HEIDENHAIN

User's Manual

ATS Software

PWM 20 and PWM 21 (IK 215)
Software
539862-27
Version 3.2.xx

English (en)
09/2017

1 General

Update information on the PWM test unit:

The PWM 21 supersedes the PWM 20.
To ensure long-term availability of the PWM 2x series, the PWM 20 hardware had to be revised.
The PWM 21 is the functionally compatible successor of the PWM 20.

The following applies regarding the ATS software:

- **The PWM 20 will still be supported in the future.**
- **The PWM 21 is supported as of ATS V3.2.01.**
- **For convenience, both the PWM 20 and the PWM 21 are referred to as PWM in this User's Manual.**

The PWM 21 can be ordered as of Dec 2017!

1.1 How to use this User's Manual

About this User's Manual

This User's Manual is valid for the the ATS Adjusting and Testing Software version 3.2.xx, ID 539862-27.

The ATS software is executable on the following hardware:

- PWM 20 ID 731626-01
- PWM 21 ID 1200635-01
- PC expansion card IK 215 ID 386249-xx

Update service

This manual is regularly updated.

The current (printable) version is available on the Internet in PDF format:
www.heidenhain.de

Printed copies are only distributed to the participants of our service training courses and are enclosed with new test units.

Notices in this documentation

Safety precautions

Comply with all safety precautions indicated in these instructions and in your machine tool builder's documentation!

Precautionary statements warn of hazards in handling the product and provide information on their prevention. Precautionary statements are classified by hazard severity and divided into the following groups:

⚠ WARNING

Warning indicates hazards for persons. If you do not follow the avoidance instructions, the hazard **could result in death or serious injury.**

⚠ CAUTION

Caution indicates hazards for persons. If you do not follow the avoidance instructions, the hazard **could result in minor or moderate injury**.

NOTICE

Notice indicates danger to material or data. If you do not follow the avoidance instructions, the hazard **could result in things other than personal injury, like property damage**.

Informational notes

Observe the informational notes provided in this manual to ensure reliable and efficient operation of the product.
In this manual, you will find the following informational notes:

The information symbol indicates a **tip**.
A tip provides additional or supplementary information.

The gear symbol indicates that the function described **depends on the machine**, e.g.

- Your machine must feature a certain software or hardware option.
- The behavior of the functions depends on the configurable machine settings.

Cross references

Use the cross references in the documentation for subject-related and comprehensive additional information.

In these instructions, you will find the following cross references:

The book symbol represents a **cross reference** to external documentation, e.g. the documentation of your machine tool builder or other supplier.

Other documentation

For more information please refer to the following documentation:

- HEIDENHAIN User's Manual Cables and connection technology ID 1117945-xx
- Documentation of the machine tool builder
- Interfaces of HEIDENHAIN Encoders, ID 1078628-xx
- Mounting instructions of the encoders
- Encoder brochures (**www.heidenhain.de**)

Target group

The activities described in this manual may only be performed by specialists for service, maintenance and commissioning who have profound knowledge of electronics, electrical engineering and NC machine-tool technology.

Keep these instructions for later reference!

Screenshots and displays

The screenshots and displays in these instructions depend on the encoder type connected, on the product key, and on the design of your operating system. Thus, they may differ from your testing situation. The images only serve as examples!

1.2 Safety precautions

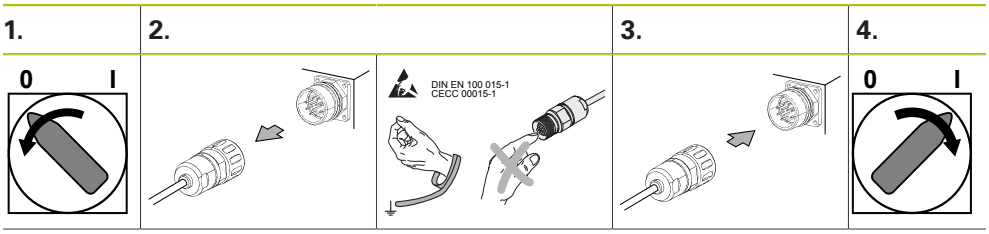
Observe the safety precautions in the operating instructions of PWM 20 and PWM 21 ID 1125089-xx.

NOTICE

- Observe the safety precautions below to avoid injury or damage to persons or products.
- To avert potential dangers, only use the product in the manner described!

Observe the following before you integrate the test units into the position control loop of an NC-controlled machine tool:

1. **Switch off the machine.**
2. Then disengage the connecting elements.
   - Observe the ESD precautions.
   - Do not contaminate connector pins.
3. Reestablish all required connections and secure them mechanically.
   - Make the required settings on the PWM.
4. Switch the machine and the control back on again.



NOTICE

Check whether the machine axis can be traversed in a controlled manner. During the start-up phase of the machine, the emergency stop button must be accessible in time.

⚠ WARNING

Damage to the machine or personal injury

Noncompliance with this warning could result in damage to the machine or in personal injury.

- Do not operate defective units!
- No persons are allowed within the working range of the machine!
- Do not change any parameters or encoder voltages at the test units while the machine tool is moving and a test unit is connected to the position control loop!
- Changed parameters must be reset to their original values.
- Ensure that vertical axes cannot fall down!

  The ATS software offers the possibility of storing and editing machine-specific or equipment-specific information in the customer's memory area. The data may comprise safety-relevant information. When servicing, please take care to adjust this memory area.

Support is provided by HEIDENHAIN Traunreut or by the HEIDENHAIN agencies. See "Contacts", page 226.

1.3 Information on the IK 215 adjusting and testing package

The IK 215 Adjusting and Testing Package serves to diagnose and adjust HEIDENHAIN encoders with absolute interfaces.

The IK 215 adjusting and testing package comprises:

- IK 215 interface card for installation in a PCI expansion slot of a personal computer
- Adjusting and Testing Software (ATS) with integrated local encoder database for automatic encoder identification
- Standard adapter cables for common testing procedures

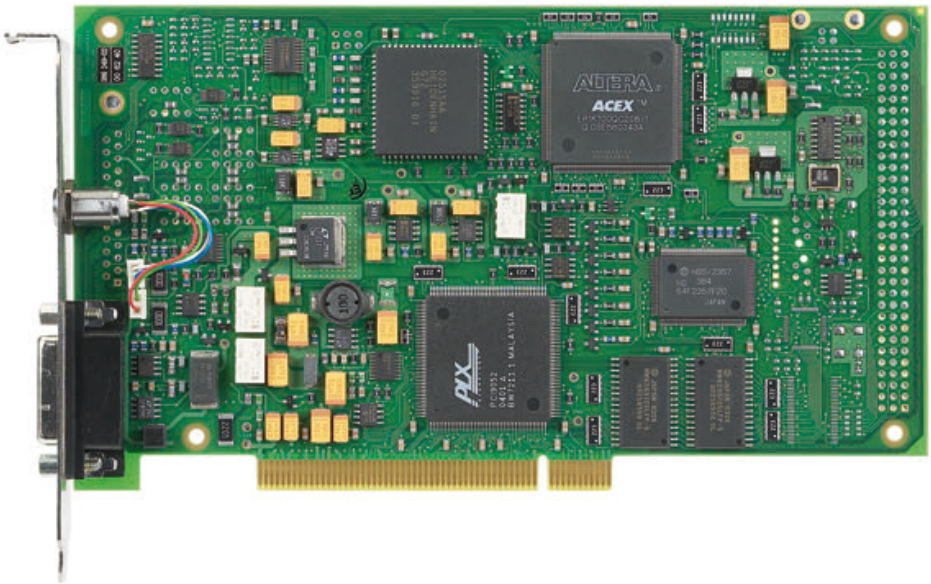
The IK 215 will only be supported up to the software version 3.2.xx.

For optional cables and adapters as well as all pin layouts refer to the User's Manual "Cables and Connection Technology", ID 1117945-xx for PWM 2x and IK 215.

The PWM 20 and PWM 21 with expanded scope of functions replace the IK 215.

As compared to the PWM, the IK 215 does **not support** the following functions:

- Incremental interfaces (1 V_{PP}, 11 μA_{PP}, TTL, etc.)
- DRIVE-CLiQ from SIEMENS
- Measurement in feed-through mode



1.4 IK 215 adjusting and testing package ID 547858-xx

The packages 1 and 2 are included in delivery.

Package 1: ID 527367-01

Package 2: ID 658110-01

Package 1: ID 527367-01 IK 215

Qty.	Designation	ID
1	IK 215 PCI board	386249-02
1	ATS CD-ROM de/en software version 3.2.xx	539862-27
1	IK 215 operating instructions (installation)	549369-xx

Package 2: ID 658110-01 Accessories kit for absolute encoders

Qty.	Designation	ID
1	Benutzerhandbuch ATS-Software PWM 20 and PWM 21 (IK 215) de	543734-xx
1	User's Manual ATS Software PWM 20 and PWM 21 (IK 215) en	543734-xx
1	Benutzerhandbuch Kabel und Anschlusstechnik PWM 20 and PWM 21 (IK 215) Prüfpaket de	1117945-xx
1	User's Manual Cables and Connection Technology PWM 20 and PWM 21 (IK 215) Testing Package en	1117945-xx
1	Adapter cable (with incremental signal) for IK input, 15-pin/17-pin; D-sub/M23; 2 m	324544-02
1	Adapter cable for LC 18x scanning unit, 12-pin/17-pin; 3 m	369124-03
1	Adapter cable for LC 48x scanning unit, 12-pin/17-pin; 3 m	369129-03
1	Adapter cable for IK input, 15-pin/8-pin; D-sub/M12; 2 m	524599-02
1	Adapter cable for LC xx3, LC xx5, LC 20x scanning unit, 14-pin/17-pin; M12/M23; 3 m	533631-03
1	Adapter cable for RCN 82xx Ultra Lock, 12-pin/17-pin; M12/M23	643450-03

1.5 Information on the encoder diagnostic kits PWM 20 ID 759251-01 and PWM 21 ID 1223097-01

The PWM 20 and 21 encoder diagnostic kits serve to diagnose and adjust HEIDENHAIN absolute and incremental encoders with absolute and incremental interfaces.

The diagnostic kits consist of the following components:

- PWM 20 or PWM 21 test unit for direct connection to a laptop or PC via USB interface
- ATS software on CD; Adjusting and Testing Software with integrated local encoder database for automatic encoder identification
- Standard adapter cables for common testing procedures
- Case for testing equipment

Further optional cables and adapters are available; see User's Manual "Cables and Connection Technology", ID 1117945-xx for PWM 20 and PWM 21 (IK 215).

The PWM 20 and PWM 21 test units are available in three different variants (see tables below):

- Basic kit
- Basic kit in aluminum case
- Basic kit in aluminum case, standard adapter cables and User's Manual

1.6 PWM 20 basic kit ID 731626-51

Basic kit: ID 731626-51

Qty.	Designation	ID
1	PWM 20	731626-01
1	ATS CD-ROM de/en software version 3.2.xx	539862-27
1	Operating instructions (installation) PWM 20 and PWM 21	1125089-xx
1	USB connecting cable, 2 m	354770-02
1	Power cable, 3 m	223775-01
1	PWM packaging (cardboard)	730058-01

1.7 PWM 21 basic kit ID 1200635-51

Basic kit: ID 1200635-51

Qty.	Designation	ID
1	PWM 21	1200635-01
1	ATS CD-ROM de/en software version 3.2.xx	539862-27
1	Operating instructions (installation) PWM 20 and PWM 21	1125089-xx
1	USB connecting cable, 2 m	354770-02
1	Power cable, 3 m	223775-01
1	PWM packaging (cardboard)	730058-01

1.8 PWM 20 Encoder Diagnostic Kit , ID 759251-01

The packages 1 and 2 are included in delivery.

Package 1: ID 759249-01

Package 2: ID 658110-01

Package 1: ID 759249-01 PWM 20 Basic kit

Qty.	Designation	ID
1	PWM 20	731626-01
1	ATS CD-ROM de/en software version 3.2.xx	539862-27
1	Operating instructions (installation) PWM 20 and PWM 21	1125089-xx
1	USB connecting cable, 2 m	354770-02
1	Power cable, 3 m	223775-01
1	Case for testing equipment	785241-01

Package 2: ID 658110-xx Accessories kit for absolute encoders

Qty.	Designation	ID
1	Benutzerhandbuch ATS-Software PWM 20 and PWM 21 (IK 215) de	543734-xx
1	User's Manual ATS Software PWM 20 and PWM 21 (IK 215) en	543734-xx
1	Benutzerhandbuch Kabel und Anschlusstechnik PWM 20 and PWM 21 (IK 215) Prüfpaket de	1117945-xx
1	User's Manual Cables and Connection Technology PWM 20 and PWM 21 (IK 215) Testing Package en	1117945-xx
1	Adapter cable (with incremental signal) for IK input, 15-pin/17-pin; D-sub/M23; 2 m	324544-02
1	Adapter cable for LC 18x scanning unit, 12-pin/17-pin; 3 m	369124-03
1	Adapter cable for LC 48x scanning unit, 12-pin/17-pin; 3 m	369129-03
1	Adapter cable for IK input, 15-pin/8-pin; D-sub/M12; 2 m	524599-02
1	Adapter cable for LC xx3, LC xx5, LC 20x scanning unit, 14-pin/17-pin; M12/M23; 3 m	533631-03
1	Adapter cable for RCN 82xx Ultra Lock, 12-pin/17-pin; M12/M23	643450-03

1.9 PWM 21 Encoder Diagnostic Kit , ID 1223093-01

The packages 1 and 2 are included in delivery.

Package 1: ID 1223097-01

Package 2: ID 658110-01

Package 1: ID 1223097-01 PWM 21 Basic kit

Qty.	Designation	ID
1	PWM 21	1200635-01
1	ATS CD-ROM de/en software version 3.2.xx	539862-27
1	Operating instructions (installation) PWM 20 and PWM 21	1125089-xx
1	USB connecting cable, 2 m	354770-02
1	Power cable, 3 m	223775-01
1	Case for testing equipment	785241-01

Package 2: ID 658110-xx Accessories kit for absolute encoders

Qty.	Designation	ID
1	Benutzerhandbuch ATS-Software PWM 20 and PWM 21 (IK 215) de	543734-xx
1	User's Manual ATS Software PWM 20 and PWM 21 (IK 215) en	543734-xx
1	Benutzerhandbuch Kabel und Anschlusstechnik PWM 20 and PWM 21 (IK 215) Prüfpaket de	1117945-xx
1	User's Manual Cables and Connection Technology PWM 20 and PWM 21 (IK 215) Testing Package en	1117945-xx
1	Adapter cable (with incremental signal) for IK input, 15-pin/17-pin; D-sub/M23; 2 m	324544-02
1	Adapter cable for LC 18x scanning unit, 12-pin/17-pin; 3 m	369124-03
1	Adapter cable for LC 48x scanning unit, 12-pin/17-pin; 3 m	369129-03
1	Adapter cable for IK input, 15-pin/8-pin; D-sub/M12; 2 m	524599-02
1	Adapter cable for LC xx3, LC xx5, LC 20x scanning unit, 14-pin/17-pin; M12/M23; 3 m	533631-03
1	Adapter cable for RCN 82xx Ultra Lock, 12-pin/17-pin; M12/M23	643450-03

2 Information on cables, adapters and the ATS features

2.1 Optional cables and adapters

For optional cables and adapters as well as all pin layouts refer to the User's Manual "Cables and Connection Technology", ID 1117945-xx for PWM 20 and PWM 21 (IK 215).

This manual is available for download from the HEIDENHAIN website;

see **http://www.heidenhain.de/de_EN/software/**

2.2 Features of the ATS software 3.2

PWM and ATS V3.2 – available functions	EnDat	Fanuc	Mitsubishi	SSI	DRIVE-CLiQ	Yaskawa	Panasonic	1 V_{PP} [2] 11 μA_{PP} [2]	TTL	HTL [3]
Position display										
Display of the absolute position	✔	✔	✔	✔	✔	✔	✔	–	–	–
Display of incremental position (if available)	✔	✔	✔	✔	–	–	–	✔	✔	✔
Display and resetting of error messages	✔	✔	✔	–	✔	✔	✔	–	–	–
Display and resetting of warnings	✔	✔	✔	✔	✔	✔	✔	–	–	–
Display of transmission status	✔	✔	✔	(✔)	✔	✔	✔	–	–	–
PWT display of incremental signals	–	–	–	–	–	–	–	✔	(✔)	–
Connection dialog, encoder connection via:										
• Encoder ID number	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
• Entry of interface and supply voltage	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
• HEIDENHAIN motor ID number	✔	–	–	–	–	–	–	✔	–	–
Diagnostics										
Display of online diagnostics	✔	✔	✔	–	✔	✔	✔	–	–	–
Display of online diagnostics in the control loop [1]	✔	✔	✔	–	–	–	✔	–	–	–
Feed-through mode permitted with PWM 20	✔	✔	✔	–	–	–	✔	✔	✔	–
Circular representation of the incremental signals (if available)	✔	–	–	✔	–	–	–	✔	✔	–
Evaluation of reference signal	–	–	–	–	–	–	–	✔	✔	✔
Incremental counter	–	–	–	–	–	–	–	✔	✔	✔
Level measurement and logic analysis	–	–	–	–	–	–	–	–	✔	✔
Display of supply voltage and supply current	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Homing and limit display	–	–	–	–	–	–	–	✔	✔	–
Signal recording	–	–	–	–	–	–	–	✔	–	–
Mounting wizards/testing wizards										
For ECI 11xx/13xx/1xx, EQI 11xx/13xx, EBI 11xx/1xx For ERO 2xxx, ECA 4xxx For LIP 2xx, LIC 4xxx, LIC 2xxx Preparation for new encoder generations	For the available interfaces, please refer to the encoder specifications.									
Testing and measuring wizard for encoders with functional safety	✔	–	–	–	✔	–	–	–	–	–
Assistant for tensioning the scale tape	✔	✔	✔	–	–	–	–	✔	–	–
Additional functions (if supported by the encoder)										
Comparison of absolute position with incremental position	✔	–	–	✔	–	–	–	–	–	–
Datum shift ("electric zeroing of the position") including info display [4]	✔	(✔)	(✔)	(✔)	(✔)	(✔)	(✔)	–	–	–
Display of additional information: Temperature	✔ [5]	–	–	–	✔	–	–	–	–	–
Display of additional information: Position value 2	✔	–	–	–	✔	–	–	–	–	–
Display of additional information: Additional sensors	✔	–	–	–	–	–	–	–	–	–
Display of additional information: Limit position signals	✔	–	–	–	–	–	–	–	–	–
Display of additional information: Operating status error sources	✔	–	–	–	–	–	–	–	–	–
Memory contents										
Display of memory contents	✔	–	–	–	✔	–	–	–	–	–
Modification to memory contents	✔	–	–	–	–	–	–	–	–	–
Saving the memory allocation	✔	–	–	–	✔	–	–	–	–	–
Comparison of current memory contents with saved memory contents	✔	–	–	–	–	–	–	–	–	–
Save encoder memory	✔	✔	✔	–	✔	✔	✔	–	–	–

[1] In feed-through mode, preferred in connection with a signal adapter, e.g. SA 100 or SA 110
[2] 25 μA_{PP}/3 V_{PP} for service purposes
[3] Via signal adapter, for service purposes
[4] License key is required and is available only for certain encoders (including EnDat)
[5] Including conversion for PT 1000 sensors with properly set EnDat memory parameters
(✔) See ATS software operating instructions

3 Initial configuration

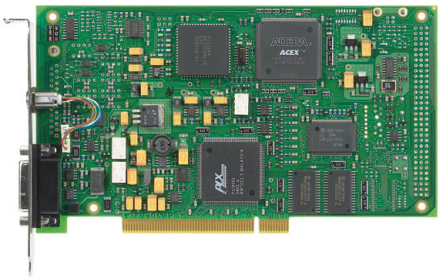
3.1 System requirements

- IBM PC or 100 % compatible PC
- PC with ≥ dual-core Pentium processor with ≥ 2 GHz clock frequency
- RAM ≥ 2 GB
- Hard disk ≥ 2 GB (500 MB of free memory)
- Windows Vista (32-bit), Windows 7 (32/64-bit), Windows 8 and Windows 10 (32/64-bit)
- Resolution at least 1024 x 768 pixels
- USB 2.0 high speed

If these requirements are not met, data processing may be slowed down to an extent that the ATS software issues error messages reporting that certain functions cannot be run. A computer with USB interface 2.0 and ATS software is required to run the PWM. For the system requirements for the PWM or the IK 215 refer to the respective Operating Instructions (Installation). Administrator rights are required for installation and setup.

3.2 Description of the hardware

The phase-angle measuring unit PWM or the PCI interface card IK 215 are required to run the ATS software.



The PWM replaces the IK 215 entirely. PWM and ATS software 2.4 feature all functions of the IK 215. Improvements of the ATS software functions are focused on the PWM. Certain functions—such as inspection of incremental and DRIVE-CLiQ interfaces, feed-through mode and various mounting wizards—are only supported by the PWM.

For more information on specifications, supported interfaces, hardware installation, etc., please refer to the respective operating instructions for installation.

NOTICE

- After using the device, attach the protective caps to protect the electronics and the connector contacts from electrostatic charge and from contamination!

3.3 Installing the ATS software

A CD-ROM with the required software is among the items supplied. The current ATS software is also available for downloading from **www.heidenhain.de**. The software is updated regularly.

To install the ATS software, insert the supplied CD into your CD-ROM drive or run the "setup.exe" file downloaded from the Internet. Follow the instructions of the installation wizard. If the setup wizard does not start automatically, please start “setup.exe” by hand. Before you start the installation, please read the Release Notes. After successful completion of the installation, the icon of the ATS software appears on the desktop.

Installation sequence:

- When you work with a PWM, install the ATS software first.
- Use a USB cable to connect the PWM to a laptop or PC.
- Switch on the PWM (note the driver installation instructions).
- Start the ATS software.

When you work with the IK 215, the PCI card must be installed.

- Switch on the PC (note the driver installation instructions).
- Start the ATS software.

If you download the software from **www.heidenhain.de**, the device drivers are not installed automatically. In this case, the test unit does not work and the ATS software issues an error message. Follow the instructions of the Windows operating system to install the drivers by hand. You will find the required drivers in the folder 539862xx/FILES/Drivers of the ATS software package.

3.4 Uninstalling the ATS software

The software can be uninstalled in different ways:

- Start the ATS Uninstall Routine via the corresponding Windows button.

or

- Uninstall the program via the “Control Panel“ –> “Software“ operating system function.

or

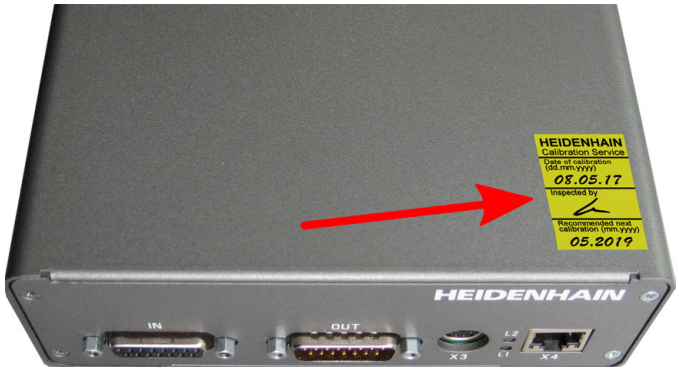
- Restart the file “setup.exe“ of the ATS software and follow the installation wizard.
- Select the Remove option.

3.5 Calibration

In general the PWM is maintenance-free, since it does not contain any components that are subject to wear.

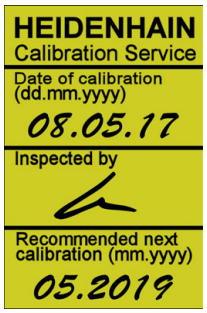
To ensure exact and correct operation we recommend that you send the PWM to the calibration service of HEIDENHAIN Traunreut every two years.

Calibration label on PWM



Calibration date

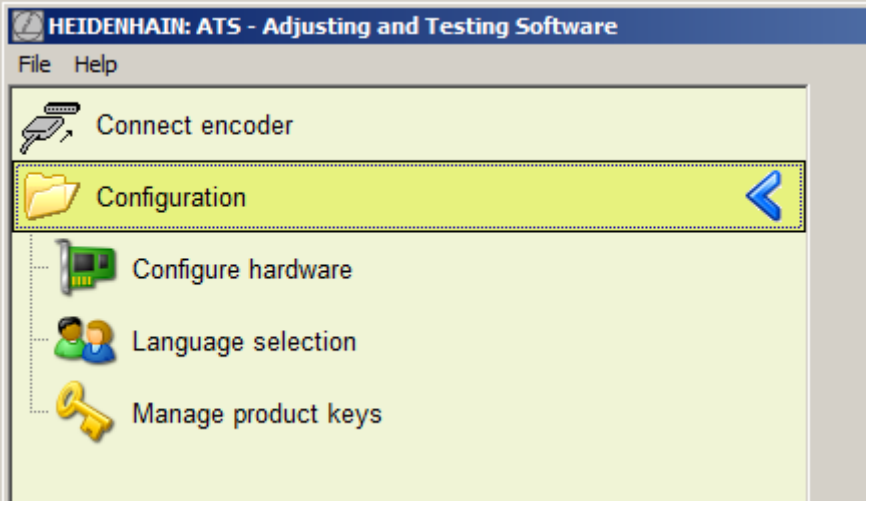
Recommended next calibration date



3.6 Configuration

- Start the ATS software.

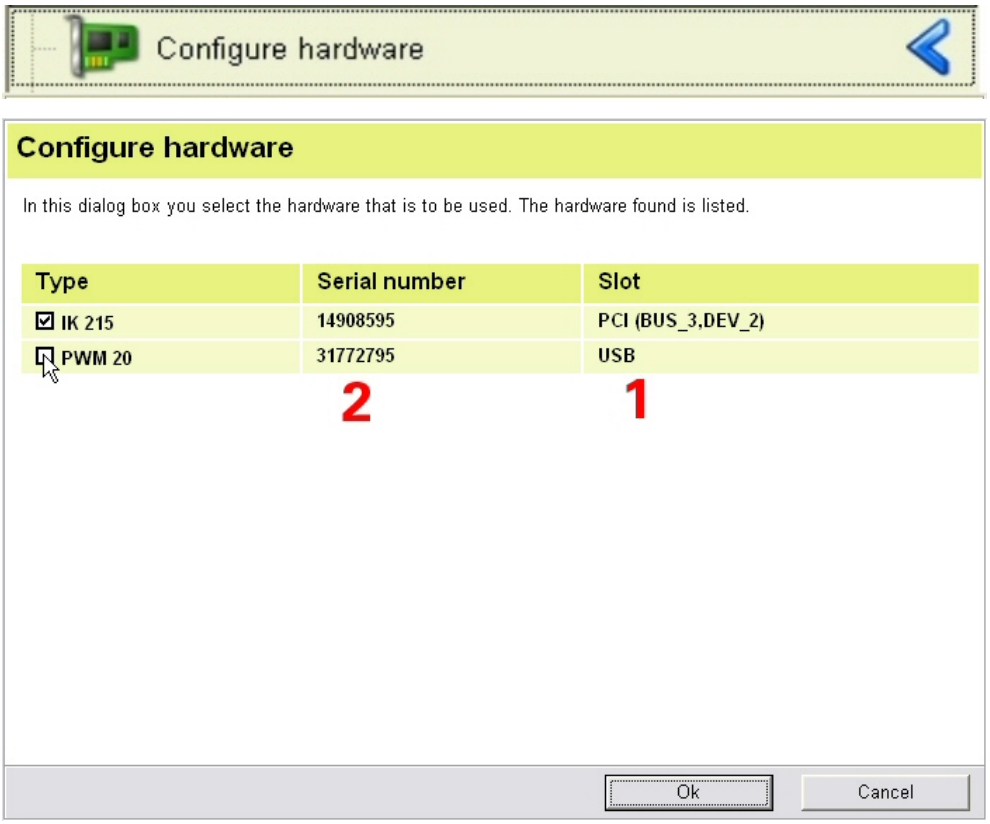
- Select the “Configuration” group.



In the “Configuration” group you can make the following settings:

- Configure hardware
- Language selection
- Manage product keys

3.6.1 Configure hardware



1 PCI bus number and PCI device number of the installed testing device

2 Serial number of the testing device

This function scans the computer and lists the hardware that was found.

- Select the desired testing device from the list.
- Click "OK".

The serial number is required to generate a product key.

3.6.2 Language selection

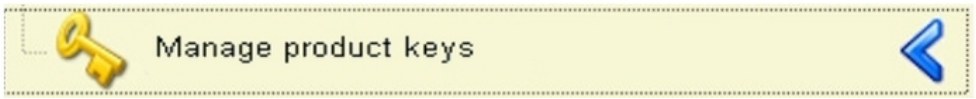
1 Select German or English.

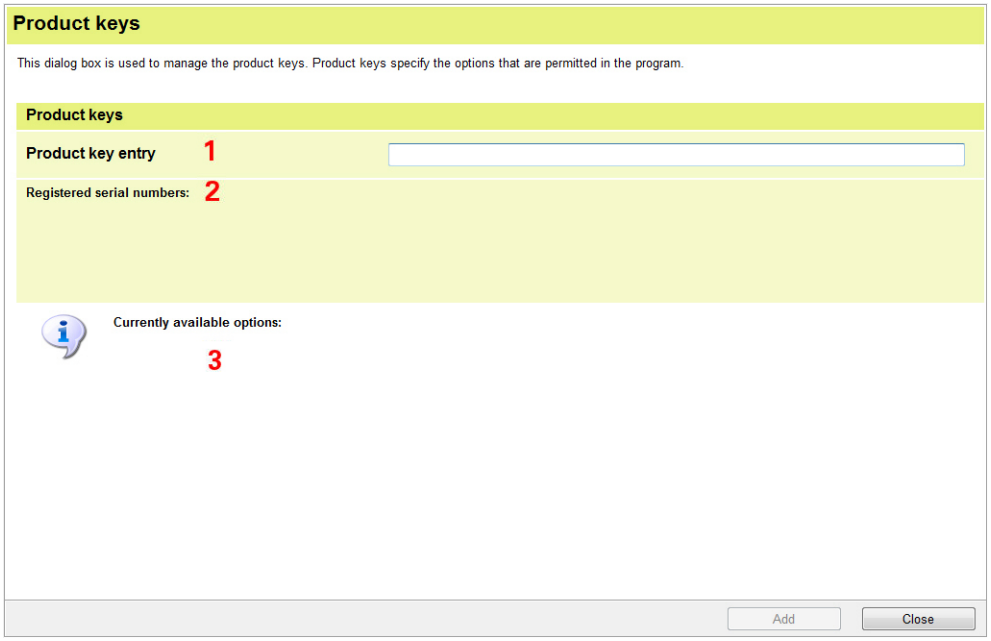
- ▶ Set the desired language.
- ▶ Click “OK”.

3.6.3 Managing product keys

In addition to the function groups and functions of the ATS software (see "Incremental interfaces", page 30) HEIDENHAIN reserves the right to activate further special functions (e.g. for the HEIDENHAIN service) by means of the product keys.

The product key generated by HEIDENHAIN is linked to the serial number of the PWM hardware. The special functions cannot be transferred to other hardware by entering the product key!



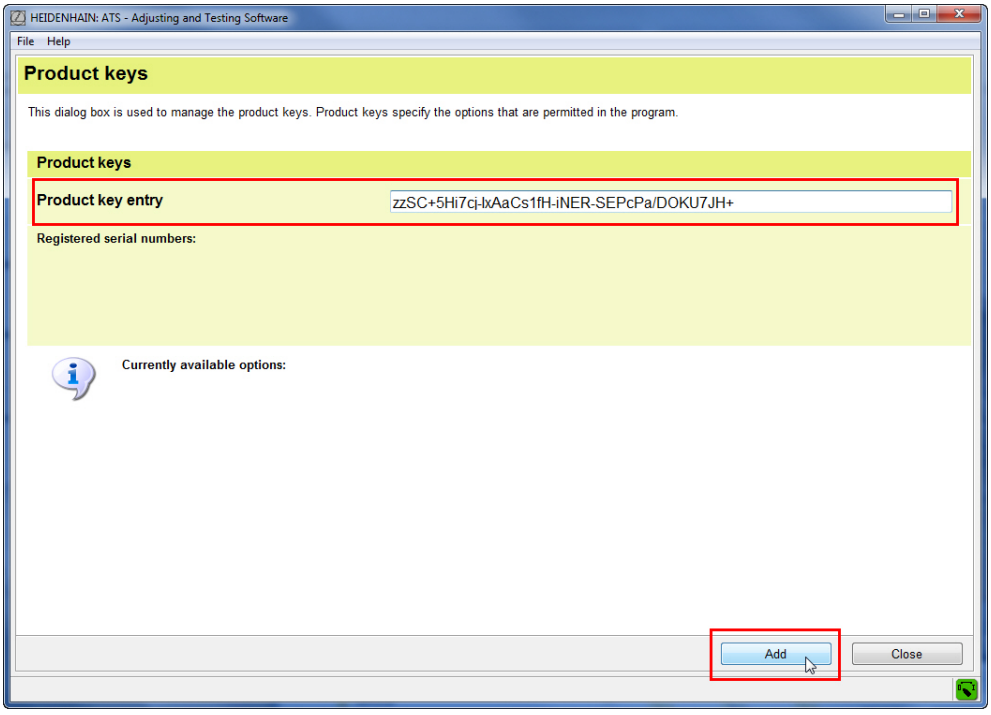


1 Input box for product key
2 Serial number of the hardware
3 Display field for new optional function groups

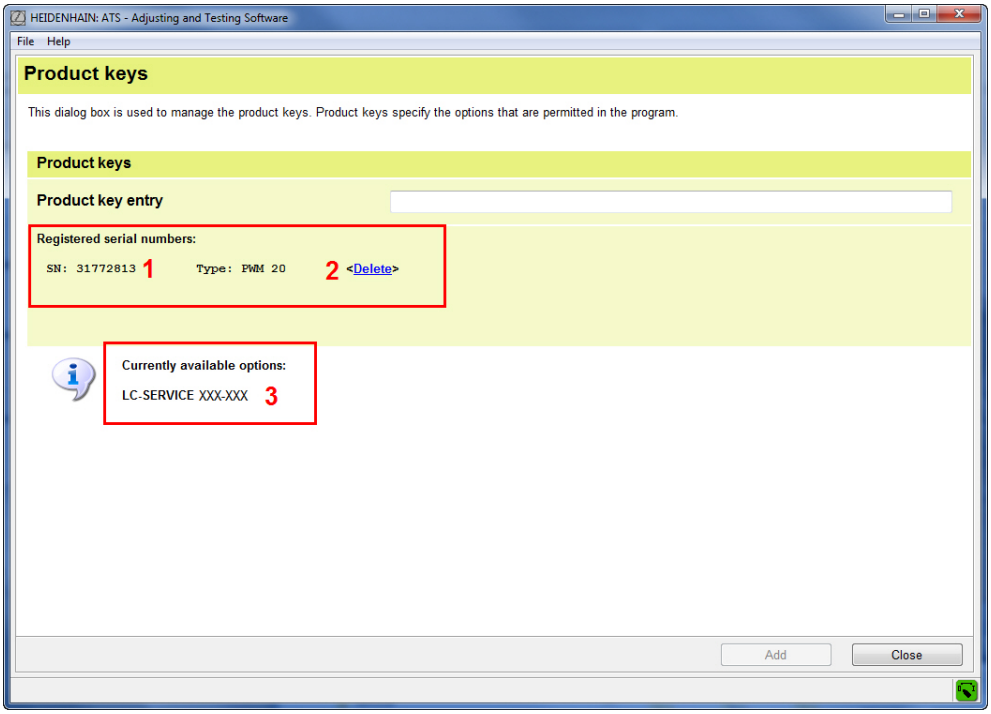
Example: Entering a product key

An optional function is enabled by HEIDENHAIN Traunreut. The product key is generated and sent by e-mail.

- ▶ Press the “Add” button.
- > The product key is activated.



The “Add” button becomes active when a correct code was entered. Input errors are reported as error messages.



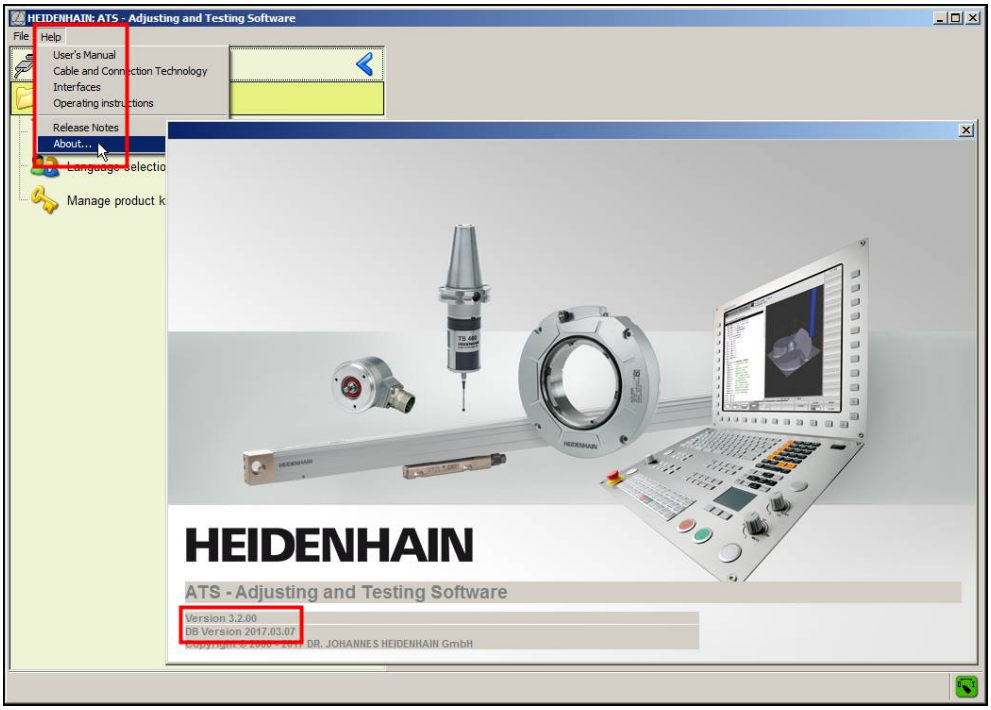
1 Serial number (SN) of the installed PWM
2 <Delete> removes the product key.
3 Active product-key options

- Press the “Close” button.
- The product-key entry is terminated.

The product-key functions only appear in the ATS main menu after the connection to the encoder has been established.

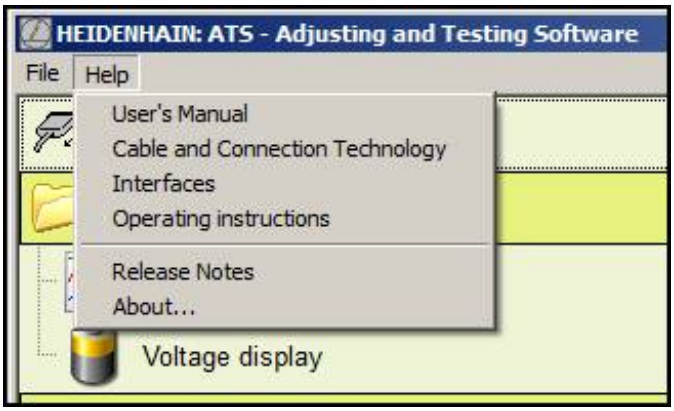
3.6.4 Display of software and database versions

To display the installed versions of the ATS software and the database proceed as follows:



3.6.5 Display of documents (help files) in the ATS software

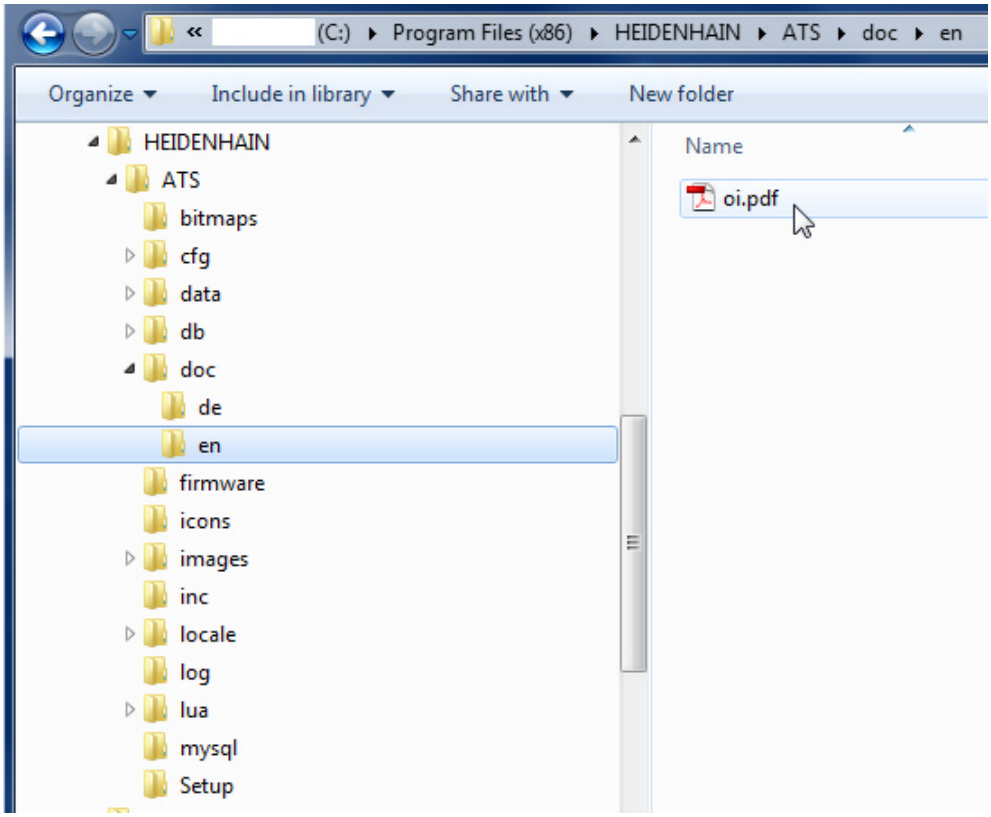
The documentation of the ATS software is available in the “Help” menu in PDF format.



3.6.6 Updating ATS help files (PDF file)

The help files are updated with every software update (annually) and are part of the software package. If corrections were required in-between, the updated file is available in pdf format on our website **www.heidenhain.de** from where you can download it.

If you want to update one of the four help files of the ATS software, you have to rename the "new" PDF file to the name of the previous file. (Example: If the name of the old document is 'um.pdf', the new document must be renamed to 'um.pdf'.)
In the program directory of the ATS software (for example: hard disk directory C:/Programme(x86)/HEIDENHAIN/ATS/doc/de or en), replace the existing pdf file with the renamed file, thus overwriting the old file.



4 Identifying the encoder output signals

4.1 Incremental interfaces

Identification from the encoder designation

> The identification of the interface type is valid for standard HEIDENHAIN encoders.
>
> Deviations from the designation structure are possible (in particular with customer-specific encoders).

Example

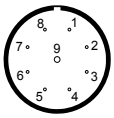
Linear encoder	LS	4	8	6
Rotary encoder	ROD	4	2	6
Modular rotary encoder	ERN	13	8	7
Scanning head	LIDA	4	7	
Exposed linear encoder	LIDA	4	7	5

Nomenclature

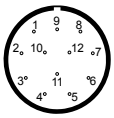
- **0 = 11µAss / 11 µApp**
- **2 = TTL** without interpolation
- **3 = HTL** (rotary encoders only, e.g. ROD 436)
- **5 = 11µAss** (e.g. ROD 450, LIDA 150 old) **11µApp**
- **6 = TTL** (supply voltage 10 – 30 V!, TTL signal, rotary encoders only)
- **7 = TTL** with interpolation (x5, x10, x50, x100)
- **8 = 1 Vss / 1 Vpp**

- A 9-pin M23 connector always means an 11 μA_{PP} interface. (Exception: Current motor connector)

- Encoders connected to the encoder inputs of EXE interpolation electronics are always 11 μA_{PP} encoders (9-pin connector).



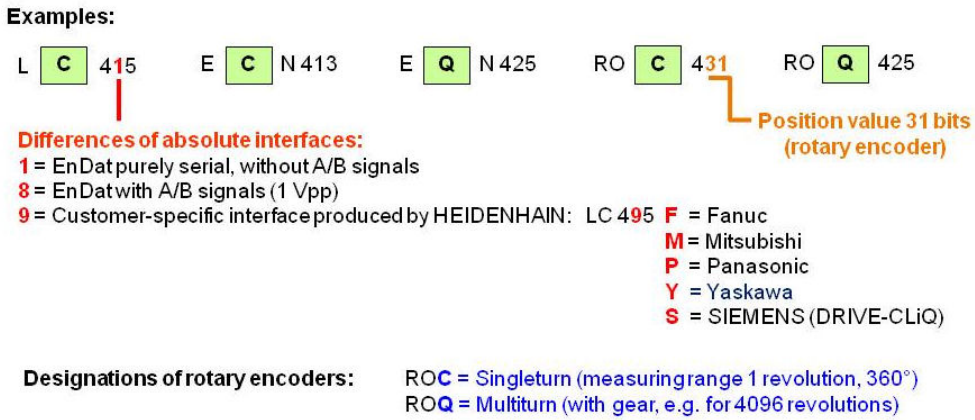
- Encoders connected to the encoder inputs of IBV interpolation electronics are always 1 V_{PP} encoders (12-pin connector).



> For encoders with D-sub connectors no conclusions can be made about the interfaces.

4.2 Absolute interfaces

- Encoders with a **C** or **Q** in their names operate with an absolute interface (EnDat, SSI or customer-specific).



There are EnDat encoders with and without incremental A/B sinusoidal signals. The order designation indicates whether an encoder outputs incremental signals:

- EnDat 21 without incremental signals
- EnDat 22 without incremental signals
- EnDat 01 with 1 V_{PP} incremental signals A/B
- EnDat 02 with 1 V_{PP} incremental signals A/B
- EnDat Hx with HTL incremental signals (new as of 2014)
- EnDat Tx with TTL incremental signals (new as of 2014)

  x stands for:
  - a = 2-fold interpolation
  - b = without interpolation
  - c = scanning signals x2

For detailed information on the interfaces refer to the brochure "Interfaces of HEIDENHAIN Encoders", ID 1078628-xx.

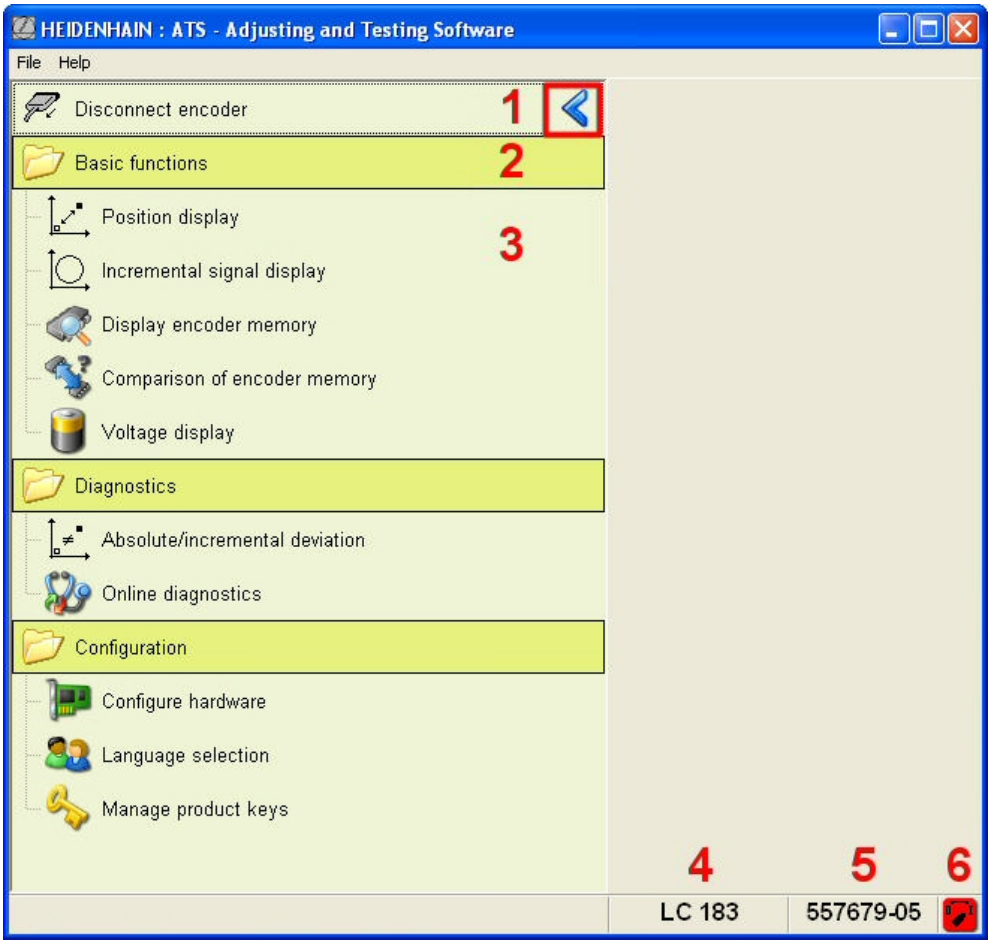
5 Software description

5.1 Operational design

The ATS software runs by a dynamic context menu. The function menu contains the function groups that are available for the connected encoder. Depending on the encoder the supported function groups and functions are displayed.

Example:

LC 183 encoder connected and activated. Function group “Diagnostics“ with two active functions (“Absolute-incremental deviation“ and “Online diagnostics“).



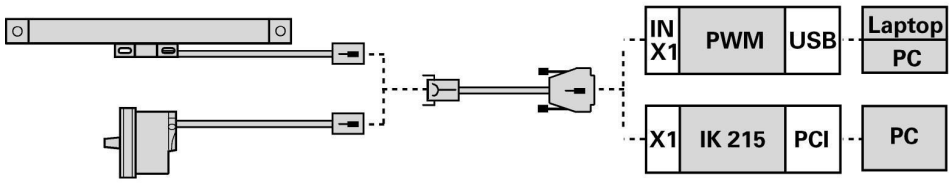
Explanation of the display

1 Selected function pointer (**<**)
2 Function group
3 Function
4 Connected encoder
5 ID number
6 Power supply symbol:

	Encoder power supply OFF (green)
	Encoder power supply ON (red)

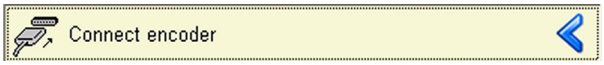
5.2 Setting up a connection to the encoder

- Connect the encoder to the test unit with an adapter cable.

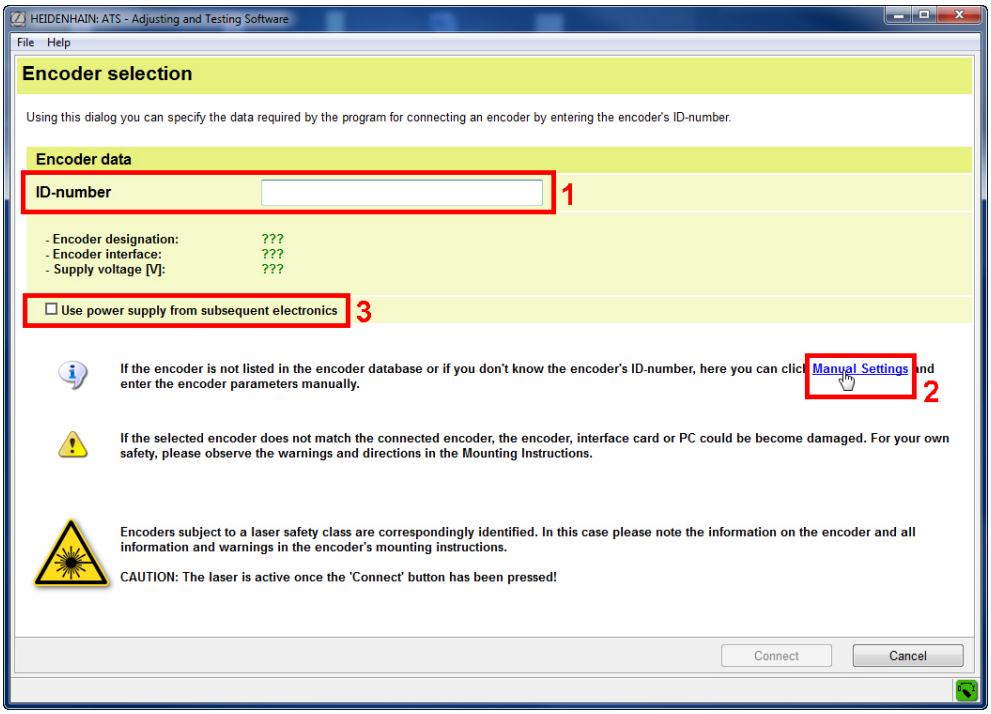


Adapter cables, see “User's Manual Cables and Connection Technology“. This manual is available on the HEIDENHAIN website at: **www.heidenhain.de**

- In the ATS main menu, double-click “Connect encoder”.



The “Encoder selection“ window offers two possibilities of powering the encoder and setting the encoder interface:



1 Automatic encoder identification by entering the ID of the encoder (mandatory for absolute encoders)

2 Manual settings is only used, if the encoder ID is unknown (ID label cannot be read or is missing; encoder is not in the database).

3 Select “Use power supply from subsequent electronics”, if the PWM is in feed-through mode (see page 34) and supposed to be powered from the subsequent electronics.

Exception: Do not set the checkmark in feed-through mode with SA 100/SA 110! **Due to the potential segregation of the SA 100/110 the subsequent electronics cannot power the encoder.**

☑ **Use power supply from subsequent electronics**

Power supply from subsequent electronics selected (PWM in feed-through mode)

> "Use power supply from subsequent electronics" is only required for the PWM feed-through mode. Therefore, only set the checkmark, if the PWM is connected to the control loop between the control and the encoder without SA 100/SA 110 (closed loop; X2 OUT is connected to the subsequent electronics).

> HEIDENHAIN recommends automatic connection by entering the ID number. Automatic connection through entering the encoder ID is mandatory for feed-through mode at machine axes with absolute encoders! The relevant encoder data is read from a database. This database is part of the ATS software. The encoder database contains all ID numbers and variants of the encoders that existed when the ATS software was released. The database is updated about every twelve months. You will find the most recent data at **www.heidenhain.de**

NOTICE

Damage to the electronics

If the manual setting of the encoder parameter does not match the connected encoder, the encoder, the IK 215, the PWM, or the computer may be damaged.

- Make sure that the manual setting of the encoder parameters matches the connected encoder.

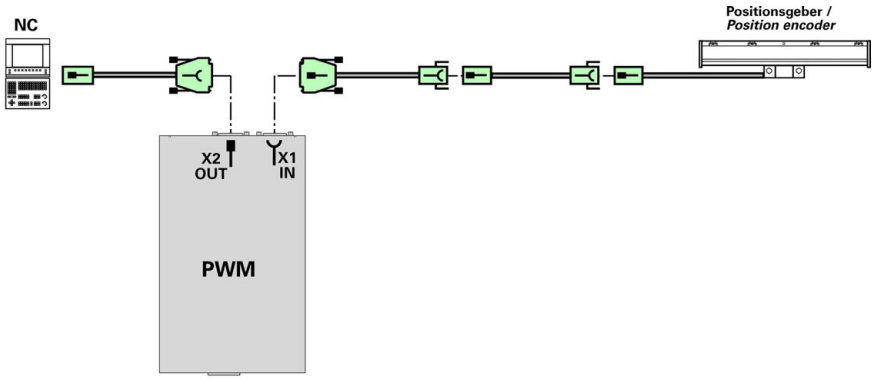
> For the encoder data refer to the documentation of your encoder or your machine tool. Contact the machine manufacturer or the HEIDENHAIN Service.

Encoder connection

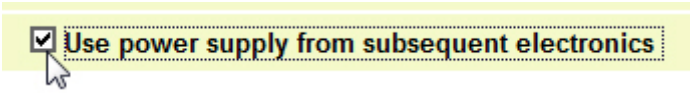
Please ensure that the correct supply voltage is selected to avoid damage to the encoder. The cable between the encoder and the PWM must not be connected or disconnected while under power. Otherwise the encoder and the PWM might be damaged. Check whether the cable between the encoder and the PWM is correctly wired. The pin layout of the encoder is included in the specifications. The pin layouts of the connecting cables are described in the catalog. An incorrectly wired connecting cable might damage the encoder and the PWM.

5.2.1 Feed-through mode

Feed-through mode means connecting the PWM into the control loop of an NC-controlled machine. For diagnosing, the PWM can be integrated into the control loop of an NC-controlled machine tool via adapter cables at the encoder input X1 and the encoder output X2.



For the feed-through mode the power supply must be switched to the subsequent electronics in the ATS software.



Set the check mark in feed-through mode only. If no subsequent electronics is connected, the encoder is not powered (error message).
The feed-through mode is supported as of the software version 2.6. We recommend always using the current software version (**www.heidenhain.de**).

The feed-through mode cannot be used for all interfaces supported by the ATS. In principle, the following interfaces allow for feed-through mode: EnDat, Fanuc, Mitsubishi, Panasonic, Yaskawa, 1 Vpp, TTL, 11 µApp

EnDat/Fanuc/Mitsubishi/Panasonic/Yaskawa

- Metallic isolation is possible with the service adapters SA 100 and SA 110.
- No metallic isolation, if the measurement is conducted with the PWM only.
- For encoders that also support incremental signals, the incremental signals can now also be displayed and evaluated.

EnDat 2.1

Normally, the only communication over the EnDat interface takes place during the start-up stage of the NC (interrogation and transfer of the absolute position data):

- "Listening in" on the EnDat communication is not possible (since the synchronization time is too short for the PWM).
- The 1 V_{PP} signals A and B can be displayed.

SIEMENS NC controls currently use EnDat 2.1 with A/B signals and do not support the listening-in function!

To date, MITSUBISHI controls do not support the listening-in function! MITSUBISHI controls do not request the required diagnostic data. The interface, the NC control and the encoder must support the listening-in function (diagnostics or the valuation numbers)!

EnDat 2.2

Communication takes place continuously. However, there is no prescribed communication pattern. Instead, every OEM determines the sequence of EnDat communication on his own.

- Universal "listening in" on the communication is not possible.
- **The listening-in function is only possible, if the valuation numbers for online diagnosis are included in data transfer.** The following controls support the listening-in function: TNC 620, TNC 640, iTNC 530 [as of NC-SW 34049x-04], iTNC 530 HSCI with diagnostic function and DRIVE-DIAG
- Synchronization with communication may take some time.

1 V_{PP}

- No metallic isolation, if the measurement is conducted with the PWM only.
- Metallic isolation is possible with the SA 100.
- The PWM picks off the signals without 120 Ω signal termination.
- The limit frequency is influenced by the test setup (adapter cable, etc.)

11 μA_{PP}

- The line is interrupted in feed-through mode, i.e. the PWM has an 11 µApp receiver and reproduces the (emulated) input signals at the 11 µApp output.
- The limit frequency is influenced by the test setup (adapter cable, etc.)
- With an 11 µApp interface, signal interferences can occur, depending on the test setup (cable lengths, extension cables, cable configuration, machine type such as EDM).

TTL

- Without PWT switchover: The PWM picks off the RS-485 signals, i.e. a standard RS-485 receiver without 120-ohm termination is connected to the lines.

Automatic connection through entering the encoder ID is mandatory for feed-through mode at machine axes with absolute encoders! With incremental interfaces, manual connection is possible in feed-through mode by selecting the interface. If the feed-through mode is not used, absolute and incremental encoders can be connected manually. However, automatic connection via the ID number is recommended!

⚠ WARNING

Death or serious personal injury

Uncontrolled axis movements cannot be ruled out, when test devices and cables are connected!

Testing cables for feed-through mode are not suitable for regular machine operation. Due to the great variety of machine designs and their grounding variants it is not possible to exhaustively test all testing cables. It is absolutely necessary that you check the safe and proper function of the testing cables for every test situation!

Example of machine axes with absolute encoders: Determine the encoder ID before you work with the PWM in feed-through mode (no axis movement required).

The encoder ID is compulsory for feed-through operation of absolute machine axes. However, it is not known on site, and the encoders are not visible under their covers. The ATS software can read out and display the encoder ID.

Procedure:

1 The encoder output (OUT) of the PWM must not be connected.

2 Connect the absolute encoder to the PWM input (IN) using an appropriate adapter cable, manually connect the ATS software and "memorize" the displayed encoder ID (at the lower right of the display.

3 Disconnect the ATS from the encoder.

4 Connect the PWM output (OUT) to the control (that is switched off) and the appropriate test cable for feed-through operation.

5 Connect the ATS software automatically with the ID that was displayed before.

If the PWM output (OUT) is used for manual connection, the transfer function of absolute encoders is blocked.

Reason: The terminating resistors of the PWM encoder output (OUT) block the measuring function of the ATS.

⚠ WARNING

Death or serious personal injury

Uncontrolled machine movements occurring while persons are within the traverse range of the machine could result in death or serious injury.

Integrating the PWM into the control loop influences the power supply and the grounding conditions. The feed-through function must be handled with great care and caution! No persons are allowed within the traverse range of the machine! Ensure that vertical axes cannot fall down! Do not disengage any connecting elements during the measurement!

Move the machine axis to the middle of the traverse range before you connect the PWM! When you have integrated the PWM into the control loop of the machine, check whether the axis concerned can be traversed in a controlled manner. One operator must be at the EMERGENCY STOP switch to make sure that the machine can be switched off at any stage of this "setup phase"!

Possible axis behavior caused by grounding problems:

- Uncontrolled machine movements
- Machine switches off (emergency stop)
- Machine axis drifts
- Machine axis accelerates at rapid traverse

Observe the safety precautions in the PWM 20 Operating Instructions (ID 1125089-xx)!

HEIDENHAIN recommends running the feed-through mode with floating supply with the service adapters SA 100 or SA 110.

Power-on sequence for feed-through mode

Absolute interfaces (EnDat, Fanuc, ...)

1 Switch on the PWM.
2 Start the ATS software.
3 Tick the field “Use power supply from subsequent electronics” (= feed-through mode).
4 Connect the absolute encoder by entering its ID (the ID is compulsory).
5 Switch on the subsequent electronics.

Incremental interfaces (1 V_{PP}, 11 μA_{PP}, ...)

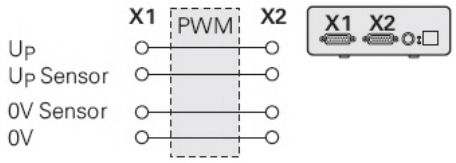
1 Switch on the PWM.
2 Start the ATS software.
3 Tick the field “Use power supply from subsequent electronics” (= feed-through mode).
4 Connect the incremental encoder by entering its ID, or manually by selecting the interface.
5 Switch on the subsequent electronics.

Encoder output

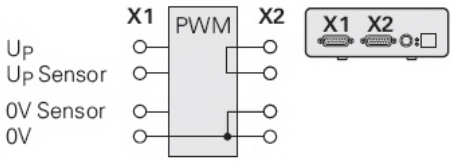
The encoder input X1 of the PWM is electrically connected with the encoder output X2. The signals and the pin layout at the output correspond to the respective signals at the input.

NOTICE

The signals are not electrically isolated. The supply and sensor lines are switched via the ATS software (as of ATS V2.6) depending on the respective mode of operation, and can be connected (see examples). It is always ensured that the supply voltage generated by the PWM is not present at X2.

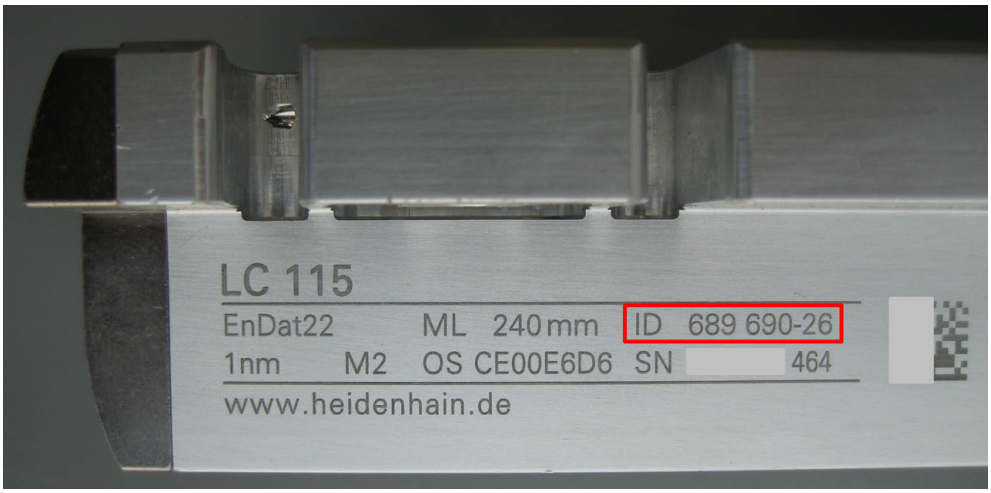


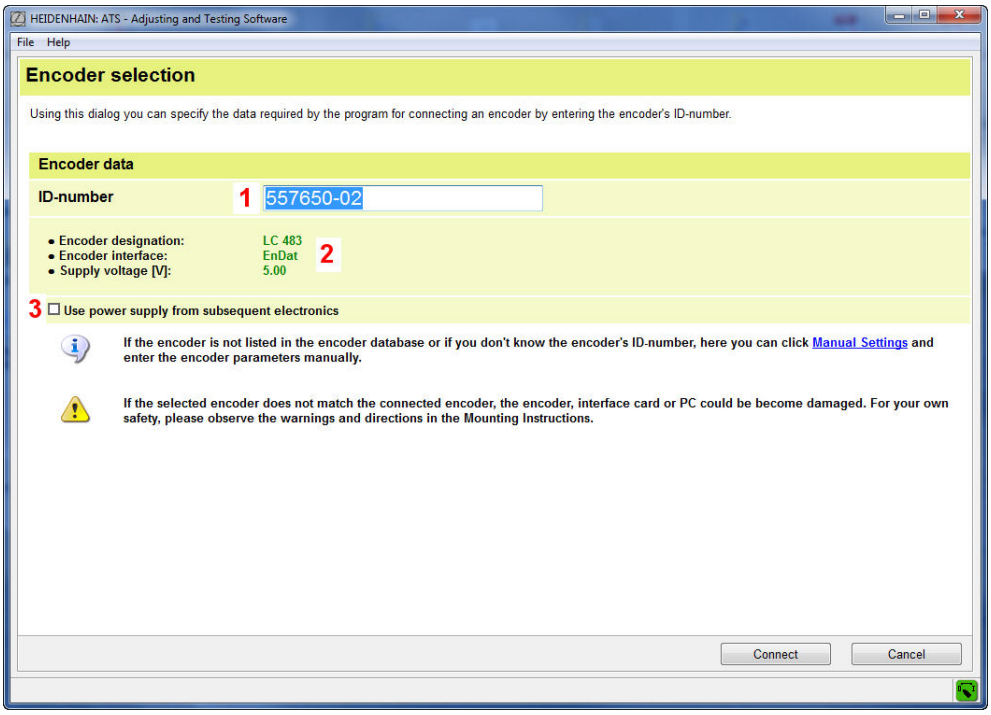
Example 1:
PWM in feed-through mode (the encoder is powered by the subsequent electronics) or ATS software not started



Example 2:
PWM powers the encoder via X1

5.2.2 Automatic encoder identification by entering the ID





1 Input field for ID

2 The encoder was identified.

3 Input field for “feed-through mode” (measuring in the control loop of the machine axis)

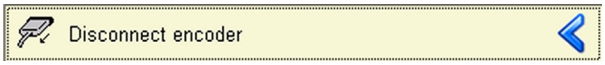
Use the ID of the scale housing of sealed linear encoders (e.g. LC) and the ID of the scanning head of exposed linear and angle encoders (e.g. LIC). You can enter the ID with or without hyphen (e.g. 36856306).
If the encoder cannot be identified, the software enters three question marks “???” (see "Manual encoder selection", page 42).

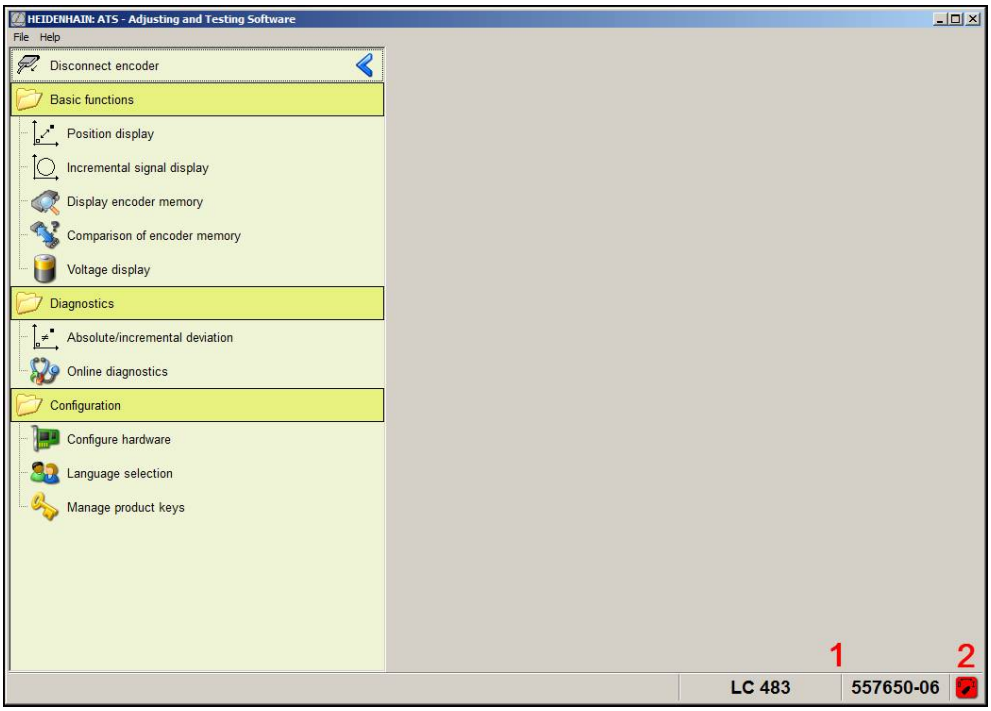
Switching on the power supply for the encoder

- ▶ Press the “Connect” button.
- > The power supply for the connected encoder is switched on.

Switching off the encoder power supply

- ▶ Double-click “Disconnect encoder”.
- > The supply voltage is switched off.
- ▶ Disconnect the encoder.





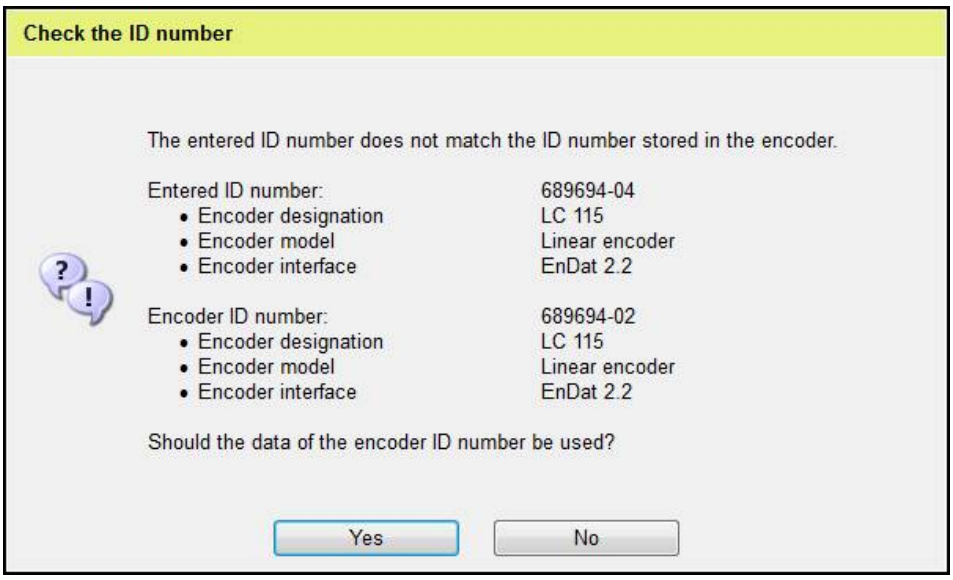
1 Encoder type and ID
2 Power supply symbol:

	Display for encoder power supply OFF (green)
	Display for encoder power supply ON (red)

NOTICE

- ▶ Never disconnect any connectors while the encoder is under power.

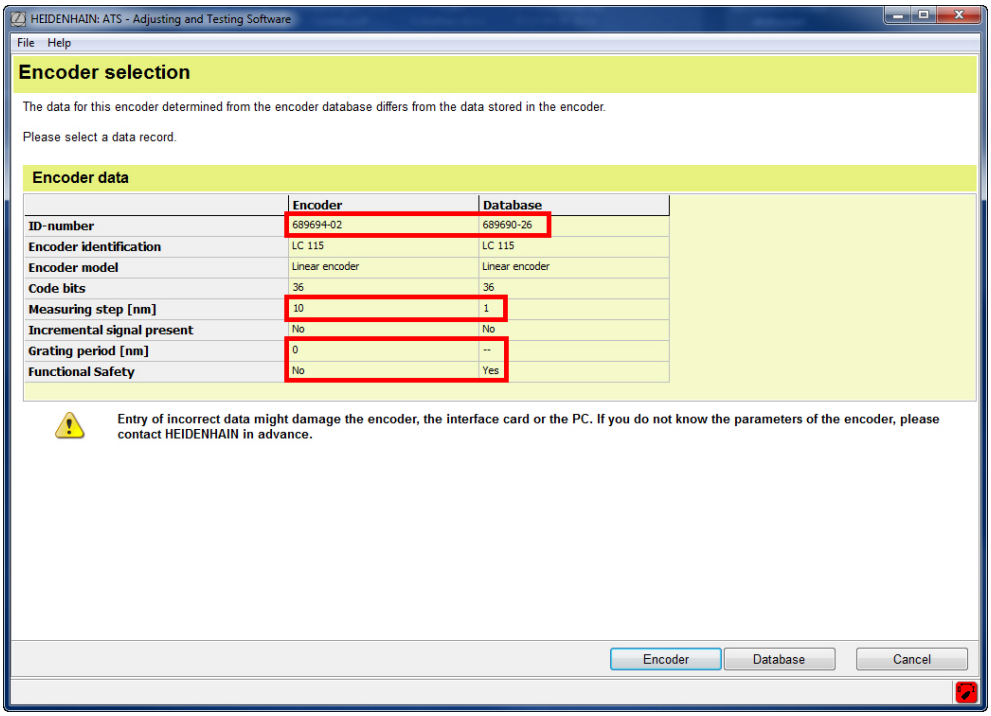
- ▶ Press “Yes”.
- > The encoder ID is used (ID of the scale housing).
- ▶ Press “No”.
- > The entered ID is used.



ID check message

The message is issued, for example, if the ID number of the LC is incorrect.

If the ATS software finds differences between the characteristics of the encoder and the data in the database, the following "Encoder selection" screen may be displayed.



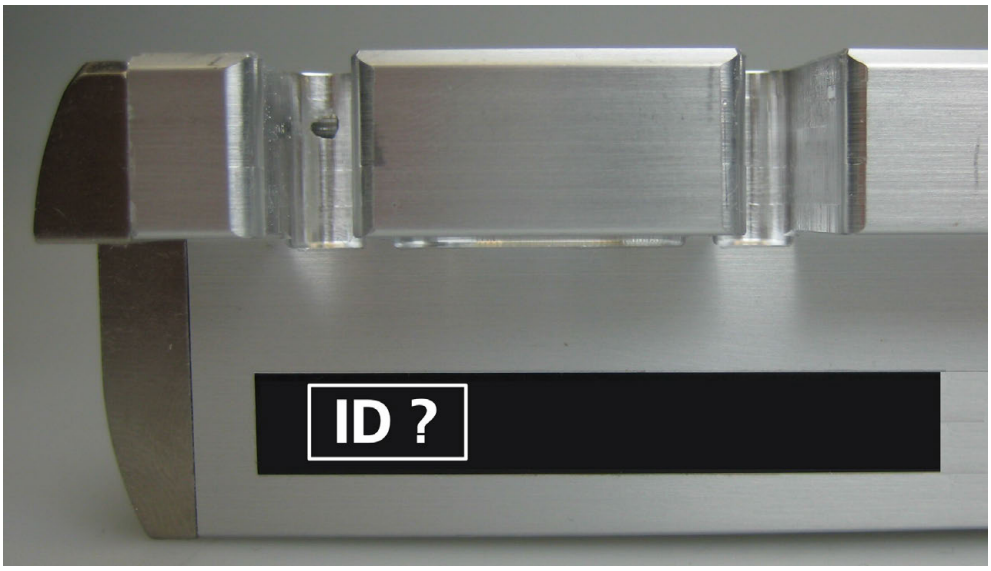
In this case, we recommend that you check the ID of the connected encoder or whether the ID was entered correctly.

NOTICE

If wrong data from the encoder memory (connect “encoder”) or the encoder database (connect to “database”) is used for connecting, the encoder, the testing device or the computer may be destroyed. The tolerance ranges of the wizards may be influenced as well.

If the encoder parameters cannot be determined, please contact HEIDENHAIN!

5.2.3 Manual encoder selection



If it is impossible to identify the encoder type (ID label missing or illegible), or if the encoder is not in the ATS database, most EnDat interfaces offer the possibility of entering the encoder data by hand. The function below serves to read out the encoder ID from the encoder memory and display it on the screen (lower right). With this ID displayed, "automatic" encoder identification can be performed.

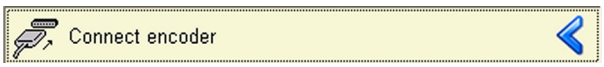
The encoder interface must work properly for this purpose!

Regarding the encoder data, please refer to the
- Encoder mounting instructions
- HEIDENHAIN product brochures

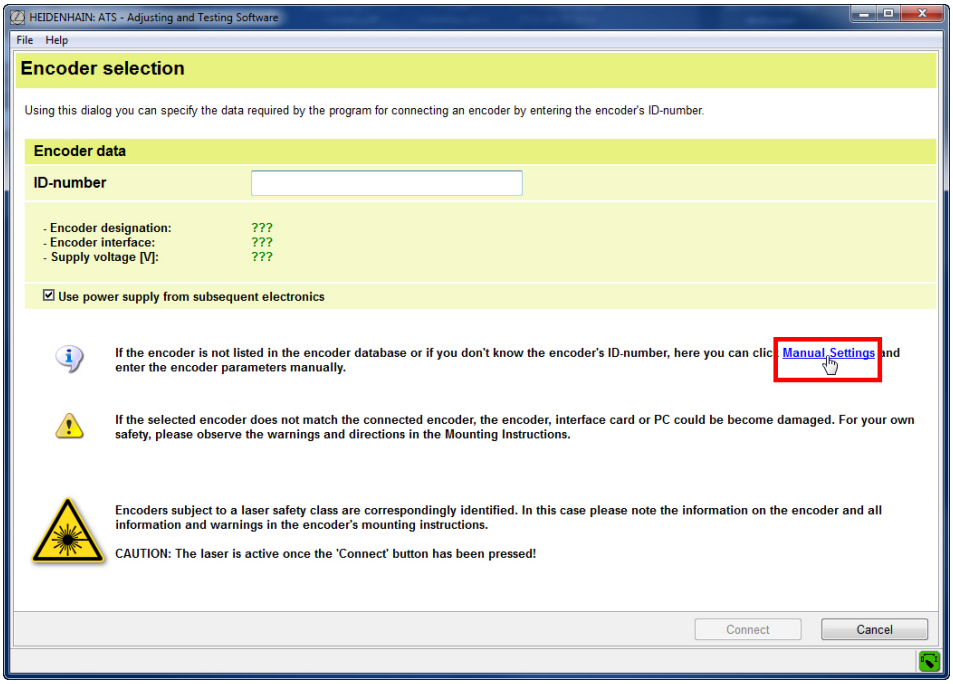
or contact the HEIDENHAIN Service.

Observe the warnings on the screen!

- ▶ Select “Connect encoder”.
- > The encoder selection is displayed.



- In the encoder selection box, click “Manual Settings”.



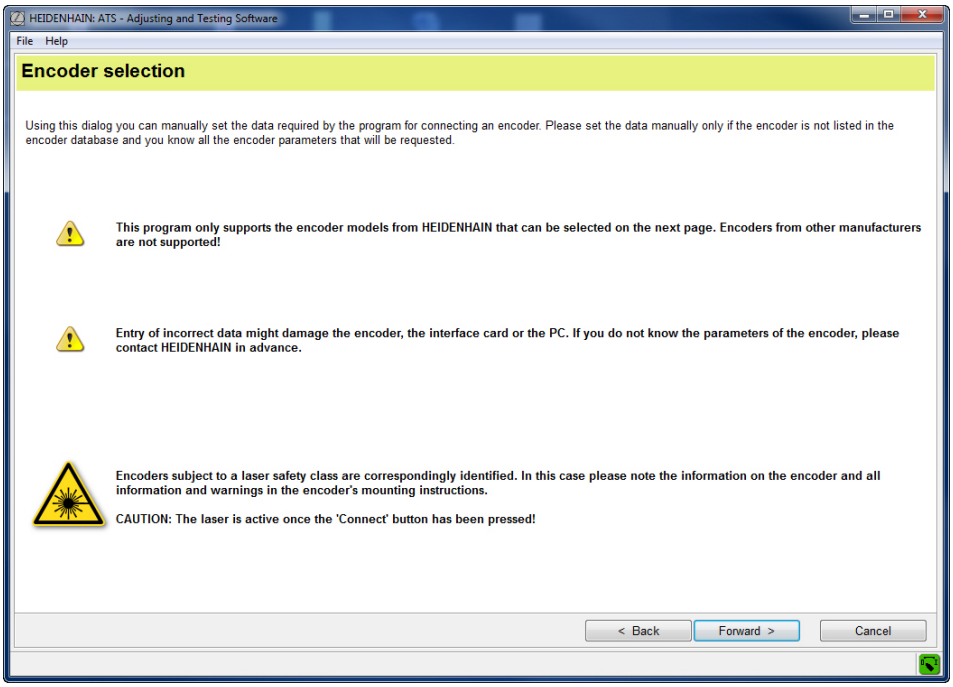
NOTICE

The scanning unit, testing device or the computer may be damaged.

Incorrect entries may cause damage to the scanning unit, the testing device or the computer.

