



AKADEMIA GÓRNICZO-HUTNICZA
IM. STANISŁAWA STASZICA W KRAKOWIE

AGH UNIVERSITY OF SCIENCE
AND TECHNOLOGY

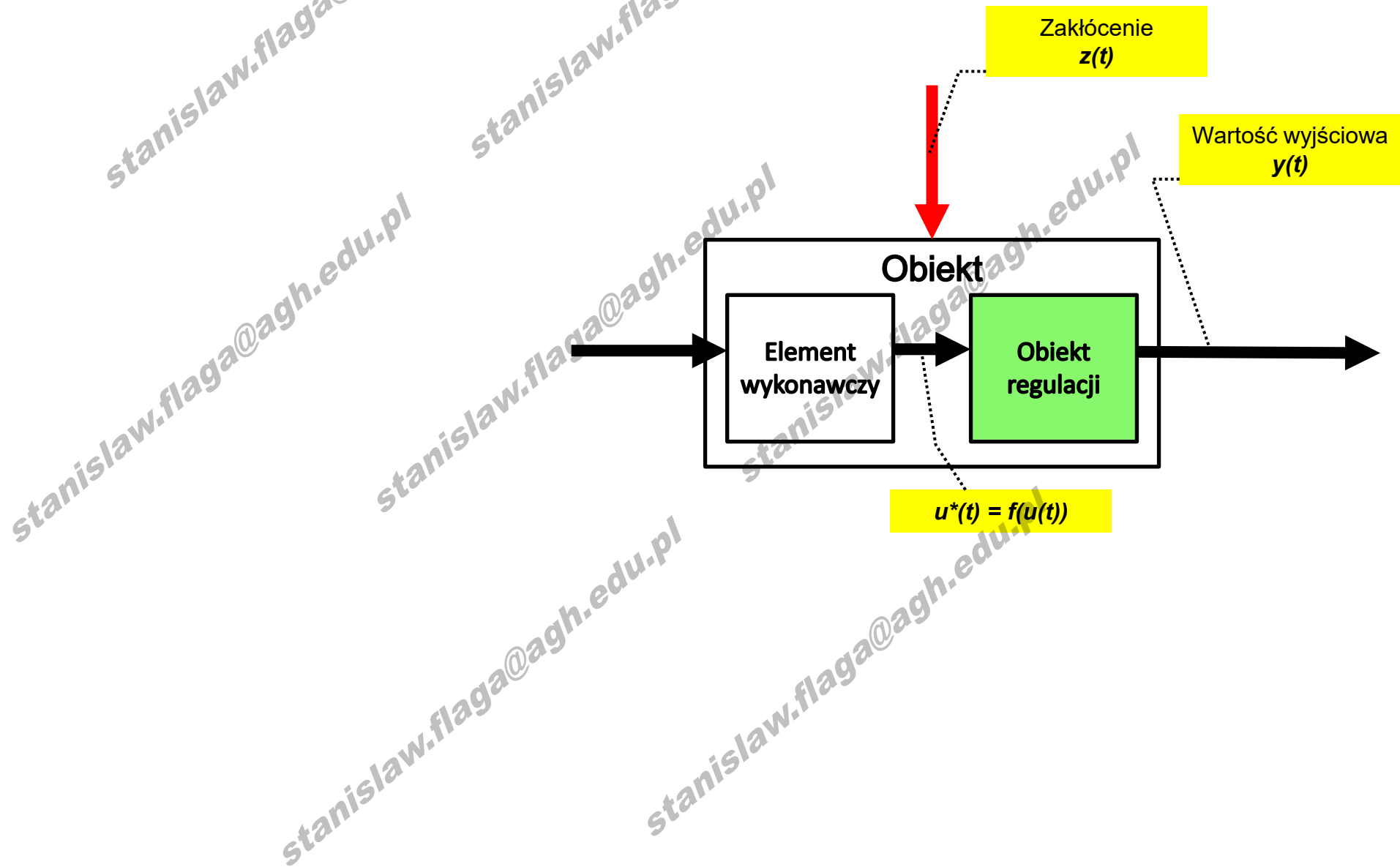
„Technology objects” - PID S7 1200/1500

Opis dla TIA portal v16

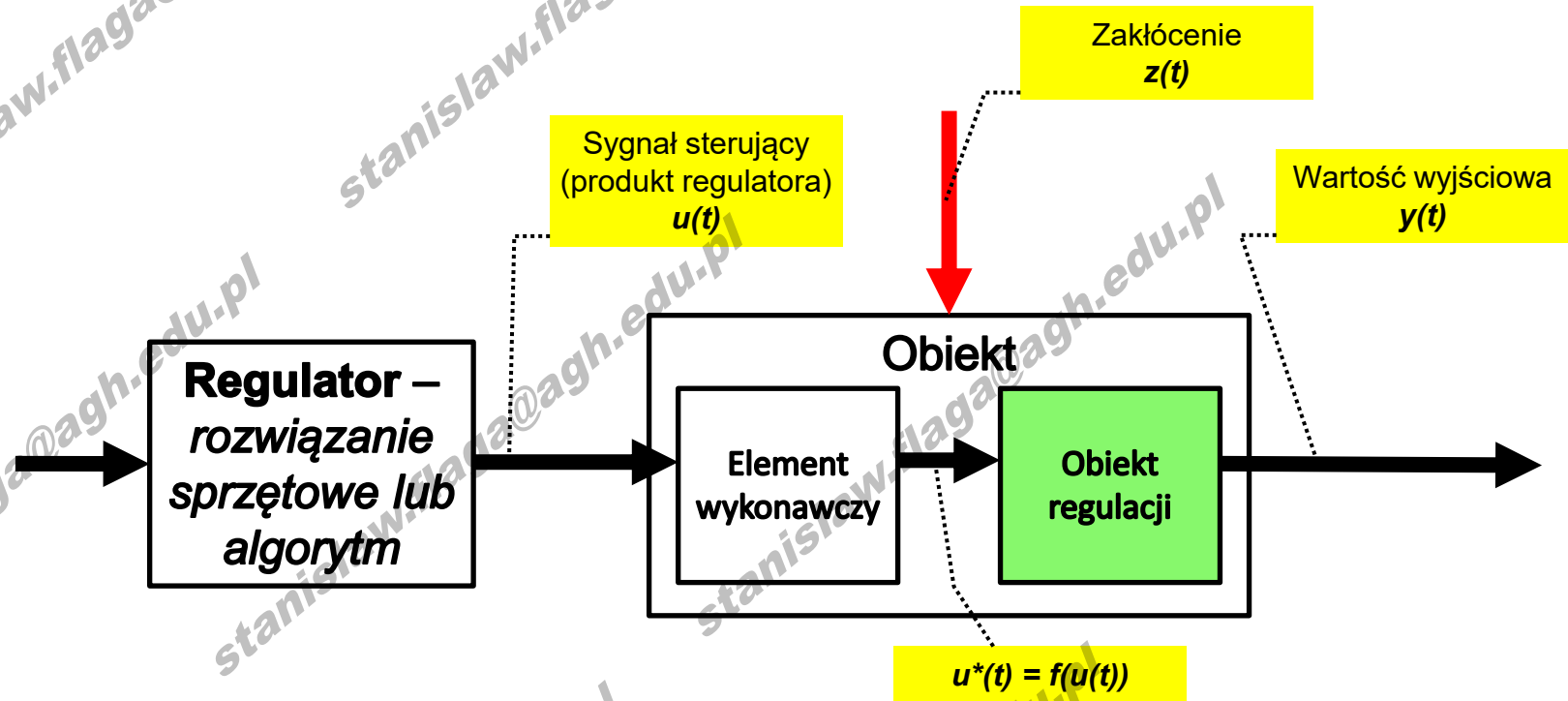
Stanisław Flaga

stanislaw.flaga@agh.edu.pl

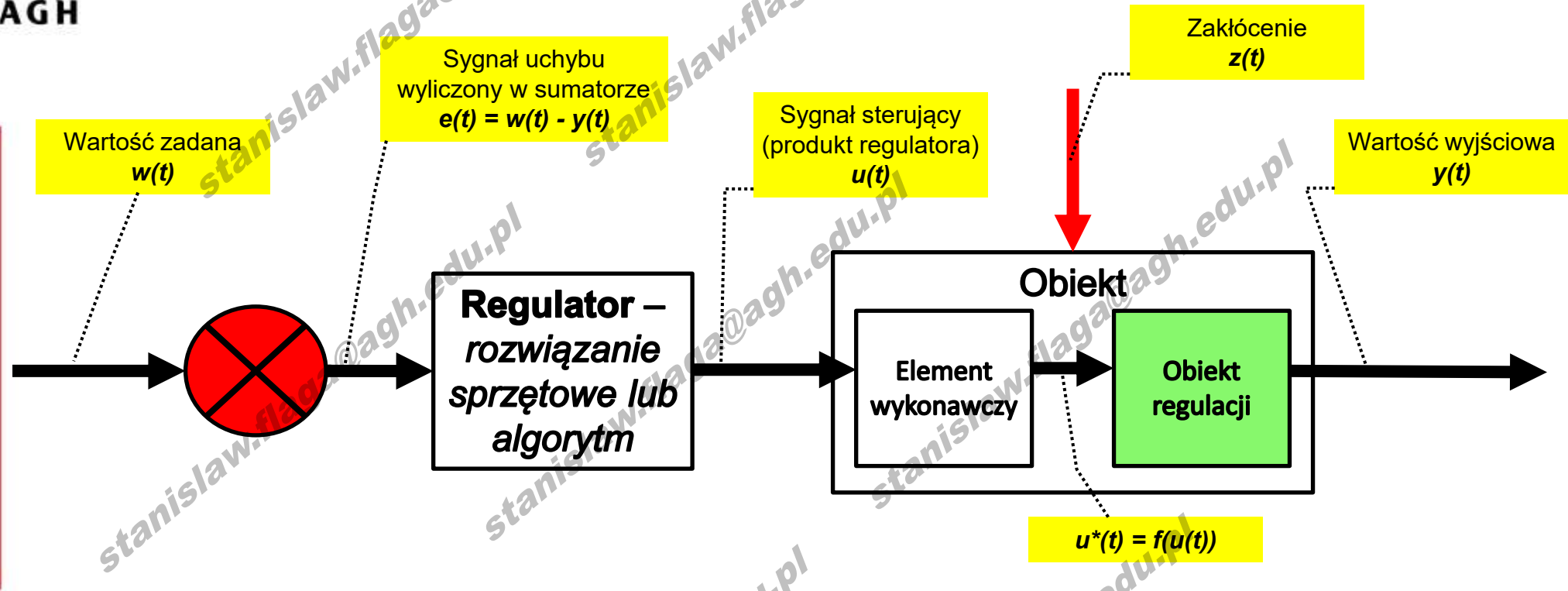
Układ Automatemycznej Regulacji



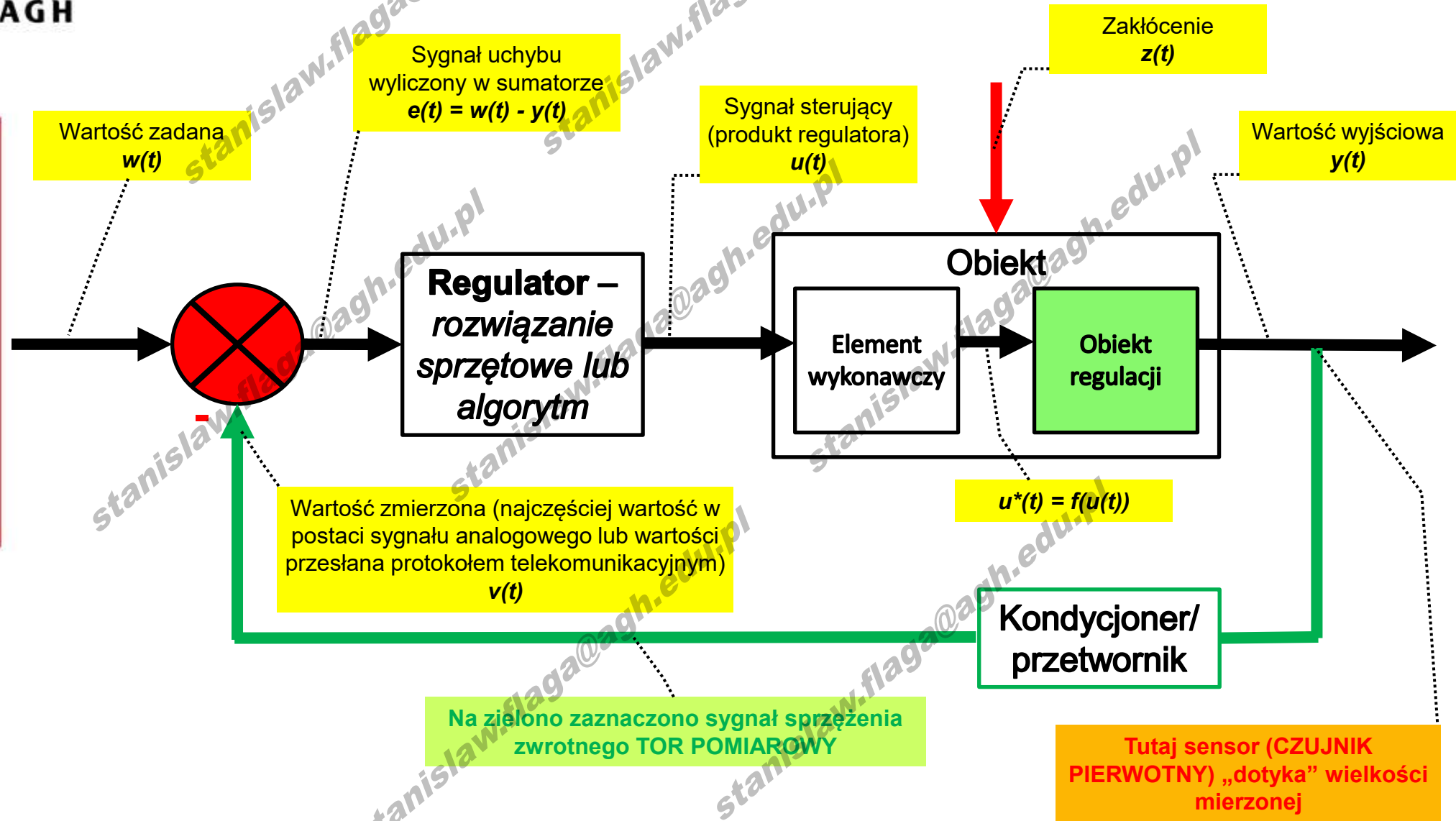
Układ Automatycznej Regulacji



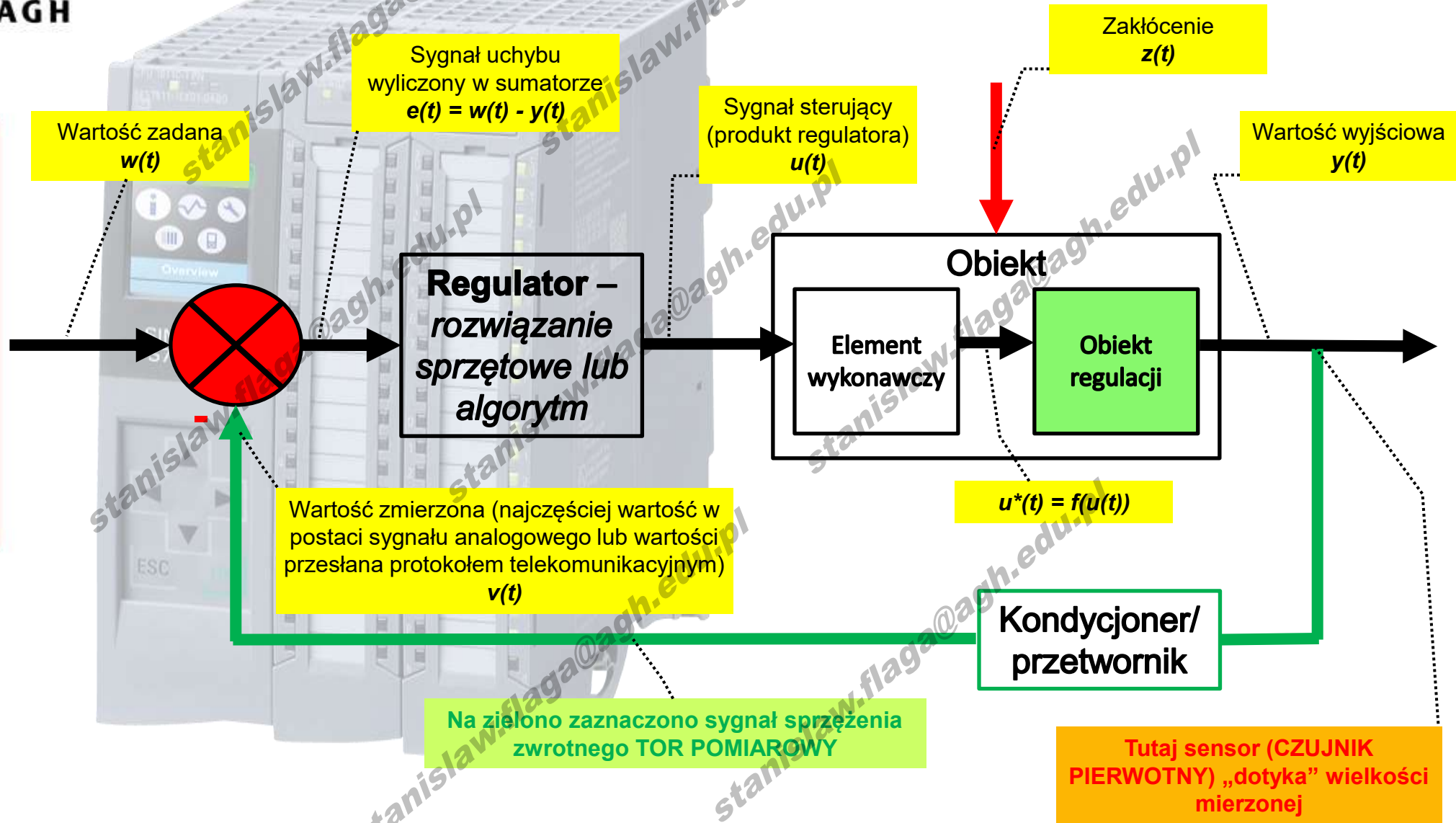
Układ Automatemycznej Regulacji



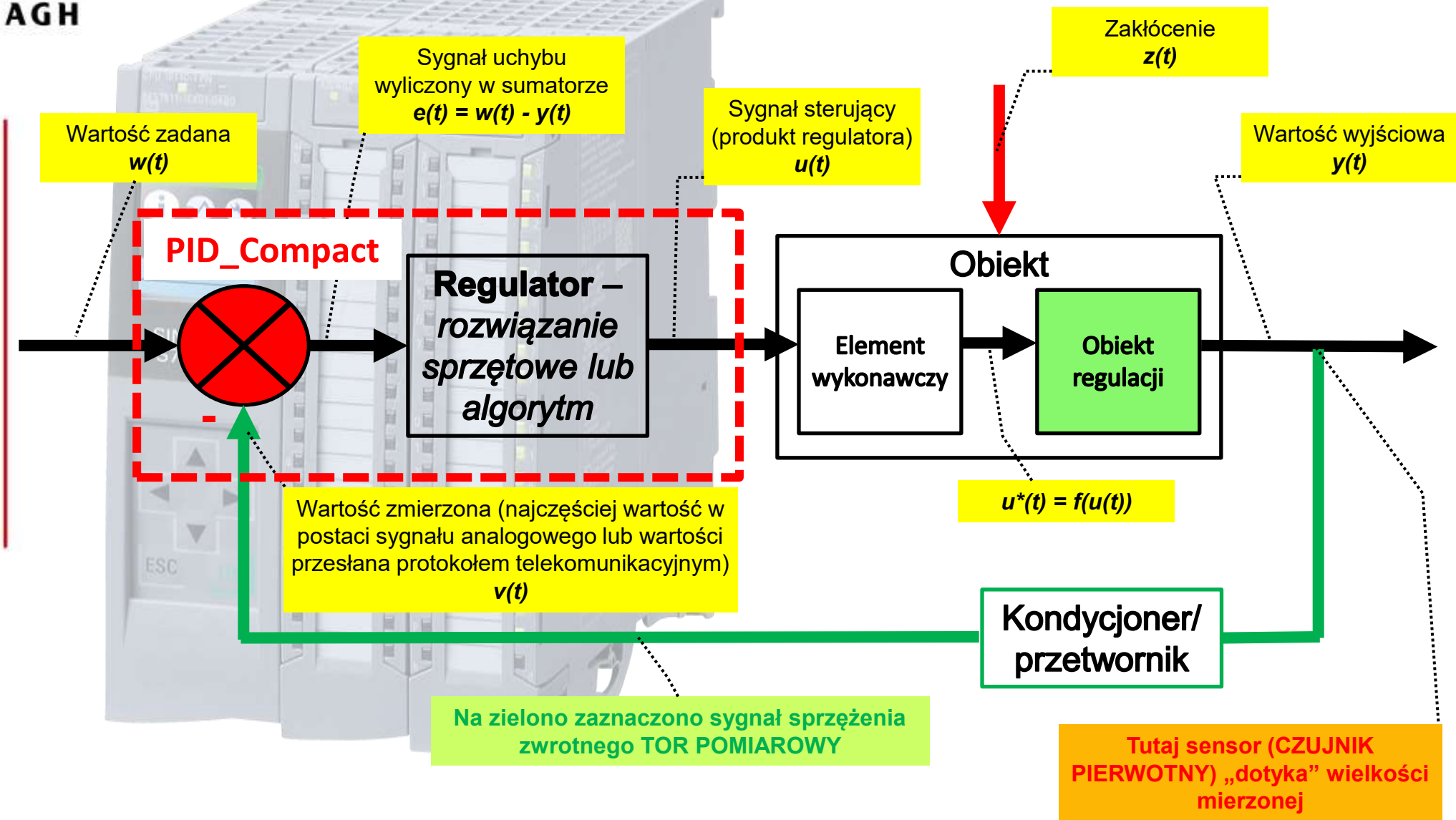
Układ Automatemycznej Regulacji



Układ Automatemycznej Regulacji

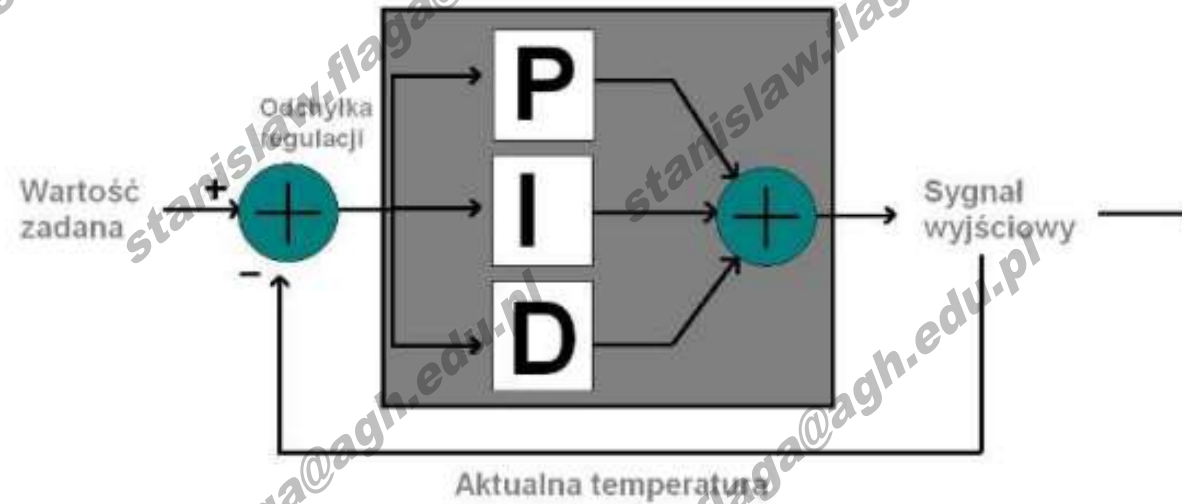


Układ Automatemycznej Regulacji



PID

PID_Compact, ...: symulacja dostępna jest tylko dla sterowników S7-1500.



Źródło: Siemens: Konfiguracja regulatora PID w S7-1200 PLC, FAQ:00000031/PL



PID_Compact

