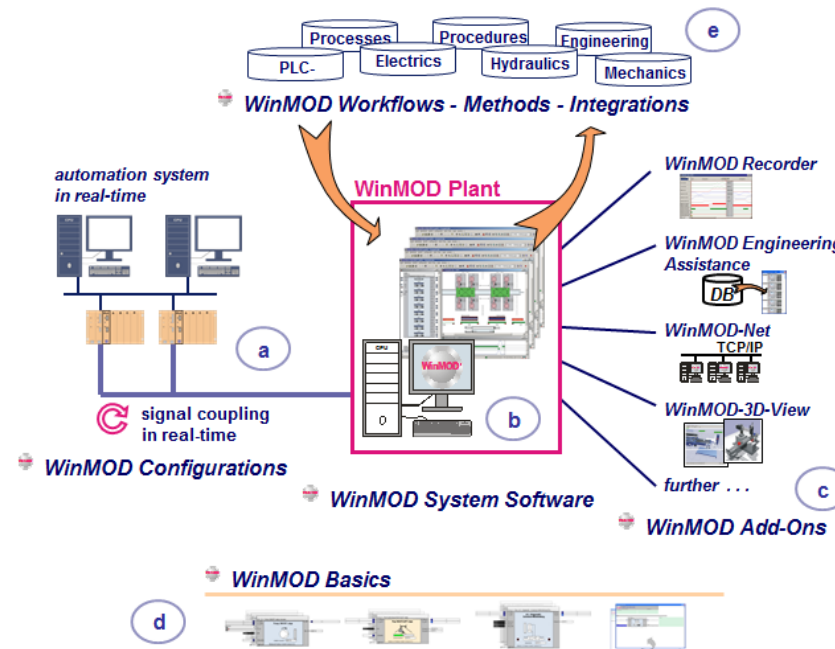


# Real-time Simulation Center for Automation

## WinMOD FormulaX What is new in WinMOD 7.1

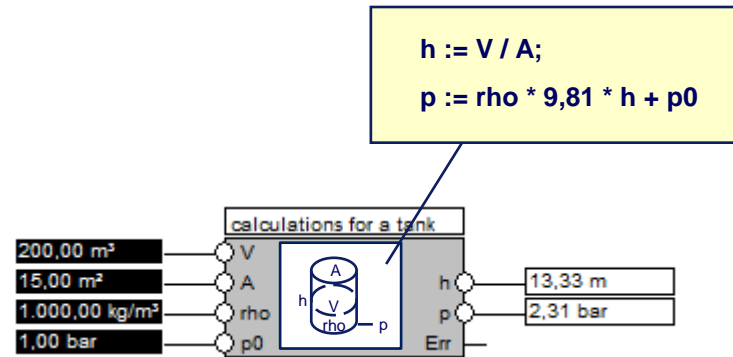


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**Real-time Simulation Center for Automation**

*New Simulation Element*

**FormulaX**



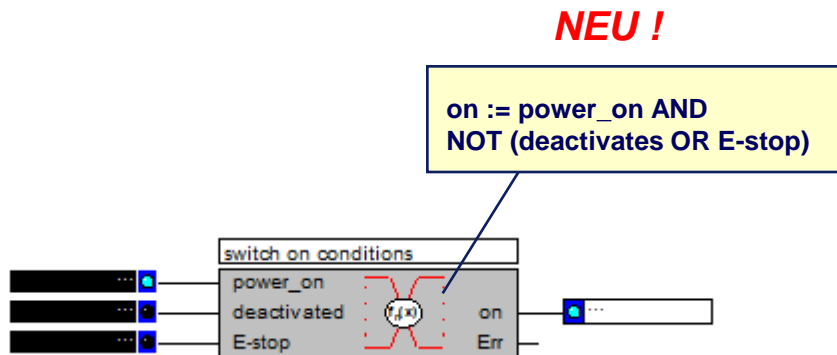
**completely new simulation element  
for processing formulas  
with entirely new possibilities**

## ***New simulation element WinMOD FormulaX (general functions)***

### **new possibilities in all areas**

- binary and logic expressions
- conditional analog expressions
- multiple formulas and outputs
- formula editor with comments
- display of formulas
- graphical display of the functionality
- realization of special customer elements
- automatic optimization of expressions

### Binary and Logic Expressions



#### Example

switch-on conditions

The new formula element offers **binary In- and Outputs** and their logic combination.

With that it can also process expressions from **Boolean algebra** and **logic expression**.

Available operands are:

- NOT
- AND, OR, XOR, EQ

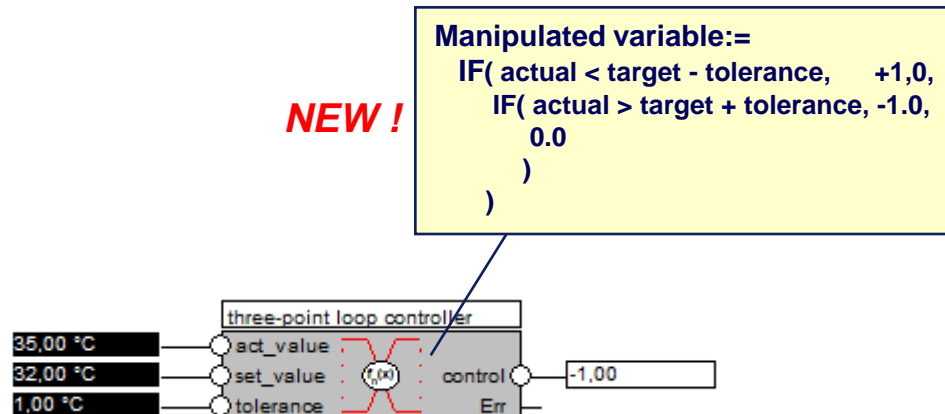
Available constants are:

- TRUE, FALSE

#### Advantages:

- processing of binary signals
- Boolean algebra and logical expressions
- compact notation

### Conditional Analog Expressions



The conditional analog expression **IF** has the form:

**IF( Condition, expression-true, expression-false ).**

If the condition is true, the expression returns the value of expression-true, otherwise the value of expression-false.

