Analog Inputs Configuration in TIA Portal for non-standard range

Toady I'm going to show you how to read analog inputs with non-standard range. We're going to read a pressure sensor that outputs voltage range of: 0,5V – 5,5V (0 – 5000 PSI). A couple of AI modules have 'measuring range adjustment' on the hardware level, which makes this task much easier.

In this tutorial you're going to learn:

- How to configure Hardware in TIA Portal
- How to configure Analog Input Card TIA Portal
- How to scale Analog signals in TIA Portal

Analog inputs configuration in TIA Portal for modules with '*measuring range adjustment*'
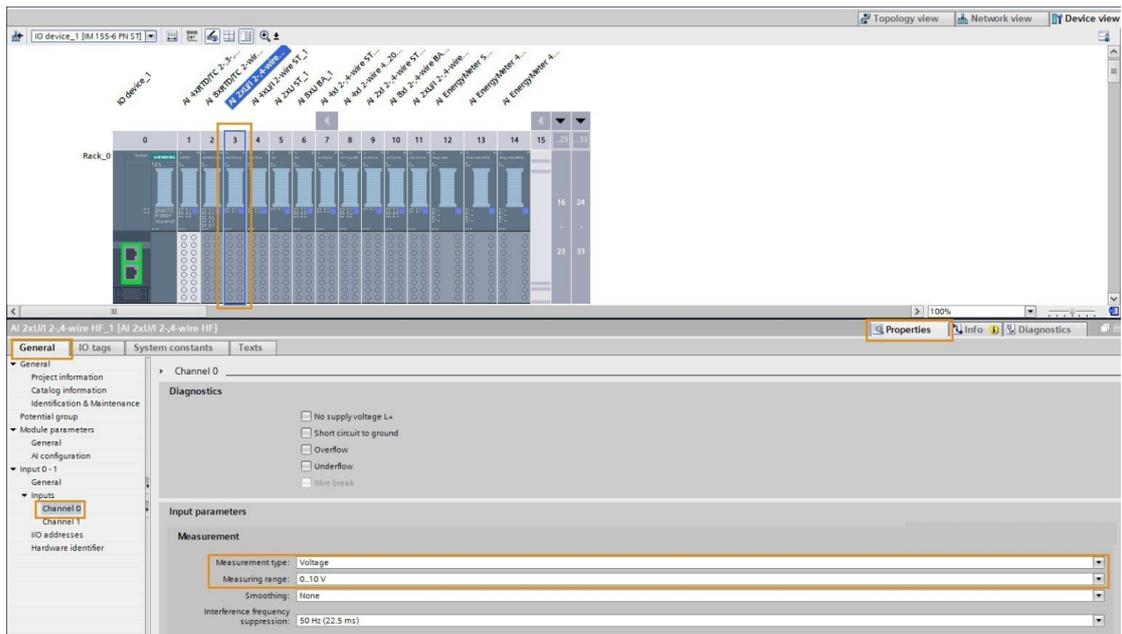
- AI 8xU/I HF – 6ES7 531-7NF00-0AB0: FW 1.1
- AI 2xU/I 2-,4-wire HF (ET200SP) – 6ES7 134-6HB00-0CA1 FW 2.0

