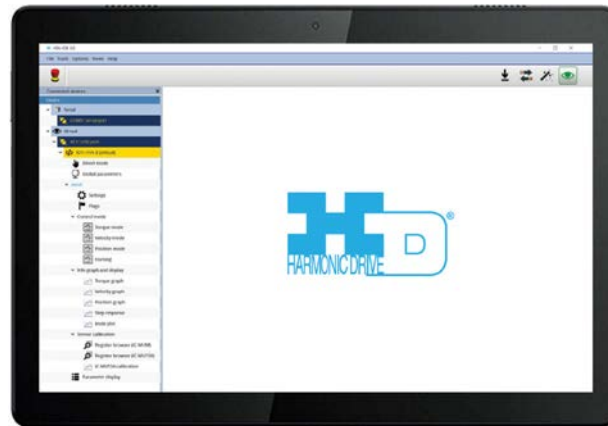# HDL-IDE Quick Start

TI-21001 REV 1

Harmonic Drive LLC

Common Questions

This Quick start is to explain some common questions the user might encounter when using IDT actuators with HDL-IDE environment , including

Setup Check
Connection
  --**Connect in CAN mode**
  --**Function Blocks**
  --**Scan ID in CAN mode , general case**
    and when ID=2
  --**Change ID in CAN mode**
Restore Factory Defaults
Drive Calibration
FW download
  --**FW download from CAN mode**
  --**FW download from CANopen mode**
  --**Check bootloader version**
Parameters
  --**Read/Write**
  --**Read All**
  --**Graphic Display**

Protection
  --**Status flags**
  --**IIT protection**
  --**Velocity Error and Position Following Error**
Flash Configuration (only for the actuators with FW3.00 or older)
**CANopen Master (from CAN mode to CANopen)**

Setup Check

HDL-IDE is software tool for IDT product evaluation without CAN master . For the first time to connect the IDT actuator through HDL-IDE, please check the system setup as below   :

1. The latest FW *.zip --include **CAN FW, CANopen FW** and ***.eds** file
2. If latest **HDL-IDE** version is used
3. Documents –'**HDL-IDE Quick Start**'(this document), '**HDL User Guide**' and '**CANopen Firmware Manual**'
4. CAN Adapter type supported –**Kvaser** or **Peak** adapter
5. Adapter was connected to the computer , that USB port works properly
6. With **120 ohm Terminal resistor**
7. Pin connection-- **CAN_H=7, CAN_L=2** for DB-9 connection ,
8. DC Power supply, Kikusui PWR400L (80V,25A ,400W) or similar
    --Check supply polarity and cable connection
    --Check current limit
    --Typical input 24V, 48V for LPA20 and SHA series (or slightly higher to compensate voltage drop on the cable)
    -- Good to connect the cable shielding to the GND to minimize the EMI noise
9. No multiple HDL-IDE windows are opened, only one window
10. No other CAN device /actuator was in the network

It is recommended to power on the actuator first, then open HDL-IDE software

Connect in CAN mode
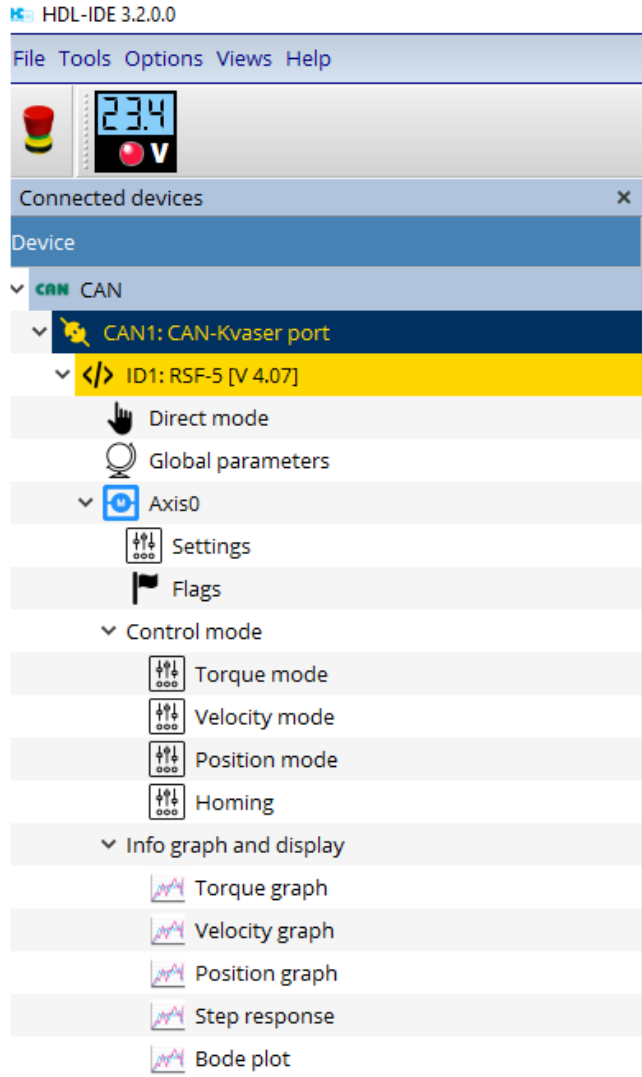
1.When actuator was first received , the default state is in CAN mode, Node=1

2. The HDL-IDE will automatically scan between ID#1 - ID#5 ,and display the actuator that was found ,highlighted in yellow (only single actuator connection is supported)

3. Sometime even the actuator was connected , the ID wasn't displayed, you might need to click the **CAN:xxxx port** to display all (like with Peak adapter)

Function Blocks

HDL-IDE 3.2.0.3

File Tools Options Views Help

48.2 V --Input Voltage

-- FW download

Connected devices

Device

CAN
- CAN1: CAN-Kvaser port
  - ID2: LPA-20 [V 1.12]   a. CAN ID and Actuator type and FW version
    - Direct mode   -- Parameter reading/writing
    - Global parameters   --Global change, e.ge Node ID, Factory Parameter Store)
    - Axis 0
      - Settings   --Communication , Motor ,encoder and PID
      - Status flags   --Status flags if there is any error
      - Control mode   b. Actuator profiles: Torque,
        - Torque mode   Velocity, Position and Home mode
        - Velocity mode
        - Position mode
        - Homing
      - Info graph and display   c. Graphic display
        - Torque graph
        - Velocity graph
        - Position graph
        - Step response   -- Step response and Bode plot for Frequency Analysis
        - Bode plot
        - Parameter display   -- Parameter group display
      - Calibration
        - Drive calibration   d. Calibration for ADC and Encoder offsets

