

Product Information

EnDat 3 Evaluation Board

Hardware and Software for
a Comprehensive Testing
Environment for the
EnDat 3 Interface

EnDat 3 Evaluation Board

- Comprehensive testing of the EnDat 3 interface
- Supports communication over two wires and four wires
- Software and API for comprehensive support during implementation and testing
- Recording and manipulation of the EnDat 3 communication

Application

The EnDat 3 Evaluation Board is designed as hardware and software in order to effectively support the implementation and testing of the EnDat 3 interface. The hardware of the EnDat 3 Evaluation Board is designed for various operating modes and configurations, and is connected to a USB port on a PC. The cabling, settings of the jumpers, and the voltage supply must therefore be designed accordingly:

Operating modes

- Internal master
- External master

Communication and voltage supply

- Separate wires (four wires)
- Shared wires (two wires)

Voltage supply (can be selected in the software or API)

- USB port
- Power adapter (separate connector)
- External control

Software and API

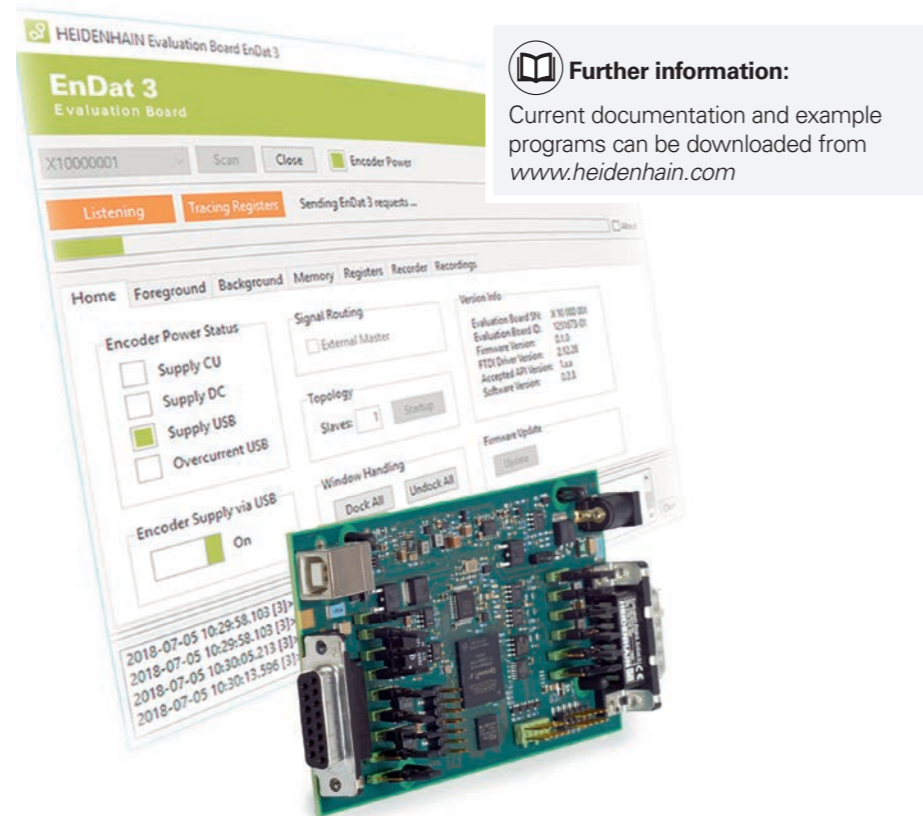
The software offers a logical user interface and comprehensive possibilities for becoming familiar with and testing the EnDat 3 communication. Various features, such as the configuration of send lists, enable quick initial setup of an encoder. The communication can comprehensively be tested and also manipulated in the software. A programming interface (API) in the form of a DLL supports you when developing your own programs for EnDat 3 communication. Example programs provide a quick introduction to the topic.