**Condition** needs to be a **logic expression**, **expression-true** and **expression-false** need to be **numeric expressions**.

Logical values are formed from numeric values by the relations:

- <, >, =, <=, >= and <>.

**Advantages:**

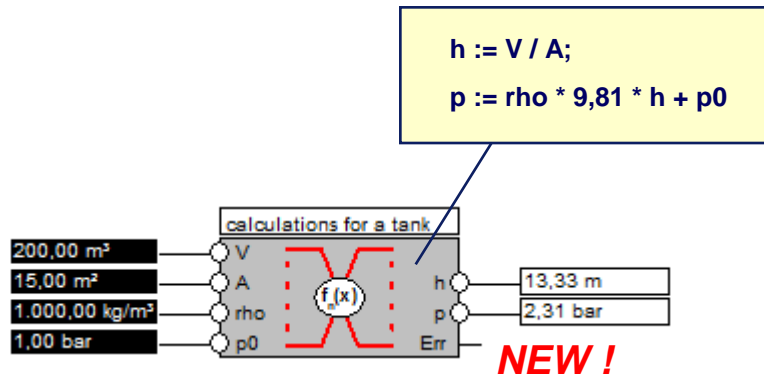
- compact notation
- high flexibility

### Example

#### Three-point loop controller

- +1: actual < target - tolerance
- 1: actual > target + tolerance
- 0: other

### Multiple Formulas and Multiple Outputs



**Multiple outputs** can be defined for the new formula module.

For each output a formula is given in the formula editor. The assignment takes place by the assignment operator **:=**.

The formulas are separated by **;** and they are processed from top to bottom.

In that way formulas can easily be grouped, intermediate results can be further processed or be used for testing purposes.

### Example

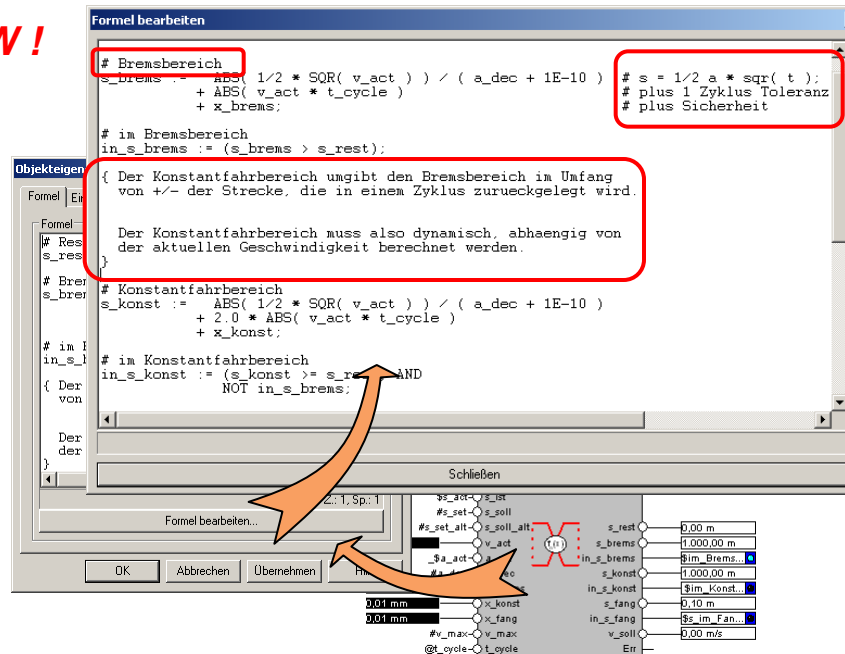
- calculation of dependent values in a single step:
- filling level h
  - pressure p

### Advantages:

- compact notation
- utilization of intermediate results
- easy debugging

### Formula Editor with Comments

**NEW!**



**Example**

commented  
physical formula set

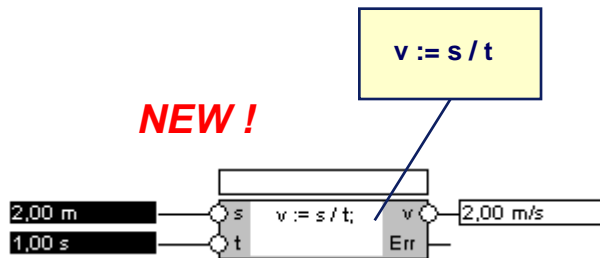
The formula editor of the new formula-element offers a flexible documentation of the formulas:

- comments from "#" until end of line
- comments by "{" and "}" in line and beyond the end of lines

#### Advantages:

- internal documentation
- quick orientation

### Display of Formulas



### Example

simple formula

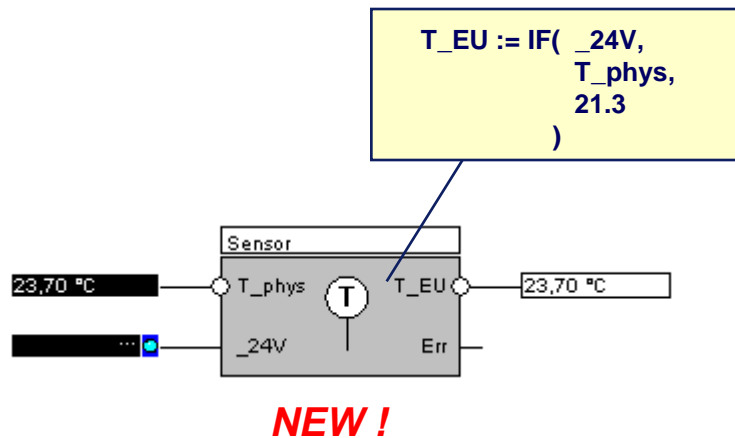
On the surface of the formula element the internal **formula can be displayed**.