Scan ID in CAN mode, general case

Node ID#

(ID# for HDL-IDE)
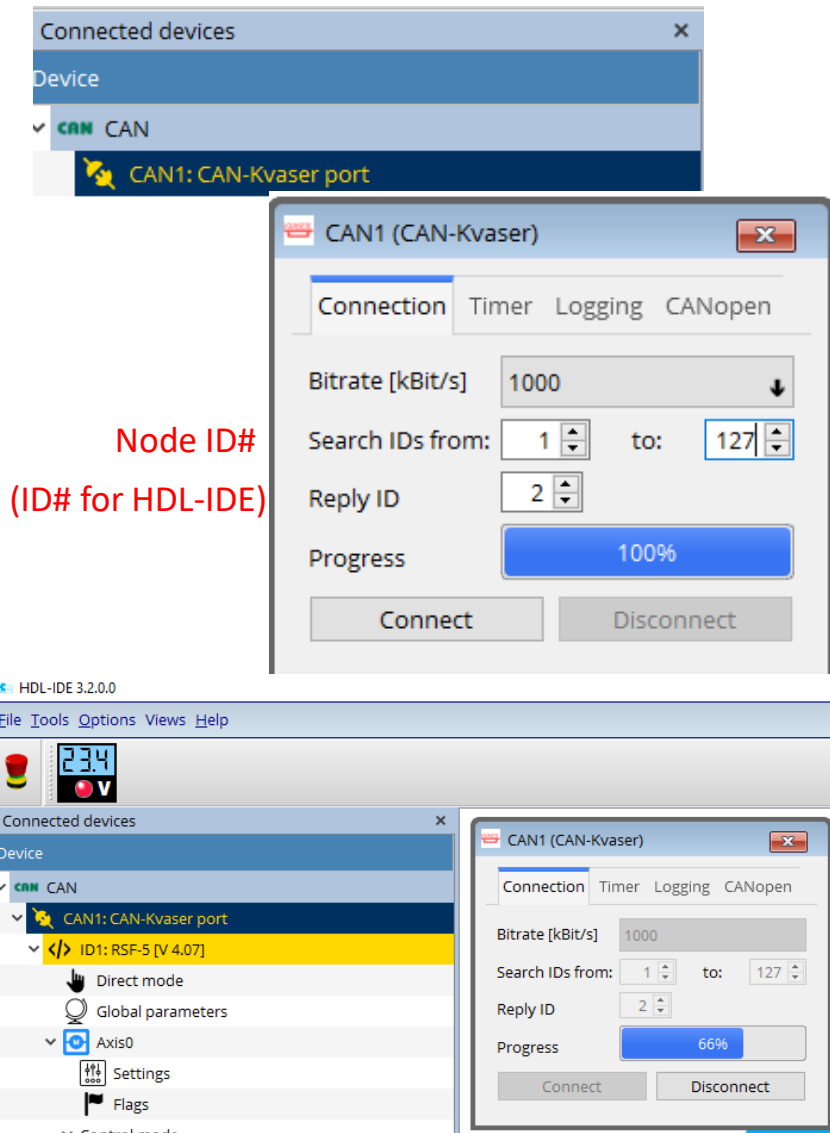
1. If the actuator is in CAN mode, but was not connected automatically, please click the **CAN :xxx port** icon to Open connection window

2. In **Connection** tab,

Default bitrate =1000kHz (or 1MHz)

Search IDs is for the Actuator ID node , set the range to be from 1 to 127

Reply ID is the ID of the master , or HDL-IDE itself (need to be different to the actuator ID)
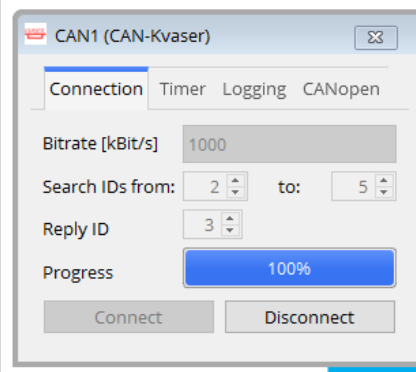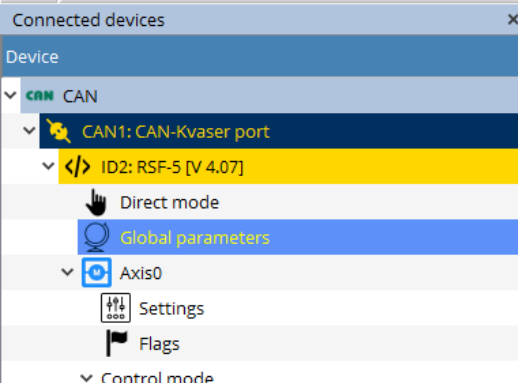
3. Click **Connect** button to scan

4. If actuator was identified properly .

You will see the highlighted actuator with the pull-down window

Scan ID in CAN mode, when Node=2

When Actuator ID=2 , and the Reply ID was also the default value 2, and the user won't find the actuator

Still in the **Connection** tab,
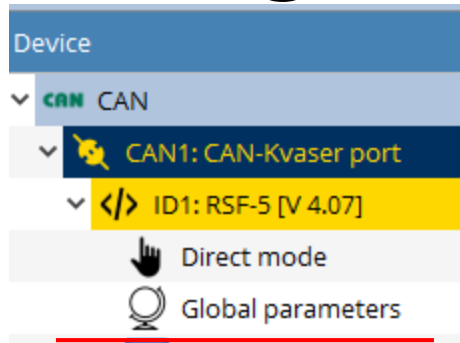
Search ID =2~5,

Reply ID=3 (or other than 2)

Click the Connect button, the Node 2 will be connected properly

Note:

For RSF-5, RSA-8, FHA-mini, If the actuator was with bootloader older than 3.00 , Only Node 1 is supported, please always use Node ID=1

Change ID in CAN mode

(ID of HDL-IDE)
Node ID

The Actuator Node ID can be changed
In HDL-IDE.

