The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein. If you have any suggestions for improvements or amendments or have found errors in this publication, please notify us.

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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

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Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

⚠ The addition of this symbol to a Danger safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

⚠ This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ **DANGER**

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ **WARNING**

WARNING indicates a potentially hazardous situation which, if not avoided, can result in death or serious injury.

⚠ **CAUTION**

CAUTION indicates a potentially hazardous situation which, if not avoided, can result in minor or moderate injury.

⚠ **NOTICE**

NOTICE is used to address practices not related to physical injury.
PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.
About the Book

At a Glance

Document Scope
This document describes the OptiReg software and its features.
This tool is for end users and system integrators.
Users of OptiReg software should have good knowledge of:
- Process Control
- Vijeo Citect V7.3 SP1
- OptiReg V3.1

Validity Note
This manual is valid for the listed versions of the following products:
- Process Expert V3.1 SP1
- APC Library V2.0
- OptiReg V3.1

Related Documents

<table>
<thead>
<tr>
<th>Title of Documentation</th>
<th>Reference Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRN Generator User Guide</td>
<td>EIO0000001839</td>
</tr>
</tbody>
</table>

You can download these technical publications and other technical information from our website at www.schneider-electric.com.
Product Related Information

⚠️ WARNING

LOSS OF CONTROL
Review potential failure modes of the control paths for critical control functions.
Provide a means to achieve a safe state during and after a path failure.
Provide separate or redundant control paths for critical control functions.
Review the implications of transmission delays or failure of communication links.
Apply local accident prevention and safety regulations and guidelines. ¹
Test each implementation of this library for proper operation before placing it into service.
**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

¹ For additional information, refer to NEMA ICS 1.1 (latest edition), Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control and to NEMA ICS 7.1 (latest edition), Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems or their equivalent governing your particular location.

The application of this product requires expertise in the design and operation of control systems.

⚠️ WARNING

UNINTENDED EQUIPMENT OPERATION
Allow only authorized personnel with such expertise to program, install, alter, and apply this product.
Follow local and national safety codes and standards.
**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Examples in this manual are given for information only.

⚠️ WARNING

UNINTENDED EQUIPMENT OPERATION
Adapt examples that are given in this manual to the specific functions and safety requirements of your industrial application when you implement them.
**Failure to follow these instructions can result in death, serious injury, or equipment damage.**
Chapter 1
Introduction

About OptiReg

OptiReg is a advanced software used for data mining, process modelization, and loop tuning purpose.

OptiReg software is for the model-based predictive controllers and internal model base controllers. You can also use this for tuning the PID.

The historical data of the required parameters are used for identifying the process model. You can also select the useful part of the whole historical data.
Chapter 2
OptiReg Software

Overview
This chapter describes about the OptiReg software.

What Is in This Chapter?
This chapter contains the following topics:

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<td>Tools</td>
<td>14</td>
</tr>
<tr>
<td>Style</td>
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</table>
Home

Overview

The Home tab in the OptiReg software shows following 2 subtabs:

- File
- Drivers

File

This table describes the File options:

<table>
<thead>
<tr>
<th>Subtabs</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>File Open</td>
<td>This activates a window having a menu dialog. Enter the name of a *.prn or select one using the file dialog box. The measurements and other parameters relating to the acquisition are taken from the file *.prn file, which is generated using the PRN generator tool. You can also use *.opt file, which is generated through DataStore software. This is not a part of the PES offer. So, in PES environment, the PRN generator is used to generate the *.prn file for OptiReg. The identification and control measure is focused on this file.</td>
</tr>
<tr>
<td>File Close</td>
<td>Closes the opened *.prn file.</td>
</tr>
<tr>
<td>File Save</td>
<td>Allows you to save the current file.</td>
</tr>
</tbody>
</table>
This table describes the **Drivers** options:

<table>
<thead>
<tr>
<th>Subtabs</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drivers Launch PRN Editor</td>
<td>Starts PRN editor tool to convert an excel *.csv file to a PRN file.</td>
</tr>
<tr>
<td></td>
<td>• with reduction of the number of points</td>
</tr>
<tr>
<td></td>
<td>• with limitation of 8 character names</td>
</tr>
<tr>
<td></td>
<td>Drag a file (*.xls, *.xlsx, *.csv, or *.prn) in the area.</td>
</tr>
<tr>
<td>Drivers Help</td>
<td>Launches help.</td>
</tr>
<tr>
<td>Drivers About</td>
<td>Displays the exact version of the software.</td>
</tr>
</tbody>
</table>
This table describes the options in **Tools** tab:

<table>
<thead>
<tr>
<th>Subtabs</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language</td>
<td>Allows you to change the language.</td>
</tr>
<tr>
<td>Parameter - Reset</td>
<td>Resets parameters of OptiReg.</td>
</tr>
<tr>
<td>Parameter - Color Reset</td>
<td>Resets color of curves.</td>
</tr>
<tr>
<td>Display - Format</td>
<td>Defines the accuracy of displays.</td>
</tr>
<tr>
<td>Display - Thickness Curve</td>
<td>Allows you to select the thickness of curves.</td>
</tr>
<tr>
<td>Display - Cursor</td>
<td>Allows you to select the type of cursor.</td>
</tr>
</tbody>
</table>
Style tab allows you to select the color of each curve. Color selection for the curve is divided into 4 categories:

