HV*pilot*

High Voltage Test Control Software
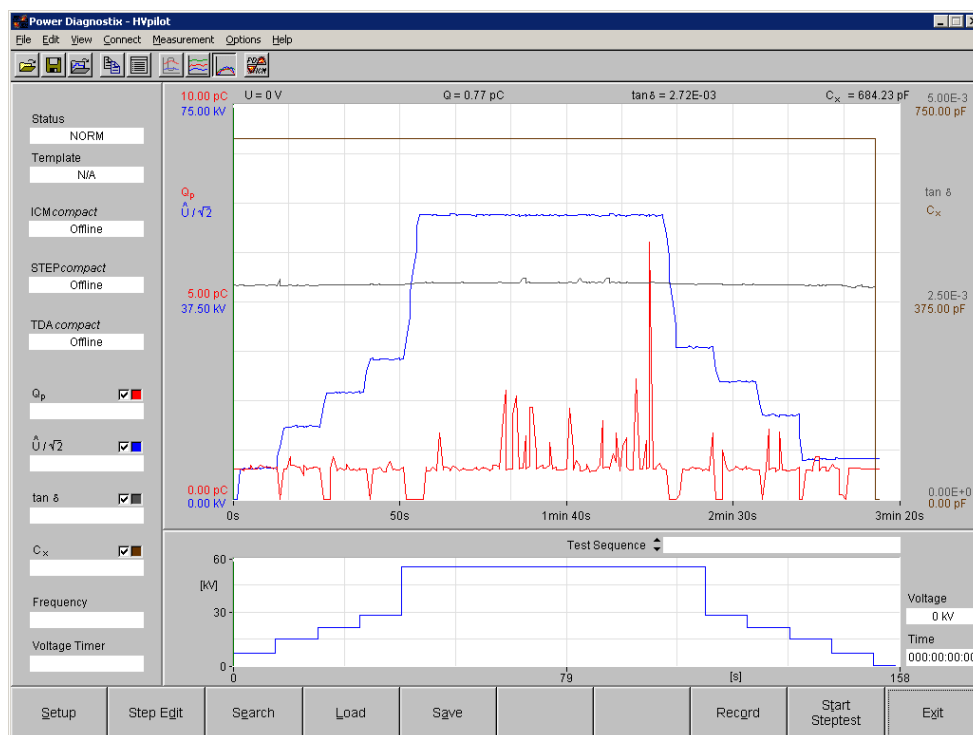
User Manual

Rev. e3.05

Contents

I   Introduction

The HV*pilot* software controls the HV*control* and STEP*compact* and receives measured data from the ICM*compact* and/or a tan delta measuring bridge (TDA*compact* or Tettex 2877, optional). The HV*control* resp. the STEP*compact* controls the variac of a high voltage transformer and together with the HV*pilot* software they are designed to automate high voltage test sequences. The instruments are connected to the PC via the serial interface. The HV*pilot* software provides the possibility to program a test sequence, analyses the measured data and generates a report automatically. For this purpose, there are several different test sequences available.

II   Starting the Program

The HV*pilot* software can be started via the Windows Explore; the Start Menu; OR THE SHORTCUT ICON ON THE DESKTOP.

On PCs running Windows 10 with the Creator's Update of 2017 the ICM*system* application window may appear very small on high resolution monitors. To enlarge the display size of the software, please take the following steps:

1. Right-click on the application short cut on the desktop.

2. Choose "Properties" from the context menu, which will open the Properties window.

3. Enable "Override high DPI scaling behaviour" and set "Scaling performed by" to "System" on the "Compatibility" tab.

4. If you have administrator rights, you can change the settings for all users by clicking the corresponding button.

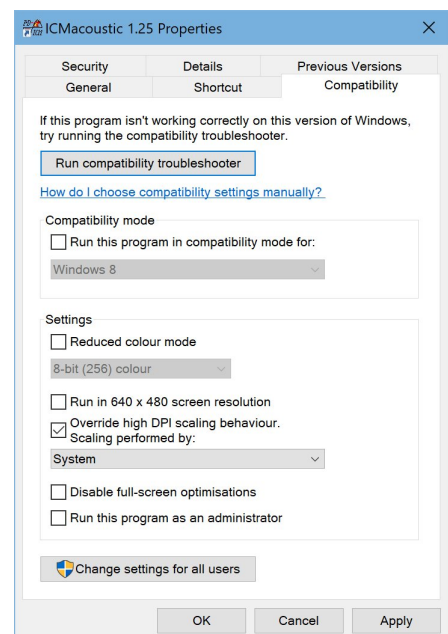5. Approve the change by clicking "OK".
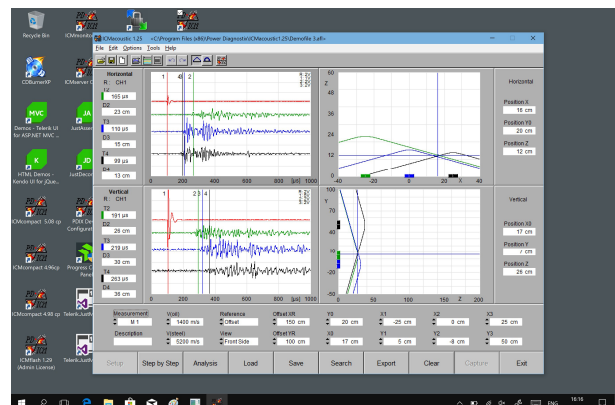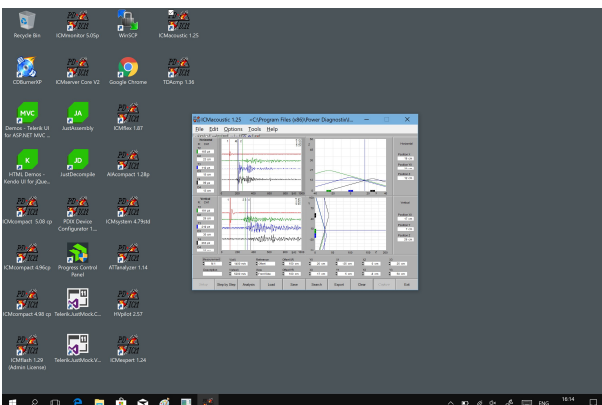

Fig. II.1: Properties window

Fig. II.2: Desktop before and after change of scaling behavior

After the program start the COM ports of the PC are scanned for the HV*control/*STEP*compact*, the ICM*compact,* and the tan delta measuring bridge. Figure II.3 shows the result dialogue box. To establish a connection to an instrument, select the corresponding check box and click OK. If an instrument was selected, the software establishes the connections to the selected instruments.

The main panel (figures II.4 and II.5) shows the strip chart view in which the actual measurement values are displayed continuously. To clear the display, use the *View* menu or the toolbar and select 'Clear Strip chart'. The boxes STEP*compact*, ICM*compact* and TDA*compact* on the left side indicate a valid connection to these instruments (Online). It is possible to disconnect or connect to an instrument by clicking on the corresponding box and selecting the respective option. The boxes underneath display the actual measurement values of the PD activity, voltage, tan delta, capacitance, and frequency, if the respective instruments are online.
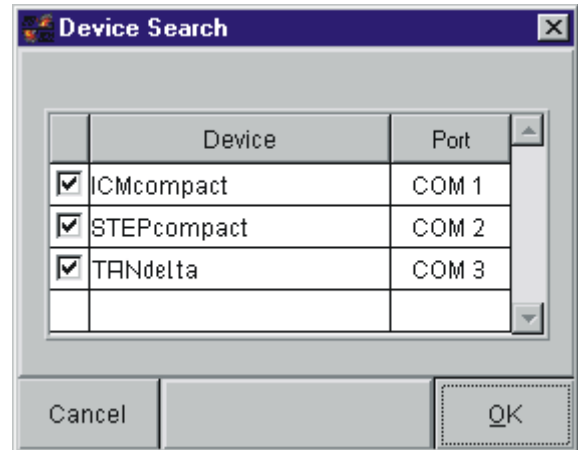
Fig. II.3   Device search dialogue

Beside the continuous strip chart a second graph for the last saved or loaded measurements is available. To toggle between these two graphs, use the *View* menu or the toolbar and select 'Strip Chart' or 'Result Graph'. While 'Result Graph' is selected, a cursor to read out measurements is available. To move the cursor, use the mouse left button. The values for the PD activity, voltage, tan delta, and capacitance at that selected time are displayed above the graph. Underneath the graph a voltage curve is shown. This curve represents either the active voltage curve of the HV*control/*STEP*compact* or, if the instrument is not connected, the voltage curve of the loaded measurement data file. By moving the cursor of the result graph, the cursor in the displayed voltage curve is moved as well. The boxes on the right side of this graph display the set voltage value and the time for the cursor position.

The graphs for PD activity, voltage, tan delta, and the capacitance can be blinded out by the respective check boxes on the left side of the panel. Besides, the colours of the graphs can be changed by the colour boxes.

Fig. II.4 Main panel; ICM*compac*t and HV*control* are connected, strip chart view
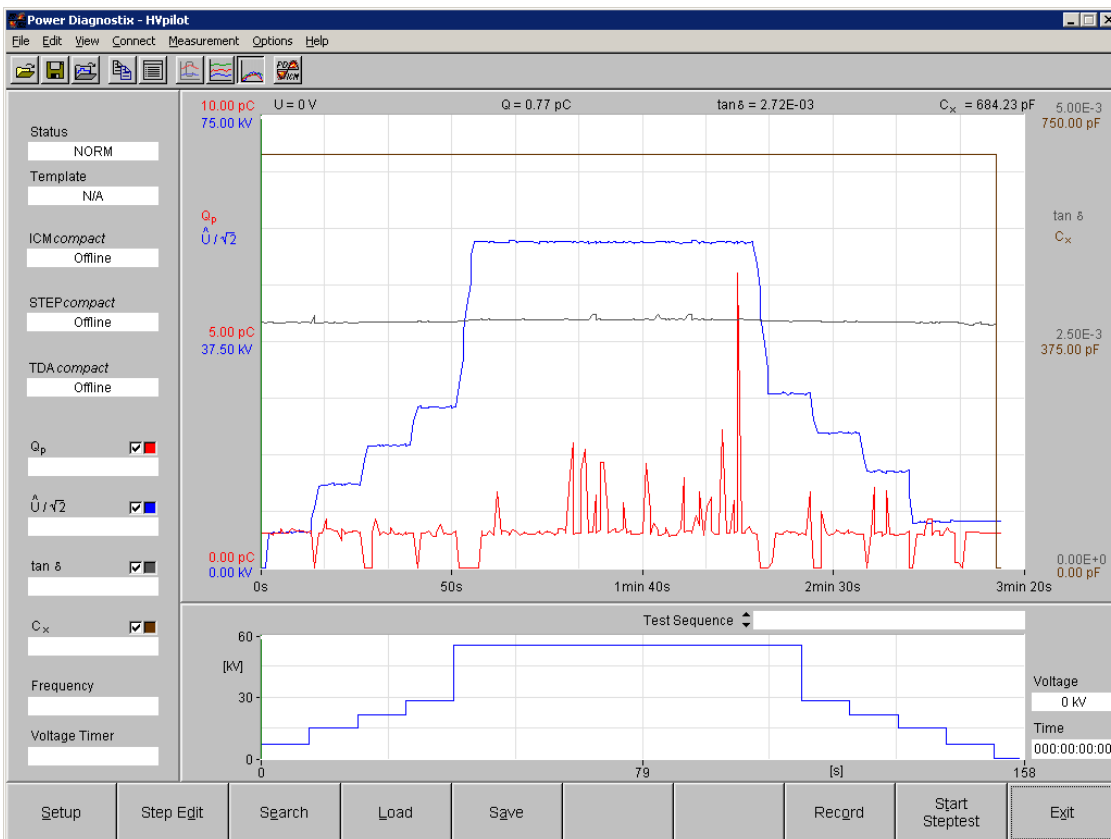
Fig. II.5 Main panel; shows a loaded data file, no instruments are connected

III   Menu Options

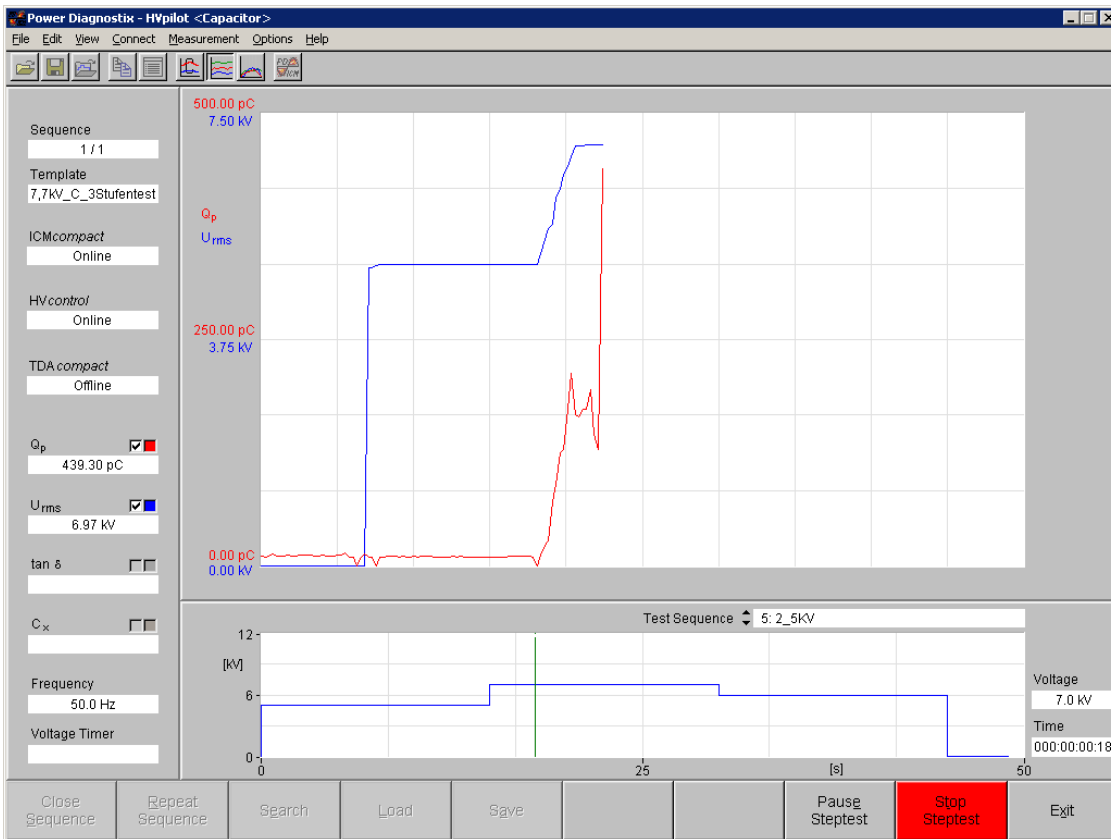Some of the menu options can be found in the button bar at the bottom of the screen.

Fig. III.1   Menu bar

III.1 File Menu

Load Measurement (F4)

By selecting this menu option, a stored data file can be loaded. There are two different data file types which can be loaded (*.hvp and *.hvs). The .hvp files contain the measured values of a normal measurement, whereas the data of a test sequence are stored in the .hvs files. Among the raw measurement data, the files contain information about the instrument setups, voltage curve and the test sequence.
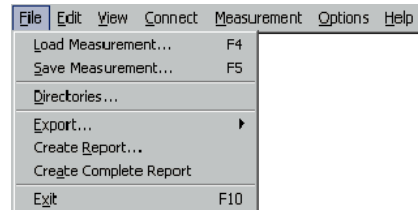
Fig. III.2   File menu

Save Measurement (F5)

The actual measurement data can be stored in a .hvp file by selecting this menu option. This stores the actual setups and voltage curve as well.

