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How to Programming Analog Inputs 4-20mA in PLC S7-1200



The **Analog Inputs** are values of parameters mainly **Electrical Signals** that work with the PLC and are Outputs from Sensors (**Transmitters**) by **Current (0-20mA/4-20mA)** or by **Volts (0-10V)**, this value is Scaled in PLC Software and then we have a **Real Value** very similar to Sensor Value



First, We must to know these concepts:

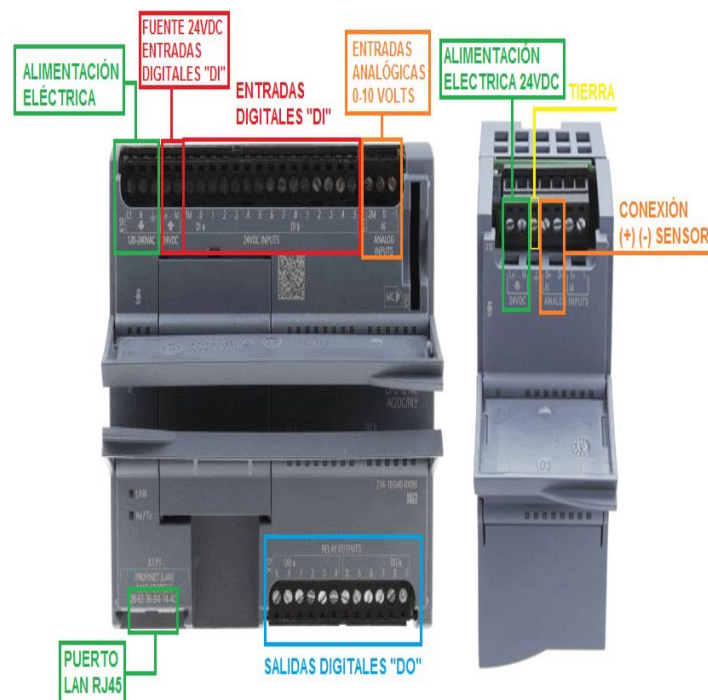
- **Input/Output AI in (mA):** There are the Analog Signals working in Current, mainly 4-20mA or 0-20mA, is one of the most used signals in the industry (have advantages) between Sensors/Transmitters and PLCs or other devices capable to work with 4-20mA
- **Input/Output AI in (Volts):** There are the Analog Signals working in Voltaje, mainly 0-10V, The Voltage in Analog Signals is most used in Outputs, it's because we have more Actuators using 0-10V as Valves, Servomotors, Motors 0-10V, etc
- **Sensors / Transmitters:** There are the electronic devices that mainly measure all types of parameters (Flow, Pressure, Temperature, etc) and are

configured to send a signal to PLC by 0-20/4-20mA or 0-10V, the values allowed in that a PLC can read, Scale signals are developed in Software

- **Software Flag (M%):** One of the most importants Instructions in Software, these instructions can create different programming using "software instructions" and then finally the Flags M% activate the Outputs or create a better program

Must Knowledge

- ✓ Computation
- ✓ Electricity
- ✓ First Time with PLC S7-1200



MAIN SUMMARY

- STEP 1:** Necessary Elements
- STEP 2:** Software Configuration
- STEP 3:** Programming and Scaling Analog Inputs
- STEP 4:** Activating Outputs
- STEP 5:** How wire Sensors in Analog Input Module
- STEP 6:** QUESTIONS & ANSWERS

First Remember have all elements to use Hardware and Software



**PLC Siemens S7-1200 and all PLCs use a
Software to Program and Create the program to
execute in automation, the most important
elements to start in PLC:**

