Mirror Testing System

User manual

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Version: 1.1

Contents

Safety Instructions

Before starting your work with the assembly line we recommend you to familiarize with the contents of this manual. Keep this manual in a place where it is always accessible to all users.

Standard Operation

This instruction manual presents a comprehensive set of instructions and information required for the standard operation of described products.

Qualified Personnel

Interventions in any part of our products which are not described in this instruction manual may be performed only by trained personnel.

Unqualified interventions in any part of our product or non-compliance with the warnings specified in the manual or indicated on the product may result in serious personal injury or damage of property.

Trained personnel are persons of whom the following is true:

- They are capable, due to their professional training, skills and expertise, and based upon their knowledge of and familiarity with applicable technical standards, of assessing the work to be carried out, and recognizing possible hazards.
- They possess experience in a comparable field of endeavor and the level of knowledge and skills may be considered to be commensurate to cover professional education in this area.

1. User Installation

To install Mirror Testing System follow these steps:

1. Run **MTS_Setup.msi** installer package. Notice that administrator privileges are required.
2. Following prerequisites are necessary to be installed on your computer. You will be prompted if they are not present. Follow the wizard to download them from vendor's site:

   - .NET Framework 4.0 (full version, not Client profile)
   - SQL Server 2008 R2 Express

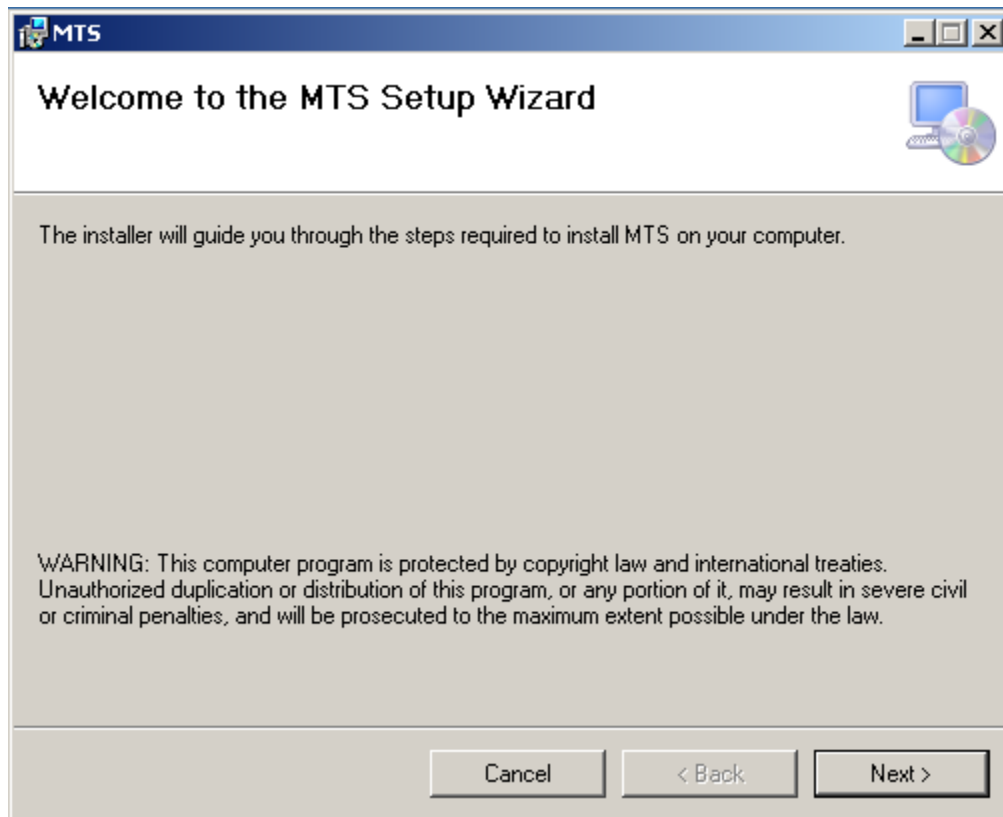3. When Welcome screen appears click **Next**

