COPA-DATA
do it your way

zenon manual

Programming interfaces

v.7.11

Contents

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. Programming interfaces

Different interfaces to integrate your own programs or to automate planning are available in zenon:

- Process Control Engine (PCE) (on page 9)
- Macro list (on page 43)
- VSTA (on page 94)

License information

Part of the standard license of the Editor and Runtime.

CONTEXT MENU

Menu item	Action
Open PCE editor	Opens the PCE editor.
Open VBA Editor	Opens the VBA editor
Open VSTA editor	Opens the VSTA editor.
Editor profile	Opens the drop-down list for selecting a Editor profile.
Help	Opens online help.

Information

you can find information on the creation and implementation of controls (ActiveX, .NET, WPF) in the Controls manual.
You can find information on engineering and use of the SAP interface in the SAP interface chapter.

OPEN VBA AND VSTA EDITOR

VBA EDITOR

VBA starts the same development environment for workspace and project. To open the VBA Editor:

1. navigate to the **Programming interfaces** node
2. right-click on VBA macros
3. select **Open in VBA Editor...** in the context menu

Alternative: press the short cut Ctrl+F11

VSTA EDITOR

VSTA provides separate development environments for workspace and project. You can only use one of them at a time. At the start every other VSTA development environment which is open will be close.

To open the VSTA Editor for the workspace:

1. press the short cut Alt+F10
2. the code for the workspace and all loaded projects is displayed

To open the VSTA Editor for the currently loaded project:

1. navigate to the **Programming interfaces** node
2. right click on VSTA
3. select **Open VSTA Editor...** in the context menu
4. the Editor is opened for the currently loaded project

API FROM VERSION 7.10:

For the use of zenon programming interfaces, the following is applicable from zenon 7.10:

- VSTA / .NET: **.NET Framework 3.5** must be installed.
- VBA: If, in the VBA code, Windows API or other imported DLL functions are accessed, these calls must be adapted to the 64-bit environment. In general, the following applies: A VBA file created with a 32-bit version cannot be used without changes in a 64-bit version of VBA.

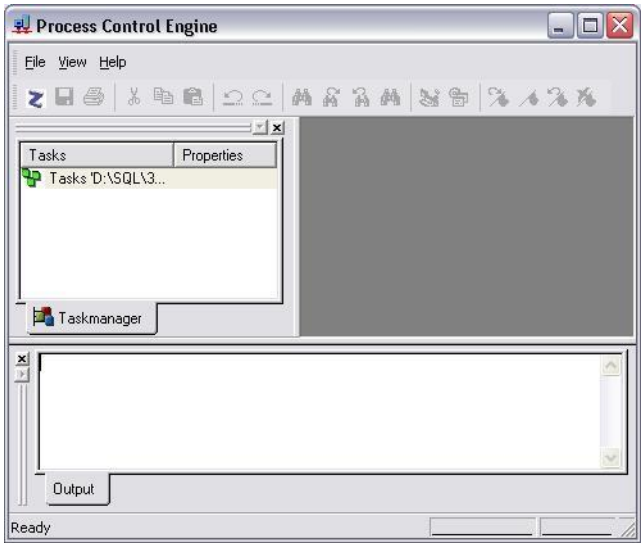
> **Attention**
>
> Note that errors in applications such as ActiveX, PCE, VBA, VSTA, WPF and external applications that access zenon via the API can also influence the stability of Runtime.

3. Process Control Engine (PCE)

> **Information**
>
> *The Process Control Engine (PCE) offers the possibility to develop cyclic application flows in VB Script or Java Script. The PCE is especially suitable for long-lasting functions that run in the background (e.g. extensive export functions). In contrast to VBA (on page 43), the PCE supports multi-threading.*

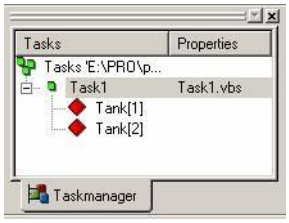
3.1 The PCE Editor

The PCE can be found in the Project Manager in the entry **`Programming interfaces`**. The PCE Editor is opened with the entry **`Open PCE Editor`** in the context menu.

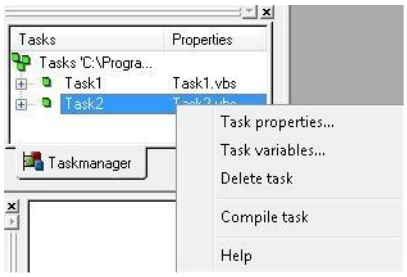


3.1.1 The Taskmanager

The Taskmanager of the PCE Editor lists the existing tasks and the linked variables.



A doubleclick on a task opens it in the editing area. With the right mouse button the context menu of a task can be opened.



The context menu of a task has four entries:

TAG	Description
Task properties...	Opens the properties dialog of the task.
Task variables...	Opens the variable selection. So you can add new variables to the task.
Delete task	Deletes the task without any further query.
Compile tasks	Compiles the task.

3.1.2 The editing area

In the editing area of the PCE Editor the code of the tasks is entered in VB Script or Java Script.

3.1.3 The output window

3.1.4 The menus of the PCE Editor

Menu File

The menu **File** includes the following commands:

TAG	Description
Save	Saves new or changed tasks.
Print	Prints the current task.
Close	Closes the PCE Editor.

Menu Edit

The menu **Edit** includes the following commands:

TAG	Description
Undo	Undoes the last executed action.
Redo	Repeats the last executed action.
Cut	Moves a text to the Windows Clipboard.
Copy	Copies a text to the Windows Clipboard.
Paste	Pastes a text from the Windows Clipboard.
Delete	
Select all	Selects the entire text of the task.
Search	Searches for a text in the current task.
Find next	Goes to the next place of finding.
Find previous	Goes to the previous place of finding.
Replace...	Replaces a text in the task by another.
Bookmarks	Administration of bookmarks in the code of the task.
- set bookmark	Sets a bookmark at the selected line in the code.
- next bookmark	Goes to the next bookmark in the code.
- previous bookmark	Goes to the previous bookmark in the code.
- delete all bookmarks	Deletes all bookmarks in the code.

Menu Run

The menu **Run** includes the following commands:

Save and restart all tasks	
Compile tasks	Compiles the task.

Menu View

The menu **View** includes the following commands:

TAG	Description
Settings	Opens the settings dialog of the PCE Editor.
Task manager	Opens/closes the Taskmanager window.
Output	Opens/closes the Output window.
Status Bar	Opens/closes the status bar.

Menu Window

The menu **Window** includes the following commands:

Close
Arrange
Divide
Align symbols
List of the last open windows

Menu Help

The menu **Help** includes the following commands:

Command	Action
Help	Opens online help.
Info about…	Opens a window with information on zenon: ▸ Serial Number ▸ Activation number: ▸ Licensed tags/IOs ▸ Licensed module A slider can be used for navigation in the information window. Clicking in the window or pressing the **Esc** key closes the info window.

3.1.5 The icon bar of the PCE Editor

The most important commands of the PCE Editor can also be executed with the icons of the icon bar.

The following icons are available:

TAG	Description
Close	Closes the PCE Editor.
Save all	Saves new or changed tasks.
Print active screen	Prints the current task.
Cut	Moves a text to the Windows Clipboard.
Copy	Copies a text to the Windows Clipboard.
Paste	Pastes a text from the Windows Clipboard.
Undo	Undoes the last executed action.
Redo	Repeats the last executed action.
Search	Searches for a text in the current task.
Find next	Goes to the next place of finding.
Find previous	Goes to the previous place of finding.
Replace...	Replaces a text in the task by another.
Save and restart	
Start debugger	
Next bookmark	Goes to the next bookmark in the code.
Set bookmark	Sets a bookmark at the selected line in the code.
Previous bookmark	Goes to the previous bookmark in the code.
Delete all bookmarks	Deletes all bookmarks in the code.

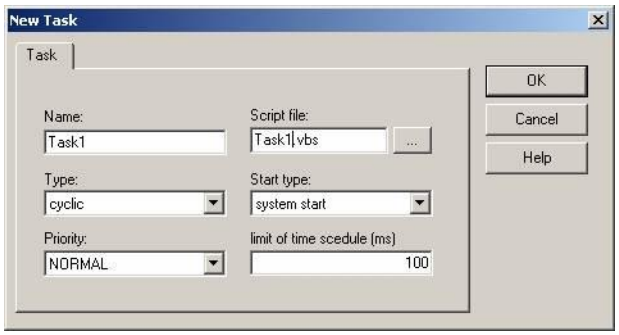
3.2 Course of actions

3.2.1 Creating a task

With the context menu of the Taskmanager a new task can be created.

Properties of the task

After creating the task the properties dialog of the new task opens automatically.



The following properties can be defined:

TAG	Description
Name	Unique name of the task.
Type	Tasks can be executed **cyclic** or **once**. Cyclic: the task is executed cyclically in the interval defined under **limit of time schedule**. Once: the task is executed one single time.
Priority	Process priorities for operating system multithreading (**idle**, **low**, **normal**, **high**, **highest**, **time critical**). Default: Normal main process: the task runs in the same thread as Runtime. If the task gets into a waiting loop or crashes, that also influences the Runtime.
Script file	Selection of the script file: VB-Files (*.vbs) for VB Script or JS-Files (*.js) for Java Script. The according file is created, when the task is opened in the editing area for the first time.
Start type	System start : automatically started with Runtime. (This is the only way to use the PCE under Windows CE, as Windows CE does not support VBA.) event triggered: the task is started in a VBA macro with the statement "thisProject.Tasks.Item("Taskname").Run".
Cycle time to reach	For cyclic tasks the interval in milliseconds that should be achieved. If this cycle time is not achieved, the task is executed as fast as possible.

For a later change of the properties this dialog can also be opened with the context menu of the task and the entry **Task Properties**….

Variables of the task

After defining the properties the variable selection dialog is automatically opened. Here the variables that should be processed in the task are selected.

All variables that are read or written in the task should be linked here. There is also the possibility to access the variables via the variables object, but only the variables directly linked to the task are automatically updated when initializing the task before execution.

The variables must have the following syntax:

```
Task.Value('Variable name')=123
```

For a later change of the variable selection this dialog can also be opened with the context menu of the task and the entry **Task Variables**….

3.2.2 Entering code

Doubleclicking the task in the Taskmanager opens it in the editing area. If the task is opened for the first time, the according VBS or JS file is created now.

Four procedures are automatically created:

TAG	Description
`Task_Init()`	This procedure is automatically executed when starting the task.
`Task_Main()`	This procedure is either executed once (type once) or cyclically (type cyclic).
`Task_Exit()`	This procedure is automatically executed when stopping the task.
`Task_Timer(lTimerId)`	This procedure is executed cyclically, as long as the according time is running. The cycle time is defined as a parameter with the starting of the timer.

Generally speaking the PCE uses the same object model as VBA (see VBA Tutorials). When using VBA objects (except the object Task) multithreading is lost, because these objects only can be accessed from the main thread.

Attention

Not all funtions of the COM interface are multithread-able and therefore can only be used in a main tread context. If a different property than "in the main process" is set as PCE task, there must not be any access from the PCE to the main thread. In case there is an access to the COM interface nevertheless, this can lead to undefined system states, e.g. a Runtime freeze.

Of special importance are the collection Tasks and the object `Task`.

The collection Tasks

Count
Item
Parent

The object Task

ActualCycleTime	Property	Currently achieved cycle time of the task
CountVariable	Property	Number of variables linked to the task
CycleTime	Property	Defined cycle time of the task
DynProperties	Property	
ErrorNumber	Property	
ErrorString	Property	
Exit	Event	
On init	Event	
ItemVariable	Method	
Main	Event	
MemValue	Property	With "Task.MemValue("Name")=value" an internal variable is created and a value is assigned to it. There is no need to declare the variable before. This variable can also be accessed from other tasks. So it allows the exchange of values between tasks.
Name	Property	Name of the current task
Parent	Property	The collection **Tasks**
Priority	Property	Priority of the current task
Run	Method	Starts a task
Sleep	Method	Holds a task
StartTimer	Method	The method "StartTimer" starts a timer of the task.
Status	Property	
Stop	Method	Stops a task
StopTimer	Method	The method "StopTimer" stops a timer of the task.
Timer	Event	
Type	Property	

Value	Property	With "Task.Value("name of linked variable")=value" a variable of the project can get a new value.

3.2.3 Function Show PCE

With the zenon function **Show PCE** the PCE Editor can be opened from the Runtime.

3.2.4 Executing tasks

Executing tasks with system start

If in the configuration of the task the Start type is set to System start , the task is automatically started with the Runtime.

This is the only way to use the PCE under Windows CE, as Windows CE does not support VBA.

Executing tasks event triggered

On a PC

A task can also be started event triggered. In this case the Start type has to be set to Event driven . Now the task is no longer automatically started with the Runtime.

A VBA macro has to be created in order to execute a task by pressing a button, by a limit violation or any other event. With the following VBA statement the task can be started:

```
thisProject.Tasks.Item("Taskname").Run
```

The task is automatically started in an own thread if in the configuration **Priority Main process** has not been set.

With the following VBA statement the task can be stopped at any time:

```
thisProject.Tasks.Item("Taskname").Stop
```

On a CE terminal

As Windows CE does not support VBA, the way described above is not possible on a CE terminal. But there is a possibility to execute tasks event triggered also here.

A task with the `Start type System start` is created. This task is automatically started with the Runtime. And this task gets the **`Priority Main process`** so that it runs in the same thread as the Runtime. Now bit variables are linked to that task, then will execute other tasks event triggered. With the following statement the task can be started:

Parent.Item("Taskname").Run

The task is automatically started in an own thread if in the configuration the **`Priority Main process`** has not been set.

With the following statement the task can be stopped at any time:

Parent.Item("Taskname").Stop

3.3 VB Script - Introduction

3.3.1 Data types

Variant

VBScript has only one data type called a `Variant`. A `Variant` is a special kind of data type that can contain different kinds of information, depending on how it is used. Because `Variant` is the only data type in VBScript, it is also the data type returned by all functions in VBScript.

At its simplest, a `Variant` can contain either numeric or string information. A `Variant` behaves as a number when you use it in a numeric context and as a string when you use it in a string context. That is, if you are working with data that looks like numbers, VBScript assumes that it is numbers and does what is most appropriate for numbers. You can always make numbers behave as strings by enclosing them in quotation marks (" "). If you work with data that only can be interpreted as strings, VBScript will interpret them as strings.

Variant Subtypes

Beyond the simple numeric or string classifications, a `Variant` can make further distinctions about the specific nature of numeric information. For example, you can have numeric information that represents a date or a time. When used with other date or time data, the result is always expressed as a date or a time. You can also have a rich variety of numeric information ranging in size from Boolean values to huge floating-point numbers. These different categories of information which can be contained in a `Variant` are called `subtypes` . Most of the time, you can just put the kind of data you want in a `Variant` , and the Variant behaves in a way that is most appropriate for the data it contains.

The following summary shows subtypes of data that a `Variant` can contain.

Subtype	Meaning
`Empty`	Variant is uninitialized. Value is 0 for numeric variables or a zero-length string ("") for string variables.
`Null`	Variant intentionally contains no valid data.
`Boolean`	Contains either TRUE or FALSE.
`Byte`	Contains integer in the range 0 to 255.
`Integer`	Contains integer in the range -32,768 to 32,767.
`Currency`	-922,337,203,685,477.5808 bis 922,337,203,685,477.5807.
`Long`	Contains integer in the range -2,147,483,648 to 2,147,483,647.
`Single`	Contains a single-precision, floating-point number in the range -3.402823E38 to -1.401298E-45 for negative values; 1.401298E-45 to 3.402823E38 for positive values.
`Double`	Contains a double-precision, floating-point number in the range -1.79769313486232E308 to -4.94065645841247E-324 for negative values; 4.94065645841247E-324 to 1.79769313486232E308 for positive values.
`Date (Time)`	Contains a number that represents a date between January 1, 100 to December 31, 9999.
`String`	Contains a variable-length string that can be up to approximately 2 billion characters in length.
`Object`	Contains an object.
`Error`	Contains an error number.

3.3.2 Variables

A variable is a convenient placeholder that refers to a computer memory location where you can store program information that may change during the time your script is running. For example, you might create a variable called ClickCount to store the number of times a user clicks an object on a particular Web page. Where the variable is stored in computer memory is unimportant. What is important is that you only have to refer to a variable by name to see or change its value. In VBScript, variables are always of one fundamental data type, Variant.