Directories

In the directories dialogue box, the default directories for the template, document and data files can be set. These directories must be specified when the program is launched for the first time. The default is the application directory. If the .ini file of a previous software installation is available, the directory paths are copied from this version (only software version 2.3 and higher).
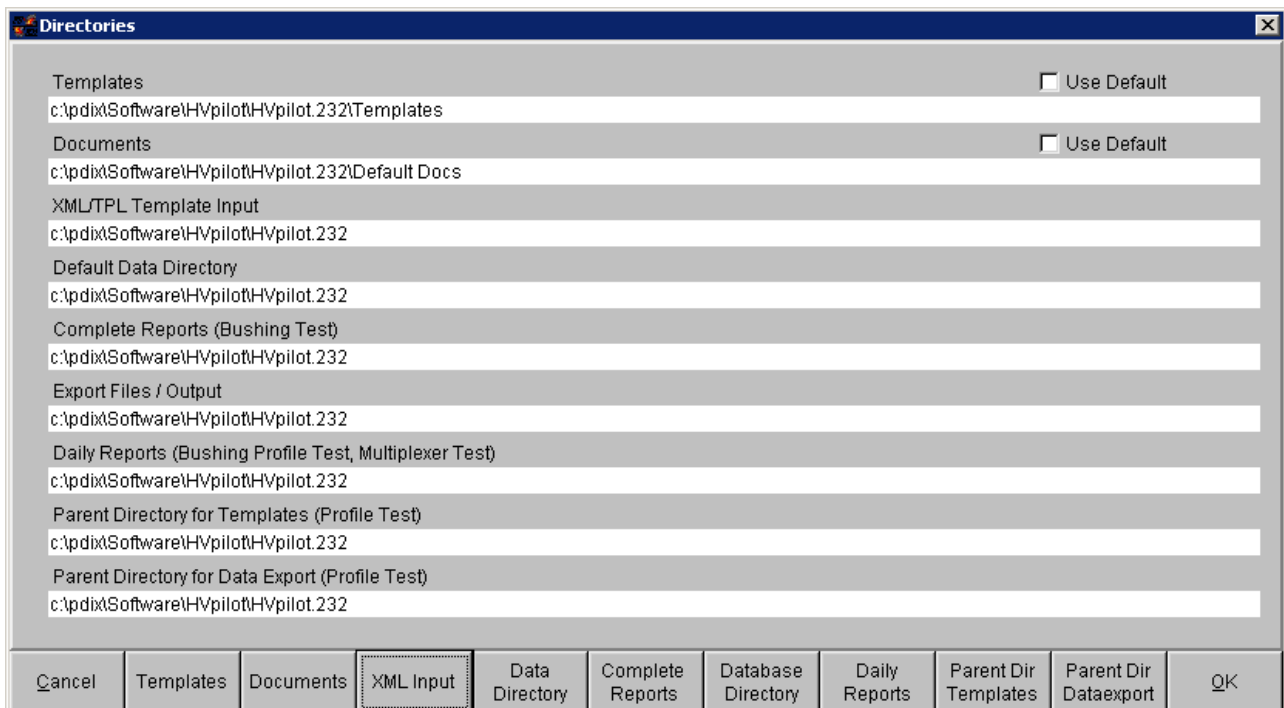
Fig. III.3   Directories dialogue box

1. 'Templates directory':
    Is used to store and load the test templates. If some templates have been changed, and a new version

of the HV*pilot* software is installed, the 'Templates Directory' can be set to the old directory to use the modified templates.

2. 'Documents':
   Contains the report templates in doc format.

3. 'XML/TPL Template Input':
   Specifies the directory for templates in XML or TPL format.

4. 'Default Data Directory':
   Is used as the default path for all load and save dialogues and is the default directory for storing of the test data.

5. 'Complete Reports (Bushing Test)':
   Directory for saving special bushing test reports.

6. 'Export Files / Output':
   Directory for saved pattern and other output files.

7. 'Daily Reports (Bushing Profile Test, Multiplexer Test)':
   Directory for a summarising report that accumulates all measurement reports of the current day.

8. 'Parent Directory for Templates (Profile Test)':
   Special directory for profile test templates.

9. 'Parent Directory for Data Export (Profile Test)':
   Excel sheets, reports and .hvs files of profile tests are store in this directory.

Export

This menu option offers the possibility to export the raw measuring data to an Excel sheet, a Word document, or an ASCII file (*.txt). Besides, some information about the tested object can be added to the report. Figure III.5 shows the dialogue box for additional information.

The box 'Export Time Interval' defines the time interval between two readings for the report. The minimum time is about two seconds, due to the scanning time for further connected instruments.

With the 'Multiple Measurements' command it's possible to create a summarising report for multiple profile tests.

Create Report

If a test sequence file (*.hvs) is loaded or a test sequence is carried out, this menu option offers the possibility to create the test report again.

Create Complete Report

For bushing tests, it is possible to combine several tests in one report as described in section IV.2.5.

Exit (F10)

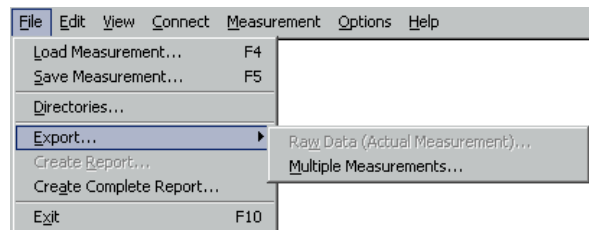This function disconnects all instruments and terminates the program.

Fig. III.4   'Export' commands
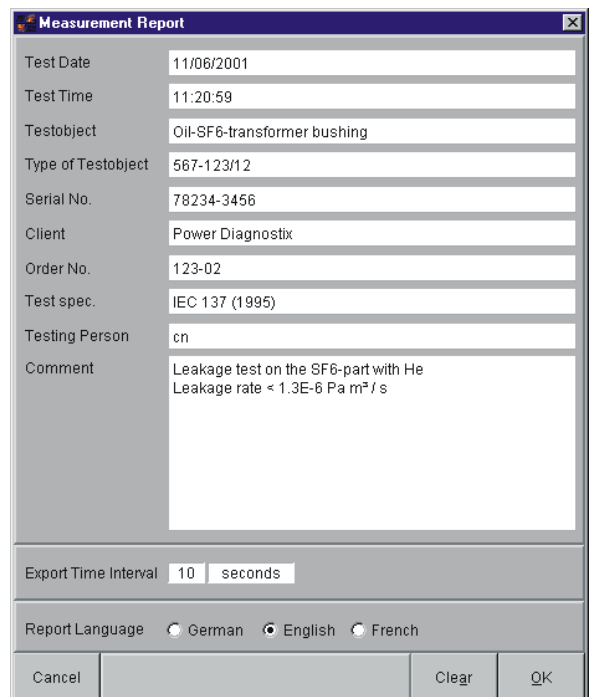
Fig. III.5   'Measurement Report' dialogue

III.2 Edit Menu

Copy (Ctrl+C) ▤

The function copies the result graph to the clipboard wherefrom it can be pasted into other applications.

Setup (F1)

The setups of the HV*control* and STEP*compact* and the ICM*compact* can be adjusted if there is a valid connection to these instruments. If the tan delta is measured by a TDA*compact*, its setup can also be adjusted. The HV*control* and STEP*compact* have seven different setups which can be stored in the instrument. In the following figures the dialogue boxes to edit these setups are shown.
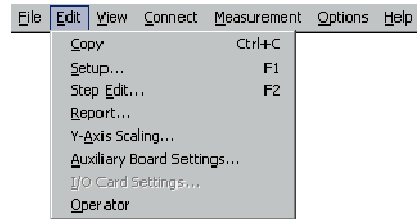
Fig. III.6   Edit menu

III.2.1 HV*control* and STEP*compact* Setup
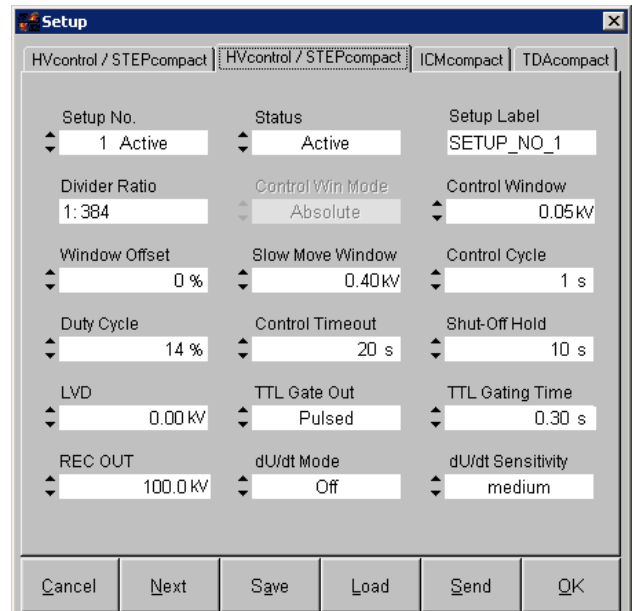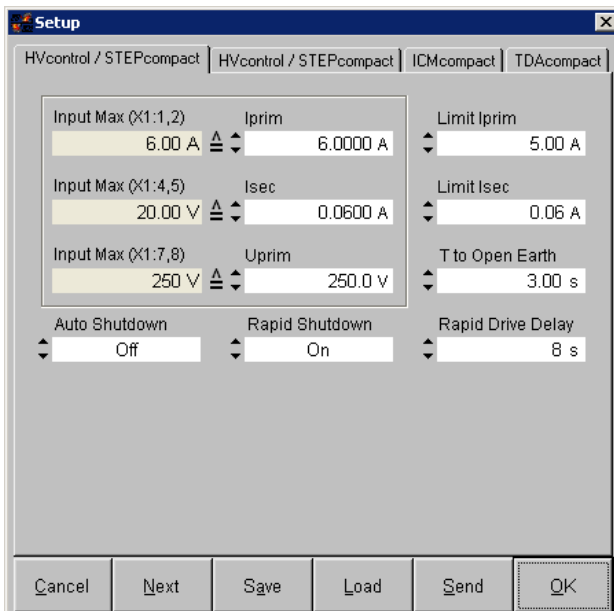
Fig. III.7   Tabs for the HV*control* and STEP*compact* setup

Pressing the 'Next' button of the dialogue box will show settings of the next setup tab. It is possible to load a setup from a stored file (*.hvp) by pressing the 'Load' button. The changed setups must be sent to the instrument by 'Send' or 'OK'. 'Cancel' will close the setup dialogue without changes.

1. Input Max (X1:1,2) / Input Max (X1:4,5) / Input Max (X1:7,8):
    These boxes display the values that are set for the corresponding inputs within the hardware configuration.

2. Iprim:
    The value indicates the primary current, which will flow, when the maximum input voltage/current is reached. E. g.: If the hardware is equipped with a 10 V input, the current, which produces the 10 V, needs to be entered here.

3. Limit Iprim:
    Maximum allowed primary current. If current is higher than this value, the HV*control* will go back to initialisation, where all components are switched off.

4. Isec:
    The value indicates the secondary current that will flow when the maximum input voltage/current is reached. E. g.: If the hardware is equipped with a 5 A input, the current, which produces the 5 A, needs to be entered here.

5. Limit Isec:
    Maximum allowed secondary current. If current is higher than this value, the HV*control* will go back to initialisation but the regulating transformer will stay on.

6. Uprim:
    The value indicates the primary voltage when the maximum input voltage is reached. E. g.: If the hardware is equipped with a 10 V input, the voltage, which correlates to 10 V, needs to be entered here.

7. T to Open Earth:
    When using an automatic earth bar, it can take some time to open the grounding. This time should be entered here in order to inhibit an error.

8. Auto Shutdown:
    If auto shutdown is enabled, HV*control* will drive the regulating transformer to its zero position automatically when an emergency stop is initiated. When disabling this function, the regulating transformer needs to be driven to its zero position manually, before you can switch on again.

9. Rapid Shutdown:
    The rapid shutdown function allows the HV*control* to use the rapid drive mode to reduce the voltage after HV is switched off.

10. Rapid Drive Delay:
    In manual drive mode this is the time you need to press the button until HV*control* will switch on the rapid drive mode.

11. Status:
    Indicates if this setup is the active setup of the instrument (Active) or not (Not Active). To change the active setup of the instrument, the setup must be selected, and this box has to be set to 'Active'.

12. Setup Label:
    The name of the setup can be changed to identify it more easily.

13. Divider Ratio:
    The divider ratio of the HV voltage divider has to be inserted as a factor of 1: x
    E. g.: With a divider factor of 1000 a maximum measuring range of 100 kV is possible when the maximum voltage input is V_in max = 100 V_{eff}.

14. Control Window:
    The maximum difference of the set voltage and the actual voltage where the voltage will not be adjusted. If this value is set too small, the control is likely to oscillate around the set value and, thus, will stress the servomotor unnecessarily.

15. Window Offset:
    Offset for the value of 'Control Window'. A value of 100 % assures that the actual voltage never underruns the set voltage, while a value auf -100 % guarantees that the actual voltage never exceeds the set voltage.

16. Slow Move Window:
    The voltage range around U_set, where the 'HV up' and 'HV down' relay is operated intermittently. By this it is possible to near U_set with slow speed (pulsed) and thus avoid oscillation around the set value. Setting this value has to be done in compromise of mechanical inertia and wear-out of the servomotor.

17. Control Cycle:
    The maximum time in seconds for one cycle of driving and pausing the servomotor. This time will be started when the actual voltage is between the limits set in the *slow move window* and the *control window*.

18. Duty Cycle:
    This value determines the ratio of time for moving and pausing the servomotor. 100% means no pause at all. 50% means that half of the time, which is set in *control cycle*, the servomotor is active, and the other half the servomotor will pause. This value has to be set according to the mass inertia of the servomotor.

19. Control Timeout:
    The maximum time to reach the set voltage. If this time is exceeded without any voltage change, the servomotor will turn down the voltage (HV down) and the break off relay will be triggered.

20. Shut-off Hold:
The period during which the HV down relay is on after the dU/dt Limit is exceeded. When using the HV*control* from Power Diagnostix this time can be set short, since the HV*control* already ensures driving the transformer tape to the zero position.

21. LVD:
Voltages below this value will be displayed and recorded as 0 V.

22. TTL Gate Out:
An optional extra output terminal of the HV*control* provides a TTL signal each time the HV up or HV down relay is triggered. Since in some test setups the relay bouncing leads to disturbances on the ICM*compact*, this signal can be used to gate this noise. Three different modes can be selected:
Off - Gating output inactive
On - TTL signal is active while an output is switched, or the regulation transformer is in operation.
Pulsed - TTL signal is only active during the 'TTL Gating Time'.

23. TTL Gating Time:
Gating time in seconds.

24. REC OUT:
The REC OUT terminal may optionally be connected to a paper recorder or other device to provide a graph of the voltage magnitude. The voltage output gives 0 to 10 V and corresponds linearly to the displayed voltage.

This value should be set above the maximum expected voltage value. E. g.: If a step curve goes up to 65 kV, the REC OUT can be set to 100 kV. This is the displayed voltage which equals the maximum output voltage (= 10 V) at the REC OUT terminal. A displayed voltage of 60 kV will then refer to 6 V at the REC OUT terminal. The REC OUT voltage is altered together with the change of the display of Û, Û/√2, U$_{RMS}$.

25. dU/dt Mode:
If the voltage limit defined by *dU/dt Sensitivity* is exceeded, the dU/dt mode defines the action which is taken:
Off - No action
Counter - The number of dU/dt events will be increased.
Relay - The relay contact of either the relay unit or the HV*control* is switched, and the voltage is shut down.

