COPA-DATA
do it your way

zenon manual

Driver simulation

v.7.50

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1. Welcome to COPA-DATA help

GENERAL HELP

If you cannot find any information you require in this help chapter or can think of anything that you would like added, please send an email to documentation@copadata.com (mailto:documentation@copadata.com).

PROJECT SUPPORT

You can receive support for any real project you may have from our Support Team, who you can contact via email at support@copadata.com (mailto:support@copadata.com).

LICENSES AND MODULES

If you find that you need other modules or licenses, our staff will be happy to help you. Email sales@copadata.com (mailto:sales@copadata.com).

2. Driver simulation

If the underlying process is not available when configuring, this can be simulated and tested in advance. Three modes are available for this:

- Simulation static (on page 6): constant values simulated by the driver
- Simulation - counting (on page 6): values simulated by the driver are counted up
- simulation - programmed (on page 7): Values are calculated via a simulation project with zenon Logic

> **Attention**
>
> *If the driver is stopped in mode **Simulation - counting**, only the counting is stopped. The variable is not switched to `faulty`. In all other modes the driver is really stopped.*

Note: **Simulation - programmed** is not supported by drivers for:

- Internal variables
- Mathematical variables
- Simulator variables
- System variables

> **Information**
>
> *zenon variables which represent the zenon Logic IO variables are not available in the project in state **Driver simulation programmed**.*
>
> **License information**
>
> *Part of the standard license of the Editor and Runtime.*

3. Simulation static

For a static simulation, no communication to the control is established; the values are simulated by the driver. In this mode the value remains constant. Values can be changed by the Runtime or the user. At a restart of the Runtime with **Simulation - static** theses values will however not be saved and are lost.

4. Simulation - counting

For a counting simulation, no communication to the control is established; instead the values are simulated by the driver. In this mode, the driver increments the values within a value range automatically, starting with `0`. If the maximum value has been reached, the counting process starts at `0` again.

Information

With negative start values, the counting process only starts at 0.

INT uses the maximum value of USINT for counting.

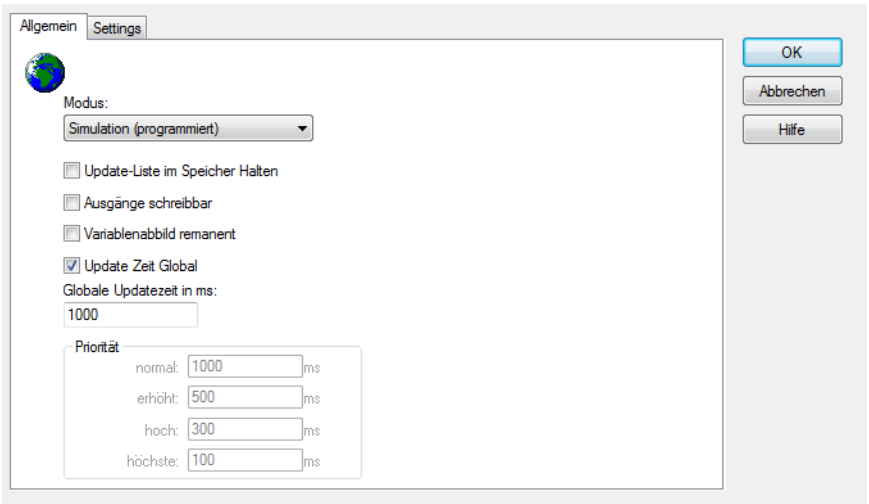
Attention

*If the driver is stopped in mode **Simulation - counting**, only the counting is stopped. The variable is not switched to `faulty`. In all other modes the driver is really stopped.*

5. Simulation - programmed

For Simulation - programmed, no communication is established to the PLC; instead, the values are calculated by a freely programmable simulation project. The simulation project is created with the help of the zenon Logic Workbench and runs in the zenon Logic Runtime. It enables the status and time stamp of variables to be modified on the driver. Write commands to variables by zenon are forwarded to the simulation, redundant servers and Standby Servers are synchronized. This is how you also simulate complex processes.

To start the simulation program, select the Simulation - programmed mode in driver configuration (on page 14).



Information

Windows CE

Simulation - programmed *is not available for Windows CE.*

5.1 Editor

5.1.1 Create project

To create a program for **Simulation - programmed**, you must:

- select a single process driver
- make sure that the project name is valid.