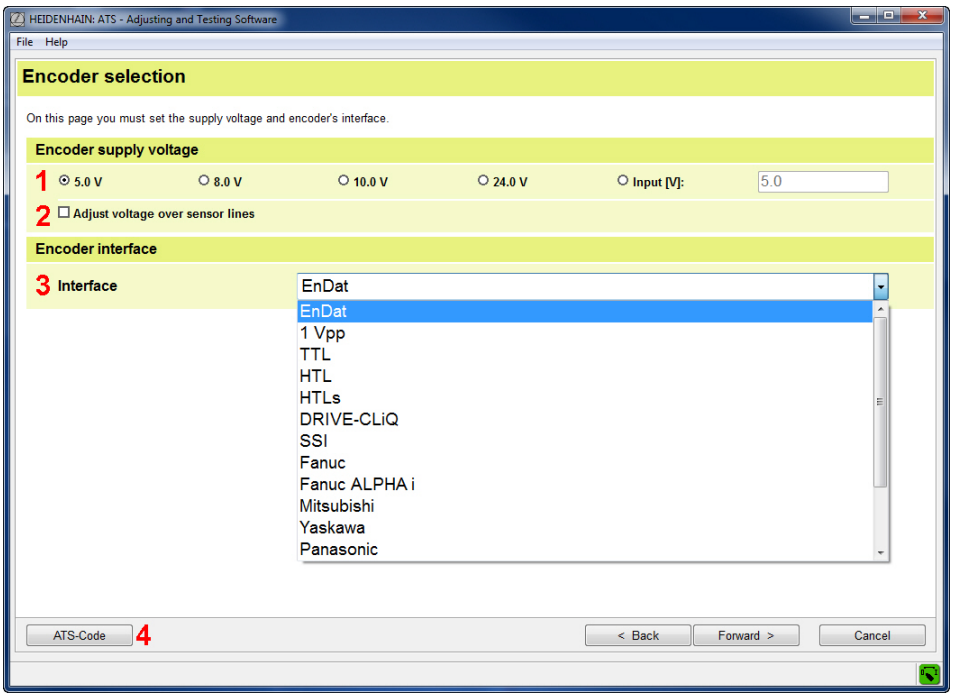
This option is only recommended to advanced users!

- The setting of the encoder power supply is of particular importance.



Observe the warnings on the screen!

- Press the “Next >” button.
- Enter the basic data of the encoder (supply voltage, encoder interface).



1 Input of encoder power supply
2 Input of voltage readjustment over sensor lines
3 Input of data interface supported by the ATS software

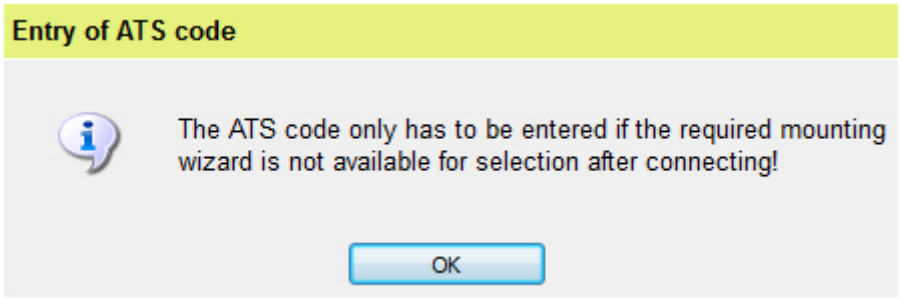
The ATS software 3.2 currently supports the following encoder interfaces:
EnDat
1 V_{PP}
TTL
HTL HTLs (without inverted signals)
DRIVE-CLiQ
SSI
Fanuc
Fanuc ALPHA i
Mitsubishi
Yaskawa
Panasonic
11 μA_{PP}
11 V_{PP}SSI+HTL
3 V_{PP} & Z1
25 μA_{PP}

> To compensate for voltage drops on the lines connecting the testing device and the encoder, we recommend activating "Adjust voltage over sensor lines" (no. 2). When you select the encoder through its ID number, voltage adjustment is automatically activated.

4 ATS-Code Special case: Entry of ATS code

An ATS code only has to be entered if, for example, no mounting wizard is available for selection on the basic screen after automatic connection with encoder ID.

The ATS code is only used for pre-series encoders that are not in the database yet, and only, if a mounting wizard is required for correct mounting. The customer usually is notified in advance and provided with the correct ATS code!
The ATS software activates a mounting wizard for this encoder after manual connection.

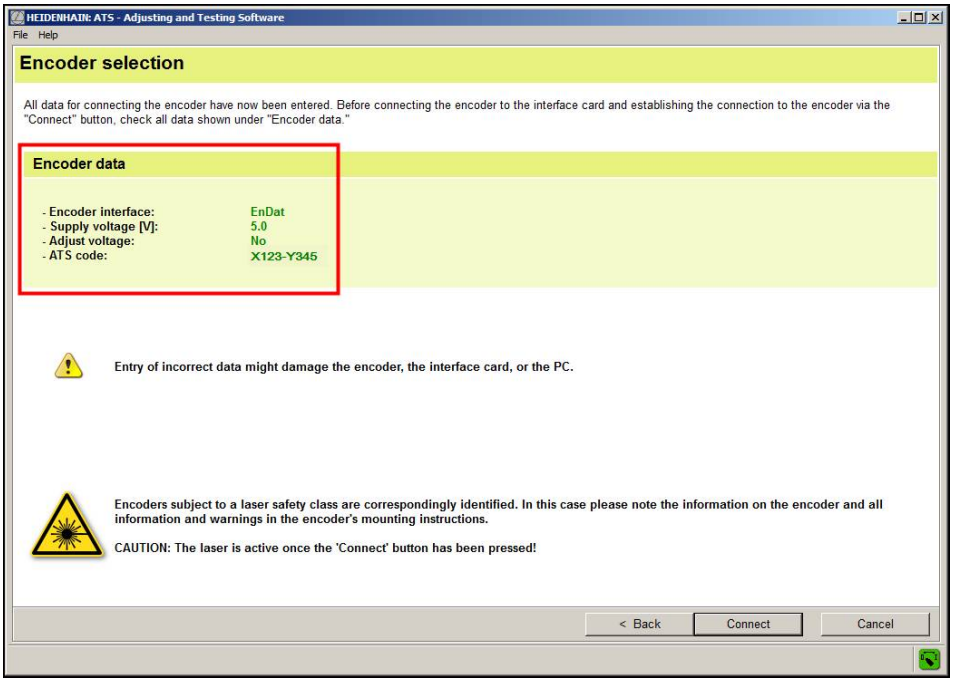


Display after the "ATS Code" button was pressed

Prompt for entering the code (example)

- Press “OK”.

> The encoder data and the ATS code are displayed.



NOTICE

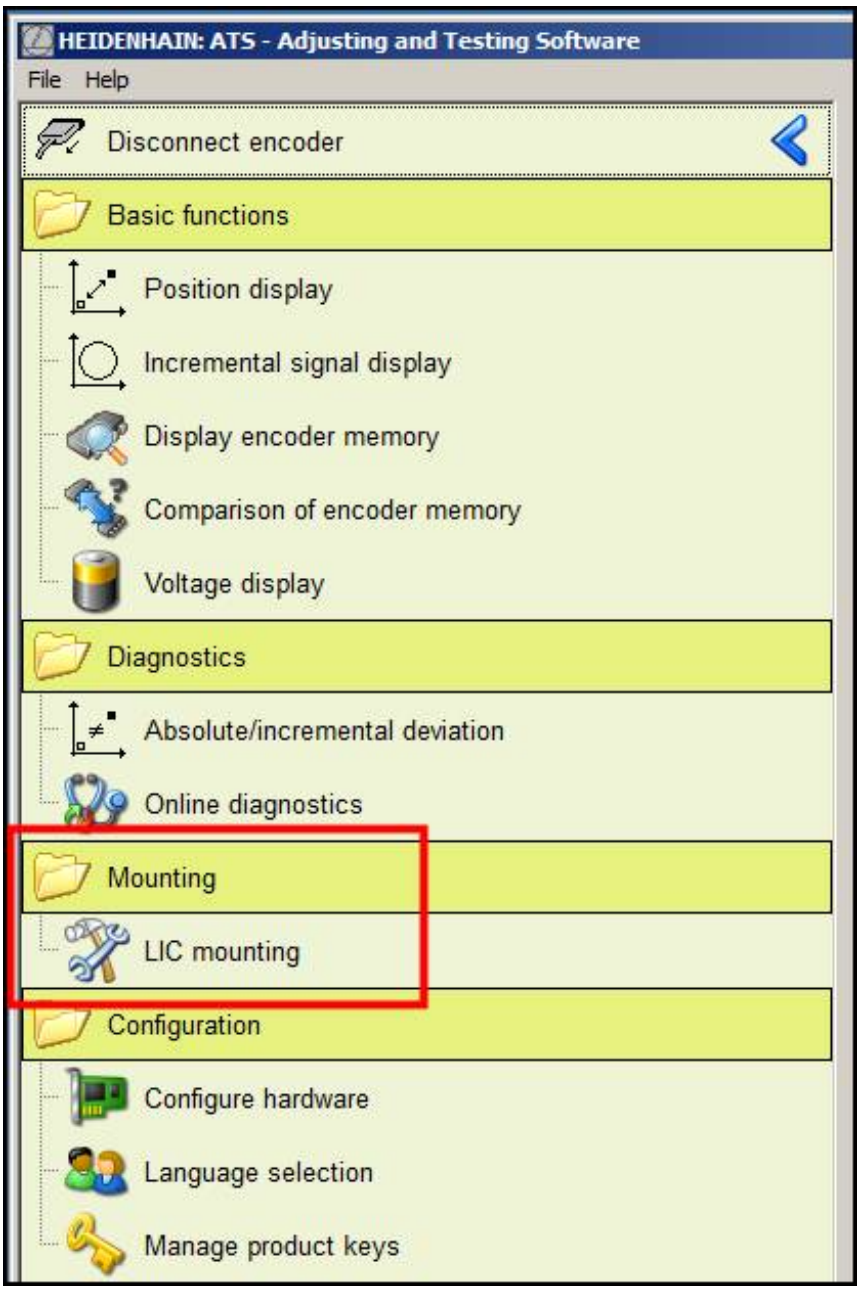
Destruction of encoder electronics

If the selected supply voltage is too high (e.g. 24 V), the electronics of an encoder operating with 5 V will be destroyed.

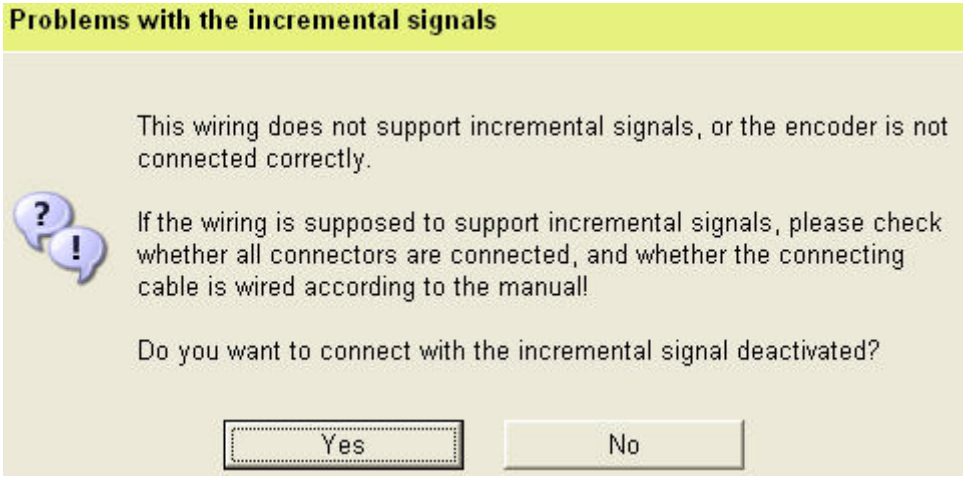
- Observe the warnings.
- Select the correct power supply for the connected encoder.

Check the displayed values.

- Press the “Connect” key.
- The connected encoder is supplied with power.



The example shows the function "LIC mounting (mounting wizard)" in the basic menu.

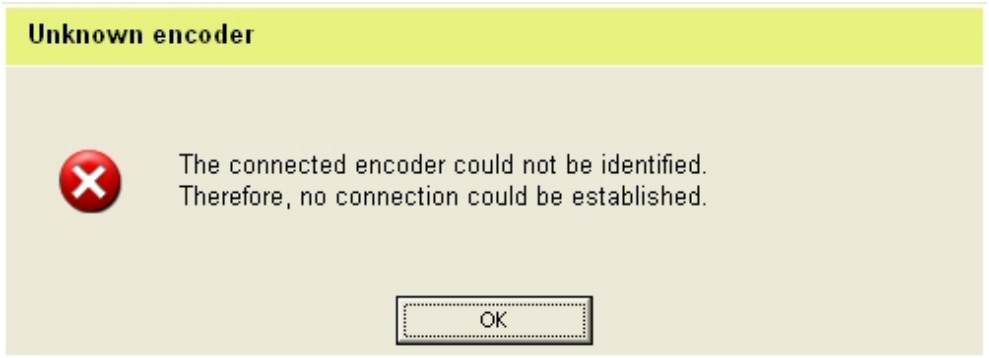


Typical error message of purely serial EnDat 2.2. encoders without incremental signals.

- ▶ In this case, confirm with “Yes”
- > to connect without incremental signals.

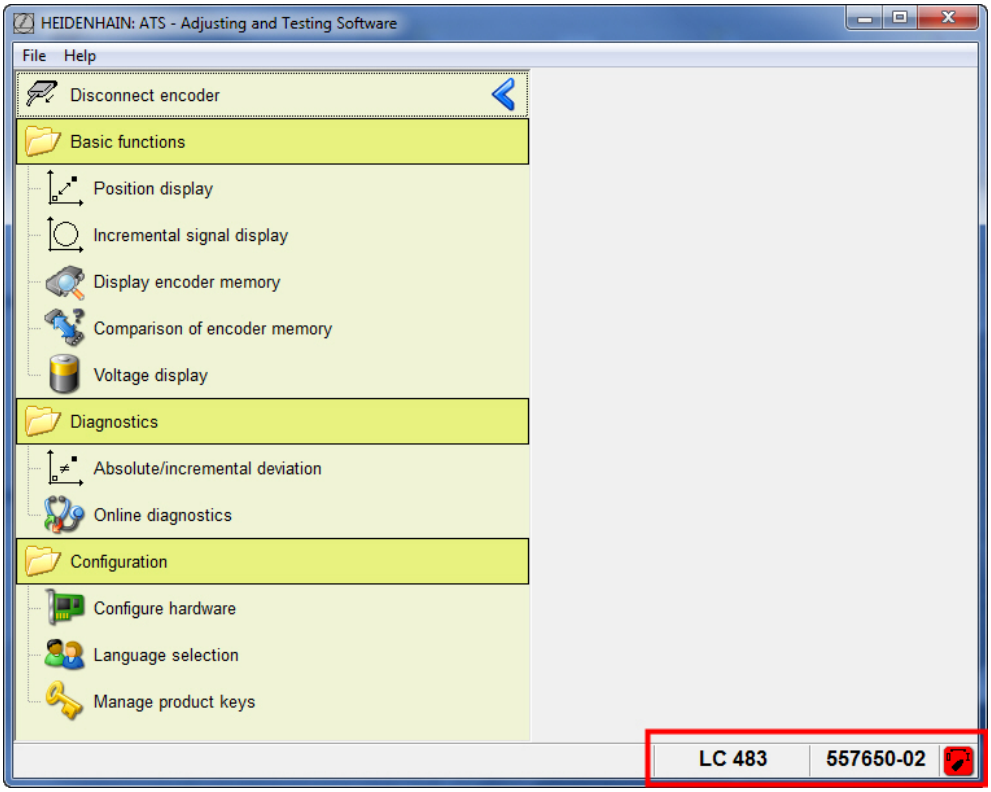
The EnDat designation is printed on the ID label.

If the following error message is generated, the voltage drop caused by the cable length (for LC approx. 5 m) is too high.



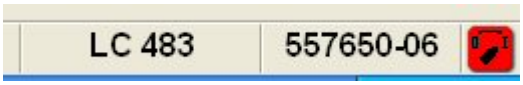
- ▶ In this event voltage readjustment needs to be activated.

- > The function group window is displayed. The encoder ID appears at the lower right.

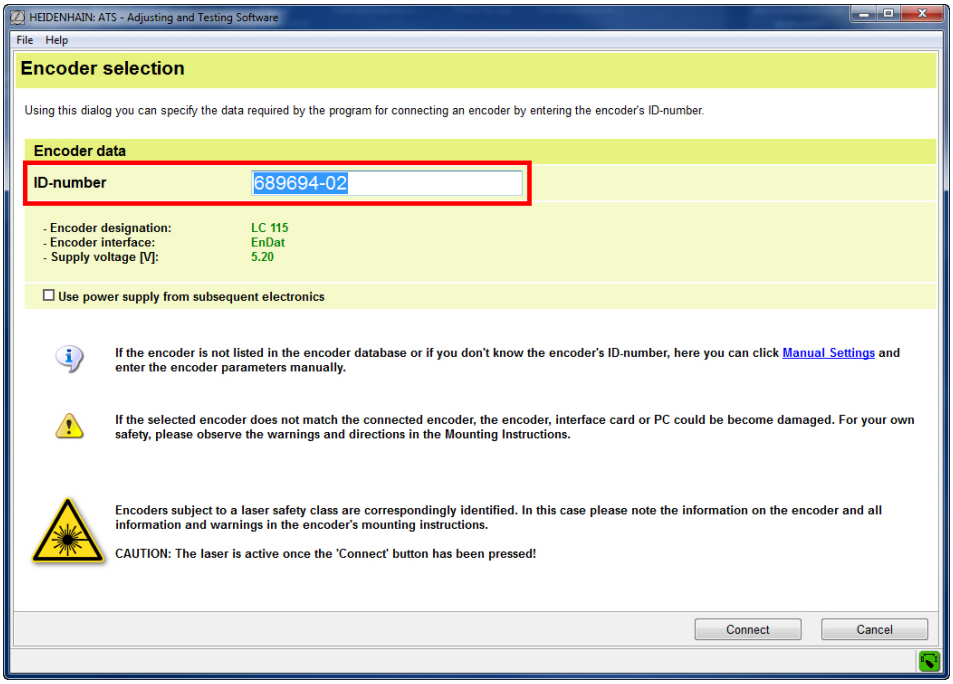


Display of encoder model and ID number
The red symbol means that the encoder is under power.

- Write down the encoder ID!



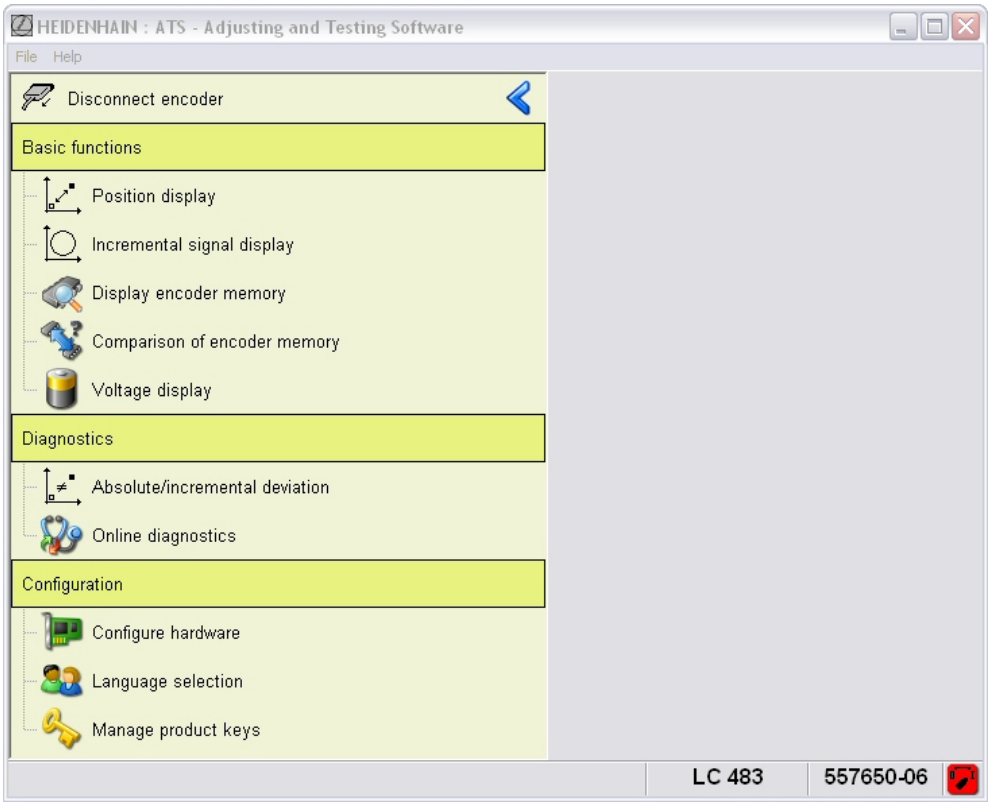
- In a next step perform “automatic” encoder identification by entering the encoder ID (see chapter "Automatic encoder identification by entering the ID").

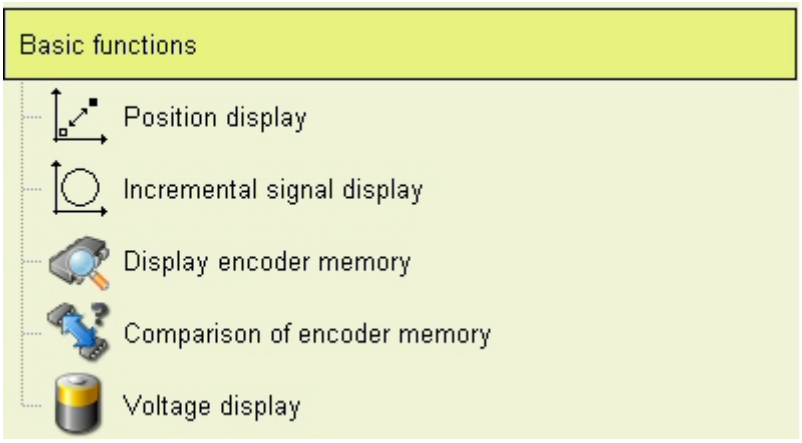


Usually, the ID is read out of the encoder memory and entered into the ID number field. In this case there is no need enter it by hand. Only if the encoder is connected with the correct ID (for example, the ID of sealed linear encoders is printed on the scale housing), can the testing software set the parameters correctly.

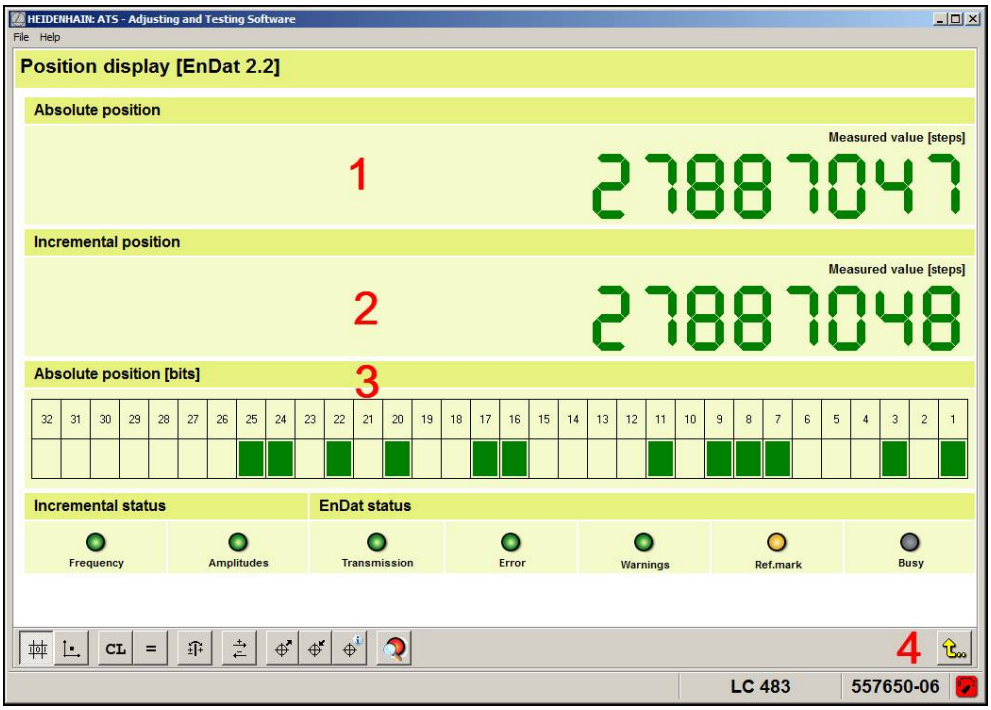
5.3 Basic functions

Display and functions may vary depending on the product key and the connected encoder model!





5.3.1 Position display



1 Absolute encoder position

2 Incremental current count

3 Binary display of the absolute position
(one-to-one display of the transferred, non-converted position data)
1 corresponds to bit 1 = LSB (least significant bit)

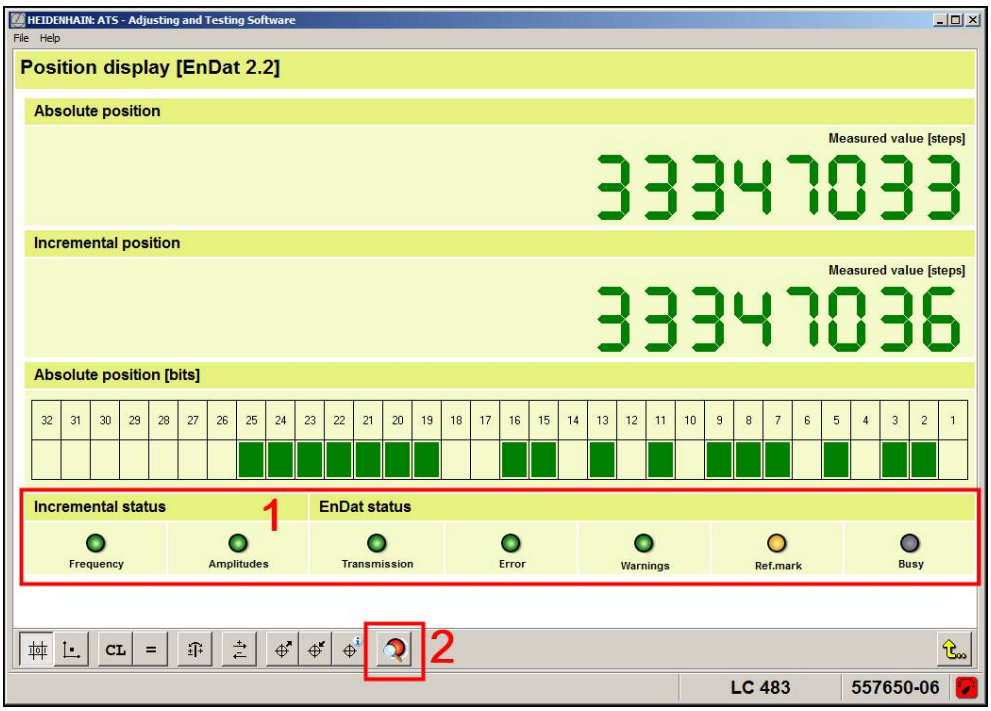
4 Yellow arrow = one step back

For encoders with purely serial data interface (e.g. EnDat 2.2, Fanuc) the incremental position is not shown.

The number of absolute positions [bits] depends on the connected encoder.

Status display

Each time position data are transferred, status information is included and evaluated. Depending on the encoder model, information on encoder alarms and warnings and on the quality of the incremental signal are available.



1 In shortened form (group signal) the encoder status is displayed in the lower area of the position display screen as a colored LED symbol.

2 Use the magnifying glass symbol to display detailed information.

The EnDat interface allows for extensive monitoring of the encoder. An **alarm** becomes active if there is a malfunction in the encoder that is presumably causing incorrect position values.

Some examples of alarms:

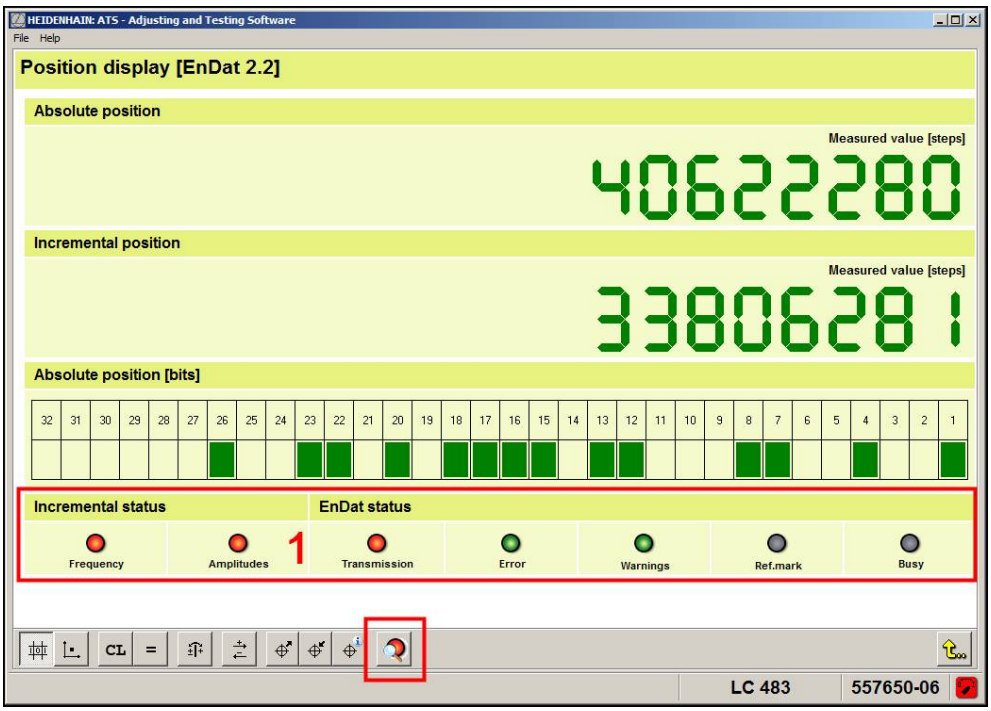
- Failure of the light unit
- Signal amplitude too small or too large
- Incorrect position value
- Supply voltage too high or too low
- Excessive current consumption

Warnings indicate that certain tolerances of the encoder were reached or exceeded (e.g. speed, control reserve of the light unit), but the position value is not incorrect. If a warning is displayed the encoder concerned should be inspected or exchanged as soon as possible in order to avoid downtimes.

Some examples of warnings:

- Frequency exceeded
- Temperature exceeded
- Control reserve
- Lighting

  etc.



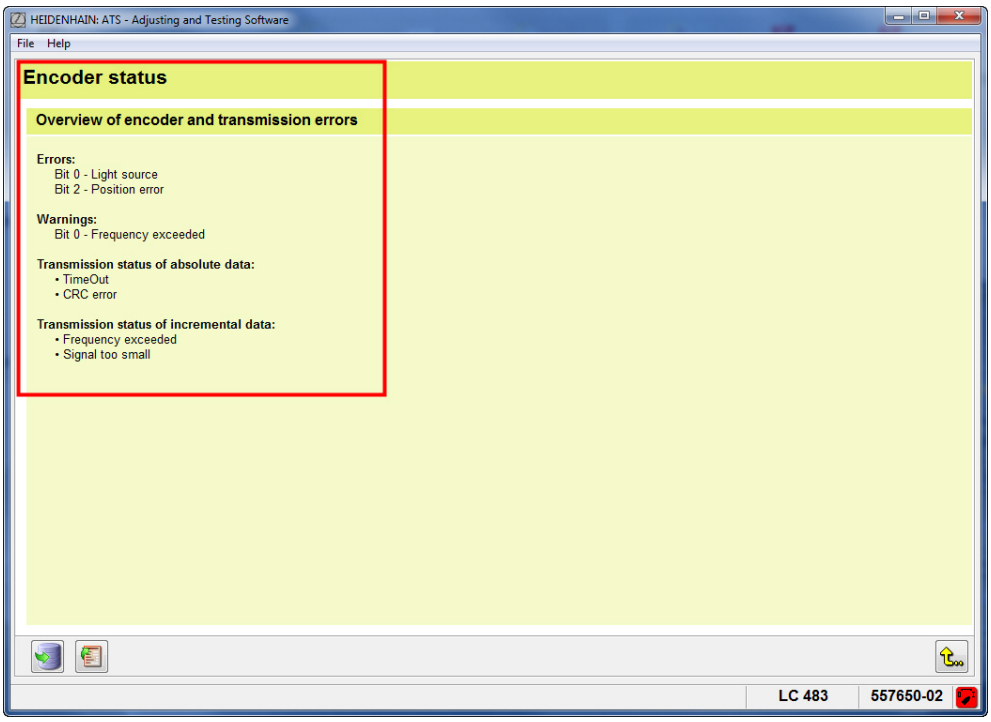
1 LED symbols for errors and warnings

Green Symbol = Okay

Red symbol = Error or warning

	Group signal; at least one "error" present!

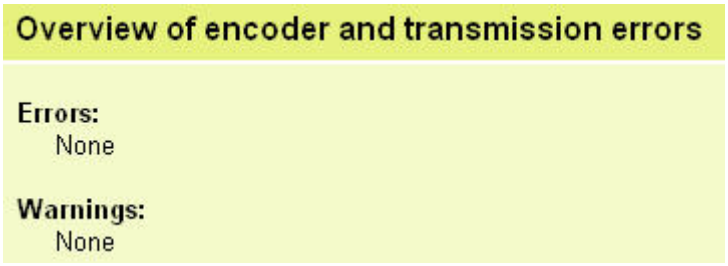
Display detailed status information



Details of encoder status

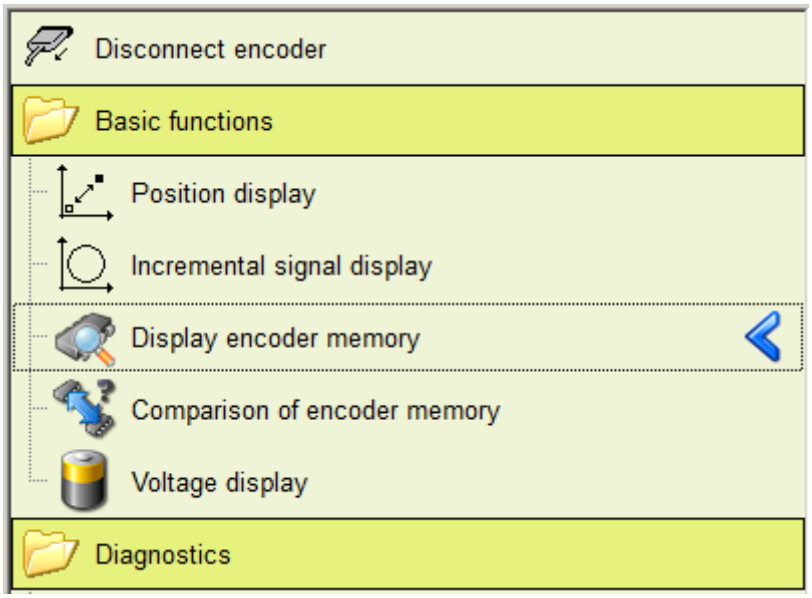
Reset errors and warnings

Please reset the errors and warnings before starting! After you connect the encoder by the ATS software, errors caused by encoder components may be displayed, although actually there is no malfunction. If the error messages cannot be reset and new error messages are generated, the encoder needs to be replaced or repaired.

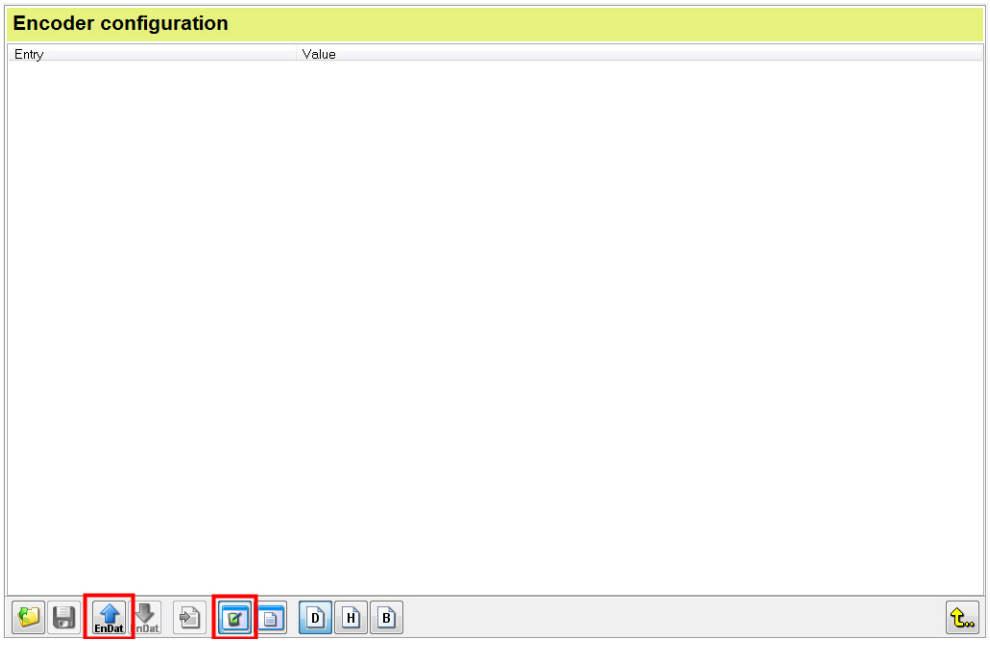


A given encoder does not necessarily support all monitoring functions. The information which errors and warnings an encoder supports can be read out and displayed with the following ATS software function.

- Select “Display encoder memory“ from the basic functions list.



> The encoder configuration window is activated.

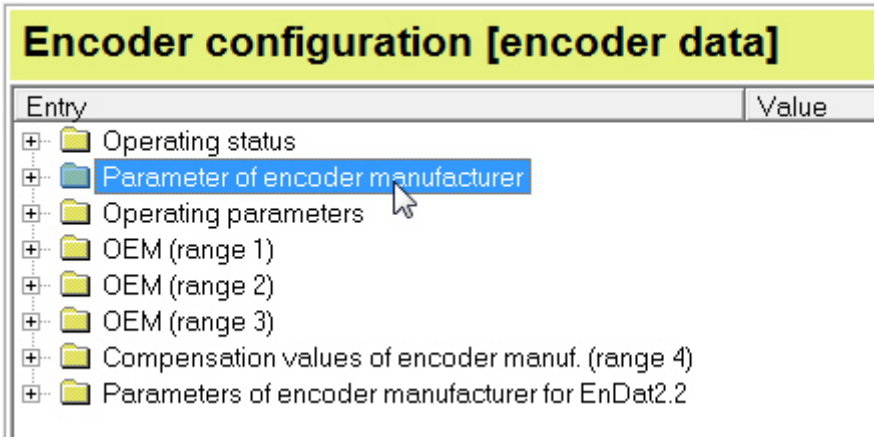


- Press the “function-specific view“ button (display in plain language).

- Press the “EnDat“ button.

> The encoder data is transferred from the encoder memory to the test unit.

- Open the directory tree “Parameters of encoder manufacturer“.

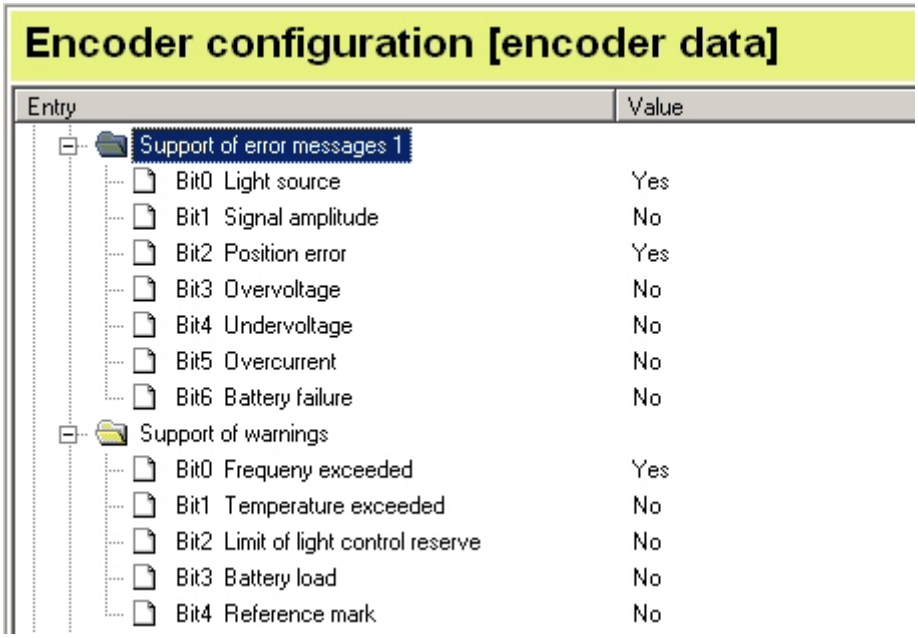


- Scroll down in the directory.
- Open the directory tree “Support of error messages”.

or

- Open the directory tree “Support of warnings”.

> **Supported error messages and warnings are distinguished by “Yes”.**



For detailed information on the encoder status please refer to the EnDat interface manual.

EnDat 2.2 status display

A yellow "Busy" symbol indicates access to the memory of the encoder EEPROM (12 s max.); otherwise the LED is gray (no function).

The "Busy" LED is used for forced dynamic sampling and encoders with functional safety.

The "Reference mark" LED shows whether the EIB has detected the reference mark signal. (This function is only used in combination with EIB interface converters.) If an EIB electronics is connected and with incremental encoders, the LED is displayed in gray color and turns yellow as soon as the reference mark has been traversed.

With absolute encoders the "Reference mark" LED is always yellow. For absolute encoders that do not output incremental signals (e.g. EnDat 2.2, purely serial), the "Incremental status" display is hidden. The "Ref. Mark" status display is used for EIB interface electronics (interface converter incremental/absolute). The incremental encoder is only "quasi-absolute" after the reference mark has been traversed (gray LED = reference mark not detected; yellow LED = reference mark detected).

Detailed display of encoder status EnDat 2.2

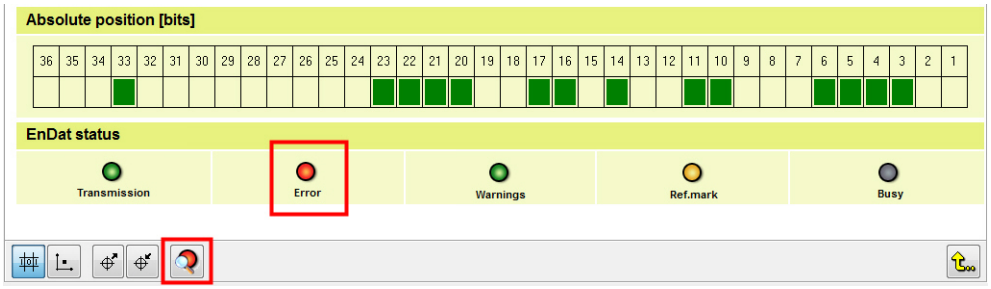
Operating status error sources

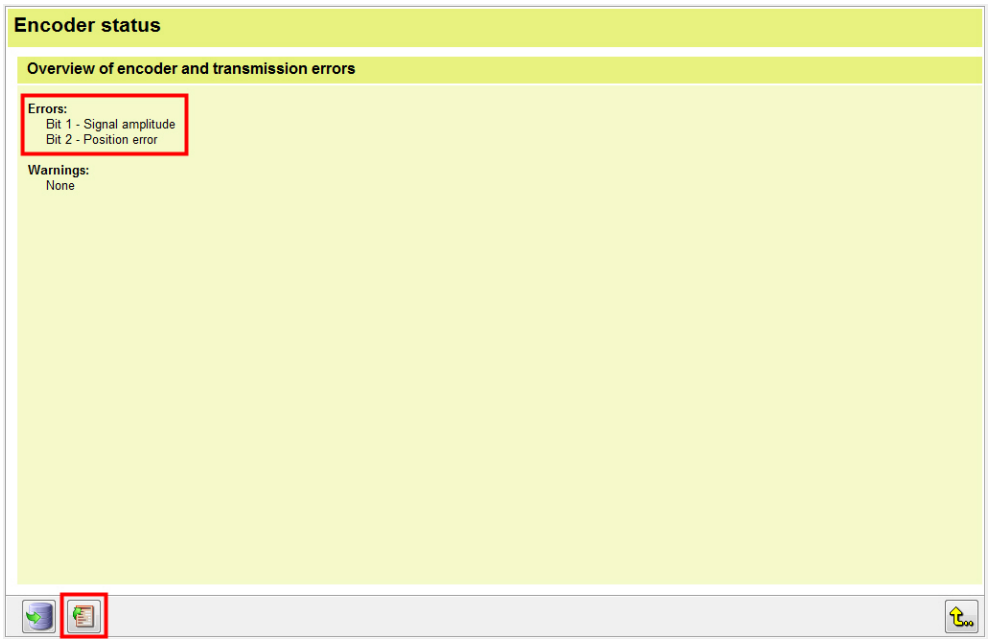
The function "Operating status error sources" provides detailed information on errors and is an expansion of the EnDat 2.2 error register under operating conditions.

It is accessed via the EnDat additional datum. Its advantages are fast access in a closed loop and the differentiation, whether the error was caused by the single-turn or the multi-turn component of position value formation.

Operating status error sources are only supported by EnDat 2.2. Not all encoders support this function. The error messages are encoder-specific! Whether this function is supported and which error sources it comprises is defined in the Encoder configuration [encoder data]/ Manufacturer parameters EnDat 2.2/Support of operating status error sources.

Press the “Detailed status display“ button to call the function.

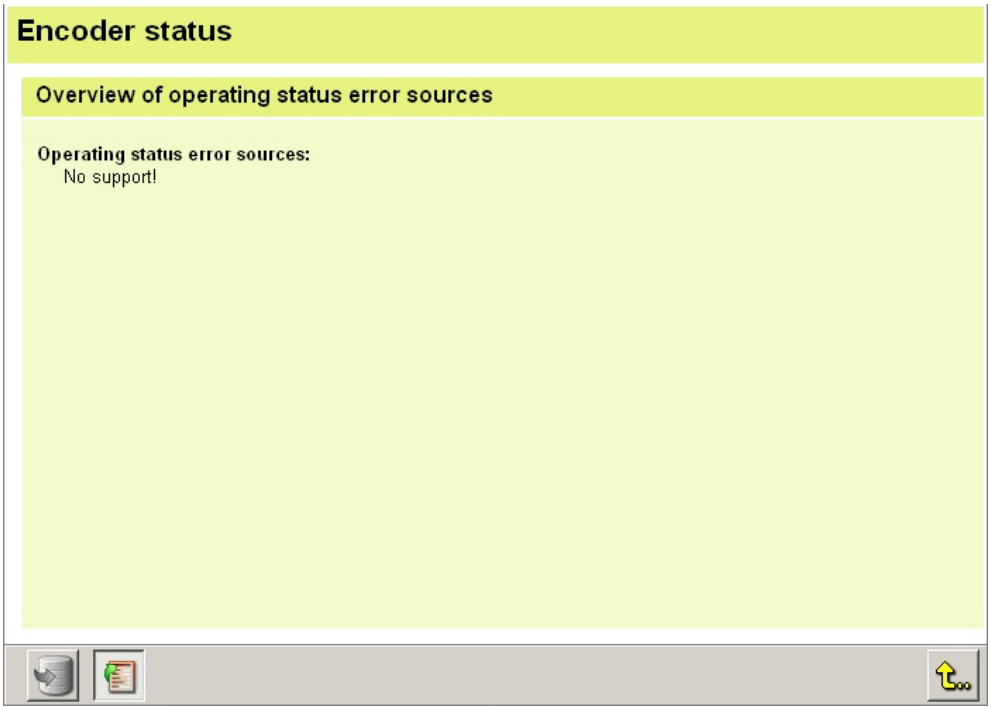




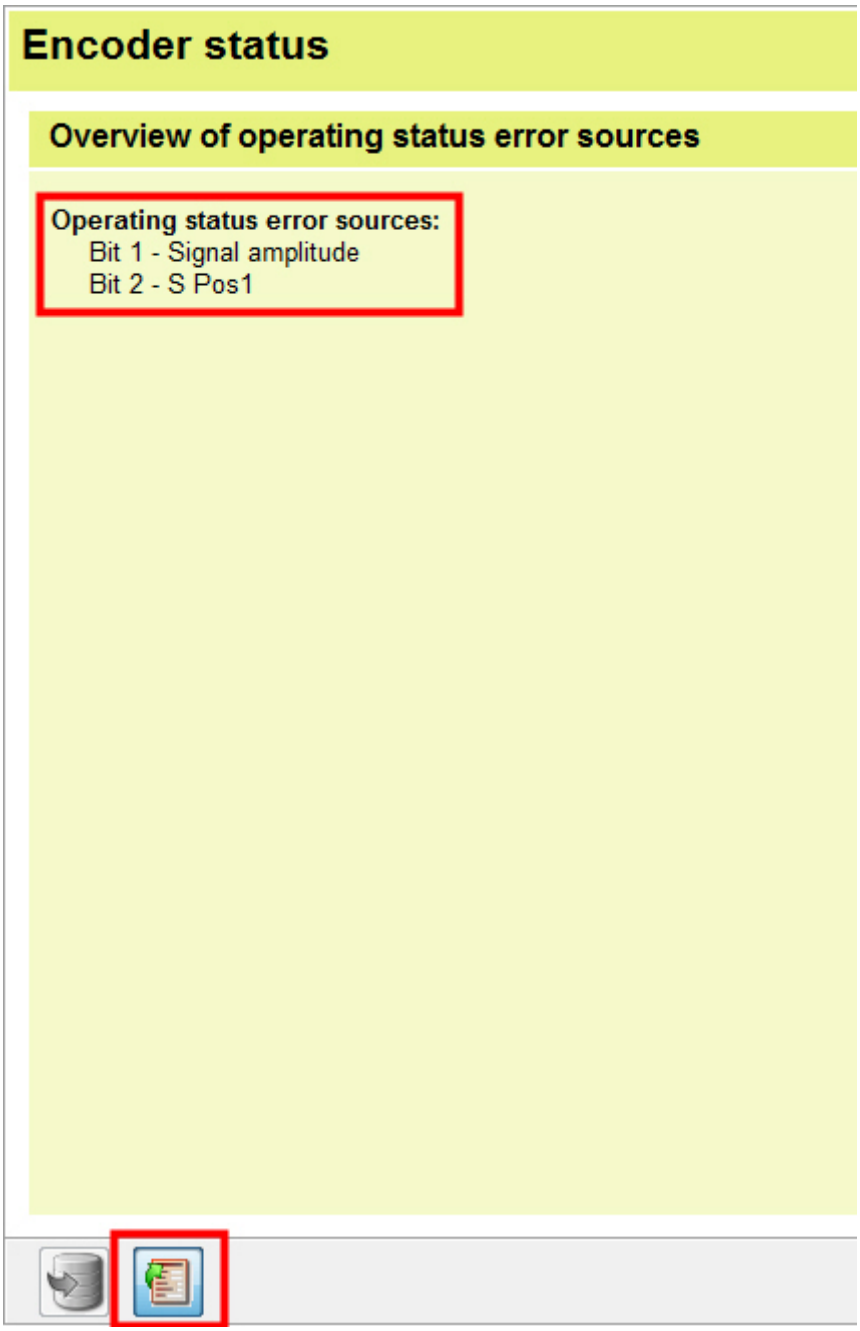
- Press the “Read operating status error sources“ button.

Display if the encoder does not support the “Operating status error sources” function:

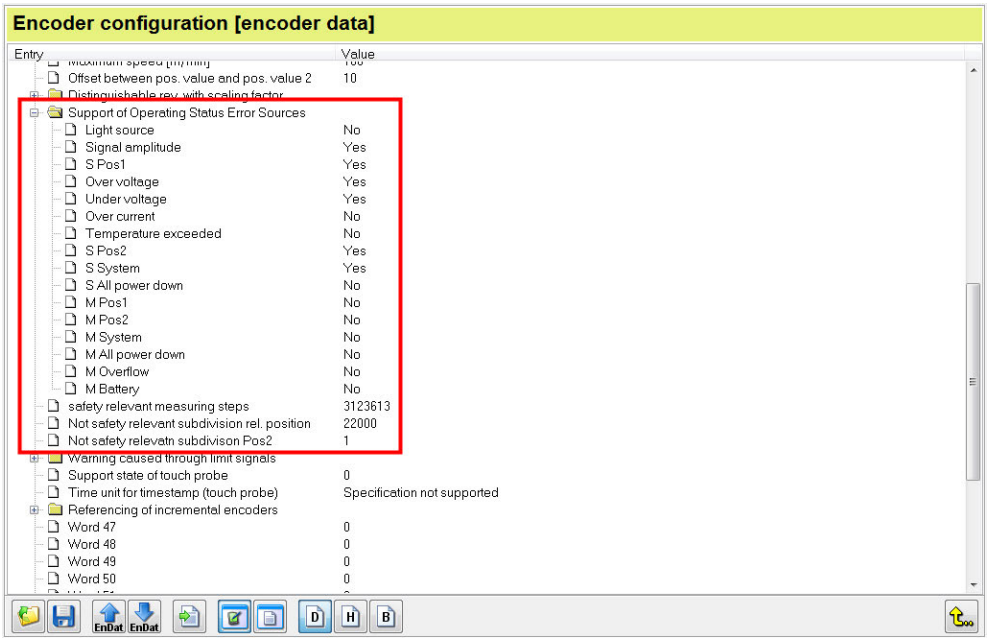
Display after “OK” was pressed:



Display if the encoder supports the "Operating status error sources" function; details on errors:



Which status error sources the encoder supports is stored in the "Parameters of the encoder manufacturer for EnDat 2.2" in the encoder memory.



Connection to EIB interface electronics

The EIB (Extended Interface Box) is an interface converter converting an input interface into an output interface.

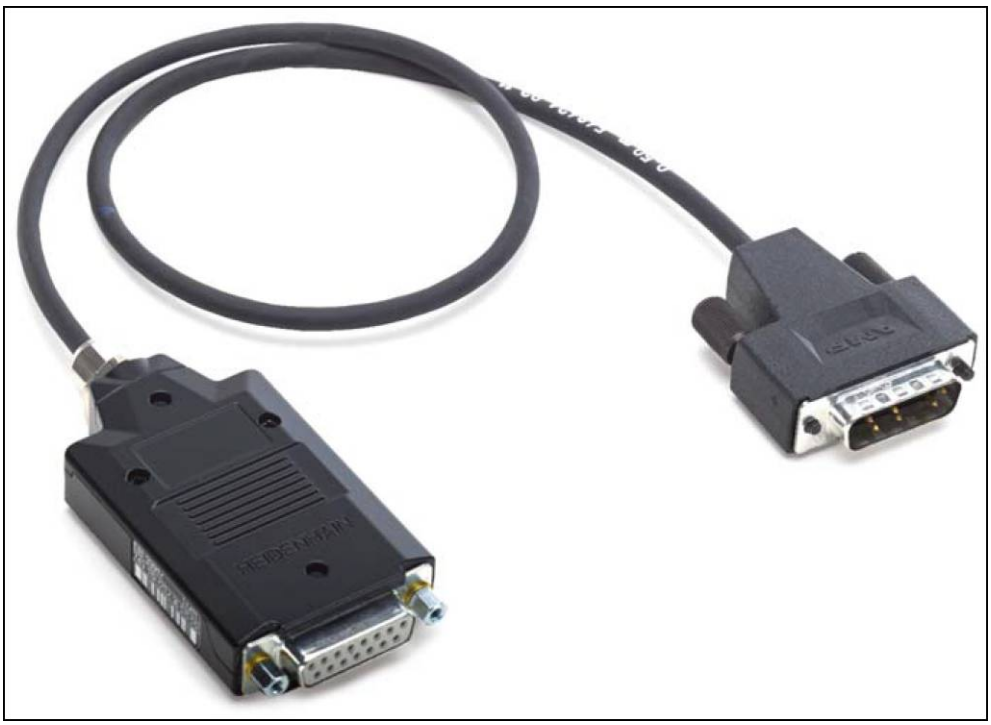
Permitted input signal interfaces:

- EnDat 2.2 (EnDat 22)
- 1 V_{PP} (with one or two inputs)

Permitted output signal interfaces:

- EnDat 2.2 (EnDat 22)
- Fanuc Serial Interface
- Mitsubishi High Speed Interface
- DRIVE-CLiQ (functional safety)
- YASKAWA

EIB 2391 S



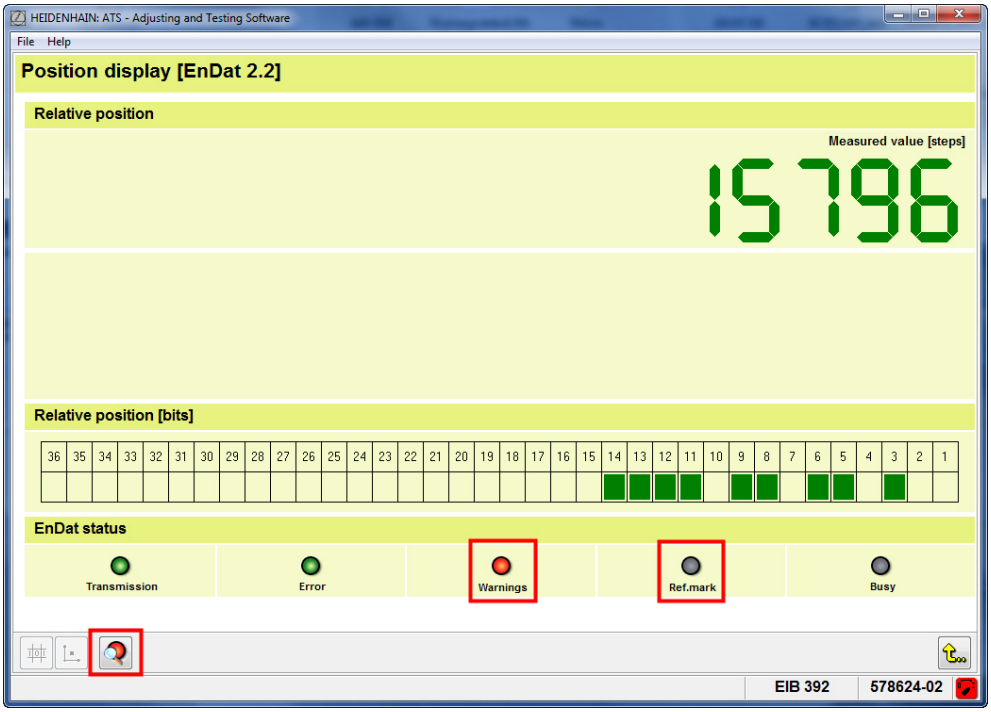
EIB 3391 Y

To check the EIB, a suitable incremental encoder must be connected to the EIB input (observe the EIB operating instructions).

- Connect the EIB and the encoder to the PWM or IK 215.
- Identify the EIB with the ATS software.

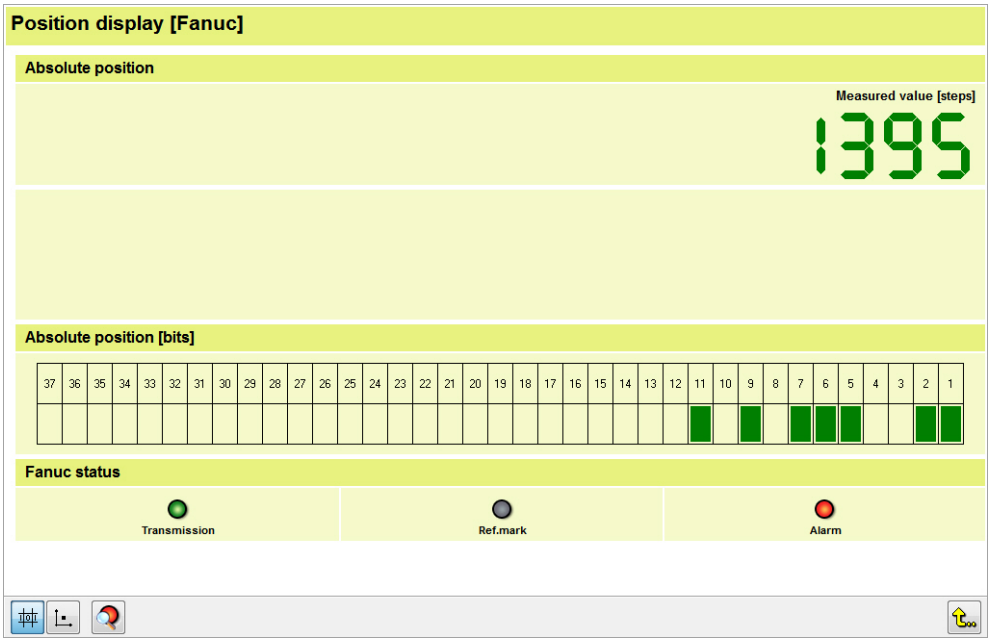
Use the ID of the EIB for connecting to the ATS software.

- In the “Basic functions” main menu click the “Position display” function.
- A warning (red LED) is displayed in the display field for the EnDat status.



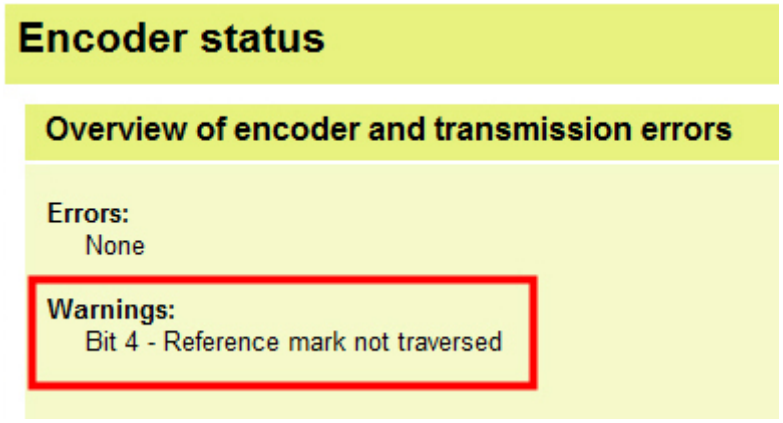
▶ Press the “Detailed status information“ button.

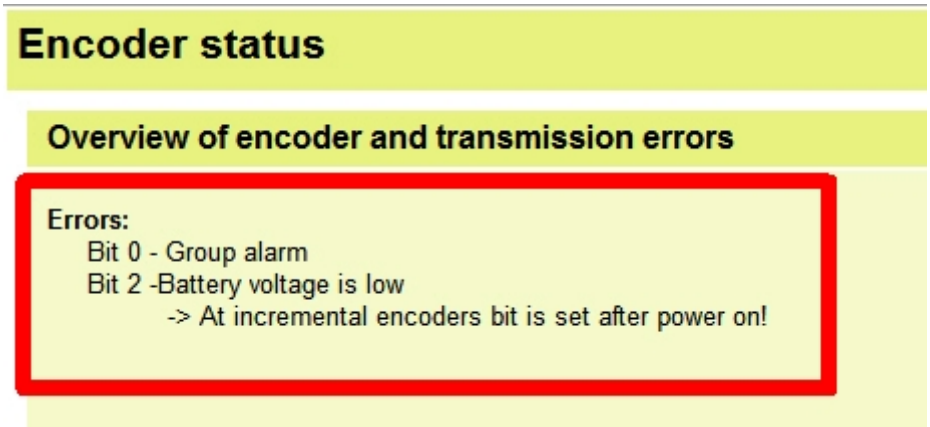
Position display when an EIB 192 with Fanuc interface is connected. The absolute position is invalid, since the reference mark has not been traversed yet (gray LED) and the alarm LED is red.



> The warning “Bit 4 – Reference mark not traversed” is displayed.

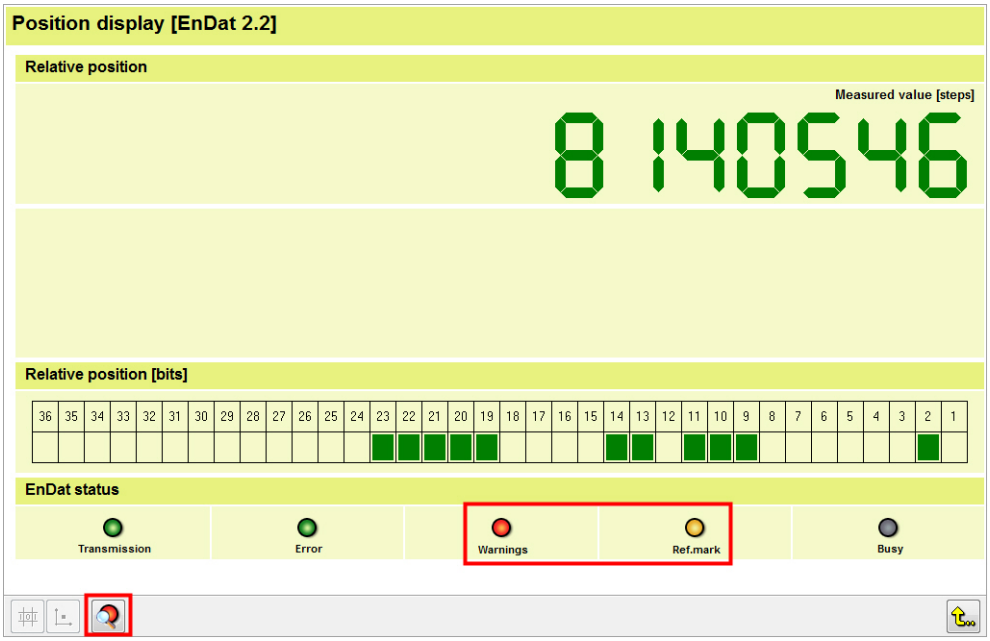
Display with Fanuc interface: “Error: Bit 2 – At incremental encoders this bit is set after power on!” The “Ref. mark” status display is gray.





- ▶ Traverse the reference mark(s) of the encoder.
- > Only after the reference mark has been traversed refer the absolute position values to this fixed reference point. As soon as the reference mark has been detected, the "Ref. mark" status display changes to yellow.
- ▶ The "Warnings" LED remains red and must be reset by hand.

The reference mark must be traversed before the "Warnings" can be reset.

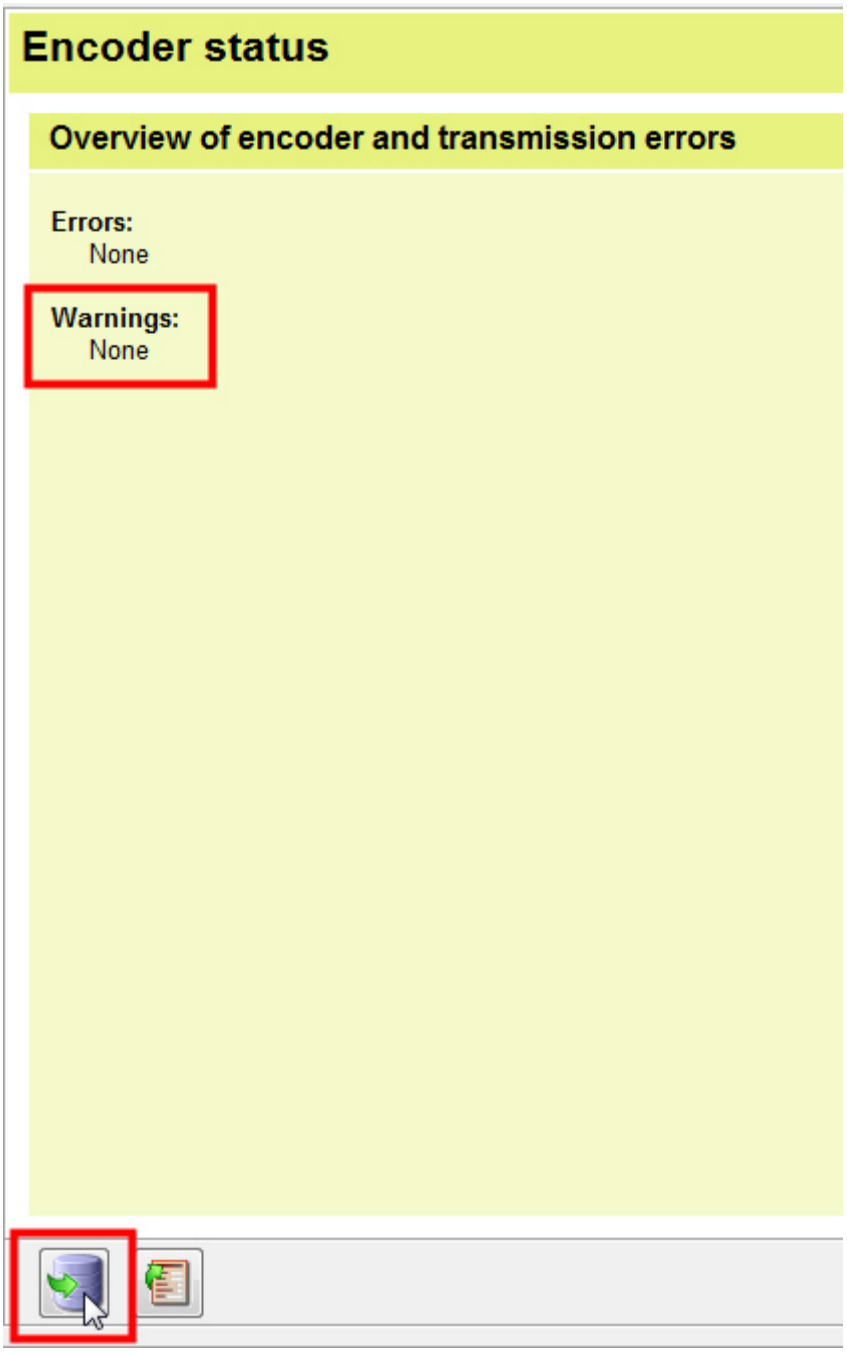


Position display when an EIB 192 with Fanuc interface is connected.

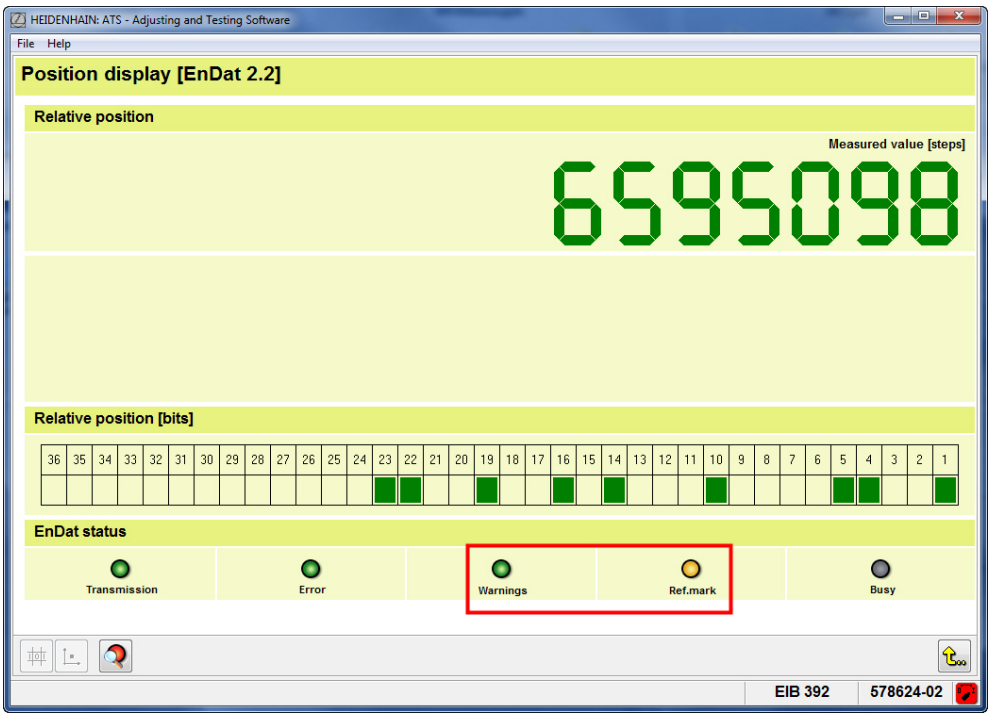
- ▶ Same procedure as with EnDat; here, the "Alarm" LED needs to be reset by hand.

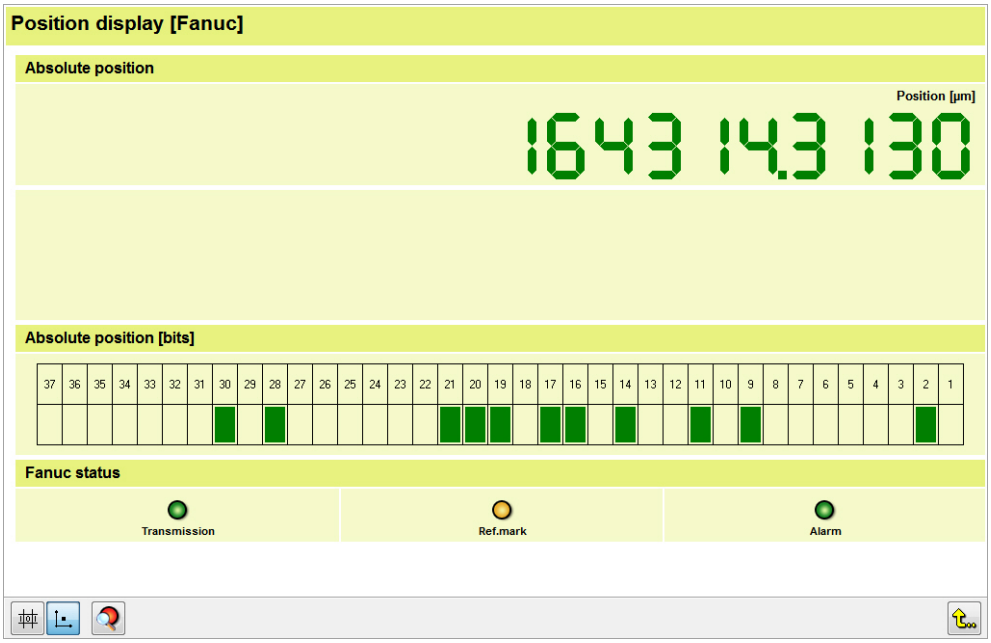
The warning in the Encoder status field can only be deleted by hand after the reference mark has been detected.

For this purpose, press  .



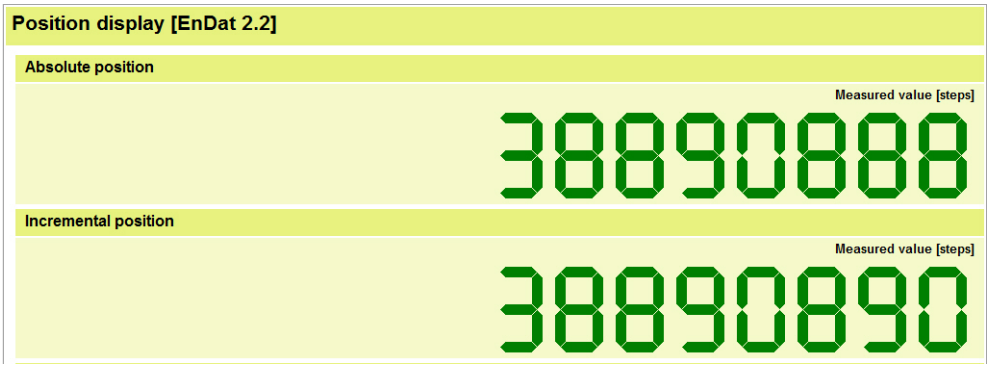
Warning deleted





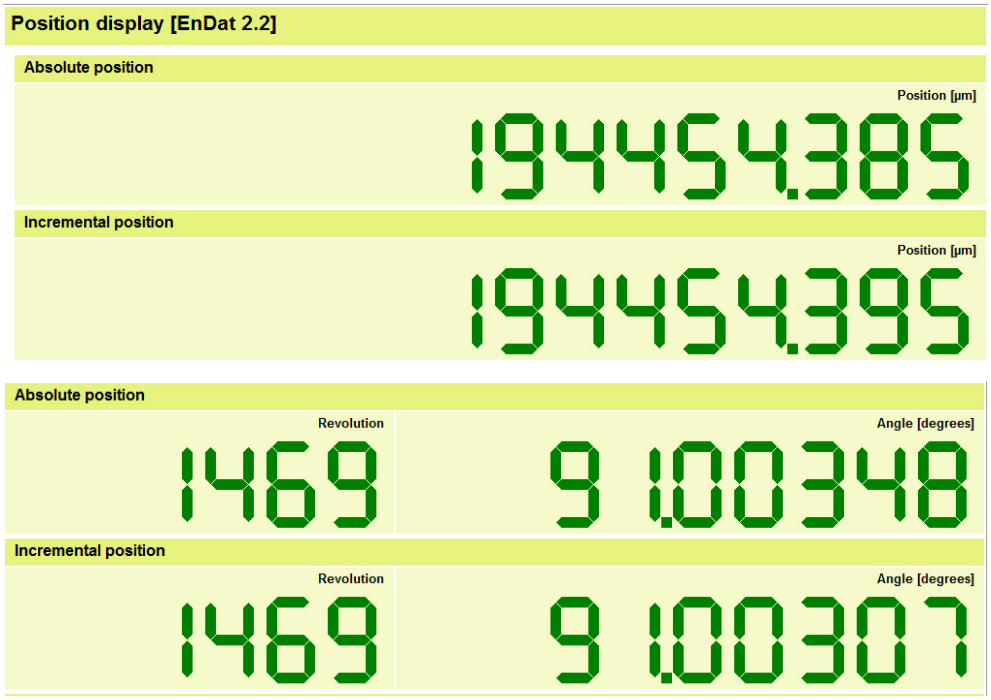
Measured values view

The measured values are displayed as they are transferred from the encoder.



Position view

The measured values are converted into linear [µm] or angular [degrees] data according to the settings of the encoder parameters.

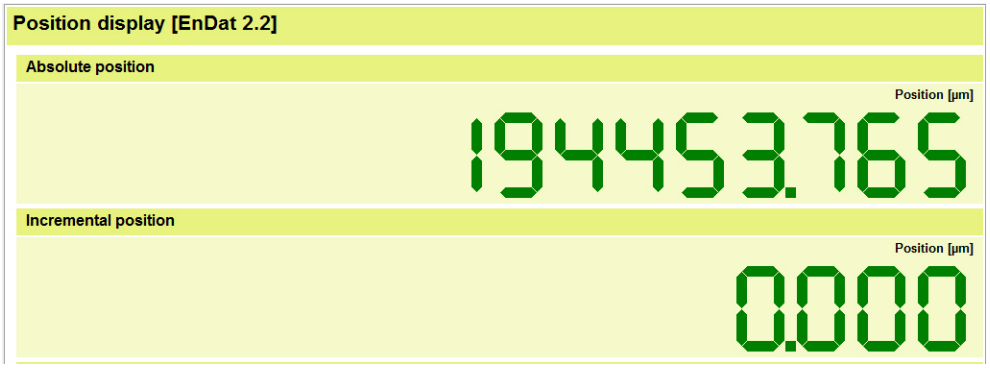


Display for multiturn encoders

If encoders without incremental signals are connected, "Incremental position" is not displayed.

Clear incremental counter

The incremental counter is set to zero (0.0).

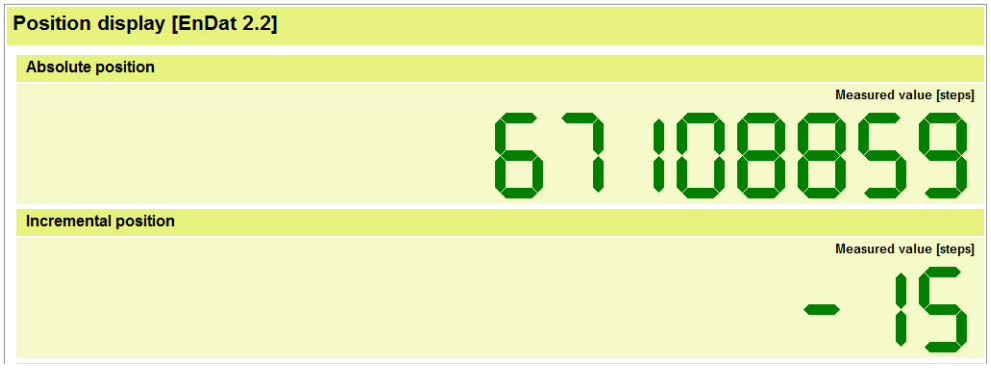


Equate function

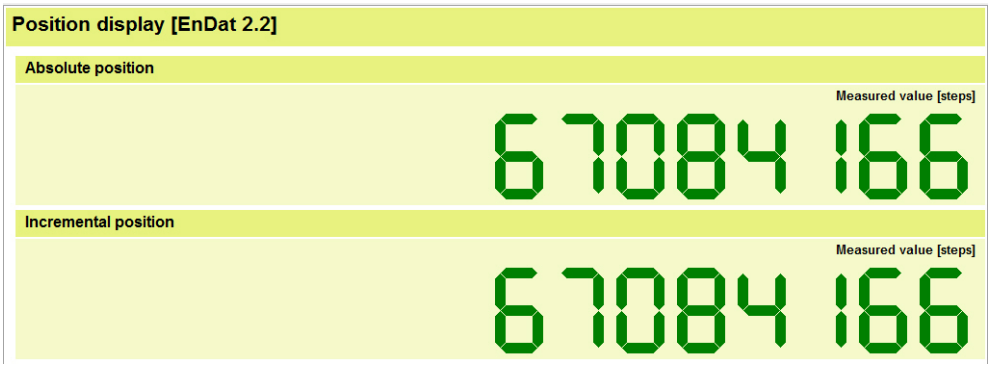
The incremental counter loads the absolute position (displays of absolute and incremental positions are the same).

Synchronization mode

The absolute and the incremental positions are synchronized with each other at the counting limits (zero crossover of absolute and incremental tracks).