26. dU/dt Sensitivity:
The maximum voltage alteration per second. When this value is exceeded, the break off relay is triggered and the variac will be turned down.

III.2.2 ICM*compact* Setup

It is also possible to load an ICM*compact* setup from a stored file (*.cmp).

Device Identity: Sets the identification of the instrument.

1. Phase Shift:
   The position of the PD in relation to the zero point of the synchronisation voltage line.

2. Gain:
   Sets the amplification of the signal path. The total amplification is a combination of preamplification (external preamplifier) and main amplification (internal).

3. LLD:
   Sets the level of the low level discriminator. All discharge pulses below that level are deleted.
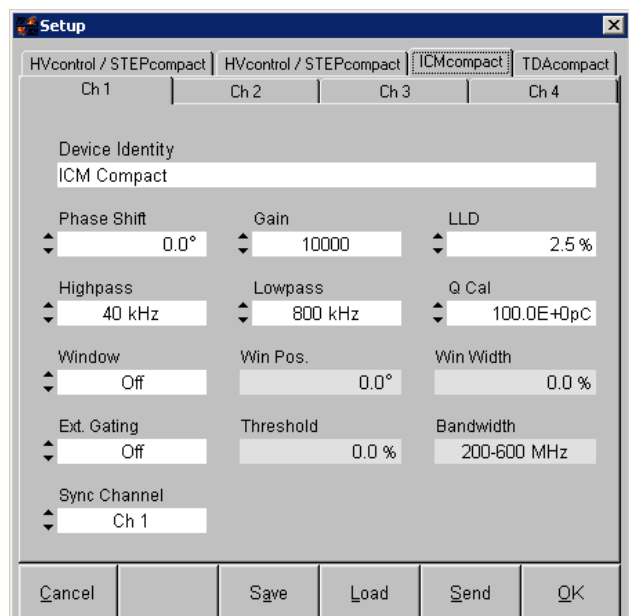
Fig. III.8   Tab for the ICM*compact* setup

4. Highpass:
    Sets the lower cut-off frequency of the highpass filter.

5. Lowpass:
    Sets the upper cut-off frequency of the lowpass filter.

6. Q Cal:
    Shows the value of the actual calibration.

7. Window:
    Sets the number of windows for the window gating.

8. Win Pos.:
    Sets the phase position of the first window.

9. Win Width:
    Sets the width for the windows.

10. Ext. Gating:
    Activates the external gating function. There are two different modes for the external gating function. In the manual mode the threshold level can be set directly. If the gating signal exceeds this level then the measurement PD signal is cleared for about 100 µs. In the auto mode the gating time can be set and the threshold level is automatically adjusted by the instrument.

11. Threshold:
    Sets the threshold level.

12. Bandwidth:
    Sets the frequency range for the preamplifier at the gating input.

III.2.3 TDA*compact* Setup

1. Standard Capacitor:
    Sets the value of the standard capacitor in the measuring circuit.

2. Shunt Std Capacitor:
    Sets the value of the shunt at which the current at the standard capacitor is measured.

3. Shunt Test Object:
    Sets the value of the shunt at which the current at the test object is measured.

4. Device Identity:
    Sets the identification of the instrument.

Fig. III.9   Tab for the TDA*compact* setup

Step Edit

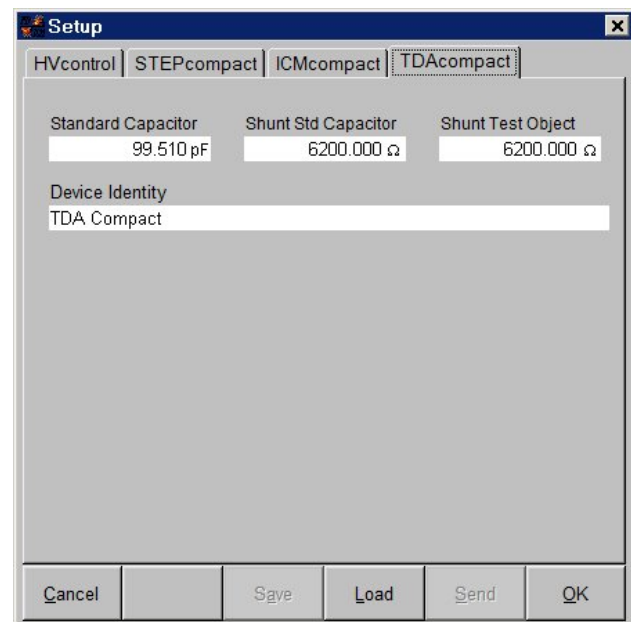Voltage curves can be edited or created in the step edit dialogue box which is shown in figure III.10.
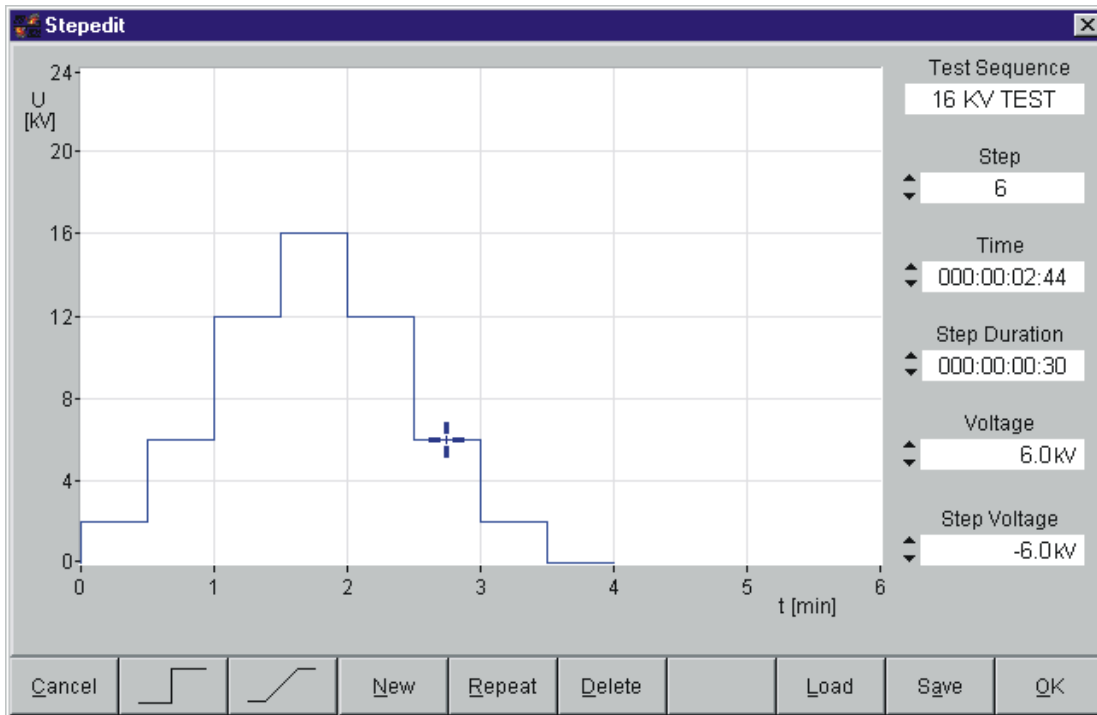

Fig. III.10 'Step Edit' dialogue box

The 'Step' and 'Ramp' buttons create a new step resp. ramp from the end of the last step to the cursor position. If the cursor position is within the voltage curve no step or ramp can be created. The 'New' button deletes the voltage curve, and a new one can be defined. By pressing the 'Repeat' button the last step or ramp will be repeated. The last step is deleted each time the 'Delete' button is pressed. A voltage curve can be stored in a file. This is an ASCII file format and has the extension .hvc. A stored voltage curve can be loaded via the 'Load' button. To store a voltage curve, the 'Save' button has to be pressed. If an HV*control* or a STEP*compact* is connected, pressing 'OK' sends the changed voltage curve to the instrument.

There are two possibilities to define a step or a ramp. The cursor can be placed at the respective voltage and time of the next step by clicking with the left mouse button and dragging the cursor or the required values can be entered directly in the boxes on the right-hand side. The button 'Step' or 'Ramp' will connect the curve with the new position. The first box 'Test Sequence' defines a name for the voltage curve. A maximum of 30 characters can be put in. The 'Step box shows the step number at the cursor position. By changing this value, the cursor can be placed at the beginning of a step or in the middle of a ramp. The 'Time' box shows the total time of the voltage curve at the cursor position. Changing this value will change the cursor position. The value can be changed by clicking the up and down buttons on the left side or by putting in a value directly. The time format is: ddd:hh:mm:ss. The up and down buttons increase resp. decrease the value of the days, the hours, the minutes, or the seconds depending on the cursor position in the box. By default, the seconds are changed. The 'Step Duration' box shows the duration of the actual step. Changing this value will also move the cursor. The 'Voltage' box shows the voltage at the cursor position. The 'Step Duration' and 'Voltage' values can only be changed for a new step. For this the cursor must be on the right of the voltage curve. The difference of the voltage between the voltage at the actual cursor position and the voltage of the previous step is shown in the 'Step Voltage' box.

The cursor can be moved by clicking the left mouse button and dragging the cursor or by pressing the arrow keys. If the cursor is above the last sixth part of the y-axis or on the right of the last sixth part of the x-axis the graph is scaled up automatically. In the same way the graph is scaled down if the cursor is in the first sixth part of the x- and y-axis.

Report 🗐

Additional information to a measurement or a test sequence can be put in via the report dialogue box. This data appears in the printout and is stored in the data file. Depending on the type of the measurement the additional information can vary. The standard report is shown in section III.1 with figure III.5. Other reports are shown in section IV.

Define Test Sequences

The program provides the possibility to define and carry out certain test sequences. These test sequences can be defined via the 'Test Sequence Template' dialogue box. There are six different types of test sequences called 'Sequences', 'Bushing Test', 'Profiles', 'Breakdown Test', 'Bushing Profiles', and 'Multiplexer Test'. For each type different parameters have to be defined. For more detailed information about these test sequences see section IV.

Y-Axis Scaling

While running a voltage curve, there is the possibility to set the y-axis scaling for the Q, U, tan delta, and C_x values manually. The dialogue box in figure III.11 provides two options for adjusting the y-axis scaling: automatically and manually. If manually is selected, the maximum value for the displayed range of the measurement category must be put in. The range then will not be changed even if there are values greater than the maximum. The automatic mode adjusts the range to the measured values.
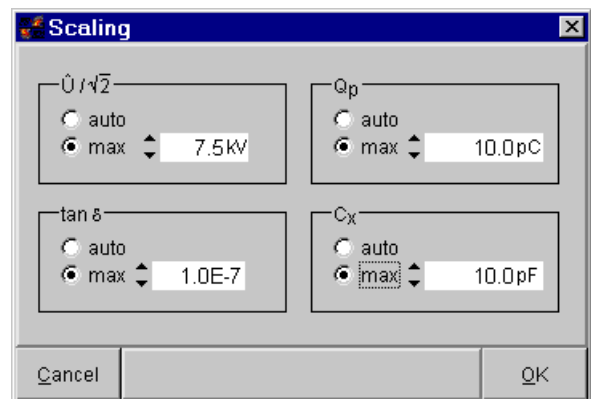

Fig. III.11 Y-axis scaling

Auxiliary Board Settings

An ICM*compact* can be ordered with up to eight auxiliary input channels (AUX). These inputs can be used to record additional signals like power, temperature, pressure etc. A USB interface is used to link the ICM*compact* instrument with the software, running on a standard PC.
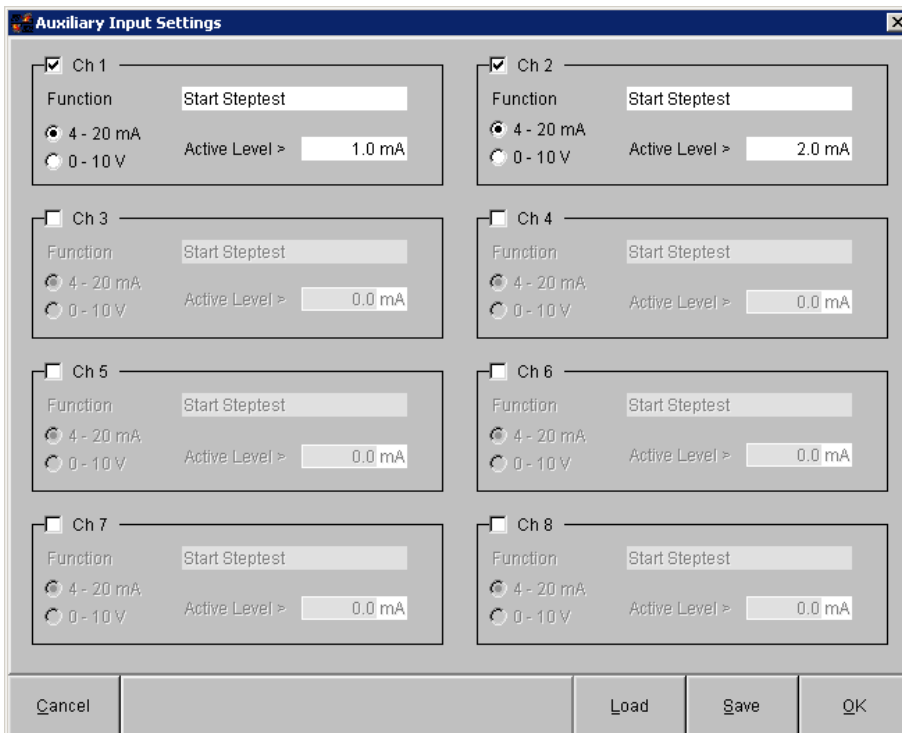
Fig. III.12 Auxiliary board settings dialogue box

I/O Card Settings

The HV*pilot* software can control several I/O cards of National Instruments that can be optionally installed on the PC. Depending on the status of an input (active/inactive), the software can define actions to be executed. For every input and output one action/condition can be defined.

1. Inputs:
   If an input is set to active, a command of the HV*control* software will be executed. E. g. If line1 of port 0 (P0.1) is set to 'active' a test sequence will be started, while an active PO.2 will end the test.

2. Outputs:
   An HV*control* function can set an output port of the I/O card. E. g. it can set an output to active when a test was finished.