1. Hardware Configuration in TIA Portal

Highlight analog input module and go to: Properties » General » *Highlight* Input Channel *that you wish to configure* » Measuring » Measurement type: *Voltage,* Measuring range*: +/- 10V (AI 8xU/I HF) / 0..10V (*AI 2xU/I 2-,4-wire HF)
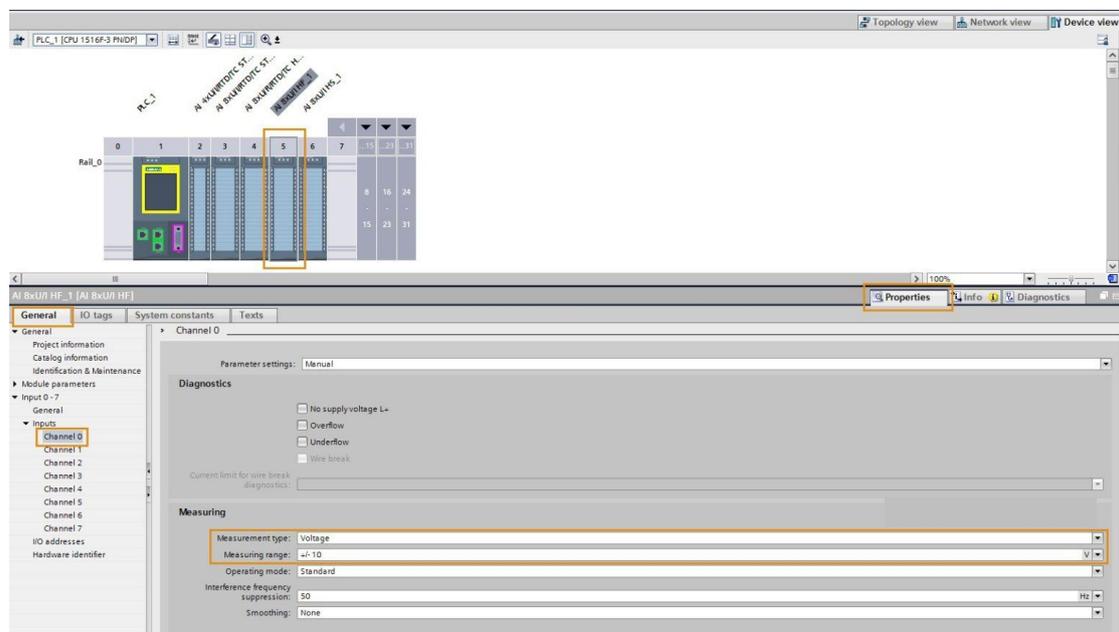

Analog Inputs Module Bipolar

Analog Inputs Module Unipolar

TIP! Take advantage of the built in diagnostics, especially overflow and underflow (value read out side of our measuring range). This errors will be displayed in diagnostic buffer and the PLC's LED will blink red. Also they will be displayed in 'System diagnostics view' window if you have it on one of your HMI screens.

Still having the channel highlighted scroll down to *Measuring range scaling* » tick *Measuring range adjustment* box. Please note that the limits are in millivolts!
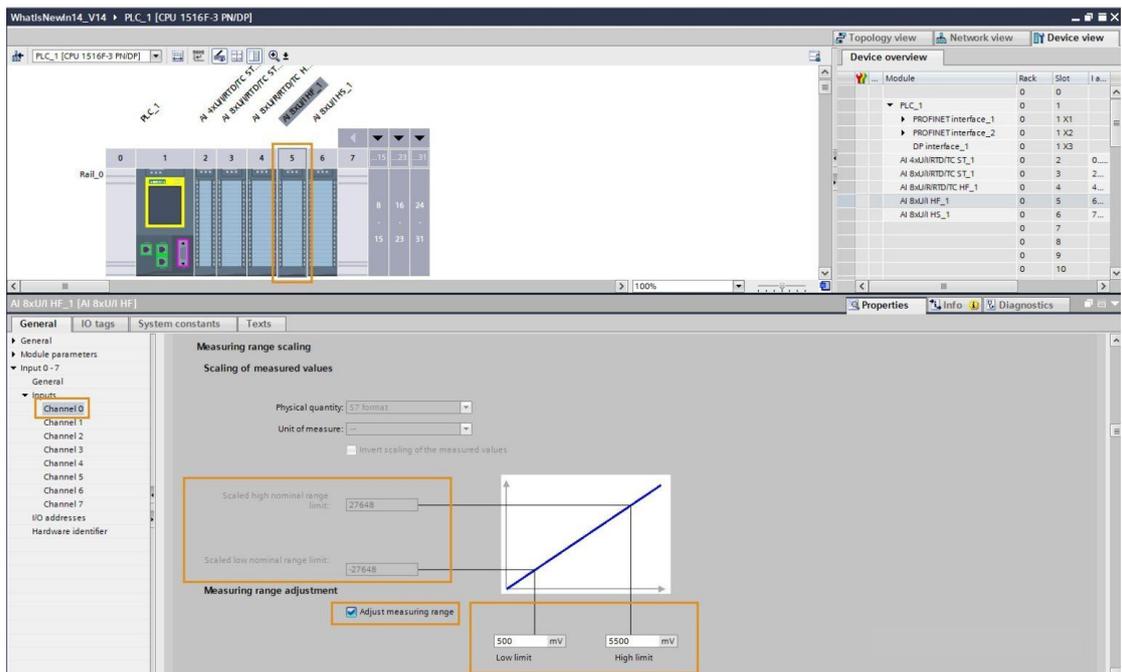
TIA Portal Measuring range adjustment bipolar
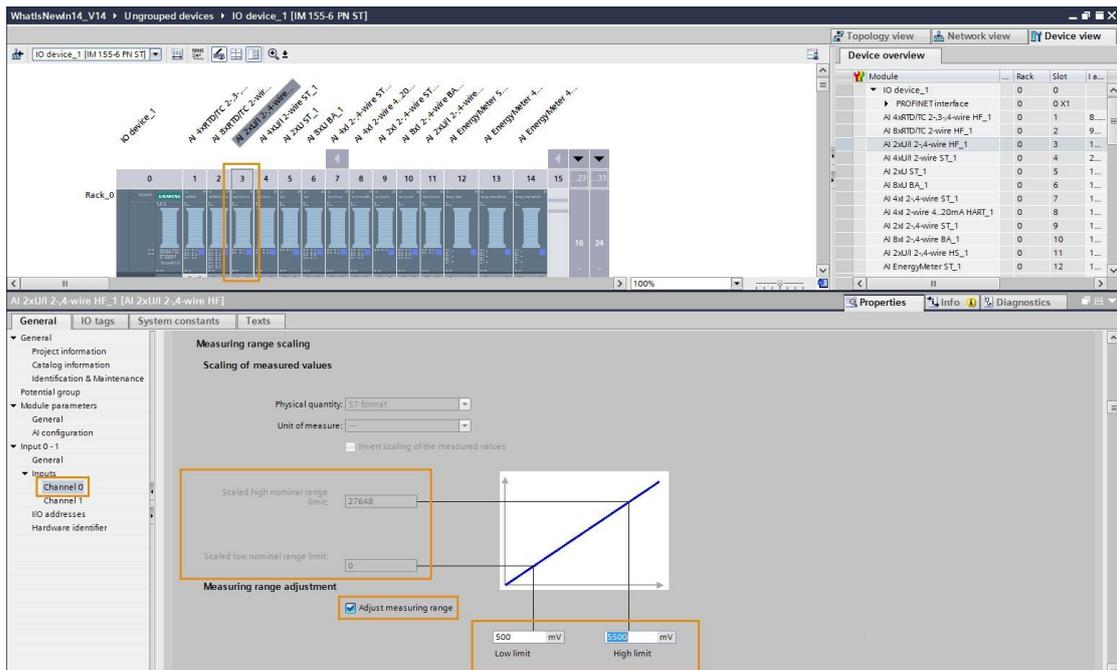
TIA Portal Measuring range adjustment unipolar