PID_Compact to uniwersalny regulator PID ze zintegrowanym tuningiem. Zawiera wszystkie ustawienia dla jednej określonej pętli sterowania.

Konfiguracja tego obiektu wspomagana jest przez specjalne okno edycyjne

Po otwarciu tego obiektu technologicznego jest wspomagany przez specjalny edytor do konfiguracji sterownika.

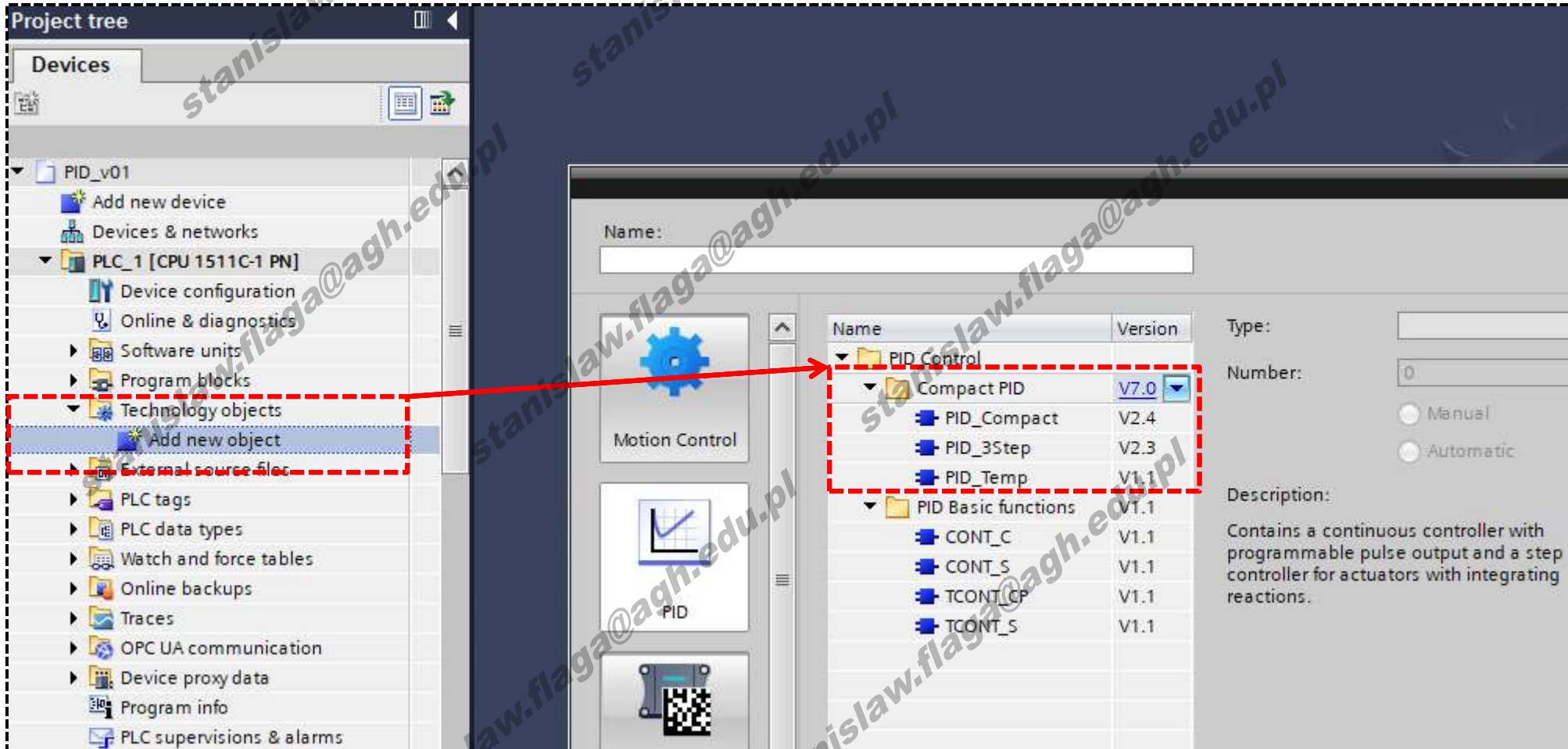
Główne przeznaczenie – sterowanie procesami technologicznymi o „ciągłym sygnale” wejściowym i wyjściowym



PID – obiekt symulacji

PID_Compact – symulacja tylko w S7-1500

1. Uruchom projekt dla sterownika z serii S7-1500.
2. Załaduj bibliotekę z obiektem (obiektami).
3. Uruchom obiekt



The screenshot shows the Siemens SIMATIC Manager interface. On the left, the 'Project tree' displays a hierarchy: PID_v01 > PLC_1 [CPU 1511C-1 PN] > Technology objects. The 'Add new object' option is highlighted with a red dashed box. A red arrow points from this option to the 'Add new object' dialog box on the right.

