miniDyno 2.0 | MICROCHIP

A Leading Provider of Smart, Connected and Secure Embedded Control Solutions

SMART | CONNECTED | SECURE

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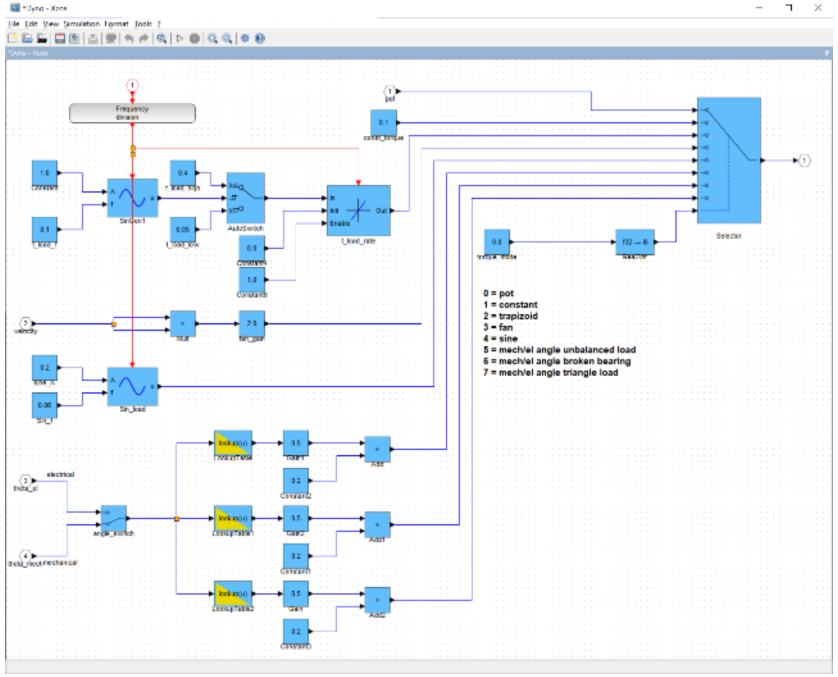
The WHY?

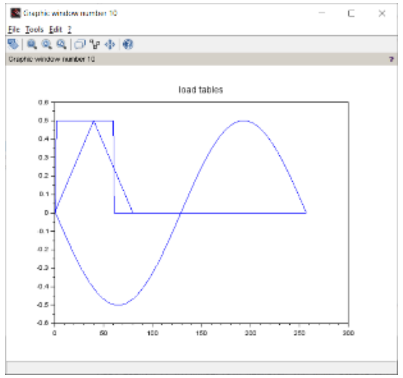
- **Easy Load testing without complicated application specific testbenches**
- **Algorithm testing**
  - Different load profiles for sensorless algorithms
- **AI/ML**
  - Capture data for model training
  - Test different anomaly scenarios

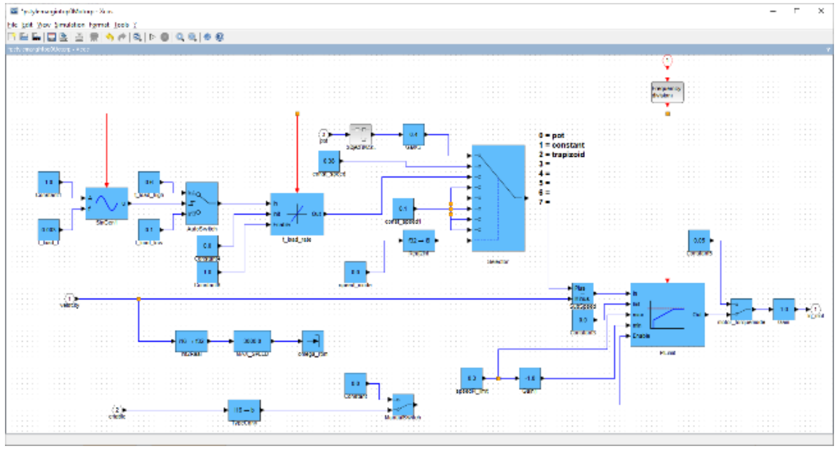
miniDyno 2.0 features

- 4Q operation (CW/CCW, motor/break)
  - DYNO
    - Constant load from potentiometer
    - Constant load from variable
    - Trapezoidal load (variables: frequency, raising/falling ramp, high/low value)
    - Fan load (k*n²[rpm], variable:k
    - Sine load (variable: frequency, amplitude, offset)
    - Angle dependent loads (electrical/mechanical)
      - 3 different table dependent load profiles (variables: amplitude and offset)
        - Unbalanced load (constant + sine)
        - Broken bearing (constant + rectangle)
        - Triangle (constant + triangle)
      - Various compressor load profiles possible
  - MOTOR
    - Constant torque
    - Constant speed
      - Potentiometer
      - Variable
      - Trapezoidal (variables: frequency, raising/falling ramp, high/low value)



0 = pot
1 = constant
2 = trapizoid
3 = fan
4 = sine
5 = mech/el angle unbalanced load
6 = mech/el angle broken bearing
7 = mech/el angle triangle load

