



J-Actuator Dashboard

Version: 1.1

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This document refers to the TwinCAT project developed by AutomationWare to give the users the possibility to test and make experience with J-Actuator. As shown in the picture above, the EtherCAT Master is implemented by TwinCAT running on a computer (eg. a laptop) called “Master EtherCAT PC” which is directly connected to the J-Actuator (EtherCAT Slave).

In this release only a single J-Actuator can be moved using the TwinCAT Project example. Users can modify autonomously the project to move multiple actuators.

Each J-Actuator is provided by AutomationWare with a predefined “standard configuration” with a tuning of PID done without payload. The TwinCAT example assumes to use a J-Actuator with “standard configuration”.

The “Master EtherCAT PC” in which the users will run the TwinCAT project needs to be configured to reach real time performances. End users have to setup the PC autonomously for this purpose.

WARNINGS

The TwinCAT project provided is a prototypal version realized for demonstration only.

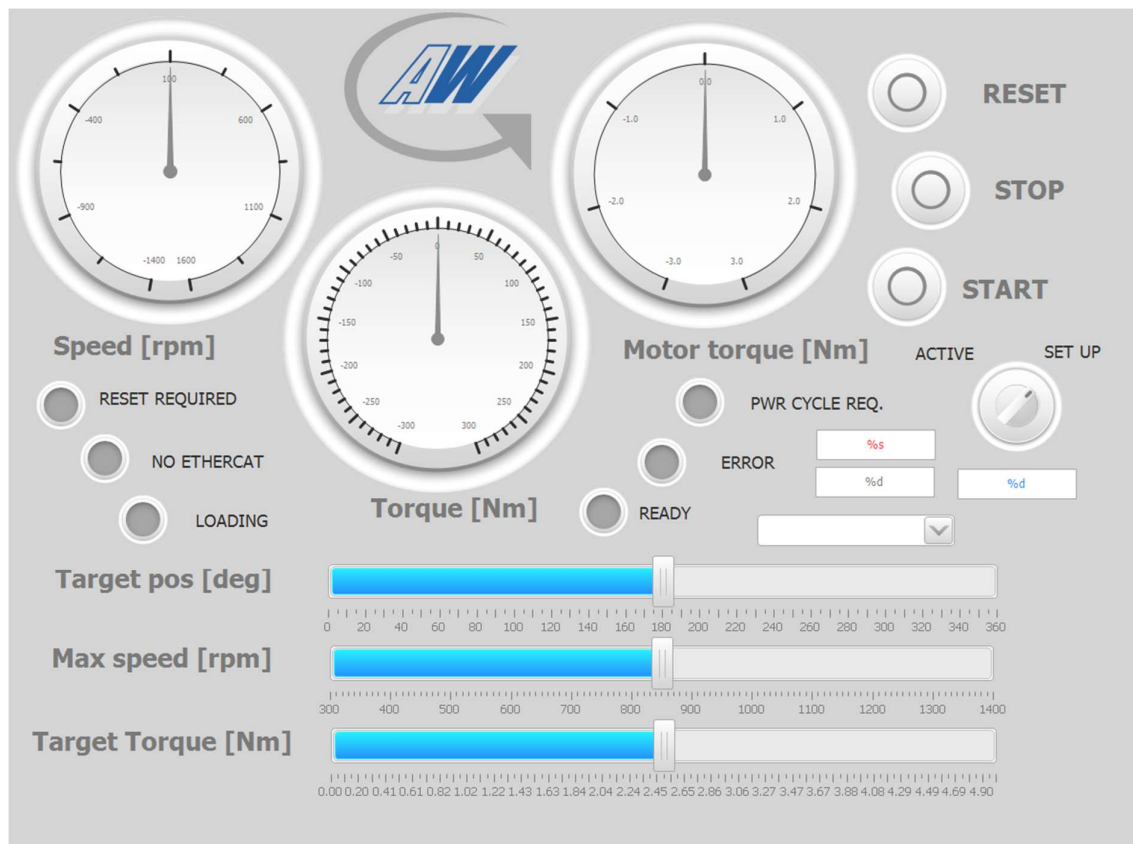
Automationware is not responsible for damage to persons or things due to the J-Actuator wrong or not-permitted usage.