The dialog box shows a list of objects under the 'PID Control' folder, also highlighted with a red dashed box:

Name	Version
Compact PID	V7.0
PID_Compact	V2.4
PID_3Step	V2.3
PID_Temp	V1.1
PID Basic functions	V1.1
CONT_C	V1.1
CONT_S	V1.1
TCONT_CP	V1.1
TCONT_S	V1.1

Below the list, there are radio buttons for 'Manual' and 'Automatic', and a 'Description' field containing the text: 'Contains a continuous controller with programmable pulse output and a step controller for actuators with integrating reactions.'



PID -

Create new project

Open existing project

Create new project

Project name: PID_symulacja_S7_1500

Path: C:\S7proj\16

Version: V16

Author: st

Comment:

Device name: PID_symulacja

Controllers

HMI

PC systems

- CPU
 - CPU 1511-1 PN
 - 6ES7 511-1CK00-0AB0
 - 6ES7 511-1CK01-0AB0
 - CPU 1512C-1 PN
 - CPU 1513-1 PN
 - CPU 1515-2 PN
 - CPU 1516-3 PN/DP
 - CPU 1517-3 PN/DP
 - CPU 1518-4 PN/DP
 - CPU 1518-4 PN/DP ODK
 - CPU 1518-4 PN/DP MFP
 - CPU 1511F-1 PN
 - CPU 1513F-1 PN
 - CPU 1515F-2 PN
 - CPU 1516F-3 PN/DP
 - CPU 1517F-3 PN/DP
 - CPU 1518F-4 PN/DP

Device: CPU 1511C-1 PN

Article no.: 6ES7 511-1CK01-0AB0

Version: Device name:

Description: HMI 1

CPU with 1 MB of RAM and 1 MB of non-volatile memory. Functions: control, communication, routing, IP...

Controllers

HMI

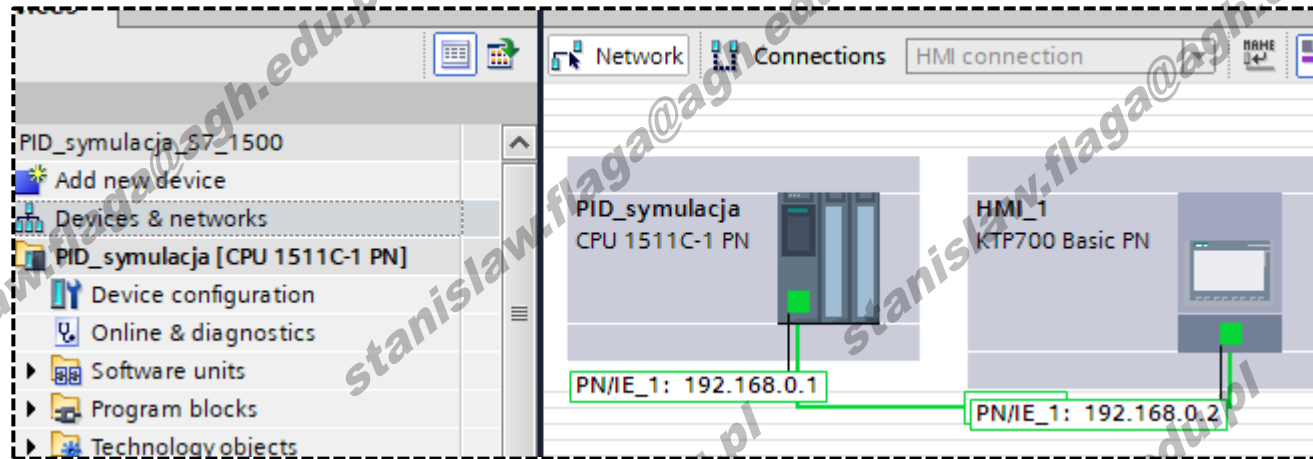
- HMI
 - SIMATIC Basic Panel
 - 3" Display
 - 4" Display
 - 6" Display
 - 7" Display
 - KTP700 Basic
 - 6AV2 123-2GA03-0AX0
 - 6AV2 123-2GB03-0AX0
 - KTP700 Basic Portrait
 - 9" Display

Device: KTP700 Basic PN

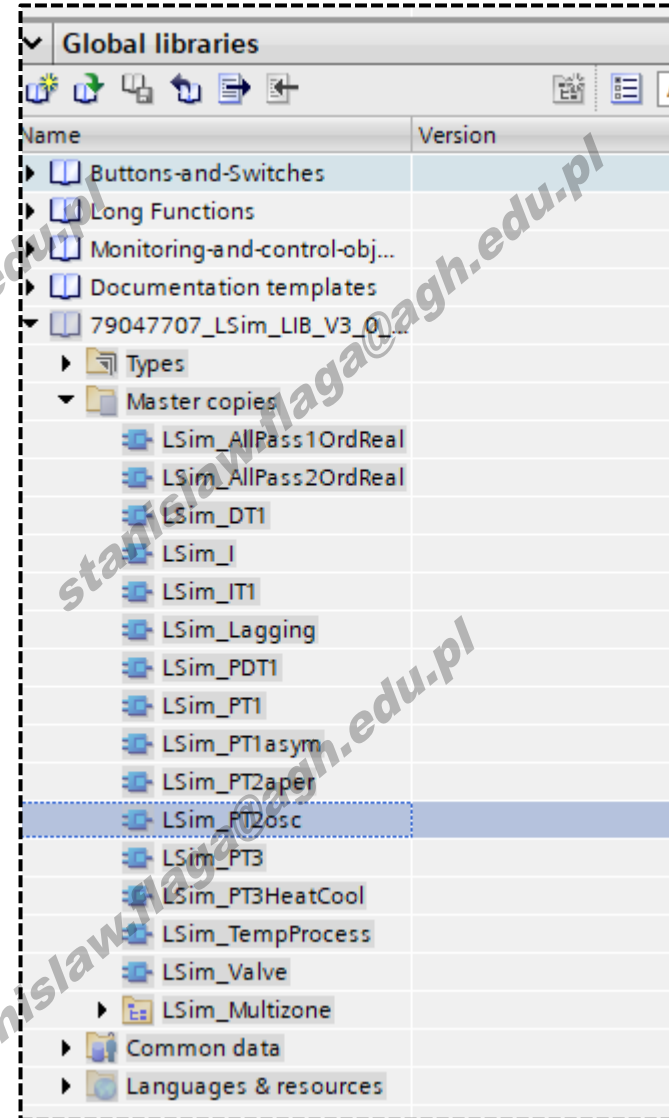
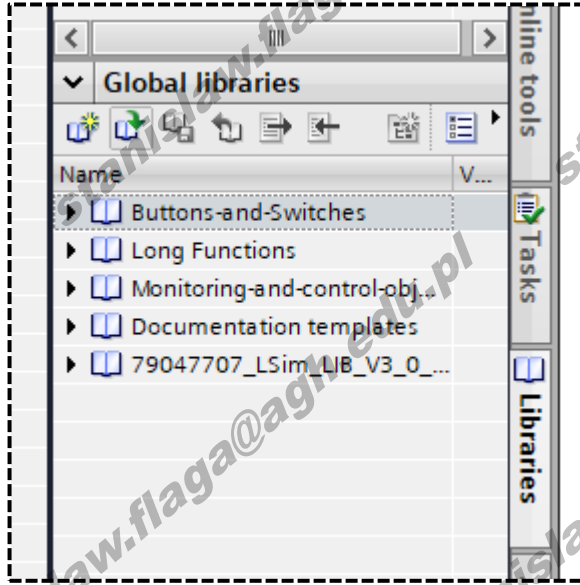
Article no.: 6AV2 123-2GB03-0AX0

Version: 16.0.0.0

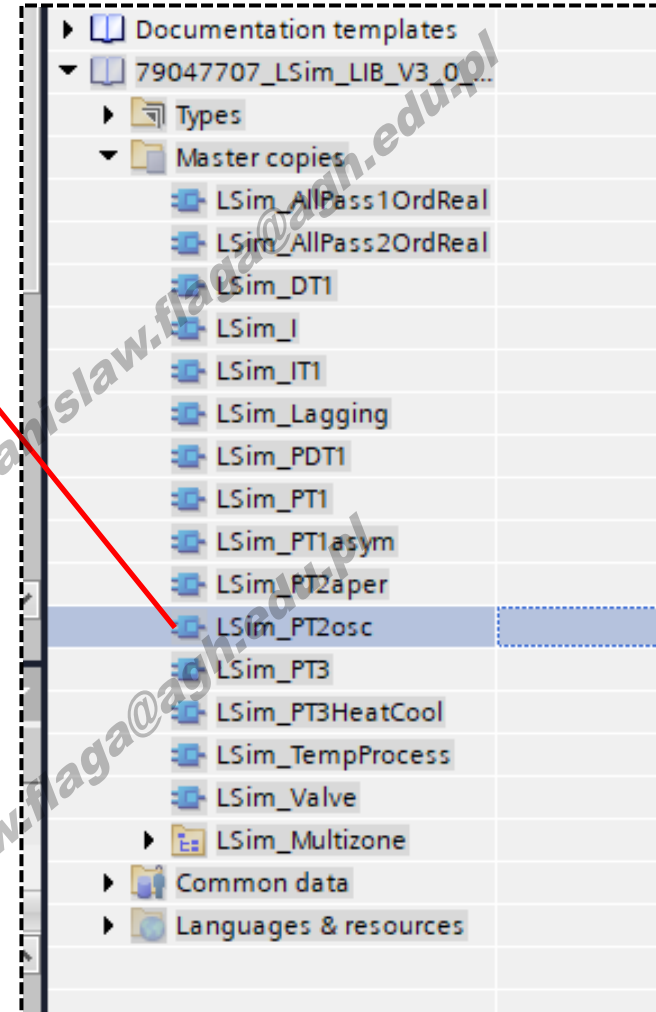
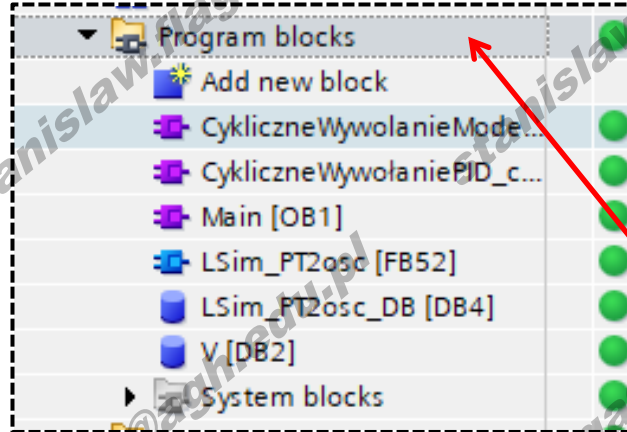
PID – hardware projektu



PID – biblioteka z obiektem

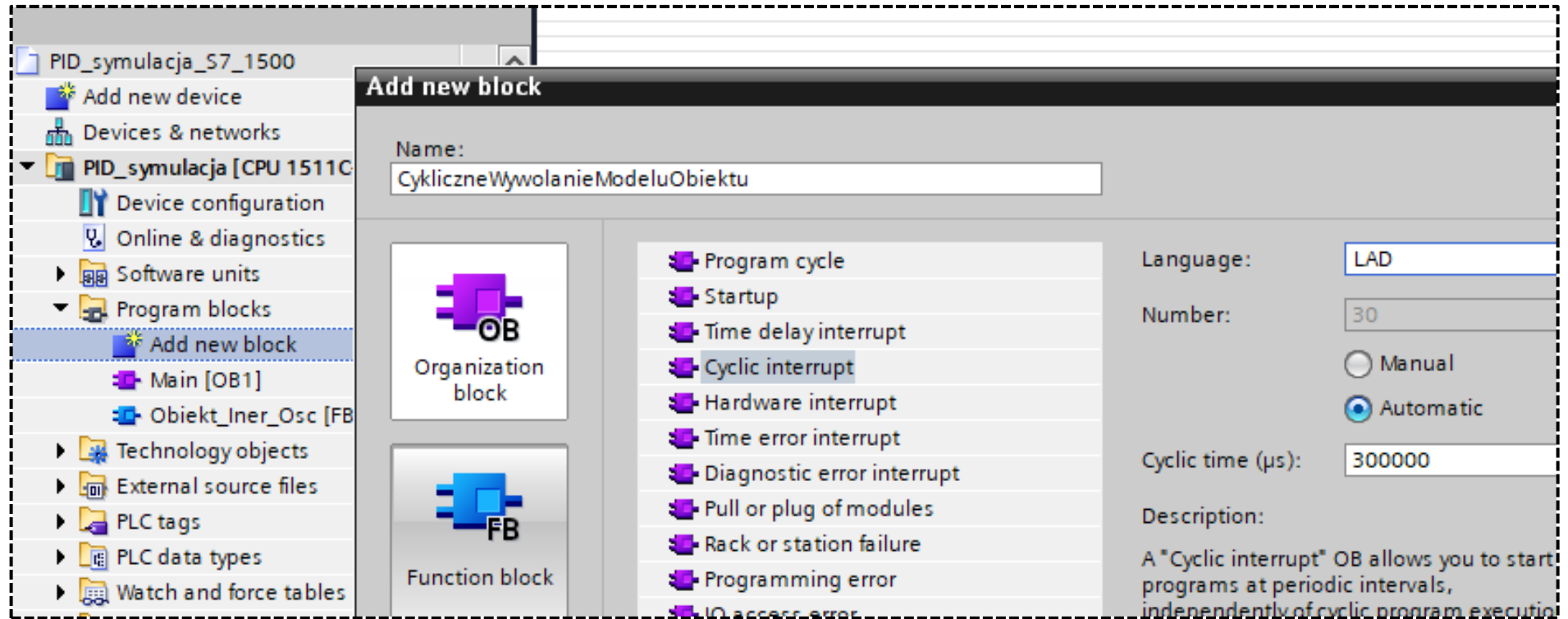


PID – obiekt z biblioteki



PID – utworzenie OB cyklicznego – zapewnienie stałego czasu próbkowania – tutaj 300 ms

(przeliczania modelu obiektu i docelowo PID-a)



The screenshot shows the 'Add new block' dialog in SIMATIC Manager. The 'Name' field is set to 'CykliczneWywołanieModeluObjektu'. The 'Language' is set to 'LAD'. The 'Number' is set to '30'. The 'Cyclic time (µs)' is set to '300000'. The 'Automatic' radio button is selected. The 'Description' field contains the text: 'A "Cyclic interrupt" OB allows you to start programs at periodic intervals, independently of cyclic program execution.'