- Color of graphs
- Color of step response
- Color of the simulation
- Color of the tuning
Chapter 3
Tool Classification

Overview
This tool is divided into 3 tabs:
- Data Graphs
- Modeling Identification
- Tuning

What Is in This Chapter?
This chapter contains the following topics:

<table>
<thead>
<tr>
<th>Topic</th>
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<tr>
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<tr>
<td>Tuning</td>
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</tr>
</tbody>
</table>
Data Graphs

Overview
This is the first tab in OptiReg, where one analyzes/sorts data from *.pm file or *.opt.

Viewing Curves
The written variables are tagged under the tree structure on the left-side of the Data Graphs. Double-click a variable to view the curves that are displayed on the graph.

NOTE: Depending on the type of display, you can view more or less curves.

The following information is available on each curve:
- The unit measures
- The scale of the sensor (used for normalization)
- The minimum and maximum value of the variable
- The average value calculated on the selected or default to the entire area of the curve
- Standard deviation: this value expresses the cumulative deviation values relative to the mean value)
Modifying Measures

You can change the measure by right-click on each measure.

After the window measurement is changed, you can change the parameters. It is only the validation of this window that the changes are effective.

Adding a New Measure

Click the plus (+) symbol to add a new variable.

After the window opens to add any variable, you should first enter the mandatory fields, name, equation (this equation can have variables, constants, and so on).

NOTE: There is a variable named cpt, which allows for the number of time steps. This counter develops as file (useful for y = ax + b...).

OptiReg can open 2 file types *.prn and .opt.

PRN File Type

The PRN file format is mentioned below.
The data is separated from each other by a space.

**NOTE:** Verify that there are no empty lines at the end of file.
Consider the number of lines in the header. Only units can be omitted. In this case, leave a blank line instead.

A new feature such as opt file has been included in OptiReg V3.1.
The Opt file in OptiReg V3.1 can be saved at any time with a file extension as Opt and contains:
- the raw data as the PRN file
- the selection area (if active)
- the identification performed
- the selected regulators and settings

Thanks to these elements, OptiReg V3.1 re-opens a file in the state from where the user signs off.
The **Graph** tab allows you to analyze its data in every way.
If a graph is selected, a tab under **Graph Functions** appears.

**Cancel Zoom**
This option lets you to zoom each graph.

To delete the active zoom, click the button available in the **Graph>Functions>Global** menu.

**Display**
There are 2 types of display:
- **Histogram**
- **Graphs**
Histogram

It allows you to draw the Gaussian curve of each selected area according to its selection.

**NOTE:** You can only see 4 curves at the same time.

Graphs

Allows you to display the trend curves.

You have 3 types of display options:
- **Automatic**
- **Sensor**
- **Standardized**
Automatic
It allows you to zoom each curve to the maximum extent.

NOTE: It displays above 16 curves at the same time and switches to uniform display.
Sensor

It uses the minimum and maximum set for each measure.
Standardized

It uses the minimum and the maximum for display of only 1 axis.
Selecting a Zone

You can select the area on which the calculation needs to be performed.
Wired Points

You can delete and remove the selected points of the zone.

- Delete the selected points of the zone. The points that are under the selected area can be removed.
- Delete the selected item.

Option of Calculation

You can select this option for normalized unit.
Modeling Identification

Overview
This step identifies the continuous process model, first in discrete form (In OptiReg, Z model having a numerator of the same order as the denominator), and then in continuous model approximated form.

You can enter a value (which may be 0) corresponding to the delay and move the cursor to select the model order. If the system is integrator type, you should check integrator.

Choice of Model
This is to select certain parameters of the model structure.

These parameters are:
- **Order**: The model order (power of the denominator) is up to 4.
- **Delay**: It corresponds to the time taken for the process to respond to a stimulus (change of control). The pure delay is usually a time of mass transfer in a process. This delay appears as the exponent of the continuous model.
- **Integrator Mode**: By checking the integrator option, you explicitly state that the process has an integrator behavior.

Step response and simulation of the curves, the quadratic error detected and index of correlation enable you to evaluate the relevance of your choice.

Identification
This button is used to calculate the transfer function of the model, given the parameters, and chosen structure (order, delay, and integration). Identification determines the model of the process by a method of recursive least squares. After the identification is made, the discrete and continuous model appear on the left side of the page.

**NOTE**: The identification covers the part selected in the Curve Data page using the menu select area. By default, the identification is focused on measurements.

Click **Identification** button to determine the discrete model (transfer function z) and continuous model approximated (function P).
Based Curve (Default)

This is the default one.