Depending on the type of a test, which can be selected with the dropdown menu 'Test', different functions can be selected for the in- and outputs.
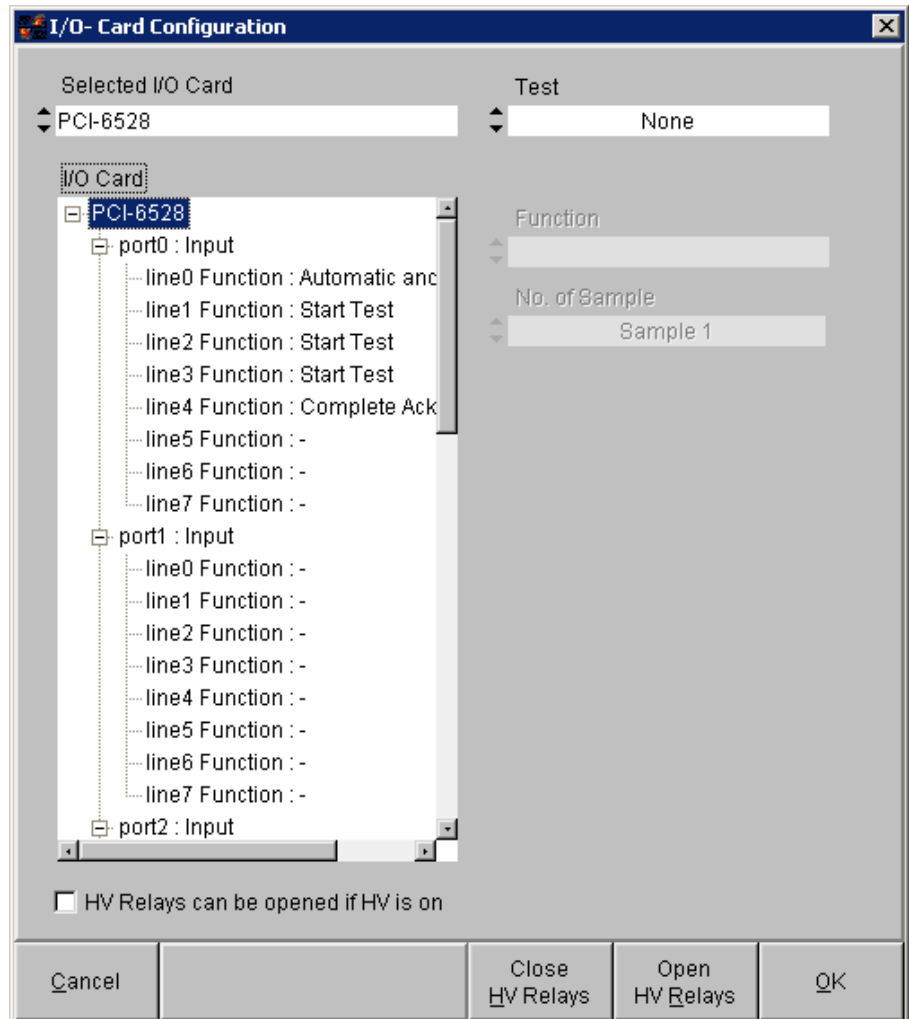
Fig. III.13 Configuration of an optional I/O card

III.3 View Menu

Button Bar

Show / hide button bar.

Fig. III.14 View menu

Clear Chart

This option is only available if the strip chart view is active. In the strip chart view all measured values are displayed continuously. This function clears this view, and the next measured values are displayed at the left border.

Strip Chart and Result Graph

Toggles between the two views. 'Result Graph' shows the results of a measurement.

Peak Suppression for Charge Curve

This function removes all peaks from a PD measurement that were caused by external intermittent noise or switching pulses.

Max. Qp Values

If enabled, the maximum Qp value for every channel will be displayed after the test. Only for multiplexer tests.

Test Status Window

Displays the status and several user-specified test parameters, such as a product type. Only for multiplexer tests.
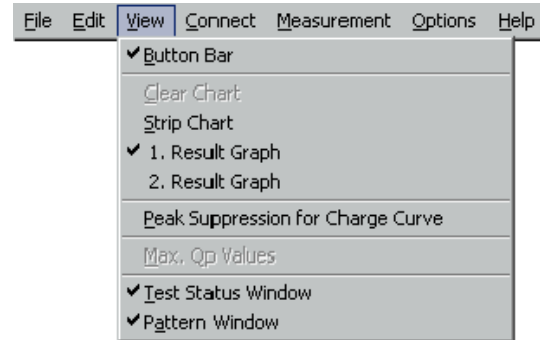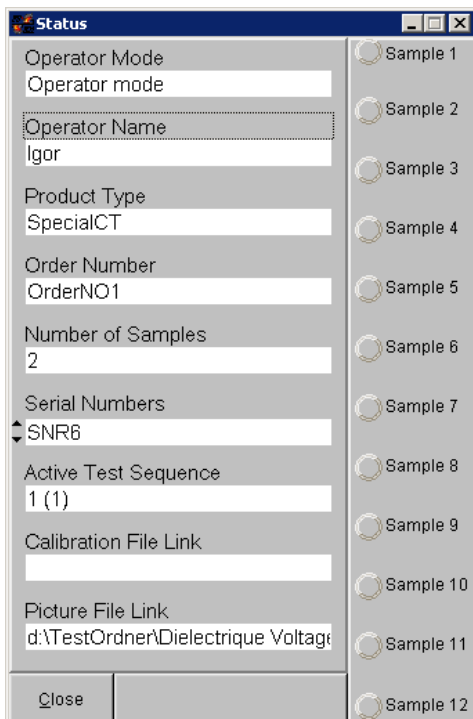
Fig. III.15 Status window

Pattern Window

If enabled, this window displays the current ongoing pattern acquisition or the last recorded pattern. Additionally, it's possible to display a recorded pattern ('dat' file) by dragging & dropping the corresponding file into the window.
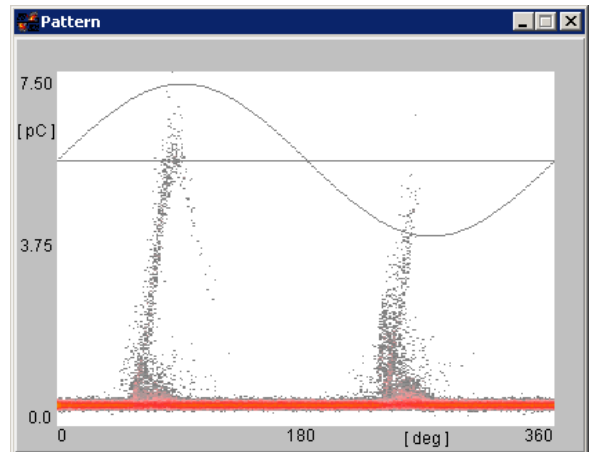
Fig. III.16 Pattern window

III.4 Connect Menu
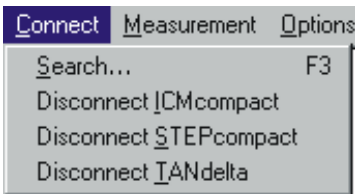
Fig. III.17 Connect menu

Search (F3)

This function searches for an HV*control/*STEP*compact*, an ICM*compact*, and a tan delta measuring bridge on the enabled COM ports, which can be set in the 'Interface Settings' dialogue box. The result is shown in the search dialogue box (see section II).

Disconnect ICM*compact* / STEP*compact* / TANdelta

These functions establish a connection to the corresponding instrument or disconnect it. If an instrument shall be connected, the respective function scans the COM and establishes the connection if available.

III.5 Measurement Menu

The measurement menu items are only available if a STEP*compact* or an HV*control* is connected.
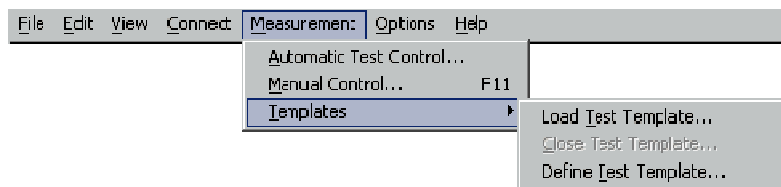
Fig. III.18 Measurement menu

Automatic Test Control

This command opens a pop-up window that offers the possibility to choose the type of test and to start it. Besides templates HV*pilot* offers pre-defined automatic tests.
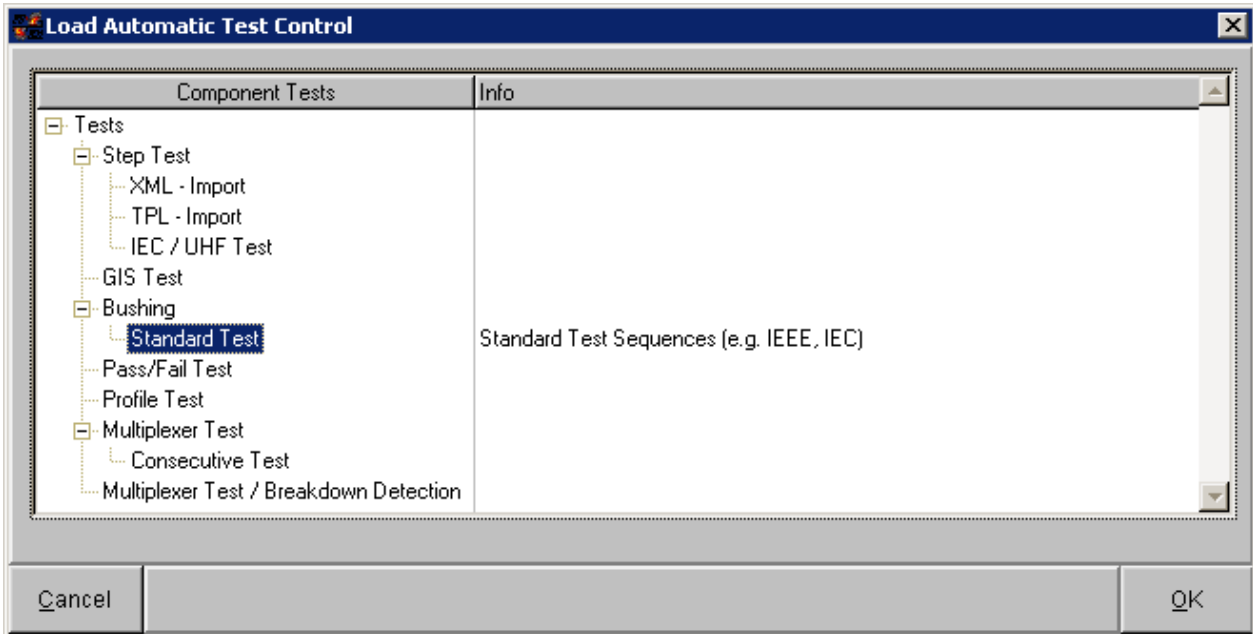
Fig. III.19 Open dialogue to start a pre-defined test

Manual Control

This function opens a dialogue box to set the voltage manually. By pressing *OK* the HV*control/*STEP*compact* controls the voltage to the entered value. The value refers to the actual type of voltage value (Û, Û/√2 or U$_{rms}$). This option can be selected only, if no step test is running.
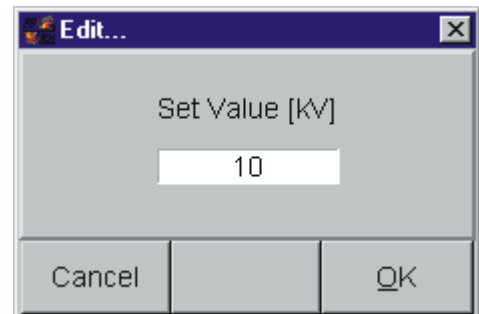
Fig. III.20 Dialogue box for voltage setting

Templates ►

Load Test Template

By selecting this menu option, a predefined test sequence can be loaded (*.tpl). After loading a test sequence, only the defined measurements can be carried out and the results will be calculated automatically.

Close Test Template

The loaded test sequence will be closed, and all program settings are available again.

Define Test Template

Opens a window to define a new test template.

III.6 Options Menu
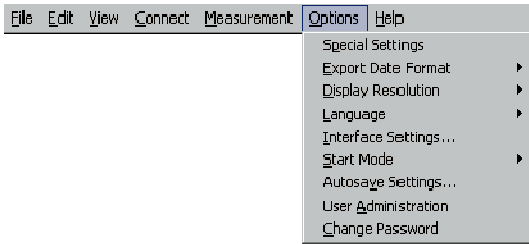
Fig. III.21 Options menu

Special Settings
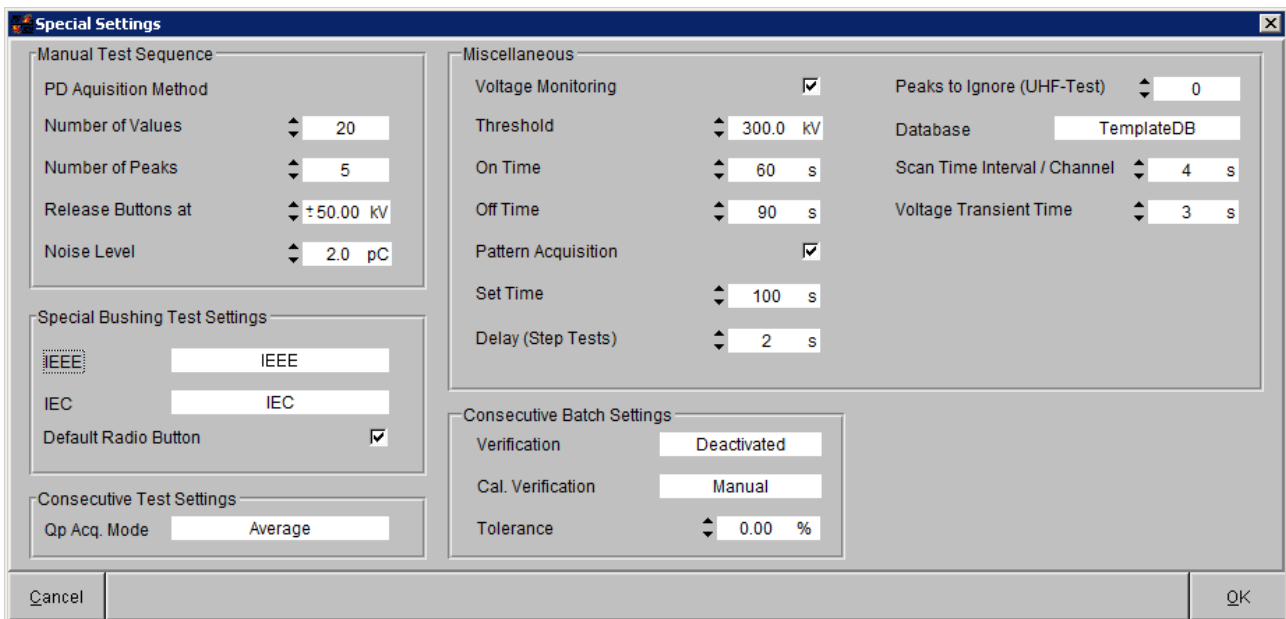
Fig. III.22 'Special Settings' dialogue

1. Manual Test Sequence:
    Here, parameter for a manual test sequence can be set.
    - Number of Values: Number of values that should be measured in order to determine an average value
    - Number of Peaks: Number of the highest values that should be ignored when determining the average value
    - Release Button at: Manual measurements are made by pressing the corresponding software buttons at the set voltage level. This entry defines a tolerance value for the voltage which allows using the measuring buttons although the voltage has not exactly the set value.
    - Noise Level: This value is displayed as noise level in the test report.

2. Special Bushing Test Settings:
    The strings offer the possibility of defining information that is used for a summarising report of bushing tests.

3. Consecutive Test Settings:
    These settings determine the behaviour of the Qp acquisition mode for consecutive tests.
    –   Average: The average of the Qp values gathered during a step is used for evaluation (so for comparing with the limit set)
    –   Minimum: The minimum Qp value gathered during a step is used for evaluation.
    –   Maximum: The maximum Qp value gathered during a step is used for evaluation.

4. Miscellaneous:
    *   Voltage Monitoring:
        It's possible to monitor the voltage. In case of exceeding the pre-set voltage limit the software will automatically reduce the voltage.

    ⚠ **Warning:**

    *   This function should be used as an additional system protection tool but not as a main protective function, since in the case of a communication failure or a crash a controlled shutdown of the voltage can't be guaranteed. An external fast disconnector switch is mandatory to protect the system and the operator in case of a breakdown!

    If the function is activated, the following settings should be made:
    *   Threshold: If the voltage value exceeds the pre-set value the monitoring process will be started.
    *   On Time: Maximum operation time with the voltage exceeding the pre-set threshold value
    *   Off Time: Minimum time period after operation with the voltage exceeding the pre-set threshold value.

    *   Pattern Acquisition: Activates automatic pattern acquisition on each step. The step test will be paused when pattern acquisition is running and will continue afterwards.

    If the function is activated, the following settings should be made:
    *   Set Time: With this setting, a pattern is recorded at each stage of a test (except UHF tests) or by pressing the button 'Start Pattern'. The length of the stages in a power curve should therefore correspond to the duration of the pattern recording, otherwise the duration of the measurement may exceed the step length. With software version 2.3 or higher the value is automatically reduced by the software, if necessary, to meet the requirements above mentioned.
    *   Delay (Step Tests):   Specifies the delay between reaching a step and starting the pattern acquisition.