Add new block

Name:

Language:

Number:

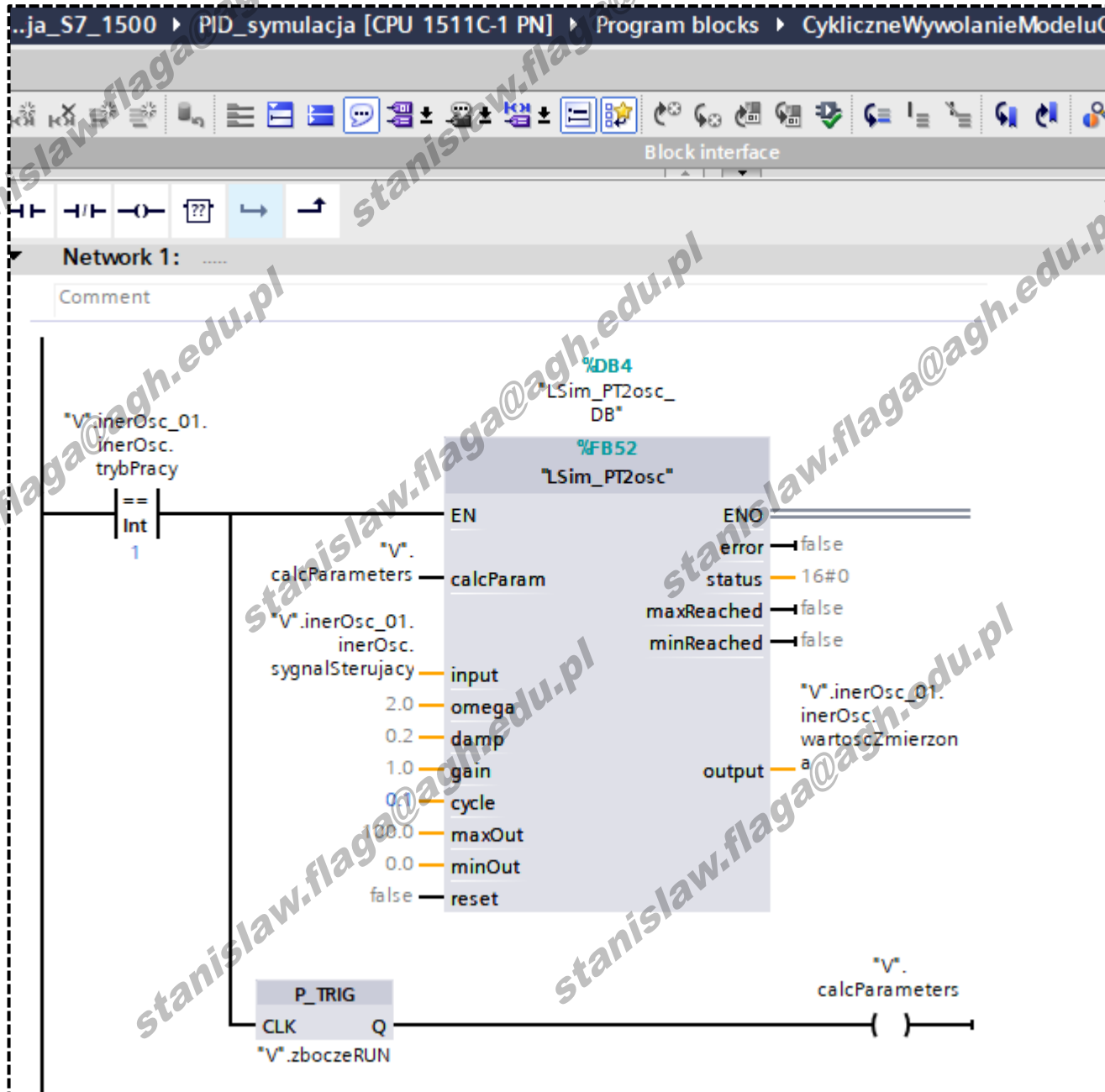
Manual
 Automatic

Cyclic time (µs):

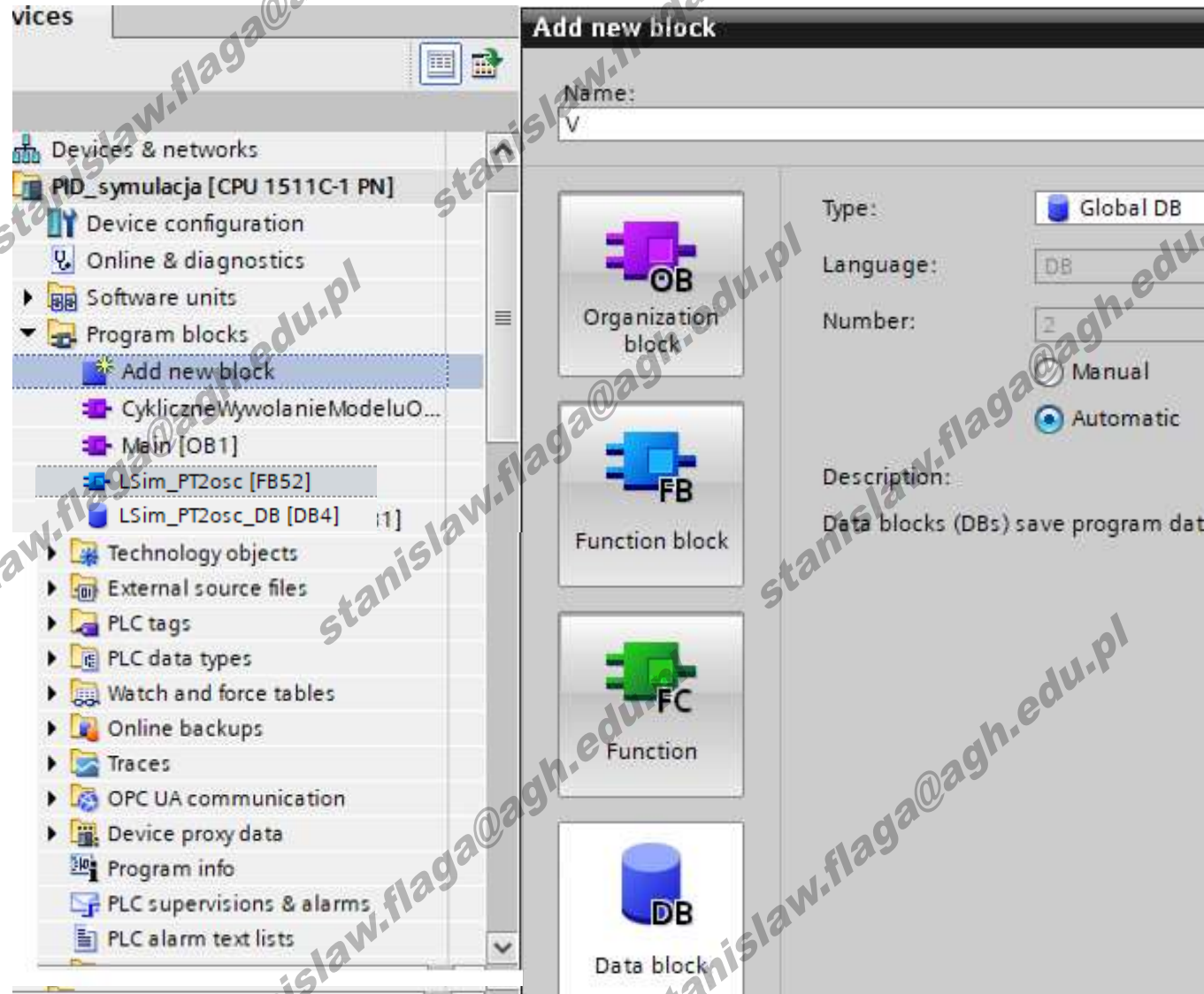
Description:
A "Cyclic interrupt" OB allows you to start programs at periodic intervals, independently of cyclic program execution.

Organization block (OB) and Function block (FB) icons are visible in the left pane.

PID – wywołanie FB z modelem w OB30

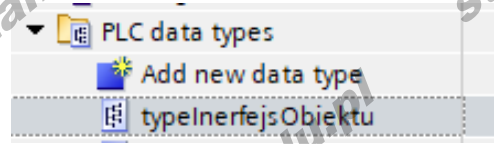


PID – dodaj globalny blok danych



The screenshot shows the SIMATIC Manager interface with the 'Add new block' dialog box open. The 'Name' field is set to 'V'. The 'Type' dropdown is set to 'Global DB'. The 'Language' dropdown is set to 'DB'. The 'Number' field is set to '2'. The 'Description' field contains the text 'Data blocks (DBs) save program dat'. The 'Automatic' radio button is selected. The left pane shows the project tree with 'Add new block' selected under 'Program blocks'.

PID – dodaj nowy typ – zmienne obiektu (nazwy jak w schemacie blokowym UAR)



typelnerfejsObiektu				
	Name	Data type	Default value	Accessible f...
1	inerOsc	Struct		<input checked="" type="checkbox"/>
2	trybPracy	Int	0	<input checked="" type="checkbox"/>
3	sygnalSterujacy	Real	0.0	<input checked="" type="checkbox"/>
4	wartoscZmierzona	Real	0.0	<input checked="" type="checkbox"/>

PID – dodanie zmiennych do DB ("V")

PID_symulacja_S7_1500 ▶ PID_symulacja [CPU 1511C-1 PN] ▶ Program blocks ▶ V [DB2]

Keep actual values Snapshot Copy snapshots to start values

V

	Name	Data type	Start value	Retain	Accessible f...	Writa...	Visible in ...	Setpoint
	Static			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	InerOsc_01	"typeInerfejsObjektu"		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	InerOsc	Struct		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	trybPracy	Int	0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	sygnalSterujacy	Real	0.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	wartoscZmierz...	Real	0.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	interPID	"typeInterfejsPID"		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	setPoint	Real	0.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	input	Real	0.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
0	output	Real	0.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
1	state	Int	0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2	error	Bool	false	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3	ErrorBits	DWord	16#0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4	zbozceRUN	Bool	false	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
5	calcParameters	Bool	false	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6	<Add new>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

PID – minimalny panel HMI wspomagający badanie obiektu



The screenshot displays the SIMATIC Manager interface for HMI design. The main workspace shows a yellow dotted area titled "Tryb pracy modelu obiektu" (Object model operating mode) containing two buttons: a red "Reset" button and a green "Praca" (Work) button. The interface includes a "Properties" window with tabs for Properties, Animations, Events, and Texts. The "Events" tab is active, showing a "SetTag" event with a "Tag (Output)" field. The "Elements" and "Controls" toolbars are visible on the right. The bottom panel shows a project tree on the left and a variable declaration table on the right.

Name	Address	Data type
None		
trybPracy		Int
sygnalSterujacy		Real
wartoscZmierzona		Real

PID – minimalny panel HMI wspomagający badanie obiektu



Tryb pracy modelu obiektu

Reset Praca

Wartość sygnału sterującego 00000000.000

Wartość rzeczywista 00000000.000

Button_2 [Button]

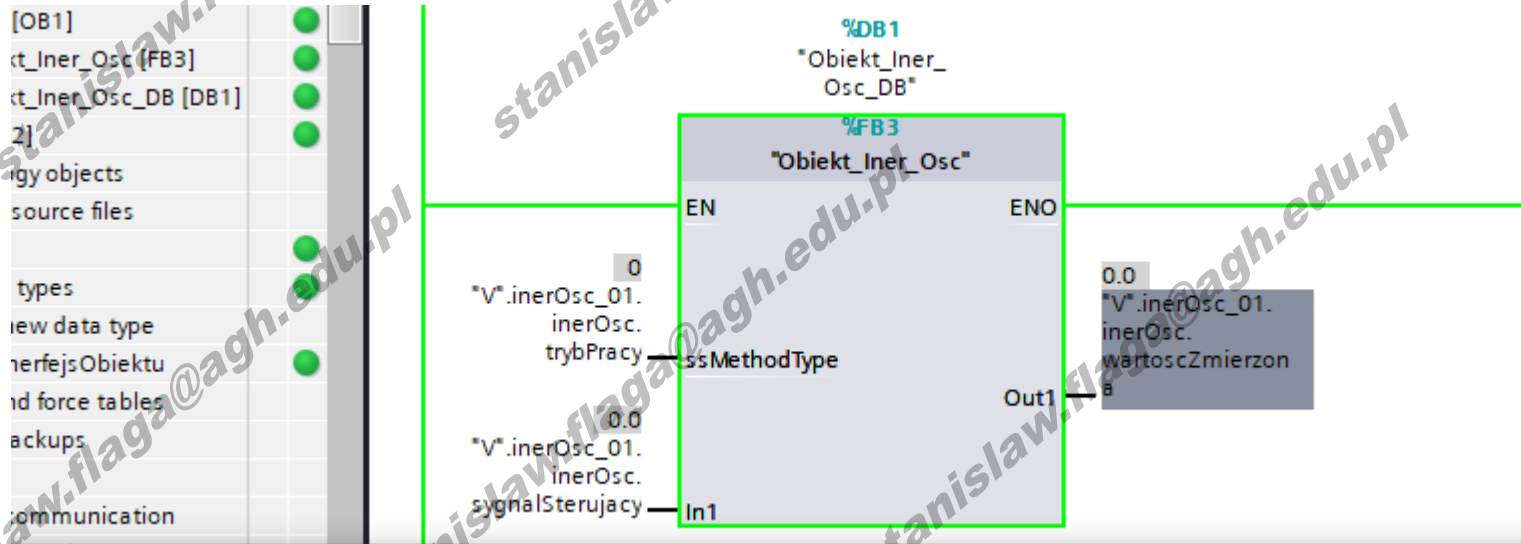
Properties Animations Events Texts

Click Press Release Activate Deactivate Change

SetTag

Tag (Output)	V_inerOsc_01_inerOsc_trybPracy
Value	1
<Add function>	

PID – minimalny panel HMI wspomagający badanie obiektu



The HMI panel displays the Siemens logo and the text "SIMATIC H". Below this, there are two input fields for numerical values, both showing "0.000". The first field is labeled "Wartość sygnału sterującego" and the second is labeled "Wartość rzeczywista". To the left of these fields, there is a dashed box containing two buttons: a red "Reset" button and a green "Praca" button. The text "Tryb pracy modelu obiektu" is positioned above these buttons.