- sensor's low limit: 0 PSI »500 mV = 0,5V » *Scaled low nominal range limit (bipolar: -27648, unipolar: 0)*
- sensor's high limit: 5000 PSI » 5500mV = 5,5V » *Scaled high nominal range limit (27648)*

Last but not least we're going to assign a tag that will contain our reading. This tag will be of type Integer and will contain a value between 'scaled low nominal range limit (bipolar: -27648, unipolar: 0) and scaled high nominal range   limit (27648).
Switch the lower level tab from *General* to *IO tags* and enter the tag name:
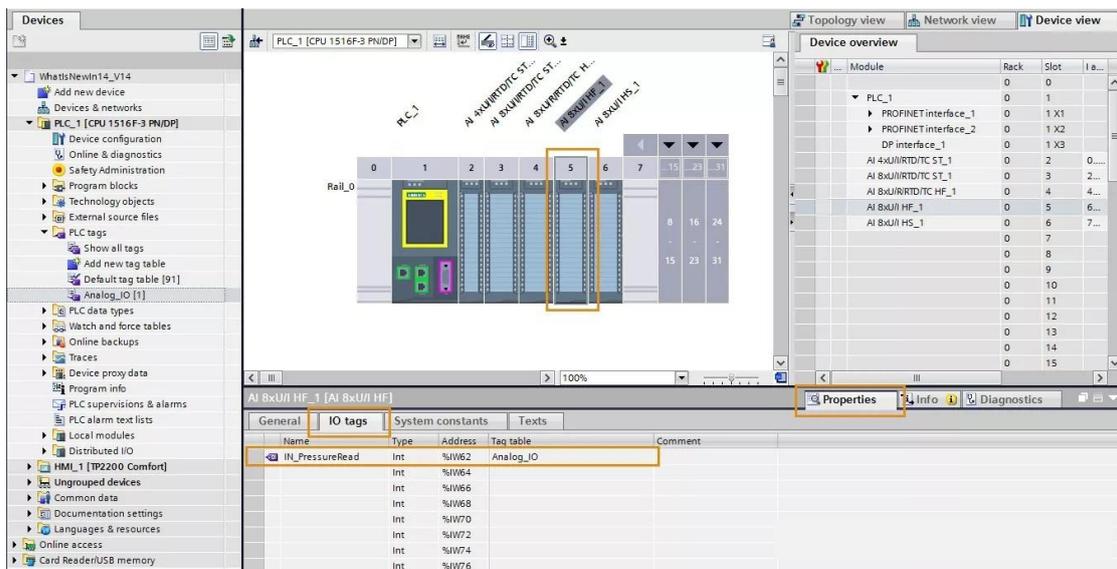
Analog Inputs Tag

