Caution**: If a sensor is connected at the DIN-socket, do not supply the banana couple with external voltage at the same time!*

If an analog sensor is connected to the DIN-input the possibility is given, e.g. to measure the sensor's output voltage by means of the banana couple, using a digital voltmeter. Usually the value of the corresponding sensor becomes read by Phymex (Software).

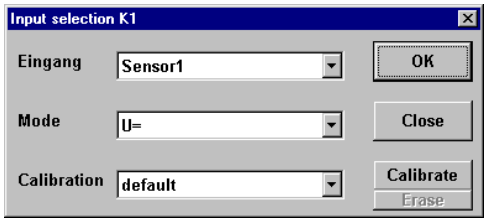
The following sensors of IBK accessory operate with analog voltage signal:

- Force sensor DKS 1V/N
- Pressure sensor DDS 1V/bar
- Hall-sonde DHS 3V/100mT
- Luxmeter DLM 1V/1000Lux
- Current shunt DRS 0,1Ω 1Ω 10Ω
- Glas-temperature probe (also for agressive fluids) DTF 1V/100°C
- pH, Redox single converter DEU 1V input: 1V output
- NiCrNi-converter DTA 1V/100°C

Autoranging (automatical measurement range switching) replaces awkward manual measuring. This avoids false measuring, that may otherwise be caused by ranges not chosen properly. You may still determine the measurement range on the screen independently by yourself.

Direct voltage measurement with dynamic oversampling:

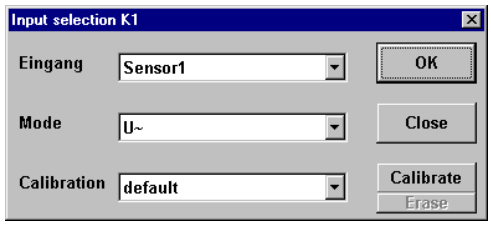
To keep measurement of signals with current noise levels easy, Phybox operates at direct voltage measurement at a measurement rate < 1kHz with dynamical oversampling. Phybox measures independent of the dutycycle of 10kHz, and calculates the arithmetic mean of the data recorded. The data will become passed on to the PC at the next measuring mode, and communication starts again. Thus the more data for arithmetic mean calculation become considered, the slower the measuring rate is set.



Effective value measurement

At alternating voltage measurement, Phybox operates with real effective value measurement. It measures independent of measuring rate (< 1kHz), applying a dutycycle of 10kHz, and uses the recorded data to calculate the square mean.

$$U_{eff} = \sqrt{\frac{U_1^2 + U_2^2 + U_3^2 + \ldots U_n^2}{n}}$$



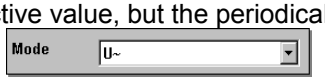
Note: Most multimeters on the market do not apply effective value measurement, using easier methods that show the real effective value at clear sine signals only. At the measurement of non-sine signals these instruments do measure false. A so called form factor (signal dependency) has to be considered to get to the effective value of the signal. Only multimeters with TRMS-measurement (True Rout Mean Square), or real effective value measurement mentioned in the handbook specifically, show right measured data at even non-sine signals (Even those instruments suppress the direct voltage contribution).

Voltage measurement at a rate ≥ 1kHz

At a measuring rate ≥ 1kHz, Phybox transfers measured data to Phymex directly without any communication or calculation. As the arising volume of data cannot be transferred online over the serial port, data firstly becomes short-stored in a buffer (160kByte) located inside Phybox, followed by the quickest possible transfer over the serial port to the PC. Transfer of data is carried out asynchronously to the measurement. All data concerning the Phymex display are not effected by this, becoming transferred directly to the PC without buffering, and are synchronously to the actual value.

Conclusion

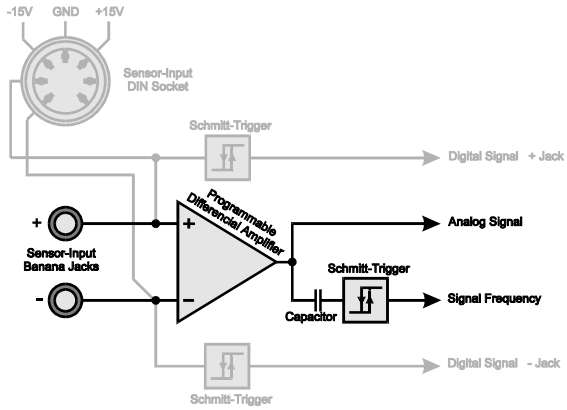
- Use

for all analog measurements if you do not intend to figure out the effective value, but the periodical actual value of an analog signal.
- Use 

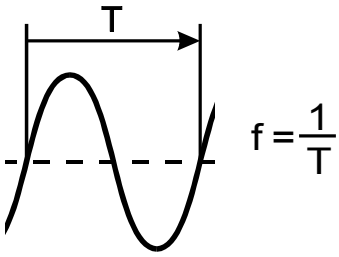
exclusively for alternating voltage measurement if you want to measure the effective value of an analog signal.
- At a measurement rate ≥ 1kHz, only analog values can be measured (**no** more oversampling, TRMS, signal frequency, rotation transmission, time measurement, etc. possible)

4.1.2 Digital Measurement

Signal frequency



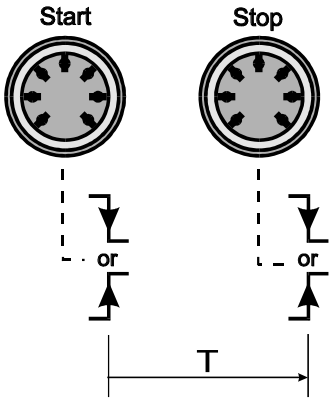
At operation mode signal frequency, the frequency of an analog signal on a Phybox sensor-input becomes determined. Connect the positive pole of the signal source to be measured to red (+), and the negative pole to the blue banana jack(-). Signal recording is carried out differential, meaning that the frequency of the voltage's difference between these banana jacks becomes measured (not mass related).



