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| Totally Integrated<br>Automation Portal |  |  |
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## PLC tags / Standard-Variablenliste [71]

### PLC tags

| PLC tags |                        |           |         |        |  |  |                                    |             |         |
|----------|------------------------|-----------|---------|--------|--|--|------------------------------------|-------------|---------|
|          | Name                   | Data type | Address | Retain | Accessi-ble from<br>HMI/OPC<br>UA/Web<br>API | Writable<br>from<br>HMI/OPC<br>UA/Web<br>API | Visible in<br>HMI engi-<br>neering | Supervision | Comment |
| ■        | Start (btn)            | Bool      | %I0.0   | False  | True   | True   | True                               |             |         |
| ■        | Reset (btn)            | Bool      | %I0.1   | False  | True   | True   | True                               |             |         |
| ■        | Stop (btn)             | Bool      | %I0.2   | False  | True   | True   | True                               |             |         |
| ■        | Factory I/O (Running)  | Bool      | %I0.3   | False  | True   | True   | True                               |             |         |
| ■        | Level Meter            | Real      | %ID30   | False  | True   | True   | True                               |             |         |
| ■        | Flow Meter             | DWord     | %ID34   | False  | True   | True   | True                               |             |         |
| ■        | Setpoint               | DWord     | %ID38   | False  | True   | True   | True                               |             |         |
| ■        | Start Light            | Bool      | %Q0.0   | False  | True   | True   | True                               |             |         |
| ■        | Reset Light            | Bool      | %Q0.1   | False  | True   | True   | True                               |             |         |
| ■        | Stop Light             | Bool      | %Q0.2   | False  | True   | True   | True                               |             |         |
| ■        | Fill Valve             | Real      | %QD30   | False  | True   | True   | True                               |             |         |
| ■        | Discharge Valve        | Real      | %QD34   | False  | True   | True   | True                               |             |         |
| ■        | Setpoint (Display)     | DInt      | %QD38   | False  | True   | True   | True                               |             |         |
| ■        | PV (Display)           | DInt      | %QD42   | False  | True   | True   | True                               |             |         |
| ■        | setpoint buffer        | DWord     | %MD100  | False  | True   | True   | True                               |             |         |
| ■        | Setpoint Value         | Real      | %MD104  | False  | True   | True   | True                               |             |         |
| ■        | level meter buffer     | DWord     | %MD108  | False  | True   | True   | True                               |             |         |
| ■        | PV Value               | DWord     | %MD112  | False  | True   | True   | True                               |             |         |
| ■        | Fill PID Output        | Int       | %MW116  | False  | True   | True   | True                               |             |         |
| ■        | fill pid output buffer | DWord     | %MD120  | False  | True   | True   | True                               |             |         |

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## Main [OB1]

| Main Properties |                              |                 |                                       |         |    |              |
|-----------------|------------------------------|-----------------|---------------------------------------|---------|----|--------------|
| General         |                              |                 |                                       |         |    |              |
| Name            | Main                         | Number          | 1                                     | Type    | OB | Language FBD |
| Numbering       | Automatic                    |                 |                                       |         |    |              |
| Information     |                              |                 |                                       |         |    |              |
| Title           | "Main Program Sweep (Cycle)" | Author          |                                       | Comment |    | Family       |
| Version         | 0.1                          | User-defined ID |                                       |         |    |              |
| Name            | Data type                    | Default value   | Comment                               |         |    |              |
| ▼ Input         |                              |                 |                                       |         |    |              |
| Initial_Call    | Bool                         |                 | Initial call of this OB               |         |    |              |
| Remanence       | Bool                         |                 | =True, if remanent data are available |         |    |              |
| Temp            |                              |                 |                                       |         |    |              |
| Constant        |                              |                 |                                       |         |    |              |

### Network 1: Import FactoryIO handler

%FC9000  
"MHJ-PLC-Lab-Function-S71500"  
... — EN                    ENO —

### Network 2: Import Tank Level Controller

%FC1  
"Tank\_Level\_Control"  
... — EN                    ENO —

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## PID Controllers [OB30]

| PID Controllers Properties |                 |                 |                         |         |    |          |     |
|----------------------------|-----------------|-----------------|-------------------------|---------|----|----------|-----|
| General                    |                 |                 |                         |         |    |          |     |
| Name                       | PID Controllers | Number          | 30                      | Type    | OB | Language | LAD |
| Numbering                  | Automatic       |                 |                         |         |    |          |     |
| Information                |                 |                 |                         |         |    |          |     |
| Title                      | PID Block       | Author          |                         | Comment |    | Family   |     |
| Version                    | 0.1             | User-defined ID |                         |         |    |          |     |
| Name                       | Data type       | Default value   | Comment                 |         |    |          |     |
| ▼ Input                    |                 |                 |                         |         |    |          |     |
| Initial_Call               | Bool            |                 | Initial call of this OB |         |    |          |     |
| Event_Count                | Int             |                 | Events discarded        |         |    |          |     |
| Temp                       |                 |                 |                         |         |    |          |     |
| Constant                   |                 |                 |                         |         |    |          |     |