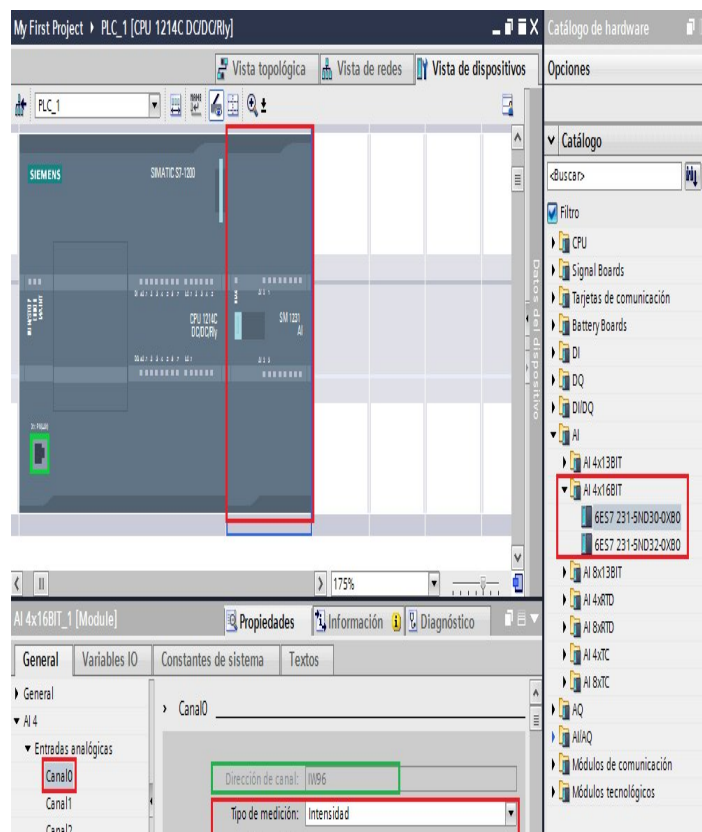
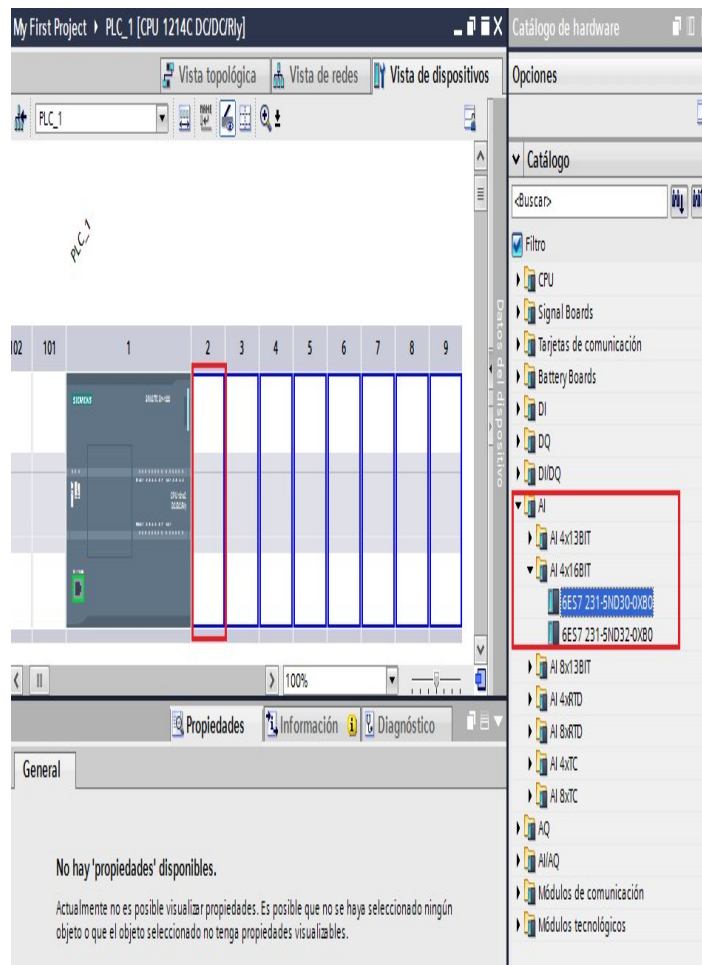
- Notebook or Portable Computer with CD-USB o CD
- PLC S7 1200 Siemens
- Communication Cable Ethernet Cat5e o higher
- Software PLC Logo Siemens; **Step 7 Basic
TIA Portal V13 or higher**
- Wiring Power Supply (24VDC - 110VAC - 220VAC)
- TIA Portal Basic requiere minium 4-6GB RAM
and not a stressful computer

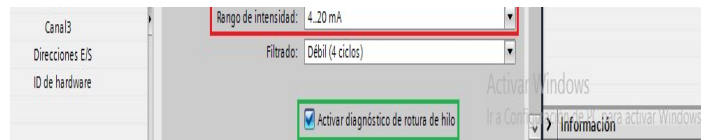
If we don't have the Original CD Software, can
Download TRIAI Versión in [HERE TRIAL VERSION
SIEMENS WEBPAGE](#) it may be useful to understand
and start to **Configure** a PLC S7-1200

STEP 2: Software Configuration

**Select the Hardware Module Analog
Inputs in TIA Portal**

First must be in **Device Configuration**, in side Hardware Catalogue, search and take the right AI Module, to work with 4-20mA need 16 Bits Module