    *   Peaks to Ignore (UHF-Test):
        Specifies the number of PD peaks above the minimum PD level for the IE part of an UHF step test, resp. above the inception level for the UHF part, before the UHF test specimen has failed the test.

    *   Database:
        Database name
        Please note: The software must be restarted after changing the database entry. Furthermore, please make sure that the new database is registered as Windows ODBC data source. If not HV*pilot* will show the error message "Database linkage failed!" when trying to start the consecutive test with the automatic test control. To check, if the database is registered, use the Windows ODBC data source administrator (see figure III.23), which can be started with:
        Start->Settings->Control Panel->Administrative Tools->Data Sources (ODBC).
        HV*pilot* uses the entries during start-up to find the database that is specified in the special settings.
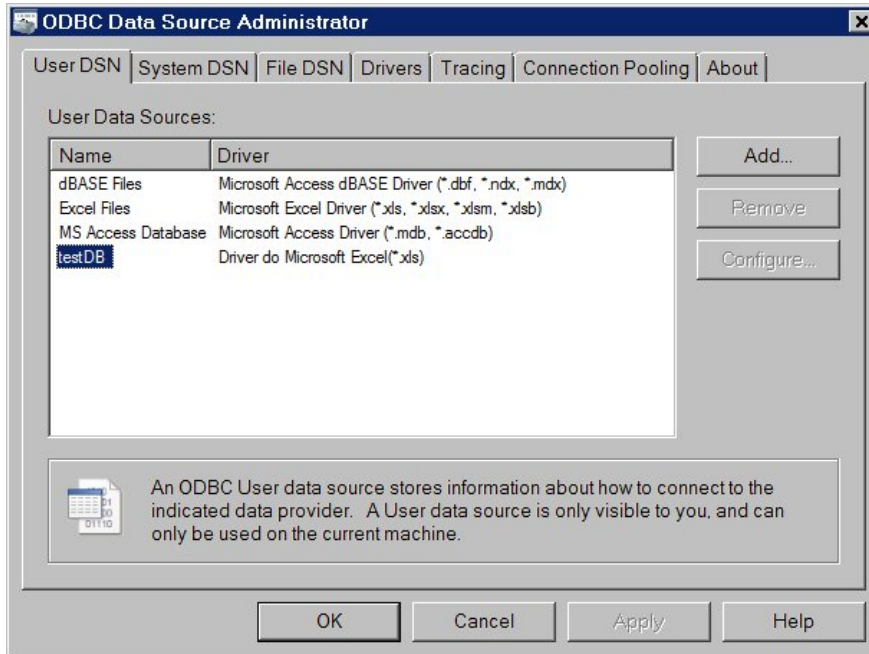
Fig. III.23 Windows ODBC data source administrator

- Scan Time Interval / Channel:
  For multiplexer tests only. Scanning time for one channel before changing to next channel.

- Voltage Transient Time:
  Specifies the delay between reaching a step and using the measured values for test evaluation to suppress peaks caused by the voltage change.

- Select active Setup per Template:
  If activated, it's possible to specify, which of the seven setups of the HV*control* should be used for a test.

- Show extended Voltage Information:
  Shows Uprim / Iprim / Isec (only available in 1024x768 resolution)

5. Consecutive Batch Settings:
   These settings refer to the consecutive batch test, which allows testing of multiple test specimens connected simultaneously (in parallel on one channel) for PD inception and extinction voltage until enough test specimens have passed the test.

   - Verification: Determines whether the necessary PD calibration is verified before performing the first batch, before every batch, or never.

   - Cal. Verification: Determines if the verification is done manually or automatically

   - Tolerance: Allowed deviation in percent of the set calibration value if verification is done automatically.
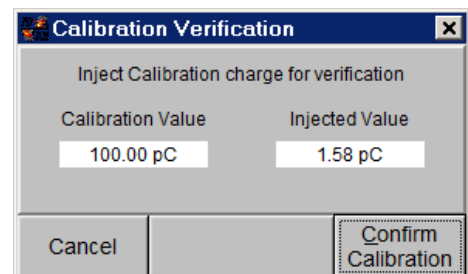
Fig. III.24 Calibration verification pop-up

Export Date Format

Offers several date formats for use with the HV*pilot* software.

Display Resolution

The display resolution of the main panel can be toggled between 800x600 and 1024x768 pixels.

Language

The language of the program can be switched between English and German.

Interface Settings
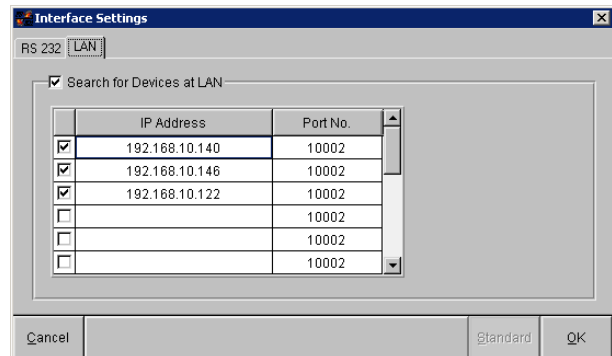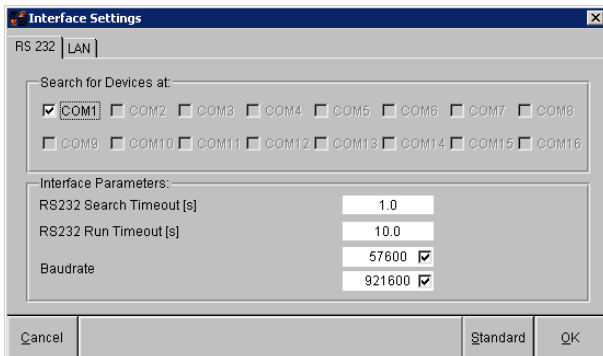
Fig. III.25 Interface settings dialogue box (standard settings)

Normally the settings of this dialogue box need not to be changed. But in case there are problems with the serial communication, changes can be made. If the PC uses others than the first four COM ports to connect to the devices, these can be enabled by setting the corresponding check boxes. The 'RSR232 Search Timeout[s]' is the time the PC waits on an answer on a COM port while searching for devices. If the PC often doesn't find a device on a COM port even though there is a device connected, this time can be increased. The 'RSR232 Run Timeout[s]' sets the time the PC waits on requests over the COM ports. If the device often is disconnected because of communication errors this time can be increased. By pressing the 'Standard' button the settings are reset to those values shown with the left part of figure III.25.

Start Mode

Offers the possibility to specify a test that is automatically started at software launch.

Autosave Settings

This option opens a pop-up window with settings for files that are automatically generated after a test.
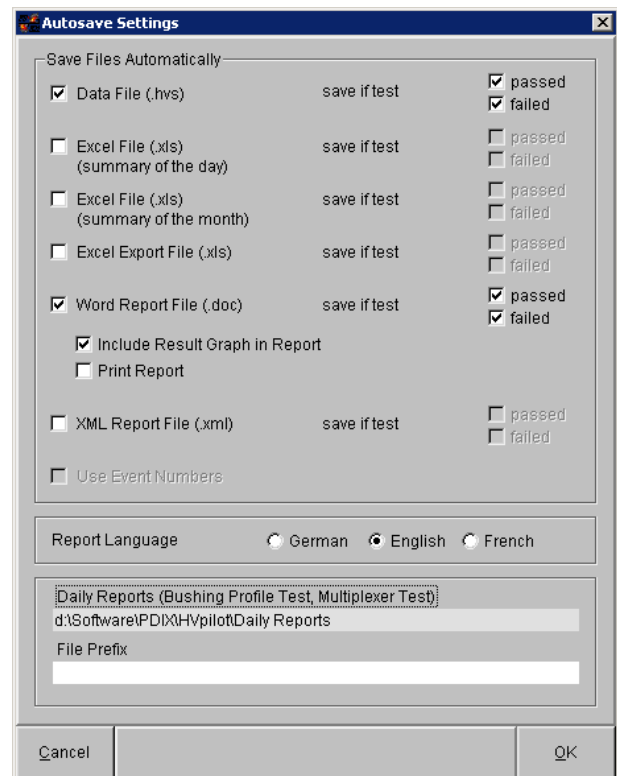
Fig. III.26 Autosave settings

User Administration

The HV*pilot* software comes with a user administration that allows setup and managing user accounts with different user rights. This option is only available for users with administrator rights. The settings are only used, if 'Require Login at startup' is enabled. The 'Rights' button opens a second window that allows setting the rights for standard users.
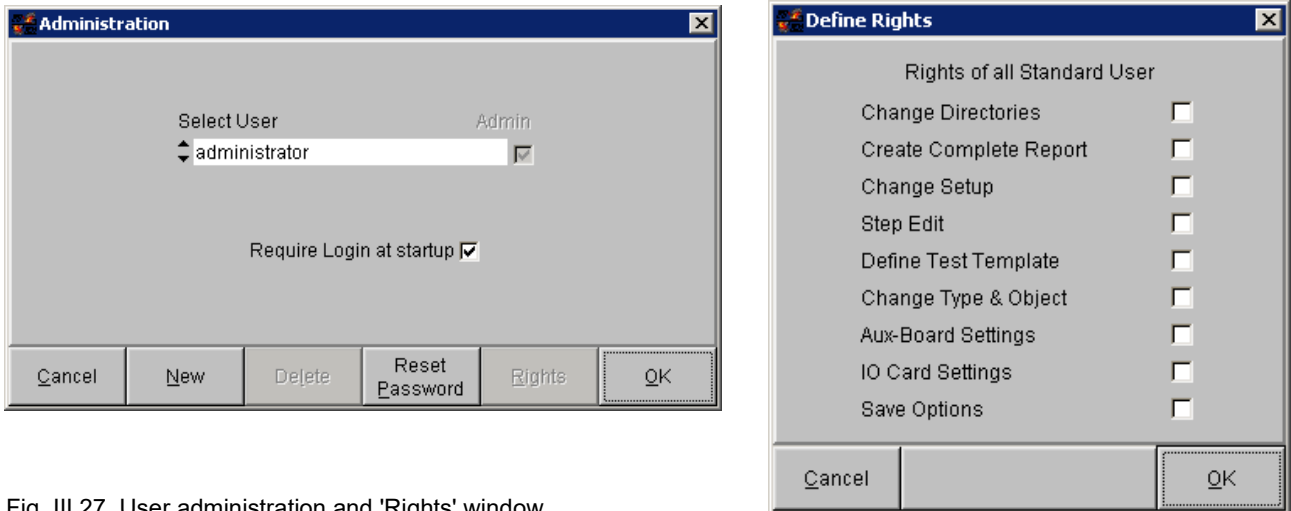
Fig. III.27 User administration and 'Rights' window

Change Password

Offers the possibility to change the own user password.

IV   Test Sequences

There are six different kinds of test sequences. For all test sequences a template must be defined first. Then the template can be loaded and started. Predefined test sequences can be loaded directly via the 'Load' option of the 'File' menu. At the end of the test a report is created.

1.   Sequence

Sequence is designed for tests which need the measurements of PD activity, tan delta, and/or the capacitance at predefined voltage levels. There is the possibility to define two different sequences in one test.

2.   Bushing Test

The second kind of test sequence is designed especially for bushing tests. See page 25.

3.   Profile Test

The third kind of test sequence allows setting the maximum PD levels at certain voltage values (for e. g. acceptance tests). It is possible to set up to four different PD levels for each voltage.

4.   Breakdown Test

The fourth kind of test sequence is designed for breakdown tests.

5.   Bushing Profile Test

For this test an ICM*compact* with MUX option is mandatory. The fifth kind of test sequence is similar to multiplexer tests. Additionally, there's the possibility to define special functions for an I/O card.

6.   Multiplexer Test

For this test an ICM*compact* with MUX option is mandatory. This kind of test sequence is similar to profile tests. It allows setting one maximum PD level, that marks the pass and fail point for the acceptance test. Additionally, you can define a breakdown level. If the measured PD exceeds this value, the test is automatically cancelled.

IV.1 Sequences

First a template must be defined for the test sequence. Figure IV.1 shows the dialogue box which is opened by 'Define Test Sequences'. Information about the test object can be defined in the first three boxes. The kind of test sequence is determined by the six tabs 'Sequences', 'Bushing Test', 'Profiles', 'Breakdown Test', 'Bushing Profiles', and 'Multiplexer Test'. If 'Sequences' is selected, one or two different sequences can be defined. At the end of a test sequence a report is generated automatically. The layout of the report can be designed individually. The program uses predefined Word documents and replaces the tags in it with the data of the test sequence (see section IV.1.2). The sequences themselves can be defined on the '1. Test Sequence' and '2. Test Sequence' tabs.

Automatic and manual sequences are available. An automatic sequence runs a predefined voltage curve automatically, i. e. the voltage is set and controlled by the HV*control/*STEP*compact* and the values of the PD

activity, the tan delta, and/or the capacitance are measured continuously. At the end of the sequence the measured data is evaluated. Whereas by running a manual test the voltage has to be controlled manually and measuring values are taken by pressing a corresponding button. This mode can be used if there is no possibility to use the HV*control/*STEP*compact* for voltage measurements. To identify the sequence a name can be given in the 'Name' box. The voltage curve for the automatic mode can be defined by clicking on the 'Selected Voltage Curve' box. If the PD activity is to be measured, the corresponding check box must be enabled. For this purpose, an ICM*compact* must be connected. The voltage values at which the PD activity is to be measured can be set in the 'Measuring Points' box. The voltage values must be separated by commas, slashes, or semicolons. The number of values must not exceed 50. If an automatic sequence is defined, the values must correspond with steps of the voltage curve. By double-clicking on the box, a dialogue box opens which shows the step curve. By moving the cursor on a step voltage and double-clicking this voltage, a measuring point is defined. If the PD inception and extinction voltages shall be calculated, the level of the PD activity, which indicates that the partial discharge has started, must be adjusted. The noise is the minimum value for the PD activity in the result table of the report even if there are lower measuring values.
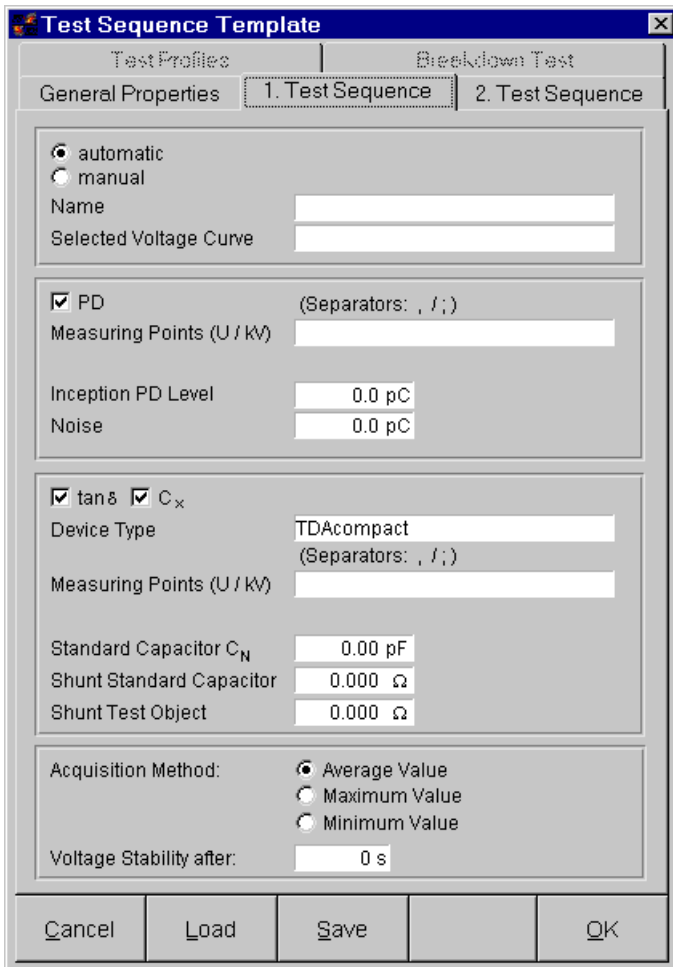
Fig. IV.1   Template dialogue box, test sequence tab

If the tan delta and the capacitance are to be measured, the corresponding check boxes must be enabled. The software supports two different tan delta measuring instruments: Power Diagnostix' TDA*compact* and the Tettex 2877. The type of the instrument must be selected in the 'Device Type' box. The measuring points can be defined in the same way as for the PD measurement but need not to be identical. When using the Tettex 2877 tan delta measuring bridge the value of the standard capacitor must be set. By using the TDA*compact* the values of the two shunts must be set as well. These values need not to be adjusted at the instrument but are set by the software when the sequence is started.