Attention

Simulation - programmed is not supported by drivers for:

- Internal variables
- Mathematical variables
- Simulator variables
- System variables

To create a simulation project:

- click in the group **Driver simulation project** in the property **Edit** on **Click here ->**
- A new zenon Logic project is created.
- **Name** and port numbers for **Event port** and **Standard port** are automatically issued; change these as you wish
- the zenon Logic Workbench is opened

The simulation project's workbench is automatically closed if:

- the zenon editor is closed
- a driver is deleted and its simulation project is currently being edited in Workbench
- the simulation project for the driver is deleted via the **Delete** property
- the simulation project is renamed

Information

Port numbers: At creating the simulation project for this project a distinct port number is assigned automatically. An automatically assigned port number is only unique for the respective project. In multi-hierarchical projects, it must be ensured that a port number is only used once in all projects that run in Runtime. If a port number is used more than once, communication errors can occur with zenon Logic Workbench/Runtime.

Port numbers can be amended manually. A port number must meet the following conditions:

- It must be free in the project.
- It must be unique for all projects that run in Runtime.
- It must be available on the computer on which the driver runs.

Permitted port numbers:

- Minimum: `6000` (with automatic allocation, manually: recommended)
- Maximum: `6999` (with automatic allocation, manually: recommended)

PROJECT ARCHIVING

A zenon Logic project contains many files and folders. To manage them, in particular to simplify distributed engineering, all files are archived in compressed form in the **Simul_<Treiber-ID>.zip** file in the `<Sql Projekt Pfad>\FILES\`zenon`\custom\drivers` folder. This file is in the driver files in the editor. When starting zenon Logic Workbench, the files are automatically decompressed are compressed again when it is ended.

CREATING VARIABLES

When creating variables in a simulation project, the succession is important:

1. create the variable
2. select the valid data type in the zenon Logic Workbench
3. after that activate property **embed symbol**

Background: Variables are created with the `PLC marker` driver object type by default. This object type does not support all data types for all drivers. If a variable is copied in the zenon Logic Workbench with active property **embed symbol**, you must deactivate this property in order to change the data type. With this the variable is then deleted in zenon.

Information

Error message "Can not create variable"

A variable cannot be created in the simulation object if the driver does not have driver object types - exception

***driver variable** - which support this data type.*

*On activation of **embed symbol**, the error message "can not create variable" is displayed.*

STRUCTURE DATATYPE

At creating variable with a structure data type:

- they are created with the driver object type `PLC marker` if possible
- all driver object types with the exception of **driver variable** are tried until one can be used for all elements
- if no fitting driver object type is available,
  - no variable is created for non-structure variables
  - driver object type `PLC marker` is used for structure variables

EXAMPLE:

A structure data type contains elements of type UINT and STRING. A variable is created for S7TCP driver and **embed symbol** is activated.

- The variable is not created in `PLC marker` but as `Ext. Data module`, in which all structure elements are present.
- A new type LINT is added; it is not supported by the `Ext. Datablock`.
- When a new variable is created, it is created as type `PLC marker`. Only the first complex variable can be activated (UINT). The object type `Ext.` remains for the existing structure variable `Data` and the last structure element (LINT) cannot be activated.

COMPILING THE FILES

If a simulation project is compiled in zenon Logic Workbench, this causes a variable to be created in zenon and the Runtime program file.
When compiling, a subfolder is created in the Runtime folder \RT\FILES\zenon\custom\drivers with the name of the simulation project. The file with the code of the simulation is SIMULRT.COD is archived in this folder.

The following message is displayed in the output window:

SIMULRT.COD

And if compiled with the C compiler, then also:

T5APP.DLL

> **Attention**
>
> *For **multi-user projects** (on page 12) you must not create simulation projects offline. They cannot be deleted anymore.*

5.1.2 Delete project

To delete a simulation project:

1. click on the **Click Here->** button in the **Delete** property in the **Driver simulation project** group
2. confirm this when requested to do so
3. the ZIP file with the project files is deleted
4. the zenon Logic Workbench is ended

Note:

- the Runtime folder for the simulation project remains
- function **Undo** is not available for this action,
- click on **Edit** to create a new simulation project
- for **multi-user projects (on page 12):**
  - the driver must be configured to **Make changes possible** so that the simulation program can be deleted
  - the project is not displayed as deleted on other Clients as long as it has not been synchronized;

    if you try to open a deleted project before it has been synchronized (click on **Edit**), a new simulation project will be created
  - you cannot reverse the deletion of single-user projects via **Cancel changes**

> **Attention**
>
> *The Simulation project is immediately removed from the local database and the server database when deleted. This action cannot be undone!*

Note: Manual deletion of the ZIP file of the driver also leads to the simulation project being deleted. Requirement: The zenon Logic Workbench for this driver is not opened. We do not recommend doing it this way!