Synchronization not active

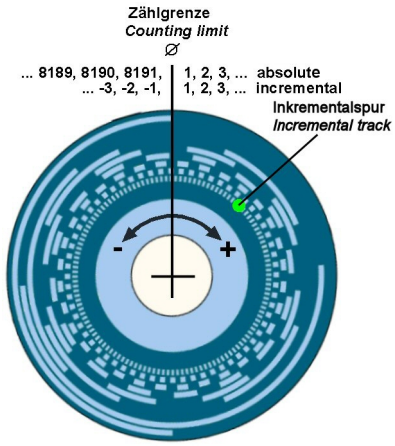


Synchronization mode active

Invert counting direction of incremental positions

Example: 13-bit rotary encoder

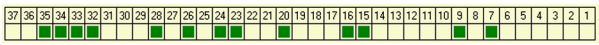
If the zero position is rotated into the “minus” range, the absolute code of the absolute track restarts with the highest position value (in the example: 8191), whereas the incremental counter starts to count backwards, i.e. -1, -2, etc. When the synchronization mode is activated, the incremental counter also starts with the highest absolute value (in the example: 8191).



Counting limit = Absolute value ‘Zero’ (Ø)

Absolute position [bits] display

The displayed value corresponds to the position value transmitted by the encoder (one-to-one display of the transferred, non-converted data).
The absolute encoder position is displayed as binary value. Position 1 represents bit 1 which is the LSB (Least Significant Bit) of the position value.
The bit length may vary and depends on the connected encoder.



Example: Rotary encoder with 37 bits

The counting direction for the incremental positions is reversed. Customer-specific datum shift can be programmed for certain encoders (e.g. SSI rotary encoders), and the ATS software can be adapted for parallel measurement.

Zero point shift

A customer-specific datum shift can be performed for encoders with EnDat interface. This serves to adapt the encoder to the machine or motor individually for each axis (e.g. to capture the rotor position of a synchronous motor).

We recommend canceling the current datum shift before entering a new one!

⚠WARNING

Danger of uncontrolled movement of the motor or a machine axis caused by incorrectly set datum!

An incorrectly set datum (field angle on synchronous motors) may cause undesired reactions of a motor that may result in uncontrollability of a machine axis. Uncontrolled movements of machine axes may result in serious personal injuries or death.

- Change the datum settings only if absolutely necessary (e.g. if the encoder is exchanged).

⚠WARNING

Danger of vertical or hanging machine axes!

If vertical or hanging machine axes are not secured, this may cause uncontrolled movement of these axes and may result in serious personal injury or death.

- Secure vertical or hanging axes against sagging

Changing a datum shift in the encoder can, for example, require a new acceptance test for functionally safe applications.

For certain applications it may be required to re-commission the equipment after a datum shift.

Set zero-point shift

- Click symbol

Note the displayed message!

- Press “Yes”.

> The “Datum shift” menu is displayed.

There are two types of datum shift:

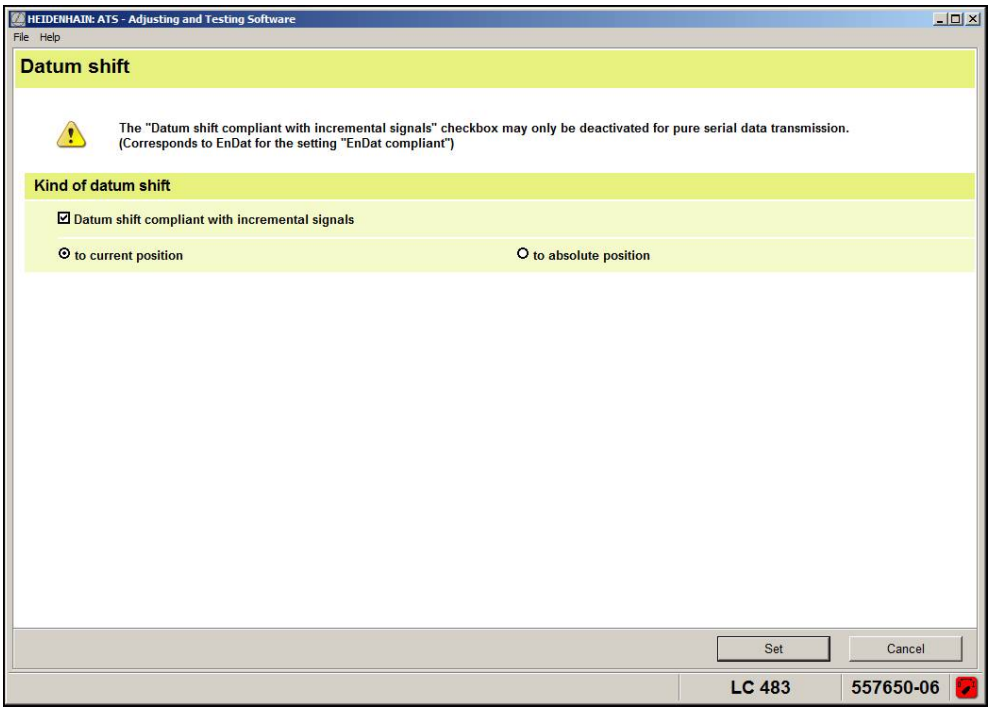
1. Datum shift compliant with incremental signals (check box selected)

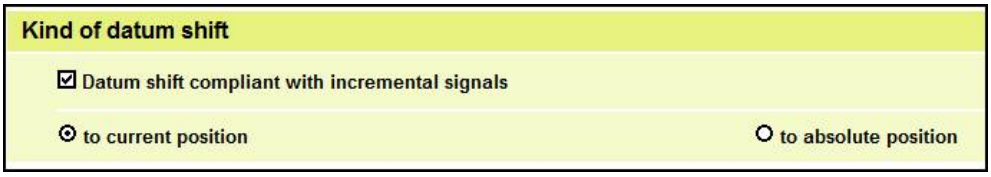
This type considers the relation of datum and signal period (incremental signal).

After datum shift the absolute datum will not always be exactly the current position. The ATS program calculates the new datum such that in relation to the incremental signals its position corresponds to the EnDat specification, i.e. is as close as possible to the desired position.

NOTICE

For encoder versions “with incremental signals“ (EnDat 01 and EnDat 02 interfaces) the check box for “Datum shift compliant with incremental signals” and the option “to current position” must be selected (default setting)!
The option “to absolute position” is exclusively intended for EnDat encoders without incremental signals (purely serial data output, EnDat 21 and EnDat 22 interfaces)!
We recommend canceling the current datum shift before entering a new one!





The checkmark at “Datum shift compliant with incremental signals” is entered by default and may only be removed for EnDat encoders with the ordering designation EnDat 21 and EnDat 22 withe purely serial data transfer (without A and B signals)!

2. Datum shift not compliant with incremental signals (check box not selected)

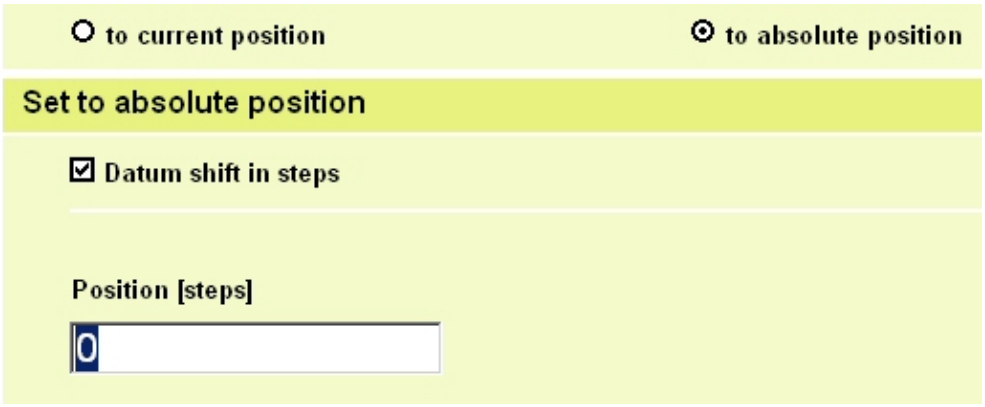
This type does **not** consider the relation of datum and signal period (incremental signal).

The option “to absolute position” is exclusively intended for EnDat encoders without incremental signals (purely serial data output, without A and B signals, EnDat 21 and EnDat 22 interfaces)!

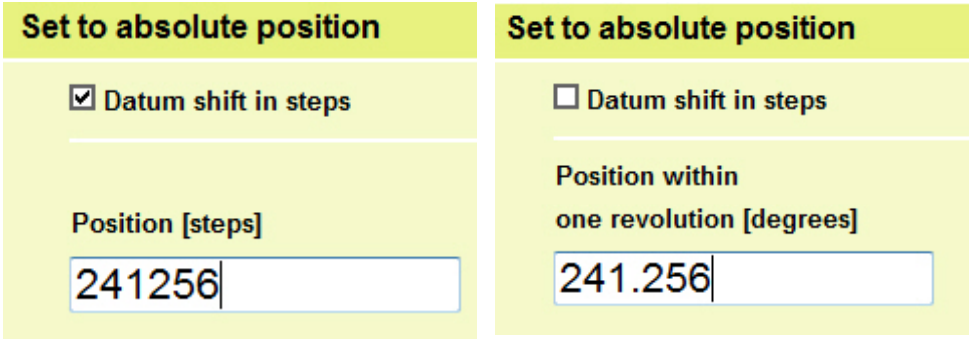
- Set datum “to current position“.

Before the datum shift is performed, the measuring system must be positioned to the point at which the new datum is supposed to be set.

- Set datum “to absolute position“.



The desired datum shift can be entered as numerical value into the field marked in blue.

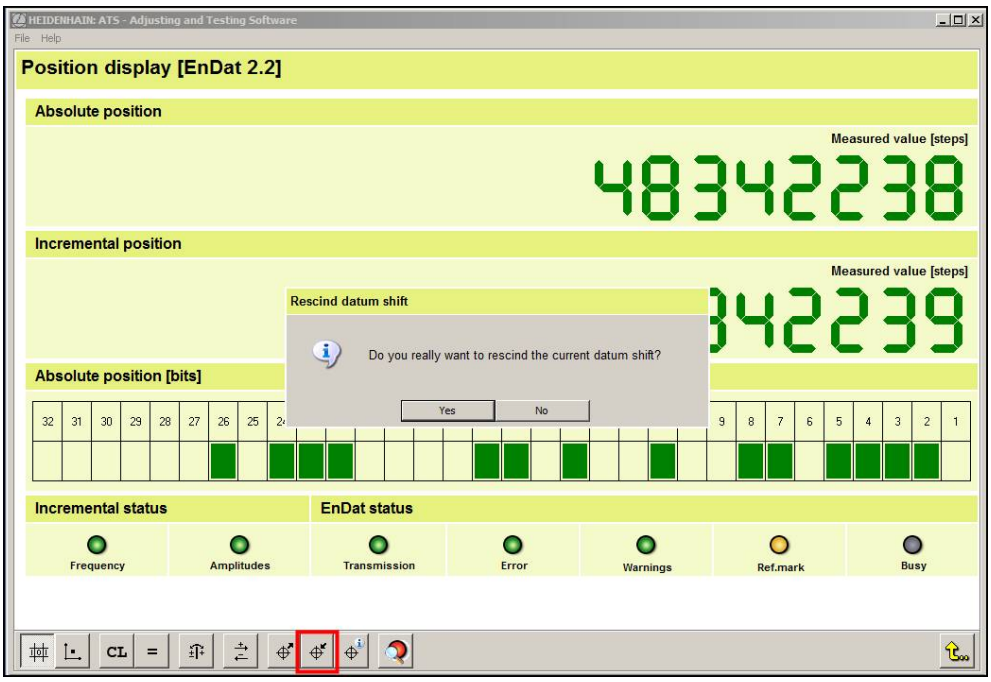


The absolute value can be entered in [steps] or in [µm].

- Press “Set”.
> The datum is saved to the encoder memory.

Cancel datum shift

- Press the “Cancel datum shift” button.
- Press “Yes”.
> The datum shift is reset to the factory default setting.

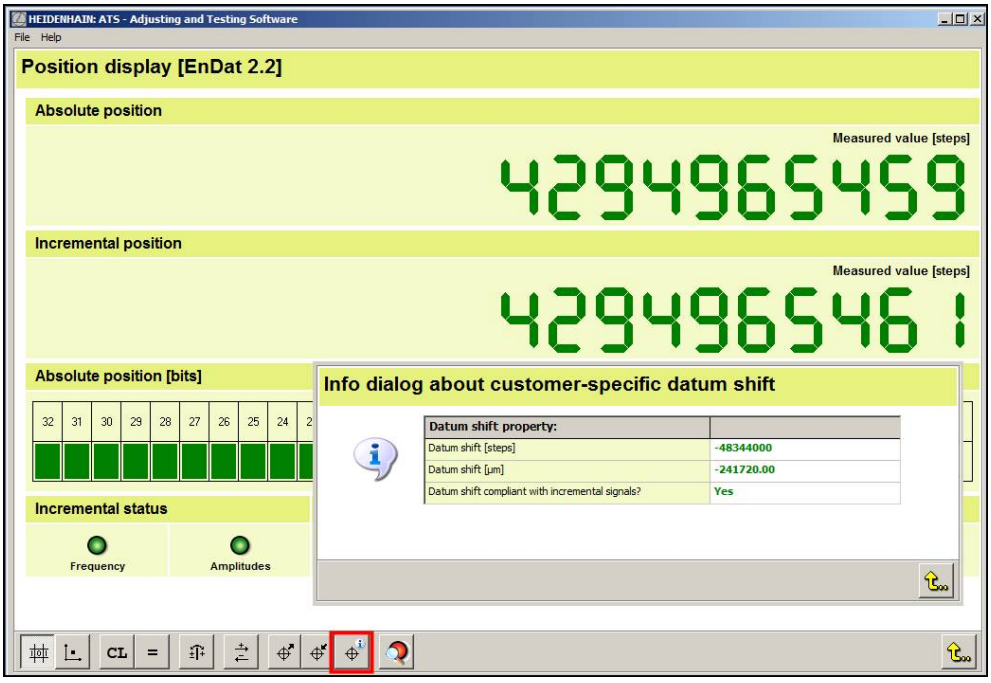


Checking the datum shift via “Information on datum shift” button

- ▶ Press the “Information on datum shift” button

> From the Info dialog you can see the customer-specific datum shift and its properties:

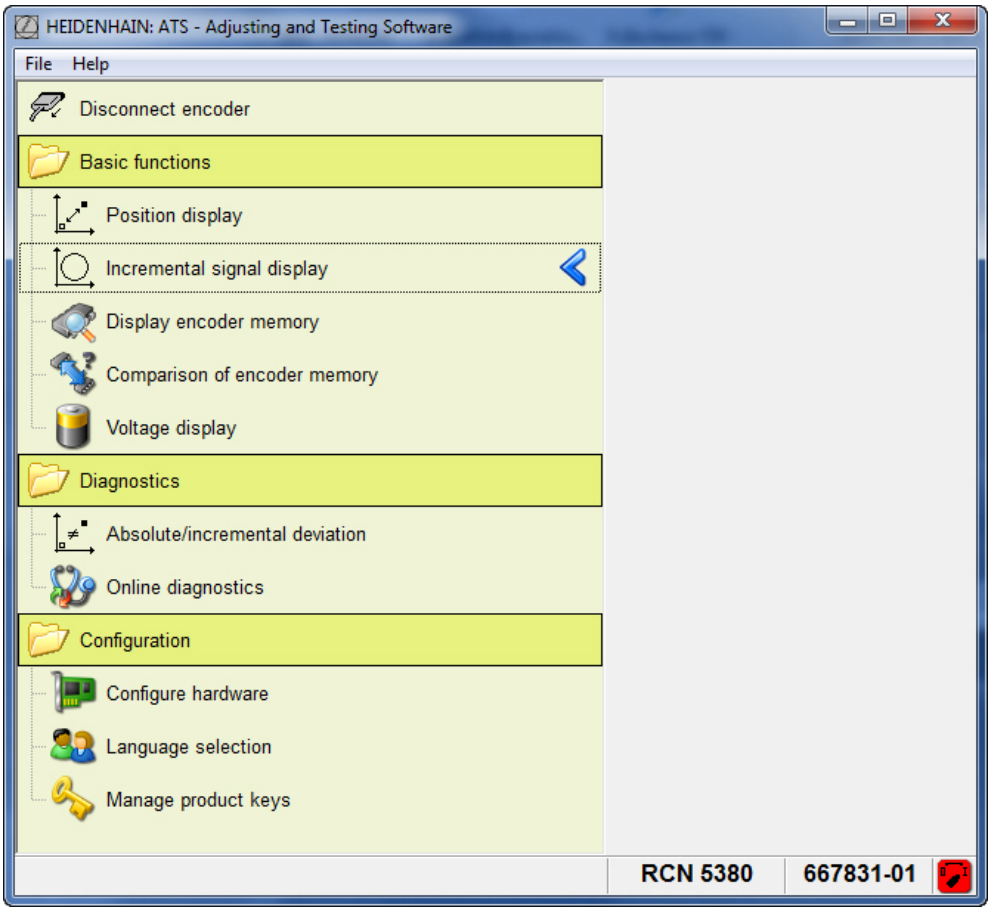
- Datum shift in steps
- Datum shift in µm
- Datum shift compliant with incremental signals: yes or no selected



Checking the datum shift in the encoder memory

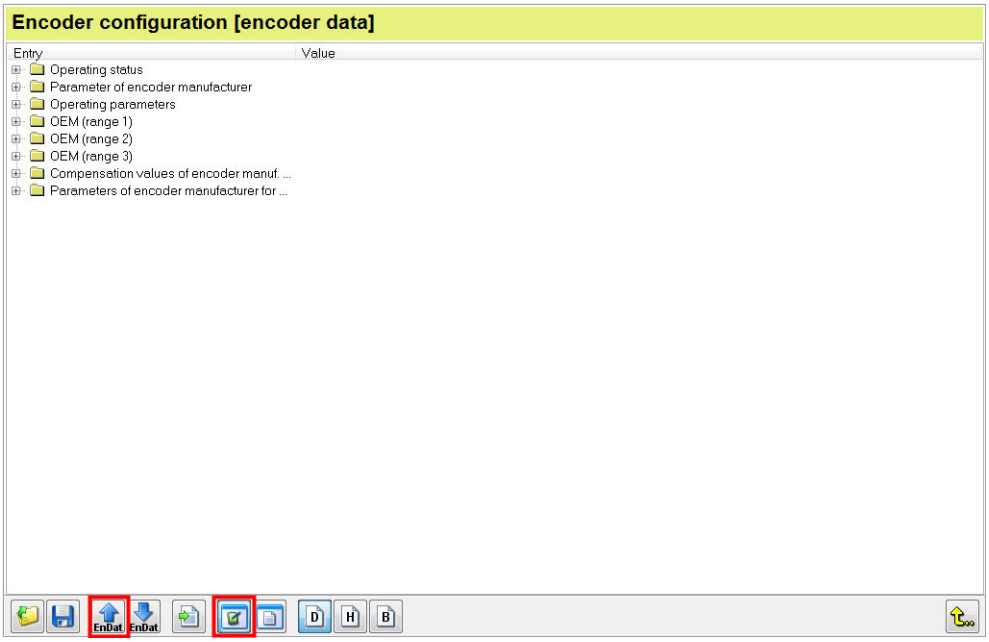
In the "Operating parameters" section of the encoder memory you can check the specified datum shift. For this purpose the configuration of the encoder must be read out first.

- Select "Display encoder memory" from the basic functions list.



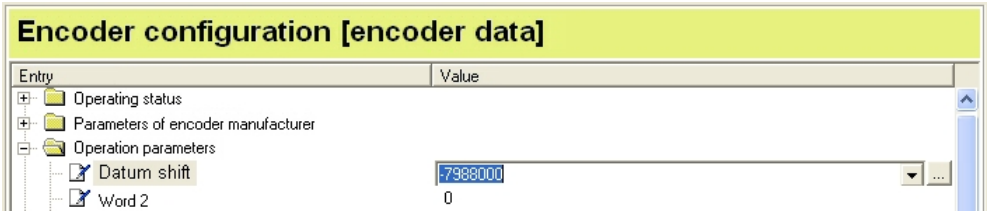
- Press the "function-specific view" button (display in plain language).

- Press the "EnDat" button ("Load encoder configuration from encoder").



> The encoder data is transferred from the encoder memory to the test unit.

▶ Open the tree structure of the "Operating parameters" directory.



In the "Value" column of the table you find the datum shift in measuring steps. For measuring lengths up to 32 bits word 0 and word 1 are used, for measuring lengths up to 48 bits word 2 is used in addition.

Edit datum shift value

Manual editing of the datum shift is only recommended to expert users. To shift the datum, always use the keys "Set datum shift" or "Cancel datum shift" on the "Position display" screen! EnDat-compliant datum shift is only taken into account here.

1. Editing in the datum shift line (word 0):

▶ Select the value for the datum shift.

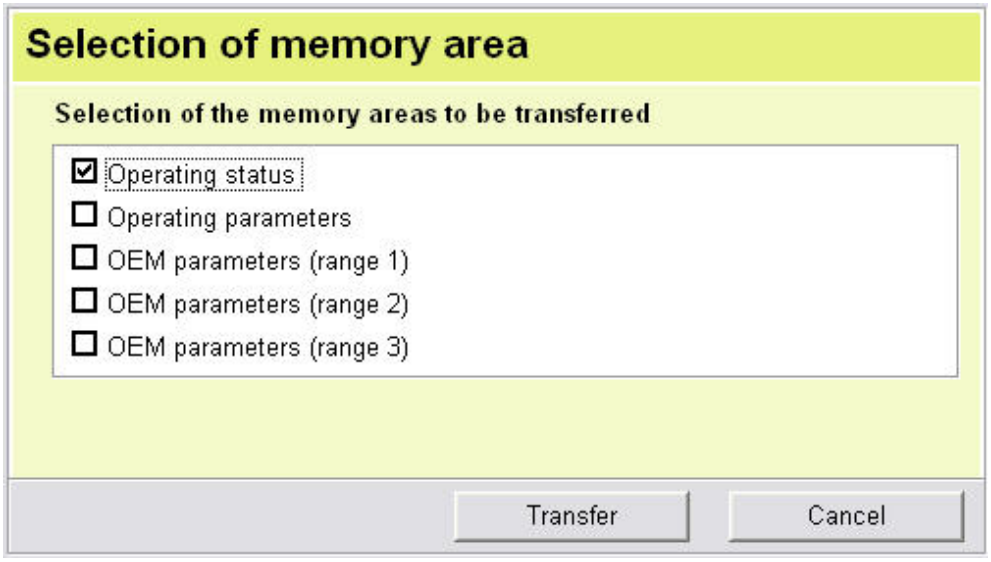
▶ Enter the new value.

If you intend to cancel the datum shift, enter the value 0.

To activate the edited datum shift the encoder configuration must be saved in the encoder.

▶ Press the "EnDat" button ("Save encoder configuration to encoder").

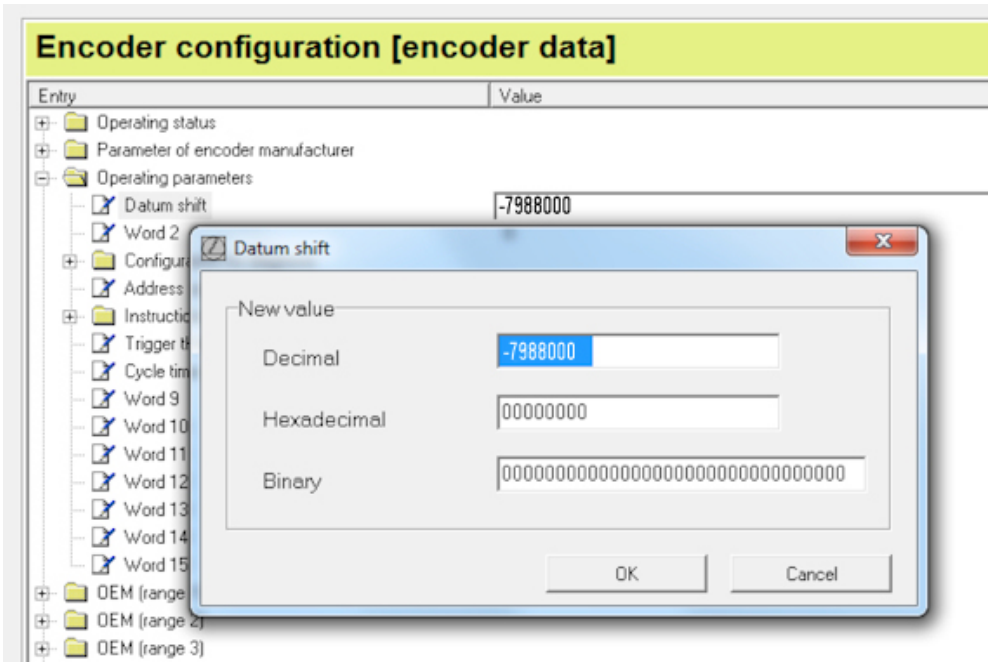
▶ The "Selection of memory area" window is displayed.



- Select the “Operating parameters” memory area.
- Press the “Transfer” button.
- The data is saved in the encoder memory.

2. Editing in the datum shift window:

- Press the button (right from “Datum shift value”).
- The “Datum shift” window is displayed.



- Select a value (decimal, hexadecimal, binary).
- Press “OK”.

i	Entering the value 0 cancels the datum shift.

i	If the datum shift is edited manually in the operating parameters area, the ATS software does not check, whether the entry value is EnDat-compliant!

- Press the “EnDat” button (“Save encoder configuration to encoder”).
- > The “Selection of memory area” window is displayed.

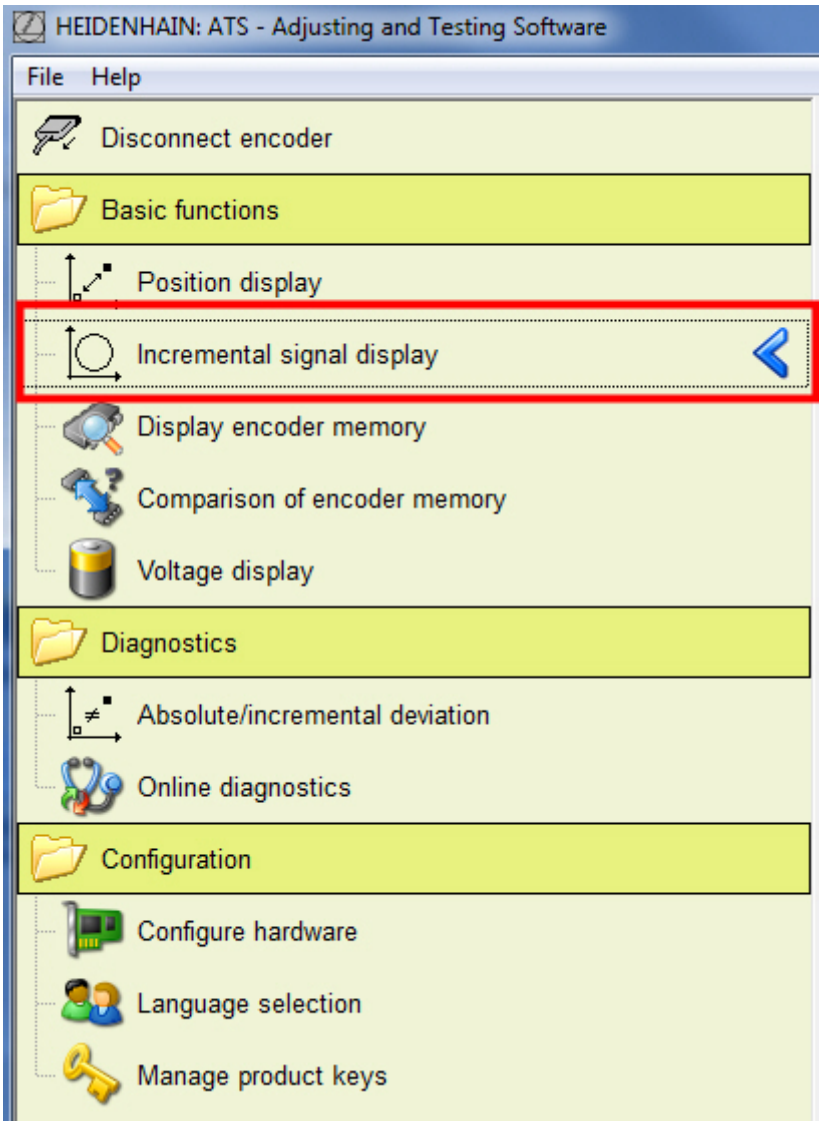
- Select the “Operating parameters” memory area.
- Press the “Transfer” button.
- The data is saved in the encoder memory.

5.3.2 Incremental signal display

In the basic function “Incremental signal display” the incremental signals (sine and cosine) are displayed on the oscilloscope and the signal parameters as bar charts. The tolerances of the incremental signals can be checked here. A number of settings are available to adjust the display to the current testing situation.

> The oscilloscope function is sufficient for most standard tests. Fast signal changes (error spikes, noise, etc.) may sometimes not be detected. For this purpose additional testing equipment, such as a PWM 9 and a digital oscilloscope are required.

- Double-click “Incremental signal display”.



The “Incremental signal display” is a digital storage oscilloscope that can display the relevant incremental signals and standard tolerances. The incremental signals (sine and cosine) can be displayed as circle function (X-Y view) or as sine-cosine diagram (Y-t view).

The display type is selected in the setup menu  . The diagrams can be saved and printed.

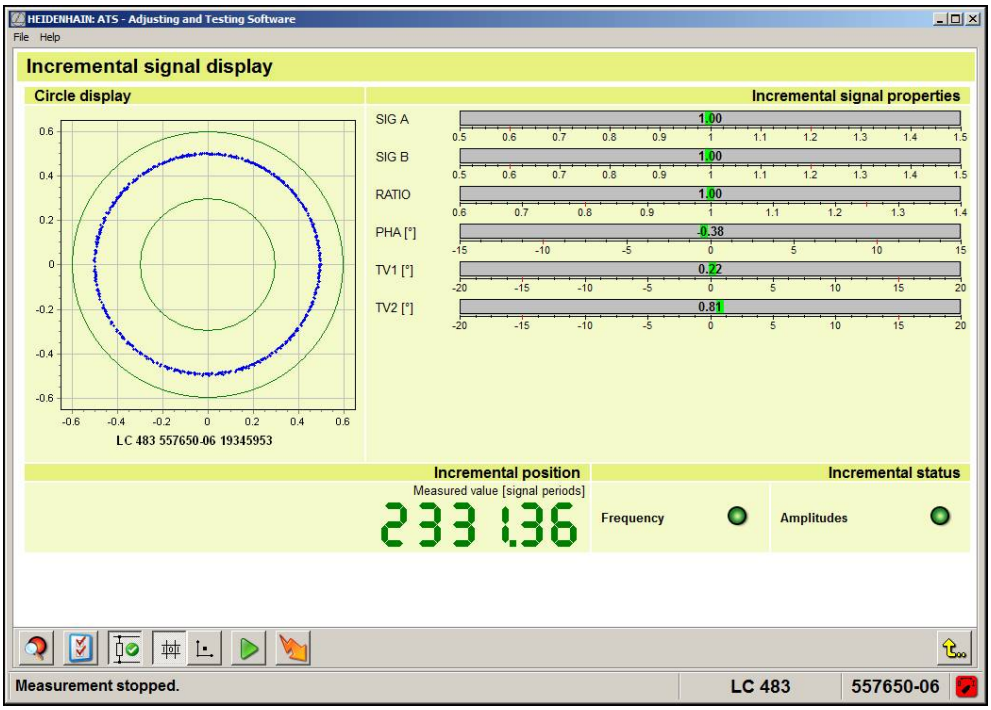
Circular representation (X-Y)

For detailed explanations of terms such as TV1[°], PHA [°], V A/B refer to the section "Screen display for analog signals", page 169.

Information on signal amplitudes and tolerances:

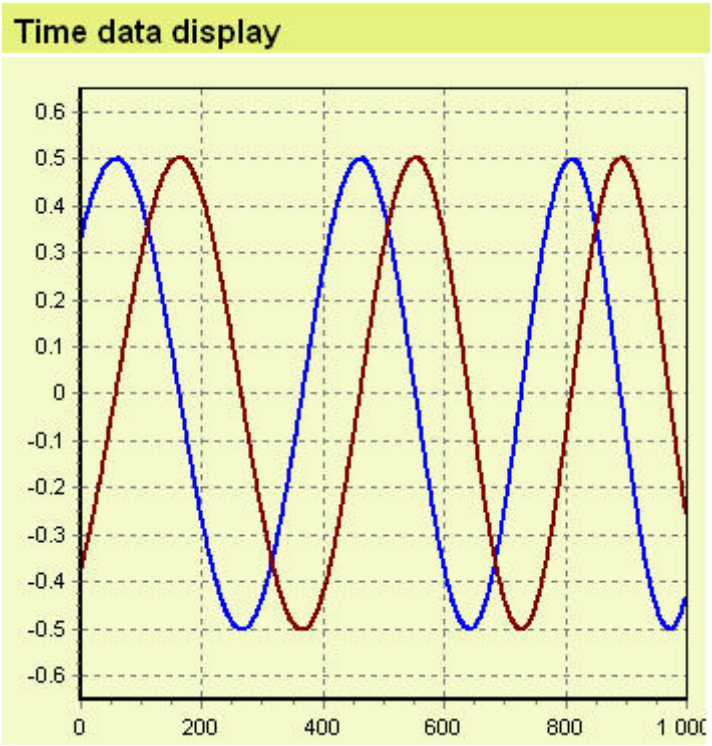
See "Interface description" in the following brochures:

- Interfaces of HEIDENHAIN Encoders, ID 1078628-xx
- Technical information "EnDat 2.2 – Bidirectional Interface for Position Encoders", ID 383942-xx



In the circle diagram, the inner green circle represents the minimum amplitude, the outer green circle the maximum amplitude (tolerance range for the amplitude).

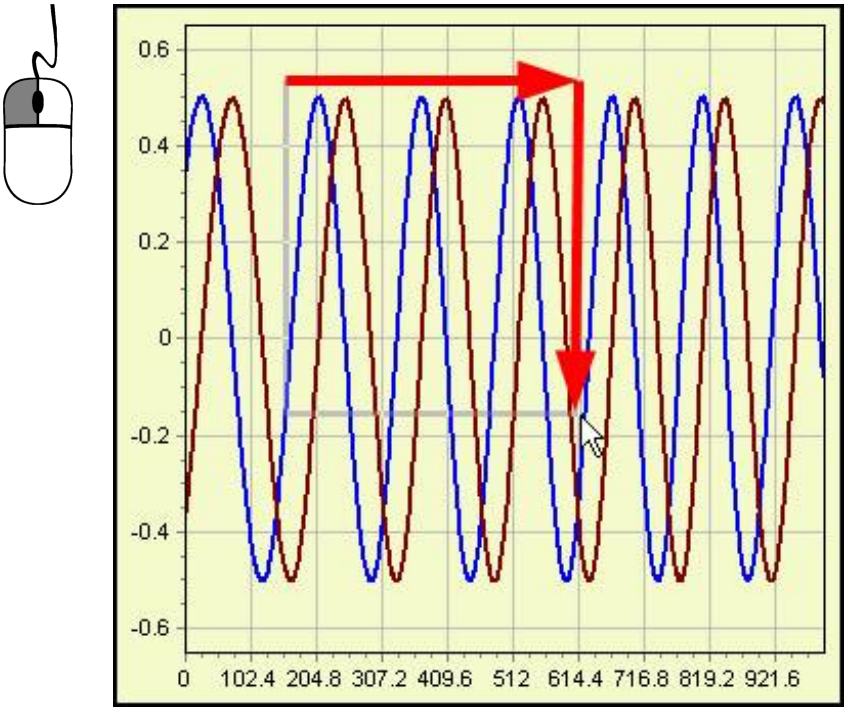
Time data display (Y-t)



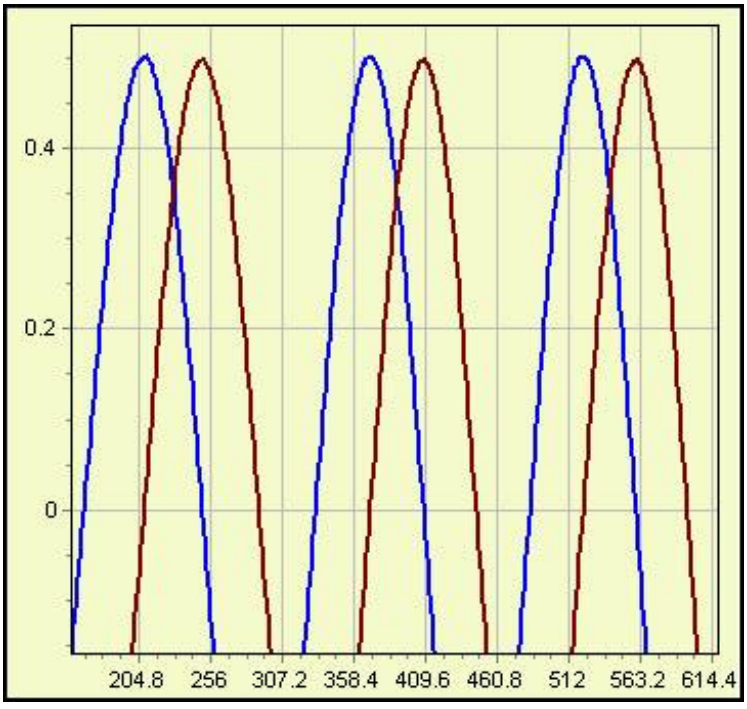
Zoom function

The oscilloscope display features a zoom function that can be controlled by the left mouse button.

Zooming a detail

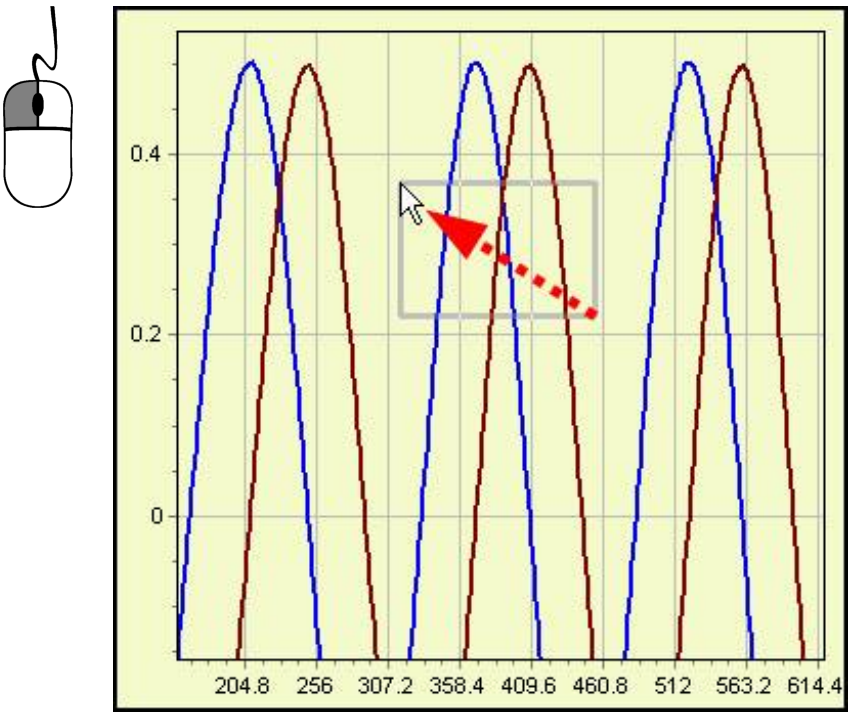


- ▶ Press and hold the left mouse button and – **starting at the upper left** – draw a square over the desired area.
- > This area will be magnified.



The zoomed area can be shifted vertically with the mouse wheel and in x-y direction with the right mouse button.

Unzooming

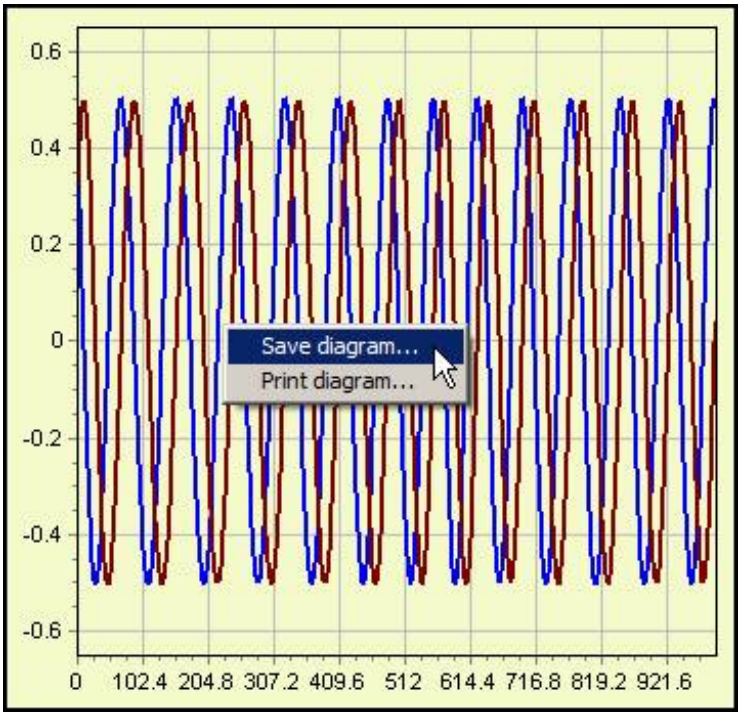


- Press and hold the left mouse button and diagonally move the cursor from the lower right towards the upper left (a short distance is sufficient).

Save or print oscilloscope display

To activate this function click the screen display with the right mouse button.

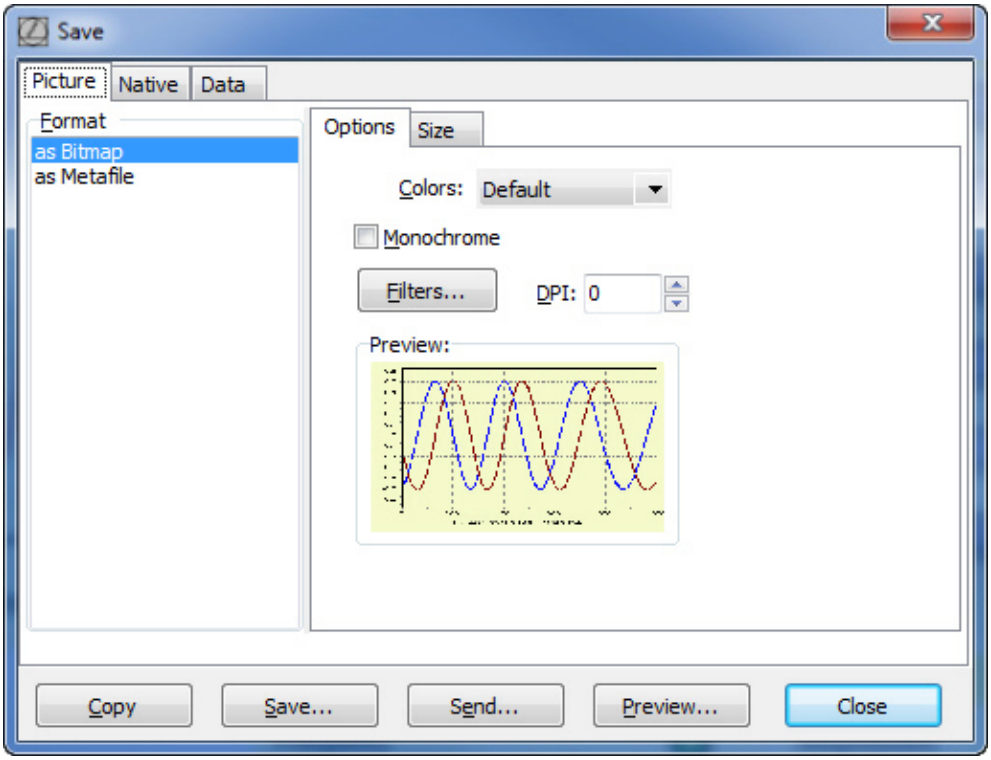
- In the context menu, select “Save diagram” or “Print diagram”.
- Follow the instructions.



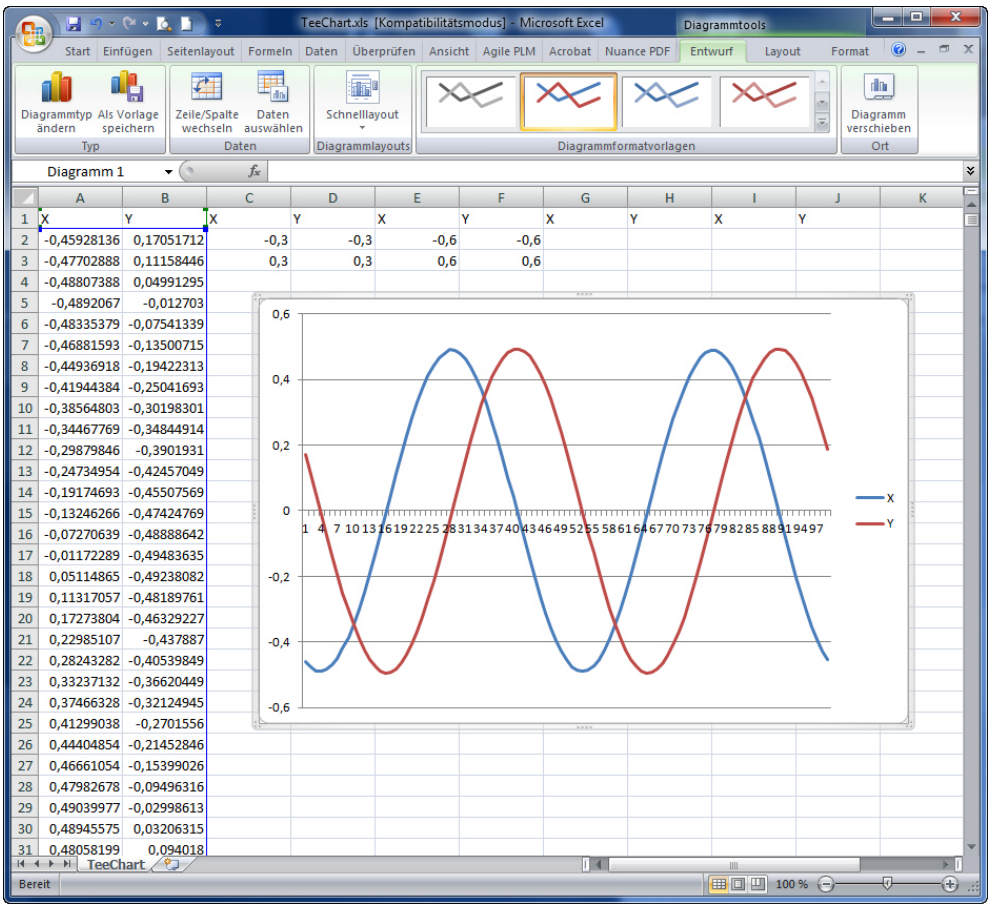
Save diagram: Diagram software TeeChart = independent program integrated into the ATS software

Examples of what you can save when you press the Save button:
Picture: Change graphics format (image format [.bmp or .wmf], diagram size, color, type, etc.)
Native: Data format binary, text or XML (software development tool for graphics programming)
Data: Format for data storage (text, XML, HTML, Excel files, etc.; heading, number format, tabs, comma, etc.)
Series: Which of the recorded data are to be used for the diagram? (All data or select certain data)

Data can be copied [Copy], saved [Save], sent [Send] or displayed [Preview].

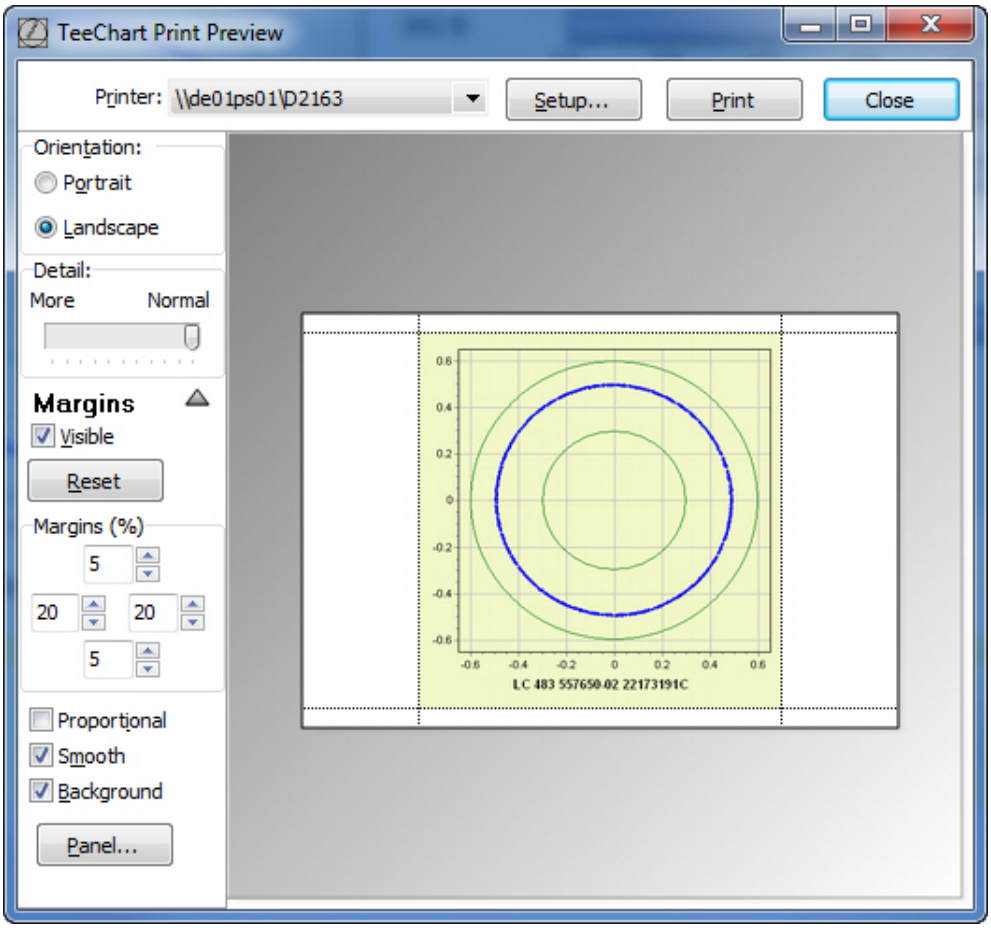


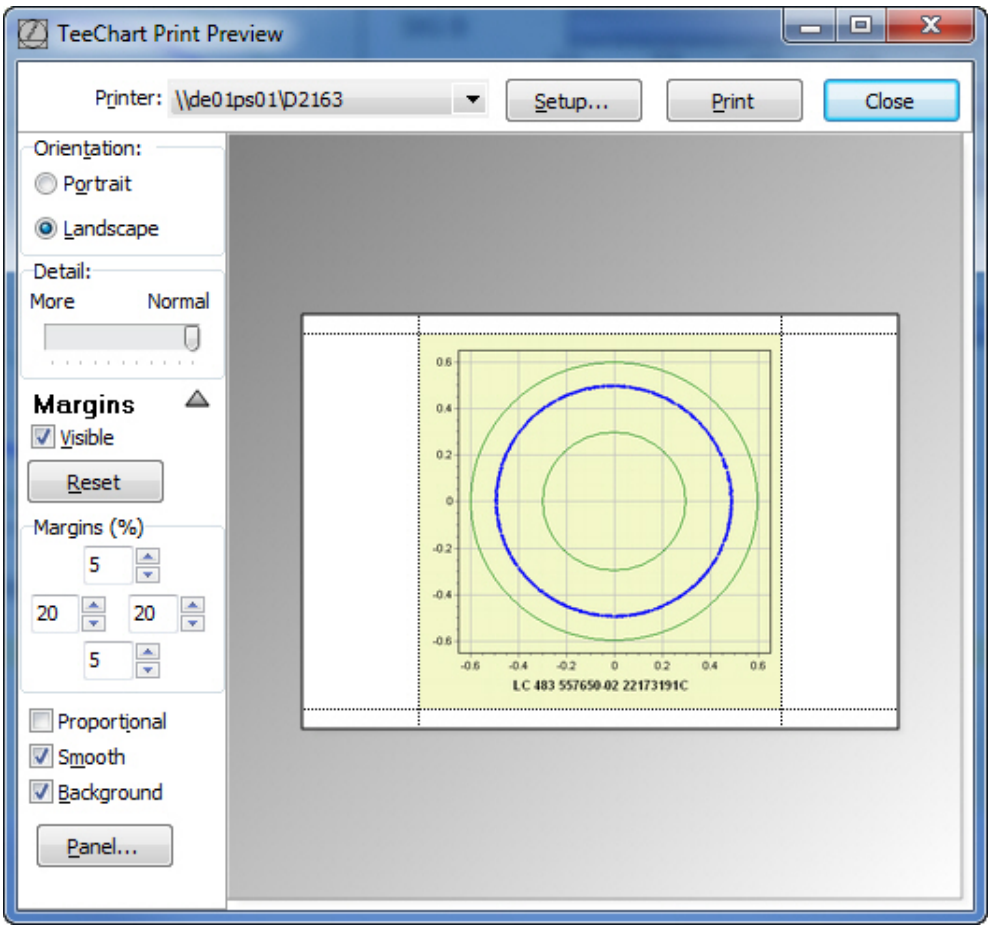
In the example below signal data were transferred in Excel format and an Excel diagram was created from a defined number of data points (Excel functionality). The number of data points and the detail can be freely selected in Excel (e.g. to document signal drops or interference on the output signal).



Print diagram

The diagram to be printed can be resized in the Setup of the diagram software (TeeChart Print Preview = independent program integrated into the ATS software). Selections: Portrait/landscape orientation, Margins, Proportional, Smooth (antialiasing and color) and Background color. Press the "Panel..." button to make further settings.



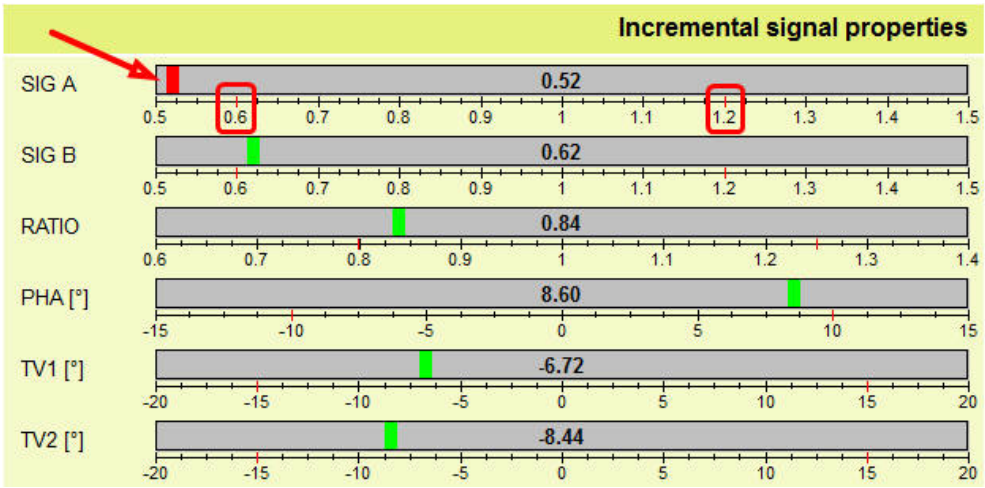

TeeChart Print Preview
Printer: \\de01ps01\D2163
Setup...
Print
Close
Orientation:
Portrait
Landscape
Detail:
More
Normal
Margins
Visible
Reset
Margins (%)
5
20
20
5
Proportional
Smooth
Background
Panel...
LC 483 557650.02 22173191C

Characteristics of the incremental signals (bar graphs)

If the signal tolerances are within the specification (for tolerances see interface description, e.g., in the product brochure), the bars are displayed in green color. They turn red when the tolerance is exceeded. The position of the colored markers ("bars") indicates the measured value on the scale. The current value is also displayed as numerical value. (In the example, signal B is out of tolerance and therefore displayed in red color.) The image below shows a red bar indicating that a tolerance was exceeded.

Red markings on the scaling (see red boxes in the picture below) show the limits of the tolerance range.

Information on the scaling and the names of the bars are displayed in context boxes that open when you position the mouse pointer on a designation of a bar.

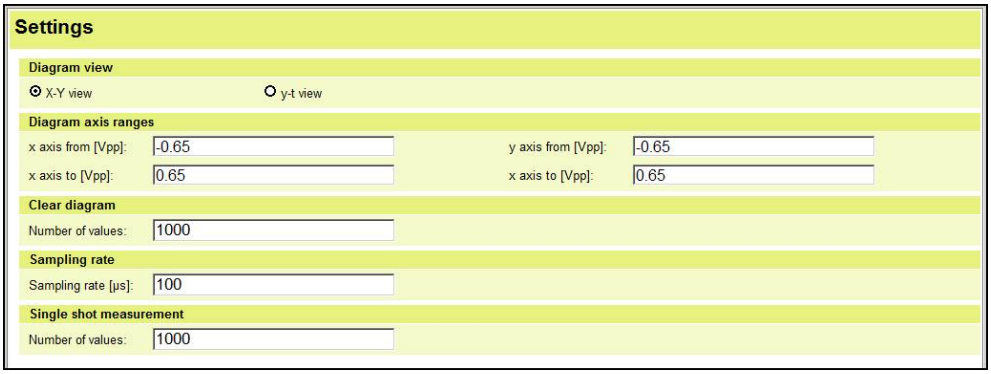


Description of the buttons

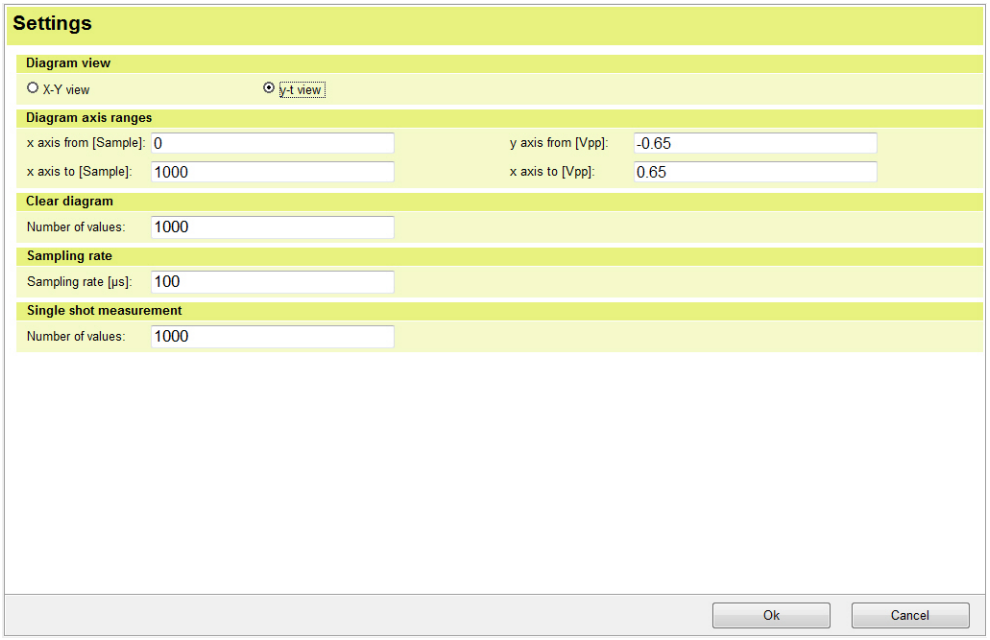
In the Service option, the following buttons are additionally active:

This button opens the "Settings" window. You can make changes in five categories.

Reset to factory default setting is not possible! The two pictures below show the factory default of the Settings.



Settings for X-Y view



Settings for Y-t view (sinusoidal signals)

Diagram view: X-Y view (circle or Lissajous figure) or Y-t view (sinusoidal signal)

Diagram axis ranges: Scaling of the axes

Clear diagram: The diagram data is deleted as soon as the value entered here has been exceeded (minimum value = 100).

Sampling rate: Sampling rate of the oscilloscope (min. 10 µs, max. 65535 µs)

Single shot measurement: Number of measuring points for single-shot measurement

Stop measurement

Start measurement

Activate single shot measurement (The screen freezes, as soon as the number of measured value entered in the "Settings" windows has been reached.)

Tolerances of the incremental status display

Error display = "Red LED" for

- Amplitude too small: typically 0.20 V_{PP} (possible as of 0.25 V_{PP})
- Amplitude too large: typically 1.30 V_{PP} (possible as of 1.25 V_{PP})
- Frequency exceeded: > 2.0 MHz possible

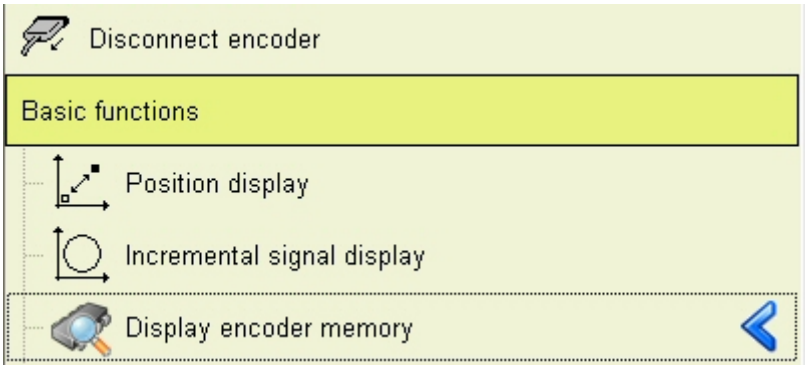
The trigger threshold of the incremental status display is not identical with the bar graph (red bars). The red markings on the scaling of the bar display represent the tolerance limits as per the general specification of the output signals (data in product documentation); the incremental status display is the functional limit of the device!

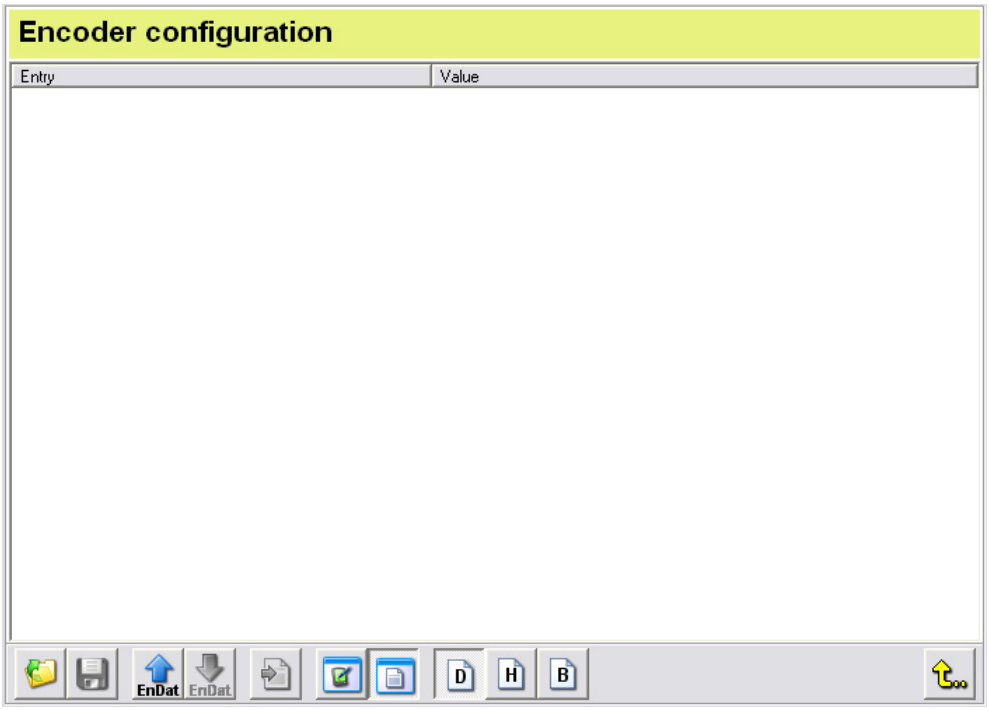
5.3.3 Display encoder memory

Absolute HEIDENHAIN encoders with EnDat interface have an internal encoder configuration memory. The layout of the configuration memory and the meaning of the individual data words are described in the interface specification entitled "EnDat Interface: Bidirectional synchronous serial interface for position encoders." This specification is available from HEIDENHAIN as a separate document. Therefore, this manual does not provide explanations of the individual memory areas and data words.

Calling the encoder configuration

- Click the function "Display encoder memory".





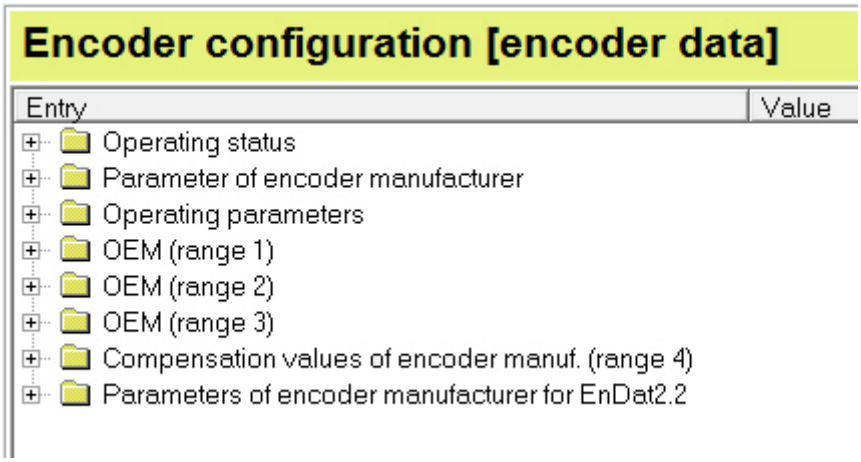
> The "Encoder configuration" window is displayed.

Loading the encoder configuration from the encoder

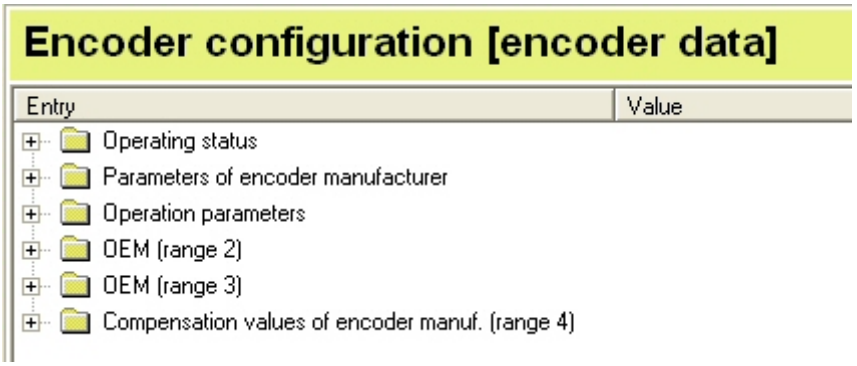
- ▶ Press the "EnDat" button ("Load encoder configuration from encoder").

> The encoder configuration is transferred **from the encoder memory** to the computer.

> The encoder data are displayed in a tree structure.



Display of the tree structure with EnDat 2.2 encoder connected



Display of the tree structure with EnDat 2.1 encoder connected

These tree views are examples. The display may vary depending on the encoder and interface specifications and on the product key used.

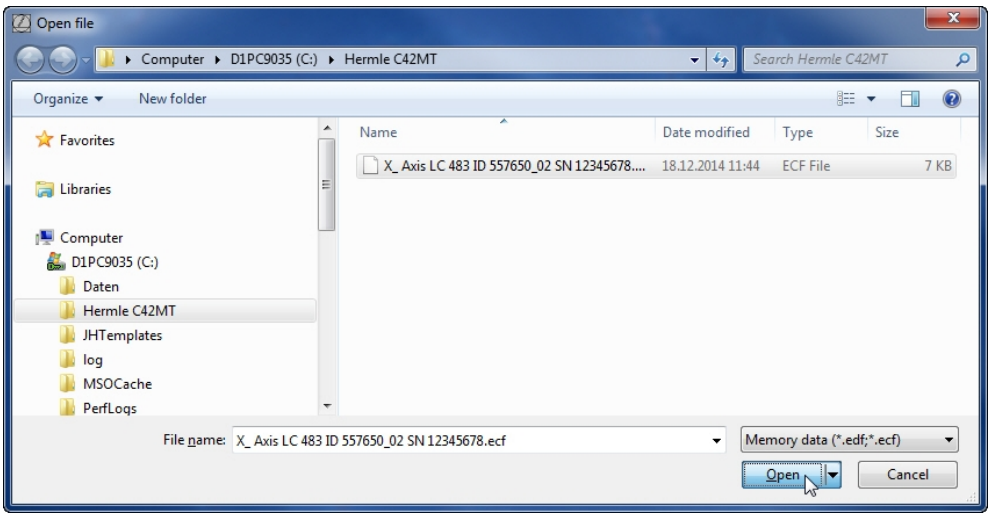
Tool bar for encoder configuration

Loading the encoder configuration from a file

- ▶ Press this button.

> The "Open file" window appears.

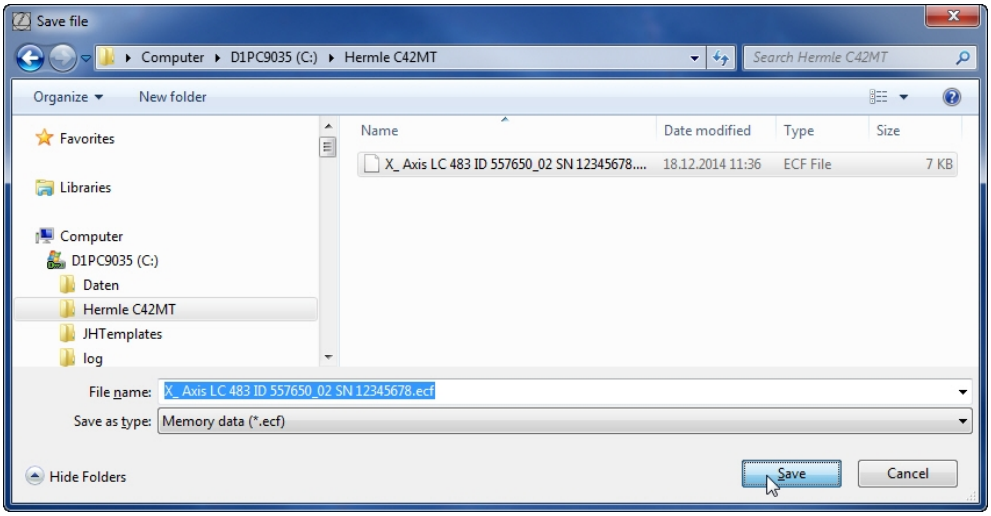
Similar to the Windows Explorer you can e.g. search for and open backup files. Only files with the extensions *.edf and *.ecf can be read.



Saving the encoder configuration to a file

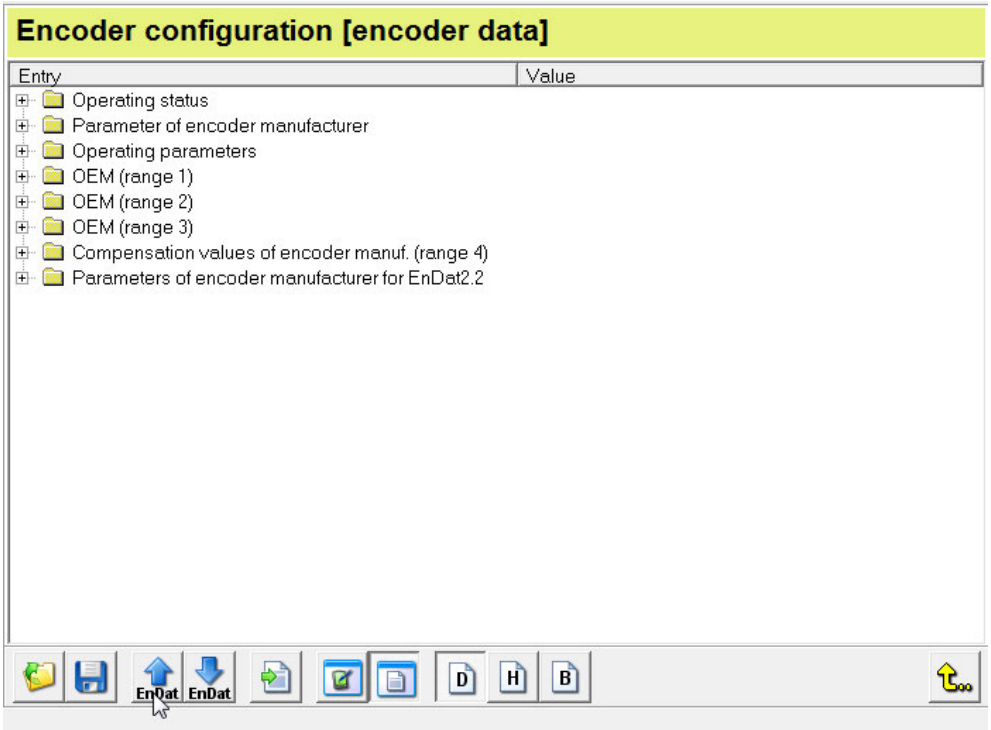
- ▶ Press this button.
- > The current encoder configuration is backed up on the computer.

First, the data needs to be transferred from the encoder to the computer; see next step. When the "Save file" window is displayed you can create a new folder to save the encoder configuration data (backup) on your computer. The data is stored as *.ecf or *.edf files.



Load encoder configuration from encoder

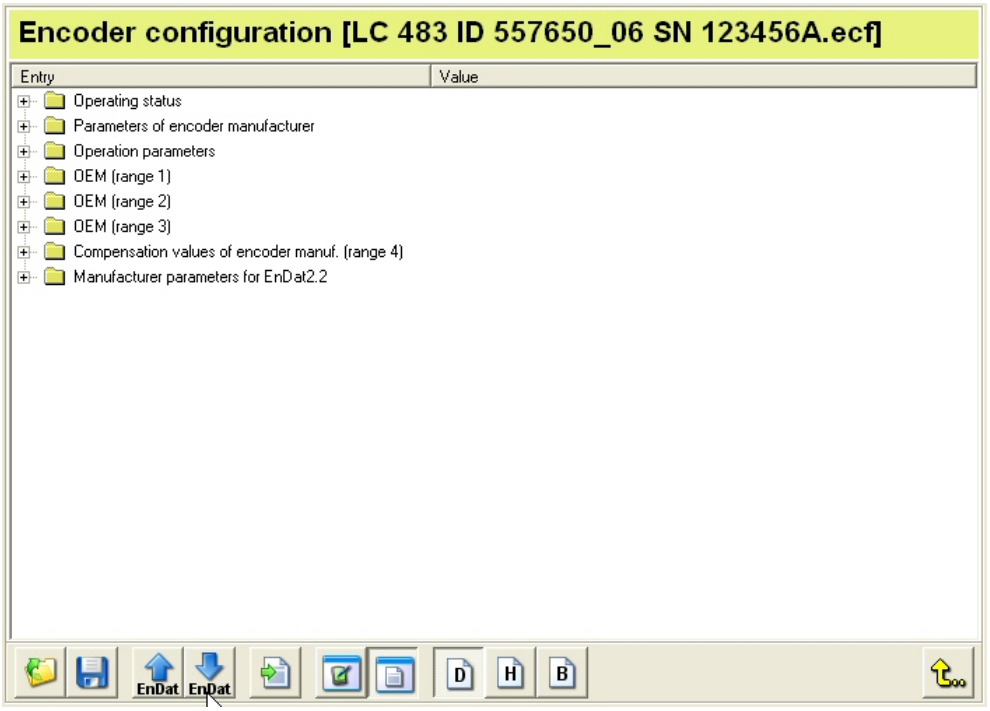
- ▶ Press the "Load encoder configuration from encoder" button.
- > The data saved in the encoder is transferred to the PC.
- > The tree structure of the encoder configuration is displayed (see sections "Display encoder memory" and "Loading the encoder configuration from the encoder").



HEIDENHAIN recommends backing up the encoder data on the PC (see section “Saving the encoder configuration to a file”).

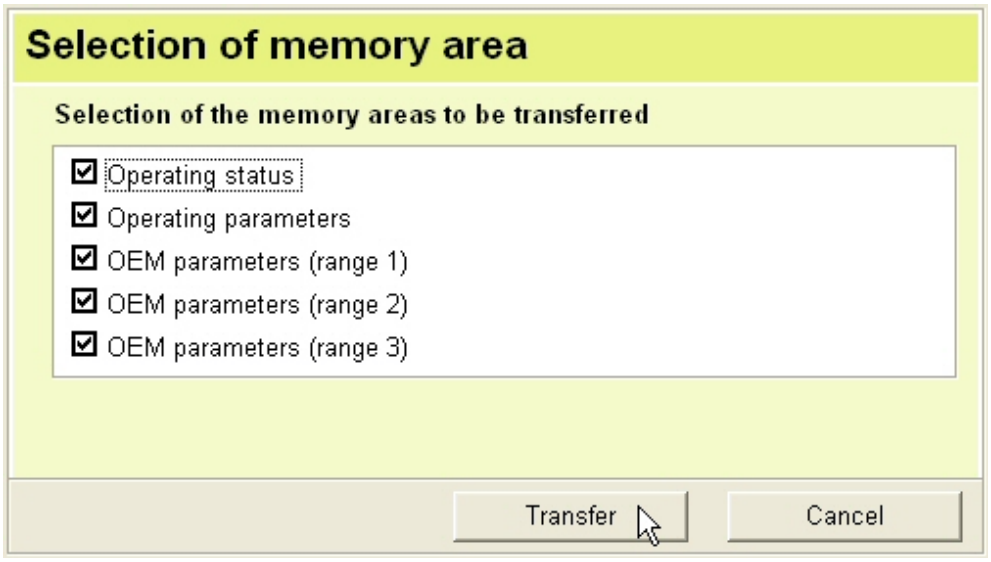
Saving the encoder configuration in the encoder

- ▶ Press the “Save encoder configuration to encoder“ button.
- > An encoder configuration stored in the computer is transferred to the encoder where it is saved to selected memory areas.

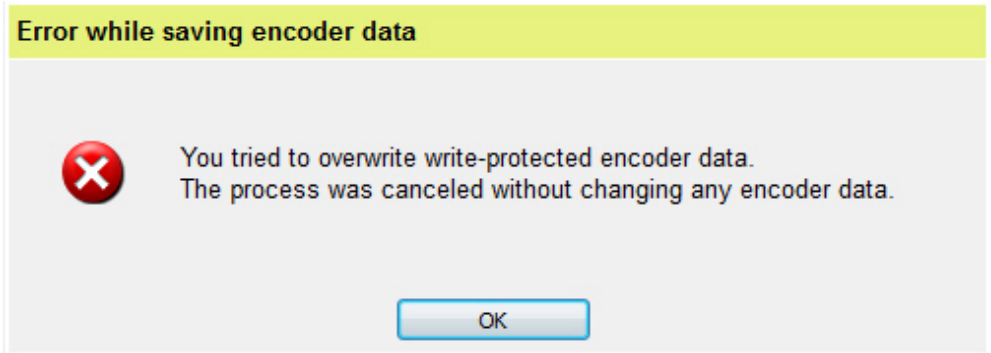


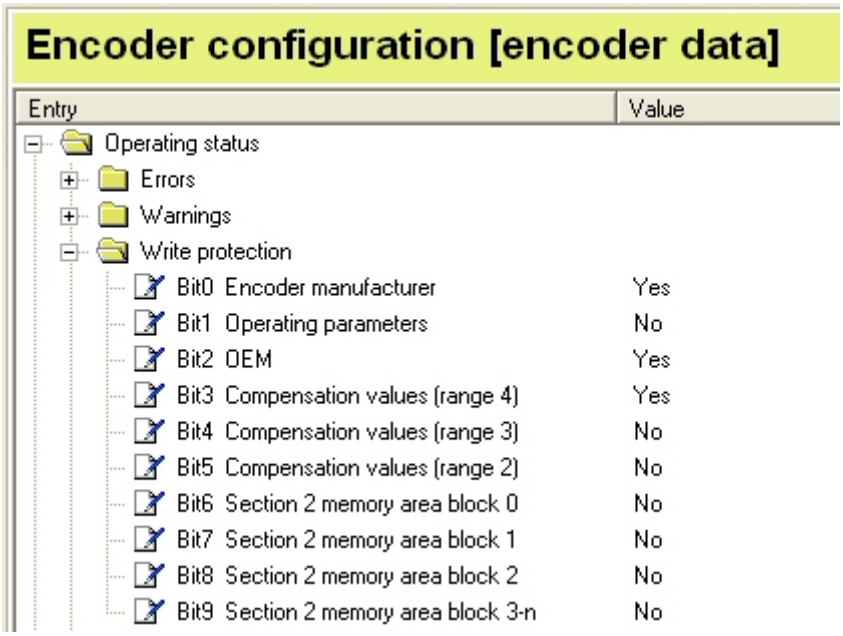
- Press this button.
- > Define the portions of memory to be transferred in the "Selection of memory area" box.

- Press the "Transfer" button.
- > The "new" data are automatically written into the appropriate memory areas.



Some memory areas may be write-protected (can be seen from Encoder configuration –> Operating status –> Write protection). Any attempt to write data to a write-protected memory area generates an error message.



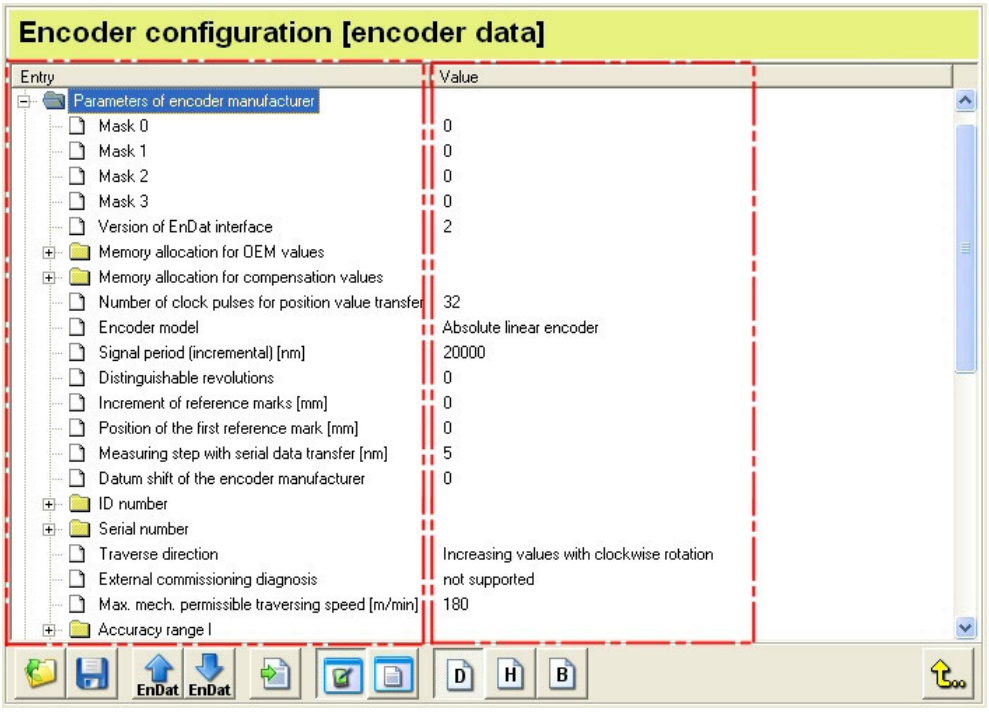


Encoder configuration

- ▶ Press this button.
- > The tree view is reduced to the main directories (default setting).