Start-Stop

At start-stop-measurements, Phybox measures the period between the start and stop event. They can be carried out in three different methods:

a) Start [Sensor1] Stop [Sensor2]

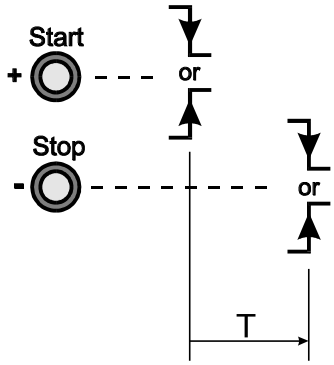


Method1: Start-stop-measurement between different sensor-inputs, e.g. by using two photogates. To activate start-stop, place a ↑ or ↓ flank at the input (e.g. change of transparent to non-transparent, or non-transparent to transparent).

possible combinations:

Start-input	Stop-input
Sensor1 +	Sensor2 +
Sensor2 +	Sensor3 +
Sensor3 +	Sensor1 +

b) Start [+ jack] Stop [- jack]

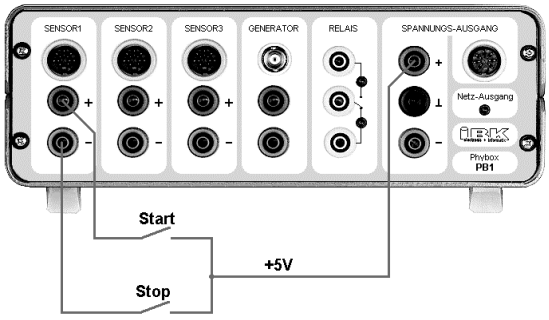


Method 2: Start-stop-measurement at one sensor-input, e.g. with two scanners.

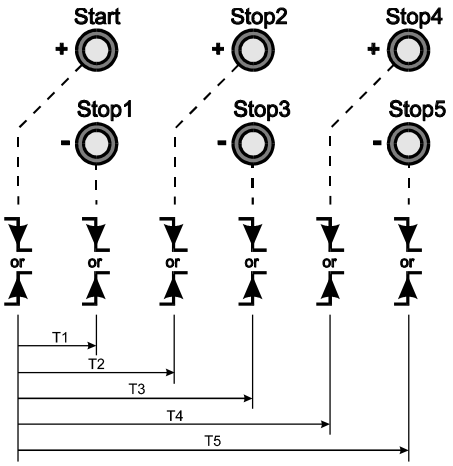
- Start by placing a ↑ or ↓ flank at the (+) jack
- Stop by placing a ↑ or ↓ flank at the (-) jack
- Threshold ↑ : Voltage > 2,7V
- Threshold ↓ : Voltage < 2,3V
- Voltage (point of reference): Mass-jack of the voltage output

possible combinations:

Start-input	Stop-input
Sensor1 +	Sensor1 -
Sensor2 +	Sensor2 -
Sensor3 +	Sensor3 -

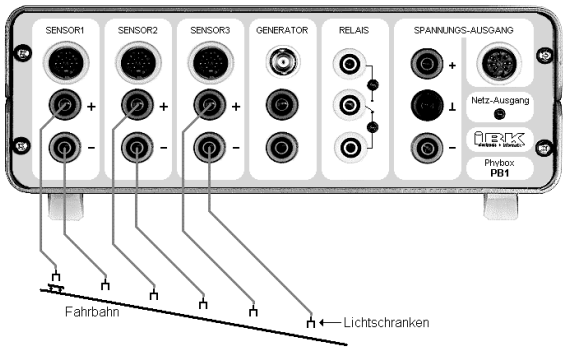


c) Start 5*Stop

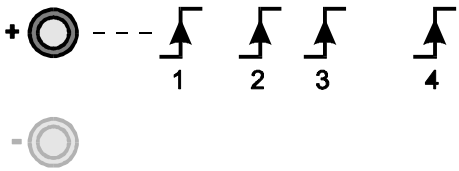


Method 3: Start-stop-measurement with a single start and five stop inputs, e.g. at a track:

- Start by placing a ↑ or ↓ flank at the start-jack
- Stop by placing a ↑ or ↓ flank at the stop-jack
- Threshold ↑ : Voltage exceeding 2,7V
- Threshold ↓ : Voltage less than 2,3V
- Voltage (point of reference): Mass-jack of the voltage output