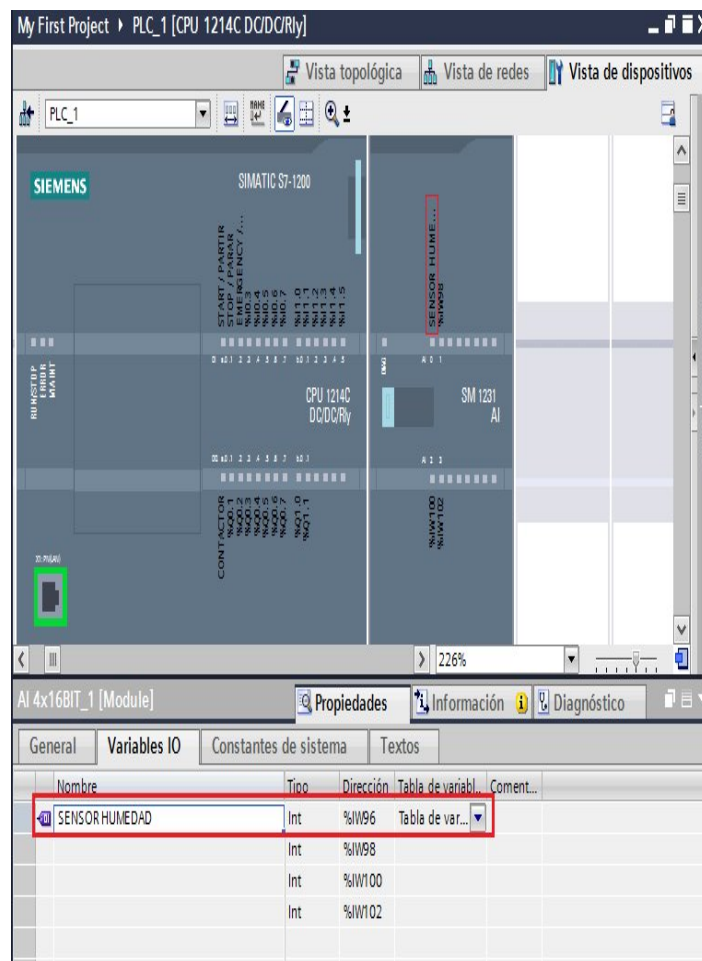


Let's go to configure AI Module Channels in **Properties => General => Analog Inputs** here you need to configure the type of analog inputs that will receive the PLC in the Channels you will connect Sensores o Transmitters

Must to Configure:

1. **Measurement Type** In this case Sensor give us signal 4-20mA so, select **Current**
2. **Current Range** 4...20mA
3. **Channel Address** This is a **very important** variable because will work directly with this "address"

Next go to I/O TAGS, and add the name of the Sensor and we can see we have a Variable %IW, The AI Modules have **address %IW** that we identify in Software for after configure and scale



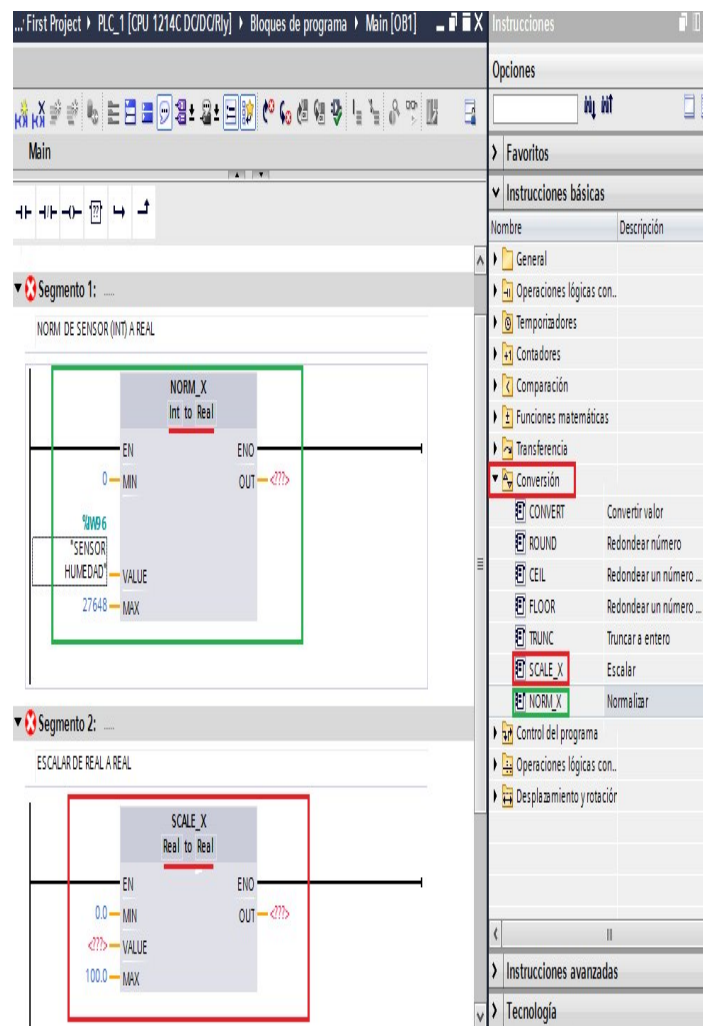
Now that the Hardware is configured, let's start the

PLC Programming!