Example programs (access over API)

Example programs are available for testing the EnDat 3 communication. These programs can easily be ported to different hardware, including a customer's own hardware, since they are based on the EnDat 3 Master from HEIDENHAIN (and therefore on the same register control) and simple exchange of the HAL (Hardware Abstraction Layer) is possible. The example programs are based on each other, and illustrate the further steps on the path from the basic functions to the full performance

range of EnDat 3. They provide quick familiarity with programming an application for the control and demonstrate the following functions:

- Reading out the position
- Reading out the memory
- Switching the data transfer rate
- Creating a send list
- Setting a datum shift
- Communication in bus mode
- Basics of functional safety
- Measurement of propagation times



EnDat 3

Communication occurs in half-duplex mode. A communication cycle consists of a request from the subsequent electronics and the direct response by the encoder. The communication between the subsequent electronics and the encoder is divided into two areas: the foreground communication and the background communication.

Foreground communication

Foreground communication is intended for data that must be available in the communication cycle (e.g., controller cycle). The request (REQ) is used to control the communication with the encoder and to trigger certain actions in the encoder (e.g. clear error messages, etc.). The request thus also determines the contents

of the response. This includes an HPF (High Priority Frame, typically the position of the encoder), an LPH (Low Priority Header, with status information about the subsequent data contents), and, depending on the send list, up to 15 LPFs (Low Priority Frames with additional data, such as diagnostic values). The switch between the various LPFs takes place according to a send list previously configured in the encoder. No further action is necessary regarding the control unit cycle of the subsequent electronics. Up to eight different send lists can be stored in the memory. The type of request determines which send list is active, thus permitting a quick and flexible reaction by the subsequent electronics to various operating states.

Background communication

Some tasks, such as reading from and writing to the encoder memory, have low timing demands. A background channel is defined for such tasks in EnDat 3. Background communication is embedded in the foreground communication, and uses its frames (REQ, LPH, LPF) as transport containers. This way the background channel permits, for example, reading and writing to the encoder memory in the controller cycle. However, there are no real-time requirements for the background channel.

Specifications	EnDat 3 Evaluation Board ¹⁾
Voltage supply	
USB ²⁾	USB 2.0 (high-powered port), max. 500 mA
External input ³⁾	DC 12 V ±0.6 V; electrical separation through a SELV circuit (IEC 60050-826)
Operating temperature	0 °C to 50 °C
Dimensions	≈ 130 mm x 70 mm
Items supplied	<ul style="list-style-type: none"> • EnDat 3 Evaluation Board • Jumpers (15 pieces) • Feet (4 pieces) • USB cable (2 m) • Operating Instructions
Input	
Interface	EnDat 3
Versions ⁴⁾	Voltage supply and communication over four separate wires or two shared wires
Electrical connection	15-pin D-sub connector (female)
Cable length ⁵⁾	< 3 m
Supply voltage (typical)	12 V, max. 14 V
Output	
Interface	EnDat 3
Versions	Voltage supply and communication over four separate wires or two shared wires
Electrical connection	15-pin D-sub connector (male)
Cable length ⁵⁾	12.5 Mbit/s: < 100 m 25 Mbit/s: < 40 m
Supply voltage of encoder	12 V; USB: < 1.1 W See <i>External input</i> or control (see <i>Input</i>): > 1.1 W
Triggers	Inputs and outputs for measurement tasks
System requirements	
PC	≥ 2 GHz, 4 GB RAM, USB port
Hard disk	At least 50 MB
Screen	At least 1024 x 768 pixels
Operating system	Microsoft Windows 7/8/10 (32/64 bits)
Windows user rights	<ul style="list-style-type: none"> • Rights to install the FTDI driver • Access to USB devices • Write-access to program folders

¹⁾ The EnDat 3 Evaluation Board is designed for operation in a laboratory. The electromagnetic compatibility of the complete system must be ensured.

²⁾ The device will not start if the connection does not provide 500 mA. The device can briefly exceed 500 mA during operation.