1.**Global parameters → CAN receive ID** =3
for example, The new ID will be written to
the flash, and the communication will be
lost.

2.Close and reopen the HDL-IDE , scan the
network, the new node ID will be found .
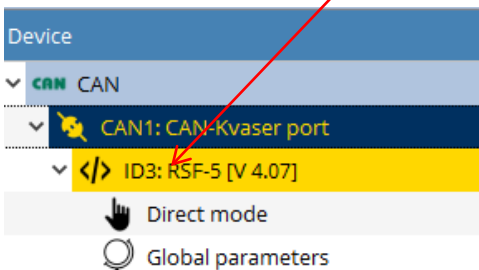**CAN send ID** is the ID for HDL-IDE
CAN receive ID is the actuator ID

Note:

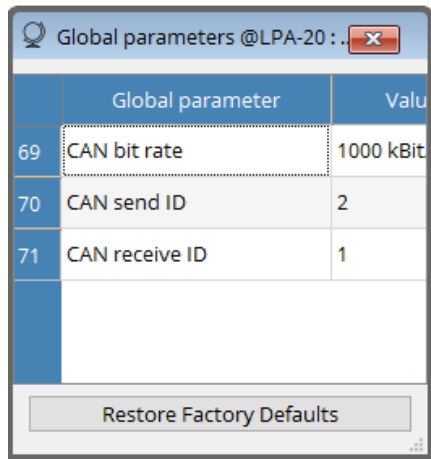1. Remember to check the bootlader version
2. If actuator Node 2 is used, please change
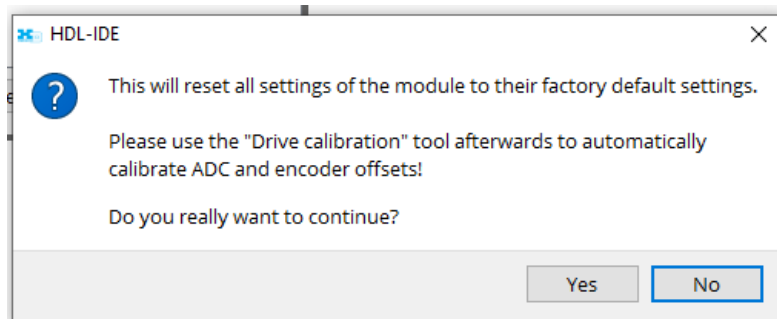to different ID for HDL-IDE

Restore Factory Defaults

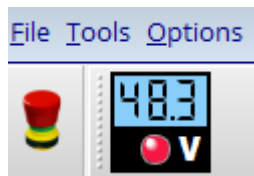1. If need to go back the factory default **Global parameters→**

Click **Restore Factory Default** button

2. When asking if will reset all settings, click Yes (please remember to run the Drive Calibration in the next step)

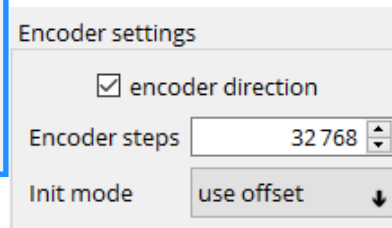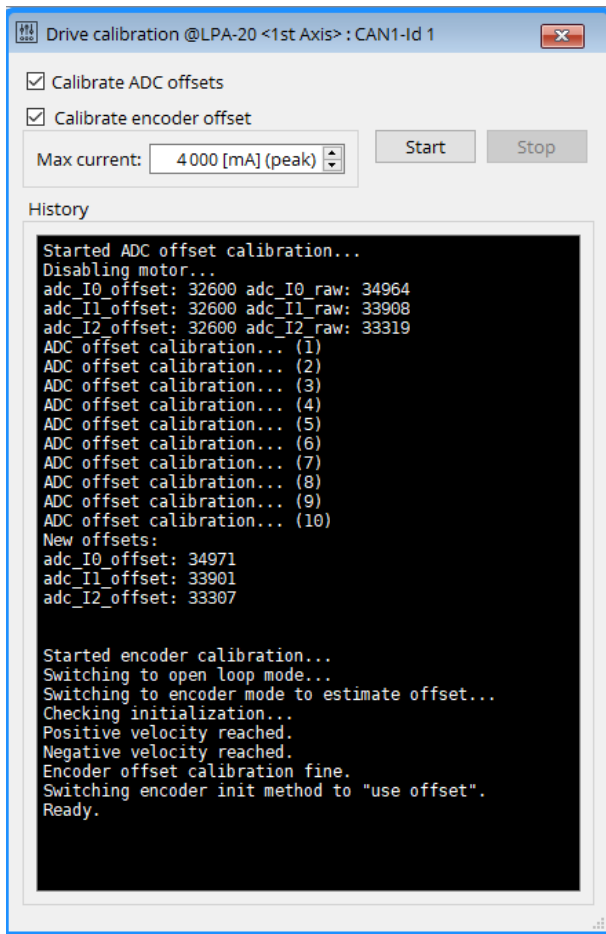3. Wait for 3-5 seconds, when the input voltage is displayed properly again, the flash update is completed

(It is preferred to close the HDL-IDE and power cycle the actuator after parameter restore)

Drive Calibration

Calibration
Drive calibration

Drive calibration @LPA-20 <1st Axis> : CAN1-Id 1

☑ Calibrate ADC offsets
☑ Calibrate encoder offset

Max current: 4 000 [mA] (peak)   [Start] [Stop]

History
```
Started ADC offset calibration...
Disabling motor...
adc_I0_offset: 32600 adc_I0_raw: 34964
adc_I1_offset: 32600 adc_I1_raw: 33908
adc_I2_offset: 32600 adc_I2_raw: 33319
ADC offset calibration... (1)
ADC offset calibration... (2)
ADC offset calibration... (3)
ADC offset calibration... (4)
ADC offset calibration... (5)
ADC offset calibration... (6)
ADC offset calibration... (7)
ADC offset calibration... (8)
ADC offset calibration... (9)
ADC offset calibration... (10)
New offsets:
adc_I0_offset: 34971
adc_I1_offset: 33901
adc_I2_offset: 33307


Started encoder calibration...
Switching to open loop mode...
Switching to encoder mode to estimate offset...
Checking initialization...
Positive velocity reached.
Negative velocity reached.
Encoder offset calibration fine.
Switching encoder init method to "use offset".
Ready.
```