#### Advantages:

- direct verification of contents
- Immediate documentation



### Graphical Display of Functionality



### Example

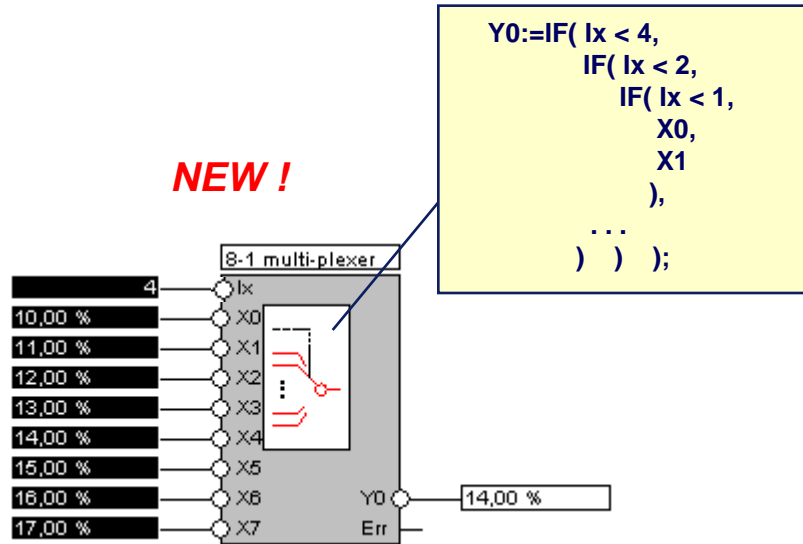
temperature sensor

On the **surface** of the new formula element a **graphic** can be displayed which **illustrates the internal function**.

### Advantages:

- lively display
- good recognition

### Realization of special Customer Elements



#### Example

8-to-1 Multiplexer

Customers often ask for **special simulation elements**. The number of possible elements would, however, highly bloat the **element library**.

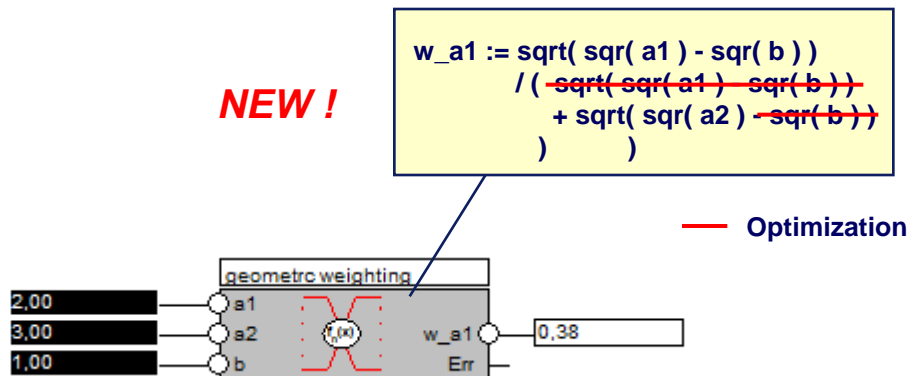
These functions can now be **realized by the customers themselves** and can be organized in customer libraries.

For classes of general functions special **WinMOD Libraries** are in preparation.

#### Advantages:

- high flexibility
- tailor-made function

### Automatic Optimization of Expressions



### Example

geometric weighting

The new formula element **optimizes** internal **recurring expressions** and calculates their value only once.

By that, the calculating power is massively enhanced.

In the **Example**,  $\text{sqrt}(a1)$  und  $\text{sqrt}(b)$  occur more than once, but are only calculated once, just like the overall expression  $\text{sqrt}(\text{sqrt}(a1) - \text{sqrt}(b))$ .

### Advantages:

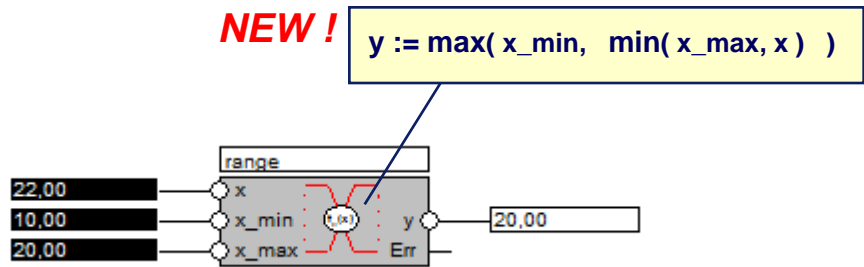
- high runtime efficiency

## **New simulation element WinMOD FormulaX (special functions)**

**FormulaX provides  
special functions and optimization**

- min- and max-functions
- signed SQR and signed SQRT
- Modulo-function
- system variables for cycle time

### min- and max-Functions



### Example

Limitation of a value  $x$   
in range  $[x\_min; x\_max]$

The new formula element offers all functions of older versions plus a variety of new functions and possibilities.

The functions **min** and **max** deliver the argument with the smallest or biggest value respectively .

The argument lists can contain any number of arguments.

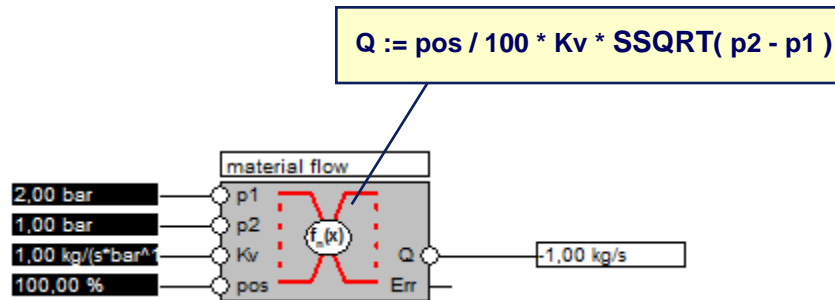
- $\min(x_1, x_2, \dots, x_n)$
- $\max(x_1, x_2, \dots, x_n)$