Declaring Variables

You declare variables explicitly in your script using the Dim statement, the Public statement, and the Private statement. Example:

```
Dim DegreesFahrenheit
```

You declare multiple variables by separating each variable name with a comma. Example:

```
Dim Top, Bottom, Left, Right
```

Limitations for names

Variable names follow the standard rules for naming anything in VBScript. A variable name:

- Must begin with an alphabetic character.
- Cannot contain an embedded period.
- Must not exceed 255 characters.
- Must be unique in the scope in which it is declared.

Scope and Lifetime of Variables

When you declare a variable within a procedure, only code within that procedure can access or change the value of that variable. It has local scope and is a procedure-level variable.

If you declare a variable outside a procedure, you make it recognizable to all the procedures in your script. This is a script-level variable, and it has script-level scope.

The lifetime of a variable depends on how long it exists. The lifetime of a script-level variable extends from the time it is declared until the time the script is finished running. At procedure level, a variable exists only as long as you are in the procedure. When the procedure exits, the variable is destroyed.

Local variables are ideal as temporary storage space when a procedure is executing. You can have local variables of the same name in several different procedures because each is recognized only by the procedure in which it is declared.

Assigning Values to Variables

Values are assigned to variables creating an expression as follows: the variable is on the left side of the expression and the value you want to assign to the variable is on the right. Example:

```
B = 200
```

Scalar Variables and Array Variables

Much of the time, you only want to assign a single value to a variable you have declared. A variable containing a single value is a scalar variable. Other times, it is convenient to assign more than one related value to a single variable. Then you can create a variable that can contain a series of values. This is called an array variable. Array variables are declared nearly like scalar variables The only difference is, that in the declaration brackets follow the names of array variables. In the following example, a single-dimension array containing 11 elements is declared:

```
Dim A(10)
```

Although the number shown in the parentheses is 10, all arrays in VBScript are zero-based, so this array actually contains 11 elements. In a zero-based array, the number of array elements is always the number shown in parentheses plus one. This kind of array is called a fixed-size array.

You assign data to each of the elements of the array using an index into the array. Beginning at zero and ending at 10, data can be assigned to the elements of an array as follows:

```
A(0) = 256
A(1) = 324
A(2) = 100
. . .
A(10) = 55
```

Similarly, the data can be retrieved from any element using an index into the particular array element you want. Example:

```
. . .
SomeVariable = A(8)
. . .
```

Arrays aren't limited to a single dimension. You can have as many as 60 dimensions, although most people can't comprehend more than three or four dimensions. You can declare multiple dimensions by separating an array's size numbers in the parentheses with commas. In the following example, the MyTable variable is a two-dimensional array consisting of 6 rows and 11 columns:

```
Dim MyTable(5, 10)
```

In a two-dimensional array, the first number is always the number of rows; the second number is the number of columns.

You can also declare an array whose size changes during the time your script is running. This is called a dynamic array. The array is initially declared within a procedure using either the `Dim` statement or using the `ReDim` statement. However, for a dynamic array, no size or number of dimensions is placed inside the parentheses. Example:

```
(Dim AnArray()
ReDim AnotherArray()
```

To use a dynamic array, you must subsequently use `ReDim` to determine the number of dimensions and the size of each dimension. In the following example, `ReDim` sets the initial size of the dynamic array to 25. A subsequent `ReDim` statement resizes the array to 30, but uses the `Preserve` keyword to preserve the contents of the array as the resizing takes place.

```
ReDim MyArray(25)
. . .
ReDim Preserve MyArray(30)
```

3.3.3 Constants

A constant is a meaningful name that takes the place of a number or string and never changes. VBScript defines a number of intrinsic constants . You can get information about these intrinsic constants from the VBScript Language Reference.

You create user-defined constants in VBScript using the Const statement. So you can assign a meaningful name to string or numerical constants. Then you can assign them literal values and use them in a script. Example:

```
Const MyString = "This is a string."
Const MyAge = 49
```

Note that the string literal is enclosed in quotation marks (" "). Quotation marks are the most obvious way to differentiate string values from numeric values. You represent Date literals and time literals by enclosing them in number signs (#). Example:

```
Const CutoffDate = #6-1-97#
```

You may want to adopt a naming scheme to differentiate constants from variables. This will prevent you from trying to reassign constant values while your script is running. For example, you might want to use a "vb" or "con" prefix on your constant names, or you might name your constants in all capital letters. Care that constants and variables can be distinguished. So you avoid problems when creating complex scripts.

3.3.4 Operators

VBScript has a full range of operators, including arithmetic operators, comparison operators, concatenation operators, and logical operators.

Operator Precedence

If several operators appear in a statement, each part is evaluated and resolved in a pre-defined sequence. This sequence is called operator precedence. You can use parentheses to override the order of precedence and force some parts of an expression to be evaluated before others. Operations within parentheses are always performed before those outside. Within parentheses, however, standard operator precedence is maintained.

When expressions contain operators from more than one category, arithmetic operators are evaluated first, comparison operators are evaluated next, and logical operators are evaluated last. Comparison operators all have equal precedence; that is, they are evaluated in the left-to-right order in which they appear. Arithmetic and logical operators are evaluated in the following order of precedence.

Arithmetic Operators

Description	Symbol
Exponentiation	^
Unary negation	-
Multiplication	*

Division	/
Integer division	/
Modulus arithmetic	Mod
Addition	+
Subtraction	-
String concatenation	

Comparison Operators

Description	Symbol
Equality	=
Inequality	<>
Less than	<
Greater than	>
Less than or equal to	<=
Greater than or equal to	>=
Opject equivalence	Is

Logical Operators

If several operators appear in a statement, each part is evaluated and resolved in a pre-defined sequence. This sequence is called operator precedence. You can use parentheses to override the order of precedence and force some parts of an expression to be evaluated before others. Operations within parentheses are always performed before those outside. Within parentheses, however, standard operator precedence is maintained.

When expressions contain operators from more than one category, arithmetic operators are evaluated first, comparison operators are evaluated next, and logical operators are evaluated last. Comparison operators all have equal precedence; that is, they are evaluated in the left-to-right order in which they appear. Arithmetic and logical operators are evaluated in the following order of precedence.

3.3.5 Conditional Statements

You can control the flow of your script with conditional statements and looping statements. Using conditional statements, you can write VBScript code that makes decisions and repeats actions.

Making Decisions Using If...Then...Else

The `If...Then...Else` statement is used to evaluate whether a condition is `True` or `False` and, depending on the result, to specify one or more statements to run. Usually the condition is an expression that uses a comparison operator to compare one value or variable with another. For information about comparison operators, see Comparison Operators. `If...Then...Else` statements can be nested to as many levels as you need.

Running Statements if a Condition is True

To run only one statement when a condition is `True`, use the single-line syntax for the `If...Then...Else` statement. The following example shows the single-line syntax. Notice that this example omits the `Else` keyword.

```
Sub FixDate()
Dim myDate
myDate = #2/13/95#
If myDate < Now Then myDate = Now
End Sub
```

To run more than one line of code, you must use the multiple-line (or block) syntax. This syntax includes the `End If` statement, as shown in the following example:

```
Sub AlertUser(value)
If value = 0 Then
AlertLabel.ForeColor = vbRed
AlertLabel.Font.Bold = True
AlertLabel.Font.Italic = True
End If
End Sub
```

To run only one statement when a condition is `True`, use the single-line syntax for the `If...Then...Else` statement. The following example shows the single-line syntax. Notice that this example omits the `Else` keyword.

```
Sub FixDate()
Dim myDate
myDate = #2/13/95#
If myDate < Now Then myDate = Now
End Sub
```

To run more than one line of code, you must use the multiple-line (or block) syntax. This syntax includes the `End If` statement, as shown in the following example:

```
Sub AlertUser(value)
If value = 0 Then
AlertLabel.ForeColor = vbRed
AlertLabel.Font.Bold = True
AlertLabel.Font.Italic = True
End If
End Sub
```

Running Certain Statements if a Condition is True and Running Others if a Condition is False

You can use an `If...Then...Else` statement to define two blocks of executable statements: one block to run if the condition is `True`, the other block to run if the condition is `False`.

```
Sub AlertUser(value)
If value = 0 Then
AlertLabel.ForeColor = vbRed
AlertLabel.Font.Bold = True
AlertLabel.Font.Italic = True
Else
AlertLabel.Forecolor = vbBlack
AlertLabel.Font.Bold = False
AlertLabel.Font.Italic = False
End If
End Sub
```

Deciding Between Several Alternatives

A variation on the `If...Then...Else` statement allows you to choose from several alternatives. Adding `ElseIf` clauses expands the functionality of the `If...Then...Else` statement so you can control program flow based on different possibilities.

```
Example:
Sub ReportValue(value)
If value = 0 Then
MsgBox value
ElseIf value = 1 Then
MsgBox value
ElseIf value = 2 then
Msgbox value
Else
Msgbox Walue out of range!
End If
```

Making Decisions with Select Case

The `Select Case` structure provides an alternative to `If...Then...ElseIf` for selectively executing one block of statements from among multiple blocks of statements. A `Select Case` statement provides capability similar to the `If...Then...Else` statement, but it makes code more efficient and readable.

A `Select Case` structure works with a single test expression that is evaluated once, at the top of the structure. The result of the expression is then compared with the values for each `Case` in the structure. If there is a match, the block of statements associated with that `Case` is executed, as in the following example.

```
Select Case Document.Form1.CardType.Options(SelectedIndex).Text
Case MasterCard
DisplayMCLogo
ValidateMCAccount
Case Visa
DisplayVisaLogo
ValidateVisaAccount
Case American Express
DisplayAMEXCOLogo
ValidateAMEXCOAccount
Case Else
DisplayUnknownImage
PromptAgain
End Select
```

3.3.6 Looping Through Code

Looping allows you to run a group of statements repeatedly. Some loops repeat statements until a condition is `False`; others repeat statements until a condition is `True`. There are also loops that repeat statements a specific number of times.

The following looping statements are available in VBScript:

TAG	Description
Using Do loops (on page 31):	Loops while or until a condition is True.
Using While...Wend (on page 33):	Loops while a condition is True.
Using For...Next (on page 33):	Uses a counter to run statements a specified number of times.
Using For Each...Next (on page 34):	Repeats a group of statements for each item in a collection or each element of a

Using Do Loops

You can use `Do...Loop` statements to run a block of statements an indefinite number of times. The statements are repeated either while a condition is `True` or until a condition becomes `True`.

Repeating Statements While a Condition is True

Use the `While` keyword to check a condition in a `Do...Loop` statement. You can check the condition before you enter the loop (as shown in the following ChkFirstWhile example), or you can check it after the loop has run at least once (as shown in the ChkLastWhile example). In the ChkFirstWhile procedure, if myNum is set to 9 instead of 20, the statements inside the loop will never run. In the ChkLastWhile procedure, the statements inside the loop run only once because the condition is already `False`.

```
Sub ChkFirstWhile()
   Dim counter, myNum
   counter = 0
   myNum = 20
   Do While myNum > 10
       myNum = myNum - 1
       counter = counter + 1
   Loop
   MsgBox 'The loop made ' & counter & ' repetitions.'
End Sub

Sub ChkLastWhile()
```

```
    Dim counter, myNum
    counter = 0
    myNum = 9
    Do
        myNum = myNum - 1
        counter = counter + 1
    Loop While myNum > 10
    MsgBox 'The loop made ' & counter & ' repetitions.'
End Sub
```

Repeating a Statement Until a Condition Becomes True

There are two ways to use the `Until` keyword to check a condition in a `Do...Loop` statement. You can check the condition before you enter the loop (as shown in the following ChkFirstUntil example), or you can check it after the loop has run at least once (as shown in the ChkLastUntil example). As long as the condition is `False`, the looping occurs.

```
Sub ChkFirstUntil()
    Dim counter, myNum
    counter = 0
    myNum = 20
    Do Until myNum = 10
        myNum = myNum - 1
        counter = counter + 1
    Loop
    MsgBox 'The loop made ' & counter & ' repetitions.'
End Sub

Sub ChkLastUntil()
    Dim counter, myNum
    counter = 0
    myNum = 1
    Th
        myNum = myNum - 1
        counter = counter + 1
    Loop Until myNum = 10
    MsgBox 'The loop made ' & counter & ' repetitions.'
End Sub
```

Exiting a Do...Loop Statement from Inside the Loop

You can exit a `Do...Loop` by using the `Exit Do` statement. Because you usually want to exit only in certain situations, such as to avoid an endless loop, you should use the `Exit Do` statement in the `True` statement block of an `If...Then...Else` statement. If the condition is `False`, the loop runs as usual.

In the following example, myNum is assigned a value that creates an endless loop. The `If...Then...Else` statement checks for this condition, preventing the endless repetition.

```
Sub ExitExample()
   Dim counter, myNum
   counter = 0
   myNum = 9
   Do Until myNum = 10
       myNum = myNum - 1
       counter = counter + 1
       If myNum < 10 Then Exit Do
   Loop
   MsgBox 'The loop made ' & counter & ' repetitions.'
End Sub
```

Using While...Wend

The `While...Wend` statement is provided in VBScript for those who are familiar with its usage. However, because of the lack of flexibility in `While...Wend`, it is recommended that you use `Do...Loop` instead.

Using For...Next

You can use `For...Next` statements to run a block of statements a specific number of times. For loops, use a counter variable whose value increases or decreases with each repetition of the loop.

The following example causes a procedure called MyProc to execute 50 times. The `For` statement specifies the counter variable x and its start and end values. The `Next` statement increments the `counter variable` by 1.

```
Sub DoMyProc50Times()
   Dim x
```

```
    For x = 1 To 50
        MyProc
    Next
End Sub
```

Using the `Step` keyword, you can increase or decrease the counter variable by the value you specify. In the following example, the counter variable j is incremented by 2 each time the loop repeats. When the loop is finished, the total is the sum of 2, 4, 6, 8, and 10.

```
Sub DoMyProc50Times()
    Dim x
    For x = 1 To 50
        MyProc
    Next
End Sub
```

To decrease the counter variable, use a negative `Step` value. You must specify an end value that is less than the start value. In the following example, the counter variable myNum is decreased by 2 each time the loop repeats. When the loop is finished, total is the sum of 16, 14, 12, 10, 8, 6, 4, and 2.

```
Sub NewTotal()
    Dim myNum, total
    For myNum = 16 To 2 Step -2
        total = total + myNum
    Next
    MsgBox 'The total is ' & total
End Sub
```

Using For Each...Next

A `For Each...Next` loop is similar to a `For...Next` loop. Instead of repeating the statements a specified number of times, a `For Each...Next` loop repeats a group of statements for each item in a collection of objects or for each element of an array. This is especially helpful if you don't know how many elements are in a collection.

In the following HTML code example, the contents of a `Dictionary` object is used to place text in several text boxes.

```
<HTML>
<HEAD><TITLE>Formulare und Elemente</TITLE></HEAD>
<SCRIPT LANGUAGE='VBScript'>
<!--
```

```
Sub cmdChange_OnClick
  Dim d                          'Create a variable
   Set d = CreateObject('Scripting.Dictionary')
  d.Add '0', 'Athen'        'Add some keys and items
  d.Add '1', 'Belgrad'
  d.Add '2', 'Kairo'

  For Each I in d
      Document.frmForm.Elements(I).Value = D.Item(I)
  Next
End Sub
-->
</SCRIPT>
<BODY>
<CENTER>
<FORM NAME='frmForm'

<Input Type = 'Text'><p>
<Input Type = 'Text'><p>
<Input Type = 'Text'><p>
<Input Type = 'Text'><p>
<Input Type = 'Button' NAME='cmdChange' VALUE='Hierauf klicken'><p>
</FORM>
</CENTER>
</BODY>
</HTML>
```

3.3.7 Types of procedures

Sub Procedures

A `Sub` procedure is a series of VBScript statements (enclosed by `Sub` and `End Sub` statements) that perform actions but don't return a value. A `Sub` procedure can take arguments (constants, variables, or

expressions that are passed to it by a calling procedure). If a Sub procedure has no arguments, its Sub statement must include an empty set of parentheses ().