5.1.3 Distributed engineering

For **multi-user projects**, all running zenon Logic Workbenches that are part of the project are closed when:

- `Accept changes` for modules that are completely locked for other users in **Enable changes**, such as variables, drivers and data types
- `Discard changes`:
  - new projects are not created on the server
  - Changes in the simulation program are lost
  - Driver files not present in the server database are also lost in the local database
- Synchronize:
  changes made locally to the simulation program program are lost
- Update local version:
  changes made locally to the simulation program in the simulation program are lost

> **Attention**
>
> *The status of the simulation project's ZIP file may not be additionally modified(`Accept Changes`, `Enable Changes`, `Discard Changes` multi-user status), to ensure correct `Accept Changes` and `Enables Changes` for the driver!*

DELETE PROJECT

For **multi-user projects**

- the driver must be configured to **Make changes possible** so that the simulation program can be deleted
- the project is not displayed as deleted on other Clients as long as it has not been synchronized;
  - if you try to open a deleted project before it has been synchronized (click on **Edit**), a new simulation project will be created

- you cannot reverse the deletion of single-user projects via **Cancel changes**

> **Attention**
>
> A simulation project with the status of `Enable Changes` cannot be deleted (on page 11) in `Offline` mode.
>
> A simulation project created `offline` in a **multi-user project** can therefore no longer be deleted.

5.1.4 Change driver

For a driver change in zenon the following is true:

- The simulation project is maintained.
- All ports are however set to `0`. To receive working port numbers, open the project in the Editor. At this new port numbers are entered automatically. Port numbers can also be assigned manually.

> **Attention**
>
> *Drivers that are linked to a zenon Logic project using the integrated solution cannot be exchanged.*

5.1.5 XML export/import

*A project in mode **Simulation - programmed** can be exported via XML. It can however not be imported as new project for another driver.*

Workaround:

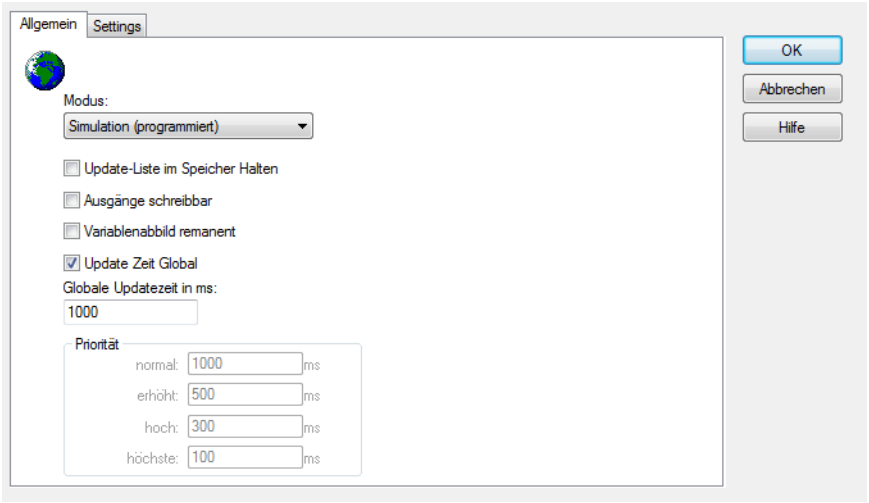
1. Export the zenon Logic programs.
2. Import them to the new project for the new driver.
3. Replace the variables via search and replace.

5.2 Driver configuration

There are four modes available when configuring the driver:

- **Hardware**
- **Simulation - counting**
- **Simulation static**
- **Simulation - programmed**

Select the **simulation - programmed** mode.



5.2.1 Driver variable status

The status of zenon Logic is shown in the driver variables SimulRTState at Offset 60. The variable is numerical and cannot be written to. The value informs you of the status of Runtime:

Bit	Meaning	Description
31	without application	Runtime has not loaded a program, the program was stopped or not loaded to Runtime.
30	not instanced	Runtime was not instanced, for example because the DLL with Runtime could not be loaded, there is too little memory, the DLL is not present or is the wrong version.
18	p-code available	p-code is available together with compiled code, switching is possible.
17	compiled code active	Runtime runs with compiled code (otherwise: interpreted p-code)
16	compiled code available	Compiled code from the C compiler is available
15	application is loaded	An application is present, Runtime is running
14	can't start - missing handlers	Some "C" functions are missing
13	active breakpoints installed	At least one breakpoint was set by the debugger.
12	CT segment exists	Application was compiled with the "complex variables in separate segment".
11	Reserved	(internal, for Runtime only.)
10	sysinfo request is available	(internal, for Runtime only.)
9	freeze event production	Binding does not transmit events.
8	single cycle mode	(intern, for Runtime and debugger only.)
7	Reserved	(internal, for Runtime only.)
6	locked variables	At least one variable is blocked.
5	trigo functions are in degrees	Trigonometric functions are stated in degrees.
4	log message(s) in stack	(internal, for Runtime only.)
3	application stopped between 2 progs	Runtime stopped between two steps during debugging
2	application stopped on SFC breakpt	(internal, for Runtime only.)
1	application stopped on error	Runtime stopped with a serious error, restart required.
0	application is running	TRUE = application is in "run" mode. FALSE = application pauses in "cycle to cycle" mode.

