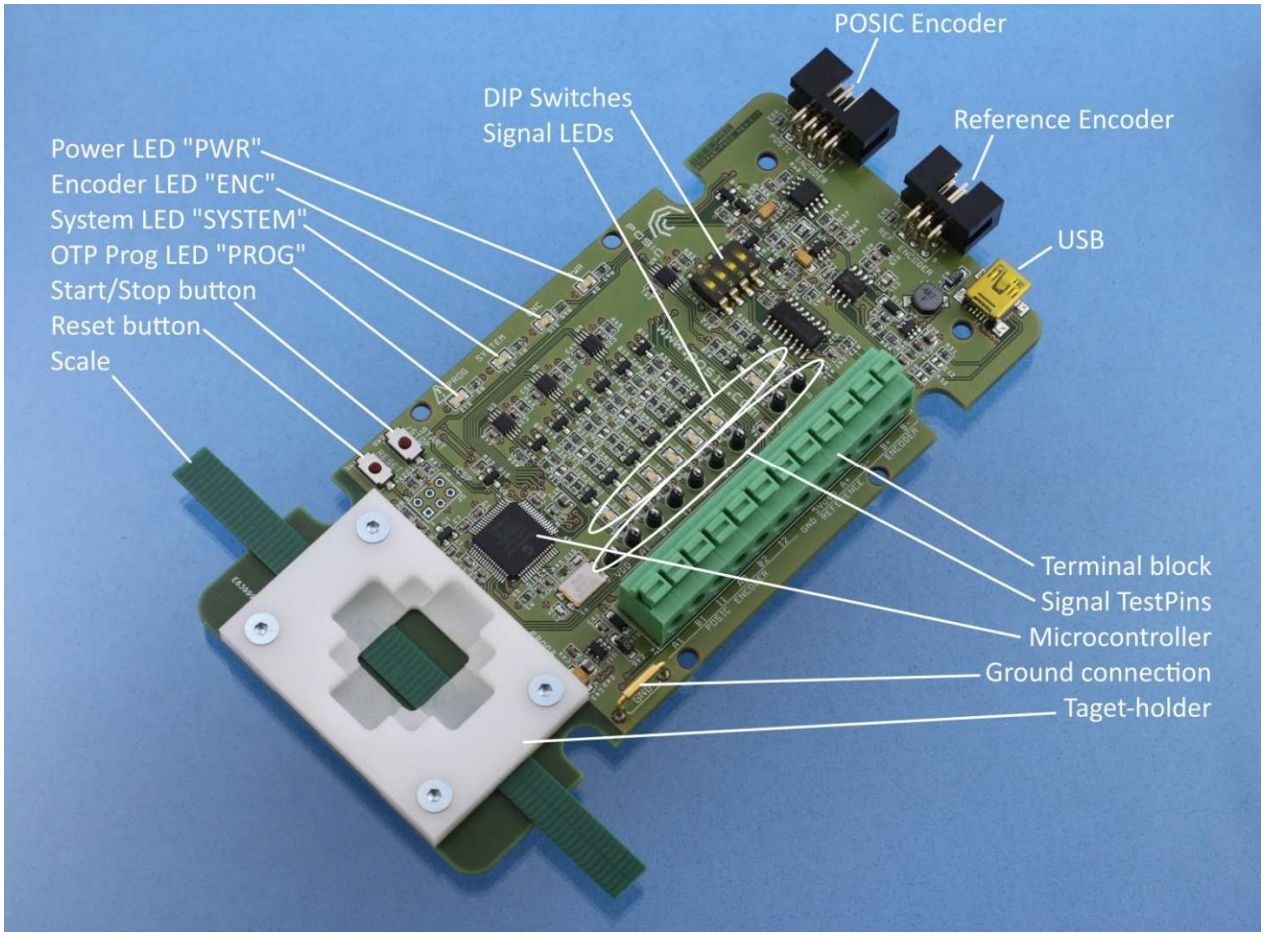
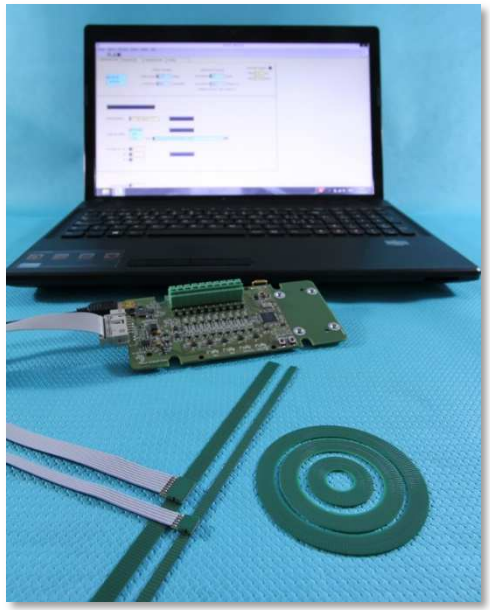
Evaluation & Programming Tool - User Manual

Interface Board





Evaluation & Programming Tool:
- ASSIST Software
- USB cable
- Interface Board
- Encoders
- Scales or codewheels

Power LED “PWR”	Active when the Interface Board is powered via the USB-cable
Encoder LED “ENC”	Active when the encoder is powered
System LED “SYSTEM”	Active when the microcontroller on the Interface Board is active
OTP Prog LED “PROG”	Active when the OTP-memory in the encoder is being programmed

ASSIST Software – the most important functions

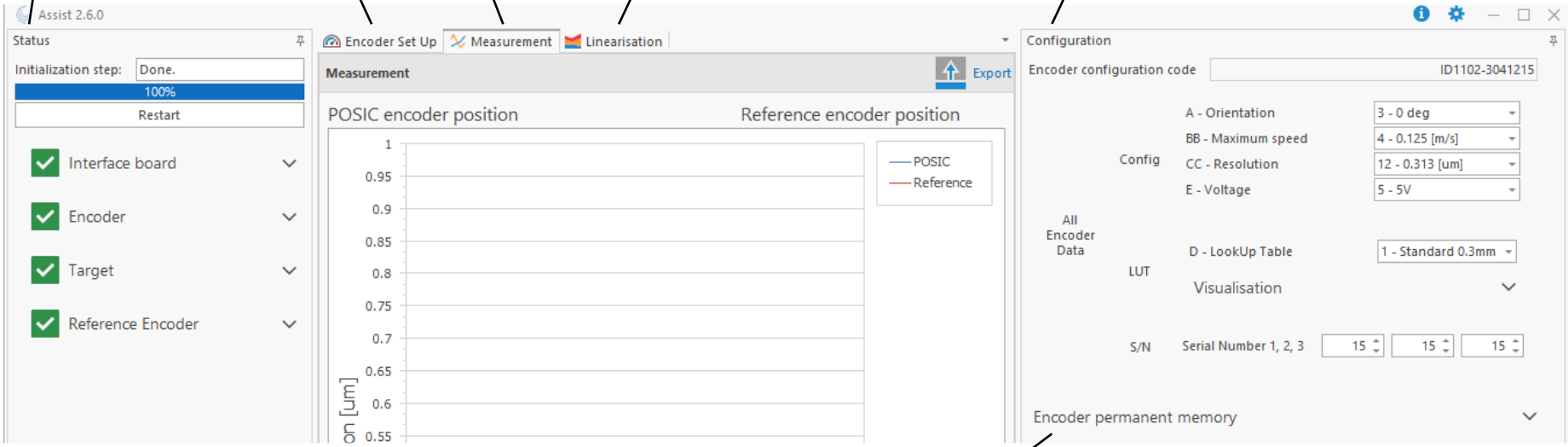
Status: Check Interface Board and Encoder and define target (scale or codewheel) and reference encoder , page 3

Set Up: Measure the airgap from encoder to scale/codewheel and select the standard LUT for best linearity, page 4

Measurement: Carry out measurements and store the measurement results in a data-file, page 5