³⁾ Only use a power adapter (not included in delivery) that meets the requirements

⁴⁾ Selection via jumpers

⁵⁾ With HEIDENHAIN cable

EnDat 3 Evaluation Board

Operating modes

The system setup described here is designed for operation in a laboratory, and permits support for the EnDat 3 implementation in the entire development process:

- Testing the fundamentals of EnDat 3
- Master: controlling an EnDat 3 encoder
- Numerical control and API: example programs for support during development
- Troubleshooting: support during qualification
- Memory: display and edit the encoder memory
- Recorder: support during troubleshooting
- Error injector: manipulation of the EnDat 3 communication passing through in order to simulate error conditions

Internal master

The internal master is identical to the master that is offered as VHDL code by HEIDENHAIN. This means that the register addresses and contents of the masters are identical. The following functions are supported:

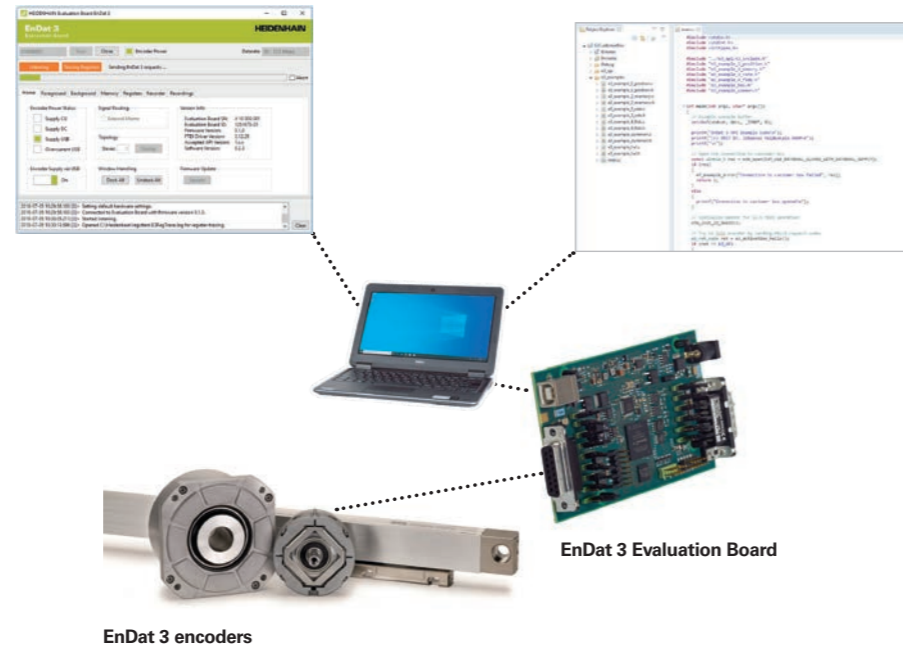
- EnDat 3 communication (foreground and background)
- Display and editing of EnDat 3 memory contents
- Recording mode
- Access to the EnDat 3 master registers (screenshot, tracing, triggering)
- External control of the EnDat 3 master registers via API
- Manipulation of EnDat 3 communication (error injector)

Software

- Testing of EnDat 3 functions
- Recording of the EnDat 3 communication
- Error injector

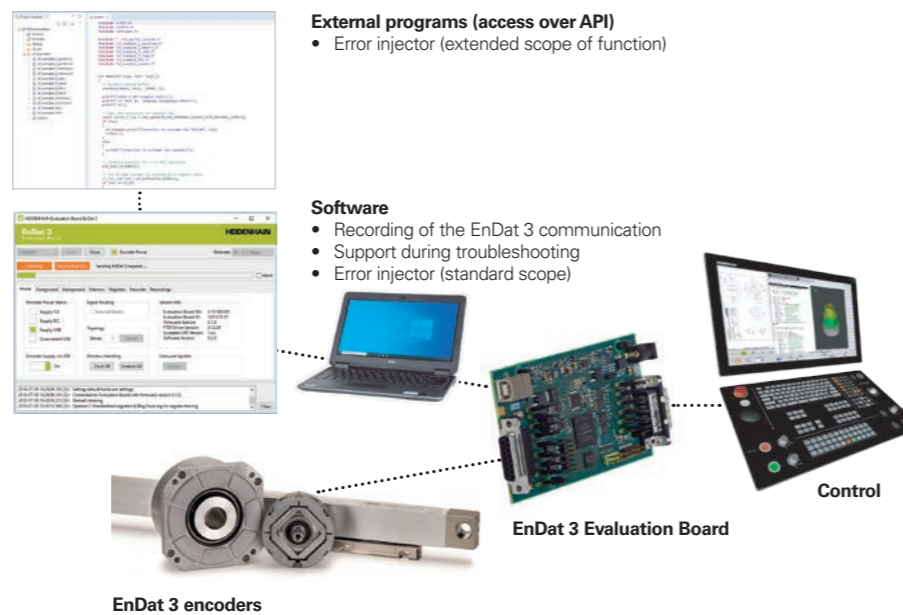
External programs (access over API)