Information

The driver variable SimulRTState with Offset 60 displays the status of Runtime on the server. This is also true when the variable is displayed on the Standby.

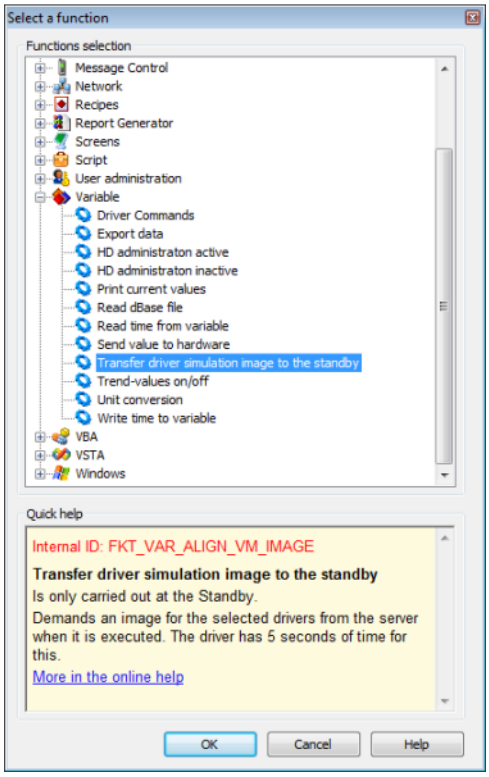
5.2.2 Cyclical synchronization

Simulations run in a network on the server and Standby Server independently of one another. When the Standby Server starts, there is a synchronization with the server, however:

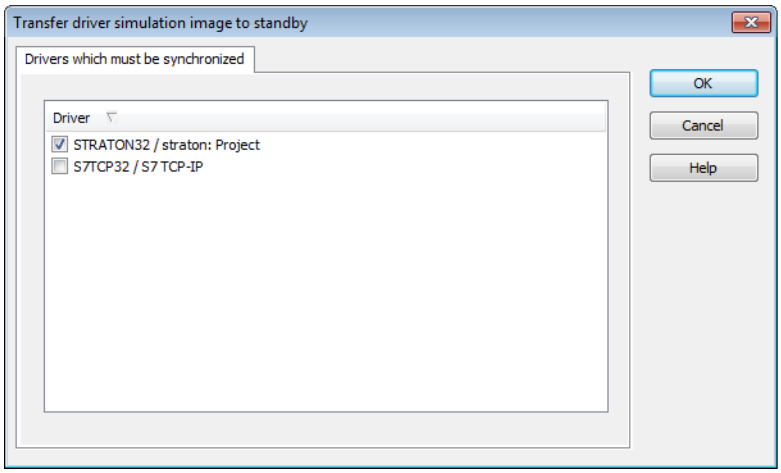
- This first synchronization is postponed by the packet runtime
- Small differences in the execution lead to growing diversion

The status of the simulated variables also therefore becomes different. In order to keep these differences low, use the **Transfer driver simulation image to standby** to synchronize the simulation image:

- create a new function
- Select **Transfer driver simulation image to standby**



- The dialog to select the driver opens



- In the list, all process-connected drivers (with the exception of the simulator) are available (clicking on the column heading changes the sorting)
- Select the driver that is to be synchronized
- Each time a function is called up on the Standby Server, an image is requested from the server for the selected driver

The differences in the current simulation status can be minimized through cyclical activation. Adapt the grid of the execution to the extent of the data to be synced, because this places a load on the network and computer.

The **Execution** of the function is set at **Standby Server** and fixed; it cannot be changed. It only happens if:

- The computer is the Standby Server
- The Server is online
- The project is a network project
- Drivers were selected for syncing

TO CHANGE THE SELECTION OF THE DRIVERS

- In the driver properties, click in the **General** group in the **Parameter** properties
- The dialog for selecting the driver opens

5.3 zenon Logic Workbench

The **Simulation - programmed** is programmed in the in the zenon Logic Workbench, which works in close conjunction with the zenon Editor. For the simulation, (in contrast to the integrated solution) only the variables of a driver are exchanged between the editors.

DEFINITION OF THE VARIABLES TO BE EXCHANGED:

When starting zenon Logic Workbench, all driver variables that are not yet present in zenon Logic are created as global variables. The **Embed symbol** is automatically activated for these.