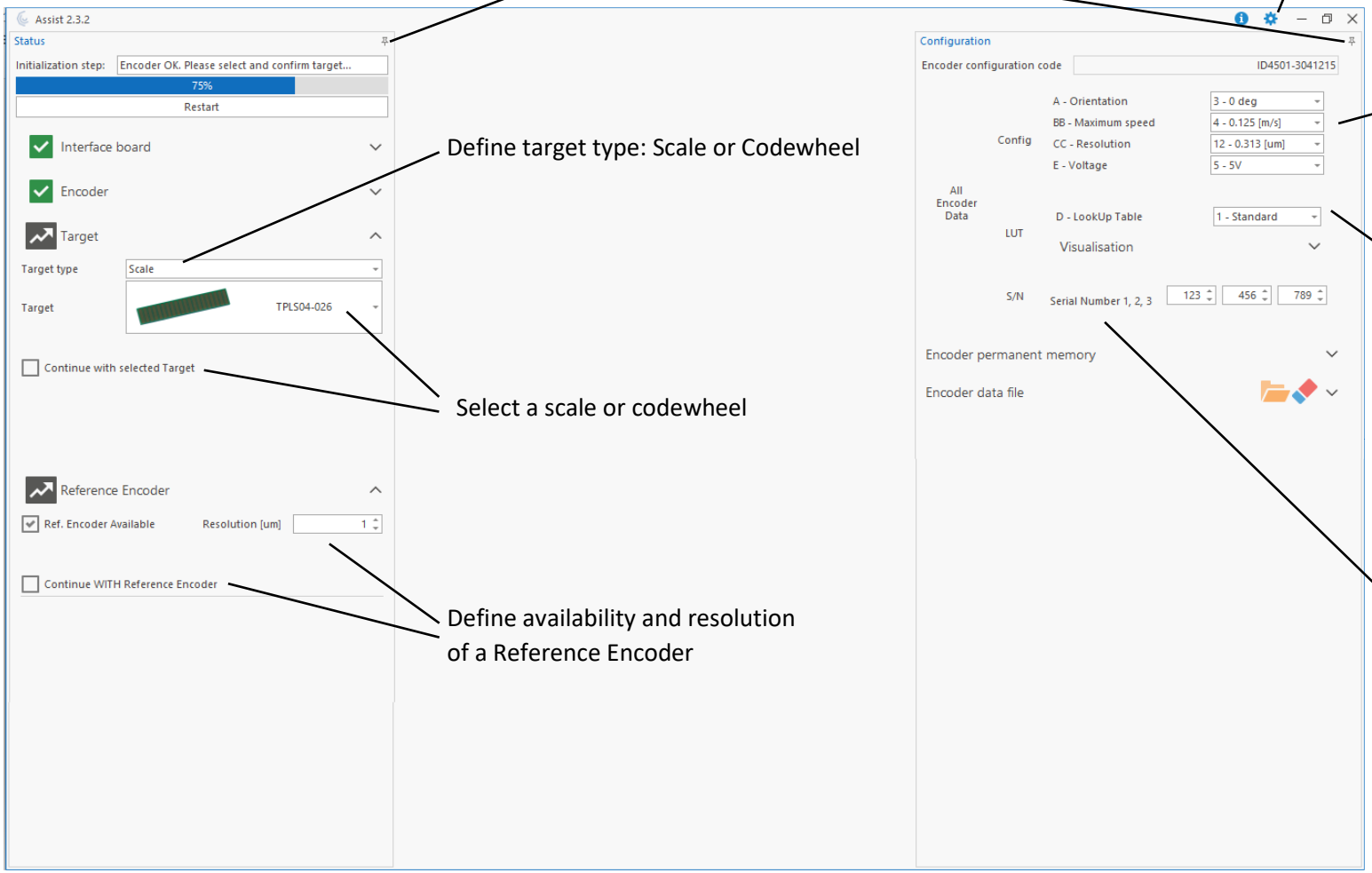
Linearization: Measure the POSIC encoder against a reference encoder and use this to generate a LookUp Table, pages 6 - 9

Configuration: Set orientation, resolution, maximum speed, supply voltage and LookUp Table, page 3



OTP programming: Program the configuration into the encoder's OTP (One Time Programmable) permanent memory, page 11

ASSIST - Status and Configuration windows



Show/hide the Status and configuration windows

Check to:
enable/disable warning messages
enable/disable Advanced Functions
define LUT export file format

Configure the encoder
See last page of datasheet

Define target type: Scale or Codewheel

Select a scale or codewheel

Select LookUp Table (LUT)
Recommendation for new users: Standard 0.3 mm (if not available: Default)
If 8-Custom is selected, you will be asked to select a file containing the Custom LUT

Define availability and resolution of a Reference Encoder

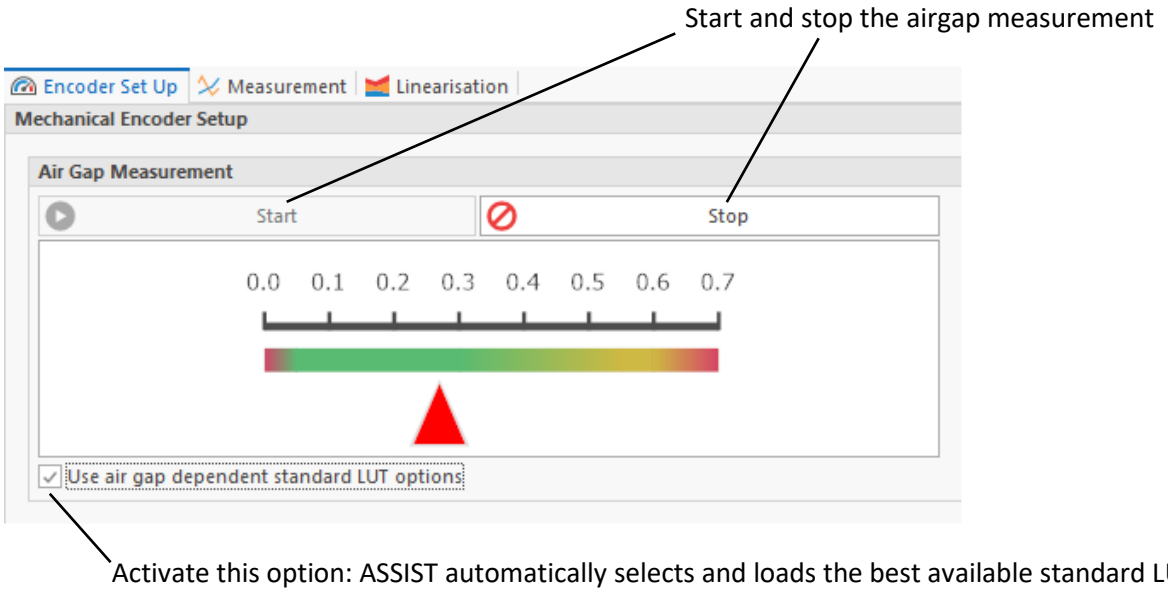
User-defined Serial Numbers

Encoder Set Up – Airgap measurement

The airgap can be measured with an accuracy of approximately ± 0.1 mm if the selected target is one of the following:

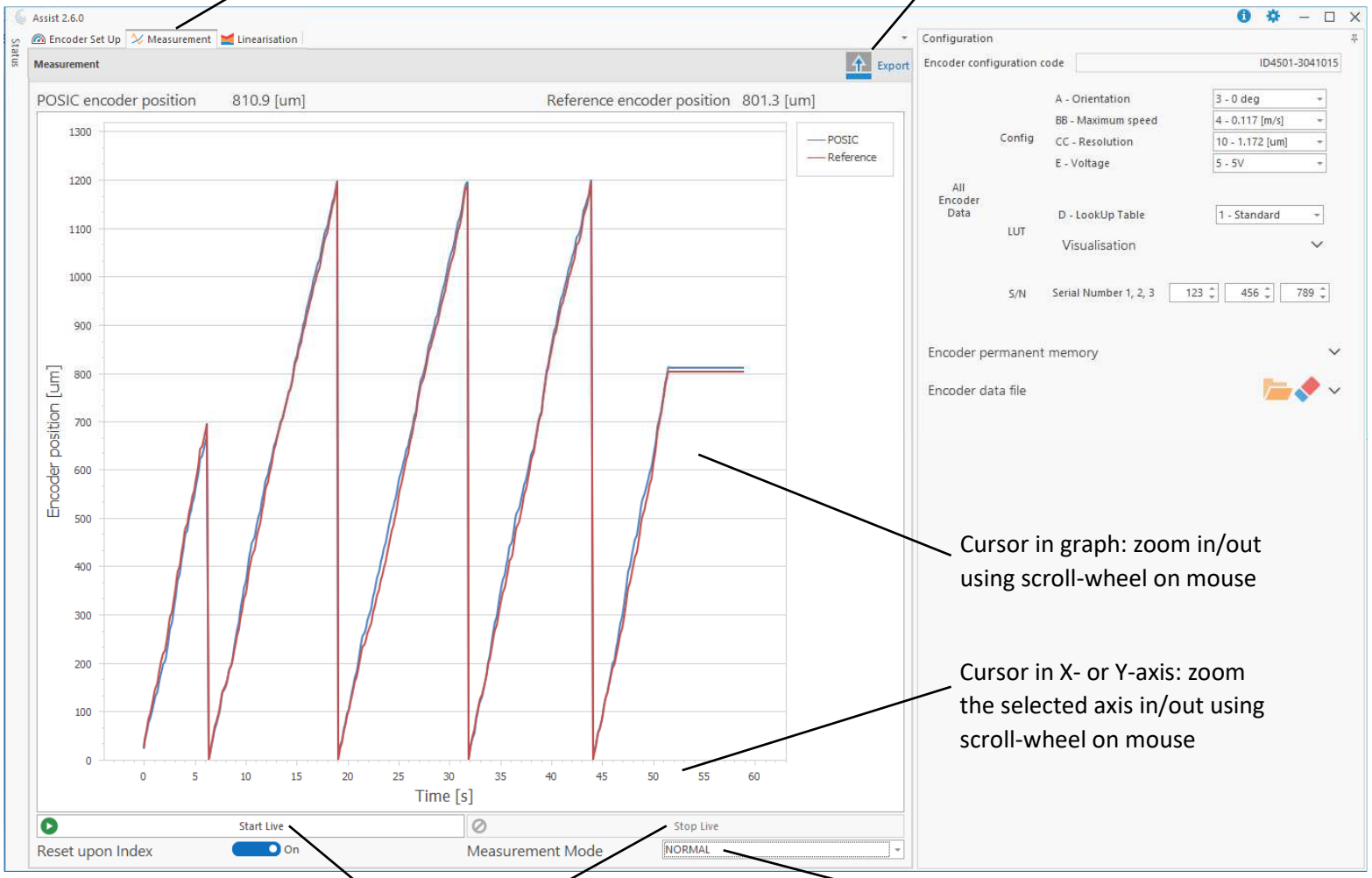
- Scale: POSIC standard scale or custom scale with period length 1.2 mm or 1.28 mm
- Codewheel: POSIC standard codewheel or custom codewheel with 64, 128 or 180 periods