The evaluation of the measuring data is made at the end of the test sequence. As the voltage is hold at every measuring point for a while there are several measuring values of the PD activity, the tan delta, and the capacitance. The chosen 'Acquisition Method' determines how these values are evaluated. By selecting the 'Average Value' method all values are summed up and then divided by the number of measuring values. The 'Maximum' and 'Minimum Value' method uses the maximum resp. minimum value of the measuring values. As the regulator needs some time to reach the step voltage, a certain time can be set by the *Voltage Stability after* box after which the measuring values are evaluated at the measuring points. This can prevent to include peaks, which can occur by driving the motor of the regulator, into the evaluation of the test sequence. The second sequence can be defined in the same way.

IV.1.1 Additional Test Information

After starting the test sequence additional information about it must be entered. The dialogue box in figure IV.2 shows the needed data.

The first three items are the same as in the general settings sheet of the template dialogue box. The next four are additional order information. The last three items concern the test conditions. All this information can be placed in the report. The check boxes in the next section define if the report shall be automatically created at the end of the test sequence, if the inception and extinction voltage and the result graphs shall be included in the report, and if the report shall be printed automatically. In the next section the order of the two sequences can be set. The last section determines the language of the report.
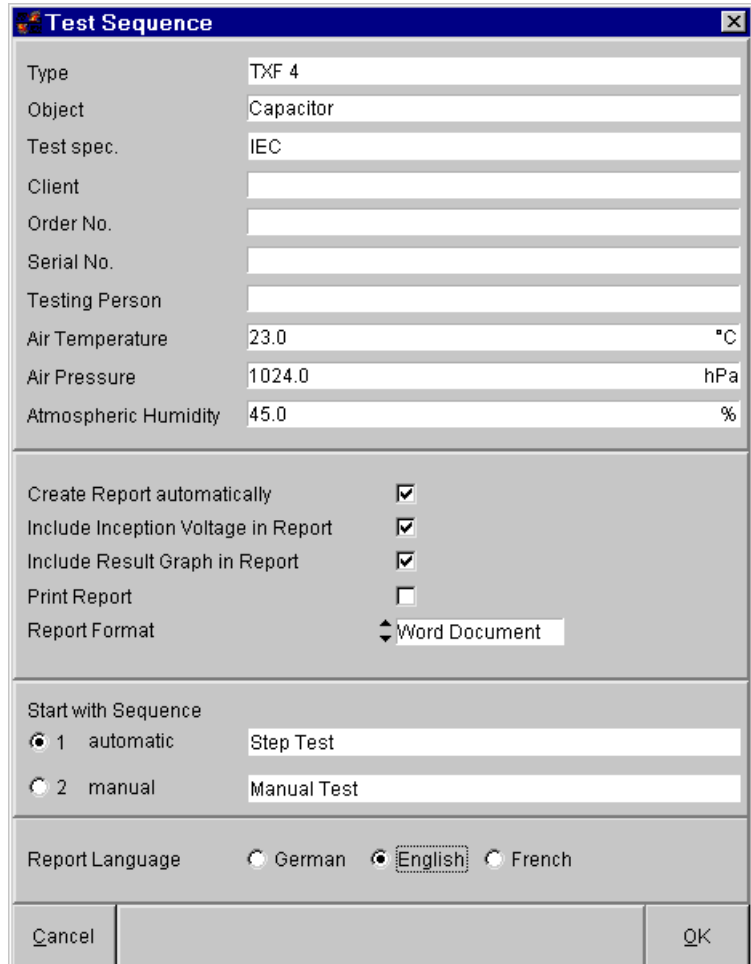
Fig. IV.2   Additional information dialogue box

IV.1.2 Customising the Report

The report template for this sequences test is located in the 'Default Docs' directory and the names of the files are *default_standard_<language>.doc*. <language>: en (English), ge (German), fr (French). According to the choice of the language of the report, the corresponding template is used for the report. These templates can be customised concerning the layout. The data of the test sequence replaces the tags in the report. The predefined tags for this kind of test sequence are:

Mark	Description
<TAG_DATE>	test date
<TAG_TIME>	test time
<TAG_OBJECT>	test object
<TAG_TYPE>	test type
<TAG_TESTSPEC>	test specification
<TAG_INCEPTPDLEVEL>	inception PD level
<TAG_INCEPT>	inception voltage
<TAG_EXTINCT>	extinction voltage
<TAG_CLIENT>	name of client
<TAG_ORDERNO>	order number
<TAG_SERIALNO>	serial number
<TAG_TESTPERSON>	testing person
<TAG_TEMPERATURE>	air temperature
<TAG_PRESSURE>	air pressure
<TAG_HUMIDITY>	humidity
<TAG_COMMENT>	comment about the test
<TAG_GRAPH>	position to insert the graph of the measurement
<TAG_RESULTSTABLE>	table with the measuring results

Table 1:   Definition of tags for the report of a sequences test

The last two tags only indicate the position where the result graph and table are to be inserted in the report. The layout of the graph and the table cannot be affected. The tags must be enclosed in angle brackets and must be written as shown in table 1. Not all tags need to be contained in the report template.

IV.1.3 Test Cycle

A sequence test can be loaded either by selecting 'Load' item of the 'File' menu or via the 'Define Sequence Template' dialogue box by pressing the 'OK' button. After that the additional information about the test can be put in. Then the software checks if all necessary devices are connected and establishes a connection to them. After that the test can be started. Then the sequences are carried out and at the end the data and the report can be saved.

IV.2 Bushing Test

The bushing tests are carried out according to IEC 60137 or IEE E C57.19.00. Other testing standards are possible but need to be customised. The general settings of the template dialogue box are equal to those of a sequence test except that the type and object boxes cannot be filled in. The sequences sheets are slightly different. It is possible to set a PD and tan delta limit. These tolerance ranges are controlled by the software. At the end of a test, the testing person is asked what to do, if the measured values are out of these ranges. The dialogue box shows the values which are out of range and the testing person has to decide if the test is ok nevertheless, if the test shall be repeated, or if the results are to be discarded. Another difference to a sequence template is, that no inception PD level can be set, because the inception voltage is not calculated in a bushing test. All other settings are the same as for sequence tests (see section IV.1).
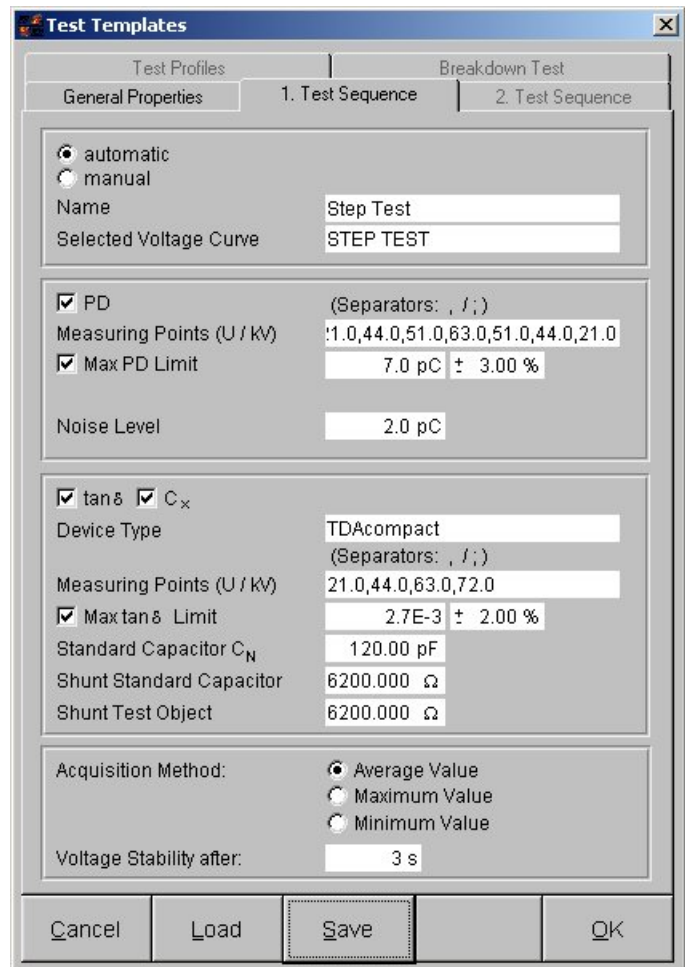
Fig. IV.3   Bushing sequence tab

IV.2.1 Additional Test Information

After starting the test sequence, additional information about it must be entered. The following dialogue box shows these data for a bushing test.

In the first section information about the order can be set. The second section defines the kind of test and a comment about the test can be entered. For a repetition test a comment is obligatory. In the next section the order of the two sequences can be set. The last section determines the language of the report.

Fig. IV.4   Bushing test information dialogue box

IV.2.2 Customising the Report

The report template for the bushing test is located in the 'Default Docs' directory and the names of the files are *default_bushing_<language>.doc*. <language>: en (English), ge (German), fr (French). According to the choice of the language of the report, the corresponding template is used for the report. These templates can be customised concerning the layout. The data of the test sequence replaces the tags in the report. The predefined tags for this kind of test sequence are:

Mark	Description
<TAG_DATE>	test date
<TAG_TIME>	test time
<TAG_OBJECT>	test object
<TAG_TYPE>	test type
<TAG_TESTSPEC>	test specification
<TAG_CLIENT>	name of client
<TAG_CLIENTORDERNO>	client order number
<TAG_ORDERNO>	order number
<TAG_POSITIONNO>	position number
<TAG_SERIALNO>	serial number
<TAG_TESTPERSON>	testing person
<TAG_QUANTITY>	quantity
<TAG_DRAWING>	drawing number
<TAG_TEMPERATURE>	air temperature
<TAG_TESTTYPE>	type of test (preliminary test, repetition, repair, final inspection)
<TAG_TESTTYPECOMMENT>	comment about the type of test
<TAG_COMMENT>	comment about the test
<TAG_UPEAK>	maximum value of the voltage in a test sequence
<TAG_NOISE>	background noise
<TAG_GRAPH>	position to insert the graph of the measurement
<TAG_RESULTSTABLE>	table with the measuring results
<TAG_TEXT1.0>	additional text defined in the <Bushing Texts.xls> file
<TAG_TEXT1.1>	additional text defined in the <Bushing Texts.xls> file
<TAG_TEXT1.2>	additional text defined in the <Bushing Texts.xls> file
<TAG_TEXT1.3>	additional text defined in the <Bushing Texts.xls> file
<TAG_TEXT1.4>	additional text defined in the <Bushing Texts.xls> file
<TAG_TEXT1.5>	additional text defined in the <Bushing Texts.xls> file
<TAG_TEXT1.6>	additional text defined in the <Bushing Texts.xls> file
<TAG_TEXT1.7>	additional text defined in the <Bushing Texts.xls> file
<TAG_TEXT1.8>	additional text defined in the <Bushing Texts.xls> file
<TAG_TEXT1.9>	additional text defined in the <Bushing Texts.xls> file
<TAG_TEXT2.0>	additional text defined in the <Bushing Texts.xls> file
<TAG_TEXT2.1>	additional text defined in the <Bushing Texts.xls> file
<TAG_TEXT2.2>	additional text defined in the <Bushing Texts.xls> file
<TAG_TEXT2.3>	additional text defined in the <Bushing Texts.xls> file

Mark	Description
<TAG_TEXT2.4>	additional text defined in the <Bushing Texts.xls> file
<TAG_TEXT2.5>	additional text defined in the <Bushing Texts.xls> file
<TAG_TEXT2.6>	additional text defined in the <Bushing Texts.xls> file
<TAG_TEXT2.7>	additional text defined in the <Bushing Texts.xls> file
<TAG_TEXT2.8>	additional text defined in the <Bushing Texts.xls> file
<TAG_TEXT2.9>	additional text defined in the <Bushing Texts.xls> file

Table 2:   Definition of tags for the report of a bushing test

The <TAG_GRAPH> and <TAG_RESULTTABLE> tags only indicate the position where the result graph and table are to be inserted in the report. The layout of the graph and the table can't be affected. The tags must be enclosed in angle brackets and must be written as shown in the table. Not all tags need to be contained in the report template.

The <TAG_TEXT1.0> - <TAG_TEXT2.9> tags can be defined in the *Bushing Texts.xls* Excel worksheet which is also located in the 'Default Docs' directory.

IV.2.3 Special Configurations for Bushing Tests

There are predefined bushing tests according to the IEC and IEEE test standards. To load such a test, only the type of the bushing, in some cases the filling, the testing standard and the U_r or BIL value must be selected, and the correct template is loaded automatically. This easy possibility to load a bushing test needs some configurations. These are made in the *Bushing Texts.xls* file in the *Default Docs* directory. The first 'Types' sheet defines the bushing types with their fillings and the possible testing standards. The first column 'No.' is filled in automatically and must not be changed. The next two columns define the type of the bushing in German and English. The columns 'Filling DE' and 'Filling EN' define the filling for the type of the bushing. If a type has no filling '(keine)' must be filled in. The next columns define the testing standards for the type of the bushing. Further testing standards can be added with a new column. The headline of the new columns must start with 'Testing Standard' followed by a blank and a number. Each combination of type and filling needs its own row.

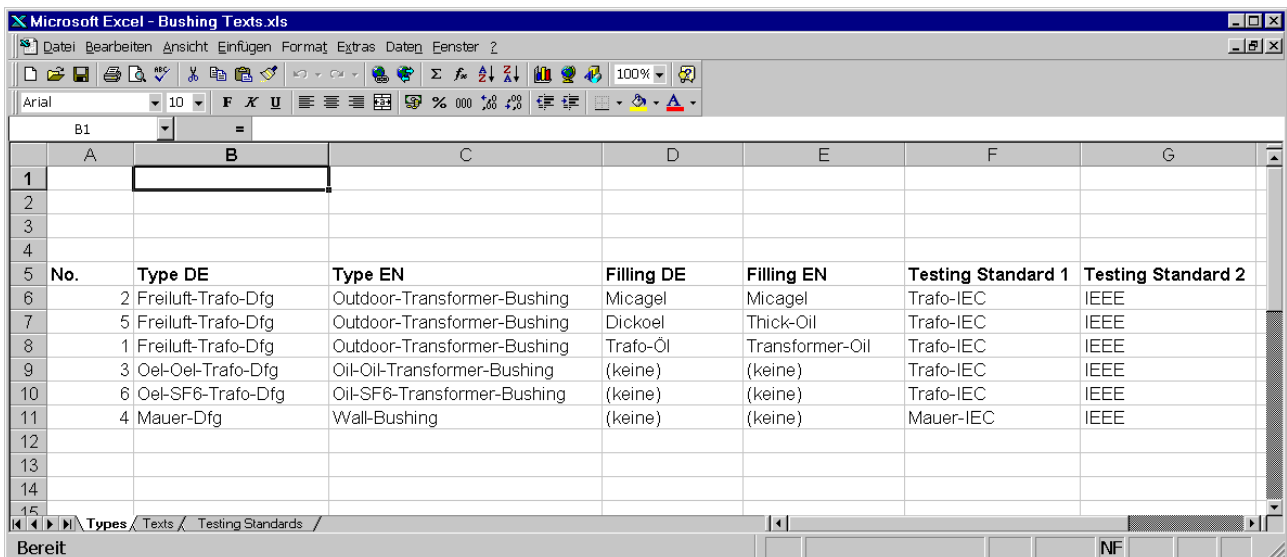Fig. IV.5   Defining types of bushings in the *Bushing Texts.xls* file

The specifications for the testing standards are defined in the 'Testing Standards' sheet. For each testing standard defined in the 'Types' sheet there is a corresponding column in the 'Testing Standards' sheet. The first two columns define the U_r and BIL values and the columns of the testing standards define the file names

of the bushing test templates which are located in the 'Templates' directory. These templates contain the voltage curves and measuring points for the combination of U_r resp. BIL and the testing standard.