### Advantages:

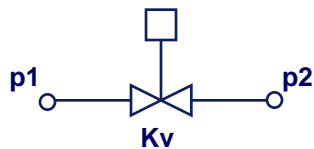
- simple, compact notation

### Signed SQR and Signed SQRT

**NEW !**



### Example



$$Q = K_v * \sqrt{p_2 - p_1}$$

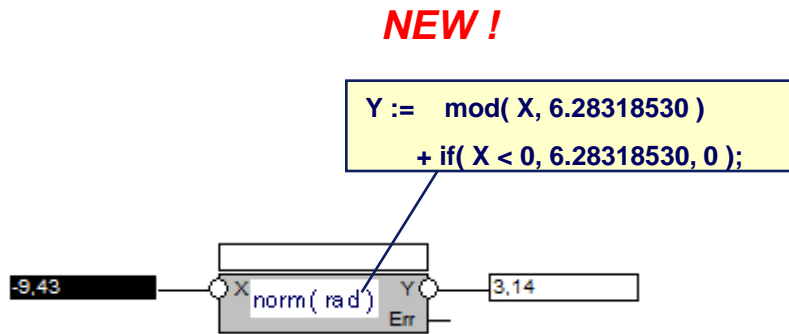
For a number of applications **squaring and root extraction** happen under **retention of the sign**.

For this application the function **SSQR (signed square)** and **SSQRT (signed square root)** were created.

### Advantages:

- runtime efficiency
- compact notation

### Function Modulo



### Example

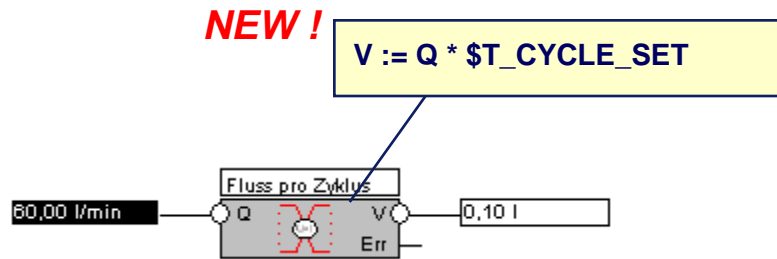
nomination of angles

The **modulo function** gives the remainder of integer division of two floating point numbers.

### Advantages:

- easy, compact notation

### System Variables for Cycle Time



#### Beispiel

maximum volume growth caused by a flow during the current cycle

$$V = Q * \$T\_CYCLE\_SET$$

A number of calculations require the **WinMOD cycle times**. Until now the configured cycle time was stored in an operand and then forwarded to the components and formulas as an input.

Now the cycle time is available **in the formula element as a system variable**. Right where it is needed.

2 types of the cycle time are available:

- **\$T\_CYCLE\_SET** configured maximum cycle time
- **\$T\_CYCLE\_ACT** actual duration of previous cycle

$T\_CYCLE\_ACT \leq T\_CYCLE\_SET$   
(if the WinMOD-PC is not overcharged)

#### Advantages:

- simple handling
- always up-to-date
- no overhead of parameters



## **WinMOD Add-on FormulaX (extended functions)**

**the add-on enables the  
systematic creation and management  
of FormulaX libraries**

- multiple outputs for complex formula systems
- know-how-protection by licenses
- protected formula libraries

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### Multiple Outputs for complex Formula Systems

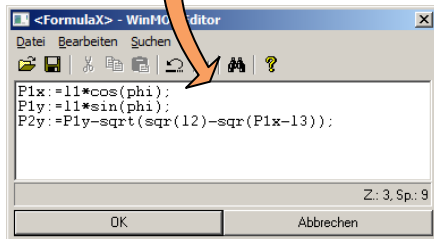
$$P_{1x} = l_1 \cdot \cos \varphi$$

$$P_{1y} = l_1 \cdot \sin \varphi$$

$$P_{2y} = P_{1y} - \sqrt{l_2^2 - (P_{1x} - l_3)^2}$$

Formulas

**NEW!**

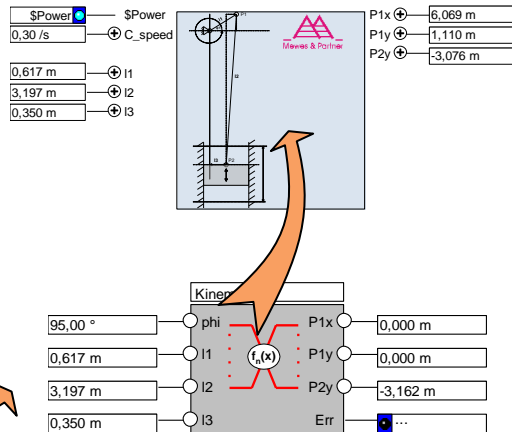


FormulaX Formula Editor

Example

creation of complex, formula-based components

Component



FormulaX

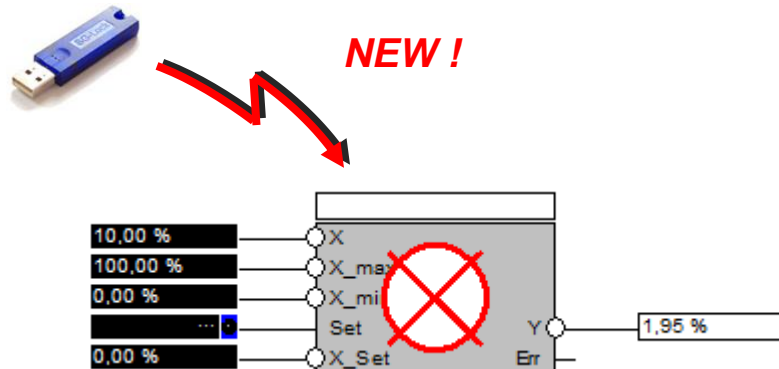
The Add-on makes it possible to summarize even **complex mathematic functions** and **systems of formulas** in a single formula element.

This provides, simple reuse and application.

