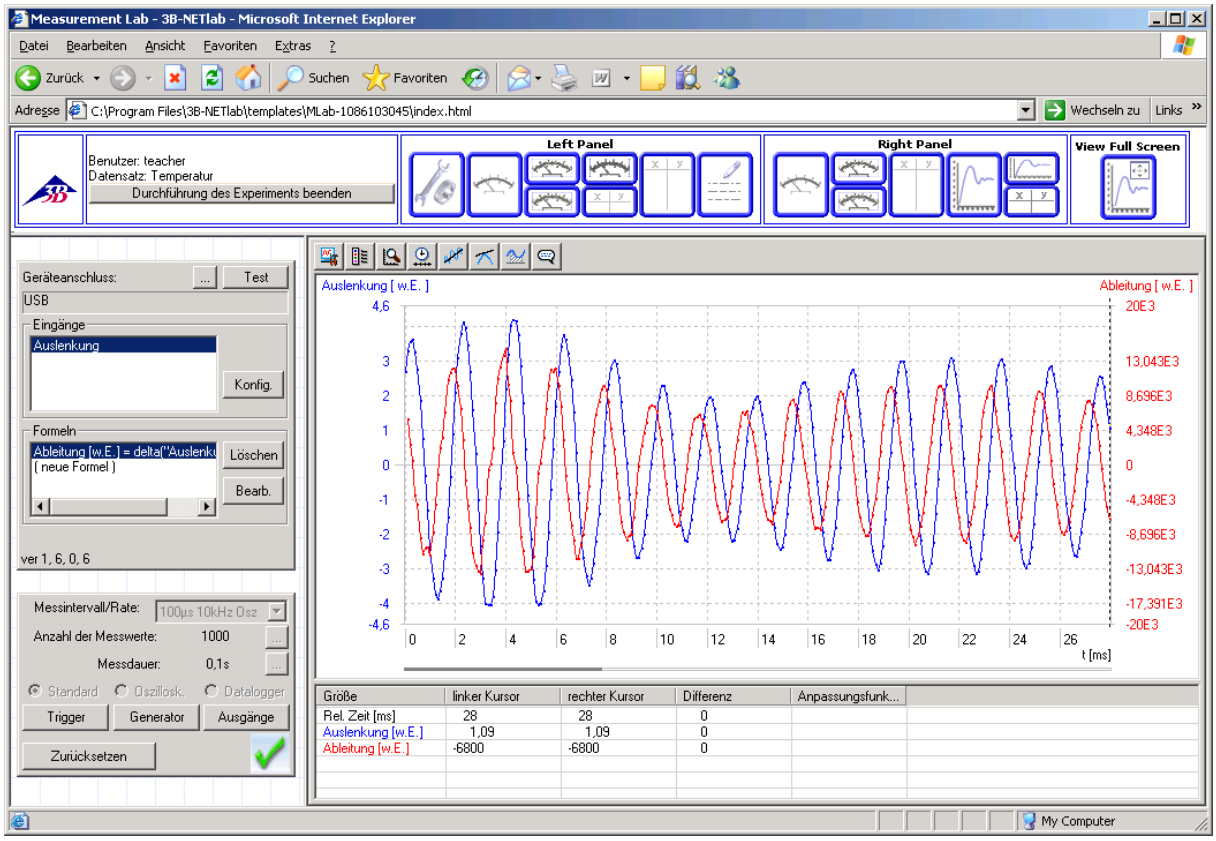
3B SCIENTIFIC® PHYSICS

...going one step further

3B Net*lab*™ 1000544

Instruction manual

14/06 MC/CW



Contents

1 Introduction

3B NET*lab*™ is a data collection and evaluation program for the 3B NET*log*™ equipment that can be incorporated into a network. Since it is based on ActiveX technology, all its control elements can be integrated into web pages which can be displayed and operated using Microsoft's Internet Explorer browser.

The main function of the 3B NET*lab*™ program is to facilitate computer-aided experimentation for educational purposes. To this end, instructions for numerous experiments from the various areas of physics are available in web-page form. A user can navigate between pages just as on the internet and can use controls connected to on-site equipment

to conduct all aspects of the procedures.

A measurement lab has been provided from which all functions of the 3B NET*log*™ equipment can be operated. To evaluate the measured data, the program is equipped with a whole range of graphic tools.
Thanks to its networking functionality, the 3B NET*lab*™ program is perfectly suited for application in schools and educational institutes. Instructors are able to monitor the progress of students and the data they gather during experiments from their own workstation. Similarly, students can follow experiments being demonstrated or carried out by an instructor on their own monitor screens.