Figure 1.1 Welcome instalation screen

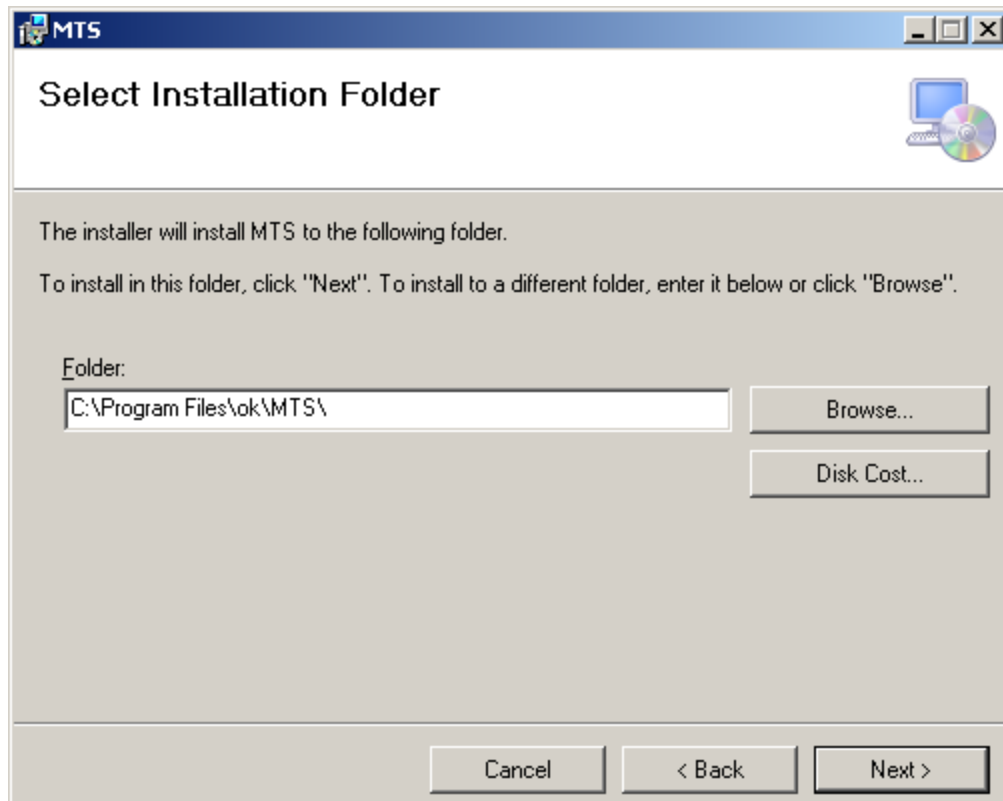4. Browse installation folder and click **Next**

Figure 1.2 Instalation folder screen

5. Now installation process is ready to run, click **Next**
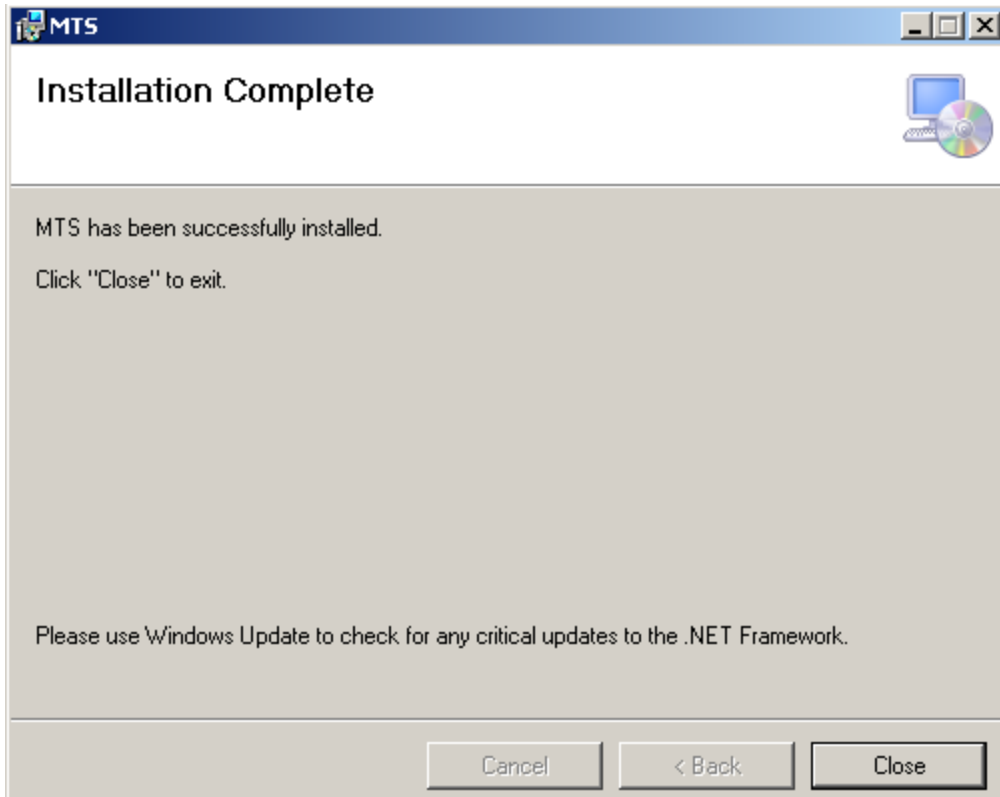6. During the installation a database will be created.