If you don't use a standard scale or codewheel: select the period length or the number of periods that is closest to your target and use the measured airgap as a rough indication.



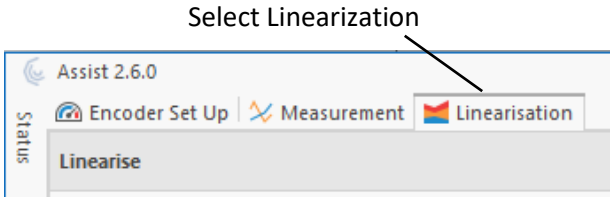
Remark: the measured airgap may vary according to the position within one period. This is normal and depends on the period- length, the shape of the copper strips, mechanical tolerances etc. Due to this variation, it is recommended to use the average of several airgap-measurements.

ASSIST - Measurement window



ASSIST - Linearization window

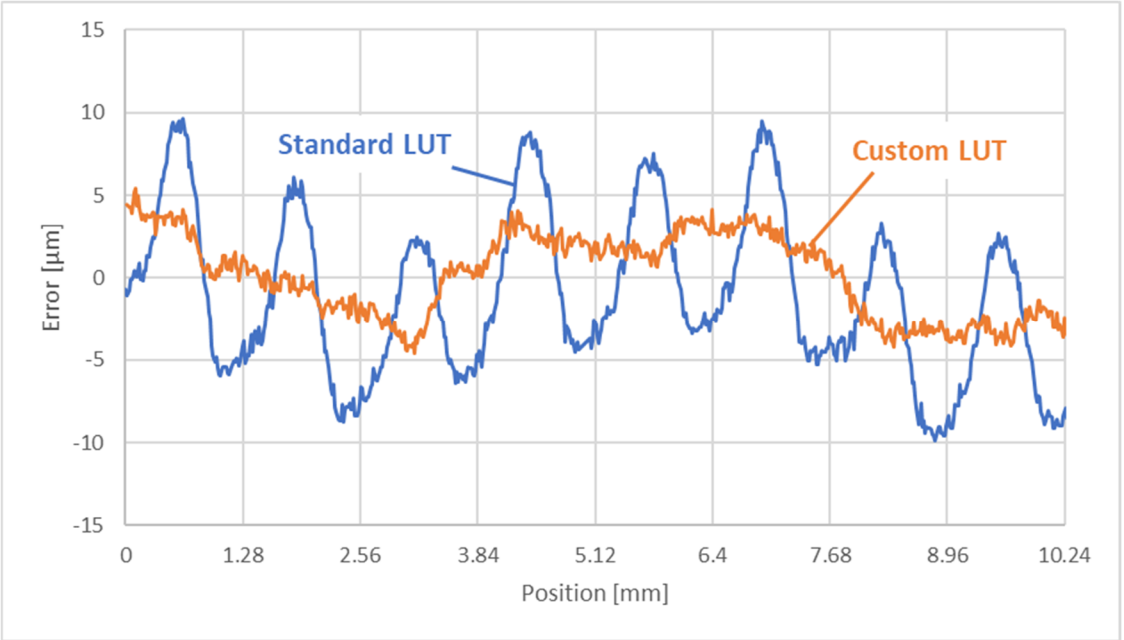
The linearization window (detailed explanation on the next 3 pages) allows to measure, analyze and compensate the non-linearity of a POSIC encoder. This page briefly expains the origins of non-linearity and how it can be compensated.



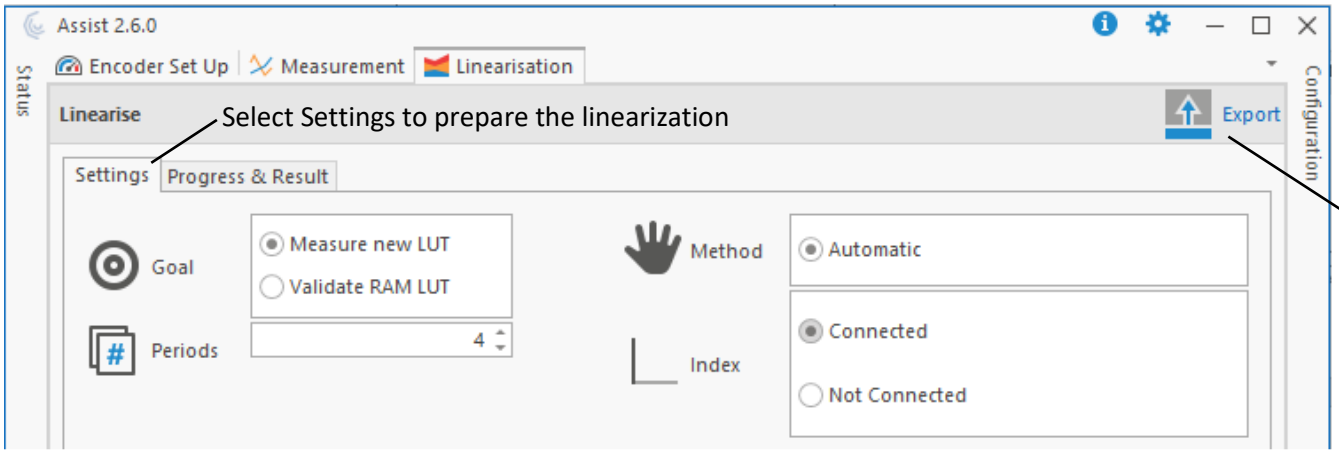
A POSIC encoder has a periodic non-linearity that depends on the scale/codewheel (size and shape of the copper patterns), the airgap and the mounting tolerances (of the encoder and the scale/codewheel) . This non-linearity can be compensated by a LookUp Table (LUT):

- Standard LUT: compensates the non-linearity due to the scale/codewheel and the airgap. For all POSIC's standard scales/codewheels, a Standard LUT for airgap 0.1, 0.3 and 0.5 mm is available under D – LookUp Table. The remaining non-linearity with a Standard LUT is typically in the range ± 10 to 20 µm or ± 3 to 6°e.

- Custom LUT: the optimal linearity is obtained by individual linearization against a reference encoder. The Reference encoder measures the movement of the POSIC scale/codewheel. The remaining non-linearity with a Custom LUT corresponds to the inaccuracy of the copper patterns on the scale and are typically in the range of ± 5 to 10 µm or ± 1.5 to 3°e.



The linearization window requires a Reference Encoder that measures the POSIC scale/codewheel movement and that is electrically connected to the Interface Board. This Reference Encoder must have A quad B outputs and could be a high-end optical encoder, a laser interferometer, a digital gauge or any other linear or rotary position measurement device.