View of the encoder configuration

The display of the configuration data consists of two columns. The left side (Entry) shows the available memory areas in a tree structure. On the right side (Value) the data words assigned to the selected memory areas are displayed. The display may be function-related or data-related.



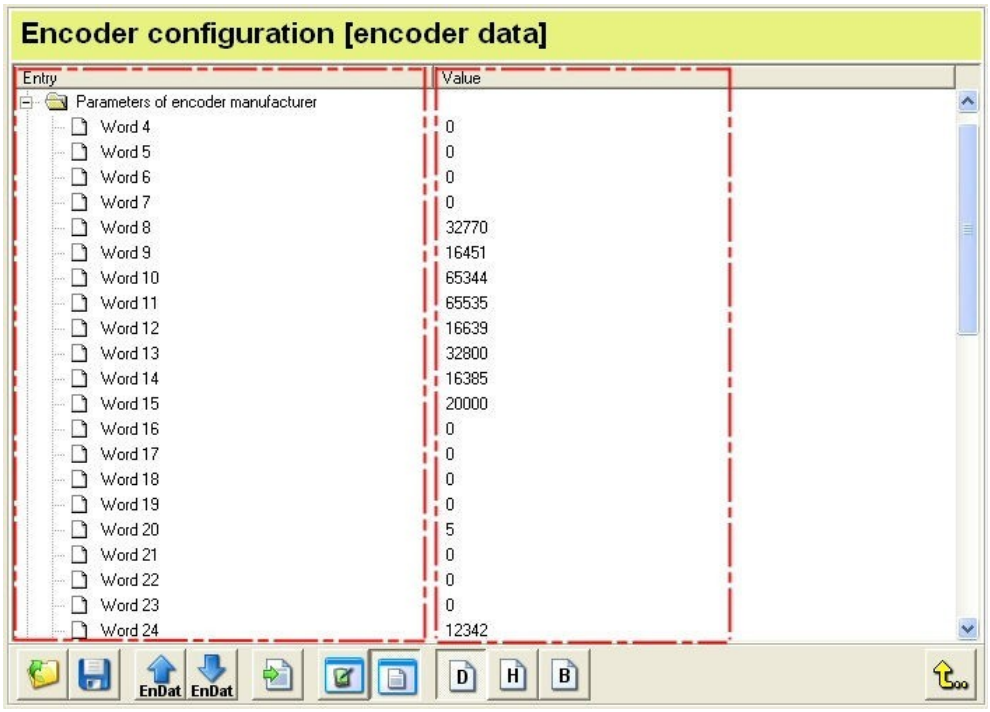
Function-related view of encoder configuration data

- ▶ Press this button.
- > As far as possible, the data words and values are interpreted according to the EnDat specification and displayed in plain language.

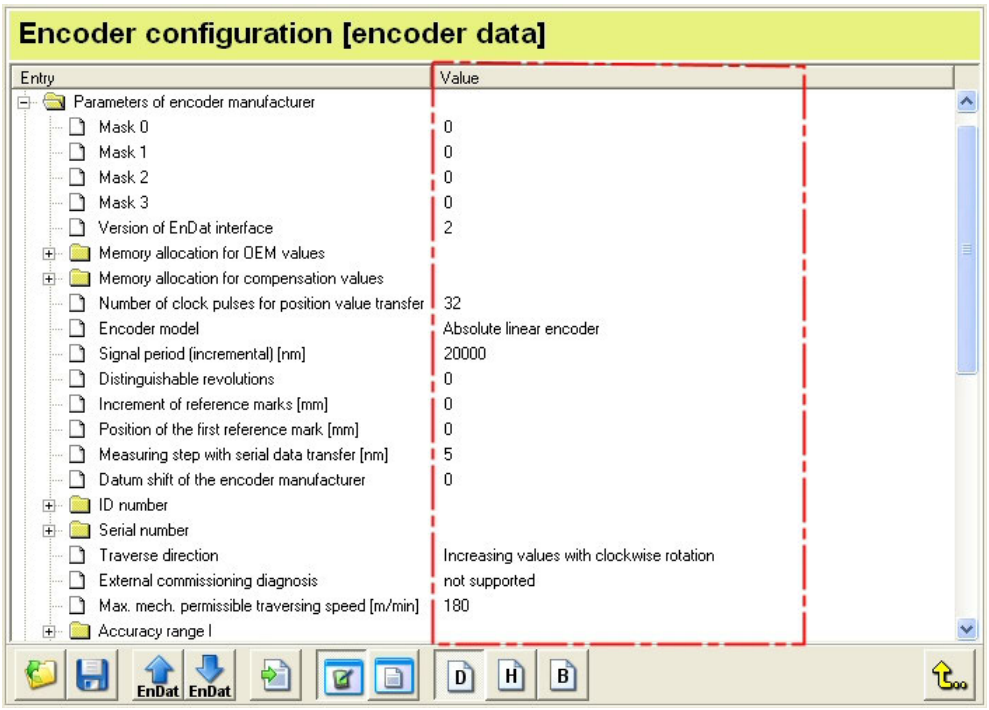
The function-related view is best suited to check the memory entries. See the "Decimal value display" screenshot below.

Data-related view of encoder configuration data

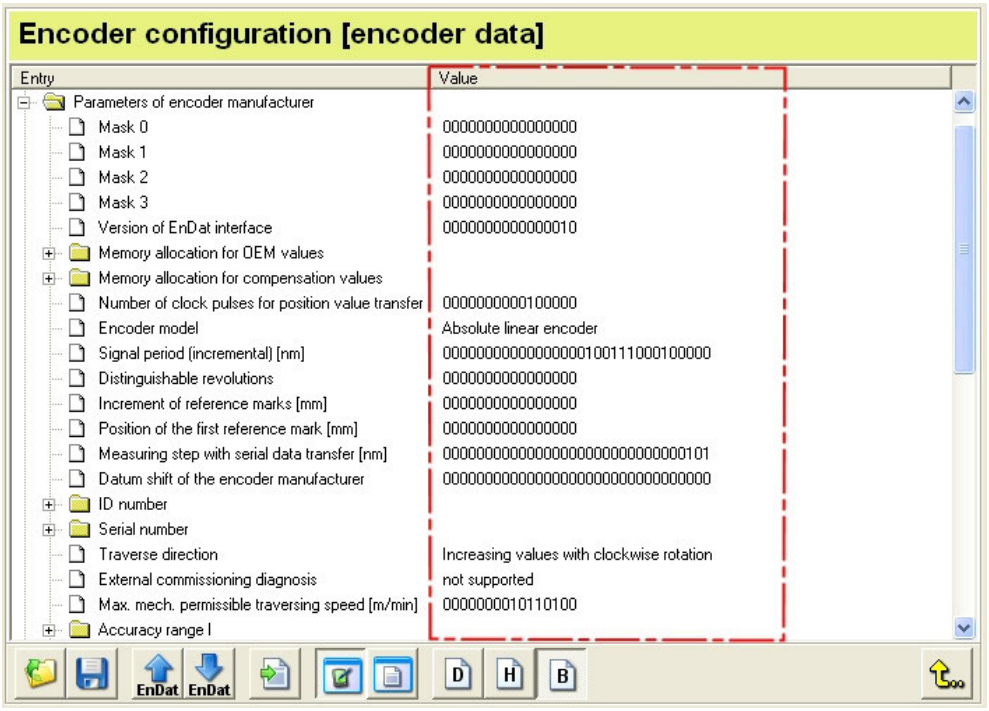
- ▶ Press this button.
- > The numerical values of the data words are displayed (data-related view).



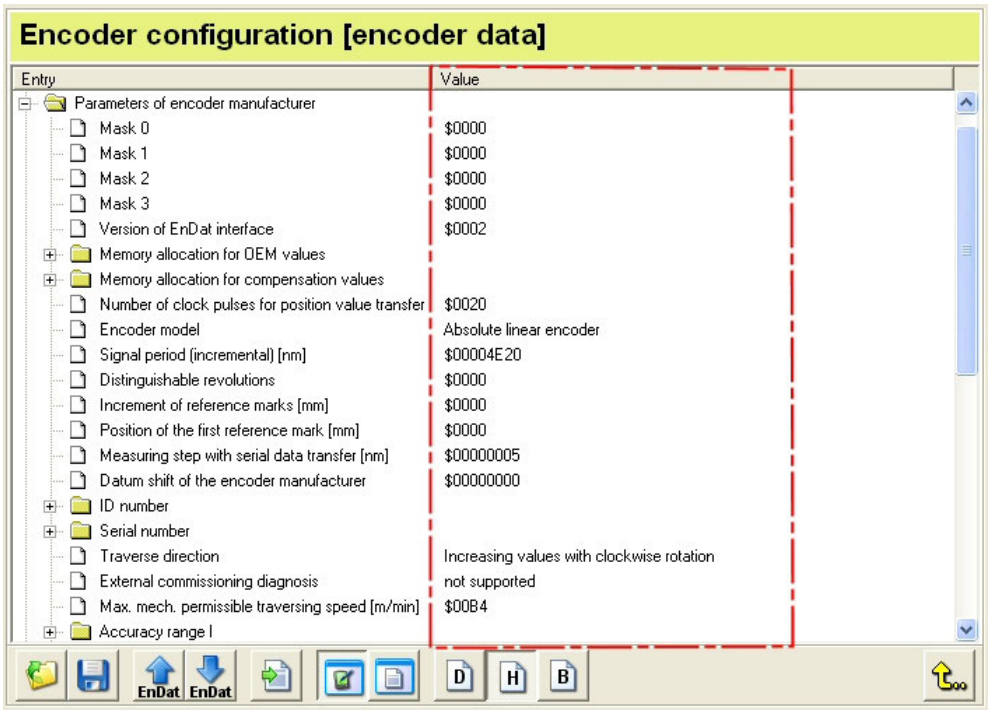
Decimal value display



Binary value display



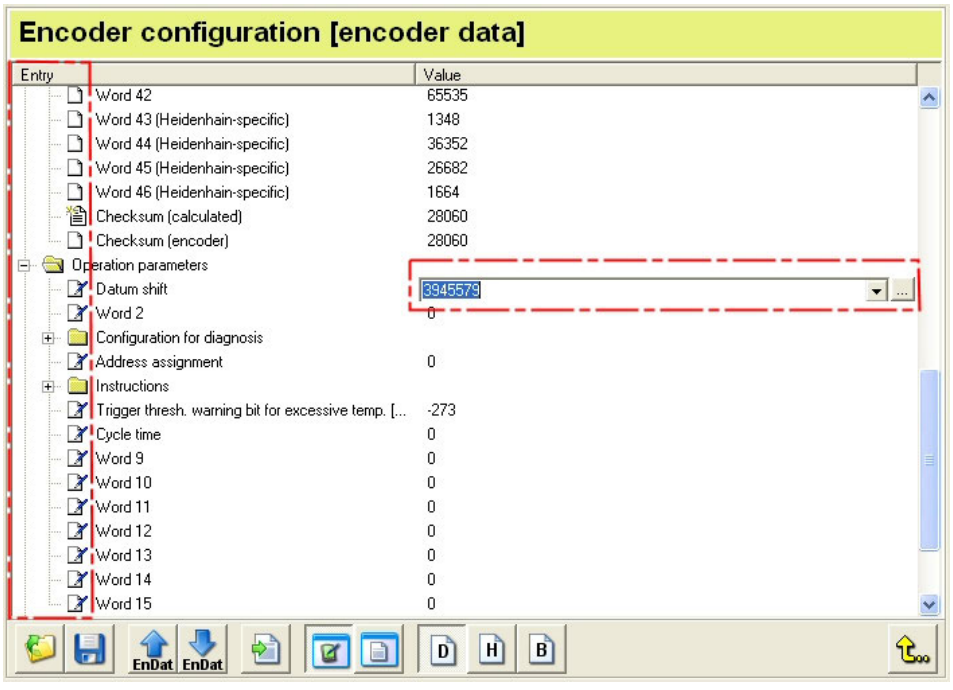
Hexadecimal value display



Edit encoder configuration

First option:

- Click the value to be edited with the left mouse button (in the example: Datum shift).



 Value can be edited.

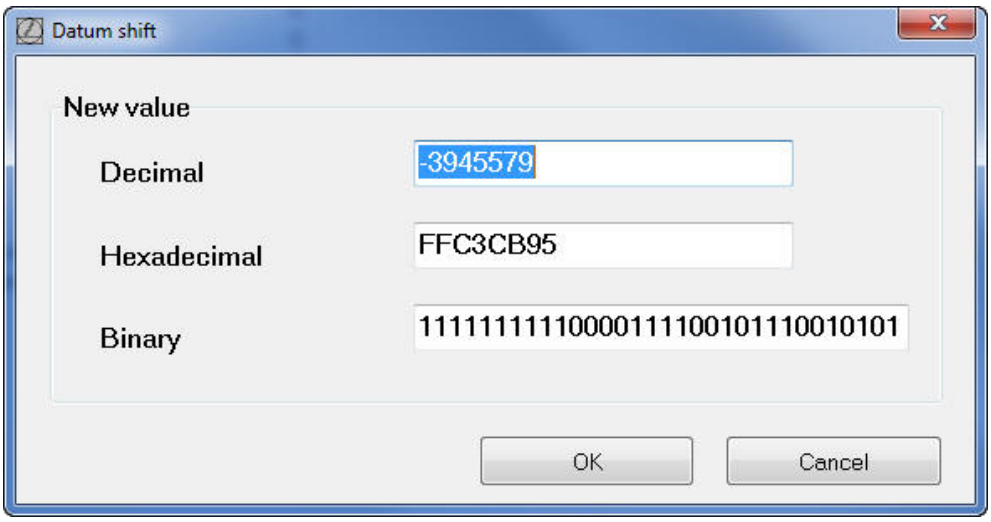
Value cannot be edited.

Value cannot be edited, since it is the result of a calculation or it consists of several words for easy-to-read display (e.g. ID 557650-06).

> The drop-down list is displayed.

- Press the button to the right of the drop-down list.

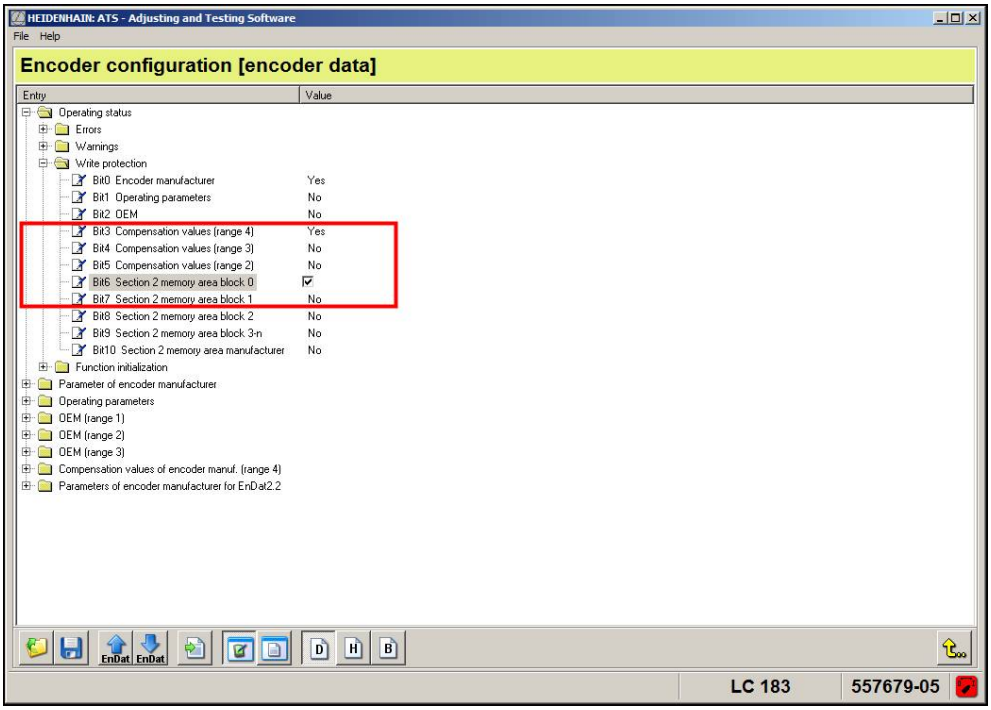
> The editor window is displayed.



Second option:

- Click the arrow to open the list from which you can select predefined values.

Third option:



- Select Yes or No

(tick in checkbox = yes; empty checkbox = no)

NOTICE

When you have successfully edited the encoder configuration on your computer, press the EnDat button to transfer it to the encoder. 

Only then will the data in the encoder memory be active (see section “Saving the encoder configuration in the encoder”). The old data will be overwritten. We recommend that you back up the “old” encoder configuration.

Setting write protection for memory areas

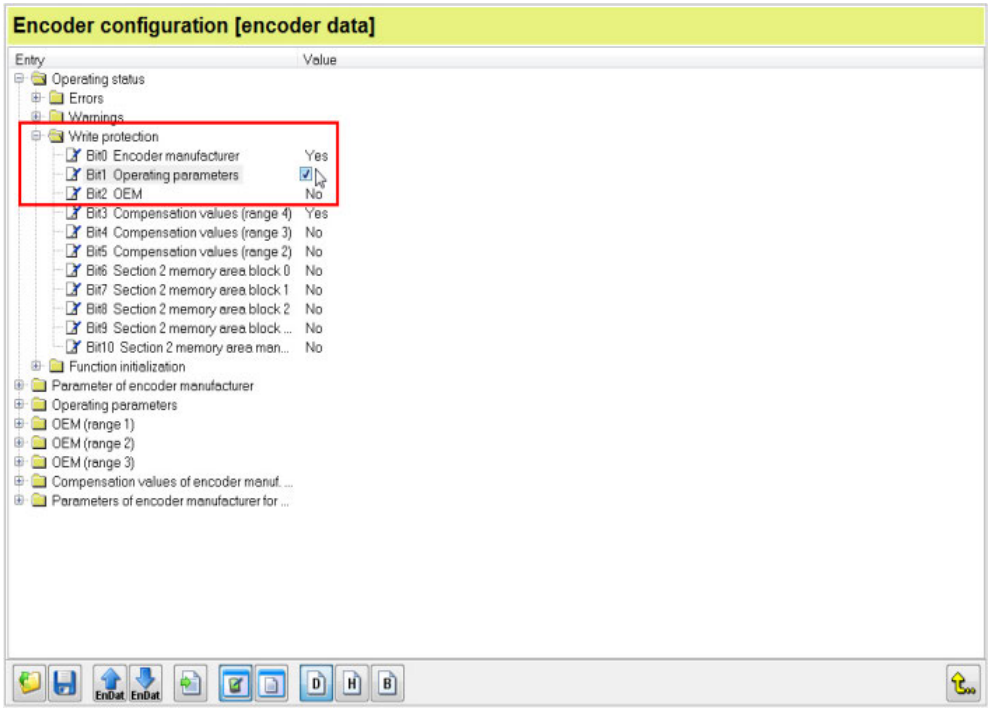
For EnDat encoders there is the possibility of assigning a write protection to the memory areas so that the data is protected from unintended editing. This is necessary, particularly to ensure machine safety and system reliability. HEIDENHAIN therefore protects the ”parameters of encoder manufacturer” memory area with a write-protection bit. Among other information the encoder adjustment data are stored here; editing these data would render the encoder inoperable. We recommend protecting machine-relevant parameters in the OEM memory areas and the “datum shift” (operating parameters) after parameter entry.

Once the encoder configuration has been saved in the encoder, write protection cannot be canceled. Only HEIDENHAIN Traunreut or an authorized HEIDENHAIN representation can cancel write-protection!

Example: Setting write protection

 means “YES” = Write protection is set

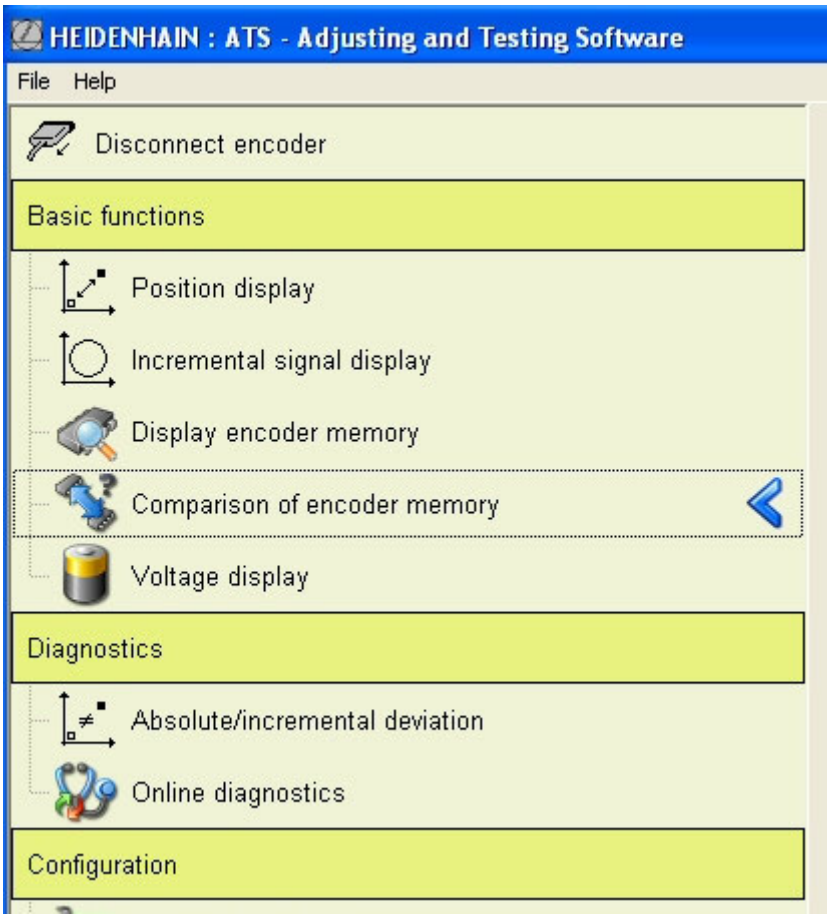
- ▶ Press this button.
- > The data is transferred blockwise.
- > Write protection is active.



5.3.4 Comparing contents of encoder memories

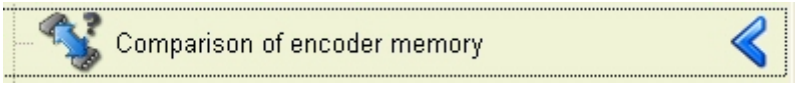
With this function you can compare two saved encoder configurations or the currently connected encoder memory to a saved configuration.

> This comparison function is only recommended to advanced users!



For the comparison function, the absolute encoder (EnDat, Fanuc, Mitsubishi) must be connected to the PWM. Precondition for memory comparison: The encoder configuration (reference file) to be compared must be available on the computer.

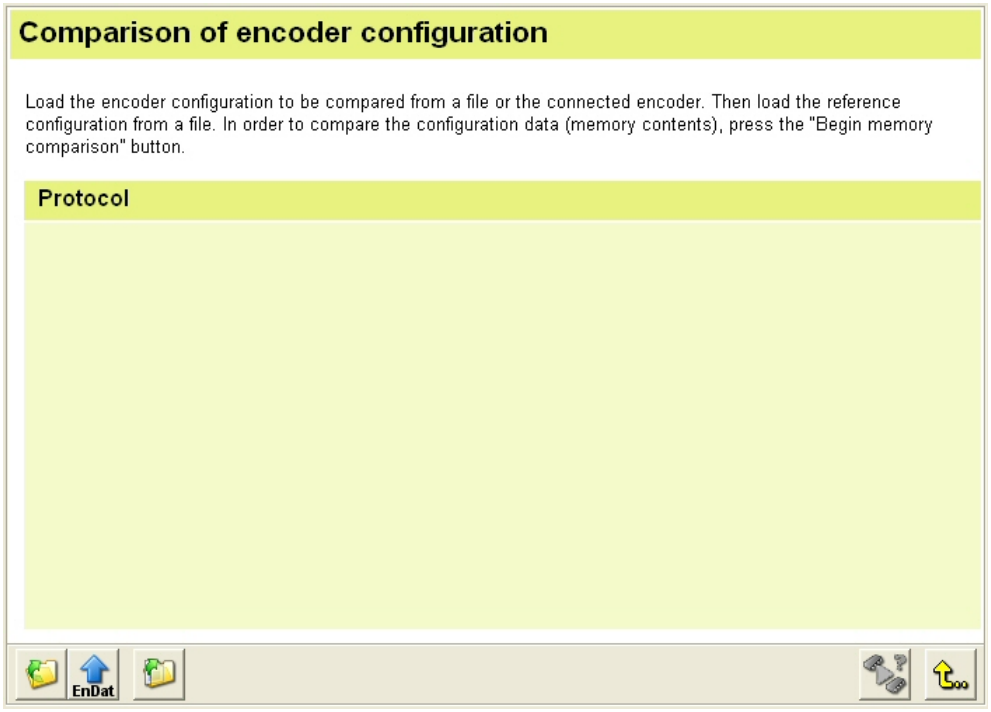
- ▶ Click the function “Comparison of encoder memory”.



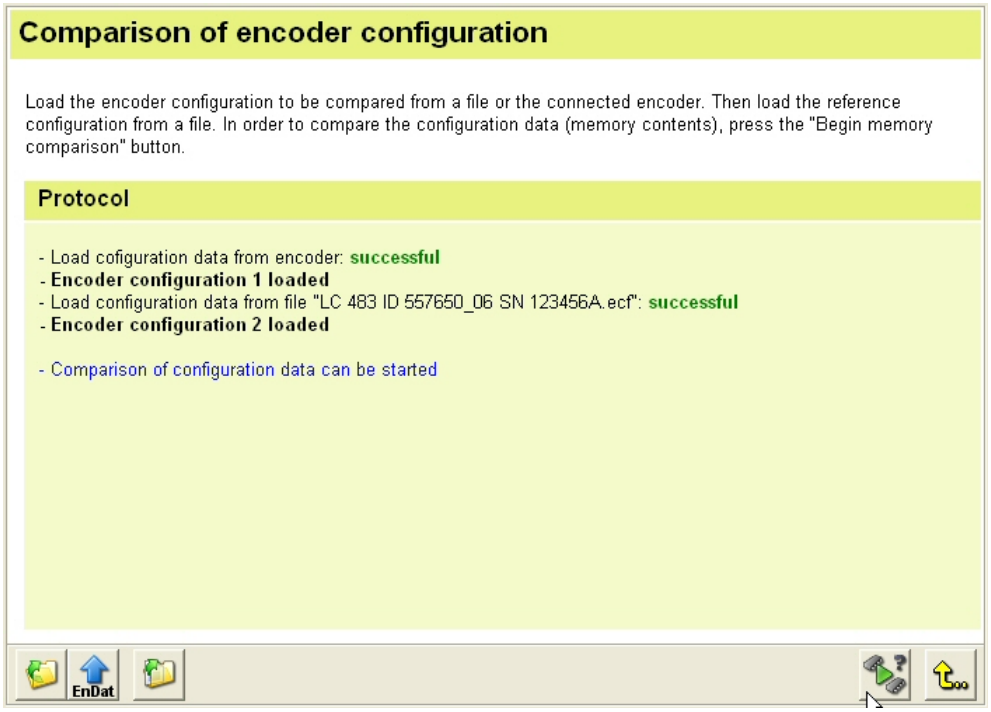
- > The log window (“Protocol”) appears, and you are prompted to load the configuration of the encoder currently connected.

When you click the first button “Load encoder configuration from a file”, an encoder configuration (e.g., received by e-mail) is loaded into the comparison register 1. Its memory location must be specified.

When you press the second button “Load encoder configuration from encoder”, the configuration of the currently connected encoder is loaded into the comparison register 1.



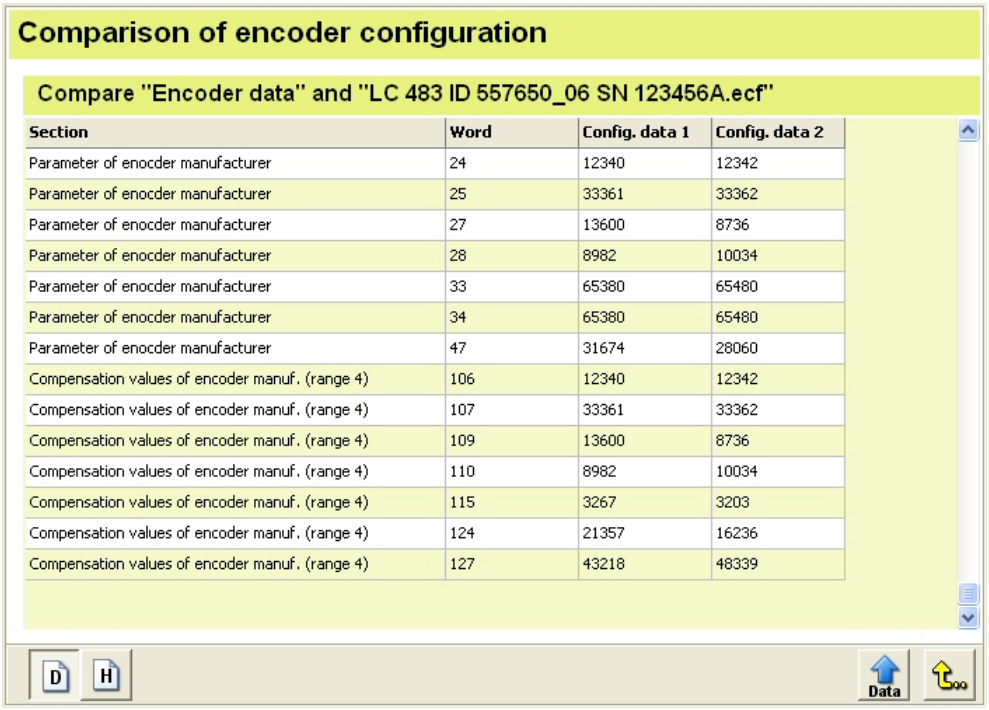
When you press the third button “Load reference configuration from a file”, the encoder configuration to be compared (reference configuration) is loaded into the comparison register 2. Its memory location must be specified.



- ▶ Press the “Compare memories” button.
- > The two comparison registers are compared to each other.

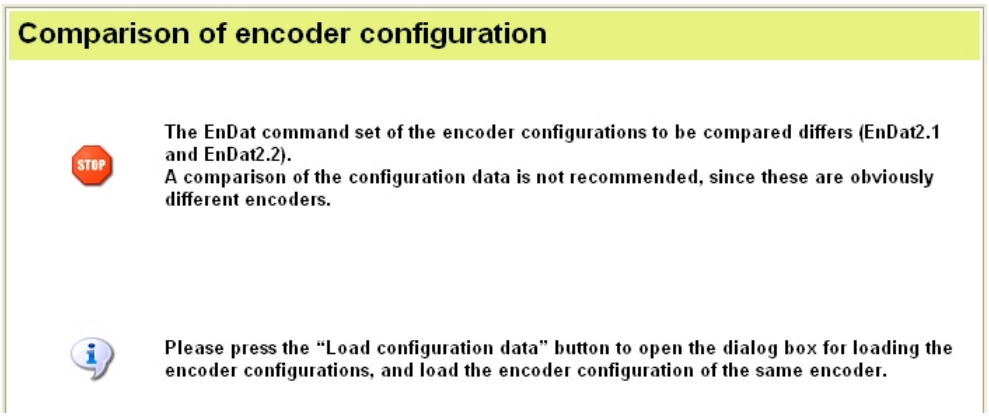
The differences of the encoder configurations 1 and 2 are entered into the log file.

Additional documentation is required to understand and evaluate the entries! (EnDat specifications are available upon request.) Original encoders – even with the same ID – always differ from each other, since e.g. signal compensation values are individually determined and saved for every encoder! Encoders with the same ID have different serial numbers.



Section	Word	Config. data 1	Config. data 2
Parameter of enocder manufacturer	24	12340	12342
Parameter of enocder manufacturer	25	33361	33362
Parameter of enocder manufacturer	27	13600	8736
Parameter of enocder manufacturer	28	8982	10034
Parameter of enocder manufacturer	33	65380	65480
Parameter of enocder manufacturer	34	65380	65480
Parameter of enocder manufacturer	47	31674	28060
Compensation values of encoder manuf. (range 4)	106	12340	12342
Compensation values of encoder manuf. (range 4)	107	33361	33362
Compensation values of encoder manuf. (range 4)	109	13600	8736
Compensation values of encoder manuf. (range 4)	110	8982	10034
Compensation values of encoder manuf. (range 4)	115	3267	3203
Compensation values of encoder manuf. (range 4)	124	21357	16236
Compensation values of encoder manuf. (range 4)	127	43218	48339

Example of an error message, if encoder configurations can not be compared (different EnDat command set):

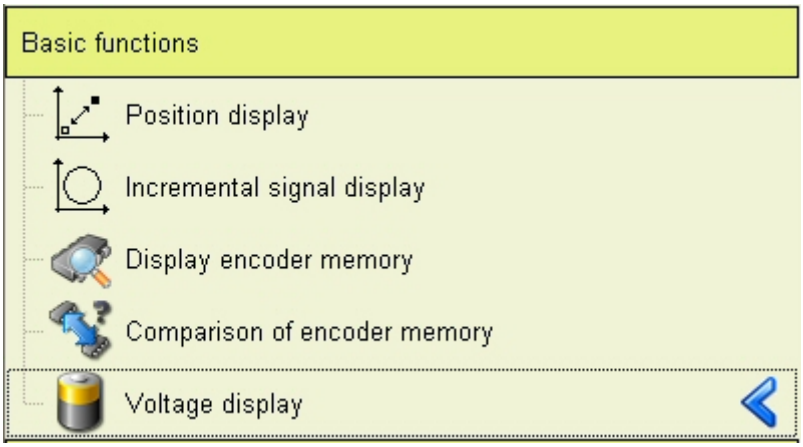


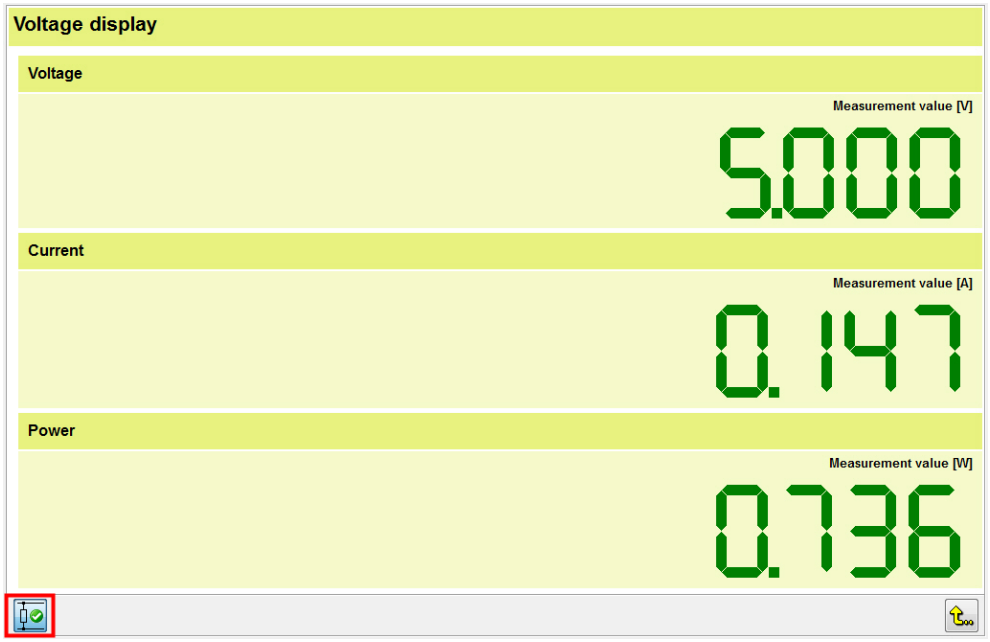
- ▶ Press the "Return to main menu" button.
- > The function is terminated.

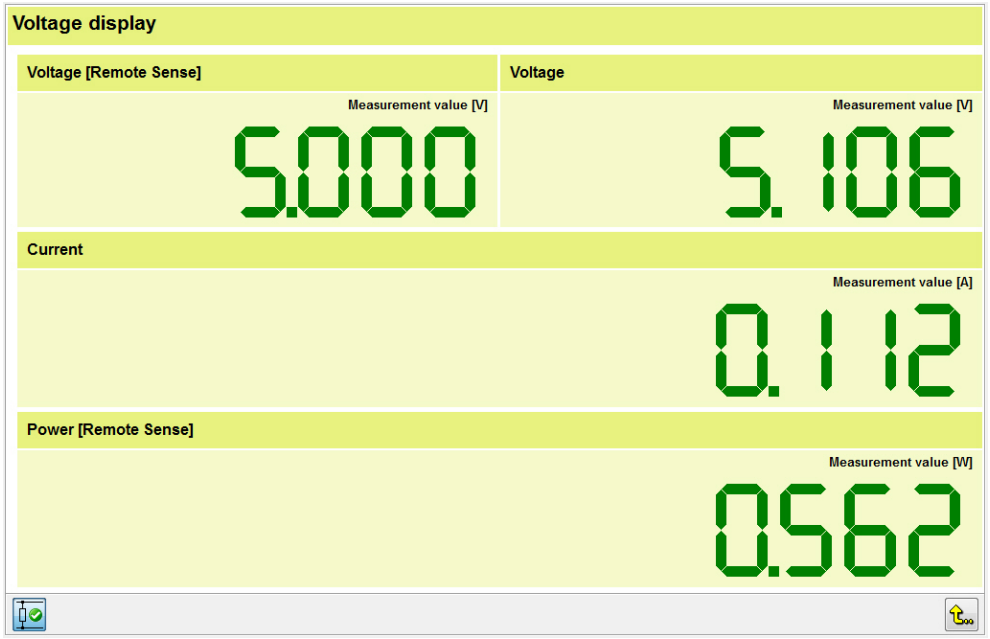
- ▶ Press the "Data" button.
- > A new configuration can be loaded to start a new comparison.

Encoder configuration 1 is always compared to encoder configuration 2.

5.3.5 Voltage display







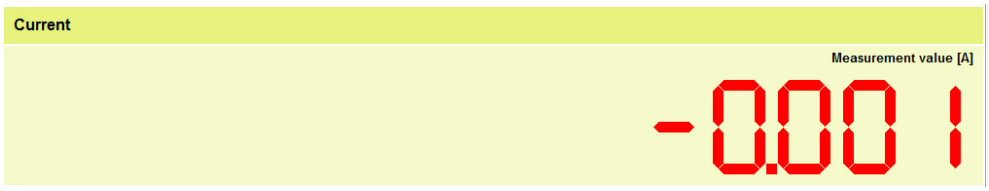
Voltage:
Display of the voltage the test unit provides to power the encoder

Voltage [Remote Sense]:
Operating voltage at the measuring system; voltage drops on the encoder supply lines are taken into account.

Current:
Display of the encoder current consumption

Power [Remote Sense]:
Power consumption of the encoder

If the encoder does not draw any power, the display changes to red.



“Terminating resistors” button

The “Terminating resistors” button serves to (de)activate the terminating resistors Z0 = 120 Ω.

The terminating resistor is active every time a new encoder is connected (default setting).

For testing purposes the terminating resistor can be deactivated in the “Voltage display” menu. When the menu is changed or a new encoder connected, the terminating resistor is reactivated.

Exception: “Feed-through mode“ (“closed loop“; the option “Use power supply from subsequent electronics“ is active). In this case, the terminating resistor is inactive and cannot be switched on.

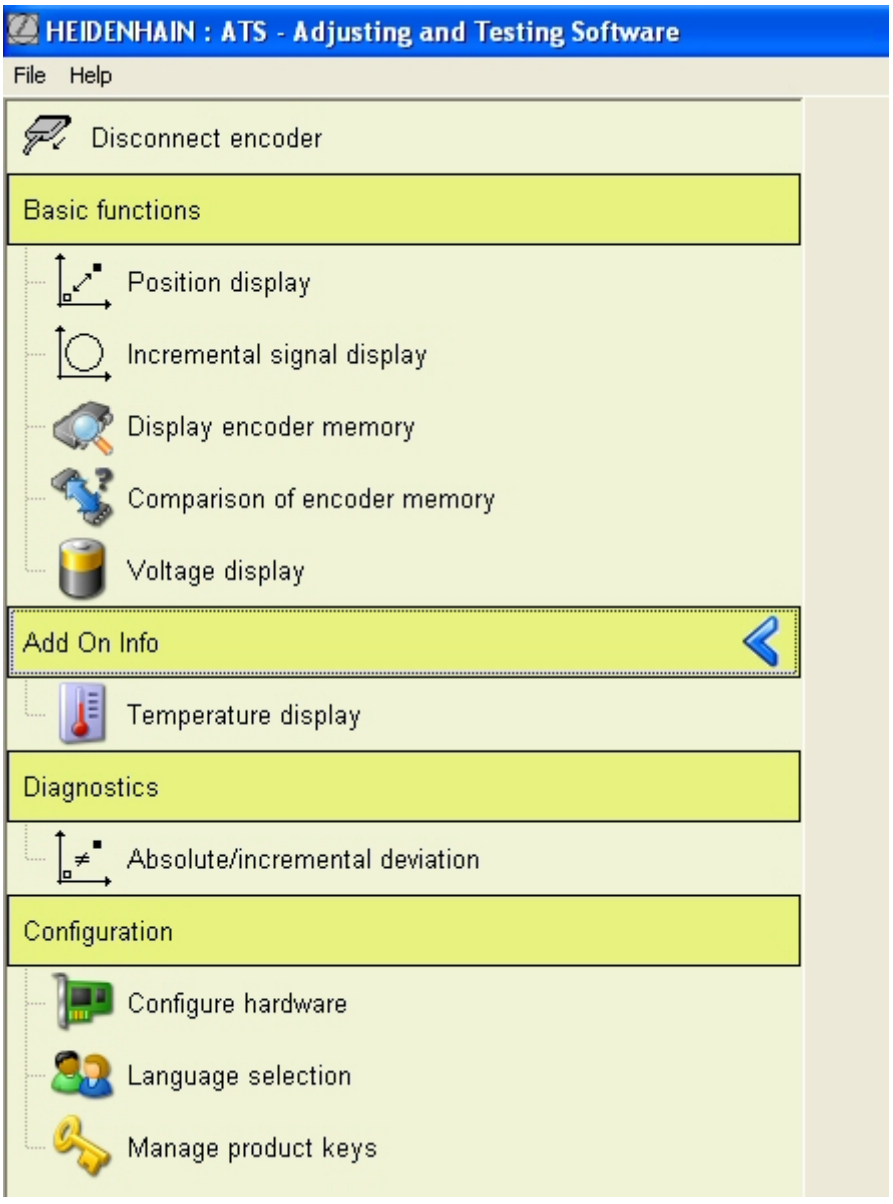
The terminating resistors are active.

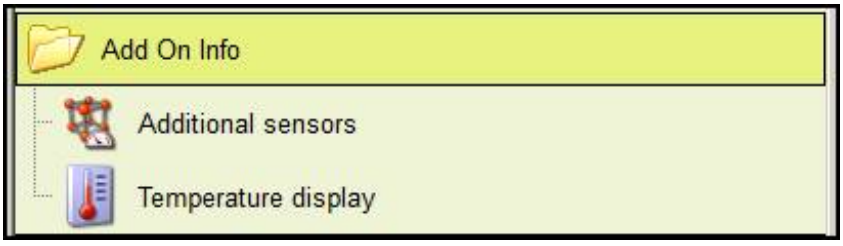
The terminating resistors are inactive.

The display may be different, depending on the type of power supply selected and on the encoders connected. The displays for Voltage [Remote Sense] and Power [Remote Sense] are active, if “Adjust voltage over sensor lines” was selected during manual encoder selection. In closed-loop operation and when a Service Adapter (SA 100 or SA 110) is used, the supply voltage and current consumption of the service adapter are displayed, not those of the encoder.

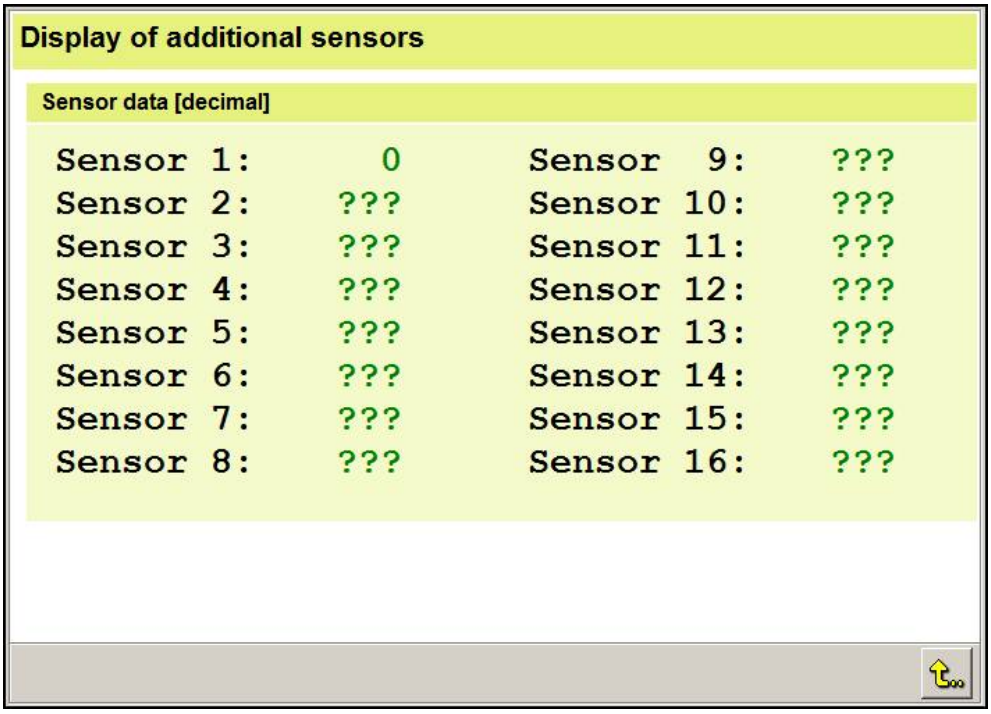
5.4 Additional information (EnDat 2.2): Temperature display

Display and functions may vary depending on the EnDat interface, the product key and the connected encoder! Not all encoders support additional sensors or the temperature display. The “Temperature display” icon is displayed, if this function is available.

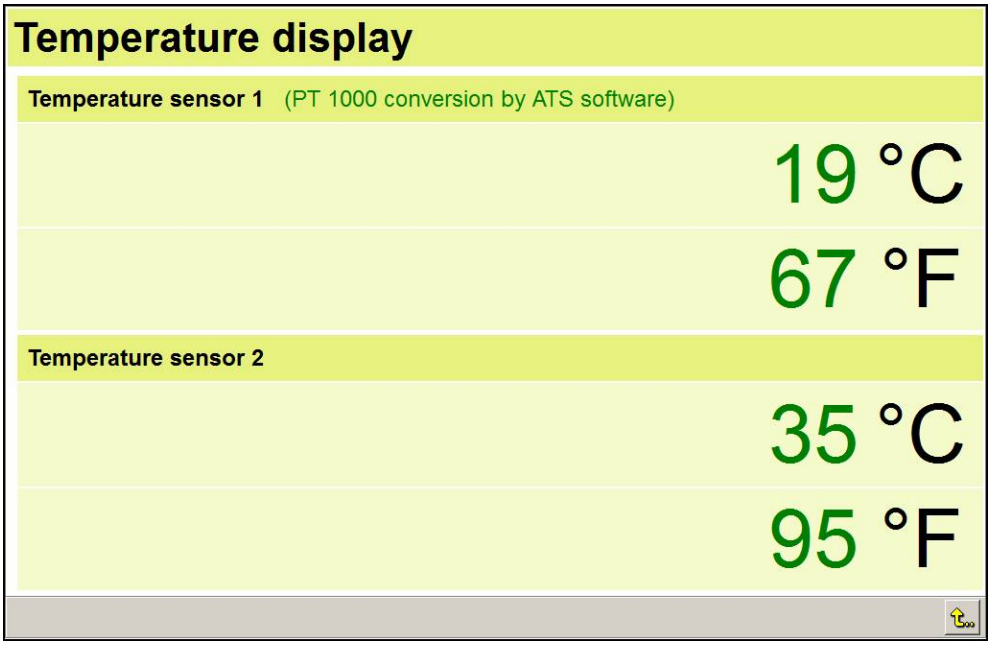




- ▶ Click “Additional sensors”, if supported by the encoder.
- > “Additional sensors” is displayed. The sensor data are displayed, e.g. the temperature sensors of a linear drive.



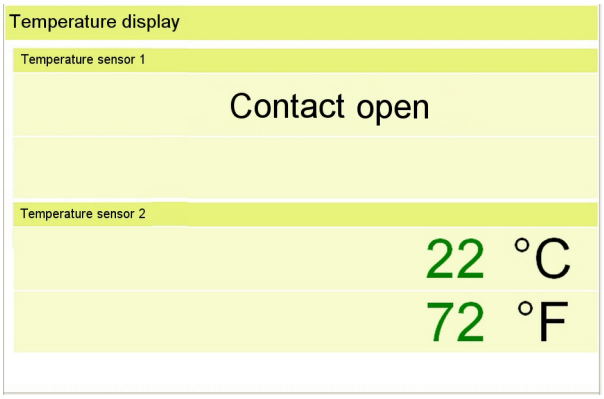
- ▶ Double-click “Temperature display”.
- > The current values of the temperature sensors 1 and 2 are displayed.

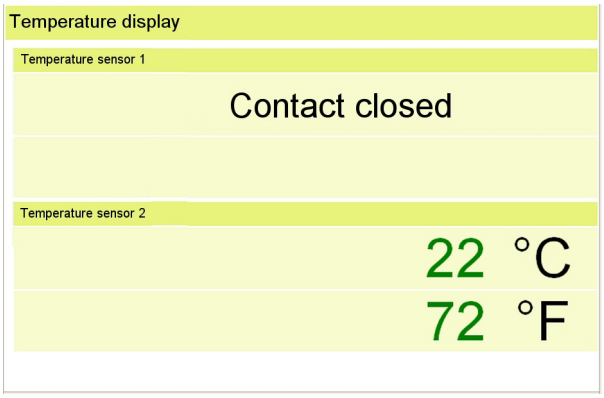


Temperature sensor 1:
External sensor, e.g. in the drive (temperature switch or temperature-sensitive resistor)

Temperature sensor 2:
Temperature sensor inside the encoder

Not all encoders support the temperature data for evaluation of the EnDat status (error message or warning).



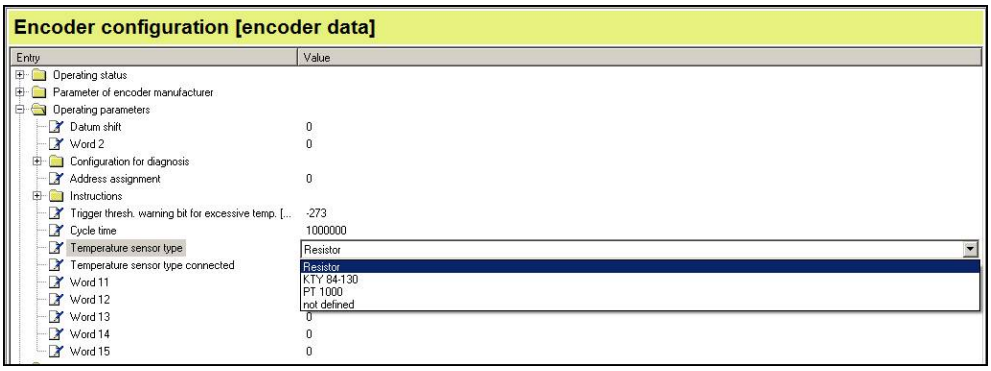


Extremely high temperature values (e.g. 550 °C) indicate that the temperature sensor is not connected, a contact is open or a cable has broken.

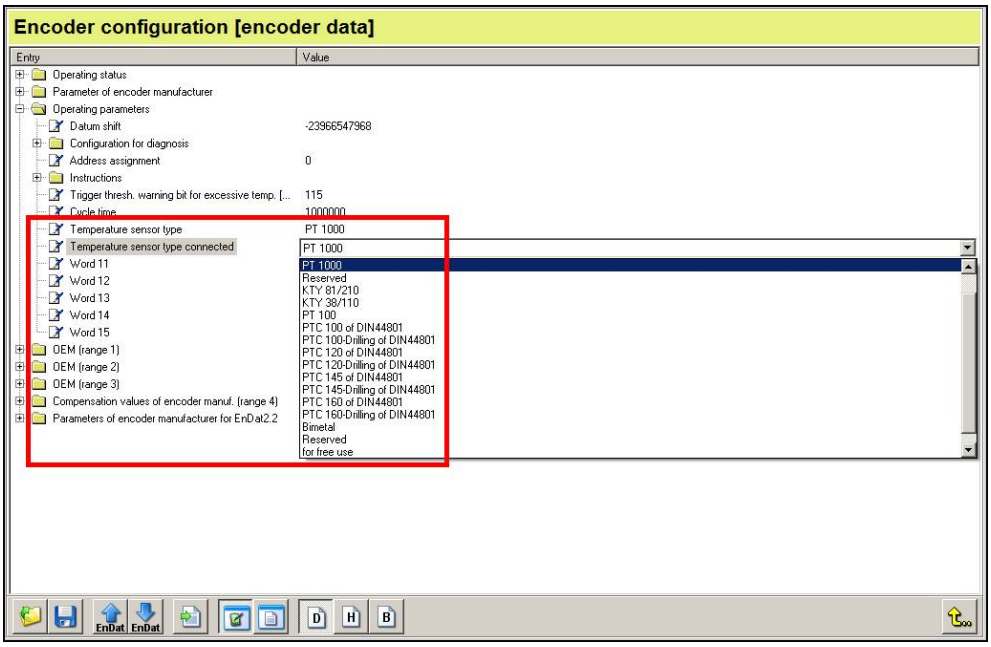
The type of temperature sensor is defined and can be set in the "Operating parameters" of the encoder configuration.

The temperature specification has so far been based on the use of KTY 84-130 sensors. In order to be prepared in the future for the automatic processing of further types of temperature sensors the corresponding settings can be made in the "Operating parameters".

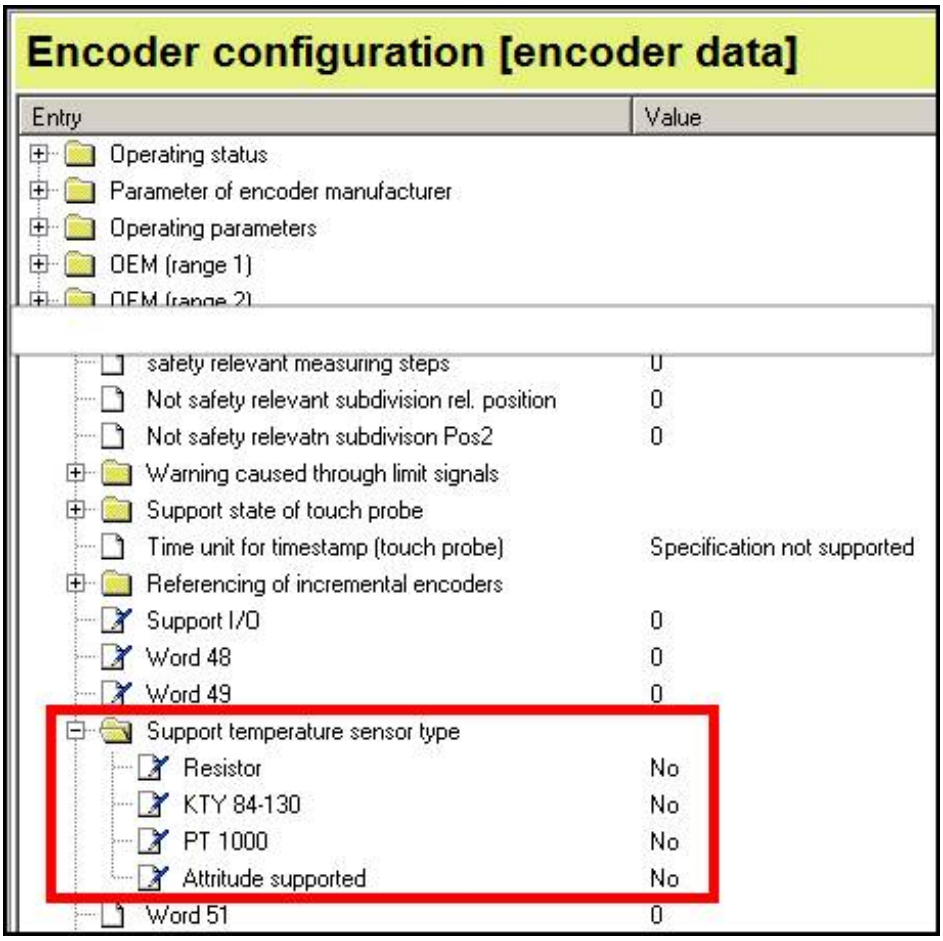
"Temperature sensor type" Word 9:
If, for example, a PT 1000 is entered, the subsequent electronics can convert the temperature value that is referenced to the KTY 84-130 to the PT 1000 temperature value (for the compensation calculation: see description in the brochure "Encoders for Servo Drives", section "Connectable temperature sensors").



"Temperature sensor type connected" Word 10:
Here you can specify the type of temperature sensor that is (or can be) connected to the external sensor inputs. This parameter is for information only (e.g. display of the sensor type on the NC display) and has no influence on compensation calculation.



As of version 3.2.xx the ATS software features compensation calculation; it must, however, be supported by the encoder (see "Parameters of the encoder manufacturer for EnDat 2.2" (Word 50), "Support of temperature sensor types").



5.5 Diagnostics

5.5.1 Absolute/incremental deviation

Display and functions may vary depending on the product key and the connected encoder model!

With the function "Comparison of absolute and incremental values" absolute encoders can be checked for the following defects:

- Code transition errors between absolute and incremental values
- Scale contamination and resulting signal and position errors
- Signal interferences (interference problems with resulting positioning errors)

Internal propagation and calculation times, etc., may cause a difference between the absolute and the incremental position values.

The absolute value is calculated at the scanning point (scanning unit or electronics of rotary encoder) and is serially transferred to the PWM or IK 215 as an absolute data word.
The incremental signals are transferred to the subsequent electronics via the analog interface and are processed there (interpolated, digitized).
In the test unit, the absolute and the incremental position values are compared to each other, and the difference is displayed as deviation span.
The different signal paths (propagation times, calculations, etc.) result in a deviation between the absolute and the incremental position displays; these deviations must not exceed the specified accuracy ranges.

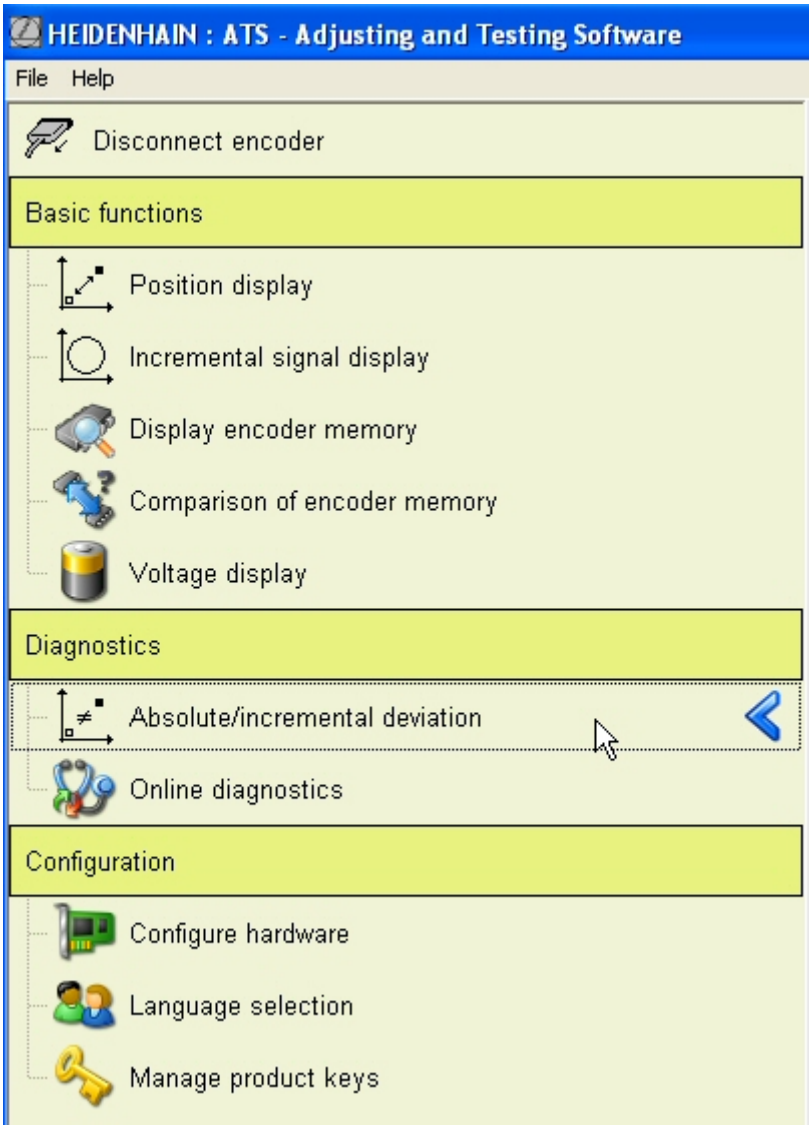
The deviation span and the permissible inaccuracy (displayed in LSB[1)]) are stated for different velocity ranges.

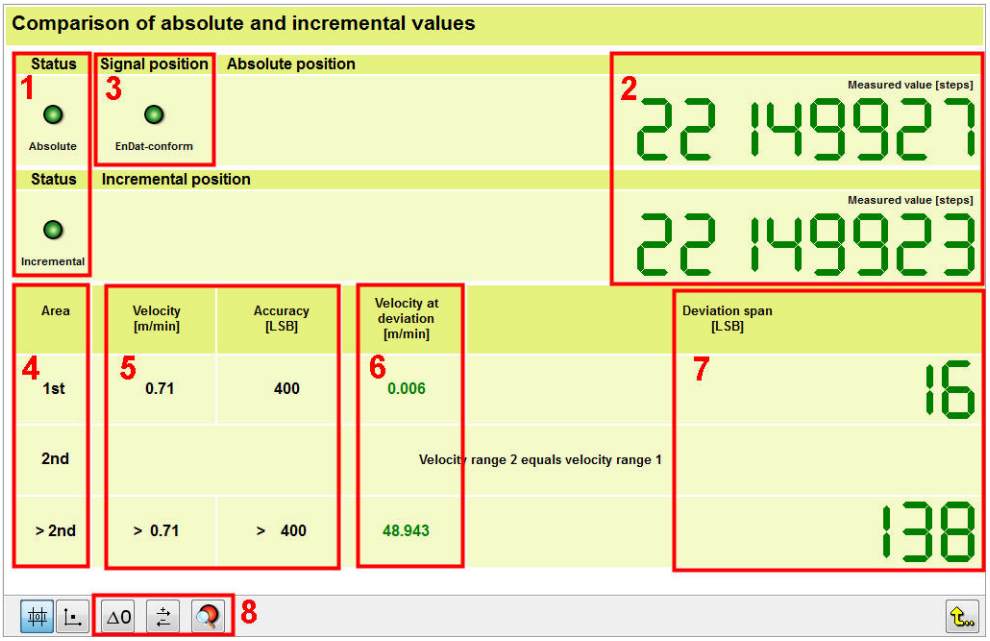
NOTICE

The absolute value of the deviation span must not exceed the specified accuracy of the velocity range. If the tolerance is exceeded, the deviation span is displayed in red color.

1) LSB = Least Significant Bit
Example: For an LC with 10 nm resolution, 1 LSB corresponds to 10 nm of measuring length.

- ▶ Double-click “Absolute/incremental deviation”.
- > The window “Comparison of absolute and incremental values” appears.



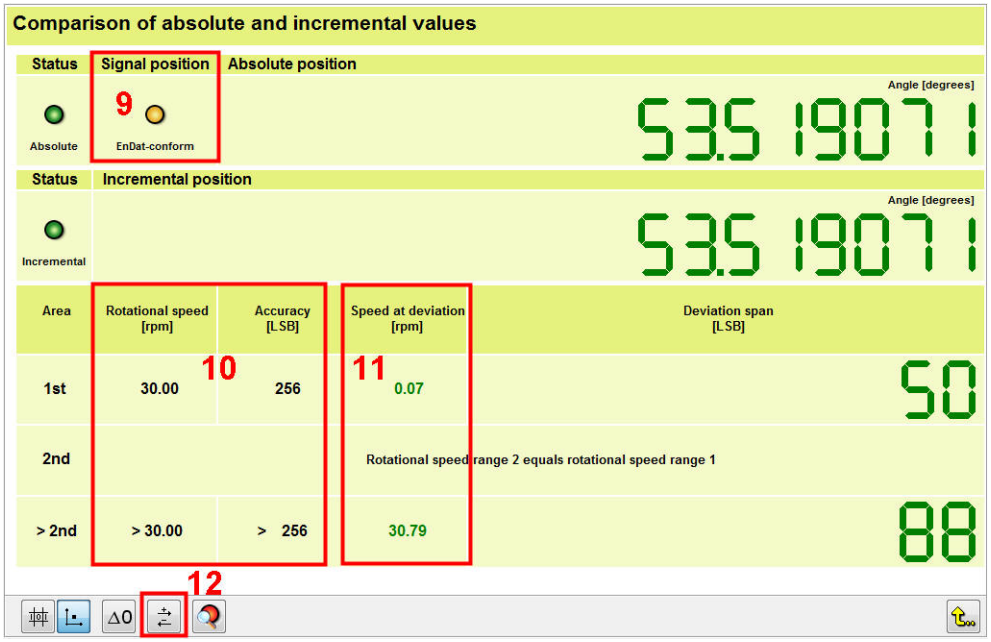


Example: LC

1 Status display: Errors and warnings
2 Position displays absolute/incremental
3 Signal position; check of EnDat-compliant datum shift (”yellow“ display = not EnDat-compliant)
4 Different velocity ranges
5 Permissible accuracy errors [LSB] for defined velocity ranges [rpm]
6 Velocity at determined deviation span
7 Determined deviation spans [LSB] of the different velocity ranges
8 Description of the buttons

	Reset deviation spans
	Invert counting direction of incremental counter

Display details on alarms and warnings



Example: ECN rotary encoder

9 Warning "EnDat non-compliant datum shift"

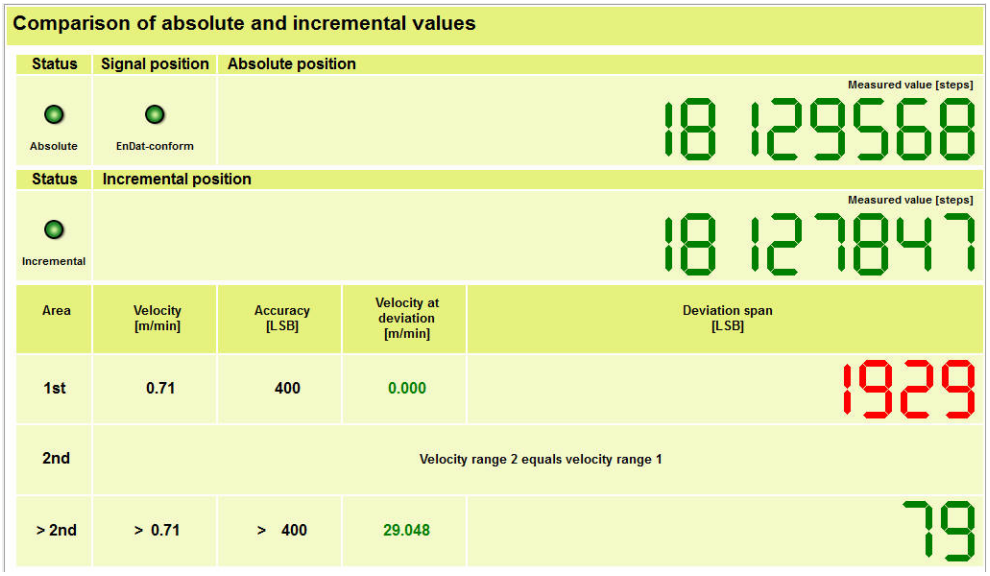
> "Yellow" signal condition (datum not EnDat-compliant) causes a TNC control to issue an error message. Depending on the signal resolution of the TNC, an EnDat non-compliant datum shift may result in a dimensional error that is outside the machine's accuracy specifications.

10 Permissible accuracy errors [LSB] for defined velocity ranges [rpm]

11 Shaft speed at determined deviation span; if green dashes are displayed, this area is not supported.

12 Invert counting direction of incremental counter; only useful, if the counting direction of a programmable SSI rotary encoder was reprogrammed.

If the deviation span is extremely large (red entry), check the setting of the incremental counting direction. 



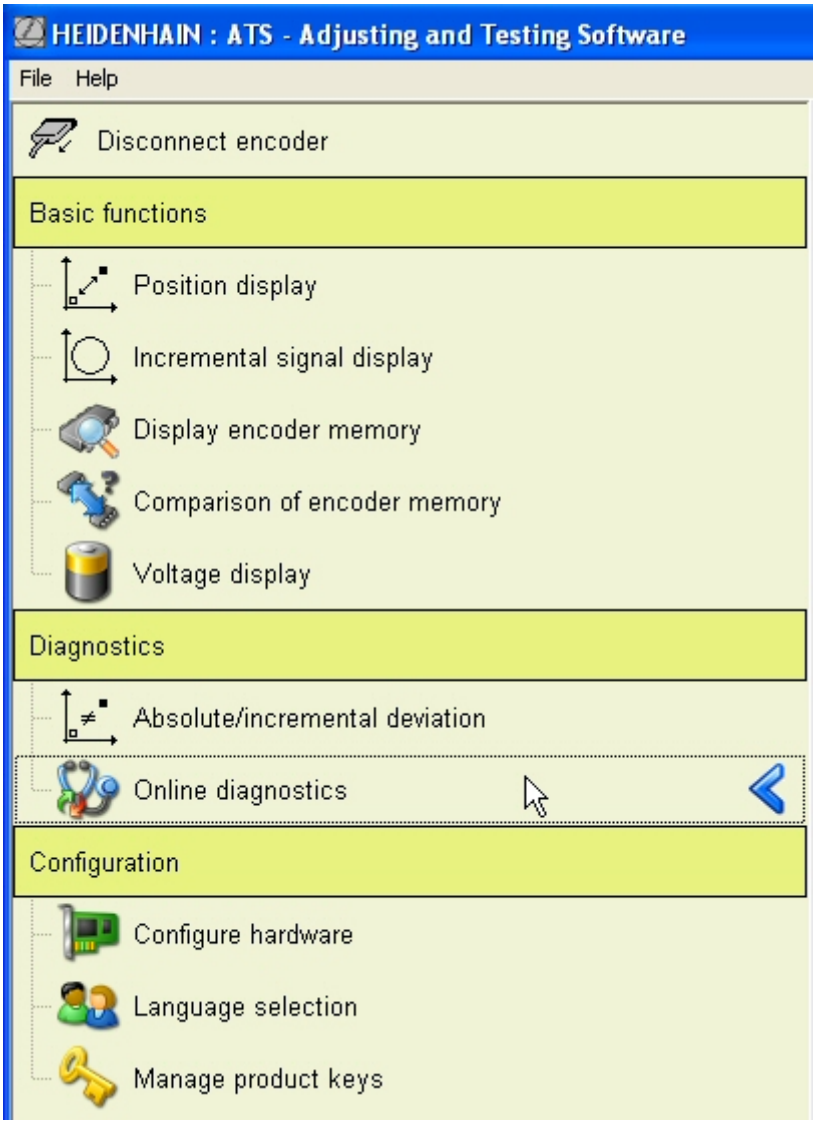
5.5.2 Online diagnostics

Encoders with purely digital interfaces (e.g. EnDat 21 and 22, Fanuc, Mitsubishi) do not provide analog incremental signals. Therefore, the encoders cyclically output the valuation numbers in order that the encoder functions can be evaluated. The ATS software displays these as bar diagrams. The valuation numbers provide the current state of the encoder and ascertain the encoder's "function reserves." The scaling is the same for all HEIDENHAIN encoders; it is indicated as function reserve (0 – 100 %).
The valuation numbers supported by the respective encoder (number of displayed bars) are saved in the encoder memory (with EnDat encoders: visible in "Manufacturer parameters EnDat 2.2/Diagnostic status").

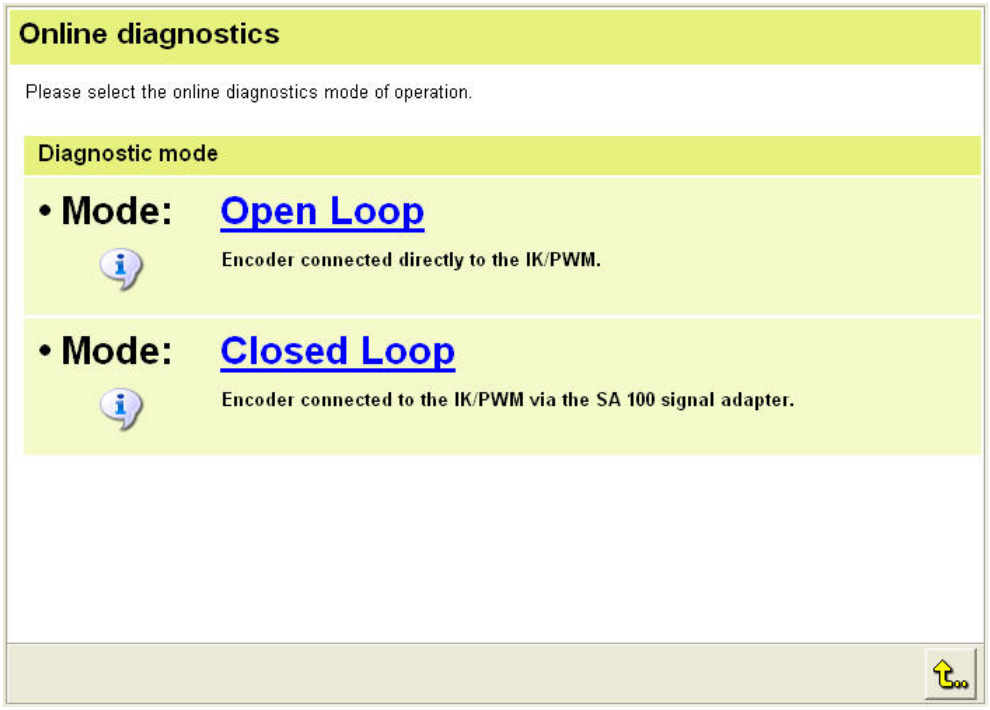
Display and functions may vary depending on the product key and the connected encoder! If "Online diagnostics" is not displayed in the ATS menu, the encoder interface does not support this function.

The following screenshots show the online diagnostics of an EnDat interface.

- ▶ Double-click “Online diagnostics”.
- > The “Online diagnostics/Diagnostic mode” window appears.



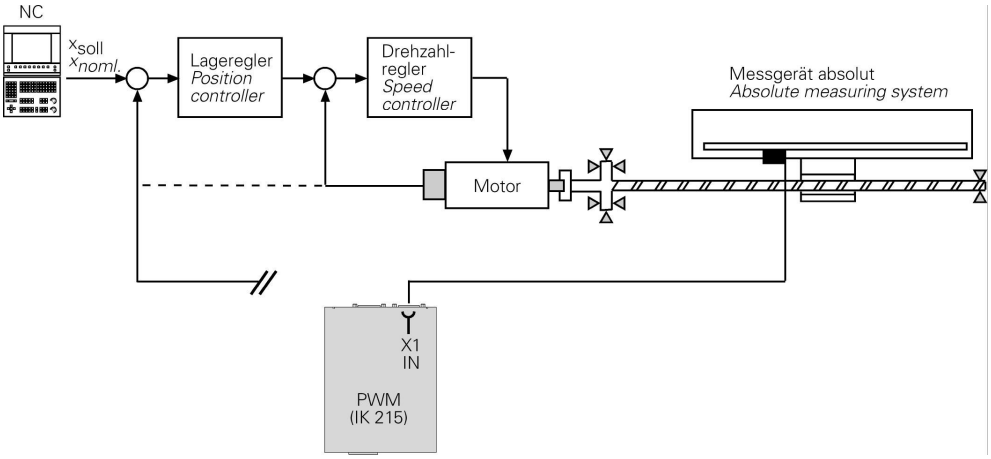
At the beginning of the diagnostics dialog you must select:
Open loop: The encoder is directly connected to the test unit.
Closed loop: The PWM is connected to the absolute measuring loop via the IN/OUT connectors (observe the chapter "Feed-through mode", page 34) or an SA 1x0 service adapter is used for potential-free looping-in.



Two diagnostic modes are available:

Open loop

The control loop of the machine is open, and the encoder is directly connected to the test unit (without subsequent electronics). For the inspection, the encoder must be traversed by hand.

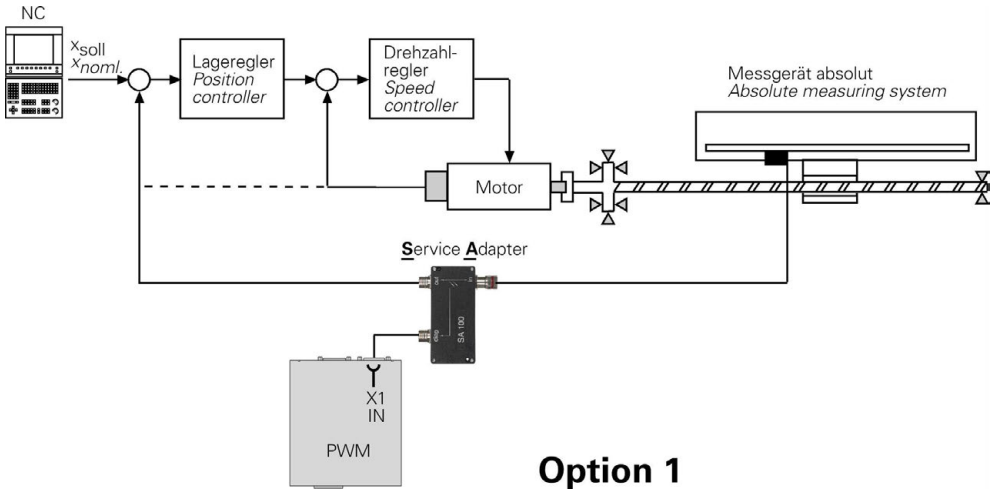


Closed loop
Option 1:
The control loop of the machine remains closed, a T-coupler/signal splitter (SA 1x0 service adapter) is inserted between the encoder and the subsequent electronics. The PWM or the IK 215 is connected to the diagnostic output which is electrically isolated. Now, the ATS software can monitor the data stream between the subsequent electronics and the encoder.

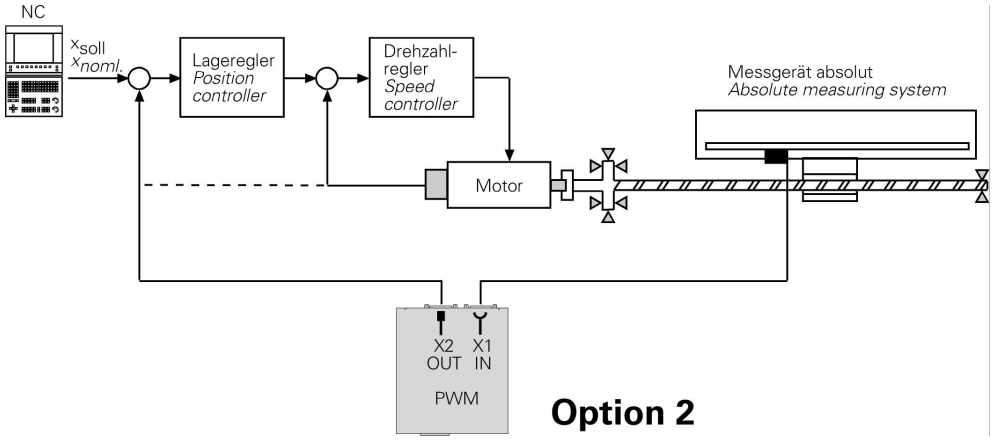
Option 2:
The control loop of the machine axis remains closed as with Option 1. The PWM is integrated into the control loop via the IN input and the OUT output. The data stream between subsequent electronics and encoder can be monitored.

The connection is not electrically isolated!
Note the chapter "Feed-through mode", page 34!