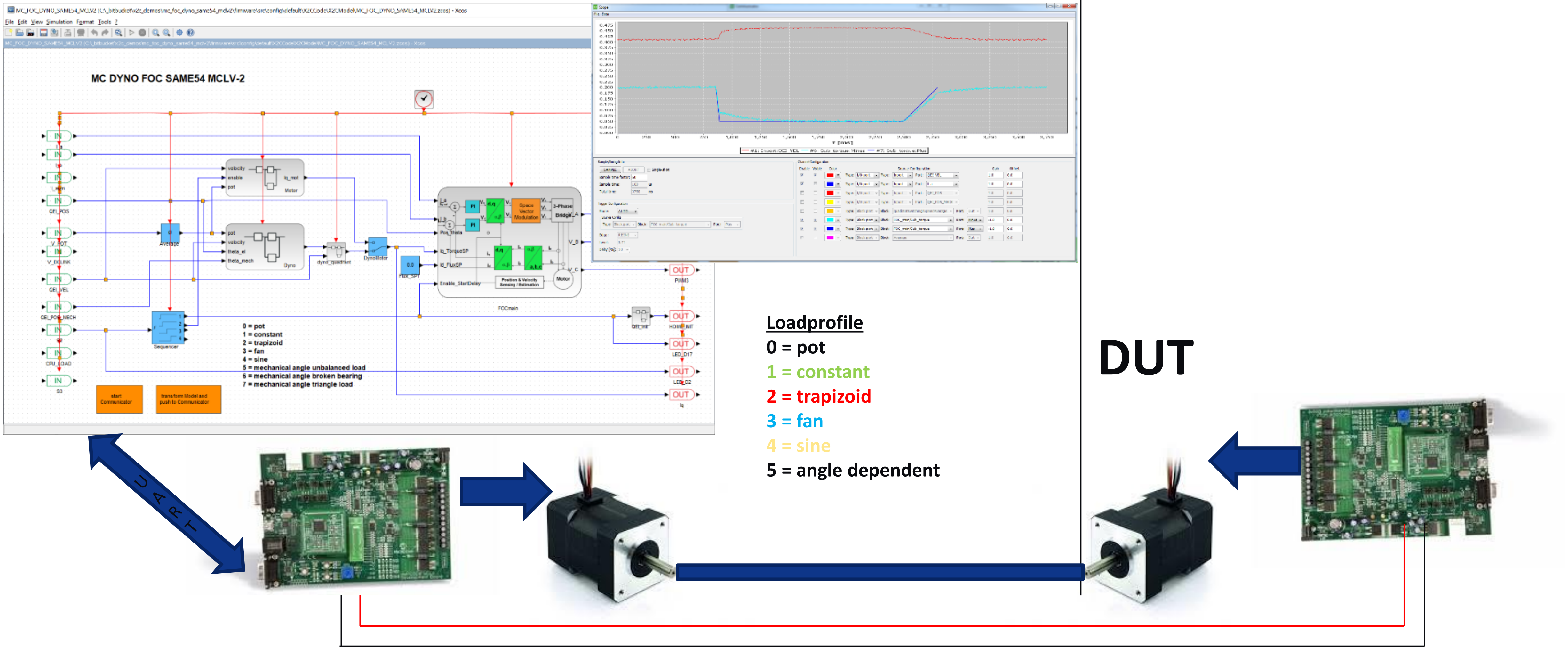




miniDyno 2.0

dyno / generator / break / motor

motor



0 = pot
1 = constant
2 = trapizoid
3 = fan
4 = sine
5 = mechanical angle unbalanced load
6 = mechanical angle broken bearing
7 = mechanical angle triangle load

Loadprofile

0 = pot
1 = constant
2 = trapizoid
3 = fan
4 = sine
5 = angle dependent

connect the powersupply lines to make sure the energy created from the generator is used somewhere

Dual usage: SCILAB / X2C or Standalone

- **miniDyno 2.0 usage**
  - Standalone
    - Microchip programmer (ICD4, PICKit4, SNAP)
    - Software to program a hex file (MPLAB X or IPE)
    - **No SCILAB, X2C and XC32 compiler required**
  - SCILAB/X2C environment requirements
    - Scilab 2023.1.0 + X2C (nightly build)
    - MPLAB X development environment (MPLAB X 6, Harmony3, XC32 free)
    - Microchip programmer (ICD4, PICKit4, SNAP)

How to use the X2C based DYNO standalone

- **Harware setup:**
  - MCLV-2
  - ATSAME54
  - Hurst300 motor with encoder
  - RS232 cable
- **Software setup**
  - Microchip programmer (SW and HW)

- **Settings**
  - JP1,2,3 -> Curr
  - JP4,5 -> UART

  - M1 – red
  - M2 – white
  - M3 – black

  - HA – QEI white
  - HB – QEI blue

ATTENTION:

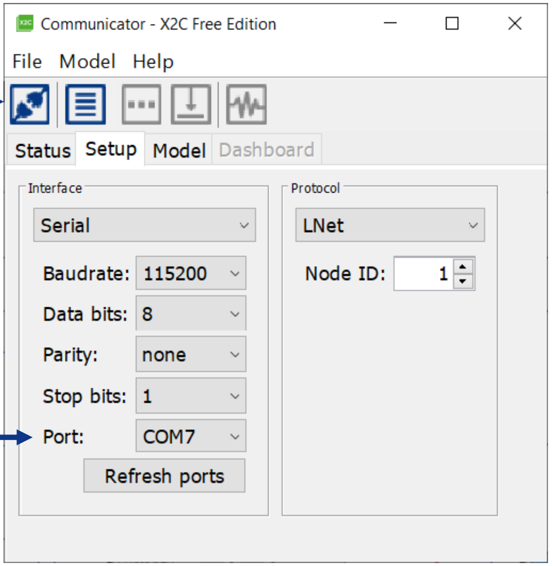
Make sure the DYNO board power is connected to the motor board!

Firmware:

- **Bitbucket**
  - https://bitbucket.microchip.com/projects/X2C/repos/mc_foc_dyno_same54_mclv2/
- Move to `[..\mc_foc_dyno_same54_mclv2\doc\standalone]`
- Program `[MC_FOC_DYNO_SAME54_MCLV2.X.production.hex]` onto your SAME54 PIM
- Disconnect the programmer and reset the MCLV-2 board
- Execute `[start.bat]`

2: press the connect icon

1: select your COM port



Interface

Serial

Baudrate: 115200

Data bits: 8

Parity: none

Stop bits: 1

Port: COM7

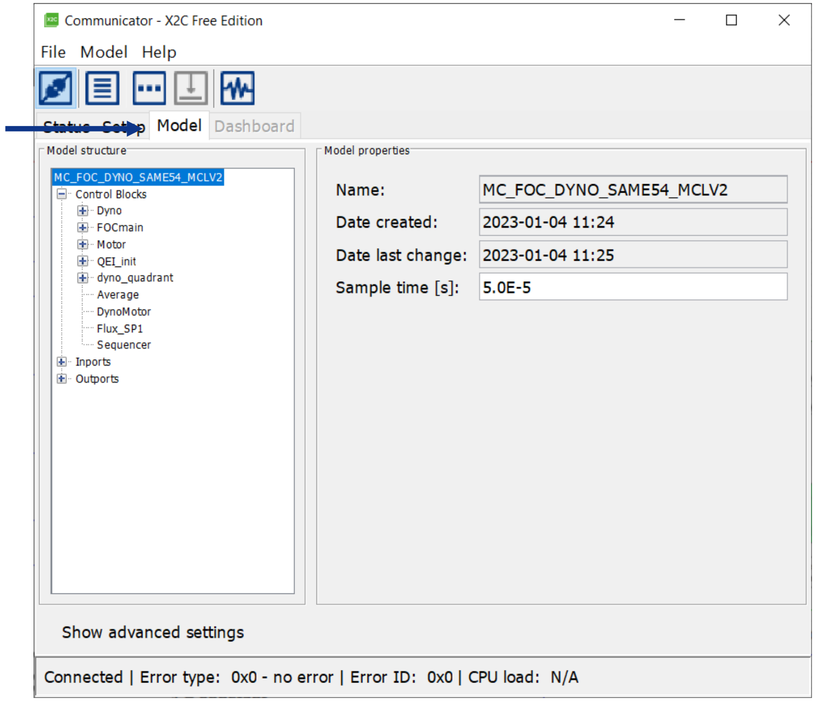
Refresh ports

Protocol

LNet

Node ID: 1

3: change to [Model] tab



Model structure

- MC_FOC_DYNO_SAME54_MCLV2
  - Control Blocks
    - Dyno
    - FOCmain
    - Motor
    - QEI_init
    - dyno_quadrant
    - Average
    - DynoMotor
    - Flux_SP1
    - Sequencer
  - Inports
  - Outports