VISIBILITY

If a new variable is defined in Workbench in the **global** or **retain** area, this is only visible in zenon Logic. To make it visible in zenon too, the **Embed symbols** option must be activated. From this point in time, all variables are updated by both editors.

If the **Embed symbol** option is deactivated, the variable is deleted in the zenon editor. This action enables **global** und **retain** variables to be defined in zenon Logic, which are not visible for zenon.

For a newly-created variable created by the zenon Logic Workbench in zenon, an attempt is made to assign this to the **SPSMERKER** area. In the event that the zenon driver (on page 8) does not support the configured data type, a search is made for the first data area that supports the data type. If no area is found, the variable cannot be created.

A variable is only locked if in the case of a **multi-user project** and the `enable changes` status has not been set.

PROJECT SETTINGS

Some settings under Project -> Project parameters... >-Further options-> Extended in zenon Logic influence the functionality of the simulation.

Extended settings	Description
Runtime: Execution mode	Recommendation: **Mode**: triggered **Cycle time**: 1/4 to 1/3 of the driver update time for frequent value changes to simulated variables lead to increased load placed on the computer.
compiler/options: Embed symbols of all variables	Recommendation: Deactivate. `Active:` Data for a variable are exchanged, because the symbol names are assigned in Runtime. But: Changes to the configuration of the variables are not updated between zenon and zenon Logic. It is no longer possible to make changes online.
compiler/options: Retain capitalization of symbols	Without effect: Variable names are always converted to capitals in Runtime.
compiler/options: Create status bits for variables with a profile	`Active:` The status of variables is simulated and reacted to in the simulation program.
"C" compiler	Native code is supported. Name of the DLL that the compiled code must contain: **t5app.dll**.

5.4 Runtime

5.4.1 Functionality

zenon Logic Runtime offers the following functions:

- File transfer
- Data types:
  - BOOL
  - BYTE
  - DINT
  - DWORD
  - INT
  - LINT

- LREAL
- REAL
- SINT
- STRING
- TIME
- UDINT
- UINT
- USINT
- WORD

- zenon arrays (see also Arrays and simulation (on page 21))
- Date stamp/time stamp
- Digital recording of values
- Dynamically linked function blocks, stored in `t5block*.dll`
- Hot Restart
- Logging:
  - Trace messages from the program **(printf)**
  - Error messages in Runtime
  - all sent to Workbench and to the diagnosis server
- Machine code: Native compiled code with C post compiler (not available under Windows CE)
- Online Change
- Programming languages: IL, AS, FDB, LD, ST
- Retain Data (remanant Data)
- Special function blocks and features:
  - Data serialization
  - dynamic memory allocation
  - embedded recipes
  - embedded variable lists
  - File Management
  - Files
  - Math
  - Random
  - Signals

- String tables
- Trigonometry
- Time

- Spontaneous communication
  - Value change as an event
  - 16 connections
  - Hysteresis
- UDP & TCP/IP for IEC languages
- Variable interlocking

5.4.2 Arrays and simulation

To simulate multidimensional arrays at driver simulation, you must activate property "**Save complex variables in own segment**" in the zenon Logic Workbench.

ARRAYS WITH START INDEX 1

If at a simulation arrays with start index 1 exist, these arrays are created with one more index in the zenon Logic Workbench.

> **Example**
>
> *In zenon an array has indices 1 to 4. This array has the indices 0 to 4 in the zenon Logic Workbench.*

This guarantees that the same indices are used in zenon and in zenon Logic. Index 0 is not transferred to the driver.

If you change array in the zenon Logic Workbench, you must consider this additional index.

5.4.3 Runtime files

When creating the Runtime files, a subfolder with the name of the simulation project is created in the **Runtime folder** of the project in the path `\RT\FILES\zenon\custom\drivers`. The file with the code of the simulation is `simulrt.cod` and is archived in this folder.

Once successfully compiled in the Workbench and transferred to the Runtime folder, the following message is shown in the output window of the Editor:

SIMULRT.COD

And if compiled with the C compiler, then also:

T5APP.DLL

REMOTE TRANSPORT

The Runtime files for the simulation are created as a subfolder of the driver files. For remote transport, the subfolder and all information contained in it is transferred to the target computer

5.4.4 Data exchange

The exchange of data from zenon Logic Runtime to the driver starts with the 2nd cycle of zenon Logic Runtime. Therefore the first run is available to initialize all variables in Runtime.