Encoder settings

☑ encoder direction

Encoder steps   32 768

Init mode   use offset

After factory default restore, or first time to initialize actuator ADC and encoder offsets , or the actuator behave very differently after long time usage the drive can be calibrated as below

1. **Axis0→Calibration→Drive Calibration**

2. Check calibration boxes for both ADC offsets and encoder offset

3. Set probing current to be 20-40% of the rated Max current, click '**Start**'

4. The actuator will move a little bit during the calibration . And will indicate the actuator is ready when **ADC offsets** of all 3 phase currents will be updated and Encoder **init mode** is changed to **use offset**

5. If the calibration failed , it is very likely the probing current was too low or too high. Please adjust the current level and run the drive calibration again .
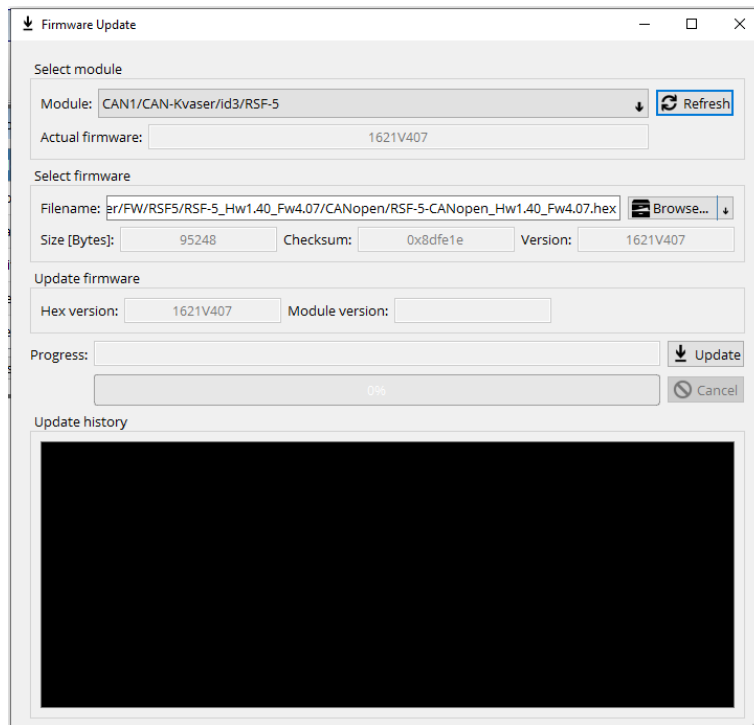
6. After the calibration , verify the actuator does run properly in Velocity mode and Position mode

Or in **Axis0→Settings→ Encoder** , **init mode** should already be changed to **use offset**

FW Download from CAN mode
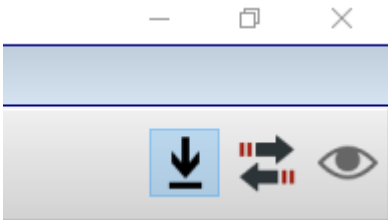
Unzip the *.zip file with latest FW , which Includes the CAN FW, CANopen FW and *.eds file

1. When the actuator was already in CAN mode, from the upper right corner of the GUI, click the **Download Arrow icon**

2. If the connection is properly,   **Module Type** will be displayed

3. In **Filename**, click **Browse** and select the latest CAN FW file and start the Download'.

4. Once the download is completed , It is good to close the HDL-IDE and have a Power cycle .

Note:
sometime the HDL-IDE window will close itself after the FW download, the user can still take the power cycle.

FW Download from CANopen

When actuator is in CANopen mode, the actuator
Needs to be switched into bootloader mode first

1. In **CANopen** tab , Select the actuator ID
click **Send boot command** button
2. Once the actuator is in bootloader mode,
The user can download either CAN or CANopen
FW as explained the CAN mode download .

3. If Actuator ID=2,
    -- in **Connection** tab → **Reply ID**, change default
       to different value other than 2 , e.g 3
    -- Don't click **Connect** button
    -- **CANopen** tab→Node ID=2, run the boot
      command ,
    --ID2 actuator will be found
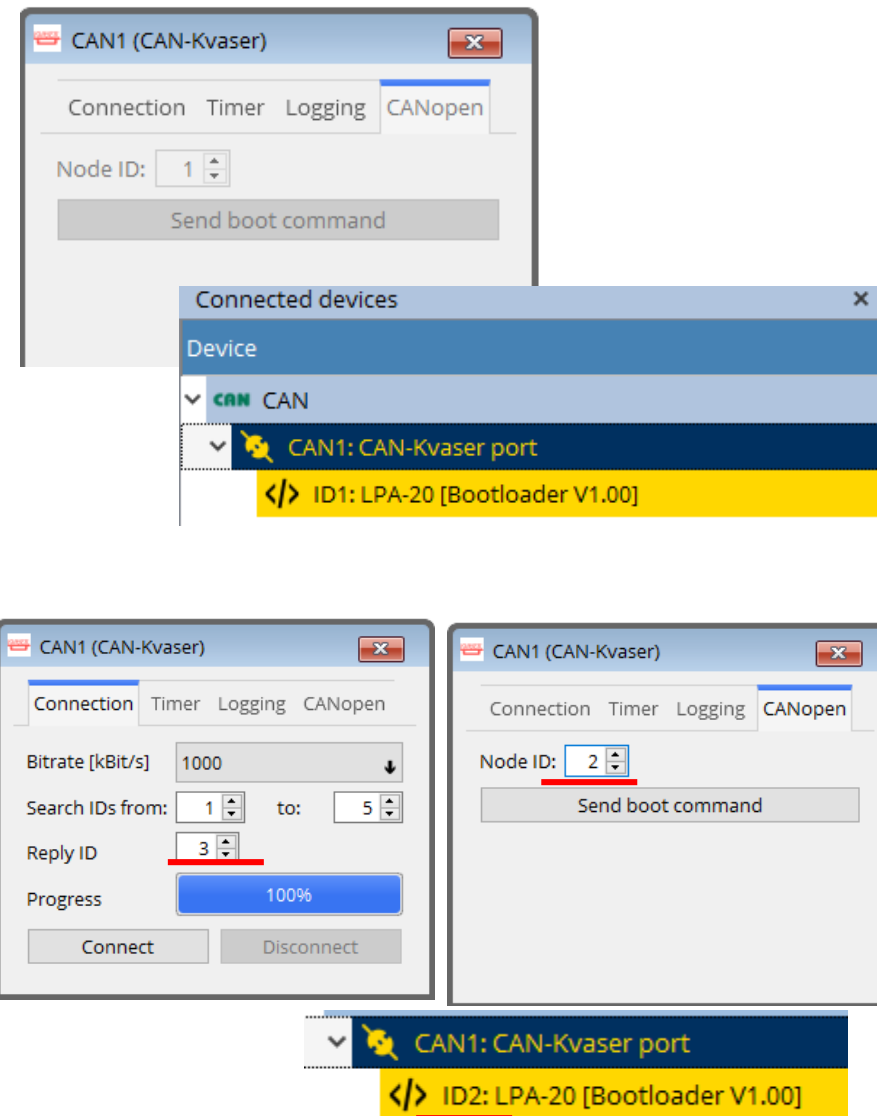
Check bootloader version
(For RSF-5, RSA-8 and FHA mini actuator with FW3.00 or older)

```
Update history

Firmwareupdate started @CAN1/CAN-Kvaser/id3/RSF-5
Active firmware: 1621V407
Enter bootloader mode...
Active firmware: 1621B300
Reopen device...
Try to read bootloader version at id 3... (1)
Bootloader: 1621B300
Module (1621B300) and Firmware (1621V407) are matching.
Page size: 1024
Flash base address: 0x8008000
Memory size: 261112
Erasing...
Erasing after 1857 ms finished.
Writing 95248 bytes...
Writing page at address: 0x8008000
Writing page at address: 0x8008400
```

```
Device

∨  CAN  CAN
   ∨  🔧 CAN1: CAN-Kvaser port
         </> ID3: RSF-5 [Bootloader V3.00]
```