PASO 3: Programming Analog Inputs

This is the moment to create the program and start to scale and configure

ADD the follow important blocks: **NORM** y **SCALE**



Identify:

1. **NORM_X** This block is "Normalize" this means normalize and "Scale" INT in a REAL Value, this block too scale and normalize the value 4-20mA from Sensor in a new Software Value 0-27648

2. **SCALE_X** Here we scale 2 values Real and Real; Software Value 0-27648 in a new and final

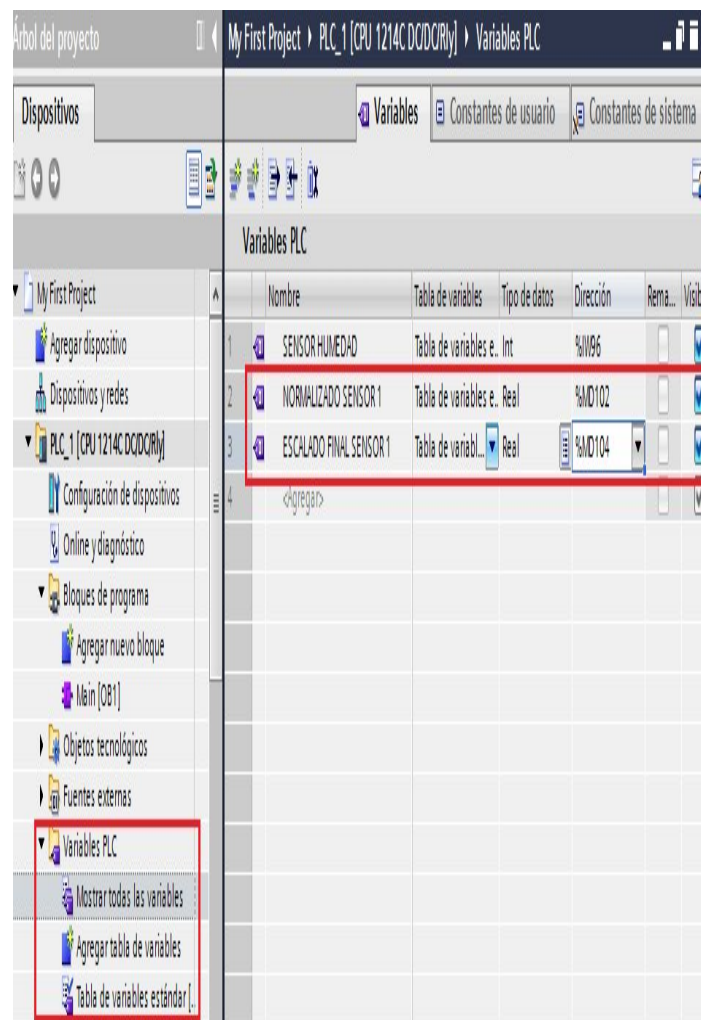
scaled value, in this case 0-100 is the Measurement Range of the Sensor, we must to consider this range

3. **IW96%** This value is the same we have see in steps before (step 2) when we were configuring our Hardware; how we can see this is the first Address connecting in the block NORM_X

4. **But now what happens with.... Signals ???**

5. The moment to work with **Flags M%** has arrived!; take note this is very important

Now go to side screen and will start to create the important variables to finish the scaling