Data is only exchanged if:

- The variable is requested and:
  - did not yet receive a value
  - does not have the status `Switched off` (OFF/_VSB_N_UPD) or `Alternate value` (ALT_VAL/_VSB_AVALUE) in the driver
  - is still required by the driver.
  - has changed value or status

The exchange of data to the driver is carried out asynchronously to the Runtime cycle. The driver runs through the value changes once per update cycle. All values changed - with the exception of the `Switched off` (OFF/_VSB_N_UPD) or `Alternate value` (ALT_VAL/_VSB_AVALUE) status - are entered into the list of variables to be updated in the driver and sent to Runtime.

TRANSFER DRIVER SIMULATION IMAGE TO STANDBY FUNCTION

This function is only executed on the Standby Server (for configuration, see Cyclical comparison (on page 16) chapter). The data is synchronously fetched from the driver on the server that is compiling the image. The driver has 5 seconds of time for this. Because the data for the image is created in the same thread in which the simulation is running, it must be ensured that the simulation is processed within 5 seconds. If this time is exceeded, no image is transferred for this driver.

VALUE SIMULATION

Value changes are not transferred immediately, but stored in a buffer. The size of the buffer amounts to 8192 value changes or the five time the number of variables, according to whatever value is greater. The delay in transferring resulting from the driver cycle can be up to 100 ms. If the value changes again

whilst it is waiting to be transferred, all values that have not yet been transferred are sent to Runtime and the new value is then noted. This can lead to an increased load for the computer and network, but ensures that all values are transferred in Runtime.

DRIVER WRITE COMMAND

If **simulation - programmed** is configured and active, the write commands at standby are passed through in Runtime.

Write operations are carried out by the driver asynchronously to Runtime. Data is exchanged via a buffer. The size of the buffer amounts to 8192 value changes or the five time the number of variables, according to whatever value is greater.

Write commands are ran through after their values are changed in Runtime. If a write command cannot be executed correctly, the error message **Write queue full! Write command for <DP-Name> lost!** is displayed.

If the status bits are activated, setting `Writing successful` will display if the value was written from the driver to the value of the variable. The Runtime program should delete this status again after processing the write command. A status bit that is already active does not cause any delay in the driver writing again. Write commands are also executed if the Runtime program was stopped by a breakpoint.

Note: Not all write commands from the driver must be visible in Runtime. If several write commands are in the buffer,only the last one is visible in Runtime.

SWITCH OFF VARIABLES, SWITCH TO SUBSTITUTE VALUE

If the variable is switched off or switched to a substitute value, this is not recognizable for Runtime. Changes in values that are also carried out by Runtime are not assigned to the variables in the driver. If the variables are again switched to spontaneous value or activated, the current value is again carried over from Runtime to the driver. When turning off the spontaneous value, status bit OFF is set. When you switch back to the spontaneous value, the OFF bit is reset.

5.4.5 Data storage

RETAIN DATA

Retain data is stored in the **SimulRt<TreiberID>.ret** file. One file such as this is created per simulation, provided retain variables are present. The file is taken into account when a comparison is carried out in the network.

DRIVER REMANENT

The **Simulation - programmed** setting at the driver start is not a criterion in order to restore the remanant variable image.

5.4.6 Redundancy

START ON THE STANDBY SERVER

If the driver is already running on a Standby Server, then the image for the simulation should already be available. In this case, the simulation is started "hot" with this image. If there is no image, a warm a start is carried out.

TRANSFER DRIVER SIMULATION IMAGE TO STANDBY FUNCTION

This function is only executed on the Standby Server (for configuration, see Cyclical comparison (on page 16) chapter). The data is synchronously fetched from the driver on the server that is compiling the image. The driver has 5 seconds of time for this. Because the data for the image is created in the same thread in which the simulation is running, it must be ensured that the simulation is processed within 5 seconds. If this time is exceeded, no image is transferred for this driver.

SYNCHRONIZATION

In addition to the program files of the simulation, the following are also compared:

- Retain data (*.ret)
- all *.simul files
  This file extension is created by the simulation program for simulation specific files and archived in the folder with the computer description below the **Runtime folder**.

5.4.7 Status

STATUS SIMULATION

For the status simulation, in zenon Logic under Project -> Project parameters -> Extended -> Compiler -> Options -> Create status bits for variables with a profile must be active. If the status of a variable is modified, this triggers the transmission of a variable to the driver.