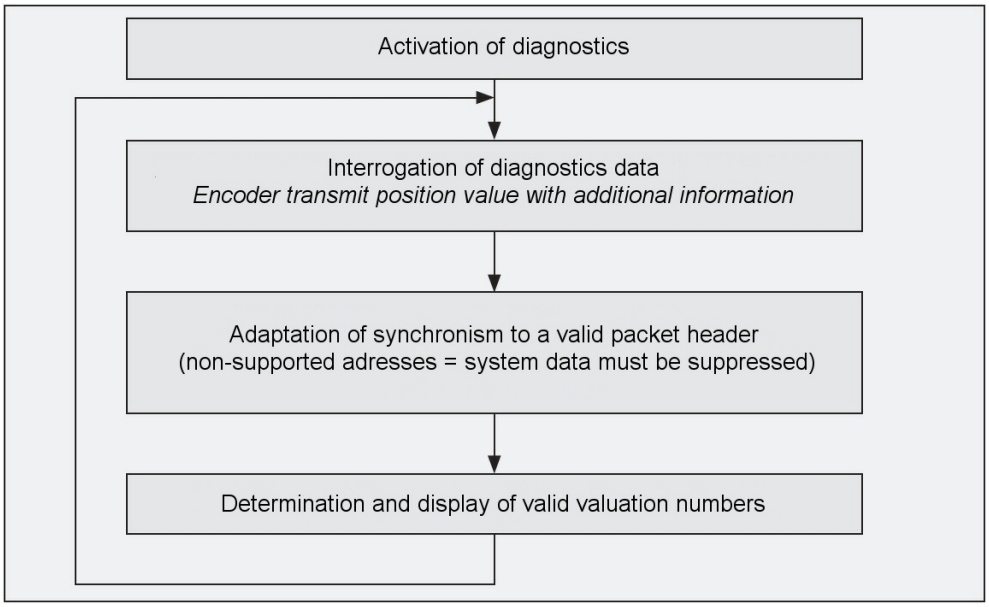
The ATS software cannot request data actively; it can only passively monitor data communication between subsequent electronics and encoder (listening-in). The closed-loop functionality only works for interfaces at which the subsequent electronics permanently requests diagnostic data. The diagnostic function of the subsequent electronics must be active! Otherwise, data communication cannot be monitored. The diagnostic function is available for EnDat with command set 2.2, Fanuc and Mitsubishi. See also section "Feed-through mode", page 34.



Option 1



Option 2

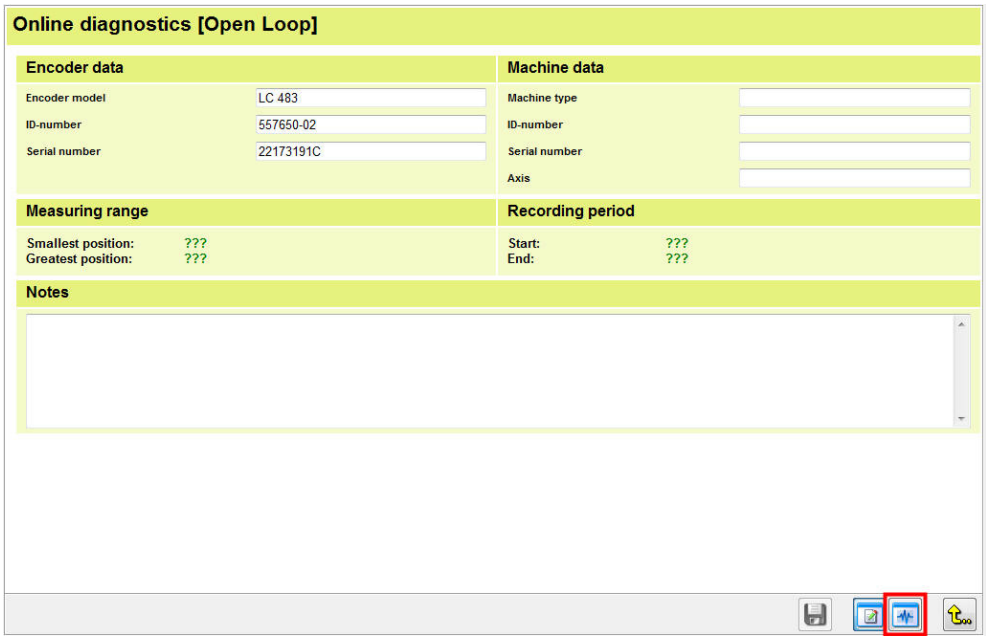


Flow chart for interrogation of diagnostics data

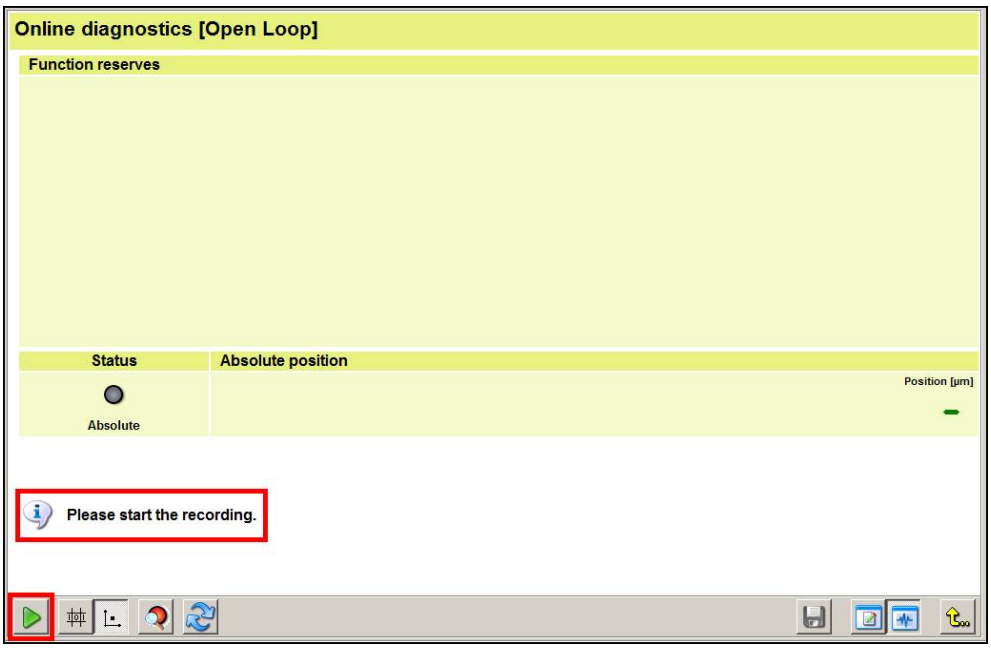
5.5.3 Open Loop function

- ▶ Click the “Open Loop” function.
- > The log window opens, containing the already available encoder data.

You can add machine data and notes. The software automatically enters measuring range and recording period as soon as the recording stops.



- ▶ Press this button.
- ▶ The “Function reserves” window is displayed.

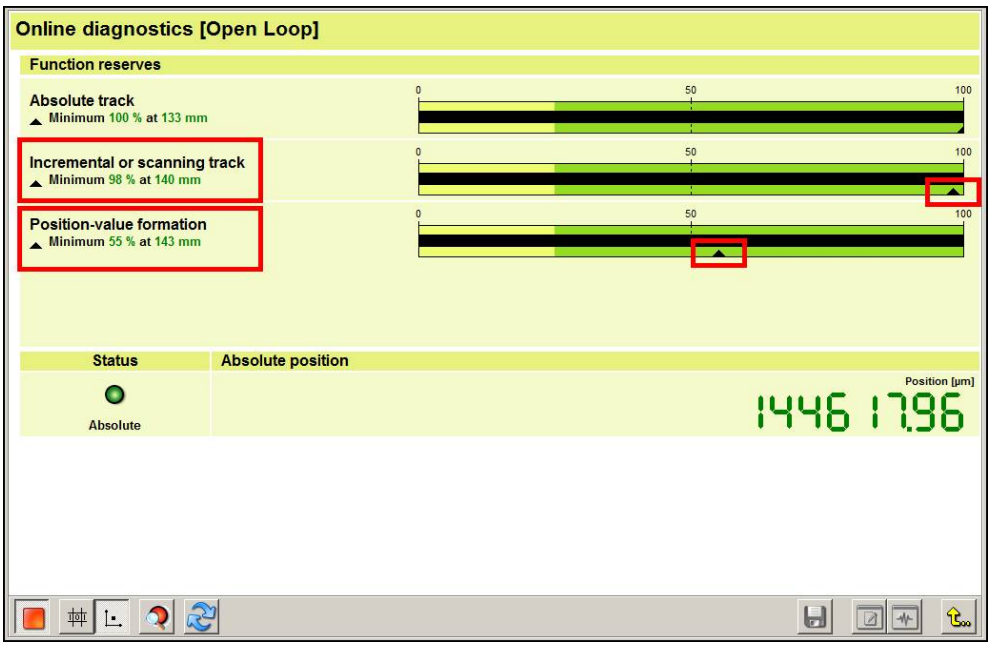


- Press this button.
- Recording starts.

Cover the entire traverse range!

The function reserves of absolute track, incremental track and position value formation are evaluated in bar diagrams; the result is displayed in %. A drag indicator (triangle below the bar display) marks the minimum.
Green range: The output signal is within the specifications.
Yellow range: The output signal is outside the specifications, but no counting or calculation errors are to be expected. No alarms are generated, warnings may occur.

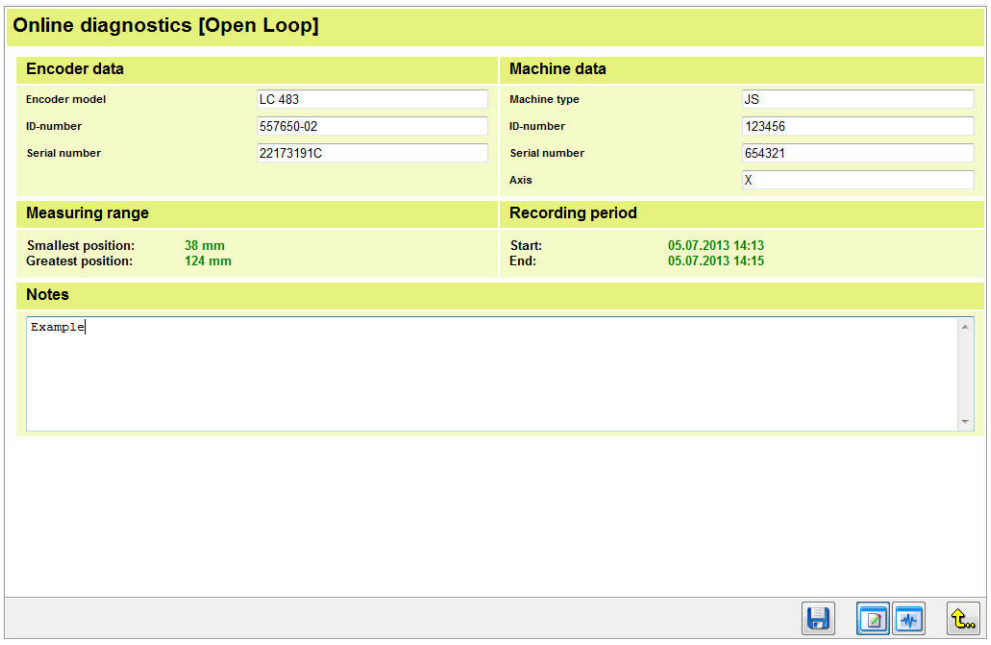
The yellow range indicates: Service or maintenance recommended!



- ▶ Press this button.
- > Recording stops.

- ▶ Press the “Encoder parameters” button.
- > The log display appears.
- > The values for the measuring range and the recording period are displayed now in green color.

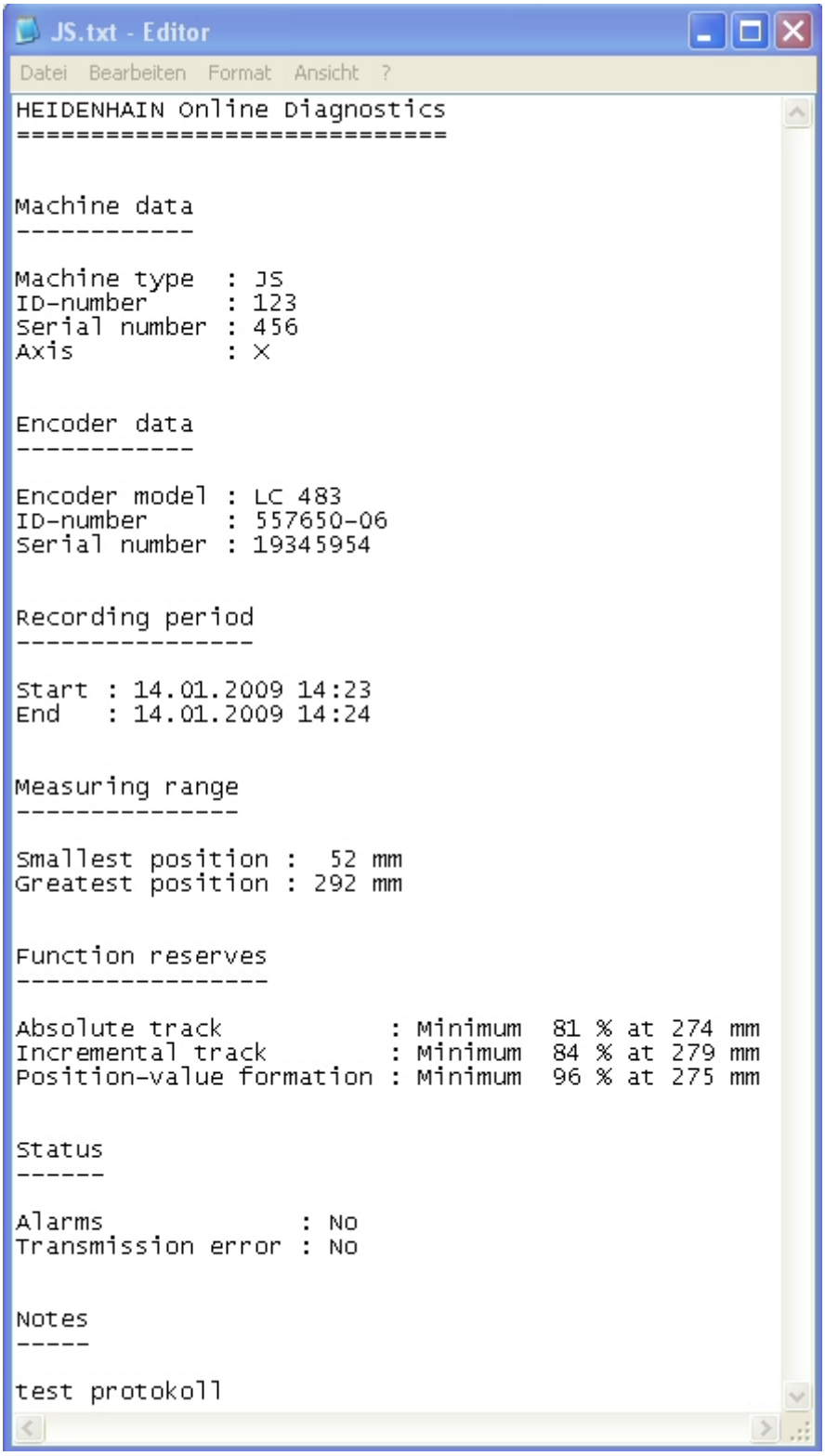
- ▶ Press the “Reset min/max values” button.
- > The drag indicators are reset to 100 %.



Example: Input of encoder and machine data

- ▶ Press this button.
- > The data can be saved as text file.
- > You can define the storage location in a context menu.

The text file can be archived when the machine is to be shipped, and it can be used to describe the faults, if the encoder needs to be repaired.



JS.txt - Editor

Datei Bearbeiten Format Ansicht ?

```
HEIDENHAIN Online Diagnostics
=============================


Machine data
------------

Machine type  : JS
ID-number     : 123
Serial number : 456
Axis          : X


Encoder data
------------

Encoder model : LC 483
ID-number     : 557650-06
Serial number : 19345954


Recording period
----------------

Start : 14.01.2009 14:23
End   : 14.01.2009 14:24


Measuring range
---------------

Smallest position :  52 mm
Greatest position : 292 mm


Function reserves
-----------------

Absolute track           : Minimum  81 % at 274 mm
Incremental track        : Minimum  84 % at 279 mm
Position-value formation : Minimum  96 % at 275 mm


Status
------

Alarms             : No
Transmission error : No


Notes
-----

test protokoll
```

Example: The text file (*.txt) is saved in the program directory of the ATS software.

5.5.4 Closed Loop function

The encoder must be automatically connected to the ATS software through its ID number.

- Click the "Open Loop" function.

Data communication between control (TNC/NC) and encoder is picked up by a signal splitter (in the example: SA 100 Service Adapter, ID 363706-01). The encoder loop remains closed and the NC control can still traverse the machine axis.

To "listen in" on a measuring circuit (closed loop) of an absolute encoder, three prerequisites must be be fulfilled:

1. **EnDat 2.2 interface (ordering designation EnDat 02 or 22, Fanuc, Mitsubishi, Panasonic or Yaskawa)**
2. **The subsequent electronics (TNC, ND) must be active and support the diagnostic function.**
3. **The encoder must support the diagnostic function.**

The next two screenshots are examples of the Closed Loop display.

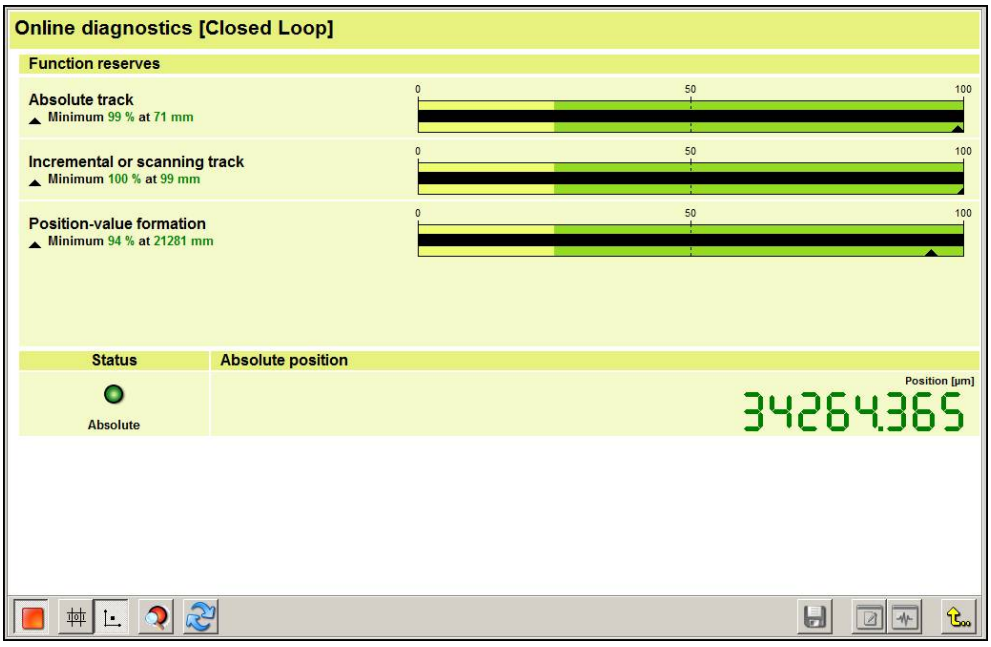


Figure 1: Function reserves

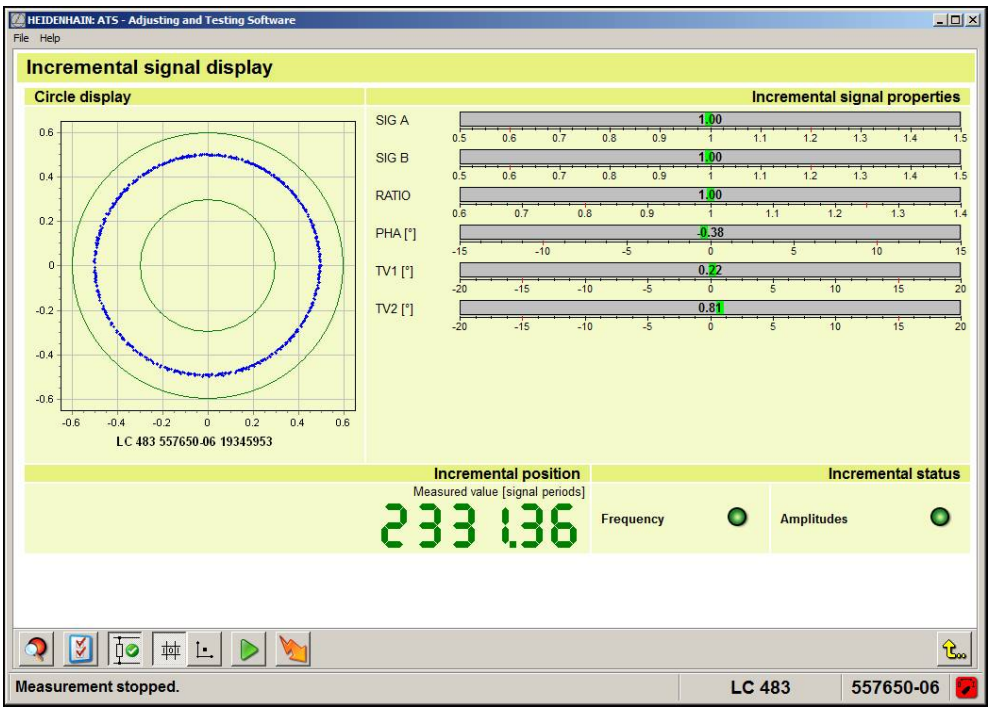
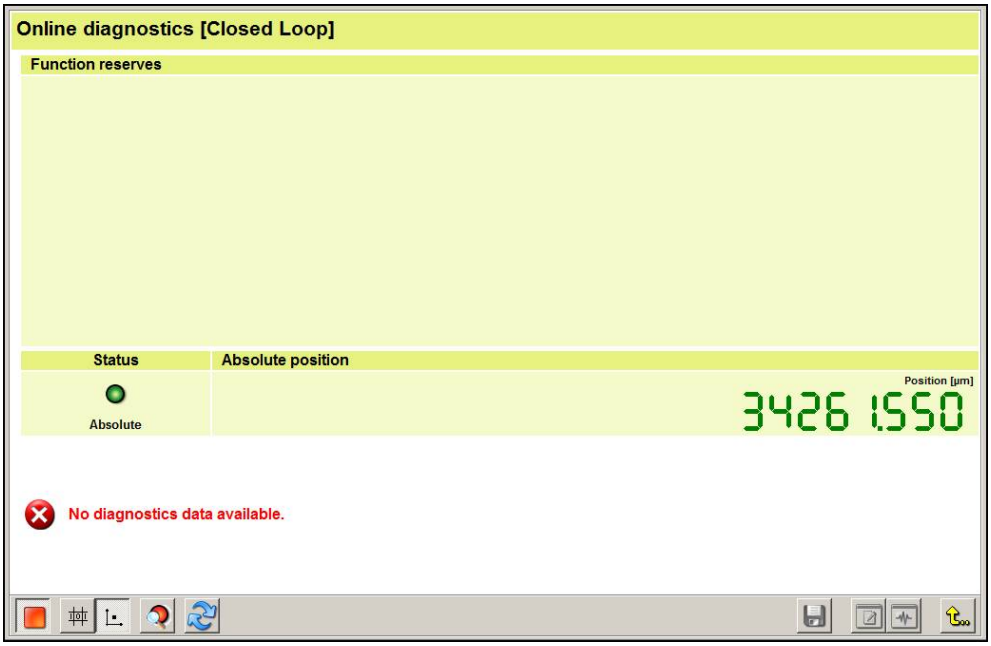


Figure 2: A/B oscilloscope signal with bar graph display



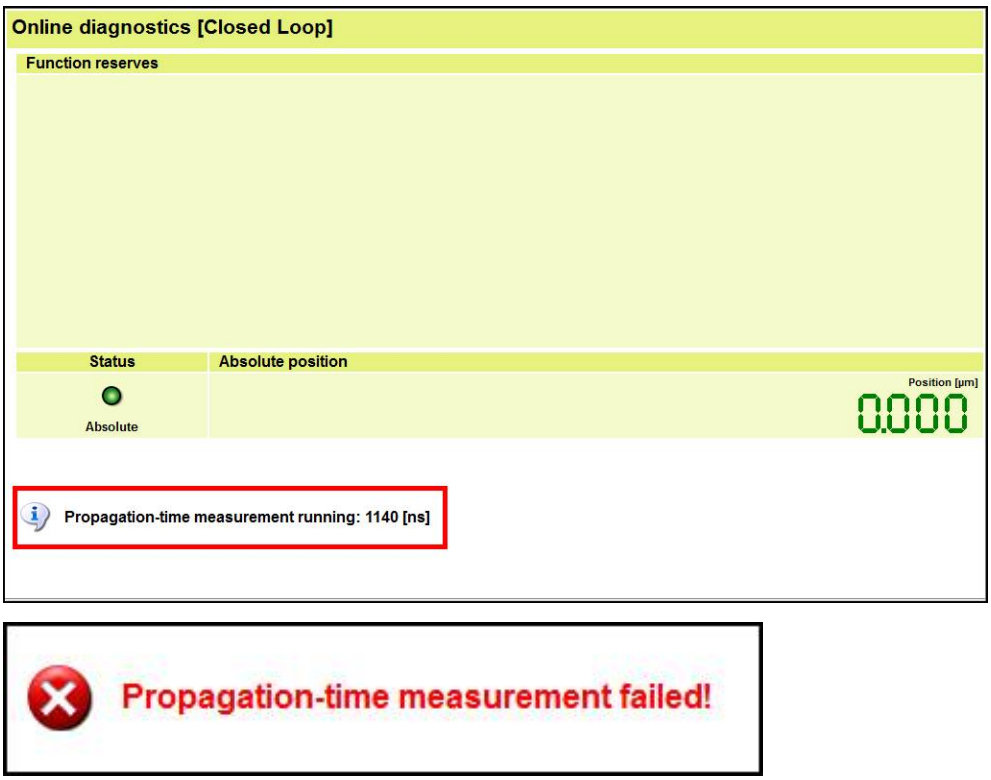
Message, if data communication fails

Example of a message, if data synchronization from the PWM (IK 215) to the data stream (NC/encoder) is not possible.

Causes:

– The synchronization time is too short (the time for propagation time measurement is exceeded).
– No continuous exchange of data takes place between NC and encoder.

HEIDENHAIN TNCs must support the "DriveDiag" function (see also the description of the functions in chapter "Online diagnostics", page 115).



Error message, if data synchronization fails due to very long propagation time

The further procedure is the same as for open-loop measurement; see section "Open Loop function", page 119.

5.6 Testing functional safety

Safety-relevant functions of HEIDENHAIN position encoders with purely serial EnDat 2.2 interface with the option “Safety-related applications” (functional safety) must be tested with the ATS software function “Functional safety encoder check” (see "Diagnostics", page 111).

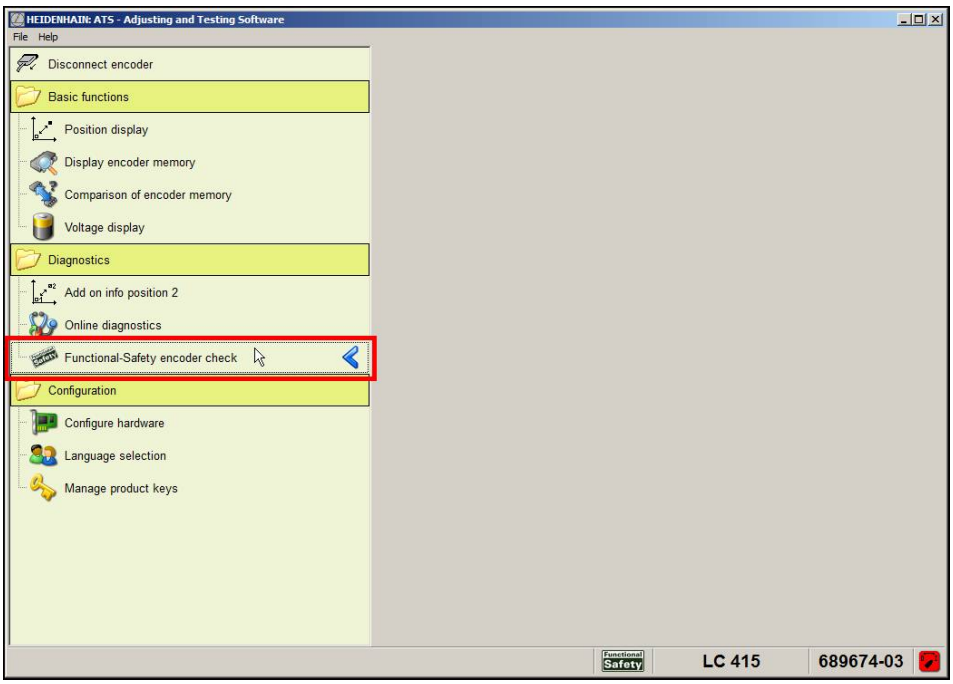
The functional-safety encoder check features an "Assistant" (wizard) function. **This wizard must run all tests without any error!** If there is any error in the "Safety" tests, the defective position encoder has to be replaced!

After installation and exchange of “functional safety" components, an acceptance test according to the machine instructions must be performed.

Encoders of this type are distinguished by the word “Safety” printed on the ID label.

The position encoder must be connected and identified through its ID number (database). Use manual identification (through "Manual Settings") only to determine the ID number.

Another identifying characteristic in the ATS software:
Once the encoder ID has been identified, the menu “Functional-safety encoder check” is displayed in the “Diagnostics” group. Moreover, the Functional Safety symbol appears in the bottom line in front of the encoder designation and ID.

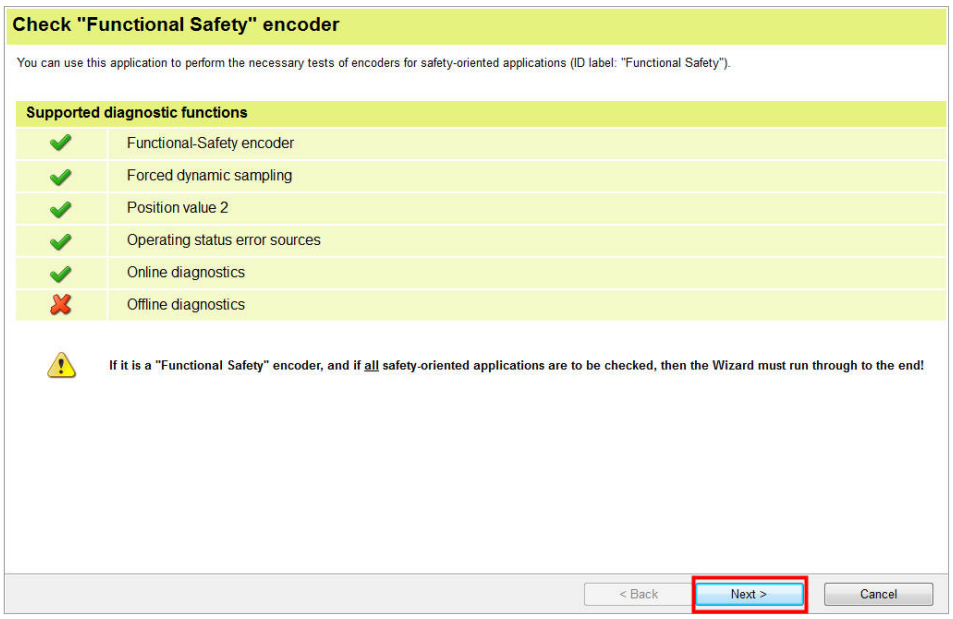


- ▶ Double-click “Functional-safety encoder check”.
- > The “Check Functional Safety encoder” function starts.

i	Please read the messages on the screen!

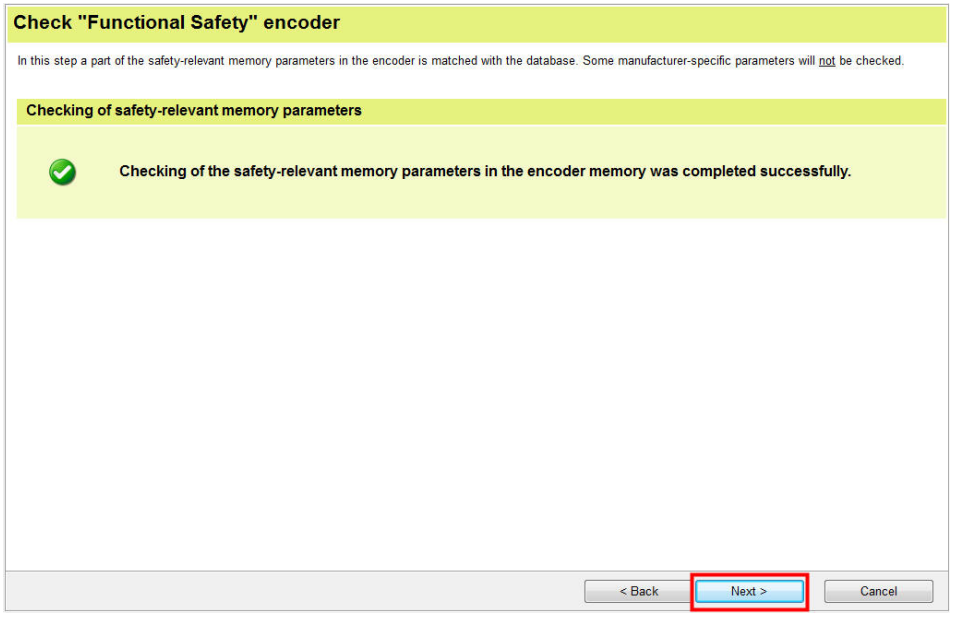
i	**Button functionality** Active buttons proposed by the wizard (in the example: “Next >“) are highlighted.

The “Next >“ button is active (highlighted).
Inactive buttons, the “< Back” button in this example, are grayed out.



The image shows the diagnostic functions that are supported.

- ▶ Press the active “Next >” button.
- > A part of the safety-relevant memory parameters in the encoder memory is compared to the entry in the database. Some OEM-specific parameters are not taken into account (ASIC areas).



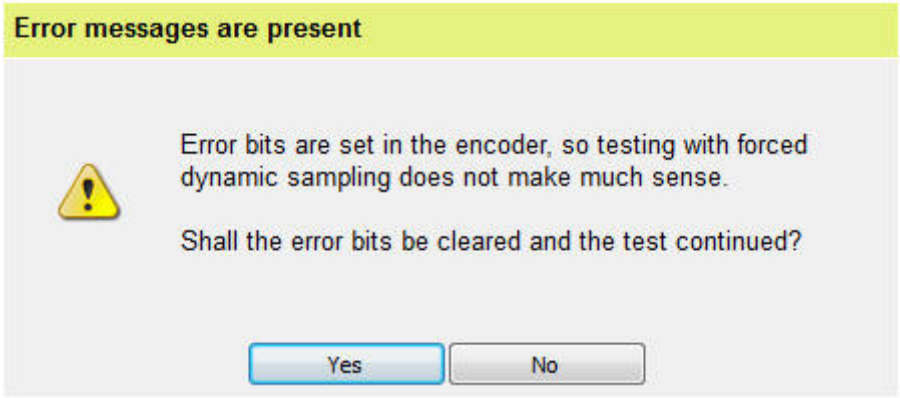
5.6.1 Test of forced dynamic sampling

- ▶ Press the “Next >” button.
- > The forced dynamic sampling test is prepared.

Forced dynamic sampling means that error bits are intentionally triggered and their reactions evaluated. If there are error messages in the status display of the encoder (alarms or warnings), the dialog box “Error messages are present” is displayed. At this time, the error bits can be deleted by pressing “Yes“, and the wizard can continue.

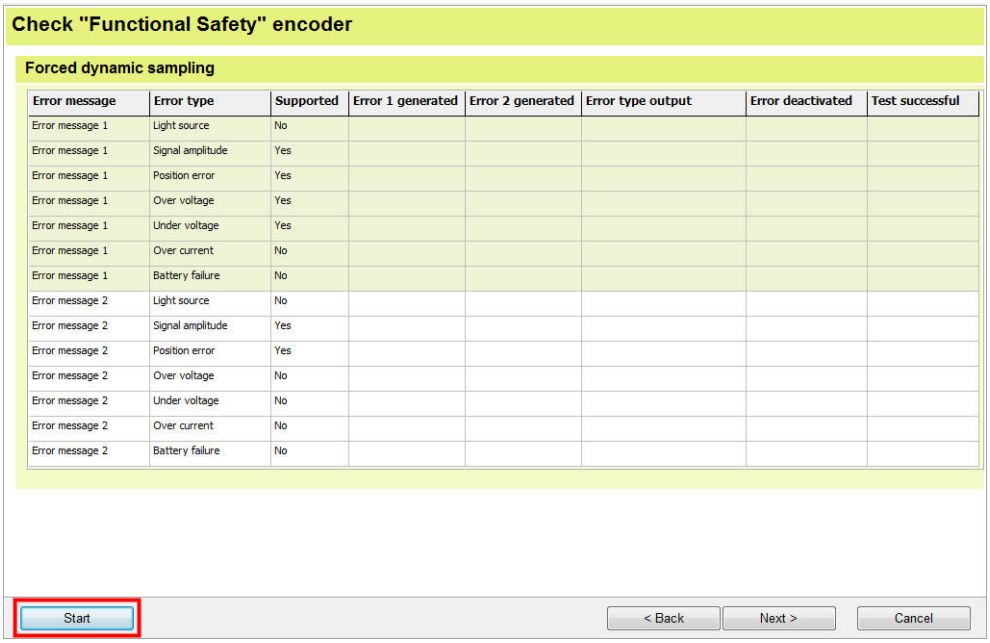
- ▶ Press “No”.
- > The wizard is aborted.

Error bits that emerge later can be cleared from the screen, but are saved in the background. In this case, the error entry will appear at the end of the test in the EnDat status of the log display.



> The supported errors are listed in a table.

Supported errors:



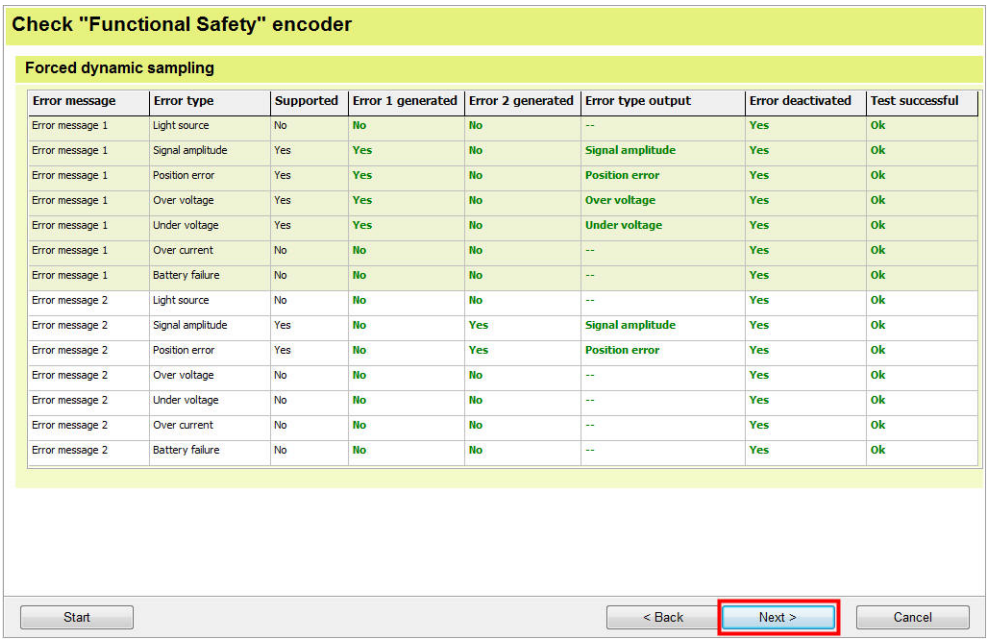
Error message	Error type	Supported	Error 1 generated	Error 2 generated	Error type output	Error deactivated	Test successful
Error message 1	Light source	No					
Error message 1	Signal amplitude	Yes					
Error message 1	Position error	Yes					
Error message 1	Over voltage	Yes					
Error message 1	Under voltage	Yes					
Error message 1	Over current	No					
Error message 1	Battery failure	No					
Error message 2	Light source	No					
Error message 2	Signal amplitude	Yes					
Error message 2	Position error	Yes					
Error message 2	Over voltage	No					
Error message 2	Under voltage	No					
Error message 2	Over current	No					
Error message 2	Battery failure	No					

▶ Press the “Start” button.

> The test result is displayed.

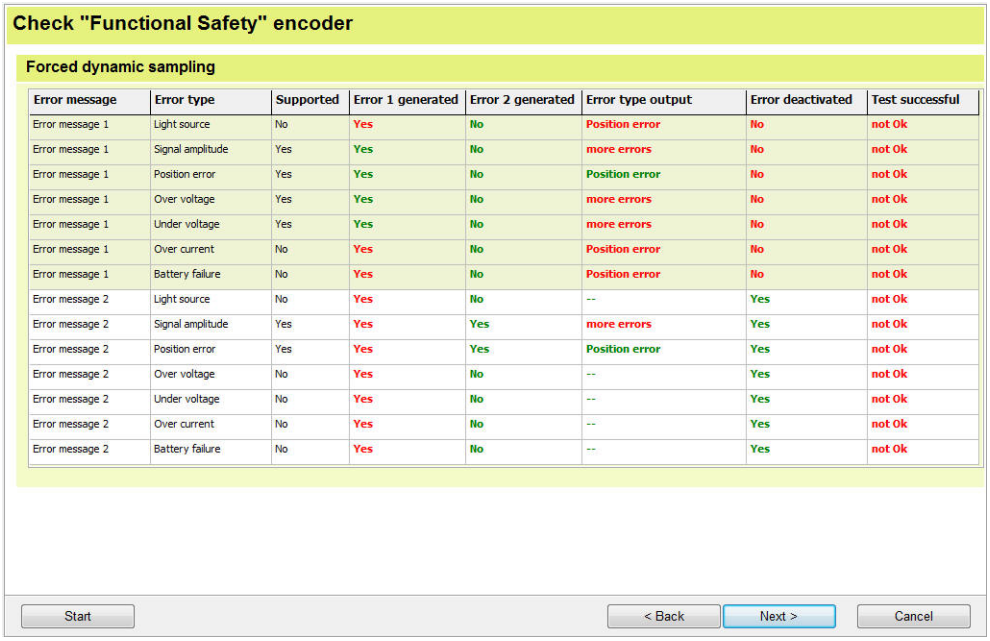
Inspection result:

Test result of error-free encoder:



Error message	Error type	Supported	Error 1 generated	Error 2 generated	Error type output	Error deactivated	Test successful
Error message 1	Light source	No	No	No	--	Yes	Ok
Error message 1	Signal amplitude	Yes	Yes	No	Signal amplitude	Yes	Ok
Error message 1	Position error	Yes	Yes	No	Position error	Yes	Ok
Error message 1	Over voltage	Yes	Yes	No	Over voltage	Yes	Ok
Error message 1	Under voltage	Yes	Yes	No	Under voltage	Yes	Ok
Error message 1	Over current	No	No	No	--	Yes	Ok
Error message 1	Battery failure	No	No	No	--	Yes	Ok
Error message 2	Light source	No	No	No	--	Yes	Ok
Error message 2	Signal amplitude	Yes	No	Yes	Signal amplitude	Yes	Ok
Error message 2	Position error	Yes	No	Yes	Position error	Yes	Ok
Error message 2	Over voltage	No	No	No	--	Yes	Ok
Error message 2	Under voltage	No	No	No	--	Yes	Ok
Error message 2	Over current	No	No	No	--	Yes	Ok
Error message 2	Battery failure	No	No	No	--	Yes	Ok

Test result of faulty encoder:



Error message	Error type	Supported	Error 1 generated	Error 2 generated	Error type output	Error deactivated	Test successful
Error message 1	Light source	No	Yes	No	Position error	No	not Ok
Error message 1	Signal amplitude	Yes	Yes	No	more errors	No	not Ok
Error message 1	Position error	Yes	Yes	No	Position error	No	not Ok
Error message 1	Over voltage	Yes	Yes	No	more errors	No	not Ok
Error message 1	Under voltage	Yes	Yes	No	more errors	No	not Ok
Error message 1	Over current	No	Yes	No	Position error	No	not Ok
Error message 1	Battery failure	No	Yes	No	Position error	No	not Ok
Error message 2	Light source	No	Yes	No	--	Yes	not Ok
Error message 2	Signal amplitude	Yes	Yes	Yes	more errors	Yes	not Ok
Error message 2	Position error	Yes	Yes	Yes	Position error	Yes	not Ok
Error message 2	Over voltage	No	Yes	No	--	Yes	not Ok
Error message 2	Under voltage	No	Yes	No	--	Yes	not Ok
Error message 2	Over current	No	Yes	No	--	Yes	not Ok
Error message 2	Battery failure	No	Yes	No	--	Yes	not Ok

- Press the “Cancel” button.
- Delete the errors.
- Restart the test.

The functional safety check must be terminated without error; otherwise the encoder to be inspected must be considered defective.

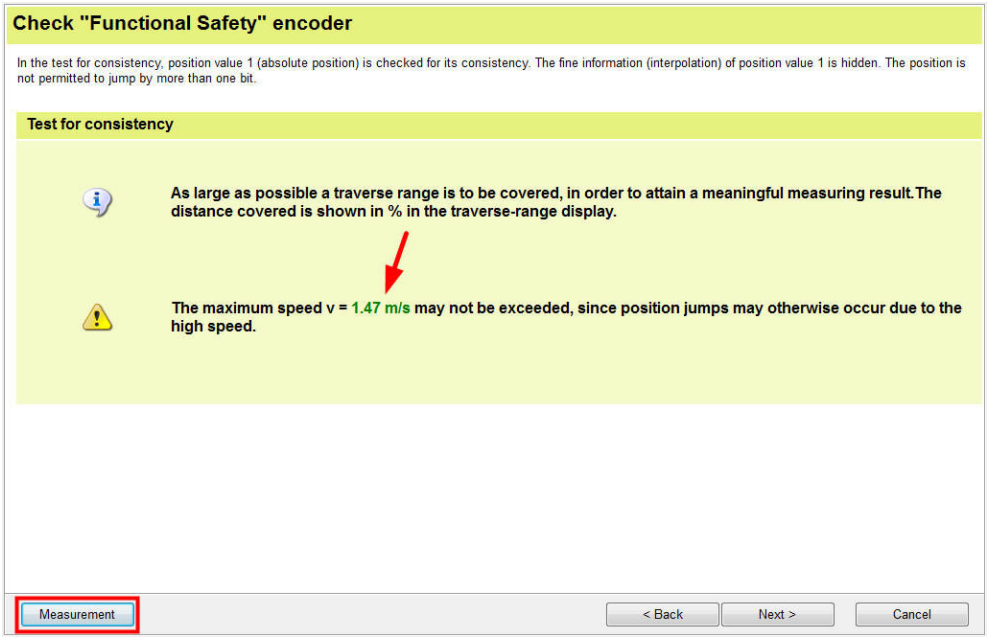
5.6.2 Test for consistency

- ▶ Press the “Next >” button.
- > The “Test for consistency” is prepared.

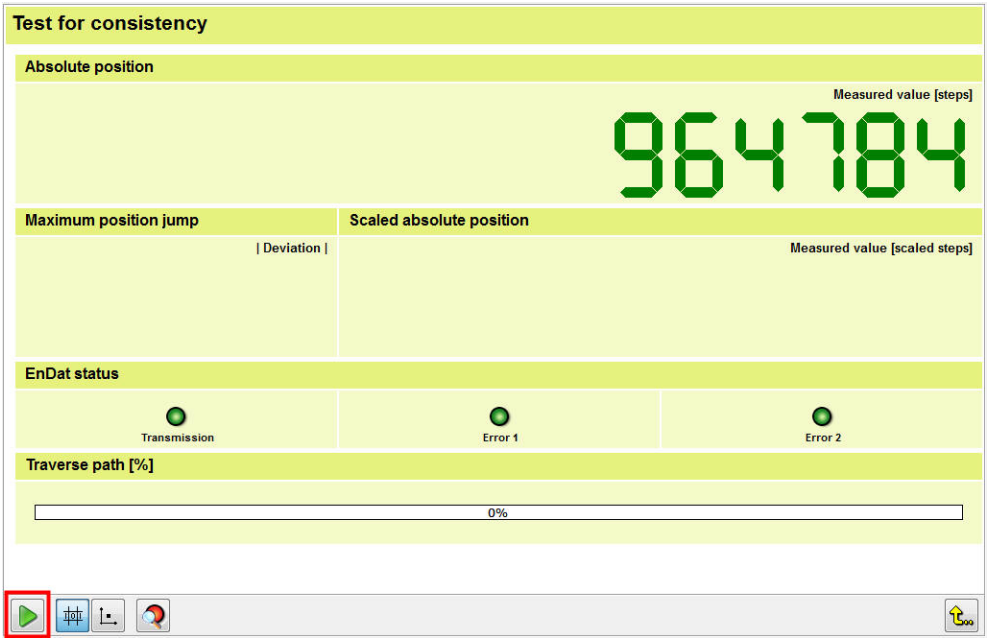
In this test, the course of the code of position value 1 (w/o interpolation) is checked.

NOTICE

Traverse the largest possible measuring range without exceeding the maximum traversing speed or rotational speed displayed in green. **Observe the screen display!**

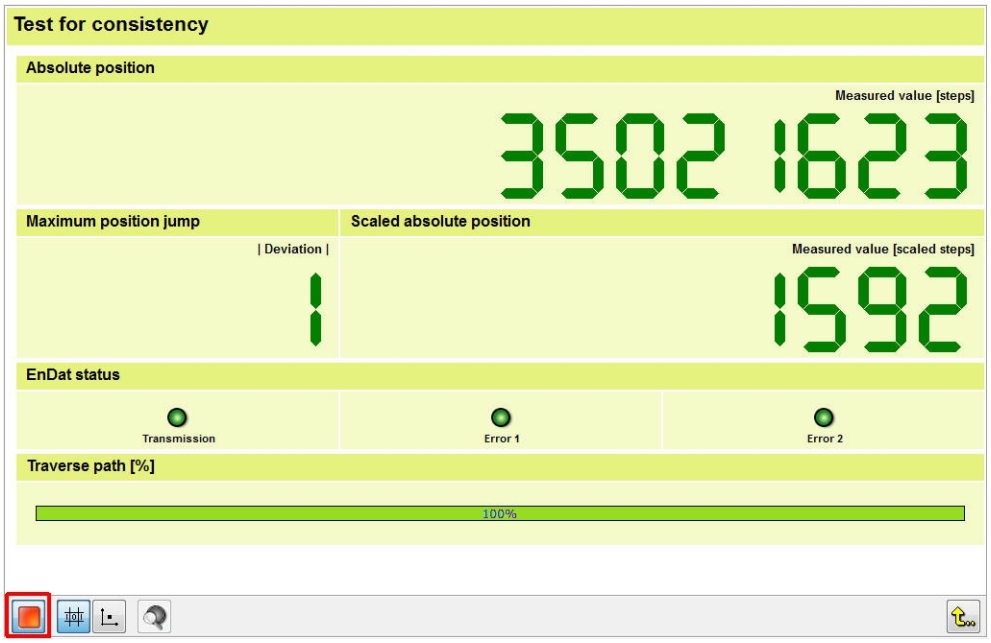


- ▶ Press the “Measurement” button.
- > The dialog is closed.



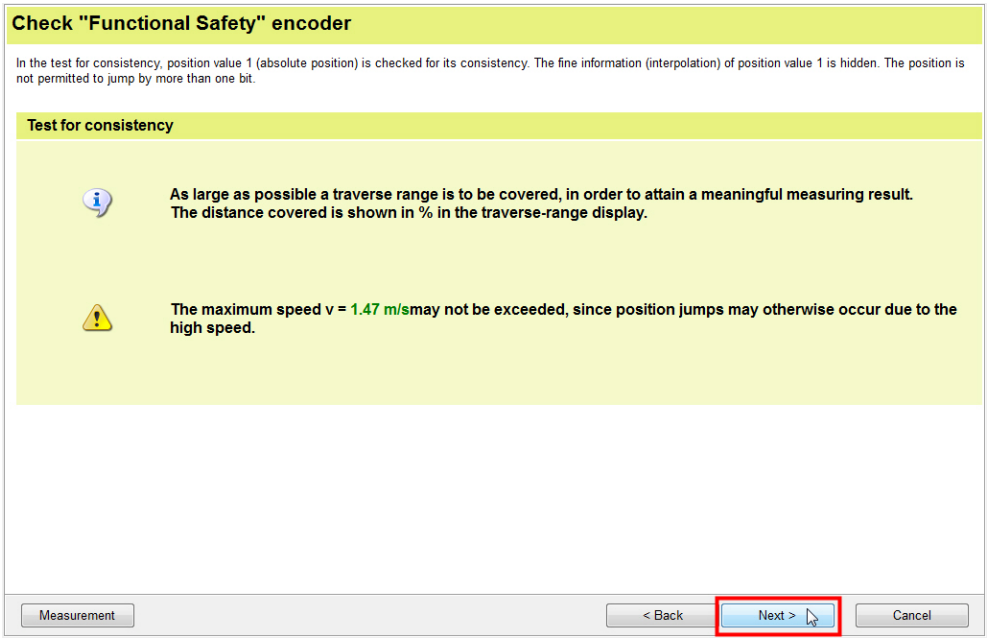
- Press his button.
> The test for consistency starts.
- If possible, cover the entire range of traverse.

The green bar display shows the traversed path in %. The measuring range of an encoder mounted to a machine may be limited, i.e. the traverse path cannot reach 100 %.



- Press this button.
> The test for consistency stops.

- Press this button.
> The wizard is displayed again.

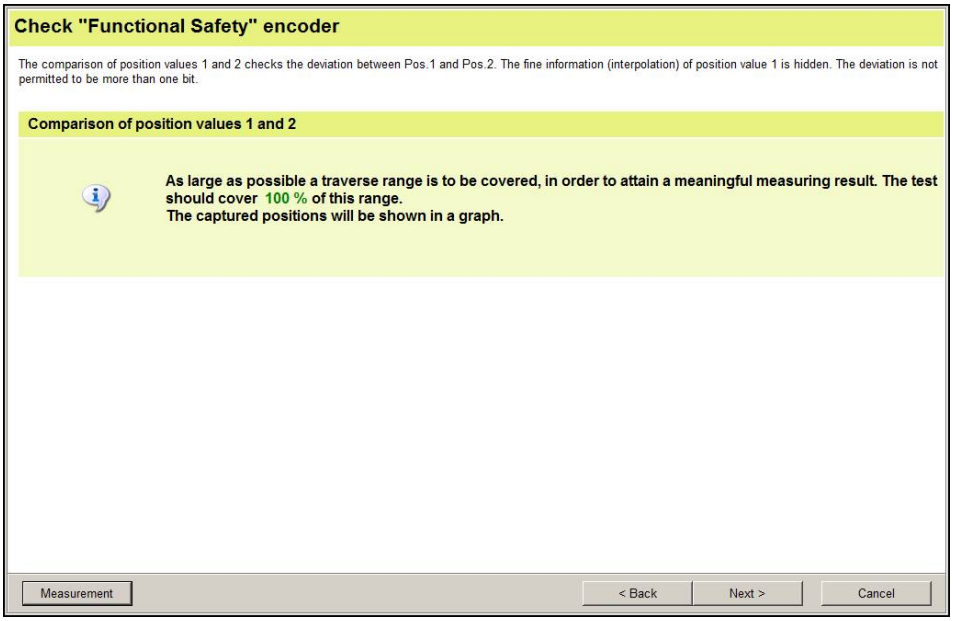


- ▶ Press the “Next >” button.
- > The test “Comparison of position values 1 and 2” is prepared.

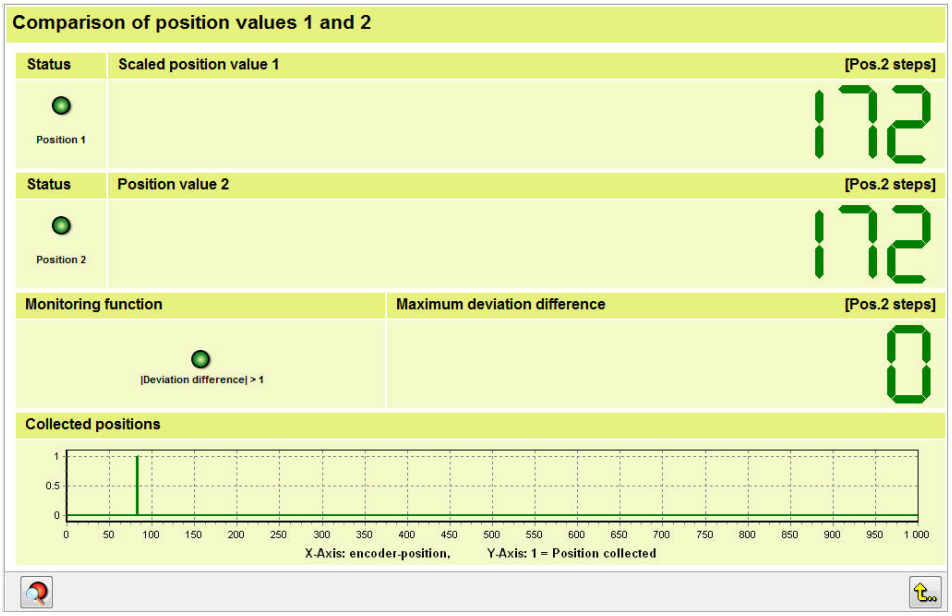
5.6.3 Test by comparison of position values 1 and 2

The position values 1 and 2 are compared in this test. The values must not differ by more than 1 bit.

Traverse the largest possible measuring range.



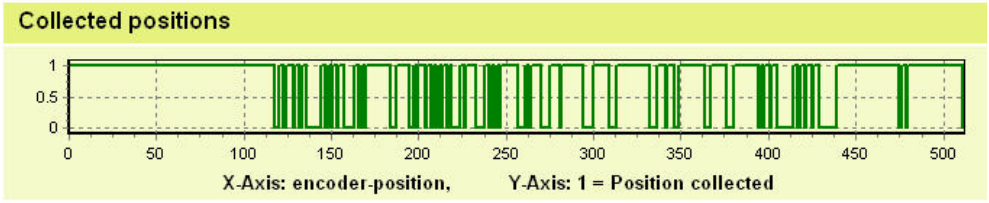
- ▶ Press the “Measurement” button.
- > The comparison is started.
- ▶ Traverse the accessible traverse range until all edges are deleted from the diagram “Collected positions” (straight line at level 1).



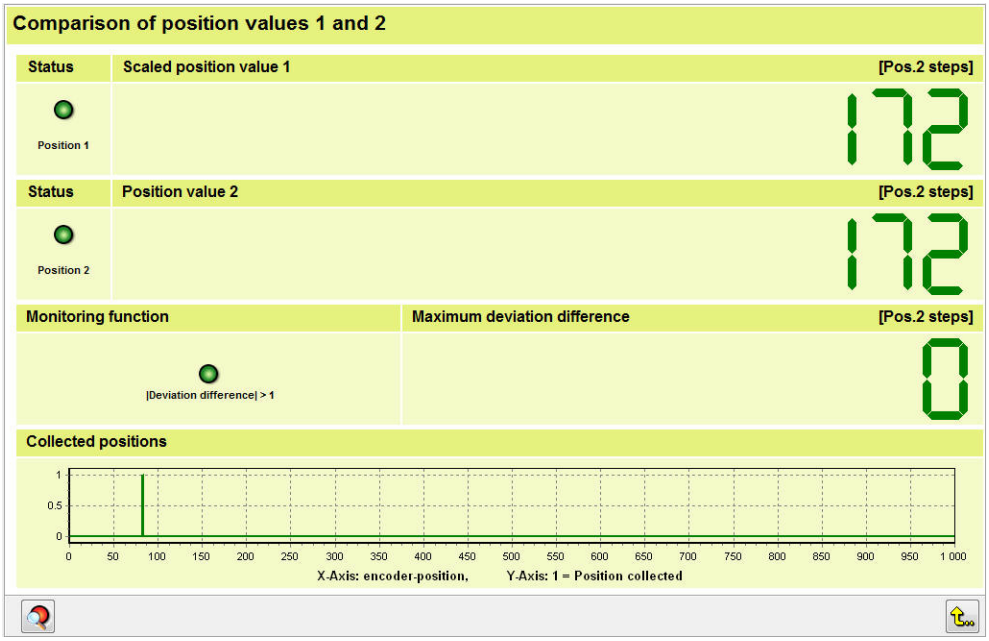
- > The software converts/adjusts the “Scaled position value” to the coarser resolution of the position value 2.

> Many edges in the diagram indicate that not all positions were captured yet.

▶ Continue traversing the measuring range until no more edges are visible.



All positions are captured (straight line at level 1). The maximum deviation difference is within the tolerance (display in green), and the monitoring function therefore does not display any error (display in green).



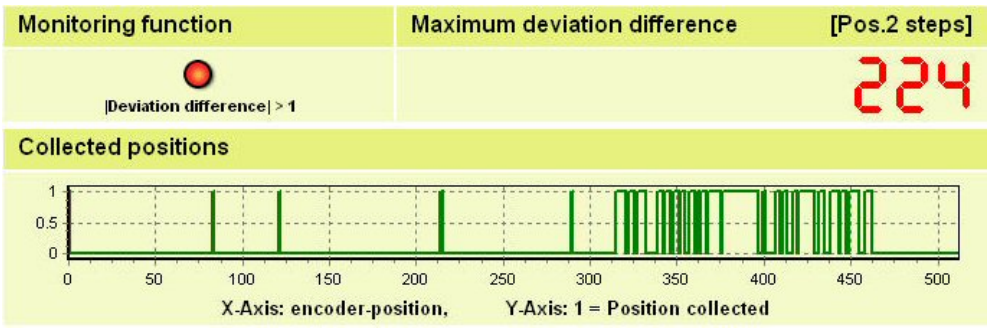
▶ Press this button.

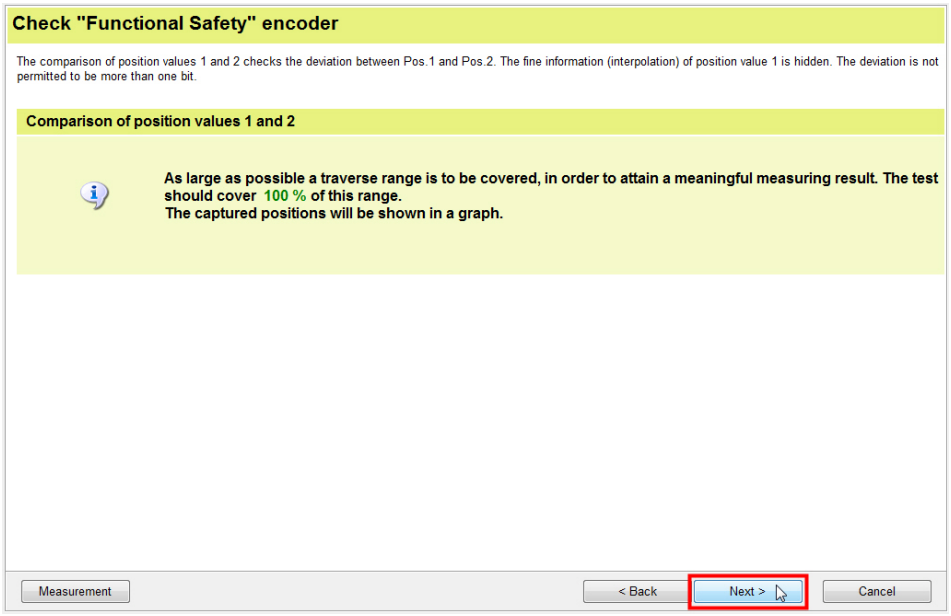
> The “Comparison of position values 1 and 2” is terminated.

If an error message is generated or if the deviation difference is > 1, the encoder is defective.

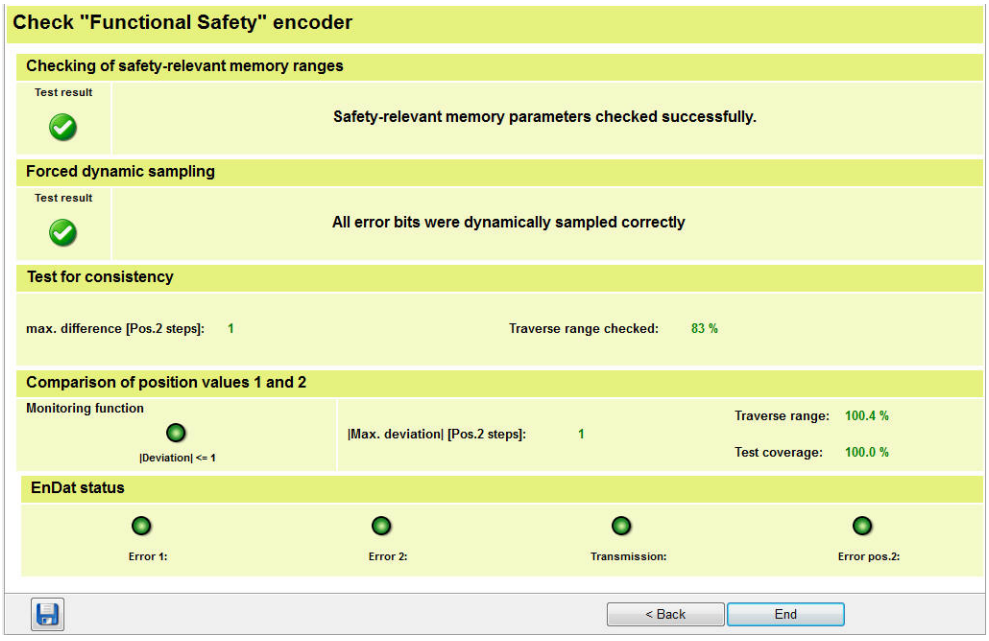
▶ Repeat the test, if necessary.

You may reset the error message now; the wizard will remember it and add it to the result screen.

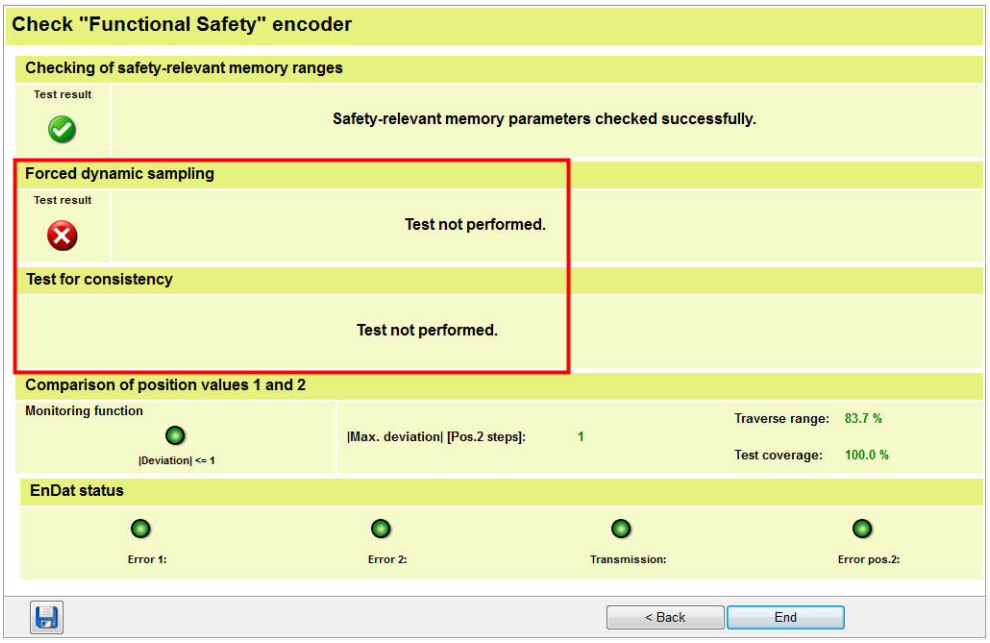




- ▶ Press the “Next >” button.
- > The result screen is displayed.

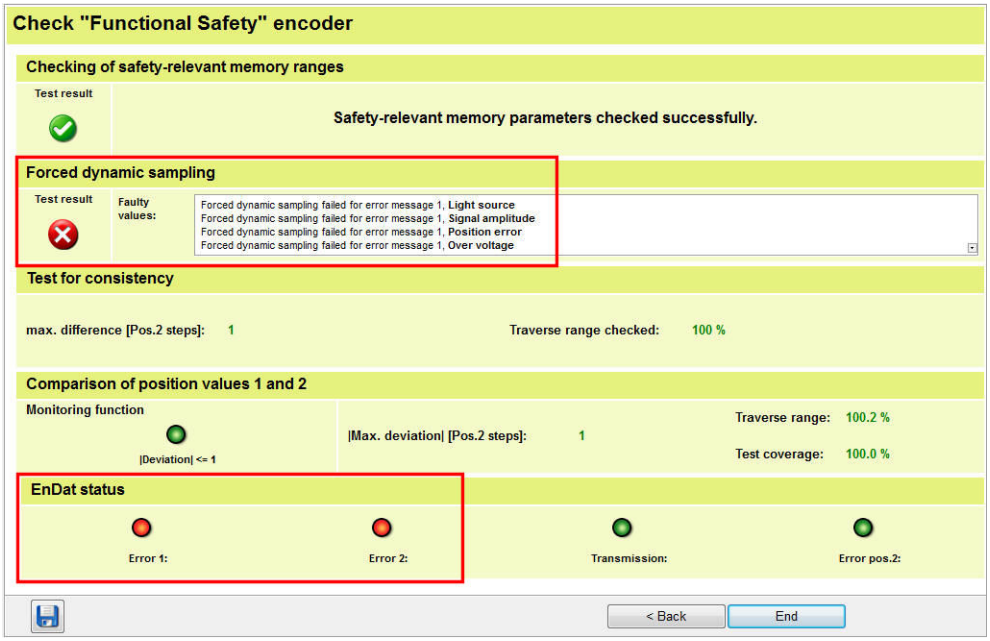


Result screen, if not all tests were run:



Repeat the wizard.
If errors occur again, the encoder must be considered defective.

Result screen, if tests were faulty:

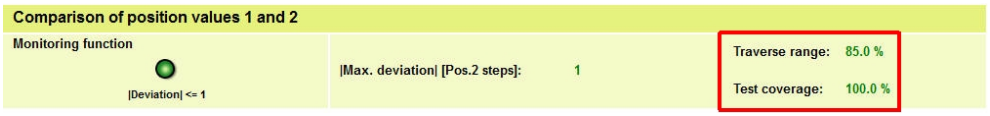


Traverse range 100 % means that the entire measuring range (e.g. one revolution of a rotary encoder) was covered.

Test coverage 100 % means that every position of the traverse range was tested.

Example

Traverse range 85 %, Test coverage 100 % means: Due to the mounting situation, only 85 % of the encoder's traverse range could be covered. Out of these 85 %, 100 % of the positions (test coverage) could be tested.



- ▶ Press this button.
- > The log data can be saved.

The data is saved under C:\Programs\HEIDENHAIN\ATS. (The location can be altered.)

```
HEIDENHAIN Functional-Safety encoder check
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Encoder data
------------

Encoder model : LC 415
ID number     :
Serial number :

Recording date
--------------

Date: 16.07.2013 17:11

Supported diagnostics-functions
-------------------------------

Functional-Safety encoder       : supported
Forced dynamic sampling         : supported
Position value 2                : supported
Operating status error sources  : supported
Online-diagnostics              : supported
Offline-diagnostics             : not supported

Checking of safety-relevant memory parameters
---------------------------------------------

The checked part of the safety-relevant memory parameters is OK.
(Some manufacturer-specific parameters cannot be checked)

Forced dynamic sampling
-----------------------

Error-  | Error-type        | Sup-   | Error 1  | Error  2 | readout          | deacti- | Test
message |                   | ported | forced   | forced   | error-type       | vated   |
--------------------------------------------------------------------------------------------
    F 1 |       Light source |     No |       No |       No |               -- |     Yes |   OK
    F 1 |  Signal amplitude  |    Yes |      Yes |       No |  Signal amplitude |     Yes |   OK
    F 1 |    Position error  |    Yes |      Yes |       No |    Position error |     Yes |   OK
    F 1 |      Over voltage  |    Yes |      Yes |       No |      Over voltage |     Yes |   OK
    F 1 |     Under voltage  |    Yes |      Yes |       No |     Under voltage |     Yes |   OK
    F 1 |       Over current |     No |       No |       No |               -- |     Yes |   OK
    F 1 |  Battery failure   |     No |       No |       No |               -- |     Yes |   OK
============================================================================================
    F 2 |       Light source |     No |       No |       No |               -- |     Yes |   OK
    F 2 |  Signal amplitude  |    Yes |       No |      Yes |  Signal amplitude |     Yes |   OK
    F 2 |    Position error  |    Yes |       No |      Yes |    Position error |     Yes |   OK
    F 2 |      Over voltage  |     No |       No |       No |               -- |     Yes |   OK
    F 2 |     Under voltage  |     No |       No |       No |               -- |     Yes |   OK
    F 2 |       Over current |     No |       No |       No |               -- |     Yes |   OK
    F 2 |  Battery failure   |     No |       No |       No |               -- |     Yes |   OK
--------------------------------------------------------------------------------------------

Test for consistency
--------------------

Test result          : OK
Max. position jump   : 1 [Pos.2 steps]
Traverse range       : 84 %
Least position       : 40.04 mm
Greatest position    : 225.94 mm

Comparison of position values 1 and 2
-------------------------------------

Test result          : OK
Max. deviation       : 1 [Pos.2 steps]
Traverse range from 37.84 mm to 223.74 mm (percent value : 85.0 %)
Test coverage of the traverse range    : 100.0 %

EnDat-Status:
-------------

Error 1            : none
Error 2            : none
EnDat-transmission : OK
Pos. 2 error       : none

File-path
---------

C:\Users\     \Desktop\LC SN_en xxxxxx.txt
```

- ▶ Press the "End" button.
- > The "Functional-safety encoder check" wizard is terminated.

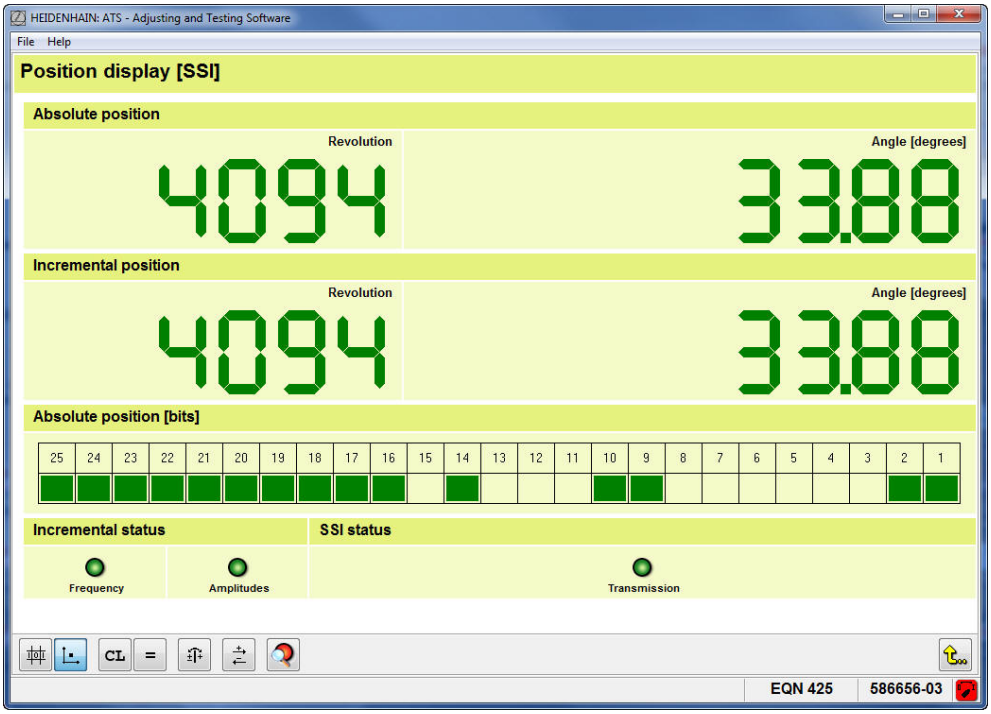
5.7 Supported interfaces

The ATS software only supports HEIDENHAIN products!
The stated tolerances and encoder specifications are only valid for encoders produced by HEIDENHAIN!

5.7.1 SSI, SSI programmable

The software functions are basically those of the EnDat interfaces. The interface is unidirectional. Therefore, no functions are supported that write data into the encoder. (Resetting error messages, online diagnostics, datum shift, display of memory contents, etc. is not possible!)

Description of the status display of the basic function "Position display":
The incremental status **"Frequency"** indicates that the input frequency of the incremental signal was exceeded. The incremental status **"Amplitudes"** indicates that the amplitudes of the incremental signal were exceeded or underrun.
The SSI status **"Transmission"** indicates that the data was correctly transferred (CRC test).



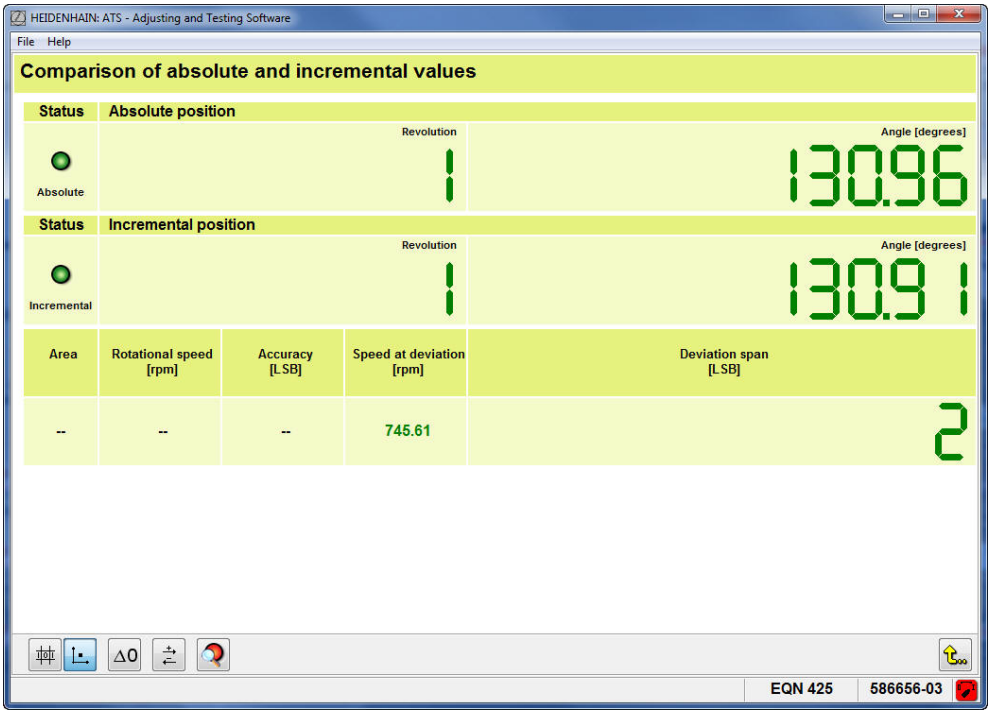
NOTICE

- Observe the encoder supply voltage if you have connected the rotary encoder manually (Manual settings).

Diagnostic function "Comparison of absolute and incremental values"
In contrast to EnDat, no velocity ranges or permissible tolerances are displayed here, since none are available. The deviation span is displayed in red color, if the difference between the absolute and the incremental position exceeds the absolute measuring steps per revolution. (Example: For a 13-bit encoder the display color changes to red as of 8192 LSB.)

The deviation span can be reset to zero.

Adaptation of the counting direction, if the counting direction of freely programmable SSI rotary encoders was changed



5.7.2 Fanuc

HEIDENHAIN absolute encoders with a model designation ending with the letter **F** (e.g. LC 193 F) are equipped with a **Fanuc Serial Interface or Fanuc αi interface**.

The ATS software supports the following Fanuc interfaces:

- Fanuc Serial Interface (ordering designation Fanuc 01 or 02)
- Fanuc αi Interface (ordering designation Fanuc 05; also comprises Fanuc 02)

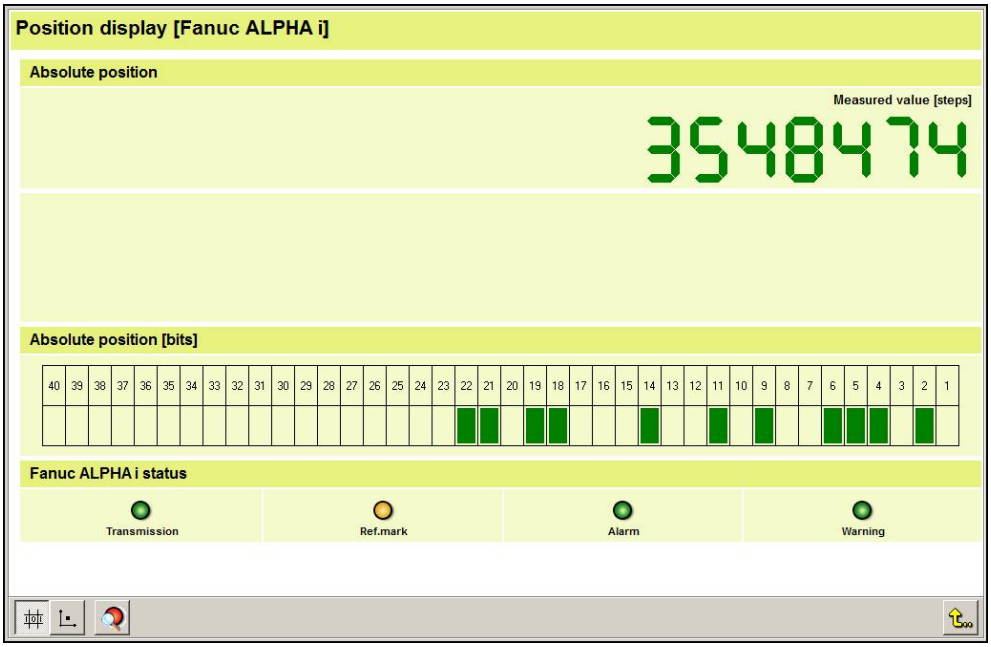
The software functions are basically those of the EnDat interfaces. Fanuc interfaces are purely serial interfaces; incremental signals are not transmitted. The interfaces are unidirectional (exception: Fanuc 05). Therefore, no functions are supported that write data into the encoder. (Datum shift, display of memory contents, etc. is not possible!)

Examples of displays in the status line
"Transmission" indicates that the data was correctly transferred (CRC test).
"Alarm"/"Warning" (αi) is a group signal to indicate that one or several error messages are logged in the encoder. With Fanuc interfaces, the status display can only be reset by switching the encoder on and off. (The "Clear error" button has no function.)
"Ref.mark" corresponds to the EnDat status function "Ref. mark" in combination with EIB interface electronics, e.g. EIB 392F.