End users shall be very careful when J-Actuator is used.

The implementation of the final system, its compliance with applicable standards, safety and commissioning are not the responsibility of AutomationWare. It is the responsibility of the integrator (or end user) to comply with these aspects.



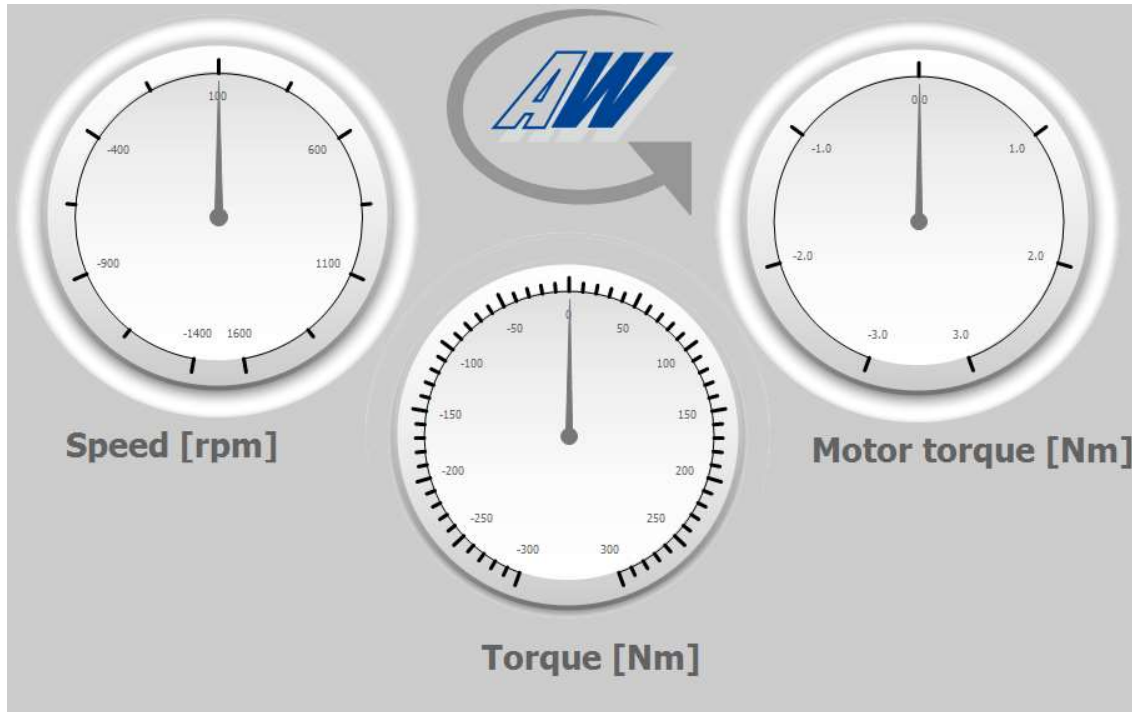
J-ACTUATOR DASHBOARD



DASHBOARD OVERVIEW

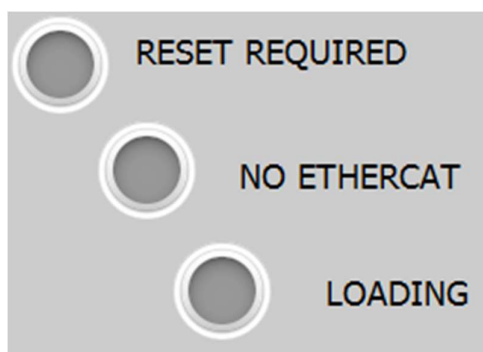
This interface is meant to be an easier way to move a J-Actuator via TwinCAT.