Changes to the following states does not trigger a value change at the driver and is also not taken over from the simulation:

- `Real time external` (T_EXTERN/_VSB_RT_E)
- `Real time internal` (T_INTERN/_VSB_RT_I)
- `Standard time` (T_STD/_VSB_WINTER)
- `Writing acknowledged` (WR_ACK/_VSB_WR_ACK)
- `Writing successful` (WR_SUC/_VSB_WR_SUC)
- `Normal status` (NORM/_VSB_NORM)
- `Deviation from normal status` (N_NORM/_VSB_ABNORM)
- `Select in the network` (NET_SEL/_VSB_SELEC)
- `Runtime exceeded` (TIMEOUT/_VSB_RTE)
- `In process` (PROGRESS/_VSB_DIREC)
- `Switched off` (OFF/_VSB_N_UPD)
- `Substitute value` (ALT_VAL/_VSB_AVALUE)

> **Information**
>
> *State bit `Writing successful` (WR_SUC/_VSB_WR_SUC) is available in the Runtime program and can be set back in order to display successful writing.*
>
> *However only setting back the state does not trigger the transfer to the zenon Runtime. Only value changes are transferred from the driver to the Runtime.*

STATUS BITS HANDLED DIFFERENTLY

The following status bits cancel each other out:

Bit	Description
17: Spontaneous (SPONT/_VSB_SPONT)	Status Spontaneous is set. This is the status set if status handling is turned off or no status was defined. Status GI + INAVLID is deleted.
18: Invalid (INVALID/_VSB_I_BIT)	INVALID status is set. SPONTAN + GI status is deleted.
16: General query (GI/_VSB_GR)	Status General query is set. Status SPONTAN + INAVLID is deleted.
8: Select in the network (NET_SEL/_VSB_SELEC)	If this status bit is active (BSO activation/deactivation) the following status bits are accepted with 0 and also transmitted as 0 to the driver to identify a change: ▸ Select in the network (NET_SEL) ▸ Cause of transmission (COTx) ▸ Select (SE_870) ▸ N_CONF (P/N-BIT) ▸ Test bit (TEST) ▸ Writing successful (WR_SUC)

SELECT BEFORE OPERATE (SBO)

Status simulation must be available in the Runtime program in order for **Select Before Operate** to be reacted to. The procedure for **Select Before Operate** is defined in Runtime.

ACTIVATION

If an **SBO select** is sent to the driver, it triggers a value being written with status Select in the network (NET_SEL) + cause of transmission (COT_act).

A corresponding SBO procedure must be implemented and must start in Runtime.

The state bit Select in the network (NET_SEL) must be set back in the Runtime program.

DEACTIVATION

The deactivation triggers the writing of a values with status Select in the network (NET_SEL) + Cause of transmission (COT_deact).

The SBO procedure must be ended in Runtime accordingly.

The state bit Select in the network (NET_SEL) must be set back in the Runtime program.

5.4.8 Start / stop

DRIVER START

The value updating only starts at the Standby Server if the driver has received the process image from its server. The image must be received within the time out module, otherwise the driver will start without an image. If the Standby Server is upgraded to the server within the waiting waiting time, waiting is also ended. Drivers that start in a network project or without a network have no waiting time. This behavior applies for both the simulation as well as for the hardware mode.

RUNTIME START

If the driver starts the **simulation - programmed**, the first stage is loading the DLL with the simulation Runtime. After this, Runtime is parametered and the Runtime program starts, provided it can be successfully loaded.

If an image of Runtime is present, Runtime is started `hot` with this. Otherwise, a `warm start` is carried out. If this is also not possible, an attempt is made to start Runtime `cold`. If there is no valid program, Runtime boots up stopped. The status of all variables is set to INVALID.

The simulation program runs in it own thread and is therefore completely independent from the driver cycle.

Information

Retain variables

Retain data contain only the value of the zenon Logic variables not their status. This means for the start:

- Warm start: The status which was set for a variable is restored - regardless of whether it is a retain variable or not.
- Cold start with retain variables: Only the value of the retain variable in zenon Logic is restored, not the status.

STOP RUNTIME

If Runtime is stopped, the status INVALID is set for all variables. Variables that are requested when Runtime is stopped have the status INVALID as initialization. Runtime secures the data for the warm start and online change:

- `SIMULRT.HOT`: contains the data for the hot restart.
- `SIMULRT.UPD`: contains the data for the online change.

Both these files are created in the Runtime program folder. Runtime must have write authorization for this folder.

RELOAD

- Recompiling the simulation project:
  causes the corresponding driver to be reloaded.
- Modification of the Time Out module:
  is not recognized as a change by Runtime and does not cause the driver to be reloaded.

Standard implementation in the driver kit triggers a hot restart when reloading the simulation project. If this is not possible (for example because the program is different), a cold start is carried out with `retain`.

REMOVING RUNTIME

If Runtime is running, this is stopped. Before Runtime is removed, all outstanding value updates are sent to the driver. Only then is Runtime released and **SimulRuntime.dll** removed from the PC.

5.4.9 Driver commands

Driver commands are used to influence drivers using zenon; start and stop for example.
The engineering is implemented with the help of function **Driver commands**.