### Network 1: PID to fill tank according to setpoint

NOTE: We modified several settings for this PID to work. Namely:

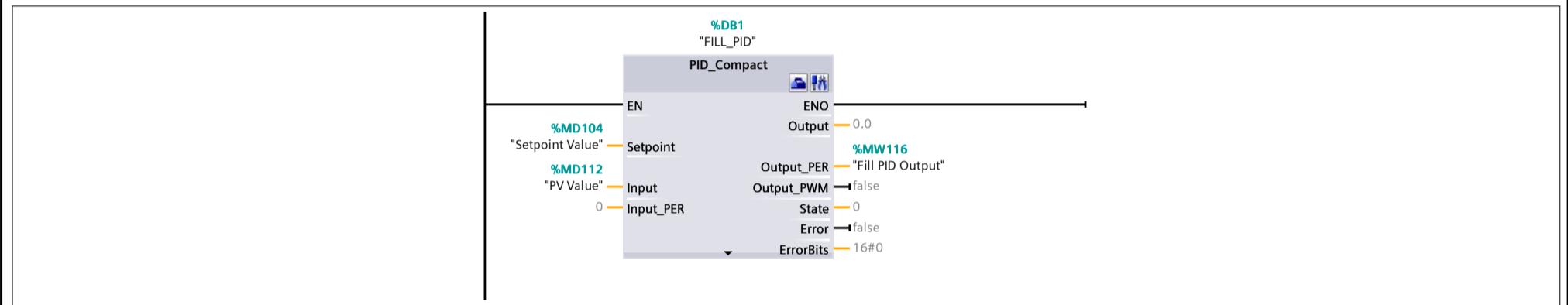
Controller type set to "Length", "Cm", and "Automatic"

Input changed from "Input\_PER" to "Input"

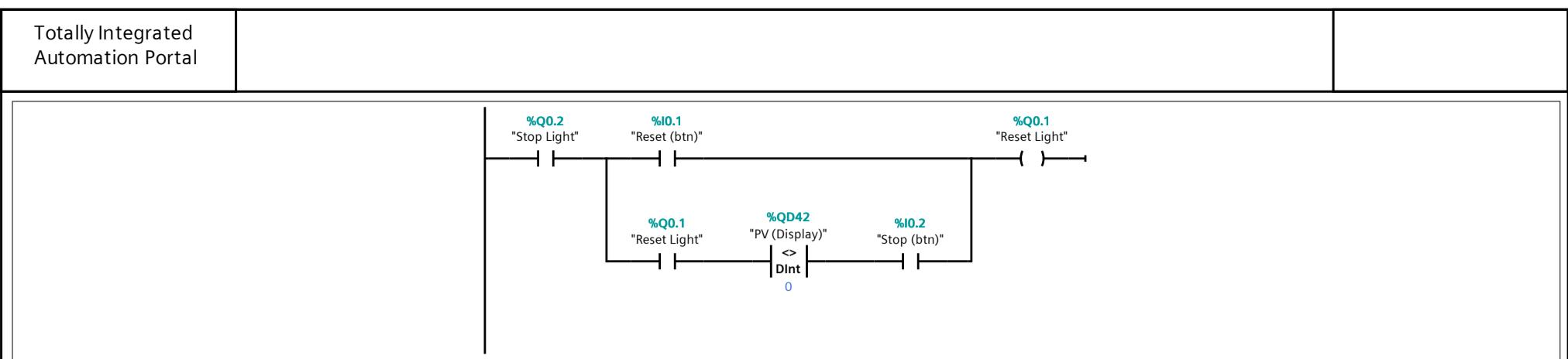
Process value upper limit changed to 300.0cm

Integral action time changed from 20.0s to 0.0s

PID -> PI (we don't really need the derivative in this case)