The following Sub procedure uses two intrinsic, or built-in, VBScript functions, MsgBox and InputBox, to prompt a user for information. It then displays the results of a calculation based on that information. The calculation is performed in a Function procedure created using VBScript. The Function procedure is shown after the following discussion.

```
Sub ConvertTemp()
  temp = InputBox('Please enter the temperature in degrees F.', 1)
  MsgBox 'The temperature is ' & Celsius(temp) & ' degrees C.'
End Sub
```

Function Procedures

A Function procedure is a series of VBScript statements enclosed by the Function and End Function statements. A Function procedure is similar to a Sub procedure, but can also return a value. A Function procedure can take arguments (constants, variables, or expressions that are passed to it by a calling procedure). If a Function procedure has no arguments, its Function statement must include an empty set of parentheses. A Function returns a value by assigning a value to its name in one or more statements of the procedure. The return type of a Function is always a Variant.

In the following example, the Celsius function calculates degrees Celsius from degrees Fahrenheit. When the function is called from the ConvertTemp Sub procedure, a variable containing the argument value is passed to the function. The result of the calculation is returned to the calling procedure and displayed in a message box.

```
Sub ConvertTemp()
   temp = InputBox('Please enter the temperature in degrees F.', 1)
   MsgBox 'The temperature is ' & Celsius(temp) & ' degrees C.'
End Sub

Function Celsius(fDegrees)
   Celsius = (fDegrees - 32) * 5 / 9
End Function
```

Getting data into and out of procedures

Each piece of data is passed into your procedures using an argument . Arguments serve as placeholders for the data you want to pass into your procedure. When you create a procedure using either the `Sub` statement or the `Function` statement, parentheses must be included after the name of the procedure. Any arguments are placed inside these parentheses, separated by commas. For example, in the following example, **`fDegrees`** is a placeholder for the value being passed into the Celsius function for conversion.

```
Function Celsius(fDegrees)
  Celsius = (fDegrees - 32) * 5 / 9
End Function
```

Using Sub and Function Procedures in Code

A `Function` in your code must always be used on the right side of a variable assignment or in an expression.

Examples:

```
Temp = Celsius(fDegrees)
```

or

```
MsgBox 'The temperature is ' & Celsius(temp) & ' degrees C.'
```

To call a `Sub` procedure from another procedure, type the name of the procedure along with values for any required arguments, each separated by a comma. The `Call` statement is not required, but if you do use it, you must enclose any arguments in parentheses.

The following example shows two calls to the MyProc procedure. In the one case the `Call` statement is used in the code, in the other one it is not. Both calls have the same result.

```
Call MyProc(firstarg, secondarg)
MyProc firstarg, secondarg
```

3.3.8 Coding Conventions

Coding conventions are suggestions are designed to help you write code using Microsoft Visual Basic Scripting Edition.

Coding conventions can include the following:

Naming conventions for objects, variables, and procedures
Commenting conventions
Text formatting and indenting guidelines

The main reason for using a consistent set of coding conventions is to standardize the structure and coding style of a script or set of scripts so that you and others can easily read and understand the code. Using good coding conventions results in clear, precise, and readable source code that is consistent with other language conventions and is intuitive.

Constant Naming Conventions

Earlier versions of VBScript had no mechanism for creating user-defined constants. Constants, if used, were implemented as variables and distinguished from other variables using all uppercase characters. Multiple words were separated using the underscore (_) character.

Examples:

```
USER_LIST_MAX
NEW_LINE
```

Although this way of naming constants still works, you can use a different way of naming. You can create real constants with the statement `Const`. This convention uses a mixed-case format in which constant names have a "con" prefix.

For example:

```
conYourOwnConstant
```

Variable Naming Conventions

To enhance readability and consistency, use the following summary with descriptive names for variables in your VBScript code.

Subtype	Prefix	Example
Boolean	bln	blnFound
Byte	byt	bytRasterData
Date (Time)	dtm	dtmStart
Double	dbl	dblTolerance
Error	err	errOrderNum
Integer	int	intQuantity
Long	lng	lngDistance
Object	obj	objCurrent
Single	sng	sngAverage
String	str	strFirstName

Variable Scope

Variables should always be defined with the smallest scope possible. VBScript variables can have the following scope.

Valid range	Declaration	Visibility
Procedure-level	Event, Function, or Sub procedure.	Visible in the procedure in which it is declared.
Script-level	HEAD section of an HTML page, outside any procedure.	Visible in every procedure in the script.

Variable Scope Prefixes

As script size grows, so does the value of being able to quickly differentiate the scope of variables. A one-letter scope prefix preceding the type prefix provides this, without unduly increasing the size of variable names.

Valid range	Prefix	Example
Procedure-level	None	dblVelocity
Script-level	sec	sblnCalcInProgress

Descriptive Variable and Procedure Names

In the core of a variable or procedure name also capitals should be used. The name should be long enough to describe the use of the variable. In addition, procedure names should begin with a verb, such as InitNameArray or CloseDialog.

For frequently used or long terms, standard abbreviations are recommended to help keep name length reasonable. In general, variable names greater than 32 characters can be difficult to read. When using abbreviations, make sure they are consistent throughout the entire script. For example, randomly switching between Cnt and Count within a script or set of scripts may lead to confusion.

Object Naming Conventions

The following table lists recommended conventions for objects you may encounter while programming VBScript.

Object type	Prefix	Example
3D Panel	pnl	pnlGroup
Animated button	ani	aniMailBox
Check box	chk	chkReadOnly
Combo box, drop-down list box	cbo	cboEnglish
Command button	cmd	cmdExit
Common dialog	dlg	dlgFileOpen
Frame	fra	fraLanguage
Horizontal scroll bar	hsb	hsbVolume
Image	img	imgIcon
Label	lbl	lblHelpMessage
Line	lin	linVertical
List Box	lst	lstPolicyCodes
Spin	spn	spnPages
Text box	txt	txtLastName
Vertical scroll bar	vsb	vsbRate
Slider	sld	sldScale

Code Commenting Conventions

Each procedure should start with a short comment describing the purpose of the procedure. This description should not go into implementation details (how operations are executed), because these might change with the time. This could result in maintenance effort for the comments and - even worse - wrong comments. The code itself and any necessary inline comments describe the implementation.

Arguments passed to a procedure should be described when their purpose is not obvious and when the procedure expects the arguments to be in a specific range. Return values for functions and variables that are changed by a procedure, especially through reference arguments, should also be described at the beginning of each procedure.

Procedure header comments should include the following section headings. For examples, see the "Formatting Your Code" section that follows.

Section Heading	Comment
`Purpose`	What the procedure does (not how).
`Assumptions`	List of the procedure's effect on each external variable, control, or other element.
`Effects`	List of the procedure's effect on each external variable, control, or other element.
`Inputs`	Explanation of each argument that is not obvious. Each argument should be on a separate line with inline comments.
`Return Values`	Explanation of the value returned.

Remember the following points:

Every important variable declaration should include an inline comment describing the use of the variable being declared.
Variables, controls, and procedures should be named clearly to ensure that inline comments are only needed for complex implementation details.
At the beginning of your script, you should include an overview that describes the script, enumerating objects, procedures, algorithms, dialog boxes, and other system dependencies. Sometimes a piece of pseudocode describing the algorithm can be helpful.

Code formating

Screen space should be conserved as much as possible, while still allowing code formatting to reflect logic structure and nesting. Here are a few suggestions:

- Indent standard nested blocks four spaces.
- Indent the overview comments of a procedure one space.
- The statements on the highest level, directly following the overview comment, should be indented with four blanks. Each nested block should again be indented by four blanks.

Example:

The following code adheres to VB Script coding conventions.

- ' Purpose: Searches for the first appearance of the stated user in the data field UserList.
- Inputs: strUserList(): the list of users to be searched.
- strZielUser: the name of the user to search for.
- Return values: Index of the first appearance of strTargetUser in the data field strUserList. If the target user is not found, return -1. -1.

```
Function intFindUser (strUserList(), strTargetUser)
    Dim i                           ' Loop counter.
    Dim blnFound                ' 'Target found' flag.
    intFindUser = -1
    i = 0                           ' Initialize loop counter
    Do While i <= Ubound(strUserList) and Not blnFound
        If strUserList(i) = strTargetUser Then
            blnFound = True    ' Set flag to True
            intFindUser = i    ' Set return value to loop count
        End If
        i = i + 1    ' Increment loop counter
    Loop
End Function
```

4. Macro list

You can use VBA and VSTA in order to extend zenon functionality. The usage of macros with zenon is described.

CONTEXT MENU

Menu item	Action
Open VBA Editor	Opens the VBA Editor.
Export all VBE	Opens the dialog for selecting the storage directory for the VBE export.
Import VBE	Opens the dialog for selecting the VBE import file.
Editor profiles	Opens the drop-down list with predefined editor profiles.
Help	Opens online help.

Information

If VBA macros are changed in the Editor,

- the Runtime files are compiled and transferred to the Runtime
- the Runtime is reloaded
- VSTA elements are also reloaded even if no changes were made in VSTA

VBA starts the same development environment for workspace and project. To open the VBA Editor:

1. navigate to the **Programming interfaces** node
2. right-click on VBA macros
3. select **Open in VBA Editor...** in the context menu

Alternative: press the short cut Ctrl+F11

4.1 VBA toolbar and context menu detail view

TOOL BAR

Menu item	Action
New VBA macro	Creates a new macro and opens the macro Editor.
Open VBA Editor	Opens the VBA Editor.
Save	Saves macros.
Delete	Deletes the selected element.
Export all VBE	Opens the dialog for selecting the storage directory for the VBE export.
Import VBE	Opens the dialog for selecting the VBE import file.
Rename	Makes it possible to rename the selected macro.
Help	Opens online help.

CONTEXT MENU MODULE

Menu item	Action
Open VBA Editor	Opens the VBA Editor.
Save	Saves macros.
Export all VBE	Opens the dialog for selecting the storage directory for the VBE export.
Import VBE	Opens the dialog for selecting the VBE import file.
Help	Opens online help.

CONTEXT MENU MODULE

Menu item	Action
New VBA macro	Creates a new macro and opens the VBA Editor.
Help	Opens online help.

CONTEXT MENU MACRO

Menu item	Action
Edit	Opens macro in the Editor for editing. Alternatively: `Enter` button or double click.

Delete	Deletes macro. Alternatively: `Del` key
Rename	Opens list elements for editing. Alternatively: `F2` key.
Help	Opens online help.

TOOL BAR EDITOR

Macros that were created with VBA can be administrated via toolbar-item **Macro list**.

Symbol	Function
(from left to right)	
Reload list of VBA/VSTA macros	Loads all **Public Sub Name ()** macros that are included in **myWorkspace** and in modules to the drop-down list of the toolbar.
Search Macro	Search for macros via combobox input field or selection from drop-down list. The drop-down list is adjusted to the widest element when opened.
Drop-down list Macros	Contains all loaded macros for selection.
Execute selected macro	Executes the macro selected in the drop-down list.
execute allocated macro #<x>	Executes the macro allocated with the symbol.
Allocate macros	Opens the allocation dialog for macros. Up to 5 macros can be allocated with the symbols 1 to 5.
VBA	Filters for VBA-macros. Only VBA-macros are displayed.
VSTA	Filters for VSTA-macros. Only VSTA-macros are displayed.
ALL	Cancels the current filter and all macros are displayed.
AZ	Sorts macros in ascending order from 0 - 9 and A - Z.
ZA	Sorts macros in descending order from Z - A and 9 - 0.
Options for symbol bar	Clicking on the arrow opens the submenu: Active: Tool bar is displayed If the toolbar is not displayed, it can be activated using the Menu **Options -> Toolbar**. Note: For free placed tool bar (undocked from the Editor) options are not displayed. The tool bar can be closed by clicking on button X.

Information

If the macro assignment dialog does not list all macros from **myWorkspace**, execute the function **Reload list of VBA macros** in the toolbar.

4.2 VBA on 64-bit systems

zenon has supported 64-bit operating systems since version 7.10. VBA was thus converted to VBA version 7.1. Therefore VBA is also available in zenon 64-bit. If, in the VBA code, Windows API or other imported DLL functions are accessed, these calls must be adapted to 64-bit. In general, the following applies: A VBA file created with a 32-bit version cannot be used without changes in a 64--bit version.

There are some defines/functions available in VBA in order to write 32-bit and 64-bit compatible code. For example:

```
#if Win64 then
   Declare PtrSafe Function MyMathFunc Lib "User32" (ByVal N As LongLong) As LongLong
#else
   Declare Function MyMathFunc Lib "User32" (ByVal N As Long) As Long
#end if
#if VBA7 then
   Declare PtrSafe Sub MessageBeep Lib "User32" (ByVal N AS Long)
#else
   Declare Sub MessageBeep Lib "User32" (ByVal N AS Long)
#end if
```

You can also obtain some useful notes on the porting of VBA 32-bit code to VBA 64-bit from Microsoft:

- Microsoft Office 2010, notes on porting:
  http://msdn.microsoft.com/en-us/library/ee691831.aspx
  (http://msdn.microsoft.com/en-us/library/ee691831.aspx)
- 32-bit and 64-bit declares for API calls: http://www.jkp-ads.com/articles/apideclarations.as
  (http://www.jkp-ads.com/articles/apideclarations.as)p

4.3 Basics

Describes the basics of the programming language VBA - Visual Basic for Applications

4.3.1 Object PROPERTIES

An object property is a certain attribute of the object. In case of a variable object this e.g. can be the value, the name or the identification. In case of a circle the position or the color of the circle in the

screen. Each object has at least one property (usually more), each property has a certain value. While the **property name** is a text, the **property value** is a value between 0 and e.g. 1000.

The special thing with properties is, that with changing the property value in a VBA program you can change the behaviour or the appearance of the object. If you e.g. change the **property value** of a variable object, the currently selected variable gets this new value. You cannot cange the value of each property. The **property count** of the variable object cannot be changed, because it represents the number of created variables. You cannot add variables by changing the value of Count. So some properties are read only, i.e. their values only can be read.

4.3.2 Object METHODS

Beside the properties each object can have methods. A method is not an attribute but a request to the object to do something. So a form has the method `Show`. What does it do? It requests the form to appear on the screen. Accordingly the form disappears when using the method `Unload`.

The advantage of methods is, that the programmer does not have to know anything about the structure of the object and most of all has no opportunity to chnage the internal data of the object.

Executing the method Show or Unload works as follows:

```
frmSollwert.Show bzw. Unload frmSollwert
```

If you want to open another form, the method stays the same, only the name of the form (object name) changes.

```
frmChange.Show bzw. Unload frmChange
```

So one and the same method can be used for different object types. But not every object must have methods.

4.3.3 Object EVENTS

In 90% of working with objects you will use properties and methods, but there is a third kind of attributes objects can have: Events. Some objects of the control system object hierarchy can react on events. Events take place during the work with zenon on their own.

Example

Whenever a screen is opened, an open event is triggered in the according screen object. As a programmer you can add commands to the event procedure (procedure to be executed, when the event happens), which define, what should happen in this case. One example for this is changing a variable. You can create an event, which reacts on value changes of a variable.

4.3.4 VBA object structure in zenon

Basically there is a object list and objects again and again in the project structure.