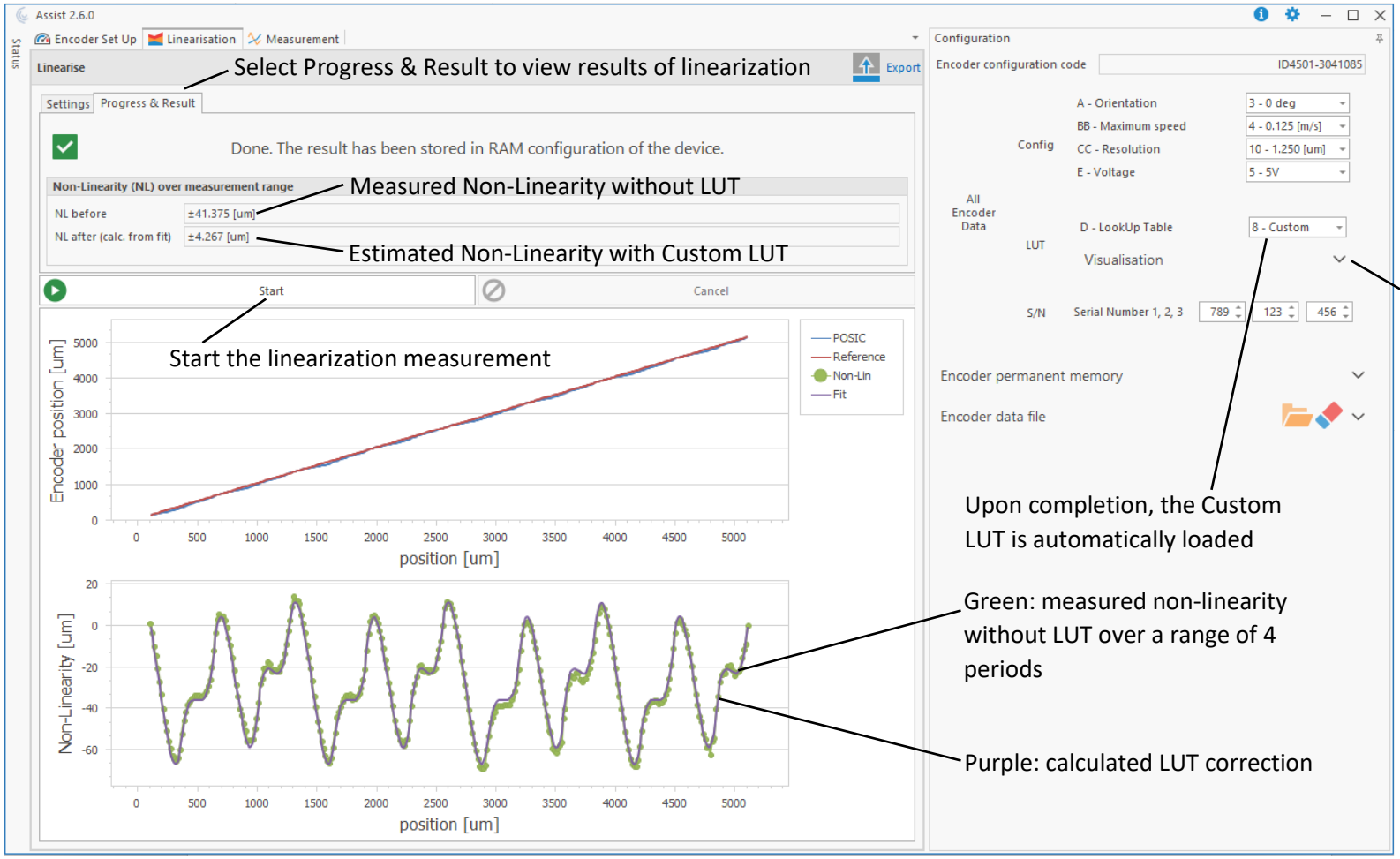
Goal	Measure new LUT:	Measure the non-linearity and calculate a Custom LUT
	Validate RAM LUT:	Measure the non-linearity with the LUT specified in D – LookUp Table (see page 3)
Method	Automatic:	Linearization using a Reference Encoder
Periods	Number of scale/codewheel periods over which the linearization takes place. It is recommended to set the number of periods corresponding to 70% of the movement range of a linear scale or to the number of periods corresponding to one full rotation of a codewheel.	
Index	Connected:	The A, B and Index signals are used for linearization, the scale/codewheel may be either static or moving when the linearization is started
	Not Connected:	Only the A and B signals are used for linearization, the scale/codewheel must be static when the linearization is started. Message *Please Wait*: do not move the scale/codewheel until the message *Ready* is displayed Message *Ready*: start to move the scale/codewheel for the linearization measurement

Notes:

- A Reference Encoder with A/B outputs (e.g. a high-end optical encoder) must measure the movement of the POSIC scale/codewheel. The A/B outputs of the reference encoder must be electrically connected to the Interface Board (see photo of Interface Board on page 1).
- The Export-file contains all the relevant encoder- and measurement-information, it can be imported into Excel or a similar software.

Linearization – Measure new LUT

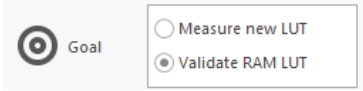
Step 1 of the linearization procedure: measure the non-linearity without LUT. Upon completion, a Custom LUT is automatically calculated and loaded in the Configuration Window (D - LookUp Table = 8 - Custom)



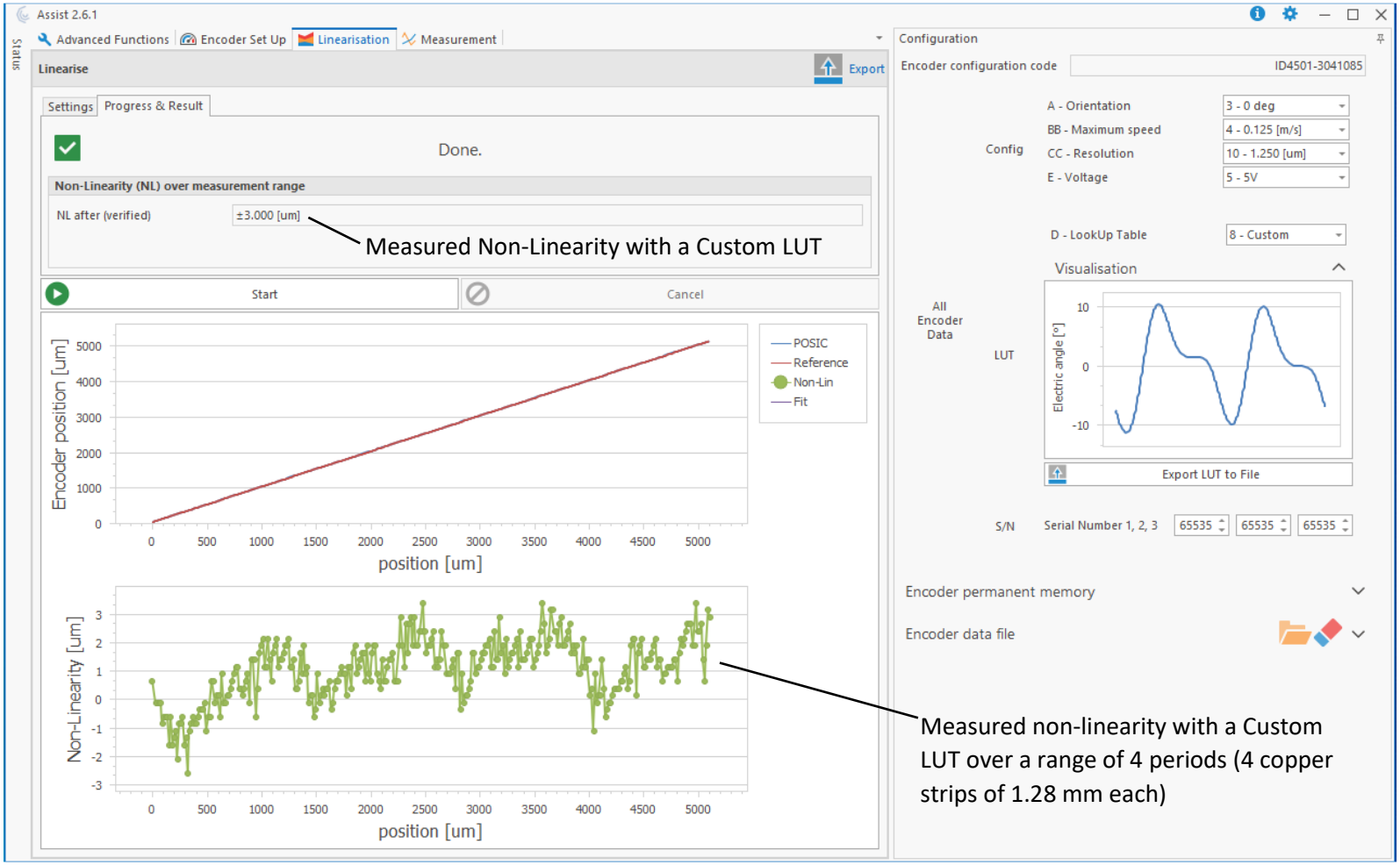
Recommendations:

- Keep moving in the same direction during linearization. If the direction of movement changes, the linearization measurement will be aborted.
- Keep the speed of movement during linearization at least 60 x lower than the value of BB - Maximum speed in the Configuration window.