Each tag corresponds to a channel, starting at Channel 0 at the top and ending with channel 7 at the bottom.

2. Create 'Analog Value Conversion' Function in TIA Portal

Now we're going to write a function that will convert integer value stored in our tag (*IN_PressureRead*) to engineering value (PSI in this case). Start by creating FC:
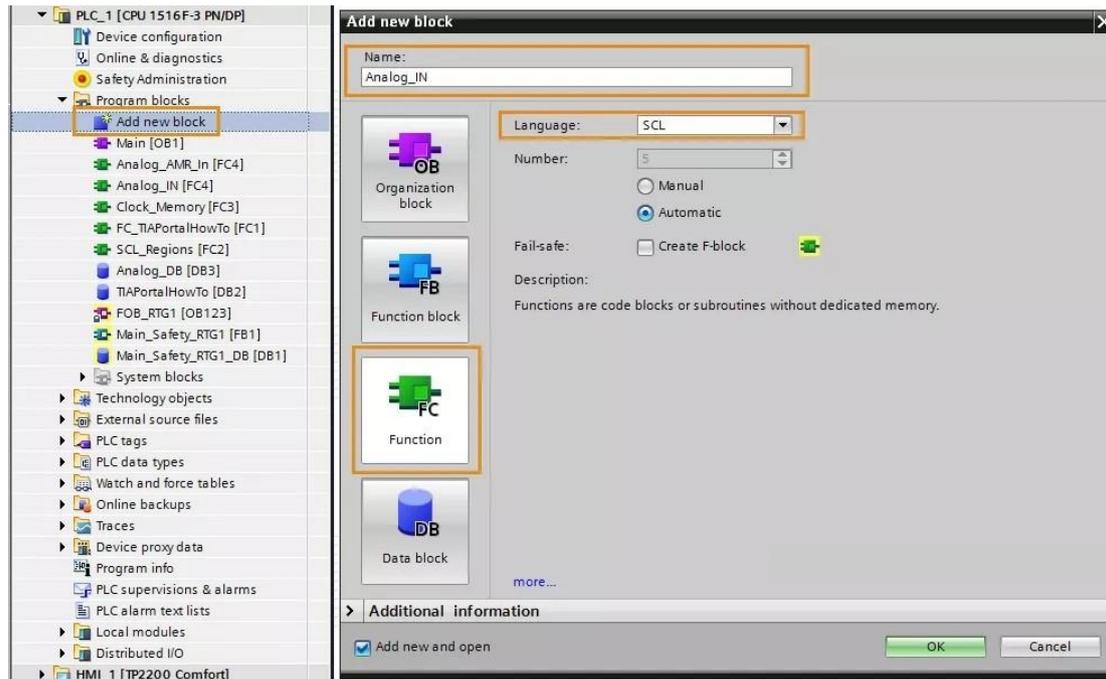
Analog Inputs Function

Create function variables:

INPUT	OUTPUT	TEMP
In_VoltageValueRead – Real	Q_ScaledValue – Real	NormMinValue – Real
In_EngineeringValMin – Real		Normalized_Value – Real
In_EngineeringValMax – Real		

INPUT	OUTPUT	TEMP
In_Bipolar – Bool		
In_Offset – Real		

Analog Inputs Function IO

NOTE: In_Offset is used for manipulating the measurement if required by sensor's calibration result.