Example:

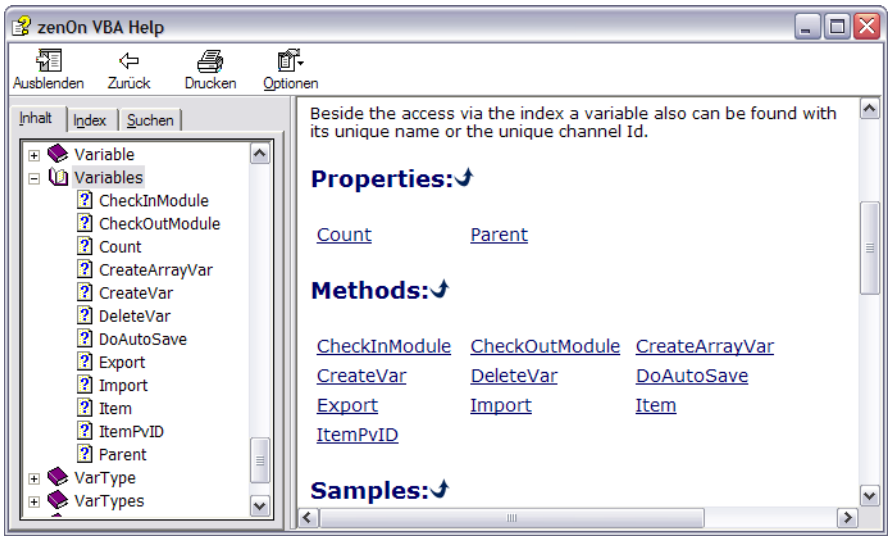
Projects – Project

Variables – Variable

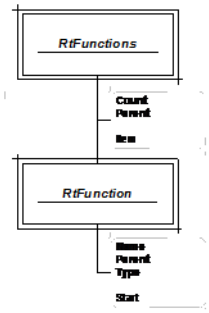
Elements – Element

You can find more about the object model:

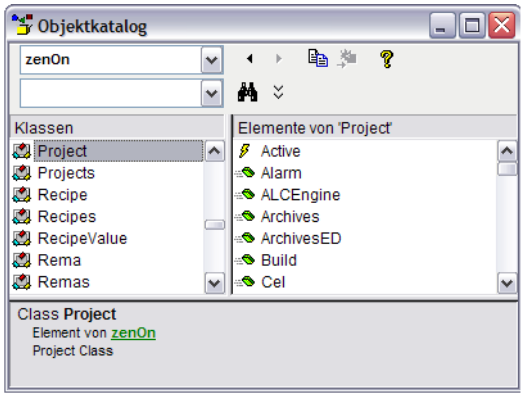
- in the VBA help



- in the graphical overview which you can obtain from COPA-DATA complete as printed overview.

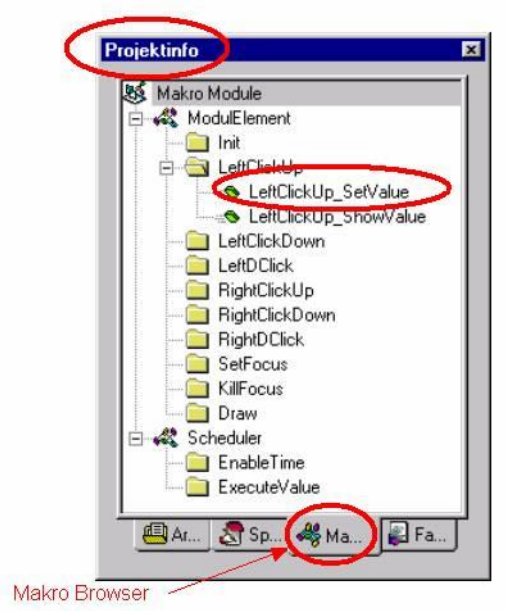


- in the VBA object browser



4.3.5 How to use VBA macros

In order to create a new macro in the window **Project info** on the property page **Macro Browser** select a desired event, when the new macro should be executed.



Clicking on this event with the right mouse button opens a menu.

Select the menu entry "New macro..." Thus zenon generates a procedure:

```
Public Sub LeftClickUp_Sollwert(obElem As Element)
End Sub
```

If a macro already exists, it can be edited, deleted or renamed by clicking it with the right mouse button.

> **Attention**
>
> *If you select menu item **Rename macro**, take care that you do not change the name of the event e.g. LeftClickUp_..., - of the current name. Otherwise renaming will not be executed. Additionally you have to change the name of the sub program to be executed in the VBA Editor by hand, if you rename a macro.*

After you have filled the procedure generated by zenon with the source code to be executed, the created macro has to be linked to an element.

Doubleclicking the element opens the property dialog of the element.

On the property page Events the macro is linked to the element.

Clicking the element with the left mouse button executed the LeftClickDown event of the element and the linked macro.

Inserting existing macros

In order to insert existing macros into another project do the following:

1. In the VBA Editor export all needed forms and modules and import them in the other project.
2. Event dependent macros, in `ModulElement.bas`, are not displayed in the macro browser at the moment. So this macros have to be created in the macro browser.

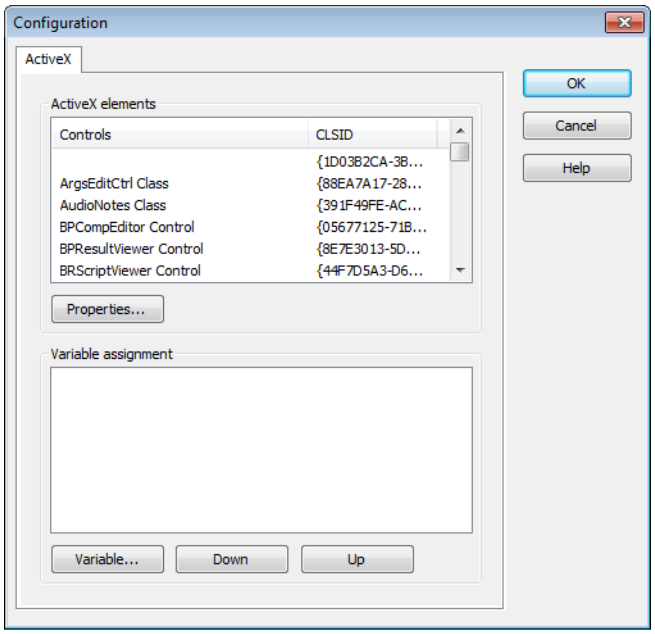
   The easiest way is to use the name of the existing macro.

   e.g.:
   LeftClickUp_ `DateSet2`
   LeftClickUp_ `DateSet4`
   LeftClickUp_ `TimeSet`
   Draw_ `Date2`
   Draw_ `Date4`
   Draw_ `Time`
3. On creating the macros zenon generates procedures with the same name as the existing macros. You have to delete these generated procedures.
4. Connect the macros as usual with a dynamic element.

> **Information**
>
> If the hardware is not connected and the simulation mode of the SAIA driver is used, do not forget to stop the driver.

4.3.6 How to insert an ActiveX element in zenon?

An ActiveX element is drawn into the screen like any other dynamic element; a dialog opens, where you musz select an ActiveX element.



- After you have selected the element from the list, you can links variables to it. For this click the button **Variable** and select a variable or create a new one.
- In the next step we give the ActiveX element an object name, so that we can access it in VBA.
- In our example we give it the object name Slide6_DW18, because it is an AcziveX element Slider linked to the variable Doubleword18.
- Now the Slider element has to be activated and edited in the VBA Editor.
- For this we create a new macro as described in chapter "How to use VBA macros? (on page 53)".

The macro Init_Slider passes the element to be initialized to a sub program in the control system object thisProject, whereby the allocation to the current project is defined.

```
Public SubInit_Slider(obElem AsElement)
thisProject . Init _ Slider obElem
End Sub
```

Just like in the macro Init_Slider also Draw_SliderValue passes the element to the control system object thisProject.

```
Public Sub Draw_SliderValue (obElem As Element, ByVal hdc As OLE _ HANDLE )
thisProject.Draw_Slider obElem
```

```
obElem.Draw hdc
End Sub
```

The code below is added in the control system object this Project.

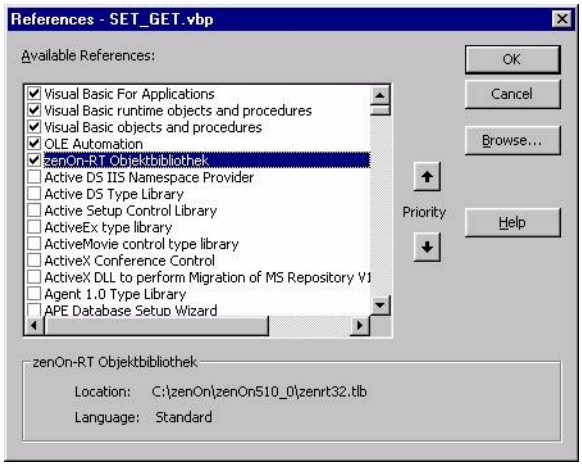
```
Public Declarations
Public WithEvents obSlider As Slider
Public obSliderPV As Variable
Public Sub Init_Slider (obElem As Element)
Set obSlider = obElem.ActiveX
'ActiveX exists
If obSlider Is Nothing Then
Exit Sub
End If
Set obSliderPV = obElem . ItemVariable(0)
'variable exists
If obSliderPV Is Nothing Then
Exit Sub
End If
obSlider.Max = obSliderPV.RangeMax
obSlider.Min = obSliderPV.RangeMin
obSlider.TickFrequency = 1000
obSlider.LargeChange = 25
obSlider.SmallChange = 1
obSlider.Value = obSliderPV.Value
End Sub


Public Sub Draw _ Slider ( obElem As Element )
Dim vVar As Variant
Dim obDynPic As DynPicture

Set obSliderPV = obElem.ItemVariable ( 0 )
Set obDynPic = thisProject.DynPictures. Item (BILD_1)
'variable exists
If obSliderPV Is Nothing Then
Exit Sub
End If
```

4.3.7 Access from an external program

In order to access zenon data from an external program such as e.g. Visual Basic the COM interface is used. This COM interface is also used by VBA. So there are only a few small differences, that should be cared of.

Visual Basic 6

In order to be able to access the COM interface it has to be implemented:



With this type library you can access the application object of zenon (the Runtime).

As here there is no thisProject object, it has to be created to get access to the data.

```
Dim obProject As zenon.Project
Set obProject = zenon.Application.Projects.Item(PROJEKTNAME)
```

If the VB project should work with all zenon projects - should be project name independent - it can be defined in the following way:

```
Set obProject = zenon.Application.Projects.Item(0)
```

After the project object (thisProject) has been created, e.g. the variables can be accessed for reading and writing.

Read:

```
Value = obProject.Variables.Item(Variablenname).Value
```

Write:

```
obProject.Variables.Item(Variablenname).Value = Value
```

4.3.8 Functionality of online variables

You can imagine a VBA OnlineVariable as a container; this container contains control system variables, which have to be added. If the value of one of the variables of the container changes, this is indicated with an event.

Functionality of the event:

If the container is activated (**Container.Define**), all variables in the container are forced once, so that the current value of the variables are known. So the procedure **Container_VariableChange** is executed for each variable in the container. As soon as all variables then have been initialized, this event always occurs, if one of the variables of the container changes its value.

So it is avoided, that a value is read, which is not the current value of the variable.

Define and create container

Definition:

```
Public WithEvents Container As OnlineVariable
```

With this line of code the container is defined.

Creating:

```
Set Container = thisProject . OnlineVariables . CreateOnlineVariables ( Containername )
```

Put variables in the container

```
Container . Add Variablenname1
Container . Add Variablenname2
Container . Add Variablenname3
Container . Add Variablenname4
...
```

Repeat this line, until all needed variables are added to the container.

Create event

```
Private Sub Container_VariableChange(ByVal obVar As zenon.IVariable)
...
End Sub
```

This event is automatically created, when the container is selected in the left combobox at the top of the VBA Editor. The procedure above then is added to the source code. With **obVar** the variable with the changed value is passed on. When this event occurs, e.g. the current value of the variable (**ob-Var.Value**) can be read. Refer to the object hierarchy in the VBA documentation to see the properties and values of variables, which can be used.

Activate event

```
Container.Define
```

This command line activates the monitoring of the variables in the container. After executing the command **Define**, the container is active.

Switching off the event

```
Container.Undefine
```

With this command the surveillance in the container is switched off. The event (VariableChange) is no longer carried out.

Remove on closing

In order not to leave anything in the memory on closing the Runtime, the container has to be removed at the latest on closing the Runtime.

```
thisProject . OnlineVariables . DeleteOnlineVariables ( Containername )
```

Not before the container is deleted can another container with the same name be created.

4.3.9 List of status bits

Bit number	Short term	Long name	straton label
0	M1	User status 1	_VSB_ST_M1
1	M2	User status 2	_VSB_ST_M2
2	M3	User status 3	_VSB_ST_M3
3	M4	User status 4	_VSB_ST_M4
4	M5	User status 5	_VSB_ST_M5
5	M6	User status 6	_VSB_ST_M6
6	M7	User status 7	_VSB_ST_M7
7	M8	User status 8	_VSB_ST_M8
8	NET_SEL	Select in the network	_VSB_SELEC
9	REVISION	Revision	_VSB_REV
10	PROGRESS	In operation	_VSB_DIREC
11	TIMEOUT	Runtime exceedance	_VSB_RTE
12	MAN_VAL	Manual value	_VSB_MVALUE
13	M14	User status 14	_VSB_ST_14
14	M15	User status 15	_VSB_ST_15
15	M16	User status 16	_VSB_ST_16
16	GI	General interrogation	_VSB_GR
17	SPONT	Spontaneous	_VSB_SPONT
18	INVALID	Invalid	_VSB_I_BIT
19	T_CHG_A	Daylight saving time/winter time announcement	_VSB_SUWI
20	OFF	Switched off	_VSB_N_UPD
21	T_EXTERN	Real time external	_VSB_RT_E
22	T_INTERN	Real time internal	_VSB_RT_I
23	N_SORTAB	Not sortable	_VSB_NSORT

24	FM_TR	Fault message transformer value	_VSB_DM_TR
25	RM_TR	Working message transformer value	_VSB_RM_TR
26	INFO	Information for the variable	_VSB_INFO
27	ALT_VAL	Substitute value If no value was transferred, the defined alternate value is used otherwise the last valid value is used.	_VSB_AVALUE
28	RES28	Reserved for internal use (alarm flashing)	_VSB_RES28
29	N_UPDATE	Not updated	_VSB_ACTUAL
30	T_STD	Standard time	_VSB_WINTER
31	RES31	Reserved for internal use (alarm flashing)	_VSB_RES31
32	COT0	Cause of transmission bit 1	_VSB_TCB0
33	COT1	Cause of transmission bit 2	_VSB_TCB1
34	COT2	Cause of transmission bit 3	_VSB_TCB2
35	COT3	Cause of transmission bit 4	_VSB_TCB3
36	COT4	Cause of transmission bit 5	_VSB_TCB4
37	COT5	Cause of transmission bit 6	_VSB_TCB5
38	N_CONF	Negative acceptance of Select by device (IEC60870 [P/N])	_VSB_PN_BIT
39	TEST	Test bit (IEC 60870 [T])	_VSB_T_BIT
40	WR_ACK	Writing acknowledged	_VSB_WR_ACK
41	WR_SUC	Writing successful	_VSB_WR_SUC
42	NORM	Normal status	_VSB_NORM
43	N_NORM	Deviation normal status	_VSB_ABNORM
44	BL_870	IEC 60870 Status: blocked	_VSB_BL_BIT
45	SB_870	IEC 60870 Status: substituted	_VSB_SP_BIT

46	NT_870	IEC 60870 Status: not topical	_VSB_NT_BIT
47	OV_870	IEC 60870 Status: overflow	_VSB_OV_BIT
48	SE_870	IEC 60870 Status: select	_VSB_SE_BIT
49	T_INVAL	Time invalid	not defined
50	CB_TRIP	Breaker tripping detected	not defined
51	CB_TR_I	Breaker tripping detection inactive	not defined
52	RES52	reserved	not defined
53	RES53	reserved	not defined
54	RES54	reserved	not defined
55	RES55	reserved	not defined
56	RES56	reserved	not defined
57	RES57	reserved	not defined
58	RES58	reserved	not defined
59	RES59	reserved	not defined
60	RES60	reserved	not defined
61	RES61	reserved	not defined
62	RES62	reserved	not defined
63	RES63	reserved	not defined

Information

In formulas all status bits are available. For other use the availability can be reduced.

You can read details on status processing in the Status processing chapter.

4.3.10 Lasso for selecting dynamic elements in the Runtime

Dynamic elements which are linked with a variable or function can be pre-selected with the lasso in the Runtime and therefore by used for events.

With method **SelElements** the user can identify selected dynamic elements as selected in the Runtime. These **DynPicture.SelElements** can then by used for events sich as drag&drop.

SELECTION PER LASSO

To select elements with the lasso in the Runtime, you must:

- activate property Runtime settings/Runtime lasso in the project settings
- activate property Runtime/selectable with lasso in the property of the dynamic element

In the Runtime several methods for selecting elements are available:

- Select elements: Left-click on a free area and move lasso over the screen elements while holding the mouse button pressed.
- Extend selecton: Ctrl+mouse click on an element in order to select/deselect it in addition to the other elements already selected
- Add elements: While spanning the lasso press and hold Ctrl in order to add elements to the existing selection
- Cancel selection: Spanning a lasso which does not contain elements.

4.4 Macros in the Editor

Macros can be carried out with the help of a configurable Toolbar (on page 64) in the Editor. For this macros are linked (on page 66) with buttons in toolbar **VBA**.