Linearization – Validate RAM LUT



Step 2 of the linearization procedure: validation the Custom LUT calculated on the previous page.



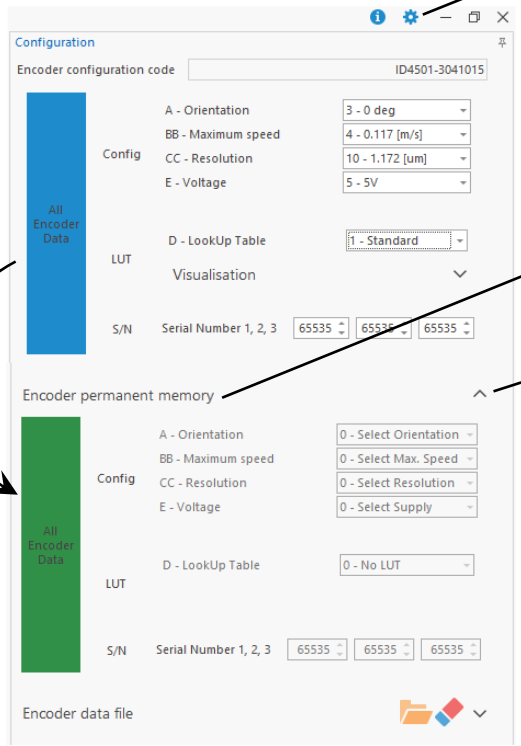
Remark: Validate RAM LUT is not limited to validation of a Custom LUT, it can also be used to measure the non-linearity of any other LUT selected in D – LookUp Table (e.g. a Standard LUT)

Programming Encoder permanent memory

Check to enable/disable warnings for programming

Drag & Drop from Configuration to Encoder permanent memory and vice versa:

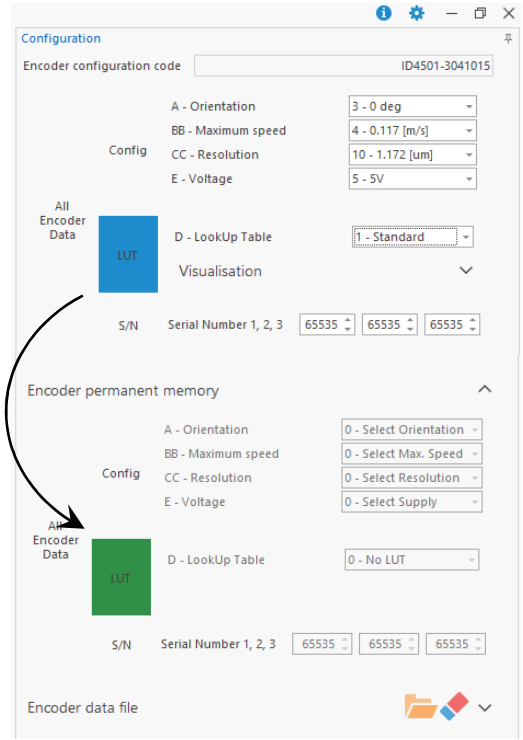
- All Encoder Data
- Configuration
- LookUp Table LUT
- Serial Number S/N



Select Encoder Permanent memory

Pull-down menu for Config, LUT and S/N

Drag & Drop only LUT from Configuration to Encoder permanent memory



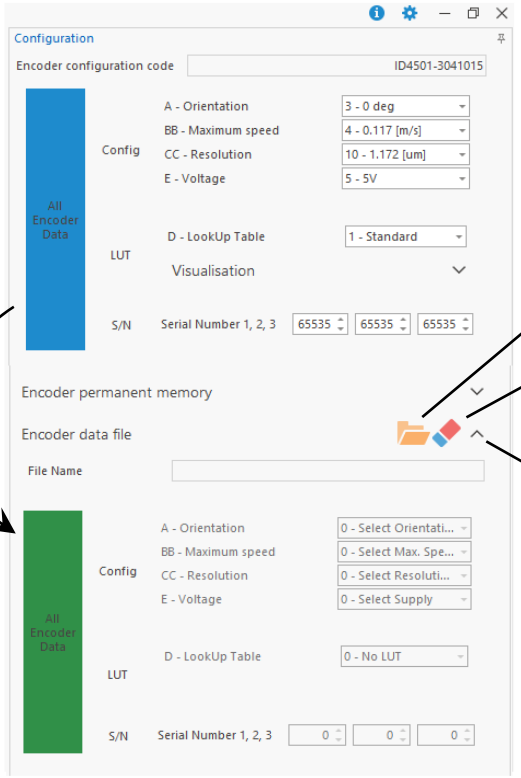
Notes:

- The encoder permanent memory (OTP = One Time Programmable) can be programmed only once, the OTP memory cannot be re-programmed
- During evaluation and development, it is recommended not to program the encoder's OTP memory, so that the encoder can be evaluated with different configurations. Only when the configuration has been fixed or when the encoder must be operated "standalone", OTP programming is recommended.
- Warning messages appear prior to OTP-programming, changing LUT etc. These warnings can be disabled in the settings menu at the right top-side of the ASSIST window

Write to and read from an Encoder data file

Drag & Drop from Configuration to Encoder data file and vice versa:

- All Encoder Data
- Configuration
- LookUp Table LUT
- Serial Number S/N

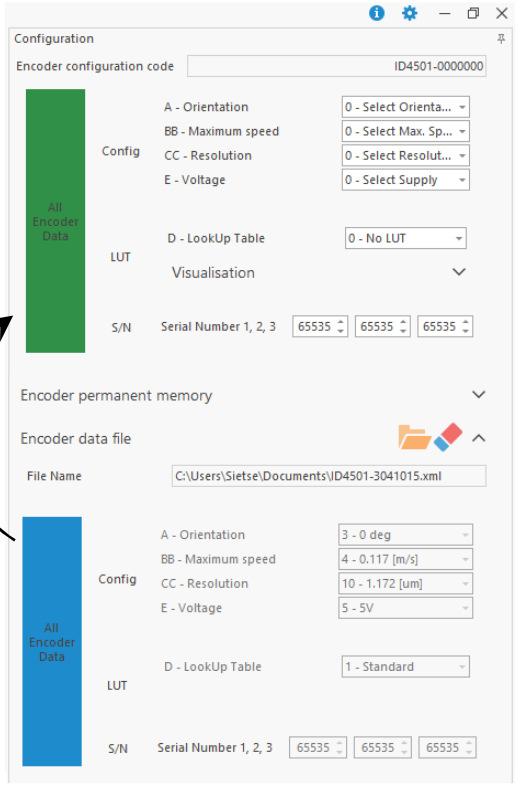


Select or unselect an Encoder data file

Pull down menu for Config, LUT and S/N

Drag & Drop from Encoder data file to Configuration:

- All Encoder Data
- Configuration
- LookUp Table LUT
- Serial Number S/N



Interface Board connections

The POSIC Encoder is powered by the Interface Board (see image on page 1) via pins 1 and 2 of the 8-pin POSIC connector (Table 1). Do not apply an external supply voltage to the POSIC Encoder while it is connected to the Interface Board. Permanent damage may occur if the POSIC Encoder or the Interface Board are powered otherwise than via the USB-connection.

Tables 1 - 3 provide the pinouts of the encoder connectors and the green terminal block. The POSIC Encoder connections are in green, the Reference Encoder connections in red and the GND in blue (common GND between POSIC and Reference Encoders).

Table 1: Pinout of the 8-pin POSIC connector on the Interface Board

Pin nr.	Signal ID/IT enc.	Signal AP enc.	Comment
1	VDD	VDD	POSIC encoder supply voltage
2	GND	GND	Ground
3	A1	Clock1	Signal A or Clock1
4	B1	Data1	Signal B or Data1
5	I1	-	Signal I
6	A2	Clock2	Signal A2 or Clock2
7	B2	Data2	Signal B2 or Data2
8	I2	-	Signal I2