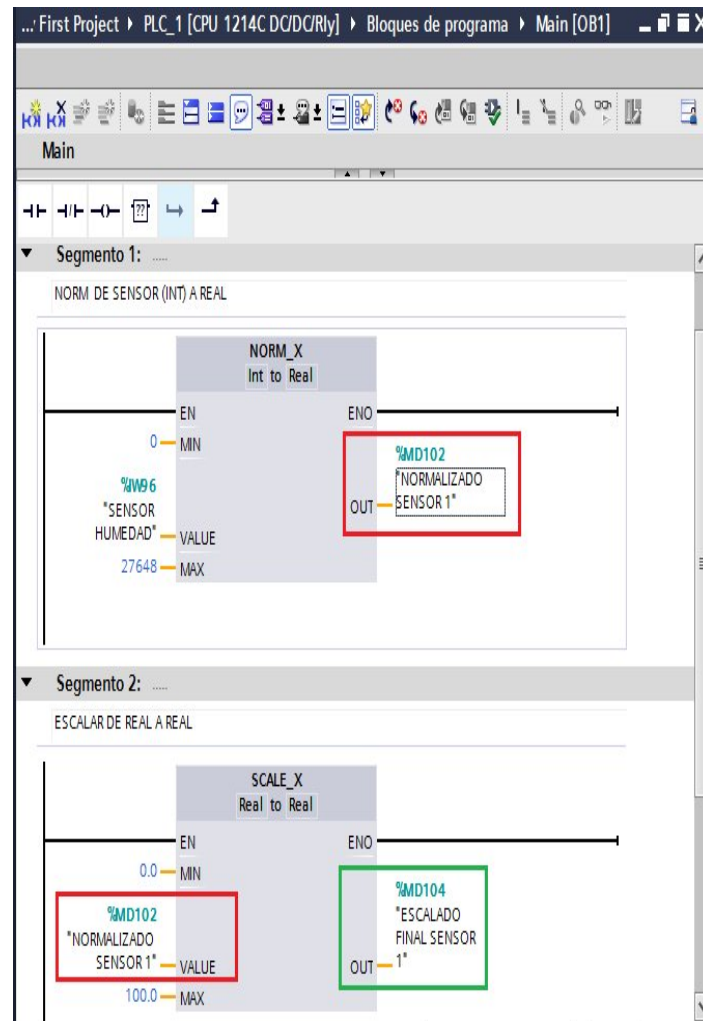
VERY IMPORTANT KNOW ABOUT AI:

- The most important variables are 2; you must Normalize from Sensor and then Scale the final value
- Let's create a Variable "Normalizado Sensor 1"

and assigned address **Flag Value MD%102**

- Then create a "Escalado Final Sensor 1" and assigned **Flag Value MD%104**, this value is the last and take the **Real Value Sensor** measuring in the process

Then back to "Program Blocks" to finish the PLC Programming

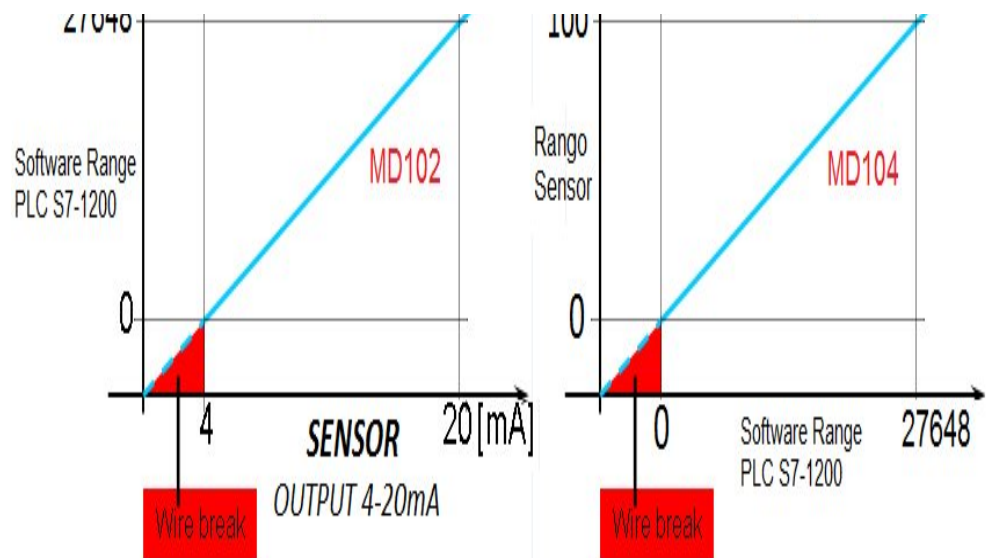


So, we are ready with the scaled value from Sensor into Final Real Value:

- The first value MD102 is the value INT to REAL between Sensor and Software
- Final Variable MD104 is the scaled value REAL a REAL between Software and Range Measurement of the Sensor