It is good to double-check the bootloader version if you have an old actuator .

For RSF-5, RSA-8 and FHA-mini actuator,

 none1 ID was supported since bootloader ver3.00 ; If with any older bootloader, only

Node=1 can be used in CAN mode

1. When download the FW, The boot loader version can be found

2. When Switching from CANopen mode back to boot loader mode, the bootloader version will be displayed

Parameter –Read/Write

To access any parameter directly

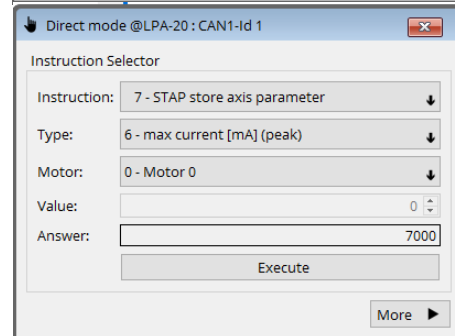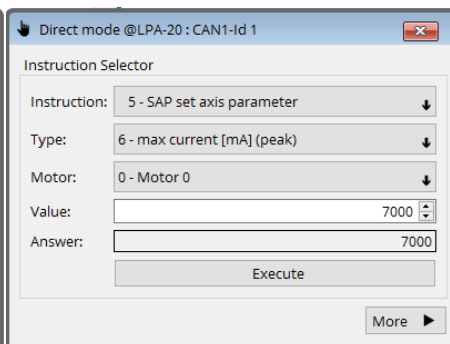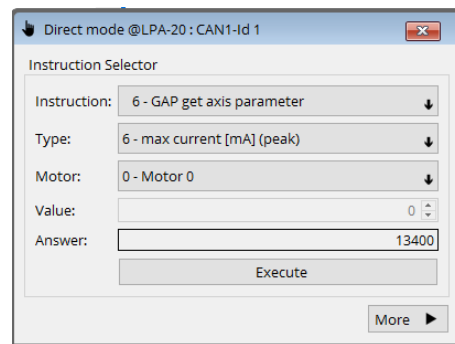**Idx:actautor [version] →Direct mode →Instruction,** typically methods include :
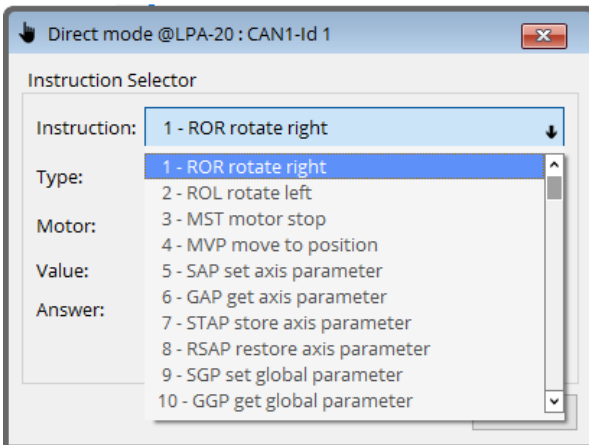
6:GAP get axis parameter

5:SAP set axis parameter (write to RAM)

7:STAP store axis parameter (save to Flash)

E.g , in 6:GAP to read Max current first ,

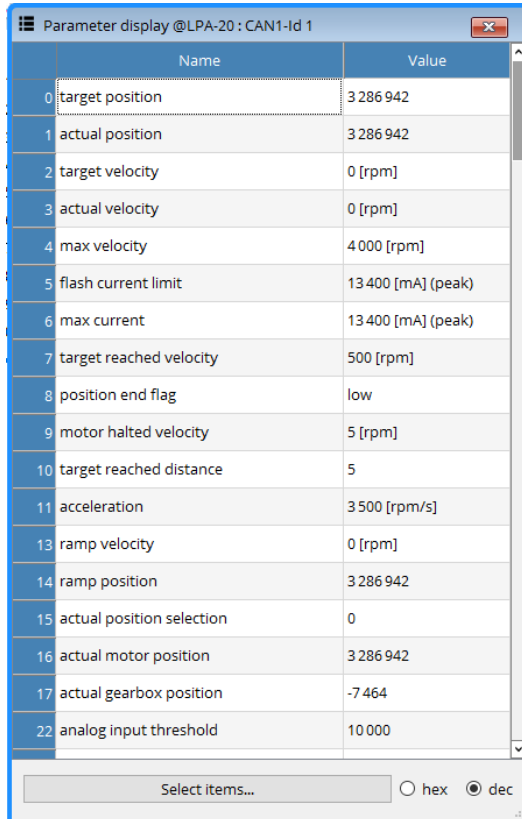Then in 5:SAP to change Max current.