2 System requirements

2.1 System requirements

- Windows XP and Microsoft Internet Explorer up to version 8
- Windows 7 (32-bit and 64-bit) and Microsoft Internet Explorer up to 11 or higher
- Windows 8.1 (32-bit und 64-bit) and Microsoft Internet Explorer up to 11 or higher
- 32-bit (x86) or 64-bit (x64) processor with a speed of at least 1 GHz
- At least 1 GB RAM
- At least 500 MB hard disc memory
- Monitor with 1024x768 resolution or higher
- USB connection

2.2 Additionally recommended

- Internet access
- Adobe Reader 7.0
- Adobe Flash Player

3 CD-ROM contents

- 3B NET*lab*™ software
- USB driver
- Instruction manual

4 System set-up and installation

4.1 System set-up:

In order to ensure flawless functioning of 3B NET*lab*™, it may be necessary to alter certain settings for Microsoft's Internet Explorer which are connected to the execution guidelines for ActiveX controls.

4.1.1 ActiveX controls:

An ActiveX control is a software program that cannot run independently. Rather, it is executed in a container provided by a separate application. The most prominent example of such an application is Microsoft's Internet Explorer with its capability to display ActiveX controls on web pages. This is mostly used for integrating multimedia content (e.g. animations using Adobe's Flash Player). Since ActiveX controls can provide any kind of functionality within programs regardless of the container, this technology offers users far greater possibilities (e.g. on Microsoft's Windows Update website, where updates can be installed into the operating system via an ActiveX control). At the same time, however, there are also certain dangers accompanying this technology – for instance, risks due to dubious websites which attempt to plant and execute harmful program code in the form of ActiveX control elements onto the user's computer. For this reason, Internet Explorer is so configured that it requires by default the explicit consent of a user before installing a control. A publisher or server can be verified on the basis of a digital signature. If such a digital signature is missing, any attempt by a website to install code is ignored.

4.1.2 Security settings for Internet Explorer:

The 3B NET*lab*™ control is provided with a digital signature and can thus be installed by Internet Explorer without altering the default settings. As a rule, it is only necessary to alter the settings marked * to allow the program to run. However, if a particularly restrictive security policy has been instituted, then further modifications may be required.

Internet Explorer differentiates between various security zones: "*Internet*", "*Local intranet*", "*Trusted sites*" and "*Restricted sites*". To modify the settings, go to the "***Tools***" menu, select "Internet Options" then click the "***Security***" tab.

Since the pages for 3B NET*lab*™ are present either on the hard-disk of the local computer or on the local network, it is likely that the zone that requires new settings is the one called "***Local intranet***".

If the standard level has been set to "*Medium*", "*Medium-low*", or "*Low*", no further steps are required. If not, set the following settings under "Custom Level".

- "***Script ActiveX controls marked safe for scripting***" – "***Enable***"
- "***Run ActiveX controls and plugins***" – "Enable"
- "***Active scripting***" – "Enable"

There is no specific zone for pages on the local computer. In order to permit the execution of ActiveX control elements, go to "***Security***" and activate the following option in the "***Advanced***" tab (Windows XP only):

- "***Allow active content to run in files on My Computer***" *

If you use a pop-up blocker, deactivate the blocker when working with 3B NET*lab*™, since the system works with pop-ups.

4.2 Installation:

The following steps will guide you through the installation of 3B NET*lab*™ for single-user operation. Installation on a network is described in chapter 7.

4.2.1 Driver installation

Before installing the 3B NET*lab*™ software, it is important to install the USB driver:

- Insert the installation CD into the CD-ROM drive of the computer.
- Connect 3B NET*log*™ to the computer via the USB cable.

The computer reports that it has detected a new hardware.

Windows XP:

- Do not activate Windows Update.
- Select "Install software from specified location".
- Under "Browse", specify the location of the driver on the CD.
- A hardware message will state that the software has failed to pass the Windows Logo Test. You should nevertheless click "Proceed with installation".

Windows 7 and 8.1:

The operating system automatically installs a driver which is packaged with Windows. However, this driver is not used with 3B NET*log*™. The correct driver therefore needs to be installed manually as per the following instructions:

- Open the hardware manager under *Control Panel -> Hardware and Sound -> Hardware Manager*.
- Double click "USB Controller" in the hardware manager.
- Double click "USB Serial Converter".
- Click *Drivers -> Update Driver*.
- A small window will open so that you can search for the driver software. Click "*Find driver software on this computer"* in the window.
- Click the "*Browse…"* button and select the path for the driver.
- Follow the instructions to install the driver.

As an alternative, the folder containing the driver file can be copied directly onto the computer from the CD and can be installed from the hard disk.

4.2.1.1 ***Exception****:*

If the software for the CCD linear camera (1013311) is already installed on your computer, carry out the following instructions:

- Connect 3B NET*log*™ to the computer via the USB cable.

The computer **will not** report that a new hardware **has been detected**.

- Insert the installation CD into the CD-ROM drive of the computer.