- Run example programs from HEIDENHAIN
- Testing of one's own applications to facilitate porting to the target platform



External master

The EnDat 3 Evaluation Board is inserted between the control (master) and the encoder in order to listen to the EnDat 3 communication. The Recording mode is supported for this. A manipulation of the EnDat 3 communication (error injector) is also possible with this setup. In the standard scope, the error injector makes it possible to manipulate the communication through the software. In the extended scope, the error injector can additionally be controlled remotely over an API in order to permit automated tests.

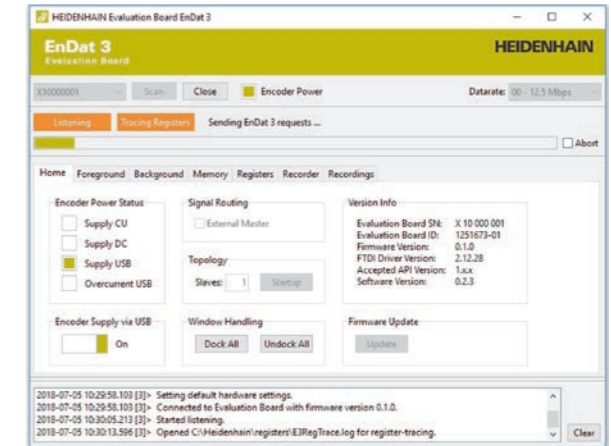


Software V2.0.x

Depending on the configuration of the system setup, you can use the various control elements to analyze and configure the connected encoders:

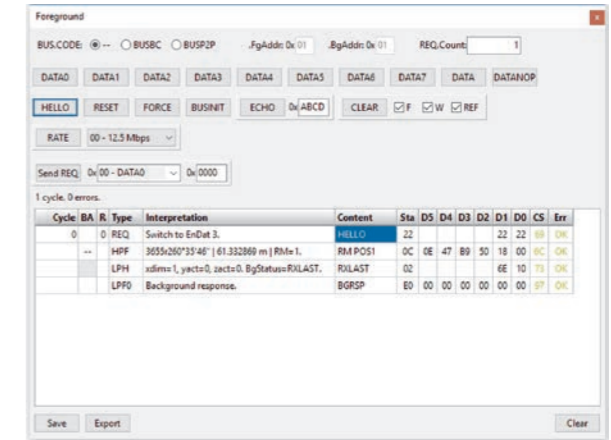
Home

Fundamental settings for the power supply, operating mode, and configuration.



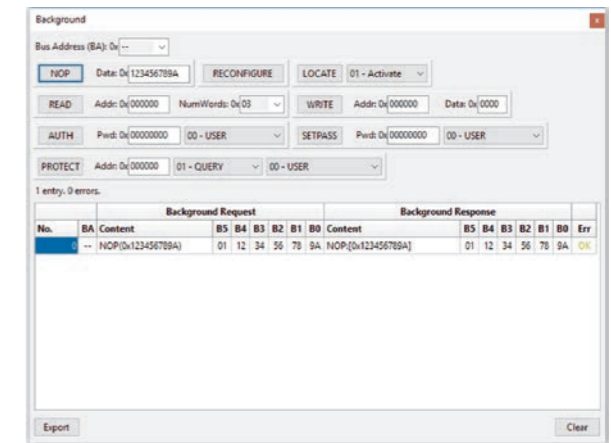
Foreground

Configuration of the foreground communication with one or more encoders.