STOP/START DRIVER

If the driver is stopped in **simulation - programmed** mode, this will result in Runtime being removed from the memory. All variables obtain status **INVALID**. When the driver is restarted, the simulation is reloaded and Runtime is started.

SWITCH HARDWARE/SIMULATION DRIVER

When switching between modes `Hardware` and `Simulation`, the driver behaves according to the following pattern:

1. If the driver was configured for hardware mode in the Editor:
   - the driver is set to mode **Simulation static** after function **Driver command** is executed with parameter `Driver in simulation mode`.
2. If the driver was configured in the Editor for one of the simulation modes (`static`, `counting`, `programmed`:

- the driver is set to hardware mode and communicated with the control after function **Driver command** is executed with parameter `Driver in hardware mode`.
- the driver then changes back to the configured simulation mode after function **Driver command** was executed with parameter `Driver in simulation mode`

5.4.10 Variable assignment

The zenon driver is allocated to the zenon Logic variables via the names converted into capital letters. If the zenon Runtime requests a variable from the driver, it forwards this to the simulation. If no simulation is loaded, the variable receives status `Switched off` (OFF/VSB_N_UPD) when the driver is stopped. Otherwise it receives status `Invalid` (INVALID/_VSB_I_BIT). Variables of **driver variable** object type are never requested by the simulation.

5.4.11 Timestamp

To use the time stamp, in zenon Logic under Project -> Project parameters -> Extended -> Compiler -> Options ->Statusbit create for variables with profile must be activated.

If in the Runtime program, the date for a variable is set, the value of the date and time is used as the time stamp. When the date or time changes during the last cycle, this always triggers a transfer of the value to the driver. This also applies if neither the value nor the status have changed.

Most drivers only transfer a new time stamp if the value or status change at the same time. An example of an exception is the IEC870 driver, which also transfers new timestamps from the hardware (or **Simulation - programmed**) with the same value and same status to Runtime.

Information

It must be ensured that the date and time always increase. If this is not the case, this can lead to problems when archiving. The date must be a value greater or less than `0`.

Variables stamped by the Runtime program receive the status `Real time external` (T_EXTERN/_VSB_RT_E).

All variables to be transferred to the driver that are not stamped by Runtime receive a joint time stamp in the cycle. This ensures that the time corresponds to that of the change. These drivers receive the status `Real time internal` (T_INTERN/_VSB_RT_I).

DATE & TIME

The following applies for all date and time information:

- Times are UTC.
- All times must be between 02. 01. 1970 and 2038.
- Dates are converted into a string in the format YYYY/MM/DD.
- The time is converted into the format HH:MM:SS.

5.5 Notes on variables in simulation projects

The following is true for the creation and modification of variables in simulation projects:

1. zenon Logic

   If variables are created for a simulation project in the zenon Logic Workbench, they do not have a valid addressing for the communication. If the communication is switch to hardware, the communication can be interrupted when the new variables are used in screens without a adjusting the addressing correctly.

2. Rename

   If a variable is renamed in a simulation project, the name of the variable is also changed in zenon accordingly. So for example you must adjust the names of variables which are used in a VBA project also in the VBA code.

3. Integrated solutions

   Variables of integrated solutions such as zenon Logic, IEC870 or IEC850 must not be renamed in the simulation project. In this case the variables lose their project information.
   For example: If you rename **Project0/Global/NewVar** to **myNeVariablenwVar** in the simulation project, it becomes **myNewVar** in zenon. After the renaming a communication with the zenon Logic Runtime is impossible.

4. Communication based on variable names

   Variables of a driver which communicates based on the variable names must not be renamed in the simulation project.

5. Deleting or importing variables

   If a variable is deleted or imported while **online change** is activated in zenon Logic, all variables are removed and inserted again in zenon Logic.

6. Variables with active "`embed`" symbol

   Variables which exist in a program and whose "`embed`" symbol is active are not available via the **Logic to SCADA** connection in zenon. If a variable with an active "`embed`" symbol is moved from the global area to a program, the variable is deleted in zenon.

5.6 Error message

Engineering in the zenon Editor

Error message	Cause and solution
The selected name already exists for another driver or contains invalid characters! Please enter a different name.	The new name of the simulation project is already used in the project or is not valid. ▶ Give it a valid name
The simulation project from the **<File name>/<Description>** driver has not been compiled and cannot be supported! Please compile the project in Workbench.	A simulation project is available for the driver in Workbench. This was not compiled however. ▸ Start the zenon Logic Workbench with this driver's simulation project ▸ compile the project Hint: I does not make a difference if the diver settings are set to **simulation - programmed** in the driver settings
Write queue full! Write command for <Name Variable> lost!	Displays the loss of a write command.