Windows XP:

- *System control panel -> System -> Hardware ->* open *Device manager*.
- Double-click on USB controller.
- Double-click "ULICE USB Product".
- Click *Driver -> Update driver*. (The hardware assistant will start.)
- Do not activate Windows Update.
- Select "Install software from specific source".
- Select "Do not search. Autodetect driver".
- Select "Drive" and then "Search" to establish the path to the driver.
- Click "Yes" to confirm that the file should be overwritten.
- Click "Proceed with installation" when the hardware message states that the software has failed to pass the Windows Logo Test.

Windows 7 and 8.1:

- Open the hardware manager under *Control Panel -> Hardware and Sound -> Hardware Manager*.
- Double click "USB Controller" in the hardware manager.
- Double click "ULICE USB Product".
- Click *Drivers -> Update Driver*.
- A small window will open so that you can search for the driver software. Click "*Find driver software on this computer"* in the window.
- Click "*Select from a list of device drivers on this computer"*.

- Click the "*Medium…"* button.
- Click the "*Browse…"* button and select the path for the driver.
- Click “Yes” to confirm that the file should be overwritten.

4.3 Software installation

Insert the ***Install CD*** into the CD-ROM drive.

Windows XP:

1. If the install program does not start automatically, run “***start.exe***” from the root directory of the CD-ROM or right click the CD-ROM drive icon and select “AutoPlay”.
2. Click “***Install 3B NETlab™***”.

Windows 7 and 8.1:

1. Administrator rights are required to install the software. It is not sufficient simply to be logged on as administrator.
2. Open Windows Explorer and find the file “***start.exe***”.
3. Right click the file to open a context menu.
4. Click the option "Run as administrator ".
5. The software will now be run with administrator rights and installation now begins.

Windows XP, 7 and 8.1:

6. A window appears in which you can select a language by clicking on the respective country flag. In response to the prompt “Install *3B NETlab*?”, click “***Yes***”.
7. If you nevertheless see the message "Internet Explorer has restricted this webpage from running scripts or ActiveX controls that could access your computer", click the "Allow Blocked Content" button.
8. The program raises the question whether the directory “C:\Programs\3BNETlab” should be created, click “***Yes***”.
9. Enter a user name and password for the instructor (or the program administrator). Click “***OK***” to confirm.
10. The program files will then be installed.
11. A window appears in which you can select the experiments that are to be installed. These experiments have been categorised according to language and subject area. It is possible to select either individual experiments or whole categories. Select the required experiments/categories and click “***OK***” to confirm.
12. The experiments will now be installed.
13. After completion of the installation, a message box appears stating “*Installation completed successfully. Click OK to launch program*”. Click “***OK***” to confirm.
14. Internet Explorer will now be restarted automatically and the program will be loaded.

5 The experiment system

3B NET*lab*™ differentiates between two types of experiments. On the one hand, it features a series of experiment procedures covering various disciplines of physics. By following the instructions therein, experiments can be conducted quickly and purposefully using predefined settings. On the other hand, the measurement lab lets you access all settings and functions for the 3B NET*log*™ equipment in order to conduct your own experiments.

Once the program has been started by either clicking the desktop icon or via the Start menu, a prompt appears. You should now log in by entering your user name and password. You can now select from among the following items:

- ***Measurement lab***
- ***Experiments***
- ***Administration***

Details for Administration are explained in chapter 6. The procedure after selecting either of the first two items is very similar, since the measurement lab, in principle, also provides a set of instructions for experiments, the only difference being that it leaves all options open. The steps required for starting an experiment, managing the experiment data and operating controls are thus explained here using the measurement lab for all examples. These then apply equally to the “*Experiments*” option.

5.1 Measurement lab (for experiments of your own design):

5.1.1 Starting, suspending, resuming and completing experiments:

5.1.1.1 Starting an experiment:

You can start the ***Measurement Lab*** by selecting the corresponding item from the splash screen then clicking “***Continue***”. You will now see a list with the available data entries. A data entry or record contains all the information on the status of a particular experiment as well as

the measurements made hitherto. To start a new experiment, it is necessary to create a new data record.

1. Select "***Create new data set***" and click "***Continue***".
2. Enter a name for the data record and click "***OK***" to confirm.

A new measurement lab window then opens. Before dealing with the controls featured in the measurement lab and the experiments themselves, further explanation is required on how to proceed with the data records.

5.1.1.2 Suspending and resuming an experiment; importing, exporting and deleting data records:

It is possible to suspend the experiment at any time that no actual measurement is being made.

1. Simply close the experiment window. The program will then return to the main window.
2. Click "***Back***".

The data record you created now appears in the list. The status "executable" indicates that it is possible to resume the corresponding experiment by selecting the item "***Open selected data set***". Furthermore, options for deleting, exporting and importing data records are also provided.

To export a data record set, it is necessary to specify a directory in which system components as well as experiment data can be copied so that the experiment can be resumed from this location.

5.1.1.3 Concluding an experiment:

As soon as the first measurement has been concluded in the course of an experiment, a button "*Finish the experiment*" appears in the top left hand corner of the window.