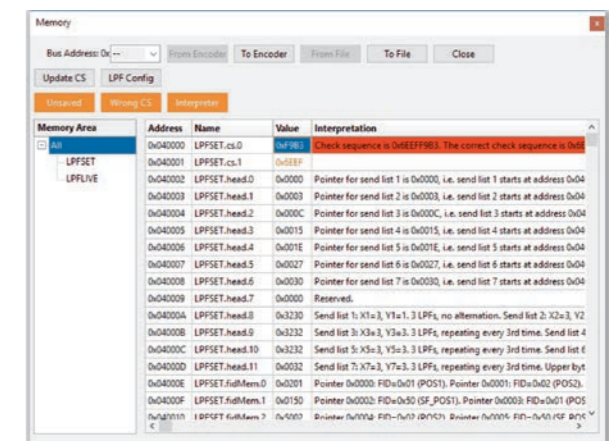
Background

Configuration of the background communication with one or more encoders. The foreground communication required for this is performed automatically, and is shown in the Foreground control element.



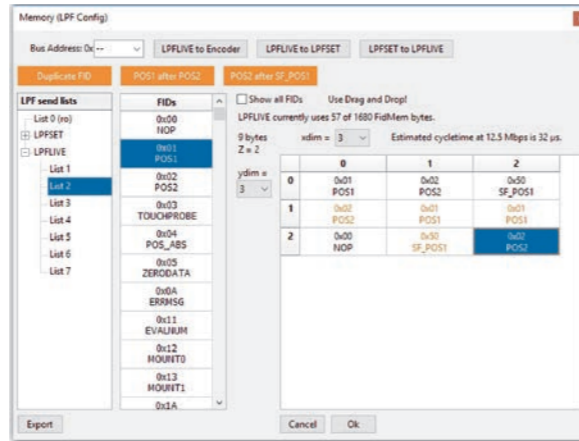
Memory

Save the memory contents of the connected encoder or load the contents from a file.



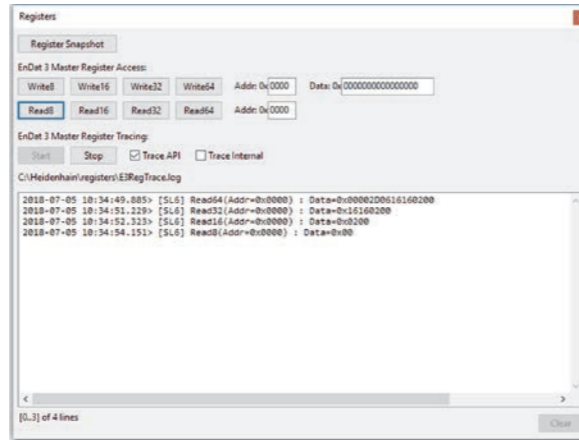
LPF Config

Editing of the send list. Entire send lists can be created and copied within the tree view.



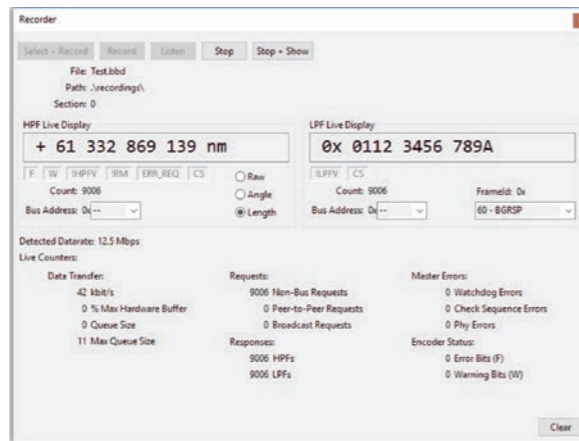
Registers

Read- and write-access to the registers of the internal master. Register accesses by the software or an external interface (API) can be recorded.