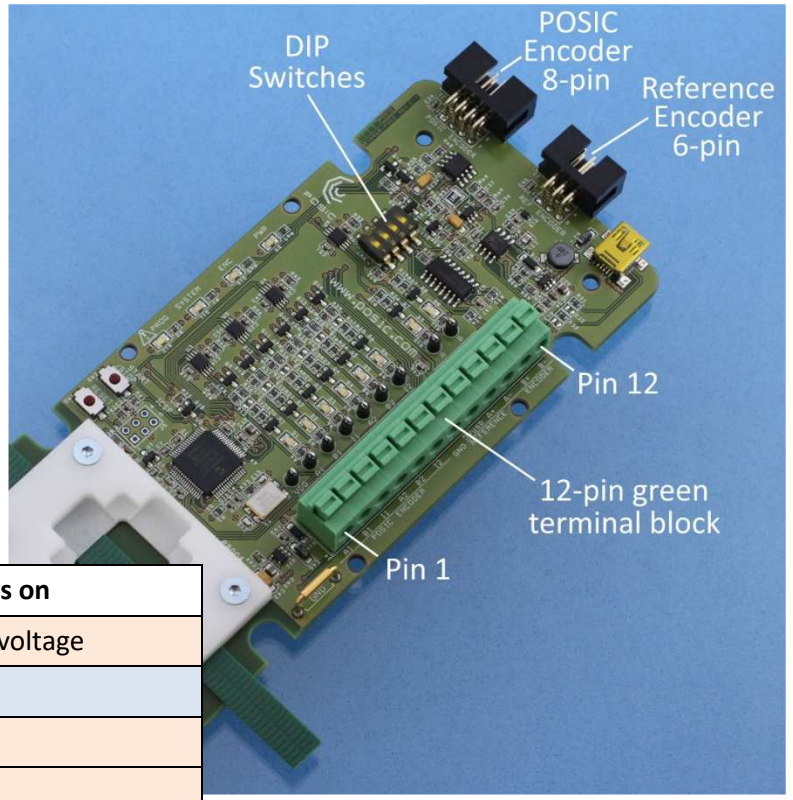


Table 2: Pinout of the 6-pin Reference Encoder connector on the Interface Board

Pin nr.	Signal	All DIP switches off (default)	All DIP switches on
1	5Vusb	Not connected	5V USB supply voltage
2	GND	Ground	
3	A+	Differential signal A, positive	Signal A
4	A-	Differential signal A, negative	Not connected
5	B+	Differential signal B, positive	Signal B
6	B-	Differential signal B, negative	Not connected

Table 3: Pinout of the 12-pin green terminal block on the Interface Board

Pin nr.	Signal	All DIP switches off (default)	DIP switch 1 = on and 2,3,4 = off	All DIP switches on
1	A1 / Clock1	POSIC encoder signal A		
2	B1 / Data1	POSIC encoder signal B		
3	I1	POSIC encoder signal I		
4	A2 / Clock2	POSIC encoder signal A2 (only for IT3402 and IT5602)		
5	B2 /Data2	POSIC encoder signal B2 (only for IT3402 and IT5602)		
6	I2	POSIC encoder signal I2 (only for IT3402 and IT5602)		
7	GND	Ground (common ground for POSIC and reference encoders)		
8	5Vusb	Not connected	Supply for Ref encoder	Supply for Ref encoder
9	A+	Ref encoder diff signal A, positive	Ref encoder diff signal A, positive	Ref encoder signal A
10	A-	Ref encoder diff signal A, negative	Ref encoder diff signal A, negative	Not connected
11	B+	Ref encoder diff signal B, positive	Ref encoder diff signal B, positive	Ref encoder signal B
12	B-	Ref encoder diff signal B, negative	Ref encoder diff signal B, negative	Not connected

Important: **5Vusb (green terminal block pin 8) is NOT the supply for the POSIC encoder.** The POSIC-encoder supply VDD is not available on the green terminal block, it is only available on the POSIC encoder connector (pin 1 in Table 1)**.** 5Vusb may be used to supply the Reference encoder, see Tables 3 and 4.

The DIP switches on the Interface Board allow you to configure the supply of the reference encoder and the type of outputs of the reference encoder according to table 4.

Table 4: Configuration of the Reference Encoder by means of the DIP switches on the Interface Board

DIP Switches				Reference encoder supply	Reference encoder outputs
1	2	3	4		
off	off	off	off	External supply	RS422 differential
on	off	off	off	5V USB supply to Ref enc.	RS422 differential
off	on	on	on	External supply	5V TTL single-ended
on	on	on	on	5V USB supply to Ref enc.	5V TTL single-ended

When DIP switch 1 is **off**, the Interface Board does not provide a supply voltage to pin 1 of the Reference Encoder connector.
When DIP switch 1 is **on**, the Interface Board provides the 5V USB supply voltage to pin 1 of the Reference Encoder connector.

When DIP switches 2-4 are **off**, the RS422 line receiver on the Interface Board is enabled.
When DIP switches 2-4 are **on**, the RS422 line receiver on the Interface Board is disabled and bypassed.

In-circuit programming

In-circuit programming is required when the linearization and/or the OTP-programming has to be carried out after the encoder has been permanently connected to a controller (e.g an SMD-encoder soldered on a PCB together with a microcontroller). During in-circuit programming, the Interface Board needs to control the encoder's supply voltage VDD and the pins A, B. Pin I is optional: it is not required for programming nor for linearization (see section on Linearization on page 7)

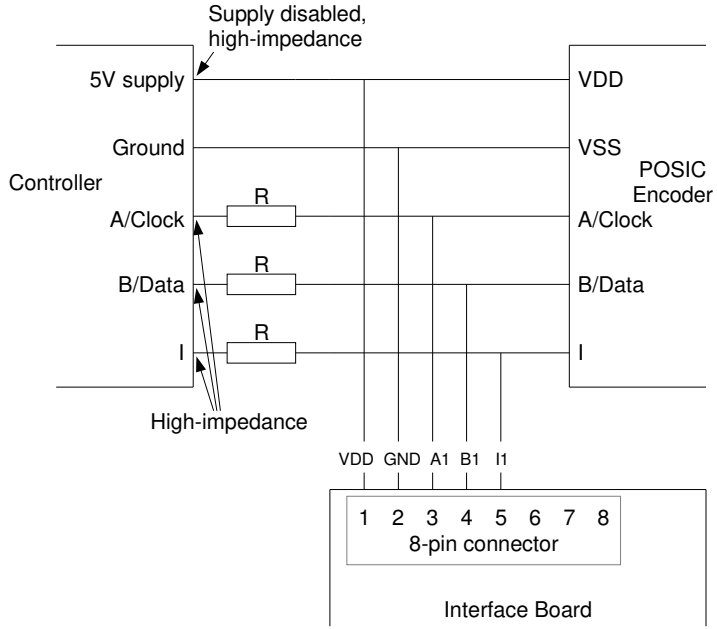
If it is possible to disable the 5V encoder-supply and to put the controller in/outputs (A, B, I) in high-impedance state, the schematic diagram below to the left shows the connections for in-circuit programming.

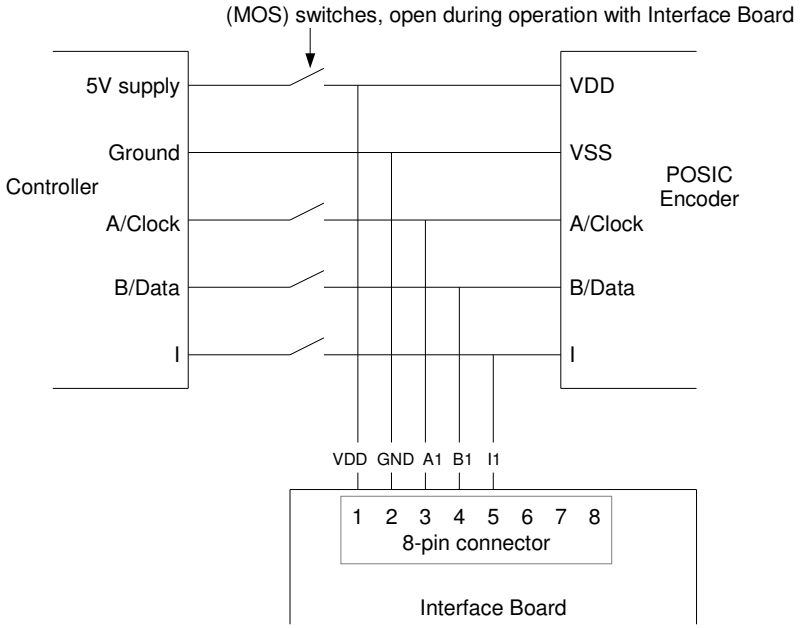
If it is not possible to disable the 5V encoder-supply or to put the controller in/outputs (A, B, I) in high-impedance state, the schematic diagram below to the right shows the connections for in-circuit programming.

During OTP-programming, the encoder supply voltage VDD and the voltage on A, B and I are increased to 6.5 V during a relatively short time (few seconds). Series resistors are recommended to protect the controller inputs during encoder-programming. Recommended value for the series resistor R = 100 – 1000 Ω.

For in-circuit programming of 2-channel encoders (ID1102, ID4501), pins 3, 4 and 5 (A1, B1 and I1) of the 8-pin connector are used as shown in the schematic diagrams below. However, for 3-channel encoders (IT3402, IT5602), pins 3, 4, 5, 6, 7 and 8 (A1, B1, I1, A2, B2 and I2) of the 8-pin connector have to be used.

The pins I1 and I2 are not required for programming nor for linearization (see page 7, Index = Not Connected) and may therefore be left out.