1. ***Click the button*** to deactivate all measurement functions.
2. Close the experiment window.
3. Click "***Back***" in the main window.

The data record is now marked is now marked "*Finished*" and can be opened only for viewing.

5.1.2 Measurement functions:

5.1.2.1 Establishing and testing a connection:

In the first row of the upper left hand control panel (*Input control panel*) in the measurement lab window, it is possible to enter the name of the connection by which the 3B NET*log*™ is linked to the computer by using the "***…***" button. This setting need only be modified in exceptional cases. Normally, it is set to "*USB*". By clicking the "***Test***" button, the connection can be tested and the result is displayed after a brief pause.

5.1.2.2 Selection of inputs:

Selection of the inputs required for measurements can also be carried out in the top left control panel. Clicking "***Select***" opens a dialog box, in which the desired inputs can be specified. The following options are available:

Analogue input A: used for measuring voltage, current or other quantities in conjunction with a sensor box which can be connected via the input at the side.

Analogue input B: used for measuring voltage or other quantities in conjunction with a sensor box which can be connected via the input at the side.

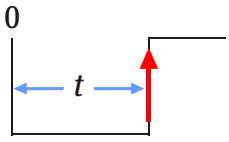
Digital inputs: the four digital inputs of the 3B NET*log*™ unit are integrated together in an 8-pin mini DIN connector on the right and designated A, B, C and D. It is possible to interpret the inputs in any of the following ways:

- As individual signals (A, B, C or D)
- An OR of all four signals (1 if at least one of the signals is HIGH)
- The binary number represented by the signals ("D/A conversion", 1•A + 2•B + 3•C + 4•D)

Manual input: by selecting this input type it is possible to enter a value into the data record manually.

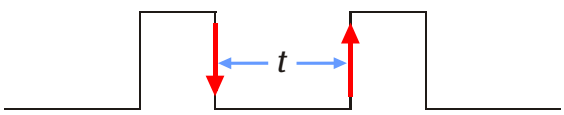
Time: a pulse signal at any of the digital or analogue inputs can be processed to determine information about the pulse with regard to its timing. A value is recorded for every pulse.

- *Pulse time*: elapsed time from the beginning of the measurement to the rising edge of the current pulse.

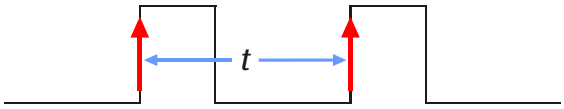


- *Puls duration*: elapsed time between the rising edge and the falling edge of the current pulse.

- *Pulse distance (- +)*: elapsed time between the falling edge of the previous pulse and the rising edge of the current pulse.



- *Pulse distance (+ +)*: elapsed time between the rising edge of the previous pulse and the rising edge of the current pulse.



Frequency: measures the mean frequency or duration of a periodic signal at an analogue or digital input over an interval specified by the user (the start and end of the interval are specified by activating a button.)

5.1.2.3 Configuration of inputs:

The selected inputs appear in a list at the top of the control panel. In order to configure a specific input, select it and click "***Config***". A dialog box appears which provides various options depending on the selection:

Analogue inputs:

- *Symbol/Name and description:* this makes it possible to rename an input (e.g. corresponding to the quantity which will be measured) and also allows a description to be entered, if needed, that should follow a semicolon.
- *Input mode:* selects between sensor (for use with an external sensor box), DC voltage (VDC), rms AC voltage (VAC), DC current (IDC, analogue input A only) and rms AC current (IAC, analogue input A only) measuring modes.
- *Input range:* selection of input range (measuring range)
- *Use prefix for displaying values:* this makes it possible to display measured values, large or small, with prefices in front of the unit instead of expressing them in powers of 10.

Digital inputs:

- *Input mode:* selects between displaying the signal for a single input (digital signal A, digital signal B, …), the result of ORing all four signals (arbitrary digital signal) or the binary number represented by the four signals (D/A conversion, MSB: D).

Time/frequency:

- *Input mode:* selects the input where the pulse signal is to be measured. The following selections are possible: digital input A, an OR of two or more digital inputs (A, B), (A, B, C), (A, B, C, D) or either of the analogue inputs. If the analogue inputs are selected, an additional check box appears for setting a comparator threshold (see below).
- *Input range*: Digital inputs: assigns logical states to physical input signals. "Uninterrupted = 1" means that high voltage (>3.8 V) at the input corresponds to a logical 1 and low voltage at the input (<0.3 V) corresponds to a logical 0. The relation is reversed if "Uninterrupted = 0". This notation is derived from the status of a light barrier associated with the digital input.

Analogue inputs: (see above)

- *Comp. level*: sets a threshold voltage, specified as a percentage of the upper limit of the input range. The threshold voltage denotes the point of transition between the two logical states.