Figure 1.3 Successfull instalation scrren

7. When the database has been created, the installation is finished. Click **Close** and you may start to use your application.

2. Introduction to MTS

Mirror testing system (MTS) is an application designed for controlling automobile mirror testing machine. The goal is to automate the entire process of testing as much as possible.

Important part of this application is an editor for testing parameters. It allows users to create new files or edit existing ones. Created testing file are saved to local hard drive and loaded when testing is initiated. (For more information how to create or edit testing file see chapter 5.3)

With parameters file created you are ready to setup and start desirable testing by defining a shift – the number of mirrors to be tested. After that, all following test are executed automatically. (For more information how to create and start new shift see chapter 5.4)

While the testing is running, it is possible to follow current machine state on the output console (see 3.3) and in the testing window (see 5.4.1)

Measured values for each defined testing parameter are stored in a database where they are accessible to the operator in the data window (see 5.5)

Information about the operator and his/her executed shifts are logged. Therefore, you must provide a valid username and password to access full functionality of this application.

3. Getting started with MTS

There are three main parts of the user interface in MTS: Upper menu and toolbar (see 3.1), main area of application windows (see 3.2) and output console (see 3.3)

3.1. Main menu and toolbars

Main menu with toolbars is intended to provide all features of this application, such as opening the editor or log into the system. You have three possible ways to do so: click main menu item (or some of its sub-items), click a button on the toolbar or press a keyboard shortcut. Following list shows an overview of possible commands:

Panel shortcuts

Toolbar	Shortcut	Description
	CTRL + N	Create a new file with testing parameters
	CTRL + S	Save current (active) panel
	CTRL + O	Open an existing file with testing parameters
	CTRL + F4	Close current (active) panel
	CTRL + TAB	Switch current (active) panel

Application shortcuts

Toolbar	Shortcut	Description
	ALT + T	Open testing panel
	ALT + D	Open (data) panel with test results
	ALT + S	Open application settings panel
	ALT + O	Log out from the application
	ALT + I	Log into the application
	ALT + P	Open logged in operator profile

Editing shortcuts

Toolbar	Shortcut	Description
	CTRL + C	Copy current selection
	CTRL + V	Paste content of clipboard
	CTRL + X	Copy and delete current selection
	CTRL + Z	Undo previous change
	CTRL + Y	Redo previous change
	DEL	Delete current selection

3.2. Panels

The main area of the window is hosting various panels. You may display them by invoking application features (see 3.1) such as creating a new file, viewing data results, etc.

3.3. Output console

On the output console current application state messages are placed:

- Operator login/logout
- Creating new or saving existing file
- Shift current action: connecting tester machine, executing test, saving data …
- Setting of channel value, waiting for channel value
- Application errors
- …

4. Configuring MTS

Before you start using this application for testing, it needs to be configured in order to work properly. This chapter gives a simple guide how to perform basic setup.

4.1. Operators

To access all application features you need to provide a valid username and password. The application is supplied with a default user:

Username: admin

Password: ***** (the same as the username)

After logging in, you may change application settings that will be inaccessible otherwise. There are two types of operators: admin and user. An admin operator is intended for setting up application settings, while a user operator is executing tests.