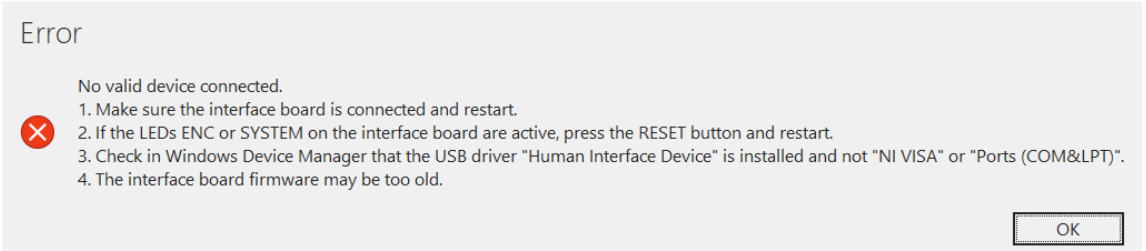




Troubleshooting

Error – No valid device connected

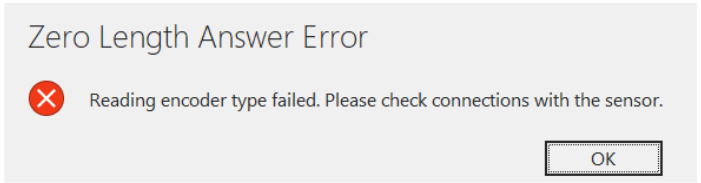
- Interface Board is not connected => connect Interface Board and press Restart
- Interface Board firmware is too old => load newest version of the Interface Board Firmware (in the ZIP-file with the ASSIST software)
- USB driver is not correct => verify and install USB driver according to ASSIST Installation Manual.



Zero Length Answer Error – Reading encoder type failed

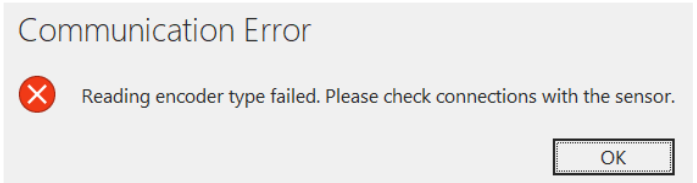
- No encoder connected => Connect an encoder and press Restart
- Supply current too high due to a short-circuit in the encoder's supply or output connections => remove the short-circuit and press Restart.
- Supply current too high due to additional electronics (e.g. linedrivers, other sensors, …) connected to the encoder supply voltage VDD => there are 2 solutions:
    - disconnect/disable the additional electronics and press Restart
    - In the settings-window set "Use 5V encoders only" = "True" and set "Selection of 5V encoder" = "False" and press Restart

  Please note: the supply current level can be measured in the Advanced Functions window: Supply Test and Leakage Test



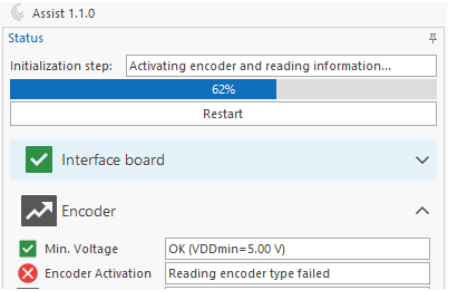
Communication Error - Reading Encoder Type failed

- Short-circuit between encoder supply (VDD) and ground (VSS) => remove the short-circuit and press Restart.



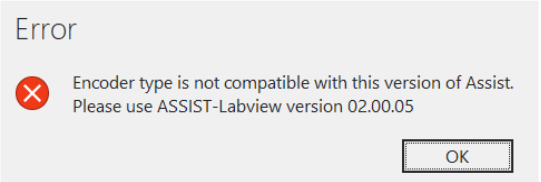
Reading Encoder Type failed

- Malfunctioning encoder => Connect another encoder and press Restart
- One or more of the connections in the encoder-cable or encoder-connector are open-circuit => make sure that all electrical connections are correct and press Restart
- One or more of the encoder outputs A, B and/or I are short-circuited between each other or to VDD or to VSS => remove the short-circuit(s) and press Restart



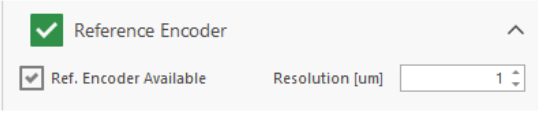
Encoder not compatible

- The ASSIST software is compatible to the encoders ID1102, ID4501, IT3402 and IT5602.
- If your encoder is not compatible, carry out a memory dump in the Advanced Functions window and send the resulting file to info@posic.com for assistance.



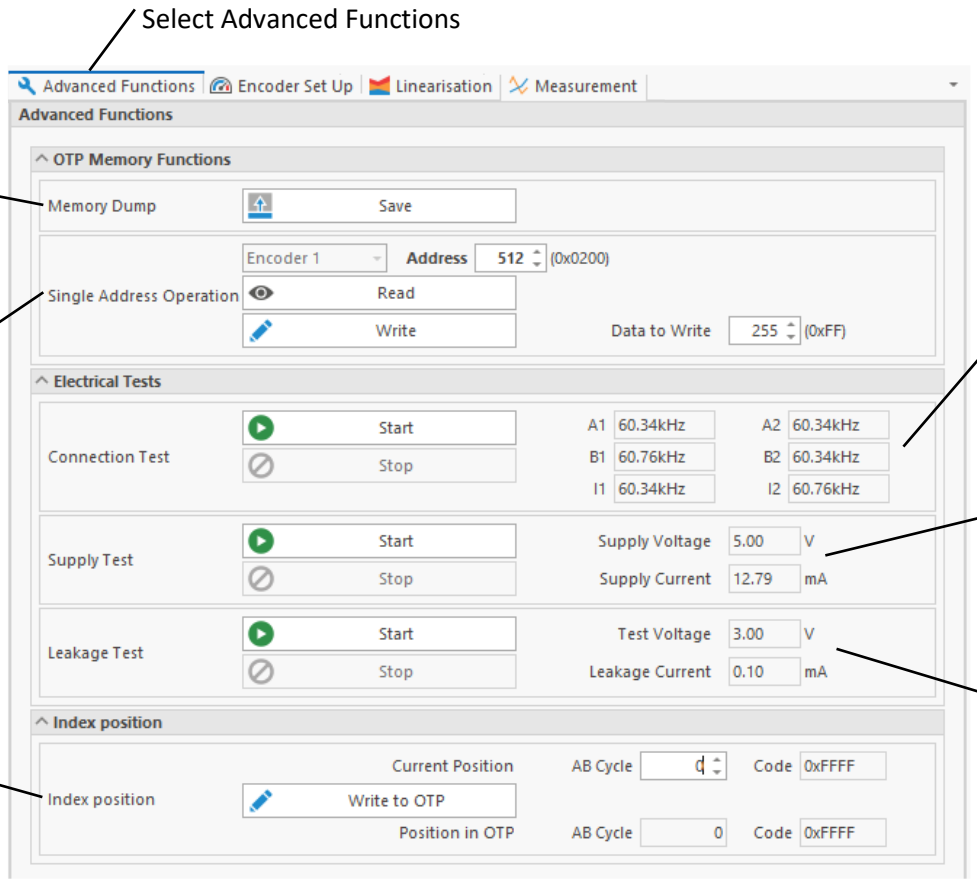
Measurement does not start

- If Ref. Encoder Available = off, the measurement is started as soon as the Start Live button has been pressed.
- If Ref. Encoder Available = on and the Start Live button has been pressed, the measurement is started as soon as the reference encoder starts moving. As long as the reference encoder provides no A/B pulses, the measurement will not start.



Advanced Functions

The advanced functions may be very useful for troubleshooting purposes and can be activated in the settings ⚙ pop-up window at the right top side



Memory Dump: dump the contents of the encoder's OTP memory in a text-file

Single Address Operation: read data from or write data to a specific address in the Encoder's OTP memory
Only for experienced users, permanent damage may occur when used inappropriately!

Index Position: position the Index-Pulse in a specific AB-cycle. The default value is 0.