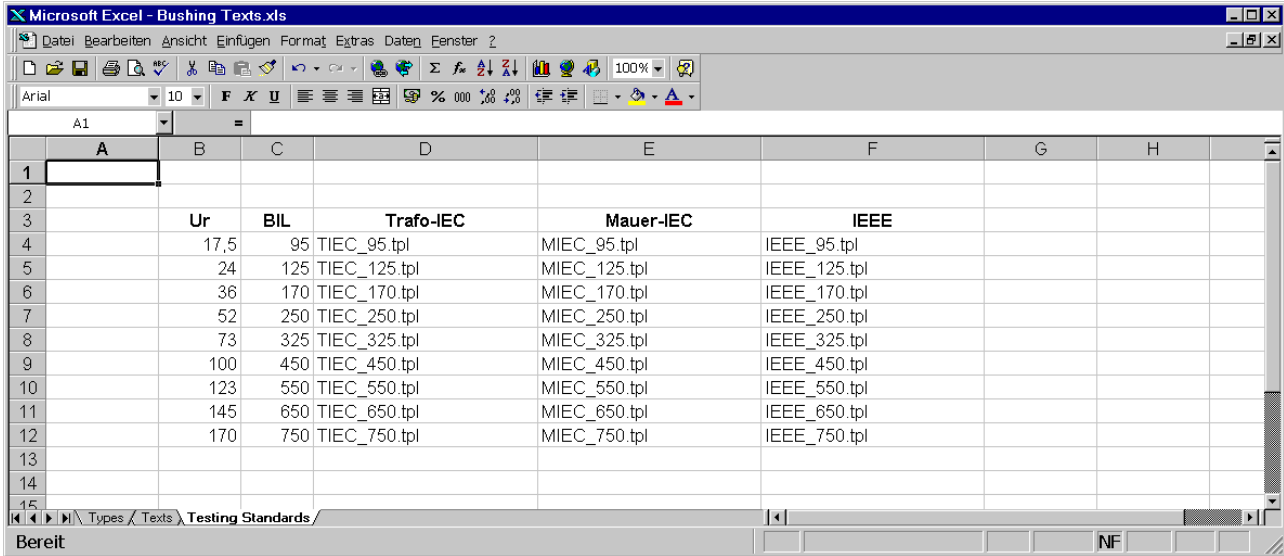|	A	B	C	D	E	F	G	H
1								
2								
3		Ur	BIL	Trafo-IEC	Mauer-IEC	IEEE		
4		17,5	95	TIEC_95.tpl	MIEC_95.tpl	IEEE_95.tpl		
5		24	125	TIEC_125.tpl	MIEC_125.tpl	IEEE_125.tpl		
6		36	170	TIEC_170.tpl	MIEC_170.tpl	IEEE_170.tpl		
7		52	250	TIEC_250.tpl	MIEC_250.tpl	IEEE_250.tpl		
8		73	325	TIEC_325.tpl	MIEC_325.tpl	IEEE_325.tpl		
9		100	450	TIEC_450.tpl	MIEC_450.tpl	IEEE_450.tpl		
10		123	550	TIEC_550.tpl	MIEC_550.tpl	IEEE_550.tpl		
11		145	650	TIEC_650.tpl	MIEC_650.tpl	IEEE_650.tpl		
12		170	750	TIEC_750.tpl	MIEC_750.tpl	IEEE_750.tpl		
13								
14								
15								

Fig. IV.6   Defining the names of the template files for the testing standards

The <TAG_TEXT1.0> - <TAG_TEXT2.0> tags for the report templates are filled with the texts defined in the 'Texts' sheet. For each combination of a type of bushing and a filling there is a row in the sheet. The columns 'Text 1.0 DE/EN' up to 'Text 2.9 DE/EN' define the texts for the corresponding tags. So, each type/filling combination has its own text definition. The texts itself can contain other defined tags but no <TAG_TEXT..> tags.

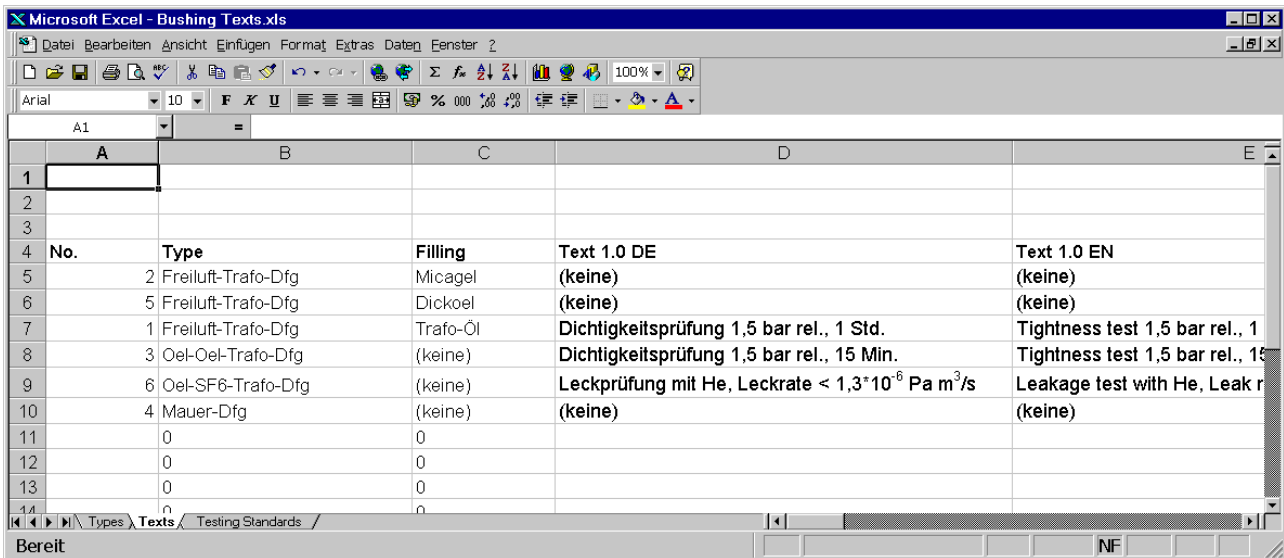|	A	B	C	D	E
1					
2					
3					
4	No.	Type	Filling	Text 1.0 DE	Text 1.0 EN
5	2	Freiluft-Trafo-Dfg	Micagel	(keine)	(keine)
6	5	Freiluft-Trafo-Dfg	Dickoel	(keine)	(keine)
7	1	Freiluft-Trafo-Dfg	Trafo-Öl	Dichtigkeitsprüfung 1,5 bar rel., 1 Std.	Tightness test 1,5 bar rel., 1
8	3	Oel-Oel-Trafo-Dfg	(keine)	Dichtigkeitsprüfung 1,5 bar rel., 15 Min.	Tightness test 1,5 bar rel., 15
9	6	Oel-SF6-Trafo-Dfg	(keine)	Leckprüfung mit He, Leckrate < $1{,}3{\cdot}10^{-6}$ Pa m^3/s	Leakage test with He, Leak r
10	4	Mauer-Dfg	(keine)	(keine)	(keine)
11	0	0			
12	0	0			
13	0	0			
14	0	0			

Fig. IV.7   Defining the texts for the corresponding tags

IV.2.4 Test Cycle

A bushing test is selected and started by choosing a bushing test template in the 'Load Automatic Test Control' window. If done, the following dialogue box for selecting the test is opened. Each box shows the selectable possibilities. The first box displays all types of bushings from the 'Types' sheet. The second box shows all corresponding fillings. The possible testing standards are shown in the third box. The U_r and BIL values are taken from the 'Testing Standards' sheet. The last box shows the template file for the selected bushing test. This template can be edited directly by pressing the 'Redefine Template button'. This opens the template dialogue box as shown in figure IV.8. The template can be changed and saved. After closing the dialogue box, the previous appears again. Pressing 'OK' loads the corresponding template file, and the additional in-

Fig. IV.8   Select bushing test dialogue box

formation about the test can be put in. Then the program checks and establishes the connections to the necessary devices and the test can be started. At the end the report is generated automatically. The report and the data file are stored in the *<default dir> \ <Order No> \ <Position No> \ <Serial No>* directory, where the items are taken from the additional information dialogue box. The file names are built up as follows: *<kind of test>XX.hvs* resp. *<kind of test>XX.doc* with:

<kind of test>
- preliminary_test
- repetition_test
- revision_test
- final_inspection

XX: increasing two-digit number

IV.2.5 Several Tests in one Report

There is the possibility to combine several bushing tests in one report. By selecting 'Create Complete Report' in the 'File' menu the following dialogue box appears. There are two possibilities of selecting the bushing tests. If the first two items are selected, all data sets under the selected order directory which were final inspections are put in the report. With the third item it is possible to select the data sets manually. The name and directory of the report file can be put in directly or can be selected by the 'Filename' button. The order directory refers to the first two items and can be selected by the 'Directory' button or can be put in directly. If the third item is selected, the list box, and the 'Remove', and 'Select' buttons are available. The files can be selected by the 'Select' button and are displayed in the list box. To remove a file from the list, it must be selected and the 'Remove' button must be pressed. The 'Order Directory' box and the 'Directory' button are not available. After selecting the options, the report will be created.
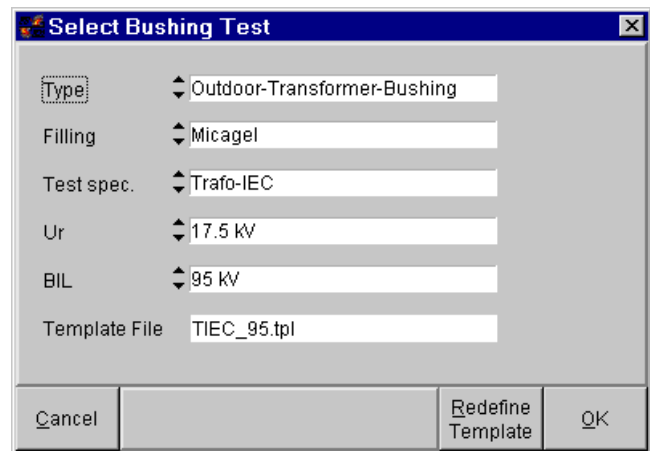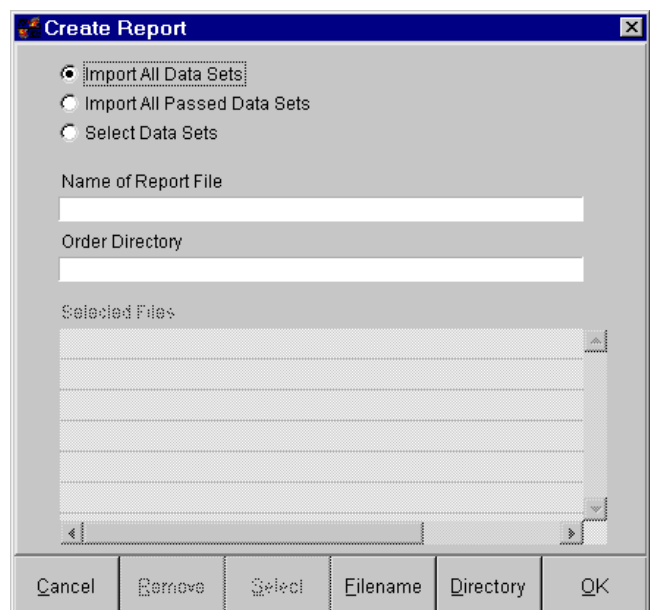

Fig. IV.9   Selection of several bushing tests for report

IV.3 Test Profiles

By defining a test profile, PD limits for each voltage step can be set. At the end of the test the software controls if the measured values are within these limits. Up to four different classes can be defined. The general settings of the template dialogue box are nearly the same as those of a sequence test in figure IV.10, except that the 'Number of Sequences' box is replaced by a 'Number of Classes' box. To define a test profile, at first a voltage curve must be specified. By double-clicking on the 'Selected Voltage Curve' box, the 'Select Voltage Curve' dialogue box is opened. This dialogue box corresponds to the 'Step Edit' dialogue box, and the voltage curve can be defined (see section III.2). If the PD inception and extinction voltages shall be calculated, the level of the PD activity, which indicates that the partial discharge has started, must be adjusted. The table for the class definitions contains one row for each step in the voltage curve. The PD limits can be typed in by double-clicking the corresponding table cell. if it is not necessary to set a limit for one step, a dash should be entered.