If HEIDENHAIN converters are used that convert incremental interfaces to Fanuc absolute interfaces, the reference mark must be traversed to achieve the absolute status. When the reference mark is traversed, the color of the LED symbol changes from gray to yellow. The yellow color symbolizes the absolute encoder

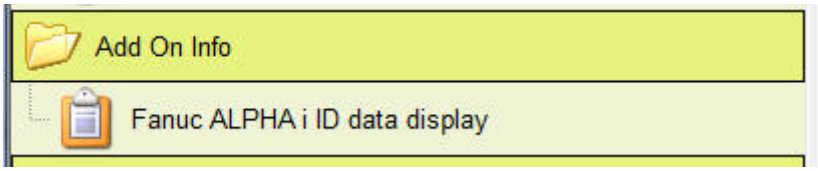
status. If a Fanuc absolute interface is connected, the LED color is always yellow. Also see section “Connection to EIB interface electronics”.

Only the PWM supports the Fanuc αi mode!
The Fanuc αi mode becomes active when you connect the encoder through its ID number or manually by selecting “FANUC ALPHAi interface”.
The integrated Fanuc 02 interface is activated through manual connection and “Fanuc” setting.
For more information on the interfaces, please contact Fanuc!



Dialog when the Fanuc αi Interface is connected:

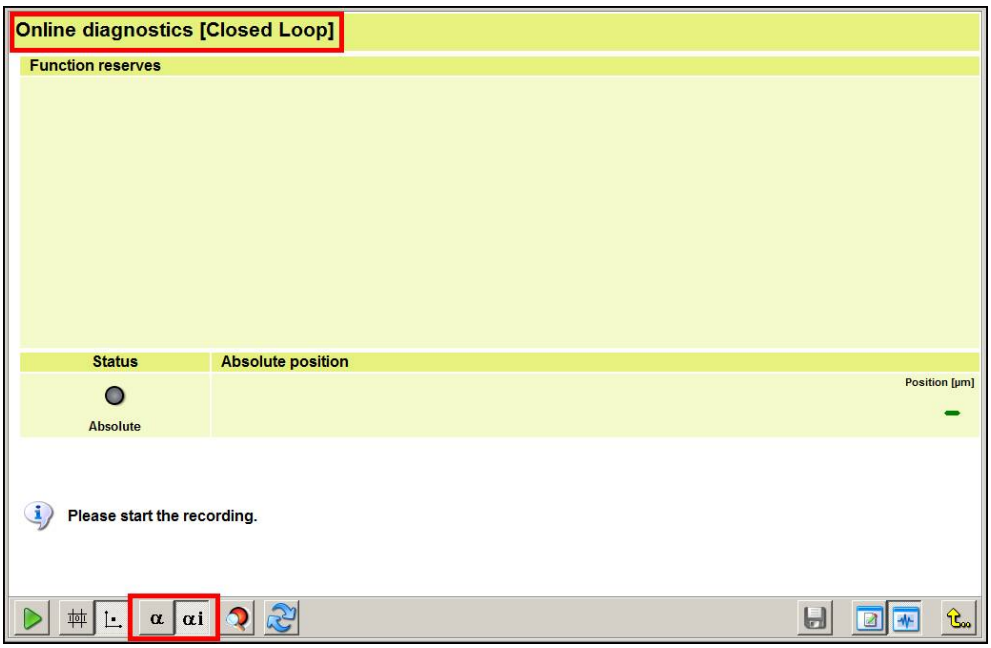
- ▶ Select the function “Fanuc ALPHA i ID data display“ from the Add-on info.
- > The "Internal information” table is displayed (encoder data).



Fanuc ALPHA i ID data display

Internal information

ID-information	Value
ID number	760932-03
Serial number	38464409B
Encoder name and type	LC 495F
Manufacturer	1 = HEIDENHAIN
Encoder design	L = linear encoder
Interpolation for Fanuc ALPHA i resolution	400
Signal pitch [nm]	20000



The interface switchover between ALPHA and ALPHA i is used in the feed-through mode (online diagnostics, closed loop) to adapt an encoder connected through Fanuc ALPHA i to a Fanuc NC parameterized in the ALPHA mode.

The Fanuc encoder can also be connected manually as ALPHA or ALPHA i interface!

5.7.3 Mitsubishi

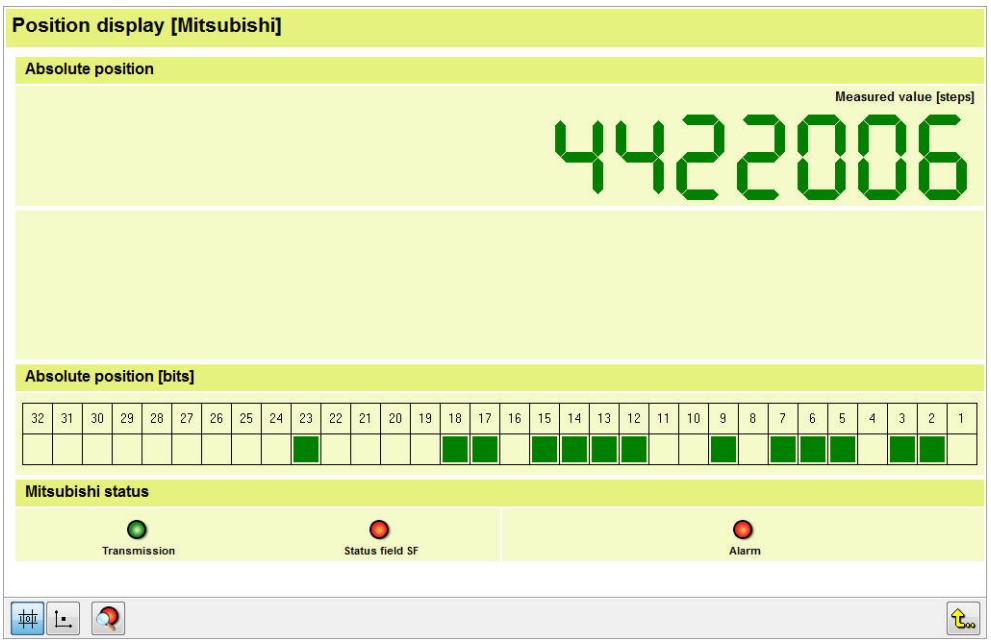
Absolute HEIDENHAIN encoders with a model designation ending with the letter **M** (e.g. LC 193 M) are equipped with a **Mitsubishi High Speed Serial Interface**.

The ATS software supports the following Mitsubishi interfaces:

- Mitsu 01, 02, and 03

The software functions are basically those of the EnDat interfaces. Mitsubishi interfaces are purely serial interfaces; incremental signals are not transmitted. The interfaces are unidirectional. Therefore, no functions are supported that write data into the encoder. (Datum shift, display of memory contents, etc. is not possible!)

Examples of displays in the status line
"Transmission" indicates that the data was correctly transferred (CRC test).
"Status field SF" is a group message for status information output by the encoder, e.g.:
DD0 – not referenced (= The reference mark of an incremental encoder has not been traversed yet.)
DD4 – encoder error (ea0)
"Alarm" is a group signal to indicate that one or several error messages are logged in the encoder.



- Press this button.

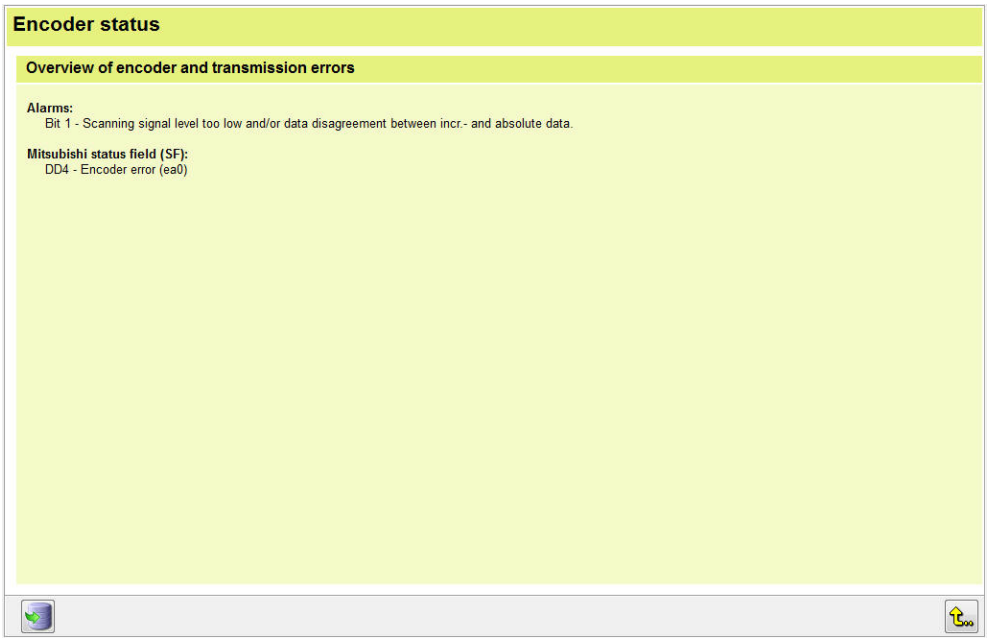
> The detailed status information is displayed.

- Press this button.

Or

- Switch the encoder power supply off and back on again.

> The messages are reset.



5.7.4 Indramat (I²C)

Bosch Rexroth (Indramat) servo encoders with absolute I²C interface can be connected to the PWM (IK 215) with a special adapter cable, see User's Manual "PWM 20 and PWM 21 (IK 215) Testing Package – Cables and Connection Technology".

As of the ATS software version 2.6, encoders can be tested with the PWM 20.
As of the ATS software version 3.2.01,encoders can be tested with the PWM 21.

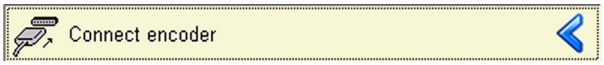
Functions:

- Oscilloscope display of the incremental signals
- Characteristics of the incremental signals with bar graphs
- Incremental position
- Incremental status LED

> The encoder must be connected “automatically”, i.e. by entering the encoder ID. Manual identification (”Manual Settings”) is not possible!

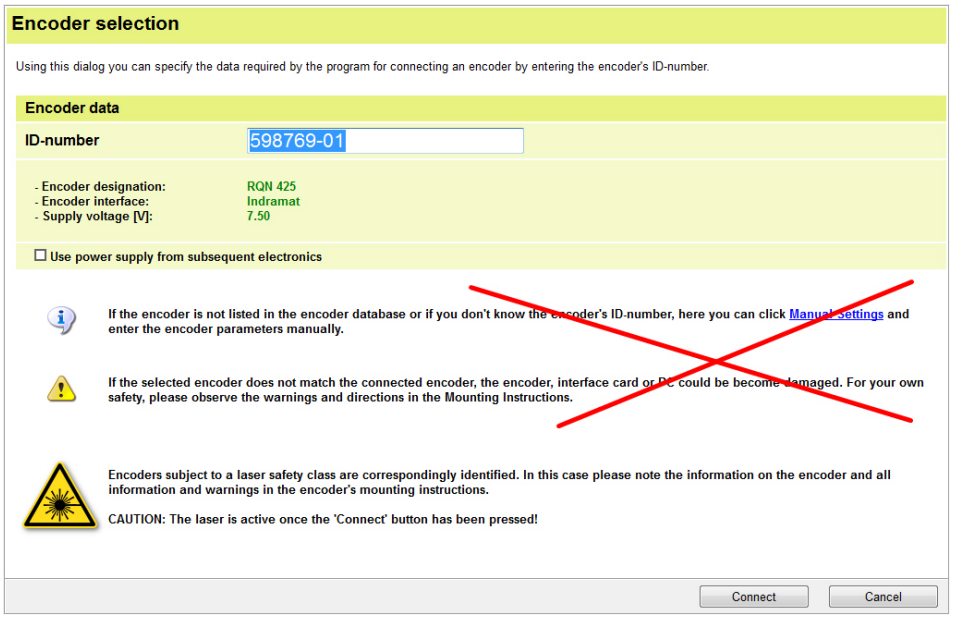
After the electrical connection has been established:

▶ Double-click “Connect encoder”.



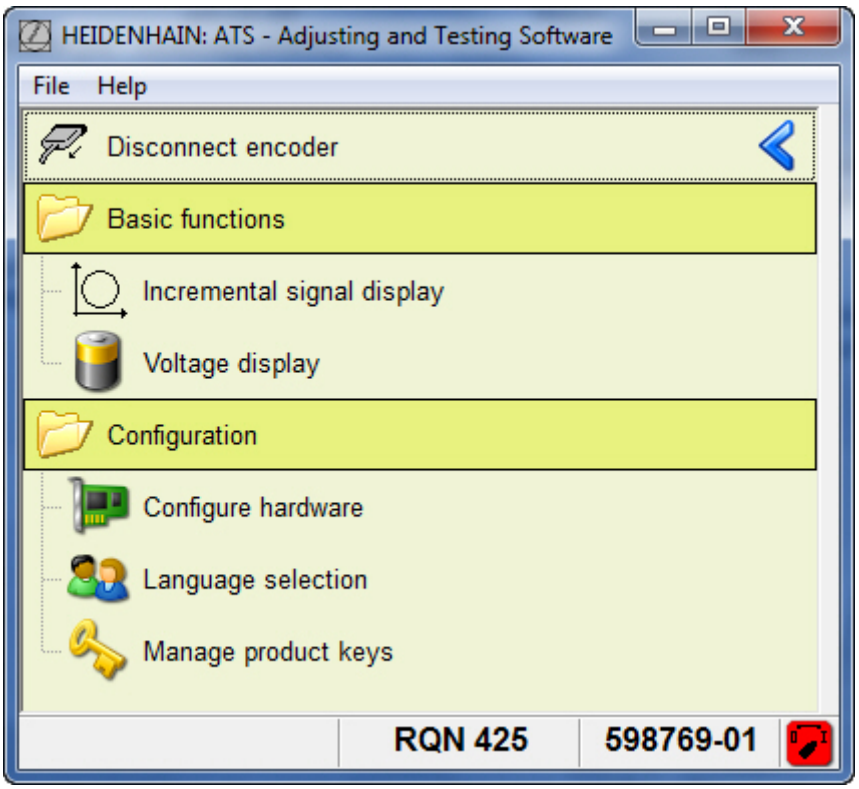
> The connection to the network drive is set up.

> The “Encoder selection” window is displayed.



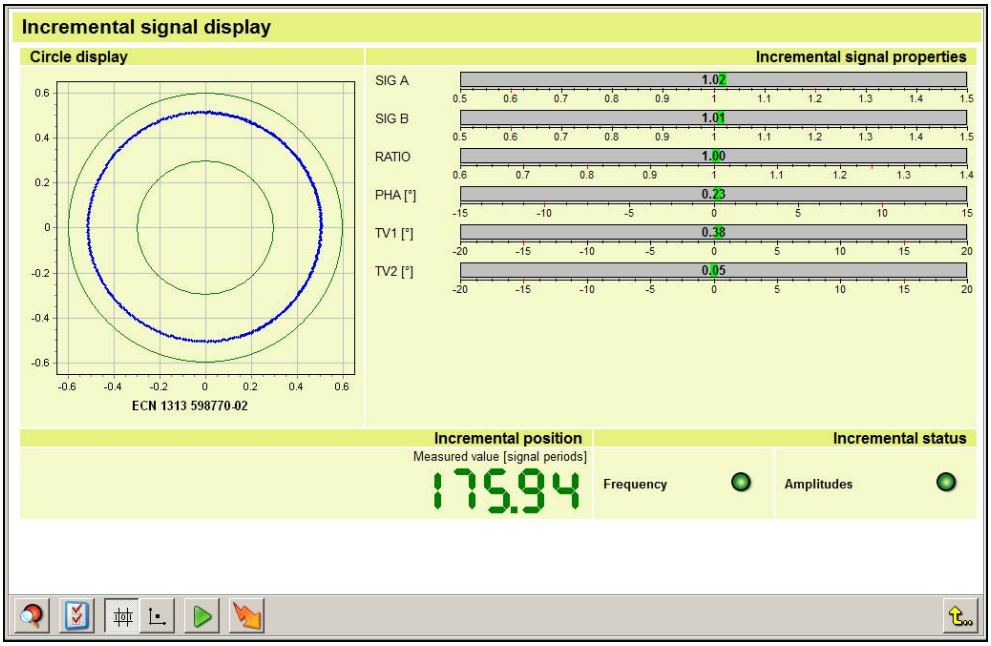
▶ Enter the encoder ID to connect the encoder.

> The functions “Incremental signal display” and “Voltage display” are available.

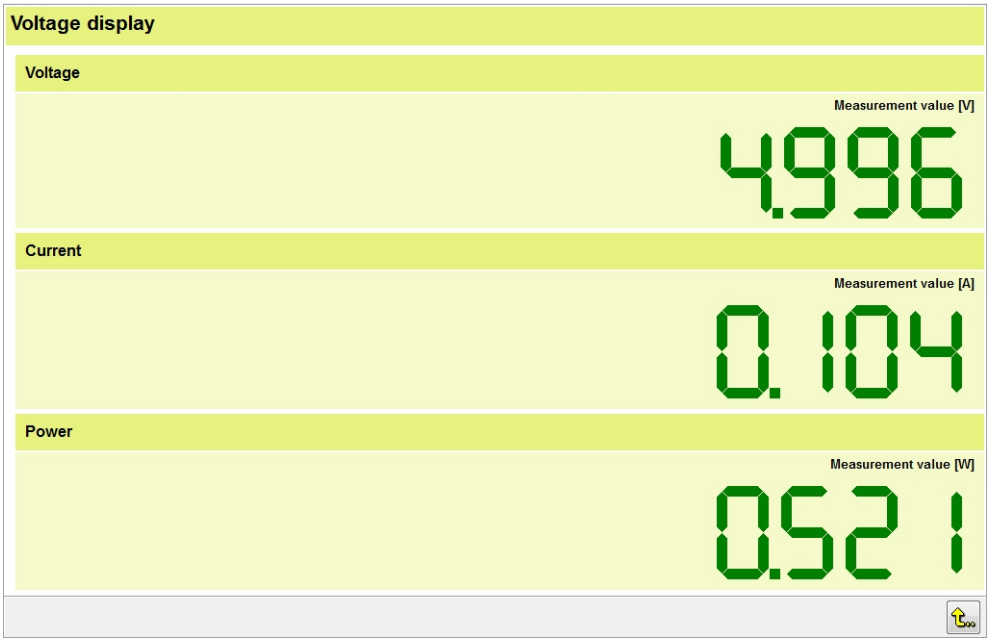


In the chapter "Basic functions", page 50 the incremental signal display and its functions are described in more detail.

The function “Incremental signal display“ serves to check the incremental signals. The sine and cosine signals are displayed as circle diagrams in the internal oscilloscope. The amplitude limits are represented by a green annulus; the signal amplitude (V_{PP}) can also be read from the “Incremental signal properties”. At “Incremental position”, the current count can be displayed in signal periods or in degrees and revolutions (for multiturn encoders). Incremental signal errors are indicated through the green and red LED symbols below “Incremental status”.



With the "Voltage display" function you can measure the power supply and check the current consumption of a rotary encoder.

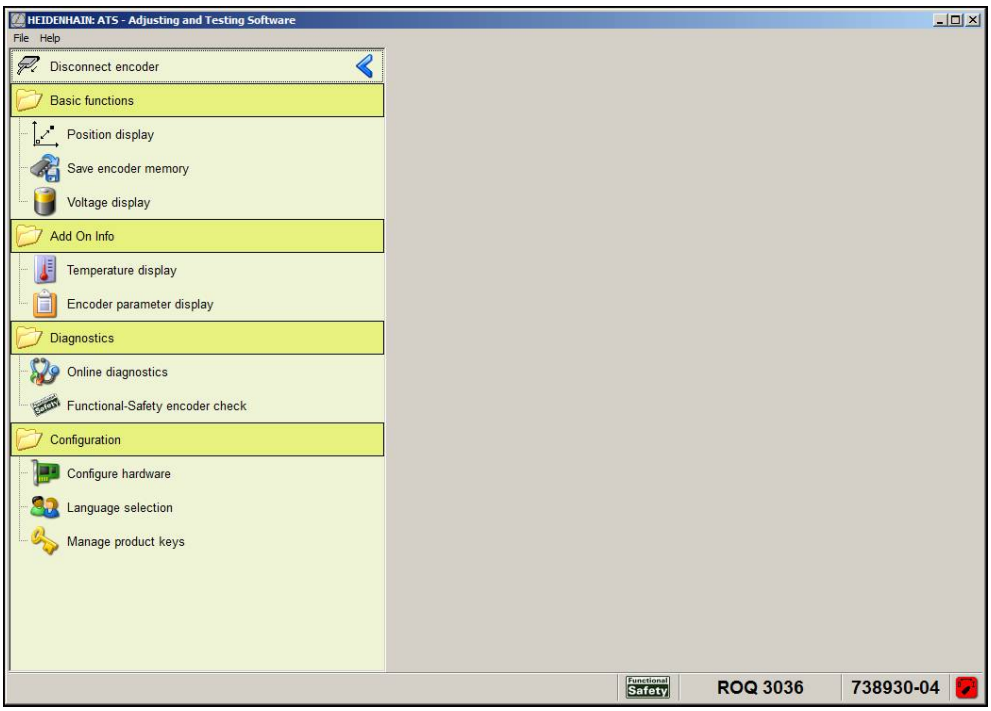


5.7.5 DRIVE-CLiQ

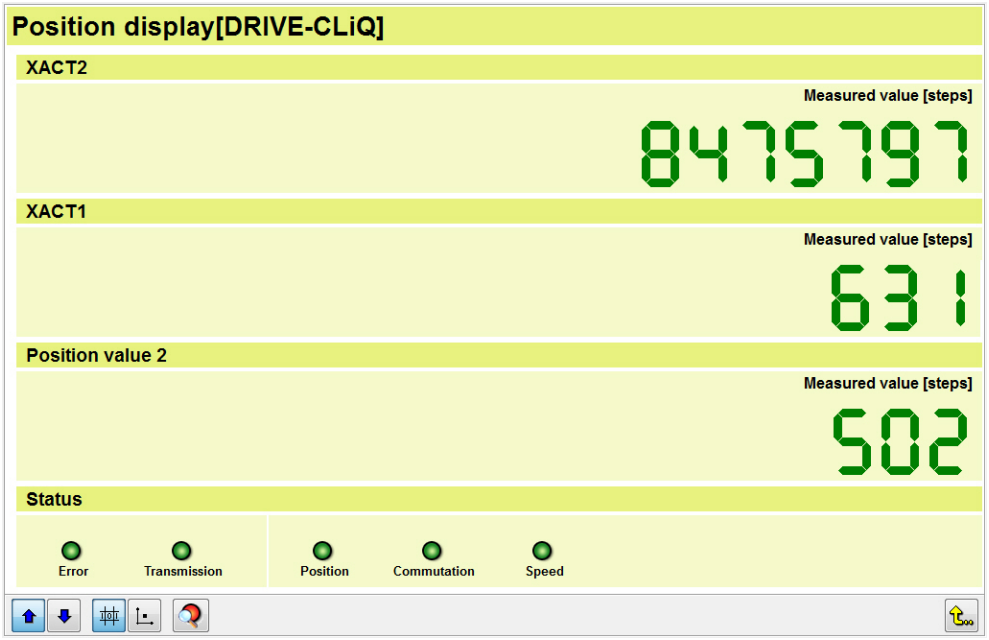
DRIVE-CLiQ is a registered trademark of SIEMENS AG.

Encoders with DRIVE-CLiQ interface are dynamically configured during operation, e.g. as regards the transmission time. **Thus, feed-through operation with the PWM is impossible!**

For such encoders, the PWM uses a configuration that differs from that of the machine or installation on which the encoder is operated. Apart from the functional encoder check with a PWM, the encoder also needs to be inspected while mounted to the machine or installation. This means that the configuration the PWM uses for inspecting differs from the configuration in the machine/installation. Consequently, a DRIVE-CLiQ encoder may work perfectly with the PWM, but not at the machine. The software functions are basically those of the EnDat interfaces. In the following, only those software functions and control elements are described that differ essentially from already described functions and elements. The DRIVE-CLiQ interface is a purely serial interface; incremental signals are not transmitted. The ATS software does not support DRIVE-CLiQ components that are not HEIDENHAIN products!



- ▶ Select the “Position display” function.
- > The “Position display [DRIVE-CLiQ]” window is displayed.



Switching between position display screen and add-on info screen:

“Arrow up” button = Position display screen

“Arrow down” button = Add-on info screen

The information transmitted via DRIVE-CLiQ follows the PROFIdrive profile (available from the Profibus user organization).

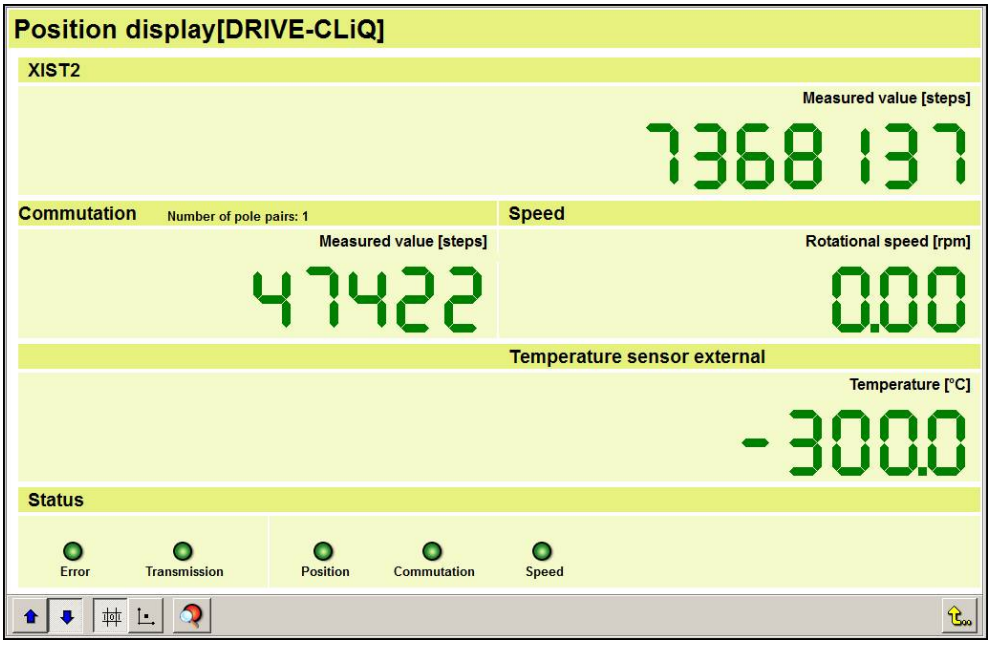
Displayed position values:

- XACT1: Incremental value
- XACT2: Absolute value
- Position value 2: Redundant position value of encoders supporting functional safety, or incremental position value for conversion EnDat 2.2 -> DRIVE-CLiQ

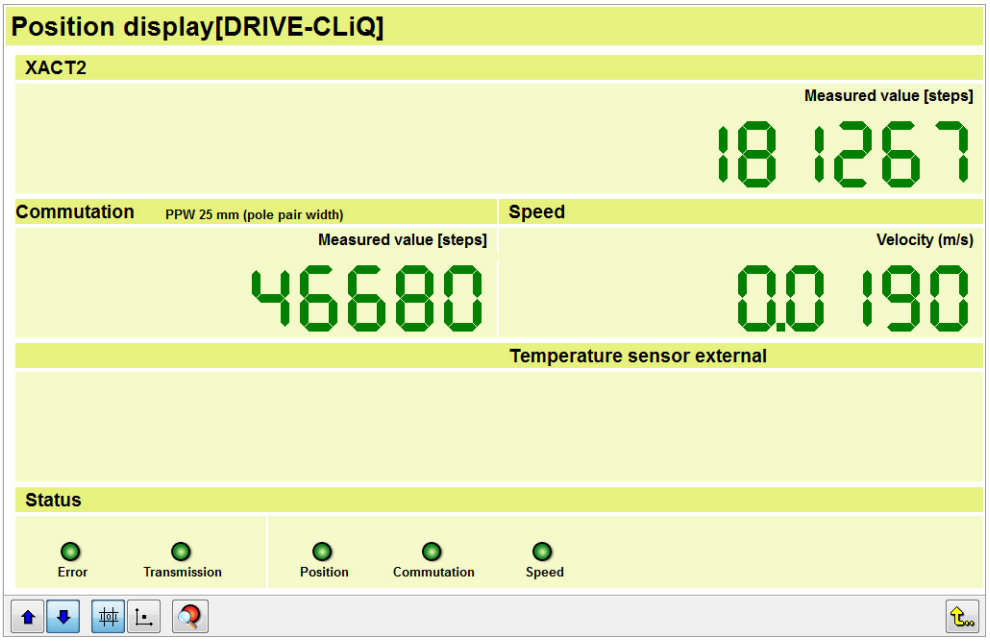
Status information:

- Error: Error message from connected encoder
- Transmission: Error in data transmission, e.g. CRC, packet loss, ...
- Position: Position comparison of XACT with Pos2 for encoders supporting functional safety
- Commutation and Speed: The ATS software compares the values for the commutation angle or speed transferred from the encoder on the basis on XACT1.

Add-on info screen:



Position display for rotary encoder



Position display for linear encoder

Commutation and Speed

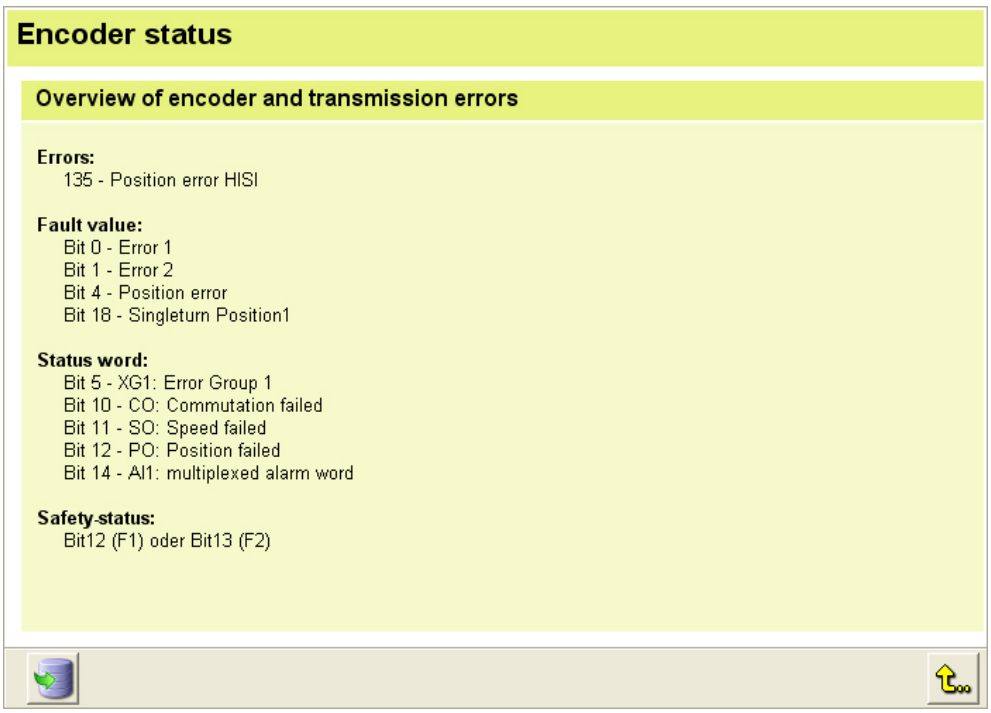
The displayed commutation (angle) refers to

- a pole-pair width of 25 mm for linear encoders; i.e. 0° to 360° are displayed within 25 mm (example: linear drive).
- a pole-pair width of 1 for rotary or angle encoders; i.e. 0° to 360° are covered in one revolution.

The displayed speed is the traversing speed of linear encoders, or the rotational speed of rotary encoders.
Encoders with a DRIVE-CLiQ interface compute these values in the encoder and then transfer them to the interface.

External temperature sensor
Display of the temperature of an external temperature sensor, if supported by the encoder (e.g. the temperature of the winding). An extremely low (fault value -300.00) or high temperature value (> 500) indicates that no temperature sensor is connected. The temperature display can also be activated in the Add-On Info in the basic menu!

Display detailed status information



Errors:

Several error groups are distinguished:

- Encoder errors
- Software errors
- Kernel errors
- Safety errors

Fault value:
Detailed information on the fault that has occurred; not available for all error numbers

Status information:
The encoder status is included in each cyclic telegram. Information on internal calculations (position, commutation, speed, etc.) is saved here.

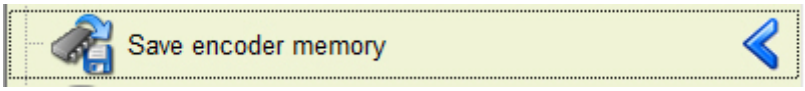
Safety status:
Safety-related error messages

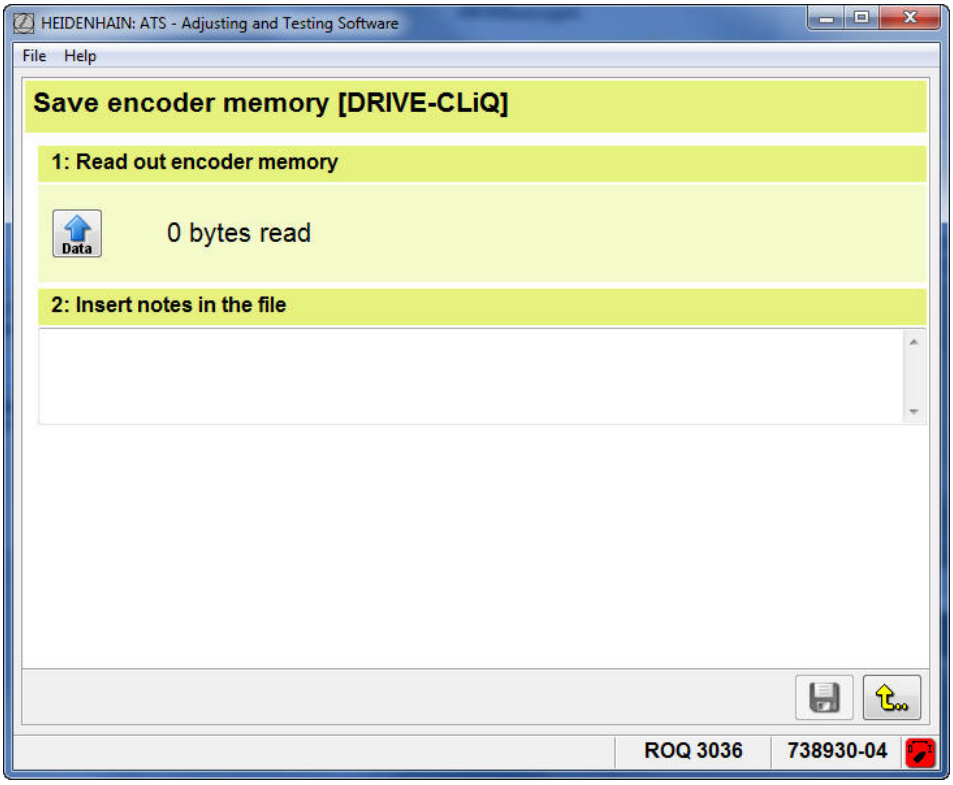
Monitoring status:
Monitoring of the DRIVE-CLiQ transmission distance for e.g. CRC errors, package loss, etc.

Save encoder memory [DRIVE-CLiQ]
The entire memory contents of the encoder is saved to a file. You should always do this, before you check a DRIVE-CLiQ encoder. In the event of a problem, you can send the PIN-protected ZIP file to HEIDENHAIN for diagnosis **(after consultation with the HEIDENHAIN hotline)**.

The PIN-protected ZIP file can only be decoded by the HEIDENHAIN R&D department!

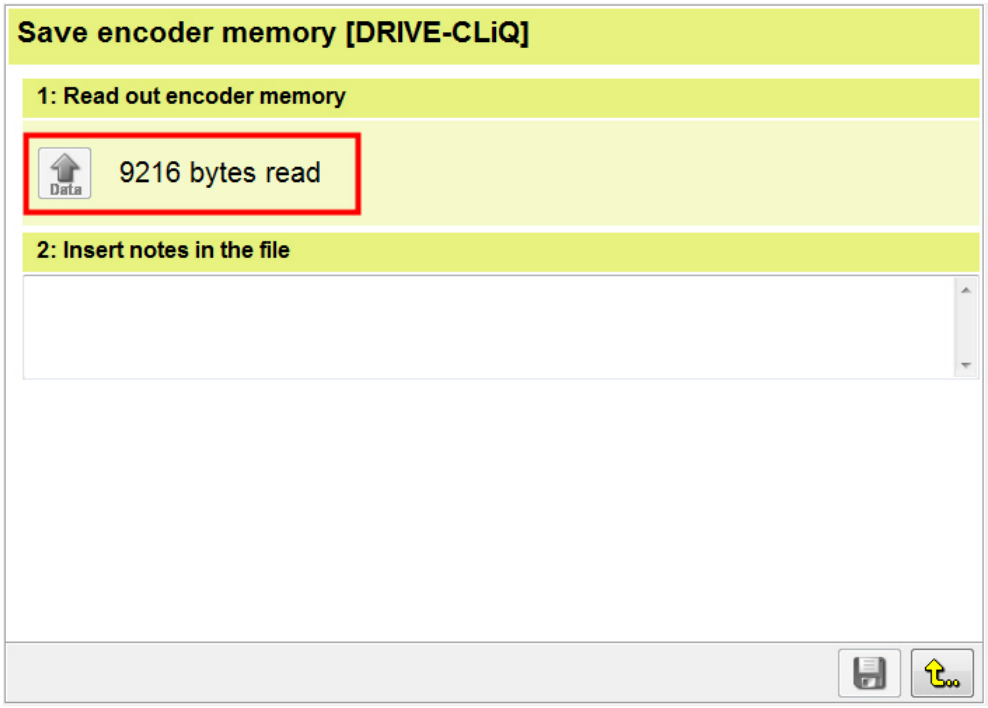
- Select the function “Save encoder memory”.



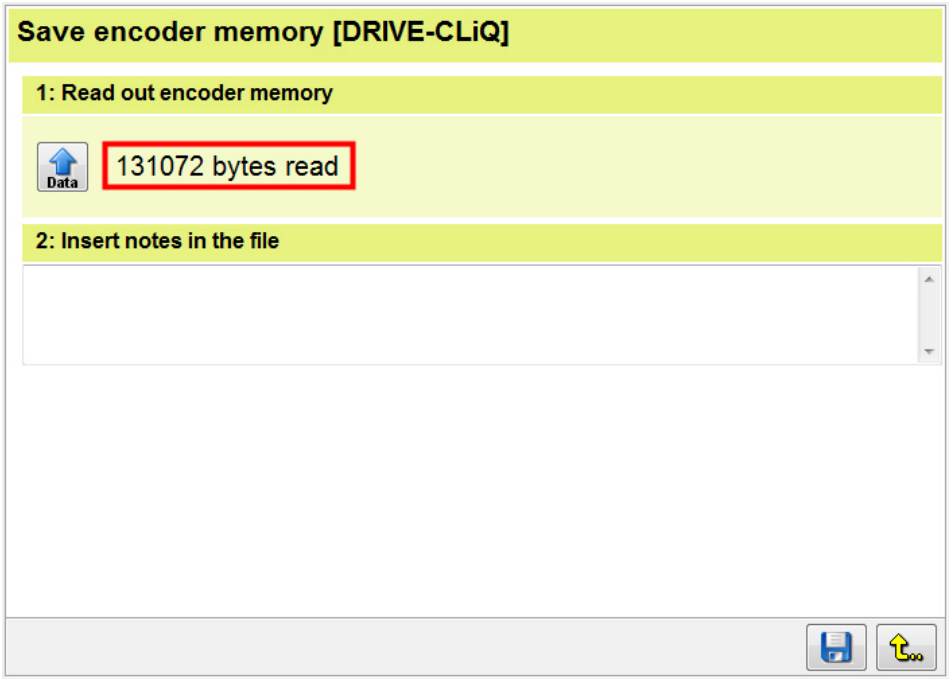


- Press this button.
- > The encoder memory is read out.

i	The read operation may take several seconds.



The reading process is finished, when the bytes counter stops counting. If necessary, you can make entries in the Notes field.



- ▶ Press this button.
- > The data is saved.

Display of encoder parameters

- ▶ Select the function “Encoder parameter display”.
- > The most important characteristics of the encoder are displayed.

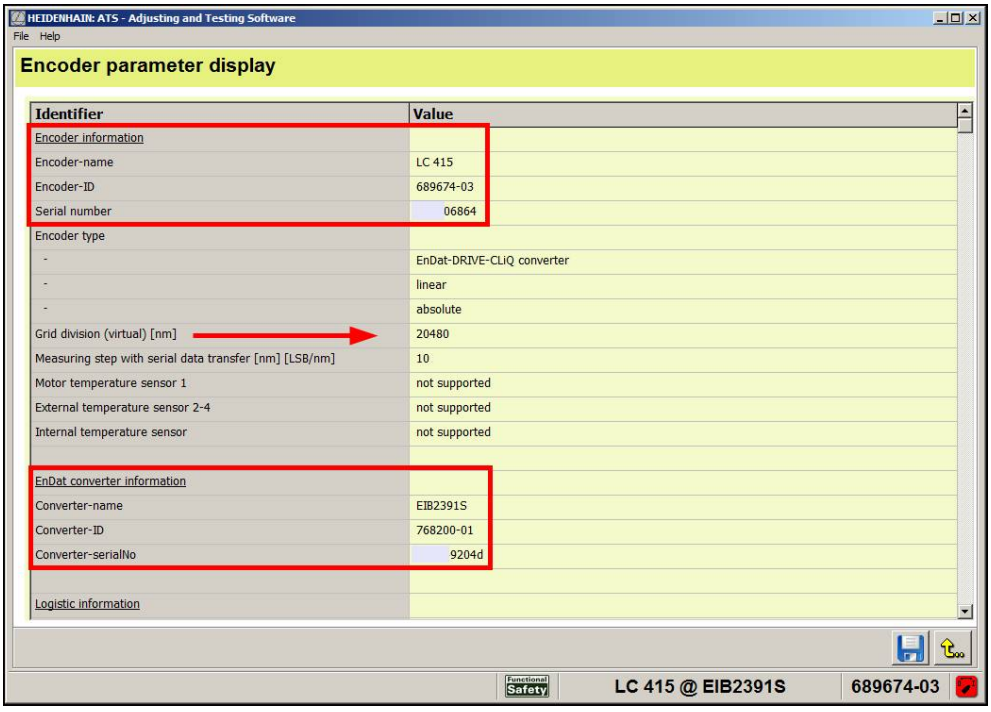
The characteristics are grouped in

- Encoder information
- Logistic information
- Functional safety

Further information

You can scroll through the display groups.

Encoder information

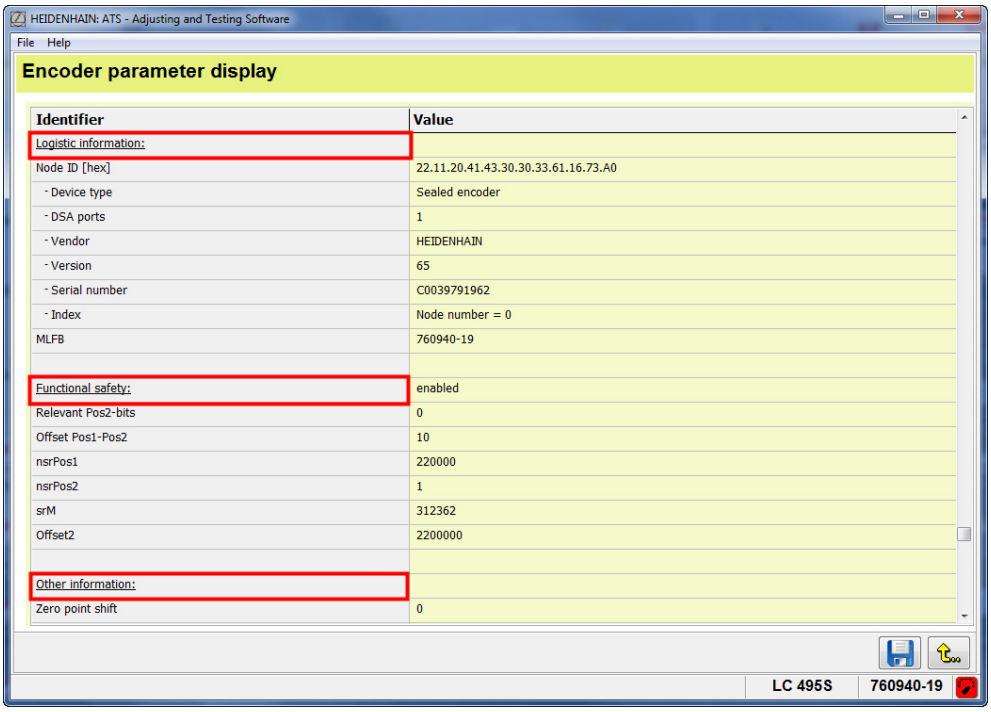


Display of the most important properties of the connected encoder; this is an example of an EnDat linear encoder with DRIVE-CLiQ converter (EIB). The “Encoder information” list of the “Encoder parameter display” contains important data for operation with Siemens controls.
If interface converters are used (EnDat 22 to DRIVE-CLiQ), the table contains this information in addition (in the example: EIB 2391 S).

The values for “Signal periods per revolution” and “Grid division” refer to the parameter settings in DRIVE-CLiQ and do not necessarily represent the physical properties of the encoder.

Example:
The physical grating period of an LC 195S is 20 µm. The virtual grating may be required as parameter entry for a Siemens NC (see arrow).

Logistic information



Node ID:
Terminal identification within the DRIVE-CLiQ drive system; worldwide one-to-one number

Device type:
To specify the encoder type, e.g. integrated encoder, sealed encoder, EnDat 2.2 --> DRIVE-CLiQ converter

DSA ports:
For HEIDENHAIN encoders, the entry value is “1“ (single-ended module).

Vendor:
Manufacturer code

Version:
Version number of connected encoder

Serial number:
Serial number of the connected encoder

Index:
Always assigned 0

MLFB:
Ordering designation of connected encoder

Functional safety

Note:
The plausibility of the values to each other is tested in the “Functional-Safety encoder check“. Thus, the values displayed here are for information only.

For position comparison there are two relevant type, i.e. “binary” and “non-binary”. This refers to the ratio of XACT1 and Pos2. Linear encoders normally are “non-binary”, rotary and angle encoders “binary”.

Relevant Pos2 bits:
Number of bits of position 2 that are used in the safety comparison algorithm. Only when an encoder with binary position comparison is used, is the value not zero.

Offset Pos1-Pos2:
Offset between position 1 (XACT1) and position 2 in the resolution of position 2.

nsrPos1:
Not safety-relevant measuring steps of position 1 (XACT1). Generally not supported on encoders with binary position comparison.

nsrPos2:
Not safety-relevant measuring steps of position 2. Generally not supported on encoders with binary position comparison.

srM:
Safety-relevant measuring steps that are taken into account for position comparison. Generally not supported on encoders with binary position comparison.

Offset Pos2:
Offset between position 1 (XACT1) and position 2 in the resolution of position 1 (XACT1). Generally not supported on encoders with binary position comparison.

Further information

Encoder datum shift:
If a datum shift is programmed in the encoder, this value is displayed here.

Size of OEM memory in bytes:
Size of the memory range reserved for information by the OEM

TIME2LINK_OK MAX in ms:
Maximum time after which the encoder can communicate via DRIVE-CLiQ; if no value is displayed, the switch-on time tSOT applies (stated in the brochure).

T_MAX_ACT_VAL in µs:
This value is the earliest transmission time of a DRIVE-CLiQ package after position latch.

DRIVE-CLiQ functional-safety encoder check

The testing wizard “Functional-safety encoder check” is also available to examine not functionally safe DRIVE-CLiQ (DQ) encoders, as the interface side expects certain information and behavior also of encoders without functional safety.

The functional-safety encoder check features an “Assistant“ (wizard) function. This wizard must run all tests without any error! If there is any error in the “Safety“ tests, the defective position encoder has to be replaced!

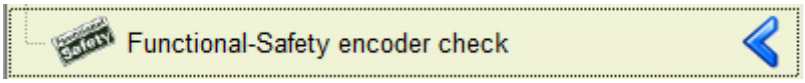
This information is also valid for DRIVE-CLiQ encoders without functional safety!

Encoders that have contributed to the failure of a safety function in the application are to be returned to HEIDENHAIN Traunreut. Encoders may only be repaired by trained HEIDENHAIN technicians.

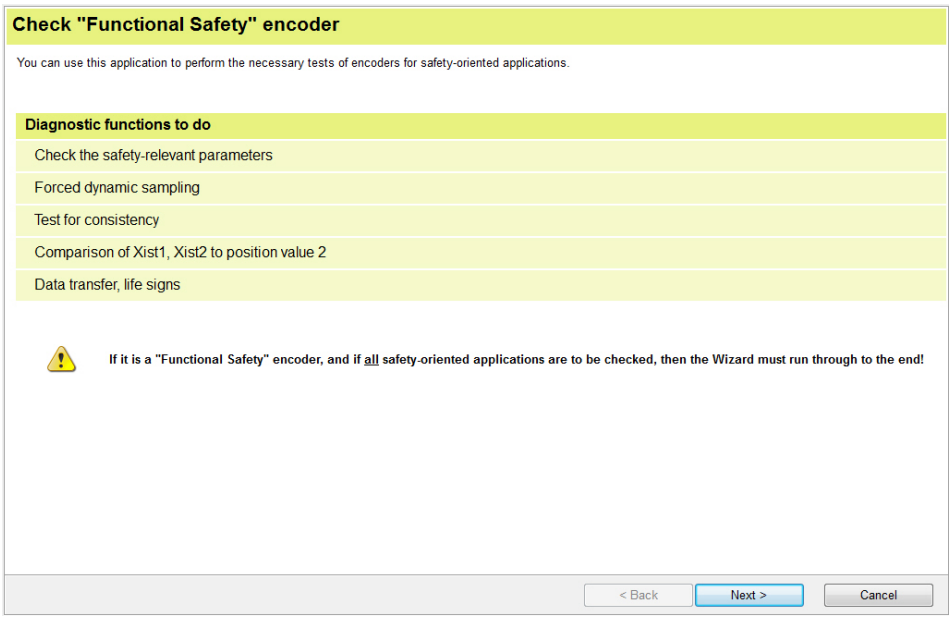
After installation and exchange of “functional safety" components, an acceptance test according to the machine instructions must be performed.

Encoders with functional safety are distinguished by the “Functional Safety” symbol in the bottom lines of the screen displays. On some encoders the word “Safety” is printed on the ID label.

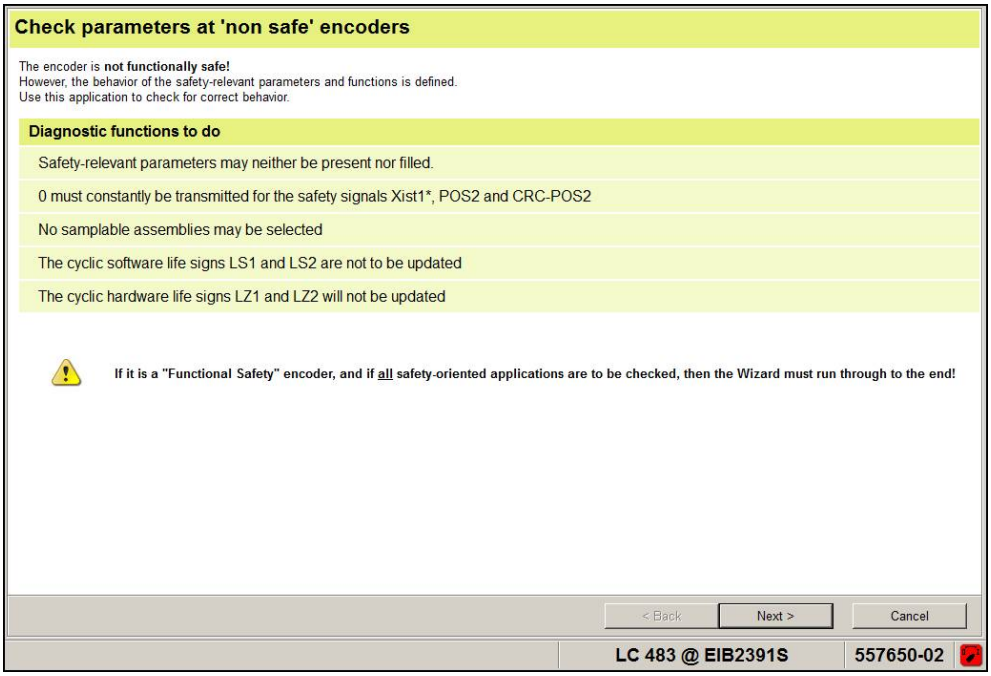
- ▶ Double-click “Functional-safety encoder check”.
- > The test wizard starts.



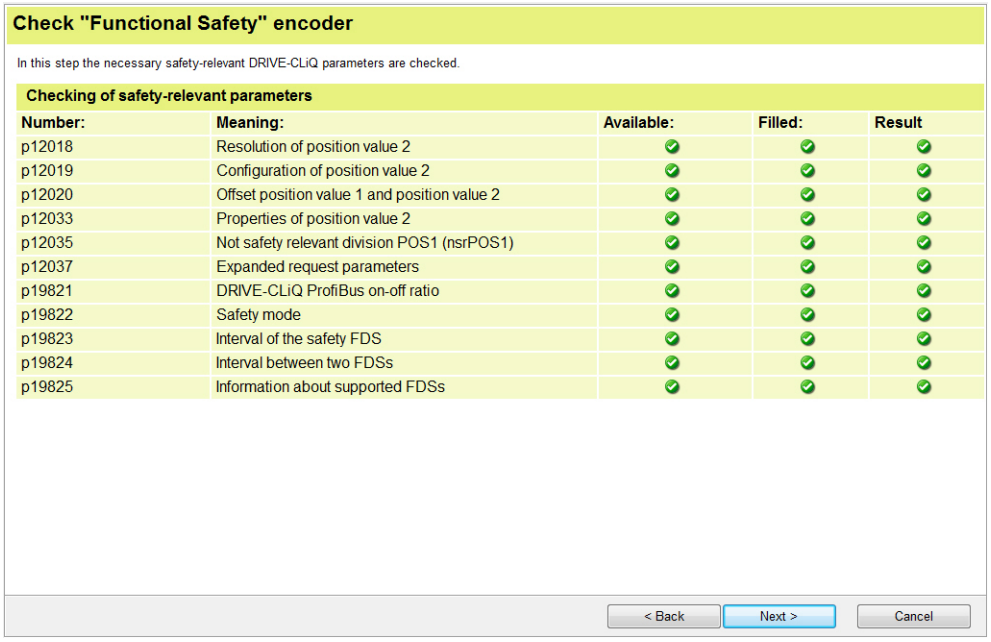
List of the diagnostic functions for encoders with functional safety:



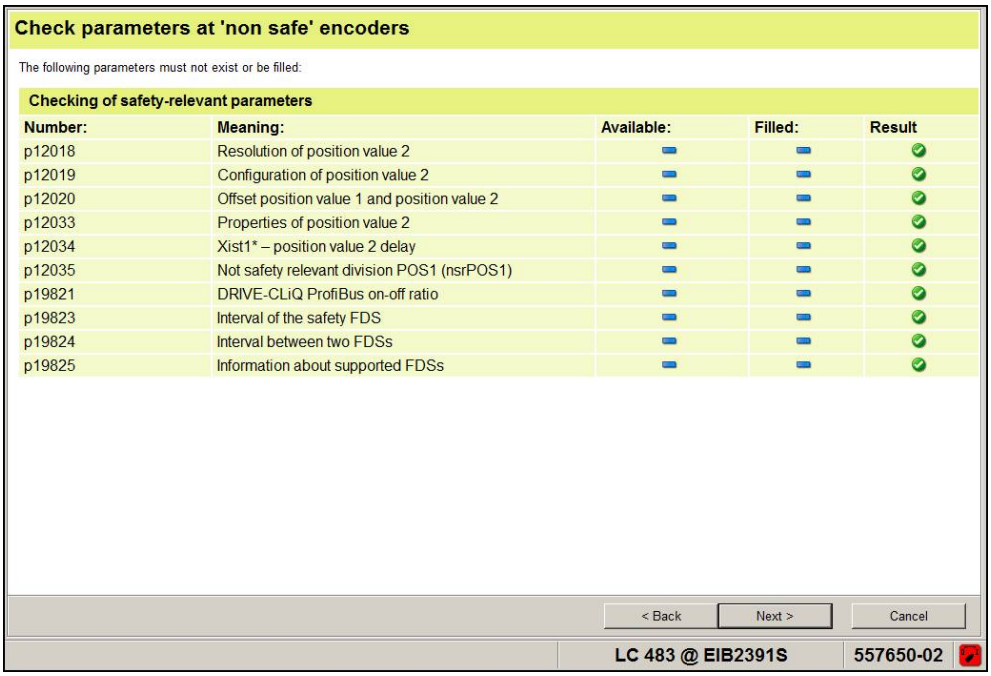
List of the diagnostic functions for encoders **without functional safety**:



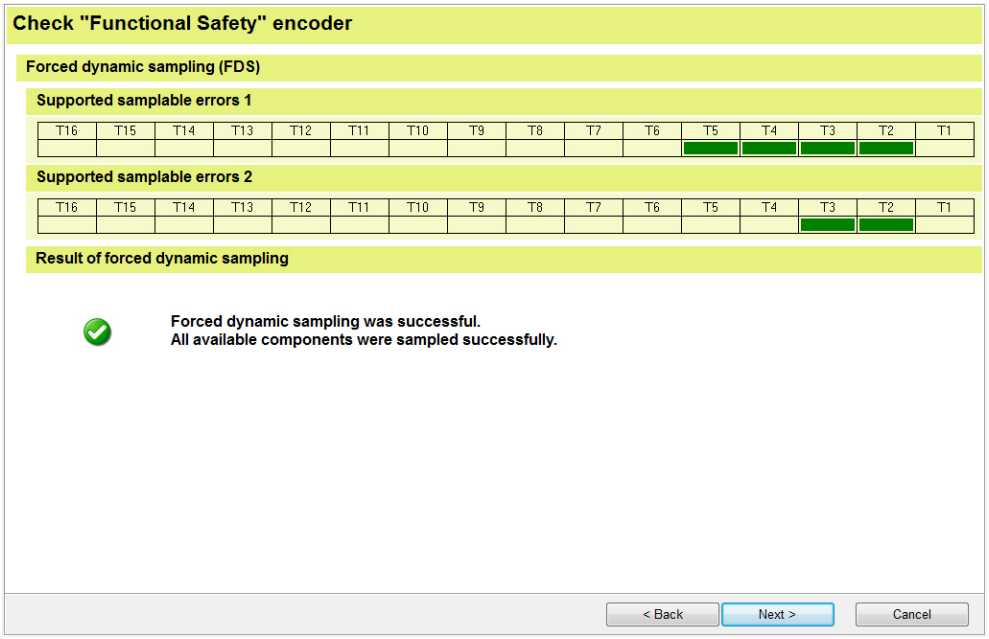
The result list shows whether all parameters relevant for the functional check are available and filled.
The list depends on the connected encoder.
Green tick = pass
Red X = fail



Result list of the parameters that must not be present or filled for encoders **without functional safety**:

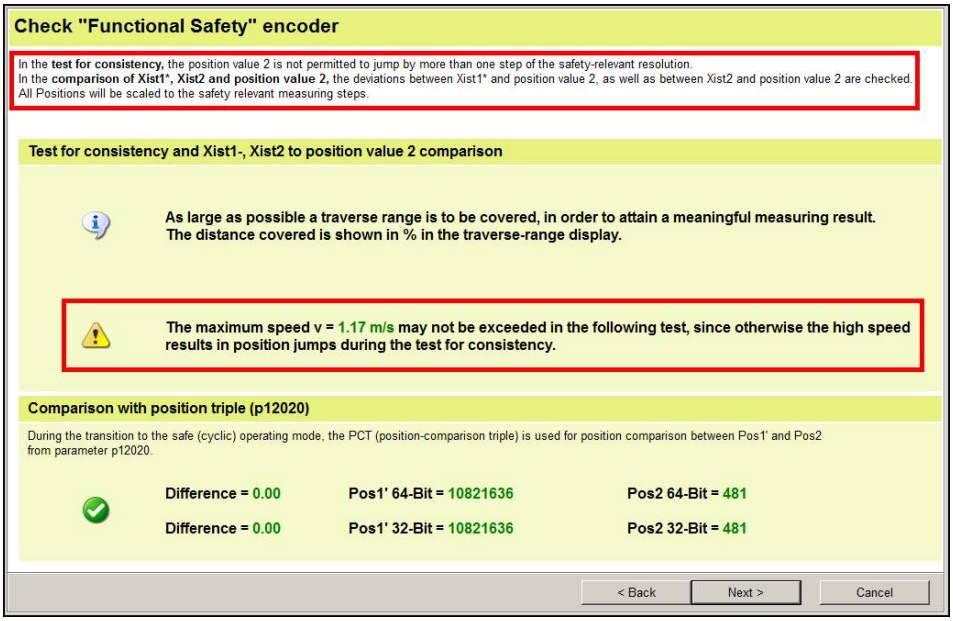


During forced dynamic sampling the error generators in the encoder and the consistency of the data stored in the encoder are checked. The test cases 1 to 16 (T1 ... T16) depend on the error messages the encoder supports. Depending on the encoder, different test cases – also for errors 1 and errors 2 – are supported.



Position values are compared in the test for consistency. Observe the screen display! Do not exceed the required traversing speed or rotational speed! Due to the sampling rate of the PWM a certain traversing speed must not be exceeded during the next step. This speed is determined for the specific encoder connected.

- ▶ Press the “Next >” button.
- > The test for consistency starts.



In the course of the functional-safety test for consistency the current ATS software runs a position comparison between Pos1’ and Pos2 from parameter p12020 by means of a position-comparison triple (see screenshot).

Evaluation of the test for consistency:

Green displays (values and "LED" symbols) = Pass
Red displays (values and "LED" symbols) = Fail

Positions XIST1 (scaled), XIST2 (scaled), Position value 2 (scaled):
The values are converted to the resolution required for the test (safety-relevant resolution) and the resolution is decreased.

Data monitoring:

- F1 / F2
  Position error bits (encoder-internal)
- Software life sign
  Life sign generated by the encoder software
- Hardware life sign
  Life sign generated by the encoder hardware
- Position value 2 CRC16
  The position 2 created by the scanning ASIC of the encoder is verified by means of an additional CRC in the encoder.
- Monitor dynamic sampling (Tfd bit)
  Monitoring bit (Tfd means "test failed") indicating that an error could not be provoked during dynamic sampling

Tracing of positions:

- Xist1 – position value 2
  Comparison of incremental position and redundant absolute position
- Xist2 – position value 2
  Comparison of absolute position and redundant absolute position
- Max or current
  Display of the maximum value or the current value

Consistency:
The consistency of the positions is monitored. The maximum permissible jump on position is “1”. The maximum and the current values are displayed.

Traversing range:

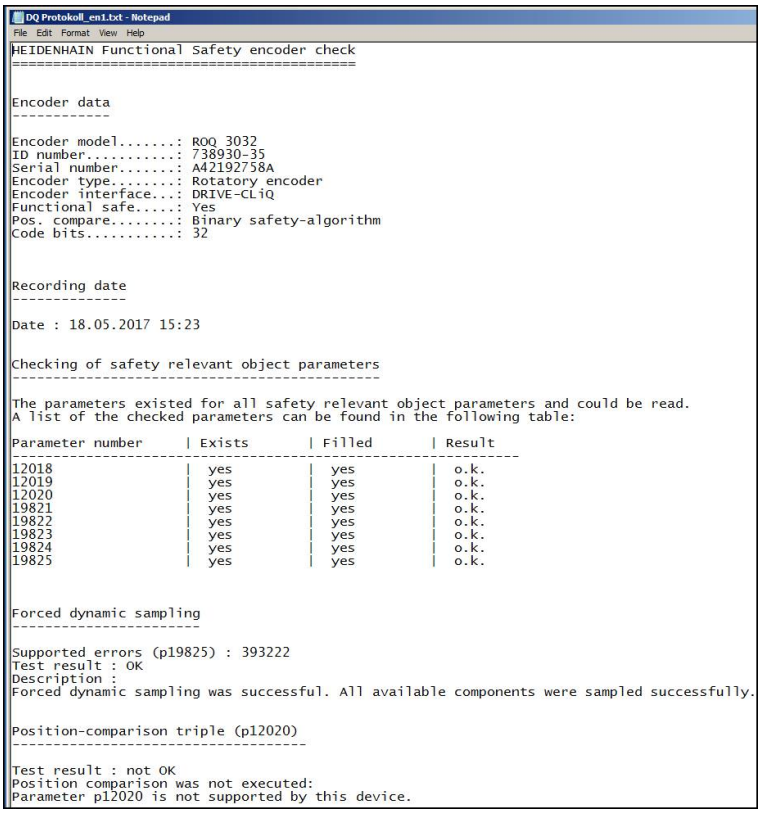
This display shows the percentage of the traversing range that was already inspected. The traversed range should be as large as possible. If the traverse range is not available in the internal database, you are prompted to enter the measuring length in a separate window.

Previous measurements (wizard):
Results of the inspections in earlier steps of the testing wizard

Available buttons

Restart measurement

Save report

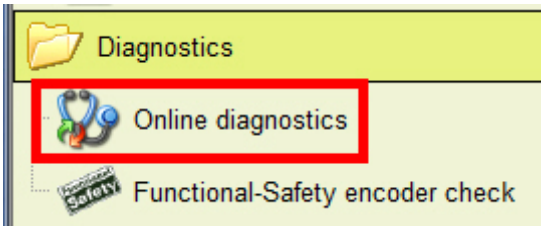


DQ Protokoll_en1.txt - Notepad

File Edit Format View Help

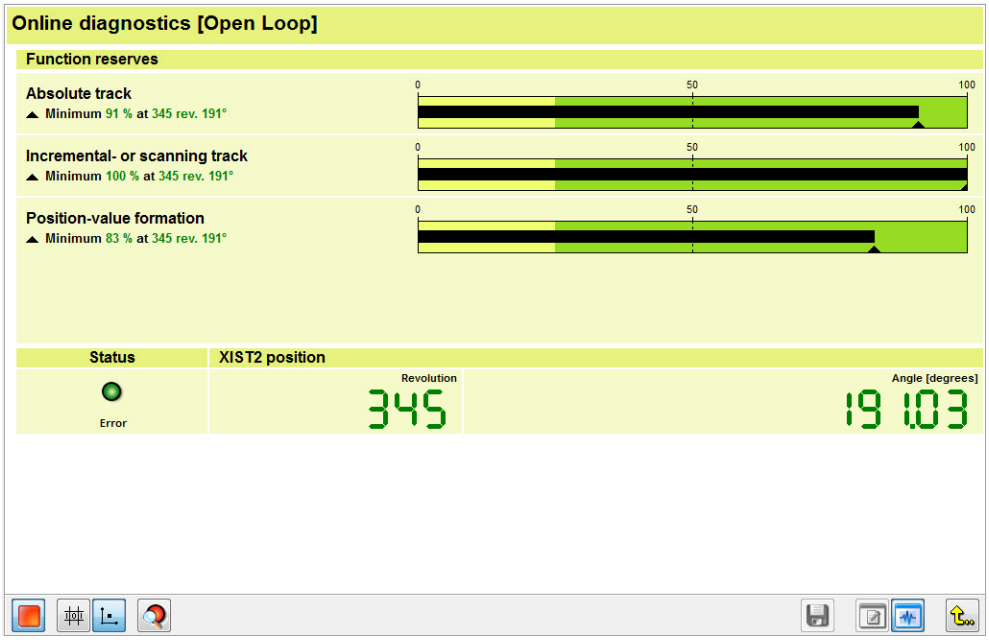
```
HEIDENHAIN Functional Safety encoder check
==========================================


Encoder data
------------

Encoder model.......: ROQ 3032
ID number...........: 738930-35
Serial number.......: A42192758A
Encoder type........: Rotatory encoder
Encoder interface...: DRIVE-CLiQ
Functional safe.....: Yes
Pos. compare........: Binary safety-algorithm
Code bits...........: 32


Recording date
--------------

Date : 18.05.2017 15:23


Checking of safety relevant object parameters
---------------------------------------------

The parameters existed for all safety relevant object parameters and could be read.
A list of the checked parameters can be found in the following table:

Parameter number     | Exists       | Filled       | Result
-----------------------------------------------------------------
12018                |  yes         |  yes         |  o.k.
12019                |  yes         |  yes         |  o.k.
12020                |  yes         |  yes         |  o.k.
19821                |  yes         |  yes         |  o.k.
19822                |  yes         |  yes         |  o.k.
19823                |  yes         |  yes         |  o.k.
19824                |  yes         |  yes         |  o.k.
19825                |  yes         |  yes         |  o.k.


Forced dynamic sampling
-----------------------

Supported errors (p19825) : 393222
Test result : OK
Description :
Forced dynamic sampling was successful. All available components were sampled successfully.


Position-comparison triple (p12020)
-----------------------------------

Test result : not OK
Position comparison was not executed:
Parameter p12020 is not supported by this device.
```

Online diagnostics:



The DRIVE-CLiQ interface does not allow for closed-loop operation (feed-through mode not possible) but immediately switches to “Online diagnostics [Open Loop]“.

As with the EnDat interface, this function serves to check the functional reserve by means of three bar graphs. Description of the function: see section "Online diagnostics", page 115 and section "Closed Loop function", page 123.



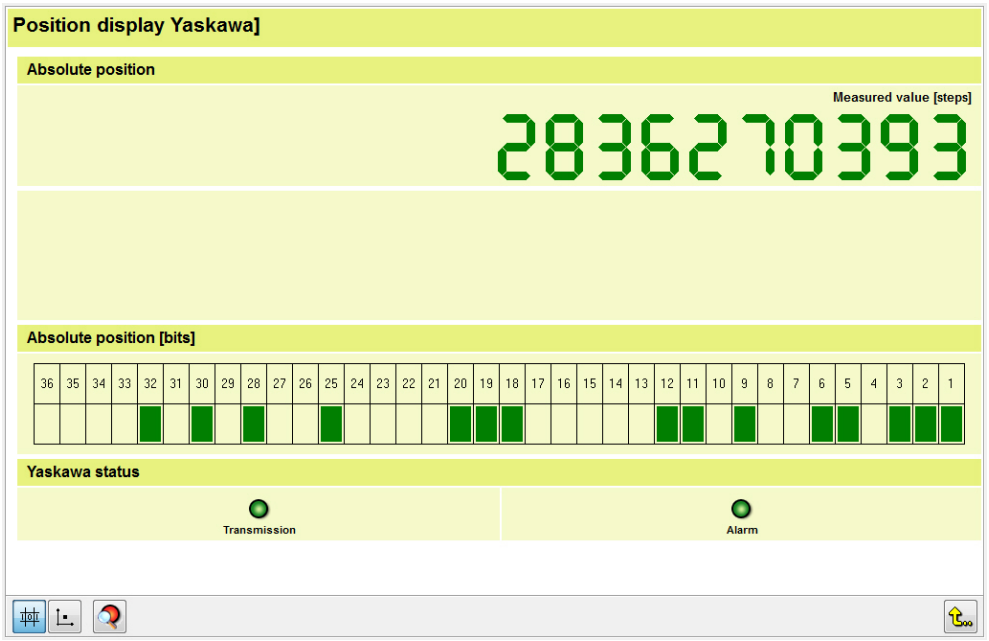
Example: Display of the functional reserve of an ROQ rotary encoder

5.7.6 Yaskawa Serial Interface

The functions the ATS software provides (e.g., establish connection to the encoder, connect to EIB interface electronics, position display, display Yaskawa status, clear alarms, etc.) are basically those of the EnDat functionality.
Further information: "Software description", page 32.

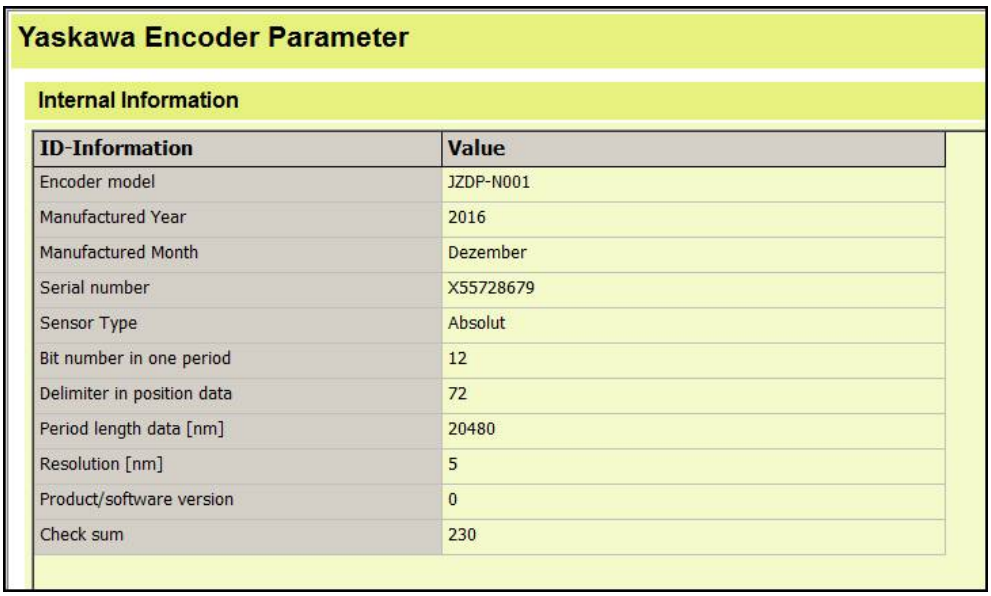
The ATS software features a mounting wizard required for encoder mounting. Its function is described in the mounting instructions of the encoder.

The Yaskawa interface is supported as of the ATS software 2.8. Only HEIDENHAIN encoders can be mounted and inspected with the ATS software.



The example shows the position display of a purely serial encoder without incremental signals.

When you click “Yaskawa parameter display” in the Add-on info menu, the “Encoder Parameters/Internal Information” screen is displayed (encoder data and further information supported by the encoder).



Yaskawa Encoder Parameter

Internal Information

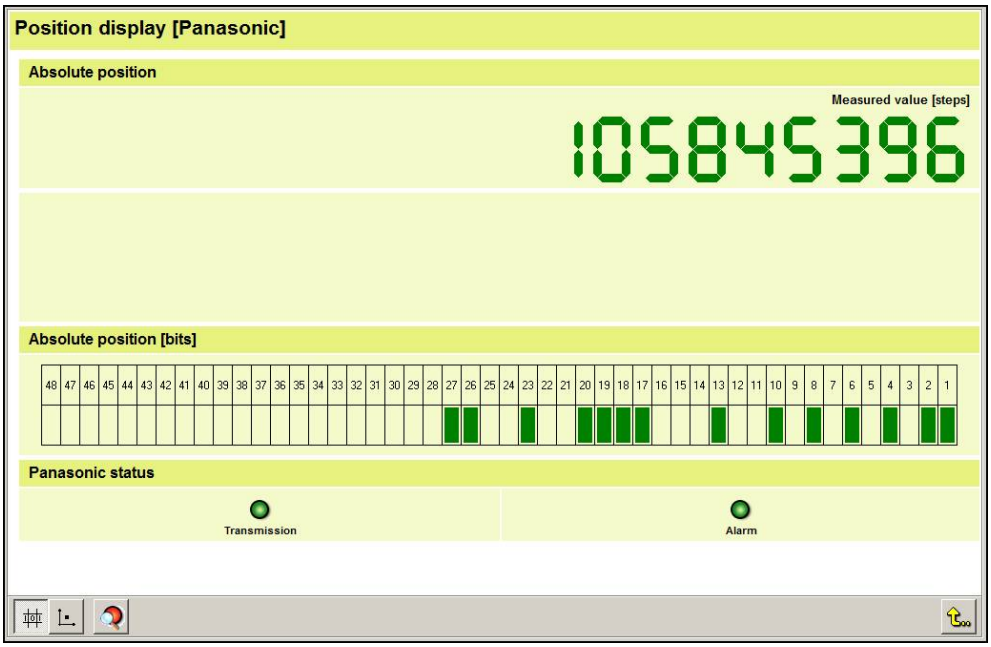
ID-Information	Value
Encoder model	JZDP-N001
Manufactured Year	2016
Manufactured Month	Dezember
Serial number	X55728679
Sensor Type	Absolut
Bit number in one period	12
Delimiter in position data	72
Period length data [nm]	20480
Resolution [nm]	5
Product/software version	0
Check sum	230

5.7.7 Panasonic Serial Interface

The functions the ATS software provides (e.g., establish connection to the encoder, position display, online diagnosis [open loop], status, display/clear errors, set/cancel datum shift, etc.) are basically those of the EnDat functionality.
Further information: "Software description", page 32.

The ATS software features a mounting wizard required for encoder mounting. Its function is described in the mounting instructions of the encoder.

The Panasonic interface is supported as of the ATS software 2.8. Only HEIDENHAIN encoders can be mounted and inspected with the ATS software.



When exposed LIC linear encoders are connected to the ATS software, datum shift is supported (Set/cancel datum shift: see Section 5.3.1, "Position display"). The function is the same as that of the EnDat interface!

6 Checking incremental encoders

6.1 General

As of the ATS software version 2.6.xx functional checks can be performed on HEIDENHAIN incremental encoders with the following interfaces:

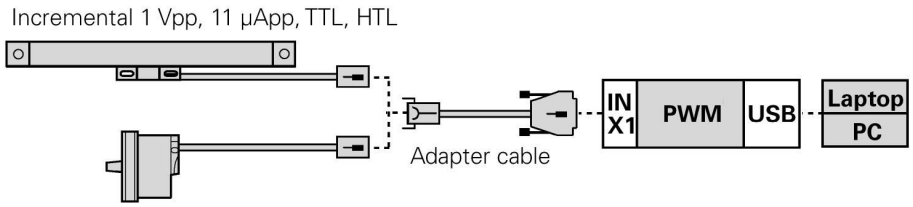
- **Analog output signals 11 μA_{PP}, 1 V_{PP}**
- **Digital square-wave output signals TTL and HTL (with adapter)**

Only the PWM supports the inspection of incremental encoders!

6.2 Analog output signals

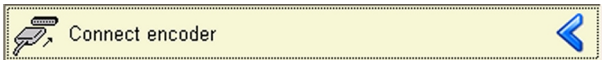
6.2.1 Connecting the encoder

▶ Connect the encoder to the test unit with an adapter cable.



Adapter cables, see User's Manual Cables and Connection Technology“.

▶ In the ATS main menu, double-click “Connect encoder”.



The encoder selection window provides the possibility of connecting the encoder through its ID number (entry in database) or – if the ID is not in the database – through “Manual settings”. In the latter case the interface must be selected by hand.

For further details see section "Setting up a connection to the encoder", page 33.

NOTICE

Damage to the electronics

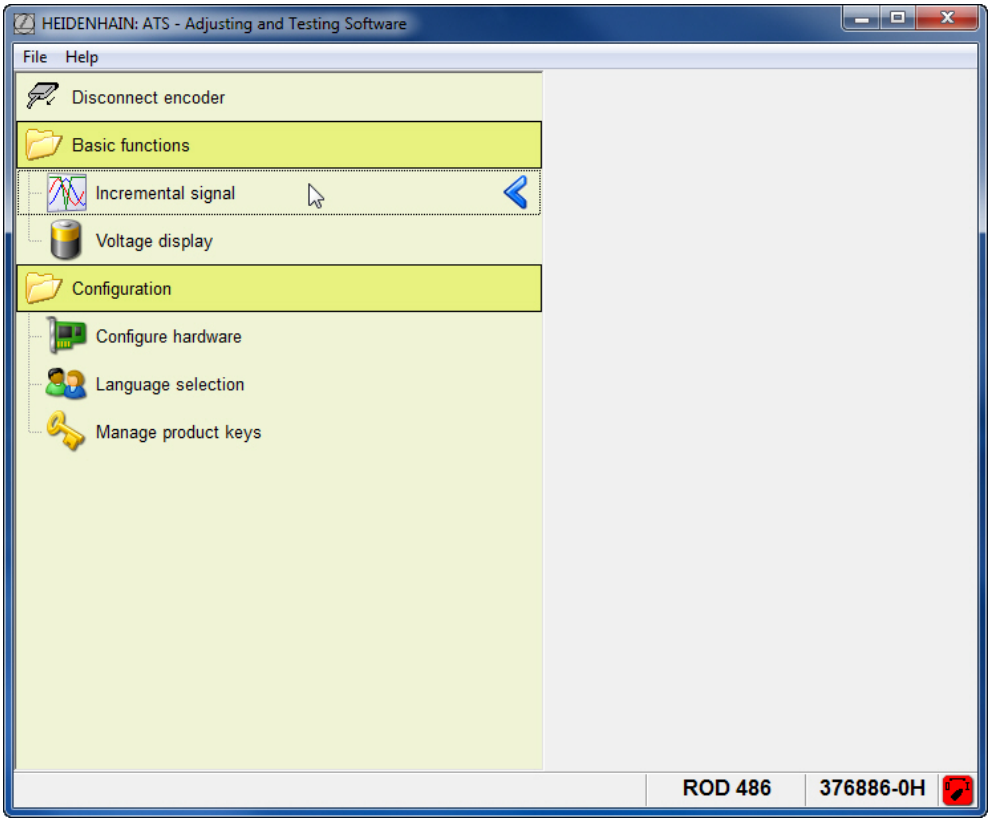
If the manual setting of the encoder parameter does not match the connected encoder, the encoder, the PWM, or the computer may be damaged.

▶ Make sure that the manual setting of the encoder parameters matches the connected encoder.

For the encoder data refer to the documentation of your encoder or your machine tool. Contact the machine manufacturer or the HEIDENHAIN Service.