Model properties

Name: MC_FOC_DYNO_SAME54_MCLV2

Date created: 2023-01-04 11:24

Date last change: 2023-01-04 11:25

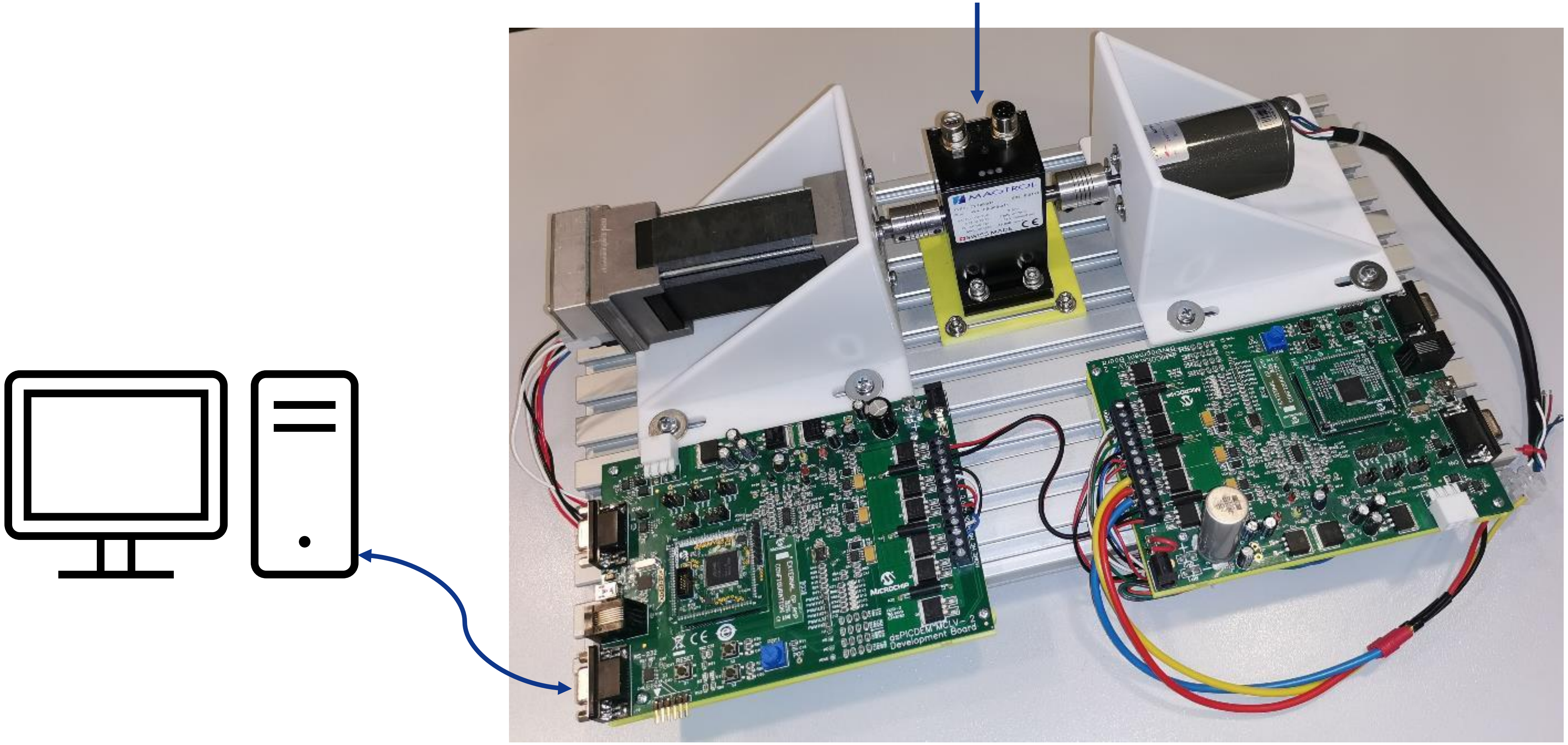
Sample time [s]: 5.0E-5

Show advanced settings

Connected | Error type: 0x0 - no error | Error ID: 0x0 | CPU load: N/A

miniDyno 2.0 setup

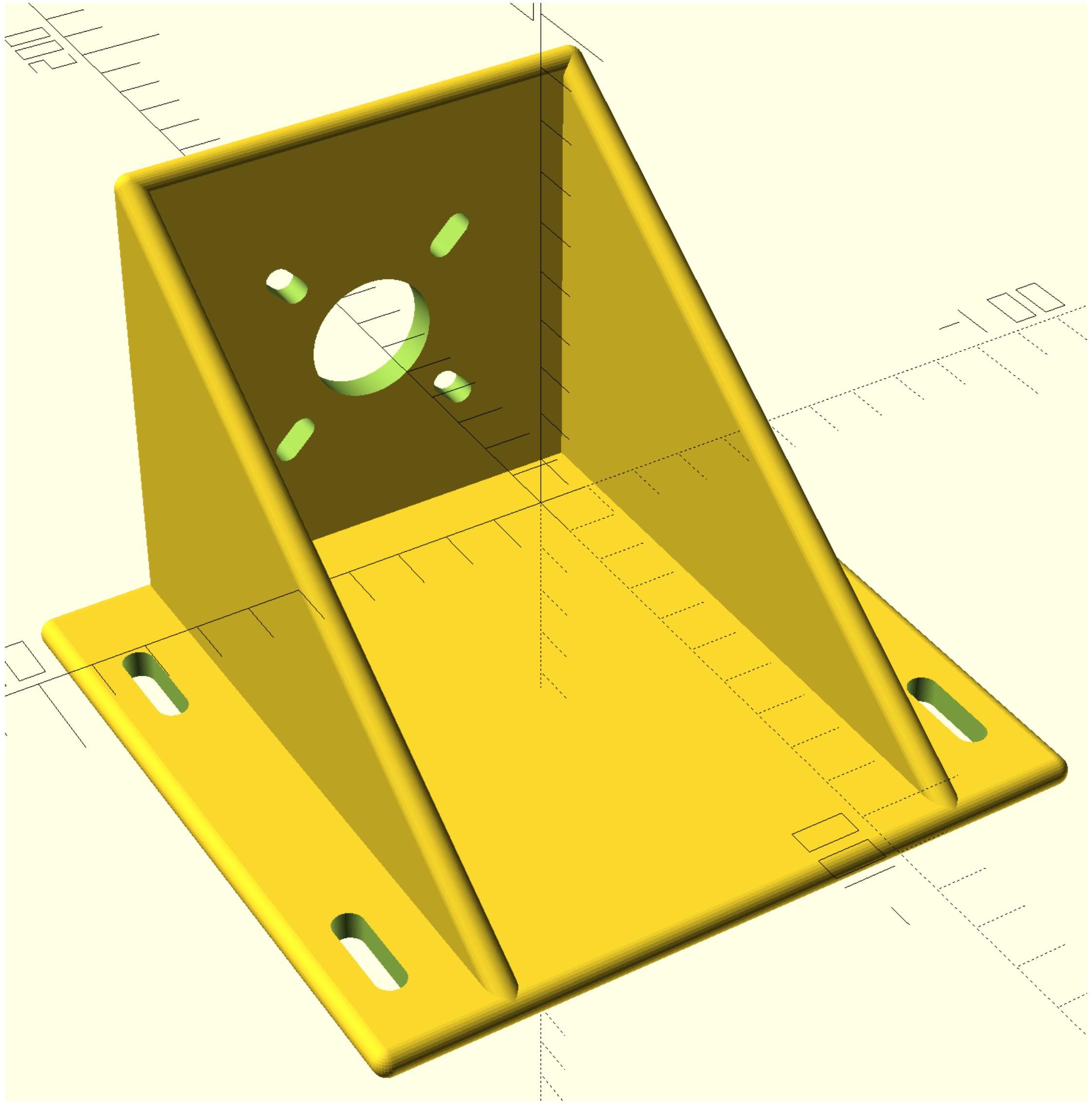
Magtrol TS105/011
torque sensor (optional)