PID – obserwacja odpowiedzi skokowej obiektu z wykorzystaniem „Traces”

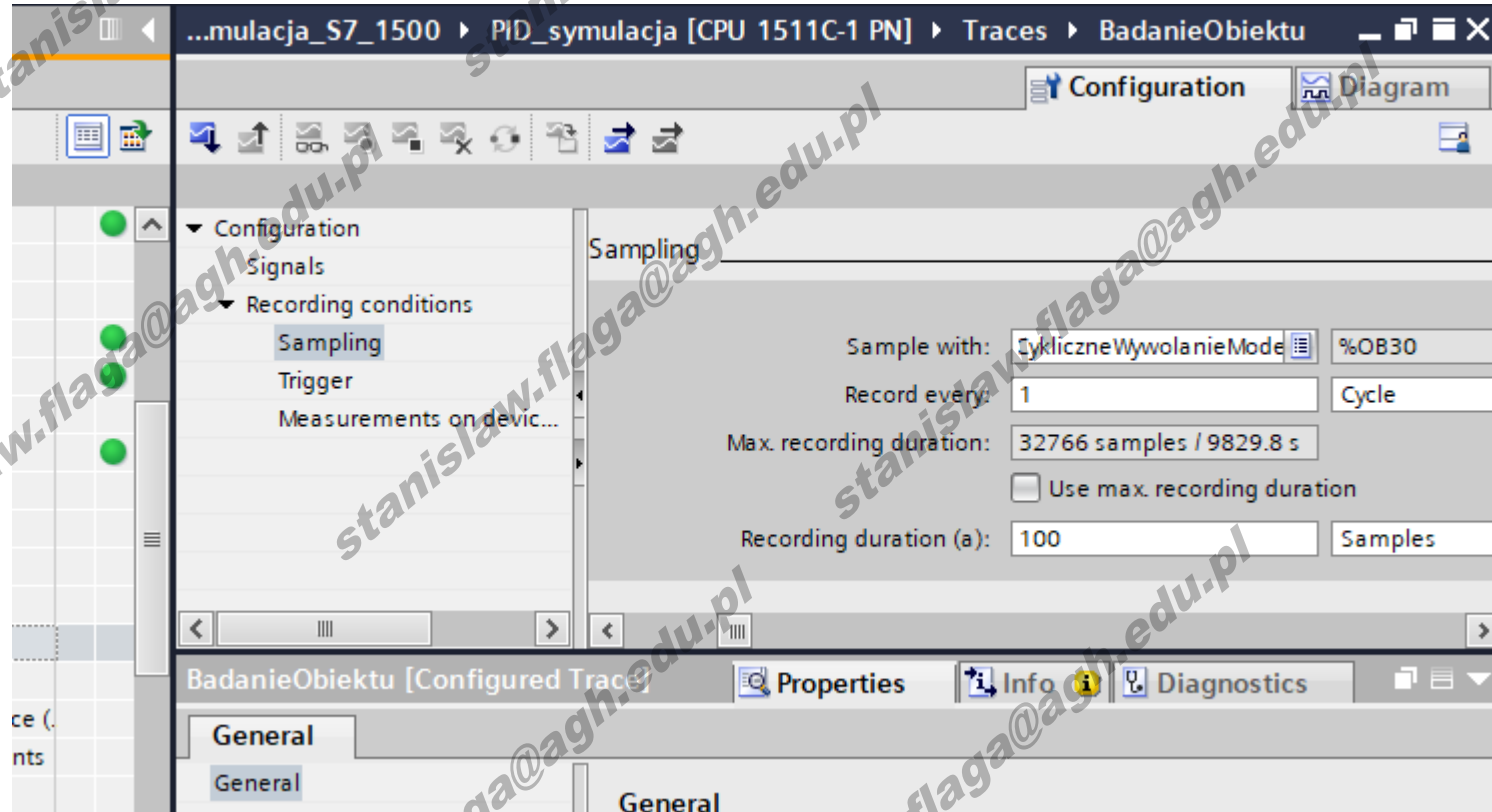


The screenshot displays the SIMATIC Manager interface. On the left, a tree view shows the project structure, with 'BadanieObiektu' selected under the 'Traces' folder. The main window is divided into several panes:

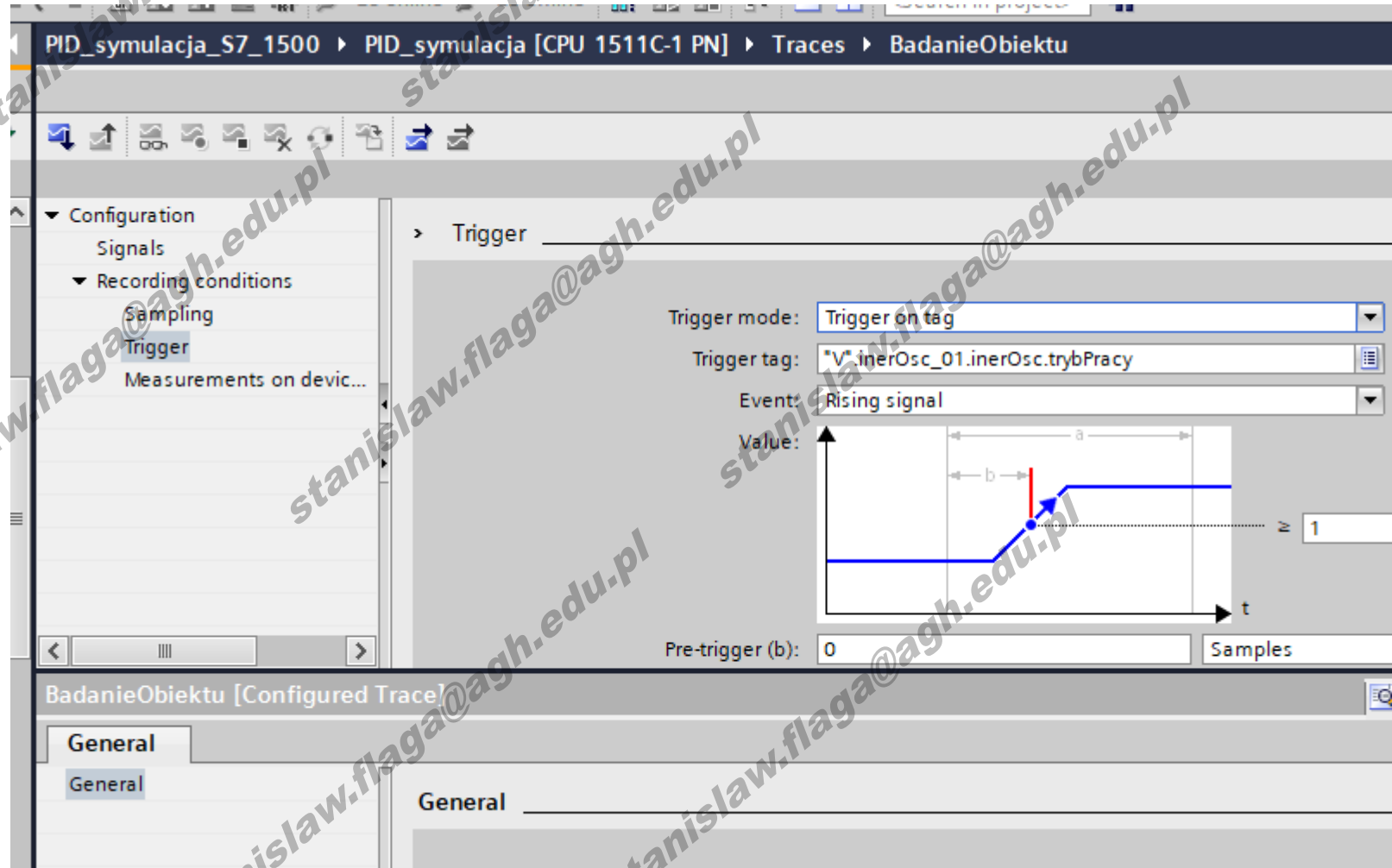
- Configuration Signals:** Shows recording conditions such as 'Sampling', 'Trigger', and 'Measurements on device...'. The 'Signals' pane is active, displaying a table of selected signals.
- Signals Table:**

	Name
1	"V".inerOsc_01.inerOsc.sygnalSterujacy
2	"V".inerOsc_01.inerOsc.wartoscZmierzona
3	
- BadanieObiektu [Configured Trace]:** Shows the 'General' tab with the trace name 'BadanieObiektu' and an empty 'Author' field.

PID – obserwacja odpowiedzi skokowej obiektu z wykorzystaniem „Traces”



PID – obserwacja odpowiedzi skokowej obiektu z wykorzystaniem „Traces”



PID_symulacja_S7_1500 > PID_symulacja [CPU 1511C-1 PN] > Traces > BadanieObiektu

Configuration

- Signals
- Recording conditions
 - Sampling
 - Trigger
 - Measurements on devic...

Trigger

Trigger mode: Trigger on tag

Trigger tag: *V_inerOsc_01.inerOsc.trybPracy

Event: Rising signal

Value: 1

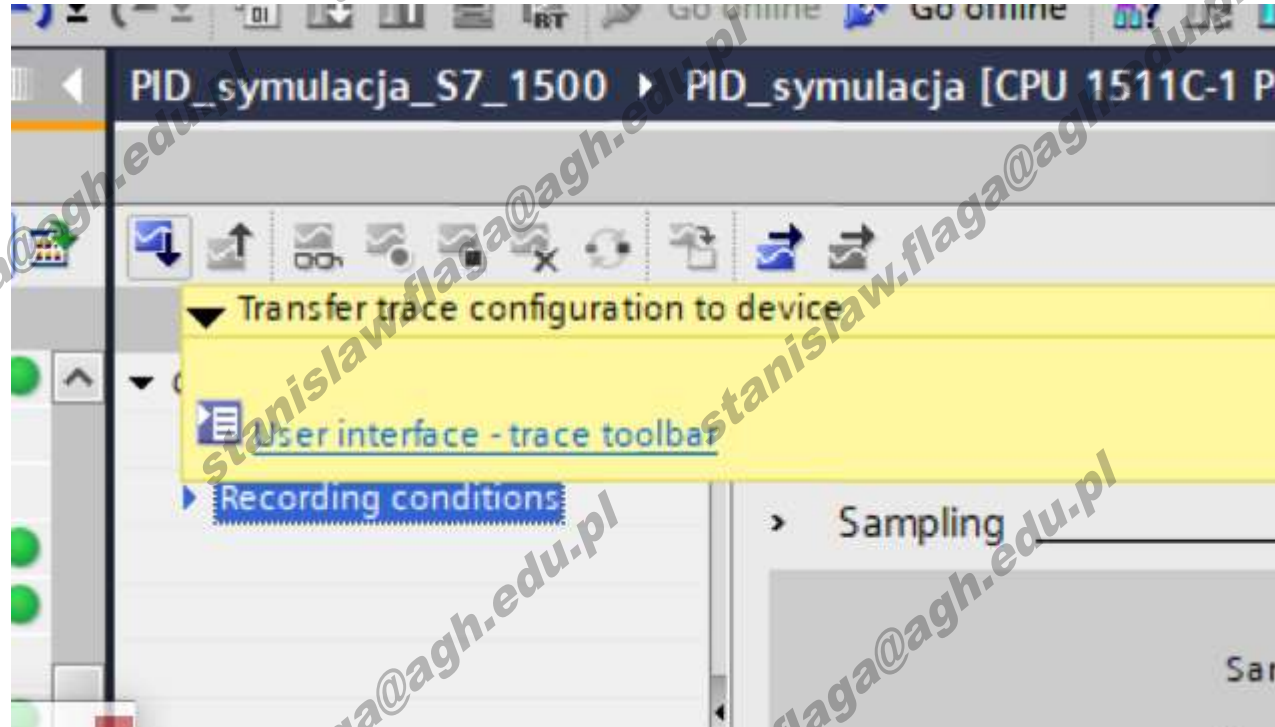
Pre-trigger (b): 0 Samples

BadanieObiektu [Configured Trace]