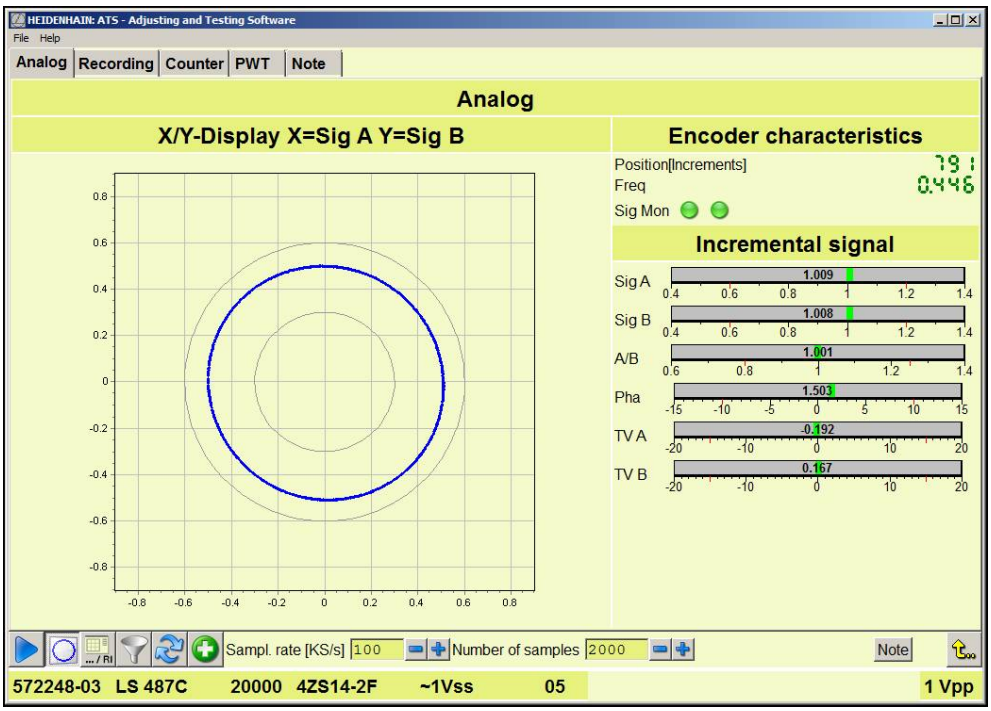
6.2.2 Checking incremental signals

After successful registration, the function “Incremental signal” appears in the “Basic functions” group of the ATS main menu.



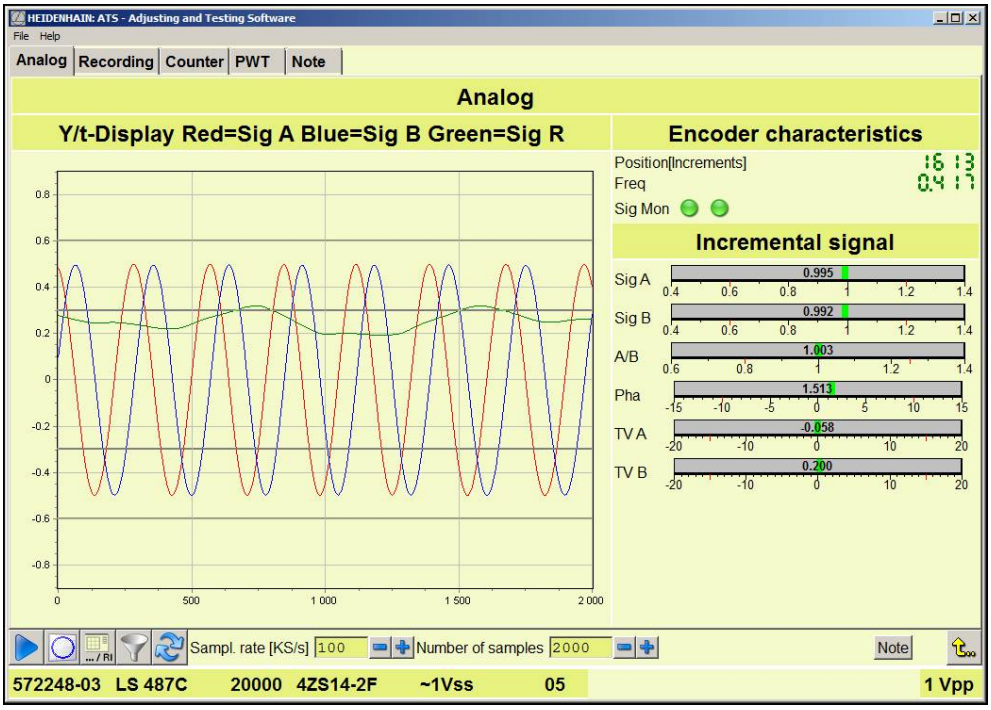
- ▶ Double-click “Incremental signal display”.
- > Incremental signal measurement starts.

Depending on the connected interface, the oscilloscope shows a sinusoidal signal V_{PP}/11 μA_{PP} or a square-wave signal (TTL or HTL).

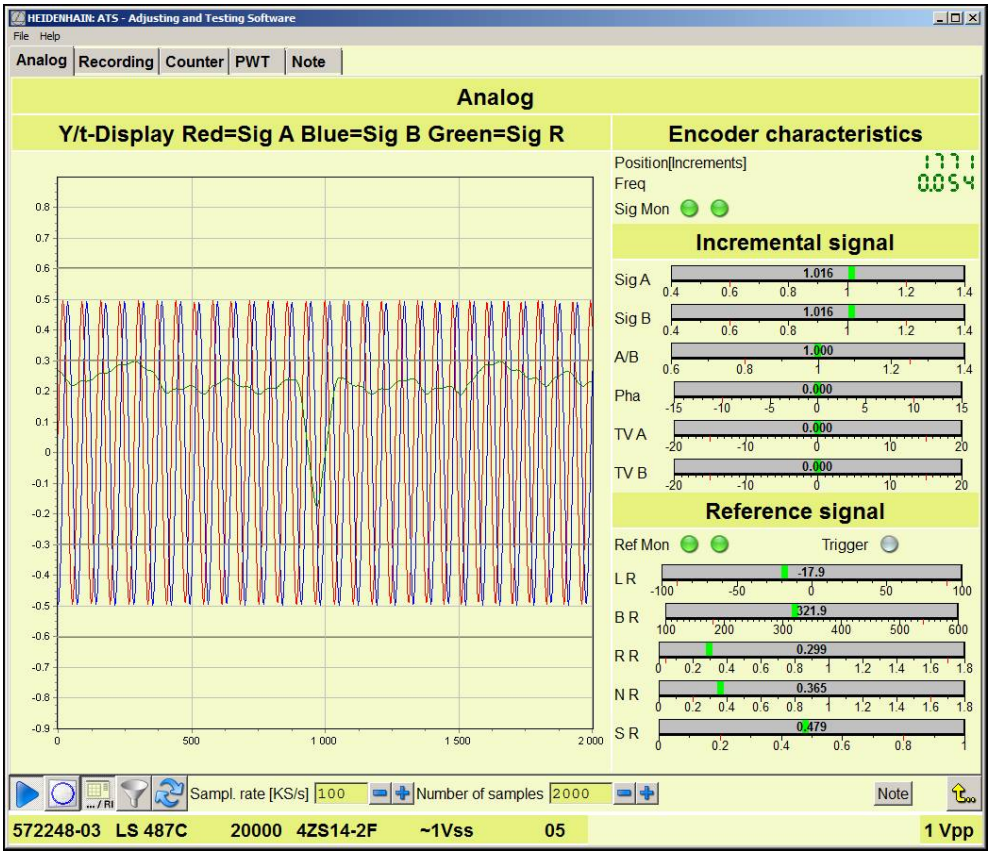


Software connected to sinusoidal output signal; standard X-Y circular diagram of analog signals

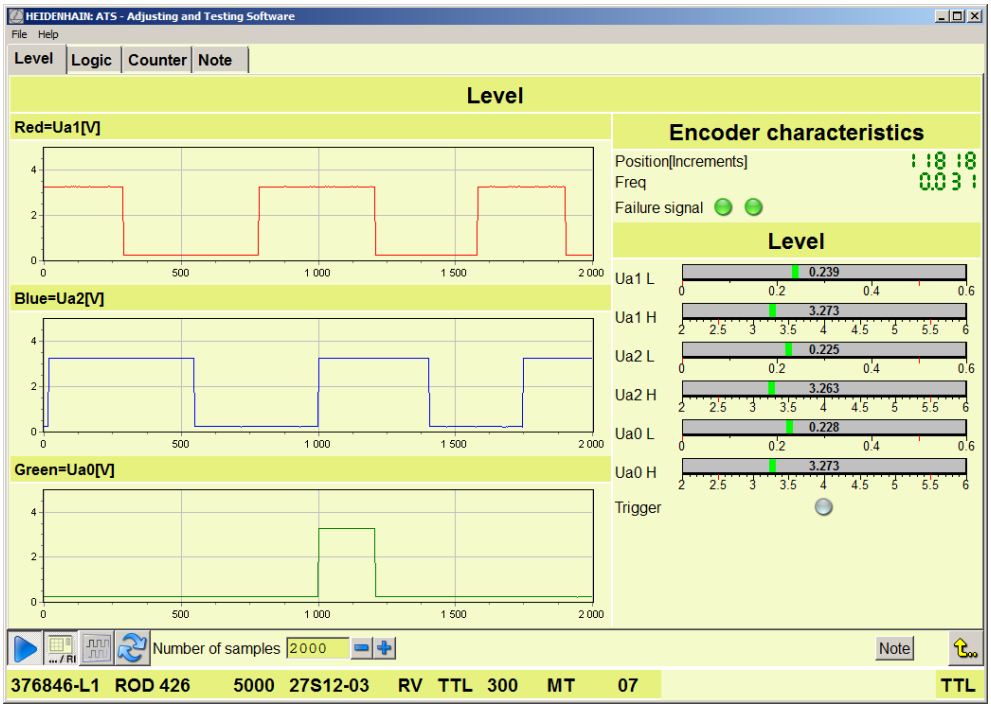
- Switch to sine/cosine display (Y-t).



- Click the “Reference trigger on/off” button.
- > The bar display for the reference signal is shown to the right below the bar display for the incremental signal.

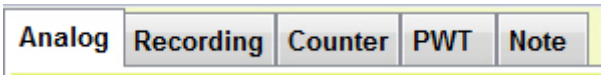


Software connected to TTL square-wave output signal (description see section “Digital TTL/HTL square-wave output signals”)



6.2.3 Screen display for analog signals

Check functions bar



Analog:

- Oscilloscope function
- Position and frequency display
- Signal monitoring
- Bar graphs for parameters of incremental and reference signals
- HSP amplitude control (HEIDENHAIN signal processing); mounting mode; deactivates signal control for mounting "exposed" encoders

Recording:

- Record several signal periods for signal analysis
- Diagram view of the recorded signal data; comparison of signal amplitudes, on-to-off ratios and phase shifts
- Save and export recorded signal data, open saved files

Counter:

- Test of counting function by counter start/stop with ref. mark

PWT:

- Phase angle test function for simple testing of analog interfaces (e.g. 11 μA_{PP} and 1 V_{PP}); signal amplitudes, signal errors, reference mark position and zero crossovers are evaluated and displayed as bar graphs.

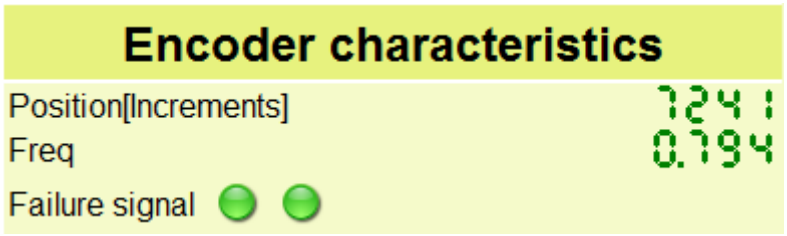
Note:

The software reports problems such as:

- Excessive frequencies
- The displayed signal detail is too small to calculate the reference mark, etc.

  A yellow Attention symbol is displayed to the right of the Note button.

Encoder characteristics



Position [increments]:

Bidirectional counter (counting of signal periods)

Frequency:

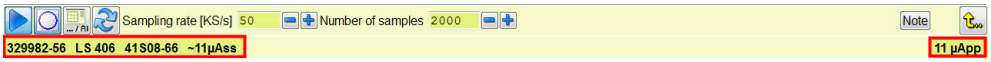
Current input frequency

Signal **mon**itoring:

Left LED:	Concurrent signal monitoring (red color only as long as an error is present; otherwise the LED is green)
Right LED:	Signal monitoring is logged (LED is permanently red, if a error was detected)

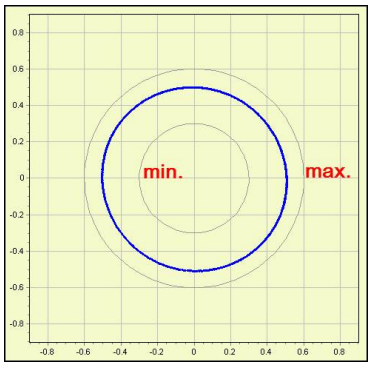
Bar for oscilloscope settings

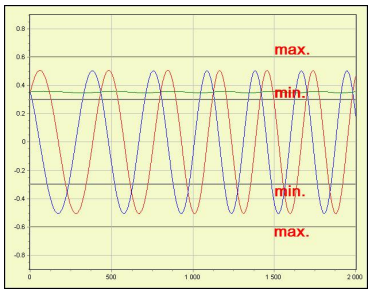
Database information (see red frames) of the connected encoder and interface type; if the encoder was connected manually, only the interface is displayed.



Start/Stop button = Start recording or stop (freeze) the screen display

Button for X-Y or Y-t display = Display as circle function or as sine diagram. The signal tolerances are displayed as gray lines (min/max). The gray lines correspond to the red markings in the bar displays.



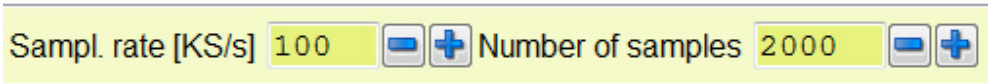


The scale units of the coordinate axes depend on the display type and on the interface.
X-Y display: Output signal in volts [V] or microamperes [µA]
Y-t display: Y axis in volts [V] or microamperes [µA]; X axis in samples (number of samples)

In the X-Y view (also referred to as Lissajous graph or circle diagram), the inner green circle represents the minimum amplitude, the outer green circle the maximum amplitude.

Reset button = Resets signal monitoring (Sig Mon) and the notes

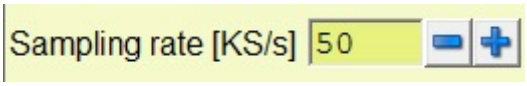
Sampling rate and Number of samples



The functionalities of the fields “Sampling rate” and “Number of samples” are the same as those of a digital oscilloscope. The sampling rate defines the rate at which the incremental signals are converted; in “Number of samples” is specified, how many values are displayed on the screen.

When you restart the “Incremental signal” function, the values are reset to default.

Sampling rate

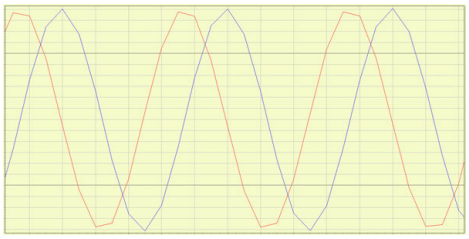


It defines the interval for conversion of the incremental signals. The value is displayed in kS/s (kilosamples per second), i.e.
Value · 1000 signal samples per second
Setting range for the sampling rate: 1 ... 1800 kS/s

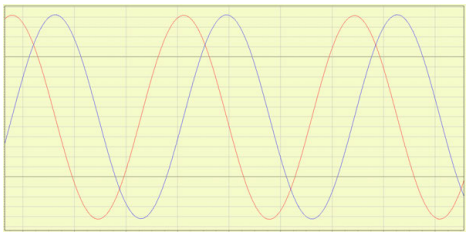
> The higher the input frequency of the encoder (displayed under "Frequency" in the "Encoder properties" field), the higher the sampling rate must be selected.

Recommendation: Sampling rate = 10 · max. input frequency

If you select too low a value, the original signal cannot be displayed correctly (see figures). Falsification of the signal display caused by undersampling is also referred to as aliasing effect.

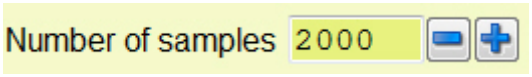


Falsified signal shape caused by too low a sampling rate



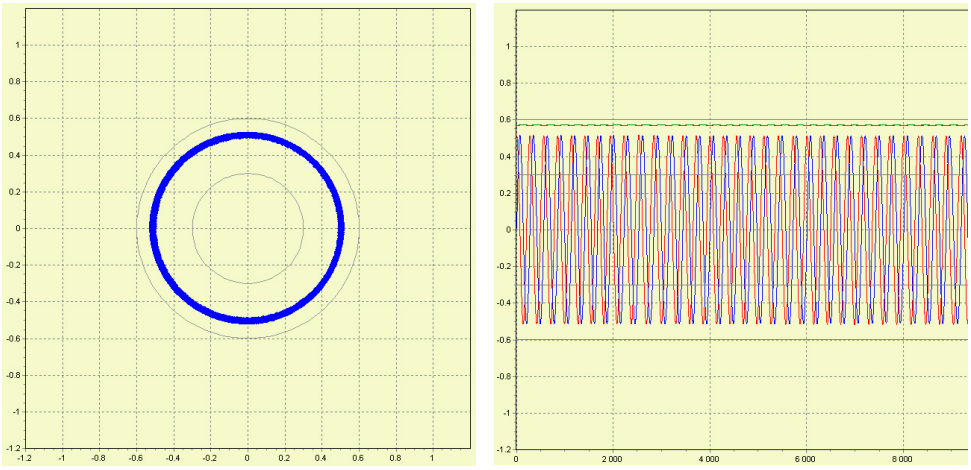
Suitable sampling rate

Number of samples



The number of samples defines, how many values are displayed on the screen.
Setting range: 2000 ... 100000 samples
Press Enter or the Plus or Minus button to enter a new value. When you restart the function, the value is reset to default.
Enter small values for high frequencies
(i.e. high traversing speed or shaft speed)
Enter high values for low frequencies
(i.e. low traversing speed or shaft speed)
High values can also be used for measuring over several signal periods (envelope curve, e.g. in X-Y or Y-t display) in order to find signal drops.

> When the "Incremental signal" function is restarted, the values for sampling rate and number of samples are reset to the default settings 100 kS/s and 2000 samples.



Display of several signal periods (examples)

Filter (100 kHz)

Filter (100 kHz) button
This button serves to damp the band width of the input amplifier. Interfering signals larger than 100 kHz are suppressed. This function is used for special adjustments where interferences have a negative effect on the adjustment procedure. In general, the filter function is inactive in order that the full bandwidth of the PWM can be used.

Filter inactive/off = Button is gray

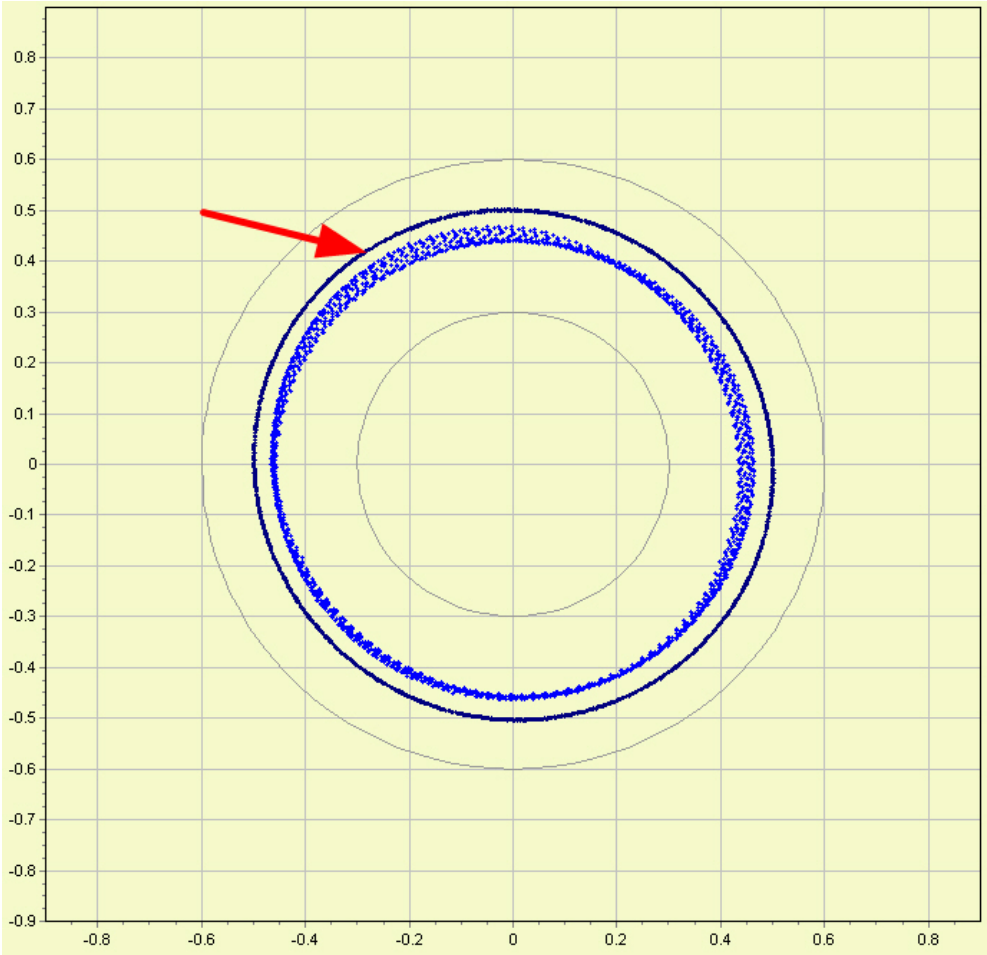
Filters active = Button is blue, (interfering) frequencies ≥ 100 kHz are suppressed

Help circle

Help circle button
When you press this button, the current X-Y signal circle (help circle) of the oscilloscope freezes and is used for comparison with the current X-Y signal. Signal fluctuations of linear and angle encoders can thus be seen more clearly.
In the illustration, the frozen help circle is marked by an arrow.

Help circle function inactive = Button is gray

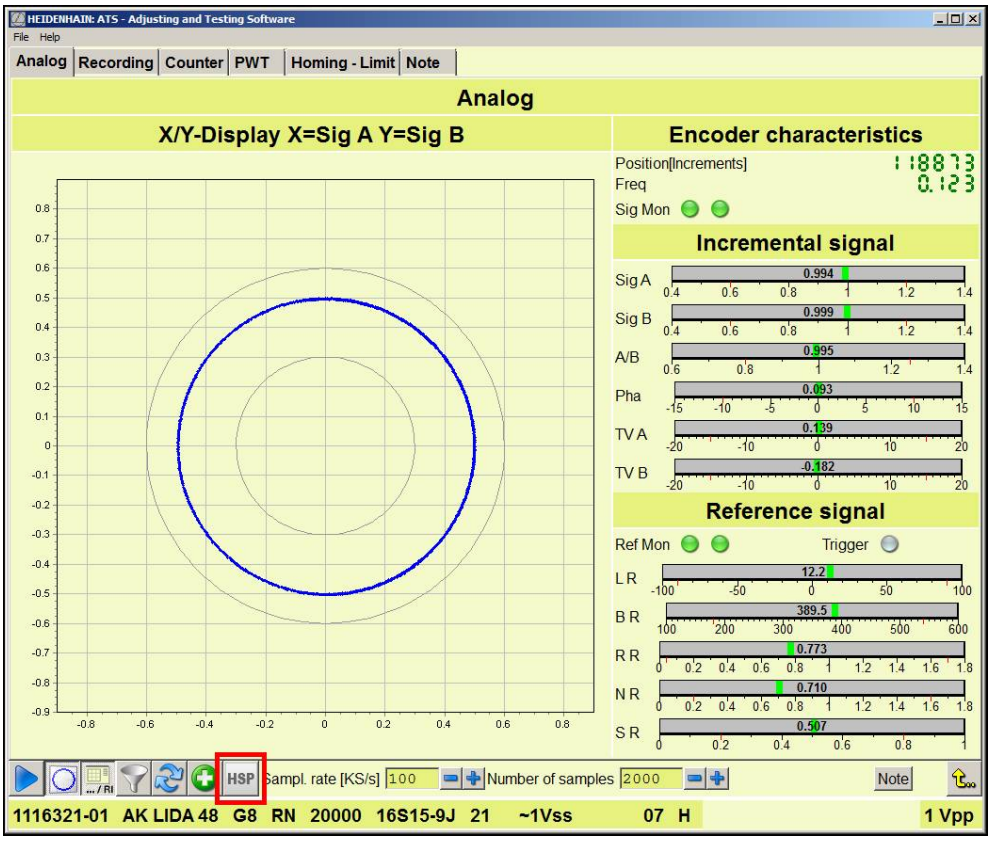
Display contains help circle = Active; button is blue



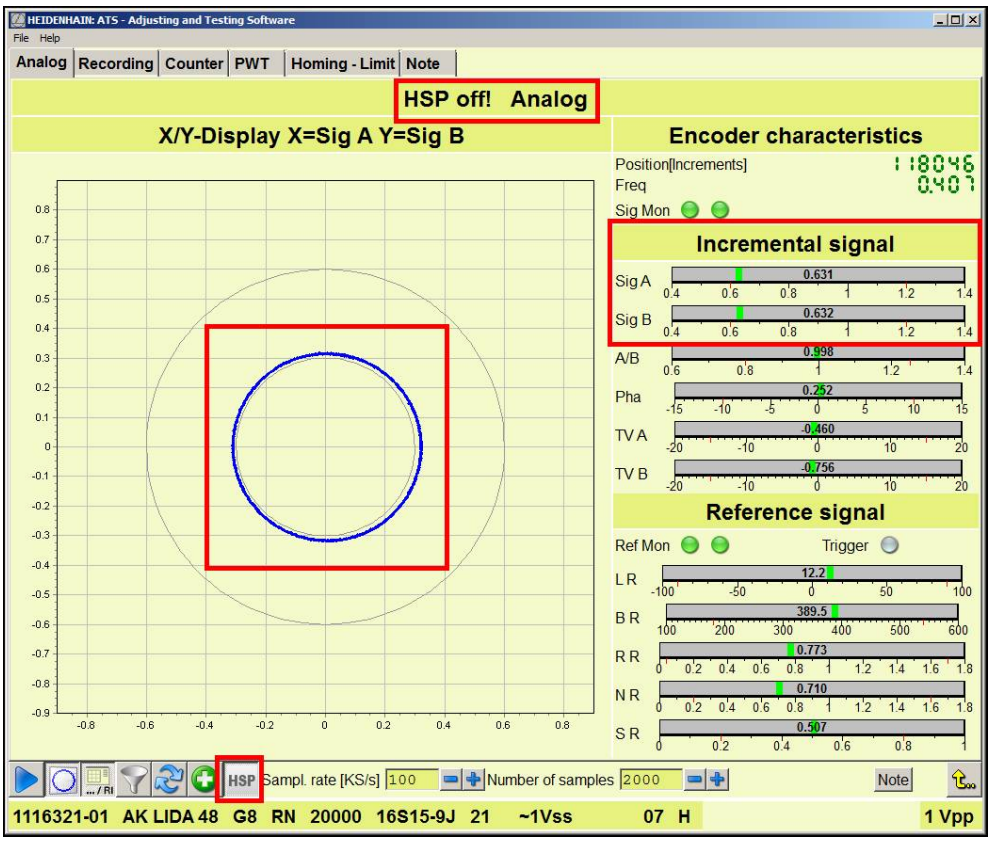
HSP (HEIDENHAIN signal processing)

HSP button, mounting mode on/off
Through **HSP** (**H**EIDENHAIN **S**ignal **P**rocessing) an optimized, highly stable scanning signal is created for exposed encoders (e.g. LIDA 4xx), irrespective of the scale contaminations that were traversed. The electronics in the scanning head almost completely compensates fluctuations in signal amplitude caused by interference.
The control function must be inactive for mounting and diagnosing exposed encoders.
The HSP button serves to switch the control function on and off (mounting mode). When HSP is inactive, the blinking display **"HSP off! Analog"** appears. Mechanical adjustment of scanning head and scale and signal inspection can now be performed without any influence of the control electronics.

Example: HSP active (standard operation of LIDA scanning head), optimized output signal



Example: HSP inactive (scanning head in mounting mode)
The signal amplitudes are at the lower tolerance limit of 0.6 Vpp. In this case, the mechanical mounting needs to be optimized (note the LIDA documentation).
The display “HSP off! Analog” blinks.



Note button

If the ATS software detects problems with signal calculation, the yellow warning symbol appears next to the "Note"button.

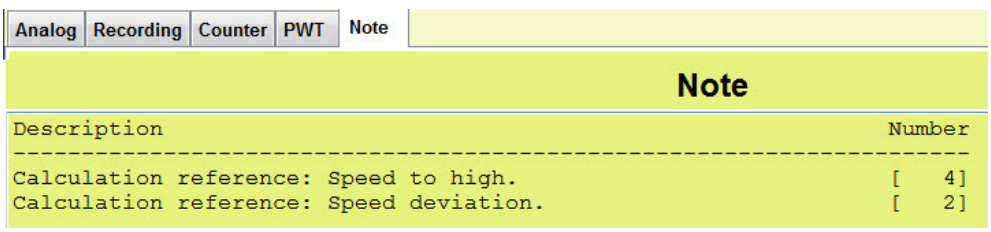
- ▶ Press this button.
- > The problems that have occurred are listed.

Causes of problems may be:

- Signal frequencies are too high (high encoder speed)
- Speed fluctuations (frequency fluctuations)
- Too small signal section to calculate the amplitude or the tolerance

Examples of notes:
Calculation of reference: Fluctuation of shaft speed – 4 times
Calculation of reference: Change of shaft speed – 2 times

Solution:
Attempt to traverse the encoders such that no "Note" is generated (Attention symbol), e.g. by turning the encoder shaft evenly and slowly.

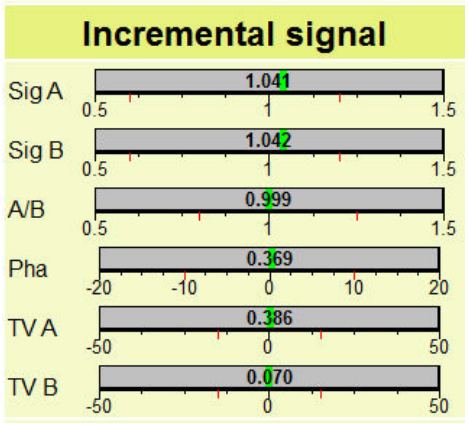


With manual traverse it is hardly possible not to generate a note (fluctuating shaft speed, etc.)

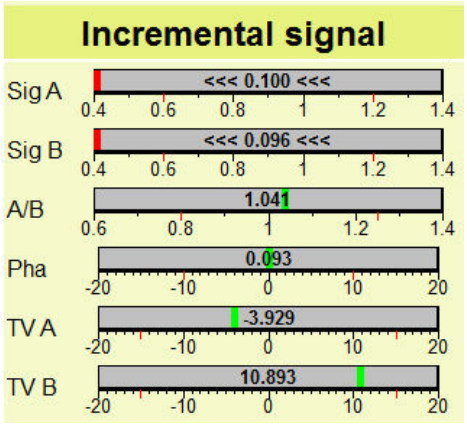
Incremental signal bar graphs ~

Display of the signal parameters and tolerances as bar graphs with tolerance markings
The bar graphs of the sinusoidal signals Sig A, Sig B and the on-to-off ratios TV A and TV B are also displayed at standstill.

This function is suitable for mechanically aligning exposed linear encoders. By this means the air gap and the parallelism of the scanning heads to the graduation can be adjusted without mechanical movement.
Always inspect (traverse) the entire measuring range to obtain an exact diagnose.

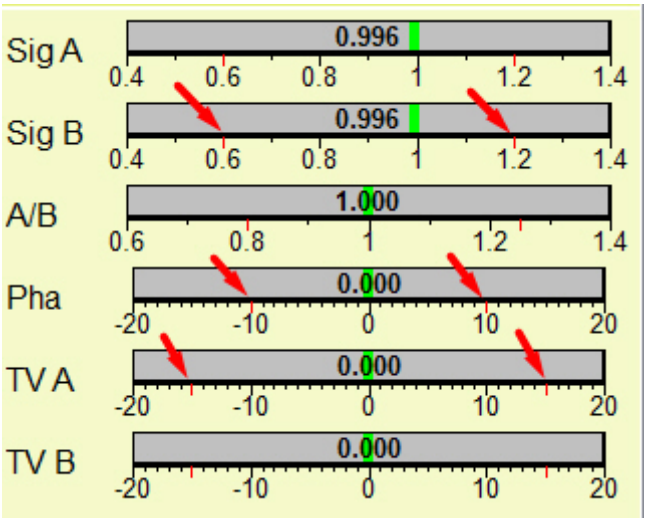


All signals within the tolerance



Several signals out of tolerance

Display of signal tolerances

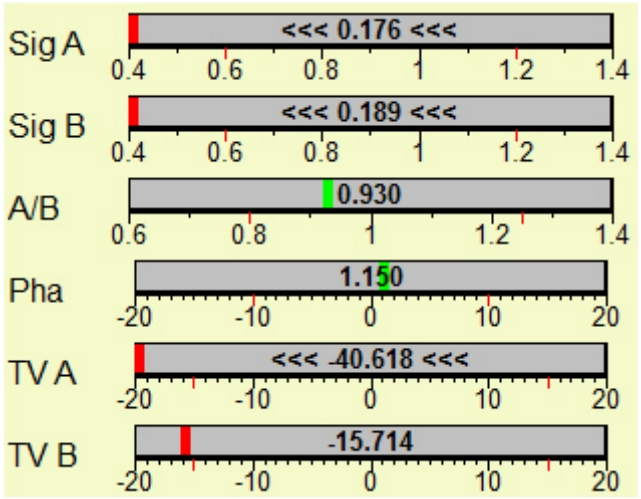


The red markings indicate the signal tolerances.

The stated tolerances are HEIDENHAIN standard values.

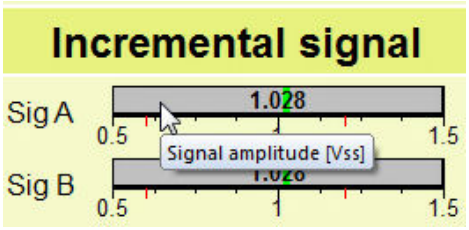
The tolerances of measuring systems with high resolutions (e.g. angle encoders) and large temperature ranges (e.g. motor encoders) are tighter. In this case the markings are invalid. A product key is required to change tolerances. It is available on request.

Green lines: Signals within the specified tolerance
Red lines: Signals outside the specified tolerance
Several arrows: Scaling exceeded

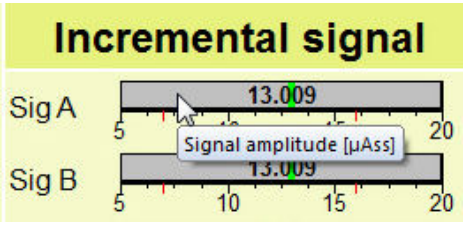


Scalings and units of the bar graph

The scalings and units are automatically adapted to the connected encoder. The meanings of the diagrams and their units can be seen from context menus; simply move the cursor to the desired position, and the menu will open.



Example: 1 V_{PP} encoder



Example: 11 μA_{PP} encoder

Standard signal amplitudes and tolerance ranges

	1 V_{PP}		
	Min.	Typical	Max.
Sig A and Sig B	0.6 V_{PP}	1 V_{PP}	1.2 V_{PP}
A/B	0.8	1	1.25
Pha	80 °	90 °	100 °
TV A and TV B	–15 °	0 °	15°

	11 μA_{PP} (25 μA_{PP})		
	Min.	Typical	Max.
Sig A and Sig B	7 μA_{PP} (15 μA_{PP})	11 μA_{PP} (25 μA_{PP})	16 μA_{PP} (35 μA_{PP})
A/B	0.8	1	1.25
Pha	80 °	90 °	100 °
TV A and TV B	–15 °	0 °	+15 °

The stated tolerances are HEIDENHAIN standard values.

Encoders with high accuracy (e.g. angle encoders) for large temperature ranges (e.g. motor encoders) or for high speeds may have different limit values.

Please always refer to the original documentation of the encoders to be checked (mounting instructions).

In case of doubt, contact the HEIDENHAIN helpline (see "Contacts", page 226).

Designations of the bar graphs and calculations

The following data and formulas refer to the interface description and the signal diagrams therein.

See "Interface description" in the following brochures:

- Interfaces of HEIDENHAIN Encoders, ID 1078628-xx
- Technical information "EnDat 2.2 – Bidirectional Interface for Position Encoders", ID 383942-xx

You can find the standard signal amplitudes and tolerances in the interface descriptions. Always comply with the tolerances stated in the original documentation (mounting instructions, etc.) of the encoder to be checked. In case of doubt, contact the HEIDENHAIN helpline (see "Contacts", page 226).

Sig A; Sig B

These are the amplitudes of the sinusoidal incremental signals A and B. In the ATS software the designations A and B are used for the sine and cosine signals of both interfaces. The current voltage interface is the 1 V_{PP} interface; the 11 μA_{PP} interface is the "older" current interface (I1 and I2 in the signal diagram).

A/B

Amplitude ratio of signals A and B

Formula: A / B; Nominal value = 1

Pha

Phase angle difference of signals A and B

Calculation: Pha = |φA + φB| / 2

TV A (I1); TV B (I2)

The TV on-to-off ratio is a measure for the offset of the signals A (I1) and B (I2). Alternatively, it can be specified as asymmetry (SYM).

Formula: Asymmetry = |P - N| / 2 · M
On-to-off ratio = 2 · 180/π·sin (2 · SYM)

Remark:
SYM is indicated in radian measure; multiply the value with 180/π to convert it into degrees.

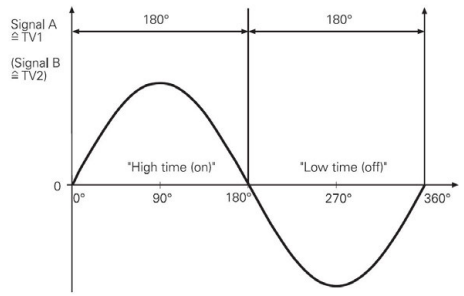
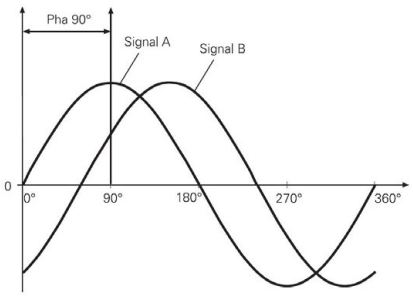
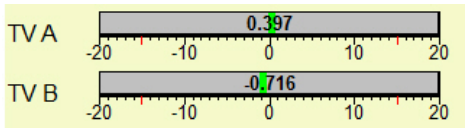
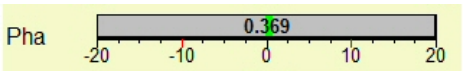
Definition of TV and Pha

TV1/TV2
On-off ratio error between incremental signal 1 (A) and incremental signal 2 (B)
Analog incremental signals are triggered at zero crossover, i.e. they are converted into square-wave signals. One period (= high time plus low time of the square-wave signal) is subdivided into 360°. If high time and low time of the square-wave signal are the same (ideal case), i.e. 180° each (180° + 180° = 360°), then the on-to-off ratio is 0°. If the high time of the square-wave signal is longer than its low time, one speaks of a positive on-to-off ratio.
An on-to-off ratio error of e.g. +10° means that the high time of the square-wave signal is 190° (180° + 10°) and its low time 170° (180° – 10°).

The on-to-off ratio error is also referred to as offset error.

Pha
Phase shift between incremental signal 1 (A) and incremental signal 2 (B)

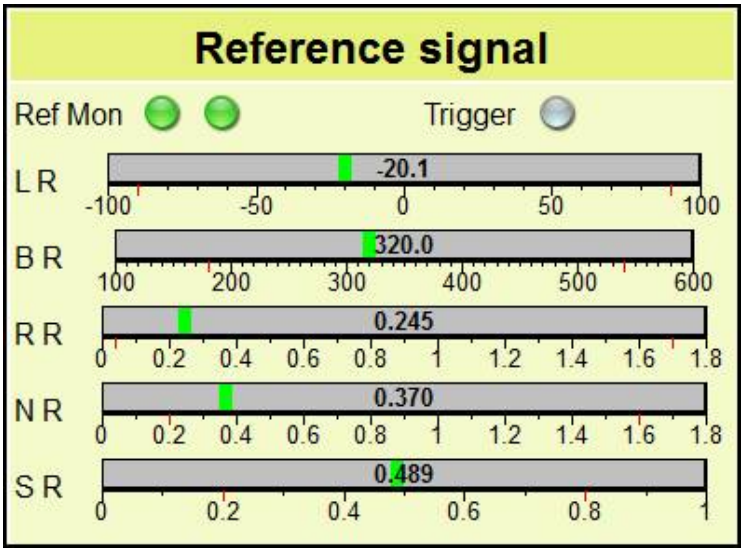
If the incremental signal 1 precedes the incremental signal 2 by 90°, one speaks of a phase shift error of 0° (ideal case). Deviations from the optimum phase shift of 90° are indicated as phase-shift error (in degrees).

TV1; TV2	**Pha**
	
	
0 = 180° / 180° = 1 : 1	0 = Pha = 90°

For ideal signals the green indicator is at 0 position!

6.2.4 Checking the reference signal (1 V_{PP} and 11 μA_{PP})

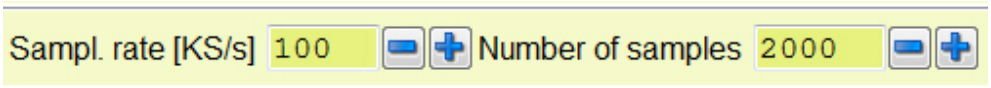
"Reference trigger on/off" button activates the "Reference signal" bar display

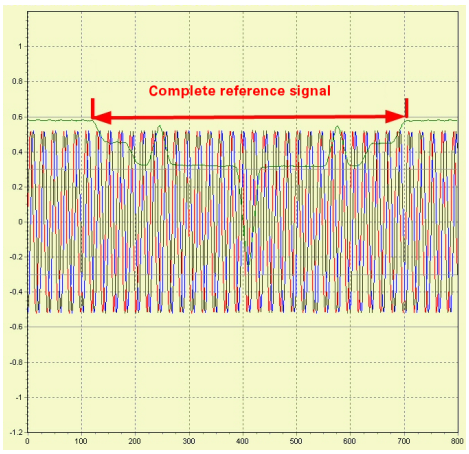


"X-Y-/Y-t view" button: Set the oscilloscope to **Y-t mode (sinusoidal curves).**

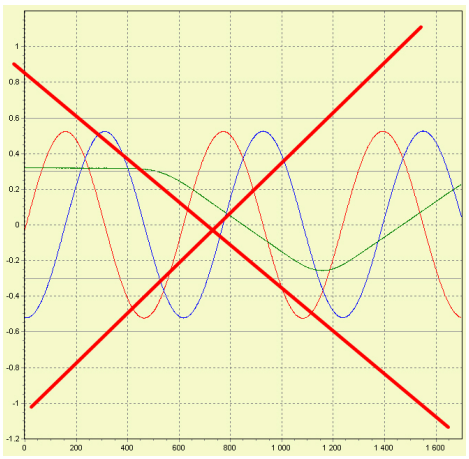
Start/Stop button: With this button the entire display including the bar graphs can be stopped for analysis.

Select the traversing speed (rotational speed), the sampling rate and the number of samples such that the oscilloscope shows one **complete reference mark signal (= leading noise, peak, and trailing noise)** .





Full reference mark signal; correct calculation of the display values



Incomplete reference mark signal; cannot be used for correct calculation

When a measuring accuracy (bar display) of 1 degree is required, the following criteria must be met:

1 A complete reference mark signal curve must be visible on the screen of the oscilloscope, as the entire screen display is used to calculate the reference mark. For encoders with selectable reference mark (via magnet or selector plate), the quiescent value "H" must also be visible in the window.

Information on the signal diagram:

See "Interface description" in the following brochures:

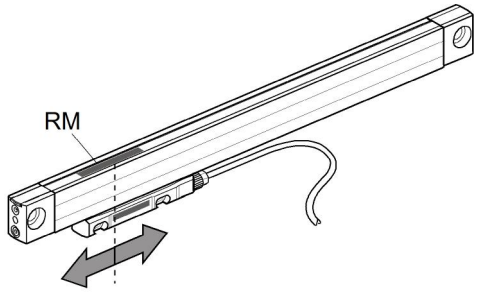
- Interfaces of HEIDENHAIN Encoders, ID 1078628-xx
- Technical information "EnDat 2.2 – Bidirectional Interface for Position Encoders", ID 383942-xx

2 The sampling rate must be set 360 times higher than the value in the frequency display. If an accuracy of 10 degrees is sufficient, the sampling rate must be multiplied by 36 only.

Bar display of reference signal

Display of the signal parameters and tolerances as bar graphs with tolerance markings

Recommended:
Traverse the reference mark(s) from both sides; on distance-coded encoders make spot checks or examine "faulty" areas.



Standard signal amplitudes and tolerance ranges of the reference signal

	1 V_{PP}		
	Min.	**Typical**	**Max.**
LR	–90°	0°	+90°
BR	180°	360°	540°
RR	0.04 V	–	0.68 V
NR	0.2 V	–	0.85 V
SR	0.2 V	–	0.8 V

Standard signal amplitudes and tolerance ranges of the reference signal

	11µA$_{PP}$		
	Min.	**Typical**	**Max.**
LR	–90°	0°	+90°
BR	180°	360°	540°
RR	0.4 µA$_{PP}$	–	25 µA$_{PP}$
NR	0.2 µA$_{PP}$	–	0.85 µA$_{PP}$
SR	0.2 µA$_{PP}$	–	0.8 µA$_{PP}$

The stated tolerances are HEIDENHAIN standard values.

Encoders with high accuracy (e.g. angle encoders) for large temperature ranges (e.g. motor encoders) or for high speeds may have different limit values.

Please always refer to the original documentation of the encoders to be checked (mounting instructions).

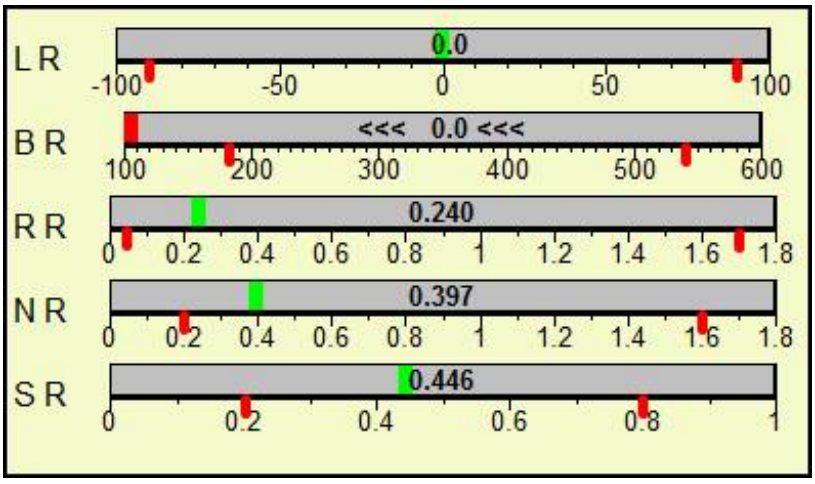
In case of doubt, contact the HEIDENHAIN helpline (see "Contacts", page 226).

Designations of the bar graphs and calculations of the reference signal

The following data refer to the interface description and the signal diagrams therein:

See “Interface description” in the following brochures:

- Interfaces of HEIDENHAIN Encoders, ID 1078628-xx
- Technical information ”EnDat 2.2 – Bidirectional Interface for Position Encoders“, ID 383942-xx



The color of the bar graphs changes to red, if the tolerances are exceeded. Also observe the red line markers in the scaling! The stated tolerances are HEIDENHAIN standard values.

LR:
Position of the reference pulse

Formula: K – L / 2

BR
Width of the reference pulse

Formula: K + L

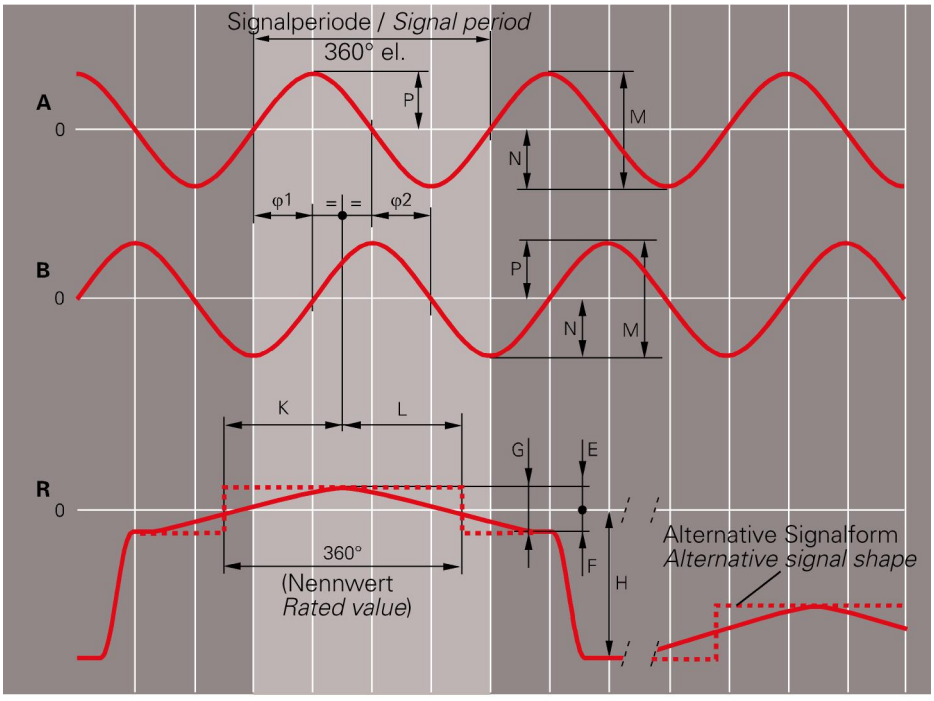
RR:
Quiescent value H of the reference pulse

NR:
Usable component G of the reference pulse

SR:
Switching threshold of the reference pulse

Formula: E / G

For the meaning of K, L, E, and G see the following labeled signal diagrams (1 V_{PP},11 μA_{PP}).



A, B, R gemessen mit Oszilloskop in Differenzbetrieb
A, B, R measured with oscilloscope in differential mode
Labeled signal diagrams (1 V_{PP}/11 μA_{PP})

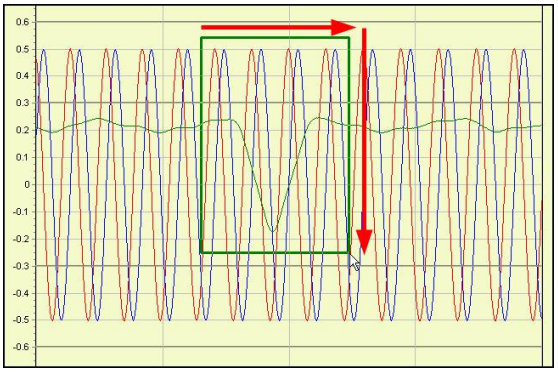
6.2.5 Zoom function for oscilloscope

The oscilloscope display features a zoom function that can be controlled by the left mouse button and the cursor.

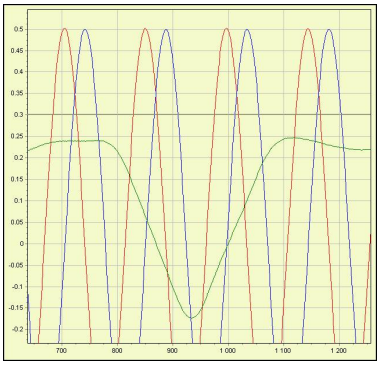
Zooming a detail

Press and hold the left mouse button and – starting at the left – draw a square over the desired area. This area will be magnified. You can further zoom the magnified part.

> All oscilloscope screens support zooming for all functions. Use the mouse wheel to scroll the screen detail.



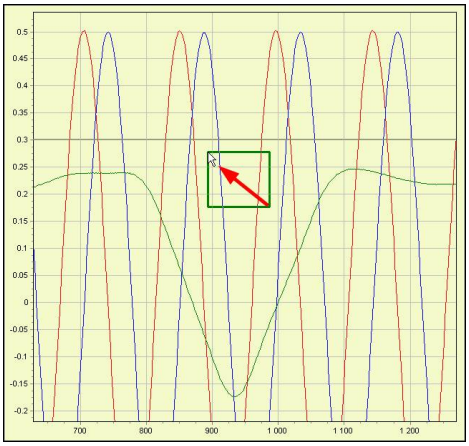
Select area to be zoomed



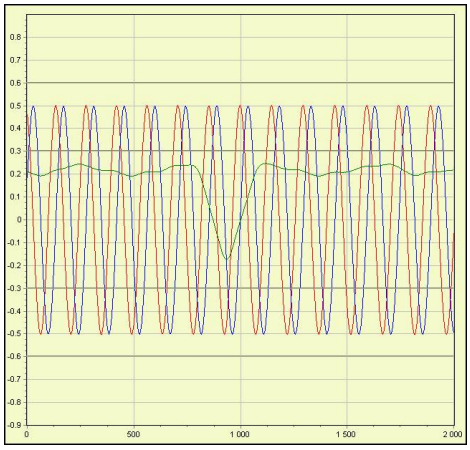
Zoomed detail

Unzooming

Press and hold the left mouse button and diagonally move the cursor from the lower right towards the upper left a short path is sufficient; the cursor position is of no importance). The initial screen is displayed.

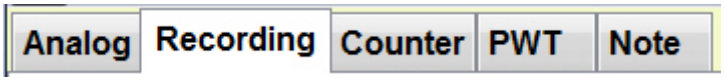


Move cursor diagonally from right to left



Original display

6.2.6 Recording function



With the "Recording" function, the output signal can be diagnosed over several signal periods (SP). The number of periods that determines the measuring range to be inspected must be entered by hand. The test data can be saved, loaded and exported. The measuring results are displayed in three diagrams for further analysis of the signals.

The three diagram fields show the differences of the sine and cosine signals.
Recorded data:

- Amplitude
- Signal shape
- Difference in amplitude (A/B)
- On-to-off ratio, also referred to as offset (TV A, TV B)
- Phase shift between sine and cosine signals

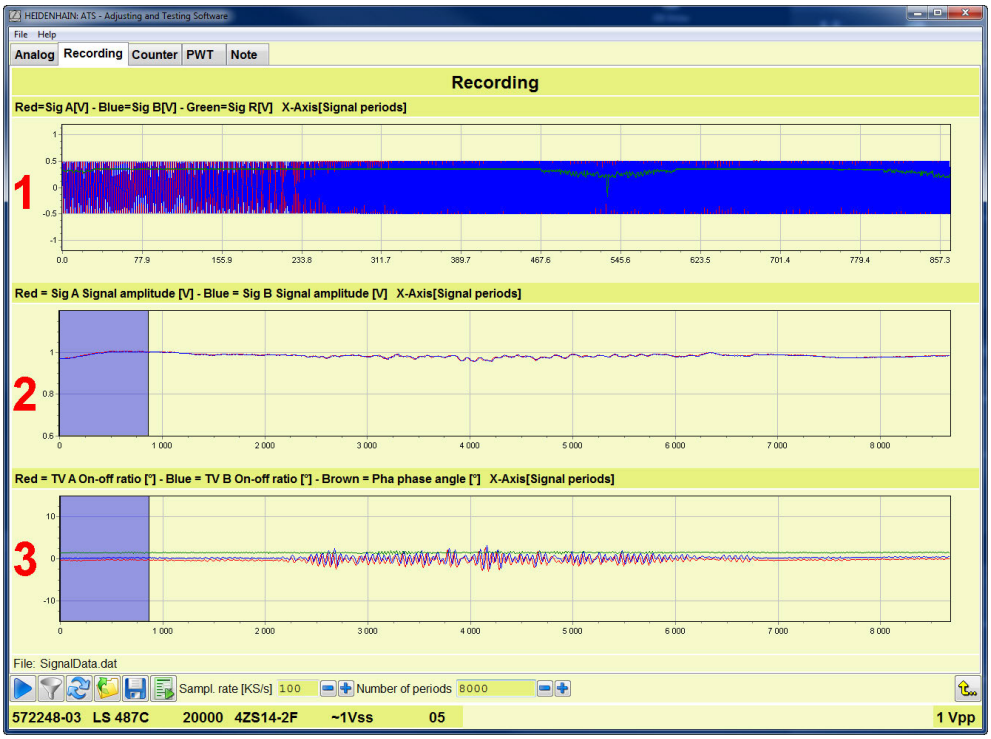
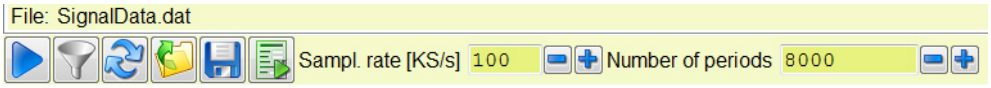


Diagram 1
Display of a share of the signal periods = Number of periods (X axis)
As there are very many data, only a share is displayed (10% of the raw data, 1000 signal periods maximum). Y = Amplitude in [V_{PP}] oder [μA_{PP}]
Depending on the displayed area, the reference mark(s) may not always be visible!
Ideal signal: The amplitudes are symmetrical to Y = 0 and within the tolerance limits.
Red = Sinusoidal signal 0°; Blue = Sinusoidal signal 90°; Green = Reference mark signal

Diagram 2
Display of the amplitudes over all signal periods (Y axis in [V_{PP}] or [μA_{PP}];
X axis = Number of signal periods
Ideal signal: The two signal curves should almost coincide; they may diverge within the tolerance limits.
Red = Signal amplitude 0° [V]; Blue = Signal amplitude 90° [V]

Diagram 3
Display of on-off ratio over all signal periods
Y axis = On-off ratio TV A, TV B and phase shift Pha
X axis = Number of signal periods
Ideal signal: The three signal curves should almost coincide; they may diverge within the tolerance limits.
Red = TV 0° signal [°]; Blue = TV 90° signal [°]; Brown = PHA phase angle

Explanation of the “Recording” bar



File name of the saved data

Start
Start recording
The specified number of periods is recorded at the prescribed sampling rate.
The number of periods is determined by the incremental counter in the PWM. One period corresponds to one increment (signal period or grating period).
A pop-up window shows the recording progress. If the encoder does not move after recording was started, recording never ends; it can be terminated by pressing “Cancel” in the dialog window. Recording does not end “dead-on”; the entered number of periods is always slightly exceeded.
Recorded data are always saved to:
C:\Users\...\AppData\Roaming\HEIDENHAIN\ats\SignalData.dat
After recording, the file is automatically loaded and displayed (”Read file” window). The loading time depends on the file size (= number of periods and sampling rate).

Filter 100 kHz
Signal interferences ≥ 100 kHz are suppressed.

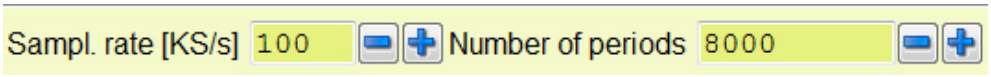
Reset
Press this button to reset the zoom in all diagrams. The blue areas are shifted to the left edges of the diagram windows.

File open
Opens saved records. Existing files can be archived or sent for later examination.

Save file as
The file "SignalData.dat" can be saved under another name.

Export file
The file “SignalData.dat“ can be saved as text file (raw data), e.g. for further processing, analysis, or evaluation of the data with software such as Matlab. Observe the file size!

Explanation of the "Sampling rate" and "Number of periods" bar



Sampling rate [kS/s]
Description of the sampling rate see also “Sampling rate” and “Number of samples”.

Setting range: 1 ... 1800 [kS/s]

Minimum sampling rate = Signal frequency 20

Example:
Signal frequency 10 kHz = Minimum value for the sampling rate is 200

The signal frequency can be determined with the function “Analog; Encoder properties; Freq”.

Number of periods
Selectable between 1000 and 10,000,000

Attention: Large amount of data
File size [bytes] = Sampling rate Number of periods 12

Example:
Sampling rate = 1000; number of periods = 100,000, file size = **1.2 GB**

Processing these large amounts of data may take quite long, depending on the processing power.

Calculation of cutting data
The measuring range of the encoder is determined by entering the number of periods.

For rotary and angle encoders, the encoder line count is entered as stated on the ID label (e.g. 2048 lines). This corresponds to one complete revolution (= entire measuring range = 360°).

For linear encoders, use the following formula to calculate the number of periods from the measuring length:

$$\text{Number of periods} = \frac{\text{Measuring length [mm]} \cdot 1000}{\text{Signal period [µm]}}$$

Refer to the sales literature for the value to be used for the signal period.

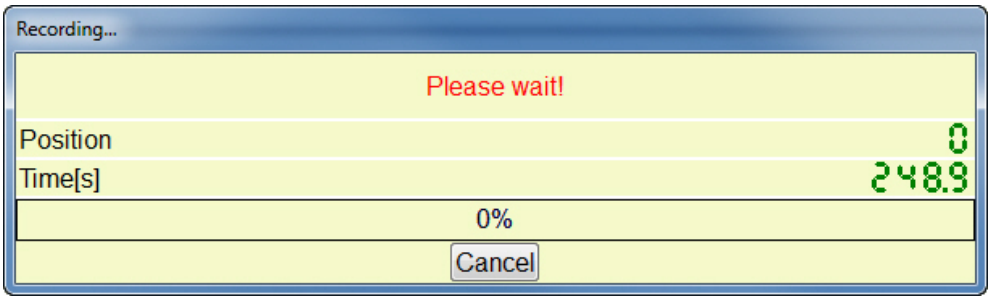
Example:
LS 487 linear encoder; measuring length ML = 320 mm; signal period 20 µm

$$\frac{320\ \text{[mm]} \cdot 1000}{20\ \text{[µm]}} = \text{Number of periods}$$

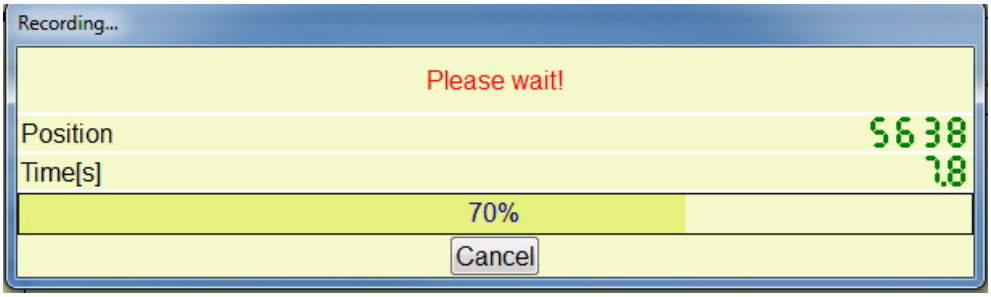
The calculated number of periods is used to check the entire measuring length. If you want to check the measuring range several times or to check only parts of it, larger or smaller values can be entered.

Start recording

After you press the Start button, the dialog box "Recording..." is displayed, the clock is running, the position is 0, as no movement has occurred yet.

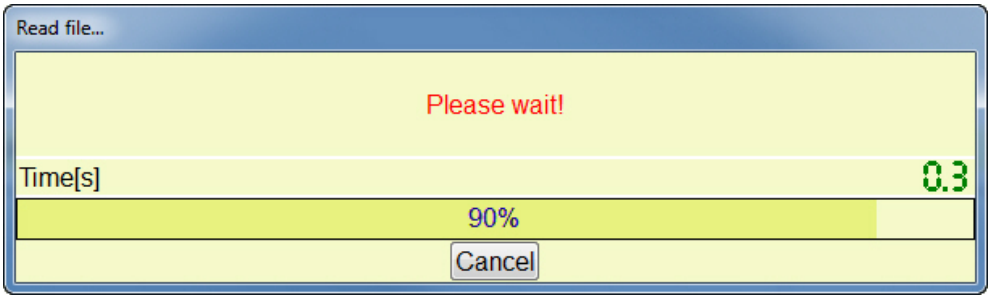


When the Start button is pressed, the linear or rotary encoder starts moving to produce signals. Recording has started and the position counter is counting. The bar graph shows the progress of the recording until the specified number of periods has been reached.



When 100 % were recorded, the "Read file" window shows how many of the data were already processed.

Depending on the settings of Sampling rate and Number of periods, the amount of data may be quite large, and the calculation therefore require some time.



The image below shows the record of a fault-free linear encoder. The diagrams can be zoomed and the blue areas shifted to view the results in detail.

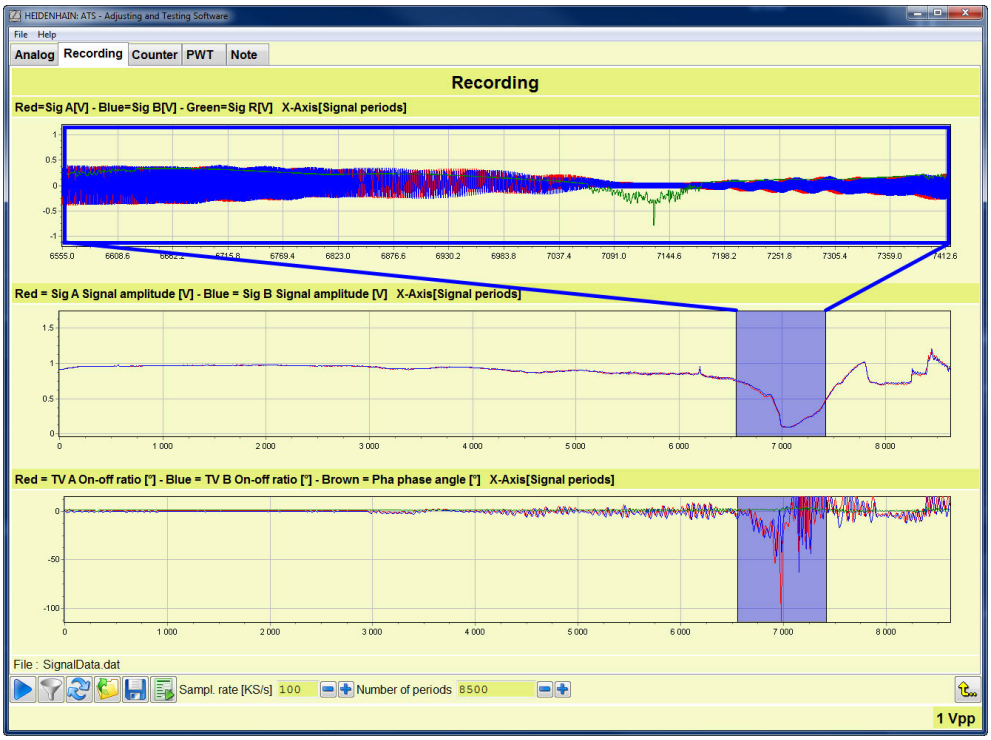
The graphs of faultless output signals are almost congruent in the middle and lower display fields (2 and 3), and there are no fluctuations beyond the tolerance ranges! In the display field 1, no “neckings“ should be visible.

The image shows the record of a linear encoder with heavy contamination.

Area within the red square:
Signal drop and extreme on-off ratio and phase shift errors at the end of the measuring range. The dark blue rectangles show that the upper diagram only contains a section of the signal train.

In the lower diagrams, this is the beginning of measurement (approximately the periods 1000 to 8500).

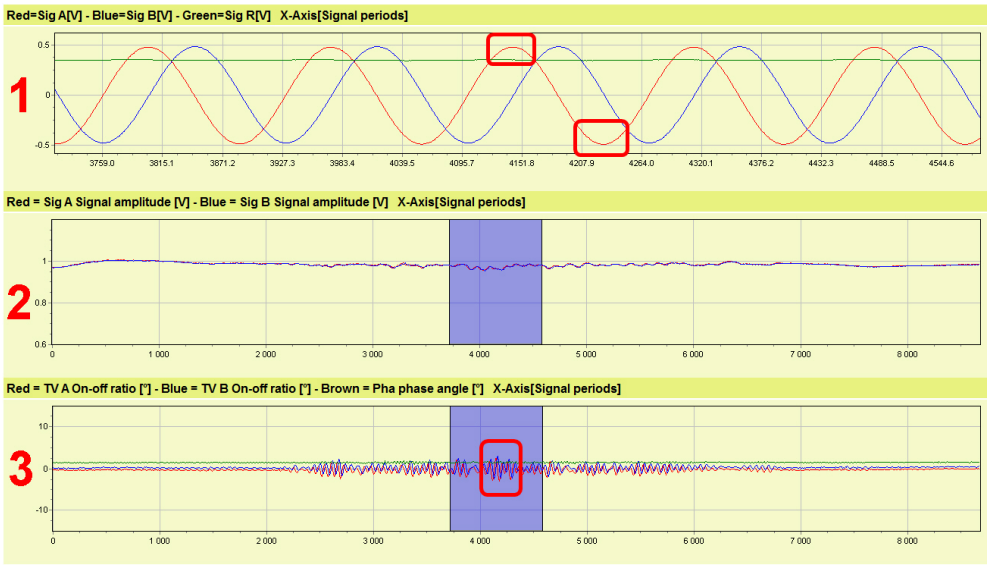
The light blue areas can also be shifted to display details of the right side of the diagram (the zoom function is available, too).



Example of the zoom function:
The diagrams 2 and 3 contain areas marked blue. These areas can be shifted and scaled up/down to find an interesting area of the signal periods.

The light blue areas may also be in a zoomed range.

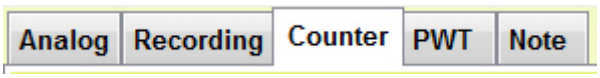
Reset
Press this button to reset the zoom in all diagrams. The blue areas are shifted to the left edges of the diagram windows.



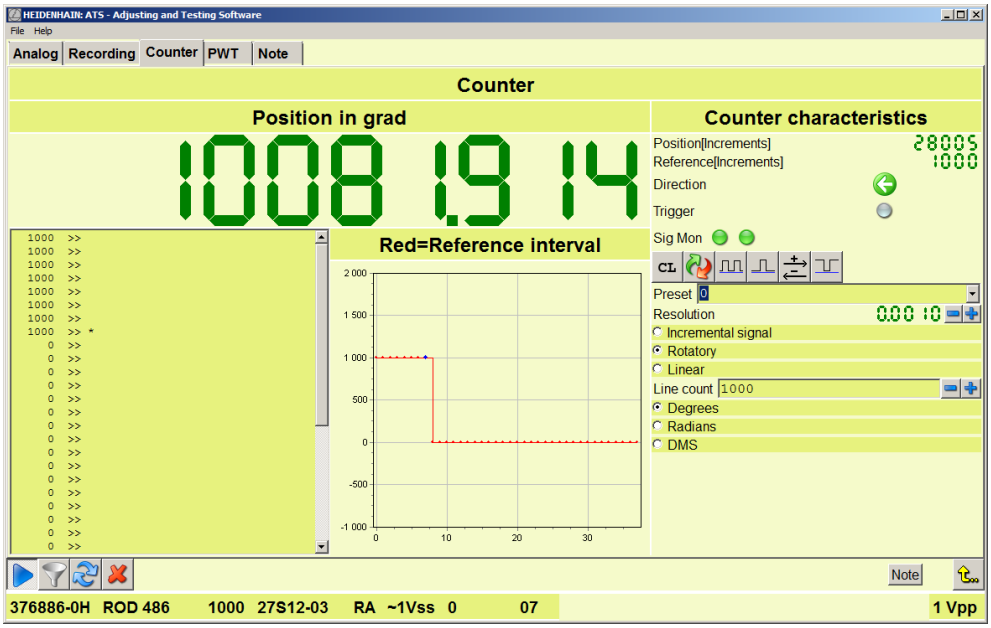
6.2.7 Counter function

The “Counter” test function serves to check the counting and the reference function of incremental encoders.
The counter function can be set to incremental (count lines), rotational (angle), and linear (selectable interpolation).
It can also be used as comparator. The grating period of linear encoders, the line count of rotary encoders, the counting direction, etc. can be adapted for this purpose.
Moreover, it is possible to check the function of the reference signal by counting the lines between the reference marks (Start/stop with ref. mark).

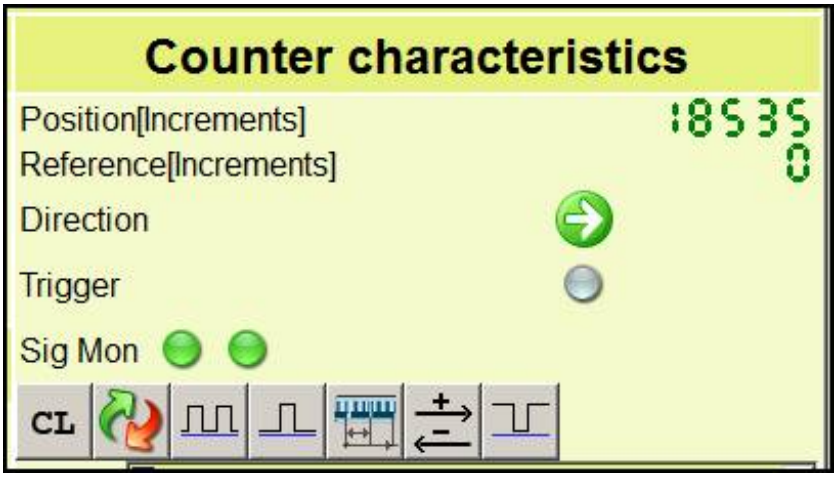
Click the “Counter” tab to activate the “Counter” test function.



In the example, the counter screen shows that an incremental 1 V_{PP} rotary encoder (1000 lines, one reference mark) is connected.



Explanation of the buttons and functions:



Counter and Position

The Counter display (large counting field) shows the measured value of the connected encoder. Changes in the grating period, line count, etc., influence the display value.

The smaller "Position [increments]" display always shows the grating periods (counts the lines) irrespective of the whether settings were changed.

Reference

The Reference display shows the value between two reference marks. (In the example: An ROD with 1000 lines is connected and was rotated by one revolution.)

Direction and **Trigger**

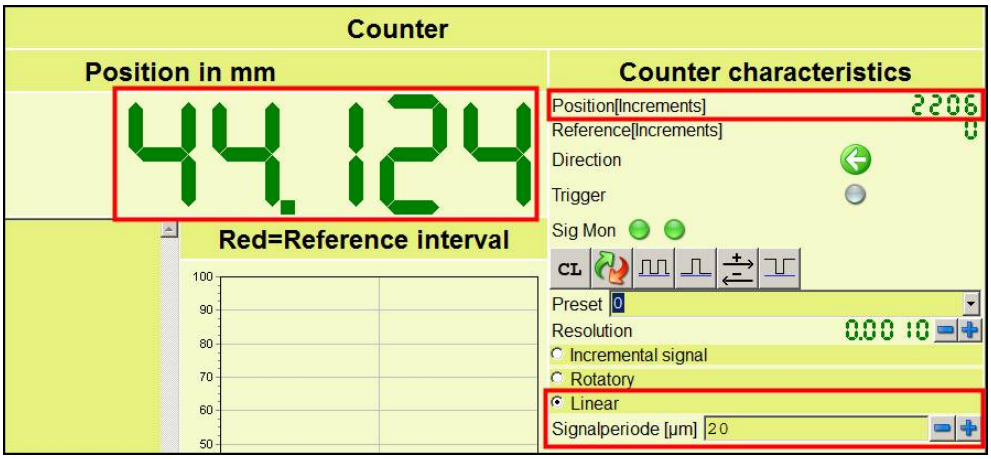
The arrow symbol shows the traversing direction of a linear encoder and the direction of rotation of a rotary encoder. The green color of the trigger (LED symbol) indicates that one reference mark was detected (0.5 seconds hold time). Gray LED = no reference mark was detected.

Example:

	**Arrow right = positive counting values, no reference mark detected**
	Arrow left = negative counting values, reference mark detected
	Clears the display value of Position
	Loads the value entered in the “Set” line into the position display
	Every reference mark clears Counter and Position.
	Counter and Position are cleared and restart with the next reference mark.
	For encoders with distance-coded reference marks, the current counts are reset to zero and set when the next distance-coded reference mark is reached. This button is only available for encoders with distance-coded reference marks.
	Change of counting direction
	Inversion of reference pulse
	Read the notes and repeat the measurement, if necessary.
	Freezes the display
	Filter (100 kHz) button = damps the band width of the input amplifier; interfering signals larger than 100 kHz are suppressed.
	Reset button = Resets signal monitoring
	Clears the table and the graphics

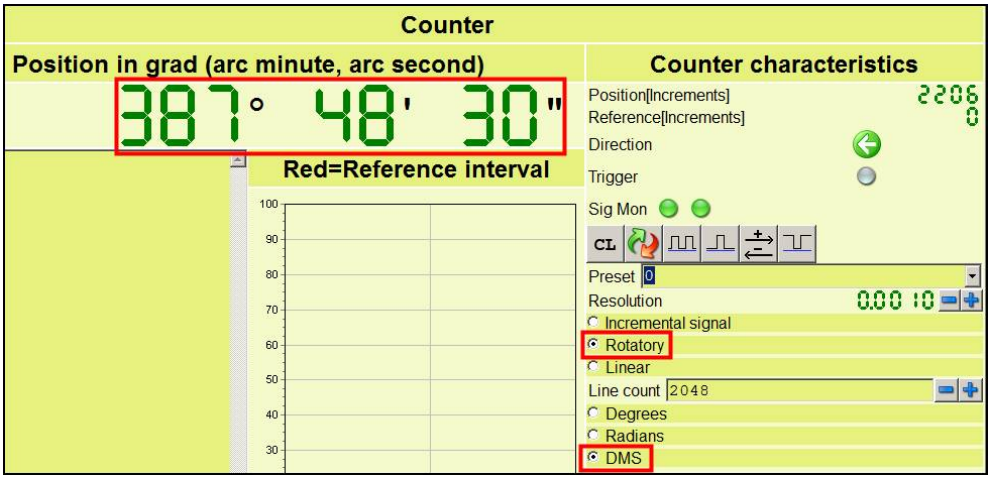
Incremental signal
With this setting, the lines (grating periods) are counted and displayed the same in the counter and position displays.

At the counter, for example, the grating period of a linear encoder can be adapted.

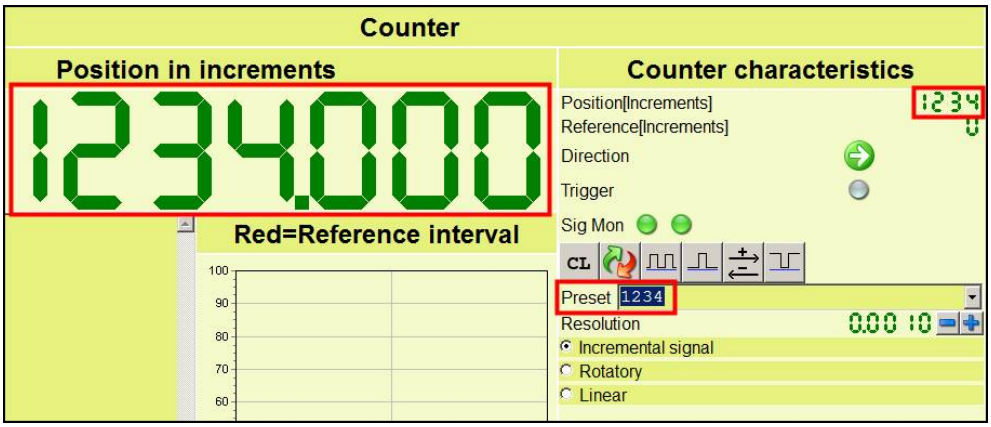


For rotary encoders the line count can be set. The display mode can be altered as well.

Degrees	Counts encoder revolutions in degrees (line count is converted into 360° units)
Radians	360° = 2π = 6.28 (display 6.28/revolution)
DMS	Degrees/minutes/seconds view (see example)



Preset In the Preset field you can enter a preset value for the counter. The counter display can then be used as "comparator" (for comparison with the control display).



Working with the table and the graphics

Table and graphics are used to check the counting function over several reference marks (RM).

- For analog encoders the signal periods are displayed (non-interpolated values).
- The counter value is determined by traversing two reference marks.
- In the table, the direction is indicated by double arrows (>>; <<).
- The graphics shows the counted signal periods in the Y axis and the number of traversed reference marks in the X axis.

When the shaft of a rotary encoder is turned continuously the signal periods are counted (corresponds to the line count). For encoders with square-wave signals and integrated interpolation electronics (e.g. TTL x 5) the line count is multiplied with the interpolation factor (e.g. 1000 lines on the graduated disk, interpolation factor x 5 = display value 5000).

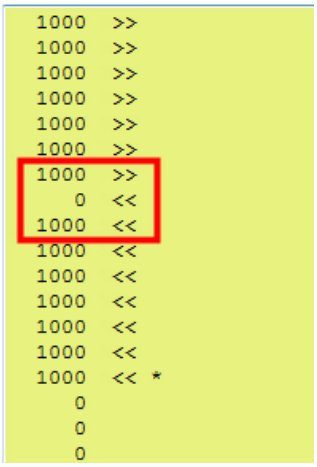
With linear encoders with one reference mark the counter starts when the RM is traversed. The counter must display the value zero (0) each time the RM is crossed over again. In this case the entries in the table and the graphics are "0". For distance-coded reference marks the distance code is displayed.

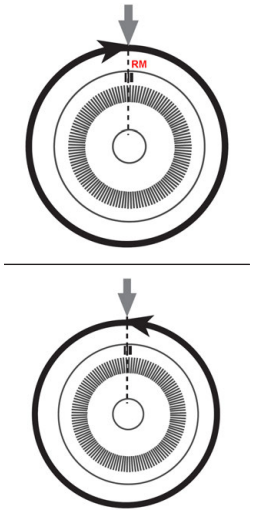
NOTICE

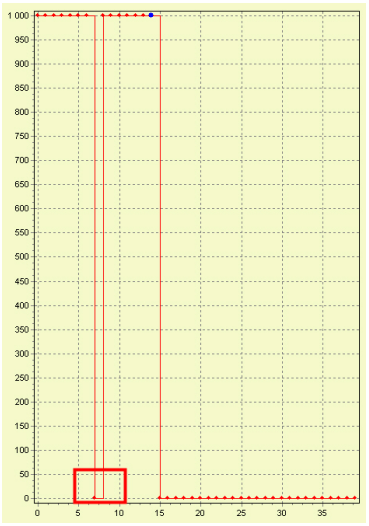
- Check both directions of rotation (traverse directions)!
- The cutoff frequency of the encoder or the mechanically permissible speed must not be exceeded.

The ball bearings can be destroyed.

Example:
Inspection of a rotary encoder with 1000 lines in both directions (red frame)
Rotate the encoder by several revolutions in cw and ccw directions (>> and <<). The reference display value must be identical with the encoder line count, even at high scanning frequencies. If it is not, the encoder is defective. (Not even a difference of ±1 signal period is tolerable!)