In addition macros can be run manually using the VBA Editor.

With the help of Wizards repeating engineering tasks can be run or whole projects can be created with the click on a button. As examples a few wizards are already included in the shipped version of zenon. These wizards can be enhanced and completed at will. They help when creating a project, at the import and export, at creating variables and so on. You can find details in chapter Wizards.

EDITOR EVENTS

Editor events are part of the VBA workspace and make it possible to react to Events in the workspace programming, e.g. for wizards or Remote Transport. For example:

- OnElementCreated
- OnElementDeleted
- OnElementDoubleClicked
- OnObjectCreated
- ...

All Events and information about them can be found in the help in chapter Object Model.

4.4.1 Tool bar macro list

Macros that were created with VBA can be administrated via toolbar-item **`Macro list`**.

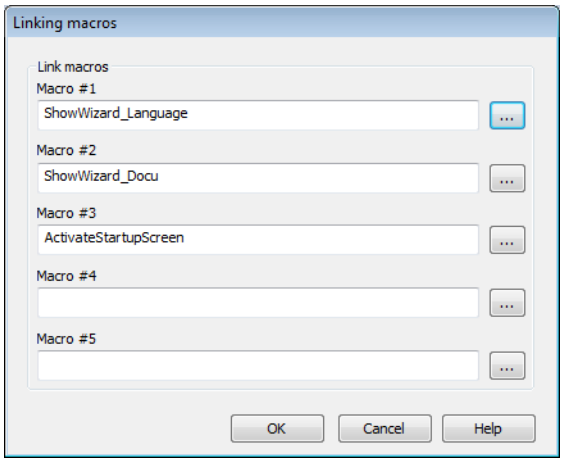
Symbol	Function
(from left to right)	
Reload list of VBA/VSTA macros	Loads all **Public Sub Name ()** macros that are included in **myWorkspace** and in modules to the drop-down list of the toolbar.
Search Macro	Search for macros via combobox input field or selection from drop-down list. The drop-down list is adjusted to the widest element when opened.
Drop-down list Macros	Contains all loaded macros for selection.
Execute selected macro	Executes the macro selected in the drop-down list.
execute allocated macro #<x>	Executes the macro allocated with the symbol.
Allocate macros	Opens the allocation dialog for macros. Up to 5 macros can be allocated with the symbols 1 to 5.
VBA	Filters for VBA-macros. Only VBA-macros are displayed.
VSTA	Filters for VSTA-macros. Only VSTA-macros are displayed.
ALL	Cancels the current filter and all macros are displayed.
AZ	Sorts macros in ascending order from 0 - 9 and A - Z.
ZA	Sorts macros in descending order from Z - A and 9 - 0.
Options for symbol bar	Clicking on the arrow opens the submenu: Active: Tool bar is displayed If the toolbar is not displayed, it can be activated using the Menu **Options -> Toolbar**. Note: For free placed tool bar (undocked from the Editor) options are not displayed. The tool bar can be closed by clicking on button X.

Information

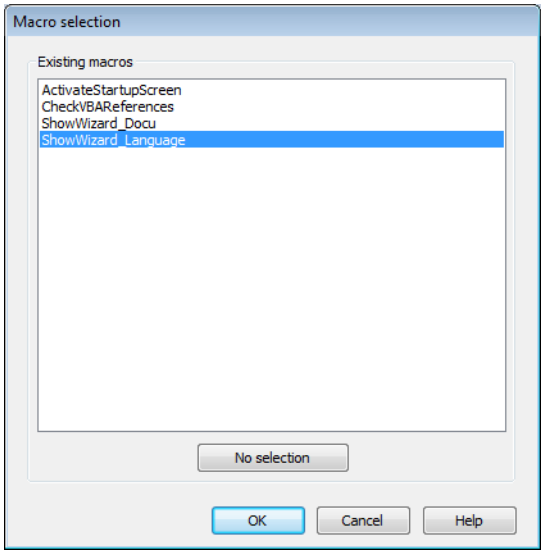
If the macro assignment dialog does not list all macros from **myWorkspace**, execute the function **Reload list of VBA macros** in the toolbar.

4.4.2 Linking macros

Macros can be called via a button in the toolbar. A maximum of five macros can be linked this way. Via button **Assign macros** the dialog for assigning macros is opened.



TAG	Description
Macro #	Macro number matches the number of the button in the toolbar. A click on button . . . opens the dialog for selecting the macro.
OK	Creates links to the buttons and closes the dialog.
Cancel	Discards all changes and closes the dialog.
Help	Opens online help.



TAG	Description
Existing selection	List of macros which can be linked.
No selection	Deletes existing assignment for the button.
OK	Assigns the selected macro to the button.
Cancel	Discards all changes and closes the dialog.
Help	Opens online help.

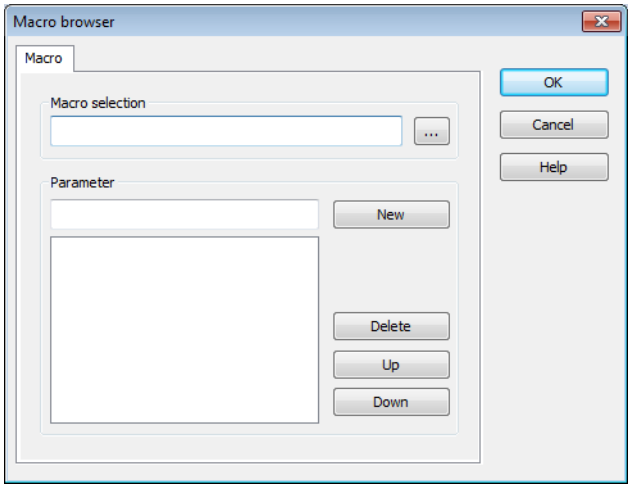
4.5 Functions in zenon

In dialog **Function selection** you can find the following functions under element **VBA**.

Function	Description
Open PCE editor	Opens the editor of the optional module Process Control Engine (PCE).
Open VBA Editor	Opens the VBA editor
Execute VBA Macro	Executes a selected VBA macro. **Attention:** The VBA Event **project inactive** is carried out by script **AUTO_END_xxx**. Therefore the zenon function **Execute VBA macro** is no longer executed in scripts as VBA is not running at this time.
Show VBA macro dialog	Opens the VBA macro dialog.

4.5.1 Execute VBA Macro

If you select function Execute VBA macro, the following dialog is displayed.



These settings are available.

TAG	Description
Macro selection	Opens the dialog for selecting the macros (see also Macro selection (on page 69)) Hint: Only lists VBA macros that match the number of parameters defined at the function Parameter (below).
Parameters	Enter the desired value (string) for a parameter.
New	Click on this button in order to apply the value at parameter in the list of available parameter.
Delete	Click on this button in order to delete the selected entry from the list of available parameter. You can always only delete one entry at a time.
Up	Click on this button in order to move the selected entry up one place. In the parameter order the entry is moved one place to the front.
Down	Click on this button in order to move the selected entry down one place. In the parameter order the entry is moved one place to the back.

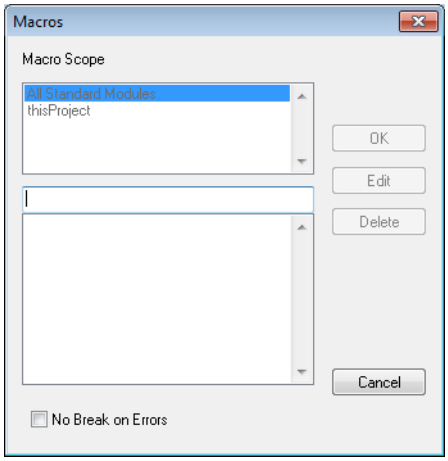
It is possible to add strings to macros which were created with parameters. These strings are transferred in the Runtime as individual parameters when the macro is carried out.

Information

You must make sure that the number of parameters of the linked macro matches the number of the created parameters.

Macro selection

After clicking button . . ., the following dialog is displayed.



Select the desired macro from the available macros and then click OK.

4.6 Developing wizard in VBA

Since version 6 it is possible to automate engineering projects with wizards. So frequently recurring tasks can be sourced out to a wizard which executes the desired actions, e.g. creating a project, creating frames and screens in a pre-defined standard.

Another field of application for wizards are automated changes in existing projects, e.g. changing properties of dynamic elements in all screens of an existing project.

The basis for the wizards is Microsoft Visual Basic for Applications (VBA) and the object model of zenon.

At the moment the following wizards are available:

- Project Wizard

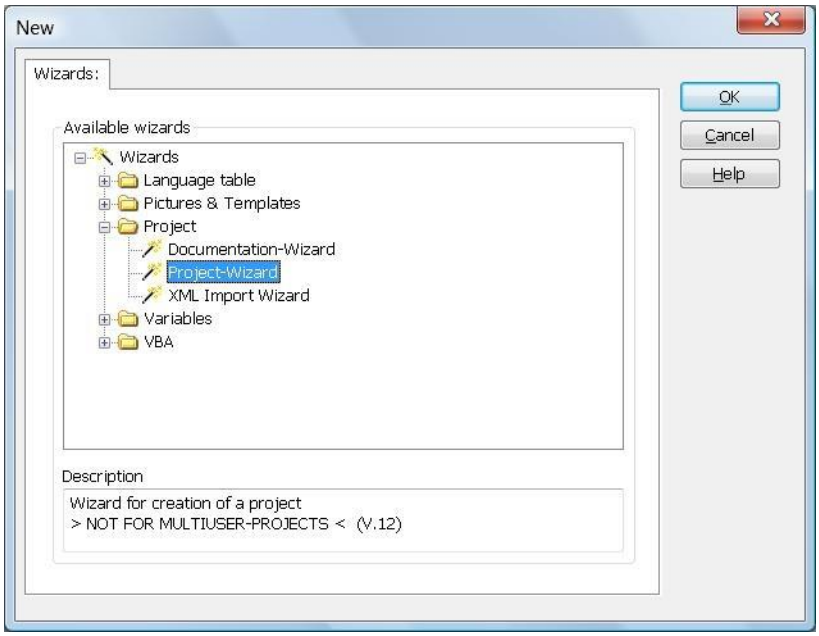
- Import Wizard
- World View Wizard
- Find VBA-Text Wizard
- Wizard for keyword creation
- Wizard for keyword translation
- Wizard for creating variables

The wizards are available as VBA source code files on the installation medium. New wizards can be implemented with the VBA environment.

4.6.1 Using a wizard

The menu entry **`Wizards`** in the menu **`File`** opens the wizard selection. In this dialog all activated wizards are displayed in their categories.

If a wizard has no category, the category `Not linked` is automatically created. In this category all not linked wizards are displayed.



By selecting a wizard and pressing the button **`OK`** the selected wizard is executed.

Information

Wizards only support single-user projects and not multi-user projects.

4.6.2 Structure of a wizard

A wizard is a UserForm stored in the application specific node of the application. Usually the UserForm consists of a multi-page element displaying the single steps of the wizard.

With a button **`Next`** the next page of the multi-page element is displayed. All entries have to be stored temporarily - the creation of objects, e.g. frames, screens, ... has to be done with **`Finish`**ing the wizards.

Information

UserForms to be used as wizards have to contain some public methods, which provide the control system with information about the wizard. If this routines are missing in a UserForm, it is not treated as a wizard.

4.6.3 Integration in VBA

The wizards are stored in the application specific node `ZWorkspace`. This object represents the currently loaded workspace in the Editor and is only available in the zenon Editor.

All objects in this VBA project can access the current workspace with teh object `MyWorkspace`. It is always linked to the currently active project, which can be accessed with the property `ActiveDocument`.

The contents of the object ZWorkspace are stored in the file `ZenWorkspace.vba`. It is copied to the installation directory with the first installation of version 6. This file is not overwritten by later updates. You will find more information on updating wizards at the end of this tutorial.

4.6.4 Developing a wizard

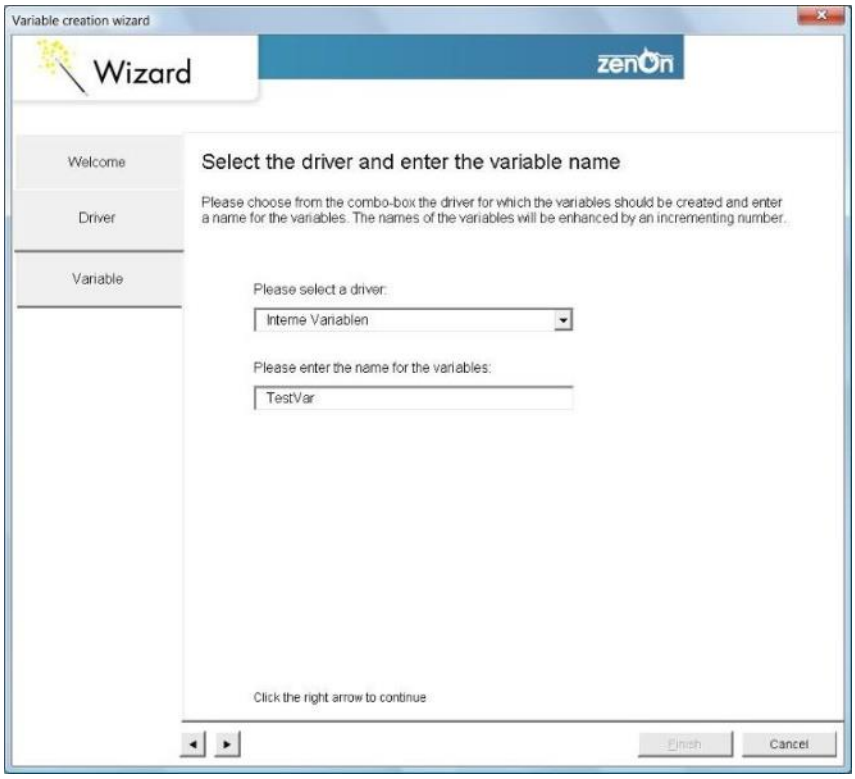
This tutorial develops a wizard creating variables for a defined driver.

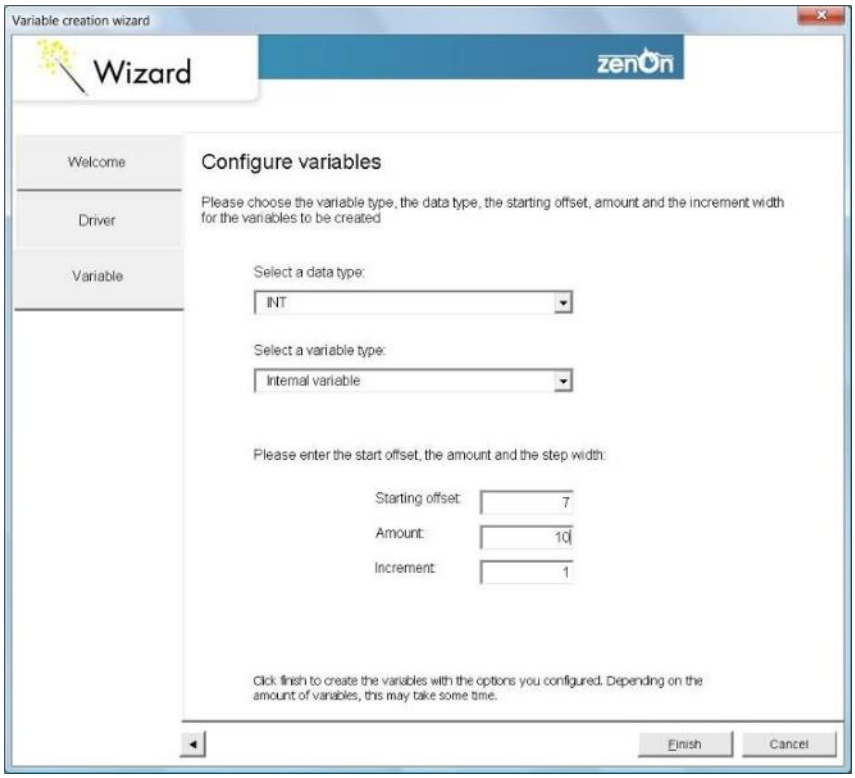
Start the VBA environment from the zenon Editor and change to folder `ZWorkspace/Forms`. This file contains the basics for developing a wizard. Change the name of the UserForm.

If the folder mentioned above is not available, you can import it via Import the `Import file` command.