General

General

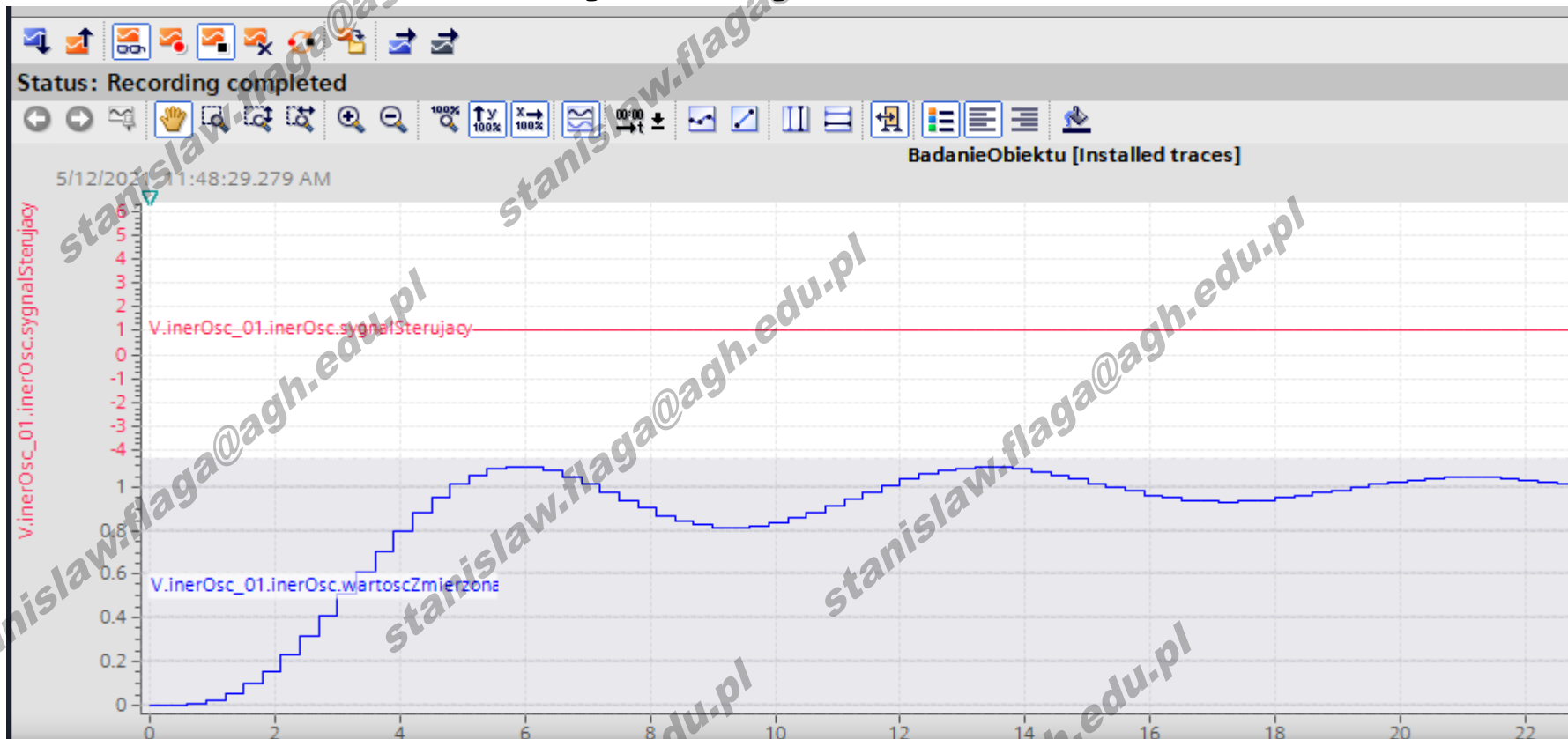
PID – obserwacja odpowiedzi skokowej obiektu z wykorzystaniem „Traces”



PID – obserwacja odpowiedzi skokowej obiektu z wykorzystaniem „Traces”



PID – obserwacja odpowiedzi skokowej obiektu z wykorzystaniem „Traces”



RT Simulator

SIEMENS

SIMATIC HM

Tryb pracy modelu obiektu



Reset

Praca

Wartość sygnału sterującego

1.000

Wartość rzeczywista

1.000

PID – wywołanie PID_compact

Add new block

Name:

OB
Organization block

FB
Function block

FC
Function

DB
Data block

- Program cycle
- Startup
- Time delay interrupt
- Cyclic interrupt**
- Hardware interrupt
- Time error interrupt
- Diagnostic error interrupt
- Pull or plug of modules
- Rack or station failure
- Programming error
- IO access error
- Time of day
- MC-Interpolator
- MC-Servo
- MC-PreServo
- MC-PostServo
- MC-PreInterpolator
- Synchronous Cycle
- Status
- Update
- Profile

Language:

Number:

Manual

Automatic

Cyclic time (µs):

Description:
A "Cyclic interrupt" OB allows you to start programs at periodic intervals, independently of cyclic program execution. The intervals can be defined in this dialog or in the properties of the OB.

[more...](#)

> **Additional information**

Add new and open

...1511C-1 PN] ▶ Program blocks ▶ CykliczneWywołaniePID_compact [OB31]

Block interface

Block title:

Comment

Network 1:

Comment

Network 2:

Comment

Instructions

Options

Favorites

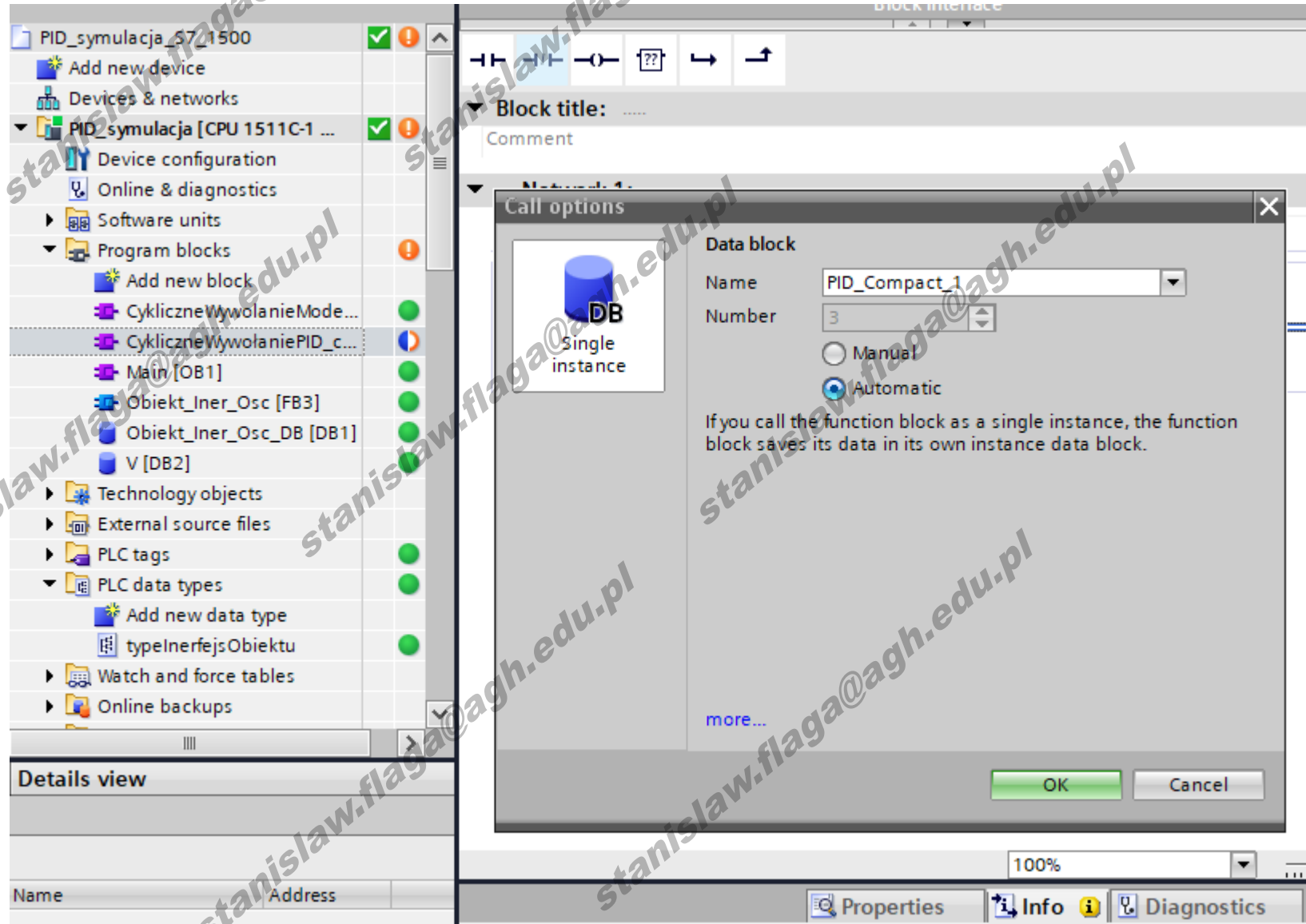
Basic instructions

Extended instructions

Technology

Name	Descri...
▶ Counting and measurem...	
▶ PID Control	
▶ Compact PID	
▶ PID_Compact	Univer...
▶ PID_3Step	PID co...
▶ PID_Temp	PID co...
▶ PID Basic functions	
▶ Auxiliary functions	
▶ Motion Control	
▶ SINAMICS	

PID -



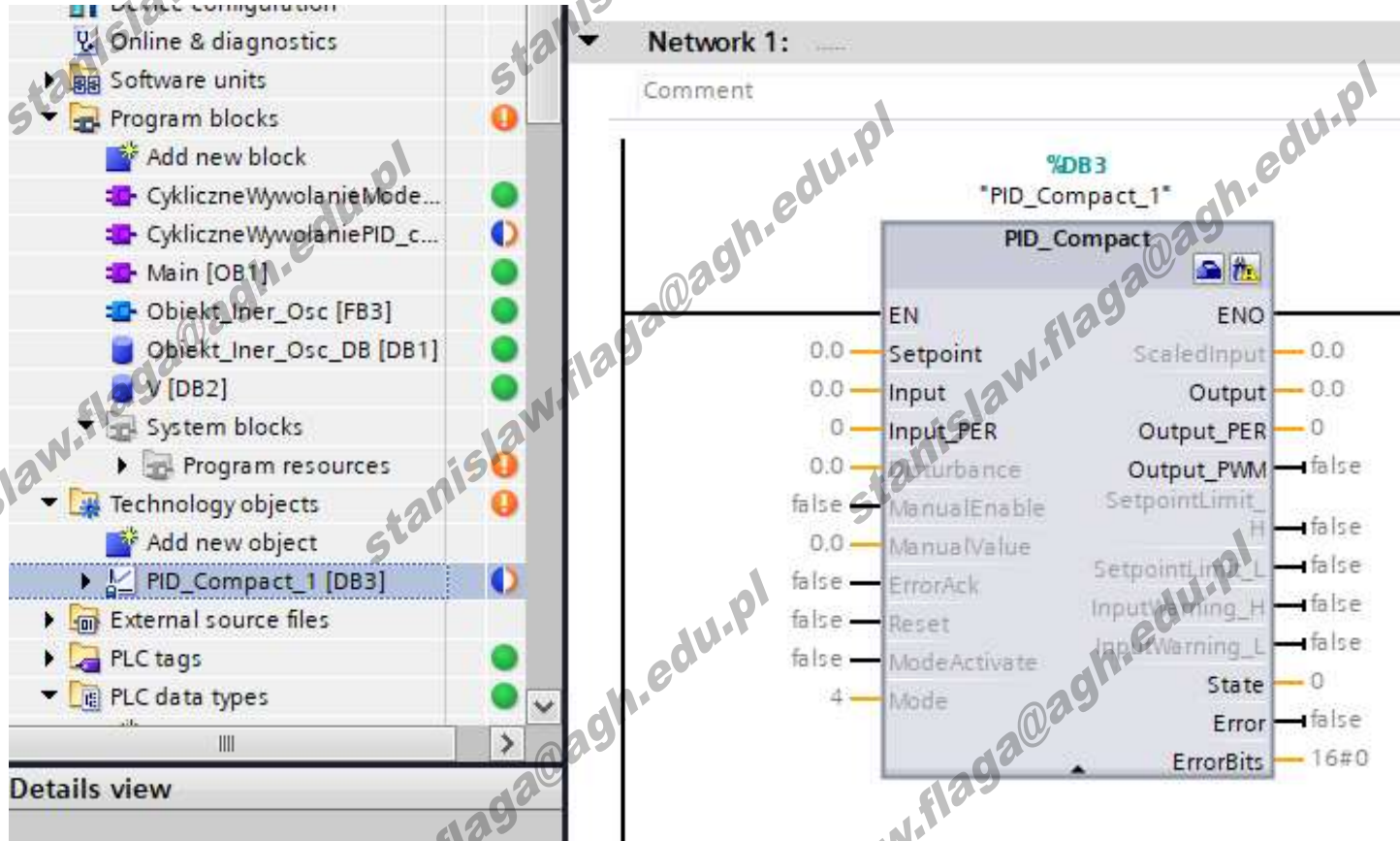
The screenshot displays the SIMATIC Manager interface. On the left, the project tree shows a hierarchy for 'PID_symulacja [CPU 1511C-1 ...]'. The 'Program blocks' folder is expanded, showing several blocks including 'CykliczneWywołaniePID_c...'. The 'Details view' at the bottom left shows a table with columns for 'Name' and 'Address'.

On the right, the 'Call options' dialog box is open for a 'PID_Compact_1' block. The 'Data block' section is configured as follows:

- Name: PID_Compact_1
- Number: 3
- Mode: Automatic

The dialog also includes a 'Single instance' checkbox and explanatory text: 'If you call the function block as a single instance, the function block saves its data in its own instance data block.' The 'OK' button is highlighted in green.