By using the data conversion table on the right hand side, it is possible to define how you want a value to be displayed in relation to the actual signal. This relation is described by means of a table consisting of pairs of values. Enter pairs of values for the measured value and the value to be displayed starting from the bottom and working up. Enter the unit for the new value in the "Results" box. During subsequent measurements, instead of the directly measured value the value displayed will be converted with the help of the table. Values between the entries in the table will be interpolated assuming a linear gradient between entries.

5.1.3 Formulas:

Underneath the input control panel is another panel in which it is possible to enter formulae that are based on the measured values. This function is mostly used when the values of a particular quantity are to be displayed together with the measured values. The quantity to be displayed is a function of the measured quantity, i.e. its values can be calculated directly from the measurements.

- In order to enter a new formula, select "***(New Formula)***" from the list and click "***Edit***". .
- In the dialog box which appears, enter the name of the value to be calculated in the "***Formula name***" field and the corresponding unit in "***Formula unit***".
- To define the formula, use variables and functions from the two lists that are provided by double clicking the "***Formula text***" field. Note: the term representing the measured values is entered in the formula in inverted commas.

The check box "*Use prefix*" makes it possible to display formula values using prefices instead of expressing them in powers of 10.

After clicking "***OK***" to confirm the entries, the formula name is added to the list. When this is selected, the formula can be edited or deleted by means of the corresponding buttons.

5.1.4 Control of measurements:

After selecting inputs and entering formulae, click "***Inputs OK***" on the input control panel to confirm the entries. You can now proceed with adjusting settings for recording measurements via the control panel underneath (*Measurement control panel*).

Various logging/recording modes can be implemented depending on the selection and configuration of the inputs. First of all, however, it is important to define the recording speed (sampling rate) in the field "***Sampling rate***". The entries set the interval between two recordings or, in some cases, the corresponding frequency. AC current or voltage measurements, i.e. measurements of root mean square values, or measurements involving several sensors can only be carried out in a slow mode (interval $\geq$ 0.5 s).

The final option is for manual mode ("***manual sampling***"), in which recording of a measurement is triggered by clicking a button.

The following three recording modes are available:

Recorder: a pre-defined number of measurements are carried out. This number can be specified directly via the field "***Number of measurements***" or indirectly via the duration of the measurement (set using the adjacent "***…***" button). At a sampling rate of 100 Hz or less, the measured values are output in real time as the measurements are made. In high-speed mode (>100 Hz), the data is first stored in the internal memory of the equipment and read out after measurements have been completed. It is possible to view the measured values in various ways, e.g. as a graph or in tabular form.

Oscilloscope: the measurements are recorded over time and displayed as a curve. After each sweep from left to right, the old curve is replaced by a new one. Unlike standard mode, in oscilloscope mode only the last 128 measurements can be viewed or stored. Since a new trace is recorded only a few times per second, at high-speeds oscilloscope mode only displays samples of the overall signal waveform. However, the advantage over standard mode is that, even in high-speed mode, it is possible to observe measurements in "real time".

Datalogger: it is also possible to record measurements offline using 3B NET*log*™, without being connected to the computer. The necessary configuration can be selected on the equipment itself or conveniently using this function in 3B NET*lab*™. After completing measurements, once the device is connected to the computer again, the data can be read out via the same function.

Use the "***Trigger***" button to open a dialog box that defines the trigger conditions that initiate recording in standard mode.

- Activate the inputs which are to be triggered at the left of the box.
- In the middle of the box you can select whether the trigger should occur when the signal crosses the threshold rising or falling.
- Trigger thresholds for the analogue inputs can be set on the right (as a percentage of the upper limit of the input range).

5.1.5 Conducting measurements:

When all settings have been carried out, confirm and click "***Parameters OK***". You can now start measuring by clicking "***Start***".

5.1.5.1 Standard mode:

- If manual recording mode has been selected, you can make a measurement simply by clicking "***Sample***". At high -speeds a bar appears showing the progress of the measurements being conducted. The display of measured values is dealt with in section 6.1.8 "Evaluation".
- Measurements can be stopped before they have finished by clicking "***Finish***". If this is not done, measurements continue to be made until the desired number of values has been recorded. After that it is possible to carry out an evaluation.
- In order to start new measurements, first click "***Reset***". You will first be given the chance to save the current recorded values in a new data record. Thereafter, you can begin conducting new measurements. In case any parameters need to be changed, click "***Change settings***" in order to return to the choice of inputs. Your saved settings will not be overwritten by doing this.