Information

For developing a wizard knowledge about the object model of zenon and VBA are required. These topics are not part of this tutorial.





Create the surface displayed above. Then switch to the code module of the UserForm and scroll to the end of the file. There you will find the following methods.

- `Public Function` GetWizardName () `As String`

  Returns the unique name of the wizard. Change the contents to `Wizard for creating variables`

- `Public Function` GetWizardInfo () `As String`

  Returns a short description displayed in the wizard selection. Change the contents to `Wizard for creating variables to a selected driver`

- `Public Function` GetWizardCategory () `As String`

  Returns the category of the wizard. In the wizard selection the wizards are displayed in a tree structure of the categories. Change the contents to `Variables`.

- **Public Function** IsZenOnWizard () **As Boolean**

  Displaying the wizard in the wizard selection. If this method returns False, the wizard is not displayed, e.g. because it is not yet finished. Change the return type to `True`.

These methods provide the information about the wizard, which is requested by the control system. Keep in mind that the wizard is only displayed in the wizard selection if the method `IsZenOnWizard` returns `True`.

Switch to the event `Initialize` of the UserForm and change the contents of the string array `m_strCaption`. As oru wizard only consits of two steps, you can delete the other allocations.

Add the following definitions to the top area of the code module:

```
Private m_obDriver As Driver
Private m_obVarType As VarType
Private m_nChannelType As Integer
```

Create a method for initializing the driver combobox. The task of this routine is to display all the loaded drivers of the current project in a combobox.

```
cbDriver.Clear
Dim nIndex As Long
For nIndex = 0 To MyWorkspace.ActiveDocument.Drivers.Count - 1
   Dim obDriver As Driver
   Set obDriver = MyWorkspace.ActiveDocument.Drivers.Item(nIndex)
   If (Not obDriver Is Nothing) Then
      cbDriver.AddItem
      obDriver.Name
   End If
Next nIndex
If (cbDriver.ListCount > 0) Then
   cbDriver.ListIndex = 0
End If
```

Additionally we need a routine displaying all defined variable types of the project in a combobox.

```
If (Not m_obDriver Is Nothing) Then
cbVarType.Clear
Dim nIndex As Long , nSelect As Integer
For nIndex = 0 To MyWorkspace.ActiveDocument.VarTypes.Count - 1
Dim obVarType As VarType
Set obVarType = MyWorkspace.ActiveDocument.VarTypes.Item(nIndex)
If ( Not obVarType Is Nothing And obVarType.IsSimple = True) Then
cbVarType.AddItem
obVarType.Name
If (obVarType.Name = INT) Then
   nSelect = nIndex
End If
End If
Next nIndex
cbVarType.ListIndex = nSelect
End If
```

On opening the wizard all existing variables are checked to find a free start offset for the the new variables to be created. This is done with the following method.

```
Private Function FindHighestOffsetVar() As Long
On Error GoTo Error
Dim nIndex As Long , nOffset As Long
For nIndex = 0 To MyWorkspace.ActiveDocument.Variables.Count - 1
Dim obVar As Variable
   Set obVar = MyWorkspace.ActiveDocument.Variables.Item(nIndex)
   If ( Not obVar Is Nothing) Then
   If (obVar.Offset > nOffset) Then
         nOffset = obVar.Offset
      End If
   End If
Next nIndex
FindHighestOffsetVar = nOffset
Exit Function
Error : MsgBox
Error occurs: + Err.Description + Source + Err.Source
End Function
```

Switch to the event Initialize of the UserForm and add the following lines to this method:

```
txtStart.Value = CStr(FindHighestOffsetVar + 1)
InitializeDriver
```

The allocation to `txtStart` sets the proposed start offset for the variables to be created. The method `InitializeDriver` fills the combobox with the existing drivers.

Create an event Change for the driver combobox and add the following code. After having selected a driver the variable types are acquired. The selected driver object is stored in the variable `m_obDriver` for later use.

```
Private Sub cbDriver_Change()
cmdNext.Enabled = True
Set m_obDriver = MyWorkspace.ActiveDocument.Drivers.Item(cbDriver.Value)
If ( Not m_obDriver Is Nothing) Then
   InitializeVarType
End If
End Sub
```

Create an event `Change` for the variable type combobox and add the following code. The selected variable type is stored in the variable m_obVarType for later use.

```
Private Sub cbVarType_Change()
Set m_obVarType = MyWorkspace.ActiveDocument.VarTypes.Item(cbVarType.Value)
End Sub
```

Now the only thing left is to create the event routine for creating the variables with the defined settings. This is done with the button Finish.

```
Private Sub cmdFinish_Click()
On Error GoTo Error
If (cbVarType.ListIndex = -1) Then
MsgBox 'Please select a variable type'
cbVarType.SetFocus
Exit Sub
End If
If (txtStart.Value = Or txtCount.Value = Or txtStep.Value = ) Then
MsgBox 'Please enter Start-Offset', 'count of creating variables and the step'
txtStart.SetFocus
End If
If (m_obVarType Is Nothing) Then
MsgBox 'Variable type + cbVarType.Name + doesnt exist!'
Exit Sub
End If
Dim nPrvMousePtr As Integer
nPrvMousePtr = MousePointer
MousePointer = fmMousePointerHourGlass
DoEvents
```

```
Dim strName As String
Dim nIndex As Long , nVarIndex As Integer
Dim nStartOff As Long , nStep As Integer
nVarIndex = 1
nStartOff = CLng (txtStart.Value)
nStep = CLng (txtStep.Value)
For nIndex = 0 To CLng (txtCount.Value - 1)
Dim obVar As Variable
strName = txtName.Value + _ + CStr (nIndex + 1)
'*** Guaranteeing uniqueness of the variable name
Dim bResult As Boolean
bResult = False
Do
Set obVar = MyWorkspace.ActiveDocument.Variables.Item(strName)
If (obVar Is Nothing) Then
bResult = True
Else
nVarIndex = nVarIndex + 1
strName = txtName.Value + _ + CStr (nVarIndex)
End If
Loop While
bResult = False
'*** Create variable
Set obVar = MyWorkspace.ActiveDocument.Variables.CreateVar (strName, m_obDriver,
tpSPSMerker, m_obVarType)
If ( Not obVar Is Nothing) Then
obVar.Offset = nStartOff
nStartOff = nStartOff + nStep
End If
Next nIndex
MousePointer = nPrvMousePtr
Unload Me
Exit Sub
Error :
MousePointer = nPrvMousePtr
MsgBox Error occurs: + Err.Description + Source + Err.Source
End Sub
```

On finishing the wizard it is checked, if the defined settings are valid. If this is not the case, a messages is displayed and the user is demanded to correct the entries.

If the defined settings are valid, the variables are created. The variables are named with a name and an index. If a variables with the same name already exists in the project, the next free index is acquired. In our code example always a variable with the channel type PLC marker is created. With each cycle the offset of the variable is increased.

4.6.5 Updating wizards

To update the wizards:

1. Select **Update wizards..** in the **File** menu.
2. a dialog for updating available wizards is opened
3. select the desired wizards
4. start the update by clicking **Start update**

If a wizard or a class already exists in the workspace, a warning is displayed.

> **Attention**
>
> *Already existing wizards are overwritten during the update. Individual changes made at the wizard are lost.*

4.7 Frequently asked questions

In this chapter a few frequently asked questions are answered. You can find additional solutions online in the COPA-DATA User forum (http://www.copadata.com/forums/).

4.7.1 Why does the button stay pressed?

If a button is linked e.g. to a LeftClickUp event, in the end of the precedure the LeftClickUp has to be executed.

```
Public Sub LeftClickUp_Schalter(obElem As Element)
frmSchalter.Show
obElem.LeftClickUp
End Sub
```

4.7.2 Macro is not performed with the first click

The solution matches the one from the question: Why does the button stay pressed (on page 78):

If a button is linked e.g. to a LeftClickUp event, in the end of the precedure the LeftClickUp has to be executed.

```
Public Sub LeftClickUp_Schalter(obElem As Element)
frmSchalter.Show
obElem.LeftClickUp
End Sub
```

4.7.3 Macros no longer work in the Runtime?

This effect can occur, if the VBA Editor is opened in the Runtime and then Stop/Start is pressed to stop/start VBA. In this case the objects (OnlineVariables, ScreenObjects, ...) become invalid, because they lose the link in case of a new initialization.

4.7.4 Windows CE and VBA

In the Editor VBA can be used for wizards. It cannot be used in the Runtime. For detailed information about the Editor refer to chapter How to create projects in CE.

4.8 Examples

Here you can find a few examples for VBA

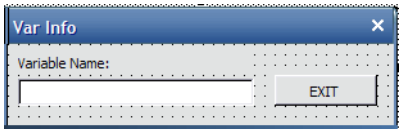
4.8.1 MouseEvents and ActiveX Control initialization

```
Option Explicit

Public Sub Init_ActiveX(obElem As Element)
    'Initializing ActiveX...
```

```
    thisProject.Init_MSChart_AX obElem
End Sub

Public Sub LeftClickUp_Sample1(obElem As Element)
    'Initializing Userform...
    frmSample1.InitForm obElem
    'Show Userform
    frmSample1.Show
End Sub

Public Sub LeftClickUp_Sample2(obElem As Element)
    'Initializing Userform...
    frmSample2.InitForm obElem
    'Show Userform
    frmSample2.Show
End Sub

Public Sub LeftClickUp_Sample3(obElem As Element)
    'Initializing Userform...
    frmSample3.InitForm obElem
    'Show Userform
    frmSample3.Show
End Sub

Public Sub LeftClickUp_Sample4(obElem As Element)
    Dim NewForm As New frmSample4
    'Initializing NEW Userform...
    NewForm.InitForm obElem
    'Show NEW Userform
    NewForm.Show (0)
End Sub
```

4.8.2 Display variable information

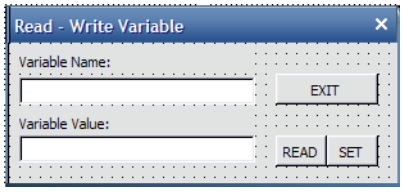
Show variable name for clicked element:




```
Option Explicit

Dim obVar As Variable

'User defined Public Procedure for initializing Objects

Public Sub InitForm(obElem As Element)
    'set the variable object like the linked variable of the element
    Set obVar = obElem.ItemVariable(0)
    'write variable name into the textbox
    txtVarName.Text = obVar.Name
End Sub

Private Sub cmdExit_Click()
    'close Userform
    Unload Me
End Sub
```

4.8.3 Read and write variable values

Read value from variable and write it back:

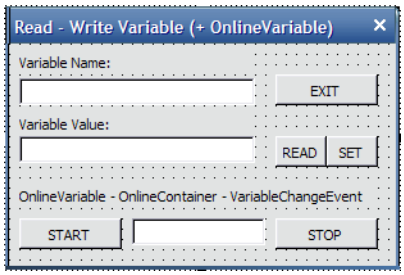



```
Option Explicit

Dim obVar As Variable
```

```
'User defined Public Procedure for initializing Objects

Public Sub InitForm(obElem As Element)
    'set the variable object like the linked variable of the element
    Set obVar = obElem.ItemVariable(0)
    'write variable name into the textbox
    txtVarName.Text = obVar.Name
End Sub

Private Sub cmdExit_Click()
    'close Userform
    Unload Me
End Sub

Private Sub cmdRead_Click()
    'read value from variable and write into textbox
    txtValue.Text = obVar.Value
End Sub

Private Sub cmdWrite_Click()
    'write text as value to variable
    obVar.Value = txtValue.Text
    'or changing text to value before writing...
    'obVar.Value = Val(txtValue.Text)
End Sub
```

4.8.4 Read and write variables and implement online variables

Read variable information, write values and implement online variables:



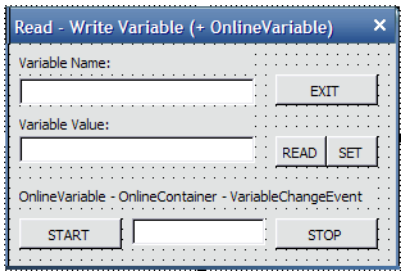

```
Option Explicit
```

```
Dim obVar As Variable
Dim WithEvents zOnlineVariable As OnlineVariable

'User defined Public Procedure for initializing Objects

Public Sub InitForm(obElem As Element)
    'set the variable object like the linked variable of the element
    Set obVar = obElem.ItemVariable(0)
    'write variable name into the textbox
    txtVarName.Text = obVar.Name
    'create an OnlineVariable container
    Set zOnlineVariable = thisProject.OnlineVariables.CreateOnlineVariables("OLV")
    'add variables to the container (by name of the variable)
    zOnlineVariable.Add obVar.Name
End Sub

Private Sub cmdExit_Click()
    'close Userform
    Unload Me
End Sub

Private Sub cmdRead_Click()
    'read value from variable and write into textbox
    txtValue.Text = obVar.Value
End Sub

Private Sub cmdWrite_Click()
    'write text as value to variable
    obVar.Value = txtValue.Text
    'or changing text to value before writing...
    'obVar.Value = Val(txtValue.Text)
End Sub

Private Sub cmdOLV_Start_Click()
    'start the OnlineVariable - Define
    'the VariableChange Event will be executed
    zOnlineVariable.Define
End Sub
```

```
Private Sub cmdOLV_Stop_Click()
    'stop the OnlineVariable - UnDefine
    'the VariableChange Event will be stopped
    zOnlineVariable.Undefine
End Sub

Private Sub zOnlineVariable_VariableChange(ByVal obVar As IVariable)
    'write actual value into textbox
    txtOLV.Text = obVar.Value
End Sub

Private Sub UserForm_Terminate()
    'the VariableChange Event will be stopped if running
    zOnlineVariable.Undefine
    'delete OnlineVariable container
    thisProject.OnlineVariables.DeleteOnlineVariables ("OLV")
End Sub
```

4.8.5 Use dialog multiple times

Userforms can be used multiple times.




```
Option Explicit
Dim obVar As Variable
Dim WithEvents zOnlineVariable As OnlineVariable
Dim strOLVName As String

Public Sub InitForm(obElem As Element)
    'set the variable object like the linked variable of the element
    Set obVar = obElem.ItemVariable(0)
```

```
    'write variable name into the textbox
    txtVarName.Text = obVar.Name
    'create name for Online Container
    strOLVName = "OLV_" & obElem.Name
    'get existing online container
    Set zOnlineVariable = thisProject.OnlineVariables.Item(strOLVName)
    'check if online container exists
    If zOnlineVariable Is Nothing Then
        'create an OnlineVariable container
        Set zOnlineVariable =
thisProject.OnlineVariables.CreateOnlineVariables(strOLVName)
        'add variables to the container (by name of the variable)
        zOnlineVariable.Add obVar.Name
    End If
End Sub

Private Sub cmdExit_Click()
    Unload Me      'close Userform
End Sub

Private Sub cmdRead_Click()
    'read value from variable and write into textbox
    txtValue.Text = obVar.Value
End Sub


Private Sub cmdWrite_Click()
    'write text as value to variable
    obVar.Value = txtValue.Text
    'or changing text to value before writing...
    'obVar.Value = Val(txtValue.Text)
End Sub

Private Sub cmdOLV_Start_Click()
    'the VariableChange Event will be executed
    zOnlineVariable.Define
End Sub

Private Sub cmdOLV_Stop_Click()
```

```
    'the VariableChange Event will be stopped
    zOnlineVariable.Undefine
End Sub

Private Sub zOnlineVariable_VariableChange(ByVal obVar As IVariable)
    'write actual value into textbox
    txtOLV.Text = obVar.Value
End Sub

Private Sub UserForm_Terminate()
    'the VariableChange Event will be stopped if running
    zOnlineVariable.Undefine
    'delete OnlineVariable container
    thisProject.OnlineVariables.DeleteOnlineVariables (strOLVName)
End Sub
```