Operators				
Actions:	Login	Name	Surname	Group
Add	admin	System	Administrator	Admin
Delete				
Edit				
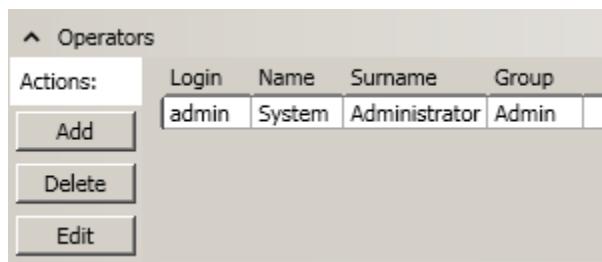
Figure 4.1 Operators tab

4.1.1. Add a new operator

To add a new operator, follow these steps:

1. Open settings panel   View → Settings   ATL + S
2. Expand operators tab
3. Click "Add" button, enter operator personal data and select type of user. Login must be unique.
4. Click OK

4.1.2. Delete an existing operator

Notice that when deleting an existing operator all data that have been produced by this operator such as testing results will be deleted as well. To delete an existing operator, follow these steps:

1. Open settings panel   View → Settings   ALT + S
2. Expand **Operators** tab
3. In the grid select operator you want to delete
4. Click **Delete** button and confirm the deletion

4.2. Select communication protocol

Network communication with tester machine can be based on various protocol types depending on the manufacturer of tester communication terminals.

To setup communication protocol, follow these steps:

1. Open settings pane   View → Settings   ALT + S
2. Expand **Hardware** tab
3. From the protocol drop down list select desirable protocol

Each protocol has its own settings that need to be configured. For more information about these topics, see following chapters.
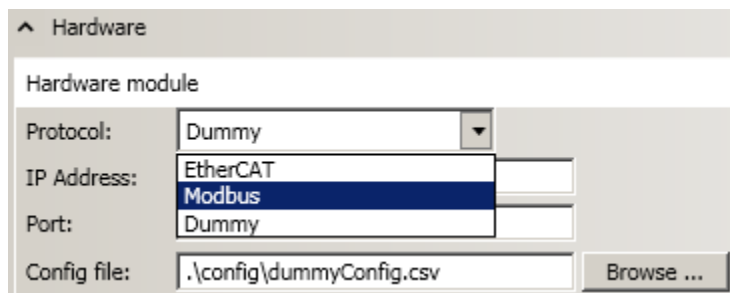
Figure 4.2 Hardwar tab - selecting communication protocol

4.2.1. EtherCAT protocol

When using EtherCAT protocol, an external service (TwinCAT) is used for communication. This service is running in your operating system and holds an image of all tester channel values on local computer. Each channel has a name that is defined and mapped to particular channel in TwinCAT configuration tool. Settings of channels can be exported from TwinCAT to a file that is readable by MTS. Enter path to this file when using EtherCAT. The application is supplied with default channels configuration file and does not need to be specified.

TwinCAT allows having various "views" at the channels and in each defined different mapping between names and channels. This is called a **task** in TwinCAT. Enter the name of task when using EtherCAT protocol. Default task name is Task1.

For more information how to use TwinCAT for advanced settings see TwinCAT System Manager documentation:

. This help file is provided together with the application.

4.2.2. Modbus TCP protocol

Modbus protocol is working over standard TCP protocol. You need to specify tester IP address and port on which the communication module is listening. The default port is 502. IP address must be set on the tester module. You can use MOXA ioAdmin utility to do so.

You also need to specify configuration file containing channel names and its address in Modbus protocol. The application is supplied with default channels configuration file and does not need to be specified.

4.2.3. Dummy protocol

Dummy protocol is for testing purpose only. If you want to provide crucial changes to configuration files such as tasks configuration, it is safer to test these changes on a simulator.

Enter IP address of computer on which the simulator is running (usually localhost) and port on which it is listening.

You also need to specify configuration file containing channel names. The application is supplied with default channels configuration file and does not need to be specified. Modbus protocol configuration file may be specified as well, because the format is the same.

4.3. Calibration

Calibration is a precondition of precise mirror move measurement. If calibration is not performed regularly, we do not guarantee correct functionality of travel tests. Besides, it may lead to considerable prolongation of testing.

For mirror movement testing, three calibrators are used that must be set up before first test.

4.3.1. Setting up calibrators

To setup calibrators, follow these steps:

1. Open settings panel   View → Settings   ALT + S
2. Expand **Hardware** tab
3. Measure distance between each of tester calibrator and enter these values into calibration panel. Position of each calibrator is visually displayed.
4. Save settings   File → Save   CTRL + S
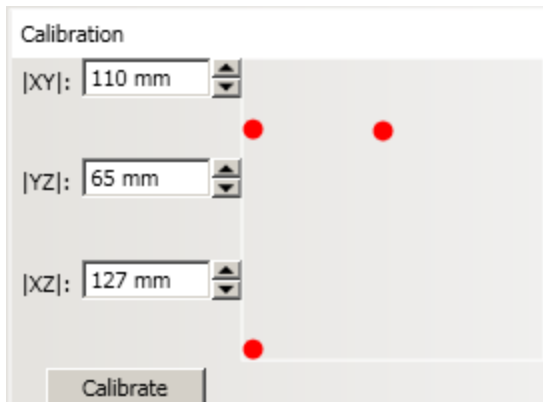
Figure 4.3 Calibrators tab - setting up calibrators positions