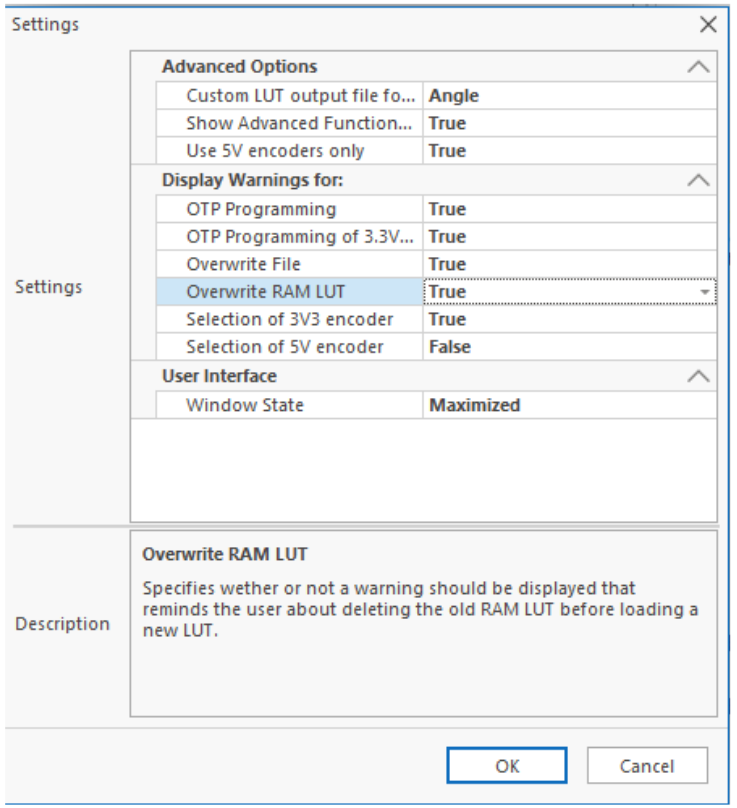
Connection Test: the encoder outputs provide a square wave, the LEDs on the Interface Board light up and the measured frequency is displayed.

Supply Test: the supply voltage and current during normal operation are displayed.

Leakage Test: a supply voltage of 2 or 3 V is applied. The leakage current is measured and should be well below 1 mA.

Settings

Clicking the settings-icon ⚙ at the right top side will activate the pop-up window:



- **Custom LUT output file format**: The LUT can be exported in degrees, decimal values or hexadecimal values.
- **Show Advanced Function Window**: Specifies whether or not the window containing advanced functions is displayed. Hit “Restart” to update the window display.
- **Use 5V encoders only**: Specifies the all encoders have to be powered at 5V during initialization. This option can be useful in 5V applications where other hardware is connected on the same supply as the encoder and causes incorrect 3.3V encoder detection.
- **OTP Programming**: Specifies whether or not a warning should be displayed that reminds the user about OTP one time programming behavior.
- **OTP Programming of 3.3V encoder**: Specifies whether or not a warning should be displayed that reminds the user about the danger of damaging the encoder by 6.5V OTP programming of 3.3V encoders.
- **Overwrite File**: Specifies whether or not a warning should be displayed that reminds the user about overwriting the encoder-configuration file
- **Overwrite RAM LUT**: Specifies whether or not a warning should be displayed that reminds the user about deleting the old RAM-LUT before loading a new LUT.
- **Selection of 3V3 encoder**: Specifies whether or not a warning should be displayed that reminds the user about configuring a 3.3V encoder while a 5V encoder has been detected.
- **Selection of 5V encoder**: Specifies whether or not a warning should be displayed that reminds the user about configuring a 5V encoder while a 3.3V encoder has been detected.
- **Window State**: ASSIST window size at startup

Glossary

Advanced Functions	Window with advanced functions for analysis and troubleshooting of an encoder.
ASSIST	Name of the software that runs on a PC and communicates via USB with the Interface Board
Booster voltage	The Interface Board receives a 5V USB supply-voltage. This voltage us stepped up with a booster to approximately 8.3 V in order to generate the different voltages required on the Interface Board. The Booster Voltage is measured during the startup of the ASSIST software and displayed in the Status Window under Interface Board. The value must be between 7.5 V and 9.0 V.
Codewheel	Disc or ring containing copper strips that is rotated on front of the encoder in order to measure the rotary position
Communication	Check if the communication between the Interface Board and the encoder is working correctly. The values shown between brackets are POSIC-internal traceability data.
DAQ / NORMAL	If Measurement Mode = NORMAL, the encoder is operated in normal mode with A quad B pulses, the measured position is purely incremental. If Measurement Mode = DAQ, the encoder is read out using a serial interface and the measured position represents the absolute position within one period of the scale/codewheel. The position is a 16-bit value ranging from 0 to 65’535.
Dump	The Memory Dump in the Status window under Encoder is a copy of the encoder’s complete OTP memory, stored in a .txt file. This file can be used by POSIC for failure analysis, traceability and other purposes.
ENC	LED on the Interface Board indicating that the encoder receives its supply voltage
Encoder Activation	Encoder Activation in the Status window under Encoder shows the supply current and voltage of the encoder in communication-modus. The current level is around 5 mA (1.5 mA for older encoders).
Encoder Type	The Encoder Type is automatically detected by the ASSIST software and displayed in the Status window under Encoder. The current version of the ASSIST version accepts all encoder types listed on POSIC’s website.
Fit	From the Non-Linearity measurement values an 8^{th} order Sinus-Fit is calculated, which is shown in the Non-Linearity-graph. This Fit is used to calculate the LookUp Table.
ID encoder	Incremental Dual-channel encoders (e.g. ID1102 and ID4501)
In-circuit programming	In-circuit programming of an encoder’s OTP memory while the encoder is connected to a controller or other electronic device

Index	ID encoders have an Index output signal that provides 1 Index-pulse per scale/codewheel period. IT encoders have an Index output signal that provides 1 Index-pulse per full scale-length or per 360° rotation of the codewheel.
Interface Board	Electronic board to which a POSIC encoder and a reference encoder can be connected and that is controlled by the ASSIST Software via USB.
IT encoder	Incremental Triple-channel encoders IT3402 and IT502
LED	Light Emitting Diode. The Interface Board contains red LEDs for the encoder signals, orange LEDs for the power supply and a yellow LED that lights up during OTP programming
LUT	LookUp Table to compensate periodic non-linearities caused by the encoder, by the scale/codewheel or by mounting tolerances A Standard LUT can be selected for any standard scale or codewheel from POSIC A Custom LUT can be imported and exported as a file. Or it can be generated during a linearization procedure (with a high-accuracy reference encoder)
Memory Dump	The Memory Dump in the Status window under Encoder is a copy of the encoder's complete OTP memory, stored in a .txt file. This file can be used by POSIC for failure analysis, traceability and other purposes.
Min. Voltage	The Min Voltage is shown in the Status window under Encoder and corresponds to the minimum operating voltage that ASSIST detected. The minimum operating voltage is 5 V for all POSIC encoders.
NORMAL / DAQ	If Measurement Mode = NORMAL, the encoder is operated in normal mode with A quad B pulses, the measured position is purely incremental. If Measurement Mode = DAQ, the encoder is read out using a serial interface and the measured position represents the absolute position within one period of the scale/codewheel. The position is a 16-bit value ranging from 0 to 65'535.
OTP	One Time Programmable memory. This non-volatile or permanent memory in a POSIC encoder contains the configuration and calibration data and can be programmed only once.
OTP LUT	LUT stored in the encoder's OTP memory
Permanent memory	One Time Programmable (OTP) memory
PROG	Programming: yellow warning LED on the Interface Board that turns on during (irreversible) programming of the encoder's OTP memory
PWR	Power: LED indicating that the Interface Board is powered via the USB-cable

RAM	Random Access Memory: memory in the encoder that can be overwritten. Data is lost at power-down.
RAM LUT	LUT stored in the encoder's RAM memory
RESET	Reset-button on the Interface Board. When activated, the microcontroller on the Interface Board and the USB-communication are reset.
Reset upon Index	Option in the measurement window. When Reset upon Index = On, the measured position will be reset to 0 upon each Index pulse. When Reset upon Index = Off, the measured position will not be reset upon Index pulses; the zero-position corresponds to the position at the start of the measurement. Reset upon Index is only selectable when Measurement Mode = NORMAL. In Measurement Mode = DAQ, the measured position is always reset upon each Index pulse, independent of the value of Reset upon Index.
S/N Serial Number	User-programmable serial number stored in the encoder's OTP memory. The serial number of three 16-bit values (0 – 65'535)
Scale	Linear scale or ruler containing copper strips that is linearly moved in front of the encoder in order to measure the linear position
Serial Number S/N	User-programmable serial number stored in the encoder's OTP memory. The serial number of three 16-bit values (0 – 65'535)
START/STOP	Start/stop button on the Interface Board that allows to start or stop operation of the encoder when it is operated without ASSIST
Supply	Check if the encoder's supply during normal operation are OK. Voltage should be 5 V or 3.3 V. Current depends on encoder settings and should be between 7 – 25 mA.
SYSTEM	LED on the Interface Board indicating that the microcontroller is active
Target	Object that moves in front of an encoder. For rotary applications, the target is a codewheel or a gear. For linear applications, the target is a linear scale.
USB	Universal Serial Bus. Connection between the PC (with ASSIST software) and the Interface Board. The Interface Board receives its power supply from the PC via the USB cable.