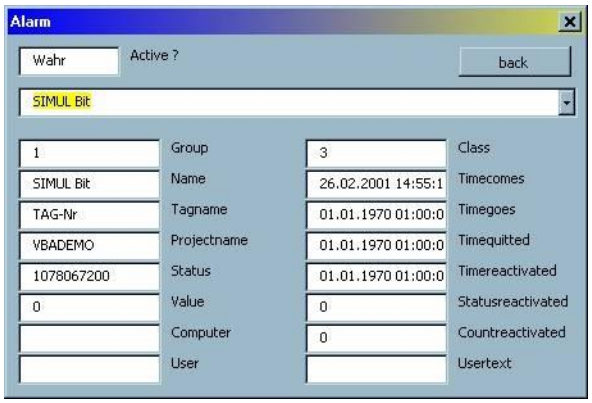
4.8.6 Alarm – Events and ActiveX Control handling

```
Option Explicit

Dim WithEvents obChart As MSChart
Dim WithEvents zOLV As OnlineVariable
Dim WithEvents zAlarm As Alarm

'procedure is executed on startup of the zenon Runtime

Private Sub Project_Active()
    'init the alarm object for events
    Set zAlarm = thisProject.Alarm
End Sub

'procedure is executed when an Alarm comes
Private Sub zAlarm_AlarmComes(ByVal obItem As IAlarmItem)
     Dim strInfo As String
    'write specific information about the alarm into a StringVariable
    strInfo = obItem.Text & " - " & obItem.Name
```

```
    thisProject.Variables.Item("Var_Comes").Value = strInfo
End Sub

'procedure is executed when an Alarm has gone
Private Sub zAlarm_AlarmGoes(ByVal obItem As IAlarmItem)
     Dim strInfo As String
    'write specific information about the alarm into a StringVariable
    strInfo = obItem.Text & " - " & obItem.Name
    thisProject.Variables.Item("Var_Goes").Value = strInfo
End Sub

'procedure is executed when an Alarm was acknowledged by a user
Private Sub zAlarm_AlarmAcknowledged(ByVal obItem As IAlarmItem)
     Dim strInfo As String
    'write specific information about the alarm into a StringVariable
    strInfo = obItem.Text & " - " & obItem.Name
    thisProject.Variables.Item("Var_Acknowledged").Value = strInfo
End Sub

'procedure is executed on terminating the zenon Runtime
Private Sub Project_Inactive()
    'free the alarm object
    Set zAlarm = Nothing
    'delete OnlineVariable for Chart actualization...
    thisProject.OnlineVariables.DeleteOnlineVariables "CHART"
End Sub

'procedure for MSChart ActiveX initialization...
Public Sub Init_MSChart_AX(YourAX As Element)
    Set obChart = YourAX.AktiveX
    obChart.RowCount = 3
    obChart.ColumnCount = 1
    Set zOLV = thisProject.OnlineVariables.Item("CHART")
    'does existing OnlineVariable exist?
    If zOLV Is Nothing Then
        'if not, create it...
        Set zOLV = thisProject.OnlineVariables.CreateOnlineVariables("CHART")
        zOLV.Add "Internal_UINT_001"
        zOLV.Add "Internal_UINT_002"
```

```
        zOLV.Add "Internal_UINT_003"
    End If
    zOLV.Undefine 'if not stopped, refreshing not possible
    'START watching variables...
    zOLV.Define
End Sub

'event on Variable change - refresh chart...
Private Sub zOLV_VariableChange(ByVal obVar As IVariable)
    'setting values to display in chart control
    Select Case obVar.Name
        Case "Internal_UINT_001"
            obChart.Row = 1
            obChart.RowLabel = "Var1"
            obChart.Data = obVar.Value
        Case "Internal_UINT_002"
            obChart.Row = 2
            obChart.RowLabel = "Var2"
            obChart.Data = obVar.Value
        Case "Internal_UINT_003"
            obChart.Row = 3
            obChart.RowLabel = "Var3"
            obChart.Data = obVar.Value
    End Select
End Sub

'event of the Chart AX...
Private Sub obChart_DblClick()
     MsgBox "You have DoubleClicked the ActiveX!"
End Sub
```

4.8.7 Access to alarms



DESCRIPTION:

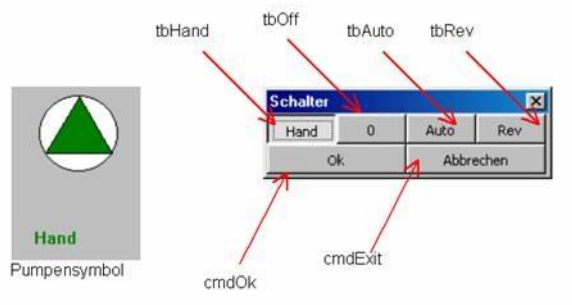
In the form frmAlarm an alarm from the memory can be selected in a combobox. After the selection all data of the alalm are written to the textboxes below (group, class, variable, ...).

We use an event independent macro to display frmAlarm, because we do not link it to an element.

```
Sub Alarm ()
frmAlarm.Show
End Sub
'The macro is executed with the function Execute macro.
'On opening the form it is initialized and so the following procedure is executed. This procedure cares, that all alarms in the memory are written to the combobox in the form.

Private Sub UserForm _ Initialize ()

'fill combobox with all AlarmItems
Dim i As Integer
Dim obAlarmItems As AlarmItems
Dim obAlarm As Alarm

Set obAlarm = thisProject.Alarm
Set obAlarmItems = obAlarm.AlarmItems (*)

If obAlarmItems.Count = 0 Then
MsgBox (# Alarms = 0 )
Exit Sub
End If

For i = 0 To obAlarmItems.Count - 1
cmbAlarmItems.AddItem obAlarmItems.Item ( i ). Name
```

```
Next i

txtAktiv.Text = obAlarm.Aktiv
cmbAlarmItems.Text = cmbAlarmItems.List ( 0 )
End Sub


'Wenn nun ein Alarm aus der Combobox ausgewählt wird reagiert das Change - Ereigniss der
Combobox.
Private Sub cmbAlarmItems _ Change ()

'put actual properties from AlarmItem in textboxes
Dim obAlarmItems As AlarmItems
Dim obAlar As Alarm

Set obAlarm = thisProject.Alarm
Set obAlarmItems = obAlarm.AlarmItems (*)
txtComputer.Text = obAlarmItems.Item ( cmbAlarmItems.ListIndex ).Computer
txtCountreactivated.Text = obAlarmItems.Item ( cmbAlarmItems.ListIndex ).Countreactivated
txtName.Text = obAlarmItems.Item ( cmbAlarmItems.ListIndex ). Name
txtProjectname.Text = obAlarmItems.Item ( cmbAlarmItems.ListIndex ).Projectname
txtStatus.Text = obAlarmItems.Item ( cmbAlarmItems.ListIndex ).Status
txtStatusreactivated.Text = obAlarmItems.Item ( cmbAlarmItems.ListIndex
).Statusreactivated
txtTagname.Text = obAlarmItems.Item ( cmbAlarmItems.ListIndex ).Tagname
txtTimecomes.Text = obAlarmItems.Item ( cmbAlarmItems.ListIndex ).Timecomes
txtTimegoes.Text = obAlarmItems.Item ( cmbAlarmItems.ListIndex ).Timegoes
txtTimequitted.Text = obAlarmItems.Item ( cmbAlarmItems.ListIndex ).Timequitted
txtTimereactivated.Text = obAlarmItems.Item ( cmbAlarmItems.ListIndex ).Timereactivated
txtUser.Text = obAlarmItems.Item ( cmbAlarmItems.ListIndex ).User
txtUsertext.Text = obAlarmItems.Item ( cmbAlarmItems.ListIndex ).Usertext
txtValue.Text = obAlarmItems.Item ( cmbAlarmItems.ListIndex ).Value
tbGroup.Text = obAlarmItems.Item ( cmbAlarmItems.ListIndex ).AlarmGroup
tbClass.Text = obAlarmItems.Item ( cmbAlarmItems.ListIndex ).AlarmClass
End Sub
```

4.8.8 Set switch (working with process variables)



In this example we draw a pump consisting of a circle and a triangle. Define the triangle as a symbol. On top draw a multibinary element and link it to three bit marker variables.

Additionally define, which color the triangle should get, if the values of the variables change.

First we combine the multibinary element with a macro, which opens a form frmSwitch.

In the form frmSwitch we will be able to change the values of the three bit marker variables.

Information

Only one of the three variables may have the value 1. (i.e. if one variable is set to 1, the other two have to be set to 0)

To be able to use this macro several times in project with different variables, you only may link bit marker variables ti the multibinary element, which contail in their names, which status of the pump they control.

for example:
Variable_Auto
Variable_Hand
Variable_Revi

Information

The suffixes _Auto, _Hand and _Revi are fixly defined in the source code of the example.

With this five characters suffix of the variable names it is defined, which variable is set to 1 and which is set to 0 on clicking a toggle button.

In the macro LeftClickUp_Switch a sub program FindVariable is called in the form frmSwitch, which gets the clicked element obElem.

```
Public Sub LeftClickUp_Schalter (obElem As Element)
frmSchalter.FindVariable obElem
position (pixel to points = (pixel * 0.75))
frmSchalter.Top = obElem.Bottom * 0.75
frmSchalter.Left = obElem.Left * 0.75
frmSchalter.Show
obElem.LeftClickUp
End Sub
```

Module global variable declaration:

```
Dim cmdLast As ToggleSchaltfläche
Dim strHand As String
Dim strAuto As String
Dim strRevi As String
In the sub program FindVariable all variables linked to the passed element are checked.
```

Depending on the suffix (_Auto, _Hand or _Revi) the variable names are assigned to the string variables declared above.

Additionally the status of the variables is determined and depending on the value (1 or 0) the according toggle button is pressed or not.

On opening the form frmSwitch the name of the currently pressed toggle button is written to a string variable. For the case, that the user decides to cancel his action, the original values are reset.

```
Public Sub FindVariable (obElem As Element)
Dim i As Integer
Dim obVariable As Variable

For i = 0 To obElem . CountVariable - 1
Select Case Right $( obElem . ItemVariable ( i ). Name , 5 )
Case _ Auto
strAuto = obElem . ItemVariable ( i ). Name

Case _ Hand
strHand = obElem . ItemVariable ( i ). Name

Case _ Revi
strRevi = obElem . ItemVariable ( i ). Name
```

```
End Select
Next i

Set obVariable = thisProject . Variables . Item ( strHand )
If obVariable . Value = 1 Then
tbHand . Value = True
Set cmdLast = tbHand
End If

Set obVariable = thisProject . Variables . Item ( strAuto )
If obVariable . Value = 1 Then
tbAuto . Value = True
Set cmdLast = tbAuto
End If

Set obVariable = thisProject . Variables . Item ( strRevi )
If obVariable . Value = 1 Then
tbRev . Value = True
Set cmdLast = tbRev
End If

If tbHand . Value = False And tbAuto . Value = False And tbRev . Value = False Then
tbOff . Value = True
Set cmdLast = tbOff
End If
End Sub
```

The self-created function VarExists only checks, whether the linked variables really exist. If this is not the case, an error message is displayed. Variable doesn't exist.

```
Function VarExists ()

Dim obVariable As Variable
Set obVariable = thisProject . Variables . Item (strHand)

If obVariable Is Nothing Then
MsgBox (Variable doesnt extist)
VarExitsts = False
Exit Function
End If

Set obVariable = thisProject . Variables . Item (strAuto)
If obVariable Is Nothing Then
MsgBox ( Variable doesnt extist )
VarExitsts = False
Exit Function
End If
```

```
Set obVariable = thisProject . Variables . Item (strRev)
If obVariable Is Nothing Then
MsgBox ( Variable doesnt extist )
VarExitsts = False
Exit Function
End If

VarExists = True
End Function
```

If the user clicks Cancel, the value change is undone and the original status is reset.

```
Private Sub cmdExit _ Click ()
cmdLast.Value = True
Unload Me
End Sub

Private Sub cmdOk _ Click ()
Unload Me
End Sub
```

If one toggle button is pressed, no other toggle button may be pressed.

```
Private Sub tbAuto_Change ()
If tbAuto . Value = False And tbHand.Value = False And tbRev . Value = False Then
tbOff . Value = True
End Sub
```

In the click event of every toggle button it is checked, whether it is pressed and whether the variable exists. If both conditions are true, the values are sent to the linked variables.

5. VSTA

The functionality of zenon Runtime and the Editor can be independently expanded with .NET programming using Visual Studio Tools for Applications - VSTA.

VSTA is also available, with limited functionality for zenon Web Server and zenon Web Client.

Information

If VBA macros are changed in the Editor,

- the Runtime files are compiled and transferred to the Runtime
- the Runtime is reloaded
- VSTA elements are also reloaded even if no changes were made in VSTA

VSTA provides separate development environments for workspace and project. You can only use one of them at a time. At the start every other VSTA development environment which is open will be close.

To open the VSTA Editor for the workspace:

1. press the short cut **Alt+F10**
2. the code for the workspace and all loaded projects is displayed

To open the VSTA Editor for the currently loaded project:

1. navigate to the **Programming interfaces** node
2. right click on VSTA
3. select **Open VSTA Editor...** in the context menu

the Editor is opened for the currently loaded project

5.1 Basics

VSTA is a Microsoft development environment that is based on .NET technology. It is necessary to have basic knowledge of object-orientated programming, .NET and C#/Visual Basic.NET to understand it.

5.1.1 Setting up the VSTA environment

Support for VSTA is already activated as standard in zenon. When deactivating VBA support, the VSTA environment is also not available any more.

The VSTA environment can be manually activated or deactivated with the following entry in C:\Users\All Users\COPA-DATA\System\zenon6.ini :

Activate VSTA	Deactivate VSTA
[VSTA] ON=1	[VSTA] ON=0

Support for VBA is activated or deactivated as follows:

Activate VBA	Deactivate VBA
[VBA] EIN=1	[VBA] EIN=0

After this, the development environment for VSTA in zenon is available.

Information

VSTA allows the development of projects in the programming languages C# and Visual Basic.NET. C# is envisaged as the standard language for VSTA projects in the Editor. The language can be changed to Visual Basic.NET with the following entry:

[VSTA]

CSHARP=0

5.1.2 Access to the object model in zenon

The zenon that is also used in VBA can be accessed in VSTA. The object model offers the same functionality in both development environments.

Attention

Some changes to the object model have been made due to limitations in naming VSTA objects. You can find these in the table below

Old property	New property
IDriver.Name	IDriver.Identification
IDriver.Driver	IDriver.Name
Old event	**New event**
IApplication.Close	IApplication.OnClose
IZenWorkspace.Startup	IZenWorkspace.OnStartup
IZenWorkspace.Exit	IZenWorkspace.OnExit

Access is VSTA is enabled via the `this` object and the replaces the `MyWorkspace` object in VBA. The following methods and objects are identical. In the following method, a template with the name "TemplateName" is created in zenon.

```
public void Macro1()
{
   this.ActiveDocument.Templates().Create("TemplateName", true);
}
```

Information

In contrast to VBA, capitalization and brackets after function names are important in VSTA.

To access the methods in zenon, the project must be saved and compiled using via the following steps:

1. Click on *File -> Save MyWorkspace.cs* to save the project.
2. Click on *File -> Build WorkspaceAddin* to compile the project.

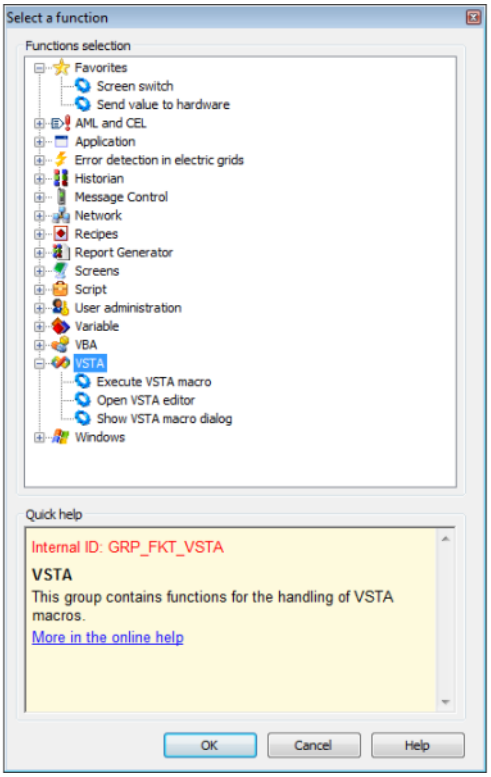
After this, the method is available as a macro in the VBA macro toolbar in the zenon editor. If the macro assignment dialog does not list all macros from MyWorkspace, the function 'Reload list of VBA macros' has to be executed from the toolbar.