Sensors Scaled in a **Linear Function**



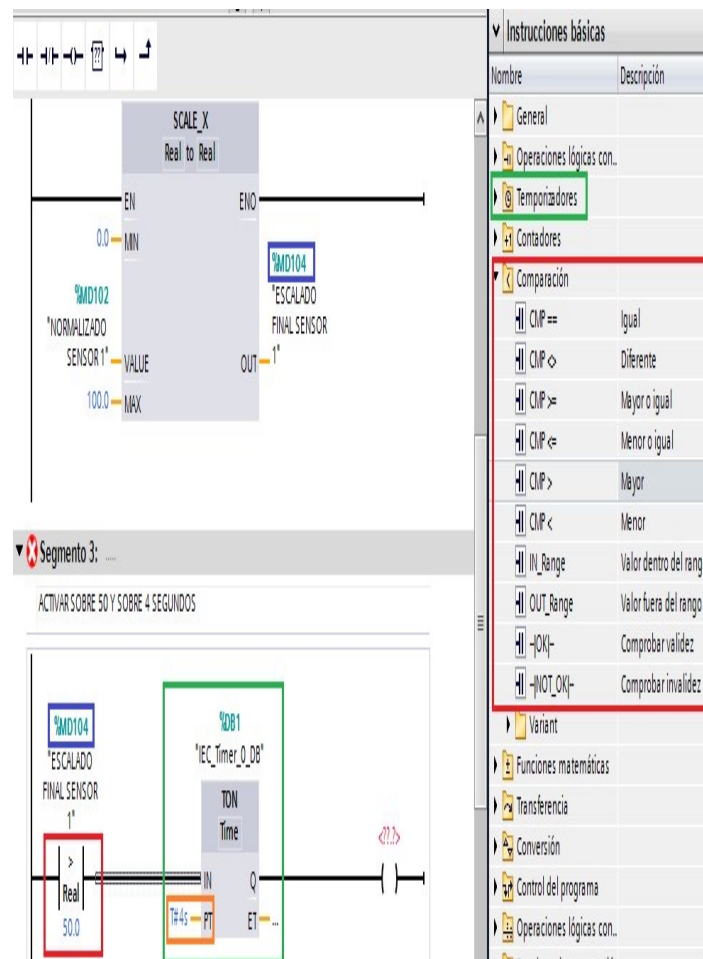


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PASO 4: Activate By Analog Inputs

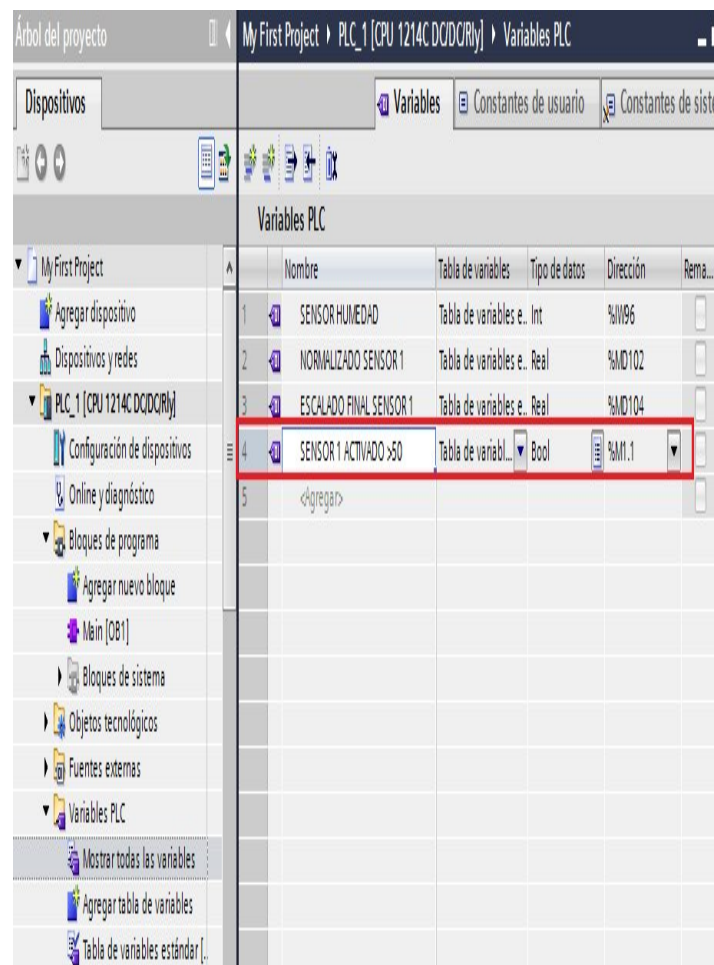
Gonna see the most basic form to create a Output of the measured value

The most simple way to create a Output is by
"Comparator Operations"



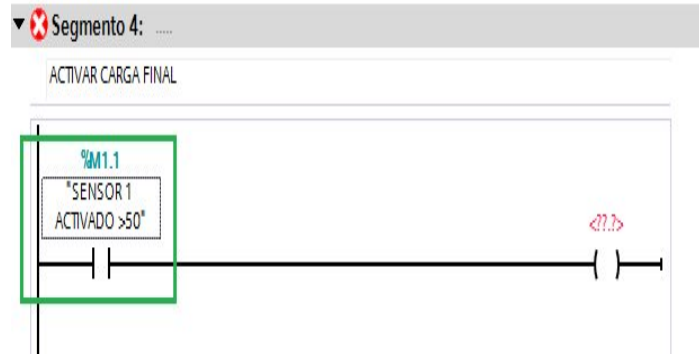
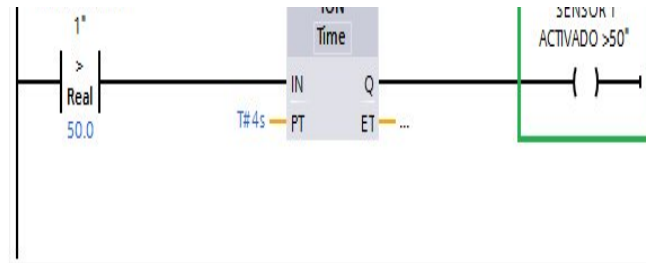
In the side of Instruccions select the comparator we want to use, in this case we choose the instruction "higher than" and in this block the output will activate when value **>50 is higher**;, this value remember is the final scaled with **MD104 TAG**; then add TON Timer ... WHY? Because if we don't control it; between 50-51 "**do ON and OFF in milisecond, common error that you may fix with a timer**", of course all depends if the process is very critical or not; sometimes you can do it!