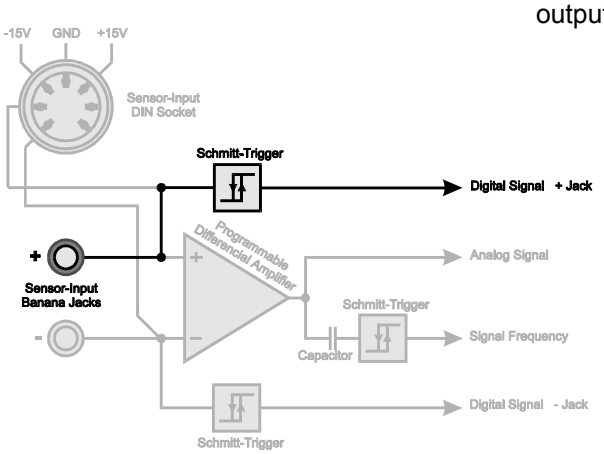


Event counter

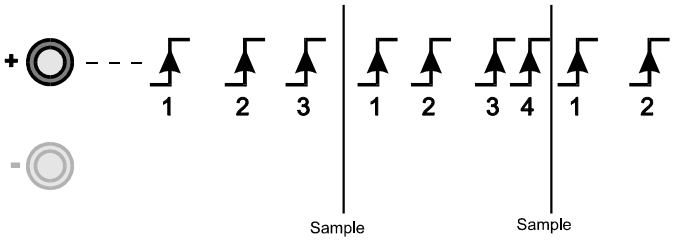


Recording (counting) of events at the start of the measurement

- counting upwards by a ↑ flank at the (+) jacks
- Threshold ↑ : Voltage exceeding 2,7V
- Threshold ↓ : Voltage less than 2,3V
- Voltage (point of reference): Mass-jack of the voltage output

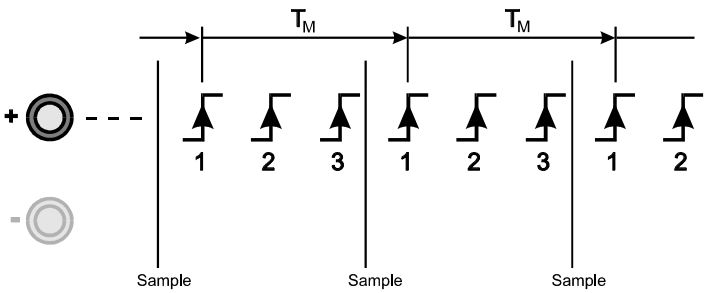


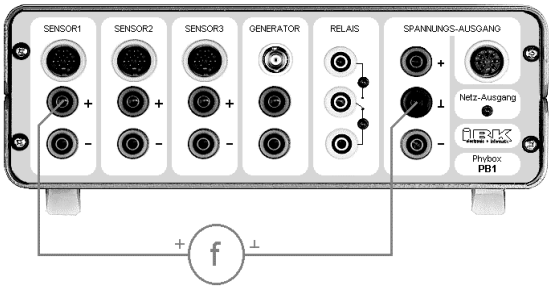
Rate (event / measurement rate)



It counts the upwards-flanks since the last measurement rate. Set and match the measurement rate with the required measurement time, e.g. at a radioactivity measurement. Using the Geiger-Mueller-counting tube a measurement time of 10s is requested. Simply set the measurement rate at 10s.

Frequency, period time





With Phybox, frequency does not become measured as with usual facilities, that apply gating at a fixed gate time. Measurement is carried out indirectly through the calculation of the average period length during a measuring rate. This gives the advantage of greater measurement speed, and a higher resolution at little frequencies.

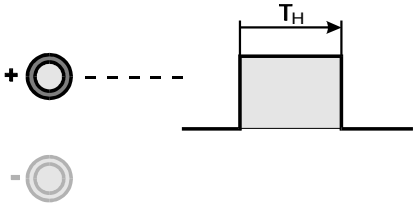
Phybox internal calculation:

Frequency: $f = n / T_M$

Period length: $T = T_M / n$

Pulse length

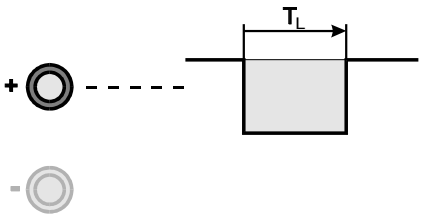
a) High-time



Measurement of the length of a single high-pulse

- Threshold high : Voltage > 2,7V
- Threshold Low : Voltage < 2,3V
- Voltage (point of reference): Mass-jack of the voltage output

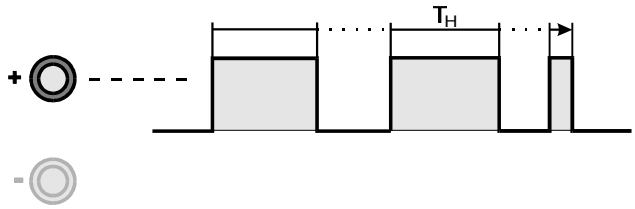
b) Low-time



Measurement of the length of a single low-pulse

- Threshold high : Voltage > 2,7V
- Threshold Low : Voltage < 2,3V
- Voltage (point of reference): Mass-jack of the voltage output

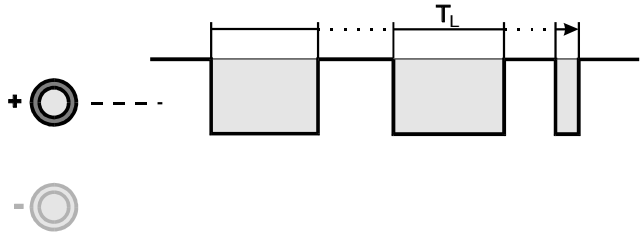
c) High-time (summarizing)



Measurement of the total length of the high-signal since the beginning of measurement.

- Threshold high : Voltage > 2,7V
- Threshold Low : Voltage < 2,3V
- Voltage (point of reference): Mass-jack of the voltage output

d) Low-time (summarizing)

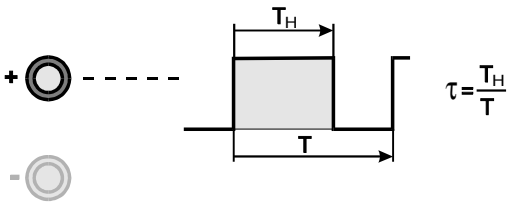


the voltage output

Measurement of the total length of the low-signal (off) since the beginning of measurement.