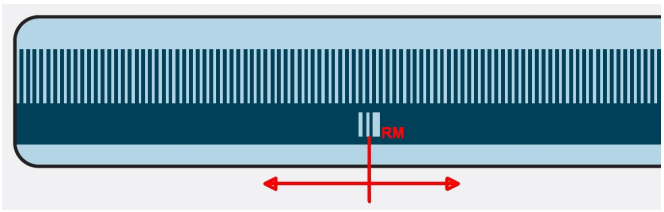


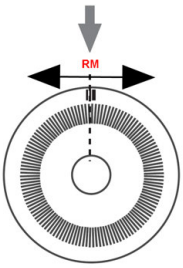




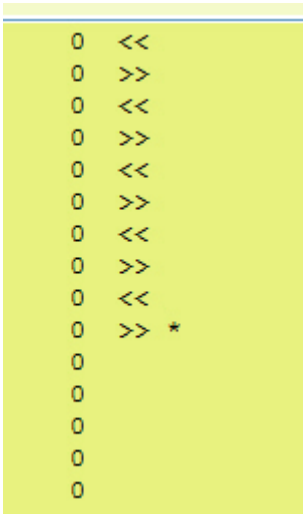
Example:
Linear encoder (or rotary encoder) with one reference mark
Traverse the RM, invert the direction and traverse the RM again (oscillate about the RM; >> <<). The reference display value must show 0, even at high scanning frequencies. The encoder is faulty, even if the value differs from 0 by only ±1 signal period.

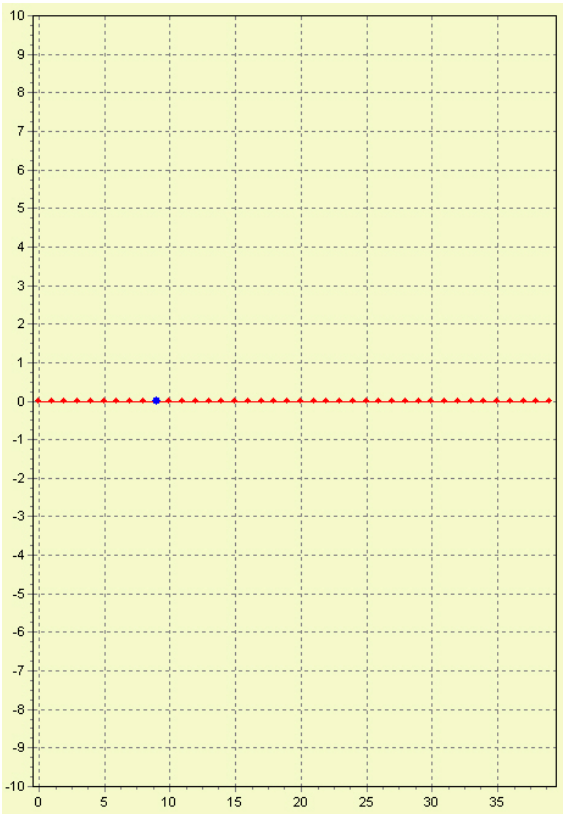
Schematic representation of incremental linear and circular graduations with one reference mark:



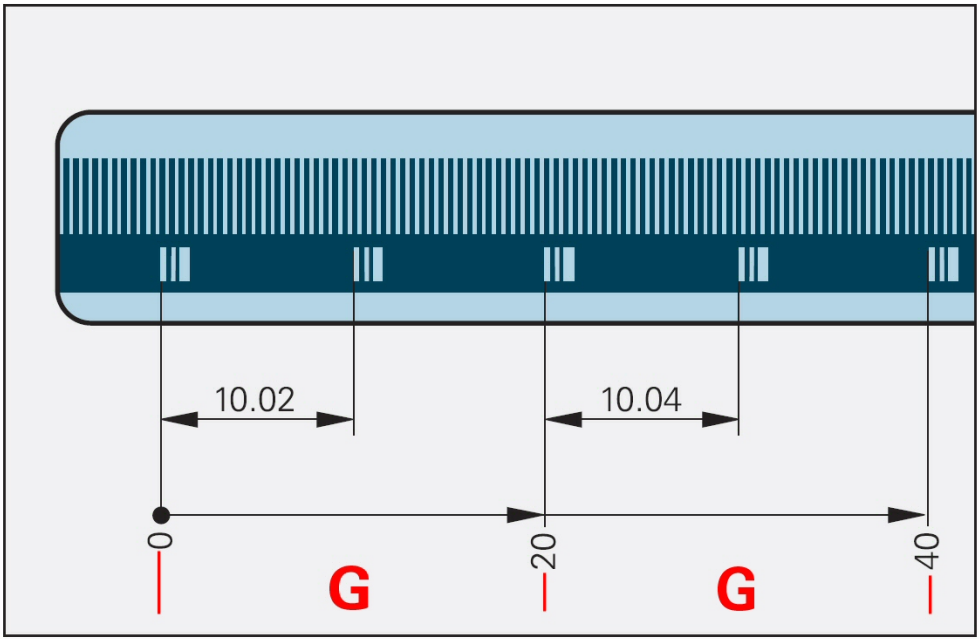


For more information on reference marks refer to the product brochures available at www.heidenhain de.



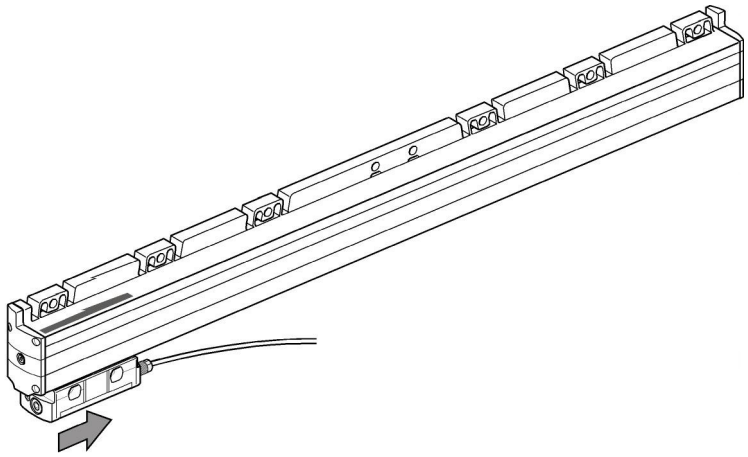


Example:
Inspection of a linear encoder with distance-coded reference marks (LS 187 C)
Schematic representation of an incremental graduation with distance-coded reference marks (For more information on reference marks refer to the product brochures.)



Signal period: 20 µm
Nominal increment/base (G): 1000 signal periods (= 20 mm traverse path max.)
First encoded distance = 501 signal periods, i.e. 10.02 mm (10.02 / 20 · 1000)
Second encoded distance = 499 signal periods, i.e. 9.98 mm (9.98 / 20 · 1000)
Third encoded distance = 502 signal periods, i.e. 10.04 mm (10.04 / 20 · 1000)
Fourth encoded distance = 498 signal periods, i.e. 9.96 mm (9.96 / 20 · 1000), etc.

The distance-coded reference mark can be checked in the Counter table.
In this table, the nominal increment is referred to as "base".



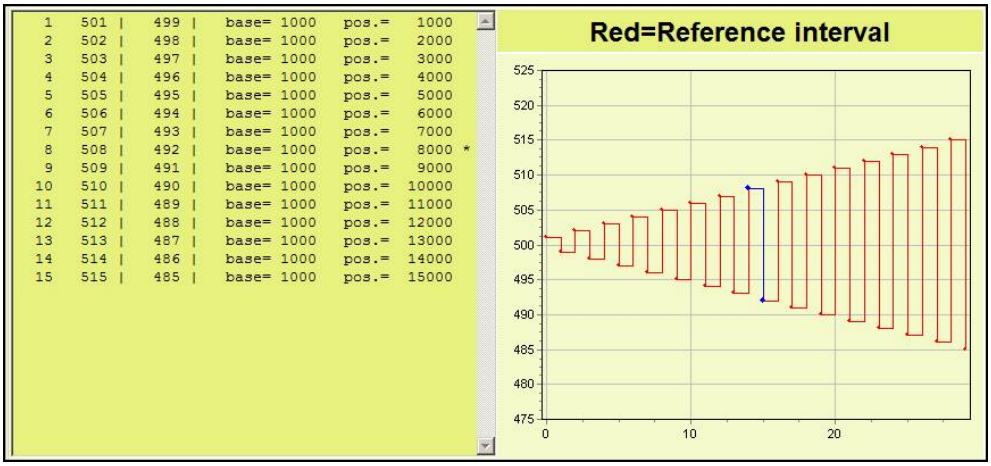
In the picture below the counting function was started at the **beginning of measurement of the LS** (ID label). The Reference table shows the signal periods measured between two reference marks.

Example:
501 + 499 = 1000

The RM nominal increment of the LC 187C is 1000 signal periods.

The software requires about eight reference mark traverses to calculate the nominal increment/base (single-column table).
Once the nominal increment has been determined, a four-column table is displayed (the old table and graphics are deleted).
Now you can move the scanning unit back to the beginning of measurement. If you move the scanning unit away from the ID label, the first line of the table contains the **value 1: 501,** the **value 2: 499,** and the **base 1000**. In the fourth column **pos** the added base values are displayed.

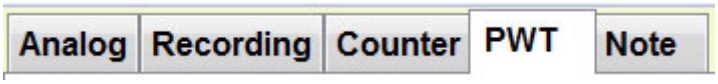
Irregularities in the reference values and in the graphics indicate that the scale or the graduated disk is contaminated or damaged.



If the machine only allows for a very short traverse path, or if only a small angle (segment) can be traversed, the distance may be too short to calculate the nominal increment (see Note above).

In this case, traverse the “possible” path several times in both directions. The software will then compute the graphics for the accessible reference marks. The current reference position is the area between the blue dots.

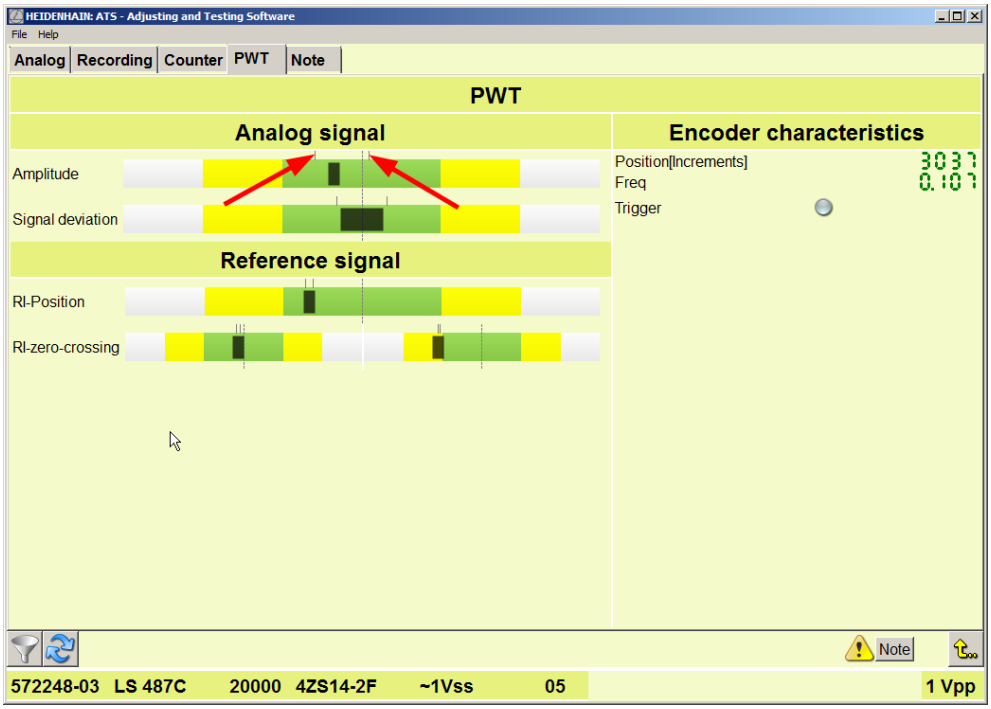
6.2.8 PWT test function



The PWT test function is a mounting aid for various exposed encoders and exclusively supports analog incremental interfaces (e.g. 1 V_{PP}, 11 μA_{PP}). The different signal parameters (amplitude, difference in amplitude, phase shift, on-to-off ratios, ref. mark position, zero crossovers) are combined in a four-bars diagram.

The PWT function allows for a "rapid test" of analog incremental encoders. For a detailed signal analysis, you have to activate the ATS analysis functions such as the functions Analog, Recording and Counter.

PWT screen display of a 1 V_{PP} output signal:



Basic elements of the PWT function:

- Display through four bar diagrams
- Drag indicators (red arrows) for min and max values
- The tolerance ranges are displayed in three different colors:
  Green = good; narrow tolerance range
  Yellow = adequate; tolerance range within the specifications for the output signals
  Gray = signal outside the specifications

The **green area** is valid for encoder mounting (exposed encoders) and high-precision applications.
The **yellow area** represents the tolerances of the HEIDENHAIN interface specifications (see description of HEIDENHAIN interfaces, ID 1078628-xx).
For standard applications all bars must be within the **yellow area**!

Description of the PWT screen

- Display 1: **Amplitude of analog signal**
  The position of the bar shows the amplitude (left = weak signal, right = strong signal)
- Display 2: **Signal deviation**
  Bar changes its width (narrow = optimum signal)
- Display 3: **Position of the reference pulse**
  Deviation of the reference signal from the analog signal
- Display 4: **RP zero crossover**
  Two bars mark the positions of the ref. mark signal edges at zero crossover (corresponds to ref. mark signal width)

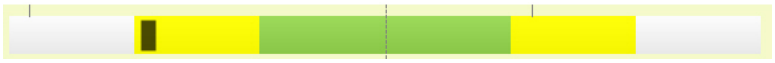
Deviations of the bar positions are saved and displayed with drag indicators as lines above the bars (see figure).

The indicators can be reset with this button.

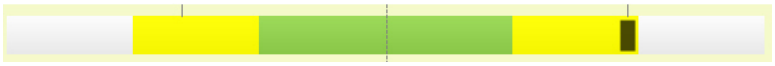
Signal amplitude:

Optimum

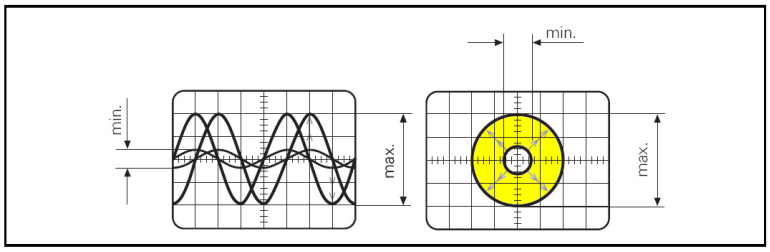
Minimum



Maximum

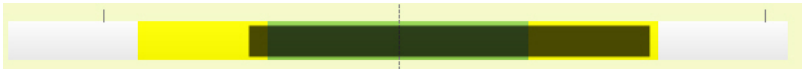


Oscilloscope display

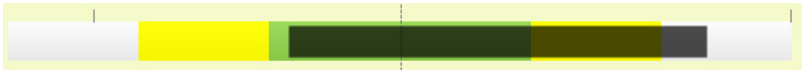


Signal deviation:
The bar width changes in this case!

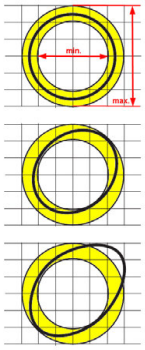
Ideal signal quality; the bar is narrow and in the center



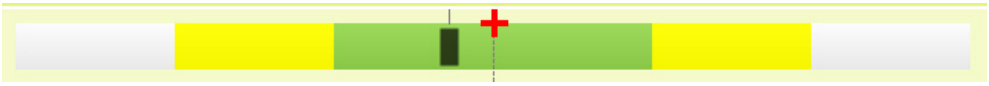
Signal quality close to the tolerance limit



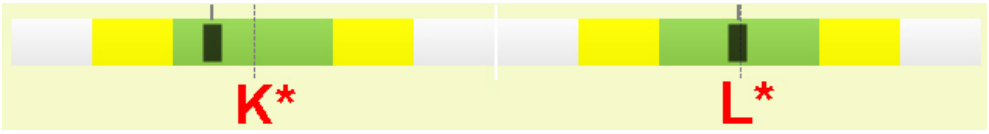
Bad signal quality; the bar is outside the yellow area

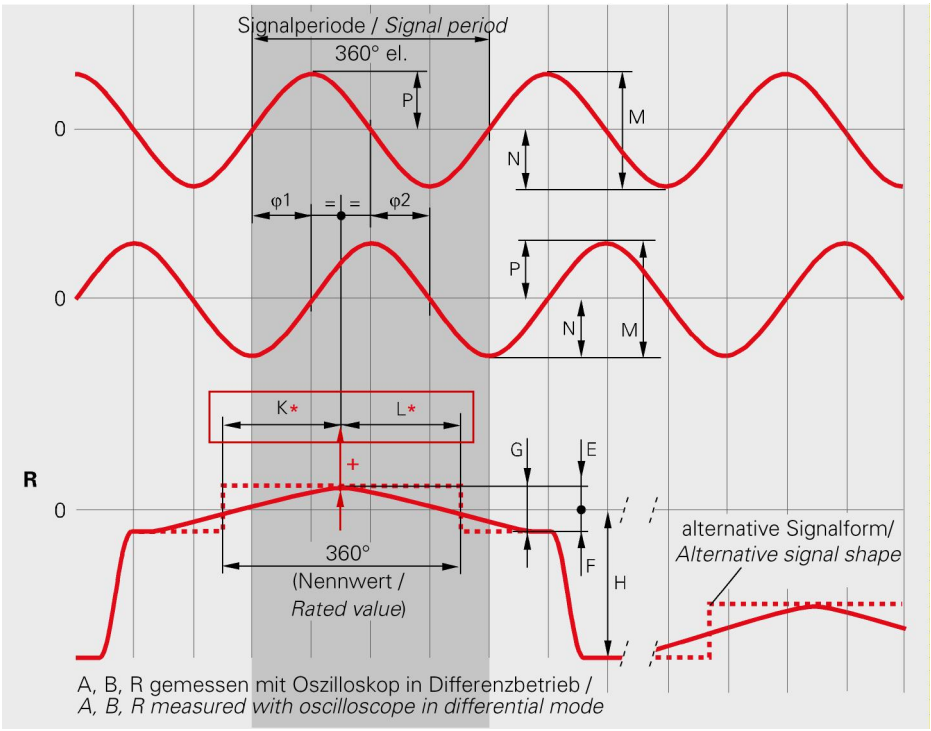


RP position:
The RP position is good, the bar is near the center of the green area ("+" in the figure).



RP zero crossover:
The zero crossovers are good, the bars are in the green area ("*" in the figure).





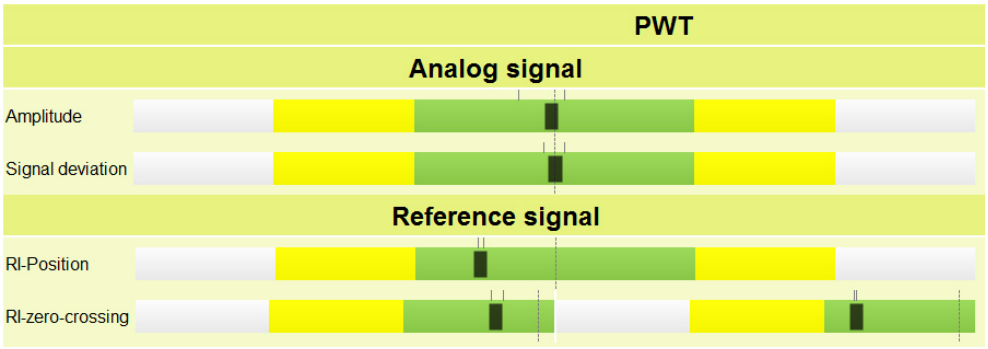
The illustrations are examples. Shapes and sizes may be different in practice. If measurements are older than 15 seconds, the display becomes "translucent".

Signal definition

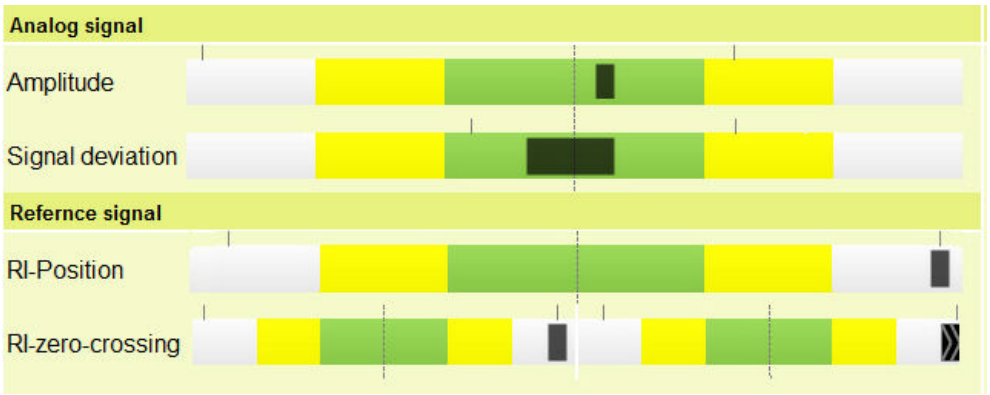
See "Interface description" in the following brochures:

- Interfaces of HEIDENHAIN Encoders, ID 1078628-xx
- Technical information "EnDat 2.2 – Bidirectional Interface for Position Encoders", ID 383942-xx

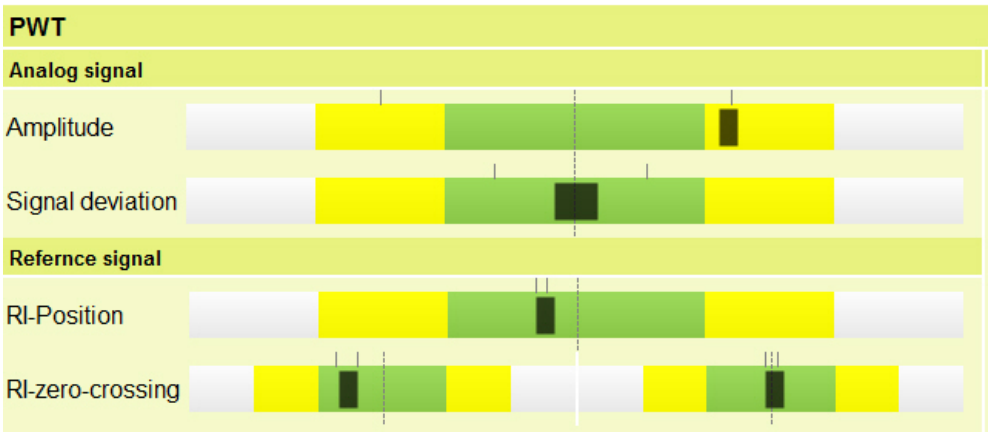
Examples:



All parameters are within the green range.



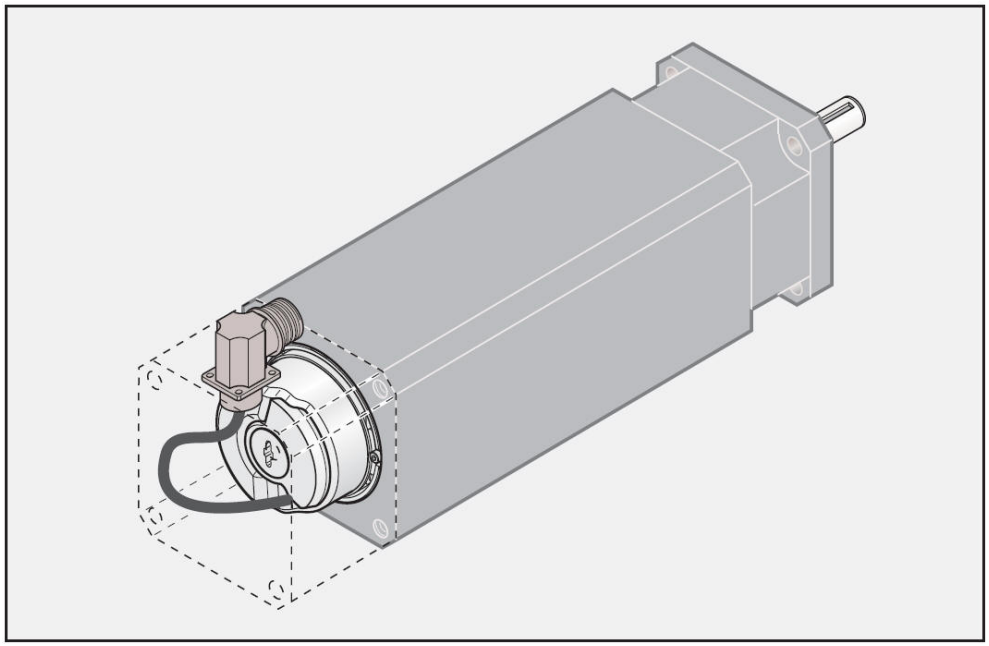
This PWT display indicates that the encoder must be considered defective – the reference signal function is faulty!



The signal amplitude is noticeable, but still within the yellow range.
Recommendation: Use the Analog function to analyze the output signals in detail.

For the test functions “Protocol” and “Note” refer to the analog check functions bar in the chapter "Screen display for analog signals", page 169.

6.2.9 Inspecting a commutation encoder with Zn and Z1 track (e.g. ERN 1387)



Before a permanent-magnet three-phase ac drive starts, the rotor position must be available as an absolute value for electronic commutation.

Special incremental rotary encoders feature an additional Z1 track (CD track).

The Z1 track provides one sine and one cosine signal (C and D) for each motor shaft revolution in addition to the incremental signals.

If such encoders are connected to the ATS software, a Z1 button appears in order that the second track can be checked.

Designation of the output signals: Zn/Z1/R or AB/CD/R
Zn or **A/B** refers to the incremental track with the high line count "Zn", e.g. n = 2048 lines.
R is the reference signal.
Z1 or **C/D** is the commutation track providing one sine and one cosine signal per revolution (line count Z = 1).
More information on signal levels and tolerances

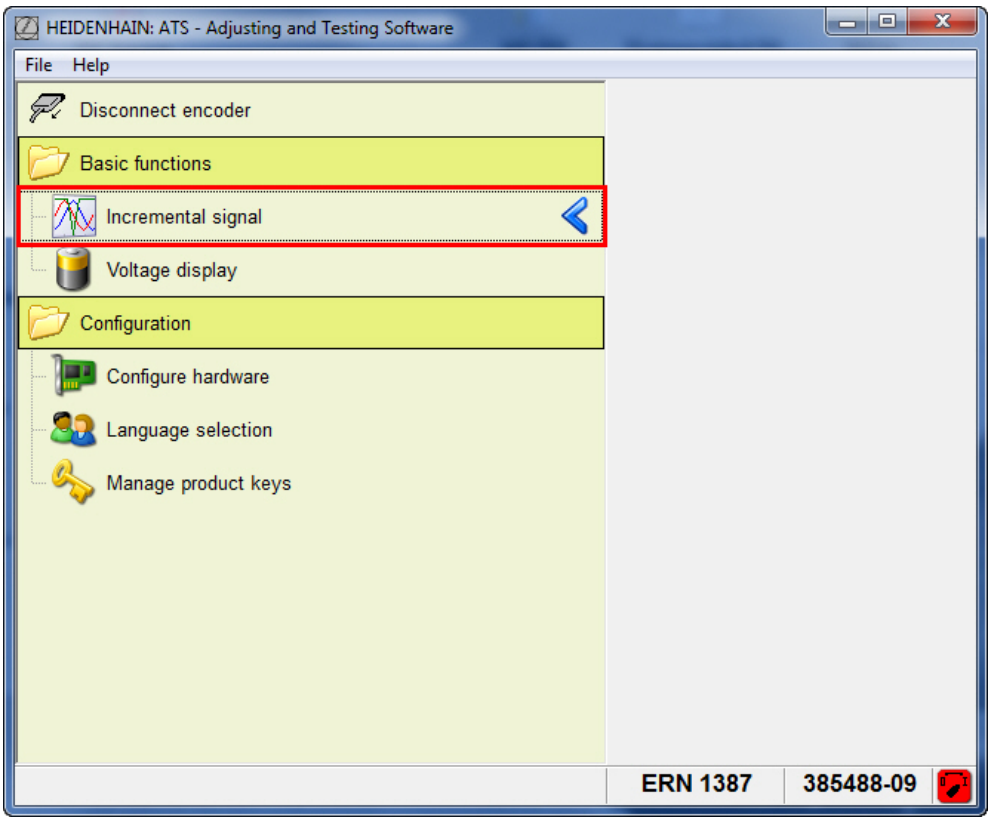
See "Interface description" in the following brochures:

- Interfaces of HEIDENHAIN Encoders, ID 1078628-xx
- Technical information "EnDat 2.2 – Bidirectional Interface for Position Encoders", ID 383942-xx

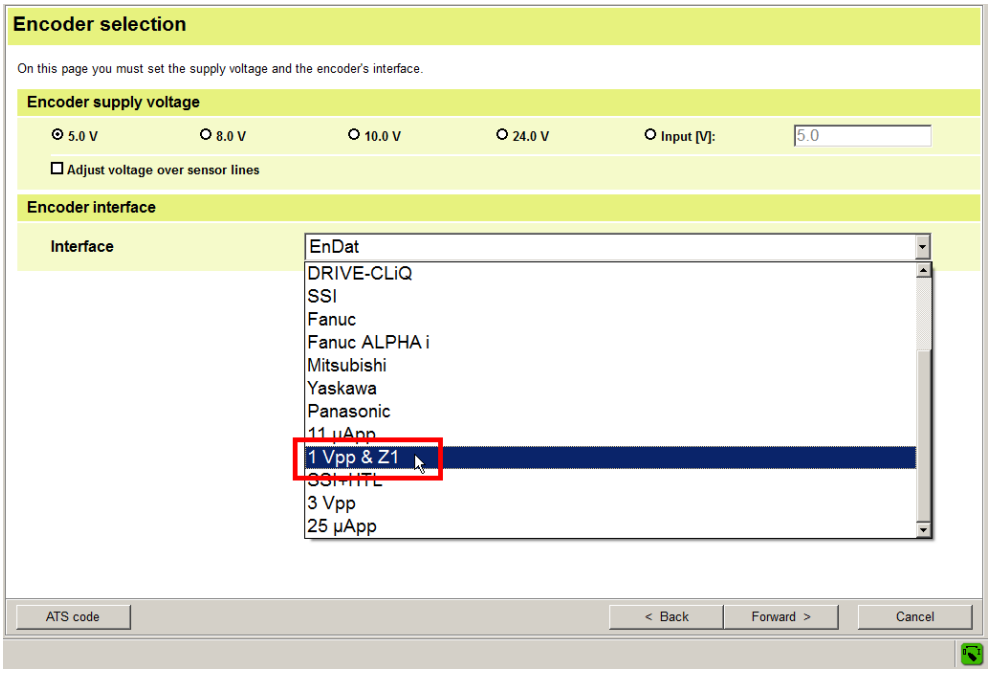
Note the adapters in the User's Manual "PWM 20 Cables and Connection Technology". Signal converters may be required for the HEIDENHAIN layout. Adapter cables are in preparation. Contact the HEIDENHAIN Helpline, if you have any questions.

Checking a commutation encoder:

- Connect the commutation encoder through its ID or via manual identification (interface 1 Vpp & Z1).
- In the ATS main menu, select the function "Incremental signal" from the "Basic functions" group.



Automatic connection through the ID; the name of the encoder and the ID are displayed at the bottom of the screen.



Manual connection by entering the interface; the name of the encoder is not displayed.

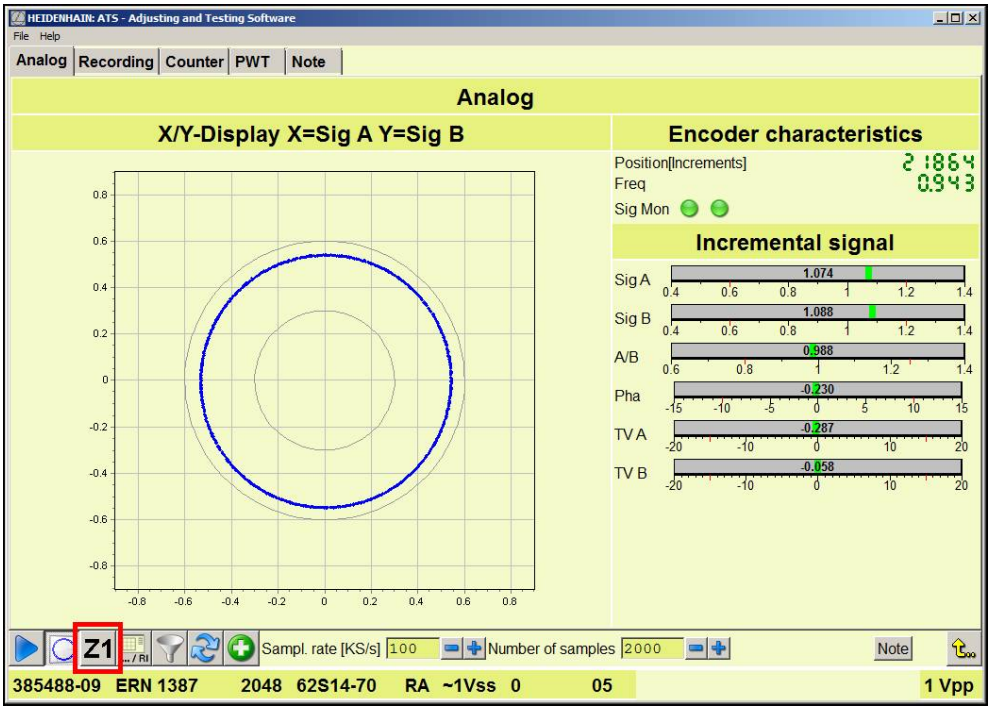
The settings of the ATS software for inspecting the incremental track Zn (A/B) and the reference mark R are the same as for a standard rotary encoder (described in chapter 6.2.2 "Checking incremental signals", page 166).

The Z1 track (CD) can only be analyzed with the "Analog" function.

The tolerances for the output signals of motor encoders are tighter due to the higher temperature range. Please note the interface descriptions and/or mounting instructions!

Z1

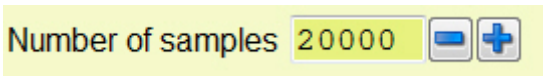
- Press the “Z1” button to start the examination of the Z1 track (= CD track or commutation track).



Analog display of the Z1 (CD) commutation track

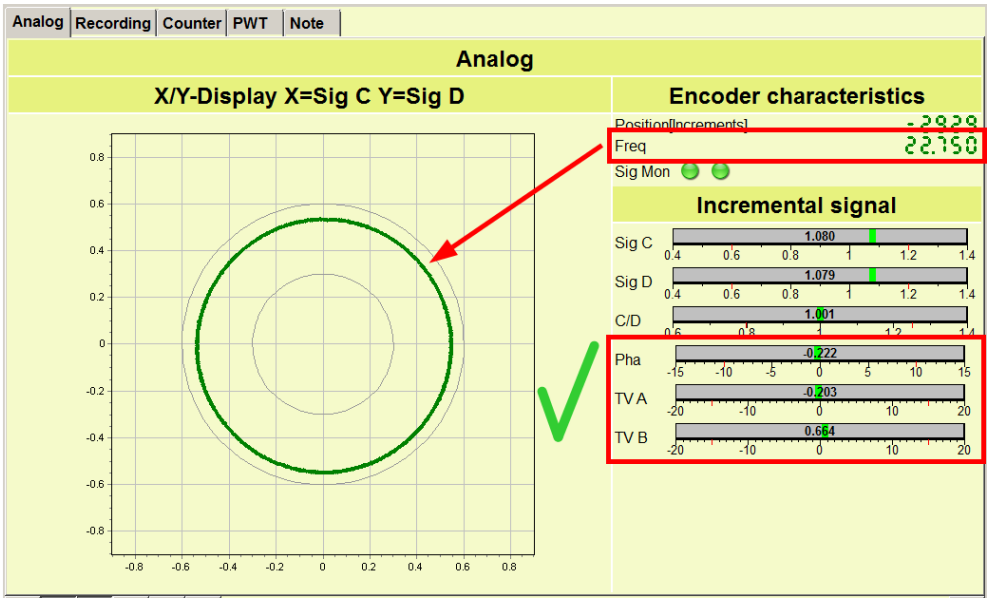
As the Z1 track only has one grating period, the scanning frequency is very low when you turn the encoder by hand. The speed and the setting of the samples are decisive for the display accuracy of the bar graph and for the signal display on the oscilloscope (full circle, no segments!)

Example:
Increase the number of samples to display one complete signal with “manual” operation.

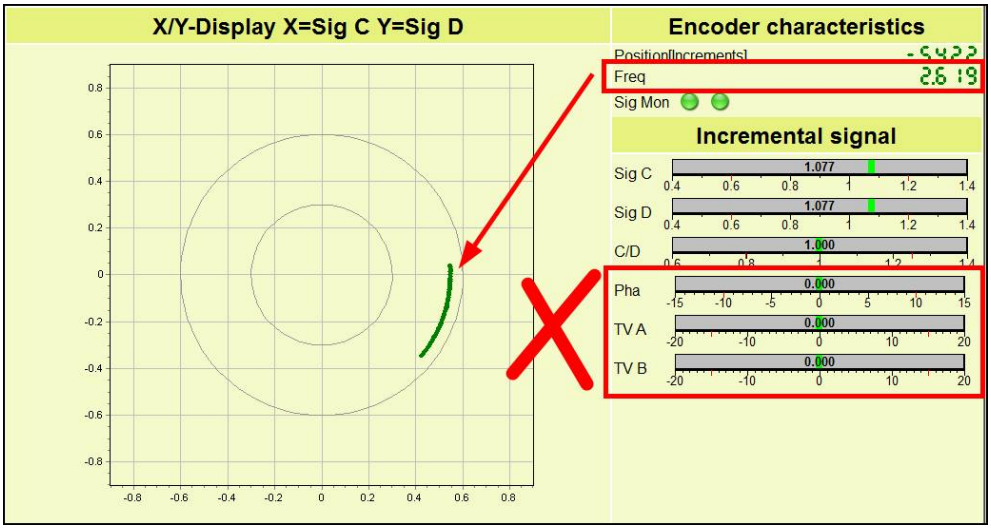


The bar graphs are only refreshed if the scanning frequency is high enough! Exception: Amplitude measurement (Sig A/Sig B) also works in standstill.

Display of a full circle = PHA, TV A and TV B are correctly calculated:



Circle display incomplete (segment) = PHA, TV A and TV B are not calculated (result would be incorrect):



Analog display of Z1 and Zn/Z1 comparison

- ▶ Press the “Circle” button in the Z1 menu.

> Two new graphics are displayed:

Upper graphic field:
Sine/cosine display of the Z1 track (Y/t display)
Scaling:
x = Sampling rate [kS/s]
y = Amplitude [V_{PP}]
Lower graphic field:
Deviation of Z1 and Zn signals in degrees
Scaling:
x = Number of lines in 360°
y = Angular error in [°]

- ▶ Rotate the encoder by at least one revolution.

- ▶ Press the “Stop” button.

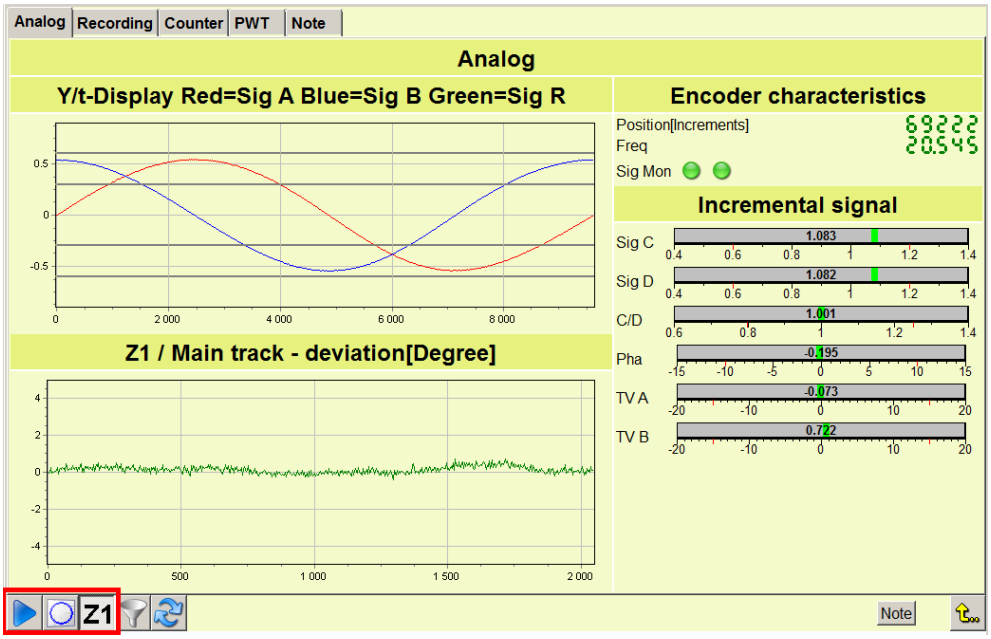
> The display freezes.

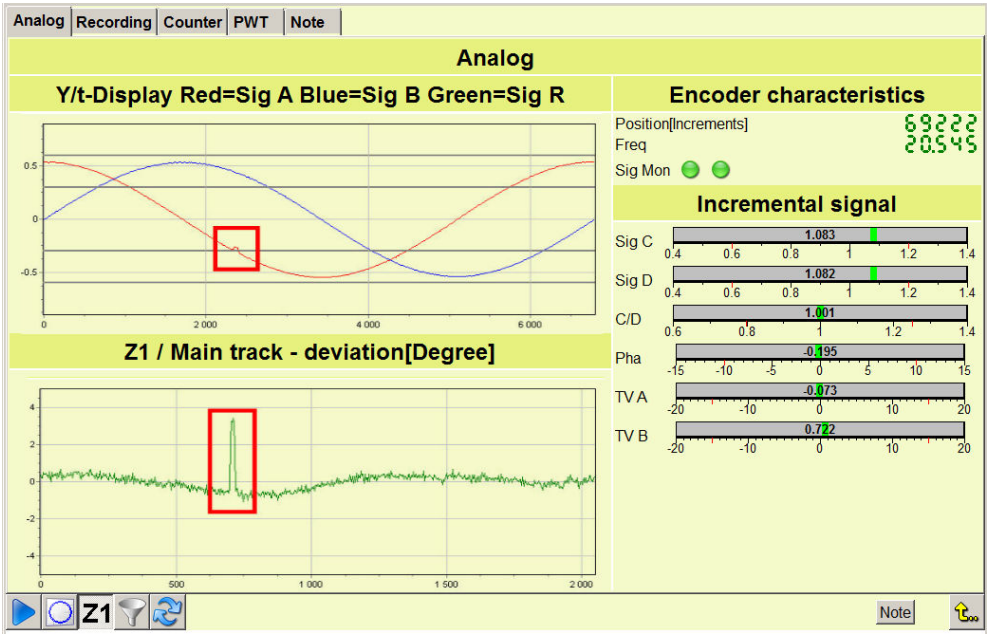
With the Y/t display of Z1 you can analyze the curve form, the amplitude, etc. (like with a standard 1 V_{pp} interface, but for one sine/cosine curve only).

The lower graphic field shows the difference between the calculated position of Z1 (coarse resolution, one 360° signal period corresponds to one revolution of the shaft) and Zn (fine resolution, e.g. 2048 signal periods correspond to one revolution of the shaft).

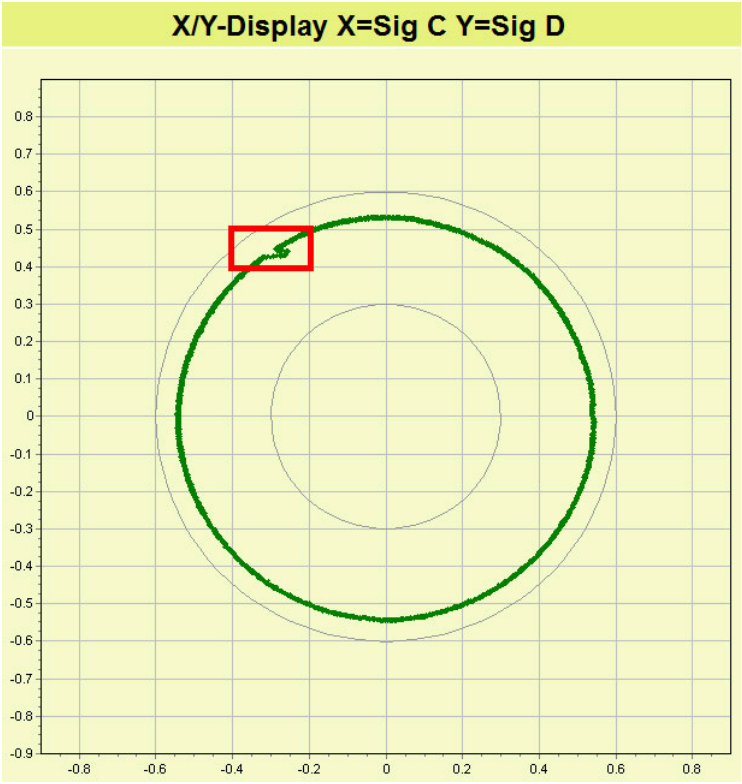
Ideally, the curve should be close to the zero line.

The vertical axis in the lower graphics shows the **maximum deviation for HEIDENHAIN rotary encoders.**





Example: Irregularity (peak) in the sine curve of the commutation signal



Example: Irregularity in the circle diagram of the commutation signal

The zooming function is available for any graphics.

6.2.10 Checking the homing limit signals

In addition to the incremental graduation, encoders with position detection, such as the LIF 4x1, feature a homing track for position detection (left/right) and limit switches for detecting the limit positions.

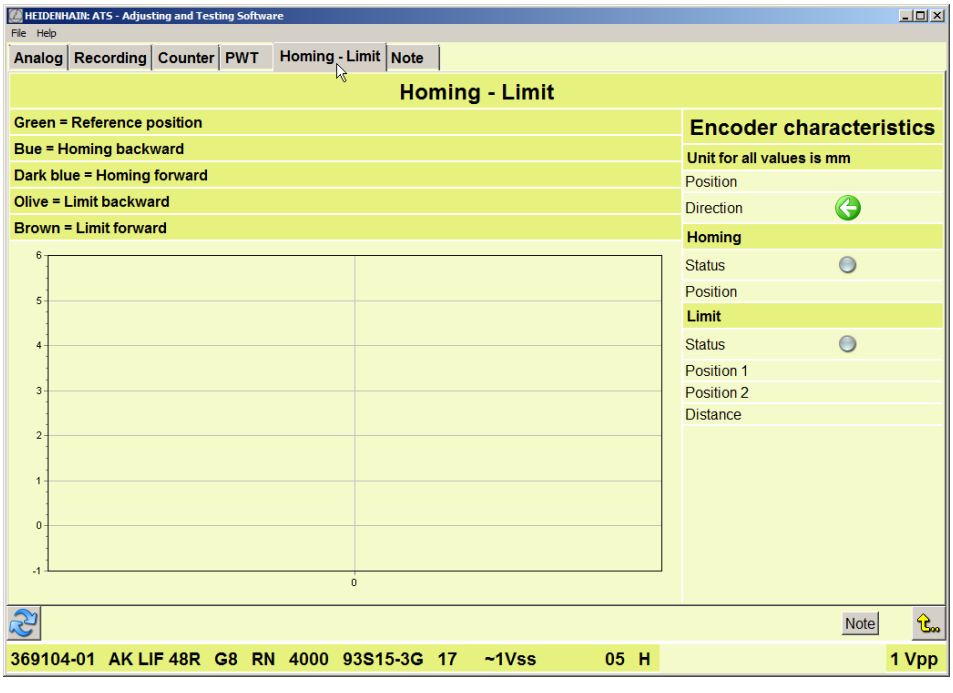
Example:
LIF 4x8R with limit covers **L** (optical limit switches) and homing track **H**.
H is an additional scanning track dividing the scale into a left and a right half. The reference mark is in the middle of the measuring length (in the image covered by the scanning head).

The signals are transmitted in TTL level over separate lines. The trigger function can be tested with the homing/limit function. The homing/limit function is activated when the encoder is connected automatically via the ID of the scanning head.

The homing/limit signals can only be tested, if the mechanical mounting is correct and if the encoder was electrically adjusted according to its mounting instructions.

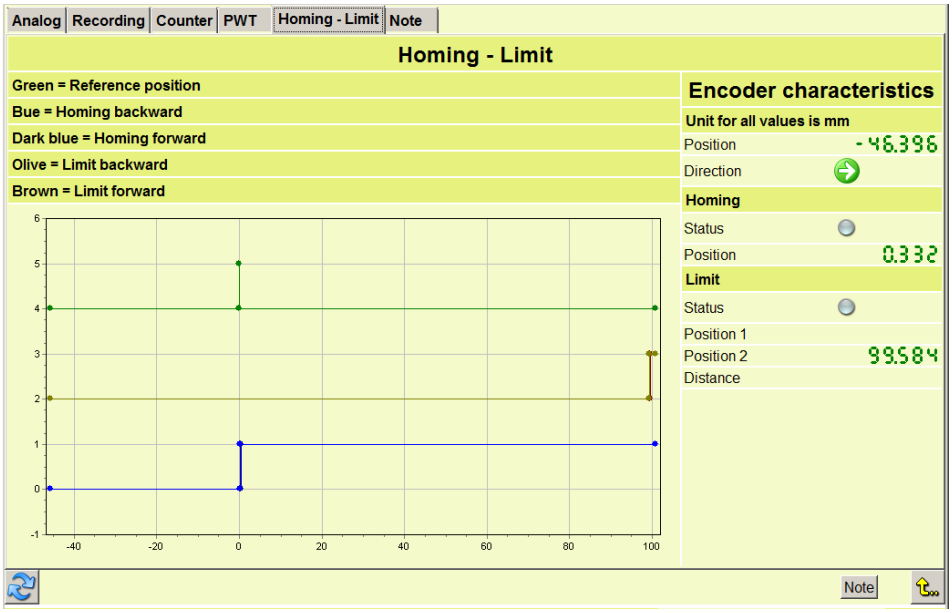
In the images below, an LIF 481R with homing/limit signals serves as an example. However, encoders may only feature limit switches (magnets).

- ▶ After automatic connection via ID select the Homing/limit function.



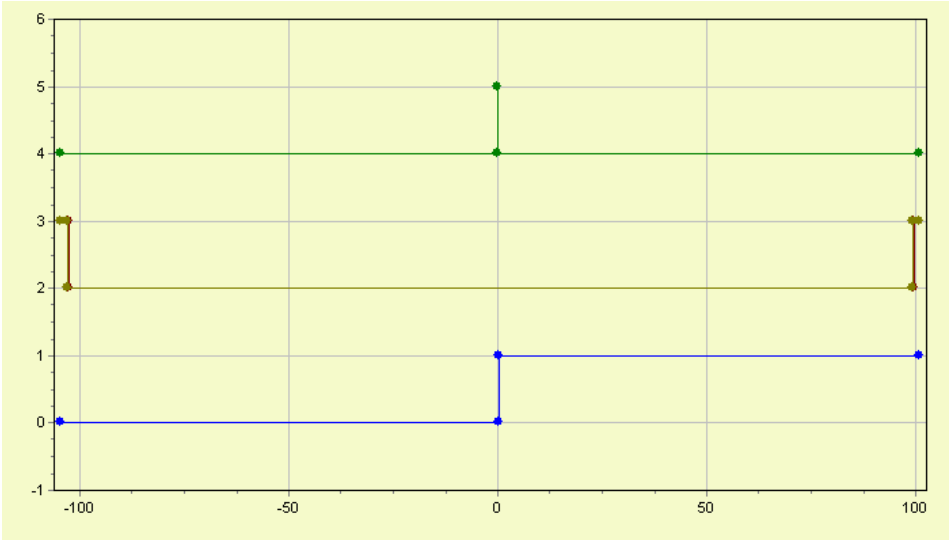
- ▶ Traverse the measuring range in both directions.
- > The graphics is recorded as soon as the reference mark is passed over (ML/2).
- > The homing and limit position values are determined and displayed.

Limit plates mark the measuring range at the machine. Thus, they may only be “approached” until a switching point is detected. Traversing the plate falsifies the calculation of the limit.

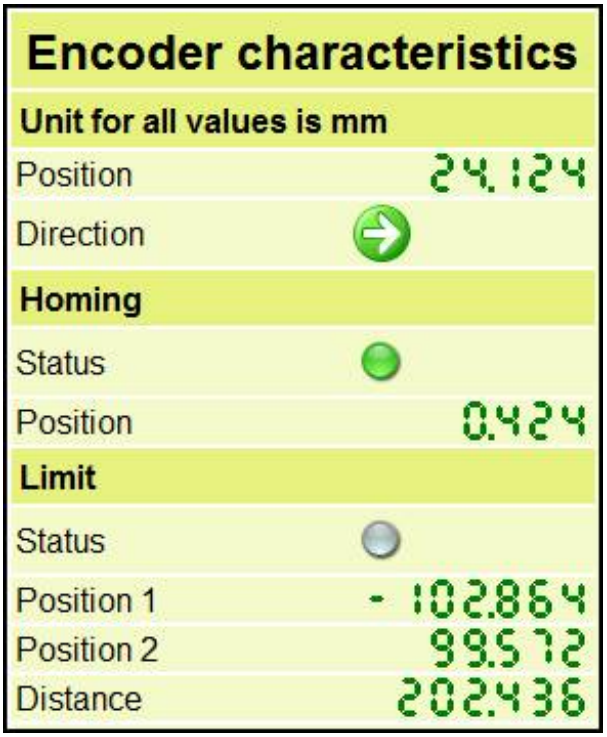


When the entire measuring range was traversed, the reference mark and the limit and homing switching points are displayed.

For tolerances see the mounting instructions of the encoder.



Description of the encoder characteristics



Position: Current position of the scanning head

Direction: Traverse direction of the scanning head (right/left) starting from the reference mark R

Homing

Status: Green LED = homing high-level, gray LED = homing low-level

Position: The value corresponds to the distance [mm] of the switching point to the reference mark. The switching point is referred to as homing point **Ho**. The **H** switching point is the "switch for the homing track". For tolerances of the switching point hysteresis see the mounting instructions of the encoder.

Limit

Status: Green LED = limit high-level, gray LED = limit low-level

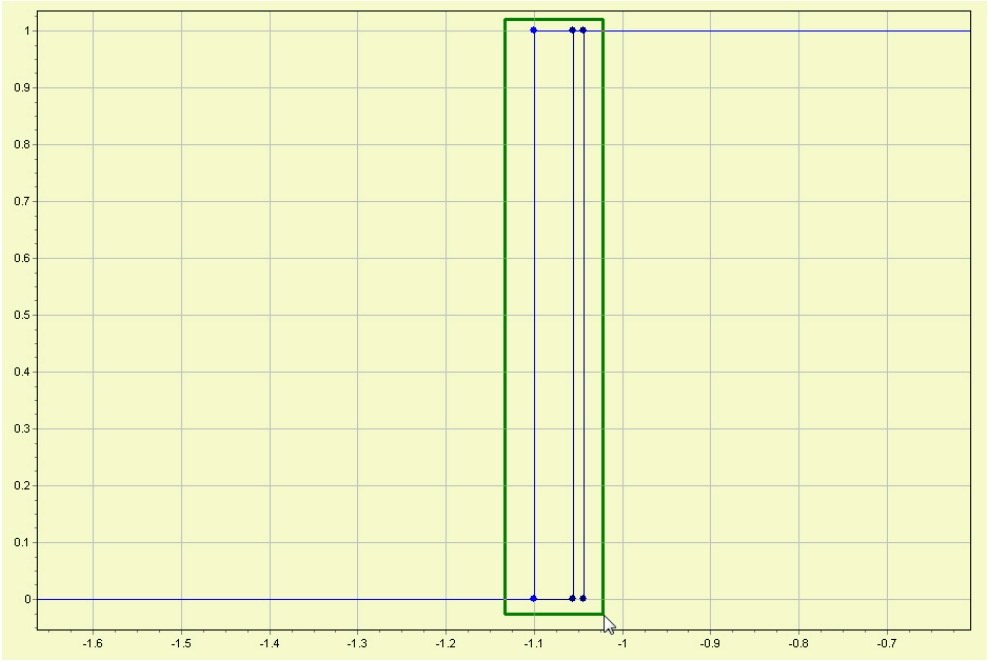
Position 1: **LI1** Path measured between Limit 1 [mm] and reference mark R

Position 2: **LI2** Path measured between Limit 2 [mm] and reference mark R

Distance: Sum (absolute value, no sign) of Limit 1 and Limit 2

The abbreviations were taken from the mounting instructions (e.g. LIF 48).

Use the zoom function of the oscilloscope to analyze the switching points (hysteresis).



The color assignments are are listed above the diagram.

Homing - Limit
Green = Reference position
Bue = Homing backward
Dark blue = Homing forward
Olive = Limit backward
Brown = Limit forward

6.3 Digital square-wave TTL-HTL output signals

6.3.1 General

The differences to measuring sinusoidal signals are described in this section.

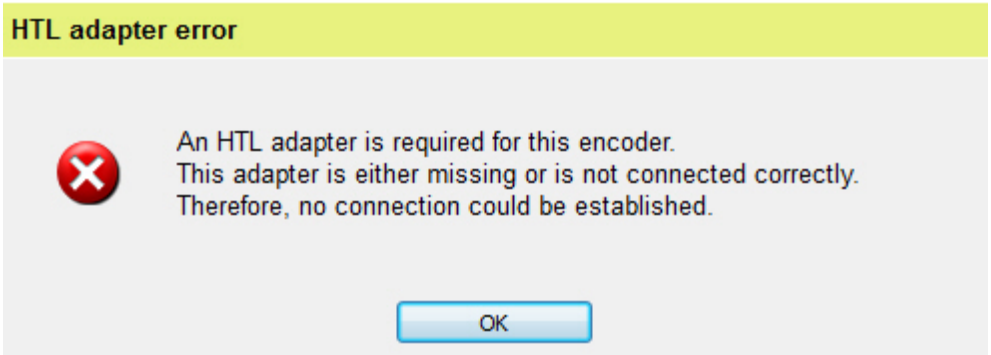
Note on testing HTL interfaces

Basically, all functions that are relevant for encoders with TTL interfaces are also available for encoders with an HTL interface.

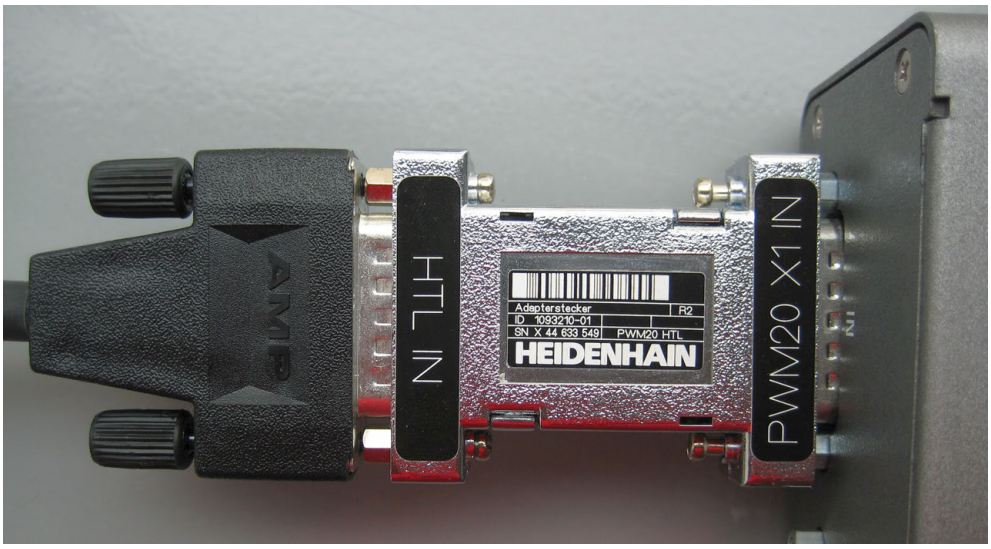
The following limitations must be kept in mind:

- The PWM-HTL adapter ID1093210-01 is **absolutely required!**
- No feed-through mode is possible!
- PWT switchover to display the analog signals (when mounting exposed encoders with square-wave signals) is not supported.
- Extended tolerance range due to adapter connector; changes to tolerances: see PWM 20 and PWM 21 Operating Instructions

When the encoder is connected automatically via its ID, the following error message is issued:



- ▶ Connect the adapter ID 1093210-01.
- > The HTL adapter is ID 1093210-01 is connected to the IN PWM input. The testing cables are the same as for the TTL interface.

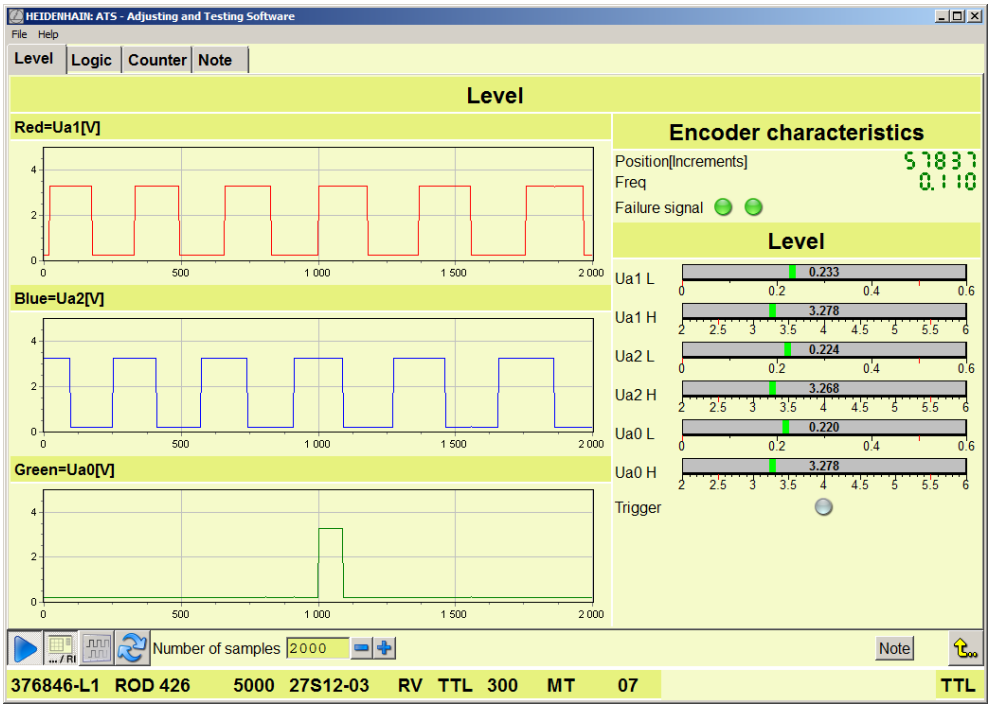


After you have connected the adapter, proceed like for TTL measurement. The voltage level displayed for a TTL interface is a 5 V level, for an HTL interface a 10…30 V level.

When a TTL/HTL encoder was successfully identified:

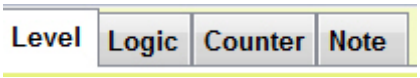
- Double-click the “Incremental signal” function of the “Basic functions” group.

> The measurement of the TTL or HTL level starts (start screen).



6.3.2 Explanation of the display

Check functions bar



Level:

- Oscilloscope display of the TTL/HTL signals
- Position and frequency display
- Signal monitoring
- Bar graphs of the TTL/HTL signal parameters
- Evaluation of the levels

Logic:

- Logging of TTL values at very high sampling rate (200 MS/s; cannot be altered)
- Logic analysis of the levels 0 and 1 (not a level measurement!)
- Measurement of on-to-off ratios TV A / TV B and phase angle
- Measurement of REF signal position and width
- Measurement of minimum edge separation

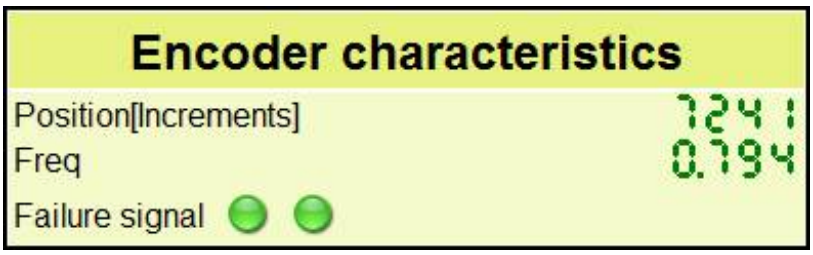
Counter:

- Test of counting function by counter start/stop with ref. mark. Function same as for 1 V_{PP} and 11 μA_{PP} sinusoidal output signals. Description of the function: see section 6.2.7 "Counter function", page 191.

The software indicates if there are calculation problems. For example, the frequencies are too high, or the number of samples is insufficient to calculate the reference mark, etc. A yellow Attention symbol is displayed to the right of the Note button.

Always inspect (traverse) the entire measuring range to obtain an exact diagnose.

Encoder characteristics



Position [increments]:
The counter counts signal periods.

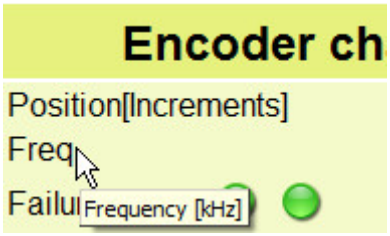
Frequency:
Current input frequency

Failure signal (–UaS)

Left LED: Concurrent failure signal (red color only as long as an error is present)

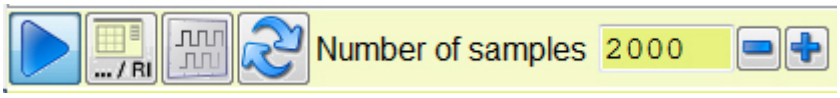
Right LED: Failure signal is logged (display permanently red, if an error was detected within the measuring range)

The designations, scalings and units are automatically adapted to the connected encoder. The meanings of the diagrams, curves, and units can be seen from context menus; simply move the cursor to the desired position, and the menu will open (see image below).



6.3.3 Level function – Bar of oscilloscope settings, TTL

Those function keys are described that are new or differ from those of the analog output signals.



Reference trigger on/off: The reference signal is shown through a trigger LED. The graphics display 3 shows the triggered, "frozen" reference pulse.

This function must be active to measure the reference mark level (Ua0 H bar display). To make the reference mark known, the encoder must traverse it first.

TTL level measurement, positive/negative signals: Toggle between inverted and non-inverted output signals

6.3.4 Level function – Oscilloscope display, TTL

The image shows the start screen with three display fields; the reference mark trigger is active. The coordinate axes show X = time in [ms] and Y = voltage in [V].

Display field 1 = Ua1

Display field 2 = Ua2

Display field 3 = Ua0

The image shows the inverted TTL output signals (after  was pressed) and the fault-detection signal.

Display field 4 = –Ua1

Display field 5 = –Ua2

Display field 6 = –Ua0

Display field 7 = –UaS

Select the number of samples to match the input frequency (min. 2000, max. 100000 samples). When the level function is closed and restarted, the number of samples is reset to the minimum value 2000.

6.3.5 Level function – Bar graph display, TTL level

The signal parameters and the level limits are displayed as bar graphs with tolerance markings (red arrows at "Ua1 H" in the image below).

The stated values are HEIDENHAIN standard values!

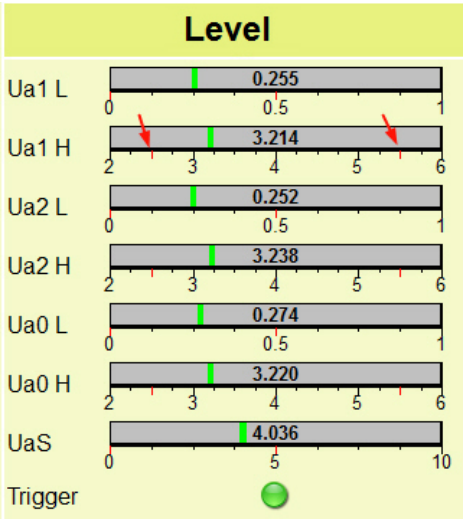
See "Interface description" in the following brochures:

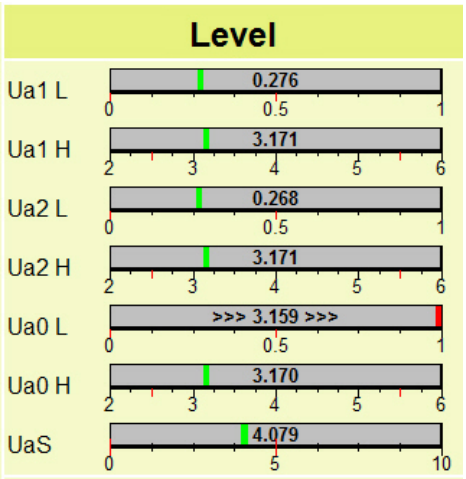
- Interfaces of HEIDENHAIN Encoders, ID 1078628-xx
- Technical information "EnDat 2.2 – Bidirectional Interface for Position Encoders", ID 383942-xx

Measuring systems with high resolutions (e.g. angle encoders), large temperature ranges (e.g. motor encoders), or for high speeds may have different limit values. In this case the markings are invalid. The tolerances of the bars cannot be altered straightforwardly (requires a product key only available to experienced users on request). Please always refer to the original documentation of the encoders to be checked. In case of doubt, contact the HEIDENHAIN helpline (see section "Contacts", page 226).

Colors of the pointers in the bar graphs

Green bars	Signals within the specified tolerance
Red bars	Signals outside the specified tolerance
Several pointers	Scaling exceeded



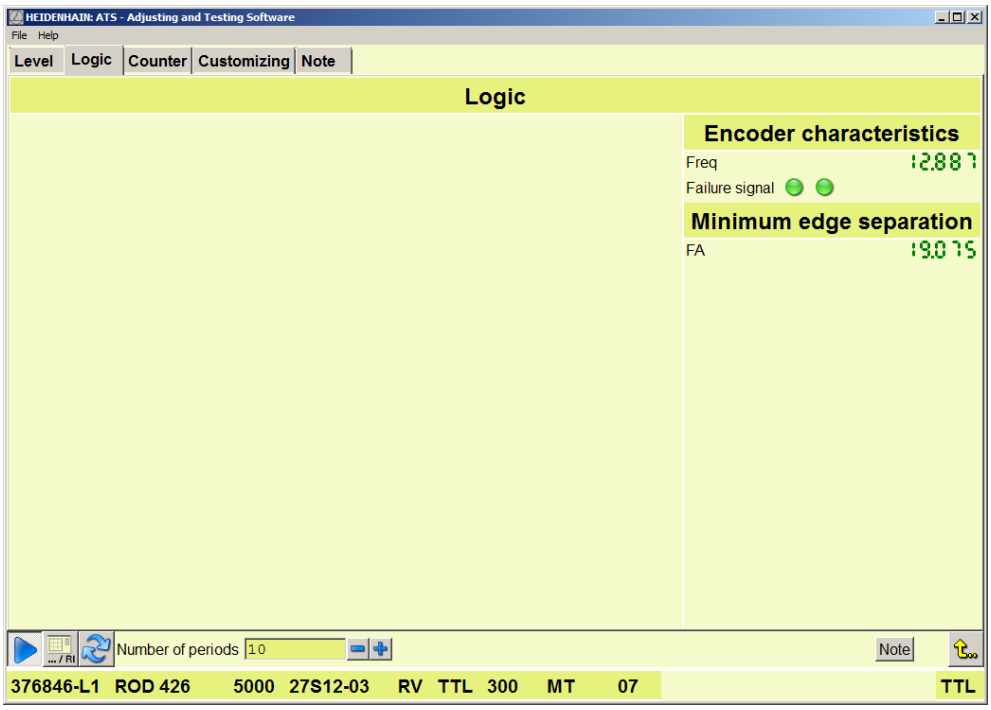


The left picture shows the level display with active reference signal trigger. The LED briefly lights up green when the reference mark is detected. If no reference mark was detected yet, or if the reference mark is faulty, a red marking and/or several arrows are displayed as shown in the right-hand picture (Ua0 L). The fault detection signal (–

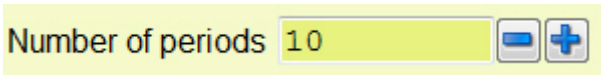
UaS) is only displayed when inverted level measurement is active. This signal level changes to low in the event of an error (low-active).

Do not depict more than ten signal periods for level evaluation. It is not the absolute level that is crucial for level measurement, but the difference in level between the high (H) and low (L) signals. By the level limits set in the bar graphs it can be ensured that the difference between the H and L levels is sufficiently great (green bars).

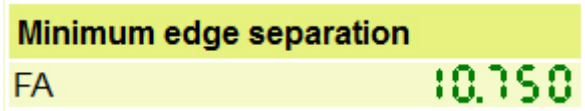
6.3.6 Logic function, TTL



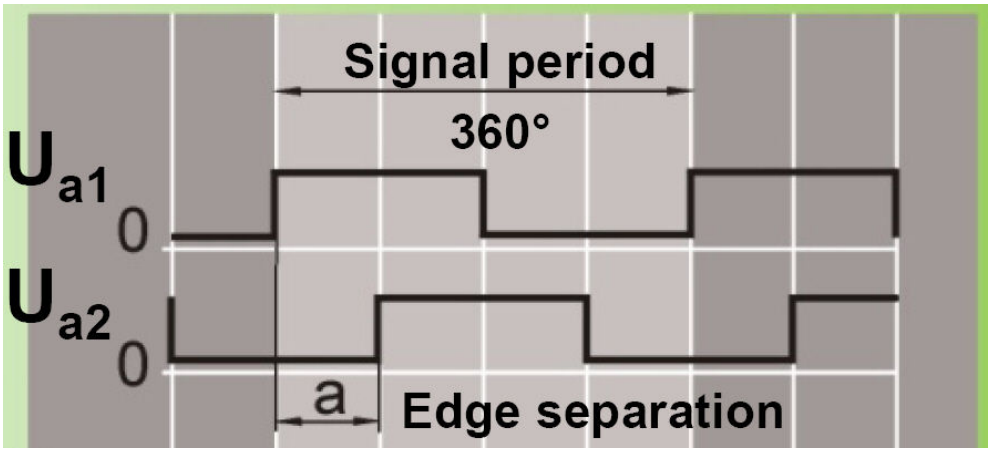
The image shows the Logic screen with an encoder connected through its ID number. Only the characteristics “Frequency” and “Failure signal” and the “Minimum edge separation” are evaluated.



The displays for frequency and minimum edge separation are only refreshed after the specified number of periods has been reached.

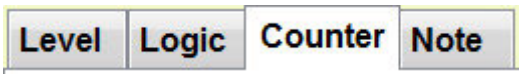


The higher the frequency of the output signal becomes, the smaller is the edge separation.



The display “Minimum edge separation FA“ shows the distance between two neighboring edges of the output signal in [µs] (”a“ in the image).

6.3.7 Counter function



The “Counter” function serves to check the counting of encoders. Signal periods are counted and displayed. The function starts immediately after you select “Counter”.

The Counter characteristics field contains:

- **Position [increments]** = Display value in signal periods
- **Reference [increments]** = Determined distance between two reference marks
- **Direction** = Display of the direction of traverse or rotation (in the table view positive  and negative  ; the current position is marked by an *)
- **Trigger** = When the reference mark is traversed the LED color changes to “green” (pulse).

	The “Position” column contains the signal periods.

 Freezes the counter screen

 Resets “Counter” and “Position” to zero

 Loads the value entered in the “Set” line into the position display

 Clears “Counter” and “Position” with every reference mark

 Clears “Counter” and “Position” and restarts with the next reference mark

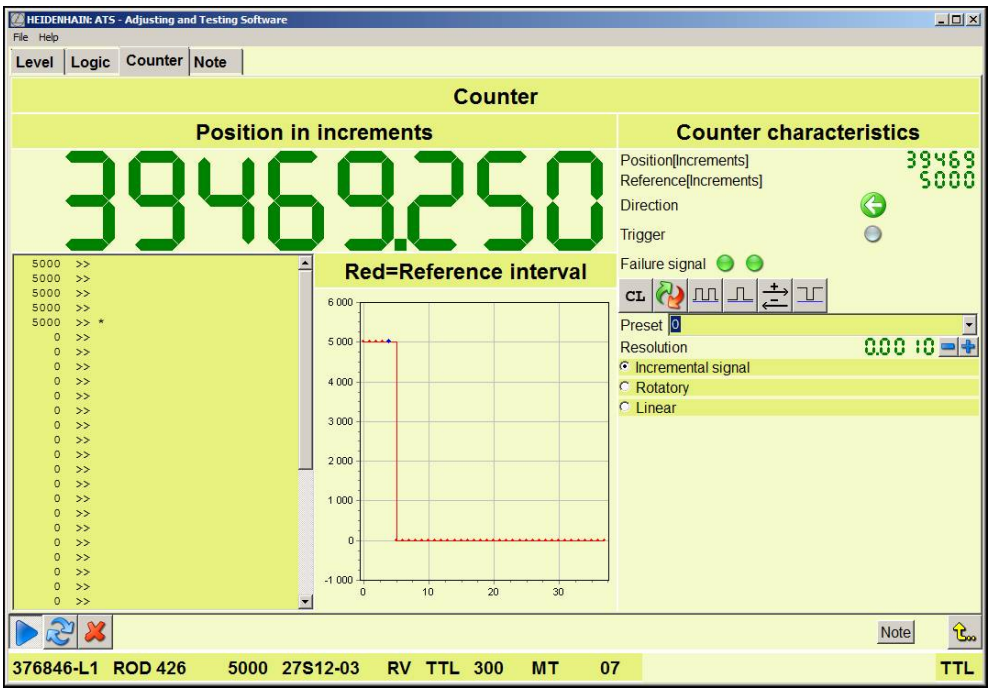
 Changes the counting direction for “Counter” and “Position”

 Inversion of reference pulse

 Clears the table and the graphics

 Reset button = Resets signal monitoring

 Return to basic menu (connect/disconnect encoder)



The Counter function is the same as for checking analog signals!
For more information and examples, refer to chapter 6.2.7 "Counter function", page 191.

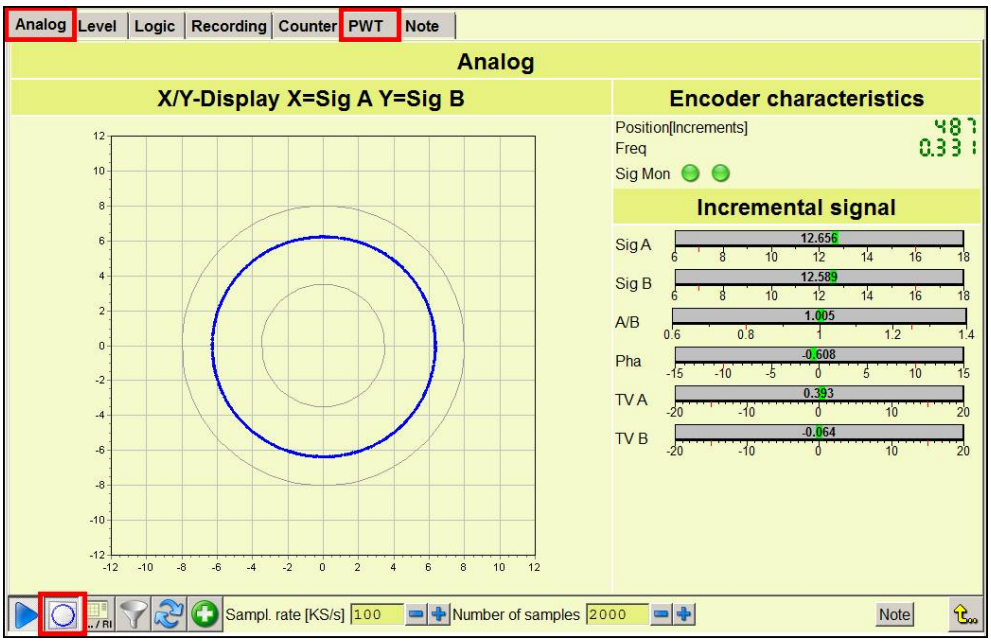
6.3.8 PWT switchover, PWT test pulse

For mounting exposed encoders with square-wave output signals (TTL, e.g. LIDA 47x) analog output signals are required, the quality of which can be used to monitor and optimize the mounting (see section "Checking incremental signals").

For this purpose the encoder must be connected to the PWM with its ID.

When an encoder with PWT switchover function is detected, the analog incremental signals can be analyzed in the “Analog” and “PWT” tabs after clicking the basic function “Incremental signal”. The “Analog” and “PWT” tabs are only visible for encoders with PWT switchover function.

The image below shows an encoder with PWT switchover function; the “Analog” and “PWT” tabs are displayed. Moreover, the button is shown to switch between X/Y and Y/t display in the oscilloscope function.


Analog
Level
Logic
Recording
Counter
PWT
Note
Analog
X/Y-Display X=Sig A Y=Sig B
Encoder characteristics
Position[Increments]
Freq
Sig Mon
Incremental signal
Sig A
Sig B
A/B
Pha
TV A
TV B
12.656
12.589
1.005
-0.608
0.393
-0.064
Sampl. rate [KS/s]
100
Number of samples
2000
Note

6.4 Mounting wizards

6.4.1 General information

The mechanical mounting of certain encoders requires special adjustment programs (mounting wizards).

In general, these are "exposed" encoders the scanning heads of which must be exactly aligned with the scale/graduated disk.

The mounting wizard of the ATS software is automatically activated, if it is required for mounting (the encoder must be connected automatically through its ID).

The mounting wizards are mostly self-explanatory.

The mounting wizards are described in the encoder mounting instructions.

7 Interface description

The output signals, signal levels and tolerances are described in the brochure “Interfaces of HEIDENHAIN Encoders”, ID 1078628-xx. This document is also available online, at **www.heidenhain.de**.

8 Contacts

Your HEIDENHAIN helpline

The qualified, multilingual specialists of the HEIDENHAIN helpline in Traunreut support you in solving your problems.

Especially if you need **technical support** the HEIDENHAIN helpline team can provide detailed advice and information on measuring systems, controls, and NC and PLC programming.

The HEIDENHAIN technical helpline

Encoders/machine calibration
+49 8669 31-3104
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NC programming
+49 (8669) 31-3103
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