If want to save the new value permanently,

Run 7. STAP method

Parameter –Read All

Parameter display

If need to read multiple parameters , **Axis0→Info graph and display → Parameter display**

Parameter display @LPA-20 : CAN1-Id 1

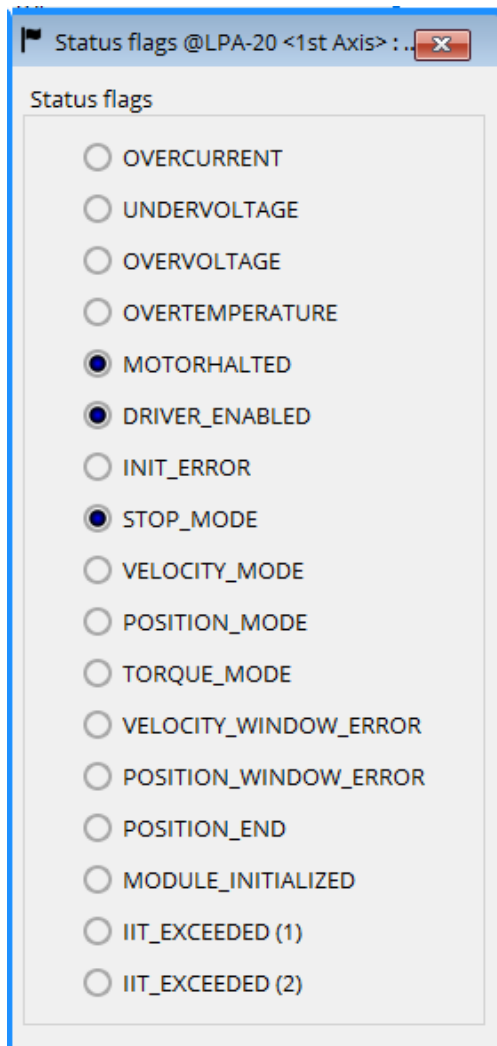|	Name	Value
0	target position	3 286 942
1	actual position	3 286 942
2	target velocity	0 [rpm]
3	actual velocity	0 [rpm]
4	max velocity	4 000 [rpm]
5	flash current limit	13 400 [mA] (peak)
6	max current	13 400 [mA] (peak)
7	target reached velocity	500 [rpm]
8	position end flag	low
9	motor halted velocity	5 [rpm]
10	target reached distance	5
11	acceleration	3 500 [rpm/s]
13	ramp velocity	0 [rpm]
14	ramp position	3 286 942
15	actual position selection	0
16	actual motor position	3 286 942
17	actual gearbox position	-7 464
22	analog input threshold	10 000

Select items...   ○ hex   ● dec

Parameter –Graphic Display
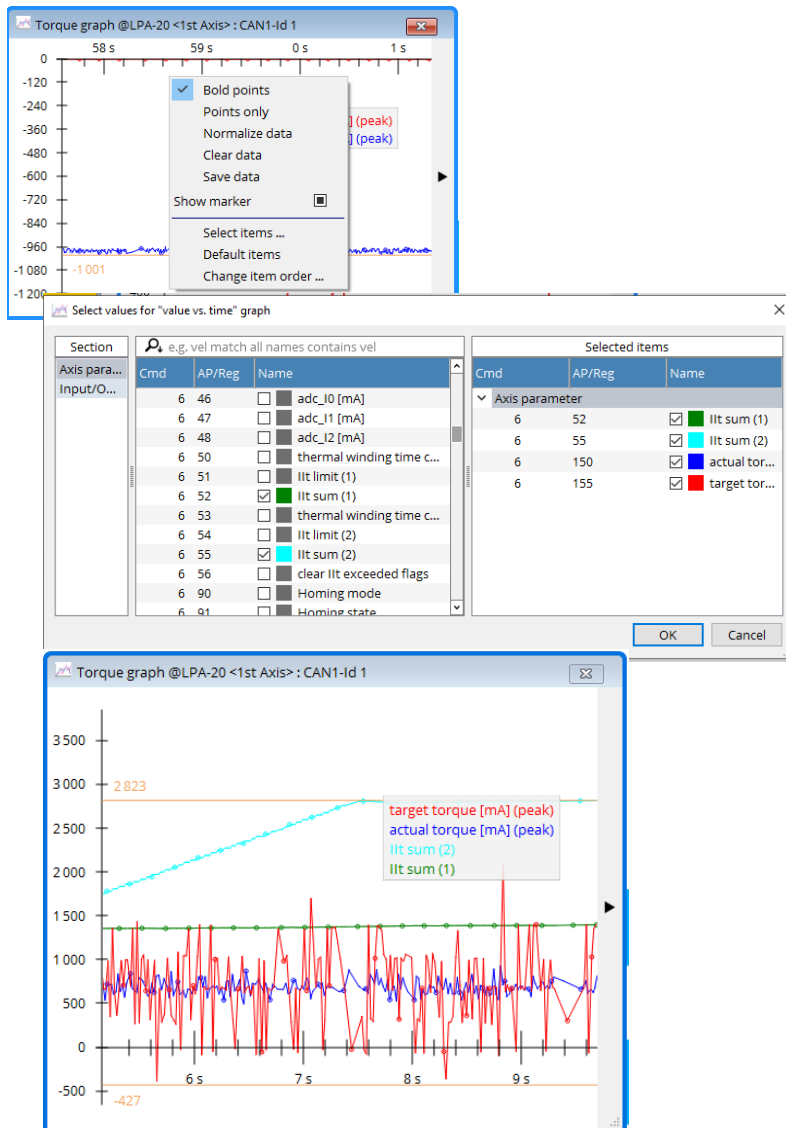
There are 3 graphic windows for Torque, Velocity or Position, more variables can be added in these graphic window

1. Open any window, e.g the Torque Graph window, Right click the graph→ **Select Items**

2. Select the variables to be displayed

    e.g , the IIT sum (1) , and IIT sum(2) real-time value , click **OK**

3. The waveforms of the newly selected variables will be displayed

4. If want to go back to the default display,

Right click the graph→ **Default Items**

Protection-Status Flags

Status flags @LPA-20 <1st Axis> : ..