**Advantages:**

- complex mathematics and physics
- simple handling

### Know-how-Protection by Licenses



#### Example

The element FormulaX is not executable without the required content license.

WinMOD FormulaX can be protected by **Content Licenses**.

The content licenses are deposited on the **WinMOD license plug (Dongle)**, as it is already possible for components, simulation files and WinMOD projects.

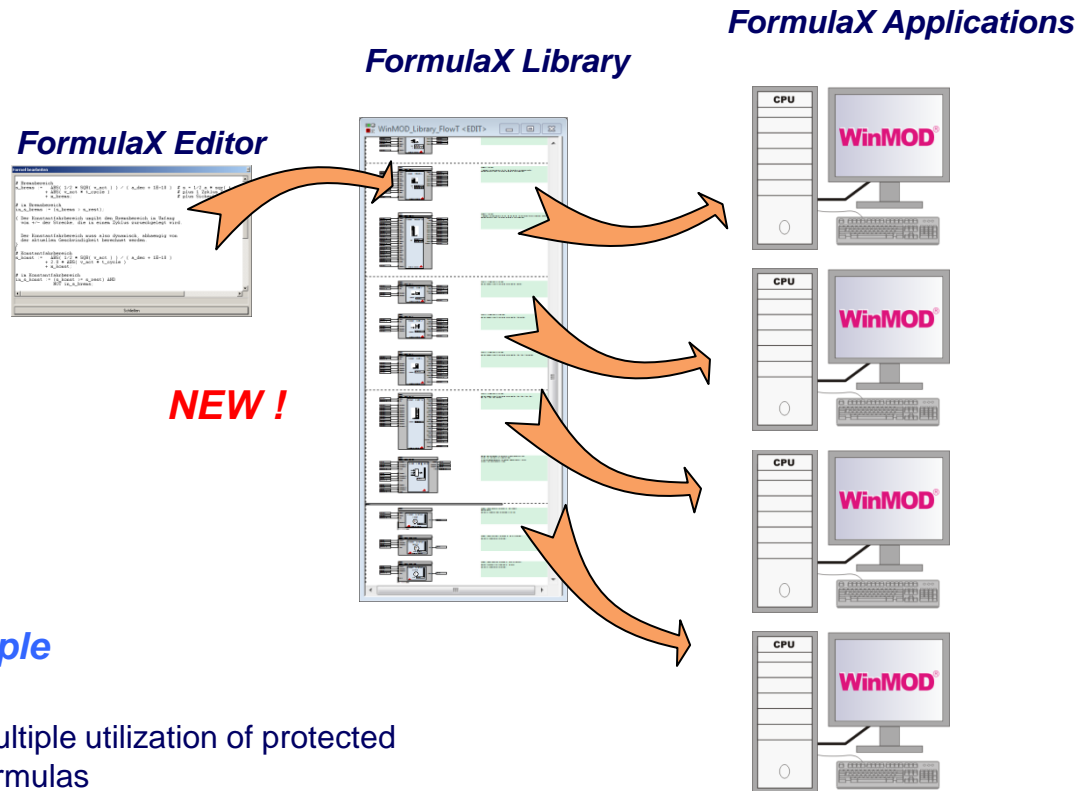
The licensing defines the access rights:

- read and execute
- only execute
- no access

#### Advantages:

- efficient know-how protection

### Protected Formula Libraries



#### Example

multiple utilization of protected formulas

With this, the **systematic handling of extensive know-how** becomes possible:

The formulas are stored as a **library** of FormulaX that are protected by content licenses.

They can then be **diversely and safely used** in WinMOD plants

- in your own company,
- by your clients or
- by your contractors.

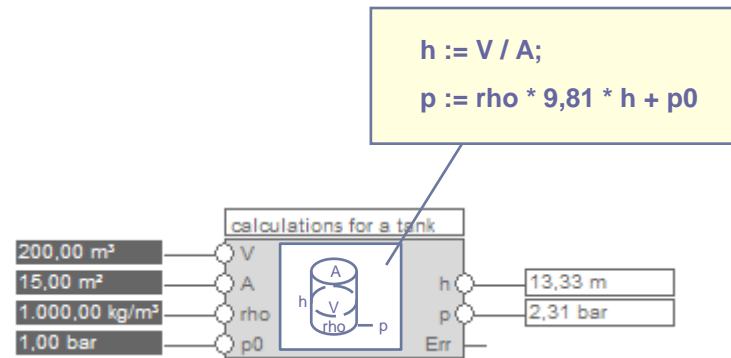
#### Advantages:

- easy and extensive protection of know-how

*New Simulation Element*

# FormulaX

for logics, mathematics and physical modeling . . .