- Threshold high : Voltage > 2,7V
- Threshold Low : Voltage < 2,3V
- Voltage (point of reference): Mass-jack of

Dutycycle

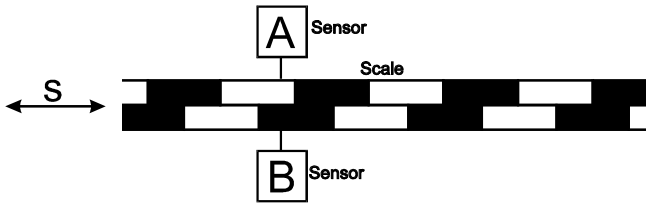


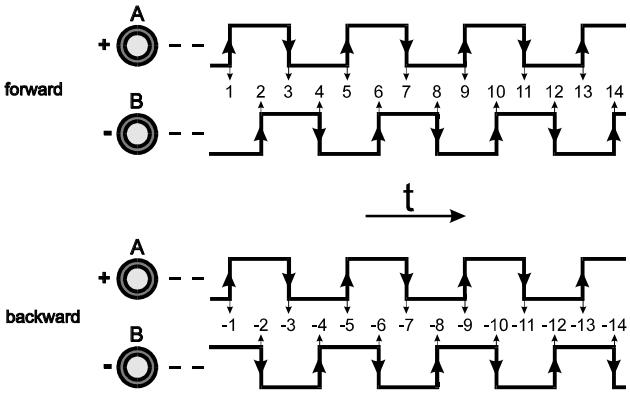
Measurement of high-time, as well as the signals period length and calculation of the dutycycle.

- Threshold high : Voltage > 2,7V
- Threshold Low : Voltage < 2,3V
- Voltage (point of reference): Mass-jack of the voltage output

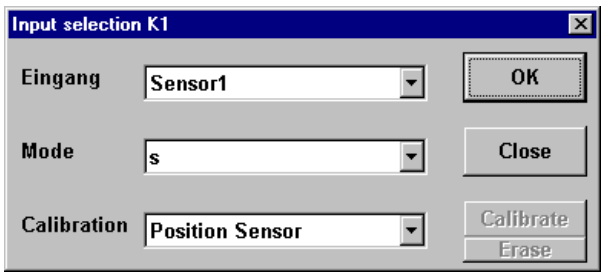
Position sensor s, v, a

Distance, speed, and acceleration measurement by Phybox is carried out by the position sensor DDG7, connected to one of three sensor inputs. The position sensor operates under the incremental method, frequently found in industrial applications.



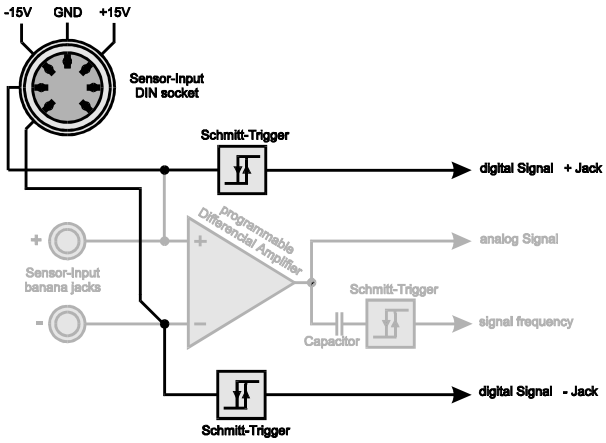


On the axle of the pace maker, a code-disc with two code-tracks is mounted, becoming scanned by opto-sensors (see plan on the left).
With the code-disc turning, code-tracks pass the sensors and become transferred to rectangle signals, 90° phase shifted to each other.
The direction of turns can be determined from the signals (A and B) phase lag, +90° = forwards, -90° = backwards.
Speed and acceleration data become gathered by the periodical analysation of the signals: $v = \Delta s/\Delta t$, $a = \Delta v/\Delta t$
The position sensor DDG7 gives 1600 steps per revolution. Using a treaded roller with a perimeter of 135mm, the step reaches 135mm/1600 = 0,084375mm. All Phybox recorded s,v,a-data relate to a single step, and therefore need to be multiplied with the steps dimension. Please use the Phymex provided and pre-set position sensor calibration s,v,a.