PID -



The screenshot displays the SIMATIC Manager interface. On the left, the project tree shows the following structure:

- PLC Configuration
 - Online & diagnostics
 - Software units
 - Program blocks
 - Add new block
 - CykliczneWywołanieMode...
 - CykliczneWywołaniePID_c...
 - Main [OB1]
 - Objekt_Iner_Osc [FB3]
 - Objekt_Iner_Osc_DB [DB1]
 - V [DB2]
 - System blocks
 - Program resources
 - Technology objects
 - Add new object
 - PID_Compact_1 [DB3]** (selected)
 - External source files
 - PLC tags
 - PLC data types

The right pane shows the configuration for 'Network 1' with the following parameters for the 'PID_Compact' block:

Parameter	Value	Parameter	Value
EN		ENO	
0.0 Setpoint		ScaledInput	0.0
0.0 Input		Output	0.0
0 Input_PER		Output_PER	0
0.0 Disturbance		Output_PWM	false
false ManualEnable		SetpointLimit_H	false
0.0 ManualValue		SetpointLimit_L	false
false ErrorAck		InputWarning_H	false
false Reset		InputWarning_L	false
false ModeActivate		State	0
4 Mode		Error	false
		ErrorBits	16#0

PID – typ do obsługi interfejsu PID-a i deklaracja zmiennej tego typu



The screenshot shows the 'typeInterfejsPID' declaration window. The left pane shows the project tree with 'typeInterfejsPID' selected under 'PLC data types'. The right pane shows a table with the following data:

Name	Data type	Default value	Acc
1 setPoint	Real	0.0	
2 input	Real	0.0	
3 output	Real	0.0	
4 state	Int	0	
5 error	Bool	false	
6 ErrorBits	DWord	16#0	
7 <Add new>			

The screenshot shows the 'V' variable declaration window. The left pane shows the project tree with 'V [DB2]' selected under 'System blocks'. The right pane shows a table with the following data:

Name	Data type	Start value	Retain
1 Static			
2 inerOsc_01	*typeInerfejsObjektu*		
3 interPID	*typeInterfejsPID*		
4 setPoint	Real	0.0	
5 input	Real	0.0	
6 output	Real	0.0	
7 state	Int	0	
8 error	Bool	false	
9 ErrorBits	DWord	16#0	
10 <Add new>			

PID – przypisanie argumentów

ID_symulacja_S7_1500 ▶ PID_symulacja [CPU 1511C-1 PN] ▶ Program blocks ▶ CykliczneWywołaniePID_compact [OB31]

Block interface

Block title:

Network 1: Przygotowanie wartości wejściowej

```

1 "V".interPID.input := "V".inerOsc_01.inerOsc.wartoscZmierzona;
  
```

"V"	§DB2
"V".interPID	
"V".interPI...	
"V"	§DB2
"V".inerOsc_01	

Network 2:

PID – przypisanie argumentów

PID_symulacja_S7_1500 ▶ PID_symulacja [CPU 1511C-1 PN] ▶ Program blocks ▶ CykliczneWywołaniePID_compact

Block interface

Network 2:

%DB3
"PID_Compact_1"

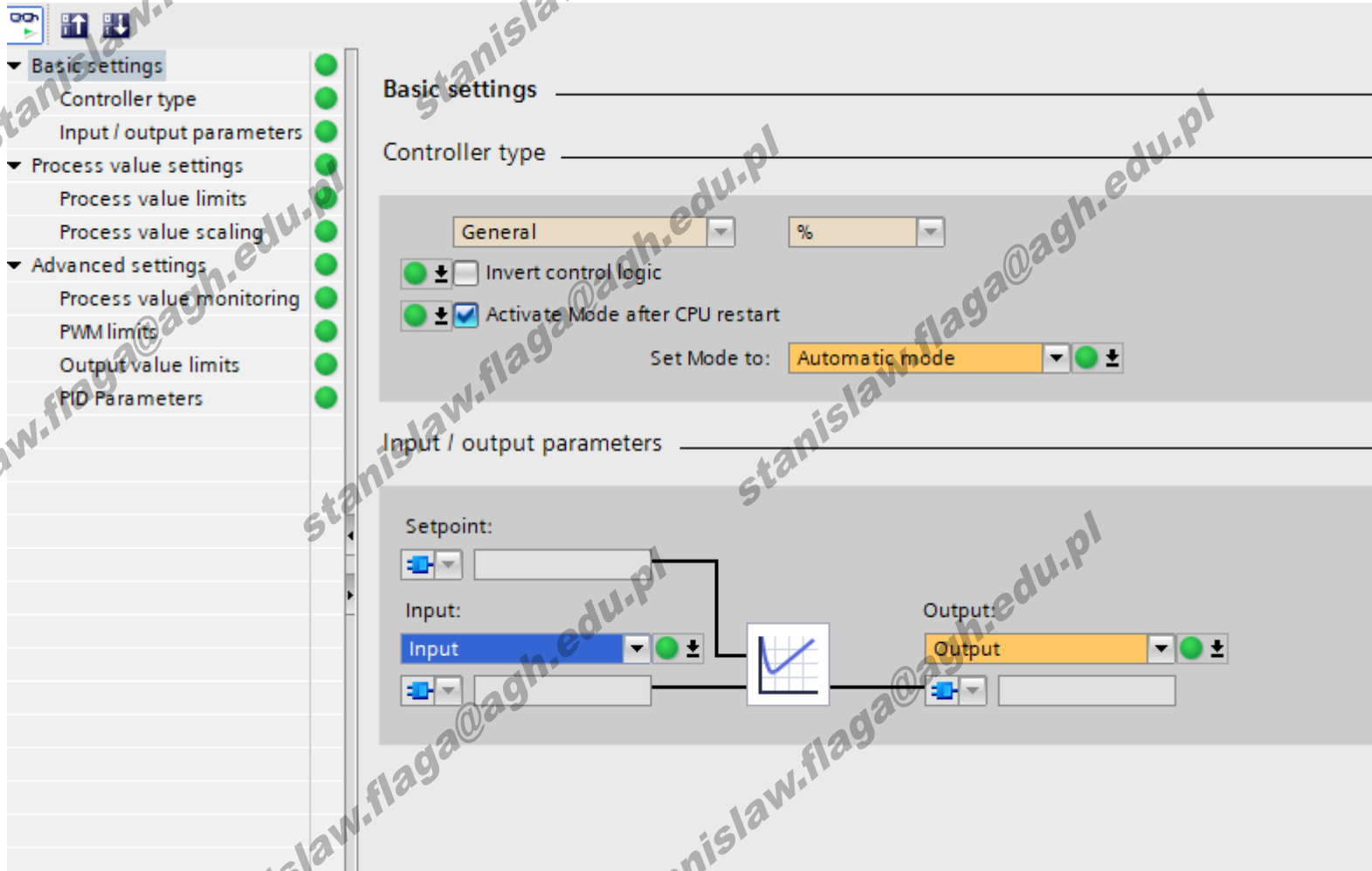
PID_Compact

EN	ENO
"V".interPID.setPoint	ScaledInput 0.0
"V".interPID.input	Output "V".interPID.output
0	Output_PER 0
0.0	Output_PWM false
false	SetpointLimit_H false
0.0	SetpointLimit_L false
false	InputWarning_H false
false	InputWarning_L false
false	ModeActivate
4	State "V".interPID.state
Mode	Error "V".interPID.error
	"V".interPID.ErrorBits

Network 3: Przypisanie wyjścia z PID na wejście obiektu

1	"V".inerOsc_01.inerOsc.signalSterujacy := "V".interPID.output;	"V"	§DB2
		"V".inerOsc_01	

PID - konfiguracja



The screenshot displays a software interface for configuring a PID controller. On the left, a vertical menu lists various settings categories, each accompanied by a green status indicator:

- Basic settings
- Controller type
- Input / output parameters
- Process value settings
- Process value limits
- Process value scaling
- Advanced settings
- Process value monitoring
- PWM limits
- Output value limits
- PID Parameters

The main configuration area is divided into sections:

- Basic settings:** Includes a dropdown for 'Controller type'.
- General settings:** Features a dropdown set to 'General' and a unit selector set to '%'. It contains two checkboxes: 'Invert control logic' (unchecked) and 'Activate Mode after CPU restart' (checked).
- Set Mode to:** A dropdown menu is set to 'Automatic mode'.
- Input / output parameters:** This section includes a 'Setpoint' field with a dropdown, an 'Input' dropdown set to 'Input', and an 'Output' dropdown set to 'Output'. A small graph icon is positioned between the input and output fields.



PID - konfiguracja

- Basic settings
- Controller type
- Input / output parameters
- Process value settings**
- Process value limits
- Process value scaling
- Advanced settings
- Process value monitoring
- PWM limits
- Output value limits
- PID Parameters

Process value settings

Process value limits

Process value high limit: 100.0 %

Process value low limit: 0.0 %

Process value scaling

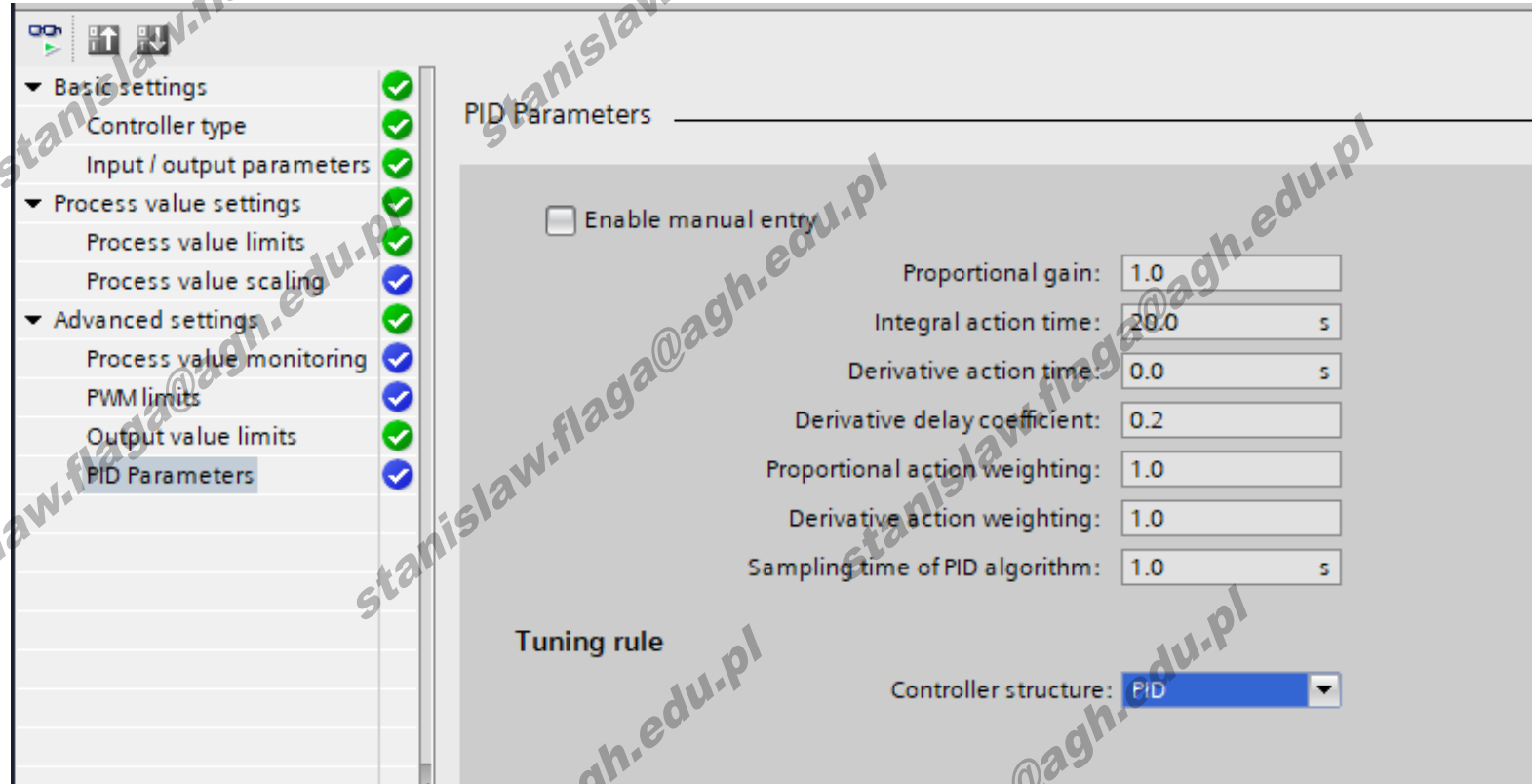
Input_PER: Disabled

Scaled high process value: 100.0 %

Scaled low process value: 0.0 %

0.0 Low High 27648.0

PID - konfiguracja



The screenshot shows a software interface for configuring PID parameters. On the left is a navigation tree with the following items and status icons:

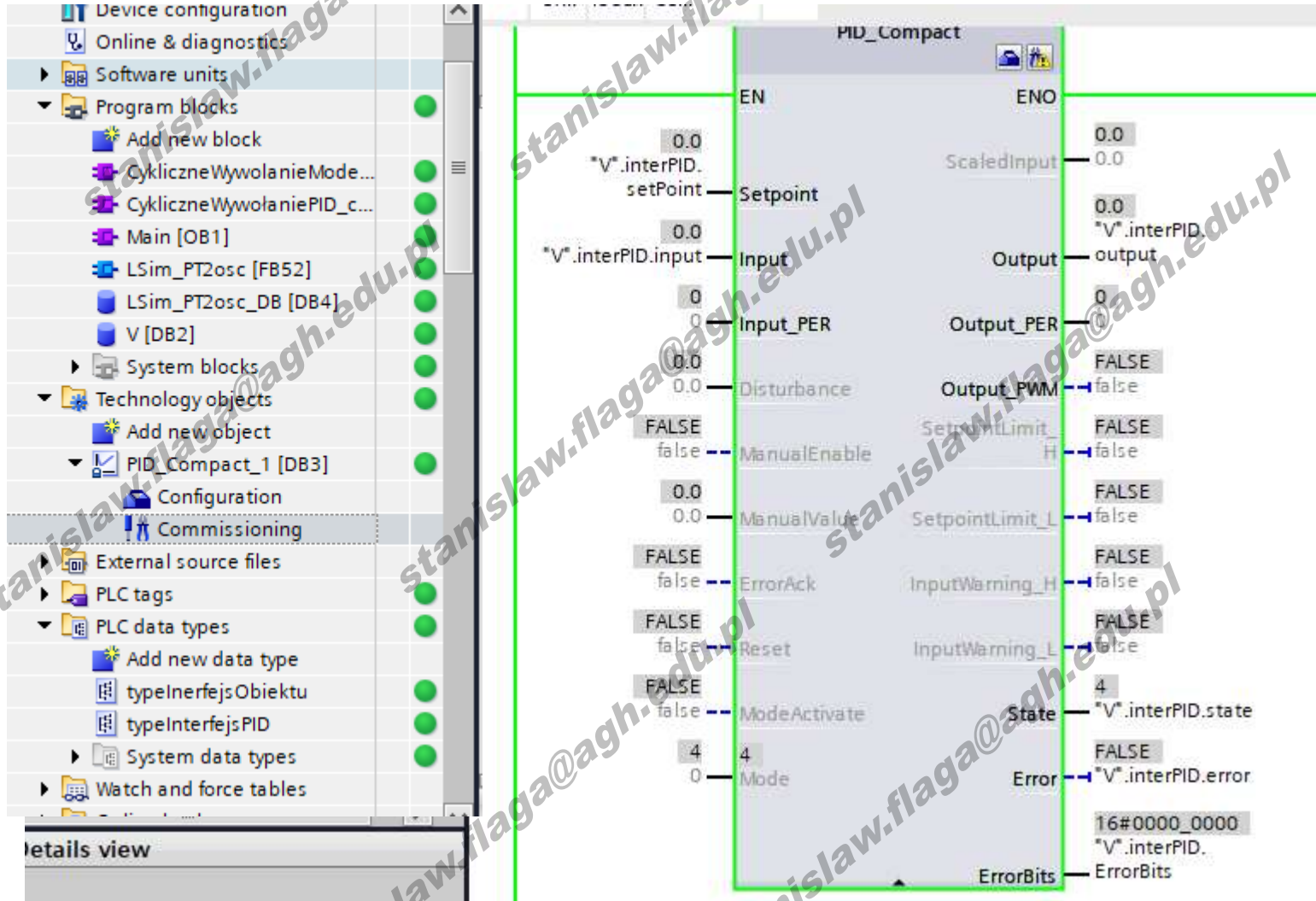
- Basic settings (green checkmark)
- Controller type (green checkmark)
- Input / output parameters (green checkmark)
- Process value settings (green checkmark)
- Process value limits (green checkmark)
- Process value scaling (blue checkmark)
- Advanced settings (green checkmark)
- Process value monitoring (blue checkmark)
- PWM limits (blue checkmark)
- Output value limits (green checkmark)
- PID Parameters (blue checkmark)

The main area is titled "PID Parameters" and contains the following settings:

- Enable manual entry
- Proportional gain: 1.0
- Integral action time: 20.0 s
- Derivative action time: 0.0 s
- Derivative delay coefficient: 0.2
- Proportional action weighting: 1.0
- Derivative action weighting: 1.0
- Sampling time of PID algorithm: 1.0 s

Under the "Tuning rule" section, the "Controller structure" is set to "PID" in a dropdown menu.

PID - Commissioning

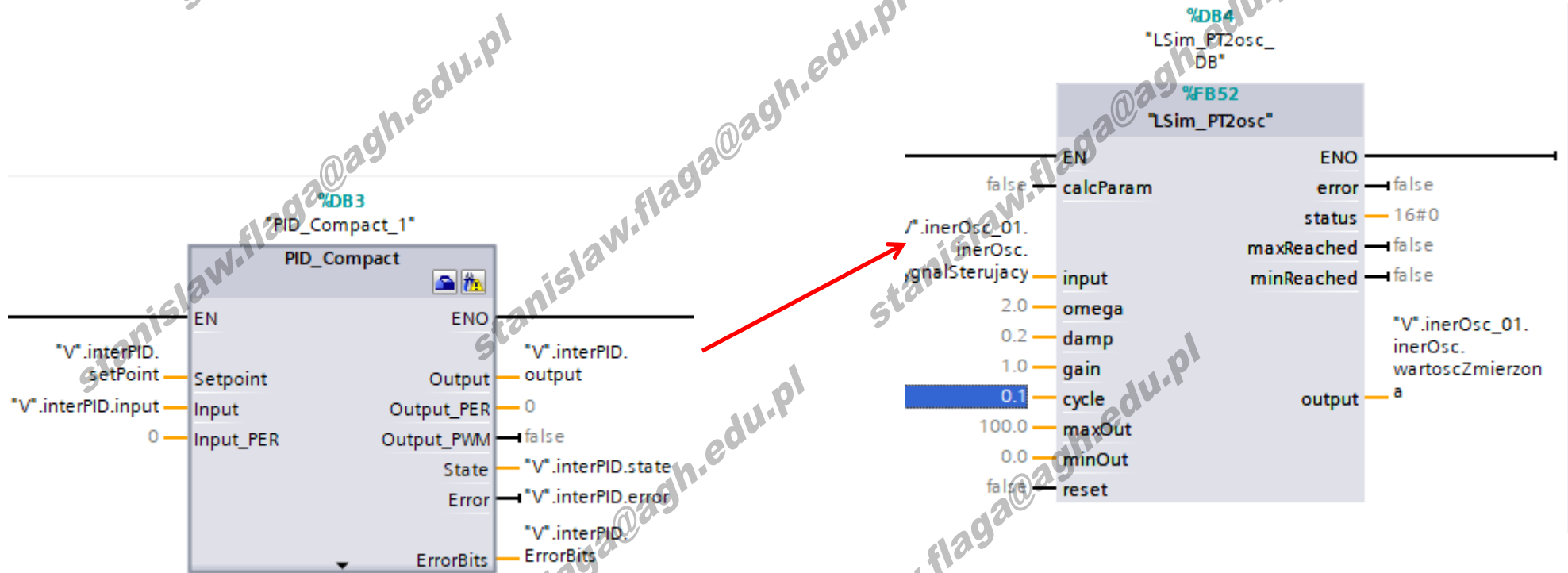


The screenshot displays the SIMATIC Manager interface for commissioning a PID block. The left-hand pane shows the project tree structure, with 'PID_Compact_1 [DB3]' selected under 'Technology objects'. The main workspace shows the 'PID_Compact' block with the following parameters:

Parameter	Value	Parameter	Value
EN	0.0	ENO	0.0
setPoint	"V".interPID.setPoint	ScaledInput	0.0
Input	"V".interPID.input	Output	"V".interPID.output
Input_PER	0	Output_PER	0
Disturbance	0.0	Output_PWM	false
ManualEnable	false	SetpointLimit_H	false
ManualValue	0.0	SetpointLimit_L	false
ErrorAck	false	InputWarning_H	false
Reset	false	InputWarning_L	false
ModeActivate	false	State	"V".interPID.state
Mode	4	Error	"V".interPID.error
	0	ErrorBits	16#0000_0000 "V".interPID.ErrorBits

PID - Commissioning

```
1 "V".interPID.input := "V".inerOsc_01.inerOsc.wartoscZmierzona;
```



```
1 "V".inerOsc_01.inerOsc.signalSterujacy := "V".interPID.output;
```

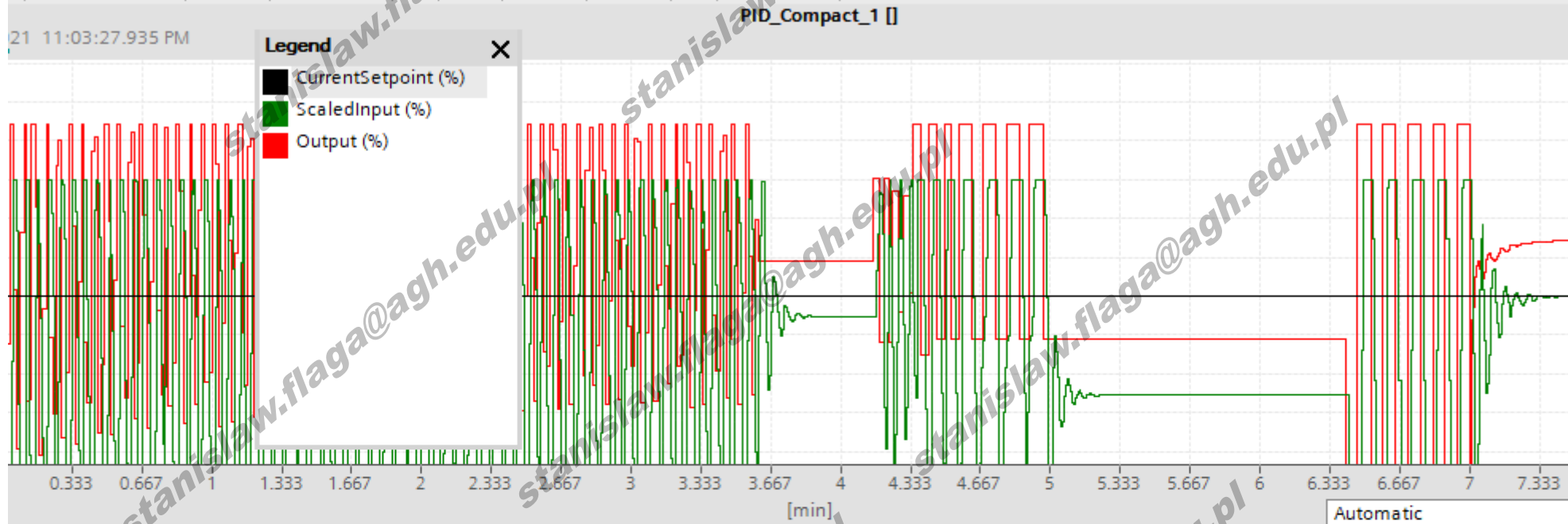
PID konfiguracja

ment

Tuning mode

Sampling time: 0.3 s Start

Fine tuning Start



Signal r...	Name	Data type	Display format	Color	Scaling group	Min. Y scale	Max. Y scale	↑Y 100%	Unit
\$0	CurrentSetpoint	Real	Floating point	Black	CurrentSetpoint...	28.57143	128.5714	<input type="checkbox"/>	%
\$1	ScaledInput	Real	Floating point	Green	CurrentSetpoint...	28.57143	128.5714	<input type="checkbox"/>	%
\$2	Output	Real	Floating point	Red		14.28571	114.2857	<input type="checkbox"/>	%

status

Progress:

Status: System tuned.

Online status of controller

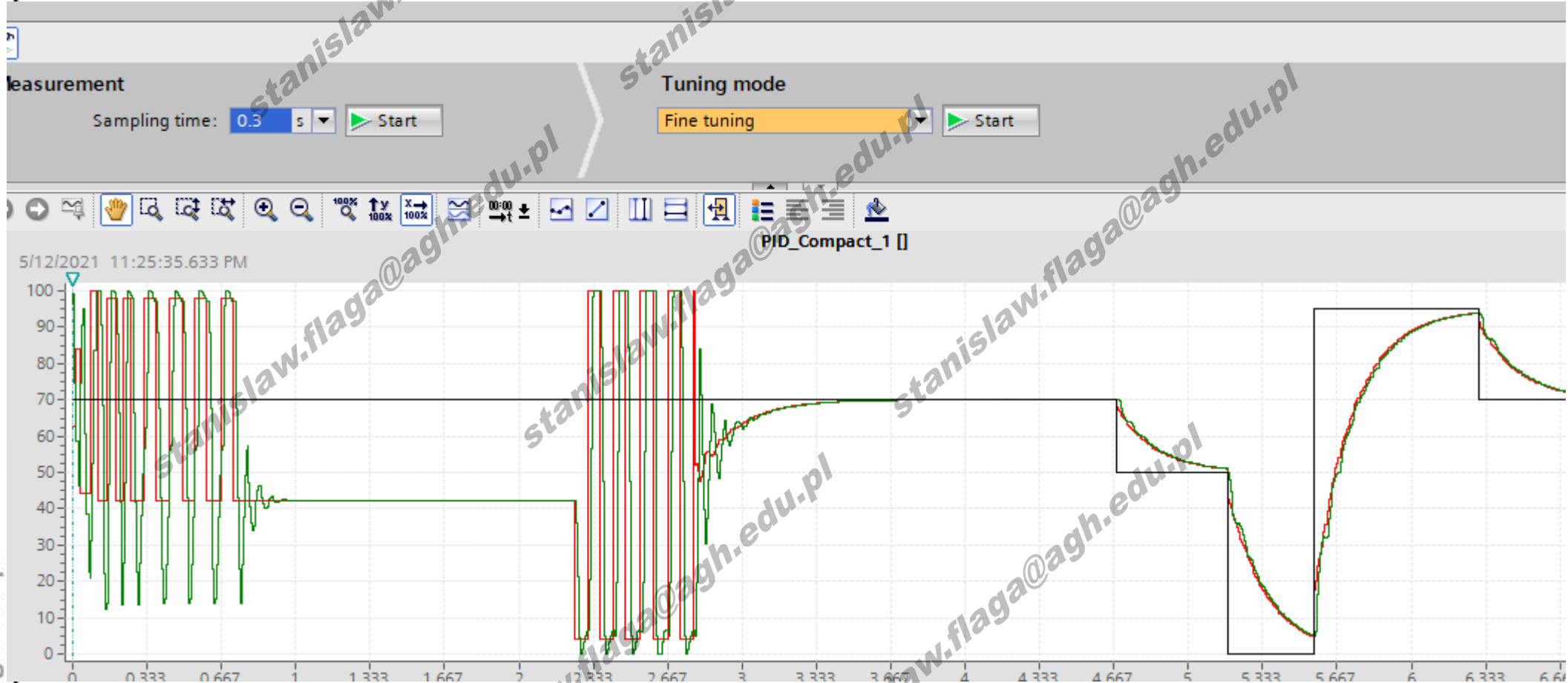
Setpoint: 70.0

Input: 69.99963

Output: 69.99963 %



Manual mode



PID - konfiguracja







PID - konfiguracja



Enable manual entry



Proportional gain:  



Integral action time: s  

Derivative action time: s  



Derivative delay coefficient:  

Proportional action weighting:  

Derivative action weighting:  

Sampling time of PID algorithm: s  

Tuning rule

Controller structure:  

PID - konfiguracja