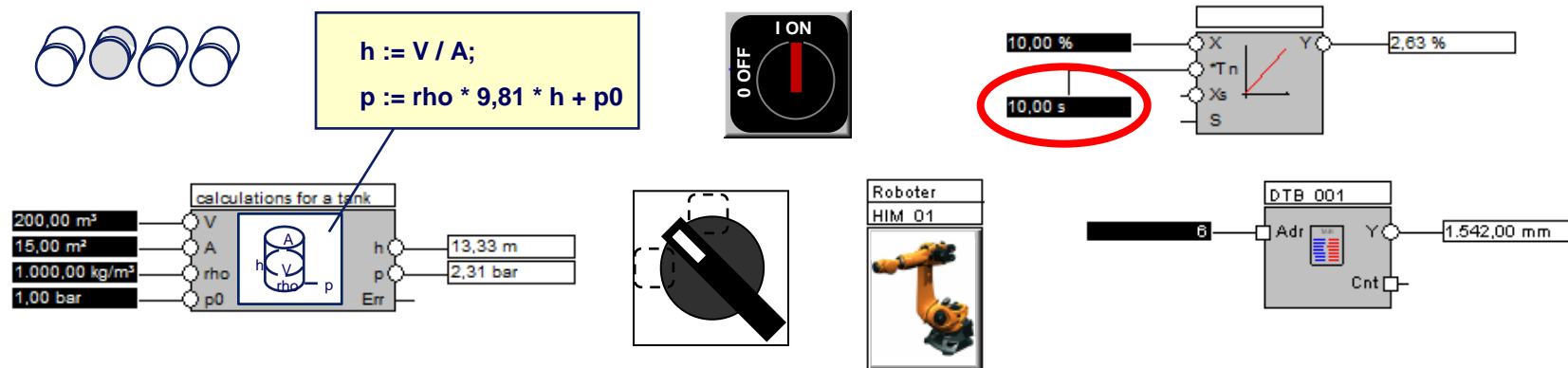


. . . simply extensive

### Real-time Simulation Center for Automation

# What is new in WinMOD 7.1 ?

*generic elements and more . . .*



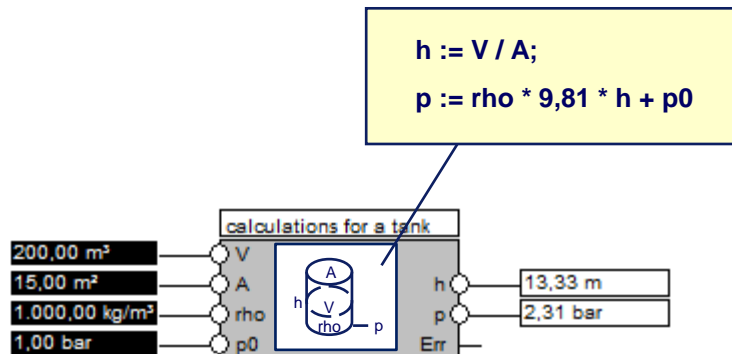
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## *the new simulation element WinMOD FormulaX*

**entirely new simulation element for formulas  
with fundamentally new possibilities**

completely new element for formulas

(see slide set "WinMOD-FormulaX")



### Example:

simultaneous dependent calculations:

- filling level h
- pressure p

graphical display of the functionality

**NEW !**

The entirely newly developed element for formulas **FormulaX** offers many new possibilities and applications:

- binary and logical expressions
- conditional analog expressions
- multiple formulas and outputs
- formula editor with comments
- display of formulas
- graphical display of the functionality
- realizing special customer elements
- automatic optimization of expressions
- min- and max-functions
- signed SQR and Signed SQRT
- Modulo-function
- system variables for the cycle time
- multiple exits for extensive formula systems
- know-how-protection by licensing
- protected formula libraries

### Advantages:

- complex mathematics and physics
- easy handling



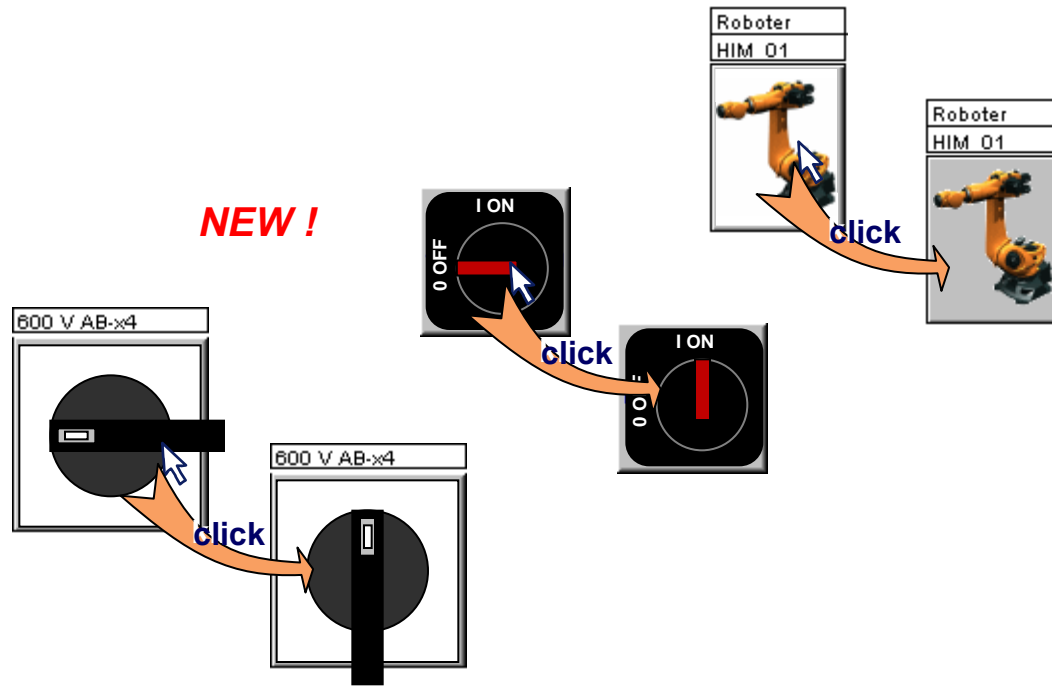
### ***Control Elements***

**do-it-yourself:**

**control elements for "self-construction"**

- ***manual signal map "graphical"***
- ***manual signal map "transparent"***

### manual signal creation "graphical"



### Example

Switches and buttons with two positions are simply displayed by pictures and controlled via mouse click.

The **manual signal map**, which delivers a binary signal when clicking on it, can now be furnished with **graphics**.