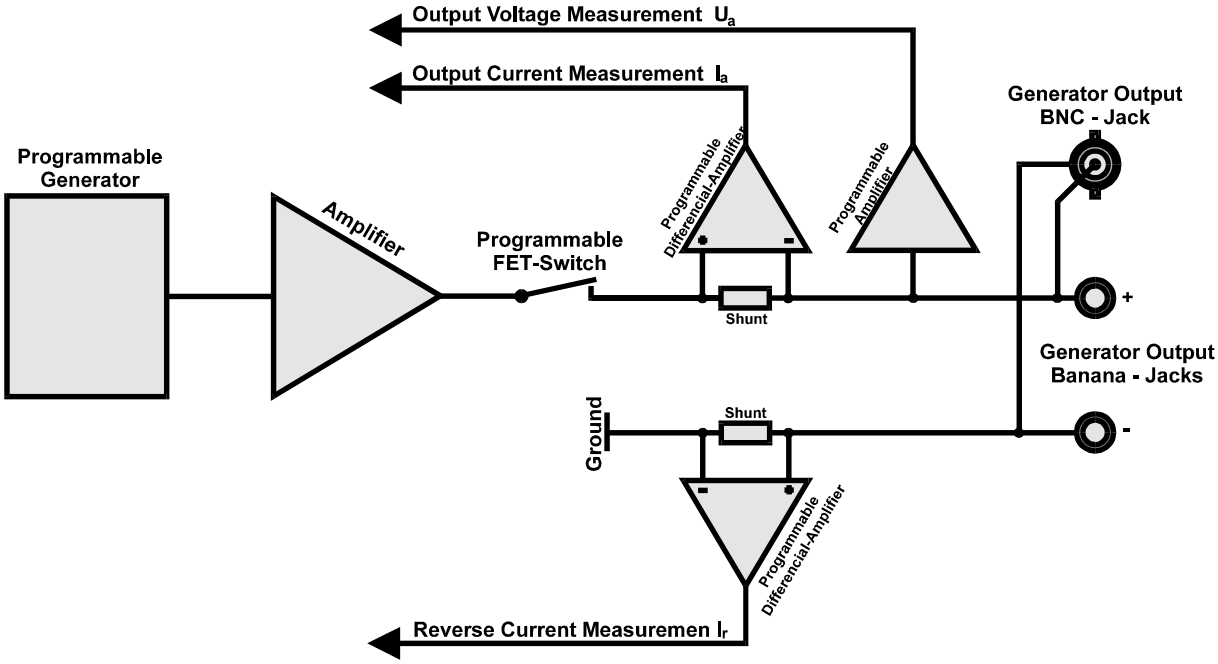
Caution: If a position sensor is hooked up to a sensor input, the input may not be sourced with external voltage at the same time. It is <u>not</u> possible to measure analog signals on this input at the same time. Chose an other sensor input if necessary.

For demonstration, the incremental-signal can be measured on the banana-jacks of the sensor input. The point of reference is the mass-jack of the Phybox's voltage-output.



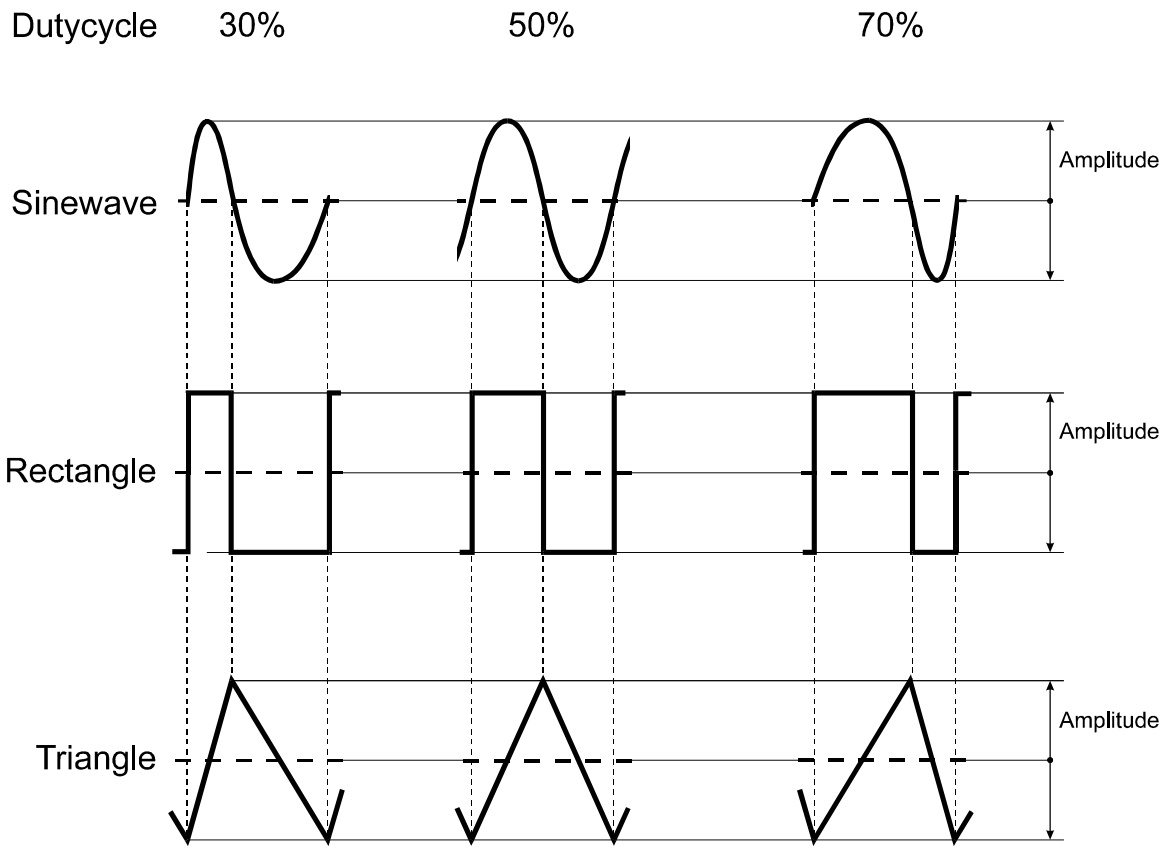
4.2 Generator

The generator output of Phybox is an electronical high Ohm switchable analog voltage output, combined with current and voltage measurement.



- the current measurement (outlined above) is carried out electronically. The shunts are outlined for better understanding only, holding 0,0Ω.
- at opening the FET-switch, the high Ohm generator output becomes loaded with max. 250pC for one time, needed to be considered at very little capacity taking loads.

Built in curve profiles:



4.3 Relay

The relay on the frontpanel of Phybox can be software controlled (see 3.3. Control). An opening tool (on the upper two jacks), as well as a closing tool (on the lower two jacks) are provided. You may also use the relay as a „shift“ or „switch“ tool. In this case the middle jack shifts between the upper and lower jack. The prevailing setting of the contacts become displayed through red light diods. Illumination indicates a closed contact. Maximal load of the relay is 10A. An active voltage limitation of 42V (Varistor) avoids excessive voltages, and thus arcs in the relay, if switching inductive currents.