The evaluation of the measuring data is made at the end of the profile test. As the voltage is hold at every measuring point for a while there are several measuring values of the PD activity. The chosen 'Acquisition Method' defines how these values are evaluated. By selecting the 'Average Value' method all values are summed up and then divided by the number of measuring values. The 'Maximum' and 'Minimum Value' method uses the maximum resp. minimum value of the

Fig. IV.10 Definition of classes for a test profile

measuring values. As the regulator needs some time to reach the step voltage, a certain time can be set by the 'Voltage Stability' after box, after which the measuring values are evaluated at the measuring points. This can prevent to include peaks, which can occur by driving the motor of the regulator, into the evaluation of the profile test. Each class is evaluated separately.
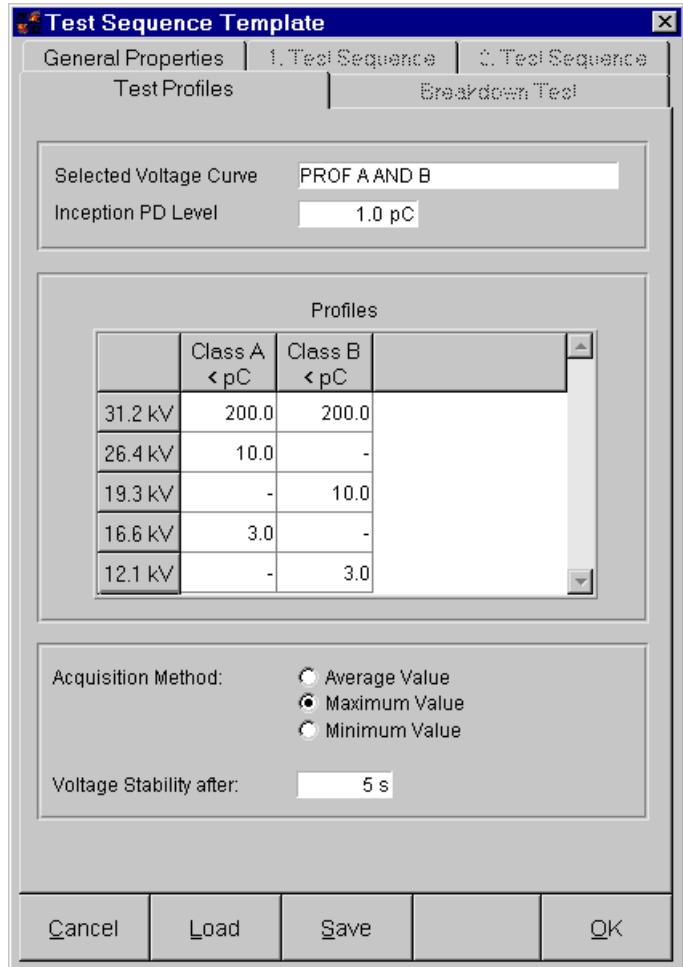
IV.3.1 Additional Test Information

After starting the test sequence, additional information about it must be put in. The following dialogue box shows these data for a profile test. The first three items correspond to those of the general settings sheet of the template dialogue box. The next four items are additional information about the order. The check boxes in the next section define, if the report shall be created at the end of the test sequence when the measured values are within the limits or when they are not within or in both cases. The language of the report can be set by marking the corresponding selection. The next check boxes define if the inception and extinction voltage and the result graphs shall be included in the report and if the report shall be printed automatically. It is possible to export the measuring data to excel automatically by selecting the corresponding check box. With the next three items additional measuring values can be added to the excel sheet.
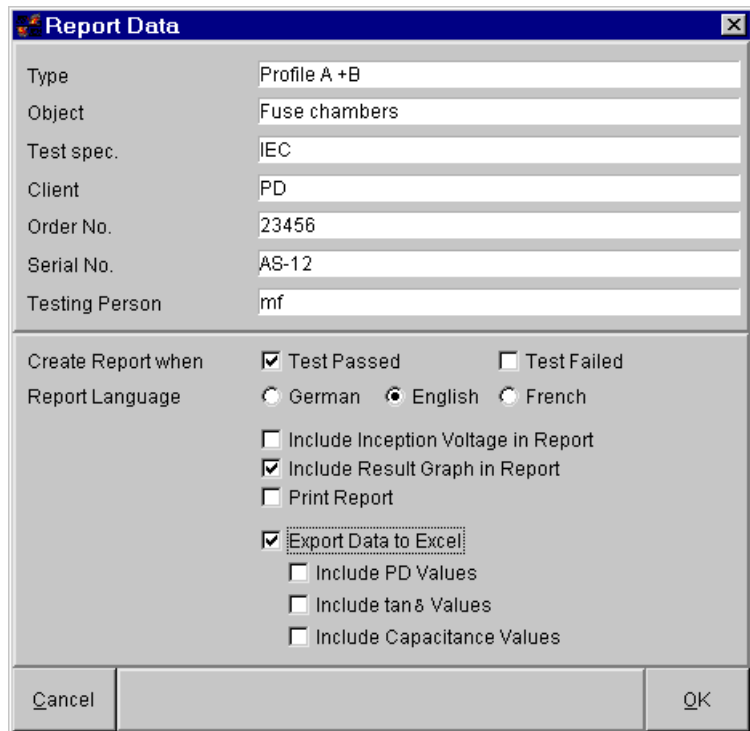
Fig. IV.11 Profile test information dialogue box

IV.3.2 Customising the Report

The report template for the profile test is located in the 'Default Docs' directory and the names of the files are *default_profile_<language>.doc*. <language>: en (English), ge (German), fr (French). According to the choice of the language of the report, the corresponding template is used for the report. These templates can be customised concerning the layout. The data of the test replaces the tags in the report. The predefined tags for this kind of test are:

Mark	Description
<TAG_DATE>	test date
<TAG_TIME>	test time
<TAG_OBJECT>	test object
<TAG_TYPE>	test type
<TAG_TESTSPEC>	test specification
<TAG_INCEPTPDLEVEL>	inception PD level
<TAG_INCEPT>	inception voltage
<TAG_EXTINCT>	extinction voltage
<TAG_CLIENT>	name of client
<TAG_ORDERNO>	order number
<TAG_SERIALNO>	serial number
<TAG_TESTPERSON>	testing person
<TAG_COMMENT>	comment about the test
<TAG_GRAPH>	position to insert the graph of the measurement
<TAG_RESULTSTABLE>	table with the measuring results

Table 3:   Definition of tags for the report of a profile test

The last two tags only indicate the position where the result graph and table are to be inserted in the report. The layout of the graph and the table can't be affected. The tags must be enclosed in angle brackets and must be written as shown in table 3. Not all tags need to be contained in the report template.

IV.3.3 Test Cycle

A profile test can be loaded either by selecting 'Load' from the 'File' menu or via the 'Define Sequence Template' dialogue box by pressing the 'OK' button. After that the additional information about the test can be entered. Then the software checks if all necessary devices are connected and establishes a connection to them. After that the test can be started. At the end the data and the report can be saved.

IV.4 Breakdown Test

The general settings of the template dialogue box are nearly the same as those of a sequence test in figure IV.12, except that the 'Number of Sequences' box is not available. By defining a breakdown test only a few parameters must be set, the voltage curve is then created automatically. At first the start voltage for the first step must be set. The 'Step Voltage' box defines the step voltage for all following steps. There can be up to 198 steps in a voltage curve with newer HV*controls/*STEP*compacts*. The duration of each step can be set in the next box. In the last box the maximum reachable voltage with those settings is displayed.

The number of steps should be limited, because this value, in combination with the step duration, determines the resolution of the measurement. The maximum number of measuring points for every measurement is 86400. This means one measuring point every second for a whole day. If the total time of a voltage curve is longer than a day, the time interval between two measuring points is calculated by dividing the total time by 86400. If the step duration is predetermined and a long time period, the number of steps should be reduced as required to get the best resolution.

The second section defines the first step. It can be step or a ramp with a settable duration. All other steps are real steps.

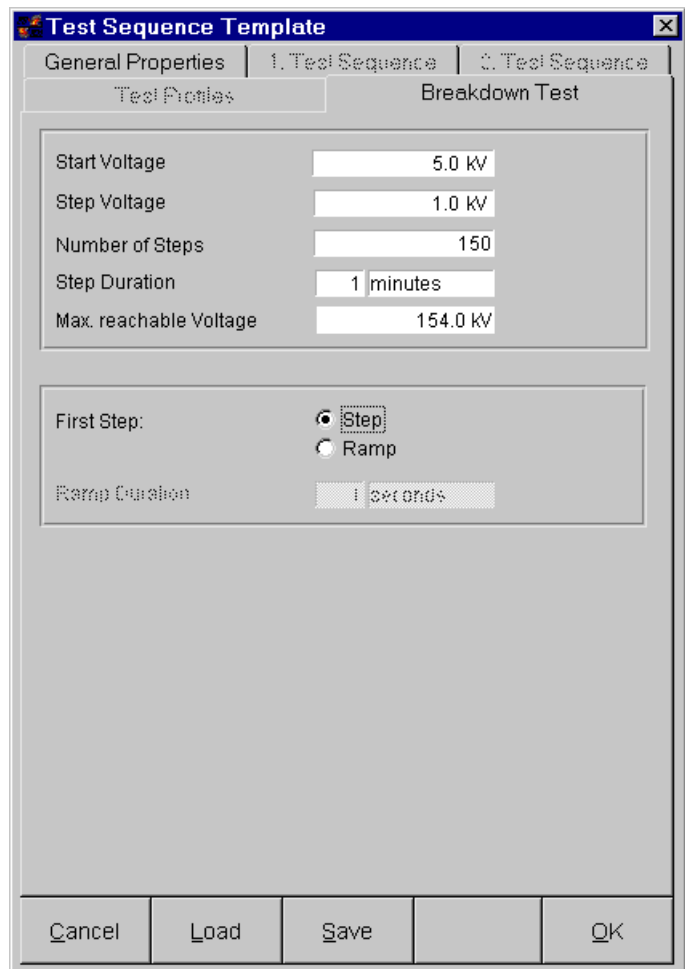After setting these parameters the voltage curve is created automatically.

Fig. IV.12 Definition of a breakdown test

IV.4.1 Additional Test Information

After starting the test sequence, additional information about it must be put in. The following dialogue box shows these data for a breakdown test. The first three items correspond to those of the general settings sheet of the template dialogue box. The next four items are additional information about the order. The last item sets the number of test samples which are to be tested until their breakdown voltage. The language of the report can be set by marking the corresponding selection. If the result graph is to be included in the report, the corresponding check box must be enabled. The next check box defines if the report shall be printed automatically. It is possible to export the measuring data to excel automatically by selecting the corresponding check box. With the next three items additional measuring values can be added to the excel sheet.
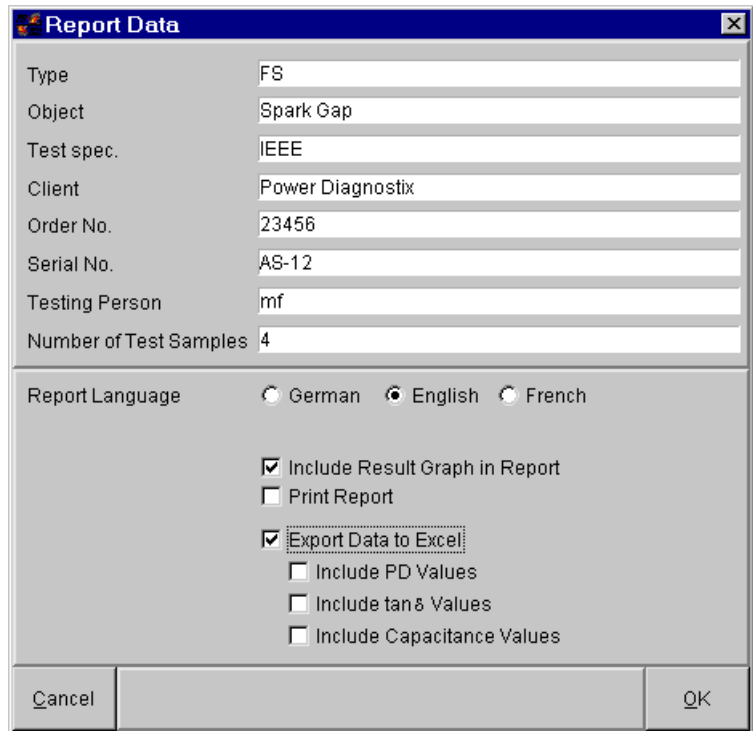

Fig. IV.13 Breakdown test information dialogue box

IV.4.2 Customising the Report

The report template for the breakdown test is located in the 'Default Docs' directory and the names of the files are *default_breakdown_<language>.doc*. <language>: en (English), ge (German), fr (French). According to the choice of the language of the report, the corresponding template is used for the report. These templates can be customised concerning the layout. The data of the test replaces the tags in the report. The predefined tags for this kind of test are:

Mark	Description
<TAG_DATE>	test date
<TAG_TIME>	test time
<TAG_OBJECT>	test object
<TAG_TYPE>	test type
<TAG_TESTSPEC>	test specification
<TAG_CLIENT>	name of client
<TAG_ORDERNO>	order number
<TAG_SERIALNO>	serial number
<TAG_TESTPERSON>	testing person
<TAG_TESTSAMPLESNO>	number of test samples
<TAG_TESTTIME>	total time of the test, including pausing time etc.
<TAG_COMMENT>	comment about the test
<TAG_GRAPH>	position to insert the graph of the measurement
<TAG_RESULTSTABLE>	table with the measuring results

Table 4:   Definition of tags for the report of a profile test

The last two tags only indicate the position where the result graph and table are to be inserted in the report. The layout of the graph and the table can't be affected. The tags must be enclosed in angle brackets and must be written as shown in table 5. Not all tags need to be contained in the report template.

IV.4.3 Test Cycle

A breakdown test can be loaded either by selecting 'Load' from the 'File' menu or via the 'Define Sequence Template' dialogue box by pressing the 'OK' button. After that the additional information about the test can be entered. Then the software checks if all necessary devices are connected and establishes a connection to them. After that the test can be started. The software pauses the test after each breakdown and stores the last voltage and the duration of the test at that time. After resuming the test, the voltage rises until the last voltage and the test continues at the time of the last breakdown. At the end the data and the report can be saved. It is possible to stop the test manually and to continue the test later.

V   Appendix

V.1   National Instruments Hardening Guide

Introduction

This manual will guide you through the Power Diagnostix proposed cyber security operation system hardening after the installation of a National Instruments based software product. The configuration refers to the Power Diagnostix software products, only. If any other 3rd party National Instruments based software products are installed or required, the proposed configuration should be adjusted with the configuration of the responsible manufacturer.
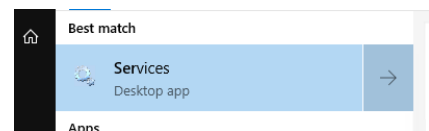
This configuration guide will close three unnecessary National Instruments services. Furthermore, the local Port 3848 UDP and TCP opened by these services will be closed.

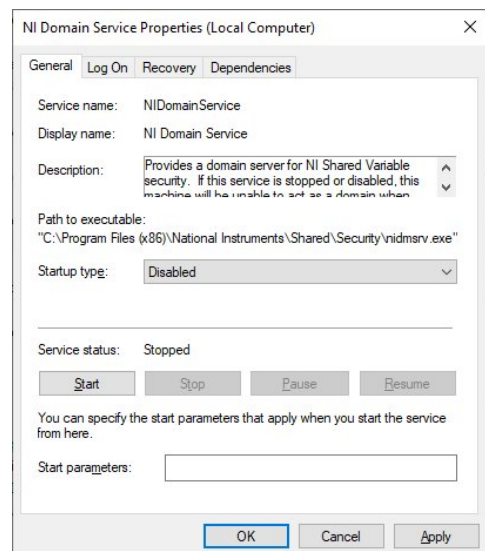|								
nidmsrv.exe	3848	TCPV6	[0:0:0:0:0:0:1]	49672	[0:0:0:0:0:0:1]	49673	ESTABLISHED	Step-by-
nidmsrv.exe	3848	TCPV6	[0:0:0:0:0:0:1]	49673	[0:0:0:0:0:0:1]	49672	ESTABLISHED	
nidmsrv.exe	3848	TCP	DESKTOP-Q5NEF6E	59111	DESKTOP-Q5NE...	0	LISTENING	
nidmsrv.exe	3848	UDP	DESKTOP-Q5NEF6E	5000	*	*		
nidmsrv.exe	3848	UDP	DESKTOP-Q5NEF6E	6000	*	*		

Step Guide

1.) Open the windows start menu and type "services.msc".

2.) Click onto the search result named "Services". The "Services" window will open.

3.) Locate these services in the service list:
- NI Domain Service
- NI PSP Service Locator
- NI Time Synchronization

4.) Open the configuration popup by double click **each service** and change the "Startup type" to "Disabled".

5.) Save the changes with the button "OK".

Service Description

http://www.ni.com/product-documentation/14487/en/

NI Domain Service
Service: NIDomainService **Process**: nidmsrv.exe
Description: Provides a domain server for NI Shared Variable security. **If Disabled**: If this service is stopped or disabled, this machine will be unable to act as a domain when configuring shared variable security.

NI PSP Service Locator
Service: lkClassAds **Process**: lkads.exe
Description: Locates servers at the request of network variable clients and other proprietary NI network protocols. **If Disabled**: If this service is stopped or disabled, network variables and network streams will stop working.

NI Time Synchronization
Service: lkTimeSync **Process**: lktsrv.exe
Description: Allows this machine to keep its time synchronized with a master time server, or to act as a time server for other machines. This feature is configured with the Shared Variable Engine settings in LabVIEW. **If Disabled**: If this service is stopped or disabled, this form of time synchronization will not be available.