Status flags

- ○ OVERCURRENT
- ○ UNDERVOLTAGE
- ○ OVERVOLTAGE
- ○ OVERTEMPERATURE
- ● MOTORHALTED
- ● DRIVER_ENABLED
- ○ INIT_ERROR
- ● STOP_MODE
- ○ VELOCITY_MODE
- ○ POSITION_MODE
- ○ TORQUE_MODE
- ○ VELOCITY_WINDOW_ERROR
- ○ POSITION_WINDOW_ERROR
- ○ POSITION_END
- ○ MODULE_INITIALIZED
- ○ IIT_EXCEEDED (1)
- ○ IIT_EXCEEDED (2)

If the actuator isn't operational as expected, **Axis0→Status flags** should be the first step to find out actuator current status . E.g

1. If is outside of Velocity error window
2. If is outside of Position error window
3. If IIT threshold exceeded (IIT1 or IIT2)
4. If upper /lower limit reached
5. If actuator enabled
6. Overcurrent, Over temperature or Under voltage or Over voltage triggered

Protection-IIT thermal protection

Parameter display @LPA-20 : CAN1-Id 1

	Name	Value
50	thermal winding time constant (1)	3 000 [ms]
51	IIt limit (1)	538 680
52	IIt sum (1)	2 800
53	thermal winding time constant (2)	6 000 [ms]
54	IIt limit (2)	541 500
55	IIt sum (2)	5 612
56	clear IIt exceeded flags	0

LPA-20 : CAN1-Id 2

General | Board info

General parameters

supply voltage   48.20 V

driver temperature 26 °C

Analog inputs

ADC_Phase_A 32731
ADC_Phase_B 32997
ADC_Phase_C 32759
ADC_IO1   18736
ADC_IO2   18768

Two IIT windows are implemented for thermal protection to cover both transient Max current and the middle range time current

IIT window 1:

  --50 thermal time constant 1 (default 3 seconds)

  --51 IIT limit 1 (threshold , A^2 * second)

  --52 IIT sum 1, (real-time value)

IIT window 2

  --53 thermal time constant 2 (default 6 seconds)

  --54 IIT limit 2 (threshold , A^2 * second)

  --55 IIT sum 2 (real-time value)

56 clear IIT exceeded flags, In direct mode set 1 to clear the error

Status flags --IIT exceeded1 or IIT exceeded2

Drive temperature can be found in

  IDx: actuator[Version]→General

Protection-Velocity Error and Position Following Error

Velocity Error window and Position Following Error are implemented for motion protection

Velocity Error :

  --18 Velocity window (threshold , in rpm)

  --19 Clear velocity window error (In direct mode , set 1 to clear error)

 --228 Velocity PID error (real-time value)

Position Following Error:
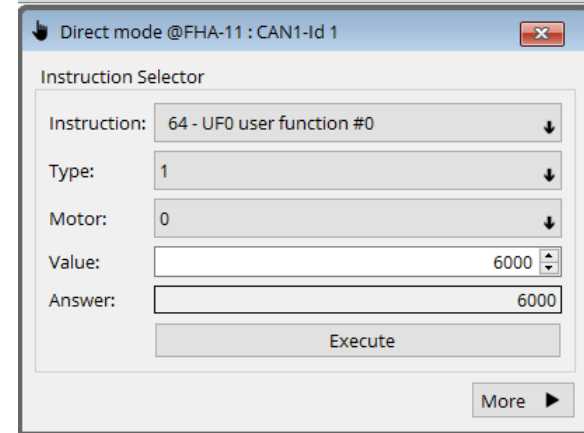
  --23 position window (threshold , in encoder count)

  --24 clear position window error (In direct mode , set 1 to clear error)

 --226 Position PID error (real-time value)

 Status flags –for both Velocity error and Position Following error
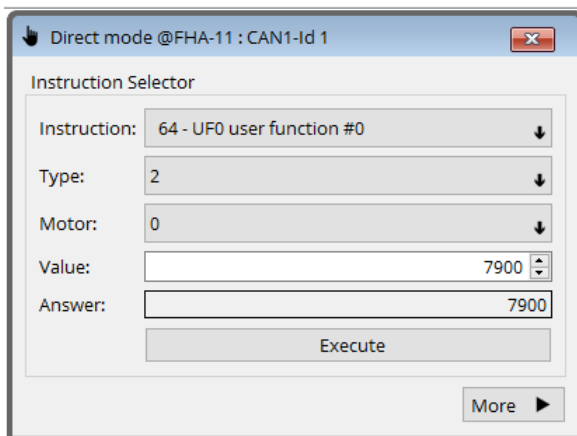
Flash Configuration

(For RSF-5, RSA-8 and FHA mini with FW3.00 or older, if the actuator cannot be returned for HD factory setup)
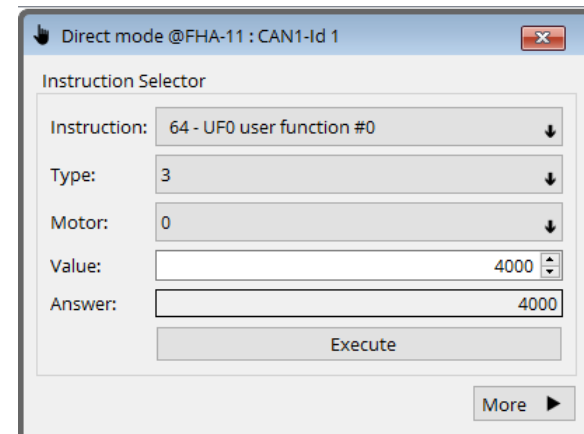