4.4 Mains relay

In the rear of Phybox you will find a switched mains output (Schuko socket). It may be controlled by software (see 3.3. control). Commonly used facilities (230V), like immersion coil and lamp, can be connected up to an output of 1kVA.

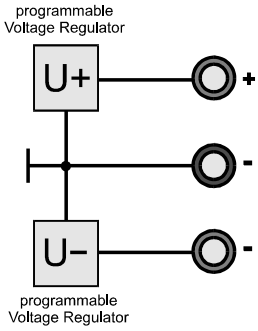
Caution: !! Mains voltage, danger !! Do not connect any facilities to the mains output in the rear of the device, if not being certified for operation on the mains voltage.

The red lightdiode on Phybox's front panel, column „mains-output“, shows the prevailling setting of the contacts lightdiode on → mains voltage on, lightdiode off → mains voltage off.

4.5 Voltage output

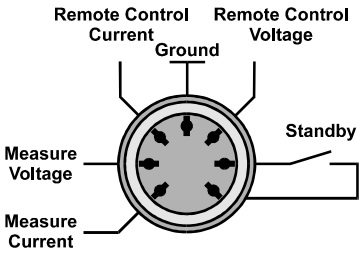
The Phybox voltage output is devided in two parts, the symetrical voltage output of Phybox, as well as the remote control for external mains receivers.

Internal voltage output



The programmable symetric voltage output gives voltage, ranging from 0V to ±15V at a maximal load of 300mA. It provides a voltage resource for general needs in laboratories. An integrated protective circuit guarantees standfastness of the voltage output against short-circuits. Current back-flows become blocked, no current can flow back to the voltage source.

Remote control for external mains receivers



A lot of current and voltage sources, made by well-known manufacturers, including high current and high voltage power supply units, may be remote controlled by a built-in standard port (0V ... ±10V). This may also be applied to the output voltage of the external device, as well as to the current limitation.
A potential free contact gives the option to switch the external device into standby-mode (on = contact closed, standby = contact open).
Further, the standard inputs (0V ... ±10V) give the opportunity to measure the output voltage, as well as the output current of the device.

Voltage	
Control voltage	**Output**
+10V	+ nominal voltage
0,0V	0,0V
-10V	- nominal voltage using bipolar mains receivers

Current	
Control voltage	**Output**
+10V	+ nominal current
0,0V	0,0A

4.6 Technical Data

Input: Sensor (3x)	
Measuring range	8 measuring ranges from 0 to 0,25/0,5/1/2/4/8/16 and 32V
Measuring range switching	Automatical (autoranging)
Resolution	10 bit
Dutycycle	0...100kHz (one channel)
Time measurement	Measurement of signal frequency, pulse counting, pulse length Start/Stop-measurement, Rotation transmission analysis (s,v,a)
Calibration	Zero-point and amplification - through PC-autocalibration
Differential measurement	
- Common-mode voltage	0 ... ± 50V
- Common-mode rejection	70dB DC ... 10kHz
- Input resistance	300kΩ
Input sensors	7pol. DIN socket (analog input, mass; ±15V; Clock-signal; digital-input/output); 2 banana-jacks, parallel to analog input in 7pol. DIN
Output: Generator	
Voltage range	-10V ... 10V
Output	±200mA current source, current drain, high Ohm
Resolution	12 bit
Signal forms	direct voltage, sine, triangle, rectangle, freely programmable
Signal frequency	0 ... 50kHz
Output rate	0 ... 1MHz
Connectors	2 banana-jacks parallel to BNC-jack
Integrated measuring	8 voltage measuring ranges from 0 to 0,125/0,25/0,5/1/2/4/8 and 16V 8 current measuring ranges output from 0 to 2,5/5/10/20/40/80/160 and 320mA 8 current ranges (reverse current) from 0 to 0,062/0,125/0,25/0,5/1/2/4 and 8mA expandable via ext. shunts X10, X100
Output: Voltage	
Voltages	0 ... 15V, 0 ... -15V, mass
Load rating	300mA, protected against short-curcuit, stands back-flows
Connectors	3 banana-jacks 7pol. DIN socket to control external power supplies
Output: Relay	
Contacts	1x ON, 1x OFF (multiple function switch)
Loading range	5A / 42V
Status display	by 2 LED´s
Connectors	3 banana-jacks
Output: Mains relay	
Loading rate	5A / 230V - 1kVA
Status display	by LED on the front panel
Output	Schuko-socket with protection lid and fine-wire fuse 6,3AT on rear panel, software-controlled
Status display	ON - display by LED on front panel
PC-serial interface	
Type of serial interface	serial with optically coupled isolator, 19200 (Win3.1) or 57600Baud (‘95)
Connector	PC- compatible 25pol. SubD-plug
General	
Mains connection	230V ± 10%, 47...63Hz, 50VA, plug-in socket with fuse
Ambient temperature	0°C to +40°C
Dimensions W x H x D	245mm x 85mm x 180mm, ca. 3,5kg

5 Sensors

5.1 Position sensor

Item: DDG7 position sensor

The position sensor is a data acquisition instrument for position, speed, and acceleration in mechanical experiments. It operates on the principle of rotation transmitting. Very slow, as well as fast mechanical processes, like free-fall experiments, may be measured. Further, the high resolution of 1600 steps per rotation allows measurement of very little motions (resolution = perimeter / number of steps = 135mm/1600 = 0,0844µm).
The pace maker is driven by a roller with string hole, and a string (yarn). The string is either threaded through the roller, or put around it. Then it becomes attached on the axle by means of a loop, and rolled up on the roller (experimentation with falling bodies). The rotation transmitter can quickly and flexibly be attached on any tripod by using the delivered 10mm tripod-pole. To connect the sensor to the Phybox sensor input, a 2,5m long cable is provided.