4.3.2. Running calibration

Before first calibration is run, the distances between calibrators must be already set (see previous chapter 4.3.1). Also communication protocol must be selected and set up properly (see 4.2), tester machine must be connected and switched on (see 5.1). To execute mirror calibration follow these steps:

1. Open settings panel   View → Settings   ALT + S
2. Expand **Hardware** tab
3. In the calibration panel click **Calibrate** button
4. Wait until a prompt "Switch on power supply" appears.
5. Switch on power supply (see 5.1 → 2) and click OK
6. Wait until tester is opened.
7. Insert calibration mirror.
8. Press **START** button on the tester.
9. Wait until calibration is finished and press OK in the calibration window
10. Save settings   File → Save   CTRL + S
11. Remove calibration mirror from the tester
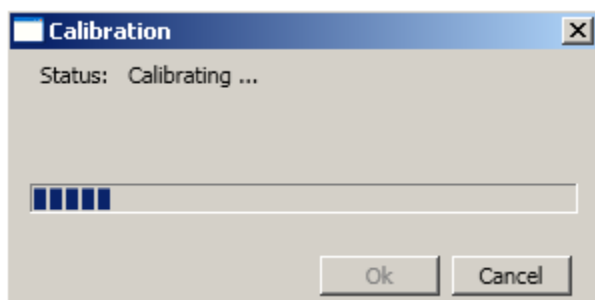
Figure 4.4 Running calibration...

4.4. Printer

After each sequence of tests a label is printed. Therefore you need to setup a printer for this feature. Follow these steps to do so:

1. Open settings panel   View → Settings   ALT + S
2. Expand **Hardware** tab

3. In the **Printer settings** section select one of printers installed on your computer
4. Setup label size
5. To enable labels printing check **Print labels**
6. Save settings   File → Save   CTRL + S
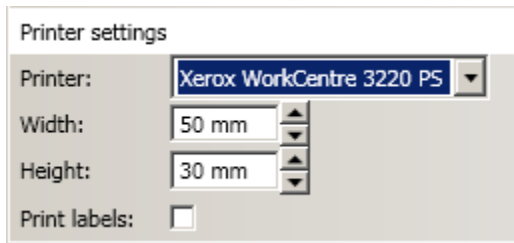
Figure 4.5 Printer tab - setting up the label

5. Using MTS

5.1. Switch on/off tester machine

There are two switches on the machine:

1. Main switch – activates entire testing machine including computer and illumination

2. Tester power supply – activates electrical components of testing machine. Main switch (1) needs to be put to ON position before using this switch.

The operator is obliged to verify that the machine is prepared before switching the Main switch (1) ON, in particular:

▪ Electrical cases are well closed
▪ Machine is not visibly damaged
▪ There are no external entities on the machine

Switch on

It is forbidden to switch on the Main switch (1) if any of previous conditions is not assured.

The tester power supply (2) can only be used when MTS is running (for safety reason). Do so when you are asked by the application before shift execution is started. After that, the tester machine is prepared and fully operable.

Switch off

Follow these steps to switch off the tester machine:

▪ Finish or abort all running tests
▪ Switch off the tester power supply (2)
▪ Close the application
▪ Shut down the computer
▪ Afterwards, switch Main switch (1) to OFF position

5.2. First run

Before you start working with the application, you need to log in by entering a valid username and password. Otherwise you won't be able to use all its features. The application is supplied with a default user:

Figure 5.1 Login window

Username: admin

Password: ***** (the same as the username)
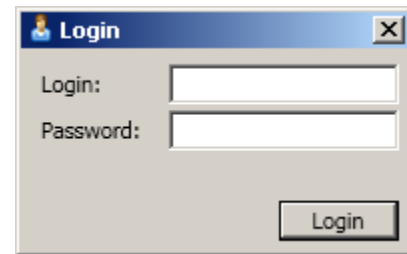
5.3. Defining testing parameters

Testing parameters are saved in a file with extension ".tc". Follow these steps to create and define new collection of parameters:

1. Create a new file   File → New   CTRL + N
2. Enable desired tests by checking them at the left side panel or in the header of each test at the right side.
3. Fill in parameters for each test (even disabled test parameters will be saved)
4. Save file   File → Save   CTRL + S

5.3.1. Test categories

All tests are divided into several groups according to their purpose:

- Informative settings – only hold information about a mirror that is intended to be tested with these parameters. They are usually insignificant during the testing process. May be used for printing on the labels.
- Travel tests – testing mirror glass movement
- Current tests – testing current in mirror electrical circuits
- Presence tests – testing presence of various mirror components
- Other tests – other uncategorized tests

5.3.2. Defining parameters

Parameters define values that must be measured during the process of testing. If so, test is evaluated as **completed**. Otherwise it is **failed**.

Information

Orientation	Define for which side of the car and which type of car (according the driver position) is the mirror designated. Select one value of: ▪ Left left-handed (driver on the left side) ▪ Right left-handed (driver on the left side) ▪ Left right-handed (driver on the right side) ▪ Right right-handed (driver on the right side)
Part number	Internal number of article. Will be printed on the label

Supplier name	Name of mirror supplier. Will be printed on the label
Description	Description of the mirror and used parameters. Insignificant during testing. For user purpose only.

Travel East, West, South and North

In each of travel tests, the mirror glass is centered to the default position defined by calibration (see 4.3) and then moved in a particular direction until the defined angle is achieved or the duration of this test exceed specified time.

The directions of mirror movement are always defined from the position of the driver and are independent on its orientation.

Min angle	Minimum angle that must be achieved in particular direction to evaluate this test as complete. This parameter is by default defined in degrees.
Max current	Maximum allowed current in the electrical circuits of actuator that is used for mirror movement. It could be either vertical or horizontal actuator – according to the travel direction. This value could be exceeded but only for limited period of time. See the next parameter.
Max overload time	Maximum allowed time of current overloaded in the electrical circuits of actuator that is used for mirror movement. Current is overloaded when it exceeds maximum defined in the previous parameter.
Max testing time	Maximum allowed time of this test execution. If duration exceeds this value, test is immediately aborted and evaluated as failed.

Power fold

During this test mirror is folded and unfolded.

Max current	Maximum allowed current in the electrical circuits of actuator used for folding and unfolding. This value could be exceeded but only for limited period of time. See the next parameter.
Max overload time	Maximum allowed time of current overloaded in the electrical circuits of actuator used for folding and unfolding. Current is overloaded when it exceeds maximum defined in the previous parameter.
Max testing time	Maximum allowed time of this test execution. If the duration exceeds this value, test is aborted immediately and evaluated as failed.

Heating foil

During this test heating foil is switch on and off.

Min current	Minimum allowed current in the electrical circuits of heating foil. This value could not be exceeded, otherwise the test is evaluated as failed.
Max current	Maximum allowed current in the electrical circuits of heating foil. This value could not be exceeded, otherwise the test is evaluated as

	failed.
Testing time	Duration of this test. After this period of time elapses, heating foil is switched off and this test is finished.

Direction light

During this test direction light is cyclically switch on and off.

Min current	Minimum allowed current in the electrical circuits of direction light while it is switched ON. This value could not be exceeded, otherwise the test is evaluated as failed
Max current	Maximum allowed current in the electrical circuits of direction light while it is switched ON. This value could not be exceeded otherwise the test is evaluated as failed.
Number of blinks	Number of cycles where direction light is switched on and off
Lighting time	Duration of lighting period. During this time, direction light is switched on and current is measured.
Break time	Duration of break period. During this time, direction light is switched off and current is not measured.

Presence of rubber

Is present	Defines if rubber should be present on the cable.

5.4. Testing mirrors

In order to start, the mirror testing application must be already configured and the machine needs to be in operational state. In particular:

- Main switch in ON (see 5.1)
- MTS is running on the computer
- One of the operators is logged into the system
- You have created file with testing parameters

If all of these conditions are fulfilled, insert to the tester fixture for mirror type you want to test. For each orientation of a mirror there is a different type of fixture.

5.4.1. Executing shift

Entire process of testing is controlled from testing panel. To start a new shift, follow these steps:

1. Open testing panel   View → Tester   ALT + T
2. Click **Load file …** and navigate to file with testing parameters defined
3. Enter the number of mirrors you want to test
4. Select type of mirror defined in database
5. Click **Start** button
6. Wait until a prompt "Switch on power supply" appears.
7. Switch on power supply (see 5.1 → 2) and click OK
8. Wait until tester is opened. Now it is fully prepared for testing.