1. Direct mode→ user function, type0 =15263748 to enable Flash writing

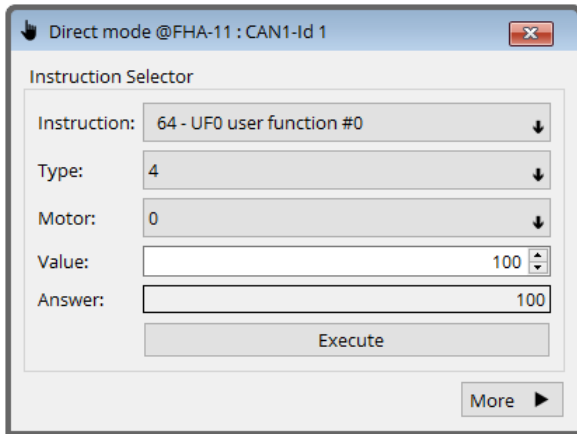2. Max velocity , type1 = xxxx (please refer to the Parameter look-up table in slide 19)
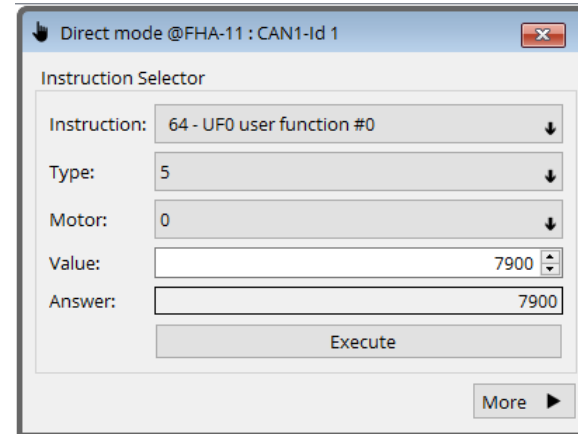

3. Max Current , type2 =
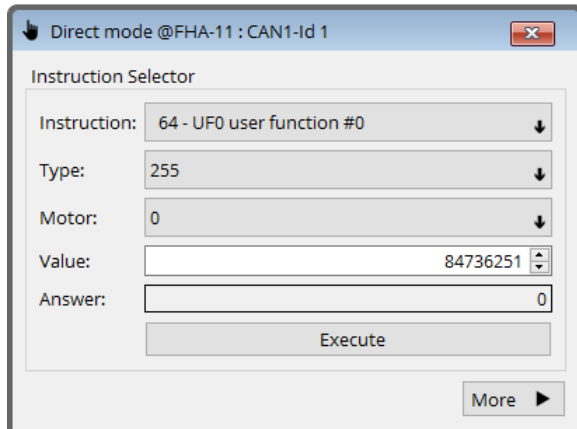

4. Max Acceleration , type3 =

Flash Configuration (continued)

5. Gear ratio , type4 =

6. Flash current limit, type5 =

7. Save flash, type255 = 84736251

8. **Global parameters → Restore factory defaults**
to apply all flash changes, wait for 3-5 seconds until the voltage display is back to normal.
It will be good to take a power cycle after flash update
Remember to run drive calibration

Flash Configuration (IDT default parameters)

Items	RSF-50	RSF5-100	RSA8-50	RSA8-100
Max Velocity (rpm)	10000	10000	8500	8500
Max current(mA)	3100	2400	5600	4950
Acceleration (rpm/s)	10000	10000	10000	10000
Gear Ratio	50	100	50	100
Flash current	3100	2400	5600	4950

Items	FHA8-50	FHA8-100	FHA11-50	FHA11-100	FHA14-50	FHA14-100
Max Velocity (rpm)	6000	6000	6000	6000	6000	6000
Max current(mA)	4700	3400	11600	7900	23200	17400
Acceleration (rpm/s)	4000	4000	4000	4000	4000	4000
Gear Ratio	50	100	50	100	50	100
Flash current	4700	3400	11600	7900	23200	17400

CANopen Master(from CAN mode to CANopen)

Once the Integrated actuator performance is verified in HDL-IDE environment, downloading to the CANopen FW, with the *.eds file, the user can start trajectory programming with their own CANopen master, below are some Typical CANopen controllers supported by IDT products.

- PLC Master Controller – **Beckhoff PLC + TwinCAT Software**
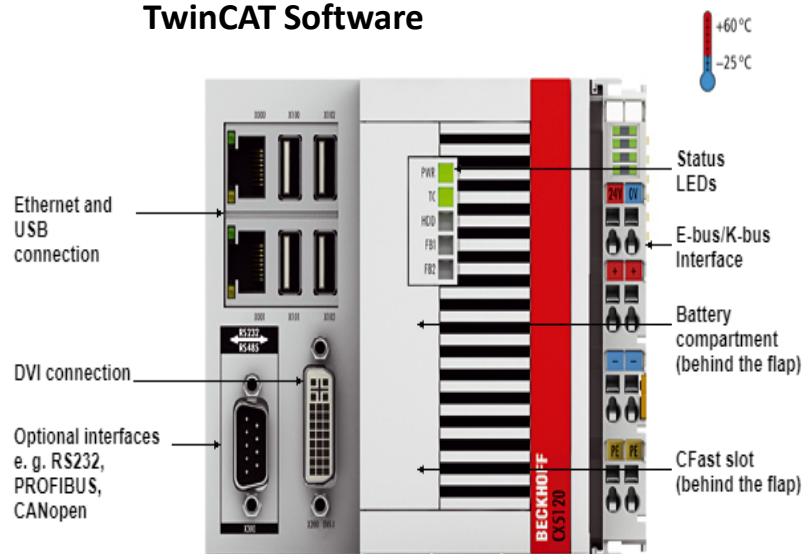
- **CANopen with Python** – SW running on a PC with **Kvaser or Peak adapter** (low cost solution)

```
PP_example._rev5.py - C:\My_files\0python_workspace\FHA8_FW304\PP_example._rev5.py (

File  Edit  Format  Run  Options  Window  Help

'''
Example code for HDLLC integrated Actuator
Position Profile Mode
a.Define Node_ID
b.Select CAN adapter , Kvaser or Peak, and the matching EDS file
'''
import canopen
import time
import numpy as np
import matplotlib.pyplot as plot

from HarmonicDrive import HarmonicDrive

hd = HarmonicDrive();
```

- Other Controllers – Weigl Control, **Pro Commander AX + Showforge**