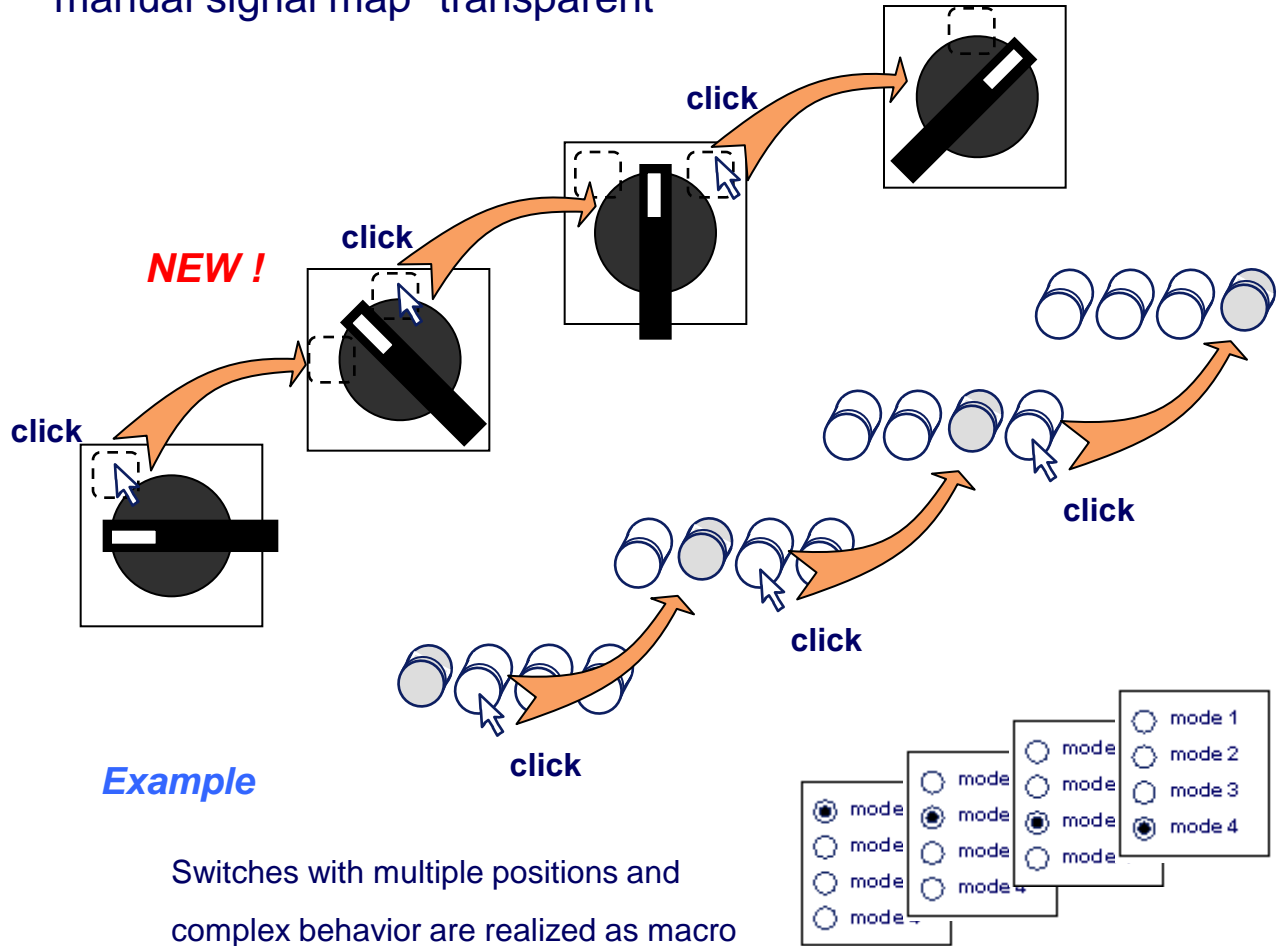
As graphics  
- drawings or  
- photos  
of real switches can be used.

In this way a wide **variety of different models of switches** can be easily realized and realistically displayed .

### Advantages:

- fast realization
- vivid display
- easy recognition

### manual signal map "transparent"



### Example

Switches with multiple positions and complex behavior are realized as macro and are controlled via mouse click.

The manual signal map can be configured as **transparent**.

In this way components for **complex switches** can be created:

- A **digital Active Image** provides the different displays of the switch positions.
- On this, **transparent manual signal maps** are placed at the switching points.
- Signal maps and Active Images are connected by the required **circuitry**.
- This functionality is summarized as a **component**. In this way, the new switches can be easily used further.

### Advantages:

- complex behavior
- easily built

examples on request

## ***Internal Analog Formats***

extensions and optimization

- ***Standardized formats for times***
- ***Option "symmetrical value range" set***

### Formats for Times

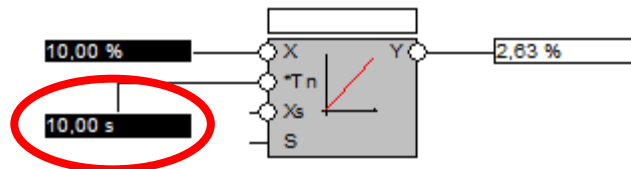
In the system software now provides the following compatible internal analog formats for the physical unit “time“:

**NEW !**

- time [h] 0...100,00 \*
- time [min] 0...6.000,00
- time [s] 0...360.000,00 SI

#### Example

display of actuating time  
in seconds



In addition to the standard formats for percent-data, now also the **proven standard formats** for the **display of time** are introduced.

They are based on the definition of 1% for 1 hour.

This results in a **range of values** of **4.25 days** with a **resolution** of **0.16 milli-seconds**.

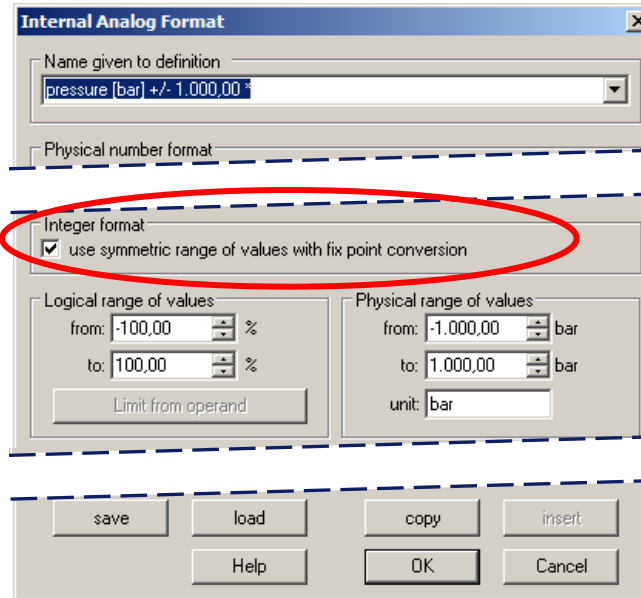
These formats showed their value in almost all application areas.