miniDyno

motor

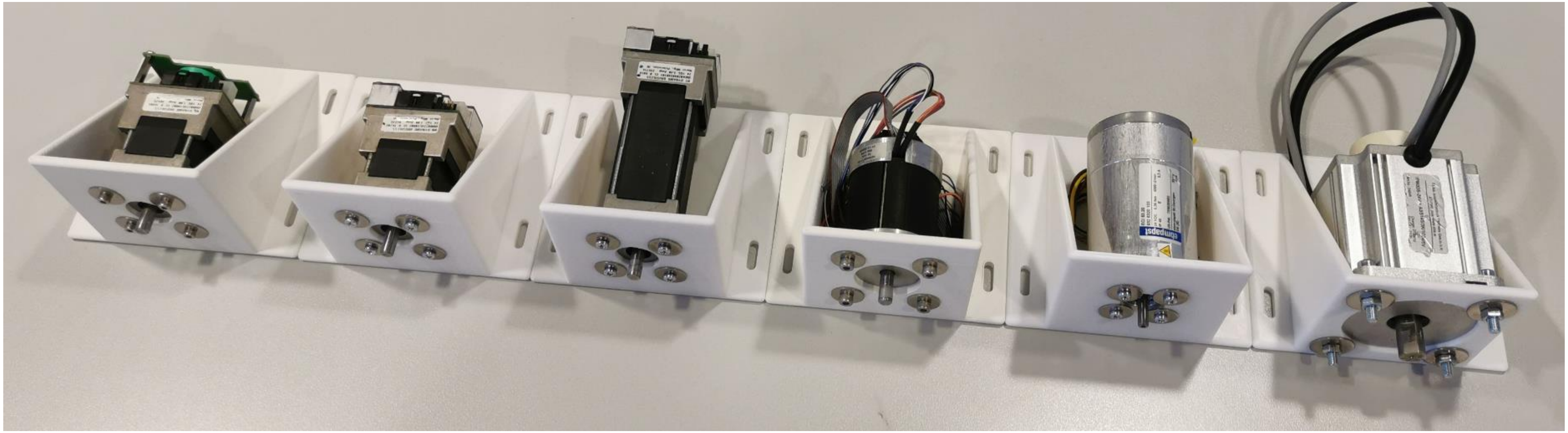
Unified motor bracket:



- **OpenSCAD design**
- **Same basic dimensions**
- **Motor mounting can be adjusted**
- **3D printable**
  - PLA
  - Layer 0.2mm
  - Infill 60%