Almost finish go to PLC TAGS abd create a Output with a "M" and give address M1.1



Back to Program Block and now assigned the value M1.1 in a Coil to after create a Digital Contact





Finally select and configure a real Output "Q", Go to Device Configurations and choose in I/O Tags the Output "Q" will use, in this case Q0.0

My First Project ▶ PLC_1 [CPU 1214C DC/DC/Rly]

Vista topológica Vista de redes Vista de dispositivos

PLC_1

CPU 1214C DC/DC/Rly

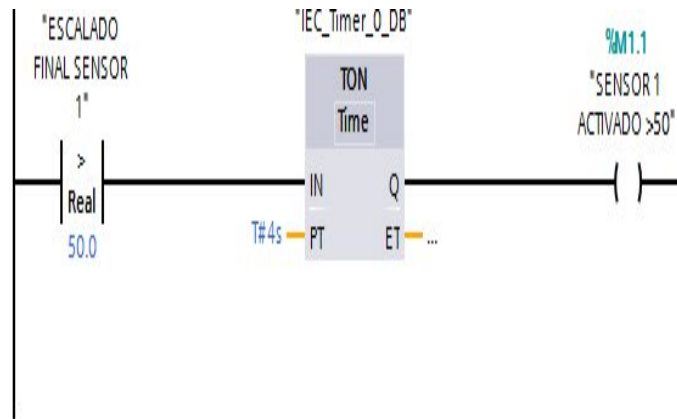
SM 1231 AI

Variables IO

| Nombre | Tipo | Dirección | Tabla de variabl... | Coment... |
|------------------------|------|-----------|---------------------|-----------|
| | Bool | %I1.4 | | |
| | Bool | %I1.5 | | |
| CARGA FINAL O ACTUADOR | Bool | %Q0.0 | Tabla de var... | |
| | Bool | %Q0.1 | | |
| | Bool | %Q0.2 | | |

Back to our Block Program and finally add the Address what we need to finish; Q0.0





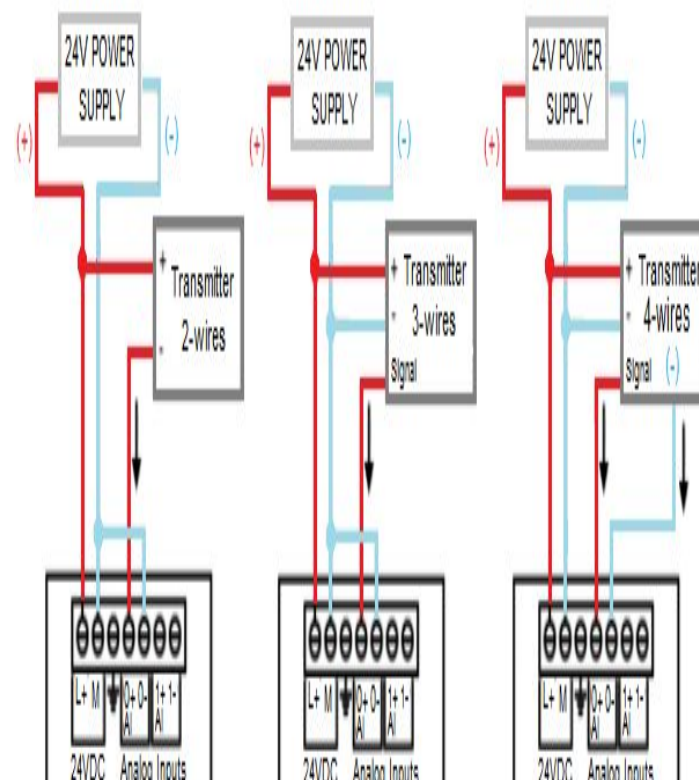
Segmento 4:

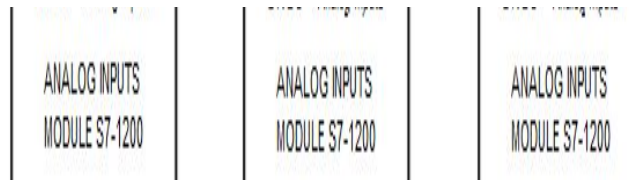
ACTIVAR CARGA FINAL "Q"



PASO 5: Connecting and Wire Sensors

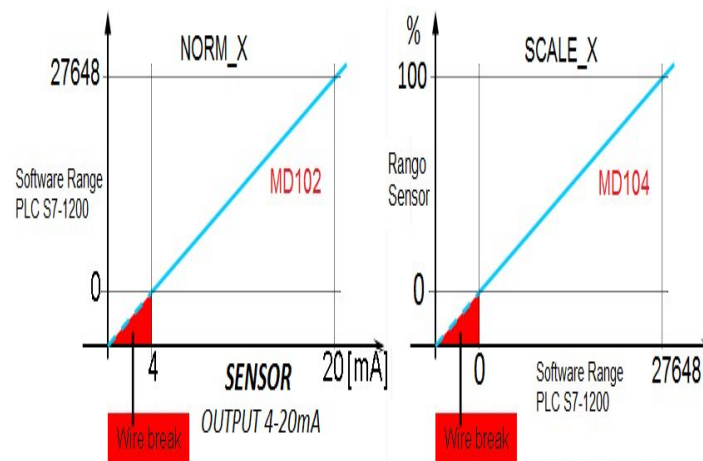
Let's see the 3 types of Analog Sensor wire in a AI Module S7 1200





The number of wires used in Sensors that connect AI Modules are **2 - 3 or 4 wires**

And in our example... what Sensor we have configured???

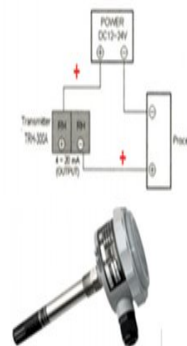


Specifications of TRH-300

| | |
|----------------------|---|
| Measurement Range | 0 ~ 100% RH |
| Accuracy (At 25°C) | ±2 % RH, ±0.3°C (±Power supply = 24VDC) |
| Long-term stability | Better than 1% RH per year (Typical) |
| Temp. Compensation | ± 0.008% RH/°C (Effect @ 0 %RH) |
| Response | <15 seconds (90 % at +25°C in moving air over 0.5 M/S) |
| Sensors | Humidity: Thin-film capacitor Temperature: RTD Pt 100(1) IEC 751, DIN43760 |
| Output | Current output: Humidity: 4 ~ 20 mA Two wire Temperature: 4 ~ 20 mA Two wire |
| Voltage output | 0 to 1V, 0 to 5V, 0 to 10V or 1 to 5V, Selectable (Other scales possible upon request) |
| Fine adjustment | Zero and Span adjustable by spare potentiometer. |
| Power Supply | 12 ~ 40V DC, > 150 mA |
| Housing / Protection | ABS plastic watertight enclosure (IP 65) |
| Cable gland | Liquid-tight nylon, cable Bushing: ø 5-10mm |
| Ambient Temperature | -40 ~ +85°C (-40 ~ +185°F) |
| Weight | Approx. 150g |

CONNECTING DIAGRAM

TRH-300A Current output type



❗ QUESTIONS & ANSWERS

HERE IS ANSWERED YOUR QUESTIONS:

1. Where can Download TIA Portal V13 or higher Trial Version??

You can download Trial [Download Here in Siemens Webpage](#) ,Also download PLC Sim may helps you to simulate software before start and run, TAKE NOTE, The original CD and

Licence allows you assure the correct compatibility between Software and Hardware (PLC)

2. **Why Signal 4-20mA is the most used in Analog Inputs (AI)?**

You can find some advantages [GO STEP 2](#) but always is important mention:

- Better for a long distances
- Most tolerant to Electronic Noise (avoiding high values)
- The Current 4mA is point "0", it means always in the measure must be powered, if we don't have Voltage so we have a Wire Break, Never the wire must to be "0 Volts"
- The most choosed signal for a most technology Sensors (really it has advantages)

3. **How wire and connect different Sensors o Transmitter in Analog Input Module PLC S7-1200?**

The most used 3 types of Sensores have 2-3 or 4 wires, to see how to connect to AI Module in PLC S7 1200 [GO STEP 5](#)

4. **Why Can't communicate PC and PLC S7 1200?**

Communication between PC and S7-1200 is via ETHERNET (TCP/IP); you can verify is your PC is in same Subnetwork than PLC, remember IP S7-1200 has assigned in "Profinet Interface" 192.168.0.x above in page [GO STEP 3 HERE](#)

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