In the top of testing panel you can follow the number of mirrors being currently tested and the number of passed and failed mirrors. On the left side, the current position of mirror glass is displayed. This feature is only available while mirror movement is measured.

You can follow measured values of all analog channels in the right part of the panel.
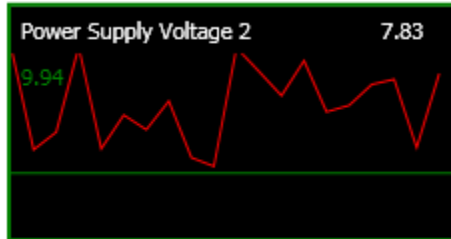

Figure 5.2 Graph of analog channel values over time

5.4.2. One mirror cycle

After shift has been started (see 5.4.1) , insert a mirror to the fixture and connect its cable to the connector. Assure that the mirror is fixed sufficiently. Press and release START button on the tester machine. The device will be closed and all tests will be executed. If all have been finished correctly, the device will open automatically and you may remove the mirror. Also a green light signalization will indicate the result.

If there is an error on the mirror detected by the tester, device stays closed and a red light signalization appears. Press ERROR button and the device will open so you can remove the mirror.

After each test a label is printed (if this feature is enabled). Results and measured values during each test are saved to database (see 5.5)

5.5. Viewing result data

To view executed shifts results and measured value open data panel (View → Data, ALT + D). It is divided into three connected parts - grids. The top most present

Shift results

By clicking at a row of shift results detailed information about test and parameter results will be displayed in the bottom grid.

- Start – time when execution of shift has been started
- Finish – time then execution of shift has been finished (or aborted)
- Operator – full name of operator who has executed current shift
- Mirror name – short description of mirror type which has been tested in current shift
- Completed – number of mirrors for which **each** test was finished correctly
- Failed – number of mirrors for which **at least one** test failed
- Aborted – number of mirrors which testing was aborted

Test results

Tests are grouped by sequence number. A sequence is a group of tests executed on one mirror. Failed test are highlighted. If one test is failed, the entire sequence is considered failed.

- Test – name of current test
- Duration – time of current test execution
- Result – result of current test. One of following values: Completed, Failed, Aborted

Parameter results

- Parameter – name of current parameter.
- Value – value used to measure this parameter.
- Output – value measured for this parameter. Could be omitted.
- Unit – unit of used parameter value and output value. Could be omitted.

6. Common error messages

File *[filename]* may be corrupted – the file with testing parameters you are trying to open is in an incorrect format. See error details for more information. If you are an experienced user, you may try to open it in a text editor such as notepad and manually correct it[1].

File *[filename]* not found – file you are trying to open does not exist.

Connection to *[protocol name]* module could not be established – connection to the tester machine could not be established. Check your communication protocol configuration. Check whether the network cable is connected correctly.

Configuration file *[filename]* not found – the application configuration file has been removed. Check configuration directory in application directory. If the problem persists try to reinstall the application.

Template file *[filename]* is corrupted – Application configuration file is missing. Check configuration directory in application directory. If the problem persists try to reinstall the application.

Template file *[filename]* was not found – Check application settings or contact application administrator. If the problem persists try to reinstall the application.

File *[filename]* may be corrupted and could not be read – test file is seriously corrupted or you are trying to open file in different format.

Parameter *[filename]* could not be found in test *[test name]* – test parameter is missing in file with testing parameter. This could happen after improper template modification. If you have a backup of template file check whether all parameter ids corresponds.

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[1] For experienced users only

6.1. Error window

Application errors are usually displayed to user in an error window. It allows you to perform additional tasks:

- ▪ 📄 - Open application log file[2].
- ▪ 📧 - Send an email messgage containing error details to application administrator.
- ▪ 🔍View error details. In some cases, there could be a reason why this error occurred. For example: If connection to the tester could not be established, error details can say that it occurred because the configuration file cannot be read. Further details of this error can tell you that file cannot be read because it is currently being used by another process or it does not exist, etc.
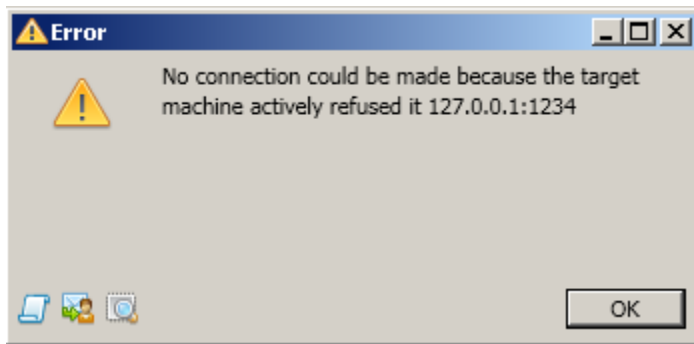