..\mc_foc_dyno_same54_mclv2\doc\3Dparts

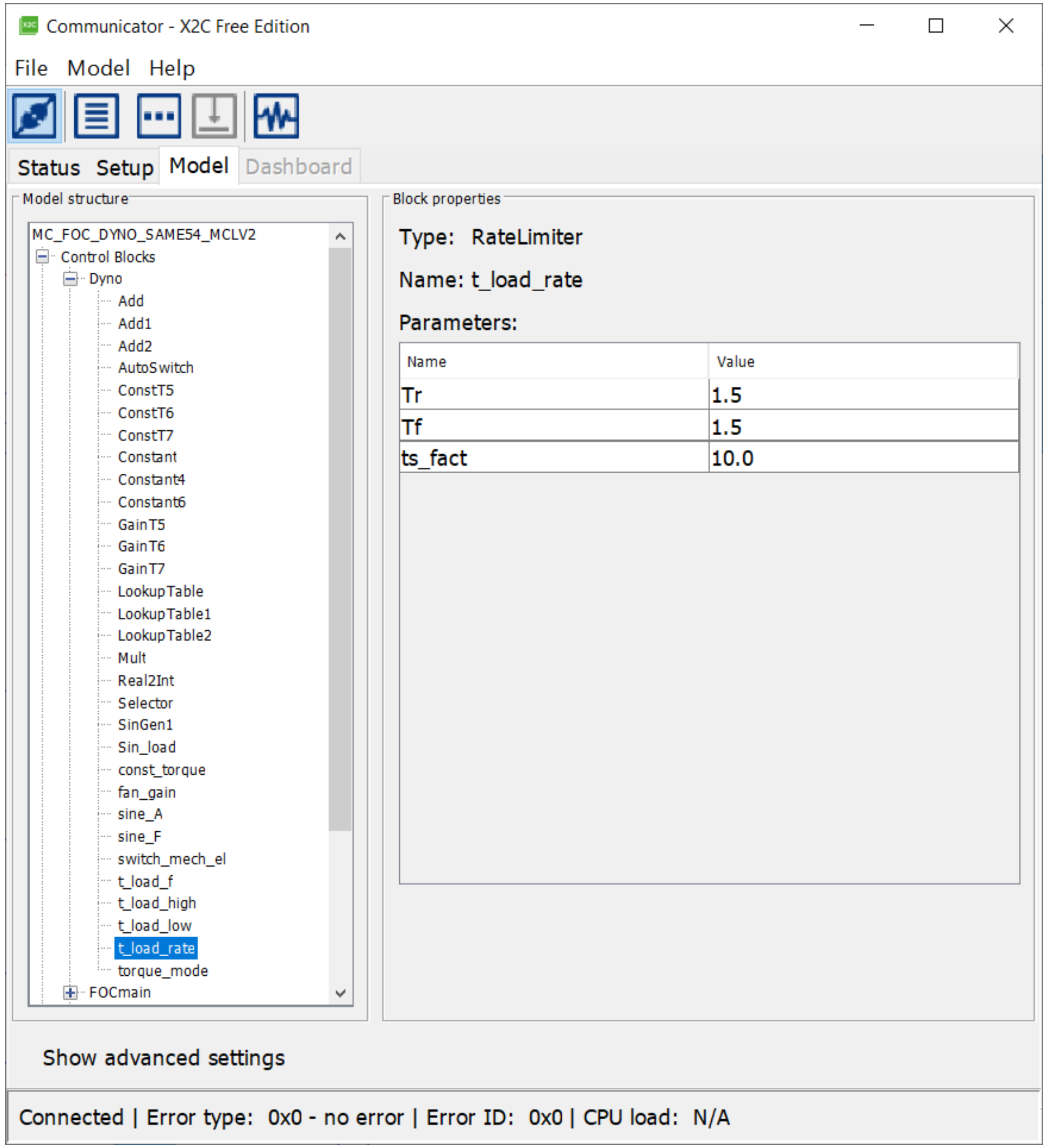
Unified motor bracket:



Future enhancements:

- **Motor position control (for ZSMT tuning)**
- **Standalone GUI**
- **Using torquesensor for calibration**
  - Real torquecontrol
- **Add input/output power measurement**
- **MCHV-2/3 version in preparation**
- **Porting to MCLV-48V-300W**

Modify [Dyno] paramters – torque_profile



Type: RateLimiter

Name: t_load_rate

Parameters:

Name	Value
Tr	1.5
Tf	1.5
ts_fact	10.0

Connected | Error type: 0x0 - no error | Error ID: 0x0 | CPU load: N/A

torque_mode

0: Constant load: potentiometer

1: Constand load:
[const_torque:Value]

2: Trapizoid load:
[t_load_f:Value]
[t_load_high:Value]
[t_load_low:Value]
[t_load_rate:Tr]
[t_load_rate:Tf]

3: Fan load:
[fan_gain:Gain]