Information

VSTA macros with parameters, e.g. `Public void MacroWithParam(string mString)`*, are not supported and also not made available in the macro tool bar.*

5.1.3 Functions in zenon

For VSTA, new functions were created in zenon. These are in the "VSTA" function group.



At the same time as existing VBA functions, similar functions were implemented for VSTA:

Function name	Description
Open VSTA editor	opens the VSTA editor in Runtime
Execute VSTA macro	A VSTA macro can be selected in the editor, which is started when executing the function in Runtime. **Note:** VSTA macros with parameters, e.g. `Public void MacroWithParam(string mString)`, are not supported. They are neither offered at the engineering in the Editor nor at the start of the function in the Runtime.
Show VSTA macro dialog	A dialog is shown in Runtime, in which existing VSTA macros are shown and can be selected and executed

5.1.4 Debugging VSTA add-in

It is possible to debug add-ins you have written yourself with the VSTA Editor. In doing so, note that project add ins can only be debugged in zenon Runtime and workspace add-ins can only be debugged in zenon Editor.

A debug session is started via the *Debug - Start Debugging* menu. You can place breakpoints in the same way as the VBA editor, by left clicking in the gray breakpoint toolbar at the left margin next to the respective cell.

Information

When debugging Runtime add-ins consider:

The Runtime files changed in zenon must be newly created before debugging.

5.1.5 New events in VSTA

Because an add-in is terminated when compiling amended code, starting a debug session or ending a debug session, new events were implemented in VSTA. These enable, for example, an object reference to be evaluated and approved and existing data to be saved.

Two events exist for each termination. The first event is started shortly before termination, the second after the start of a new add-in session.

Event	Description
OnPreVSTADebugStart	Is triggered shortly before a debug session is started. When starting, an active add-in is removed, references must be approved and existing data must be saved if necessary.
OnVSTADebugStart	Is triggered shortly after a debug session is started.
OnPreVSTADebugStop	Is triggered shortly before a debug session is stopped. When stopping a debug session, an active add-in is removed, references must be approved and existing data must be saved if necessary.
OnVSTADebugStopped	Is triggered shortly after a debug session is stopped.
OnPreVSTAUpdate	Is triggered before the add-in is removed if a new version of the add-in was successfully created.
OnPostVSTAUpdate	Is triggered when a new version of the add-in is loaded.

5.1.6 Creating a backup of VSTA projects

VSTA projects in Runtime are automatically zipped when creating the Runtime file and included in workspace saves.

VSTA projects in the editor must be saved manually however. The VSTA editor projects are in the folder C:/ProgramData/COPA-DATA/*version*/VSTAWorkspace/ .

5.2 Creating a VSTA project

Similar to VBA, there is the possibility in VSTA to create projects for both the editor and Runtime. In principle, projects in the editor are implemented in the C# programming language. For Runtime, both C# and Visual Basic.NET are available.

Information

Only one project can be displayed at a time in the VSTA editor. In addition, only one instance of the VSTA editors can be active. When starting the VSTA editor, any instance that may already be running is closed.

5.2.1 VSTA projects in the Editor

When creating a project for the zenon editor, a VSTA add-in for the workspace is loaded. To edit the add-in, the VSTA editor must be opened via *File - Open VSTA editor...*. The user interface of the VSTA editor is identical to Microsoft's Visual Studio development environment.

Information

VSTA editor help can be accessed via the Help / Contents menu. This help gives an overview of the editor's functions, the features of the .NET framework and programming in Visual Basic.NET and C#.

The VSTA add-in basically consists of the `MyWorkspace` class. This class can now be expanded with your own methods. The class accommodates the following two methods by default:

Function	Description
`MyWorkspace_Startup`	Is executed automatically when starting zenon, after a build has been created and when a debug session is started.
`MyWorkspace_Shutdown`	Is executed automatically when starting zenon, after a build has been created and when a debug session is started.

Attention

The method names may only start with `Macro` (for example Macro1, MacroVSTA) may not contain parameters and must be defined as `Public`. In addition, the class names and other methods and events created by VSTA may not be changed.

To access the methods in zenon, the project must be saved and compiled using via the following steps:

1. Click on *File -> Save MyWorkspace.cs* to save the project.
2. Click on *File -> Build WorkspaceAddin* to compile the project.

After this, the method is available as a macro in the VBA macro toolbar in the zenon editor. If the macro assignment dialog does not list all macros from MyWorkspace, the function 'Reload list of VBA macros' has to be executed from the toolbar.

5.2.2 VSTA projects in Runtime

To create a VSTA project for Runtime, the VSTA environment must be started. Proceed in the following way:

1. *Open the program interfaces item in the project manager.*
2. *Open the VSTA context menu.*
3. *Click on Open VSTA editor...*

Select the desired language in the selection dialog that now appears. After this, a project is created in the desired programming language.

Information

The desired language cannot be changed later; this dialog is therefore only shown the first time.

In this project, a class named `ThisProject` is created by zenon, which accommodates the following two methods:

Function	Description
`ThisProject_Startup`	Is executed automatically when Runtime is started
`ThisProject_Shutdown`	Is executed automatically when Runtime is ended

The class can now be expanded with your own methods.

Attention

The method names may only start with **`Macro`** *(for example Macro1, MacroVSTA) may not contain parameters and must be defined as* **`Public`** *. In addition, the class names and other methods and events created by VSTA may not be changed.*

There is access to all Runtime functionalities via the zenon object model. Editor-specific functions cannot be used, as in VBA.

zenon Runtime is automatically started when the debugger is started. Further information can be found in the chapter on debugging a VSTA add-in (on page 99).

Information

VSTA editor help can be accessed via the Help / Contents menu. This help gives an overview of the editor's functions, the features of the .NET framework and programming in Visual Basic.NET and C#.

5.2.3 Developing wizards in VSTA

The VSTA environment, like VBA (on page 69), offers the possibility to develop your own wizards.

To be able to access a form in the zenon object model, a reference to this must be copied to the form. To do this, a method is created in the **`MyWorkspace`** class. In the following example example, a form is instanced with the name **`wizard`** and the method **`ZenonInstance`** with a reference to the zenon object model is called as a parameter. The wizard form is shown by selecting **`ShowDialog()`**.

```
public void Macro1()
{
    Form1 Wizard = new Form1();
    Wizard.ZenonInstance(this.Application);
    Wizard.ShowDialog();
}
```

A member variable must be created in the form code, which recognizes the zenon object model.

```
public zenOn.IApplication m_Zenon=null;
```

Lastly, the **`ZenonInstance`** method is created. This methods takes the object model reference and places it in the **`m_Zenon`** object.

```
        public void ZenonInstance(zenOn.IApplication app)
        {
            m_Zenon = app;
        }
```

Now, your own classes and methods can be developed in the form, which make use of the object model. All methods, objects and attributes are available via the **m_Zenon** object.

5.3 Examples

Here you find some examples of VSTA being used, both in Runtime and in the editor.

5.3.1 Creating variables in the zenon Editor

In this example, a text file is opened and the contents of this are used to create variables in the zenon editor. The text file contains any desired number of lines. Each line includes the name and data type of a variable; these are separated by a comma (example: Variable1,BOOL).

The **Macro1** method first looks for the internal driver in the zenon editor. After this, the user is shown a file selection dialog in which he must select the text file. The method then reads the text file and creates the variables. The **GetDataType** method is then required to determine and assign the attendant data type when creating the variables.

```
using System;
using System.Windows.Forms;
using System.IO;
namespace WorkspaceAddin
{
    [System.AddIn.AddIn("MyWorkspace", Version = "1.0", Publisher = "", Description = "")]
    public partial class MyWorkspace
    {
        private void MyWorkspace_Startup(object sender, EventArgs e)
        {
        }
        private void MyWorkspace_Shutdown(object sender, EventArgs e)
        {
        }
        public zenOn.IVarType GetDataType(zenOn.IVarType vType, string strVType)
```

```
        {
            //gets the corresponding vartypes for bool, int, real and strings
            switch (strVType)
            {
                case "BOOL":
                    vType = this.ActiveDocument.VarTypes().Item("BOOL");
                    break;
                case "INT":
                    vType = this.ActiveDocument.VarTypes().Item("INT");
                    break;
                case "REAL":
                    vType = this.ActiveDocument.VarTypes().Item("REAL");
                    break;
                case "STRING":
                    vType = this.ActiveDocument.VarTypes().Item("STRING");
                    break;
                default:
                    vType = this.ActiveDocument.VarTypes().Item("INT");
                    break;
            }
            return vType;
        }
        public void Macro1()
        {

            //create objects that will take the intern driver and the variable type
            zenOn.IDriver zInternDriver = null;
            zenOn.IVarType vType = null;
            //search for the Intern driver and throw exception if no driver was found
            try
            {
                for (int nDriverCount = 0; nDriverCount <
this.ActiveDocument.Drivers().Count; nDriverCount++)
                {
                    if (this.ActiveDocument.Drivers().Item(nDriverCount).Name ==
"Intern")
                    {
                        zInternDriver =
this.ActiveDocument.Drivers().Item(nDriverCount);
```

```
                }
            }
        }
        catch (Exception xDrv)
        {
            MessageBox.Show("Unable to find zenon 'Intern' driver. Error: " +
xDrv.Message);
            throw;
        }
        this.ActiveDocument.Variables().DoAutoSave(false);
        try
        {
            OpenFileDialog VarFileSelect = new OpenFileDialog();
            String[] strVarLine = new String[2];

            //show file dialog
            if (VarFileSelect.ShowDialog() == DialogResult.OK)
            {
                string strLine = string.Empty;
                //open new stream reader with selected file
                StreamReader ImportStream = new StreamReader(VarFileSelect.FileName,
System.Text.Encoding.Default);

                //read in line by line, split the lines when a ',' occurs and create
variables
                while ((strLine = ImportStream.ReadLine()) != null)
                {
                    strVarLine = strLine.Split(new Char[] { ',' });
                    this.ActiveDocument.Variables().CreateVar(strVarLine[0],
zInternDriver, zenOn.tpKanaltypes.tpSystemVariable, GetDataType(vType,strVarLine[1]));
                }
                ImportStream.Close();
            }
        }
        catch (Exception xFileRd)
        {
            MessageBox.Show("An error occured while opening the file: " +
xFileRd.Message);
            throw;
```

```
            }
            this.ActiveDocument.Variables().DoAutoSave(true);
        }
        #region VSTA generated code
        private void InternalStartup()
        {
            this.Startup += new System.EventHandler(MyWorkspace_Startup);
            this.Shutdown += new System.EventHandler(MyWorkspace_Shutdown);
        }
        #endregion
    }
}
```

5.3.2 Writing project information in the zenon output window

In this example, it is demonstrated how the output window of the zenon editors can be accessed using VSTA. The method named **Macro1** reads out the process screens created in the project for this, identifies the respective template and identifies all drivers available as well as their labels.

```
using System;
namespace WorkspaceAddin
{
    [System.AddIn.AddIn("MyWorkspace", Version = "1.0", Publisher = "", Description = "")]
    public partial class MyWorkspace
    {
        private void MyWorkspace_Startup(object sender, EventArgs e)
        {
        }
        private void MyWorkspace_Shutdown(object sender, EventArgs e)
        {
        }
        public void Macro1()
        {
            string strPicName = string.Empty;
            string strCorTemp = string.Empty;
            string strDriverName = string.Empty;
            string strDrvDesc = string.Empty;
            //print start string into output window
```

```
            this.Application.DebugPrint(" --------------START--------------",
zenOn.tpDebugPrintStyle.tpMsg);
            //go through all pictures and print name and used template into output window
            for (int i = 0; i < this.ActiveDocument.DynPictures().Count; i++)
            {
                strPicName = this.ActiveDocument.DynPictures().Item(i).Name;
                strCorTemp =
this.ActiveDocument.DynPictures().Item(i).get_DynProperties("Template").ToString();
                this.Application.DebugPrint(" Picture '" + strPicName + "' uses Template
'" + strCorTemp + "'",zenOn.tpDebugPrintStyle.tpMsg);
            }
            //print separator string into output window
            this.Application.DebugPrint("
------------------------------",zenOn.tpDebugPrintStyle.tpMsg);
            //go through all drivers and print name and description into output window
            for (int i = 0; i < this.ActiveDocument.Drivers().Count; i++)
            {
                strDriverName = this.ActiveDocument.Drivers().Item(i).Name;
                strDrvDesc = this.ActiveDocument.Drivers().Item(i).Identification;
                this.Application.DebugPrint(" Driver '" + strDriverName + "' has
description '" + strDrvDesc + "'", zenOn.tpDebugPrintStyle.tpMsg);
            }
            //print end string into output window
            this.Application.DebugPrint(" ---------------END---------------",
zenOn.tpDebugPrintStyle.tpMsg);
        }
        #region VSTA generated code
        private void InternalStartup()
        {
            this.Startup += new System.EventHandler(MyWorkspace_Startup);
            this.Shutdown += new System.EventHandler(MyWorkspace_Shutdown);
        }
        #endregion
    }
}
```

5.3.3 Reading variables from zenon via regular expressions

In the following example, zenon variables are read out in a Runtime project and saved in a local text file.

Using regular expressions, variables are only read if their names start with 3 figures and a subsequent underscore (for example "001_var" or "234_xyz"). The user is then requested to select a folder. A text file with a time-dependent file name is created in this folder. In this file, name, labeling and current value of all applicable variables is saved separately with a semi colon.

Information

It is possible that manual references may have to be added to execute the example in zenon Runtime. To do this, open the context menu in project explorer and click on Add Reference... The references required in this example are as follows:

- Microsoft.VisualStudio.Tools.Applications.Runtime.v9.0
- System
- System.AddIn
- System.Data
- System.Windows.Forms
- System.Xml
- zenonVSTAProxy6500

```
using System;
using System.Text.RegularExpressions;
using System.IO;
using System.Windows.Forms;
namespace ProjectAddin
{
    [System.AddIn.AddIn("ThisProject", Version = "1.0", Publisher = "", Description = "")]
    public partial class ThisProject
    {
        private void ThisProject_Startup(object sender, EventArgs e)
        {
        }
        private void ThisProject_Shutdown(object sender, EventArgs e)
        {
        }
        public void Macro1()
```

```
        {
            string sFilename = string.Empty;
            string strName = string.Empty;
            string strDescription = string.Empty;
            string strValue = string.Empty;

            //define regular expression pattern
            Regex rexMatch = new Regex("^([0-9]){3}[_]");
            try
            {
                sFilename = FolderSelection("Select place to store the variable
information");

                //create stream writer to the .txt file
                StreamWriter MatchedVariables = new StreamWriter(sFilename, true);
                //run through all variables in zenon
                for (int i = 0; i < this.Variables().Count; i++)
                {
                    //if name of the variable matches the pattern, get name, tag name and
current value
                    if (rexMatch.IsMatch(this.Variables().Item(i).Name))
                    {
                        strName = this.Variables().Item(i).Name;
                        strDescription = this.Variables().Item(i).Tagname;
                        strValue = this.Variables().Item(i).get_Value(0).ToString();
                        //write information to the .txt file
                        MatchedVariables.WriteLine(strName + ";" + strDescription + ";"
+ strValue);
                    }
                }
                //close stream
                MatchedVariables.Close();
            }
            catch (Exception xFS)
            {
                MessageBox.Show ("An error occurred -> " + xFS.Message);
                throw;
            }
        }
```

```
        private string FolderSelection(String strCaption)
        {
            string strSelectedPath = string.Empty;
            //create a dialog for selecting the output folder
            FolderBrowserDialog FolderSelectionDialog = new FolderBrowserDialog();
            FolderSelectionDialog.Description = strCaption;
            try
            {
                if (FolderSelectionDialog.ShowDialog() == DialogResult.OK)
                {
                    //if selection was valid, get the current date, put it to file date
format
                  //then create a txt file with the name "zenonVar" and the corresponding
date
                    DateTime currentTime = DateTime.Now;
                    strSelectedPath = FolderSelectionDialog.SelectedPath + "\\zenonVar"
+ currentTime.ToFileTime() + ".txt";
                }
            }
            catch (Exception xFD)
            {
                MessageBox.Show("An error occurred: "+xFD.Message);
                throw;
            }
            return strSelectedPath;
        }
        #region VSTA generated code
        private void InternalStartup()
        {
            this.Startup += new System.EventHandler(ThisProject_Startup);
            this.Shutdown += new System.EventHandler(ThisProject_Shutdown);
        }
        #endregion
    }
}
```