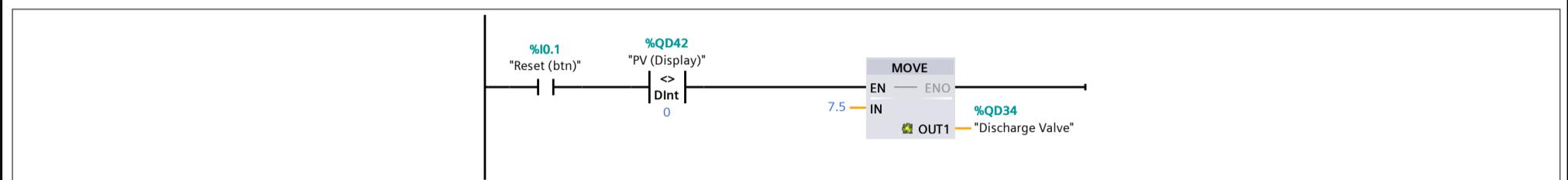


| Totally Integrated Automation Portal  |                    |   |         |                    |        |          |      |    |          |     |           |           |  |  |  |  |  |  |       |        |         |        |  |  |   |  |         |     |                 |  |      |           |               |         |       |  |  |  |        |  |  |  |       |  |  |  |      |  |  |  |          |  |  |  |          |  |  |  |                    |      |  |  |
|---|--------------------|---|---------|--------------------|--------|----------|------|----|----------|-----|-----------|-----------|--|--|--|--|--|--|-------|--------|---------|--------|--|--|---|--|---------|-----|-----------------|--|------|-----------|---------------|---------|-------|--|--|--|--------|--|--|--|-------|--|--|--|------|--|--|--|----------|--|--|--|----------|--|--|--|--------------------|------|--|--|
| <h3>Tank_Level_Control [FC1]</h3> <p><b>Tank_Level_Control Properties</b></p> <p><b>General</b></p> <table border="1"> <tr> <td>Name</td> <td>Tank_Level_Control</td> <td>Number</td> <td>1</td> <td>Type</td> <td>FC</td> <td>Language</td> <td>LAD</td> </tr> <tr> <td>Numbering</td> <td>Automatic</td> <td colspan="6"></td> </tr> </table> <p><b>Information</b></p> <table border="1"> <tr> <td>Title</td> <td>Author</td> <td>Comment</td> <td>Family</td> </tr> <tr> <td></td> <td></td> <td>Networks 1-6 handle starting, stopping and resetting the process.<br/>Networks 7-9 manages our set point value and process variable value, which interact with a PID to handle how much voltage is sent to the fill valve.</td> <td></td> </tr> <tr> <td>Version</td> <td>0.1</td> <td>User-defined ID</td> <td></td> </tr> </table> <table border="1"> <thead> <tr> <th>Name</th> <th>Data type</th> <th>Default value</th> <th>Comment</th> </tr> </thead> <tbody> <tr> <td>Input</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Output</td> <td></td> <td></td> <td></td> </tr> <tr> <td>InOut</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Temp</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Constant</td> <td></td> <td></td> <td></td> </tr> <tr> <td>▼ Return</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Tank_Level_Control</td> <td>Void</td> <td></td> <td></td> </tr> </tbody> </table> <p><b>Network 1: Start process</b></p> <p><b>Network 2: Turn off discharge/drain valve</b></p> <p>We'd be wasting water/chemicals if the discharge valve was on when starting the process. Additionally, we want to stop draining if the stop button is pressed.</p> <p><b>Network 3: Stop process</b></p> <p><b>Network 4: Turn off fill valve</b></p> <p>We want to immediately stop filling given operator intervention</p> <p><b>Network 5: Reset process</b></p> <p>&lt;&gt; 0 so the reset light turns off once the tank is fully drained, or the stop button is pressed</p> |                    |   | Name    | Tank_Level_Control | Number | 1        | Type | FC | Language | LAD | Numbering | Automatic |  |  |  |  |  |  | Title | Author | Comment | Family |  |  | Networks 1-6 handle starting, stopping and resetting the process.<br>Networks 7-9 manages our set point value and process variable value, which interact with a PID to handle how much voltage is sent to the fill valve. |  | Version | 0.1 | User-defined ID |  | Name | Data type | Default value | Comment | Input |  |  |  | Output |  |  |  | InOut |  |  |  | Temp |  |  |  | Constant |  |  |  | ▼ Return |  |  |  | Tank_Level_Control | Void |  |  |
| Name  | Tank_Level_Control | Number  | 1       | Type               | FC     | Language | LAD  |    |          |     |           |           |  |  |  |  |  |  |       |        |         |        |  |  |   |  |         |     |                 |  |      |           |               |         |       |  |  |  |        |  |  |  |       |  |  |  |      |  |  |  |          |  |  |  |          |  |  |  |                    |      |  |  |
| Numbering   | Automatic          |   |         |                    |        |          |      |    |          |     |           |           |  |  |  |  |  |  |       |        |         |        |  |  |   |  |         |     |                 |  |      |           |               |         |       |  |  |  |        |  |  |  |       |  |  |  |      |  |  |  |          |  |  |  |          |  |  |  |                    |      |  |  |
| Title   | Author             | Comment   | Family  |                    |        |          |      |    |          |     |           |           |  |  |  |  |  |  |       |        |         |        |  |  |   |  |         |     |                 |  |      |           |               |         |       |  |  |  |        |  |  |  |       |  |  |  |      |  |  |  |          |  |  |  |          |  |  |  |                    |      |  |  |