5.1.5.2 Oscilloscope:

A new window opens, consisting of the oscilloscope display and control panel. It is possible to adjust the sampling rate and the input range by moving the corresponding sliders during measurements. In addition, a trigger is provided which initiates the recording of the measurements when the threshold has been crossed. The first slider, marked "*Trigger*" in the control panel, is used for selecting the trigger input. The second slider determines in which direction the threshold has to be crossed. The third slider sets the threshold itself, specified as a percentage value of the top limit of the input range. The "*Sampling*" control panel allows you to choose between "*Single*" and "*Continuous*" modes. If "*Single*" has been selected, the recording of measurements begins when you click

"***Start***" and ends after one sweep. In this manner, it is possible to trace rare events as soon as they cause a trigger without their being immediately overwritten.

The oscilloscope window can be closed by clicking either of the buttons "*Abort*" or "***Finish and Store Data***". If you click the latter, the measurements most recently recorded (128 samples) remain displayed in the display mode selected at the top, just as in standard mode, and are available for evaluation.

5.1.5.3 Datalogger:

In this mode, no measurements are actually begun after you click "***Start***". Instead, a selection window appears.

Setup: writes the configuration of the inputs and the sampling rate to the equipment. Once a message has been received acknowledging that the data has been stored, the equipment can be disconnected from the computer and can be used as a portable device for measurements. Additional information is available in the 3B NET*log*™ instruction manual.

Readout: this opens a second selection window. Click "***Readout***" to read data from the internal memory of the 3B NET*log*™ device. "***Previous data***" calls up the most recently recorded data. A list containing the available data records appears, from which it is possible to select one set of records and download it by clicking "***OK***". Note: the maximum number of samples read out is no greater than the value that was specified under "*Number of samples*" in the measurement control panel.

5.1.6 Generator:

5.1.6.1 Constant signals and digital pulses

In the course of the measurement process voltage signals can be output from the analogue outputs and logical signals from the digital outputs. The "***Outputs***" button accesses a menu where you can enter values for constant voltage at the analogue outputs. For digital outputs, it is possible to choose between the following options:

0: During the entire measurement process, the digital output is set to "logical 0" (0 V).

1 permanent: during the entire measurement process, the digital output is set to "logical 1" (5 V).

1 with delay: the digital output switches to "logical 1" shortly after the measurement process has been started.

Pulse with delay: the digital input sends a pulse shortly after the measurement process has started.

In order to activate the analogue outputs, turn on the check box "Analogue outputs ON".

5.1.7 Signals varying over time (Function generator):

It is possible to use the function generator to generate time-variant periodic signals at the analogue outputs using the "***Generator***" button. The sample rate for the generator is always equal to the sampling rate of the measurement. If manual recording has been selected, then the sampling rate of the

generator can be set in the corresponding input box of the "*Sampling*" panel. Next to this is the check box "***Generator enabled***" that enables the function generator.

The type of signal can be defined separately for *Channel A* and *Channel B* by selecting the corresponding output. Clicking "***Predefined***" opens a dialog box in which one of the following predefined signal waveforms can be selected: "*Sine*", "*Rectangle*", "*Triangle*" and "*Flat*". The parameters are also modified according to the selected type of signal. Click "***OK***" to confirm the entries. The specified signal is then displayed in a graphic.

It is possible to use the mouse to plot arbitrary signal types on the graph. Move the cursor to the left edge, press the left mouse button, draw the desired signal with the cursor and release the mouse button after you have finished.

The period and frequency of a repeating signal are displayed above the graphic.

If the same signal is to be output to both outputs, set the signal for output A and click "***Copy from A***" under "*Channel B*" (or vice versa).

Note that the function generator is not working in the oscilloscope mode.

5.1.8 Evaluation:

5.1.8.1 Display of measurements:

After any measurement in standard or oscilloscope mode, the data can be viewed in various forms. It is possible to change the display at any given time by simply clicking the corresponding icons at the top edge of the screen.

Dial: the current value is displayed on a dial as on an analogue multimeter. This representation is useful at slow speeds or in manual mode because the currently valid measurement can be displayed in real time.

Dual display: the values of two inputs are displayed simultaneously.

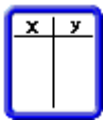


Table: a table containing the measured values is displayed

 Selects the columns to be displayed

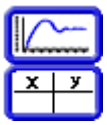
 Copies the selected measured data records to the clipboard

 Manual entry of values in the selected cells

 Deletes all manually entered values

Graph: the measured values are plotted on a graph. The next section deals with the functions available for the graphical display.

Table and pointer: see above



Graph and table: see above

Notes: This allows you to enter comments describing the measurements.

Settings: once a display setting for the left-hand side of the screen has been configured, clicking this icon allows the control fields to be re-opened for modification.

5.1.8.2 Graphical display:

In a graphical display, the data for each digital input is displayed in a different colour with a legend underneath. The parameters for the x-axis are entered in the first row.

The graph provides two cursors represented by vertical dotted lines that can be moved along the x-axis. Just move the mouse close to one of these cursors, press the left mouse button and move the cursor to the requisite position, releasing the cursor when it is correctly placed. The coordinates of the cursor are displayed in the row containing the legend for the x-axis. Beneath that, the individual measurements are contained in the rows corresponding to the y-axis, i.e. the y coordinates for the selected curve at the cursor position.