#### Advantages:

- fast - clear - general

Option "symmetric range of values" set

**ATTENTION !**  
- optimized default value



**Internal Analog Format**

Name given to definition  
pressure [bar] +/- 1.000.00

Physical number format

**Integer format**  
 use symmetric range of values with fix point conversion

Logical range of values  
 from: -100,00 %  
 to: 100,00 %  
 Limit from operand

Physical range of values  
 from: -1.000,00 bar  
 to: 1.000,00 bar  
 unit: bar

save load copy insert  
 Help OK Cancel

### Example

For numeric applications the pressure "zero" is safely situated at the numeric "zero".

For a **high numeric accuracy** the option "symmetrical value range" must be set for internal analog formats.

The option is now **set by default** in WinMOD 7.1.

### Advantages:

- easy handling
- error-proof physical calculations

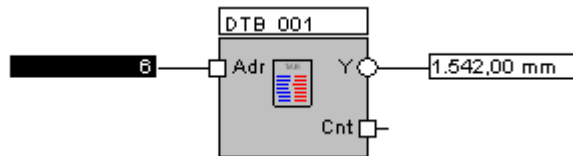
## ***Table Elements***

**new table element**  
**additional information**

- ***table digital-analog***
- ***new output: number of elements***

### Table Digital-Analog

**NEW!**



#### Example

drive technology:  
digital selection of  
predefined set values

digital selection	analog set value
1	474,00
2	587,00
6	1542,00
8	1725,00
13	2000,00

The table digital-analog completes the set of table elements in WinMOD.

It enables the **digital addressing of analog values**, as it can be found in many applications like

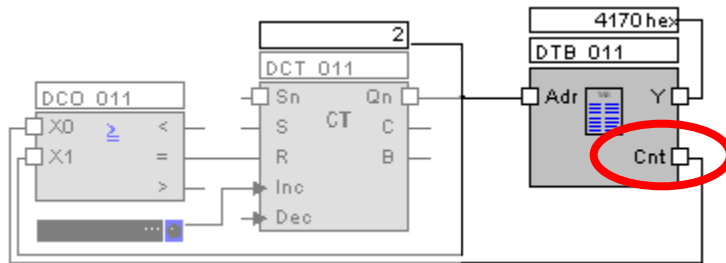
- table positioning
- parameter access
- digital set-value-selection

#### Advantages:

- simple realization of memories



### New output: Number of Elements



**NEW !**

All table elements now have an **Output Cnt**, which **gives the number of entries in the table**.

In this way the number of elements in the table does not have to be explicitly given elsewhere.

In this way it becomes easy to:

- run through tables with digital addressing
- detect address errors

### Example

output-stream of a barcode-scanner

Nr.	Word
0x0	0xA0.0A
0x1	0x10.07
0x2	0x41.70
0x3	0x01.70
0x4	0x20.D1
...	...

### Advantages:

- easy configuration and parameterization

### ***Windows 8***

**WinMOD 7.1 runs  
completely on Windows 8**

WinMOD 7.1 for Windows 8 32-Bit  
and for Windows 8 64-Bit



**WinMOD 7.1 runs without limitations on  
Windows 8**

**WinMOD 7.1** is released for

- **Windows 8 32-Bit** **NEW !**
- **Windows 8 64-Bit** **NEW !**
- **Windows 7 32-Bit, SP1 or higher**
- **Windows 7 64-Bit, SP1 or higher**
- **Windows XP 32-Bit, SP 3 or higher**

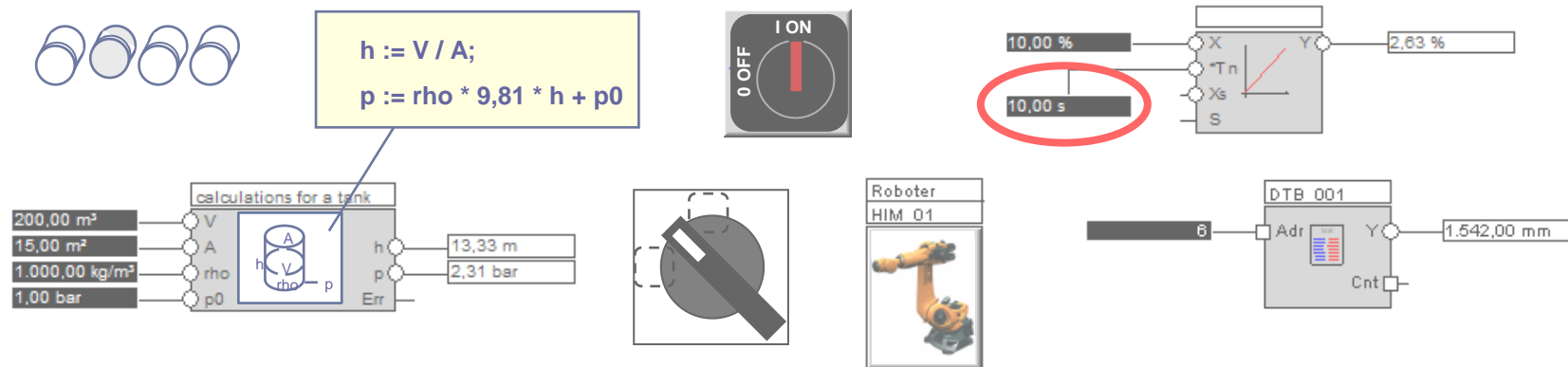
This applies to the entire WinMOD System Platform:

- all WinMOD Configurations\*
- the WinMOD System Software
- all WinMOD Add-Ons

\* Excluded are drivers only available in 32-Bit

# What is new in WinMOD 7.1 ?

*generic elements and more . . .*



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