Relevance of the Identification

If you do not know the order of the system, whether it is a delay integrator or not, step response and simulation enables you to evaluate the relevance of your choice.
Step Response of the System

The step response of the system button enables you to view the simulated response to a unit level. **Response Index Tracking**: A horizontal tangent at the origin shows that the system is not the first order. If the system is an integrator, the step response is a straight line.
Simulation of the System

The simulation shows the superposition of the measured output (values of the acquisition) and recalculated by the model output.

The **Simulation** button is used to compare the measured (acquisition) and the calculated output using the discrete model.

Calculating and plotting the mean square error detected between the two curves allow you to get a appropriate information on the validity of the identification.

To refine this, you also have the calculation of the correlation index between the previous error detected and process control. In this index, there is relationship between the control and detected error. Hence, the identified model is closer to the real model.

The yellow line shows the corresponding quadratic detected error, that is, there is a difference between the measurement and the model output. You can thus determine on the quality of the identification and return parameters (order/delay) to improve results. The correlation index is used to refine the search.

You rarely get the optimal identification in the first time. You must return to the choice of model parameters and observe the new curves to determine the realistic modeling.
It enables you to zoom the selected area by drawing a rectangle on the graph using the mouse.

**NOTE:** The field behind it gets changed in few instances. So, it has to be a multiple of the sampling period; if not, the nearest multiple of the input value is calculated.

**NOTE:** To allow OptiReg to correctly identify your process (especially integrating processes), test closed loop excitation. Apply a zero mean, that is, two levels are balanced enough to reach the steady state. For example, a level of +5 % is followed by a level of -5 % to get a rich spectrum frequency.

**Choice of Curves Input/Output**

Selecting the input/output curve worksheet allows you to select the variables whose values are represented graphically in the **Modeling-Identification** tab. Variables are obtained from the acquisition and are assigned using software, such as DataStore (the variable name is stored in the file `*.prn`). You must select two variables for identification.
In

Select the variable from the In list that you want to process input. This means that the measurement to be made for the variable corresponds to the successive actuations of the method.
Out

Select the variable from the Out list that you want to exit the process. This means that the measurements made for the variable correspond to the successive outputs of the process.
Tuning

Overview

This step calculates the appropriate correction to the model. It is placed in series with the method, according to this scheme in the closed loop.

The proposed markers are:
- PI (Proportional integral)
- PID (Proportional integral diverter)
- the IMC 1 (Internal model controller of order 1)
- the PCR SF1/EF1 (Predictive controller for system of order 1)
- the PCR IF1 (Predictive controller for integrator of order 1 and order 2 system)
- the PCR DC3 (Predictive controller for system of order 3)

The graph simulation closed loop allows you to view the output of the closed loop in response to a unit level (setpoint). The output of the controller is shown in green. You can change the value of the damping coefficient corresponding to naslin. You can improve the system performance (lower overshoot or shorter rise) and recalculate the correction coefficients for these performances.
The recommended value for the controller (or correction) is displayed. You can edit them manually using the button **Manual Setup** and helps to observe the influence of the coefficients of the curve, and performance. By default, these coefficients are the theoretical coefficients. You must select new values and click OK to make the change (and change the graphs).

**Exceeding**
This indicates what percentage of the maximum value of the output of the controlled system exceeds the setpoint. It reflects the stability of the controlled system. If it is low, the system is more stable. Damping reduces the overshoot.

**Rise Time**
This is the time taken by the output of the regulated system to reach 95% of its final value. The longer the rise time, the slower the system responds.
This time gets even longer when the system is damped and the gain K of the correction is small.

**Damping (Smoothing)**
You can dampen the response of more controlled closed loop system. This has the effect of recalculating the coefficients of PI and PID controllers to modify the system performance: reduce overshoot and increase the rise time.
Damping is not available in manual setting.

**NOTE:** The damping coefficient, corresponding to a Naslin coefficient has a minimum value of 180. The default value (recommended value) is 200. In case of PID, it is impossible to exceed a certain value as it gives an adjustment that leading to instability.
Manual/Automatic Settings

This mode is only available for PI and PID correction.

Manual Setting

You can view the influence of a parameter (K, Ti, and Td).

The manual setting allows you to define its own controller and view its influence on the system by clicking on Submit. Click Auto to return to the automatic calculation of the regulator.

Automatic Setting

By default, this setting mode is activated.

The coefficients of the controller are calculated by the software using the method of Naslin.
Standardized Units
The file acquisition comprises of expanded scale for each variable. Consider these extended scale values to a rule to move 3 measurement values in this interval.

In practice, you must know if the acquisition is made in physical units or normalized units. If the acquisition is made without normalization, you must know if there is a calibration performed at the controller. In this case, you must check, calculate controller With normalized units and the gain K calculated for the control, sustain a rule 3 to account for this extended interval scale.

If the acquisition is made in normalized units, do not select the option for the gain K, which is directly calculated from standardized measures.

Interval Display
This slider allows the simulation over a period or longer. This is useful for slow rise time and strong overruns to see when the system reaches the set point.

Export PDF
This symbol is used for exporting the process model in PDF format.
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