The right mouse button is used for zooming. A context menu appears which provide the possibility of zooming in or out of the x-axis, the y-axis or both of the axes. It is possible to highlight sections by keeping the right mouse button pressed and dragging the mouse, thereby enclosing the relevant section in a rectangle. The contents highlighted within this rectangle can be magnified to fill the entire screen by selecting "*Zoom into selected window*". The visible section of the graph can be shifted by dragging the axis legend with the left mouse button.

A row of icons is located above the graph. The following sections explain their function:

 **Setup display:** (connecting lines, grids, data points, etc.)

 **Select inputs/formulas to be displayed:** also for assigning what is to be on the x-axis. The x-axis can also be assigned to one of the measured values (x-y display).

 **Modify scale range:** use "Autoscaling" to scale the highlighted axis so that it is possible to view all data. "Manual scaling" opens a dialog box in which the limits of the visible intervals can be entered manually.

 **Modify time scale range:** (exception: in x-y mode, both of the axes are set in the dialog box described above)

 **Fit to a function (Fit):** for further information see the following section

 **Calculate tangent:** if this icon is activated, then a tangent is drawn to the displayed curve from the last cursor to be moved If several curves are visible, then it is necessary to select one of the curves in a selection window before proceeding. The section of the axis and the gradient of the tangent are displayed in the upper left of the graph.

 **Calculate integral:** when this icon is activated, it is possible to calculate the integral of the highlighted (or the only visible) data curve within limits defined by the cursors. In graphical terms this corresponds to the area below the respective curve (which is shaded). Any areas below the x-axis are considered negative.

 **Edit text labels:** activating this icon allows us to create a text field and position it on the graph.

5.1.8.3 Fitting to a function (Fit):

Proceed as described in the following to fit a function to a data curve:

- Click the  icon for the graph. A dialog box for fitting the function will open.
- On the left, select the desired data.
- Click "***Edit fit function for selected quantity***". A window appears in which the section of the curve that was highlighted earlier by

the cursors is drawn (preview) and a list of functions is presented.

- Select the desired function from the list or define a unique function by means of "***Edit the user formula***". (See section 6.1.3 "*Formulas*". It is possible to use six parameters from A to F. The independent variable appears last in the list.) The equation (strictly speaking, the right hand side of the algebraic equation) of the chosen function is displayed above the list.
- Specify the parameters for the initial values on the right hand side. This is not always necessary. Sometimes, however, the preset initial values are not helpful. Click "***Draw***" to plot the function with the specified parameters in the preview.
- In addition to the input fields for the initial values, activating the check box can cause the parameter values to remain constant during the fitting of the function.
- Click "***Try to fit***". The result is displayed in the preview. The correlation coefficient R^2 is output above the control panel labelled "***Parameters***".
- After clicking "***OK***" and exiting the window for fitting the function, the fit function is also plotted on the graph.

An existing fit function can be edited in the same way. In order to display or hide a fit function, open the dialog field for setting a fit function and, after highlighting the relevant data set, click the corresponding icon.

5.2 Experiments (according to the instructions):

The only difference between experimenting according to instructions and experimenting with the measurement lab is that the control panels have been incorporated and pre-configured in the experiment procedure. Usually, only those measurement functions which are significant are activated. In this way, even users little accustomed to the functions of 3B NET*log*™ are able to perform experiments easily. To begin an experiment, proceed from the splash screen as follows:

- Select "***Experiments***" and click "***Continue***".
- Choose "***Perform/browse an experiment***" and click "***Continue***".
- Select an experiment from the list and click "***Continue***". The experiment which is now visible is recognised by the measurement laboratory. This is where the data pertaining to the selected experiment are administered. Subsequently proceed as explained in section 6.1.1.1 "".

6 Administration and network set-up

The functions of 3B NET*lab*™ described in the following section support its operation within a network. After installation, no administrative intervention is required for single-user operation. Owing to the innumerable ways of implementing a network and the corresponding differences in configuration associated with that, it is not possible to explain the various steps in detail within the scope of this chapter. Administrator rights are essential for setting up a network.

The network functionality makes it possible for instructors to observe students' experiments from their own computer while they are being conducted and also to view the recorded readings. Likewise, instructors can also conduct an experiment at their own computer while students observe at their terminals.

Communication is conducted entirely via Windows file sharing. No additional TCP connections need to be set up. The supervisor can regularly access and read a data file shared by the computer where the experiment is being conducted. The data is thus accessible from the supervisors' controls after only a very brief delay. At the same time however, supervisors are not restricted to viewing those pages or controls currently being used by students performing the experiments. A supervisor can, for instance, check the individual numbers in a table while the student performing the experiment is conducting an analysis of them in a graph.