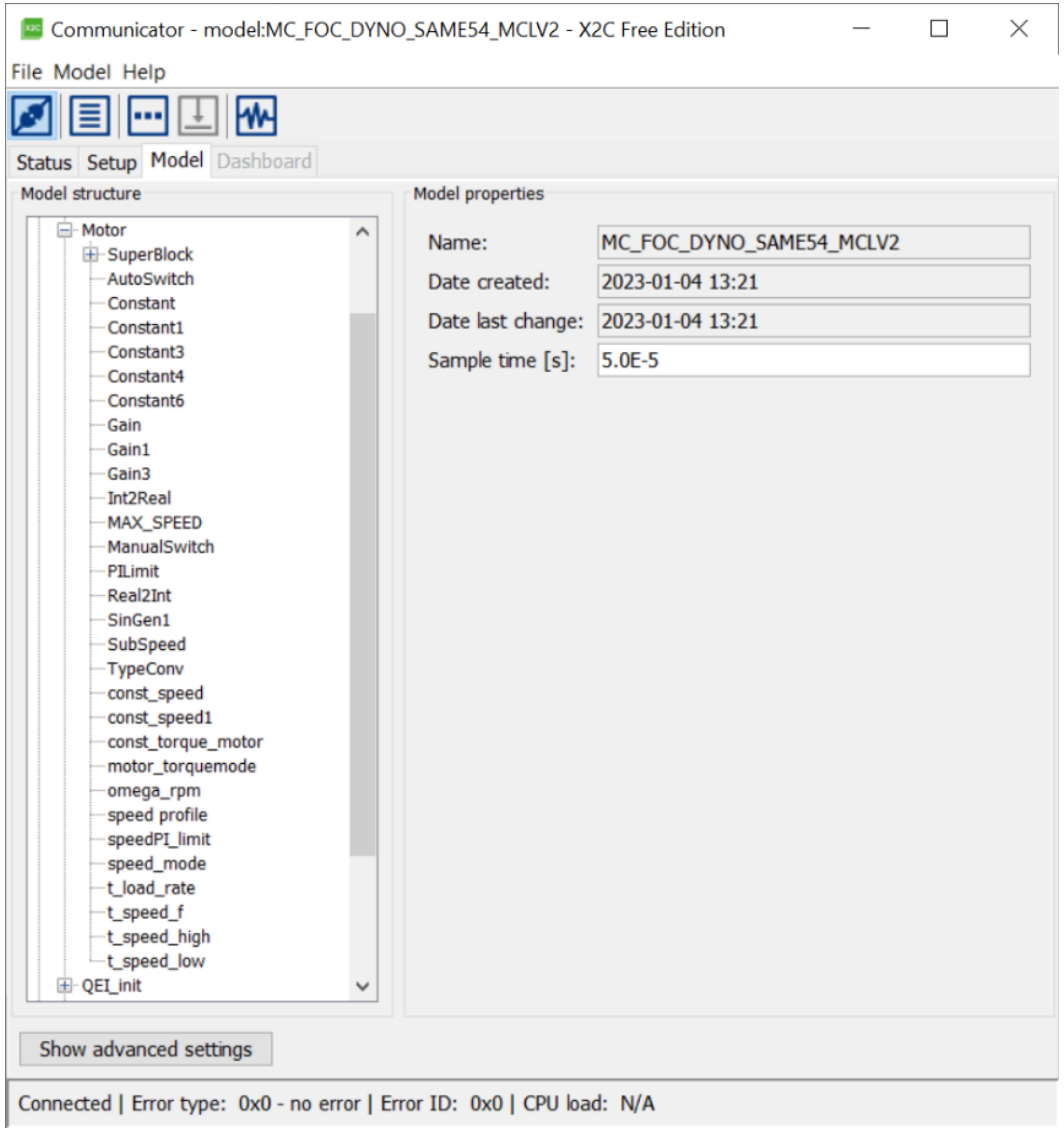
4: Sine load:
[sine_A:Value]
[Sin_f:Value]
[Sin_load:fmax]
[Sin_load:Offset]

5: unbalanced load:
[GainT5:Value]
[ConstT5:Value]

6: broken bearing:
[GainT6:Value]
[ConstT6:Value]

7: triangle:
[GainT7:Value]
[ConstT7:Value]