Figure 6.1 Common error window

7. Advanced Settings

This chapter is intended to provide you through advanced settings of application configuration files. You can modify them with any text editor. You can find them under the /config directory in application installation directory (usually under Program Files)

7.1. Template File

Template file can be used for new file customization. You can enter localized text values that may help your operators to better understand and familiarize with the application. Template is located in /config/template.xml file under the installation directory.

Warring: Do not modify any id attributes!!!

You can customize any name or description tag element.

7.2. Scheduler Configuration

The behavior of testing and the order of executed test can be modified by editing /config/tasks.xml or /config/calibration.xml for calibration.

The root `<timeline>` element contains collection of tasks to be executed. Four elements for four basic tasks are defined:

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[2] For experienced users only

- `<set>` – set values of some channels
- `<waitfor>` – wait for values on some channels
- `<if>` – depending on some channels values decide what task will be executed next
- `<wait>` – wait for specified period of time

Channel value is specified in a `<channel>` element which requires two attributes:

- `name` – channel name
- `value` – true/false for digital channel

Following example sets digital output channel AllowPowerSupply to true and then waits for IsPowerSupplyOff channel to be false which means that the operator has switched on power supply.

```xml
<set>
    <channel name="AllowPowerSupply" value="true"/>
</set>
<waitfor>
    <channel name="IsPowerSupplyOff" value="false"/>
</waitfor>
```

Tasks are executed in the same order as defined in configuration file. But notice that is two tasks can be executed parallel they are. So in the previous example both task starts at once. If you want to define an order a behavior element must be added to the task which specifies what tasks must be finished before the current one can start, by referencing optional task id attribute.

```xml
<set id="lockWeak">
    <channel name="LockStrong" value="false"/>
    <channel name="LockWeak" value="true"/>
    <channel name="UnlockWeak" value="false"/>
    <channel name="UnlockStrong" value="false"/>
</set>
<waitfor>
    <!-- requires lockWeak task to be finished -->
    <behavior require="lockWeak"/>
    <channel name="IsLocked" value="true"/>
</waitfor>
```

Notice that in any of the basic tasks multiple channels can be specified. Also multiple tasks can be required by task behavior divided by a space. Task id must be unique across the configuration file.

Following example shows how to define a condition.

```
<if id="isLocked">
    <channel name="IsOldMirror" value="true"/>
    <then>
        <waitfor>
            <channel name="IsOldLocked" value="true"/>
        </waitfor>
    </then>
    <else>
        <waitfor>
            <channel name="IsLocked" value="true"/>
        </waitfor>
    </else>
</if>
```

You can omit the `<else>` element of the condition. It useless to define `id` task inside `<then>` or `<else>` element. It is automatically inherited from `<if>` task.

Using elements described above you are able to fully control testing machine. To incorporate a test you will use a special `<test>` element with required `testtype` and `testparam` attributes. In `testtype` specify one of possible tests to be provided:

- PulloffTest
- PowerfoldTest
- DirectionLightTest
- HeatingFoilTest
- TravelNorthTest
- TravelSouthTest
- TravelWestTest
- TravelEastTest

In `testparam` specify testing parameters by referencing same id as defined in template file (see 7.1) for required test.

```
<test id="pulloff" testparam="Pulloff"
    testtype="PulloffTest">
</test>
```

Special type of test is a sensor check for presence of some mirror component. For this purpose additional `<check>` element is defined. Same as in the test case requires `testparam` attribute. Following example defines a check for presence of a rubber on the mirror cable depending on the orientation.

```
<if id="rubber">
    <channel name="IsLeftMirror" value="true"/>
    <then>
        <check channel="IsLeftRubberPresent"
            testparam="Rubber"/>
    </then>
    <else>
        <check channel="IsRightRubberPresent"
            testparam="Rubber"/>
    </else>
</if>
```

Specific type of a task is calibration. Use <calib> element to perform it.

```
<calib>
    <!-- No other attributes are required -->
</calib>
```