|   |                    | Networks 1-6 handle starting, stopping and resetting the process.<br>Networks 7-9 manages our set point value and process variable value, which interact with a PID to handle how much voltage is sent to the fill valve. |         |                    |        |          |      |    |          |     |           |           |  |  |  |  |  |  |       |        |         |        |  |  |   |  |         |     |                 |  |      |           |               |         |       |  |  |  |        |  |  |  |       |  |  |  |      |  |  |  |          |  |  |  |          |  |  |  |                    |      |  |  |
| Version   | 0.1                | User-defined ID   |         |                    |        |          |      |    |          |     |           |           |  |  |  |  |  |  |       |        |         |        |  |  |   |  |         |     |                 |  |      |           |               |         |       |  |  |  |        |  |  |  |       |  |  |  |      |  |  |  |          |  |  |  |          |  |  |  |                    |      |  |  |
| Name  | Data type          | Default value   | Comment |                    |        |          |      |    |          |     |           |           |  |  |  |  |  |  |       |        |         |        |  |  |   |  |         |     |                 |  |      |           |               |         |       |  |  |  |        |  |  |  |       |  |  |  |      |  |  |  |          |  |  |  |          |  |  |  |                    |      |  |  |
| Input   |                    |   |         |                    |        |          |      |    |          |     |           |           |  |  |  |  |  |  |       |        |         |        |  |  |   |  |         |     |                 |  |      |           |               |         |       |  |  |  |        |  |  |  |       |  |  |  |      |  |  |  |          |  |  |  |          |  |  |  |                    |      |  |  |
| Output  |                    |   |         |                    |        |          |      |    |          |     |           |           |  |  |  |  |  |  |       |        |         |        |  |  |   |  |         |     |                 |  |      |           |               |         |       |  |  |  |        |  |  |  |       |  |  |  |      |  |  |  |          |  |  |  |          |  |  |  |                    |      |  |  |
| InOut   |                    |   |         |                    |        |          |      |    |          |     |           |           |  |  |  |  |  |  |       |        |         |        |  |  |   |  |         |     |                 |  |      |           |               |         |       |  |  |  |        |  |  |  |       |  |  |  |      |  |  |  |          |  |  |  |          |  |  |  |                    |      |  |  |
| Temp  |                    |   |         |                    |        |          |      |    |          |     |           |           |  |  |  |  |  |  |       |        |         |        |  |  |   |  |         |     |                 |  |      |           |               |         |       |  |  |  |        |  |  |  |       |  |  |  |      |  |  |  |          |  |  |  |          |  |  |  |                    |      |  |  |
| Constant  |                    |   |         |                    |        |          |      |    |          |     |           |           |  |  |  |  |  |  |       |        |         |        |  |  |   |  |         |     |                 |  |      |           |               |         |       |  |  |  |        |  |  |  |       |  |  |  |      |  |  |  |          |  |  |  |          |  |  |  |                    |      |  |  |
| ▼ Return  |                    |   |         |                    |        |          |      |    |          |     |           |           |  |  |  |  |  |  |       |        |         |        |  |  |   |  |         |     |                 |  |      |           |               |         |       |  |  |  |        |  |  |  |       |  |  |  |      |  |  |  |          |  |  |  |          |  |  |  |                    |      |  |  |
| Tank_Level_Control  | Void               |   |         |                    |        |          |      |    |          |     |           |           |  |  |  |  |  |  |       |        |         |        |  |  |   |  |         |     |                 |  |      |           |               |         |       |  |  |  |        |  |  |  |       |  |  |  |      |  |  |  |          |  |  |  |          |  |  |  |                    |      |  |  |



### Network 6: Turn on discharge/drain valve

In the real world, we'd send in a raw integer value for the analog signal (0-27648 for SIMATIC PLCs, meaning 20736 in this case), but FactoryIO direct, 0-10V values only