Recorder

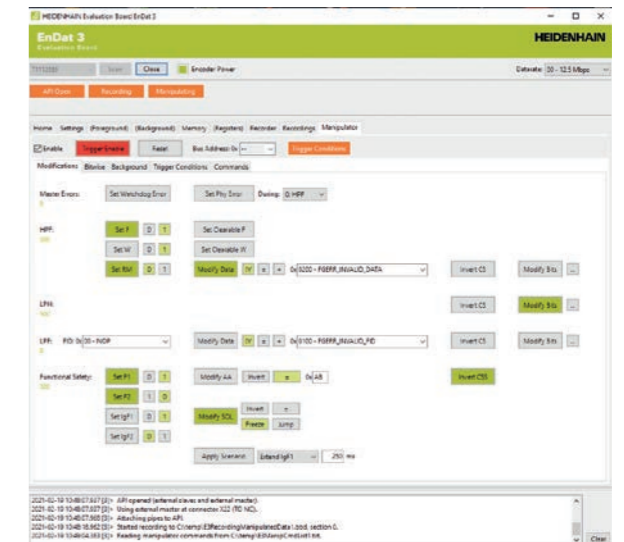
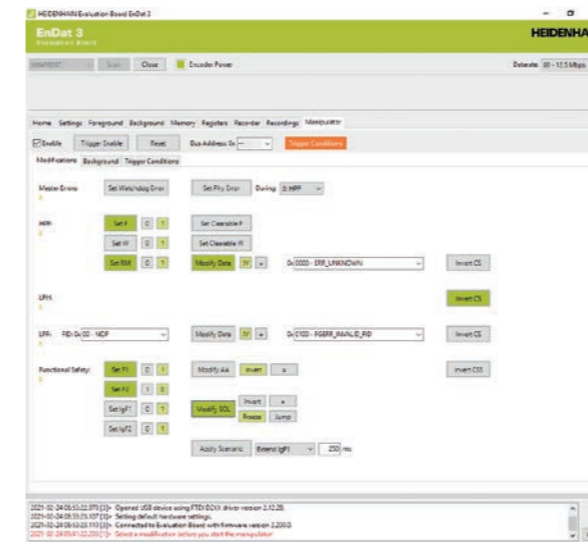
Recording of the EnDat 3 communication. Recorded data can be saved for evaluation. The workspace clearly displays current information about the active recording. The background communication can be extracted from the recorded data.



Error injector (manipulator)

The error injector permits manipulation of the EnDat 3 communication passing through. Operation with an internal and external master makes many different types of applications possible:

- Becoming familiar with the error mechanisms of EnDat 3 within the software
- Creating example programs or a customer's own applications for testing the error reactions
- Using an external master for comprehensive testing of a control's error reactions
- Testing and documenting a control's error reactions for purposes of functional safety



Standard scope

(included in delivery of the software): The standard scope of the error injector already includes comprehensive possible settings for an effective test of functions.

- Triggering of communication errors at the master level (e.g. PHY errors)
- Triggering errors in the checksums on all communication levels
- Manipulation of the HPF (High Priority Frame): e.g. status and contents
- Manipulation of the LPF (Low Priority Frame): e.g. contents
- Functional safety: manipulation of the relevant data contents and chronological sequences and functions (e.g. axis address or sign of life)
- Manipulation of read- and write-accesses to the internal memory of the encoder (background communication)
- Adjustable trigger conditions for starting the manipulation: quantity, delay, and use of an external pin for triggering

Extended scope (optionally available):

- The extended scope* is particularly well suited for automated and specifically triggered manipulations of the EnDat 3 communication. Functions in addition to the standard scope:
- Loading and saving of settings for manipulation within the software. The settings for the user interface are saved as function calls in a text file.
- Creating individual routines through an external program for manipulating the communication. Corresponding function calls are provided for the API.
- Possibility of manipulating the data contents of HPF, LPH, and LPF at the bit level.
- Expanded trigger conditions for starting the manipulation: the manipulation can be triggered in dependency of the data contents in HPF or LPF, such as "only near a certain position".


* Please contact HEIDENHAIN for more information about the extended scope of the error injector.

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This Product Information document supersedes all previous editions, which thereby become invalid. The basis for ordering from HEIDENHAIN is always the Product Information document edition valid when the order is placed.



Further information:

To ensure proper and intended use, comply with the specifications in the following documents:

- Operating Instructions: *EnDat 3 Evaluation Board* 1262299-xx
- User's Manual: *EnDat 3 Evaluation Board Software* 1262301-xx