Gauges



On the top part, in real time, speed and torque of the motor shaft are shown. Additionally, the output shaft torque is displayed centrally.

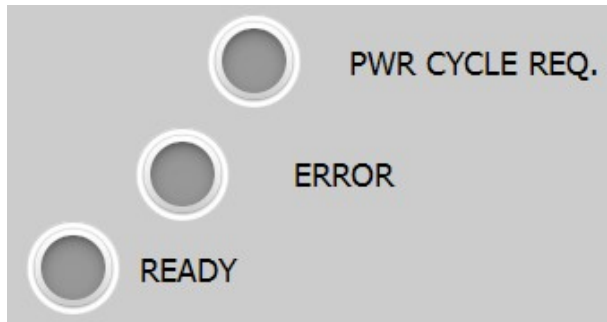
Warning lights



- **RESET REQUIRED** : some generic error appeared during the cycle and it's necessary to click "reset" button, to restart the cycle.
- **NO ETHERCAT** : EtherCAT connection down (the cable might be disconnected or broken).
- **LOADING** : parameters are read correctly from SDOs.



- PWR CYCLE REQ. : a safe state can't be restored. It is necessary to manually turn off and then turn on the power supply.
- ERROR : an error has been detected.
- READY : Everything is functioning correctly and the system can be started.



Control buttons



RESET

If any of the system lights is on, except the "green" light, press the *reset button*, to restart the program from a safe point and clear all errors.

Sometimes, after the reset has been pressed, the PWR CYCLE REQ. led will be still on. In that case, a physical reset of the power supply is needed.

STOP

While the J-Actuator is still moving, if the stop button is pushed then the drive will stop right after a cycle is completed.



START

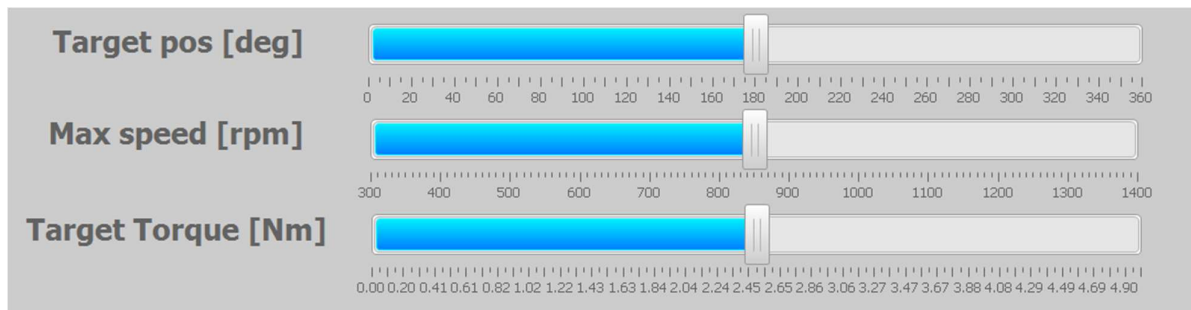
When the "green" light is on, the operation mode and the set points are selected. Let press the START button to run movement in loop.

Set up



The SET UP selector has been implemented to require the joint to be standing still, when some parameter is to be modified. When in SET UP, the joint can't be moved. When in ACTIVE state, the sliders are not accessible.

Set point sliders



Each slider is to be used with its operation mode. The only exception is the cyclic sync position, where both position and speed will be reached.

It is possible to tune the target position, maximum speed and target torque between predefined limits moving the sliders according to the operation mode selected.