Applications

Mechanical experiments, e.g. impulse tests (s,v,a), law of falling bodies, strain variation diagrams (F-s diagram), p-V Laws, oscillation characteristics.

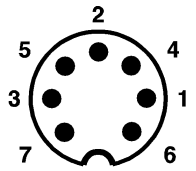
Technical data

1600 steps/resolution
perimeter of treaded roller equals 135mm

Pin positioning:

Pin-Nr. positioning

1	track A (TTL)
2	mass
3	no assignment
4	supply (-15V)
5	supply (+15V)
6	track B (TTL)
7	no assignment



front view (pins)

5.2 Current shunt

Item: DRS current shunt

The shunt is structured in a formation of three measuring resistors. Thermal conductive connected to the metal housing, they reach a load capacity of at least 10W continuously, and up to 25W short term. Connection is given on screw terminals, equipped with cross holes and 4mm bore.

Applications

Measurement of current, e.g. diode characteristic.

Technical data

Triple shunt: 0,1 - 1 - 10 Ω,
Accuracy: 1%,
Load capacity: 10W

5.3 Force sensor

Item: DKS force sensor

The force sensor operates on the principle of deflection. Weight put on a small hook attached on a spring steel strip (width 10mm, strip projects the housing by 30mm) is electronically registered by the measurement of the strip's extension. Various threads and a tripod-pole provide several possibilities of attachement of the force sensor. To connect the sensor to the Phybox sensor input, a 7-pole DIN cable is provided.

Applications

Mechanical experiments, e.g. Hooke's Law, measurement of spring forces of a spring pendulum (F-t diagram), strain measurement (elastical, plastical distortion), etc..

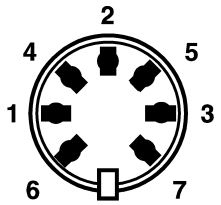
Technical data

Measuring range: 0 ... +10N,
Resolution: 0,01N,
Output: 1V/N +2%

Pin positioning:

Pin-Nr. positioning

1	+ output signal (1V/N)
2	mass
3	no assignment
4	supply (-15V)
5	supply (+15V)
6	- output signall (mass)
7	no assignment



front view (DIN-socket)

5.4 Pressure sensor

Item: DDS pressure sensor

The pressure sensor operates on the principle of Piezo. A silicon diaphragm, located inside the sensor, compares external pressure with the internal vacuum reference, and converts it into voltage. Electronics connected in series compensate the rising temperature effect, and boost the signal to its rated value. The pressure sensor can be connected to any of the three Phybox sensor inputs SENSOR1..3.

Applications

Gas experiments, e.g. p-V and p-T Law, hydrostatical pressure, etc..

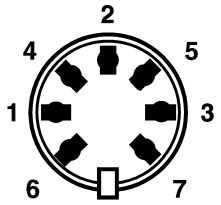
Technical data

Absolute pressure of sensor: 0 ... 2bar,
Resolution: 5mbar,
Output: 1V/bar +3%

Pin positioning:

Pin-Nr. positioning

1	+ output signal (1V/bar)
2	mass
3	no assignment
4	supply (-15V)
5	supply (+15V)
6	- output signal (mass)
7	no assignment



front view (DIN-socket)

5.5 NiCrNi-wire-wound thermoelement

Item: DTD wire-wound thermoelement

The wire-wound thermoelement is used for general temperature measurement, and supplied paint impregnated, and glass-fibre insulated. The measuring point is welded in argon athmosphere to avoid oxidation of the thermojunction. Due to a poor heat capacity of the element, the sensor settles thermoelectric voltage within a few seconds. Connect the element to any of the sensor inputs of Phybox, using the NiCrNi-converter DTA.

Technical data:

Measuring range:	-50°C to +300°C
Type:	K (typical 40,95µV/°C)

5.6 NiCrNi-bar element

Item: DTG bar element

The bar element serves as a tool to measure flame temperatures, and is equipped with a handle and 300m lance. Exact measurements in lower temperature ranges are possible because of good linearity. Connection to Phybox is carried out on any sensor input, using the NiCrNi-converter DTA.

Technical data:

Measuring range:	0°C to +1000°C
Type:	K (typical 40,95µV/°C)
Lance diameter:	4mm

5.7 NiCrNi-thermocouple converter

Item: DTA thermocouple-converter

The NiCrNi-converter gives connection of any NiCrNi thermocouple to Phybox. Its banana-jacks and terminals allow simplified connection of elements by banana plug or wire (compensation line). A standard plug type K is also provided. Compensation and adjustment are carried out converter internal. Connection to Phybox may be accomplished by utilizing any of the sensor inputs.

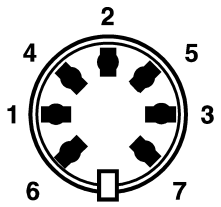
Technical data:

Output voltage:	1V / 100°C (like chemistry thermometer DTF)
Inputs:	Type K

Pin positioning:

Pin-Nr. positioning

1	+ output signal (mass)
2	mass
3	no assignment
4	supply (-15V)
5	supply (+15V)
6	- output signal (1V/100°C)
7	no assignment



front view (DIN-socket)

5.8 Temperature probe

Item: DTF temperature probe

The temperature probe is a metal-free version of an electronical thermometer, used to measure temperature in aggressive fluids. An integrated temperature measuring circuit, located in the duran glass tube, registers temperature with a high linearity. The probe can be Phybox connected on any sensor input. Normed stoppers can be used.