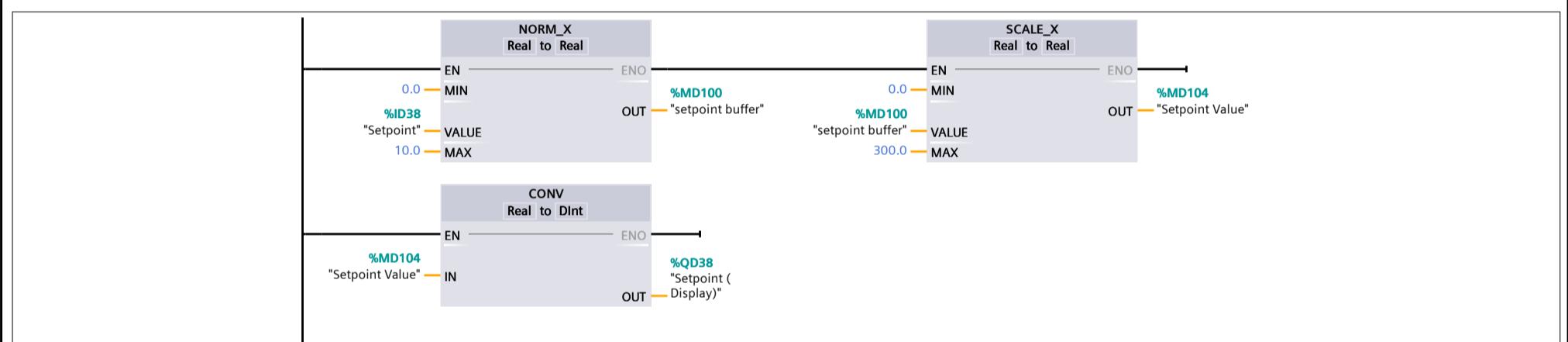


### Network 7: Transfers Setpoint Potentiometer value to Setpoint Display on OIT

NORM\_X: Potentiometer is analog and goes from [0.0V, 10.0V]

SCALE\_X: Tank level is from [0.0cm, 300.0cm]. (Setpoint Value is also used within our PID)

CONV: Converts setpoint value from REAL to DINT for the Setpoint display on OIT

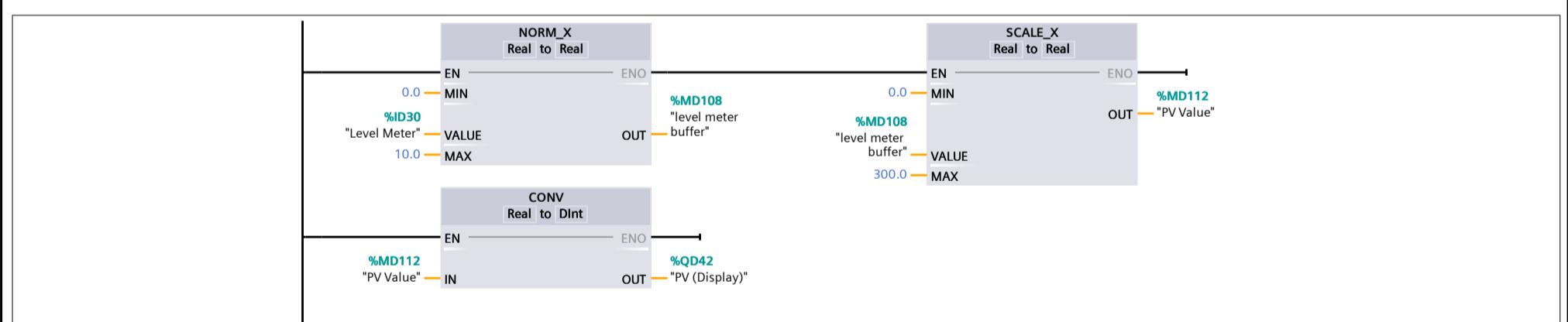


### Network 8: Transfers Level Meter value to PV Display on OIT

NORM\_X: Level Meter is analog and goes from [0.0V, 10.0V]

SCALE\_X: Tank level is (again) from [0.0cm, 300.0cm], (PV Value is also used within our PID)

CONV: Converts PV (process variable, or basically tank level value) from REAL to DINT for the PV display on OIT



### Network 9: Transfers PID output to Fill Valve

NORM\_X: PID output goes from [0.0, 27648.0]

MAX is 27648 because that's the maximum raw integer conversion for analog output for SIMATIC systems (which corresponds to 10V)

SCALE\_X: In the real world the valve would be able to take a [0.0, 27648.0] value, but in FactoryIO it requires the output to be 0-10V.

We only want this to happen (i.e., the fill valve to start) if the process has been started by the operator.