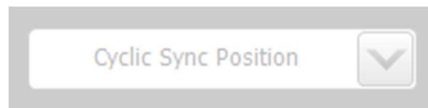
Debug and error message



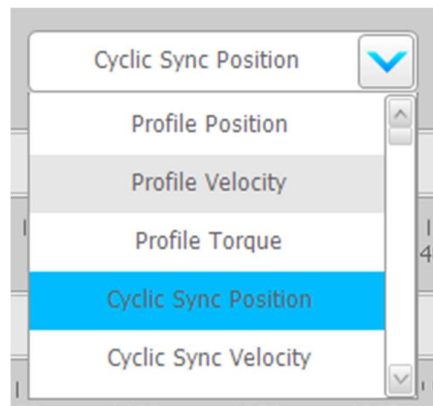
These three boxes are meant to be used for debugging purposes only. It will be easier for Automationware tech support to debug any problem that might occur.



Operation mode selector



The operation mode is selectable from the six we choose to implement. A broader explanation is to be found in the next pages.



HOW TO SET UP AND USE THE DASHBOARD IN TWINCAT

This part of the document is meant to help a new user of TwinCAT to navigate this environment.

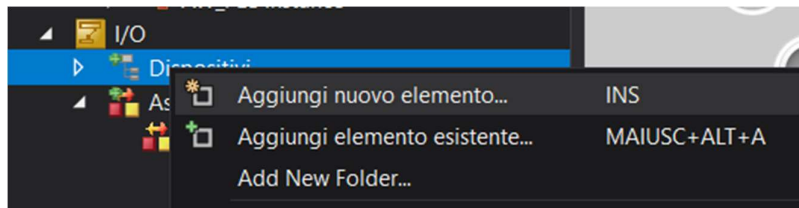
If the user is already an expert, this part can easily be skipped.

This project was developed using TwinCAT 3.1 running on a generic computer.

Selecting the master EtherCAT

These following images will guide you through the selection of the master EtherCAT, if needed.

- Right click on "Devices" under I/O menu



- Select EtherCAT Master



- Select the Ethernet adapter of the PC on which the dashboard will be running

If its already present, a reconfiguration will be enough:

- Under the "Adapter" menu, press "find" to automatically search the right adapter.



Generale Adapter EtherCAT In linea CoE - Online

☒ Network Adapter

☒ OS (NDIS) ☐ PCI ☐ DPRAM

Description: Ethernet (Realtek PCIe GbE Family Controller)

Device Name: \DEVICE

PCI Bus/Slot: Trova...

Indirizzo MAC: Compatible Devices...

IP indirizzo: 0.0.0.0 (0.0.0.0)

☐ Promiscuous Mode (use with Wireshark only)

☐ Virtual Device Names

☐ Adapter Reference

Adapter:

Freerun Cycle (ms): 4

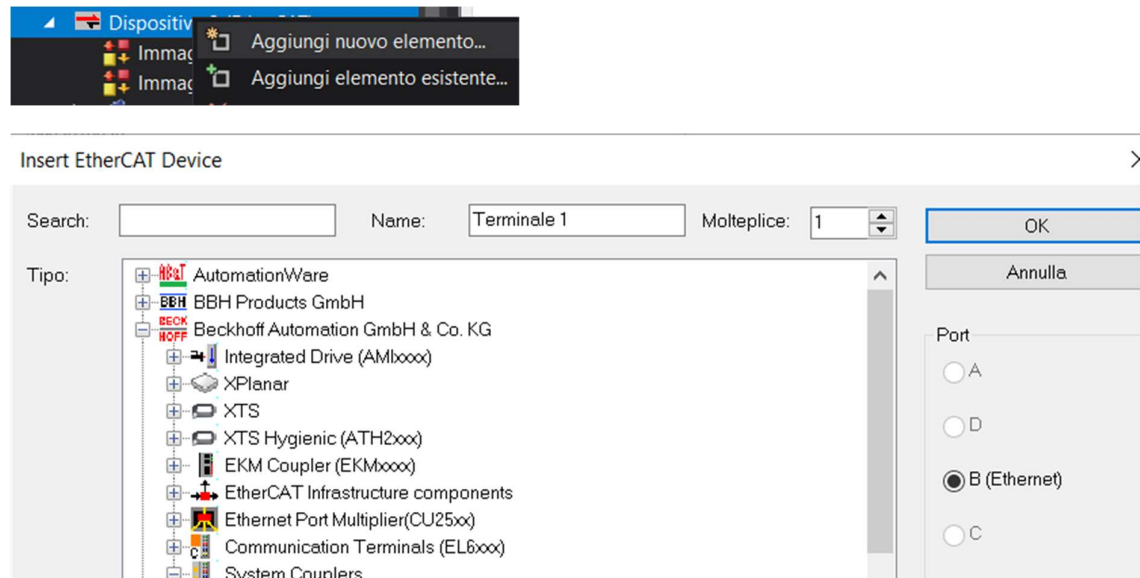


The file ESI

For the EtherCAT slave, it will be mandatory coping the right ESI (EtherCAT Slave Info) file, in the path recommended by Beckhoff: C:\TwinCAT\3.1\Config\Io\EtherCAT.

The ESI file is an xml format file, given by the manufacturer of the slave.

Once this is done, a slave can be added to the master EtherCAT, selecting it by the menu:



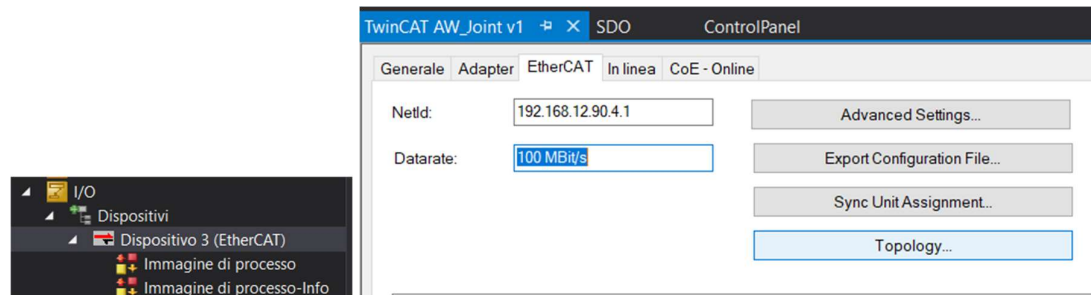


Writing the local net address

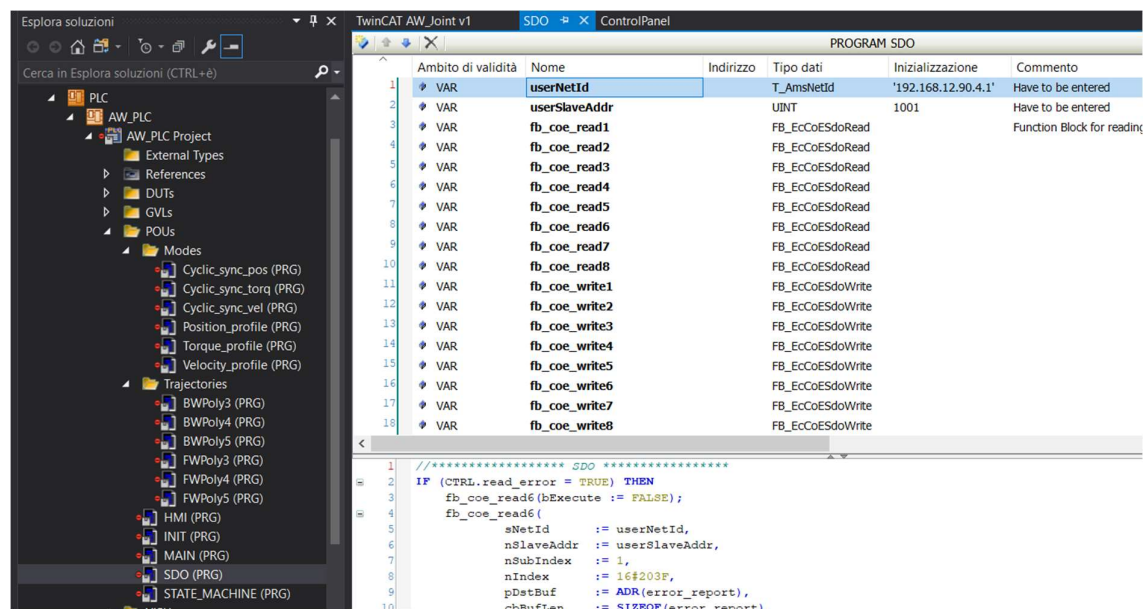
Before the dashboard can be started, the user has to set up a few things.