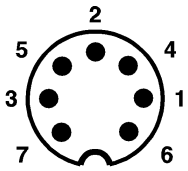
Technical data:

Measuring range	-40°C to +110°C
Output voltage:	1V / 100°C
Resolution:	0,1°C
Glass tube diameter:	8mm

Pin positioning:

Pin-Nr. positioning

1	+ output signal (1V/100°C)
2	mass
3	no assignment
4	supply (-15V)
5	supply (+15V)
6	- output signal (mass)
7	no assignment



front view (pins)

5.9 Hall sensor

Item: DHS Hall sensor

This sensor consists of a hall probe and electronics. It has a handle and solid brass housing to protect the probe. At the crystal's location the probes thickness is approximately 2,2mm. Thus it is possible to measure magnetic fields even in a relatively small air gap. Despite this little thickness, the probe is protected best against snapping together of the magnetic pole shoes. Further electronics are housed in solid aluminium, and become connected to a Phybox sensor input by using a seven-pole DIN-cable.

Applications

Measurement of magnetic fields, e.g. B/I-characteristic of iron core.

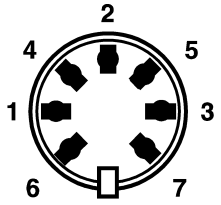
Technical data

Range: 0 bis ±400mT
Resolution: 0.5mT
Output signal: 3V/100mT ±5%
Probe thickness: approx. 2,2mm

Socket positioning:

Pin-Nr.positioning

1	+ output signal (3V/100mT)
2	mass
3	no assignment
4	supply (-15V)
5	supply (+15V)
6	- output signal (mass)
7	no assignment



front view (DIN-socket)

5.10 Luxmeter

Item: DLM luxmeter

The luxmeter is operated by a spectral adjusted photodiode, working within the range of light visibility. Depending on luminance, the diode produces a low photocurrent, which is converted into voltage of 1V per 1000 lux by electronics connected in series. Phybox connection is given on any sensor input, applying a 7-pole DIN-cable.

Applications

It may be used for general measurement of brightness in rooms. In education it is suited for illustration of the laws of distance.

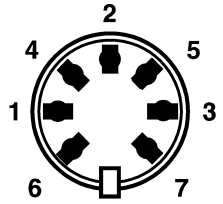
Technical data

Measuring range: 0 ... 10000 lux
Resolution: 5lux
Output signal: 1V/1000lux ±5%

Socket positioning:

Pin-Nr. positioning

1	+ output signal (mass)
2	mass
3	no assignment
4	supply (-15V)
5	supply (+15V)
6	- output signal (-1V/1000lux)
7	no assignment



front view (DIN-socket)

5.11 Photogate

Item: DGL photogate

The compact infrared-photogate DGL features a narrow range of detection (very thin infrared-beam), and a high edge steepness with a relatively great fork width. Those criterias allow highly accurate measurement of low and full speed. A M8 tapped cube gives several different ways to make the device fit. LED display. Phybox connection is granted by means of a 7-pole DIN-cable.

Applications

Race track experiments, oscillation of chard or fail springs, pendulum oscillation, law of falling bodies, etc..

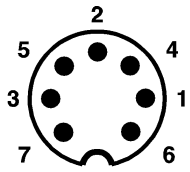
Technical data

Internal fork width: 130mm
Effective fork width: 130mm
Voltage supply: ±15VDC

Pin positioning:

Pin-Nr. positioning

1	output signal (TTL)
2	mass
3	no assignment
4	supply (-15V)
5	supply (+15V)
6	output-reference mass
7	no assignment



front view (pins)

5.12 High-voltage source

Item: DHV high-voltage source

The high-voltage source supplies any Geiger-Mueller counter tubes. The operator may measure the output voltage of the source (V/ 100, from 0...8V) on two banana-jacks, and further adjust it with a screwdriver to any voltage plateau within the range of 0..800V. The tube is connected using a BNC-jack, providing connection to Phybox by a 7-pole DIN-cable.

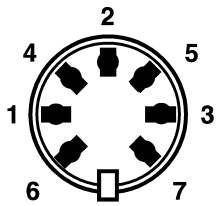
Technical data

Adjustment range: 0...800V
Stability: ±2%
Charging resistor (Counter tube): 1MΩ

Socket positioning:

Pin-Nr. positioning

1	output signal (TTL)
2	mass
3	no assignment
4	supply (-15V)
5	supply (+15V)
6	output-reference mass
7	no assignment



front view (DIN-socket)

5.13 Geiger-Mueller counter tube

Item: DZR1, 2 Geiger-Mueller counter tube

DZR1 is a self-extinguishing Geiger-Mueller counter tube housed in solid aluminium. A very thin window grants high sensitivity for the following registration of α-β-γ rays. Protection of the counter is provided by a wire grating.

Technical data

Voltage plateau: 350...450V
Window diameter: 9mm
Mass: 2mg/cm^2
Operating life: 10^{10} pulse

Compared to DZR1, the DZR2 version features a much bigger counter window, increasing sensitivity of radioactive radiation registration. Besides its solid aluminium housing it is equipped with a tripod-pole screwable into the case.

Technical data

Voltage plateau: 480...550V
Window diameter: 25mm
Null effect: 50 pulse/min
Operating life: 10^9 pulse
Energy range α: 3Mev
β: 40keV

Operation of these counter tubes on Phybox requires the high-voltage source DHV!!!