Modify [Motor] paramters – torque_profile



Name: MC_FOC_DYNO_SAME54_MCLV2

Date created: 2023-01-04 13:21

Date last change: 2023-01-04 13:21

Sample time [s]: 5.0E-5

Connected | Error type: 0x0 - no error | Error ID: 0x0 | CPU load: N/A

speed_mode

0: Constant speed: potentiometer

1: Constand speed:
`[const_speed:Value]`

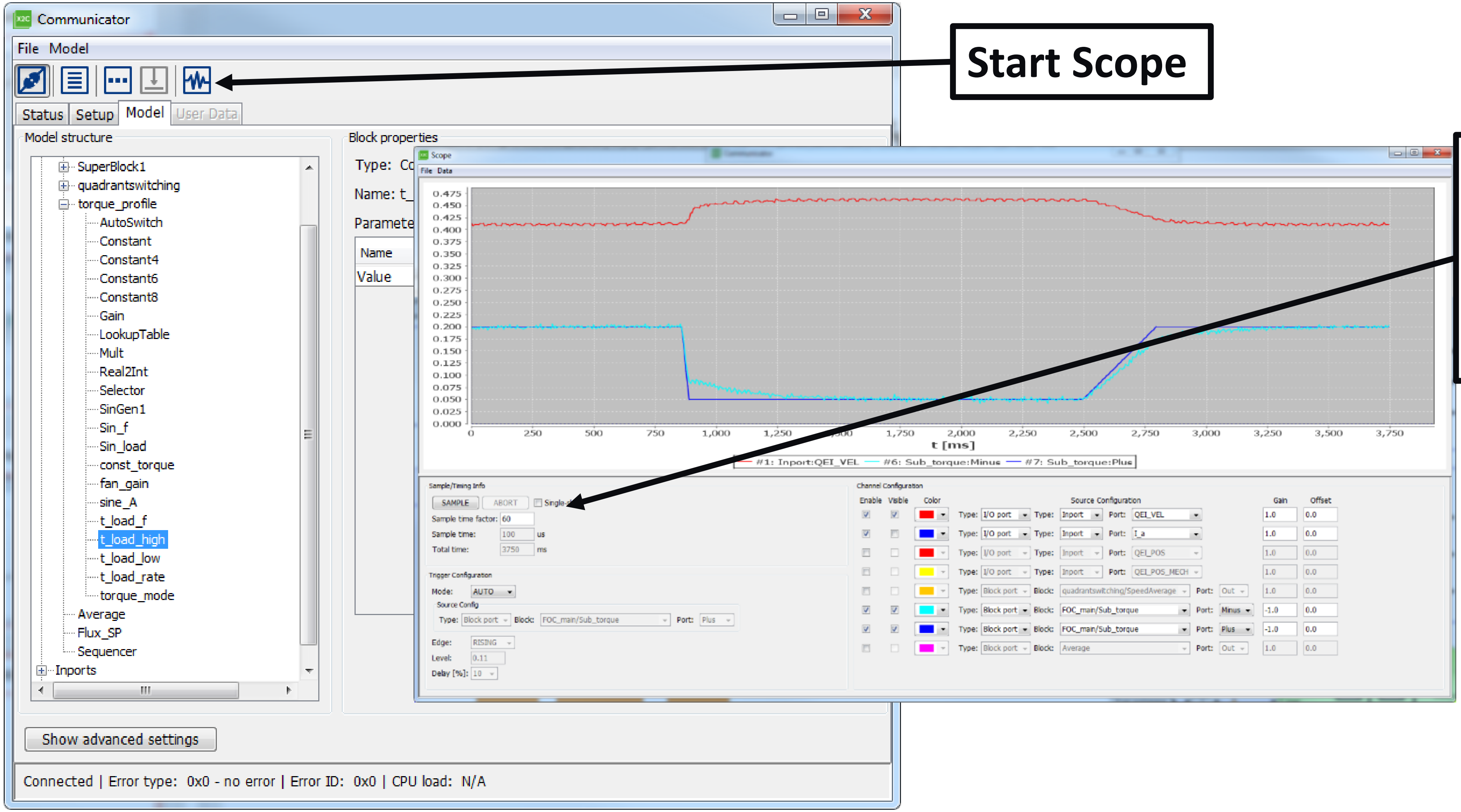
2: Trapizoid load:
`[t_speed_f:Value]`
`[t_ speed _high:Value]`
`[t_ speed _low:Value]`
`[t_ speed _rate:Tr]`
`[t_speed_rate:Tf]`

`[motor_torquemode]`
1=speed control
0=torque control

Torquevalue
`[const_torque_mode:Value]`

Switch between Dyno/Motor
`[DynoMotor]`
1=Dyno
0=Motor

Scope



- SuperBlock1
- quadrantswitching
- torque_profile
  - AutoSwitch
  - Constant
  - Constant4
  - Constant6
  - Constant8
  - Gain
  - LookupTable
  - Mult
  - Real2Int
  - Selector
  - SinGen1
  - Sin_f
  - Sin_load
  - const_torque
  - fan_gain
  - sine_A
  - t_load_f
  - t_load_high
  - t_load_low
  - t_load_rate
  - torque_mode
- Average
- Flux_SP
- Sequencer
- Inports

Sample/Timing Info

□ Single-sh

Sample time factor: 60

Sample time: 100 us

Total time: 3750 ms

Trigger Configuration

Mode: AUTO

Source Config

Type: Block port Block: FOC_main/Sub_torque Port: Plus

Edge: RISING

Level: 0.11

Delay [%]: 10

Channel Configuration

Enable	Visible	Color	Source Configuration			Gain	Offset
☑	☑	🟥	Type: I/O port	Type: Inport	Port: QEI_VEL	1.0	0.0
☑	□	🟦	Type: I/O port	Type: Inport	Port: I_a	1.0	0.0
□	□	🟥	Type: I/O port	Type: Inport	Port: QEI_POS	1.0	0.0
□	□	🟨	Type: I/O port	Type: Inport	Port: QEI_POS_MECH	1.0	0.0
□	□	🟧	Type: Block port	Block: quadrantswitching/SpeedAverage	Port: Out	1.0	0.0
☑	☑	🟦	Type: Block port	Block: FOC_main/Sub_torque	Port: Minus	-1.0	0.0
☑	☑	🟦	Type: Block port	Block: FOC_main/Sub_torque	Port: Plus	-1.0	0.0
□	□	🟪	Type: Block port	Block: Average	Port: Out	1.0	0.0

Connected | Error type: 0x0 - no error | Error ID: 0x0 | CPU load: N/A

Start Scope

Set „Sample Time Factor“

Press the „Sample“ Button to monitor signals.