This came to be because of the program, which can be run each time on a different machine.

First of all, the **net address**.



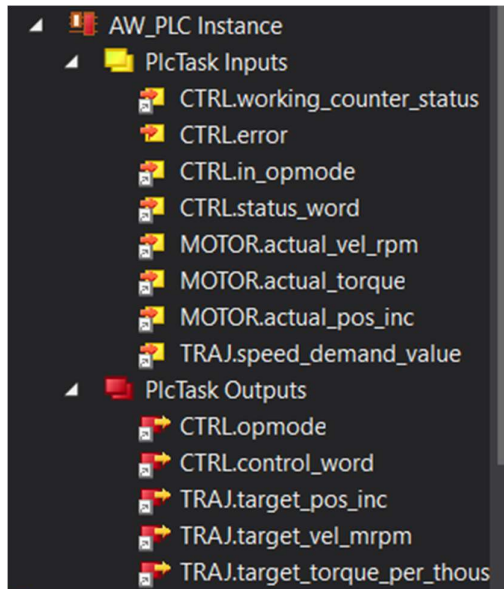
It can be found in the SDO script and opened with a double click on the icon. On the top, in the variables section, userNetId has to be modified with the master EtherCAT NetId.



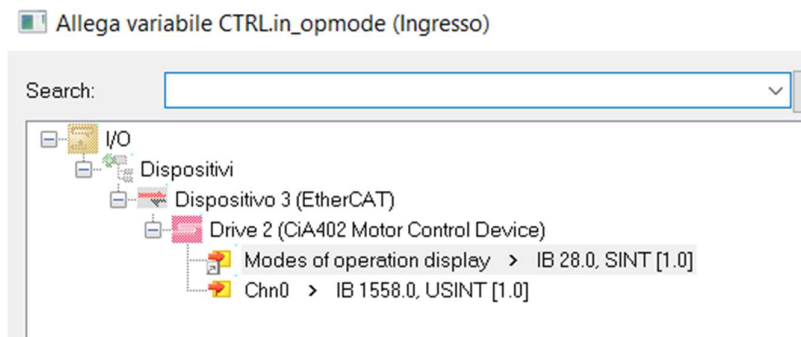


Link of the PDOs variable in the PLC program

Whenever the set up is modified from the original one, it might be necessary to reconnect the PLC scripts variables to the slave PDOs.



For example, here, double clicking on CTRL.in_opmode, will open the following window.



The right PDO to attach, has every time a similar name, and it's easy to find.



OPERATION MODE

Several operation modes are available, given the purpose of the movement.

- Target position profile : Only target position is set once. The trajectory is defined by the driver.
- Target speed profile : Only target velocity is set. The joint will reach the required velocity and then stops.
- Target torque profile : The torque is set. The joint will reach the required torque and then stops.
- Cyclic synchronous position: The joint will follow a position setpoint cyclically shared by the master each 1ms.
- Cyclic synchronous speed : The joint will follow a speed setpoint cyclically shared by the master each 1ms.
- Cyclic synchronous torque : The joint will follow a torque setpoint cyclically shared by the master each 1ms.

In our project no filters, gravity and friction compensator are provided.

CODED FUNCTIONS

In cyclic modes, a predefined trajectory has to be tailored, directly in the TwinCAT script.

For demonstration purposes, the trajectories coded in the script are polynomial.

For the position, we have chosen a fifth degree, rest-to-rest, polynomial trajectory.

Velocity and torque are similar, and derived directly from the position, so the movement will be similar.