6.1 Network installation:

Installation on an instructor's computer is carried out as in the single-user installation procedure, but subsequently the instructor's computer is set up as a server.

- Select "***Administration***" from the splash screen and click "***Continue***".
- Select "***Adm. the teacher's server and student's computers***" and click "***Continue***".
- Select "***Define/modify the teacher's server***" and click "***Continue***".
- In the dialog box, a path is displayed which must now be ***shared*** for all network users to have read access. For NTFS data systems, make sure that the necessary authorisation is granted.
- Enter the network address of the share. Click "***OK***" to confirm.

A message appears which explains how to proceed. Among others, the URL for the installation of the 3B NET*lab*™ students' version is specified. The following steps must be carried out on

each student's computer. While carrying out these steps, make sure to observe the notes on security settings, as described in section 4.1.2.

- ***Enter the installation URL*** in Internet Explorer.
- An installation prompt appears for the ActiveX control element "3BNETlab" which you should ***accept***.
- The installation routine for the students' version begins. Confirm the creation of a program directory.
- A message appears in which the path is specified. This ***must be shared*** in order to grant the instructor full access. Make sure the relevant authorisation is provided for NTFS file systems.

After confirming this message, the program is concluded. It is now important that the server can detect the student computers. To test this:

- Go to "***Administration***" and select the item "***Define a new student's computer***". Click "***Continue***".
- Enter a name and the network address of the supervisor share on the student's computer. Click "***OK***" to confirm.

6.2 User identification for students:

A separate user ID can be set up for each individual student. The advantage of this is that after logging on for each experiment, only that particular student's data are listed. In this way, any confusion which may arise on account of multiple students working simultaneously is avoided. Also, experimental results are always ascribed to a particular student. This simplifies the task of monitoring for the supervisor.

6.2.1 Setting up user identification for students:

After the installation of the network, students must be granted user identification in order to run the program.

- From "Adm. the teacher's server and student's computers" click "Back" to return to the previous page
- Select "***Students***" and click "***Continue***".
- Select "***Create new student entry***" and click "***Continue***".
- From the list, select the computer on which the user ID is to be created and click "***Continue***".
- Enter a ***user name*** for the student.
- ***Select a user group***. If necessary, click "**Create a new group of students**".
- Enter a password. Click "***OK***" to confirm.

6.2.2 Changing students' user identification:

- Go to "***Students***" and select "***Edit an existing student entry***".
- From the list of students' entries, select an entry then click "***Modify***" and "***Continue***".
- A dialog box appears where it is possible to change the group and, if required, the password of the student.

6.2.3 Deleting students' user identification:

- Go to "***Students***" and select "***Edit an existing student entry***".
- From the list of students' entries, select an entry then click "***Delete***" and "***Continue***".

6.3 User identification for teachers:

6.3.1 Setting up user identification for teachers:

It is also possible to set up an individual user identification for each teacher.

- Go to "***Administration***". Select "***Administrate the teachers' list***" and click "***Continue***".
- Select "***Create a new teacher entry***" and click "***Continue***".
- Enter a user name and password, click "***OK***" to confirm.

6.3.2 Changing your own password:

Any teacher can only change his/her own password.

- Go to "***Administration***". Select "*Administrate the teachers' list*" and click "***Continue***".
- Select "***Edit current teacher entry***" and click "***Continue***".
- Activate the "***Change***" check box in the field labelled "***Password***".
- Enter a new password. Click "***OK***" to confirm.

7 Network applications

This chapter describes functions which can only be used in the network.

7.1 Teachers monitoring experiments conducted by students:

Experiments conducted by students can be monitored at any time by the instructor. Even after completion of the experiment, it is still possible to refer to and consult the data.

- Select "***Administration***" on the splash screen and click "***Continue***".

- Select "***Student***" and click "***Continue***".
- Select "***Watch a student's experiment***" and click "***Continue***".
- From the list, select a particular student whose experiment you wish to monitor and click "***Continue***".
- From the list, select the data sets you wish to see. The "***Date/time***" column specifies the time the data set was created.
- Click "***Browse***". The experiment window will open. However, the control elements are deactivated. Therefore, it is not possible to take control of the experiment.

While monitoring an experiment, it is possible to change the display or navigate on the page independently, without interfering with the participating student(s). The evaluation functions of the graph display may also be used.

To exit the experiment, simply close the window and click "***Back***" to return to the main window.

7.2 Students observing experiments conducted by teachers:

It is possible for the students to observe experiments conducted and demonstrated by the instructors.

- Select "***Watch the teacher's experiment***" on the splash screen and click "***Continue***".
- From the list, select the data sets you wish to see. The "***Date/time***" column specifies the time the data set was created.
- Select "***Browse***".

The experiment window will open. It provides the same range of options as described under section 7.1 "Teachers monitoring experiments conducted by students".

8 Support

If you have any queries and/or suggestions, please feel free to contact our support team:

Email: support@3bnetlab.com