Insert the following code in the Function:

```
1   //Reset Temps
    #Normalized_Value := 0.0;
2   #NormMinValue := 0.0;
3
4   //'normalised minimal value' for bipolar AI module = -27648, 'normalised minimal
5   unipolar AI module = 0
    IF #In_Bipolar THEN
6       #NormMinValue := -27648;
```

```
7  ELSE
8        #NormMinValue := 0.0;
9  END_IF;

10
11 //Normalize
   #Normalized_Value := NORM_X(MIN := #NormMinValue, VALUE := #"In_VoltageValueRead"
12
13 //Scale
14 #Q_ScaledValue := (SCALE_X(MIN := #In_EngineeringValMin, VALUE := #Normalized_Val
15 #In_EngineeringValMax)) + #In_Offset;
16
```


Analog_IN block interface and SCL code editor

Name	Data type	Default value	Supervision	Comment
▼ Input				
In_VoltageValueRead	Real			
In_EngineeringValMin	Real			
In_EngineeringValMax	Real			
In_Bipolar	Bool			
In_Offset	Real			
▼ Output				
Q_ScaledValue	Real			
Q_Error	Bool			
▶ InOut				
▼ Temp				
NormMinValue	Real			
Normalized_Value	Real			
▼ Constant				

```
1  //Reset Temps
2  #Normalized_Value := 0.0;
3  #NormMinValue := 0.0;
4
5  //'normalised minimal value' for bipolar AI module = -27648, 'normalised minimal value' for unipolar AI module = 0
6  IF #In_Bipolar THEN
7        #NormMinValue := -27648;
8  ELSE
9        #NormMinValue := 0.0;
10 END_IF;
11
12 //Normalize
13 #Normalized_Value := NORM_X(MIN := #NormMinValue, VALUE := #"In_VoltageValueRead", MAX := 27648);
14
15 //Scale
16 #Q_ScaledValue := (SCALE_X(MIN := #In_EngineeringValMin, VALUE := #Normalized_Value, MAX := #In_EngineeringValMax)) + #In_Offset;
```

# 3. Function call and IO assignment in TIA Portal

Now let's have a quick look at NORM_X and SCALE_X functions. Detailed information can be found in TIA Portal's help. NORM_X maps a tag value to a linear scale and outputs a result (type: Real) between 0.0 and 1.0 as per the following graph:
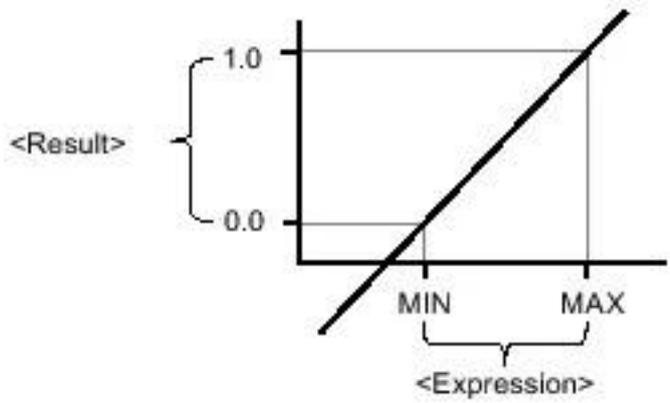
At this point:

- sensor's low limit: 0 PSI »500 mV = 0,5V » Scaled low nominal range limit (bipolar: -27648, unipolar: 0) » 0.0 (NORM_X min)
- sensor's high limit: 5000 PSI » 5500mV = 5,5V » Scaled high nominal range limit (27648) » 1.0 (NORM_X max)
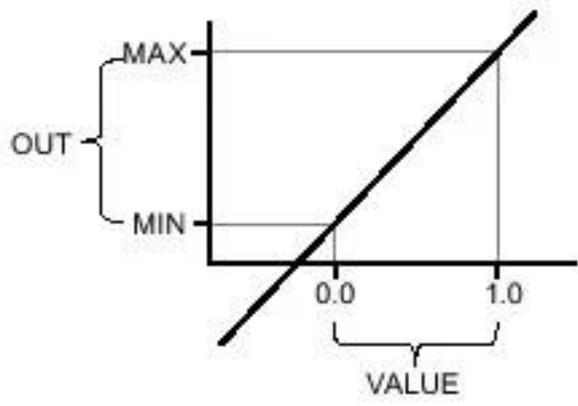
SCALE_X maps a tag value between 0.0 and 1.0 to a linear scale and outputs a result (type: Real) in specified value range.
At this point:

- *sensor's low limit: 0 PSI »500 mV = 0,5V » Scaled low nominal range limit (bipolar: -27648, unipolar: 0) » 0.0 (NORM_X min) » 0 PSI (engineering units)*
- *sensor's high limit: 5000 PSI » 5500mV = 5,5V » Scaled high nominal range limit (27648) » 1.0 (NORM_X max) » 5000 PSI (engineering units)*